Spatio-temporal distribution of air-water CO_2 exchange in Doñana wetlands (Spain)

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3

9th INTECOL INTERNATIONAL WETLANDS CONFERENCE

WETLANDS IN A COMPLEX WORLD

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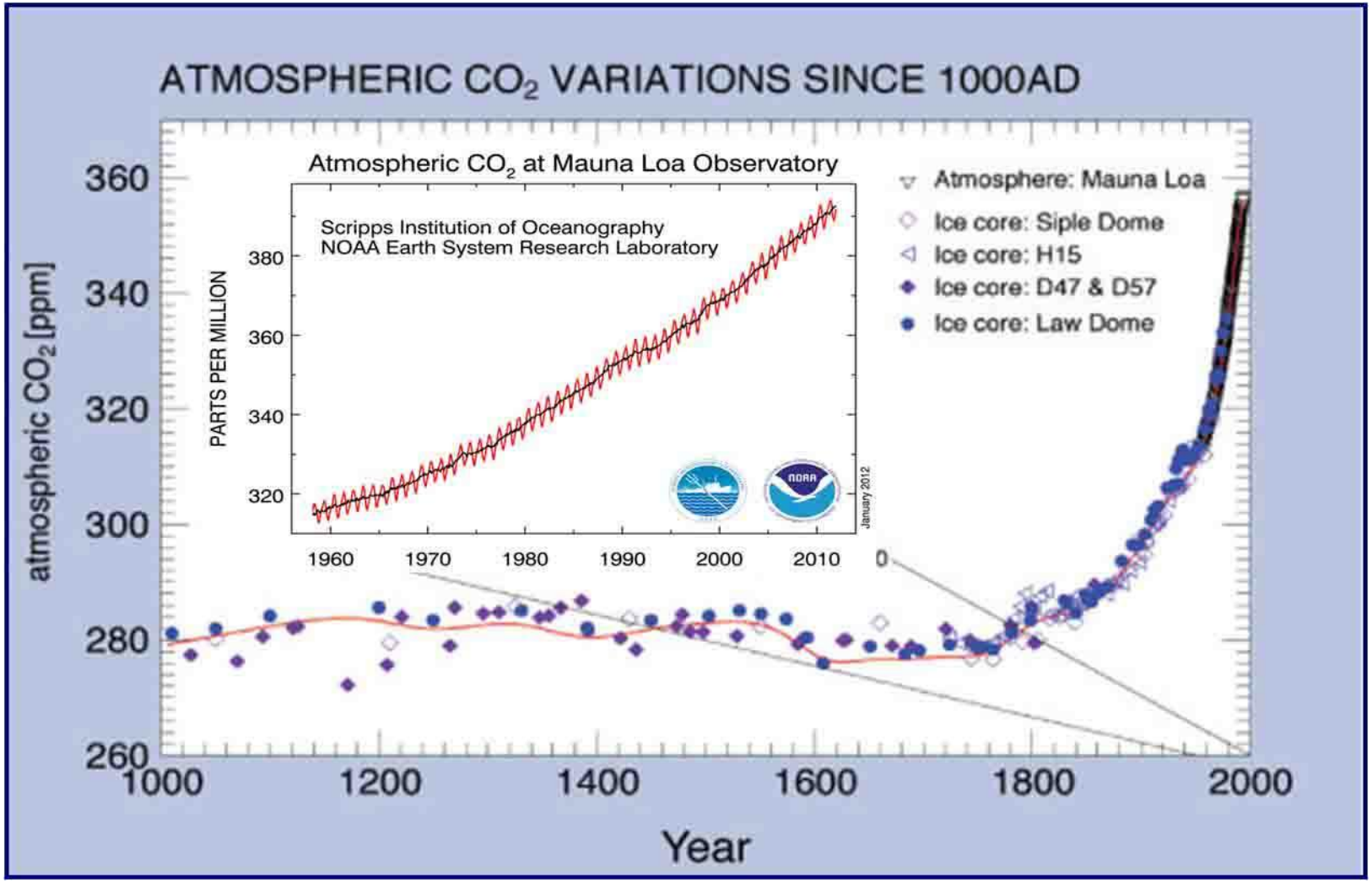
Contents

1. Introduction:
   - The CO_2 problem
   - Study Area
2. Methodology
3. Results
4. Conclusions
5. Future outgoing

1. Introduction: CO_2 Problem



Gruber, Keeling and Bates (2002) *Science*

1. Introduction: CO_2 Problem

Fate of Anthropogenic CO_2 Emissions (2010)

9.1±0.5 PgC y^{-1}

0.9±0.7 PgC y^{-1}

+

5.0±0.2 PgC y^{-1}

50%

2.6±1.0 PgC y^{-1}

26%

Calculated as the residual of all other flux components

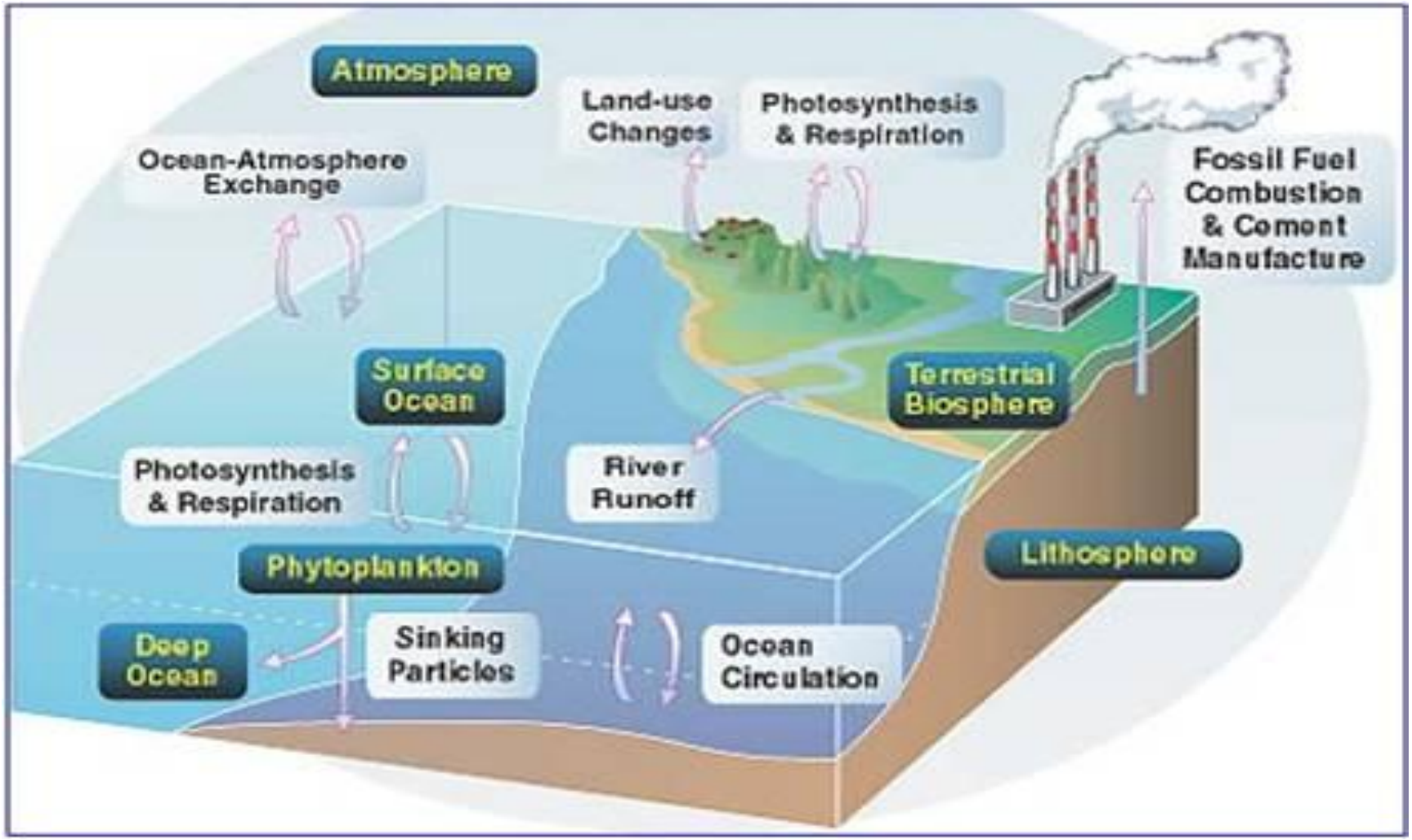
24%

2.4±0.5 PgC y^{-1}

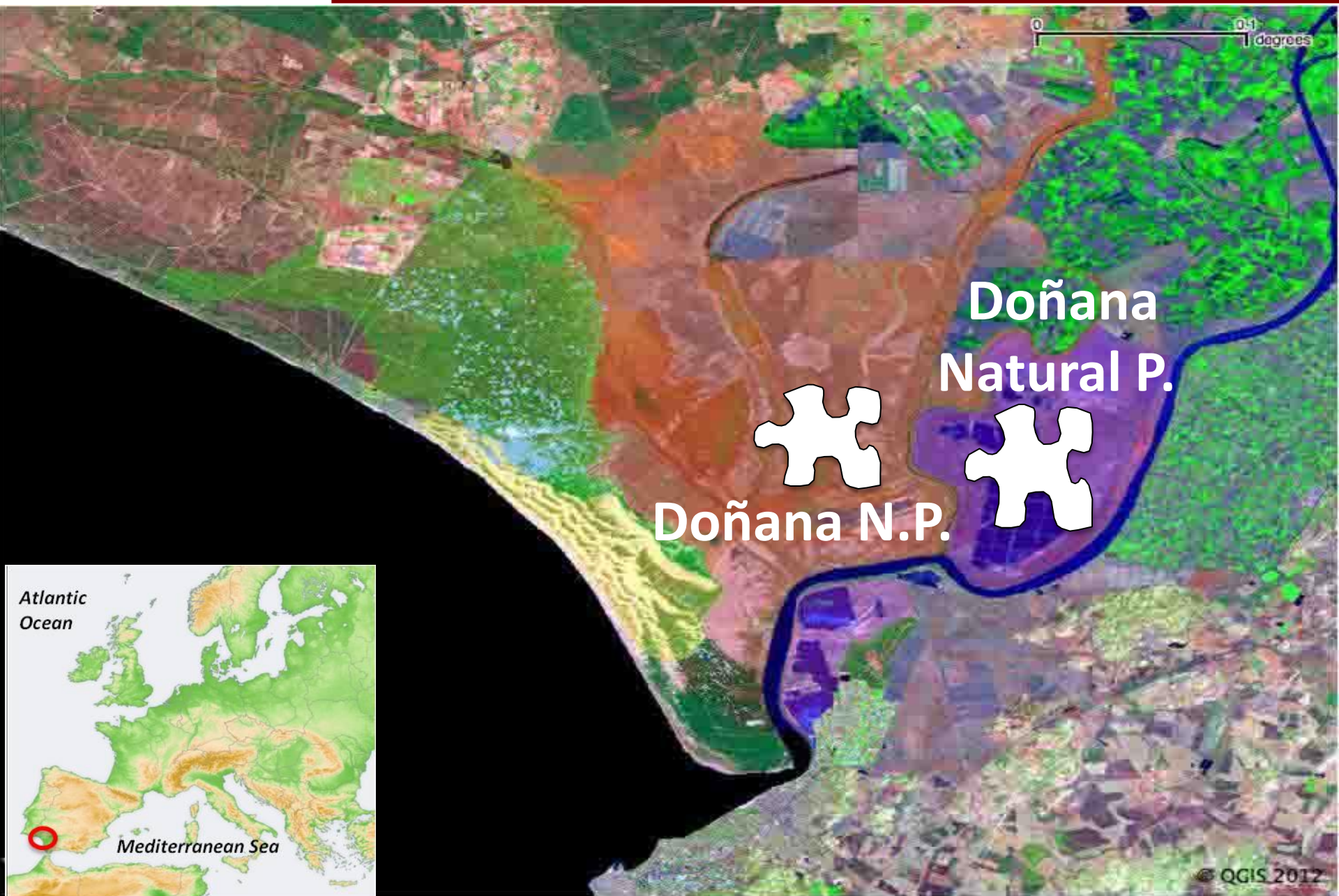
Average of 5 models

Global Carbon Project 2010; Updated from Le Quéré et al. 2009, Nature Geoscience; Canadell et al. 2007, PNAS

