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Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

AIRS Validation

Eric Fetzer and AIRS Validation Team

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, CA

Approach

- **Put together a draft V5 validation report**
  - ***Delivered no earlier than 1 Dec.***
  - ***Based on manuscripts submitted / in prep.***

- **Today's talks will be loosely organized around this plan.**

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Core Products

Black = Not emphasized here

Red=Needed for Val Report

	Validation Status by Geophysical Conditions					
	Ocean		*Land*			*Polar*
	Low lat	*High lat*	*Desert*	*Temperate*	*Frozen*	
Core Products						
CC Rad	Strow	Strow	Strow	Strow	Strow	Strow
SST	Aumann	Aumann	N/A	N/A	N/A	N/A
LST	N/A	N/A	Hook	Hook	Hook	Walden?
T(all)						
T (p>700 hPa)	Gambacorta, Irion, Teixeira	Gambacorta, Irion	No corr. data	Gambacorta, Irion	Gambacorta, Irion	Irion
T (300<p<700 hPa)	Gambacorta, Irion, Teixeira	Gambacorta, Irion	No corr. data	Gambacorta, Irion	Gambacorta, Irion	Irion
T (100<p<300 hPa)	Gambacorta, Irion, Teixeira	Gambacorta, Irion	No corr. data	Gambacorta, Irion	Gambacorta, Irion	Irion
T (p<100 hPa)	Tian	Tian	Tian	Tian	Tian	Tian
q(p>700 hPa)	Gambacorta, Irion, Teixeira	Gambacorta, Irion	No corr. data	Gambacorta, Irion	Gambacorta, Irion	Gambacorta, Irion
q(300<p<700 hPa)	Gambacorta, Irion, Teixeira	Gambacorta, Irion	No corr. data	Gambacorta, Irion	Gambacorta, Irion	Gambacorta, Irion
q(p<300 hPa)	Gambacorta, Irion, Fetzer	Gambacorta, Irion, Fetzer	No corr. data	Gambacorta, Irion, Fetzer	Gambacorta, Irion, Fetzer	N/A
TPW	Fetzer	Fetzer	Knuteson, Granger,	Knuteson, Granger, Irion	Knuteson, Granger, Irion	Knuteson, Granger, Irion
Cld Frc	Kahn	Kahn	Kahn	Kahn	Kahn	Kahn
CTH	Kahn	Kahn	Kahn	Kahn	Kahn	Kahn
CTT	Kahn	Kahn	Kahn	Kahn	Kahn	Kahn

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Radiosondes are key to T and q

- **Several locations and seasons: more than 900 independent/dedicated sondes matched to AIRS retrievals**
  - ***Bill Irion is analyzing all sondes for T and q.***
  - ***Antonia Gambacorta / Dave Tobin - ARM sites.***

JPL AIRS team analyses: *shown on 31 July; blue = progress*

- **High northern latitude T and q:** Hengchun Ye examining Siberia/Canada
- **Tropical upper trop water vapor (TICO, Vömel):** special cases of dedicated sondes.
- **Trade-wind boundary layer over ocean (RICO):** Joao Teixeira
- **Microwave-only water vapor profiles:** E. Fishbein will do HSB val study + MEaSUREs
- **Tropopause properties:** Baijun Tian with GPS-met group.
- **Total water vapor in So. Cal. & Japan from ground-based GPS:** Stephanie Granger
- **Clouds:** Brian Kahn has completed several studies**.**
- **Ozone:** Bill Irion (intercomparisons and collaborating with Divakarla.

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V5 Validation Report

- **Report to contain:**
  - ***Summary of the literature on AIRS validation.***
  - ***Summaries of dedicated sonde comparisons.***
  - ***Summaries of other analyses, like ground-based GPS total water vapor, tropopause properties.***
- **Data sets and documentation:**
  - ***Dedicated sondes + other matched, QC'd data.***
- **Paper drafts in the late fall time frame**
- **Aqua End of Prime Mission Review in early December**

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Validation of AIRS boundary layer structure in the trade-wind region

