
GWF
GEOSPATIAL WORLD FORUM
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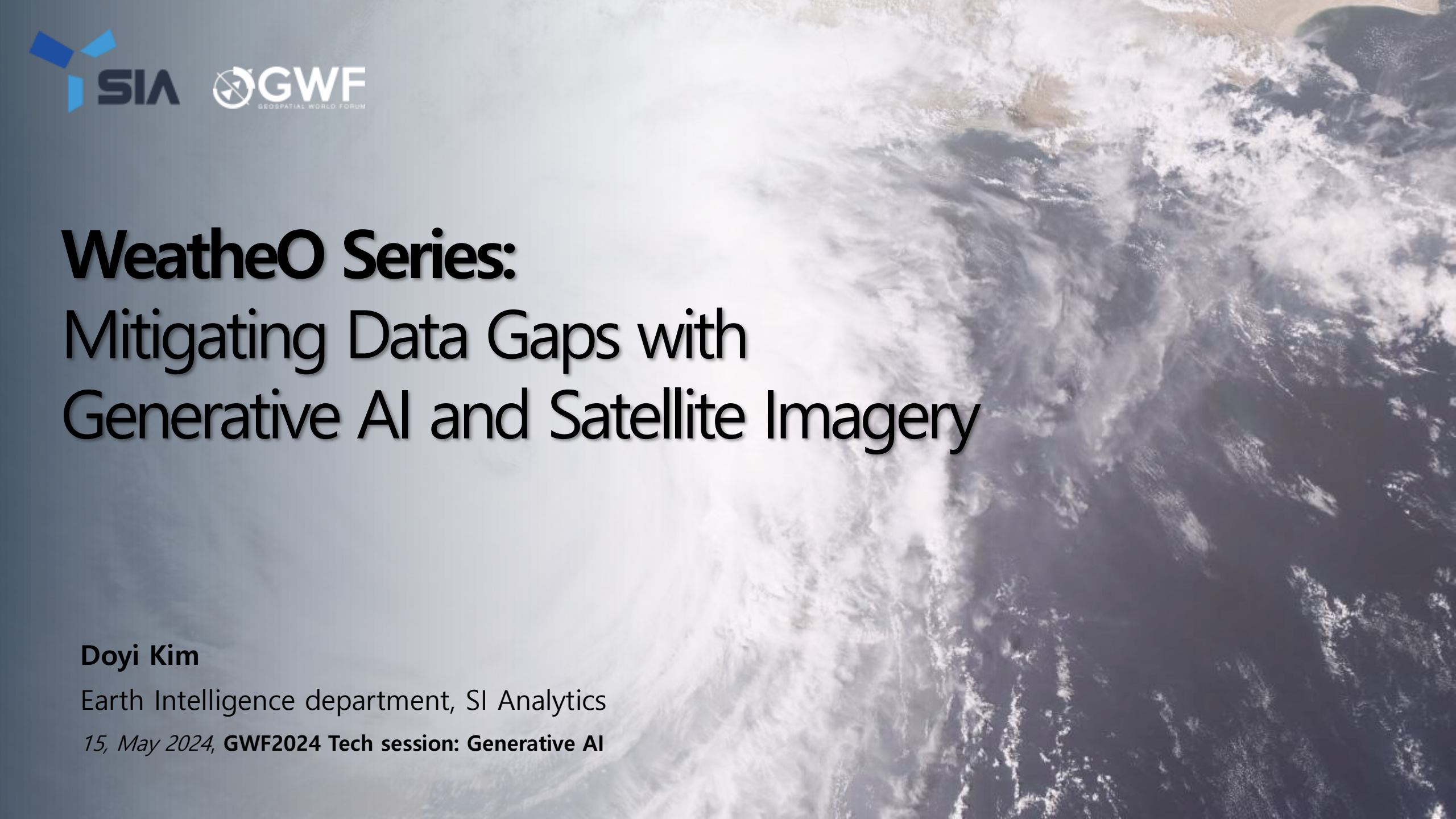


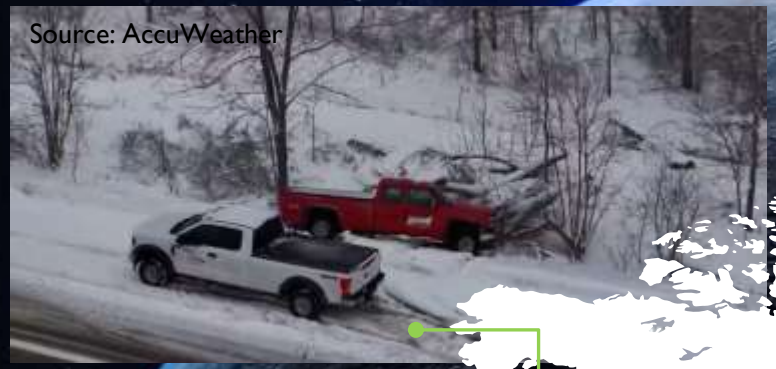
WeatheO Series:
Mitigating Data Gaps with Generative AI and Satellite Imagery

Doyi Kim

Earth Intelligence department, SI Analytics

15, May 2024, **GWF2024 Tech session: Generative AI**

Climate-related Disasters



USA, Snowstorm (2024. 3)

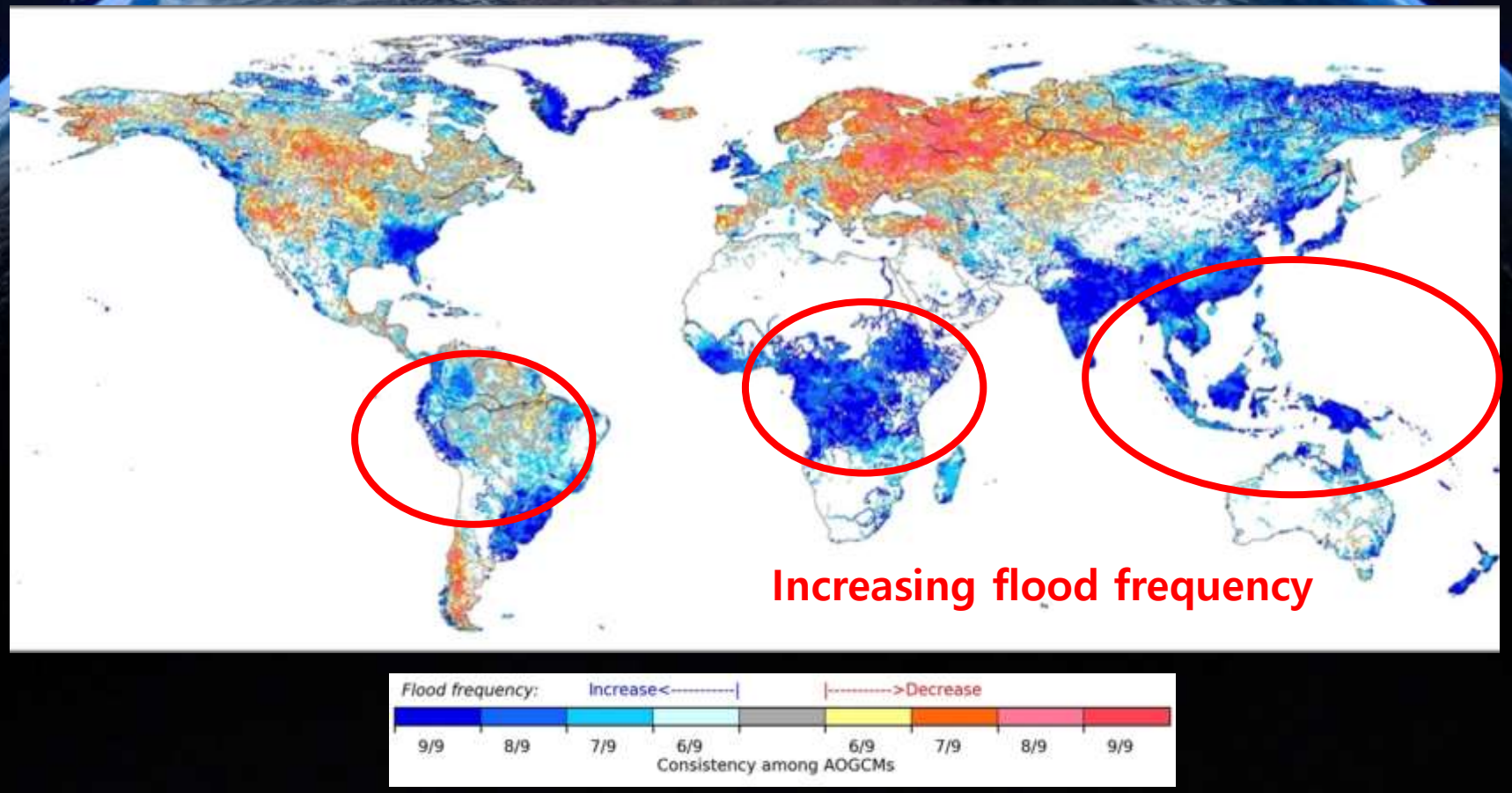
Switzerland: Avalanche (2024. 3)

Ecuador: Landslide (2024. 4)

Philippines: Floods and Landslides (2024. 1)

Dubai: Floods (2024. 4)

