

# **Multi-Year Statistics of Mixed-Phase Arctic Stratus at Barrow and Eureka: Process Studies, Assessment of CloudSAT Detection, and Applications to Models**

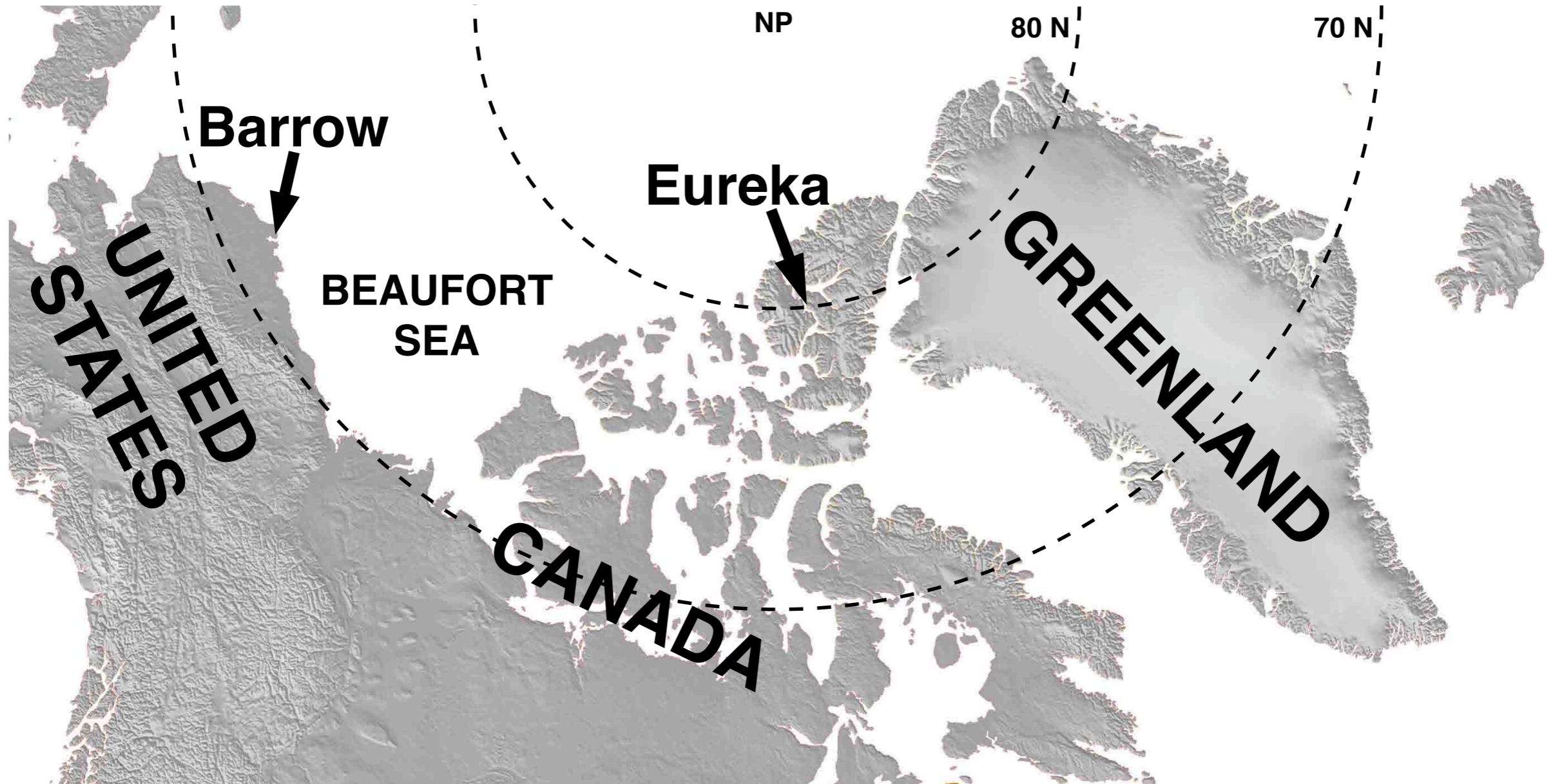
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of WISCONSIN  
MADISON

(2)  NOAA ESRL

(3)  NCAR

# Introduction



Barrow: 09/04-11/04

Eureka: 08/05-present

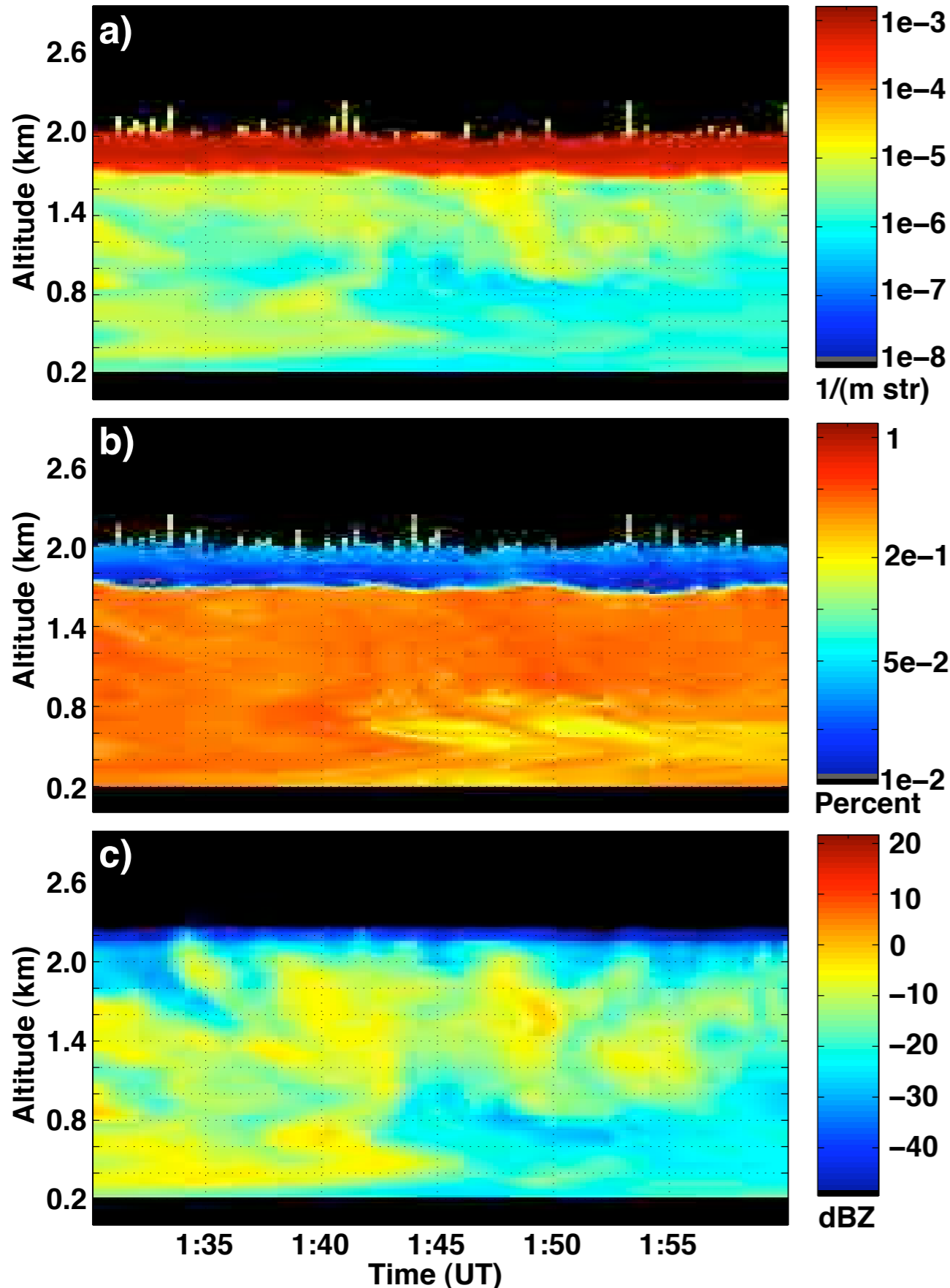
High Spectral Resolution Lidar  
MMCR (35 GHz)

