

Observing System Simulation Experiments (OSSEs) as tools for the investigation of data assimilation systems

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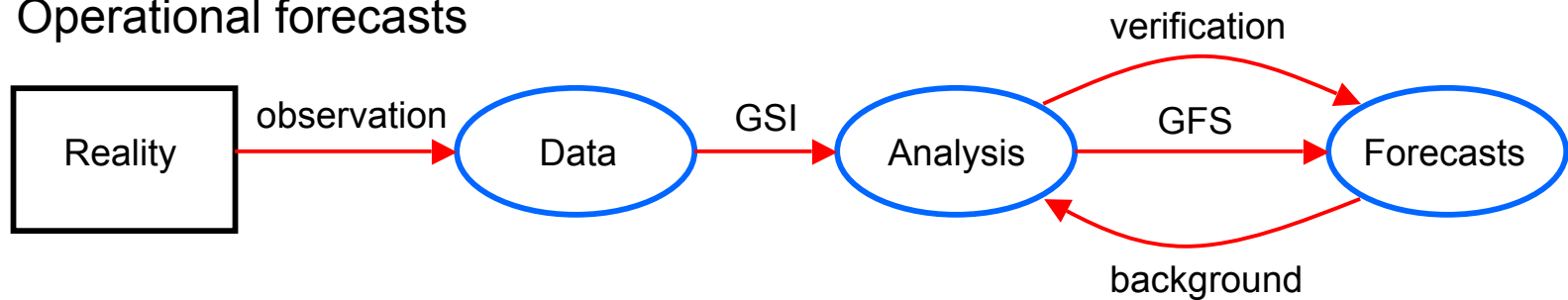
What is an OSSE?

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.

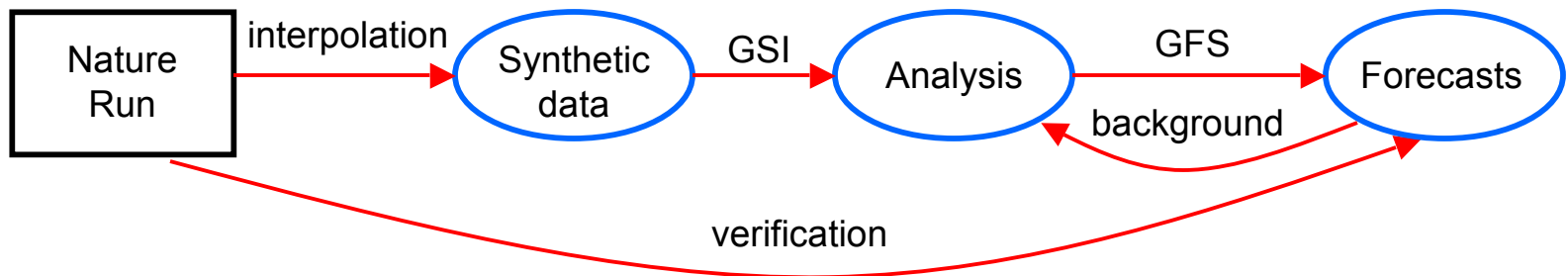
- A long free model run is used as the “truth” - the Nature Run
- The Nature Run fields are used to back out “synthetic observations” from all current and new observing systems.
- The synthetic observations are assimilated into a different operational model
- Forecasts are made with the second model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

