Rapid wind-driven fluctuations of the pycnocline drive phytoplankton blooms in a long, narrow bay

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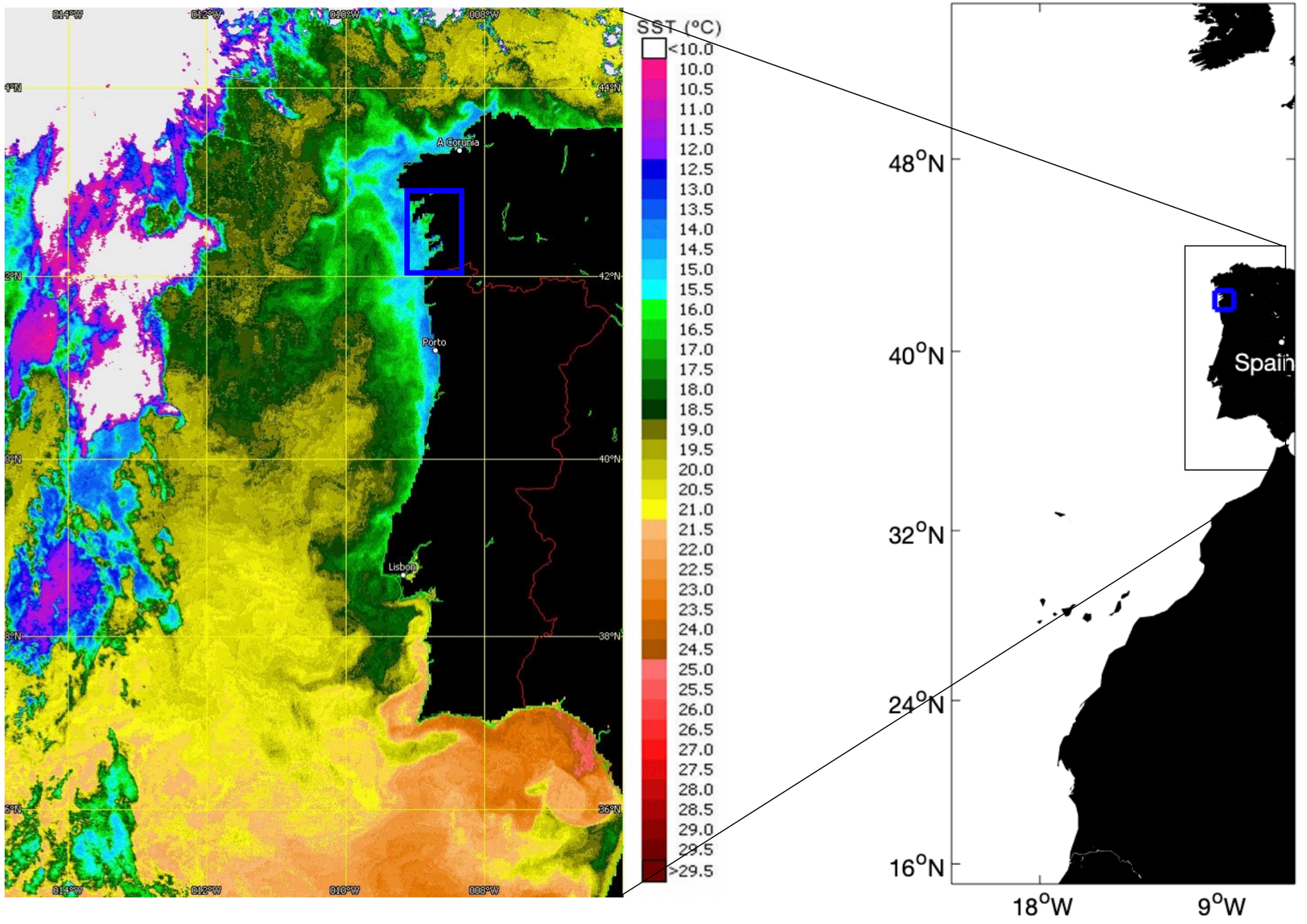
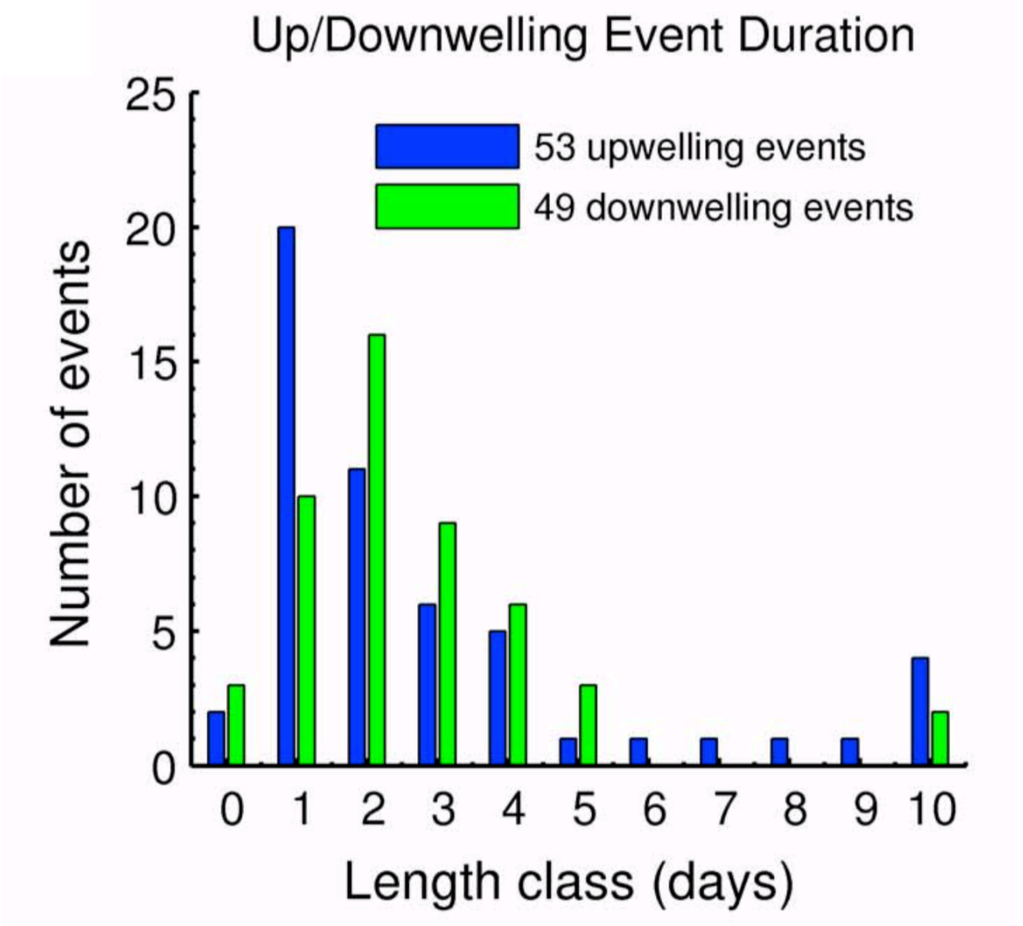
Canary Current-Iberian upwelling system