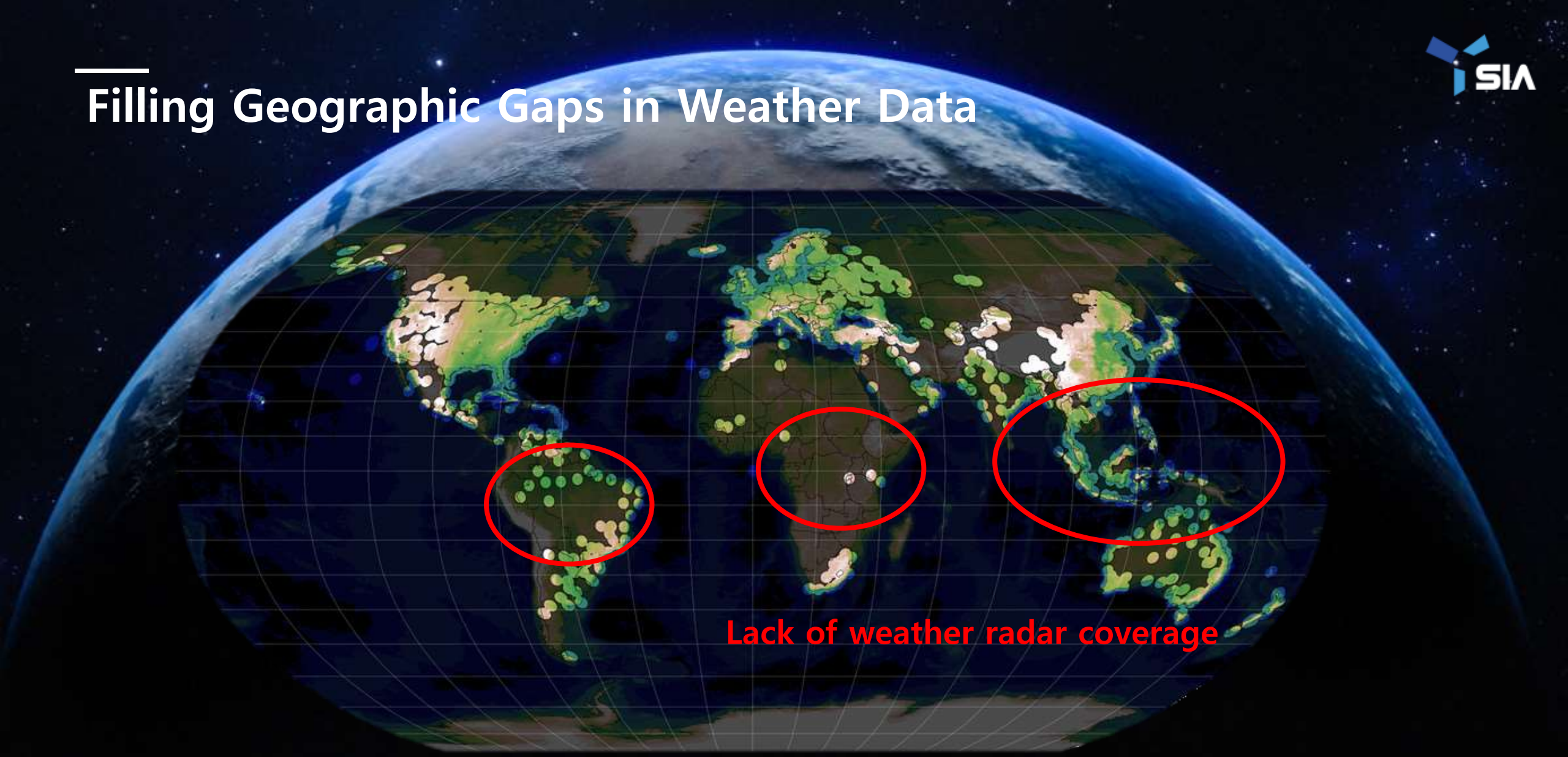
Filling Geographic Gaps in Weather Data



Flood frequency change scenario

[1] Hirabayashi, Yukiko, et al. "Global exposure to flooding from the new CMIP6 climate model projections." Scientific reports 11.1 (2021): 3740.

Filling Geographic Gaps in Weather Data

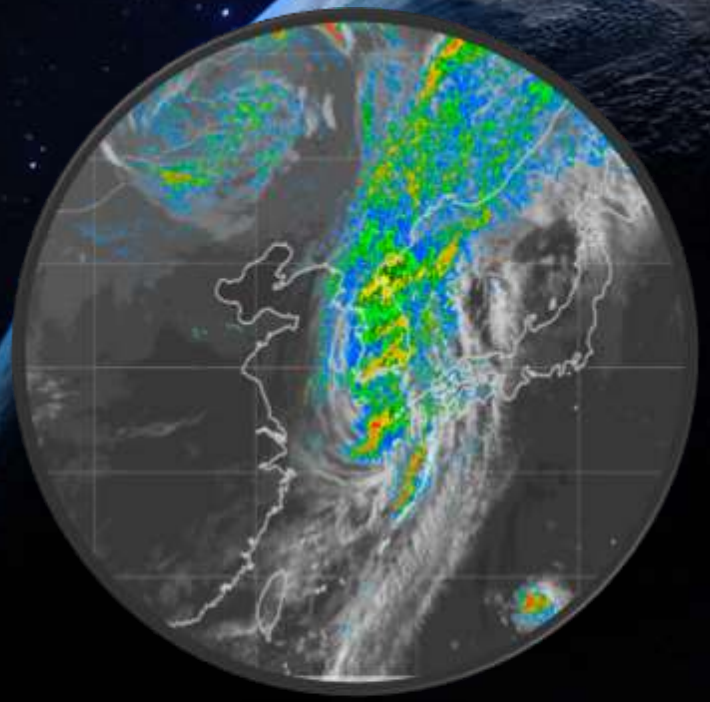


A map of global weather radar coverage

[2] Saltikoff, Elena, et al. "An overview of using weather radar for climatological studies: successes, challenges, and potential." *Bulletin of the American Meteorological Society* 100.9 (2019): 1739-1752.

SIA WeatheO Series:

AI-Based Weather and Climate Information

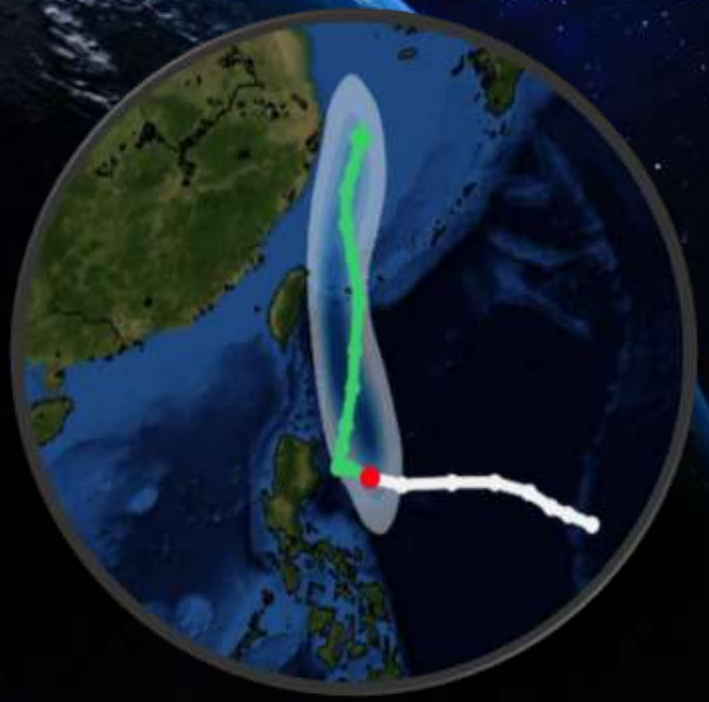


WeatheO_Rain

Proxy radar rain map

WeatheO_Cloud

Satellite imagery prediction



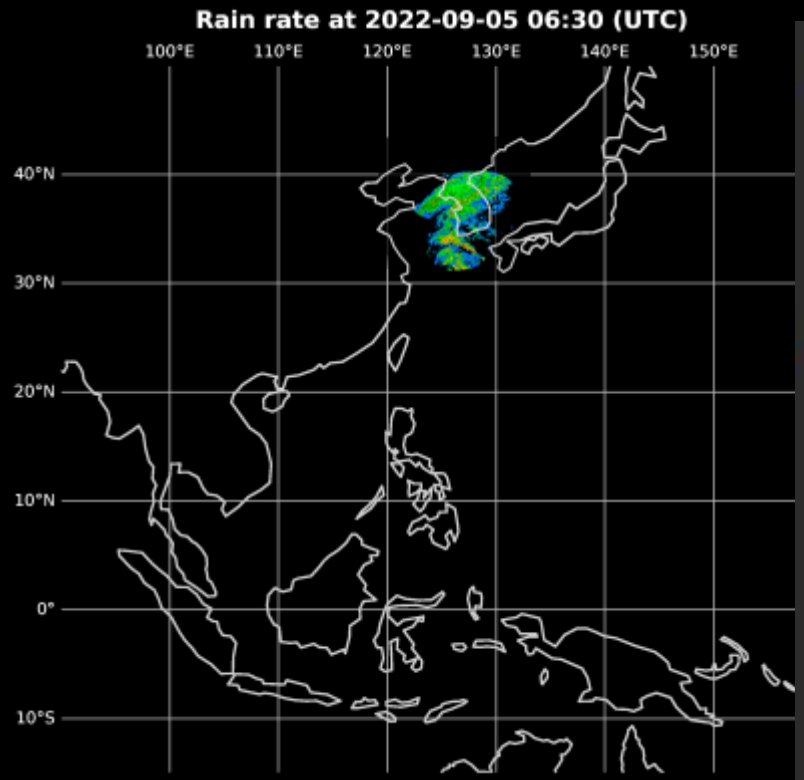
WeatheO_Storm

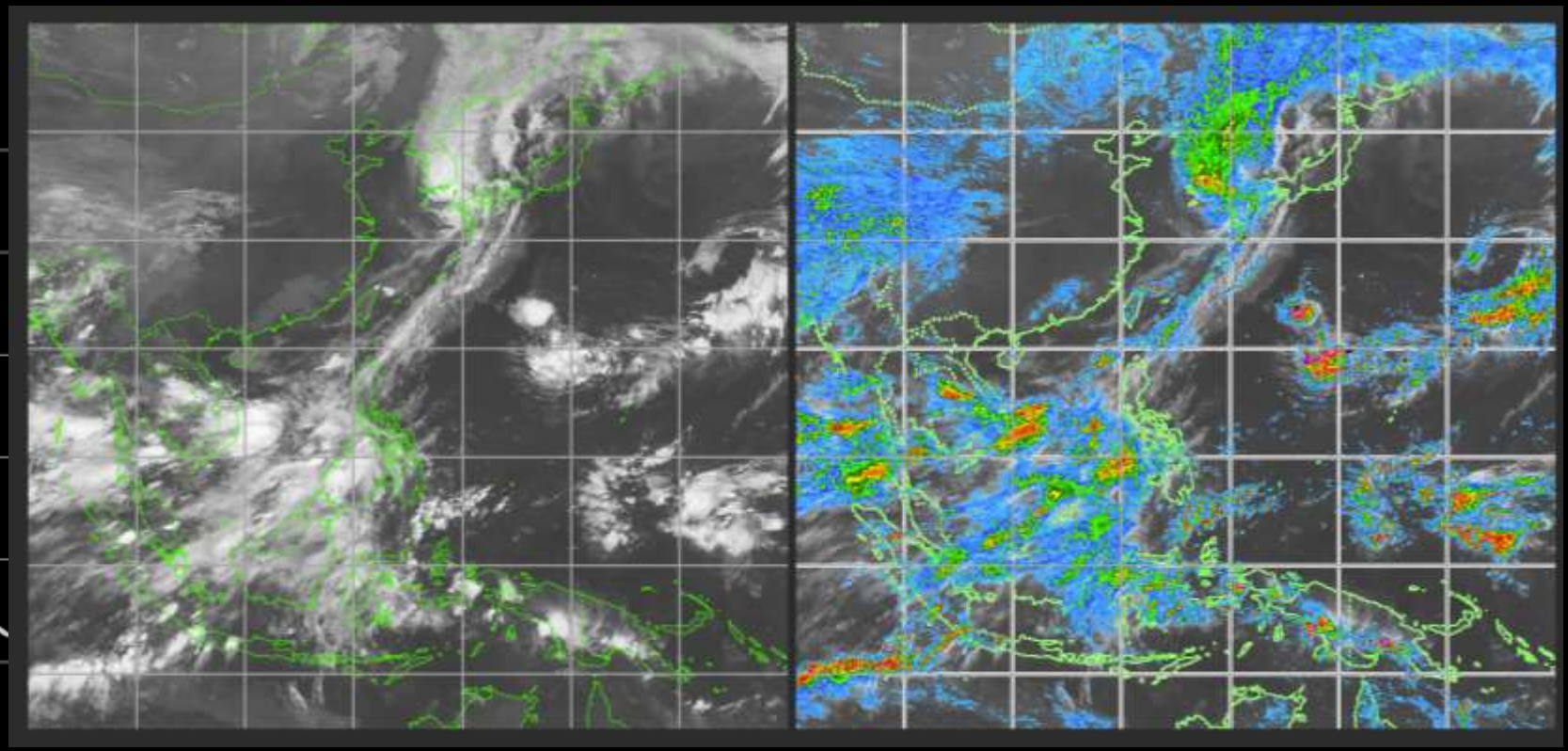
Trajectory and intensity prediction

WeatheO_Rain

Proxy radar rain map to monitor areas lacking weather radar

- Using high-resolution geostationary satellite imagery and Generative AI model
- Improved computational efficiency and accuracy compared to operational algorithm
- Free from the topographical constraints for ground-based weather observation systems





KMA Radar Coverage

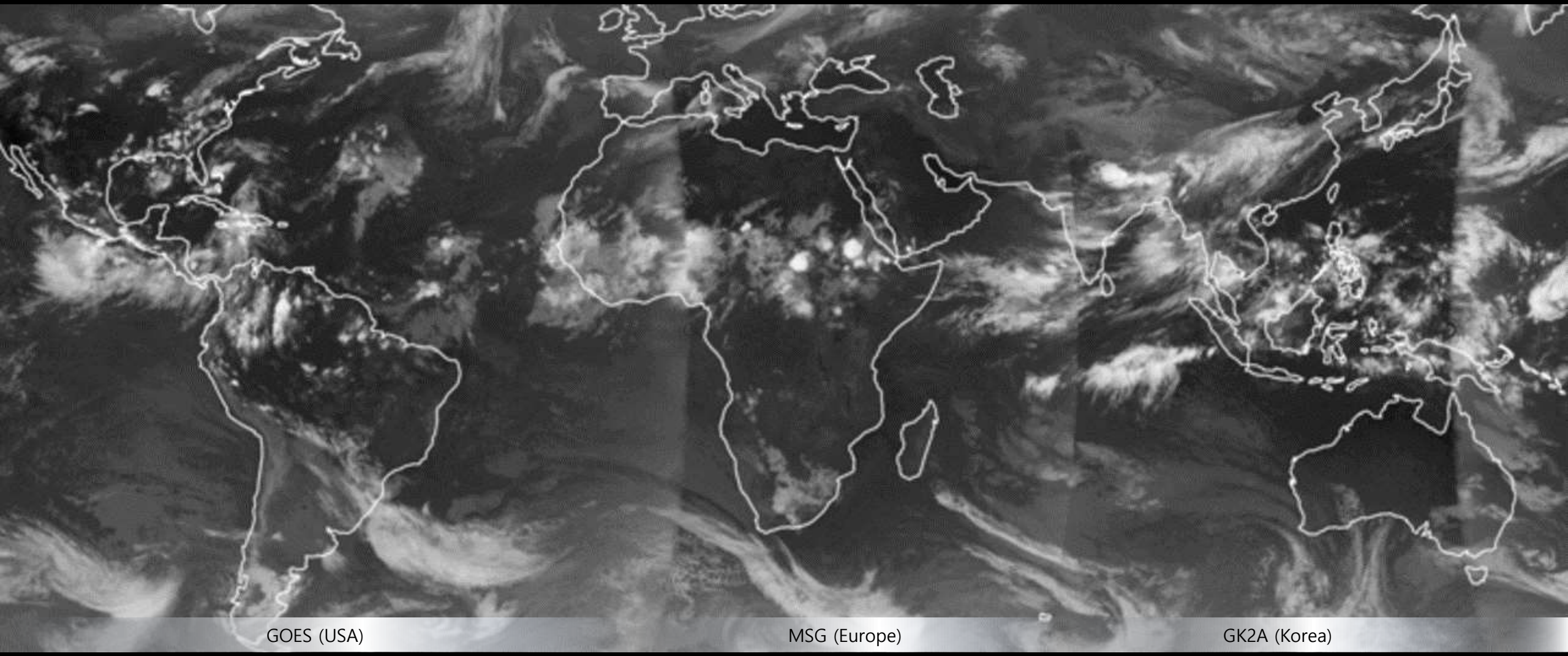
GK2A Satellite IR10.5 observation

Generated Radar Map (rain rate)

WeatheO_Rain

Bridging the weather observation gap

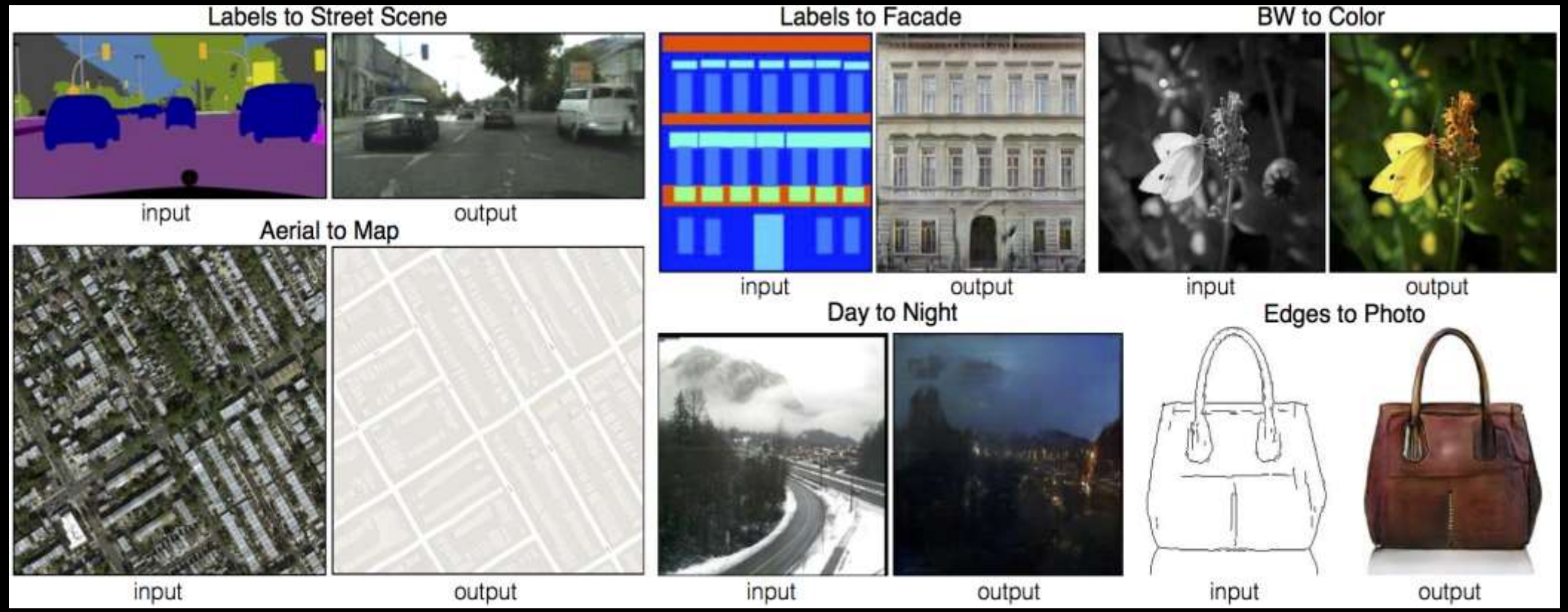
- Using geostationary satellites to cover the whole globe



WeatheO_Rain

Generative Adversarial Network(GAN) for Rain

- Isola et al.(2017) suggested a general-purpose solution to resolve **image-to-image translation problems** using conditional GAN (cGAN)

