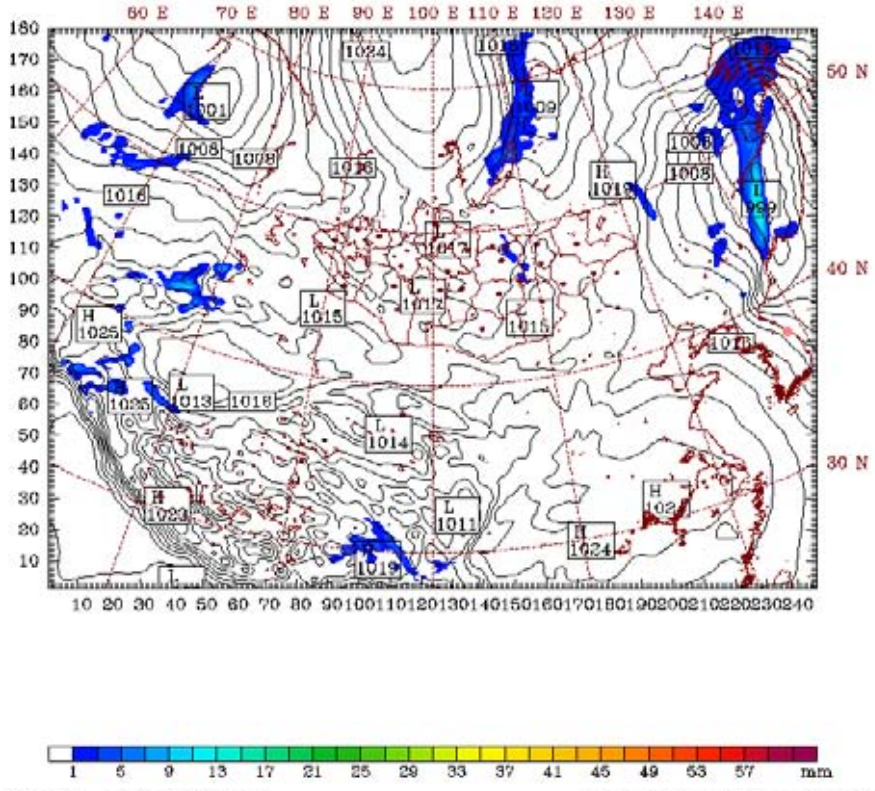
別冊３　　気象予報

・ 短期予報（1 日 2 回）
・ 長期予報（年 2 回）
・ コンピュータによる典型的な天候や異常気象に係る事例集

Dataset: R1 RIP: rain-18 Init: 1200 UTC Tue 22 Apr 08
Fcst: 24.00 Valid: 1200 UTC Wed 23 Apr 08 (2000 LST Wed 23 Apr 08)



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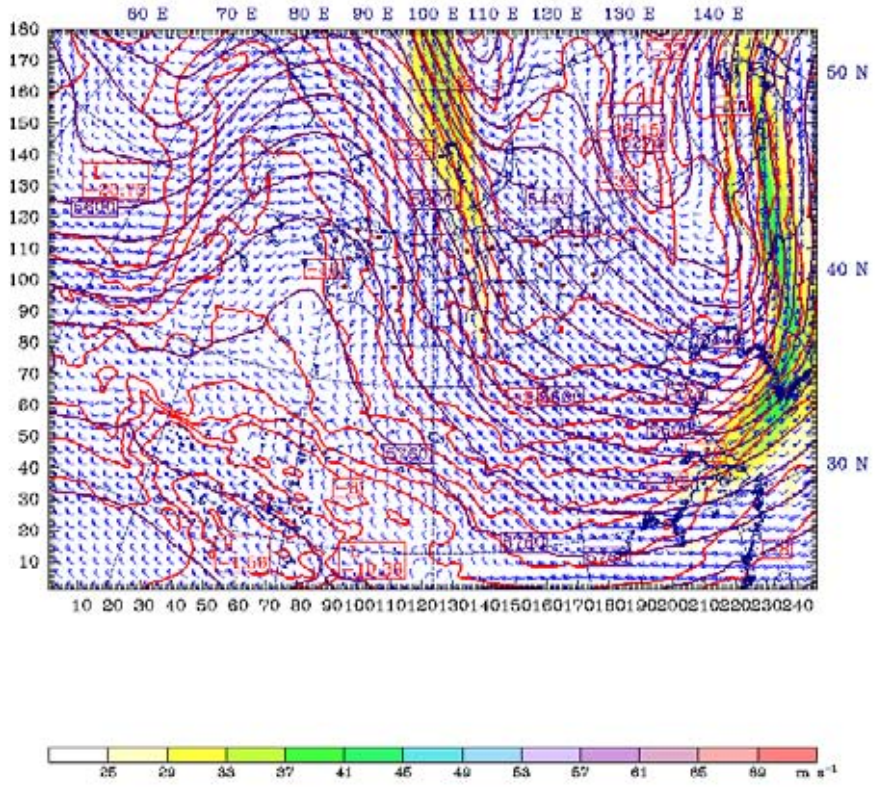
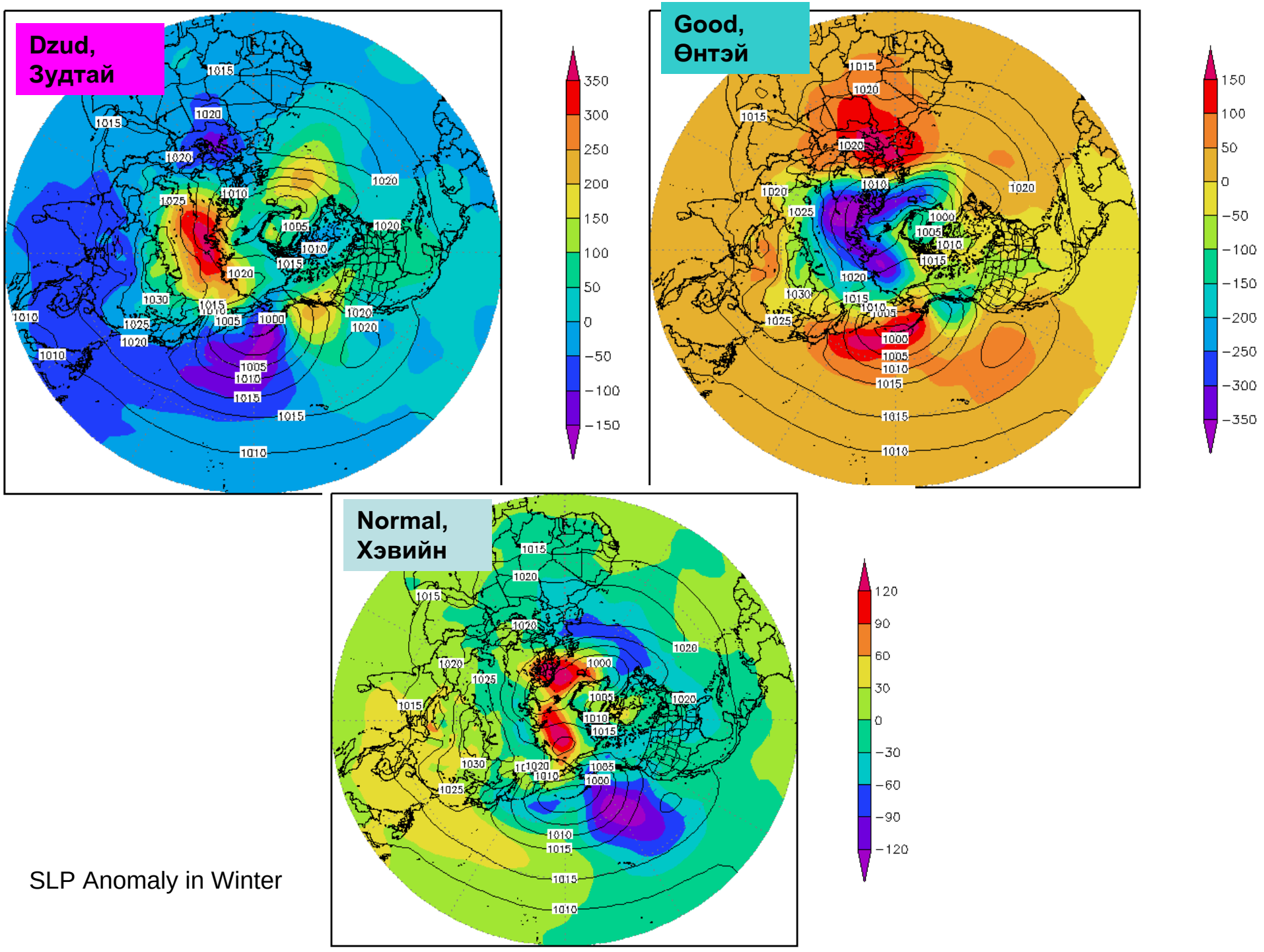


WINTER WEATHER OUTLOOK in 2008-2009

Forecast research laboratory
Forecast section
Institute of Meteorology and Hydrology



SLP Anomaly in Winter

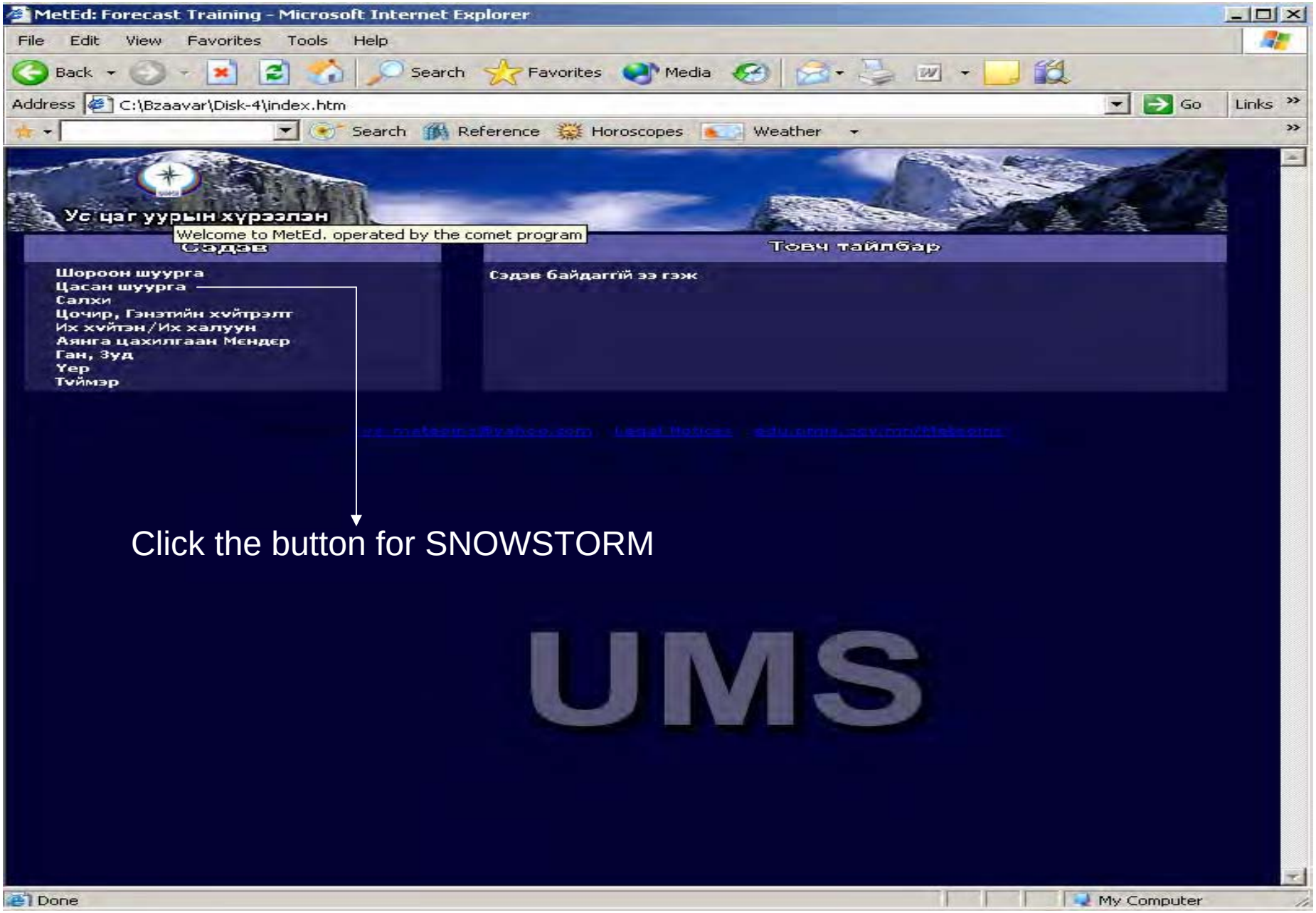
Basic design of HAND-BOOK for the typical weather phenomena