Radiosondes



AGU Fall Meeting, San Francisco, CA 15-19 December, 2008

# Introduction



AHSRL Backscatter

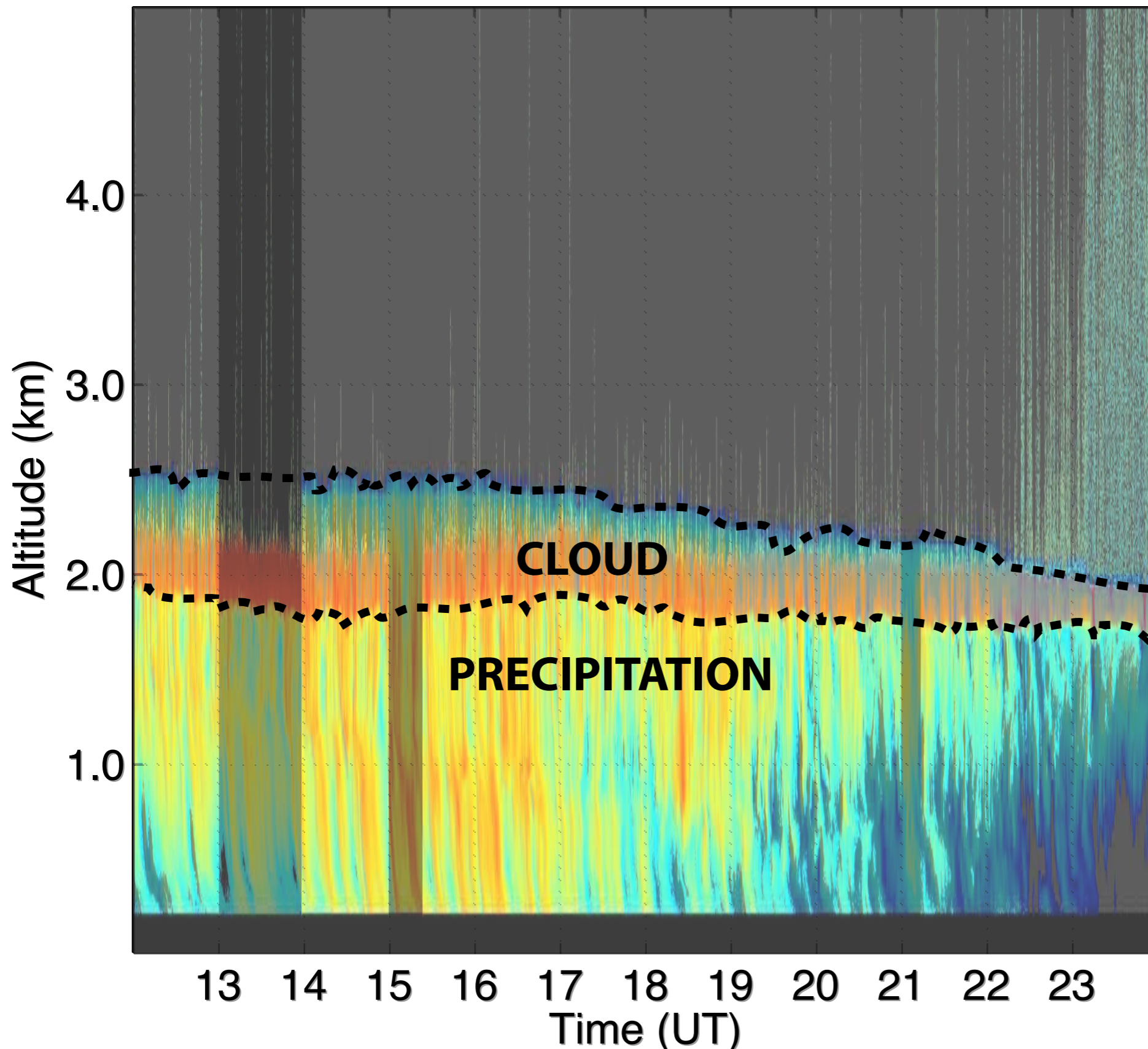
AHSRL Depolarization

MMCR Reflectivity

# Introduction

- Low altitude stratus frequency of up to 70% during transition seasons (Herman and Goody, 1976; Curry et al., 1996)
- Reduces wintertime net surface cooling by 40-50 W/m<sup>2</sup> (Curry et al., 1996)
- Commonly observed during several recent Arctic experiments (SHEBA, MPACE, SEARCH, ISDAC)
- Often long-lived, surviving up to several days at a time (de Boer et al., 2008)
- Difficult to simulate (Klein et al., 2008)

# Property Statistics

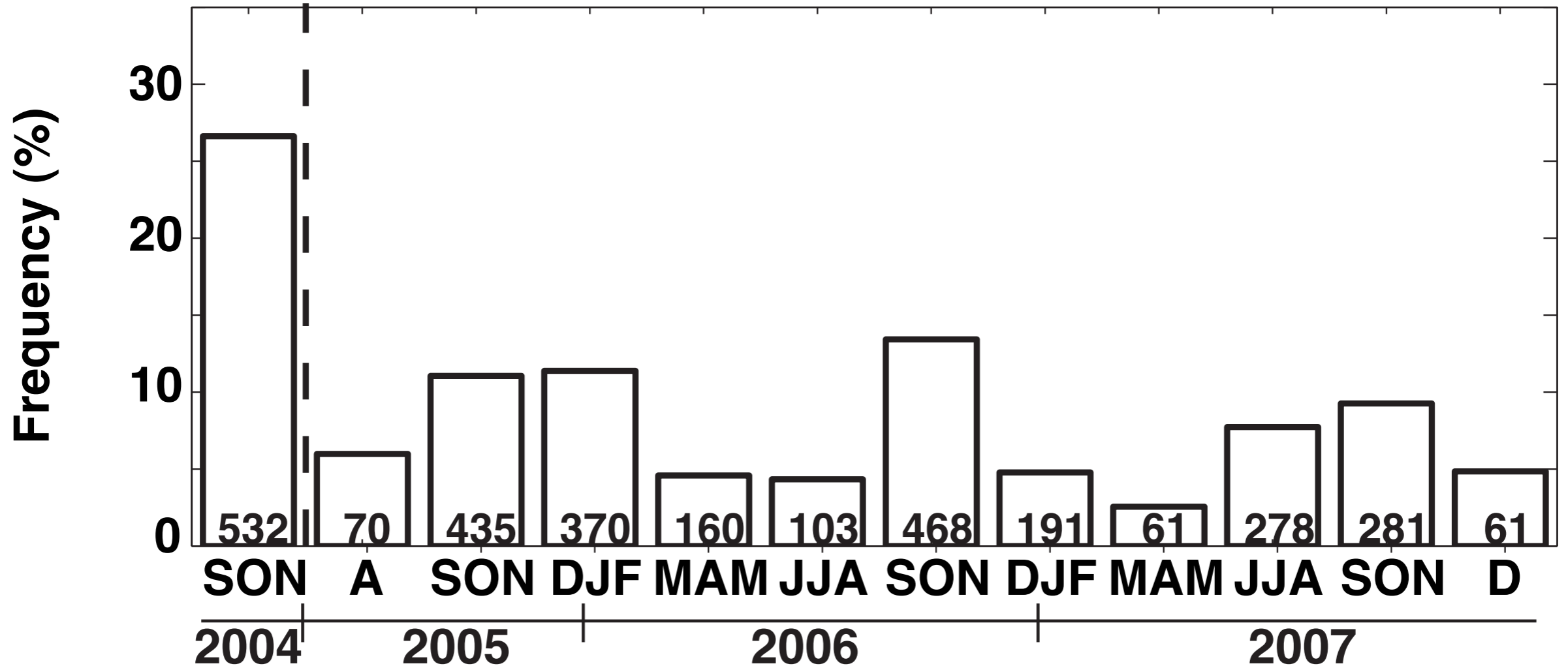


Single-layer  
mixed phase  
stratus  
observations

- 216 hours  
from Barrow  
(fall 2004)

- 1240 hours  
from Eureka  
(fall 2005-2007)