1. Introduction: CO_2 Problem



1. Introduction: Study Area



1. Introduction : Relevance

Global ecological significance




- Declared UNESCO Biosphere Reserve (1981).
- World Heritage Site (1994).
- Listed under the Ramsar Wetland Convention.
- Habitat of the Iberian Lynx

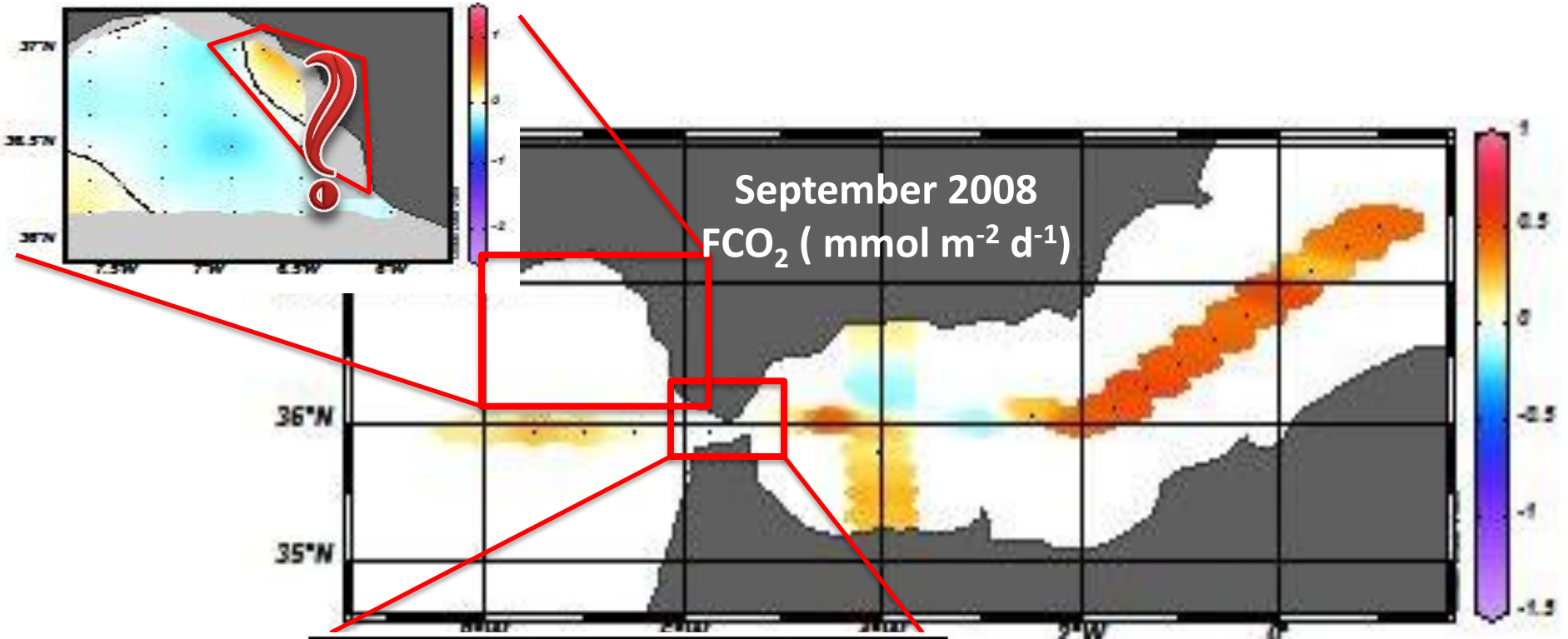
1. Introduction : Relevance

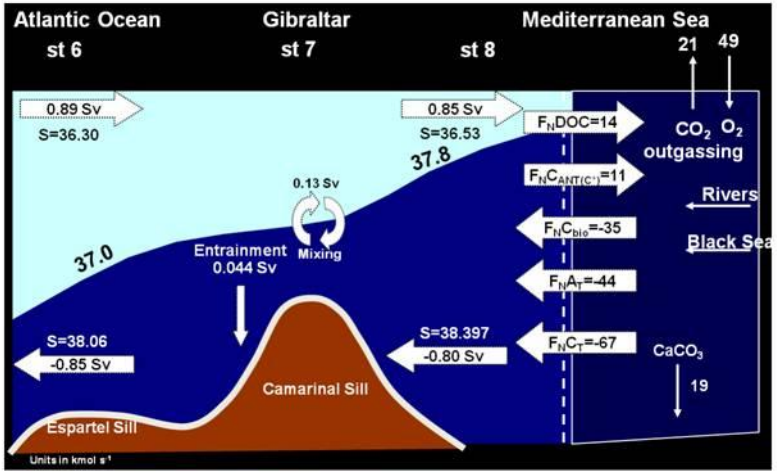
Socio-economic importance



- Important fishing activity in the Coastal area.
- Guadalquivir river, only navigable river in Spain.
- Touristic importance of the National park:~ 400000 visits per year.
- Strong agriculture and aquaculture sectors in the natural park

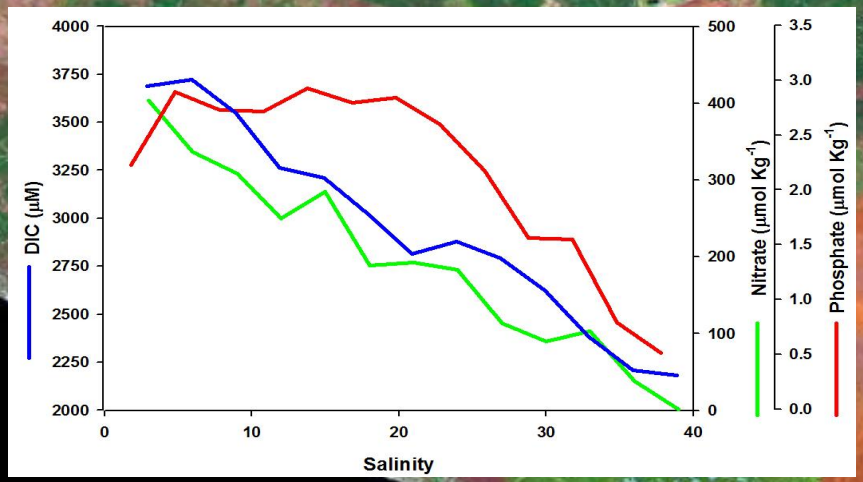
1. Introduction: Study Area

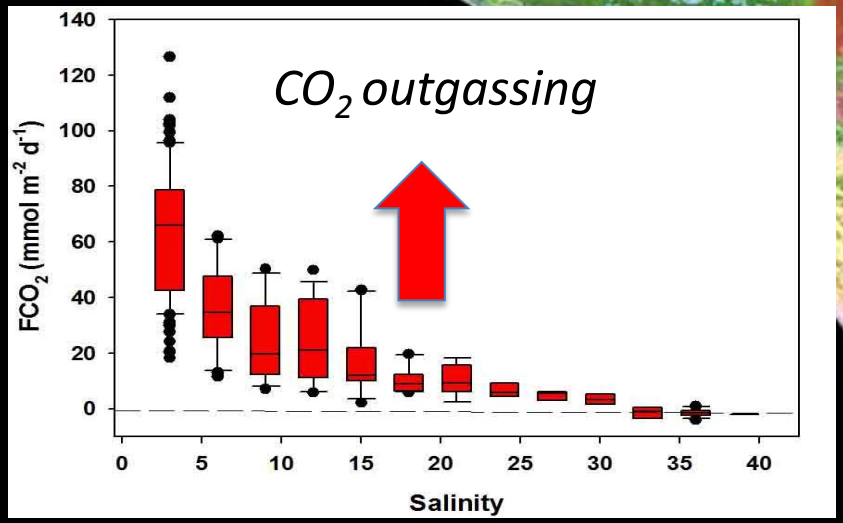




Huertas et al., (2006) *Deep-Sea Res. II*
Huertas et al., (2009) *Biogeosciences*
Flecha et al., (2011) *Jour. Mar. Syst*
de la paz et al., (2011) *Aquat. Sci.*

Introduction: Study Area



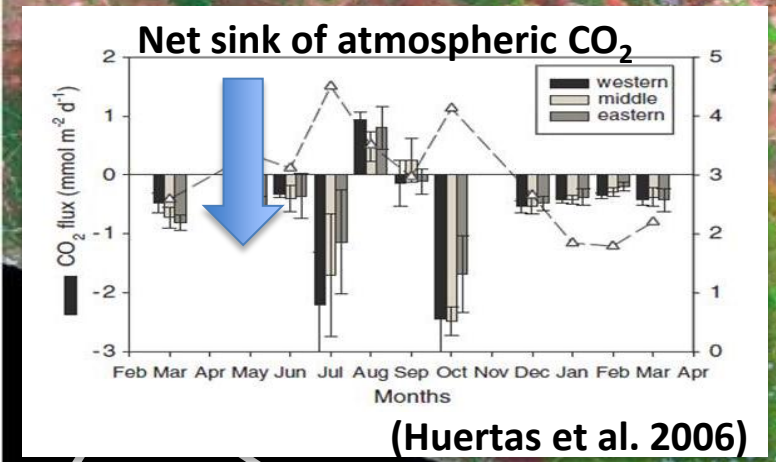


Guadalquivir estuary:

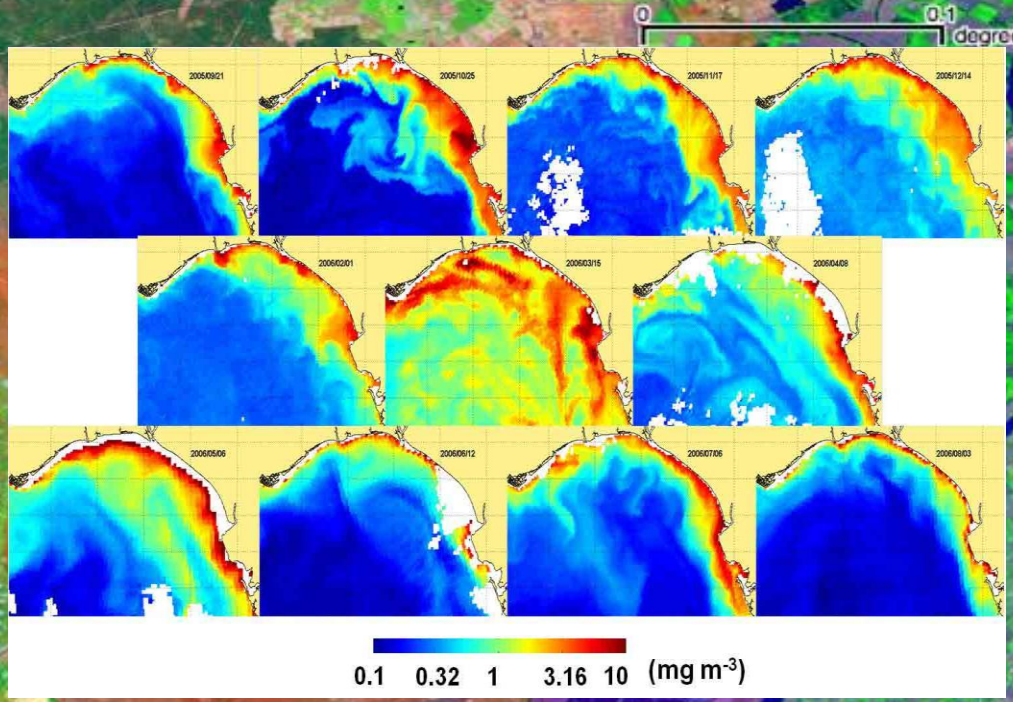
- High nutrients loads
- Export of inorganic carbon to the coastal area.

