

CMA plans for AI/ML exploitation and opportunities for coordination

Presented to CGMS-51 plenary
28 June, 2023, Tokyo

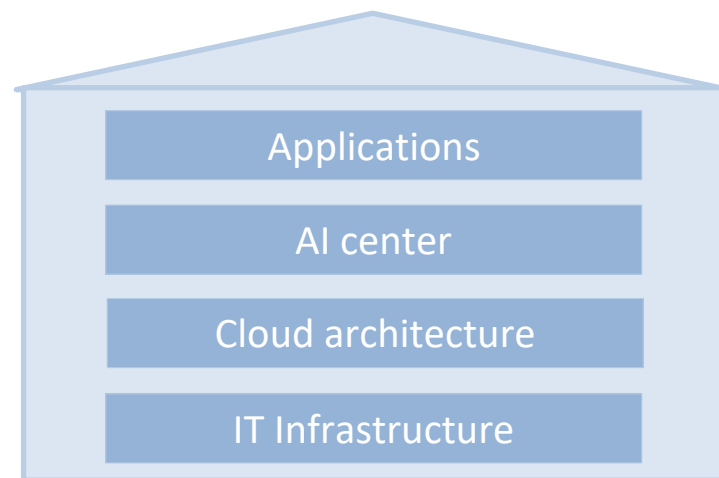
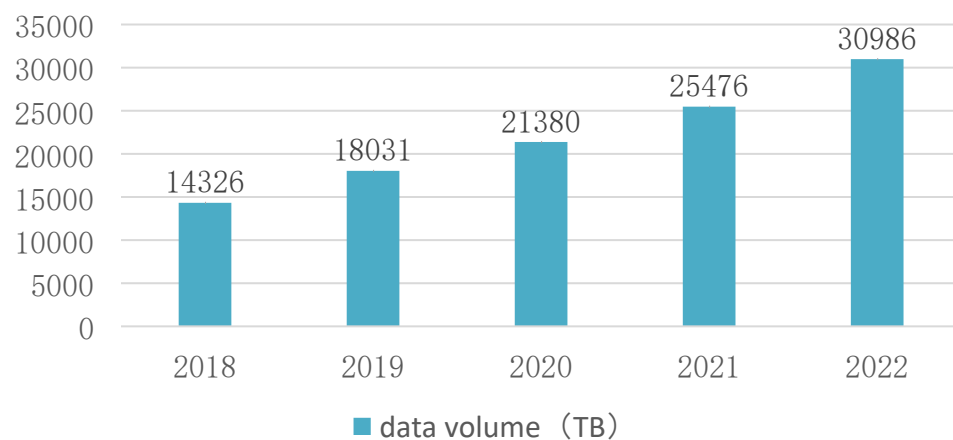
Outline

- **Background**
- **Applications**
- **Future prospects**

1. Background

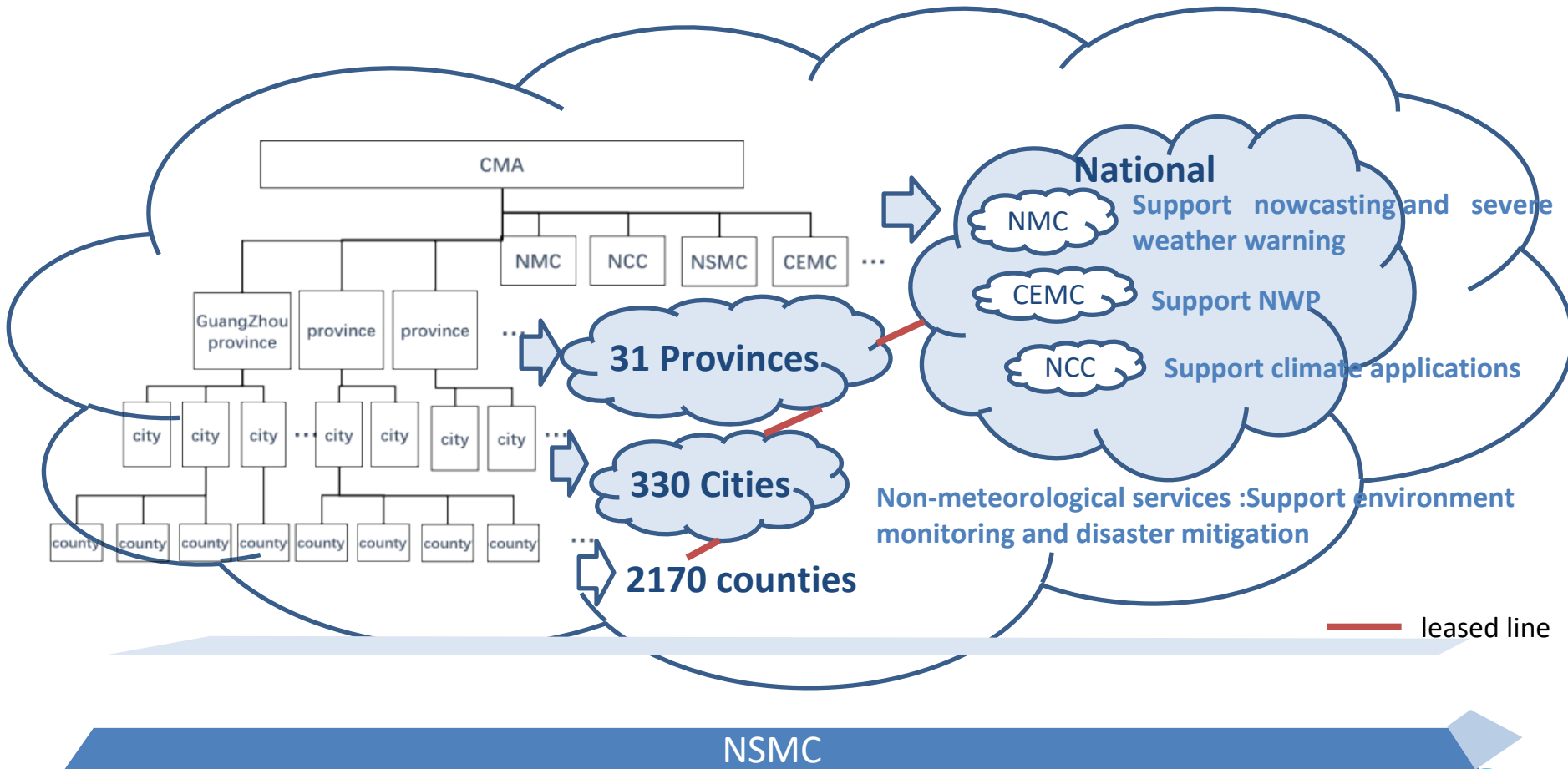


Cumulative archived data(TB)



