Impact Analysis of LEO Hyperspectral Sensor IFOV size on the next generation NWP model forecast performance

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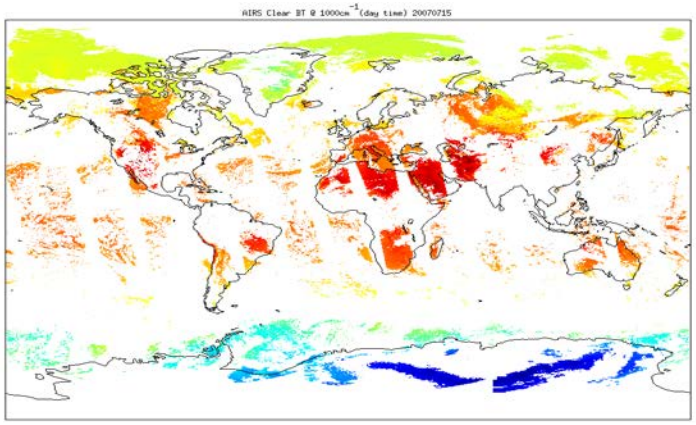
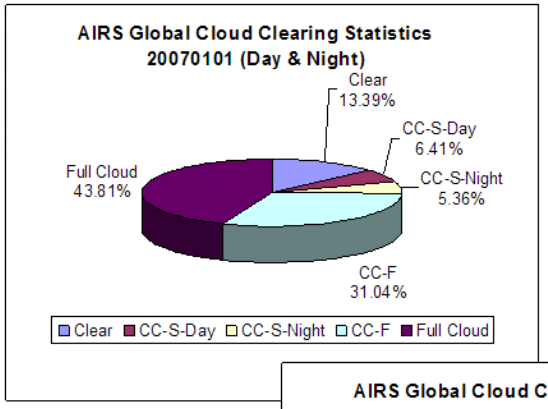
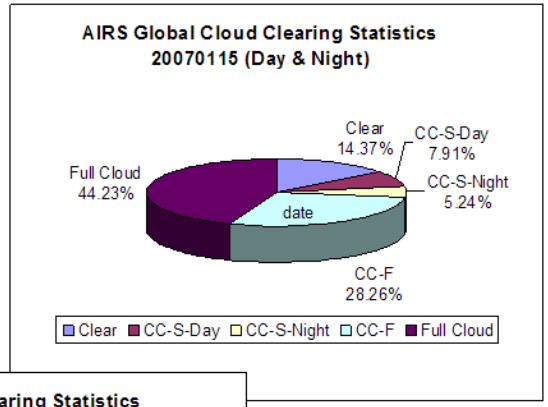
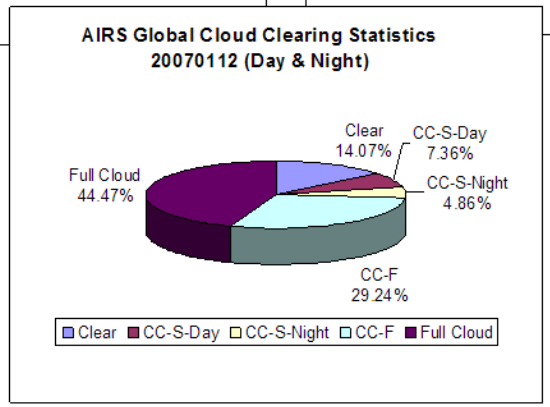
Current Infrared Hyperspectral Sounder greatly impacted by clouds due to large FOV size



