

Assimilation of all-sky AMSU-A and ABI/AHI radiances with Global JEDI-MPAS

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National Center for Atmospheric Research



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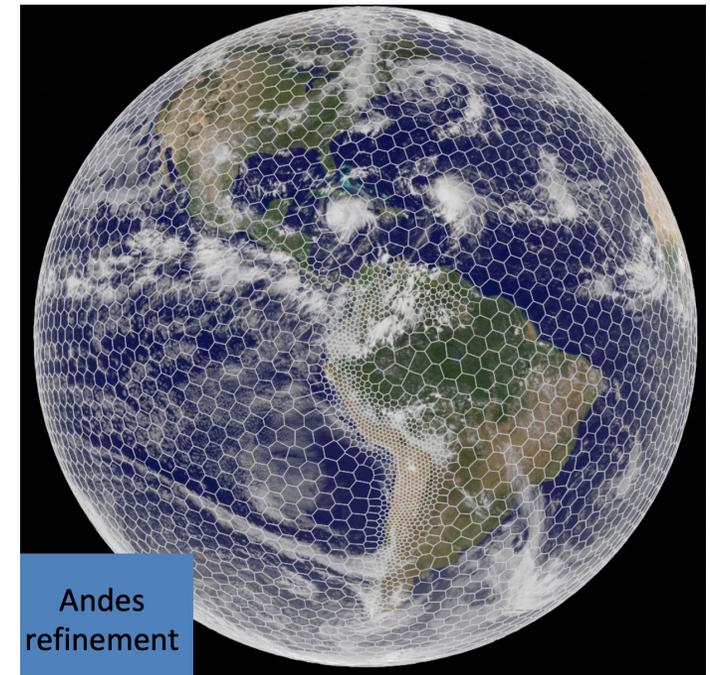
<https://www.jcsda.org/jedi-mpas>

JEDI-MPAS 1.0.0

JEDI-MPAS is a multi-component software package that provides everything that is needed to run data assimilation applications for the atmospheric core of the [Model for Prediction Across Scales](#) (MPAS). The National Center for Atmospheric Research (NCAR) and the JEDI core team jointly develop JEDI-MPAS.

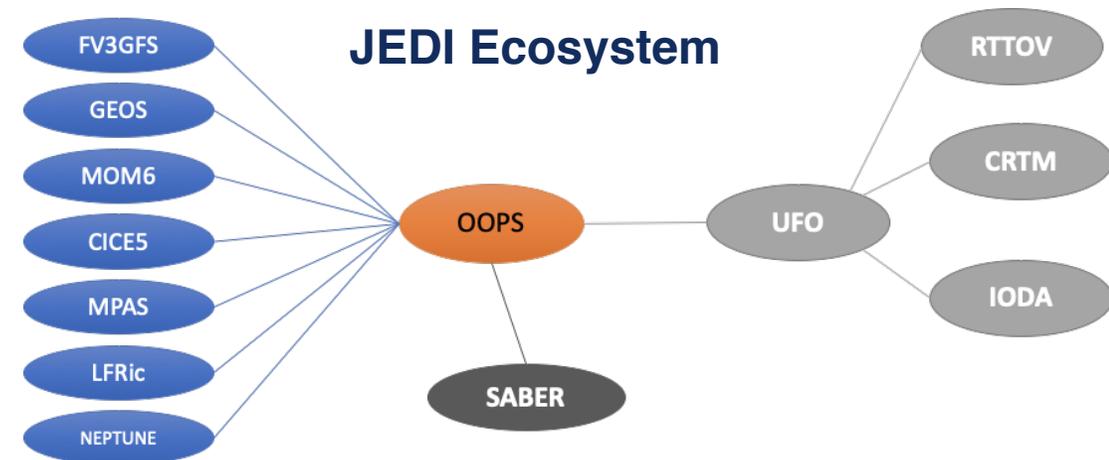
MPAS is a collaborative project for developing atmosphere, ocean and other earth-system simulation components for use in climate, regional climate and weather studies, whose primary development partners are Los Alamos National Laboratory and NCAR. The atmospheric core of MPAS solves the the fully compressible nonhydrostatic equations of fluid motion on an MPAS unstructured Voronoi mesh and offers a subset of the [Advanced Research WRF](#) physical parameterizations. MPAS is used at NCAR for research into Earth-System predictability, spanning both weather and climate.

