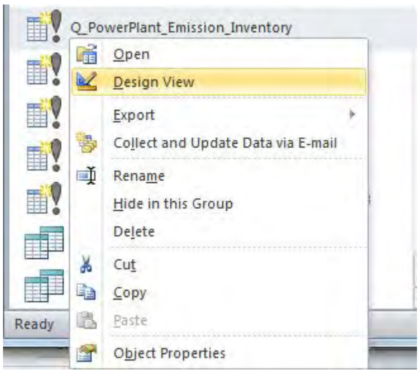
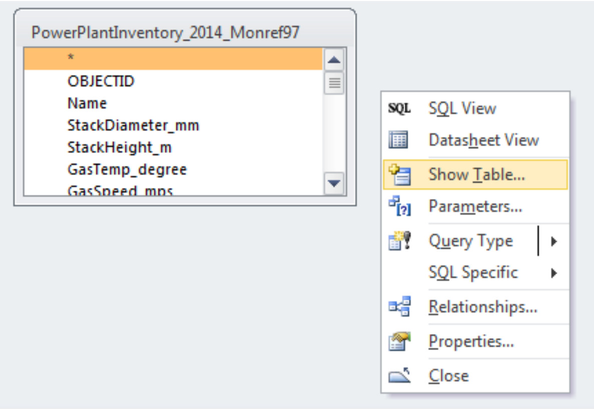
4 Export of Emission Data from Access File

4.1 Power Plant

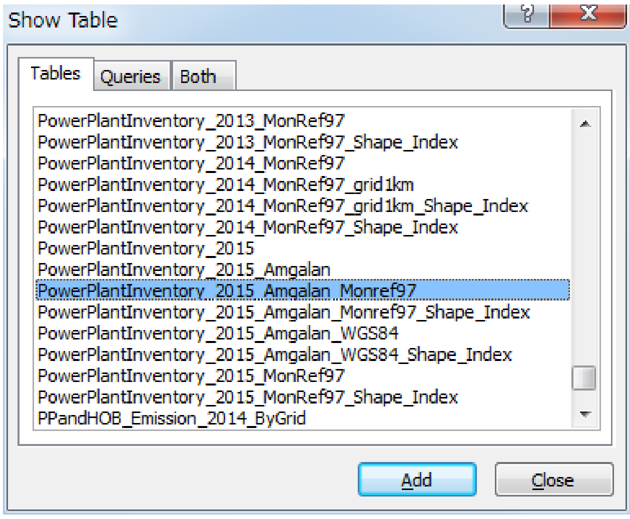
Open "StationarySources.mdb" and after right-clicking "Q_PowerPlant_Emission_Inventory" query, click [Design View].



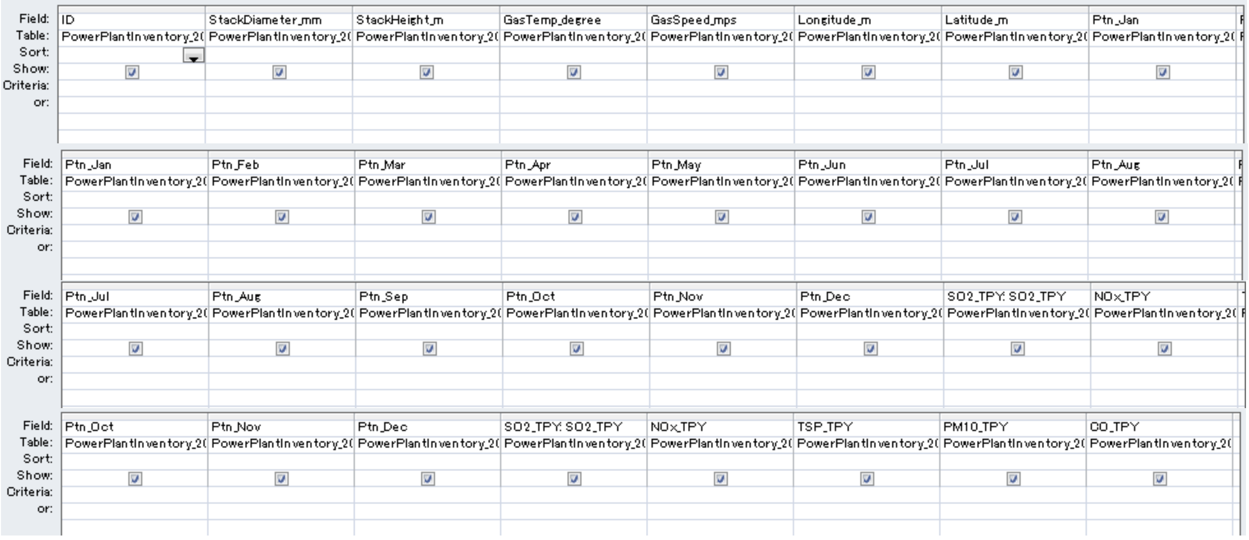
After right-clicking on the area that table is displayed, click [Show Table].



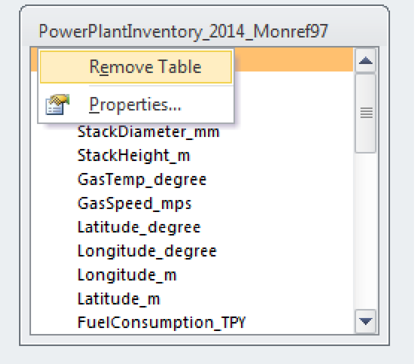
Select "PowerPlantInventory_2015_Amgalan_MonRef97" table in [Tables] tab and click [Add].



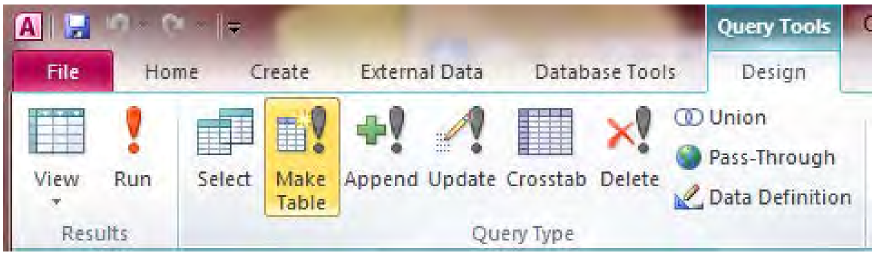
Apply the setting of each field to the items of “PowerPlantInventory_2015_Amgalan_MonRef97” table.



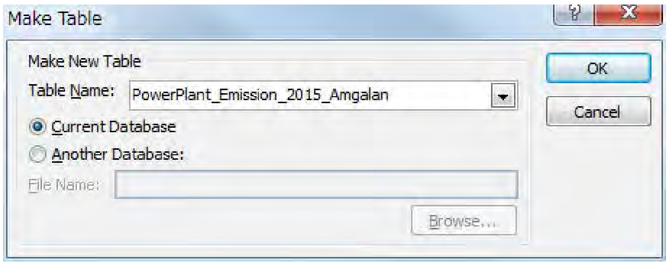
To delete the old table, right-click this table and click [Remove Table].



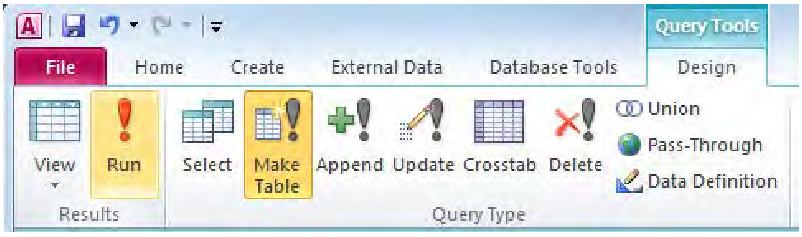
Click [Make Table] in [Design] tab



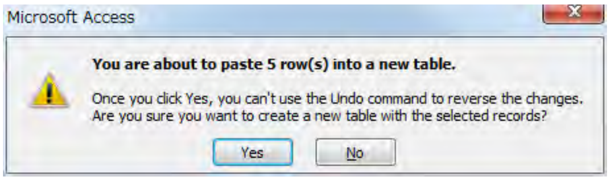
Set the table name (Here it is “PowerPlant_Emission_2015_Amgalan”).



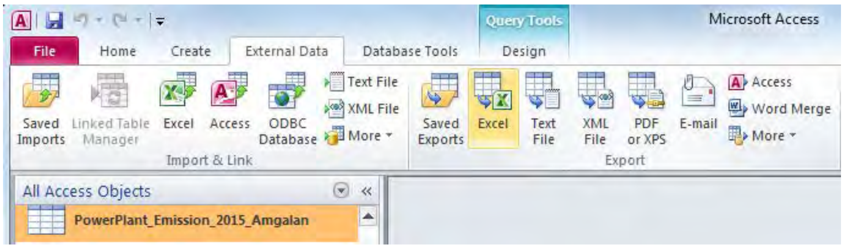
Click [Run] and make new table.



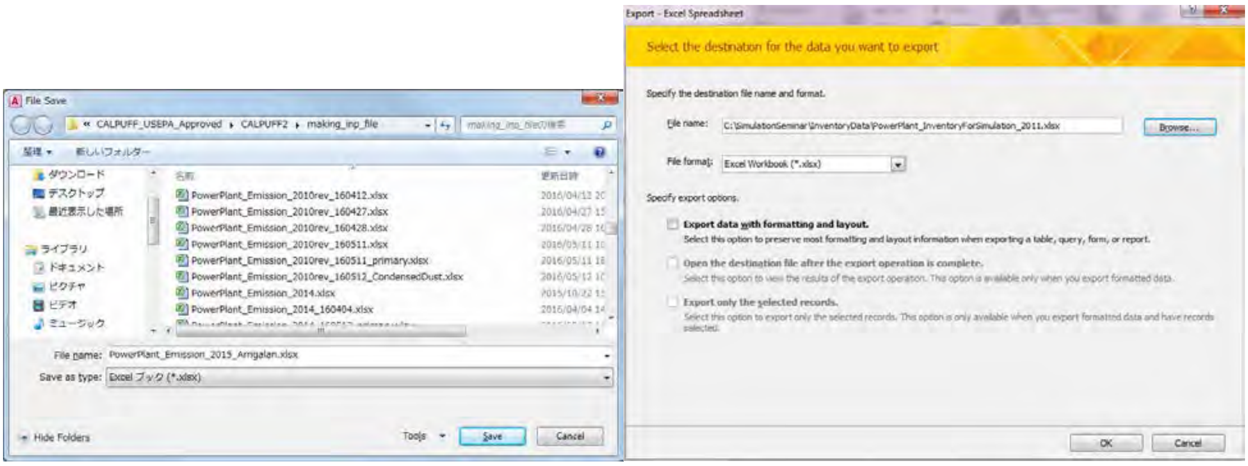
Click [Yes].



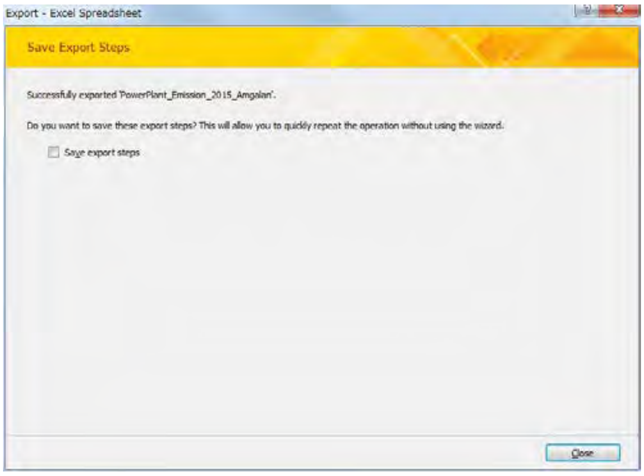
Select the created table and click [Export]-[Excel] in [Design] tab.



After setting the file save location at [Browse], click [OK].

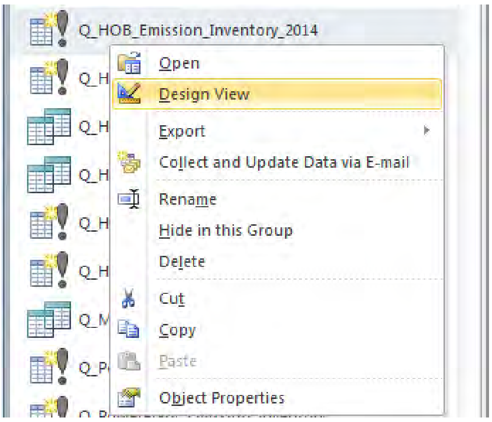


Click [Close].

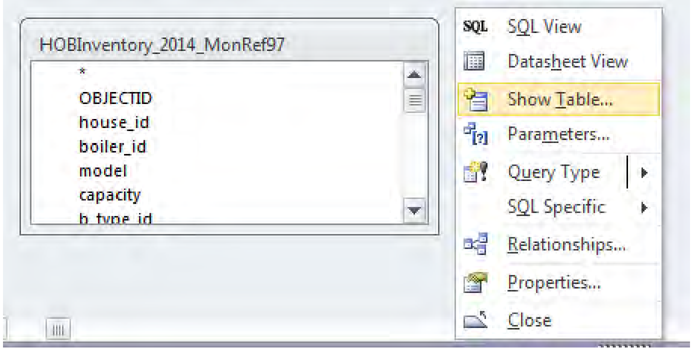


4.2 HOB

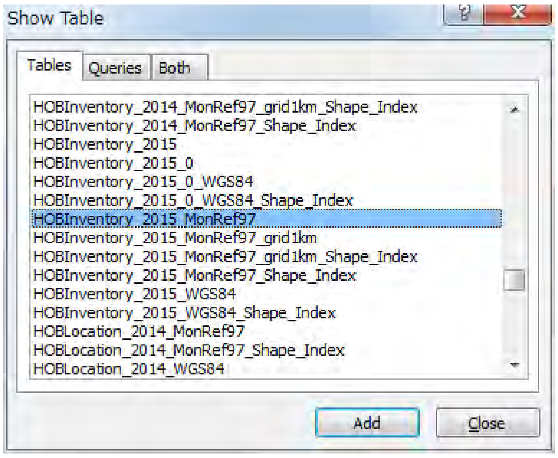
Open "StationarySources.mdb" and after right-clicking "Q_HOB_Emission_Inventory_2014" query, click [Design View].



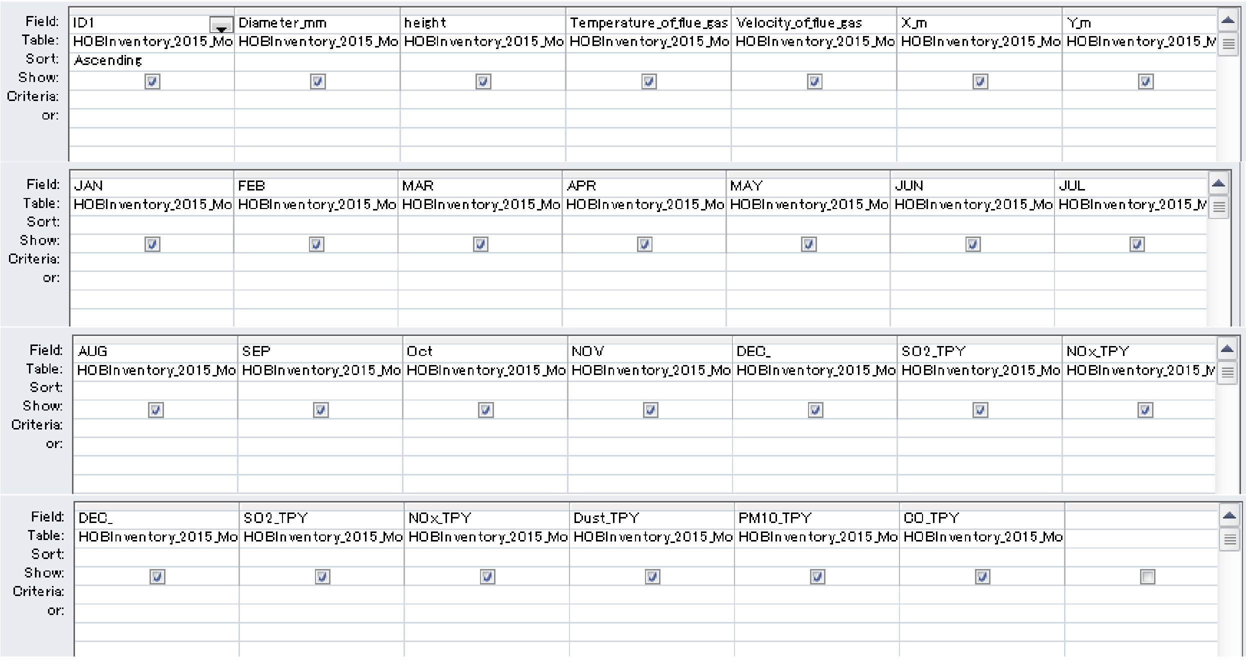
After right-clicking on the area that table is displayed, click [Show Table].



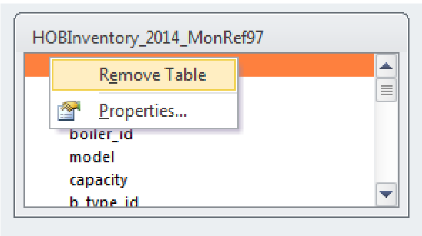
Select "HOBInventory_2015_MonRef97" table in [Tables] tab and click [Add].



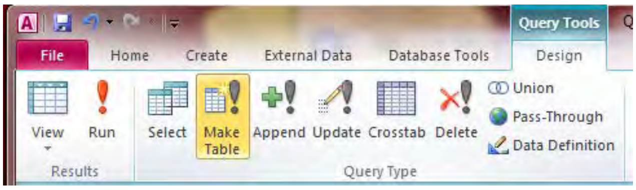
Apply the setting of each field to the items of “HOBInventory_2015_MonRef97” table.



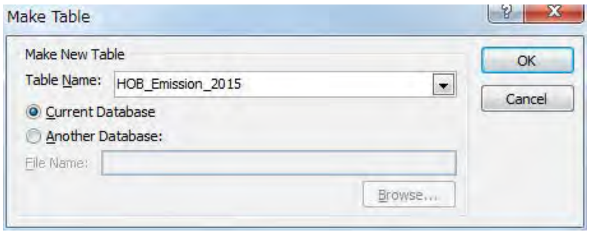
To delete the old table, right-click this table and click [Remove Table].



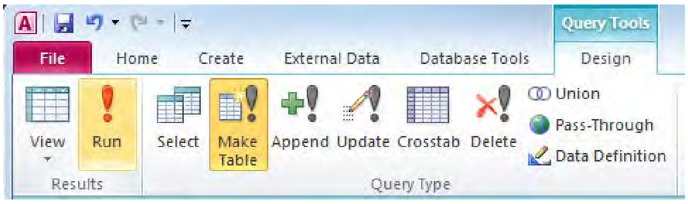
Click [Make Table] in [Design] tab



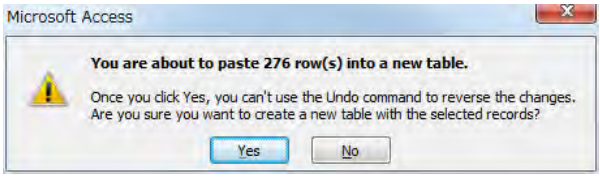
Set the table name (Here it is "HOB_Emission_2015").



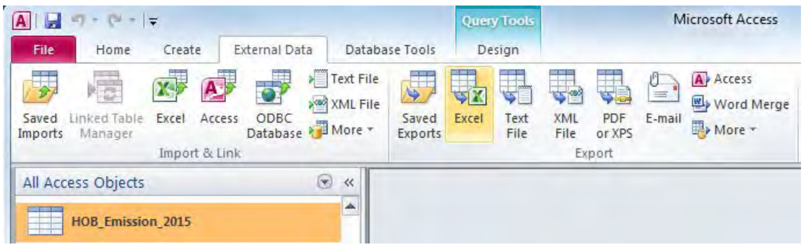
Click [Run] and make new table.



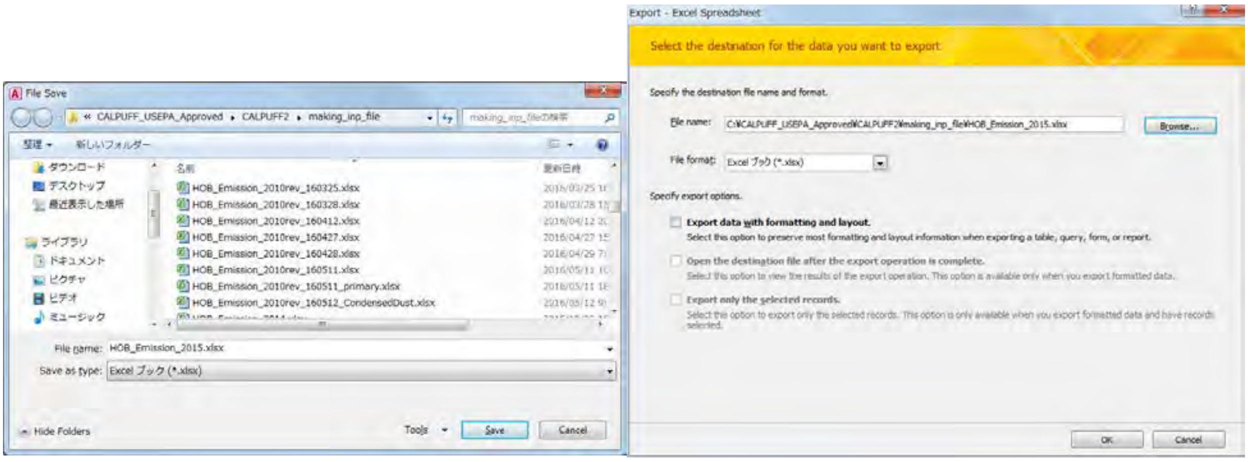
Click [Yes].



Select the created table and click [Export]-[Excel] in [Design] tab.



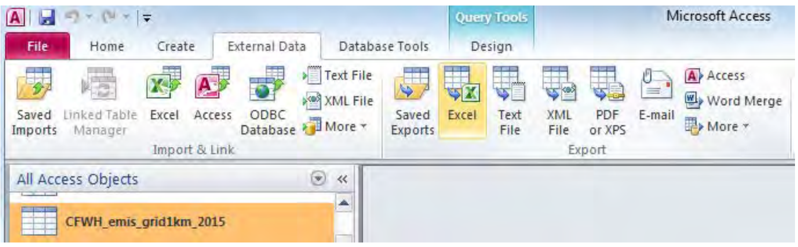
After setting the file save location at [Browse], click [OK].



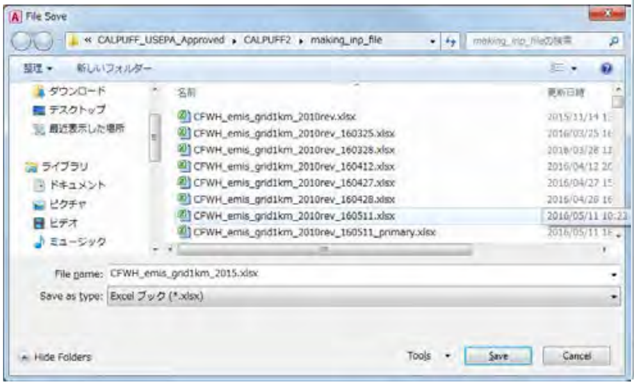
Click [Close].

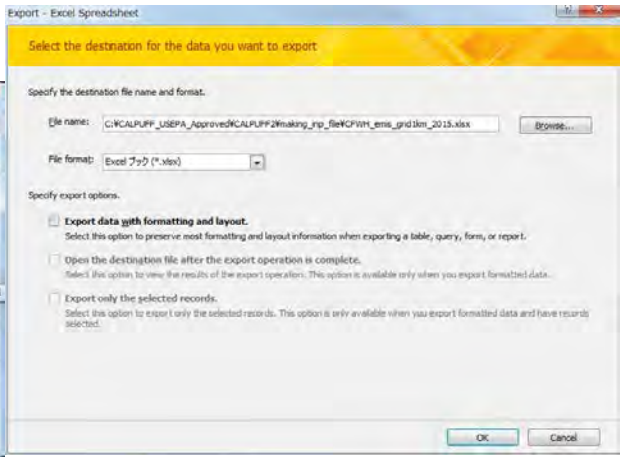
4.3 CFWH

Select the table organizing emissions by grid and click [Export]-[Excel] in [Design] tab (Here it is "CFWH_emis_grid1km_2015" table).



After setting the file save location at [Browse], click [OK].

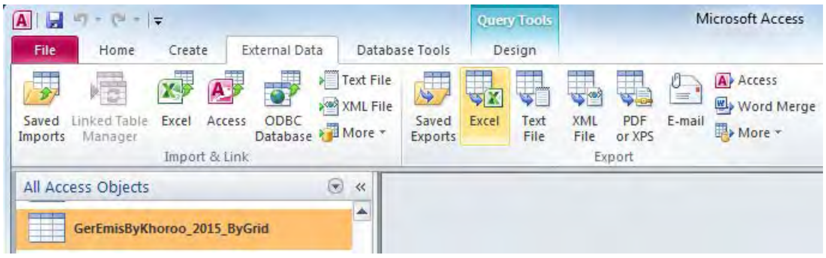




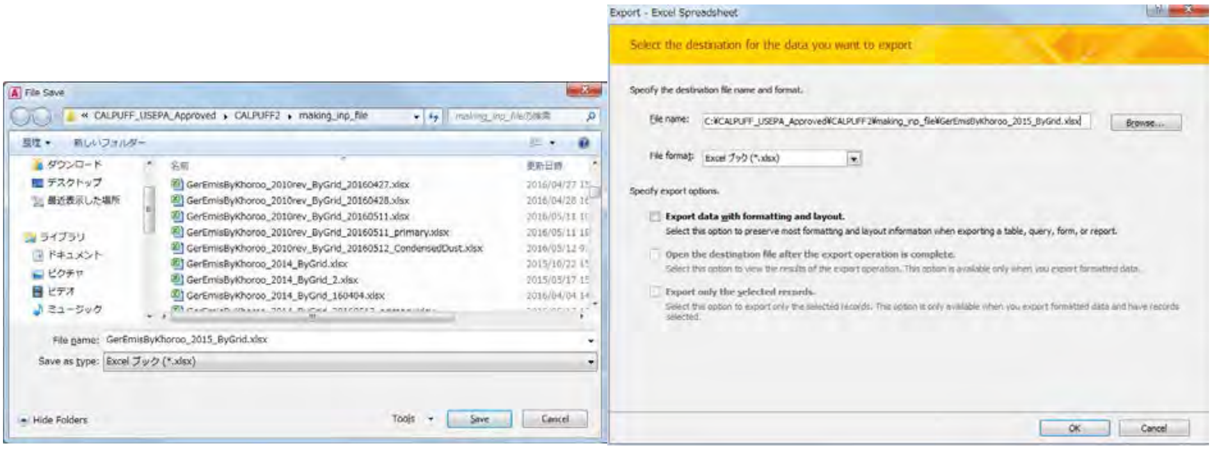
Click [Close].

4.4 Small Stove for Household

Select the table organizing emissions by grid and click [Export]-[Excel] in [Design] tab (Here it is “GerEmisByKhoroo_2015_ByGrid” table).



After setting the file save location at [Browse], click [OK].

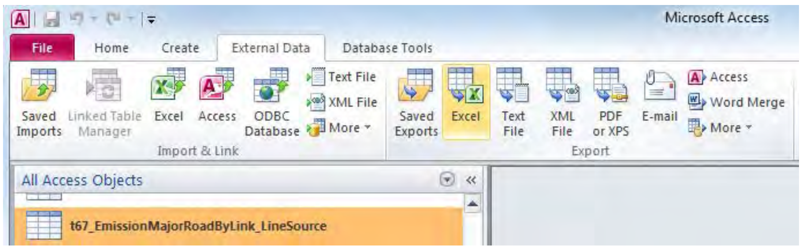


Click [Close].

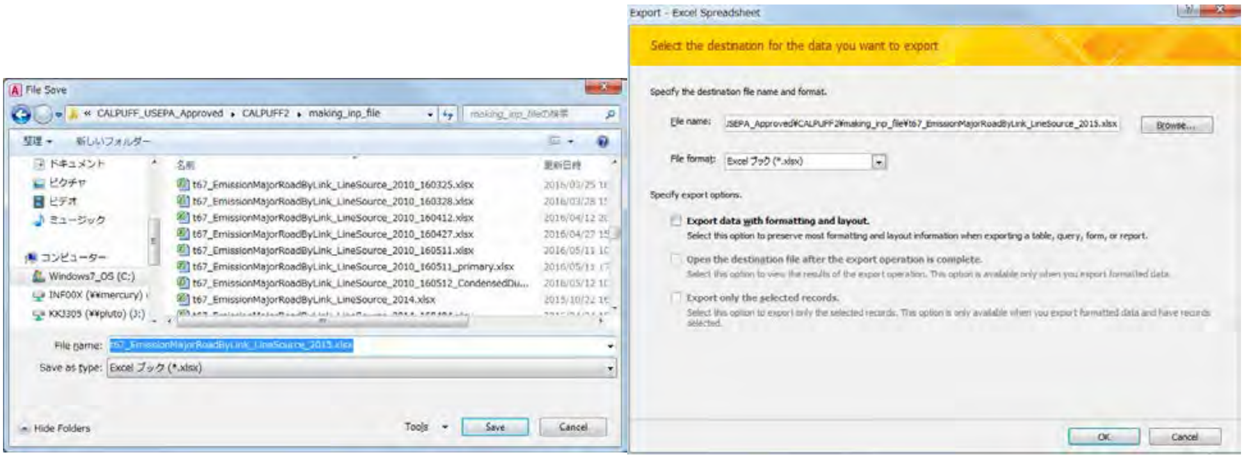
4.5 Mobile Sources

4.5.1 Vehicle Exhaust Gas in Major Road

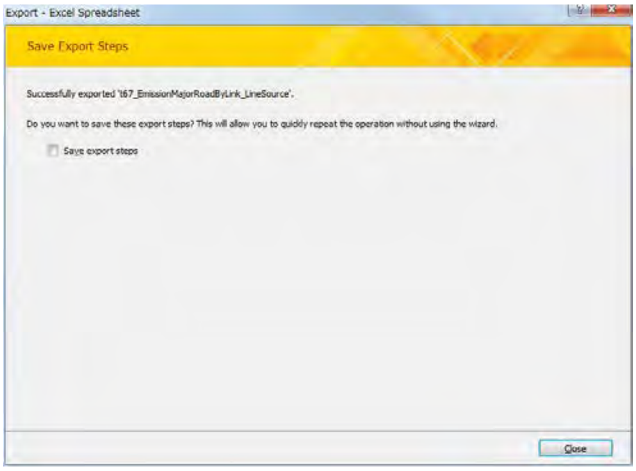
Select the table organizing emissions by grid and click [Export]-[Excel] in [Design] tab (Here it is “t67_EmissionMajorRoadByLink_LineSource” table).



After setting the file save location at [Browse], click [OK].

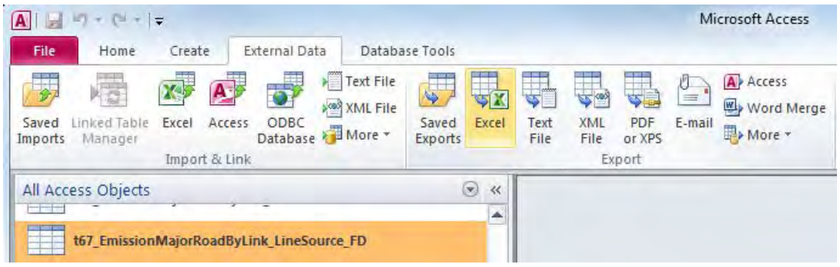


Click [Close].

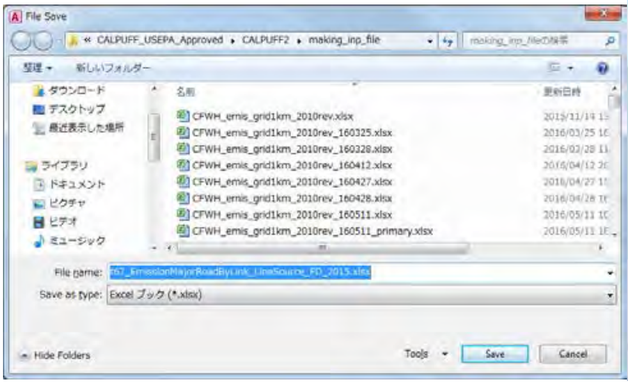


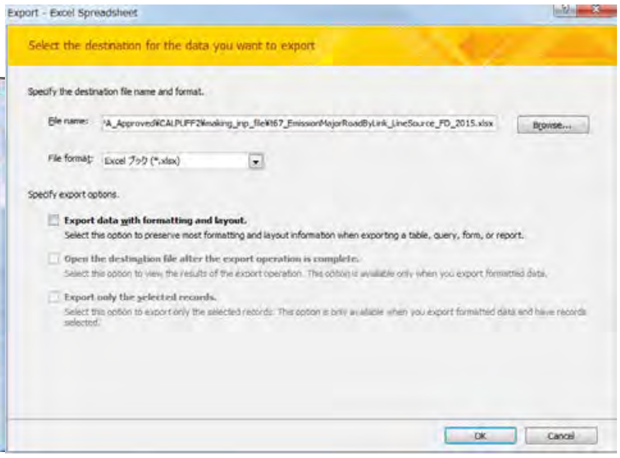
4.5.2 Fugitive Dust by Travelling Vehicle in Major Road

Select the table organizing emissions by grid and click [Export]-[Excel] in [Design] tab (Here it is “t67_EmissionMajorRoadByLink_LineSource_FD” table).

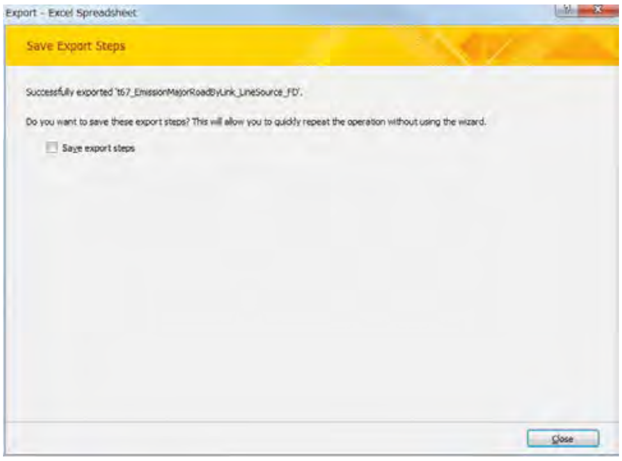


After setting the file save location at [Browse], click [OK].



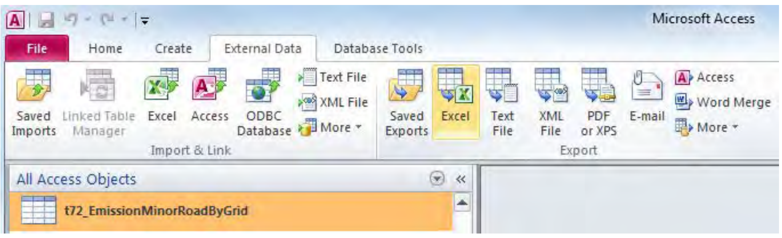


Click [Close].

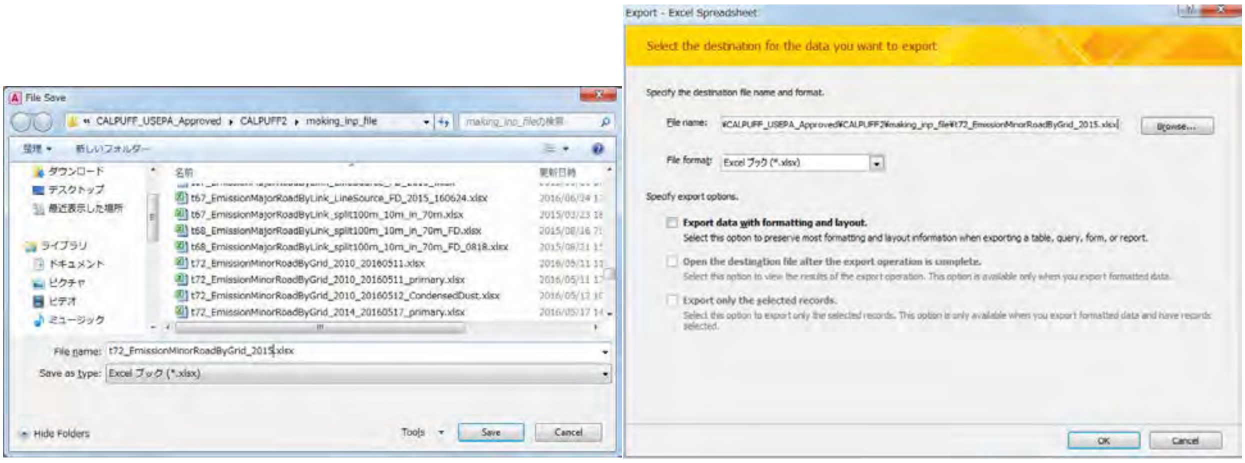


4.5.3 Vehicle Exhaust Gas in Minor Road

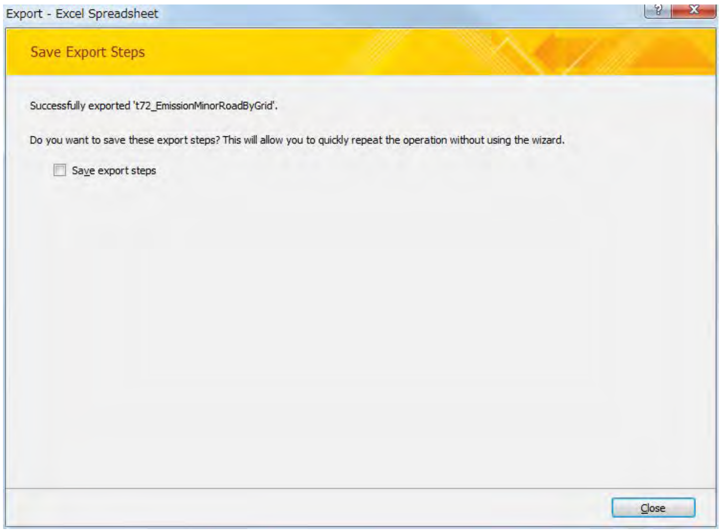
Select the table organizing emissions by grid and click [Export]-[Excel] in [Design] tab (Here it is “t72_EmissionMinorRoadByGrid” table).



After setting the file save location at [Browse], click [OK].



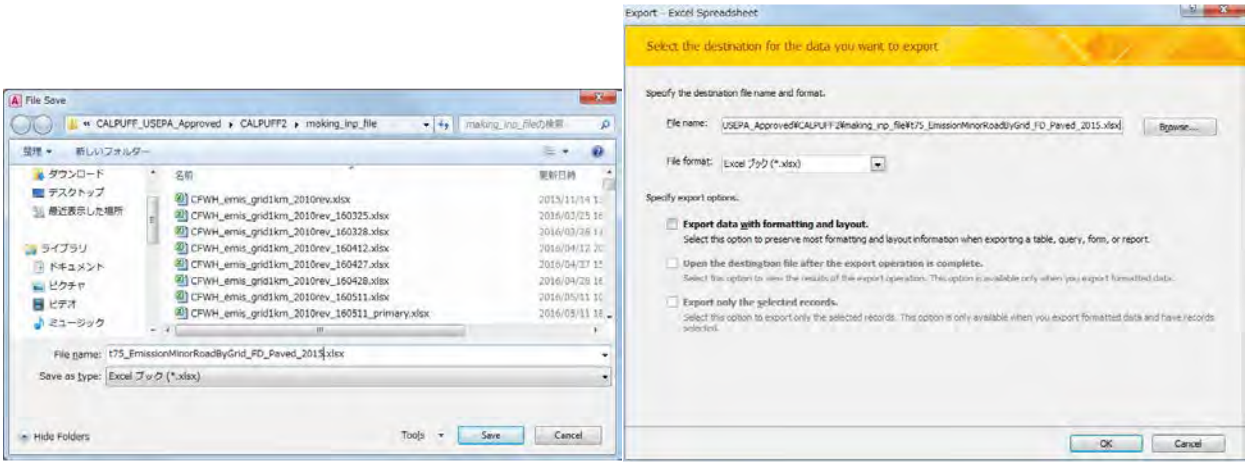
Click [Close].



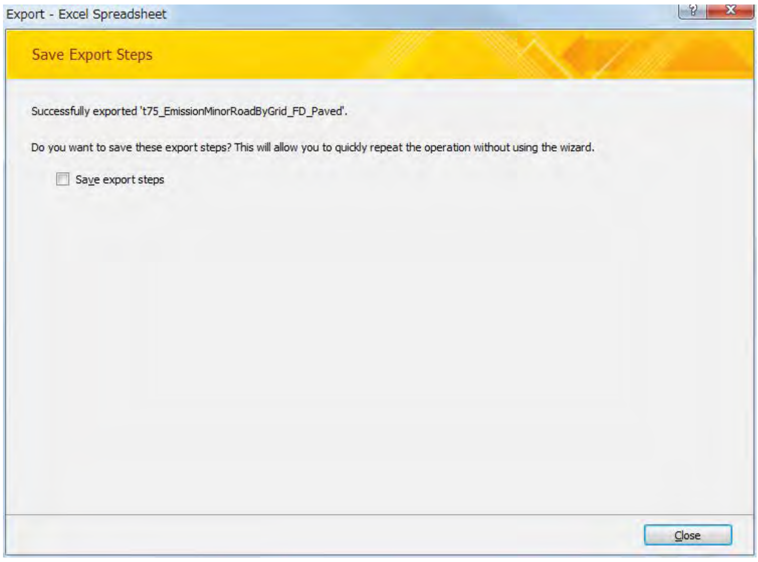
4.5.4 Fugitive Dust by Travelling Vehicle in Minor Road (Paved Road)

Select the table organizing emissions by grid and click [Export]-[Excel] in [Design] tab (Here it is “t75_EmissionMinorRoadByGrid_FD_Paved” table).

After setting the file save location at [Browse], click [OK].



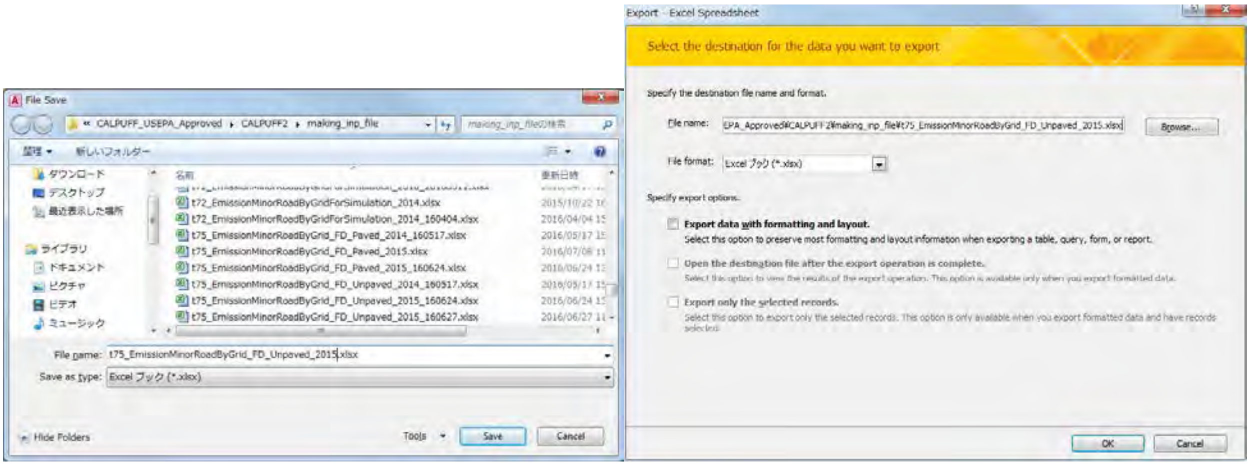
Click [Close].



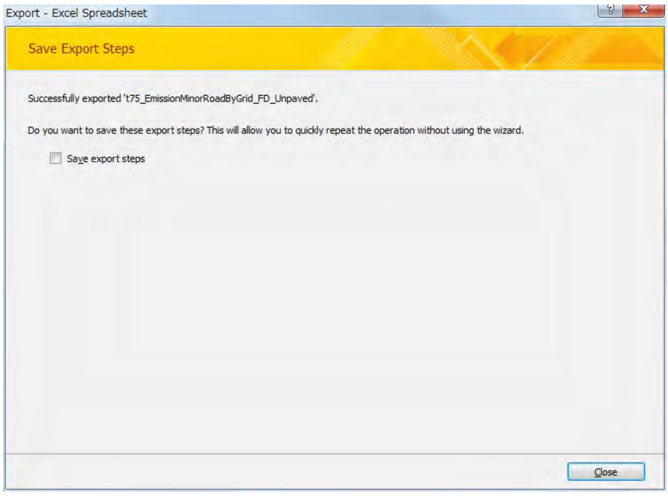
4.5.5 <u>Fugitive Dust by Travelling Vehicle in Major Road(Unpaved Road)</u>

Select the table organizing emissions by grid and click [Export]-[Excel] in [Design] tab (Here it is "t75_EmissionMinorRoadByGrid_FD_Unpaved" table).

After setting the file save location at [Browse], click [OK].



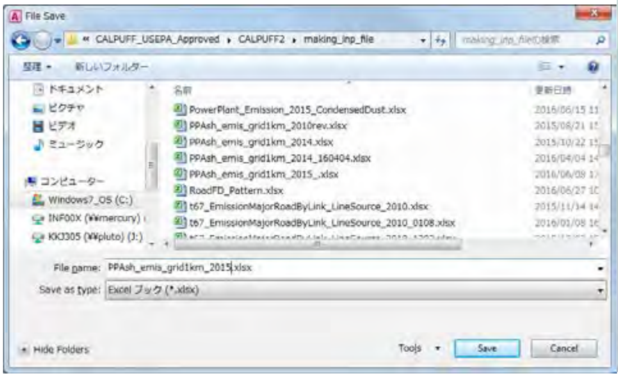
Click [Close].

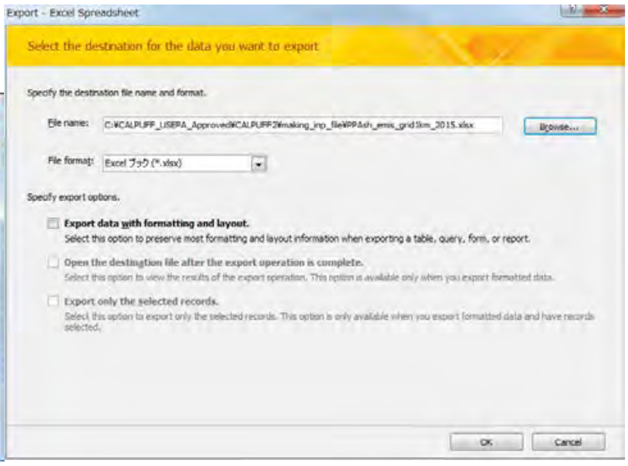


4.6 Other Source (Fugitive Ash from Ash Pond of Power Plant)

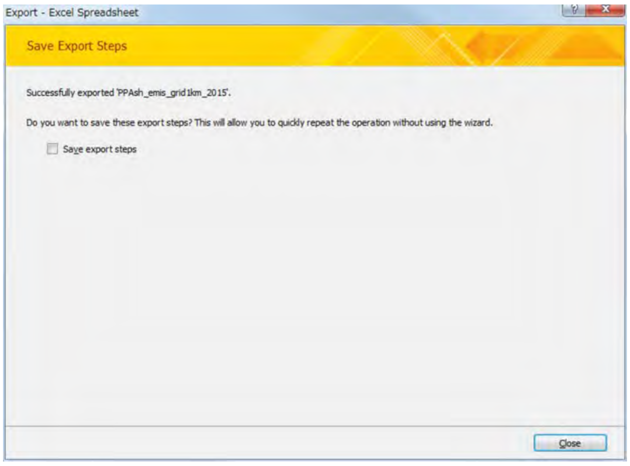
Select the table organizing emissions by grid and click [Export]-[Excel] in [Design] tab (Here it is “PPAsh_emis_grid1km_2015” table).

After setting the file save location at [Browse], click [OK].


File Save
CALPUFF_USEPA_Approved ▸ CALPUFF2 ▸ making_inp_file
PowerPlant_Emission_2015_CondensedDust.xlsx
PPAsh_emis_grid1km_2010rev.xlsx
PPAsh_emis_grid1km_2014.xlsx
PPAsh_emis_grid1km_2014_160404.xlsx
PPAsh_emis_grid1km_2015_.xlsx
RoadFD_Pattern.xlsx
t67_EmissionMajorRoadByLink_LineSource_2010.xlsx
t67_EmissionMajorRoadByLink_LineSource_2010_0108.xlsx
File name: PPAsh_emis_grid1km_2015.xlsx
Save as type: Excel ブック (*.xlsx)
Hide Folders
Tools
Save
Cancel


Export - Excel Spreadsheet
Select the destination for the data you want to export
Specify the destination file name and format.
File name: C:¥CALPUFF_USEPA_Approved¥CALPUFF2¥making_inp_file¥PPAsh_emis_grid1km_2015.xlsx
Browse...
File format: Excel ブック (*.xlsx)
Specify export options.
Export data with formatting and layout.
Select this option to preserve most formatting and layout information when exporting a table, query, form, or report.
Open the destination file after the export operation is complete.
Export only the selected records.
OK
Cancel

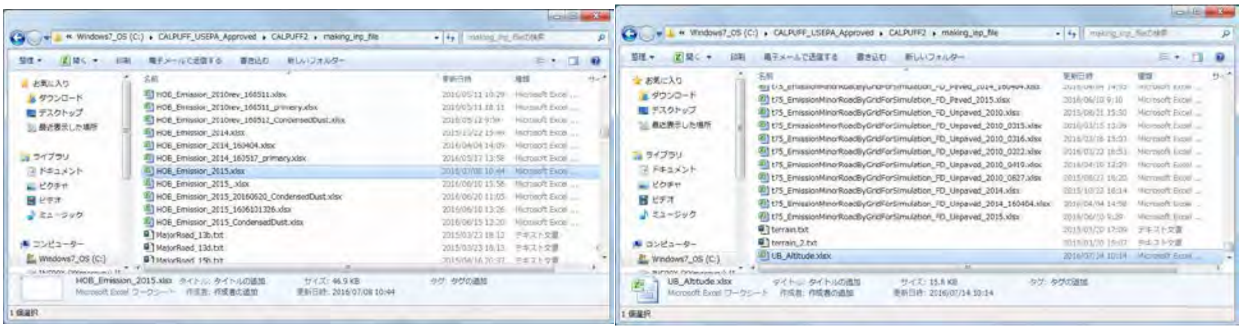
Click [Close].


Export - Excel Spreadsheet
Save Export Steps
Successfully exported 'PPAsh_emis_grid1km_2015'.
Do you want to save these export steps? This will allow you to quickly repeat the operation without using the wizard.
Save export steps
Close

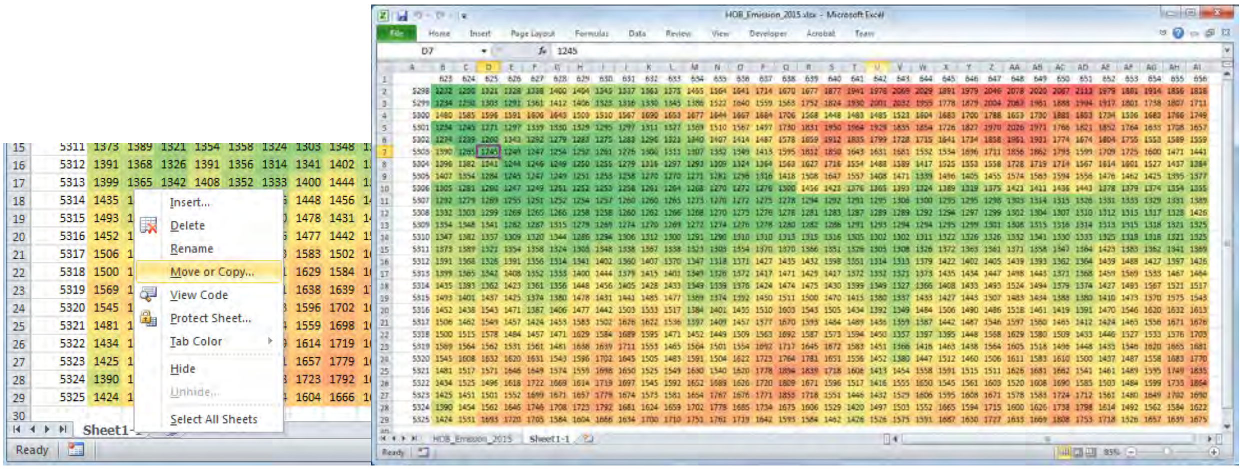
5 Converting to the Source Input Format for CALPUFF

5.1 Point Source

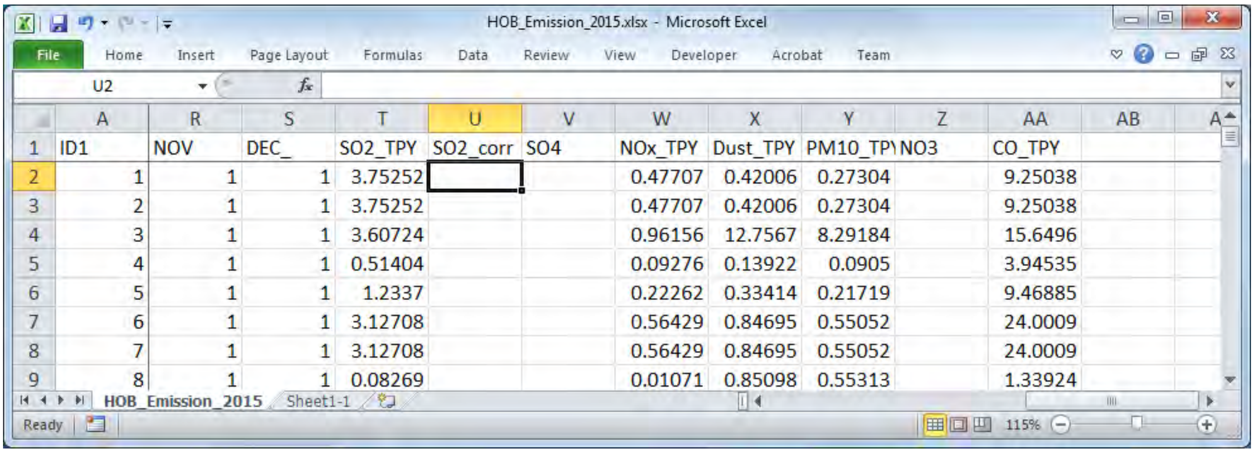
Open the Excel file in export destination folder and the file of elevation data by grid (UB_altitude.xlsx).



Copy "sheet1-1" of "UB_altitude.xlsx" to the Excel file in export destination folder



Add columns to calculate the emissions of SO2, SO4 and NO3.

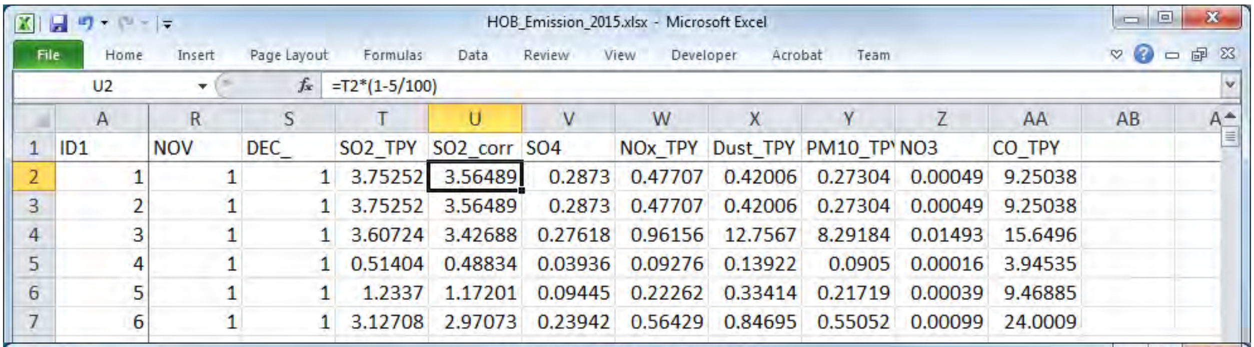


Input formulas to calculate the emission of SO4 and NO3.

SO4 Emission =SO2 Emission x conversion ratio from SO2 to SO4 x 96/64

SO2 Emission = SO2 Emission x (1- conversion ratio from SO2 to SO4)

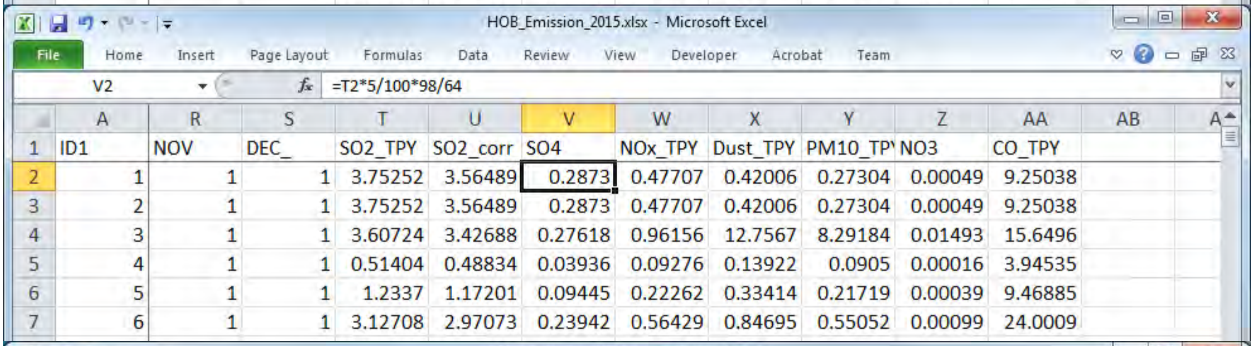
NO3 Emission =PM10 Emission x NO3 contribution ratio by composition analysis of PM10



HOB_Emission_2015.xlsx - Microsoft Excel

U2 =T2*(1-5/100)

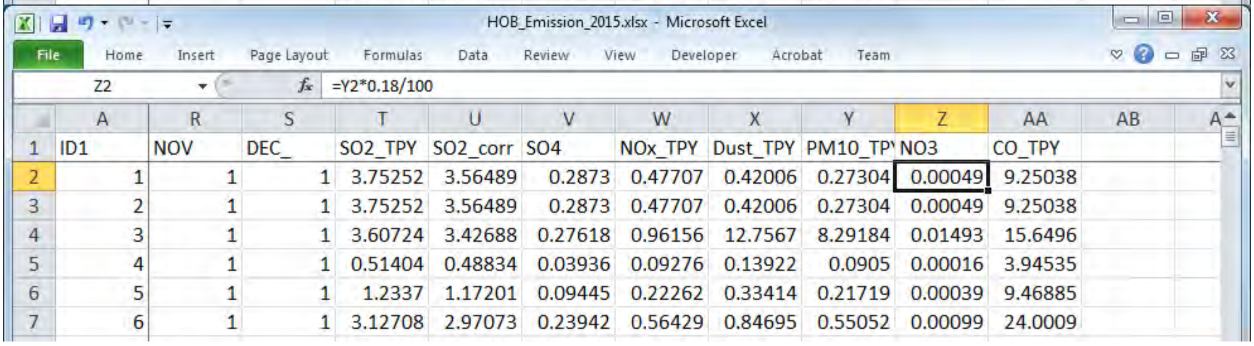
	A	R	S	T	U	V	W	X	Y	Z	AA	AB
1	ID1	NOV	DEC_	SO2_TPY	SO2_corr	SO4	NOx_TPY	Dust_TPY	PM10_TP'	NO3	CO_TPY	
2	1	1	1	3.75252	3.56489	0.2873	0.47707	0.42006	0.27304	0.00049	9.25038	
3	2	1	1	3.75252	3.56489	0.2873	0.47707	0.42006	0.27304	0.00049	9.25038	
4	3	1	1	3.60724	3.42688	0.27618	0.96156	12.7567	8.29184	0.01493	15.6496	
5	4	1	1	0.51404	0.48834	0.03936	0.09276	0.13922	0.0905	0.00016	3.94535	
6	5	1	1	1.2337	1.17201	0.09445	0.22262	0.33414	0.21719	0.00039	9.46885	
7	6	1	1	3.12708	2.97073	0.23942	0.56429	0.84695	0.55052	0.00099	24.0009	



HOB_Emission_2015.xlsx - Microsoft Excel

V2 =T2*5/100*98/64

	A	R	S	T	U	V	W	X	Y	Z	AA	AB
1	ID1	NOV	DEC_	SO2_TPY	SO2_corr	SO4	NOx_TPY	Dust_TPY	PM10_TP'	NO3	CO_TPY	
2	1	1	1	3.75252	3.56489	0.2873	0.47707	0.42006	0.27304	0.00049	9.25038	
3	2	1	1	3.75252	3.56489	0.2873	0.47707	0.42006	0.27304	0.00049	9.25038	
4	3	1	1	3.60724	3.42688	0.27618	0.96156	12.7567	8.29184	0.01493	15.6496	
5	4	1	1	0.51404	0.48834	0.03936	0.09276	0.13922	0.0905	0.00016	3.94535	
6	5	1	1	1.2337	1.17201	0.09445	0.22262	0.33414	0.21719	0.00039	9.46885	
7	6	1	1	3.12708	2.97073	0.23942	0.56429	0.84695	0.55052	0.00099	24.0009	

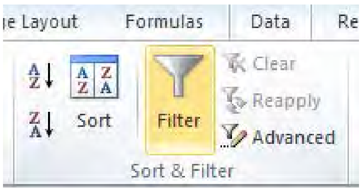


HOB_Emission_2015.xlsx - Microsoft Excel

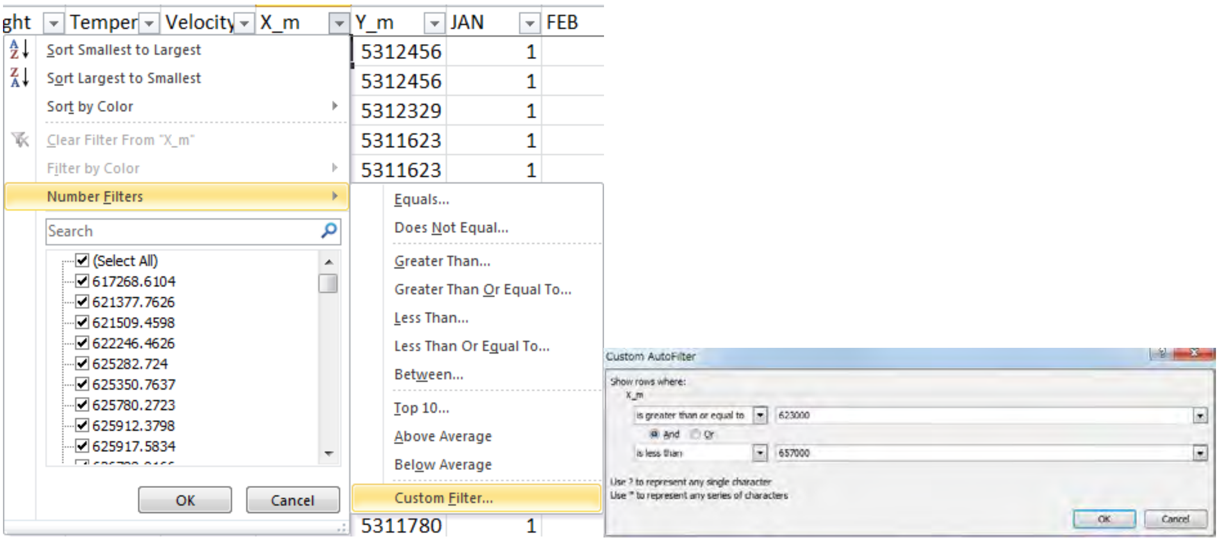
Z2 =Y2*0.18/100

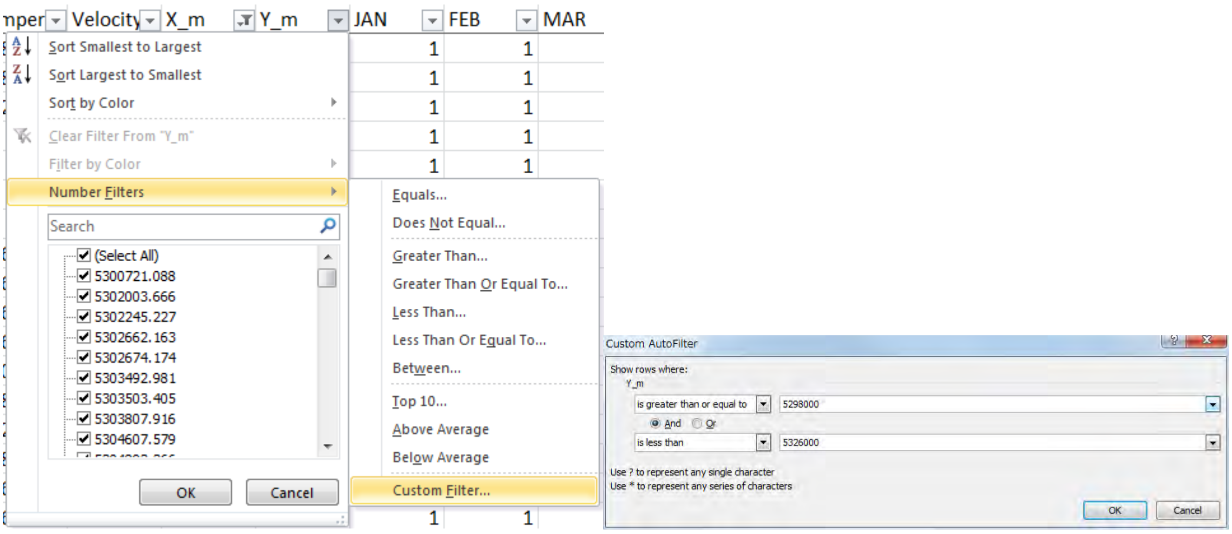
	A	R	S	T	U	V	W	X	Y	Z	AA	AB
1	ID1	NOV	DEC_	SO2_TPY	SO2_corr	SO4	NOx_TPY	Dust_TPY	PM10_TP'	NO3	CO_TPY	
2	1	1	1	3.75252	3.56489	0.2873	0.47707	0.42006	0.27304	0.00049	9.25038	
3	2	1	1	3.75252	3.56489	0.2873	0.47707	0.42006	0.27304	0.00049	9.25038	
4	3	1	1	3.60724	3.42688	0.27618	0.96156	12.7567	8.29184	0.01493	15.6496	
5	4	1	1	0.51404	0.48834	0.03936	0.09276	0.13922	0.0905	0.00016	3.94535	
6	5	1	1	1.2337	1.17201	0.09445	0.22262	0.33414	0.21719	0.00039	9.46885	
7	6	1	1	3.12708	2.97073	0.23942	0.56429	0.84695	0.55052	0.00099	24.0009	

Click [Filter] in "Data" tab and add filter function to the first row.

