Ice processes in Antarctica: identification via multi-wavelength active and passive measurements and model evaluation

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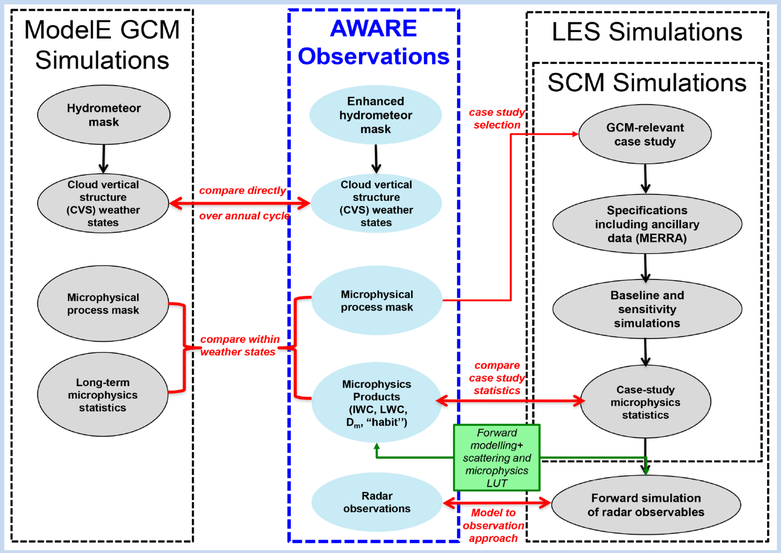
RATIONALE & OBJECTIVES

The deployment at the McMurdo site on the southern tip of Antarctica's Ross Ice Shelf during the AWARE field campaign of an **unprecedented number of multi-wavelength active and passive systems simultaneously observing the vertical column** -with the first ever triple-frequency radar observation in Antarctica- offers the opportunity of overcoming the scarcity of cloud information at southern high latitudes and of unravelling processes related to cloud&precipitation physics at high temporal and spatial resolution.

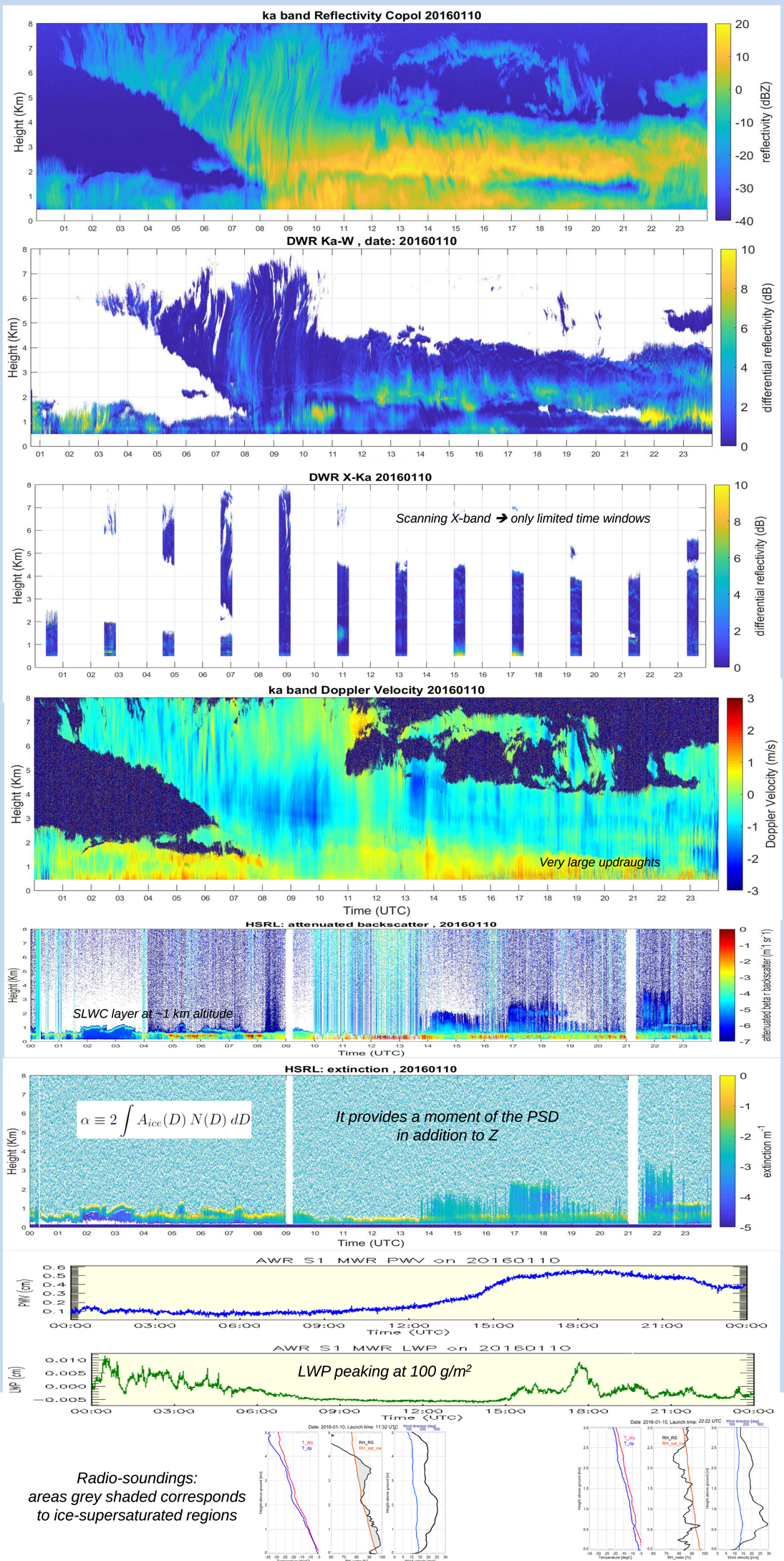
SO1: Novel quantitative characterization of hydrometeor properties using a ground-breaking combination of lidar, triple-frequency radar and MWRs at the McMurdo site.

