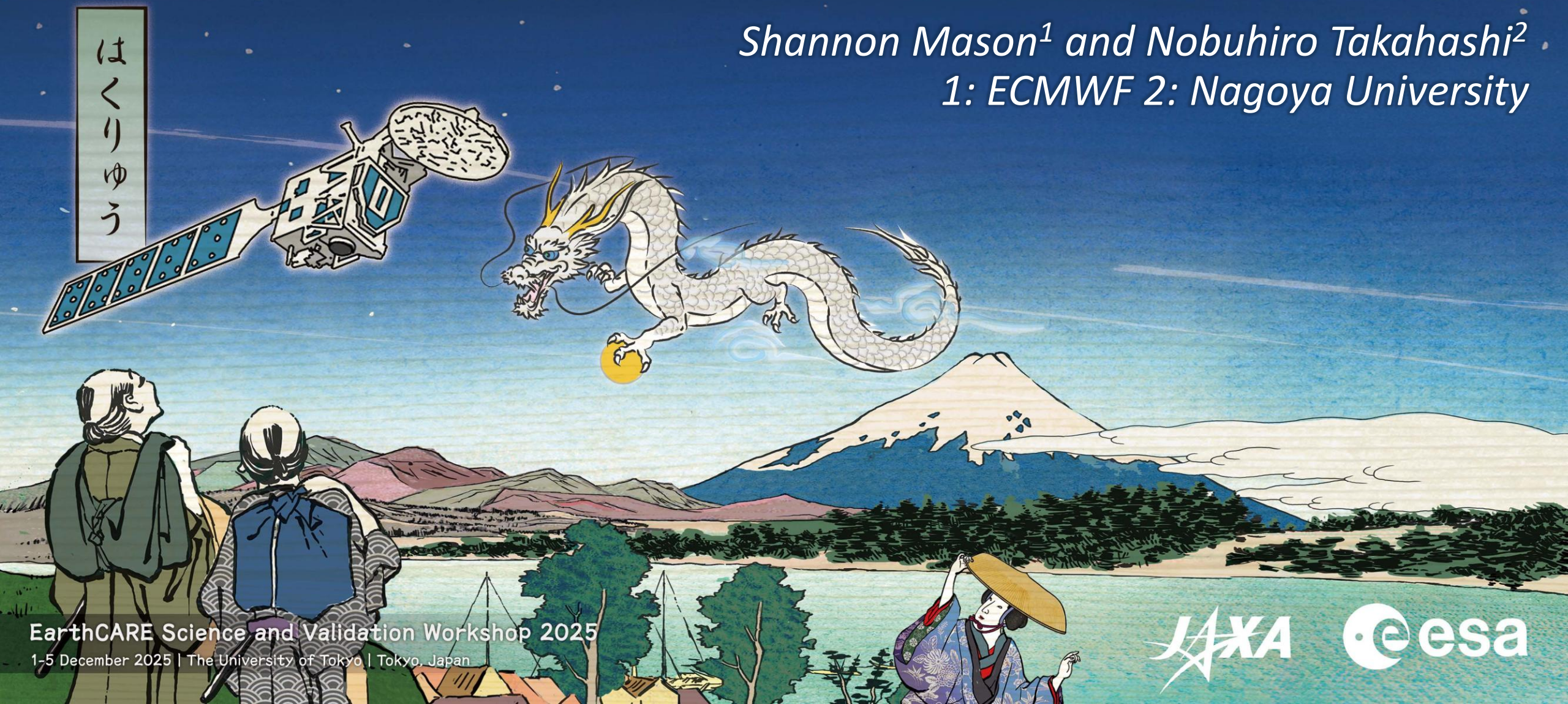


Highlight and Recommendation on Cloud and Precipitation

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- Calibration
 - calibration of CPR, ground-based radar, and airborne radar became stable to available for validation (Horie, Imura)
 - CPR calibration implemented by external calibration and roll maneuver calibration (Horie)
 - Slight trend is pointed out from normalized surface backscattering cross section (σ^0) (Mroz)
- Radar reflectivity factor (Z)
 - radar reflectivity factor is validated by ground-based radar statistically and under flight airborne radar using closer frequency (Horie, Pfizenmaier, Imura, O'Connor, **Roversi, Borque, McLinden**)
- Doppler velocity (Vd)
 - Doppler velocity bias of CPR is almost quantitatively corrected
 - Doppler velocity of CPR is validated by ground-based radar statistically and under flight airborne radar (**Pfitzenmaier, Moisseev, Roversi, Imura, Borque, McLinden**).
 - **New proposed approach for Doppler products for spectral (Tanelli)**



