A micro-physical investigation of Arctic mixed-phase clouds

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Arctic Amplification & Clouds

The Arctic is warming rapidly

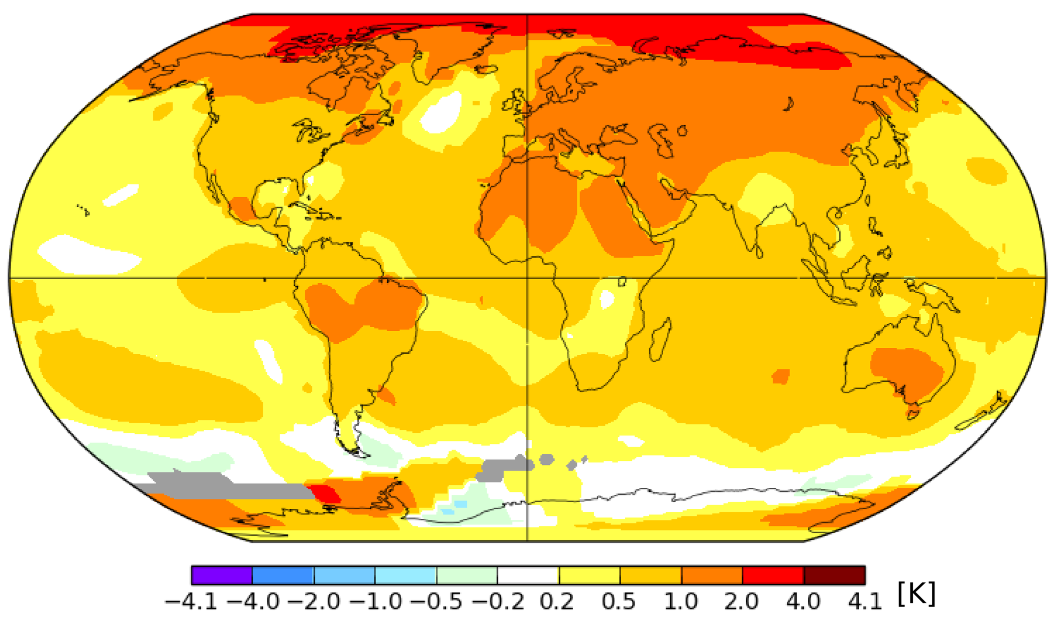

Fig 1. Mean temperature anomaly 2007-2016 compared to 1951-80.[1,2]

Clouds in the climate system

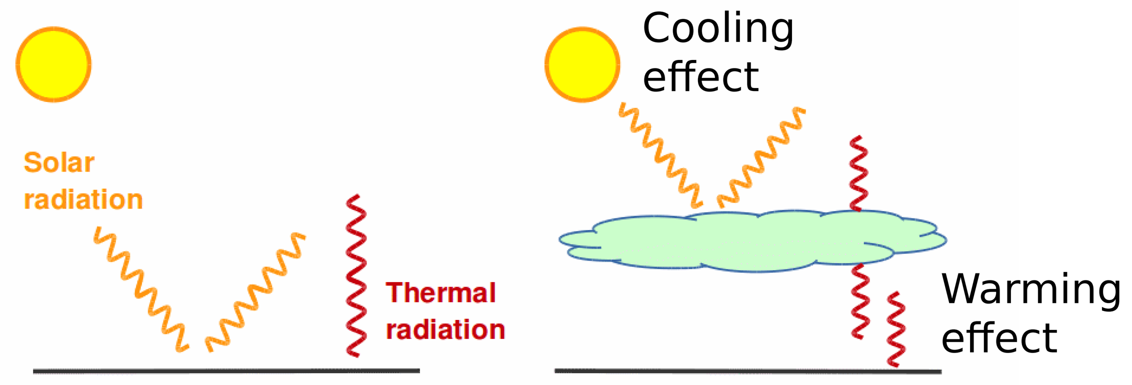

Fig 2. Clouds can have a net cooling or warming effect, depending on altitude, phase and other properties.

