

Status and plans for satellite data assimilation at the Korea Meteorological Administration

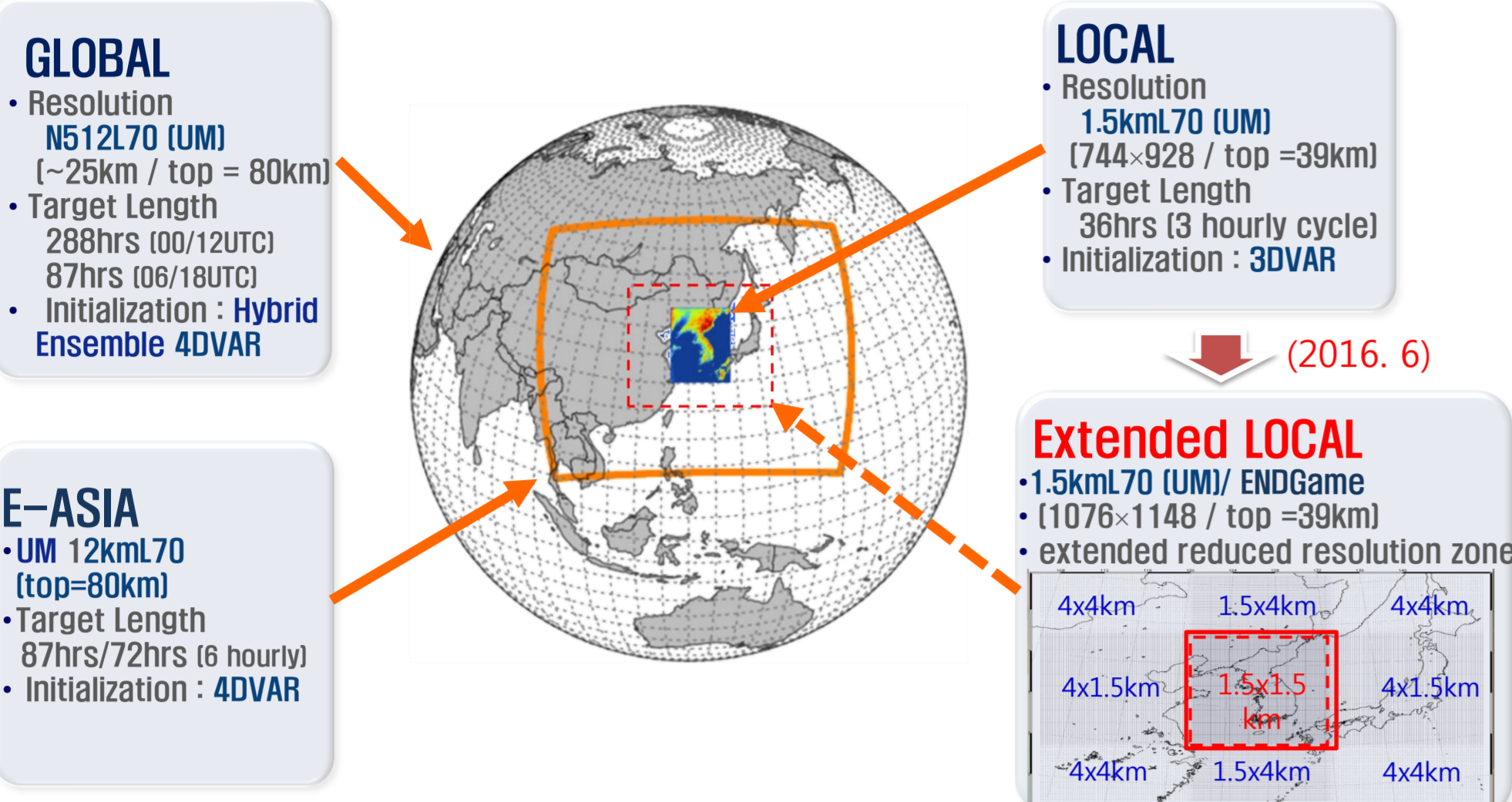
