GRUAN Data Product (ver.2) for Meisei iMS-100 & RS-11G radiosondes

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Background / motivation

- Meisei iMS-100 radiosonde has been used since 2017 at JMA’s radiosonde sites including Tateno and Minamitorishima
- The TU sensor used in iMS-100 is common with RS-11G
- The validation of RS-11G-GDP.1 (Kobayashi et al., 2019) shows some issues especially in RH observation
- The improvement of processing algorithm is needed

Major changes / differences from RS-11G-GDP.1 (RH)

- Considering of the different time constant / sensor-temperature relation for absorption / desorption in time-lag correction
- Formulation of hysteresis (slow regime time-lag) effect correction
- Improvement of TUD (temperature-humidity dependency) correction with laboratory experiments and CFH observations

Major changes / differences from RS-11G-GDP.1 (iMS-100 specific)

- The wind from motion vector from GPS-based position (latitude and longitude) is adopted as the wind data instead of the wind from GPS doppler shift.
- The GPS module for iMS-100 interpolates the geoid height from the sparse (10 deg x 10 deg) grid model. In GDP processing, the geometric altitude is recalculated with the geoid height interpolated from the finer model (EGM2008, 5 min x 5 min grid model).

Major changes / differences from RS-11G-GDP.1 (other)

- The long gap over 3 minutes in temperature observation is treated as the end of reliable sounding even if the payload achieved higher level (but it rarely occurs).

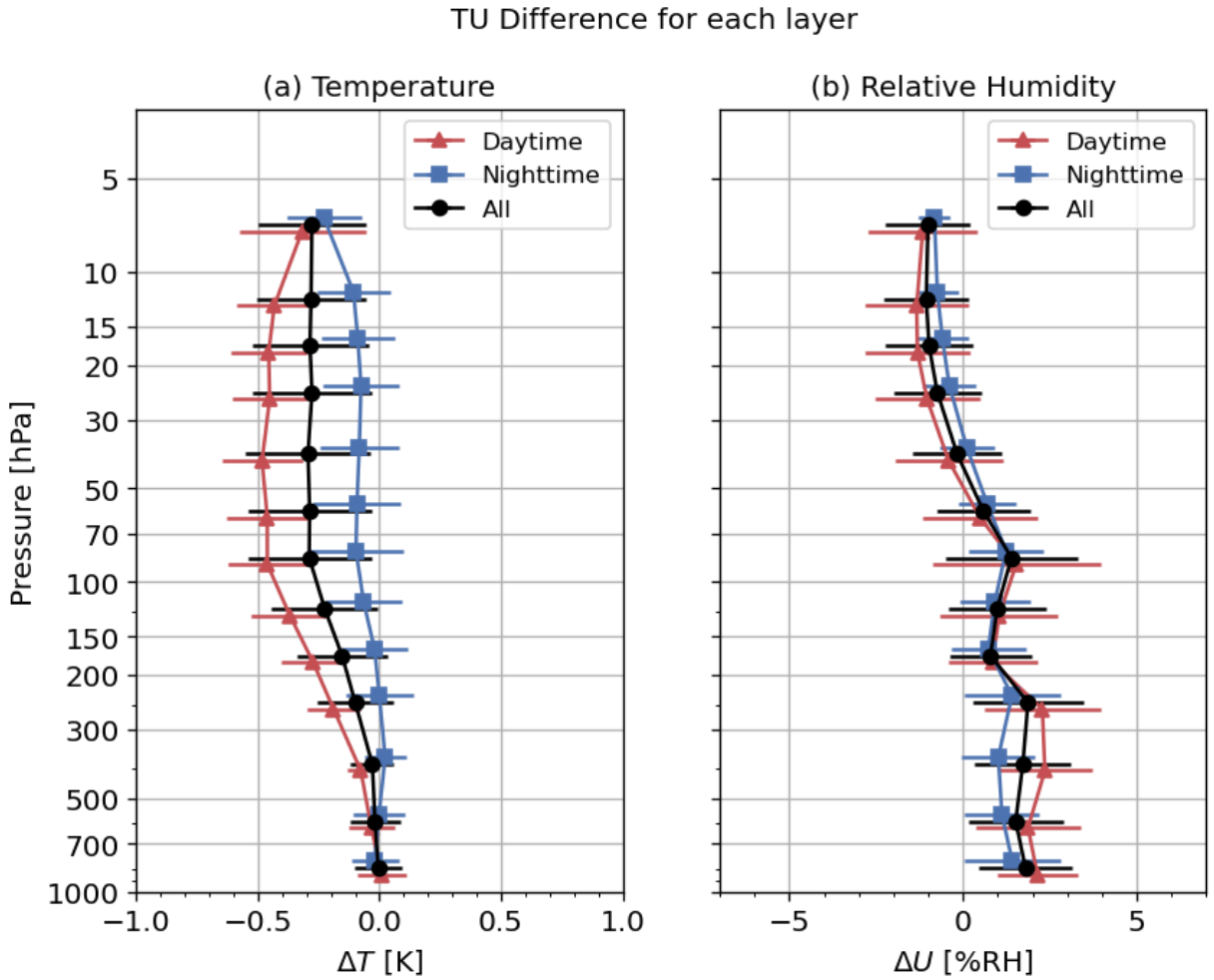
Intercomparison between IMS-100-GDP and RS92-GDP.2