Case on SNOWSTORM
/Sample of Website/

2006

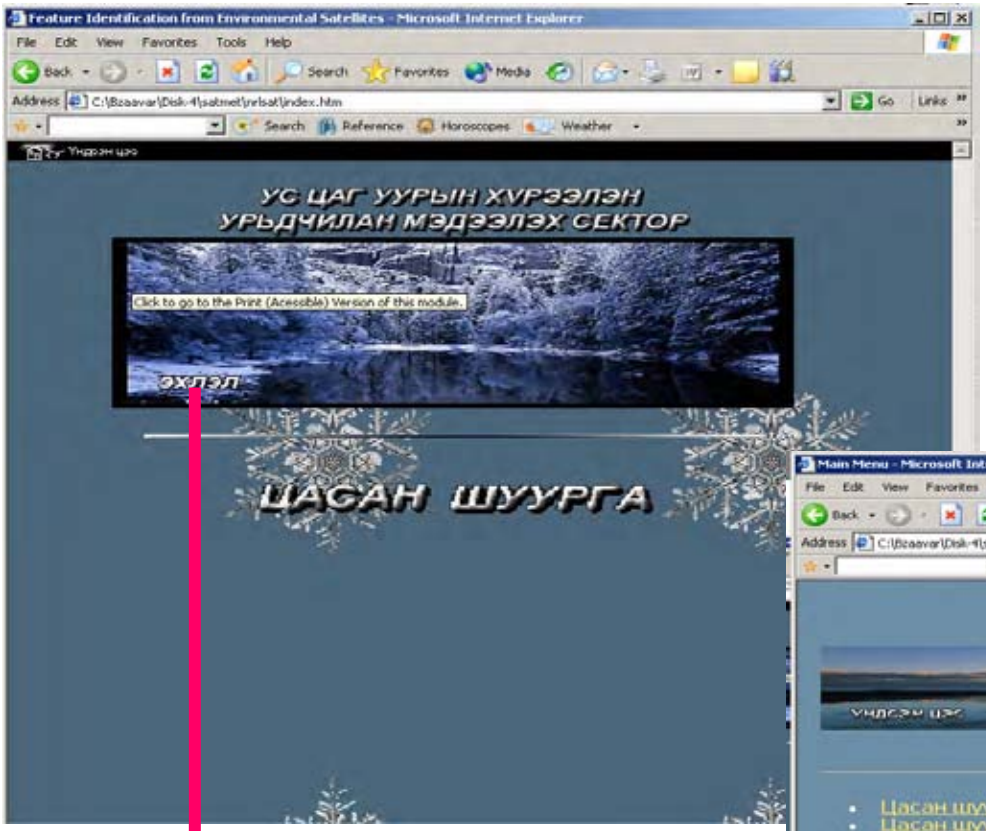
NAMHEM

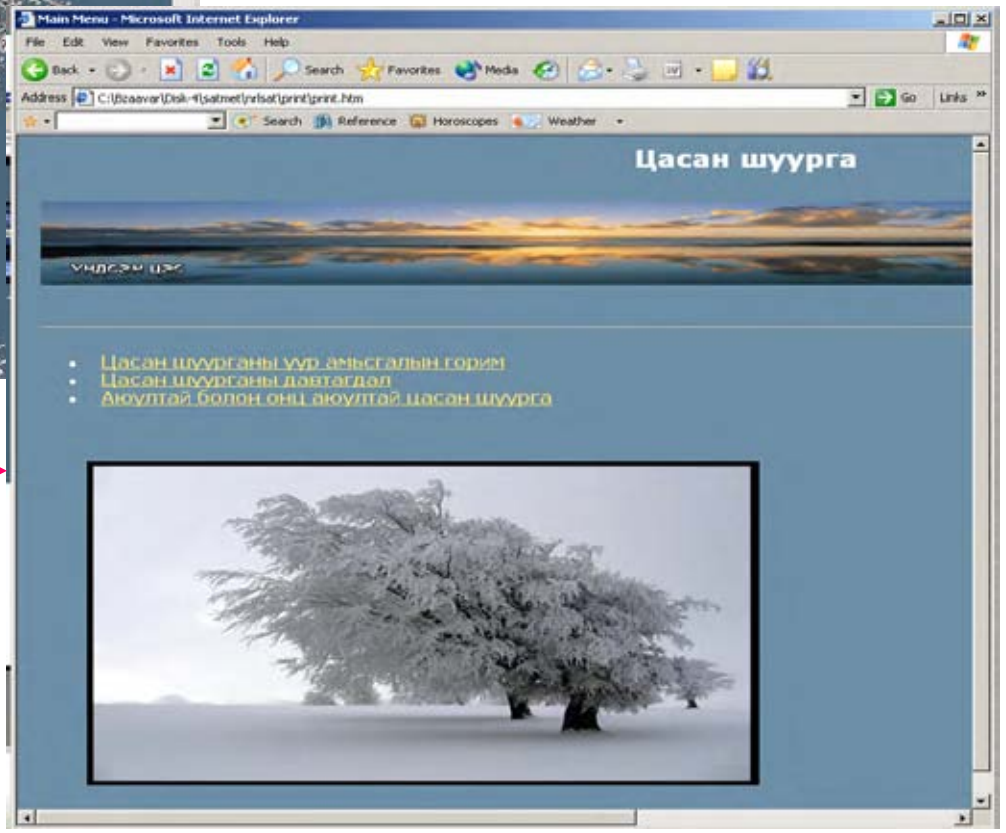
MAIN MENU



Click the button for SNOWSTORM

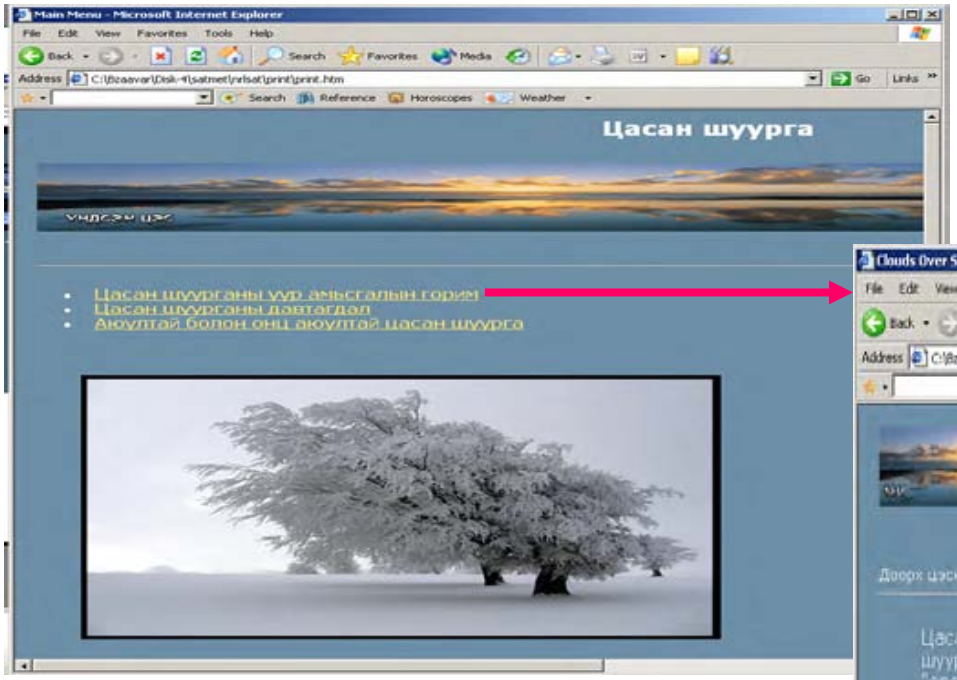
TOP MENU

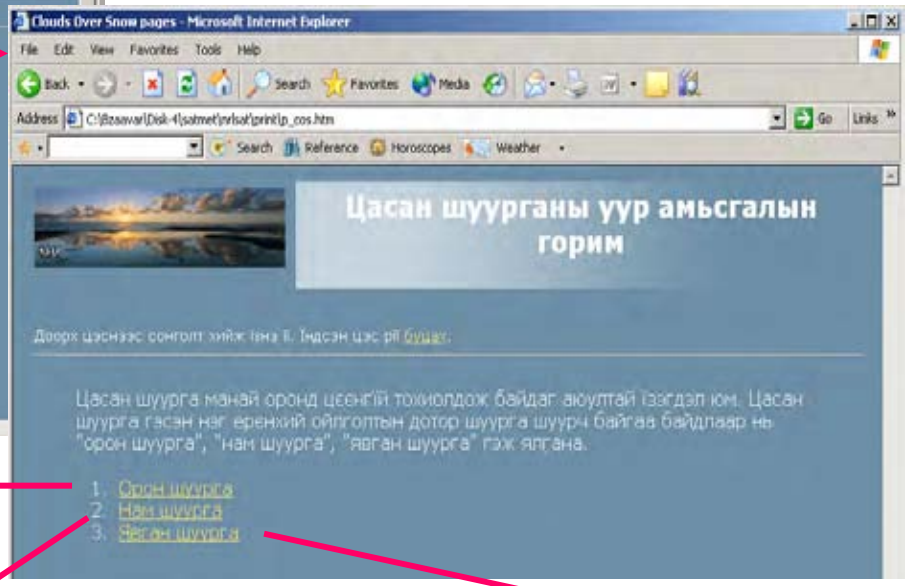


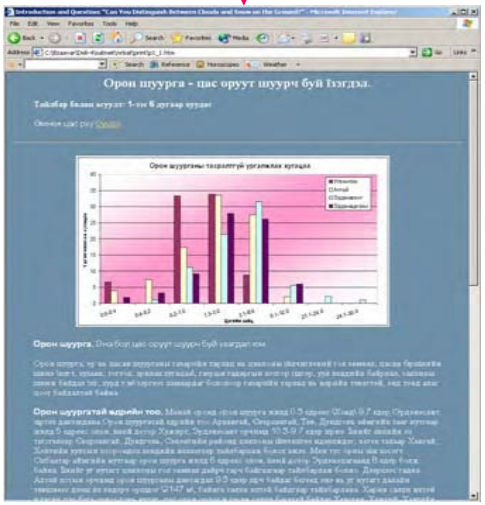


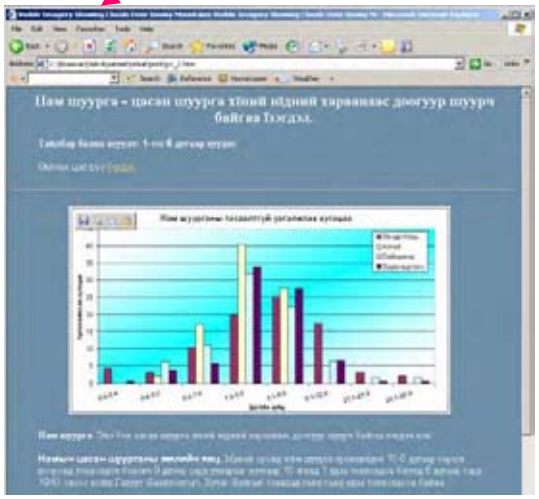
beginning

TOP MENU for SNOWSTORM









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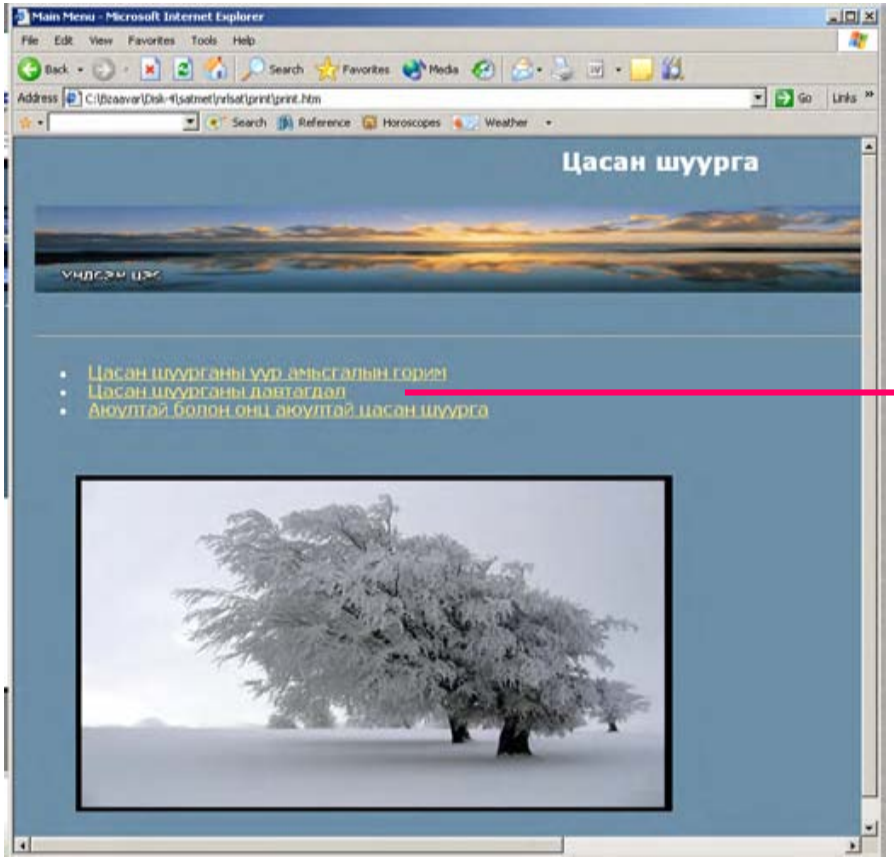
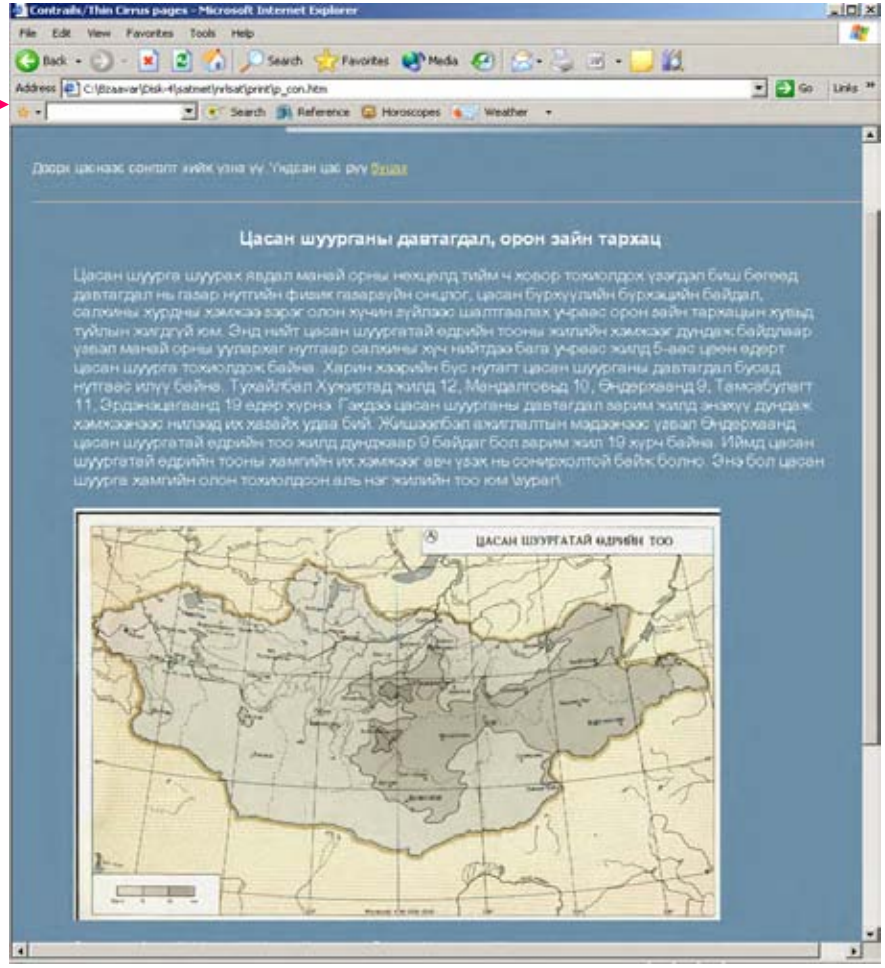
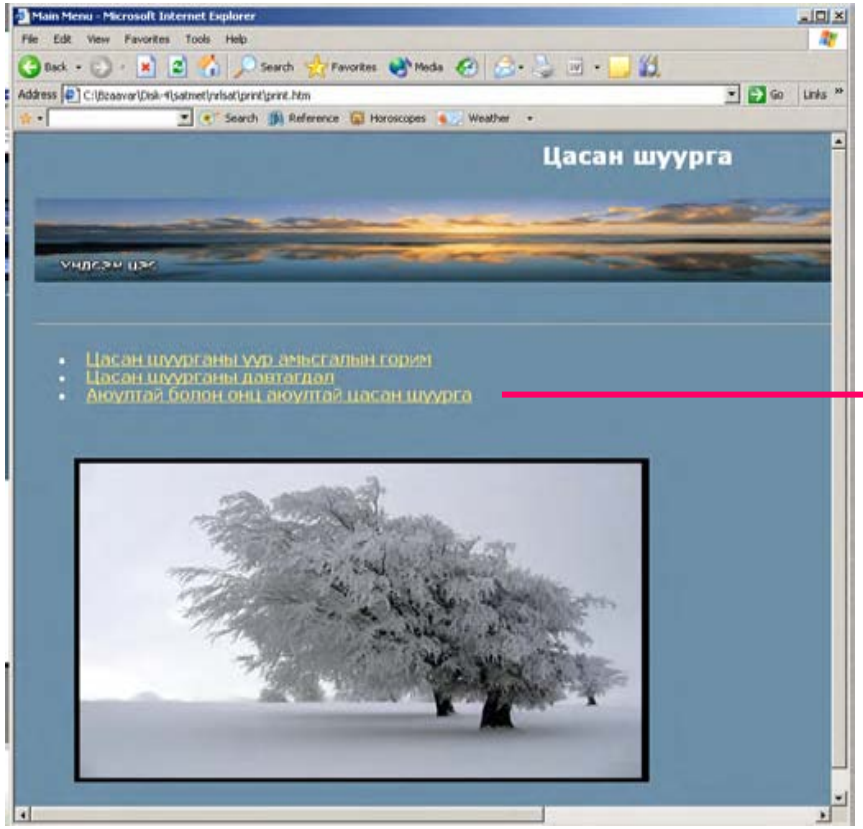

Main Menu - Microsoft Internet Explorer
Цасан шуурга
Цасан шуурганы үүр амьсгалын горим
Цасан шуурганы давтагдал
Аюултай болон онц аюултай цасан шуурга


Contrails/Thin Cirrus pages - Microsoft Internet Explorer
