

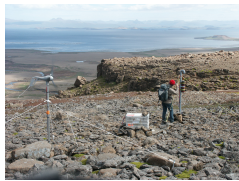
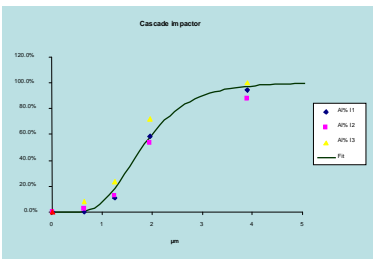
Dust size measurements over Austral Ocean, Xiamen 2-9 march 2007

R. Losno¹ (losno@lisa.univ-paris12.fr), T. Wagener², F. Dulac^{1,3}, C. Guieu², S. Triquet¹ and J.L. Colin¹

¹ LISA, Université Paris 7-Paris 12 CNRS, 61 av. du Gal de Gaulle F-94010 Créteil, France
² LOV, Université Paris 6 - CNRS, Quai de la Darse, F-06230 Villefranche sur mer, France
³ LSCE, IPSL, CEA-CNRS-UVSQ, CEA Saclay 701, F-91191 Gif-Sur-Yvette cedex, France



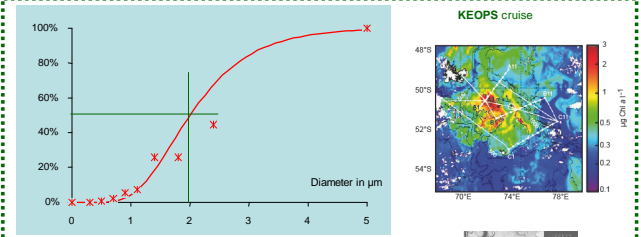
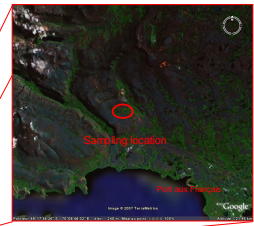
Abstract: Measurements of dust over remote oceanic regions of the South Hemisphere is still a difficult task because of very low atmospheric load, but is useful to compute dust deposition and nutrient input to the global ocean. Here we present results from a measurement campaign around Kerguelen Region in the Austral Ocean (50°S, 70°E) during January and February 2005. Aerosol samples were taken on the French "Marion Dufresne" research vessel during the KEOPS cruise using a specially designed system to prevent on board contamination. Four samples were simultaneously collected on filters for further laboratory analyses and a particle counter was running continuously. One filter was used for single particle analyses with TEM (transmission electronic microscopy) coupled with chemical analysis, and the other was analyzed by X-Ray fluorescence (XRF) for bulk chemical composition determination. At the same time, a bulk filter and a cascade impactor sampling systems were operated on the Kerguelen Island 12 km West of the French base "Port aux Français" during the KEPHREN campaign. Analyses were also performed using XRF. Measured concentration of crustal dust, including Al and Fe, was the same at both sampling sites. Size distribution determined by cascade impactor and microscopy were also the same showing a single mode with a median diameter between 1 and 2 µm, as well as the thin mode measured by the particle counter. Among the measured elements, only sulphur exhibits a submicronic mode. Large particles of sea salt were recorded on the ship, but not at the ground based station situated at 270 m above the mean sea level. The average total amount of dust measured (~50 ng/m³) was much lower than simulated by models.



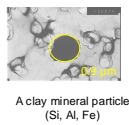
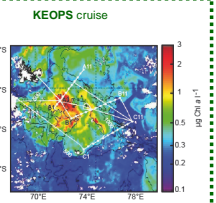
Sampling site and location at Kerguelen Island

Mass size distribution of Al in cascade impactors sampled at Kerguelen Island. I1 is 25/01/2005 to 29/01/2005; I2 is 29/01/2005 to 06/02/2005 and I3 is 08/02/2005 to 12/02/2005.

Lognormal fit is obtained with a median value of 1.8 µm and a standard deviation of 0.4 µm



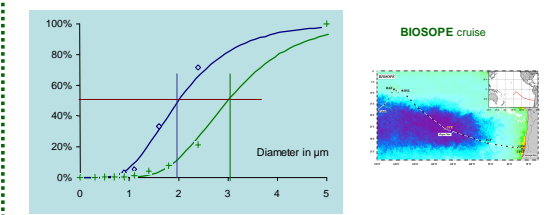
Fit has a median diameter of 2µm and a standard deviation of 40%.