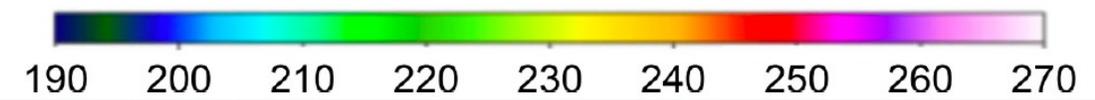
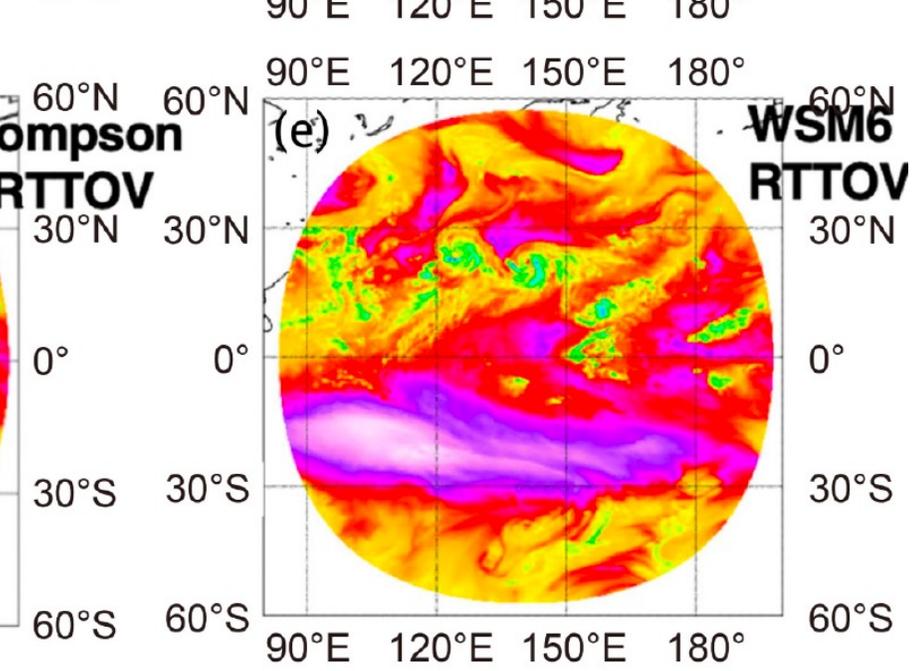
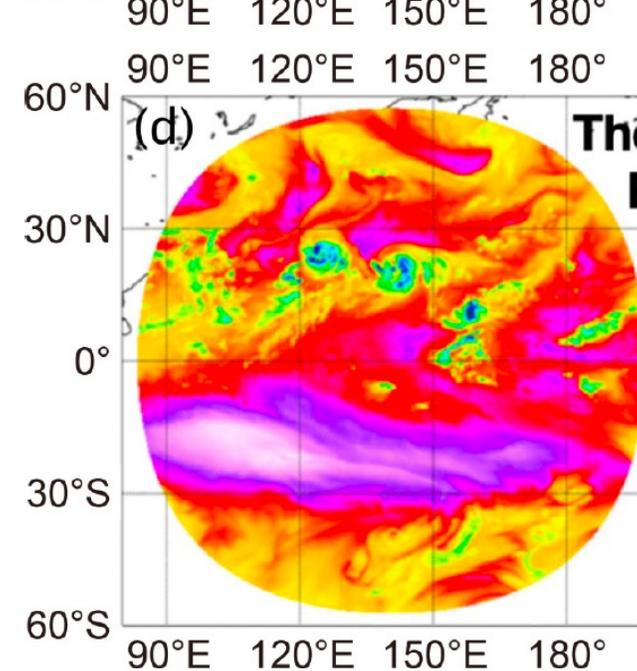
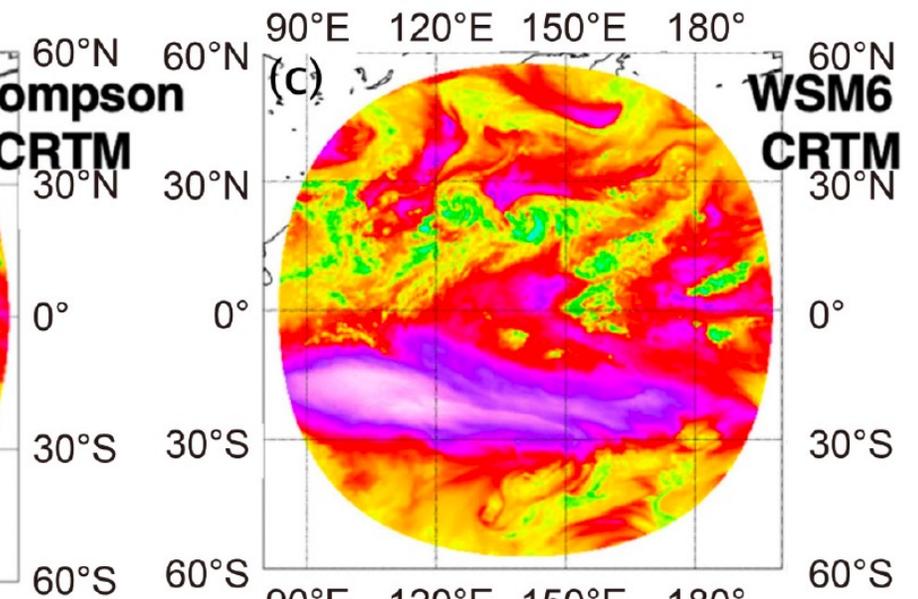
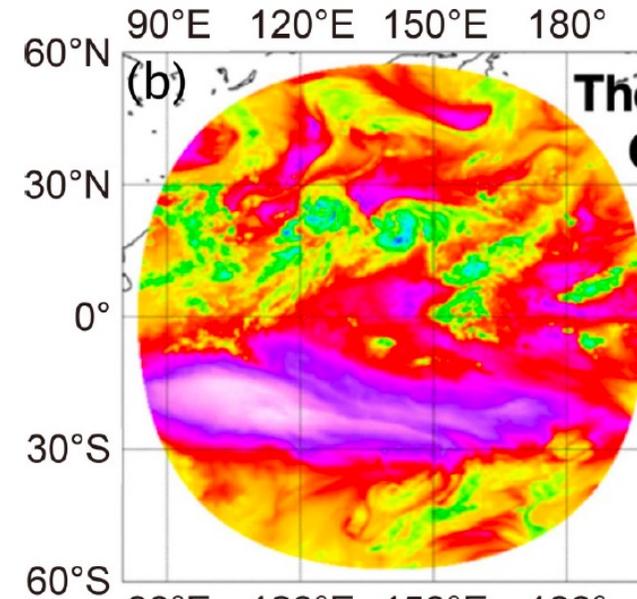
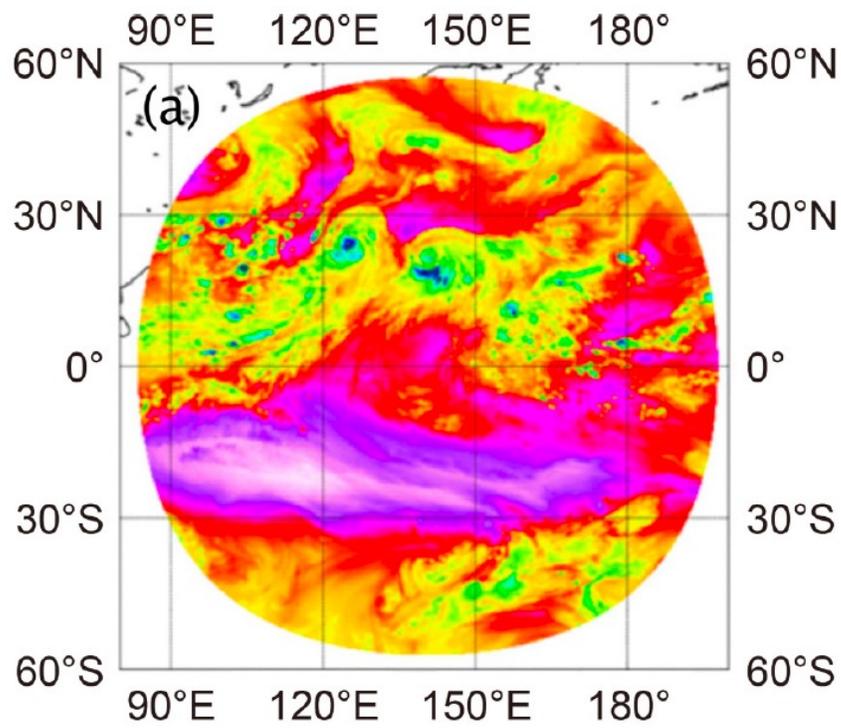
JEDI-MPAS employs MPAS's native meshes, including regional and variable-resolution meshes, and performs I/O with native MPAS-A files.