1. Background

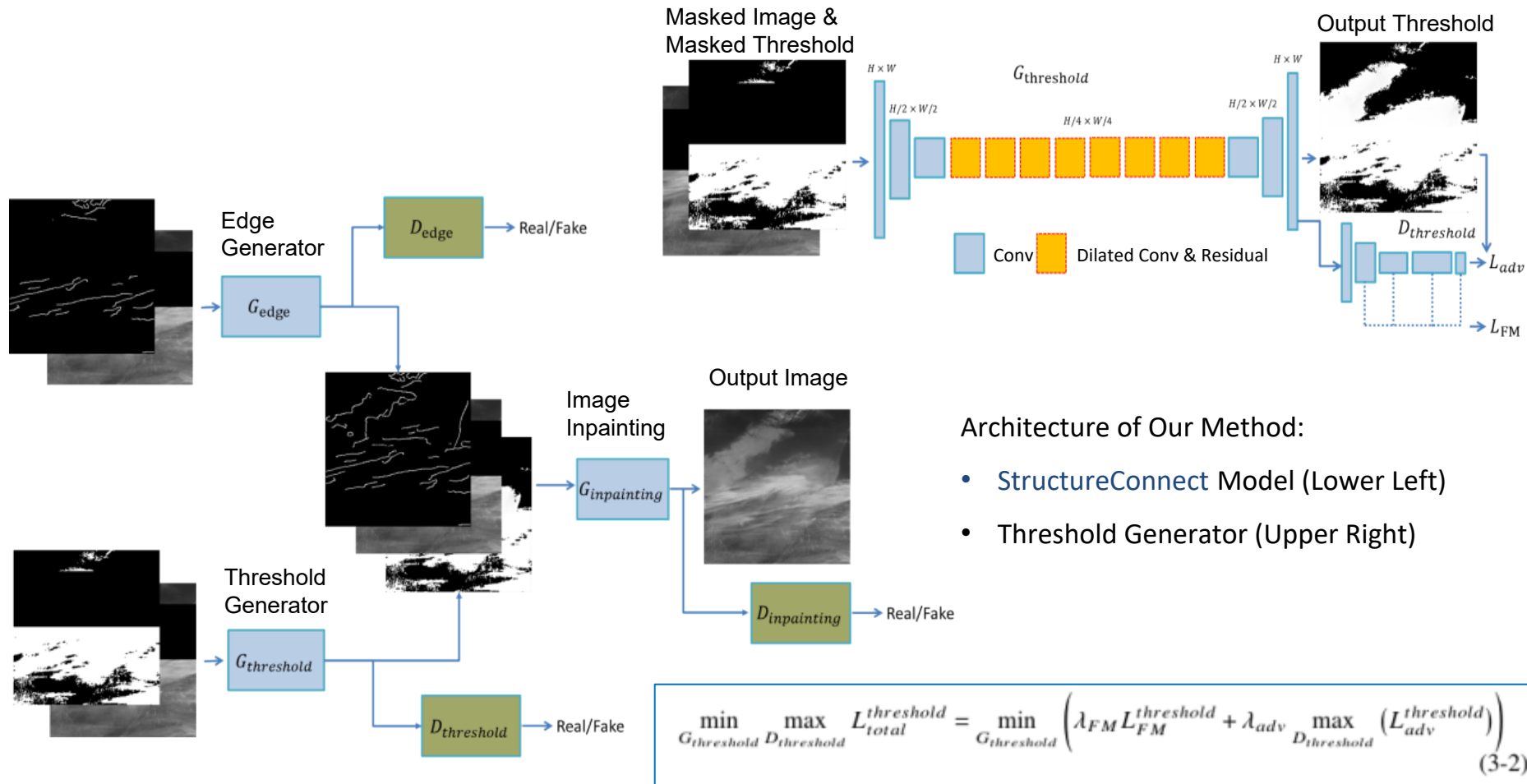
Purpose of AI/ML in NSMC: weather forecasting oriented



2.Applications: AI/ML technologies in all processing and utilization stages

1 Observation	2 Forecasting	3 Climate	4 Services
• Calibration • Navigation • Operation	• Image • Nowcasting • TC forecasting •	• Climate forecasting • Climate Change(SST, Sea ice, precipitation, cloud, etc.) • Climate data sets • Greenhouse Gas Watch	• Early Warnings for All • Data sharing • Applications • Etc.

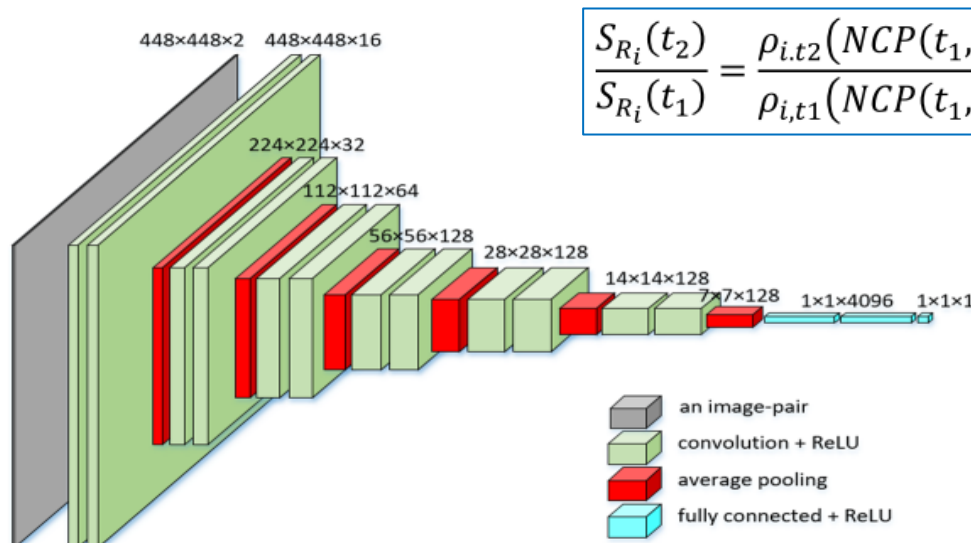
1) Observation: Satellite Image Inpainting



1) Observation: Calibration

Relative Radiometric Calibration Based on Convolutional Neural Network

A CNN regression model is trained to directly estimate the ratio of the relative sensitivity coefficient given an image pair, which bypasses the no-change pixels (NCPs) detection step in conventional methods.

