

Rapid response of diazotrophs to hydrography variability in an upwelling bay



Motivation

Nitrogen (N) is very abundant in the atmosphere as N₂, however it is only accessible to a limited group of organisms. Through biological N fixation, a high energy demand process, diazotrophs are capable of reducing N₂ to ammonium, which is easier to assimilate. Despite the energy cost, diazotrophs are enigmatically present and active in eutrophic regions, including coastal upwellings. Previous studies in the coastal upwelling off NW Iberia revealed that diazotrophs respond to changes in hydrodynamic forcing over seasonal scales. However, inside the bays, upwelling can occur as transient events with a typical duration of a few days, interspersed with relaxation or downwelling.

Sampling site

- Upwelling bays are one of the most productive areas of the ocean.
- Galician Rías display a strong short-term variability.

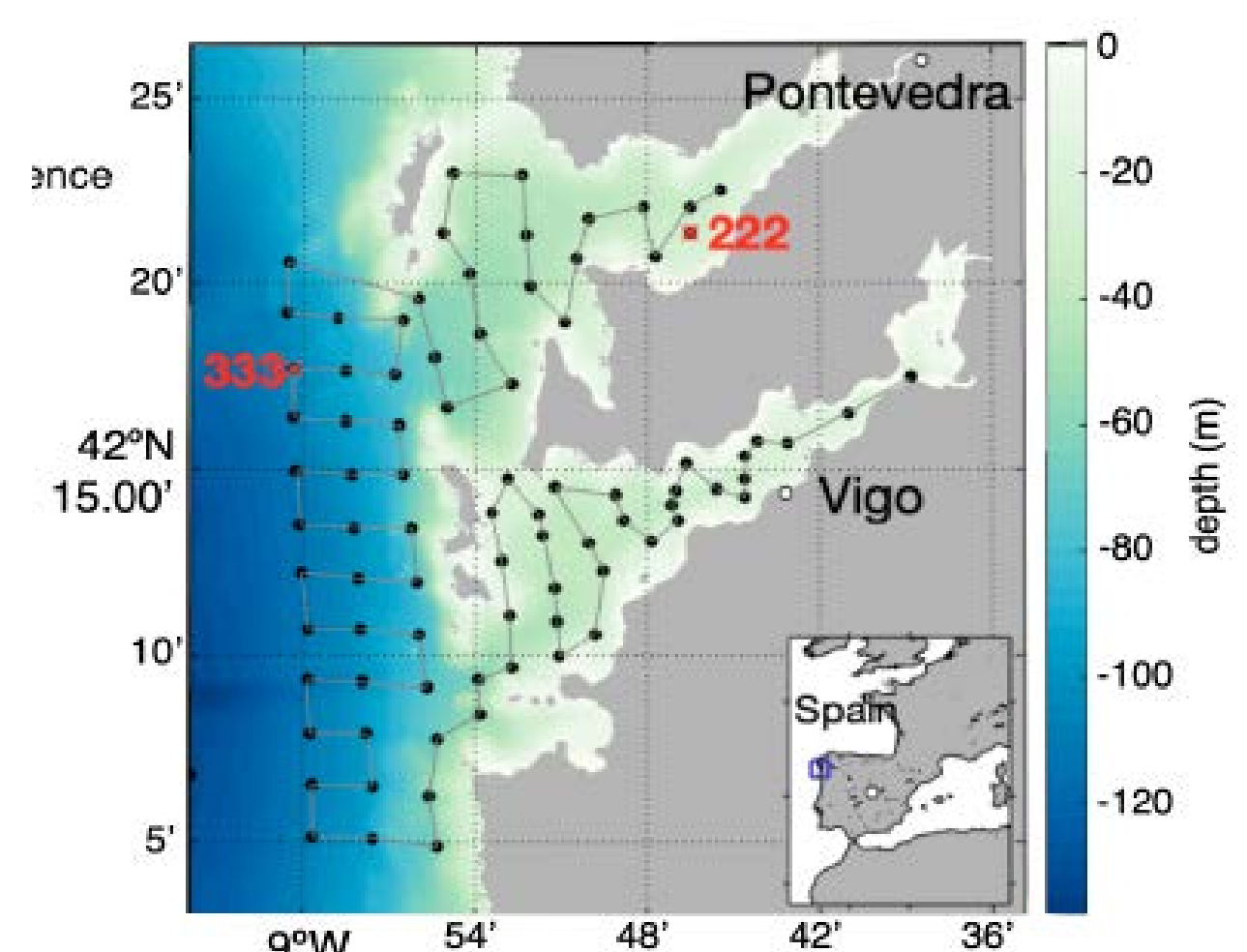


Figure 1. Observations were collected between 29th June and 15th July 2018 in Ría de Pontevedra, at the shelf (st. 333) and the inner part (st. 222).