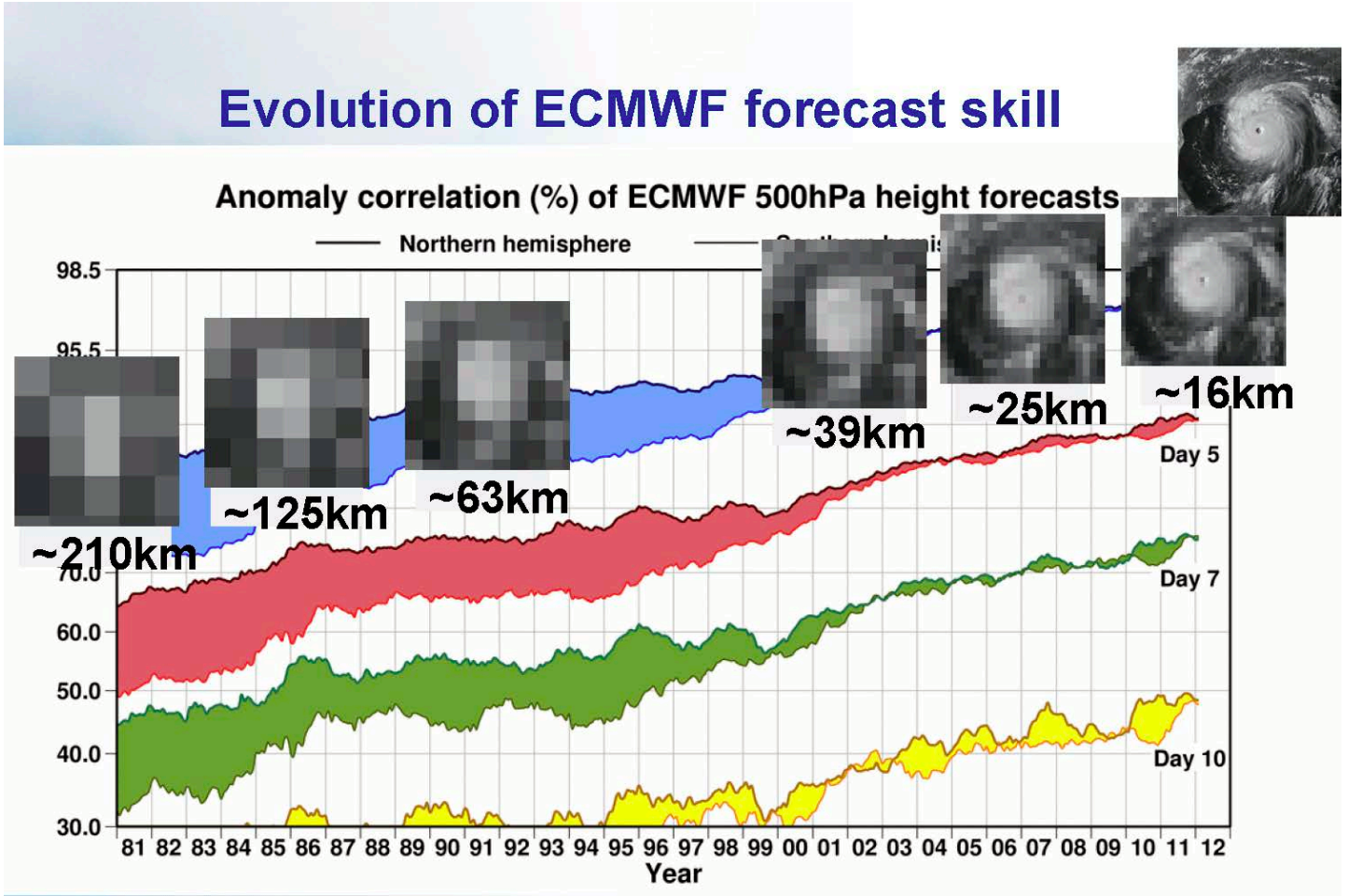
AIRS Global Cloud Clearing Statistics







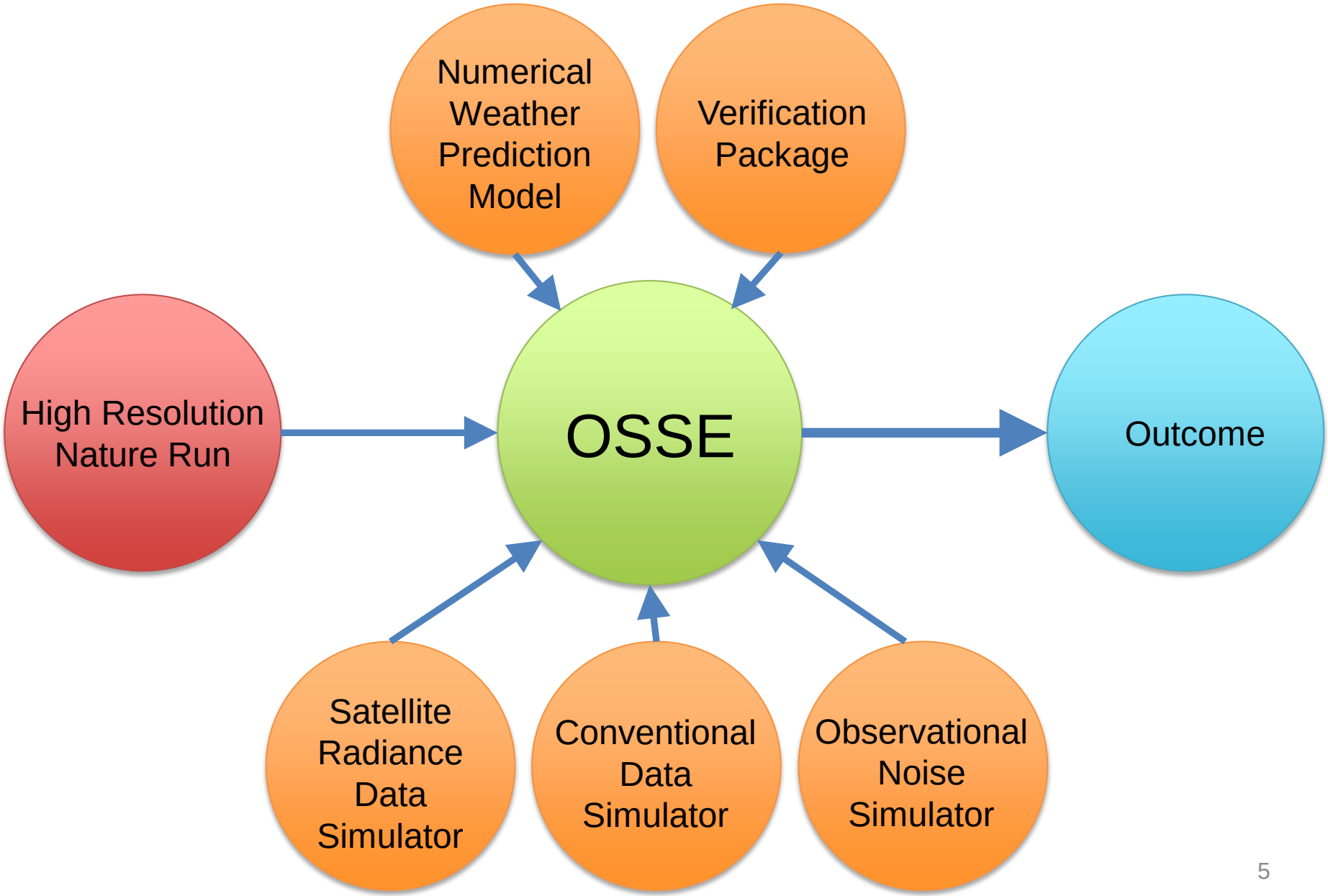
Why Small FOV CrIS matters to Global & Regional NWP



Motivation

To assess the forecast impact obtained from the assimilation of next generation CrIS observations with increased spatial resolution in a high resolution global model

