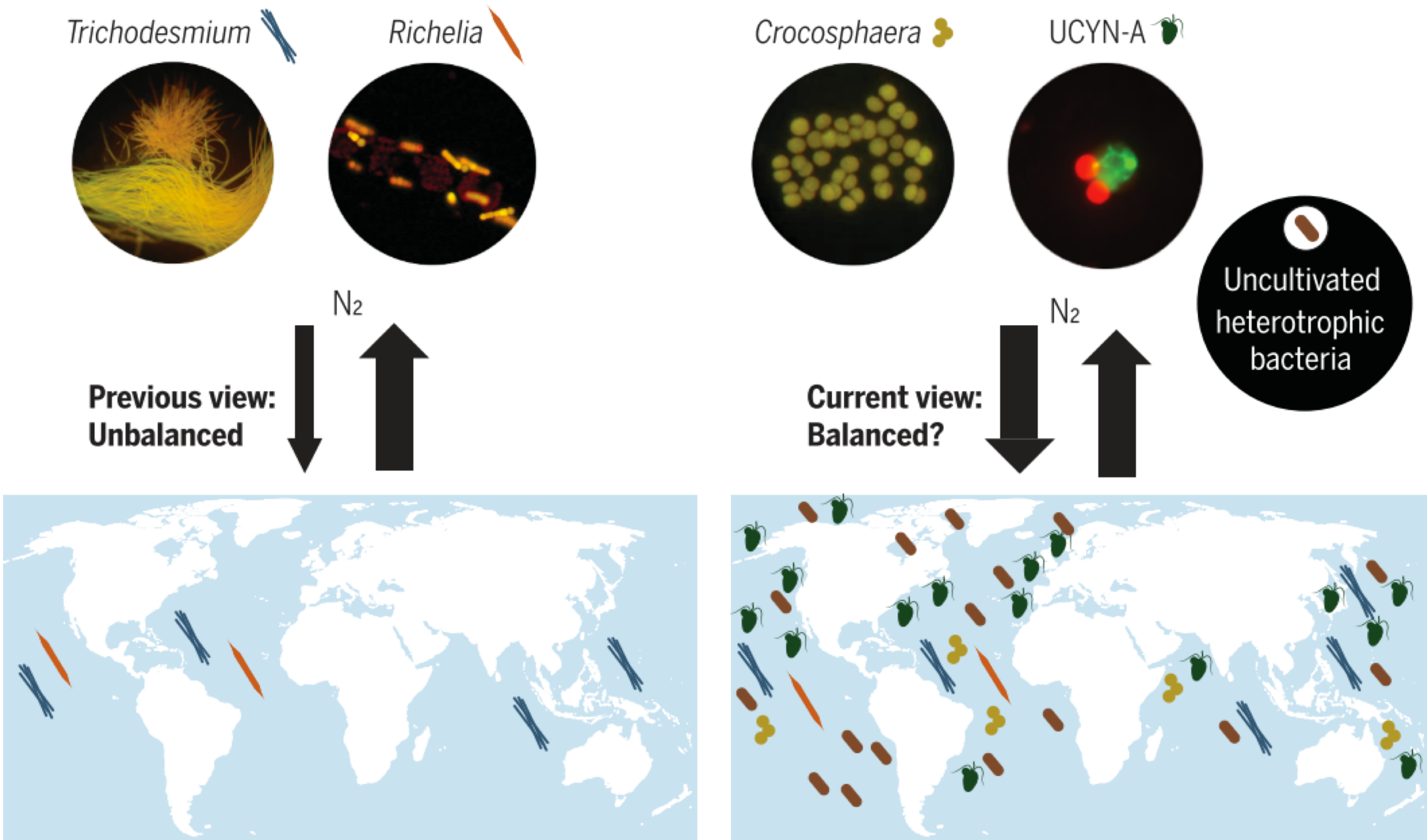
2021 Aquatic Sciences Meeting

Short-term variability in the activity and composition of the diazotroph community in a coastal upwelling system

B. Mouriño-Carballido[1], R. Alba[2], E. Broullón[1], P. Chouciño[1], A. Fernández Carrera[3], B. Fernández-Castro[4], D. Fernández-Román[1], H. Farnelid[5], A. Fuentes-Lema[1], V. Joglar[1], M. Pérez-Lorenzo[1], S. Martínez[1], T. Rodríguez-Ramos[2], M. M. Varela[2]

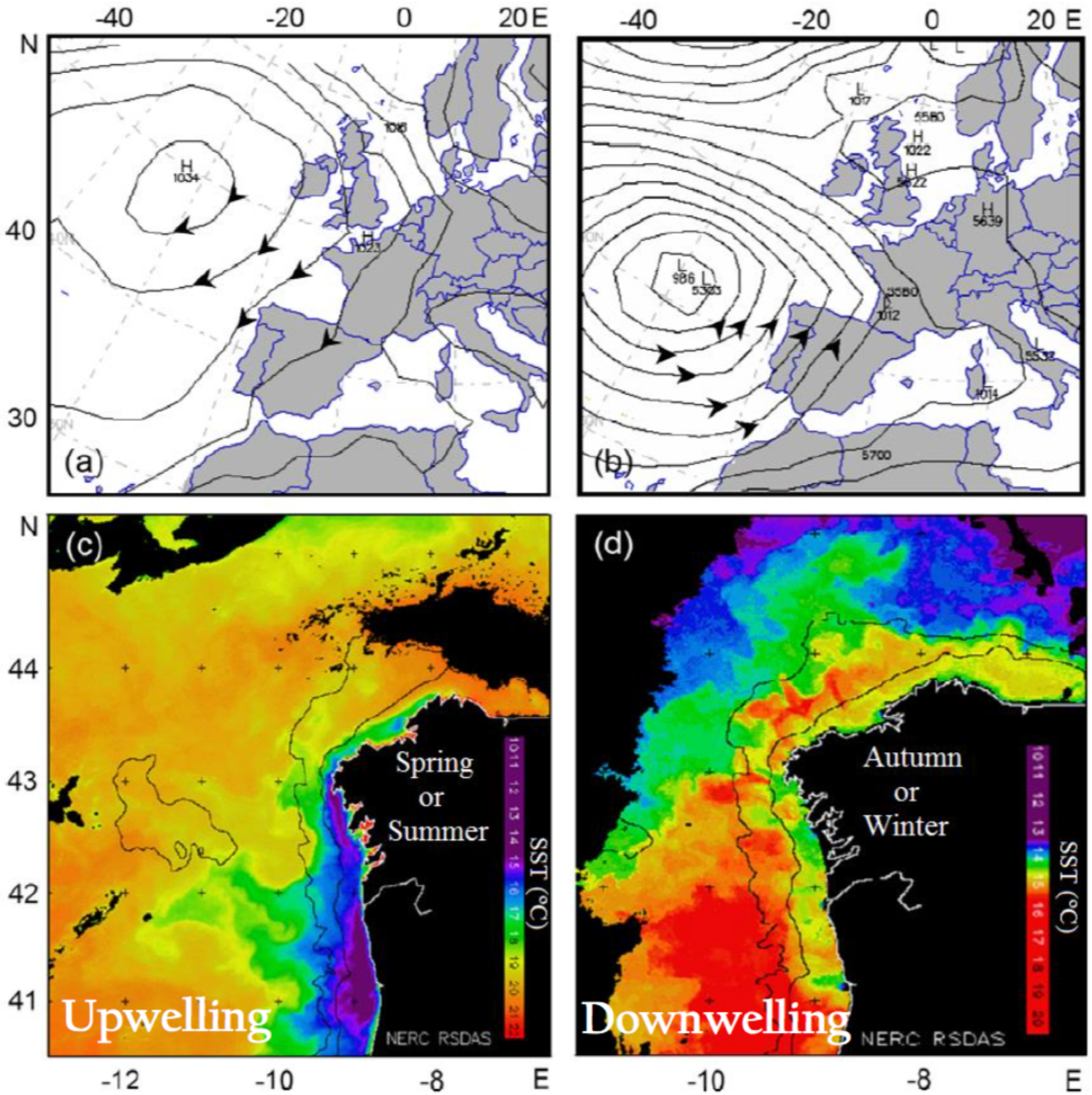
1. Universidade de Vigo, Spain
2. Instituto Español de Oceanografía-A Coruña, Spain
3. Leibniz Institute for Baltic Sea Research, Germany
4. University of SouthamptonNational Oceanography Centre Southampton, UK
5. Linnaeus University, Sweden

