

# Air-sea CO<sub>2</sub> fluxes in the global coastal ocean

## Simulated trends and anthropogenic uptake

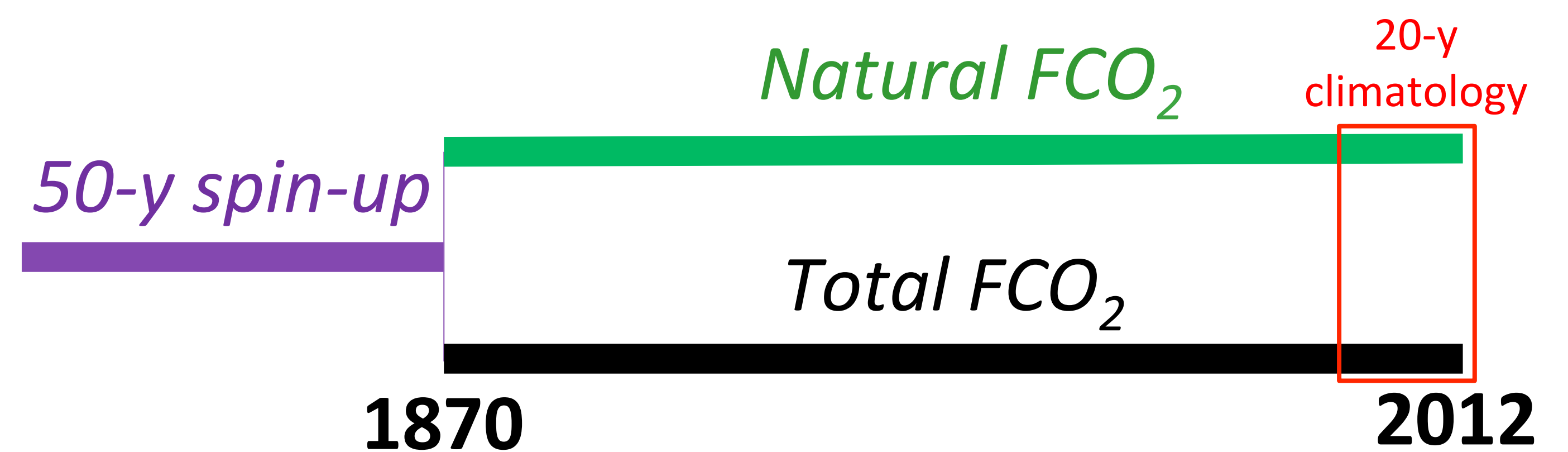
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### Introduction

