

Nitrogen fixation in the Northeast Atlantic Ocean.

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1. Introduction

The translocation of atmospheric CO₂ to the deep sea, where it can stay for centuries, is mainly driven by the biological carbon pump. Phytoplankton, responsible for this activity, need nutrients such as nitrate to carry it out. In oligotrophic environments like the North Atlantic gyre, nitrate is often a limiting factor of this carbon sequestration (Capone et al., 2005). The incorporation of atmospheric N₂ by diazotrophs through nitrogen fixation is one of the main routes to compensate for this shortage (Landrum et al., 2011). Little is known about the importance of N₂-fixation to the primary production and carbon export. Yet it is vital since the marine nitrogen cycle and the global carbon cycle are closely linked by primary production (Montoya et al., 2002). As a result nitrogen fixation can strongly influence the global climate regulation. In summer 2011 an expedition was conducted in the North Atlantic (DIAPICNA) to investigate the presence, identity, distribution and activity of diazotrophs in the Azores Current region.

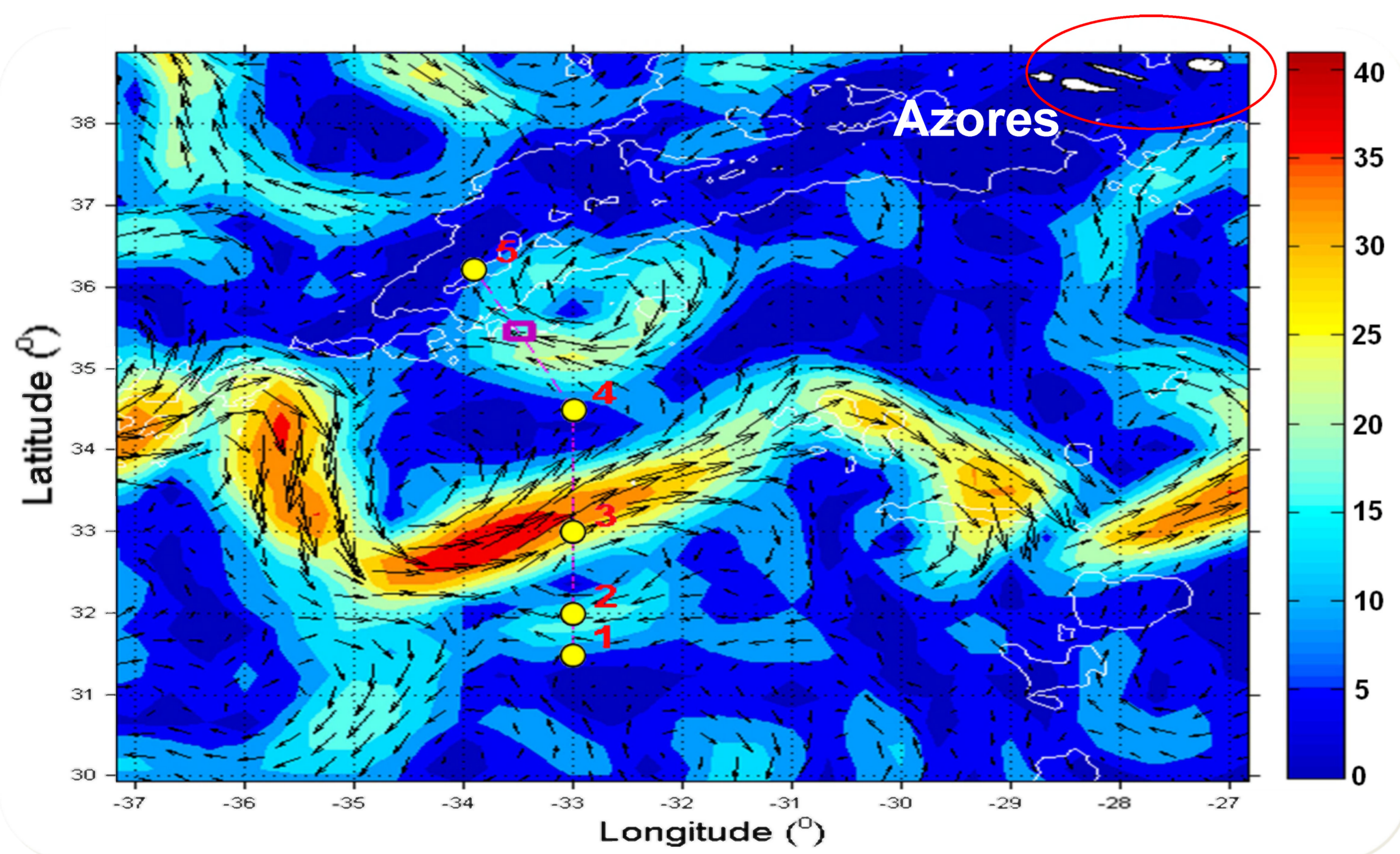


Fig. 1: Sea surface height anomalies (cm) of studied area showing the meandering of the Azores Current from AVISO(01/08/11).
Courtesy A. Martins, DOP, UAç.

