

Carbonate system dynamics in the Gulf of Trieste (North Adriatic sea)

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Why studying carbonate system in the Gulf of Trieste ?

- Bottom cyclonic circulation

- Shallow (max depth 25 m)

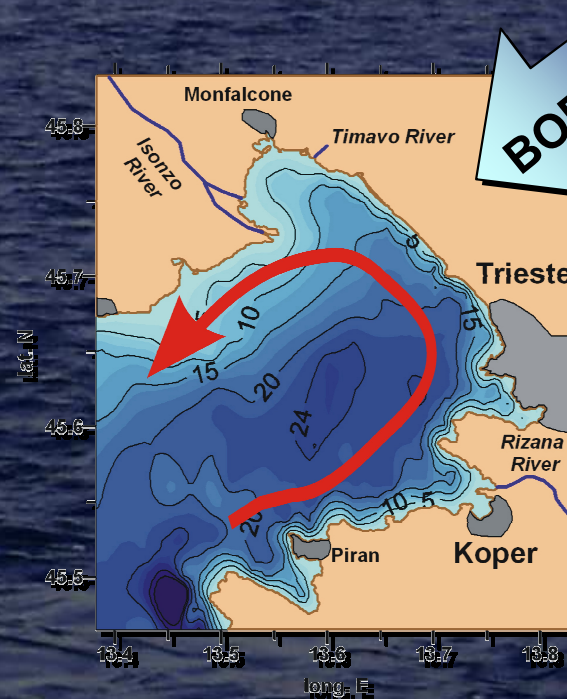
- Strong cold winds (Bora)

- Cold water in winter (7-8°C)

Potential for high CO₂ absorption and acidification

Dense water formation

Basin scale influence



- River loads

- High susceptibility to meteorological forcings

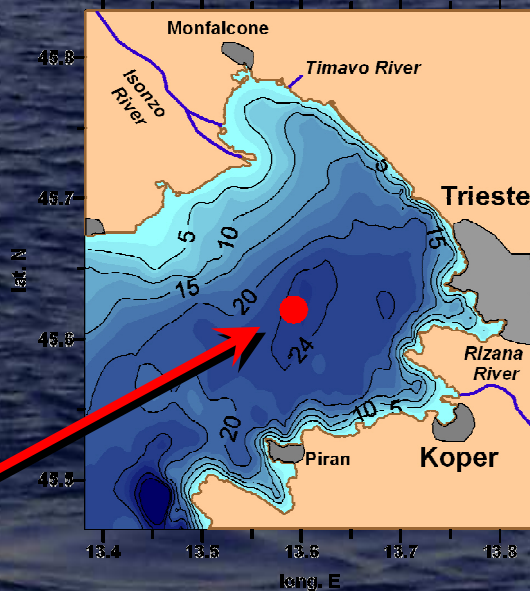
- Strong seasonal variability in biogeochemical parameters

How do they influence carbonate system and pH?

Are they buffering or do they accelerate acidification?



PALOMA Dynamic Pilon



Meteorological data:

- Air temperature
- Solar radiation
- Wind speed and direction
- Precipitations



Sea water temperature

Approach

PALOMA station

Start Jan 2008 - monthly

- Temperature, salinity, fluorescence, DO.
- Dissolve Oxygen (winkler)
- Nutrients: NO_3 , NH_4 , NO_2 , PO_4 , SiO_2
- **pH: spectrophotometric det. ± 0.003** (Byrne & Breland 1989, DOE 2007)