- Weekly dual-sounding with iMS-100 and RS92 at 00 UTC (09 LT, daytime) or 12 UTC (21 LT, nighttime) at Tateno (except summer, when the payload will fall on the populated area around Tokyo)
- Since September 2017 to January 2020, 99 dual soundings (52 and 47 cases for daytime and nighttime)
- After screening quality assessment for both radiosondes, 55 (29 and 26 for daytime and nighttime) soundings are used for intercomparison

Intercomparison between IMS-100-GDP and RS92-GDP.2

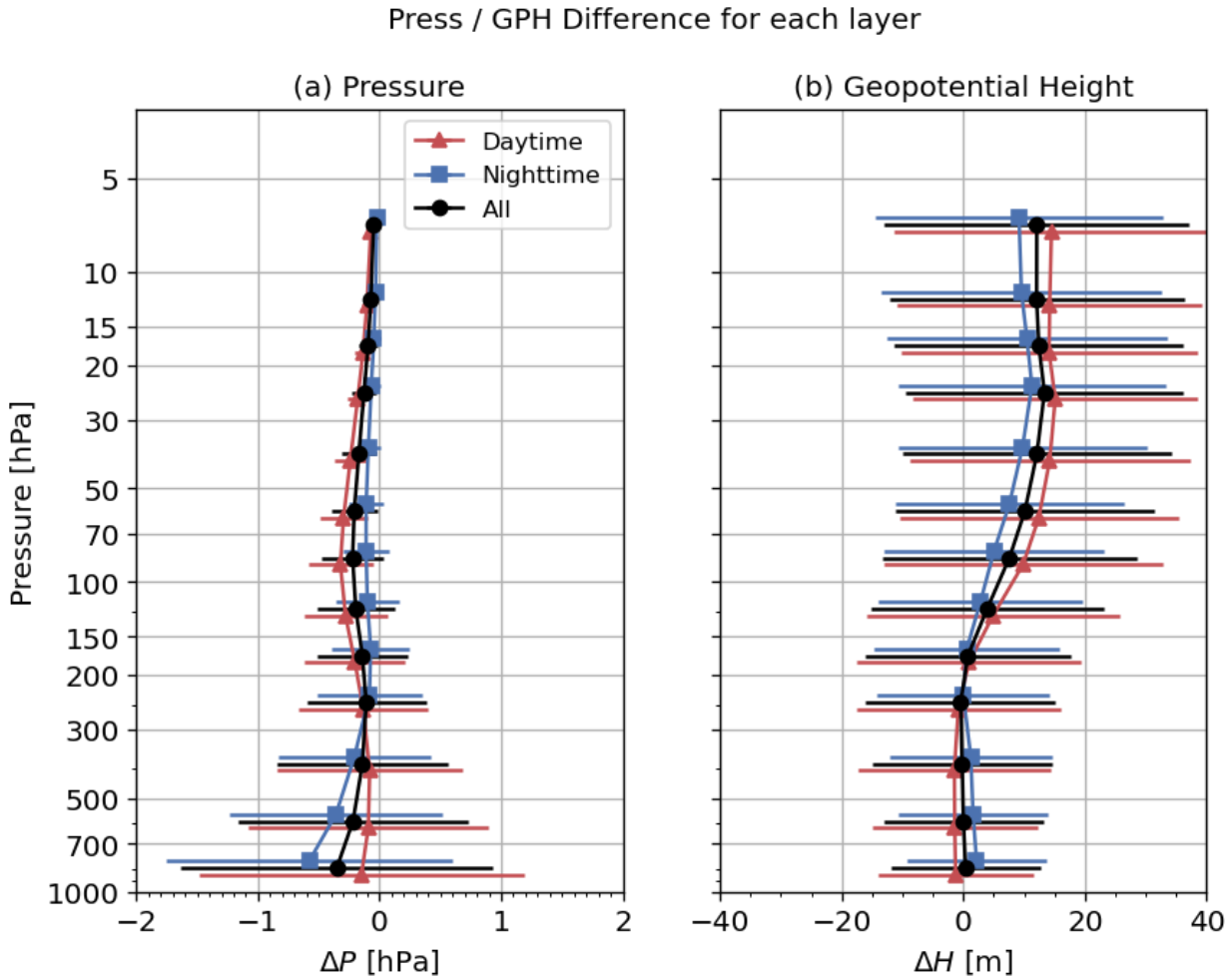
- Following the method of former researches (e.g. Kobayashi et al. (2019) for RS-11G-GDP.1 and RS92-GDP.2), the ensemble mean of differences in 13 pressure layers are derived for temperature, humidity, pressure, geopotential height and wind
- Variables except wind are compared for daytime and nighttime separately and for all data.

