Survey Comparison using GNSS and ME5000 for One kilometer Range

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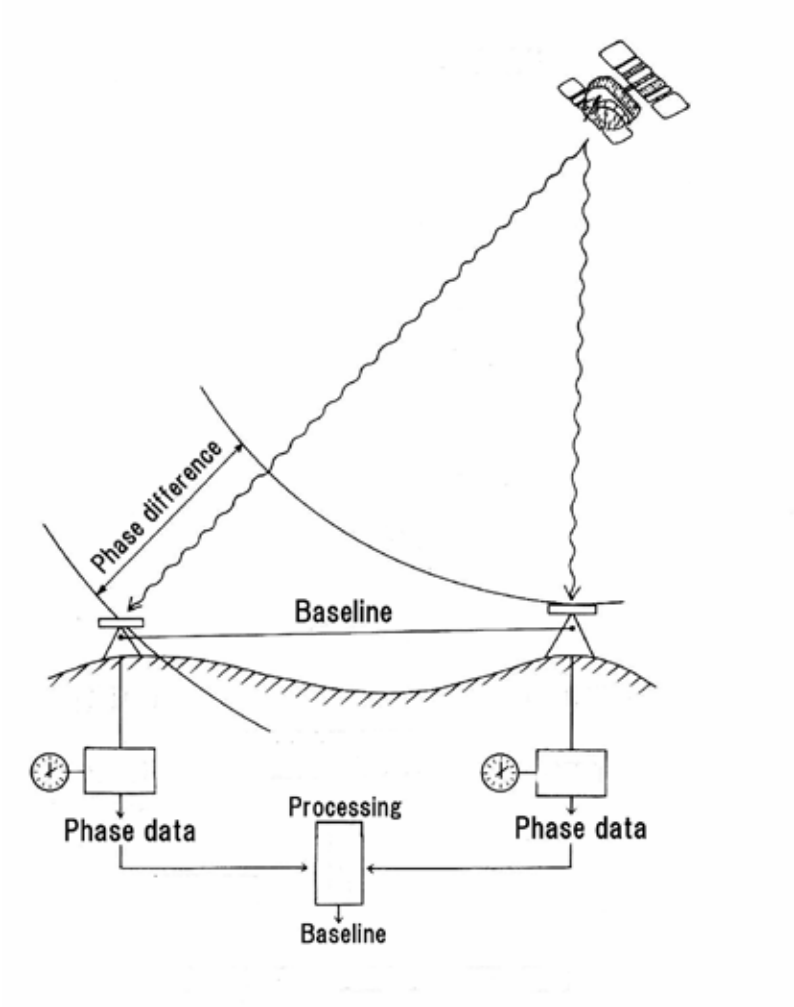
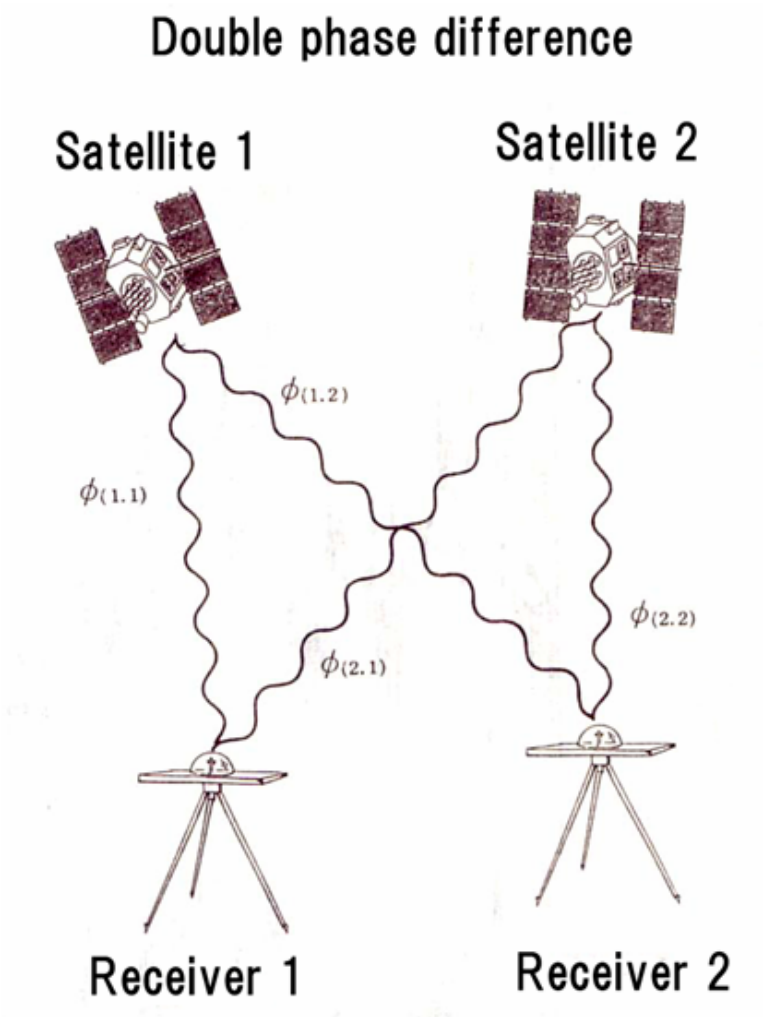
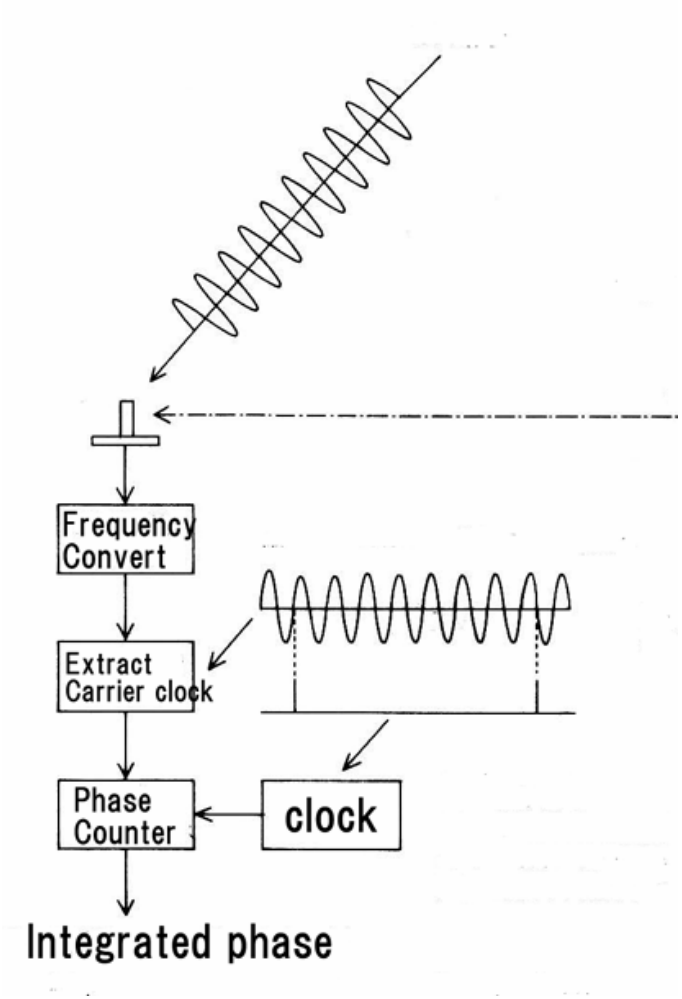
1. Static Relative Positioning
2. Measurement of GPS Antenna Center
3. Survey of Reference points around the storage ring
4. Measurement of the distances 100m-1km
5. Correction by water vapor pressure
6. Summary