Changes in perspectives in recent decades



Zehr & Capone (2020, Science)

The NW Iberian coastal upwelling

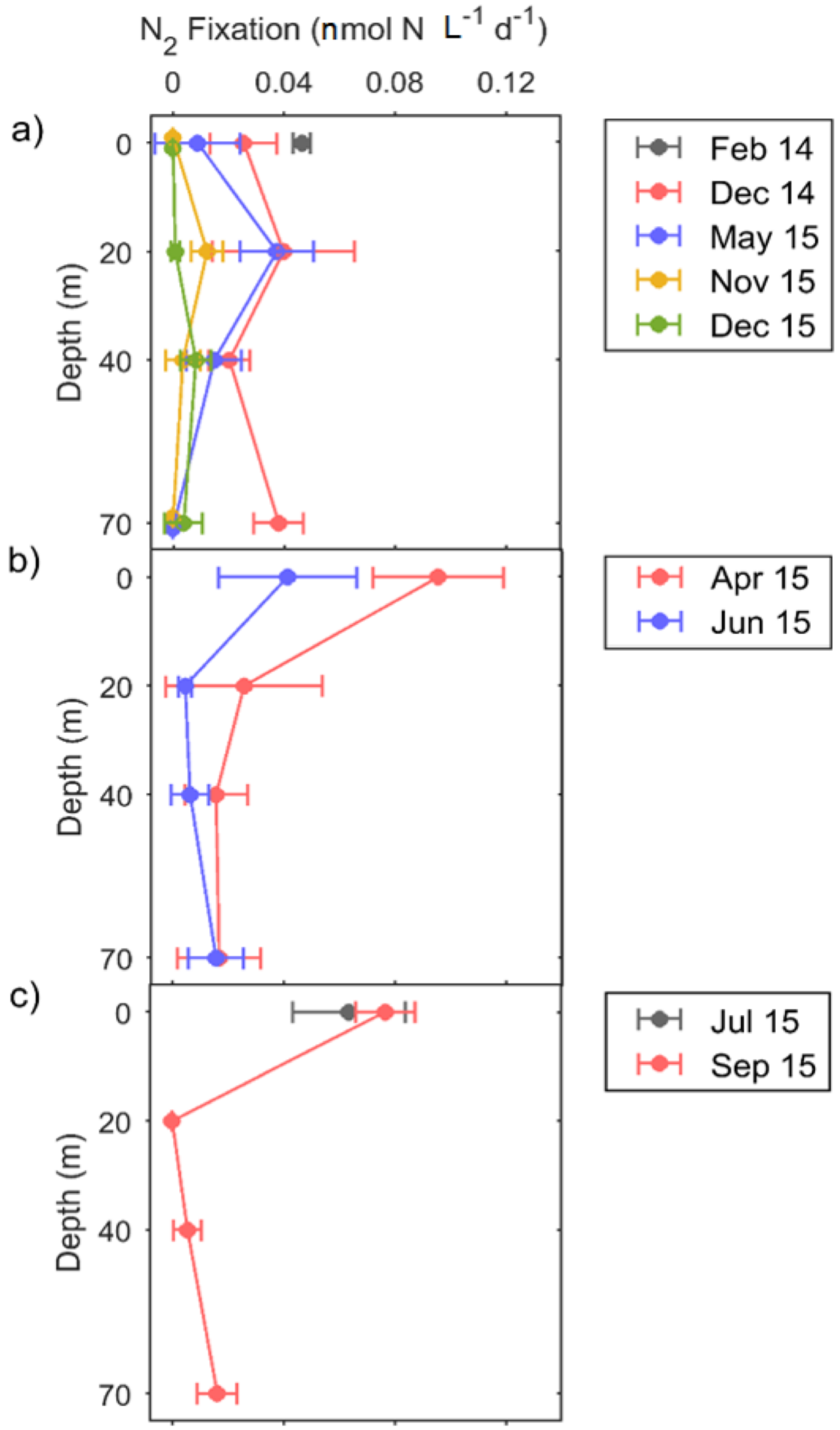


The NW Iberian coastal upwelling: variability in N_2 fixation over seasonal scales

Downwelling

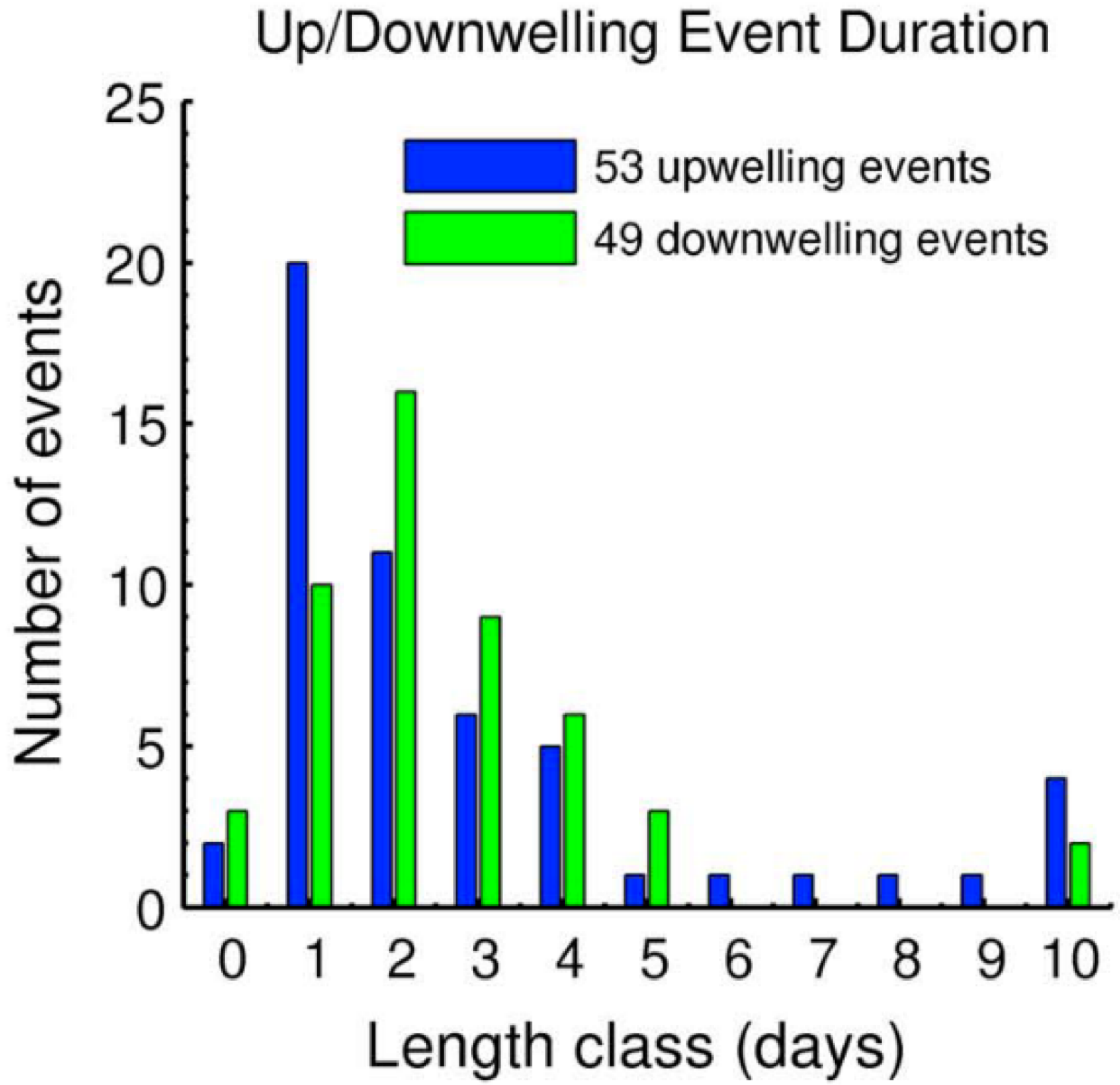
Upwelling

Relaxation



Moreira-Coello (2018, Scientific Reports)

