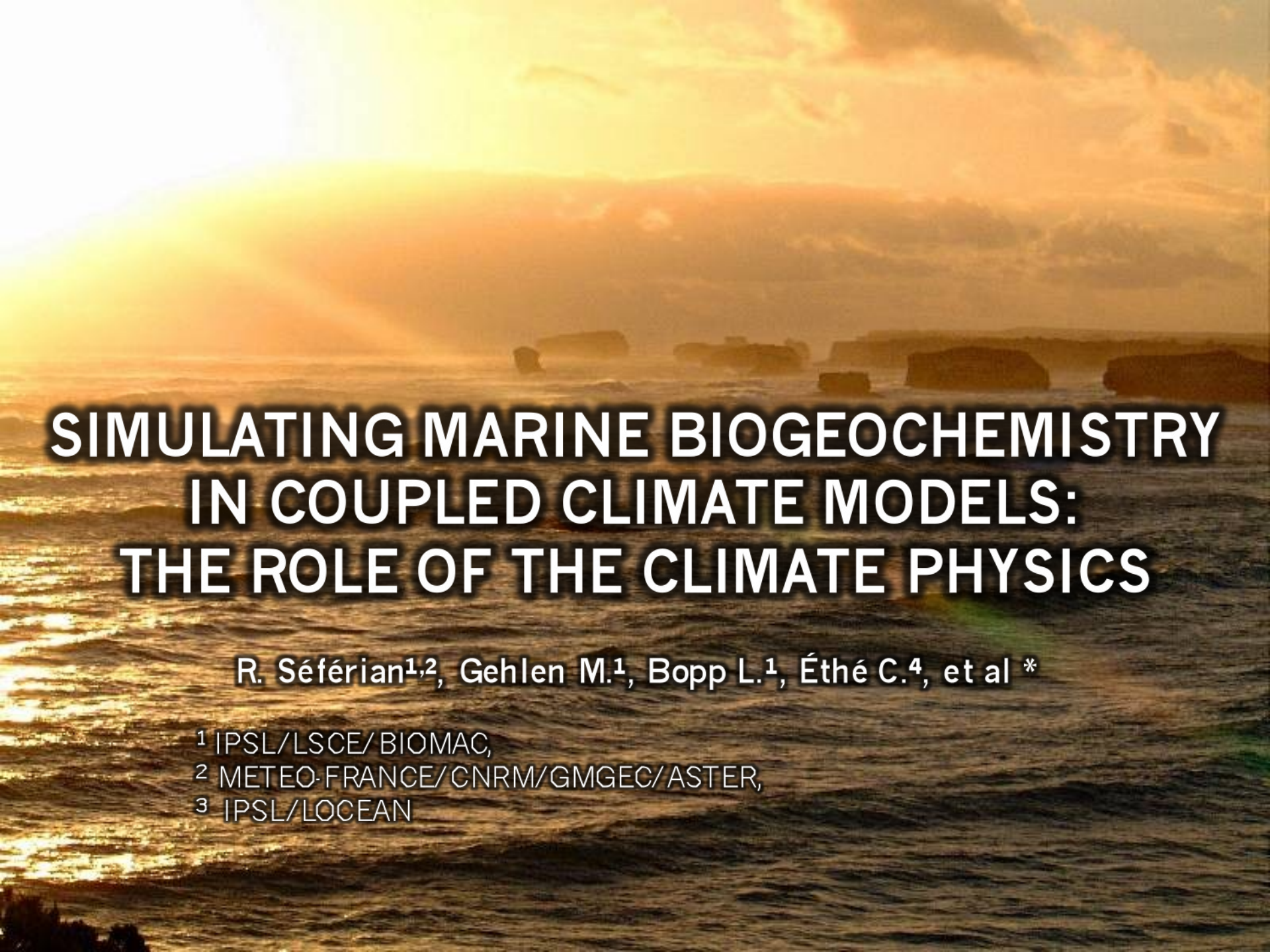

SIMULATING MARINE BIOGEOCHEMISTRY IN COUPLED CLIMATE MODELS: THE ROLE OF THE CLIMATE PHYSICS

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[3] IPSL/LOCEAN

Motivations:

- **Coupled Models are currently used for near- and long-term projections**.

