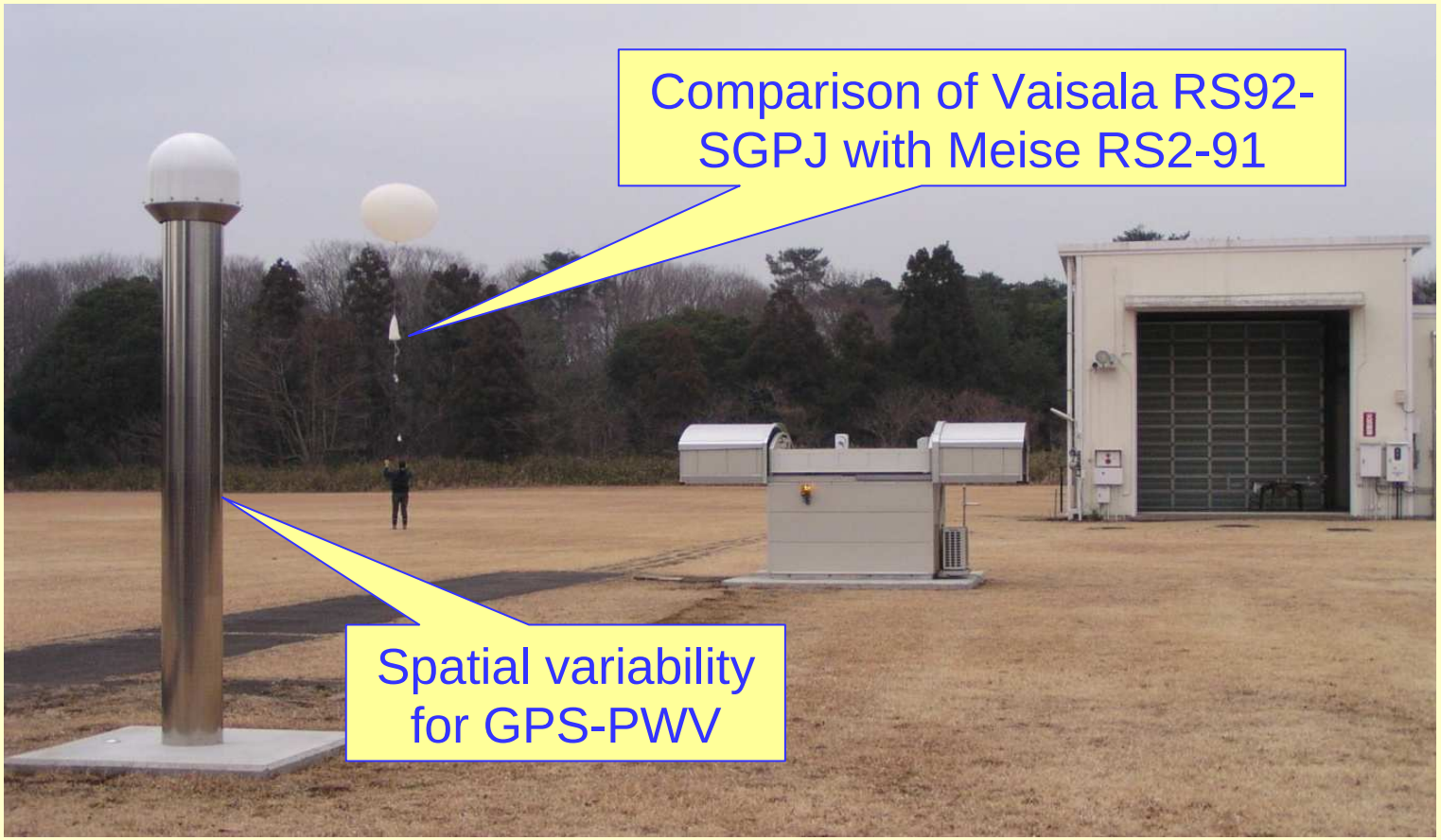
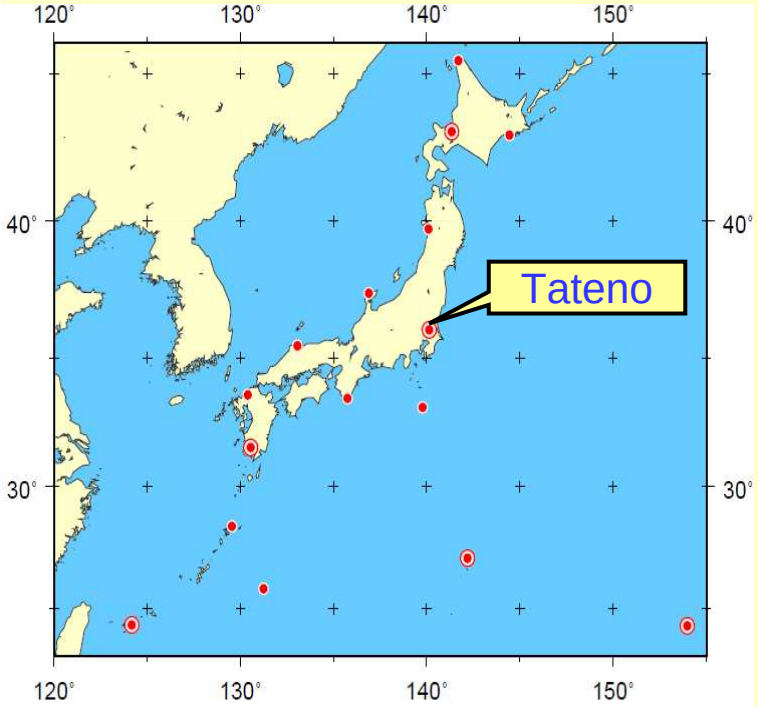
Site Report: Tateno - Japan



Hakaru MIZUNO and Nobuhiko KIZU
Japan Meteorological Agency
(GRUAN ICM-3, 28 February - 4 March 2011)

JMA Upper-air Observation Network



- 16 radiosonde stations including 6 GUAN sites

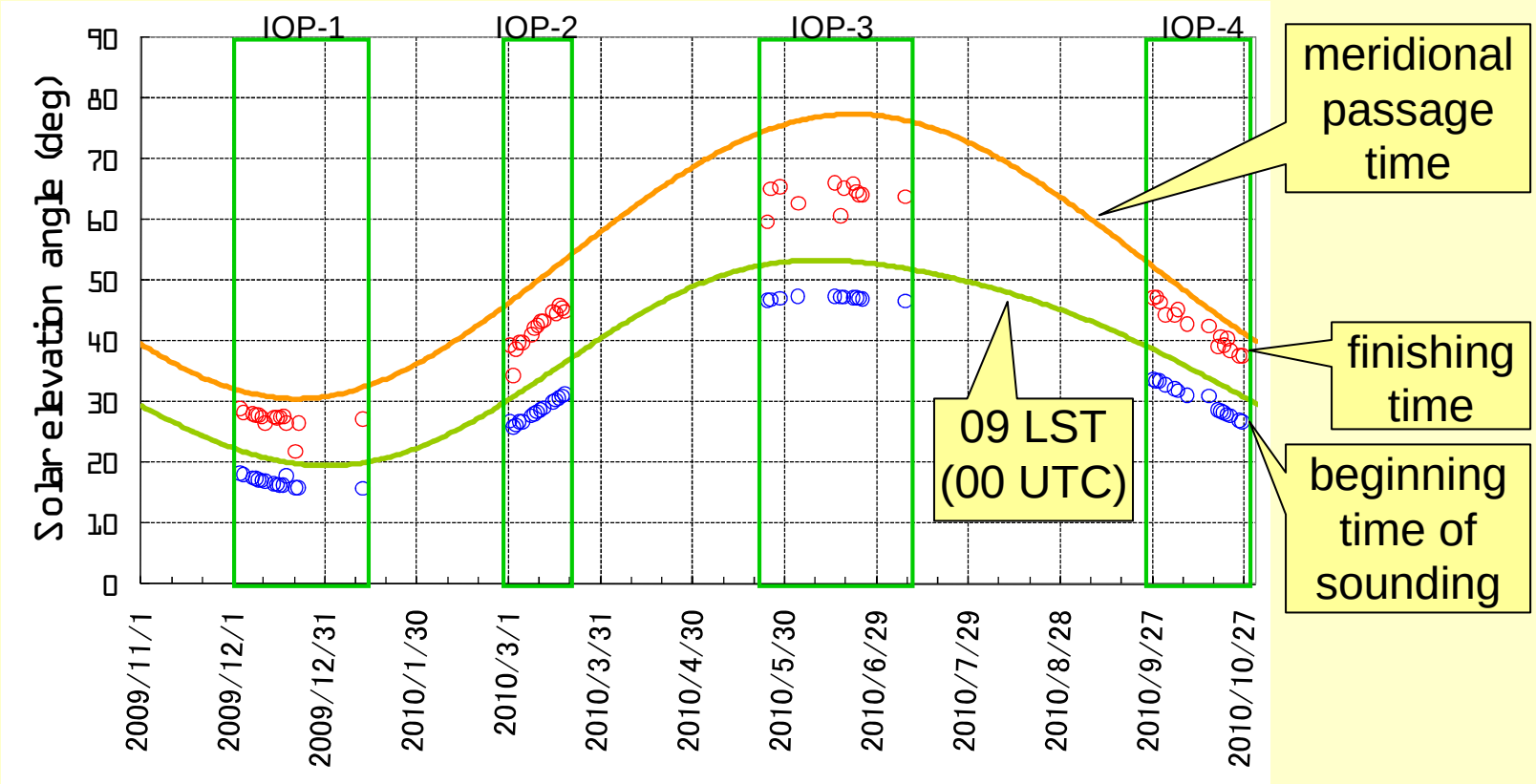
- Historical changes of radiosonde at Tateno
  - RS1-56 (15 Feb. 1957 - 3 Mar. 1981)
  - RS2-80 (3 Mar. 1981 - 30 Sep. 1992)
  - RS2-91 (1 Oct. 1992 - 30 Nov. 2009)
  - RS92-SGPJ (1 Dec. 2009 -)

A field comparison of Meisei RS2-91 with Vaisala RS92-SGPJ

-To investigate systematic differences

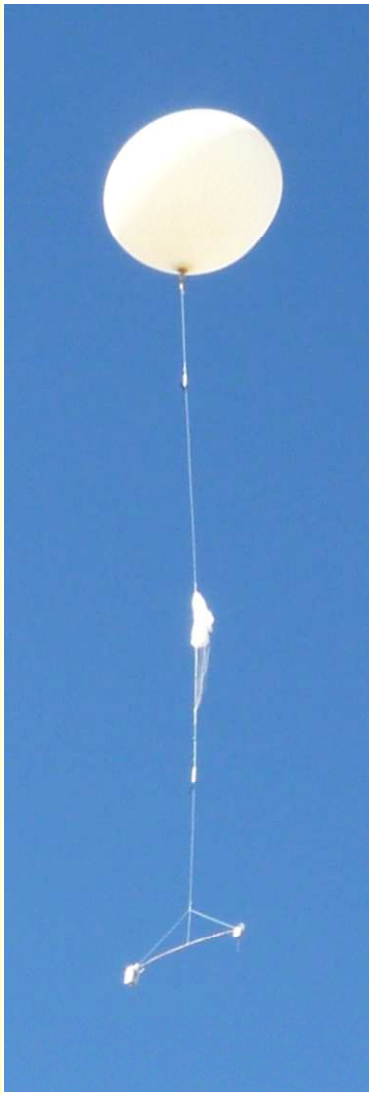
-To utilize the comparison results for the improvement of instruments and observation methods.

