Integrated Project, European Commission, FP6

Start date: 1 January 2005

Duration: five years.

CARBO-OCEAN

Marine carbon sources and sinks assessment

CARBO-OCEAN IP

Aim: an accurate scientific assessment of the marine carbon sources and sinks

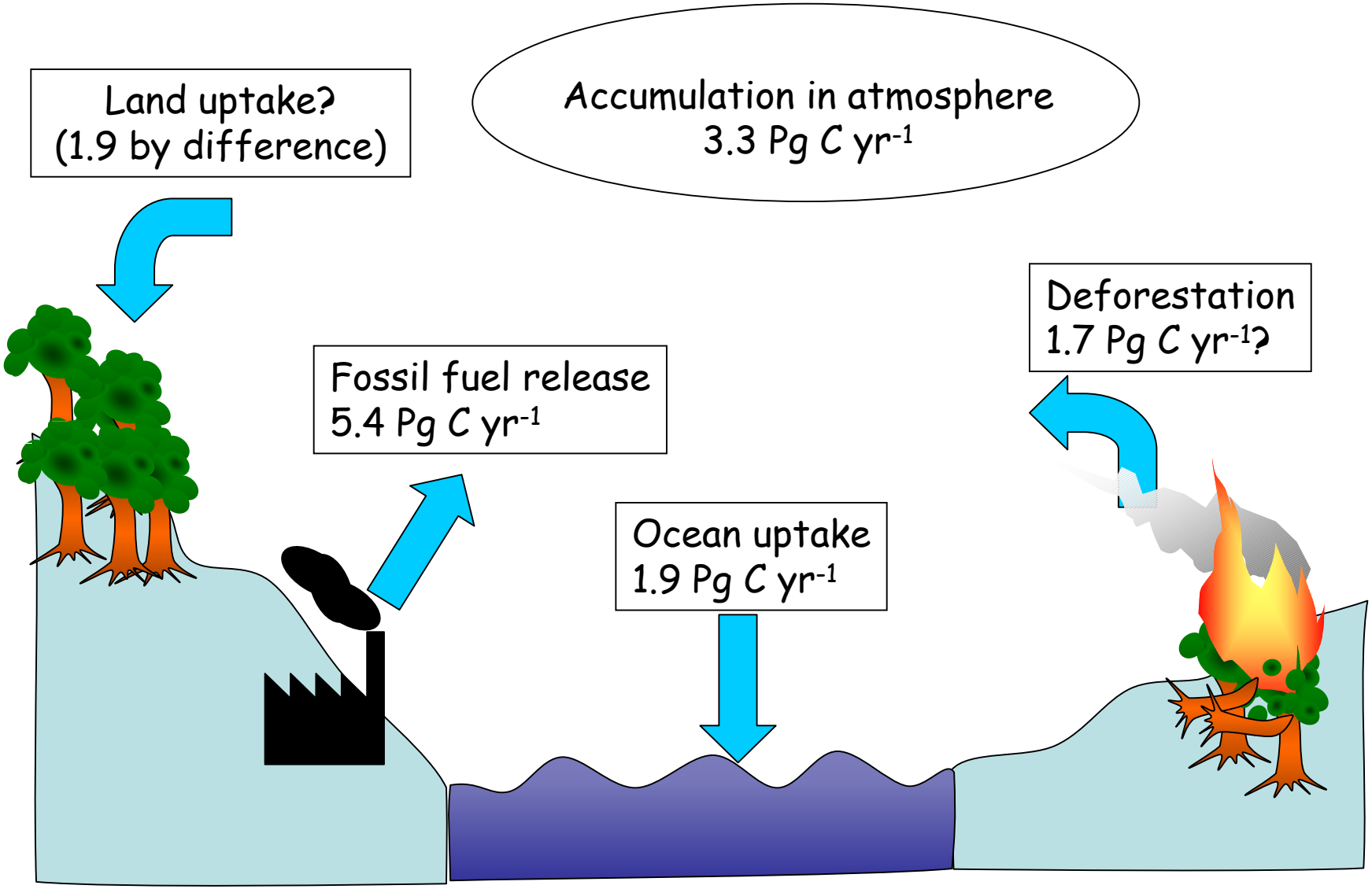
Special Focus: the Atlantic and Southern Oceans

time interval of -200 to +200 years from now.

