The Arctic Summer Cloud Ocean Study - ASCOS

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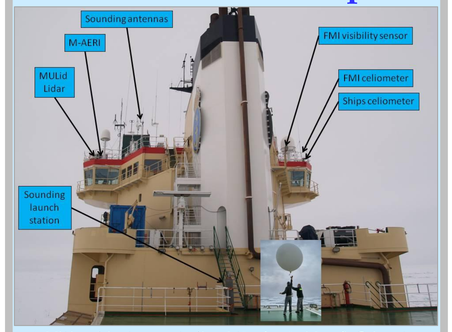
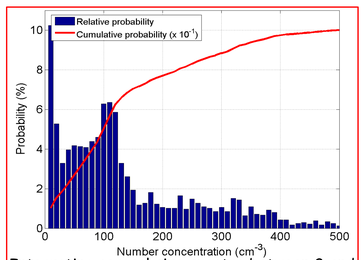
The 7th deck & helipad



Additional instruments lined the backside of *Odens* top deck, including a depolarization lidar and instruments to measure cloud base and visibility. The helipad was also used to launch radiosondes at 6-hourly intervals.

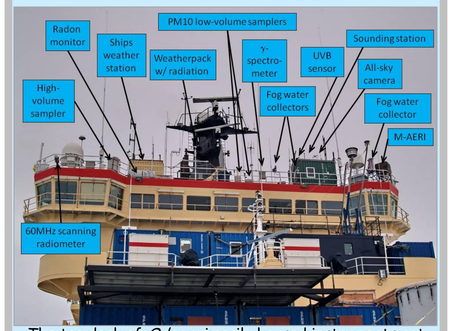
Oden's 4th deck

The 4th deck was dedicated to aerosol and atmospheric chemistry observations with central pollution controlled inlets on top of the aerosol lab. Gas-phase chemistry was sampled by instruments in separate containers.



Integrating aerosol size spectra between 3 and 800 nm displays two significant peaks, for <10 and around 100 cm^{-3}. Number concentra-tions are < 100 cm^{-3} about 50% of the time.

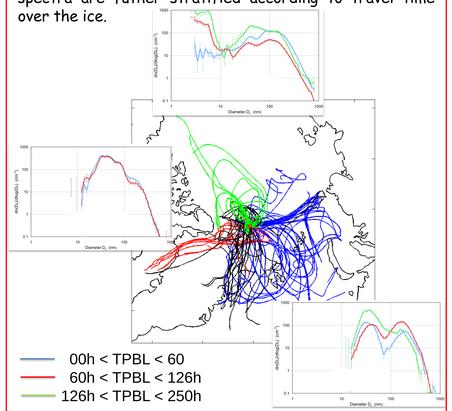
Oden's 7th deck



The top deck of *Oden* primarily housed instruments not very sensitive to ship's disturbances but needing a free view of sight. This included weather stations, sounding station, a scanning microwave radiometer and the M-AERI and a suit of aerosol instruments.

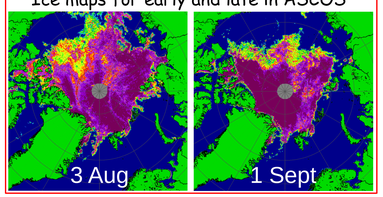
Trajectories and aerosol size characterization

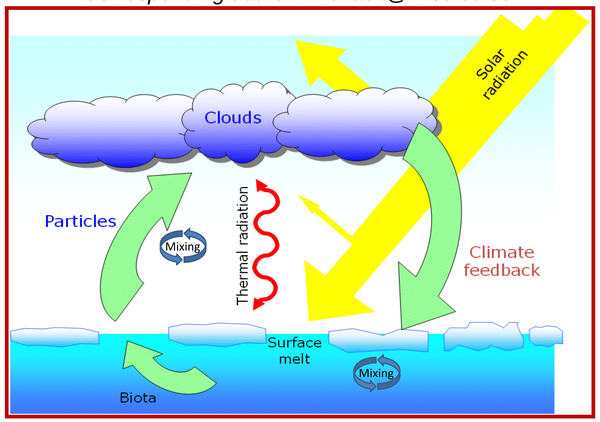
Air with different origin has different characteristics. Below is displayed aerosol size spectra from three main sources: open water surface (Greenland Sea, Barent Sea, Kara Sea); free troposphere (Greenland, Canadian Archi-pelago); and pack ice (see ice maps below). The size spectra are futher stratified according to travel time over the ice.



