

GNSS reflectometry data applications - Status in China

Presented to CGMS-52 plenary session item 5
XU NA, NSMC/CMA

Executive summary

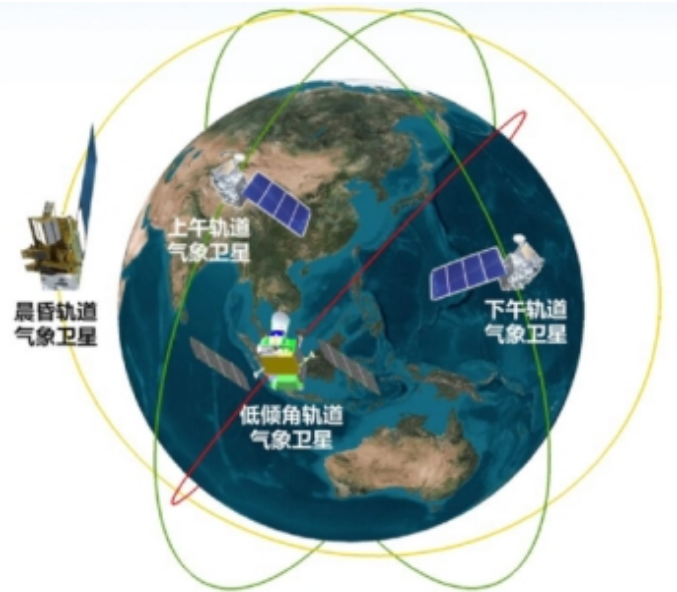
- GNSS observation instrument is a very promising technique , which can be easily carried on various satellite platforms. Beyond RO, GNSS reflectometry has experienced great growth in china.
- Each Fengyun-3 satellite is equipped with GNSS remote sensing instruments (GNOS), and since FY-3E, each satellite has both RO and reflectometry.
- GNSS observation also has a good development in commercial satellites, most of them both have RO and reflection observation.
- The application of GNSS reflectometries in China basically focus on NWP supporting, ocean, land and cryosphere researches.

Main GNSS-R Constellations

- Three main constellations, including FY-3, Yunyao, Tianmu.

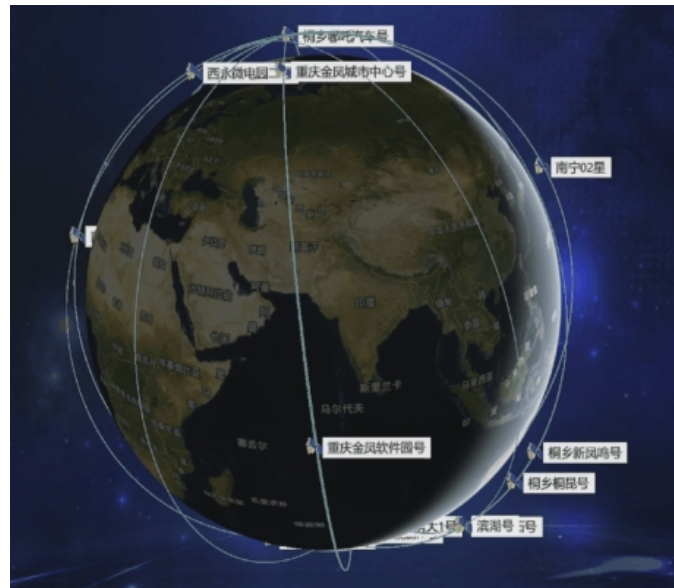
FengYun GNSS-R Constellation:

3 satellites in orbit
3 orbital planes (EM, AM, RM)



