

APPENDIX 4 MONITORING SURVEY

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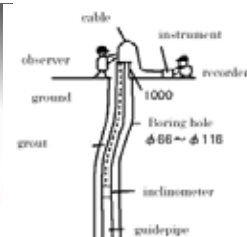
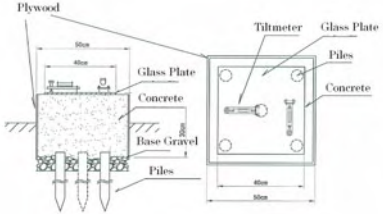
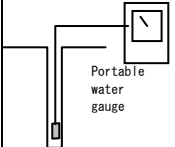
MONITORING SURVEY

4.1 INSTALLATION OF THE MONITORING DEVICES

In order to reveal the range, depth and activity of the landslide, monitoring for the landslides was carried out.

The monitoring instruments shown as Table 4.1.1 were installed in the site. The number of monitoring devices and methods is shown as Table 4.1.2. The location of monitoring devices is shown as Figure 4.1.1 and Figure 4.1.2.

Table 4.1.1 Preparation of Instruments

Instrument	Set up site/ object of measurement	Applicability
Borehole inclinometer 3 holes $\Sigma m=160m$	Borehole/ Depth of slip surface and movement of active zones	Used to detect the depth of slip surface and movement of active zones. <div style="display: flex; align-items: center; justify-content: space-around;">   </div>
Tiltmeter 13 sets	Ground surface/ Tilting mode of ground	The tiltmeter is used to monitor tilting ground surface. This instrument can detect a very small tilting. Easy to install. <div style="display: flex; align-items: center; justify-content: space-around;">  </div>
Ground water gauge 2 holes $\Sigma m=40m$	Borehole/ Ground water level	Groundwater is related to sliding. The data of groundwater level is useful information to design countermeasures. <div style="display: flex; align-items: center; justify-content: space-around;">  </div>
Rain gauge 1 gauge	Ground surface/ Rainfall	This is set up to examine the correlation between ground movement and rainfall intensity.

Source: study team

Table 4.1.2 Monitoring Devices and Methods

No.	Monitoring devices and Methods	Unit	Number		Purpose
			Sta.17+400 /18+200	Sta.17+600	
1	Borehole Inclinator	Holes	3	3	Detect the depth of the slip plane and direction of movement.
2	Tiltmeter	Sets	5	8	Detect tilting of the ground surface.
3	Ground water gauge	Holes	1	1	Detect the change of groundwater level.
4	Crack Measurement	Points	14	6	Detect the displacement of cracks on the structure.
5	Movable post	Points	4	6	Detect direction and amount of movement
6	Monitoring Erosion Depth	Lines	1	1	Detect the erosion speed of the ground
7	Rain gauge	Point	1		Examine correlation between movement and rainfall

Source: study team

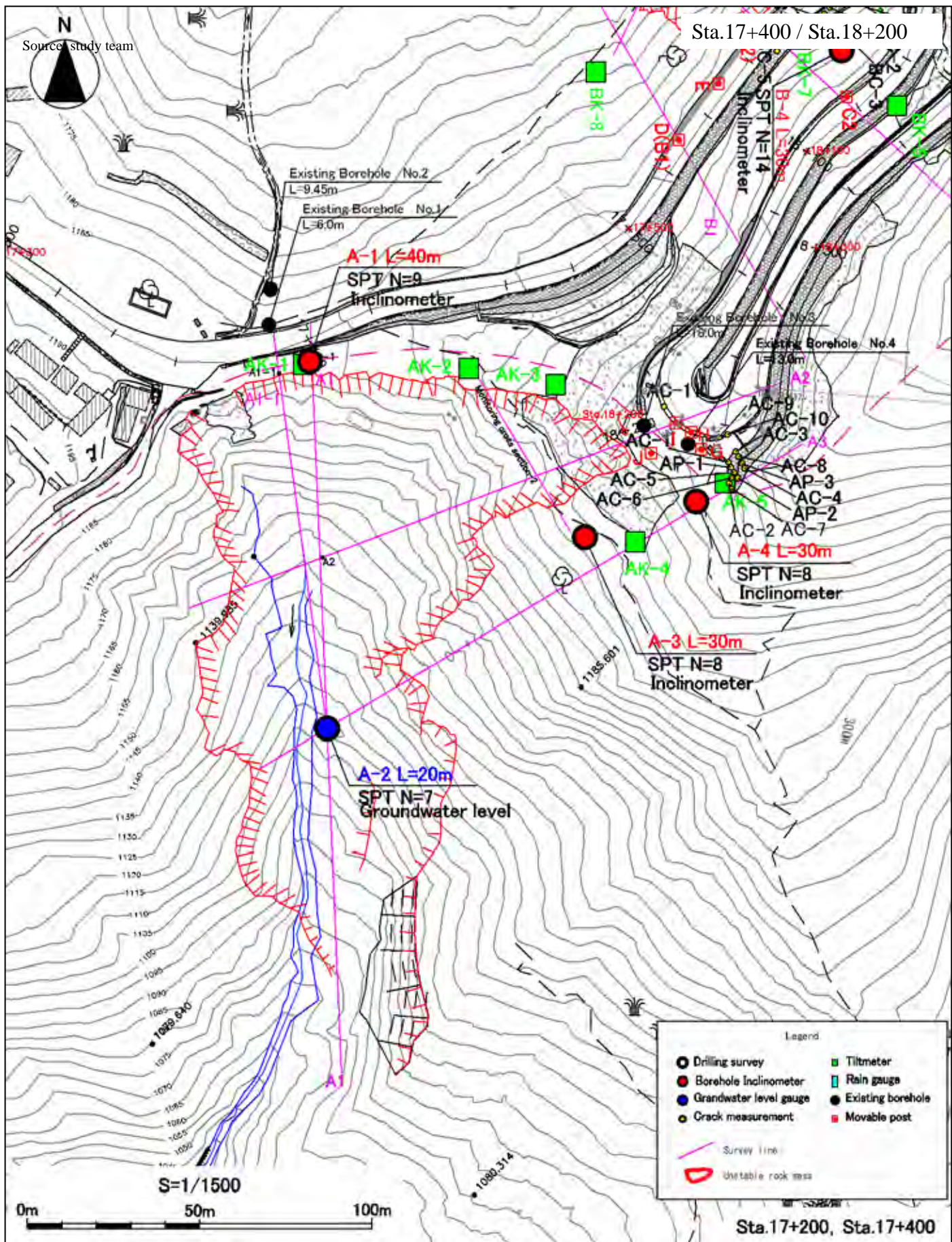


Figure 4.1.1 Location of Monitoring Devices for Sta.17+400 and Sta.18+200

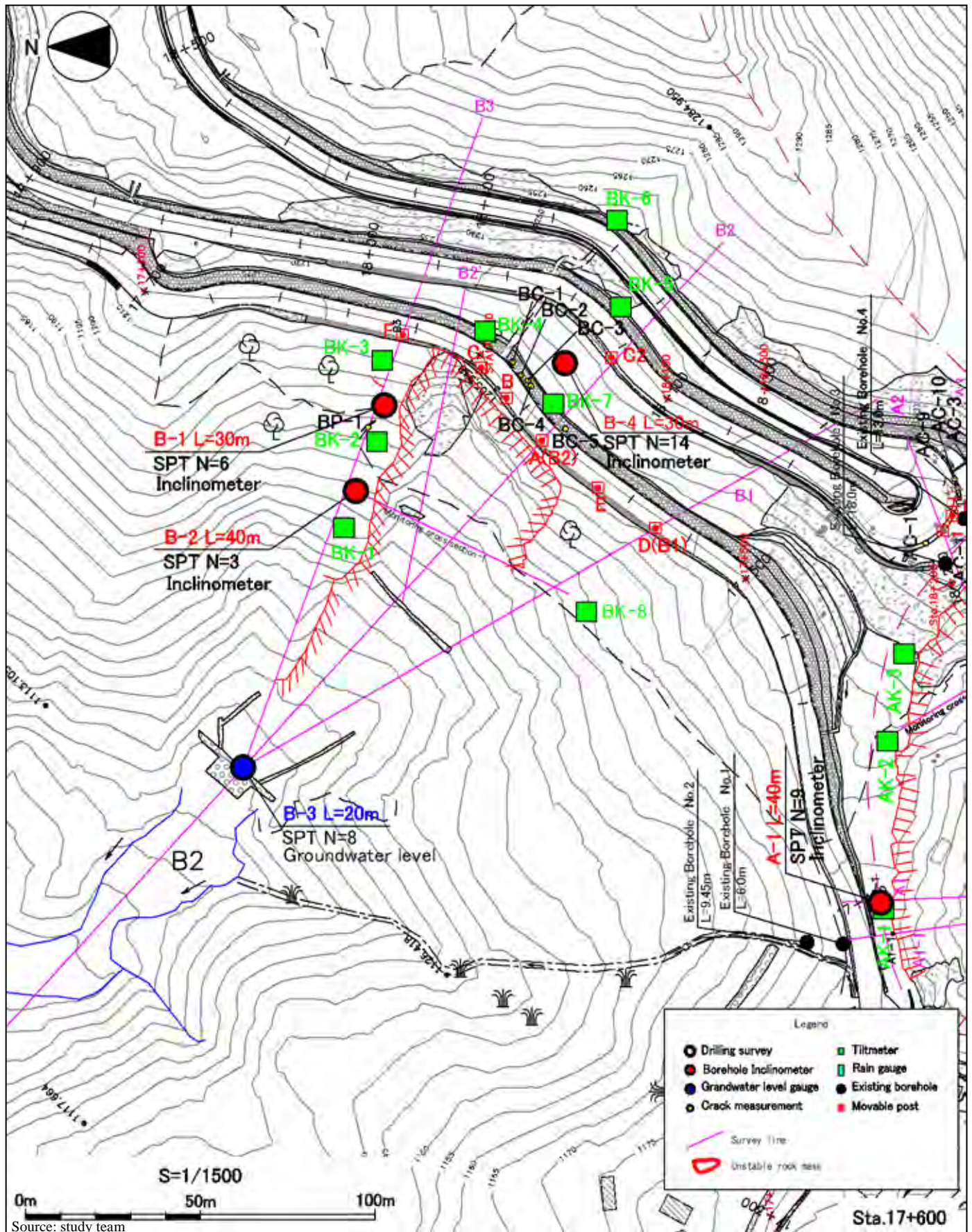
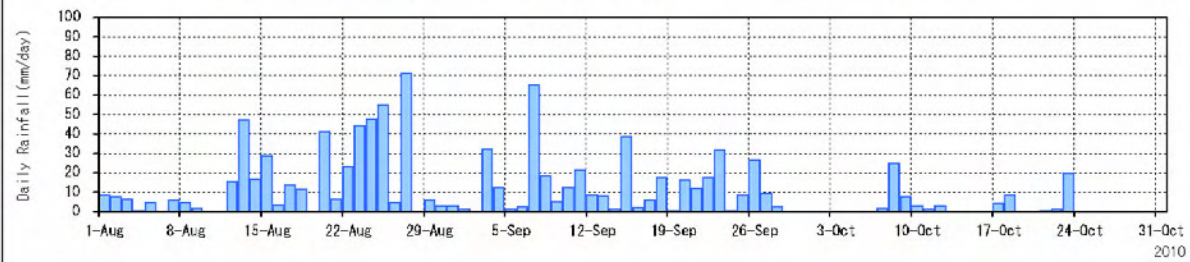
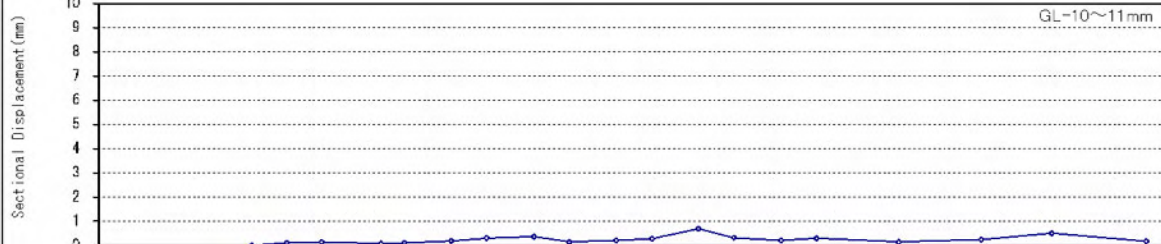
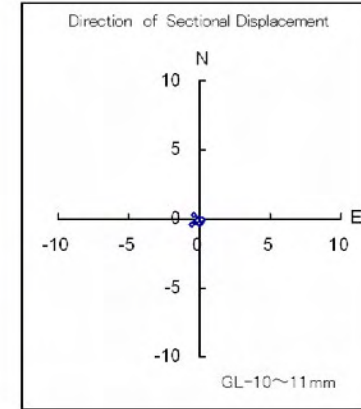
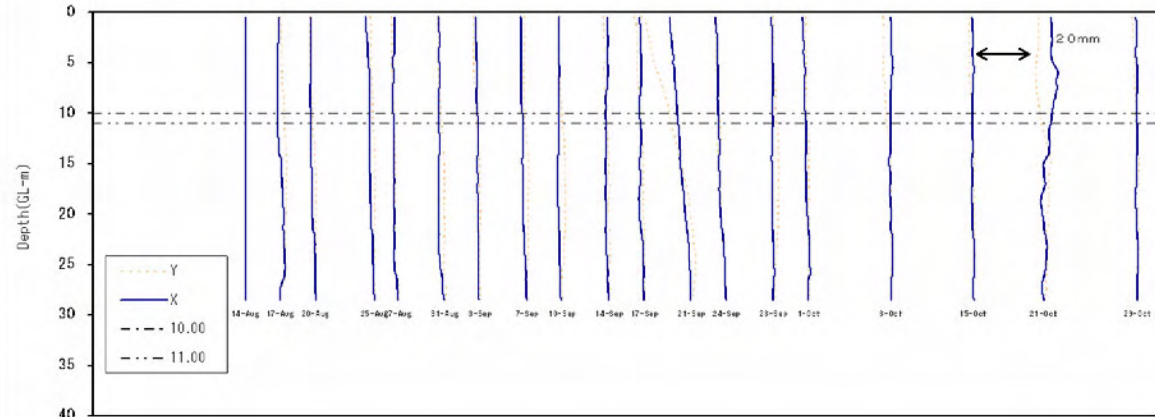