Ingredients needed by an OSSE

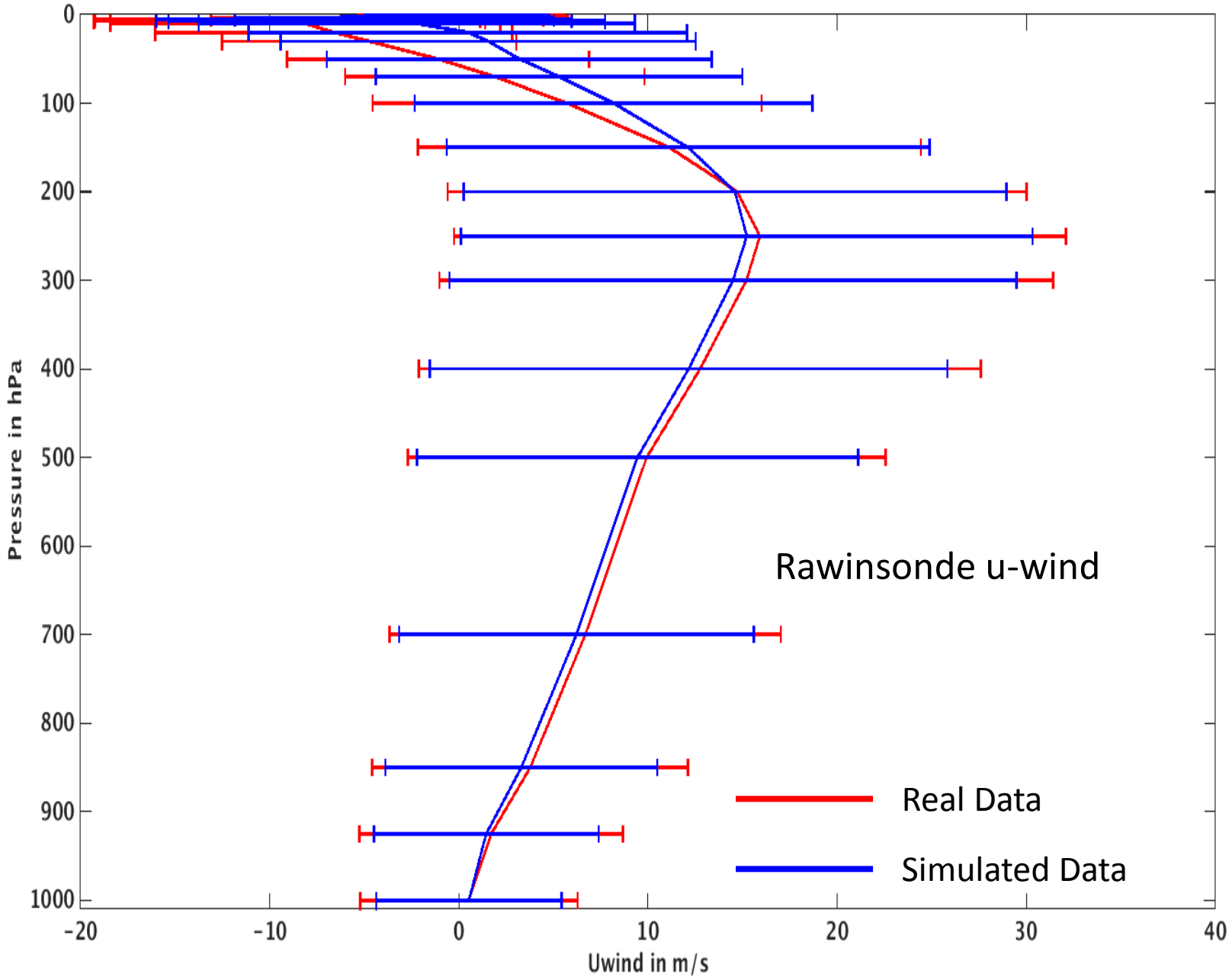


Simulation of Conventional Observations

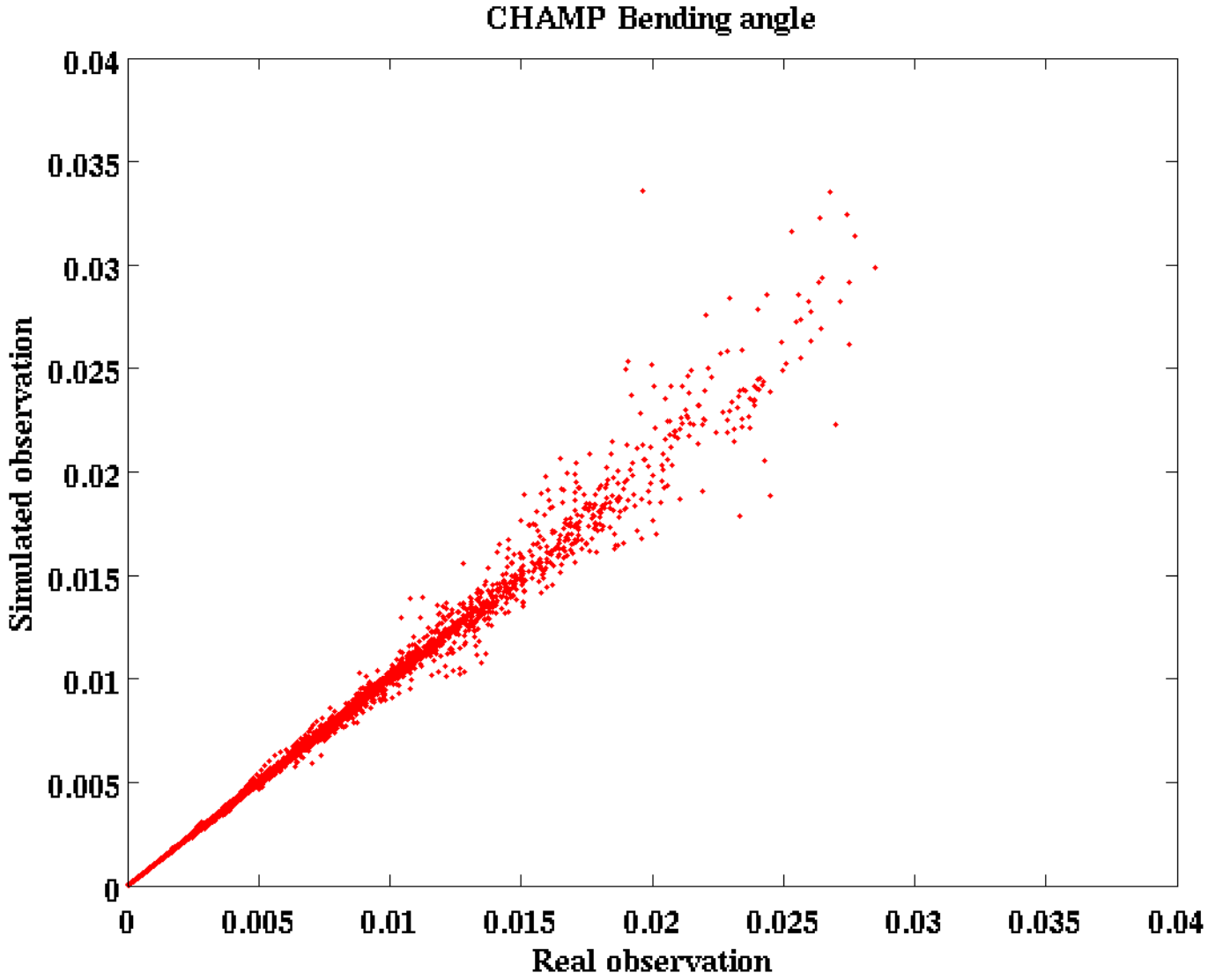
Observation location and time based on real archived data.