Joao Teixeira and AIRS Validation Team

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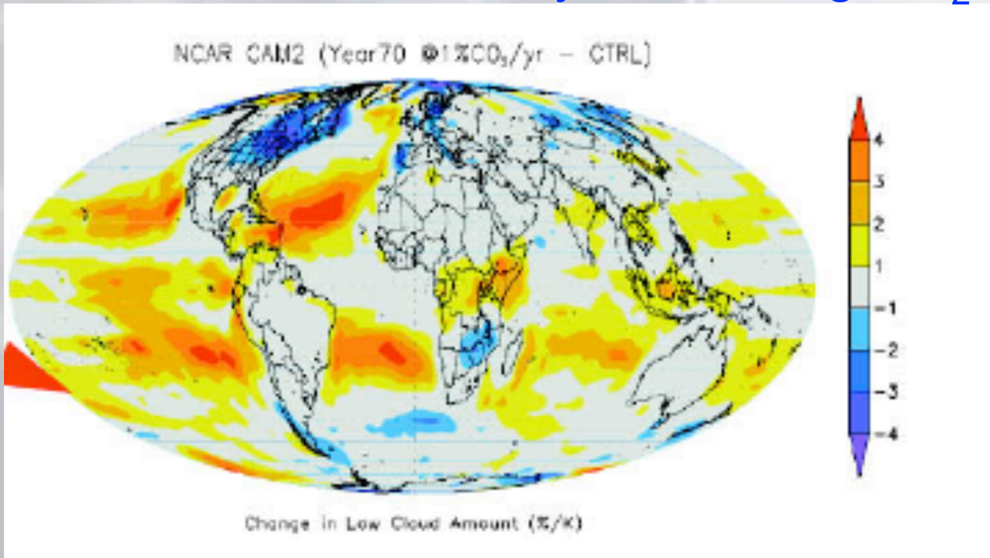
IPCC 2007: "Cloud feedbacks remain the largest source of uncertainty in climate prediction"

NCAR low cloud cover sensitivity to doubling CO_2:



Stephens, JCLI, 2005

Large cloud sensitivity in the sub-tropics (trade-wind regions)

Clouds depend on temperature and water vapor …
But how does the vertical structure of T and q look like?

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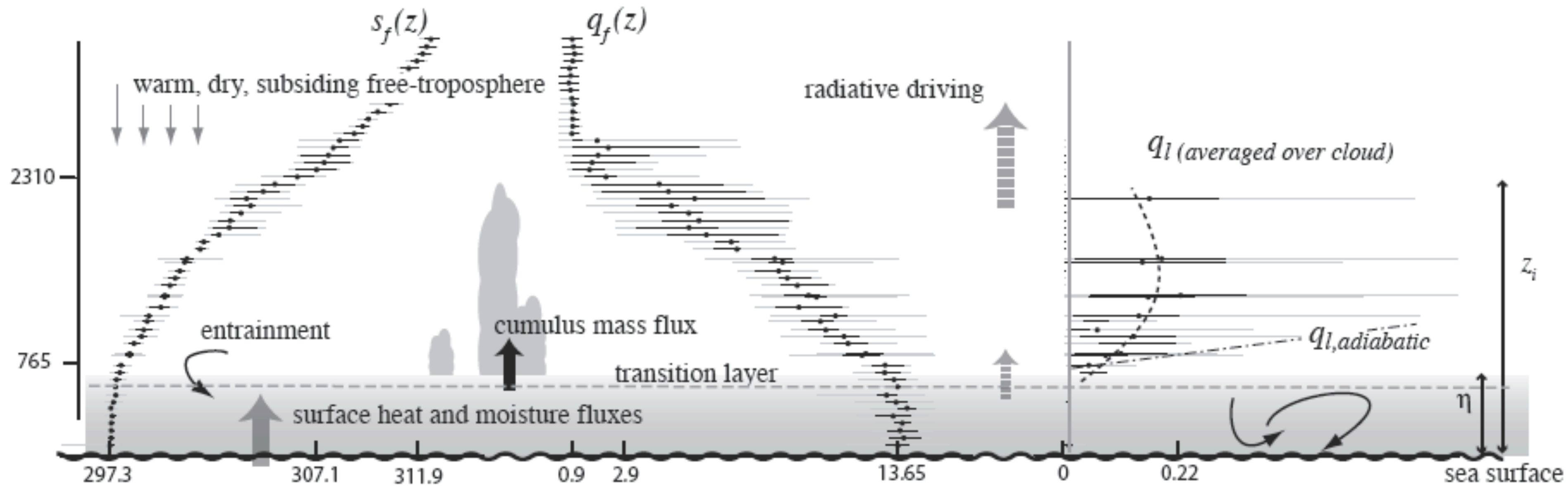
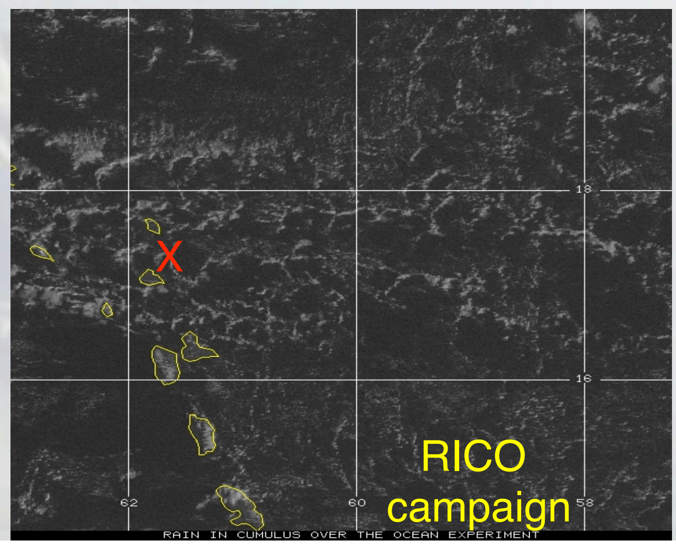
Trade-wind boundary layer vertical structure