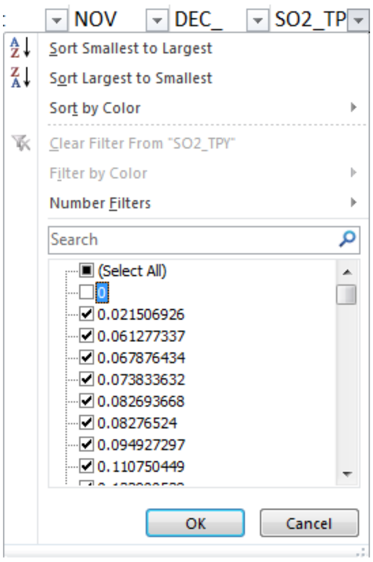


Select "▼" at [X_m] and [Y_m] and filter in calculation range in east-west and south-north directions.

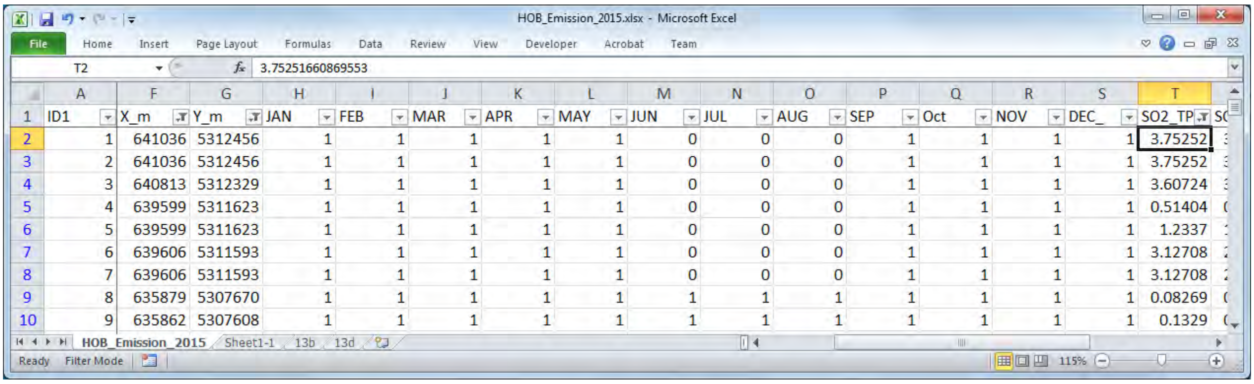




Select ”▼” at [SO2_TPY] and filter to point source that SO2 emission is not zero.

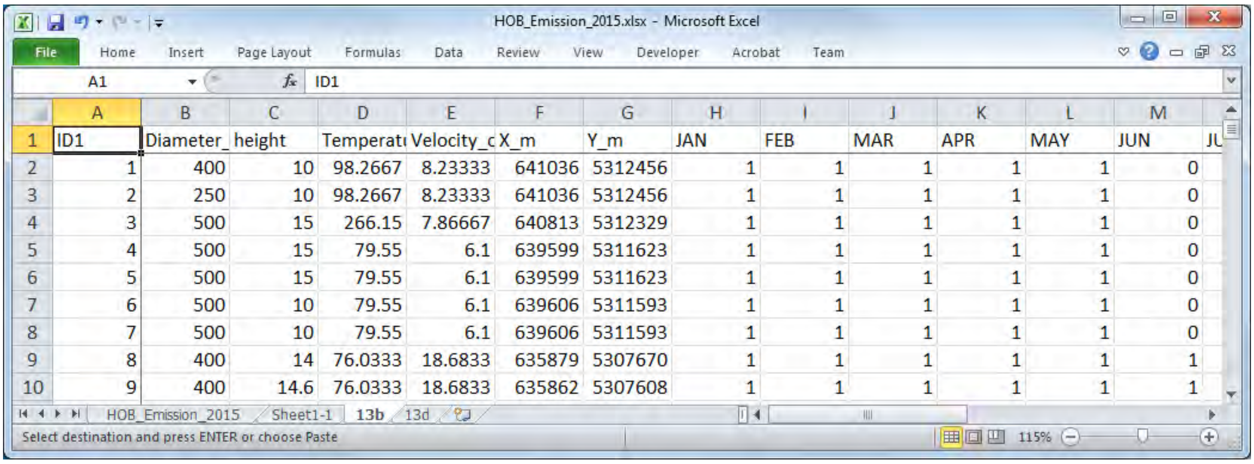


Only rows extracted by the above filter function are displayed



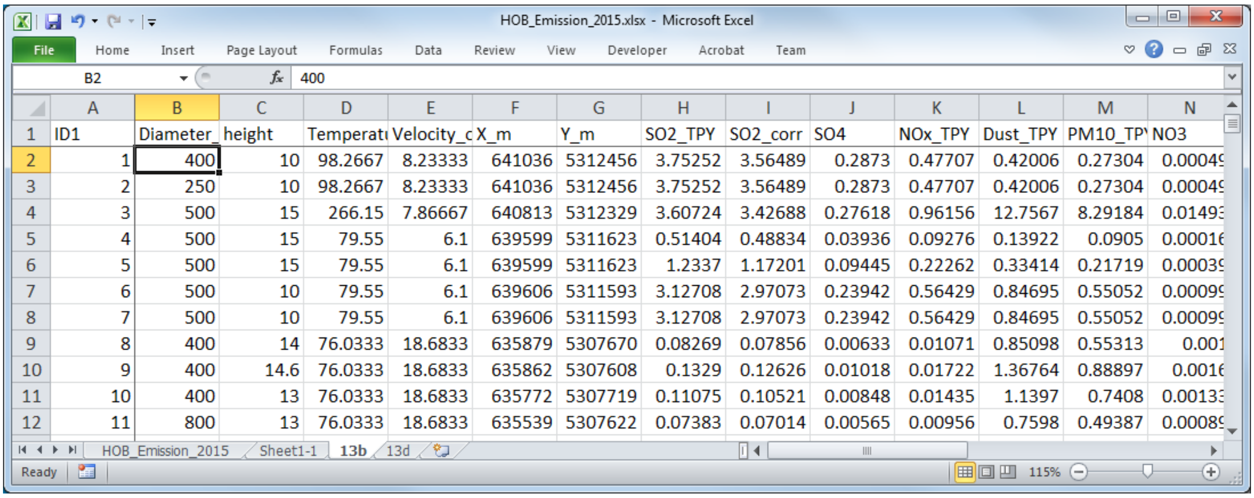
ID1	X_m	Y_m	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Oct	NOV	DEC_	SO2_TP
1	641036	5312456	1	1	1	1	1	0	0	0	1	1	1	1	3.75252
2	641036	5312456	1	1	1	1	1	0	0	0	1	1	1	1	3.75252
3	640813	5312329	1	1	1	1	1	0	0	0	1	1	1	1	3.60724
4	639599	5311623	1	1	1	1	1	0	0	0	1	1	1	1	0.51404
5	639599	5311623	1	1	1	1	1	0	0	0	1	1	1	1	1.2337
6	639606	5311593	1	1	1	1	1	0	0	0	1	1	1	1	3.12708
7	639606	5311593	1	1	1	1	1	0	0	0	1	1	1	1	3.12708
8	635879	5307670	1	1	1	1	1	1	1	1	1	1	1	1	0.08269
9	635862	5307608	1	1	1	1	1	1	1	1	1	1	1	1	0.1329

Copy the point sources generated by filter function and paste them on another sheet, and set the name of each sheet to "13b" and "13d".



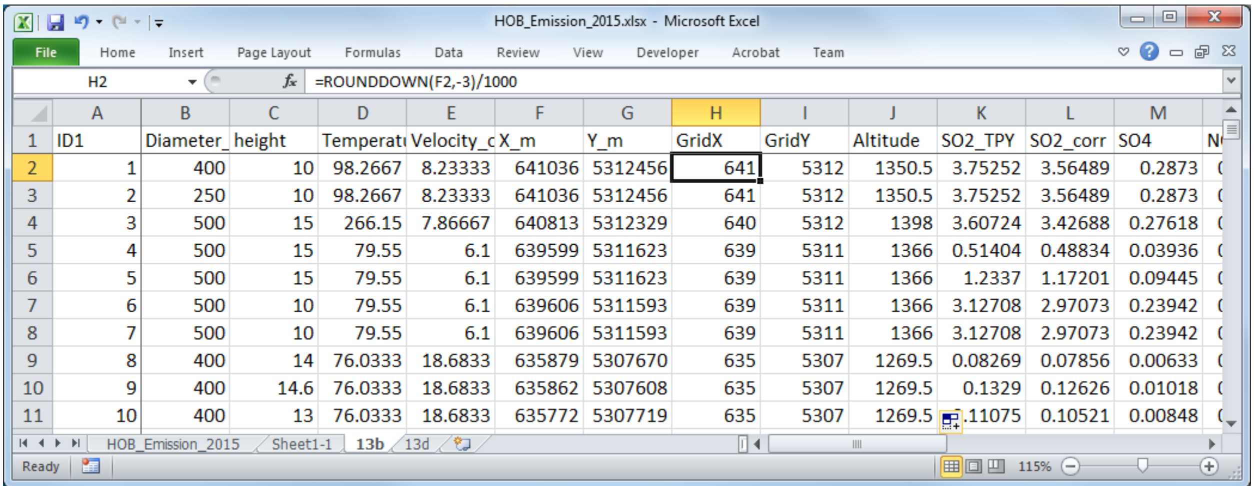
ID1	Diameter_	height	Temperatı	Velocity_c	X_m	Y_m	JAN	FEB	MAR	APR	MAY	JUN
1	400	10	98.2667	8.23333	641036	5312456	1	1	1	1	1	0
2	250	10	98.2667	8.23333	641036	5312456	1	1	1	1	1	0
3	500	15	266.15	7.86667	640813	5312329	1	1	1	1	1	0
4	500	15	79.55	6.1	639599	5311623	1	1	1	1	1	0
5	500	15	79.55	6.1	639599	5311623	1	1	1	1	1	0
6	500	10	79.55	6.1	639606	5311593	1	1	1	1	1	0
7	500	10	79.55	6.1	639606	5311593	1	1	1	1	1	0
8	400	14	76.0333	18.6833	635879	5307670	1	1	1	1	1	1
9	400	14.6	76.0333	18.6833	635862	5307608	1	1	1	1	1	1

Using the "13b" sheet, create the string information on point sources (13b) among CALPUFF input data. First, delete monthly operation patterns that are unnecessary for creating “13b”.

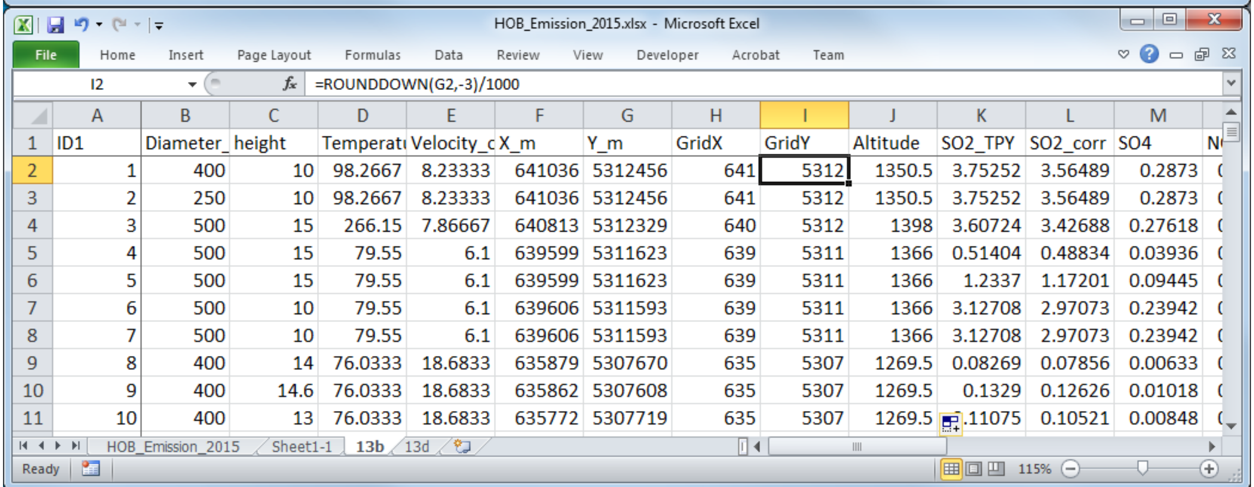


ID1	Diameter_	height	Temperatı	Velocity_c	X_m	Y_m	SO2_TPY	SO2_corr	SO4	NOx_TPY	Dust_TPY	PM10_TP	NO3
1	400	10	98.2667	8.23333	641036	5312456	3.75252	3.56489	0.2873	0.47707	0.42006	0.27304	0.0004
2	250	10	98.2667	8.23333	641036	5312456	3.75252	3.56489	0.2873	0.47707	0.42006	0.27304	0.0004
3	500	15	266.15	7.86667	640813	5312329	3.60724	3.42688	0.27618	0.96156	12.7567	8.29184	0.0149
4	500	15	79.55	6.1	639599	5311623	0.51404	0.48834	0.03936	0.09276	0.13922	0.0905	0.0001
5	500	15	79.55	6.1	639599	5311623	1.2337	1.17201	0.09445	0.22262	0.33414	0.21719	0.0003
6	500	10	79.55	6.1	639606	5311593	3.12708	2.97073	0.23942	0.56429	0.84695	0.55052	0.0009
7	500	10	79.55	6.1	639606	5311593	3.12708	2.97073	0.23942	0.56429	0.84695	0.55052	0.0009
8	400	14	76.0333	18.6833	635879	5307670	0.08269	0.07856	0.00633	0.01071	0.85098	0.55313	0.001
9	400	14.6	76.0333	18.6833	635862	5307608	0.1329	0.12626	0.01018	0.01722	1.36764	0.88897	0.001
10	400	13	76.0333	18.6833	635772	5307719	0.11075	0.10521	0.00848	0.01435	1.1397	0.7408	0.0013
11	800	13	76.0333	18.6833	635539	5307622	0.07383	0.07014	0.00565	0.00956	0.7598	0.49387	0.0008

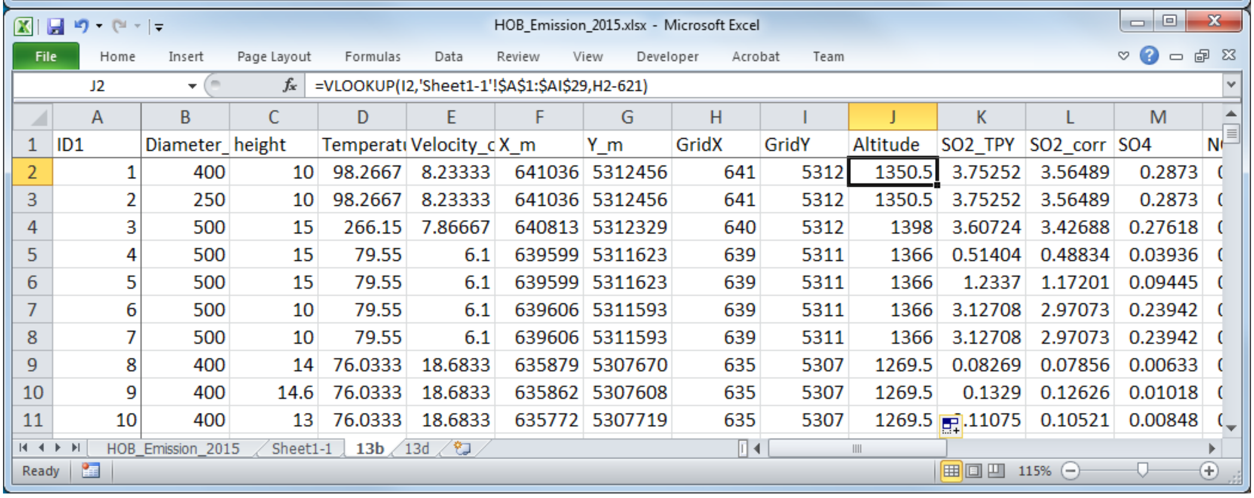
Three columns are added to the sheet on which the data is copied, and value of elevation data for each grid according to the coordinates is extracted. Calculate the grid positions specified by the coordinates in the first two columns, and enter an equation to calculate the value of elevation data by grid referenced from "sheet1-1" according to these values in the last one column.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	ID1	Diameter_	height	Temperatı	Velocity_c	X_m	Y_m	GridX	GridY	Altitude	SO2_TPY	SO2_corr	SO4	N
2	1	400	10	98.2667	8.23333	641036	5312456	641	5312	1350.5	3.75252	3.56489	0.2873	(
3	2	250	10	98.2667	8.23333	641036	5312456	641	5312	1350.5	3.75252	3.56489	0.2873	(
4	3	500	15	266.15	7.86667	640813	5312329	640	5312	1398	3.60724	3.42688	0.27618	(
5	4	500	15	79.55	6.1	639599	5311623	639	5311	1366	0.51404	0.48834	0.03936	(
6	5	500	15	79.55	6.1	639599	5311623	639	5311	1366	1.2337	1.17201	0.09445	(
7	6	500	10	79.55	6.1	639606	5311593	639	5311	1366	3.12708	2.97073	0.23942	(
8	7	500	10	79.55	6.1	639606	5311593	639	5311	1366	3.12708	2.97073	0.23942	(
9	8	400	14	76.0333	18.6833	635879	5307670	635	5307	1269.5	0.08269	0.07856	0.00633	(
10	9	400	14.6	76.0333	18.6833	635862	5307608	635	5307	1269.5	0.1329	0.12626	0.01018	(
11	10	400	13	76.0333	18.6833	635772	5307719	635	5307	1269.5	.11075	0.10521	0.00848	(

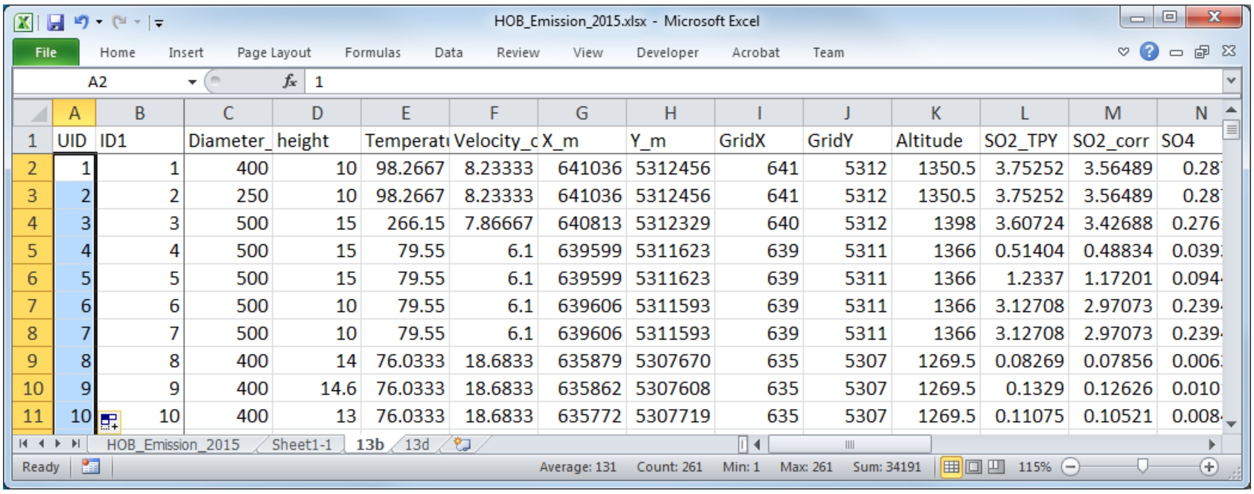


	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	ID1	Diameter_	height	Temperatı	Velocity_c	X_m	Y_m	GridX	GridY	Altitude	SO2_TPY	SO2_corr	SO4	N
2	1	400	10	98.2667	8.23333	641036	5312456	641	5312	1350.5	3.75252	3.56489	0.2873	(
3	2	250	10	98.2667	8.23333	641036	5312456	641	5312	1350.5	3.75252	3.56489	0.2873	(
4	3	500	15	266.15	7.86667	640813	5312329	640	5312	1398	3.60724	3.42688	0.27618	(
5	4	500	15	79.55	6.1	639599	5311623	639	5311	1366	0.51404	0.48834	0.03936	(
6	5	500	15	79.55	6.1	639599	5311623	639	5311	1366	1.2337	1.17201	0.09445	(
7	6	500	10	79.55	6.1	639606	5311593	639	5311	1366	3.12708	2.97073	0.23942	(
8	7	500	10	79.55	6.1	639606	5311593	639	5311	1366	3.12708	2.97073	0.23942	(
9	8	400	14	76.0333	18.6833	635879	5307670	635	5307	1269.5	0.08269	0.07856	0.00633	(
10	9	400	14.6	76.0333	18.6833	635862	5307608	635	5307	1269.5	0.1329	0.12626	0.01018	(
11	10	400	13	76.0333	18.6833	635772	5307719	635	5307	1269.5	.11075	0.10521	0.00848	(



	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	ID1	Diameter_	height	Temperatı	Velocity_c	X_m	Y_m	GridX	GridY	Altitude	SO2_TPY	SO2_corr	SO4	N
2	1	400	10	98.2667	8.23333	641036	5312456	641	5312	1350.5	3.75252	3.56489	0.2873	(
3	2	250	10	98.2667	8.23333	641036	5312456	641	5312	1350.5	3.75252	3.56489	0.2873	(
4	3	500	15	266.15	7.86667	640813	5312329	640	5312	1398	3.60724	3.42688	0.27618	(
5	4	500	15	79.55	6.1	639599	5311623	639	5311	1366	0.51404	0.48834	0.03936	(
6	5	500	15	79.55	6.1	639599	5311623	639	5311	1366	1.2337	1.17201	0.09445	(
7	6	500	10	79.55	6.1	639606	5311593	639	5311	1366	3.12708	2.97073	0.23942	(
8	7	500	10	79.55	6.1	639606	5311593	639	5311	1366	3.12708	2.97073	0.23942	(
9	8	400	14	76.0333	18.6833	635879	5307670	635	5307	1269.5	0.08269	0.07856	0.00633	(
10	9	400	14.6	76.0333	18.6833	635862	5307608	635	5307	1269.5	0.1329	0.12626	0.01018	(
11	10	400	13	76.0333	18.6833	635772	5307719	635	5307	1269.5	.11075	0.10521	0.00848	(

Insert a column before [ID] column and add serial number.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	UID	ID1	Diameter_	height	Temperatu	Velocity_c	X_m	Y_m	GridX	GridY	Altitude	SO2_TPY	SO2_corr	SO4
2	1	1	400	10	98.2667	8.23333	641036	5312456	641	5312	1350.5	3.75252	3.56489	0.28
3	2	2	250	10	98.2667	8.23333	641036	5312456	641	5312	1350.5	3.75252	3.56489	0.28
4	3	3	500	15	266.15	7.86667	640813	5312329	640	5312	1398	3.60724	3.42688	0.276
5	4	4	500	15	79.55	6.1	639599	5311623	639	5311	1366	0.51404	0.48834	0.039
6	5	5	500	15	79.55	6.1	639599	5311623	639	5311	1366	1.2337	1.17201	0.094
7	6	6	500	10	79.55	6.1	639606	5311593	639	5311	1366	3.12708	2.97073	0.239
8	7	7	500	10	79.55	6.1	639606	5311593	639	5311	1366	3.12708	2.97073	0.239
9	8	8	400	14	76.0333	18.6833	635879	5307670	635	5307	1269.5	0.08269	0.07856	0.006
10	9	9	400	14.6	76.0333	18.6833	635862	5307608	635	5307	1269.5	0.1329	0.12626	0.010
11	10	10	400	13	76.0333	18.6833	635772	5307719	635	5307	1269.5	0.11075	0.10521	0.008

Create string of information on point source to be inserted in CALPUFF input file. Input the formulas to each column as follows. The contents of "<>" are column names, and when entering these formulas, specify the corresponding cell.

=CONCATENATE(<UID>,"! SRCNAM = stac",TEXT(<ID1>,"0000")," !")

=CONCATENATE(<UID>,"! X = ",<X_m>/1000,",",<Y_m>/1000,",",< height>,",",<Altitude>,",", TEXT(<Diameter_mm>/1000,"0.###"),",",TEXT(<Velocity_of_flue_gas>,"0.###"),",",TEXT(<Temperature_of_flue_gas>+273.15,"0.###"),",0,",TEXT(<SO2_corr>/(365*24*3600)*10^6,"0.00000E+00"),",",TEXT(<SO4>/(365*24*3600)*10^6,"0.00000E+00"),",",TEXT(<NOx_TPY>/(365*24*3600)*10^6,"0.00000E+00"),",", TEXT(<Dust_TPY>/(365*24*3600)*10^6,"0.00000E+00"),",0,",TEXT(<PM10_TPY>/(365*24*3600)*10^6, "0.00000E+00"),",",TEXT(<NO3>/(365*24*3600)*10^6,"0.00000E+00"),",",TEXT(<CO_TPY>/(365*24*3600)*10^6,"0.00000E+00")," !")

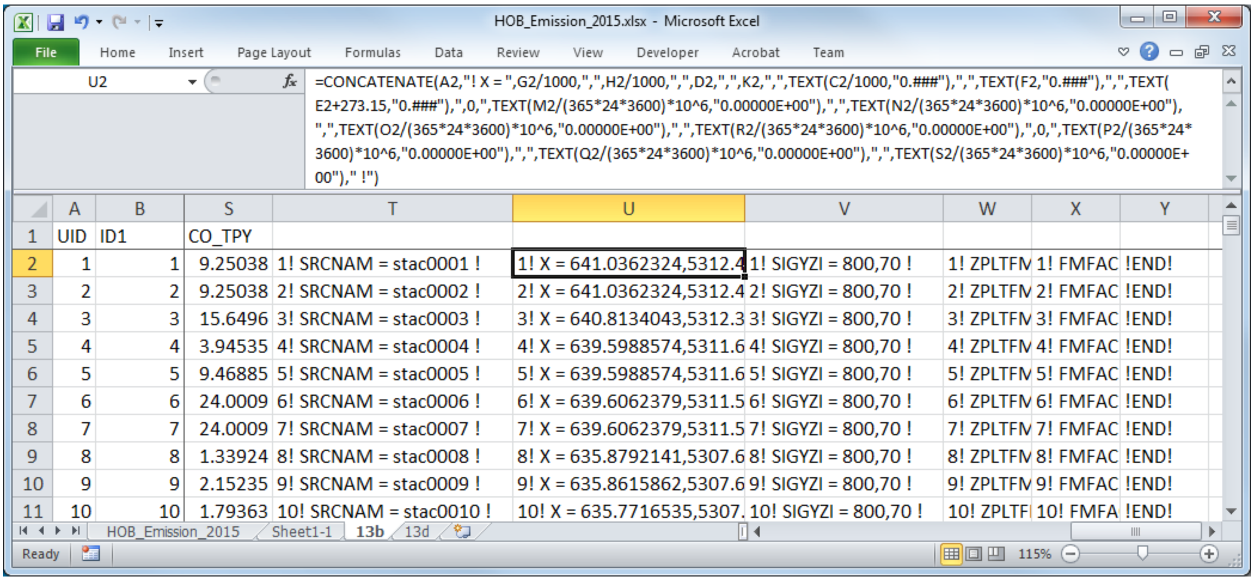
=CONCATENATE(<UID>,"! SIGYZI = 1000[7],20[8] !")

=CONCATENATE(<UID>,"! ZPLTFM = 0 !")

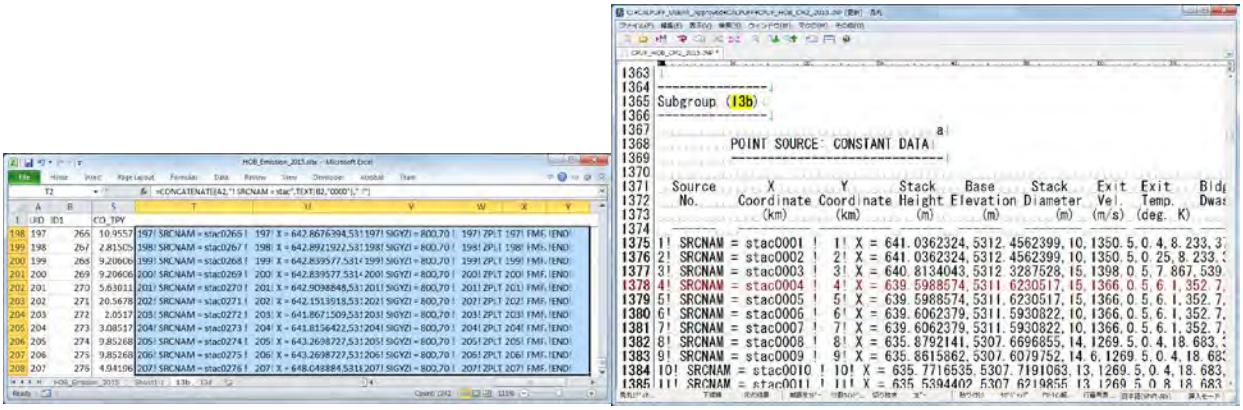
=CONCATENATE(<UID>,"! FMFAC = 1.0 !")

!END!

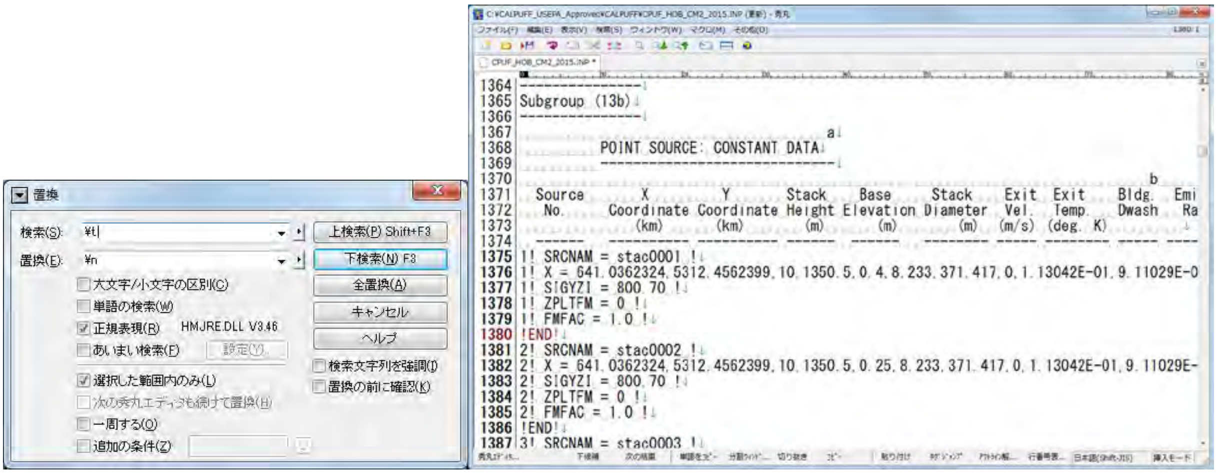
[7] Set 1000 in power plant and 800 in HOB.
[8] Set 20 in PP2 and PP3 (75 t/h), 30 in PP3 (220t/h), 100 in PP4 and Amgalan Heat Supply Station, and 70 in HOB.



Copy the created strings and paste them the relevant part of CALPUFF input file.

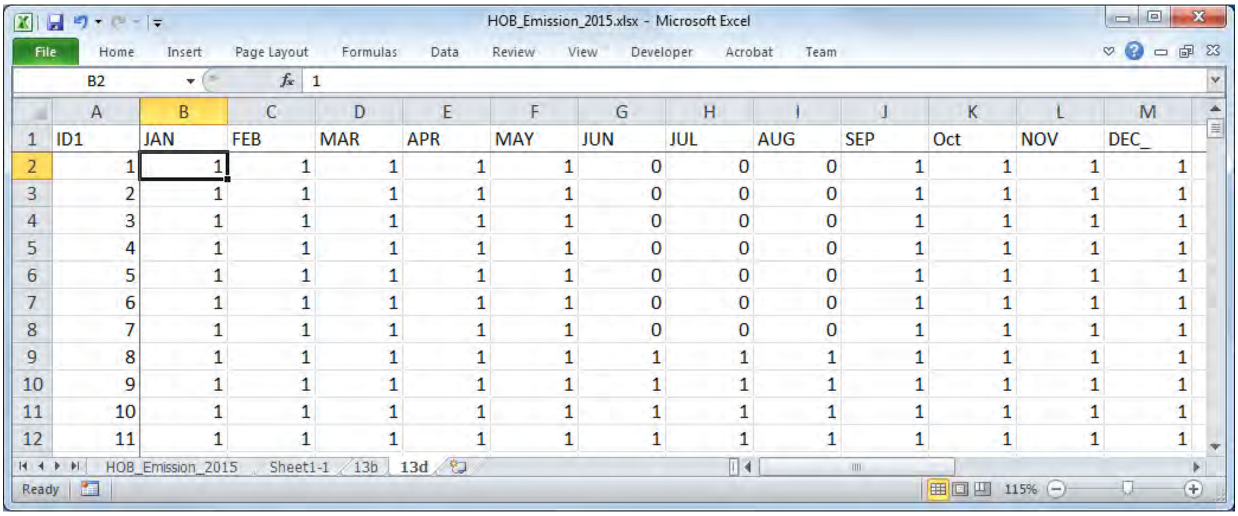


Since boundary between cells is pasted as tab, replace tab with new line.



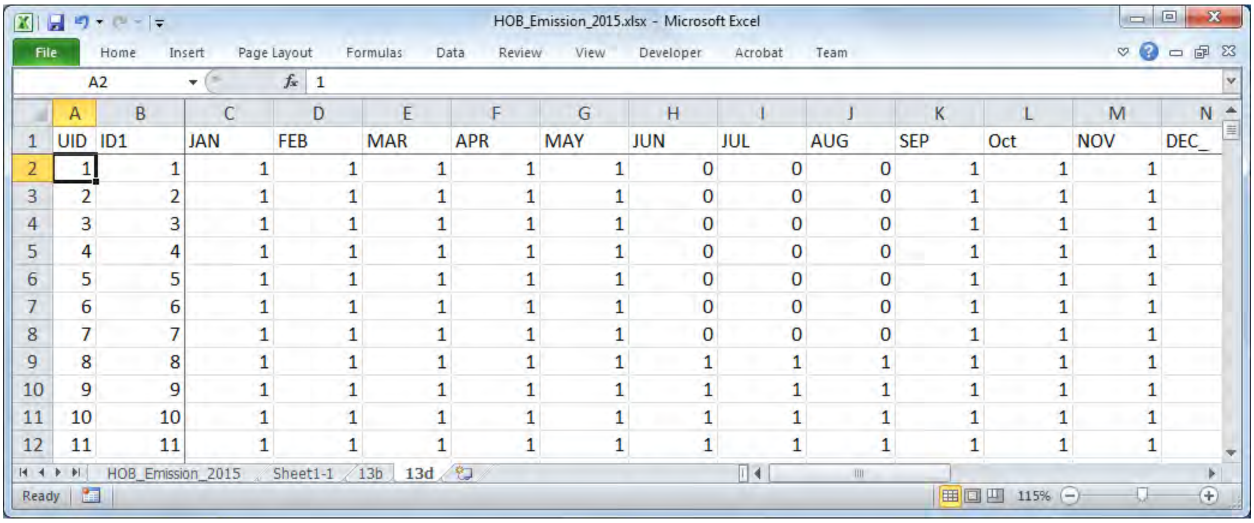
Create of “13d”

Source ID and monthly operating pattern is the only necessary column, so delete other lines.



ID1	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Oct	NOV	DEC_
1	1	1	1	1	1	0	0	0	1	1	1	1
2	1	1	1	1	1	0	0	0	1	1	1	1
3	1	1	1	1	1	0	0	0	1	1	1	1
4	1	1	1	1	1	0	0	0	1	1	1	1
5	1	1	1	1	1	0	0	0	1	1	1	1
6	1	1	1	1	1	0	0	0	1	1	1	1
7	1	1	1	1	1	0	0	0	1	1	1	1
8	1	1	1	1	1	1	1	1	1	1	1	1
9	1	1	1	1	1	1	1	1	1	1	1	1
10	1	1	1	1	1	1	1	1	1	1	1	1
11	1	1	1	1	1	1	1	1	1	1	1	1

Insert a column before [ID] column and add serial number.



UID	ID1	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Oct	NOV	DEC_
1	1	1	1	1	1	1	0	0	0	1	1	1	
2	2	1	1	1	1	1	0	0	0	1	1	1	
3	3	1	1	1	1	1	0	0	0	1	1	1	
4	4	1	1	1	1	1	0	0	0	1	1	1	
5	5	1	1	1	1	1	0	0	0	1	1	1	
6	6	1	1	1	1	1	0	0	0	1	1	1	
7	7	1	1	1	1	1	0	0	0	1	1	1	
8	8	1	1	1	1	1	1	1	1	1	1	1	
9	9	1	1	1	1	1	1	1	1	1	1	1	
10	10	1	1	1	1	1	1	1	1	1	1	1	
11	11	1	1	1	1	1	1	1	1	1	1	1	

Create strings by pollutant setting operating pattern.

=CONCATENATE(<UID>,"! SRCNAM = stac",TEXT(<ID1>,"0000")," !")

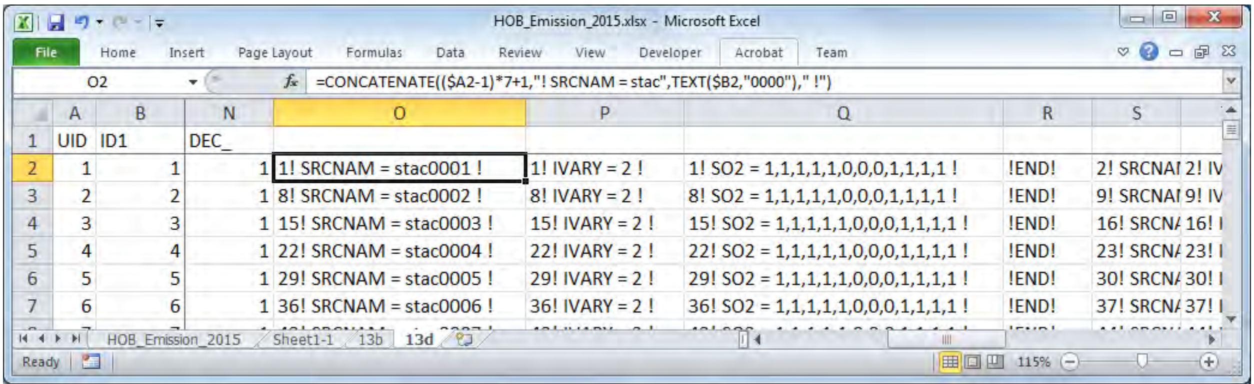
=CONCATENATE(<UID>,"! IVARY = 2 !")

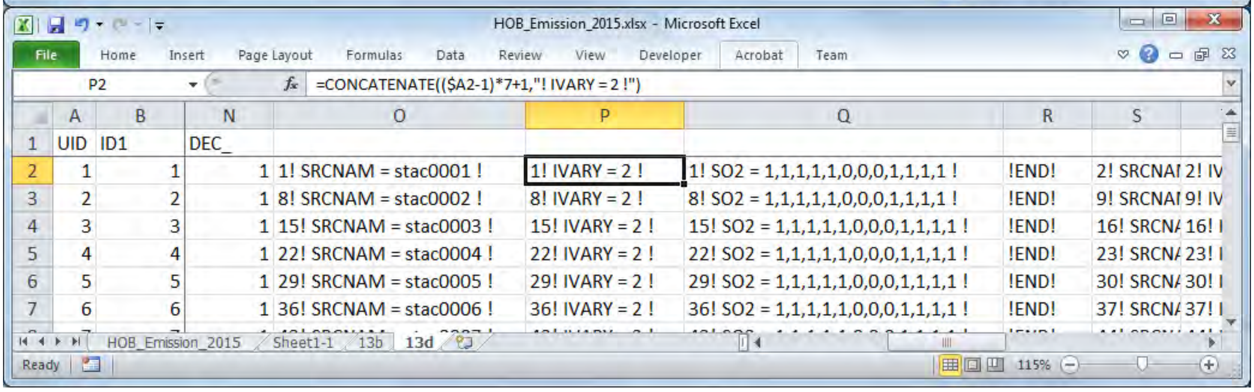
=CONCATENATE(<UID>,"! <Pollutant> = ",TEXT(<JAN>,"0.0000"),", ",TEXT(<FEB>,"0.0000"),",",TEXT(<MAR>,"0.0000"),",",TEXT(<APR>,"0.0000"),",",TEXT(<MAY>,"0.0000"),",",TEXT(<JUN>,"0.0000"),",",TEXT(<JUL>,"0.0000"),",",TEXT(<AUG>,"0.0000"),",",TEXT(<SEP>,"0.0000"),",",TEXT(<OCT>,"0.0000"),",",TEXT(<NOV>,"0.0000"),",",TEXT(<DEC>,"0.0000")," !")

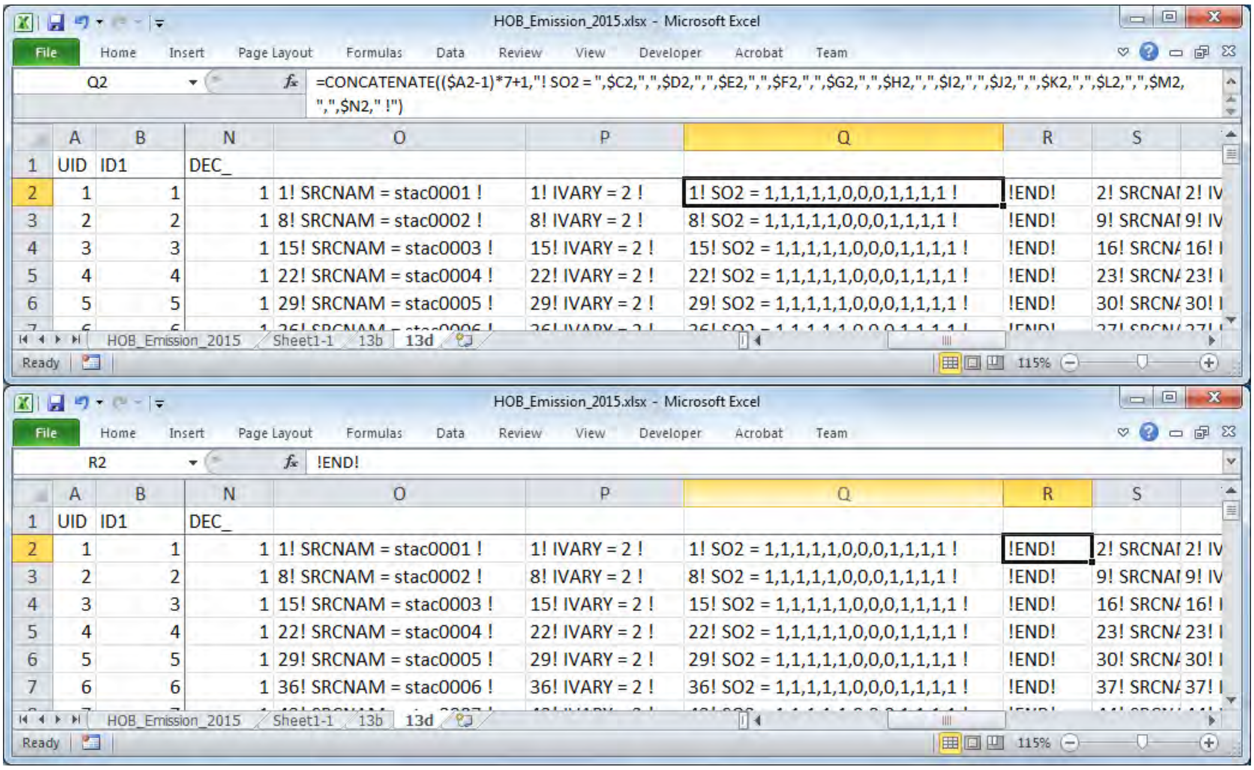
!END!

Since operating pattern needs to be created by pollutant, definition of “Unique ID” differs.

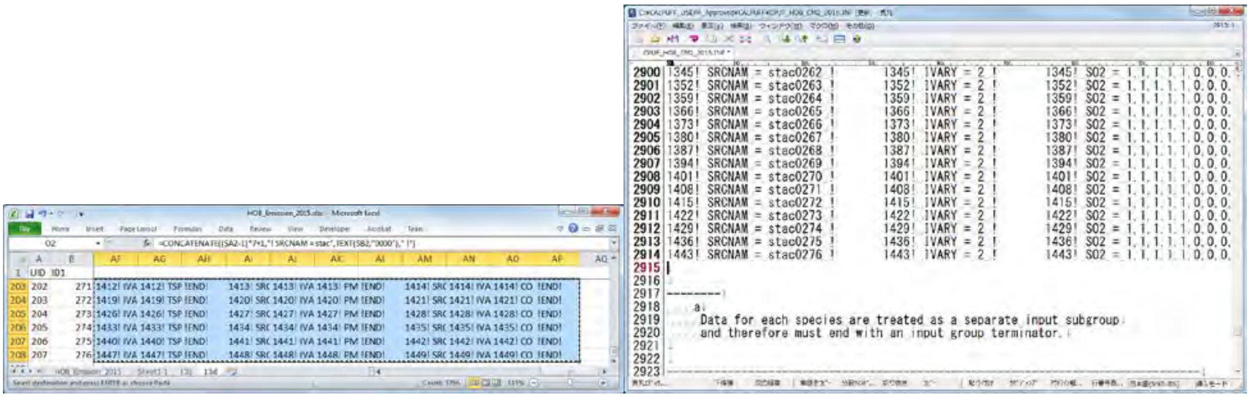
Pollutant	Unique ID
SO2	(<UID>-1)*7+1
SO4	(<UID>-1)*7+2
NOX	(<UID>-1)*7+3
NO3	(<UID>-1)*7+4
TSP	(<UID>-1)*7+5
PM10	(<UID>-1)*7+6
CO	(<UID>-1)*7+7



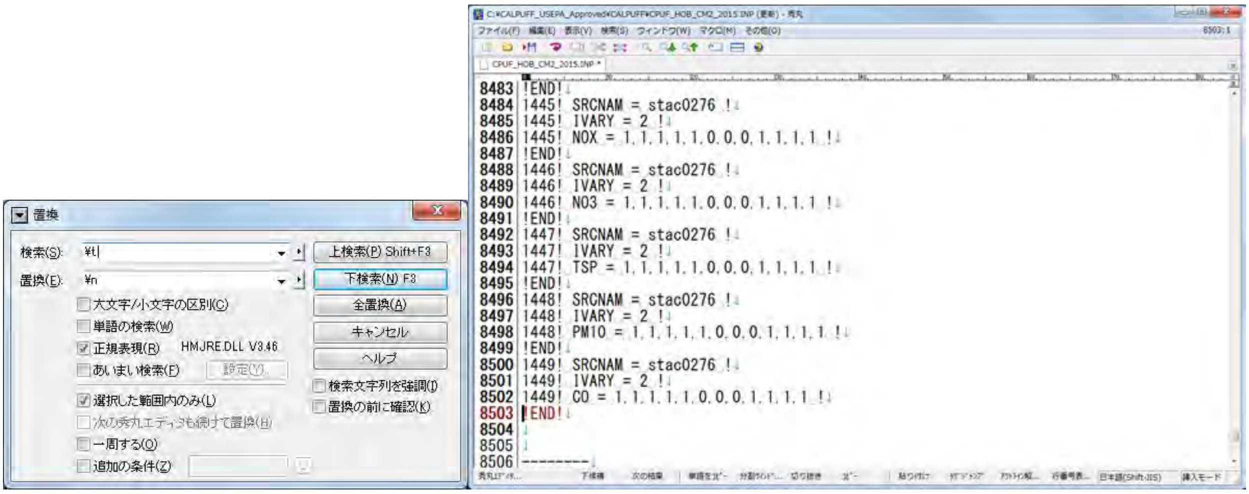




Copy the created strings and paste them the relevant part of CALPUFF input file.

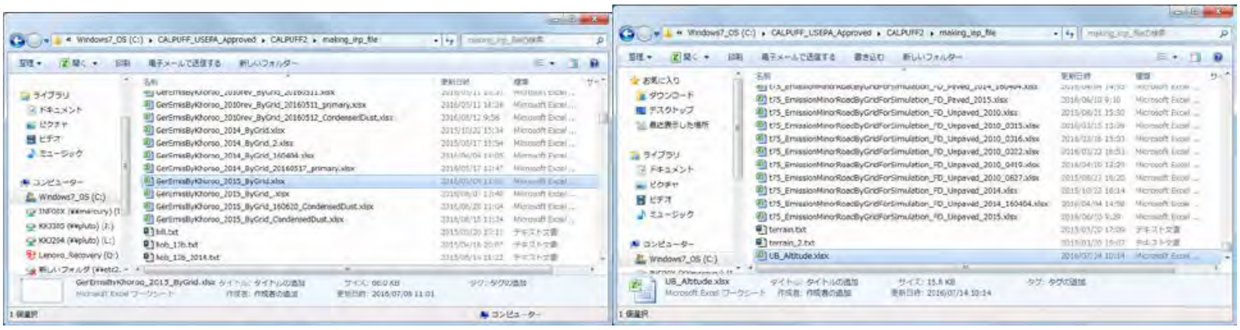


Since boundary between cells is pasted as tab, replace tab with new line.



5.2 Area Source

Open the Excel file in export destination folder and the file of elevation data by grid (UB_altitude.xlsx).



Copy ”sheet1-1” of “UB_altitude.xlsx” to the Excel file in export destination folder

Add columns to calculate the emissions of SO2, SO4 and NO3.

GerEmisByKhoroo_2015_ByGrid.xlsx - Microsoft Excel

G1 fx SO2_corr

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	IXIY	Column_	Row	MinX	MinY	TPY_SO2	SO2_corr	SO4	TPY_NOx	TPY_TSP	TPY_PM1(	NO3	TPY_CO
2	70025	7	25	617000	5305000	0.43347			0.10359	0.88659	0.57628		7.66343
3	70026	7	26	617000	5306000	0.31098			0.07432	0.63606	0.41344		5.49795
4	70027	7	27	617000	5307000	0.06765			0.01617	0.13836	0.08993		1.19593
5	70028	7	28	617000	5308000	0.72186			0.17251	1.47642	0.95967		12.7618
6	80025	8	25	618000	5305000	0.68444			0.16357	1.39989	0.90993		12.1003
7	80026	8	26	618000	5306000	1.40096			0.33481	2.8654	1.86251		24.7678
8	80027	8	27	618000	5307000	2.25095			0.53795	4.60389	2.99253		39.7949
9	80028	8	28	618000	5308000	0.3026			0.07232	0.61891	0.40229		5.34972
10	90013	9	13	619000	5293000	0.10863			0.02625	0.21095	0.13712		1.87947
11	90026	9	26	619000	5306000	18.7768			5.00217	52.3754	34.0451		417.398

Input formulas to calculate the emission of SO4 and NO3.

SO4 Emission =SO2 Emission x conversion ratio from SO2 to SO4 x 96/64

SO2 Emission = SO2 Emission x (1- conversion ratio from SO2 to SO4)

NO3 Emission =PM10 Emission x NO3 contribution ratio by composition analysis of PM10

GerEmisByKhoroo_2015_ByGrid.xlsx - Microsoft Excel

G2 fx =F2*(1-5/100)

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	IXIY	Column_	Row	MinX	MinY	TPY_SO2	SO2_corr	SO4	TPY_NOx	TPY_TSP	TPY_PM1(	NO3	TPY_CO
2	70025	7	25	617000	5305000	0.43347	0.4118	0.03319	0.10359	0.88659	0.57628	0.00046	7.66343
3	70026	7	26	617000	5306000	0.31098	0.29544	0.02381	0.07432	0.63606	0.41344	0.00033	5.49795
4	70027	7	27	617000	5307000	0.06765	0.06426	0.00518	0.01617	0.13836	0.08993	7.2E-05	1.19593
5	70028	7	28	617000	5308000	0.72186	0.68576	0.05527	0.17251	1.47642	0.95967	0.00077	12.7618
6	80025	8	25	618000	5305000	0.68444	0.65021	0.0524	0.16357	1.39989	0.90993	0.00073	12.1003
7	80026	8	26	618000	5306000	1.40096	1.33091	0.10726	0.33481	2.8654	1.86251	0.00149	24.7678
8	80027	8	27	618000	5307000	2.25095	2.1384	0.17234	0.53795	4.60389	2.99253	0.00239	39.7949

GerEmisByKhoroo_2015_ByGrid.xlsx - Microsoft Excel

H2 fx =F2*5/100*98/64

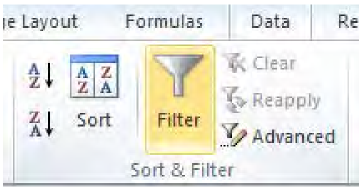
	A	B	C	D	E	F	G	H	I	J	K	L	M
1	IXIY	Column_	Row	MinX	MinY	TPY_SO2	SO2_corr	SO4	TPY_NOx	TPY_TSP	TPY_PM1(	NO3	TPY_CO
2	70025	7	25	617000	5305000	0.43347	0.4118	0.03319	0.10359	0.88659	0.57628	0.00046	7.66343
3	70026	7	26	617000	5306000	0.31098	0.29544	0.02381	0.07432	0.63606	0.41344	0.00033	5.49795
4	70027	7	27	617000	5307000	0.06765	0.06426	0.00518	0.01617	0.13836	0.08993	7.2E-05	1.19593
5	70028	7	28	617000	5308000	0.72186	0.68576	0.05527	0.17251	1.47642	0.95967	0.00077	12.7618
6	80025	8	25	618000	5305000	0.68444	0.65021	0.0524	0.16357	1.39989	0.90993	0.00073	12.1003
7	80026	8	26	618000	5306000	1.40096	1.33091	0.10726	0.33481	2.8654	1.86251	0.00149	24.7678
8	80027	8	27	618000	5307000	2.25095	2.1384	0.17234	0.53795	4.60389	2.99253	0.00239	39.7949

GerEmisByKhoroo_2015_ByGrid.xlsx - Microsoft Excel

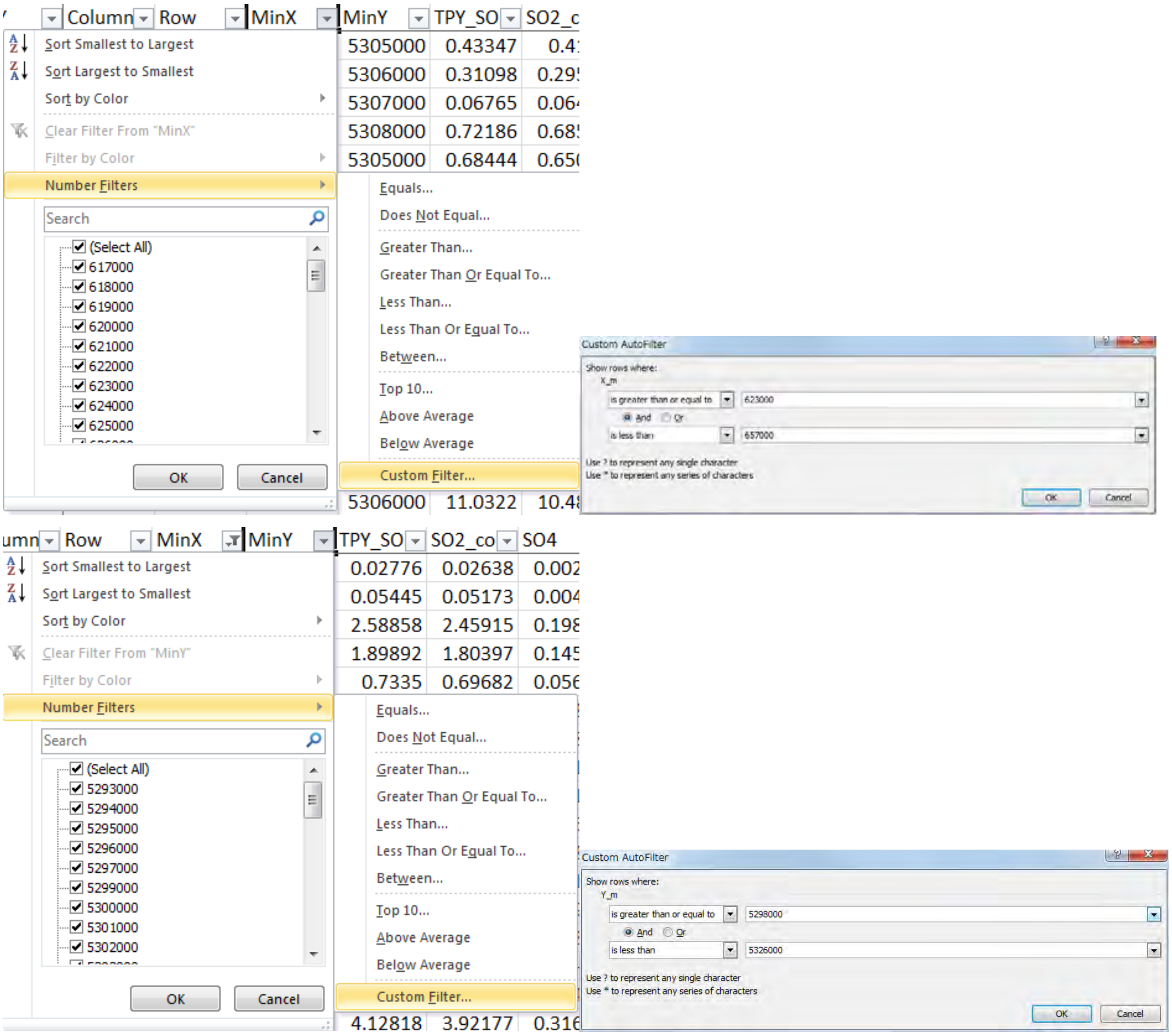
L2 fx =K2*0.08/100

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	IXIY	Column_	Row	MinX	MinY	TPY_SO2	SO2_corr	SO4	TPY_NOx	TPY_TSP	TPY_PM1(	NO3	TPY_CO
2	70025	7	25	617000	5305000	0.43347	0.4118	0.03319	0.10359	0.88659	0.57628	0.00046	7.66343
3	70026	7	26	617000	5306000	0.31098	0.29544	0.02381	0.07432	0.63606	0.41344	0.00033	5.49795
4	70027	7	27	617000	5307000	0.06765	0.06426	0.00518	0.01617	0.13836	0.08993	7.2E-05	1.19593
5	70028	7	28	617000	5308000	0.72186	0.68576	0.05527	0.17251	1.47642	0.95967	0.00077	12.7618
6	80025	8	25	618000	5305000	0.68444	0.65021	0.0524	0.16357	1.39989	0.90993	0.00073	12.1003
7	80026	8	26	618000	5306000	1.40096	1.33091	0.10726	0.33481	2.8654	1.86251	0.00149	24.7678
8	80027	8	27	618000	5307000	2.25095	2.1384	0.17234	0.53795	4.60389	2.99253	0.00239	39.7949

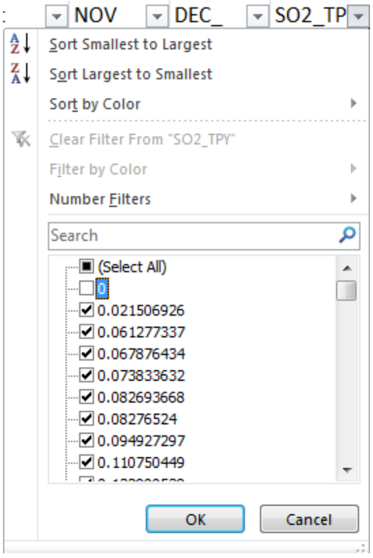
Click [Filter] in “Data” tab and add filter function to the first row.



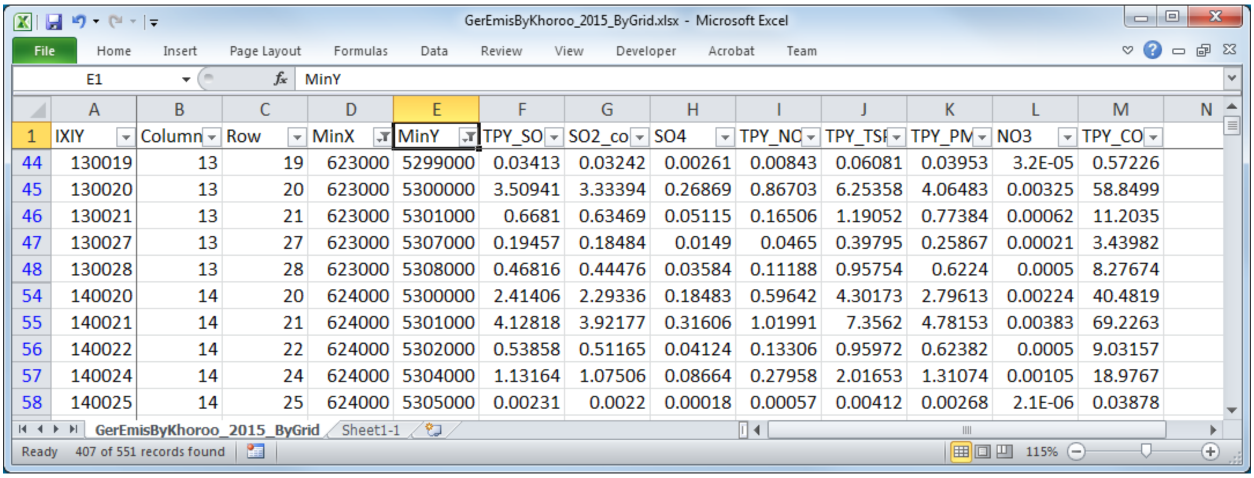
Select ”▼” at [MinX] and [MinY] and filter in calculation range in east-west and south-north directions.



Select ”▼” at [SO2_TPY] and filter to grid that SO2 emission is not zero.

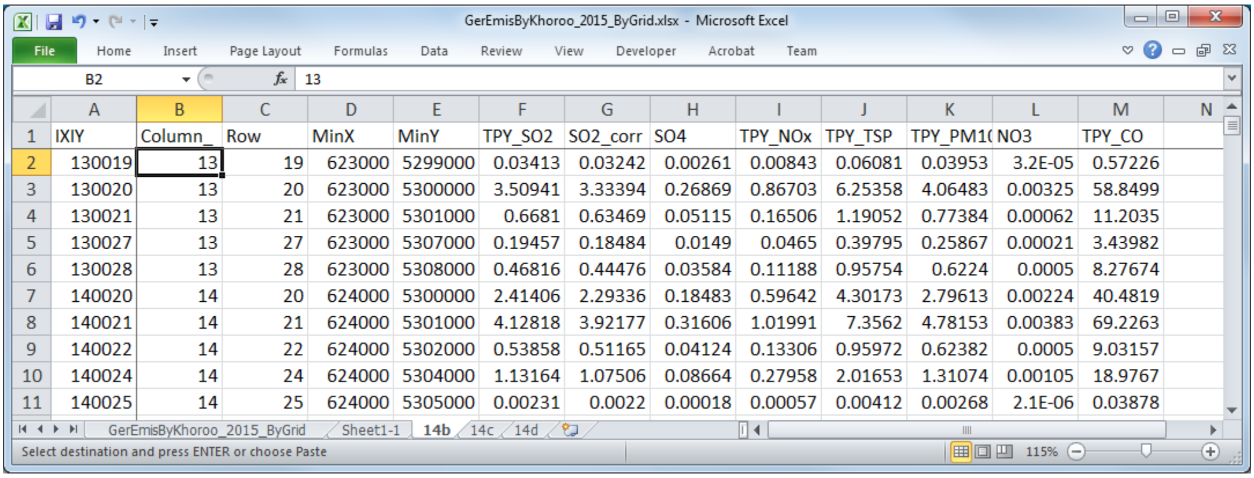


Only rows extracted by the above filter function are displayed



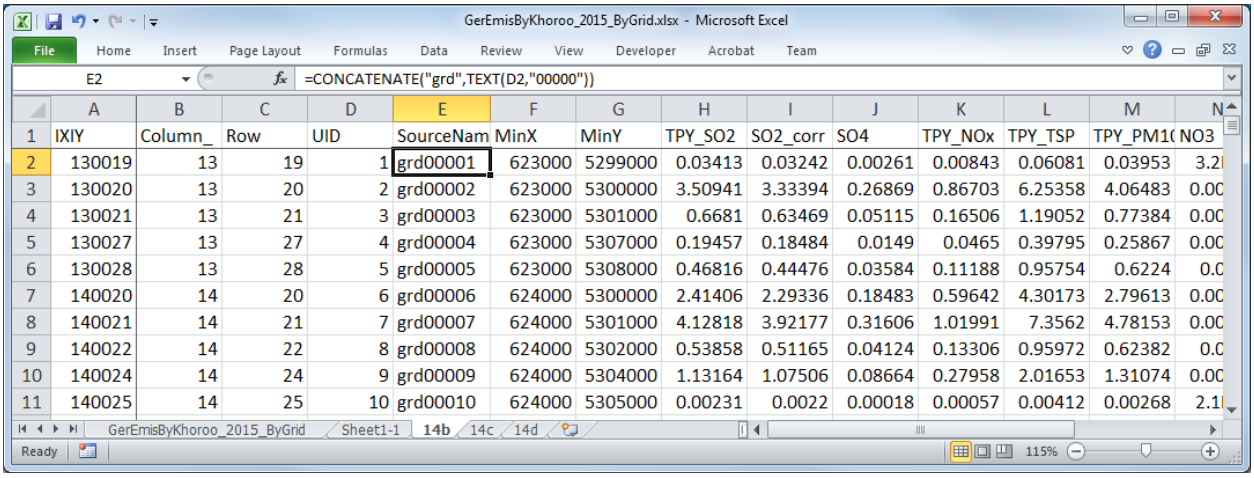
	A	B	C	D	E	F	G	H	I	J	K	L	M
1	IXIY	Column	Row	MinX	MinY	TPY_SO	SO2_co	SO4	TPY_NO	TPY_TSI	TPY_PM	NO3	TPY_CO
44	130019	13	19	623000	5299000	0.03413	0.03242	0.00261	0.00843	0.06081	0.03953	3.2E-05	0.57226
45	130020	13	20	623000	5300000	3.50941	3.33394	0.26869	0.86703	6.25358	4.06483	0.00325	58.8499
46	130021	13	21	623000	5301000	0.6681	0.63469	0.05115	0.16506	1.19052	0.77384	0.00062	11.2035
47	130027	13	27	623000	5307000	0.19457	0.18484	0.0149	0.0465	0.39795	0.25867	0.00021	3.43982
48	130028	13	28	623000	5308000	0.46816	0.44476	0.03584	0.11188	0.95754	0.6224	0.0005	8.27674
54	140020	14	20	624000	5300000	2.41406	2.29336	0.18483	0.59642	4.30173	2.79613	0.00224	40.4819
55	140021	14	21	624000	5301000	4.12818	3.92177	0.31606	1.01991	7.3562	4.78153	0.00383	69.2263
56	140022	14	22	624000	5302000	0.53858	0.51165	0.04124	0.13306	0.95972	0.62382	0.0005	9.03157
57	140024	14	24	624000	5304000	1.13164	1.07506	0.08664	0.27958	2.01653	1.31074	0.00105	18.9767
58	140025	14	25	624000	5305000	0.00231	0.0022	0.00018	0.00057	0.00412	0.00268	2.1E-06	0.03878

Copy the grids generated by filter function and paste them on another sheet, and set the name of each sheet to "14b", “14c”, and "14d".