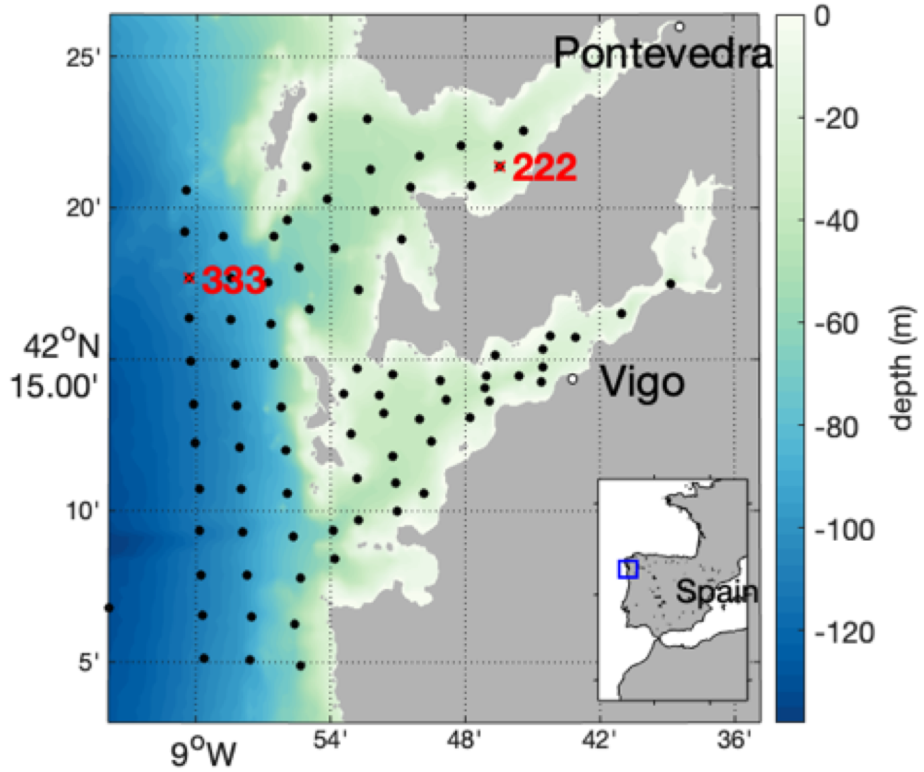
The NW Iberian coastal upwelling: short-term variability



Upwelling occurs as transient events with a duration of about 3 days (Gilcoto et al., 2017)

Does diazotrophy activity and composition respond to the short-term variability in the upwelling-downwelling regime?

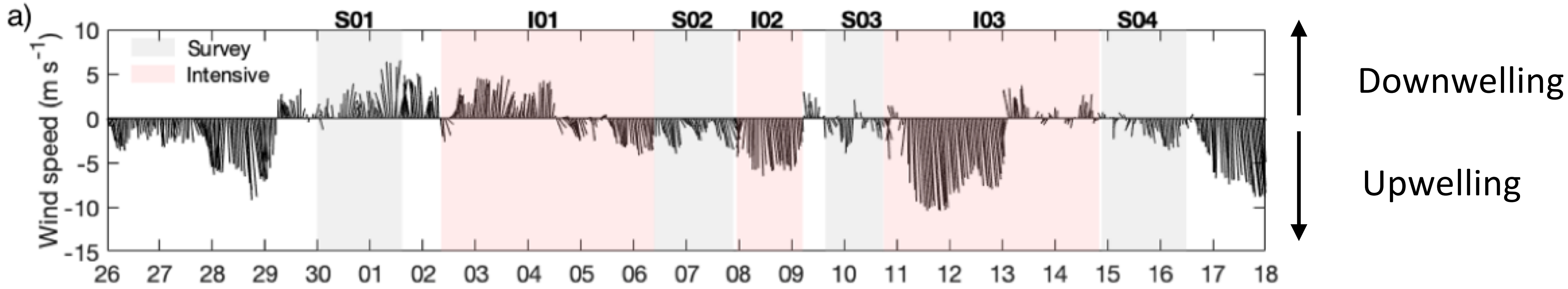
Dataset collected during the REMEDIOS cruise (summer 2018)



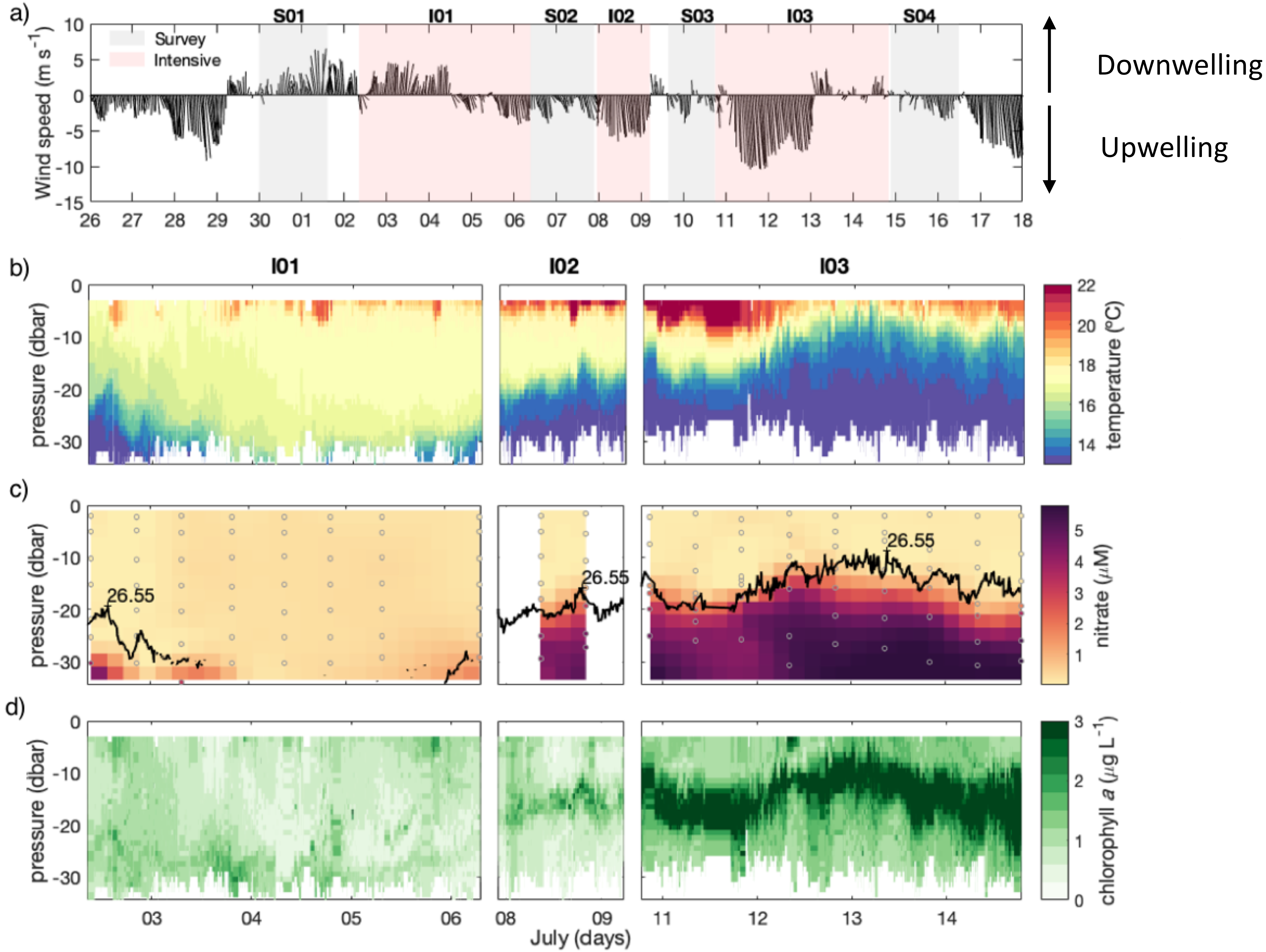
St 333 (Shelf) and st 222 (Ría de Pontevedra):

- Microturbulence profiler (st 222)
- Nitrate concentration (7-8 depths)
- Chlorophyll a (7-8 depths)
- N_2 fixation rates ($^{15}N_2$-uptake) (surface)
- Diversity of gene *nifH* (ASV level) (surface)
- Diazotroph abundances (qPCR) (surface)

