

DUNE from Cecile Guieu

Web form submitted in April 2007, + some update from July 2008 and Sept 08

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ProjectTitle: DUNE : a DUst experiment in a low Nutrient, low chlorophyll Ecosystem

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People involved are: (update from July)

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ProjectAbstract:

Here is the abstract of the proposal:

DUNE: a Dust experiment in a low nutrient, low chlorophyll ecosystem

The main goal of DUNE is to estimate the impact of atmospheric inputs on an oligotrophic ecosystem submitted to strong atmospheric inputs. Atmospheric deposition is currently recognized as a significant source of macro- and micro-nutrients for the surface ocean, but the quantification of its role on biological carbon pump is still poorly determined. The main difficulty of such a quantification relies mainly on the diversity of the processes occurring: (1) within atmospheric cycling of particles (from emission processes to deposition onto surface ocean, including physical-chemical transformations occurring during transport) and (2) within the water column (uptake by bacteria and phytoplankton of particle-derived elements of biogeochemical interest, and carbon export resulting from fertilisation induced by those inputs). We propose in DUNE to investigate the role of atmospheric inputs on the functioning of an oligotrophic system particularly well adapted to this kind of study: the Mediterranean Sea. The Mediterranean Sea – etymologically, sea surrounded by land, is submitted to atmospheric inputs that are variable both in frequency and intensity. During the stratification period, only atmospheric deposition is prone to fertilise surface waters which had become very oligotrophic due to the nutrient depletion (after the spring bloom). In order to quantify the impact of both natural (Saharan) and anthropogenic (biomass burning, human activity) inputs on productivity and biogenic carbon sequestration – key concern of international scientific community, see for example SOLAS international initiative- it is necessary to parameterise the processes affecting the ecosystem functioning. In particular, it is important to consider the fixation of atmospheric nitrogen N_2 , for which dissolved iron, which mainly originates from atmospheric deposition, is one of the limiting elements. Realistic fertilisations, aiming to mimic natural and anthropogenic events of known intensity, will be performed onto a set of large mesocosms settled in Scandola Marine Reserve, located in North Corsica. Several biological and chemical parameters will be measured before and up to one month after the fertilisation, in order to quantify bacteria and phytoplankton response. The mesocosms will be installed during two field campaigns throughout the project. With the ambition to develop large mesocosms allowing accurate measurements of trace elements (Fe, P), DUNE constitutes a veritable technological challenge. The main innovation of our approach, relative to traditional use of microcosms or mono-specific cultures, lies on the fact that these ultra-clean systems will allow for the first time to accurately study over time, the processes stimulated by atmospheric deposition and this will be done within an authentic biogeochemical assemblage which natural physico-chemical conditions will be preserved. Moreover, an accurate quantification of exported matter, collected thanks to this device, will allow to achieve an integrated view of ecosystem responses to a selected external forcing, information needed in flux models. The project will take place during 3 years. A first stage will be devoted to the collection of atmospheric end-members and their treatment in order to mimic the physical and chemical modifications during transport and to quantify the release of labile fraction depending on mixing between aerosols sources. This first stage will be followed by two fertilisations campaigns which goal will be to parameterise the processes taking place and the carbon export induced by the stimulation of the natural assemblage after several realistic input scenarios. A final modelling stage (atmosphere and ecosystem) will be, hence, possible by integrating the quantification of atmospheric inputs and the parameterisation of the experimentally described processes. In spite of previous efforts in dedicated programs (EROS, CYCLOPS, ADIOS) the question of the biological response of the Mediterranean Sea to atmospheric inputs is not answered yet and laboratory bioassay

experiments gave fragmented and limited answers. It is time now to tackle the question by using an original approach that requires strong and effective partnership between atmospheric and oceanic scientists: partners and collaborators of DUNE have internationally recognized expertise in those fields. The strong interconnections between atmospheric and marine work proposed here is an absolute and necessary asset for the success of such difficult enterprise.

KeyWords: anthropogenic and natural atmospheric inputs; fertilisation; mesocosm; Mediterranean Sea; nitrogen fixation; bacteria; phytoplankton; atmospheric modeling; ecosystem modeling

Modelling: is relevant

Activity 1.4: is relevant

Activity 1.5: is relevant

(update from July) DUNE is within the Focus 1: Biogeochemical Interactions and Feedbacks Between Ocean and Atmosphere

more specifically, it concerns the Activity 1.4 - Iron and Marine Productivity. In the project, we address the 4 major Issues that Require Resolution according to the science plan:

- What are the ecological and physiological effects of atmospheric iron deposition on the phytoplankton community in terms of productivity, nitrogen fixation rates and species composition, and what impact do these effects have on trace gas emissions and CO₂ exchange with the ocean?

- What is the temporal and spatial variability of the atmospheric transport and deposition of dust to the ocean, and how are these altered by climate changes?

- What controls the chemical transformation of iron in aerosols and how would anthropogenic and natural changes in climate affect the speciation, solubility and bioavailability of iron in surface waters?

What is the chemistry and biochemistry of iron in surface seawater?

Those 4 questions are indeed part of the DUNE project but we do not focuss only on Fe, phosphorus is also a big issue for DUNE as we focus on LNLC are such as the Mediterranean; in fact, all elements of biogeochemical interest are taken into account (including Co for ex.).

Another important point is the multidisciplinary of the team involved (expert in atmospheric chemistry and transport along with biogeochemist of the ocean) and the originality of the approach: fertilisation of large 'trace metal free' mesocosms in typical LNLC waters. We just performed the first experiment in June (I have some nice pictures of the experiment to show if needed).

startdate: (update from July) The project started January 2008 and is funded for 3 years ("ANR Blanc").

enddate:

fundingtodate: State Currency

totalfunding: 590 000 euros

fundingsources: Asked to ANR-BLANC (Feb. 2007): 590 000 euros

On-going: Phase 0 of the project (faisibility) was funded in 2007:

- programme national LEFE: 10 KE
- University of Paris VI: 10 KE

contactedrep?: yes

notcontacted because: e.g. Rep unavailable, conflict of interest etc...

<http://www.obs-vlfr.fr/LOV/DUNE/>

(update from Sept)

-Is new data be collected as part of this project? yes or no

yes

-If so Where do you plan to report/archive this data?

we have a web site (<http://www.obs-vlfr.fr/LOV/DUNE/>) where we plan to report and archive the data collected

-When do you plan to report/archive this data?

we'll have our first meeting in early december and the working group will plan the schedule for the report and archives.