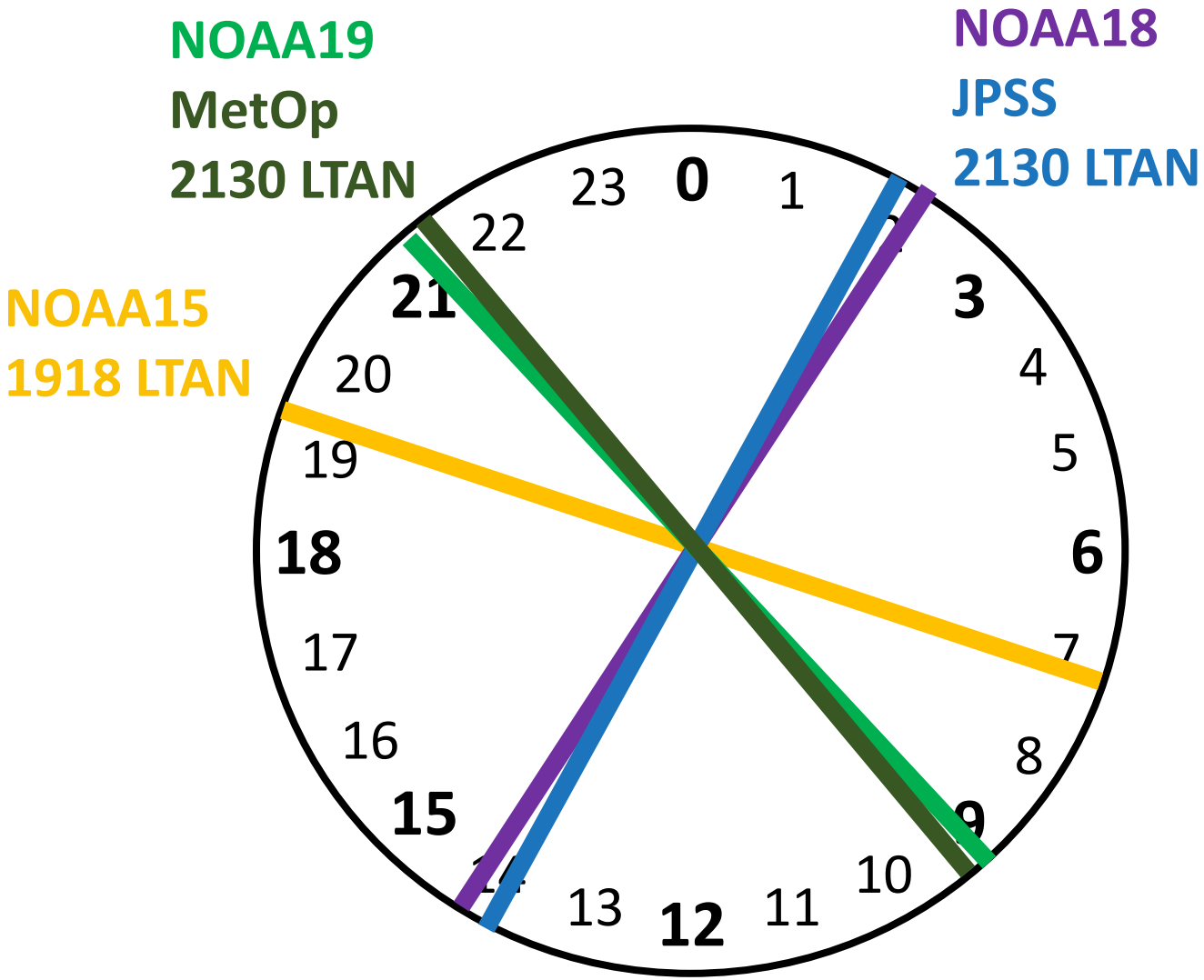


Observing System Simulation Experiments for a Future Early Morning Low Earth Orbit Observing Platform

Nikki Privé, Bryan Karpowicz, Erica McGrath-Spangler, Satya Kalluri

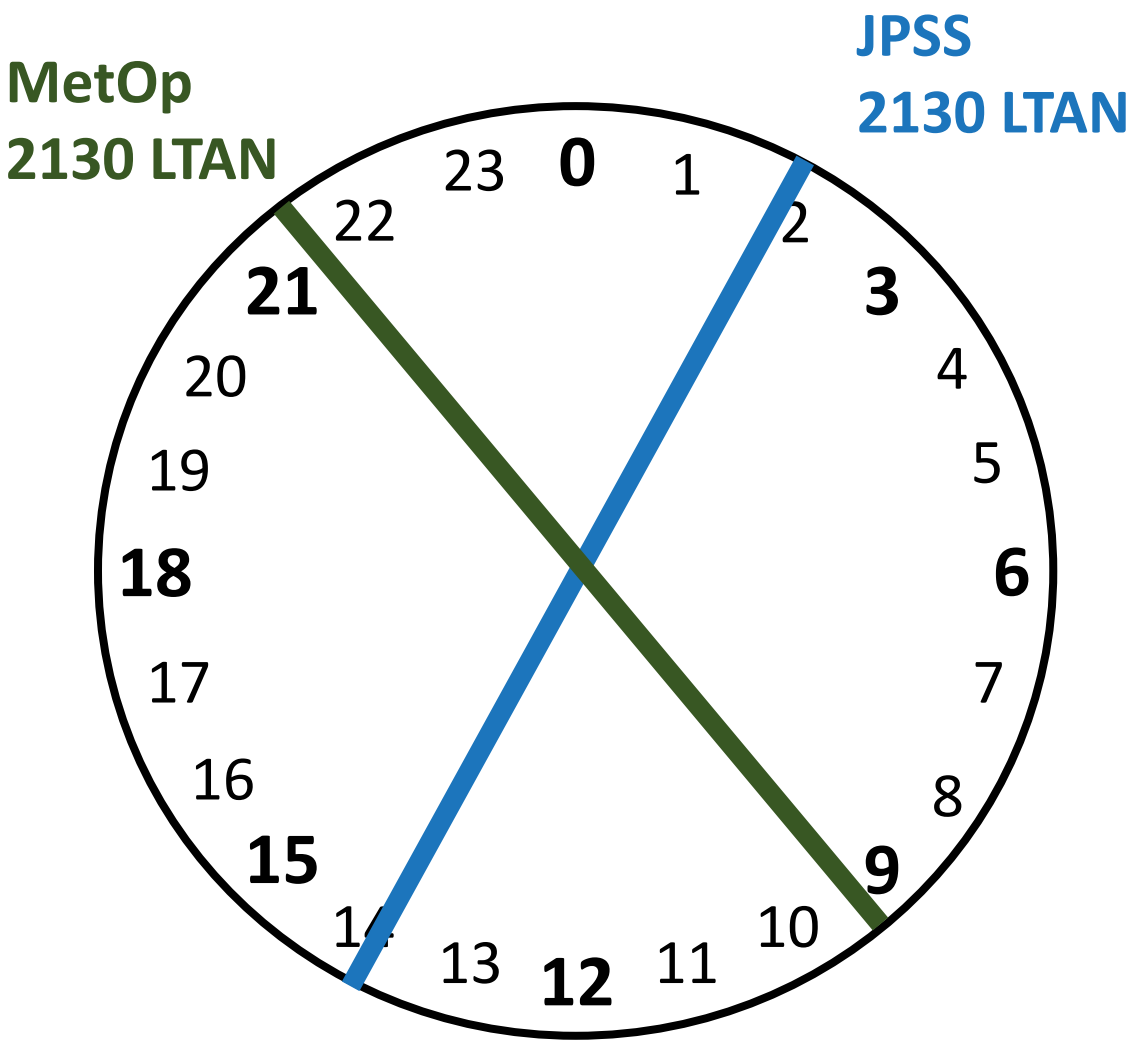
Disclaimer statement:
"The material contained in this document is based upon work supported by a National Aeronautics and Space Administration (NASA) grant or cooperative agreement. Any opinions, findings, conclusions or recommendations expressed in this material are those of the author and do not necessarily reflect the views of NASA."