- But, **uncertainties** impacting their predictive goals **are poorly constrained** (e.g., Friedlingstein et al., 2003).

⇒ **One** of them is related to the interactions between the biogeochemistry dynamics and the ocean dynamics.

Background ideas:

- biogeochemical models are only as good as the physical framework in which they are set (Doney, 1996).

- Use biogeochemical tracers to evaluate and assess ocean dynamics (England, 2001)

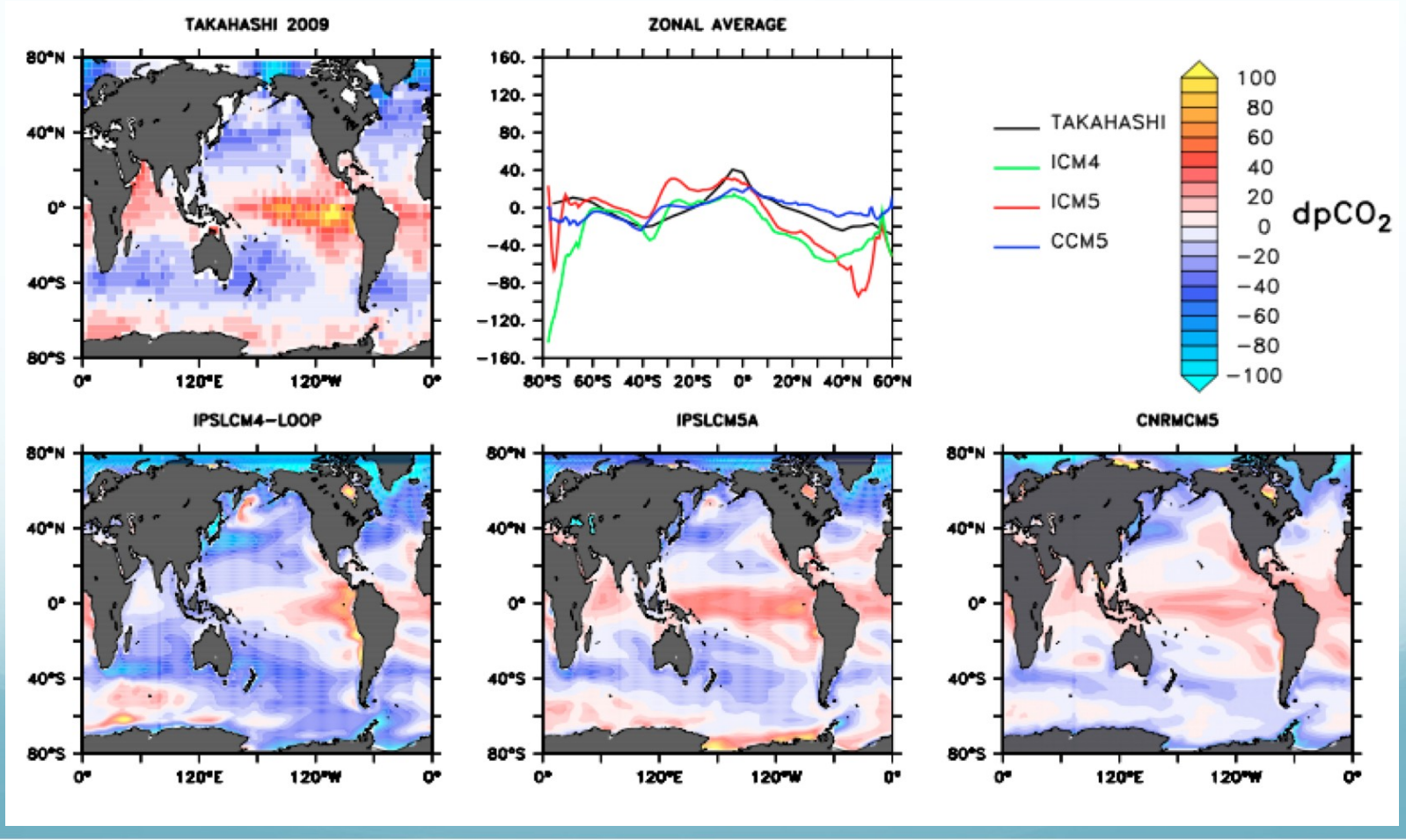
  Use **1** state-of-the-art biogeochemical model (**PISCES**) embedded in **3** ocean circulations generated by 3 different coupled models: **IPSLCM4LOOP, IPSLCM5A, CNRMCM5**