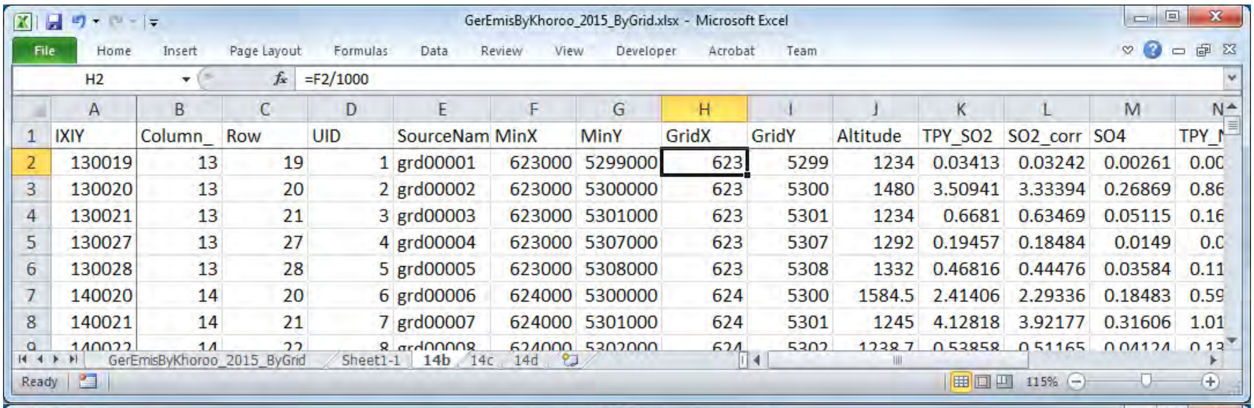
	A	B	C	D	E	F	G	H	I	J	K	L	M
1	IXIY	Column_	Row	MinX	MinY	TPY_SO2	SO2_corr	SO4	TPY_NOx	TPY_TSP	TPY_PM1(	NO3	TPY_CO
2	130019	13	19	623000	5299000	0.03413	0.03242	0.00261	0.00843	0.06081	0.03953	3.2E-05	0.57226
3	130020	13	20	623000	5300000	3.50941	3.33394	0.26869	0.86703	6.25358	4.06483	0.00325	58.8499
4	130021	13	21	623000	5301000	0.6681	0.63469	0.05115	0.16506	1.19052	0.77384	0.00062	11.2035
5	130027	13	27	623000	5307000	0.19457	0.18484	0.0149	0.0465	0.39795	0.25867	0.00021	3.43982
6	130028	13	28	623000	5308000	0.46816	0.44476	0.03584	0.11188	0.95754	0.6224	0.0005	8.27674
7	140020	14	20	624000	5300000	2.41406	2.29336	0.18483	0.59642	4.30173	2.79613	0.00224	40.4819
8	140021	14	21	624000	5301000	4.12818	3.92177	0.31606	1.01991	7.3562	4.78153	0.00383	69.2263
9	140022	14	22	624000	5302000	0.53858	0.51165	0.04124	0.13306	0.95972	0.62382	0.0005	9.03157
10	140024	14	24	624000	5304000	1.13164	1.07506	0.08664	0.27958	2.01653	1.31074	0.00105	18.9767
11	140025	14	25	624000	5305000	0.00231	0.0022	0.00018	0.00057	0.00412	0.00268	2.1E-06	0.03878

Using the "14b" sheet, create the string information on area sources (14b) among CALPUFF input data. First, add two columns and create the source name.

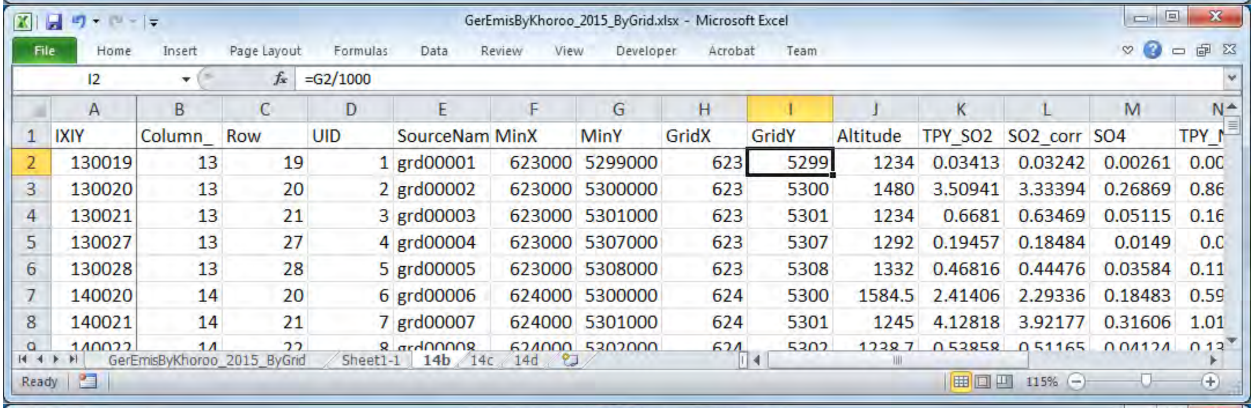


	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	IXIY	Column_	Row	UID	SourceNam	MinX	MinY	TPY_SO2	SO2_corr	SO4	TPY_NOx	TPY_TSP	TPY_PM1(	NO3
2	130019	13	19	1	grd00001	623000	5299000	0.03413	0.03242	0.00261	0.00843	0.06081	0.03953	3.2
3	130020	13	20	2	grd00002	623000	5300000	3.50941	3.33394	0.26869	0.86703	6.25358	4.06483	0.0C
4	130021	13	21	3	grd00003	623000	5301000	0.6681	0.63469	0.05115	0.16506	1.19052	0.77384	0.0C
5	130027	13	27	4	grd00004	623000	5307000	0.19457	0.18484	0.0149	0.0465	0.39795	0.25867	0.0C
6	130028	13	28	5	grd00005	623000	5308000	0.46816	0.44476	0.03584	0.11188	0.95754	0.6224	0.C
7	140020	14	20	6	grd00006	624000	5300000	2.41406	2.29336	0.18483	0.59642	4.30173	2.79613	0.0C
8	140021	14	21	7	grd00007	624000	5301000	4.12818	3.92177	0.31606	1.01991	7.3562	4.78153	0.0C
9	140022	14	22	8	grd00008	624000	5302000	0.53858	0.51165	0.04124	0.13306	0.95972	0.62382	0.C
10	140024	14	24	9	grd00009	624000	5304000	1.13164	1.07506	0.08664	0.27958	2.01653	1.31074	0.0C
11	140025	14	25	10	grd00010	624000	5305000	0.00231	0.0022	0.00018	0.00057	0.00412	0.00268	2.1

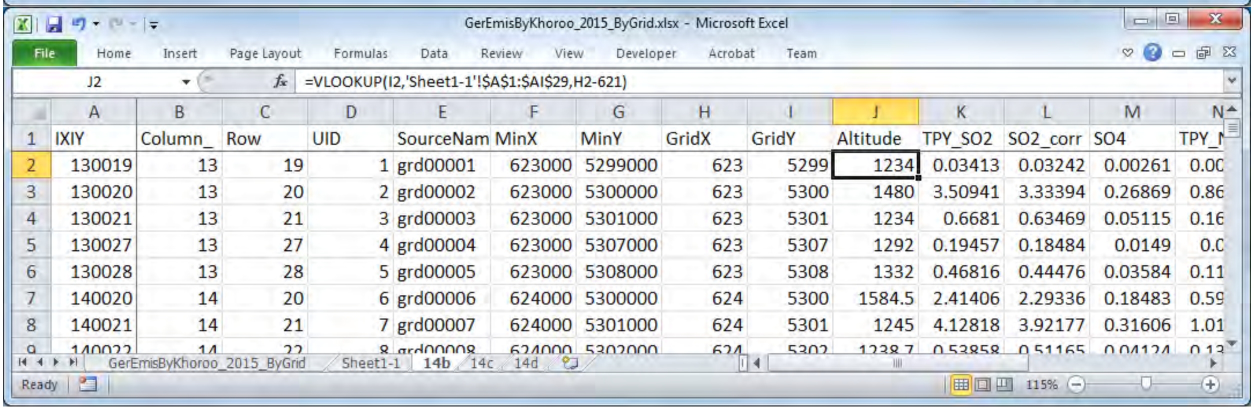
Three columns are added to the sheet on which the data is copied, and value of elevation data for each grid according to the coordinates is extracted. Calculate the grid positions specified by the coordinates in the first two columns, and enter an equation to calculate the value of elevation data by grid referenced from "sheet1-1" according to these values in the last one column.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	IXIY	Column_	Row	UID	SourceNam	MinX	MinY	GridX	GridY	Altitude	TPY_SO2	SO2_corr	SO4	TPY_
2	130019	13	19	1	grd00001	623000	5299000	623	5299	1234	0.03413	0.03242	0.00261	0.00
3	130020	13	20	2	grd00002	623000	5300000	623	5300	1480	3.50941	3.33394	0.26869	0.86
4	130021	13	21	3	grd00003	623000	5301000	623	5301	1234	0.6681	0.63469	0.05115	0.16
5	130027	13	27	4	grd00004	623000	5307000	623	5307	1292	0.19457	0.18484	0.0149	0.0
6	130028	13	28	5	grd00005	623000	5308000	623	5308	1332	0.46816	0.44476	0.03584	0.11
7	140020	14	20	6	grd00006	624000	5300000	624	5300	1584.5	2.41406	2.29336	0.18483	0.59
8	140021	14	21	7	grd00007	624000	5301000	624	5301	1245	4.12818	3.92177	0.31606	1.01
9	140022	14	22	8	grd00008	624000	5302000	624	5302	1238.7	0.53858	0.51165	0.04124	0.13



	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	IXIY	Column_	Row	UID	SourceNam	MinX	MinY	GridX	GridY	Altitude	TPY_SO2	SO2_corr	SO4	TPY_
2	130019	13	19	1	grd00001	623000	5299000	623	5299	1234	0.03413	0.03242	0.00261	0.00
3	130020	13	20	2	grd00002	623000	5300000	623	5300	1480	3.50941	3.33394	0.26869	0.86
4	130021	13	21	3	grd00003	623000	5301000	623	5301	1234	0.6681	0.63469	0.05115	0.16
5	130027	13	27	4	grd00004	623000	5307000	623	5307	1292	0.19457	0.18484	0.0149	0.0
6	130028	13	28	5	grd00005	623000	5308000	623	5308	1332	0.46816	0.44476	0.03584	0.11
7	140020	14	20	6	grd00006	624000	5300000	624	5300	1584.5	2.41406	2.29336	0.18483	0.59
8	140021	14	21	7	grd00007	624000	5301000	624	5301	1245	4.12818	3.92177	0.31606	1.01
9	140022	14	22	8	grd00008	624000	5302000	624	5302	1238.7	0.53858	0.51165	0.04124	0.13

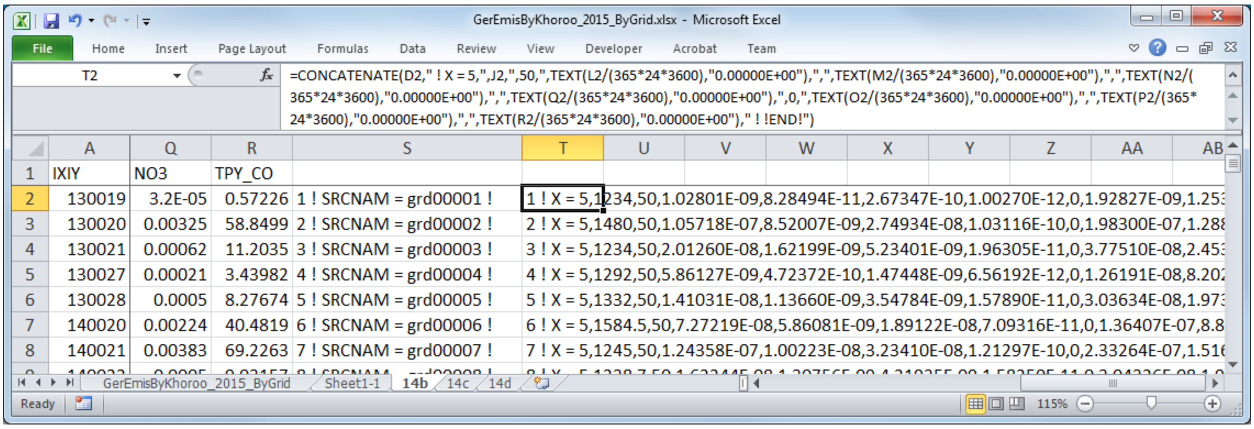


	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	IXIY	Column_	Row	UID	SourceNam	MinX	MinY	GridX	GridY	Altitude	TPY_SO2	SO2_corr	SO4	TPY_
2	130019	13	19	1	grd00001	623000	5299000	623	5299	1234	0.03413	0.03242	0.00261	0.00
3	130020	13	20	2	grd00002	623000	5300000	623	5300	1480	3.50941	3.33394	0.26869	0.86
4	130021	13	21	3	grd00003	623000	5301000	623	5301	1234	0.6681	0.63469	0.05115	0.16
5	130027	13	27	4	grd00004	623000	5307000	623	5307	1292	0.19457	0.18484	0.0149	0.0
6	130028	13	28	5	grd00005	623000	5308000	623	5308	1332	0.46816	0.44476	0.03584	0.11
7	140020	14	20	6	grd00006	624000	5300000	624	5300	1584.5	2.41406	2.29336	0.18483	0.59
8	140021	14	21	7	grd00007	624000	5301000	624	5301	1245	4.12818	3.92177	0.31606	1.01
9	140022	14	22	8	grd00008	624000	5302000	624	5302	1238.7	0.53858	0.51165	0.04124	0.13

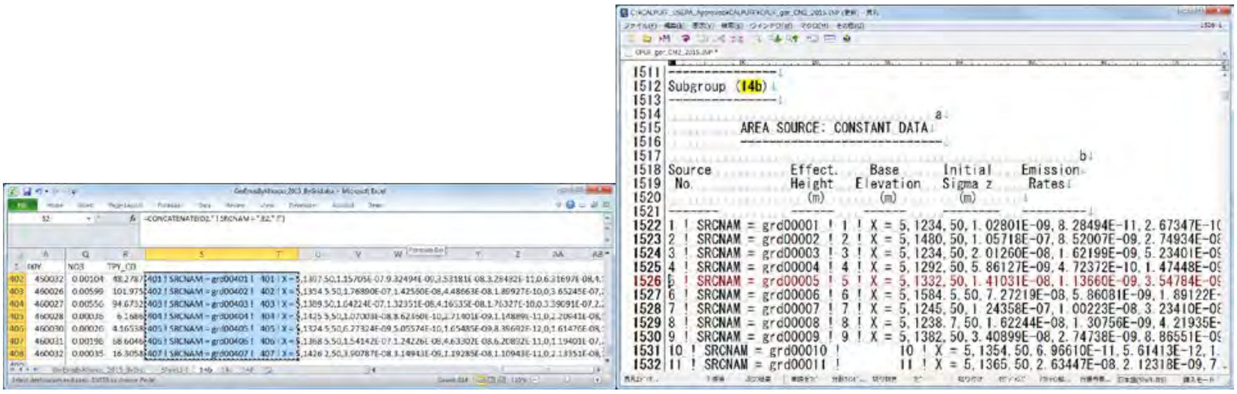
Create string of information on point source to be inserted in CALPUFF input file. Input the formulas to each column as follows. The contents of “<>” are column names, and when entering these formulas, specify the corresponding cell.

=CONCATENATE(D2," ! SRCNAM = ",E2," !")

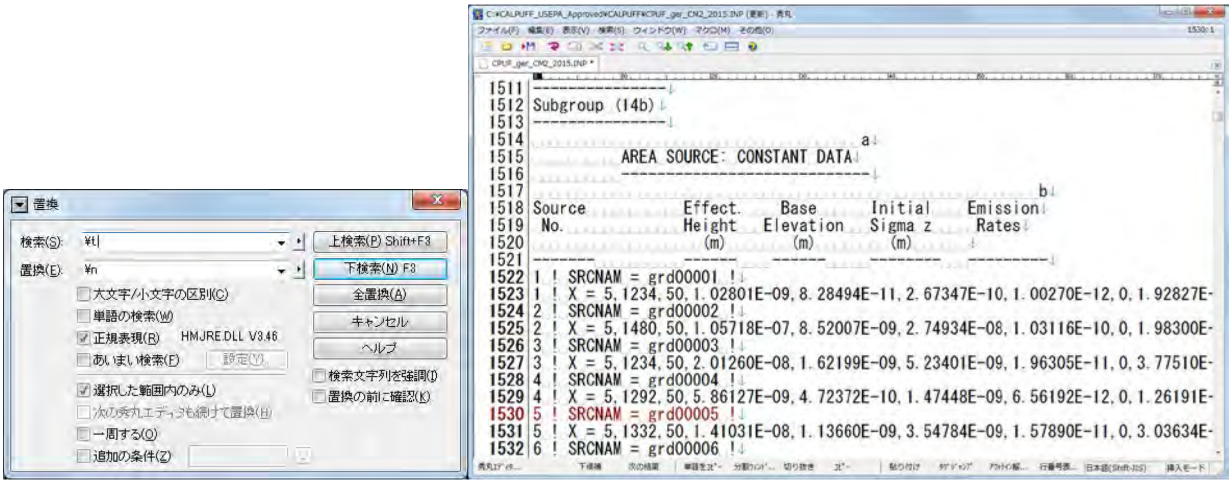
=CONCATENATE(D2," ! X = 5,",J2,",50,",TEXT(L2/(365*24*3600),"0.00000E+00"),",", TEXT(M2/(365*24*3600),"0.00000E+00"),",",TEXT(N2/(365*24*3600),"0.00000E+00"),",",TEXT(Q2/(365*24*3600),"0.00000E+00"),",0,",TEXT(O2/(365*24*3600),"0.00000E+00"),",",TEXT(P2/(365*24*3600),"0.00000E+00"),",",TEXT(R2/(365*24*3600),"0.00000E+00")," ! !END!")



Copy the created strings and paste them the relevant part of CALPUFF input file.

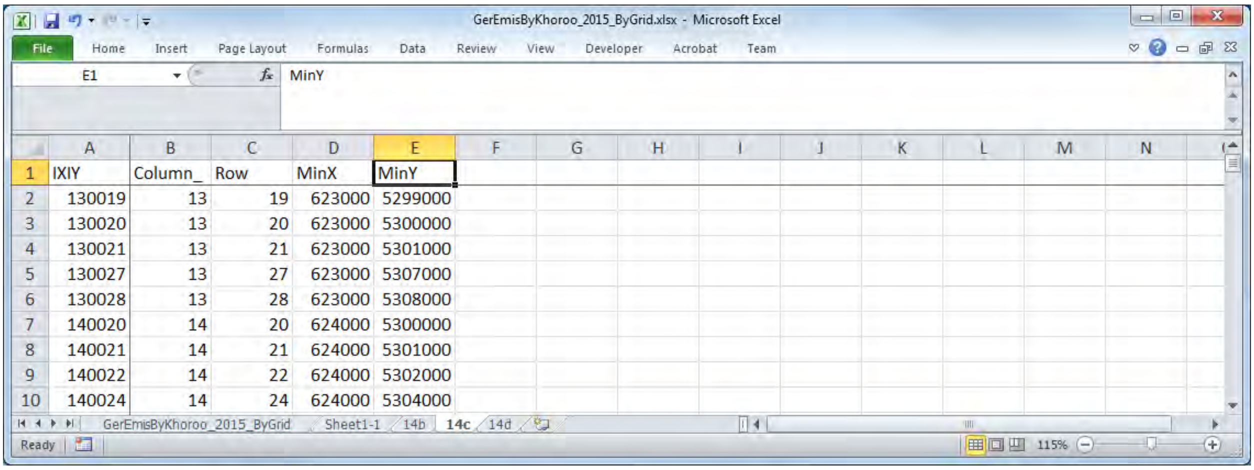


Since boundary between cells is pasted as tab, replace tab with new line.



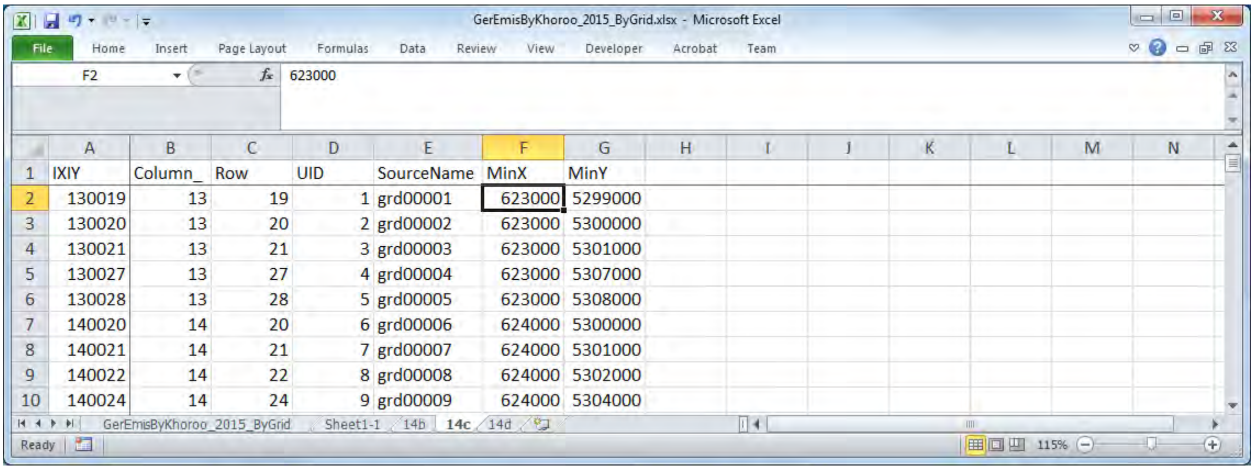
Create of “14c”.

Delete the columns other than the information on grid.



IXIY	Column_	Row	MinX	MinY
130019	13	19	623000	5299000
130020	13	20	623000	5300000
130021	13	21	623000	5301000
130027	13	27	623000	5307000
130028	13	28	623000	5308000
140020	14	20	624000	5300000
140021	14	21	624000	5301000
140022	14	22	624000	5302000
140024	14	24	624000	5304000

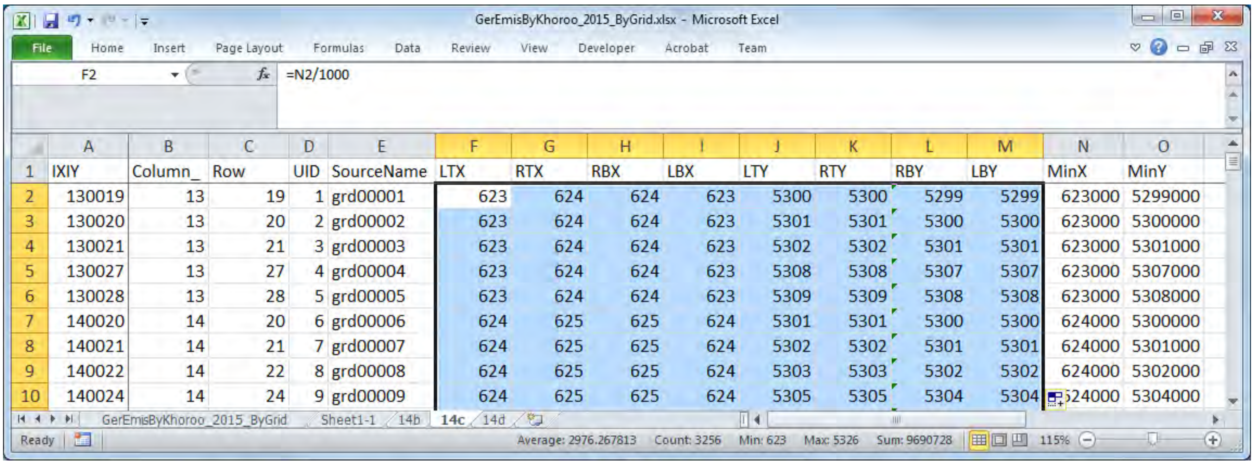
Add two columns and create the source name.



IXIY	Column_	Row	UID	SourceName	MinX	MinY
130019	13	19	1	grd00001	623000	5299000
130020	13	20	2	grd00002	623000	5300000
130021	13	21	3	grd00003	623000	5301000
130027	13	27	4	grd00004	623000	5307000
130028	13	28	5	grd00005	623000	5308000
140020	14	20	6	grd00006	624000	5300000
140021	14	21	7	grd00007	624000	5301000
140022	14	22	8	grd00008	624000	5302000
140024	14	24	9	grd00009	624000	5304000

Insert eight columns before [MinX] column and input column name and formula respectively. Column name and formula is as follows.

Column name	LTX	RTX	RBX	LBX	LTY	RTY	RBY	LBY
Contents	X of upper left	X of upper right	X of bottom right	X of bottom left	Y of upper left	Y of upper right	Y of bottom right	Y of bottom left
Formula	MinX/1000	LTX+1	RTX	LTX	MinY/1000+1	LTY	MinX/1000	RBY



F2 =N2/1000

	IXIY	Column_	Row	UID	SourceName	LTX	RTX	RBX	LBX	LTY	RTY	RBY	LBY	MinX	MinY
2	130019	13	19	1	grd00001	623	624	624	623	5300	5300	5299	5299	623000	5299000
3	130020	13	20	2	grd00002	623	624	624	623	5301	5301	5300	5300	623000	5300000
4	130021	13	21	3	grd00003	623	624	624	623	5302	5302	5301	5301	623000	5301000
5	130027	13	27	4	grd00004	623	624	624	623	5308	5308	5307	5307	623000	5307000
6	130028	13	28	5	grd00005	623	624	624	623	5309	5309	5308	5308	623000	5308000
7	140020	14	20	6	grd00006	624	625	625	624	5301	5301	5300	5300	624000	5300000
8	140021	14	21	7	grd00007	624	625	625	624	5302	5302	5301	5301	624000	5301000
9	140022	14	22	8	grd00008	624	625	625	624	5303	5303	5302	5302	624000	5302000
10	140024	14	24	9	grd00009	624	625	625	624	5305	5305	5304	5304	624000	5304000

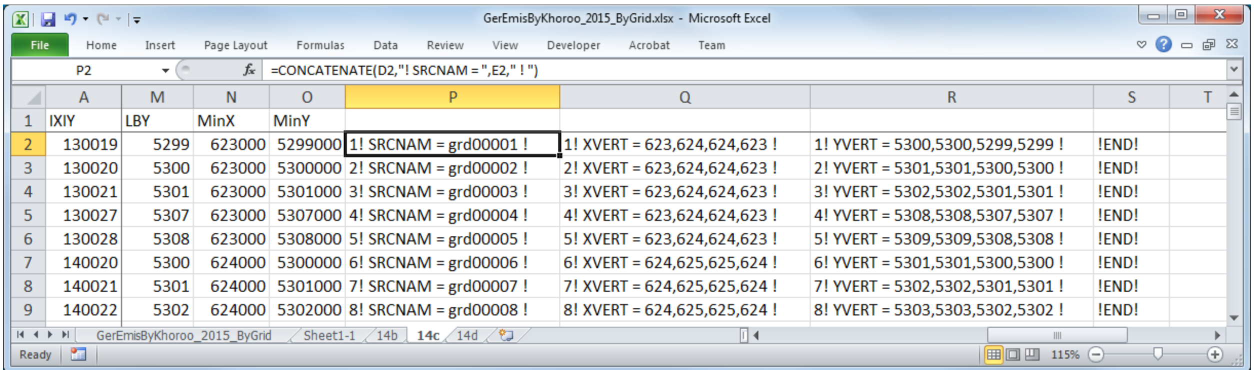
Create string of information on point source to be inserted in CALPUFF input file. Input the formulas to each column as follows. The contents of “<>” are column names, and when entering these formulas, specify the corresponding cell.

=CONCATENATE(<UID>,"! SRCNAM = ",<SourceName>," ! ")

=CONCATENATE(<UID>,"! XVERT = ",<LTX>,",",<RTX>,",",<RBX>,",",<LBX>," ! ")

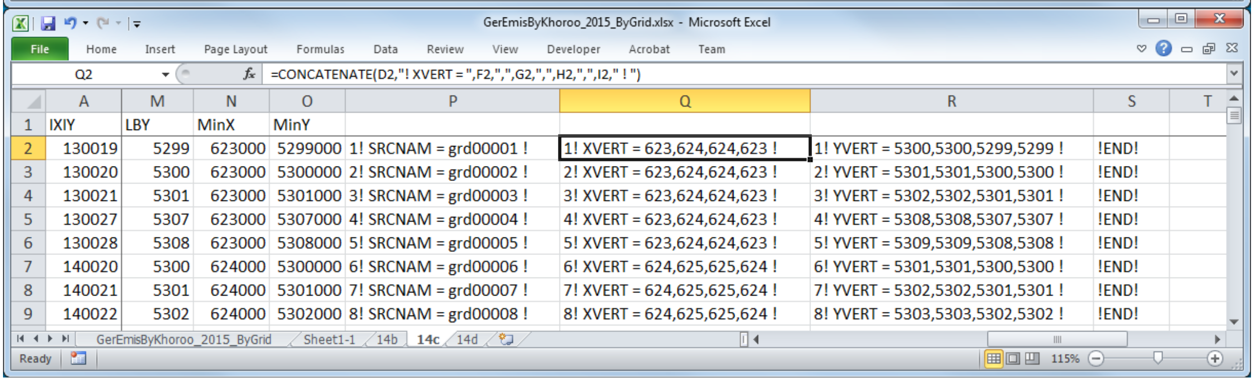
=CONCATENATE(<UID>,"! YVERT = ",<LTY>,",",<RTY>,",",<RBY>,",",<LBY>," !")

!END!



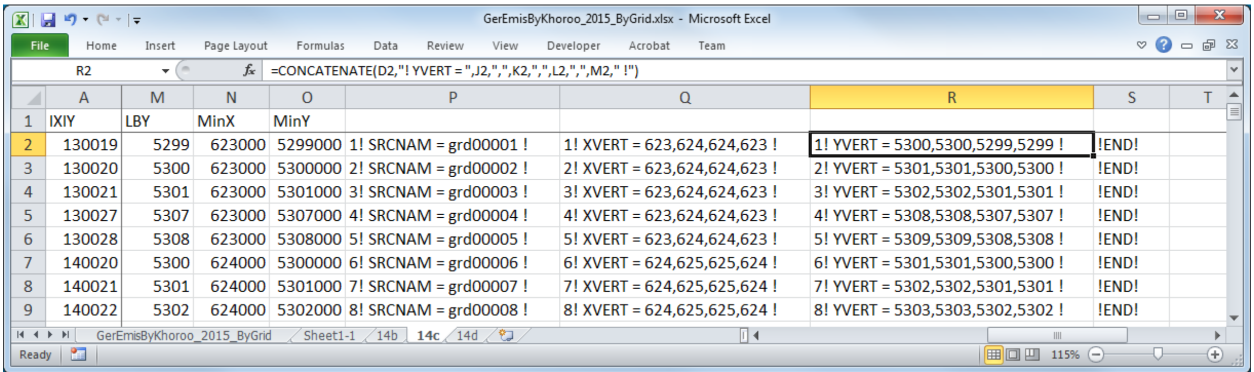
P2 =CONCATENATE(D2,"! SRCNAM = ",E2," ! ")

	IXIY	LBY	MinX	MinY	P	Q	R	S
2	130019	5299	623000	5299000	1! SRCNAM = grd00001 !	1! XVERT = 623,624,624,623 !	1! YVERT = 5300,5300,5299,5299 !	!END!
3	130020	5300	623000	5300000	2! SRCNAM = grd00002 !	2! XVERT = 623,624,624,623 !	2! YVERT = 5301,5301,5300,5300 !	!END!
4	130021	5301	623000	5301000	3! SRCNAM = grd00003 !	3! XVERT = 623,624,624,623 !	3! YVERT = 5302,5302,5301,5301 !	!END!
5	130027	5307	623000	5307000	4! SRCNAM = grd00004 !	4! XVERT = 623,624,624,623 !	4! YVERT = 5308,5308,5307,5307 !	!END!
6	130028	5308	623000	5308000	5! SRCNAM = grd00005 !	5! XVERT = 623,624,624,623 !	5! YVERT = 5309,5309,5308,5308 !	!END!
7	140020	5300	624000	5300000	6! SRCNAM = grd00006 !	6! XVERT = 624,625,625,624 !	6! YVERT = 5301,5301,5300,5300 !	!END!
8	140021	5301	624000	5301000	7! SRCNAM = grd00007 !	7! XVERT = 624,625,625,624 !	7! YVERT = 5302,5302,5301,5301 !	!END!
9	140022	5302	624000	5302000	8! SRCNAM = grd00008 !	8! XVERT = 624,625,625,624 !	8! YVERT = 5303,5303,5302,5302 !	!END!

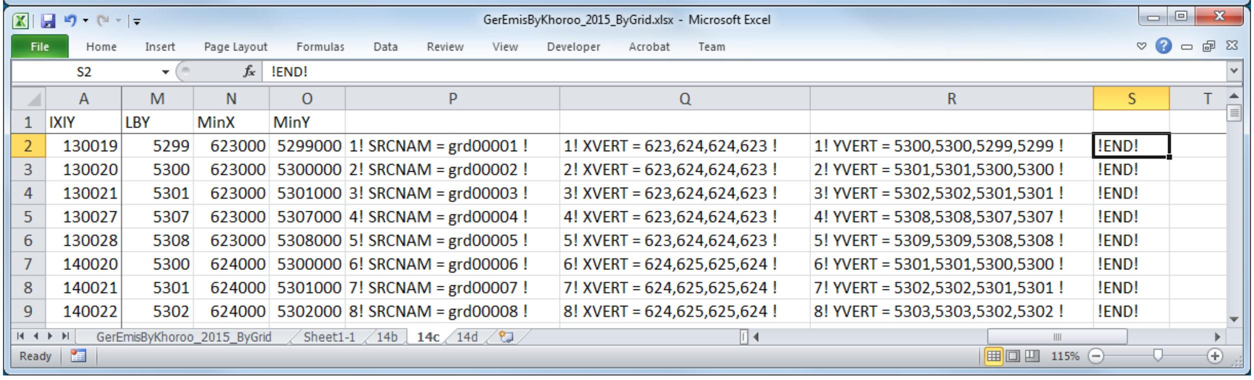


Q2 =CONCATENATE(D2,"! XVERT = ",F2,",",G2,",",H2,",",I2," ! ")

	IXIY	LBY	MinX	MinY	P	Q	R	S
2	130019	5299	623000	5299000	1! SRCNAM = grd00001 !	1! XVERT = 623,624,624,623 !	1! YVERT = 5300,5300,5299,5299 !	!END!
3	130020	5300	623000	5300000	2! SRCNAM = grd00002 !	2! XVERT = 623,624,624,623 !	2! YVERT = 5301,5301,5300,5300 !	!END!
4	130021	5301	623000	5301000	3! SRCNAM = grd00003 !	3! XVERT = 623,624,624,623 !	3! YVERT = 5302,5302,5301,5301 !	!END!
5	130027	5307	623000	5307000	4! SRCNAM = grd00004 !	4! XVERT = 623,624,624,623 !	4! YVERT = 5308,5308,5307,5307 !	!END!
6	130028	5308	623000	5308000	5! SRCNAM = grd00005 !	5! XVERT = 623,624,624,623 !	5! YVERT = 5309,5309,5308,5308 !	!END!
7	140020	5300	624000	5300000	6! SRCNAM = grd00006 !	6! XVERT = 624,625,625,624 !	6! YVERT = 5301,5301,5300,5300 !	!END!
8	140021	5301	624000	5301000	7! SRCNAM = grd00007 !	7! XVERT = 624,625,625,624 !	7! YVERT = 5302,5302,5301,5301 !	!END!
9	140022	5302	624000	5302000	8! SRCNAM = grd00008 !	8! XVERT = 624,625,625,624 !	8! YVERT = 5303,5303,5302,5302 !	!END!

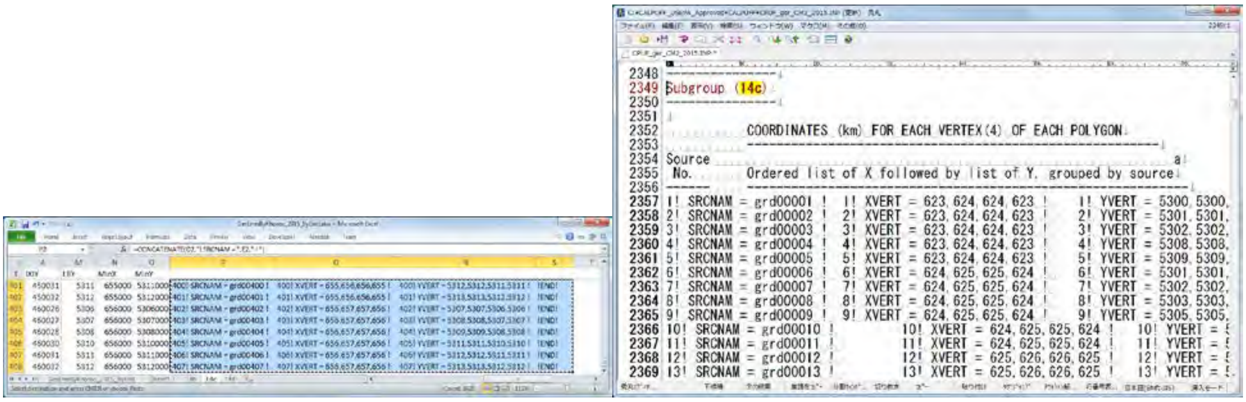


	A	M	N	O	P	Q	R	S
1	IXIY	LBY	MinX	MinY				
2	130019	5299	623000	5299000	1! SRCNAM = grd00001 !	1! XVERT = 623,624,624,623 !	1! YVERT = 5300,5300,5299,5299 !	!END!
3	130020	5300	623000	5300000	2! SRCNAM = grd00002 !	2! XVERT = 623,624,624,623 !	2! YVERT = 5301,5301,5300,5300 !	!END!
4	130021	5301	623000	5301000	3! SRCNAM = grd00003 !	3! XVERT = 623,624,624,623 !	3! YVERT = 5302,5302,5301,5301 !	!END!
5	130027	5307	623000	5307000	4! SRCNAM = grd00004 !	4! XVERT = 623,624,624,623 !	4! YVERT = 5308,5308,5307,5307 !	!END!
6	130028	5308	623000	5308000	5! SRCNAM = grd00005 !	5! XVERT = 623,624,624,623 !	5! YVERT = 5309,5309,5308,5308 !	!END!
7	140020	5300	624000	5300000	6! SRCNAM = grd00006 !	6! XVERT = 624,625,625,624 !	6! YVERT = 5301,5301,5300,5300 !	!END!
8	140021	5301	624000	5301000	7! SRCNAM = grd00007 !	7! XVERT = 624,625,625,624 !	7! YVERT = 5302,5302,5301,5301 !	!END!
9	140022	5302	624000	5302000	8! SRCNAM = grd00008 !	8! XVERT = 624,625,625,624 !	8! YVERT = 5303,5303,5302,5302 !	!END!

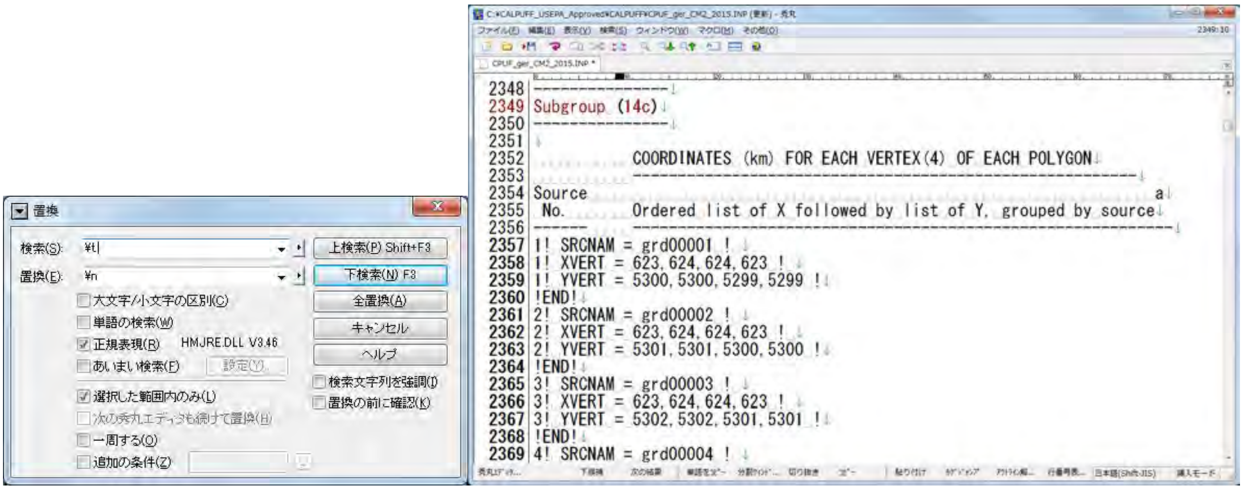


	A	M	N	O	P	Q	R	S
1	IXIY	LBY	MinX	MinY				
2	130019	5299	623000	5299000	1! SRCNAM = grd00001 !	1! XVERT = 623,624,624,623 !	1! YVERT = 5300,5300,5299,5299 !	!END!
3	130020	5300	623000	5300000	2! SRCNAM = grd00002 !	2! XVERT = 623,624,624,623 !	2! YVERT = 5301,5301,5300,5300 !	!END!
4	130021	5301	623000	5301000	3! SRCNAM = grd00003 !	3! XVERT = 623,624,624,623 !	3! YVERT = 5302,5302,5301,5301 !	!END!
5	130027	5307	623000	5307000	4! SRCNAM = grd00004 !	4! XVERT = 623,624,624,623 !	4! YVERT = 5308,5308,5307,5307 !	!END!
6	130028	5308	623000	5308000	5! SRCNAM = grd00005 !	5! XVERT = 623,624,624,623 !	5! YVERT = 5309,5309,5308,5308 !	!END!
7	140020	5300	624000	5300000	6! SRCNAM = grd00006 !	6! XVERT = 624,625,625,624 !	6! YVERT = 5301,5301,5300,5300 !	!END!
8	140021	5301	624000	5301000	7! SRCNAM = grd00007 !	7! XVERT = 624,625,625,624 !	7! YVERT = 5302,5302,5301,5301 !	!END!
9	140022	5302	624000	5302000	8! SRCNAM = grd00008 !	8! XVERT = 624,625,625,624 !	8! YVERT = 5303,5303,5302,5302 !	!END!

Copy the created strings and paste them the relevant part of CALPUFF input file.

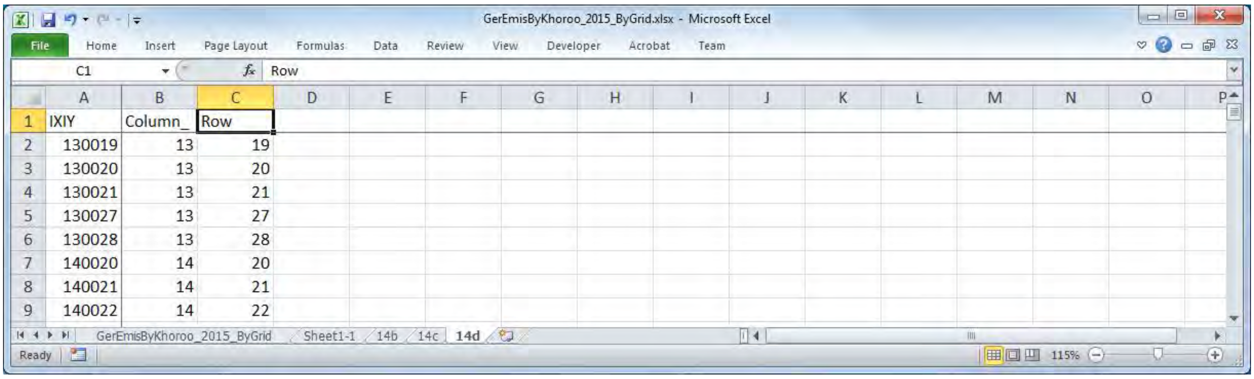


Since boundary between cells is pasted as tab, replace tab with new line.

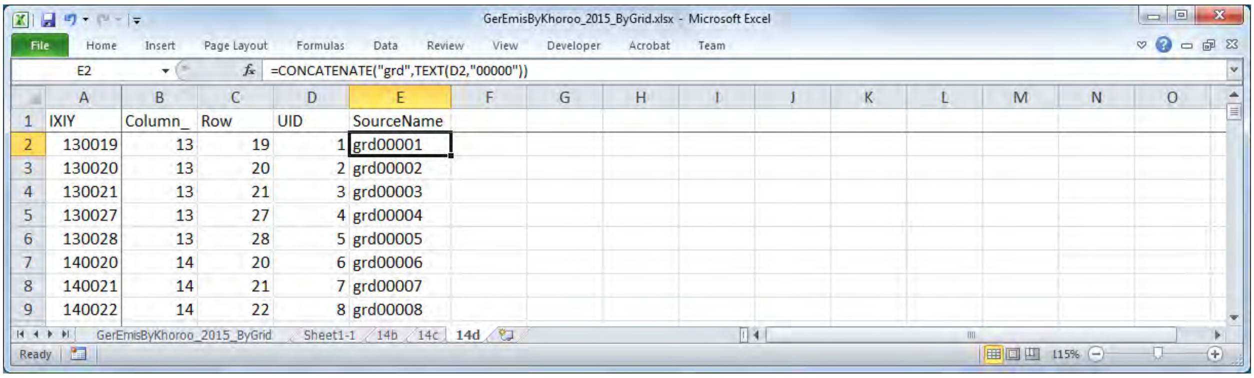


Create of “14d”

Grid number, column number, and row number is the only necessary column, so delete other lines.



Add two columns at the end and create the source name.



Create strings by pollutant setting operating pattern.

=CONCATENATE(<Unique ID>," ! SRCNAM = ",<SourceName>," !")

=CONCATENATE(<Unique ID>," ! IVARY = 3 !")

=CONCATENATE(<Unique ID>," ! <Pollutant> = <Winter1>, <Winter2>, <Winter3>, <Winter4>, <Winter5>, <Winter6>, <Winter7>, <Winter8>, <Winter9>, <Winter10>, <Winter11>, <Winter12>,")

<Winter13>, <Winter14>, <Winter15>, <Winter16>, <Winter17>, <Winter18>, <Winter19>, <Winter20>, <Winter21>, <Winter22>, <Winter23>, <Winter24>,

<Spring1>, <Spring2>, <Spring3>, <Spring4>, <Spring5>, <Spring6>, <Spring7>, <Spring8>, <Spring9>, <Spring10>, <Spring11>, <Spring12>,

<Spring13>, <Spring14>, <Spring15>, <Spring16>, <Spring17>, <Spring18>, <Spring19>, <Spring20>, <Spring21>, <Spring22>, <Spring23>, <Spring24>,

<Summer1>, <Summer2>, <Summer3>, <Summer4>, <Summer5>, <Summer6>, <Summer7>, <Summer8>, <Summer9>, <Summer10>, <Summer11>, <Summer12>,

<Summer13>, <Summer14>, <Summer15>, <Summer16>, <Summer17>, <Summer18>, <Summer19>, <Summer20>, <Summer21>, <Summer22>, <Summer23>, <Summer24>,

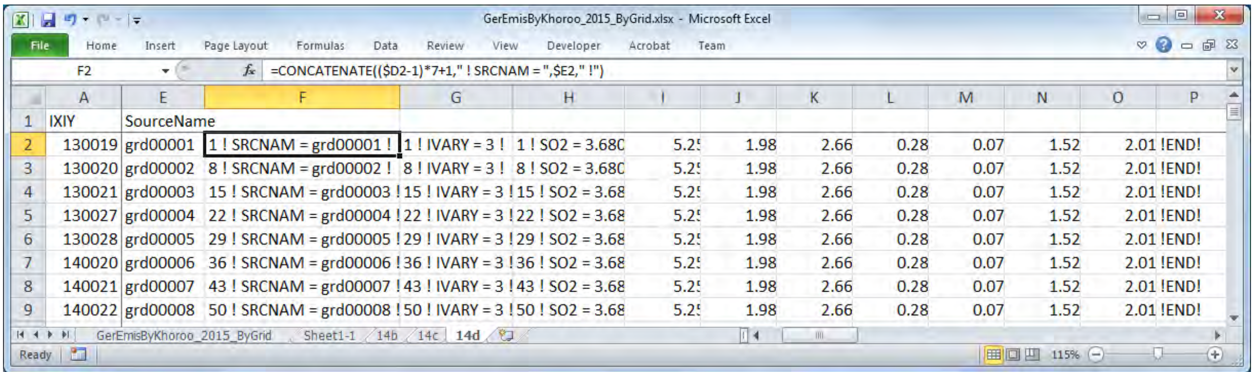
<Autumn1>, <Autumn2>, <Autumn3>, <Autumn4>, <Autumn5>, <Autumn6>, <Autumn7>, <Autumn8>, <Autumn9>, <Autumn10>, <Autumn11>, <Autumn12>,

<Autumn13>, <Autumn14>, <Autumn15>, <Autumn16>, <Autumn17>, <Autumn18>, <Autumn19>, <Autumn20>, <Autumn21>, <Autumn22>, <Autumn23>, <Autumn24> !

!END!

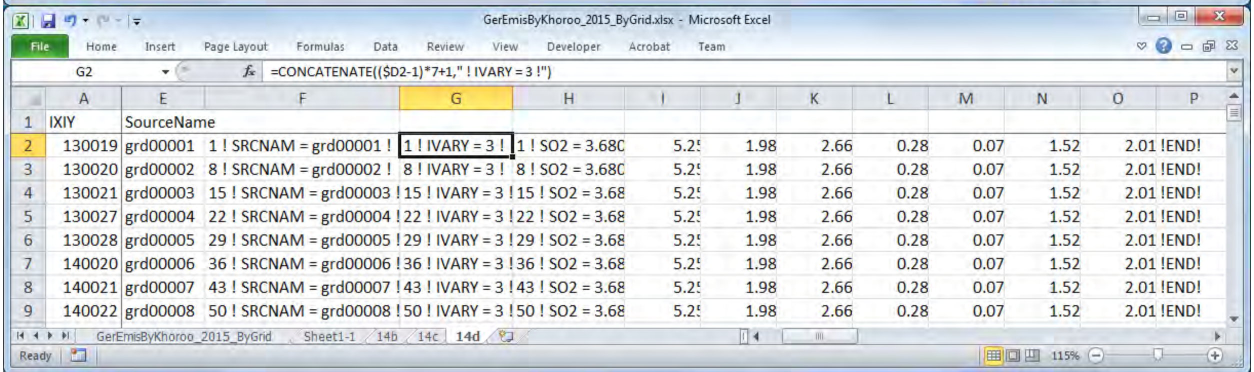
Since operating pattern needs to be created by pollutant, definition of “Unique ID” differs.

Pollutant	**Unique ID**
SO2	(<UID>-1)*7+1
SO4	(<UID>-1)*7+2
NOX	(<UID>-1)*7+3
NO3	(<UID>-1)*7+4
TSP	(<UID>-1)*7+5
PM10	(<UID>-1)*7+6
CO	(<UID>-1)*7+7



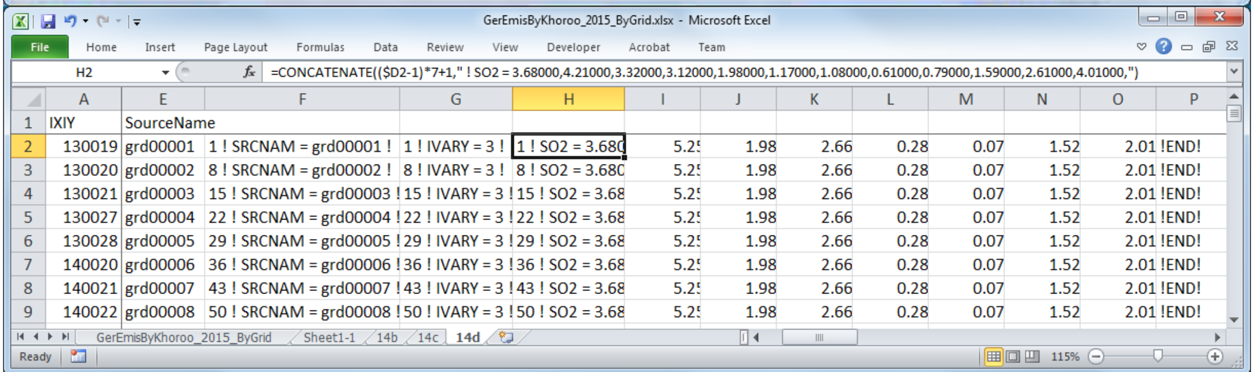
F2 =CONCATENATE(($D2-1)*7+1," ! SRCNAM = ",$E2," !")

	A	E	F	G	H	I	J	K	L	M	N	O	P
1	IXIY	SourceName											
2	130019	grd00001	1 ! SRCNAM = grd00001 !	1 ! IVARY = 3 !	1 ! SO2 = 3.680	5.2	1.98	2.66	0.28	0.07	1.52	2.01	!END!
3	130020	grd00002	8 ! SRCNAM = grd00002 !	8 ! IVARY = 3 !	8 ! SO2 = 3.680	5.2	1.98	2.66	0.28	0.07	1.52	2.01	!END!
4	130021	grd00003	15 ! SRCNAM = grd00003 !	15 ! IVARY = 3 !	15 ! SO2 = 3.68	5.2	1.98	2.66	0.28	0.07	1.52	2.01	!END!
5	130027	grd00004	22 ! SRCNAM = grd00004 !	22 ! IVARY = 3 !	22 ! SO2 = 3.68	5.2	1.98	2.66	0.28	0.07	1.52	2.01	!END!
6	130028	grd00005	29 ! SRCNAM = grd00005 !	29 ! IVARY = 3 !	29 ! SO2 = 3.68	5.2	1.98	2.66	0.28	0.07	1.52	2.01	!END!
7	140020	grd00006	36 ! SRCNAM = grd00006 !	36 ! IVARY = 3 !	36 ! SO2 = 3.68	5.2	1.98	2.66	0.28	0.07	1.52	2.01	!END!
8	140021	grd00007	43 ! SRCNAM = grd00007 !	43 ! IVARY = 3 !	43 ! SO2 = 3.68	5.2	1.98	2.66	0.28	0.07	1.52	2.01	!END!
9	140022	grd00008	50 ! SRCNAM = grd00008 !	50 ! IVARY = 3 !	50 ! SO2 = 3.68	5.2	1.98	2.66	0.28	0.07	1.52	2.01	!END!



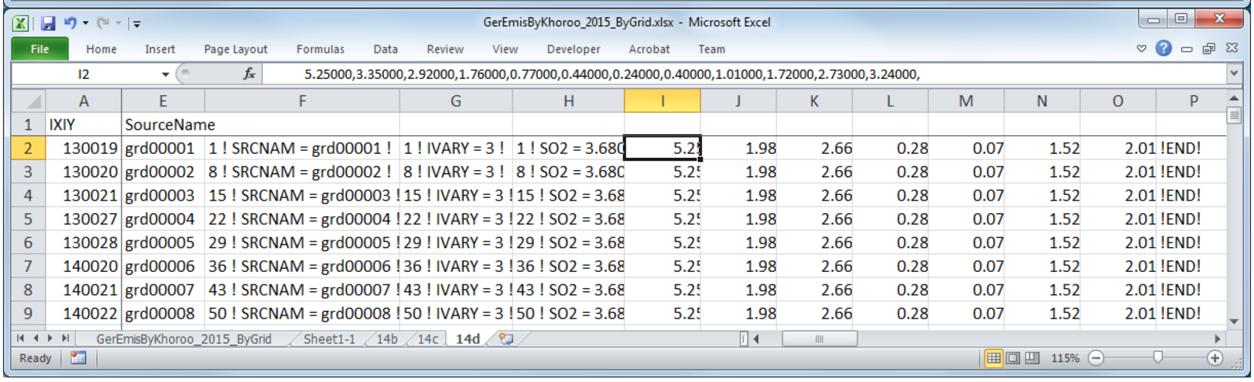
G2 =CONCATENATE(($D2-1)*7+1," ! IVARY = 3 !")

	A	E	F	G	H	I	J	K	L	M	N	O	P
1	IXIY	SourceName											
2	130019	grd00001	1 ! SRCNAM = grd00001 !	1 ! IVARY = 3 !	1 ! SO2 = 3.680	5.2	1.98	2.66	0.28	0.07	1.52	2.01	!END!
3	130020	grd00002	8 ! SRCNAM = grd00002 !	8 ! IVARY = 3 !	8 ! SO2 = 3.680	5.2	1.98	2.66	0.28	0.07	1.52	2.01	!END!
4	130021	grd00003	15 ! SRCNAM = grd00003 !	15 ! IVARY = 3 !	15 ! SO2 = 3.68	5.2	1.98	2.66	0.28	0.07	1.52	2.01	!END!
5	130027	grd00004	22 ! SRCNAM = grd00004 !	22 ! IVARY = 3 !	22 ! SO2 = 3.68	5.2	1.98	2.66	0.28	0.07	1.52	2.01	!END!
6	130028	grd00005	29 ! SRCNAM = grd00005 !	29 ! IVARY = 3 !	29 ! SO2 = 3.68	5.2	1.98	2.66	0.28	0.07	1.52	2.01	!END!
7	140020	grd00006	36 ! SRCNAM = grd00006 !	36 ! IVARY = 3 !	36 ! SO2 = 3.68	5.2	1.98	2.66	0.28	0.07	1.52	2.01	!END!
8	140021	grd00007	43 ! SRCNAM = grd00007 !	43 ! IVARY = 3 !	43 ! SO2 = 3.68	5.2	1.98	2.66	0.28	0.07	1.52	2.01	!END!
9	140022	grd00008	50 ! SRCNAM = grd00008 !	50 ! IVARY = 3 !	50 ! SO2 = 3.68	5.2	1.98	2.66	0.28	0.07	1.52	2.01	!END!



H2 =CONCATENATE(($D2-1)*7+1," ! SO2 = 3.68000,4.21000,3.32000,3.12000,1.98000,1.17000,1.08000,0.61000,0.79000,1.59000,2.61000,4.01000,")

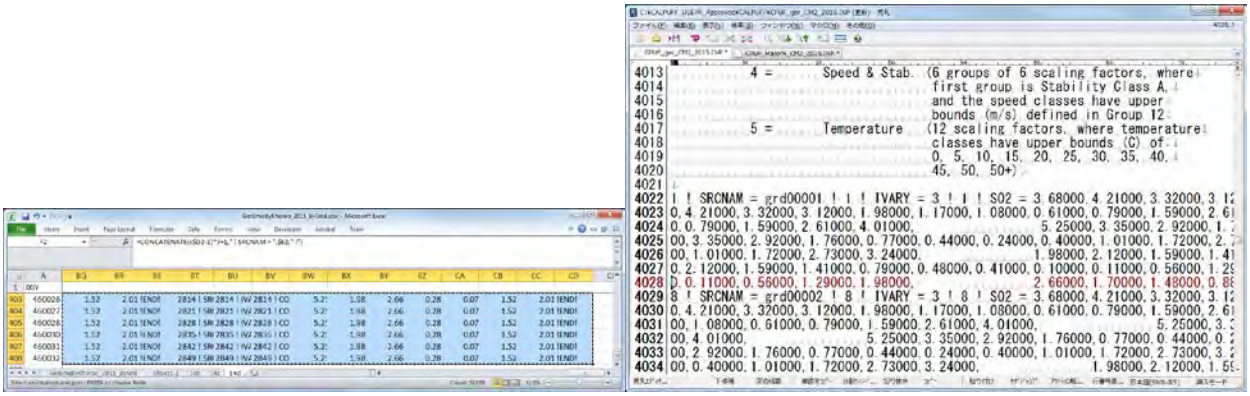
	A	E	F	G	H	I	J	K	L	M	N	O	P
1	IXIY	SourceName											
2	130019	grd00001	1 ! SRCNAM = grd00001 !	1 ! IVARY = 3 !	1 ! SO2 = 3.680	5.2	1.98	2.66	0.28	0.07	1.52	2.01	!END!
3	130020	grd00002	8 ! SRCNAM = grd00002 !	8 ! IVARY = 3 !	8 ! SO2 = 3.680	5.2	1.98	2.66	0.28	0.07	1.52	2.01	!END!
4	130021	grd00003	15 ! SRCNAM = grd00003 !	15 ! IVARY = 3 !	15 ! SO2 = 3.68	5.2	1.98	2.66	0.28	0.07	1.52	2.01	!END!
5	130027	grd00004	22 ! SRCNAM = grd00004 !	22 ! IVARY = 3 !	22 ! SO2 = 3.68	5.2	1.98	2.66	0.28	0.07	1.52	2.01	!END!
6	130028	grd00005	29 ! SRCNAM = grd00005 !	29 ! IVARY = 3 !	29 ! SO2 = 3.68	5.2	1.98	2.66	0.28	0.07	1.52	2.01	!END!
7	140020	grd00006	36 ! SRCNAM = grd00006 !	36 ! IVARY = 3 !	36 ! SO2 = 3.68	5.2	1.98	2.66	0.28	0.07	1.52	2.01	!END!
8	140021	grd00007	43 ! SRCNAM = grd00007 !	43 ! IVARY = 3 !	43 ! SO2 = 3.68	5.2	1.98	2.66	0.28	0.07	1.52	2.01	!END!
9	140022	grd00008	50 ! SRCNAM = grd00008 !	50 ! IVARY = 3 !	50 ! SO2 = 3.68	5.2	1.98	2.66	0.28	0.07	1.52	2.01	!END!



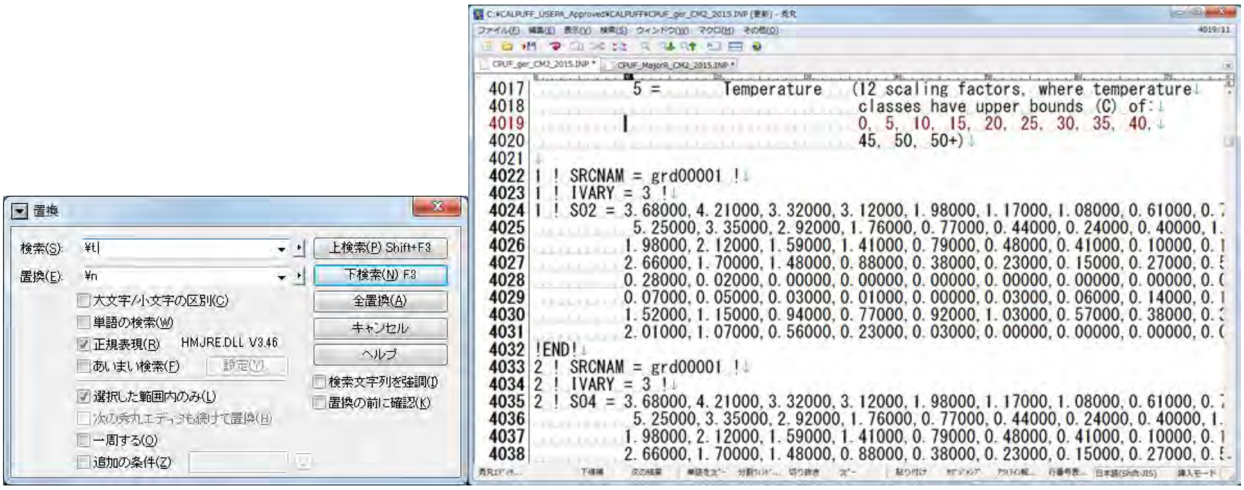
I2 5.25000,3.35000,2.92000,1.76000,0.77000,0.44000,0.24000,0.40000,1.01000,1.72000,2.73000,3.24000,

	A	E	F	G	H	I	J	K	L	M	N	O	P
1	IXIY	SourceName											
2	130019	grd00001	1 ! SRCNAM = grd00001 !	1 ! IVARY = 3 !	1 ! SO2 = 3.680	5.2	1.98	2.66	0.28	0.07	1.52	2.01	!END!
3	130020	grd00002	8 ! SRCNAM = grd00002 !	8 ! IVARY = 3 !	8 ! SO2 = 3.680	5.2	1.98	2.66	0.28	0.07	1.52	2.01	!END!
4	130021	grd00003	15 ! SRCNAM = grd00003 !	15 ! IVARY = 3 !	15 ! SO2 = 3.68	5.2	1.98	2.66	0.28	0.07	1.52	2.01	!END!
5	130027	grd00004	22 ! SRCNAM = grd00004 !	22 ! IVARY = 3 !	22 ! SO2 = 3.68	5.2	1.98	2.66	0.28	0.07	1.52	2.01	!END!
6	130028	grd00005	29 ! SRCNAM = grd00005 !	29 ! IVARY = 3 !	29 ! SO2 = 3.68	5.2	1.98	2.66	0.28	0.07	1.52	2.01	!END!
7	140020	grd00006	36 ! SRCNAM = grd00006 !	36 ! IVARY = 3 !	36 ! SO2 = 3.68	5.2	1.98	2.66	0.28	0.07	1.52	2.01	!END!
8	140021	grd00007	43 ! SRCNAM = grd00007 !	43 ! IVARY = 3 !	43 ! SO2 = 3.68	5.2	1.98	2.66	0.28	0.07	1.52	2.01	!END!
9	140022	grd00008	50 ! SRCNAM = grd00008 !	50 ! IVARY = 3 !	50 ! SO2 = 3.68	5.2	1.98	2.66	0.28	0.07	1.52	2.01	!END!

Copy the created strings and paste them the relevant part of CALPUFF input file.

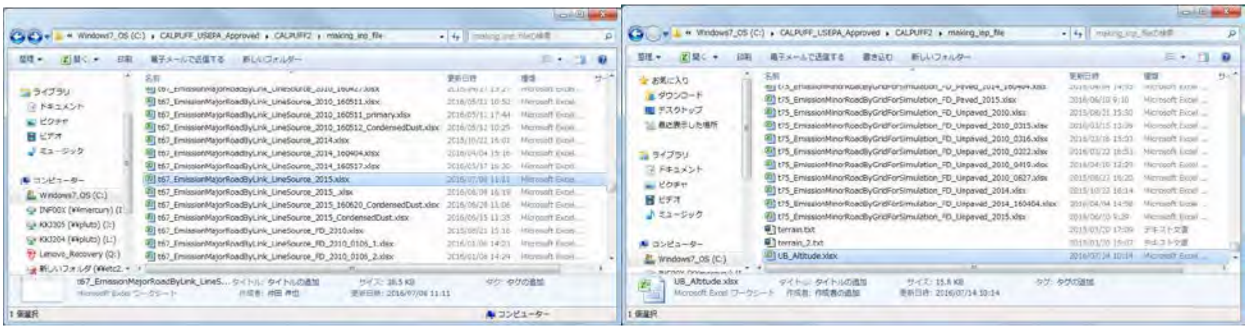


Since boundary between cells is pasted as tab, replace tab with new line.