- Geophysical products
 - LWC and IWC and size distributions validated by airborne campaign data (**Carlsen**) and ground-based RS (**Nakamura**)
 - Vertical air motion and sedimentation velocity utilized for scientific analyses showing consistency (validity) of algorithms (Hogan, Qu, Treserras)
 - Expressing confidence in target classifications at the limits of detection (**Le, O'Connor, Marinou**)
 - ATLID classification with weak features
 - CPR classification when dominated by multiple scattering/attenuation)
 - **Validation of CTH from airborne measurements (Krüger) and intercomparison of different EarthCARE CTH products (Floutsi)**
- Aircraft campaign observation results
 - Detailed evaluation of ATLID ice extinction & multiple scattering (Wirth, Hogan, Donovan)



Monitoring of CPR Quality and Calibration from ECMWF (Mroz)

Confirmation of consistency between Z and Vd, and EarthCARE and other satellites

- **Precipitation**: comparison of Z and Vd with ground-based radars with different frequency (multi-parameter radar, MRR) (Moisseev, Roversi) **and GPM (Kanemaru, Aoki)**
- microphysical process studies (Seiki)
- use of EarthCARE-GPM coincident data (Aoki, Ohata, Kanemaru, Le)
- convective cores and deep convective clouds (Hotta);
Lightning detections & convective development from GEO (Piskala)



- Higher sensitivity by about 5 dB & low clutter-free bottom than Cloudsat/CPR
 - insect detection (w/ ATLID) (Mason)
 - shallow clouds incl. open/closed cells (Kollias, Takahashi, Mayer)
- Doppler velocity observation
 - determination of folding in deep convection (Battaglia)
- Improved mirror-image masking and derivation of specific attenuation (Aoki)

Recommendations



- Calibration
 - long term monitoring of CPR calibration constant by independent approach (external calibration, roll maneuver, σ_0)
- Radar reflectivity factor validation
 - further combination with other satellites
 - utilization of multi-frequency radar (W, Ka, Ku, and X-band radar)
- Doppler velocity (air motion and/or sedimentation velocity)
 - Add flag on reliability (e.g. multiple scattering region, folding region)
 - How can we inform Doppler velocity unfolding? i.e. first-guess as structure of vertical air motion in deep convective clouds
 - Effects of ice processes on Doppler features: dendritic growth & riming; representation in models
- Target classification
 - more validation activities incl. in-situ observation (macrophysical structure & phase: supercooled layers, cloud-base, etc.)
 - validation activities on non-meteorological target (e.g. insect) for future classification categories
 - Continue capitalizing on long record of ground-based sites and networks (e.g. CloudNet) to answer specific questions needed to inform EarthCARE algorithms:
 - Thickness of melting layer & melting layer attenuation
 - Cloud-base height (when precipitating)
 - Sublimation/evaporation of precipitation near surface
 - *Can these be expressed as a function of X-MET variables?*
- Geophysical products
 - Always need more in situ flights in regimes of interest:
 - Ice clouds (& mixed-phase, supercooled layers): validating PSD assumptions to satisfy both ATLID and CPR
 - Warm liquid clouds & drizzle (stratocumulus, trade cumulus, southern ocean): *porpoising flight pattern to sample profile*
 - LWP comparison with ground-based microwave radiometer: *how to vertically distribute liquid water content given LWP?*
 - vertical air motion with atmospheric radars (e.g. MU radar, EAR, PANSY)
 - use of polarimetric information of ground-based/airborne radars (e.g. rain rate over water)
- Support the development of cloud synergistic products with observations from other missions (e.g., MTG, PACE, 3MI)

One last message from prof. H. Okamoto (CPR algorithm developer)



- For effective feedback to the algorithm developers, please consider:
 - **Specify** the version of the product, the product name, and **the parameter name**.
 - e.g. Cloud water content1, Cloud water content2
- Current phase is improvement of algorithms, **please feel free to contact algorithm developers.**