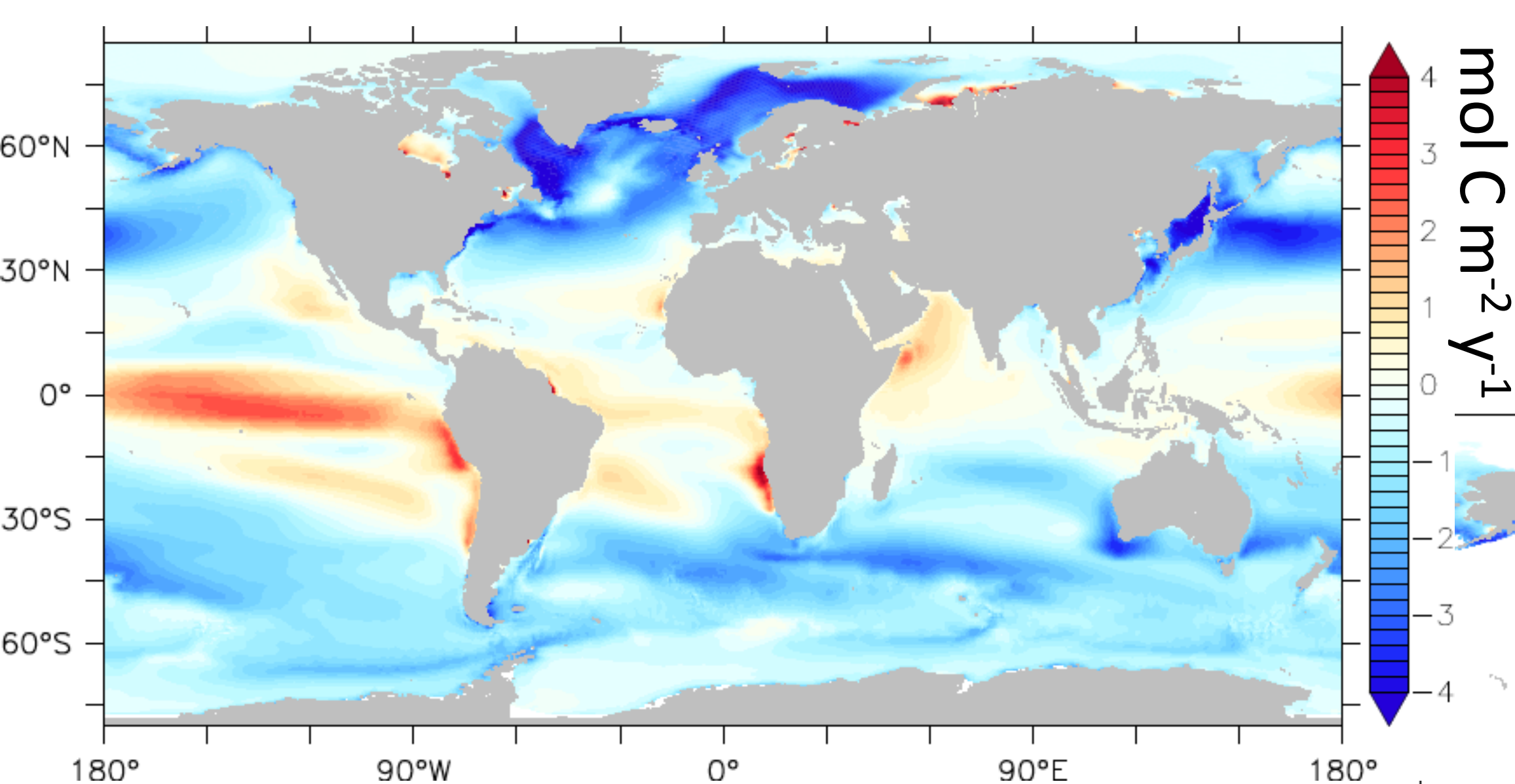
The role of the coastal ocean in the global anthropogenic carbon budget is largely unknown. More, CO<sub>2</sub> measurements do not allow to estimate the coastal anthropogenic carbon fluxes. After a model evaluation, we aim to estimate the anthropogenic carbon uptake by the global coastal ocean using a high-resolution global ocean model.

