Environnement et Changement climatique Canada | Environment and Climate Change Canada

Impact of assimilating multispectral radiances from new generation geostationary satellites on global forecasts

Alain Beaulne [1], Louis Garand [2], Stéphane Laroche [2] and Judy St-James [1]

[1] Meteorological Service of Canada, Environment and Climate Change Canada
[2] Meteorological Research Division, Environment and Climate Change Canada

Contact: alain.beaulne@canada.ca

21st International TOVS Study Conference Darmstadt, Germany 29 November - 5 December 2017

A. Introduction

- Environment and Climate Change Canada (ECCC) is testing several upgrades to its analysis and forecast suite. The upgrades include the assimilation of all Clear Sky Radiance (CSR) water vapor (WV) channels onboard the new generation of geostationary satellites instead of only the highest peaking (shortest wavelength).
- An experiment was conducted to assess the impact, on global 4DEnVar analyses and 6 day Global Environmental Multiscale (GEM) model forecasts, of including the two SEVIRI WV channels onboard the MeteoSat-8 and MeteoSat-10 satellites in addition to the three AHI WV channels onboard the Himawari-8 satellite.
- Radiance assimilation is performed over ocean and over land surfaces as well. The experiment was carried out for a two and a half month period: 15 May to 31 Jul 2017 (156 cases). In the forecast verification plots that follow, the **control** is **blue** and represent the version of the GEM model forecasts currently operational while the **experiment** is **red**.

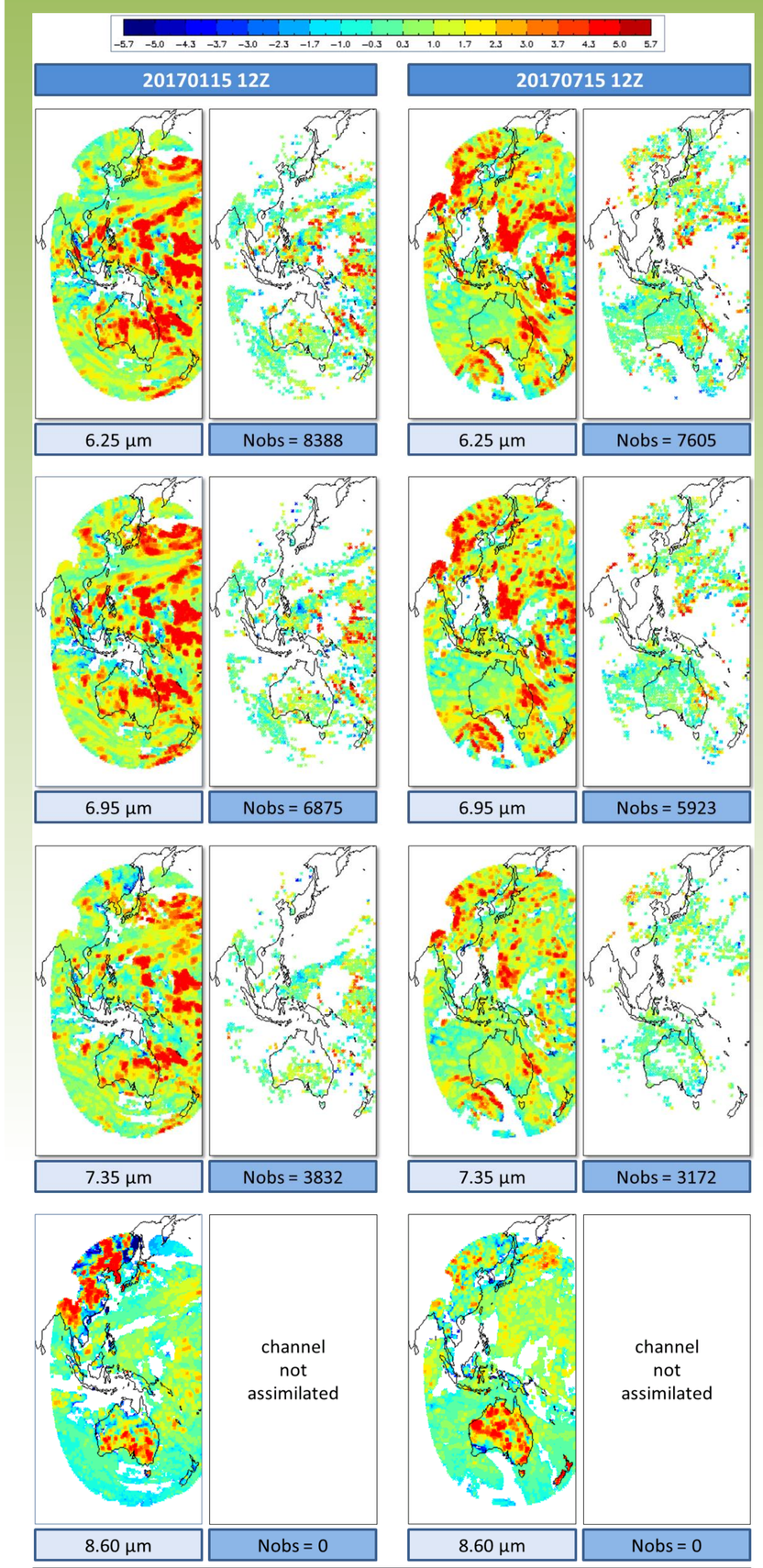
B. Setup

- WV channels from five geostationary satellites are operationally assimilated. The following table presents these current channels and the additional channels tested in the experiment.