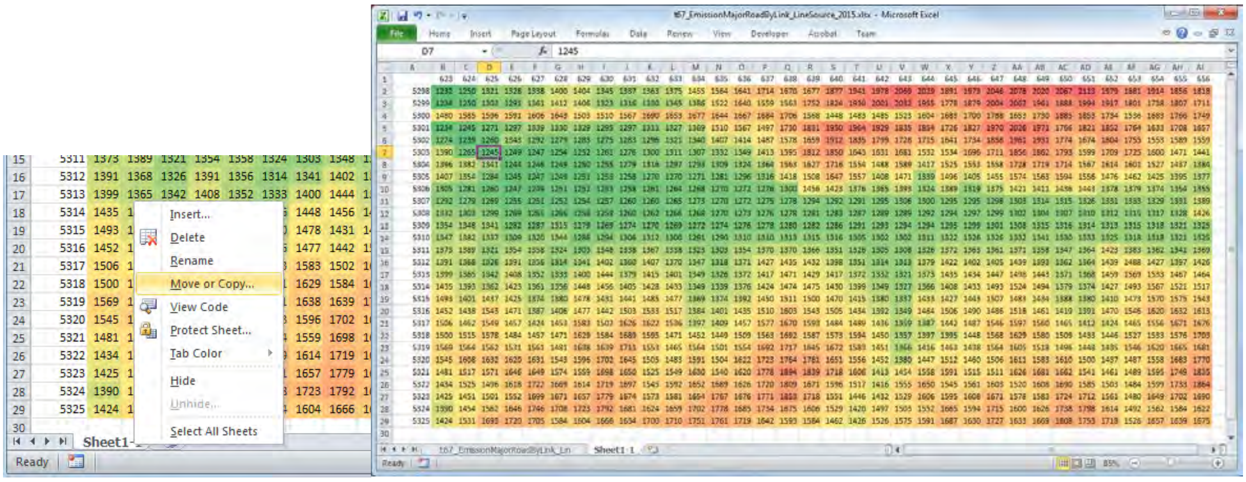


5.3 Line Source

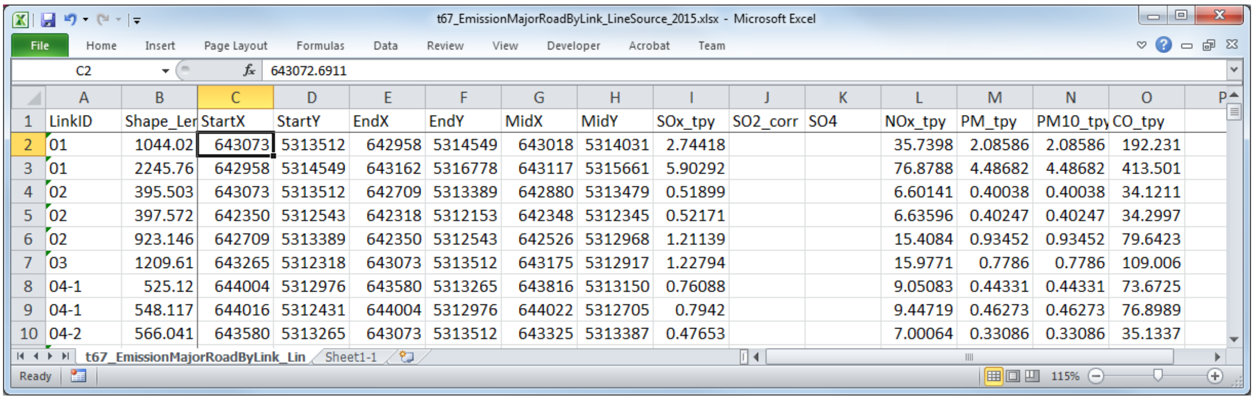
Open the Excel file in export destination folder and the file of elevation data by grid (UB_altitude.xlsx).



Copy ”sheet1-1” of “UB_altitude.xlsx” to the Excel file in export destination folder



Add columns to calculate the emissions of SO2, SO4 and NO3.

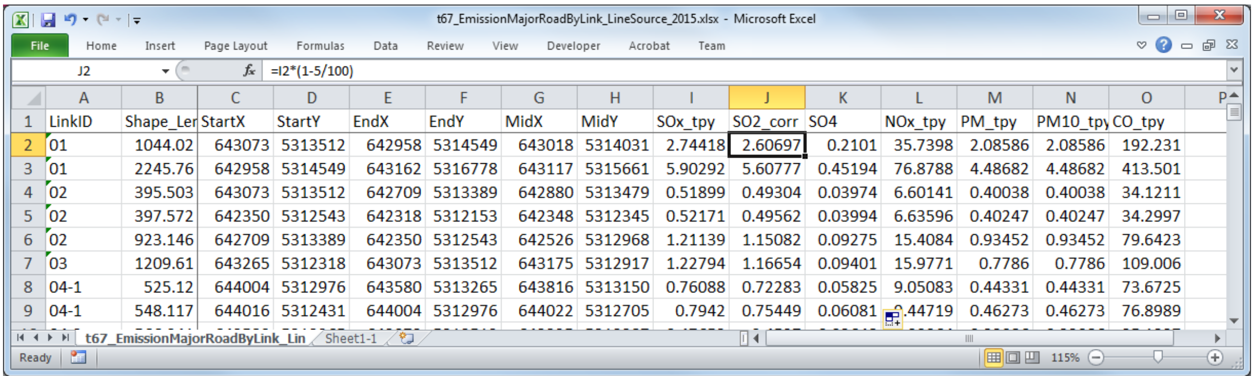


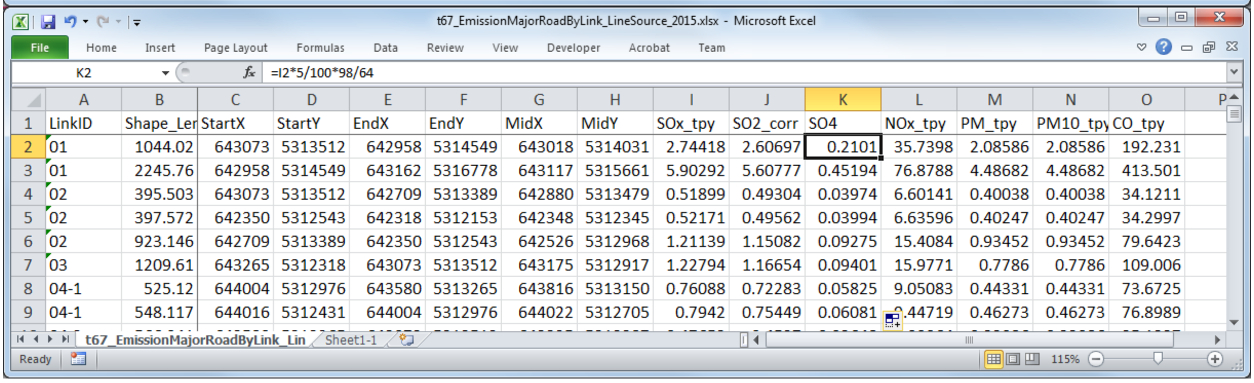
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	LinkID	Shape_Ler	StartX	StartY	EndX	EndY	MidX	MidY	SOx_tpy	SO2_corr	SO4	NOx_tpy	PM_tpy	PM10_tpy	CO_tpy
2	01	1044.02	643073	5313512	642958	5314549	643018	5314031	2.74418			35.7398	2.08586	2.08586	192.231
3	01	2245.76	642958	5314549	643162	5316778	643117	5315661	5.90292			76.8788	4.48682	4.48682	413.501
4	02	395.503	643073	5313512	642709	5313389	642880	5313479	0.51899			6.60141	0.40038	0.40038	34.1211
5	02	397.572	642350	5312543	642318	5312153	642348	5312345	0.52171			6.63596	0.40247	0.40247	34.2997
6	02	923.146	642709	5313389	642350	5312543	642526	5312968	1.21139			15.4084	0.93452	0.93452	79.6423
7	03	1209.61	643265	5312318	643073	5313512	643175	5312917	1.22794			15.9771	0.7786	0.7786	109.006
8	04-1	525.12	644004	5312976	643580	5313265	643816	5313150	0.76088			9.05083	0.44331	0.44331	73.6725
9	04-1	548.117	644016	5312431	644004	5312976	644022	5312705	0.7942			9.44719	0.46273	0.46273	76.8989
10	04-2	566.041	643580	5313265	643073	5313512	643325	5313387	0.47653			7.00064	0.33086	0.33086	35.1337

Input formulas to calculate the emission of SO4 and NO3.

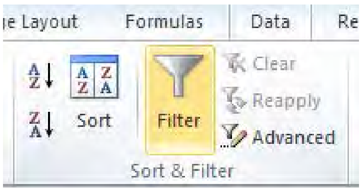
SO4 Emission =SO2 Emission x conversion ratio from SO2 to SO4 x 96/64

SO2 Emission = SO2 Emission x (1- conversion ratio from SO2 to SO4)

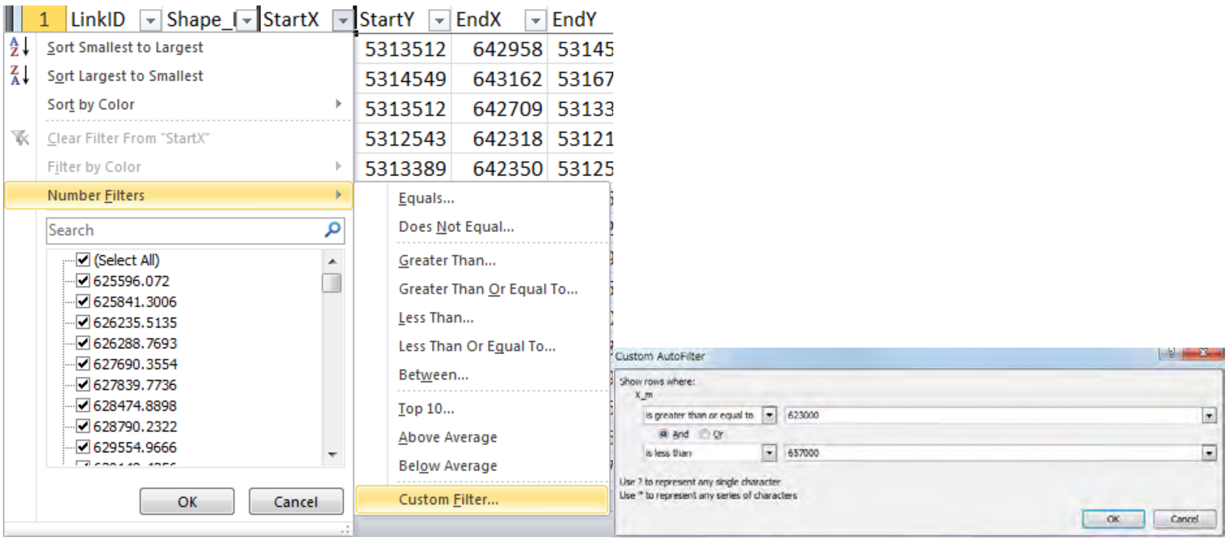


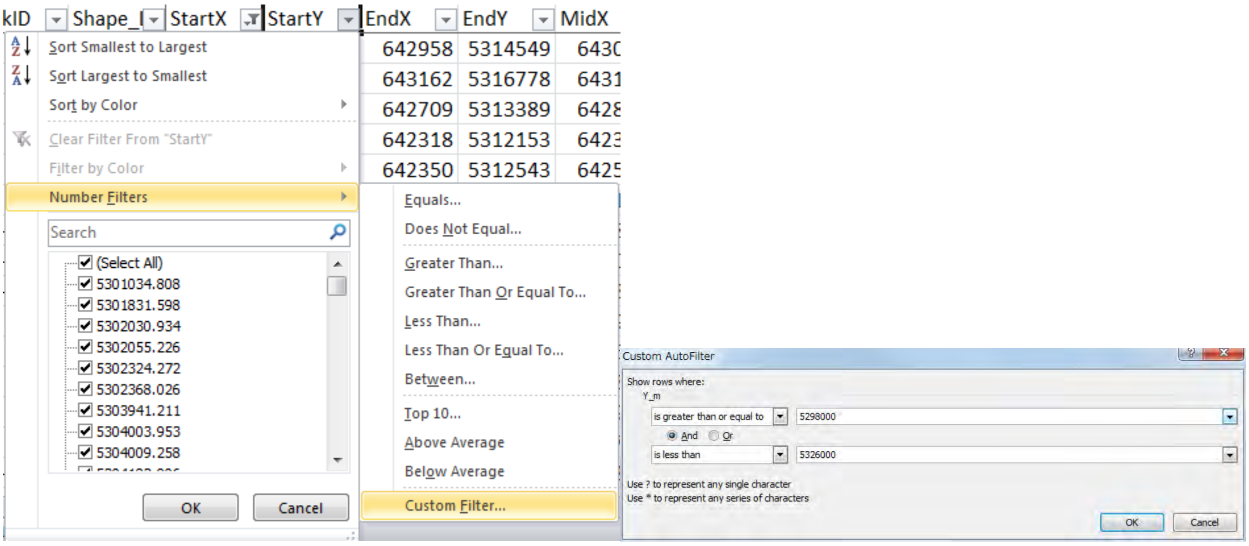


Click [Filter] in “Data” tab and add filter function to the first row.

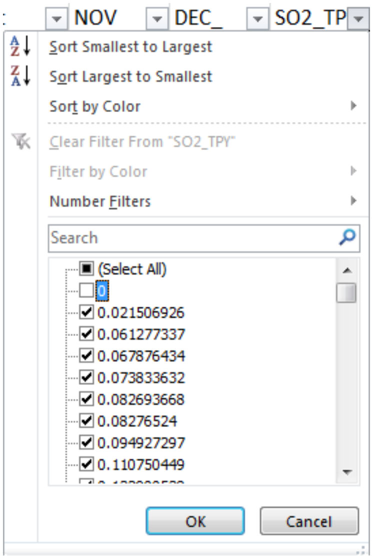


Select ”▼” at [StartX], [StartY], [EndX], [EndY], [MidX], and [MidY] and filter in calculation range in east-west and south-north directions.

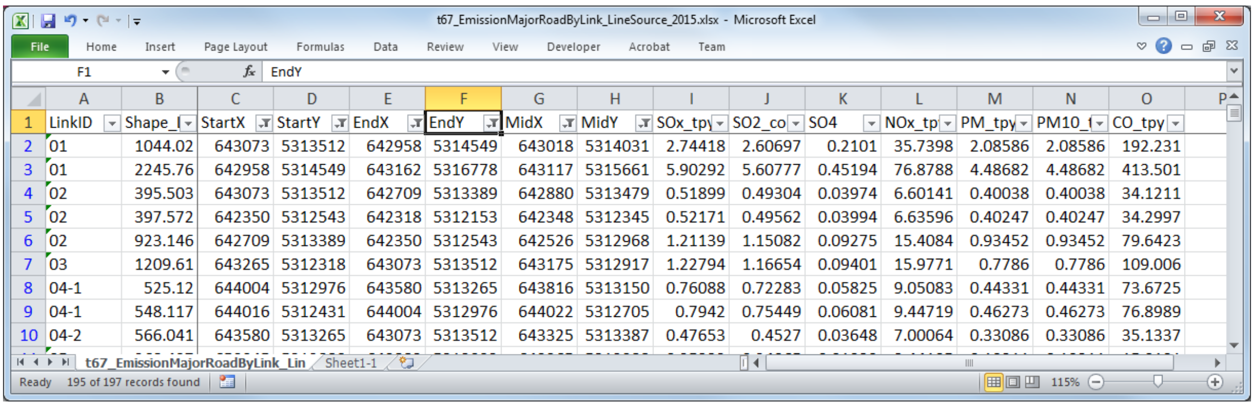




Select ”▼” at [SO2_TPY] and filter to line source that SO2 emission is not zero.

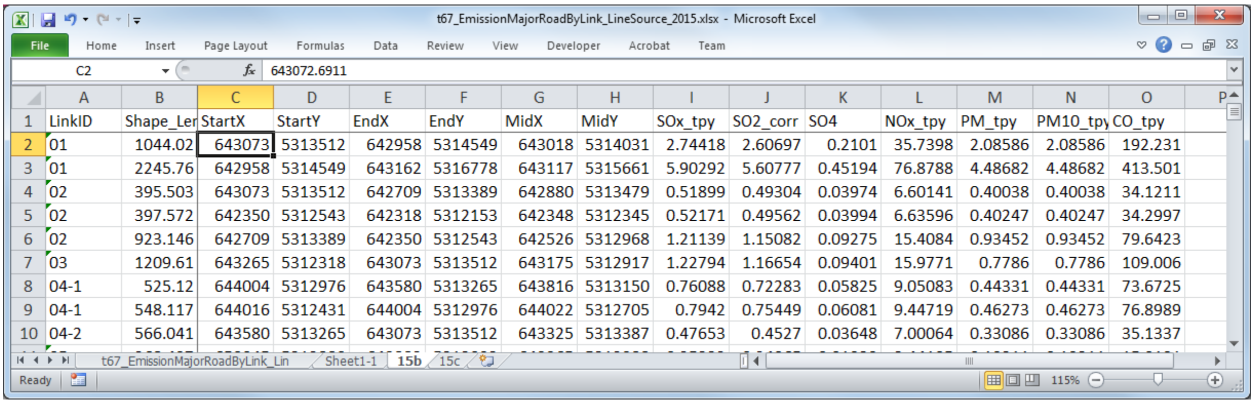


Only rows extracted by the above filter function are displayed



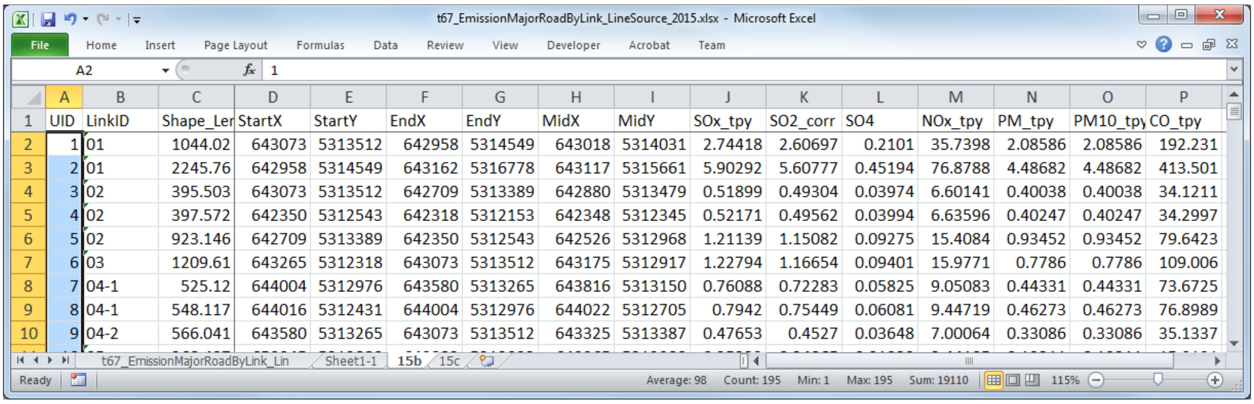
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	LinkID	Shape_l	StartX	StartY	EndX	EndY	MidX	MidY	SOx_tpy	SO2_co	SO4	NOx_tp	PM_tpy	PM10_t	CO_tpy
2	01	1044.02	643073	5313512	642958	5314549	643018	5314031	2.74418	2.60697	0.2101	35.7398	2.08586	2.08586	192.231
3	01	2245.76	642958	5314549	643162	5316778	643117	5315661	5.90292	5.60777	0.45194	76.8788	4.48682	4.48682	413.501
4	02	395.503	643073	5313512	642709	5313389	642880	5313479	0.51899	0.49304	0.03974	6.60141	0.40038	0.40038	34.1211
5	02	397.572	642350	5312543	642318	5312153	642348	5312345	0.52171	0.49562	0.03994	6.63596	0.40247	0.40247	34.2997
6	02	923.146	642709	5313389	642350	5312543	642526	5312968	1.21139	1.15082	0.09275	15.4084	0.93452	0.93452	79.6423
7	03	1209.61	643265	5312318	643073	5313512	643175	5312917	1.22794	1.16654	0.09401	15.9771	0.7786	0.7786	109.006
8	04-1	525.12	644004	5312976	643580	5313265	643816	5313150	0.76088	0.72283	0.05825	9.05083	0.44331	0.44331	73.6725
9	04-1	548.117	644016	5312431	644004	5312976	644022	5312705	0.7942	0.75449	0.06081	9.44719	0.46273	0.46273	76.8989
10	04-2	566.041	643580	5313265	643073	5313512	643325	5313387	0.47653	0.4527	0.03648	7.00064	0.33086	0.33086	35.1337

Copy the line sources generated by filter function and paste them on another sheet, and set the name of each sheet to "15b" and "15c".



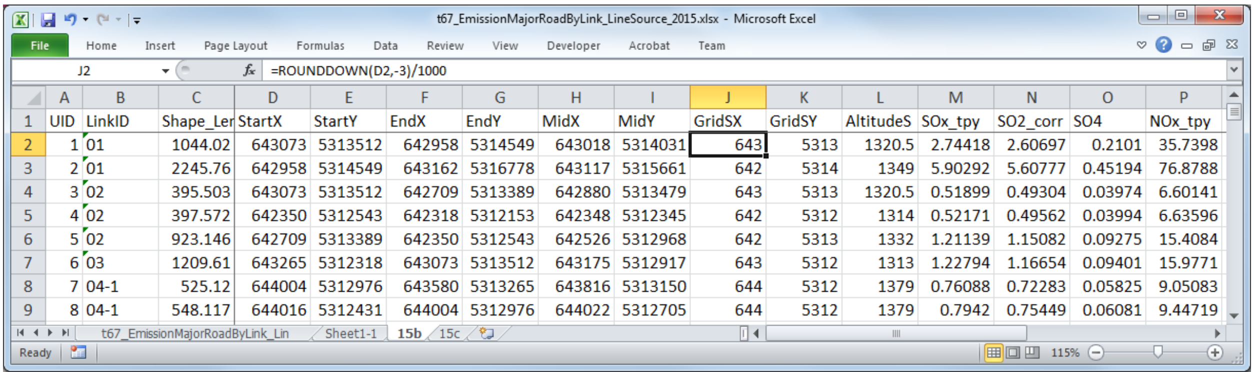
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	LinkID	Shape_Ler	StartX	StartY	EndX	EndY	MidX	MidY	SOx_tpy	SO2_corr	SO4	NOx_tpy	PM_tpy	PM10_tpy	CO_tpy
2	01	1044.02	643073	5313512	642958	5314549	643018	5314031	2.74418	2.60697	0.2101	35.7398	2.08586	2.08586	192.231
3	01	2245.76	642958	5314549	643162	5316778	643117	5315661	5.90292	5.60777	0.45194	76.8788	4.48682	4.48682	413.501
4	02	395.503	643073	5313512	642709	5313389	642880	5313479	0.51899	0.49304	0.03974	6.60141	0.40038	0.40038	34.1211
5	02	397.572	642350	5312543	642318	5312153	642348	5312345	0.52171	0.49562	0.03994	6.63596	0.40247	0.40247	34.2997
6	02	923.146	642709	5313389	642350	5312543	642526	5312968	1.21139	1.15082	0.09275	15.4084	0.93452	0.93452	79.6423
7	03	1209.61	643265	5312318	643073	5313512	643175	5312917	1.22794	1.16654	0.09401	15.9771	0.7786	0.7786	109.006
8	04-1	525.12	644004	5312976	643580	5313265	643816	5313150	0.76088	0.72283	0.05825	9.05083	0.44331	0.44331	73.6725
9	04-1	548.117	644016	5312431	644004	5312976	644022	5312705	0.7942	0.75449	0.06081	9.44719	0.46273	0.46273	76.8989
10	04-2	566.041	643580	5313265	643073	5313512	643325	5313387	0.47653	0.4527	0.03648	7.00064	0.33086	0.33086	35.1337

Using the "15b" sheet, create the string information on line sources (15b) among CALPUFF input data. Insert a column before [ID] column and add serial number (UID).



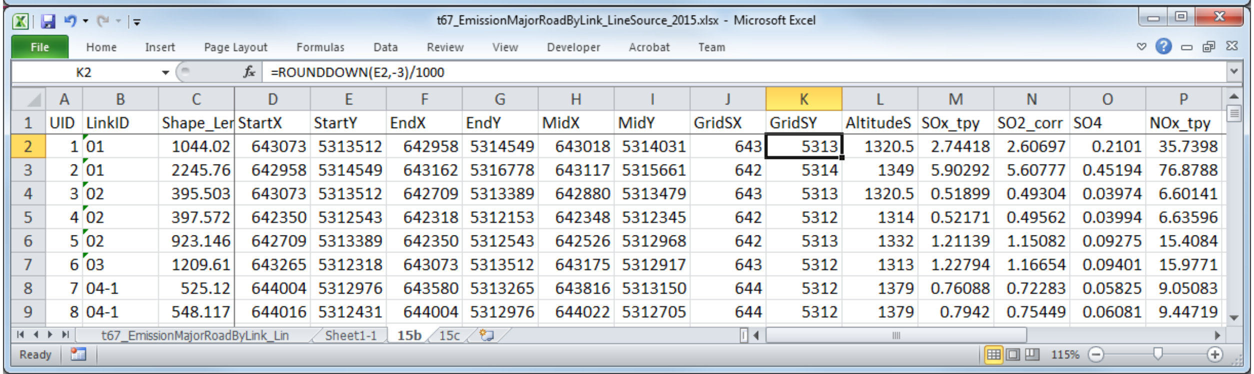
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	UID	LinkID	Shape_Ler	StartX	StartY	EndX	EndY	MidX	MidY	SOx_tpy	SO2_corr	SO4	NOx_tpy	PM_tpy	PM10_tpy	CO_tpy
2	1	01	1044.02	643073	5313512	642958	5314549	643018	5314031	2.74418	2.60697	0.2101	35.7398	2.08586	2.08586	192.231
3	2	01	2245.76	642958	5314549	643162	5316778	643117	5315661	5.90292	5.60777	0.45194	76.8788	4.48682	4.48682	413.501
4	3	02	395.503	643073	5313512	642709	5313389	642880	5313479	0.51899	0.49304	0.03974	6.60141	0.40038	0.40038	34.1211
5	4	02	397.572	642350	5312543	642318	5312153	642348	5312345	0.52171	0.49562	0.03994	6.63596	0.40247	0.40247	34.2997
6	5	02	923.146	642709	5313389	642350	5312543	642526	5312968	1.21139	1.15082	0.09275	15.4084	0.93452	0.93452	79.6423
7	6	03	1209.61	643265	5312318	643073	5313512	643175	5312917	1.22794	1.16654	0.09401	15.9771	0.7786	0.7786	109.006
8	7	04-1	525.12	644004	5312976	643580	5313265	643816	5313150	0.76088	0.72283	0.05825	9.05083	0.44331	0.44331	73.6725
9	8	04-1	548.117	644016	5312431	644004	5312976	644022	5312705	0.7942	0.75449	0.06081	9.44719	0.46273	0.46273	76.8989
10	9	04-2	566.041	643580	5313265	643073	5313512	643325	5313387	0.47653	0.4527	0.03648	7.00064	0.33086	0.33086	35.1337

Three columns are added to the sheet on which the data is copied, and value of elevation data for each grid according to the starting point coordinates is extracted. Calculate the grid positions specified by the coordinates in the first two columns, and enter an equation to calculate the value of elevation data by grid referenced from "sheet1-1" according to these values in the last one column.


t67_EmissionMajorRoadByLink_LineSource_2015.xlsx - Microsoft Excel

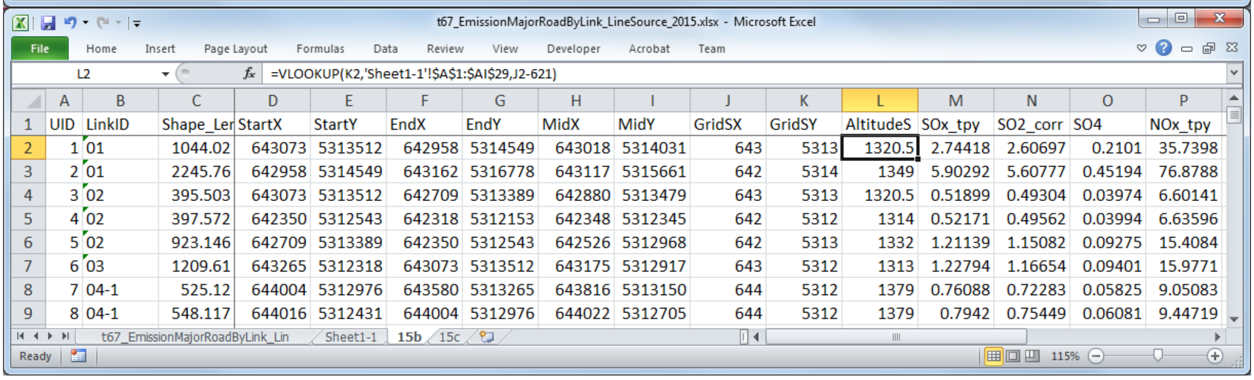
J2 =ROUNDDOWN(D2,-3)/1000

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	UID	LinkID	Shape_Ler	StartX	StartY	EndX	EndY	MidX	MidY	GridSX	GridSY	AltitudeS	SOx_tpy	SO2_corr	SO4	NOx_tpy
2	1	01	1044.02	643073	5313512	642958	5314549	643018	5314031	643	5313	1320.5	2.74418	2.60697	0.2101	35.7398
3	2	01	2245.76	642958	5314549	643162	5316778	643117	5315661	642	5314	1349	5.90292	5.60777	0.45194	76.8788
4	3	02	395.503	643073	5313512	642709	5313389	642880	5313479	643	5313	1320.5	0.51899	0.49304	0.03974	6.60141
5	4	02	397.572	642350	5312543	642318	5312153	642348	5312345	642	5312	1314	0.52171	0.49562	0.03994	6.63596
6	5	02	923.146	642709	5313389	642350	5312543	642526	5312968	642	5313	1332	1.21139	1.15082	0.09275	15.4084
7	6	03	1209.61	643265	5312318	643073	5313512	643175	5312917	643	5312	1313	1.22794	1.16654	0.09401	15.9771
8	7	04-1	525.12	644004	5312976	643580	5313265	643816	5313150	644	5312	1379	0.76088	0.72283	0.05825	9.05083
9	8	04-1	548.117	644016	5312431	644004	5312976	644022	5312705	644	5312	1379	0.7942	0.75449	0.06081	9.44719


t67_EmissionMajorRoadByLink_LineSource_2015.xlsx - Microsoft Excel

K2 =ROUNDDOWN(E2,-3)/1000

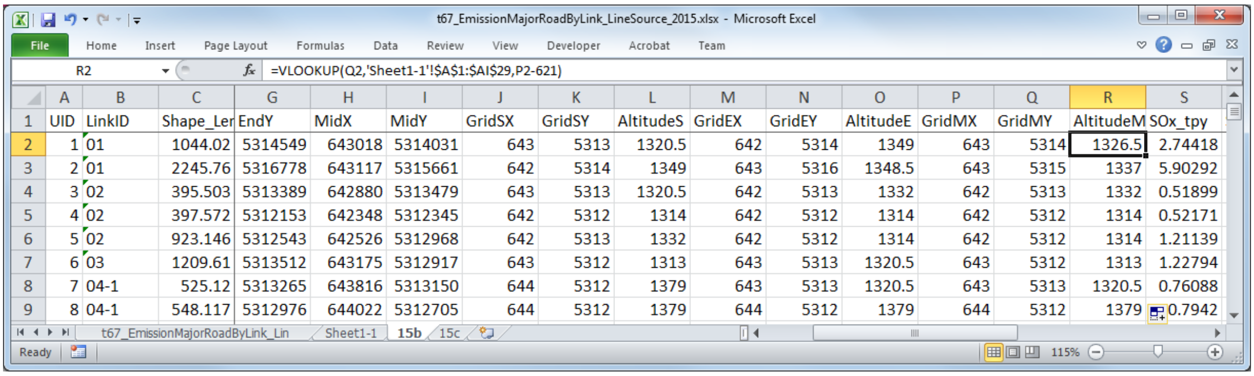
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	UID	LinkID	Shape_Ler	StartX	StartY	EndX	EndY	MidX	MidY	GridSX	GridSY	AltitudeS	SOx_tpy	SO2_corr	SO4	NOx_tpy
2	1	01	1044.02	643073	5313512	642958	5314549	643018	5314031	643	5313	1320.5	2.74418	2.60697	0.2101	35.7398
3	2	01	2245.76	642958	5314549	643162	5316778	643117	5315661	642	5314	1349	5.90292	5.60777	0.45194	76.8788
4	3	02	395.503	643073	5313512	642709	5313389	642880	5313479	643	5313	1320.5	0.51899	0.49304	0.03974	6.60141
5	4	02	397.572	642350	5312543	642318	5312153	642348	5312345	642	5312	1314	0.52171	0.49562	0.03994	6.63596
6	5	02	923.146	642709	5313389	642350	5312543	642526	5312968	642	5313	1332	1.21139	1.15082	0.09275	15.4084
7	6	03	1209.61	643265	5312318	643073	5313512	643175	5312917	643	5312	1313	1.22794	1.16654	0.09401	15.9771
8	7	04-1	525.12	644004	5312976	643580	5313265	643816	5313150	644	5312	1379	0.76088	0.72283	0.05825	9.05083
9	8	04-1	548.117	644016	5312431	644004	5312976	644022	5312705	644	5312	1379	0.7942	0.75449	0.06081	9.44719


t67_EmissionMajorRoadByLink_LineSource_2015.xlsx - Microsoft Excel

L2 =VLOOKUP(K2,'Sheet1-1'!$A$1:$AI$29,J2-621)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	UID	LinkID	Shape_Ler	StartX	StartY	EndX	EndY	MidX	MidY	GridSX	GridSY	AltitudeS	SOx_tpy	SO2_corr	SO4	NOx_tpy
2	1	01	1044.02	643073	5313512	642958	5314549	643018	5314031	643	5313	1320.5	2.74418	2.60697	0.2101	35.7398
3	2	01	2245.76	642958	5314549	643162	5316778	643117	5315661	642	5314	1349	5.90292	5.60777	0.45194	76.8788
4	3	02	395.503	643073	5313512	642709	5313389	642880	5313479	643	5313	1320.5	0.51899	0.49304	0.03974	6.60141
5	4	02	397.572	642350	5312543	642318	5312153	642348	5312345	642	5312	1314	0.52171	0.49562	0.03994	6.63596
6	5	02	923.146	642709	5313389	642350	5312543	642526	5312968	642	5313	1332	1.21139	1.15082	0.09275	15.4084
7	6	03	1209.61	643265	5312318	643073	5313512	643175	5312917	643	5312	1313	1.22794	1.16654	0.09401	15.9771
8	7	04-1	525.12	644004	5312976	643580	5313265	643816	5313150	644	5312	1379	0.76088	0.72283	0.05825	9.05083
9	8	04-1	548.117	644016	5312431	644004	5312976	644022	5312705	644	5312	1379	0.7942	0.75449	0.06081	9.44719

Like the starting point, refer to the elevation at the end point and the midpoint.


t67_EmissionMajorRoadByLink_LineSource_2015.xlsx - Microsoft Excel

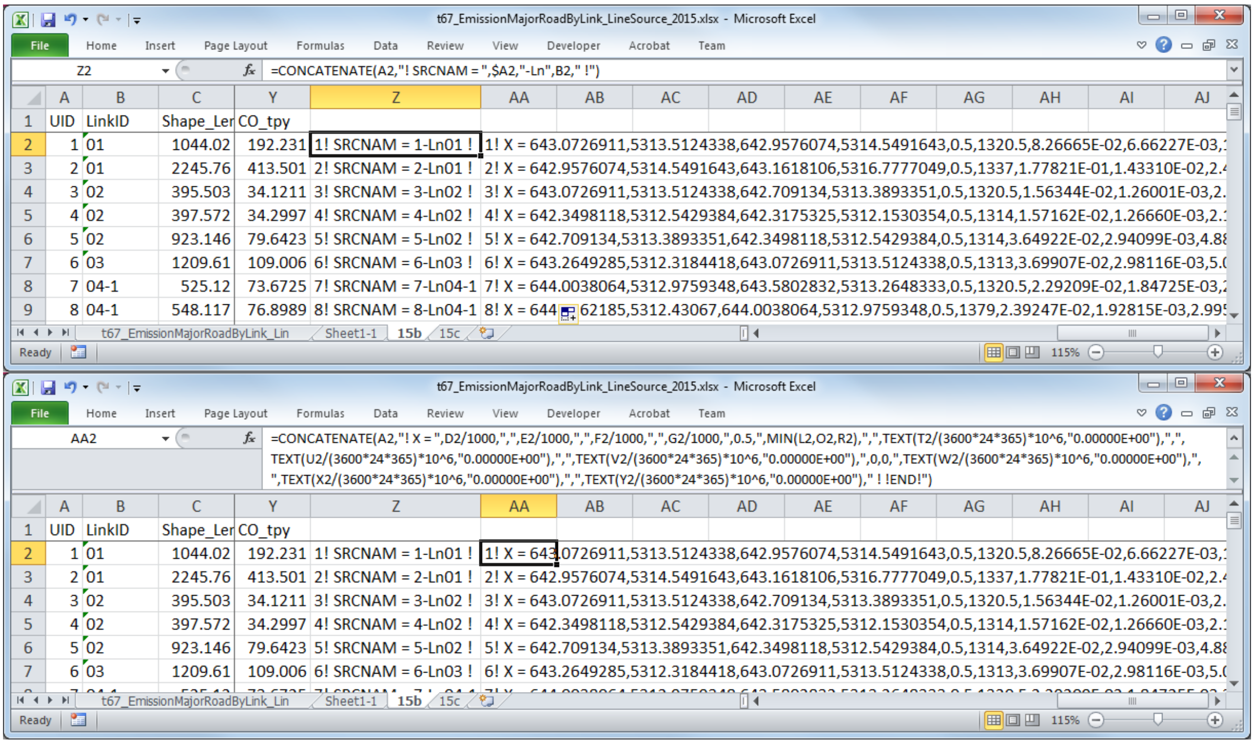
R2 =VLOOKUP(Q2,'Sheet1-1'!$A$1:$AI$29,P2-621)

	A	B	C	G	H	I	J	K	L	M	N	O	P	Q	R	S
1	UID	LinkID	Shape_Ler	EndY	MidX	MidY	GridSX	GridSY	AltitudeS	GridEX	GridEY	AltitudeE	GridMX	GridMY	AltitudeM	SOx_tpy
2	1	01	1044.02	5314549	643018	5314031	643	5313	1320.5	642	5314	1349	643	5314	1326.5	2.74418
3	2	01	2245.76	5316778	643117	5315661	642	5314	1349	643	5316	1348.5	643	5315	1337	5.90292
4	3	02	395.503	5313389	642880	5313479	643	5313	1320.5	642	5313	1332	642	5313	1332	0.51899
5	4	02	397.572	5312153	642348	5312345	642	5312	1314	642	5312	1314	642	5312	1314	0.52171
6	5	02	923.146	5312543	642526	5312968	642	5313	1332	642	5312	1314	642	5312	1314	1.21139
7	6	03	1209.61	5313512	643175	5312917	643	5312	1313	643	5313	1320.5	643	5312	1313	1.22794
8	7	04-1	525.12	5313265	643816	5313150	644	5312	1379	643	5313	1320.5	643	5313	1320.5	0.76088
9	8	04-1	548.117	5312976	644022	5312705	644	5312	1379	644	5312	1379	644	5312	1379	0.7942

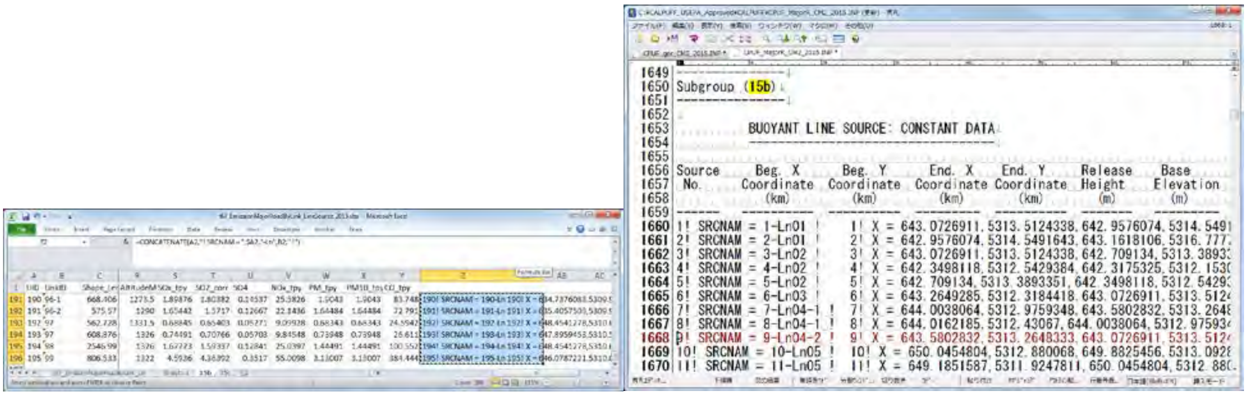
Create string of information on point source to be inserted in CALPUFF input file. Input the formulas to each column as follows. The contents of “<>” are column names, and when entering these formulas, specify the corresponding cell.

=CONCATENATE(<UID>,"! SRCNAM = ",<UID>,"-Ln",<LinkID>," !")

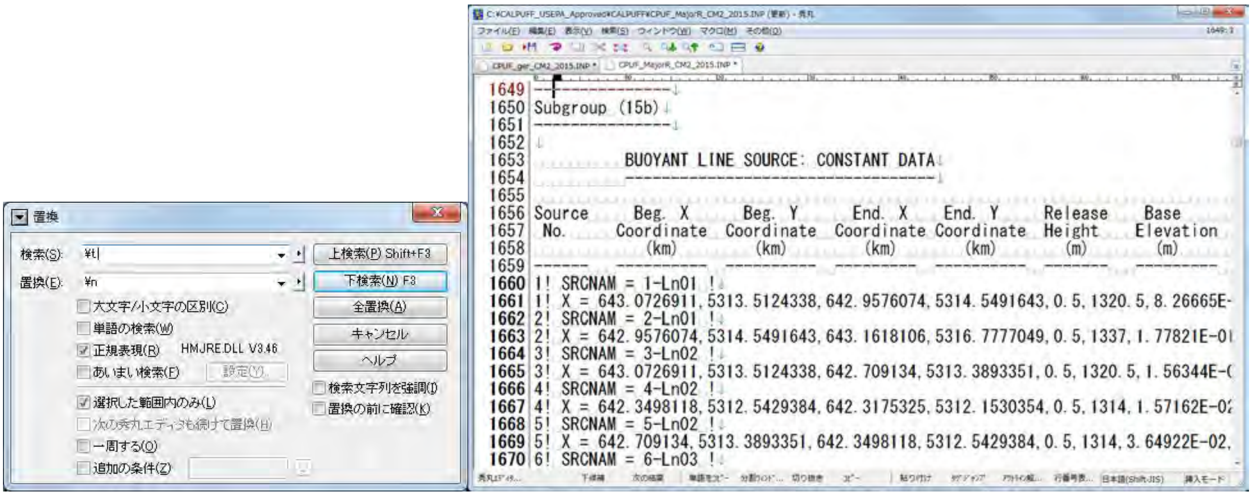
=CONCATENATE(<UID>,"! X = ",<StartX>/1000,",",<StartY>/1000,",",<EndX>/1000,",",<EndY>/1000,",0.5,",MIN(<AltitudeS>,<AltitudeE>,<AltitudeM>),",",TEXT(<SO2_corr>/(3600*24*365)*10^6,"0.00000E+00"),",",TEXT(<SO4>/(3600*24*365)*10^6,"0.00000E+00"),",",TEXT(<NOx_tpy>/(3600*24*365)*10^6,"0.00000E+00"),",0,0,",TEXT(<PM_tpy>/(3600*24*365)*10^6,"0.00000E+00"),",",TEXT(<PM10_tpy>/(3600*24*365)*10^6,"0.00000E+00"),",",TEXT(<CO_tpy>/(3600*24*365)*10^6,"0.00000E+00")," ! !END!")



Copy the created strings and paste them the relevant part of CALPUFF input file.

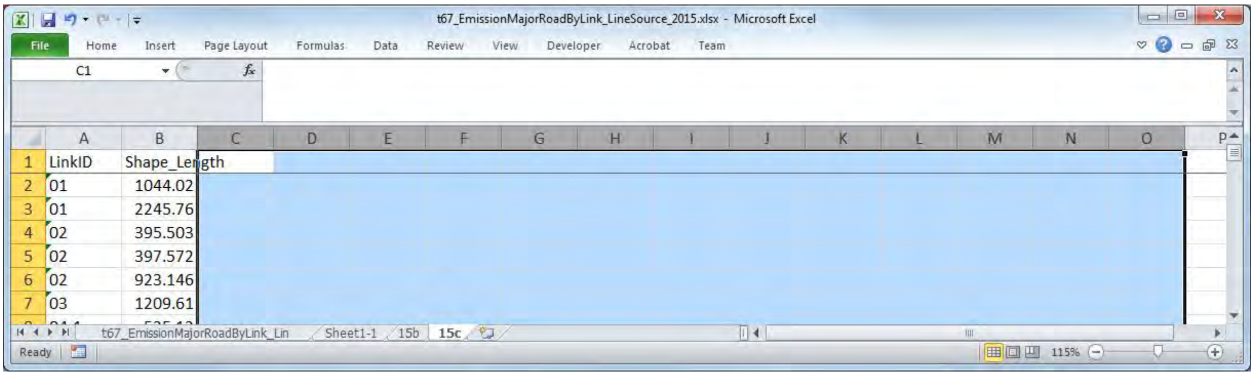


Since boundary between cells is pasted as tab, replace tab with new line.

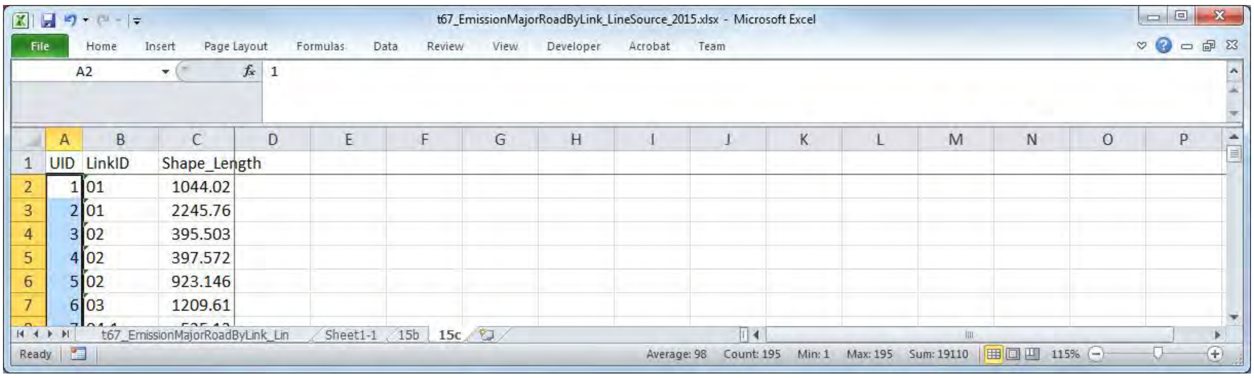


Create of “13d”

[LinkID] and road distance is the only necessary column, so delete other lines.



Insert a column before [ID] column and add serial number.



Create strings by pollutant setting operating pattern.

=CONCATENATE(<Unique ID>,"! SRCNAM = ",<UID>,"-Ln",<LinkID>," !")

=CONCATENATE(<Unique ID>,"! IVARY = 3 !")

=CONCATENATE(<Unique ID>," ! <Pollutant> = <Winter1>, <Winter2>, <Winter3>, <Winter4>, <Winter5>, <Winter6>, <Winter7>, <Winter8>, <Winter9>, <Winter10>, <Winter11>, <Winter12>,")

<Winter13>, <Winter14>, <Winter15>, <Winter16>, <Winter17>, <Winter18>, <Winter19>, <Winter20>, <Winter21>, <Winter22>, <Winter23>, <Winter24>,

<Spring1>, <Spring2>, <Spring3>, <Spring4>, <Spring5>, <Spring6>, <Spring7>, <Spring8>, <Spring9>, <Spring10>, <Spring11>, <Spring12>,

<Spring13>, <Spring14>, <Spring15>, <Spring16>, <Spring17>, <Spring18>, <Spring19>, <Spring20>, <Spring21>, <Spring22>, <Spring23>, <Spring24>,

<Summer1>, <Summer2>, <Summer3>, <Summer4>, <Summer5>, <Summer6>, <Summer7>, <Summer8>, <Summer9>, <Summer10>, <Summer11>, <Summer12>,

<Summer13>, <Summer14>, <Summer15>, <Summer16>, <Summer17>, <Summer18>, <Summer19>, <Summer20>, <Summer21>, <Summer22>, <Summer23>, <Summer24>,

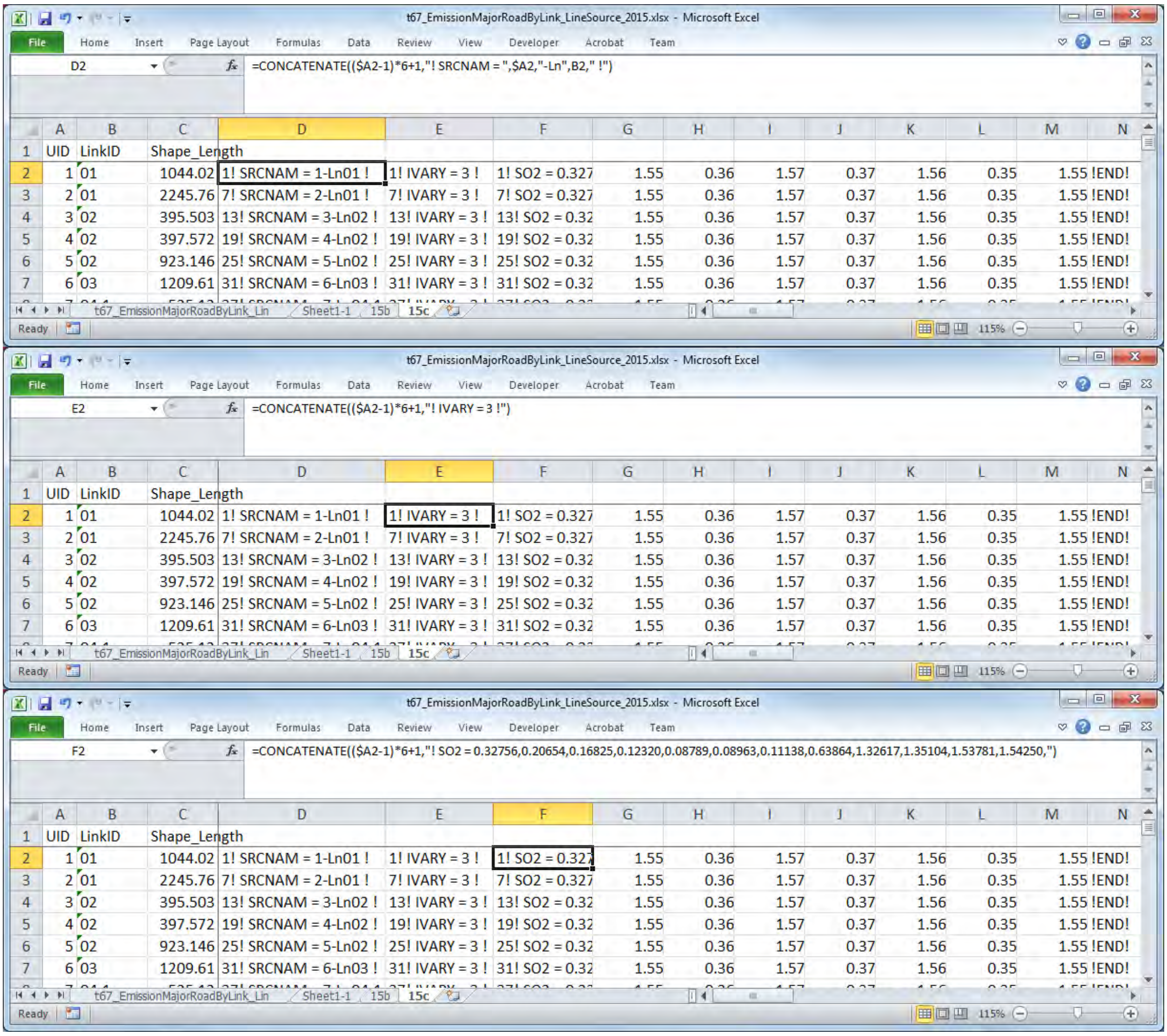
<Autumn1>, <Autumn2>, <Autumn3>, <Autumn4>, <Autumn5>, <Autumn6>, <Autumn7>, <Autumn8>, <Autumn9>, <Autumn10>, <Autumn11>, <Autumn12>,

<Autumn13>, <Autumn14>, <Autumn15>, <Autumn16>, <Autumn17>, <Autumn18>, <Autumn19>, <Autumn20>, <Autumn21>, <Autumn22>, <Autumn23>, <Autumn24> !

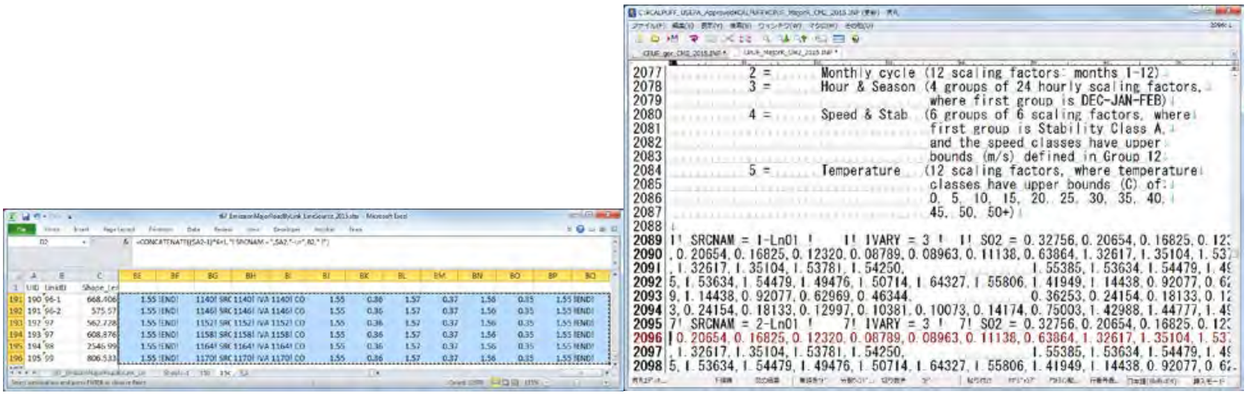
!END!

Since operating pattern needs to be created by pollutant, definition of “Unique ID” differs.

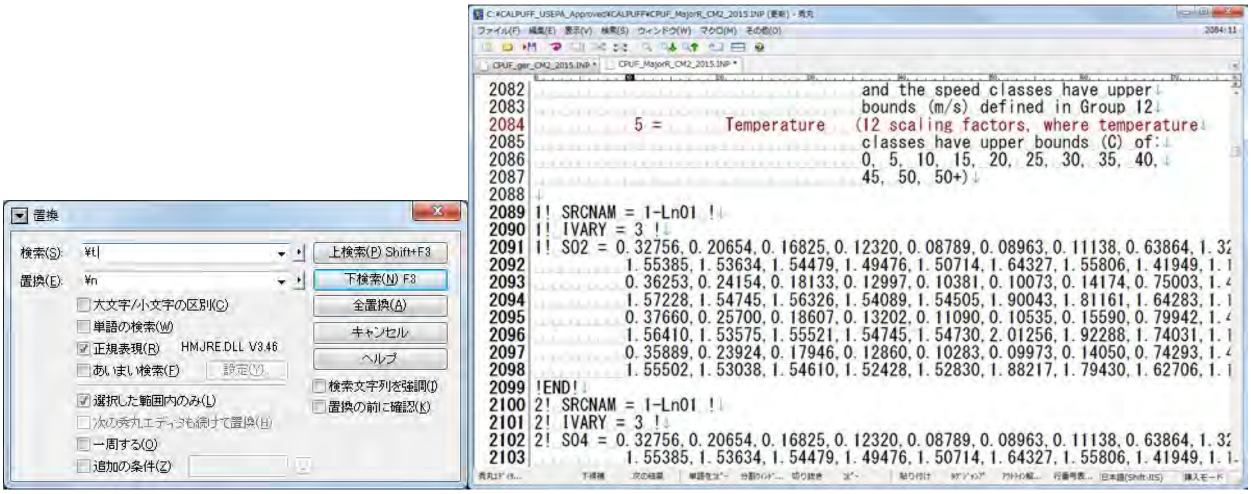
Pollutant	**Unique ID**
SO2	(<UID>-1)*6+1
SO4	(<UID>-1)*6+2
NOX	(<UID>-1)*6+3
TSP	(<UID>-1)*6+4
PM10	(<UID>-1)*6+5
CO	(<UID>-1)*6+6



Copy the created strings and paste them the relevant part of CALPUFF input file.



Since boundary between cells is pasted as tab, replace tab with new line.


置換
検索(S): ¥t|
置換(E): ¥n
大文字/小文字の区別(C)
単語の検索(W)
正規表現(R) HMJRE.DLL V3.46
あいまい検索(F)
設定(Y)...
選択した範囲内のみ(L)
次の秀丸エディタも続けて置換(H)
一周する(O)
追加の条件(Z)
上検索(P) Shift+F3
下検索(N) F3
全置換(A)
キャンセル
ヘルプ
検索文字列を強調(I)
置換の前に確認(K)
2082 and the speed classes have upper
2083 bounds (m/s) defined in Group 12
2084 5 = Temperature (12 scaling factors, where temperature
2085 classes have upper bounds (C) of:
2086 0, 5, 10, 15, 20, 25, 30, 35, 40,
2087 45, 50, 50+)
2088
2089 1! SRCNAM = 1-Ln01 !
2090 1! IVARY = 3 !
2091 1! SO2 = 0.32756, 0.20654, 0.16825, 0.12320, 0.08789, 0.08963, 0.11138, 0.63864, 1.3
2092 1.55385, 1.53634, 1.54479, 1.49476, 1.50714, 1.64327, 1.55806, 1.41949, 1.1
2093 0.36253, 0.24154, 0.18133, 0.12997, 0.10381, 0.10073, 0.14174, 0.75003, 1.
2094 1.57228, 1.54745, 1.56326, 1.54089, 1.54505, 1.90043, 1.81161, 1.64283, 1.1
2095 0.37660, 0.25700, 0.18607, 0.13202, 0.11090, 0.10535, 0.15590, 0.79942, 1.
2096 1.56410, 1.53575, 1.55521, 1.54745, 1.54730, 2.01256, 1.92288, 1.74031, 1.1
2097 0.35889, 0.23924, 0.17946, 0.12860, 0.10283, 0.09973, 0.14050, 0.74293, 1.
2098 1.55502, 1.53038, 1.54610, 1.52428, 1.52830, 1.88217, 1.79430, 1.62706, 1.1
2099 !END!
2100 2! SRCNAM = 1-Ln01 !
2101 2! IVARY = 3 !
2102 2! SO4 = 0.32756, 0.20654, 0.16825, 0.12320, 0.08789, 0.08963, 0.11138, 0.63864, 1.3
2103 1.55385, 1.53634, 1.54479, 1.49476, 1.50714, 1.64327, 1.55806, 1.41949, 1.1

6 Conducting Dispersion Simulation and Organizing the Calculation Result

6.1 Conducting Dispersion Simulation

6.1.1 Outline

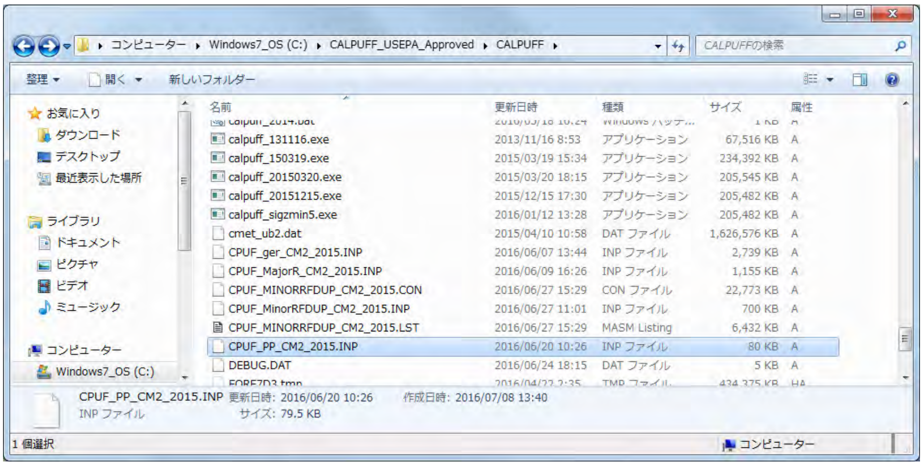
Conduct the dispersion simulation of CALPUFF using the emission data created in 3.2 and the meteorological model created with CALMET.

Set input file, output file, calculation term, calculated target substance, projection, datum, calculation range, and calculation resolution in CALPUFF. These settings have to be the same setting as those by the other processor. In this manual, set the parameter to consider the chemical reaction model in CALPUFF INP file.In addition, INP file can be set to narrow down the analysis target range inside the calculation range, and subdivide the grid in the analysis target range. For source data, paste the content of file converting data to the relevant part of CALPUFF INP file and correct the parameters such as the number of sources.

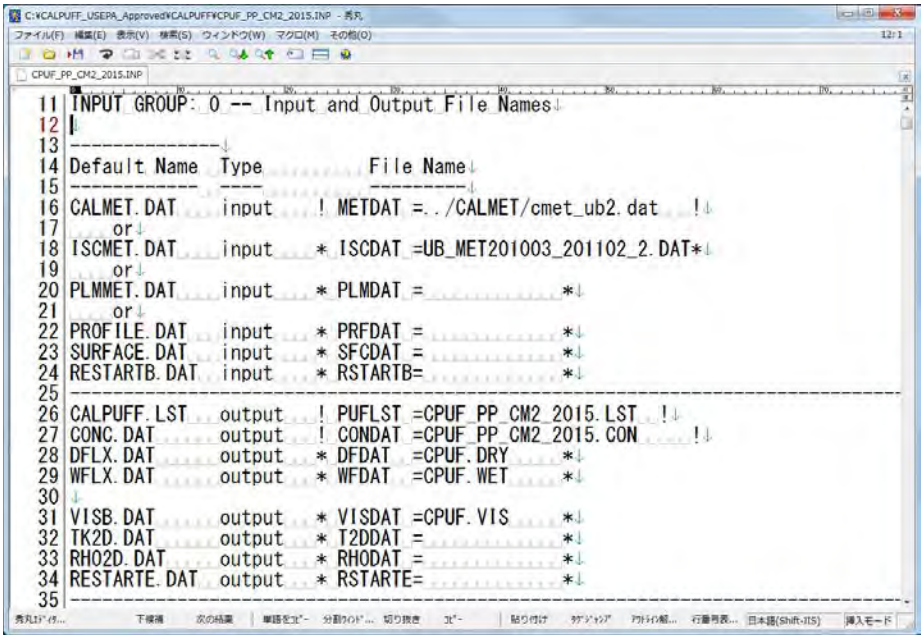
Dispersion simulation for each source is conducted in order to confirm the contribution by source.

6.1.2 Conducting Method

Open INP file in “CALPUFF” folder.

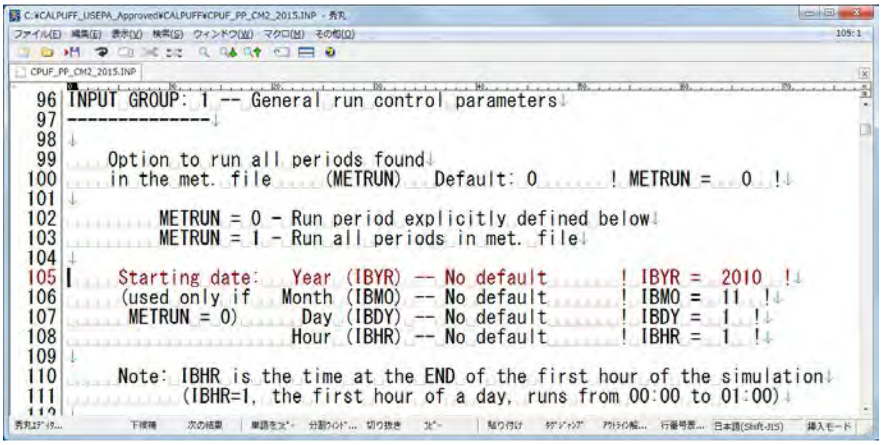


Set data file of meteorological model (METDAT), output file name (PUFLST, CONDAT).



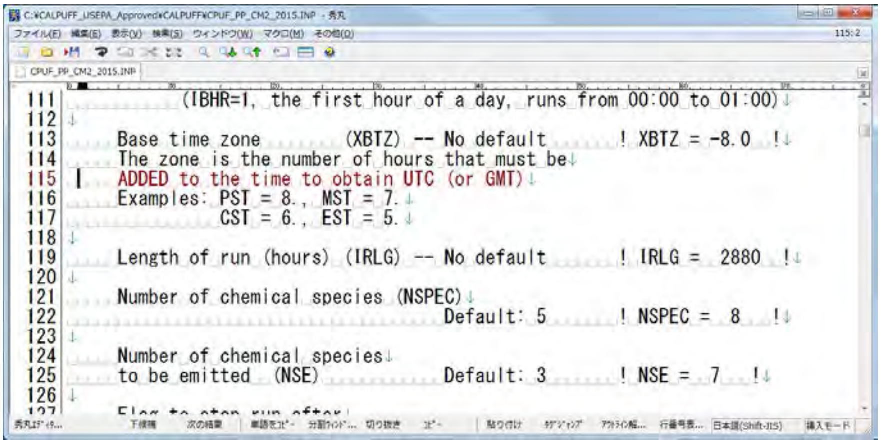
```
INPUT GROUP: 0 -- Input and Output File Names

---------------
Default Name  Type          File Name
------------  ----          ---------
CALMET.DAT    input     ! METDAT =../CALMET/cmet_ub2.dat    !
    or
ISCMET.DAT    input     * ISCDAT =UB_MET201003_201102_2.DAT*
    or
PLMMET.DAT    input     * PLMDAT =              *
    or
PROFILE.DAT   input     * PRFDAT =              *
SURFACE.DAT   input     * SFCDAT =              *
RESTARTB.DAT  input     * RSTARTB=              *
--------------------------------------------------------------------------------
CALPUFF.LST   output    ! PUFLST =CPUF_PP_CM2_2015.LST  !
CONC.DAT      output    ! CONDAT =CPUF_PP_CM2_2015.CON    !
DFLX.DAT      output    * DFDAT  =CPUF.DRY      *
WFLX.DAT      output    * WFDAT  =CPUF.WET      *

VISB.DAT      output    * VISDAT =CPUF.VIS      *
TK2D.DAT      output    * T2DDAT =              *
RHO2D.DAT     output    * RHODAT =              *
RESTARTE.DAT  output    * RSTARTE=              *
--------------------------------------------------------------------------------
```

Set target calculation term (METRUN). When setting “0”, you have to set the calculation starting date and time (IBYR, IBMO, IBDY, and IBHR). When setting “1”, the term included in meteorological model is target calculation term.