How OSSEs Work

Operational forecasts



OSSE



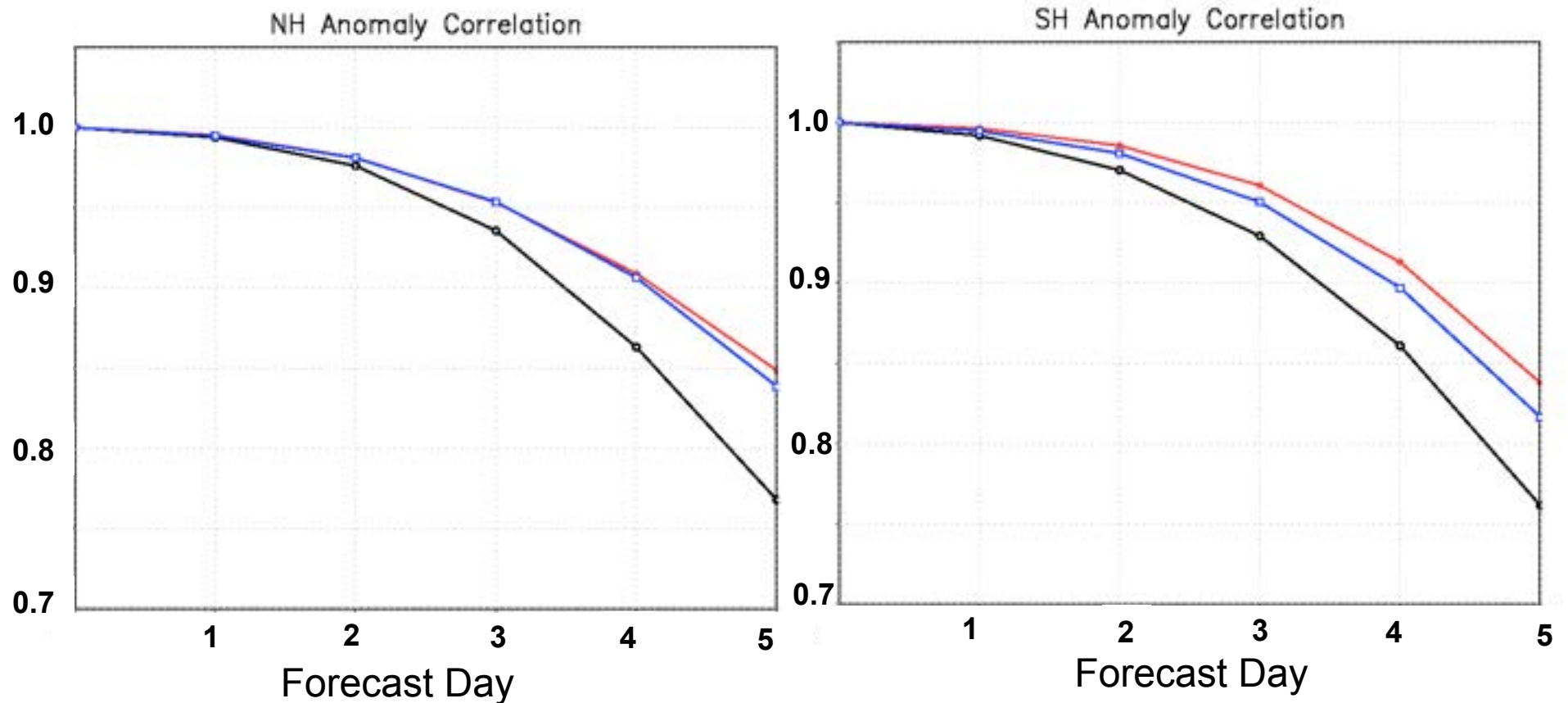
GMAO OSSE Setup

- Nature Run: 13 month run of the ECMWF operational model, T511/91L
- Synthetic Observations
 - Replicate archived observations from May 2005-May 2006
 - Includes conventional, satwind, HIRS2, HIRS3, AMSU-A, AMSU-B, AIRS, MSU types
 - Correlated errors added to 'perfect' observations
- Forecast Model
 - DAS: NCEP/GMAO GSI 3DVAR
 - Forecasts: GMAO GEOS-5 model with $0.5^\circ \times 0.625^\circ$ resolution, 72 levels

Experiments

- Three cases:
 - Archived real data (Control)
 - Synthetic observations without error (Perfect)
 - Synthetic observations with added error (OSSE)
- Cycling from 10 Dec 2005 to 5 Feb 2006
- 120 hour forecasts launched daily at 00Z
- Comparison of Perfect and OSSE cases will show the impact of observation errors
- Comparison with Control case shows relative behavior of the OSSE system to reality

