Observing System Simulation Experiments

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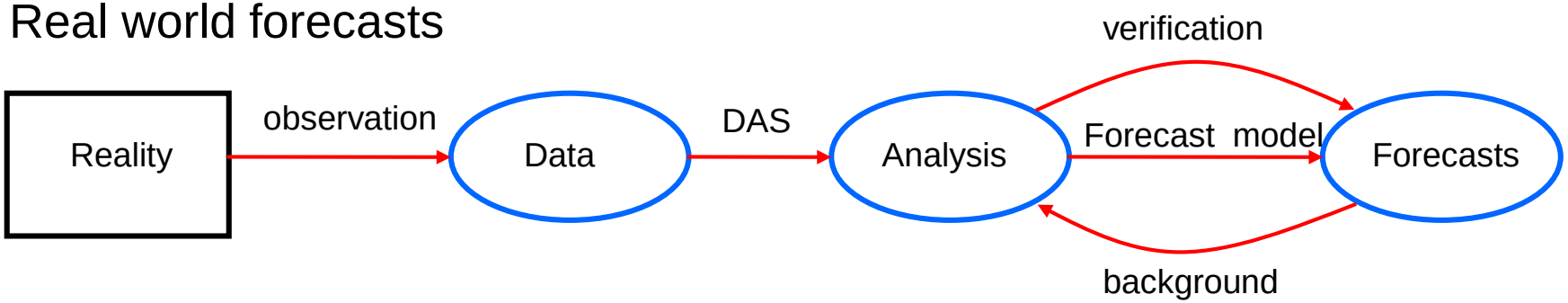
What is an OSSE?

An OSSE is a modeling experiment used to evaluate the impact of new observing systems on operational forecasts when actual observational data is not available.

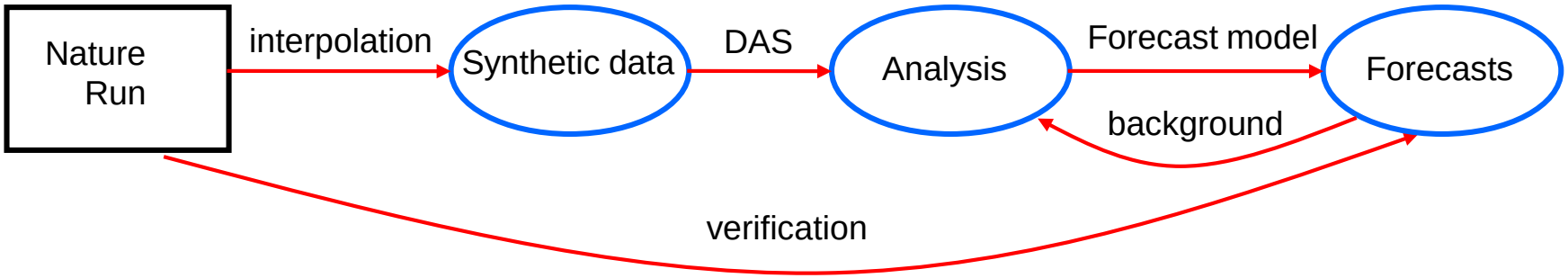
- A long free model run is used as the “truth” - the Nature Run
- The Nature Run fields are used to back out “synthetic observations” from all current and new observing systems.
- Suitable errors are added to the synthetic observations
- The synthetic observations are assimilated into a different operational model
- Forecasts are made with the second model and compared with the Nature Run to quantify improvements due to the new observing system

OSSEs vs. the Real World

Real world forecasts



OSSE forecasts



Nature Runs

- Nature Runs act as the 'truth' in the OSSE, replacing the real atmosphere.
- Usually, a long free (non-cycling) forecast from the best available model is used as the NR
  - Model forecast has continuity of fields in time
  - Sometimes an analysis or reanalysis sequence is used, but the sequence of states of truth can never be replicated by a model
- Always a push for bigger, higher resolution NR