2024 Global LEO Platforms



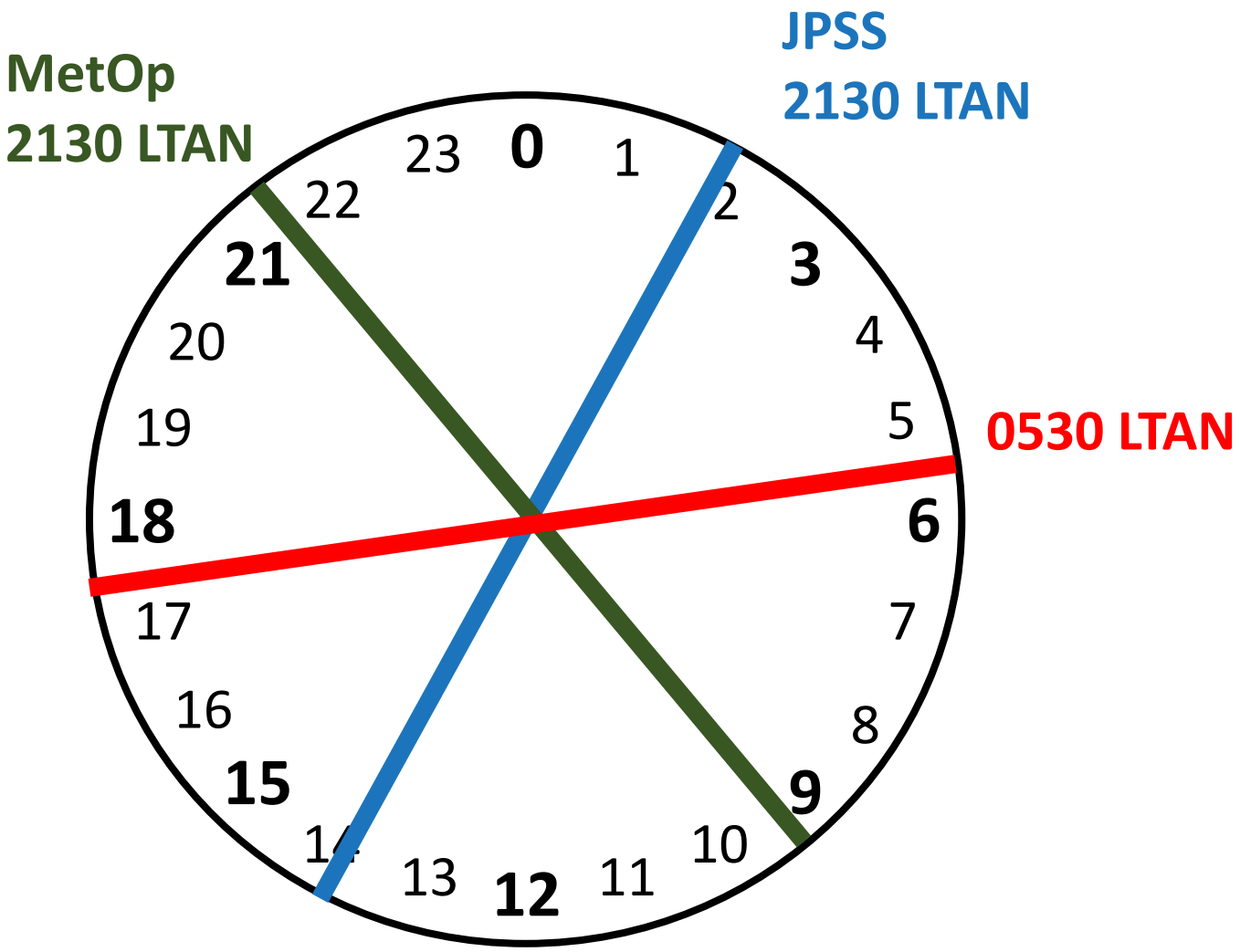
Future
LEO Platforms

82% coverage
@6hr refresh



0530 LTAN Orbit

98.6% coverage
@6hr refresh



- Evaluate the potential impact of an 0530 LEO platform on numerical weather prediction (NWP)
- Future Scenario – 2030s
- Microwave and hyperspectral infrared instruments