Hydrography and production

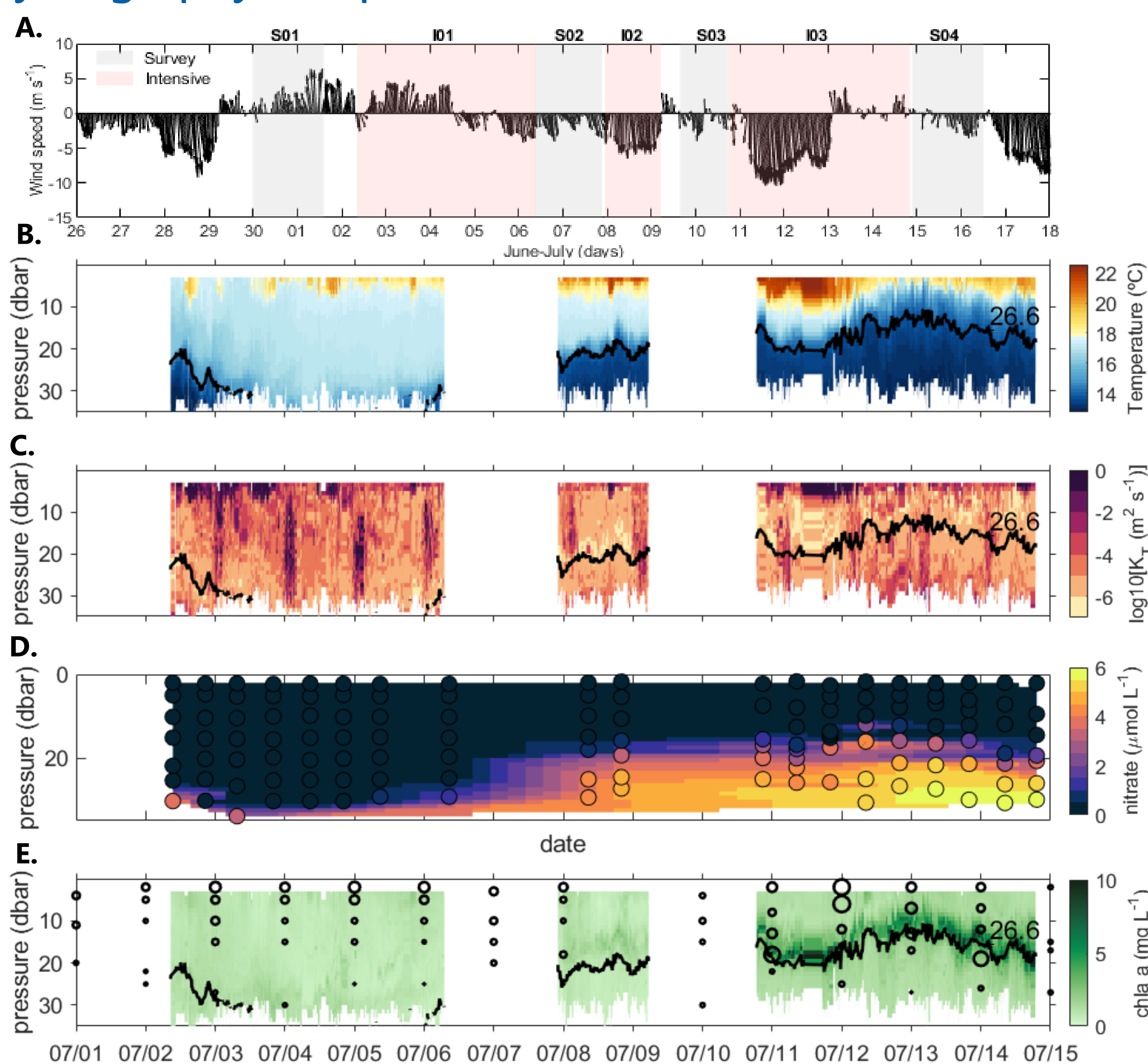


Figure 2. A) Time-series of shelf-wind vectors throughout the cruise. Gray shaded areas indicate survey samplings (CTD stations), whereas red shaded areas indicate intensive samplings (high-res CTD at st. 222). Time-series of high-resolution temperature (B), eddy diffusion coefficient (KT) (C), nitrate concentration (D) and chlorophyll a (E) at st. 222 where the scatter plot represents the magnitude of primary production.