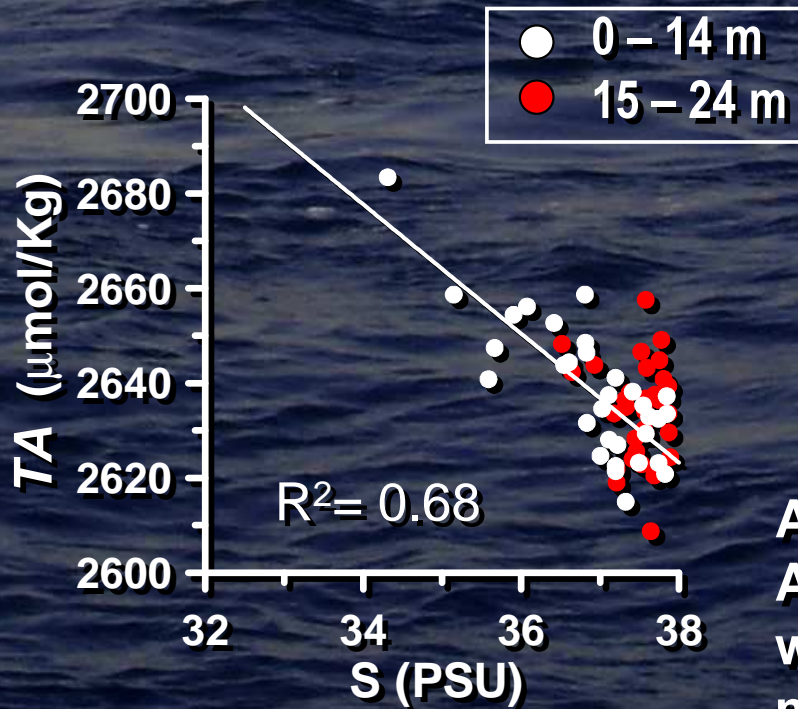
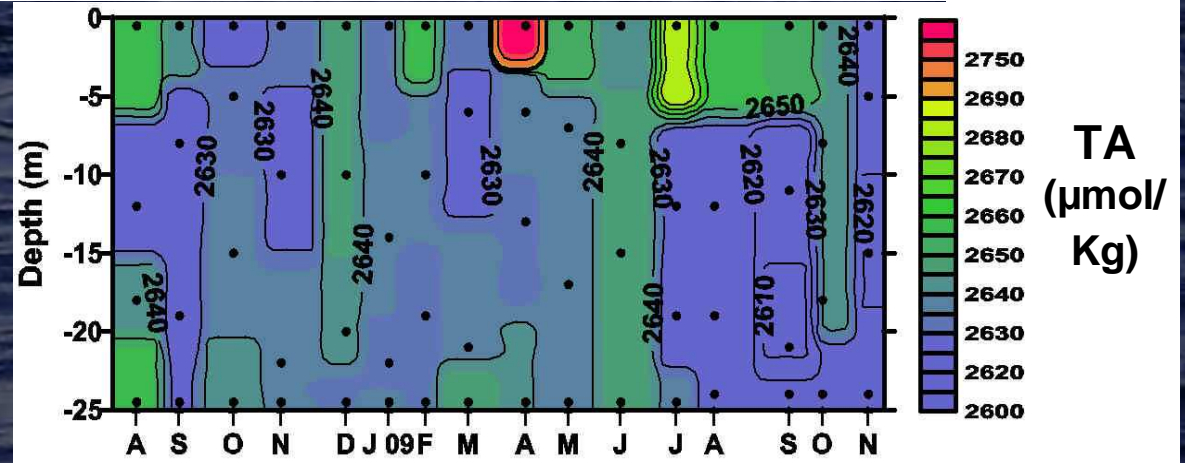
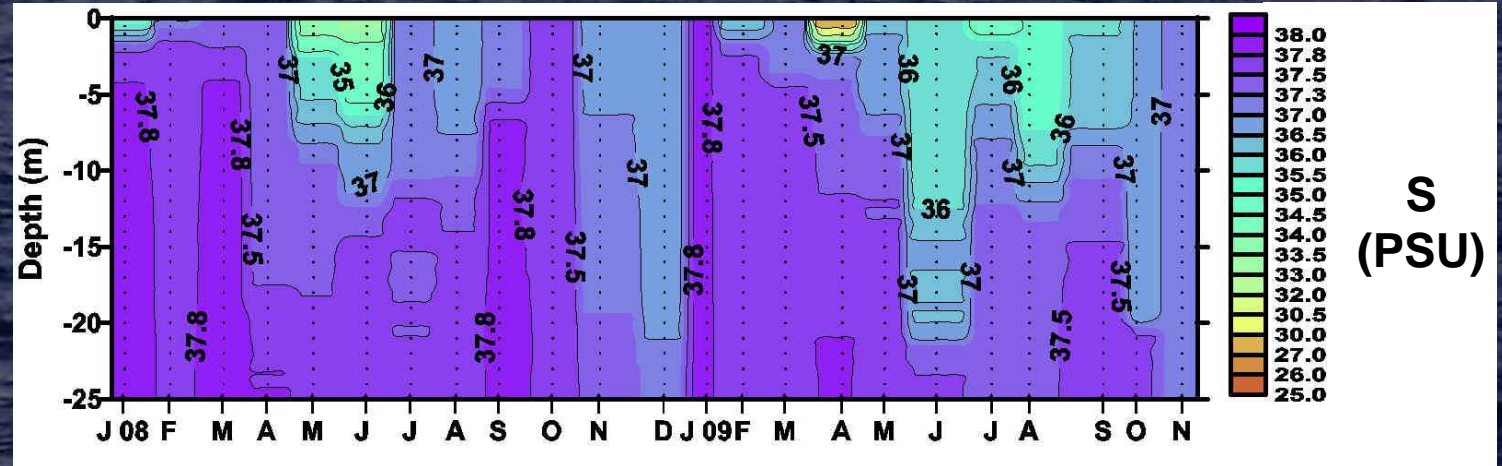
Start Aug 2008 - monthly

- **Alkalinity:** potentiometric titration ± 3 $\mu\text{mol}/\text{kg}_{\text{SW}}$ (adapted Hernandez-Ayon 1999)
- AT / S correlation used to extrapolate AT values from Jan to July 2008
- pH_T situ, pCO_2 , other parameters: calculated with "CO₂sys" (Lewis & Wallace 98)



