Snowfall studies using the MOSAiC expedition data

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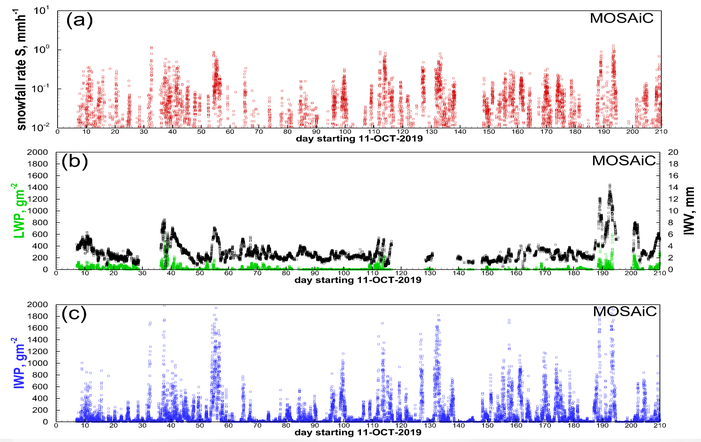
ASR Atmospheric System Research

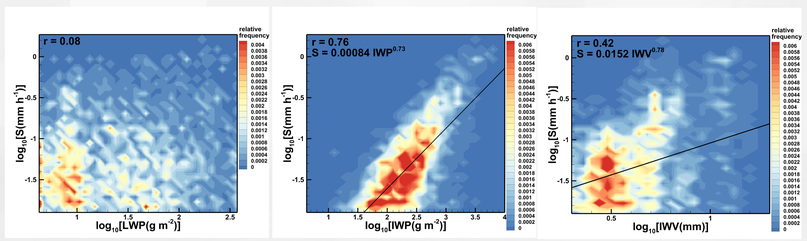
Precipitation efficiency characteristics

Approach: Use concurrent measurements of the water cycle parameters and construct observationally based relations among snowfall, cloud content and water vapor.

Results:



Measurements of water cycle parameters during MOSAiC



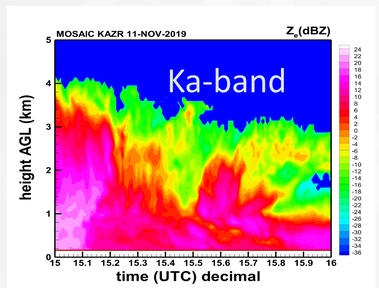
Frequency of occurrence scatter plots of liquid equivalent snowfall rate versus cloud Liquid Water Path – LWP (left), total Ice Water Path – IWP (middle) and vertically column Integrated Water Vapor IWV amount (right)

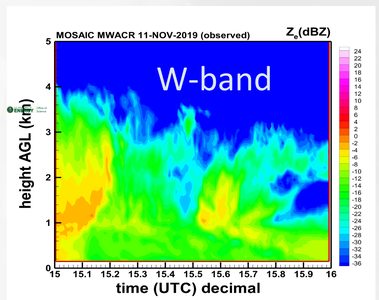
Conclusions:

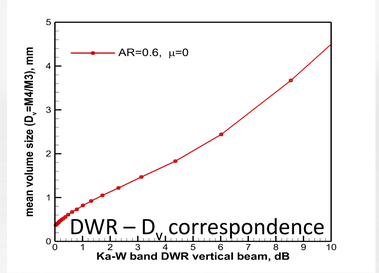
*There is no meaningful correlations between snowfall rate (for S > 0.01 mm/h) and cloud supercooled LWP
*High/moderate correlation is observed between S and IWP/IWV
*IWP values during precipitation events are, on average, an order of magnitude greater than LWP values

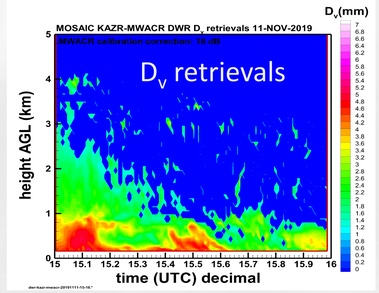
The use of MOSAiC K_a- and W-band radars to infer snowflake size profiles

Motivation: Knowing frozen hydrometeor size is important since it influences cloud and precipitation radiative feedback and provides insights into processes of particle riming and aggregation.
Approach: Radar calibration offsets are removed by forcing cloud top K_a- and W-band reflectivities to agree after corrections for attenuation in atmospheric gases and supercooled liquid. Dual-wavelength ratio (DWR)-mean volume particle size (D_v) relations are then applied for retrievals.
Measurement data and retrieval examples:







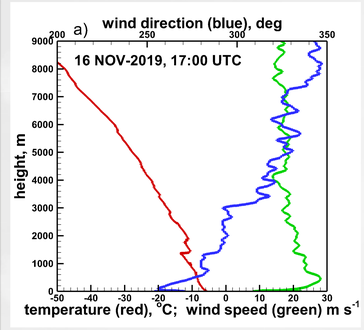


Conclusions:

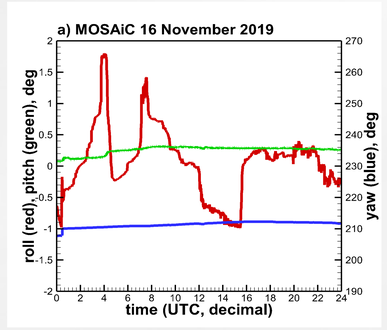
*Meaningful retrievals are generally available if D_v > 1 mm when non-Rayleigh scattering effects exceed ~1 dB
*The approach is immune to radar calibration offsets
*Profiles of D_v reveal particle growth by aggregation at lower altitudes

MOSAiC icebreaker movement influence on radar Doppler moment measurements

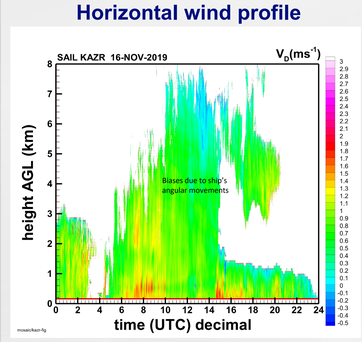
Motivation: Measurement of radar Doppler moments are widely used for hydrometeor classifications and retrievals of parameters of clouds and precipitation. During MOSAiC, however, ARM Doppler radar data were influenced by icebreaker movements. As a result, radar beam was often not exactly pointing vertical.
Illustrations:



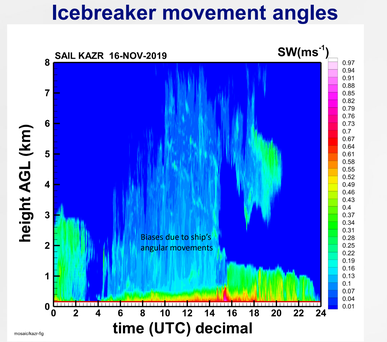
Horizontal wind profile



Icebreaker movement angles



KAZR mean Doppler velocity



KAZR spectral width

Conclusions:

*MOSAiC icebreaker rotational angles (roll, pitch) were often significant (>1-2°) causing "contaminations" of the first and second Doppler moments by horizontal wind
*The "contamination" amount also depend on the angle between the wind direction and ship's yaw. Icebreaker's angular movement influences are height dependent.

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