Comparison of Lower Tropospheric Water Vapor Vertical Distribution Measured with Raman lidar and DIAL and Their Impact of Data Assimilation in Numerical Weather Prediction Model

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09: Atmospheric temperature, water vapor, wind, turbulence, and waves

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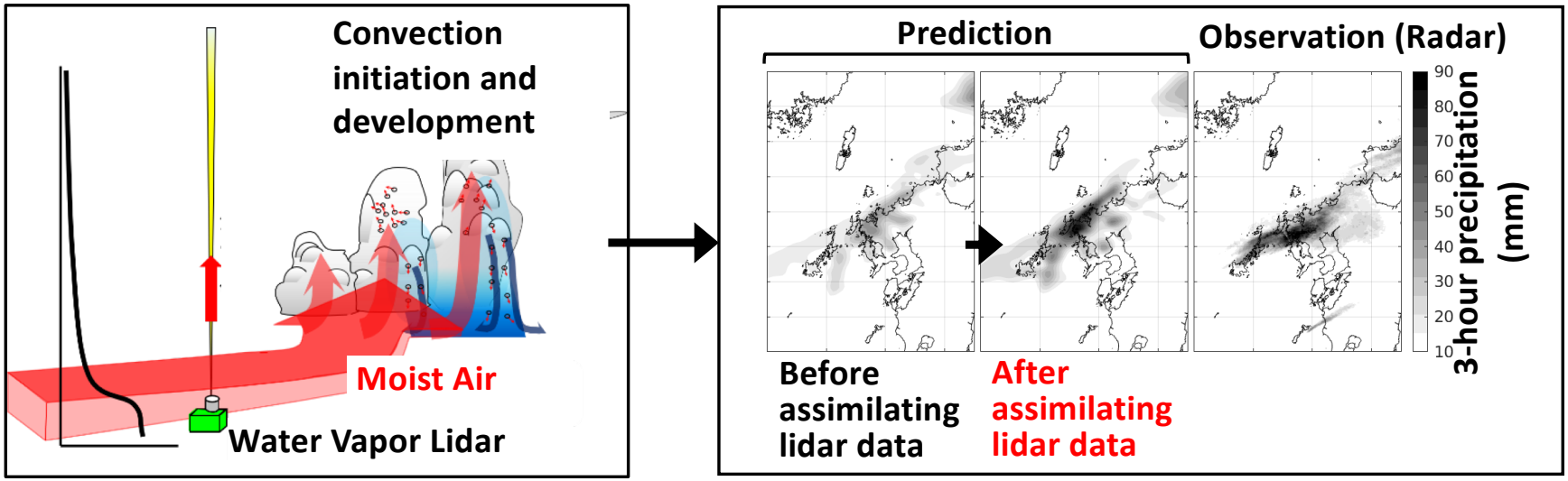
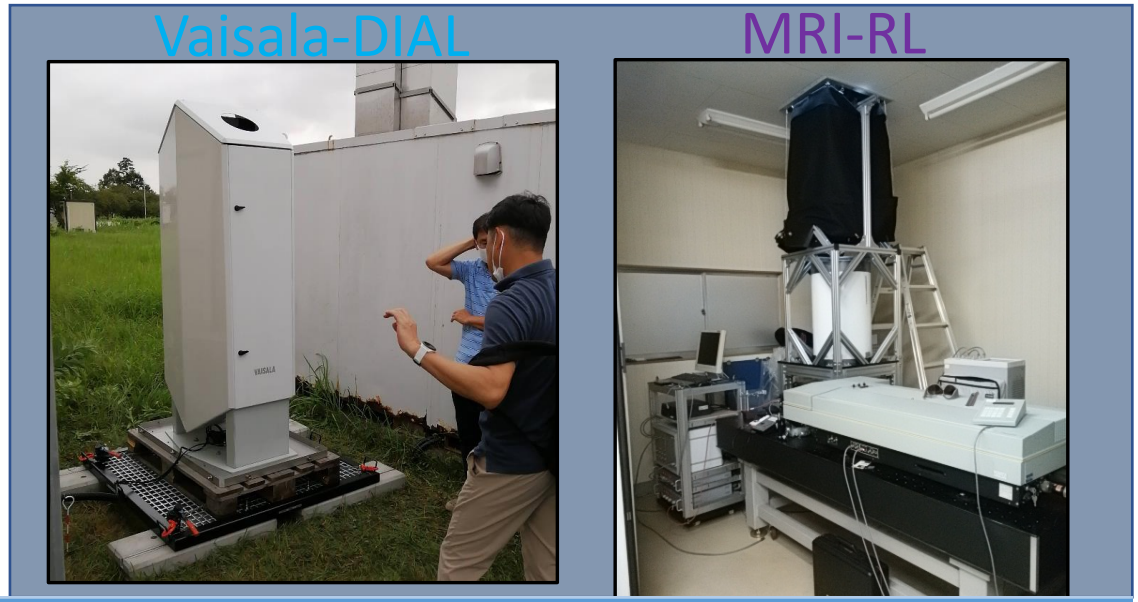
Motivation

To investigate the potential utility of water vapor lidar for mesoscale numerical weather prediction.



