WRFDA 4.4 Update and JEDI-MPAS 1.0.0 Release

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Two major new capabilities in WRFDA Release 4.4

- **Add GPM GMI radiance DA, contributed by Dr. Dongmei Xu at the Nanjing University of Information Science & Technology. See 4.4 Users Guide for related namelist setting.**

Shen, F., D. Xu, H. Li, J. Min, and R. Liu, 2021: Assimilation of GPM Microwave Imager Radiance data with the WRF Hybrid 3DEnVar System for the Prediction of Typhoon Chan-hom (2015), Atmospheric Research. 251, 105422.

- **New option for surface aerosol DA with MADE/VBS aerosol scheme. Now 3 aerosol schemes (GOCART, MOSAIC-4bin, MADE/VBS) can be used. See ~doc/README.DA_chem**

Ha, Soyoung, 2022: Implementation of aerosol data assimilation in WRFDA (V4.0.3) for WRF-Chem (V3.9.1) using the MADE/VBS scheme. Geosci. Model Dev., 15, 1769–1788.

Atmospheric Motion Vector DA using NCEP bufr files

- Previously only ingest AMVs from PrepBufr files, which does not include all AMVs

- Now also ingest satwnd.bufr file for those AMVs not included in the PrepBufr file.
  - Contributed by Jamie Bresch (NCAR/MMM)
  - New namelist variable ‘use_satwnd_bufr’, =true by default.

A bug fix for direct radar reflectivity DA

- For direct assimilation of radar reflectivity, remove the use of ”rf_qthres" in the reflectivity forward operator, which can cause an unrealistic low bound of computed reflectivity when setting it a large value.

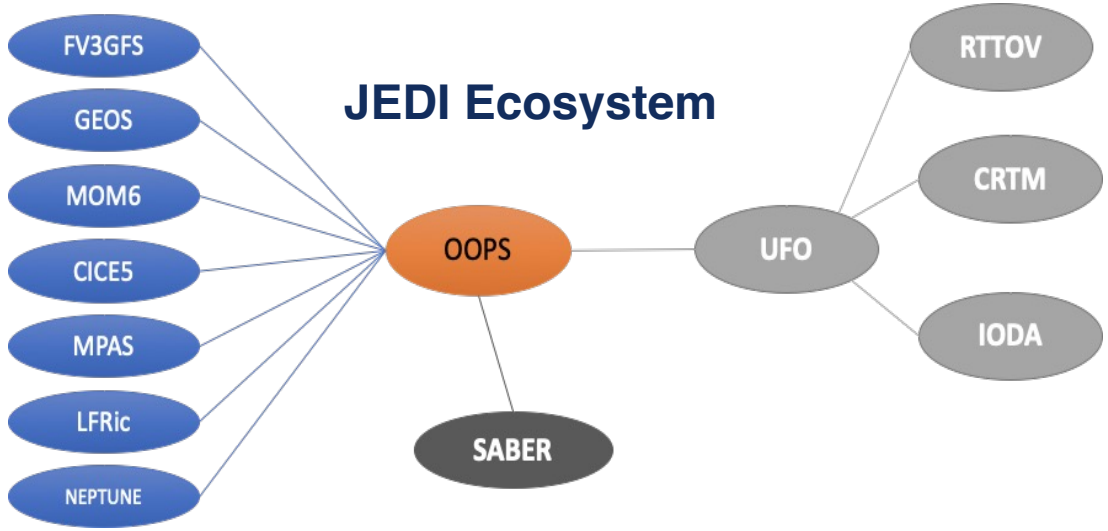
- Also simplify the quality control to keep data with both observed and background reflectivity >=rfmin (a namelist parameter).

https://www.jcsda.org/jedi-mpas

Version	Download	Quick Start - Tutorials	Support	Date
1.0.0	Code	Build and Test JEDI-MPAS	Documentation	2021-09-24
Release Notes		Simulating Observations with a JEDI-MPAS Application	Forums	
		Running the JEDI-MPAS Variational Application		

JEDI-MPAS:
Global/Regional unified MPAS DA system based on the JEDI software framework

