

# Ocean Initialization and Monitoring for CERA

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# Introduction

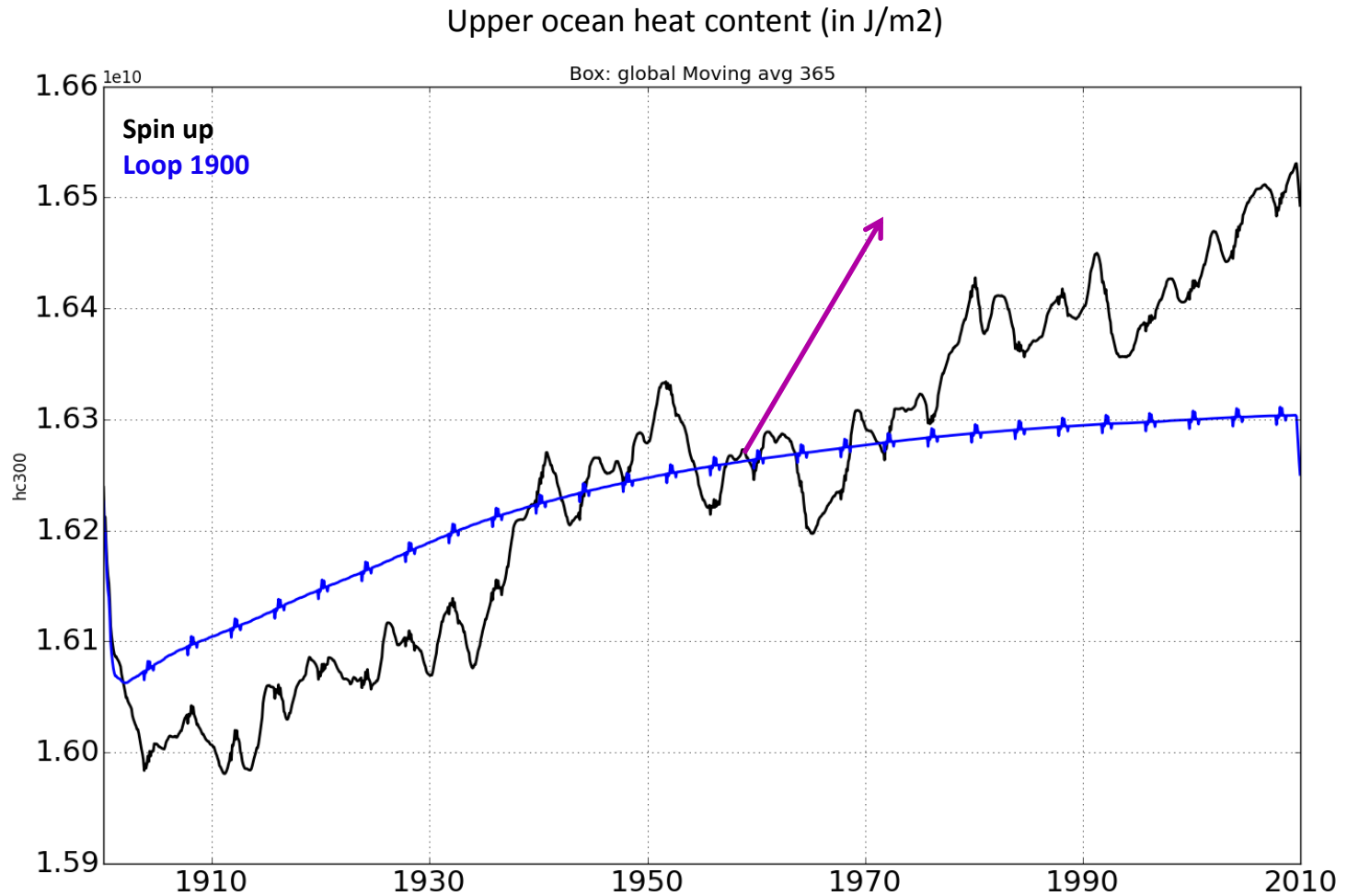
- CERA20C cannot be run in one-go: 14 streams starting every 8 years
- Need ocean and atmospheric states to initialize the streams
- Atmosphere ERA-20C, Ocean ... Need of a 20<sup>th</sup> century ocean assimilation run
- Problem: state of the ocean in 1900 unknown
- Need to represent uncertainty in the IC provided to CERA20C

## Production of ocean IC for CERA streams

Spin-up experiments: 20<sup>th</sup> century run (1900-2010)