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: Joint Effort for Data assimilation Integration



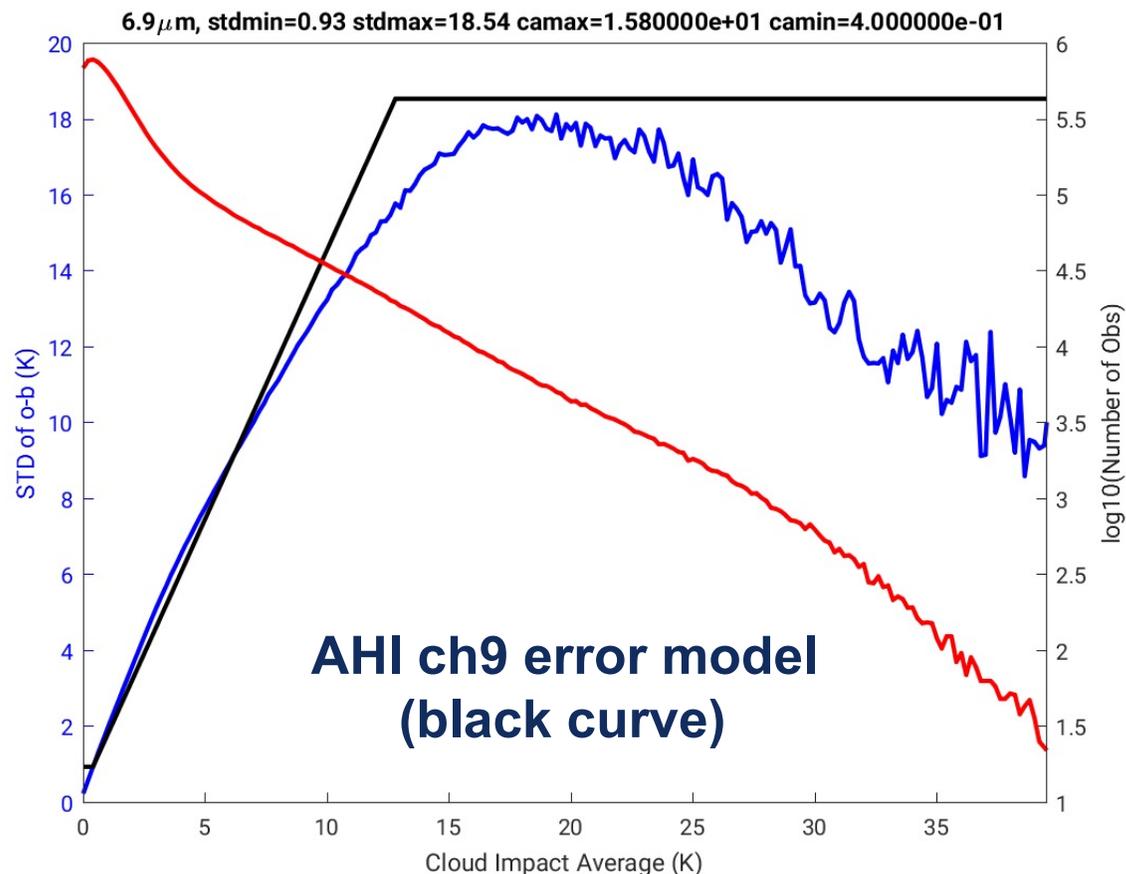


AHI channel 9 observed and simulated brightness temperature using CRTM and RTTOV with a 6-h MPAS model forecast using Thompson and WSM6 microphysics scheme, respectively.

Valid time of simulations is 1200 UTC on 8 August 2019.

Three 6-hourly 3DEnVar cycling experiments

- **clrama**
 - Assimilate radiosonde, aircraft, GNSSRO, AMVs, Ps, clear-sky AMSU-A (ch 5-9) from 6 satellites
- **cldama**
 - Add over-water all-sky AMSU-A ch 1-4 & 15 from 5 satellites above clrama
 - All-sky error model: Zhu et al. (2016), cloud liquid water path as cloud predictor
 - Zhu et al. (2016): no precipitating cloudy DA
 - JEDI-MPAS: real all-sky approach
- **abiahi**
 - Add superobed (15x15) all-sky G16-ABI & H8-AHI ch 8-10 above clrama
 - All-sky error model: Okamoto et al. (2014)



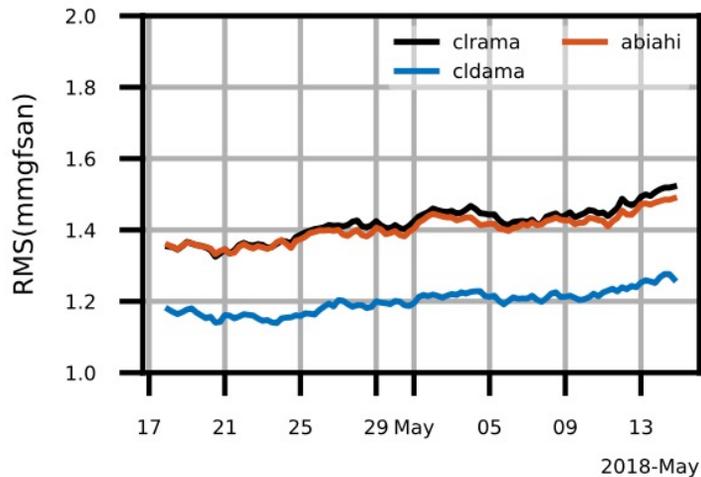
Common settings for all experiments

- Cycling period: 00 UTC 15 April – 18 UTC 14 May, 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 scale: 1200km in horizontal, 6km in vertical
- WSM6 5 hydrometeors (liquid water, ice, rain, snow, graupel) as part of analysis variables
- CRTM as radiance operator
- 10-day free forecast at each 0000 UTC from 04/18, 2018, after 3-day cycling