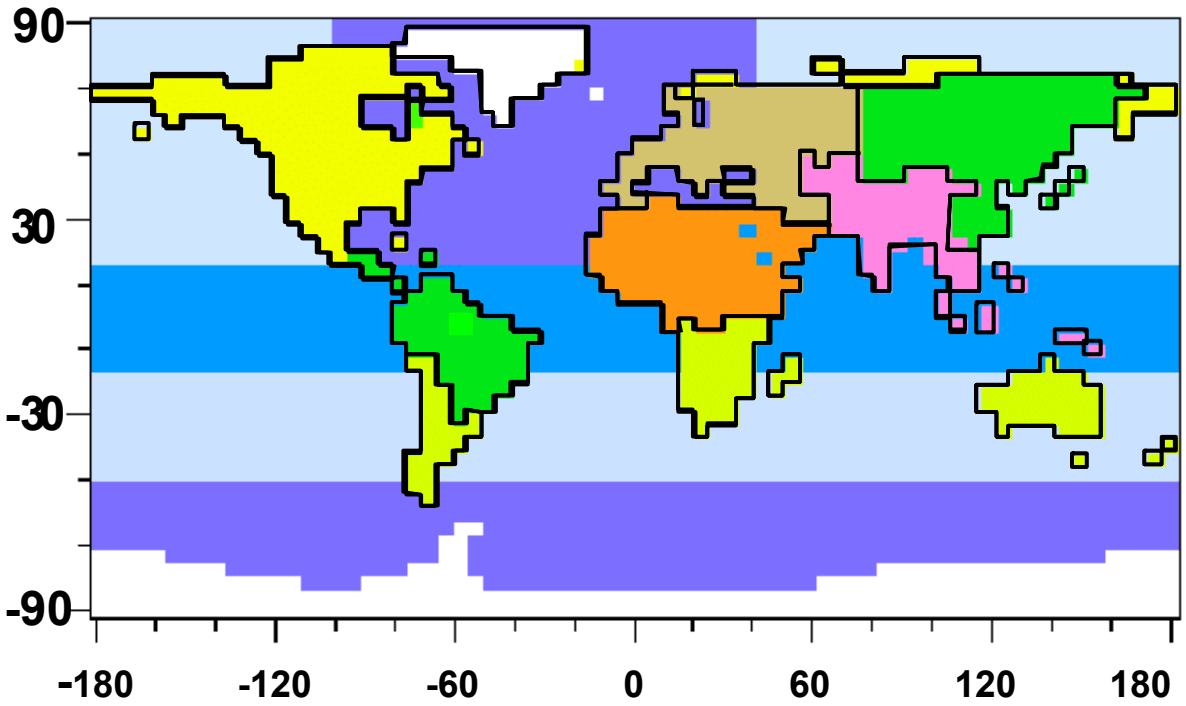
Justification:

- The ocean has the **most significant overall potential as a sink for anthropogenic CO_2**.
- Knowledge of its current size and the processes giving rise to it, essential for climate scenarios.
- Essential for current efforts to establish sizes of terrestrial sink by atmospheric inversion
- It is potentially more easily quantified than the terrestrial sink for anthopogenic CO_2.
- Complements: other major research areas (Carbo-Europe IP, Atmospheric and remote sensing programmes).