### Global Ocean Biogeochemical Model:

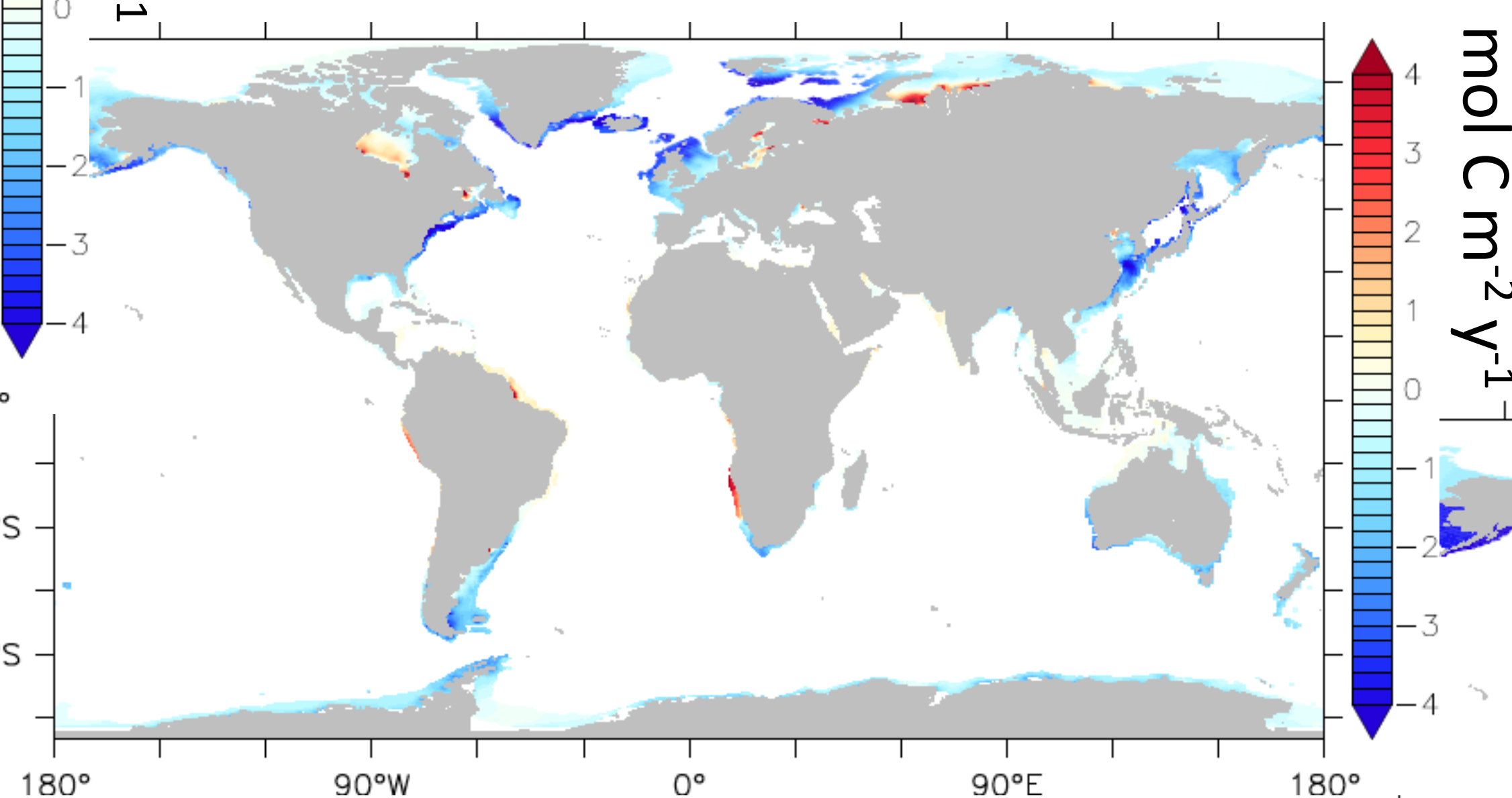
- NEMO-PISCES-LIM
- 20 to 50 km horizontal resolution