All observation types simulated except dropsondes, NEXRAD winds and satellite track winds.

GPSRO observations simulated using Radio Occultation Processing Package (ROPP) which is a 2D forward model


Pressure in hPa
0
100
200
300
400
500
600
700
800
900
1000
-20
-10
0
10
20
30
40
Uwind in m/s
Rawinsonde u-wind
Real Data
Simulated Data

Comparison of real GPSRO bending angles with simulated bending angles



Simulation of Satellite Observations

Flying satellites in the NR.

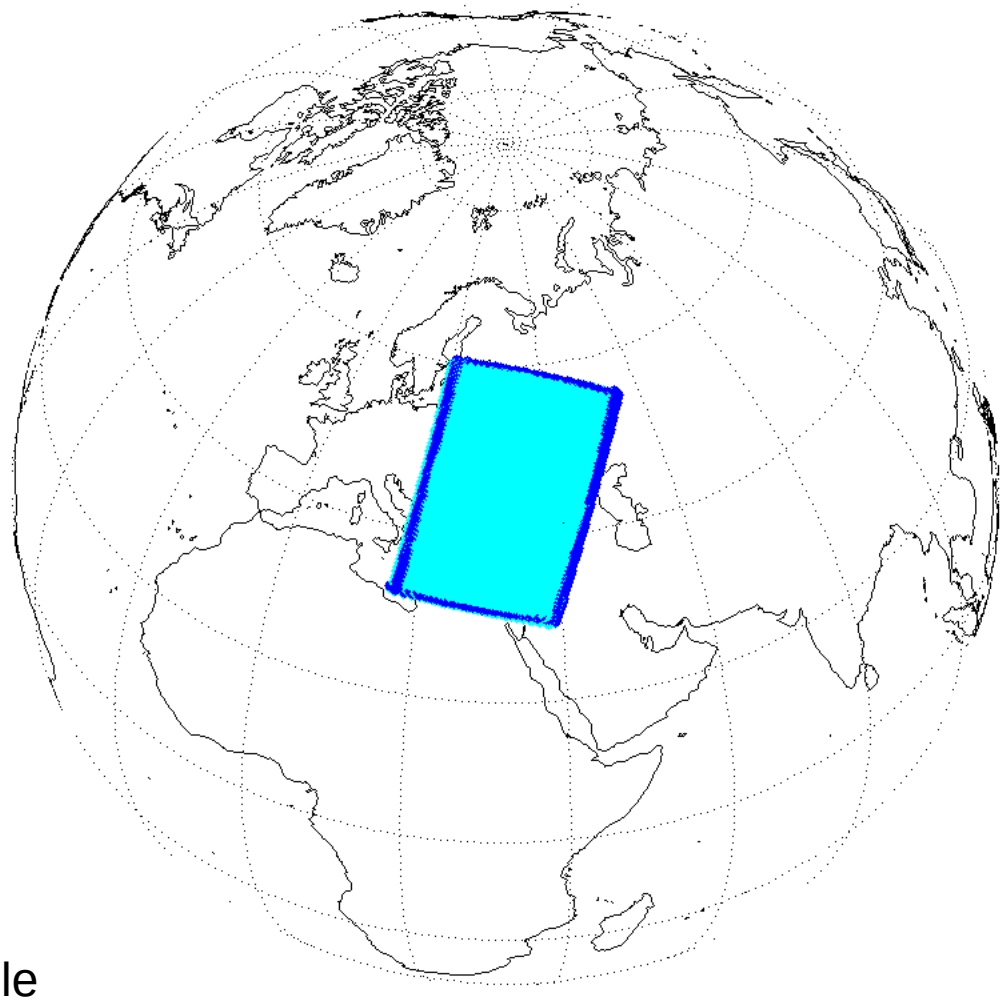
Orbit simulator

80% of the sensors assimilated in the operational GDAS included in the OSSE.

