Variational All-sky Himawari-AHI Radiance Data Assimilation at Convective-Scale

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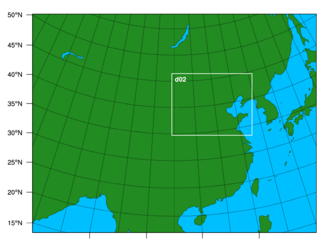
Methodology

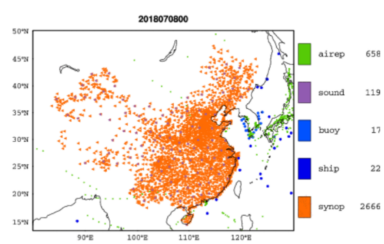
- WRFDA-3DVAR: univariate analysis including hydrometeors (qcloud, qrain, qice, qsnow, qgraupel) as analysis variables.
- Background error statistics (with cloud variables) come from the NMC method.
- CRTM-v2.3.0 used as radiance observation operator.
- AHI radiance bias correction: fixed from an offline statistics under clear-sky.
- 9km/3km two-way nested domain over north China. 57 vertical levels with top at 10 hPa.

Experimental design

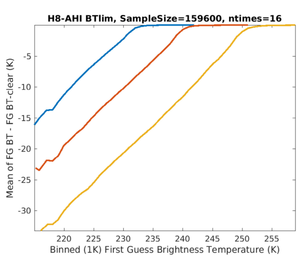
- ARW physics packages:
  - –New Thompson microphysics scheme
  - –RRTMG longwave and shortwave radiation scheme
  - –YSU planetary boundary layer scheme
  - –New Tietke cumulus parameterization for D01
- 3-hourly partial DA cycling from 2018070600 to 2018070921, reinitialize from global GFS

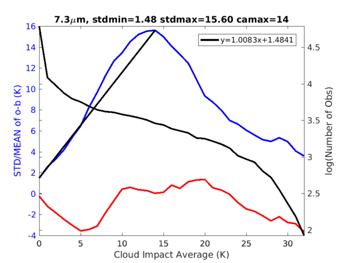
  every 00 UTC, 24-h forecasts at 00 UTC and 12 UTC.
- Three assimilation experiments (two outer loops used in 3DVAR)
  - –GTS (assimilate conventional data in D01 and D02)
  - –AHICLR (same as GTS, but add AHI 3 clear-sky WV channels in D02)
    - –Cloud detection follows Zhuge and Zou, 2016.
  - –AHICLD (same as AHICLR, but assimilate all-sky AHI radiances in D02)
    - –All-sky error model follows Harnish et al. 2016. No QC applied.





Typical Conventional Data Coverage

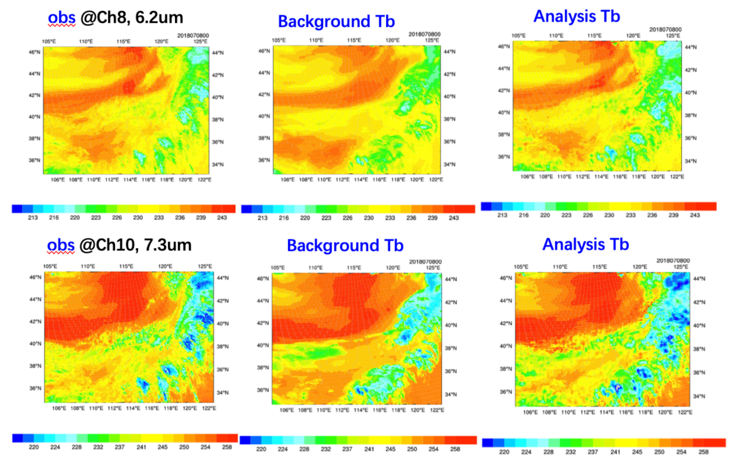


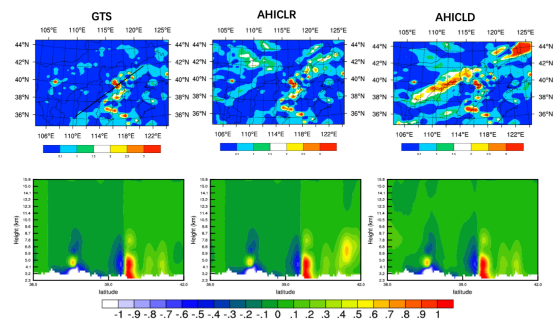


Cloud Impact:

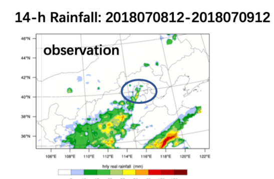
$$C_a = \frac{\max(0, BT_{lim} - BT_x) + \max\left(0, BT_{lim} - (BT_y - BT_{bias})\right)}{2}$$

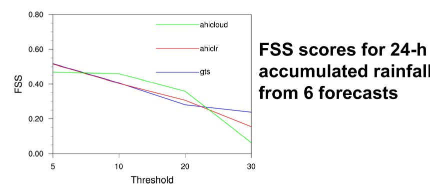
Analysis Results

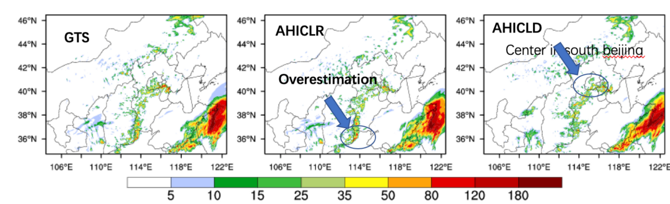




Rainfall Forecast







References

Zhuge, X. & Zou, X. (2016): Test of a modified infrared-only ABI cloud mask algorithm for AHI radiance observations. Journal of Applied Meteorology and Climatology, 55(11), 2529-2546.

Harnisch, F., Weissmanna M., and Perianezb A. (2016): Error model for the assimilation of cloud-affected infrared satellite observations in an ensemble data assimilation system. Q. J. R. Meteorol. Soc. 142: 1797–1808.