Acknowledgements

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D. Fernández-Román¹, M. Fontela², E. Broullón^{1,2}, M. M. Varela³, B. Fernández-Castro⁴, T. Rodríguez-Ramos³, H. Farnelid⁵, A. Fernández Carrera⁶, S. Martínez-García¹, B. Mouriño-Carballido¹,

1. Centro de Investigación Mariña da Universidade de Vigo (CIM-Uvigo), Vigo, Spain.
2. Instituto de Investigaciones Mariñas (IIM-CSIC), Vigo, Spain.
3. Centro Oceanográfico de Coruña (IEO-CSIC), Coruña, Spain.
4. Ocean and Earth Science, National Oceanography Centre, University of Southampton, Southampton, UK.
5. Department of Biology and Environmental Science, Linnaeus University, Centre for Ecology and Evolution in Microbial Model Systems (EEMIS), Linnaeus University Kalmar, Sweden.
6. Universidad de Las Palmas de Gran Canaria.

Objective

To describe changes in the composition, activity and biogeochemical role of diazotrophs over short temporal scales

Diazotrophic community

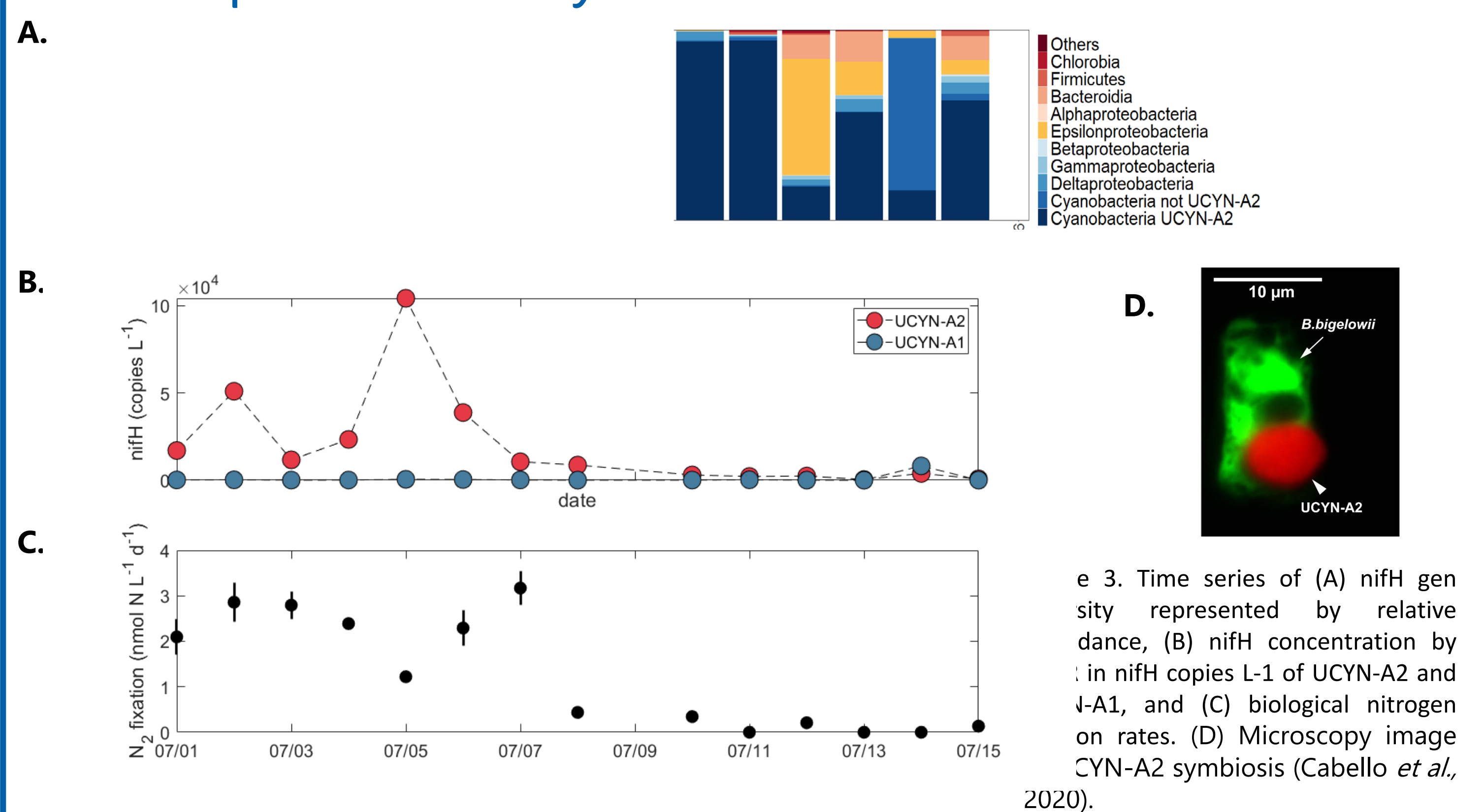


Figure 3. Time series of (A) nifH genotypes represented by relative abundance, (B) nifH concentration by nifH copies L⁻¹ of UCYN-A2 and UCYN-A1, and (C) biological nitrogen fixation rates. (D) Microscopy image of B. bigelowii and UCYN-A2 symbiosis (Cabello *et al.*, 2020).