Total Alkalinity

2610 < TA < 2860
 AVG ~ 2640
 μmol/Kg

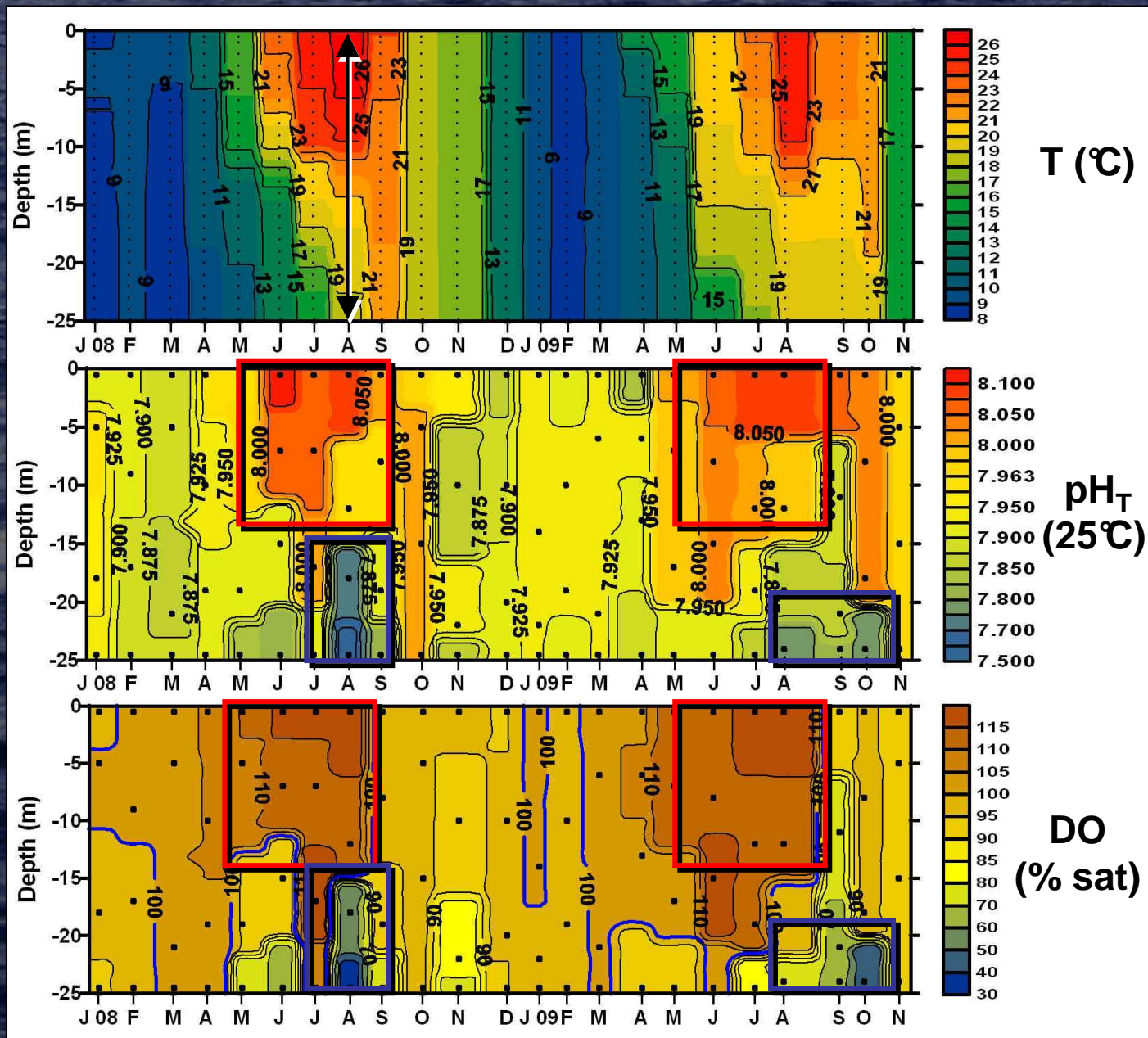


About 30 μmol/Kg
 AT not explained
 with simple two term
 mix model

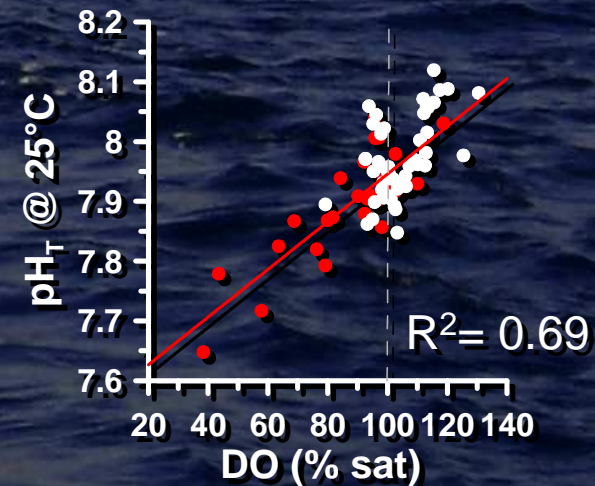
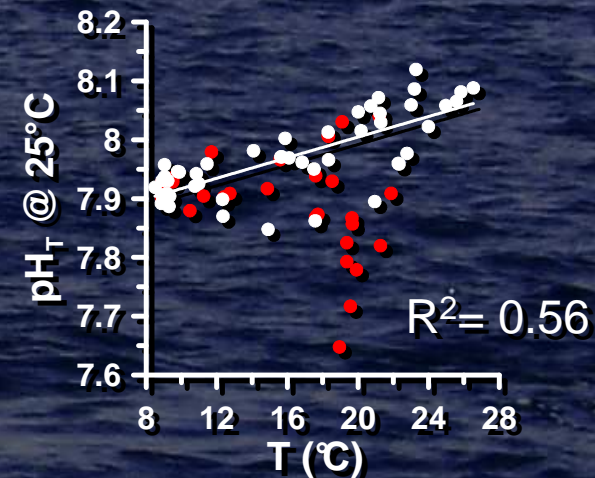
- Variability of riverine AT concentrations
- Release of AT from sediments

