GROUP ON DATA ASSIMILATION DEVELOPMENT / CENTER FOR WEATHER FORECAST AND CLIMATE STUDIES / BRAZILIAN NATIONAL INSTITUTE FOR SPACE RESEARCH

A rapid update data assimilation cycle over South America using 3DVar and EnKF

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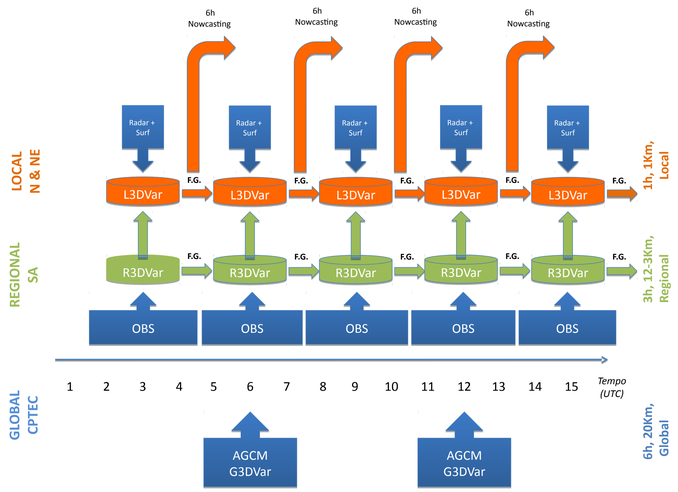
OVERVIEW

The Center for Weather Forecast and Climate Studies (Centro de Previsão de Tempo e Estudos Climáticos - CPTEC) from the Brazilian National Institute for Space Research (Instituto Nacional de Pesquisas Espaciais - INPE) has started on July, 2015 its rapid update cycle (RUC) in experimental mode over South America. CPTEC/INPE plans to extend this rapid data assimilation cycle using its convective scale regional models no later than end of 2015 with reduced latency using local data collection such as Regional ATOVS Retransmission Services (RARS). Both DTC versions of GSI in deterministic (3DVar) and ensemble (LETKF) regional forecasts using nested domains over South America, and selected locations over regional operational centers over Brazil were initially implemented. Information from observations including radar operated at these local centers will be used to be assimilated as well as validation data. This work aims to assess the preliminary results from this CPTEC/INPE Regional Modeling System (RMS) and the value of conventional and satellite information assimilated at convective scale over South America. Particular interest is in the impact of brightness temperatures in the microwave window channels over critical regions such as Amazonia and semi-arid areas in northeast Brazil. The current LETKF algorithm makes use of 20+1 ensemble members, in a resolution of 12km and 38 vertical levels, with a DA cycle intermittent every 6-3 hours. The 3DVar system runs at 9 km over South America and 3 km over the regional centers with also 38 vertical levels. The conventional datasets used in this study comprise temperature, surface pressure, moisture and zonal/meridional winds and full set of satellite data for 3DVar whereas EnKF uses only radiances from NOAA 15, NOAA 18 and Metop-a.

DATA ASSIMILATION METHODS

- GSI 3DVar for deterministic DA and observer for EnKF.
- After performing GSI Observer for observations innovation, the Ensemble Square Root (EnSRF) described in Whitaker and Hamill (2002) and a Local Ensemble Kalman Filter (LETKF) described in Hunt et al. (2006) were tested.