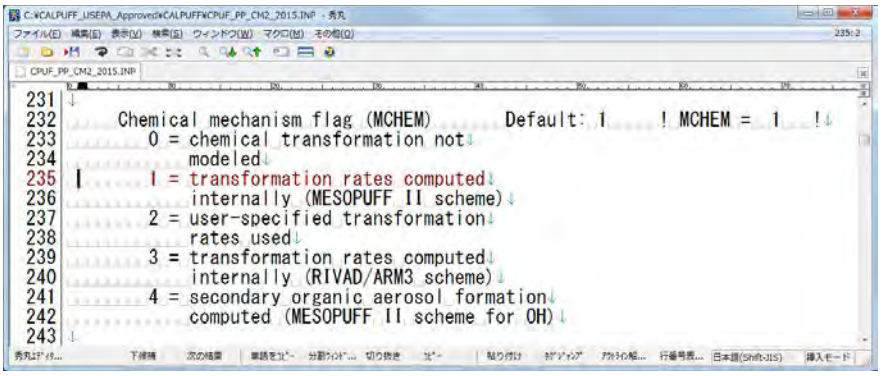


```
INPUT GROUP: 1 -- General run control parameters
--------------

   Option to run all periods found
   in the met. file     (METRUN)   Default: 0       ! METRUN =   0  !

         METRUN = 0 - Run period explicitly defined below
         METRUN = 1 - Run all periods in met. file

    Starting date:    Year  (IBYR) -- No default       ! IBYR =  2010  !
    (used only if    Month  (IBMO) -- No default       ! IBMO =  11  !
     METRUN = 0)       Day  (IBDY) -- No default       ! IBDY =  1  !
                      Hour  (IBHR) -- No default       ! IBHR =  1  !

    Note: IBHR is the time at the END of the first hour of the simulation
          (IBHR=1, the first hour of a day, runs from 00:00 to 01:00)
```

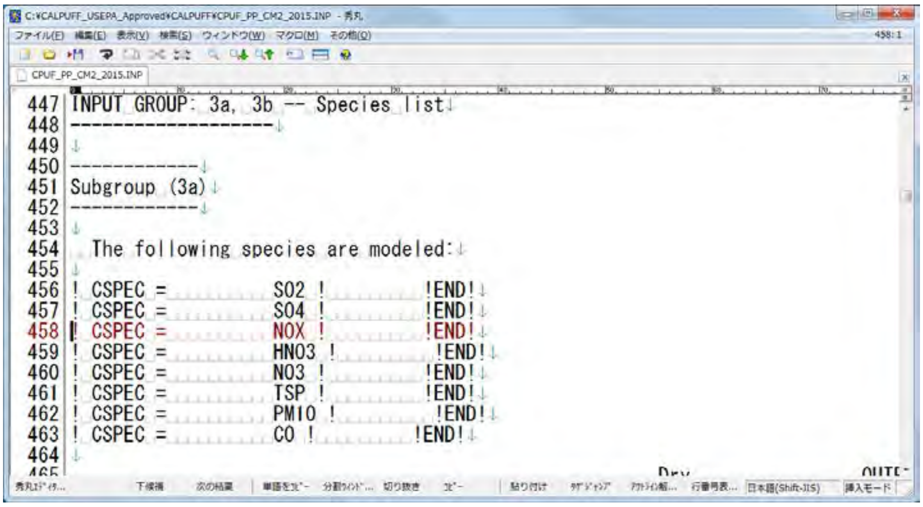
In addition, set time zone (XBTZ), the length of run (IRLG), the number of chemical species (NSPEC), and chemical species to be emitted (NSE).



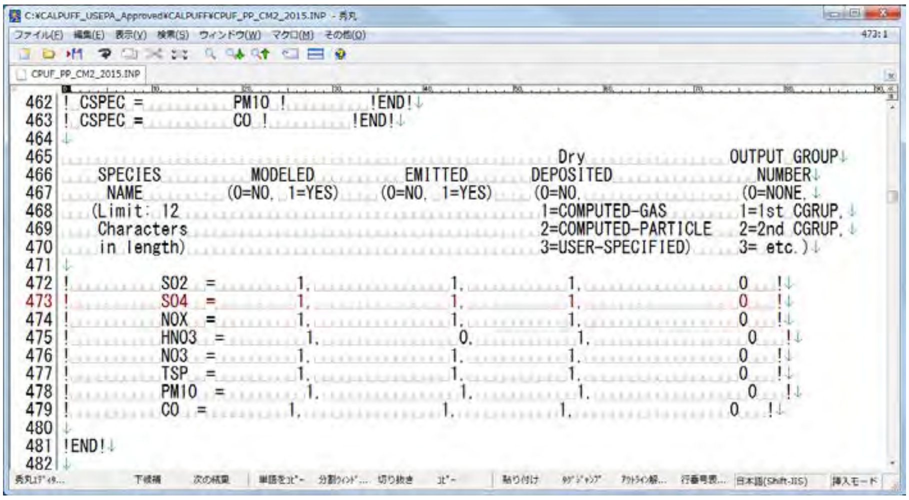
Set chemical mechanism flag (MCHEM). Set “1” to consider pseudo-first-order chemical reaction model using “MESOPUFF II” scheme in this manual.



Set the information on pollutant. Set the substances name for the number of calculated substances set by NSPEC.

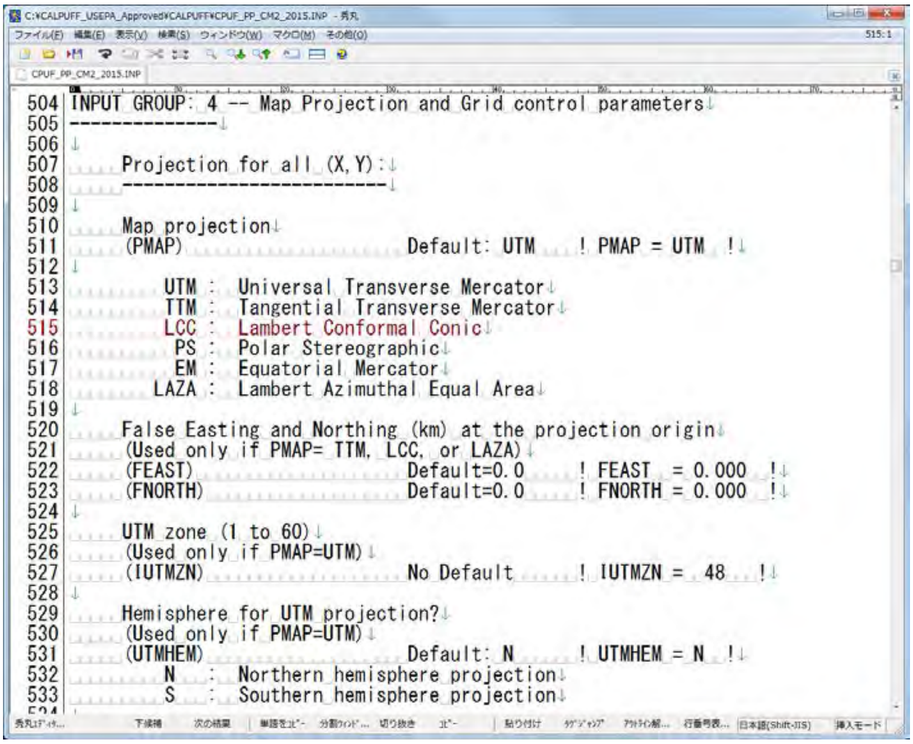


For each contaminant, set whether these substances are target of calculation output or not (MODELED) and whether they are target of emission or not (EMITTED).



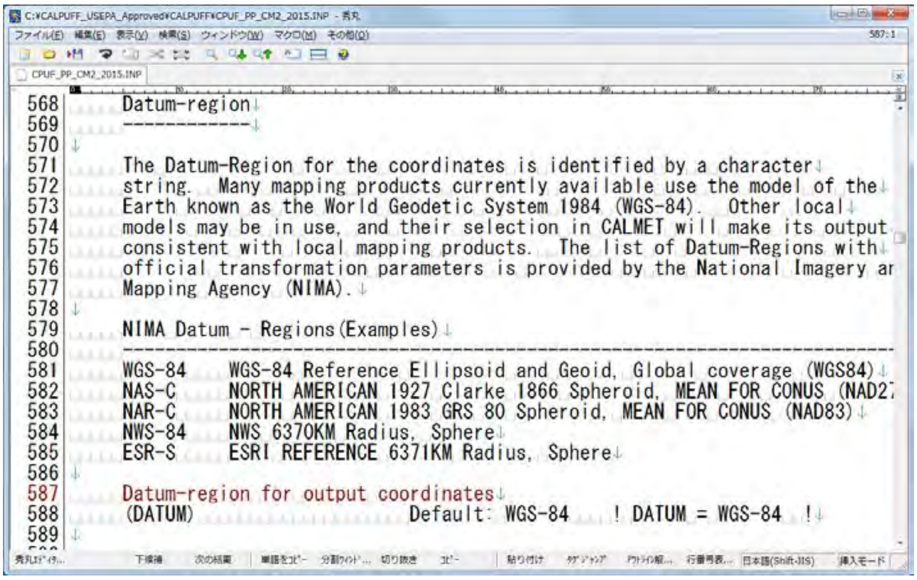
```
! CSPEC =          PM10 !          !END!
! CSPEC =          CO !            !END!

                                                   Dry               OUTPUT GROUP
    SPECIES          MODELED        EMITTED      DEPOSITED              NUMBER
     NAME          (0=NO, 1=YES)  (0=NO, 1=YES)  (0=NO,                (0=NONE,
   (Limit: 12                                    1=COMPUTED-GAS         1=1st CGRUP,
    Characters                                   2=COMPUTED-PARTICLE    2=2nd CGRUP,
    in length)                                   3=USER-SPECIFIED)      3= etc.)

!          SO2  =        1,             1,            1,                 0  !
!          SO4  =        1,             1,            1,                 0  !
!          NOX  =        1,             1,            1,                 0  !
!          HNO3  =        1,             0,            1,                 0  !
!          NO3  =        1,             1,            1,                 0  !
!          TSP  =        1,             1,            1,                 0  !
!          PM10  =        1,             1,            1,                 0  !
!          CO  =        1,             1,            1,                 0  !

!END!
```

Set the projection of output data (PMAP etc.). These setting have to be the same as CALMET etc.



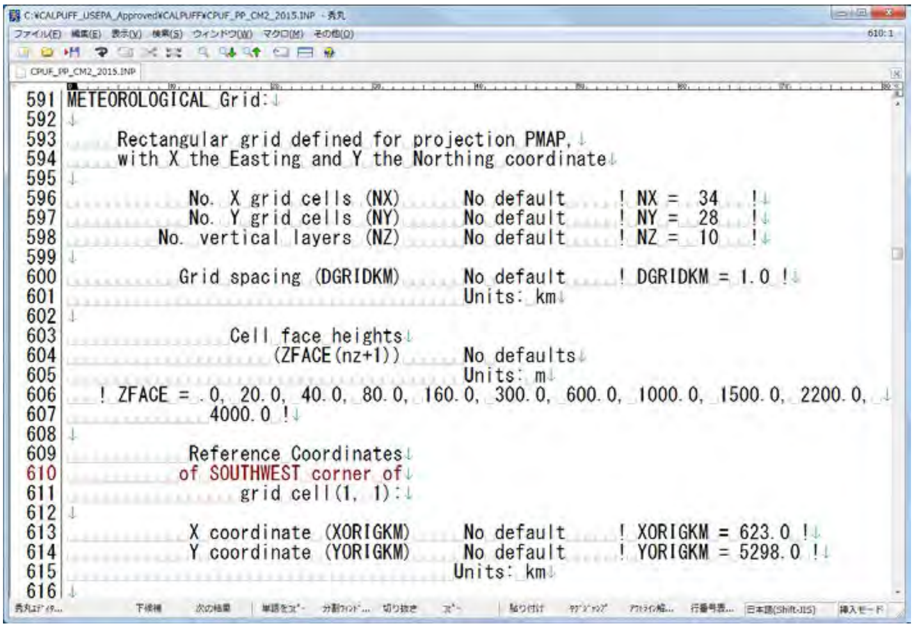
```
INPUT GROUP: 4 -- Map Projection and Grid control parameters
--------------

    Projection for all (X,Y):
    -------------------------

    Map projection
    (PMAP)                     Default: UTM    ! PMAP = UTM  !

        UTM :  Universal Transverse Mercator
        TTM :  Tangential Transverse Mercator
        LCC :  Lambert Conformal Conic
         PS :  Polar Stereographic
         EM :  Equatorial Mercator
       LAZA :  Lambert Azimuthal Equal Area

    False Easting and Northing (km) at the projection origin
    (Used only if PMAP= TTM, LCC, or LAZA)
    (FEAST)                    Default=0.0     ! FEAST  = 0.000  !
    (FNORTH)                   Default=0.0     ! FNORTH = 0.000  !

    UTM zone (1 to 60)
    (Used only if PMAP=UTM)
    (IUTMZN)                   No Default      ! IUTMZN =  48   !

    Hemisphere for UTM projection?
    (Used only if PMAP=UTM)
    (UTMHEM)                   Default: N      ! UTMHEM = N  !
         N   :  Northern hemisphere projection
         S   :  Southern hemisphere projection
```

Set the datum of output data (DATUM). These setting have to be the same as CALMET etc.



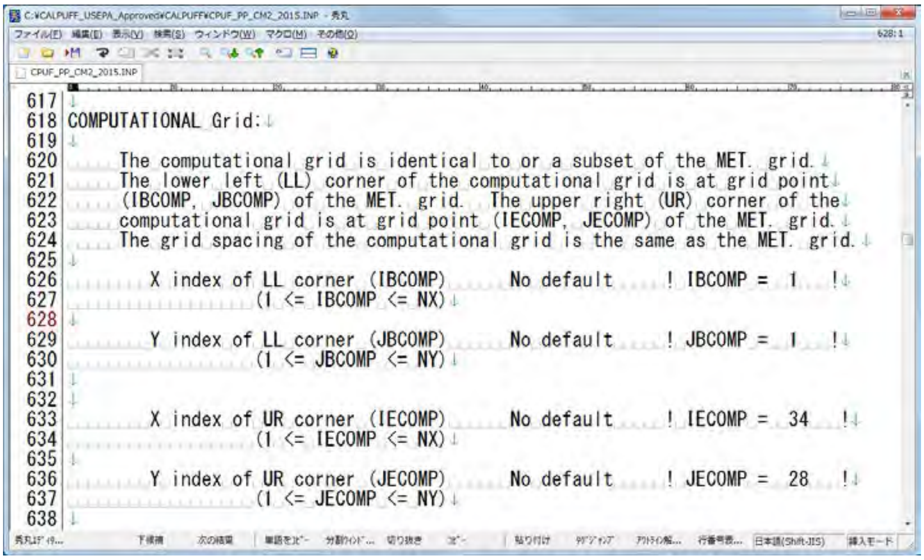
```
    Datum-region
    ------------

    The Datum-Region for the coordinates is identified by a character
    string.  Many mapping products currently available use the model of the
    Earth known as the World Geodetic System 1984 (WGS-84).  Other local
    models may be in use, and their selection in CALMET will make its output
    consistent with local mapping products.  The list of Datum-Regions with
    official transformation parameters is provided by the National Imagery ar
    Mapping Agency (NIMA).

    NIMA Datum - Regions(Examples)
    ------------------------------------------------------------------------------
    WGS-84    WGS-84 Reference Ellipsoid and Geoid, Global coverage (WGS84)
    NAS-C     NORTH AMERICAN 1927 Clarke 1866 Spheroid, MEAN FOR CONUS (NAD27
    NAR-C     NORTH AMERICAN 1983 GRS 80 Spheroid, MEAN FOR CONUS (NAD83)
    NWS-84    NWS 6370KM Radius, Sphere
    ESR-S     ESRI REFERENCE 6371KM Radius, Sphere

    Datum-region for output coordinates
    (DATUM)                       Default: WGS-84    ! DATUM = WGS-84  !
```

Set the number of grid of meteorological model data (NX, NY, and NZ), horizontal grid spacing (DGRIDKM), the number of vertical grid and the height to divide the grid (ZFACE), and the bottom-left coordinate of grid. These setting have to be the same as CALMET etc.



```
METEOROLOGICAL Grid:

    Rectangular grid defined for projection PMAP,
    with X the Easting and Y the Northing coordinate

            No. X grid cells (NX)      No default     ! NX =  34  !
            No. Y grid cells (NY)      No default     ! NY =  28  !
         No. vertical layers (NZ)      No default     ! NZ =  10  !

           Grid spacing (DGRIDKM)      No default     ! DGRIDKM = 1.0 !
                                       Units: km

                Cell face heights
                   (ZFACE(nz+1))       No defaults
                                       Units: m
  ! ZFACE = .0, 20.0, 40.0, 80.0, 160.0, 300.0, 600.0, 1000.0, 1500.0, 2200.0,
           4000.0 !

            Reference Coordinates
           of SOUTHWEST corner of
                 grid cell(1, 1):

            X coordinate (XORIGKM)     No default     ! XORIGKM = 623.0 !
            Y coordinate (YORIGKM)     No default     ! YORIGKM = 5298.0 !
                                       Units: km
```

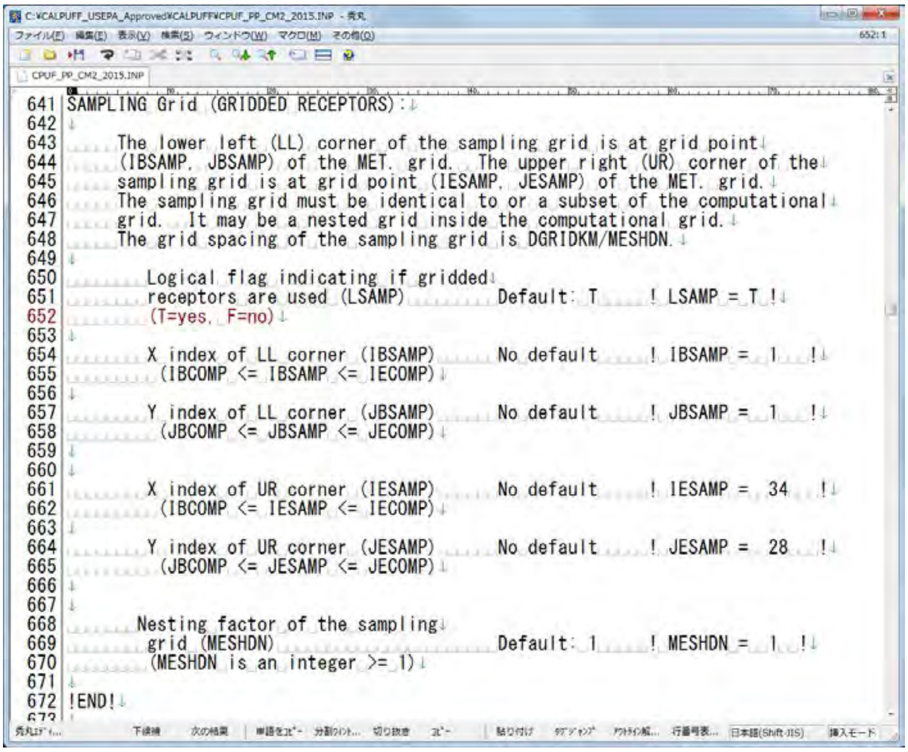
Set the range of calculation grid (IBCOMP, JBCOMP, IECOMP, and JECOMP). Set the range specified above with grid number.



```
COMPUTATIONAL Grid:

    The computational grid is identical to or a subset of the MET. grid.
    The lower left (LL) corner of the computational grid is at grid point
    (IBCOMP, JBCOMP) of the MET. grid.  The upper right (UR) corner of the
    computational grid is at grid point (IECOMP, JECOMP) of the MET. grid.
    The grid spacing of the computational grid is the same as the MET. grid.

        X index of LL corner (IBCOMP)      No default     ! IBCOMP =  1  !
                   (1 <= IBCOMP <= NX)

        Y index of LL corner (JBCOMP)      No default     ! JBCOMP =  1  !
                   (1 <= JBCOMP <= NY)


        X index of UR corner (IECOMP)      No default     ! IECOMP =  34  !
                   (1 <= IECOMP <= NX)

        Y index of UR corner (JECOMP)      No default     ! JECOMP =  28  !
                   (1 <= JECOMP <= NY)

```

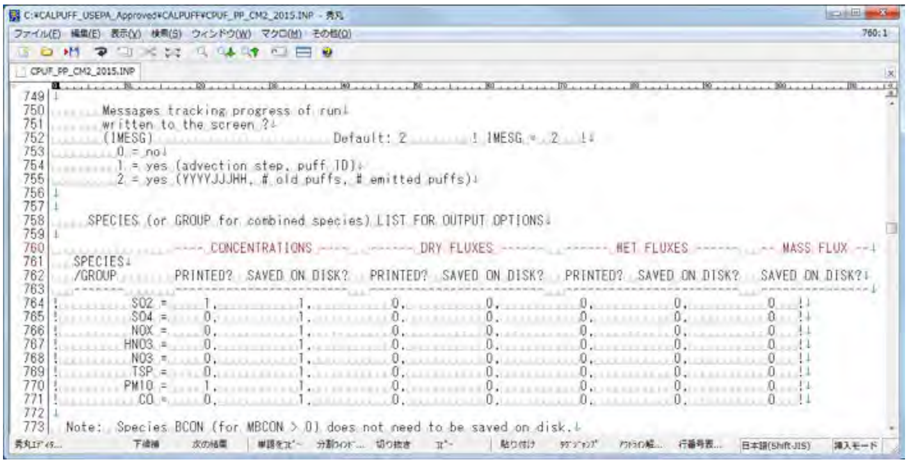
When outputting calculation results as grid data, set “LSAMP” to "T" and set the range of output grid (IBSAMP, JBSAMP, IESAMP, and JESAMP). Set the grid number within the range specified above. Set the nesting factor of the sampling grid for specifying the grid interval within the set range (MESHDN).

Example: When “DGRIDKM” is set to 5km and you want to set the grid interval for outputting the calculation result to 1km, “MESHDN” where “DGRIDKM”/”MESHDN” becomes 1, that is, may be set to 5.



```
SAMPLING Grid (GRIDDED RECEPTORS):

    The lower left (LL) corner of the sampling grid is at grid point
    (IBSAMP, JBSAMP) of the MET. grid.  The upper right (UR) corner of the
    sampling grid is at grid point (IESAMP, JESAMP) of the MET. grid.
    The sampling grid must be identical to or a subset of the computational
    grid.  It may be a nested grid inside the computational grid.
    The grid spacing of the sampling grid is DGRIDKM/MESHDN.

        Logical flag indicating if gridded
        receptors are used (LSAMP)         Default: T     ! LSAMP = T !
        (T=yes, F=no)

        X index of LL corner (IBSAMP)      No default     ! IBSAMP =  1  !
         (IBCOMP <= IBSAMP <= IECOMP)

        Y index of LL corner (JBSAMP)      No default     ! JBSAMP =  1  !
         (JBCOMP <= JBSAMP <= JECOMP)


        X index of UR corner (IESAMP)      No default     ! IESAMP =  34  !
         (IBCOMP <= IESAMP <= IECOMP)

        Y index of UR corner (JESAMP)      No default     ! JESAMP =  28  !
         (JBCOMP <= JESAMP <= JECOMP)


       Nesting factor of the sampling
        grid (MESHDN)                      Default: 1     ! MESHDN =  1  !
        (MESHDN is an integer >= 1)

!END!
```

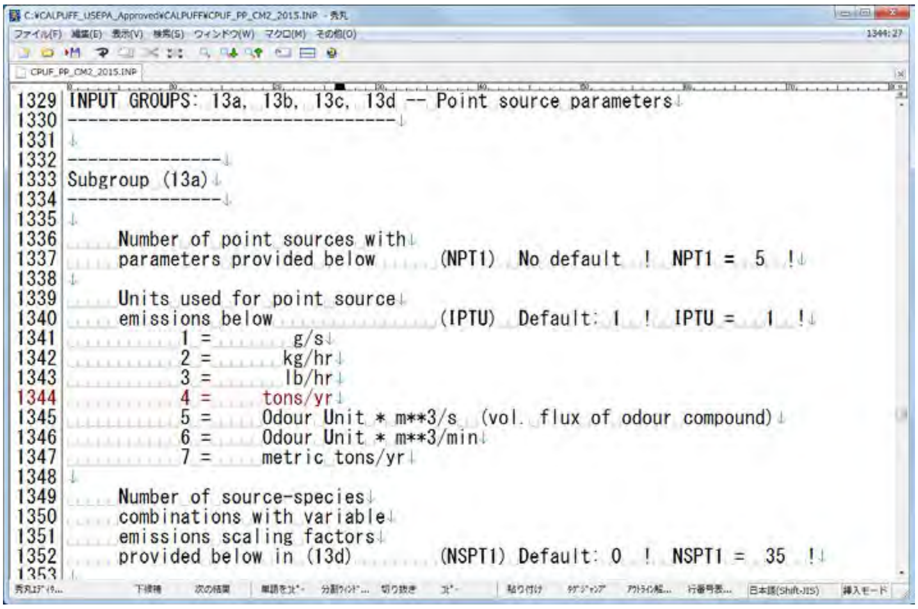
Set the substance to be output to the LIST file among the calculated pollutants.



```
     Messages tracking progress of run
     written to the screen ?
     (IMESG)                         Default: 2       ! IMESG =  2   !
        0 = no
        1 = yes (advection step, puff ID)
        2 = yes (YYYYJJJHH, # old puffs, # emitted puffs)


   SPECIES (or GROUP for combined species) LIST FOR OUTPUT OPTIONS

                 ---- CONCENTRATIONS ----   ------ DRY FLUXES ------   ------ WET FLUXES ------   -- MASS FLUX --
   SPECIES
   /GROUP        PRINTED?  SAVED ON DISK?   PRINTED?  SAVED ON DISK?   PRINTED?  SAVED ON DISK?   SAVED ON DISK?
   -------       ------------------------   ------------------------   ------------------------   ---------------
!          SO2 =     1,          1,            0,          0,            0,          0,            0   !
!          SO4 =     0,          1,            0,          0,            0,          0,            0   !
!          NOX =     0,          1,            0,          0,            0,          0,            0   !
!         HNO3 =     0,          1,            0,          0,            0,          0,            0   !
!          NO3 =     0,          1,            0,          0,            0,          0,            0   !
!          TSP =     0,          1,            0,          0,            0,          0,            0   !
!         PM10 =     1,          1,            0,          0,            0,          0,            0   !
!           CO =     0,          1,            0,          0,            0,          0,            0   !

  Note:  Species BCON (for MBCON > 0) does not need to be saved on disk.
```

Setting the emission data of point source

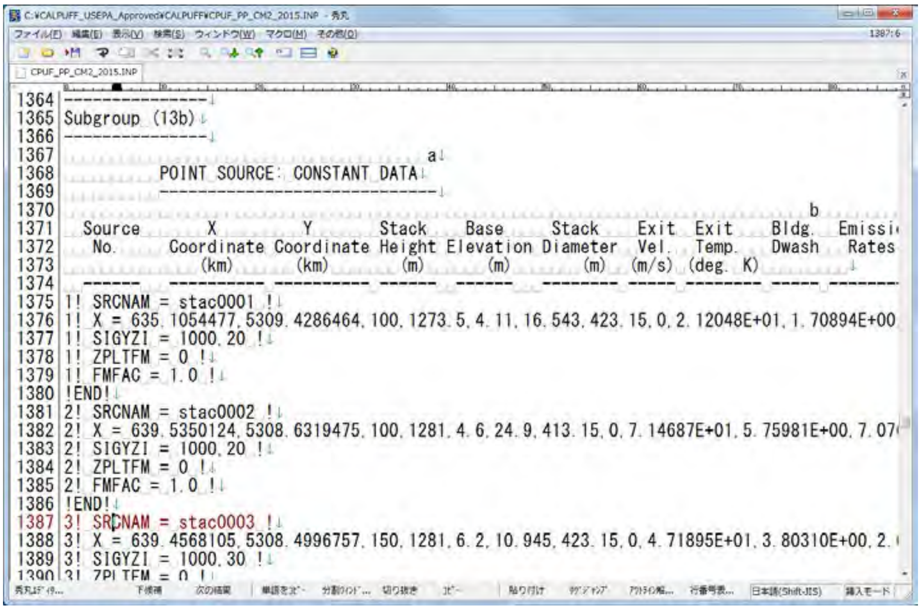
Set the number of sources (NPT1), the unit of emission (IPTU[9]), and the number of emission patterns (NSPT1) at “13a”. “NSPT1” is the value by multiplying “NPT1” by “NSE” (number of pollutants).



```
INPUT GROUPS: 13a, 13b, 13c, 13d -- Point source parameters
--------------------------------

---------------
Subgroup (13a)
---------------

     Number of point sources with
     parameters provided below      (NPT1)  No default  !  NPT1 =  5  !

     Units used for point source
     emissions below                (IPTU)  Default: 1  !  IPTU =   1  !
           1 =       g/s
           2 =      kg/hr
           3 =      lb/hr
           4 =     tons/yr
           5 =     Odour Unit * m**3/s  (vol. flux of odour compound)
           6 =     Odour Unit * m**3/min
           7 =     metric tons/yr

     Number of source-species
     combinations with variable
     emissions scaling factors
     provided below in (13d)        (NSPT1) Default: 0  !  NSPT1 =  35  !
```

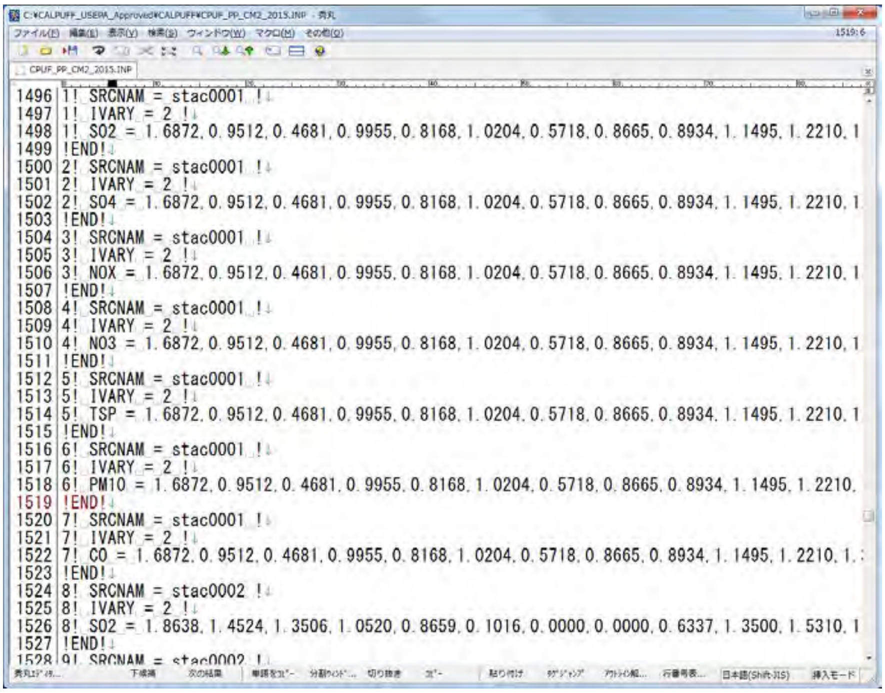
Set source name (SRCNAM), X coordinate, Y coordinate, stack height, elevation, stack diameter, flow gas velocity, flow gas temperature and emission (X) for each source at “13b”. Adjust the horizontal and vertical dispersion width (SIGYZI) as necessary.

[9] Note that “tons/yr” (4) is ton in the American Survey Act and “metric tons/yr” (7) is ton in the metric method, so these are strictly different each other. In the case of Mongolia “7” seems appropriate to be used.



```
---------------
Subgroup (13b)
---------------
                                              a
            POINT SOURCE: CONSTANT DATA
            -----------------------------
                                                                                          b
  Source        X           Y       Stack    Base      Stack    Exit  Exit      Bldg.  Emissi
   No.     Coordinate  Coordinate Height Elevation Diameter  Vel.  Temp.     Dwash   Rates
              (km)         (km)      (m)      (m)        (m)   (m/s) (deg. K)
  ------   ----------  ----------  ------  ------   --------  -----  --------  -----  -------
1! SRCNAM = stac0001 !
1! X = 635.1054477,5309.4286464,100,1273.5,4.11,16.543,423.15,0,2.12048E+01,1.70894E+00
1! SIGYZI = 1000,20 !
1! ZPLTFM = 0 !
1! FMFAC = 1.0 !
!END!
2! SRCNAM = stac0002 !
2! X = 639.5350124,5308.6319475,100,1281.4,6,24.9,413.15,0,7.14687E+01,5.75981E+00,7.07
2! SIGYZI = 1000,20 !
2! ZPLTFM = 0 !
2! FMFAC = 1.0 !
!END!
3! SRCNAM = stac0003 !
3! X = 639.4568105,5308.4996757,150,1281.6,2,10.945,423.15,0,4.71895E+01,3.80310E+00,2.
3! SIGYZI = 1000,30 !
```

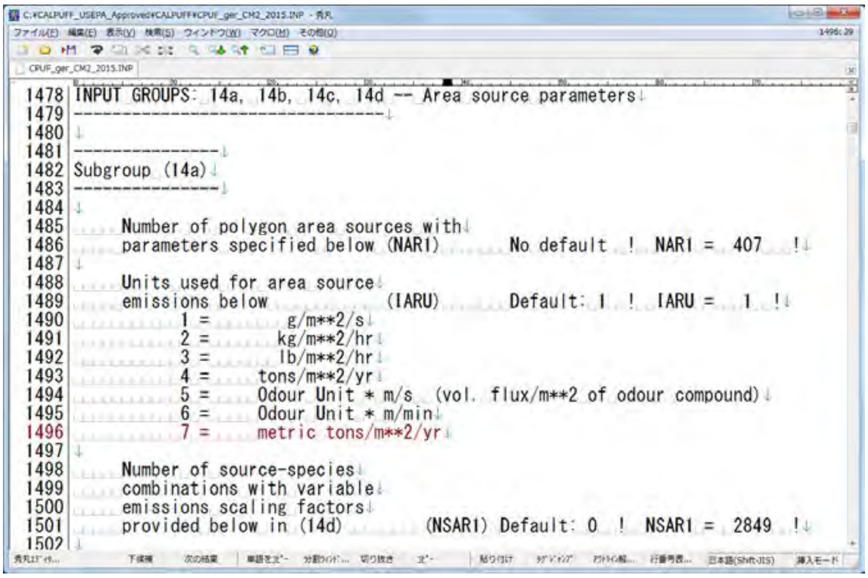
Set source name (SRCNAM), emission pattern type (IVARY) and emission pattern by substance for each source at “13d”. For “IVARY”, you can set "1" (for each time), "2" (for each month), "3" (for each season and time), etc. If not set “IVARY”, emission pattern is regarded as constant.



```
1! SRCNAM = stac0001 !
1! IVARY = 2 !
1! SO2 = 1.6872,0.9512,0.4681,0.9955,0.8168,1.0204,0.5718,0.8665,0.8934,1.1495,1.2210,1
!END!
2! SRCNAM = stac0001 !
2! IVARY = 2 !
2! SO4 = 1.6872,0.9512,0.4681,0.9955,0.8168,1.0204,0.5718,0.8665,0.8934,1.1495,1.2210,1
!END!
3! SRCNAM = stac0001 !
3! IVARY = 2 !
3! NOX = 1.6872,0.9512,0.4681,0.9955,0.8168,1.0204,0.5718,0.8665,0.8934,1.1495,1.2210,1
!END!
4! SRCNAM = stac0001 !
4! IVARY = 2 !
4! NO3 = 1.6872,0.9512,0.4681,0.9955,0.8168,1.0204,0.5718,0.8665,0.8934,1.1495,1.2210,1
!END!
5! SRCNAM = stac0001 !
5! IVARY = 2 !
5! TSP = 1.6872,0.9512,0.4681,0.9955,0.8168,1.0204,0.5718,0.8665,0.8934,1.1495,1.2210,1
!END!
6! SRCNAM = stac0001 !
6! IVARY = 2 !
6! PM10 = 1.6872,0.9512,0.4681,0.9955,0.8168,1.0204,0.5718,0.8665,0.8934,1.1495,1.2210,
!END!
7! SRCNAM = stac0001 !
7! IVARY = 2 !
7! CO = 1.6872,0.9512,0.4681,0.9955,0.8168,1.0204,0.5718,0.8665,0.8934,1.1495,1.2210,1.
!END!
8! SRCNAM = stac0002 !
8! IVARY = 2 !
8! SO2 = 1.8638,1.4524,1.3506,1.0520,0.8659,0.1016,0.0000,0.0000,0.6337,1.3500,1.5310,1
!END!
9! SRCNAM = stac0002 !
```

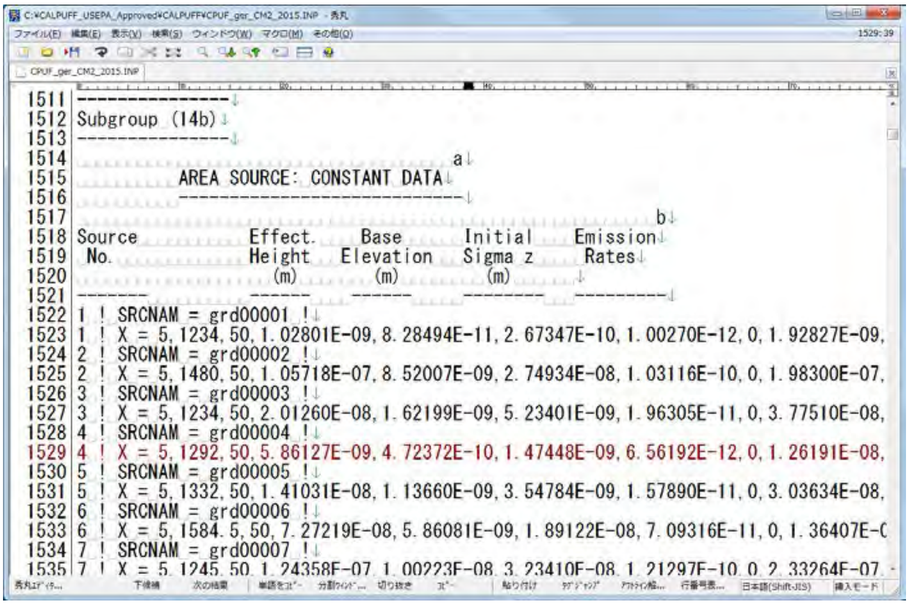
Setting the emission data of area source

Set the number of sources (NAR1), the unit of emission (IARU), and the number of emission patterns (NSAR1) at “14a”. “NSAR1” is the value by multiplying “NAR1” by “NSE” (number of pollutants).



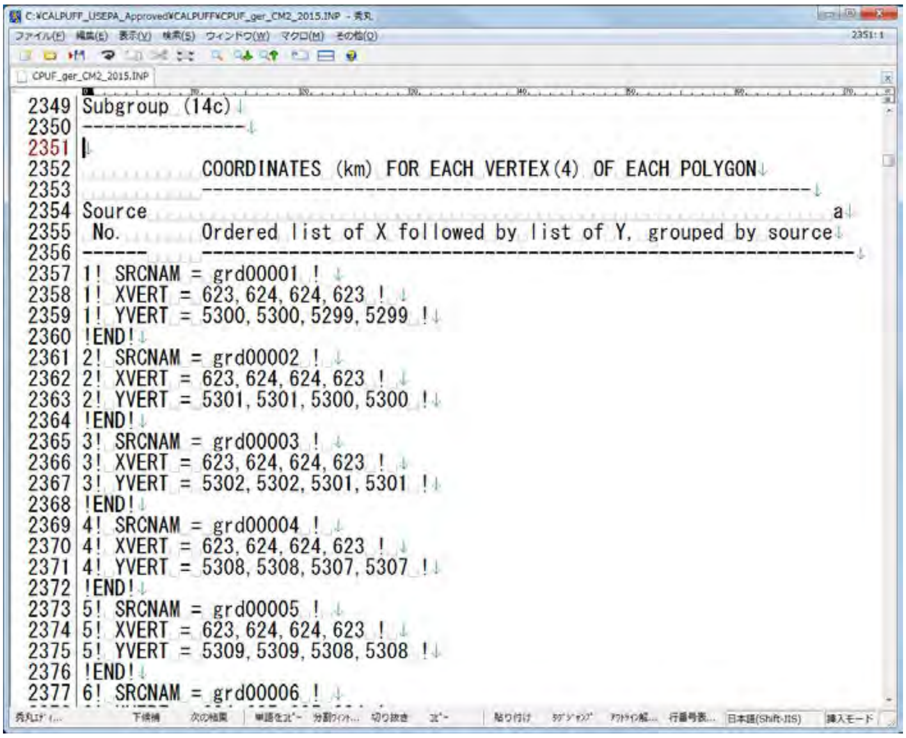
```
INPUT GROUPS: 14a, 14b, 14c, 14d -- Area source parameters
--------------------------------

---------------
Subgroup (14a)
---------------

     Number of polygon area sources with
     parameters specified below (NAR1)       No default  !  NAR1 =  407   !

     Units used for area source
     emissions below              (IARU)       Default: 1  !  IARU =   1  !
            1 =        g/m**2/s
            2 =       kg/m**2/hr
            3 =        lb/m**2/hr
            4 =     tons/m**2/yr
            5 =     Odour Unit * m/s  (vol. flux/m**2 of odour compound)
            6 =     Odour Unit * m/min
            7 =     metric tons/m**2/yr

     Number of source-species
     combinations with variable
     emissions scaling factors
     provided below in (14d)        (NSAR1) Default: 0  !  NSAR1 =  2849  !
```

Set source name (SRCNAM), effective emission height, elevation, vertical dispersion width, and emission (X) for each source at “14b”.



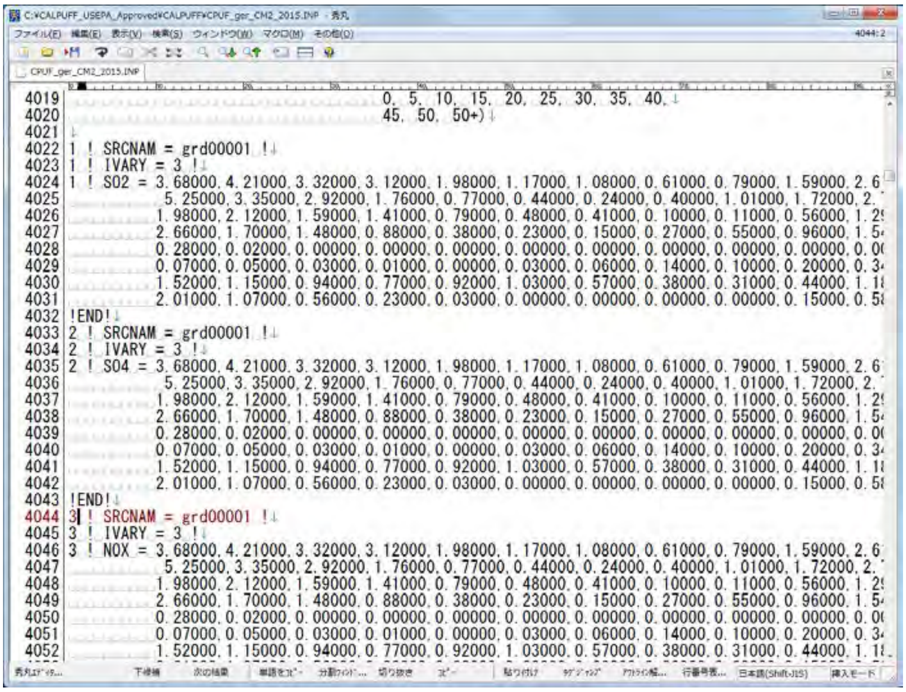
```
---------------
Subgroup (14b)
---------------
                                             a
          AREA SOURCE: CONSTANT DATA
          ----------------------------
                                                             b
Source          Effect.    Base      Initial    Emission
 No.            Height   Elevation   Sigma z     Rates
                 (m)       (m)        (m)
-------         ------   ------      --------   ---------
1 ! SRCNAM = grd00001 !
1 ! X = 5, 1234, 50, 1.02801E-09, 8.28494E-11, 2.67347E-10, 1.00270E-12, 0, 1.92827E-09,
2 ! SRCNAM = grd00002 !
2 ! X = 5, 1480, 50, 1.05718E-07, 8.52007E-09, 2.74934E-08, 1.03116E-10, 0, 1.98300E-07,
3 ! SRCNAM = grd00003 !
3 ! X = 5, 1234, 50, 2.01260E-08, 1.62199E-09, 5.23401E-09, 1.96305E-11, 0, 3.77510E-08,
4 ! SRCNAM = grd00004 !
4 ! X = 5, 1292, 50, 5.86127E-09, 4.72372E-10, 1.47448E-09, 6.56192E-12, 0, 1.26191E-08,
5 ! SRCNAM = grd00005 !
5 ! X = 5, 1332, 50, 1.41031E-08, 1.13660E-09, 3.54784E-09, 1.57890E-11, 0, 3.03634E-08,
6 ! SRCNAM = grd00006 !
6 ! X = 5, 1584.5, 50, 7.27219E-08, 5.86081E-09, 1.89122E-08, 7.09316E-11, 0, 1.36407E-C
7 ! SRCNAM = grd00007 !
7 ! X = 5, 1245, 50, 1.24358E-07, 1.00223E-08, 3.23410E-08, 1.21297E-10, 0, 2.33264E-07,
```

Set source name (SRCNAM), X coordinate (XVERT) and Y coordinate (YVERT) of four points for each source at “14c”. Set in order of upper left, upper right, bottom right, and bottom left, respectively.



```
Subgroup (14c)
---------------

                COORDINATES (km) FOR EACH VERTEX(4) OF EACH POLYGON
                --------------------------------------------------------
Source                                                                  a
 No.            Ordered list of X followed by list of Y, grouped by source
------          ------------------------------------------------------------
1! SRCNAM = grd00001 !
1! XVERT = 623, 624, 624, 623 !
1! YVERT = 5300, 5300, 5299, 5299 !
!END!
2! SRCNAM = grd00002 !
2! XVERT = 623, 624, 624, 623 !
2! YVERT = 5301, 5301, 5300, 5300 !
!END!
3! SRCNAM = grd00003 !
3! XVERT = 623, 624, 624, 623 !
3! YVERT = 5302, 5302, 5301, 5301 !
!END!
4! SRCNAM = grd00004 !
4! XVERT = 623, 624, 624, 623 !
4! YVERT = 5308, 5308, 5307, 5307 !
!END!
5! SRCNAM = grd00005 !
5! XVERT = 623, 624, 624, 623 !
5! YVERT = 5309, 5309, 5308, 5308 !
!END!
6! SRCNAM = grd00006 !
```

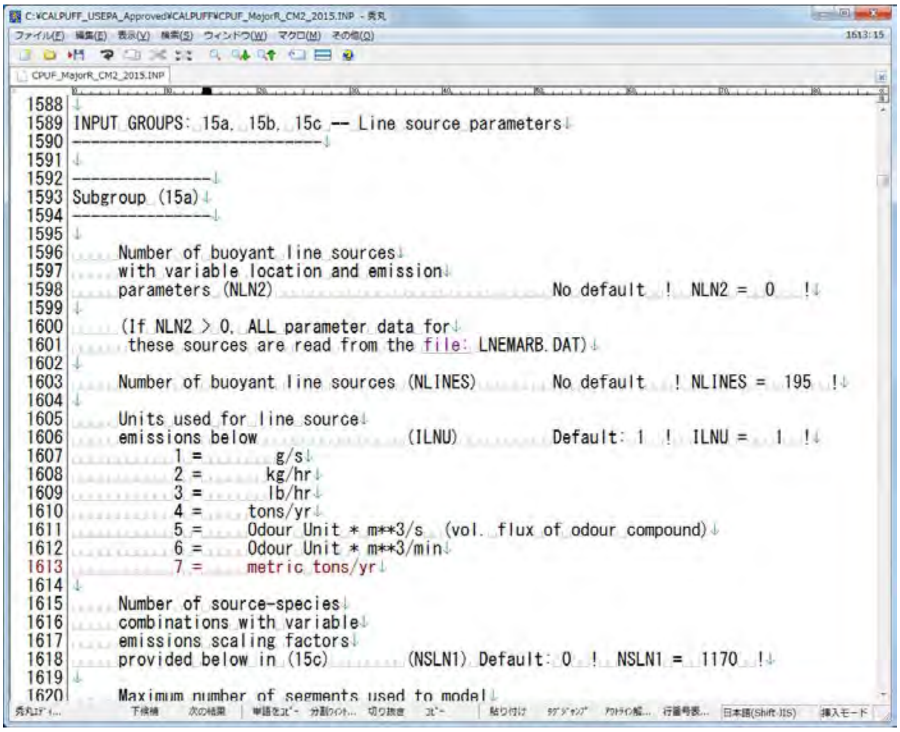
Set source name (SRCNAM), emission pattern type (IVARY) and emission pattern by substance for each source at “14d”. For “IVARY”, you can set "1" (for each time), "2" (for each month), "3" (for each season and time), etc. If not set “IVARY”, emission pattern is regarded as constant.



```
                                0, 5, 10, 15, 20, 25, 30, 35, 40,
                                45, 50, 50+)

1 ! SRCNAM = grd00001 !
1 ! IVARY = 3 !
1 ! SO2 = 3.68000, 4.21000, 3.32000, 3.12000, 1.98000, 1.17000, 1.08000, 0.61000, 0.79000, 1.59000, 2.6
           5.25000, 3.35000, 2.92000, 1.76000, 0.77000, 0.44000, 0.24000, 0.40000, 1.01000, 1.72000, 2.
          1.98000, 2.12000, 1.59000, 1.41000, 0.79000, 0.48000, 0.41000, 0.10000, 0.11000, 0.56000, 1.2
          2.66000, 1.70000, 1.48000, 0.88000, 0.38000, 0.23000, 0.15000, 0.27000, 0.55000, 0.96000, 1.5
          0.28000, 0.02000, 0.00000, 0.00000, 0.00000, 0.00000, 0.00000, 0.00000, 0.00000, 0.00000, 0.0
          0.07000, 0.05000, 0.03000, 0.01000, 0.00000, 0.03000, 0.06000, 0.14000, 0.10000, 0.20000, 0.3
          1.52000, 1.15000, 0.94000, 0.77000, 0.92000, 1.03000, 0.57000, 0.38000, 0.31000, 0.44000, 1.1
          2.01000, 1.07000, 0.56000, 0.23000, 0.03000, 0.00000, 0.00000, 0.00000, 0.00000, 0.15000, 0.5
!END!
2 ! SRCNAM = grd00001 !
2 ! IVARY = 3 !
2 ! SO4 = 3.68000, 4.21000, 3.32000, 3.12000, 1.98000, 1.17000, 1.08000, 0.61000, 0.79000, 1.59000, 2.6
           5.25000, 3.35000, 2.92000, 1.76000, 0.77000, 0.44000, 0.24000, 0.40000, 1.01000, 1.72000, 2.
          1.98000, 2.12000, 1.59000, 1.41000, 0.79000, 0.48000, 0.41000, 0.10000, 0.11000, 0.56000, 1.2
          2.66000, 1.70000, 1.48000, 0.88000, 0.38000, 0.23000, 0.15000, 0.27000, 0.55000, 0.96000, 1.5
          0.28000, 0.02000, 0.00000, 0.00000, 0.00000, 0.00000, 0.00000, 0.00000, 0.00000, 0.00000, 0.0
          0.07000, 0.05000, 0.03000, 0.01000, 0.00000, 0.03000, 0.06000, 0.14000, 0.10000, 0.20000, 0.3
          1.52000, 1.15000, 0.94000, 0.77000, 0.92000, 1.03000, 0.57000, 0.38000, 0.31000, 0.44000, 1.1
          2.01000, 1.07000, 0.56000, 0.23000, 0.03000, 0.00000, 0.00000, 0.00000, 0.00000, 0.15000, 0.5
!END!
3 ! SRCNAM = grd00001 !
3 ! IVARY = 3 !
3 ! NOX = 3.68000, 4.21000, 3.32000, 3.12000, 1.98000, 1.17000, 1.08000, 0.61000, 0.79000, 1.59000, 2.6
           5.25000, 3.35000, 2.92000, 1.76000, 0.77000, 0.44000, 0.24000, 0.40000, 1.01000, 1.72000, 2.
          1.98000, 2.12000, 1.59000, 1.41000, 0.79000, 0.48000, 0.41000, 0.10000, 0.11000, 0.56000, 1.2
          2.66000, 1.70000, 1.48000, 0.88000, 0.38000, 0.23000, 0.15000, 0.27000, 0.55000, 0.96000, 1.5
          0.28000, 0.02000, 0.00000, 0.00000, 0.00000, 0.00000, 0.00000, 0.00000, 0.00000, 0.00000, 0.0
          0.07000, 0.05000, 0.03000, 0.01000, 0.00000, 0.03000, 0.06000, 0.14000, 0.10000, 0.20000, 0.3
          1.52000, 1.15000, 0.94000, 0.77000, 0.92000, 1.03000, 0.57000, 0.38000, 0.31000, 0.44000, 1.1
```

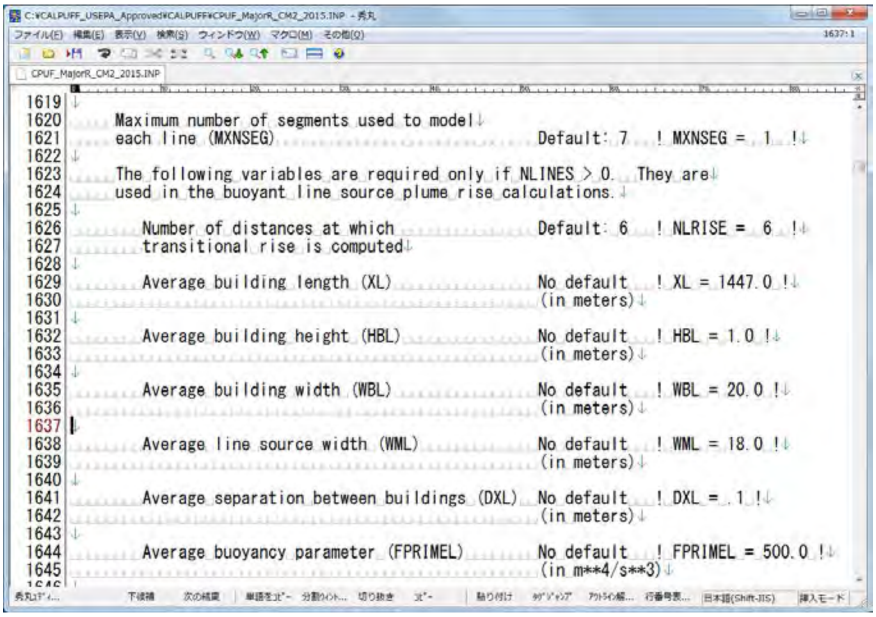
Setting the emission data of line source

Set the number of sources (NLINES), the unit of emission (ILNU), and the number of emission patterns (NSLN1) at “15a”. “NSLN1” is the value by multiplying “NLINES” by “NSE” (number of pollutants).



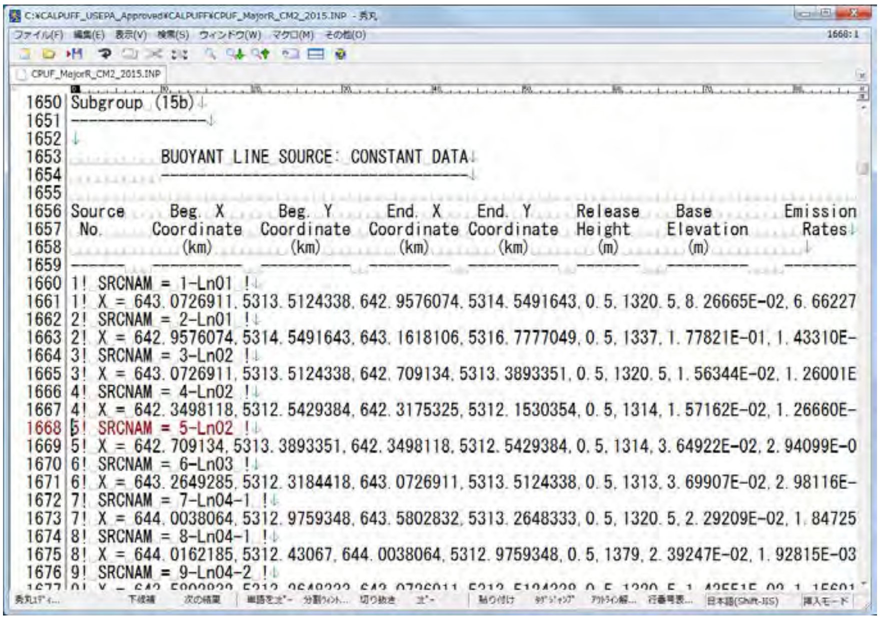
```
INPUT GROUPS: 15a, 15b, 15c -- Line source parameters
---------------------------

---------------
Subgroup (15a)
---------------

     Number of buoyant line sources
     with variable location and emission
     parameters (NLN2)                          No default  !  NLN2 =  0   !

     (If NLN2 > 0, ALL parameter data for
      these sources are read from the file: LNEMARB.DAT)

     Number of buoyant line sources (NLINES)    No default  ! NLINES =  195  !

     Units used for line source
     emissions below               (ILNU)       Default: 1  !  ILNU =   1  !
               1 =        g/s
               2 =       kg/hr
               3 =       lb/hr
               4 =     tons/yr
               5 =     Odour Unit * m**3/s  (vol. flux of odour compound)
               6 =     Odour Unit * m**3/min
               7 =     metric tons/yr

     Number of source-species
     combinations with variable
     emissions scaling factors
     provided below in (15c)       (NSLN1)  Default: 0  !  NSLN1 =  1170  !

     Maximum number of segments used to model
```

Set average building length (XL), average building height (HBL), average building width (WBL), average line source width (WML), average separation between buildings (DXL), and average buoyancy parameter (FPRIMEL).



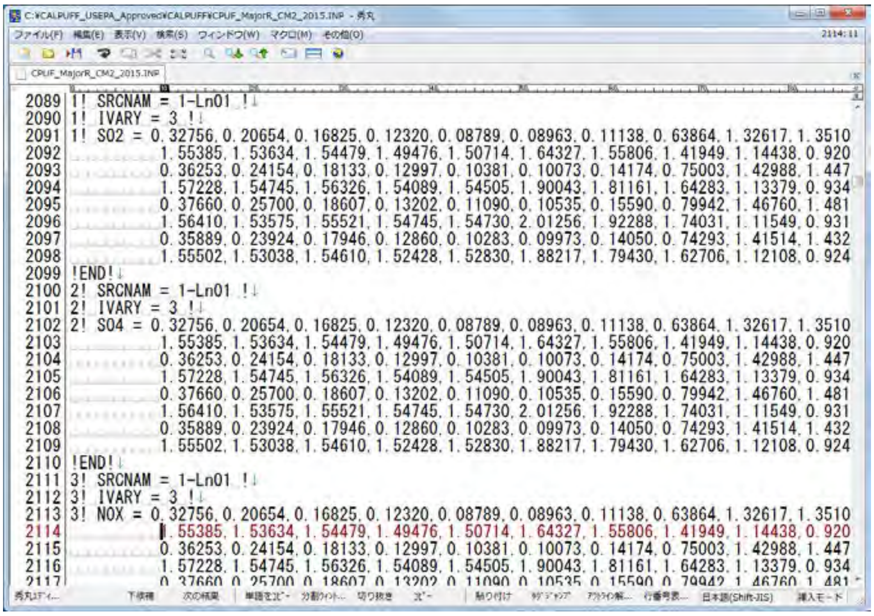
```
     Maximum number of segments used to model
     each line (MXNSEG)                         Default: 7   ! MXNSEG =  1  !

     The following variables are required only if NLINES > 0.  They are
     used in the buoyant line source plume rise calculations.

        Number of distances at which            Default: 6   ! NLRISE =  6  !
        transitional rise is computed

        Average building length (XL)            No default   ! XL = 1447.0 !
                                                (in meters)

        Average building height (HBL)           No default   ! HBL = 1.0 !
                                                (in meters)

        Average building width (WBL)            No default   ! WBL = 20.0 !
                                                (in meters)

        Average line source width (WML)         No default   ! WML = 18.0 !
                                                (in meters)

        Average separation between buildings (DXL)  No default  ! DXL =  1 !
                                                (in meters)

        Average buoyancy parameter (FPRIMEL)    No default   ! FPRIMEL = 500.0 !
                                                (in m**4/s**3)
```

Set source name (SRCNAM), X and Y coordinate of starting and ending point, emission height, elevation, and emission (X) for each source at “15b”.



```
Subgroup (15b)
---------------

          BUOYANT LINE SOURCE: CONSTANT DATA
          ----------------------------------

Source    Beg. X     Beg. Y     End. X     End. Y     Release   Base       Emission
 No.    Coordinate Coordinate Coordinate Coordinate  Height   Elevation    Rates
           (km)       (km)       (km)       (km)       (m)       (m)
------  ---------- ---------- ---------- ----------  -------  ---------   --------
1! SRCNAM = 1-Ln01 !
1! X = 643.0726911, 5313.5124338, 642.9576074, 5314.5491643, 0.5, 1320.5, 8.26665E-02, 6.66227
2! SRCNAM = 2-Ln01 !
2! X = 642.9576074, 5314.5491643, 643.1618106, 5316.7777049, 0.5, 1337, 1.77821E-01, 1.43310E-
3! SRCNAM = 3-Ln02 !
3! X = 643.0726911, 5313.5124338, 642.709134, 5313.3893351, 0.5, 1320.5, 1.56344E-02, 1.26001E
4! SRCNAM = 4-Ln02 !
4! X = 642.3498118, 5312.5429384, 642.3175325, 5312.1530354, 0.5, 1314, 1.57162E-02, 1.26660E-
5! SRCNAM = 5-Ln02 !
5! X = 642.709134, 5313.3893351, 642.3498118, 5312.5429384, 0.5, 1314, 3.64922E-02, 2.94099E-0
6! SRCNAM = 6-Ln03 !
6! X = 643.2649285, 5312.3184418, 643.0726911, 5313.5124338, 0.5, 1313, 3.69907E-02, 2.98116E-
7! SRCNAM = 7-Ln04-1 !
7! X = 644.0038064, 5312.9759348, 643.5802832, 5313.2648333, 0.5, 1320.5, 2.29209E-02, 1.84725
8! SRCNAM = 8-Ln04-1 !
8! X = 644.0162185, 5312.43067, 644.0038064, 5312.9759348, 0.5, 1379, 2.39247E-02, 1.92815E-03
9! SRCNAM = 9-Ln04-2 !
```

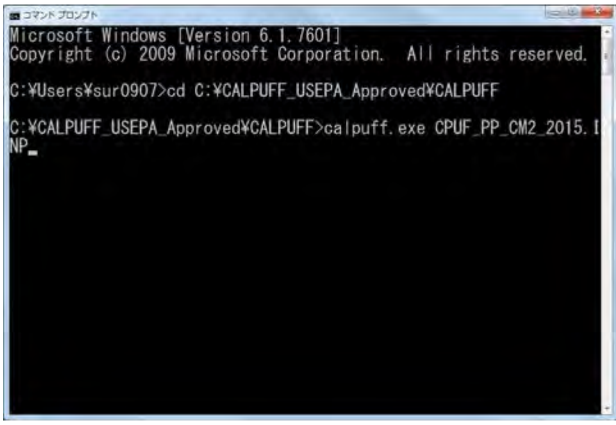
Set source name (SRCNAM), emission pattern type (IVARY) and emission pattern by substance for each source at “15c”. For “IVARY”, you can set "1" (for each time), "2" (for each month), "3" (for each season and time), etc. If not set “IVARY”, emission pattern is regarded as constant.

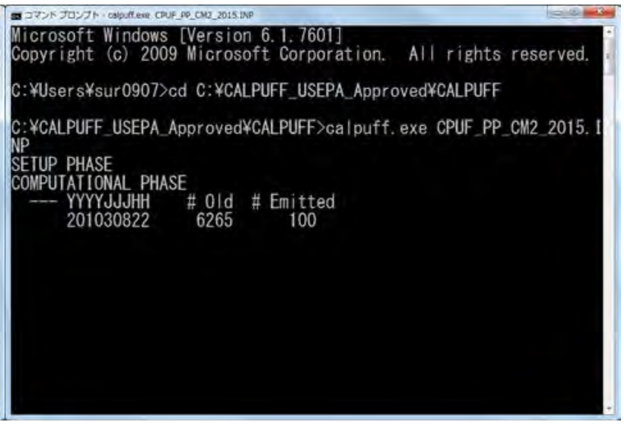


```
1! SRCNAM = 1-Ln01 !
1! IVARY = 3 !
1! SO2 = 0.32756, 0.20654, 0.16825, 0.12320, 0.08789, 0.08963, 0.11138, 0.63864, 1.32617, 1.3510
         1.55385, 1.53634, 1.54479, 1.49476, 1.50714, 1.64327, 1.55806, 1.41949, 1.14438, 0.920
         0.36253, 0.24154, 0.18133, 0.12997, 0.10381, 0.10073, 0.14174, 0.75003, 1.42988, 1.447
         1.57228, 1.54745, 1.56326, 1.54089, 1.54505, 1.90043, 1.81161, 1.64283, 1.13379, 0.934
         0.37660, 0.25700, 0.18607, 0.13202, 0.11090, 0.10535, 0.15590, 0.79942, 1.46760, 1.481
         1.56410, 1.53575, 1.55521, 1.54745, 1.54730, 2.01256, 1.92288, 1.74031, 1.11549, 0.931
         0.35889, 0.23924, 0.17946, 0.12860, 0.10283, 0.09973, 0.14050, 0.74293, 1.41514, 1.432
         1.55502, 1.53038, 1.54610, 1.52428, 1.52830, 1.88217, 1.79430, 1.62706, 1.12108, 0.924
!END!
2! SRCNAM = 1-Ln01 !
2! IVARY = 3 !
2! SO4 = 0.32756, 0.20654, 0.16825, 0.12320, 0.08789, 0.08963, 0.11138, 0.63864, 1.32617, 1.3510
         1.55385, 1.53634, 1.54479, 1.49476, 1.50714, 1.64327, 1.55806, 1.41949, 1.14438, 0.920
         0.36253, 0.24154, 0.18133, 0.12997, 0.10381, 0.10073, 0.14174, 0.75003, 1.42988, 1.447
         1.57228, 1.54745, 1.56326, 1.54089, 1.54505, 1.90043, 1.81161, 1.64283, 1.13379, 0.934
         0.37660, 0.25700, 0.18607, 0.13202, 0.11090, 0.10535, 0.15590, 0.79942, 1.46760, 1.481
         1.56410, 1.53575, 1.55521, 1.54745, 1.54730, 2.01256, 1.92288, 1.74031, 1.11549, 0.931
         0.35889, 0.23924, 0.17946, 0.12860, 0.10283, 0.09973, 0.14050, 0.74293, 1.41514, 1.432
         1.55502, 1.53038, 1.54610, 1.52428, 1.52830, 1.88217, 1.79430, 1.62706, 1.12108, 0.924
!END!
3! SRCNAM = 1-Ln01 !
3! IVARY = 3 !
3! NOX = 0.32756, 0.20654, 0.16825, 0.12320, 0.08789, 0.08963, 0.11138, 0.63864, 1.32617, 1.3510
         1.55385, 1.53634, 1.54479, 1.49476, 1.50714, 1.64327, 1.55806, 1.41949, 1.14438, 0.920
         0.36253, 0.24154, 0.18133, 0.12997, 0.10381, 0.10073, 0.14174, 0.75003, 1.42988, 1.447
         1.57228, 1.54745, 1.56326, 1.54089, 1.54505, 1.90043, 1.81161, 1.64283, 1.13379, 0.934
```

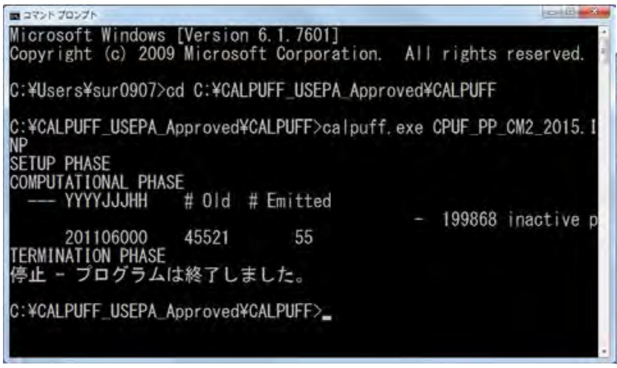
Set number of calculation point other than grid (NREC), and X coordinate, Y coordinate, elevation, and height above ground (X) for calculation point as necessary. Example of calculation point is ambient monitoring station.