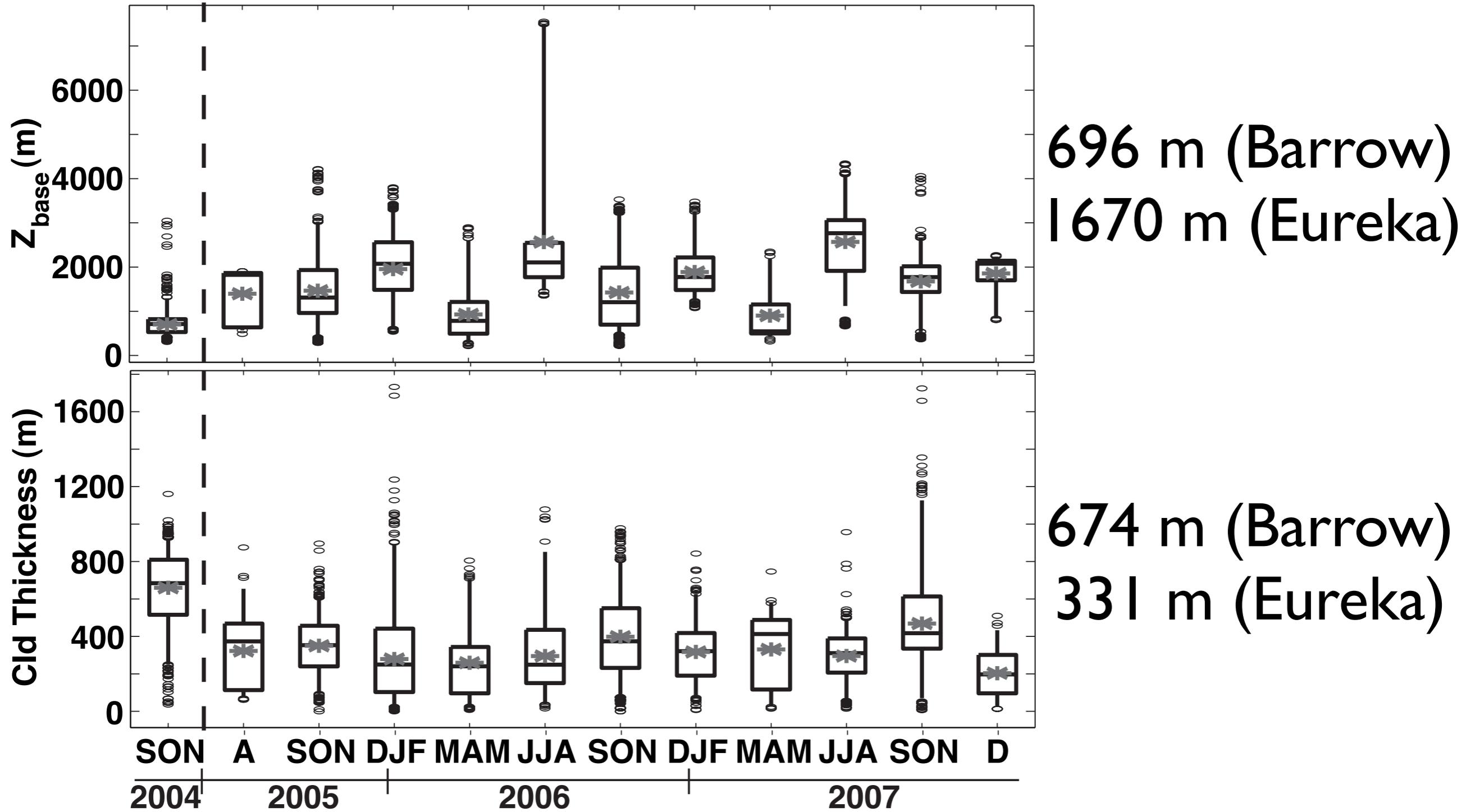
# Cloud Macrophysical Statistics



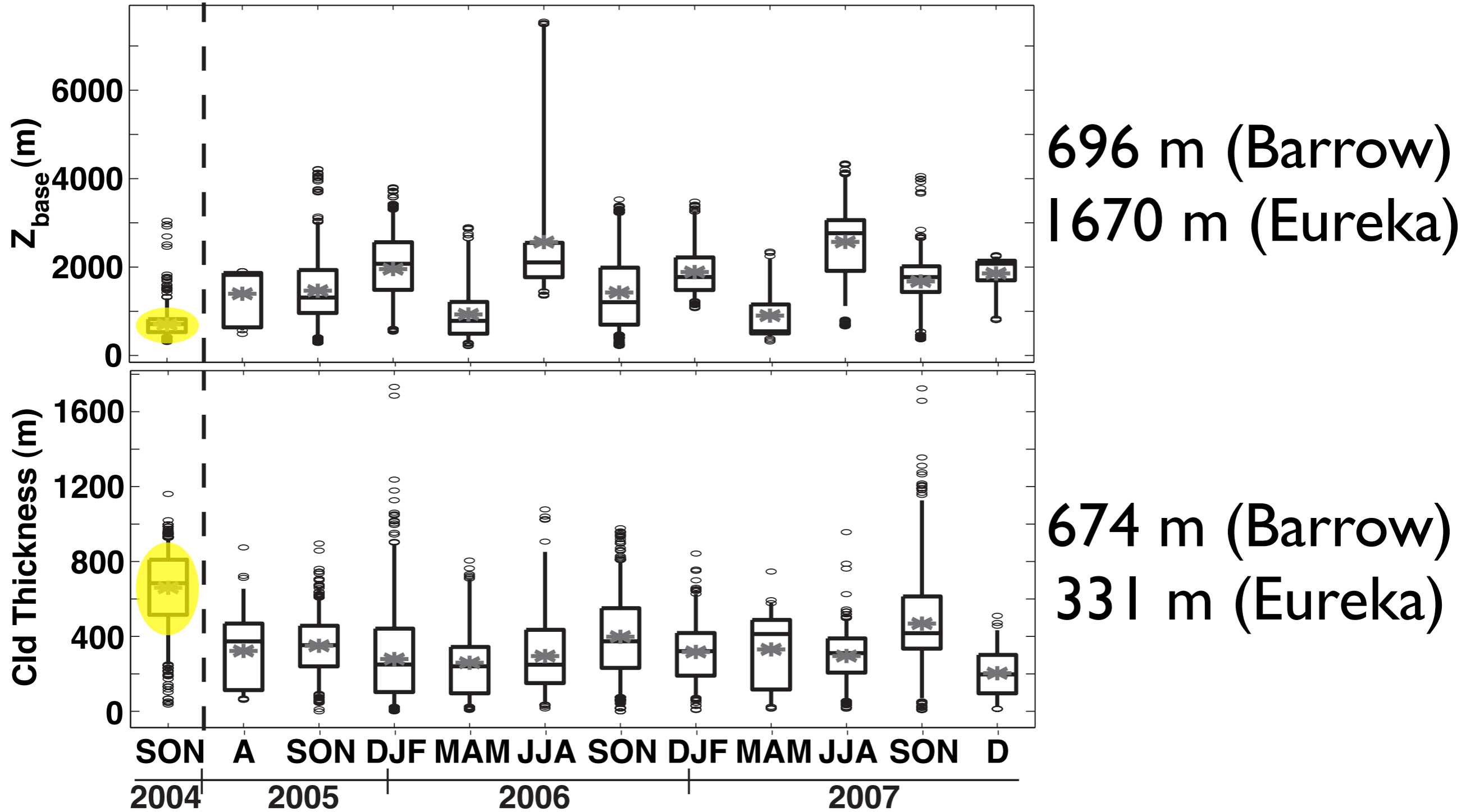
**26% (Barrow)**

**8% (Eureka)**

# Cloud Macrophysical Statistics



# Cloud Macrophysical Statistics

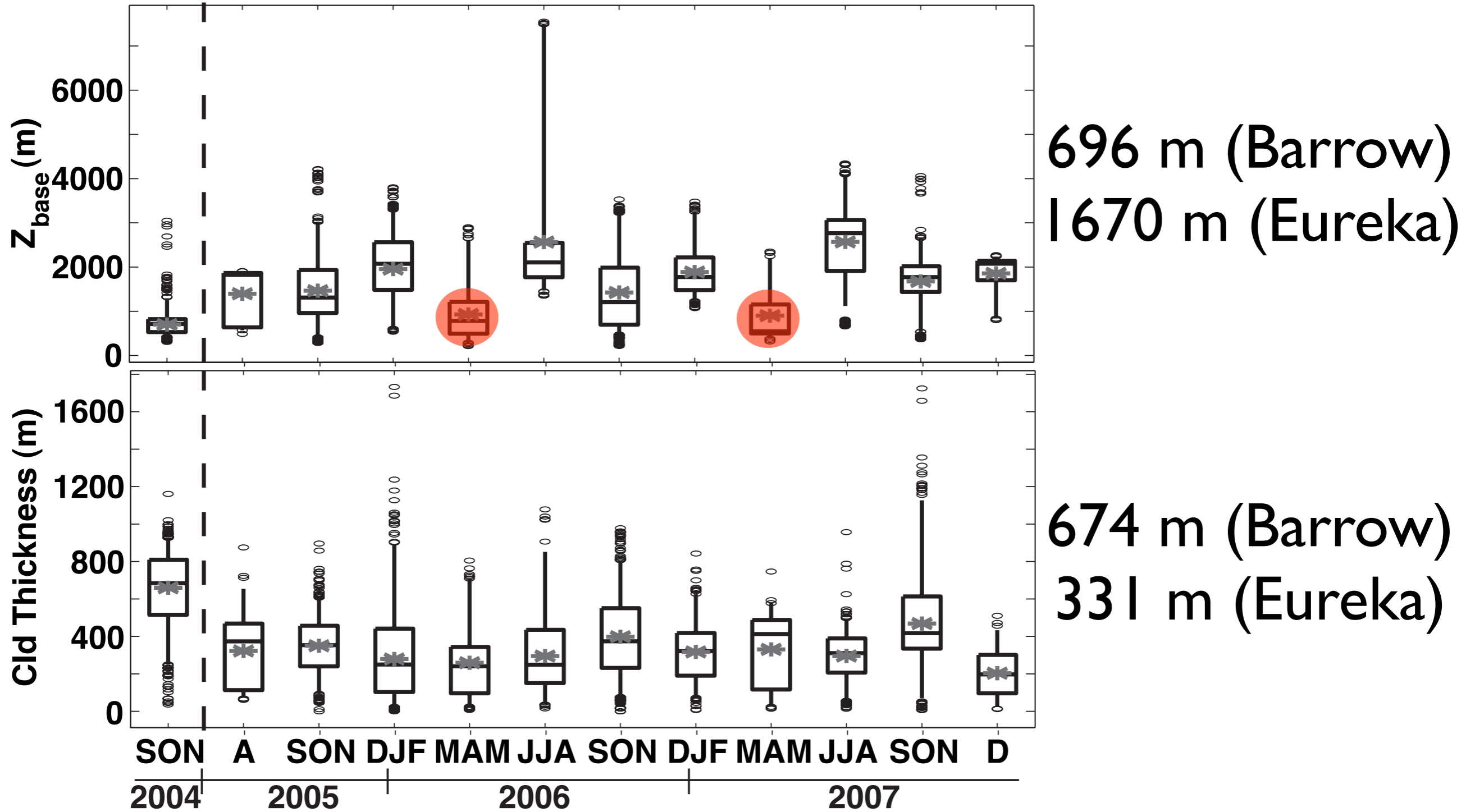


696 m (Barrow)  
1670 m (Eureka)