Intercomparison between IMS-100-GDP and RS92-GDP.2 (T, U)



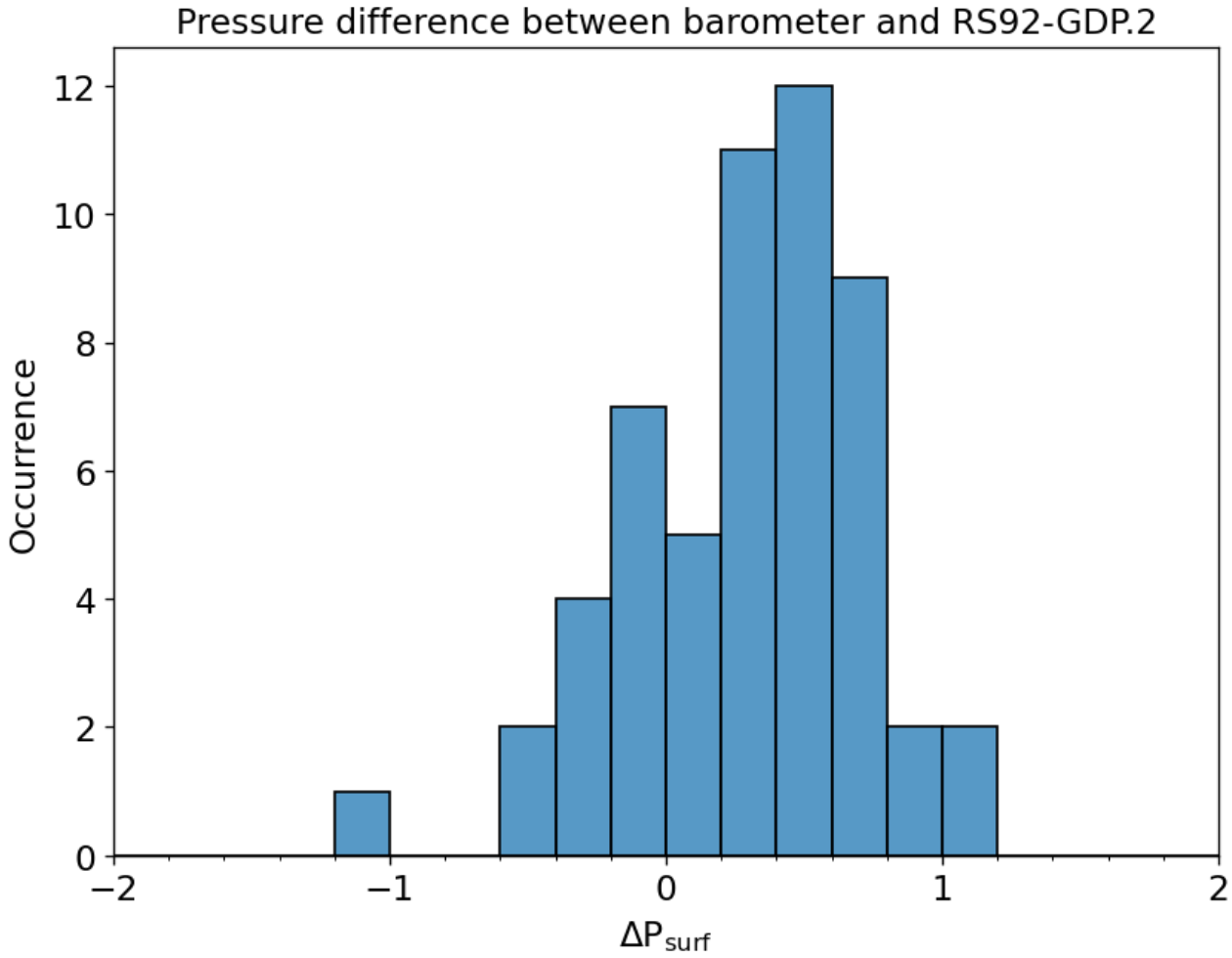
- IMS-100-GDP is about 0.5 K lower than RS92-GDP.2 in stratosphere in daytime
- IMS-100-GDP is about 1.8 %RH higher than RS92-GDP.2 below 200 hPa level and about 1.0 %RH lower above 30 hPa level