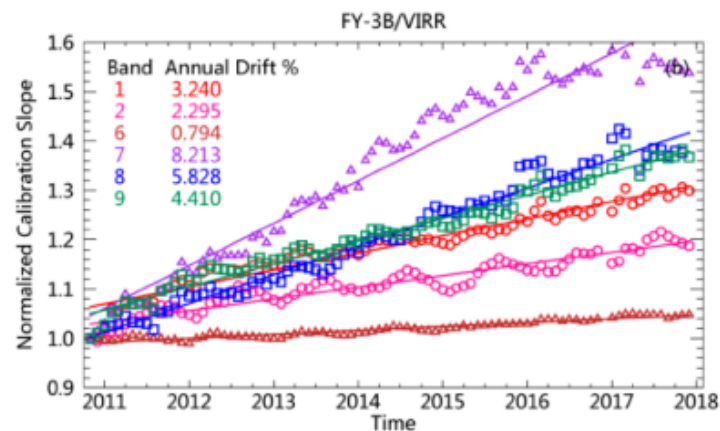


$$\frac{S_{R_i}(t_2)}{S_{R_i}(t_1)} = \frac{\rho_{i,t2}(NCP(t_1, t_2))}{\rho_{i,t1}(NCP(t_1, t_2))} = m_i(t_1, t_2)$$

Architecture of CNN Regression Model .

Input: A satellite image pair.

Output: The ratio of the relative sensitivity coefficient.

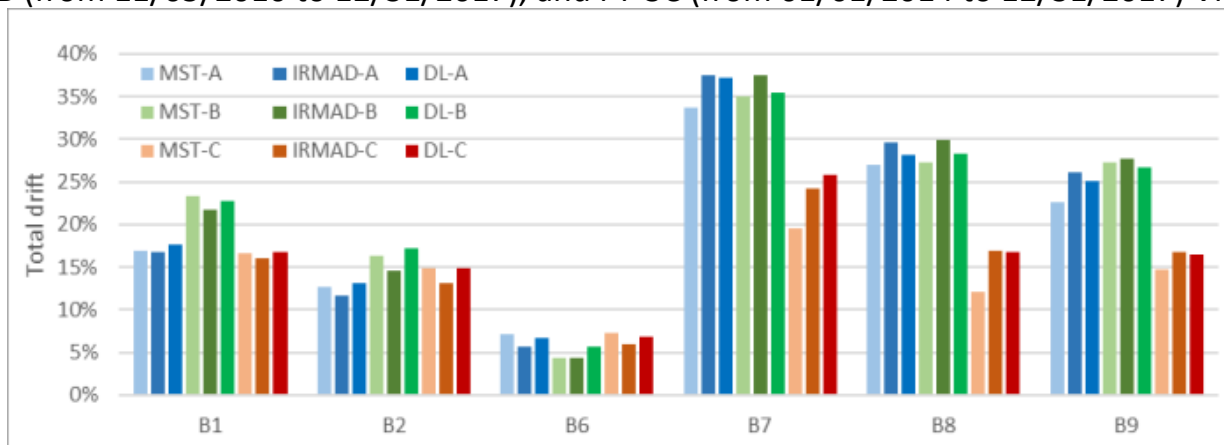


Select the section with relatively linear variation from the multi site calibration results of FY-3B as the training data.

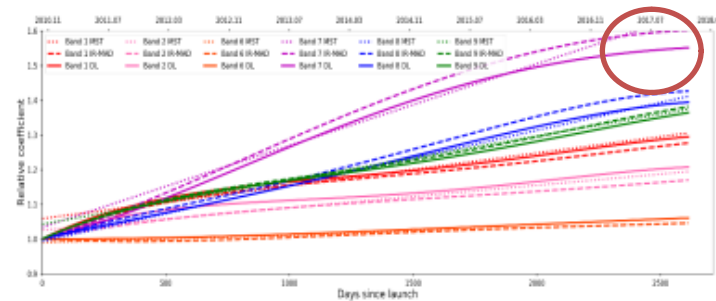
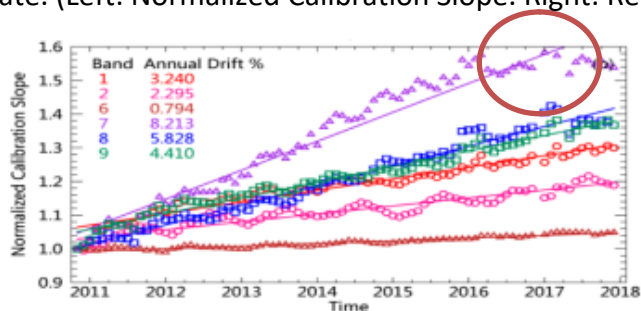
1) Observation: Calibration

Experimental Results

Comparison of total degradation rates estimated by MST, IR-MAD, and our method of FY-3A (from 01/01/2009 to 12/31/2014), FY-3B (from 11/05/2010 to 12/31/2017), and FY-3C (from 01/01/2014 to 12/31/2017) VIRRs.



The MST linear fitting results of channels 7 and 8 of FY-3B are significantly larger, while the results of deep learning methods are more accurate. (Left: Normalized Calibration Slope. Right: Relative sensitivity coefficient.)

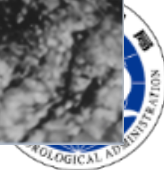
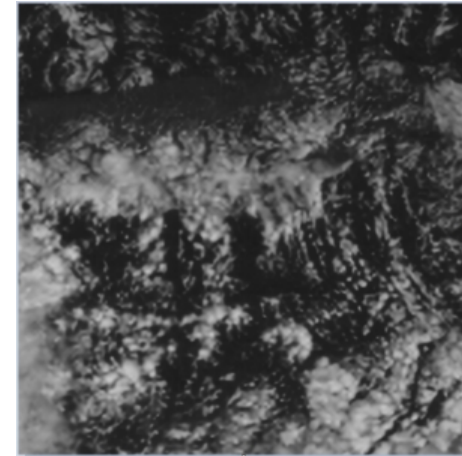
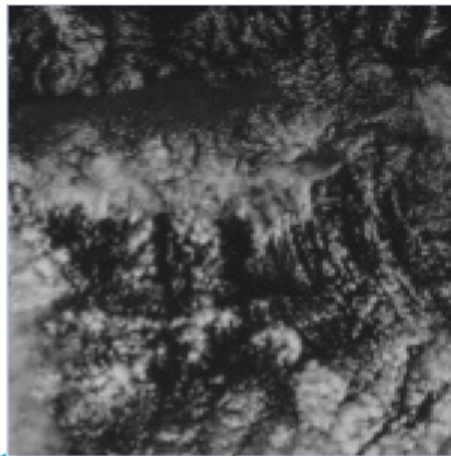
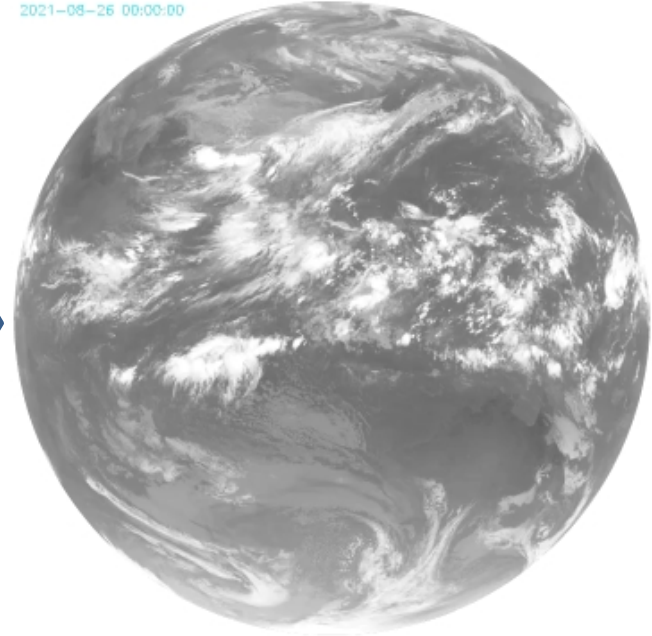
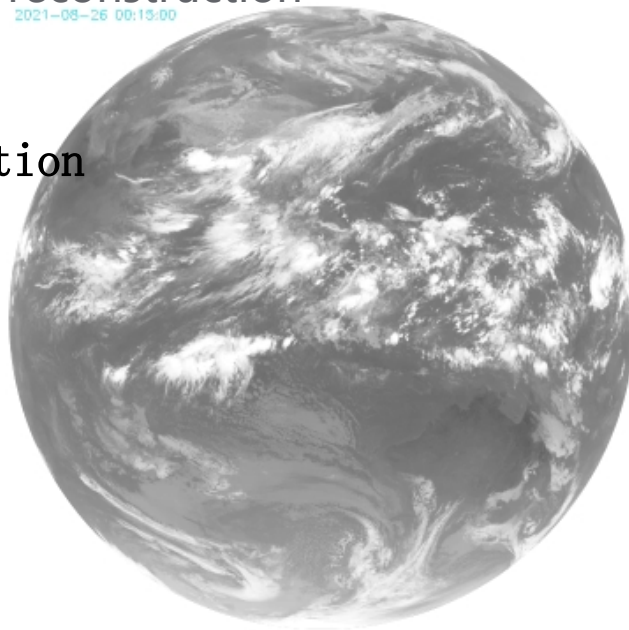