Biogeochemical dynamics:

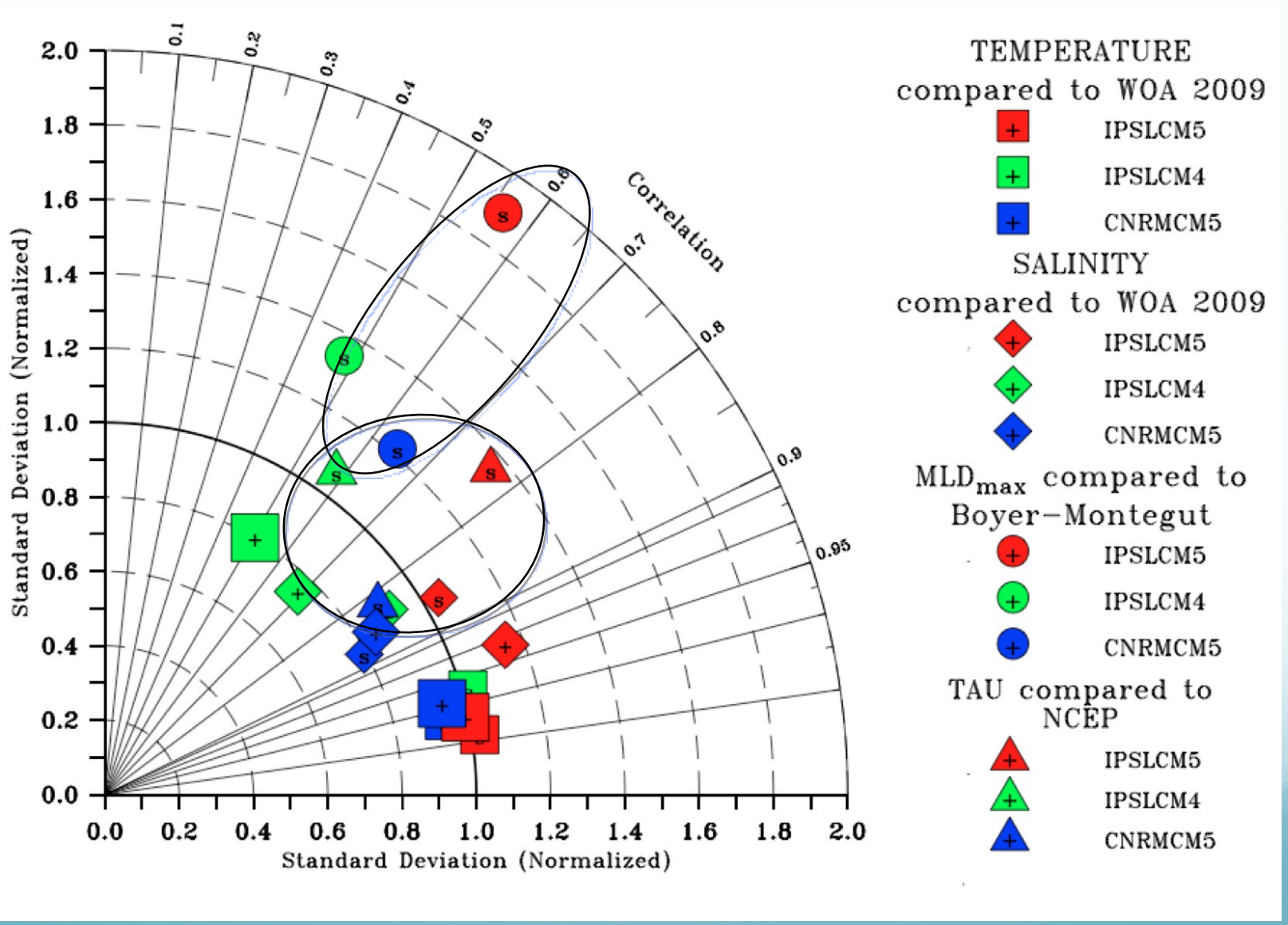
$$F_{CO_2} = K_w(\vec{v}) \cdot (k_o(SSS, SST) \cdot DIC^{surf} - p_{CO_2}^{Atm})$$