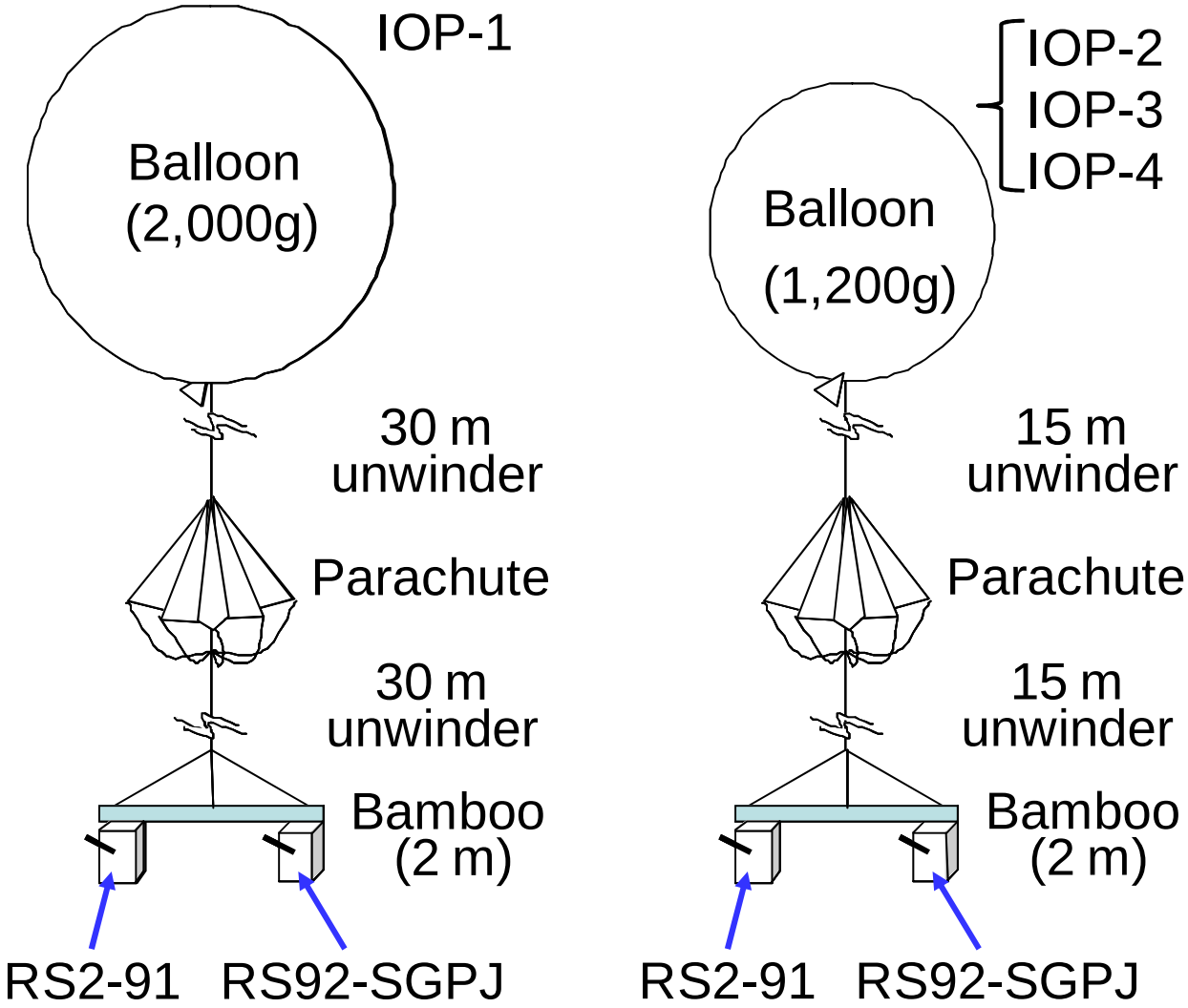
Intensive Observation Periods



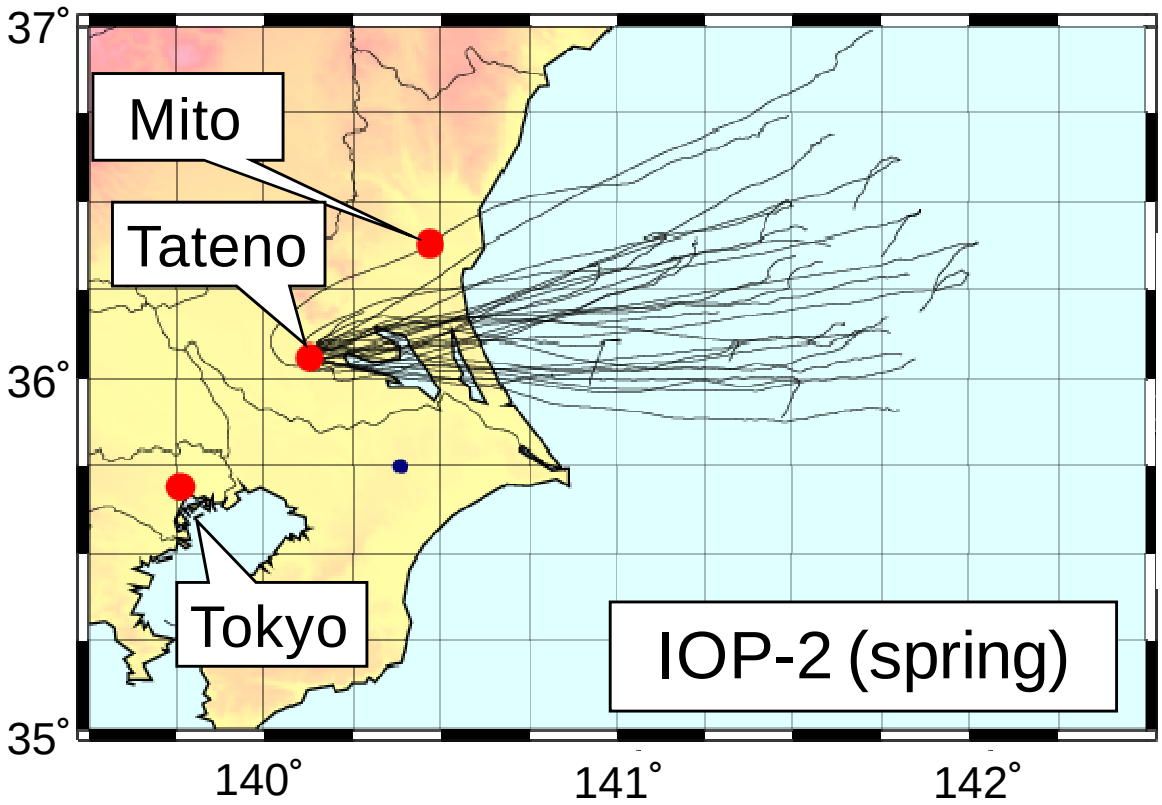
IOP No.	Season	Period	Number of dual soundings		
			00 UTC (09 LST)	12 UTC (21 LST)	Total
1	Winter	3 Dec. 2009 to 15 Jan. 2010	14	15	29
2	Spring	1 Mar. 2010 to 19 Mar. 2010	15	15	30
3	Summer	24 May 2010 to 8 Jul. 2010	12	14	26
4	Autumn	27 Sep. 2010 to 26 Oct. 2010	15	15	30
1 – 4	**–**	**–**	**56**	**59**	**115**