Estuary

Introduction: Study Area



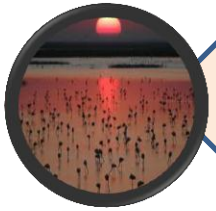
(Huertas et al. 2006)



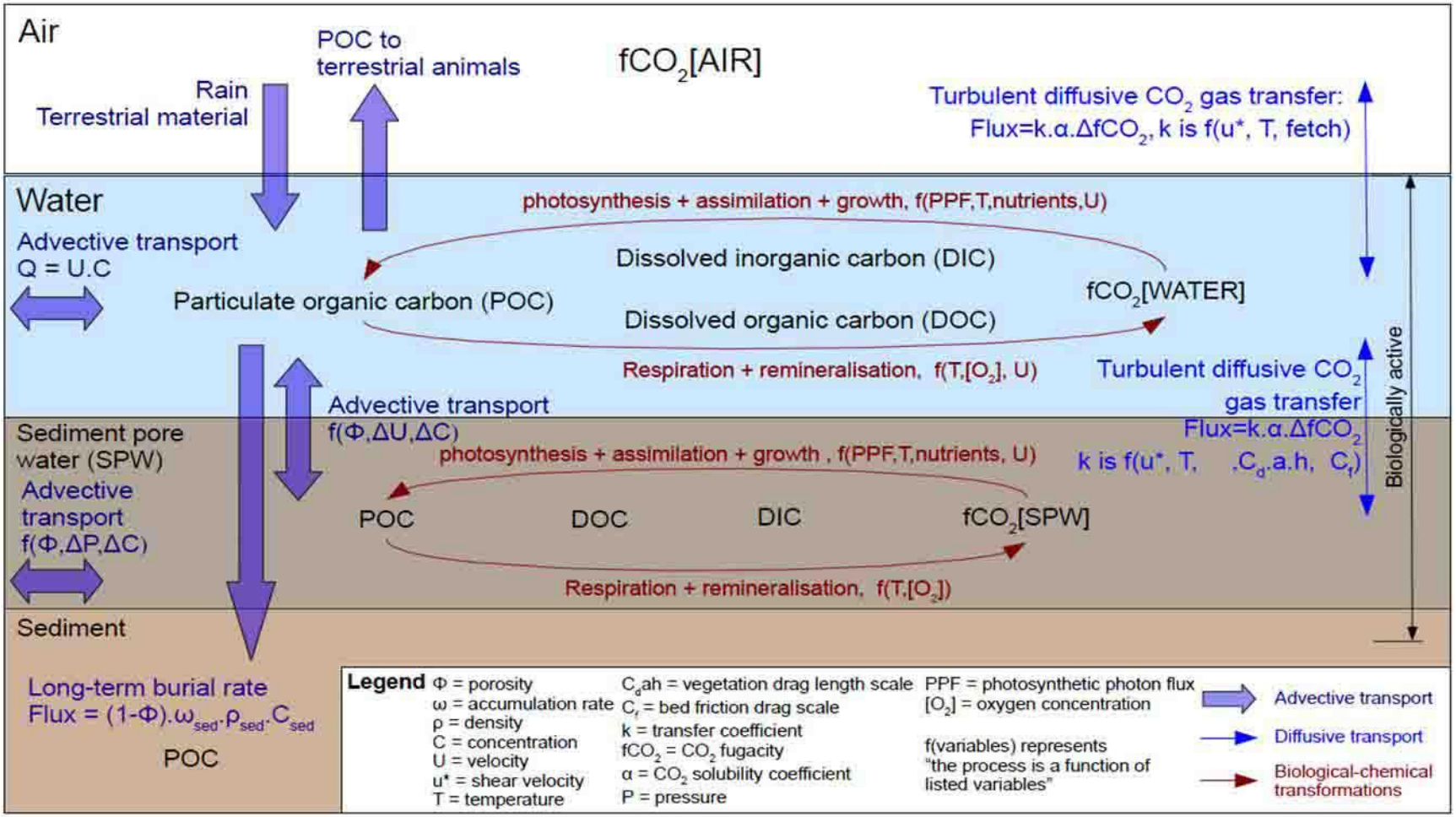
Coastal Area

- High primary production with a strong seasonality.
- Net sink of CO_2 on annual basis

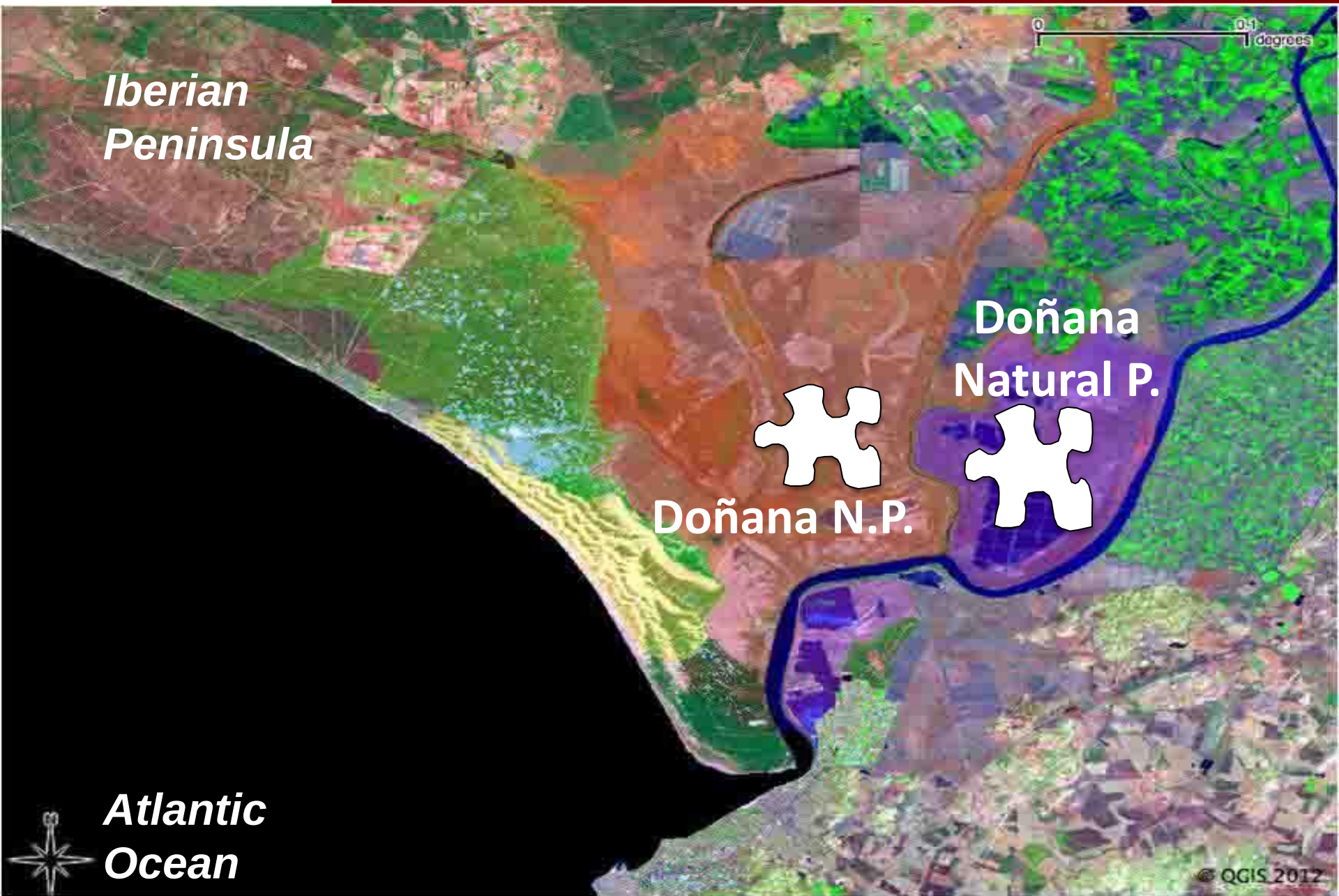
1. Introduction: Objective



Solve carbon cycle in Doñana aquatic compartiment and its relantionship with surrounding ecosystems



