Community Observing System Simulation Experiments System

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Cooperative Institute for Climate & Satellites
UNIVERSITY OF MARYLAND

NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

JOINT CENTER FOR SATELLITE DATA ASSIMILATION
NOAA NASA JCSDA Navy Air Force

Outline

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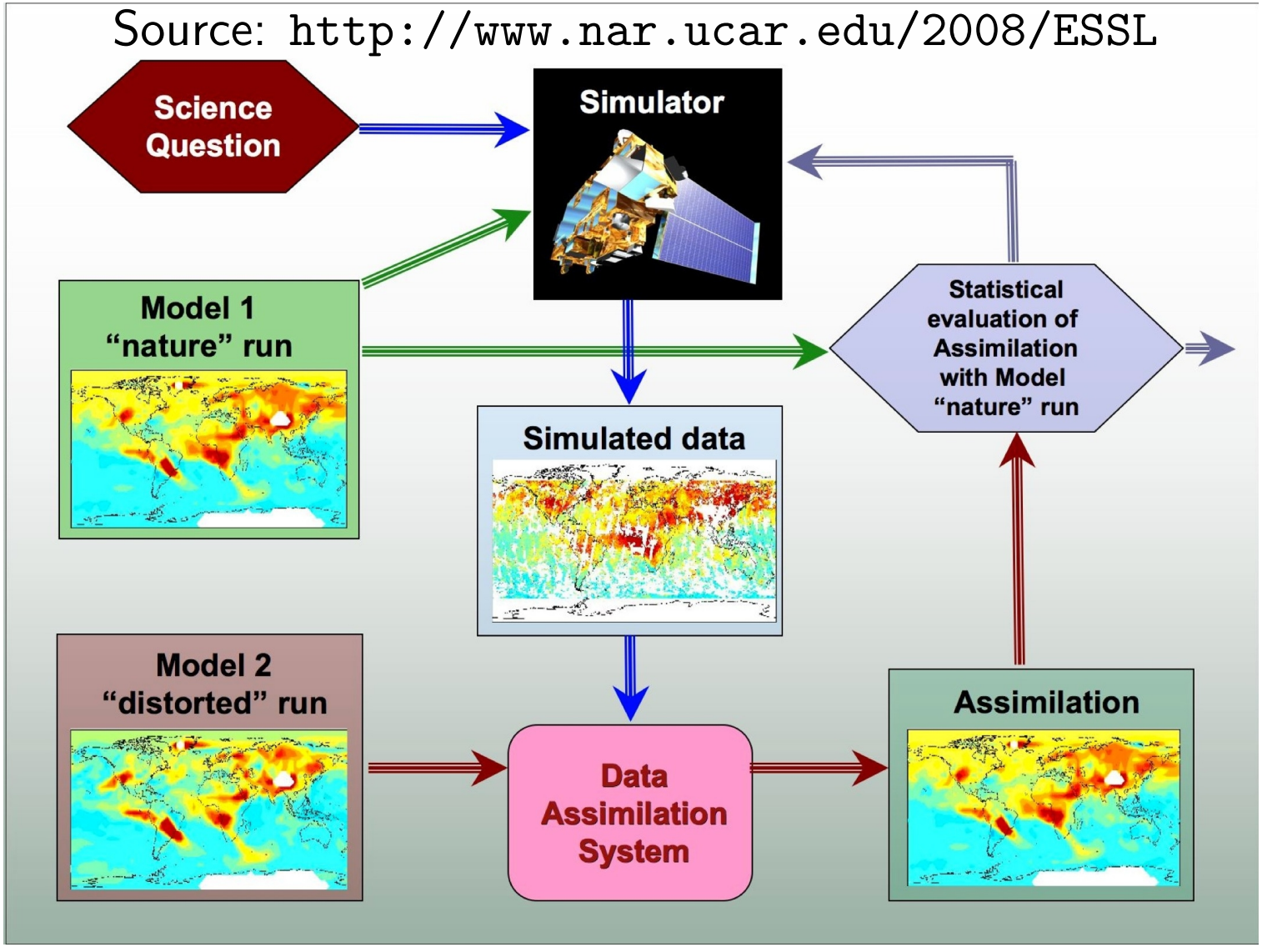
Observing System Simulation Experiments (OSSEs)