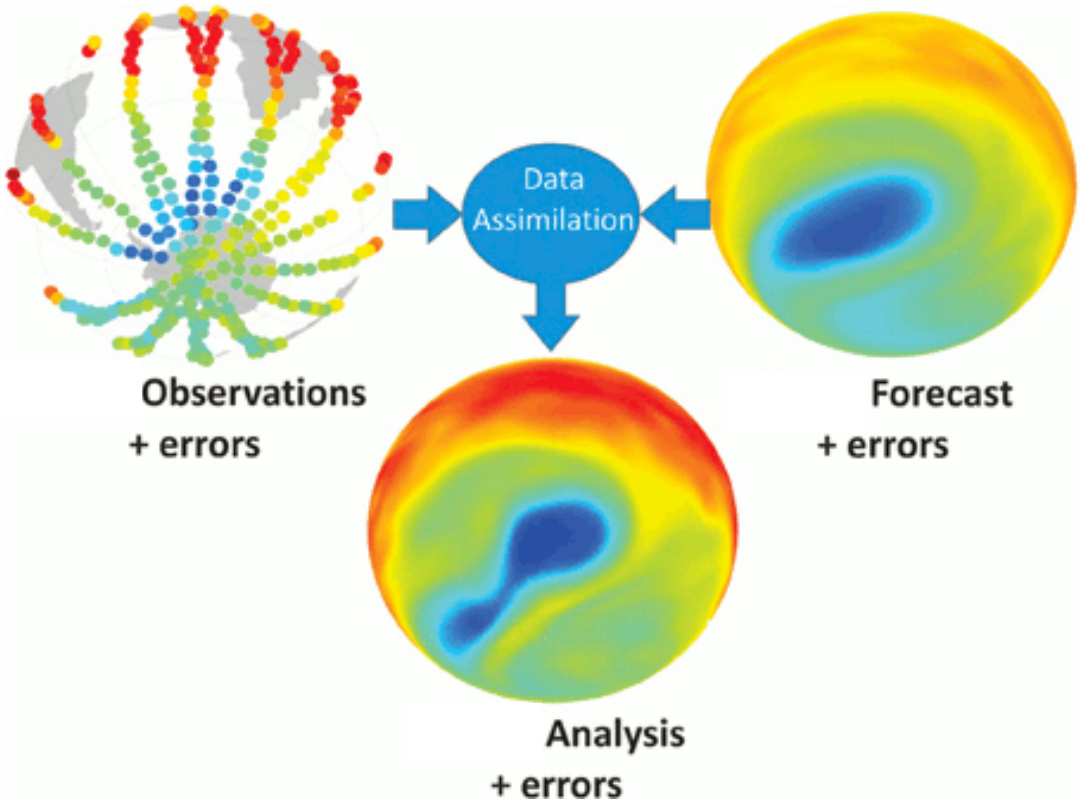
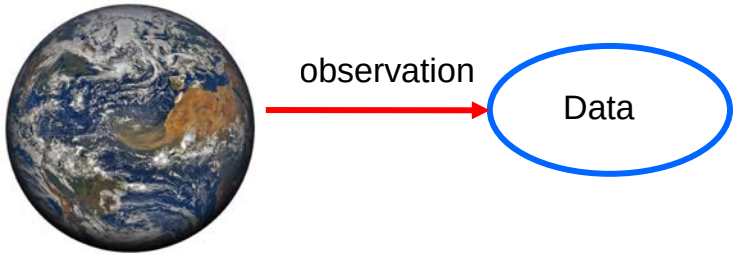


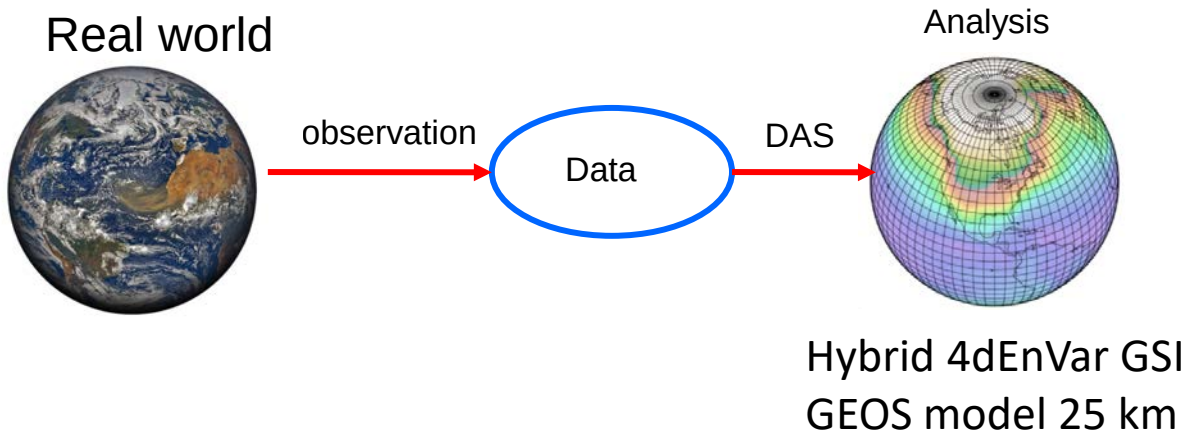
Image: Lahoz, W. and P. Schneider, Front. Environ. Sci., 2014, with permission