Aerosol spectra from open water has a significant bi-modal ("cloud processes") structure while air from the free tro-posphere has a strong Aitken mode. Air with long travel time over broken ice displayes frequent nucleation (small particles) and this signal increases with long travel time.

Ice maps for early and late in ASCOS





Aim and objective

The overriding objective of ASCOS is the simultaneous measurement of Arctic cloud-forming processes, from the upper ocean up through the ice and the atmospheric boundary layer to the top of the troposphere, and the aim is to understand formation and life cycle of central Arctic summer low clouds.

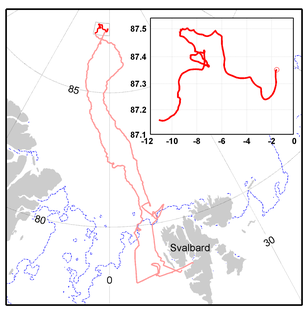
In the Arctic, stratocumulus clouds almost always warm the surface and in summer the cloud cover, mostly consisting of low clouds or fog, is persistently large. Models gene-rally misrepresent these types of Arctic clouds. The underlying problem is that if clouds behave different in the Arctic compared to other regions, then the ensemble of experimental data on which the model's moist physics relies, is unsatisfactorily small due to the paucity of observations in the Arctic. To remedy this we must first under-stand how clouds form in the Arctic, the links to surface properties and to the aerosol formation, all specific to the Arctic. This, in turn, means that we must sample the relevant processes on location in the central Arctic, north of 80°N.

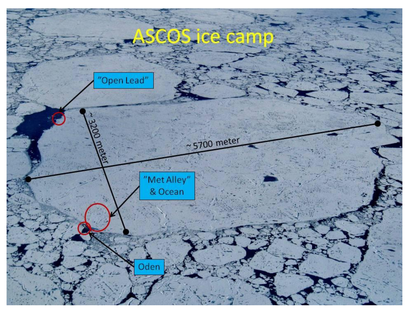
Where, when and how

ASCOS was a 40-day atmospheric expedition, 1 August to 9 September 2008, deployed on the Swedish ice-breaker *Oden*. The cruise track is shown below to the left.

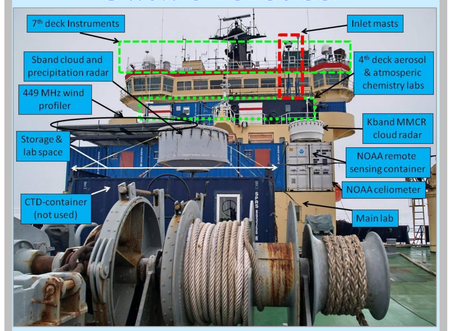
A main feature of ASCOS was a three-week ice drift, 13 August to 2 September. During this time, *Oden* was moored to a drifting 3 x 6 km large ice floe, see arial photo below to the right. A local, almost 90°, outside corner allowed turning the the ship in the four main directions, in order to face approximately upwind to reduce contamination of the atmospheric chemistry ob-servations. *Oden* served as a measurement plat-form, logistics base for work on the ice, and living quarters for 33 scientists and the 31 person crew and logistics staff.

Measurements were carried out onboard the ship and on the ice, immediately nearby and at an open lead, and with a helicopter, deploying both *in situ* instruments and surface-based remote sensing.