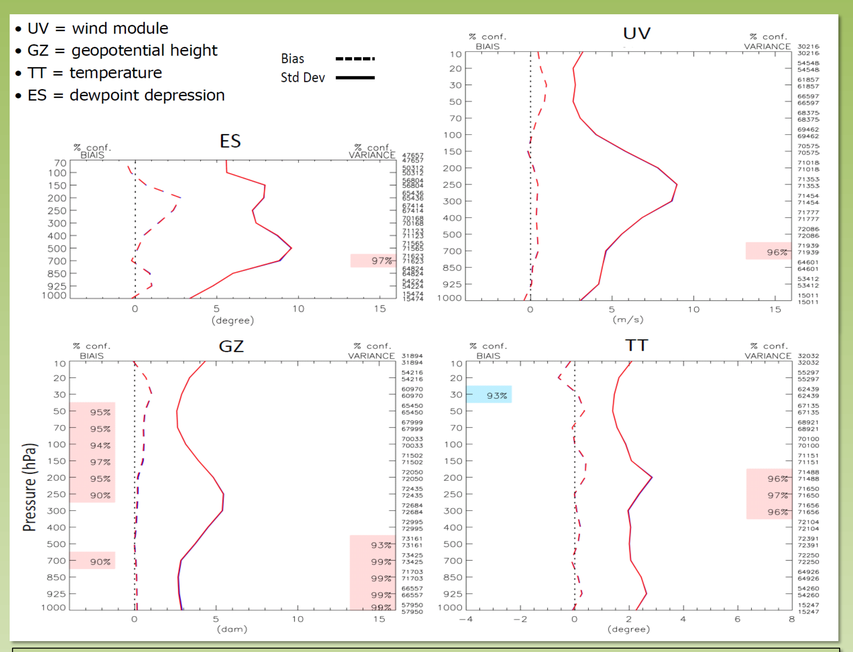
GOES-15	GOES-13	MeteoSat-10	MeteoSat-8	Himawari-8
6.55µm	6.55µm	6.25µm	6.25µm	6.25µm
		7.35µm	7.35µm	6.95µm
				7.35µm

- CSR brightness temperatures (BTs) are relatively low resolution since they represent area-averages BTs of cloud-free pixels from small regions. To avoid cloud contamination, only completely cloud-free scenes are considered for assimilation from Himawari while we use a 96% cloud-free threshold for MeteoSat and 11% for GOES satellites. Note that for Himawari and Meteosat, a cloudy pixel can be regarded as cloud-free when the contribution of cloud top emission to total radiance is negligible.
- Data thinning is 150km spatially in 15min time bins. Priority is given to the observation profile containing the most assimilated channels, then to the lowest satellite angle or percentage of cloud-free pixels in the scene (depending if the profiles are coming from different satellites or the same).

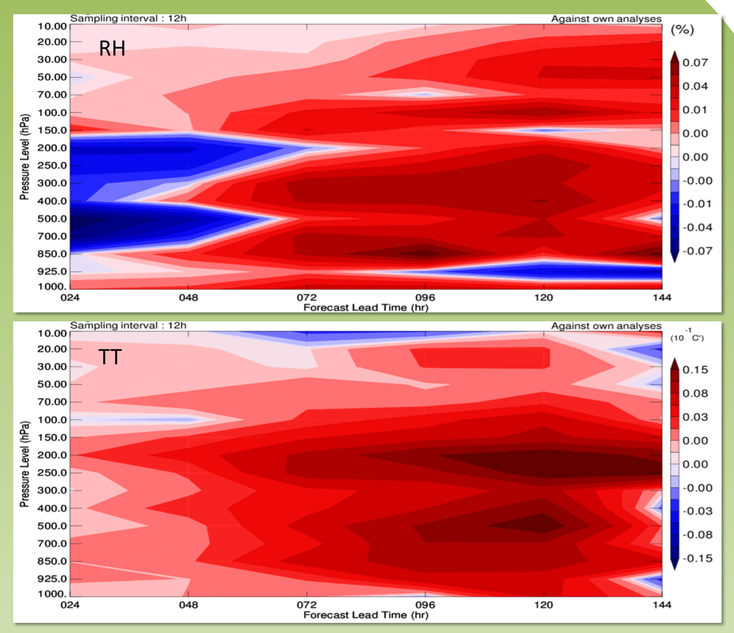
C. Results



O-F 6hr (deg) Himawari-8 all (before QC and thinning) and assimilated observations



World O-F 120hr verifications against radiosondes (15 May to 31 Jul 2017). Red/Blue shading : experience better/worse than control at 90% level.