Stevens (2006)



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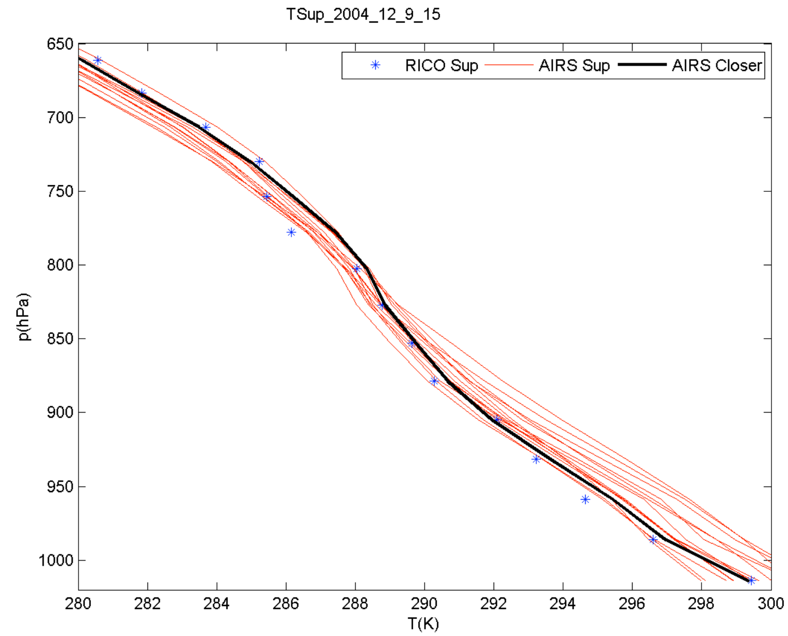
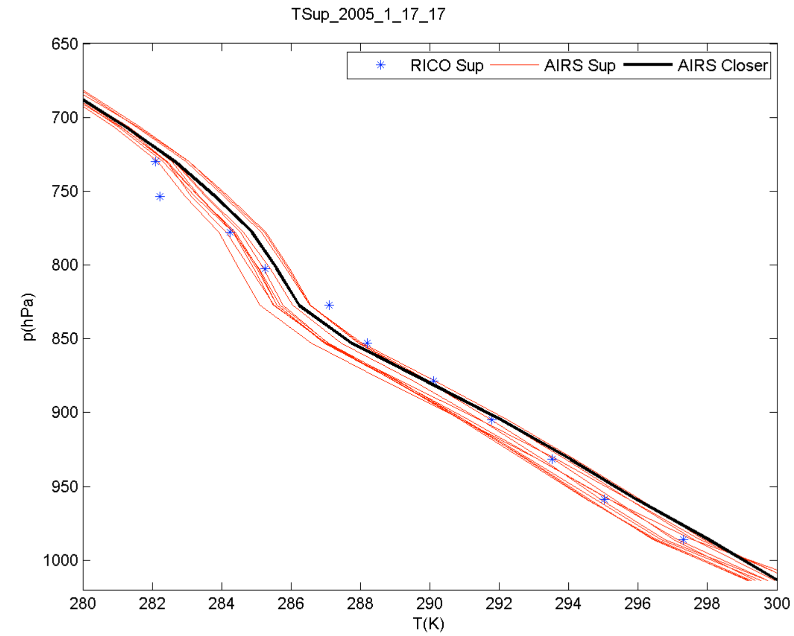
AIRS boundary layer structure versus RICO sondes

Two profiles out of more than 30 radiosondes

Temperature – 09/Dec/2004



Temperature – 17/Jan/2005



Two good examples of realistic AIRS (support) temperature boundary layer profiles … But not much vertical structure …