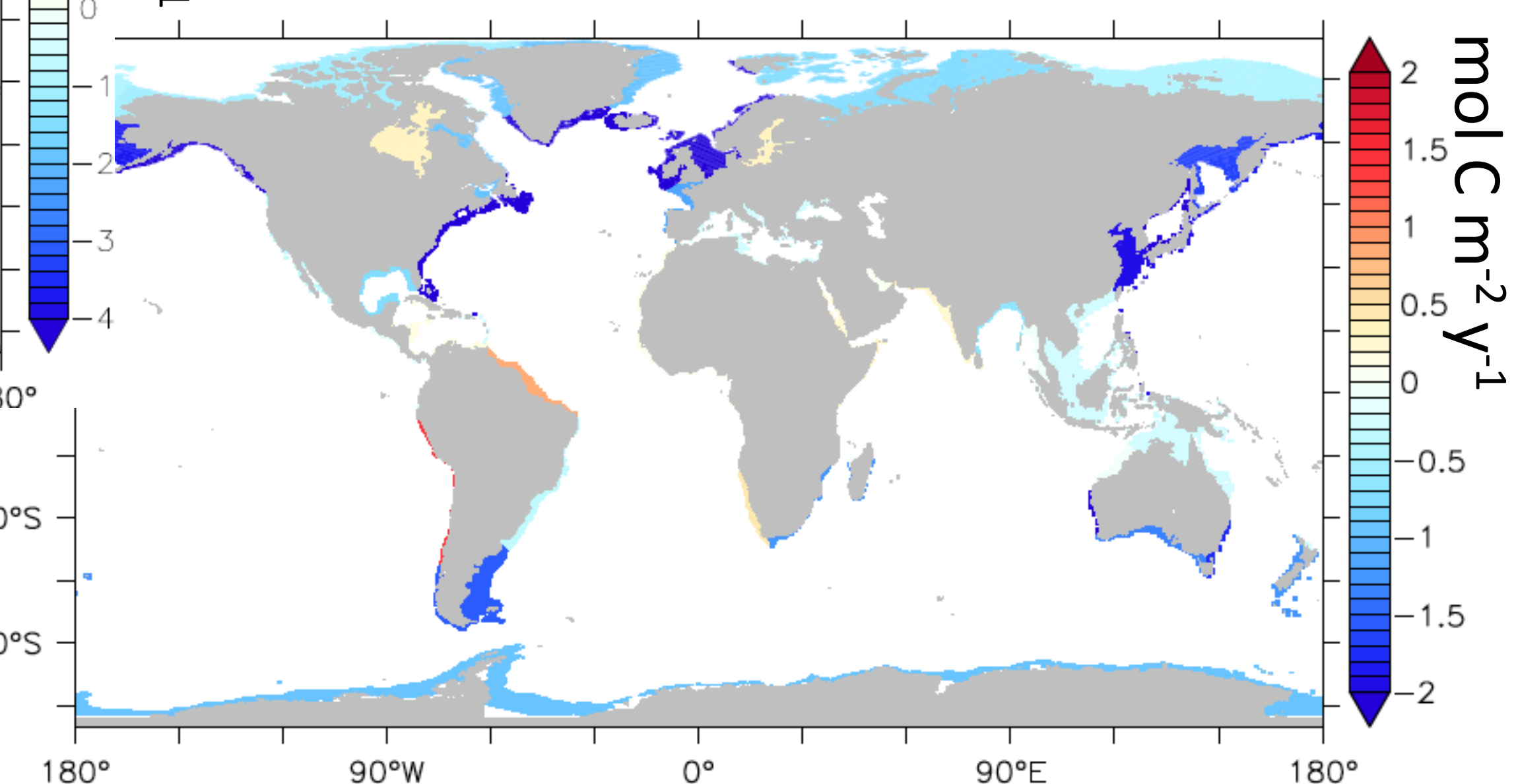
$$\text{Anthropogenic FCO}_2 = \text{Total FCO}_2 - \text{Natural FCO}_2$$



Simulated air-sea total CO<sub>2</sub> fluxes...



...for the coastal ocean...