JEDI: Joint Effort for Data assimilation Integration



Main Features in JEDI-MPAS 1.0.0

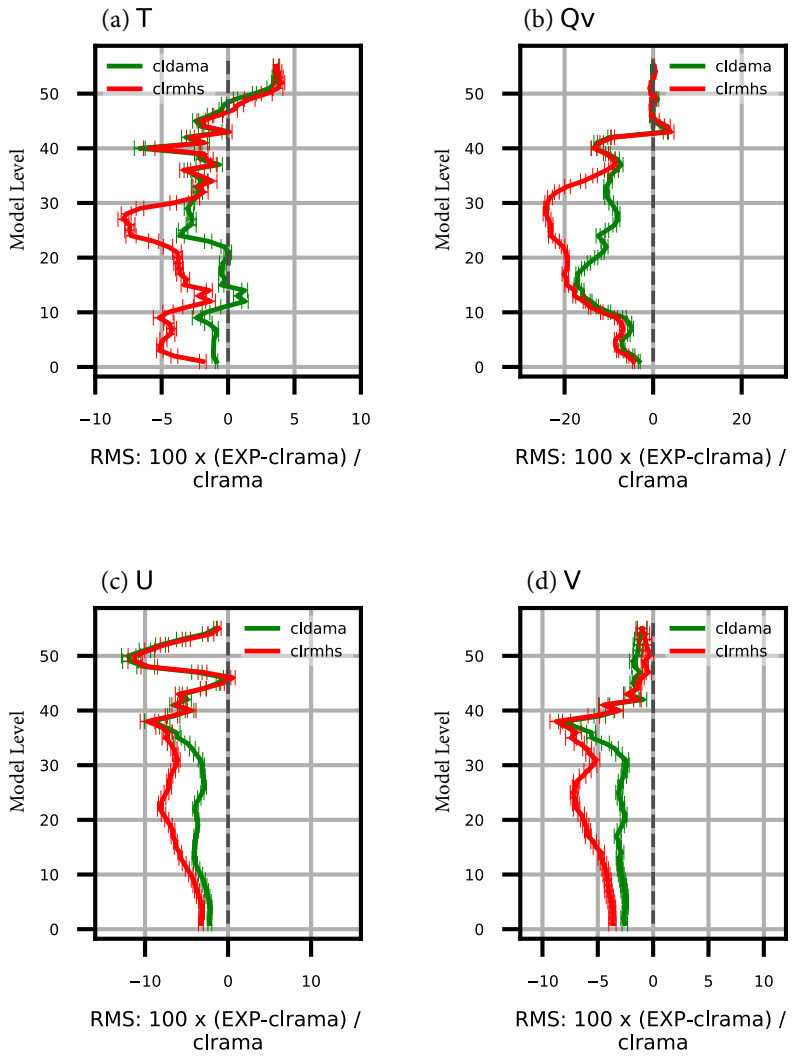
- Deterministic analysis: **3DEnVar, 4DEnVar, and 3DVar**
  - 3DEnVar has been most extensively tested so far
- Ensemble analysis : Ensemble of DAs (**EDA**), with perturbed observations
- Can run in **dual-resolution** mode
- Analysis directly done on **MPAS unstructured grid**, works for uniform mesh and **variable-resolution mesh, Global** or **regional mesh**
- Allow all-sky radiances DA for some of MW & IR sensors with hydrometeors as analysis variables
- Radiance DA: primarily based on CRTM

Three 6-hourly cycling experiments using JEDI-MPAS 1.0.0

- **clrama**: conventional obs + clear-sky AMSU-A radiances (ch 5-9) from 6 satellites
- **cldama**: obs in clrama + all-sky over-water AMSU-A radiances (ch 1-4, 15) from 5 satellites
- **clrmhs**: obs in cldama + clear-sky MHS radiances (ch 3-5) from 4 satellites

- Cycling period: 04/15 – 05/14, 2018
- Dual-resolution 3DEnVar: 30km analysis, 60km ensemble input (6-h MPAS forecast from 20-member GEFS analysis). 55 vertical levels, Model top @30km.
- Localization: 1200km in horizontal, 6km in vertical
- 10-day free forecast at each 0000 UTC from 04/18, 2018