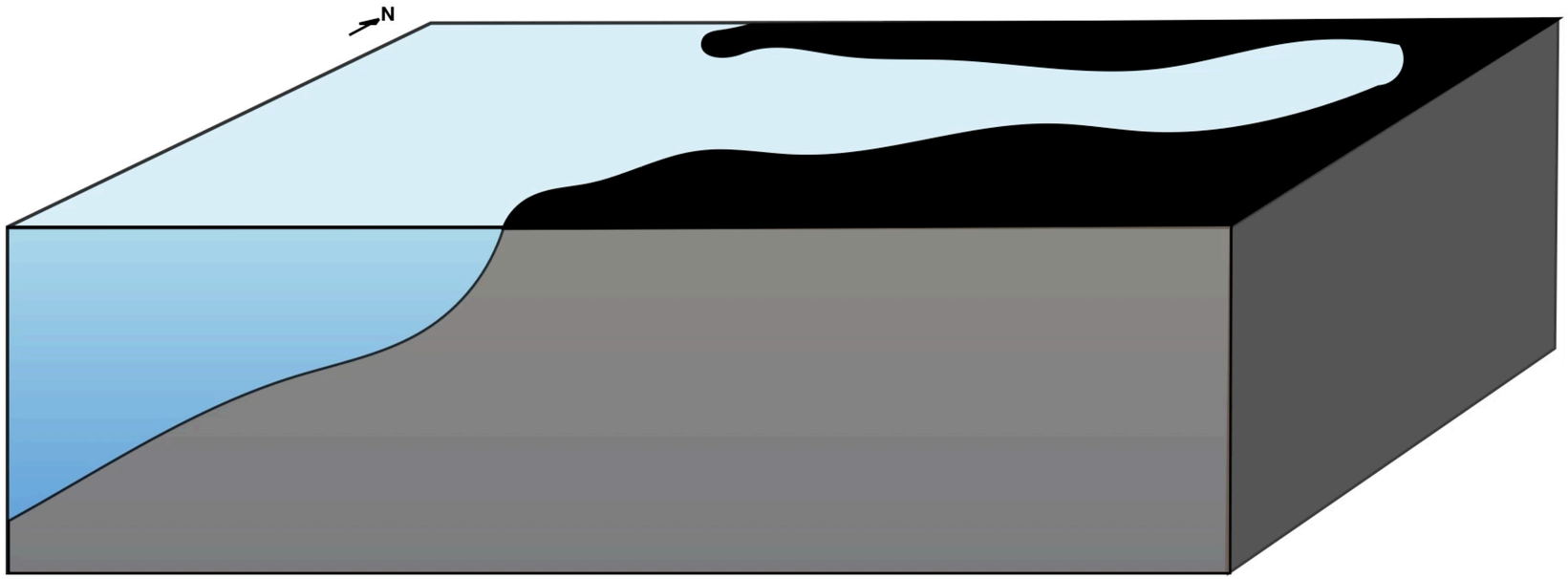
Dynamics



(Gilcoto et al., 2017)

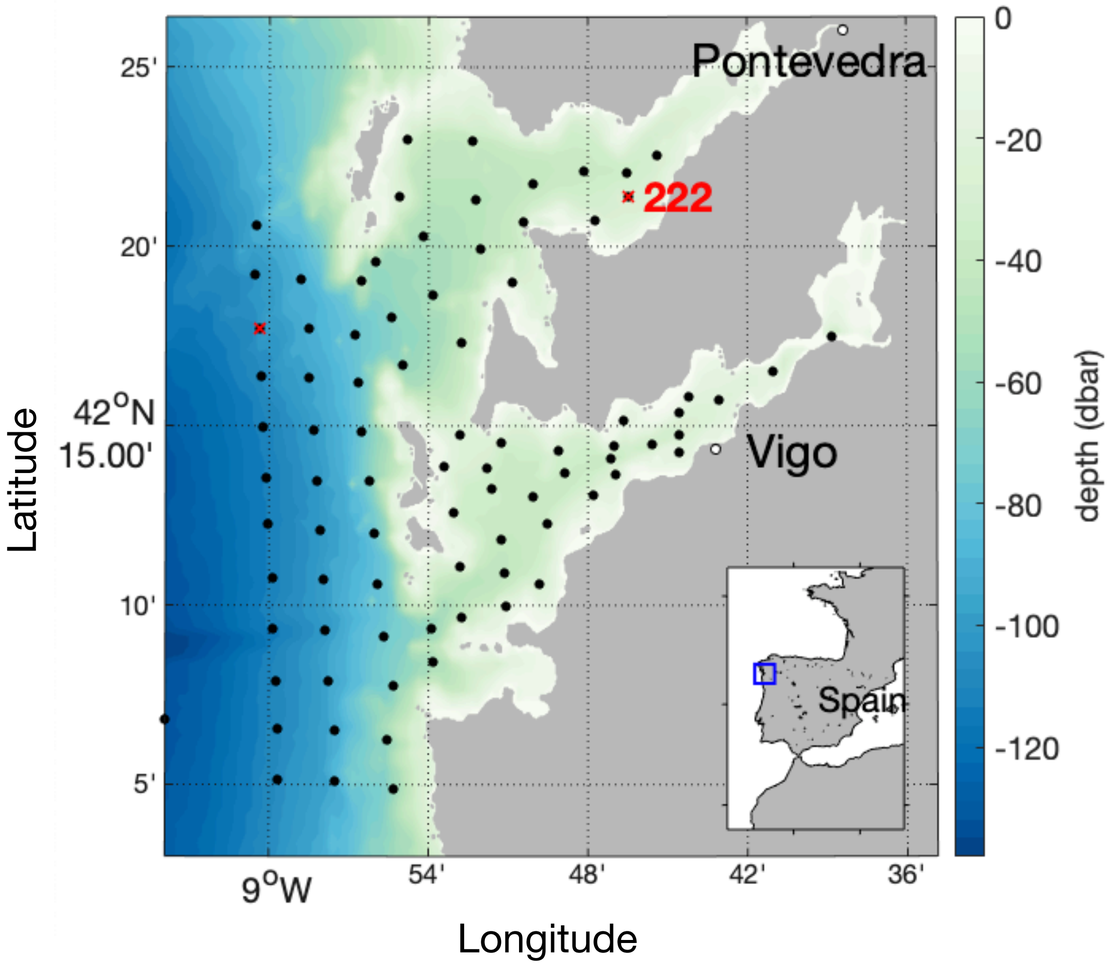
Dynamics

Upwelling in the Rías is enhanced by local wind in addition to the remote wind, leading hydrography changes in an hourly scale, shorter than the Ekman spin-up (Gilcoto et al., 2017)



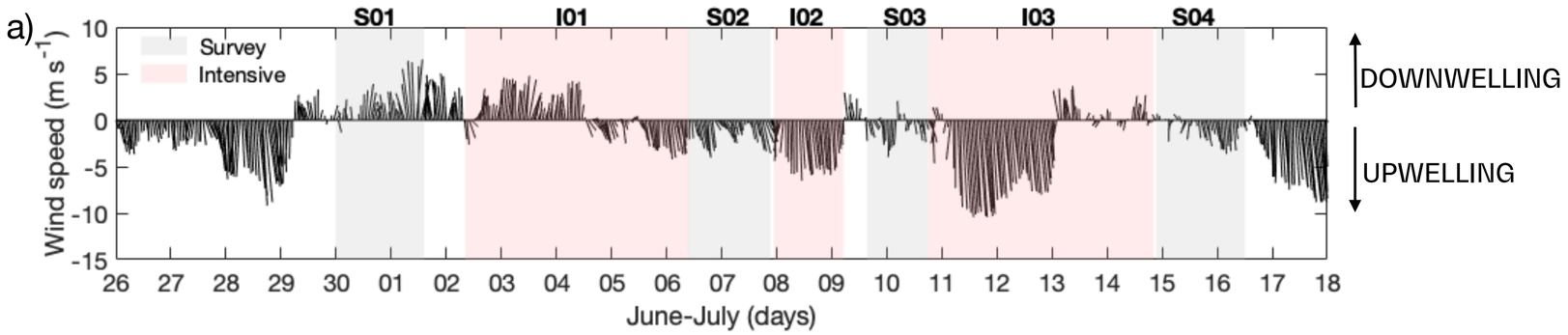
Can phytoplankton bloom in response to these short events?