2) Forecasting: Image — one graph for weather forecast

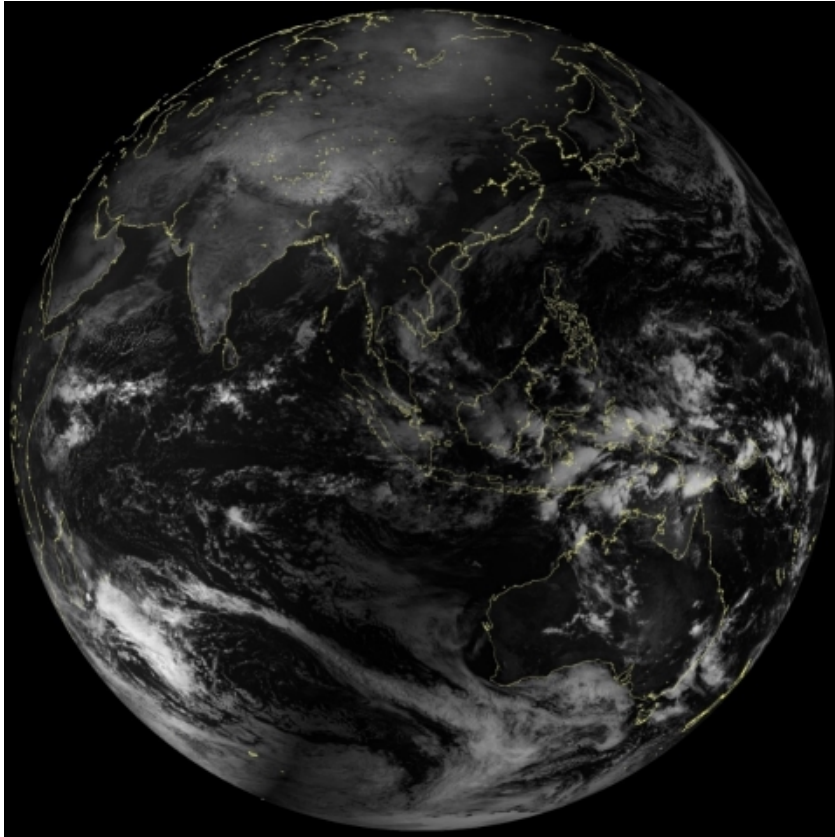
super-resolution reconstruction

2021-08-26 00:15:00

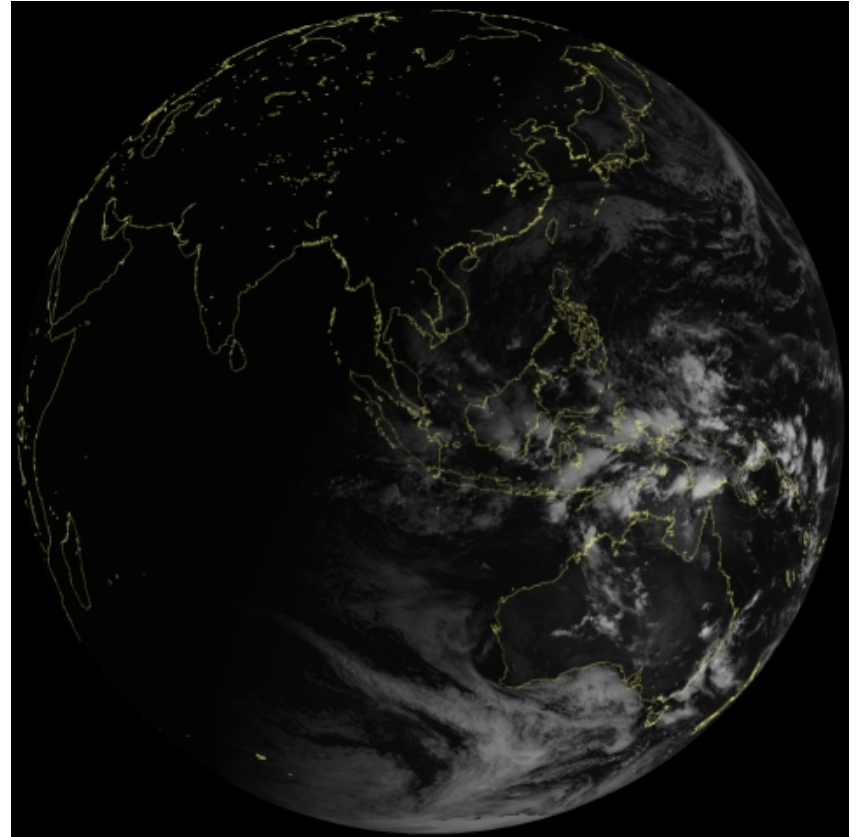
2021-08-26 00:00:00



2) Forecasting: Image — Visible Image generated by Infrared Image