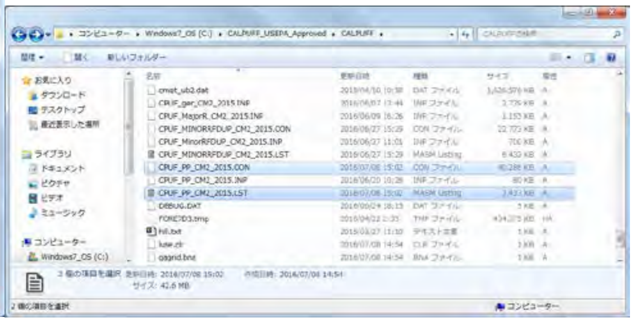
Move the “CALPUFF” folder in command prompt, input “calpuff.exe <input file name>.INP”, and press [Enter] (Here it is “CPUF_PP_CM2_2015.INP”). After starting the calculation, you can check this running progress.





When showing “TERMINATION PHASE” message and completing calculation, you check to make output files. Output file is ” CPUF_PP_CM2_2015_CON” in this case.





6.2 Output of Calculation Result

6.2.1 Outline

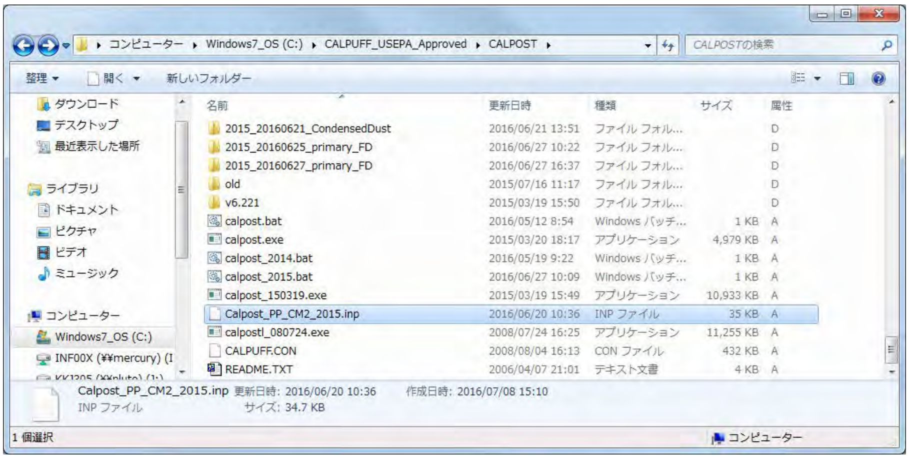
Since the calculation result of CALPUFF is compressed data, it cannot be opened with a text editor such as Notepad. Therefore, extract the calculated concentration for each grid or each specified point from the compressed data using the CALPOST processor.

In CALPOST, set the input file, output file, calculation term, output target substance, output range, calculation result the period (1 hour average, daily average, annual average, etc.).

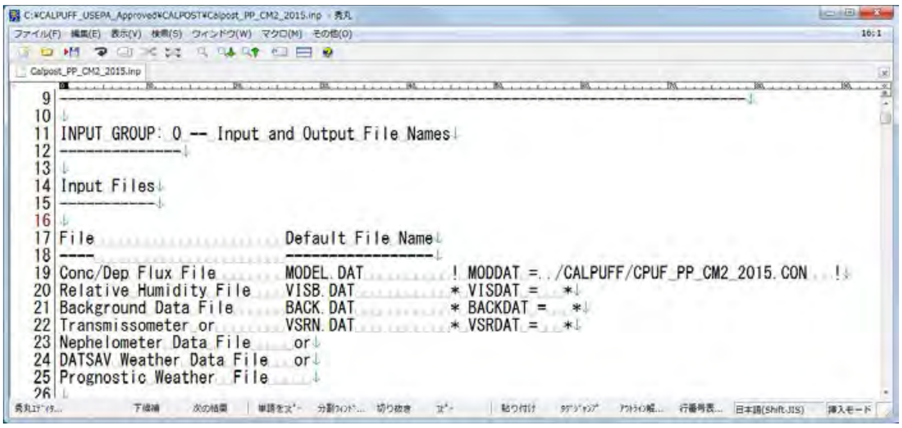
CALPUFF calculation is conducted with NOx, but the substance of environmental standard is NO2. Therefore, set the equation to convert NOx to NO2. The conversion formula in CALPOST is [NO2] = a[NOx] and value of "a" is specified as 0.75 according to the standard for environmental impact assessment in China[10], but it is necessary to consider to set this value matching to the current situation of Mongolia.

6.2.2 Conducting Method

Open INP file in "CALPOST" folder.

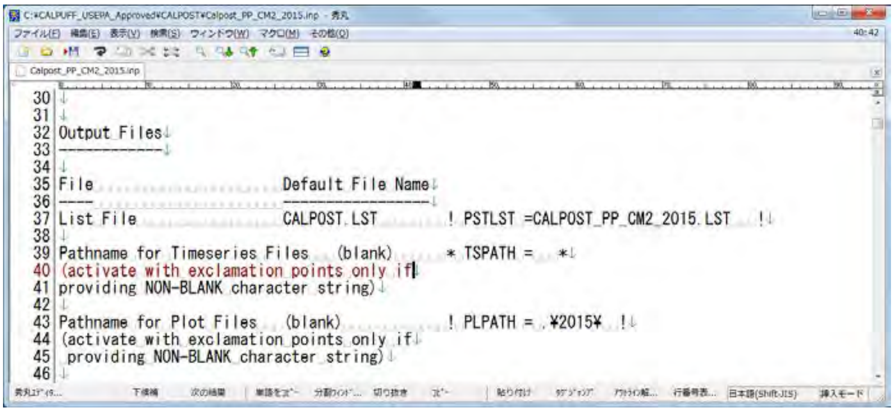


Set the result file calculated by CALPUFF as input file (MODDAT).

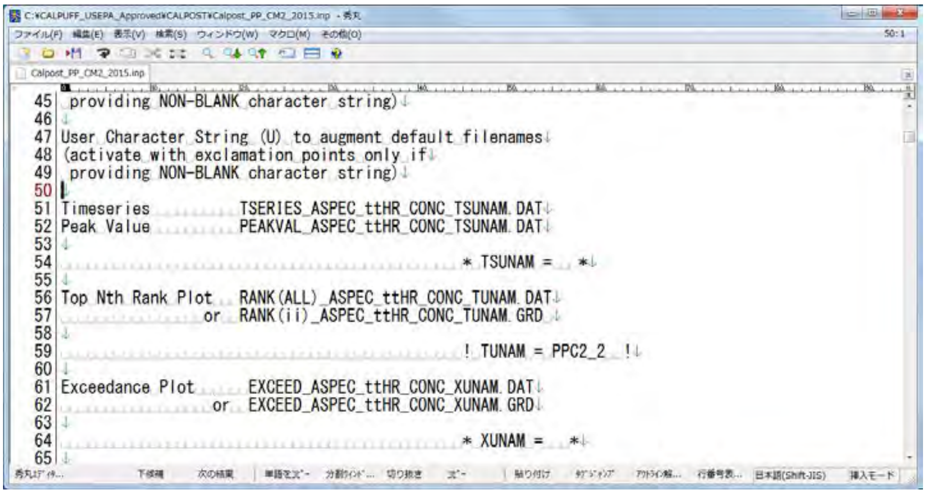


[10] Guidelines for environmental impact assessment Atmospheric environment (in Chinese) (HJ2.2-2008)

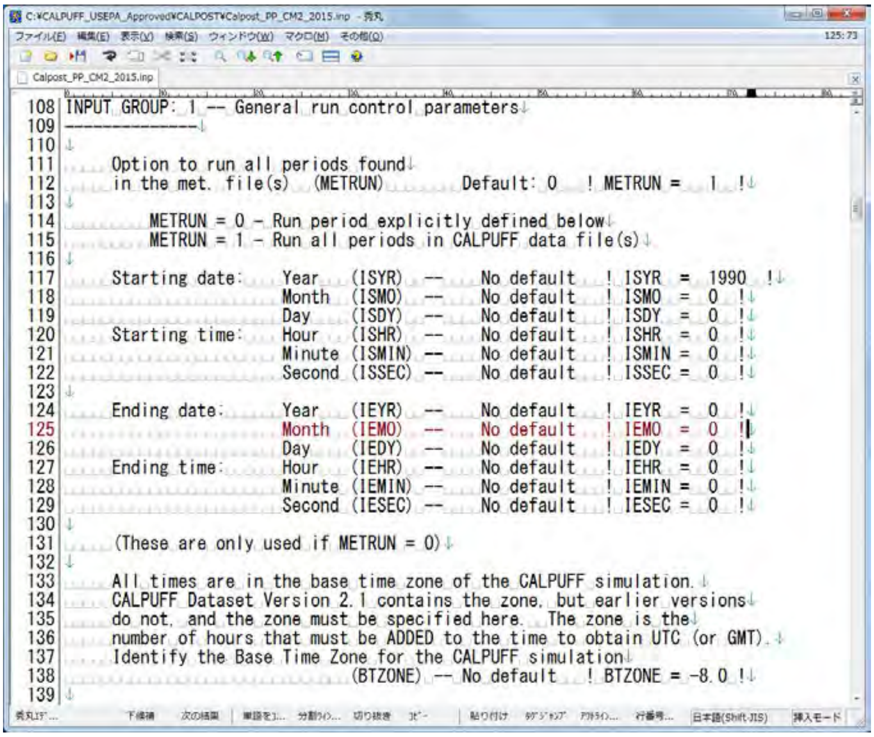
Set output file name (PSTLST), and the destination folder of output result file (PLPATH).



Set the part of output file (TUNAM).

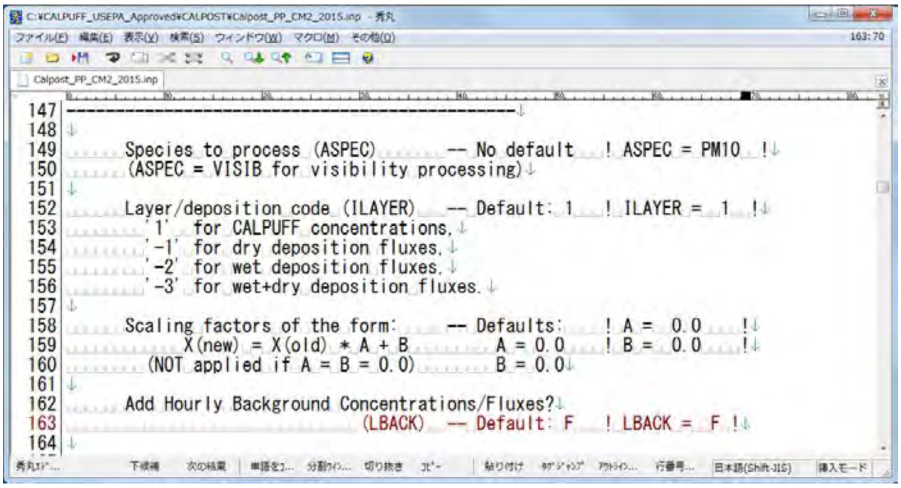


Set target calculation term (METRUN). When setting “0”, you have to set the calculation starting date and time (ISYR, ISMO, ISDY, ISHR, ISMIN, and ISSEC) and calculation ending date and time (IEYR, IEMO, IEDY, IEHR, IEMIN, and IESEC). When setting “1”, the calculated term by CALPUFF is target calculation term. In addition, set time zone (BTZONE).

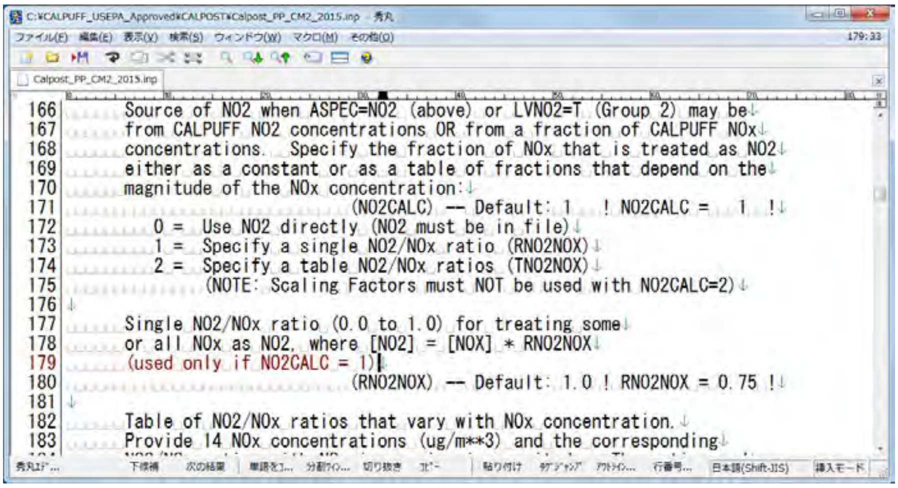


```
INPUT GROUP: 1 -- General run control parameters
--------------

     Option to run all periods found
     in the met. file(s)   (METRUN)        Default: 0    ! METRUN =   1  !

          METRUN = 0 - Run period explicitly defined below
          METRUN = 1 - Run all periods in CALPUFF data file(s)

     Starting date:    Year   (ISYR)  --    No default   ! ISYR  =  1990  !
                       Month  (ISMO)  --    No default   ! ISMO  =  0  !
                       Day    (ISDY)  --    No default   ! ISDY  =  0  !
     Starting time:    Hour   (ISHR)  --    No default   ! ISHR  =  0  !
                       Minute (ISMIN) --    No default   ! ISMIN =  0  !
                       Second (ISSEC) --    No default   ! ISSEC =  0  !

     Ending date:      Year   (IEYR)  --    No default   ! IEYR  =  0  !
                       Month  (IEMO)  --    No default   ! IEMO  =  0  !
                       Day    (IEDY)  --    No default   ! IEDY  =  0  !
     Ending time:      Hour   (IEHR)  --    No default   ! IEHR  =  0  !
                       Minute (IEMIN) --    No default   ! IEMIN =  0  !
                       Second (IESEC) --    No default   ! IESEC =  0  !

     (These are only used if METRUN = 0)

     All times are in the base time zone of the CALPUFF simulation.
     CALPUFF Dataset Version 2.1 contains the zone, but earlier versions
     do not, and the zone must be specified here.  The zone is the
     number of hours that must be ADDED to the time to obtain UTC (or GMT).
     Identify the Base Time Zone for the CALPUFF simulation
                              (BTZONE) -- No default   ! BTZONE = -8.0 !
```

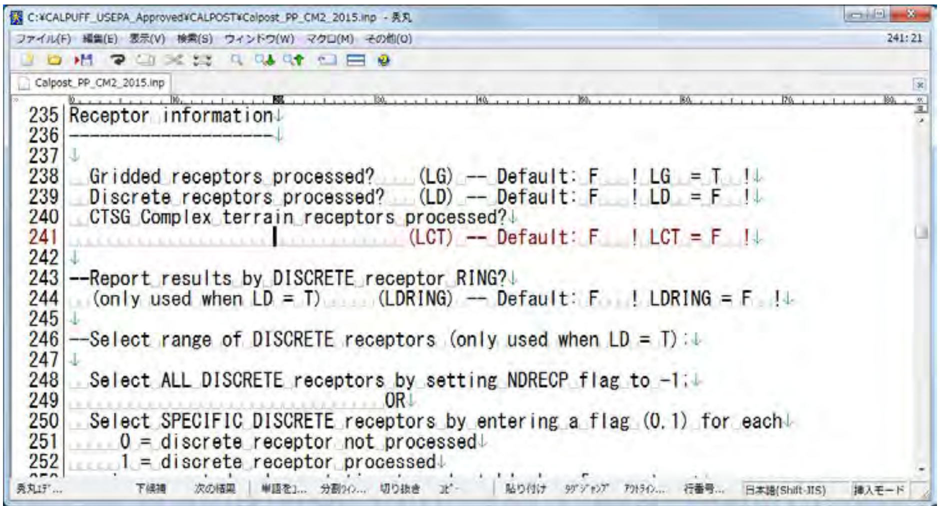
Set outputted target species (ASPEC). When setting “NO2” as outputted target species, set the ratio for converting from NOx to NO2 (RNO2NOX). The value in “Guidelines for environmental impact assessment Atmospheric environment” in China is “RNO2NOX” = 0.75.

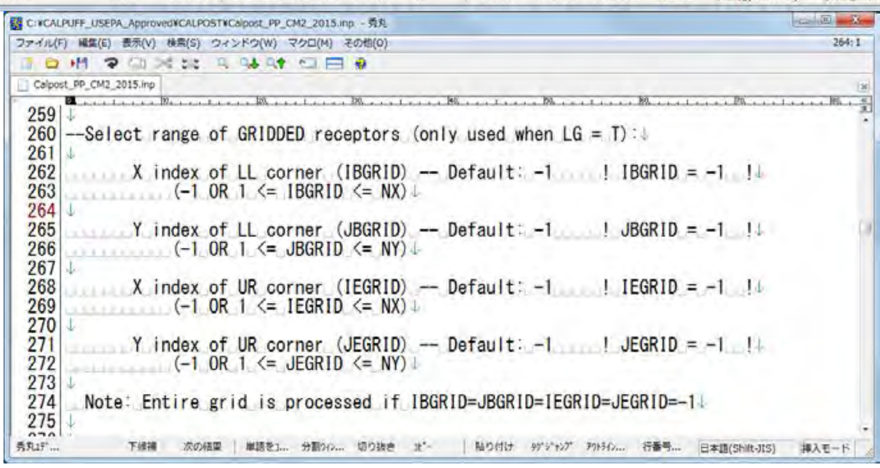


```
-----------------------------------------------

     Species to process (ASPEC)        -- No default    ! ASPEC = PM10  !
     (ASPEC = VISIB for visibility processing)

     Layer/deposition code (ILAYER)    -- Default: 1    ! ILAYER =  1  !
          '1'  for CALPUFF concentrations,
          '-1'  for dry deposition fluxes,
          '-2'  for wet deposition fluxes,
          '-3'  for wet+dry deposition fluxes.

     Scaling factors of the form:      -- Defaults:     ! A =  0.0    !
               X(new) = X(old) * A + B          A = 0.0    ! B =  0.0    !
          (NOT applied if A = B = 0.0)          B = 0.0

     Add Hourly Background Concentrations/Fluxes?
                                  (LBACK)  -- Default: F    ! LBACK =  F  !
```

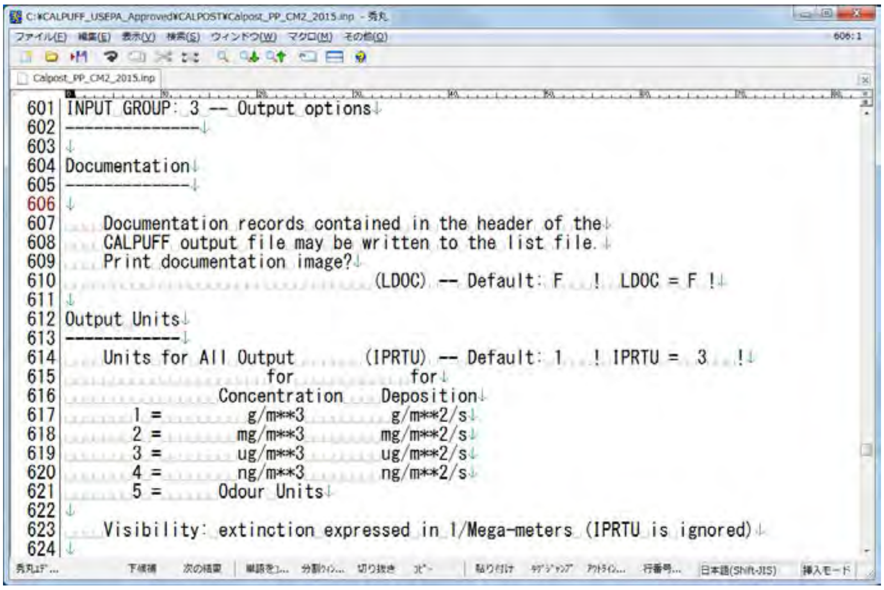


Set the target calculation result for output. When outputting the calculation result of each grid, set “LG=T” and set the target output range of calculation result with grid number (IBGRID, JBGRID, IEGRID, and JEGRID). On the other hand, when outputting the calculation result of each point specified in CALPUFF, set “LD=T”



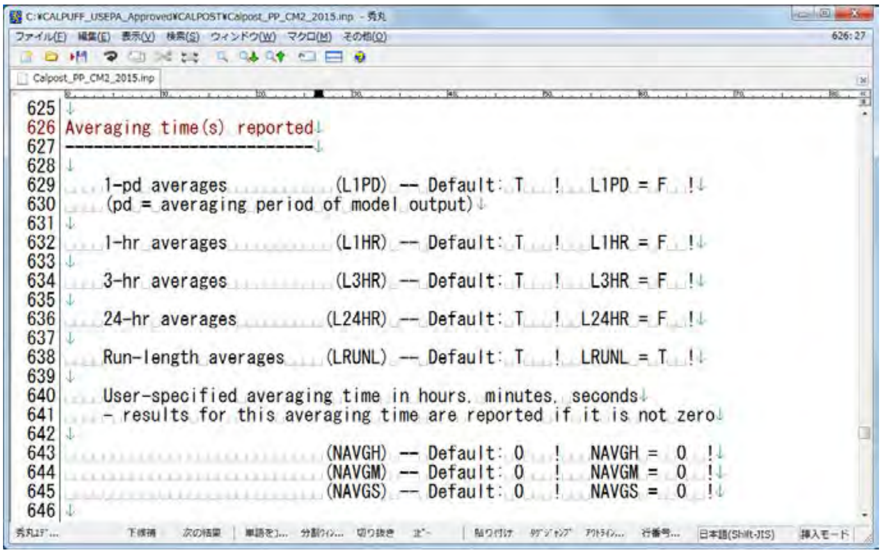


Set the unit of output concentration (IPRTU).



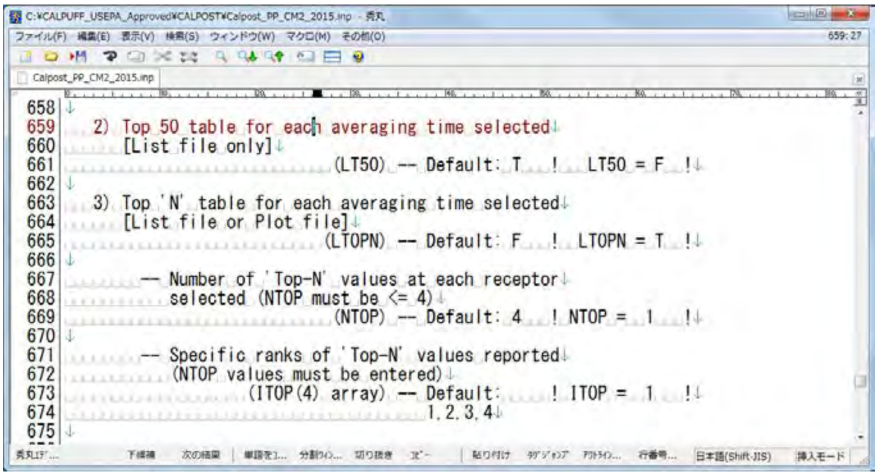
```
INPUT GROUP: 3 -- Output options
--------------

Documentation
-------------

    Documentation records contained in the header of the
    CALPUFF output file may be written to the list file.
    Print documentation image?
                                  (LDOC) -- Default: F   !  LDOC = F !

Output Units
------------
    Units for All Output       (IPRTU) -- Default: 1   ! IPRTU =  3   !
                       for              for
                 Concentration     Deposition
           1 =          g/m**3         g/m**2/s
           2 =         mg/m**3        mg/m**2/s
           3 =         ug/m**3        ug/m**2/s
           4 =         ng/m**3        ng/m**2/s
           5 =      Odour Units

    Visibility: extinction expressed in 1/Mega-meters (IPRTU is ignored)
```

Set the flag to calculate one hour averages (L1HR), three hours averages (L3HR), 24 hours averages (L24HR), and run-length averages (LRUNL). Set the selecting averaged term to “T” and set the others to “F”.

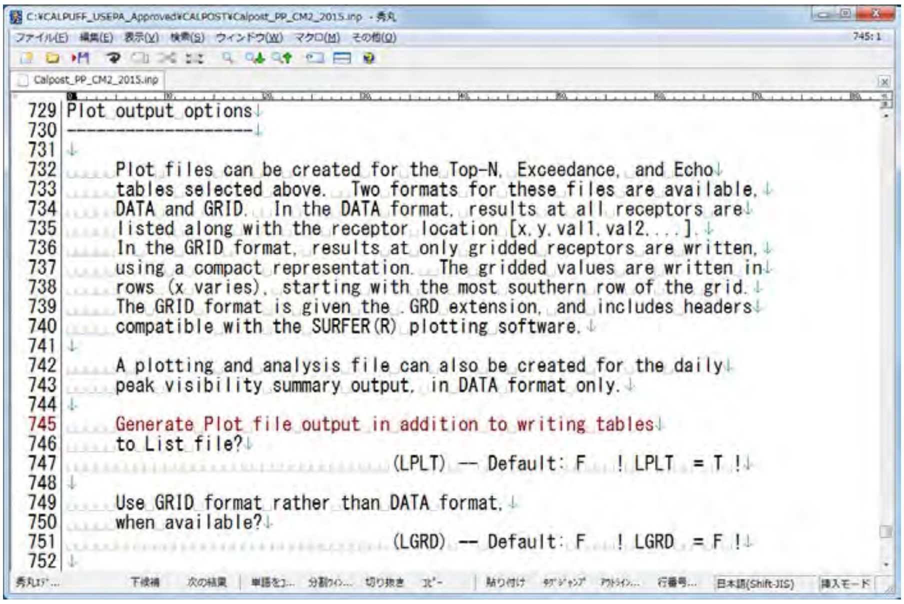


```
Averaging time(s) reported
--------------------------

    1-pd averages             (L1PD) -- Default: T   !   L1PD = F  !
    (pd = averaging period of model output)

    1-hr averages             (L1HR) -- Default: T   !   L1HR = F  !

    3-hr averages             (L3HR) -- Default: T   !   L3HR = F  !

    24-hr averages           (L24HR) -- Default: T   !  L24HR = F  !

    Run-length averages      (LRUNL) -- Default: T   !  LRUNL = T  !

    User-specified averaging time in hours, minutes, seconds
    - results for this averaging time are reported if it is not zero

                             (NAVGH) -- Default: 0   !  NAVGH =  0  !
                             (NAVGM) -- Default: 0   !  NAVGM =  0  !
                             (NAVGS) -- Default: 0   !  NAVGS =  0  !
```

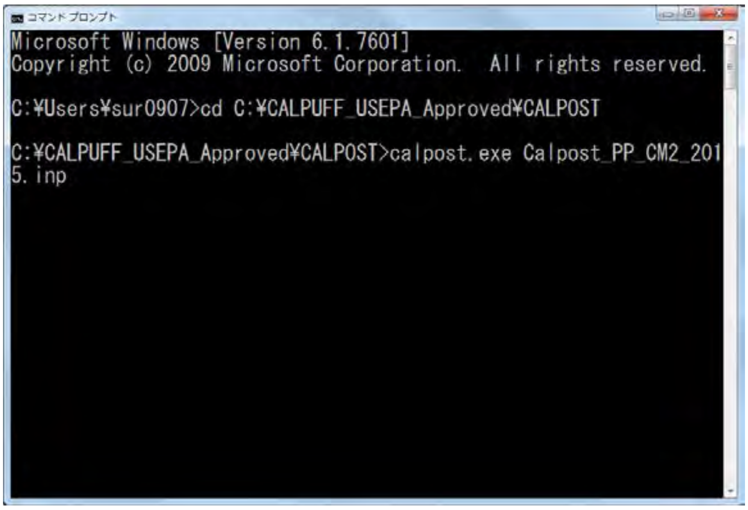
Set to output the concentration from top to Nth place among the concentration for each point.



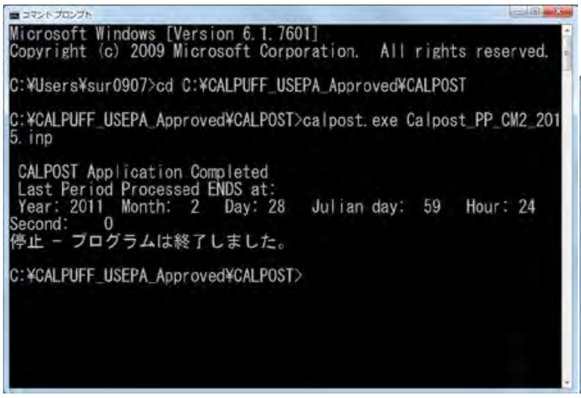
Set the format of output. Set either list format (LPLT) or grid format (LGRD) to "T".

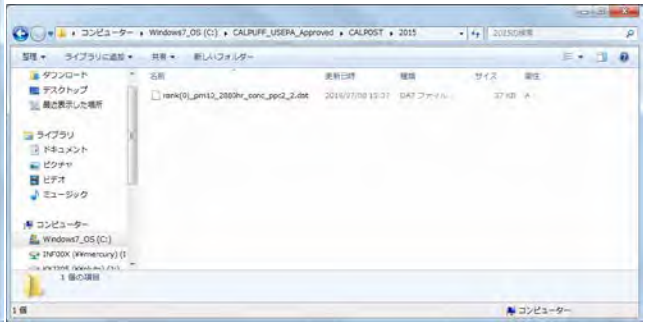


Move the “CALPOST” folder in command prompt, input “calpost.exe <input file name>.INP”, and press [Enter] (Here it is “Calpost_PP_CM2_2015.INP”).

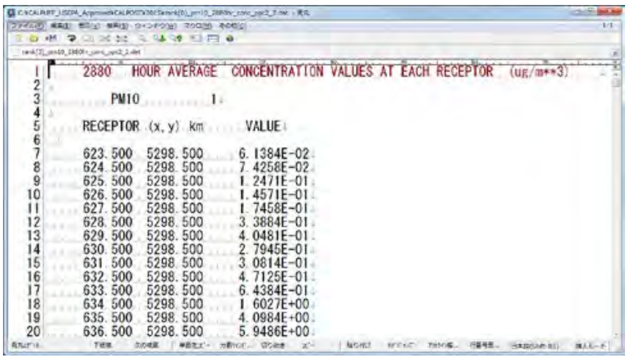


When showing “Stop – Program terminated” message and completing calculation, you check to make output files. Output file is ”rank(0)_pm10_2880hr_conc_ppc2_2.dat” in this case.





When opening the output file, the following figure is displayed. X coordinate, Y coordinate, and concentration by calculation point is outputted.



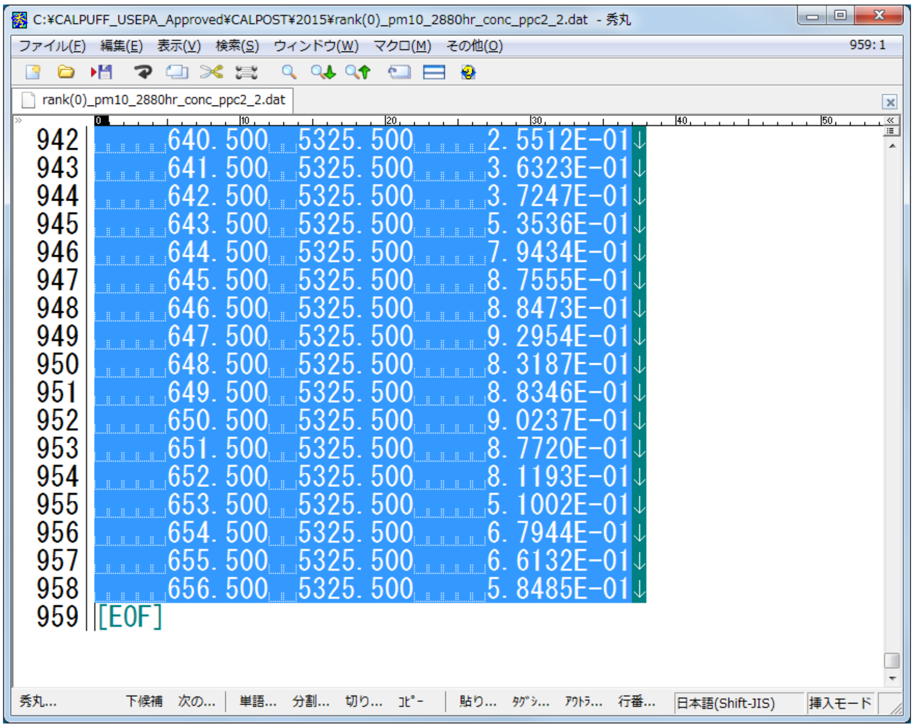
6.3 Organizing Calculation Result

6.3.1 Outline

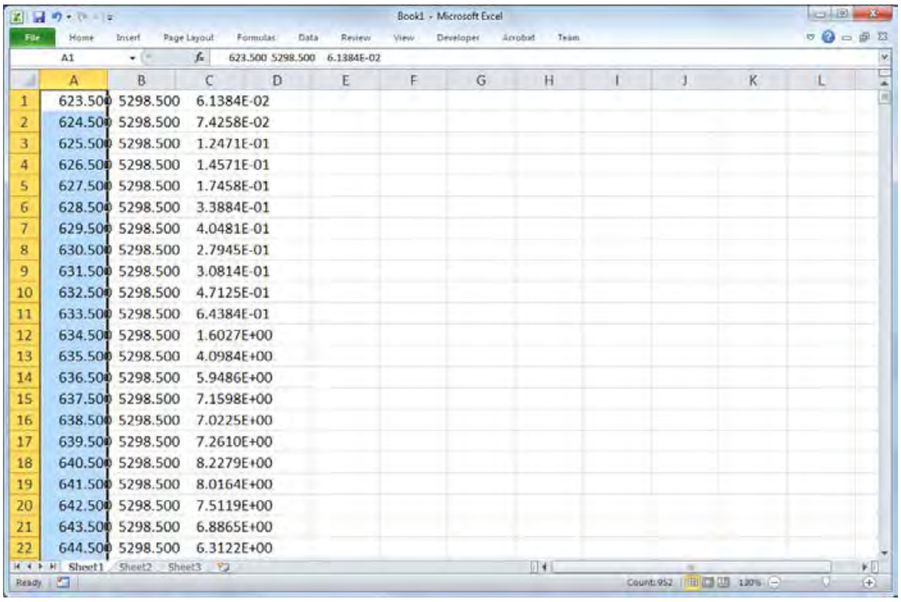
The results calculated for each source type output in 6.2 are summarized in the table below and the total concentration for each grid is calculated. For this tabulation, Excel or Access is used. The result of this tabulation is used to confirm the accuracy of the model, to create a concentration distribution chart, etc. and to evaluate the emission reduction plan.

6.3.2 Conducting Method

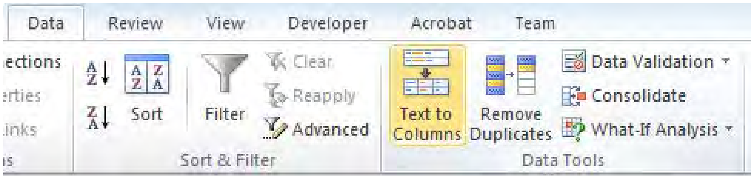
Open the calculation result file of concentration by grid outputted by CALPOST and copy the relevant range.



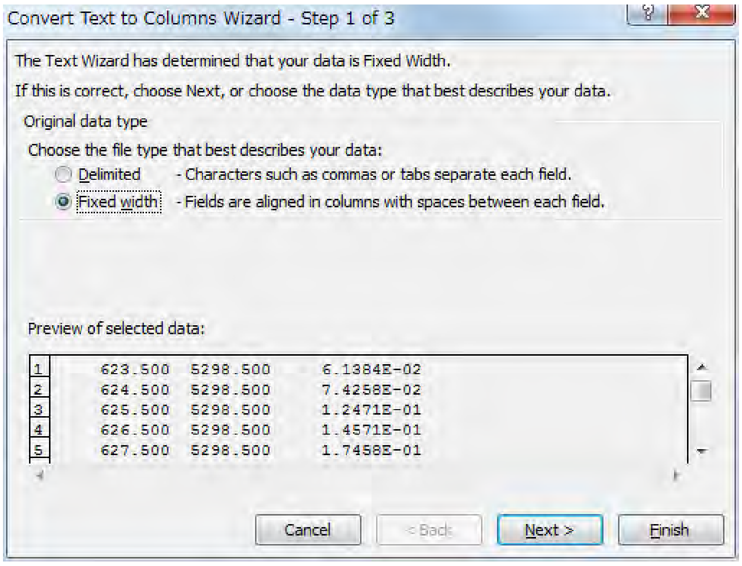
Open excel file and paste the copied data.



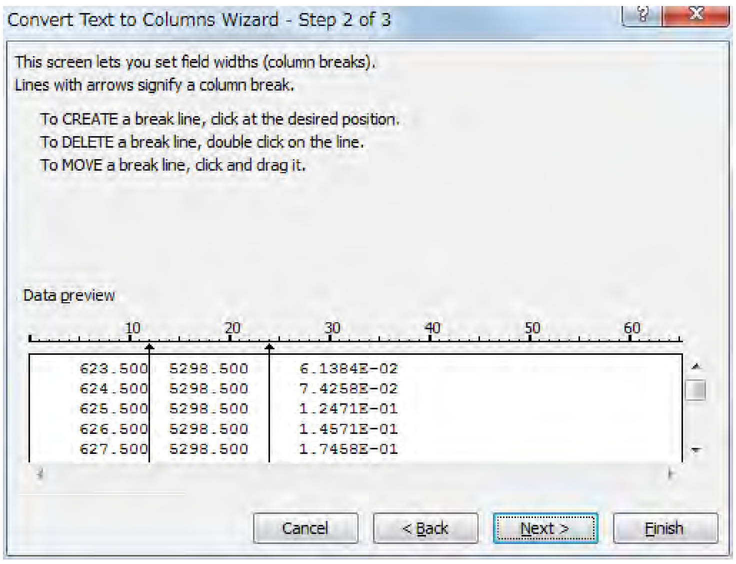
Select the pasted column and click [Data]-[Text to Columns].



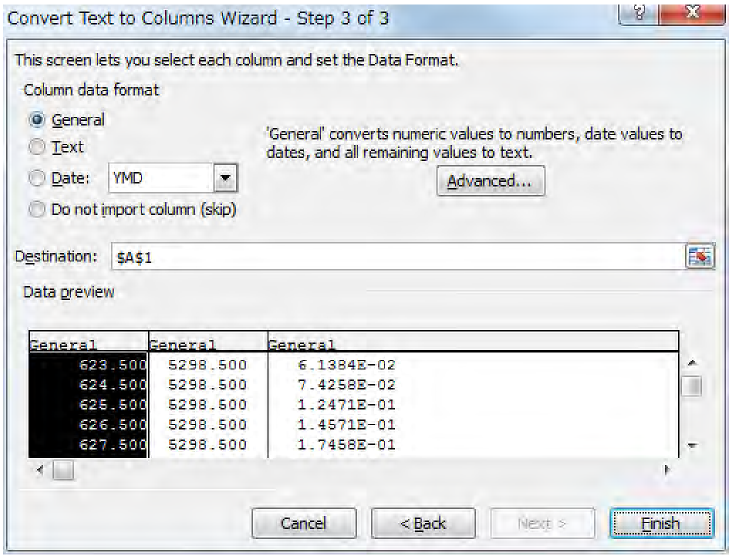
Select [Fixed width – Fields are aligned in columns with spaces between each field] in [Original data type] and click [Next].



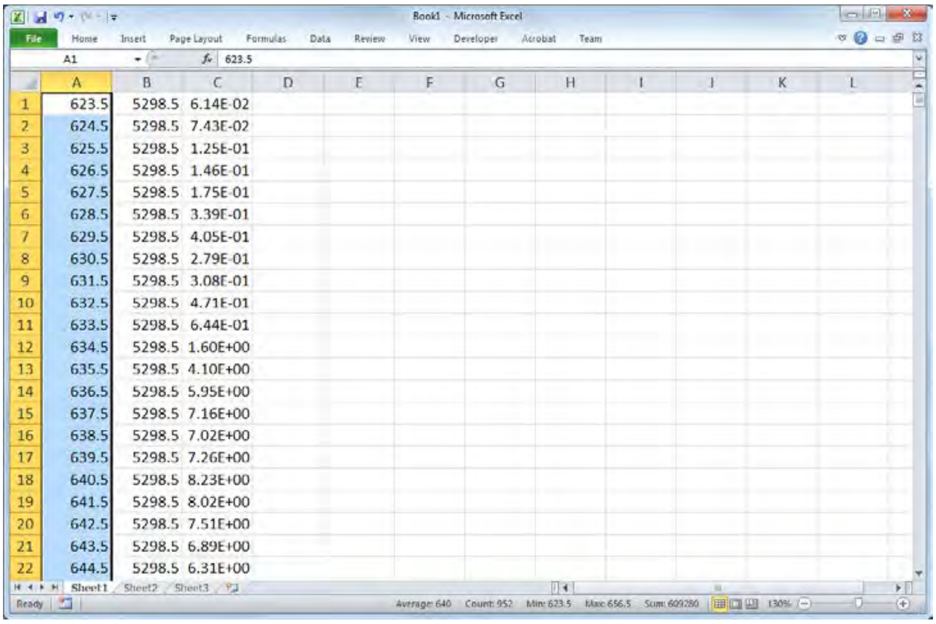
Check whether the black arrow line crosses the numerical value in the preview of the data. If it crosses, move and adjust the arrow with dragging. When adjustment is completed, click [Next].



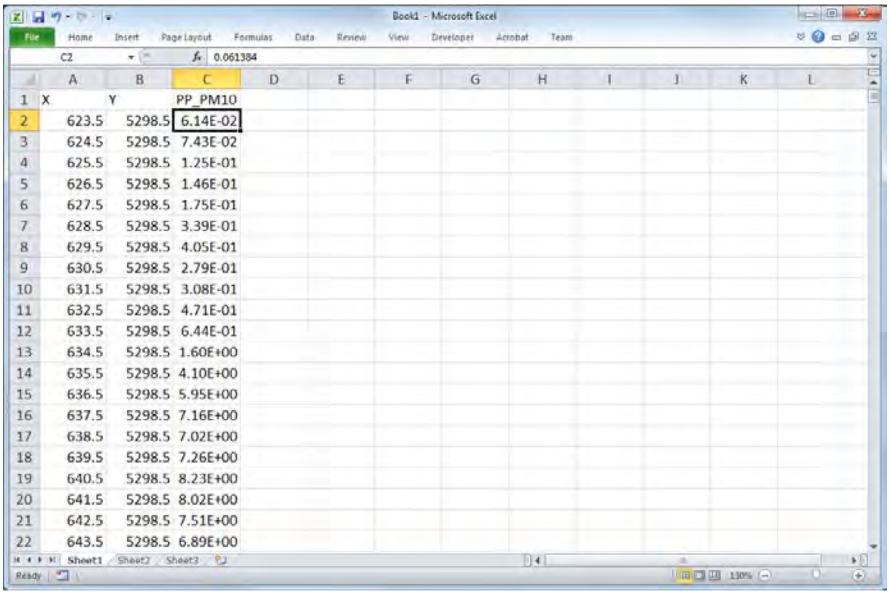
Click [Finish]



Data is divided into each column according to delimiter position.

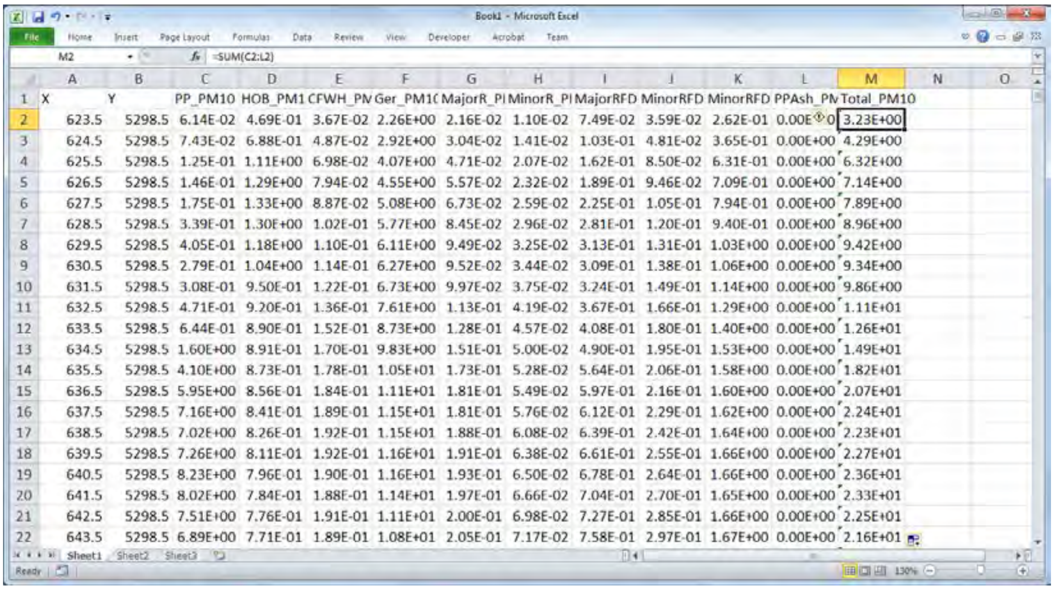


Insert one row at the first row and input column name to each column



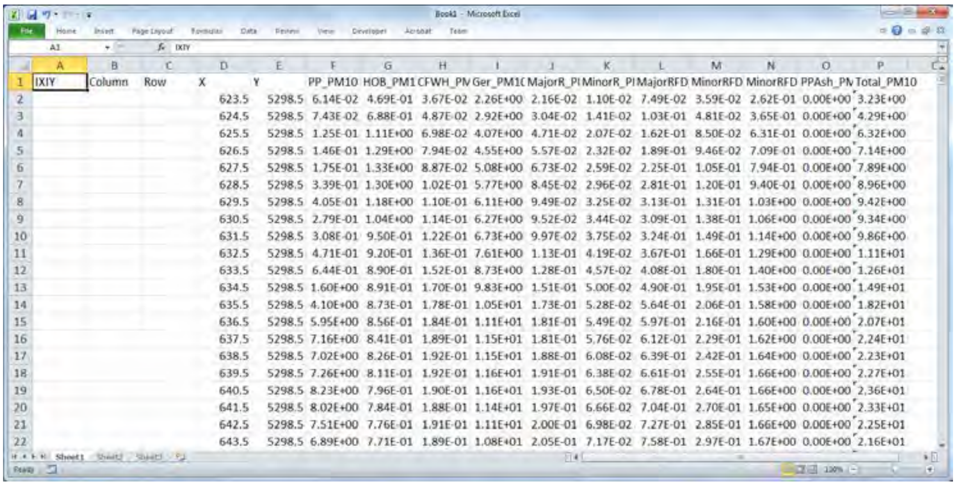
	A	B	C
1	X	Y	PP_PM10
2	623.5	5298.5	6.14E-02
3	624.5	5298.5	7.43E-02
4	625.5	5298.5	1.25E-01
5	626.5	5298.5	1.46E-01
6	627.5	5298.5	1.75E-01
7	628.5	5298.5	3.39E-01
8	629.5	5298.5	4.05E-01
9	630.5	5298.5	2.79E-01
10	631.5	5298.5	3.08E-01
11	632.5	5298.5	4.71E-01
12	633.5	5298.5	6.44E-01
13	634.5	5298.5	1.60E+00
14	635.5	5298.5	4.10E+00
15	636.5	5298.5	5.95E+00
16	637.5	5298.5	7.16E+00
17	638.5	5298.5	7.02E+00
18	639.5	5298.5	7.26E+00
19	640.5	5298.5	8.23E+00
20	641.5	5298.5	8.02E+00
21	642.5	5298.5	7.51E+00
22	643.5	5298.5	6.89E+00

For other sources as well, paste the calculation results to Excel file and calculate the total emissions by grid in the rightmost column.



	A	B	C	D	E	F	G	H	I	J	K	L	M
1	X	Y	PP_PM10	HOB_PM1	CFWH_PN	Ger_PM1(	MajorR_PI	MinorR_PI	MajorRFD	MinorRFD	MinorRFD	PPAsh_PN	Total_PM10
2	623.5	5298.5	6.14E-02	4.69E-01	3.67E-02	2.26E+00	2.16E-02	1.10E-02	7.49E-02	3.59E-02	2.62E-01	0.00E+00	3.23E+00
3	624.5	5298.5	7.43E-02	6.88E-01	4.87E-02	2.92E+00	3.04E-02	1.41E-02	1.03E-01	4.81E-02	3.65E-01	0.00E+00	4.29E+00
4	625.5	5298.5	1.25E-01	1.11E+00	6.98E-02	4.07E+00	4.71E-02	2.07E-02	1.62E-01	8.50E-02	6.31E-01	0.00E+00	6.32E+00
5	626.5	5298.5	1.46E-01	1.29E+00	7.94E-02	4.55E+00	5.57E-02	2.32E-02	1.89E-01	9.46E-02	7.09E-01	0.00E+00	7.14E+00
6	627.5	5298.5	1.75E-01	1.33E+00	8.87E-02	5.08E+00	6.73E-02	2.59E-02	2.25E-01	1.05E-01	7.94E-01	0.00E+00	7.89E+00
7	628.5	5298.5	3.39E-01	1.30E+00	1.02E-01	5.77E+00	8.45E-02	2.96E-02	2.81E-01	1.20E-01	9.40E-01	0.00E+00	8.96E+00
8	629.5	5298.5	4.05E-01	1.18E+00	1.10E-01	6.11E+00	9.49E-02	3.25E-02	3.13E-01	1.31E-01	1.03E+00	0.00E+00	9.42E+00
9	630.5	5298.5	2.79E-01	1.04E+00	1.14E-01	6.27E+00	9.52E-02	3.44E-02	3.09E-01	1.38E-01	1.06E+00	0.00E+00	9.34E+00
10	631.5	5298.5	3.08E-01	9.50E-01	1.22E-01	6.73E+00	9.97E-02	3.75E-02	3.24E-01	1.49E-01	1.14E+00	0.00E+00	9.86E+00
11	632.5	5298.5	4.71E-01	9.20E-01	1.36E-01	7.61E+00	1.13E-01	4.19E-02	3.67E-01	1.66E-01	1.29E+00	0.00E+00	1.11E+01
12	633.5	5298.5	6.44E-01	8.90E-01	1.52E-01	8.73E+00	1.28E-01	4.57E-02	4.08E-01	1.80E-01	1.40E+00	0.00E+00	1.26E+01
13	634.5	5298.5	1.60E+00	8.91E-01	1.70E-01	9.83E+00	1.51E-01	5.00E-02	4.90E-01	1.95E-01	1.53E+00	0.00E+00	1.49E+01
14	635.5	5298.5	4.10E+00	8.73E-01	1.78E-01	1.05E+01	1.73E-01	5.28E-02	5.64E-01	2.06E-01	1.58E+00	0.00E+00	1.82E+01
15	636.5	5298.5	5.95E+00	8.56E-01	1.84E-01	1.11E+01	1.81E-01	5.49E-02	5.97E-01	2.16E-01	1.60E+00	0.00E+00	2.07E+01
16	637.5	5298.5	7.16E+00	8.41E-01	1.89E-01	1.15E+01	1.81E-01	5.76E-02	6.12E-01	2.29E-01	1.62E+00	0.00E+00	2.24E+01
17	638.5	5298.5	7.02E+00	8.26E-01	1.92E-01	1.15E+01	1.88E-01	6.08E-02	6.39E-01	2.42E-01	1.64E+00	0.00E+00	2.23E+01
18	639.5	5298.5	7.26E+00	8.11E-01	1.92E-01	1.16E+01	1.91E-01	6.38E-02	6.61E-01	2.55E-01	1.66E+00	0.00E+00	2.27E+01
19	640.5	5298.5	8.23E+00	7.96E-01	1.90E-01	1.16E+01	1.93E-01	6.50E-02	6.78E-01	2.64E-01	1.66E+00	0.00E+00	2.36E+01
20	641.5	5298.5	8.02E+00	7.84E-01	1.88E-01	1.14E+01	1.97E-01	6.66E-02	7.04E-01	2.70E-01	1.65E+00	0.00E+00	2.33E+01
21	642.5	5298.5	7.51E+00	7.76E-01	1.91E-01	1.11E+01	2.00E-01	6.98E-02	7.27E-01	2.85E-01	1.66E+00	0.00E+00	2.25E+01
22	643.5	5298.5	6.89E+00	7.71E-01	1.89E-01	1.08E+01	2.05E-01	7.17E-02	7.58E-01	2.97E-01	1.67E+00	0.00E+00	2.16E+01

Insert three columns at the first column and name each column as “IXIY”, “Column”, and “Row” in order from the left.



	IXIY	Column	Row	X	Y	PP_PM10	HOB_PM1	CFWH_PN	Ger_PM1(	MajorR_PI	MinorR_PI	MajorRFD	MinorRFD	MinorRFD	PPAsh_PN	Total_PM10
2				623.5	5298.5	6.14E-02	4.69E-01	3.67E-02	2.26E+00	2.16E-02	1.10E-02	7.49E-02	3.59E-02	2.62E-01	0.00E+00	3.23E+00
3				624.5	5298.5	7.43E-02	6.88E-01	4.87E-02	2.92E+00	3.04E-02	1.41E-02	1.03E-01	4.81E-02	3.65E-01	0.00E+00	4.29E+00
4				625.5	5298.5	1.25E-01	1.11E+00	6.98E-02	4.07E+00	4.71E-02	2.07E-02	1.62E-01	8.50E-02	6.31E-01	0.00E+00	6.32E+00
5				626.5	5298.5	1.46E-01	1.29E+00	7.94E-02	4.55E+00	5.57E-02	2.32E-02	1.89E-01	9.46E-02	7.09E-01	0.00E+00	7.14E+00
6				627.5	5298.5	1.75E-01	1.33E+00	8.87E-02	5.08E+00	6.73E-02	2.59E-02	2.25E-01	1.05E-01	7.94E-01	0.00E+00	7.89E+00
7				628.5	5298.5	3.39E-01	1.30E+00	1.02E-01	5.77E+00	8.45E-02	2.96E-02	2.81E-01	1.20E-01	9.40E-01	0.00E+00	8.96E+00
8				629.5	5298.5	4.05E-01	1.18E+00	1.10E-01	6.11E+00	9.49E-02	3.25E-02	3.13E-01	1.31E-01	1.03E+00	0.00E+00	9.42E+00
9				630.5	5298.5	2.79E-01	1.04E+00	1.14E-01	6.27E+00	9.52E-02	3.44E-02	3.09E-01	1.38E-01	1.06E+00	0.00E+00	9.34E+00
10				631.5	5298.5	3.08E-01	9.50E-01	1.22E-01	6.73E+00	9.97E-02	3.75E-02	3.24E-01	1.49E-01	1.14E+00	0.00E+00	9.86E+00
11				632.5	5298.5	4.71E-01	9.20E-01	1.36E-01	7.61E+00	1.13E-01	4.19E-02	3.67E-01	1.66E-01	1.29E+00	0.00E+00	1.11E+01
12				633.5	5298.5	6.44E-01	8.90E-01	1.52E-01	8.73E+00	1.28E-01	4.57E-02	4.08E-01	1.80E-01	1.40E+00	0.00E+00	1.26E+01
13				634.5	5298.5	1.60E+00	8.91E-01	1.70E-01	9.83E+00	1.51E-01	5.00E-02	4.90E-01	1.95E-01	1.53E+00	0.00E+00	1.49E+01
14				635.5	5298.5	4.10E+00	8.73E-01	1.78E-01	1.05E+01	1.73E-01	5.28E-02	5.64E-01	2.06E-01	1.58E+00	0.00E+00	1.82E+01
15				636.5	5298.5	5.95E+00	8.56E-01	1.84E-01	1.11E+01	1.81E-01	5.49E-02	5.97E-01	2.16E-01	1.60E+00	0.00E+00	2.07E+01
16				637.5	5298.5	7.16E+00	8.41E-01	1.89E-01	1.15E+01	1.81E-01	5.76E-02	6.12E-01	2.29E-01	1.62E+00	0.00E+00	2.24E+01
17				638.5	5298.5	7.02E+00	8.26E-01	1.92E-01	1.15E+01	1.88E-01	6.08E-02	6.39E-01	2.42E-01	1.64E+00	0.00E+00	2.23E+01
18				639.5	5298.5	7.26E+00	8.11E-01	1.92E-01	1.16E+01	1.91E-01	6.38E-02	6.61E-01	2.55E-01	1.66E+00	0.00E+00	2.27E+01
19				640.5	5298.5	8.23E+00	7.96E-01	1.90E-01	1.16E+01	1.93E-01	6.50E-02	6.78E-01	2.64E-01	1.66E+00	0.00E+00	2.36E+01
20				641.5	5298.5	8.02E+00	7.84E-01	1.88E-01	1.14E+01	1.97E-01	6.66E-02	7.04E-01	2.70E-01	1.65E+00	0.00E+00	2.33E+01
21				642.5	5298.5	7.51E+00	7.76E-01	1.91E-01	1.11E+01	2.00E-01	6.98E-02	7.27E-01	2.85E-01	1.66E+00	0.00E+00	2.25E+01
22				643.5	5298.5	6.89E+00	7.71E-01	1.89E-01	1.08E+01	2.05E-01	7.17E-02	7.58E-01	2.97E-01	1.67E+00	0.00E+00	2.16E+01

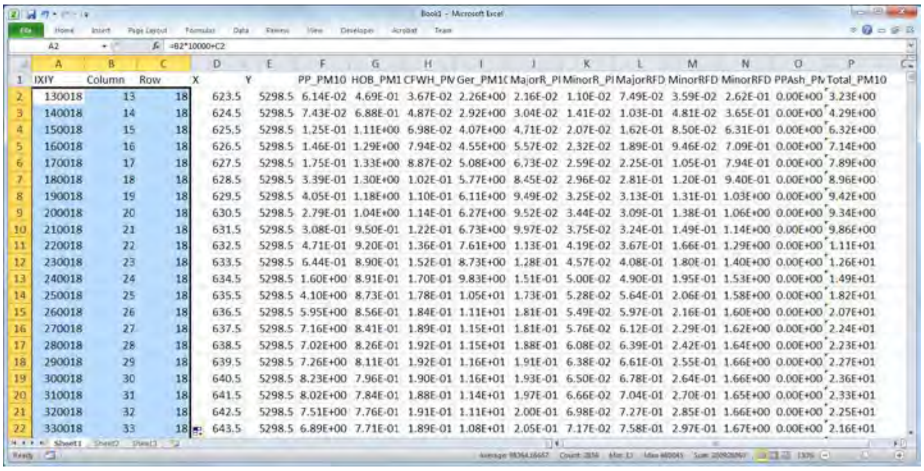
Calculate the following for each added column.

IXIY = Column x 1000 + Row

Column = X Coordinate – X Reference coorinate of bottom left + 0.5

Row = Y Coordinate - Y Reference coorinate of bottom left + 0.5

Draw cross-section diagram of concentration by source using this table, and draw concentration distribution map by importing the table into Access.



	IXIY	Column	Row	X	Y	PP_PM10	HOB_PM1	CFWH_PN	Ger_PM1(	MajorR_PI	MinorR_PI	MajorRFD	MinorRFD	MinorRFD	PPAsh_PN	Total_PM10
2	130018	13	18	623.5	5298.5	6.14E-02	4.69E-01	3.67E-02	2.26E+00	2.16E-02	1.10E-02	7.49E-02	3.59E-02	2.62E-01	0.00E+00	3.23E+00
3	140018	14	18	624.5	5298.5	7.43E-02	6.88E-01	4.87E-02	2.92E+00	3.04E-02	1.41E-02	1.03E-01	4.81E-02	3.65E-01	0.00E+00	4.29E+00
4	150018	15	18	625.5	5298.5	1.25E-01	1.11E+00	6.98E-02	4.07E+00	4.71E-02	2.07E-02	1.62E-01	8.50E-02	6.31E-01	0.00E+00	6.32E+00
5	160018	16	18	626.5	5298.5	1.46E-01	1.29E+00	7.94E-02	4.55E+00	5.57E-02	2.32E-02	1.89E-01	9.46E-02	7.09E-01	0.00E+00	7.14E+00
6	170018	17	18	627.5	5298.5	1.75E-01	1.33E+00	8.87E-02	5.08E+00	6.73E-02	2.59E-02	2.25E-01	1.05E-01	7.94E-01	0.00E+00	7.89E+00
7	180018	18	18	628.5	5298.5	3.39E-01	1.30E+00	1.02E-01	5.77E+00	8.45E-02	2.96E-02	2.81E-01	1.20E-01	9.40E-01	0.00E+00	8.96E+00
8	190018	19	18	629.5	5298.5	4.05E-01	1.18E+00	1.10E-01	6.11E+00	9.49E-02	3.25E-02	3.13E-01	1.31E-01	1.03E+00	0.00E+00	9.42E+00
9	200018	20	18	630.5	5298.5	2.79E-01	1.04E+00	1.14E-01	6.27E+00	9.52E-02	3.44E-02	3.09E-01	1.38E-01	1.06E+00	0.00E+00	9.34E+00
10	210018	21	18	631.5	5298.5	3.08E-01	9.50E-01	1.22E-01	6.73E+00	9.97E-02	3.75E-02	3.24E-01	1.49E-01	1.14E+00	0.00E+00	9.86E+00
11	220018	22	18	632.5	5298.5	4.71E-01	9.20E-01	1.36E-01	7.61E+00	1.13E-01	4.19E-02	3.67E-01	1.66E-01	1.29E+00	0.00E+00	1.11E+01
12	230018	23	18	633.5	5298.5	6.44E-01	8.90E-01	1.52E-01	8.73E+00	1.28E-01	4.57E-02	4.08E-01	1.80E-01	1.40E+00	0.00E+00	1.26E+01
13	240018	24	18	634.5	5298.5	1.60E+00	8.91E-01	1.70E-01	9.83E+00	1.51E-01	5.00E-02	4.90E-01	1.95E-01	1.53E+00	0.00E+00	1.49E+01
14	250018	25	18	635.5	5298.5	4.10E+00	8.73E-01	1.78E-01	1.05E+01	1.73E-01	5.28E-02	5.64E-01	2.06E-01	1.58E+00	0.00E+00	1.82E+01
15	260018	26	18	636.5	5298.5	5.95E+00	8.56E-01	1.84E-01	1.11E+01	1.81E-01	5.49E-02	5.97E-01	2.16E-01	1.60E+00	0.00E+00	2.07E+01
16	270018	27	18	637.5	5298.5	7.16E+00	8.41E-01	1.89E-01	1.15E+01	1.81E-01	5.76E-02	6.12E-01	2.29E-01	1.62E+00	0.00E+00	2.24E+01
17	280018	28	18	638.5	5298.5	7.02E+00	8.26E-01	1.92E-01	1.15E+01	1.88E-01	6.08E-02	6.39E-01	2.42E-01	1.64E+00	0.00E+00	2.23E+01
18	290018	29	18	639.5	5298.5	7.26E+00	8.11E-01	1.92E-01	1.16E+01	1.91E-01	6.38E-02	6.61E-01	2.55E-01	1.66E+00	0.00E+00	2.27E+01
19	300018	30	18	640.5	5298.5	8.23E+00	7.96E-01	1.90E-01	1.16E+01	1.93E-01	6.50E-02	6.78E-01	2.64E-01	1.66E+00	0.00E+00	2.36E+01
20	310018	31	18	641.5	5298.5	8.02E+00	7.84E-01	1.88E-01	1.14E+01	1.97E-01	6.66E-02	7.04E-01	2.70E-01	1.65E+00	0.00E+00	2.33E+01
21	320018	32	18	642.5	5298.5	7.51E+00	7.76E-01	1.91E-01	1.11E+01	2.00E-01	6.98E-02	7.27E-01	2.85E-01	1.66E+00	0.00E+00	2.25E+01
22	330018	33	18	643.5	5298.5	6.89E+00	7.71E-01	1.89E-01	1.08E+01	2.05E-01	7.17E-02	7.58E-01	2.97E-01	1.67E+00	0.00E+00	2.16E+01

6.4 Comparing between Calculated Value and Measured Value and Considering the Improvement Accuracy of Dispersion Simulation Model

To evaluate the accuracy of dispersion simulation model, draw correlation diagram between the calculation value by dispersion simulation and the measurement value in ambient monitoring stations. However, if the number of monitoring station whose measured value is more than the number of effective measurement time is less than three stations, this value by this method become reference value and cannot use to evaluate. Draw scatter diagram with the horizontal axis as calculated value and the vertical axis as measured value and draw the approximation straight line with intercept zero. If there is the data of the ambient monitoring station that assumes not to be affected by source, the concentration at that station is taken as the value of intercept. This value is called the background concentration.

When slope of approximation straight line is close to 1 as much as possible within the range of 0.8 to 1.2 and correlation coefficient is 0.71 or more, it means that the calculation result by dispersion simulation model can reproduces the actual situation more accurately. On the other hand, when correlation coefficient is less than 0.71, it means that there is no consistency between calculated value and measured value.

Also, when slope of approximation straight line is larger than 1.2 or smaller than 0.8, it means that the calculation result by dispersion simulation model is underestimated or overestimated for measured value. In either case, the accuracy of the calculation result of dispersion simulation model is not good, so after modifying the setting of input data such as meteorological data and emission data etc., dispersion simulation needs to be conducted again.

If possible, it is recommended to verify not only correlation between monitoring stations but also correlation of hourly concentrations at the same monitoring station. For example, by comparing the measured value with the calculated value with respect to temporal change of one hour concentration and monthly change of monthly average concentration, correlation of concentration change at a monitoring station can be verified. Figure 6.4-1 shows an example of comparing measured values and calculated values of monthly average concentrations.