Schematic description of OSSEs

Conventional data assimilation vs. OSSE

- **Data assimilation using real observations**
  - True atmosphere is sampled by imperfect instruments
  - DA system can only be validated using sparse data such as radiosonde and dropsondes
  - Real observations are only available from current instruments
- **Data assimilation using OSSEs**
  - Observations are simulated from a high-resolution NWP model known as "Nature run" using a forward model
  - DA system can be easily validated since the true atmosphere (the "Nature run") is known
  - Observations can be simulated for any future instruments as long as the forward model is available

Application of OSSEs

- investigate the impact of future instruments on the weather forecast and data assimilation
- evaluate different data assimilation techniques since the truth is well known
- examine the impact of any future gap in the weather satellites
- investigate the impact of new data types on weather forecast and data assimilation
- OSSEs can be used for many other applications such as product retrieval, satellite data bias correction, etc.

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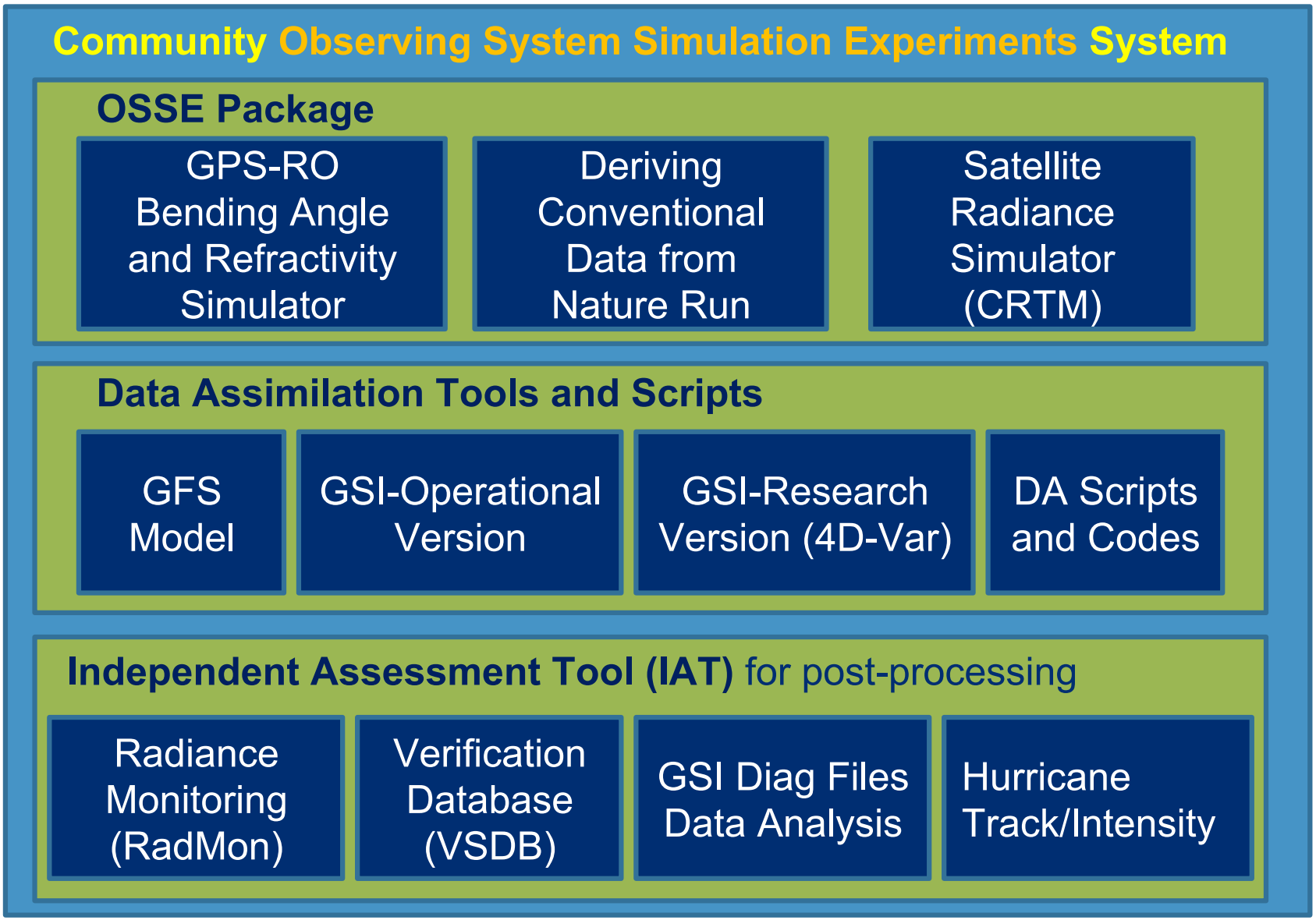
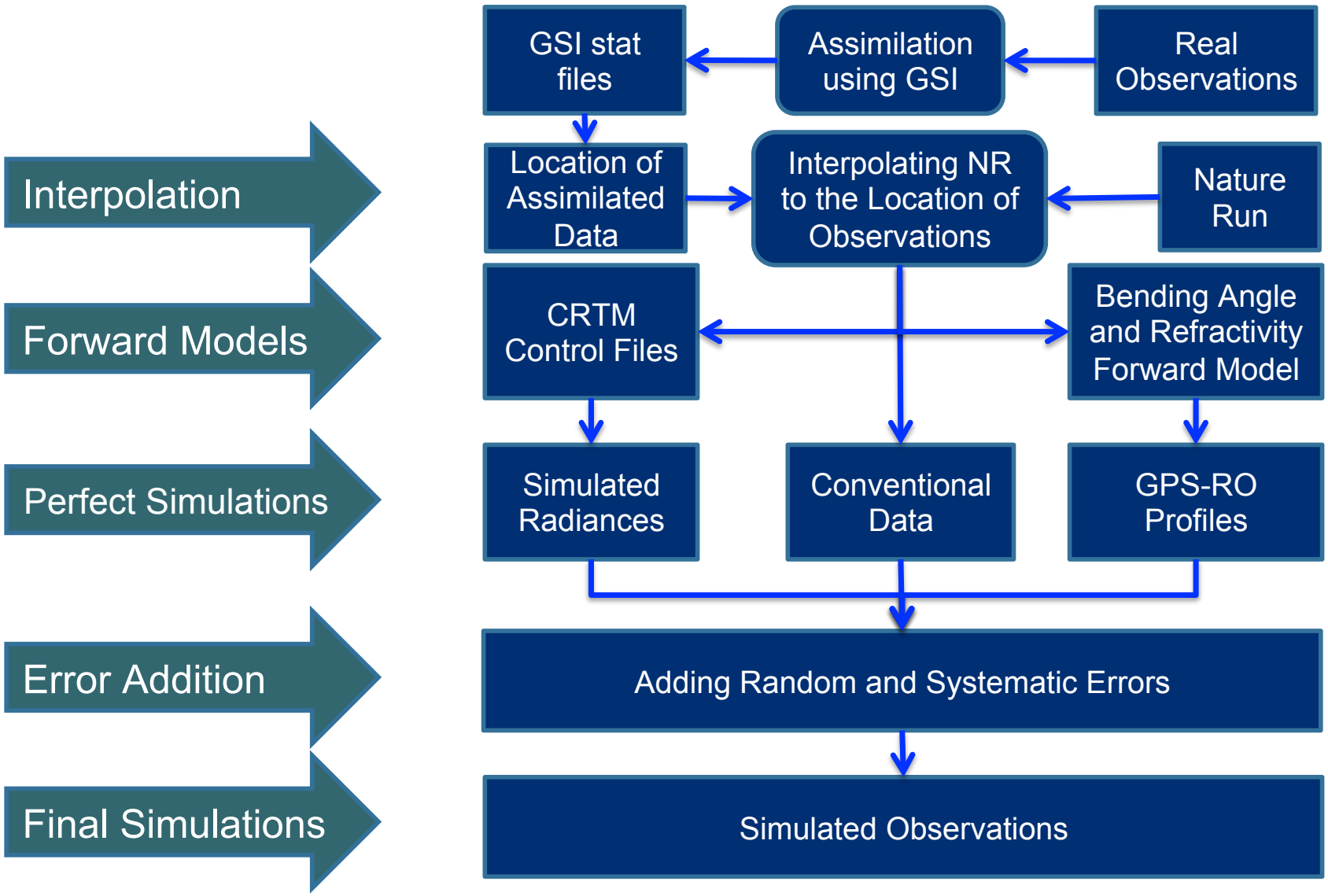
The Community OSSE System