Maintain the same channel usage as the operational

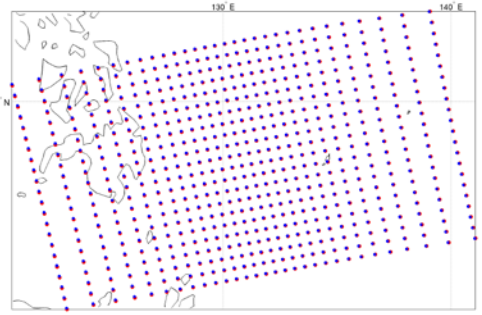
Community Radiative Transfer Model (CRTM)

Comparison of real CrIS orbits with that generated from the orbit simulator

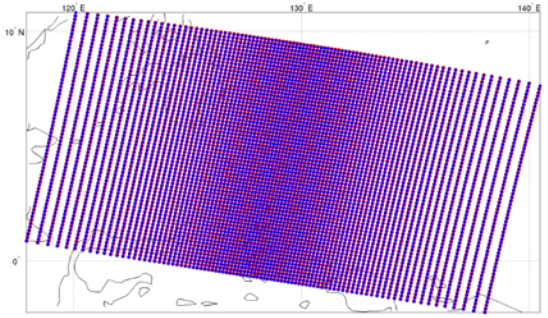


Cyan – real granule
Blue outline – simulated granule

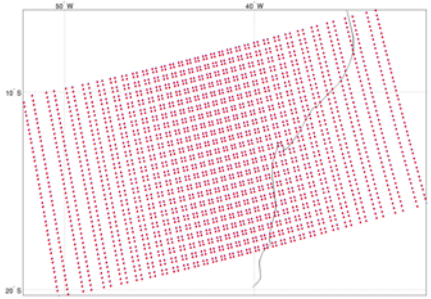
Real satellite orbits versus that generated from the orbit simulator