Intercomparison between IMS-100-GDP and RS92-GDP.2 (P, H)



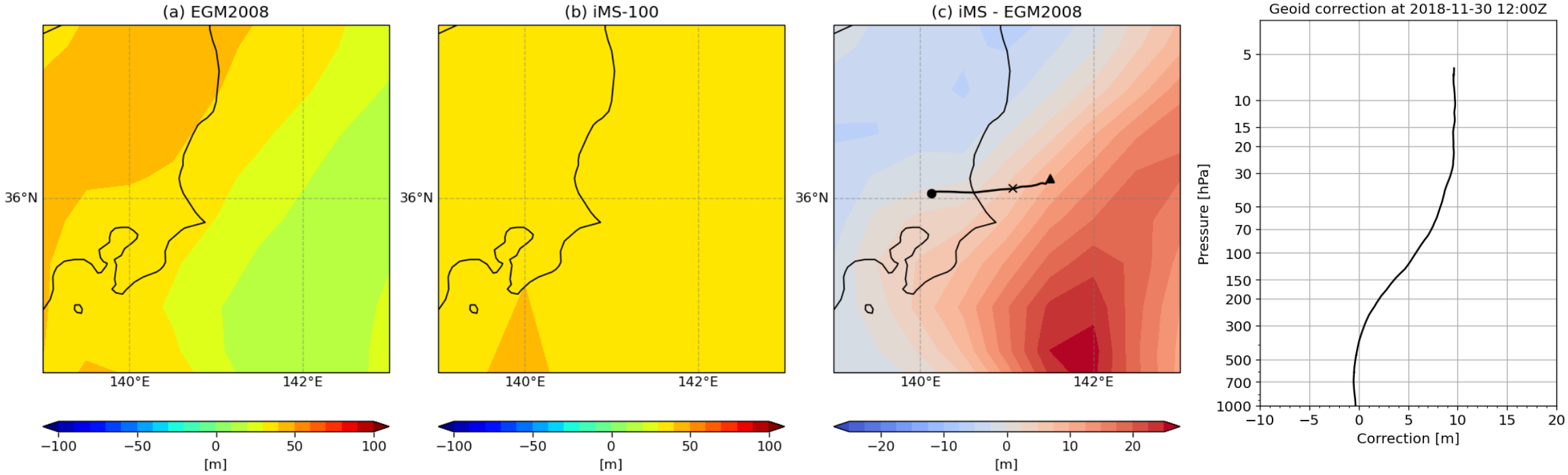
- Pressure of IMS-100-GDP is 0.4 hPa lower than RS92-GDP.2 in lower troposphere
- Geopotential height of IMS-100-GDP get larger above 100 hPa level