Figure 4.1.2 Location of Monitoring Devices for Sta.17+400 and Sta.18+200

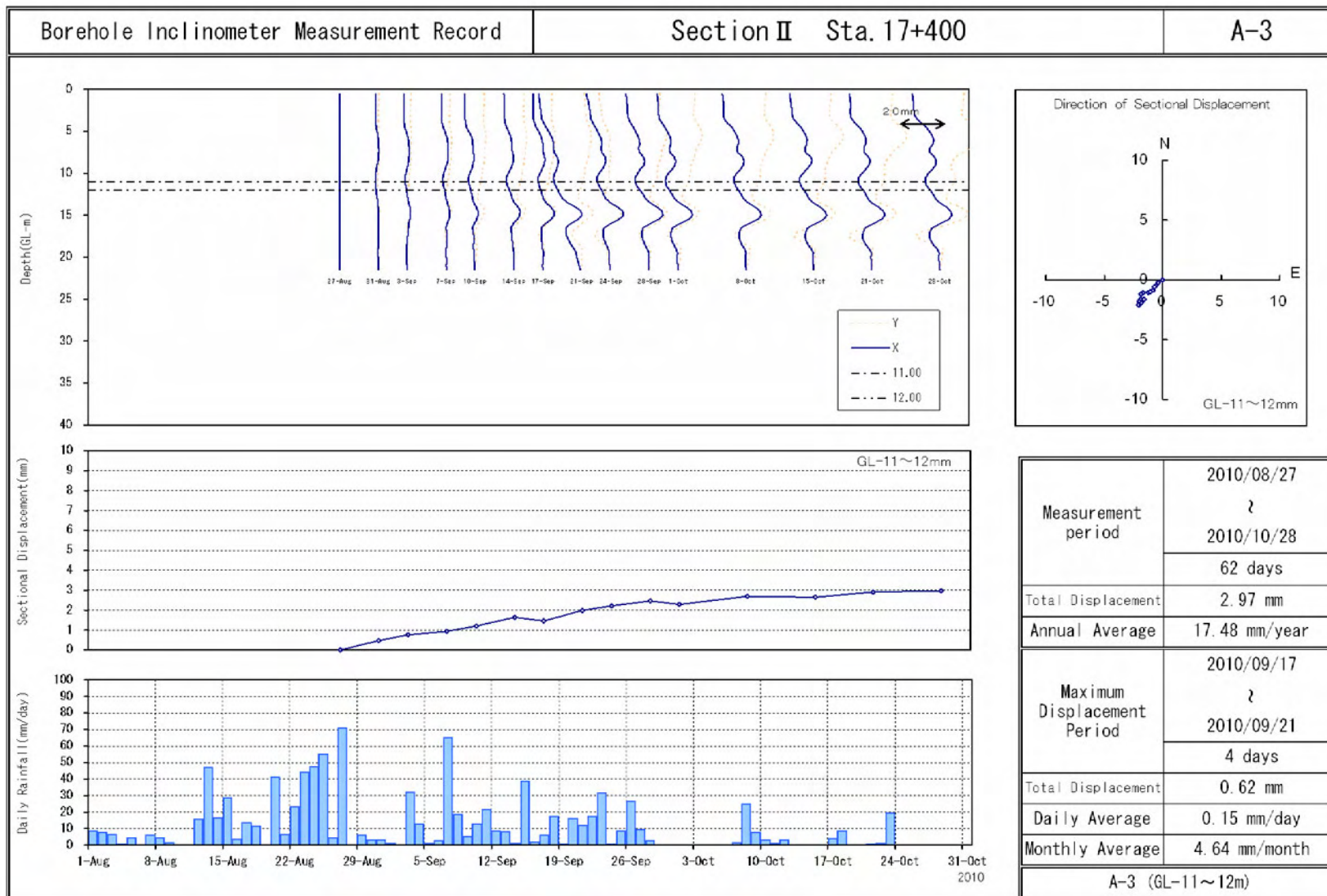
Borehole Incliner Measurement Record

Section II Sta. 17+400

A-1



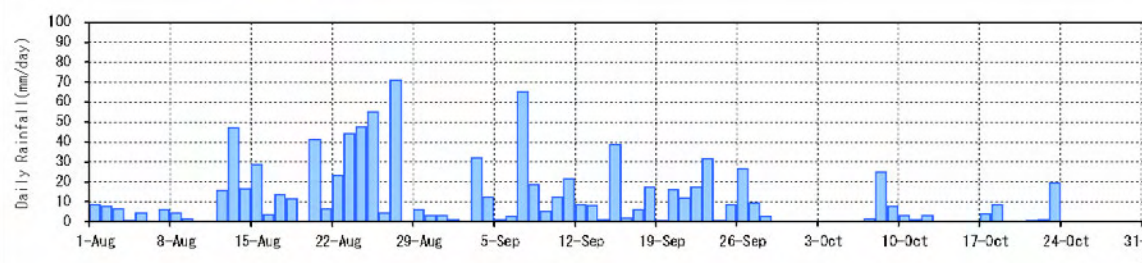
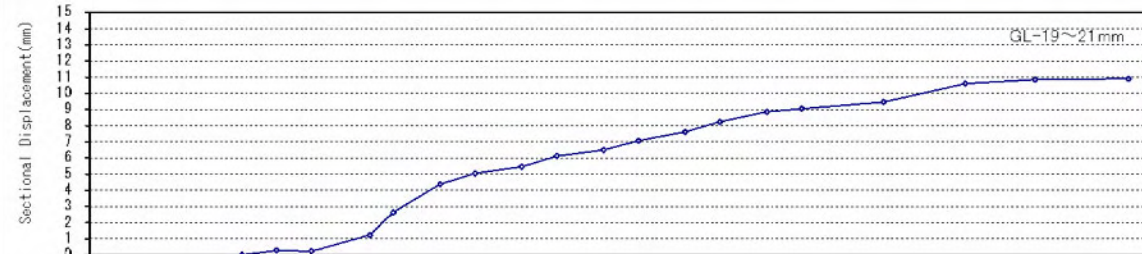
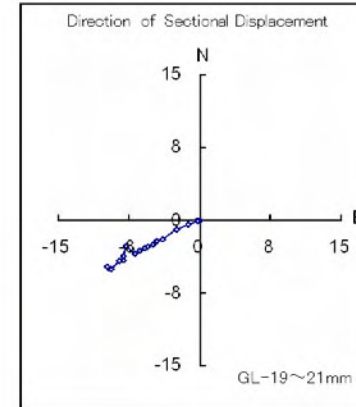
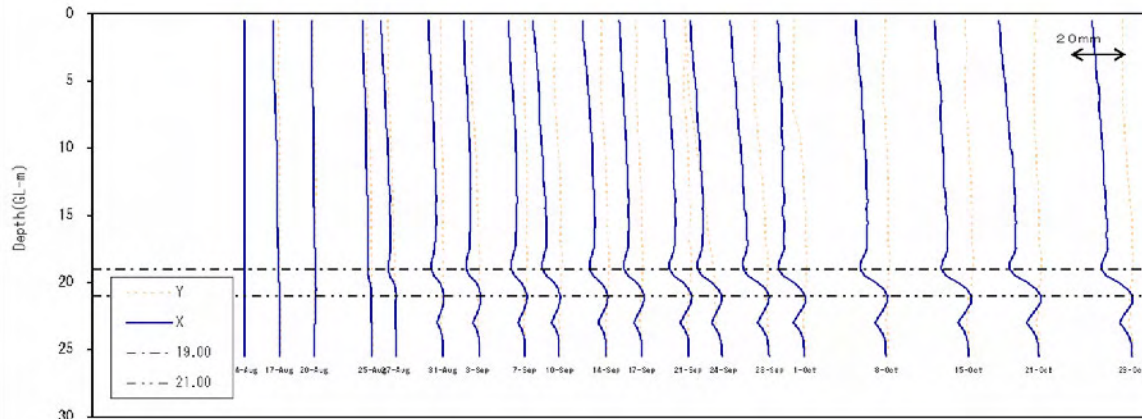
Measurement period	2010/08/14
	?
	2010/10/29
	76 days
Total Displacement	0.17 mm
Annual Average	0.82 mm/year
Maximum Displacement Period	2010/09/17
	?
	2010/09/21
	4 days
Total Displacement	0.7 mm
Daily Average	0.17 mm/day
Monthly Average	5.22 mm/month
A-1 (GL-10~11m)	