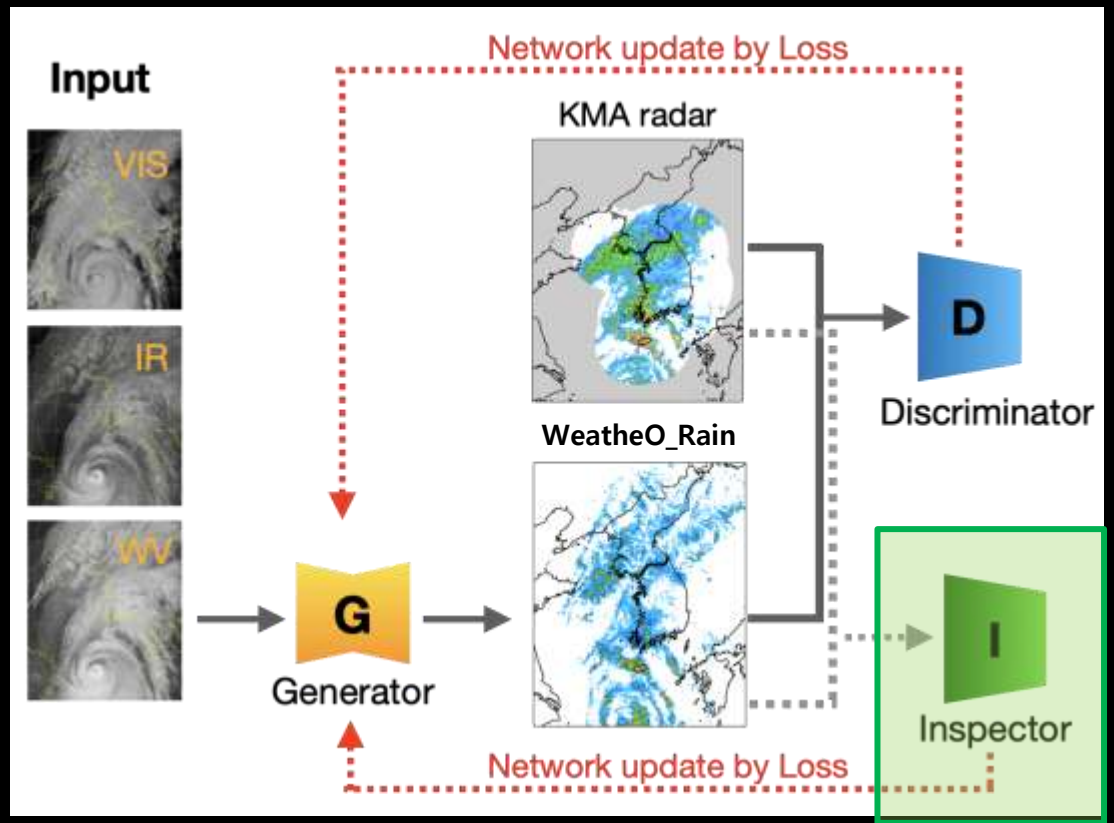


[3] Isola, Phillip, et al. "Image-to-image translation with conditional adversarial networks. arXiv e-prints." arXiv preprint arXiv:1611.07004 (2016).

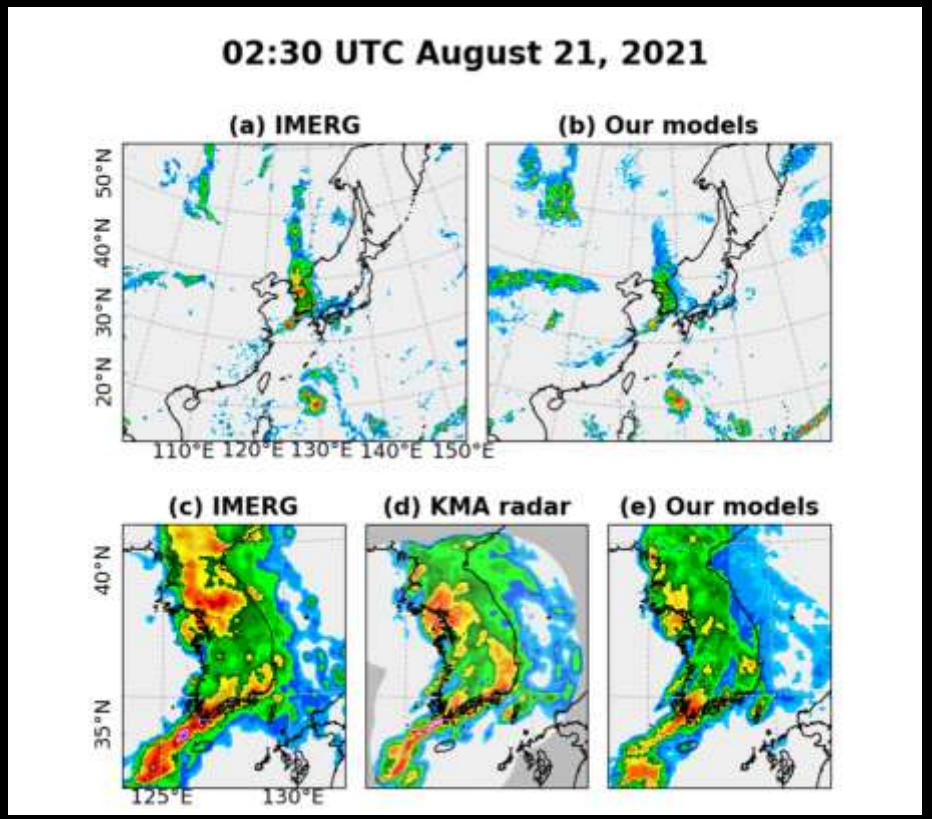
WeatheO_Rain

Generative Adversarial Network(GAN) for Rain

- Generate proxy radar reflectivity map from satellite imageries using the Pix2PixCC model ([5])
- The inspector guides the generated image to be physically consistent with the real radar image



Overview of WeatheO_Rain [4]



Qualitative results of WeatheO_Rain

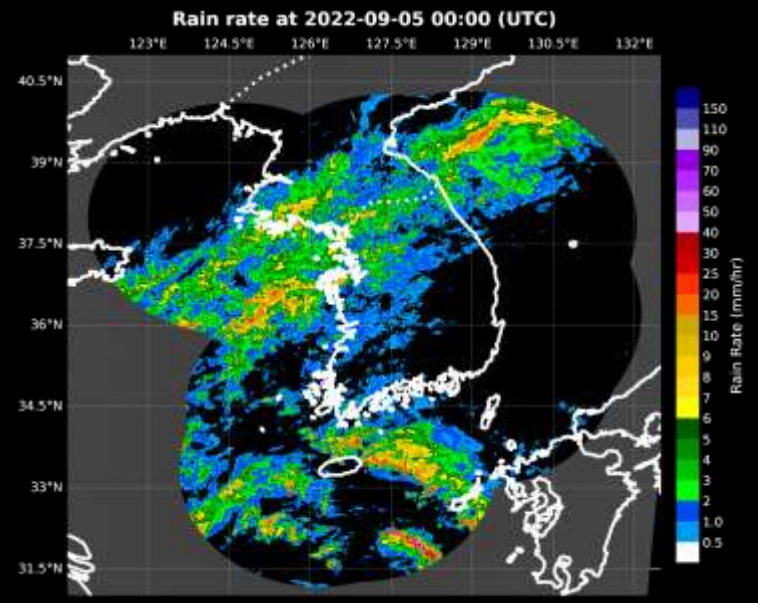
[4] Yim et al. "Global Radar Precipitation Map Generation from Integrated Geostationary Satellite Products Using Deep Learning Approaches." (AMS, 2023).
[5] Jeong, Hyun-Jin, et al. "Improved AI-generated Solar Farside Magnetograms by STEREO and SDO Data Sets and Their Release." *The Astrophysical Journal Supplement Series* 262.2 (2022): 50.