2. Methodology: Doñana



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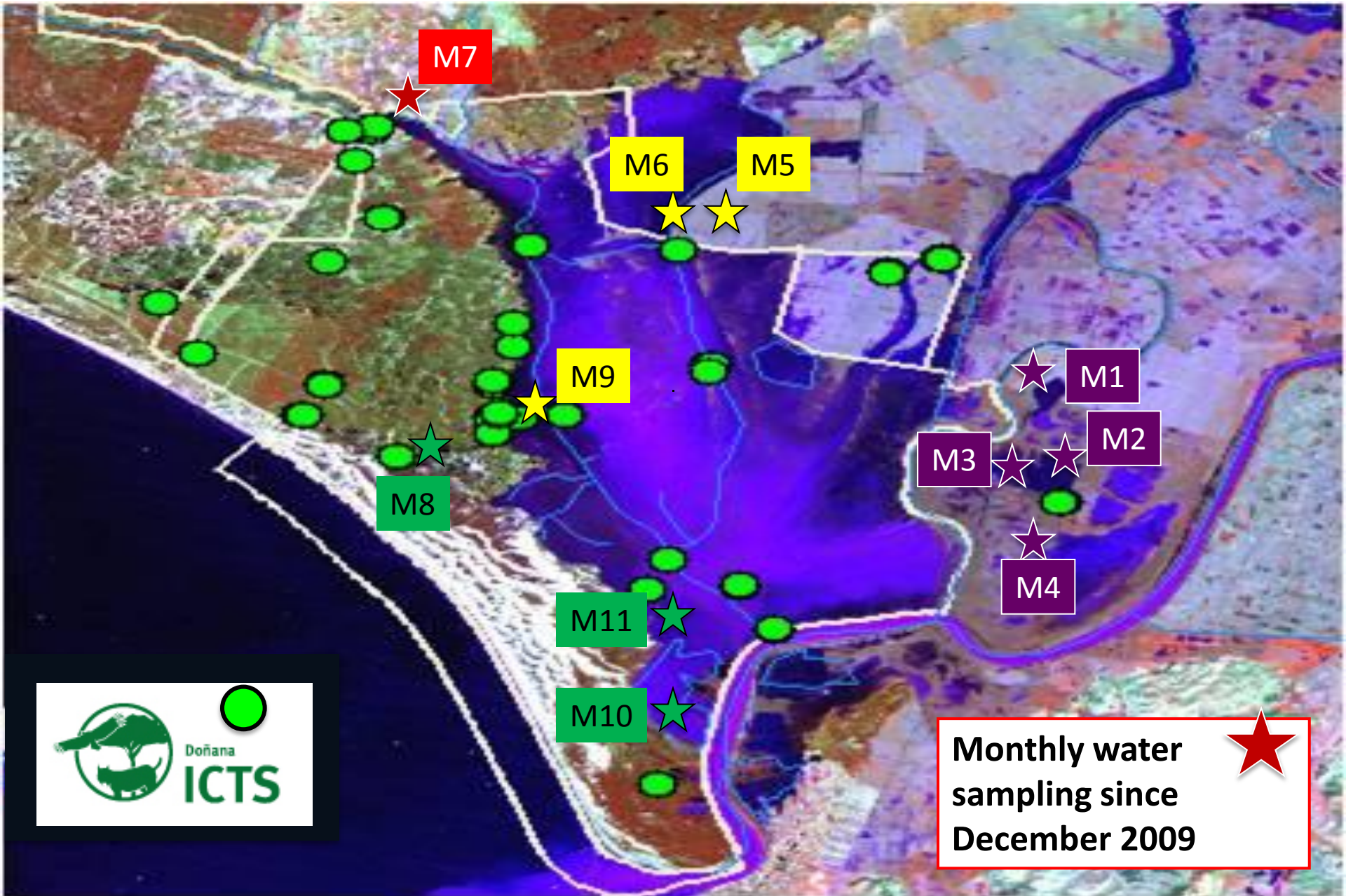
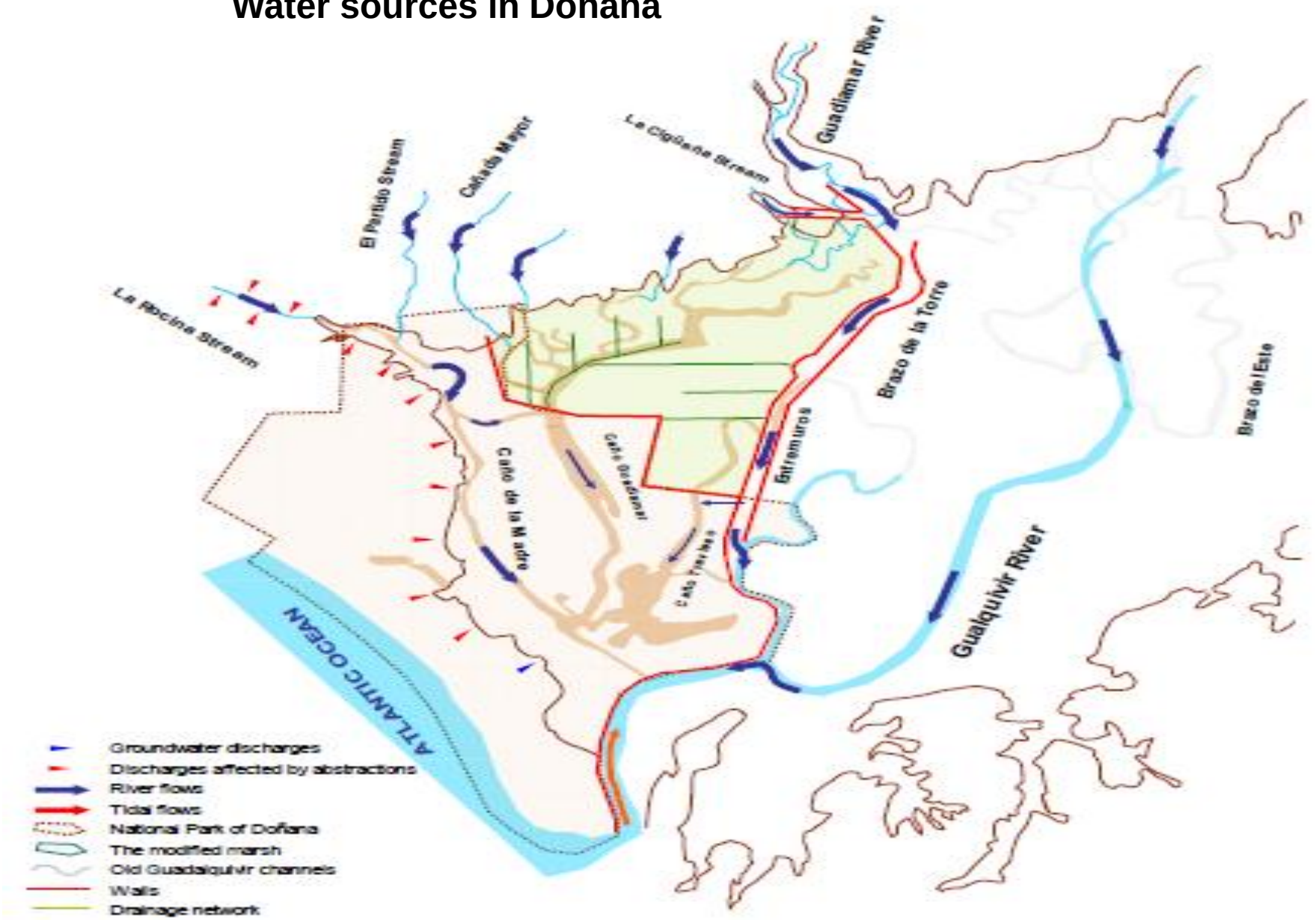