Static Relative Positioning





Phase measurement



Wavelength

190mm(L1　1.58GHz)

244mm(L2　1.23GHz)

Carrier phase precision:0.1mm

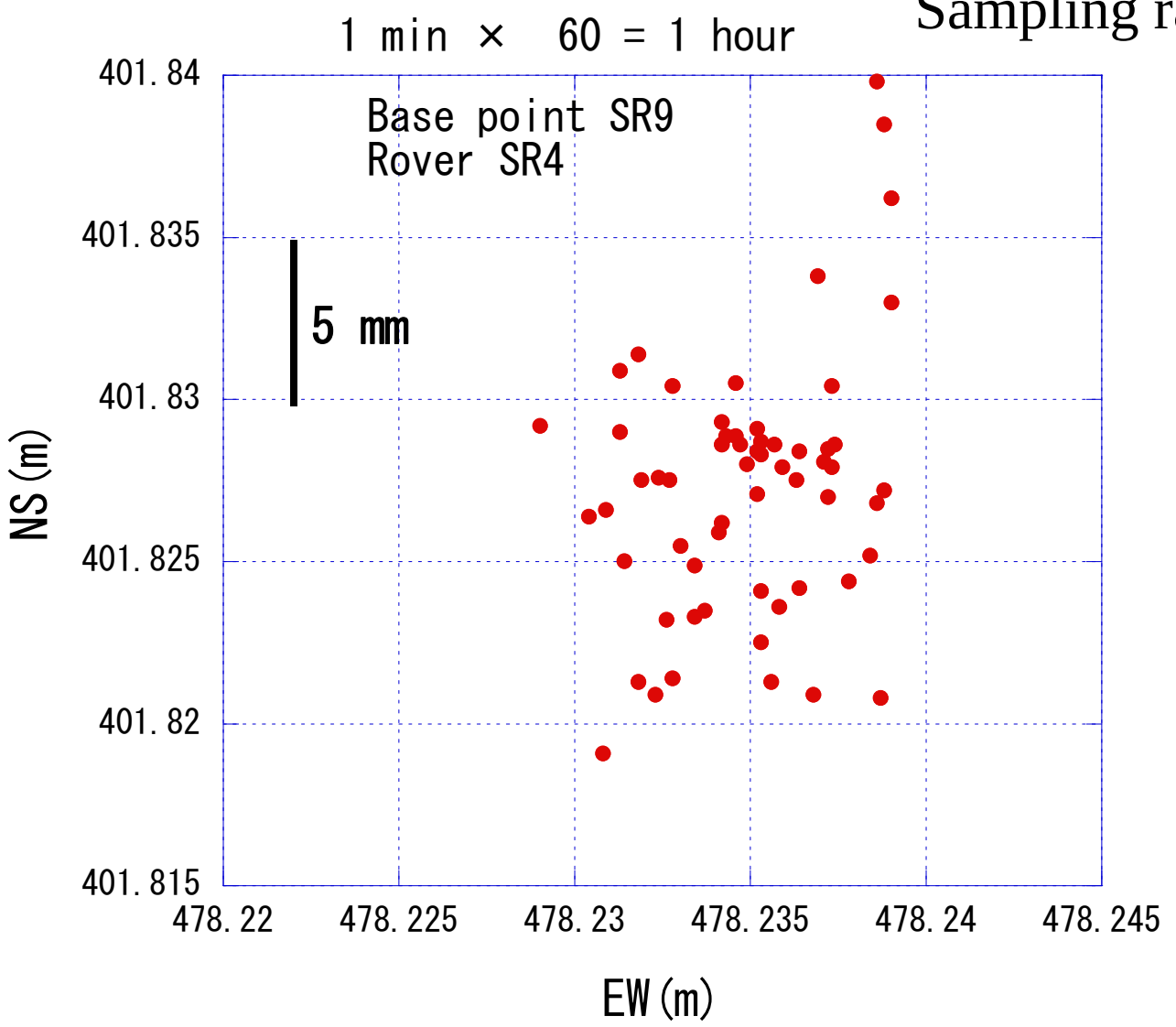
(Topcon NET G3)