Цасан шуурганы давтагдал, орон зайн тархац
ЦАСАН ШУУРГАТАЙ ӨДРИЙН ТОО

TOP MENU


Main Menu - Microsoft Internet Explorer
Цасан шуурга
Цасан шуурганы үүр амьсгалын горим
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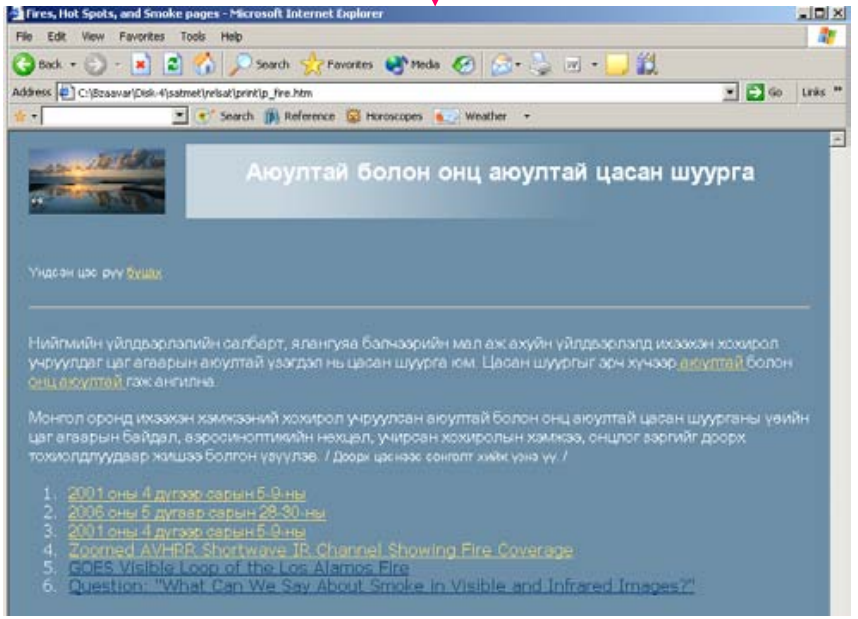
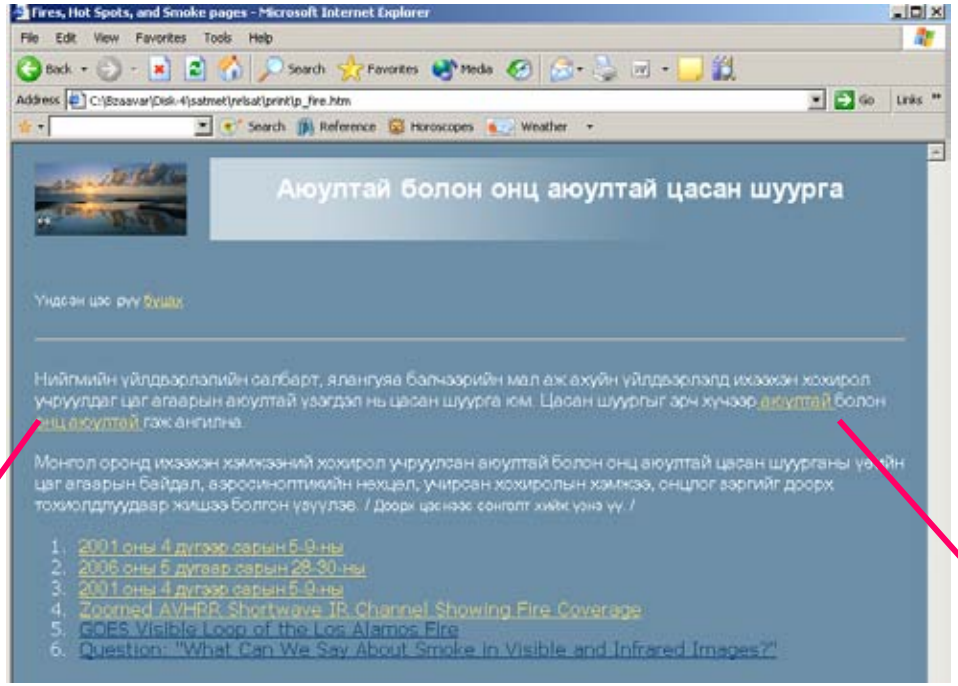
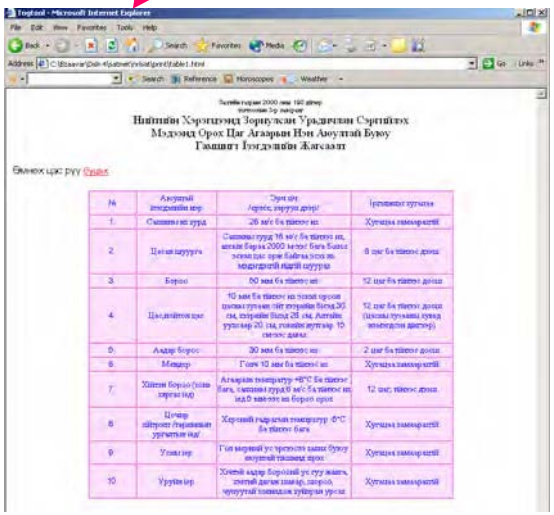
Аюултай болон онц аюултай цасан шуурга


Fires, Hot Spots, and Smoke pages - Microsoft Internet Explorer
Аюултай болон онц аюултай цасан шуурга
2001 оны 4 дүгээр сарын 5-9-ны
2006 оны 5 дүгээр сарын 28-30-ны
2001 оны 4 дүгээр сарын 5-9-ны
Zoomed AVHRR Shortwave IR Channel Showing Fire Coverage
GOES Visible Loop of the Los Alamos Fire
Question: "What Can We Say About Smoke in Visible and Infrared Images?"

