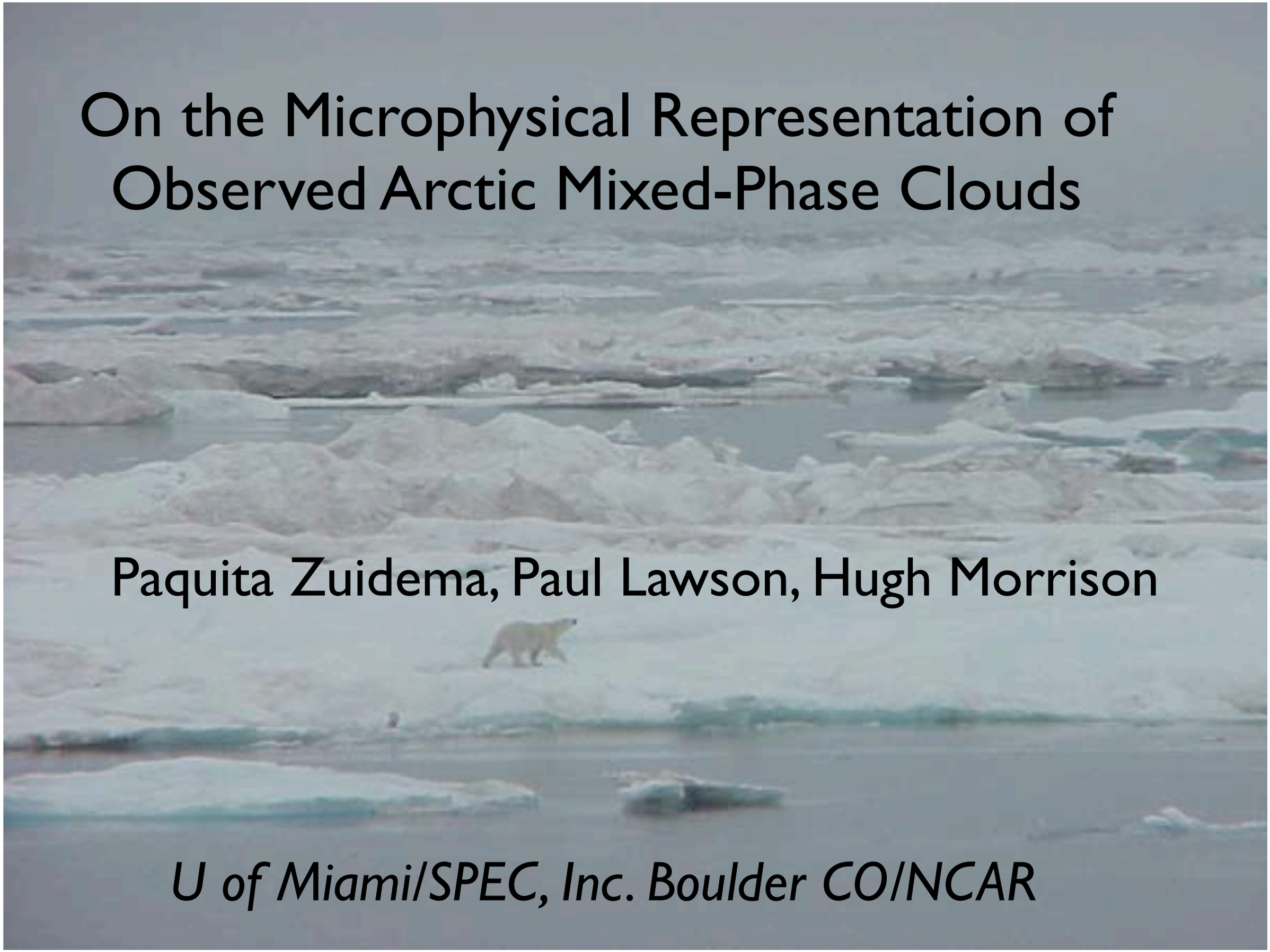
On the Microphysical Representation of Observed Arctic Mixed-Phase Clouds