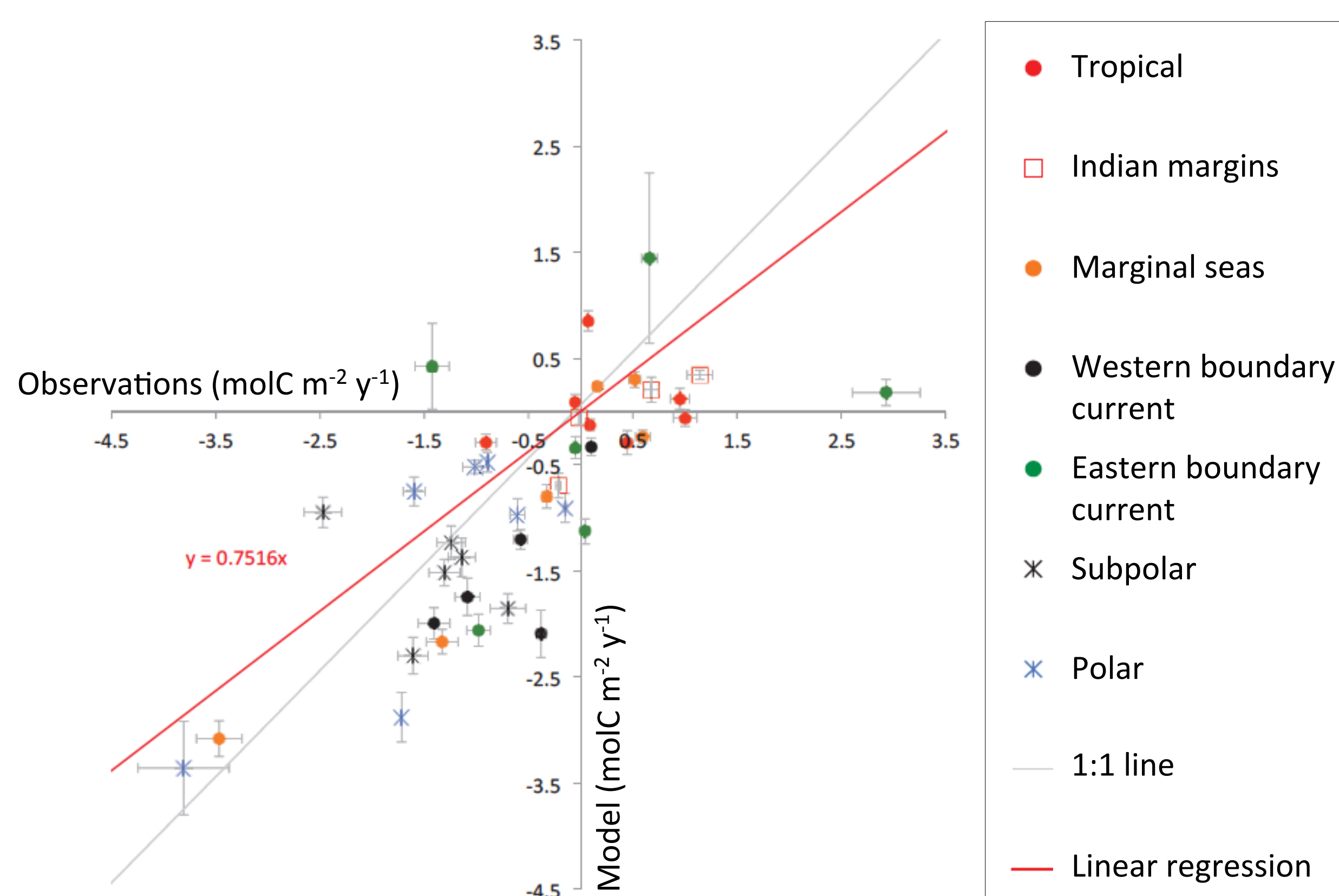


...according to a global coastal segmentation [1]

### Skills assessment for total FCO<sub>2</sub>

Using observation-based FCO<sub>2</sub> estimates from [2] :