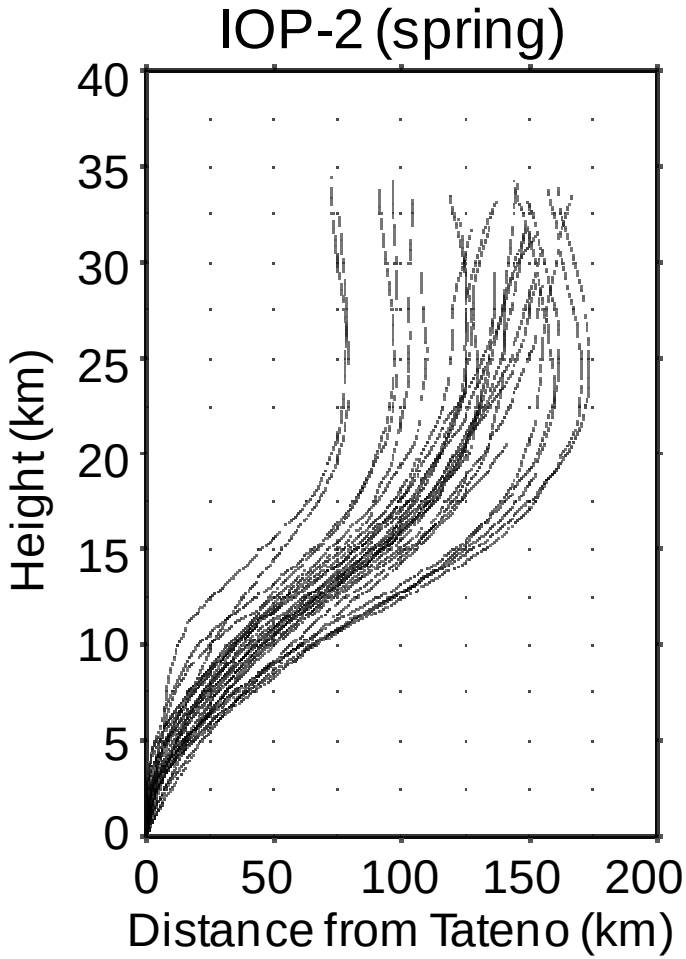
Flight Configuration of dual soundings



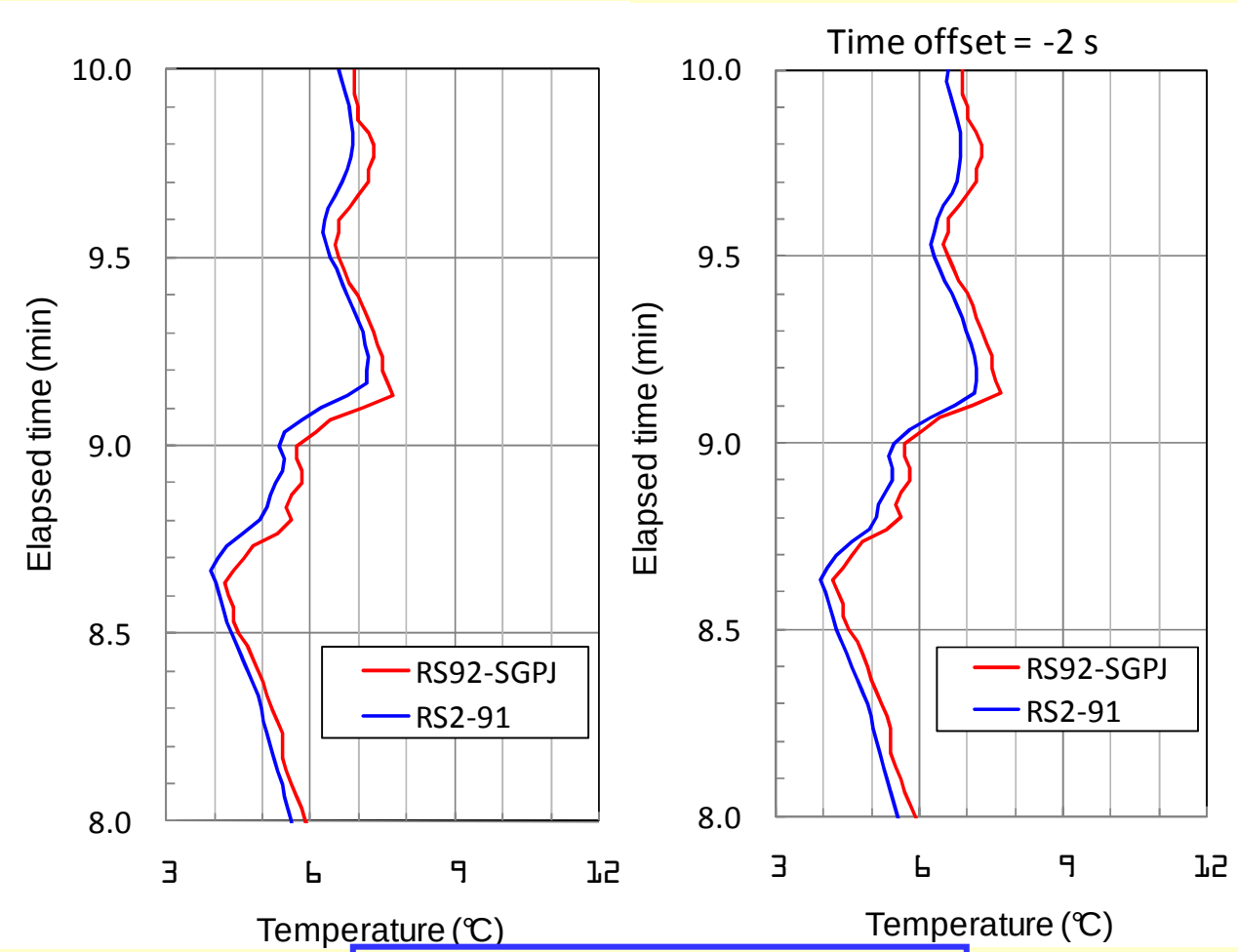


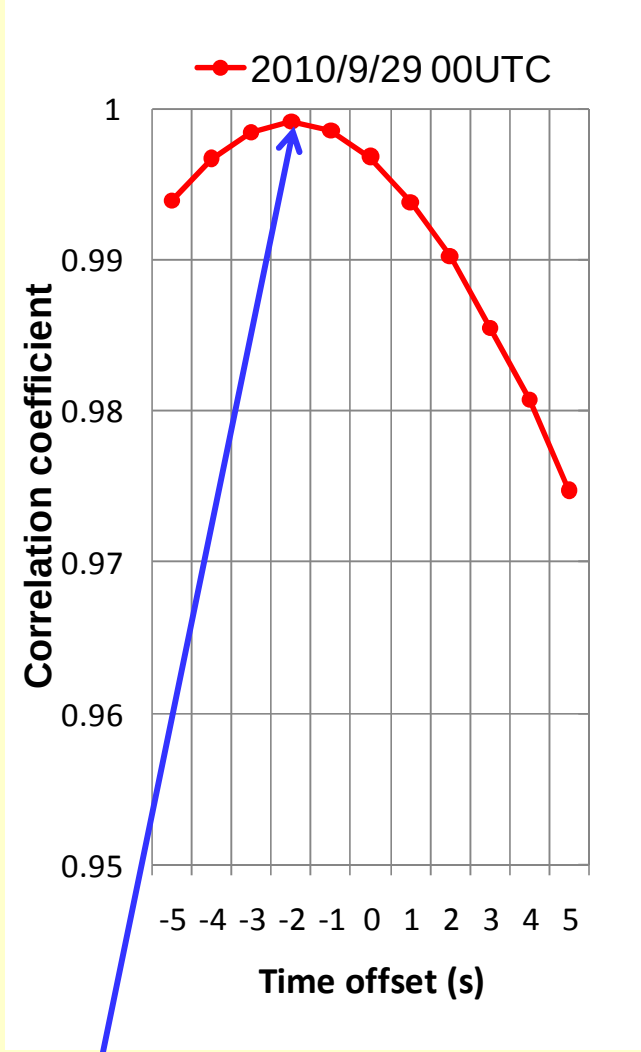
Radiosonde trajectories (IOP-2, spring)





Time adjustment procedure





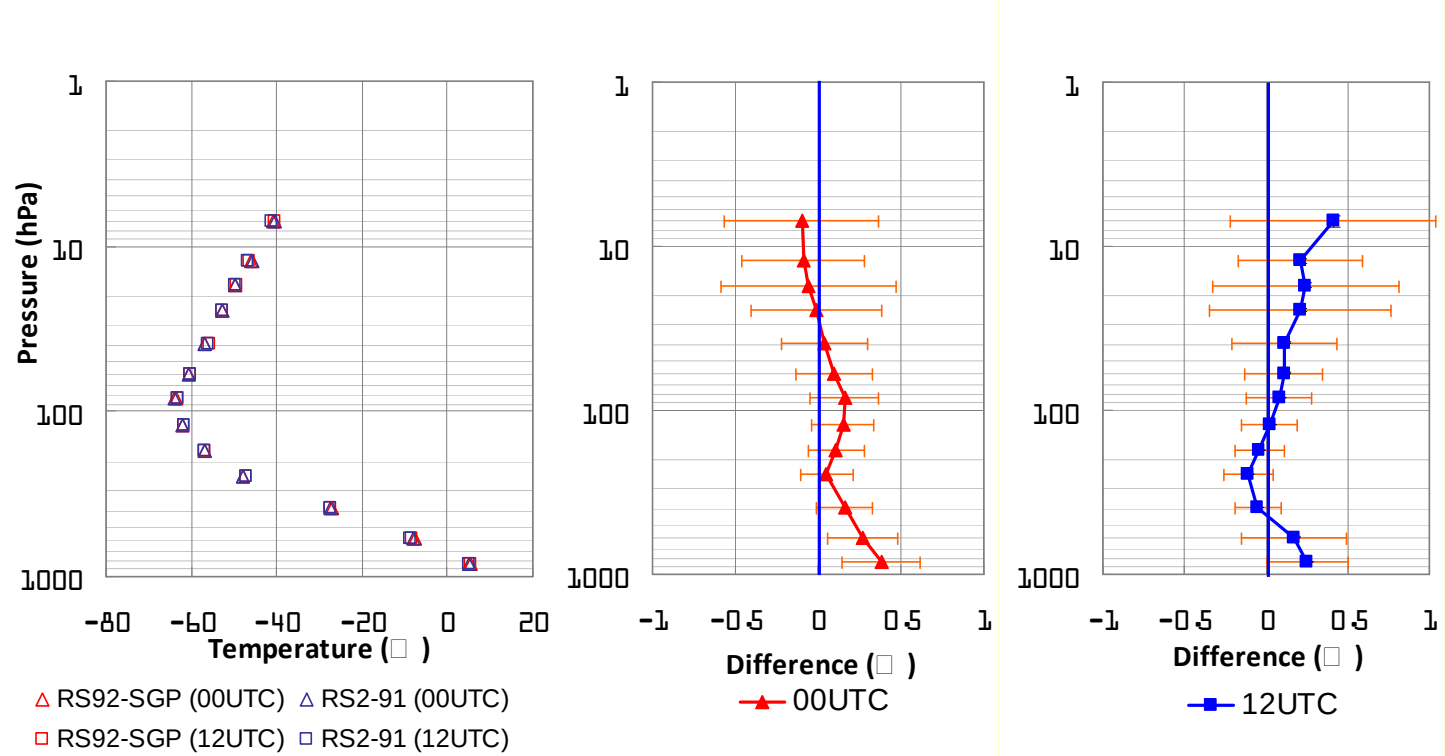
$$r_{xy} = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2}\sqrt{\sum_{i=1}^{n}(y_i - \bar{y})^2}}$$

Analysis of the dual soundings

- Comparison at various elapsed times
  - The observational data classified according to the time elapsed were grouped into 13 pressure categories.
  - Data from different flights in the same pressure range were then gathered to create a dataset and obtain mean and difference profiles.
  - To elucidate the causes of differences between the two radiosondes.
  - To provide useful information for improving radiosonde instruments and data processing procedures.
- Comparison different pressure levels
  - To provide useful information to users of radiosonde data, especially those involved in numerical weather prediction and climate analyses.