World relative humidity and temperature Std Dev difference against own analysis (15 May to 31 Jul 2017). Red shading is in favor of the experiment.

Two additional experiences were carried out over Summer 2016 and Winter 2017 seasons. During these periods, the Control and Experiment assimilate the MeteoSat-7 satellite, which has only one WV channel.

15 Jun to 31 Aug 2016

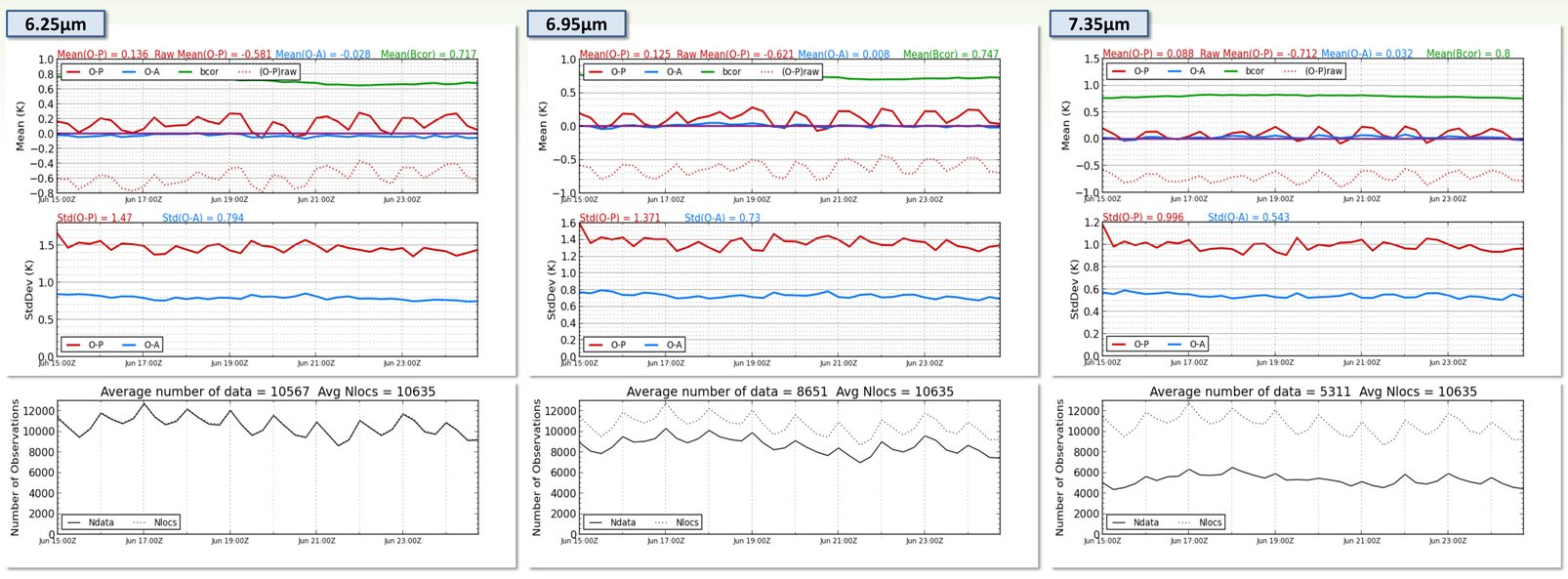
S16	UU (m/s)	HR (%)	GZ (dam)	TT (°C)
100hpa	4.41 4.39	6.71 6.67	3.26 3.21	1.70 1.69
300hpa	8.35 8.30	18.60 18.55	5.52 5.46	1.81 1.81
500hpa	5.97 5.94	23.41 23.36	4.16 4.10	2.00 1.99
850hpa	4.88 4.85	21.12 21.02	3.20 3.17	2.13 2.12

15 Dec 2016 to 28 Feb 2017

W17	UU (m/s)	HR (%)	GZ (dam)	TT (°C)
100hpa	4.42 4.40	6.33 6.35	2.83 2.82	1.59 1.59
300hpa	8.46 8.49	18.71 18.70	5.36 5.37	1.89 1.89
500hpa	5.99 6.01	22.83 22.84	3.99 4.00	2.04 2.05
850hpa	4.55 4.57	21.65 21.73	2.95 2.97	2.21 2.22

% Confidence: 0-49, 50-74, 75-99, 100

World O-F 120hr Std Dev against own analysis



Monitoring plots of assimilated observations for the three Himawari-8 WV channels. Period : 15-24 June 2016.

D. Concluding remarks

- The experiment shows that assimilating all CSR WV channels has a positive impact on global analyses and forecasts of the ECCC global 4DEnVar system. This component is part of a package of various improvements to the current system which is due for implementation in Spring 2018.
- Future work : As an additional QC criteria, check for surface sensitivity and reject all radiances from which transmittance from the surface exceeds a given threshold (0.5%). Similar evaluation planned for GOES-16/17.

Canada