Variability in hydrographic conditions

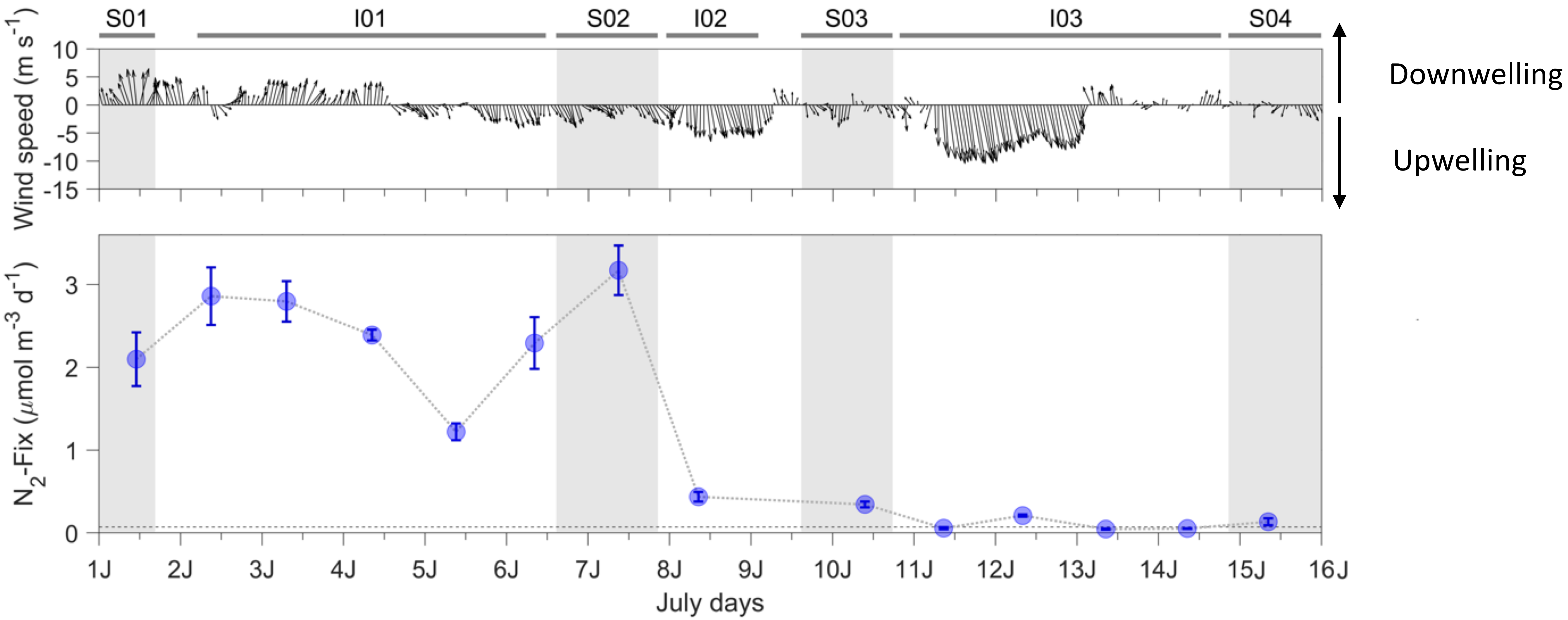


Variability in hydrographic conditions



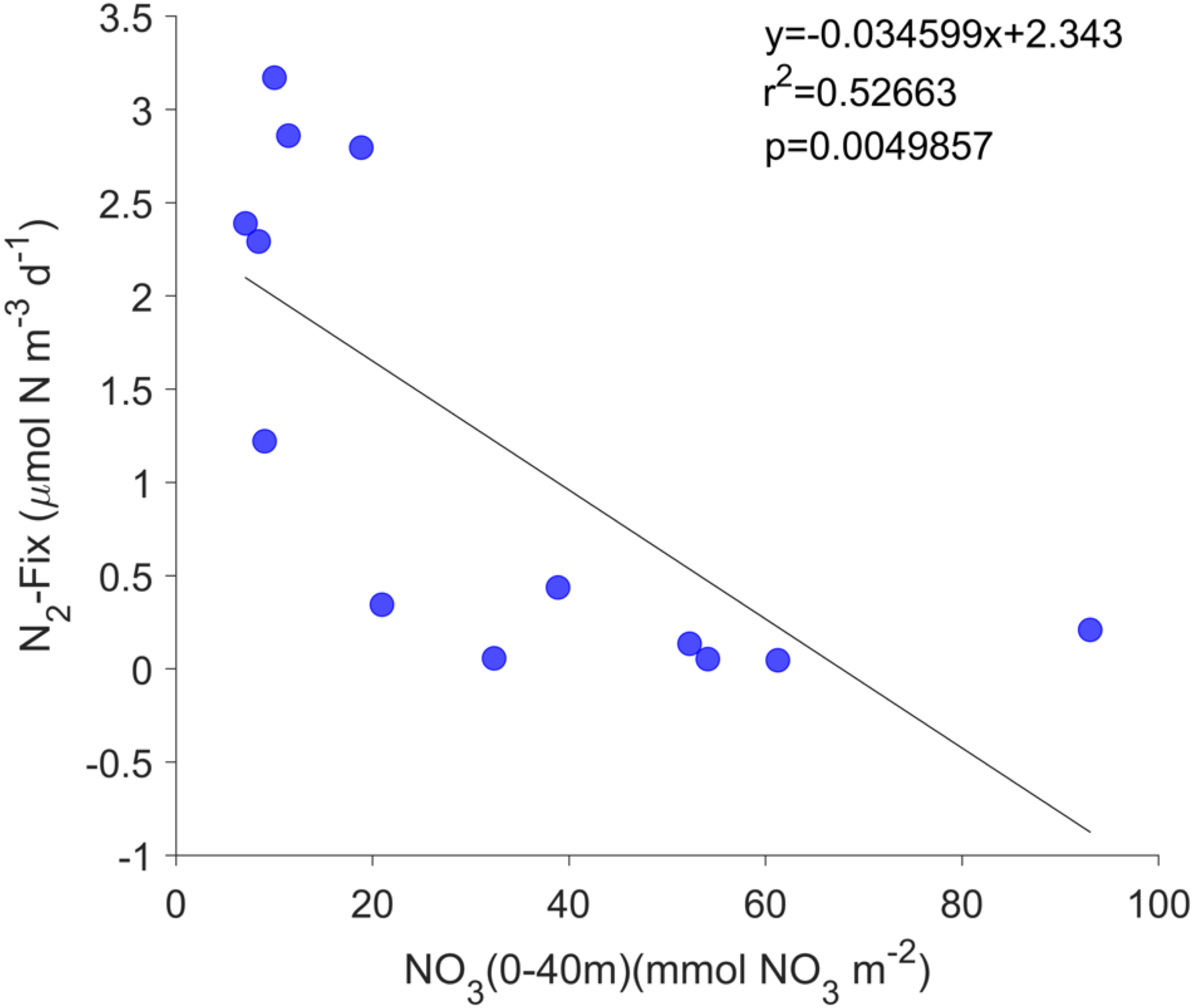
The cruise started after strong upwelling followed by few days of relaxation-downwelling, and after another upwelling pulse