Arctic mixed phase clouds

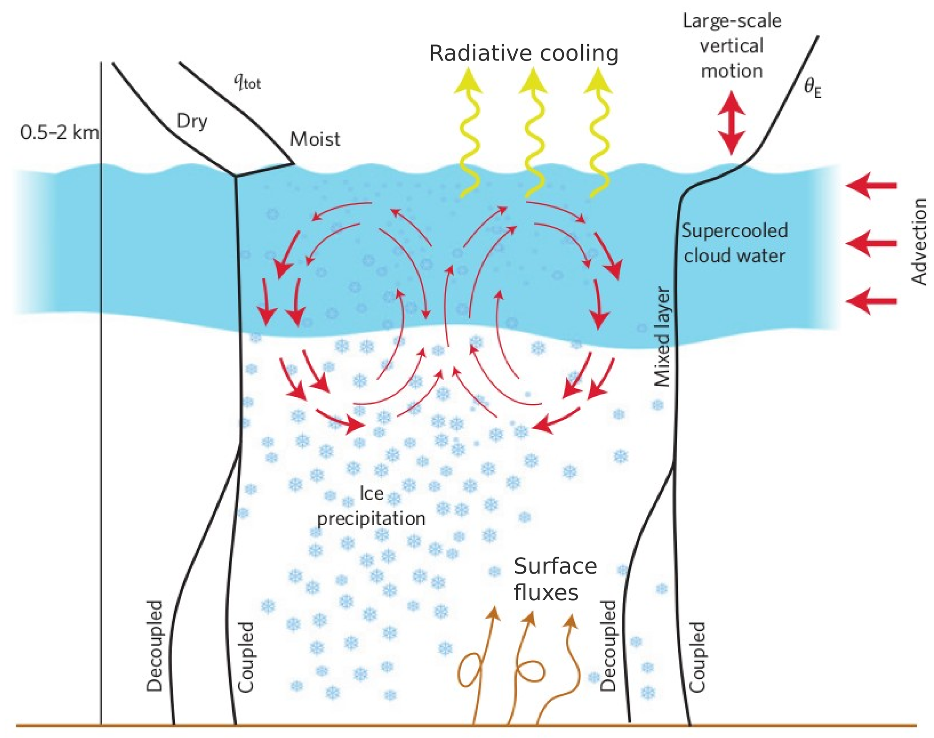

Fig 3. Structure of and key processes[3].

"Low-level stratiform liquid and mixed-phase clouds are found to be the most important contributors to the Arctic surface radiation balance."[4]

Research Plan

Retrieving micro-physical cloud properties

Observations at AWIPEV station
- Doppler spectra from cloud radar

ACLOUD campaign
- In situ obs. with aircraft

Cloud classification
- Liquid/ice/ mixed phase

Developing retrieval

Process studies of mixed phase clouds

- Balance between phases: sources and sinks for ice, liquid water and water vapor?
- How is the liquid layer sustained?
- The role of vertical motions and turbulence in creating super cooled liquid?
- Why are ice nucleating particles not depleted?

Modeling activities

- LES
- Parameterizations for mixed phase micro-physics

Observations of Mixed Phase Clouds at Ny Ålesund

Cloud Radar

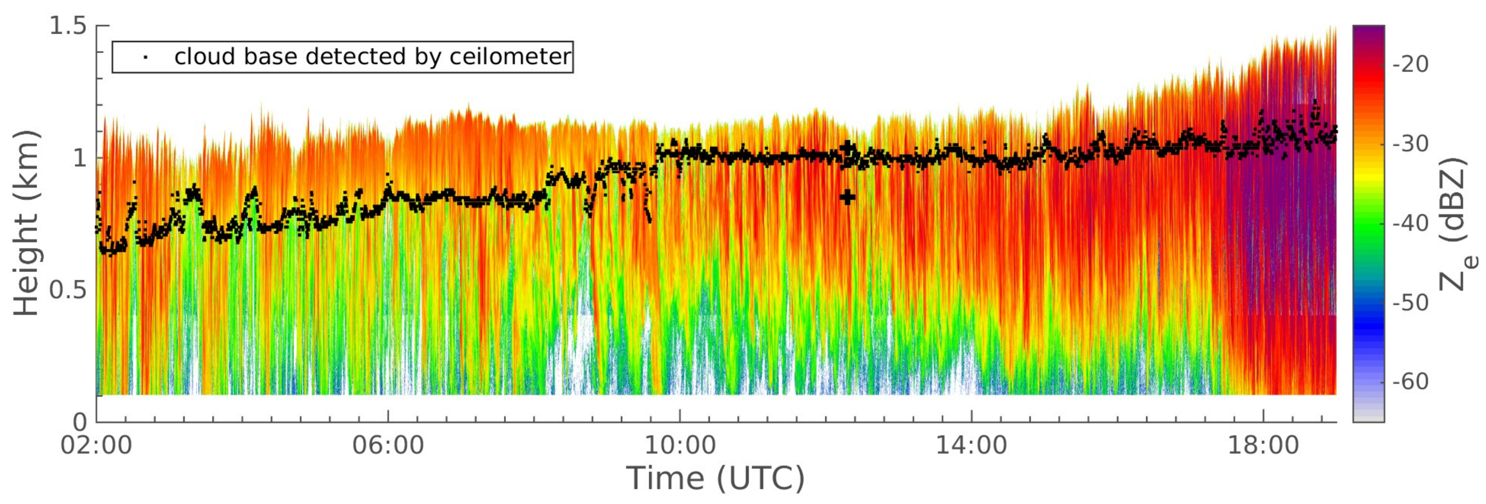

Fig 4. Example of a boundary layer cloud that persisted over 2 days (Nov 5th 2016).

