Work Package 1: Global 20th century reanalysis

Review Meeting – Patrick Laloyaux – 25 April 2016

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SEVENTH FRAMEWORK PROGRAMME

ECMWF
EUROPEAN CENTRE FOR MEDIUM RANGE WEATHER FORECASTS

MERCATOR OCEAN
OCEAN FORECASTERS

LSCE

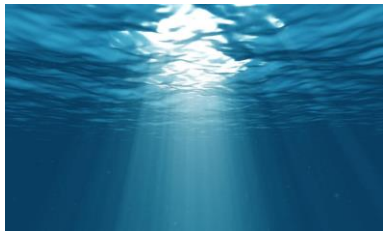
Summary of the Description of Work

Produce global reanalyses to reconstruct the past climate/wheater of the earth system

Atmosphere

Land

Wave



Ocean

Sea ice

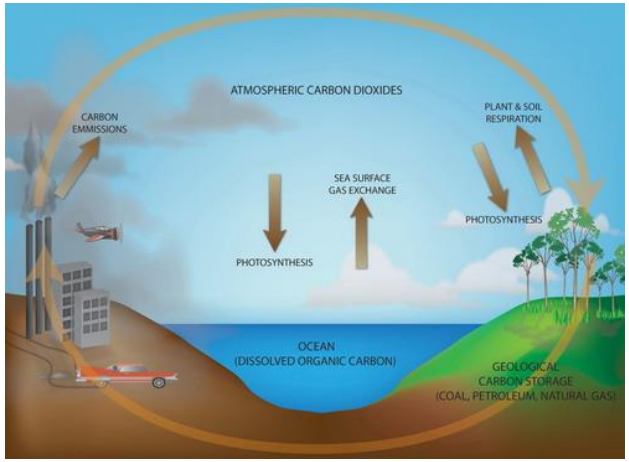
CERA-20C: A coupled reanalysis of the 20th century

- based on conventional surface and subsurface observations
- deliver long timeseries of Essential Climate Variables (ECVs)

CERA-SAT: A coupled reanalysis at higher resolution

- based on conventional and satellite observations
- evaluate the impact of a higher resolution on the coupled processes

Produce associated reanalyses to reconstruct the evolution of the carbon fluxes



CERA-20C/Carbon: land & ocean carbon reanalyses

- based on forcings from atmospheric/ocean reanalyses
- estimate carbon flux anomalies over the 20th century

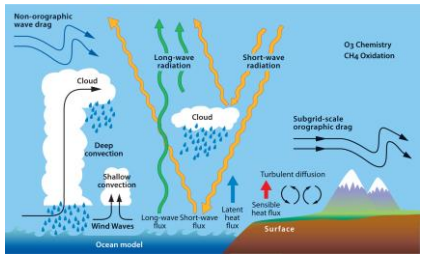
CERA-SAT/Carbon: two land carbon reanalyses

- produced online by the CTESSEL land model
- produced offline by the ORCHIDEE land model

T1.1 CERA-20C: A coupled reanalysis of the 20th century

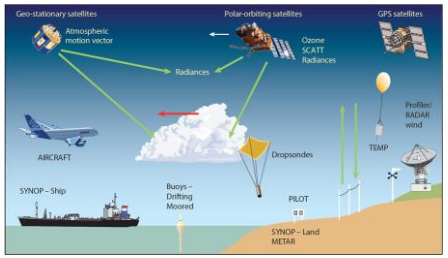
3 key elements to produce climate reanalysis

Model



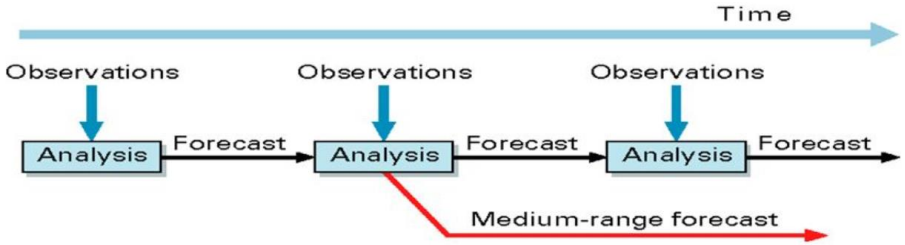
ECMWF earth system model developed for NWP

