Fine scales shaping nitrogen fIxation in the GUlf stream (FIGURE)

A Data Management Plan created using DMP Roadmap for Eurofleets+

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Project abstract:

The biological fixation of dinitrogen (N2) by marine microbes called ‘diazotrophs’ sustains ~50% of primary production in the ocean, boosting CO2 absorption and mitigating climate change. Our knowledge of diazotroph diversity and activity (diazotrophy) derives from studies conducted at very distant spatiotemporal scales: i) discrete and short duration measurements in small seawater volumes isolated from the environment, and ii) spatial extrapolations and global models of diazotrophy projected over decades to centuries. The knowledge gap between these spatiotemporal scales impedes constraining nitrogen inputs and thus quantify and predict the ocean’s potential to withdraw CO2. This gap lies at the fine scales: dynamic seawater structures <200 Km wide and <2 months lifetime. The poor spatiotemporal resolution of oceanographic in situ sampling is incapable of resolving fine scales. FIGURE will bridge this gap by implementing on-cruise high-resolution diazotrophy measurements >10-50 times faster than those available today, focusing on the Gulf Stream. Fine scales will be characterized by underway sensors of current speed, temperature and salinity, vertical nutrient fluxes and satellite altimetry data. The community composition will be examined by molecular biology methods. Diazotroph activity will be measured using high sensitivity trace gas analysis. Physical and biological data will be correlated to elucidate the effect of fine scales on diazotrophy and to assess their impact on nitrogen inputs to the ocean. The achievements of FIGURE will imply a break-through advance in oceanography and stimulate applications in biotechnology and environmental science, providing new tools, approaches and knowledge for climate change adaptation and mitigation.

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1. Data Summary

The cruise proposed here provides a unique sampling opportunity for 5 research projects granted to the chief scientist and two of the collaborators.

The purpose is to generate unprecedented spatatiotemporal resolution data of diazotroph activity and diversity in the ocean.

The results will be publicly disseminated as well as published in peer-reviewed scientific journals and scientific meetings.

The project will generate nitrogen fixation rates, cell counts, molecular diversity and physical oceanography data.

Diazotroph-related information will join the efforts of the global diazotroph database published first in 2012 in Maredat, which is currently work in progress towards a new actualization in the frame of the OCB Working group on nitrogen fixation.

Genomic data will be published in Planet Microbe.

Metadata will be deposited to a National Oceanographic Data Centre (BMDC in Belgium).

High resolution nitrogen fixation rates obtained by underway gas chromatography analyses are obtained onboard as raw data and further processed on land (transfer in hard drive).

TurboMAP, ADCP and LADCP data are obtained onboard as raw data and further processed on land (transfer in hard drive).

Physical oceanography data (currents, sea surface height, etc) are transmitted via internet from the land-based laboratory in France to the ship.

All other biological and chemical analyses (discrete nitrogen fixation rates, molecular/genomics analyses, inorganic nutrient analyses, flow cytometry counts) are obtained from physical samples that need to be transferred from the demobilisation port to each of the partner's labs. Specific analytical techniques are then applied and the results thus obtained in each lab.

TurboMAP, SBE11+CTD, thermosal, weather and LADCP data will be readily made available publiclyTurboMAP. Biological data (nitrogen fixation rates, diazotroph diversity) will be made available after published in scientific peer-reviewed papers. **Raw Data Processing:** 1) Data Quality Control includes identification and flagging of outliers, missing/null and suspect values. 2) Delivery of data at original sampling rates and bin-averaged over 1-m intervals in order to eliminate the very high frequency variability 3) Computation of derived variables **SBE 911+ CTD** 1)The raw data will be processed with the SeaBird toolbox. 2) Any further spikes will be taken apart. 3)Initial and final samples will be compare to seek for any time-deteriorating trend on the sensors. 4)Salinity samples will be taken to calibrate the conductivity sensor offset with an AUTOSAL 8400BB **Thermosalinometer and Weather station** 1)Data from the thermosalinometer will be calibrated with the uppermost pressure recorded with the SBE 911+CTD of the ship 2)If available GCPS data from the ship navigation instruments will be compare to that of the thermal and weather station 3)We will obtain true wind by removing the ship's heading and speed from the manometer. **Lowered Acoustic Doppler Current Profiler (LADCP)** 1) Use of the CODAS software to process the Vessel Mounted Acoustic Doppler Current Profiler (VMADCP) 2) Use the VMADCP to calibrate the LADCP 3) Calibrate the velocities also the Visbeck toolbox. **Data Harmonisation** 1) Definition of Headers and a standard code to flag values according to Data Quality Control 2) Data Formatting: use of header, standard variables/units and flagging of values according to Data Quality Control The final dataset will follow the FAIR agreement, being Findable, Accesible, Interoperable and Reusable. This implies having an clear format with headers and definitions, made public available as soon as possible, and with proper Data Quality Control

In the following 10-12 months after the cruise.

2.1 Making data findable, including provisions for metadata

Diazotroph, turbulence, nitrogen fixation

We will follow the guidelines of the LEFE-CYBER database and adapt as required to the format of Eurofleets and the National Oceanographic Data Centre (BMDC in Belgium).

2.2. Making data openly accessible

Turbulence, temperature, salinity, fluorescence, inorganic nutrient concentrations and flow cytometry counts will be made available immediately.
Nitrogen fixation rates and diazotroph diversity data will be publicly available after scientific publication in a peer-reviewed journal.

Diazotroph-related information will join the efforts of the global diazotroph database published first in 2012 in Maredat, which is currently work in progress towards a new actualization in the frame of the OCB Working group on nitrogen fixation.
Genomic data will be published in Planet Microbe.

2.3. Making data interoperable

All onboard operations will be documented in detail in the cruise report to be later incorporated into the databases generated.

Data will be stored in each researcher's drives and institution networks and further transmitted to databases as required.

2.4. Increase data re-use (through clarifying licences)

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4. Data security

Data will be stored by each researcher, shared among researchers via the cloud, and backed up in each researchers' institutions computing system.

6. Other issues

Those specified by LEFE-CYBER database.