2. Methodology: Doñana

Water sources in Doñana



2. Methodology: Doñana

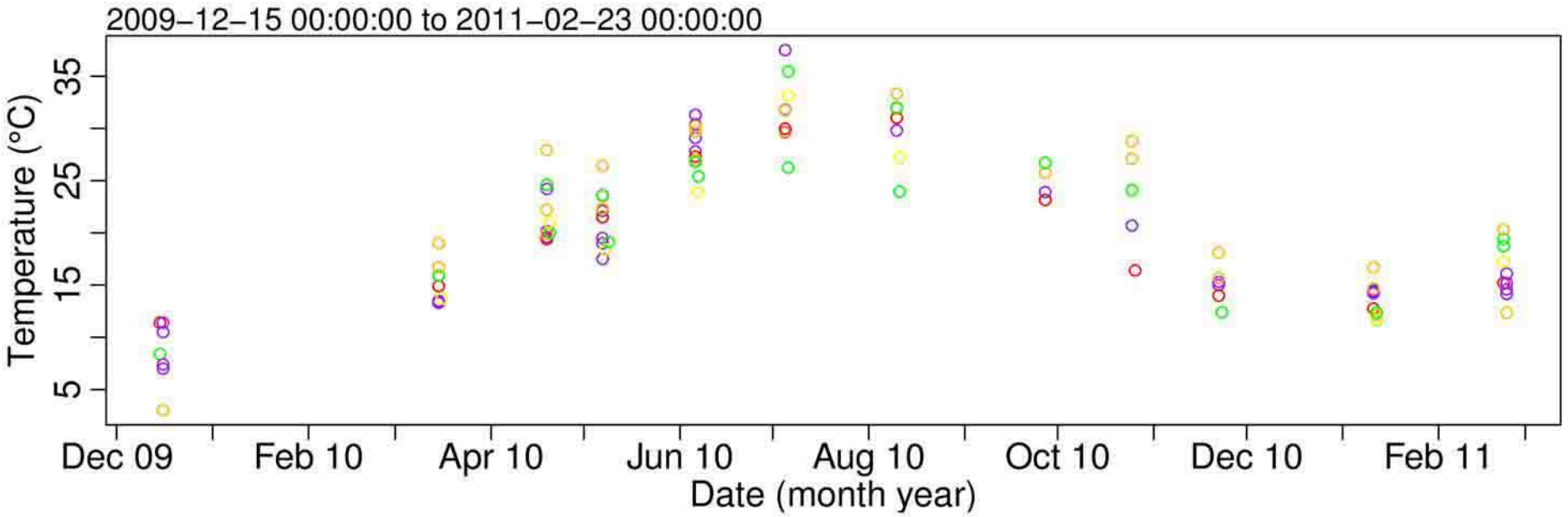
SAMI

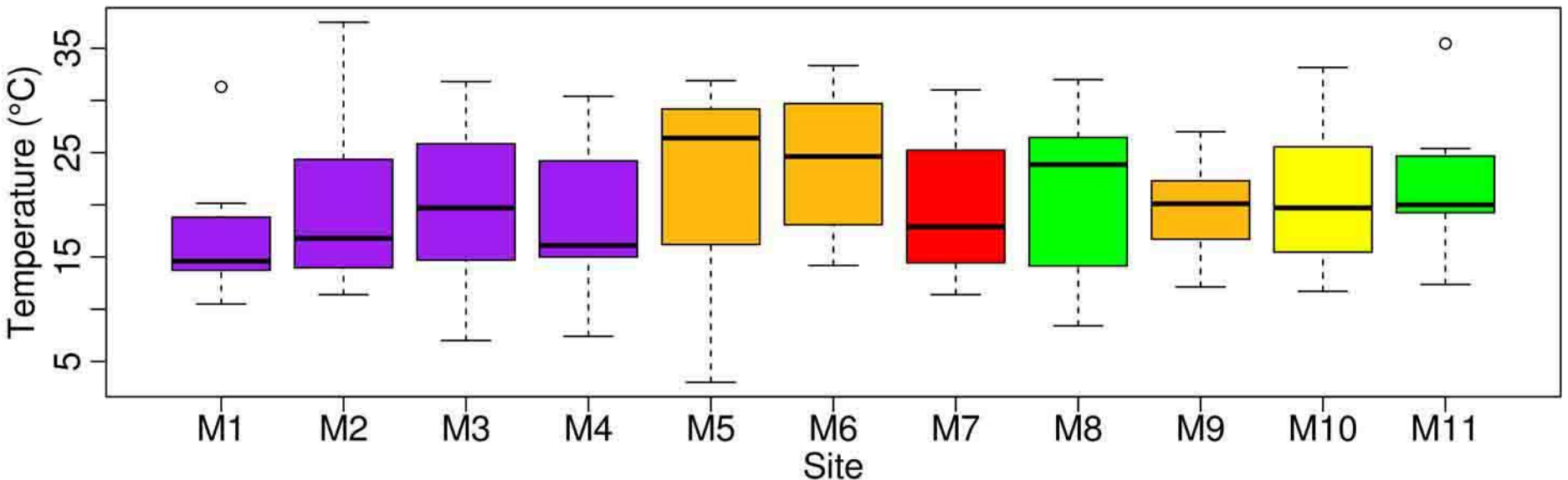
SAMI

SAMI

-SAMI pCO_2
-CTD with DO, Fluorescence and Turbidity sensors

3. Results: Monthly sampling





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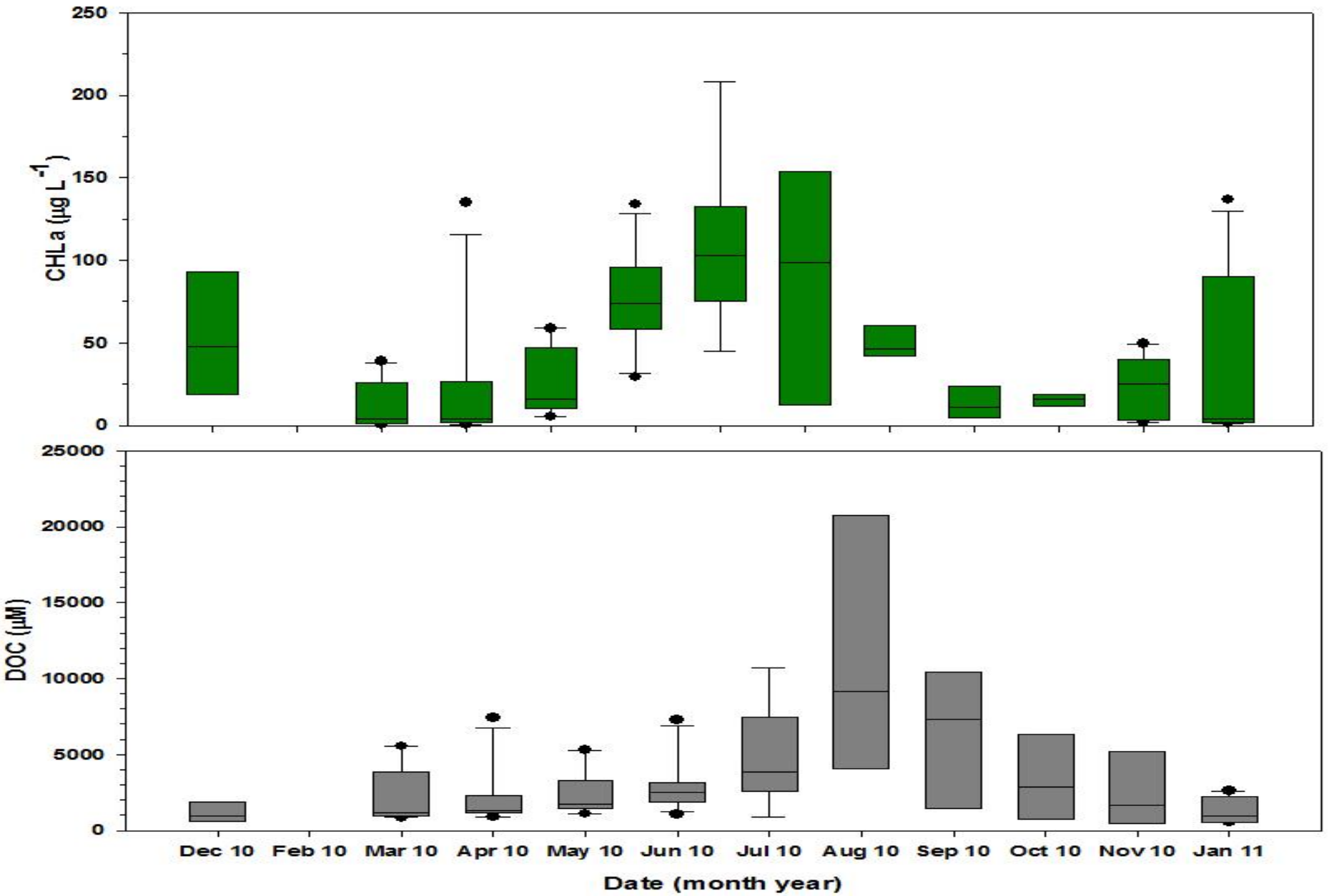

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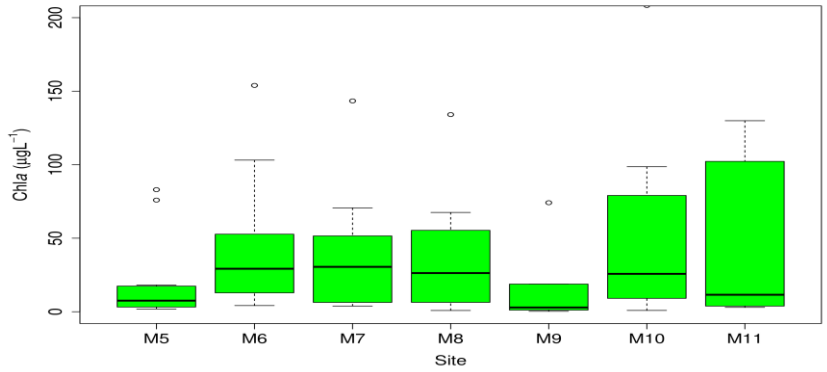

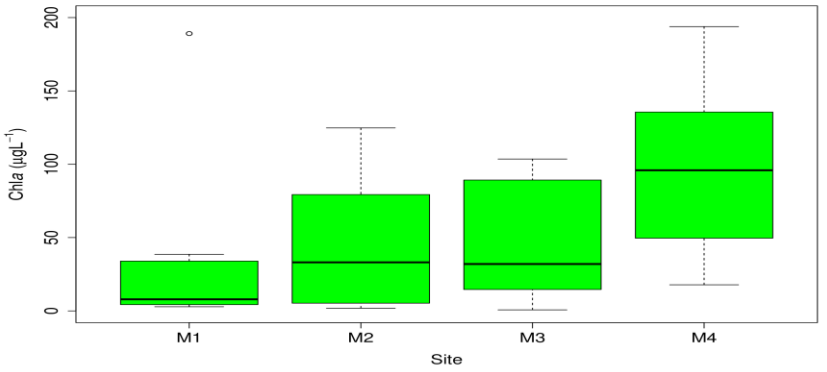

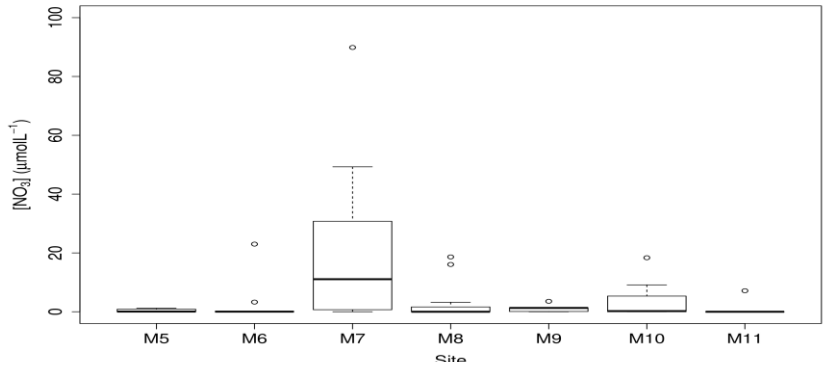

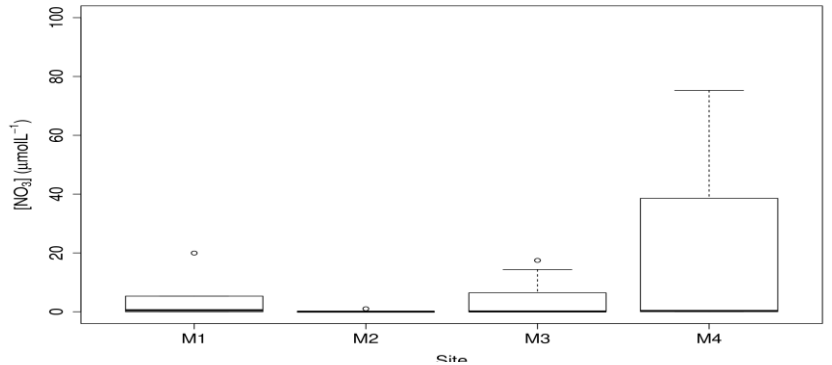

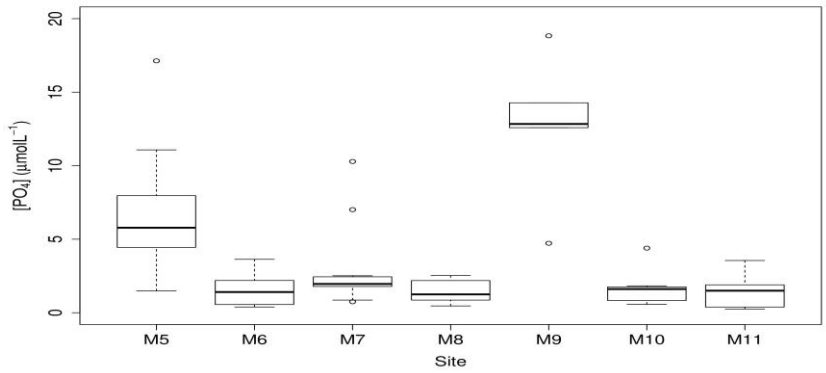

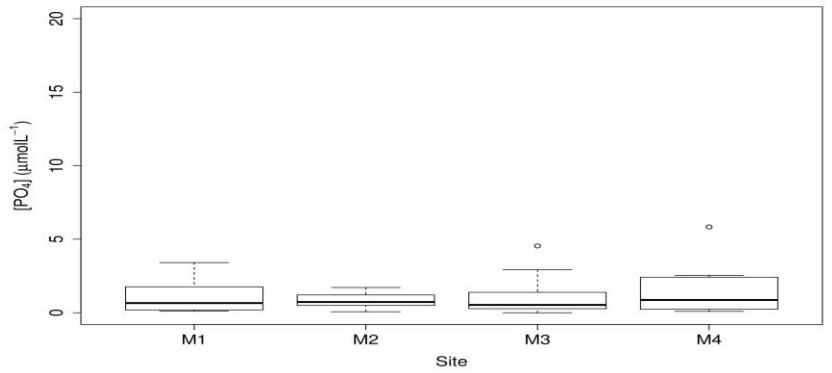

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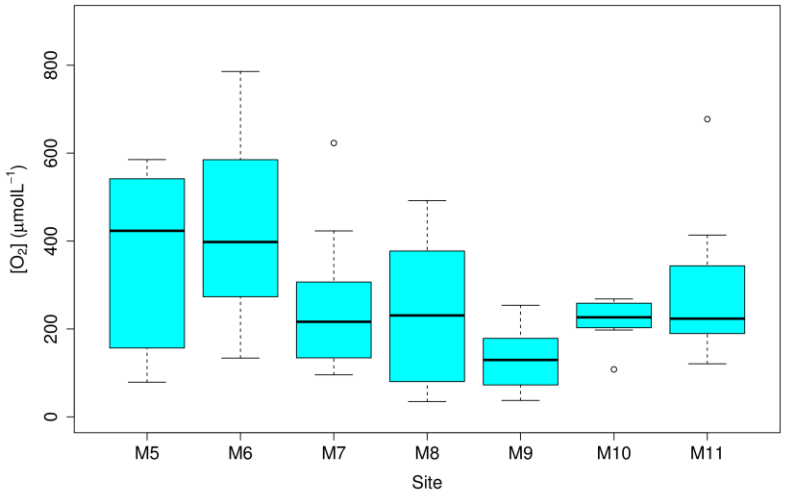