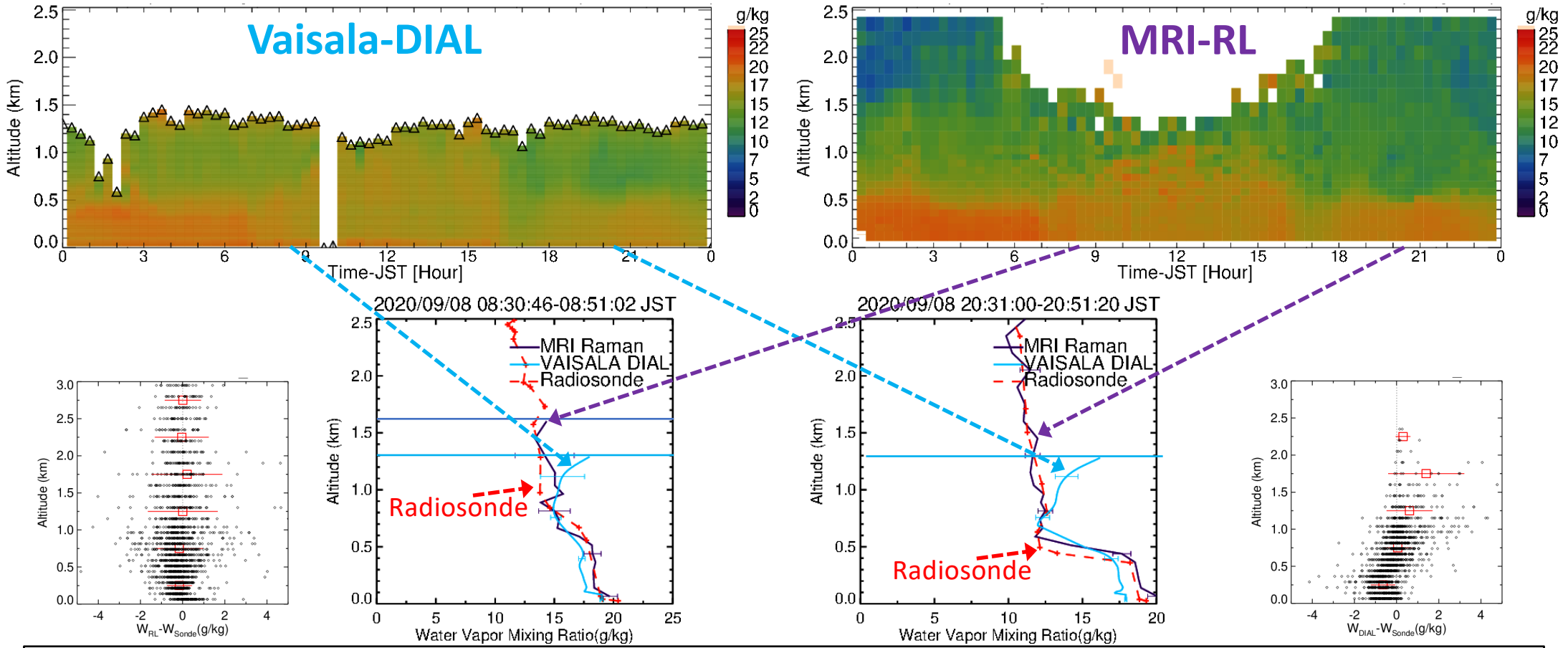
Instrumentation

Prototype Vaisala DIAL (Newsom et al., JTECH 2020) and MRI Raman lidar (modified from Sakai et al., JTECH 2007)



	Vaisala-DIAL	MRI-RL
Transmitter:		
Laser wavelength	911 nm and 910.6 nm	355 nm
Pulse Energy	9 µJ/pulse	200 mJ/pulse
Repetition Rate	10 kHz	10 Hz
Receiver:		
Telescope Diameter	15 cm and 28 cm	40 cm

