# Report of the Focus group on data assimilation

~23 Participants:

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# Three topics of discussion:

1. *Discussion on latest findings for data assimilation in cloudy and precipitating areas with current NWP systems*

2. *Discussion on the challenges related to the initialization of Kilometric scale modeling of the Earth system*

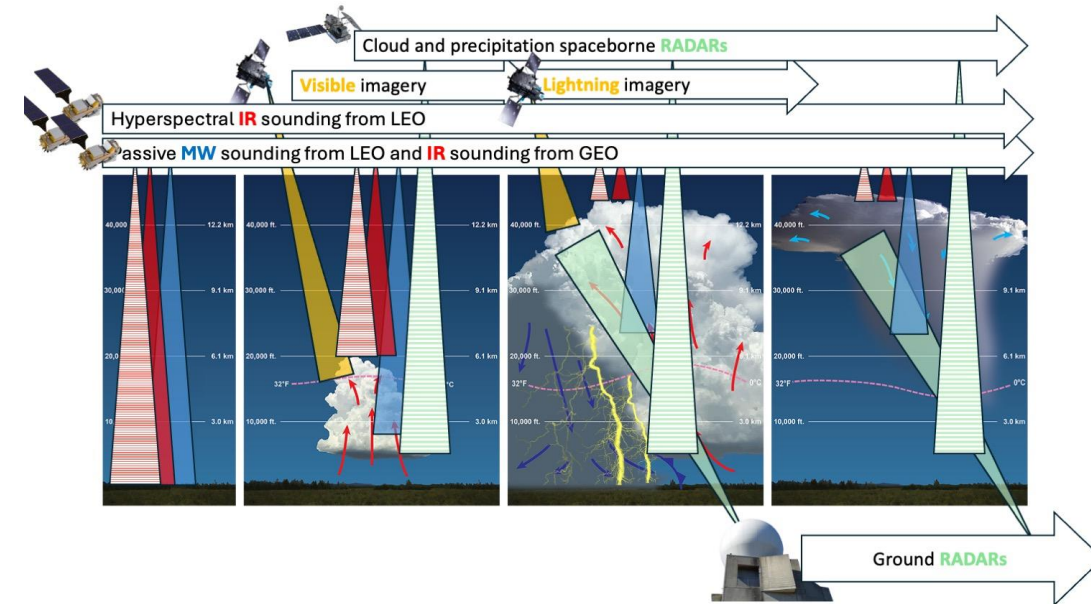3. *Discussion on the challenges related to the initialization of AI-based models*

# Summary of the discussions

## *1. Discussion on the latest findings/difficulties for data assimilation in cloudy and precipitating areas with current NWP systems*

⇒ Work on various observation kinds ongoing in the group (MW HU and T channels, IR observations, Lightning data)

⇒ Growing interest for the assimilation of space radar data (pioneering work at JMA and ECMWF, OSSE of GEO radar at RIKEN, plans of OSSE at Tomorrow.io) => challenge to assimilate the fine scale signal!



⇒ Consistent microphysics and particle scattering databases are still needed across all frequencies + Importance of tuning the forecast model to better fit the observations instead of tuning only the observation operator => challenging but done at RIKEN for DPR assimilation (e.g. fall speed velocity)

# Summary of the discussions

**2. Discussion on the challenges related to the initialization of Kilometric scale modeling of the Earth system**

$\Rightarrow$ The current gap between the number of assimilated observations and degrees of freedom is already an issue in current NWP systems => This problem will only increase in the future.