$\Delta T = 9.7^\circ\text{C}$

pH_T @ 25 °C

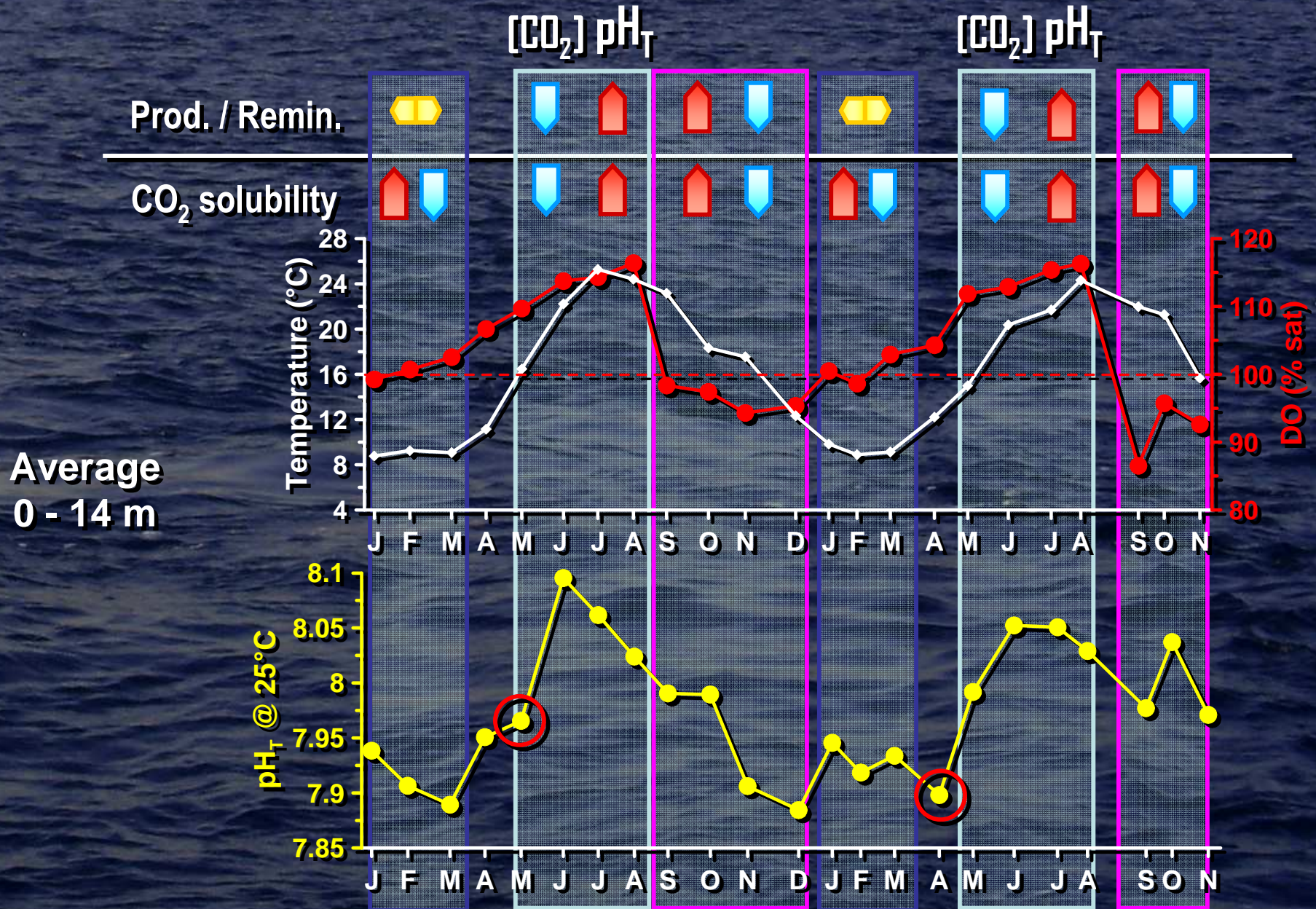


pH_T @ 25°C
Max 8.109
Min 7.648

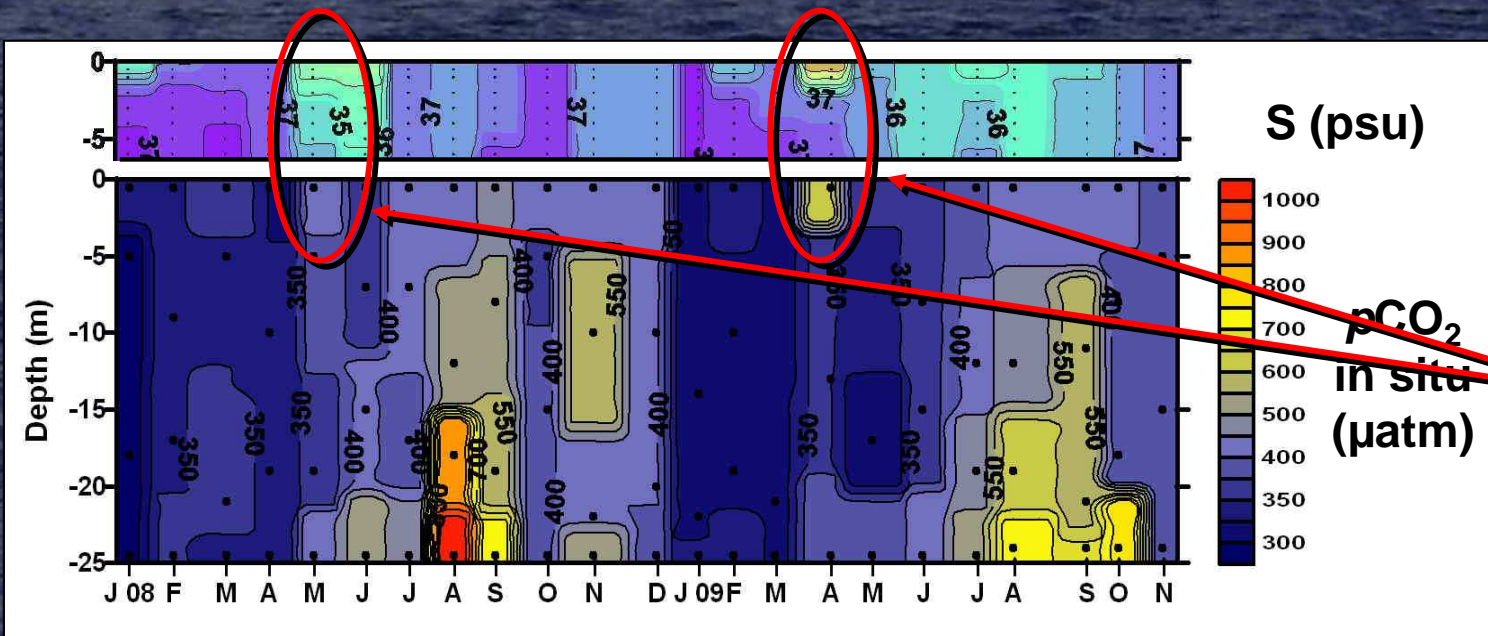


- 0 – 14 m
- 15 – 24 m

pH_T @ 25 °C upper layer: main drivers

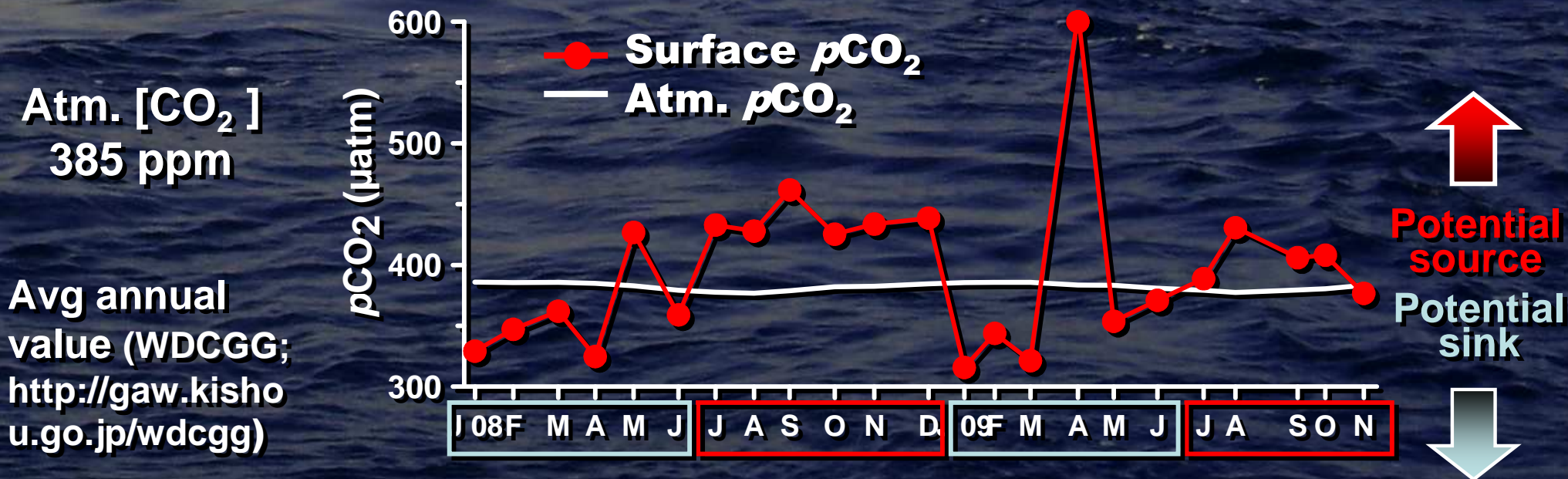


pCO₂ in situ



pCO₂ (µ atm)