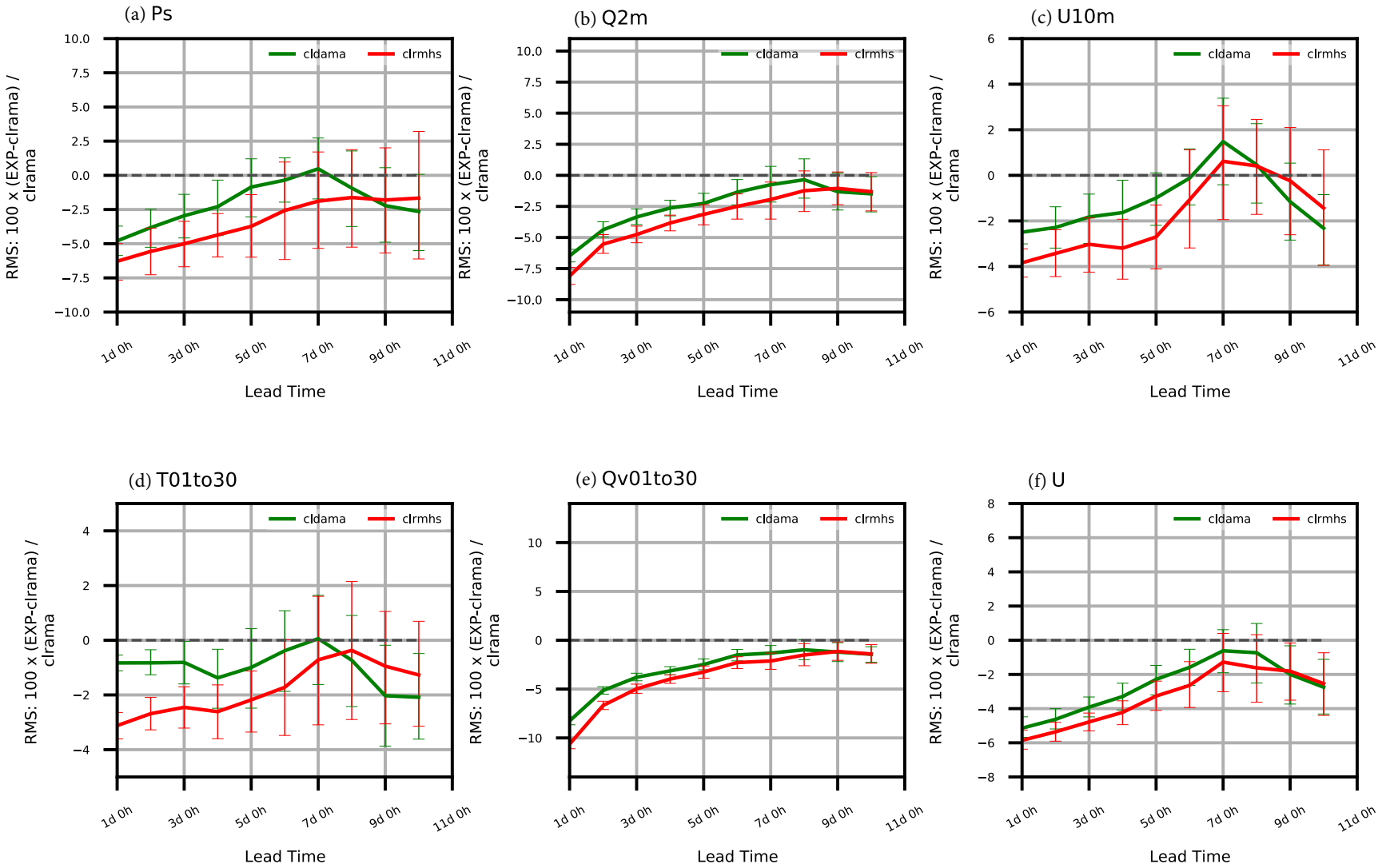
RMSE of Cycling Background w.r.t. GFS analysis