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

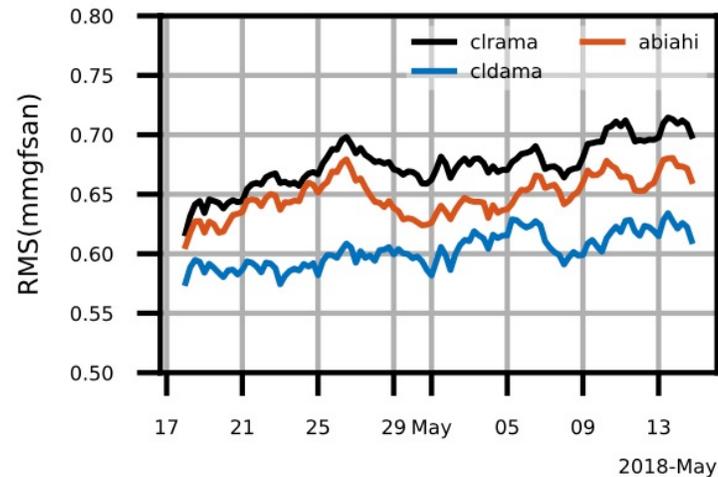
Specific humidity at different layers

Qv11to20 (g/kg) @ all



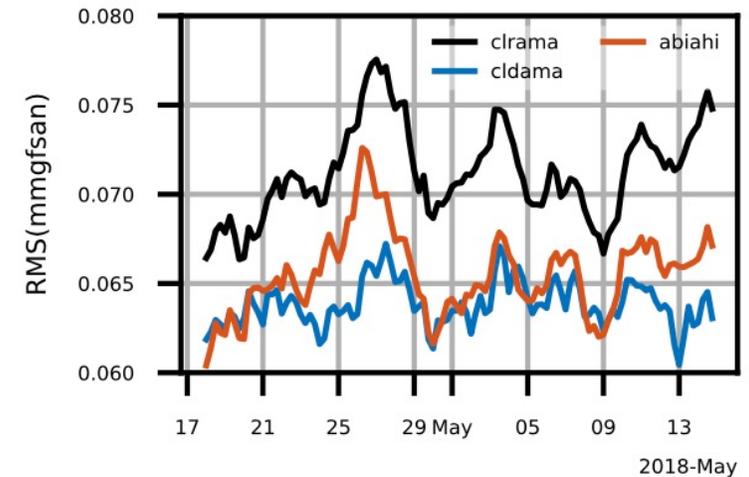
~ 1 km – 3.8 km
~ 850hPa – 560 hPa

Qv21to30 (g/kg) @ all



~ 3.8 km – 8.8 km
~ 560hPa – 330 hPa

Qv31to40 (g/kg) @ all

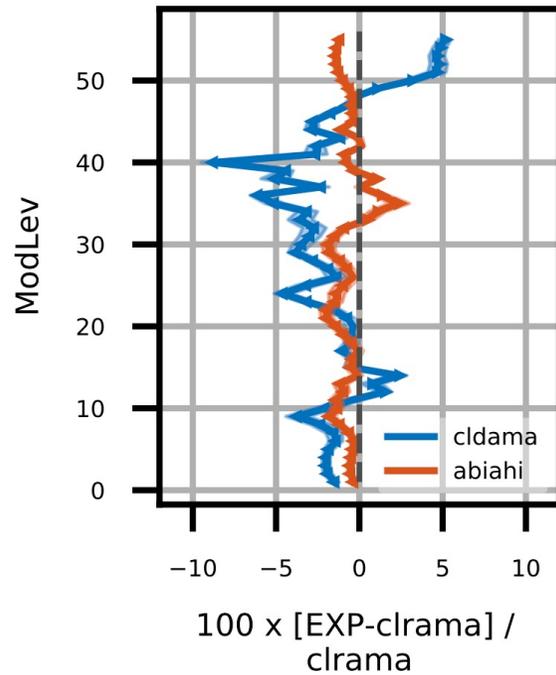


~ 8.8 km – 16 km
~ 330hPa – 110 hPa

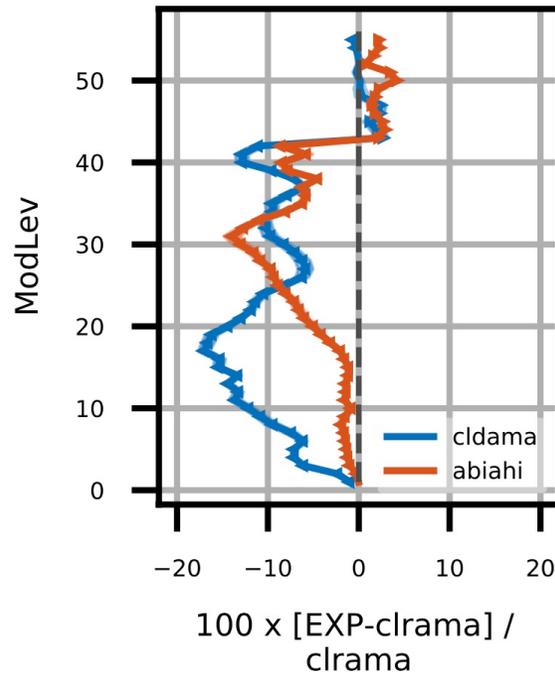
Relative RMSE reduction of Cycling Background w.r.t. GFS analysis