REMEDIOS-TLP cruise, July 2018

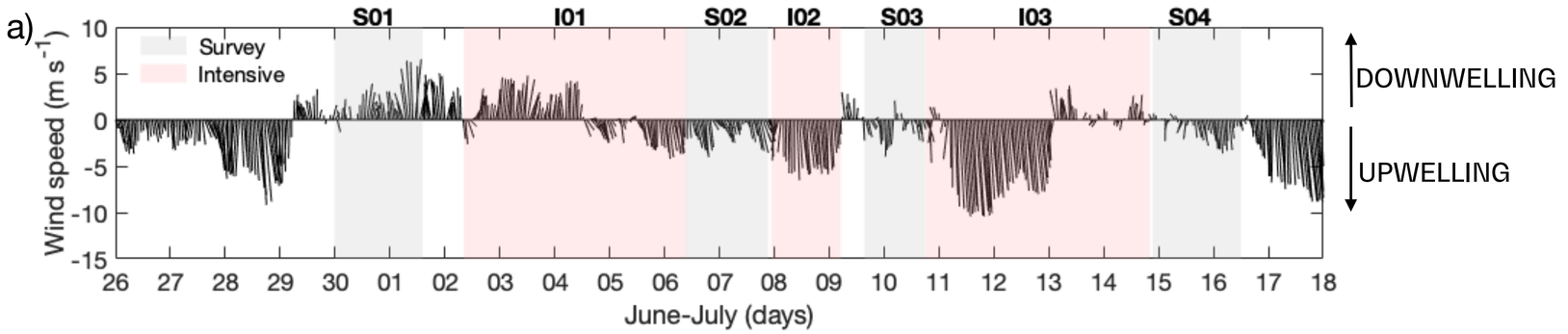


- **4 SURVEYS** (84 stations): S01, S02, S03 and S04
  - Hydrographic properties in 225 CTD profiles
- **3 INTENSIVES** at **222**: I01, I02, and I03
  - 5 high resolution CTD casts every 30 minutes (1674 profiles)
  - Water sampling at different depths every 6 h

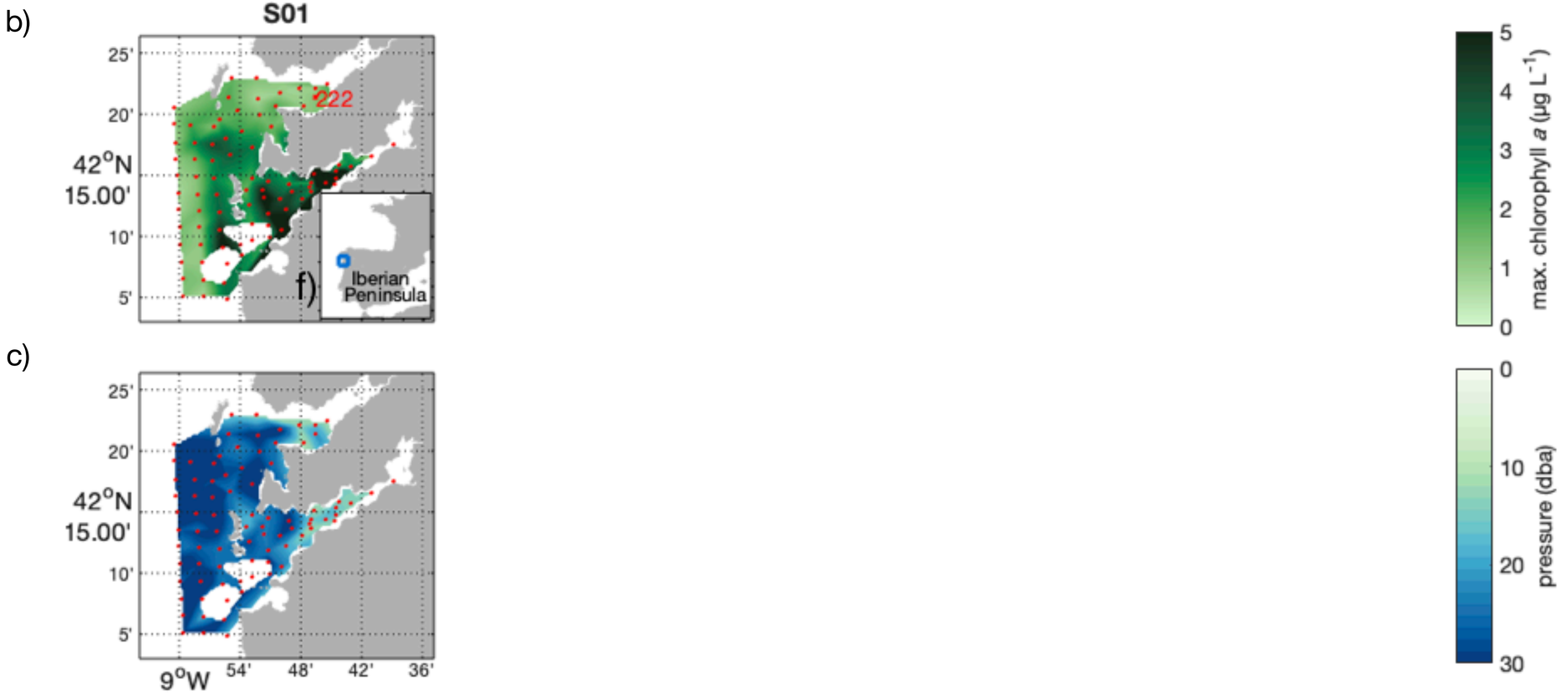
REMEDIOS-TLP cruise, July 2018



Spatial surveys



Maximum chlorophyll and its depth at σ_t=26.4-27 kg m^{-3}



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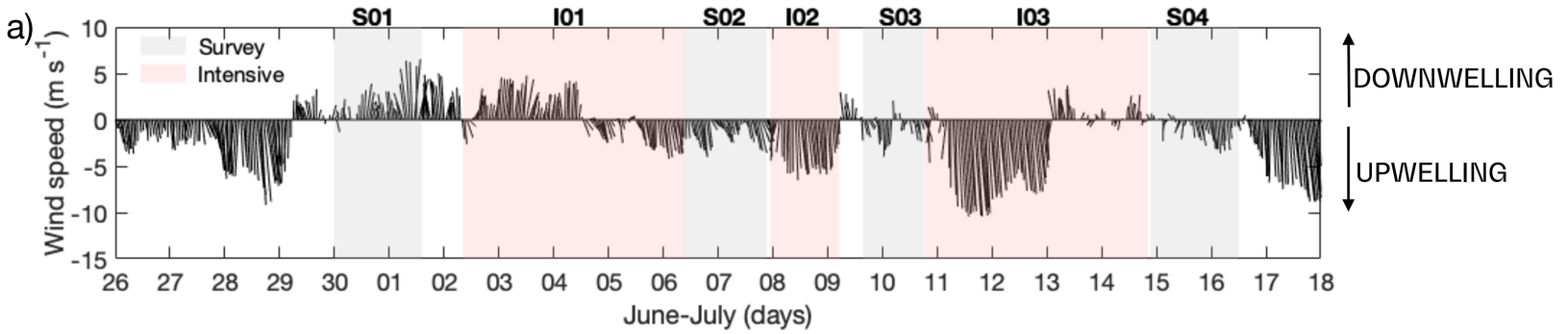