… let's look at potential temperature

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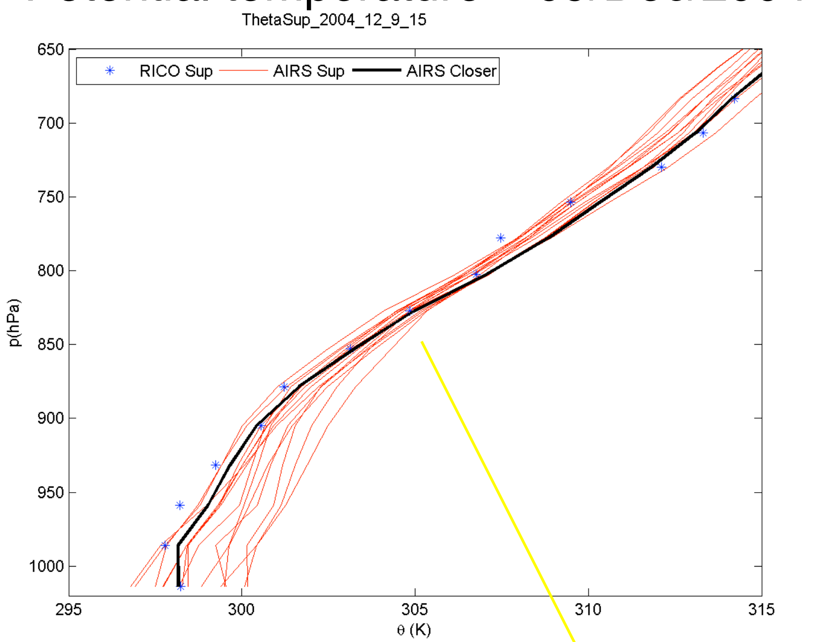
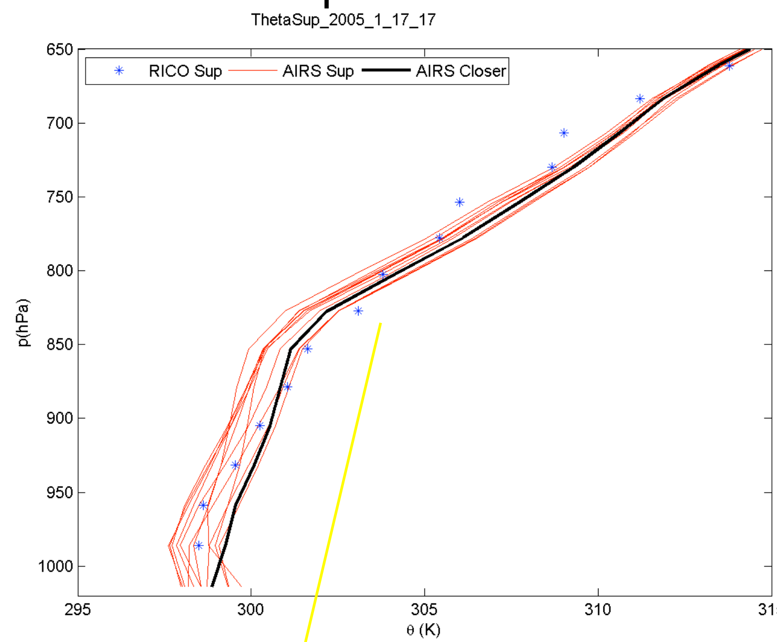
Potential temperature – 09/Dec/2004



Potential temperature – 17/Jan/2005



Boundary layer inversion is well captured

Two good examples of realistic structure of AIRS (support) potential temperature boundary layer profiles