Pressure difference of RS92-GDP.2 at surface



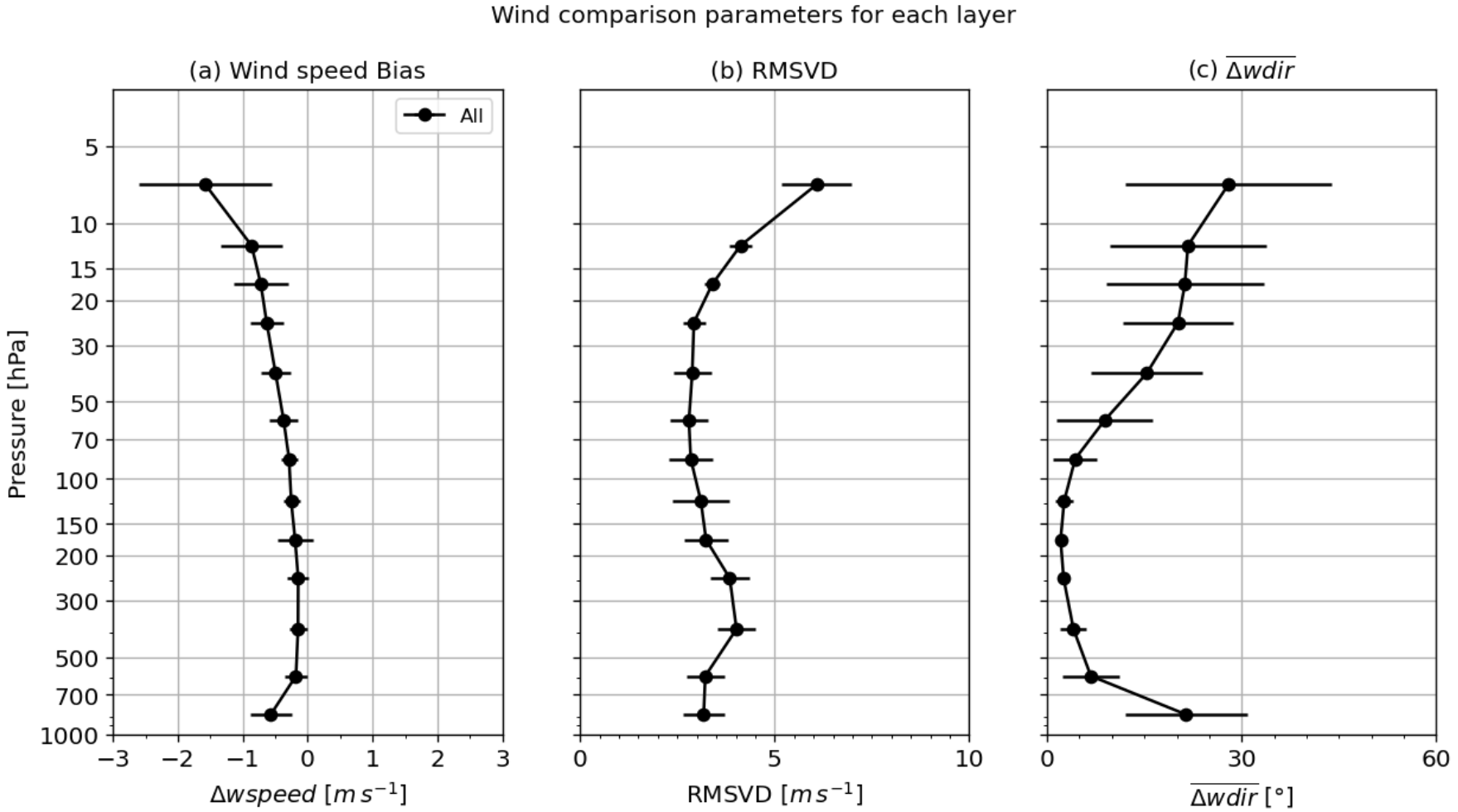
The surface pressure of RS92-GDP.2 tends to be slightly larger (median = 0.35 hPa) than surface pressure measured by barometer. This difference may cause the pressure bias between IMS-100-GDP and RS92-GDP.2 in lower troposphere.

Geoid height difference between model



- The geoid height around Tateno vary greatly depending on model
- If the radiosonde launched from Tateno take the typical track, it will pass through the region where the correction of geoid height is very large