Comparison at various elapsed time

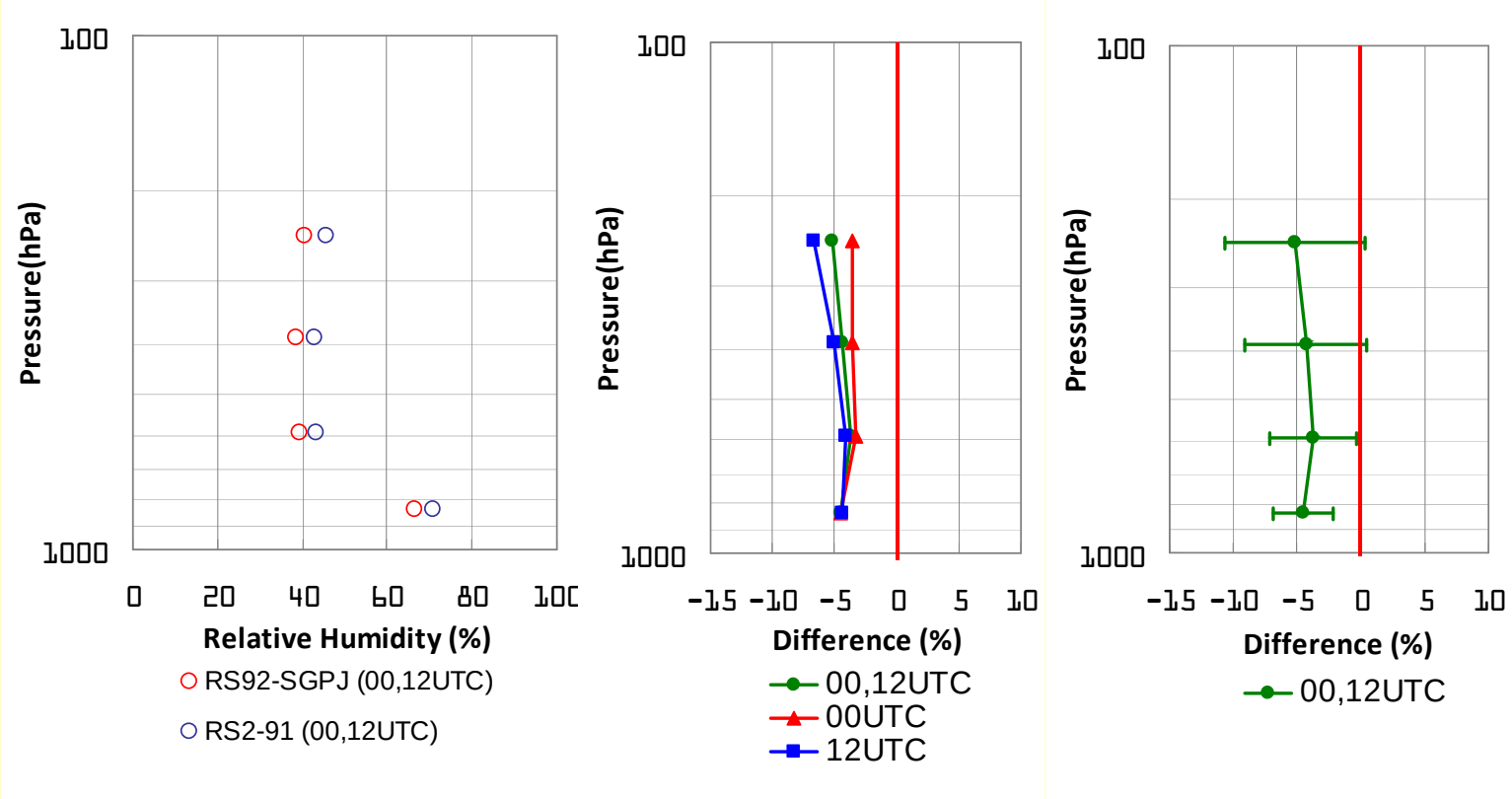
Mean and difference (RS92-SGPJ minus RS2-91) profiles for temperature



- The temperature at 00 UTC are statistically different from those at 12 UTC.
- The means differences were less than 0.4°C for all heights.
- The standard deviations became larger in the stratosphere.
- The RS92-SGPJ were 0.4 – 0.2°C higher than the RS2-91 in the layer below 300 hPa at 00 UTC and in the layer above 30 hPa at 12 UTC.

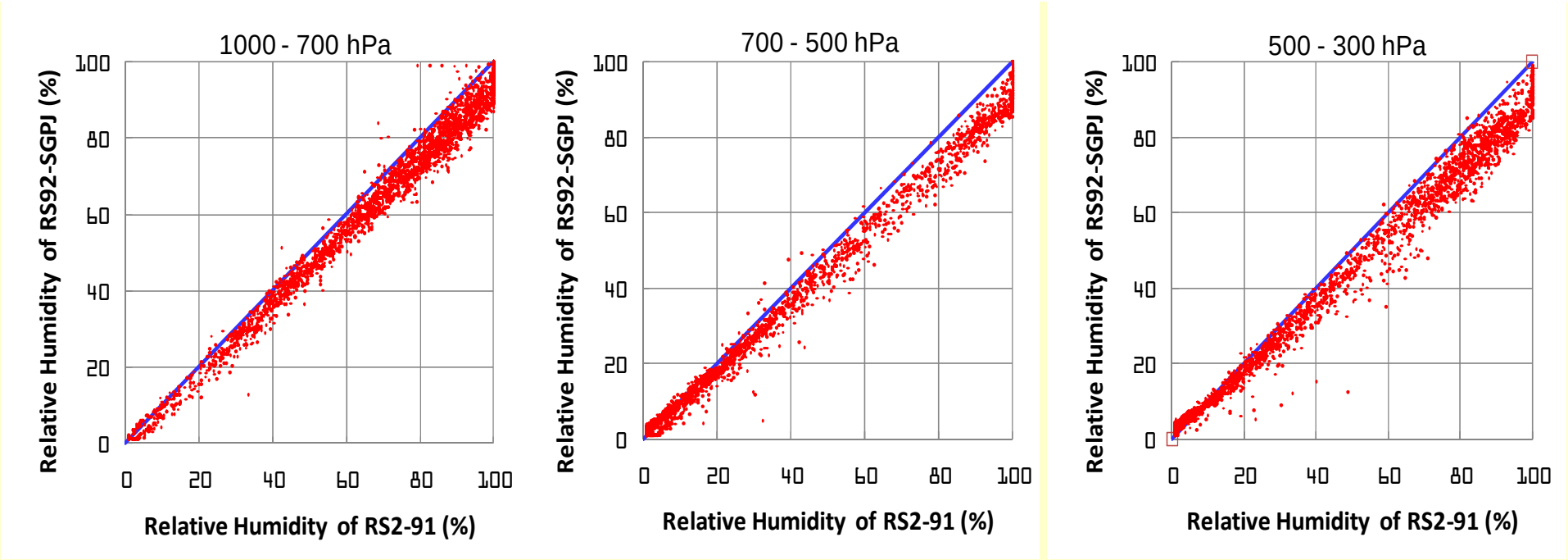
Comparison at various elapsed time

Mean and difference (RS92-SGPJ minus RS2-91) profiles for relative humidity

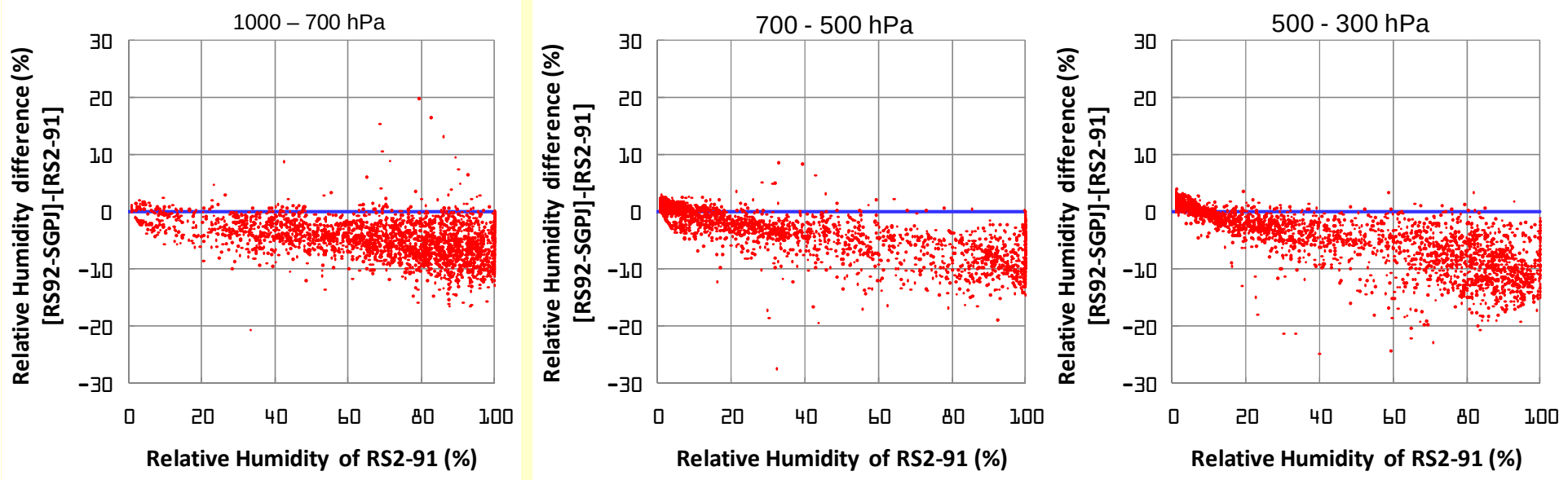


- Relative humidity measured with the RS92-SGPJ was systematically lower than the RS2-91 by 4% – 5% on average.
- The standard deviations became larger as increasing altitude.
- Relative to the RS2-91, the RS92-SGPJ showed a dry bias which increases with relative humidity.