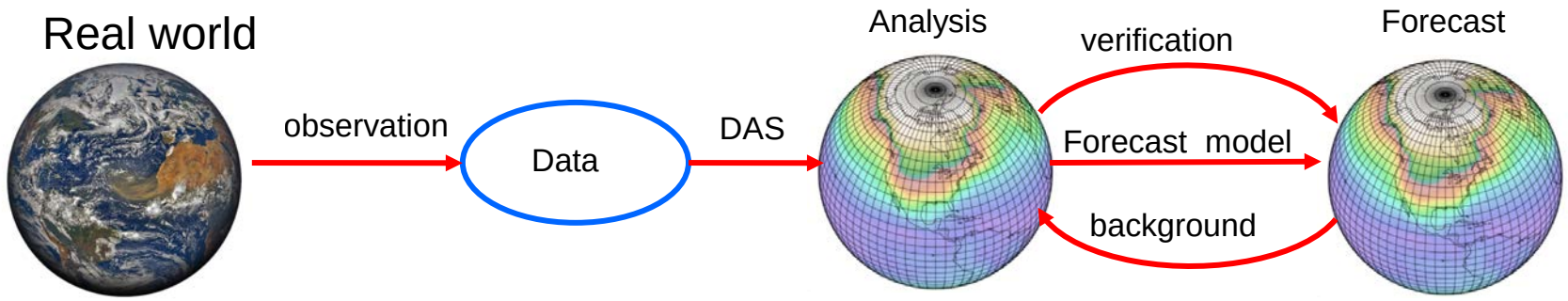
Real world

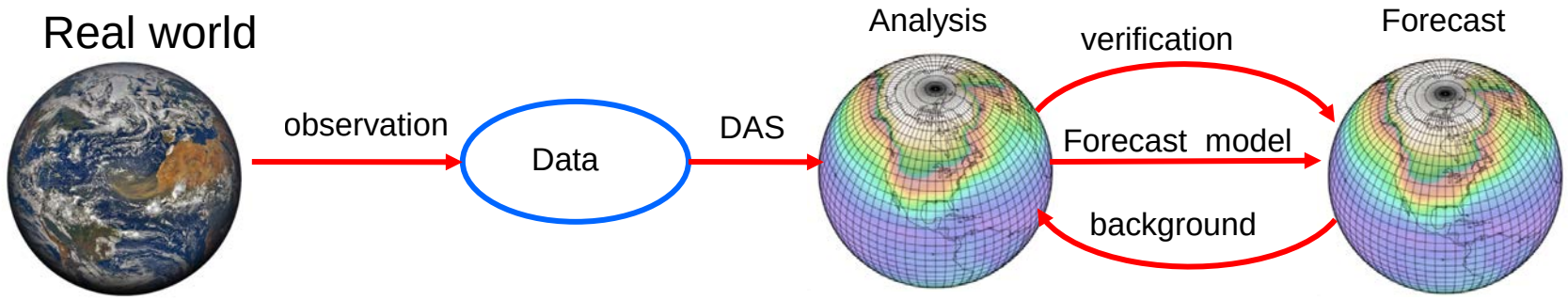


Real world




Real world
observation
Data
DAS
Analysis
Hybrid 4dEnVar GSI
GEOS model 25 km

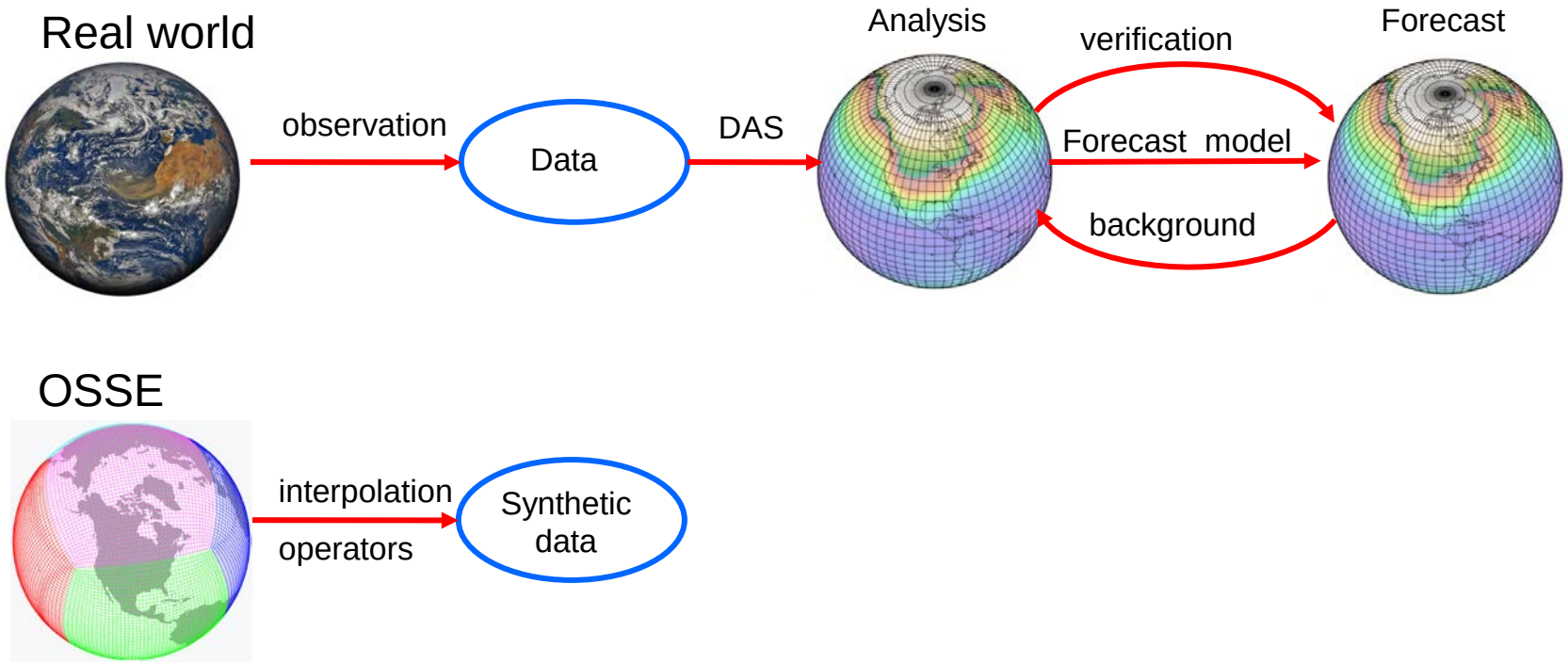

Real world
observation
Data
DAS
Analysis
verification
Forecast model
background
Forecast