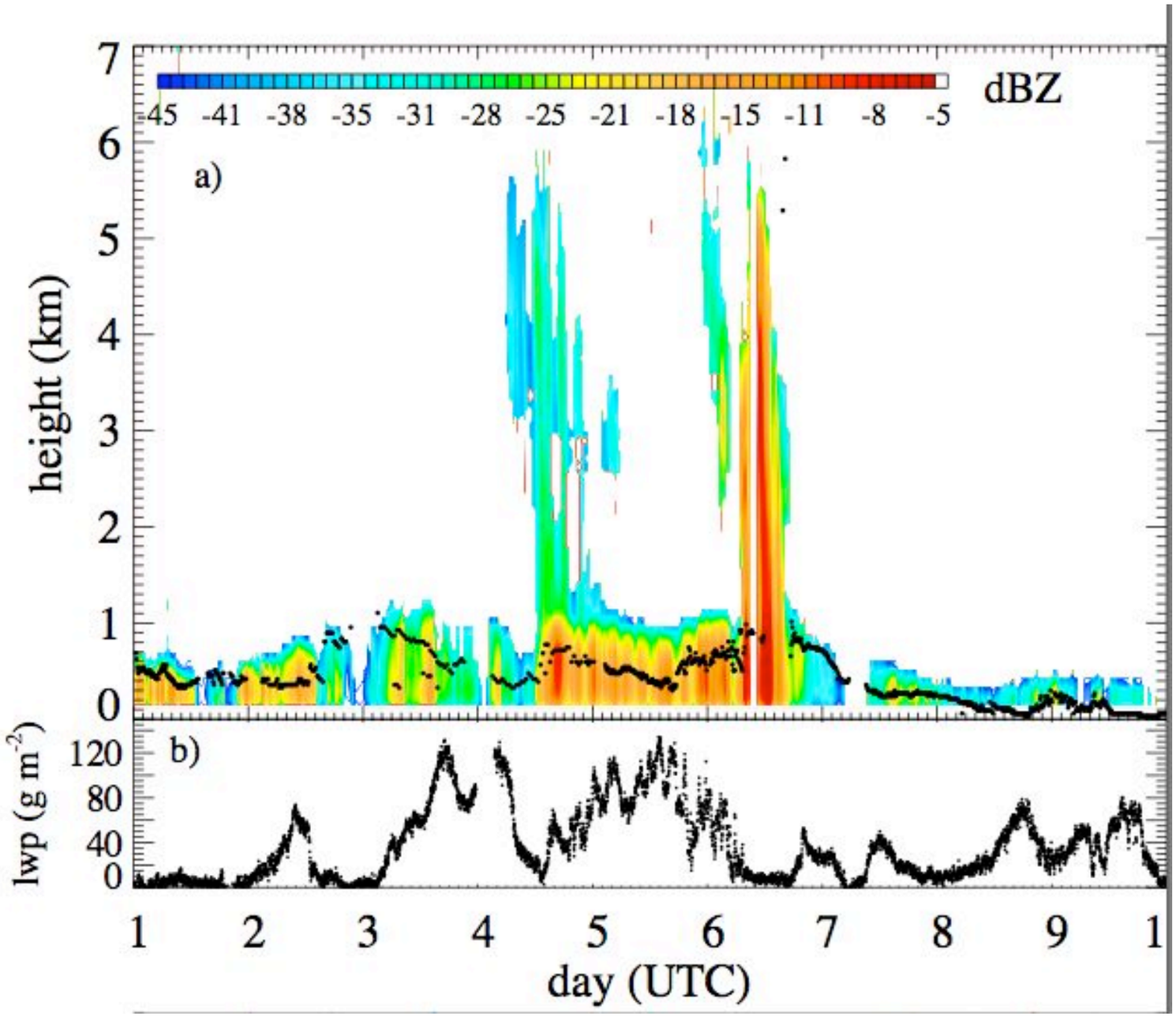


Paquita Zuidema, Paul Lawson, Hugh Morrison

U of Miami/SPEC, Inc. Boulder CO/NCAR

Arctic clouds are often:

mixed-phase (ie. both ice + supercooled water)
yet long-lasting (despite disequilibrium)



this has proved to be a modeling challenge:
modeled Arctic clouds often have:
- too little liquid & too much ice

why?