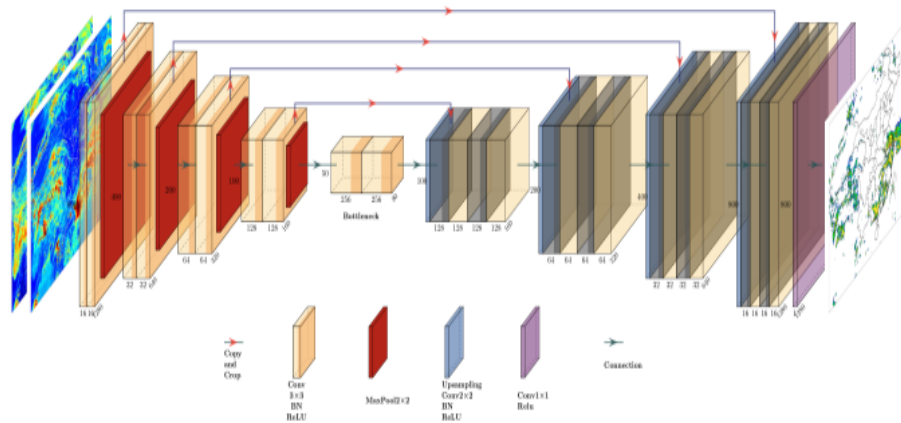


Generated graph

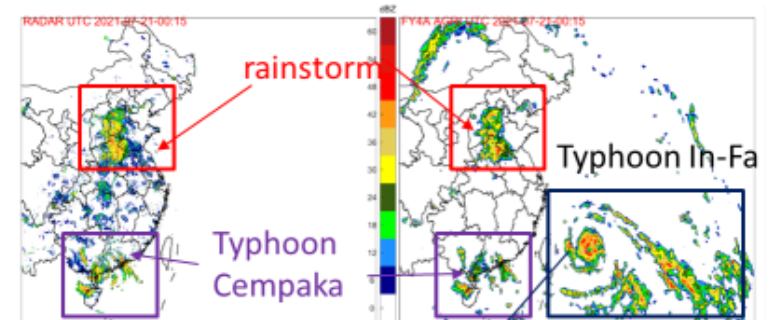


Real observation graph

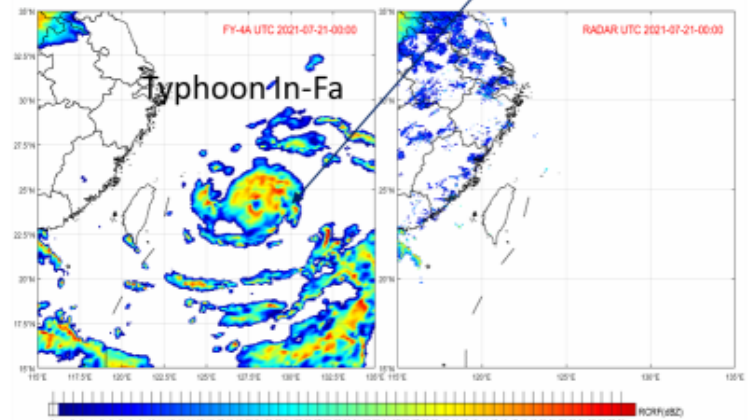
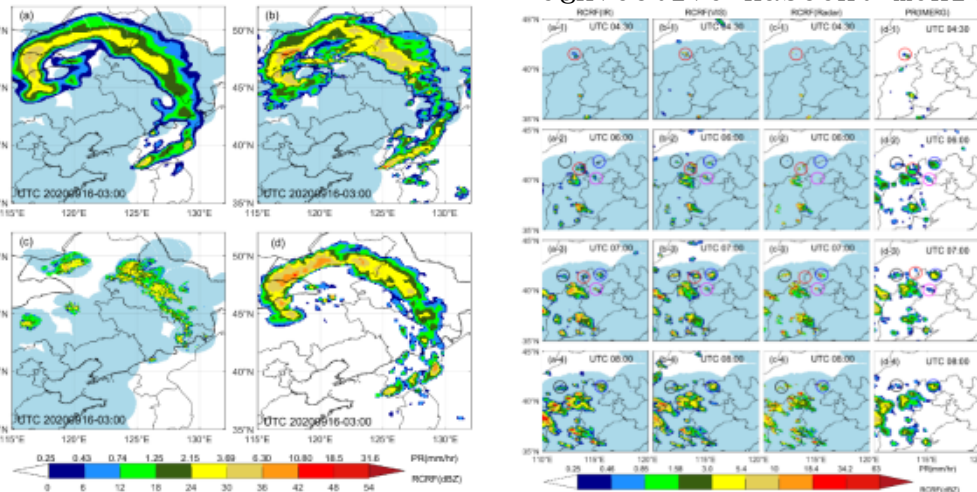
2) Forecasting: Image — Radar Simulation