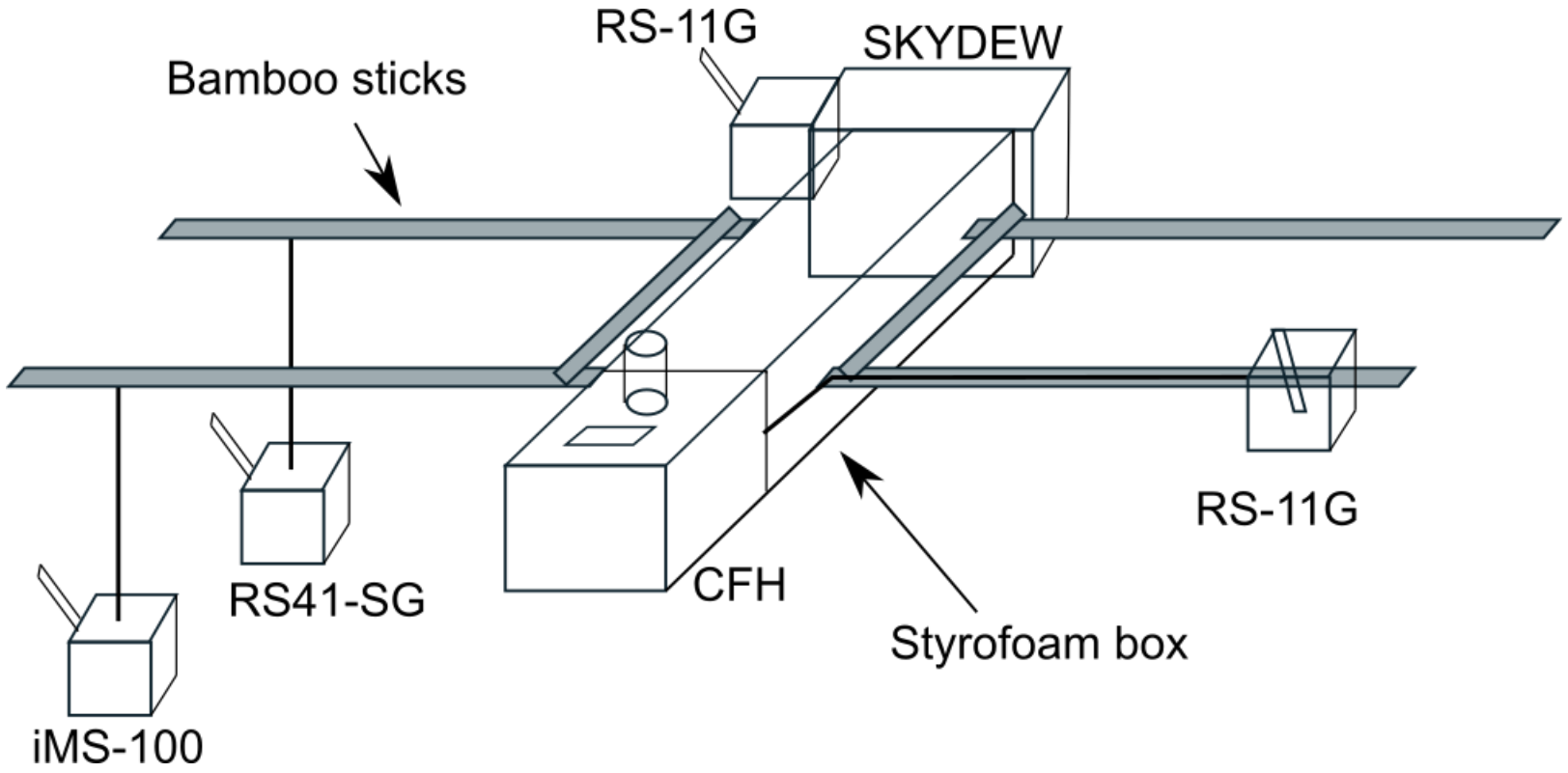
Intercomparison between IMS-100-GDP and RS92-GDP.2 (wind)