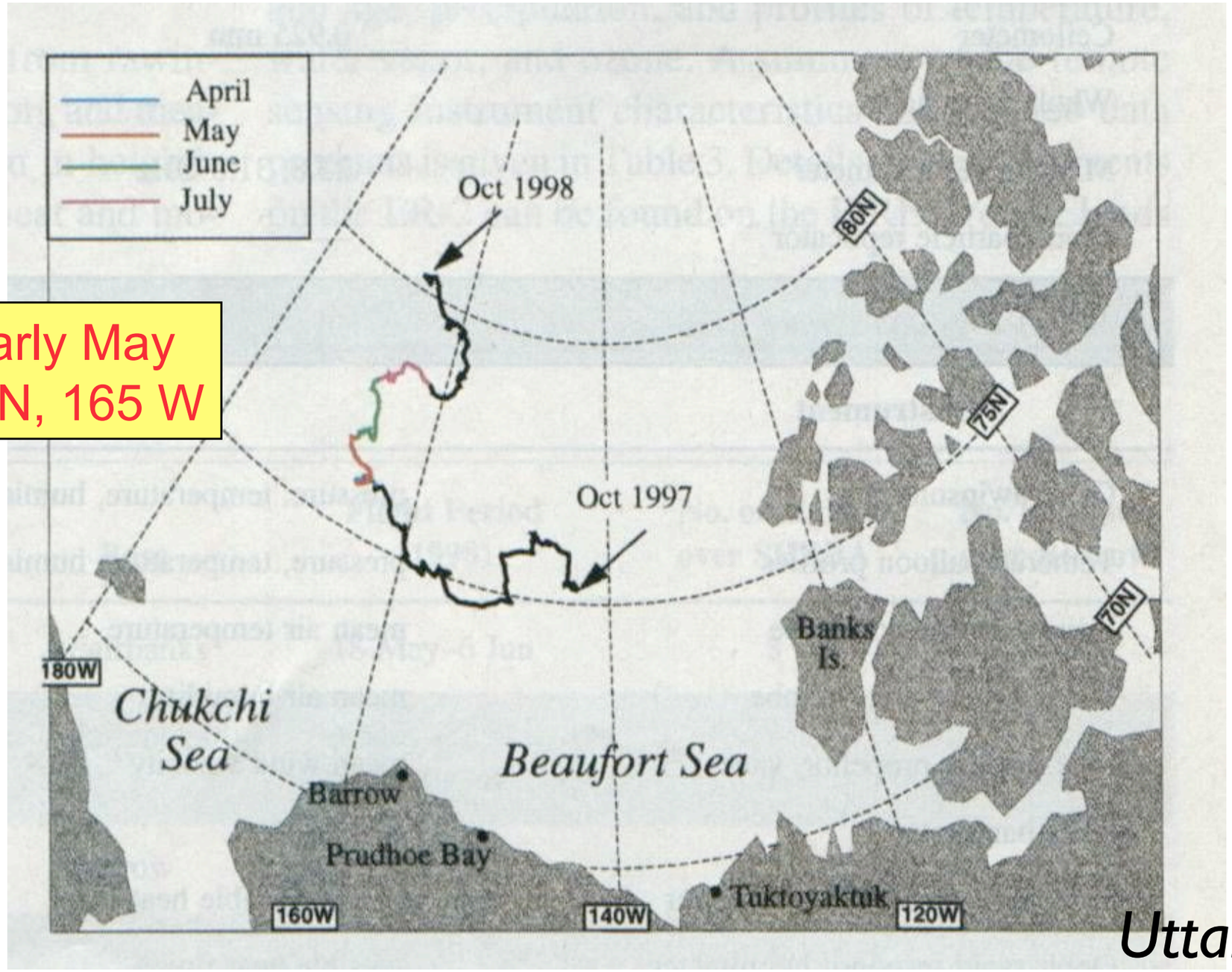
- are ice nuclei over-predicted ?

- are model parameterizations too simplistic?

- do we have a mid-latitude bias?

do we need to update model microphysical representations for the Arctic ?

Surface Heat Budget of the Arctic (SHEBA)

