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Evaluation of the performance of CrIS instrument under various assimilation scenarios

Sylvain Heilliette, Stéphane Laroche and Louis Garand

Environment and Climate Change Canada
Canadian Meteorological Center, Dorval, Québec, Canada

Contact: sylvain.heilliette@canada.ca

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The Cross-track Infrared Sounder (CrIS) instrument is now flying onboard NPP and NOAA20 platforms.

At the Canadian Meteorological Centre (CMC) NPP and NOAA20 CrIS observations are assimilated operationally since December 2015 and July 2019 respectively.

Observation system experiments were performed using a simplified assimilation system:

- Low resolution forecast model (39 km resolution instead of 25 km operationally)
- Low resolution ensembles (66 km resolution instead of 39 km)
- No coupling with the EnKF system (offline ensemble members used for all experiments)

to answer questions on the quality of the assimilation CrIS FSR observations in the CMC weather forecast system

Observations types

Conventional Observations:
- Radiosondes
- Aircraft reports
- Atmospheric motion vectors (geostationary + polar)
- Scatterometer winds
- GPS radio occultations
- Ground based GPS

Microwave radiances:
- AMSU-A (NOAA15, NOAA18, NOAA19, AQUA, METOP-1, METOP-2) 11 channels
- MHS (NOAA19, METOP-1, METOP-2) 4 channels
- ATMS (NPP, NOAA20) 17 channels
- SSSMI-S (DMSP17, DMSP18) 7 channels

Infrared radiances:
- AIRS (AQUA) 139 channels
- IASI (METOP-1, METOP-2) 142 channels
- CrIS FSR (NOAA20) (103 channels)
- CSR (GOES15, GOES16, METEOSAT8, METEOSAT11, HIMAWARI-8) water vapour channels

Assimilation experiments

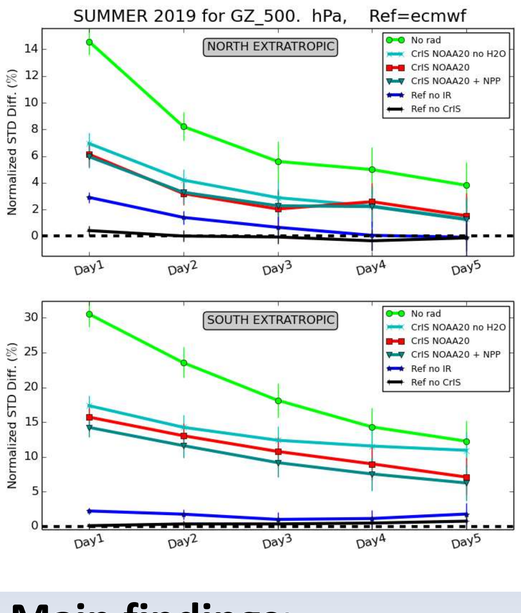
Experiment	Assimilated data
Ref (control experiment)	All observation types
No rad	Conventional observations only
CrIS NOAA20 no H2O	Conventional + CrIS NOAA20 (no water vapour channels)
CrIS NOAA20	Conventional + CrIS NOAA20 (all 103 channels)
CrIS NOAA20 + NPP	Conventional + CrIS NOAA20 and S-NPP (all channels)
Ref no IR	Conventional + Microwave radiances
Ref no CrIS	All observation types except CrIS NOAA20

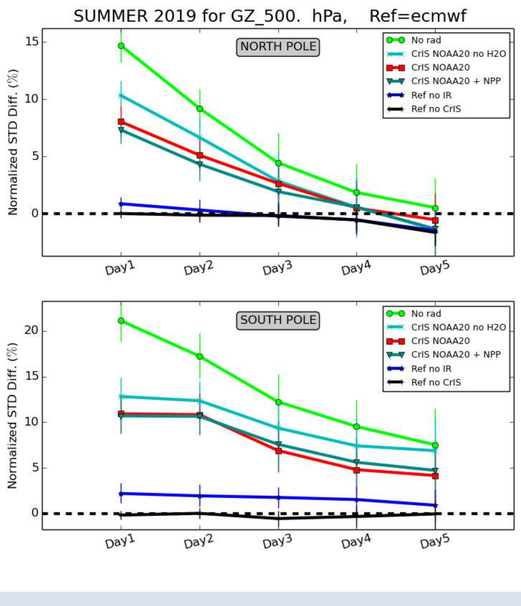
Forecast Model:
GEM 5.0 global model, Yin-Yan grid @ 39 km resolution, 84 vertical hybrid levels with top at 0.1 hPa.

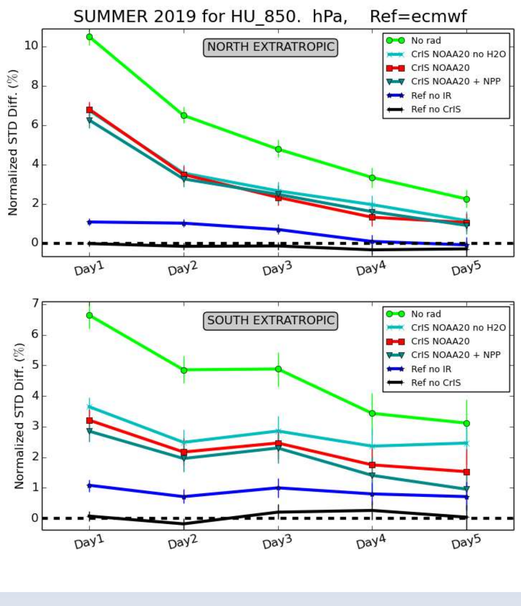
Assimilation system:
4DEnvar using 256 offline members @ 66 km (uncoupled from EnKF)

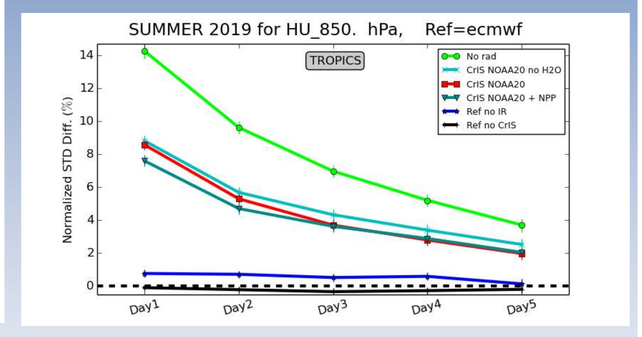
RESULTS

From 20190601 to 20190809









Main findings:

- Impact of CrIS NOAA20 assimilation on top of all other assimilated observations appears weak.
- Impact of CrIS NOAA20 assimilation on top of the No rad experiment is significant and reveals the intrisic value of the observations.
- Most of the impact comes from temperature sounding channels
- Impact of CrIS S-NPP on top of CrIS NOAA20 is moderate. It could be underestimated due to the data gaps for S-NPP during the experiments.

Future work and research avenues

In the near future, the simplified assimilation setup used in that poster will be used to answer the following questions:

- Can cloud detection be improved using the VIIRS cloud mask ?
- Is there a benefit to assimilate more channels especially in the CO2 band ?
- Can we improve our observations errors (see Joël Bédard talk) ?

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