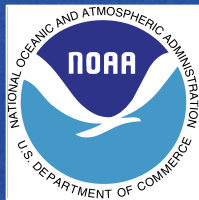


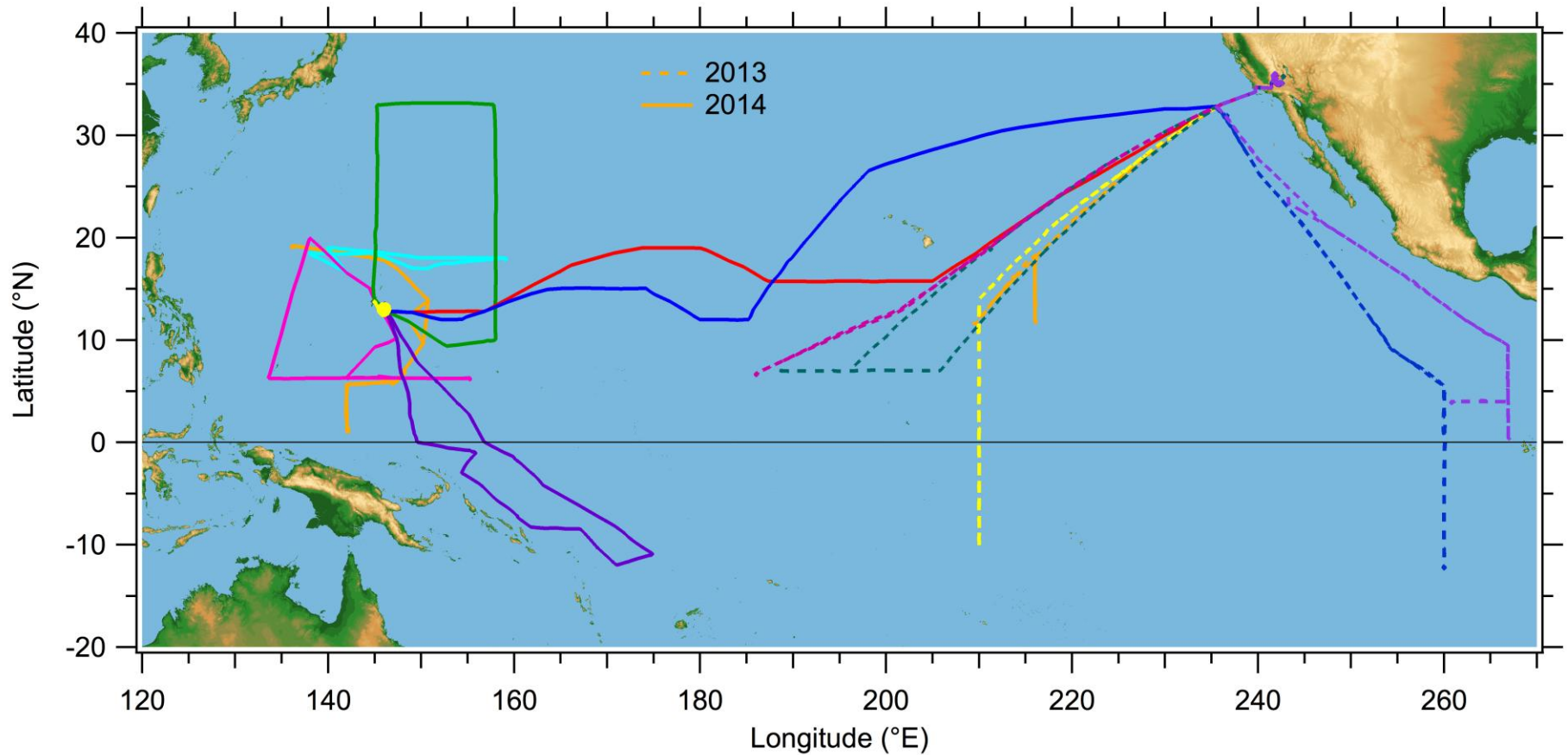
In situ observations of water vapor and cirrus IWC in the Pacific TTL during ATTREX

Troy Thornberry, Drew Rollins, Ru-Shan Gao, David Fahey
Paul Bui, Sarah Woods



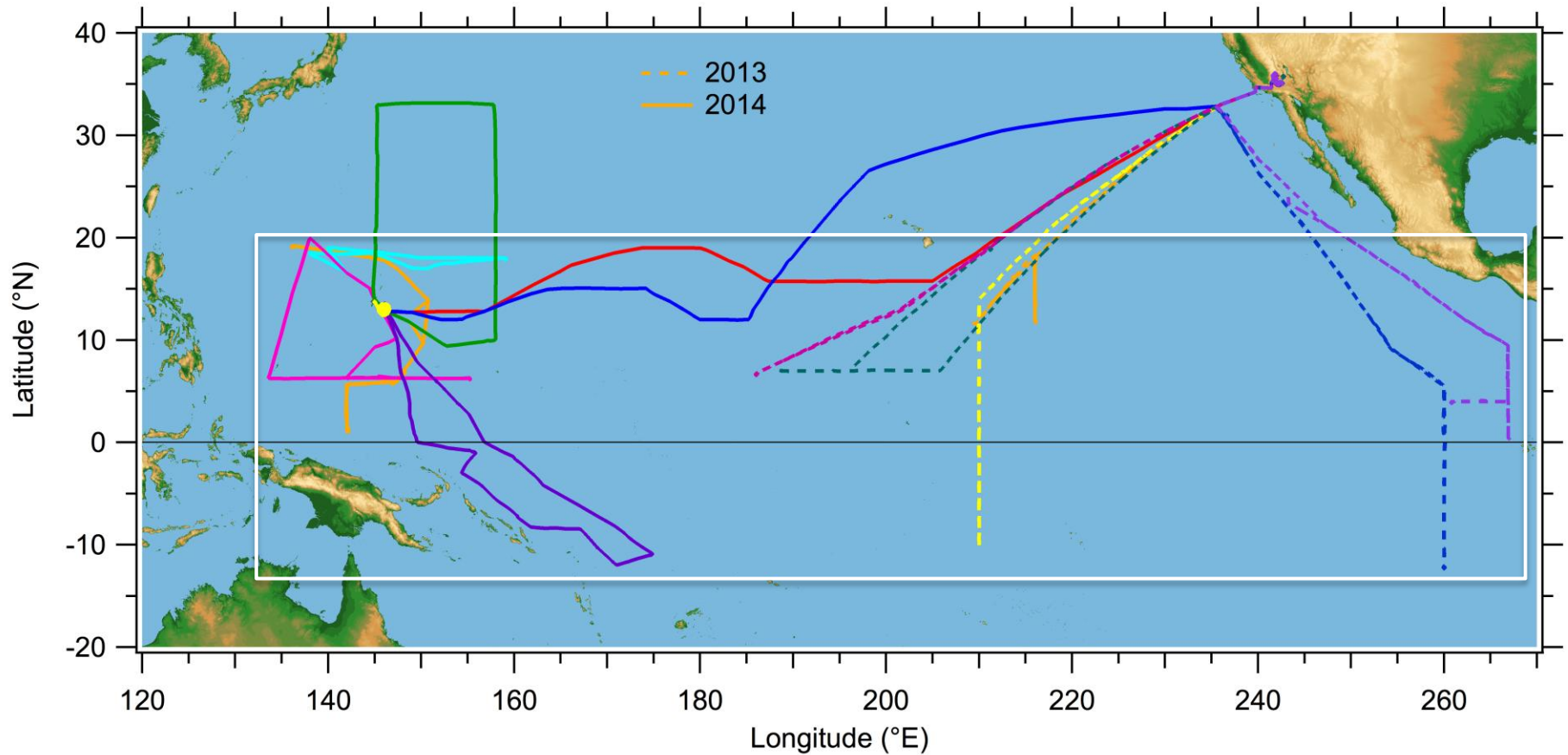
2014 Western Pacific Airborne Campaigns Science Team Meeting
Boulder Colorado, October 21, 2014

ATTREX 2 & 3 Flights



Sampling of the TTL over the Pacific with the goal of improving understanding of the dynamical and microphysical processes related to the final dehydration of air entering the stratosphere.

