

AIRS vs MERRA-2: when and where do they both agree on the impact of convection on PBL thermodynamics?

Greg Elsaesser¹

Jonathan Jiang², Hui Su², Kathleen Schiro²

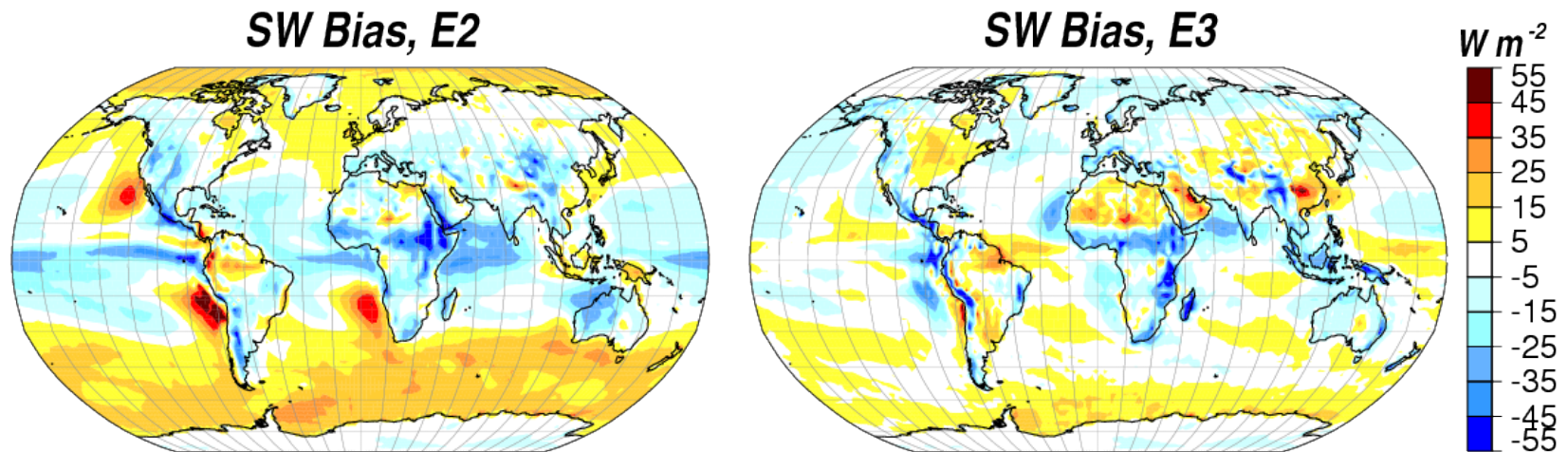
¹*Goddard Institute for Space Studies (GISS), Columbia University/NASA*

²*Jet Propulsion Laboratory (JPL)*

**NASA Sounder Science Team Meeting
2019 Sep 25 - 27
College Park, MD.**

December 2019: CMIP6 Simulations Must be Completed

NASA GISS-E3 GCM, improvements in many areas.

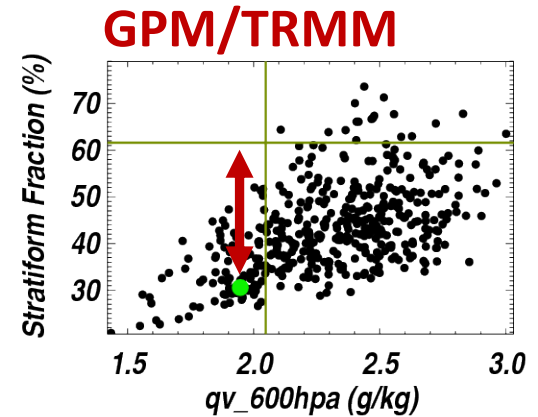
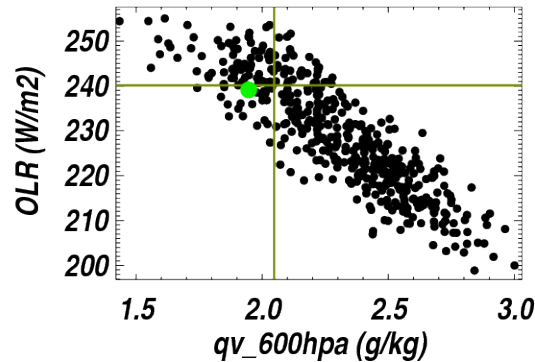
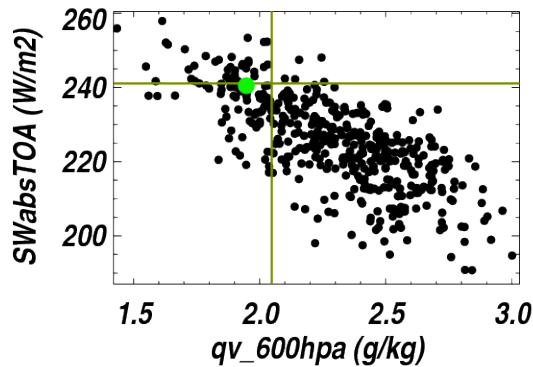