Comparison of Vaisala-DIAL, MRI-RL, and Radiosonde



- **Measurement ranges were between near ground and 1.5 km for for Vaisala-DIAL and 0.1 km–1 km in day and >2.5 km in night for MRI-RL.**
- **The values obtained with Vaisala-DIAL were lower than those obtained with radiosonde below 1km and higher than that above 1 km.**

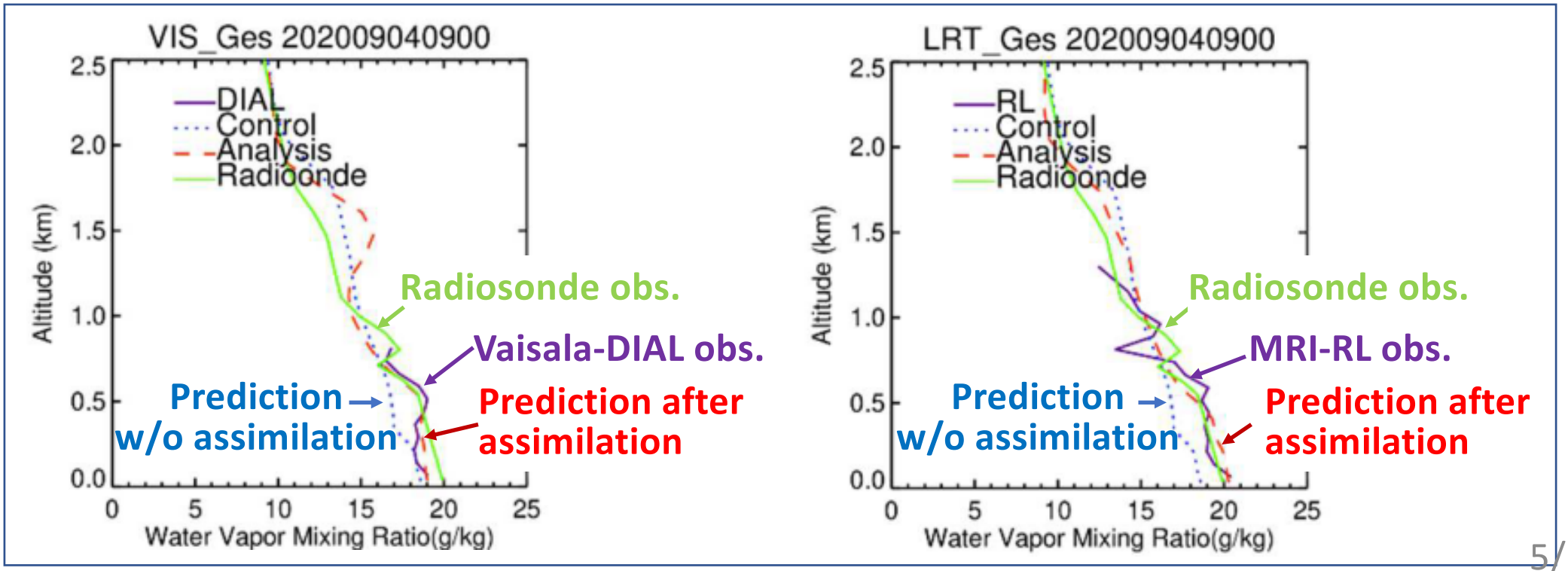
Assimilation of lidar data into numerical weather prediction model

Lidar data:

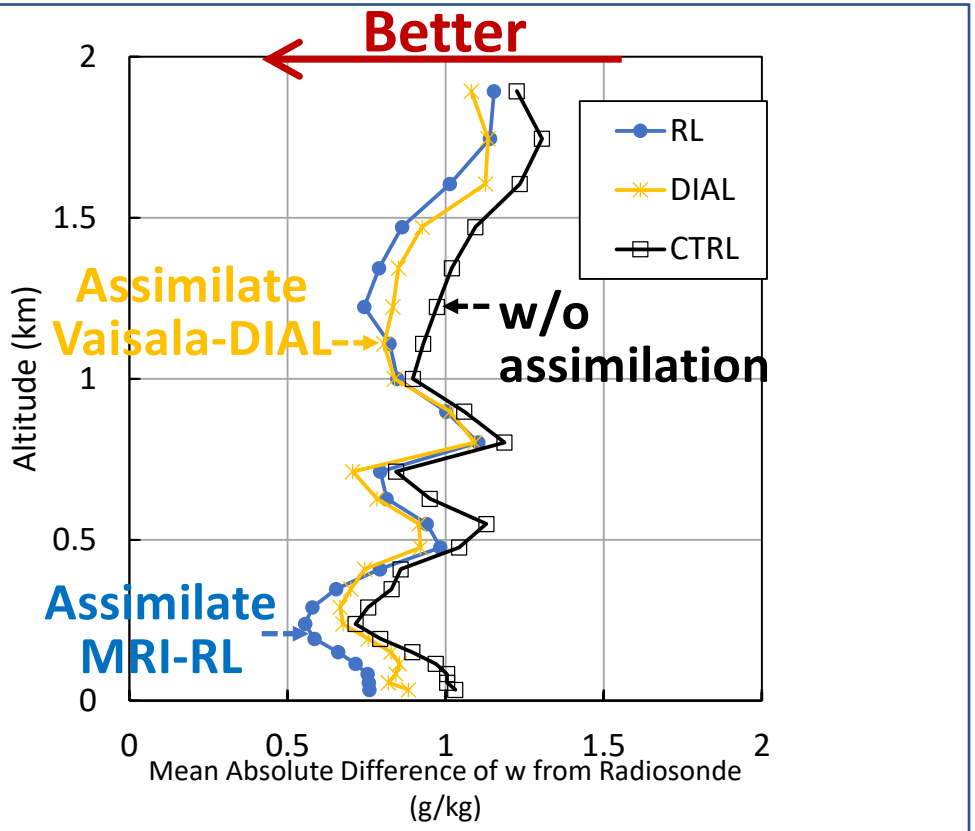
- Period: 3–12 September：2020 (10 days)
- Observation site: Tsukuba, Japan (36N, 140E)
- Quality control: measurement uncertainty < 30% and water vapor mixing ratio value between 0–30 g/kg

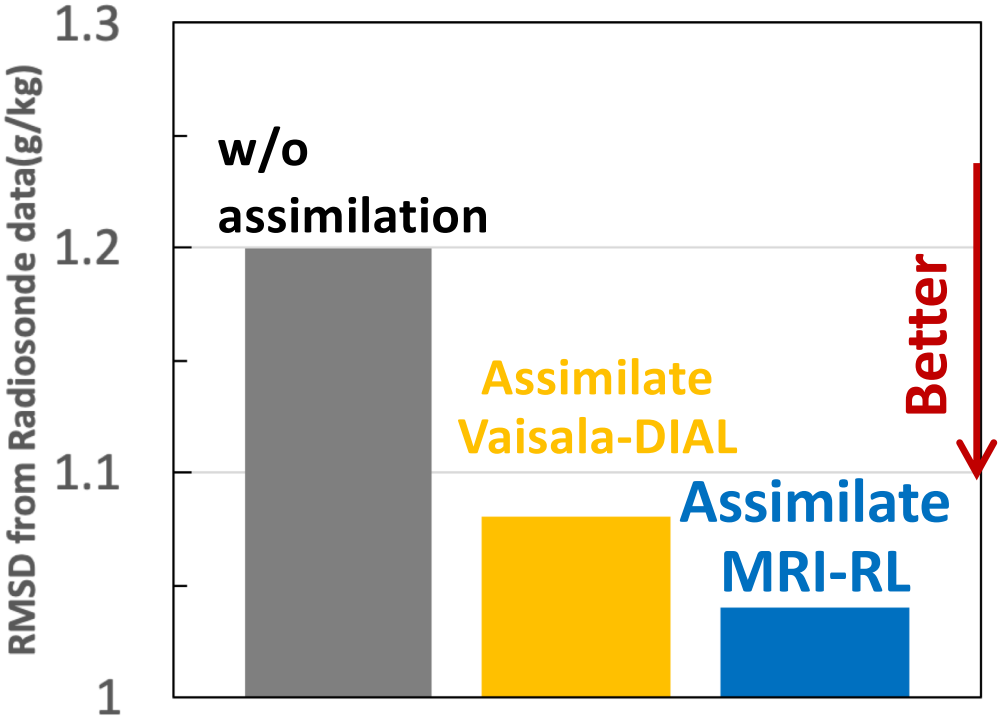
Numerical prediction model and data assimilation method:

- Japan Meteorological Agency Nonhydrostatic mesoscale model (JMA, 2019)
- Four-dimensional variational data assimilation method (Ikuta et al., JMSJ 2021)



Result of data assimilation for Vaisala-DIAL and MRI-RL measurement





- **Prediction assimilating MRI-RL data is slightly better than that assimilating Vaisala-DIAL data.**
- **Plausible reason for that is the smaller bias and RMSD of MRI-RL data than Vaisala-DIAL data.**