Borehole Incliner Measurement Record

Section II Sta.17+400

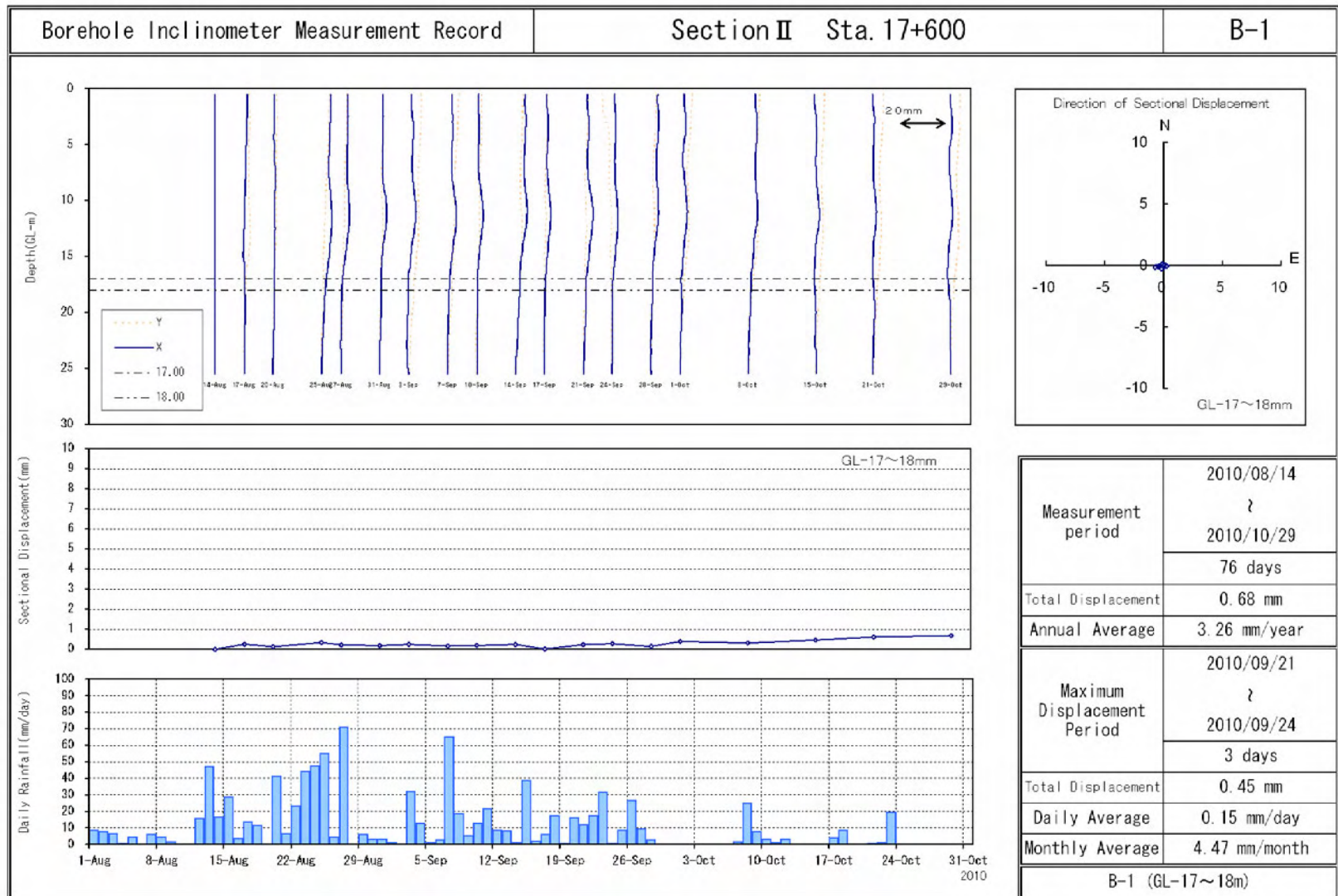
A-4

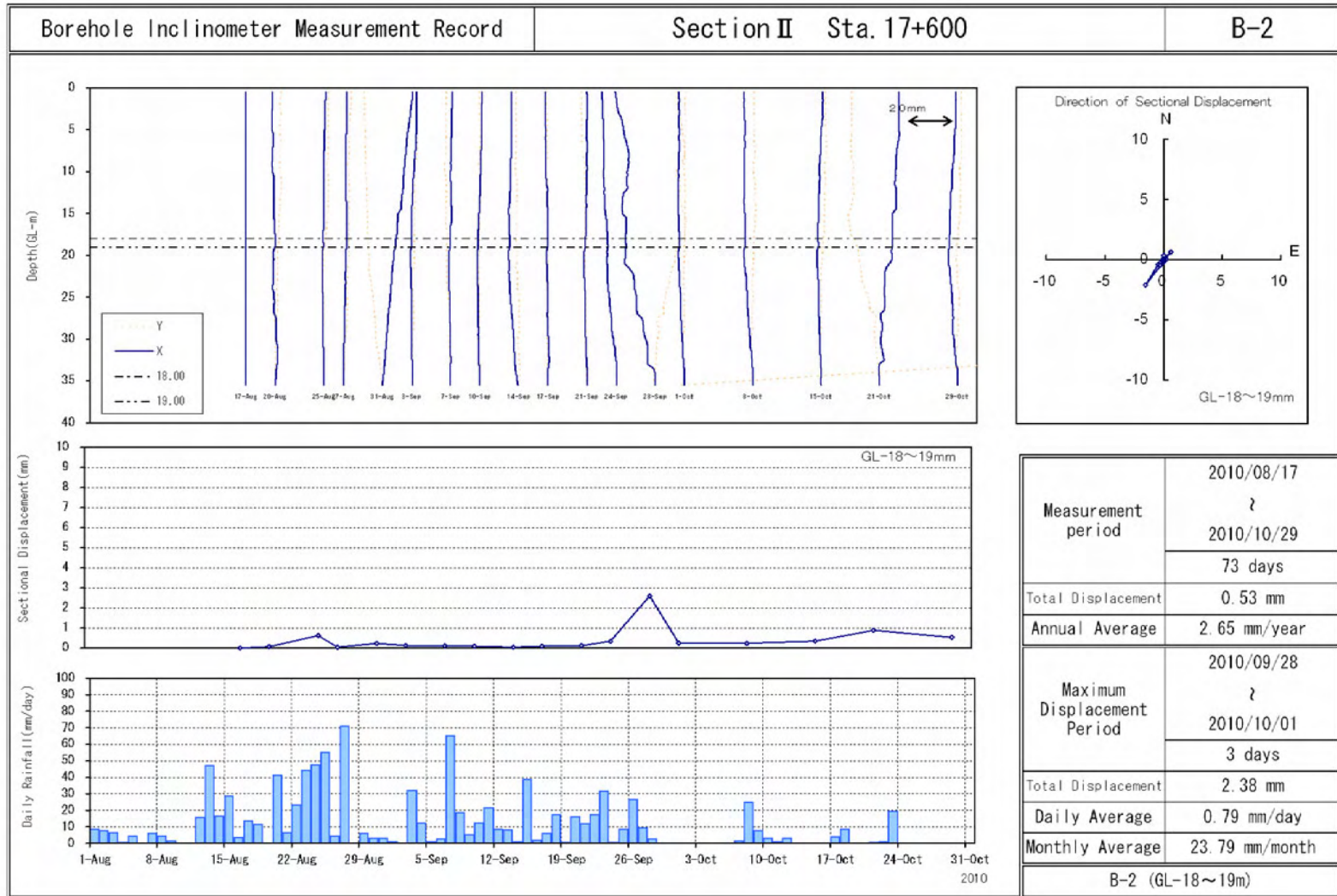


Measurement period	2010/08/14
	2010/10/29
	76 days
Total Displacement	10.92 mm
Annual Average	52.42 mm/year
Maximum Displacement Period	2010/08/25
	2010/08/27
	2 days
Total Displacement	1.4 mm
Daily Average	0.7 mm/day
Monthly Average	20.93 mm/month

A-4 (GL-19~21m)