One example: Absorbed SW radiation (bias relative to CERES EBAF Ed4.1)
GISS-E2 Bias (**left**) GISS-E3 Bias (**right**)

Take away: Right answer for right reasons in the stratocumulus regions, and high latitudes. *Improvement in deep convection even though lacking physics for large convective systems.*

December 2019: CMIP6 Simulations Must be Completed

If physics are missing, we expect it to show up somewhere in a joint radiation, moisture, precipitation analysis.



AIRS Obs4MIPS V2 water vapor

Take away: GCM Perturbed Parameter Ensemble (PPE) experiments yield numerous GCM configurations that can get close to observations...
but not for all fields.



**REAL
World**

Why does stratiform fraction matter?

**Picture from Chris
Rozoff (NCAR)**

**REAL
World**

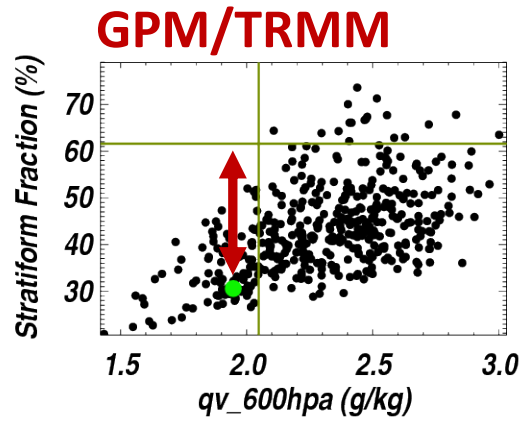
Stratiform

Convective

Stratiform

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**GCM
World**



Stratiform

Convective

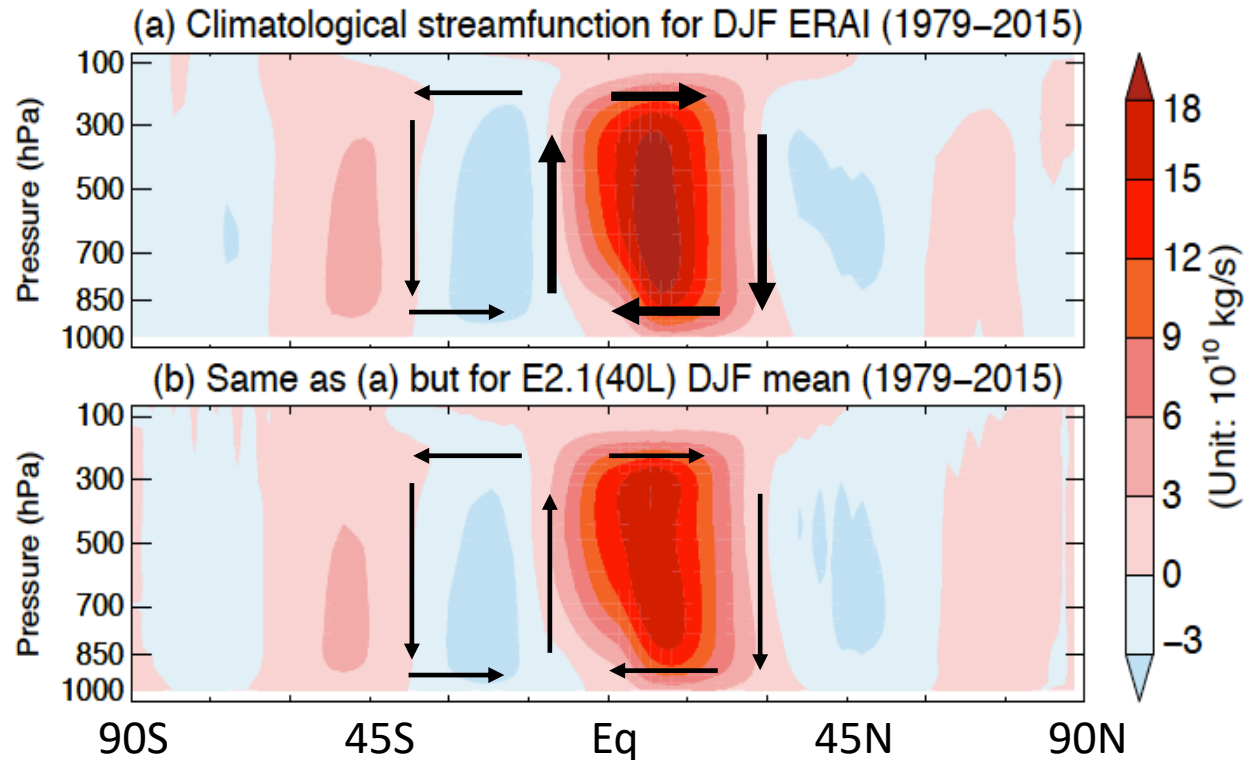
Strat

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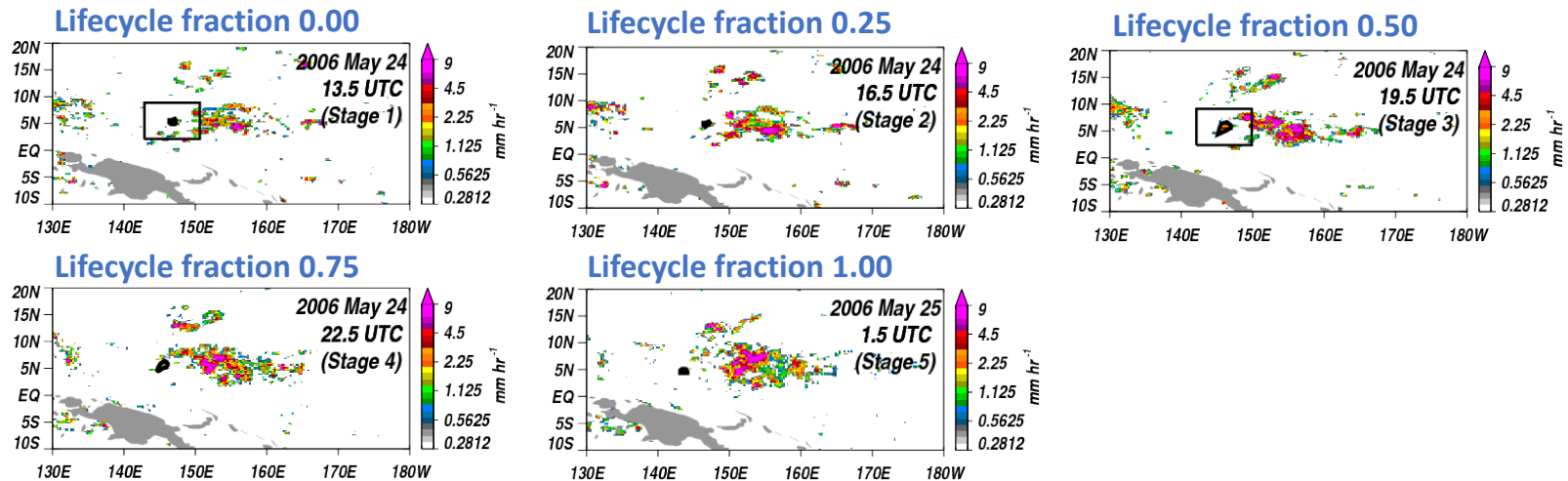
December 2019: CMIP6 Simulations Must be Completed

Lower stratiform fraction, probably less diabatic heating aloft, and probably weaker global circulation.