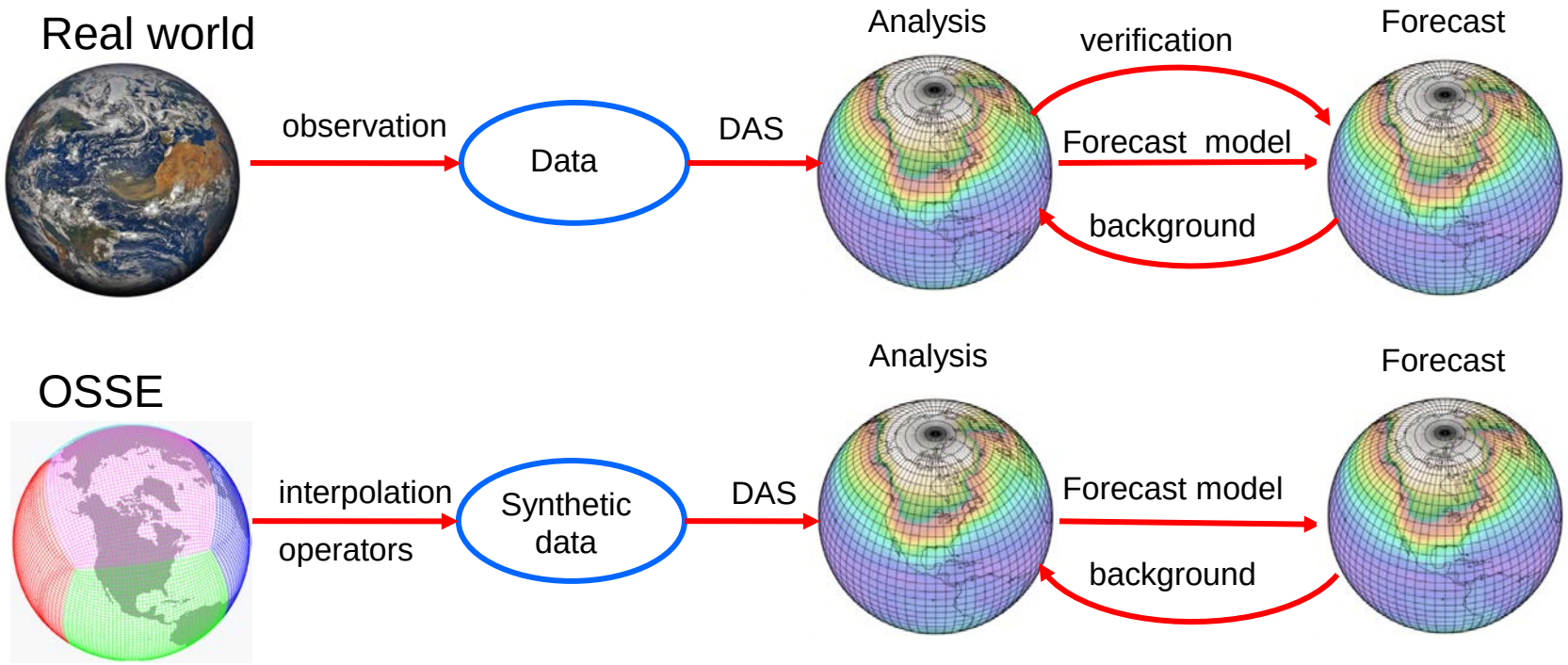


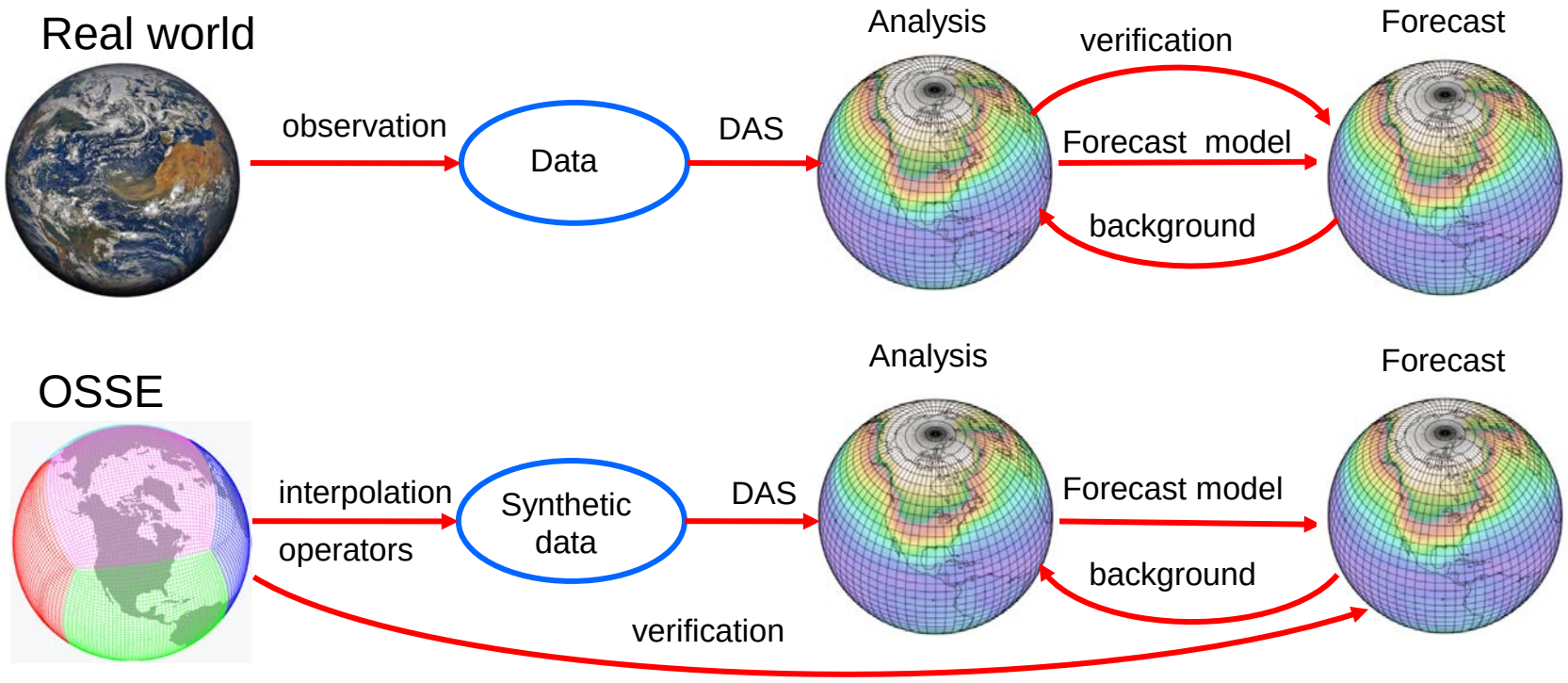
OSSE



7 km G5NR


Real world
observation
Data
DAS
Analysis
verification
Forecast
Forecast model
background
OSSE
interpolation
operators
Synthetic data


Real world
observation
Data
DAS
Analysis
verification
Forecast
Forecast model
background
OSSE
interpolation
operators
Synthetic data
DAS
Analysis
Forecast
Forecast model
background


Real world
observation
Data
DAS
Analysis
verification
Forecast
Forecast model
background
OSSE
interpolation
operators
Synthetic data
DAS
Analysis
Forecast
Forecast model
background
verification

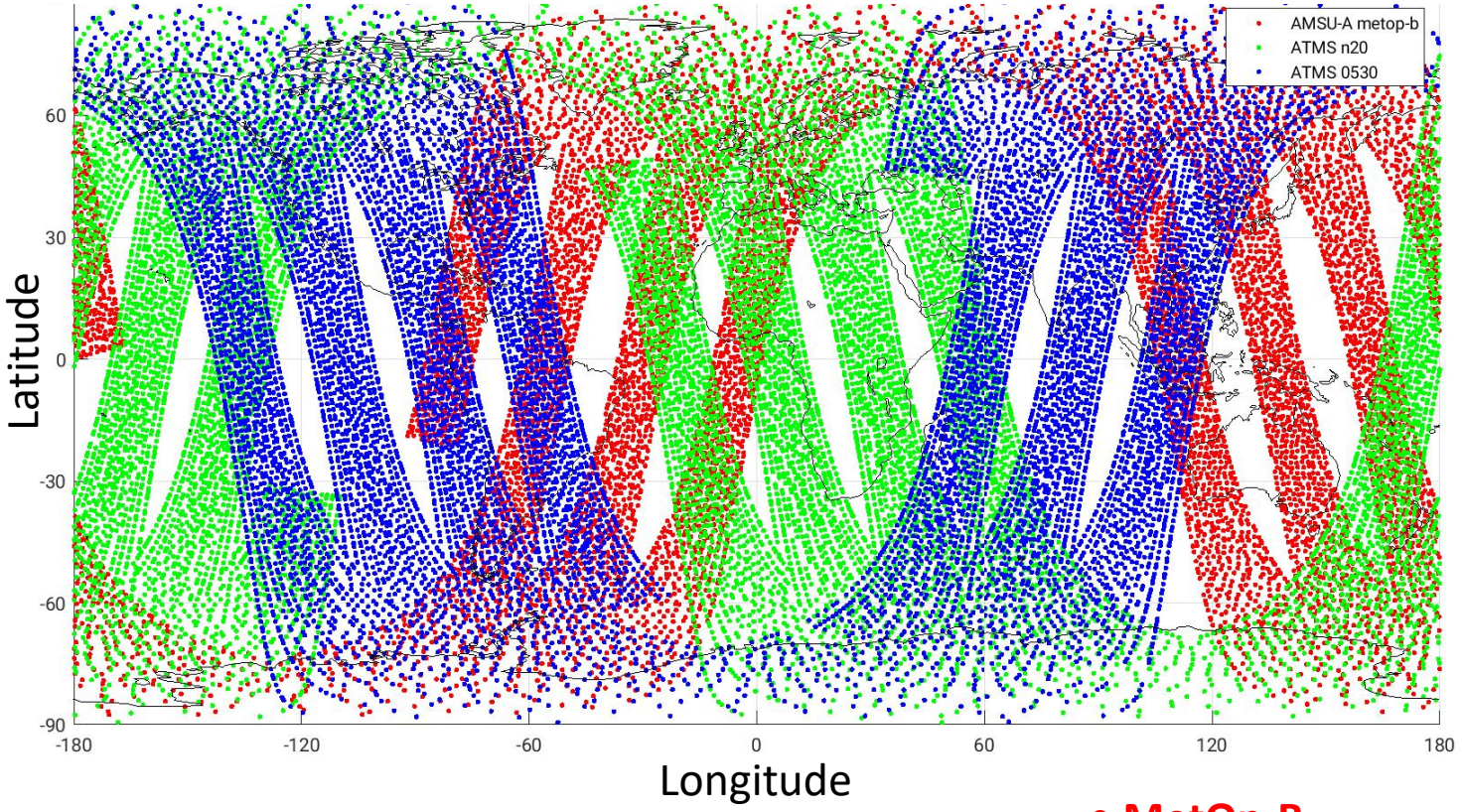
Control:

- Reduced LEO constellation: NOAA-20 and metop-b only
- GEO IR 3-Satellite ring
- Conventional, GNSS-RO

Experiment:

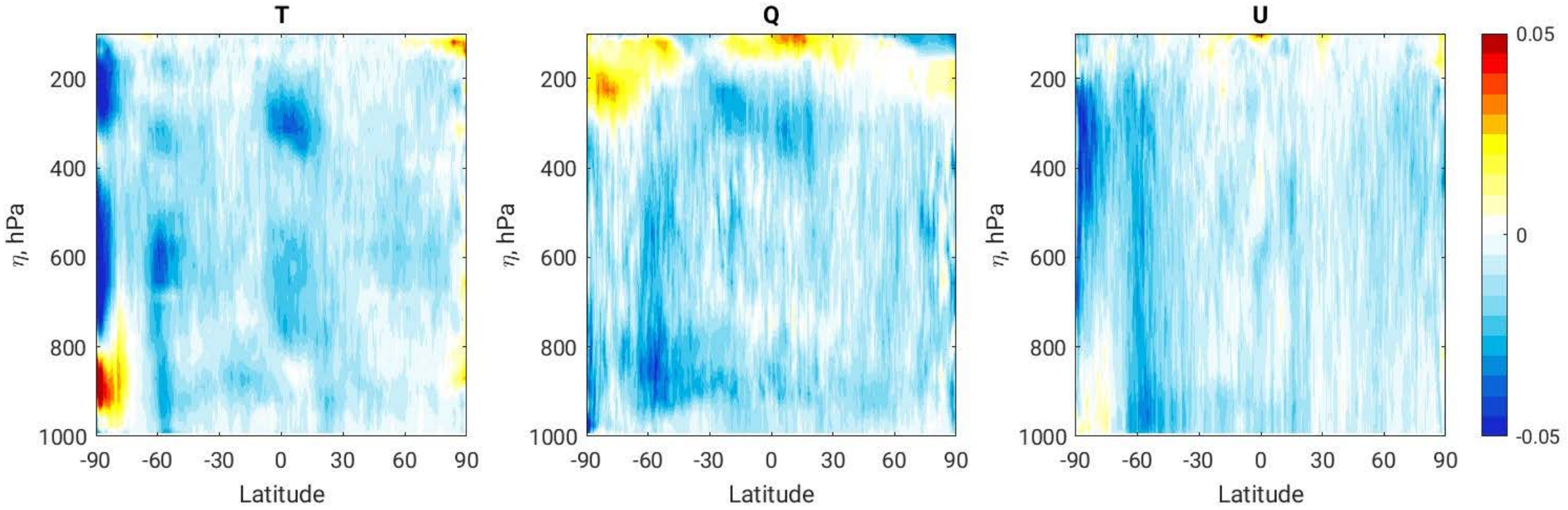
Control + 0530 LEO orbit for CrIS and ATMS