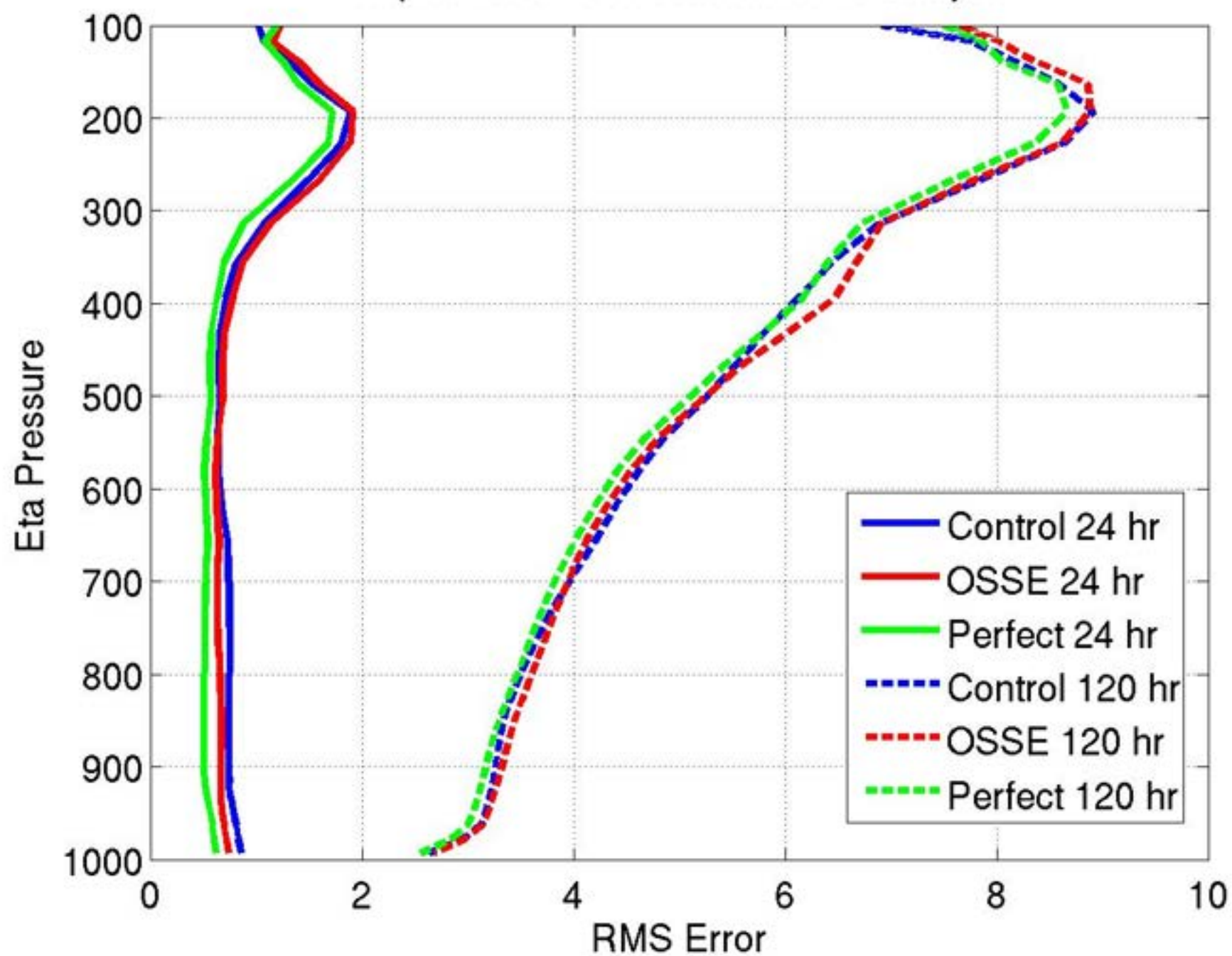
OSSE vs Real Data: Forecasts



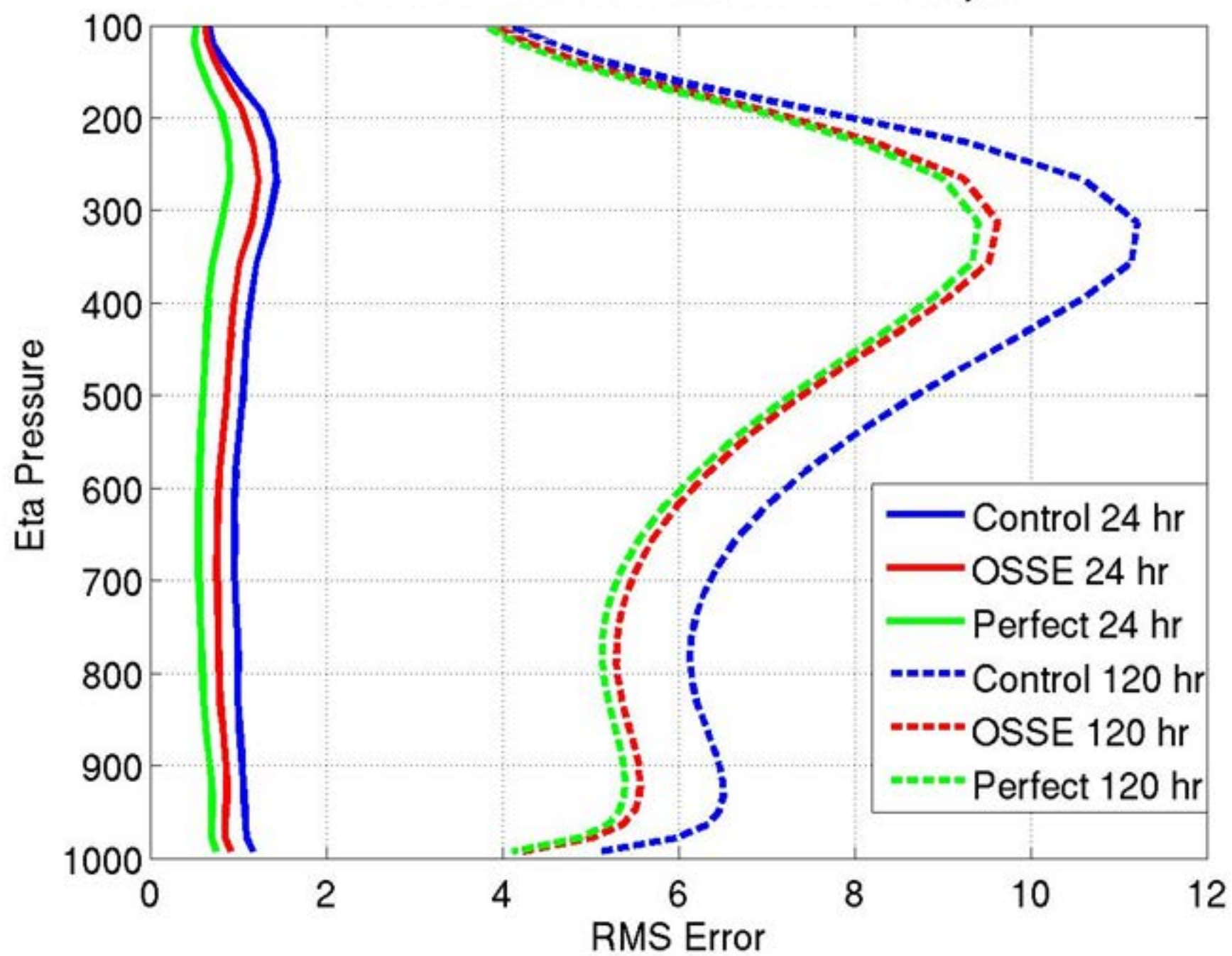
Anomaly correlations for January 2006

Control (Real)
OSSE (with Errors)
Perfect (without Errors)