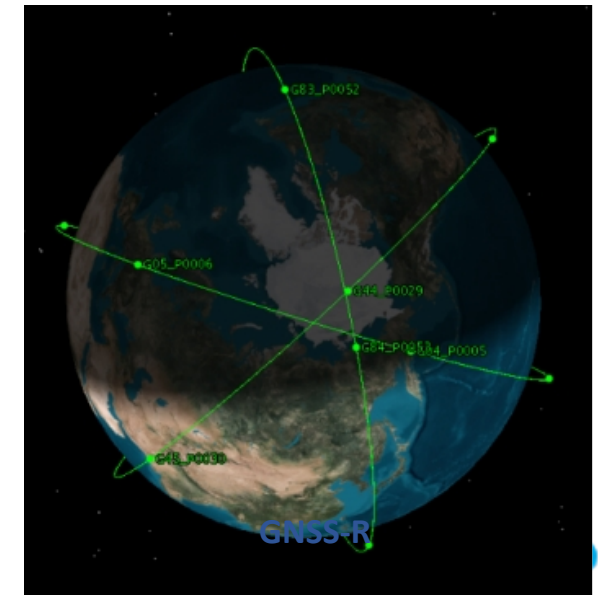
Tianmu GNSS-R Constellation:

23 satellites in orbit
26,000 atmospheric profiles data daily



Yunyao GNSS-R Constellation:

97° inclination
3 orbital planes 6 satellites

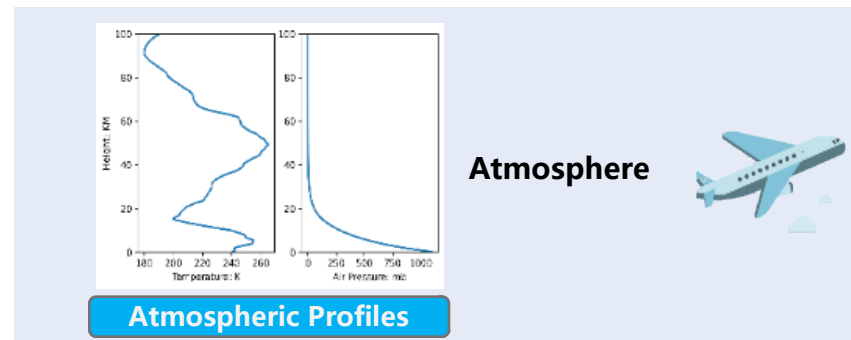


Products and Application

- The operational products cover three crucial hydrological variables, i.e., ocean winds, soil moisture, and ice.

Products

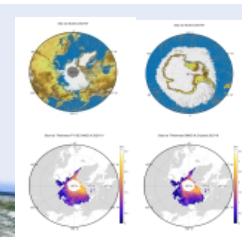
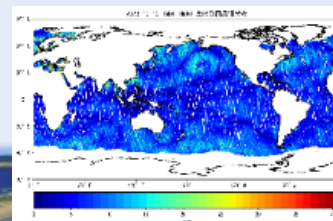
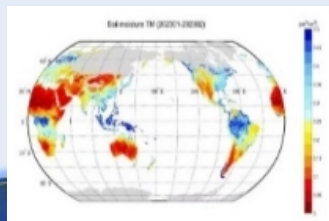
Basic elements
Sea surface wind speed
Effective wave height
sea ice identification
Sea Surface Height
Soil moisture
Flood inundation extent
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Applications

- ✓ High-precision numerical weather prediction
- ✓ Maritime meteorological navigation
- ✓ Precision aviation weather services
- ✓ Smart agriculture
- ✓ Renewable energy weather services
- ✓ Customized commercial services
-