1 degree=0.5mm

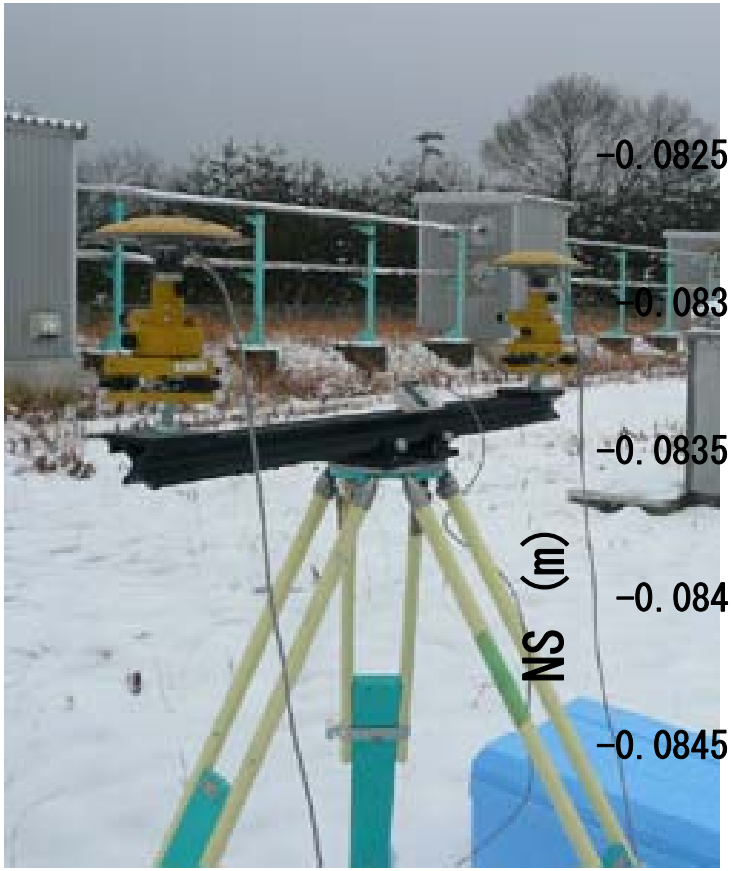
0.2 degree=0.1mm

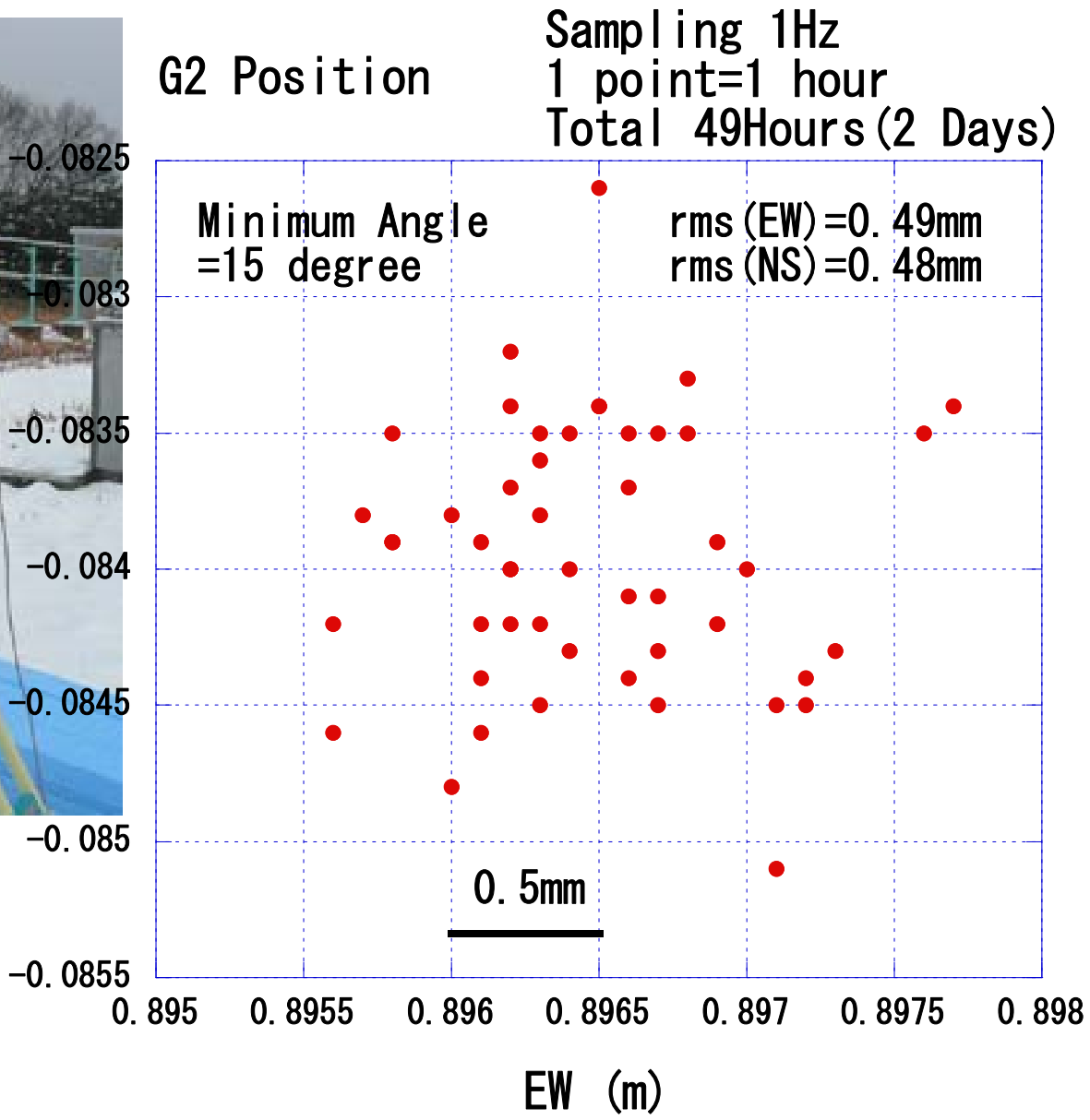
Distribution of 1 minute data

Sampling rate =1 Hz