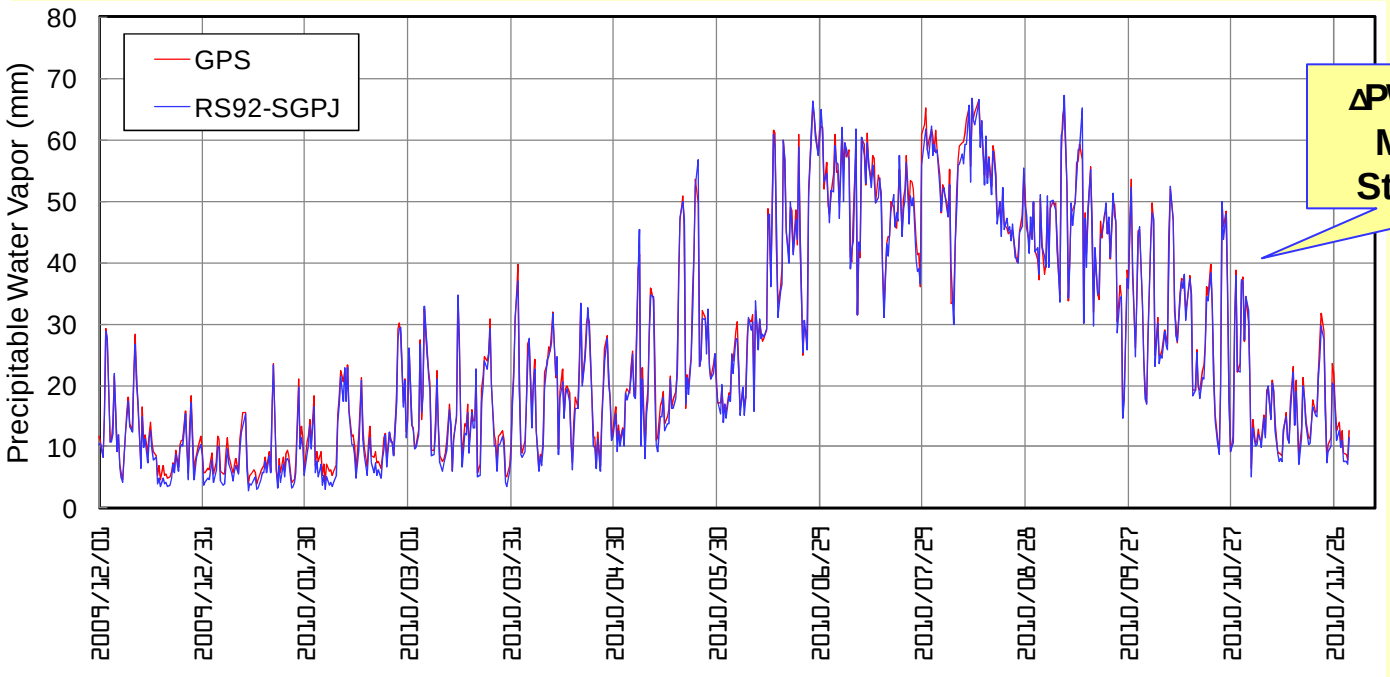
Scatter plots of relative humidity of RS92-SGPJ to RS2-91 radiosondes



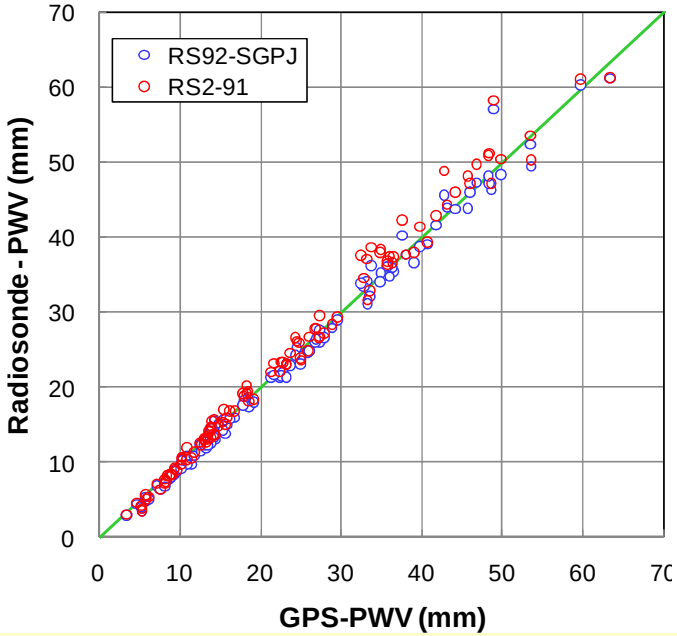
Scatter plots of RH difference (RS92-SGPJ minus RS2-91) to RH of RS2-91

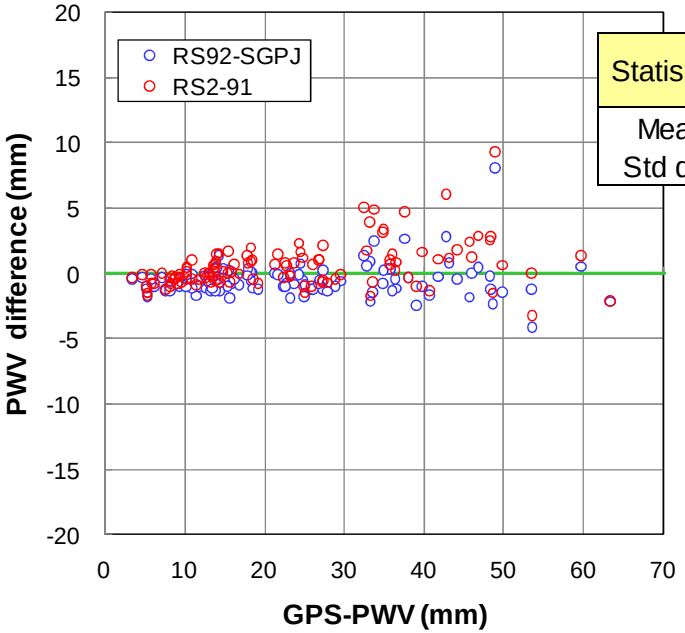


Comparison of PWV derived from GPS and radiosondes



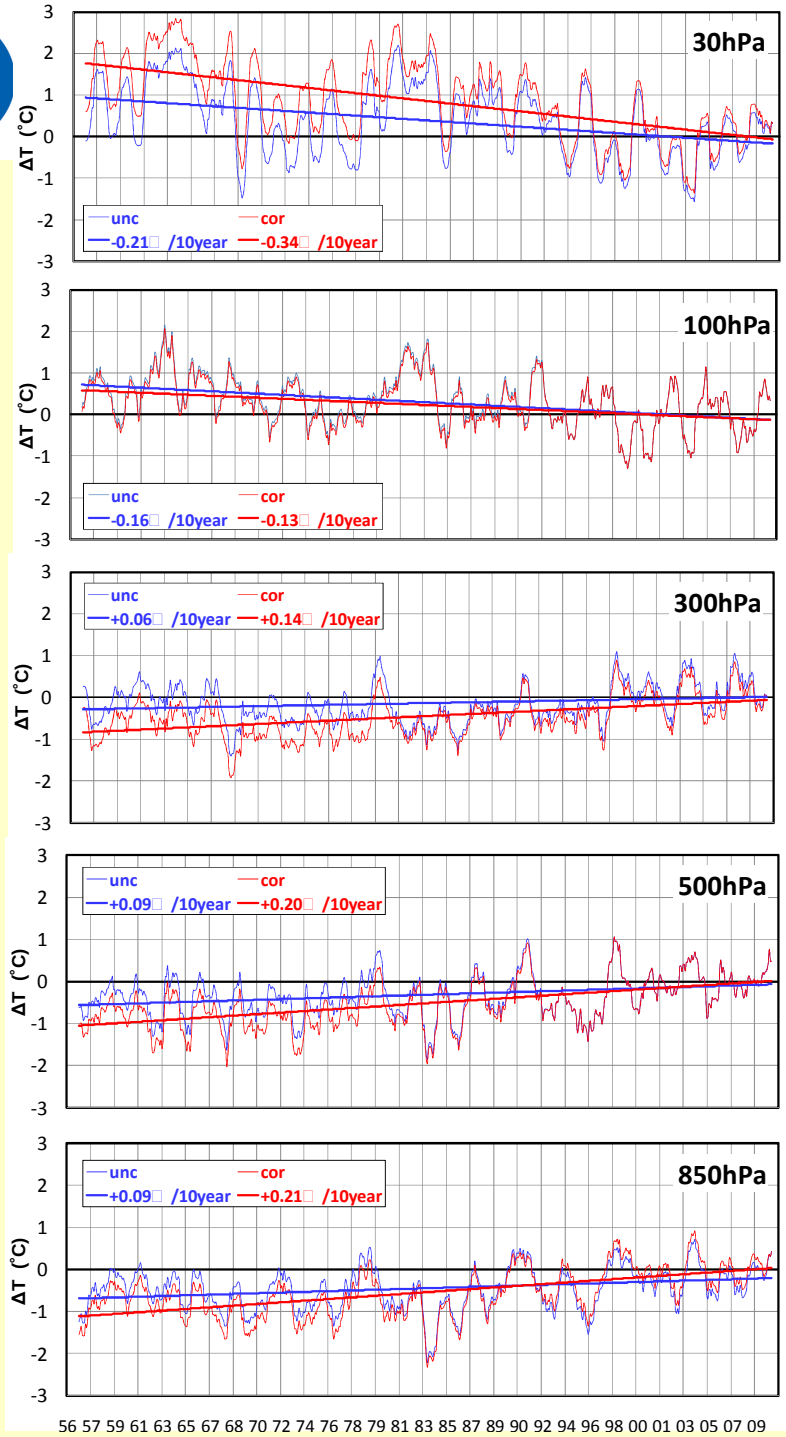
ΔPWV(RS92 – GPS)
Mean: -0.63 mm
Std dev : 1.30 mm





Statistics	PWV difference (mm)	
	RS92-SGPJ	RS2-91
Mean	**-0.53**	**0.52**
Std dev	1.28	1.72

Temperature trend for 12 UTC (21 LST) considering historical changes of radiosonde



Radiosonde changes

RSII-56, RS2-80, RS2-91, RS92-SGPJ

↓

Dual soundings

↓

Comparison at pressure levels

→

Bias correction table

Pressure level (hPa)	Temperature difference (RS92-SGPJ minus *)		
	RSII-56	RS2-80	RS2-91
1000	-0.2	0.0	0.2
925	-0.3	-0.1	0.2
900	-0.3	-0.1	0.2
850	-0.3	-0.1	0.2
800	-0.3	-0.1	0.2
700	-0.2	0.0	0.2
600	-0.2	0.0	0.1
500	-0.4	-0.1	0.0
400	-0.3	0.0	-0.1
350	-0.4	-0.1	-0.2
300	-0.5	-0.1	-0.2
250	-0.6	-0.2	-0.2
200	-0.6	-0.2	-0.2
175	-0.6	-0.2	-0.2
150	-0.5	-0.1	-0.1
125	-0.3	0.0	0.0
100	-0.1	-0.1	0.0
70	0.3	-0.1	0.0
50	0.6	0.2	0.1
40	0.5	0.1	0.0
30	0.7	0.4	0.2
20	1.5	0.9	0.4
15	1.9	1.0	0.4
10	3.6	2.1	1.4
5			2.8