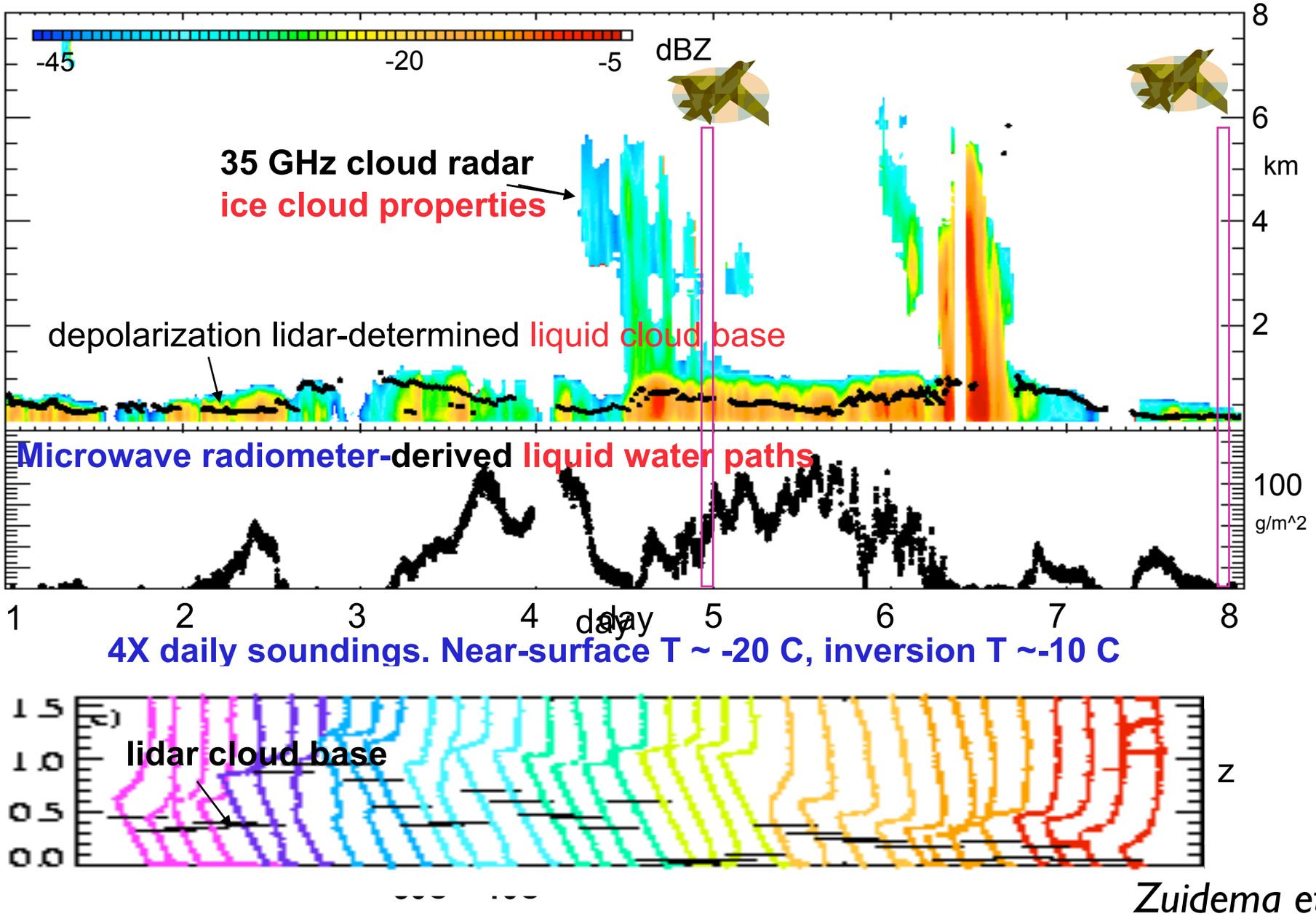


Early May
~ 76N, 165 W

Uttal et al. 2000

highly unique microphysical dataset: 16 research flights