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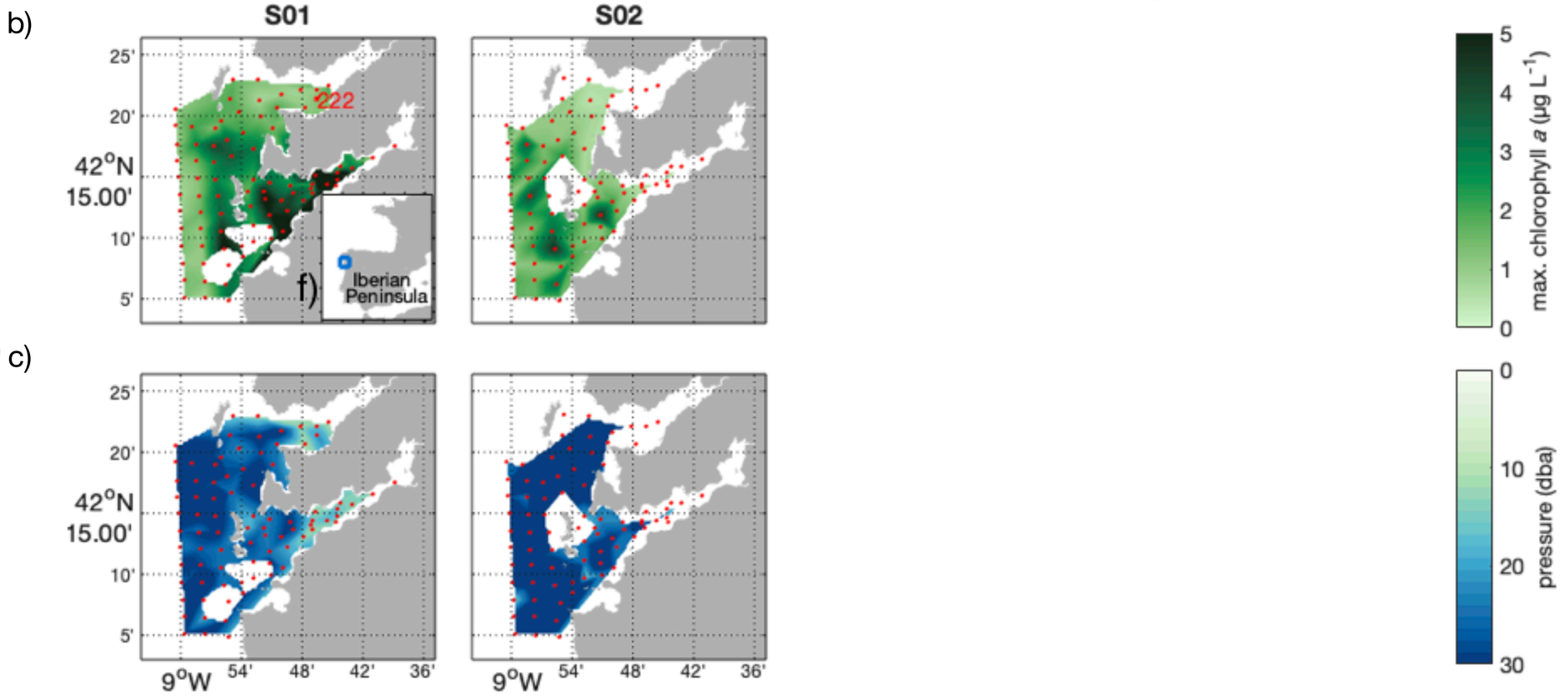
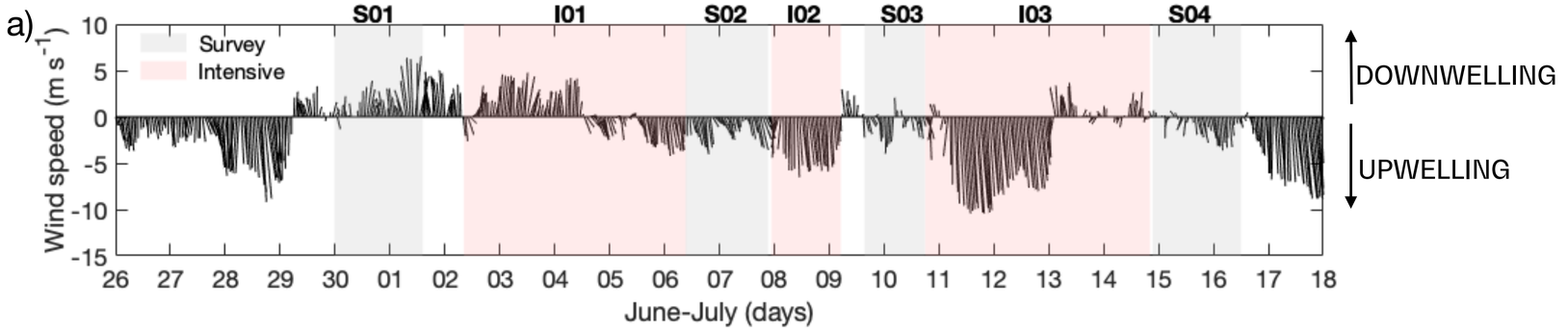


Spatial surveys



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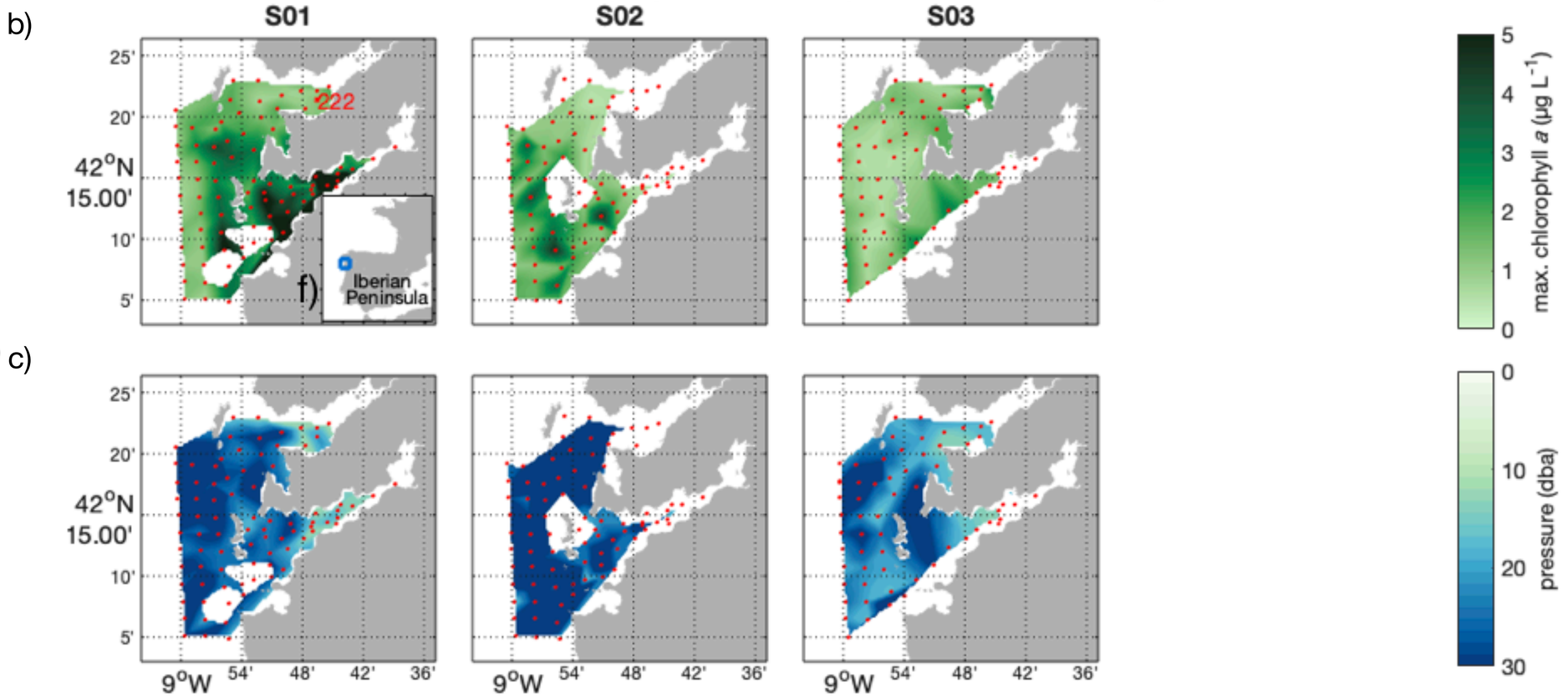

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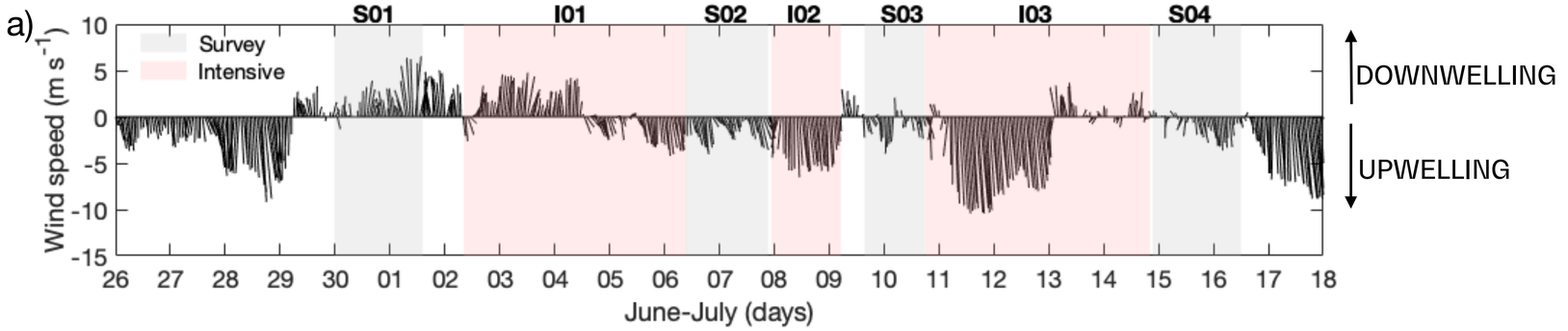