Relative RMSE reduction as a function of model level

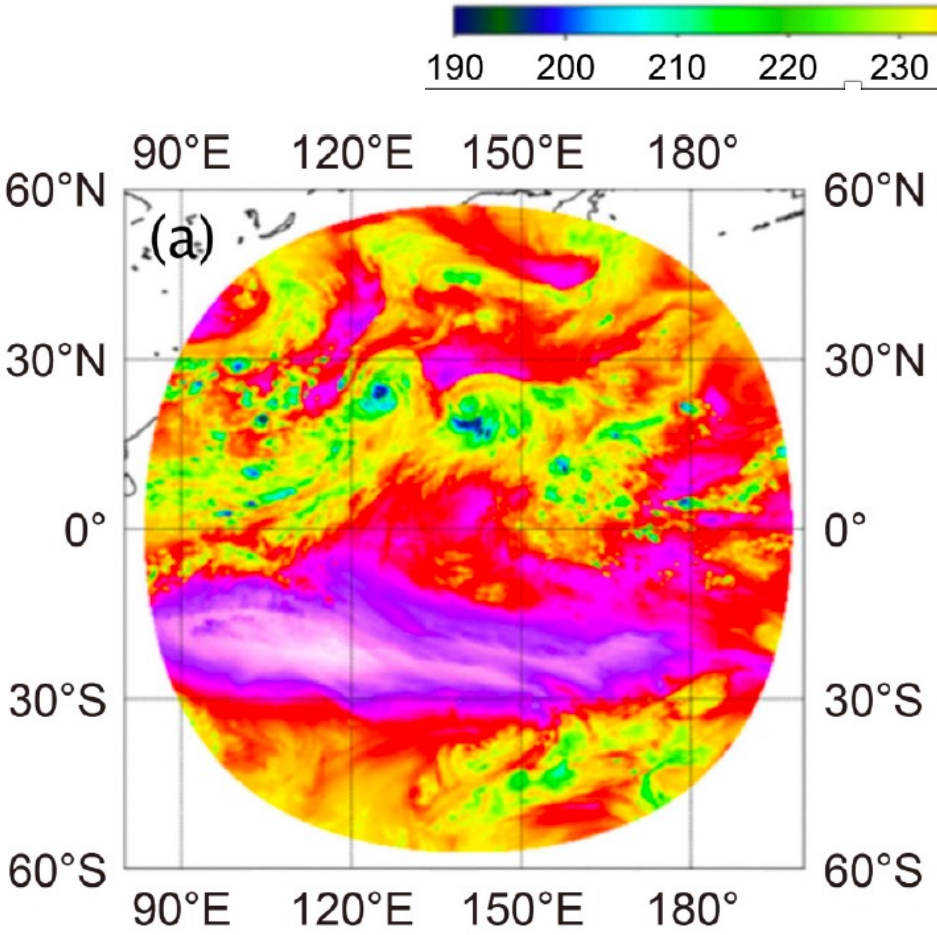
cldama & clrmhs vs. clrama

Relative RMSE reduction of 1-10 day FC w.r.t. GFS analysis

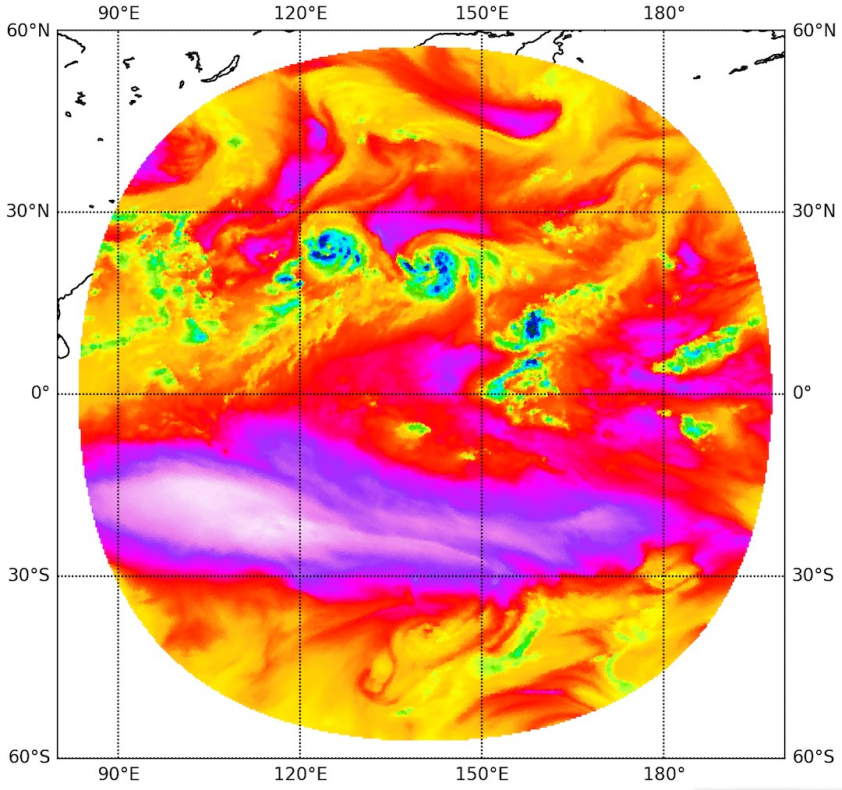


cldama & clrmhs vs. clrama