Surface-based Instrumentation: May 1-8 time series



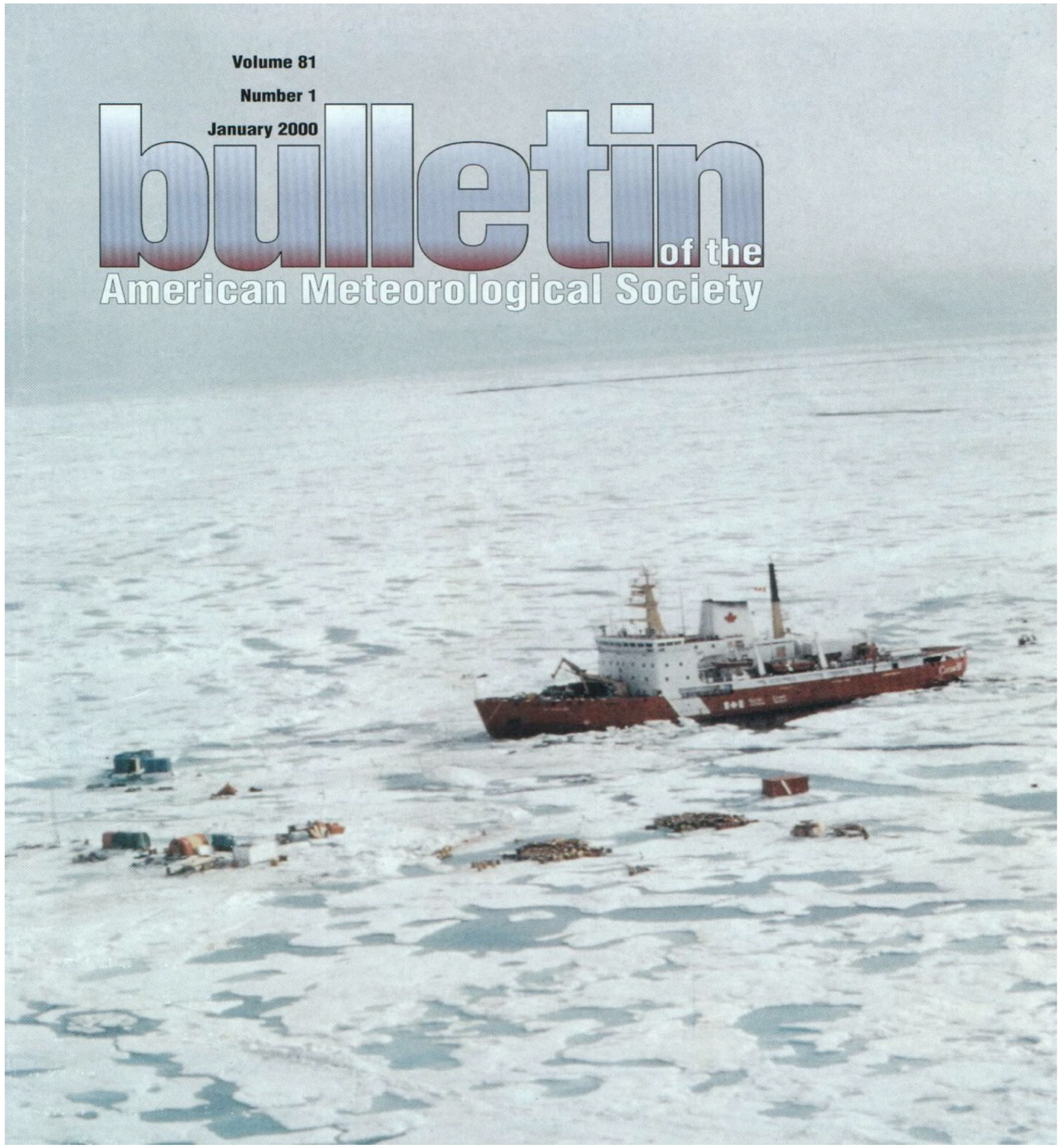
Zuidema et al., 2005

early May time period basis for a multi-model