Observations



International databanks from data rescue activities (WP3)

Data assimilation



New coupled data assimilation system (**CERA**)

- atmospheric and ocean observations assimilated simultaneously
- 10-member ensemble to represent uncertainties

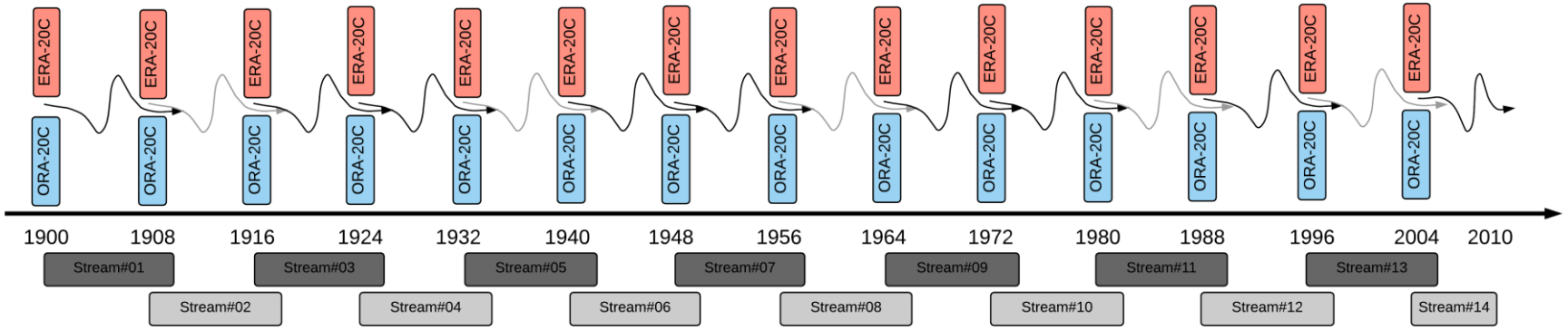
To produce climate reanalysis, particular attention is required for

- preparation of CMIP5 forcing for the atmospheric model
- specification of model and observation errors
- bias correction to reduce systematic errors (WP4)

All these developments have been implemented and assessed (M1-18)

CERA-20C: A coupled reanalysis of the 20th century

Production of CERA-20C is ongoing (85% completed, finished by end of May)



- period 1900-2010 divided in 14 streams of 10 years
- initial conditions from uncoupled climate reanalyses (ERA-20C and ORA-20C)
- all the streams are running in parallel
- 2-year overlap to ensure consistency in the final product

The first coupled climate reanalysis of the 20th century produced in Europe

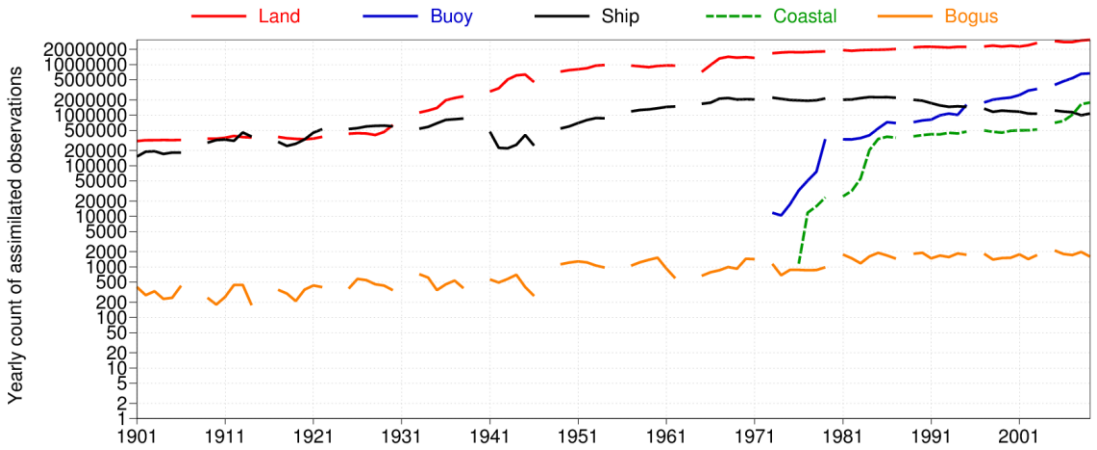
Computation footprint

7 months of production
400 Nodes (20,000 cores, 5% of ECMWF HPC system)
500,000 4D-Var problems to solve (one every 30 sec.)
optimised production suite with dedicated HPC support