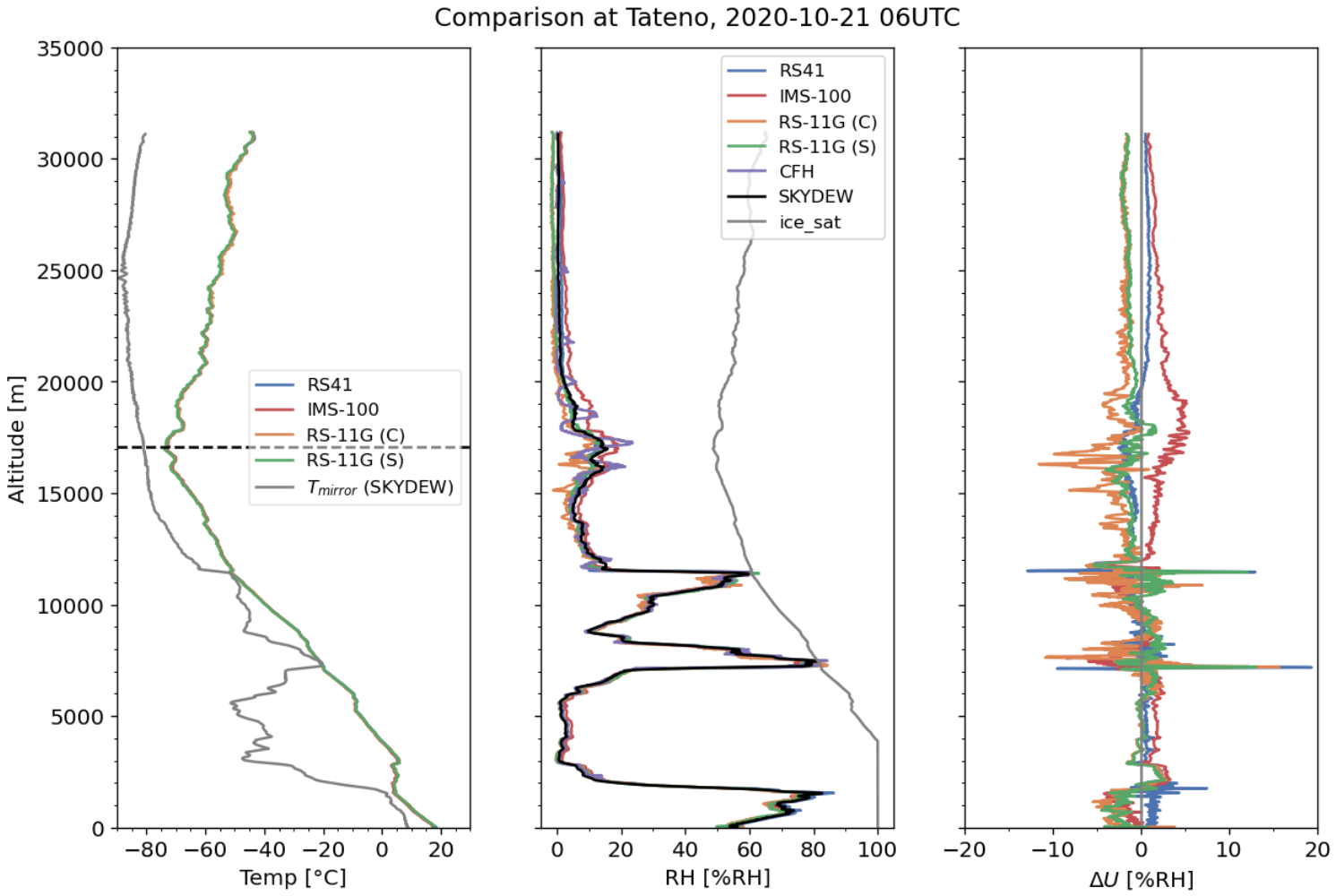
- Bias of wind speed became larger at higher level
- RMSVD (Root mean square of vector difference) is about 3 m/s under 15 hPa level
- Difference of wind direction became larger in stratosphere, because of weak wind speed

Comparison with reference sensor

Quad-sounding (RS41, iMS-100, CFH and Meisei SKYDEW) is conducted on 21 October 2020.