A4-7

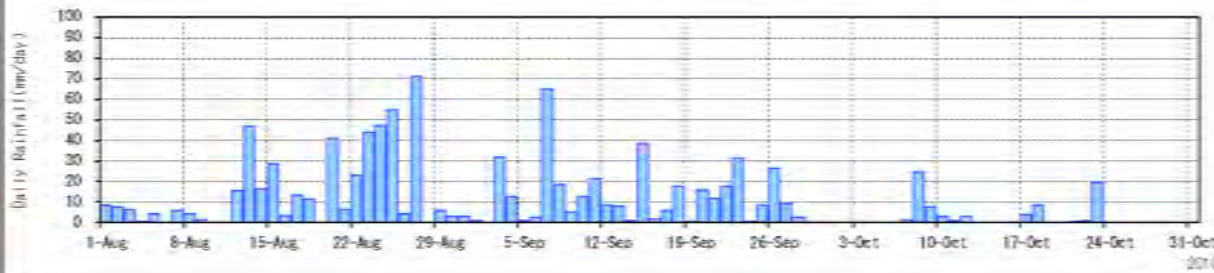
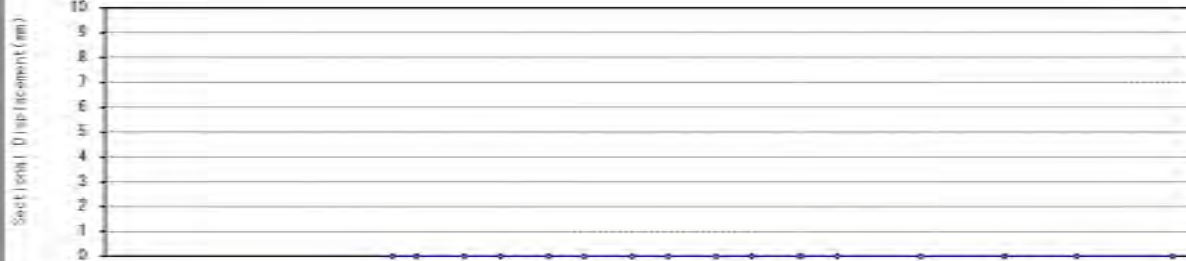
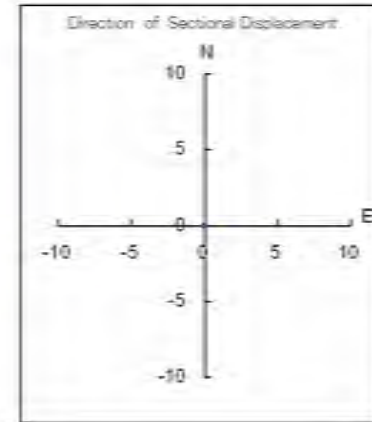
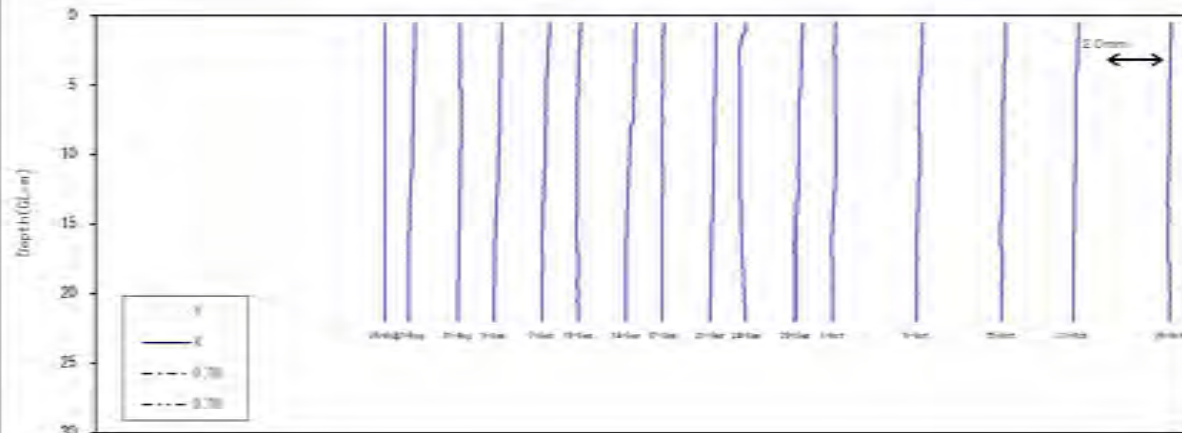