Spatial variability of GPS-PWV

1. Monthly mean and difference from Tateno

$$\overline{X_i} = \frac{1}{N}\sum_{j=1}^{N} X_{ij} \qquad \Delta X_i = \overline{X_i} - \overline{X_0}$$

2. Correlation coefficients between GPS-PWV at Tateno and those at other stations

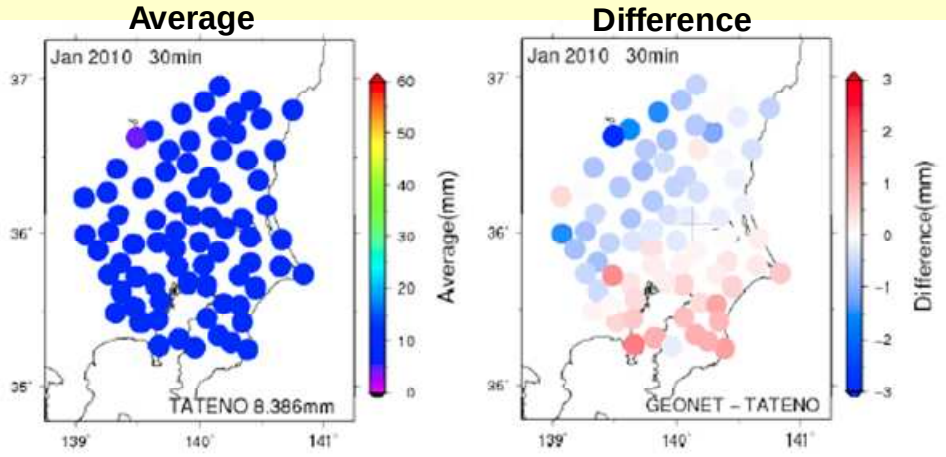
$$r_i = \frac{\sum_{j=1}^{N}(X_{ij} - \overline{X_i})(X_{0j} - \overline{X_0})}{\sqrt{\sum_{j=1}^{N}(X_{ij} - \overline{X_i})^2}\sqrt{\sum_{j=1}^{N}(X_{0j} - \overline{X_0})^2}}$$

3. Standard deviations of residuals*

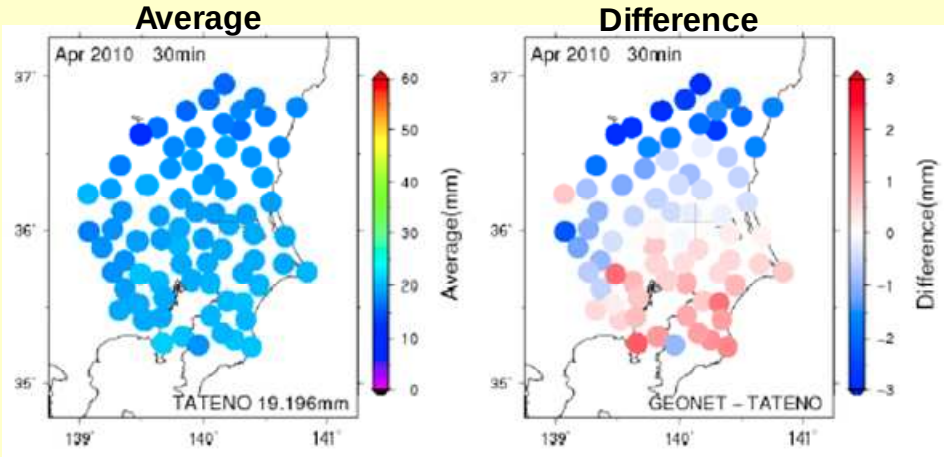
$$SR_i = SD_i\sqrt{1 - r_i^2}$$

*defined as differences between observational values and predicted values from a linear regression with GPS-PWV at Tateno (the explanatory variable) and those at other stations (the dependent variable).

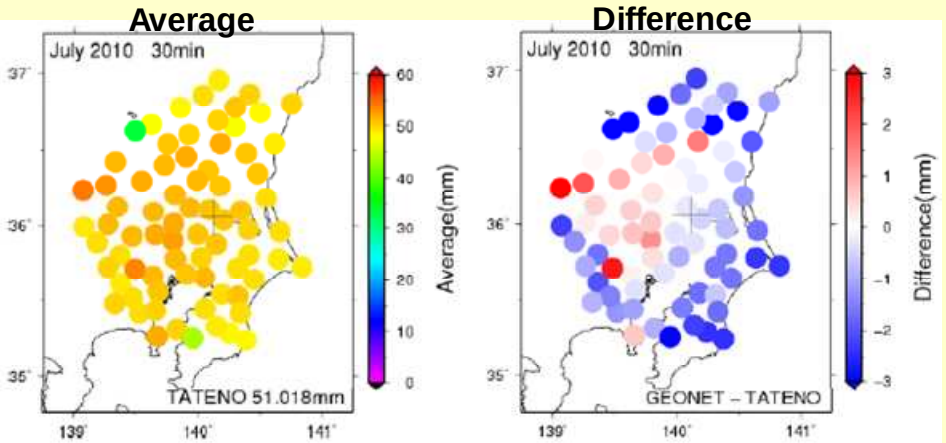
GPS-PWV monthly mean and difference from Tateno