GK2A: GEO-KOMPSAT-2A

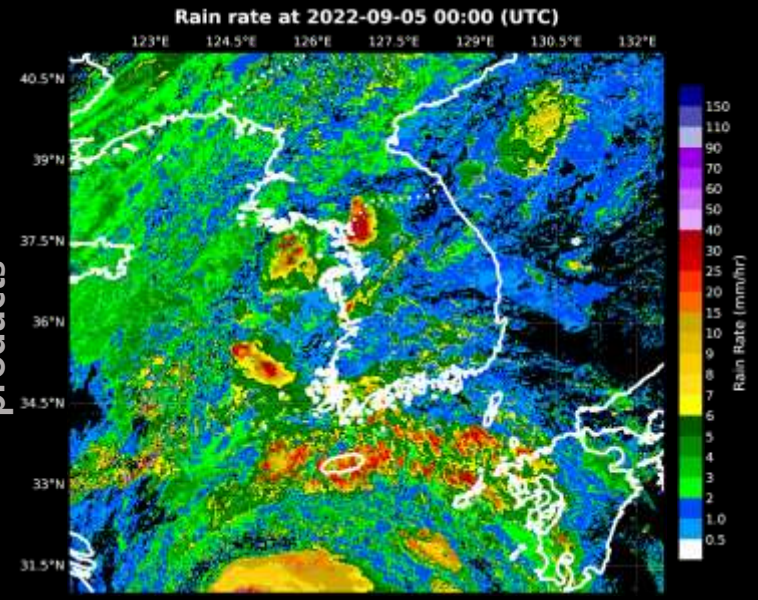
WeatheO_Rain GK2A – Asia Coverage

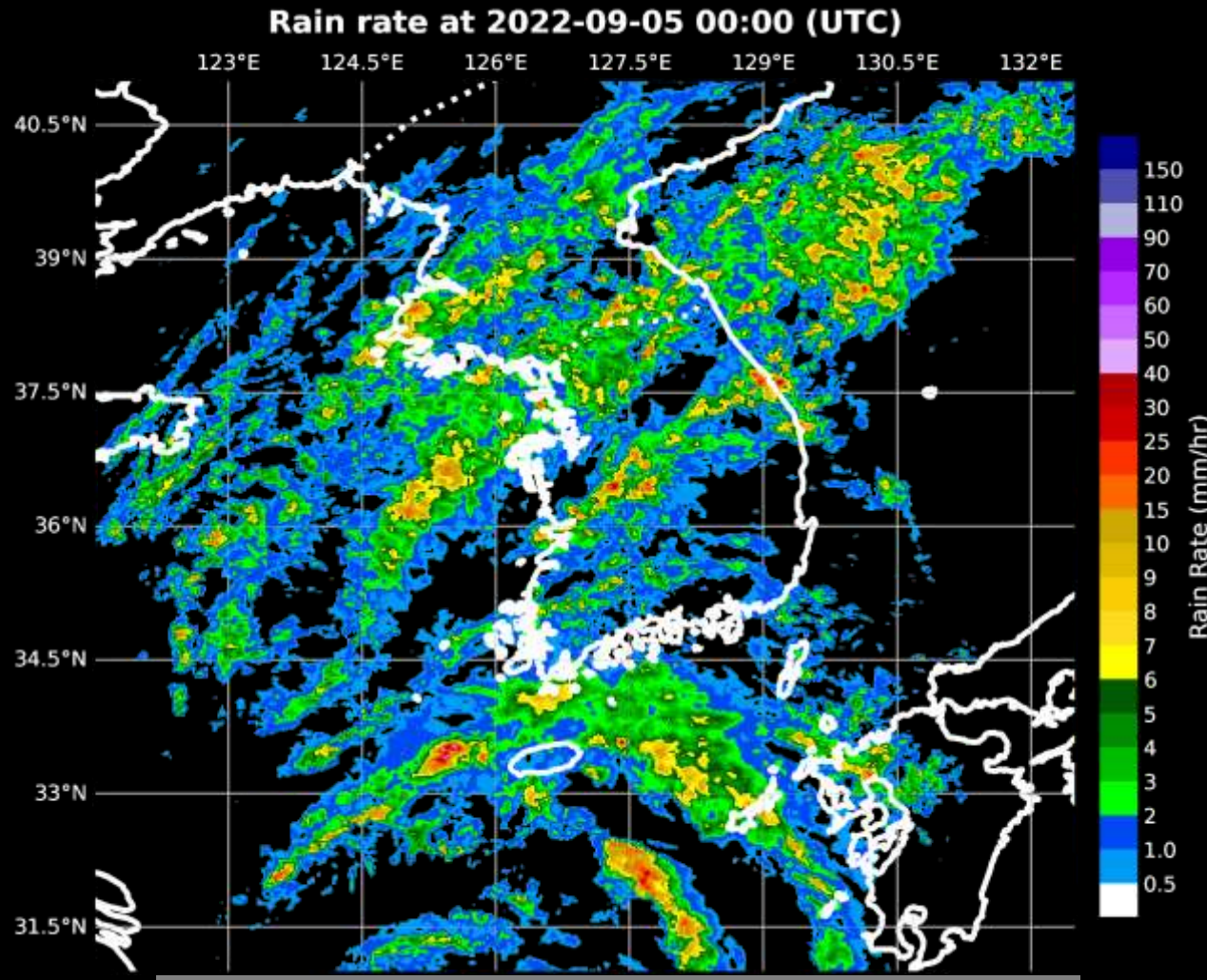
Typhoon Hinnamnor Case

KMA Radar observations



GK2A rain rate products





WeatheO_Rain (AI based predictions)