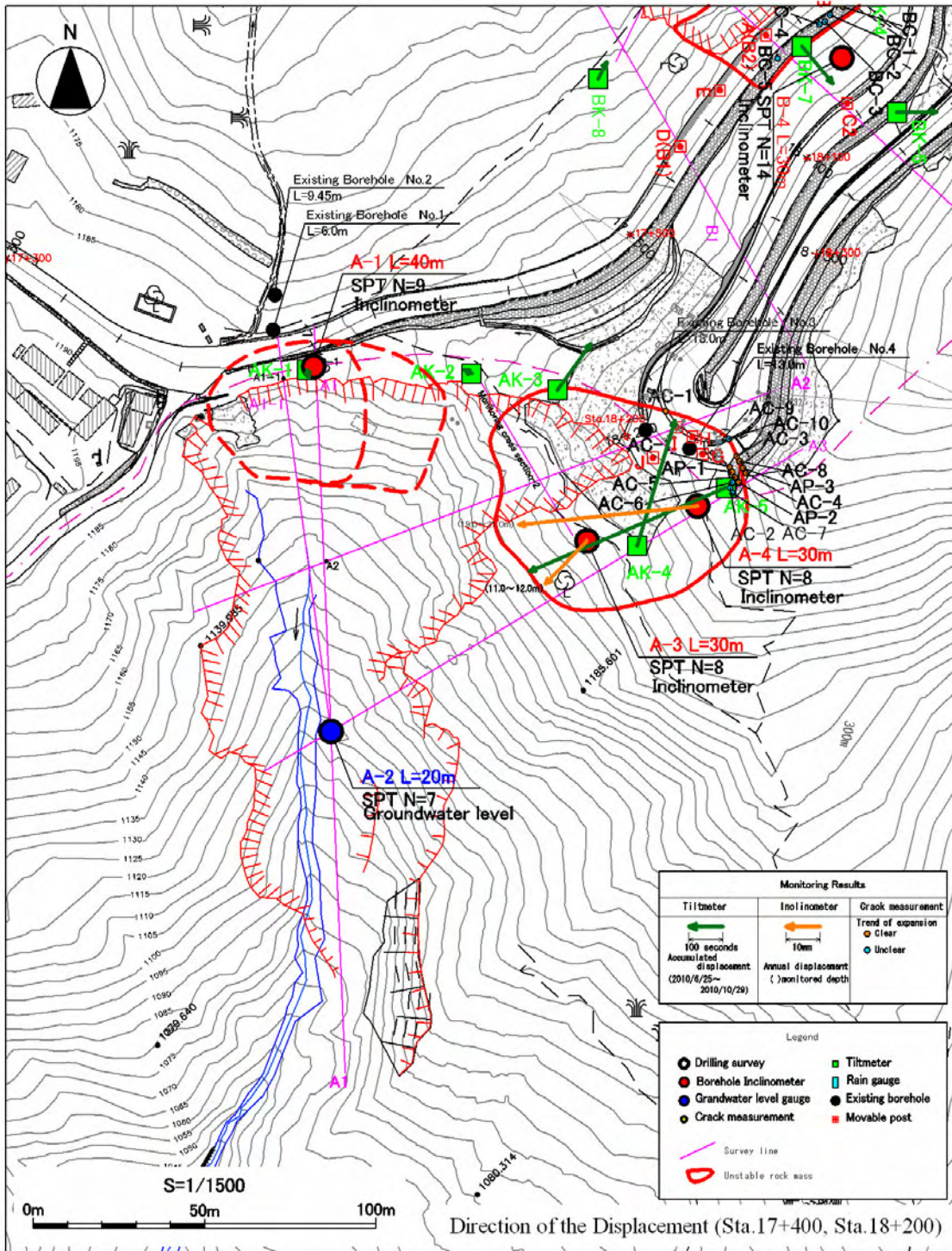
Borehole Incliner Measurement Record

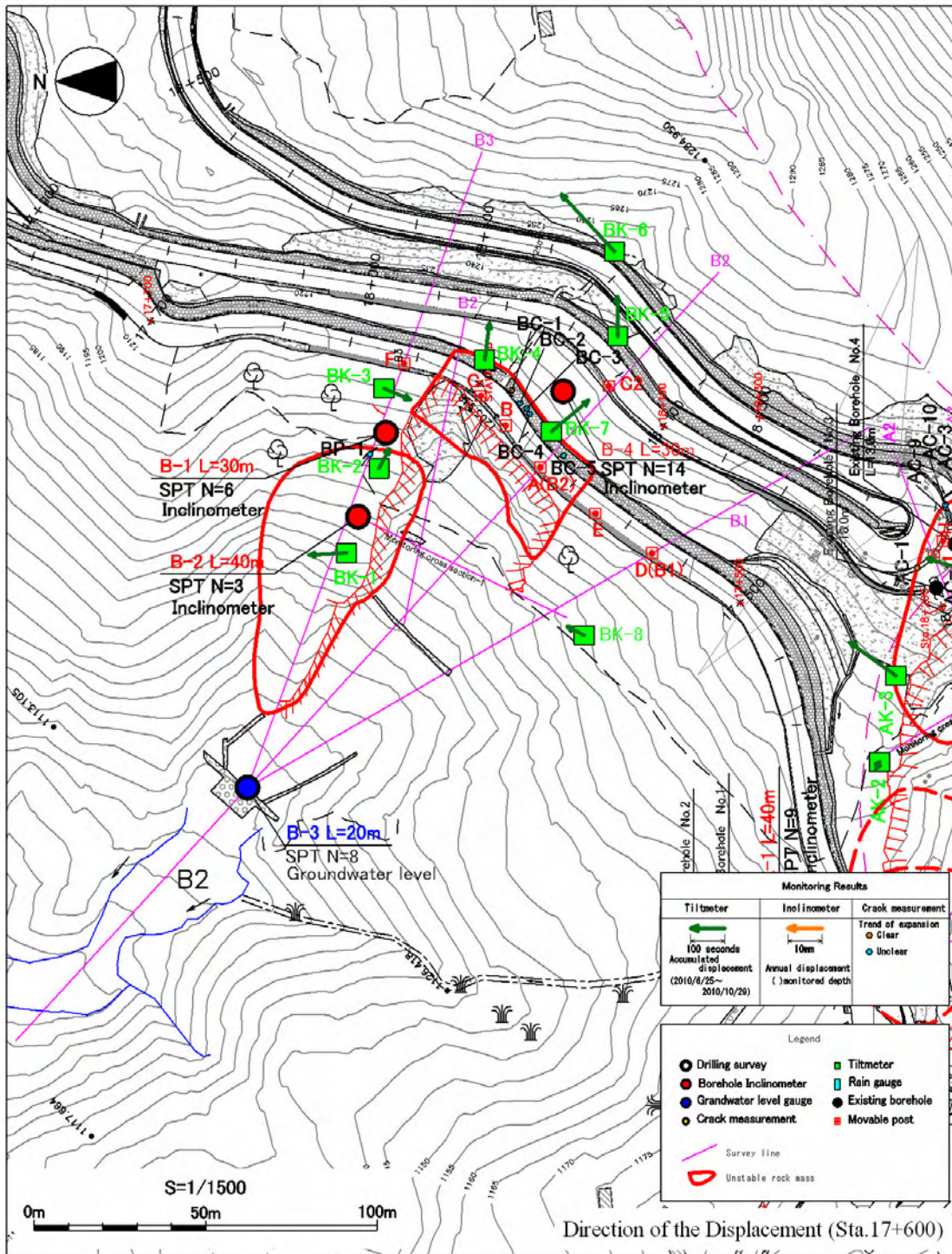
Section II Sta. 17+600

B-4

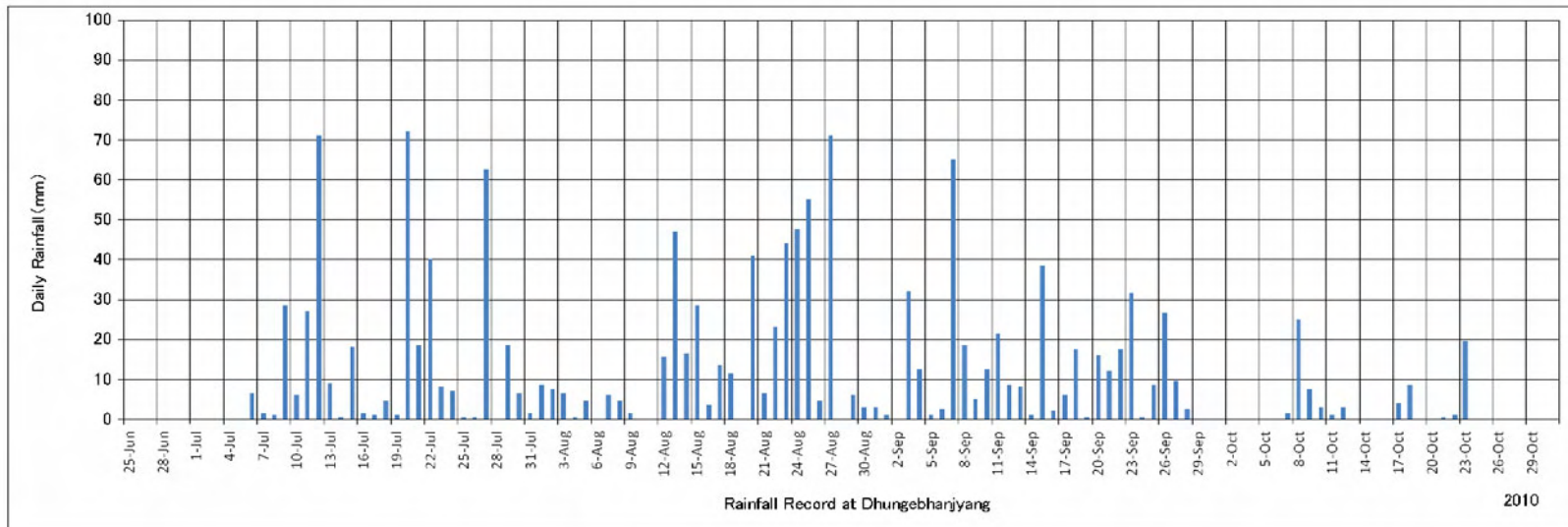
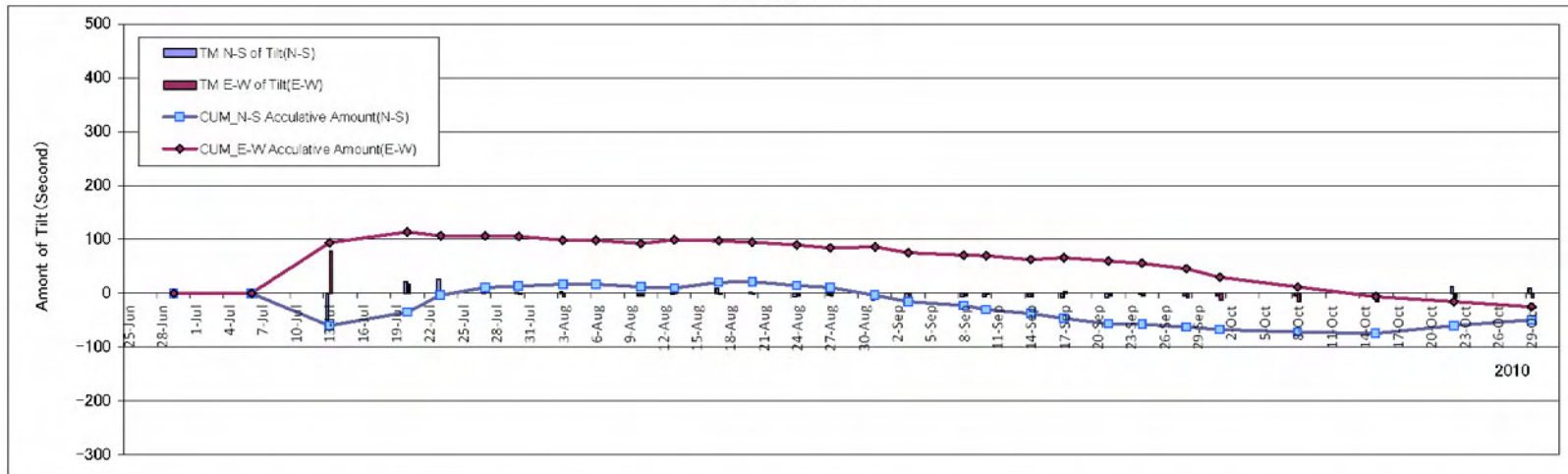


Measurement period	2010/08/25
	2010/10/29
	65 days
Total Displacement	0 mm
Annual Average	0 mm/year
Maximum Displacement Period	2010/08/25
	2010/08/27
	2 days
Total Displacement	0 mm
Daily Average	0 mm/day
Monthly Average	0 mm/month
B-4 (GL~m)	

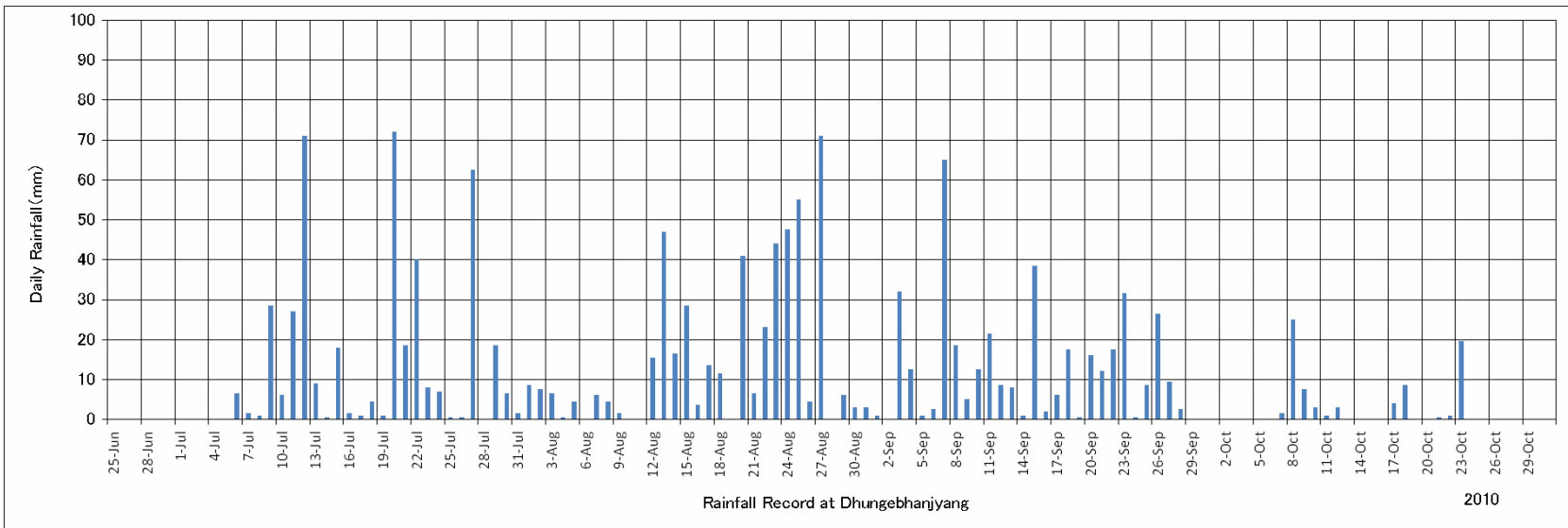
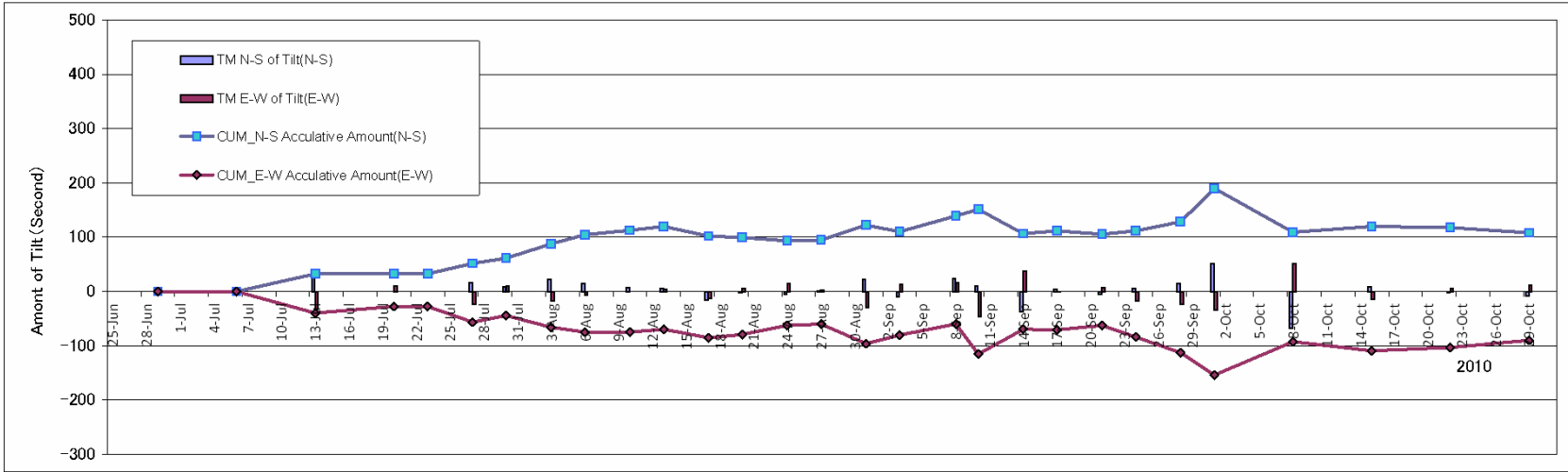