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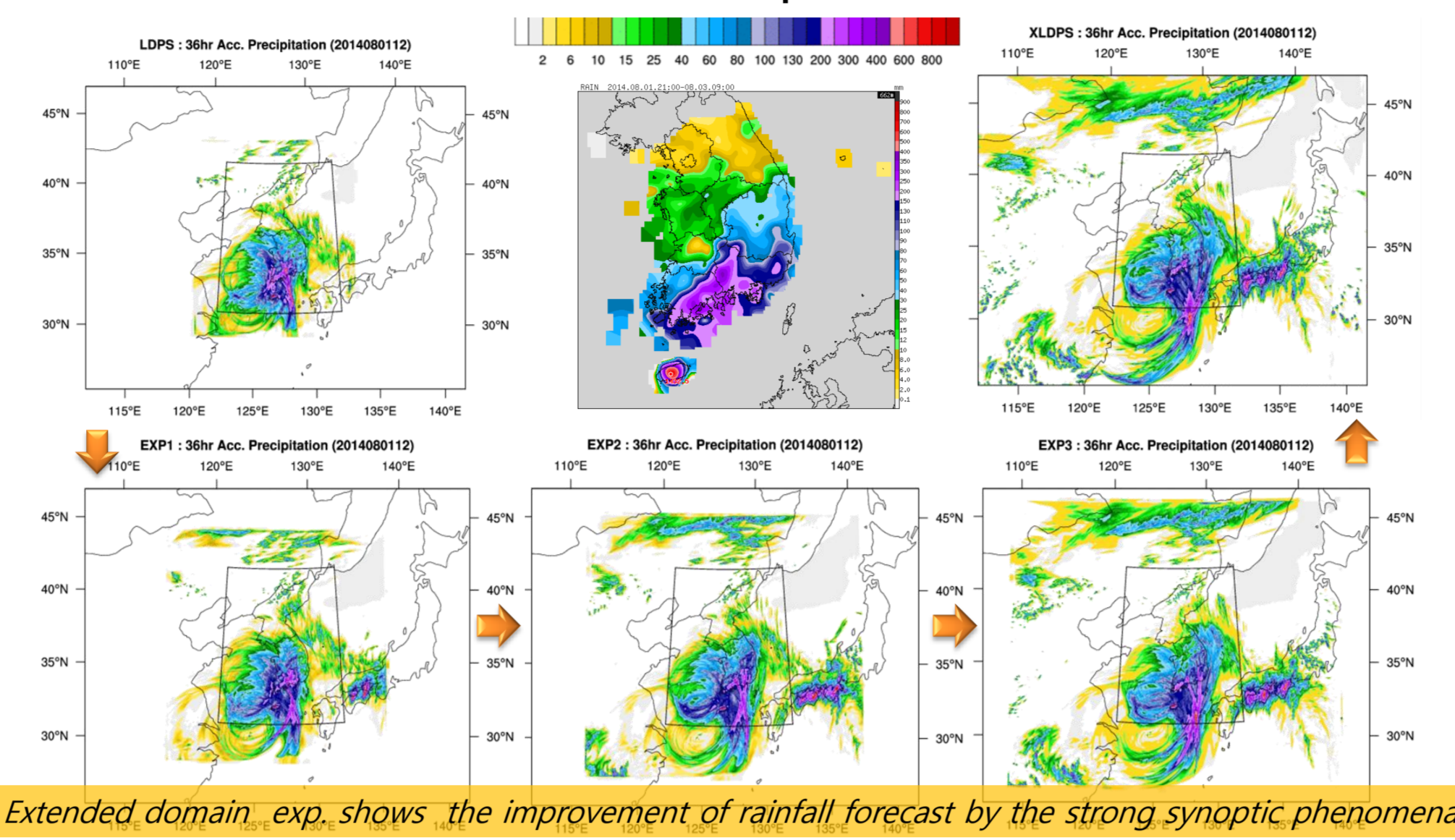


