

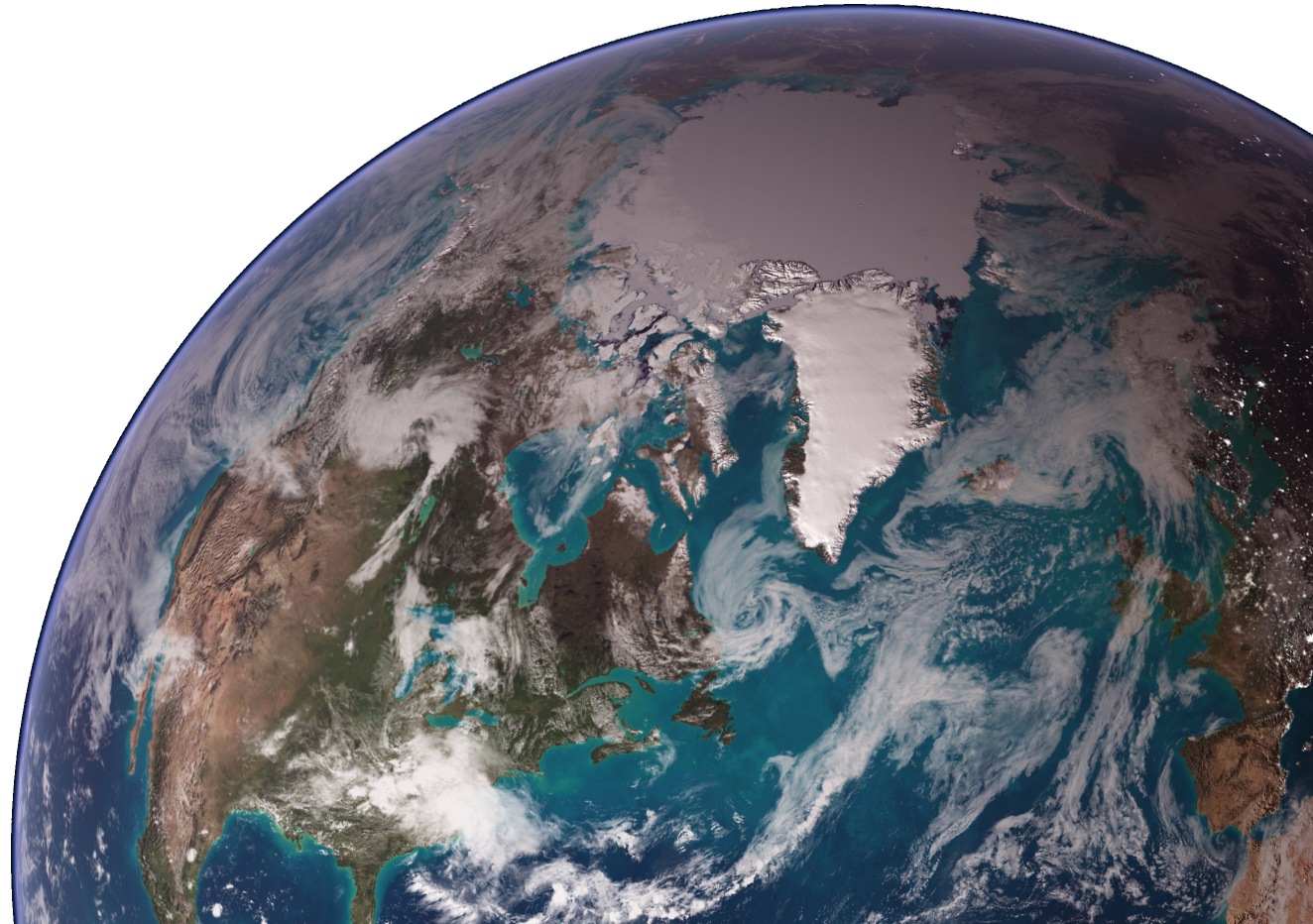


NOAA RESEARCH • ESRL • PHYSICAL SCIENCES DIVISION

# Unraveling the Secrets of Arctic Clouds

Matthew Shupe

Science Review  
12-14 May 2015  
Boulder, Colorado

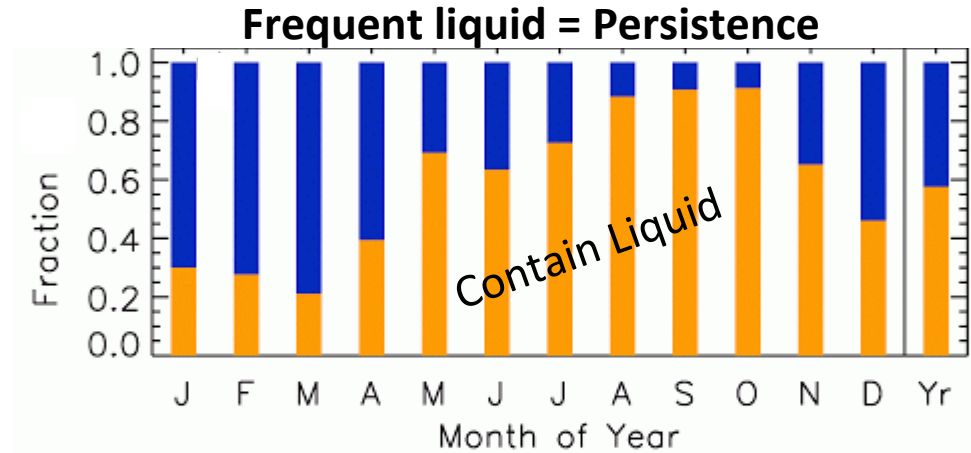
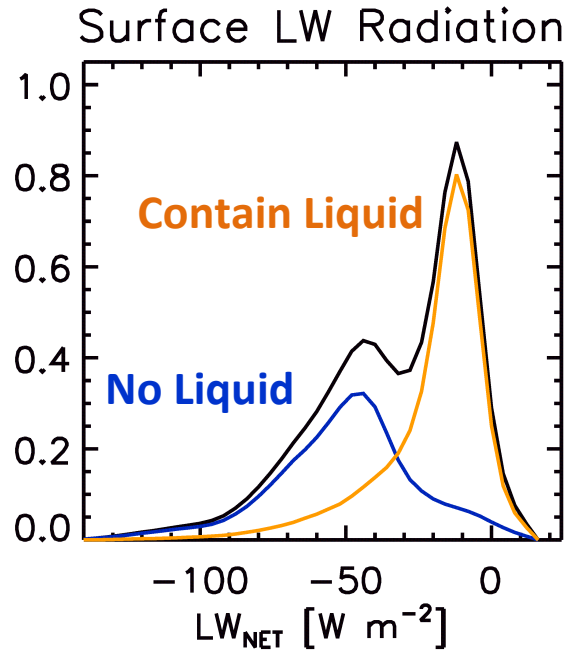