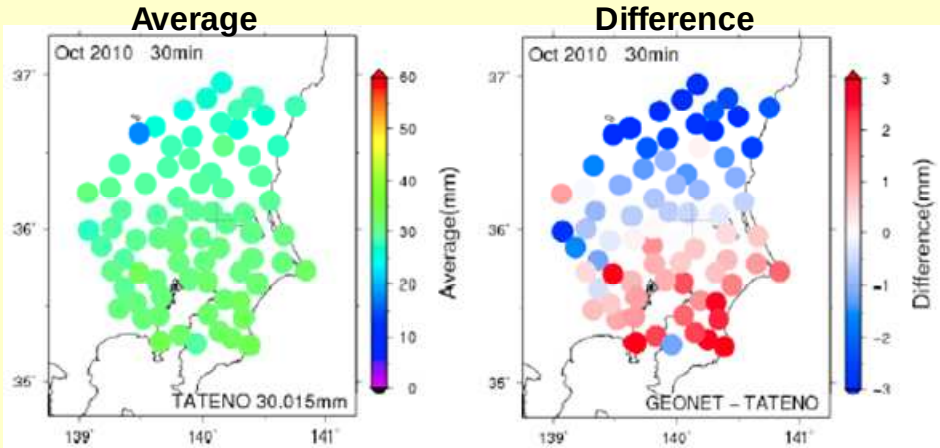
(a) January 2010



(b) April 2010



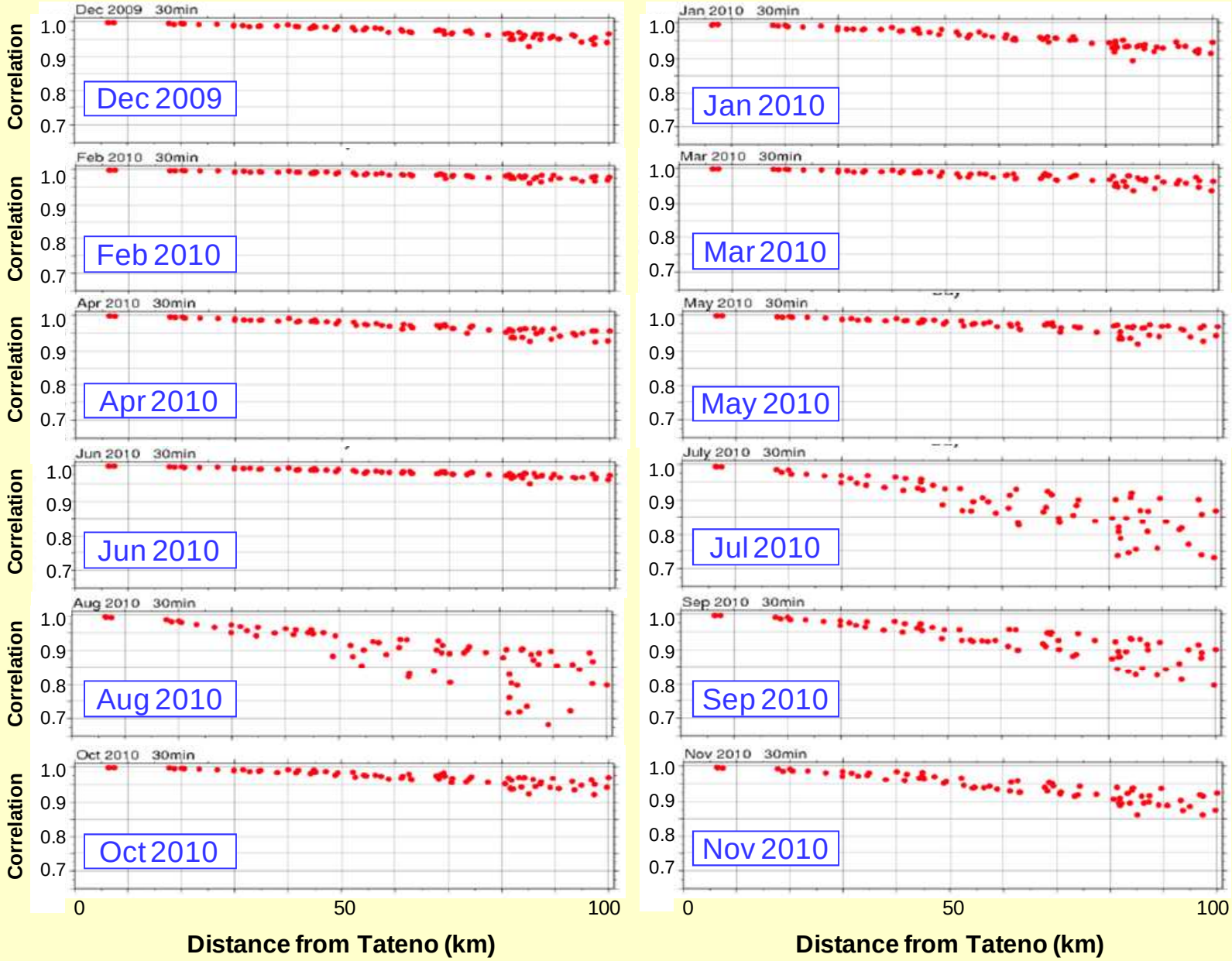
(c) July 2010



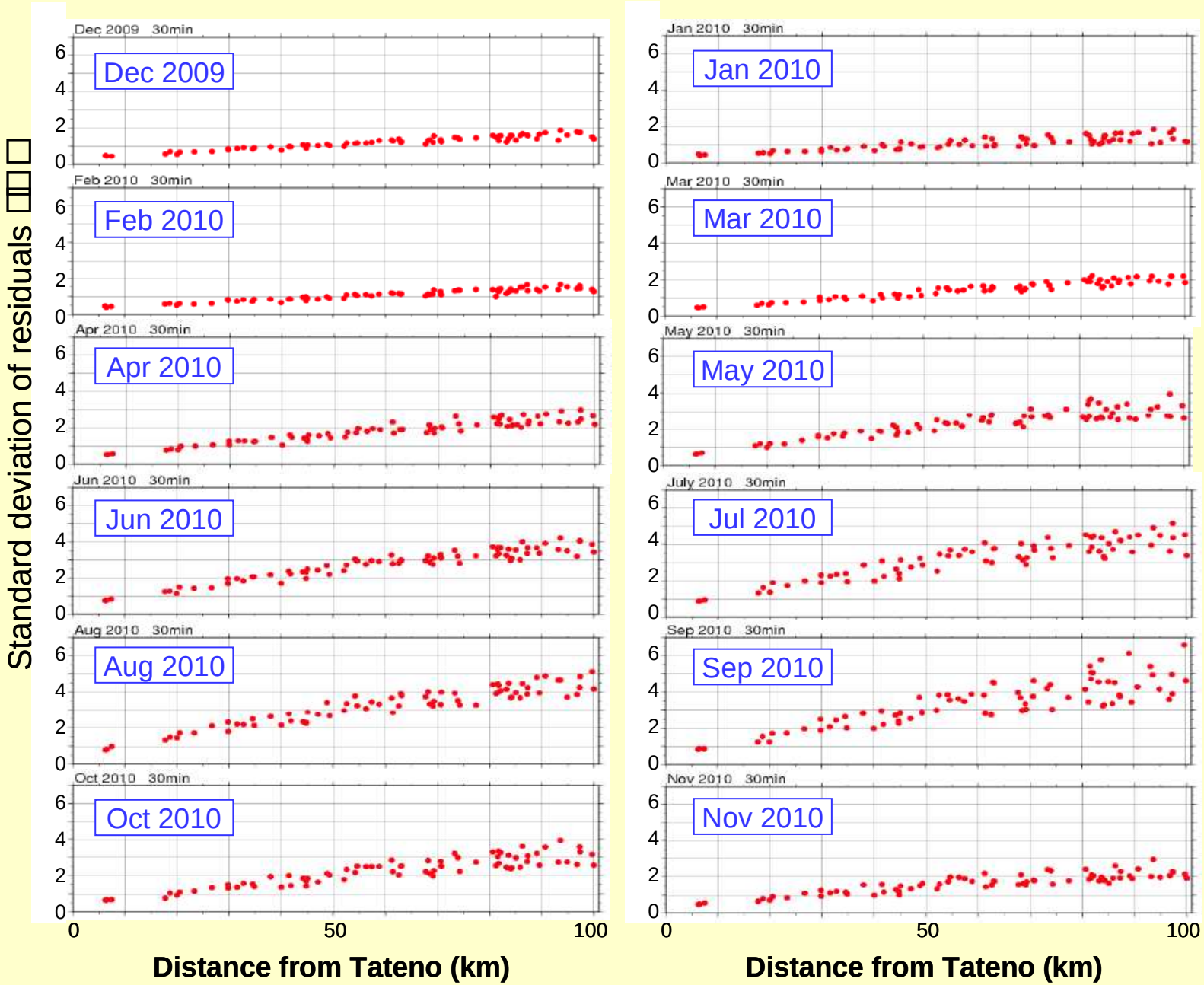
(d) October 2010

- Annual cycle in GPS-PWV monthly mean
- Small gradient from month to month in GPS-PWV differences

Correlation coefficients between GPS-PWV at Tateno and those at other stations

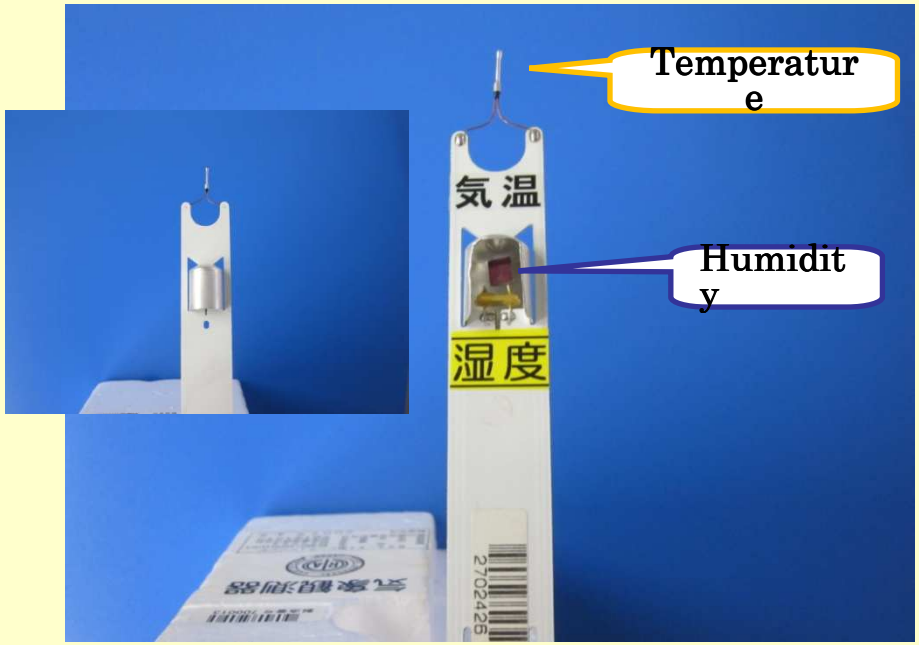


Standard deviations of residuals

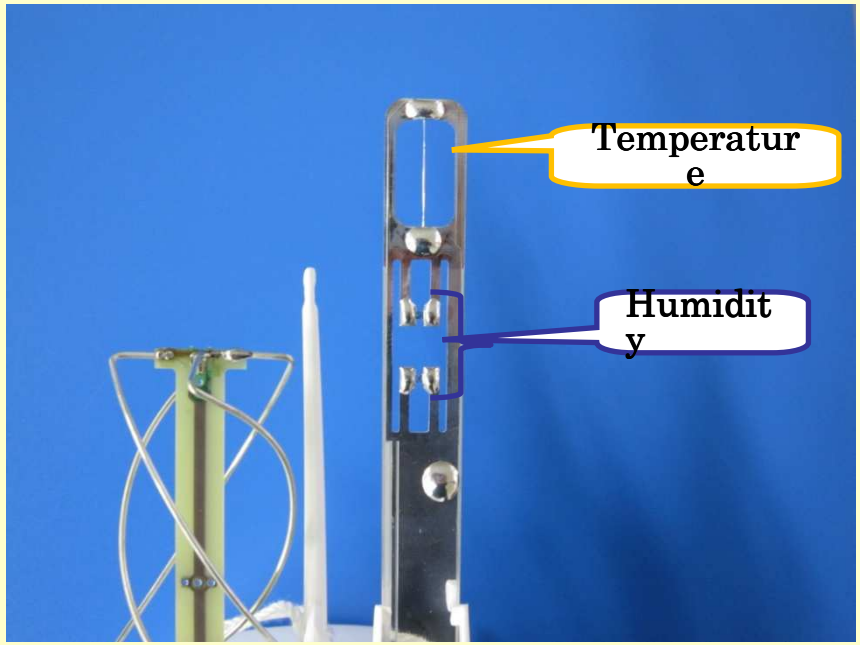


Sensors of Meisei RS2-91 and Vaisala RS92-SGPJ

- RS2-91 Type (Meisei)



- RS92-SGPJ Type (Vaisala)