INTRODUCTION

Operational NWP system



extended domain exp. with ENDGame



Satellite data usage

| Type(Sensor) | Satellite | Variables (control variables) | Model domain | | |
|----------------------------|--|--------------------------------------|--------------|--------|-------|
| | | | Global | E-ASIA | Local |
| ATOVS(G,L) (AMSU-A/B, MHS) | NOAA(15,18,19) MetOp-A/B | Radiance(t,q) | ○ | ○ | |
| AIRS | Aqua | Radiance(t,q) | ○ | ○ | |
| IASI(G,L) | MetOp-A/B | Radiance(t,q) | ○ | ○ | |
| Satwind(GEO,LEO) | COMS, Meteosat-7, MSG, GOES, MTSAT, Aqua, NOAA | U,V (IR, WV, VIS channels) | ○ | ○ | △ |
| Scatwind(ASCAT) | MetOp-A/B | U,V at 10 meter over ocean | ○ | ○ | ○ |
| GNSS-RO | COSMIC, GRACE, GRAS, KOMPSAT-5 | Bending angle, Impact parameter(t,q) | ○ | ○ | |
| Ground-based GNSS | AC: NMSC, KASI, NGII(G,L), METG(G) | Zenith Total Delay(t,q) | △ | | ○ |
| CSR | COMS | Radiance (WV channel/q) | ○ | | △ |
| Soil Moisture(ASCAT) | MetOp-A/B | Soil moisture | ○ | | |

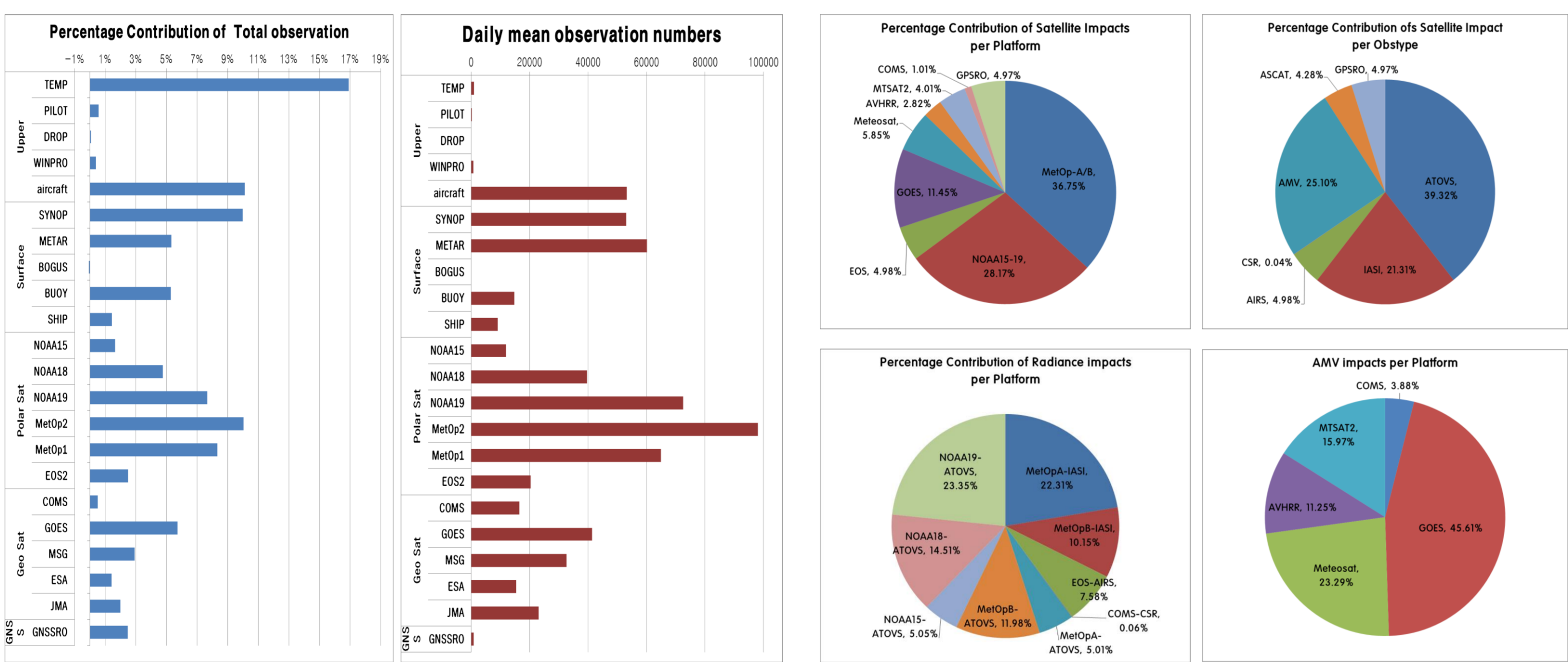
SATELLITE IMPACT IN NWP

Satellite impact evaluation using FSO

- FSOs are operationally used to evaluate the impact of satellite data in global NWP
- The errors are measured by 24 hour forecast moisture energy norm in global model

$$\delta e = (\delta w_i^{fa})^T C (\delta w_i^{fa}) - (\delta w_i^{fb})^T C (\delta w_i^{fb})$$