'clrama' as benchmark

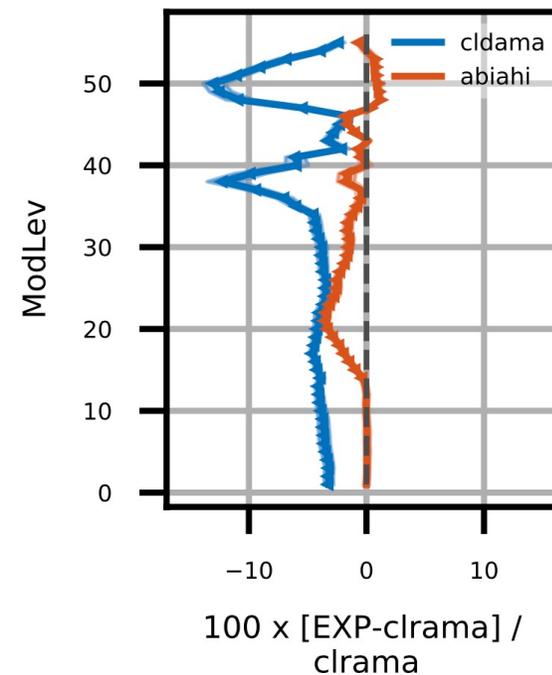
T (C) @ 0.25days



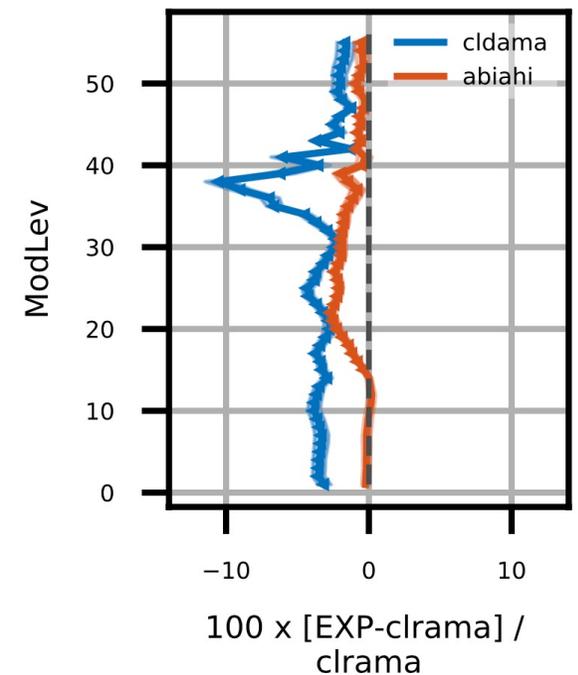
Qv (g/kg) @ 0.25days



U (m/s) @ 0.25days



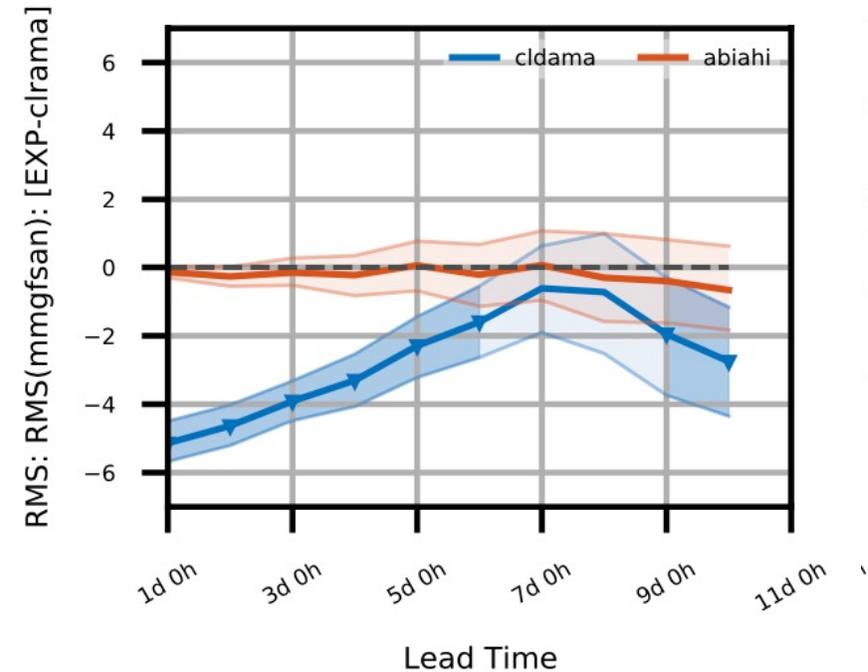
V (m/s) @ 0.25days



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

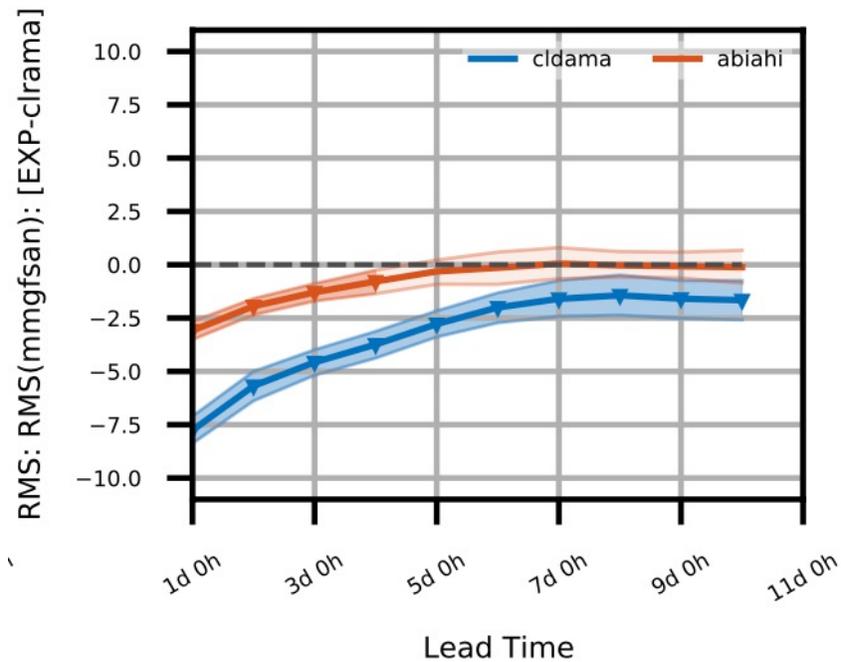