TOP MENU





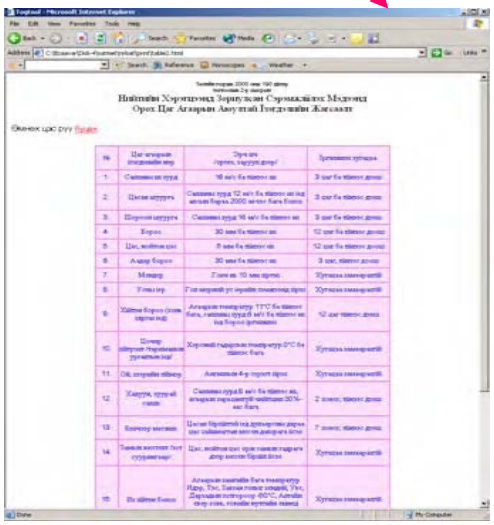
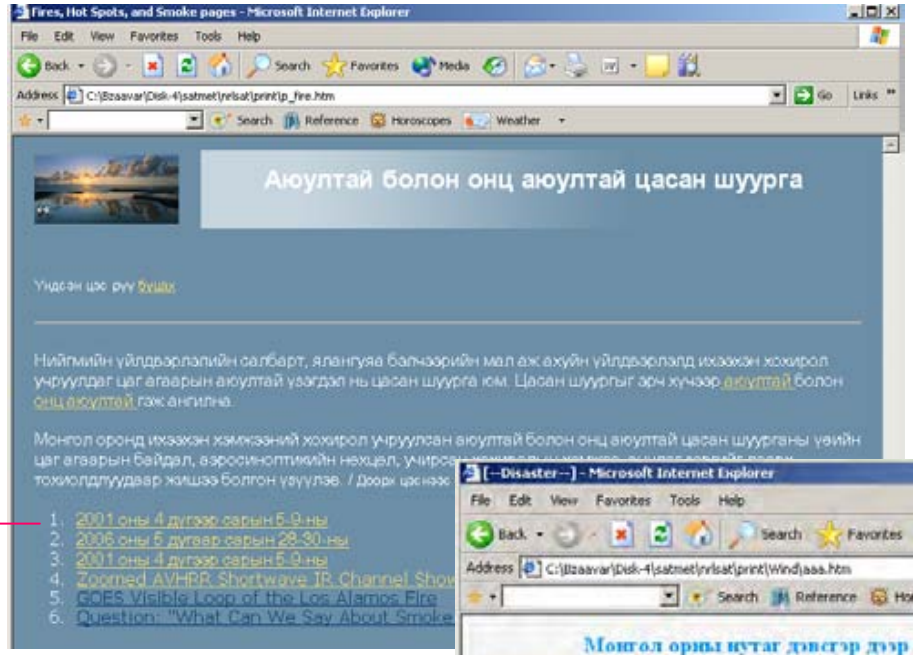
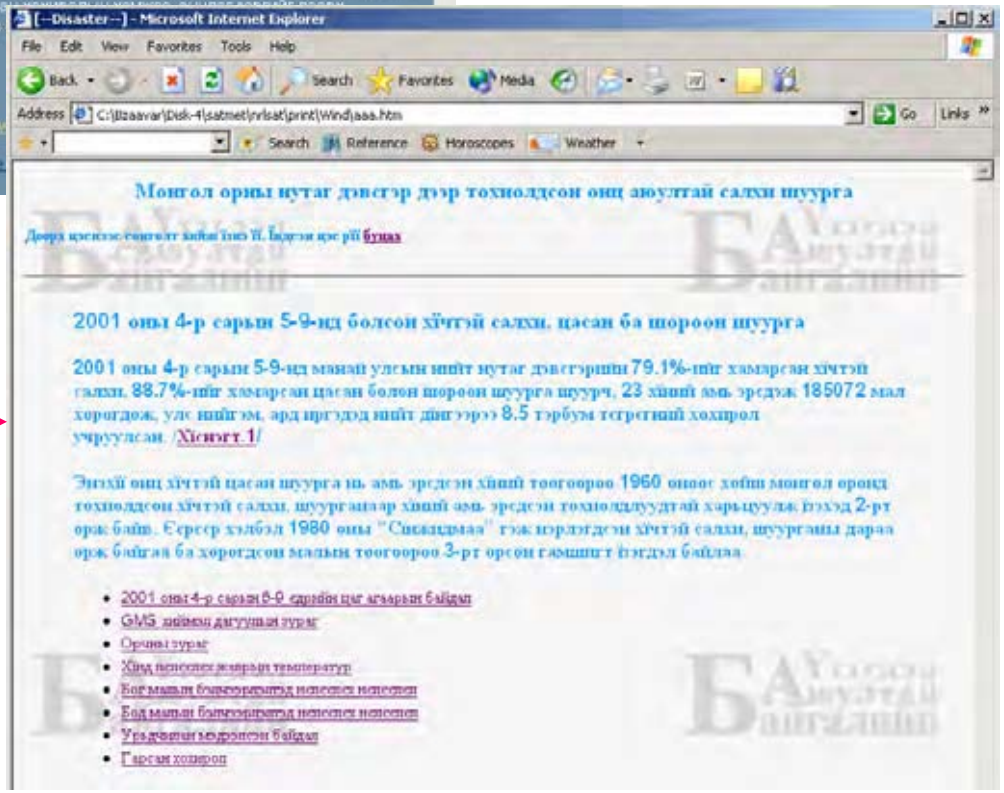


Table of criteria of extreme event end hazardious wherter phenomena

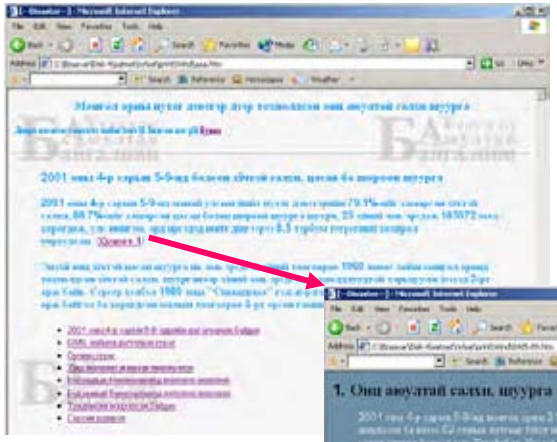
TOP MENU

Date of case

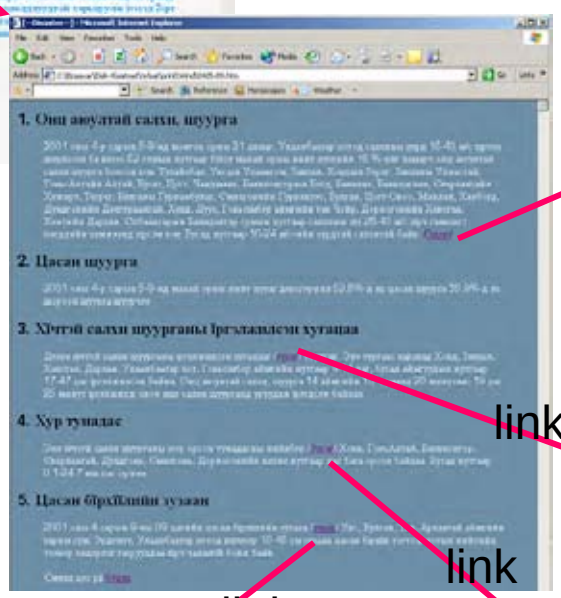




Case of 5-9 april 2001



TOP MENU



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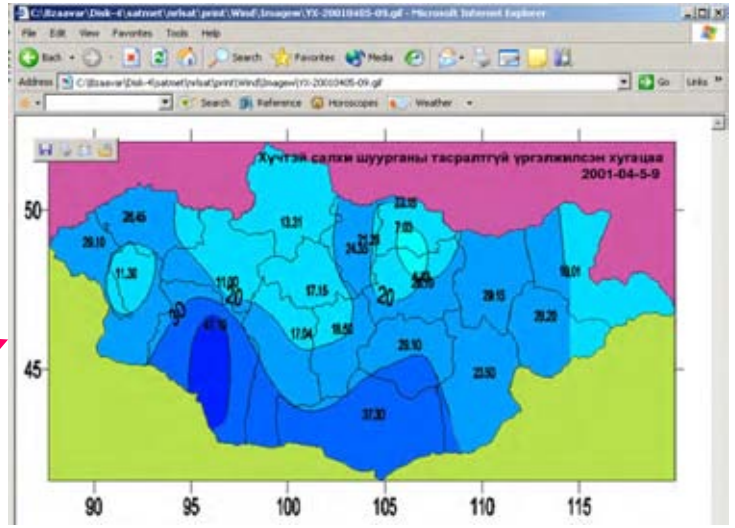

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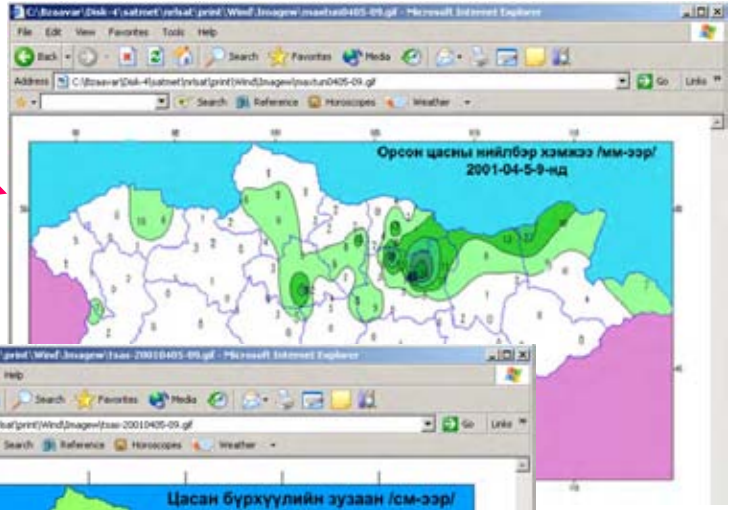

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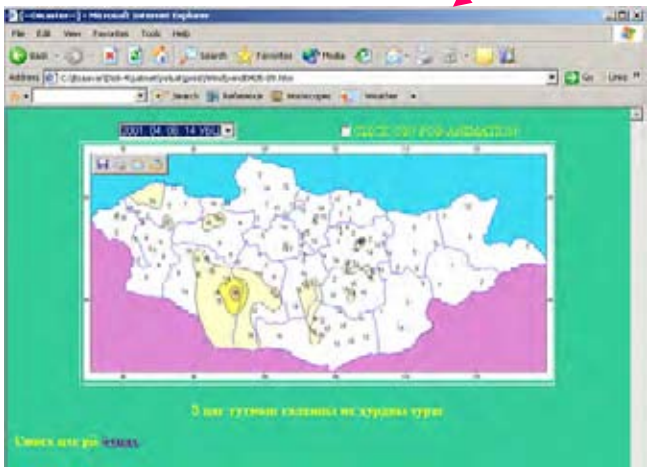
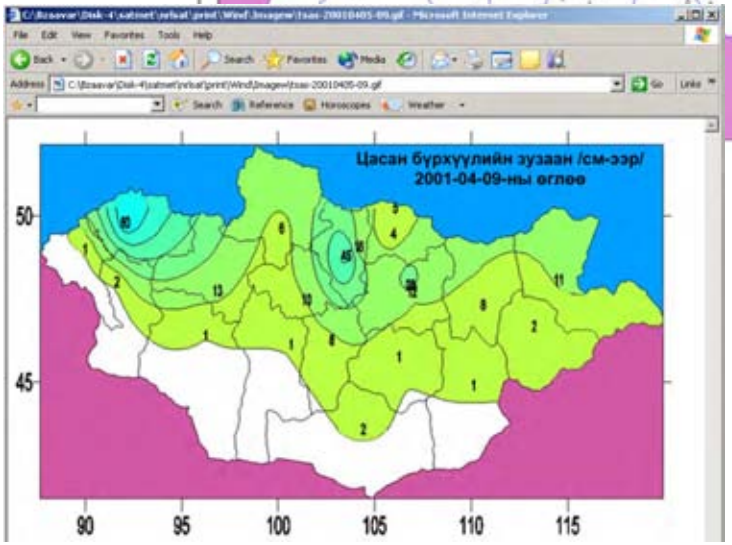
link