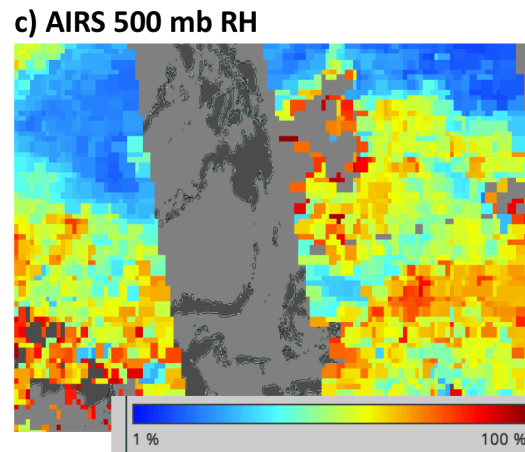
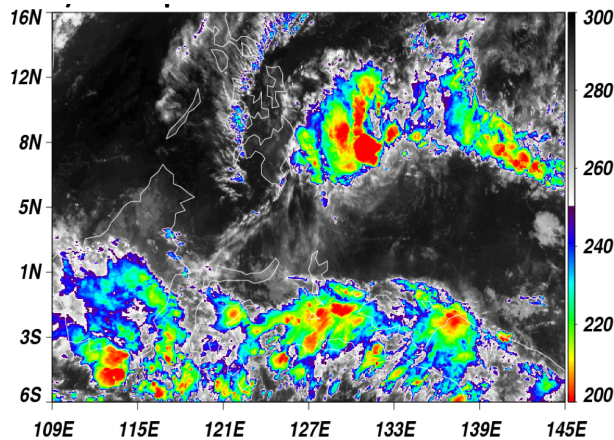


Why does stratiform fraction matter?