Column u-wind

U (m/s) @ all



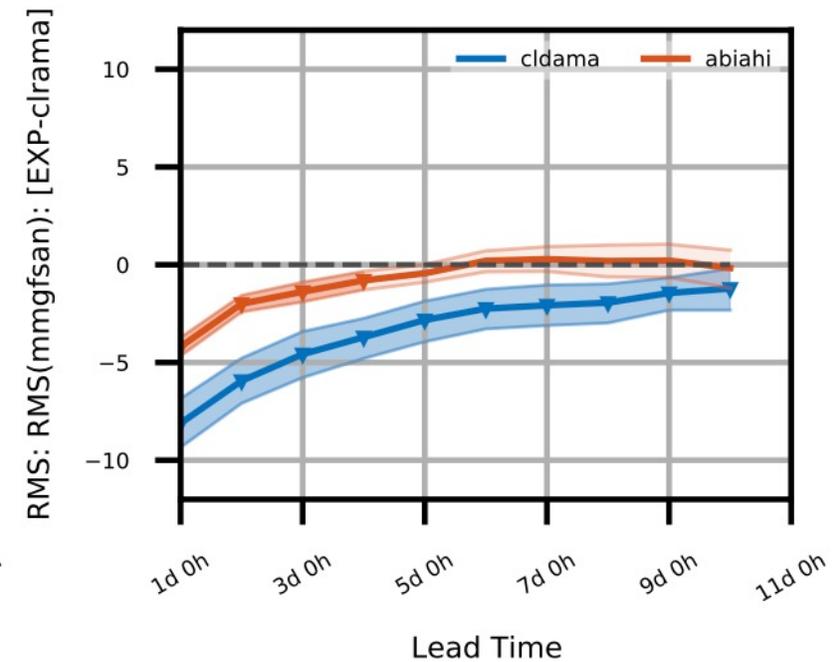
Specific Humidity: level 21-30

Qv21to30 (g/kg) @ all



Specific Humidity: level 31-40

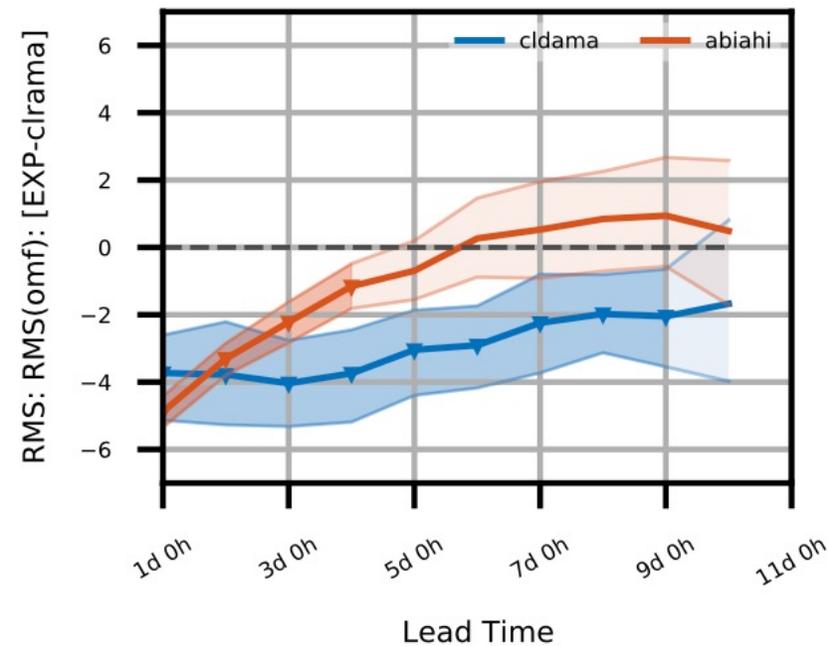
Qv31to40 (g/kg) @ all



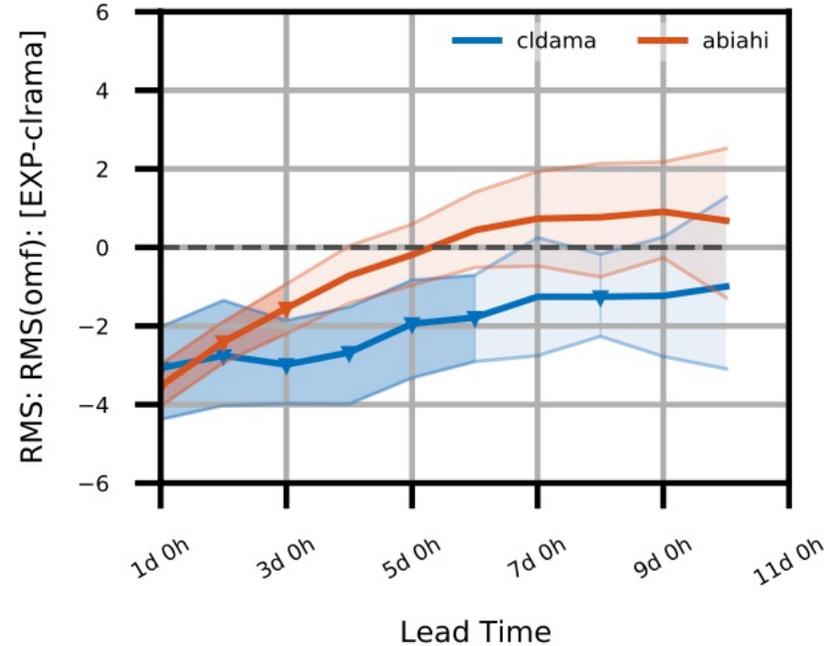
Relative RMSE reduction of 1-10-day FC w.r.t. AHI radiances: 3 WV ch