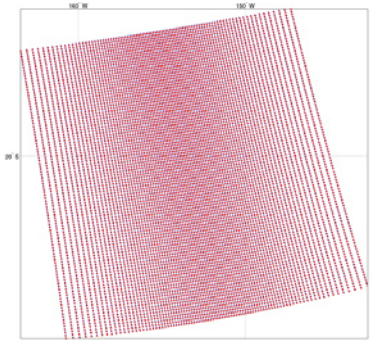
NOAA-15 AMSU-A



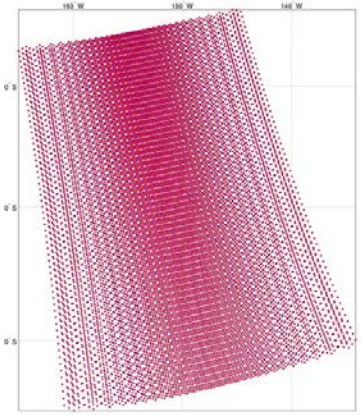
NOAA-18 MHS



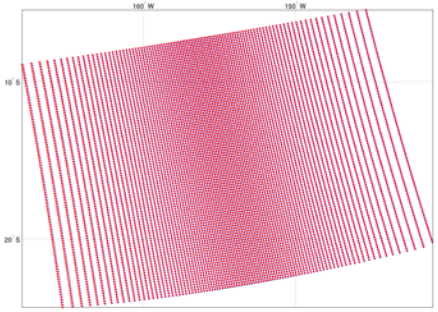
METOP-A IASI



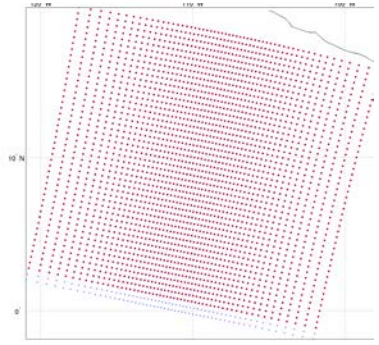
AQUA AIRS



S-NPP CrIS



S-NPP ATMS



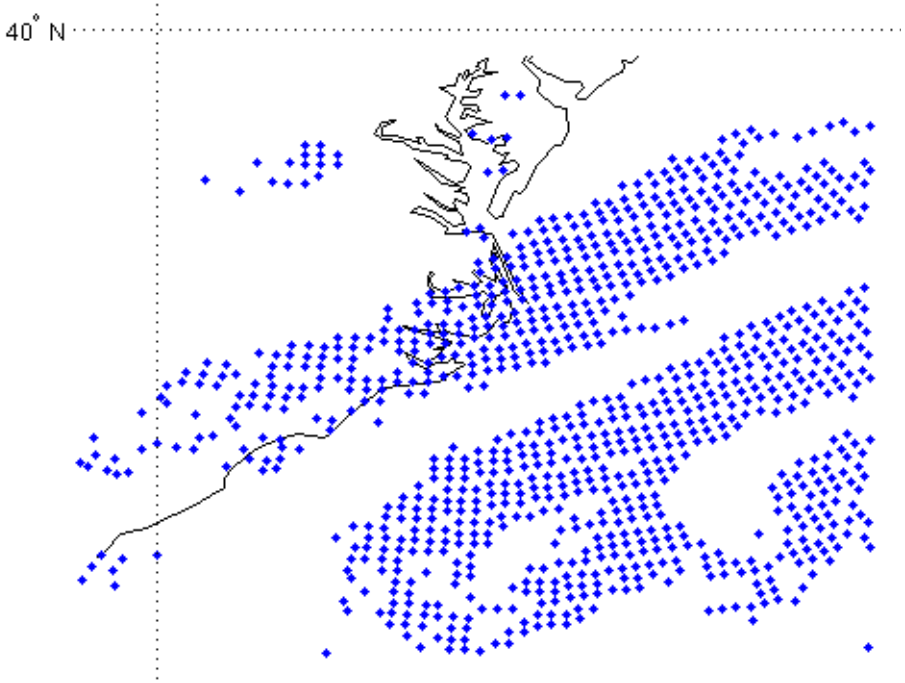
METOP-A HIRS-4

Simulated satellite orbits

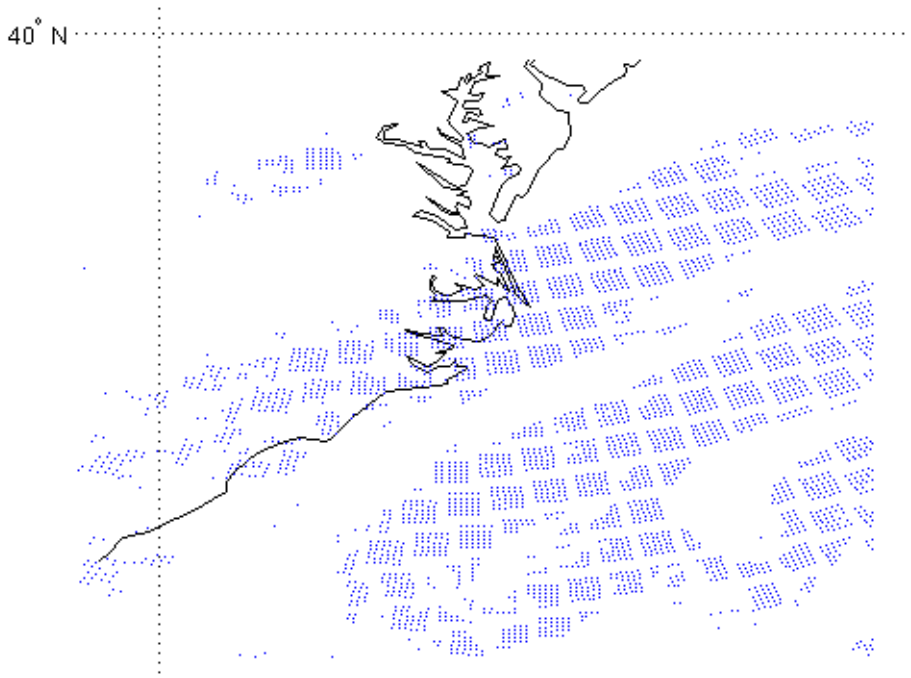
Real satellite orbits

Comparison of current CrIS FOVs with the next generation CrIS FOVs

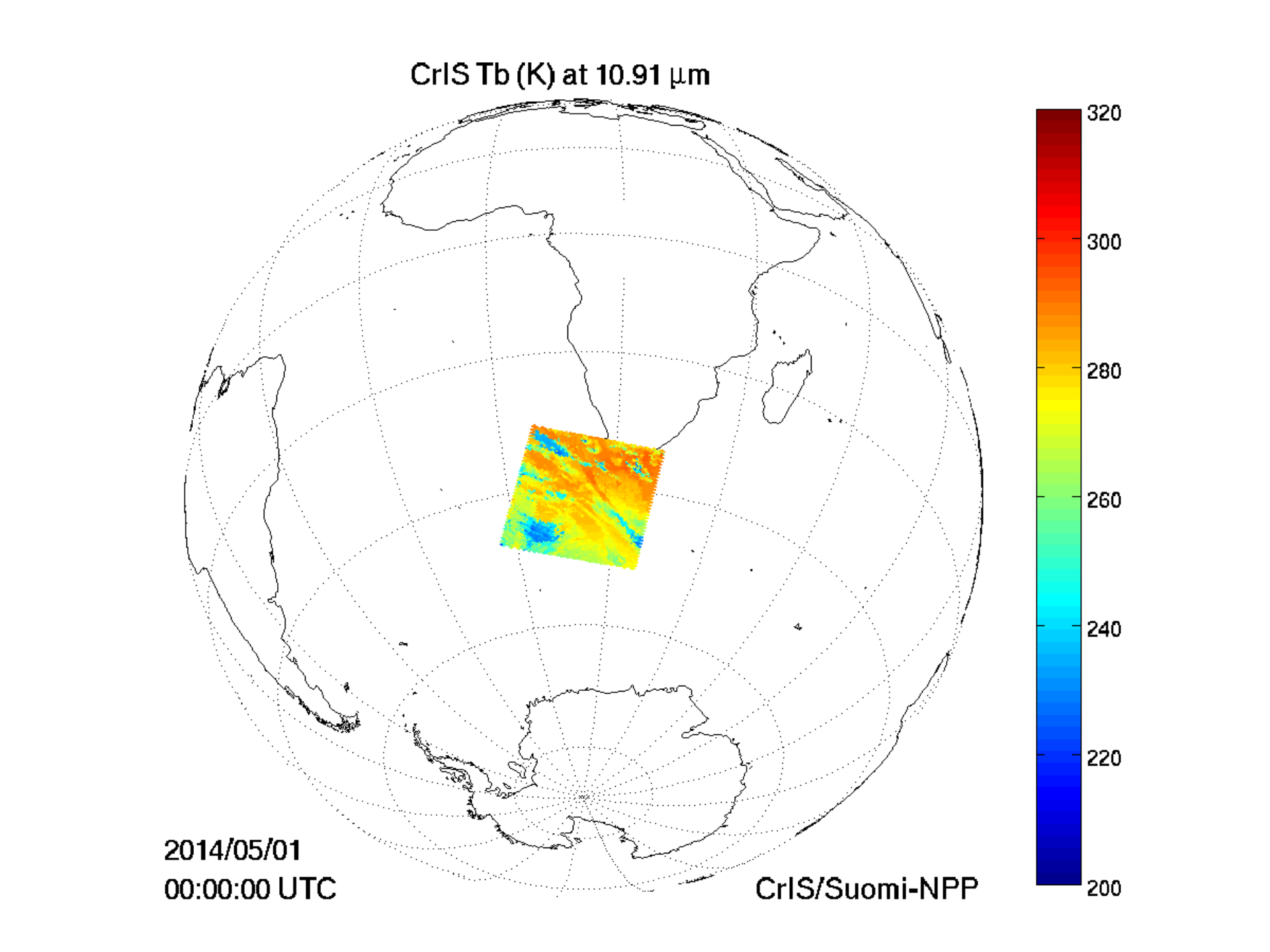
Current CrIS

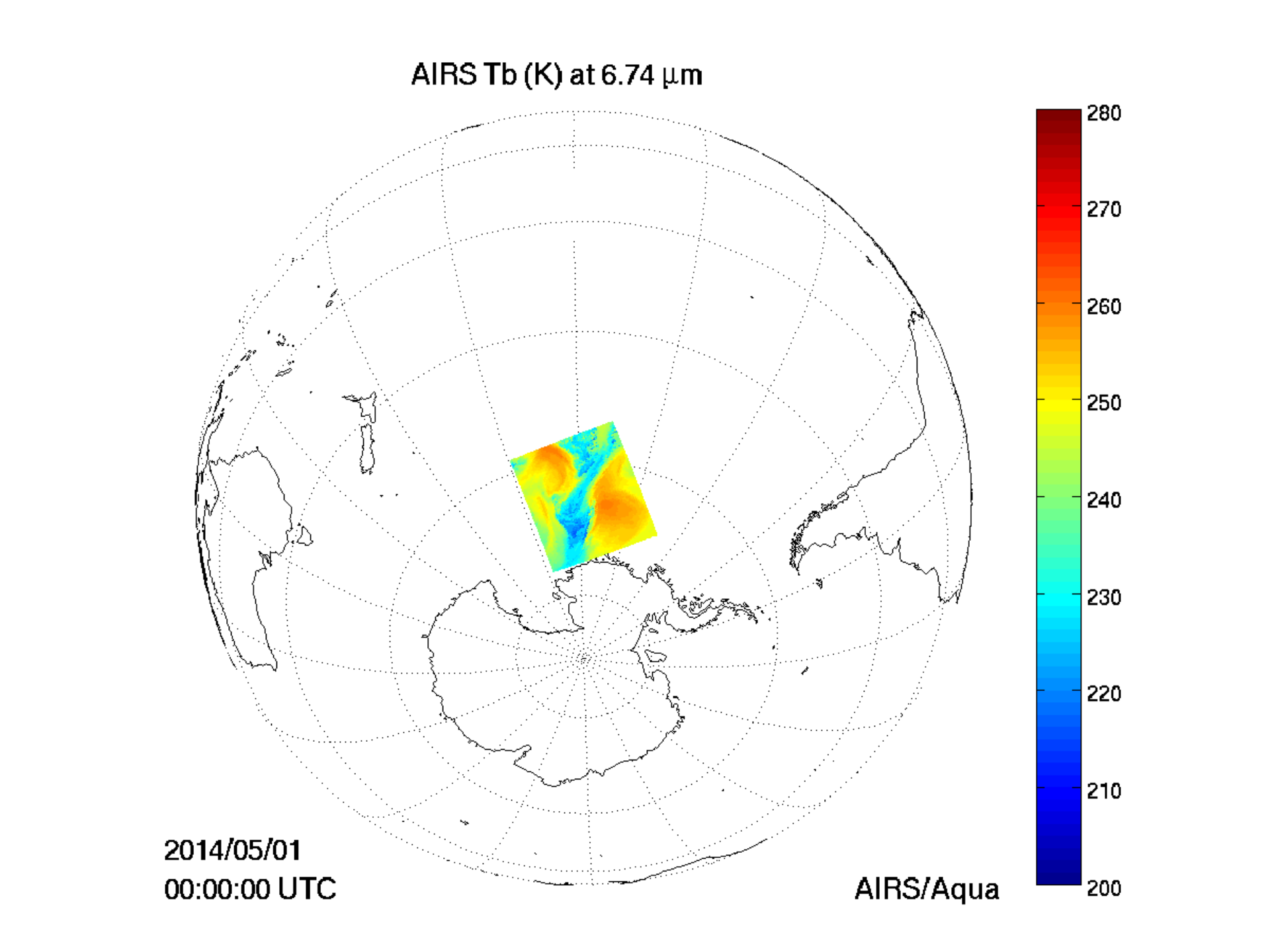


Potential next Gen CrIS



Cloud Mask


