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Summary of the new components to be implemented

- AIRS radiance data (87 channels).
- SSMM radiance data (= eliminating AMSU A Ch3 and new cloud mask for AMSU B).
- Going from RTTOV7 to RTTOV7.7 (and new vertical interpolator).
- Inclusion of high scan angle AMSU data.
- QuickSCAT oceanic surface winds (from KNMI).
- 3.9 μm AMV (nighttime low level winds).
- Dynamical bias correction for radiance data.

Current operational assimilation and forecast system

- 36 km resolution global forecast model (GEM with 80x60 points and 58 eta levels).
- 4DVAR global assimilation with 6 hour window.
- 15 km regional forecast model over North America (58 eta levels).
- 3DVAR FOAM regional assimilation with 6 hour spin-up cycle launched from global cycle every 12 hours.

SSMM:

| Data | Raw SSMM file received through ftp link from NESDIS. | Nominal resolution of 25 km. |
| Bias Correction | Removal of observation over land due to complexity of surface emissivity modeling. | Removal of data over ice and when CLW > 0.01 kg/m2. |
| Scan position and air mass correction are applied. | Thinning | A pixel per 200 km horizontal box. |

Assimilation

Observation error variance is set to the total error statistic. RTTOV7 is used as forward model or observation operator.

Text complted

QuikSCAT:

Surface wind derived from scatterometric measurements over water

Data

Near real time 10 m wind vector 100 km resolution from KNMI. Data in BURF format is gathered from ftp site.

Quality Control


Assimilation

Observation error wind components is set at 1.7 m/s.

3.9 μm AMV:

atmospheric motion vectors from the near infrared channel onboard GOES satellites

Data

- Received through GTS with similar processing than for other channels. This gives low level winds at night that complement the daytime low-level visible cloud drift observations.
- Thinning: Horizontal resolution of 1.5 degrees.

Evaluation

Along with two 1/2 months global assimilation cycles with new data for summer and winter season, the proposed configuration was tested in parallel mode this winter from January 29 up to April 18 2008. Results shown compare the operational cycle (OPSGLB) with the parallel cycle (PARGLB) that incorporates the above mentioned new satellite data and procedural changes.

Figures

Anomaly correlation compares difference between forecast and climatological values at model grid points against the average value of the forecast anomalies over the domain of interest; with the average of the difference between analyzed and climatological values at model grid points, against the average of the analyzed anomaly over the domain of interest. A value of 0.6 is generally accepted as a lower limit of a useful model forecast.

Times series of forecast model variables (temperature) statistics (standard deviation) against observed values from radiosondes.

Summary of results

The impact of all individual modifications were extensively tested in both 3D-FOAM and 4D-Var experiments of at least 1 month. Several additional modifications were tested, but did not give sufficiently positive impact and were consequently not included in the final cycles. (NOT SHOWN)

The combined impact on the medium range forecasts of the proposed modifications is consistently positive in all regions. The gain in predictability for the 5-day forecast is approximately 3-4 hours in winter 1-2 hours in summer during the test cycles.

The results shown here are for the current parallel cycle of the global model. A clear gain is noted for the anomaly correlation score over both north and south hemispheres. It is consistent with what was observed during experimental test cycles. The time series comparison of day to day performance of the geopotential field shows that the system with new data does regularly better the operational system, specifically over southern hemisphere where several busts seen at 500 hPa were avoided (although the are still episodes where this is not the case).

Northern vs Southern hemisphere

- The regional model was also tested with the addition of the new data in experimental runs and in parallel mode. However the impact (NOT SHOWN) is not as large as in the global context partly due to the relatively short regional run cut off (1850).

Given the positive impact of the new data, The Canadian Meteorological Center will implement these changes to the operational system on May 7 2008.

GPS RADIO-OCCULTATION IS NEXT DATA TYPE TO BE ASSIMILATED OPERATIONALY

GPS RO Data in these experiments

- Satellites:
  - CHAMP: 1 satellite, alt antenna, ~150 profiles/day
  - GRACE: 1 satellite, alt antenna, ~150 profiles/day
  - COSMIC (6 satellites, hel & alt antennas, ~1500 profiles/day)
- Total: ~500 profiles/6h step, excellent worldwide sampling (non repeating)
- Each profile contributes ~25 data vertically (12000 assimilated data step)
- Important:
  - All instruments are of the same type
  - There is no instrument-dependent calibration
  - GPSRO with radiosondes against GPS
  - Only postprocessing & obs. operator could introduce bias
  - Although should be very small

GPSRO assumed non-biased

- Except at very low height (~2 km MSL)

GPS RO Data processing at EC

- Refractivity profiles versus MSL height (Level 2)
- Data thinning:
  - No more than 1 profile within 45 minutes and 300 km.
  - No more than 1 observation/vertical km (approximately 1 datum out of every 5, as profiles are usually received with 20m resolution)
- Vertical Clipping: Use data
  - above 4 km MSL.
  - below model lid (10 hPa)
- Background Error Check
  - 0.5% (O/P)/(P0)
  - Translates approximately to accept
  - Temperature innovations lower than ~12 K
  - Hydrometer moisture innovations lower than 25%

AIRS: Infrared hyper spectral radiances

Data

Subset of 281 channels received from NESDIS.

Quality Control

Radiance free cloud selection based on window channel and trial profile comparison.

In presence of cloud, only radiances sensing above cloud height estimated with CO2 slicing are kept.

No shortwave channel in daytime, no data over land/farce.

No data over water if surface emissivity <0.9 channel kept if NESDIS noise flag > 0.

Channel selection: 87 channel

4 highest peaking channels discarded at latitudes above 60 degrees North or South.

No small contribution above NWP model top (10 hPa).

Good vertical sampling, low instrument noise.

Not or weakly affected by ozone or minor gases.

Thinning: 250 km horizontal pixel selection.

Assimilation

Observation error variance is set to the total error statistic. RTTOV7 is used as radiative transfer model with a new vertical interpolator.

Dynamical Bias Correction

Online calculation of corrections for all radiance data every 6 hours of the global assimilation cycle based on the last 15 days. Correction applied on the next analysis.

Microwave

Scan positions biases are removed and 2 air mass predictor are used with the Harris and Kelly scheme. Only ocean data is used for calculation.

Infrared

Observed brightness temperature as only predictor is used for the linear calculation of the correlation. No ocean mask.

Global model 5 day forecast time series of the temperature standard deviation against radiosondes

Global model 500 hPa geopotential forecast anomaly correlation

GPS RADIO-OCCULTATION IS NEXT DATA TYPE TO BE ASSIMILATED OPERATIONALY

EVALUATION

Anomaly correlation for 128 winter cases during experimental winter cycle from December 27 2006 to February 18 2007 show predictability gain over both hemisphere.

Improvement reaches 6 hours on day 5 for the southern hemispheres.

GPS RO should be implemented operationally by end of summer 2008.