- NEMO ORCA1Z42
- Forced by ERA20C surface fields
- IC from 19790101, from an ODA experiment forced by ERA-Interim over 1959-2012
- No ODA
- SST relaxation to HadISST2
- 3D T/S relaxation to climatology (WOA)
- Compared to a similar ocean run with forcing looping over the year 1900 of ERA20C and HadISST

# Production of ocean IC for CERA streams



Assimilation runs starting from 19590101 show reduced initialization shock

## Production of ocean IC for CERA streams

**Three 20<sup>th</sup> century ODA experiments** are launched from these IC

All experiments assimilate **EN4 T/S** profiles, are forced by ERA20C and constrained by HadISST2

Three different configurations are used:

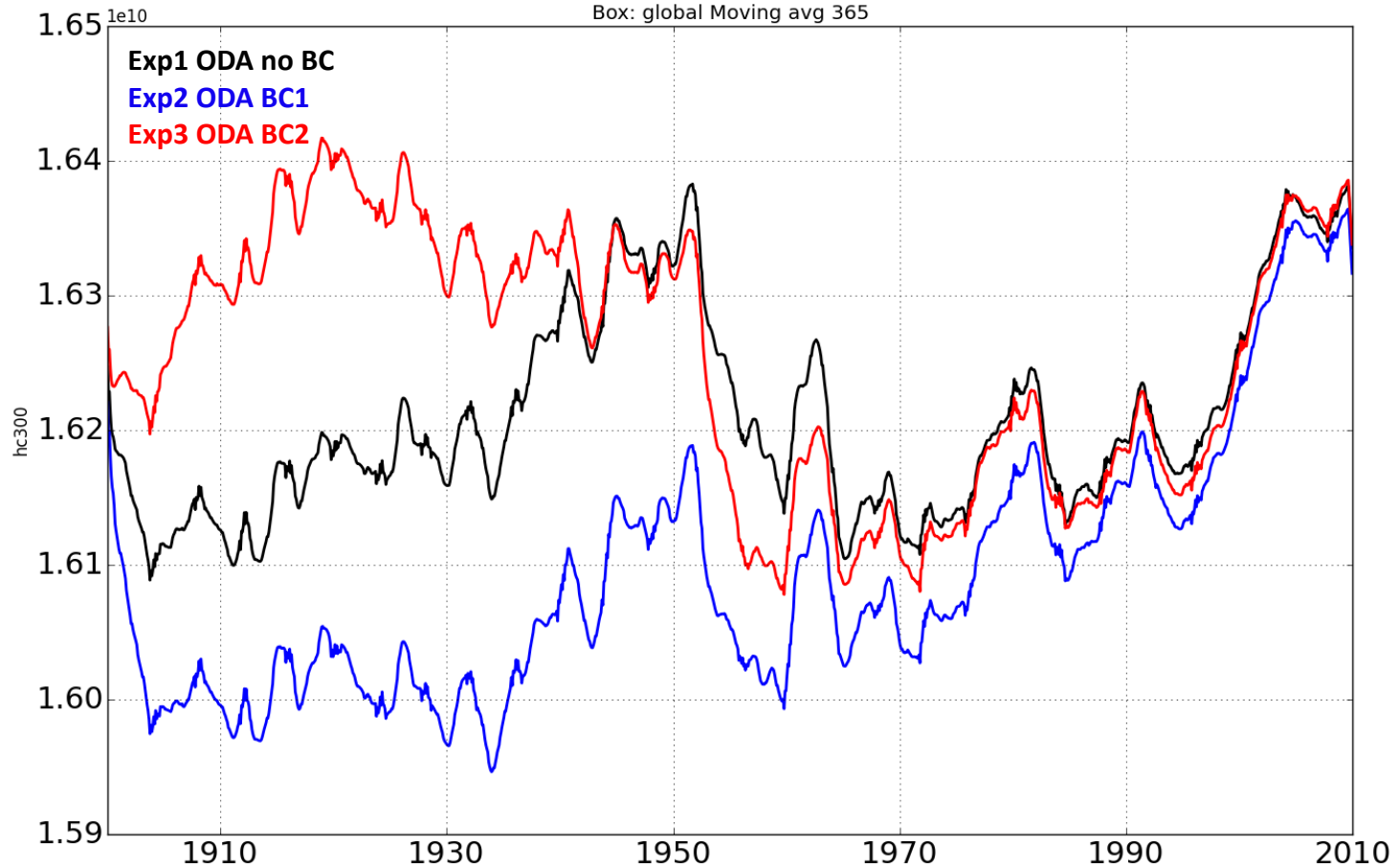
- **Exp 1**: ODA no bias correction
- **Exp 2**: ODA with bias correction estimated from ODA run forced by ERA-Interim
- **Exp 3**: ODA with bias correction estimated from ODA run forced by ERA-20C