intercomparison project (Morrison et al.)

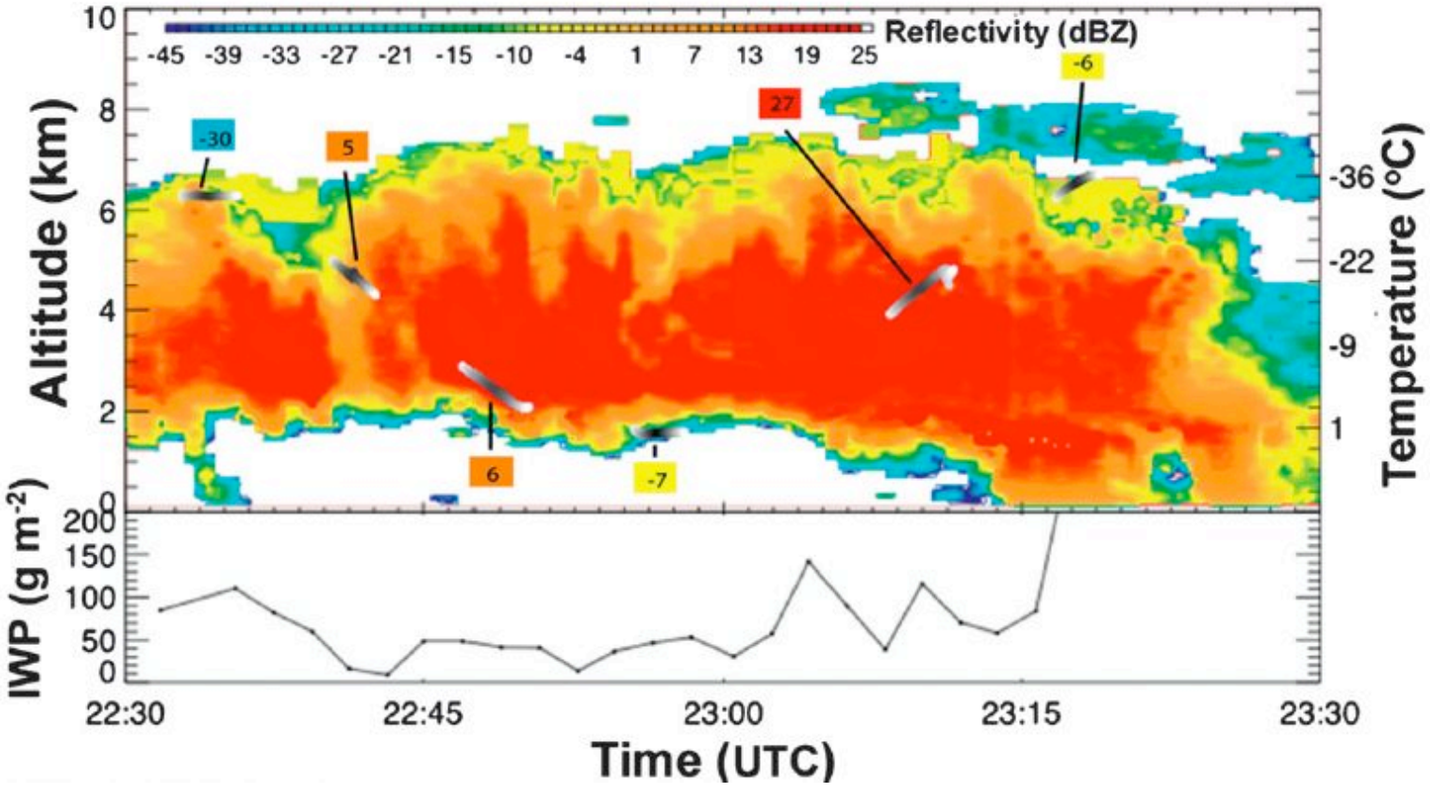
move away from individual case studies, to more comprehensive analyses