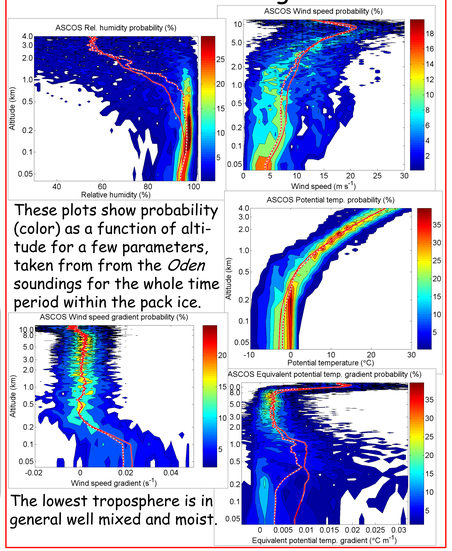


Oden's foredeck



The foredeck of Oden was dedicated to the surface-based remote sensing program. Two cloud radars were deployed here along with a wind profiling radar, several radiometers and a lidar celiometer.

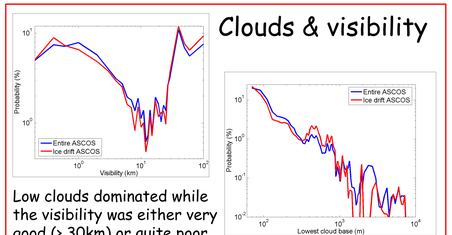
Atmospheric vertical structure from soundings



These plots show probability (color) as a function of alti-tude for a few parameters, taken from from the *Oden* soundings for the whole time period within the pack ice.

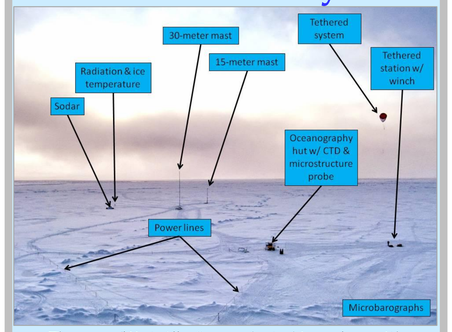
The lowest troposphere is in general well mixed and moist.

Clouds & visibility



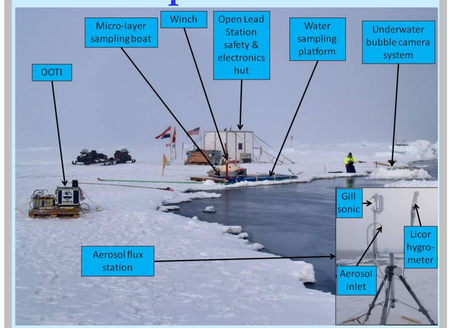
Low clouds dominated while the visibility was either very good (> 30km) or quite poor (< 2 km) and fogs vere quite frequent

The "Met Alley"



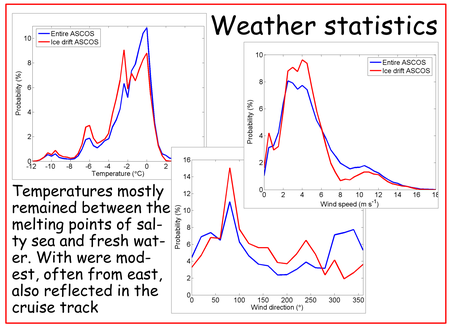
The name "Met Alley" was adopted in analogy with SHEBA's "Met City". The observations are mostly related to atmospheric and oceanic energy fluxes, complemented with a SODAR and tethered soundings.

"Open Lead"



To reduce the risk of contamination by the ship, the marine biology component was located somewhat away from the ship, at a semi-permanent open lead.

Weather statistics



Temperatures mostly remained between the melting points of sal-ty sea and fresh wat-er. With were mod-est, often from east, also reflected in the cruise track