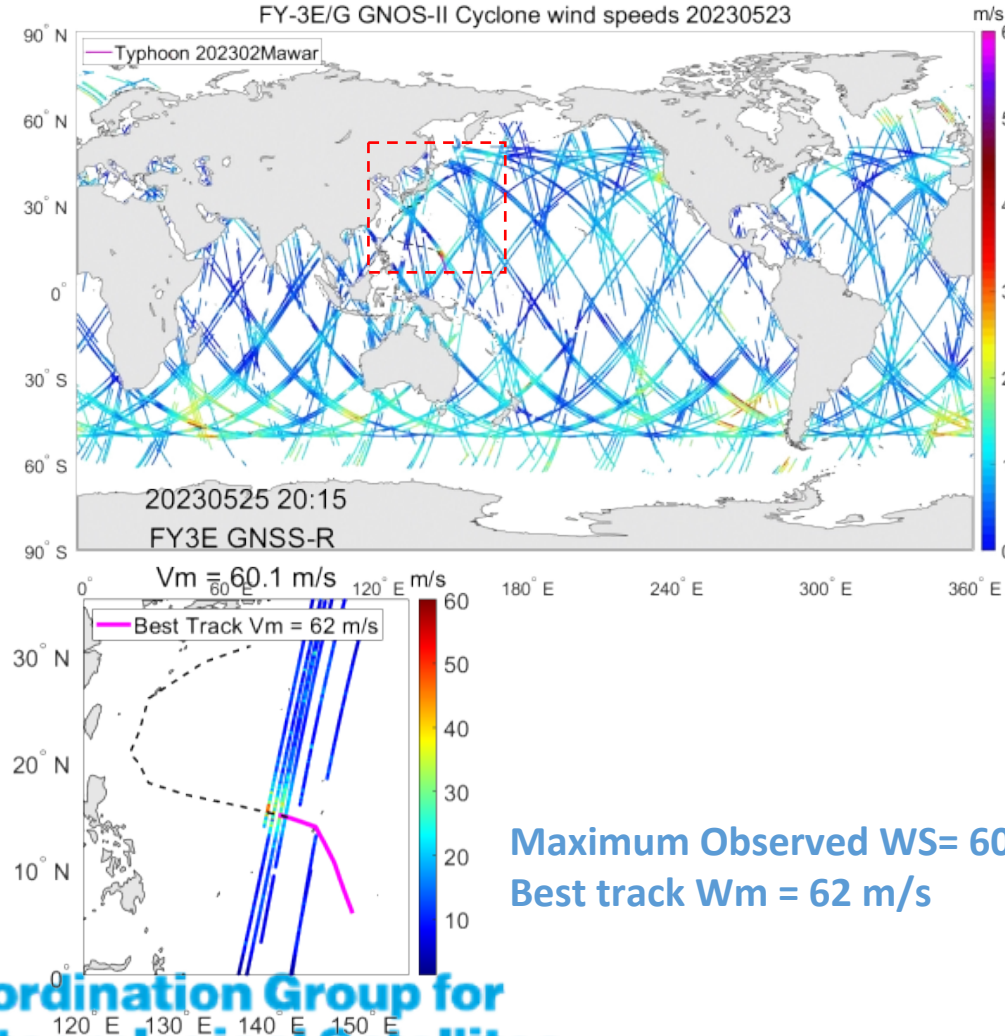
Earth Surface



CGMS

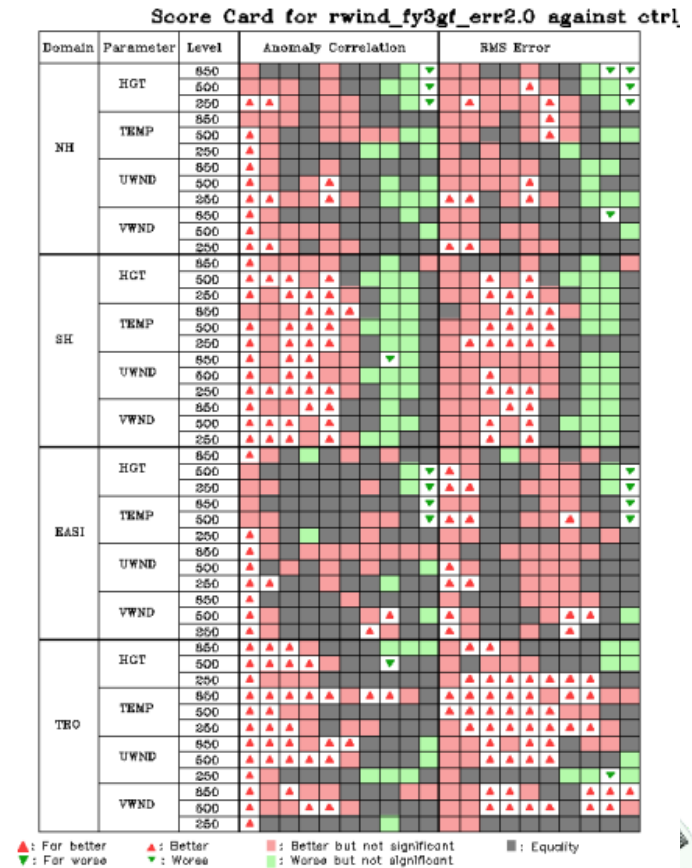
GNSS-R Ocean Surface Wind application: Monitoring of tropical cyclones and Data assimilation in NWP model