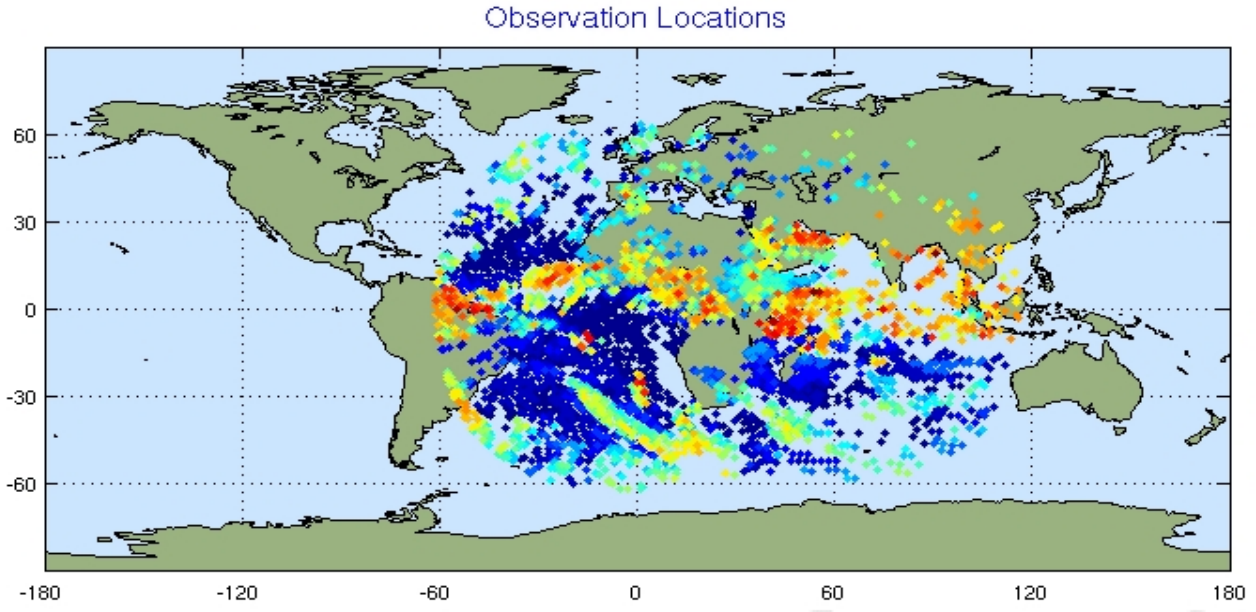
Nature Run Requirements

- Must be able to realistically model phenomena of interest
  - Dynamics and physics should be realistic
  - Must produce fields needed for “observations”
  - Should be verified against real world
- Ideally is ‘better’ than the operational model to be used for experiments
- Preferably a different model base is used for the NR and the experimental forecast model to reduce incestuousness