Variability in surface N_2 fixation rates



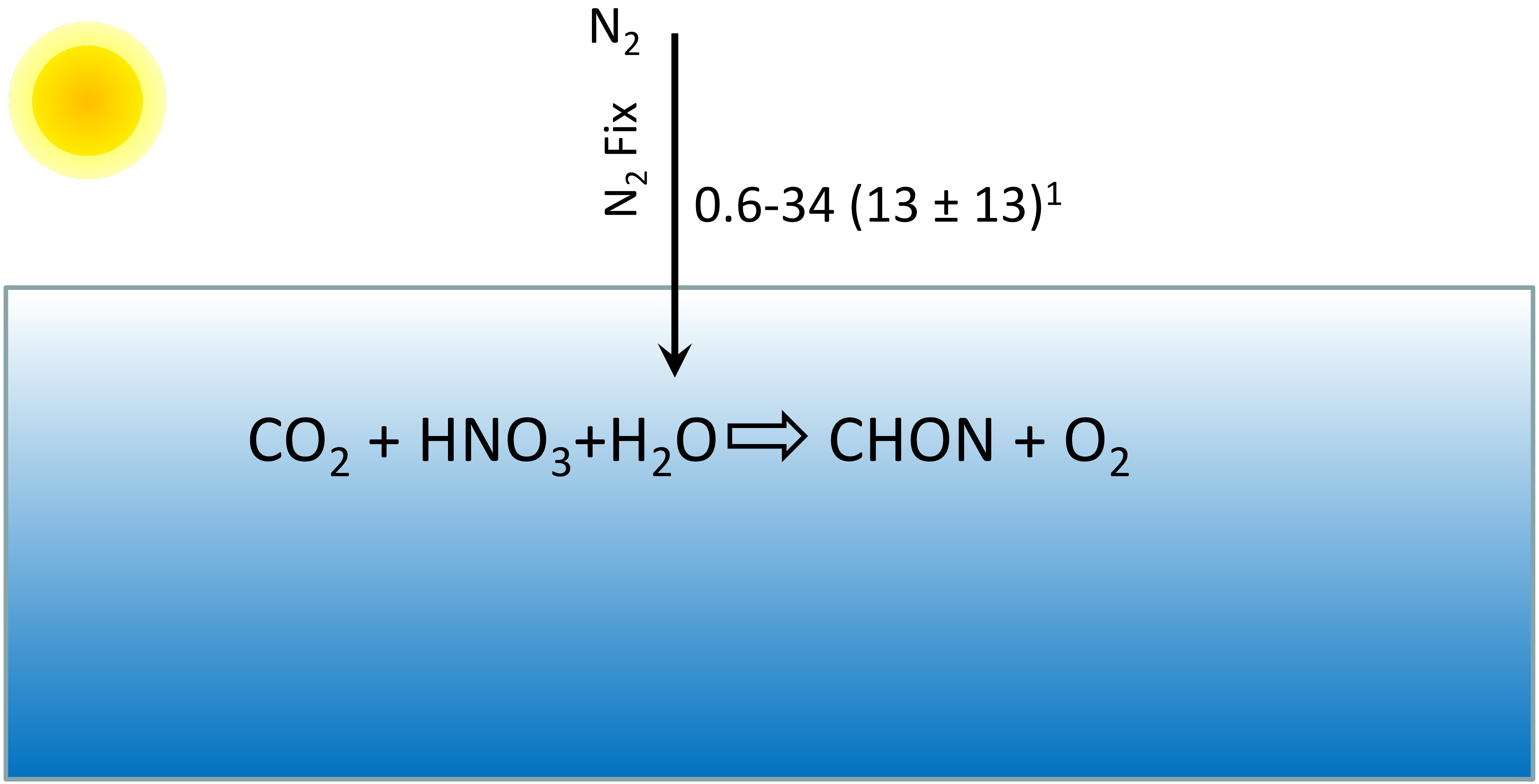
Higher rates (ca. 2.2 µmol m^{-3} d^{-1}) during relaxation-downwelling, which decreased (0.10 µmol m^{-3} d^{-1}) during the fertilization associated with upwelling

N_2 fixation versus depth-integrated NO_3 concentration

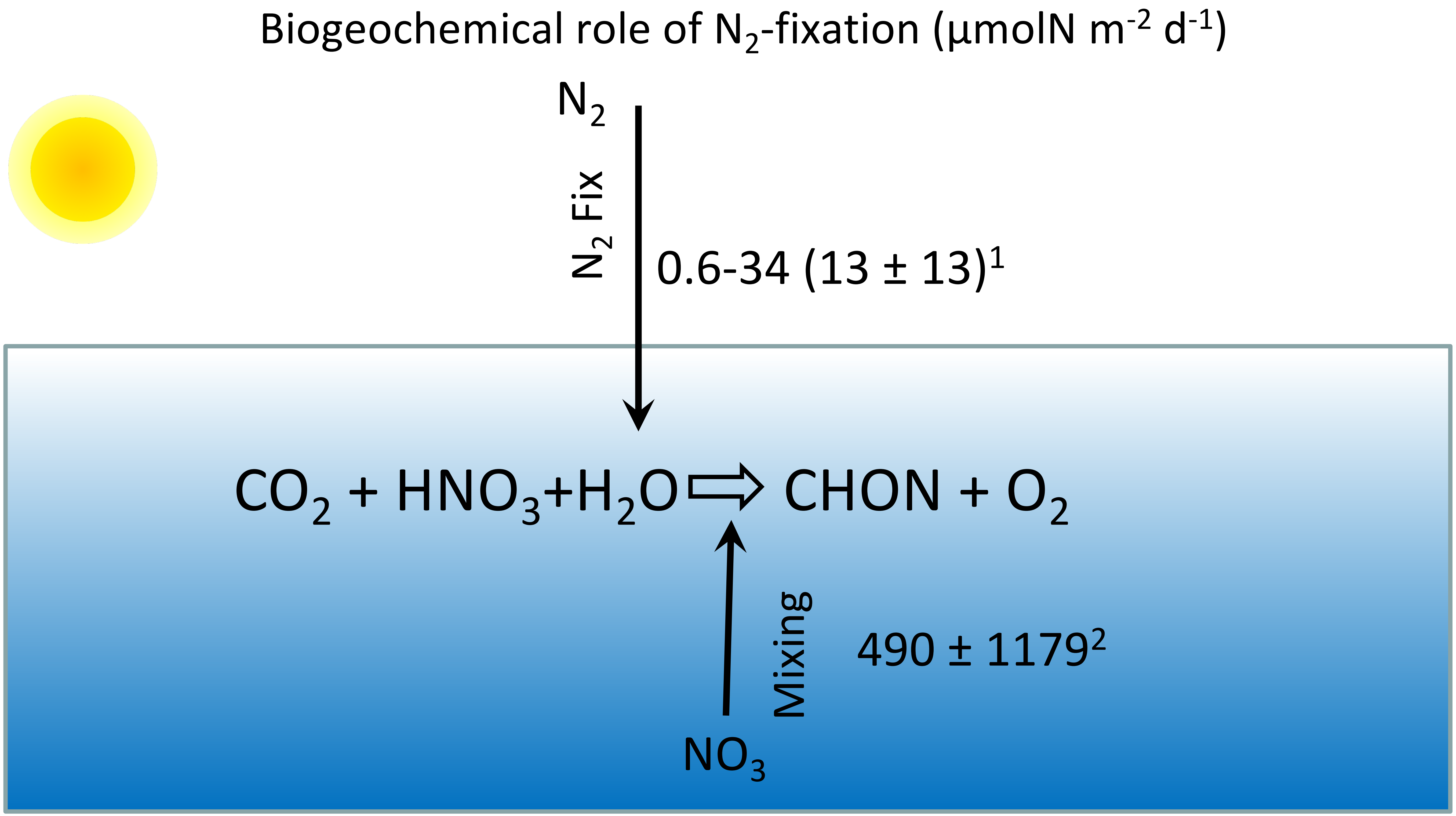


Negative relationship between N_2-fixation and depth-integrated NO_3

Biogeochemical role of N_2-fixation (µmolN m^{-2} d^{-1})