# PSD Leads Major Advance

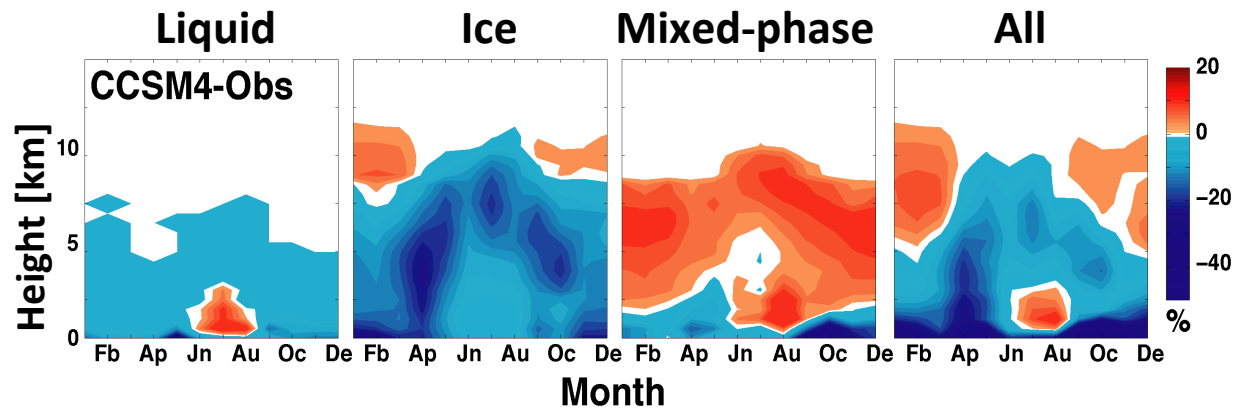
- An “end-to-end” story
- Instrument development
- Technique development
- First annual cycle
- Detailed process studies
- Advancing model capabilities
- Arctic clouds recognized as critical challenge
  - phase partitioning
  - persistence