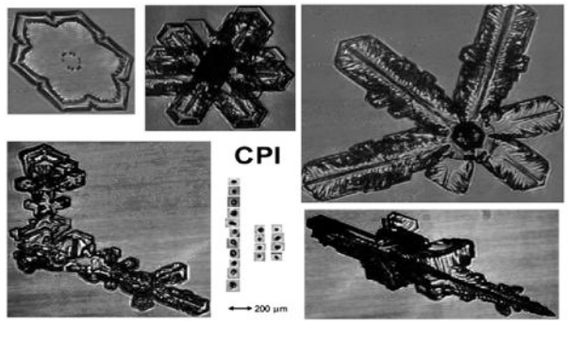
next: the July flights

- melting ice surface
  more convective

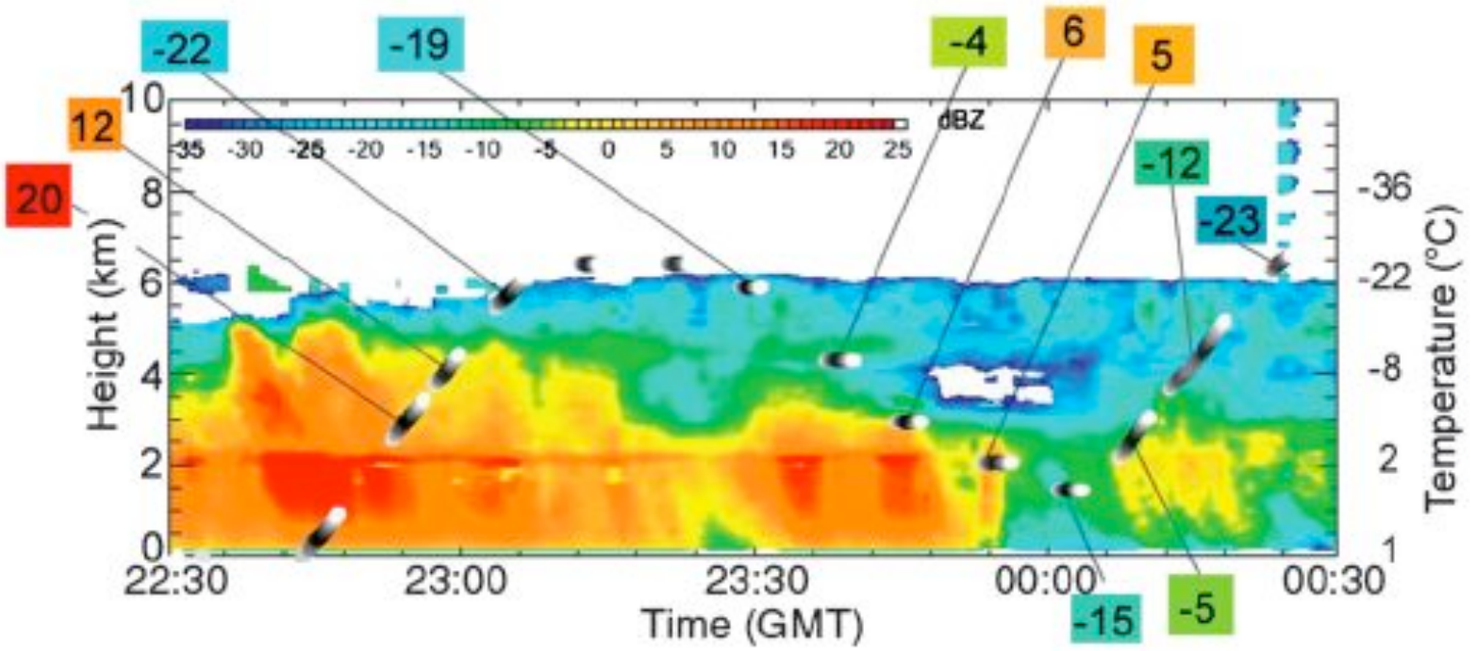


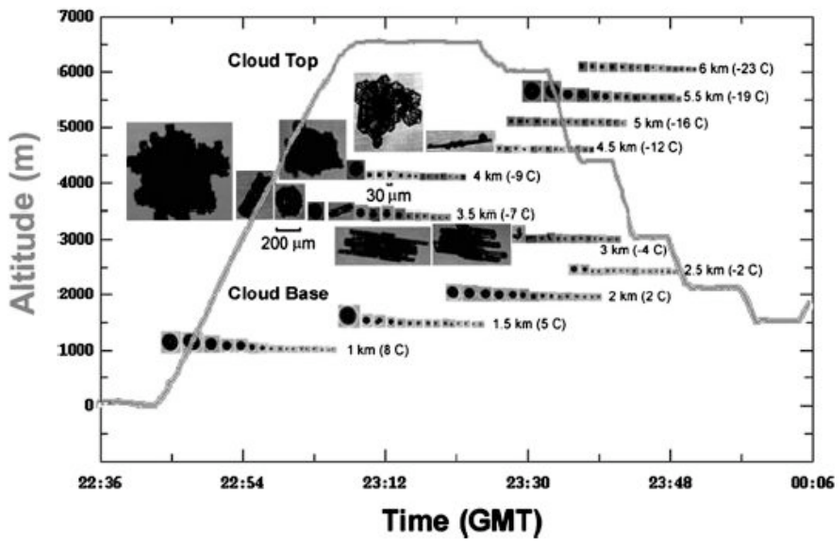
July 28





July 18





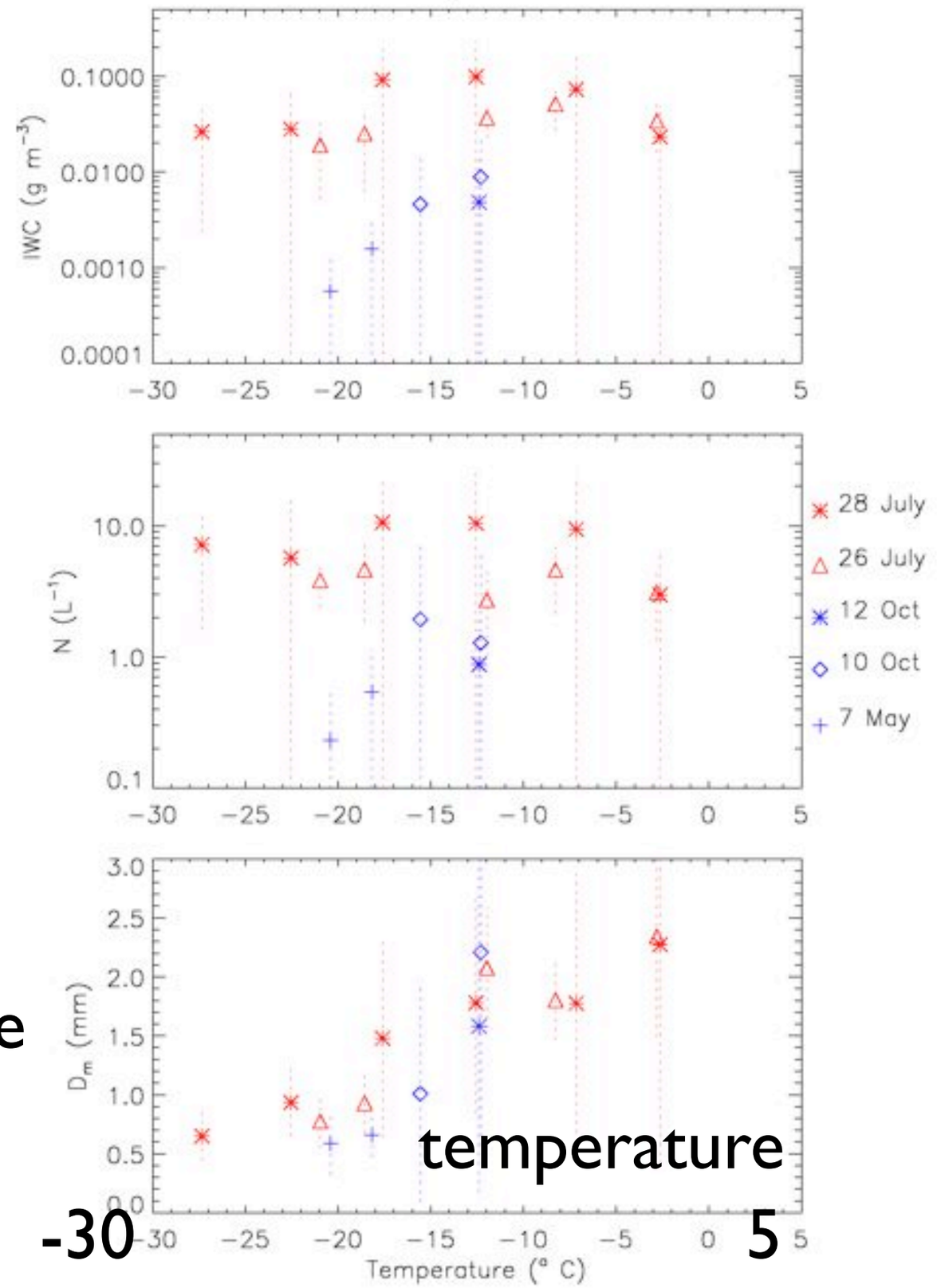
Lawson & Zuidema, 2009

also including MPACE results (McFarquhar et al., 2007)

ice water content

ice particle number

ice mean particle size



temperature

-30 5

Morrison et al., in preparation