These 3 experiments provide **10 IC** for an ODA ensemble starting in 19000101

The 10 IC are chosen in order to **sample the uncertainty** on the ocean state in 1900

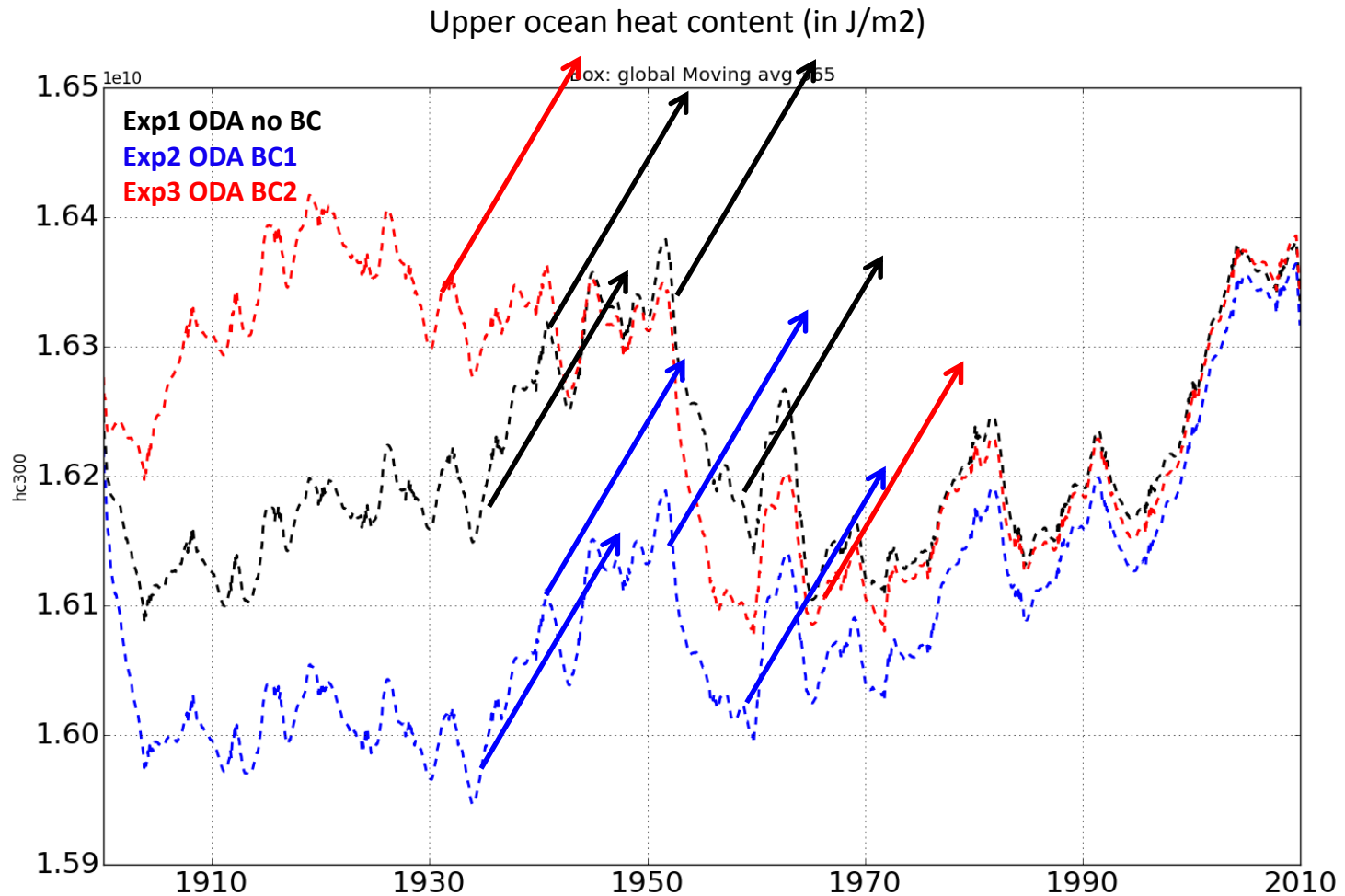
# Production of ocean IC for CERA streams