$$p_{CO_2}^{Oce}$$

$$dp_{CO_2}$$

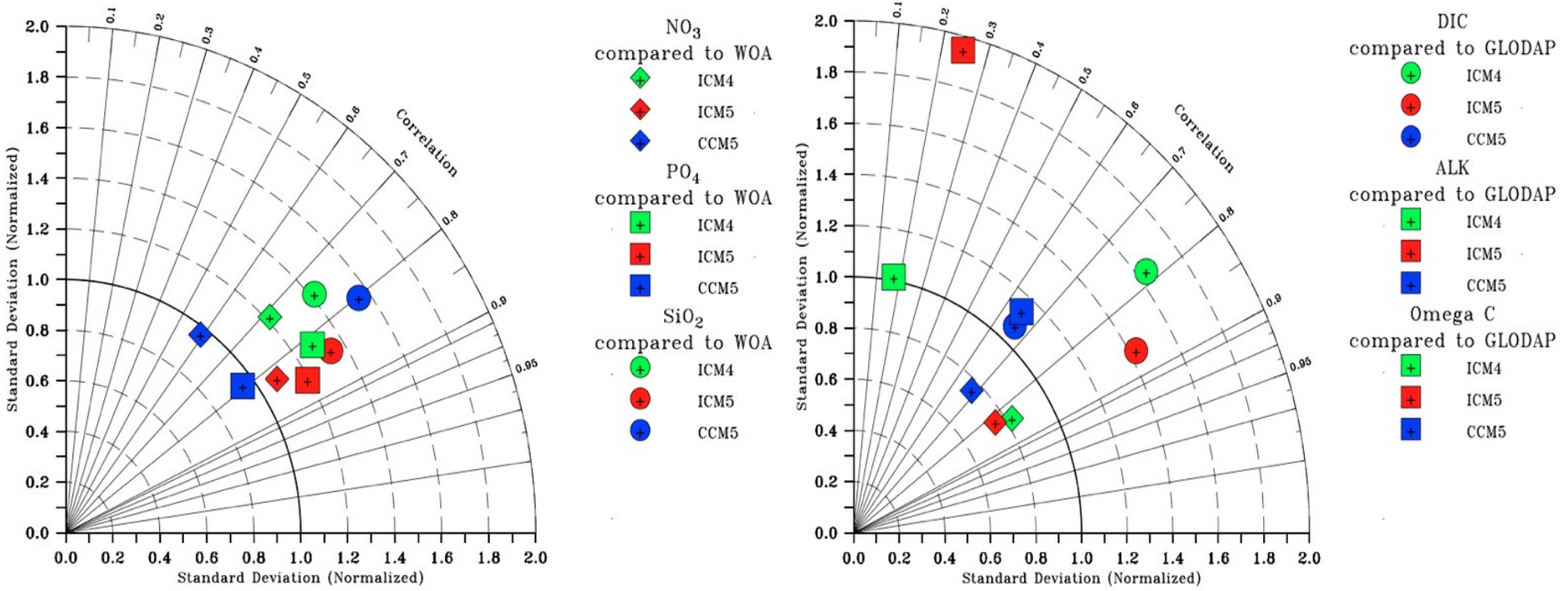


Ocean dynamics:

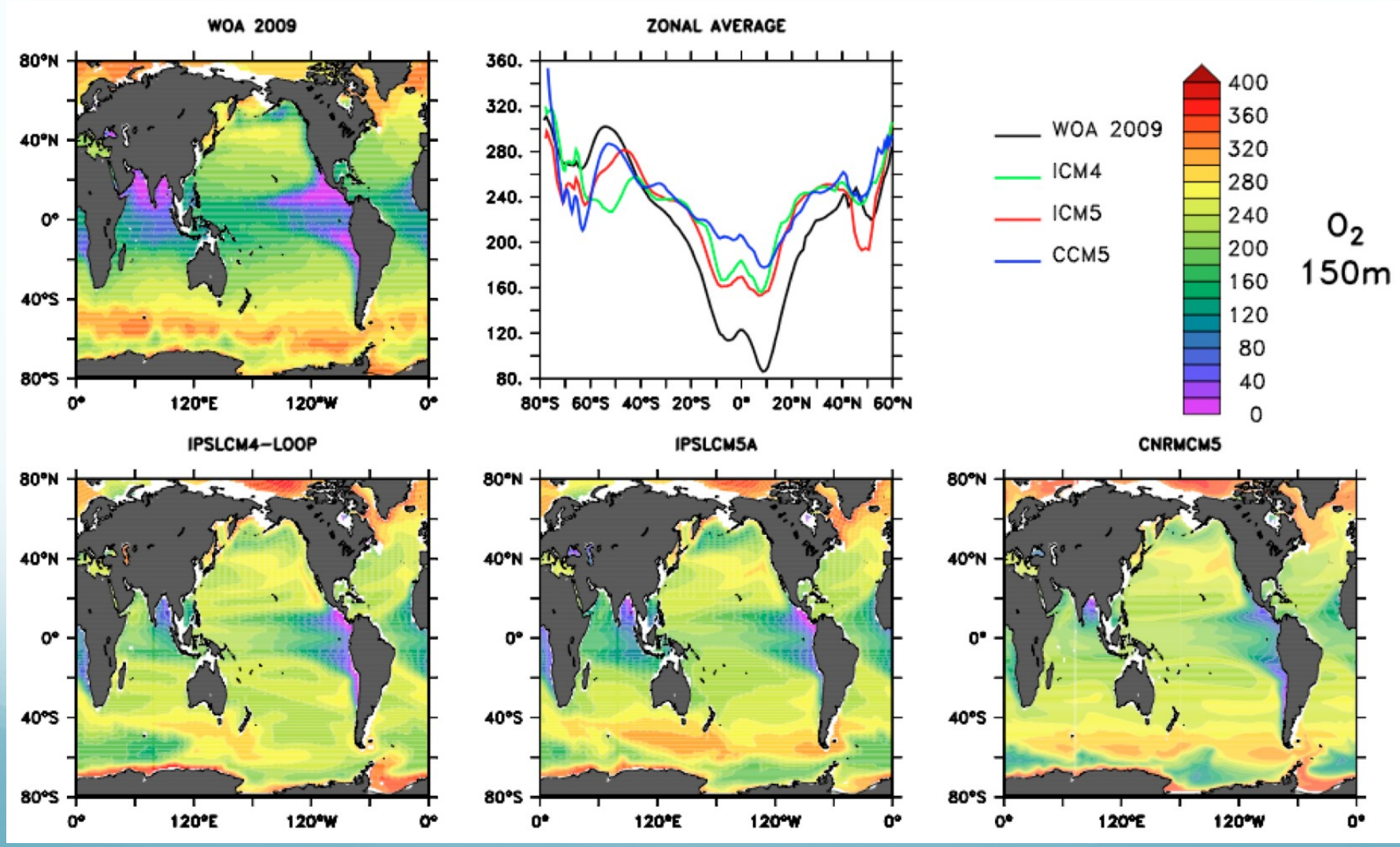


Nutrients & Carbon Chemistry components:

Intermediate Layer (1000m) concentrations



Oxygen concentrations ~ Oxygen Minimum Zone:



Oxygen concentrations ~ Oxygen Minimum Zone:

Volume Of Oxygen Minimum (10^16m3)	Obs	ICM4	ICM5	CCM5
surface-1200m	3.54	2.33	0.818	5.49
1200-bottom	7.65	1.08	3.73	24.0