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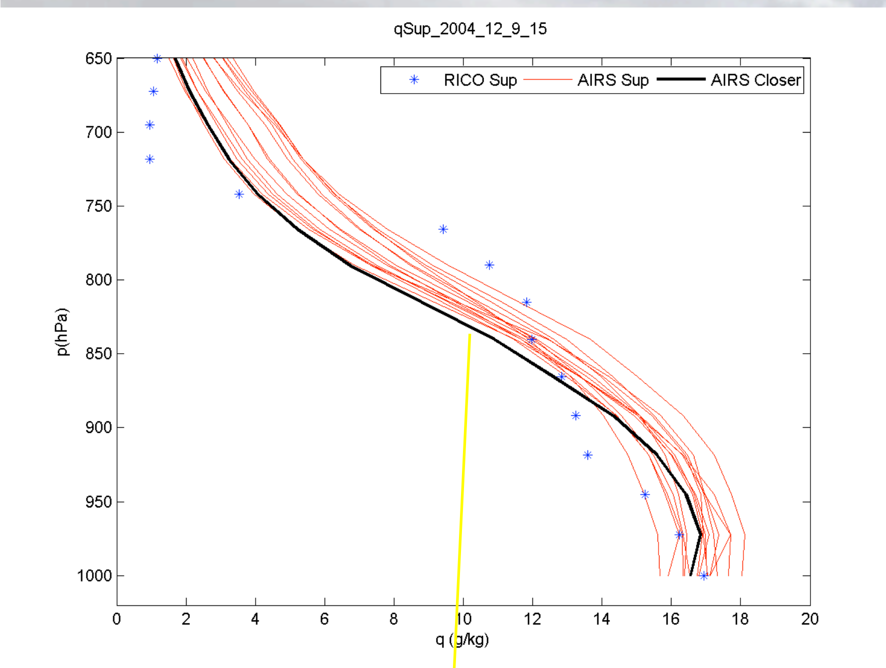
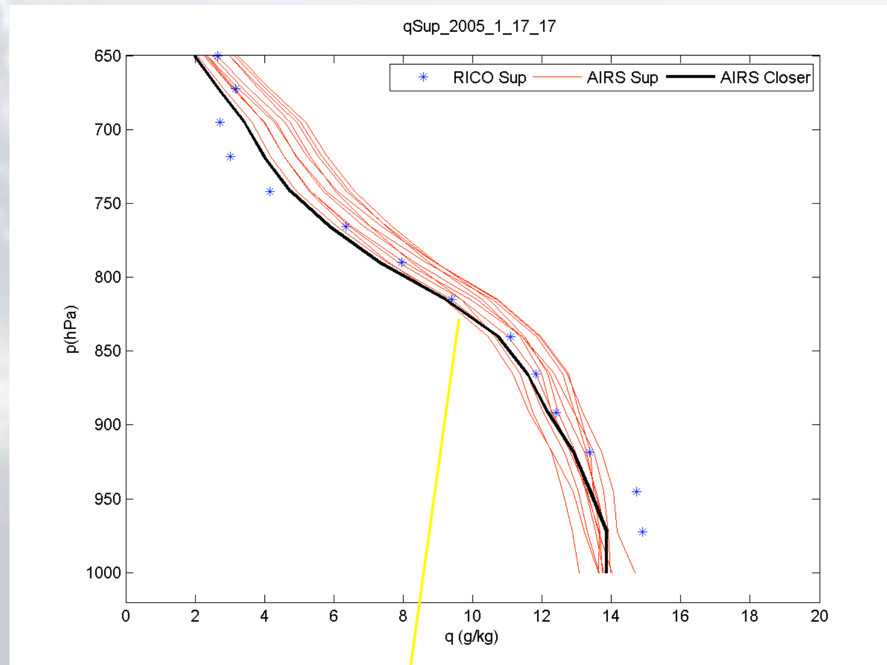
Water vapor – 09/Dec/2004



Water vapor – 17/Jan/2005



This discrepancy could be an issue with sonde

AIRS (support) water vapor in boundary layer can be very realistic

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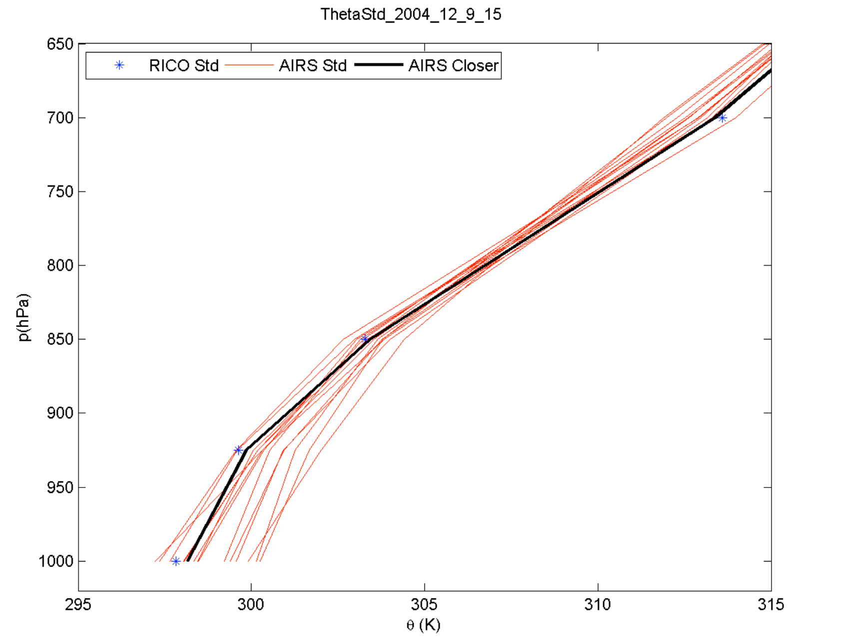
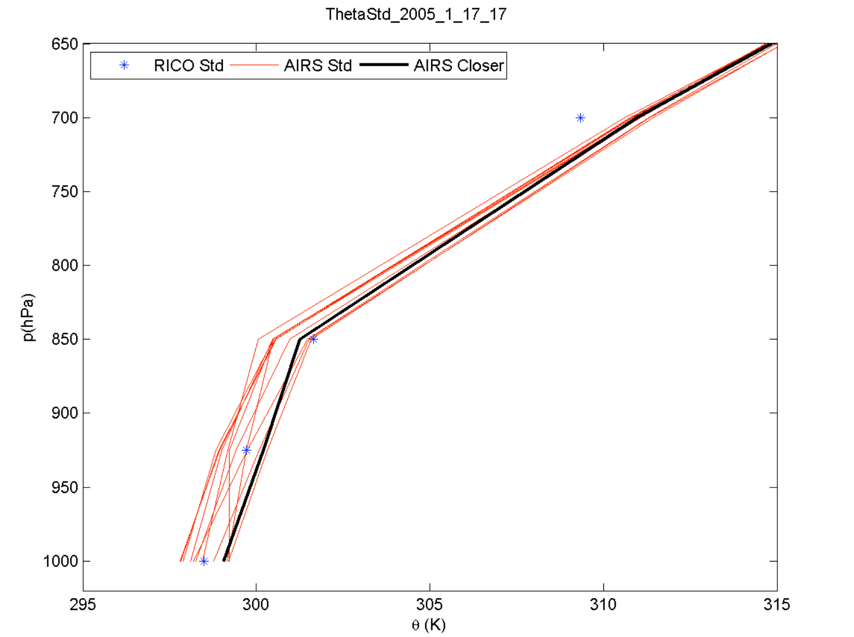
Potential T (standard) – 09/Dec/2004