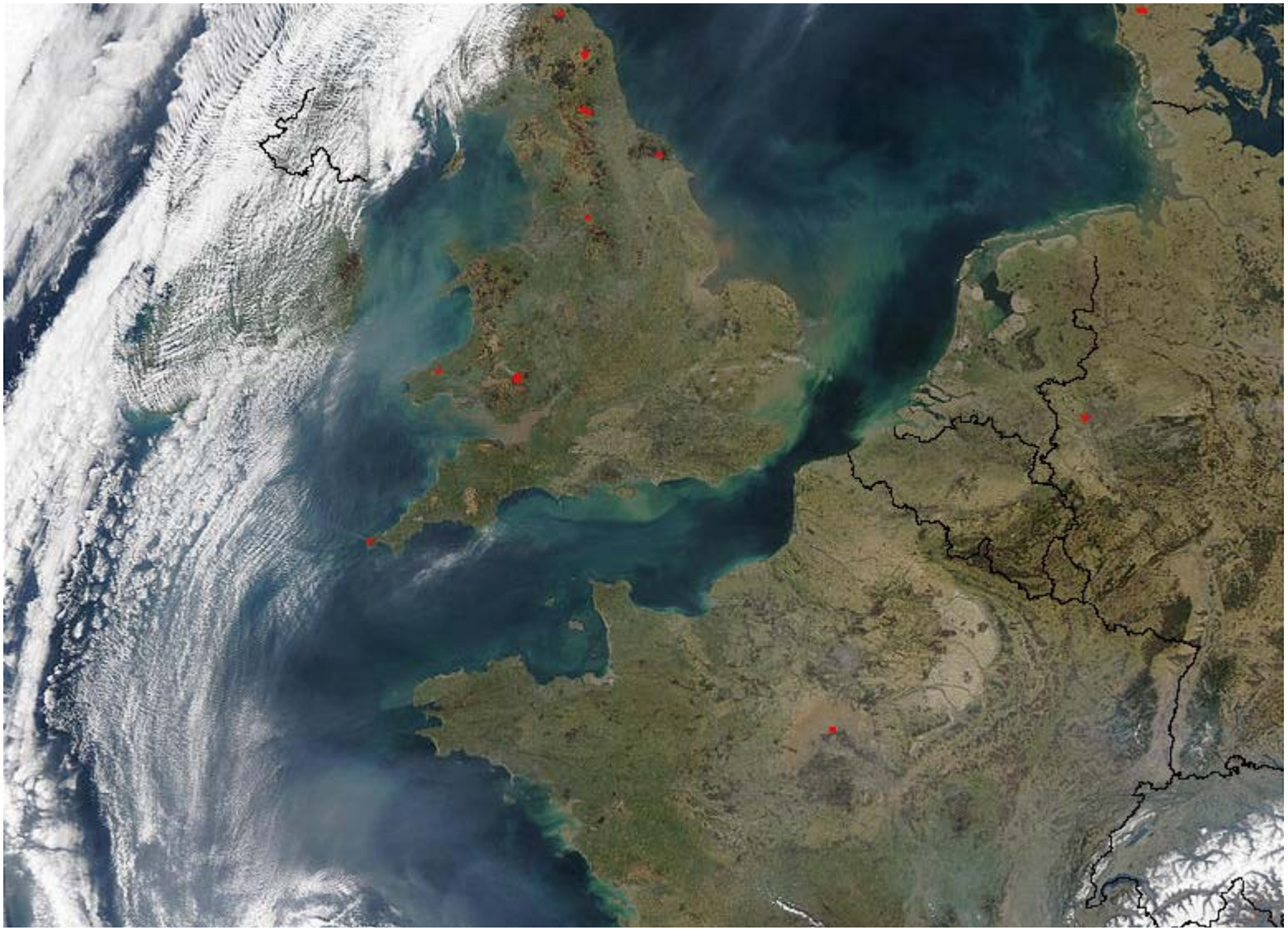
1980s budget of anthropogenic carbon dioxide.



Atmospheric Inversion calculations of CO_2 sources and sinks



- Discrimination of sources/sinks between latitude bands is relatively easy
- Localising sinks in the same latitude bands is subject to wide error.
- Fluxes over ocean basins are than easier to constrain than continental fluxes over large regions.