Upper ocean heat content (in J/m<sup>2</sup>)



- Strong uncertainty in the 1<sup>st</sup> half of the 20<sup>th</sup> century

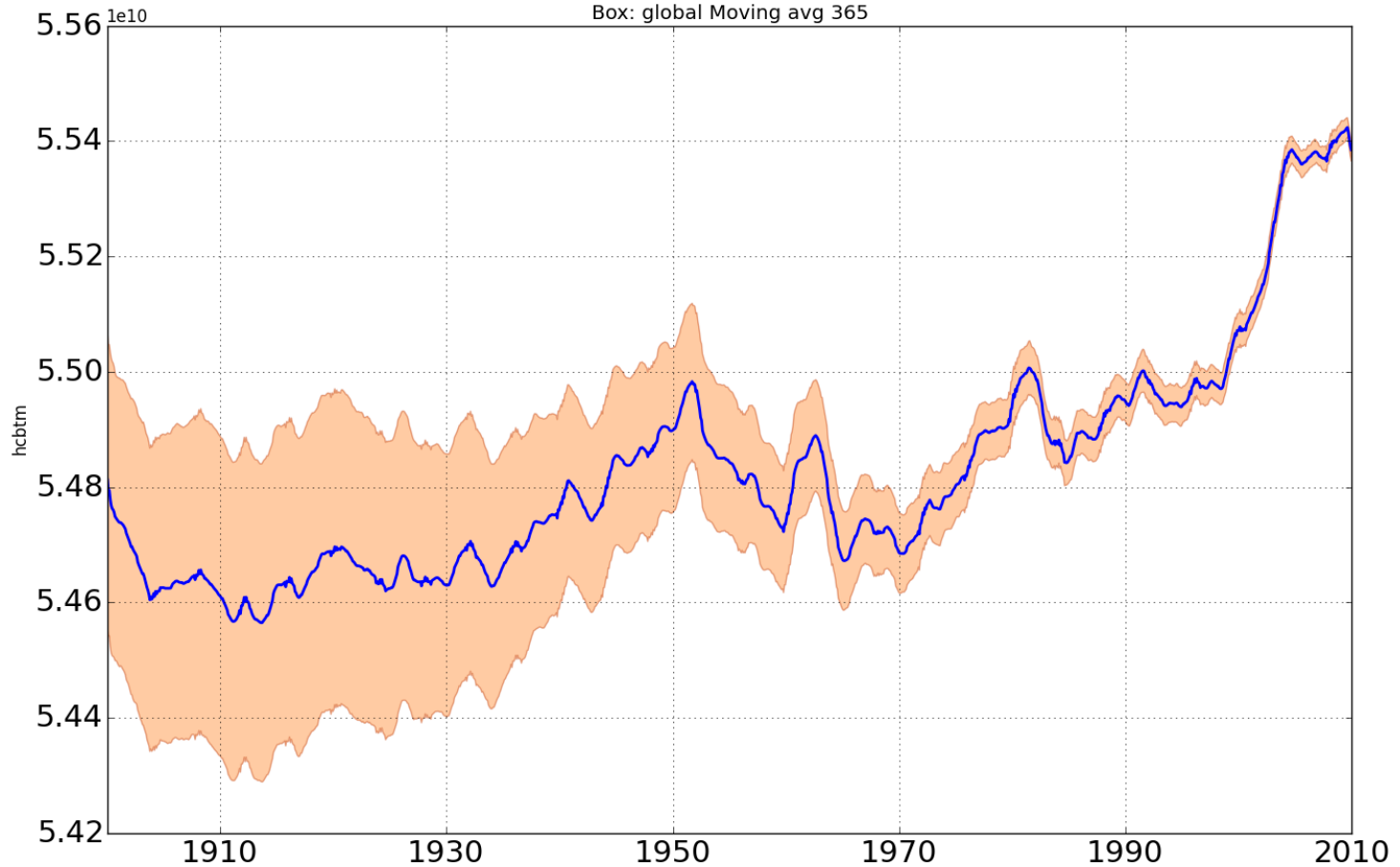
# Production of ocean IC for CERA streams



- Strong uncertainty in the 1<sup>st</sup> half of the 20<sup>th</sup> century
- 10 ocean states are selected as IC in 19000101 for a 10-member ensemble ODA