Potential T (standard) – 17/Jan/2005



AIRS standard product is also realistic … but lacks vertical structure

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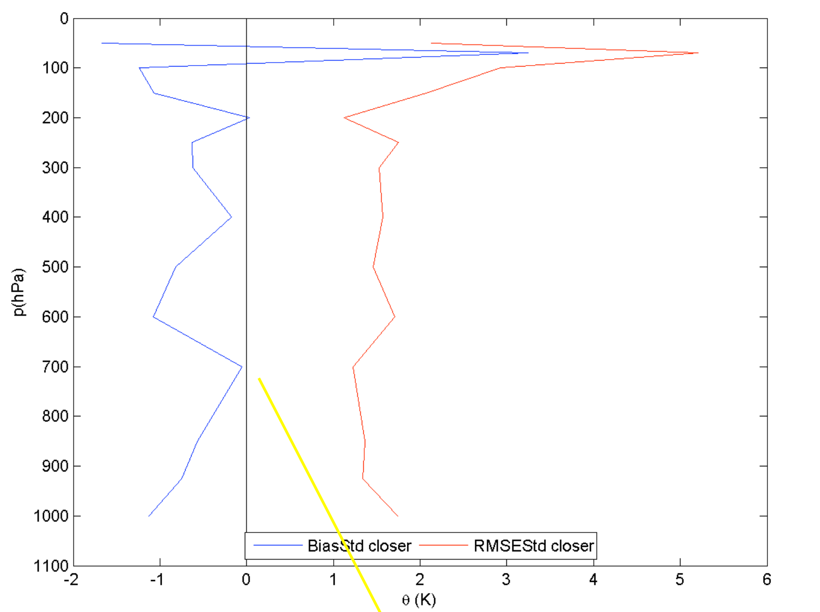
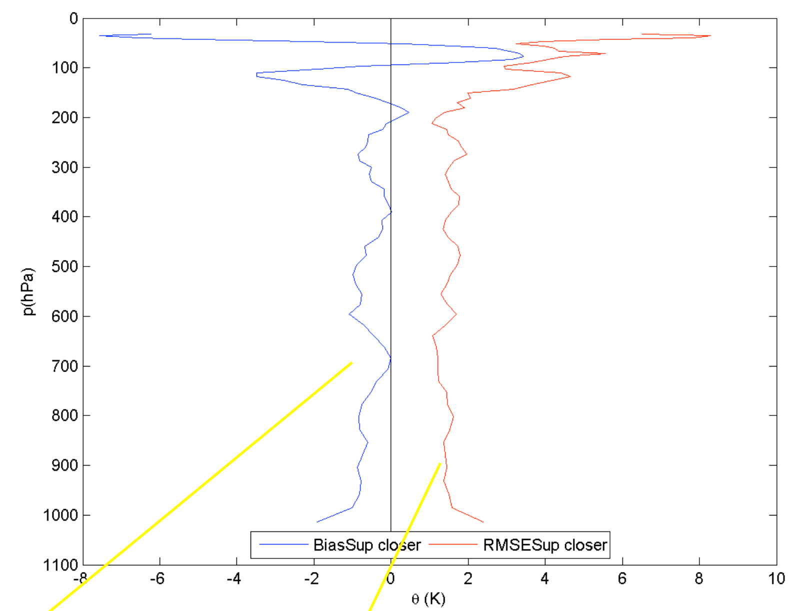
AIRS boundary layer structure versus RICO sondes

Error statistics for about 30 radiosondes

Potential temp. (**standard**) – Bias/RMSE



Potential temp. (**support**) – Bias/RMSE



Error minimum: too high to be related to inversion?