3. Material & Method

Stable ¹⁵N and ¹³C isotope incubations were performed on the ship, using the ¹⁵N spiking method of Mohr et al. (2008): degassed low nutrient seawater spiked with enriched ¹⁵N₂ gas was added to 4,5l Nalgene bottles containing seawater sample to be incubated during 24 hours.

Primary production & N₂-fixation calculation through:

- Final ¹⁵N₂ enrichment of incubations
 - Particulate Organic Carbon and Nitrogen contents and isotopic compositions (POC / PN)
 - Dissolved Inorganic Carbon isotopic composition (DIC)
- Measured by EA-IRMS

Other parameters:

- Nutrients concentration (NO₃⁻, NH₄⁺, PO₄⁻, Si(OH)₄)
 - δ¹⁵N-δ¹⁸O signatures of nitrate
- Spectrophotometry and EA-IRMS

2. Location

The temperate - subtropical North Atlantic characterised by low nutrient concentrations, positive deviation of N/P ratio of Redfield and the availability of iron, originating from the Sahara desert storms and/or hydrothermal vents (station 5).

→ Interesting region to study the fixation of new nitrogen (Fig. 1)

The Azores Current, splitting cold and fresher northern waters (15°C) from warm and more saline southern waters (18°C).

→ Gradient in parameters which can affect the rate and importance of N₂-fixation

5 stations sampled:

- Water column profile (upper 500m; 12 depths): T, S, turbidity, nutrients (NO₃, NH₄, PO₄, H₄Si(OH)₄) (Fig. 2)
- Incubation samples (5m, 45m, DCM, 200m)

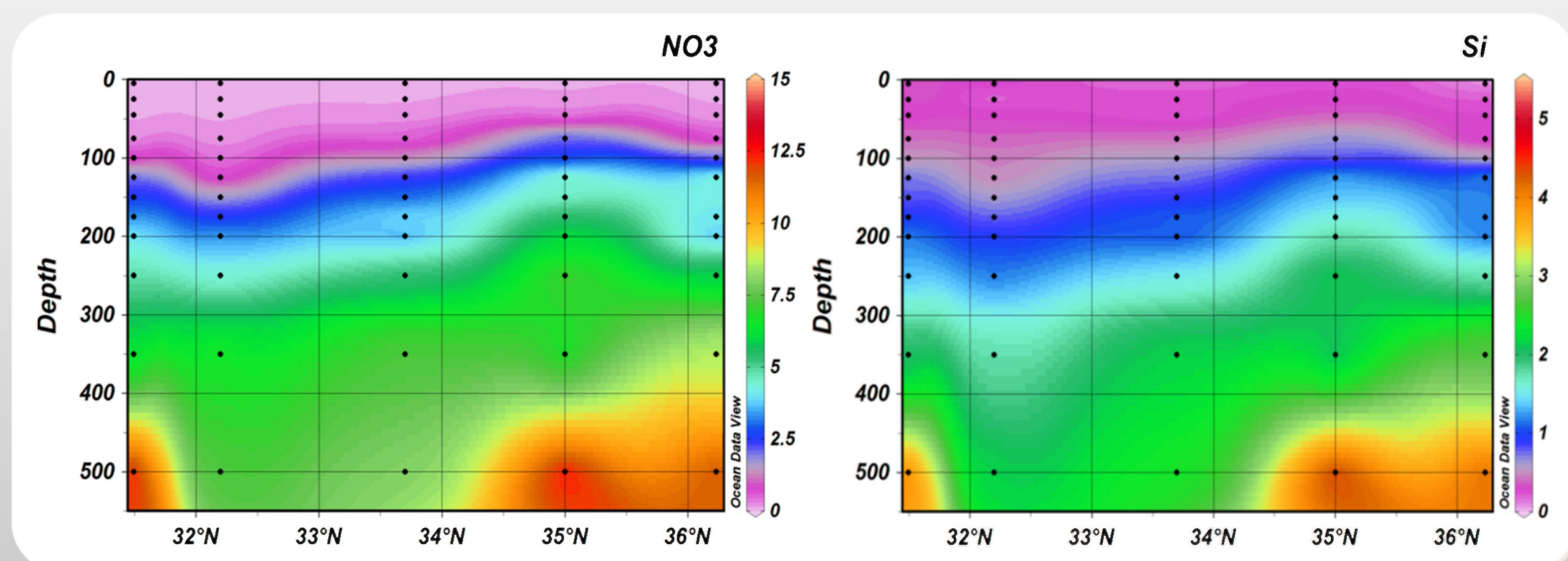


Fig. 2: Vertical profile of nitrate (μM) and silicate (μM). Azores Current and Front located between stations 3 and 4 (around 34°N).

4. Results & Perspectives

→ Analysis are currently being finalised

→ Results and interpretation will be presented in masters theses by July 2012

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