CERA-20C: A coupled reanalysis of the 20th century

Observation input

from the selected databanks, up to 20,000,000 observations are assimilated per year



Archiving footprint

1400 Tb of atmospheric data
200 Tb of ocean data
dedicated data service (WP5)

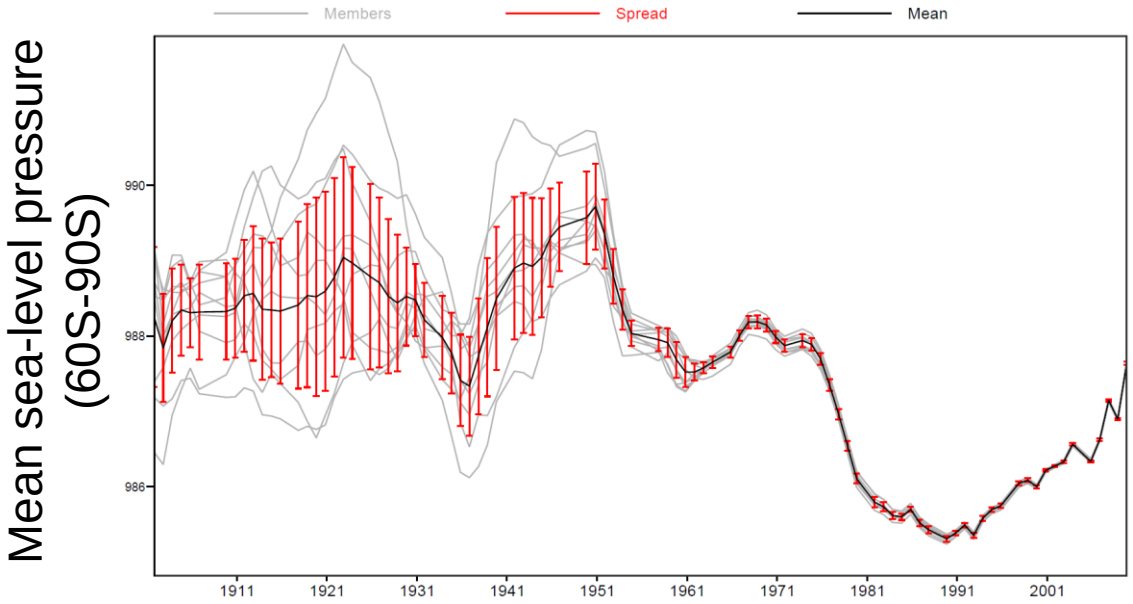
Manpower & teamwork

12/7 monitoring with required manual actions:

- related to observation inputs
- related to technical issues (HPC, filesystems, …)
- scientific monitoring

CERA-20C: A coupled reanalysis of the 20th century

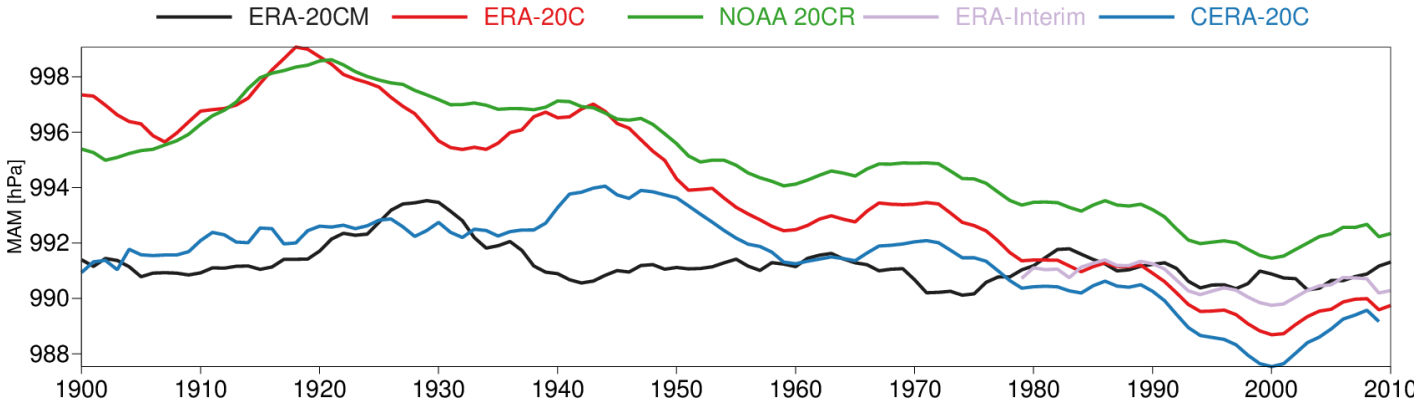
Deliver long timeseries of Essential Climate Variables (ECVs)