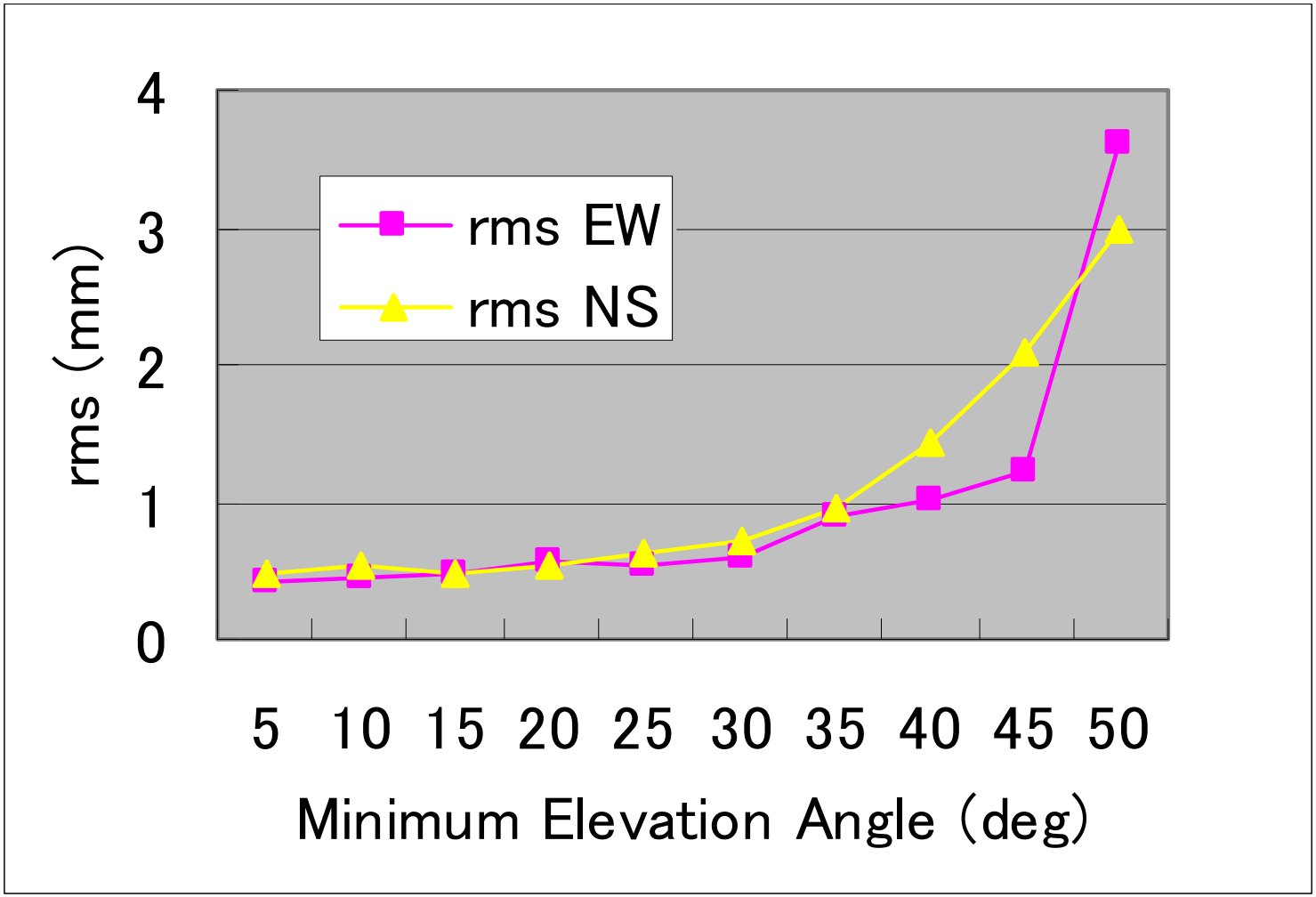


Measurement of Antenna Center

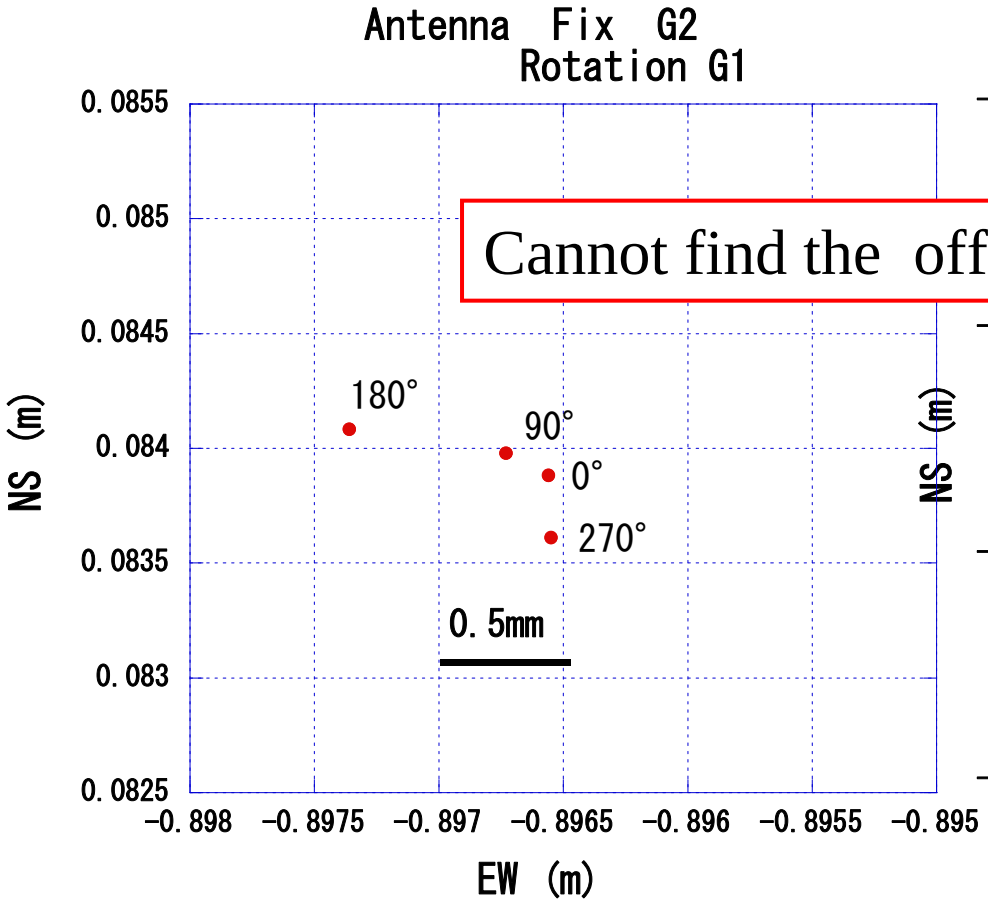




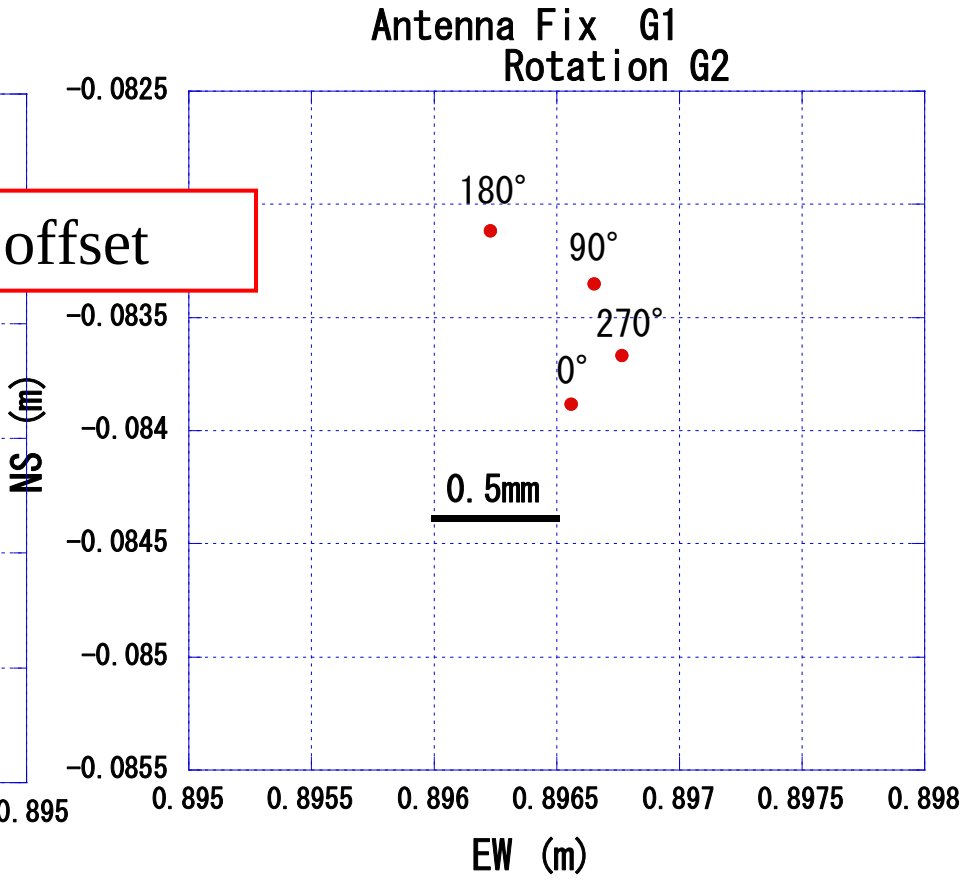
Minimum Elevation Angle vs Distribution