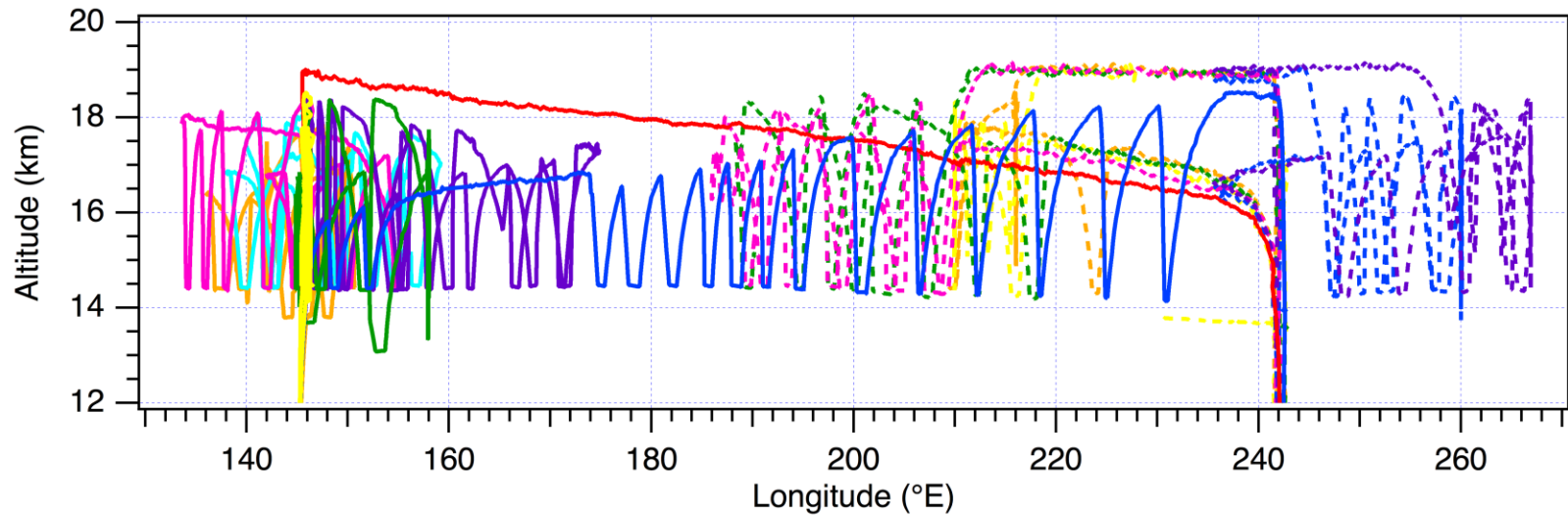
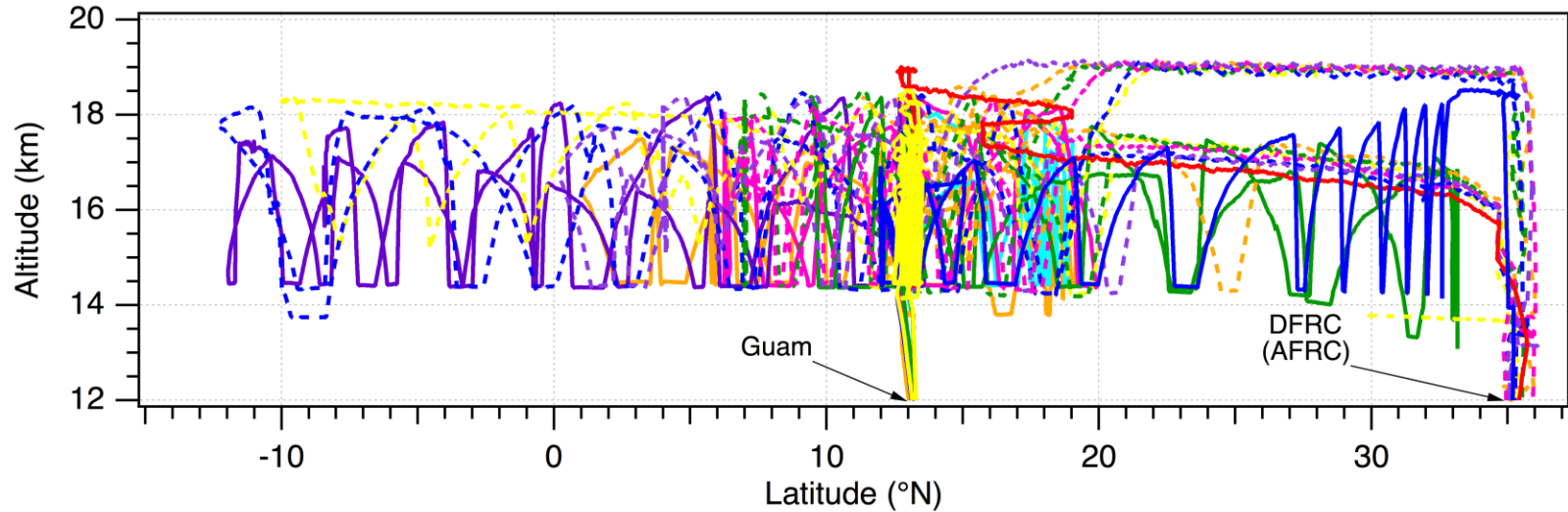
ATTREX 2 & 3 Flights



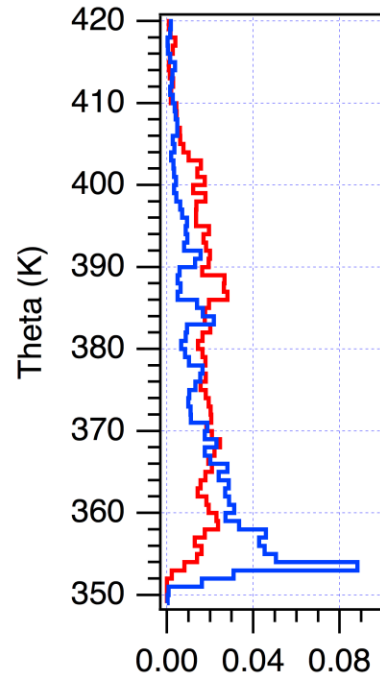
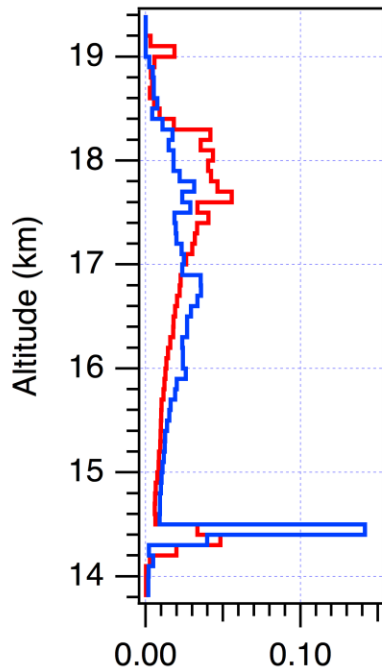
Extensive in situ sampling of the Pacific TTL with measurements of water vapor and cirrus properties.

However, some sampling limitations...