δw_i^{fb} : 24hour forecast error in a simplified forecast state initialised from an analysis
 δw_i^{fa} : the error initialised from the background state for that analysis
 C : a diagonal inner-product matrix of moist energy norm
 δy : the vector of observation innovations
 e_k : an estimate of the contribution to the total impact of the kth observation

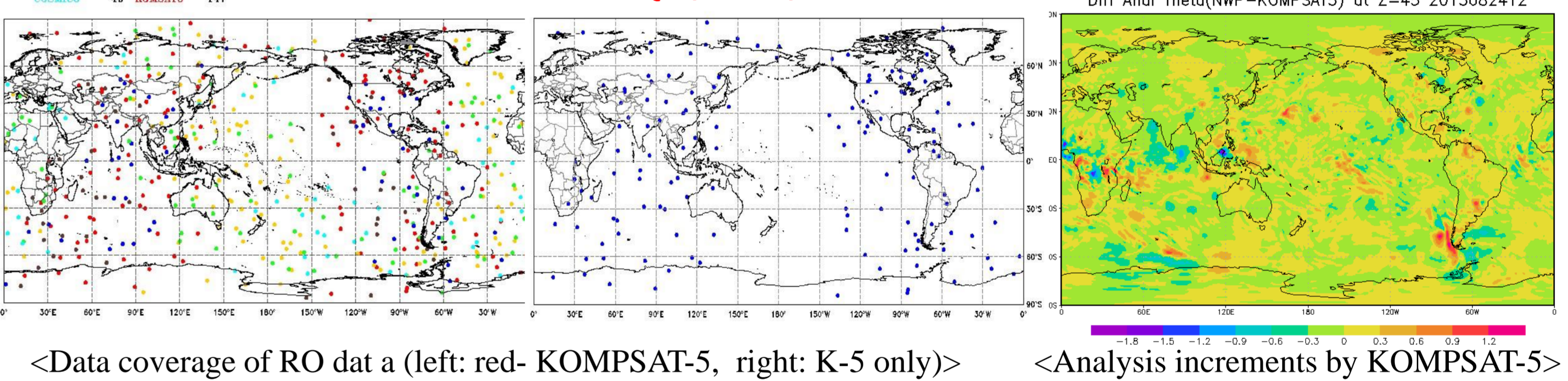
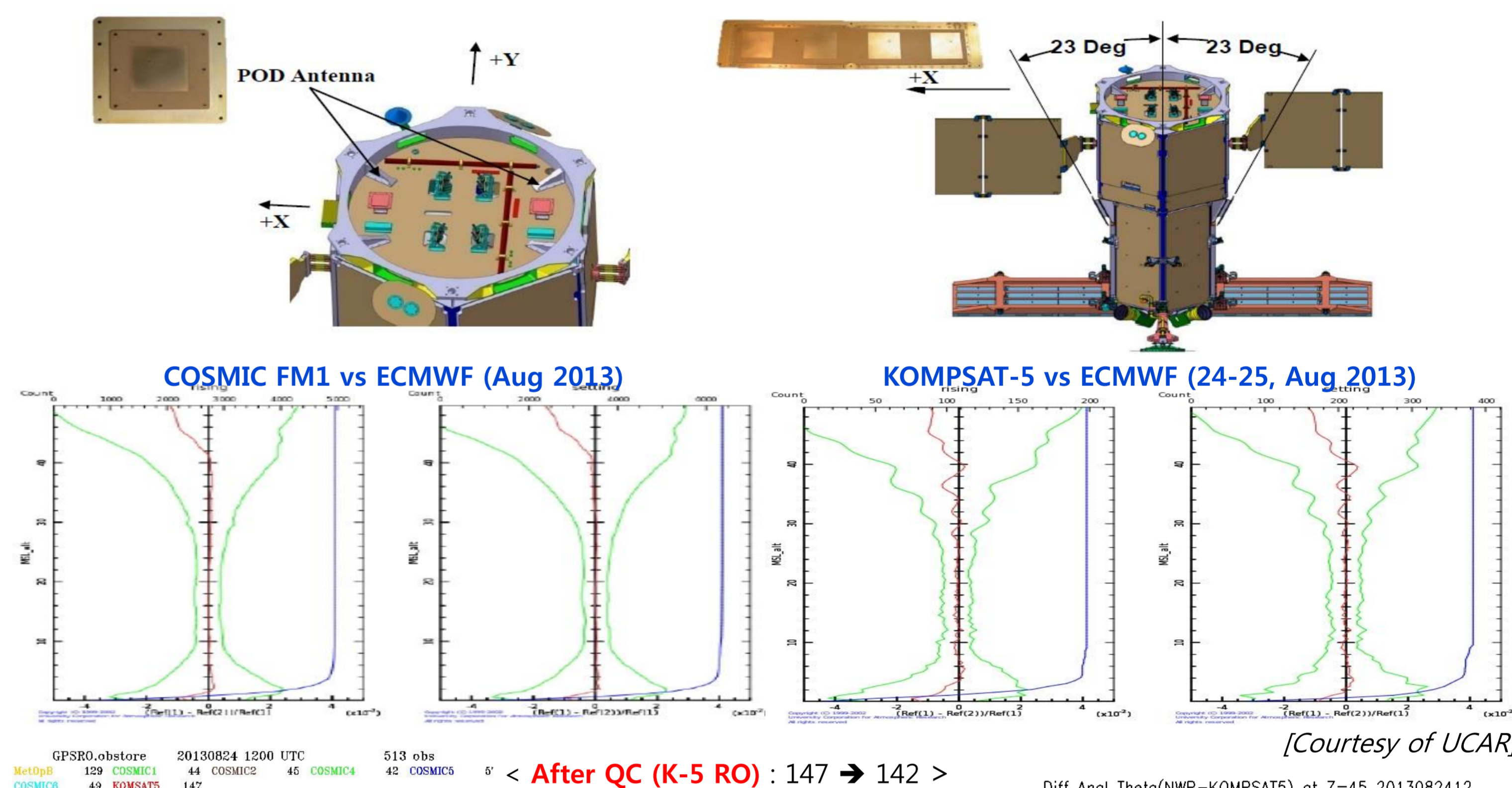