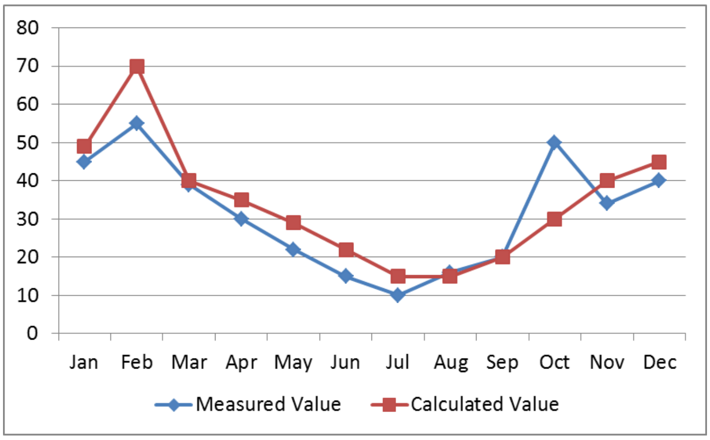
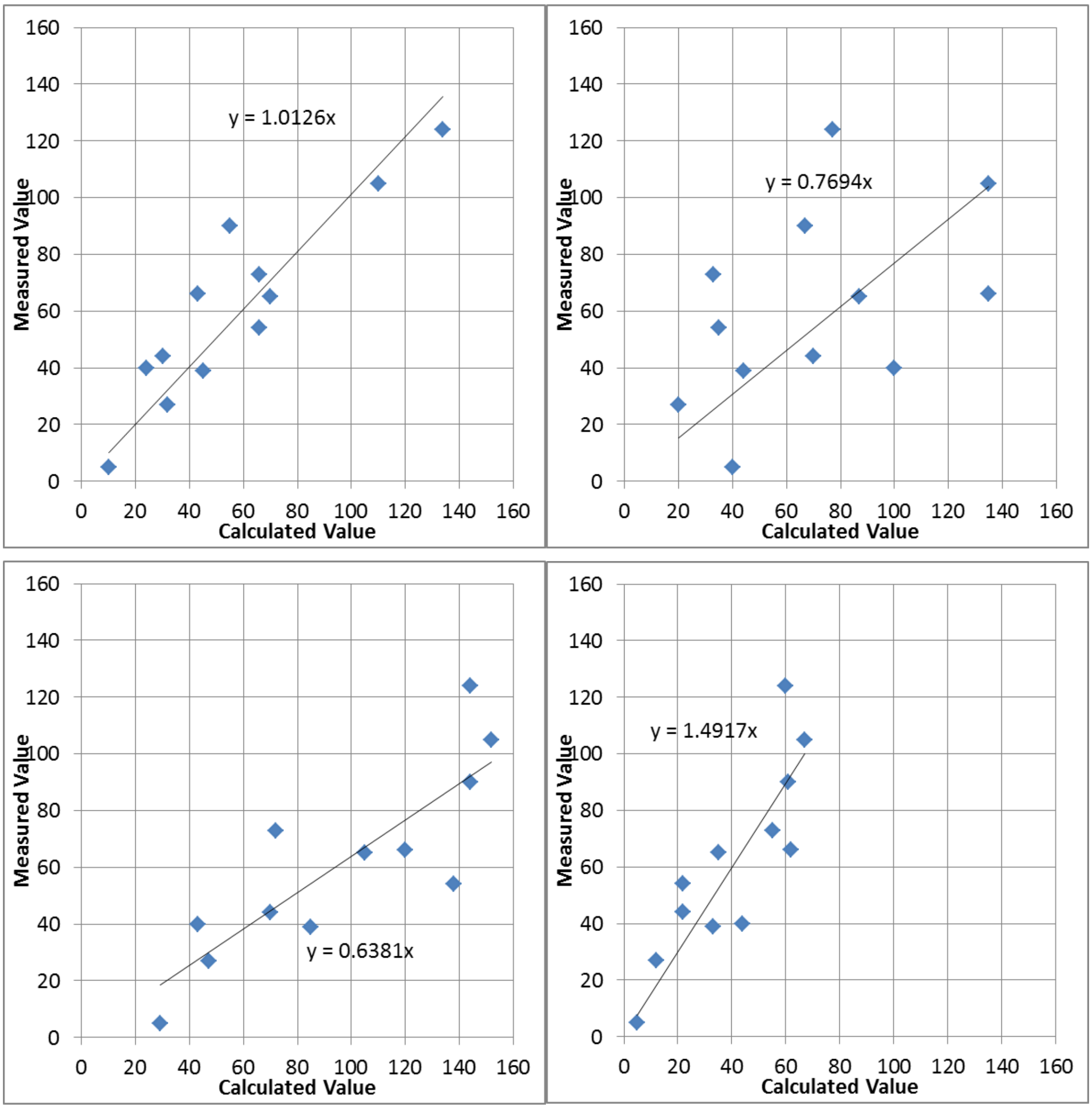


Figure 6.4-1 Example of Comparing Measured Values and Calculated Values of Monthly Average concentrations

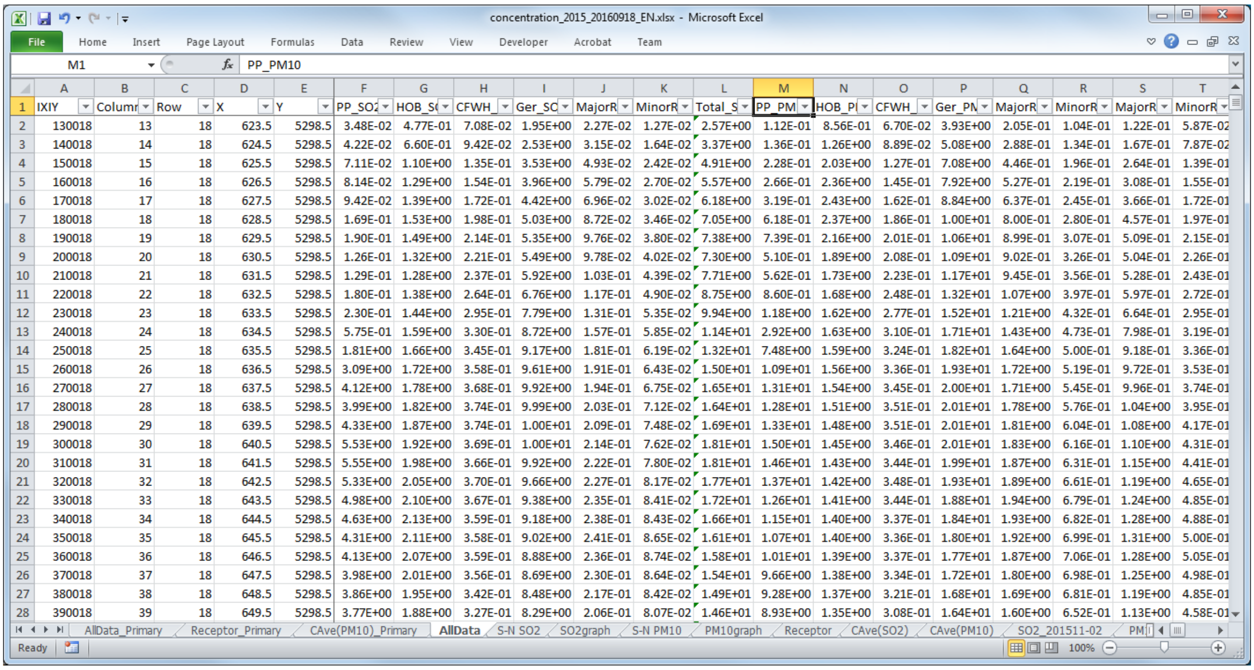


Upper left: dispersion simulation model with good accuracy (correlation coefficient: 0.909)
Upper right: correlation is not good (correlation coefficient: 0.471)
Bottom left: calculation result is overestimated (correlation coefficient: 0.839)
Bottom right: calculation result is underestimated (correlation coefficient: 0.851)

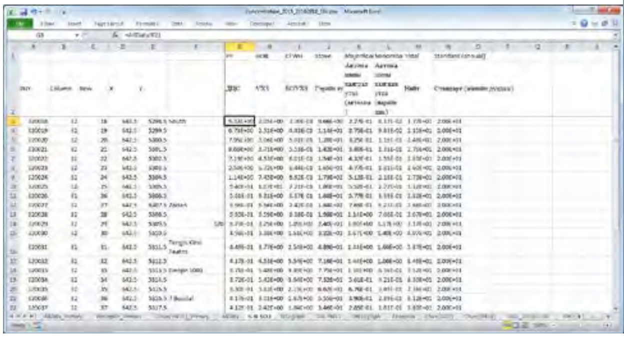
Figure 6.4-2 Comparison Example between Measured Value and Calculated Value

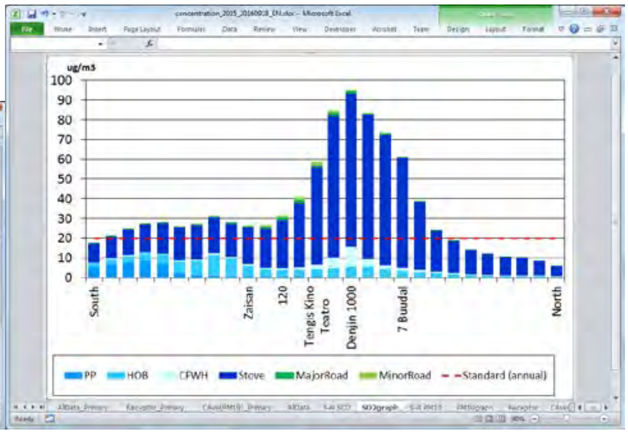
6.5 Drawing Cross-section Diagram of Concentration by Sources

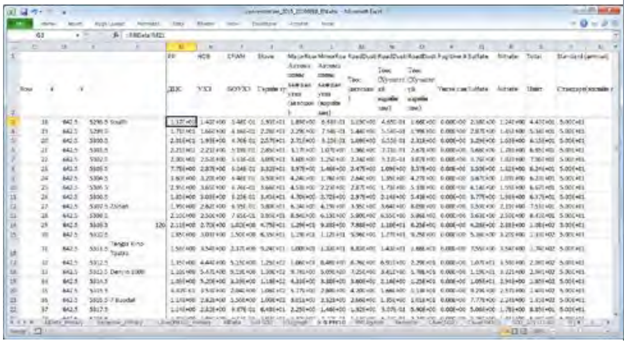
When updating the calculation result in “AllData” sheet, the update is reflected on “S-N SO2” sheet and “S-N PM10” sheet. These sheets are data lists for preparing cross-section diagram of concentration by sources and when updating the values of these sheets, cross-section diagram of concentration by sources is redrawn on “SO2 graph” and “PM10 graph” sheet.

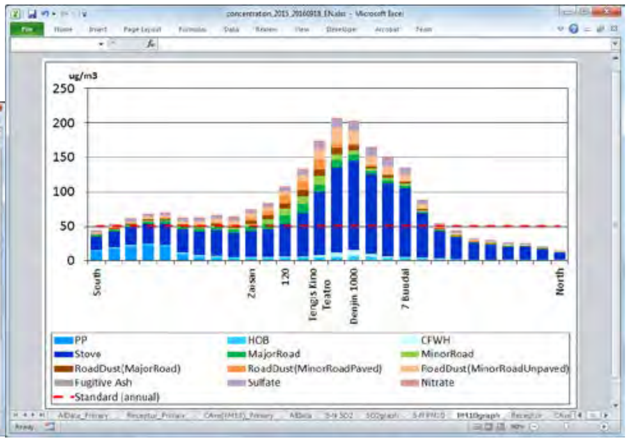


	IXIY	Columr	Row	X	Y	PP_SO2	HOB_S(	CFWH_	Ger_SC	MajorR	MinorR	Total_S	PP_PM	HOB_PI	CFWH_	Ger_PN	MajorR	MinorR	MajorR	MinorR
2	130018	13	18	623.5	5298.5	3.48E-02	4.77E-01	7.08E-02	1.95E+00	2.27E-02	1.27E-02	2.57E+00	1.12E-01	8.56E-01	6.70E-02	3.93E+00	2.05E-01	1.04E-01	1.22E-01	5.87E-02
3	140018	14	18	624.5	5298.5	4.22E-02	6.60E-01	9.42E-02	2.53E+00	3.15E-02	1.64E-02	3.37E+00	1.36E-01	1.26E+00	8.89E-02	5.08E+00	2.88E-01	1.34E-01	1.67E-01	7.87E-02
4	150018	15	18	625.5	5298.5	7.11E-02	1.10E+00	1.35E-01	3.53E+00	4.93E-02	2.42E-02	4.91E+00	2.28E-01	2.03E+00	1.27E-01	7.08E+00	4.46E-01	1.96E-01	2.64E-01	1.39E-01
5	160018	16	18	626.5	5298.5	8.14E-02	1.29E+00	1.54E-01	3.96E+00	5.79E-02	2.70E-02	5.57E+00	2.66E-01	2.36E+00	1.45E-01	7.92E+00	5.27E-01	2.19E-01	3.08E-01	1.55E-01
6	170018	17	18	627.5	5298.5	9.42E-02	1.39E+00	1.72E-01	4.42E+00	6.96E-02	3.02E-02	6.18E+00	3.19E-01	2.43E+00	1.62E-01	8.84E+00	6.37E-01	2.45E-01	3.66E-01	1.72E-01
7	180018	18	18	628.5	5298.5	1.69E-01	1.53E+00	1.98E-01	5.03E+00	8.72E-02	3.46E-02	7.05E+00	6.18E-01	2.37E+00	1.86E-01	1.00E+01	8.00E-01	2.80E-01	4.57E-01	1.97E-01
8	190018	19	18	629.5	5298.5	1.90E-01	1.49E+00	2.14E-01	5.35E+00	9.76E-02	3.80E-02	7.38E+00	7.39E-01	2.16E+00	2.01E-01	1.06E+01	8.99E-01	3.07E-01	5.09E-01	2.15E-01
9	200018	20	18	630.5	5298.5	1.26E-01	1.32E+00	2.21E-01	5.49E+00	9.78E-02	4.02E-02	7.30E+00	5.10E-01	1.89E+00	2.08E-01	1.09E+01	9.02E-01	3.26E-01	5.04E-01	2.26E-01
10	210018	21	18	631.5	5298.5	1.29E-01	1.28E+00	2.37E-01	5.92E+00	1.03E-01	4.39E-02	7.71E+00	5.62E-01	1.73E+00	2.23E-01	1.17E+01	9.45E-01	3.56E-01	5.28E-01	2.43E-01
11	220018	22	18	632.5	5298.5	1.80E-01	1.38E+00	2.64E-01	6.76E+00	1.17E-01	4.90E-02	8.75E+00	8.60E-01	1.68E+00	2.48E-01	1.32E+01	1.07E+00	3.97E-01	5.97E-01	2.72E-01
12	230018	23	18	633.5	5298.5	2.30E-01	1.44E+00	2.95E-01	7.79E+00	1.31E-01	5.35E-02	9.94E+00	1.18E+00	1.62E+00	2.77E-01	1.52E+01	1.21E+00	4.32E-01	6.64E-01	2.95E-01
13	240018	24	18	634.5	5298.5	5.75E-01	1.59E+00	3.30E-01	8.72E+00	1.57E-01	5.85E-02	1.14E+01	2.92E+00	1.63E+00	3.10E-01	1.71E+01	1.43E+00	4.73E-01	7.98E-01	3.19E-01
14	250018	25	18	635.5	5298.5	1.81E+00	1.66E+00	3.45E-01	9.17E+00	1.81E-01	6.19E-02	1.32E+01	7.48E+00	1.59E+00	3.24E-01	1.82E+01	1.64E+00	5.00E-01	9.18E-01	3.36E-01
15	260018	26	18	636.5	5298.5	3.09E+00	1.72E+00	3.58E-01	9.61E+00	1.91E-01	6.43E-02	1.50E+01	1.09E+01	1.56E+00	3.36E-01	1.93E+01	1.72E+00	5.19E-01	9.72E-01	3.53E-01
16	270018	27	18	637.5	5298.5	4.12E+00	1.78E+00	3.68E-01	9.92E+00	1.94E-01	6.75E-02	1.65E+01	1.31E+01	1.54E+00	3.45E-01	2.00E+01	1.71E+00	5.45E-01	9.96E-01	3.74E-01
17	280018	28	18	638.5	5298.5	3.99E+00	1.82E+00	3.74E-01	9.99E+00	2.03E-01	7.12E-02	1.64E+01	1.28E+01	1.51E+00	3.51E-01	2.01E+01	1.78E+00	5.76E-01	1.04E+00	3.95E-01
18	290018	29	18	639.5	5298.5	4.33E+00	1.87E+00	3.74E-01	1.00E+01	2.09E-01	7.48E-02	1.69E+01	1.33E+01	1.48E+00	3.51E-01	2.01E+01	1.81E+00	6.04E-01	1.08E+00	4.17E-01
19	300018	30	18	640.5	5298.5	5.53E+00	1.92E+00	3.69E-01	1.00E+01	2.14E-01	7.62E-02	1.81E+01	1.50E+01	1.45E+00	3.46E-01	2.01E+01	1.83E+00	6.16E-01	1.10E+00	4.31E-01
20	310018	31	18	641.5	5298.5	5.55E+00	1.98E+00	3.66E-01	9.92E+00	2.22E-01	7.80E-02	1.81E+01	1.46E+01	1.43E+00	3.44E-01	1.99E+01	1.87E+00	6.31E-01	1.15E+00	4.41E-01
21	320018	32	18	642.5	5298.5	5.33E+00	2.05E+00	3.70E-01	9.66E+00	2.27E-01	8.17E-02	1.77E+01	1.37E+01	1.42E+00	3.48E-01	1.93E+01	1.89E+00	6.61E-01	1.19E+00	4.65E-01
22	330018	33	18	643.5	5298.5	4.98E+00	2.10E+00	3.67E-01	9.38E+00	2.35E-01	8.41E-02	1.72E+01	1.26E+01	1.41E+00	3.44E-01	1.88E+01	1.94E+00	6.79E-01	1.24E+00	4.85E-01
23	340018	34	18	644.5	5298.5	4.63E+00	2.13E+00	3.59E-01	9.18E+00	2.38E-01	8.43E-02	1.66E+01	1.15E+01	1.40E+00	3.37E-01	1.84E+01	1.93E+00	6.82E-01	1.28E+00	4.88E-01
24	350018	35	18	645.5	5298.5	4.31E+00	2.11E+00	3.58E-01	9.02E+00	2.41E-01	8.65E-02	1.61E+01	1.07E+01	1.40E+00	3.36E-01	1.80E+01	1.92E+00	6.99E-01	1.31E+00	5.00E-01
25	360018	36	18	646.5	5298.5	4.13E+00	2.07E+00	3.59E-01	8.88E+00	2.36E-01	8.74E-02	1.58E+01	1.01E+01	1.39E+00	3.37E-01	1.77E+01	1.87E+00	7.06E-01	1.28E+00	5.05E-01
26	370018	37	18	647.5	5298.5	3.98E+00	2.01E+00	3.56E-01	8.69E+00	2.30E-01	8.64E-02	1.54E+01	9.66E+00	1.38E+00	3.34E-01	1.72E+01	1.80E+00	6.98E-01	1.25E+00	4.98E-01
27	380018	38	18	648.5	5298.5	3.86E+00	1.95E+00	3.42E-01	8.48E+00	2.17E-01	8.42E-02	1.49E+01	9.28E+00	1.37E+00	3.21E-01	1.68E+01	1.69E+00	6.81E-01	1.19E+00	4.85E-01
28	390018	39	18	649.5	5298.5	3.77E+00	1.88E+00	3.27E-01	8.29E+00	2.06E-01	8.07E-02	1.46E+01	8.93E+00	1.35E+00	3.08E-01	1.64E+01	1.60E+00	6.52E-01	1.13E+00	4.58E-01





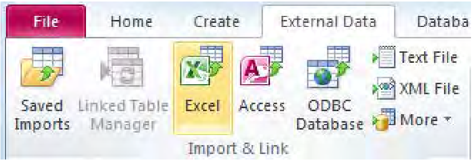




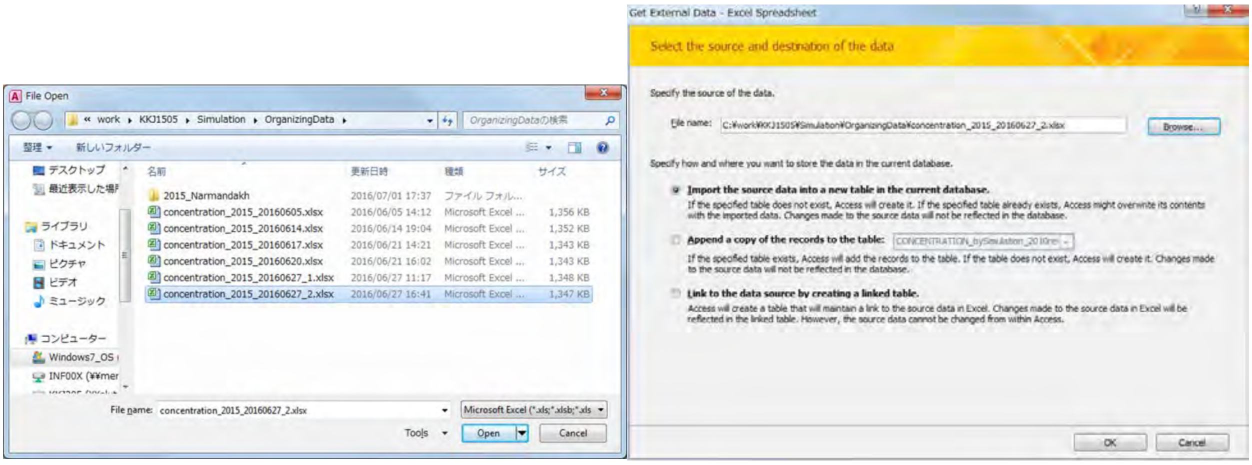
6.6 Drawing Concentration Distribution Map

6.6.1 Import to Calculation Result Organization File to Access File

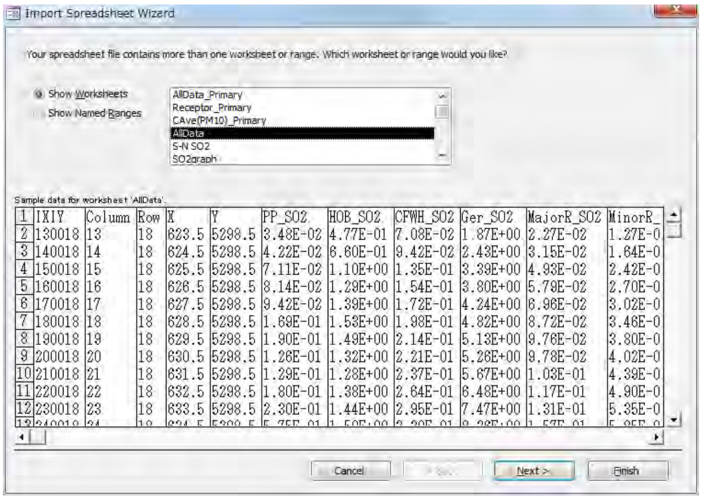
Open “Simulation.mdb” and select [Excel] button of [Import & Link] in [External Data] tab.



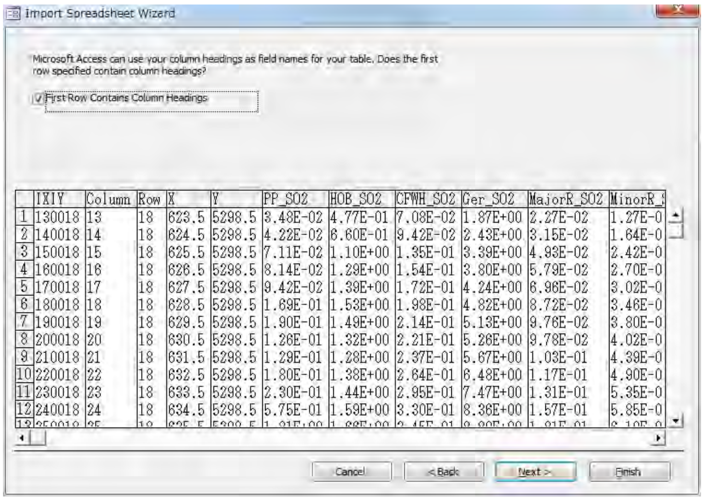
After click [Browse], select the calculation result organization file and click [OK].



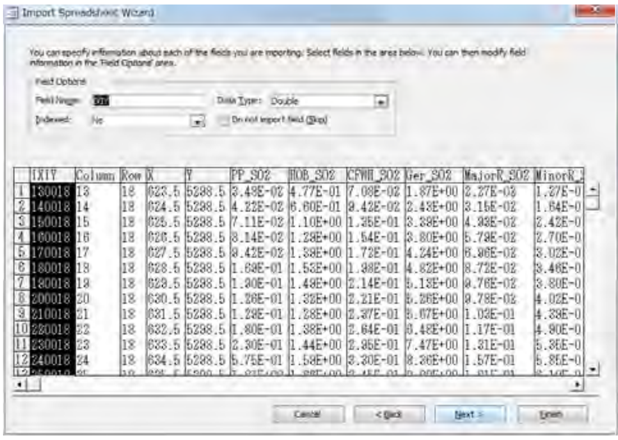
Select result organization sheet, and click [Next] (Here it is “AllData” sheet.).

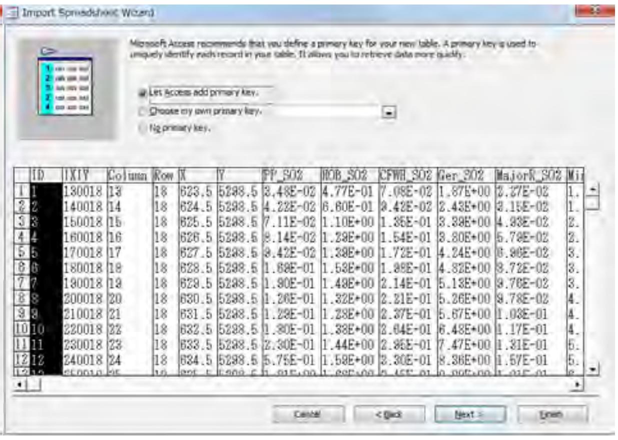


Check [First Row Contains Column Headings] is checked and click [Next].



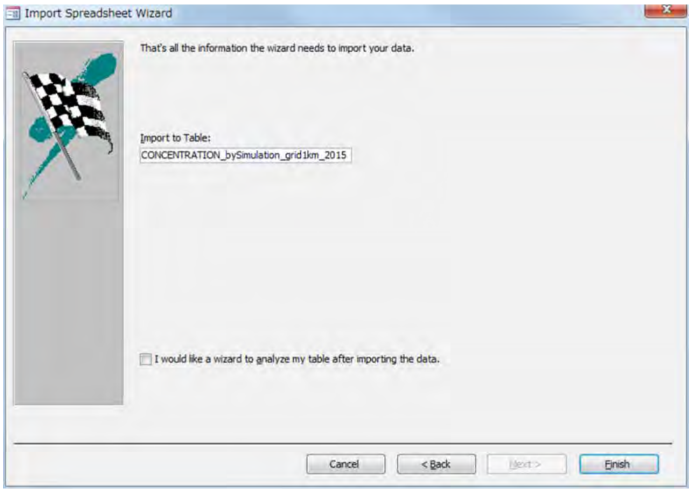
Select [Let Access add primary key.] and Click [Next].



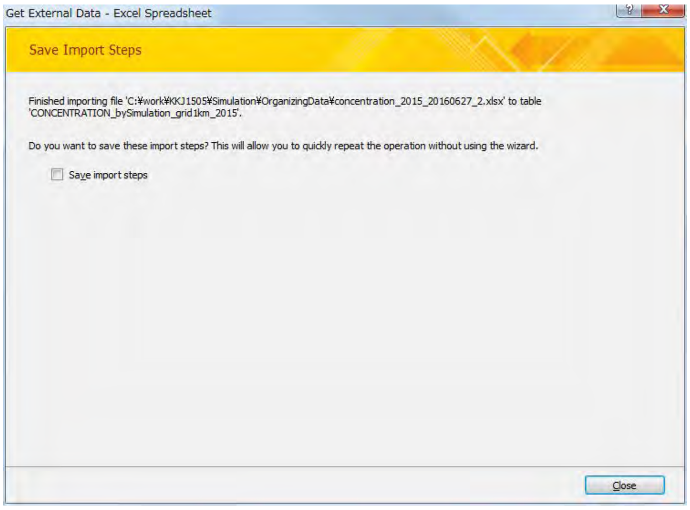


Input the table name in the [Import to Table:] textbox and click [Finish].

(Here it is “CONCENTRATION_bySimulation_grid1km_2015”.)

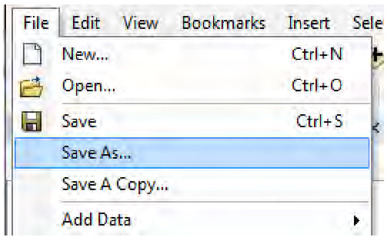


Click [Close].



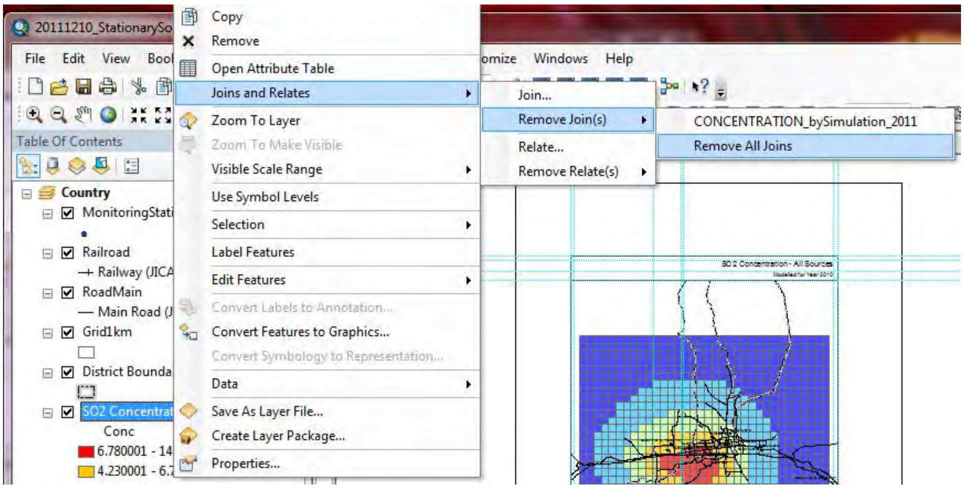
6.6.2 Drawing Concentration Distribution Map

Open template file, click [File]-[Save As], and saved as other name.

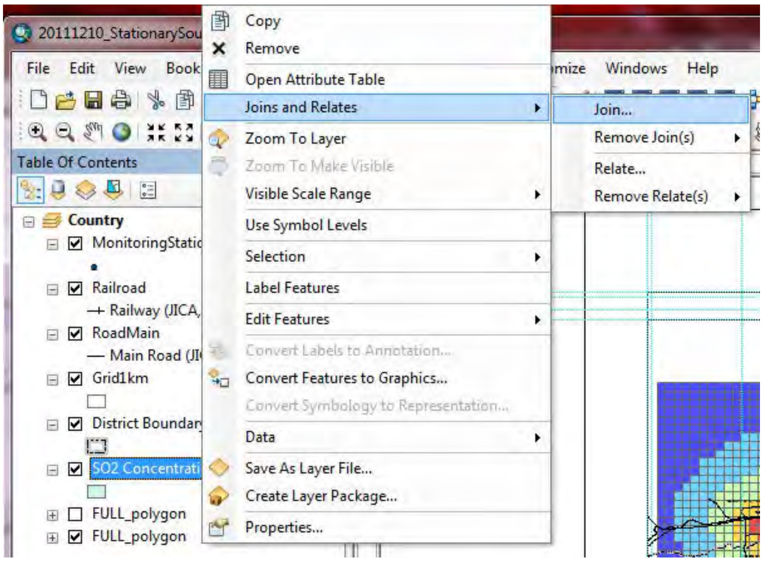


Join the table of emission by grid to "SO2 Concentration" layer

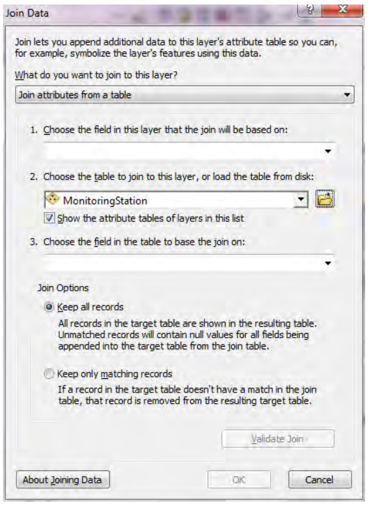
If the table is already a joined table, select [Joins and Relates]-[Remove Join(s)]-[Remove All] and remove the existing join of table.



Right-click "SO2 Concentration" layer and select [Joins and Relates]-[Join].

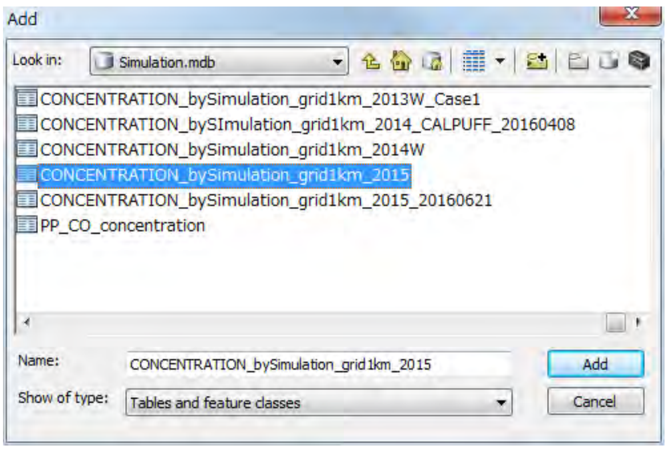


When showing the following dialog, click [button icon] button.

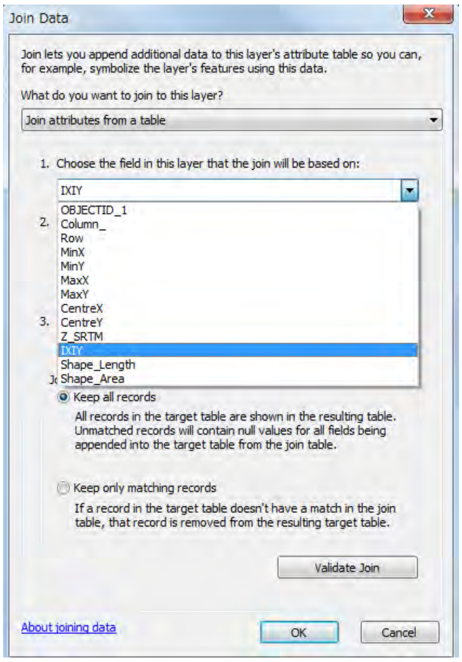


Select the table of emission by grid to join and click [Add].

(Here it is “CONCENTRATION_bySimulation_grid1km_2015” table)

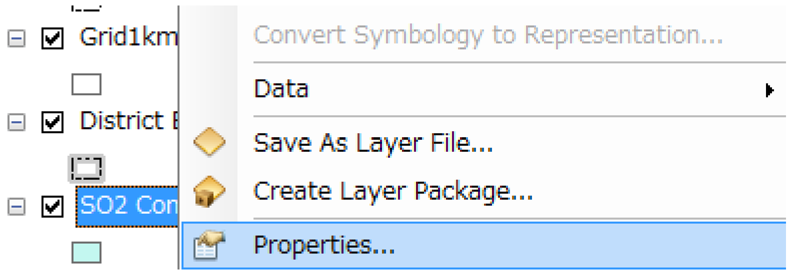


Show the selected table in the dropdown textbox of “2.”. When clicking the dropdown button of “1.” and selecting “IXIY”, show “IXIY” in “3.” automatically. After then, click [OK].

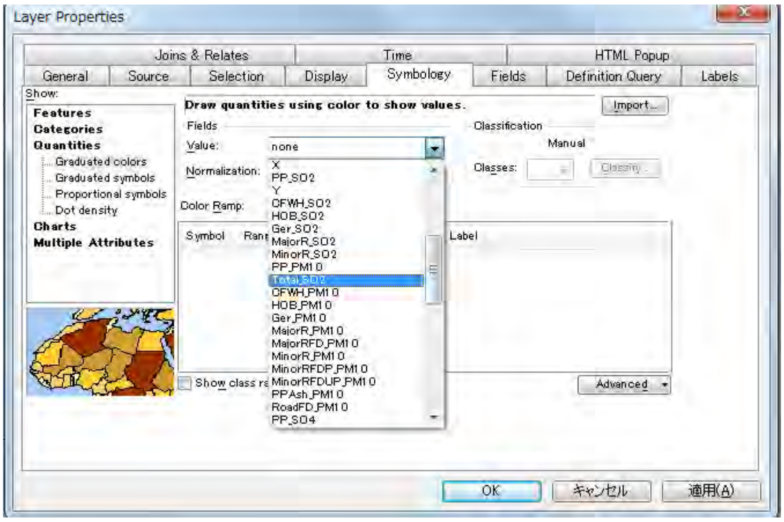


If the following dialog may be shown, click [No].

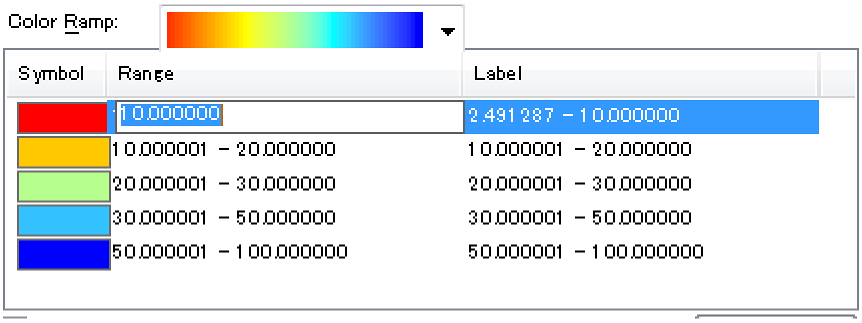
Right-click “SO2 Concentration” layer and click [Properties].



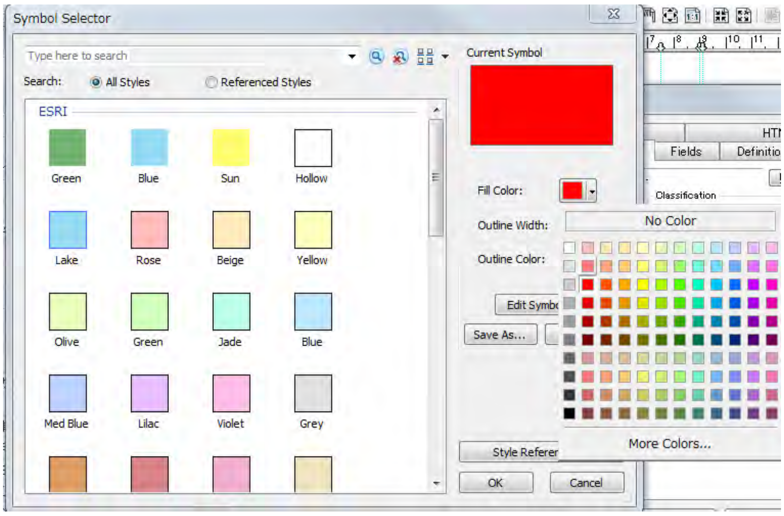
Click [Symbology] tab and select [Quantities]-[Graduated colors]. Click and select the target column name at the drop down button of [Value] (Here it is [Total_SO2].).



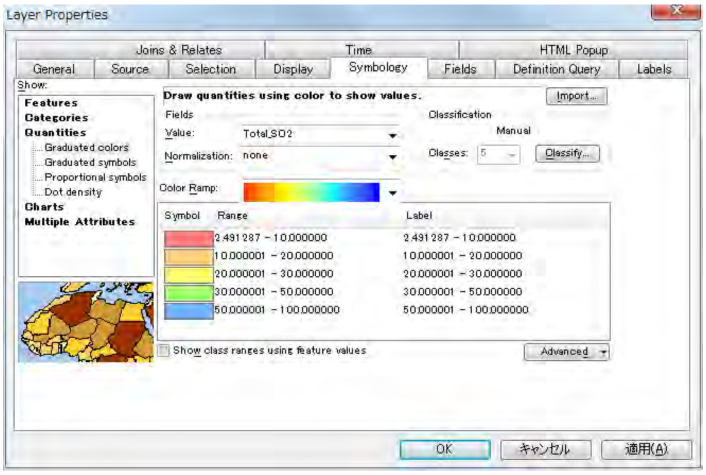
Select the color pattern in [Color Ramp] to use for the distribution map. Click the value in [Range] and input the upper limit value of rank.



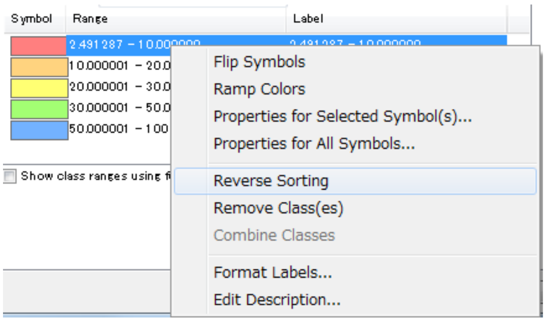
When double-clicking color in [Symbol] column, since the following dialog is shown, select color.



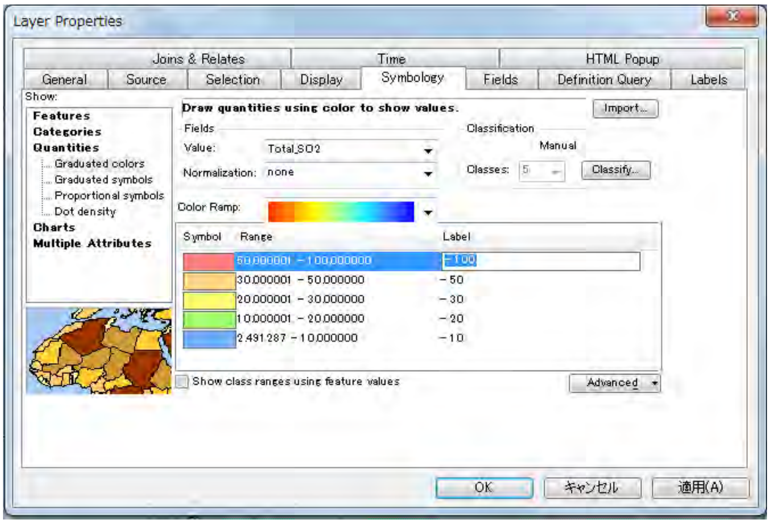
The results of selecting rank and color are as follows.



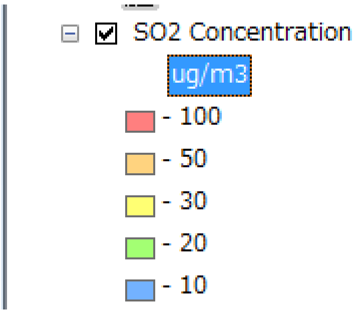
When click [Reverse Sorting] after you right-click on the [Range] column, the display order of rank changes.



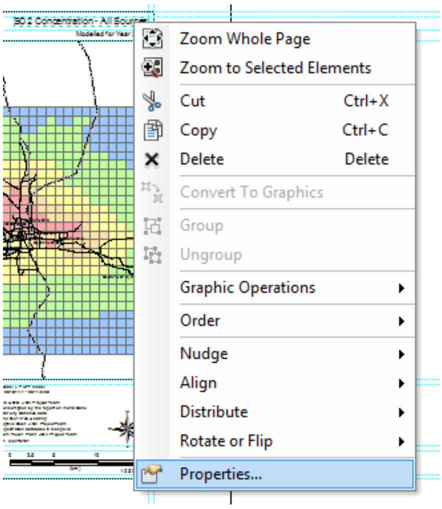
Input label to display in legend by rank. When all setting completed, click [OK].



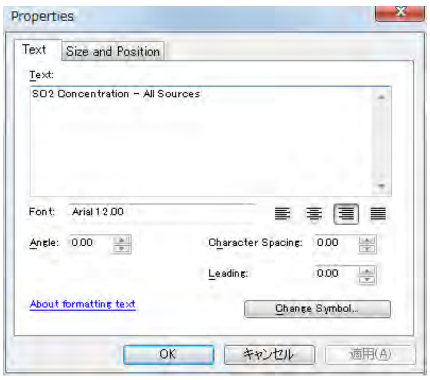
Click “Total_SO2” of “SO2 Concentration” layer and make it editable and change to “ug/m3”.



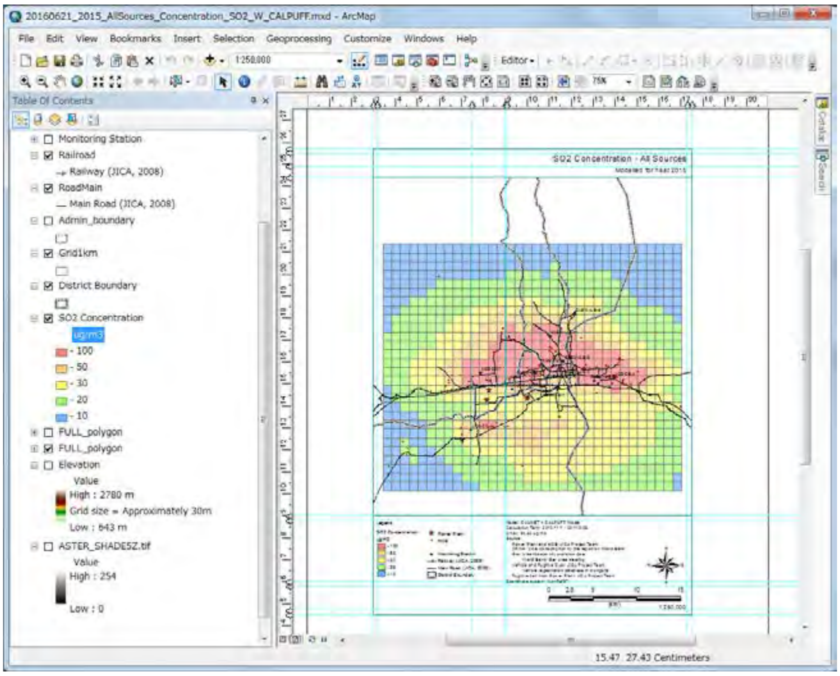
Change the title of this map. Move the cursor to the textbox of title, right-click it, and click [Properties].



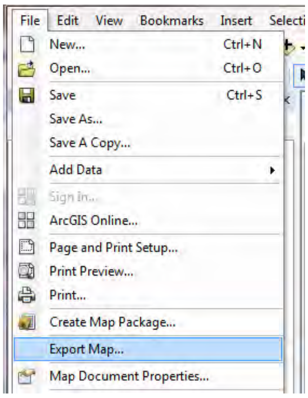
Input a title in [Text] (Here it is “SO2 Concentration – All Sources”.).



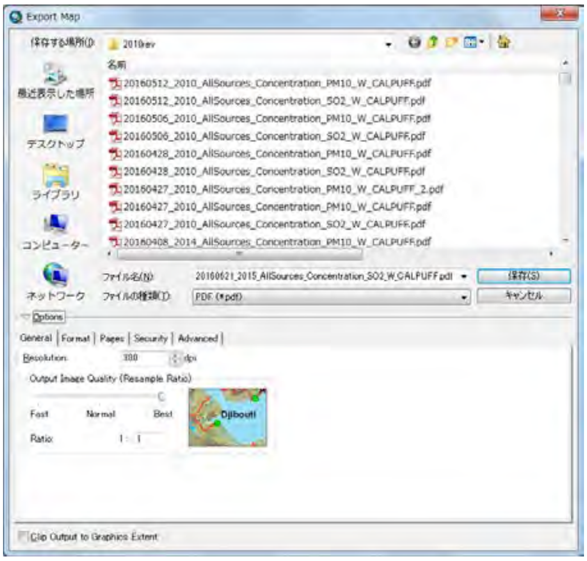
Complete drawing the concentration distribution map by ArcGIS.



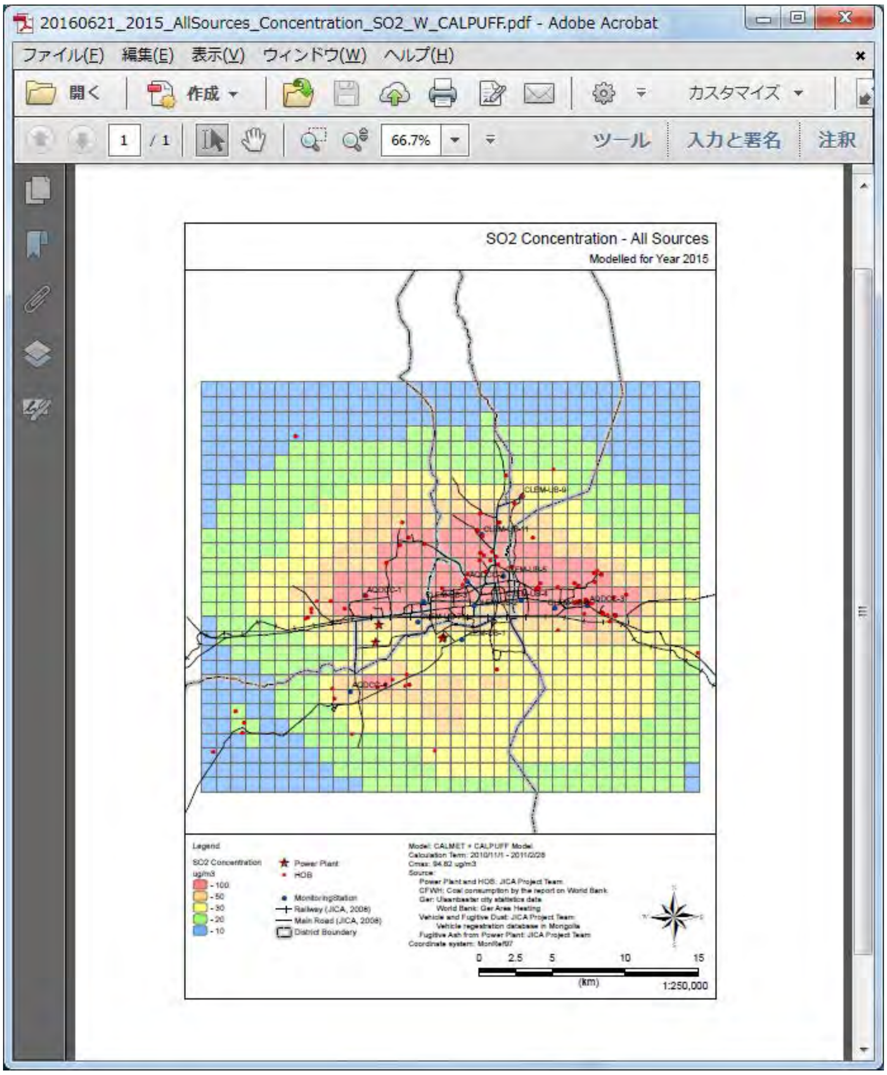
To export the distribution map to PDF file, click [File]-[Export Map].



Setting the destination and file name and click [Save].



Create the PDF file of concentration distribution map.



7 Method of Estimating the Emission of PM10 Considering Condensed Dust and Conducting Dispersion Simulation

7.1 Background

Among the various pollutants, the only PM concentration measured at the measuring station was significantly higher than the calculated concentration using the previous dispersion simulation model. Various causes were thought such as error of the equipment of the measuring station, error of the emission factor, and contribution of generating the secondary particle, so in order to make it clear, the dust in the air was collected using the FRM sampler and component analysis of the collected dust was also conducted. As a result, it was shown that POM (Particulate Organic Matter) and sulfate are major source factor in the dust collected in winter and the main source is volatile organic matter due to fuel combustion (Figure 7.1-1). From these results, it is thought that these sources are greatly affected by condensed dust.

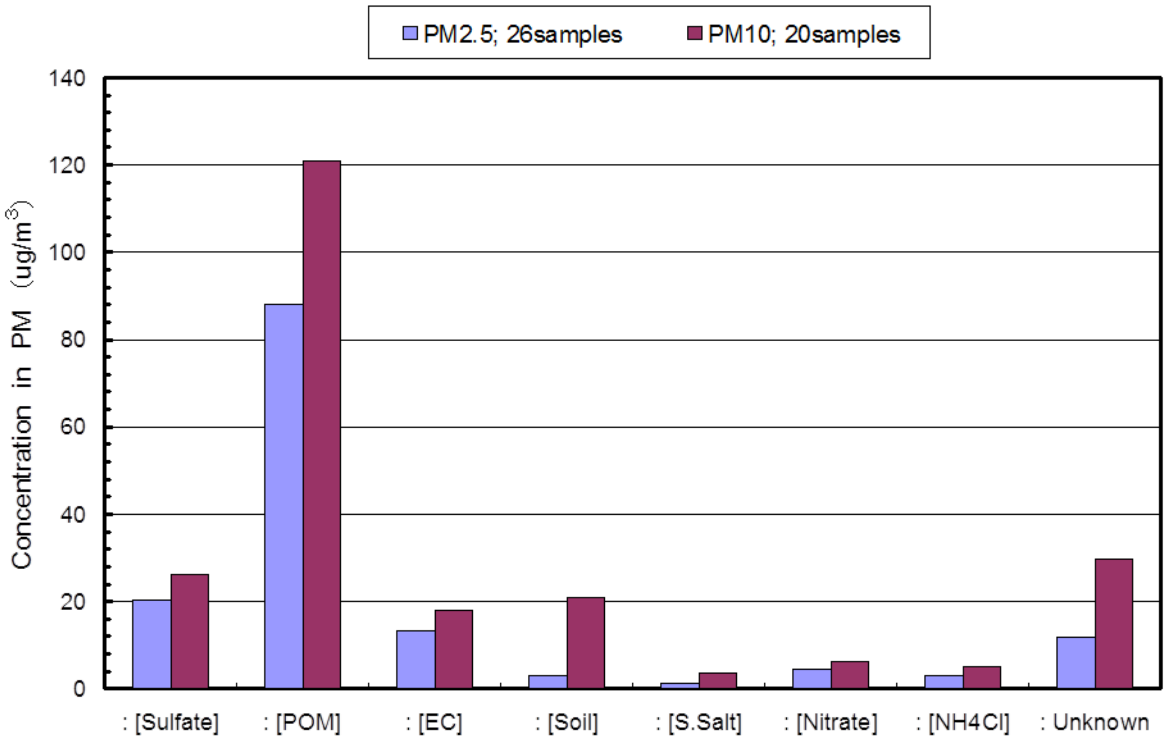


Figure 7.1-1 Comparing the origin source concentration in PM10 and PM2.5 sample from Dec.15,'14 to Jan.06,'15

In addition, Dr. Mizohata attempted PMF (Positive Matrix Factorization) analysis using the seasonal PM chemical composition analysis data obtained by previous observations and announced the obtained results at the seminar in February 2016. The number of source factors was unknown, but as a result of trial and error for 4 to 8 factors, source profiles consisting of 7 source factors and their contribution concentrations were finally derived.

7.2 Calculation Method of the Emission Considering Condensed Dust

7.2.1 Outline of PM10 Generating Process

The image of generating processes of PM10 is shown in Figure 7.2-1. The generating processes of PM10 consist of the following three processes.

1. Generating Process of Primary Particle

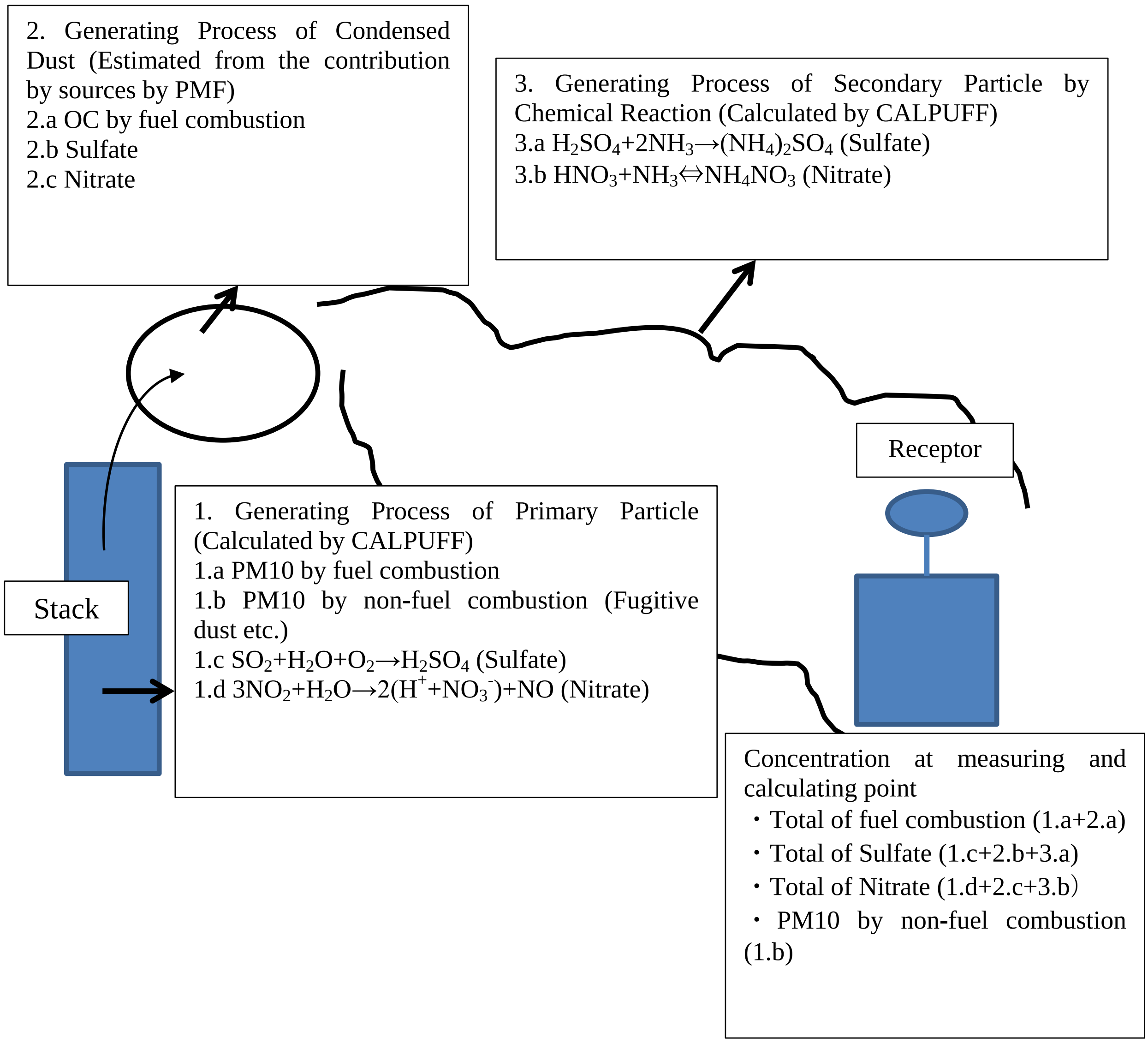
Primary particles are generated by fuel combustion or fugitive dust. The particle generated through condensation of product in the process of moisture in the stack gas reacting with SO2 or NO2 is also included as the primary particle.

2. Generating Process of Condensed Dust

Condensed Dust is produced through gas or liquid (volatile matter or vapor etc.) in the stack is condensed into particles by rapid cooling and/or mixing in the air after the stack gas is emitted.

3. Generating Process of Secondary Particle by Chemical Reaction

Secondary particles are generated by chemical reaction in the air after the stack gas is emitted.



Source: JICA Experts

Figure 7.2-1 Image of Generating Process of PM10

7.2.2 Estimation Method of the Emission of PM10 Considering Condensed Dust

The calculation of PM10 emission can only be done by using emission factor from the result of flue gas measurement and monitoring survey described previously in 1.a and 1.b. Also in CALPUFF, generating process for condensed dust is not considered in. Therefore, to estimate PM10 emission considering the condensed dust, the PM10 emission estimation method by the process of 1.c, 1.d, and 2.a to 2.c is set as following.

1. PM10 emission calculated by using emission factor from the result of flue gas measurement and monitoring survey (1.a, 1.b)

PM10 emission by source was calculated by multiplying activity data such as coal consumption to emission factor based on the result of flue gas measurement and monitoring survey.

2. Process of gas condensation and become particles in the stack (1.c, 1.d)

PM10 emission generated by chemical reaction from SO2 to SO4 (1.c) and from NO2 to NO3 (1.d) in stack were calculated.

Conversion ratio of reaction from SO2 to SO4 in stack was set as 5.0[11], SO2 and SO4 emission were estimated by the following formulas

SO4 Emission after reaction = SO2 Emission of emission inventory * 5/100 * 98/64

SO2 Emission after reaction = SO2 Emission of emission inventory * (1-5/100)

Also, NO3 emission included in PM10 was estimated using the NO3 ratio by the component analysis of the sample taken from sources (Table 7.2-1). These calculation results were added to PM10 concentration.

NO3 Emission = PM10 Emission * NO3 Ratio of each source / 100

Table 7.2-1 NO3 Ratio of Each Source by the Component Analysis

Source	Ratio (%)
Power plant	0.07
HOB	0.18
CFWH	0.04
Small stove for household	0.08
Vehicle exhaust gas	0.00

Source: JICA Experts

3. Generating process of condensed dust (2.a~2.c)

To estimate the emission of each source with consideration of generating process for the condensed dust, 1) the calculated concentration with consider ratio of generating process of primary and secondary particle, 2) average concentration of PM10at monitoring station, and 3) the PM10 contribution ratio of each source estimated by PMF were utilized.

When calculated concentration with consideration of generating process of primary and secondary particle is set as C1, PM10 average concentration at monitoring station is set as C_{AQ}, and the PM10 contribution ratio of

[11] Prediction Manual of SPM Committee of SPM Control Measure 1997 (in Japanese)

each source estimated by PMF is set as A, Cs that is PM10 average concentration of each source at monitoring station and R, the ratio to estimate the emission considered generating process for condensed dust are calculated by the following formula. PM10 emission considering the condensed dust was estimated by multiplying R to PM10 emission of emission inventory every source (Figure 7.2-2 and Figure 7.2-3).

$C_S = C_{AQ} \times A/100$

$R = C_S/C_1$

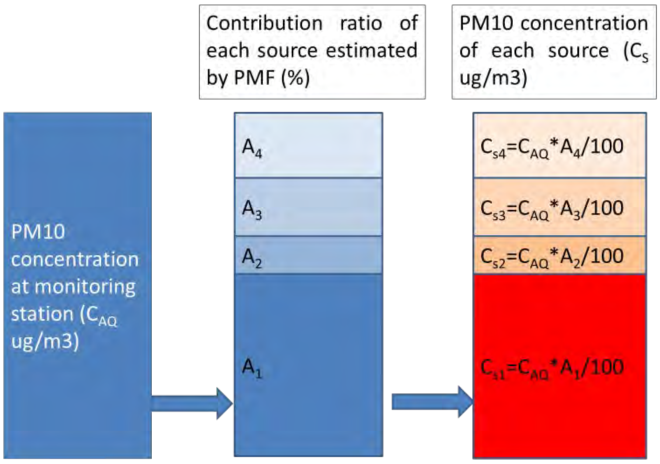
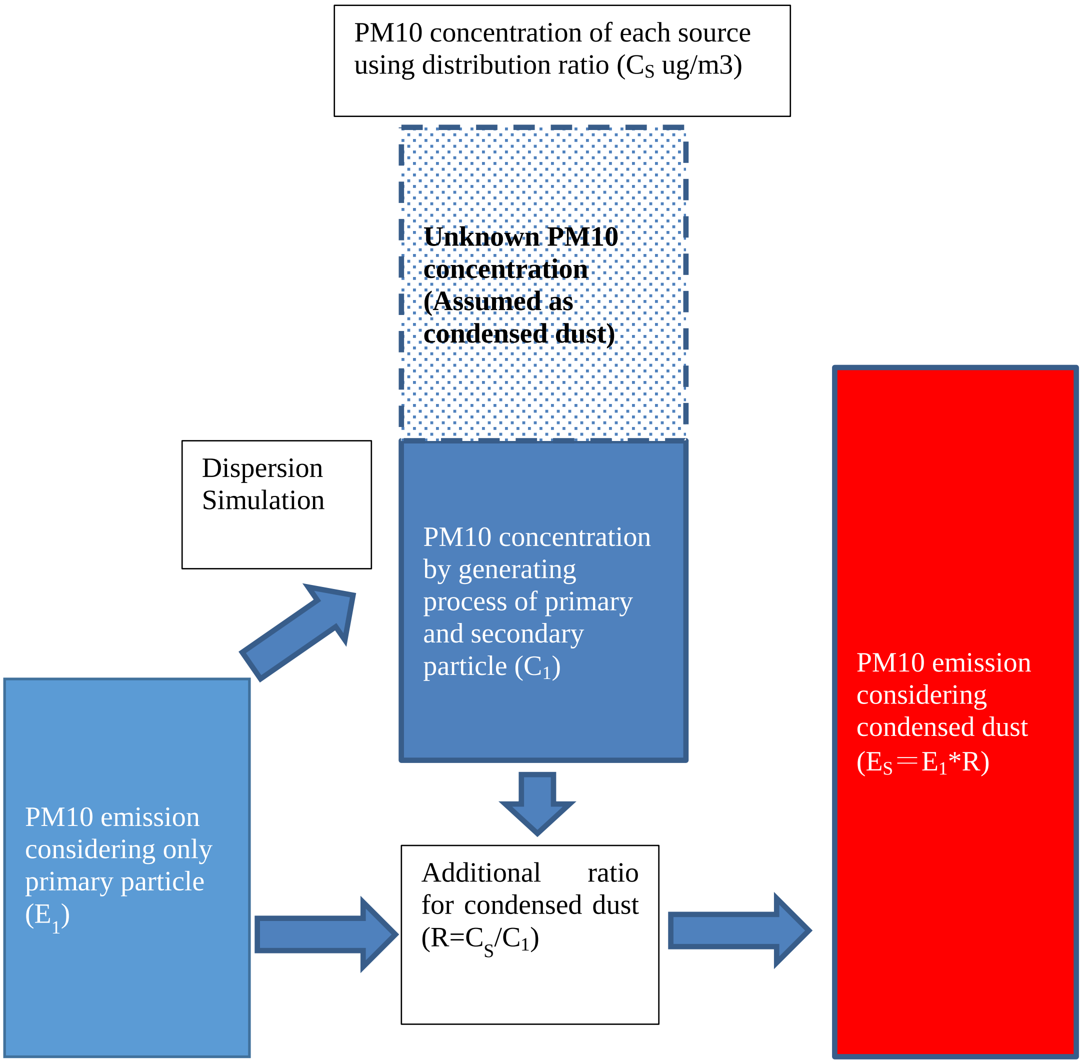


Figure 7.2-2 Estimation Image of PM10 Concentration of Each Source at Monitoring Stations using the result of PMF



Source: JICA Experts

Figure 7.2-3 Estimation Image of PM10 Emission Considering Condensed Dust

For PM10 contribution ratio of each source estimated by PMF in winter, Dr. Mizohata presented the ratio in the seminar on February 2, 2016, as shown in Table 7.2-3. The emission Es (the emission virtually added condensed dust) was estimated by multiplying E_1 (emission of each sources in emission inventory) to R.

In 7 source factors in Table 7.2-2, since LF7-3 and LF7-7 are particle matters and do not generate condensed dust, and the contributions of LF7-2 and LF7-3 are low, these source factors are excluded from the source of condensed dust. Regarding LF7-2, UB city does not have refuse incineration and general waste is burned in the open air. On the other hand, LF7-2 may include tire combustion in ger stove, but further discussion of this cause is needed.

JICA Experts pointed out that there are many buildings under construction and the contribution of cement composition may enlarge, however, since the contribution is low (1.6%), this source factor is also excluded from the source of condensed dust.

According to these reason, the sources of condensed dust are set to coal combustion, vehicle exhaust gas, sulfate, and nitrate.

Table 7.2-2 Concentration and Ratio of Each Source Factor Estimated by PMF

Source Factor by PMF	Concentration	
	ug/m3	%
LF7-4: Motor Vehicle	30.3	13.1
LF7-1: Coal Combustion	146.3	63.6
LF7-2: Refuse Incineration	3.6	1.6
LF7-3: Cement	3.4	1.5
LF7-7: Crustal	20.6	9.0
LF7-5: Sulfate	10.9	4.8
LF7-6: Nitrate	15.2	6.6
Total	230.3	100.0

Source: JICA Experts
Sum of ratio do not become the Total values because each value is rounded at the first decimal place.