Ensemble techniques to represent uncertainties

Ensemble mean and spread will be disseminated (New)

Evaluate these ECVs with respect to other reanalyses



CERA-20C/Carbon: Associated reanalyses of the carbon fluxes

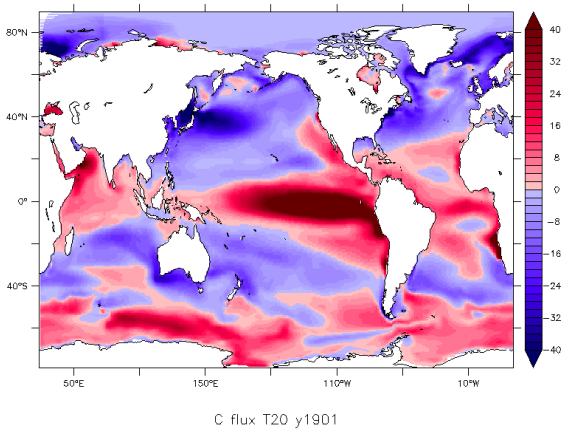
CERA-20C/Carbon for the **ocean**

- CERA-20C reanalysis delayed
- staff hired at the beginning of the project
- ERA-20C reanalysis to force the PISCES ocean model

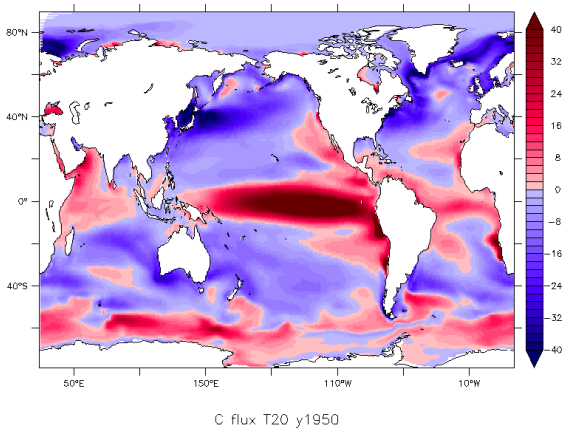
CERA-20C/Carbon for the ocean has been delivered

- possibility for a second production based on CERA-20C forcings

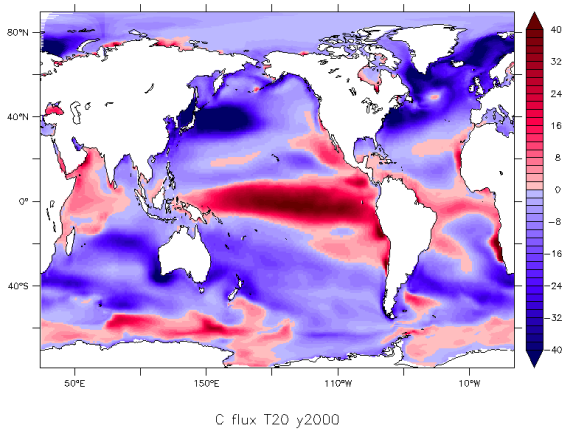
Net carbon flux in the ocean (absorption in blue and emission in red)