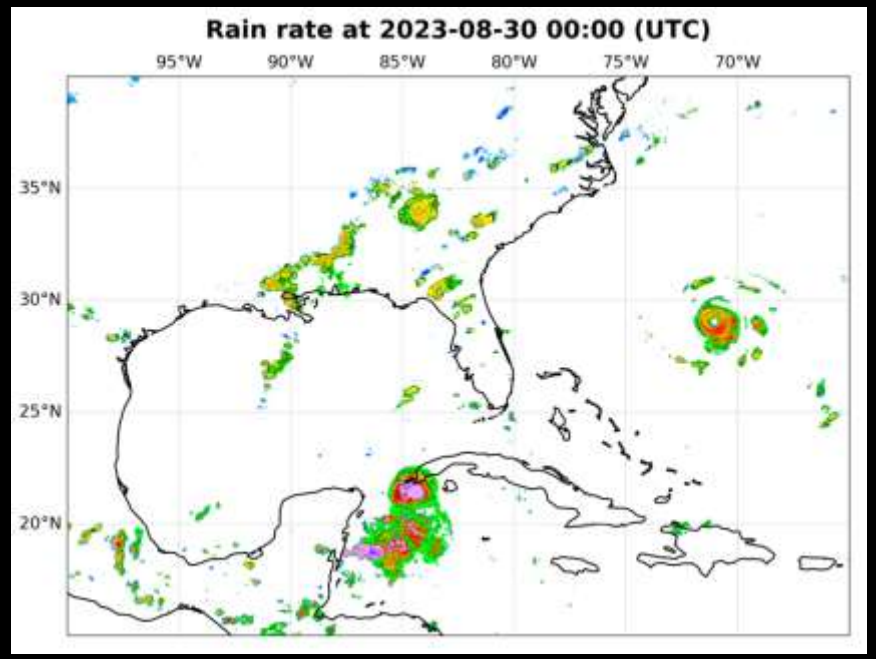
WeatheO_Rain

GOES: Geostationary Operational Environmental Satellite

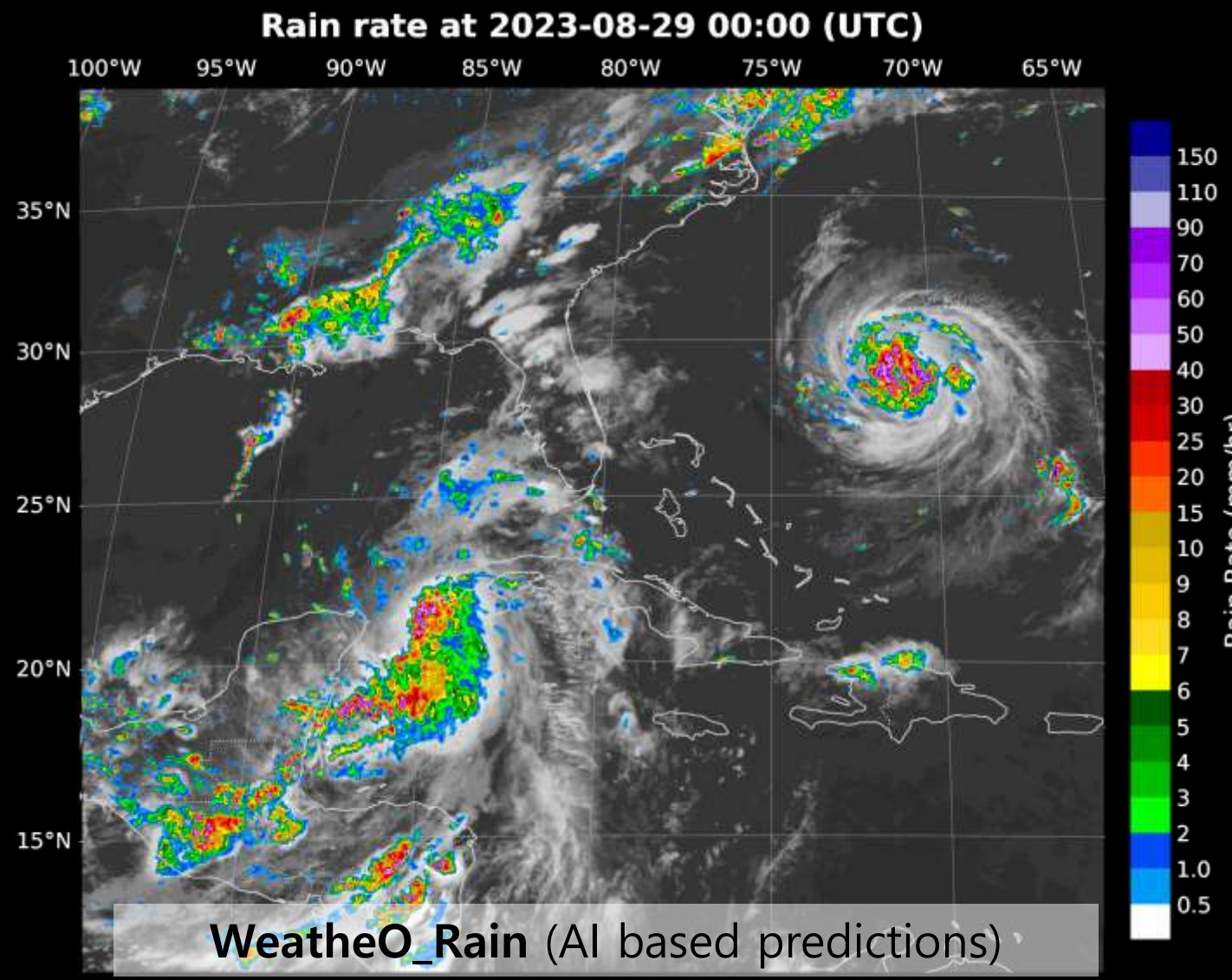
GOES – North/South America Coverage

MRRS Radar observations

GOES-16 rain rate products



Hurricane Idalia & Franklin Case



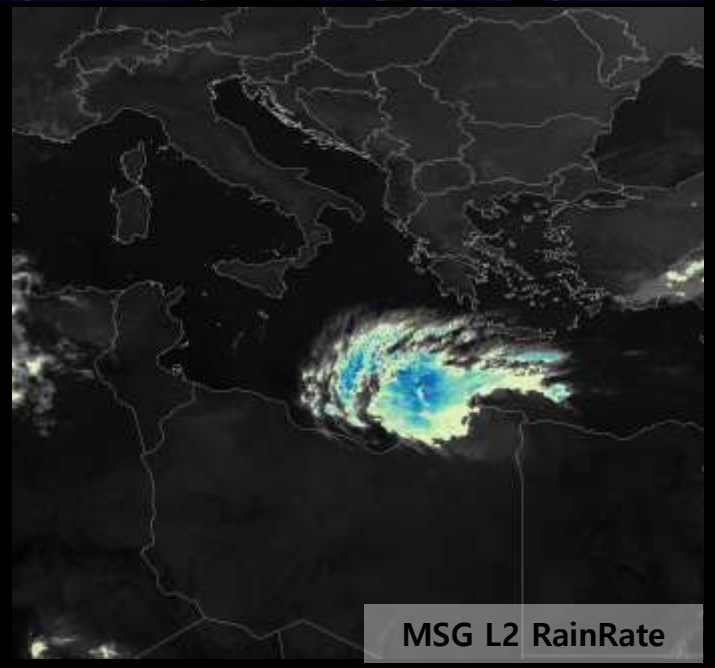
MSG: Meteosat Second Generation

WeatheO_Rain

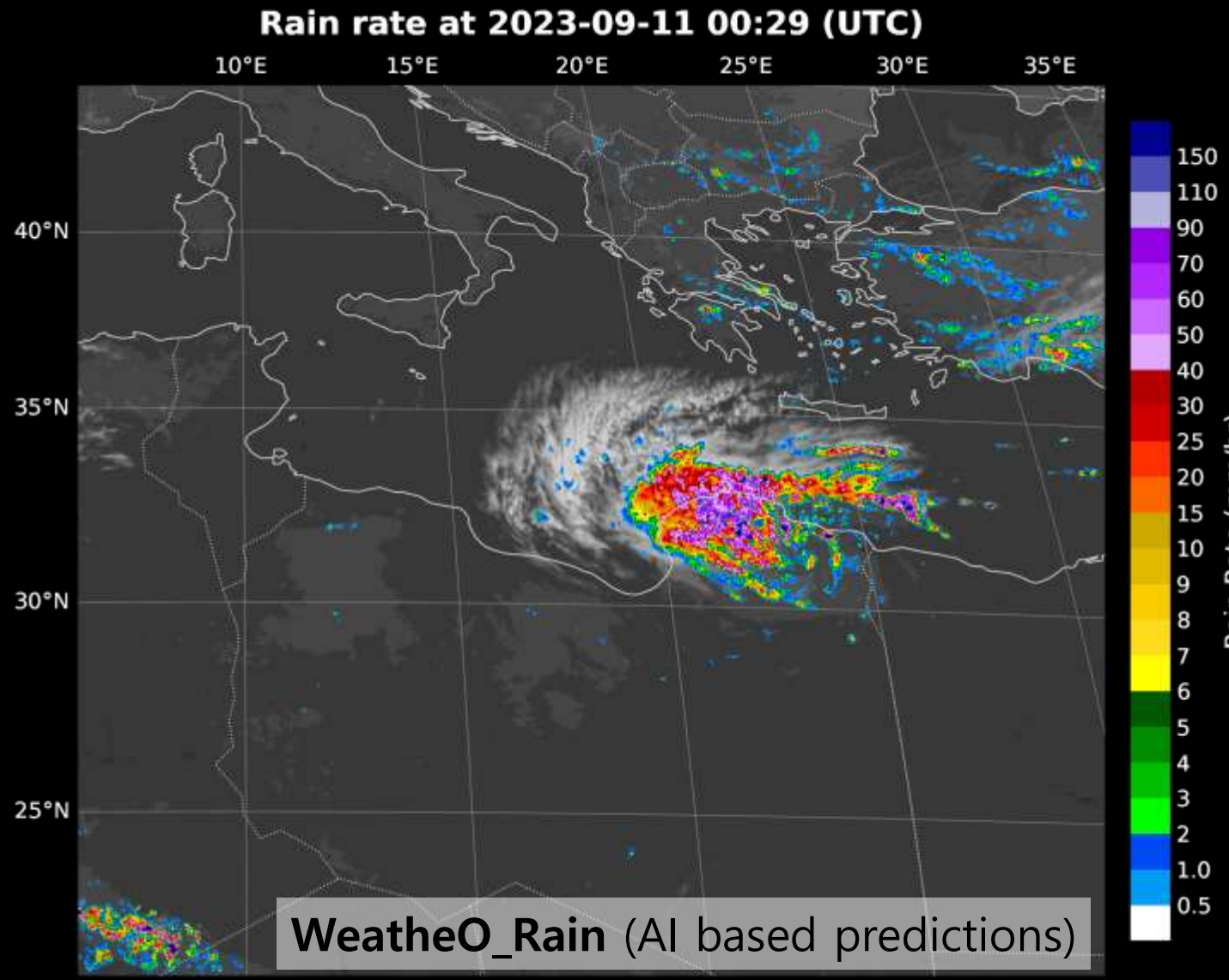
MSG – Europe & Africa Coverage

NO Radar observations

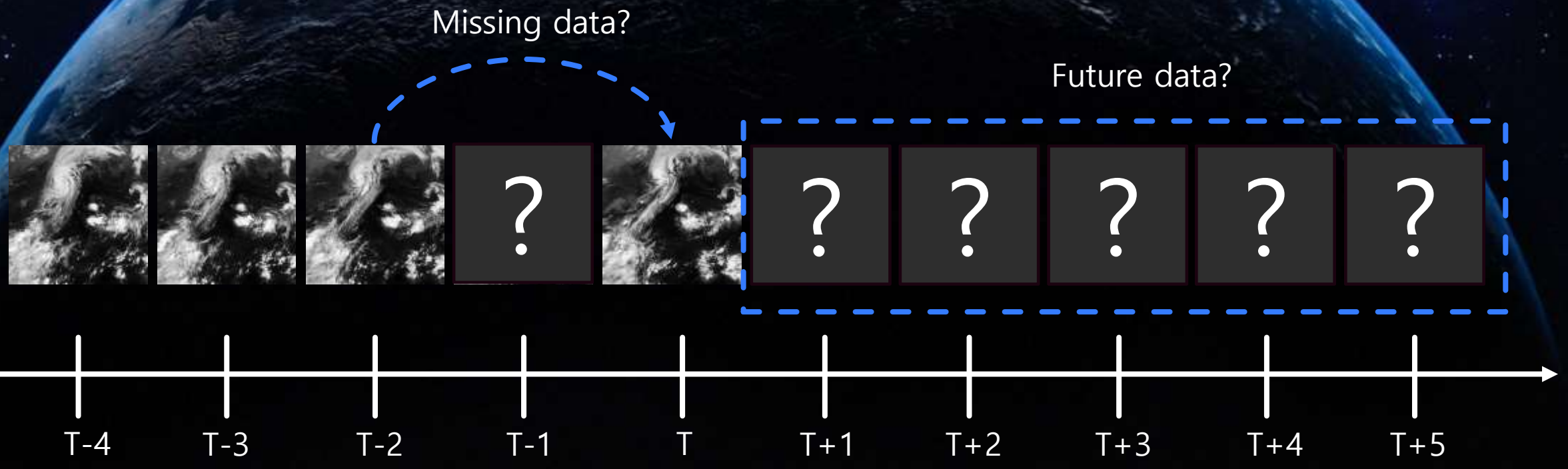
MSG rain rate products



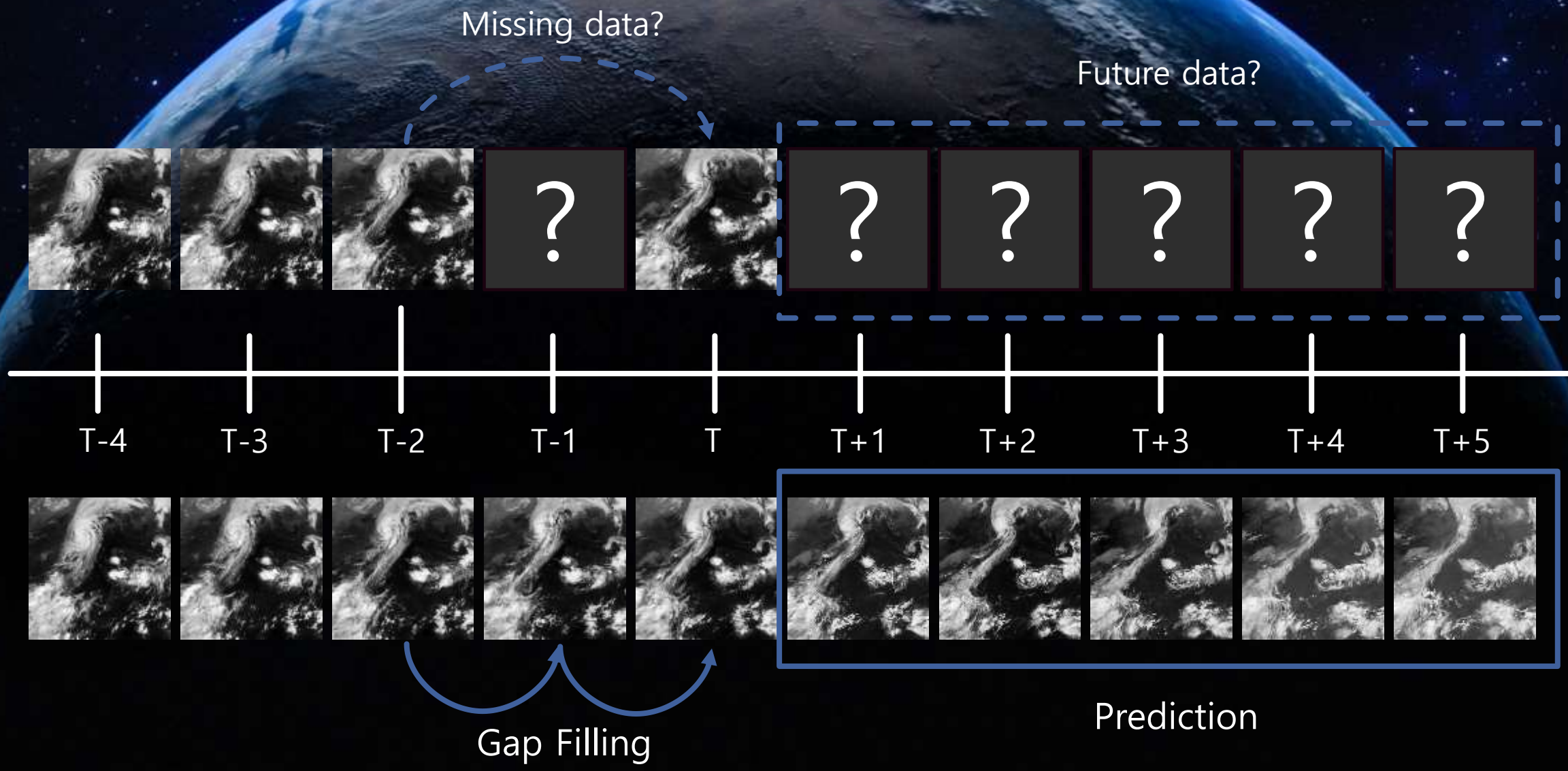
Mediterranean Hurricane Daniel Case