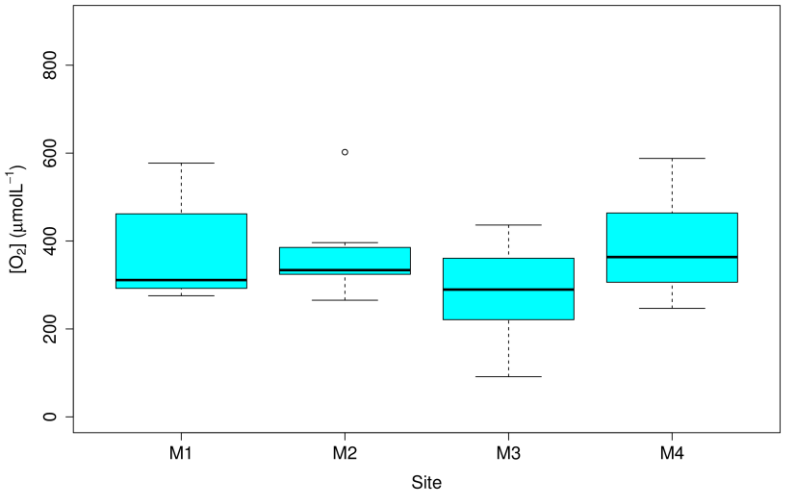

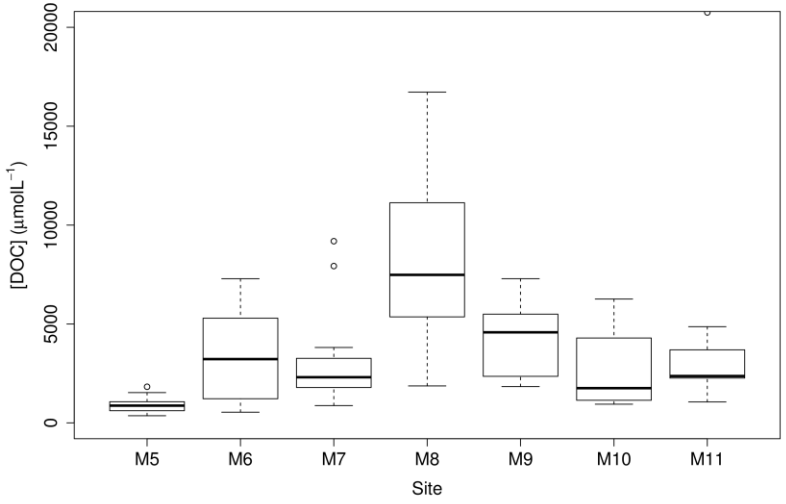

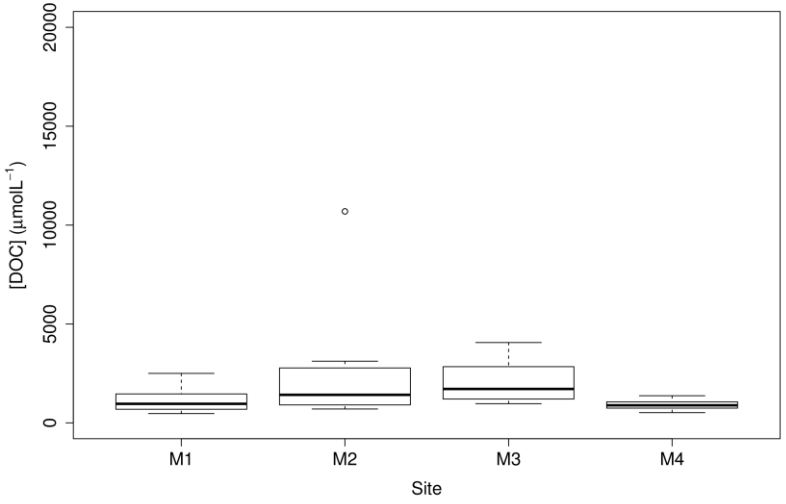

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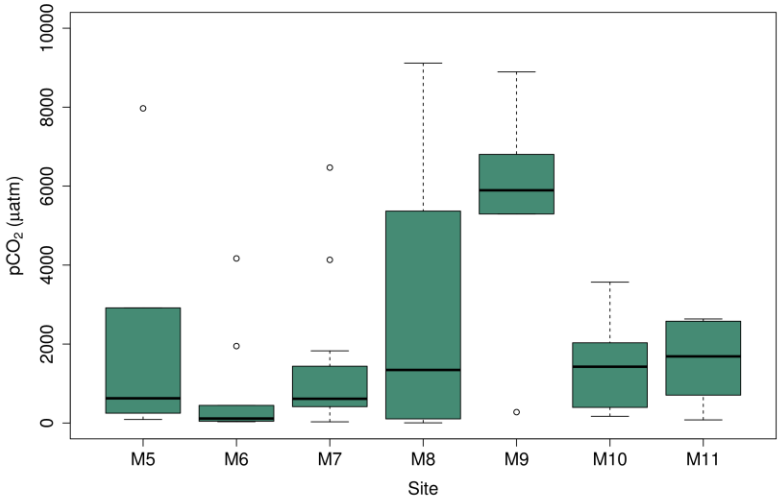
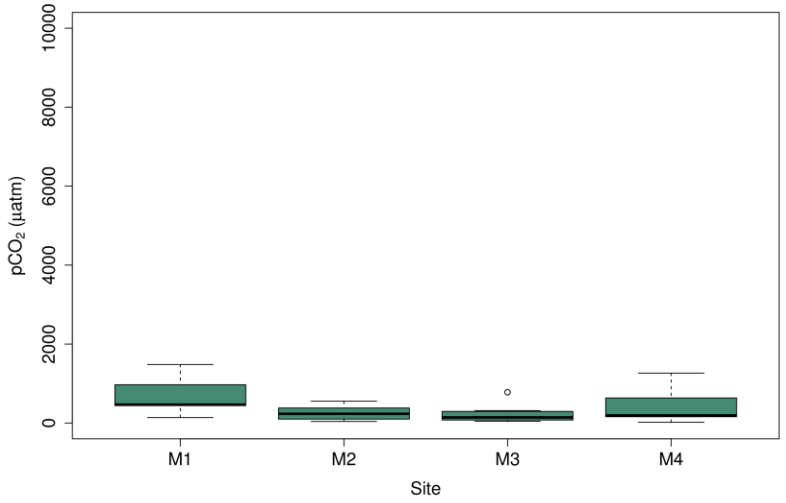
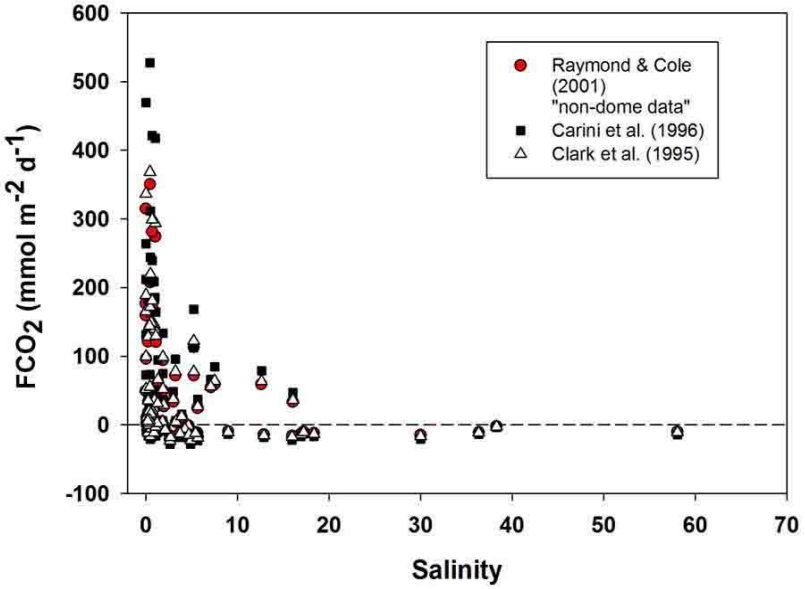




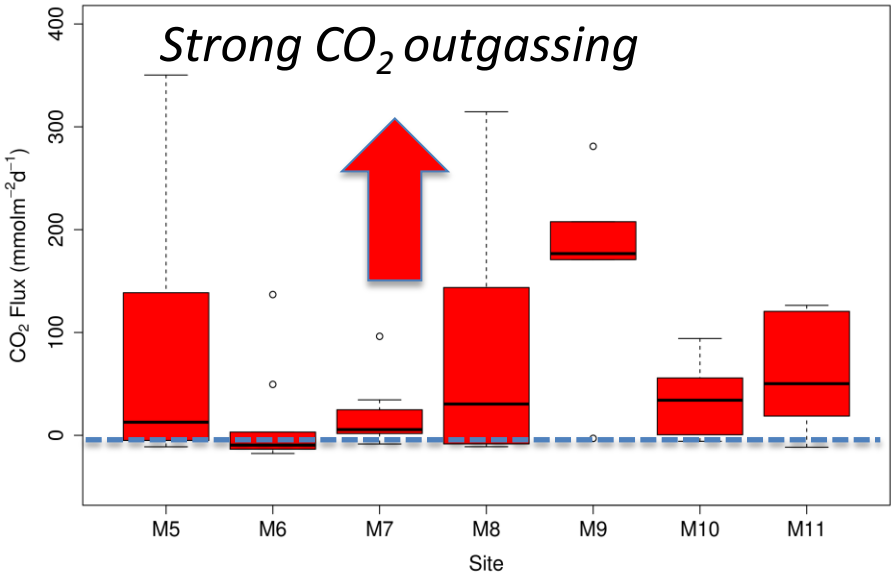


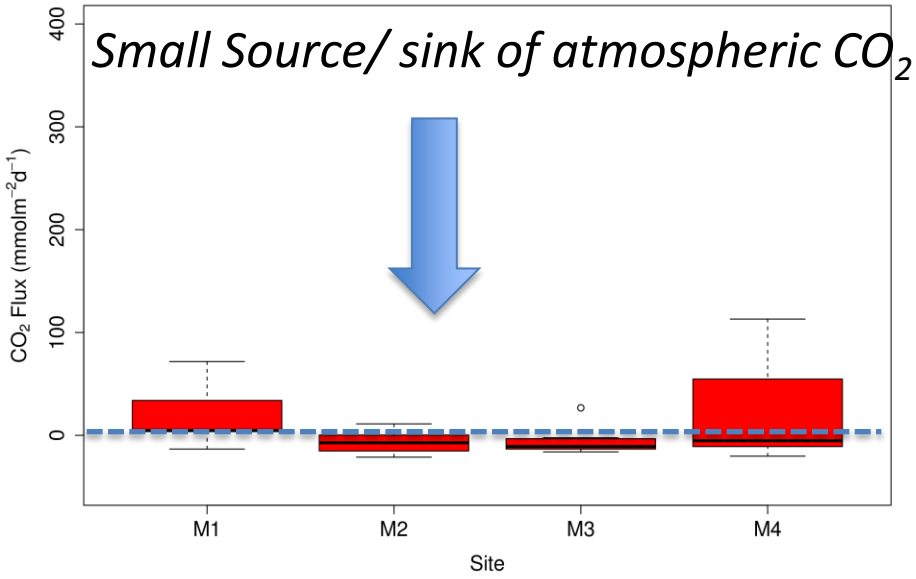
✓**pCO_2: calculated from pH and A_T using the dissociation constants from Cai and Wang (2001).**

✓**FCO_2: obtained using the gas transfer parameterizations described by:**

- ✓**Raymond and Cole (2001).**
- ✓**Carini et al.,(1996).**
- ✓ **Clarck et al.,(1995).**