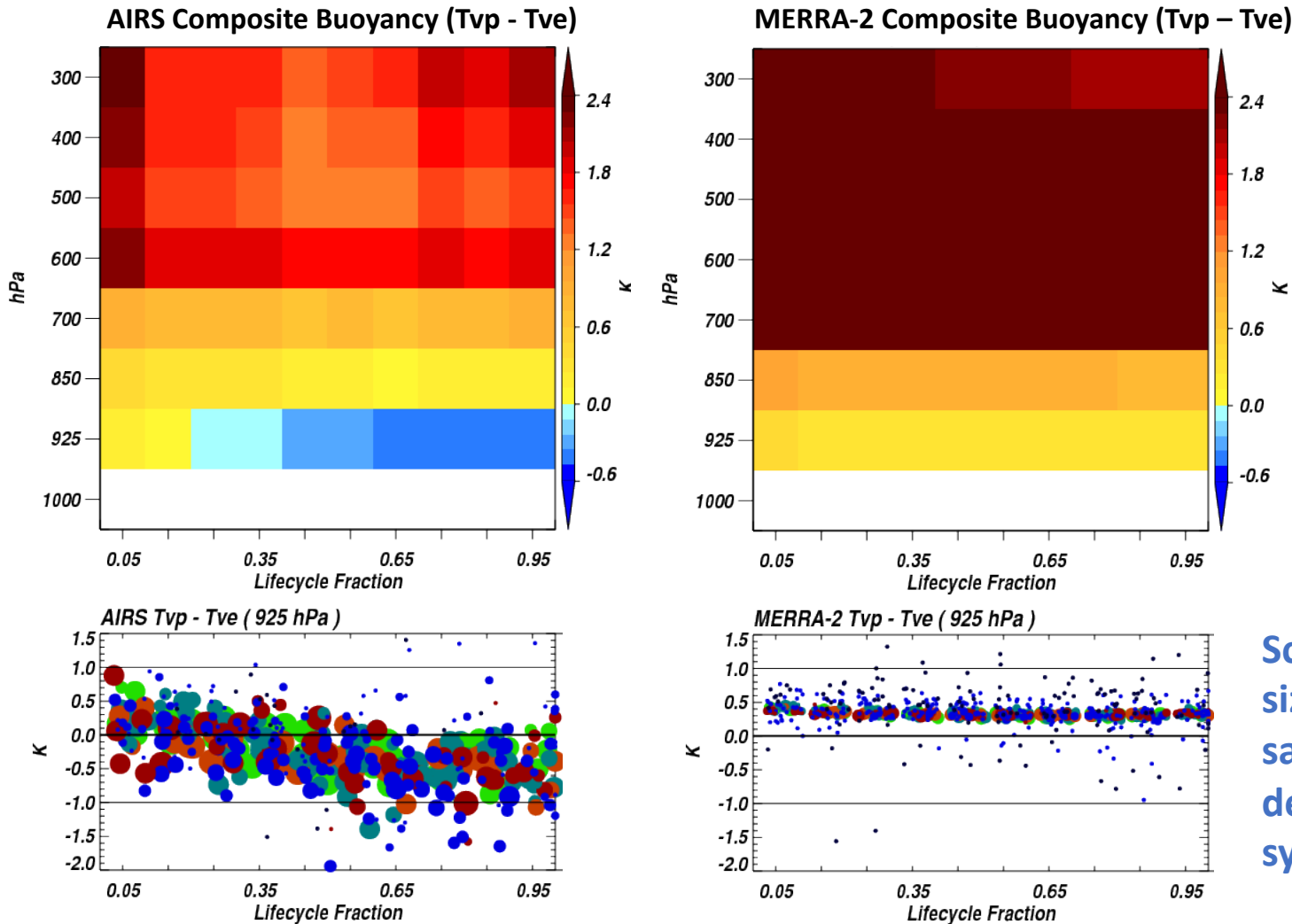
Last Year: Developed conceptual idea for stratiform rain in deep convection (related to re-ingestion of stable PBL air into clouds)



Co-locate AIRS orbital level products to systems at each stage.



Increased stability seems to be the result of decreases in 925 – 1000 hPa temperatures (MERRA-2: local stability unchanging - is this realistic?).



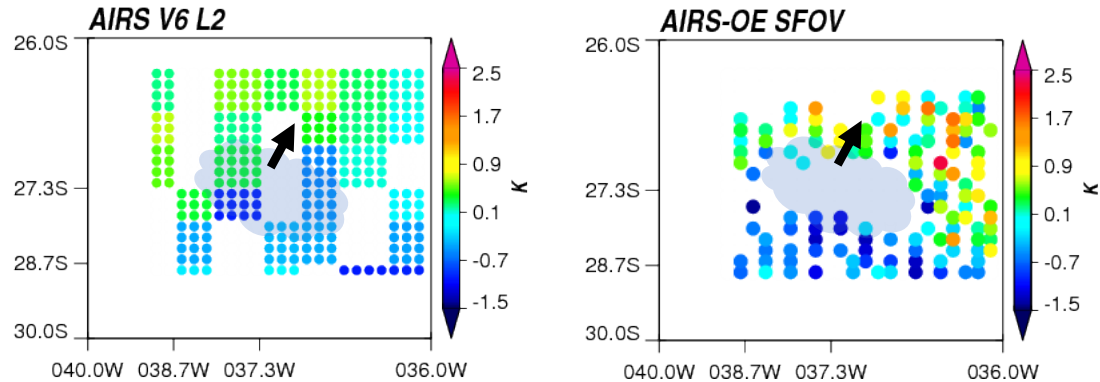
Scatterplot pixel sizes \sim number of samples; color denotes different system durations.