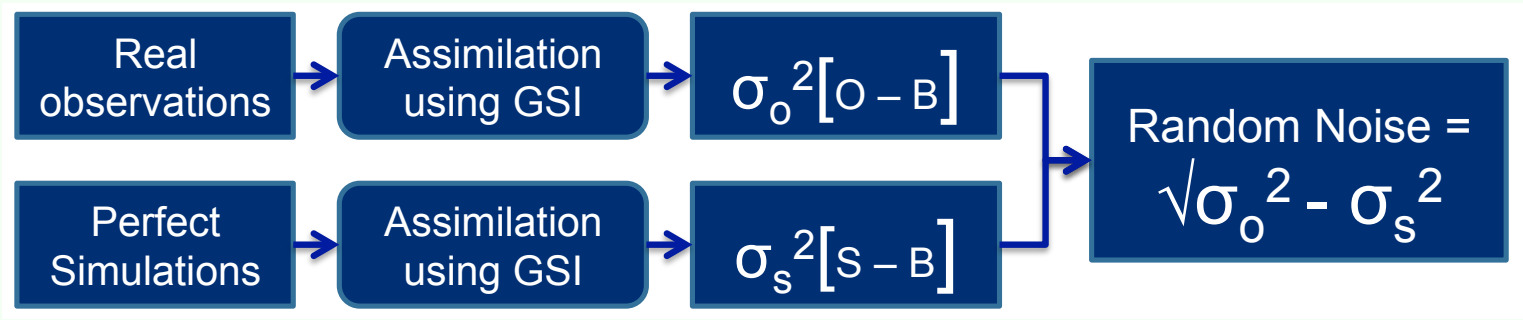
Main features of the *Community OSSE System*

- A comprehensive system integrating forward model, data assimilation and post-processing tools in one system
- Fully sub-version controlled, open-source, and integrated (e.g., all NCEP LIBs can be now compiled using one Makefile)
- Flexible that can be used to simulate different observations using different NRs
- All components (the OSSE Package, GFS, GSI, and post-processing tools) are fully tested on several HPCs
- Easy to compile and run, a simple *./run_osse YYYYMMDD* command will run all the components in sequence and controls the queue jobs

The OSSE Package



Random noise addition



- For satellite radiances, the noise is added independently for each channel with no correlation
- For conventional data, the random error is added separately for p,t,q,v and stratified by layers
- The GPS-RO random error is added separately for bending angle and refractivity

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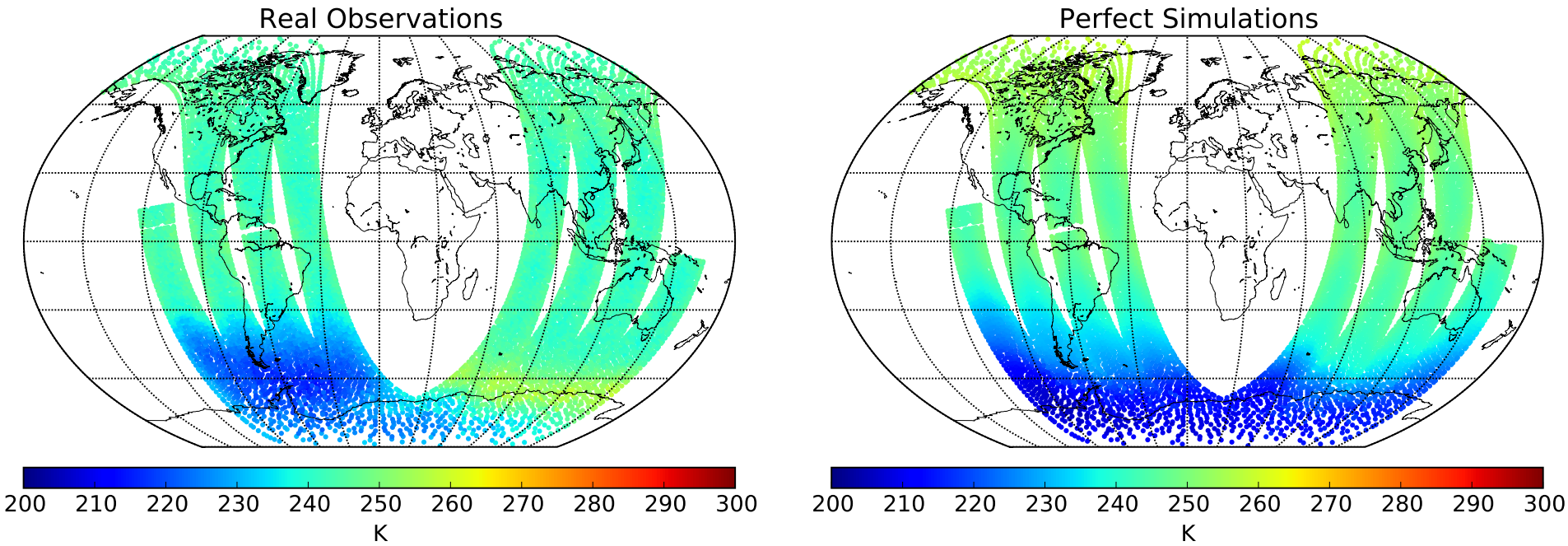
Observed versus simulated satellite radiances