3. Results: Monthly sampling



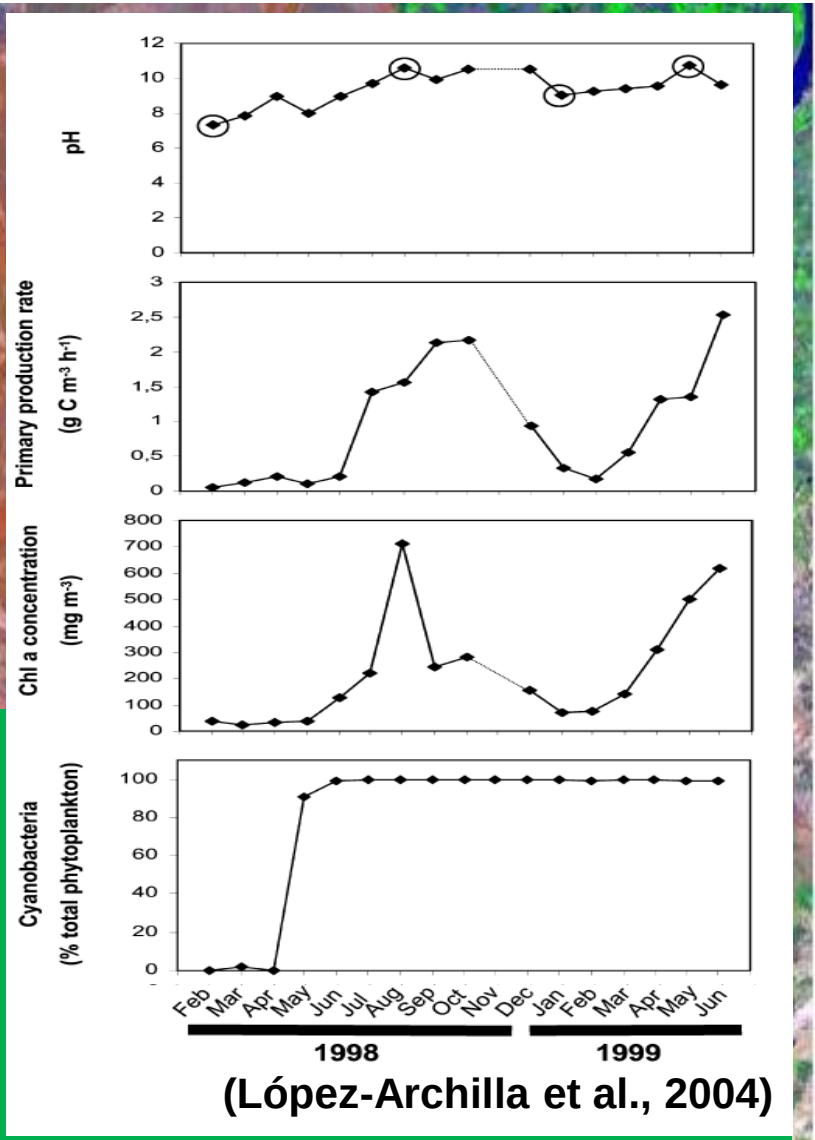


- **High nutrients concentrations.**
- **Strong primary productivity**

OM export → **BACTERIAL PRIMING?**

CO_2 release to the atmosphere

3. Results: pCO_2 Time series



(López-Archilla et al., 2004)

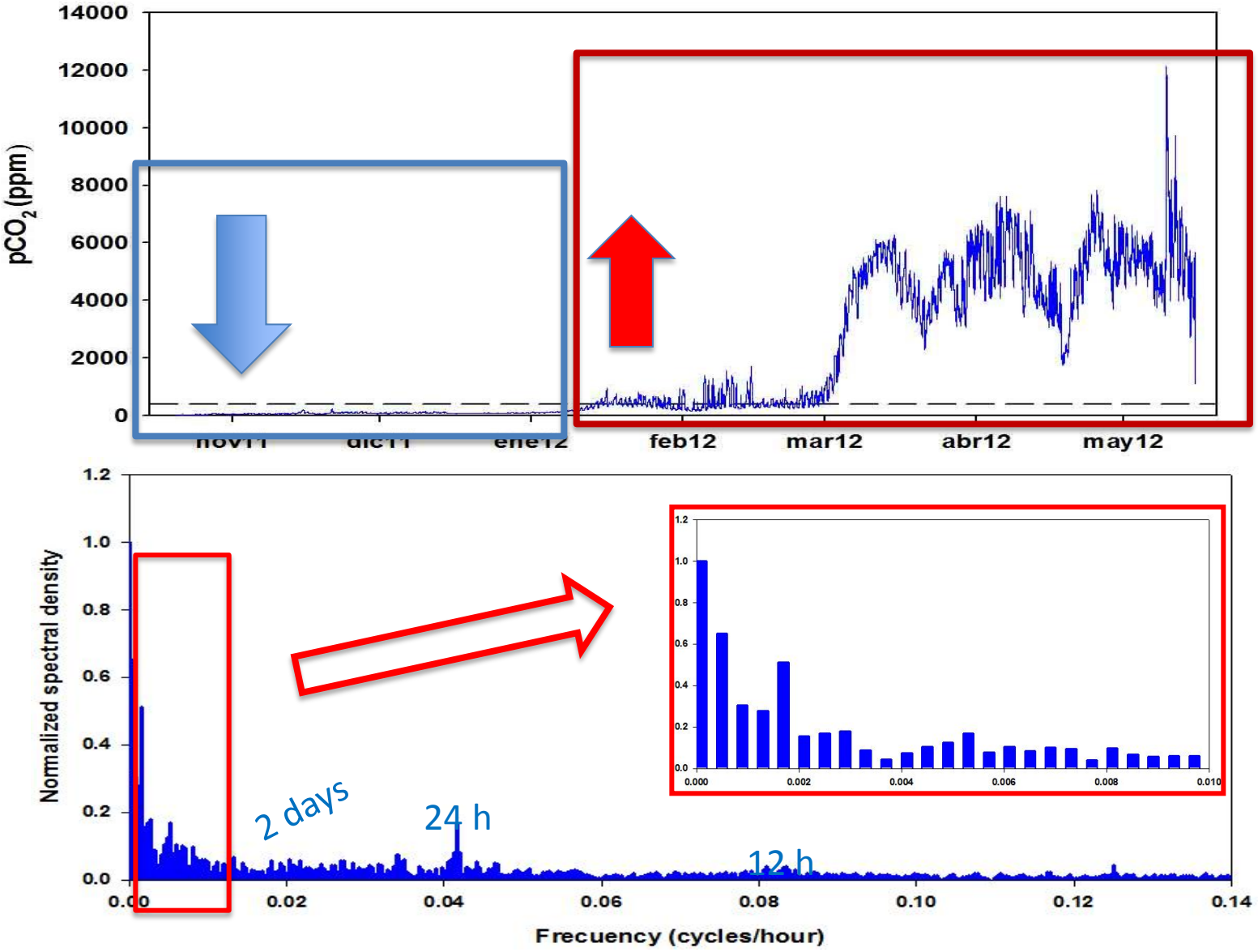
Santa Olalla:

- Permanent shallow lake groundwater-feed.

- **Underground water :**
  - Neutral pH values ~6.8
  - Moderate alkalinity ~1.66-2.26mEq $^{L-1}$

- **Hypereutrophic system.**
- Average pH of 9 consequence of high primary production.

3. Results: pCO_2 Time series



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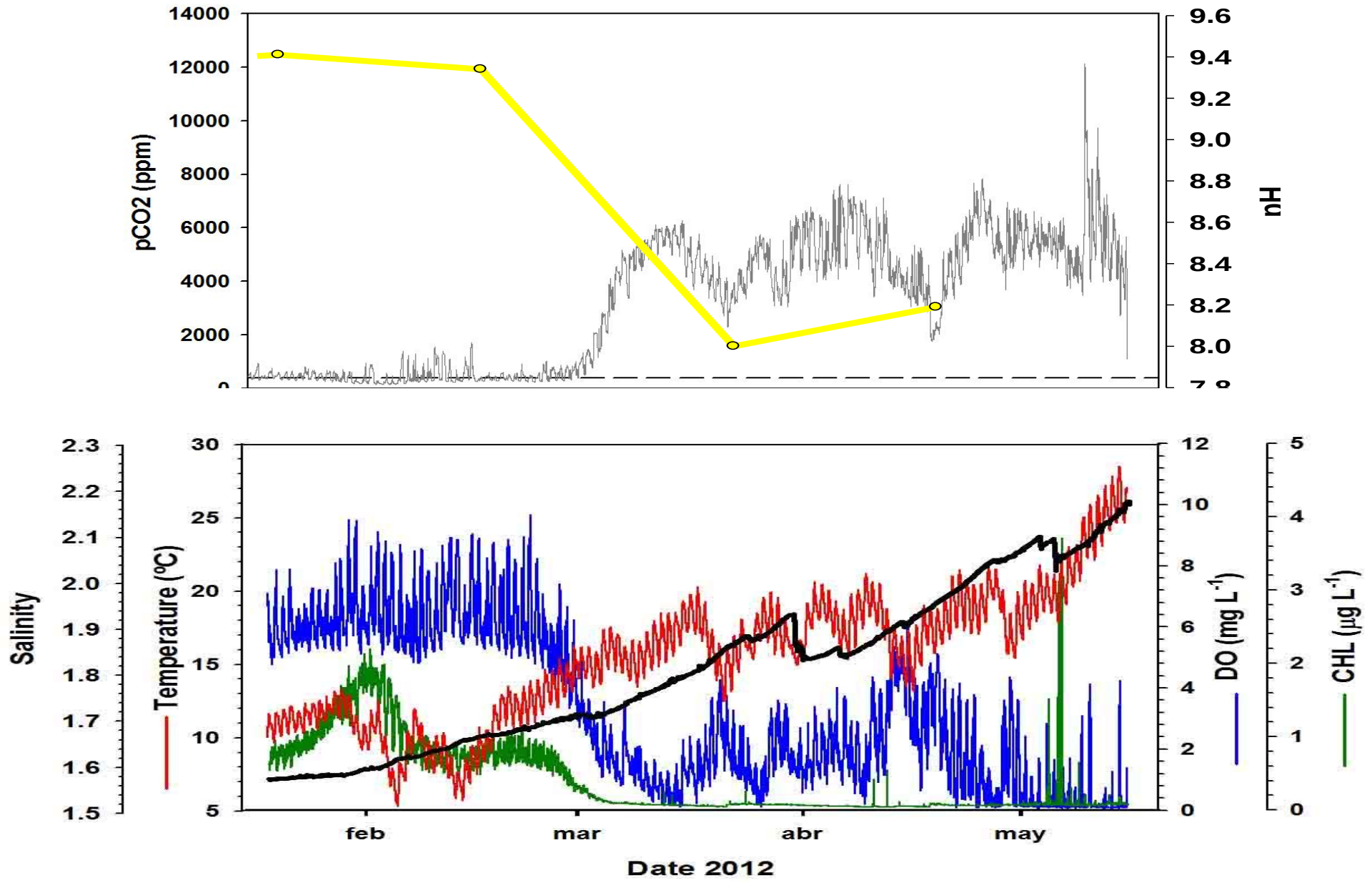

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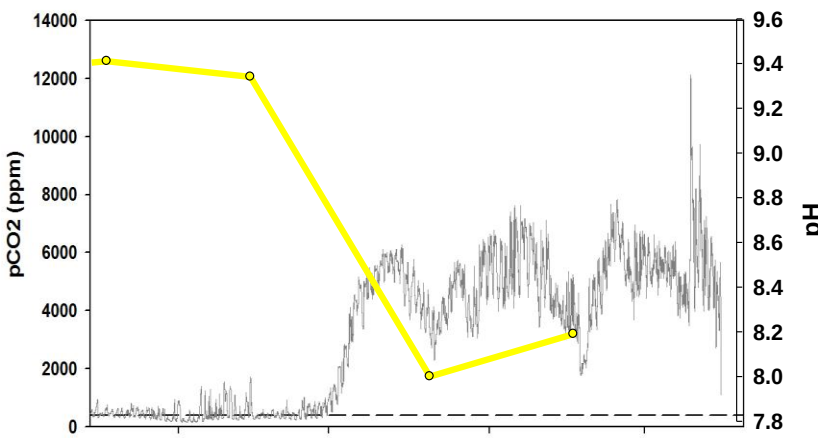
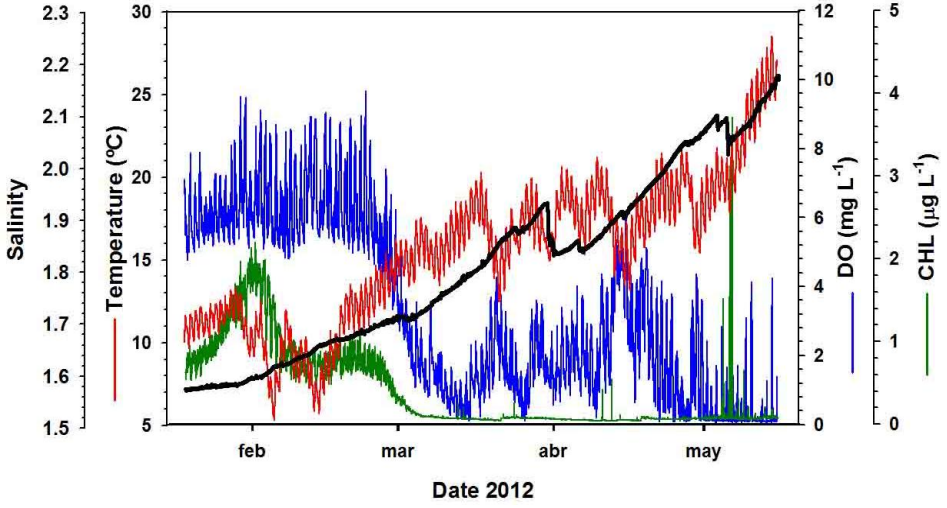




Late winter and spring pCO_2 oversaturation

Dry conditions, variations in the groundwater supply.