CrIS Tb (K) at 10.91 μm
320
300
280
260
240
220
200
2014/05/01
00:00:00 UTC
CrIS/Suomi-NPP


AIRS Tb (K) at 6.74 μm
280
270
260
250
240
230
220
210
200
2014/05/01
00:00:00 UTC
AIRS/Aqua

OSSE Calibration

Comparison of statistical properties of innovations, analysis errors and analysis increments between real and simulated world.

Importance - Verifies that the simulated data impact is comparable to real observations.

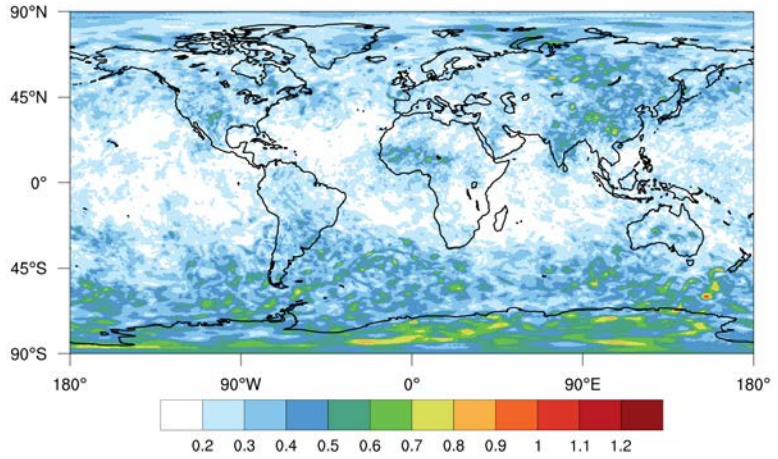
DAS configuration is held constant. (ie **B**, **R**, QC, thinning and etc).

Random correlated/uncorrelated errors and biases added to simulated observations.