Real observations (left) versus simulated observations (right)

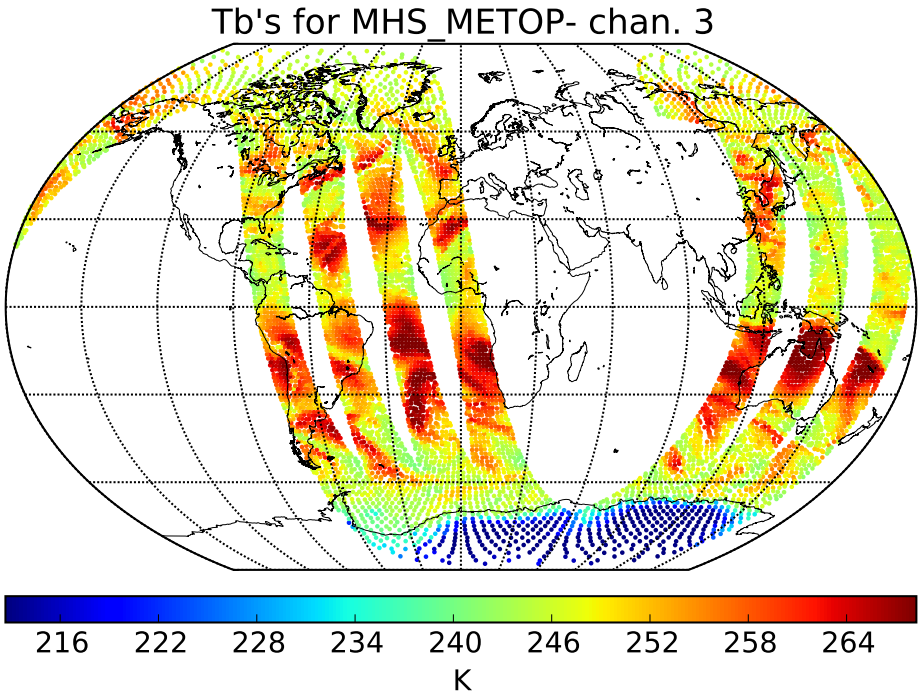
S-NPP ATMS channel 14

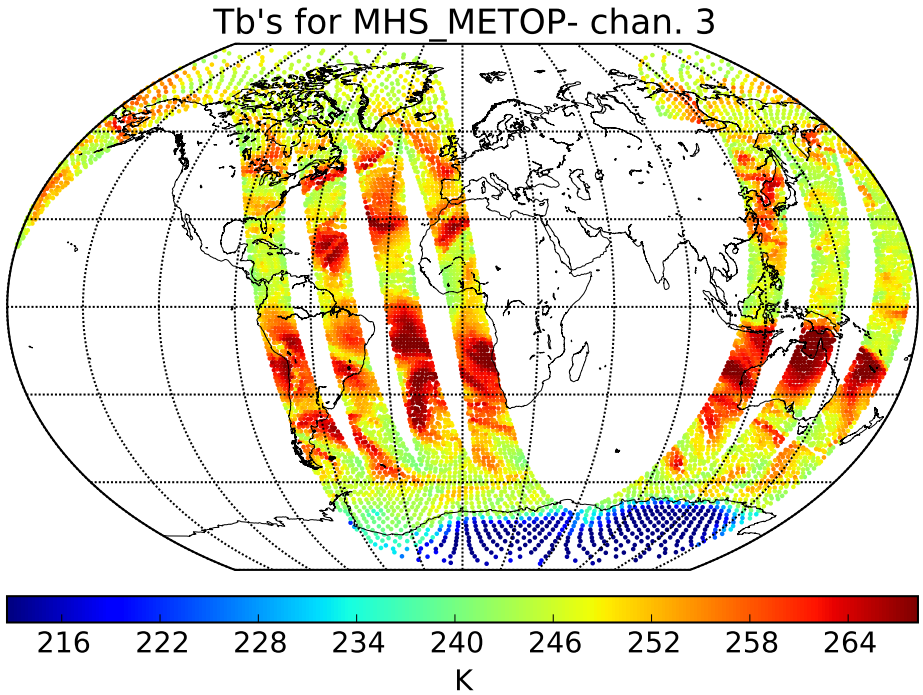


Perfect simulations versus noise-added simulations

Perfect simulations (left) versus noise-added simulations (right)