Gap Filling in weather data time series



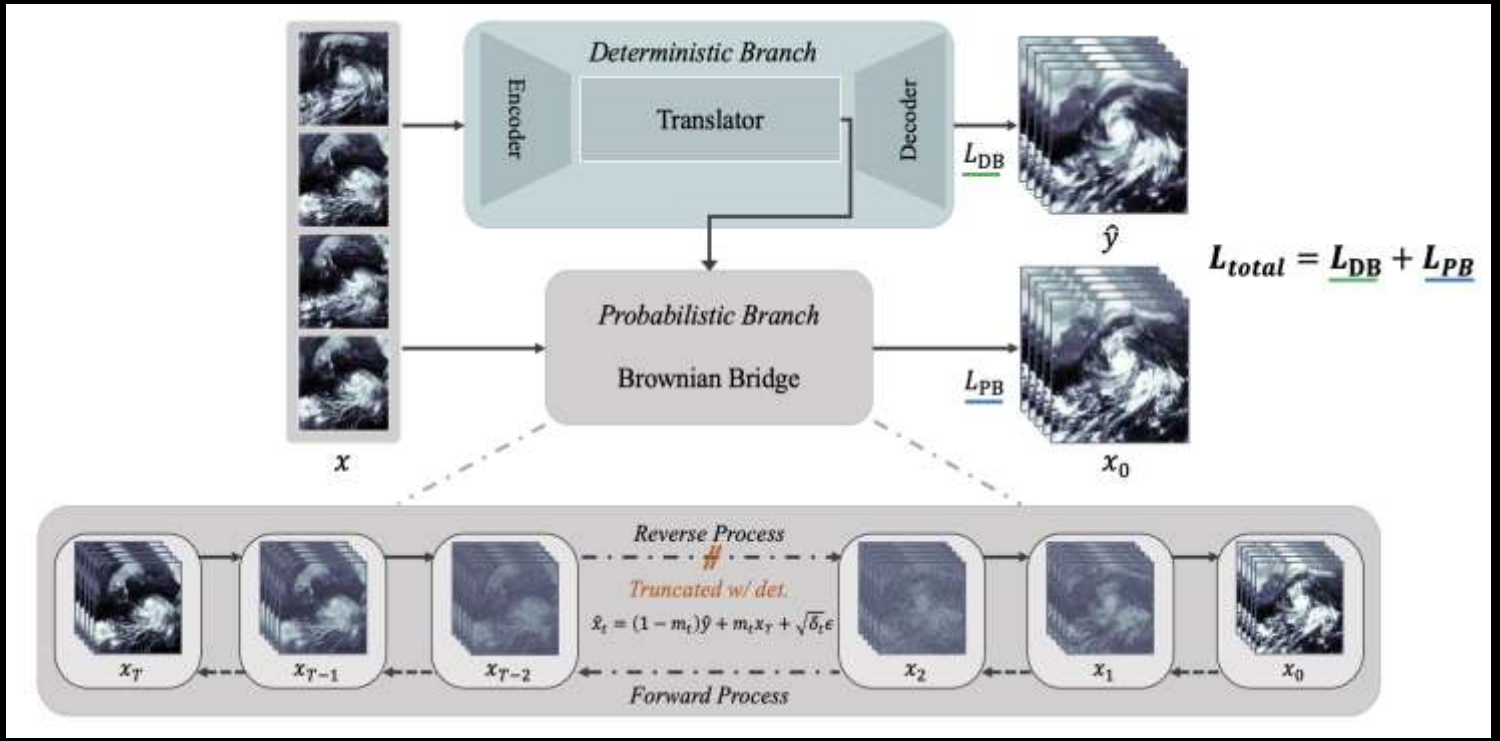
Gap Filling in weather data time series

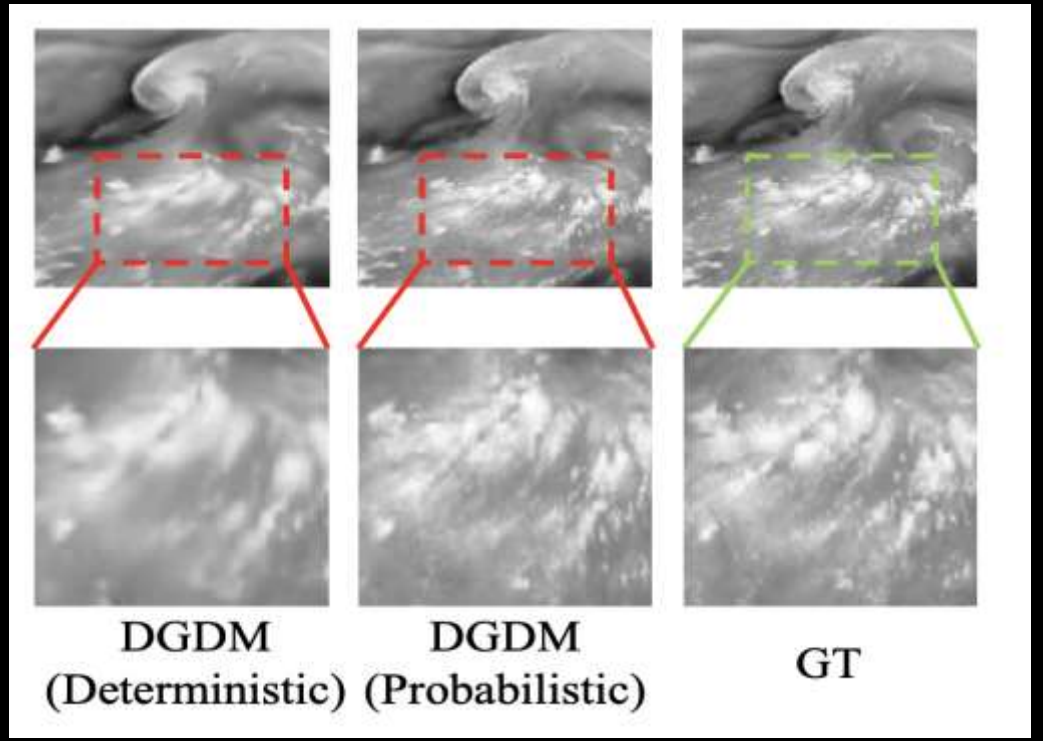


WeatheO_Cloud

Deterministic Guidance Diffusion Model (DGDM)

- Yoon et al.(2023) suggested a diffusion-based weather forecasting model which combined with deterministic and probabilistic branches
- The first probabilistic model for weather satellite imagery forecasting

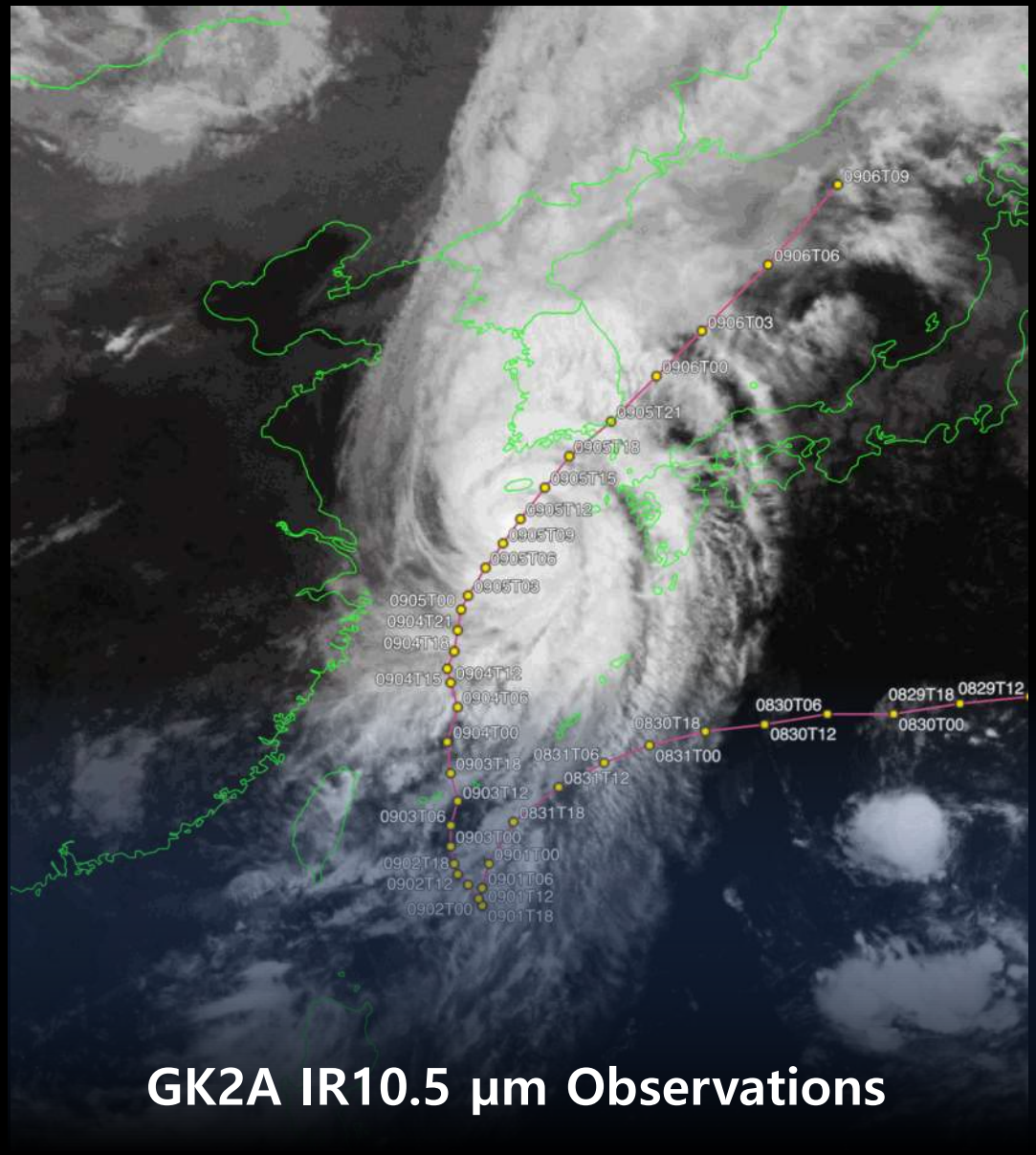




[6] Yoon, Donggeun, et al. "Deterministic Guidance Diffusion Model for Probabilistic Weather Forecasting." *arXiv preprint arXiv:2312.02819* (2023).