Conclusions:

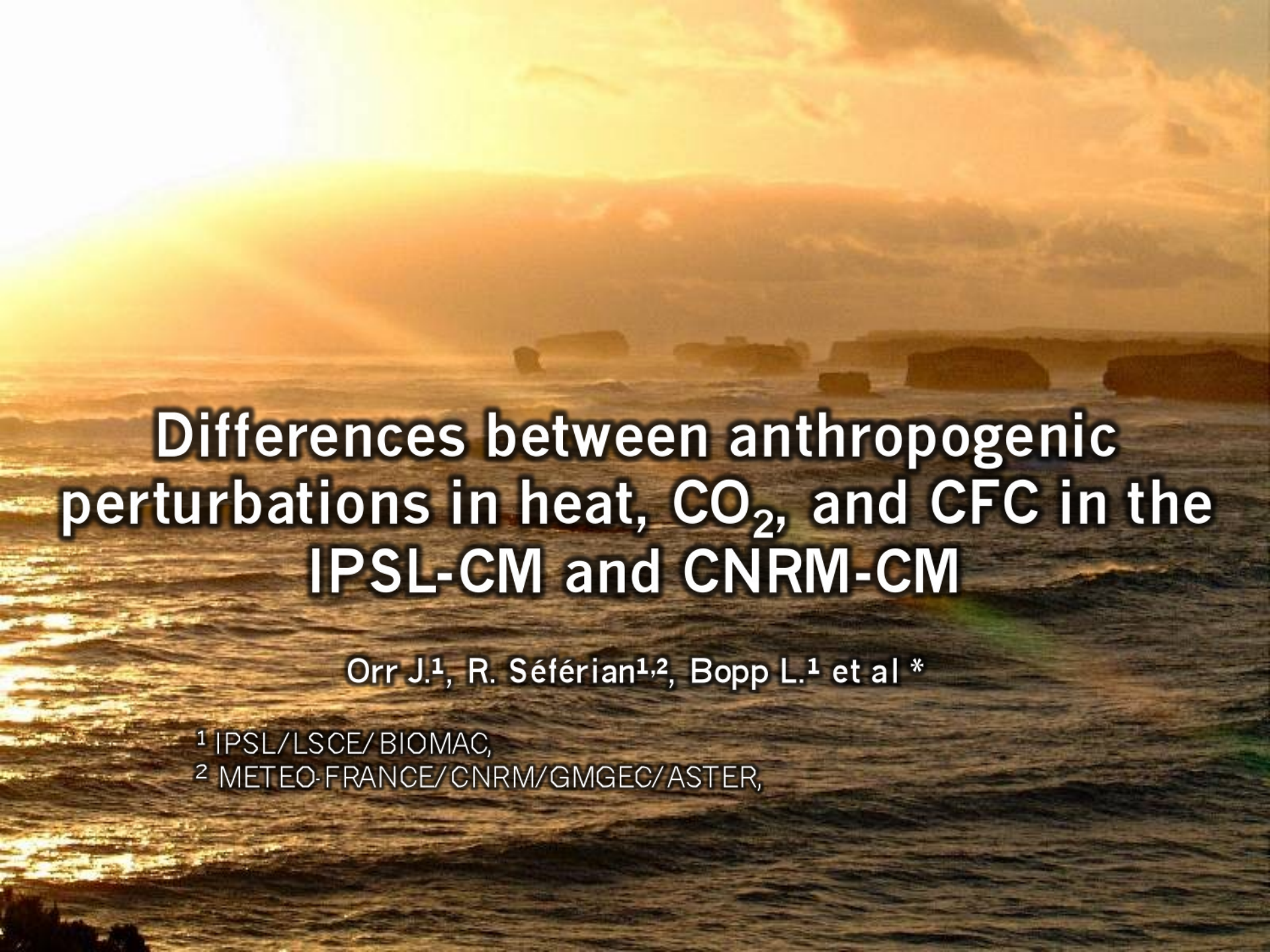
- **Large-scale ocean dynamics** appears to be sufficient for simulating **the major patterns of the global ocean carbon cycle** (based on models-data and models-models comparison)

- BUT, **local physics** (co-generated by atmosphere and ocean models) has to be improved for increasing the reliability of ocean carbon models in term of **sensitivity and impacts**.