Error in boundary layer is similar to free-troposphere

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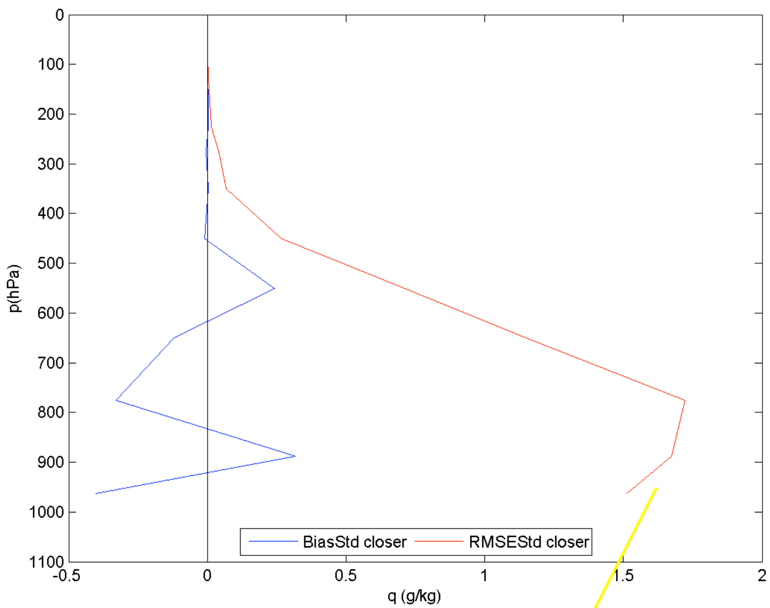
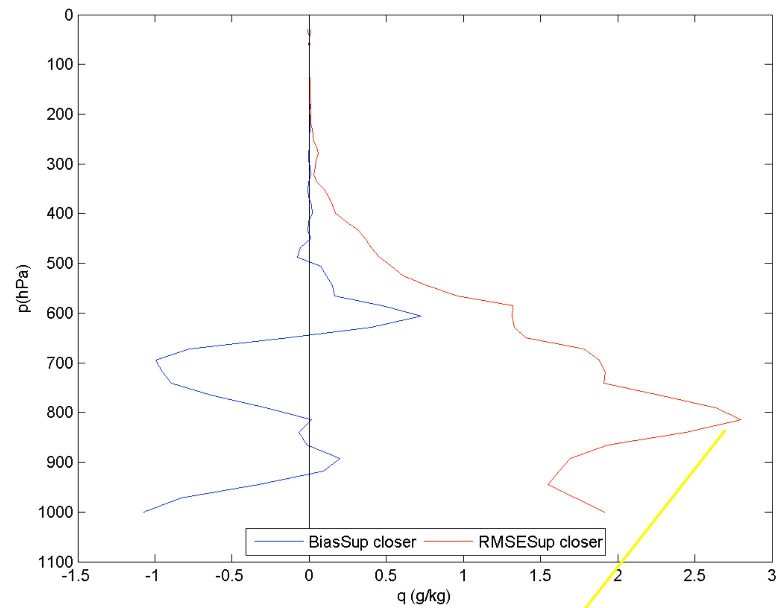
Water vapor (**standard**) – Bias/RMSE



Water vapor (**support**) – Bias/RMSE



Errors are around 10-20%

Large RMSE due to high variability of boundary layer depth

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Summary

- Trade-wind boundary layer is essential to understand and predict cloud-climate feedbacks
- In order to do this we need observations of temperature and water vapor vertical structure
- AIRS is able to produce realistic profiles of temperature and water vapor within the trade-wind boundary layer
- AIRS/RICO validation - Future work:

  i) study dependency on clouds, precipitation;

  ii) study more structural measures of boundary layer – e.g. boundary layer height and strength.

AIRS has the potential to produce a realistic global analysis of trade-wind boundary layer properties