Changes in the biological metabolism:

Temperature and salinity increase affected the biological community.

Respiration exceeds primary production .

Preliminar Conclusions

Monthly sampling data:

- Strong pCO_2 source to the atmosphere depending of the water sources.
- High autotrophic production is actually associated with high annual emission of CO_2: bacterial priming?

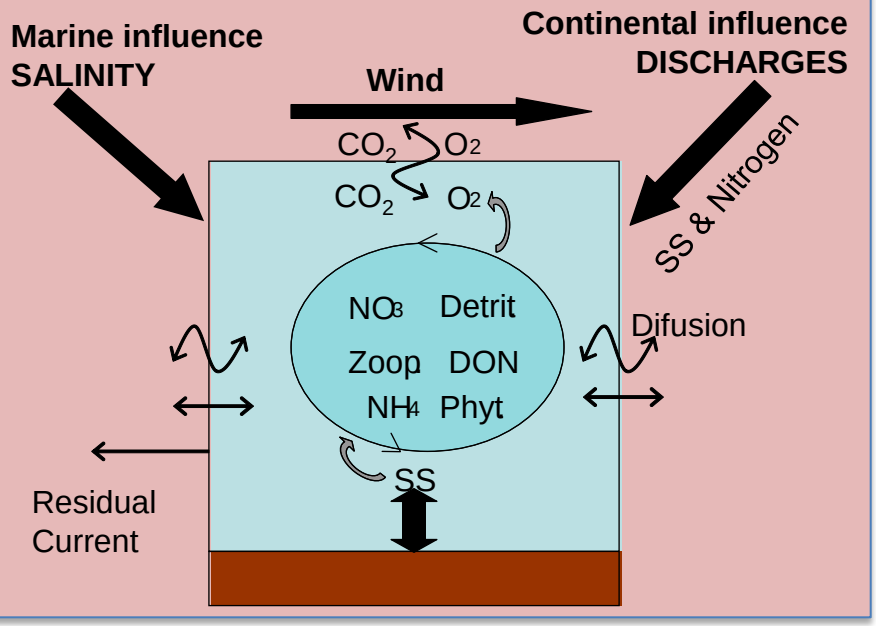
Sta. Olalla:

- Change from autotrophic to heterotrophic conditions related with changes in groundwater supply and temperature variations.

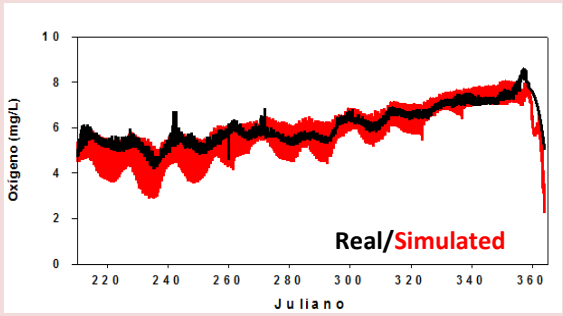
- A further analysis with the carbon sediment storage is needed.

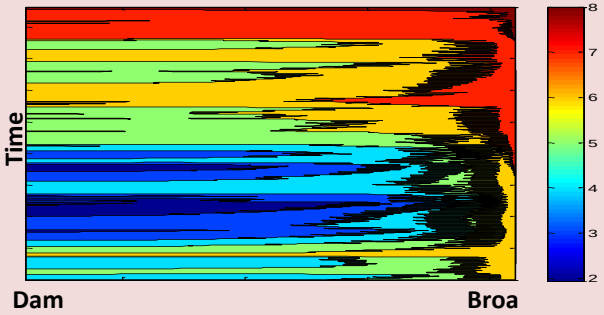
4. Future Prospects

Operational Model

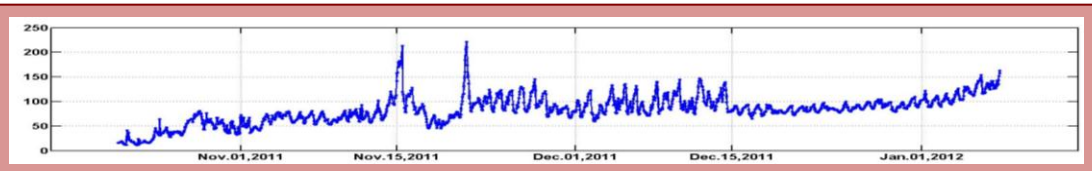


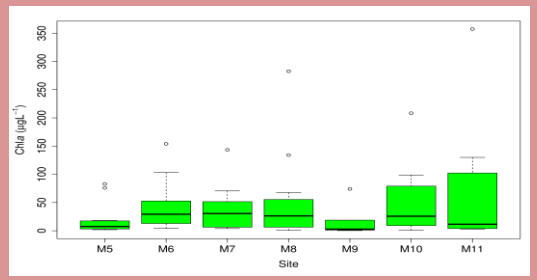
Simulations

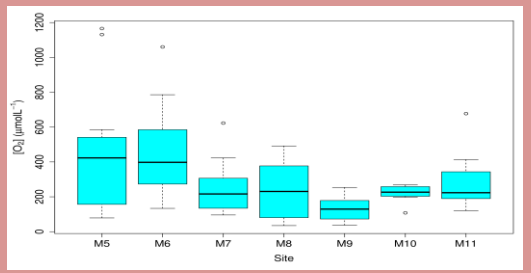




Observations



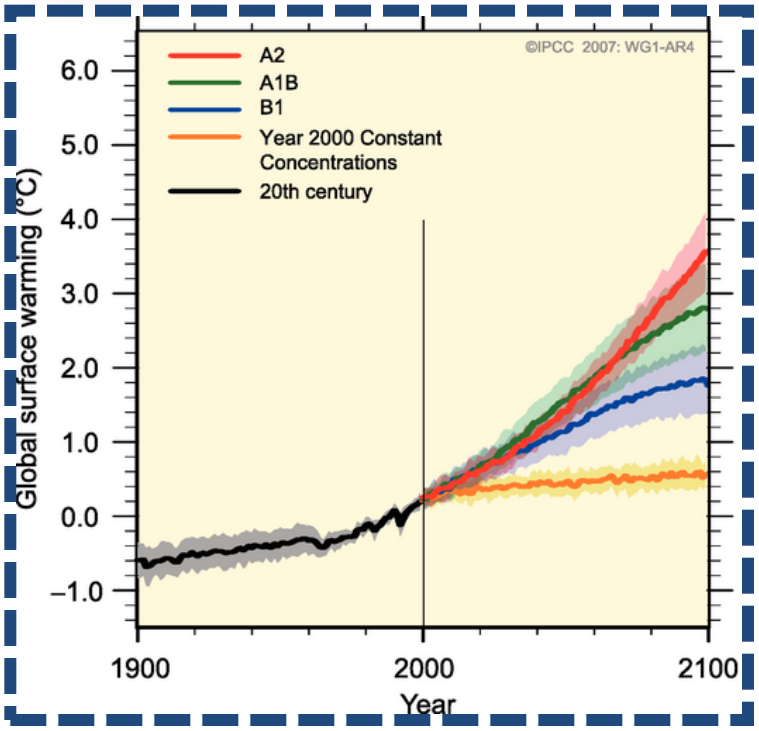




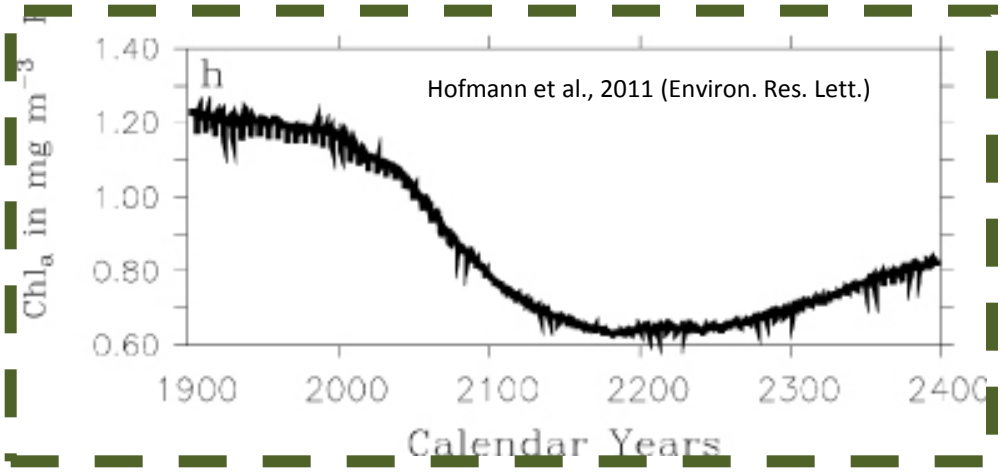
4. Future Prospects

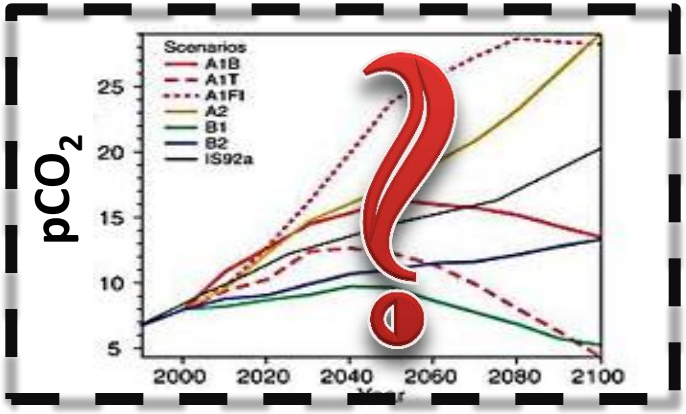
To analize this cycles in a future evolution context

Physical Pump



Biological Pump





Funding and Collaborations

PROJECTS

Contribución del compartimento acuático del Parque Nacional de Doñana al intercambio de CO_2 atmosférico
MARM2010-049 (1/1/2011 – 31/12/2013)

Estudio de los eventos de turbidez en la desembocadura del Guadalquivir mediante teledetección y su conexión con procesos meteorológicos y oceanográficos.
P09-RNM-4583 (3/2/2010 – 2/2/2014)

Propuesta metodológica para diagnosticar y pronosticar las consecuencias de las actuaciones humanas en el estuario del Guadalquivir. A.P. Sevilla & Junta de Andalucía

ADAPTACION DEL FITOPLACTON TÓXICO AL CAMBIO GLOBAL: CONSECUENCIAS EN EMBALSES DE ABASTECIMIENTO Y HUMEDALES REFUGIO DE FAUNA SALVAJE

COLABORATIONS


Thank you
for your
attention

3. Results: Doñana