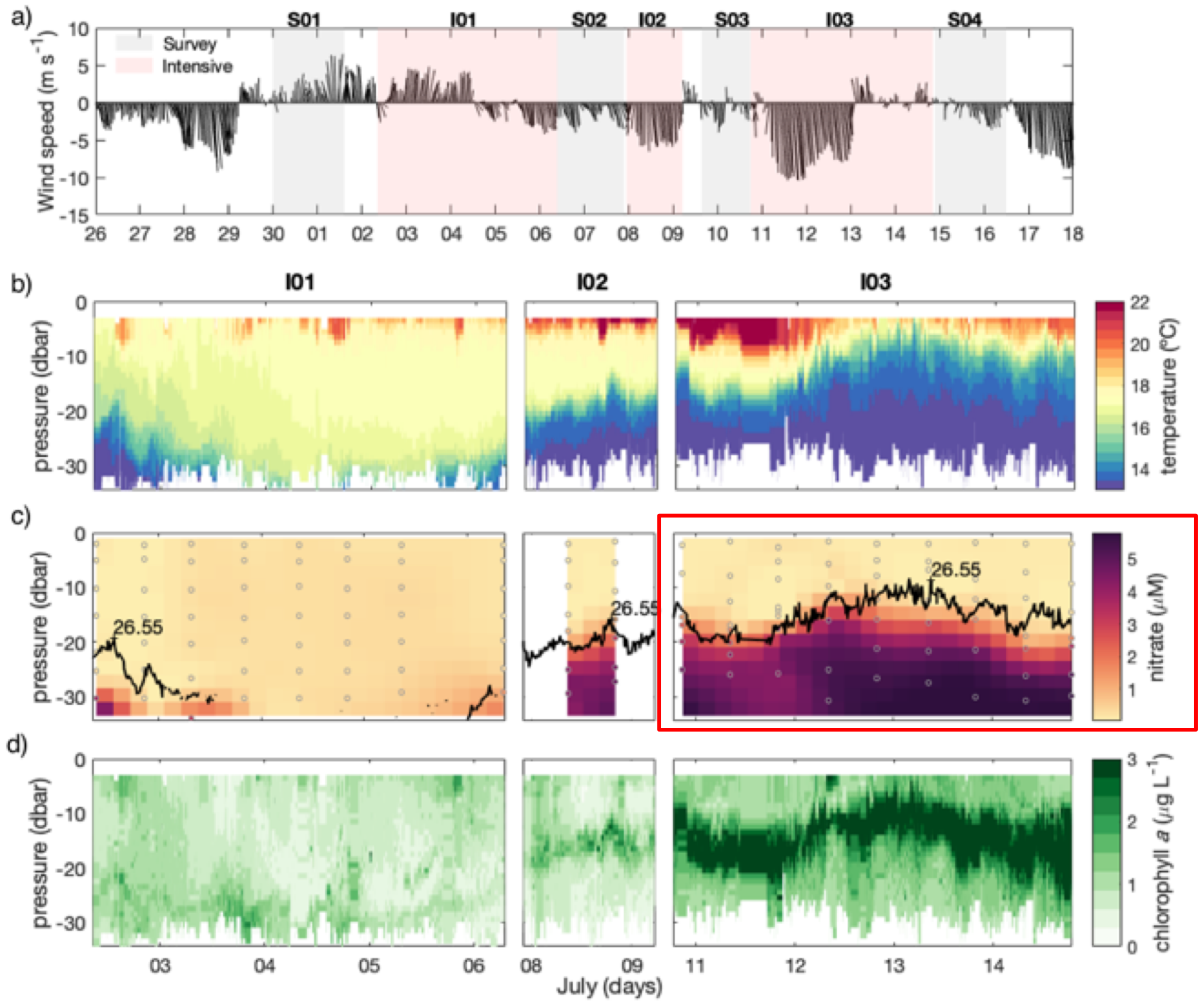
[1] Depth-integrated N_2 Fix (dBNF=f(sBNF); Moreira et al., 2017))

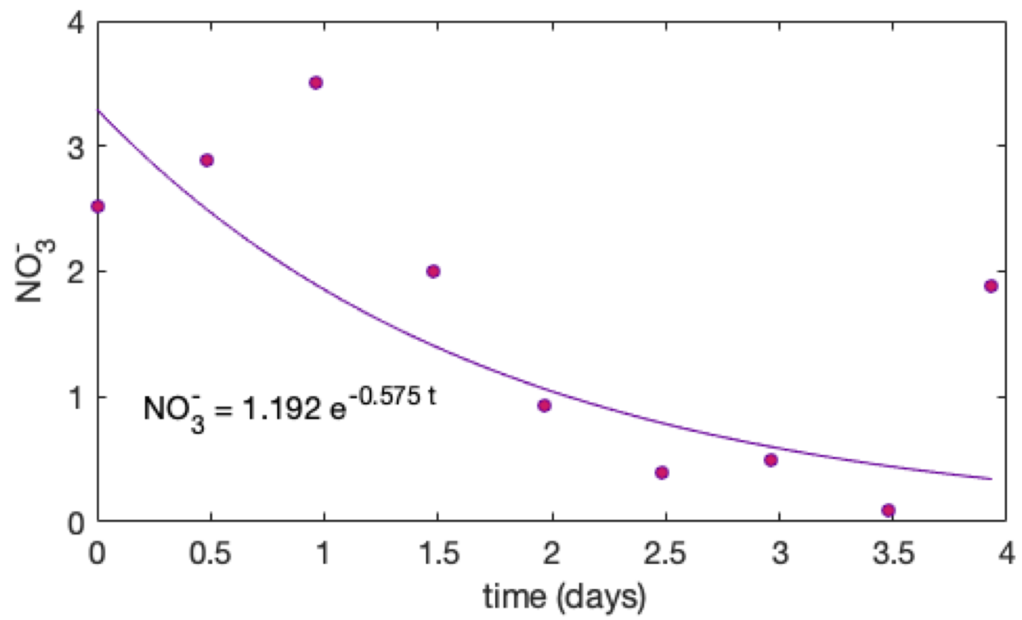


[1] Depth-integrated N_2 Fix (dN_2 Fix =f(sN_2 Fix); Moreira et al., 2017))

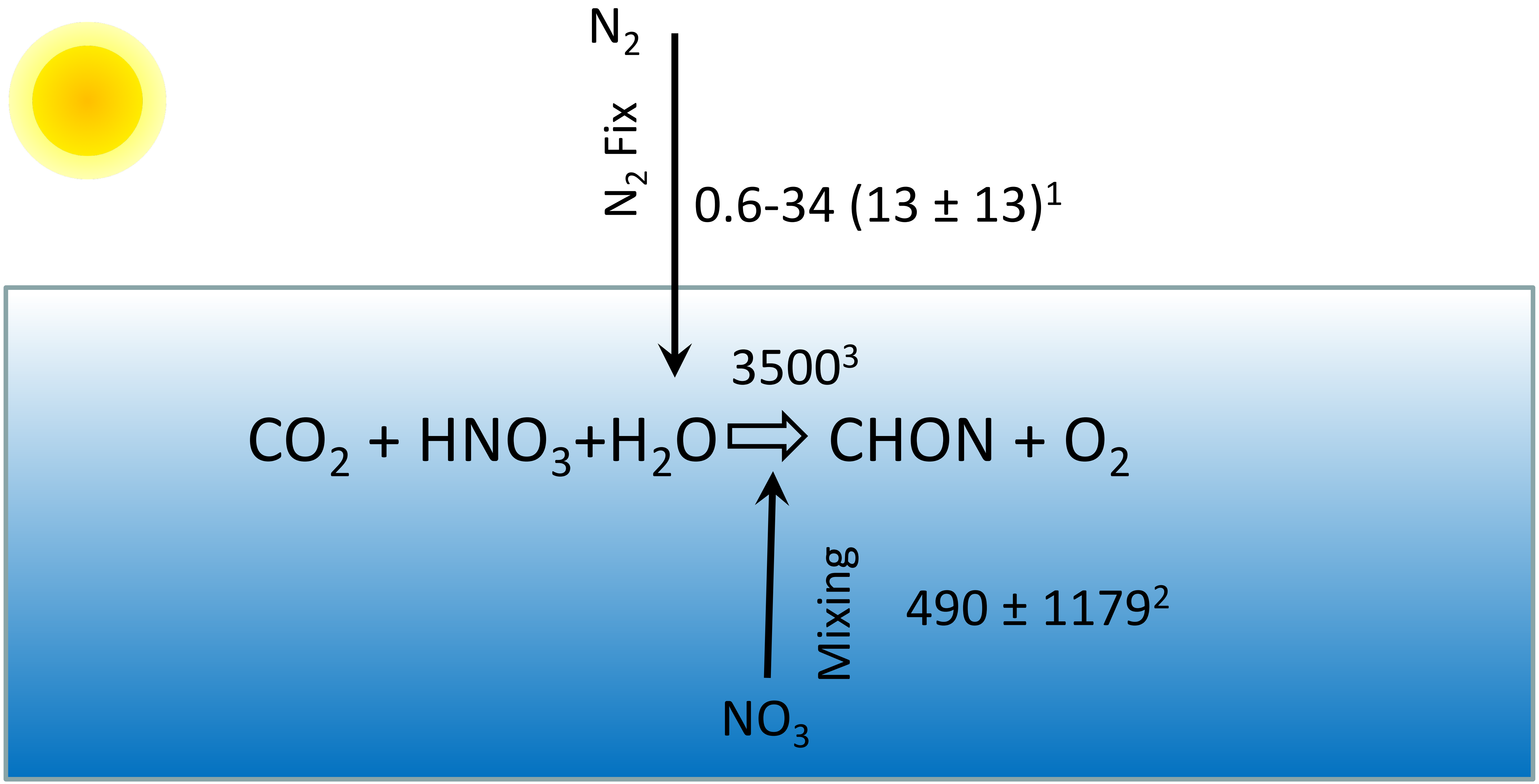
[2] NO_3 diffusive flux = $Kz \times \left(\frac{d[NO_3^-]}{dz}\right)$;

Exponential fit of NO_3 at **σ**t=26.55 kg m^{-3}





Biogeochemical role of N_2-fixation ($\mu molN\ m^{-2}\ d^{-1}$)