 Max 1043
 Min 315

**Rvierine
 CO₂
 loads**



Comparison with other Mediterranean coastal areas

Bay of Angels

Gulf of Trieste

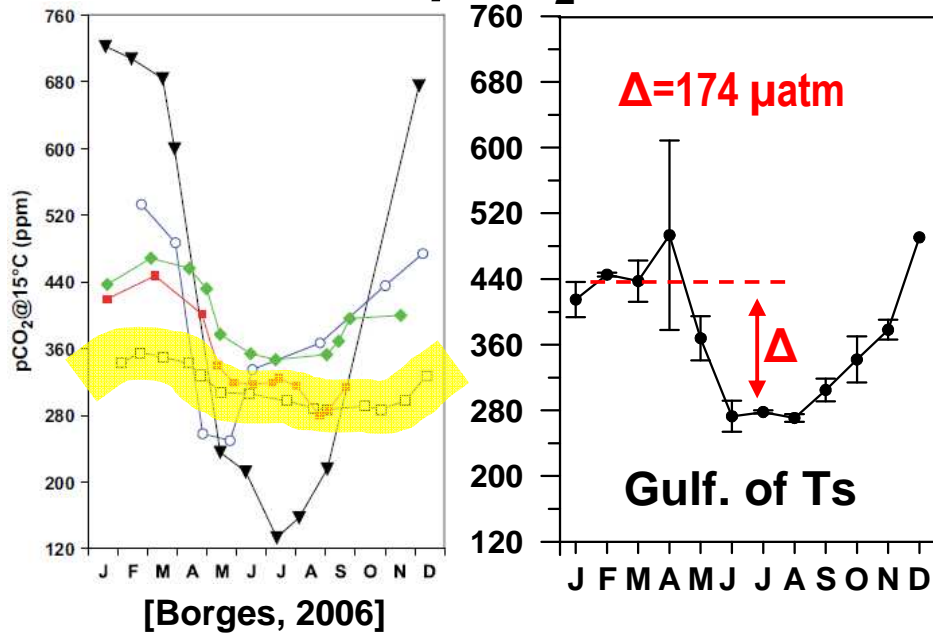


Comparison of
Surface data,
Monthly 2
years averages

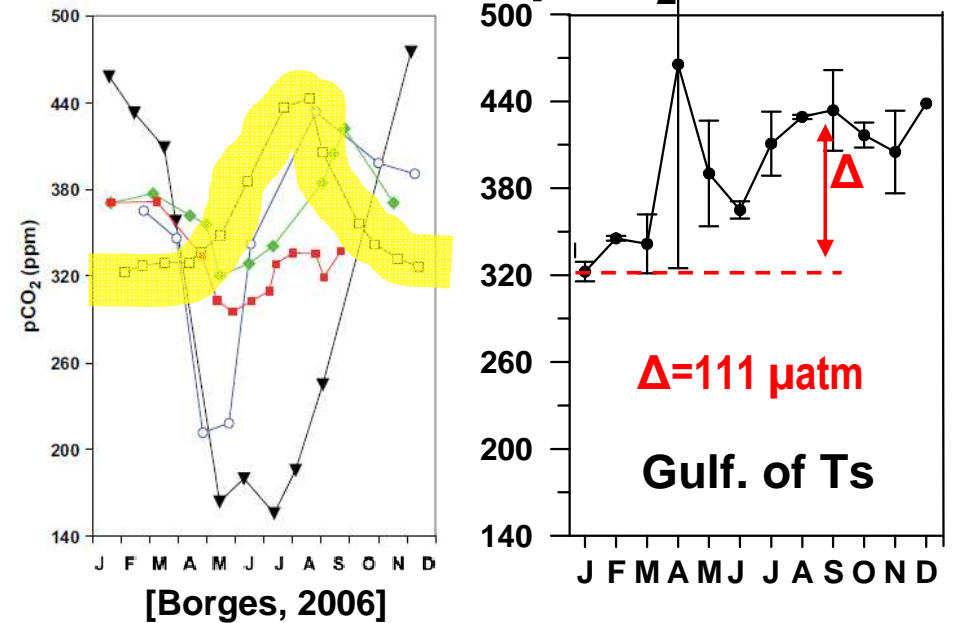
Borges, Schiettecatte, Abril, Delille, Gazeau,
2006, Est.Coasts. Shelf Sci.

Carbon dioxide in European coastal waters

Surface pCO₂ @ 15°C



Surface pCO₂ situ



pCO₂ @ 15°C

More pronounced seasonal cycle

- Higher winter values \Leftrightarrow lower SST
- Decrease in summer, increase autumn \Leftrightarrow trophic status