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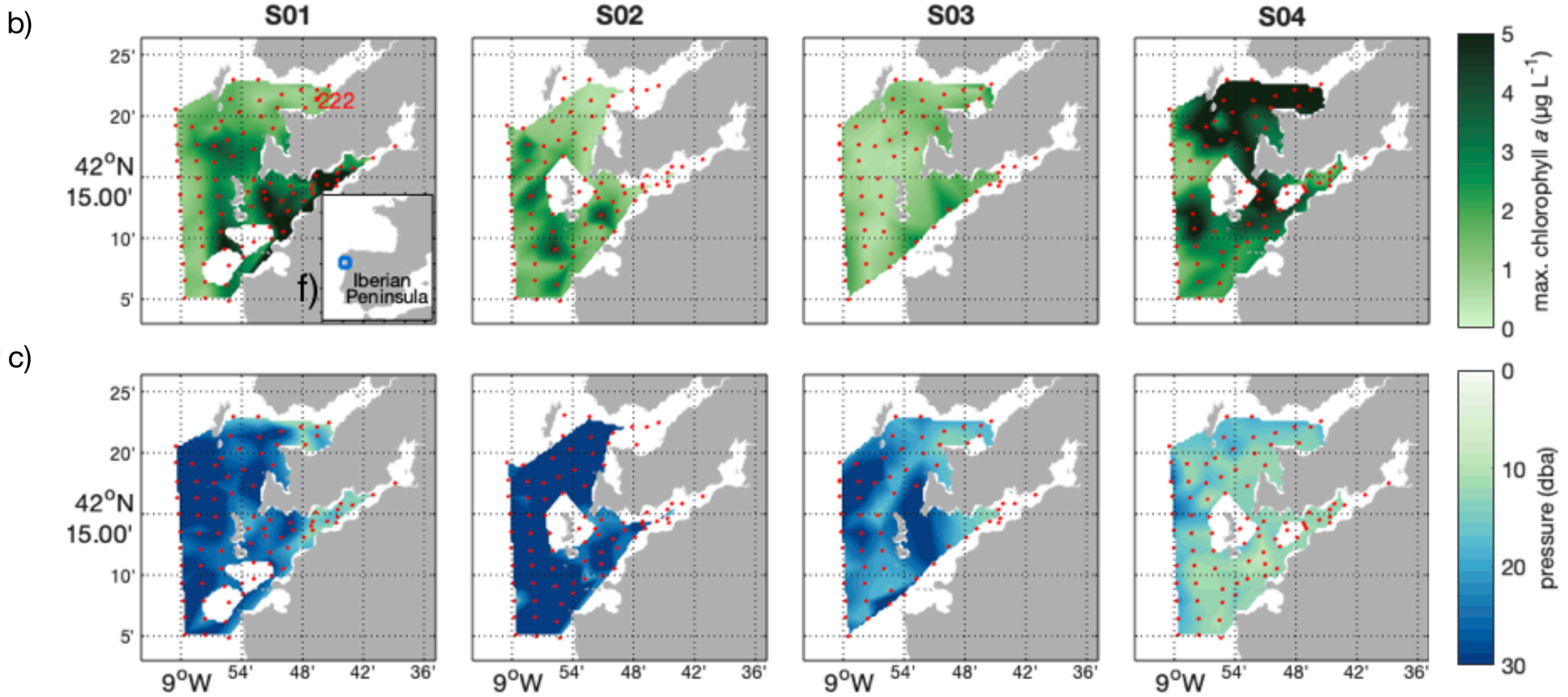
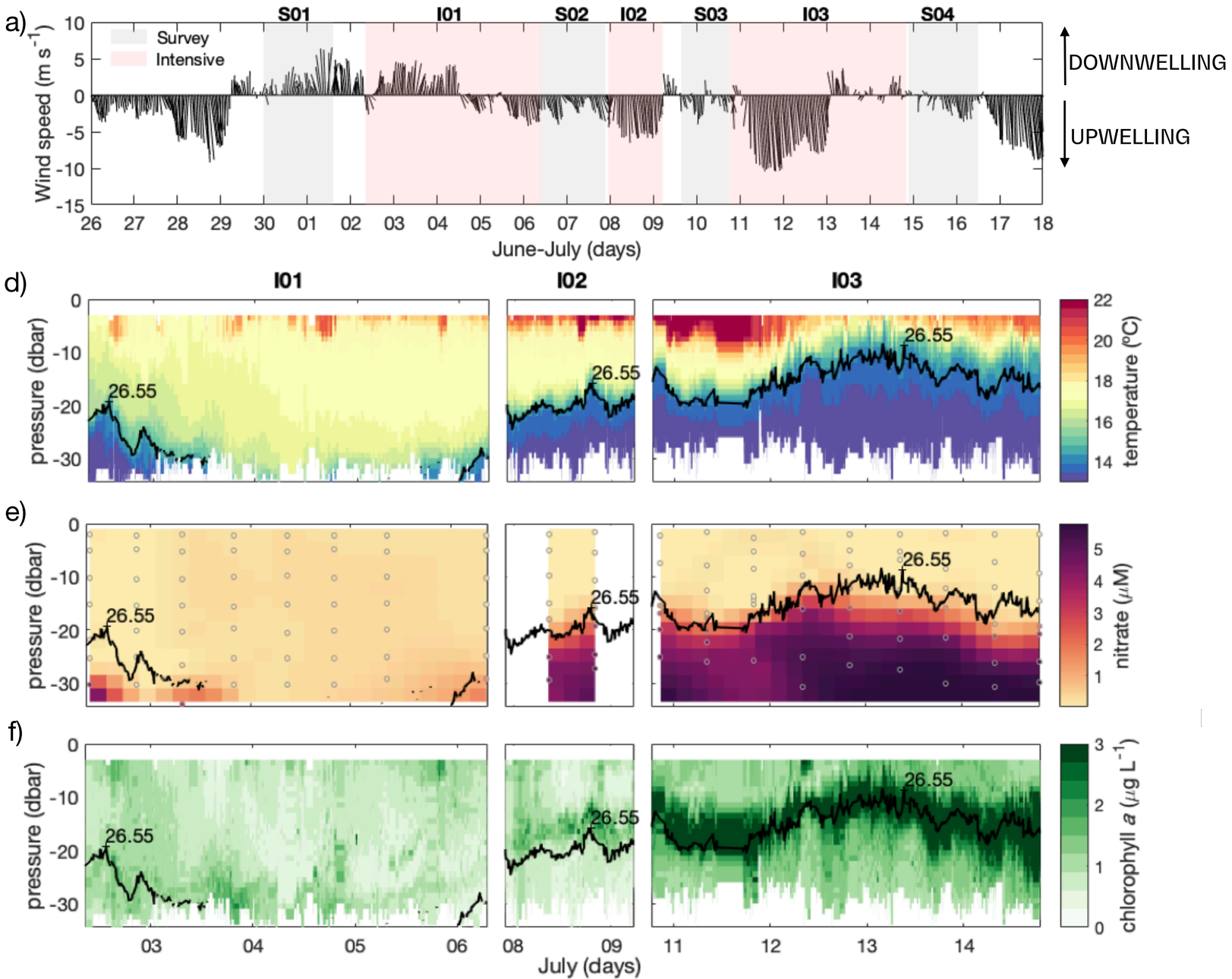
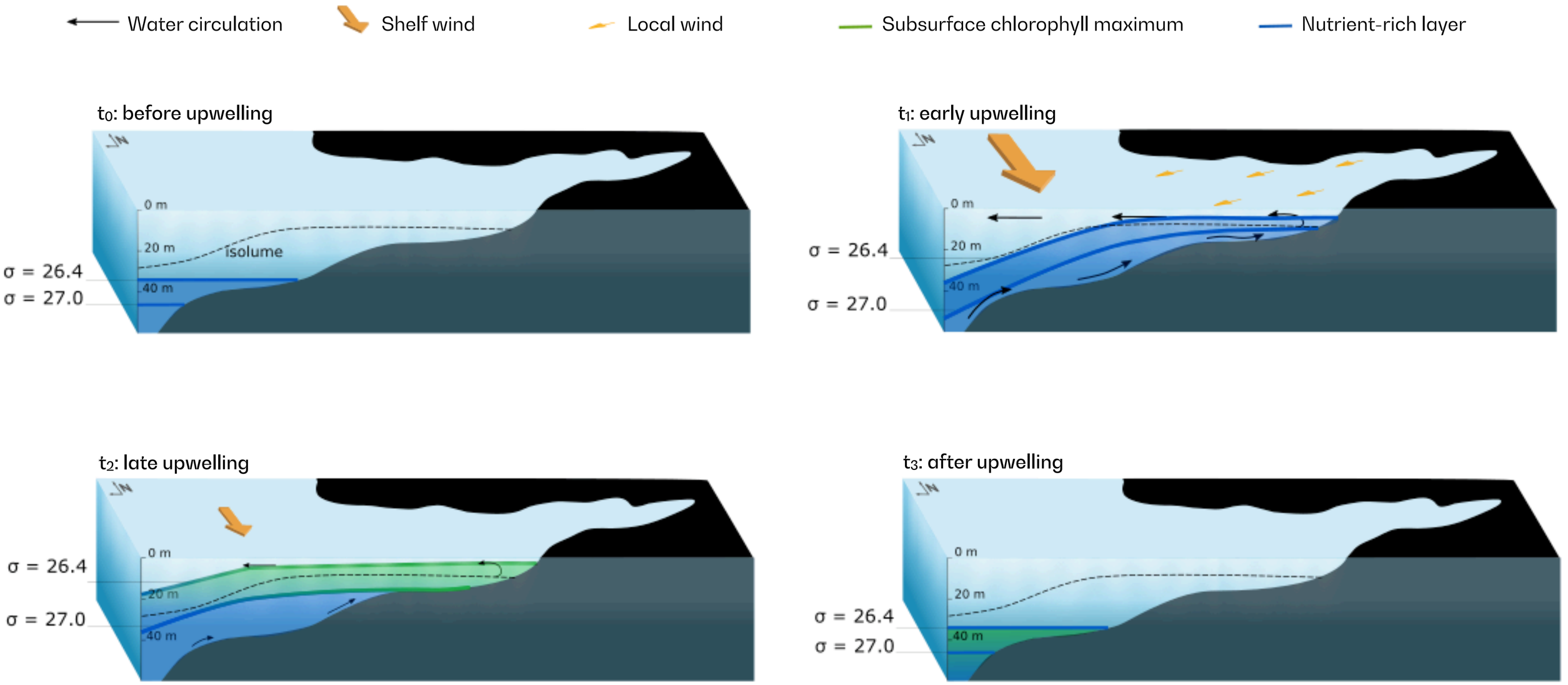