# Production of ocean IC for CERA streams

Ocean heat content (in W) – ensemble mean and spread

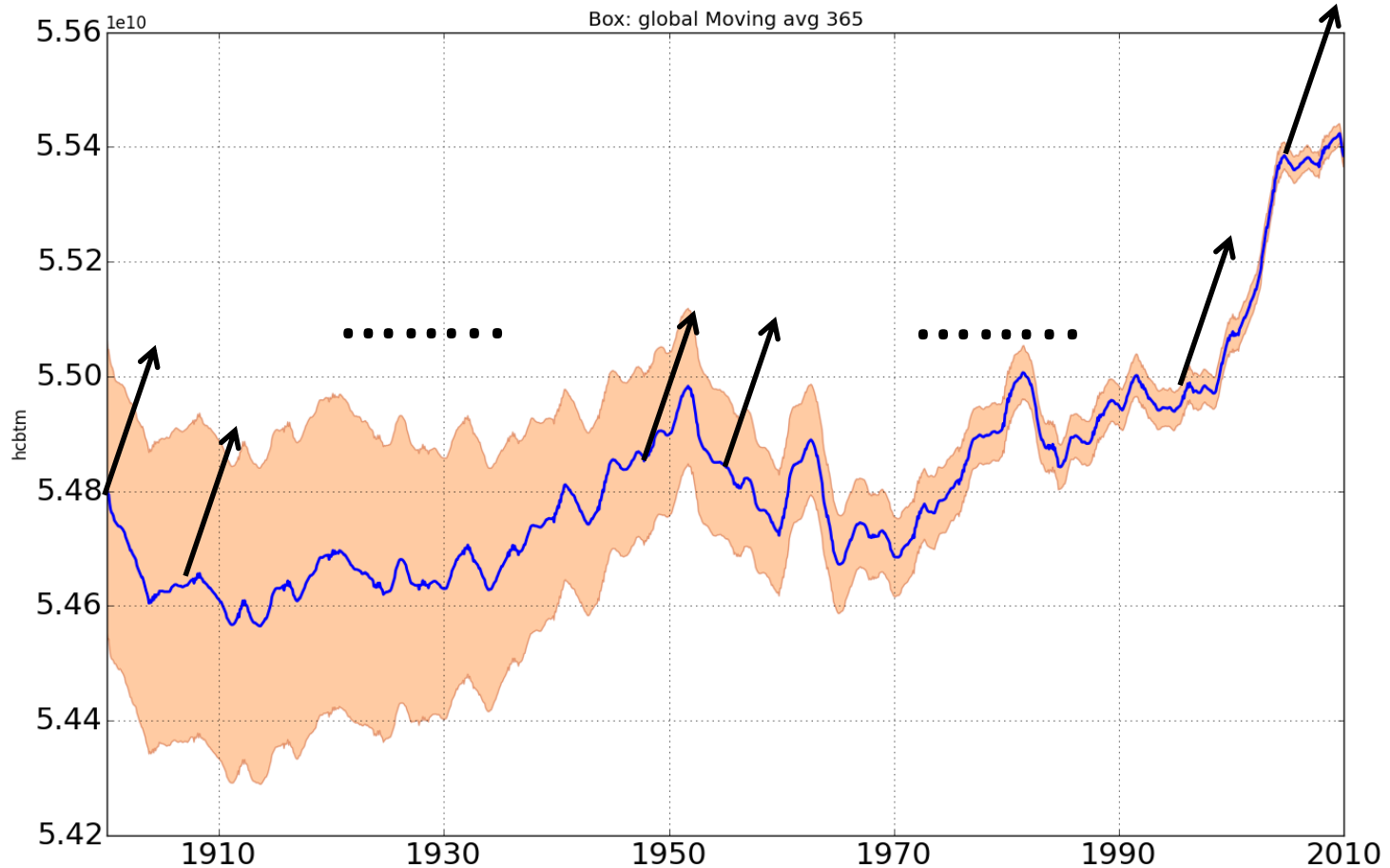


- Ensemble ODA run: assimilate EN4 T/S and uses perturbations on SST, fluxes and observations



# Production of ocean IC for CERA streams

Ocean heat content (in W) – ensemble mean and spread



- Ensemble ODA run: assimilate EN4 T/S and uses perturbations on SST, fluxes and observations
- This 10-member ensemble run provides the ocean initial states for the 14 CERA streams