- Evaluation Period : 2014.12-2015.2 (3months)
- Contributions: Satellite(50%) > Surface(22%) > Upper (9%)
- Satellite impacts: LEO (> 70%) - ATOVS(39.32%), IASI(21.31%)
- COMS AMV impacts ~ 4%
- COMS CSR impacts ~ 0.06%

GNSS DATA ASSIMILATION

KOMPSAT-5 RO data assimilation into KMA global model(GDAPS)

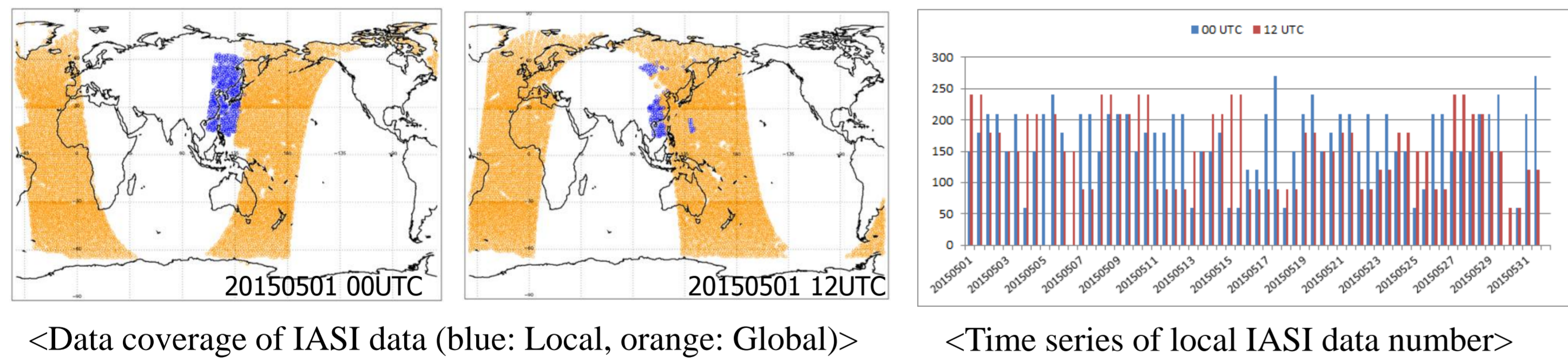
- ✓ Atmospheric Occultation and Precision Orbit Determination (AOPOD) system of KOMPSAT-5
- Dual frequency GPS receiver , 2 POD antenna and 2 occultation antenna
- More than 460 occultation event per day with similar high quality as COSMIC
- Recently firmware has been upgraded, the AOPOD reactivated since 28 July 2015.