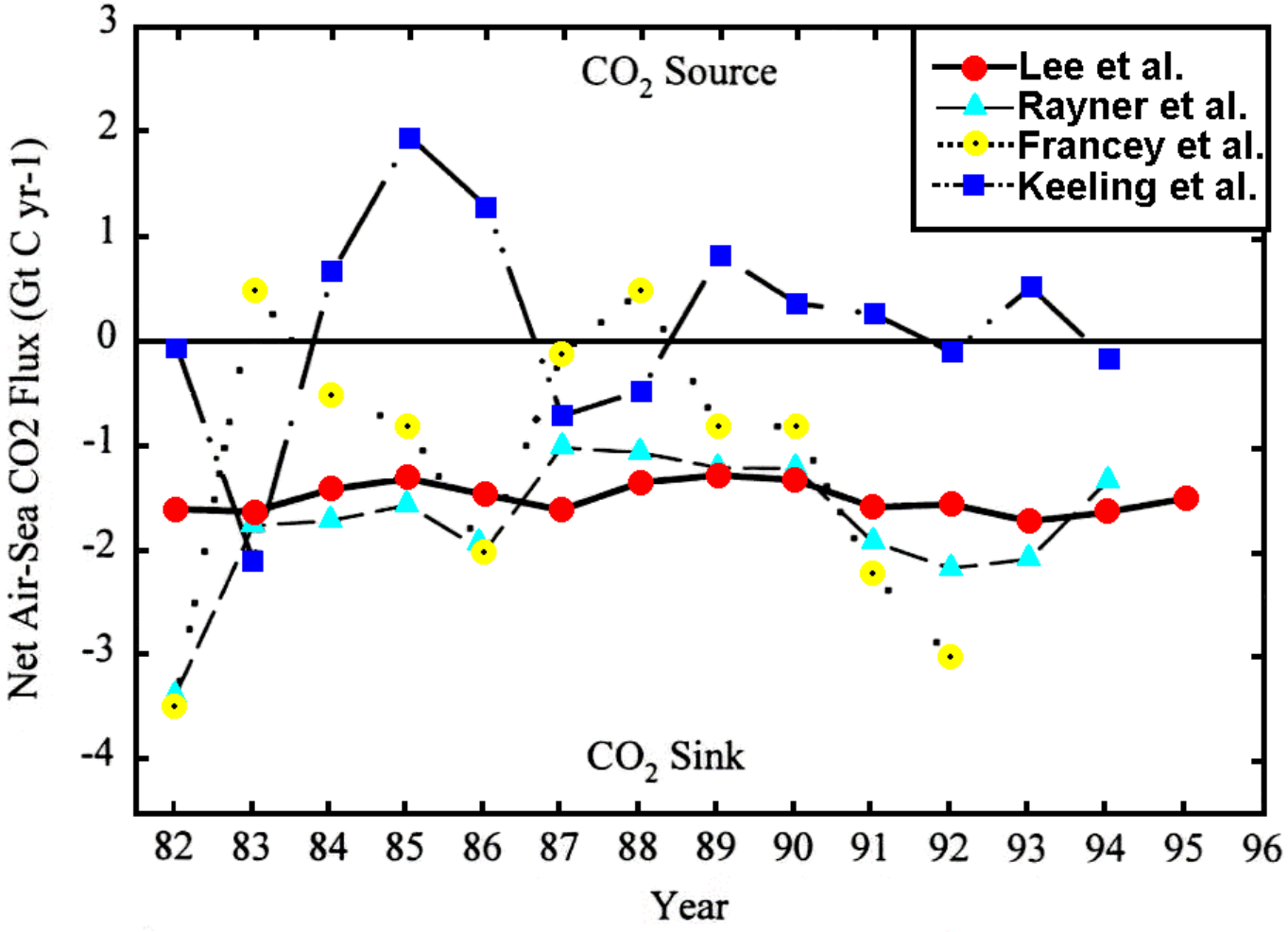


How well is the global ocean sink known?

Estimates of the global ocean sink 1990-1999

Reference	Sink (GtC yr^{-1})
IPCC (2001) Estimate (O2- CO2 method.)	1.7+/- 0.5
OCMIP-2 Model Intercomparison (ten ocean carbon models).	2.5+/- 0.4

Estimates of the ocean sink variability



CARBO-OCEAN

Five core themes structure the project work according to spatial, temporal, and topical aspects:

1. **North Atlantic and Southern Ocean CO2 air-sea exchange on a seasonal-to-interannual scale. (Andy Watson)**
2. **Detection of decadal-to-centennial Atlantic and Southern Ocean carbon inventory changes. (Doug Wallace)**
3. **Carbon uptake and release at European regional scale. (Helmuth Thomas)**
4. **Biogeochemical feedbacks on the oceanic carbon sink. (Marion Gehlen)**
5. **Future scenarios for marine carbon sources and sinks. (Christoph Heinze)**