Effect of Antenna Rotation



Cannot find the offset

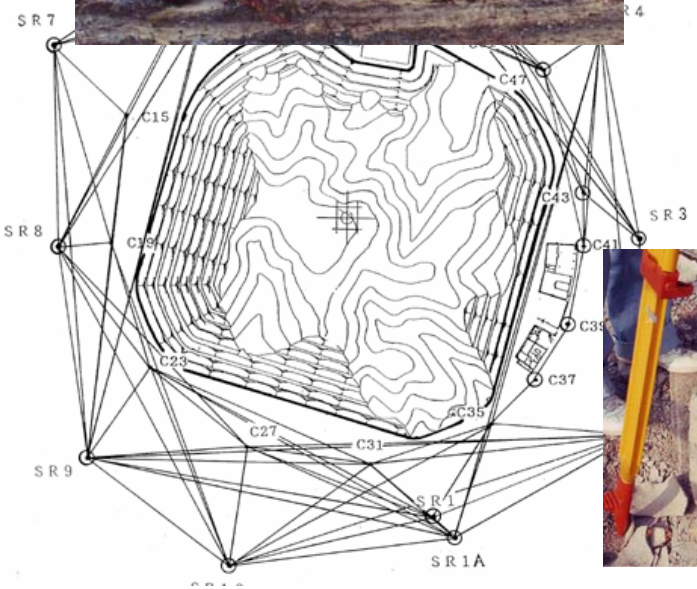


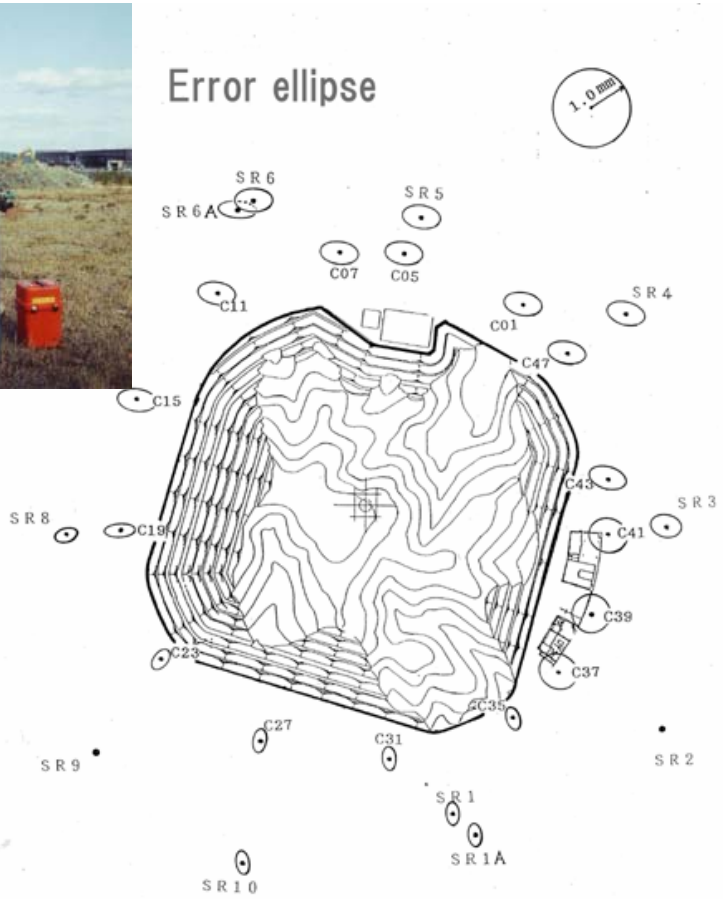
Old Survey of SPring-8 Storage Ring

(1992~1993)

