Another Climate Unknown of the Southern Ocean

Models do not effectively simulate the radiative balance of the storms in the southern ocean, why? This appears to be a significant climate issue.

Short wave forcing heavily influenced by cloud droplets, long wave by ice, yet the partitioning between the two is not well known. Few measurements are available.

Measurements of the size, phase, and type of condensed water are needed.

Ground-breaking measurements by ORCAS will go a long way towards solving this important problem, setting the stage for projects such as SOCRATES.

Storms also have huge impact on the vertical structure of pollutants, especially shorter lived species. Understanding of the storm features will help put ORCAS measurements in perspective.

ORCAS Cloud and Aerosol Instruments

King Probe Cloud Liquid Water Content

Icing Rate (presence of supercooled cloud water)

CDP Cloud Droplet Probe (2 – 47 um range)

OAP 2D Cloud Probe (25 um resolution, 64 bins)

CN Concentration – water ("under development" - may switch to butanol)

UHSAS Aerosol Probe ("under development")

GNI Giant Aerosol Impactor (sea-salt, 2 – 30 um range) ("under development")

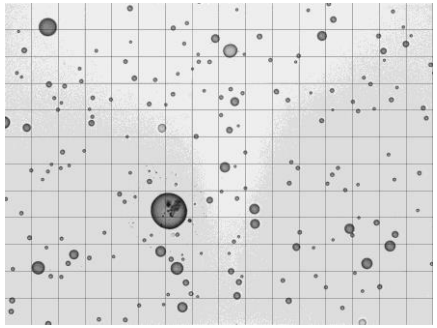
Giant sea-salt aerosols in ORCAS (Jørgen Jensen):

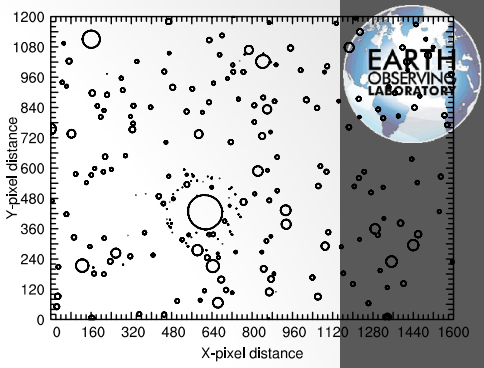
(i) Characterize both sub-micrometer (UHSAS) and giant aerosol population (r_d > 1 µm).

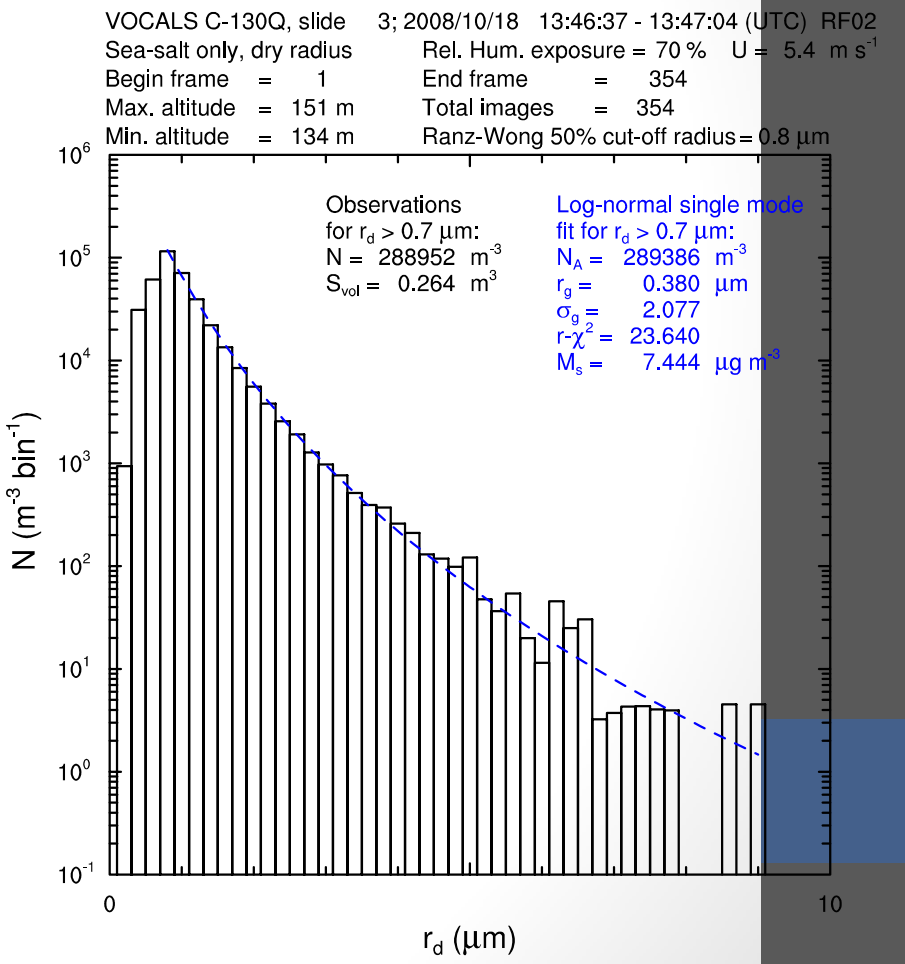
(ii) Sea-salt aerosols are primarily generated from wave breaking (bubble bursting). Use amount of airborne sea-salt aerosols as a proxy for increased trace gas exchange between air and ocean.

(iii) Impact on warm rain formation in boundary-layer clouds.

Southern Ocean is excellent for studying sea-salt aerosols under high-wind conditions.







Sample particles using microscope slides exposed outside the aircraft (Auto-GNI under development).

Analyze using optical microscopy in the laboratory.