Rainstorm and Double Typhoon Monitoring in Henan Province

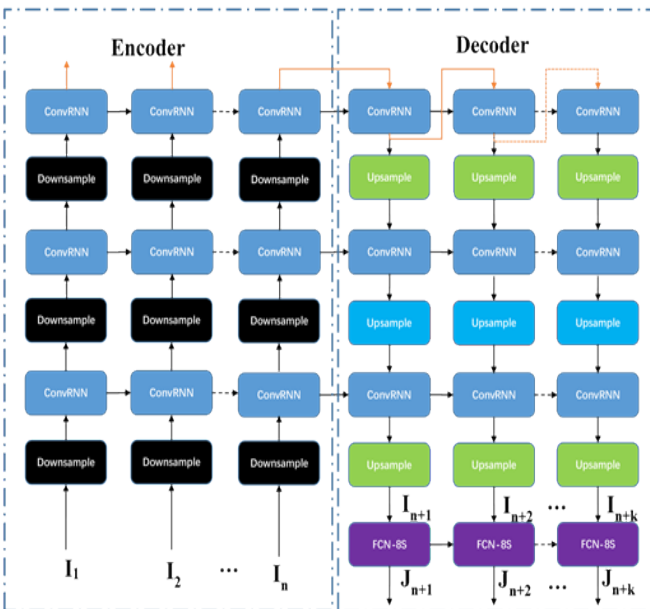


Northeast Cold Vortex Monitoring and Convective nascent monitoring

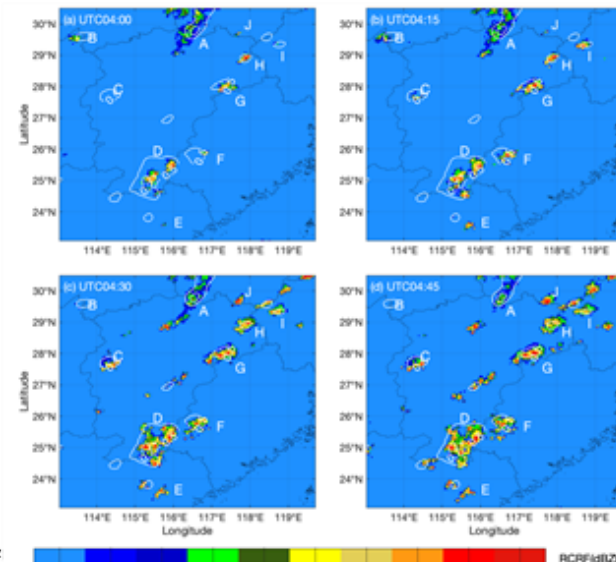
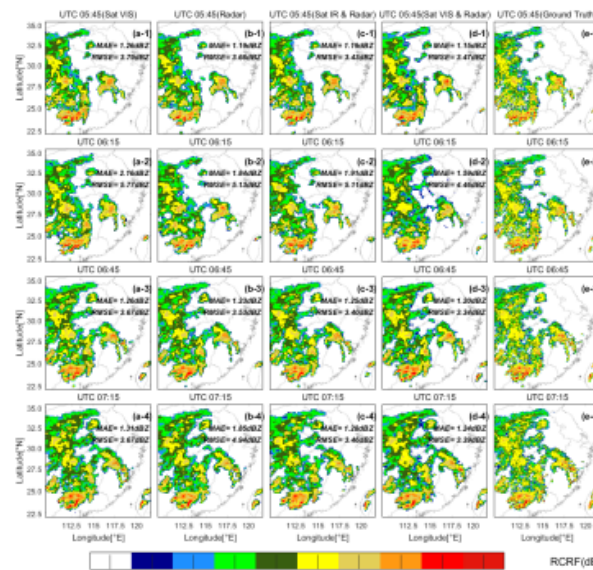


Sun, Fenglin, Bo Li, Min Min, and Danyu Qin. 2021. "Deep Learning-Based Radar Composite Reflectivity Factor Estimations from Fengyun-4A Geostationary Satellite Observations" Remote Sensing 13, no. 11: 2229.

2) Forecasting: Nowcasting—0-1h nowcasting integrating AGRI and radar



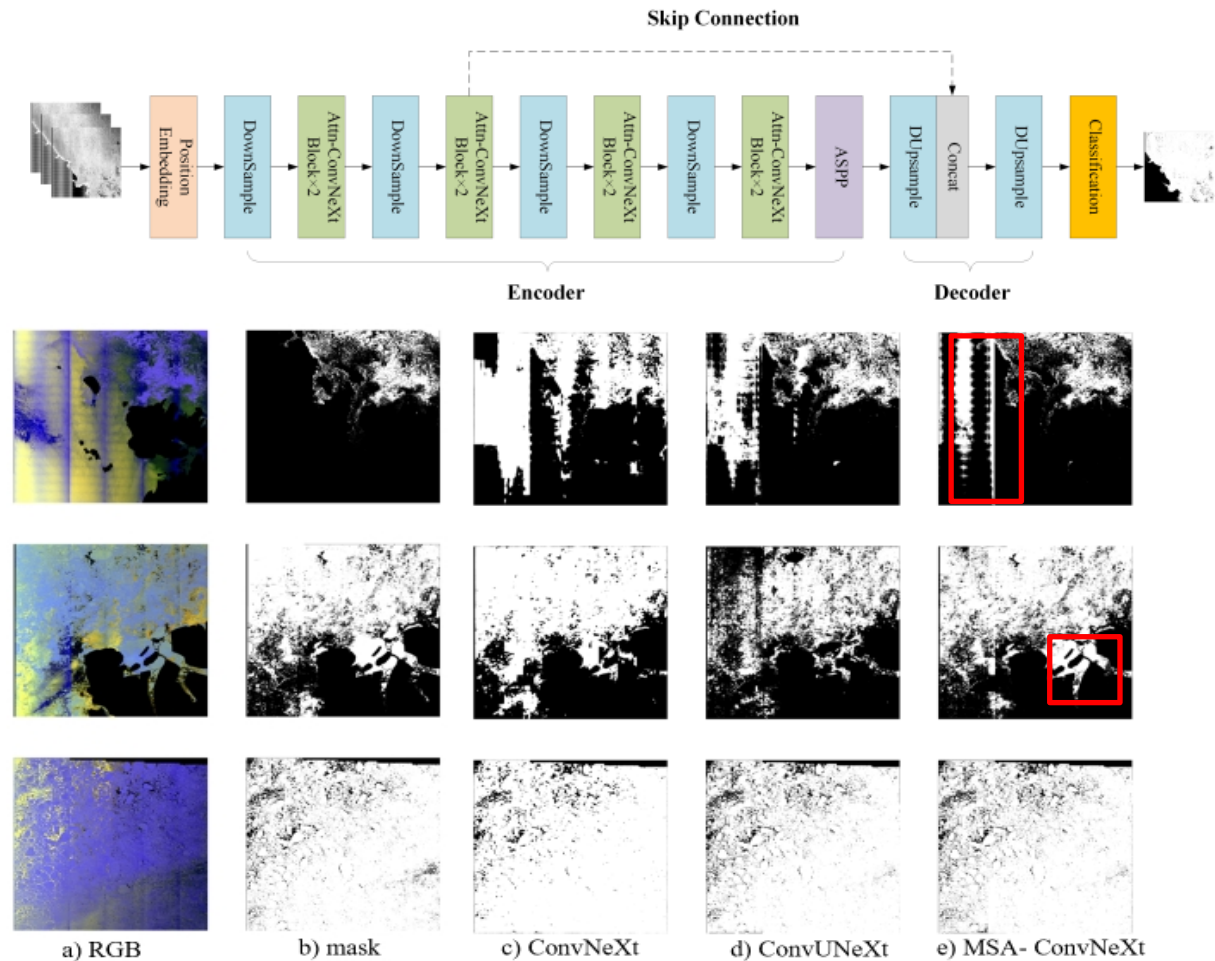
Extrapolation of radar reflectivity factor for active early warning