Super Typhoon "Mawar" (2023) – Monitoring the TC track



Maximum Observed WS= 60.1 m/s
Best track Wm = 62 m/s

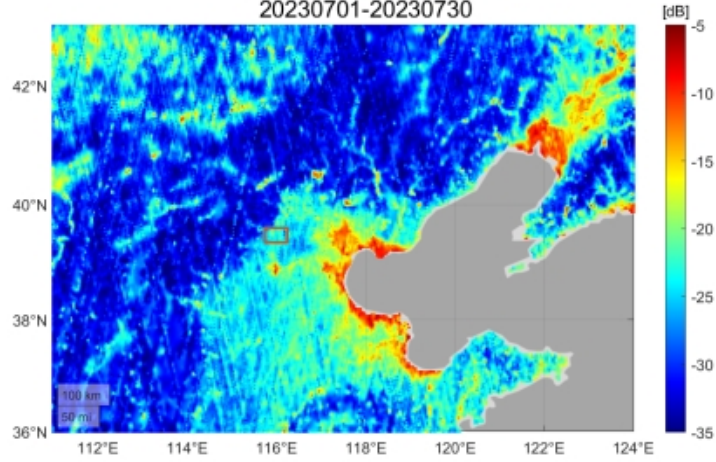
FY-3 GNSS-R winds have Positive impact on the CMA-GFS model



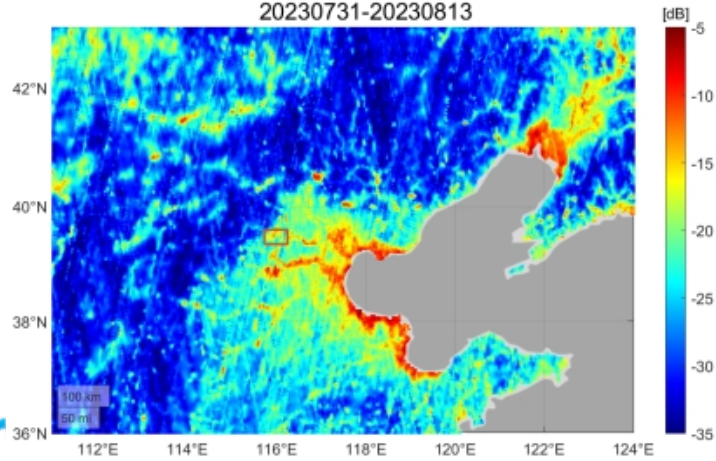
GNSS-R Land soil moisture application: Flood monitoring and Data assimilation

Flood monitoring
Hebei flood event 2023

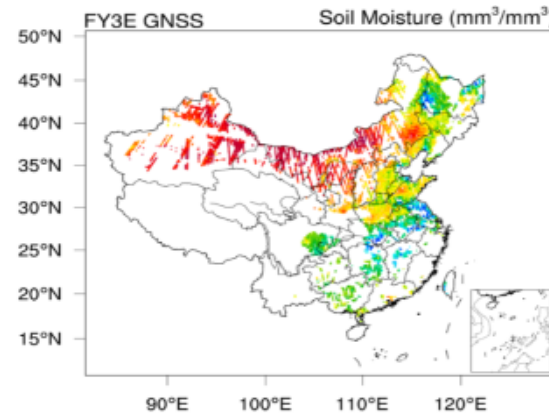
GNOS Land Reflectivity
20230701-20230730