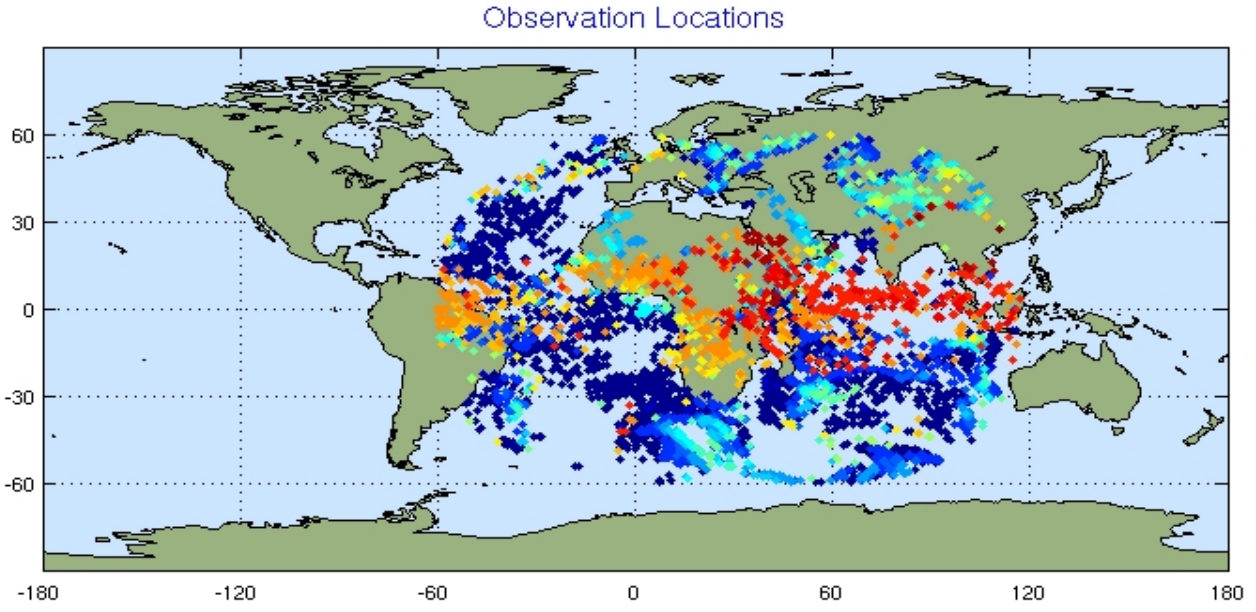
Synthetic Observations

Example of METEOSAT AMV observations at 0000 UTC 10 July

Real



Simulated



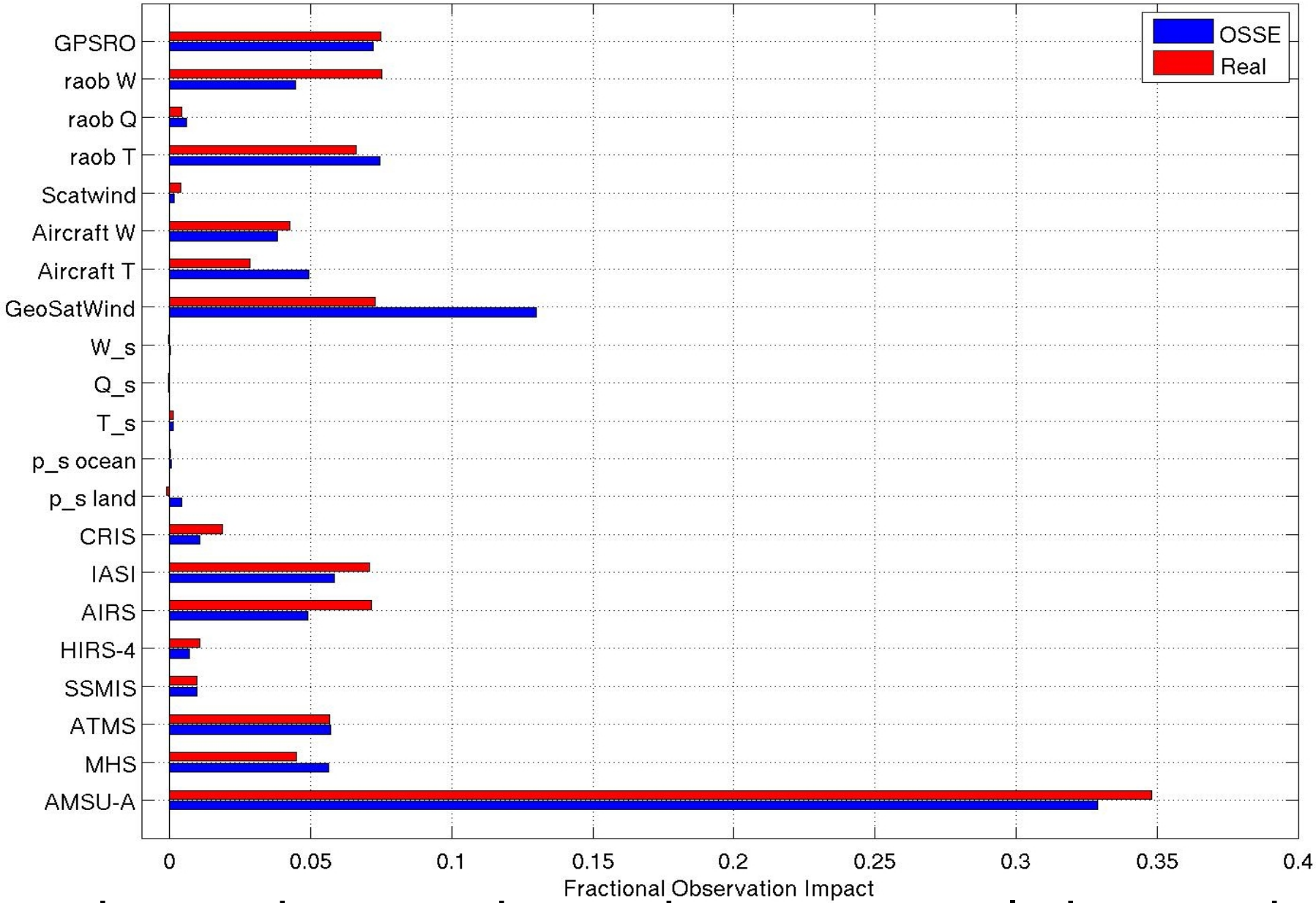
Observation Errors

- Synthetic observations contain some intrinsic interpolation/operator errors, but less than real observations (usually)
- Synthetic errors are created and added to the synthetic observations to compensate
- Error is complex and poorly understood
  - Error magnitude
  - Biases
  - Correlated errors

Calibration and Validation

- Choose some metric(s) to use as a basis for calibration
- Run analog case with real data
- Compare OSSE metrics to real data metrics
- Adjust OSSE framework to match metrics
- Compare other important metrics (not used for calibration) to validate your OSSE

Why believe OSSE results?



New observations can be put into context relative to existing observation impacts

Takeaway

- OSSEs can provide useful information about new observational types and the workings of data assimilation systems
- Careful consideration of research goals should guide each step of the OSSE process
- Validate your OSSE!
- OSSEs are hard, good OSSEs are harder