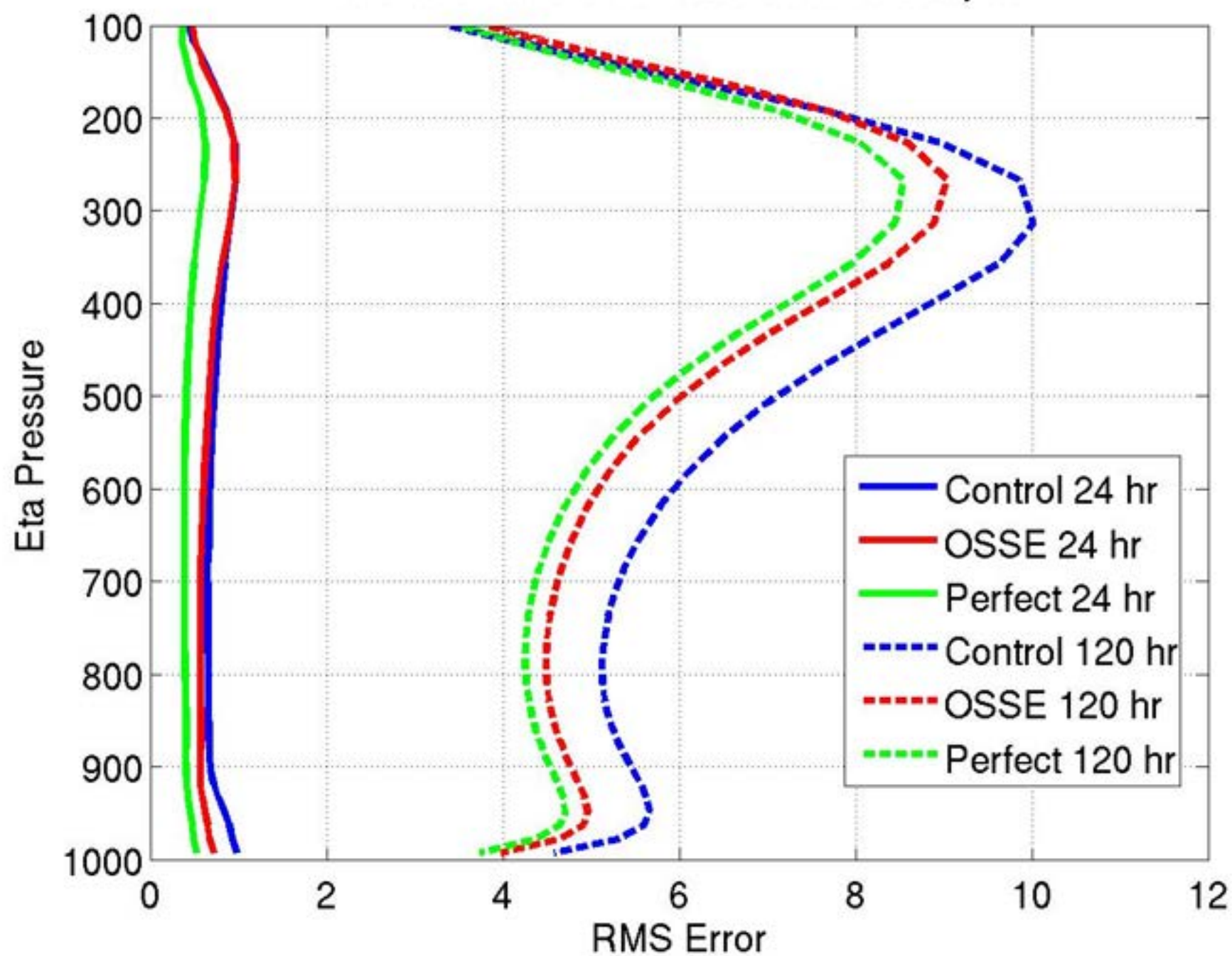
Tropics RMS U forecast error vs analysis



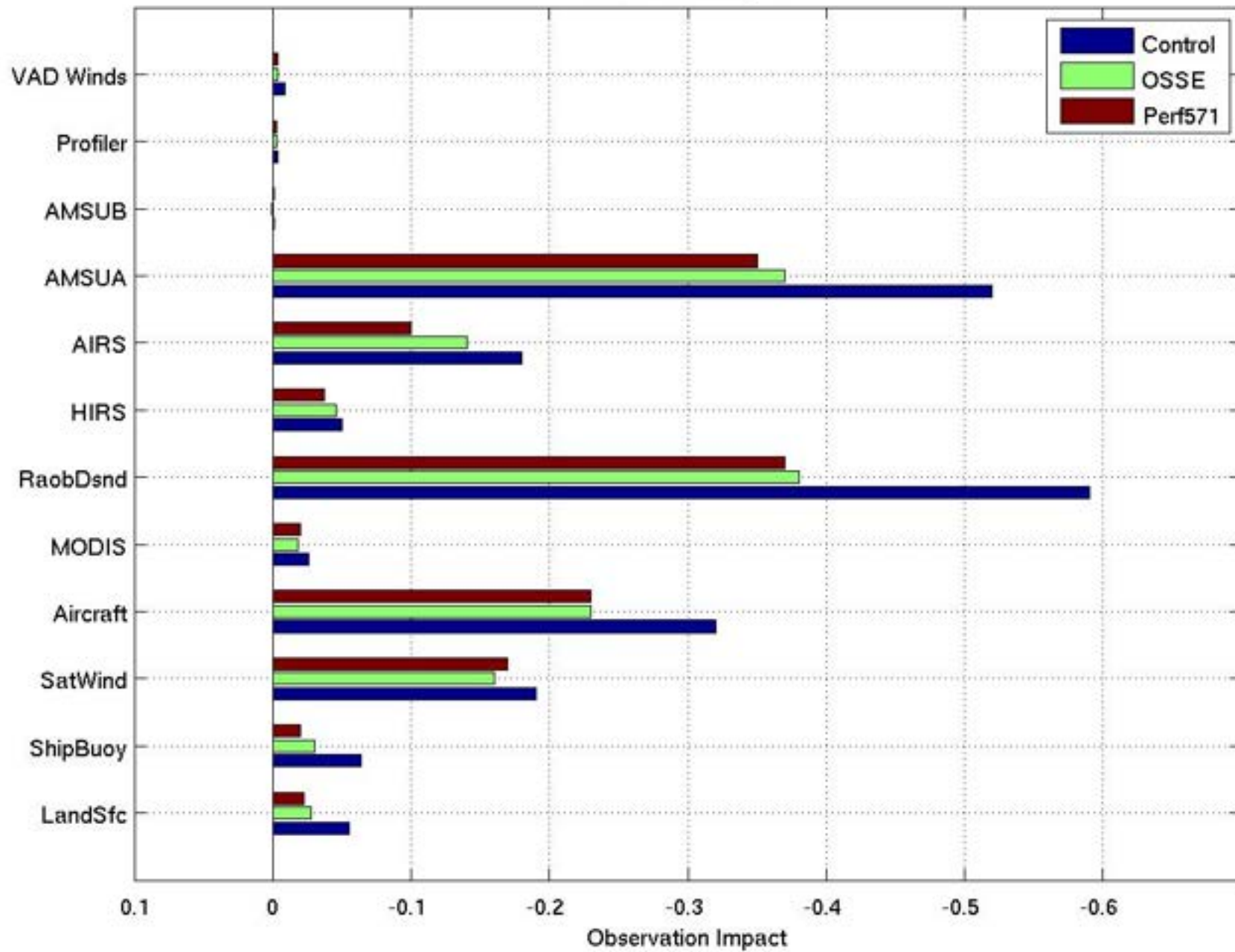
30N-90N RMS U forecast error vs analysis