$\Rightarrow$ Currently horizontal and vertical thinning is applied to avoid complex modeling of observation error covariances => progress should be made on this aspect (work has been done to estimate error correlations into some CDR datasets => interesting input for DA)
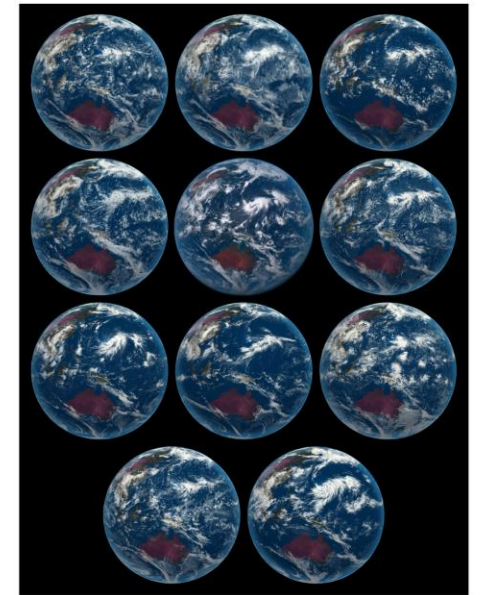
**Recommendation to ourselves :** work on advanced DA methods to increase the density of assimilated observations and progressively fill in the gaps with degrees of freedom

# Summary of the discussions

## 2. Discussion on the challenges related to the initialization of Kilometric scale modeling of the Earth system

⇒ High resolution will be needed, and one way forward is high frequencies for ice clouds, but low frequencies are also essential for rainfall assimilation.

⇒ Frequent observations will be needed depending on the application.

**Recommendation to CGMS :** make sure that future observing systems are as much complementary as possible (e.g. complementary orbital planes => as an example, good impacts of Early Morning FY3E)
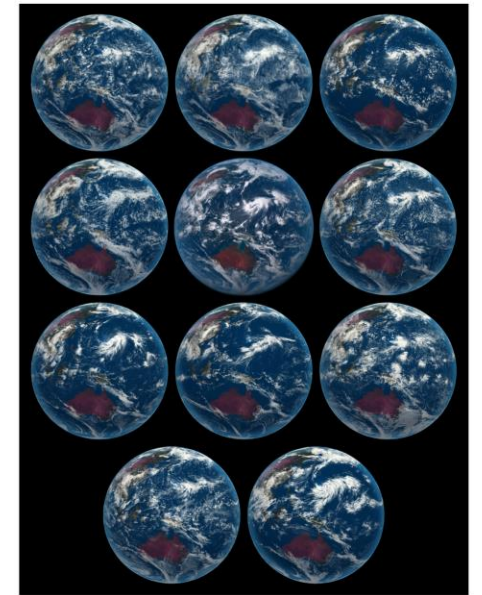
⇒ In the different ongoing projects of constellations (e.g. EPS-Sterna, Tomorrow.io), the selected orbits are sun synchronous. The Tropics may therefore remain the less sampled area of the globe with microwave data.

**Recommendation to CGMS :** consider low-inclination orbits in future architecture of the observing systems.

# Summary of the discussions

## 3. Discussion on the challenges related to the initialization of AI-based models



⇒ The quality of rainfall forecasts at the global scale of the new ML forecast models still needs to be demonstrated

**Recommendation to the leaders of IPWG validation effort :** consider adding ML forecast models to the IPWG intercomparisons
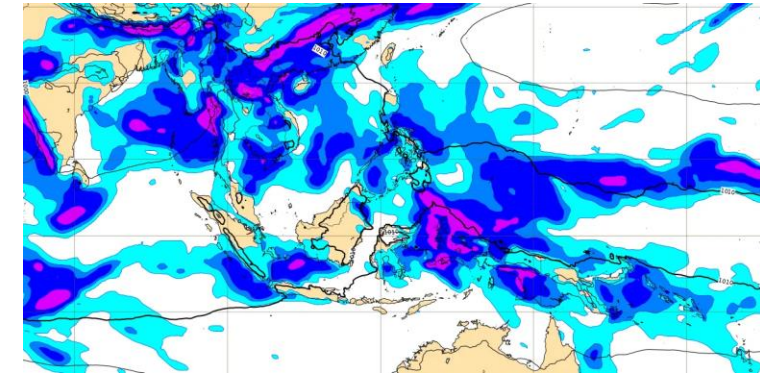
⇒ Developing these models is challenging but is also an opportunity as they run in shorter times => more time to wait for observations observations => more obs within DA

⇒ Several projects of usage of ML within the community (obs operator, quality control, background erro covariances).

⇒ Emulators can only emulate the capabilities of current systems (e.g. ERA5) => direct forecasts initialized from observations are an opportunity to improve cloud forecasts.