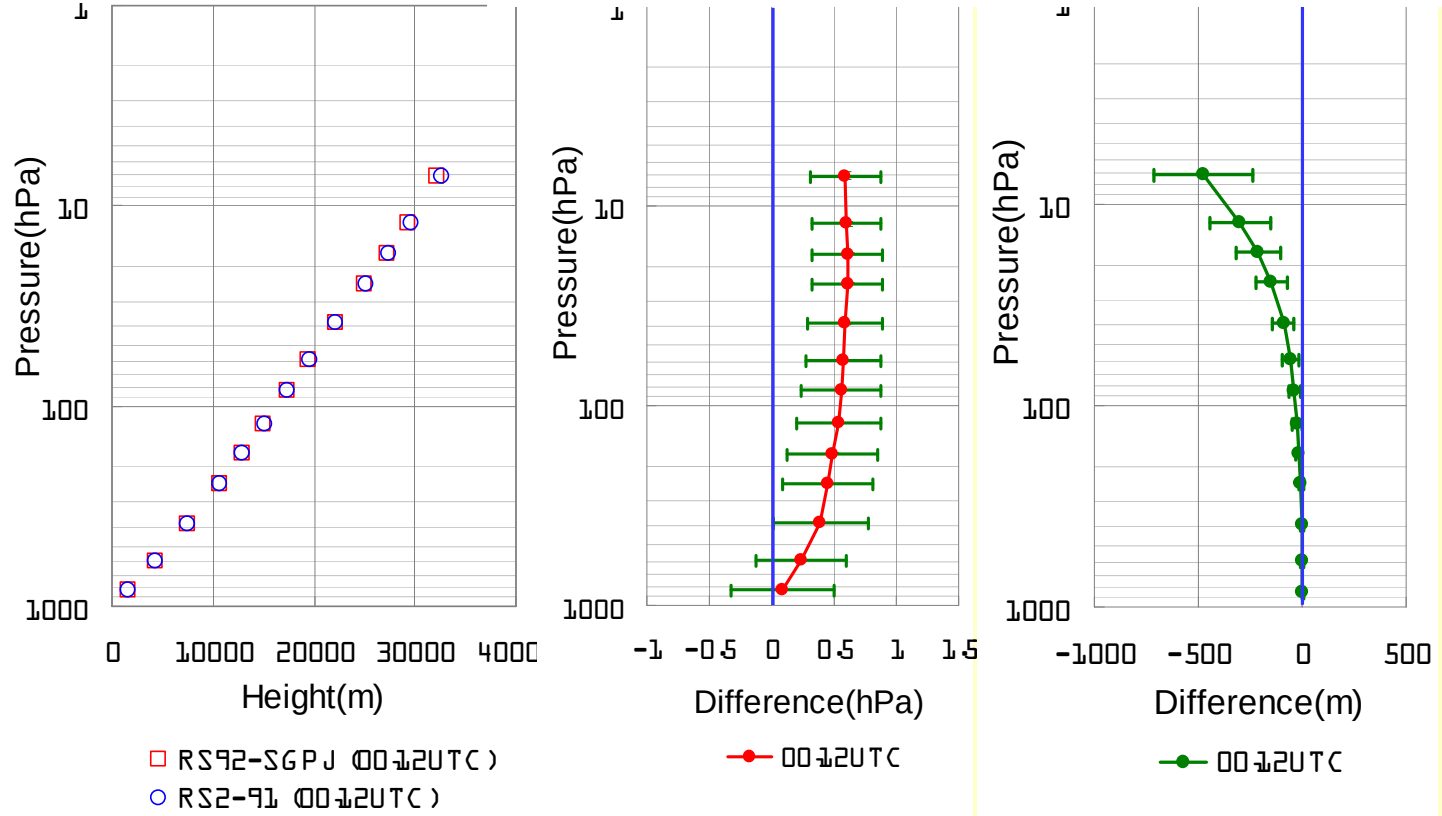


Sensor Type(RS2-91)	Sensors	Sensor Type(RS92-SGPJ)
Rod thermistor	Temperature	Capacitive wire
Thin film capacitor	Humidity	Thin film capacitor, heated twin sensor
Capacitive aneroid capsule	Pressure	Silicon

Comparison at various elapsed time

Mean profiles for heig

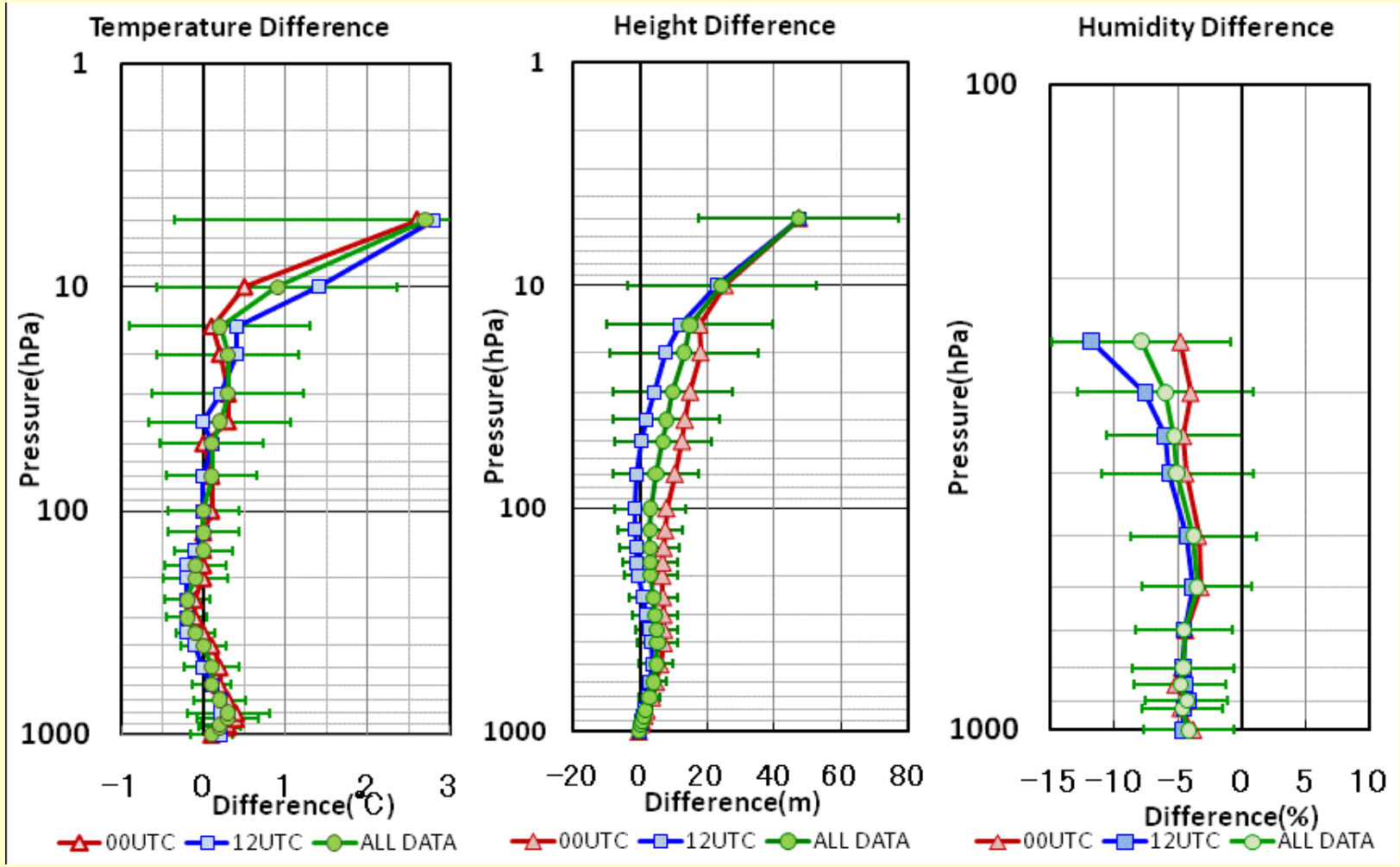
difference (RS92-SGPJ minus RS2-91) profiles for pressure and geopotential height



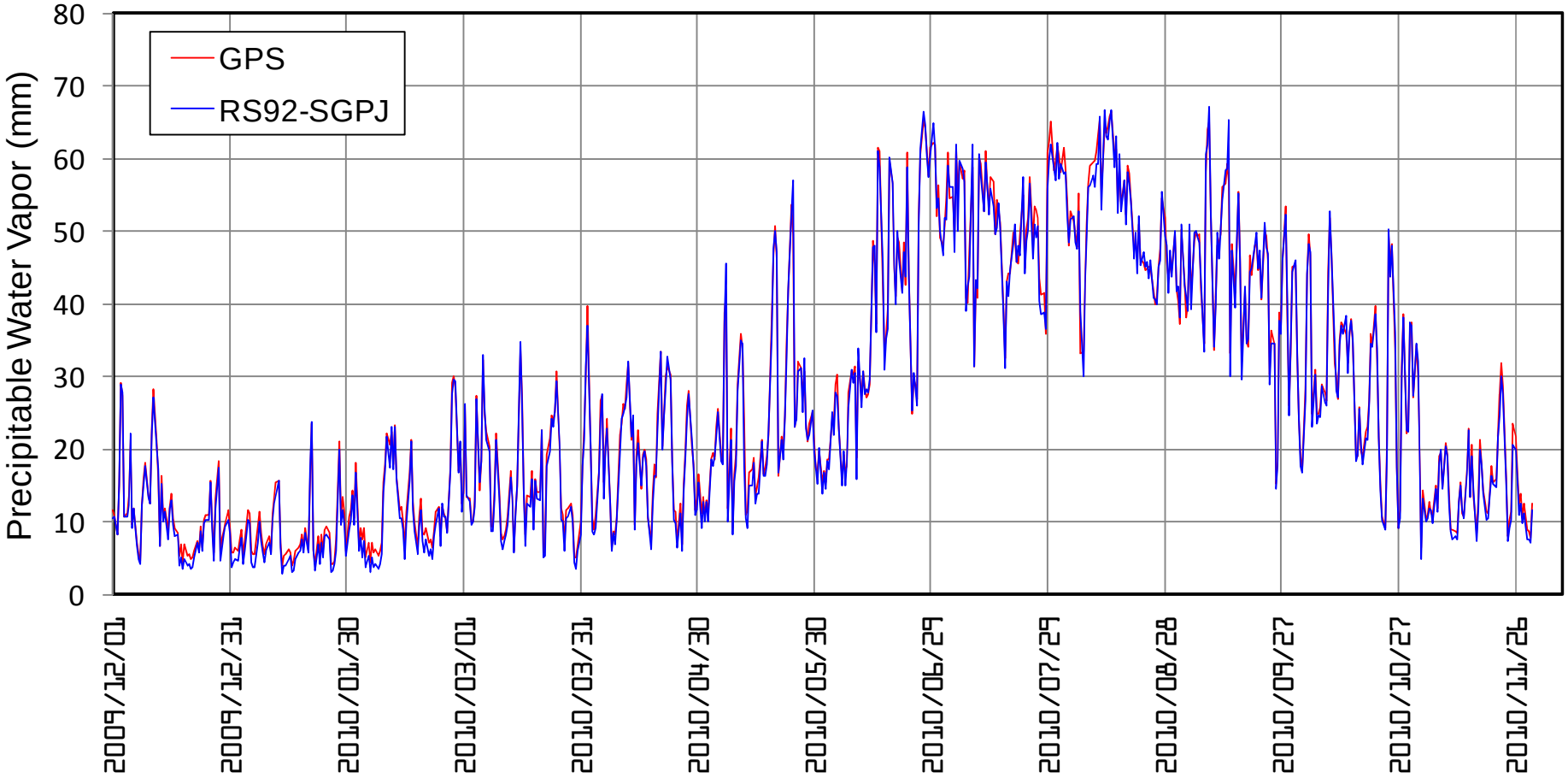
- The RS92-SGPJ showed a general trend of larger pressure values than the RS2-91, from 0 near the surface to 0.6 hPa in the stratosphere.
- In the stratosphere, the height of the RS92-SGPJ became less than that of the RS2-91 as altitude increased, in accordance with the deviation of pressure described above.

Comparison at different pressure levels

□1000, 925 , 900, 850□800, 700, 600, 500, 400, 350, 300. 250, 200, 175, 150, 125, 100, 70, 50, 40, 30, 20, 15, 10, 5 hPa)



Comparison of PWV derived from GPS and RS92-SGPJ



Mean PWV difference: -0.65 mm,
Standard deviation: 1.30 mm