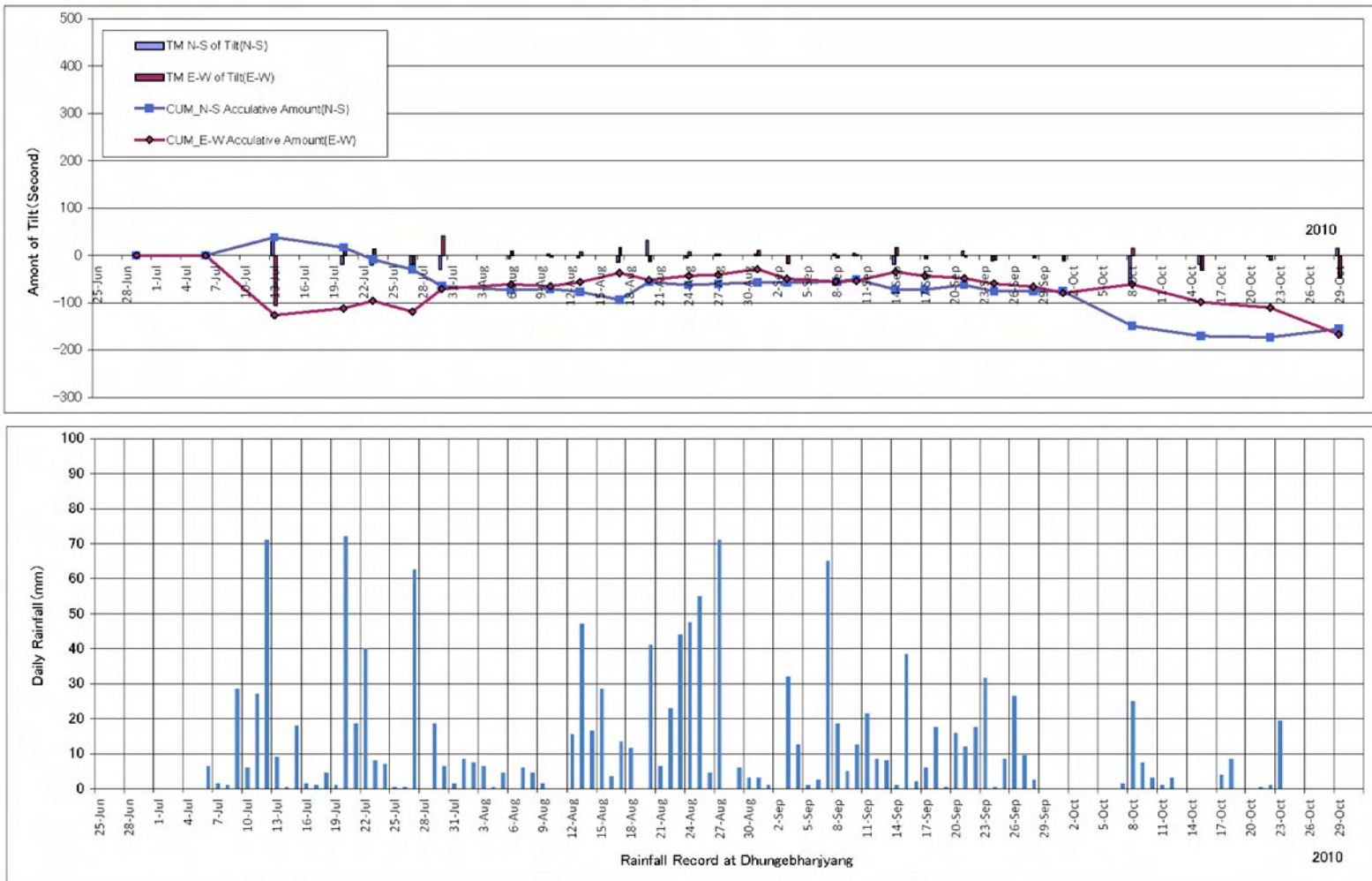
Tiltmeter BK-8



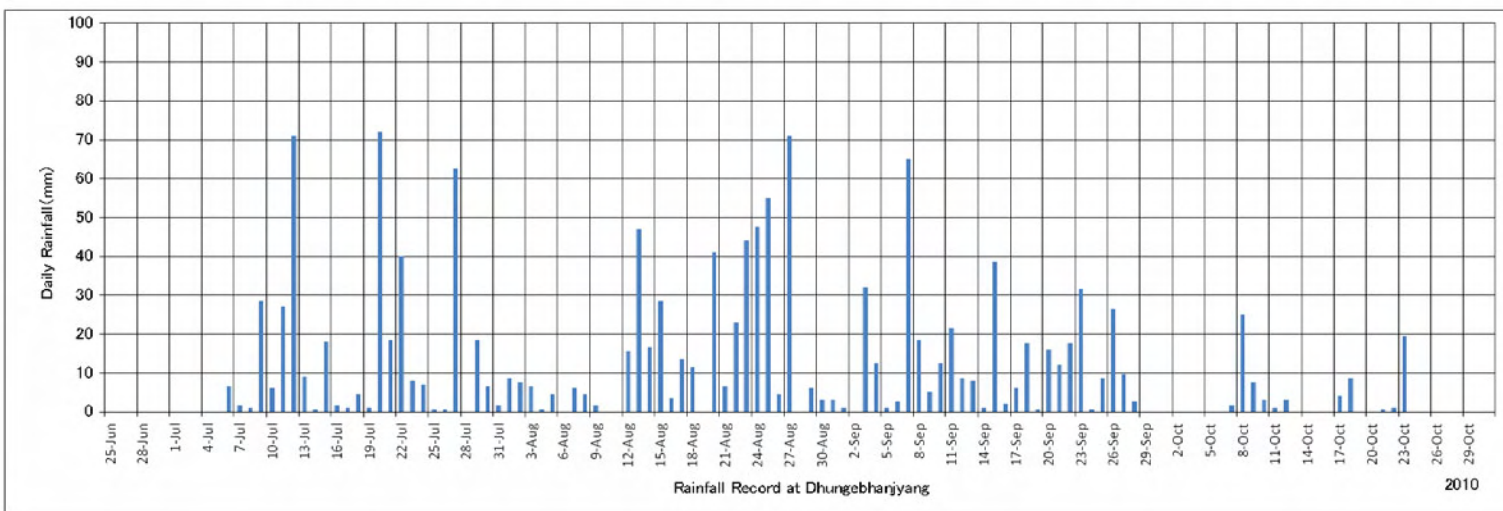
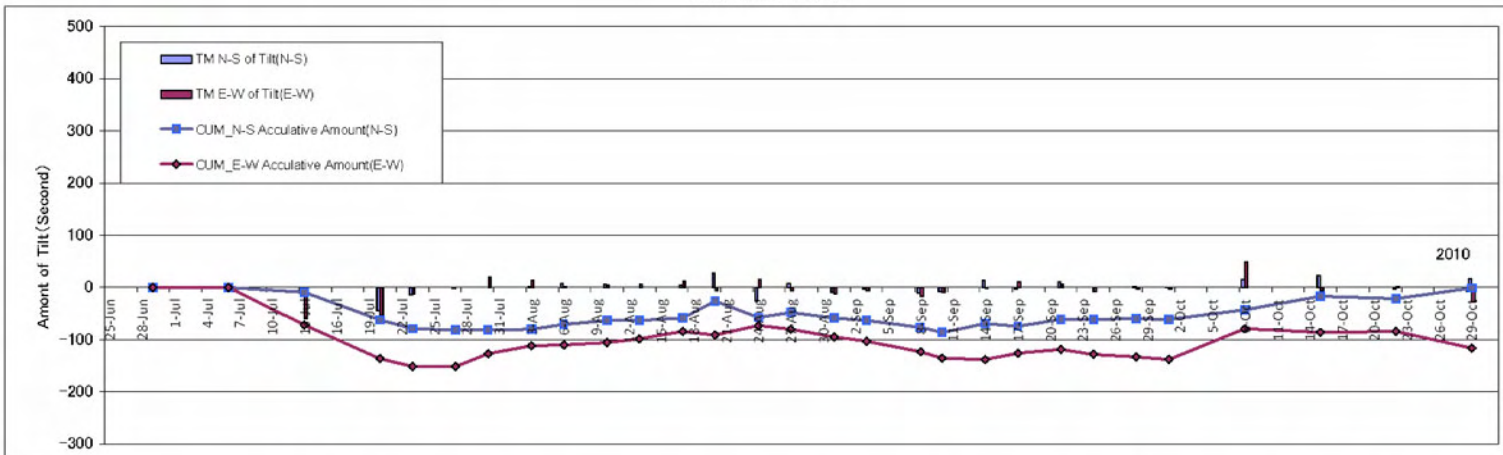
Tiltmeter BK-7



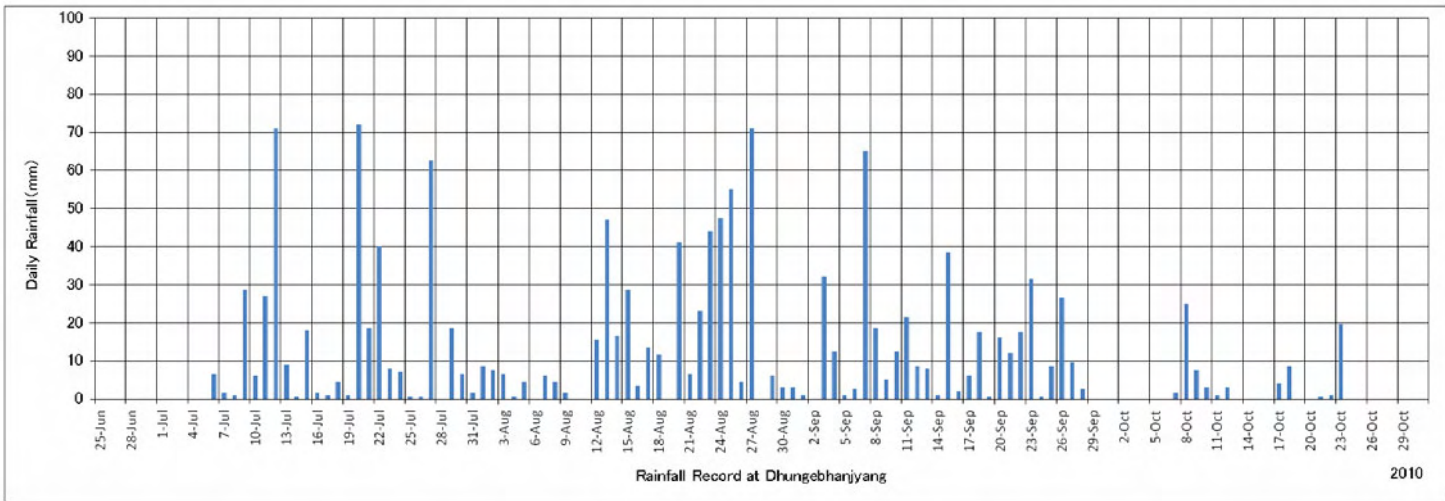
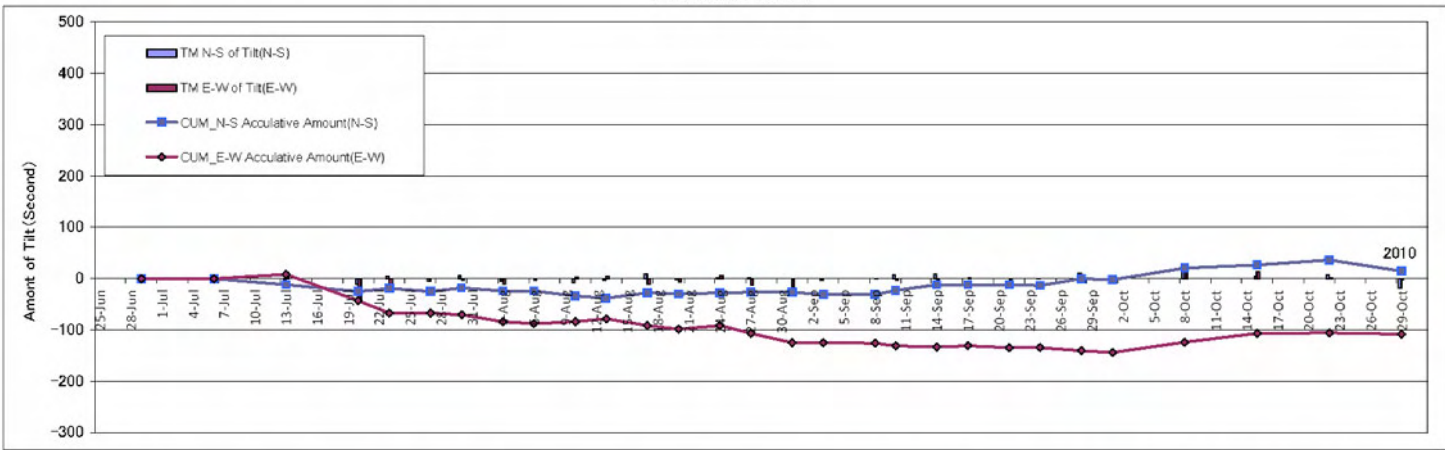
Tiltmeter BK-6