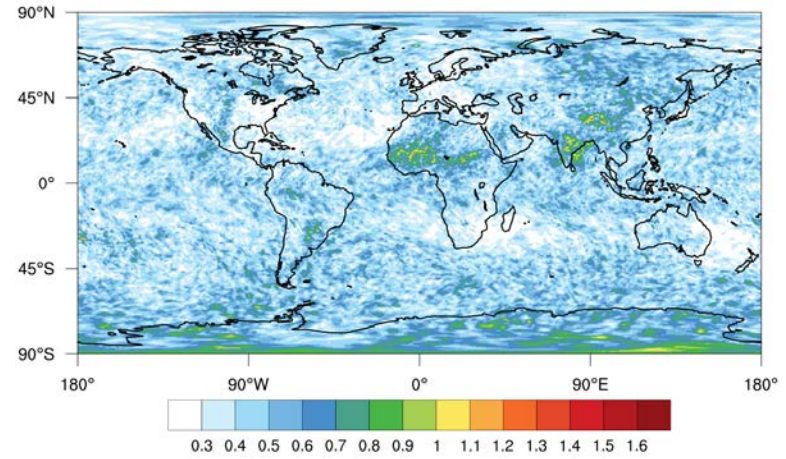
Calibration is done by adjusting errors added to simulated observations so that statistical properties of simulated world is similar to the real world.

OSSE calibration: Standard Deviation of Temperature at 500hPa

Analysis increment



Analysis Impact from denying rawinsonde

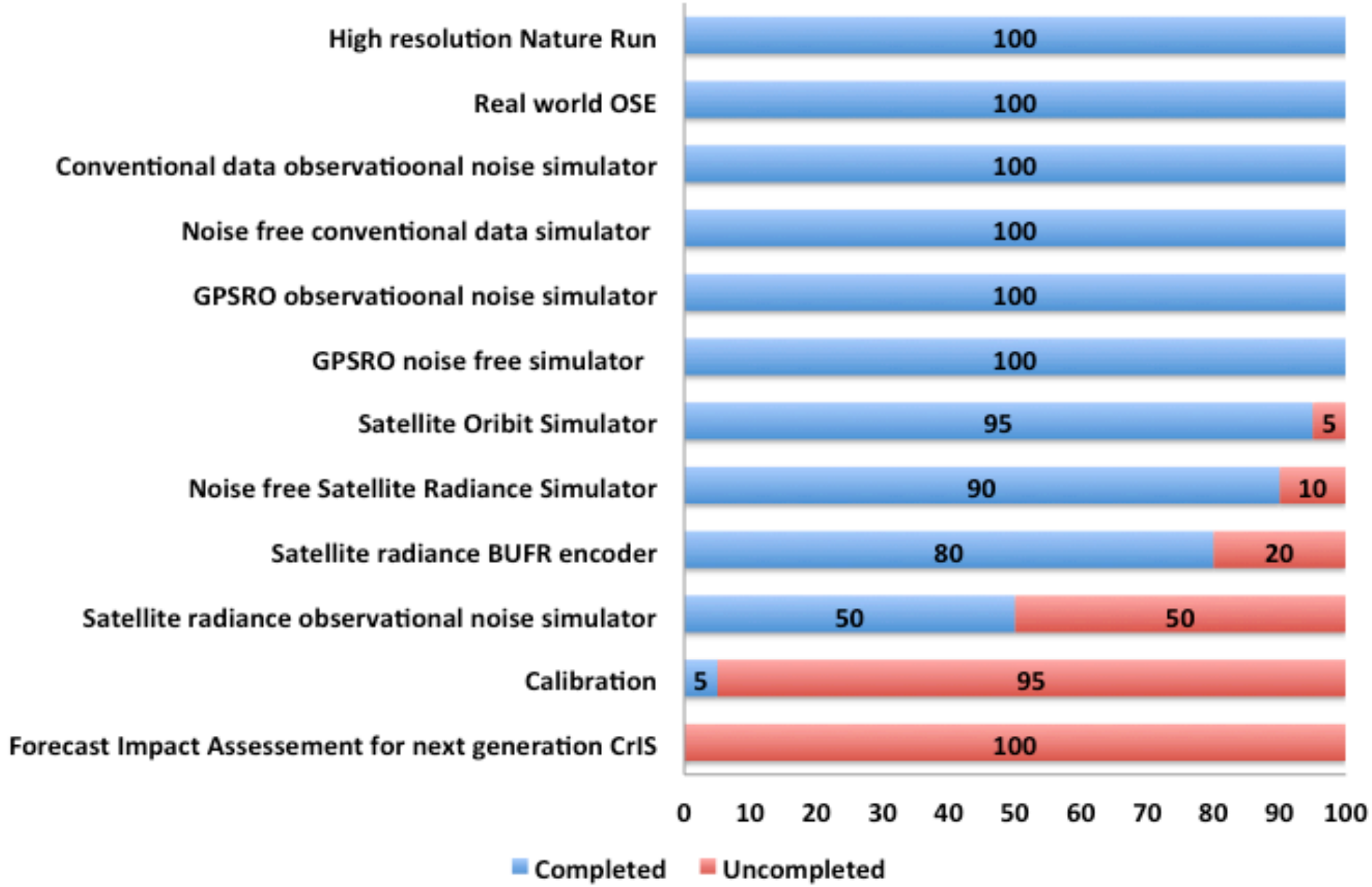


Need to achieve similar plots as the real world through adjusting errors added to simulated observations

Real World

Simulated World

Progress


High resolution Nature Run
Real world OSE
Conventional data observatioonal noise simulator
Noise free conventional data simulator
GPSRO observatioonal noise simulator
GPSRO noise free simulator
Satellite Oribit Simulator
Noise free Satellite Radiance Simulator
Satellite radiance BUFR encoder
Satellite radiance observational noise simulator
Calibration
Forecast Impact Assessement for next generation CrIS
100
100
100
100
100
100
95
5
90
10
80
20
50
50
5
95
100
0 10 20 30 40 50 60 70 80 90 100
Completed
Uncompleted

Acknowledgements

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- NASA GMAO for providing the Nature Run.
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