A clay mineral particle (Si, Al, Fe)

Mass size distribution of detected clay minerals obtained with Transmission Electronic Microscopy measurements during the KEOPS and BIOSOPE cruise. To compute the mass size distribution, particles were assumed ellipsoidal with a density of 2.5 g/cm³. Dots are experimental values, line are lognormal fit. Except the sample collected close to the Chilean coast (BIOSOPE, green), both BIOSOPE and KEOPS size distributions are quite similar.

Comparisons with BIOSOPE cruise (november 2004)



Fit has a median diameter of 2µm and a standard deviation of 45% µm for the samples collected far from the coast in the gyre (blue color). The median diameter is 3 µm and the standard deviation 35% for the last sample collected near the Chilean coast



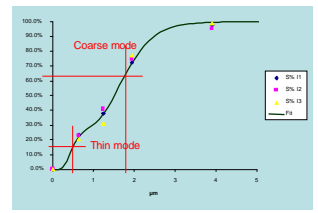
Cascade impactor stage to be renewed.



Marion Dufresne Research ship (KEOPS) anchoring in Golfe du Morbihan, Kerguelen.



Size segregated samples are collected on a 6 stages EGAI-80 cascade impactor on Nuclepore polycarbonate filters pumping almost 50 to 100 cubic meters of air. Chemical analyses of sulfur and aluminum are performed by thin layer X-Ray fluorescence (Phillips PanAnalytical 2440). At the same time, bulk filtration was performed on Zeffluor Teflon Filters. Taking into account the extremely low level of aluminum concentrations, results are found to be in good agreement. Blanks were made at each stage of the sampling and analyze to check possible contaminations, which was found no more than 10 ng per sample.

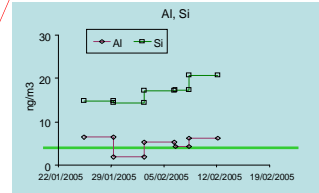


Sulfur size distribution shows two lognormal modes: the first (thin mode) is centered on 0.5 µm with a standard deviation of 40% and weight 30%. The second (coarse mode) is centered on 1.8 µm with a standard deviation of 30% and weight 70%.

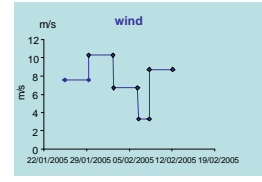
Details of inside the protective box: Wind is continuously monitored and in case of wrong direction (out of a 120° front sector), pumping is stopped and clean air is blown around the sampling filters through an EPA 99.999% filter.



EPA filter



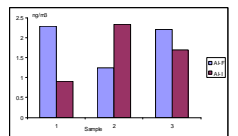
Time series of bulk filtration measurements of aluminum in air at Kerguelen. No correlation is observed with wind, so a local emission by wind erosion can be excluded.



Conclusions: During the austral summer 2004-2005, the particles observed over the South Pacific and Austral Ocean are sea salt (almost only), thin sulfur or long range transported clay minerals with a size distribution centered around 1.8-2 µm.

During both KEOPS and BIOSOPE cruise, filters are collected on board on 4 parallel devices enclosed in a protective box. One is mounted with Nuclepore™ polycarbonate membrane filter and a second with Zeffluor™ PTFE Teflon™ filter. Parts of each collected filter is deposited on a copper grid, gold metalised and the polycarbonate dissolved with chloroform. TEM analyses are performed on a JEOL 100 CXII microscope equipped with micro analyze. Particles are measured in size and if recognized as non sea salt, analyzed with the micro-probe. All non sea-salt particles seen are clay minerals with a very close relative response of major elements (Al, Si, Fe) to the micro analyze. Mass conversion was done assuming some hypothesis on the average shape and density of the particles.

The Teflon filter was analyzed in aluminum and sulfur by X-Ray fluorescence (Phillips Pan-Analytical 2440). Bulk aluminum measurement are in good agreement with aluminum calculated from TEM size distribution counting assuming a 7% mass ratio of the element.



Comparisons between aluminum measured on Nuclepore polycarbonate filters with cascade impactors (Al-I) and bulk filtration on Zeffluor Teflon filters (Al-F).