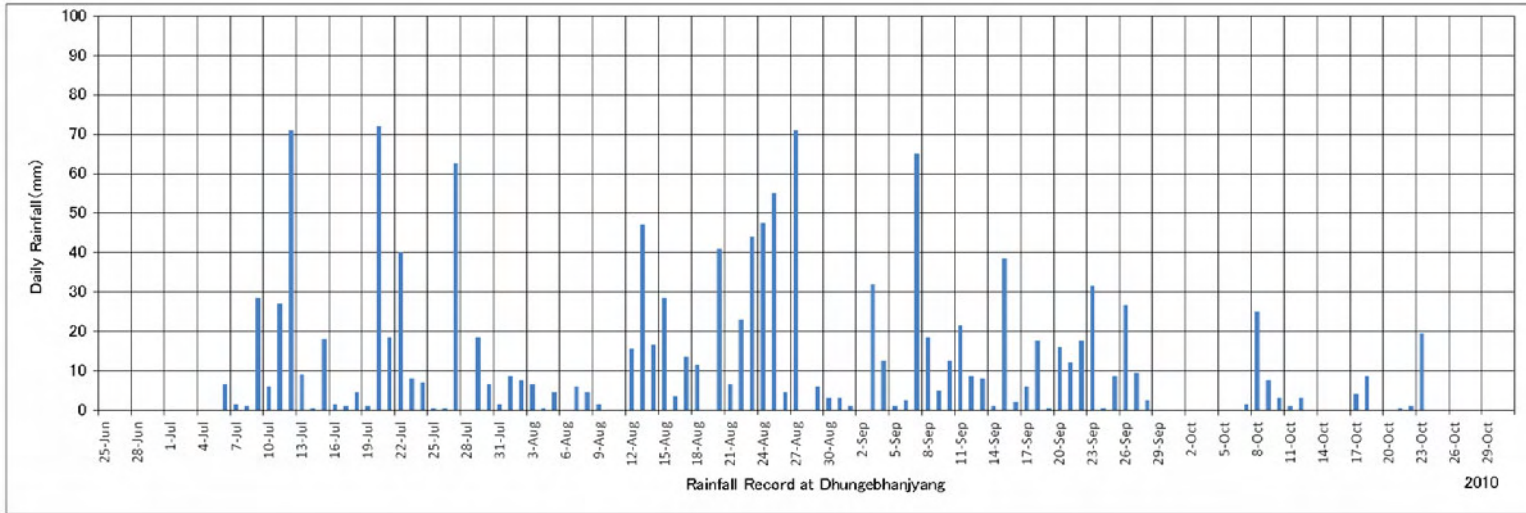
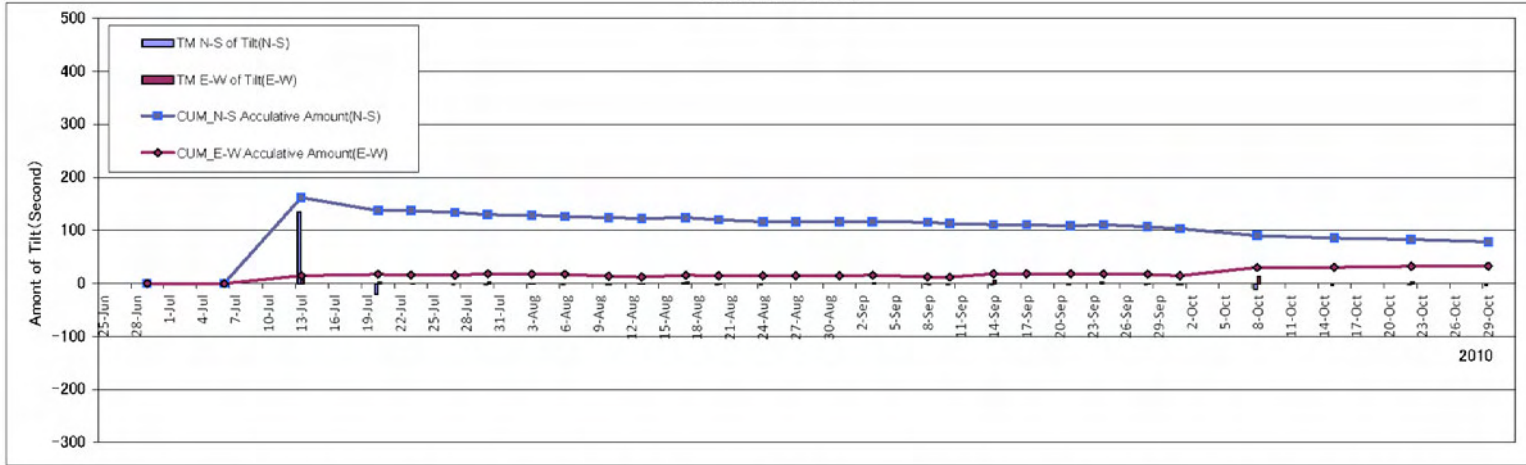
Tiltmeter BK-5



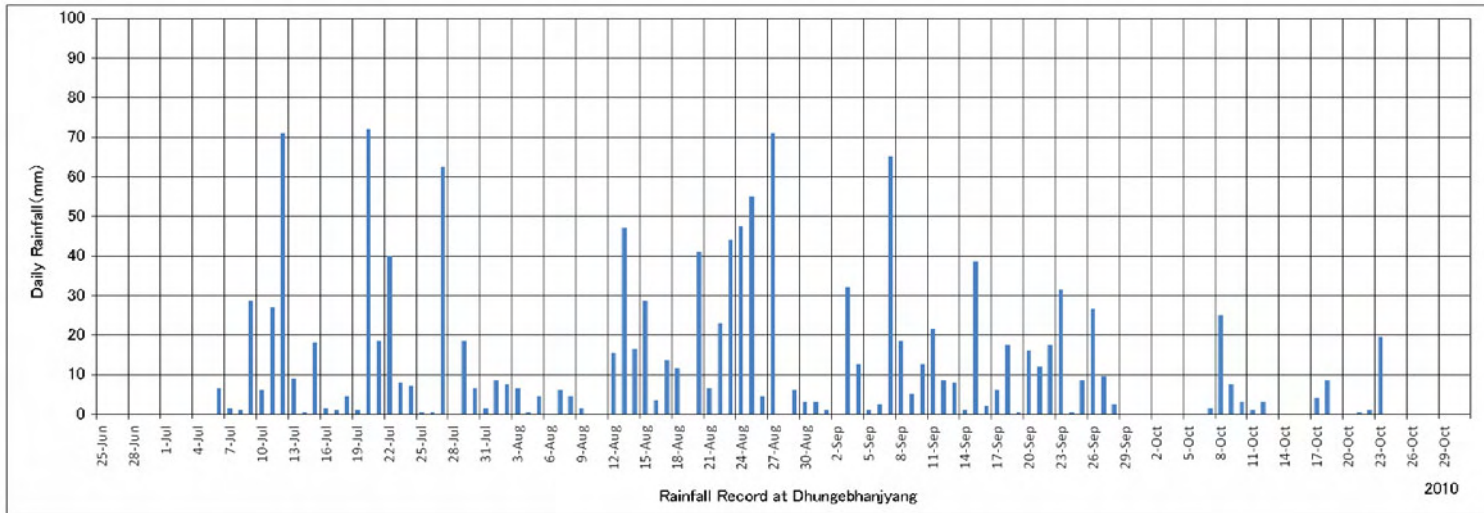
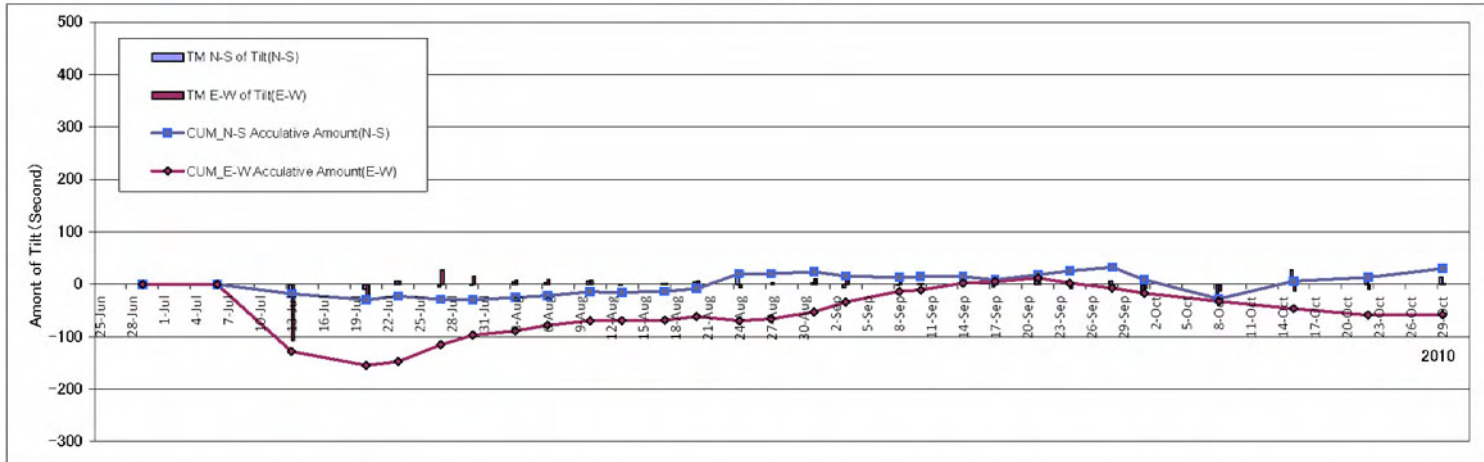
Tiltmeter BK-4