# Ocean monitoring of CERA streams

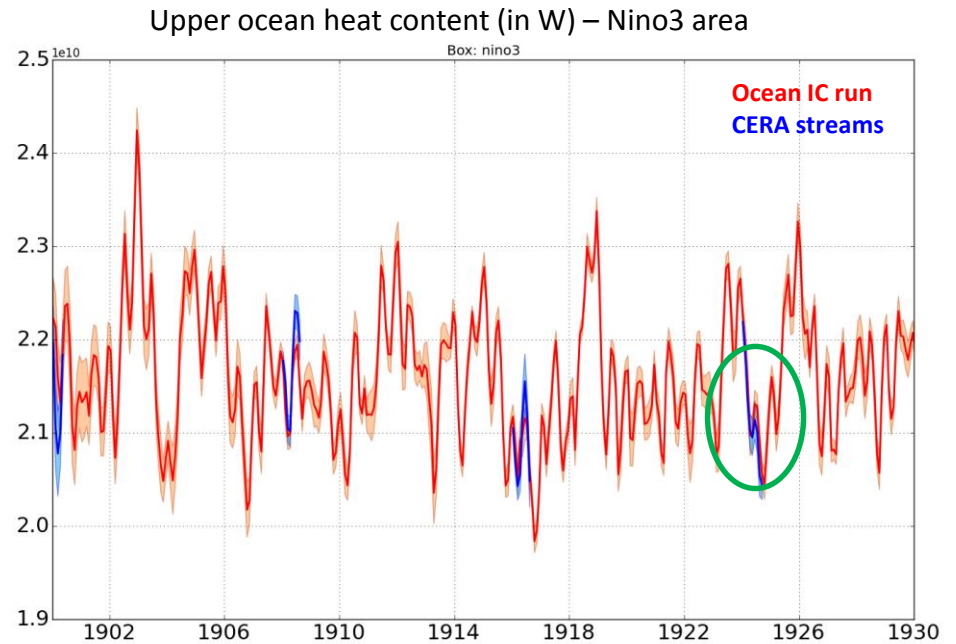
## Ocean monitoring tools

- Timeseries
- Ocean maps
- Ocean zonal/meridional sections
- Assimilation diagnostics

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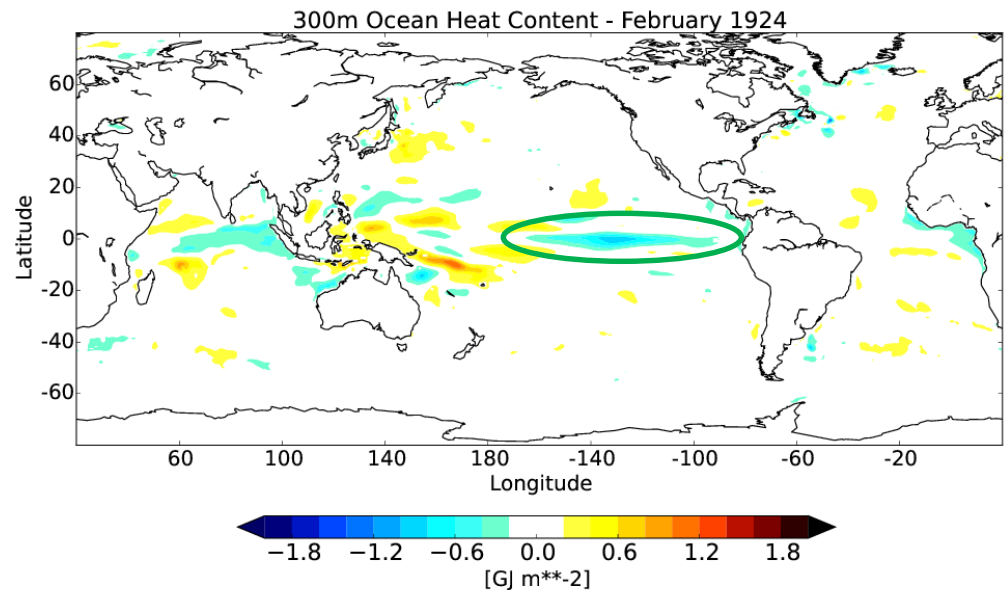