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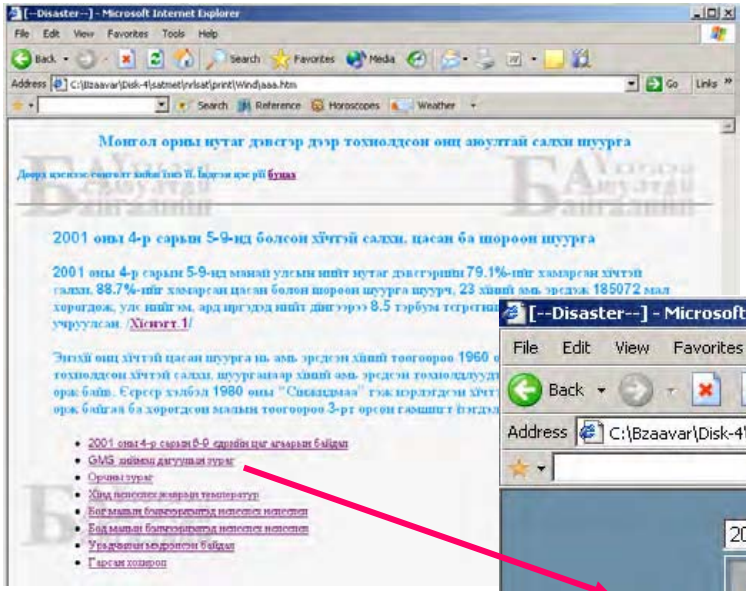
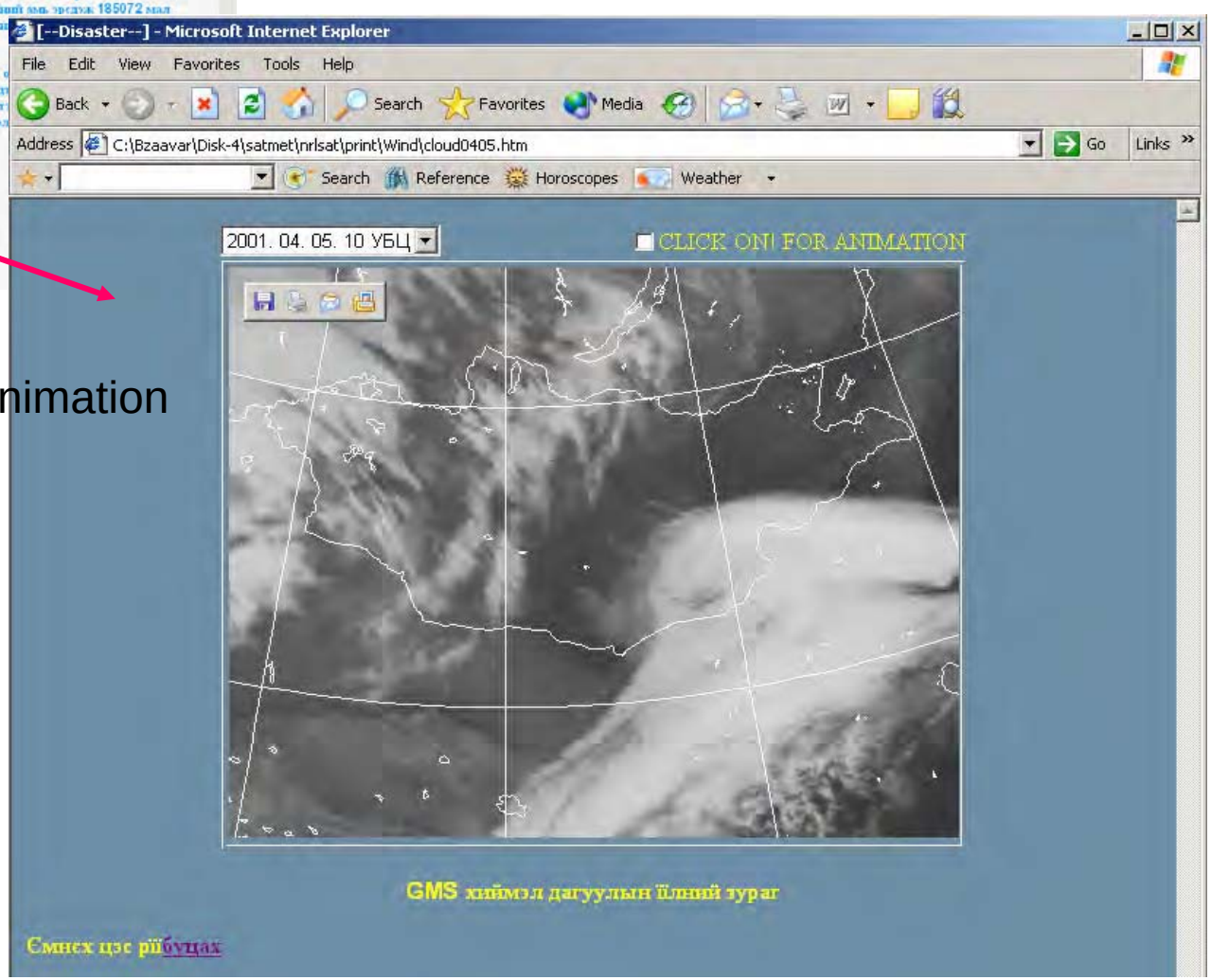
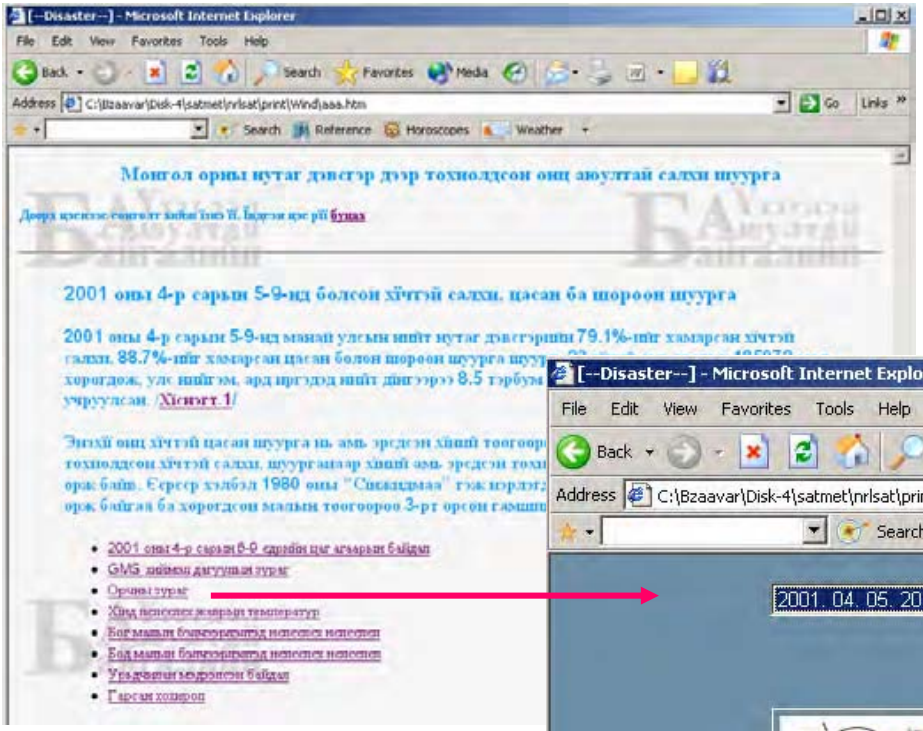