⇒ **Mixed layer depth, wind stress and shortwave** (and its co-variables) !

⇒ **Vertical profiles of DIC and Alkalinity** are important players of the ocean carbon uptake (water masses)

⇒ Weak impact of the horizontal resolution of the ocean models (?)



Differences between anthropogenic perturbations in heat, CO_2, and CFC in the IPSL-CM and CNRM-CM

Orr J.[1], R. Séférian[1,2], Bopp L.[1] et al *

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[2] METEO-FRANCE/CNRM/GMGEC/ASTER,

Motivations:

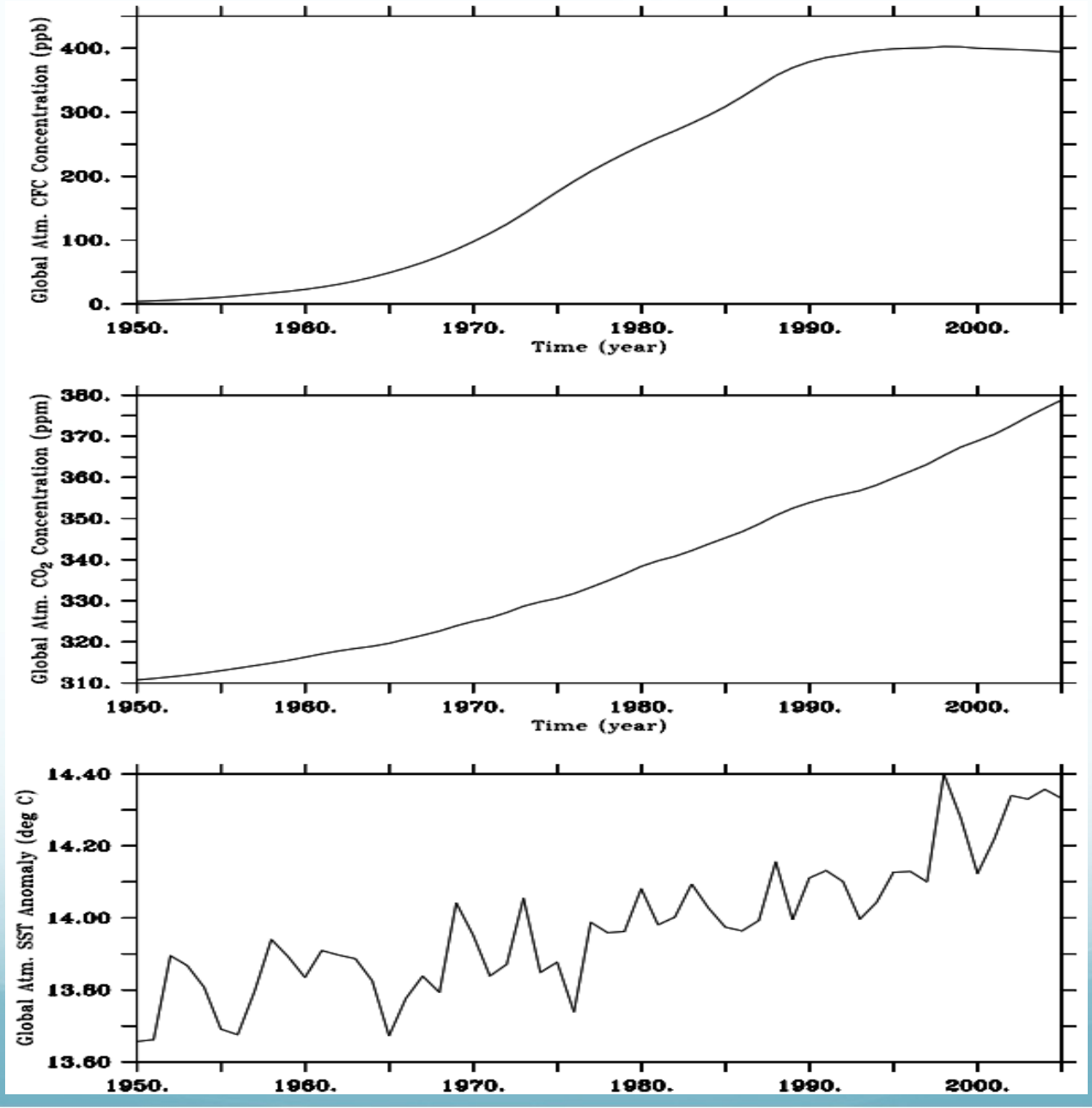
- Ocean Heat content (**OHC**), **CO2** and **CFC** are **3 anthropogenic perturbations**.
- Ocean Heat content (**OHC**), **CO2** and **CFC** have **3 different "stories"**.