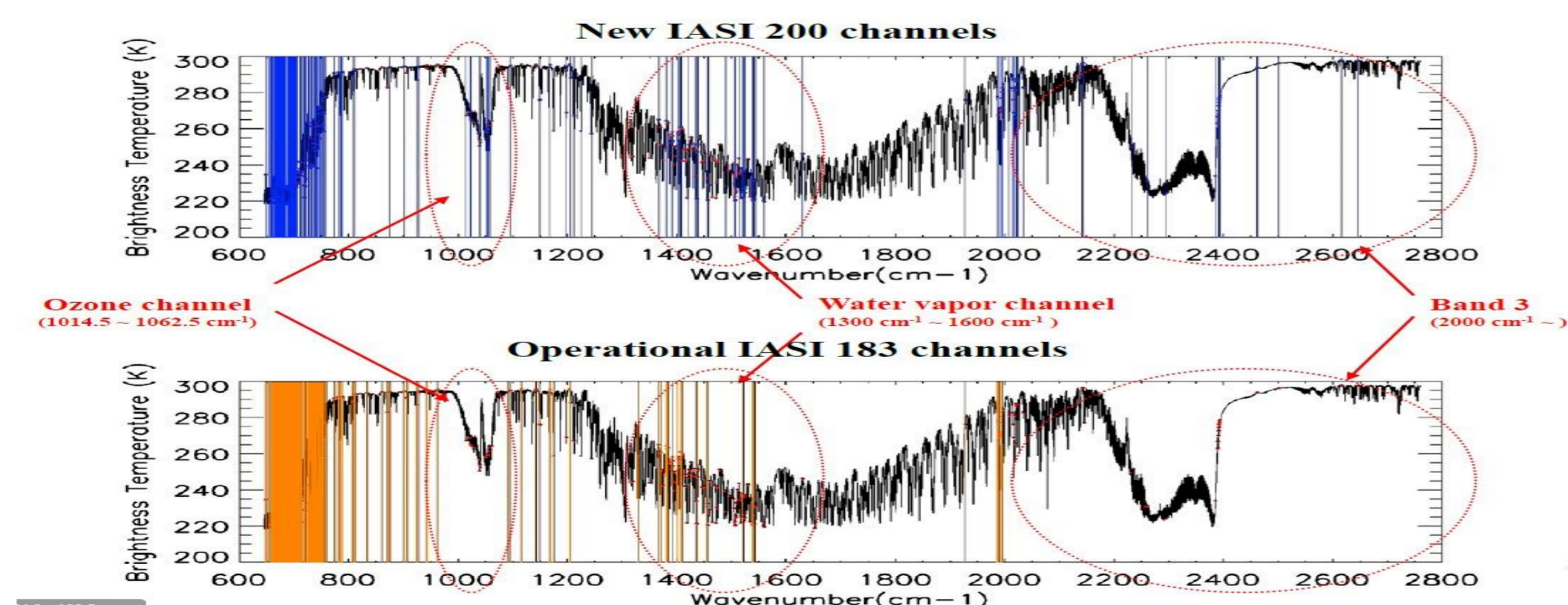
RECENT CHANGE OF IASI DA

Direct readout IASI radiance assimilation

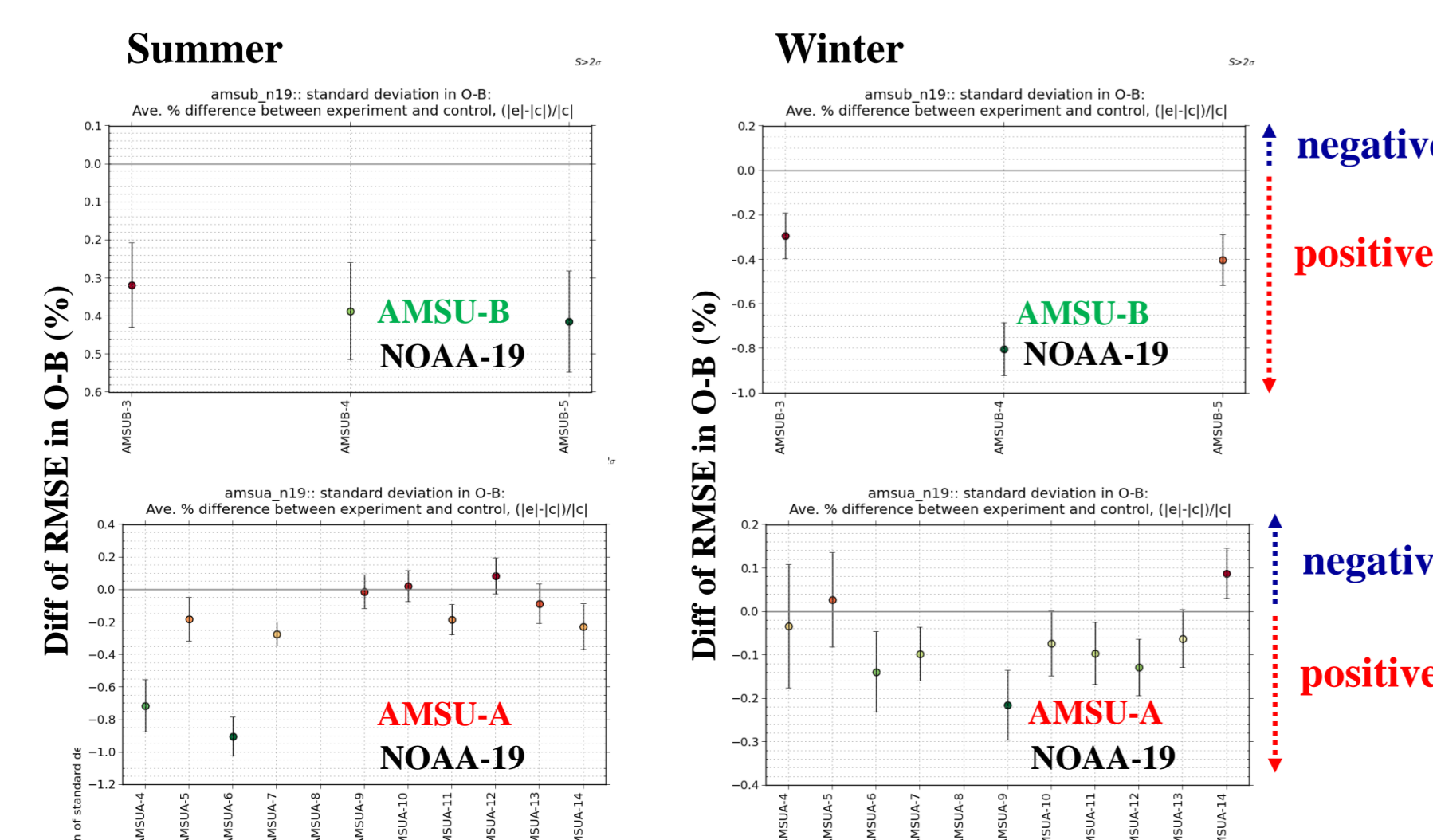
- KMA has processed direct readout IASI data using the latest version of AAPP(v7.9) since Mar 2015
