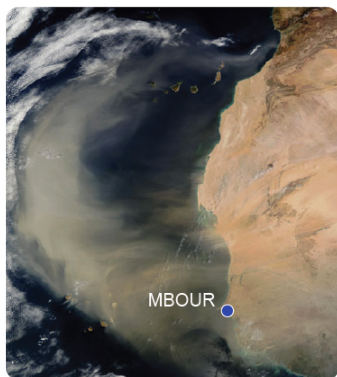


Ph.D. position in Geochemistry / Atmospheric sciences

University of Lille, France

Laboratoire d'Océanologie et de Géosciences (LOG, UMR CNRS 8187)

Laboratoire d'Optique Atmosphérique (LOA, UMR CNRS 8518)



Combining field sampling and remote sensing measurements for mineralogical and geochemical characterization of Saharan dust sources

The Sahara-Sahel region is by far the largest mineral dust source in the world, sending as much as 800 Tg of crustal material in the atmosphere every year. This vast arid and semi-arid area stretches over a ~4000km x ~2000km area at present from the Atlantic to the red sea and encompasses numerous dust emission “hot spots” spread over diverse geological settings. As a result, Saharan dust composition is manifold and varies both in space and time.

Our knowledge of the Saharan dust properties and deposition fluxes variability, however, is incomplete, precisely because of the large number of sources, their variable strength and their intermittency. Improving the existing database is therefore essential to evaluate the dust impact on the ocean biogeochemistry, to validate and improve information derived from remote sensing observations (assessment of the dust impact on incoming solar and outgoing thermal infrared radiations), to track the dispersion of Saharan dust in the atmosphere (with interest for atmospheric transport of aerosols in the Northern Hemisphere), and finally, to reconstruct past changes in the dust cycle (changes in the contributing sources for instance and transport patterns) as recorded in environmental archives such as marine sediments and polar ice sheets.

These were the motivations for launching a continuous sampling of dust deposition at Mbour (~80 km south of Dakar) on the Senegalese margin in 2006, as part of the African Multidisciplinary Monsoon Analysis (AMMA) framework, and dust deposits have been collected for nearly a decade at a weekly (or better) resolution. The sampling site was chosen for two reasons: [1] it is located under the major corridor for Saharan dust transport and therefore ideally situated for monitoring mineral dust as they reach the North-eastern Tropical Atlantic, and [2] this site was already equipped with several instruments for remote sensing of Saharan dust by the LOA (Tanré et al., 2003; Derimian et al., 2008; Léon et al., 2009, Mortier et al., 2016 in review). Preliminary results including mass fluxes, grain-size, clay mineralogy and elemental measurements spanning the first few years of this unique time series, as well as a few discrete isotopic (Sr and Nd) measurements across major Saharan outbreaks, have revealed significant compositional variations associated with seasonal shift in transport patterns, demonstrating the suitability of the approach to characterize the differing signatures of the multiple contributing sources (Skonieczny et al., 2011; 2013).

The proposed project has three main objectives. The first objective is to document the temporal change in mineralogical and chemical composition of Saharan dust transported towards the Tropical Atlantic over the entire decade of measurements. This will include clay mineralogy, major and trace elements, as well as Sr and Nd isotopes measurements of dust deposits. Based on the obtained times series, the second objective will be to typify the mineralogical and geochemical signature of the major dust sources “feeding” the tropical Atlantic. This will be carried out by tracking back major dust events to their region of provenance with the help of air-mass back-trajectories, dust transport models and satellite data provided by the LOA (the identification of the active dust emission sources will be based on previously developed satellite detection of dust using the thermal IR imagery ; Legrand et al., 2000). The third and last objective will be to combine the obtained long-term dust mineralogical and chemical records with retrievals of atmospheric aerosol composition from remote sensing measurements based on algorithms currently developed at LOA. In fact, it is known that mineralogical and elemental composition of the dust aerosol affects their absorption and diffusion properties. Some features of the dust composition can therefore be obtained from optical measurements but these complex relationships lack of field constraints. This project, which proposes to combine the long field and optical times series obtained by the LOG and LOA at Mbour therefore provides a unique opportunity to advance both our knowledge of Saharan dust mineralogical and chemical signatures and our capabilities of monitoring Saharan dust by remote sensing measurements.

We are seeking a highly motivated student with excellent academic records. Candidates should have a good background in earth sciences and/or chemistry and/or physics. Some laboratory experience is desirable. Analytical skills in geochemistry (especially isotope measurements by TIMS and MC-ICP-MS) and/or mineralogy will be a plus. Some computing proficiencies would be advantageous. The successful candidate will be expected to carry out fieldwork in Senegal during his/her Ph.D. Applicants should be aware that funding for this 3-year Ph.D. project is not secured yet and will not be so before early July 2016. Candidates should send a letter of motivation, a resume and at least two recommendation letters to both Aloys Bory (alloys.bory@univ-lille1.fr) and Yevgeny Derimian (yevgeny.derimian@univ-lille1.fr) as early as possible and no later than May 09, 2016.

References

Derimian, Y. et al. (2008). Journal of Geophysical Research-Atmospheres 113 : D00C09. / Legrand, M et al. (2001), Journal of Geophysical Research-Atmospheres 106: 18251-18274. / Léon, Derimian et al. (2009) Atmospheric Chemistry and Physics 9, 9249-9261. / Mortier, Goloub, Derimian et al. (in review) Journal of Geophysical Research. / Skonieczny, C., A. Bory, V. Bout-Roumazielles et al. (2011). Journal of Geophysical Research-Atmospheres 116: D18210. / Skonieczny, C., A. Bory, V. Bout-Roumazielles et al. (2013). Earth and Planetary Science Letters 364: 145-156. / Tanré, D., et al. (2003). Journal of Geophysical Research, 108, 8574.