3) Climate: Sea Ice

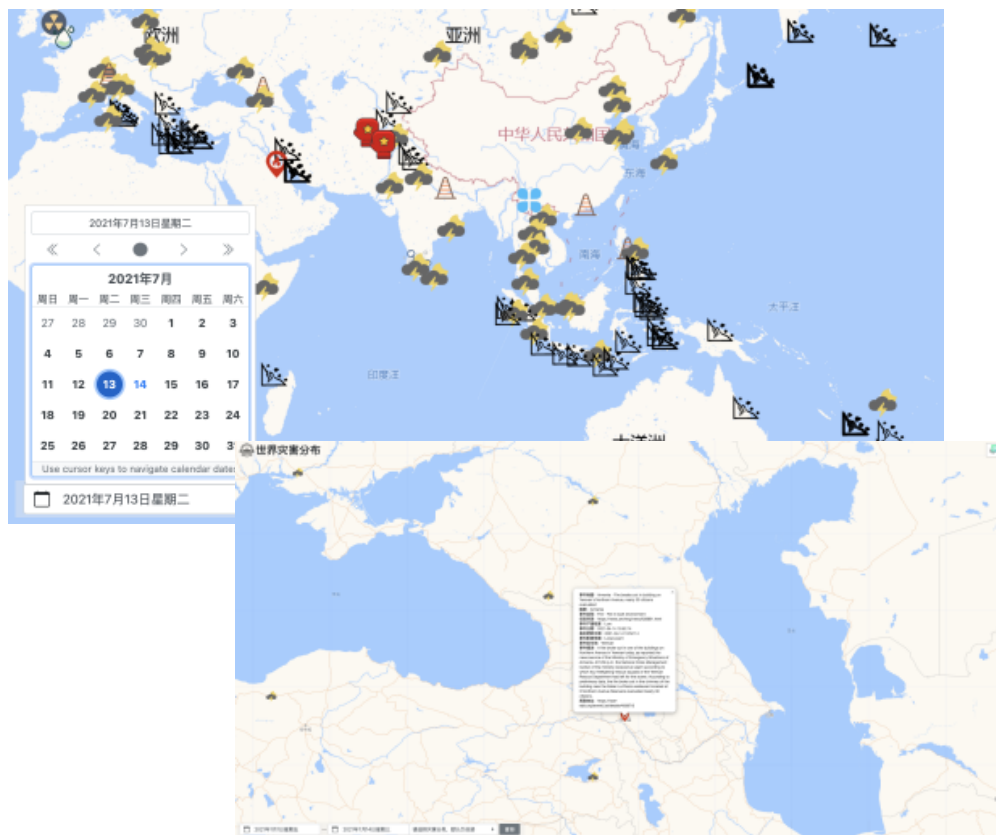


Multi-Scale Attention ConvNeXt (MSA-ConvNeXt):



4) Service: Global Disaster Information

Disaster information



事件标题: Armenia - Fire breaks out in building on Yerevan's Northern Avenue, nearly 30 citizens evacuated

国家: Armenia

事件类别: Fire - Fire in built environment

信息来源: <https://news.am/eng/news/638891.html>

事件严重程度: Low

事件日期: 2021-04-14 19:52:14

最后更新日期: 2021-04-14 19:52:14

事件影响范围: Local event

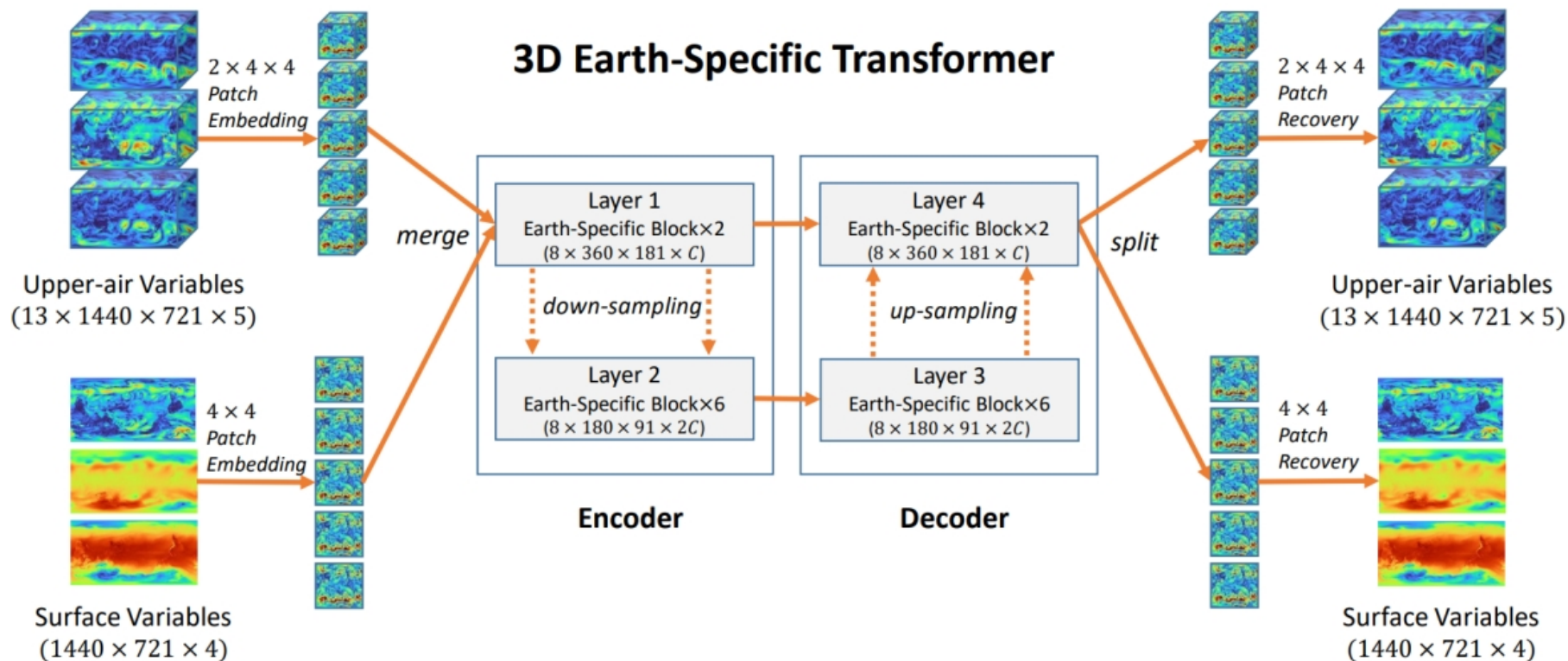
事件发生地: Yerevan

事件描述: A fire broke out in one of the buildings on Northern Avenue in Yerevan today, as reported the news service of the Ministry of Emergency Situations of Armenia. At 5:56 p.m. the National Crisis Management Center of the ministry received an alarm according to which four firefighting-rescue squads of the Yerevan Rescue Department had left for the scene. According to preliminary data, the fire broke out in the chimney of the building near the Italian La Piazza restaurant located at 5 Northern Avenue. Rescuers evacuated nearly 30 citizens.