# Ocean monitoring of CERA streams

## Ocean monitoring tools

- Timeseries

- **Ocean maps**



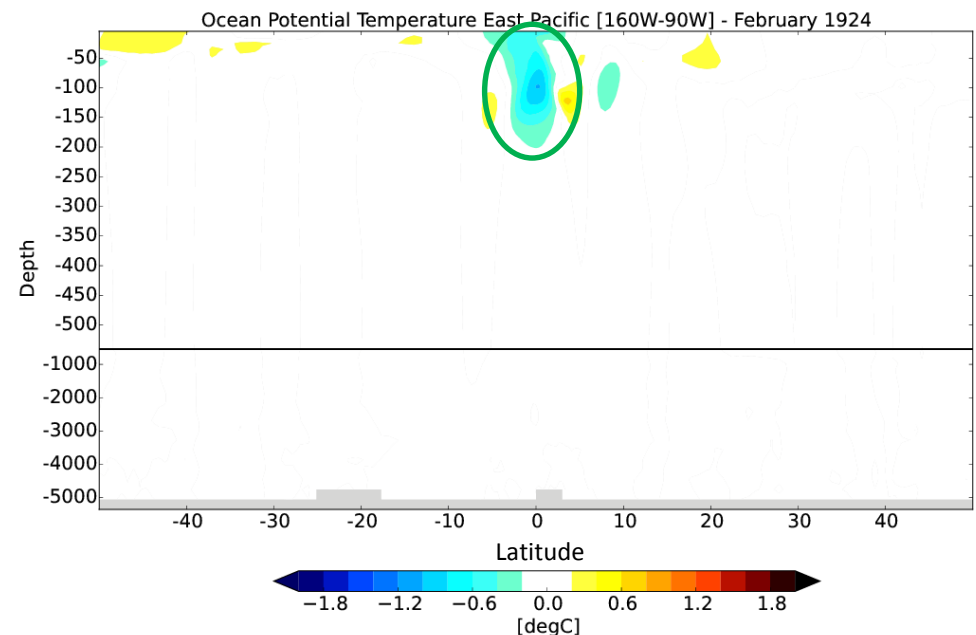
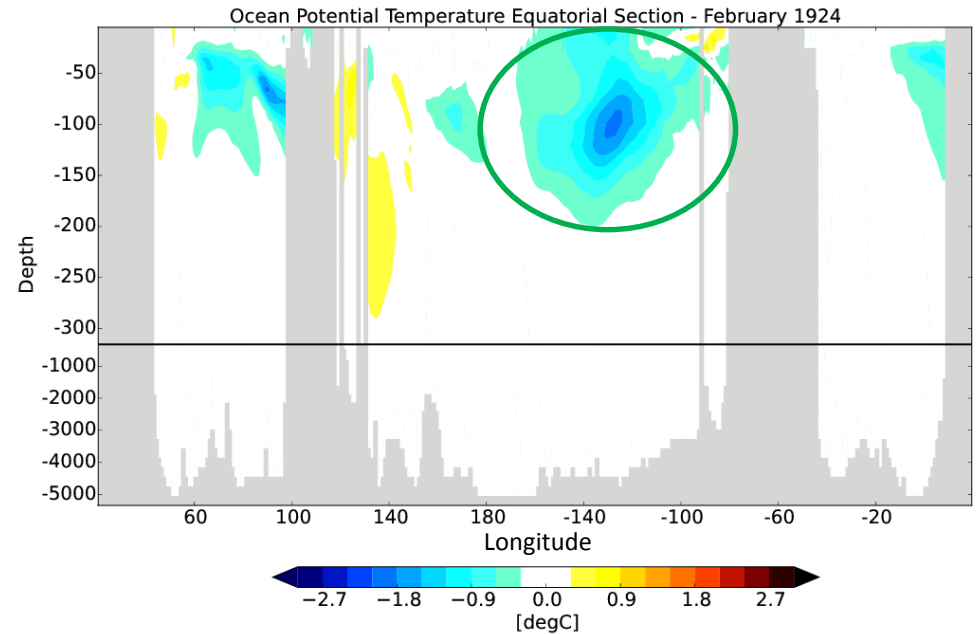
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## Ocean monitoring tools

- Timeseries
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- **Ocean zonal/meridional sections**
- Assimilation diagnostics



# Ocean monitoring of CERA streams

## Ocean monitoring tools

- Timeseries
- Ocean maps
- Ocean zonal/meridional sections
- Assimilation diagnostics: working on it...