Other instruments

- Microwave radiometer
- Doppler Wind lidar
- Ceilometer
- Radiosoundings (daily)
- Coming: Micro rain radar

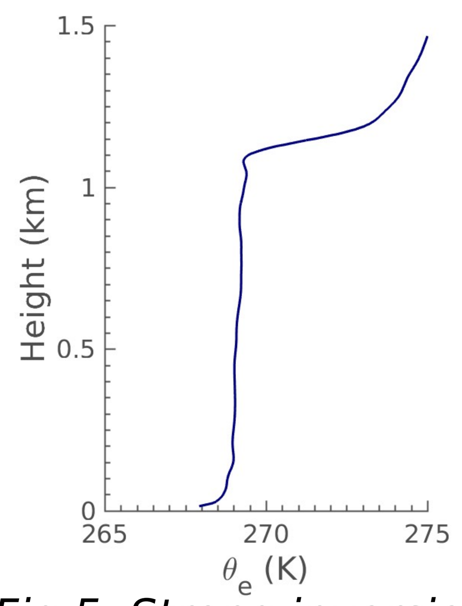

Fig 5. Strong inversion at cloud top (from sounding at 12 UTC).

Cloudnet Cloud Classification

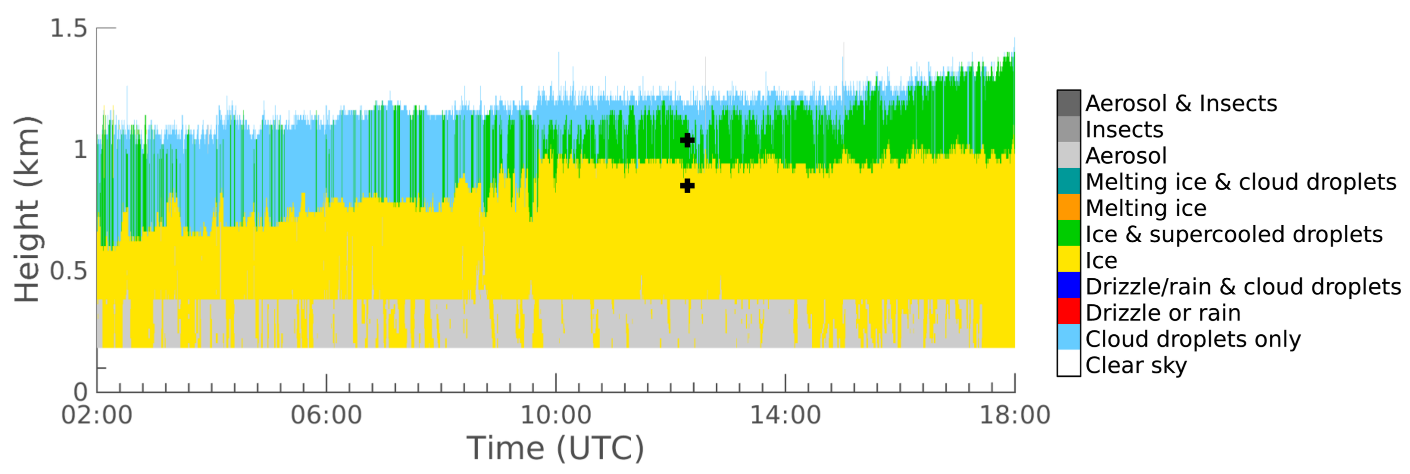

Fig 5. The target classification reveals a structure typical for a mixed phase cloud with liquid at the top and ice precipitation below.