# Why Care About Phase?

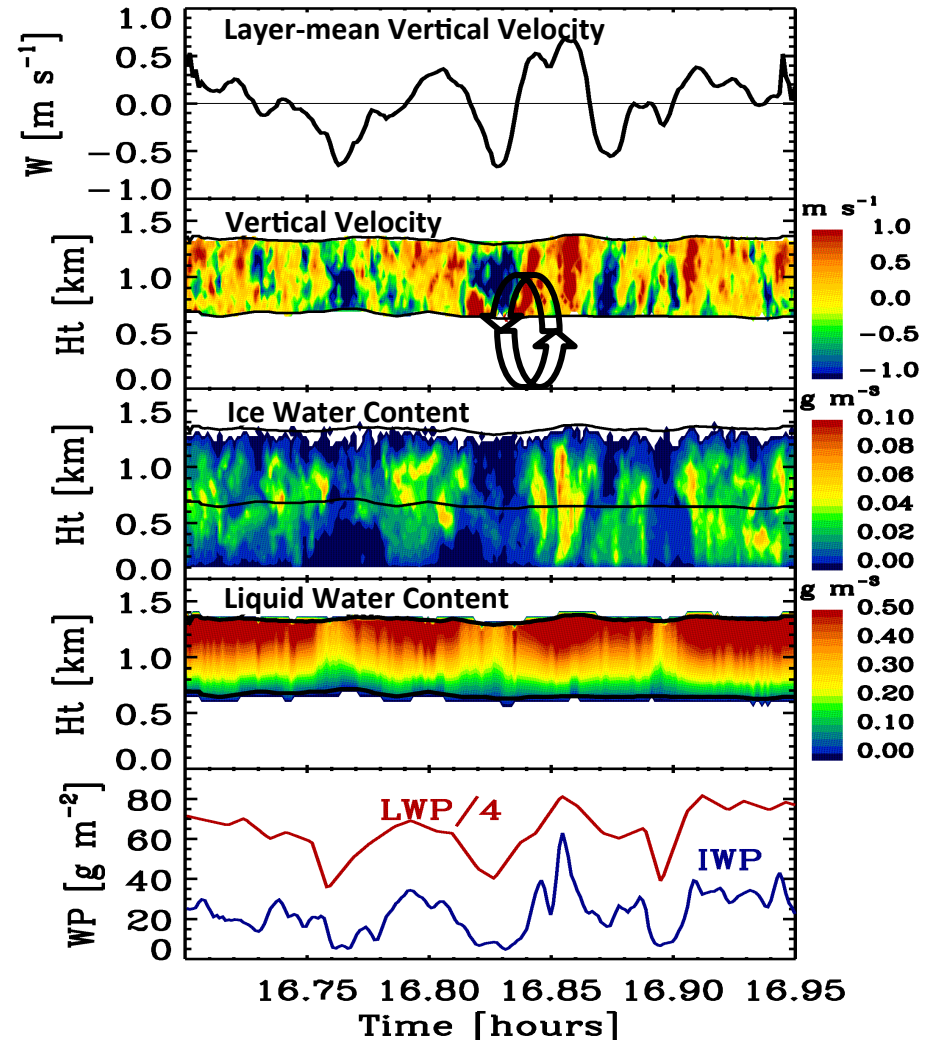


## Models struggle with cloud phase

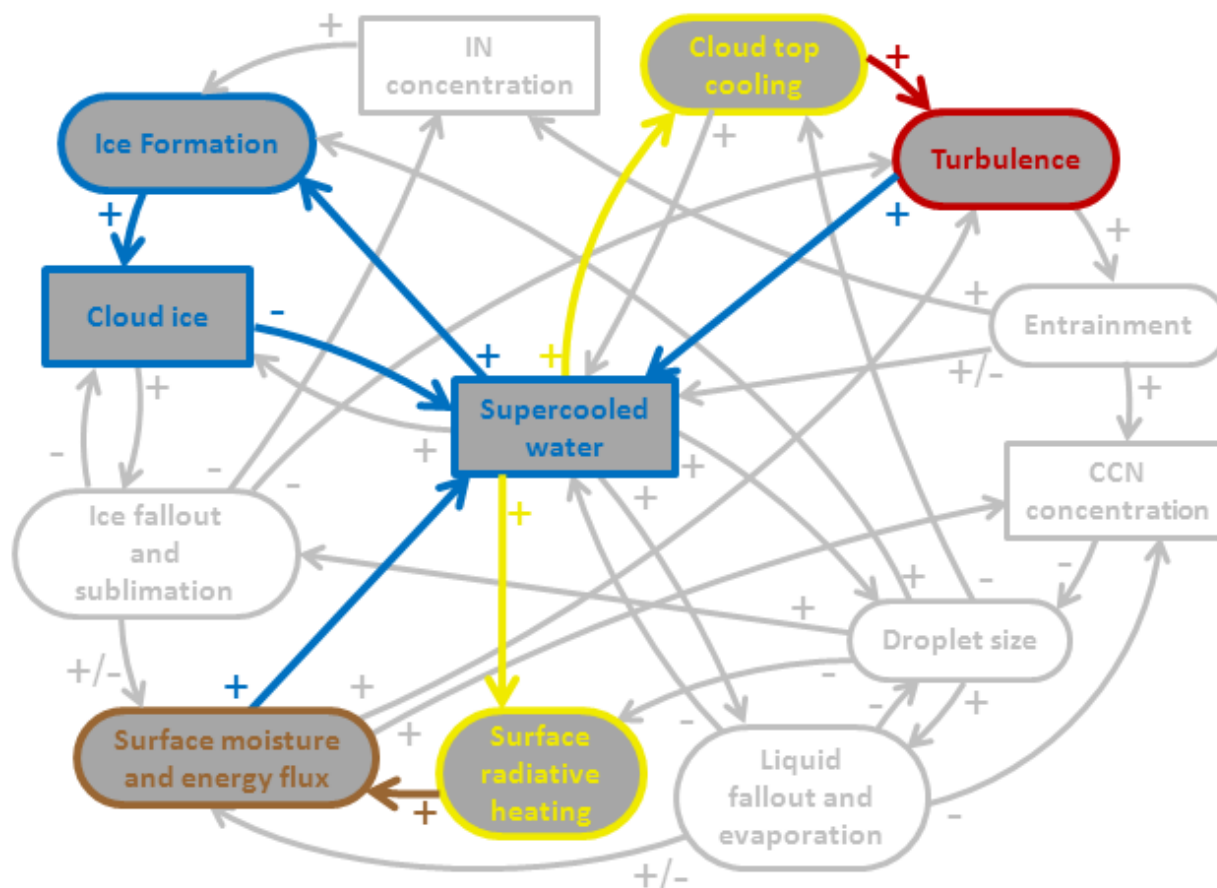


# Detailed Cloud Processes

- High resolution dynamics and microphysics
- Liquid drives turbulent motions via radiation
- Ice forms in moisture-rich regions > fallout is critical
- Processes occur at <1km scales