SO2: Identification of the dominant microphysical processes in clouds observed during AWARE.

SO3: Evaluate and improve GCM simulation of SLWC and ice cloud microphysics.



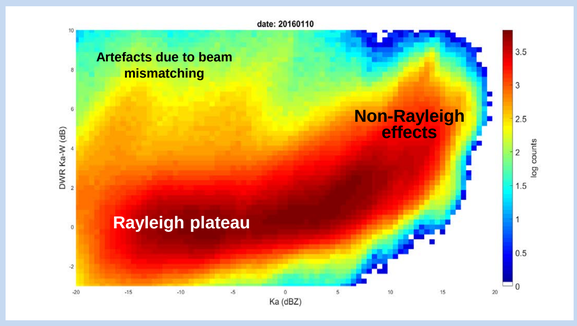
RADAR, LIDAR & PMW OBSERVATIONS: CASE STUDY 10-1-2016

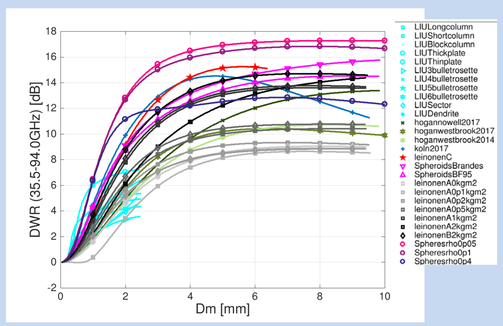


Radio-soundings: areas grey shaded corresponds to ice-supersaturated regions

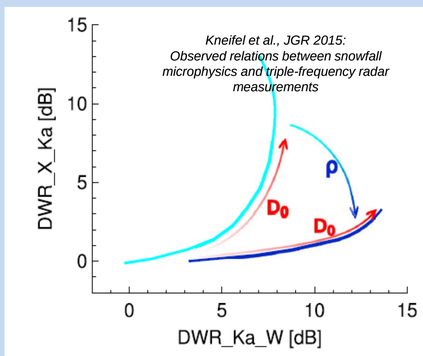
WHY MULTIWAVELENGTH DOPPLER RADARS IN ICE STUDIES?

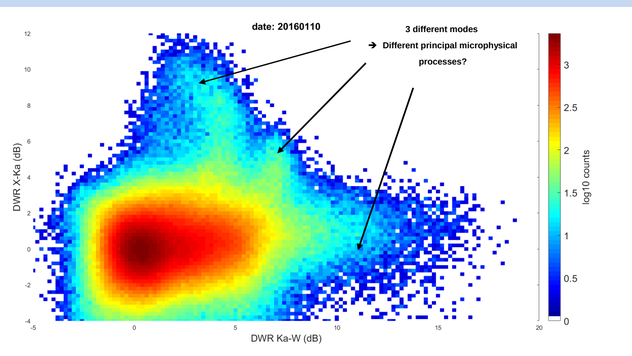
1. Sizing capabilities (e.g. a DWR of 8 dB at Ka-W is likely associated with particles of ~2 mm D_m) but large uncertainties associated to scattering models.