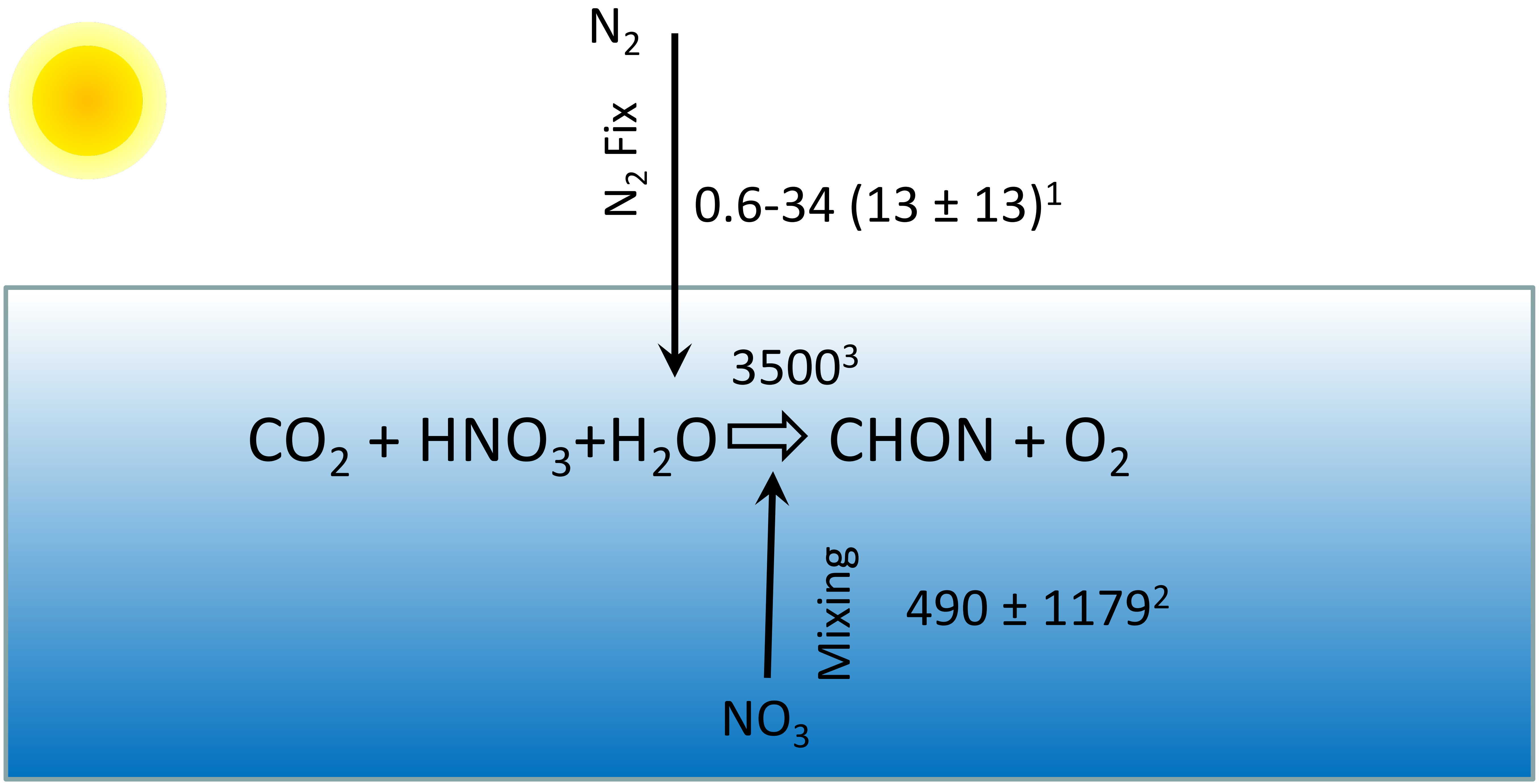


[1] Depth-integrated N_2 Fix (dN_2 Fix =f(sN_2 Fix); Moreira et al., 2017))

[2] NO_3 diffusive flux = $Kz \times \left(\frac{d[NO_3^-]}{dz}\right)$;

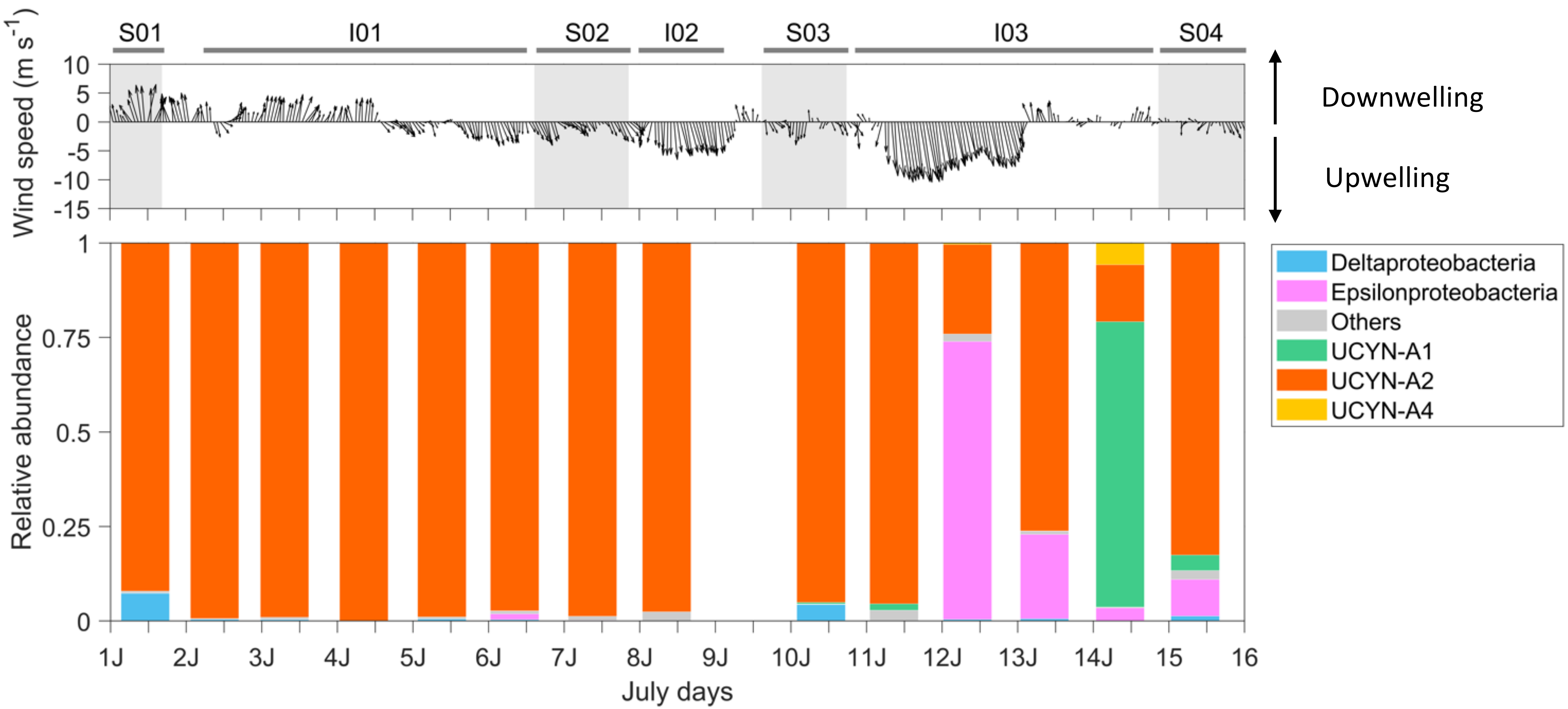
[3] NO_3 consumption on $\boldsymbol{\sigma}_t$=26.55 (NO_3=1.192$e^{-0.575t}$)

Biogeochemical role of N_2-fixation ($\mu molN\ m^{-2}\ d^{-1}$)