⇒ How models **simulate** and **capture** these different anthropogenic perturbations.

2 simulations:

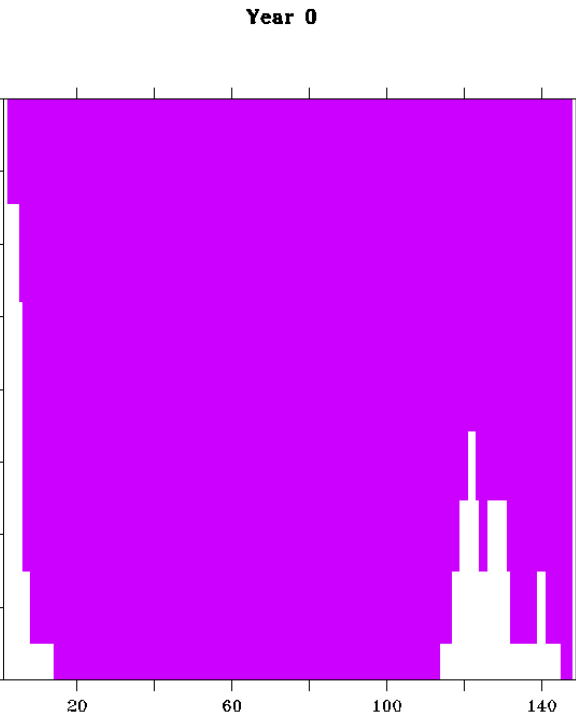
- **Historical (CMIP5) 1850/1860 – 2005**
- **Historical (OCMIP) 1950 – 2005 for CFC only**

Anthropogenic perturbations

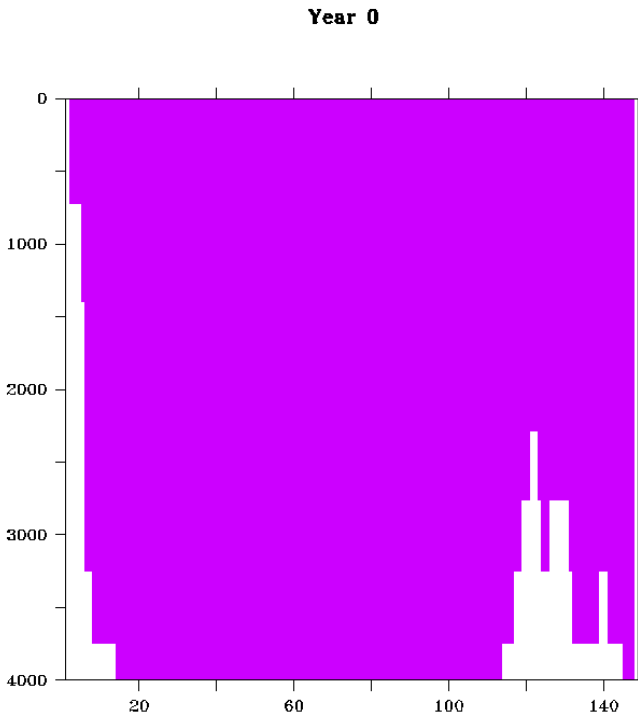


CFC concentrations evolution

IPSLCM4-LOOP



IPSLCM5A



CNRMCM5