Using distance meter ME5000

Angle Measurement T3000





GPS survey

Receiver Net G3 (Topcon)

analysis software　Pinacle

Specification

Static

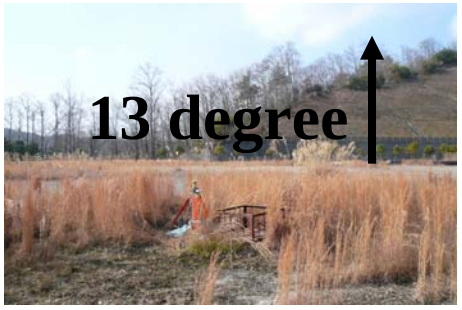
Horizontal±（3mm+0.5ppm×Distance)

Vertical ±（5mm+0.5ppm×Distance)

North

East

South



West

Shift for fifteen years

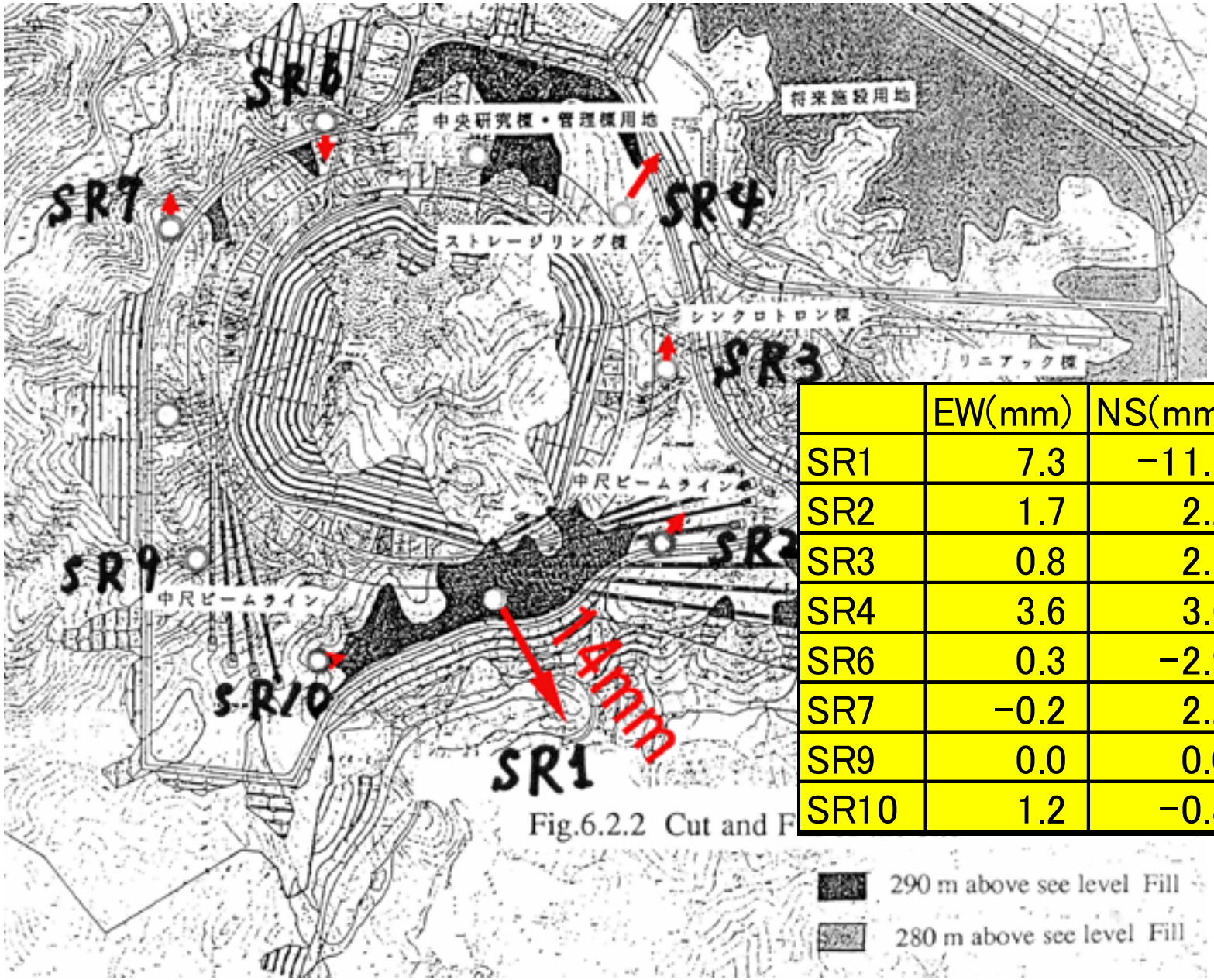
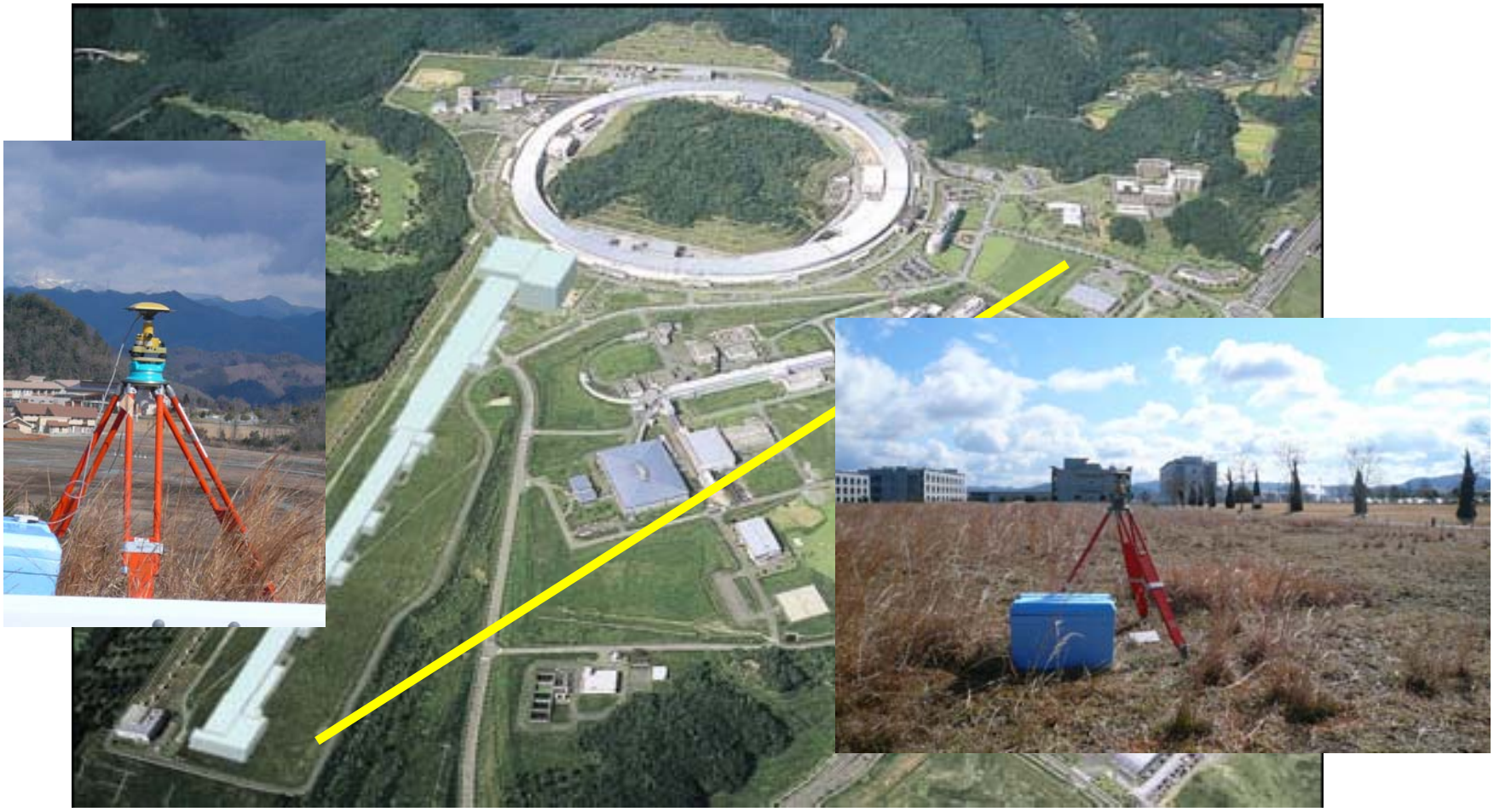