Latitude and Longitude



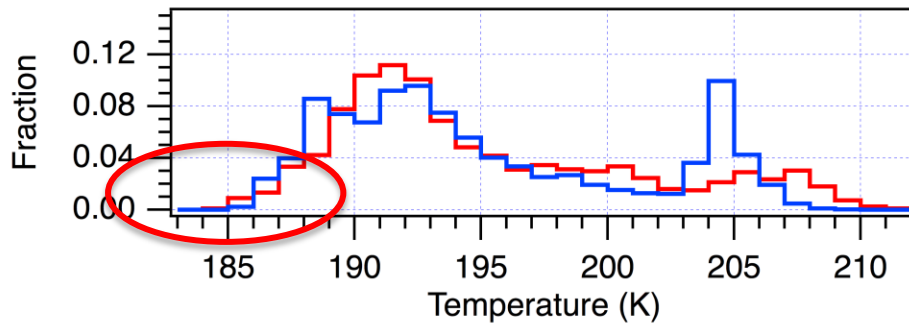
Sampling Histograms



Comparison of 2013 and 2014 from GH sampling perspective

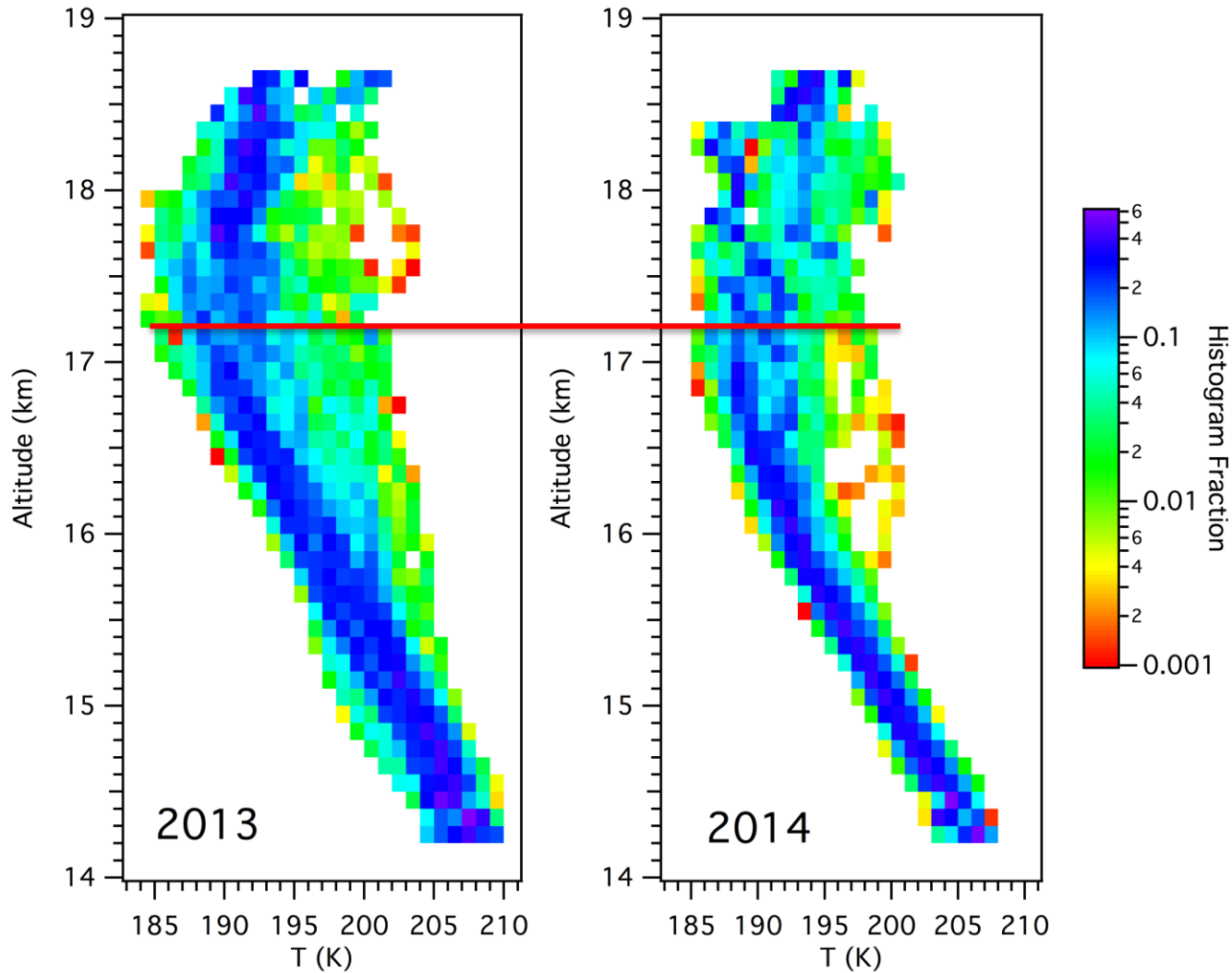
2013: > 74 hours in the TTL

2014: > 108 hours in the TTL



Limited sampling in either year at temperatures < 186 K

TTL temperature profiles

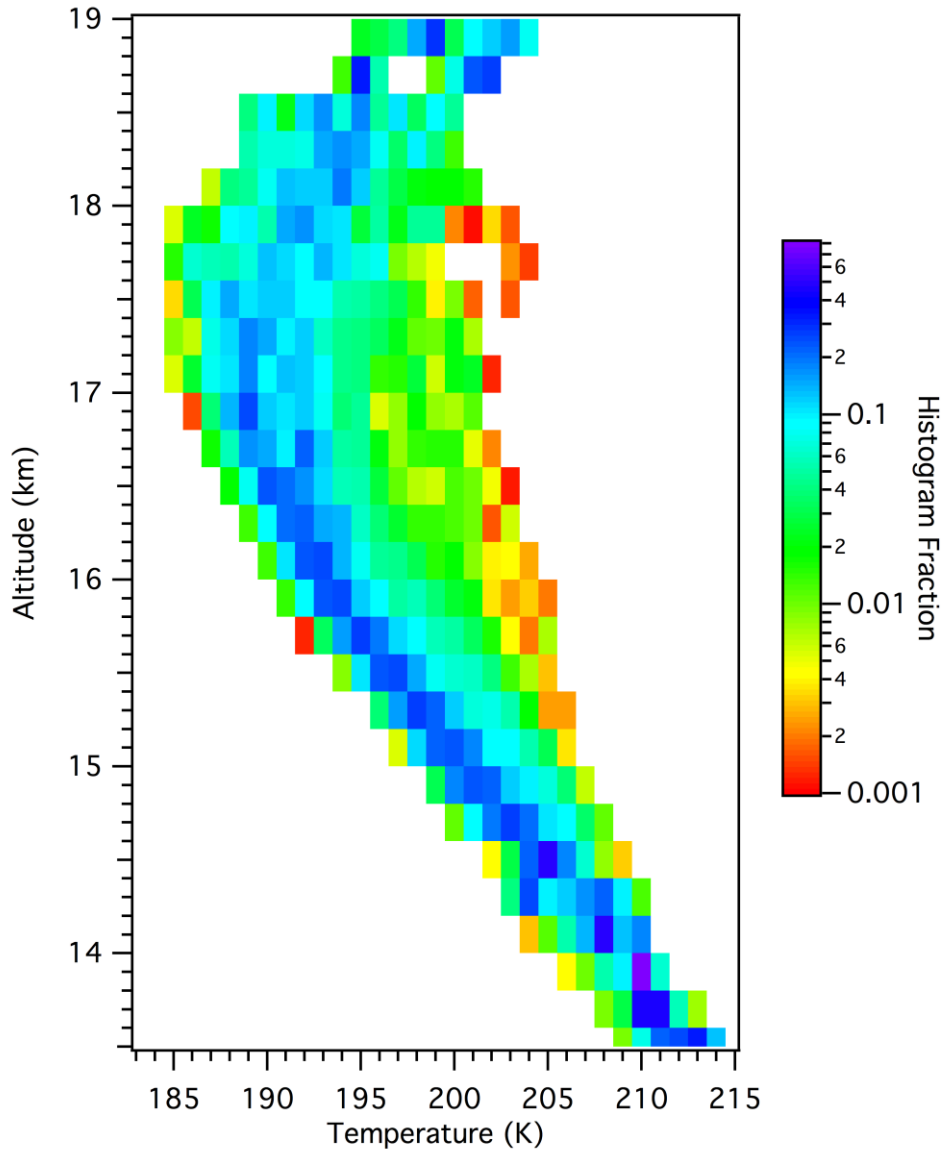


Higher CP tropopause
observed in 2013

More consistent T
structure above the
CPT in 2013

Similar lower T values
in both years
determined by GH
sampling limits

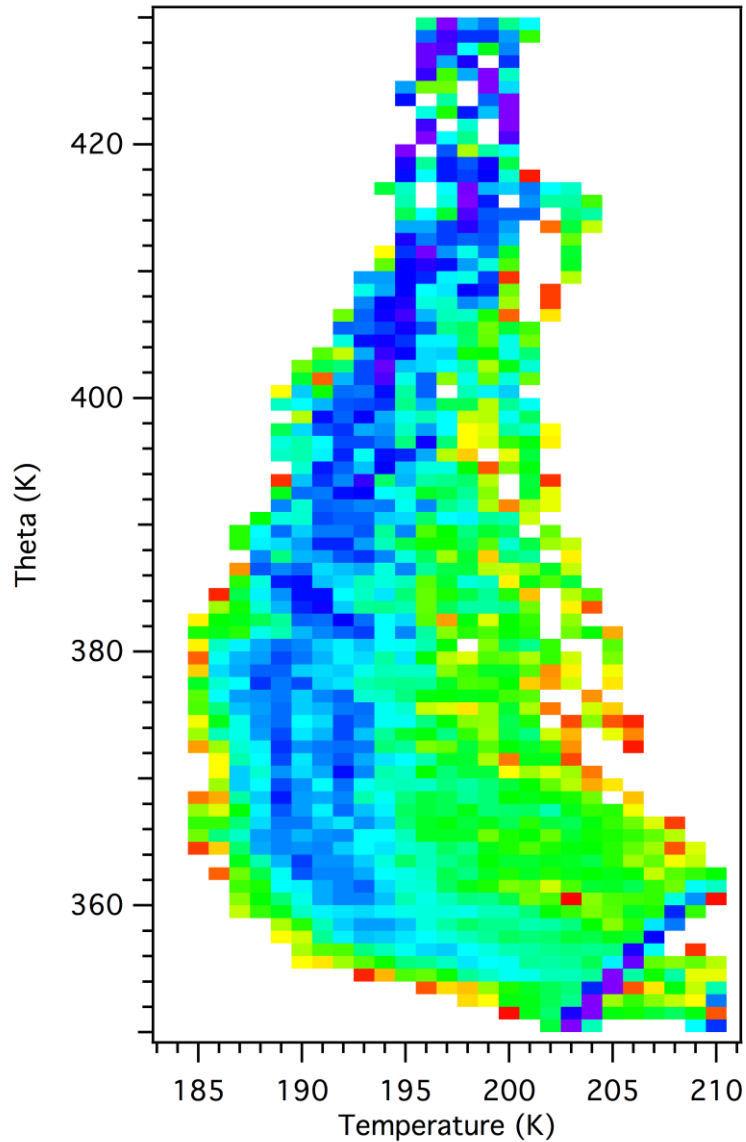
Combined Temperature profile



Combined profile looks reasonable

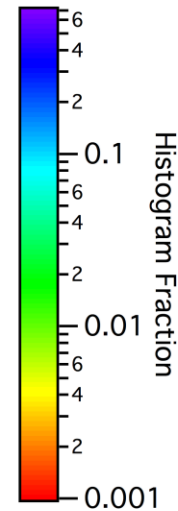
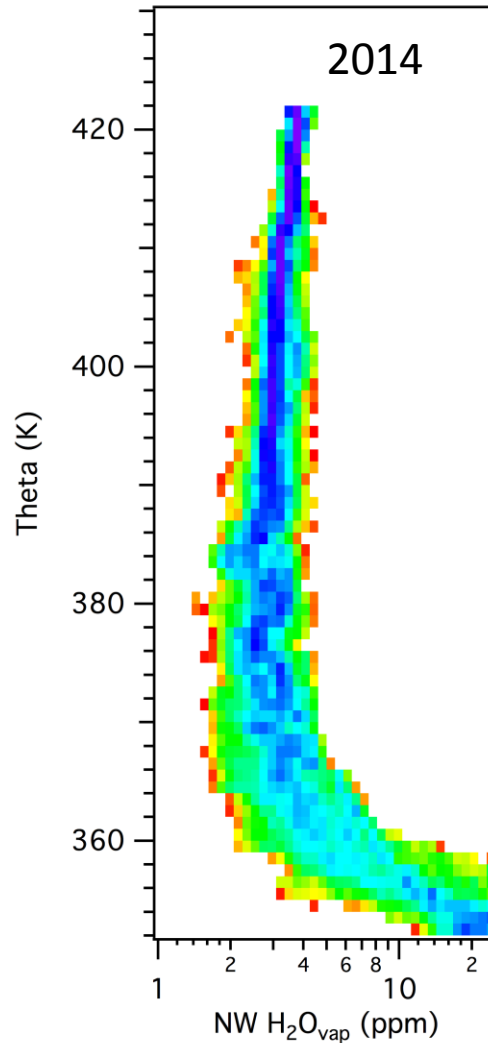
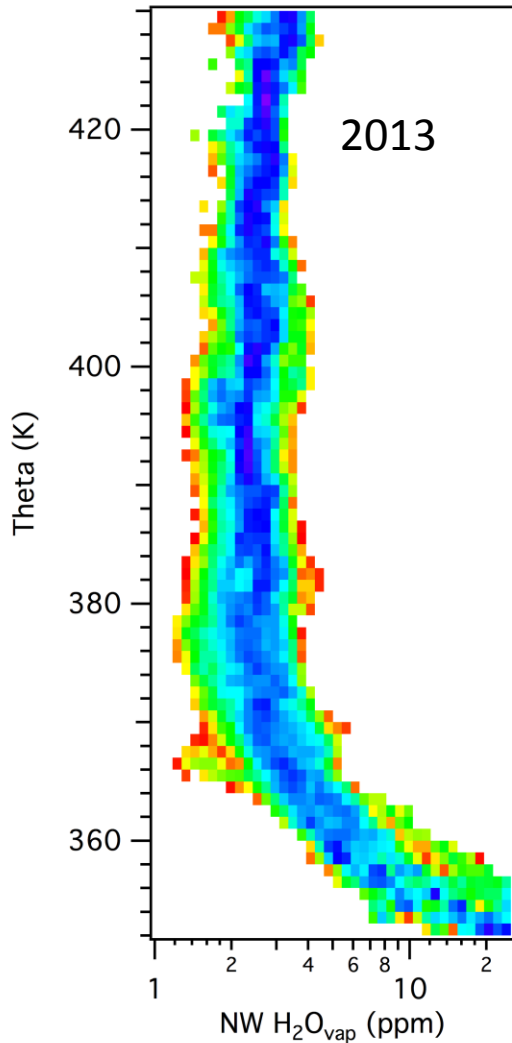
During both 2013 and 2014 a number of warm profiles were measured