- Number of IASI is 3% increased at global domain and 13 - 85 % increased at Asia domain



New channel selection of IASI



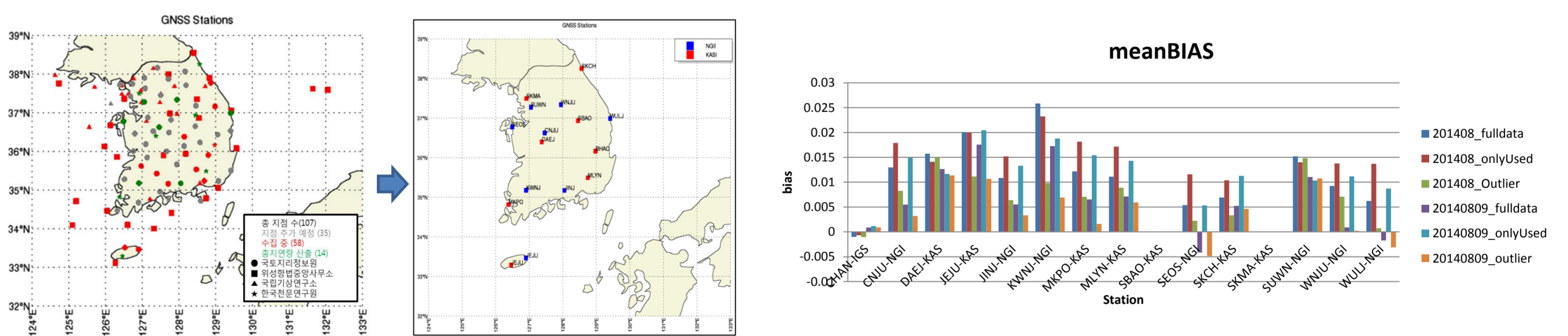
Impact of new channel selection(200) compared to the operation(183)