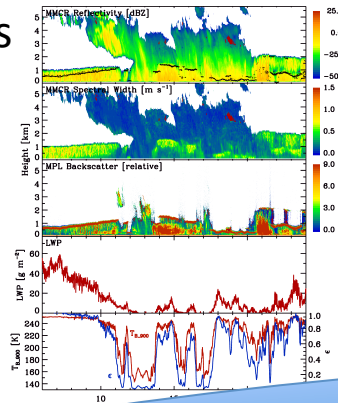
# State of our Knowledge



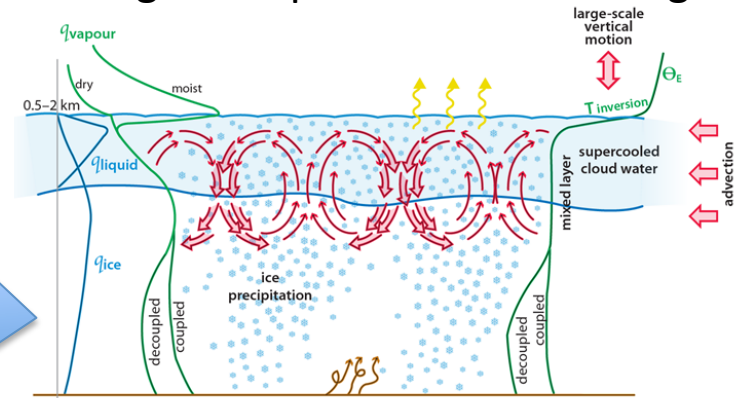
*Liquid water at heart of complex web of cloud-scale feedbacks*

# Strength of Observations + Models

## Observational analyses

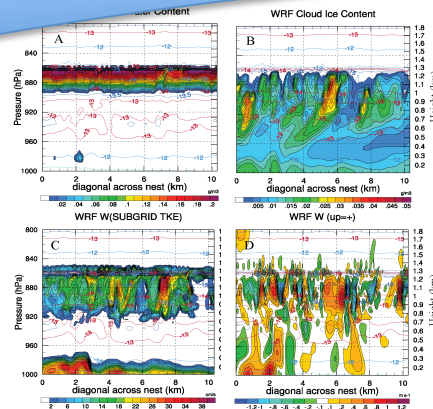
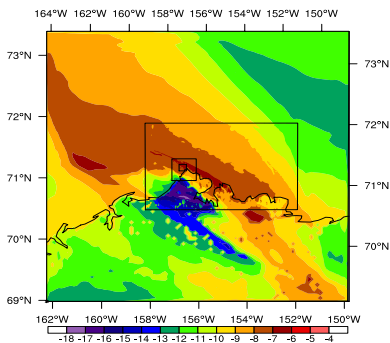


## Building Conceptual Understanding



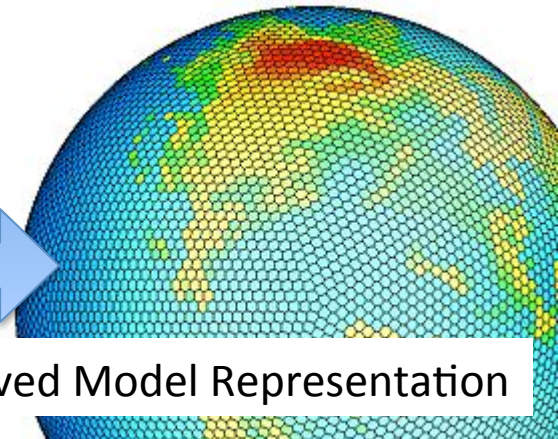
## Multi-sensor measurements

## Multi-scale modeling



## Idealized LES

## Improved Model Representation



# Summary and Future

- End-to-end story: PSD as a leader  
Instruments > Techniques > Data sets >  
Process Studies > Model Development
- Arctic liquid clouds are now a major metric for models. Broad community engagement.
- Models still struggle with supercooled liquid
- Cloud cause and response to Arctic change
- Leadership in MOSAiC, YOPP, and more