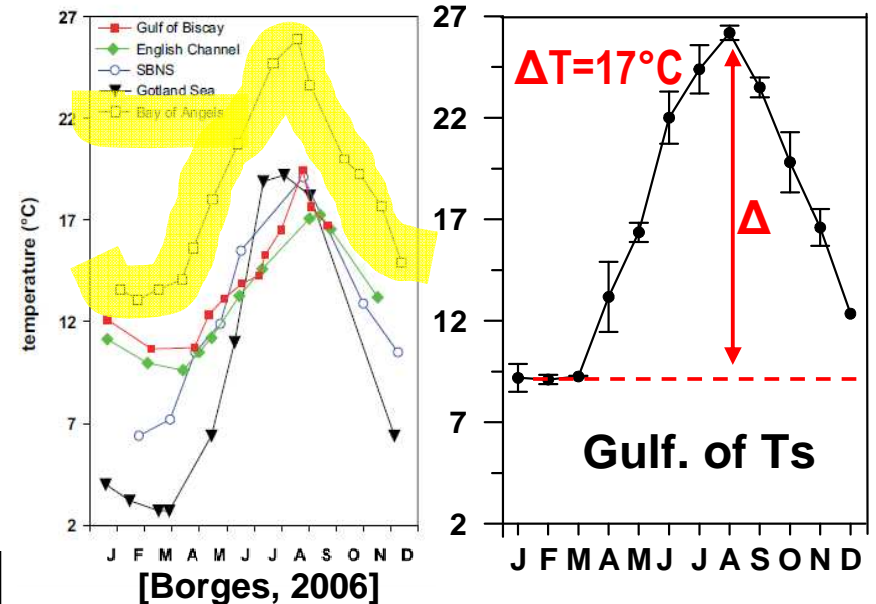
pCO₂ situ

Inversion of seasonal cycle in both Med. sites \Leftrightarrow effect of high seas.

ΔT on H₂CO₃ equilibria



SS Temperature



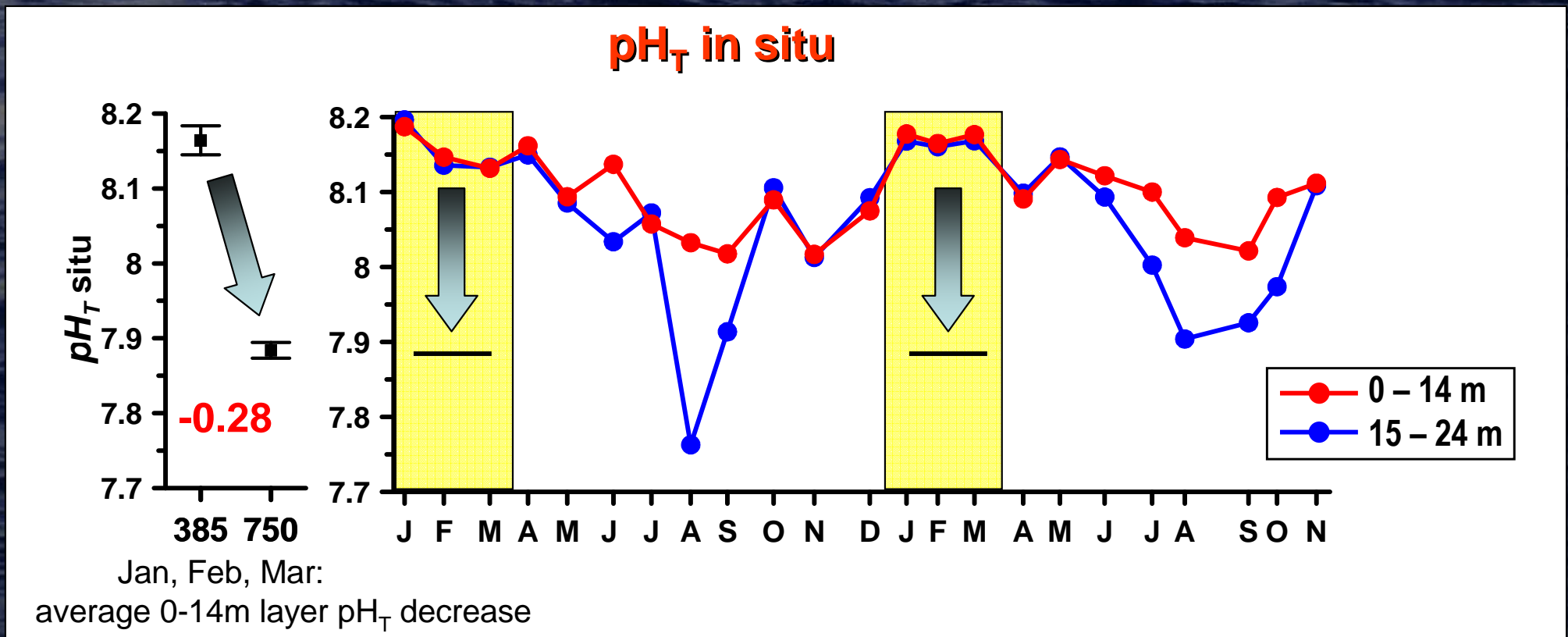
Future scenarios and in situ variability

- Selected months were atmospheric CO₂ solubilization was the main driver of sea pCO₂ : Jan, Feb, March 2008-09; 0-14 m depth
- Same S, T, Alkalinity, nutrients concentrations
- Same pCO₂ atm – pCO₂ sea surface difference