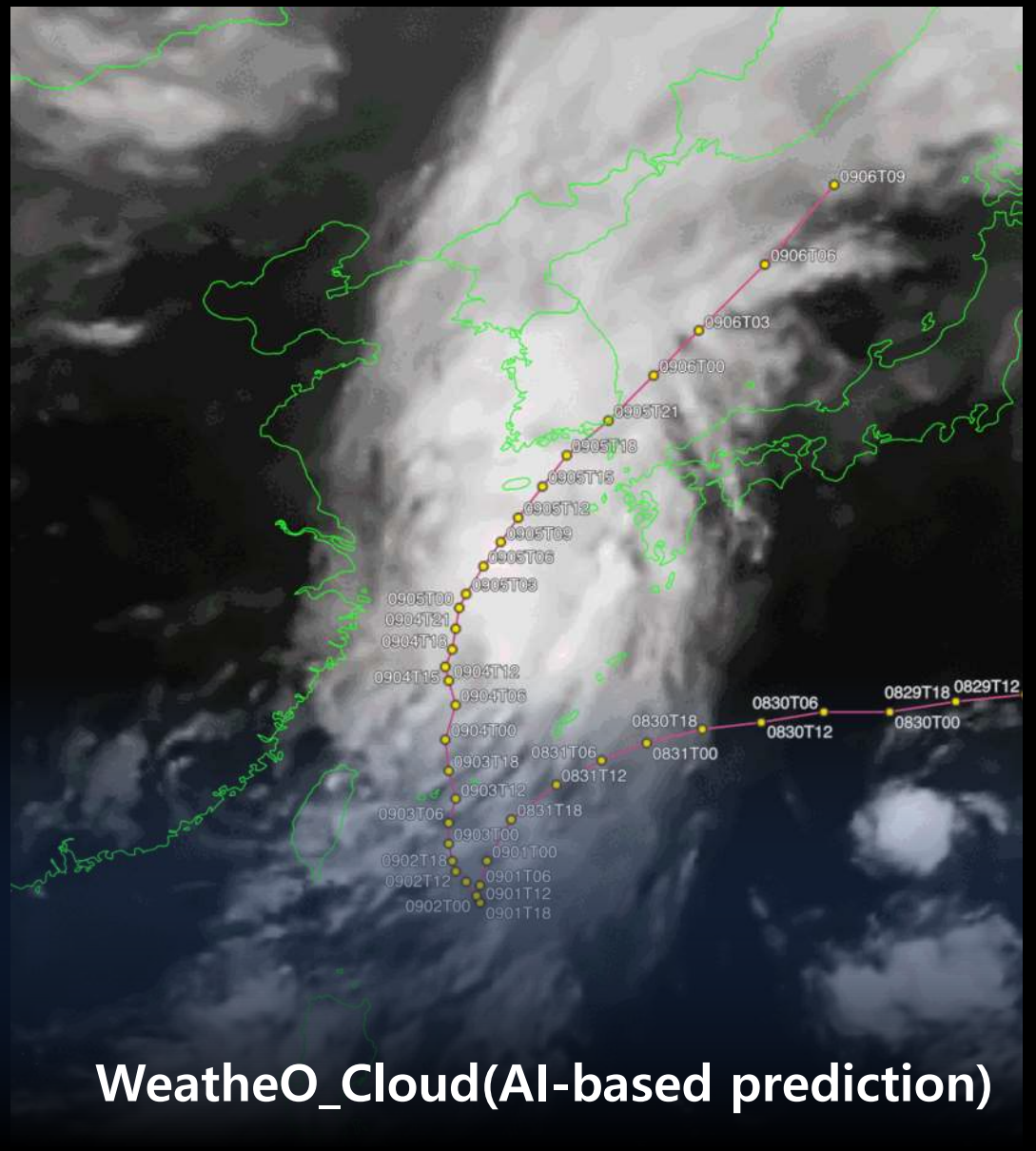
WeatheO_Cloud

Ground Truth



GK2A IR10.5 μm Observations

Forecasts of next 20 hours



WeatheO_Cloud(AI-based prediction)

WeatheO products with Weather Intelligence AI solution

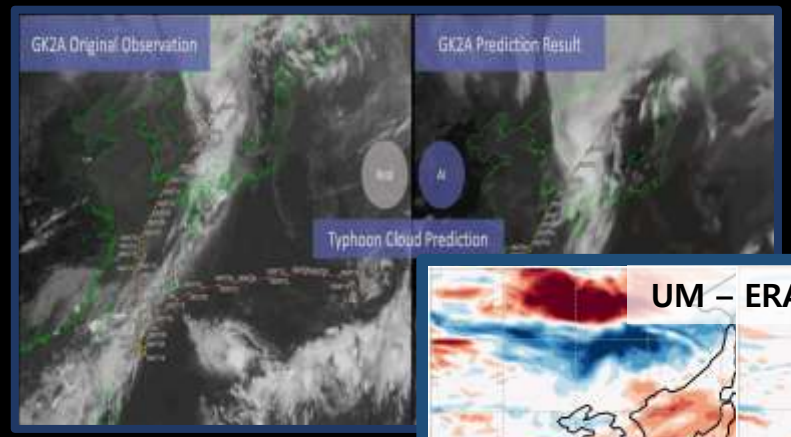
Forecasting clouds movement (**WeatheO_Cloud**)

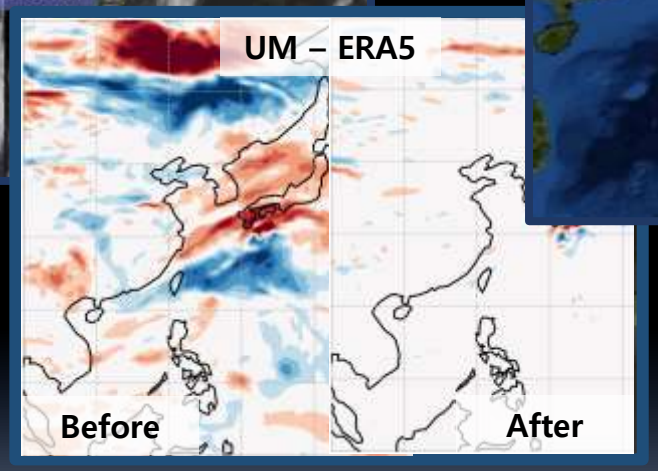
NWP forecast Bias correction

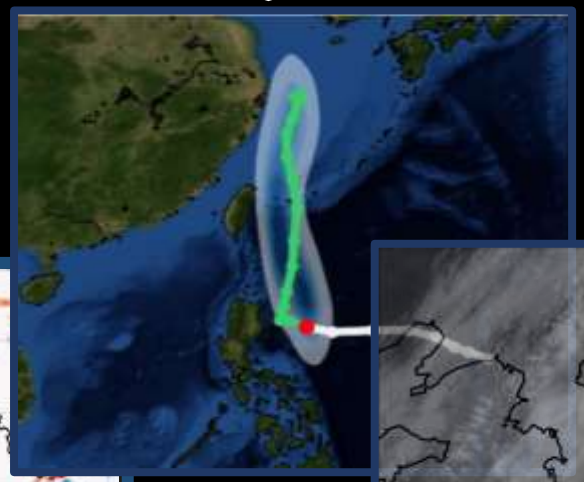
Typhoon trajectory prediction (**WeatheO_Storm**)

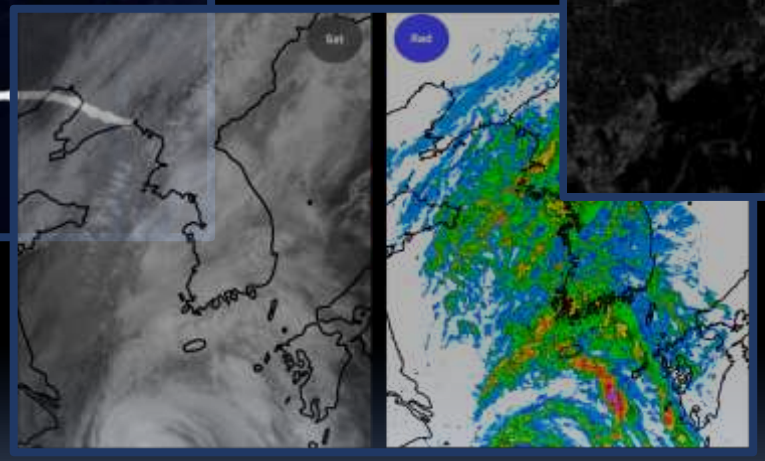
Monitoring rainfall (**WeatheO_Rain**)

Damage Assessment (**SAR2EO**)









Thank you for attention

doyikim@si-analytics.ai

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