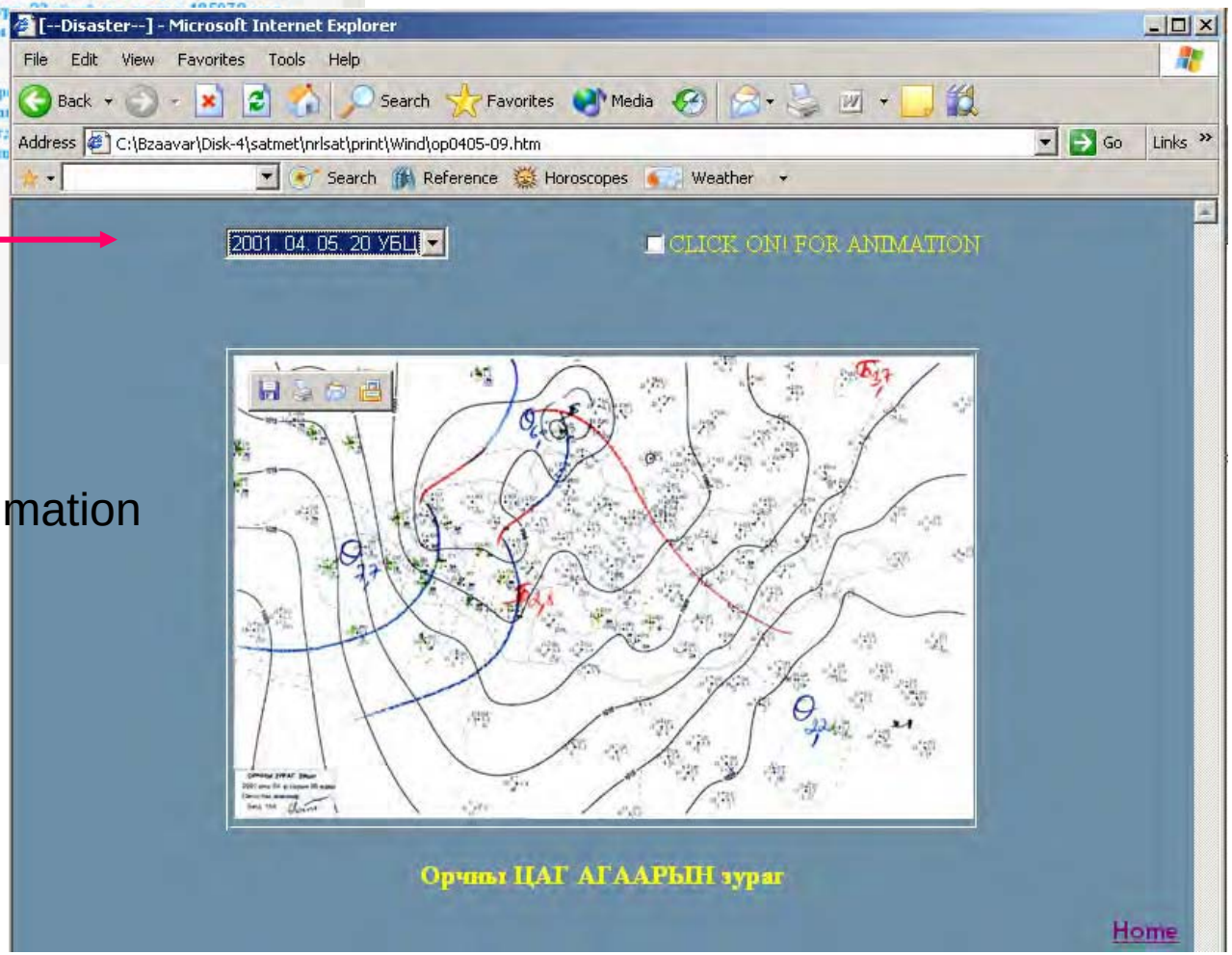
Cloud images with animation

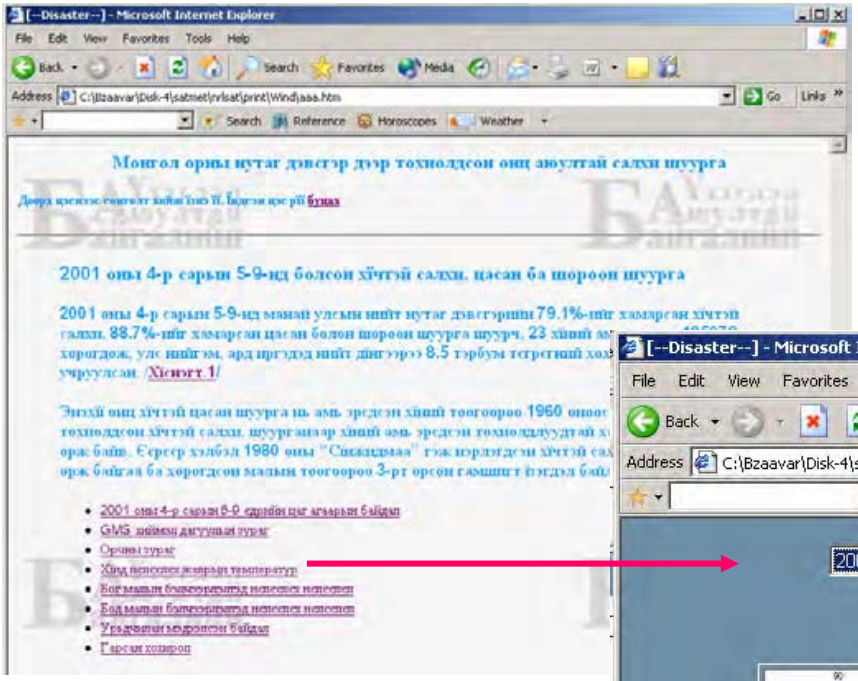




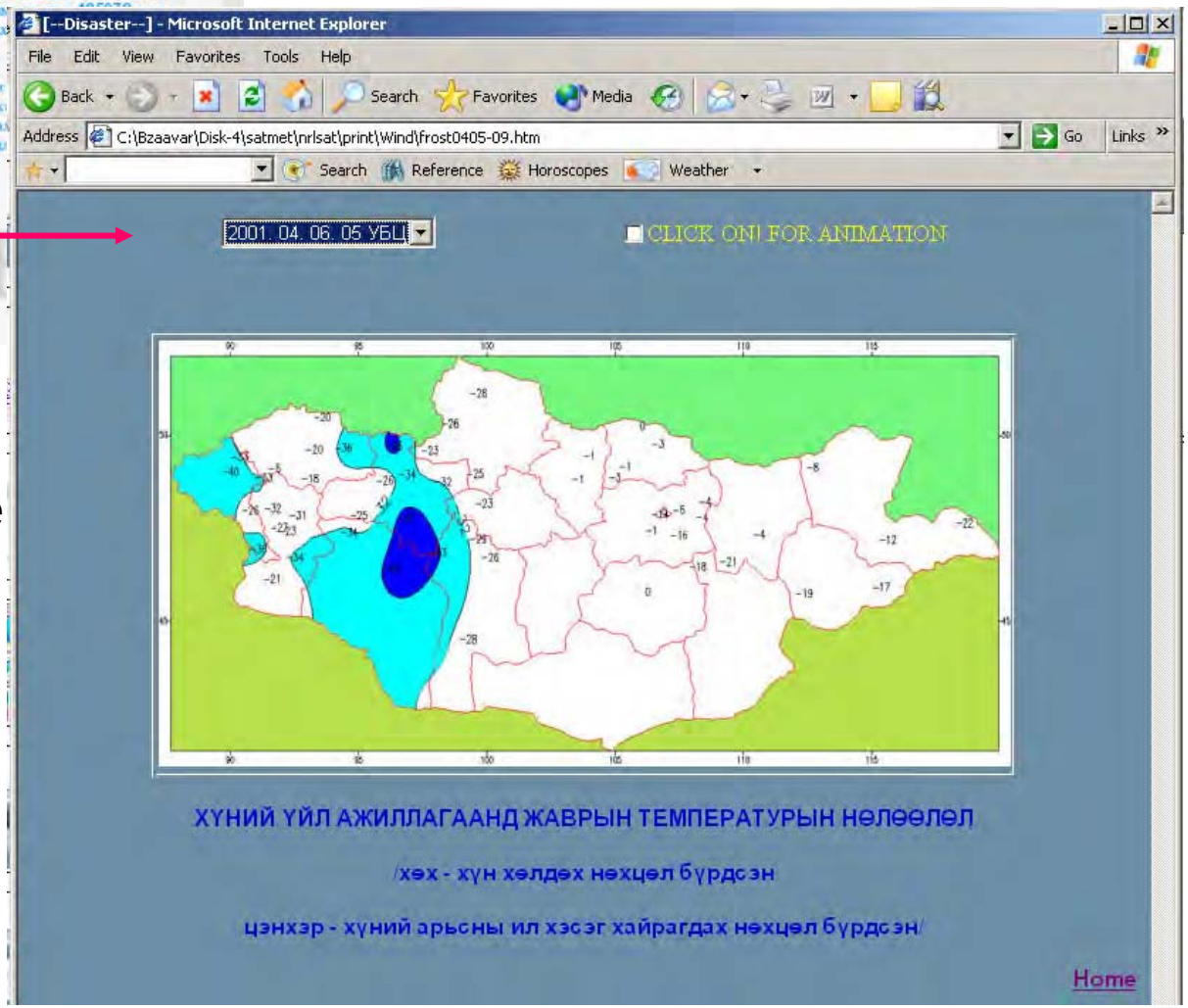
TOP MENU

Weather charts with animation



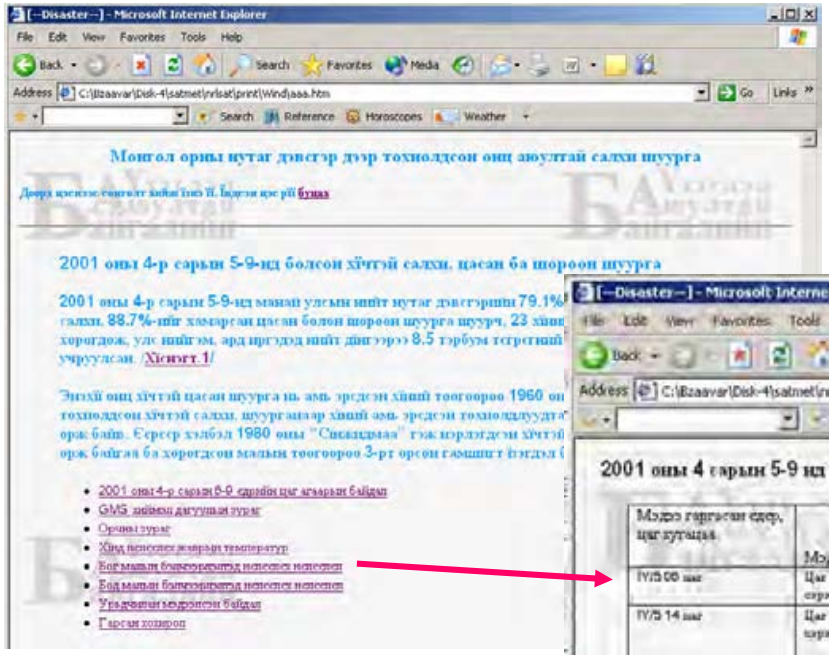


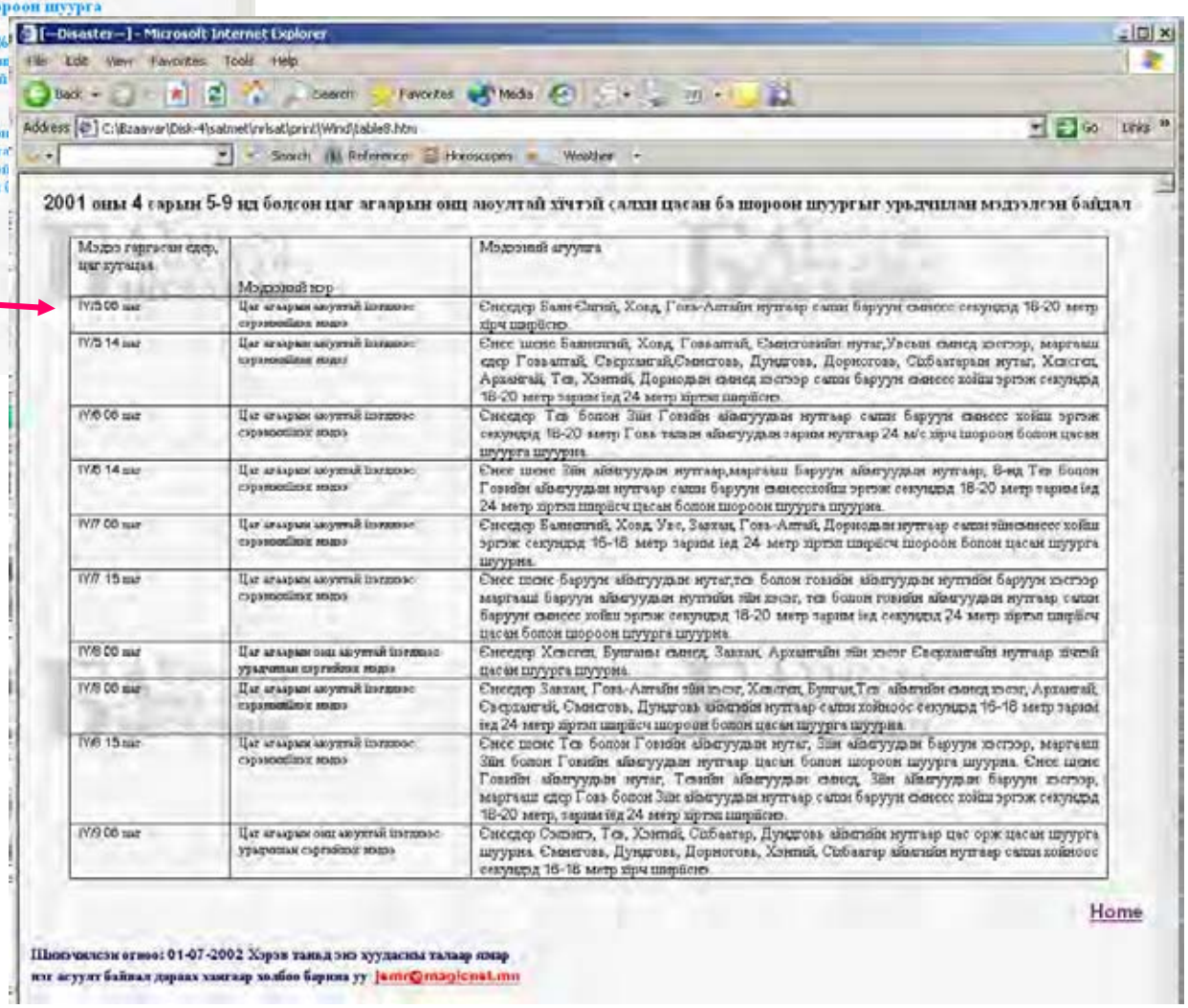
TOP MENU



Effective temperature

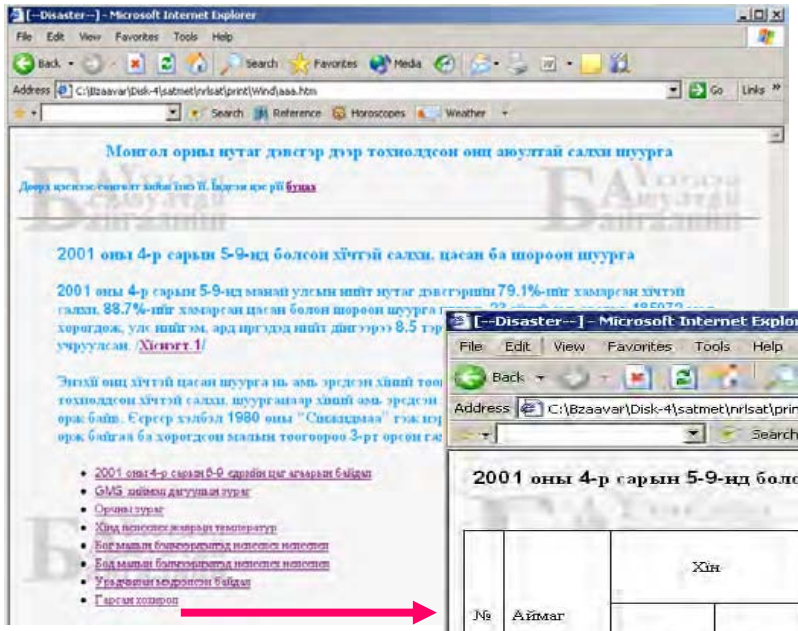
5-9 april 2001





Warning and alert information 5-9 april 2001

TOP MENU



TOP MENU

Table of economic loss and damage from 5-9 april 2001

[--Disaster--] - Microsoft Internet Explorer

Address C:\Bzaavar\Disk-4\satmet\nrlsat\print\Wind\hohirol0405-09.htm

2001 оны 4-р сарын 5-9-нд болсон цаг агаарын онц аюултай хүчтэй салхи цасан ба шороон шуурганы улмаас учирсан хохирлын урьдчилсан дүн

№	Аймаг	Хүн		Мал		Бусад хохирол						Хохирол урьдчилсан байдлаар (Сая-тег)	Орон нутгаас хохирлын мэдээ ирүүлсэн байдал (Сая-тег)	УБОК-оос үзүүлсэн дэмжлэг (Сая-тег)
							Шуурганаар унасан							
		Амь эрсэдсэн	Хөлдөж осгосон	Шуурганаар уруудсан	Уруудаж алга болсон	Шатсан гэр	Өндөр хүчдэлийн шон	Уурын зуухны яндан	Холбооны шон	Гэр	Хашаа			
1	Увс	8	1	9546	21566		88		62	179	516	62,0	64,6	37,4
2	Баян-Өлгий			2694								59,3	78,2	
3	Сүхбаатар							4		18	10	50,1	50,1	3,6
4	Хөвсгөл	1	4	2894			5			1		22,3	22,3	
5	Архангай	8	11	60000		18	39		108	500	97	20,8	300,7	48,6
6	Булган	1		30360	21331		9					15,0	922,5	
7	Өмнөговь			568	1759		1	1	15	10	57	11,5	19,2	12,0
8	Ховд			2520	560					18		9,8	9,8	3,6
9	Төв	2	1				3				7	5,0	5,0	
10	Говь-Алтай			18630	2660					16	64	4,1	4,1	
11	Хэнтий						4					2,8	2,8	
12	Өвөрхангай			31325					8	22	158	1,7	1,7	4,4
13	Завхан	3	3							6		1,2	1,2	1,2
14	Баянхонгор			36500	9000				27	9		231,6	351,8	10,0
15	Дундговь			621	15212		9				102	5,8	5,8	
16	Дорноговь			514	10040					1		8,3	8,3	
	Бүгд	23	22	185072	82328	18	138	5	220	780	1031	511,3	1848,1	122,0

УЛСЫН БАЙНГЫН ОНЦГОЙ КОМИСС

Basic design of HAND-BOOK for the
typical weather phenomena

Case on SNOWSTORM
/Sample of Website/

- We are doing basic desing of HAND-BOOK for the snowstorm 28-30 may 2006 and other typical weather phenomena is being done same as case on Snowstorm

/Amarjargal end Batjargal/

別冊 4　　天気翻訳手法

・ 領域数値予報モデルプロダクトを用いた降水量予報に係るガイダンスの提案

Suggestion for the Precipitation Guidance of MMR

2008/05/23 Ritsuko Kanohgi(Sasaki), JWA

1. Suggestion of precipitation guidance

The Mongolian MM5 precipitation result doesn't have enough accuracy so far. Our recommendation is to use MM5 output precipitation directly for precipitation guidance, but it seems that there are some difficulties for the moment. On the other hand, the precipitation guidance using neural-network system with ECMWF input data doesn't work well because of the lack of precipitation as explanatory variables. The horizontal grid resolution of 2.5 degrees of ECMWF also makes it difficult to figure local precipitation area.