1900



1950



2000

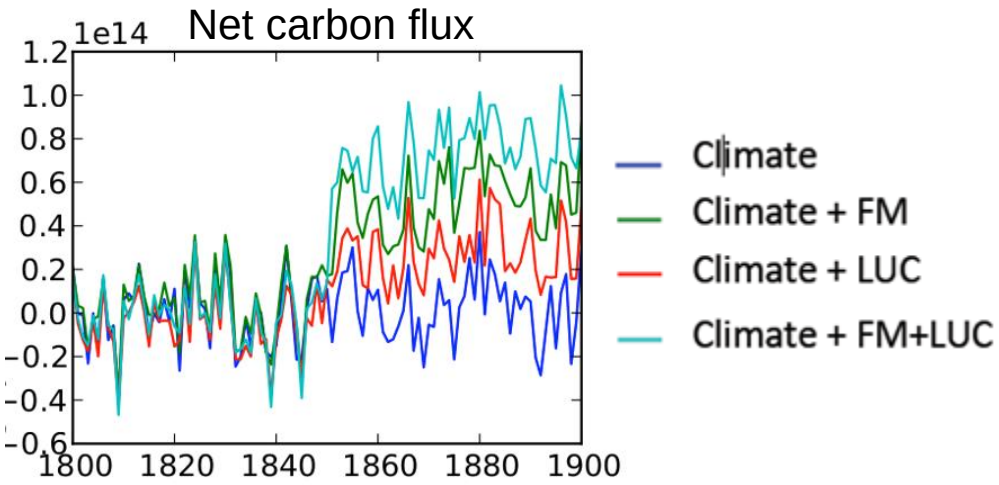
CERA-20C/Carbon: Associated reanalyses of the carbon fluxes

CERA-20C/Carbon for the **land**

- CERA-20C reanalysis delayed
- staff hired at the beginning of the project
- improve the land model parameters in ORCHIDEE

LSCE

Implementation of Land Use Change (LUC) and Forest Management (FM) for a better representation of the carbon cycle



Next steps to deliver CERA-20C/Carbon for the land

- finalise the selected scenarios for Land Use Change and Forest Management
- retrieve CERA-20C reanalysis to force the ORCHIDEE model

T1.2 CERA-SAT: higher resolution and all observation types

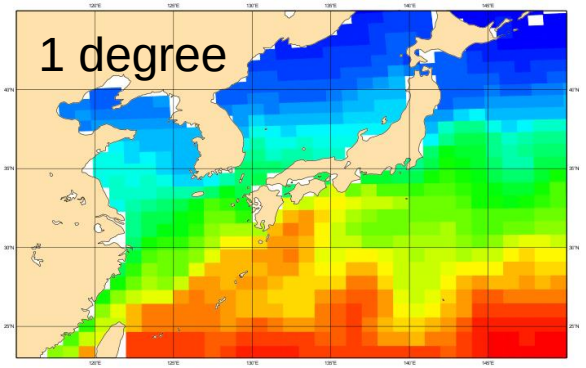
CERA-SAT is under implementation (2 new staff hired)

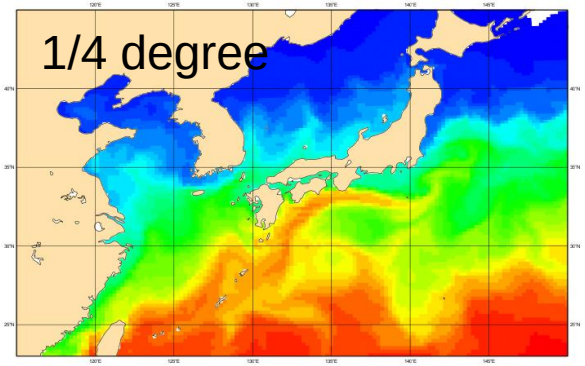
Resolution upgrade:

- atmosphere from 110km to 65km
- ocean from 1 degree (42 levels) to ¼ degree (75 levels)

Satellite assimilation:

- improve the coupled assimilation system to ingest satellite measurements





CERA-SAT production

- difficult to predict the production speed of CERA-SAT (4 days per day?)
- dedicated optimisation work required
- several years of reanalysis over a recent period (2009 to …)

CERA-SAT/Carbon production

- production based on the CTESSEL model will be computed online
- production based on the ORCHIDEE model will be computed offline (using the infrastructure developed for CERA-20C/Carbon)

Summary of deliverables

Deliverable	Description	Delivery	Status
D1.1	CERA-20C	36	On time
D1.2	CERA-20C/Carbon	48	On time
D1.3	CERA-SAT	48	On time
D1.4	CERA-SAT/Carbon	48	On time
D1.5	Progress report	8	Delivered