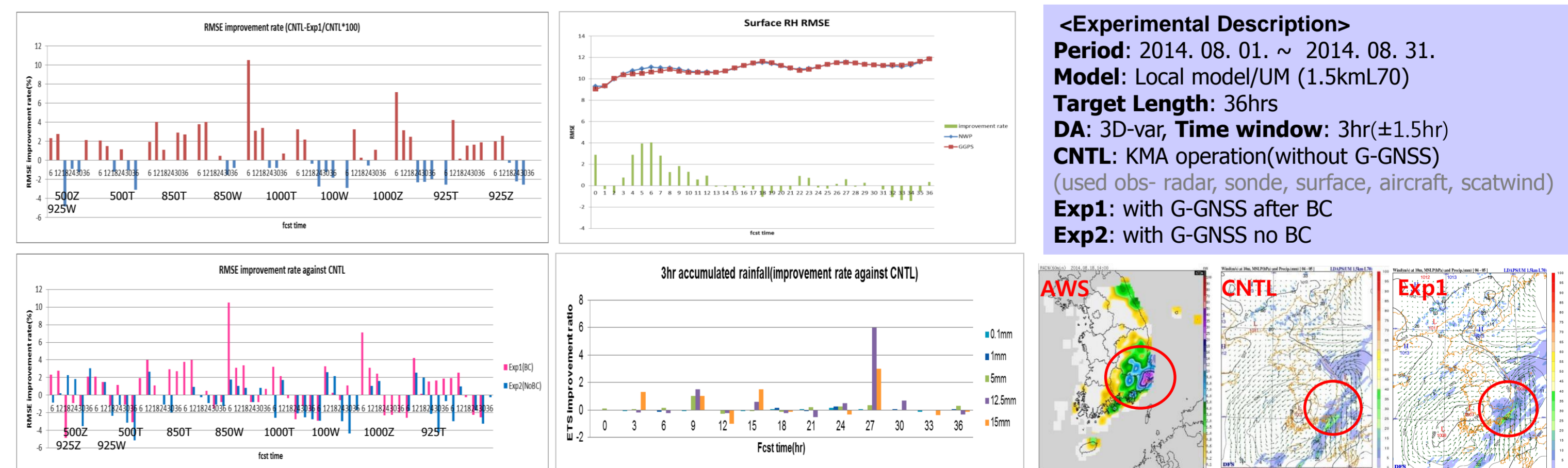
- IASI 200 channels were selected by 1D-Var simulation approach
- With the new selection of IASI channels, the ATOVS fits are improved
- O-B analysis showed improvement of t,q fields
- Operational application is ongoing(~2016)

Ground-based GNSS data assimilation into KMA local area model(LDAPS)

- More than 100 stations over Korean peninsula, but only 15 STN hourly data processed in near real time
- KMA will be exchanged ground-based GNSS data with E-GVAP using cost format
- The ZTD data at each station has a bias, simple static bias correction was applied based on (O-B)



To evaluate ground-based GNSS data, 3 experiments were conducted during Aug. 2014(1month)



Assimilation of ZTD into KMA local area model has shown a promising result. Exp1 RMSE of overall fields against analysis was reduced compared to CNTL. ETS shows improvement by up to 60%. And rainfall bands well simulated for several heavy rainfall cases.

WORK in Progress

- steady effort to assimilate new satellite data (S-NPP, Himawari-8 etc.)
- observation error tuning for ground-based GNSS data and other satellite data
- KOMPSAT-5 RO data assimilation will be implemented in operation