Doppler Spectra

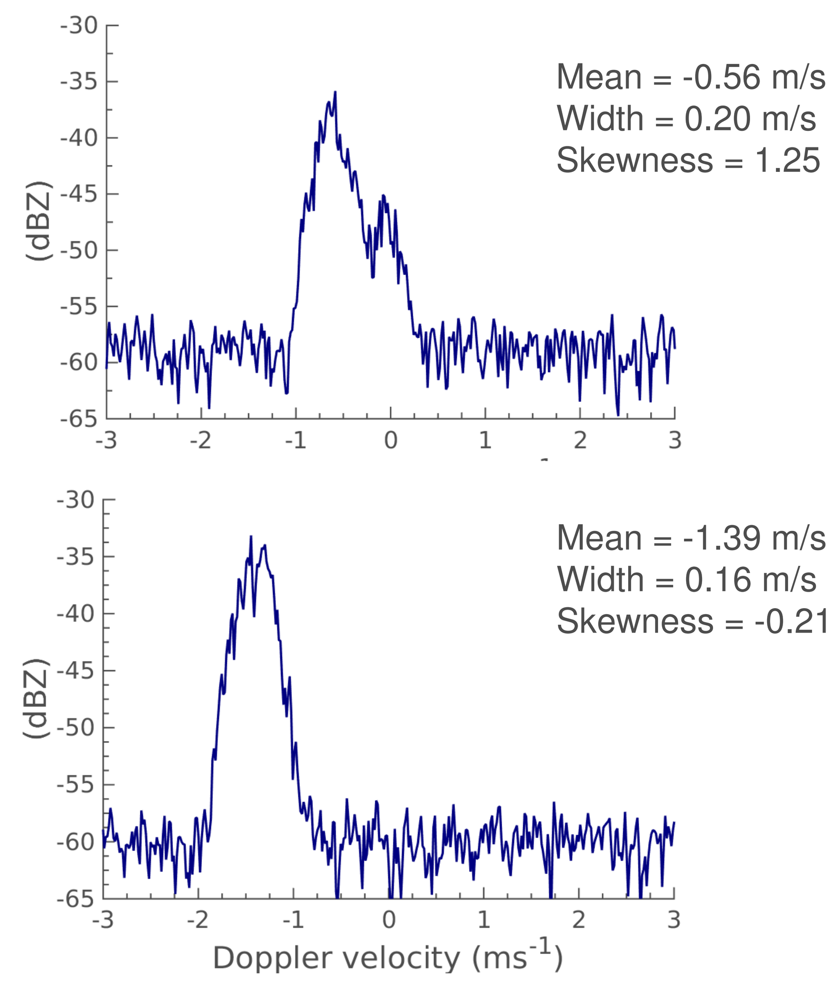

Fig 6. Doppler velocity spectra at 1038 m (top) and 852 m (bottom).

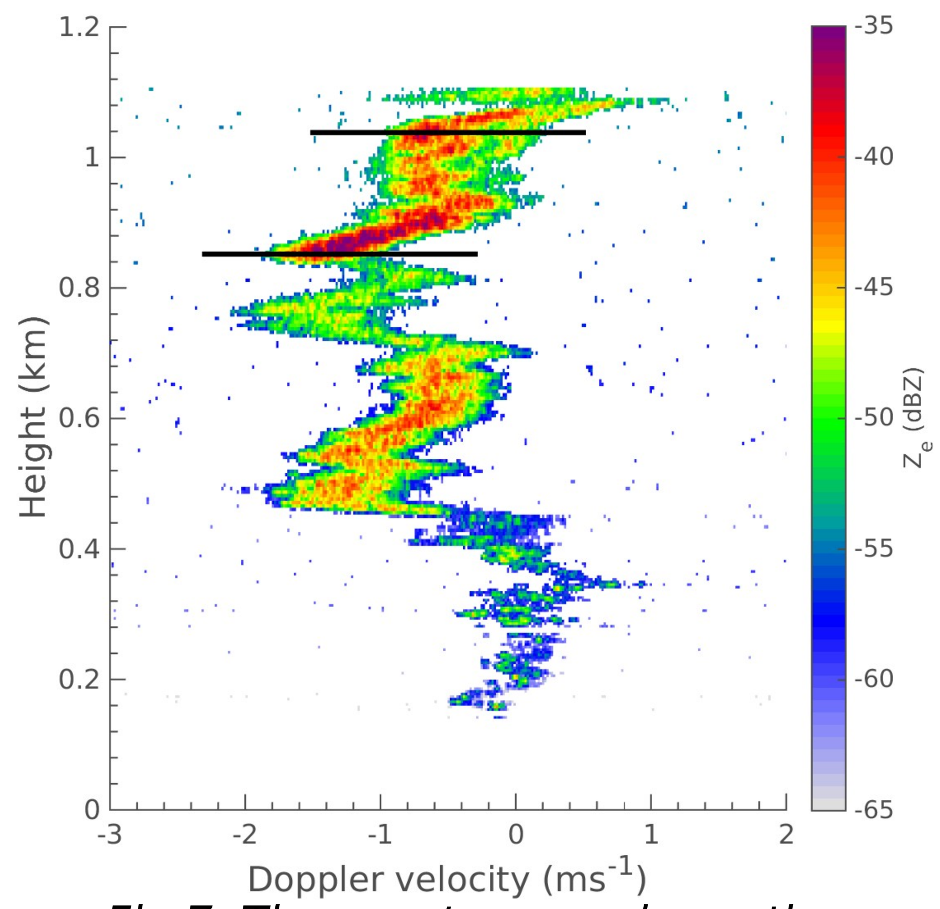

Fig 7. The spectogram shows the vertical profile of Doppler spectra.

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