Temperature vs Theta profile



} Coldest temperatures
sampled between 365 and
380 K potential temperature

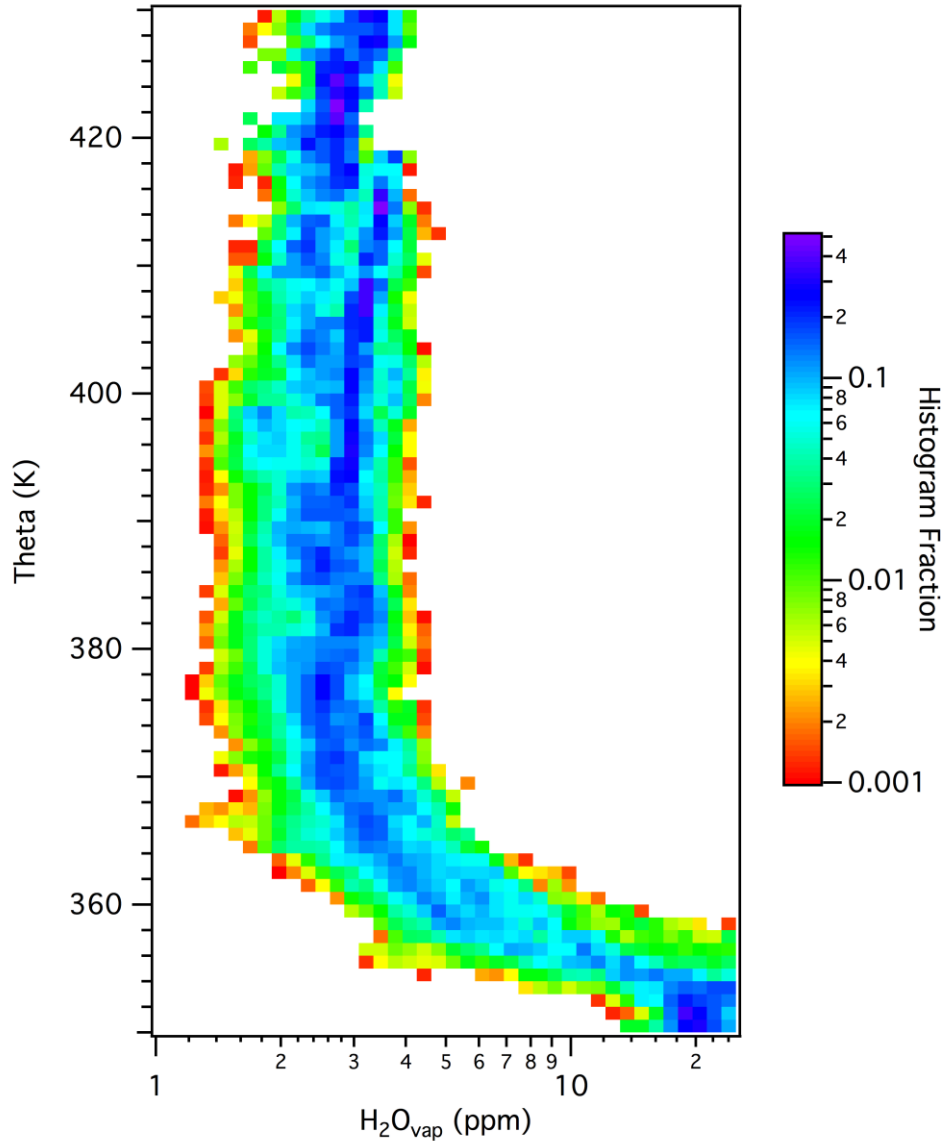
Water vapor profiles



Typical WV values above CP lower by ~ 0.5 ppm in 2013 than 2014

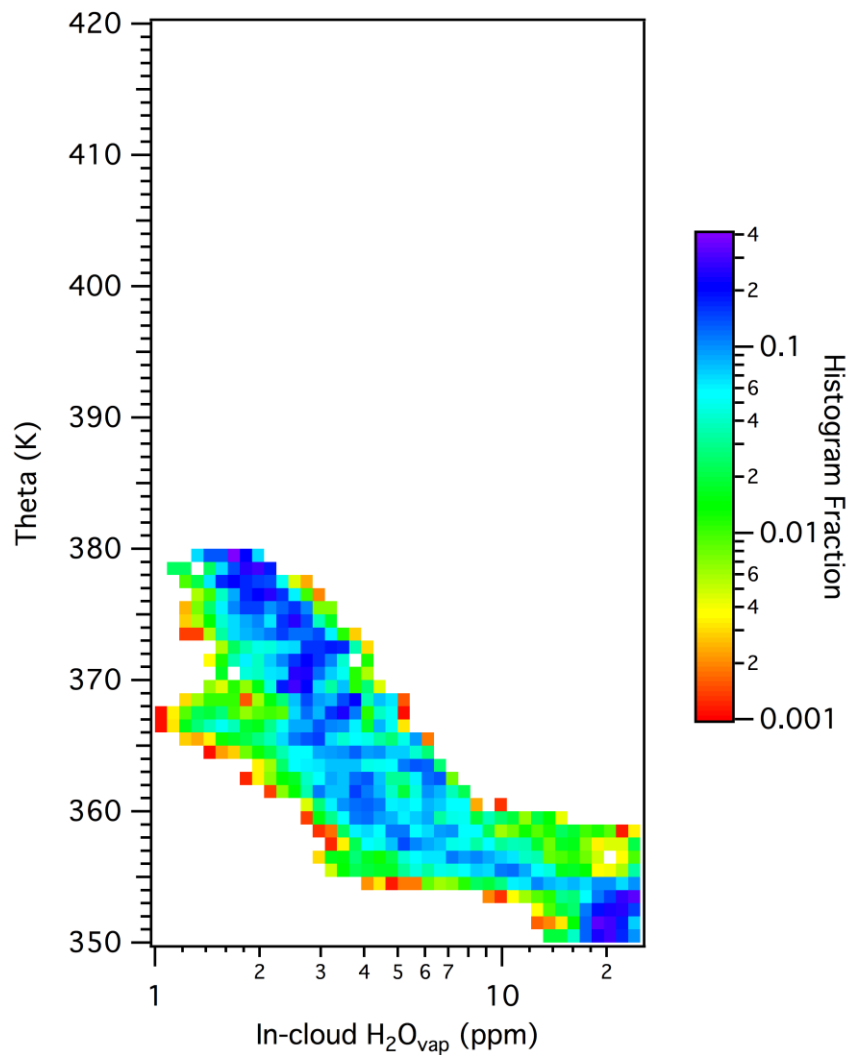
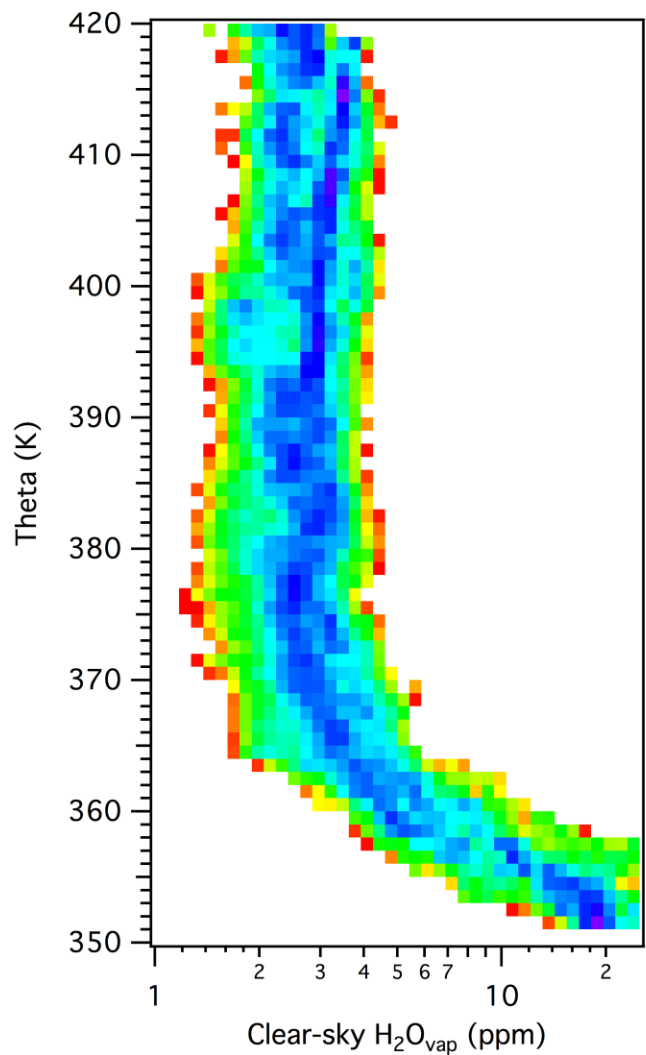
Consistent with zonal mean value difference