no easy relationships, but:

- shallow-layer cases seem to differ systematically from the deep-layer cases (less opportunity for ice mass and number to increase)

deep cases ‘mid-latitude’-like

not an easy problem....

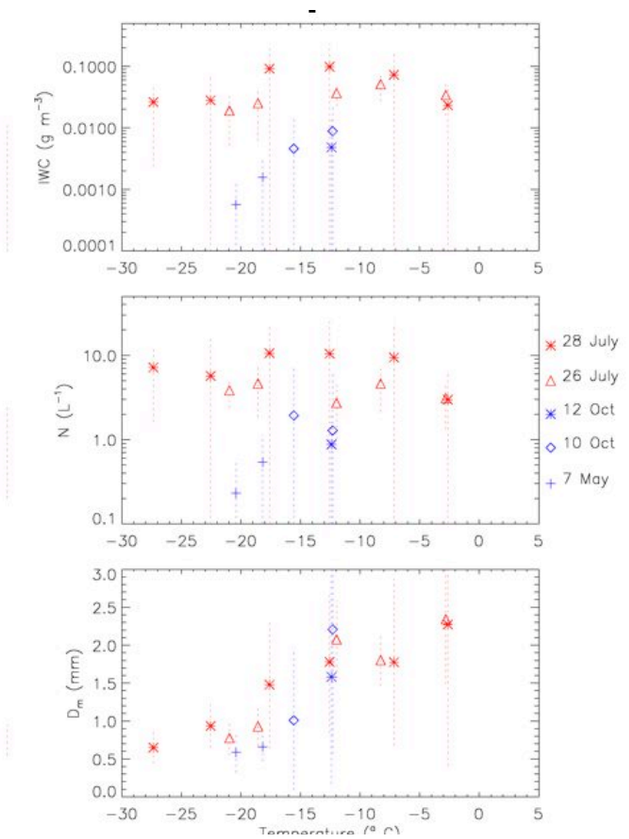


FIG. 2. Example of size distributions from particle probes during the time period from 2310:00–2310:30 UTC on 28 July showing how the PSDs are combined into a composite PSD. Breakpoints be-