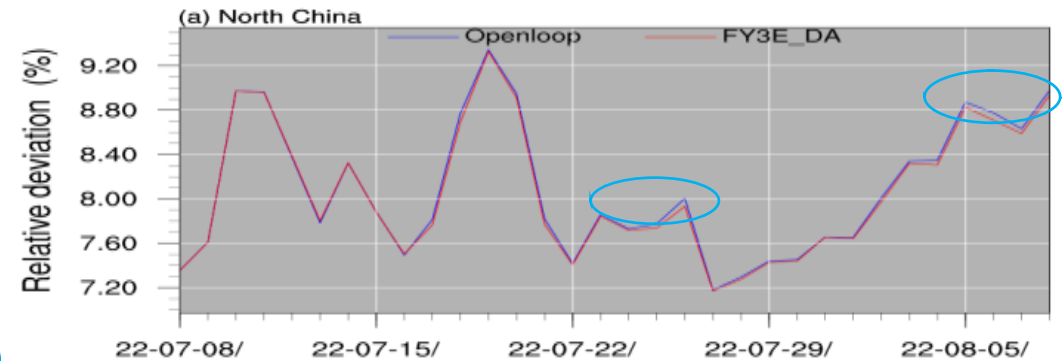
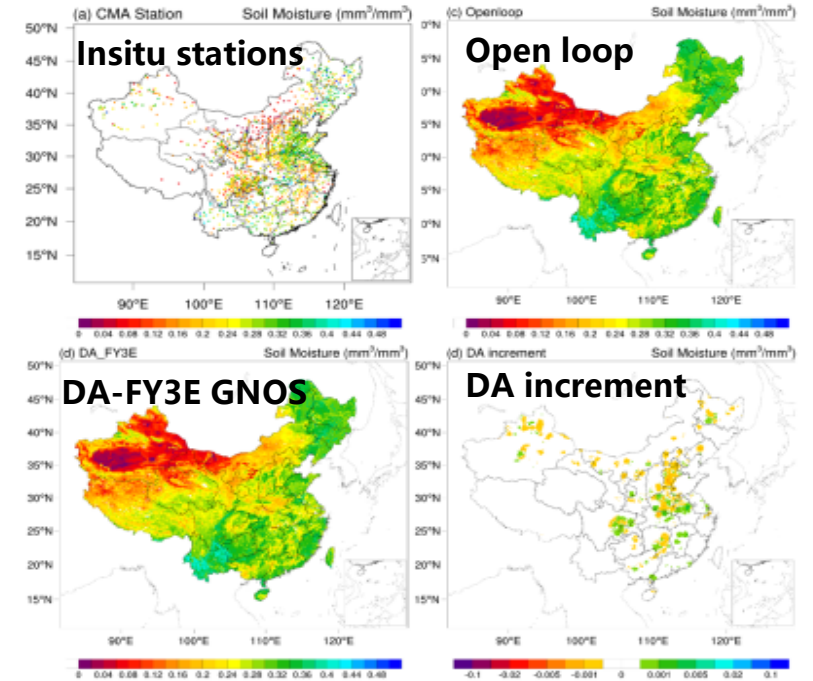
GNOS Land Reflectivity
20230731-20230813



Soil Moisture Data Assimilation



20220708-20220808
GNOS Soil Moisture



To be considered by CGMS:

GNSS-R in China is able to cover three crucial hydrological variables in order to model the Earth's climate in the following areas: soil moisture, ocean winds, and ice. However, GNSS-R applications are not limited to these three uses, but extend to other applications as well. Land applications have evolved considerably in the past few years for vegetation opacity, and wetland detection and monitoring.

GNSS-R applications with a single satellite or a limited number of satellites, could mainly used to NWP assimilation supporting. More commercial constellations and global data sharing need to be encouraged to maximize its benefits.