Combined WV profile

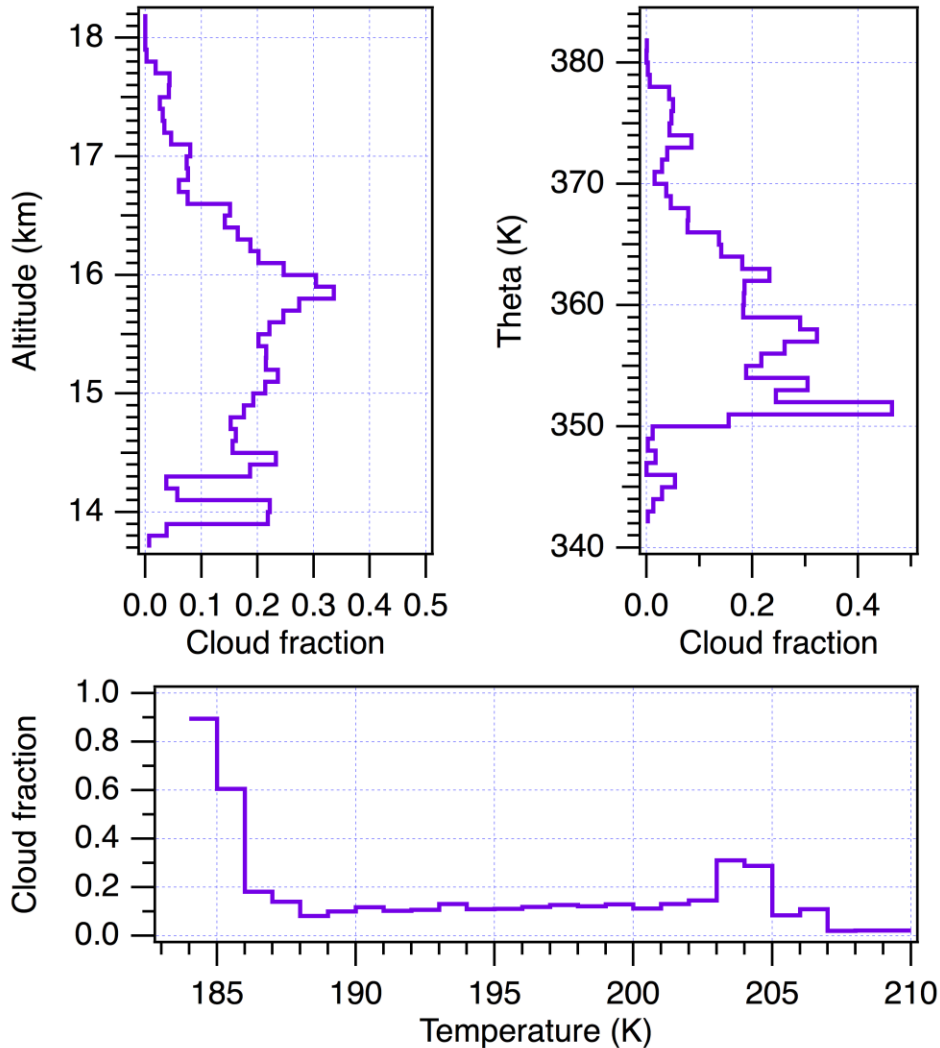


Apparent discontinuity above 410K
due to difference in profile top
between ATTREX-2 and ATTREX-3