Metop-A MHS channel 3

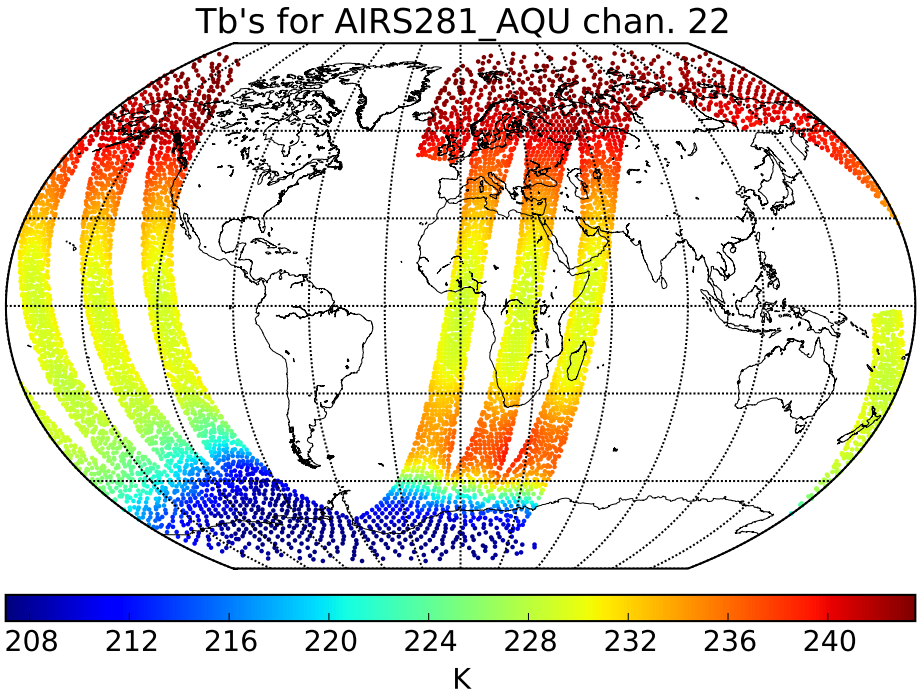


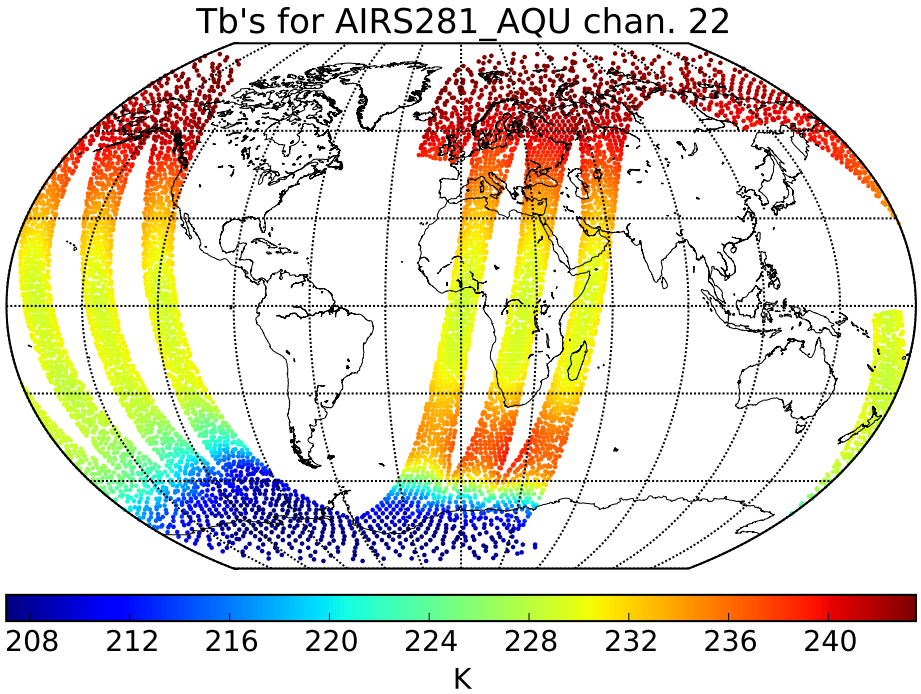


Perfect simulations versus noise-added simulations

Perfect simulations (left) versus noise-added simulations (right)