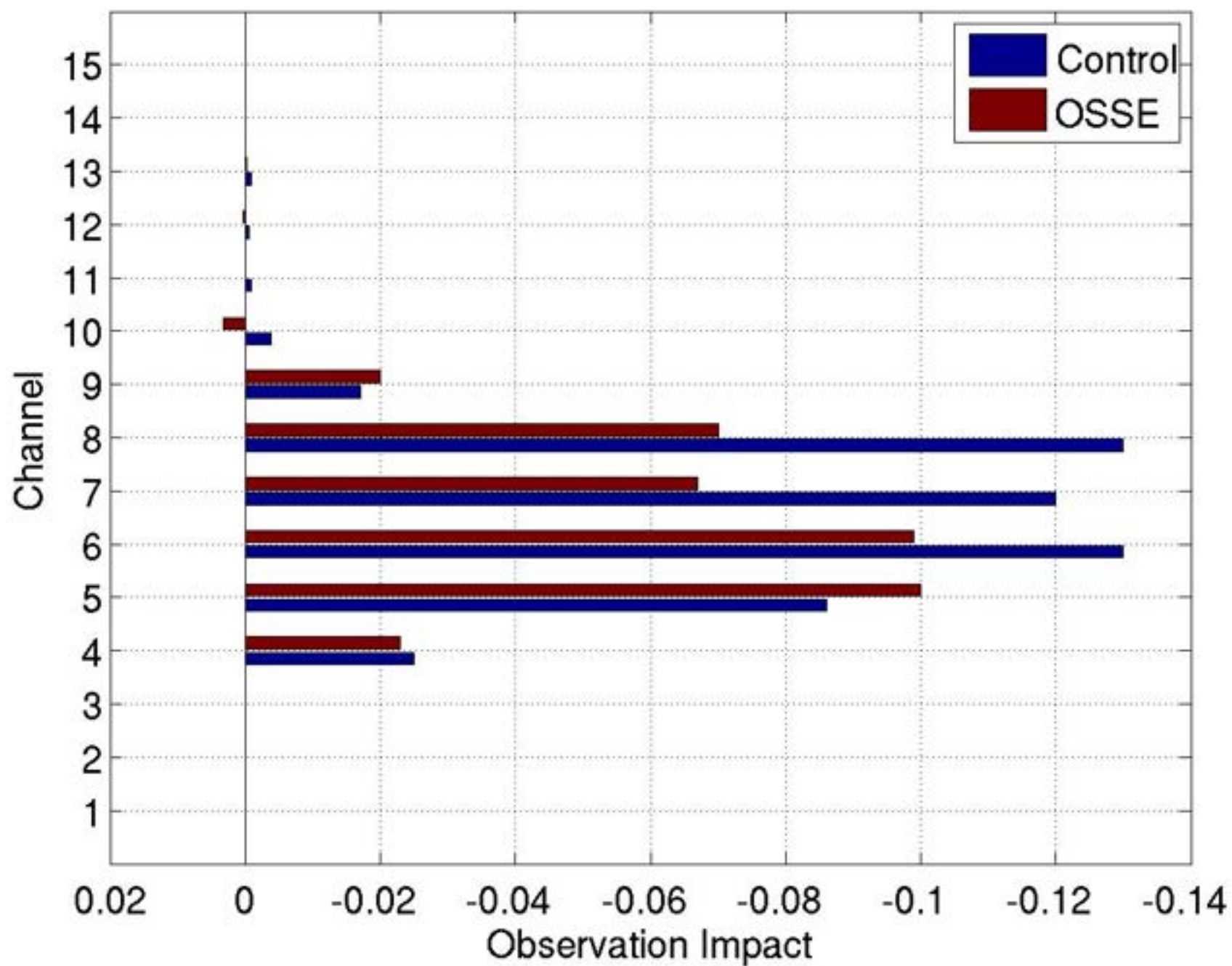
30S-90S RMS U forecast error vs analysis