Differences between AIRS-V6 and MERRA-2 warrant a bit more investigation: enter single FOV retrievals

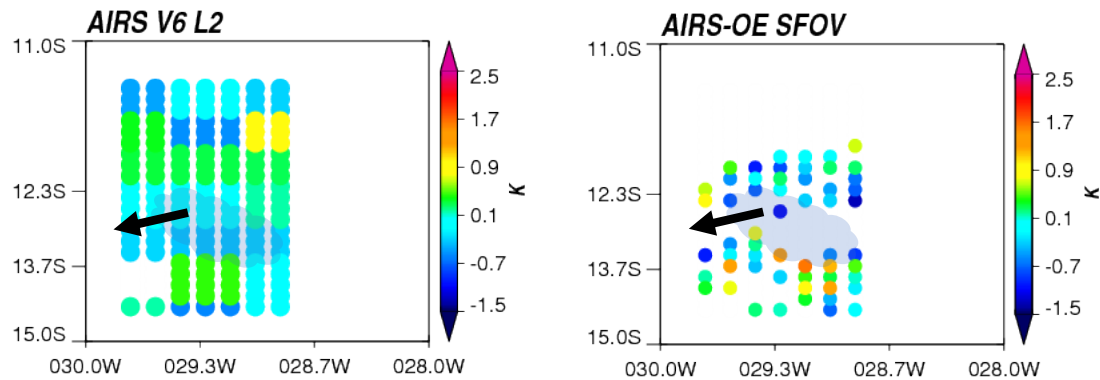
Mesoscale signals very evident in AIRS-OE SFOV retrieval case studies...

(consistent with warm early, more stable/cooler later idea)

Bill Irion's Retrievals



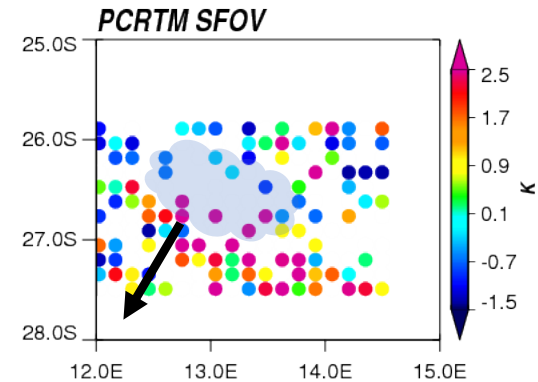
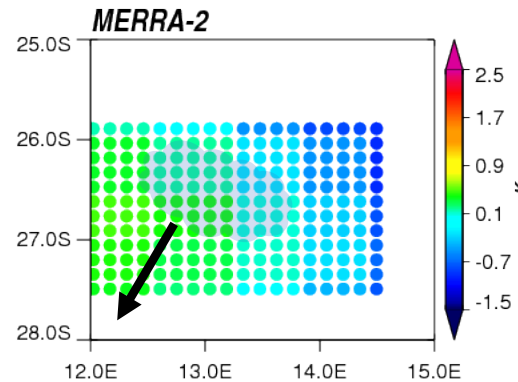
1000 hPa Temperatures



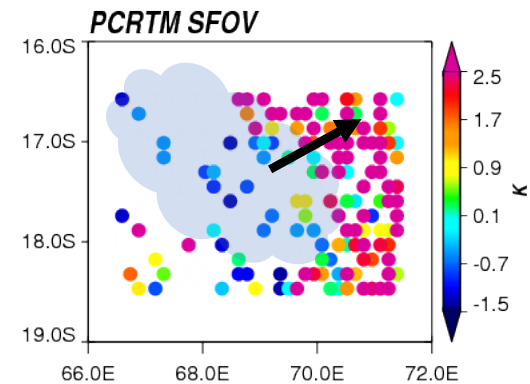
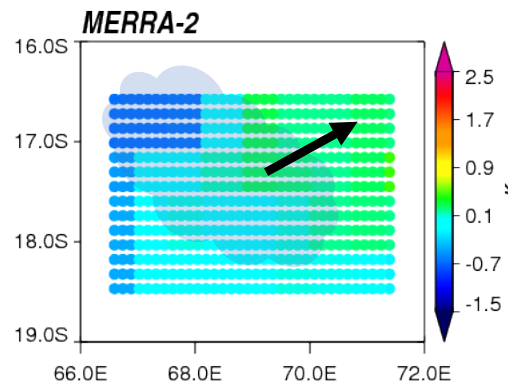
Differences between AIRS-V6 and MERRA-2 warrant a bit more investigation: enter single FOV retrievals

As well as in the PCRTM SFOV Retrievals...