AQUA AIRS281 channel 22





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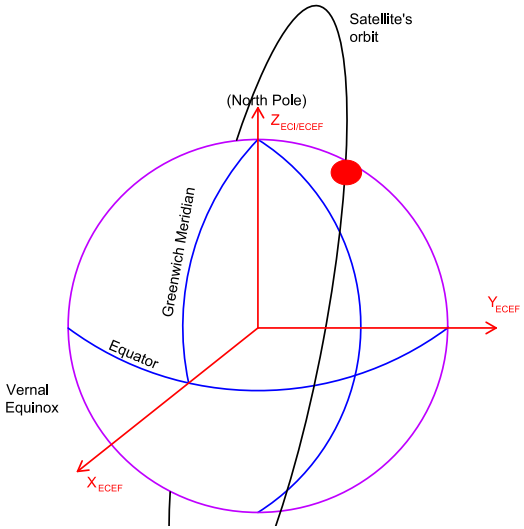
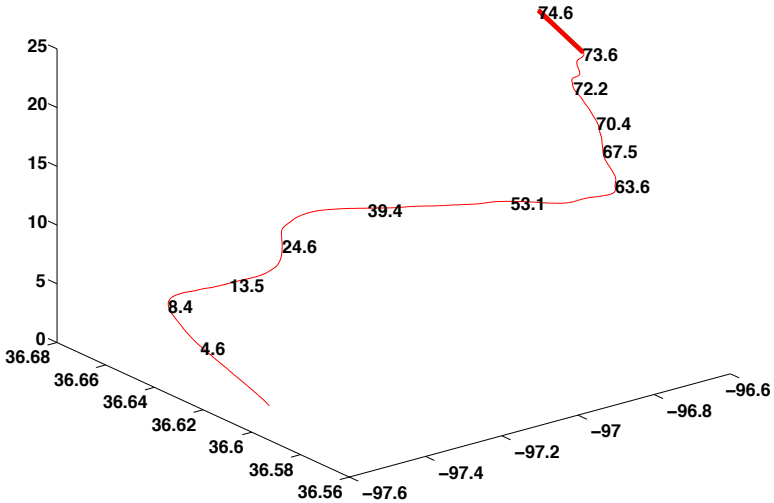
Planned enhancements