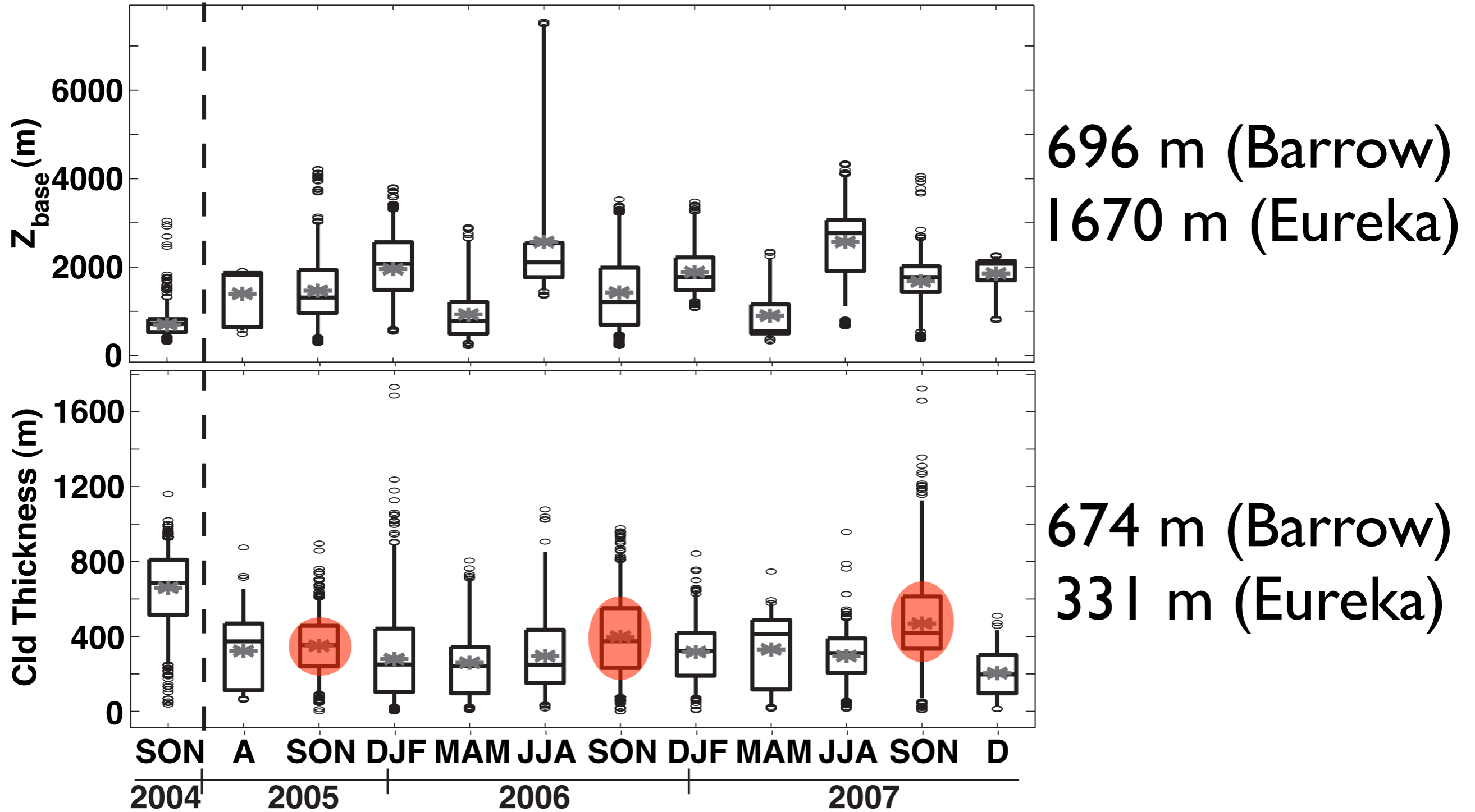
674 m (Barrow)  
331 m (Eureka)