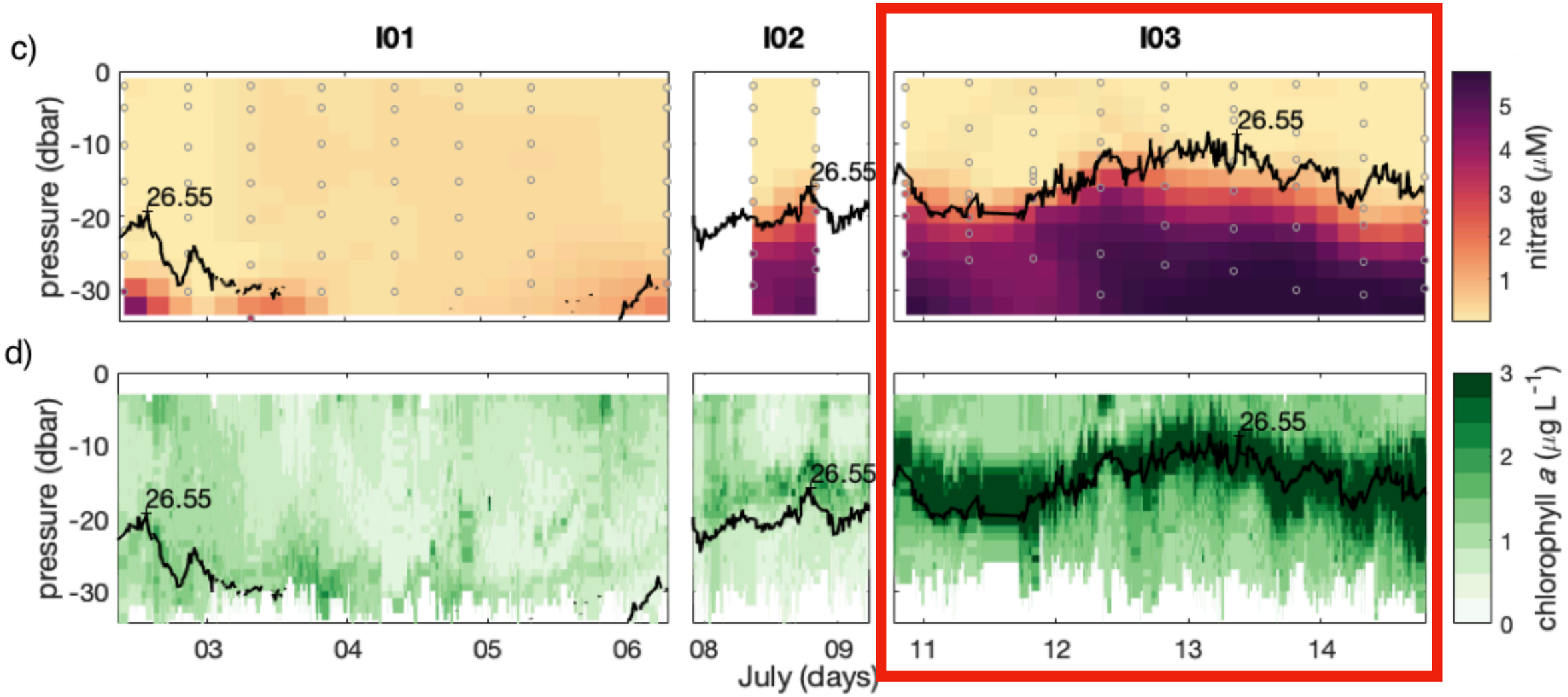
Intensive samplings



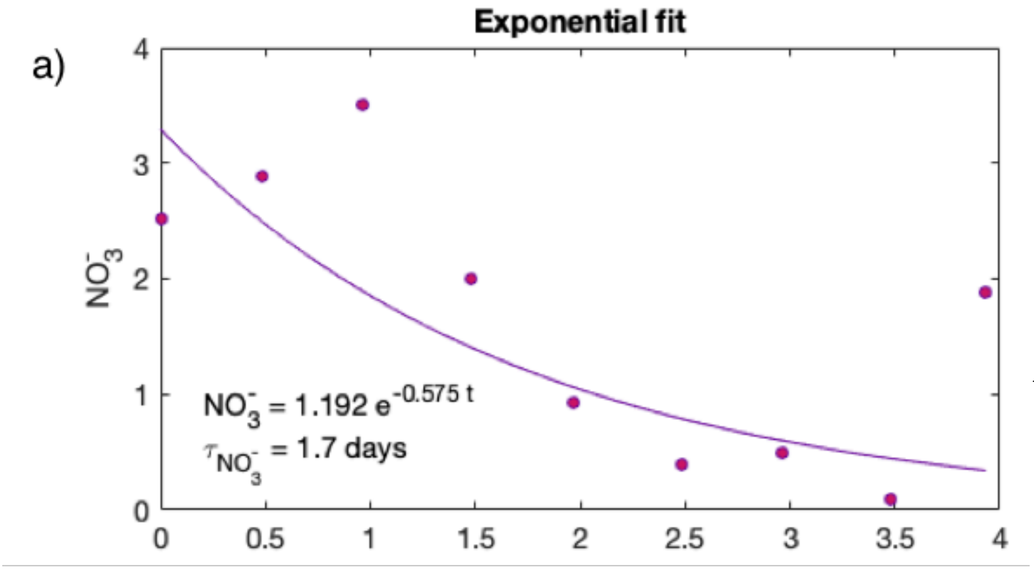
Wind-driven upwelling cycle

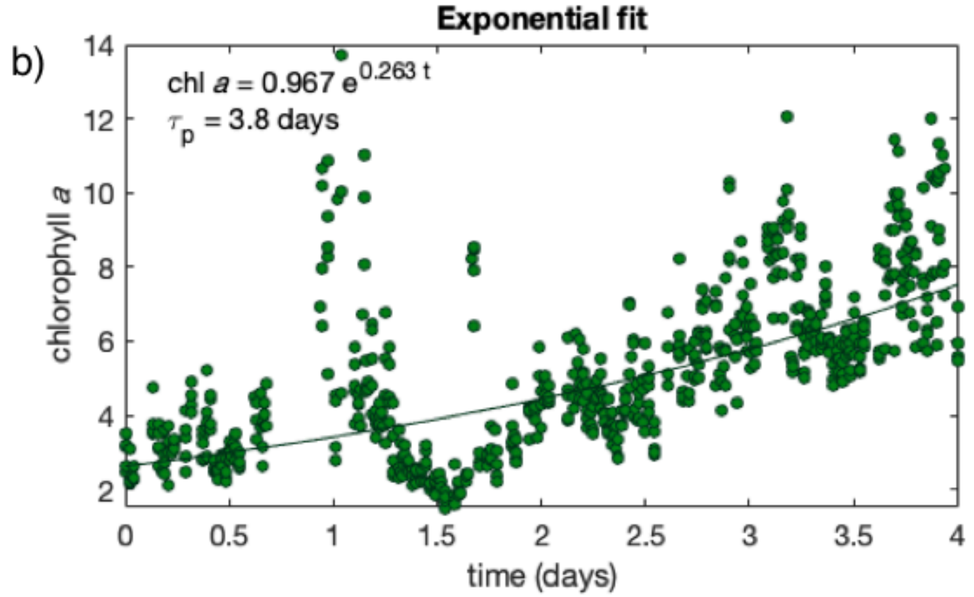