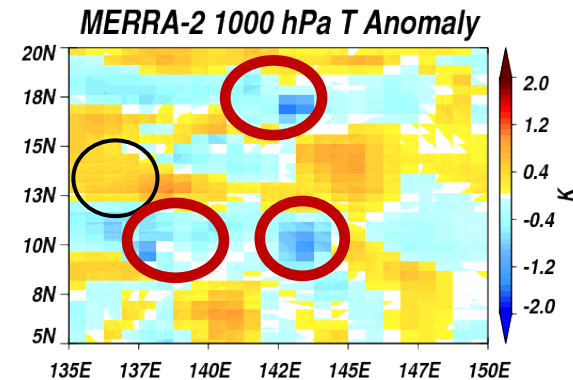
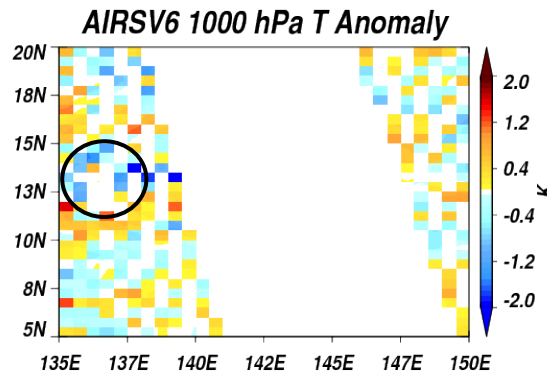
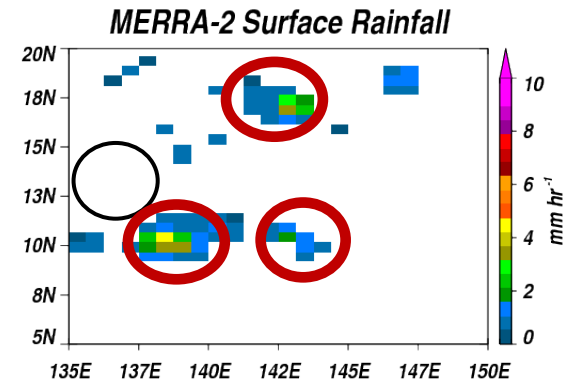
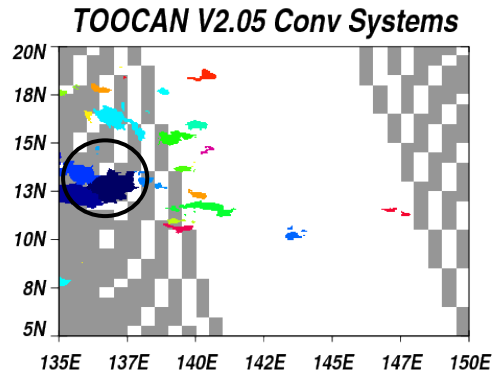
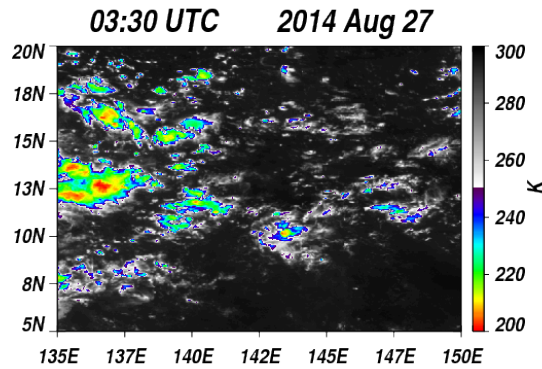
X. Liu's and W. Wu's Retrievals