## Ocean monitoring of CERA streams

- Next?? ... Second order diagnostics
  - O-A coupled processes: TIWs, MJO, ENSO
  - Interannual to Decadal climate indices (AMO, PDO)
  - Trends and climate signals: SST, sea level
  - Water masses variability
  - Dynamical variability (MOC)



**Mercator  
Ocean**  
Ocean Forecasters



**LSCE**

LABORATOIRE DES SCIENCES DU CLIMAT  
& DE L'ENVIRONNEMENT



WP1 : Global 20<sup>th</sup> century analysis

Development of the carbon component

[MERCOC] Aurélie Albert, Coralie Perruche, Yann Drillet  
[UVSQ/LSCE] Marion Gehlen

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ERA-CLIM2 2<sup>nd</sup> General Assembly EUMETSAT. 9-11 December 2015



Objectives :

- set up of the coupling of Ocean Biogeochemistry with CERA-20C
- run 10 20<sup>th</sup> century analysis of ocean biogeochemistry

Strategy :

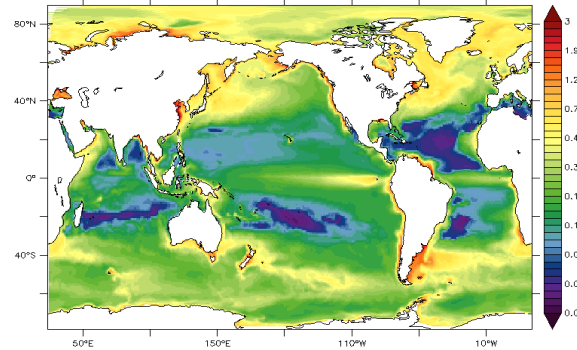
- **“offline” NEMO-PISCES** : atmospheric forcing fields from CERA-20C
- CERA-20C forcings not yet available, temporary back-up solution => simulation using ERA-20C atmospheric outputs

Two approaches :

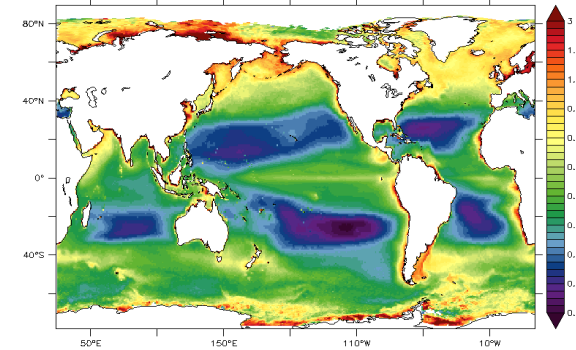
- **ECMWF set-up** : NEMO-PISCES 3.4, 42 vertical levels => 50 yrs of simulation produced

ECMWF setting : results in 1950

Surface chlorophyll  
in mg CHL / m<sup>3</sup>  
(log scale)

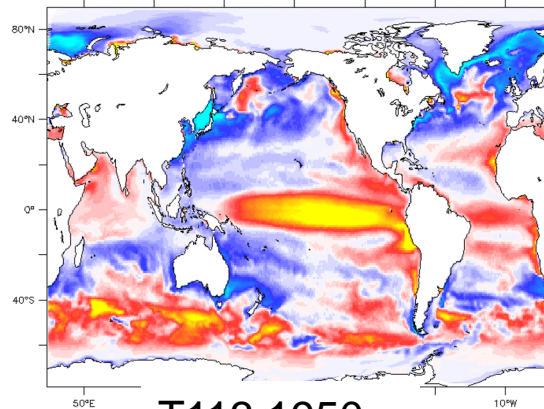


T113 1950

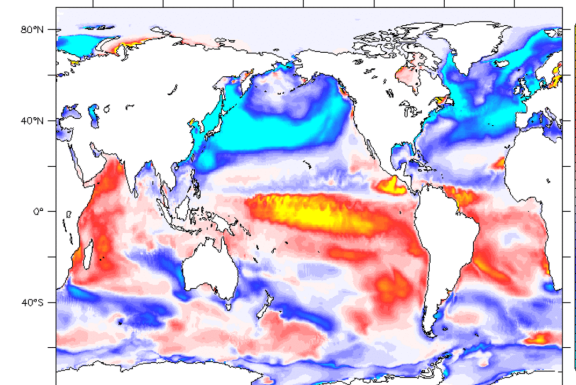


data : globcolor (1998-2011)

Sea-to-air CO<sub>2</sub> Flux  
in g C / m<sup>2</sup>



T113 1950



ORCA05-LJS18 1950

=> Chl: Loss of Pacific and S Atl oligotrophic gyres, not productive enough at high latitudes;  
FCO<sub>2</sub>: spurious outgassing in S Ocean (particular Indian sector), NW Pacific sink missing

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## Two approaches :

- ECMWF set-up : NEMO-PISCES 3.4, 42 vertical levels => 50 yrs of simulation produced
- **IPSL set-up** : NEMO-PISCES 3.6, 75 vertical levels, newest parameterization  
=> for a broader use in the community, production in progress