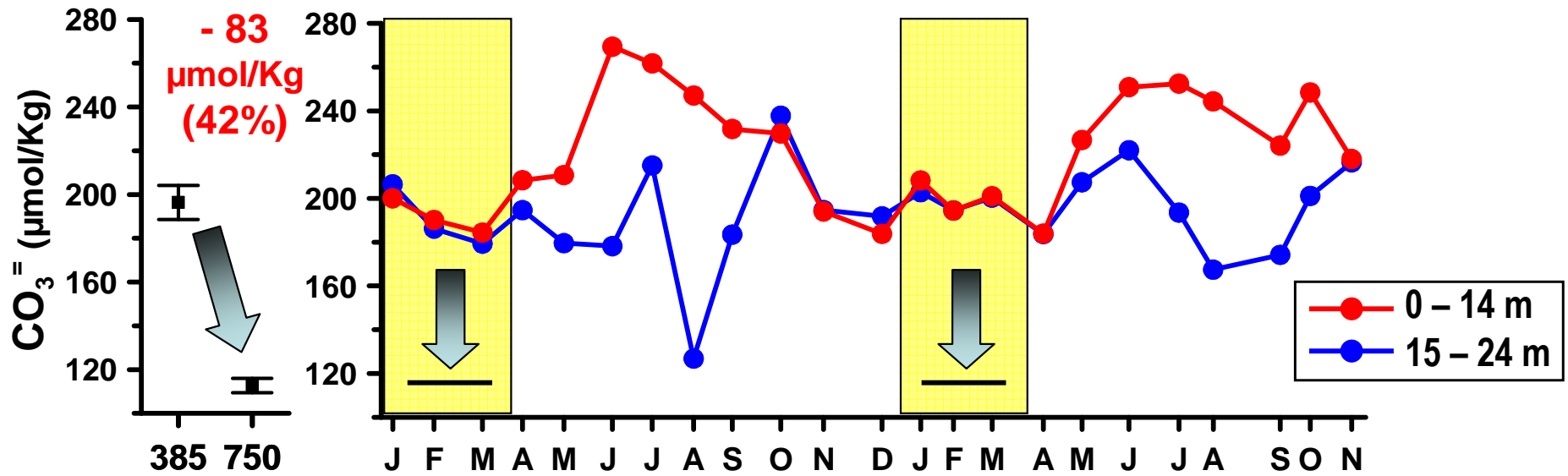
[CO₂]atm 385 ppm
Today



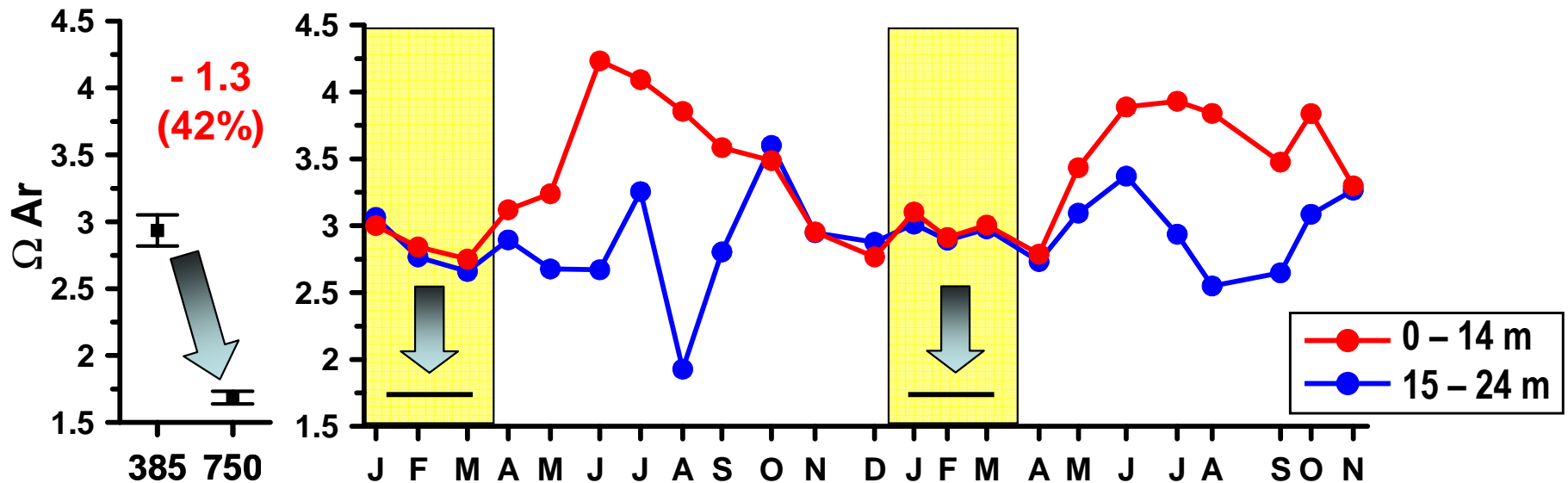
[CO₂]atm 750 ppm
By 100 years [IPCC, Business as Usual scen.]



[CO₃⁼] in situ



Ω Ar in situ



Some first answers

- River loads
- High susceptibility to meteorological forcings
- Strong seasonal variability in biogeochemical parameters



How do they influence carbonate system and pH?

Are they buffering or do they accelerate acidification?

In winter CO₂ undersaturation → High potential for CO₂ absorption and acidification

Spring riverine loads trigger phytoplankton blooms but they loads more acidic waters that mask a potential pH increase due to biological CO₂ uptake





Strong variations in carbonate system can be expected by the end of the century in cold winter waters.

But.... High alkalinity values keep the Gulf of Trieste saturated for Ca and Ar even 750 ppm scenario

And ... what will happen in summer?



Thank you for your attention !



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