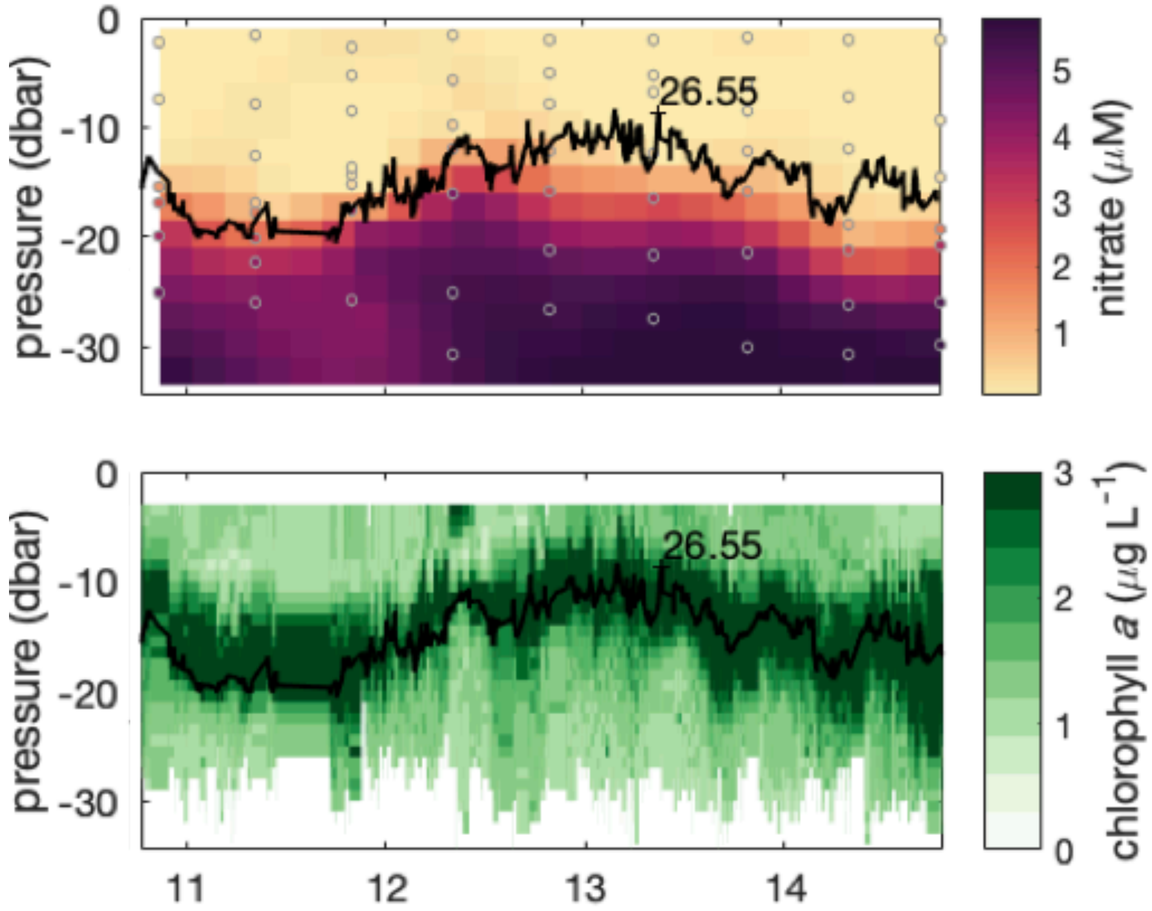
Time-scales


I01
I02
I03
c)
d)
pressure (dbar)
0
-10
-20
-30
26.55
nitrate (μM)
chlorophyll a (μg L-1)
03
04
05
06
08
09
11
12
13
14
July (days)