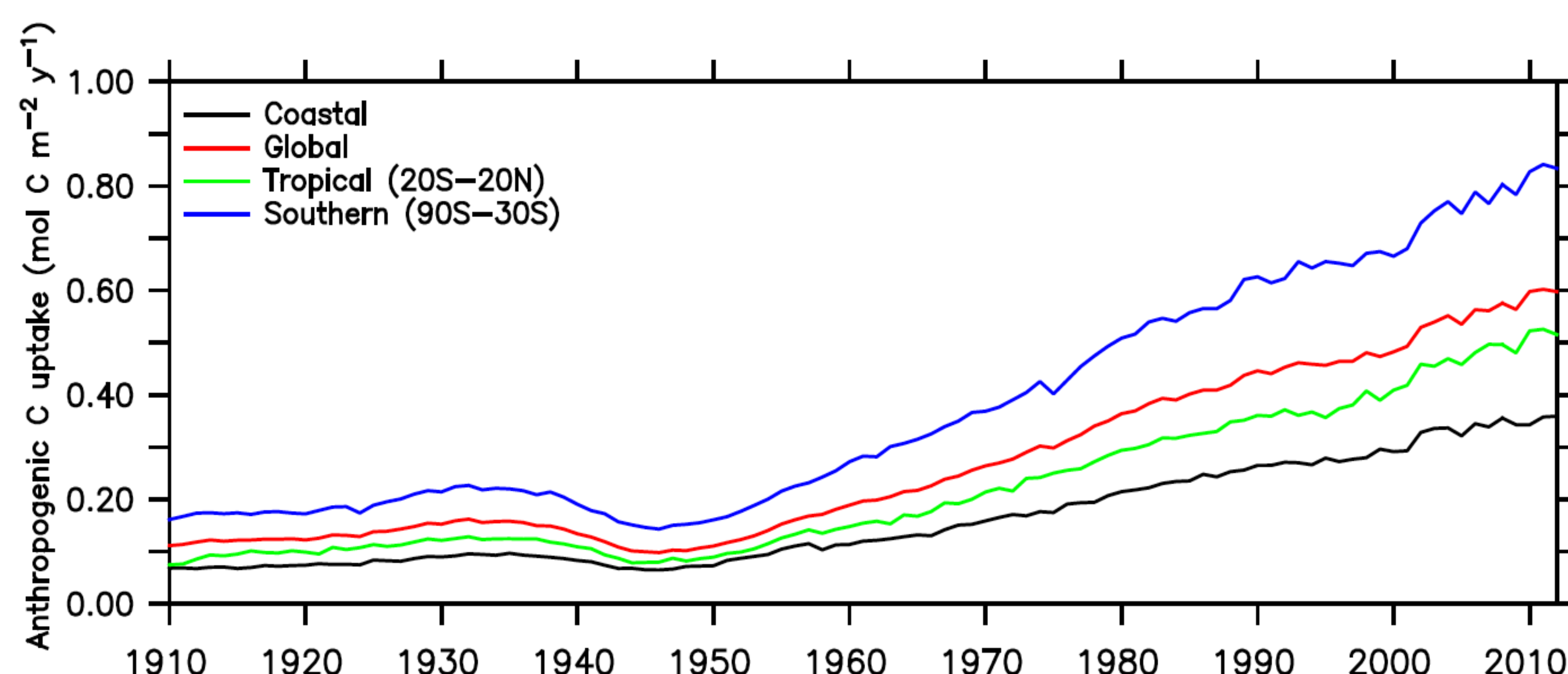
- R correlation = 0.7
- RMSE = 0.9 mol C m<sup>-2</sup> y<sup>-1</sup>
- Slight overall underestimation of the FCO<sub>2</sub>
- Misrepresentation of Eastern Boundary upwelling regions



Simulated versus Observation-based air-sea CO<sub>2</sub> fluxes from [2] (mol C m<sup>-2</sup> y<sup>-1</sup>)

### Coastal carbon uptake estimates

- Total carbon uptake: 0.27 Pg C y<sup>-1</sup>, in agreement with the latest estimates of 0.2-0.4 Pg C y<sup>-1</sup> [2,3]
- Anthropogenic carbon uptake: **0.1 Pg C y<sup>-1</sup>**, half of the last estimate [4], due to an expected limitation of the cross-shelf exchange.



Anthropogenic carbon uptake for the coastal ocean, the global ocean, the tropical ocean and the southern ocean (mol C m<sup>-2</sup> y<sup>-1</sup>)

#### Acknowledgements:

Goulven G. Laruelle provides the raw database of the observation-based air-sea CO<sub>2</sub> fluxes. Christian Eth  and Laure Resplandy monitored the model simulations.

#### References:

- [1] Laruelle *et al.* (2013). Global multi-scale segmentation of continental and coastal waters from the watersheds to the continental margins. *Hydrology and Earth System Sciences*, 17 (5), 2029-2051.
- [2] Laruelle *et al.* (2014). Regionalized global budget of the CO<sub>2</sub> exchange at the air-water interface in continental shelf seas. *Global Biogeochemical Cycles*, 28 (11), 1199-1214.
- [3] Chen *et al.* (2013). Air-sea exchanges of CO<sub>2</sub> in the world's coastal seas. *Biogeosciences*, 10 (10), 6509-6544.
- [4] Wanninkhof *et al.* (2013). Global ocean carbon uptake: magnitude, variability and trends. *Biogeosciences*, 10 (3), 1983-2000.