over all superobed pixels

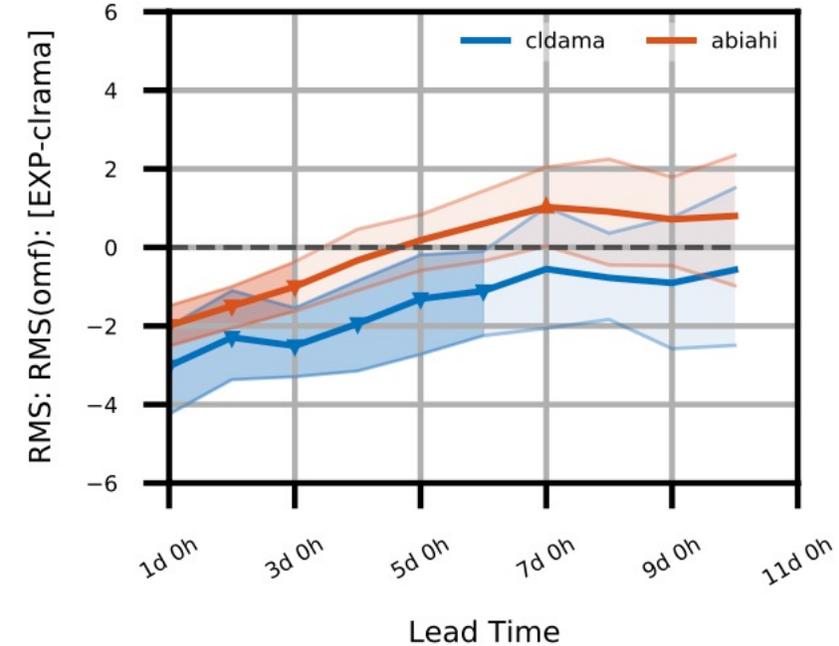
BT8 (K) @ pass



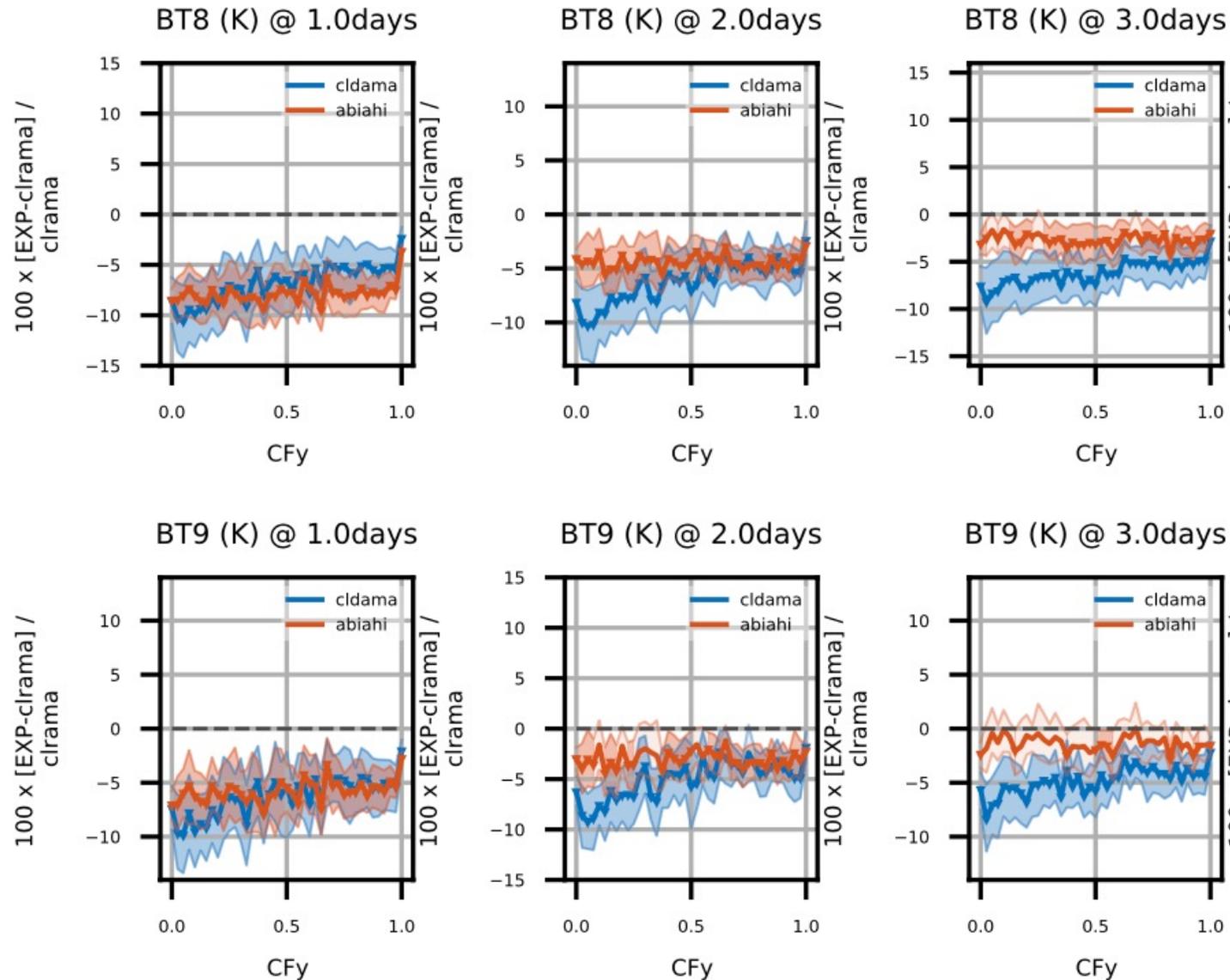
BT9 (K) @ pass



BT10 (K) @ pass



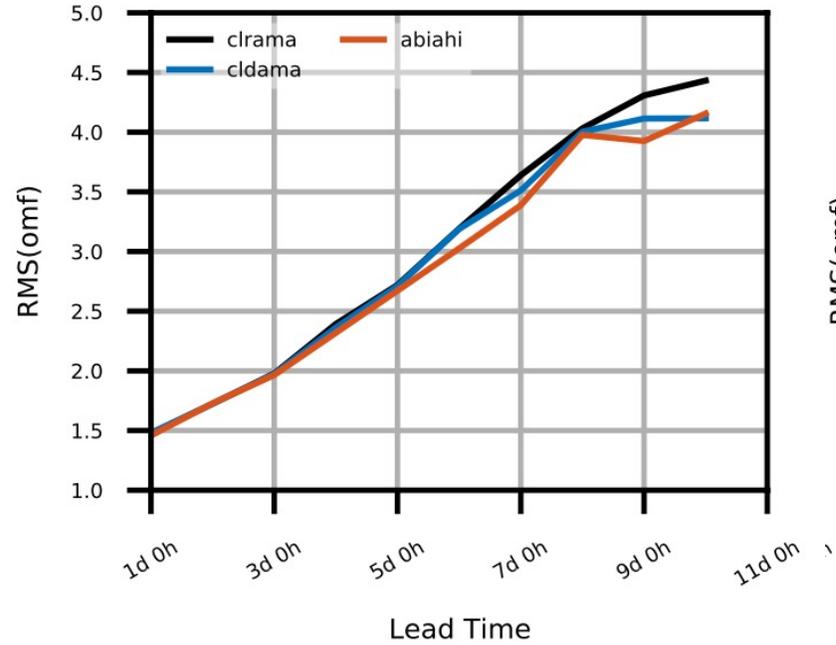
Relative RMSE reduction of 1-3-day FC w.r.t. AHI radiances



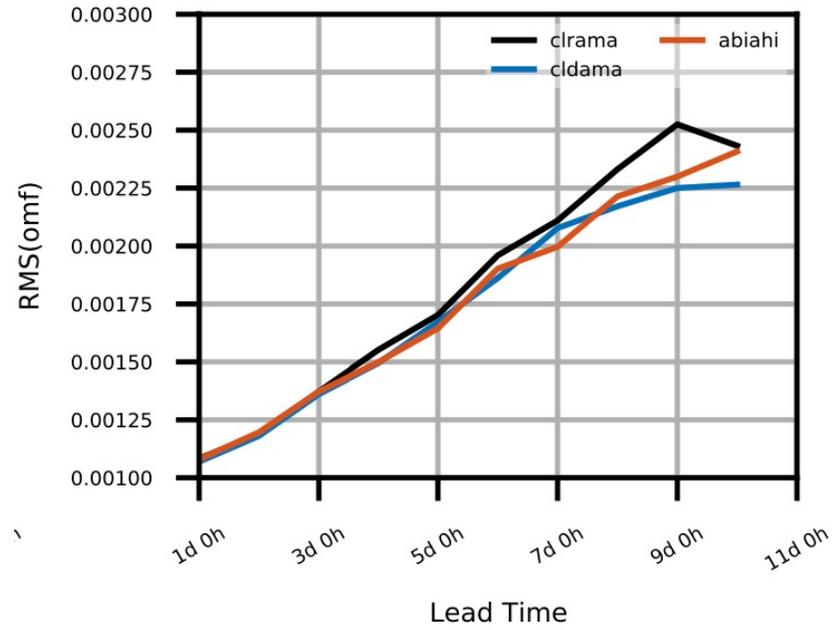
CFy: cloud fraction for superobed ABI pixels