In-cloud vs Clear-sky



ATTREX cloud fraction

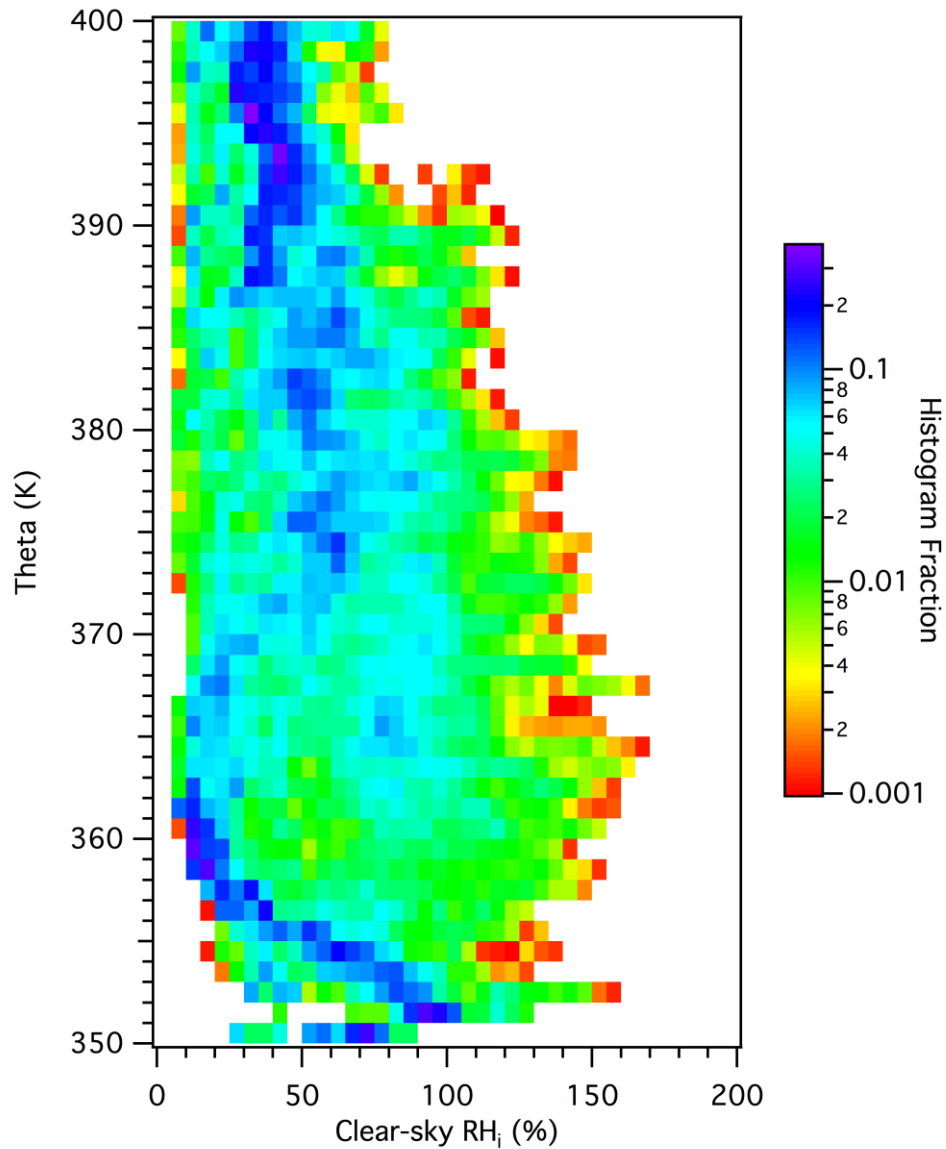


Define cloud using FCDP and
NW IWC measures

Sampled cloud fractions similar
to satellite climatology

Particularly high cloud fraction
observed at lowest sampled
temperatures

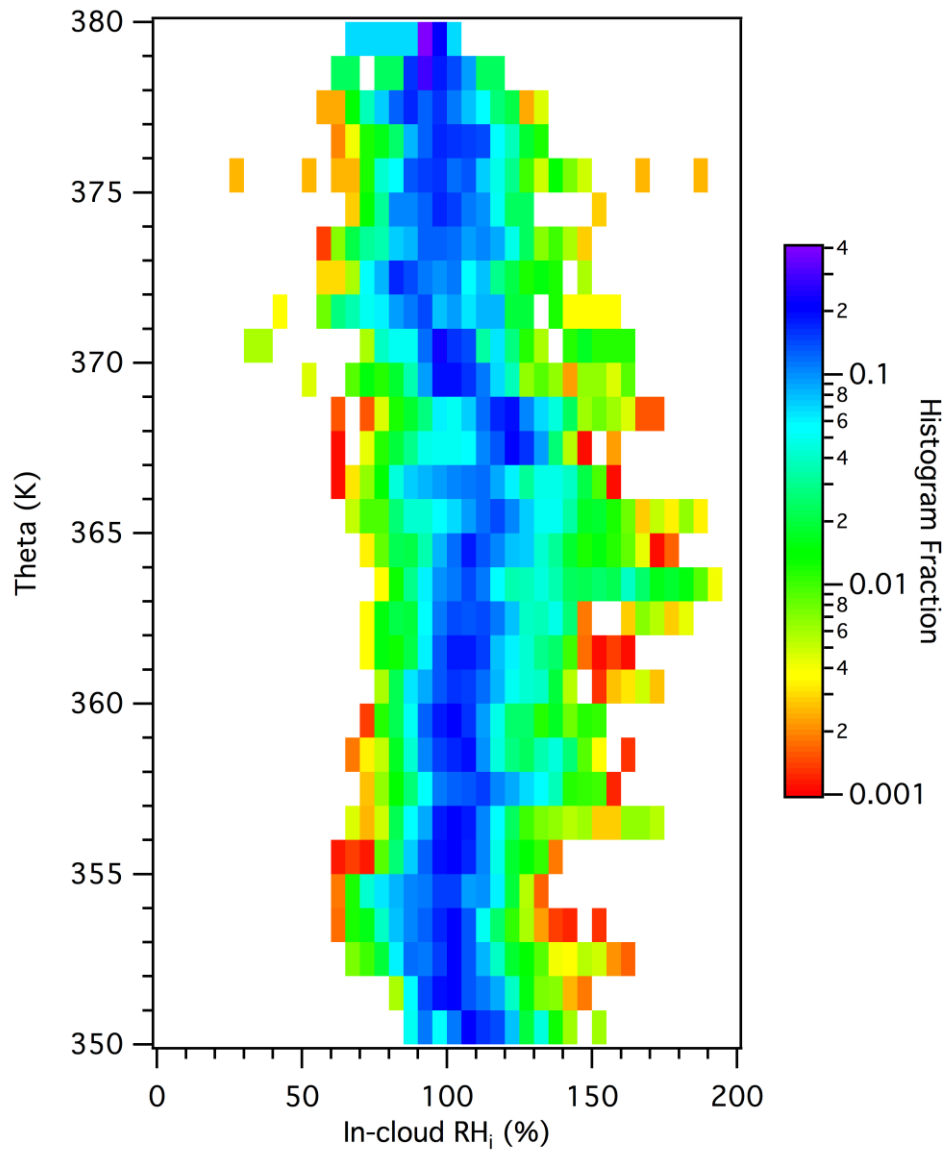
Clear-sky RH_{ice} profile



Broad range of RH_{ice} observed in clear air from very dry to supersaturated

Frequent dry values observed near 360K

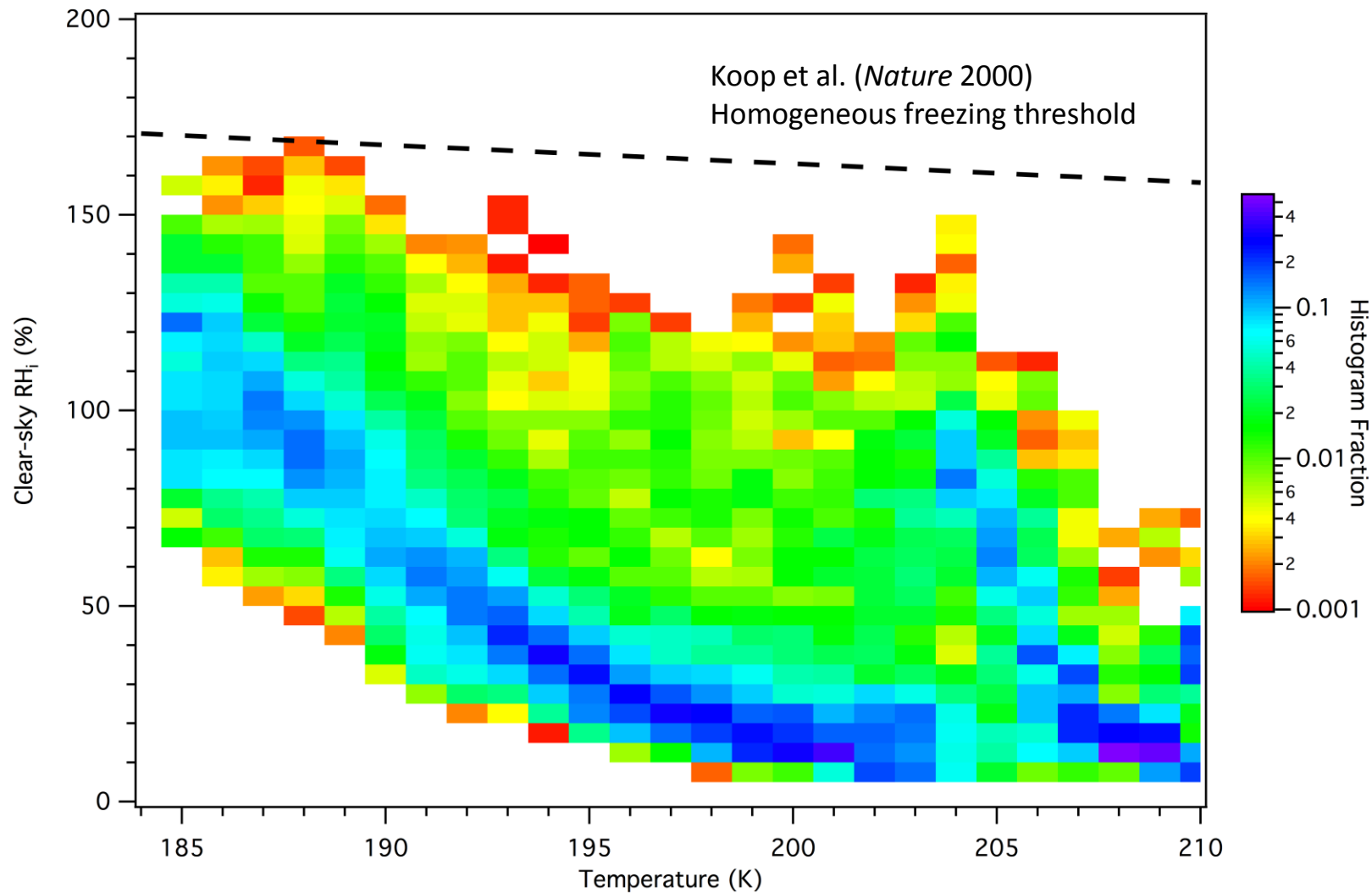
In-cloud RH_{ice} profile



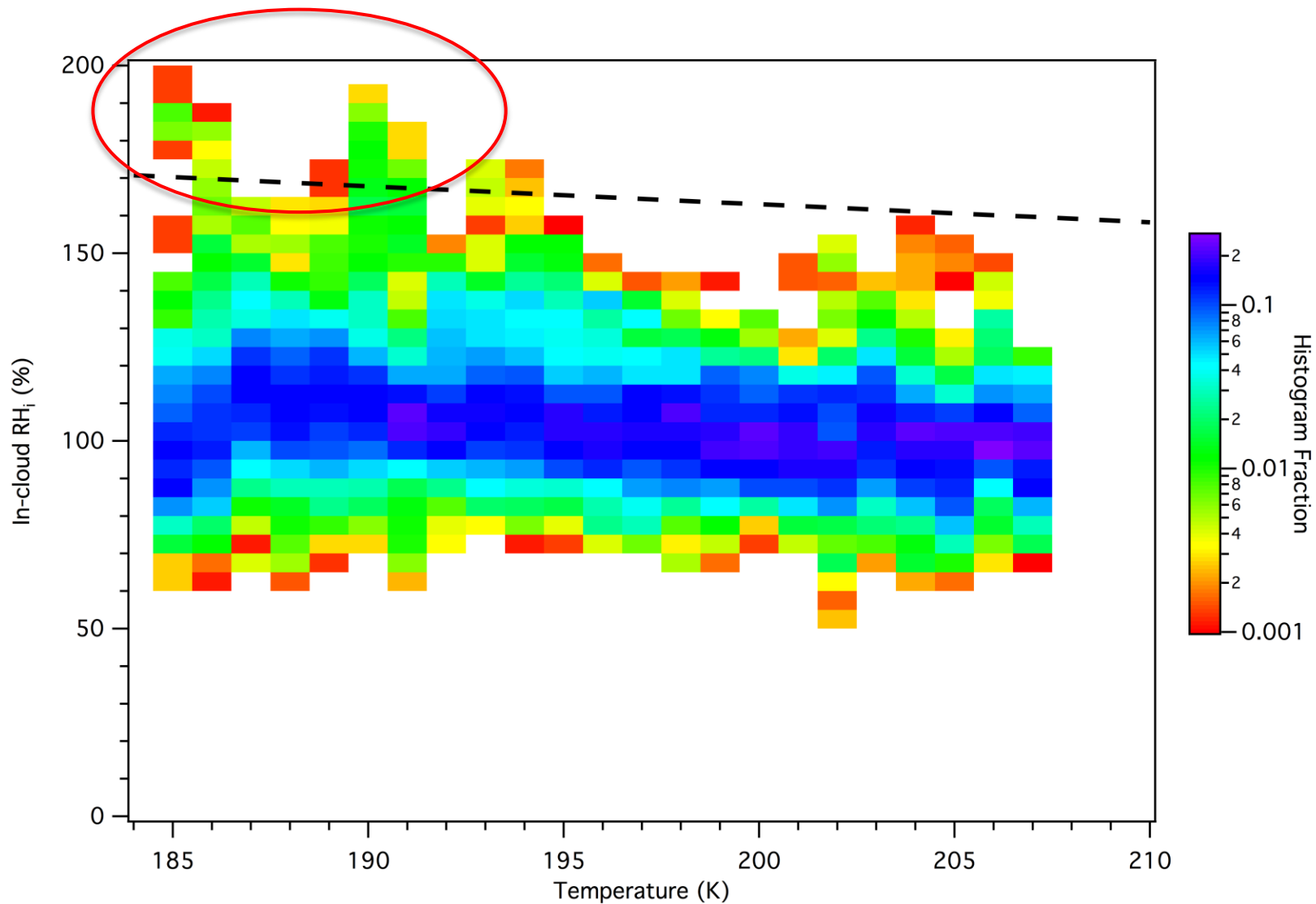
Distribution of RH_{ice} within cirrus centered near 100% throughout profile