爬取地址: <https://rsoe-edis.org/eventList/details/48387/0>

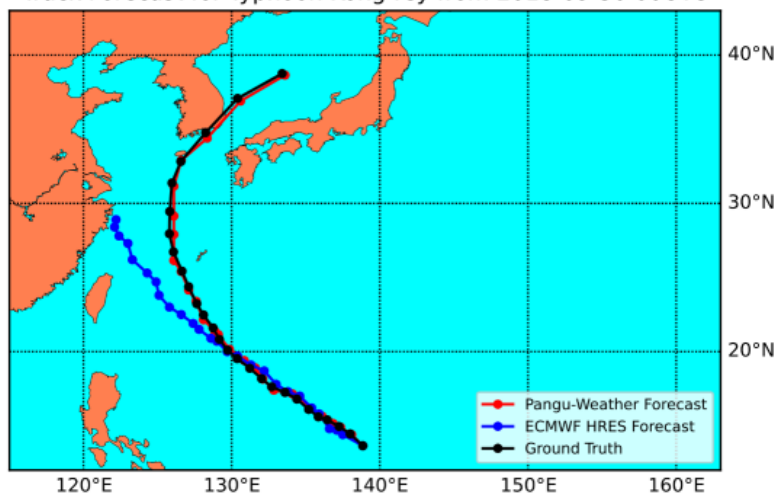
3. Future prospects

HUAWEI: Pangu-Weather AI Model

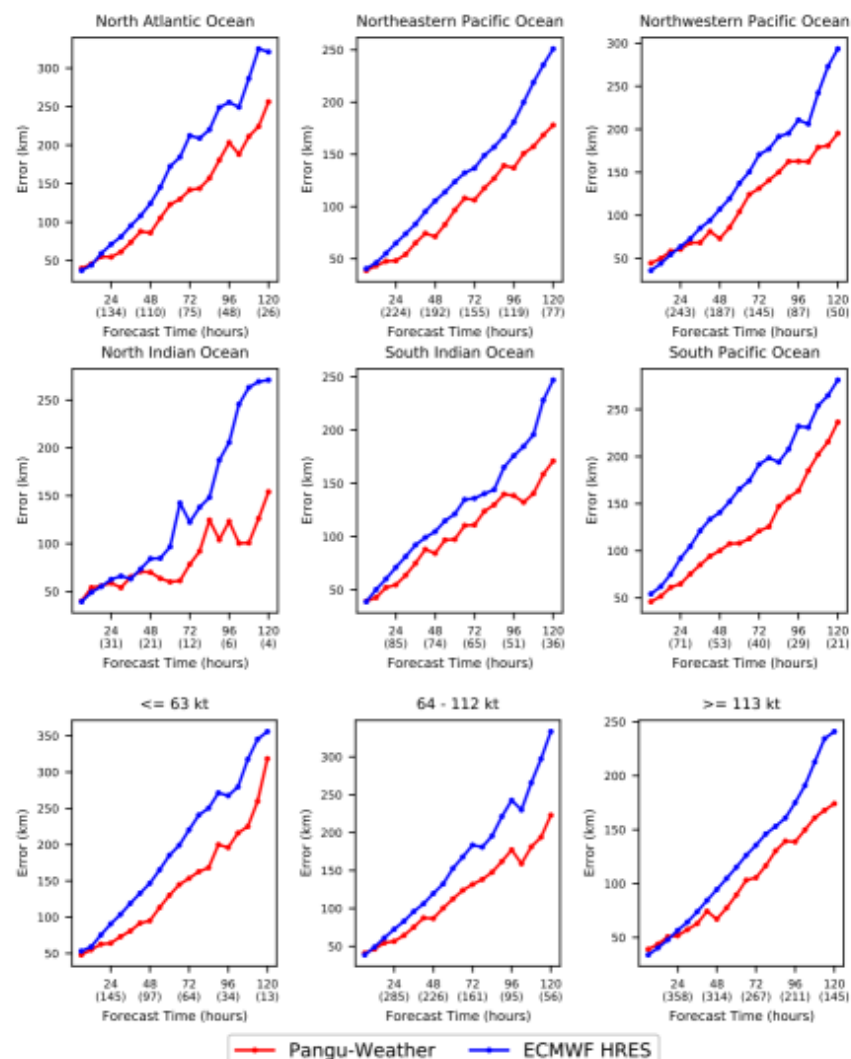
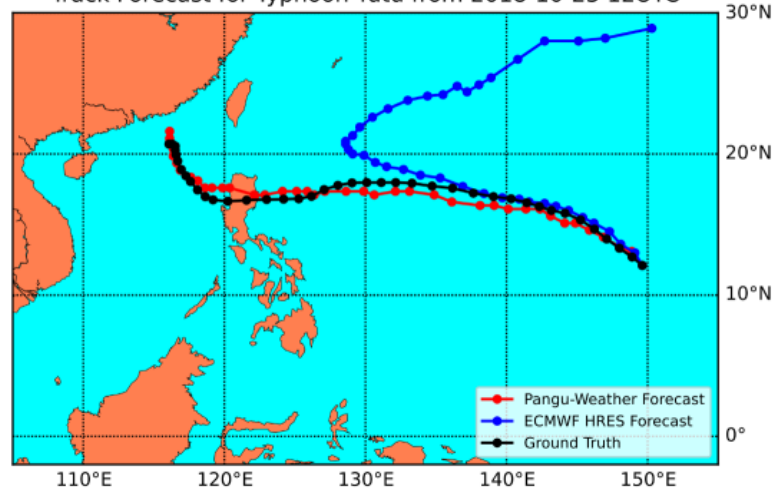


HUAWEI: Pangu-Weather AI Model — TC position forecast

Track Forecast for Typhoon Kong-rey from 2018-09-30 00UTC



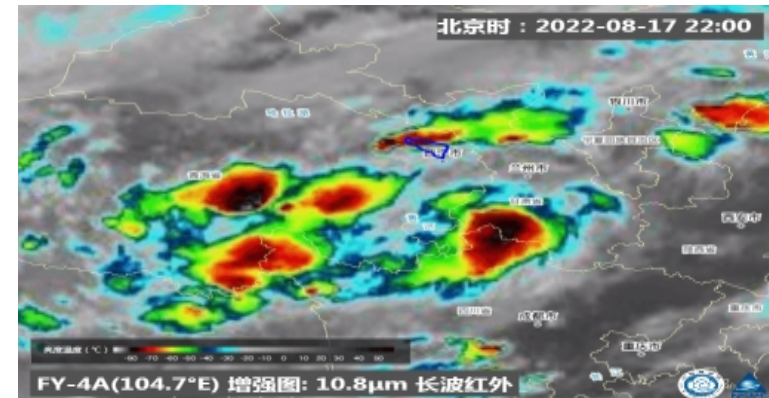
Track Forecast for Typhoon Yutu from 2018-10-23 12UTC



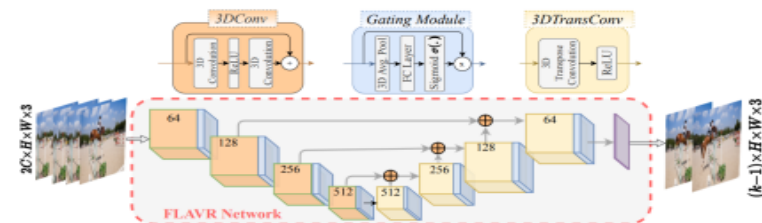
— Pangu-Weather — ECMWF HRES

- More data
- Stronger models
- More powerful hardware
- Better metrics
- More participants
- Quick implementation

Foundation meteorological model



Physical consistency and interpretability



Integrative aerospace



Thank you for your attention