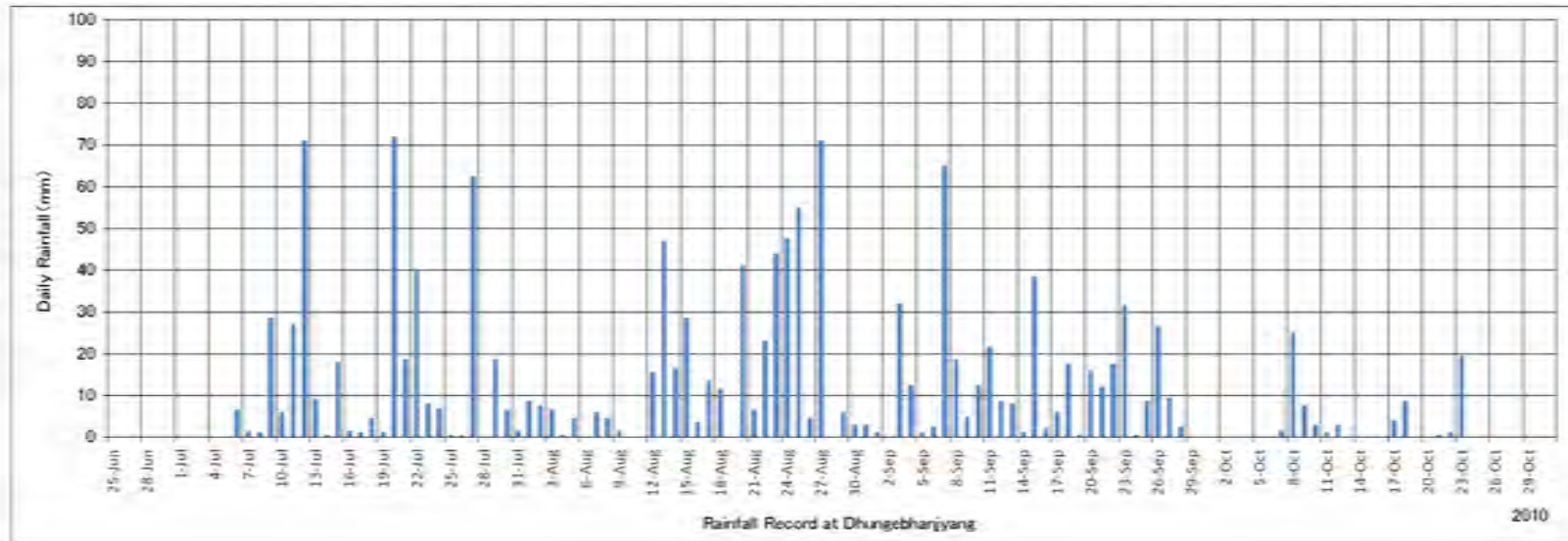
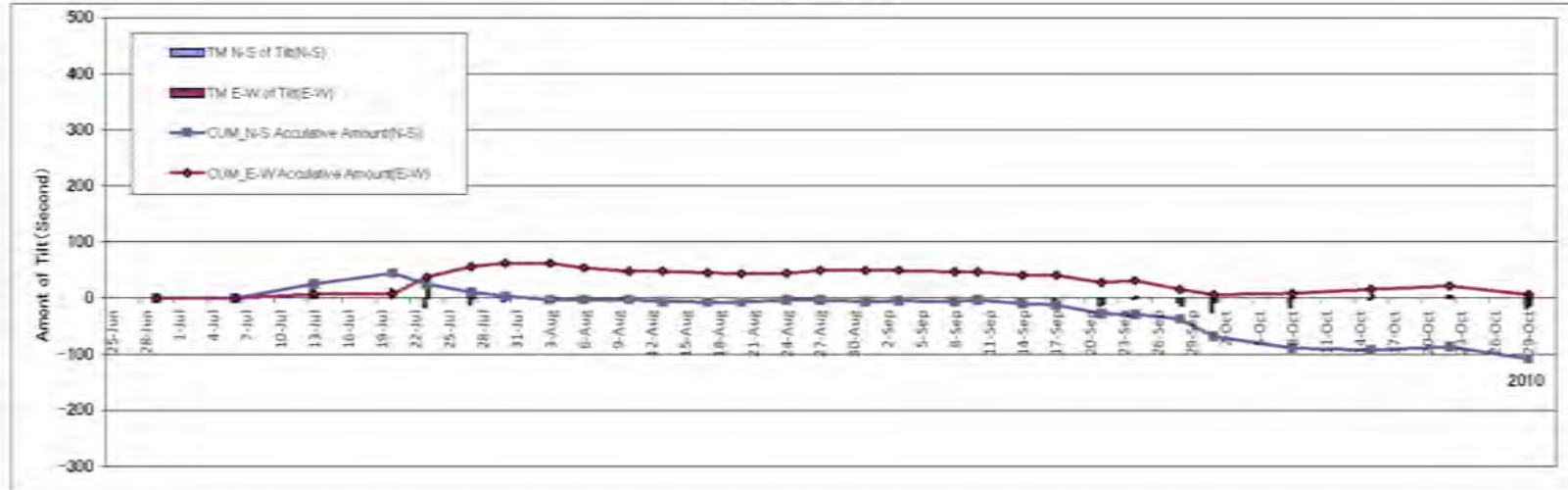
Tiltmeter BK-3



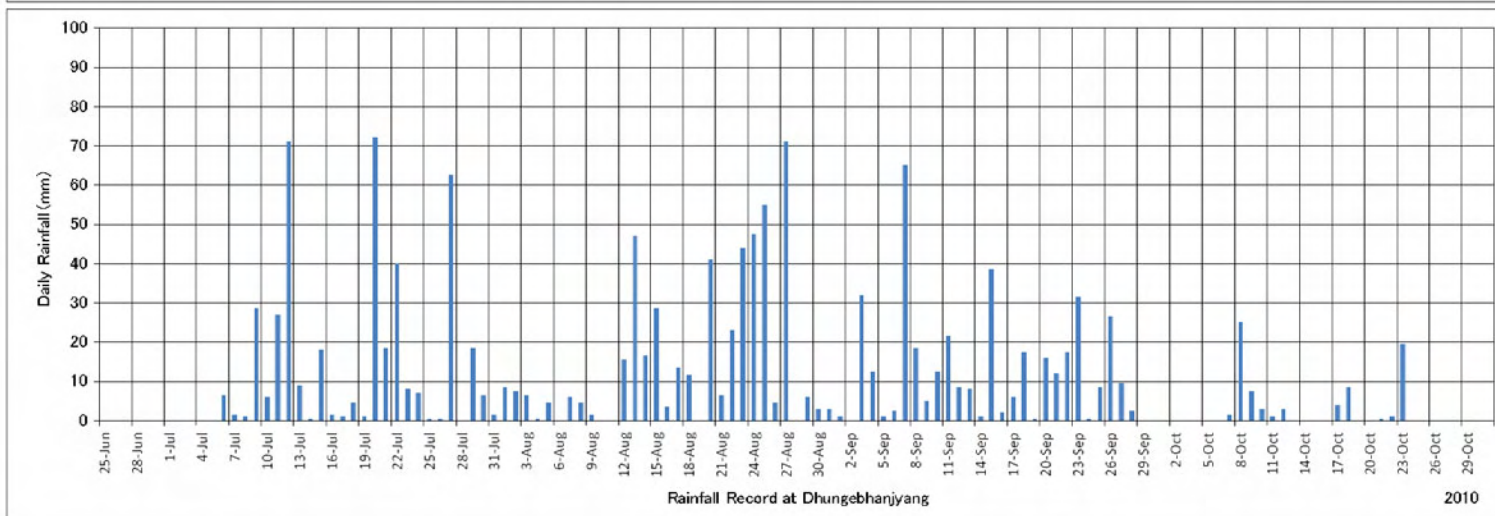
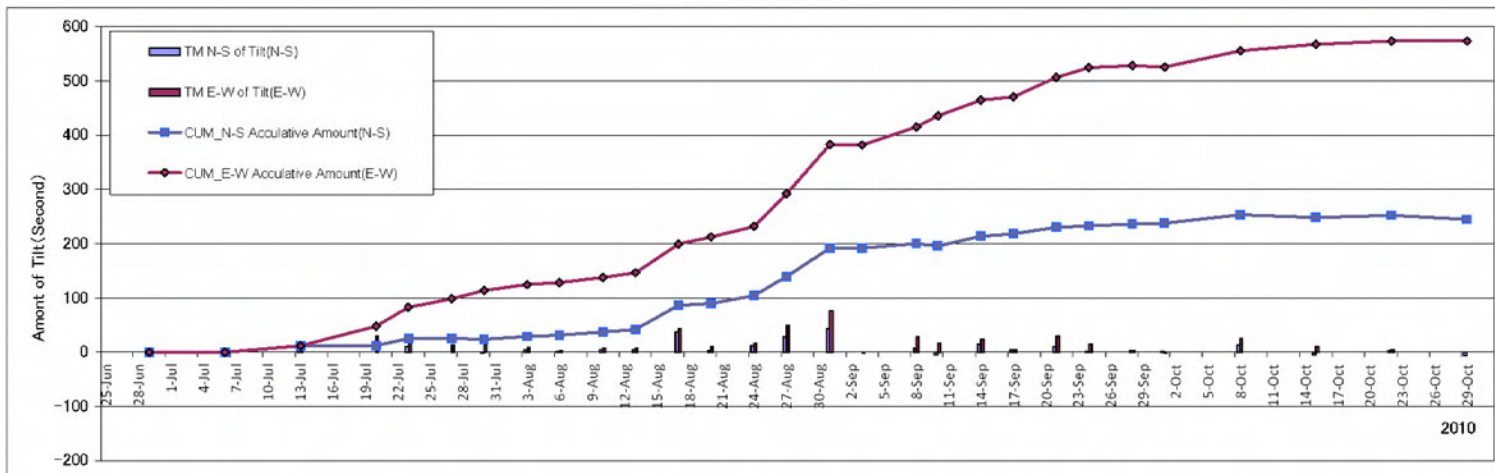
Tiltmeter BK-2



Tiltmeter BK-1



Tiltmeter AK-5



Rainfall Record at Dhungebhanjyang