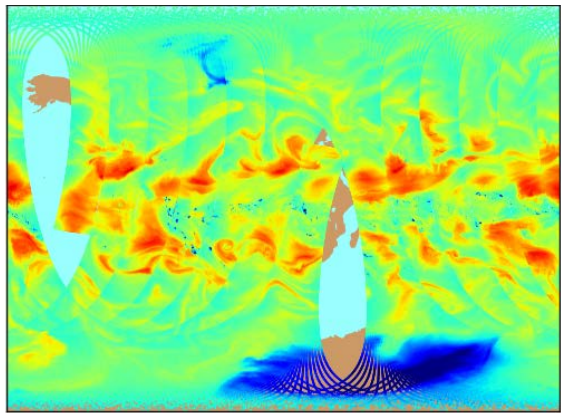
Orbit simulator

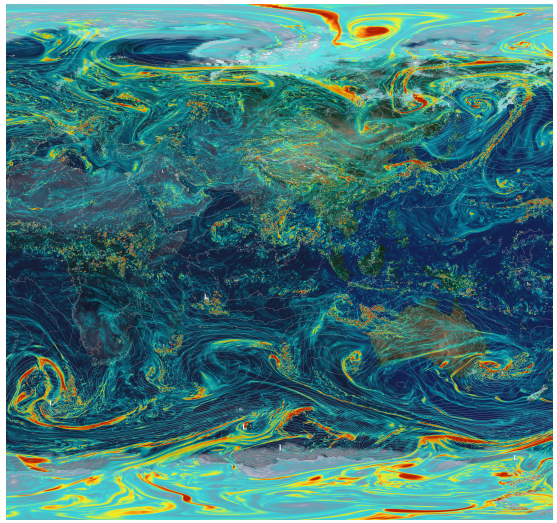




Simulating radiosonde tracks

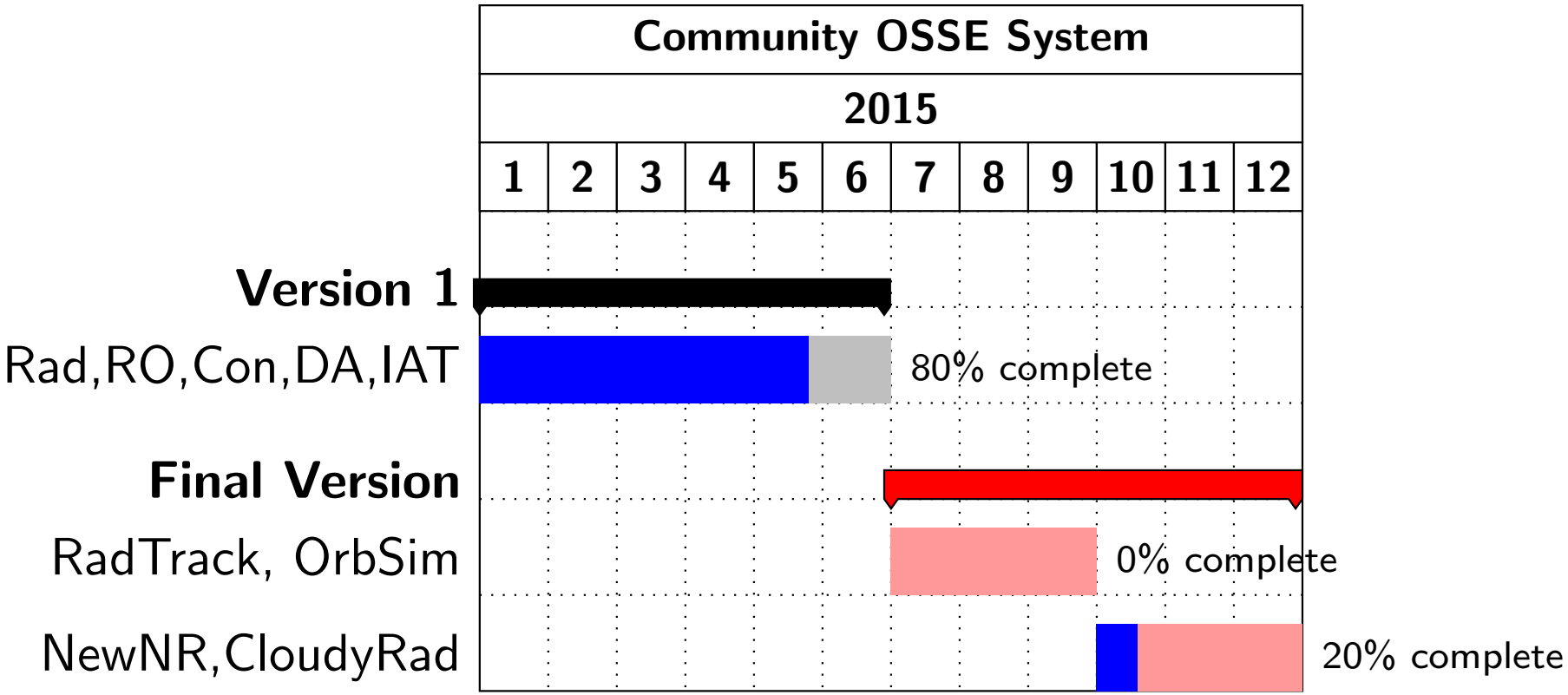
Simulating cloudy observations





Adding new NR (©NASA)

Timeline for releasing the Community OSSE System



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Conclusions

- First version of the Community OSSE System will be released in early June 2015
- Future improvements include adding radiosonde tracks, orbit simulator, cloudy radiances, and new NR
- The Community OSSE System will open a new window for practicing operational data assimilation
- The Community OSSE System not only a great tool for research but also a classroom educational tool
- Several challenges such as adding systematic errors to satellite radiances remain unsolved

Thank you for your attention!