To achieve the aim of developing precipitation guidance, we suggest that you use JMA-RSMC data. The archive of Asian data supplied twice daily might be convenient for you.

------Outline of JMA-RSMC data of Asia ---------

Area: 20S-60N, 60E-160W

Resolution: 1.25 x 1.25 deg.

Initial Times: 00, 12 (UTC)

Data interval: 6hours

Level & Element to collect to make precipitation guidance

Surface P, U, V, T, T-Td, R

1000hPa Z, U, V, T, T-Td

925hPa Z, U, V, T, T-Td, w

850hPa Z, U, V, T, T-Td, w

700hPa Z, U, V, T, T-Td, w

500hPa Z, U, V, T, T-Td

400hPa Z, U, V, T, T-Td

300hPa Z, U, V, T, T-Td

We use RH (Relative Humidity) and Q (Specific Humidity) using T-Td. → see Note 1

RSMC data of Asia supplies data at 6 hours interval for 84 hours. These Figures are examples of forecasting routine.

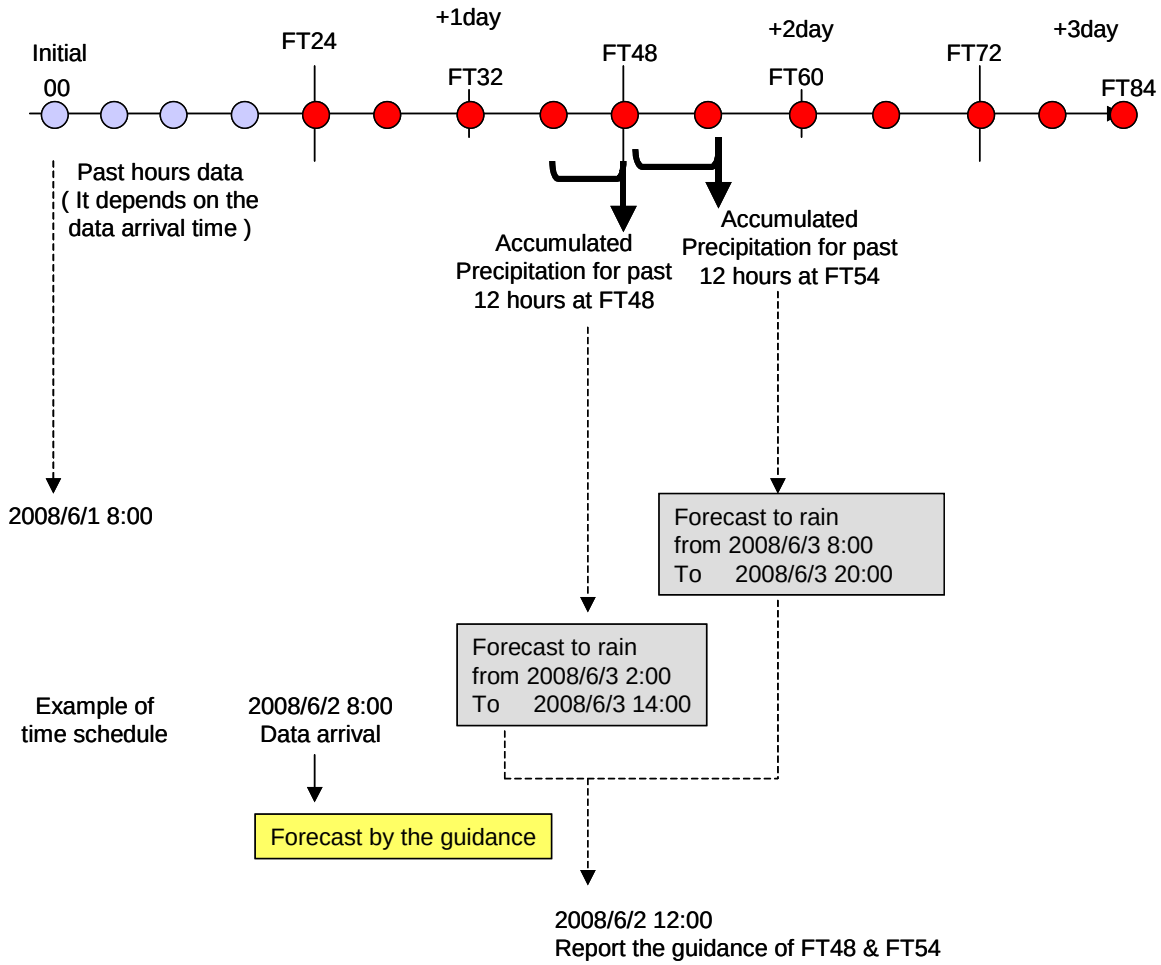


Fig.1 Example of forecasting routine using 00UTC data

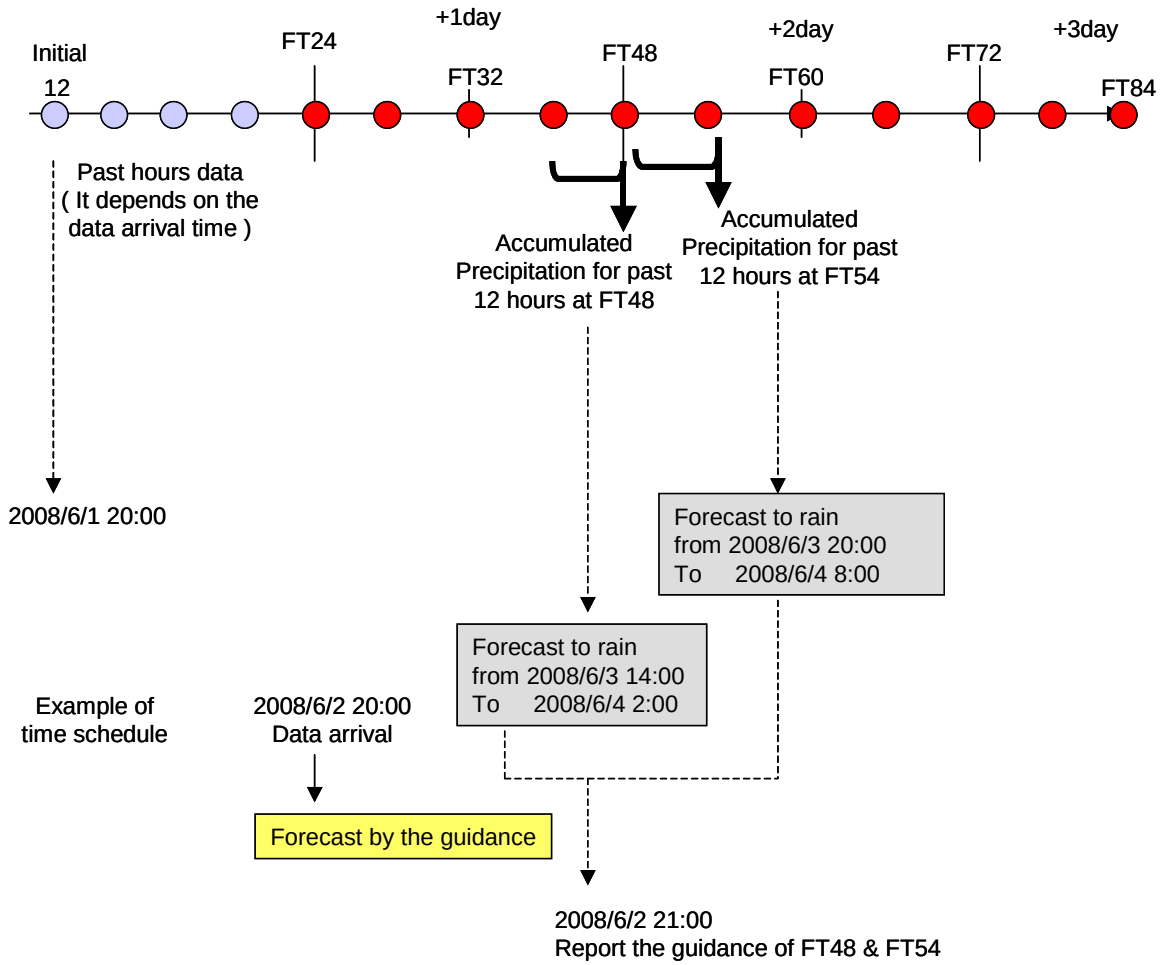


Fig.2 Example of forecasting routine using 12UTC data

To develop Mongolian precipitation forecast…

1. **Compare observed precipitation and MM5 precipitation output at some stations**
   - It's important to check MM5 ability. If MM5 failed to predict precipitation largely, you should check its distribution map and find the reason why.
   - Predicted precipitation from high-resolution models sometimes occurs spatial and temporal phase error. It's better to make spatial averaged precipitation to prevent spatial phase error.
2. **Compare observed precipitation and RSMC precipitation (1.25deg.) output at some stations.**
   - Original horizontal grid resolution of global RSMC is about 20km and it might be able to represent precipitation area at some level. If the accuracy of RSMC precipitation is enough, you don't have to make special guidance.
   - After you collect those data for 1 year, please check the prediction error in case of hit (RSMC precipitation > 0mm and Observation > 0 mm). If you can find some bias between two, you should add bias (or multiple the ratio) to RSMC precipitation. It's a kind of simple precipitation guidance.

3. Make precipitation guidance with RSMC data
   - You have already tried to make precipitation guidance by neural network system. Add precipitation and some other data (such as lower level omega) to explanatory variables and try to make new guidance with neural network system.

   I think the practical stage of the precipitation guidance is upper one.

   - JMA is operating precipitation guidance by Kalman filter. They use diagnostic elements as explanatory variables such as EHQ. The introduction of it is shown in the next page.

   After you developed the guidance, please compare with RSMC precipitation and MM5 precipitation.

2. Example of JMA precipitation guidance

(1) Explanatory variables

It's necessary to collect input data for guidance equations, both model output data and observed precipitation data. JMA precipitation guidance uses the following diagnostic vales from GPV. Let's check "GSM (rough grid size model)" column (RSM is 20km. Grid model).

Table of Predictor

Code	Content	RSM	GSM
NE50	500hPa NE-SW component		
NW50	500hPa NW-SE component		
NE85	850hPa NE-SW component	○	
NW85	850hPa NW-SE component	○	
NW8Q	850hPa NW-component × Q*low		○
SE8Q	850hPa SE-component × Q*low		○
NE8Q	850hPa NE-component × Q*low		○
SW8Q	850hPa SW-component × Q*low		○
SW5Q	500hPa SW-component × Q*low		
NW8P	850hPa NW-component		
SE8P	850hPa SE-component		
NE8P	850hPa NE-component		
SW8P	850hPa SW-component		
SSI	Showalter's Stability Index	○	
PCWV	Precipitable water × V850 × ω850	○	
QWX	Σ（ω × Q × Hu × dp）	○	○
EHQ	Σ（ΔHu × Q × DWL）	○	○
ESHS	Σ（Q × DWL）／Σ（Q*）		
OGES	Orographic ascending speed × Σ（Q × DWL）	○	○
HOGR	Orographic ascending speed × Hu		
RH85	Hu850		
DXQV	Precipitation index on winter pattern	○	○
FRR	Precipitation by the model (RSM,GSM)	○	○
CFRR	Converted value of FRR		

NE-SW component can be plus and minus, but NE-component can be only plus.

Q*low : saturated specific humidity averaged in low levels

Q : specific humidity

Hu : relative humidity

DWL : depth of wet layer

(a) NW8Q 850hPa NW-component × Q*low

(b) SE8Q 850hPa SE-component × Q*low

(c) NE8Q 850hPa NE-component × Q*low

(d) SW8Q 850hPa SW-component × Q*low

Because Japanese predominant wind direction is NW in winter and SE in summer. JMA defined these diagnostic elements. If you apply these elements to Mongolia, you should think W, E, S, N wind component instead of NW, SE, SE, NE.