Values range from ~50% to above homogeneous freezing threshold

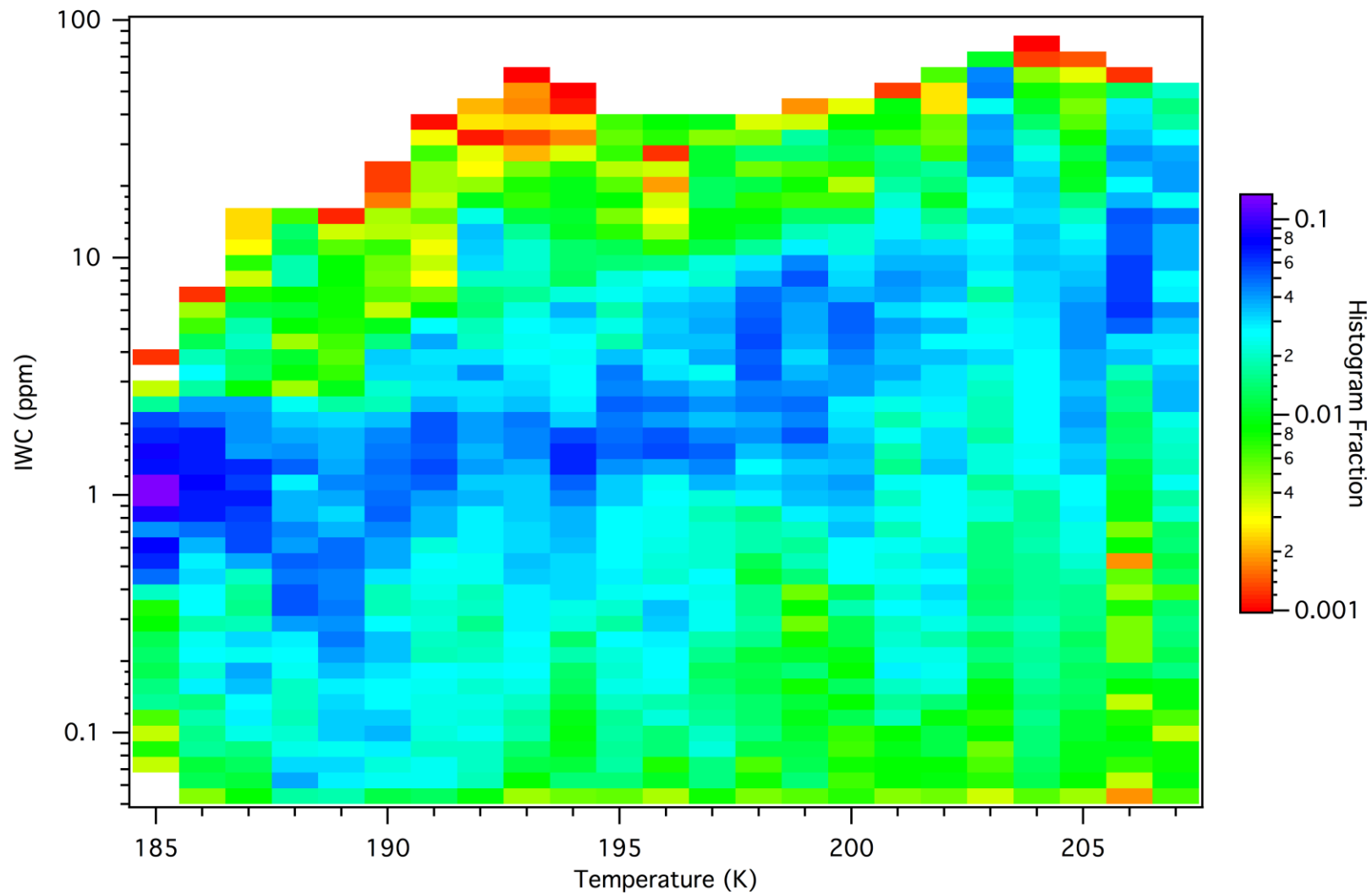
Clear-sky RH_{ice} vs T



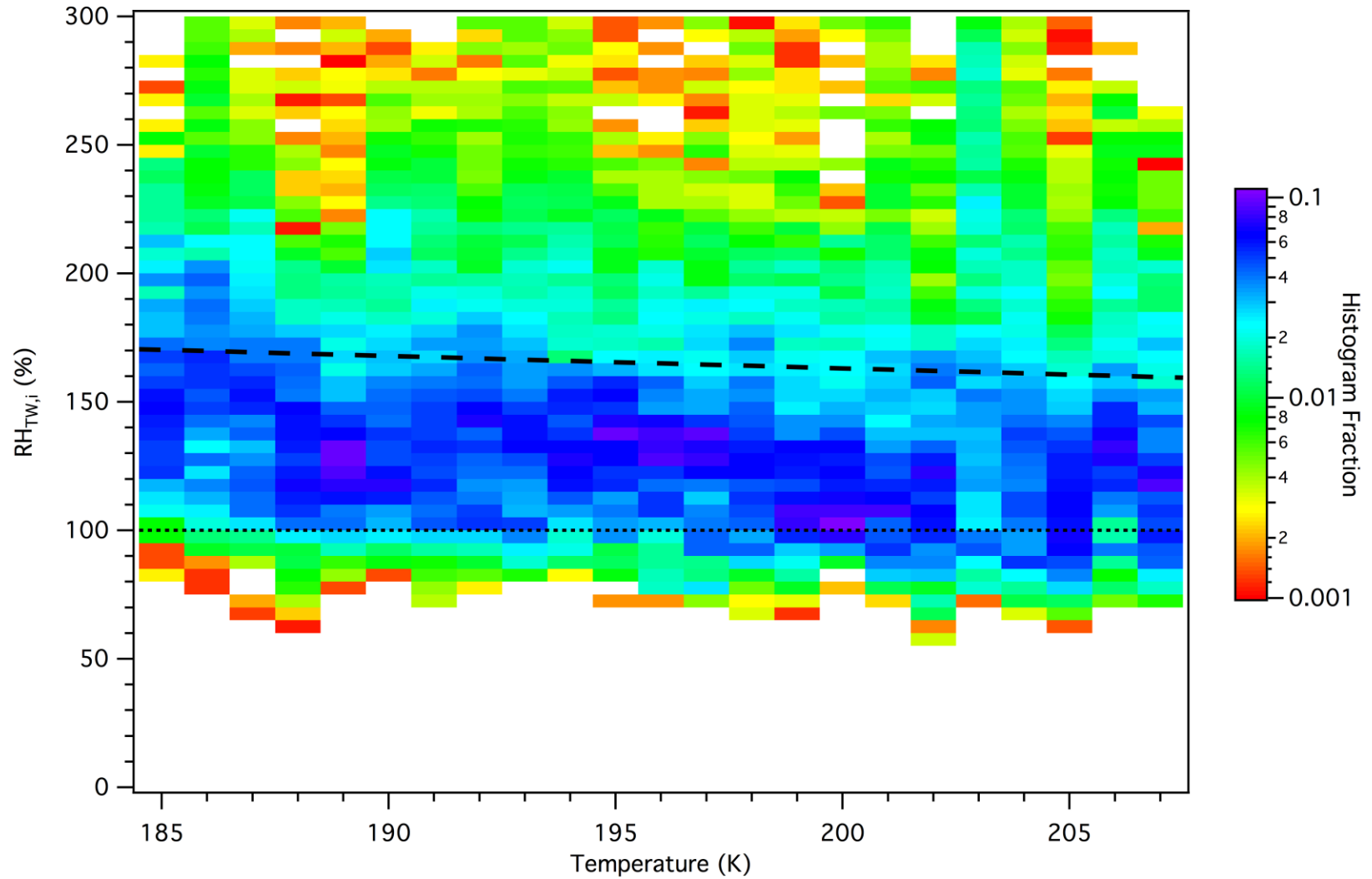
In-cloud RH vs T



IWC vs T



S_{TW} vs Temperature



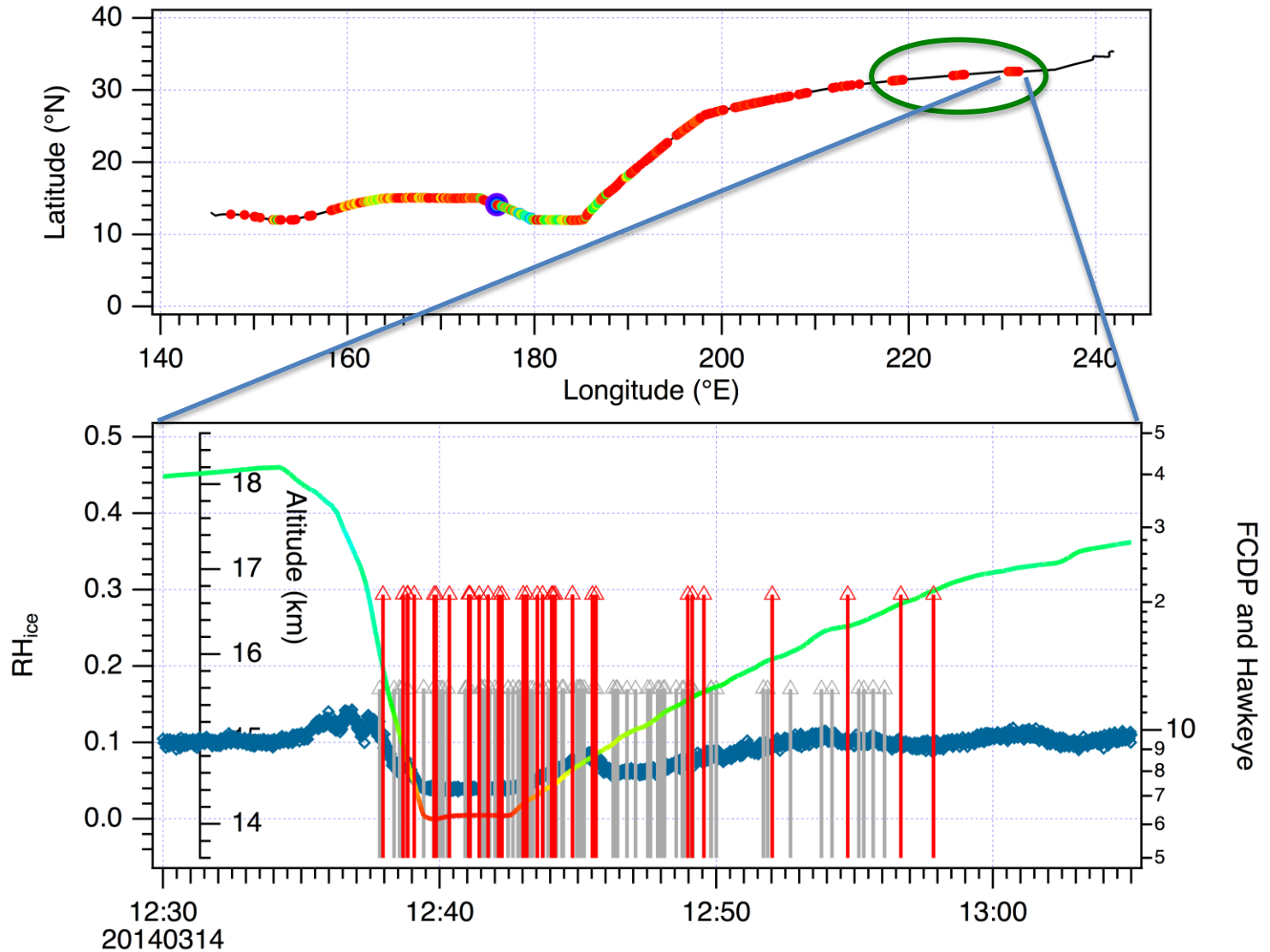
Summary

- GH observations of temperature and water vapor profiles are consistent with the zonal mean differences between 2013 and 2014
- Sampled cloud fractions higher than satellite climatology
- RH_{ice} below homogeneous freezing threshold in clear air