Simulated Sample Orbits: LEO



- **MetOp-B**
- **NOAA-20**
- **0530 LTAN**

Fractional Change to RMS Analysis Error

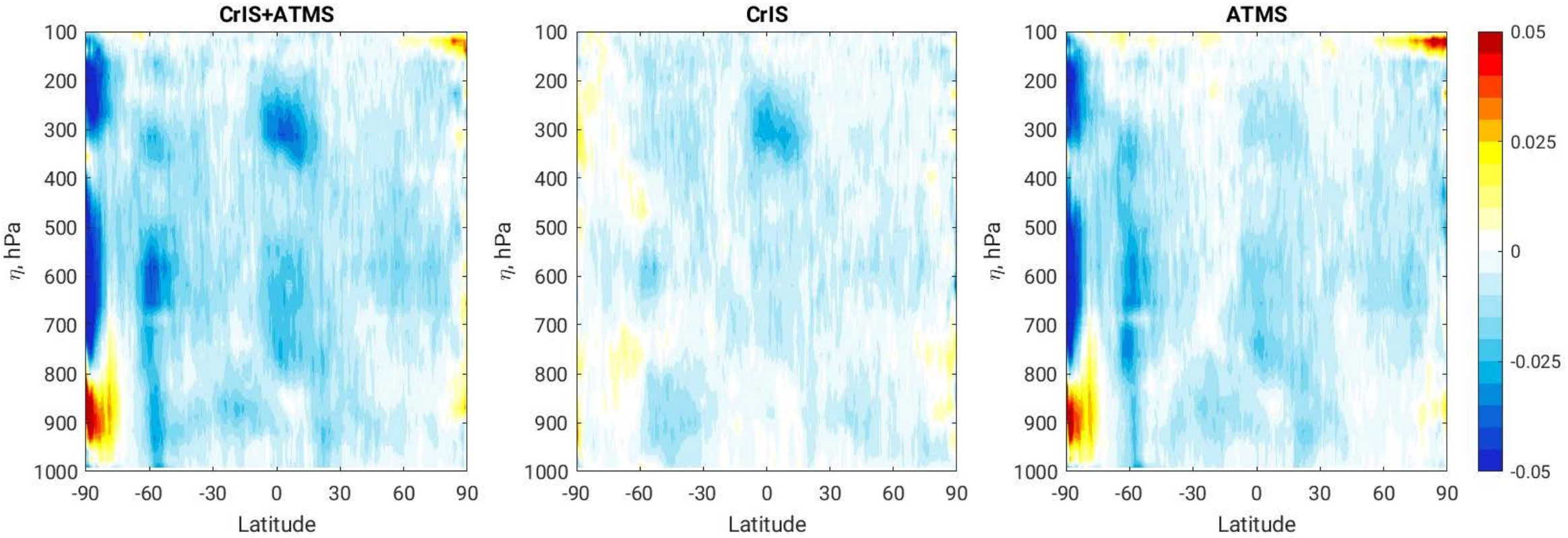


BLUE Improvement
YELLOW/RED Degradation

GODDARD EARTH SCIENCES

GESTAR II

Fractional Change to RMS T Analysis Error



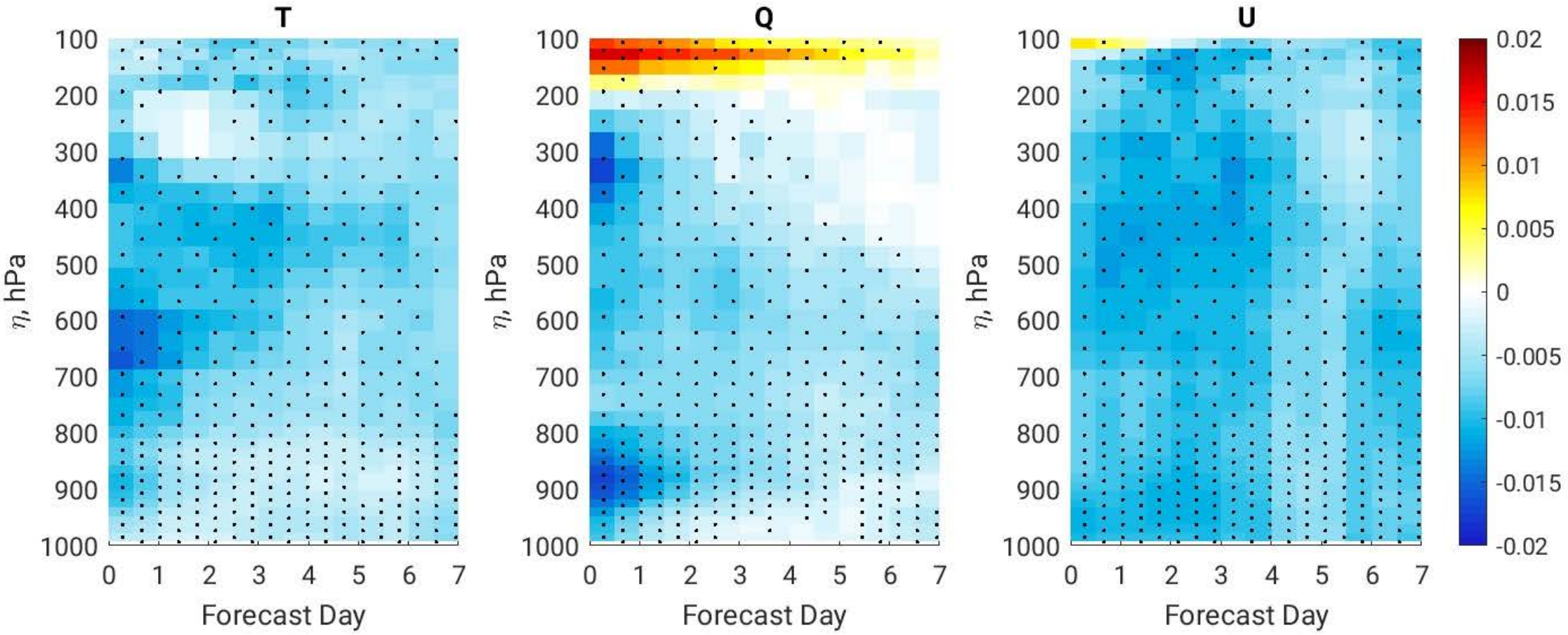
BLUE Improvement

YELLOW/RED Degradation

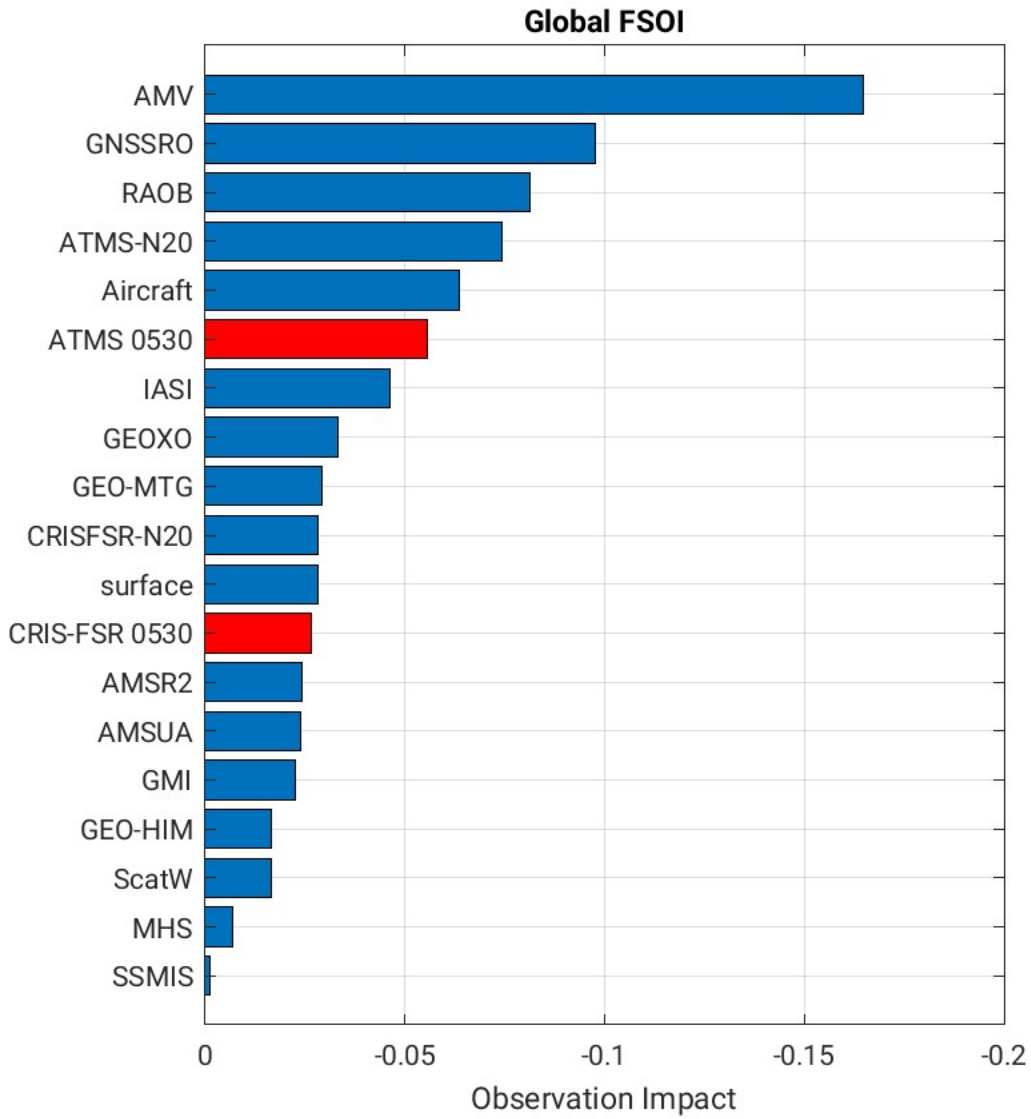
GODDARD EARTH SCIENCES

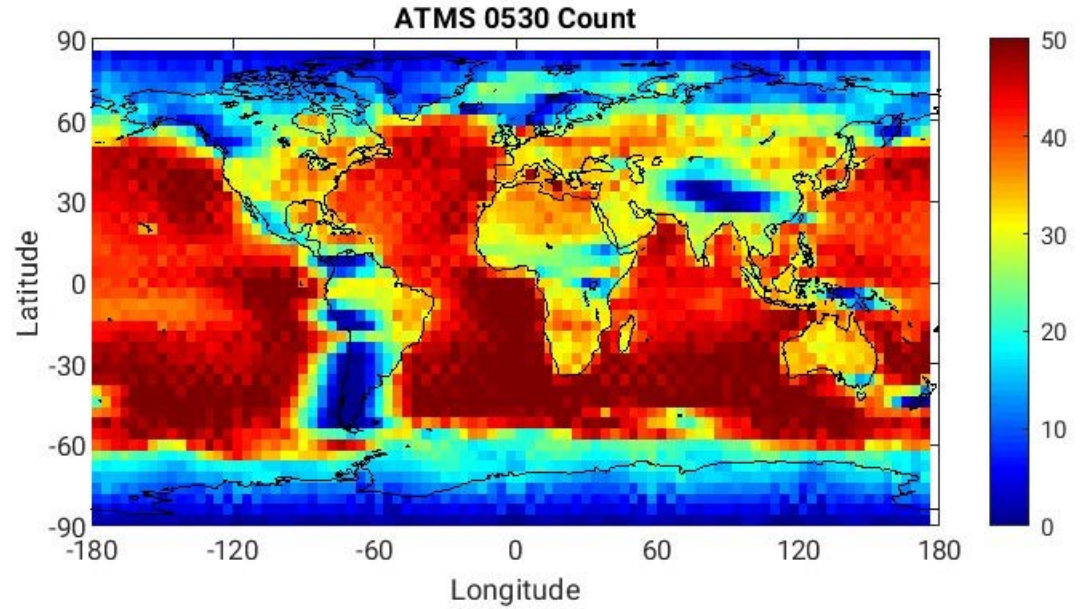
GESTAR II

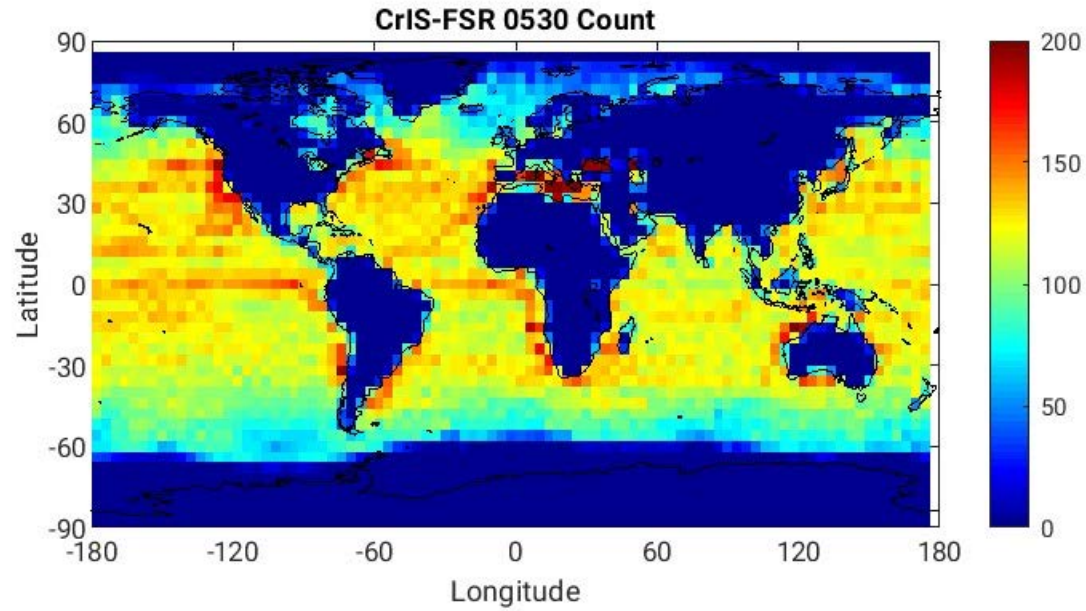
Fractional Change to RMS Forecast Error



BLUE Improvement
YELLOW/RED Degradation


Global FSOI
AMV
GNSSRO
RAOB
ATMS-N20
Aircraft
ATMS 0530
IASI
GEOXO
GEO-MTG
CRISFSR-N20
surface
CRIS-FSR 0530
AMSR2
AMSUA
GMI
GEO-HIM
ScatW
MHS
SSMIS
0
-0.05
-0.1
-0.15
-0.2
Observation Impact


ATMS 0530 Count
90
60
30
0
-30
-60
-90
Latitude
-180
-120
-60
0
60
120
180
Longitude
50
40
30
20
10
0


CrIS-FSR 0530 Count
90
60
30
0
-30
-60
-90
Latitude
-180
-120
-60
0
60
120
180
Longitude
200
150
100
50
0

Impacts of 0530 Orbit Platform:

- Forecasts improved through day 7
- Largest impacts in Southern Hemisphere for MW
- Largest impacts in Tropics for IR

Privé, N.C., Karpowicz, B.M., McGrath-Spangler, E.L. and Kalluri, S. 2024. Impacts of an Early Morning Low Earth Orbit Observing Platform in a Future Global Observing Network Scenario. Tellus A: Dynamic Meteorology and Oceanography 76(1): 1–23 DOI: https://doi.org/10.16993/tellusa.4080

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GESTAR II