Using AHI radiances for independent verification

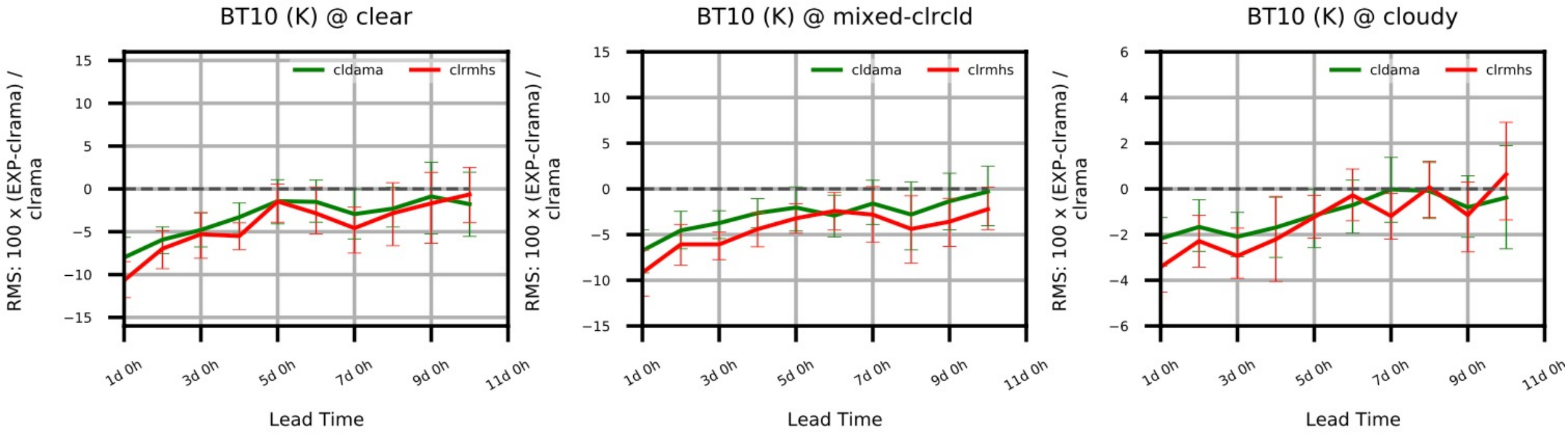


Observed AHI ch9 Tb valid at
12 UTC, 8 August 2019

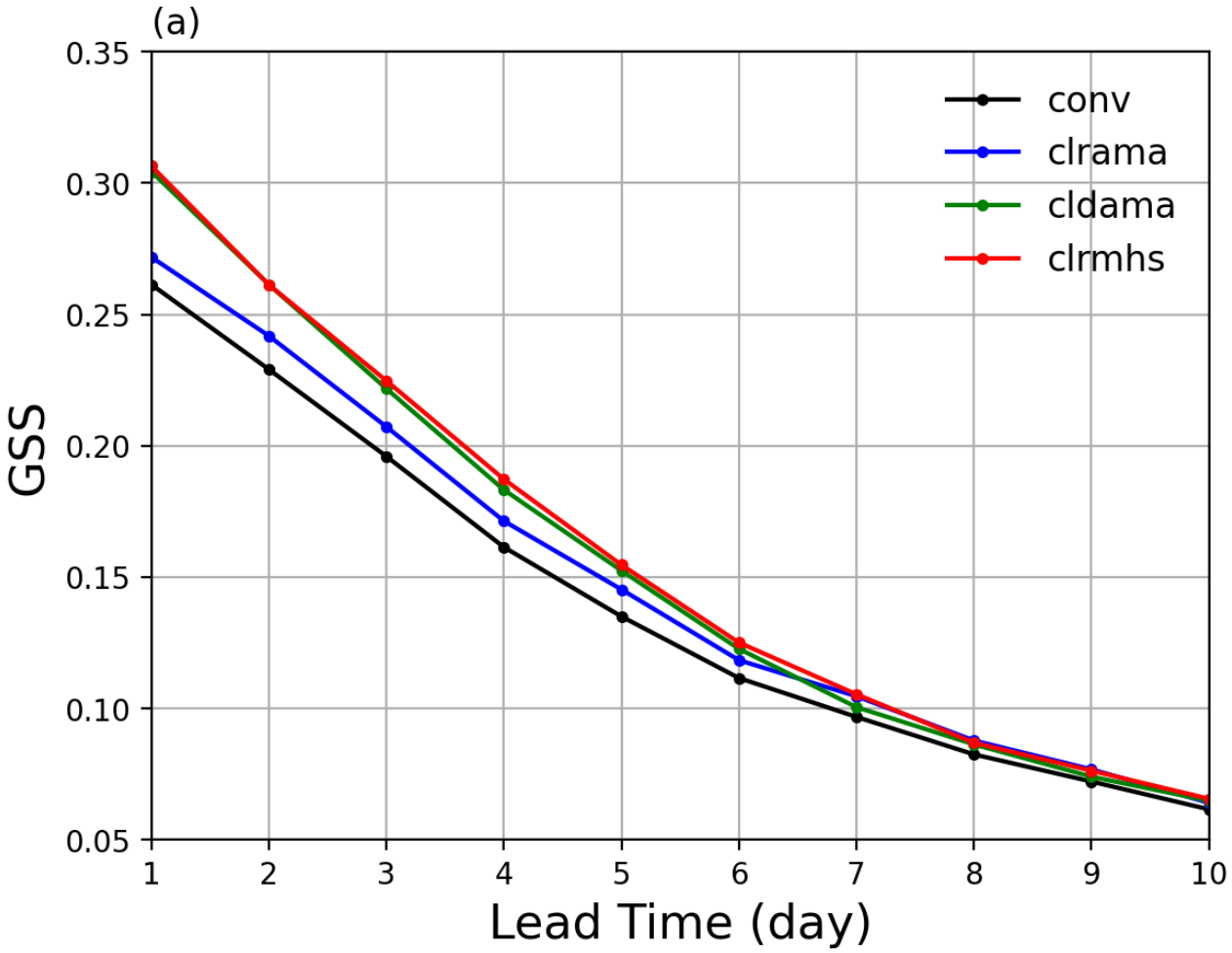


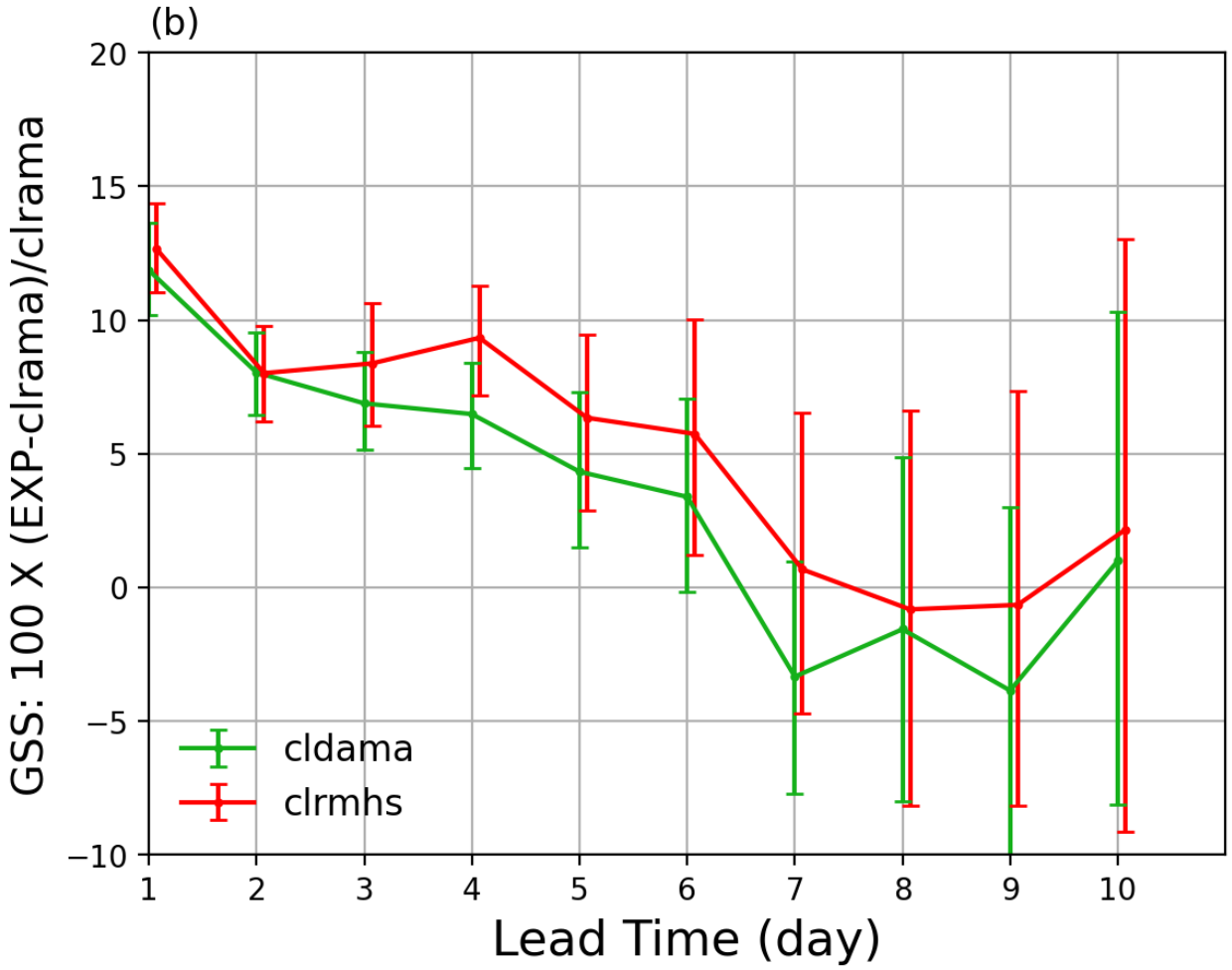
RTM-simulated AHI ch9 Tb from a MPAS
6h forecast at 30km mesh

Relative RMSE difference of 1-10-day FC w.r.t. superobbed AHI radiances (low level WV channel)



Gilbert Skill Score of 1-10-day rainfall FC w.r.t. CMORPH obs





Final remarks

- WRFDA will be kept updated as needed. No plans for future WRFDA tutorials

- Continue developing/updating JEDI-MPAS, likely do the first tutorial in 2023

Liu Z et al., 2022: Data Assimilation for the Model for Prediction Across Scales - Atmosphere with the Joint Effort for Data assimilation Integration (JEDI-MPAS 1.0.0): EnVar implementation and evaluation, submitted to GMD.