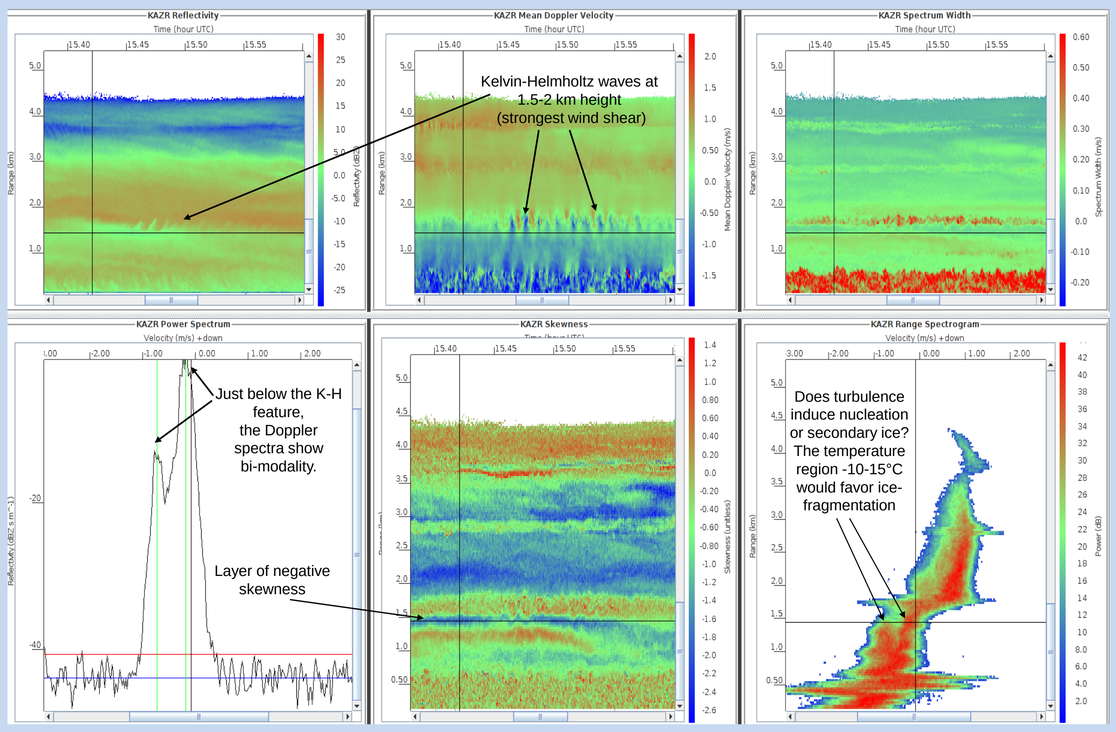


2. Identification of different processes (e.g. riming vs aggregation) from DWRs





3. Detailed study of microphysical processes in the column



SCIENCE QUESTIONS TO BE ADDRESSED

SQ1: What is the vertical structure of clouds over McMurdo? How do LWC and IWC co-vary? Is there a stratification with T for IWC and characteristic size? What are the most efficient clouds in producing snow at the ground? Are our scattering/microphysical models capable of reproducing multi-instrument observations in Antarctica?

SQ2: How frequent and relevant are microphysical processes like aggregation, riming, and sublimation in Antarctic clouds? Are models with different degree of sophistication in terms of implemented processes and spatial resolution able to reproduce the comprehensive observational fingerprints?

SO3: As one of the cleanest regions on Earth, are there systematic differences between ModelE and observations of near-surface aerosol conditions? As a function of cloud vertical structure weather state, is ModelE reasonably representing the atmospheric boundary layer structure, water vapor mixing ratios, and the occurrence of any overlying stable layers? Is SLWC being predicted at the correct frequency as a function of weather state? What are typical SLWC-containing weather state conditions, what ice properties and processes are observed in these states, and how well are they simulated in ModelE?

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