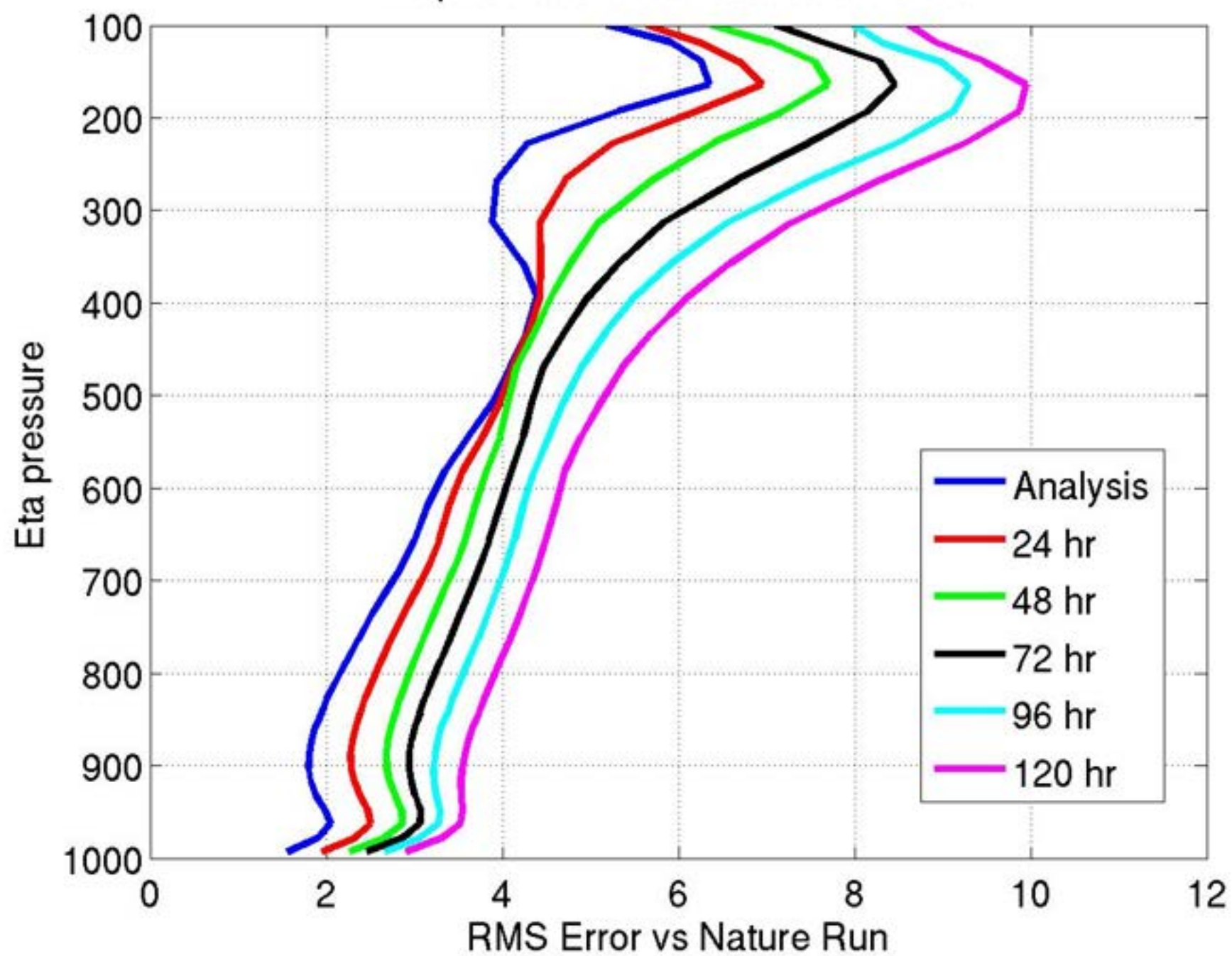
Adjoint-based observation impacts



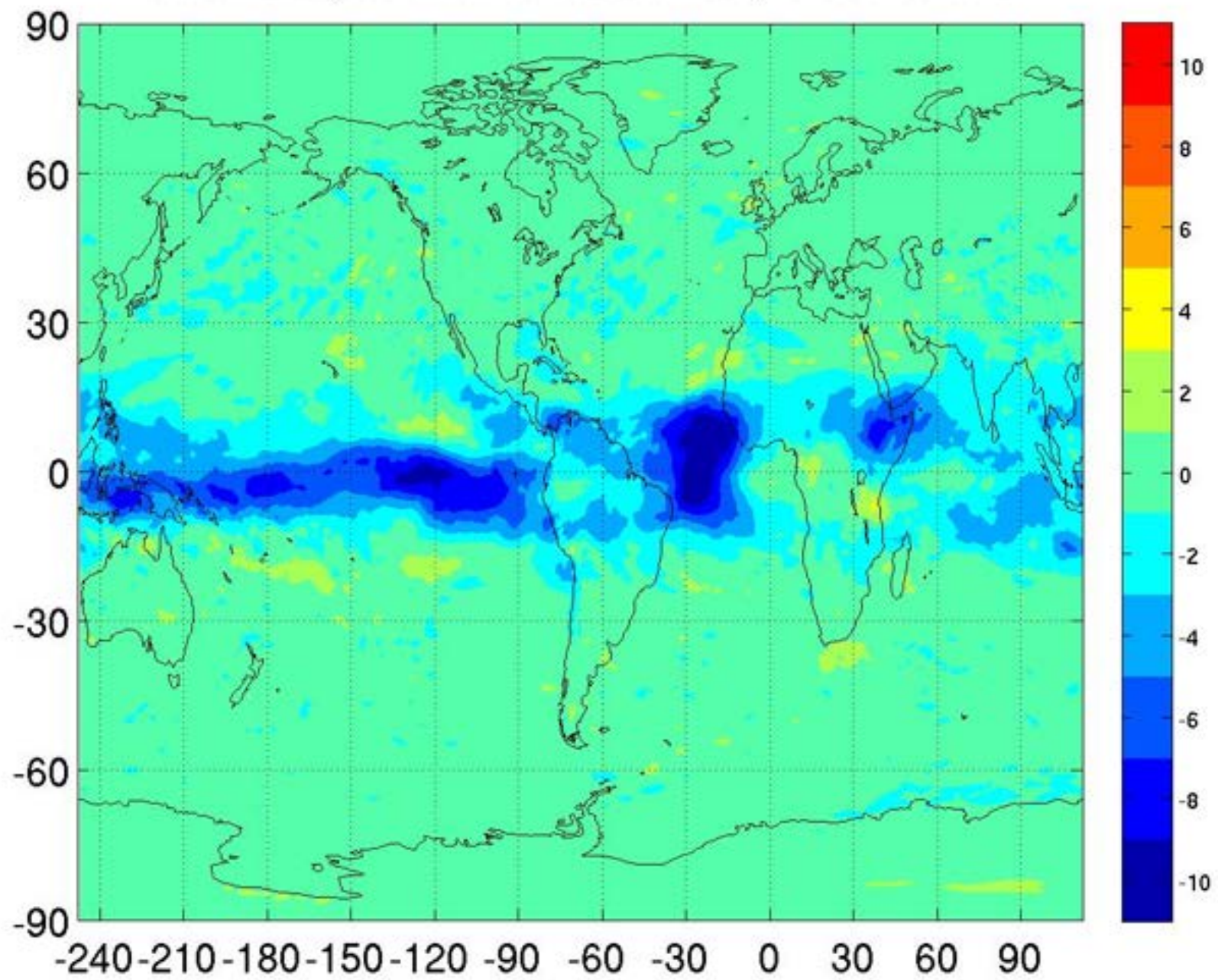
AMSU-A combined adjoint observation impact