RMSE of 1-10-day FC w.r.t. aircraft obs

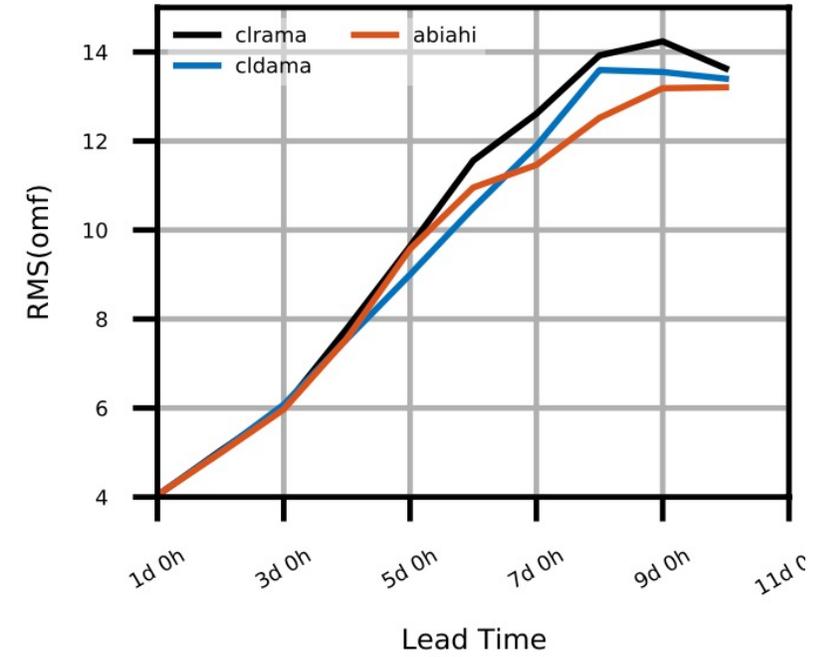
T (K) @ pass



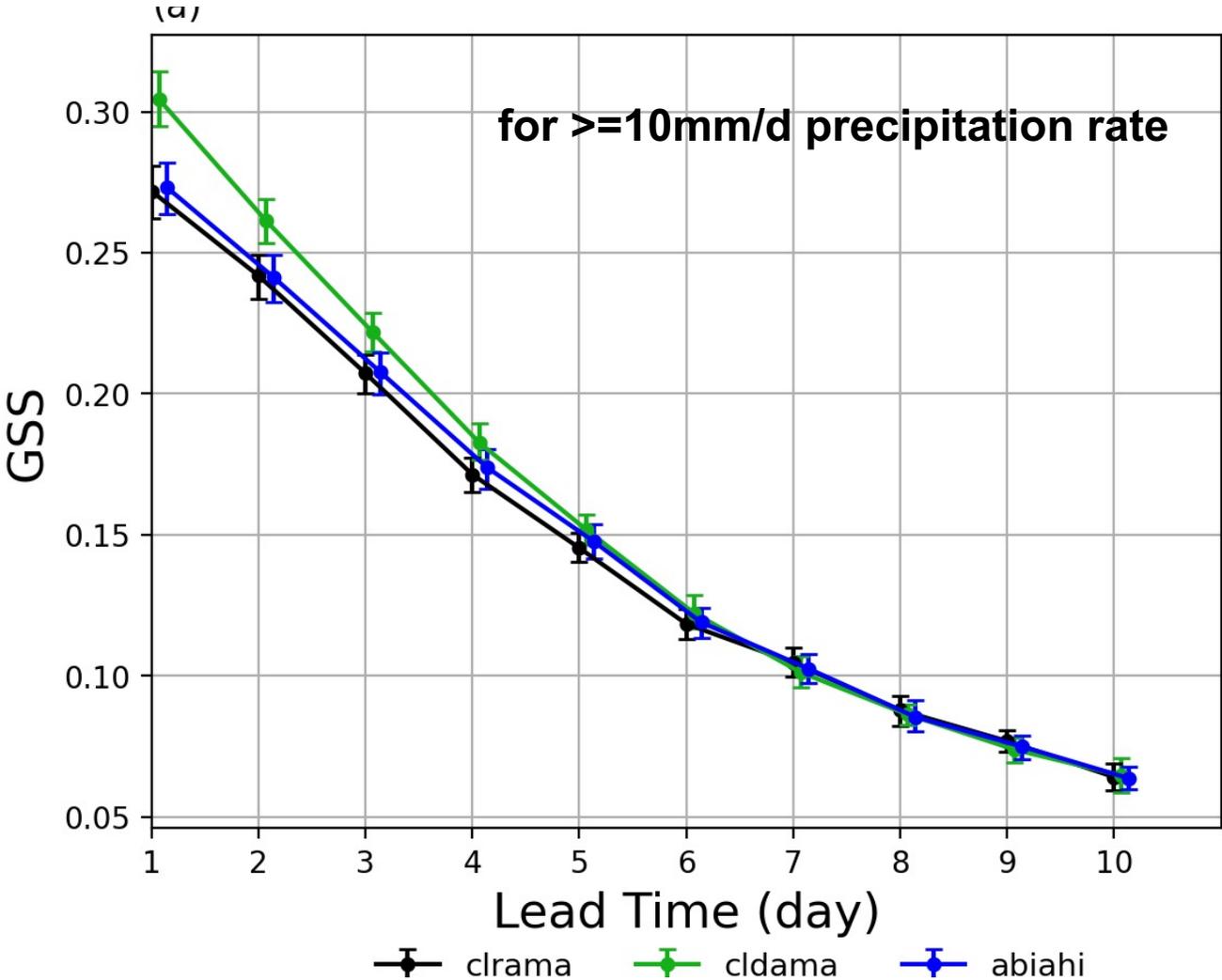
qv (kg/kg) @ pass



V (m/s) @ pass



Gilbert Skill Score of rainfall forecast w.r.t. CMORPH



Concluding Remarks

- Consistent positive impact from all-sky AMSU-A and ABI/AHI DA demonstrated with the newly-developed JEDI-MPAS DA system, with an overall larger impact from all-sky AMSU-A
- JEDI-MPAS publicly available, great potential for operational and research use
- Interested in integrating EarthCare Simulator (or expand CRTM or RTTOV) into JEDI and exploring data for model evaluation and DA