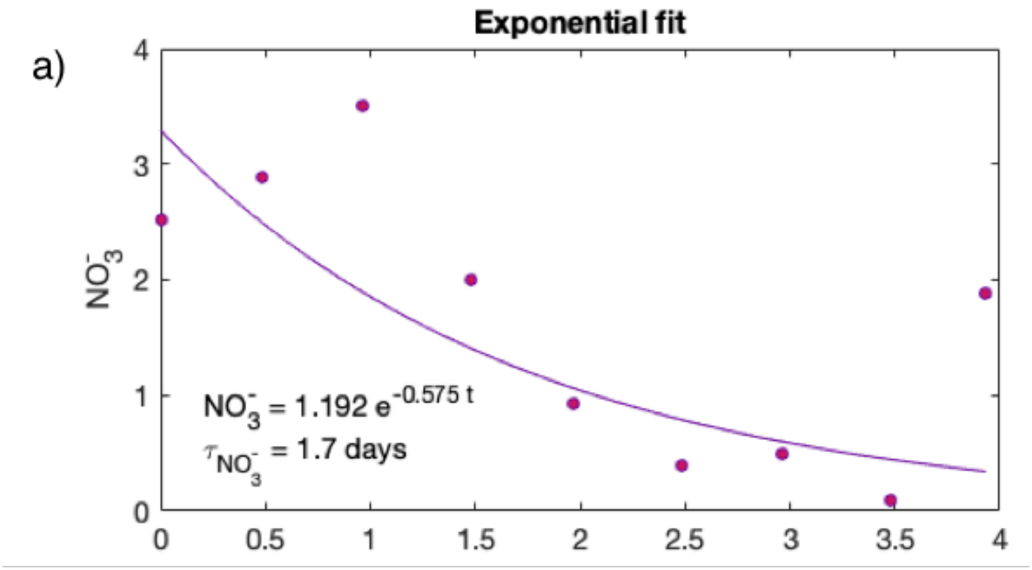
Time-scales

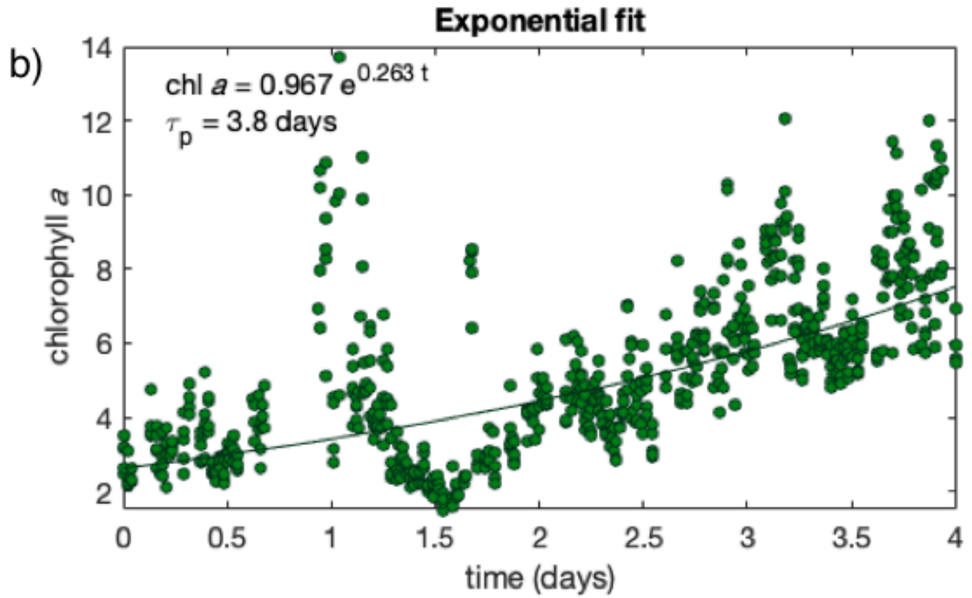

Exponential fit
a)
NO_3^-
$NO_3^- = 1.192\ e^{-0.575\ t}$
$\tau_{NO_3^-} = 1.7$ days


Exponential fit
b)
chl *a* = 0.967 $e^{0.263\ t}$
τ_p = 3.8 days
chlorophyll *a*
time (days)


pressure (dbar)
26.55
nitrate (μM)
chlorophyll *a* (μg L^{-1})

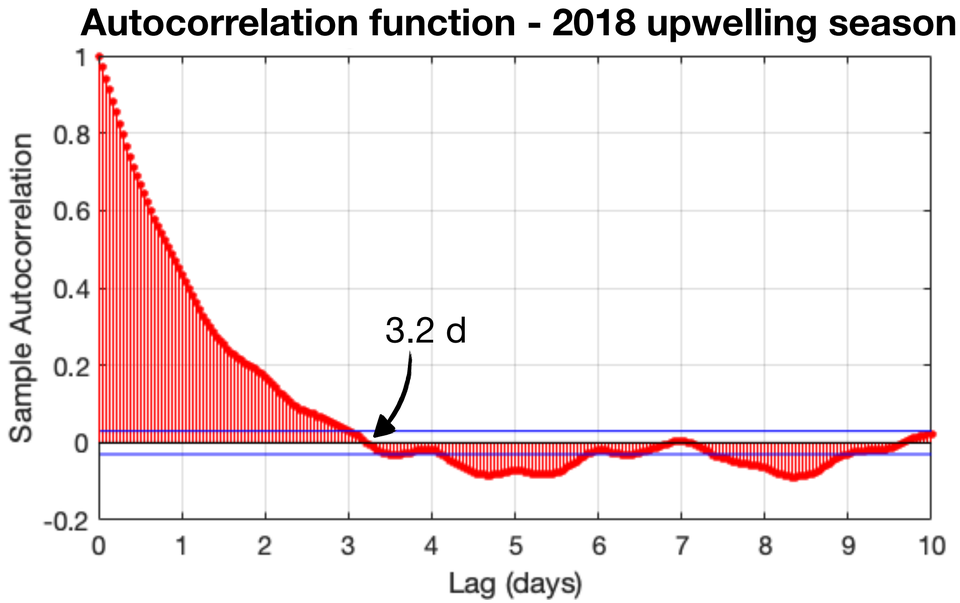
Time-scales





- The e-folding scales
  - Nitrate uptake $\tau_{NO_3^-}$= **1.74 d**
  - Chlorophyll accumulation τ_{Chl}= **3.80 d**
- Wind-decorrelation time-scale during the summer 2018 upwelling season = **3.2 d**

c)



Can phytoplankton bloom in response to these short events?

- Phytoplankton responds rapidly (~hours) to the transient exposure of deep, nutrient-rich isopycnals to light during upwelling pulses in the Rías

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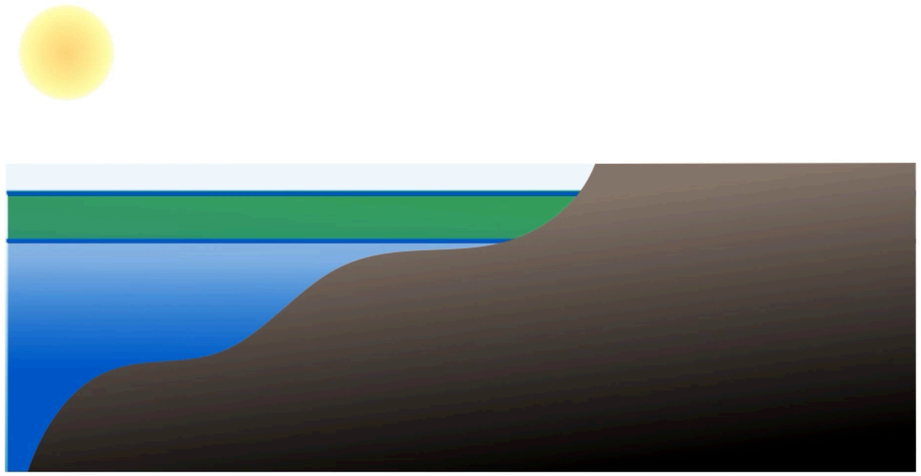
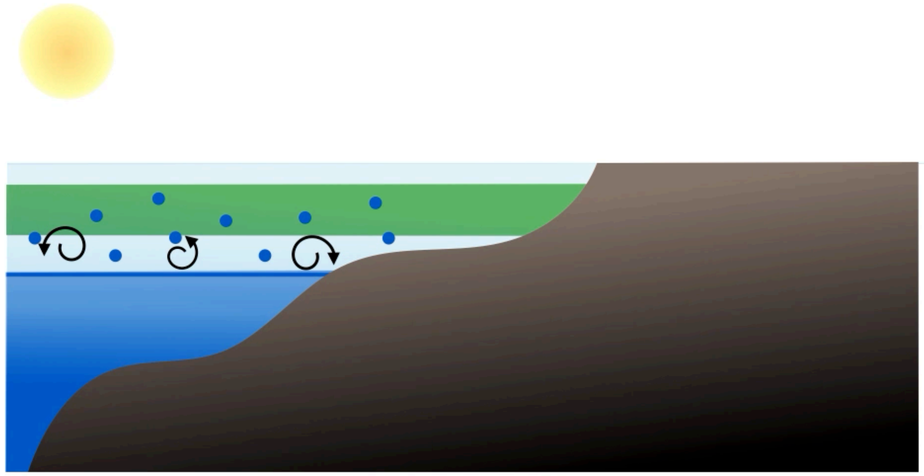
- Phytoplankton responds rapidly (~hours) to the transient exposure of deep, nutrient-rich isopycnals to light during upwelling pulses in the Rías

- Short-lived phytoplankton blooms, which explain the elevated primary productivity in the region, are thus mainly explained by the adiabatic, reversible upwelling of deep isopycnals, rather than the fertilization of surface waters by diapycnal mixing.

ADIABATIC, REVERSIBLE UPWELLING



DIAPYCNAL MIXING



Acknowledgements

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XUNTA DE GALICIA

http://proyectoremedios.com

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Thank you for your attention!

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