Table 7.2-3 Concentration by Source Factor and Ratio of Generation Process for Condensed Dust

	Coal Combustion	Vehicle Exhaust Gas	Crustal	Sulfate	Nitrate	Refuse Incineration	Cement
Averaged PM10 Concentration at monitoring station (C_{AQ})	161.34						
PM10 distribution ratio of source estimated by PMF (A, %)	63.60	13.10	9.00	4.80	6.60	1.60	1.50
PM10 concentration of each source ($Cs=C_{AQ}*A/100$, ug/m3)	102.61	21.14	14.52	7.74	10.65	2.58	2.42
Concentration by CALPUFF (C1, ug/m3)	58.51	2.23	31.81	5.15	2.81		
R=Cs/C1	1.754	9.469		1.503	3.791		

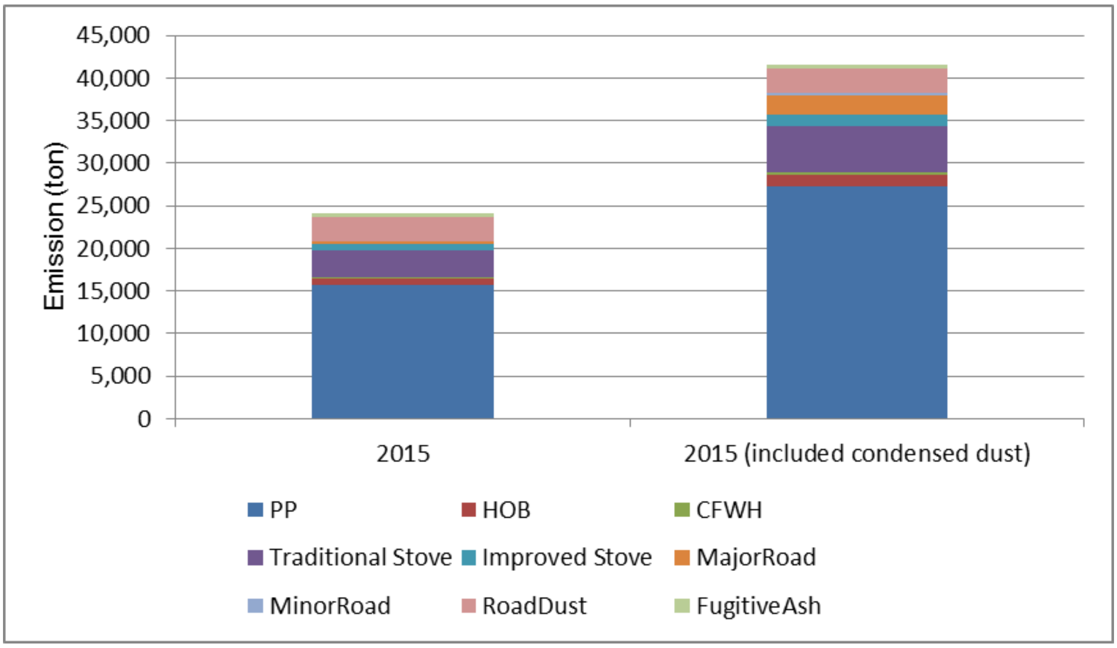
Source: JICA Experts

The condensed dust with considering PM10 emission is shown in Table 7.2-4, Figure 7.2-4, and Figure 7.2-5.

Table 7.2-4 Emission by Source before and after Considering Condensed Dust (2015)

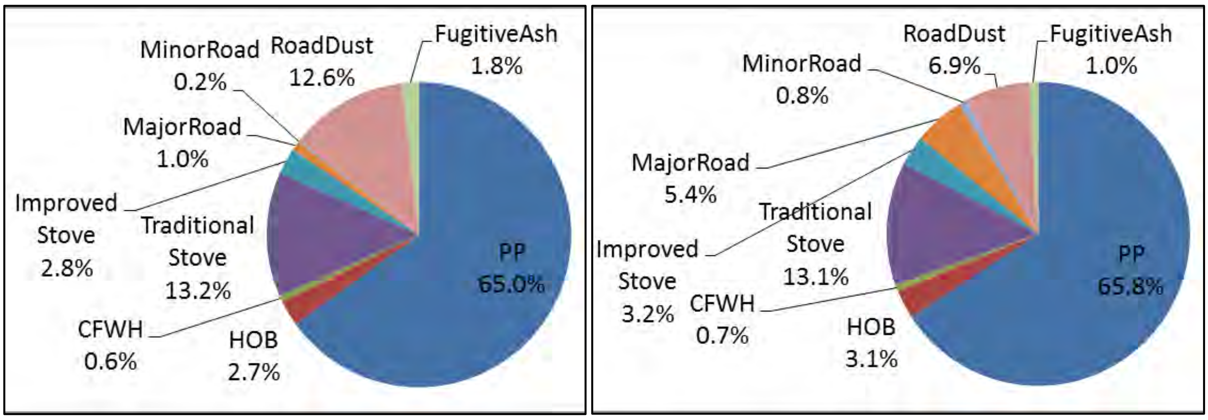
	PM10		SO4		NO3		Total	
	Before	After	Before	After	Before	After	Before	After
PP	14,786.62	25,935.72	908.98	1,366.19	10.35	39.24	15,705.94	27,341.15
HOB	623.25	1,093.18	114.75	172.48	1.12	4.25	739.13	1,269.91
CFWH	145.10	254.51	23.03	34.62	0.06	0.22	168.19	289.34
Small stove for household (Traditional stove)	3,007.86	5,275.78	104.01	156.32	2.41	9.12	3,114.27	5,441.23
Small stove for household (Improved stove)	629.17	1,103.57	142.89	214.76	0.50	1.91	772.56	1,320.23
Vehicle exhaust gas (Major road)	235.04	2,225.56	22.54	33.87	0.00	0.00	257.57	2,259.43
Vehicle exhaust gas (Minor road)	36.72	347.72	3.52	5.29	0.00	0.00	40.24	353.01
Fugitive dust from road	2,860.51	2,860.51					2,860.51	2,860.51
Fugitive ash from ash pond in PPs	409.64	409.64					409.64	409.64
Total	22,733.90	39,506.18	1,319.71	1,983.53	14.44	54.74	24,068.05	41,544.44

Unit: ton
Source: JICA Experts



Source: JICA Experts

Figure 7.2-4 PM10 Emission by Source before and after Considering Condensed Dust (2015)



Source: JICA Experts

Figure 7.2-5 Contribution by Source before and after Considering Condensed Dust (2015)

7.3 Estimation Method of PM10 Concentration

Flow diagram of dispersion simulation by using the emission considering condensed dust is shown inFigure 7.3 1.

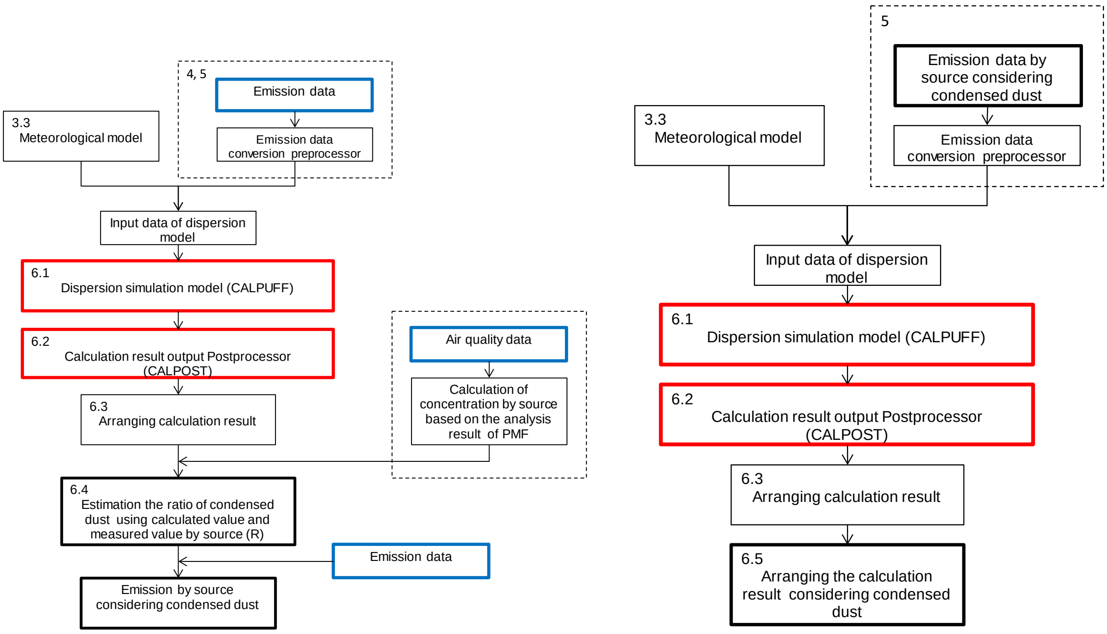


Figure 7.3-1 Flow diagram of dispersion simulation by using the emission considering condensed dust

1. Generating Process of Primary Particle Considering Condensed Dust (1.a to 1.d and 2.a to 2.c)

Based on the above, the dispersion simulation of CALPUFF was conducted using the emission with consideration of generating process for condensed dust as input data. On this occasion, concentrations calculated from SO4 and NO3 emission in generating process of primary particle were added to PM10 concentration (Figure 7.3-2).

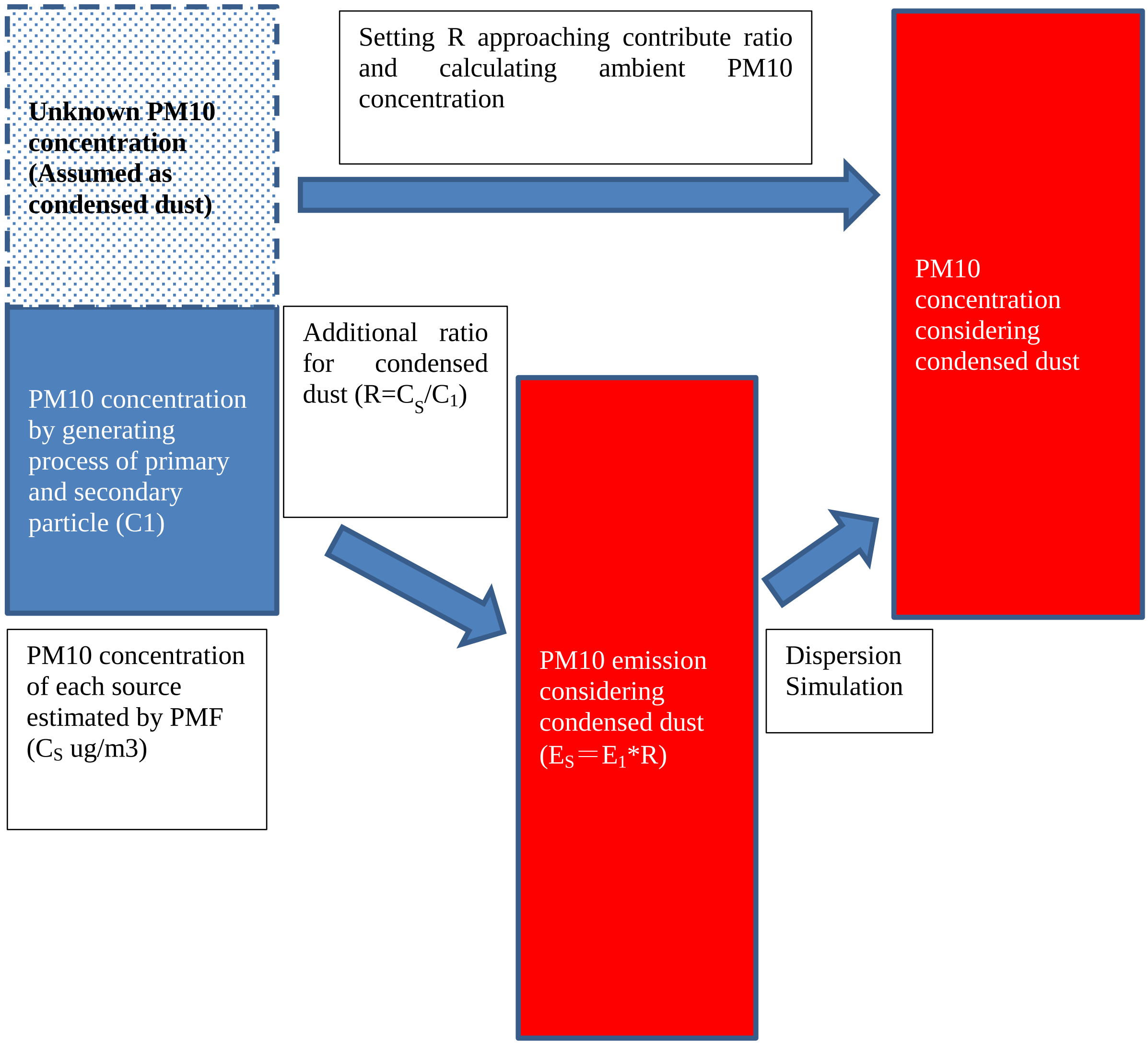


Figure 7.3-2 Estimation Image of PM10 Concentration Considered Condensed Dust

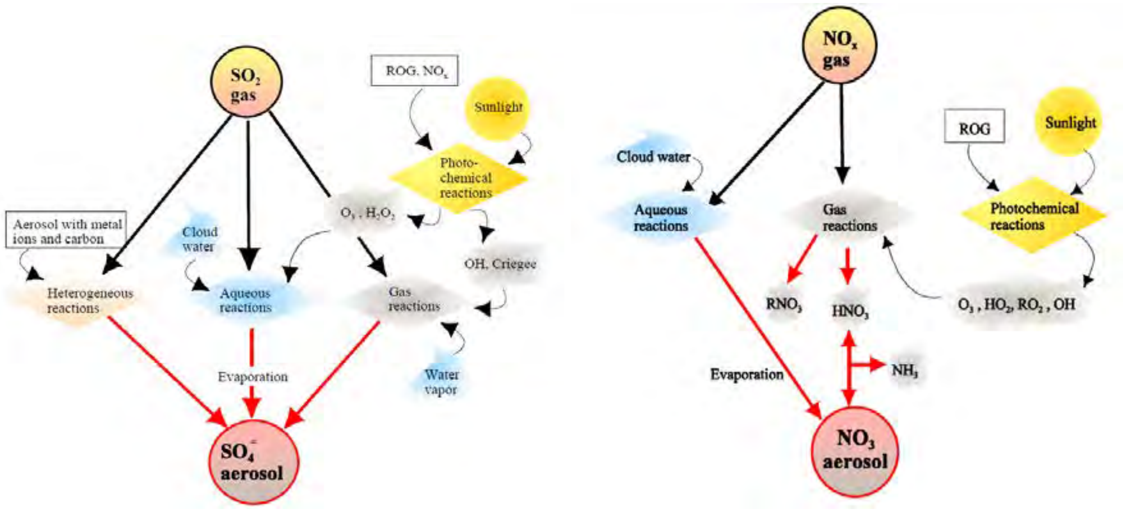
2. Generating Process of Secondary Particle by Chemical Reaction (3.a~3.b)

A pseudo-first-order chemical reaction model is applied as a chemical reaction model of CALPUFF. This chemical model considers the following generating process from SO2 to SO4, and from NOx to NO3 and HNO3.

After reactant SO2 is emitted into the air, SO4 ion is generated by the reaction to moisture, ozone and hydrogen peroxide etc. in the air, and product particle of ammonium sulfate is produced by reaction of SO4 ion and ammonia.

After reactant NOx is emitted to the air, NOx reacts in two different processes. The first process is NO3 generating process by the reaction between NOx and moisture in the air. The second process is ammonium nitrate generating process by the reaction between ammonia and the nitric acid gas to be generated by the reaction to OH radical and so on by ozone or the photochemical reaction. Besides, since this reaction is a reversible reaction depending on temperature and relative humidity, nitric acid gas and ammonium nitrate are in the equilibrium state.

The image of each generating process is shown in Figure 7.3-3. SO4, NO3 and HNO3 concentration were calculated by CALPFF dispersion simulation using SO2 and NOx emission as input data, and were added to PM10 concentration.

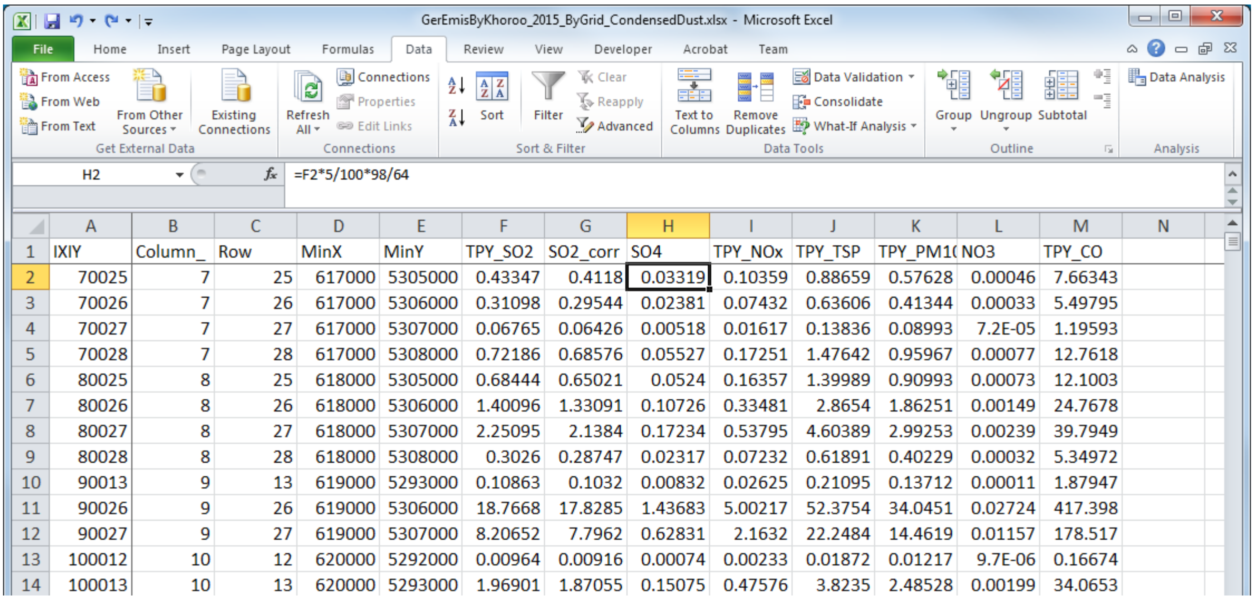


Source: A User's Guide for the CALPUFF Dispersion Model (Ver 5)

Figure 7.3-3 Generating Process of SO4 and NO3 (3.a and 3.b)

7.3.1 Converting to the Source Input Format for CALPUFF

Copy excel file created in Chapter 5 and save as new file. Open saved file and cancel the filtering function.

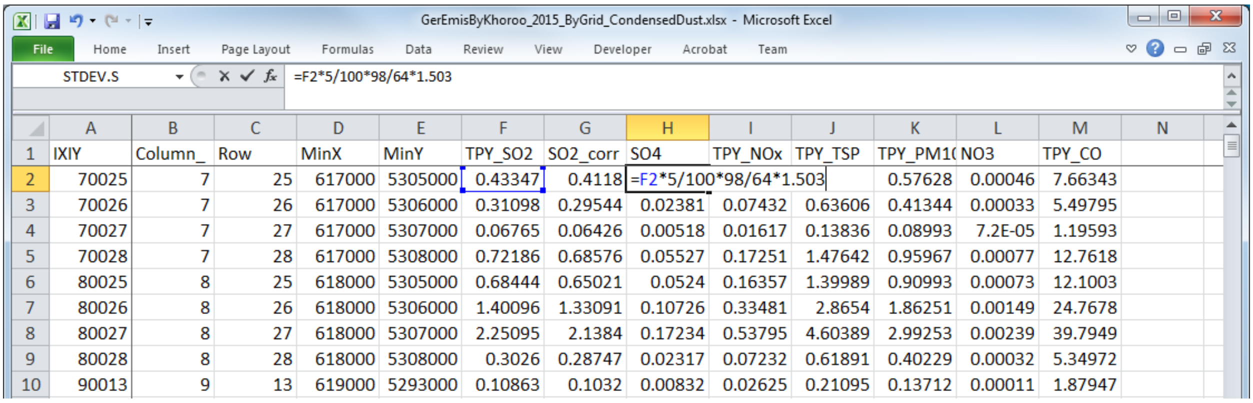


	A	B	C	D	E	F	G	H	I	J	K	L	M
1	IXIY	Column_	Row	MinX	MinY	TPY_SO2	SO2_corr	SO4	TPY_NOx	TPY_TSP	TPY_PM1(	NO3	TPY_CO
2	70025	7	25	617000	5305000	0.43347	0.4118	0.03319	0.10359	0.88659	0.57628	0.00046	7.66343
3	70026	7	26	617000	5306000	0.31098	0.29544	0.02381	0.07432	0.63606	0.41344	0.00033	5.49795
4	70027	7	27	617000	5307000	0.06765	0.06426	0.00518	0.01617	0.13836	0.08993	7.2E-05	1.19593
5	70028	7	28	617000	5308000	0.72186	0.68576	0.05527	0.17251	1.47642	0.95967	0.00077	12.7618
6	80025	8	25	618000	5305000	0.68444	0.65021	0.0524	0.16357	1.39989	0.90993	0.00073	12.1003
7	80026	8	26	618000	5306000	1.40096	1.33091	0.10726	0.33481	2.8654	1.86251	0.00149	24.7678
8	80027	8	27	618000	5307000	2.25095	2.1384	0.17234	0.53795	4.60389	2.99253	0.00239	39.7949
9	80028	8	28	618000	5308000	0.3026	0.28747	0.02317	0.07232	0.61891	0.40229	0.00032	5.34972
10	90013	9	13	619000	5293000	0.10863	0.1032	0.00832	0.02625	0.21095	0.13712	0.00011	1.87947
11	90026	9	26	619000	5306000	18.7668	17.8285	1.43683	5.00217	52.3754	34.0451	0.02724	417.398
12	90027	9	27	619000	5307000	8.20652	7.7962	0.62831	2.1632	22.2484	14.4619	0.01157	178.517
13	100012	10	12	620000	5292000	0.00964	0.00916	0.00074	0.00233	0.01872	0.01217	9.7E-06	0.16674
14	100013	10	13	620000	5293000	1.96901	1.87055	0.15075	0.47576	3.8235	2.48528	0.00199	34.0653

Update the formula to calculate SO4 and NO3 emission. This update is reflected to all rows.

SO4 Emission = SO2 Emission x conversion ratio from SO2 to SO4 x 96/64 x Additional ratio of condensed dust (R)

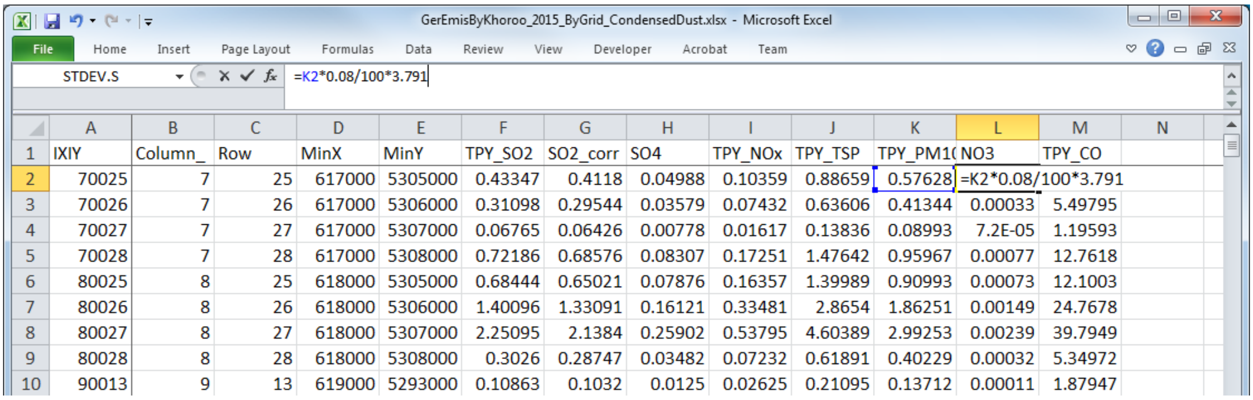
NO3 Emission =PM10 Emission x NO3 contribution ratio by composition analysis of PM10 x Additional ratio of condensed dust (R)



GerEmisByKhoroo_2015_ByGrid_CondensedDust.xlsx - Microsoft Excel

STDEV.S =F2*5/100*98/64*1.503

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	IXIY	Column_	Row	MinX	MinY	TPY_SO2	SO2_corr	SO4	TPY_NOx	TPY_TSP	TPY_PM1(	NO3	TPY_CO	
2	70025	7	25	617000	5305000	0.43347	0.4118	=F2*5/100*98/64*1.503			0.57628	0.00046	7.66343	
3	70026	7	26	617000	5306000	0.31098	0.29544	0.02381	0.07432	0.63606	0.41344	0.00033	5.49795	
4	70027	7	27	617000	5307000	0.06765	0.06426	0.00518	0.01617	0.13836	0.08993	7.2E-05	1.19593	
5	70028	7	28	617000	5308000	0.72186	0.68576	0.05527	0.17251	1.47642	0.95967	0.00077	12.7618	
6	80025	8	25	618000	5305000	0.68444	0.65021	0.0524	0.16357	1.39989	0.90993	0.00073	12.1003	
7	80026	8	26	618000	5306000	1.40096	1.33091	0.10726	0.33481	2.8654	1.86251	0.00149	24.7678	
8	80027	8	27	618000	5307000	2.25095	2.1384	0.17234	0.53795	4.60389	2.99253	0.00239	39.7949	
9	80028	8	28	618000	5308000	0.3026	0.28747	0.02317	0.07232	0.61891	0.40229	0.00032	5.34972	
10	90013	9	13	619000	5293000	0.10863	0.1032	0.00832	0.02625	0.21095	0.13712	0.00011	1.87947	



GerEmisByKhoroo_2015_ByGrid_CondensedDust.xlsx - Microsoft Excel

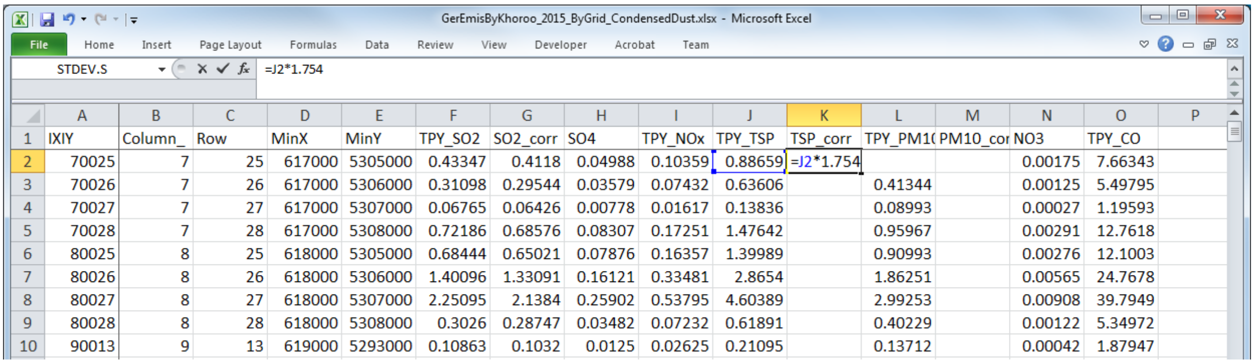
STDEV.S =K2*0.08/100*3.791

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	IXIY	Column_	Row	MinX	MinY	TPY_SO2	SO2_corr	SO4	TPY_NOx	TPY_TSP	TPY_PM1(	NO3	TPY_CO	
2	70025	7	25	617000	5305000	0.43347	0.4118	0.04988	0.10359	0.88659	0.57628	=K2*0.08/100*3.791		
3	70026	7	26	617000	5306000	0.31098	0.29544	0.03579	0.07432	0.63606	0.41344	0.00033	5.49795	
4	70027	7	27	617000	5307000	0.06765	0.06426	0.00778	0.01617	0.13836	0.08993	7.2E-05	1.19593	
5	70028	7	28	617000	5308000	0.72186	0.68576	0.08307	0.17251	1.47642	0.95967	0.00077	12.7618	
6	80025	8	25	618000	5305000	0.68444	0.65021	0.07876	0.16357	1.39989	0.90993	0.00073	12.1003	
7	80026	8	26	618000	5306000	1.40096	1.33091	0.16121	0.33481	2.8654	1.86251	0.00149	24.7678	
8	80027	8	27	618000	5307000	2.25095	2.1384	0.25902	0.53795	4.60389	2.99253	0.00239	39.7949	
9	80028	8	28	618000	5308000	0.3026	0.28747	0.03482	0.07232	0.61891	0.40229	0.00032	5.34972	
10	90013	9	13	619000	5293000	0.10863	0.1032	0.0125	0.02625	0.21095	0.13712	0.00011	1.87947	

Add one column at the right of Dust (or TSP) and PM10 column. This calculation result is reflected to all rows.

TSP Emission = TSP Emission x Additional ratio of condensed dust (R)

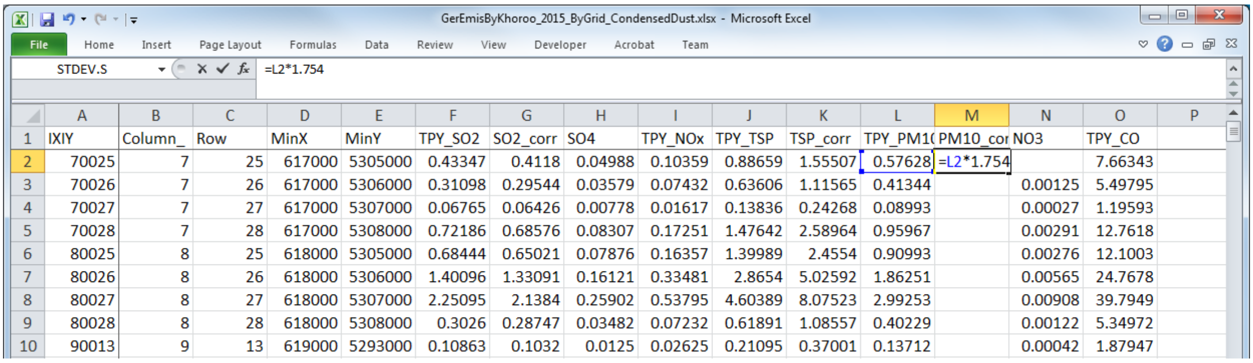
PM10 Emission = PM10 Emission x Additional ratio of condensed dust (R)



GerEmisByKhoroo_2015_ByGrid_CondensedDust.xlsx - Microsoft Excel

STDEV.S =J2*1.754

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	IXIY	Column_	Row	MinX	MinY	TPY_SO2	SO2_corr	SO4	TPY_NOx	TPY_TSP	TSP_corr	TPY_PM1(	PM10_cor	NO3	TPY_CO	
2	70025	7	25	617000	5305000	0.43347	0.4118	0.04988	0.10359	0.88659	=J2*1.754			0.00175	7.66343	
3	70026	7	26	617000	5306000	0.31098	0.29544	0.03579	0.07432	0.63606		0.41344		0.00125	5.49795	
4	70027	7	27	617000	5307000	0.06765	0.06426	0.00778	0.01617	0.13836		0.08993		0.00027	1.19593	
5	70028	7	28	617000	5308000	0.72186	0.68576	0.08307	0.17251	1.47642		0.95967		0.00291	12.7618	
6	80025	8	25	618000	5305000	0.68444	0.65021	0.07876	0.16357	1.39989		0.90993		0.00276	12.1003	
7	80026	8	26	618000	5306000	1.40096	1.33091	0.16121	0.33481	2.8654		1.86251		0.00565	24.7678	
8	80027	8	27	618000	5307000	2.25095	2.1384	0.25902	0.53795	4.60389		2.99253		0.00908	39.7949	
9	80028	8	28	618000	5308000	0.3026	0.28747	0.03482	0.07232	0.61891		0.40229		0.00122	5.34972	
10	90013	9	13	619000	5293000	0.10863	0.1032	0.0125	0.02625	0.21095		0.13712		0.00042	1.87947	

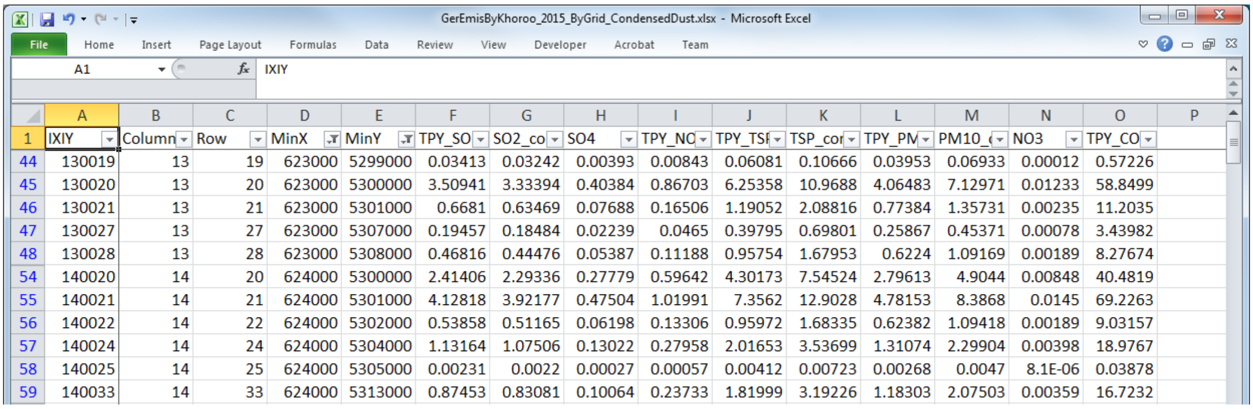


GerEmisByKhoroo_2015_ByGrid_CondensedDust.xlsx - Microsoft Excel

STDEV.S =L2*1.754

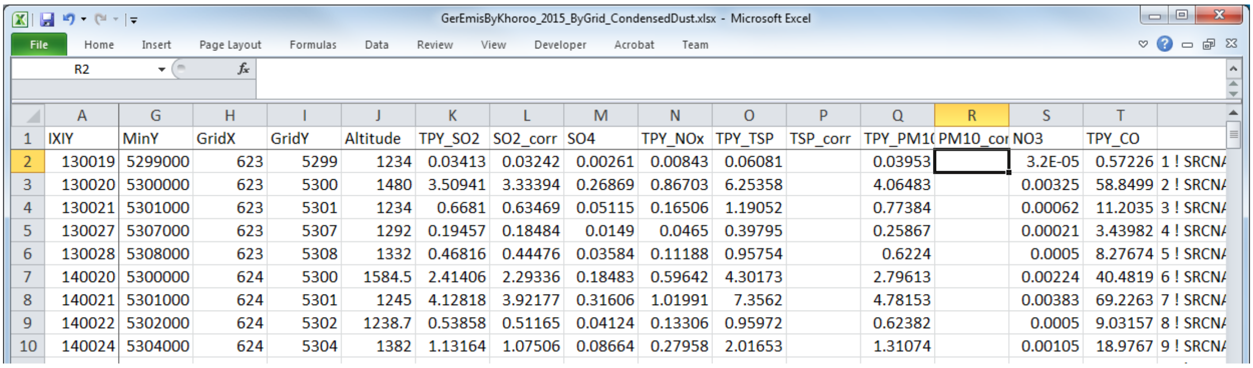
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	IXIY	Column_	Row	MinX	MinY	TPY_SO2	SO2_corr	SO4	TPY_NOx	TPY_TSP	TSP_corr	TPY_PM1(	PM10_cor	NO3	TPY_CO	
2	70025	7	25	617000	5305000	0.43347	0.4118	0.04988	0.10359	0.88659	1.55507	0.57628	=L2*1.754		7.66343	
3	70026	7	26	617000	5306000	0.31098	0.29544	0.03579	0.07432	0.63606	1.11565	0.41344		0.00125	5.49795	
4	70027	7	27	617000	5307000	0.06765	0.06426	0.00778	0.01617	0.13836	0.24268	0.08993		0.00027	1.19593	
5	70028	7	28	617000	5308000	0.72186	0.68576	0.08307	0.17251	1.47642	2.58964	0.95967		0.00291	12.7618	
6	80025	8	25	618000	5305000	0.68444	0.65021	0.07876	0.16357	1.39989	2.4554	0.90993		0.00276	12.1003	
7	80026	8	26	618000	5306000	1.40096	1.33091	0.16121	0.33481	2.8654	5.02592	1.86251		0.00565	24.7678	
8	80027	8	27	618000	5307000	2.25095	2.1384	0.25902	0.53795	4.60389	8.07523	2.99253		0.00908	39.7949	
9	80028	8	28	618000	5308000	0.3026	0.28747	0.03482	0.07232	0.61891	1.08557	0.40229		0.00122	5.34972	
10	90013	9	13	619000	5293000	0.10863	0.1032	0.0125	0.02625	0.21095	0.37001	0.13712		0.00042	1.87947	

Add the filtering function and specify the range of coordinate values of X and Y.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	IXIY	Column	Row	MinX	MinY	TPY_SO	SO2_co	SO4	TPY_NO	TPY_TSI	TSP_cor	TPY_PM	PM10_(	NO3	TPY_CO
44	130019	13	19	623000	5299000	0.03413	0.03242	0.00393	0.00843	0.06081	0.10666	0.03953	0.06933	0.00012	0.57226
45	130020	13	20	623000	5300000	3.50941	3.33394	0.40384	0.86703	6.25358	10.9688	4.06483	7.12971	0.01233	58.8499
46	130021	13	21	623000	5301000	0.6681	0.63469	0.07688	0.16506	1.19052	2.08816	0.77384	1.35731	0.00235	11.2035
47	130027	13	27	623000	5307000	0.19457	0.18484	0.02239	0.0465	0.39795	0.69801	0.25867	0.45371	0.00078	3.43982
48	130028	13	28	623000	5308000	0.46816	0.44476	0.05387	0.11188	0.95754	1.67953	0.6224	1.09169	0.00189	8.27674
54	140020	14	20	624000	5300000	2.41406	2.29336	0.27779	0.59642	4.30173	7.54524	2.79613	4.9044	0.00848	40.4819
55	140021	14	21	624000	5301000	4.12818	3.92177	0.47504	1.01991	7.3562	12.9028	4.78153	8.3868	0.0145	69.2263
56	140022	14	22	624000	5302000	0.53858	0.51165	0.06198	0.13306	0.95972	1.68335	0.62382	1.09418	0.00189	9.03157
57	140024	14	24	624000	5304000	1.13164	1.07506	0.13022	0.27958	2.01653	3.53699	1.31074	2.29904	0.00398	18.9767
58	140025	14	25	624000	5305000	0.00231	0.0022	0.00027	0.00057	0.00412	0.00723	0.00268	0.0047	8.1E-06	0.03878
59	140033	14	33	624000	5313000	0.87453	0.83081	0.10064	0.23733	1.81999	3.19226	1.18303	2.07503	0.00359	16.7232

Add one column at the right of Dust (or TSP) and PM10 column in “13b”, “14b”, and “15b” sheet.



	A	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	
1	IXIY	MinY	GridX	GridY	Altitude	TPY_SO2	SO2_corr	SO4	TPY_NOx	TPY_TSP	TSP_corr	TPY_PM1(	PM10_cor	NO3	TPY_CO	
2	130019	5299000	623	5299	1234	0.03413	0.03242	0.00261	0.00843	0.06081		0.03953		3.2E-05	0.57226	1 ! SRCNA
3	130020	5300000	623	5300	1480	3.50941	3.33394	0.26869	0.86703	6.25358		4.06483		0.00325	58.8499	2 ! SRCNA
4	130021	5301000	623	5301	1234	0.6681	0.63469	0.05115	0.16506	1.19052		0.77384		0.00062	11.2035	3 ! SRCNA
5	130027	5307000	623	5307	1292	0.19457	0.18484	0.0149	0.0465	0.39795		0.25867		0.00021	3.43982	4 ! SRCNA
6	130028	5308000	623	5308	1332	0.46816	0.44476	0.03584	0.11188	0.95754		0.6224		0.0005	8.27674	5 ! SRCNA
7	140020	5300000	624	5300	1584.5	2.41406	2.29336	0.18483	0.59642	4.30173		2.79613		0.00224	40.4819	6 ! SRCNA
8	140021	5301000	624	5301	1245	4.12818	3.92177	0.31606	1.01991	7.3562		4.78153		0.00383	69.2263	7 ! SRCNA
9	140022	5302000	624	5302	1238.7	0.53858	0.51165	0.04124	0.13306	0.95972		0.62382		0.0005	9.03157	8 ! SRCNA
10	140024	5304000	624	5304	1382	1.13164	1.07506	0.08664	0.27958	2.01653		1.31074		0.00105	18.9767	9 ! SRCNA

Copy the value of emissions from the above calculation sheets and paste them the relevant part of “13b”, “14b”, and “15b” in CALPUFF input file.

GerEmisByKhoroo_2015_ByGrid_CondensedDust.xlsx - Microsoft Excel

F44 | 0.0341255611728872

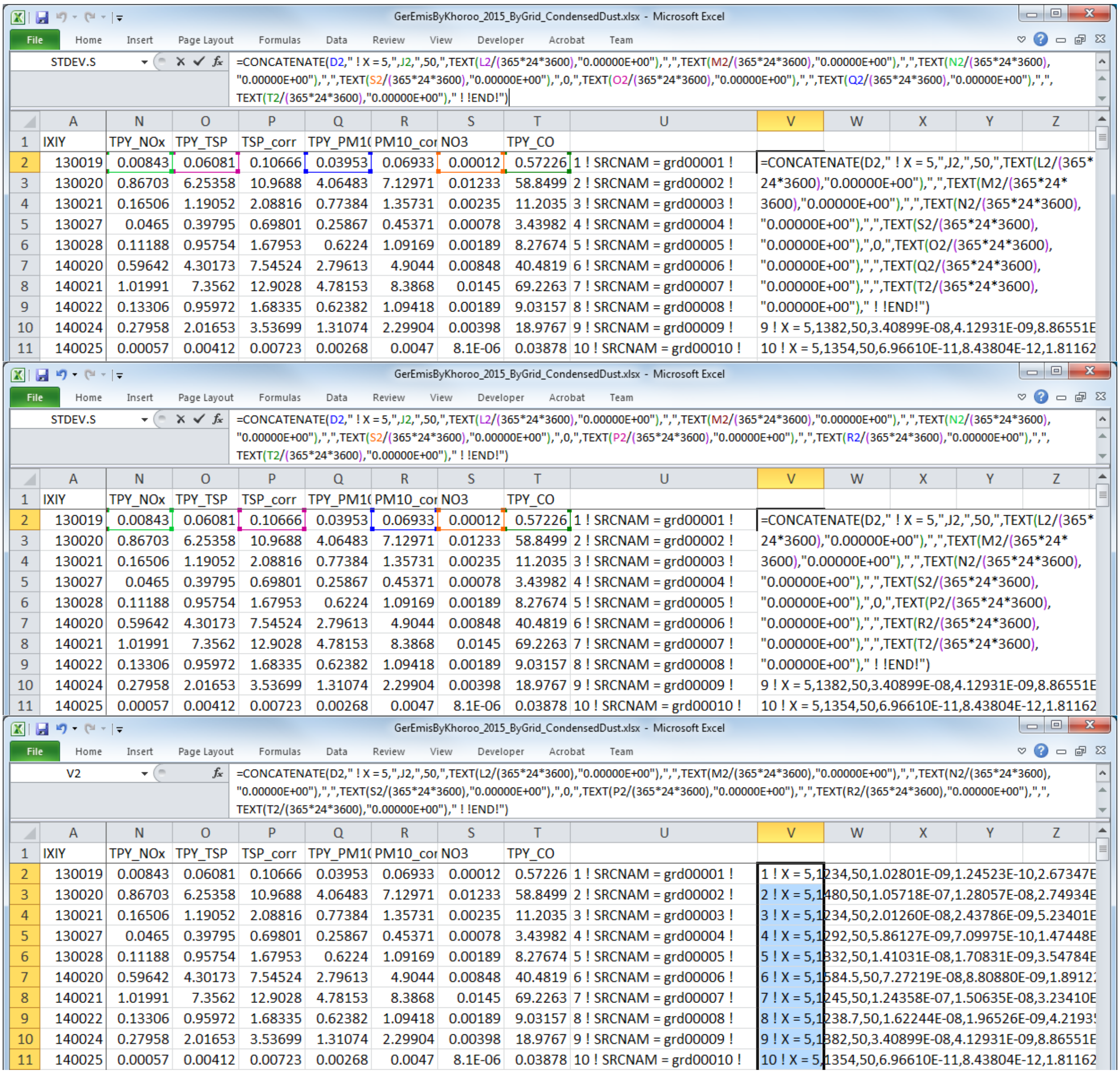
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	IXIY	Column	Row	MinX	MinY	TPY_SO	SO2_co	SO4	TPY_NO	TPY_TSI	TSP_cor	TPY_PM	PM10_(	NO3	TPY_CO
507	420029	42	29	652000	5309000	1.94661	1.84928	0.224	0.45559	4.21446	7.39217	2.7394	4.80491	0.00831	35.1221
508	420030	42	30	652000	5310000	13.8444	13.1522	1.59313	3.24022	29.9736	52.5737	19.4828	34.1729	0.05909	249.791
509	420031	42	31	652000	5311000	19.0562	18.1034	2.19286	4.45999	41.2571	72.365	26.8171	47.0372	0.08133	343.825
510	420032	42	32	652000	5312000	1.76151	1.67343	0.2027	0.41227	3.81371	6.68924	2.47891	4.34801	0.00752	31.7823
511	430030	43	30	653000	5310000	0.99476	0.94502	0.11447	0.23305	2.14689	3.76564	1.39548	2.44767	0.00423	17.9256
512	430031	43	31	653000	5311000	7.24417	6.88196	0.83361	2.05218	5.18421	9.0931	3.36973	5.91051	0.01022	95.7997
513	430032	43	32	653000	5312000	1.21939	1.15842	0.14032	0.3536	0.63245	1.10931	0.41109	0.72105	0.00125	15.3272
514	440027	44	27	654000	5307000	1.7766	1.68777	0.20444	0.42808	3.48491	6.11254	2.26519	3.97315	0.00687	30.8529
515	440028	44	28	654000	5308000	3.56841	3.38999	0.41063	0.85983	6.99968	12.2774	4.54979	7.98034	0.0138	61.9702
516	440031	44	31	654000	5311000	7.72061	7.33458	0.88844	2.23882	4.00434	7.02361	2.60282	4.56535	0.00789	97.0445

GerEmisByKhoroo_2015_ByGrid_CondensedDust.xlsx - Microsoft Excel

K2 | 0.0341255611728872

	A	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	
1	IXIY	MinY	GridX	GridY	Altitude	TPY_SO2	SO2_corr	SO4	TPY_NOx	TPY_TSP	TSP_corr	TPY_PM1(	PM10_cor	NO3	TPY_CO	
387	420029	5309000	652	5309	1313	1.94661	1.84928	0.224	0.45559	4.21446	7.39217	2.7394	4.80491	0.00831	35.1221	386 ! SRC
388	420030	5310000	652	5310	1325	13.8444	13.1522	1.59313	3.24022	29.9736	52.5737	19.4828	34.1729	0.05909	249.791	387 ! SRC
389	420031	5311000	652	5311	1422.5	19.0562	18.1034	2.19286	4.45999	41.2571	72.365	26.8171	47.0372	0.08133	343.825	388 ! SRC
390	420032	5312000	652	5312	1439	1.76151	1.67343	0.2027	0.41227	3.81371	6.68924	2.47891	4.34801	0.00752	31.7823	389 ! SRC
391	430030	5310000	653	5310	1317.5	0.99476	0.94502	0.11447	0.23305	2.14689	3.76564	1.39548	2.44767	0.00423	17.9256	390 ! SRC
392	430031	5311000	653	5311	1382.5	7.24417	6.88196	0.83361	2.05218	5.18421	9.0931	3.36973	5.91051	0.01022	95.7997	391 ! SRC
393	430032	5312000	653	5312	1488	1.21939	1.15842	0.14032	0.3536	0.63245	1.10931	0.41109	0.72105	0.00125	15.3272	392 ! SRC
394	440027	5307000	654	5307	1329	1.7766	1.68777	0.20444	0.42808	3.48491	6.11254	2.26519	3.97315	0.00687	30.8529	393 ! SRC
395	440028	5308000	654	5308	1317	3.56841	3.38999	0.41063	0.85983	6.99968	12.2774	4.54979	7.98034	0.0138	61.9702	394 ! SRC
396	440031	5311000	654	5311	1361.5	7.72061	7.33458	0.88844	2.23882	4.00434	7.02361	2.60282	4.56535	0.00789	97.0445	395 ! SRC

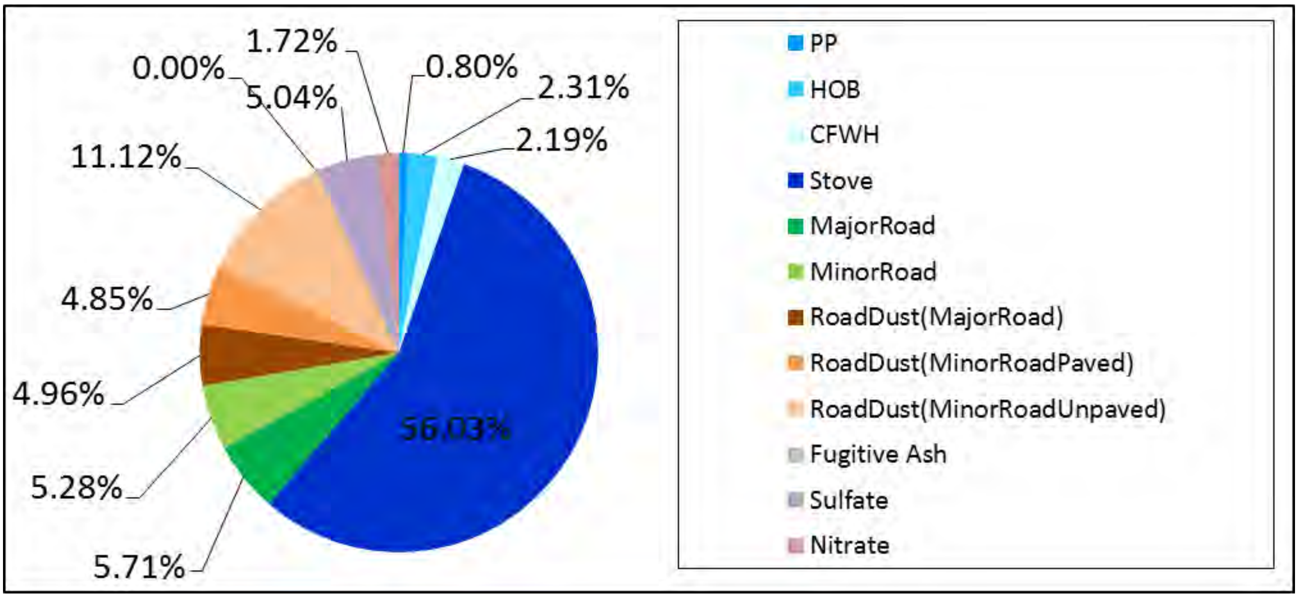
Regarding the formula in the column that creates the string of source information to be inserted in CALPUFF input file, correct the cell that specifies TSP and PM10 emission to the cell of the value considering condensed dust.



7.3.2 Conducting Dispersion Simulation and Organizing the Calculation Result by Using the Emission Considering Condensed Dust

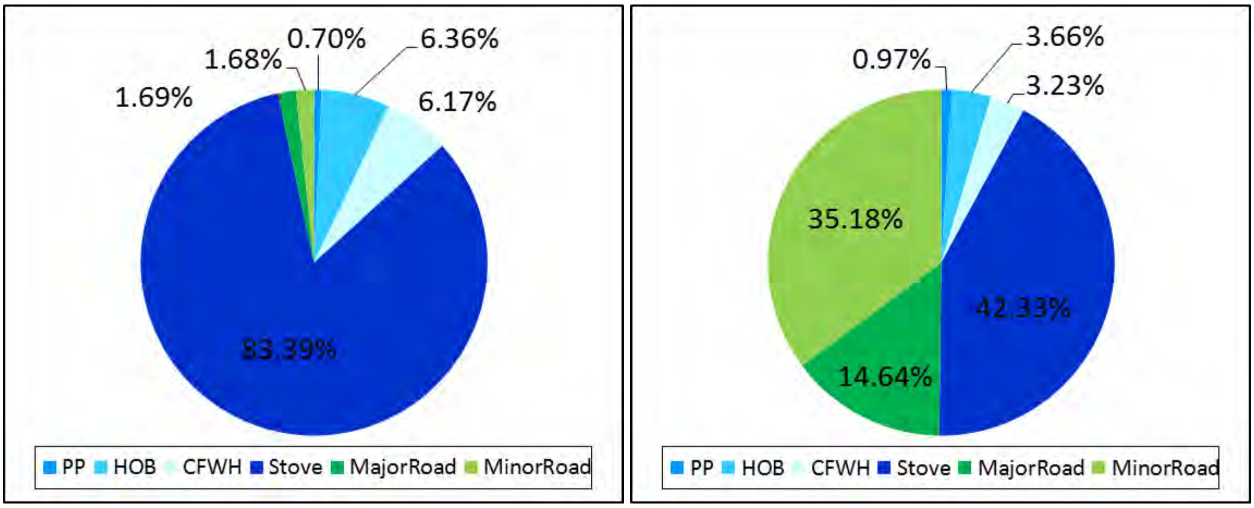
Repeat step 5 and 6.1 to 6.3 using the estimated emissions.

The result of dispersion simulation using the emission of PM10 considering condensed dust is shown in Figure 7.3-4. Also, the concentration ratio by source in sulfate and nitrate is shown in Figure 7.3-5.



Source: JICA Experts

Figure 7.3-4 PM10 Contribution Ratio at CLEM-5



Left: Sulfate, Right: Nitrate
Source: JICA Experts

Figure 7.3-5 Sulfate and Nitrate Contribution Ratio as CLEM-5

8 Evaluation of Air Pollution Control Measure Plan

8.1 Conducting the Dispersion Simulation Based on Air Pollution Control Measure Plan

Figure 8.1-1 shows the flow diagram of estimation of emission and conduct of dispersion simulation based on control measures. Two calculation methods are assumed depending on whether the reduction of PM emission in emission inventory and the reduction of condensed dust in PM emission are proportional to each other when estimating the emissions considering condensed dust after control measure.

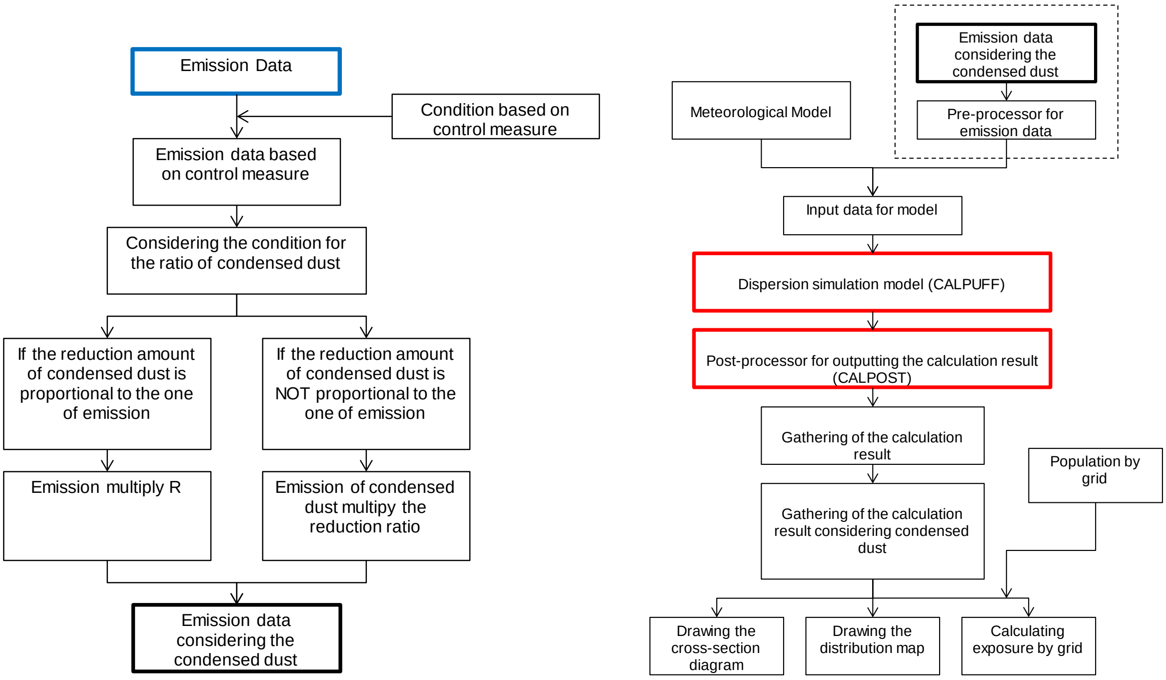


Figure 8.1-1 Flow Diagram for Estimation of Emission and Conduct of Dispersion Simulation Based on Air Pollution Control Measures

8.1.1 In the Case of Proportion

In this case, condensed dust will be assumed to decrease at the same ratio as the emission reduction in emission inventory. Therefore, estimate the emissions considering condensed dust according to the following formula. The image of the estimate of emissions is shown in Figure 8.1-2. An example of control measure is the case that coal consumption expected to decrease by replacement to a boiler or a stove with high efficiency combustion.

$$Es' = E_1' * R$$

Es': Emission considering condensed dust after control measures

E_1': Emission considering only primary particle after control measures

R: Additional ratio of condensed dust (Value of each source calculated in 7.2)

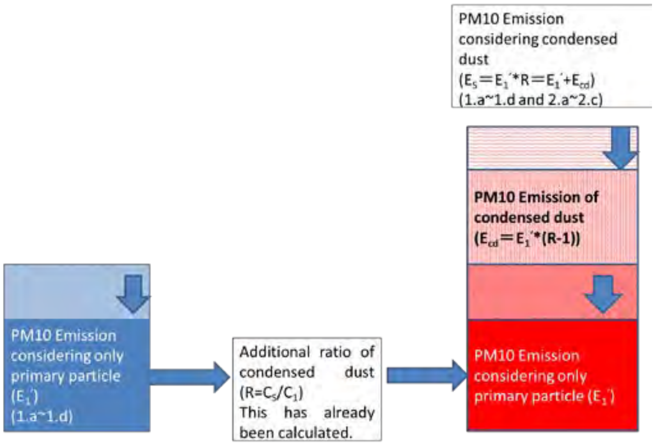


Figure 8.1-2 Image of the Estimate of Emissions in the Case of Proportion

8.1.2 In the Case of Not Proportion

In this case, the reduction of condensed dust will be assumed to change due to different factors from the emission reduction in emission inventory. Estimate the emissions considering condensed dust according to the following formula. The image of the estimate of emissions is shown in Figure 8.1-3. An example of control measure is the case that since the installation of cyclone in HOB reduces the emission of particulate matter, especially primary particles, but the volatile matter from which condensed dust is produced does not decrease, the emission of condensed dust is the same as before control measure.

$$\mathrm{Es}' = \mathrm{E}_1' + \mathrm{E}_{cd}$$

$$\mathrm{E}_{cd} = E_1 * (R - 1) * X$$

Es': Emission considering condensed dust after control measures

E_1': Emission considering only primary particle after control measures

E_{cd}: Emission of condensed dust after control measures

E_1: Emission considering only primary particle before control measures

R: Additional ratio of condensed dust (Value of each source calculated in 7.2)

X: Reduction ratio of condensed dust (X=1: Not reduction of condensed dust, X=0: Condensed dust disappears)

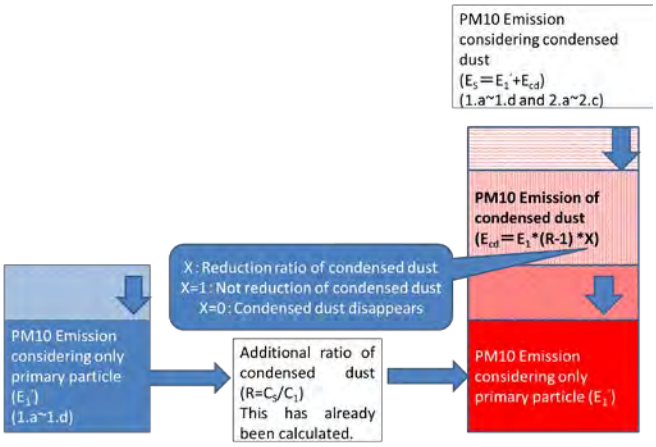


Figure 8.1-3 Image of the Estimate of Emissions in the Case of Not Proportion

8.2 Evaluation of Air Pollution Control Measure Plan

Compare emissions and concentrations (maximum concentration, average concentration) before and after implementation of control measures plan, and verify the reduction effect of emissions and concentration. On the other hand, when narrowing down the areas to which control measure is applied, the reduction effect of emission and concentration in the applicable area should be verified.

To evaluate the influence to citizens in UB city, the exposure that PM10 concentration weighted by population (PWE; Population-Weighted Exposure) was calculated. Using PWE, the concentration considered the size of population can be calculated. The method in WB (2011)[12] was used as calculation method of PWE.

$$PWE = \frac{\sum(C_i \times P_i)}{PT}$$

PWE: PWE in calculation area (μg/m3)

Ci: Concentration in grid i (μg/m3)

Pi: Population in grid i

PT: Total population in calculation area

In addition, obtain information on costs for implementing control measures and estimate the cost for implementing control measures based on this information. Estimate the cost to reduce 1ton or 1μg/m3 by dividing the estimated cost by the reduction amount of emission or concentration. The smaller this amount is, the more cost-effectiveness is.

Obtain information on costs by interviewing administrative organizations such as ministries and agencies that control measure jurisdiction and companies that produce improved fuels and flow gas treatment equipment.

As examples of utilization of these methods, a case where a cyclone is installed into a HOB without a flow gas treatment equipment is shown.

[12] Air Quality Analysis of Ulaanbaatar Improving Air Quality to Reduce Health Impacts, WB 2011

Example: Installation of cycleon for control measure to HOB

In the case of cyclone is installed to all boilers without stack gas treatment equipment (164 units) in HOB emission inventory for 2015, emission estimation and dispersion simulation were conducted.

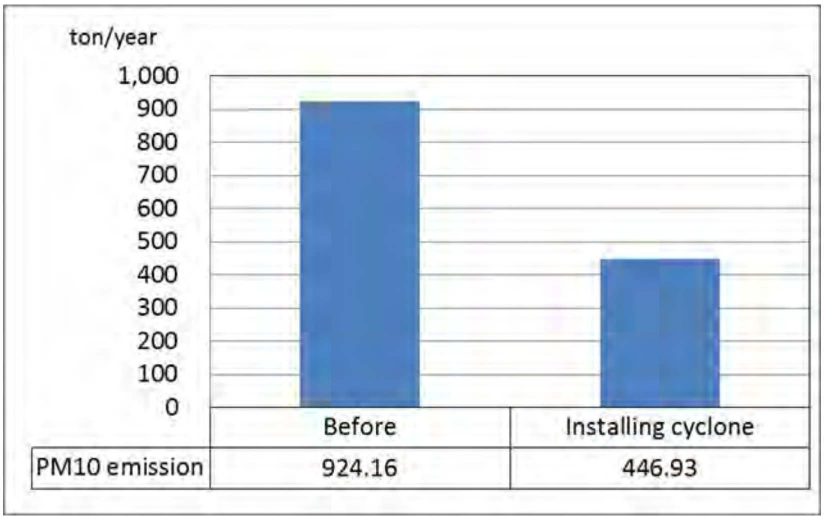
1. Setting

Dust collection efficiency of cyclone was set to 60%. Since only particle matter can be collected by cyclone, amount of condensed dust was set to be the same as before control measure.

2. Chenge PM10 emission

Change of emission is the following figure. Reduction ratio was 51.64%.

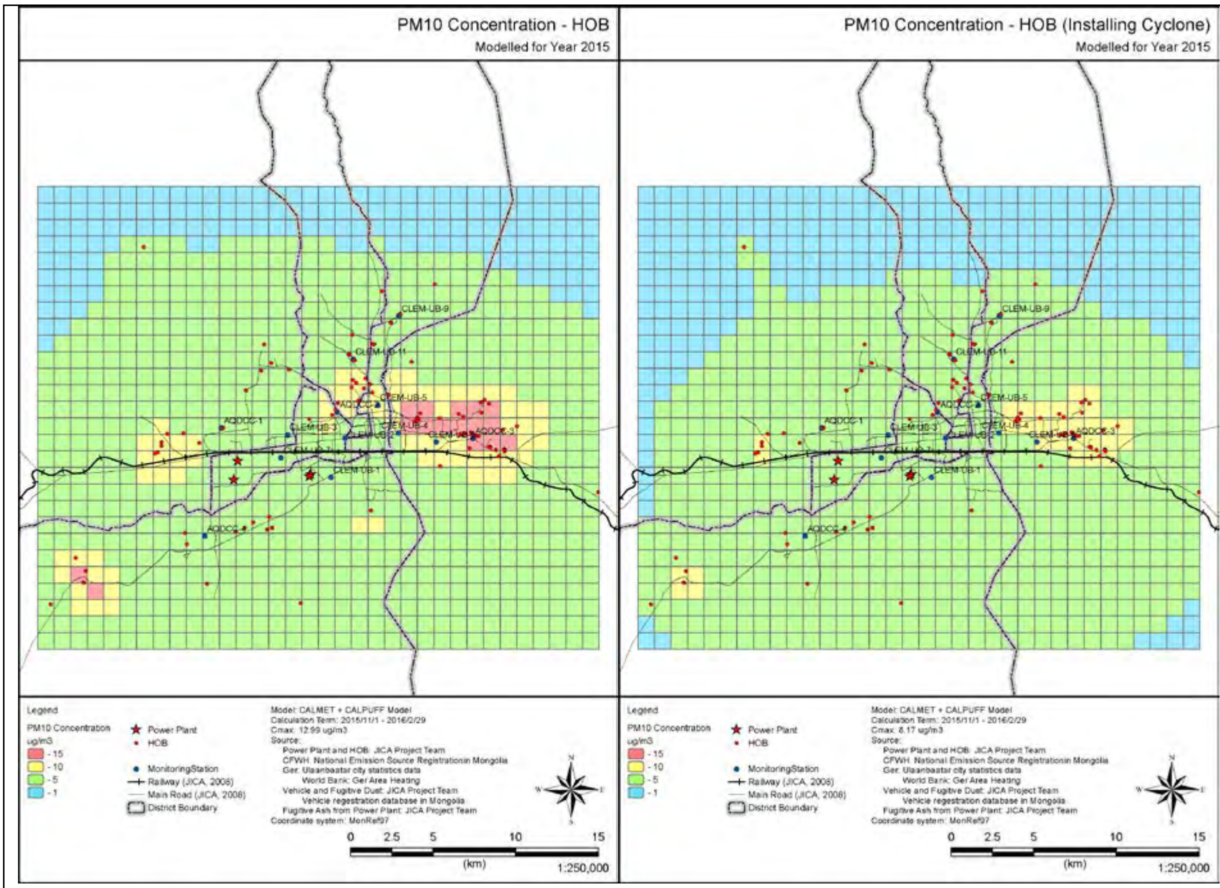
排出量の変化は以下の Figure の通りである。削減率は 51.64%であった。



3. Change PM10 concentration

PM10 concentration distribution is shown in the following figures. In addition, Maximum PM10 concentration and PWE is shown in the following table.

	Before	**After**	**Reduction amount**
Maximum concentration	12.99	8.17	4.72
PWE	4.85	3.10	1.76



4. Cost-effectiveness

Since many boilers without cyclone are relatively small capacity boilers, the installment cost of a cyclone was set as the average costs for 0.4 MW and 0.7 MW (5,940,000Tg).

5,940,000Tg x 164units / 477.23ton = 2,041,000 Tg/ton