Biogeochemical balance

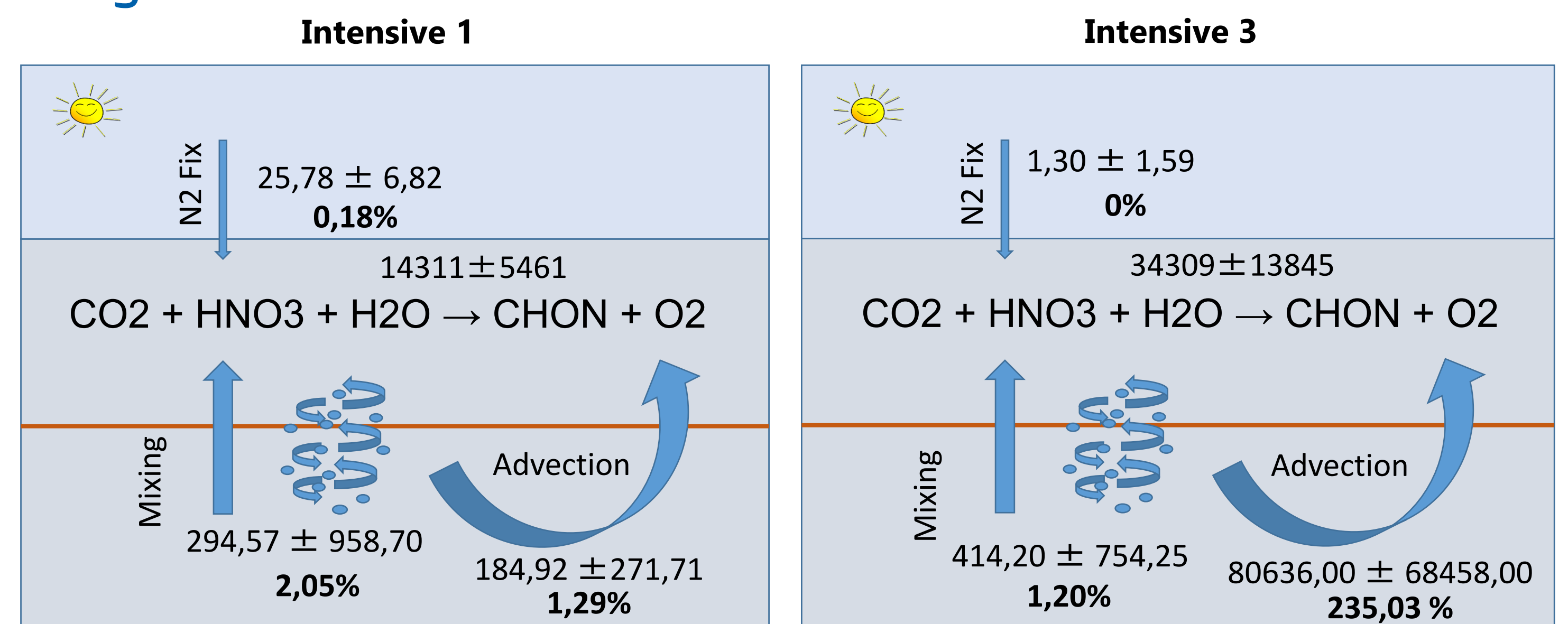


Figure 4. Magnitudes (in $\mu\text{mol N m}^{-2} \text{d}^{-1}$) of the amount of nitrogen needed to sustain NPP in the period calculated from the redfield ratio and the PP rates, biological nitrogen fixation, nitrate turbulent diffusion and nitrate advection during downwelling-relaxation (I01) and upwelling (I03). Percentages are the contribution of each nitrogen supply mechanism to NPP.

Take home messages

- Diazotrophs activity and composition respond rapidly to hydrography changes occurring over few days
- As a result of fertilization due to upwelling, community N₂ fixation and abundance of UCYN-A2 decreased by a factor of 10.
- BNF during I01 is a punctually important source from New Nitrogen, but has minimal impact on the total production, while becoming negligible during I03.

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