1000 hPa Temperatures



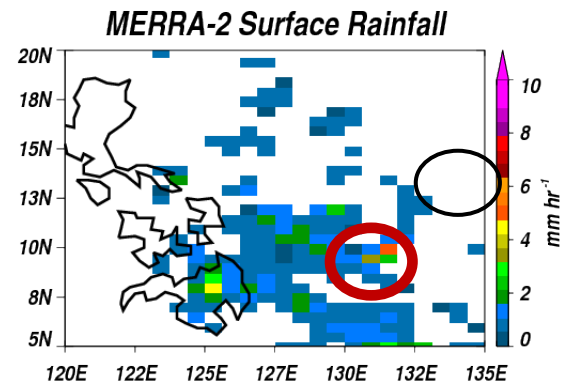
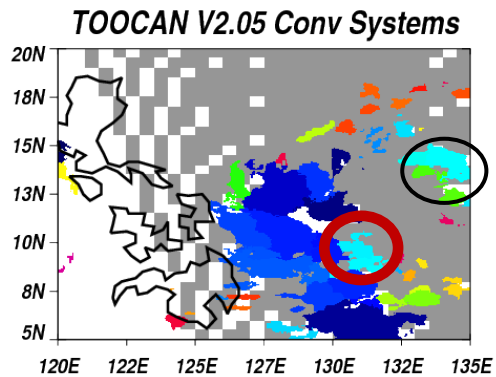
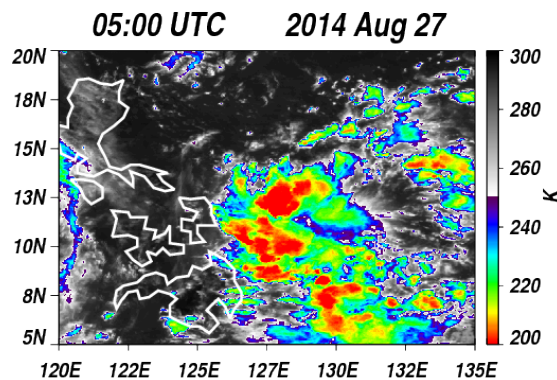
Larger search through scenes




○ Convection only in MERRA-2.

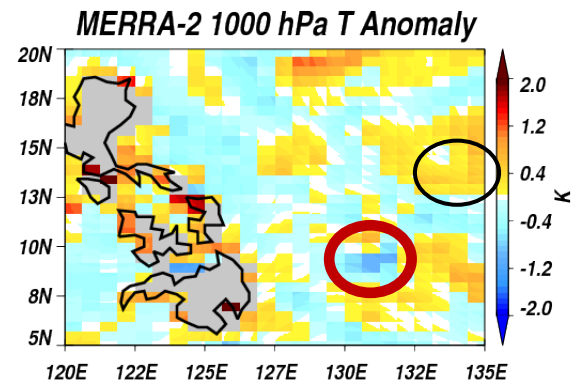
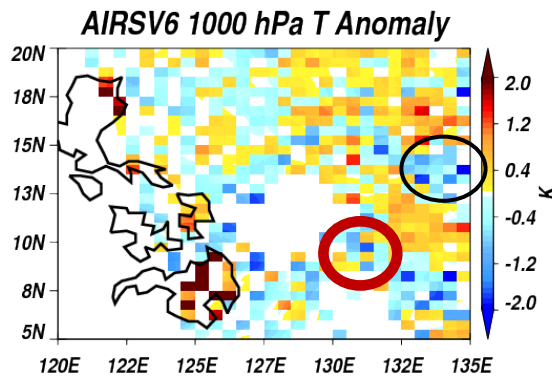
○ Convection only in IR Imagery.

Larger search through scenes



 Convection in IR imagery & MERRA-2.

 Convection only in IR imagery.



Summary

- ❖ *Noisy, but a PBL cooling signal in the pixels closest to convection is evident (and physically realistic). **The variation with lifecycle is the key science component, and is being used to help explain why convection evolves to be dominated by stratiform cloud.***
- ❖ *Single FOV retrievals have potential to be pretty useful in these scenes.*
- ❖ *MERRA-2 is probably not the best source for the local environment near observed convection or as useful for understanding how observed convection evolves on cloud system timescales (hours). It might be OK relative to its own convection, when present.*