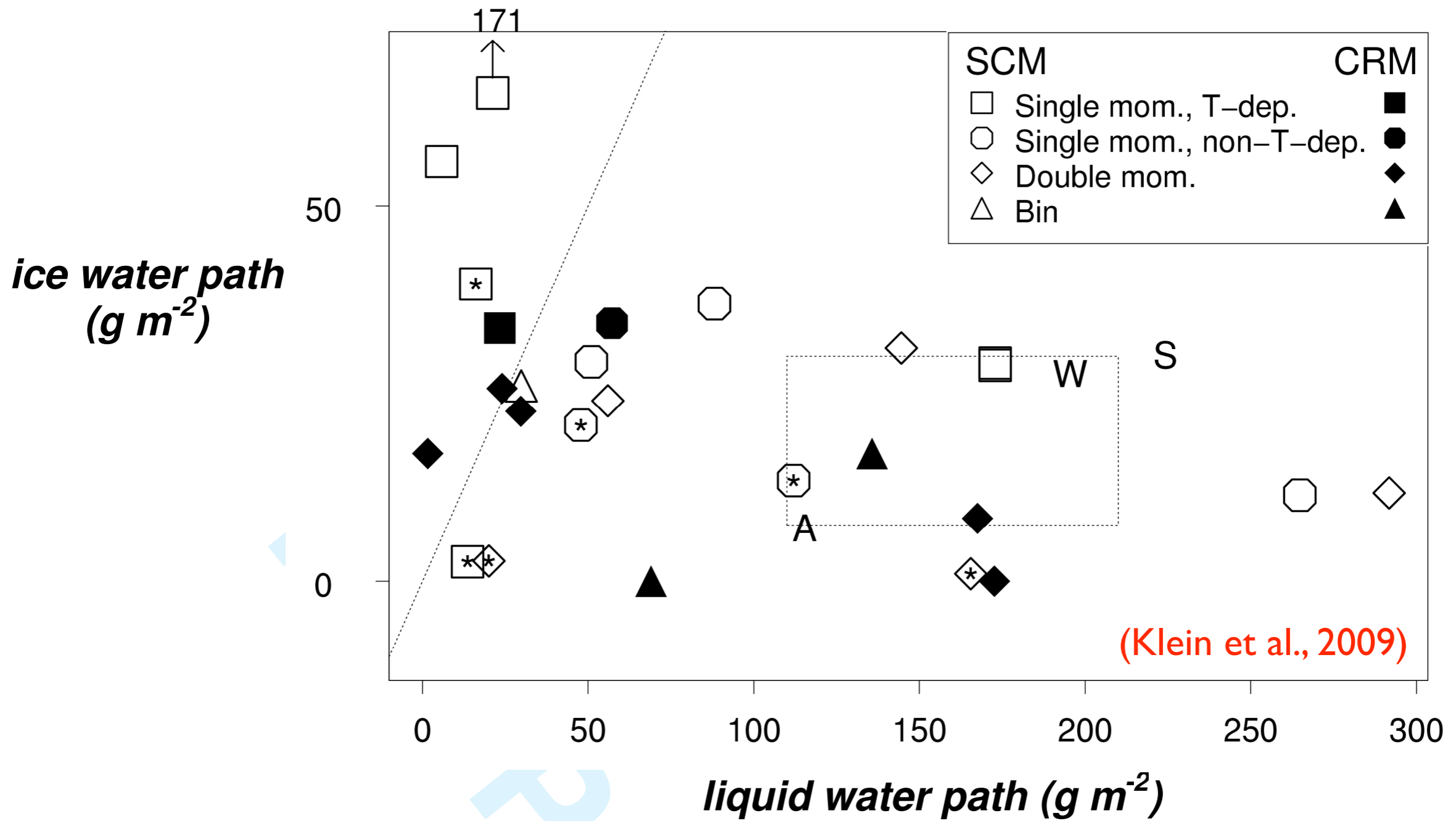
# Cloud Macrophysical Statistics



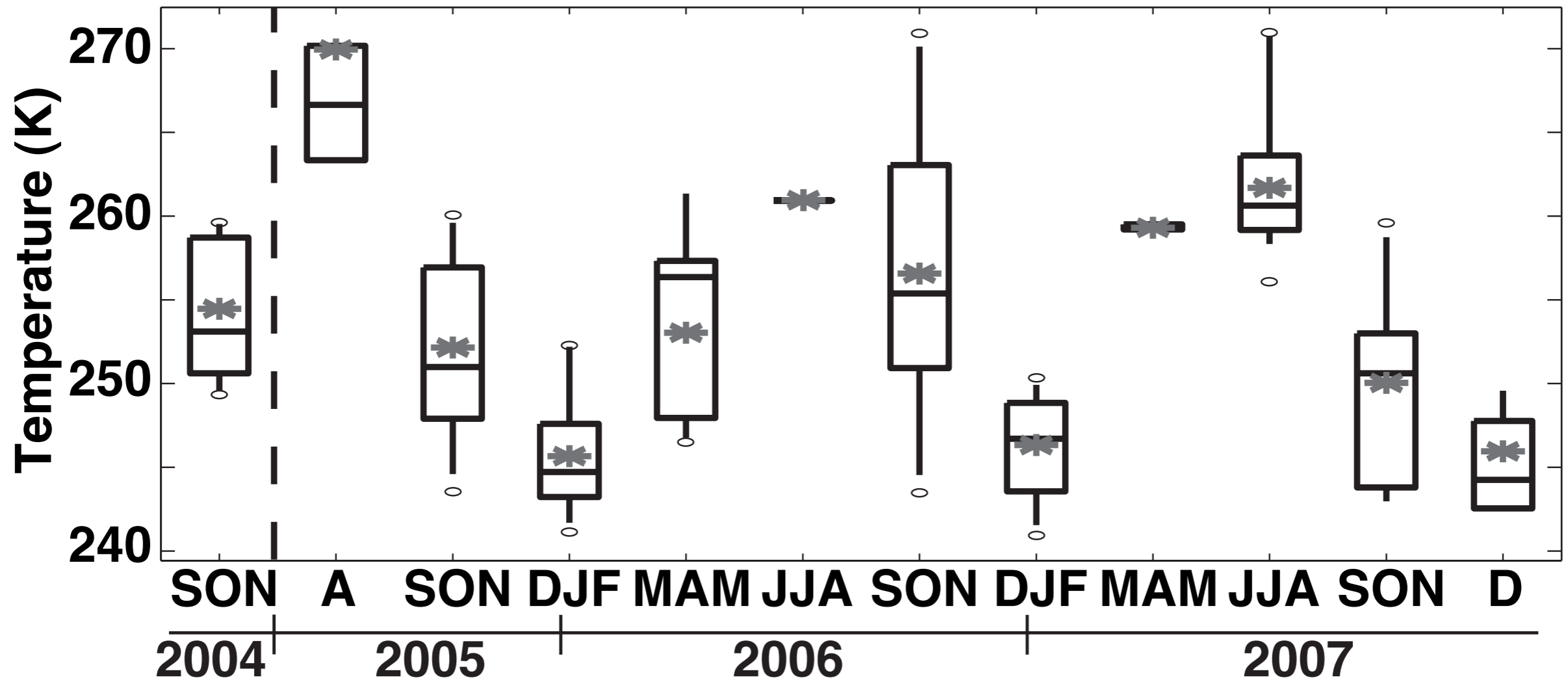
# Cloud Macrophysical Statistics



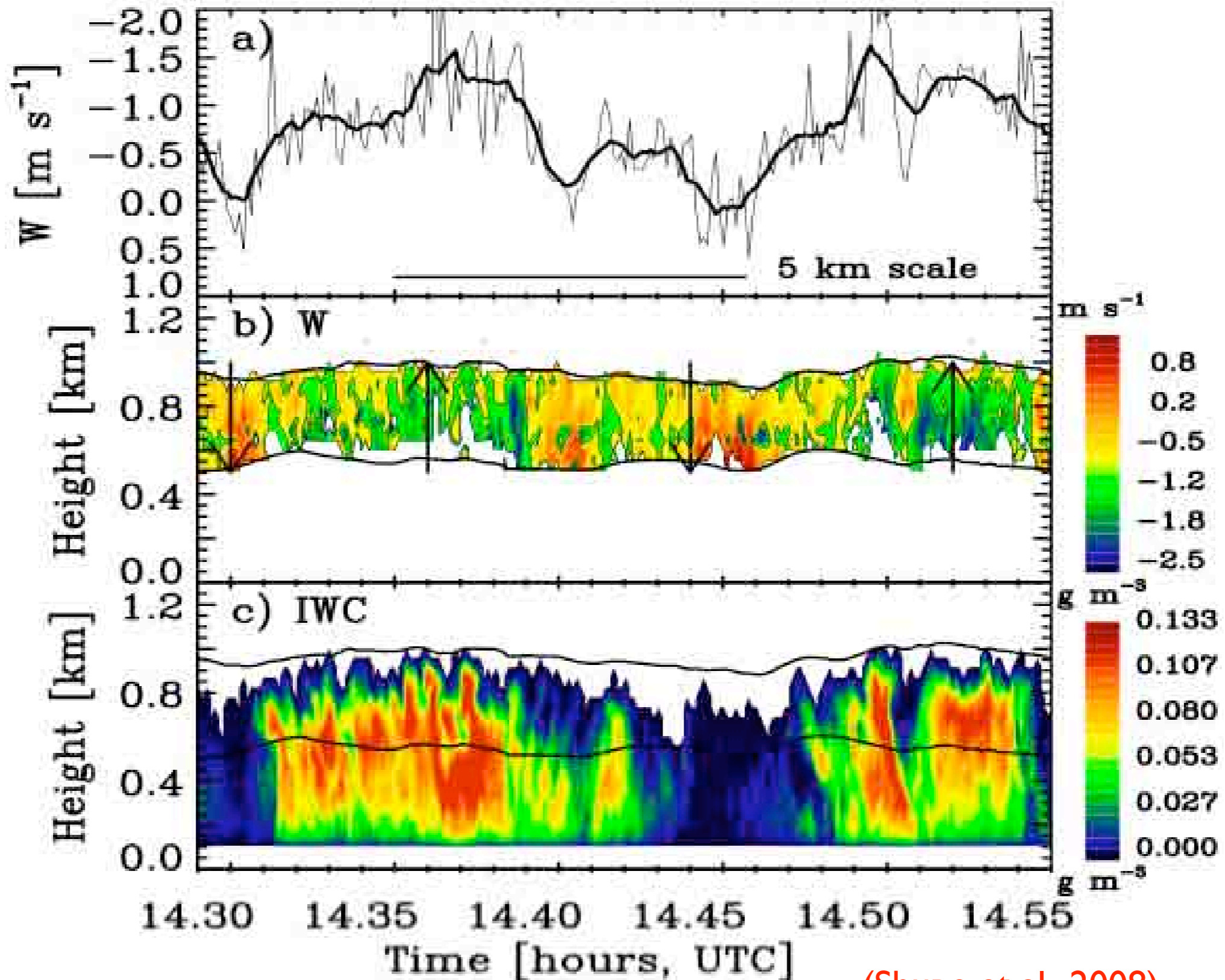