THE RAPID UPDATE CYCLE (RUC) AT CPTEC/INPE



OBSERVATIONAL DATASETS

Conventional available observations: (including satellite retrievals)

- [X] Radiosondes
- [X] Pibal winds
- [X] Synthetic tropical cyclone winds
- [X] Wind profilers: US, JMA
- [X] Conventional aircraft reports
- [X] ASDAR aircraft reports
- [X] MDCARS aircraft reports
- [X] Dropsondes
- [X] MODIS IR and water vapor winds
- [X] GMS, JMA, and METEOSAT cloud drift IR and visible winds
- [X] EUMETSAT and GOES water vapor cloud top winds
- [X] GEOS hourly IR and coud top wind
- [X] Surface land observations
- [X] Surface ship and buoy observation
- [X] SSM/I wind speeds
- [X] QuikScat, ASCAT and OSCAT wind speed and direction
- [X] SSM/I and TRMM TMI precipitation estimates
- [X] Doppler radial velocities
- [X] VAD (NEXRAD) winds
- [X] GPS precipitable water estimates
- [X] GPS Radio occultation (RO) refractivity and bending angle profiles
- [X] SBUV ozone profiles, MLS (including NRT) ozone, and OMI total ozone
- [X] SST
- [X] Tropical storm VITAL (TCVital)
- [X] PM2.5
- [X] MODIS AOD (when using GSI-chem package)
- [X] Doppler wind Lidar data
- [X] Radar radial wind and reflectivity Mosaic
- [X] METAR cloud observations
- [X] Tail Doppler Radar (TDR) radial velocity and super-observation
- [X] Flight level and Stepped Frequency Miscrowave Radiometer (SFMR) High Density Observation (HDOB) from reconnaissance aircaraft
- [X] Tall tower wind

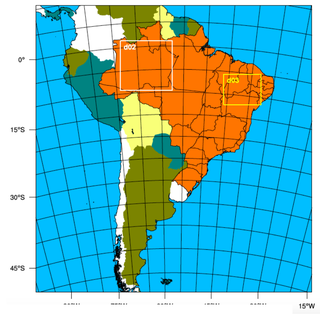
Satellite radiance/brightness temperature available observations (instrument/satellite ID)

- [X] SBUV: n17, n18, n19
- [X] HIRS: metop-a, metop-b, n17, n19
- [X] GOES_IMG: g11, g12
- [X] AIRS:aqua
- [X] AMSU-A: metop-a, metop-b, n15, n18, n19, aqua
- [X] AMSU-B: metop-b, n17

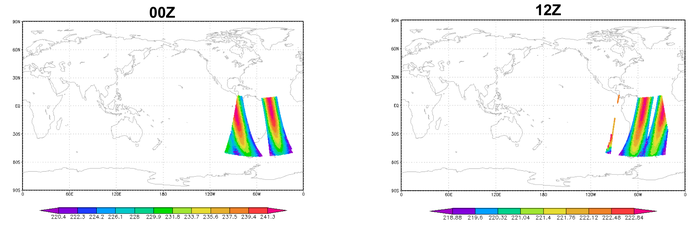
REGIONAL SETUP

Two sets of runs were performed during July 2015 with and without AMSU-A to assess its impact over South America with two nested domains over tropical Amazonia (d02) and semiarid Northeast Brazil (d03) NCEP/GFS and alternatively CPTEC/INPE MCGA lateral boundary conditions

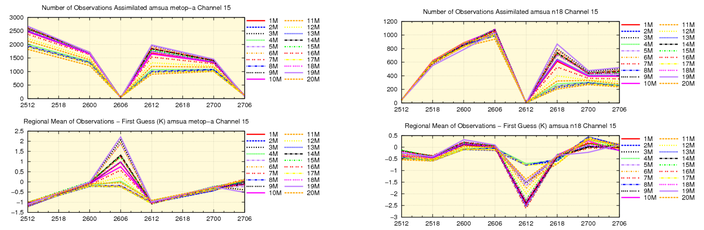
Amazonia (d02) and Northeast Brazilian (d03)



EXPERIMENTS USING SATELLITE DATA



NOAA-18, NOAA-15 e METOP-A



SUMMARY

RUC was successful implemented at CPTEC/INPE. Results show that both 3DVar and EnKF experiments presented reasonable analysis increments over SA. Furthermore, the AMSU-A sensitivity experiments resulted in different impact in the ensemble spread according to the studied region (N, NE or South America) that needs further investigation.

ACKNOWLEDGEMENTS

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