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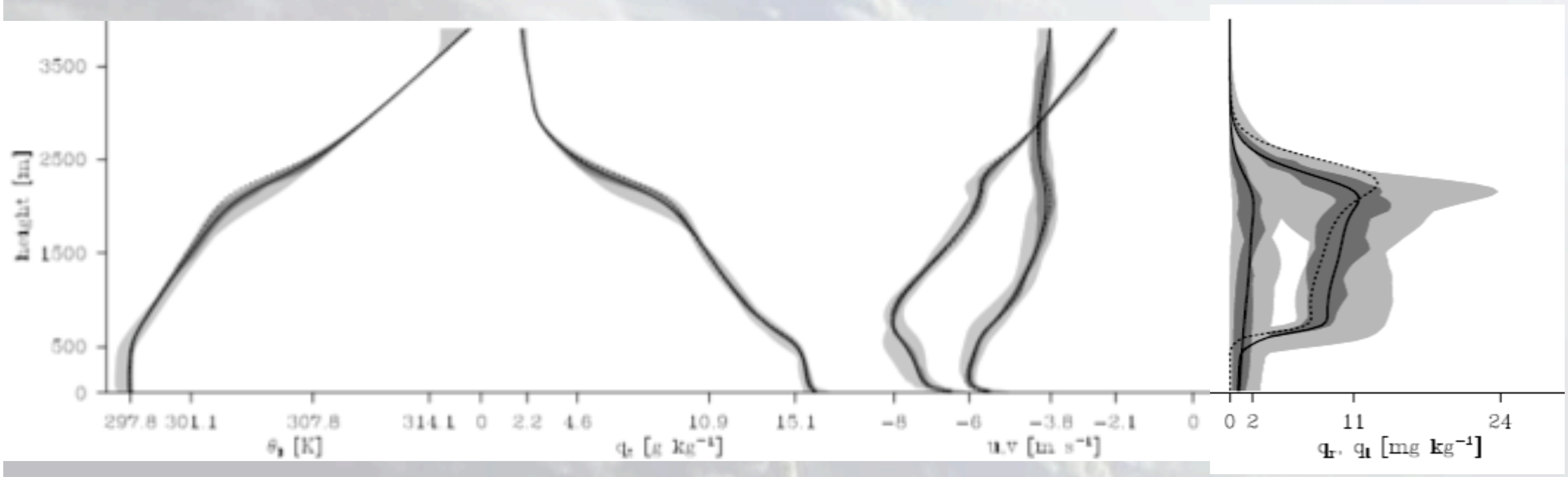
Large-Eddy Simulation

- prescribe varying wind profiles, precipitation efficiency
- domain: 12.8 x 12.8 x 4 km (100m x 100m x 40m)
- fixed / interactive surface fluxes



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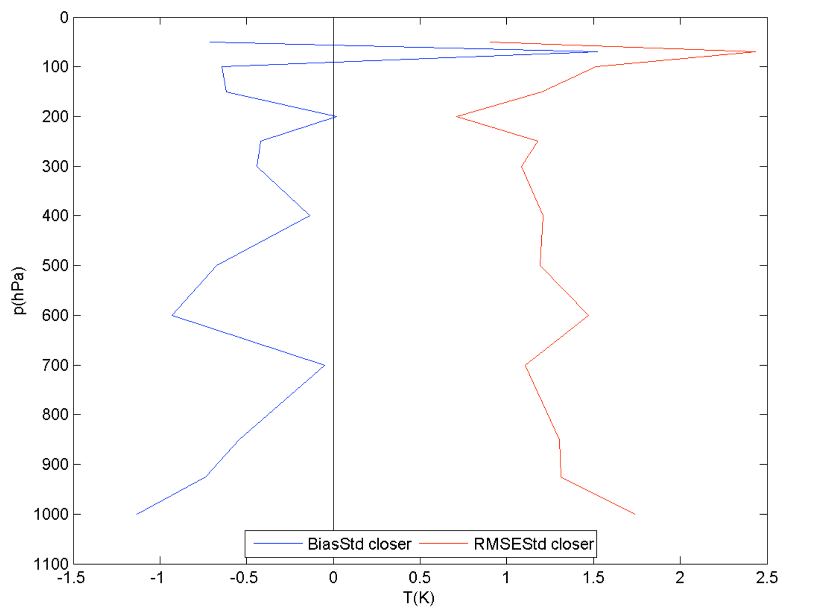
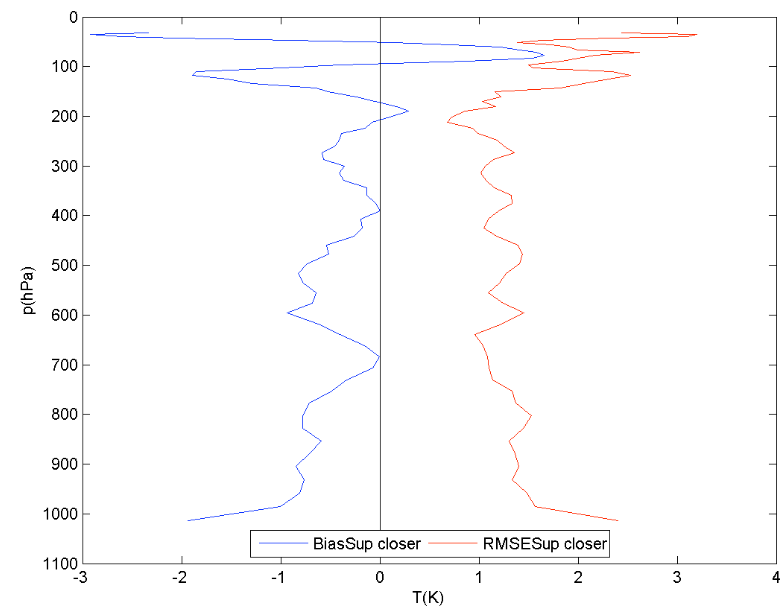


Temperature (**support**) – Bias/RMSE



Error structure is similar between
temperature and potential temperature