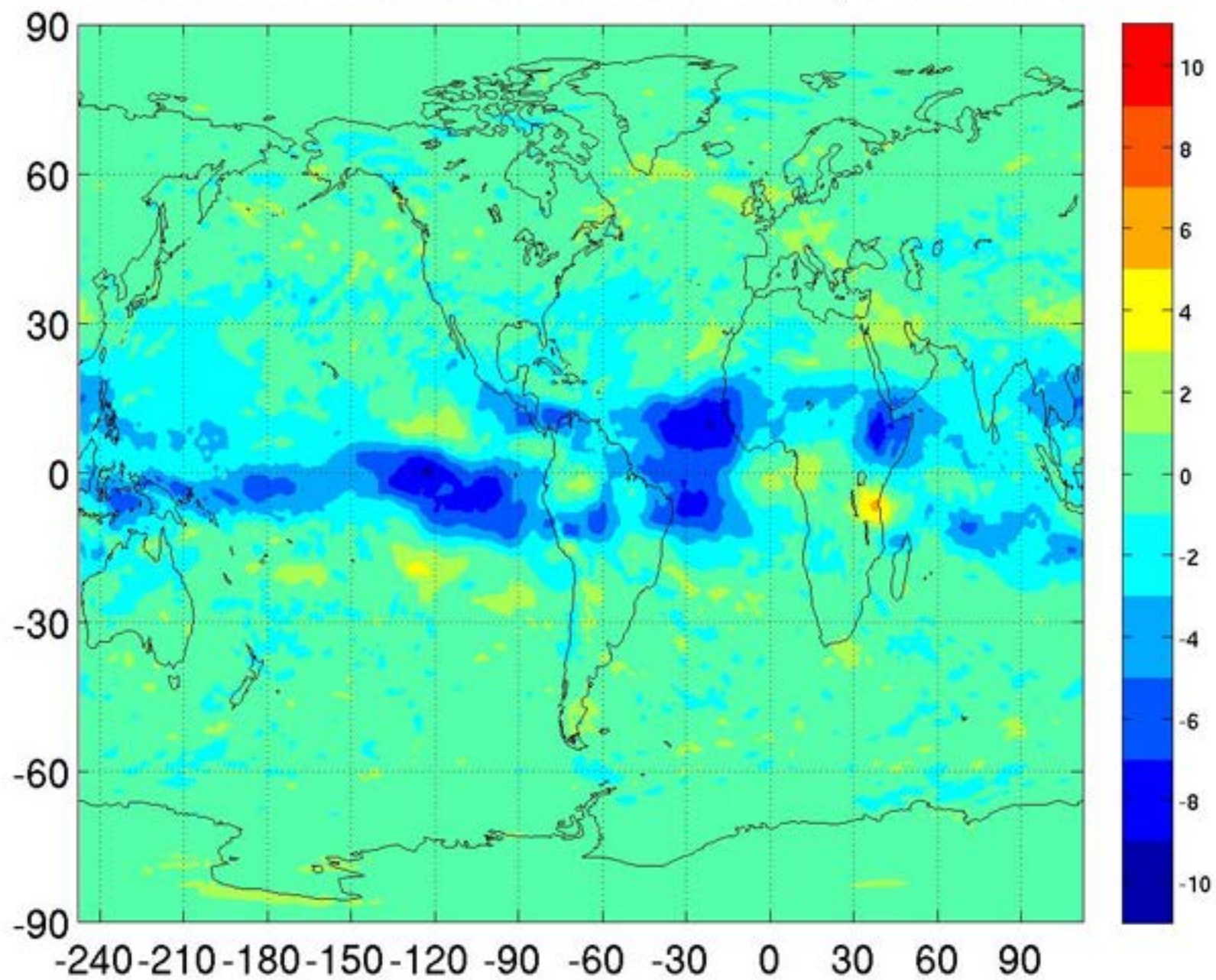
Tropics RMS U forecast error vs NR



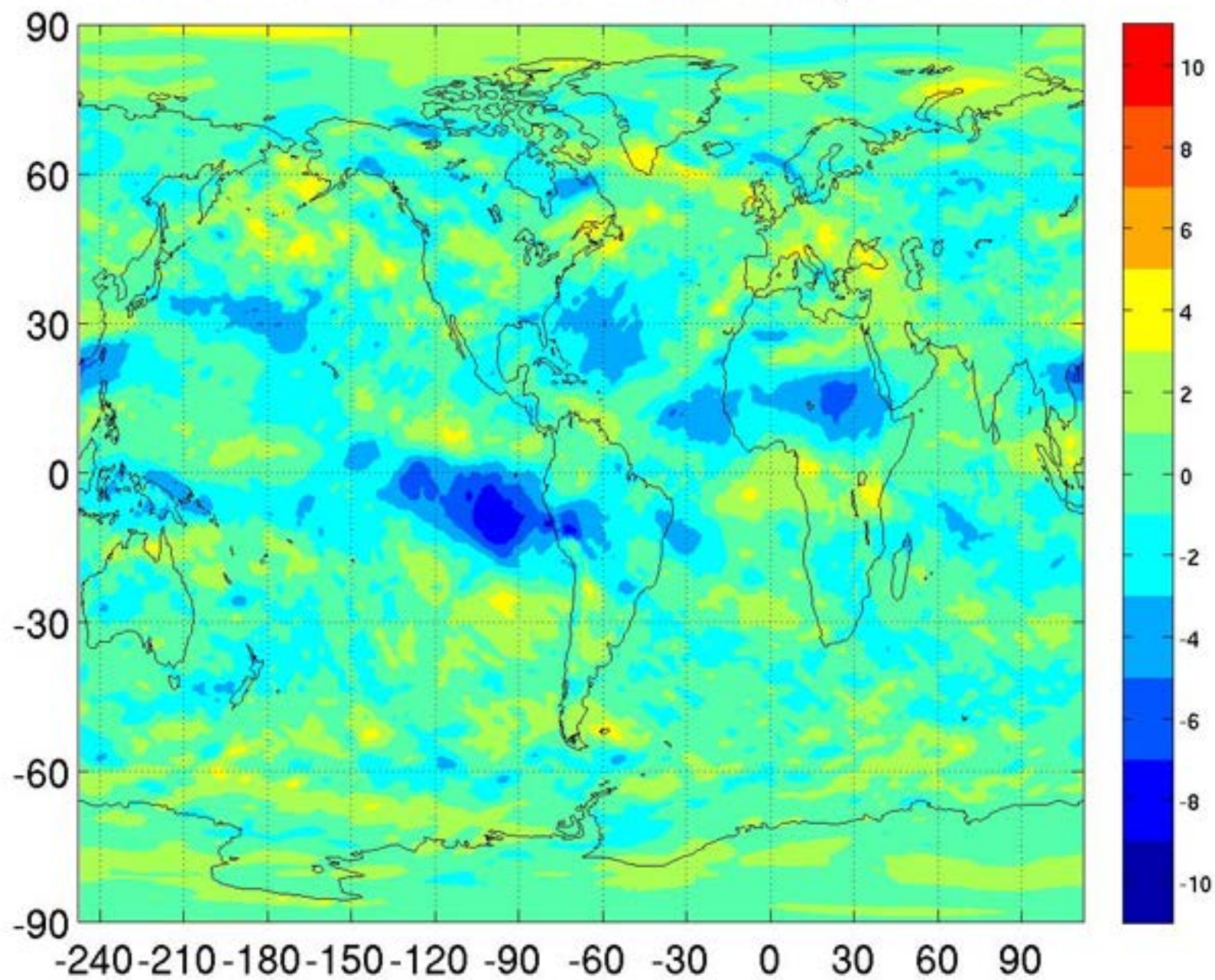
Mean analysis error vs Nature Run, U at 413 hPa