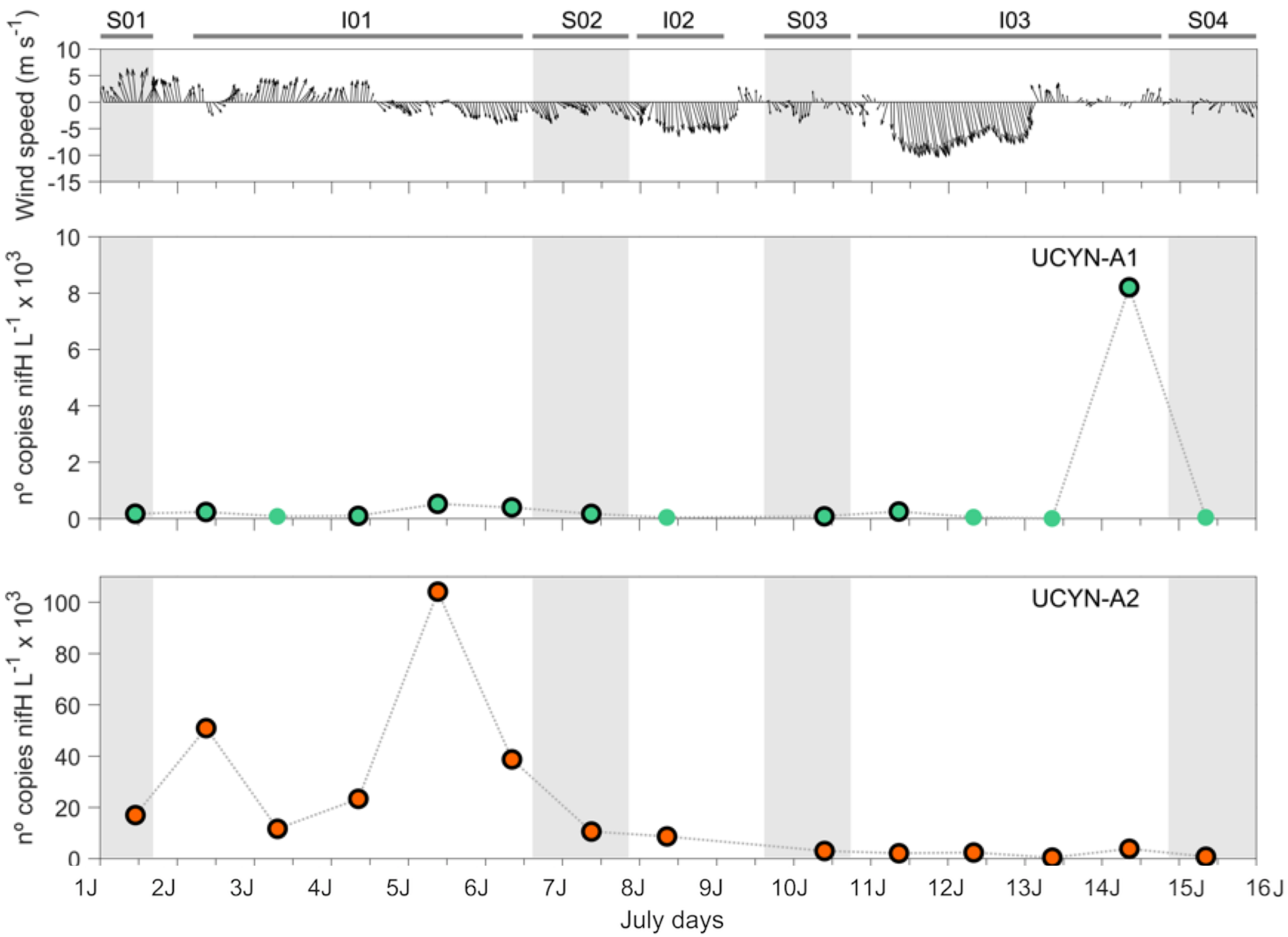
The comparison with NO_3 consumption and diffusion confirmed the minor role of N_2 Fix (<1%)

Diversity of the diazotrophic community (*nifH*)



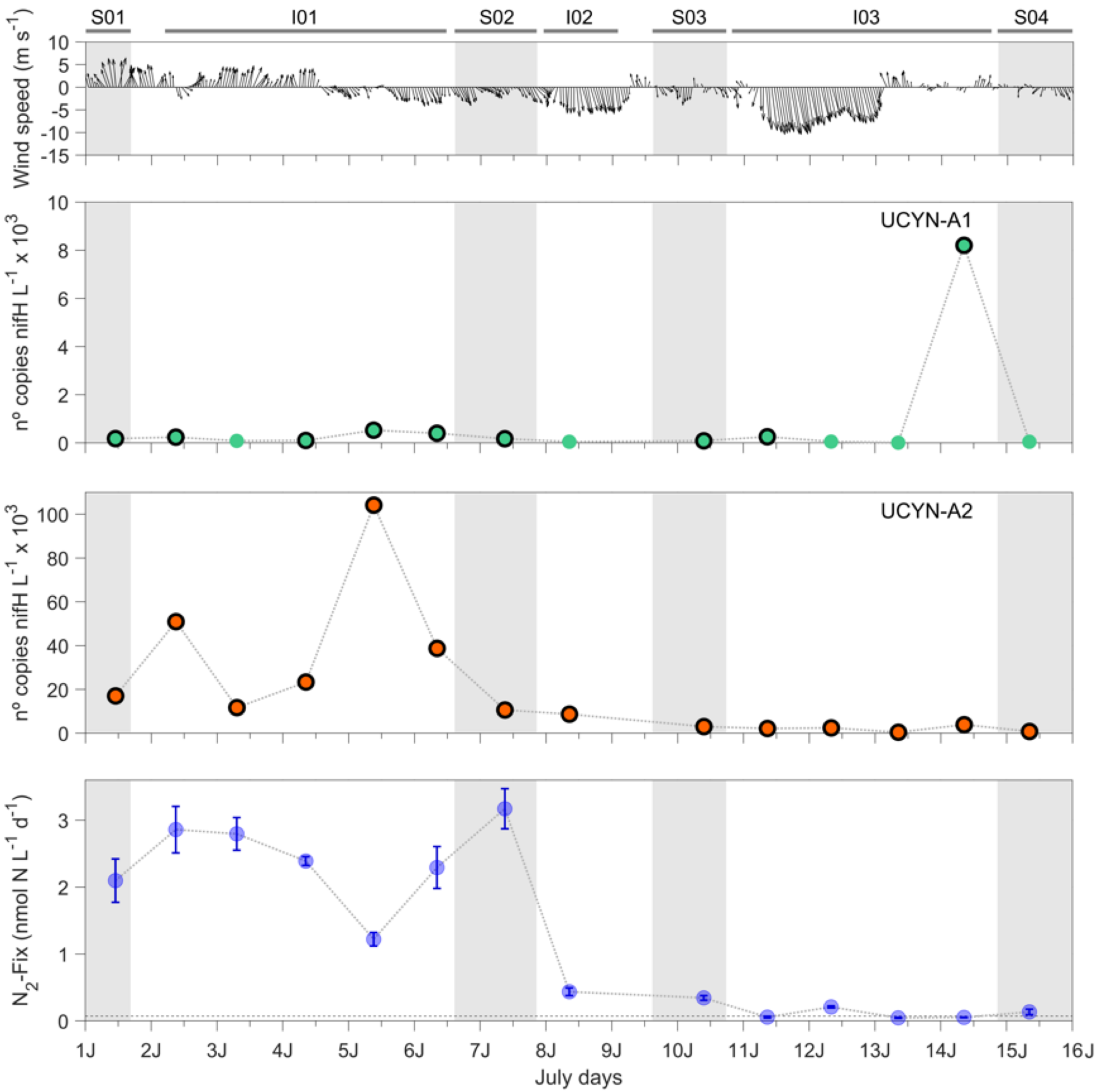
The unicellular cyanobacterium UCYN-A2 was the dominant diazotroph during the cruise

Abundance of UCYN-A1 and UCYN-A2 (qPCR)



UCYN-A2 abundance four times higher during relaxation-downwelling (4×10^4 copies L^{-1}) compared to upwelling (0.2×10^4 copies L^{-1})

Relationship between UCYN-A2 abundance and N_2 fixation



Positive relationship between UCYN-A2 abundance and N_2-fixation (R^2=0.50, $p<0.01$)

Conclusions

1. Minor role of N_2 Fix

2. Decrease in N_2 Fix rates from relaxation-downwelling to fertilizing upwelling

3. Dominant UCYN-A2 exhibited changes in abundance in parallel to N_2 Fix

Does diazotrophy activity and composition respond to the short-term variability in the upwelling-downwelling regime?

Diazotrophs respond rapidly to changes in the environment, and the availability of N controls their activity, composition and distribution

Thanks to...

- CTM2016-75451-779 C2-1-R to B. Mouriño-Carballido (Spanish government)