Variability of Ice Supersaturation, Nucleation, and Cirrus in TTL Vertical Layers

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Jensen et al. (2013) reported dehydrated layers only meters thick.

Layers corresponded to high ice particle concentrations.

Later ATTREX campaigns give chance to examine how common these layers are in the TTL.
Diode Laser Hygrometer

- Participated in ATTREX 1, 2, & 3
- Open-path measurement
- 100 Hz sampling
- < 1 m vertical res.
Outline

• Case Study: 16 February 2014

• Case Study: 09 March 2014

• Thin Layer Distribution and Statistics
Case Study: 16 Feb 2014

100 Hz

H₂O
RHᵢ
RHₘ

Time (UTC)

H₂O (ppmv)

RH (%)

Homog. Nuc. Threshold (Koop et al., 2000)
Case Study: 16 Feb 2014

Homog. Nuc. Threshold
(Koop et al., 2000)

DLH 20 Hz RH_i
NOAA 1 Hz RH_i
Case Study: 16 Feb 2014

- **DHL 20 Hz RH**
- **NOAA 1 Hz RH**

Graph showing time with FCDP (#/L) and RH (%). The graph illustrates a Homog. Nuc. Threshold (Koop et al., 2000) and a peak at > 10,000/L.
Case Study: 16 Feb 2014

Homog. Nuc. Threshold
(Koop et al., 2000)

DLH 20 Hz RH_i
NOAA 1 Hz RH_i
Case Study: 16 Feb 2014

Prevailing Wind:

- Flight Track
- Enhanced FCDP < 10 μm
- Enhanced 2DS @ 110-120 mbar

Timeline:
- 06:20, 17 Feb
- 18:30 – 22:00
Case Study: 16 Feb 2014
Case Study: 09 Mar 2014

Homog. Nuc. Threshold (Koop et al., 2000)
• Altitude and depth similar – likely same feature
• Horizontal extent: ~ 20 km
Layer Distribution & Stats

Filter Parameters
- FCDP Total Conc. > 1000/L
- FCDP < 10 um Conc. > 50% of Total Conc.
- Pressure < 200 mbar

- 0.5-3.5% cloud sampling, 18-26% of ice particles*

*only FCDP statistics
Summary

• Further evidence of thin dehydrated layers with large ice particle concentrations
  • Particle sizes typically < 10 μm in these layers

• Recent convection does not seem to play a role in layer frequency

• Layers existed for 0.5-3.5% of cloud sampling, but contributed 18-26% of ice particles

• Fast (sub 1 Hz) measurements of other tracers would help investigate layer airmass origin

• Future Work
  • Investigate convection tracers to further explore source
  • Explore influence of gravity waves
  • Examine statistics of layer vertical thickness
  • Repeat analysis with 2013 ATTREX deployment