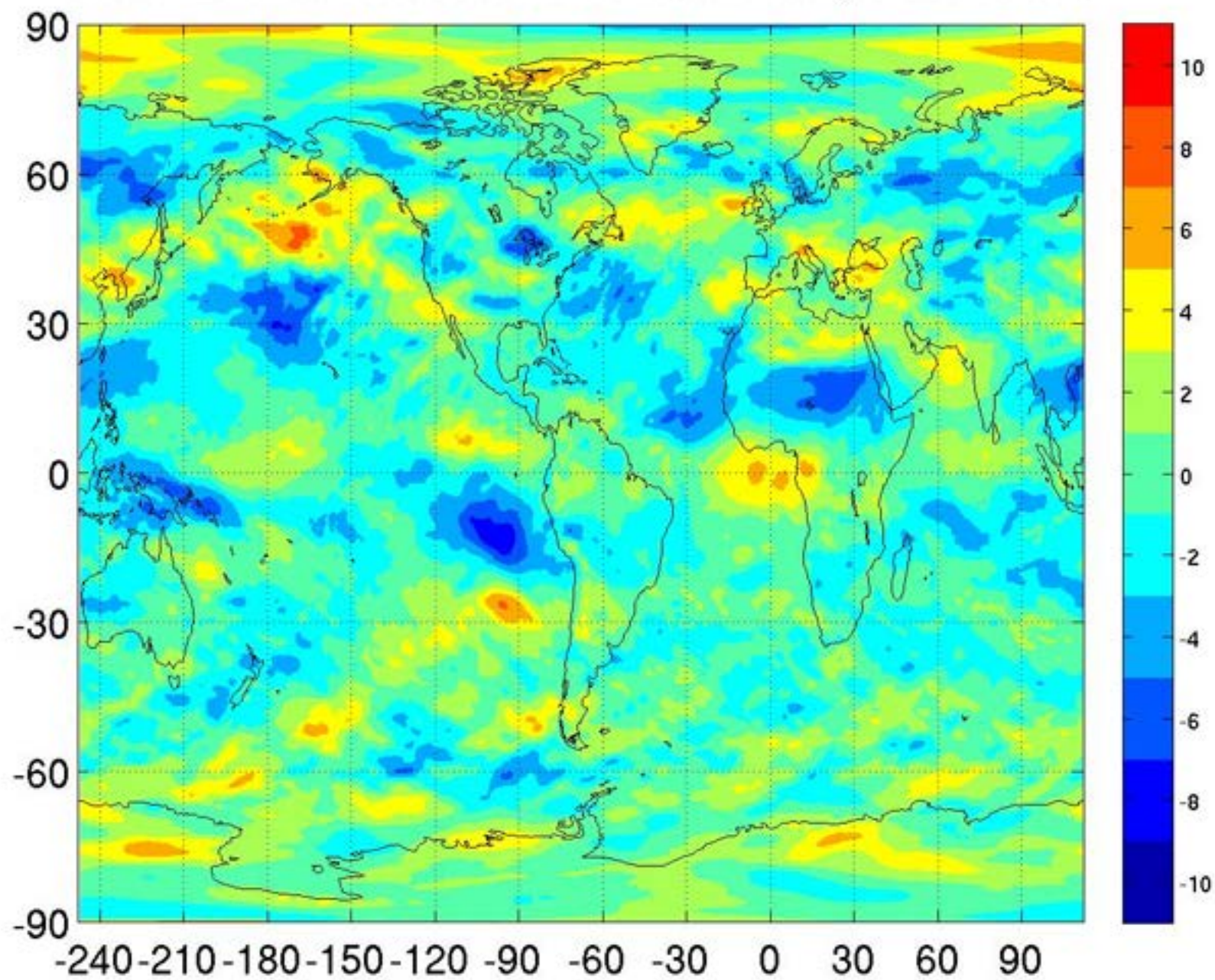
Mean 24 hour forecast error vs Nature Run, U at 413 hPa



Mean 72 hour forecast error vs Nature Run, U at 413 hPa



Mean 120 hour forecast error vs Nature Run, U at 413 hPa



Spatial correlation of
analysis error verified
against the Nature
Run “truth”:

Perfect case error
correlated with OSSE
case error

Analysis error

Lower correlation =>
greater proportional
influence of
observation error