- Distribution of RH_{ice} in cirrus peaks near 100% but has a broad range and potentially some very high values
- Significant cirrus IWC measurements along with cirrus properties measurements
- Distribution of TW (vapor + IWC) includes a number of values significantly exceeding homogeneous freezing threshold

Directions

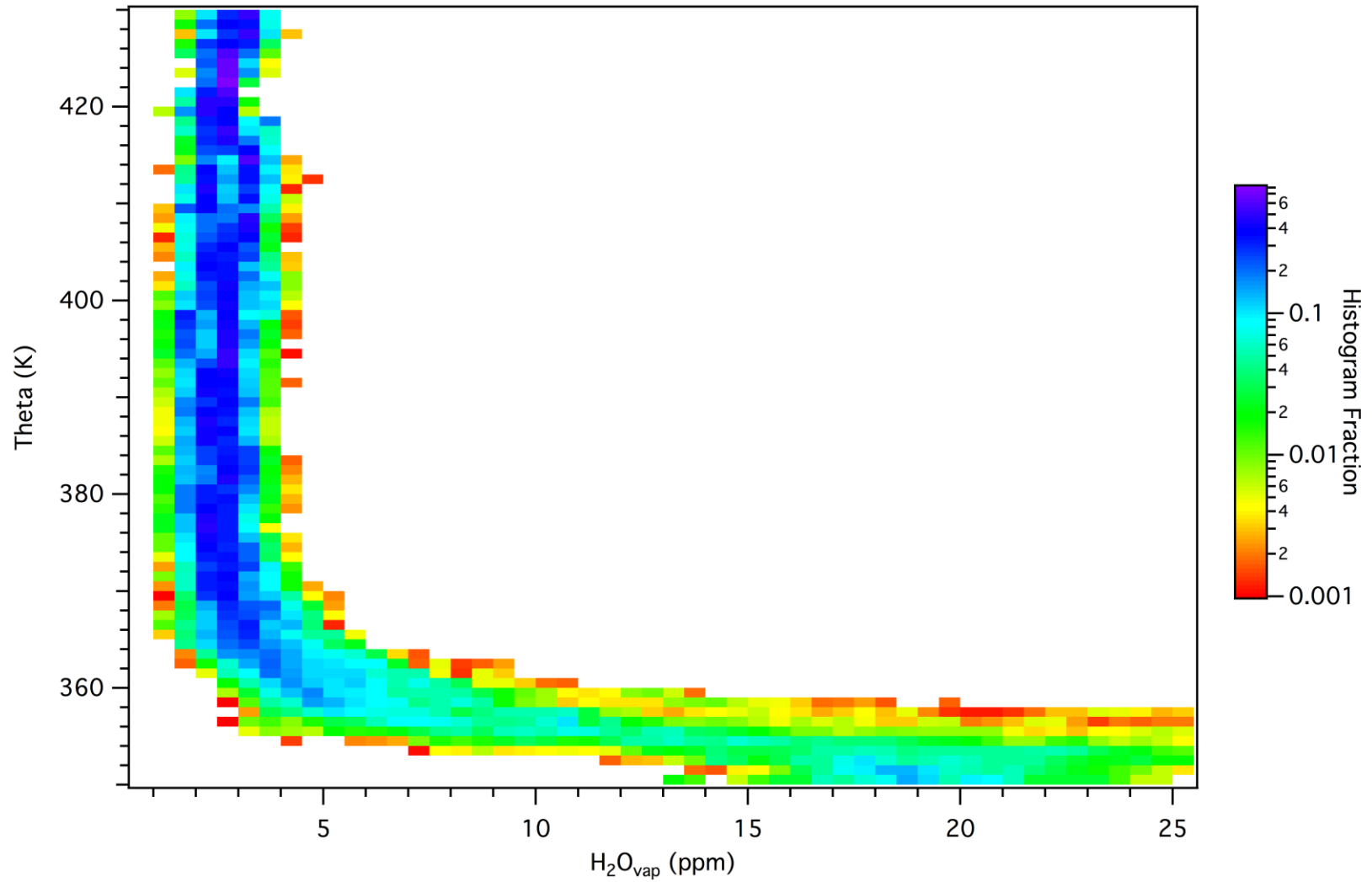
- NW and FCDP/Hawkeye IWC closure
- Investigation of in situ cirrus nucleation mechanisms
- Dehydration efficiency...

Non-water containing particles in the LS?

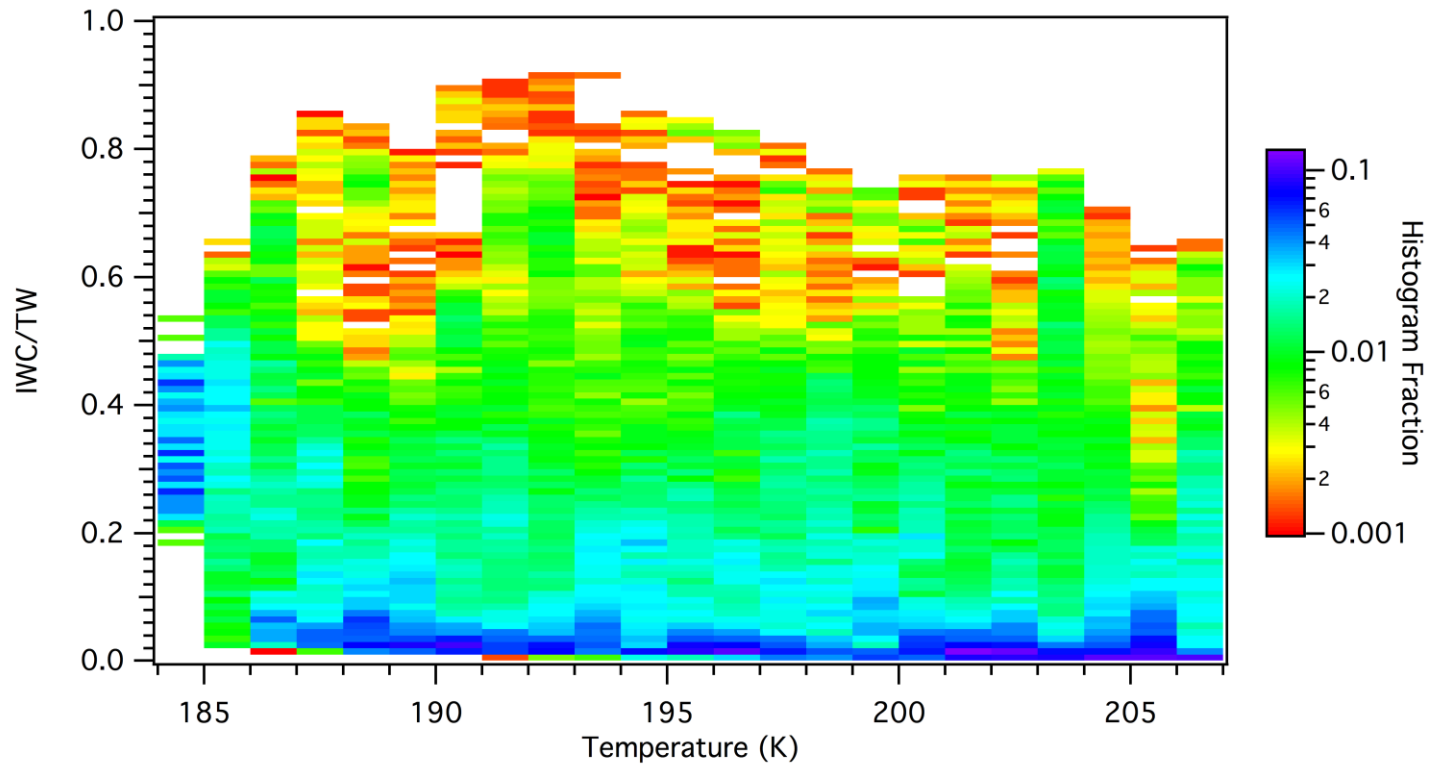


END

WV profile



IWC/TW ratio vs T



Hawkeye FCDP vs FCDP