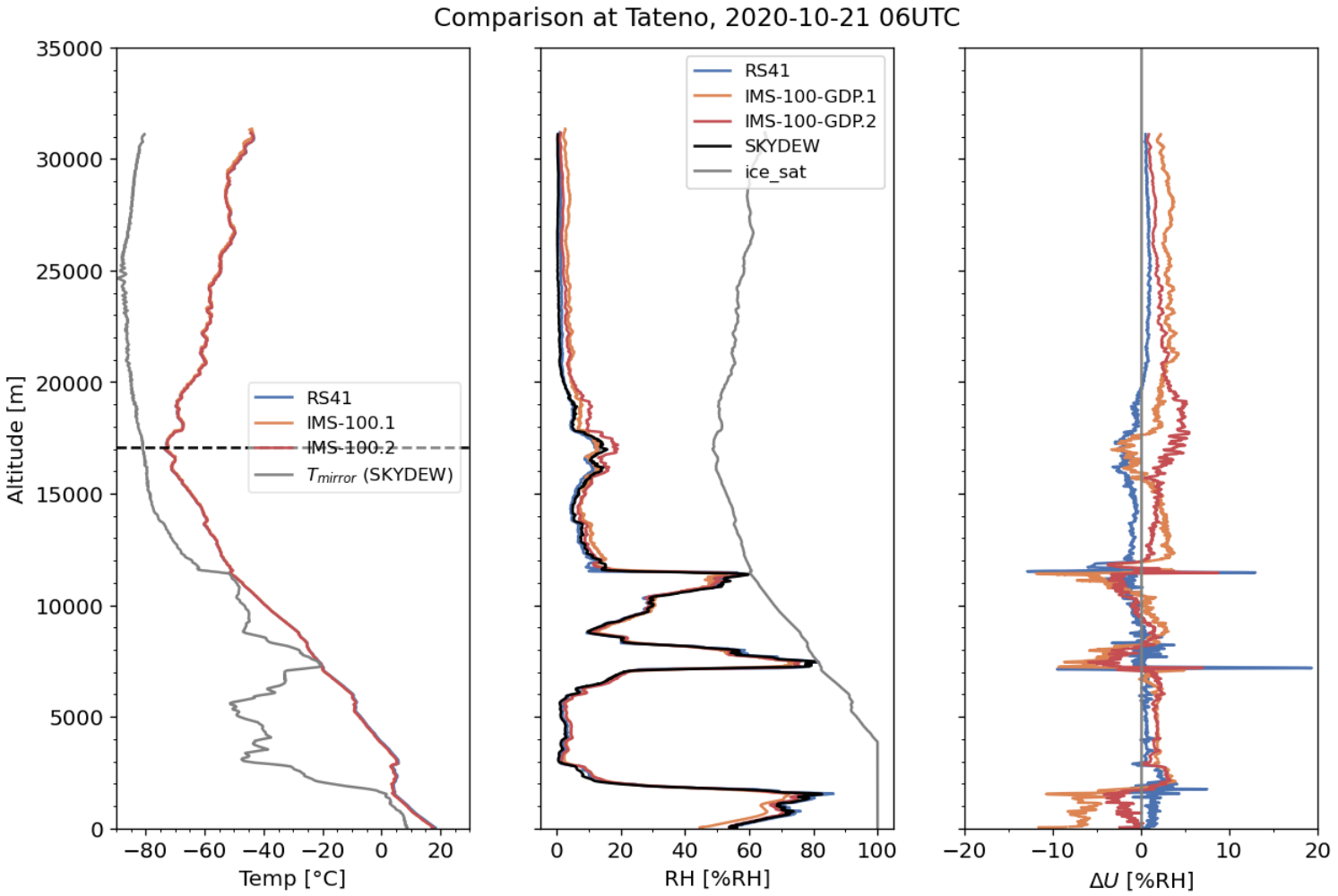


Comparison with Meisei SKYDEW



- In this case, the data of CFH is unstable above ~15 km height and below ~2 km.
- iMS-100 is slightly wetter than SKYDEW and RS41 in UTLS (but almost in agreement with RS41; $\Delta U < \sqrt{u_{41}^2(U) + u_{ims}^2(U)})$

Comparison with Meisei SKYDEW



- In this case, new algorithm improve the dry bias in the lower troposphere
- In the layer around tropopause, the new algorithm shows wet bias.

[%RH]	BIAS		RMSE	
Sonde	Old	New	Old	New
IMS-100	1.2	1.4	3.1	2.3
RS-11G	-0.8	-0.7	2.4	1.7
RS41		0.1		1.6

Summary

- Temperature: IMS-100-GDP is about 0.5 K lower than RS92-GDP.2 in stratosphere in daytime
- RH: IMS-100-GDP is about 1.8 %RH higher than RS92-GDP.2 below 200 hPa level and about 1.0 %RH lower above 30 hPa level
- RH: The bias and RMSE of IMS-100-GDP to SKYDEW is about +1.4 %RH and 2.3 %RH
- Pressure: IMS-100-GDP is about 0.3 hPa lower than RS92-GDP.2 in lower troposphere and 0.1 hPa lower for almost whole profile

Summary

- Geopotential height: the difference below 100 hPa level is small, but became larger (exceeds ~10 m) above 50 hPa level. This difference seems to be caused by estimated geoid height.
- Wind: the bias of wind speed became larger at higher level and RMSVD is about 3 m/s below 15 hPa level.

Future issues

- Revised version of TD is preparing and call for comments for the draft
- Intercomparison between GDP for iMS-100 and RS92-GDP.2 is will be submitted in near future
- Validation of the new version of GDP for RS-11G will be submitted
- Intercomparison between iMS-100 and RS41-SG at Tateno has started in July 2020. The result will be summarized in 2021 or later.

Thank you for your attention!