- W8Q -> 850hPa westerly wind component × Q*low
- E8Q -> 850hPa easterly wind component × Q*low
- S8Q -> 850hPa southerly wind component × Q*low
- N8Q -> 850hPa northerly wind component × Q*low

Q*low is saturated specific humidity averaged in low levels

(e) QWX Σ (ω × Q × Hu × dp)

ω: Upward flow (Downward flow = 0.0)

Q: Specific Humidity

Hu: Relative Humidity

Dp: Depth of layer (thickness)

Calculate "ω × Q × Hu × dp" at each level and accumulate from 1000hPa to 300hPa.

(f) EHQ Σ (ΔHu × Q × DWL)

-> see "note2"

(g) OGES Orographic ascending speed× Σ (Q × DWL)

-> see "note3"

(h) DXQV Precipitation index on winter pattern

This element is for Japanese winter precipitation system. If you apply it to Mongolia, you don't have to think it.

(i) FRR Precipitation by the model

Note1: Td→ RH, Q

Sample program

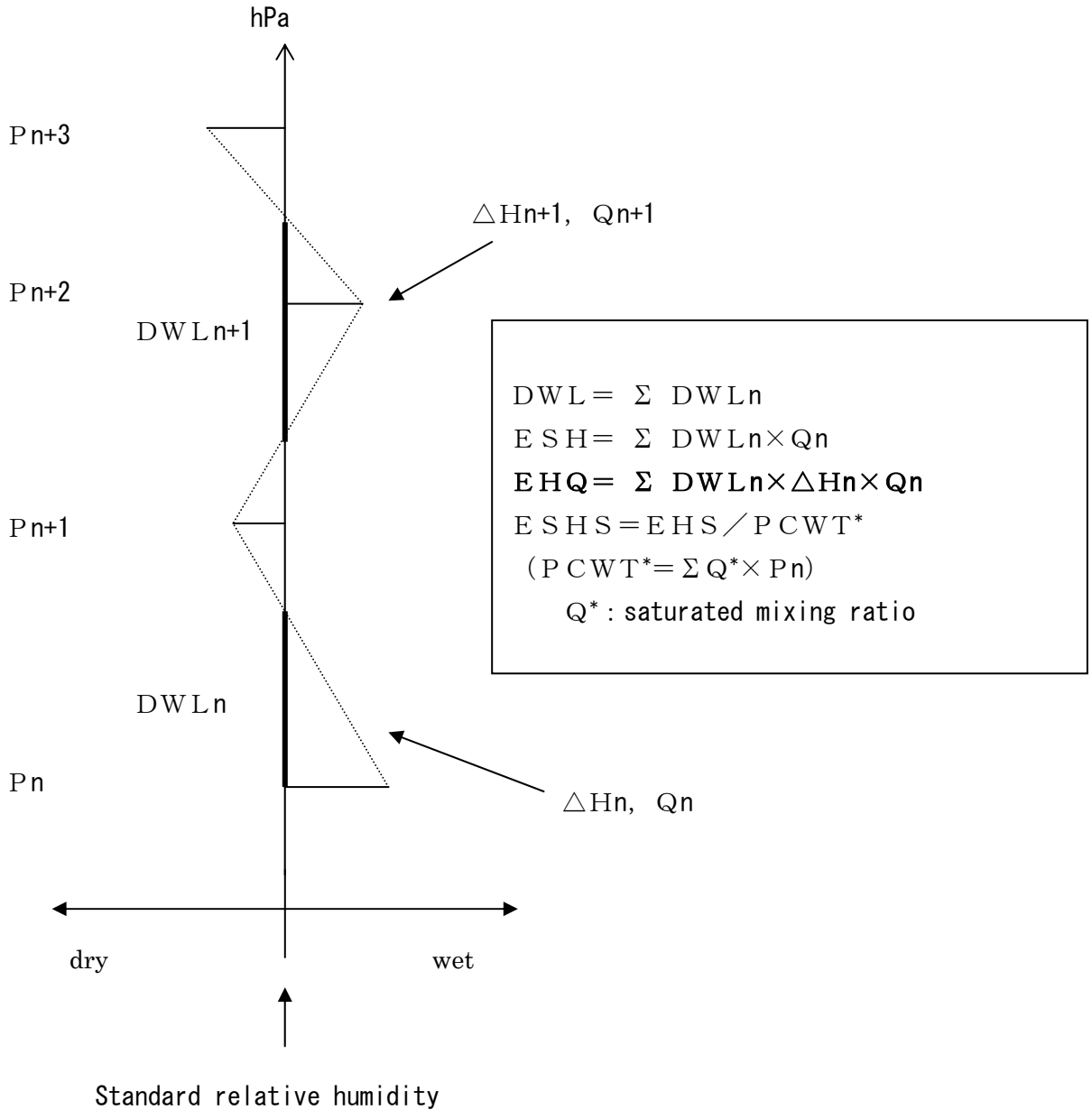
```
c
c     convert Td --> RH,Qst, Q
c     Td: Dew point temperature (C)
c     T : Temperature (C)
c     P : Pressure (hPa)
c
c     Qst : Saturated Specific Humidity (kg/kg)
c     Q   : Specific Humidity (kg/kg)
c     RH  : Relative Humidity (%)
c
      parameter (tk=273.16)

c ----- input data -----
      t=10.0
      td=8.0
      P=750.0
c ----------------------
c
      t=t+tk
      td=td+tk

      ETd= efromt(td)
      Et = efromt(t)
c
      rh=ETd/Et
      Qst=tetns(t-tk,p)
      Q  =rh* tetns(t-tk,p)
      rh=rh*100.
      write (*,*) 'RH=',rh ,Qst, Q
c
      stop
      end

      function efromq(p,q)
c ***************************************************************************
c *  subroutine purpose: given the specific humidity (in units of kg   *
c *    per kg) and pressure (in units of hPa) as input, this external  *
c *    function calculates the equivalent vapor pressure (in units of  *
c *    hPa).  the reference for the algorithm is listed below.         *
c *    p      - pressure ( units of hPa)                               *
c *    q      - specific humidity ( units of kg/kg )                   *
c *                                                                    *
c *                                                                    *
c *   outputs:                                                         *
c *    efromt - vapor pressure returned, ( units of hPa )              *
c ***************************************************************************
```

```
      parameter                 (wratio=0.622)
      parameter                 (onemmw=1.0 - wratio)

      efromq=q*p/(wratio + (onemmw*q))

      return
      end

      function efromt(t)
c ***********************************************************************
c *  subroutine purpose:  this function   calculates the saturation    *
c *    vapor pressure for a given input temperature.                    *
c *                                                                     *
c *  method: this algortihm uses a sixth order polynomial equation     *
c *          accurate to within 1 per cent over the range -50 deg c to *
c *          + 50 deg c. the clausius clapeyron equation is used       *
c *          outside that range.                                       *
c *                                                                     *
c *   inputs:                                                           *
c *    t      - temperature ( degrees kelvin )                         *
c *                                                                     *
c *   outputs:                                                          *
c *    efromt - vapor pressure (hPa) for temperature t                  *
c *                                                                     *
c ***********************************************************************
      parameter               (eat0c=6.11)
      parameter               (rsubv=461.5)
      parameter               (zeroc=273.16)
c     common
      dimension                 a(7)
      data           a        /  6984.505294,
     1                          -188.9039310,
     2                           2.133357675,
     3                          -1.288580973e-2,
     4                           4.393587233e-5,
     5                          -8.023923082e-8,
     6                           6.136820929e-11   /
c *** defined statemnent function for computation of vapor pressure
      vap(temp)=a(1) + temp*(a(2) + temp*(a(3) + temp*(a(4) + temp
     1             *(a(5) + temp*(a(6)+a(7)*temp)))))
c *** defined statement function for the latent heat
      heat(temp)=(2.5 e+6 - 2274.0*(temp - zeroc))
      if(abs(t-zeroc).lt.50.0) then
        efromt=vap(t)
      else
        efromt=eat0c*exp((heat(t)/rsubv)*((1.0/zeroc) - (1.0/t)))
      end if
      return
      end
c ***********************************************************************
```

```
c *
      function  tetns ( t, p )
c
c    @ Saturated specific humidity (kg/kg) @
c
        a  = 17.27
        b  = 237.3
c
      es    = 6.11*exp( a*t/( b+t ) )
      tetns = 0.622*es/  p
c
      return
      end
```

Note2: EHQ

Conceptual chart about EHQ ESHS

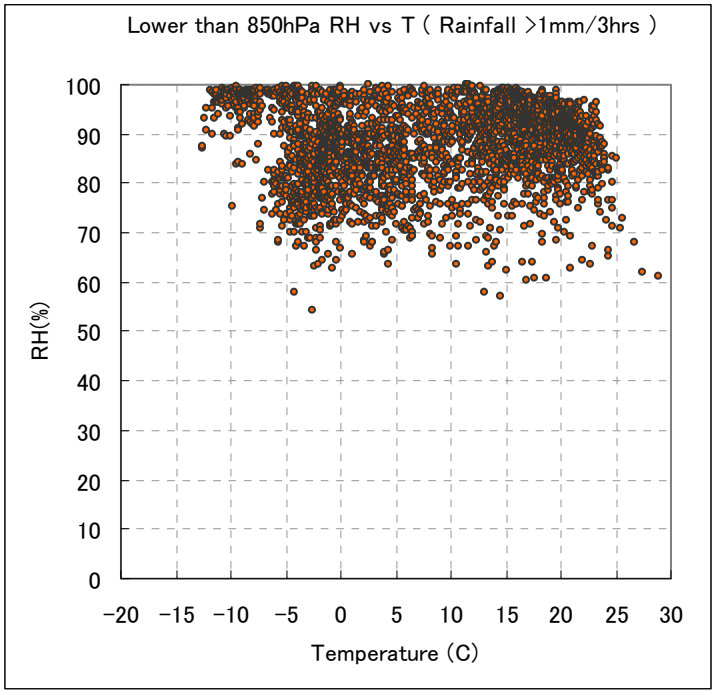


Standard relative humidity is the threshold whether air is wet enough to make cloud or not. It depends on temperature. The function to calculate it is in subroutine program.

$$EHQ = \Sigma\ DWLn \times \triangle Hn \times Qn$$

DWLn: Depth of wet layer

Depth of wet layer means the thickness that exceeds standard relative humidity. Standard relative humidity (SRH) is defined that RH when water vapor can condense as cloud. SRH is a function respect to temperature.



T Classify	Count	RH_AVE	RH_SIG	AVE-SIG	AVE-2*SIG
T≦-5℃	234	93.0	7.8	85.2	77.4
-5℃≦T＜0℃	557	85.3	8.4	76.9	68.5
0℃≦T＜5℃	423	85.1	7.6	77.5	70.0
5℃≦T＜10℃	285	86.3	8.1	78.2	70.1
10℃≦T＜15℃	796	88.5	8.2	80.4	72.2
15℃≦T＜20℃	621	90.1	6.7	83.3	76.6
T≧20℃	394	87.8	6.3	81.5	75.2

This figure is T-RH graph when it rains at one station for 1 year. According to statistics, I set standard relative humidity with “AVE-sigma”.

You should calculate depth of wet layer for each layer (DWLn), and add them from 1000hPa to 300hPa (=DWL).

DWL means depth of cloud and it has high relationship with precipitation.

△ Hn: Averaged relative humidity in the wet layer

When you check if the target layer is wet layer or not, you can also calculate Hn.

Qn: Specific humidity in the wet layer

When you check if the target layer is wet layer or not, you can also calculate Qn.

Note3: OGES and HOGR

OGES and HOGR are related to orographic ascending speed. You need an orographic gradient data (OG) at every grid in order to calculate these predictors. We have the OG calculated by 2km mesh topographic data in JMA. Our OG is calculated from 4 direction (N,E,S,W), and the gradient from any direction is estimated by these 4 direction's gradient.

The followings are wind components, specific humidity and relative humidity in low level.

ULOW = 2*U1000 + 2*U850 + 1*U700) / 5
VLOW = 2*V1000 + 2*V850 + 1*V700) / 5
QLOW = 1*Q1000 + 2*Q850 + 1*Q700) / 4
HLOW = 1*Rh1000 + 2*Rh850 + 1*Rh700) / 4

Wind speed (VLOW) and wind direction (DLOW) in low level are calculated by ULOW and VLOW. Orographic gradient (GRAD) is estimated using OG and DLOW. Then orographic ascending speed (OGS) and Orographic Index (OGR) is defined bellow.

OGS = VLOW * GRAD
OGR = OGS * QLOW

OGR is useful itself as a predictor of precipitation guidance. But we are using another predictor OGES and HOGR defined as below.

OGES = OGR * ESH
HOGR = OGS * HLOW

OGR can be a trigger of precipitation, but OGR include only low level's water amount. So, total water amount is considered in OGES as ESH. Explanation of ESH is written in another paper.