# Simulation



# Simulation

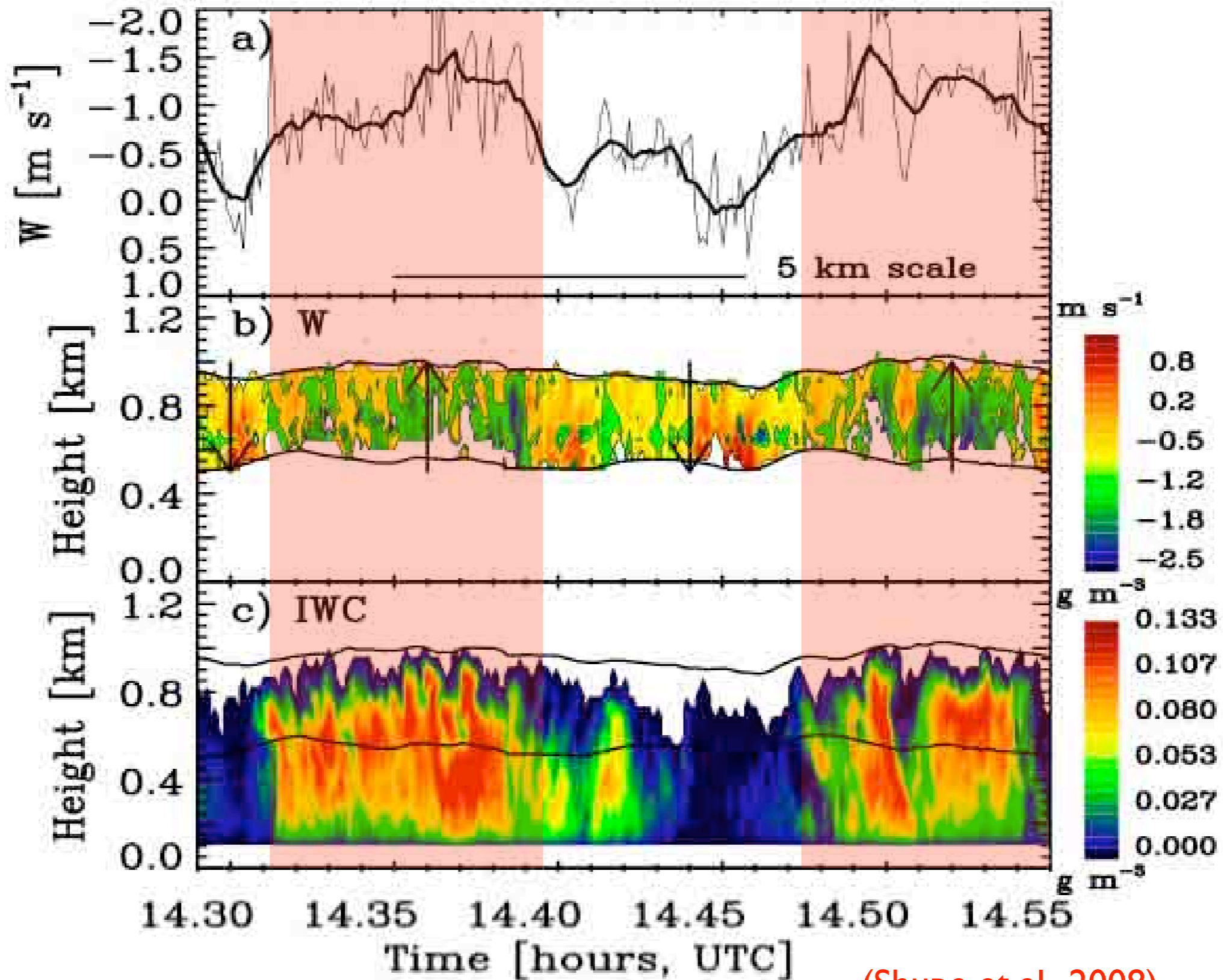


# Simulation



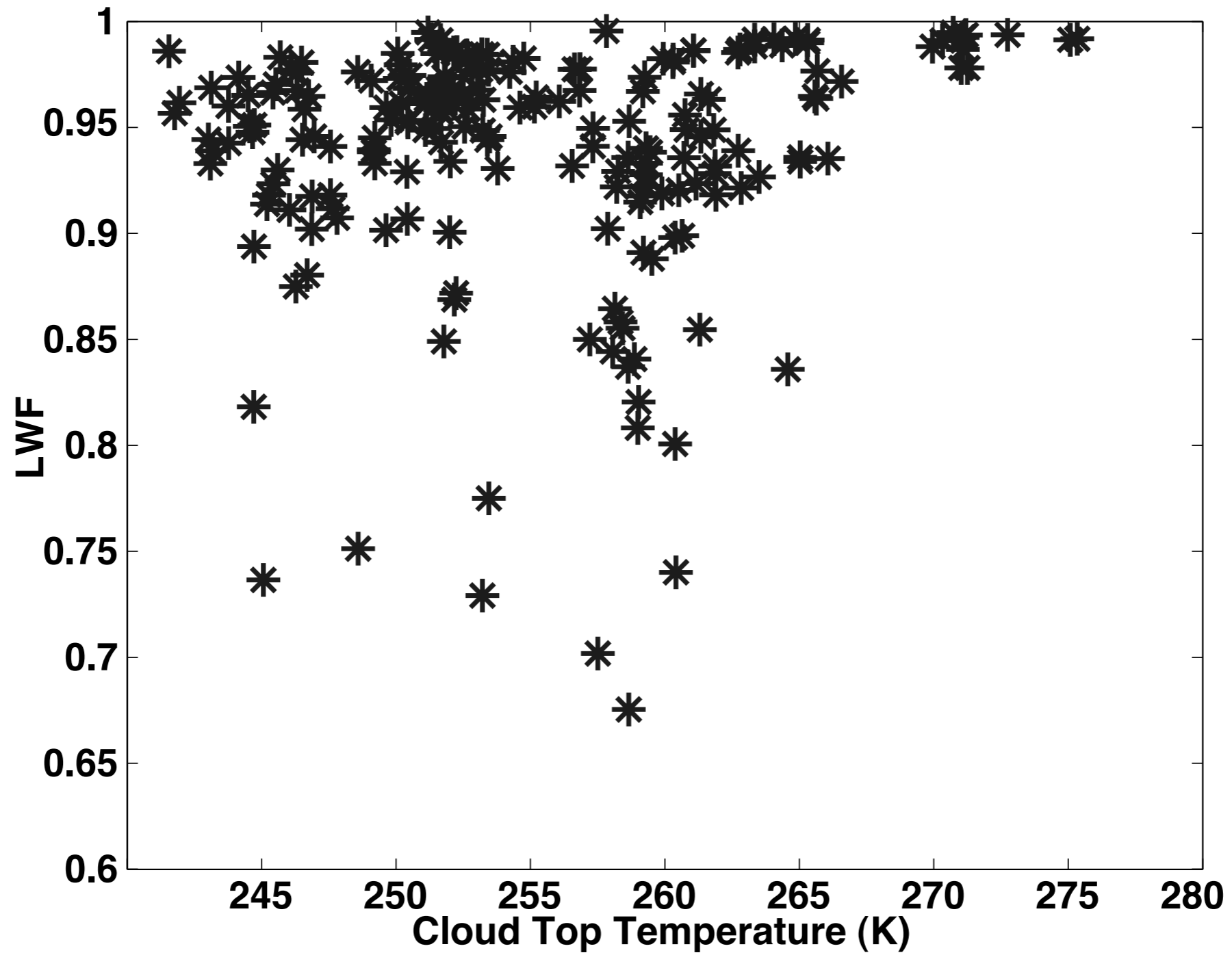
(Shupe et al., 2008)

# Simulation

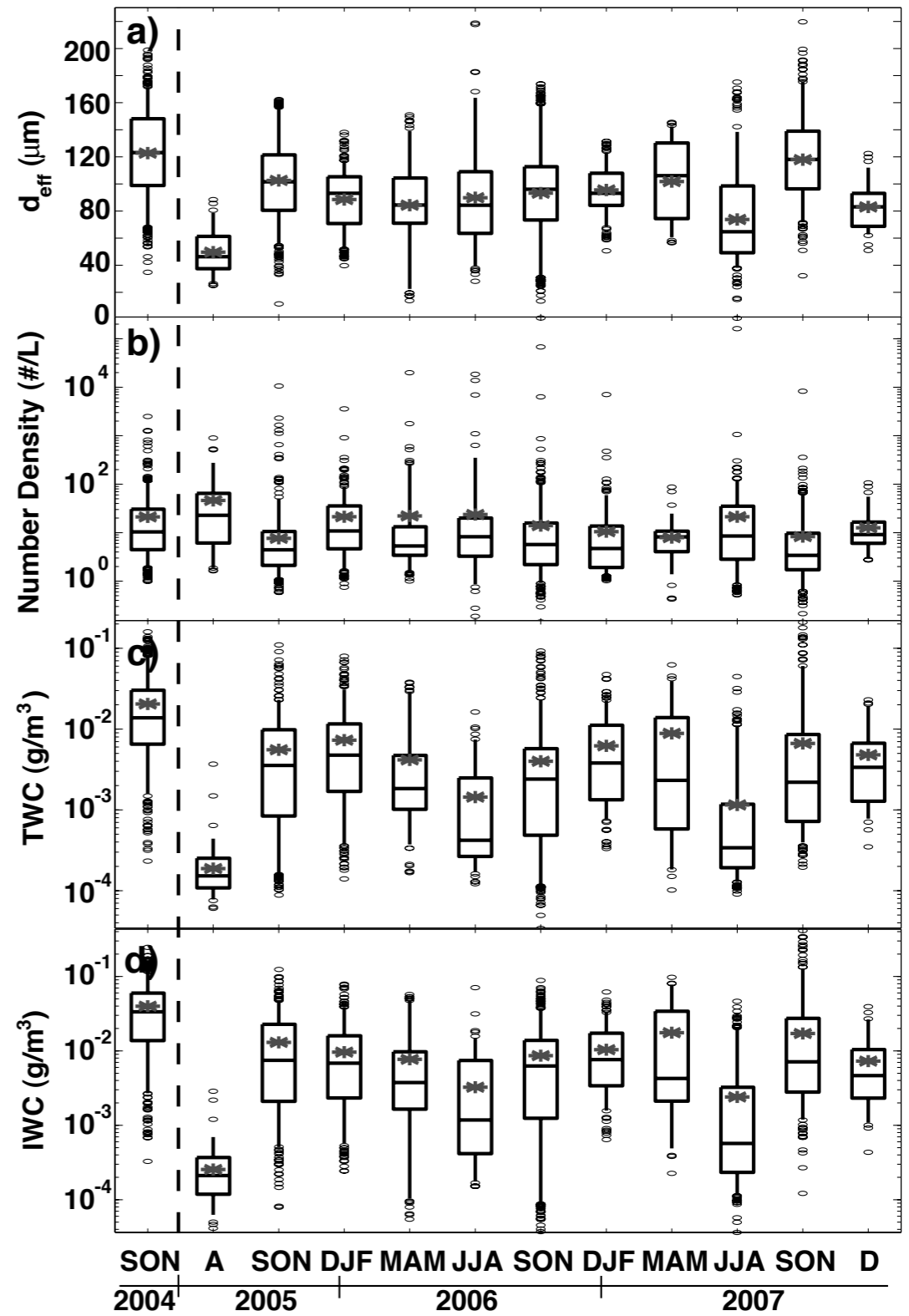
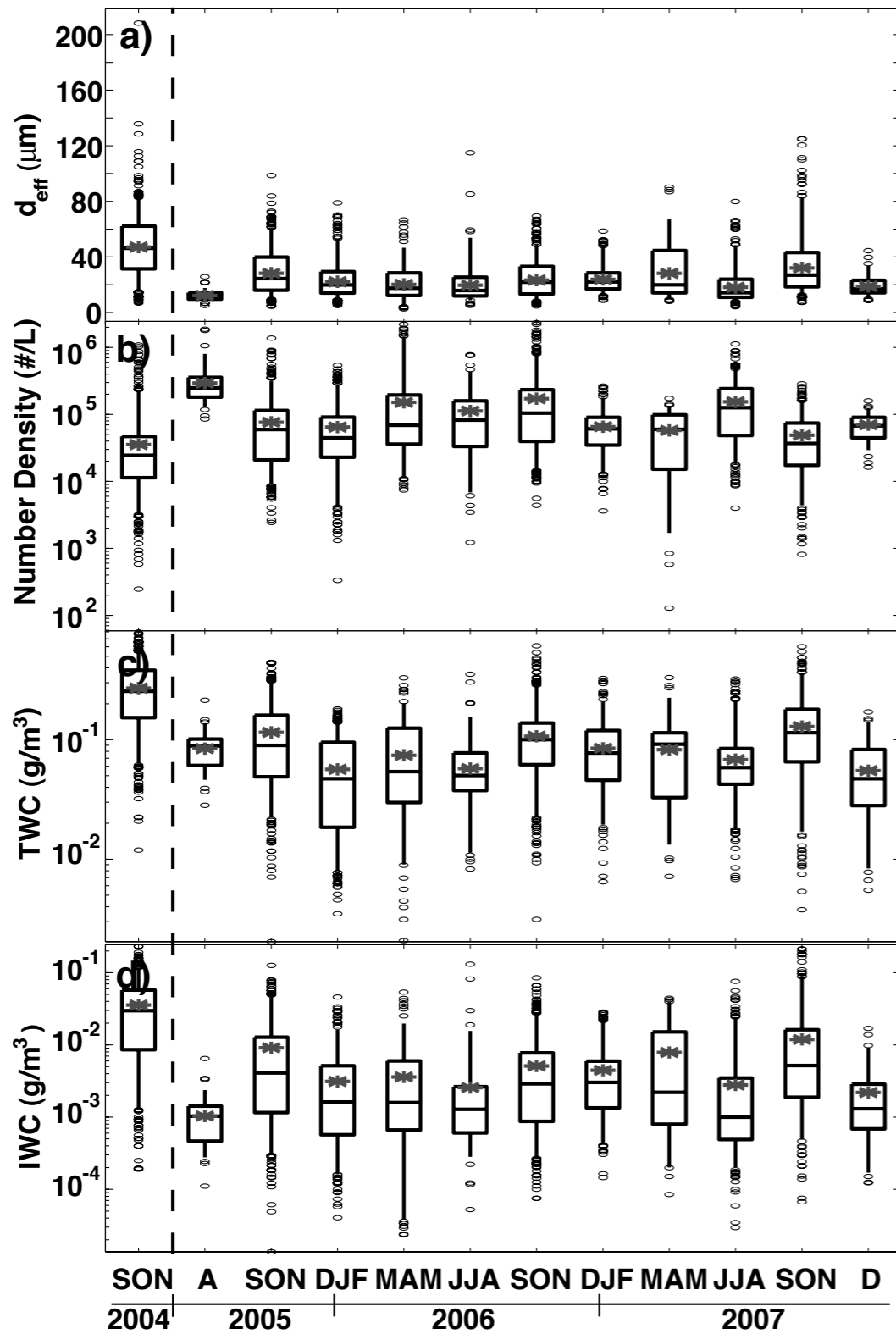