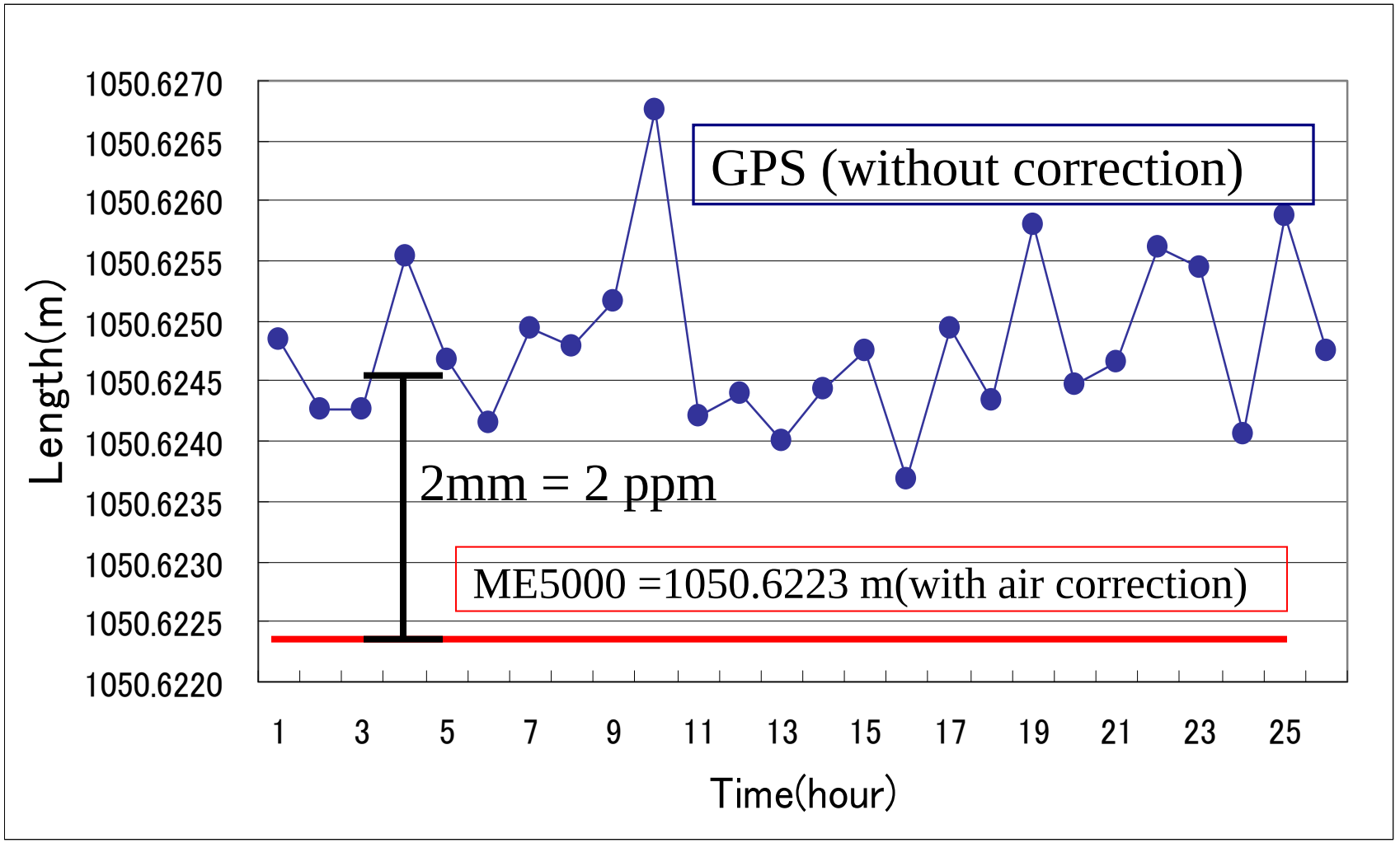
Fig.6.2.2 Cut and F

	EW(mm)	NS(mm)
SR1	7.3	−11.7
SR2	1.7	2.2
SR3	0.8	2.7
SR4	3.6	3.6
SR6	0.3	−2.9
SR7	−0.2	2.2
SR9	0.0	0.0
SR10	1.2	−0.8

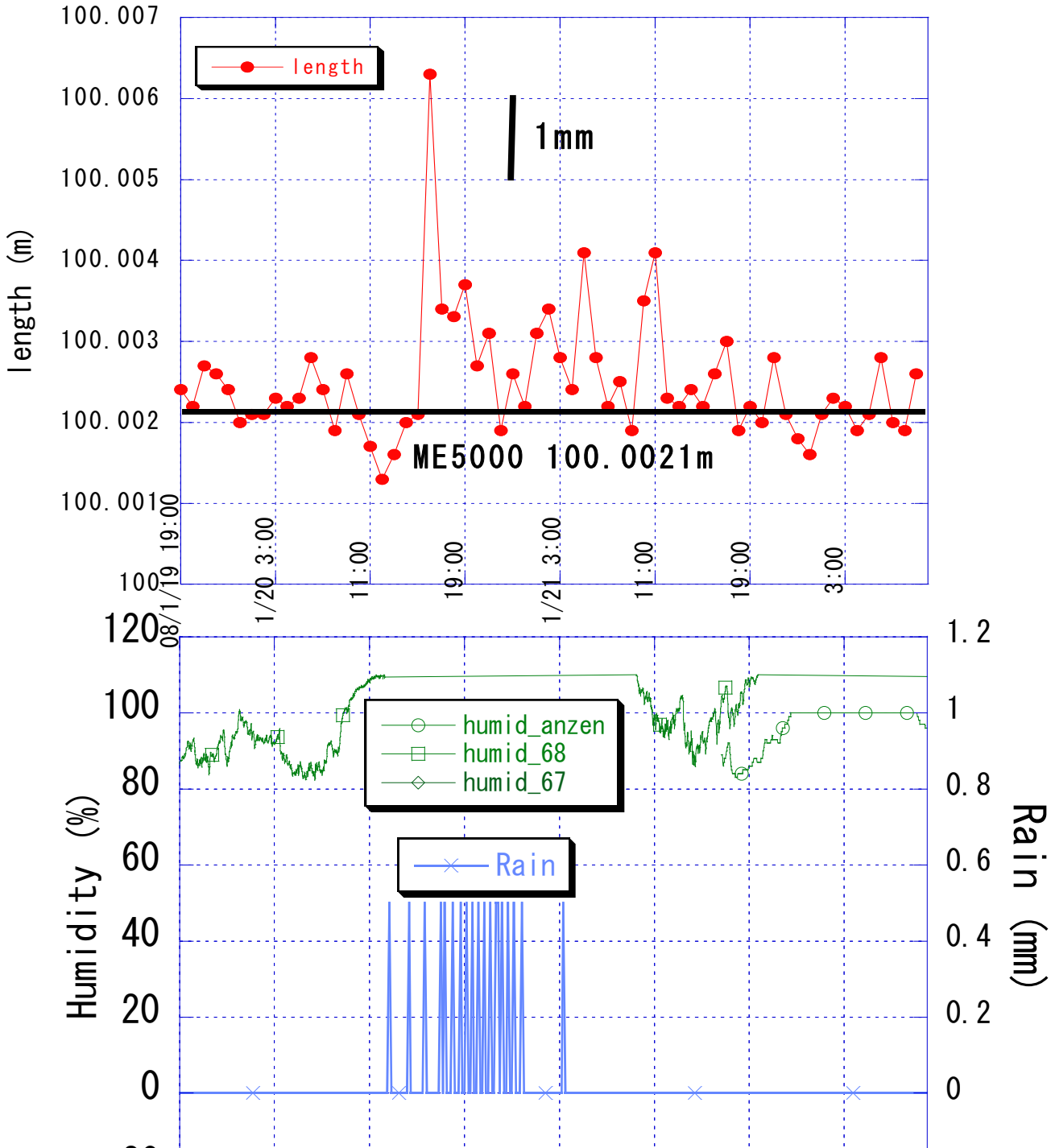
Comparison GPS and ME5000



Comparison at 1000m distance



Effect of Water Vapor



Distance Comparison

200~400m

Distance (m)	GPS (m) 1day	ME5000 (m)	difference (mm)
200	200.0052	200.0049	0.3
300	300.0066	300.0060	0.6
400	400.0034	400.0028	0.6

Correction of water vapor pressure

Air Temperature : T[K]
Water vaper pressure : e [hPa]

He Ne laser λ = 633nm

$$n = 1 - \frac{0.073 * e}{1 + 0.003661 * T} \times 10^{-6}$$

Micro wave Water Vapor Pressure 0.2 hPa~ 1ppm

$$n = 1 + 3.73 \times \frac{e}{T^2} \times 10^{-3}$$

Summary

Measured 8 Reference points by GNSS

only SR1 (on the filled ground) shift 14mm

Comparison ME5ooo and GPS

100m~400m distance difference ~1mm

Water vapor correction is very important.

Statistical error will be reduced using 20 Hz Sampling.

I think we can reduce the precision of GPS using high sampling rate and water vapor correction.