(Shupe et al., 2008)

# Simulation



# Simulation

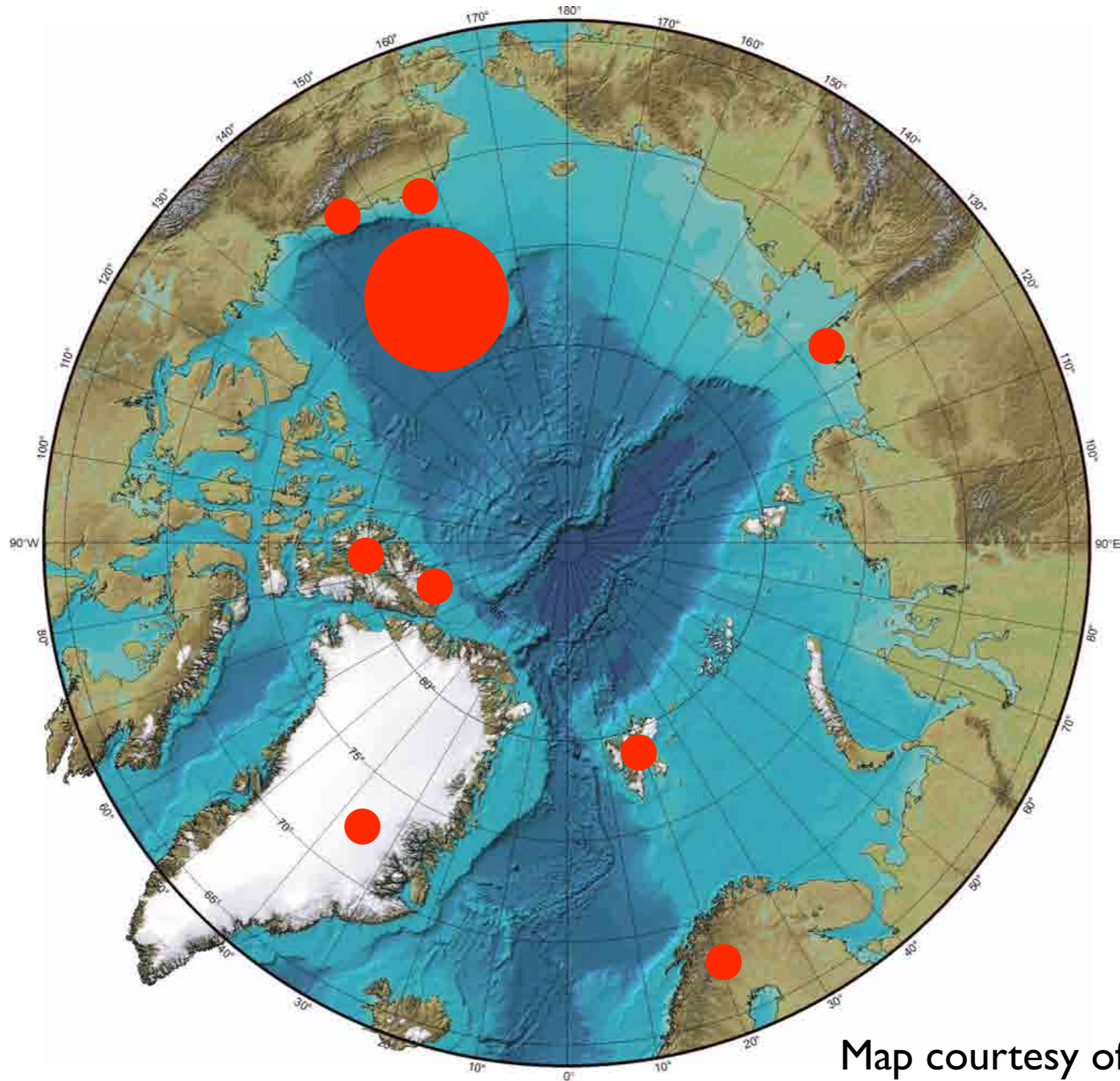


In-Cloud

Sub-Cloud

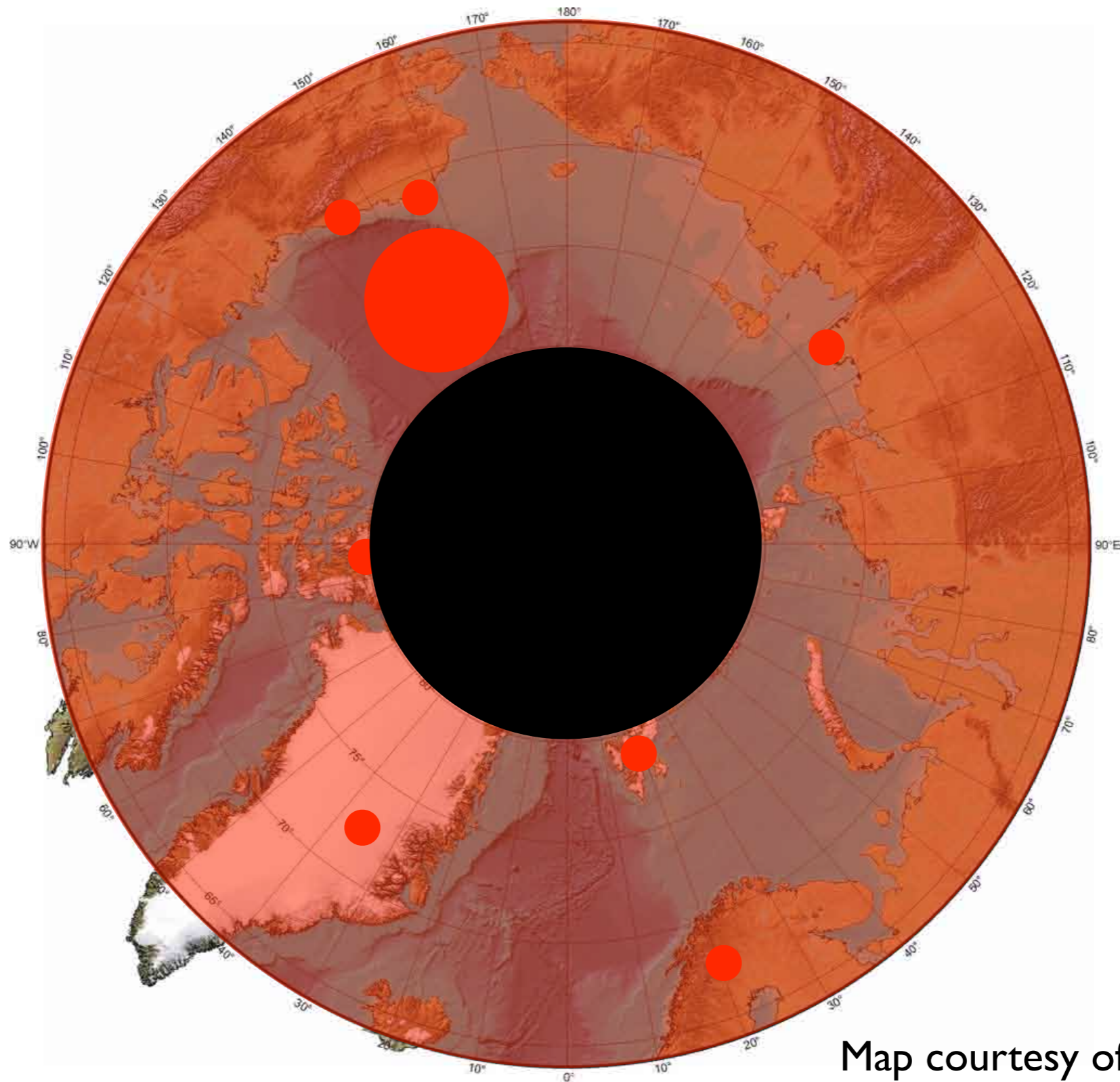


# Measurement Coverage



Map courtesy of NOAA NGDC

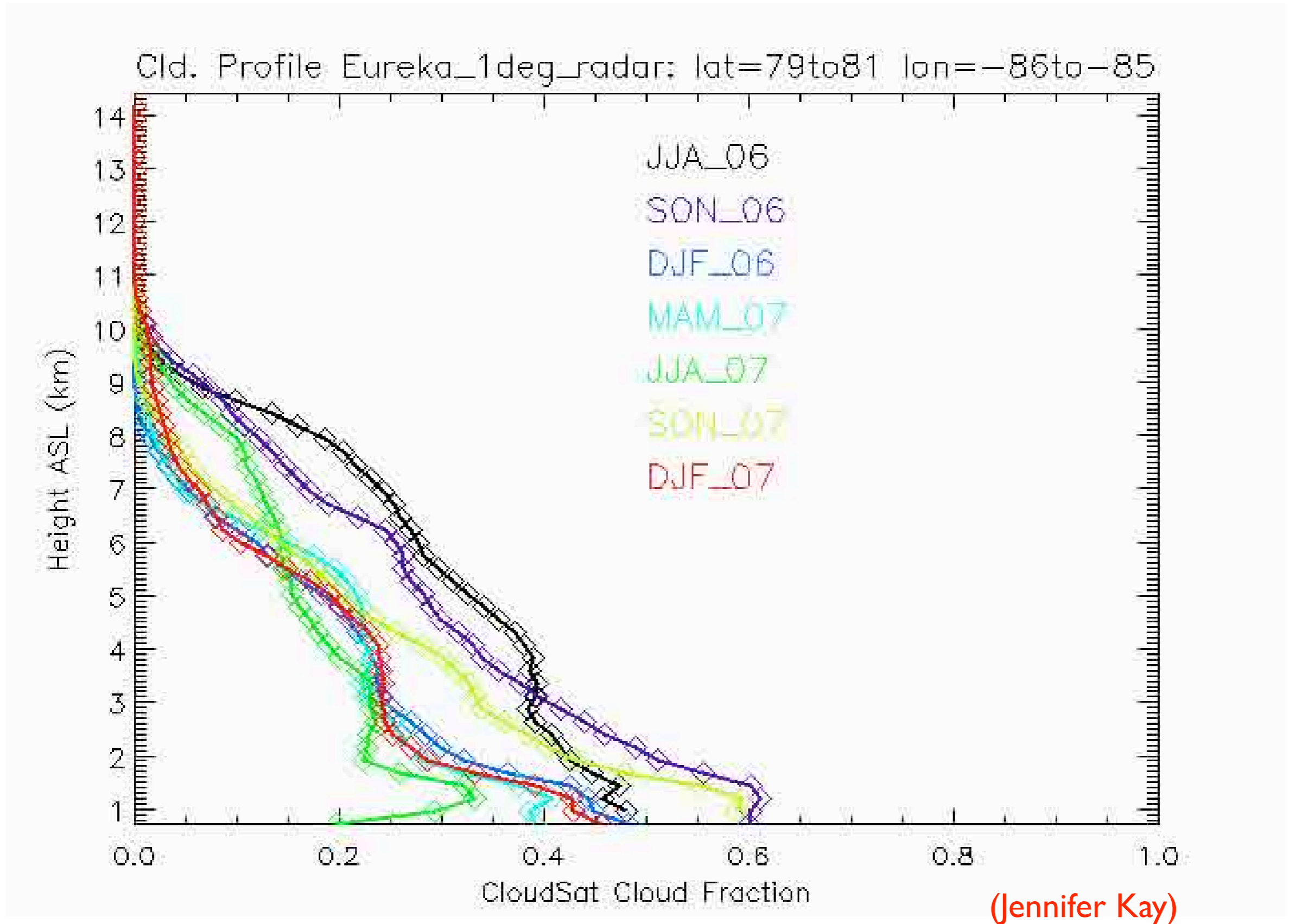
# Measurement Coverage



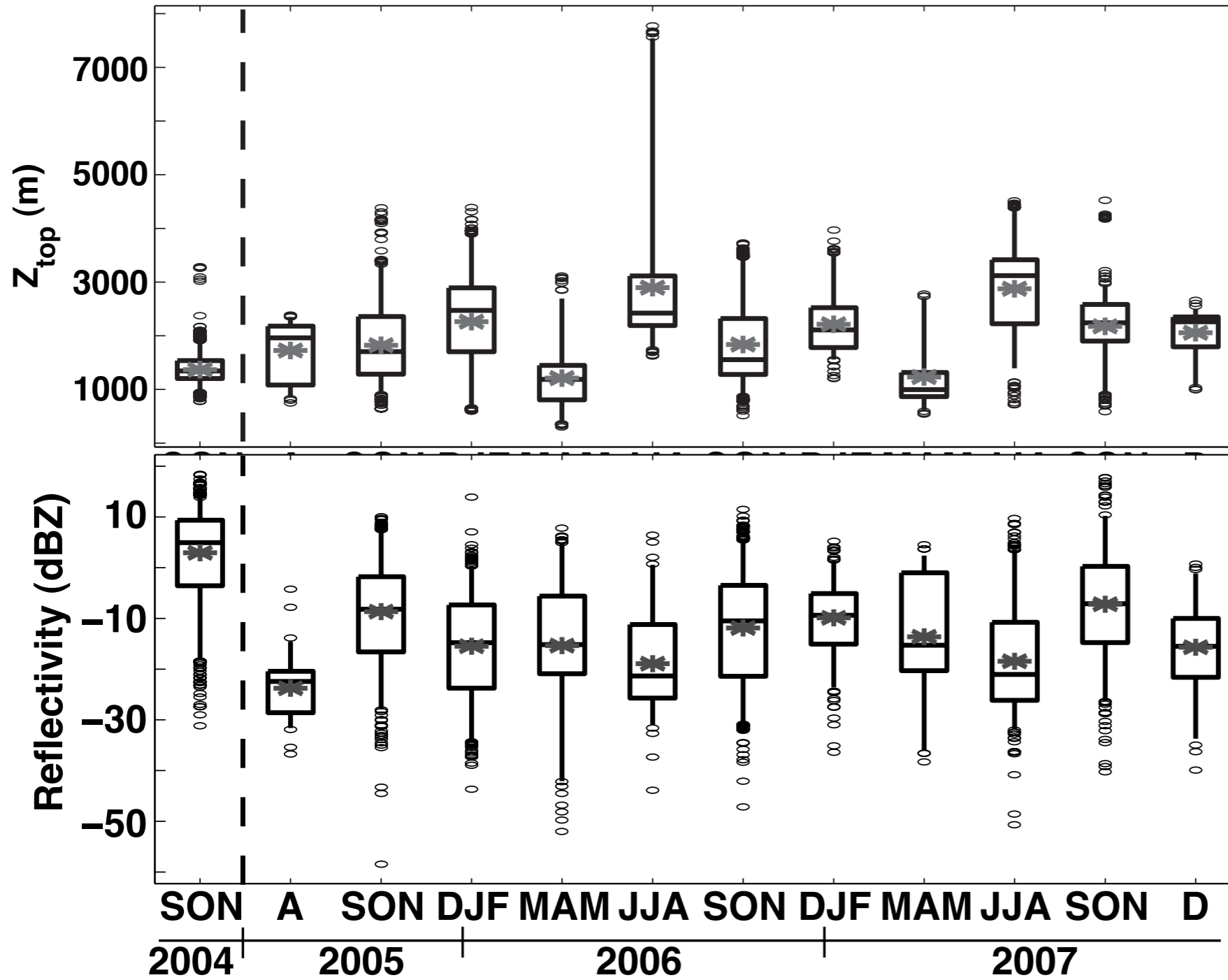
Map courtesy of NOAA NGDC

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# CloudSAT



# CloudSAT



316/3012 cases  
 $z_{top} < 1000$  m

206/3012 cases  
 $Z_{rad} < -29$  dBZ

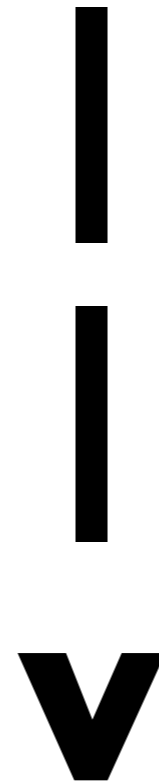
# Summary

- Low, single-layer mixed-phase clouds commonly observed at both Eureka and Barrow
- Differences in macrophysical and microphysical characteristics between different locations and inter-seasonal variation at Eureka
- Large available database to improve and validate simulation of these mixed-phase clouds (as well as others)
- Some low level clouds may easily be missed by CloudSAT

# References

- Curry, J.A., W.B. Rossow, D. Randall, and J.J. Schramm (1996), **Overview of Arctic Cloud and Radiation Characteristics**, *J. Climate*, 9, 1731-1764.
- de Boer, G., E.W. Eloranta, and M.D. Shupe (2009), **Arctic Mixed-Phase Stratiform Cloud Properties from Multiple Years of Surface-Based Measurements at Two High-Latitude Locations**, Submitted to JAS.
- Herman, G. and R. Goody (1976), **Formation and Persistence of Summertime Arctic Clouds**, *J. Atmos. Sci.*, 33, 1537-1553.
- Klein, S.A., and co-authors (2009), **Intercomparison of Model Simulations of Mixed-Phase Clouds Observed During the ARM Mixed-Phase Arctic Cloud Experiment. Part I: Single-Layer Cloud**, Submitted to QJRMS.
- Shupe, M.D., P. Kollias, P.O.G. Persson, and G.M. McFarquhar (2008), **Vertical Motions in Arctic Mixed-Phase Stratiform Clouds**, *J. Atmos. Sci.*, 65, 1304-1322.

# **EXTRA SLIDES**



### Individual and Cumulative Uptime Percentage