Cross cutting activities:
- data management
- dissemination

Consortium management

Training

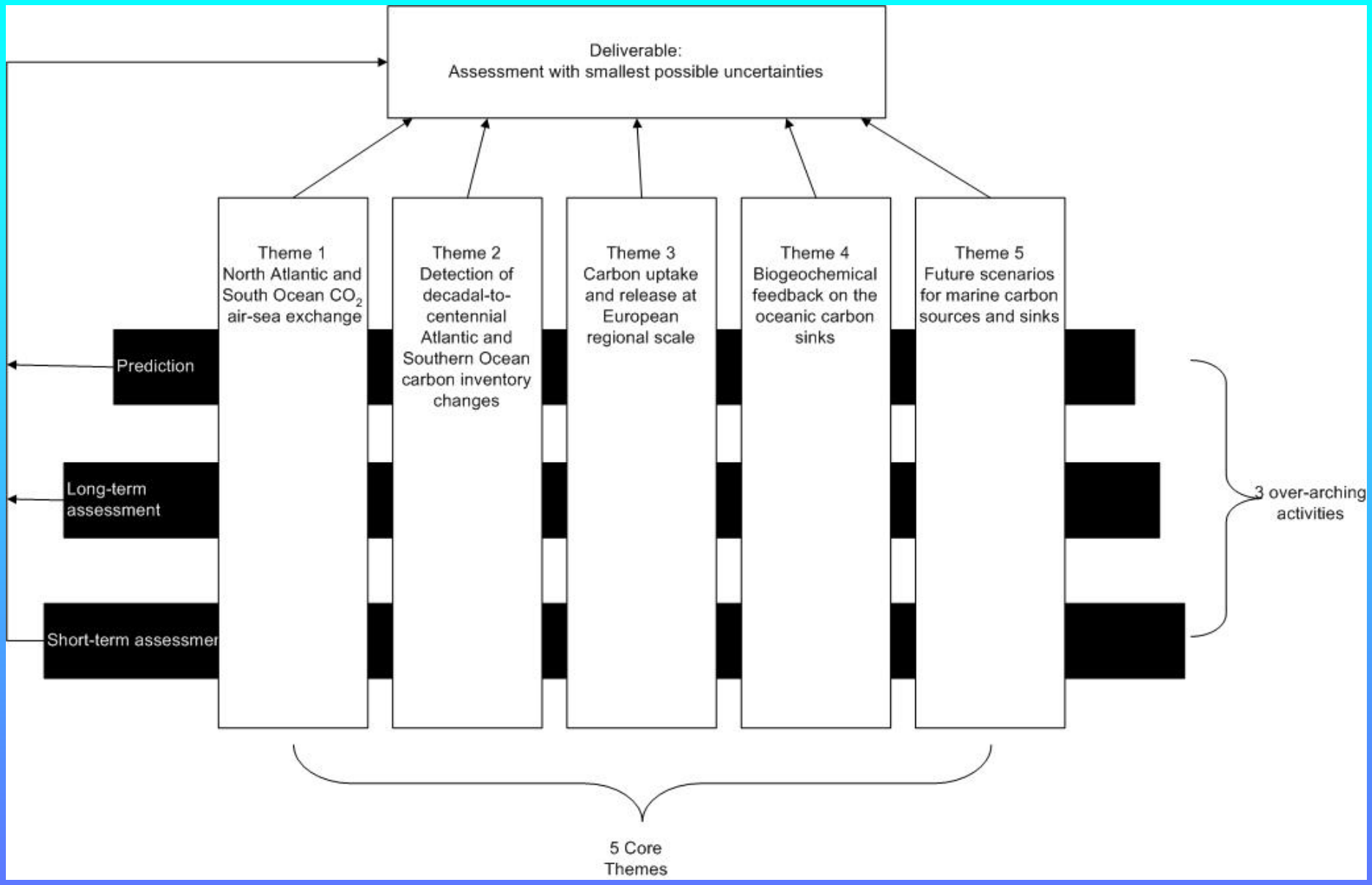
Demonstration

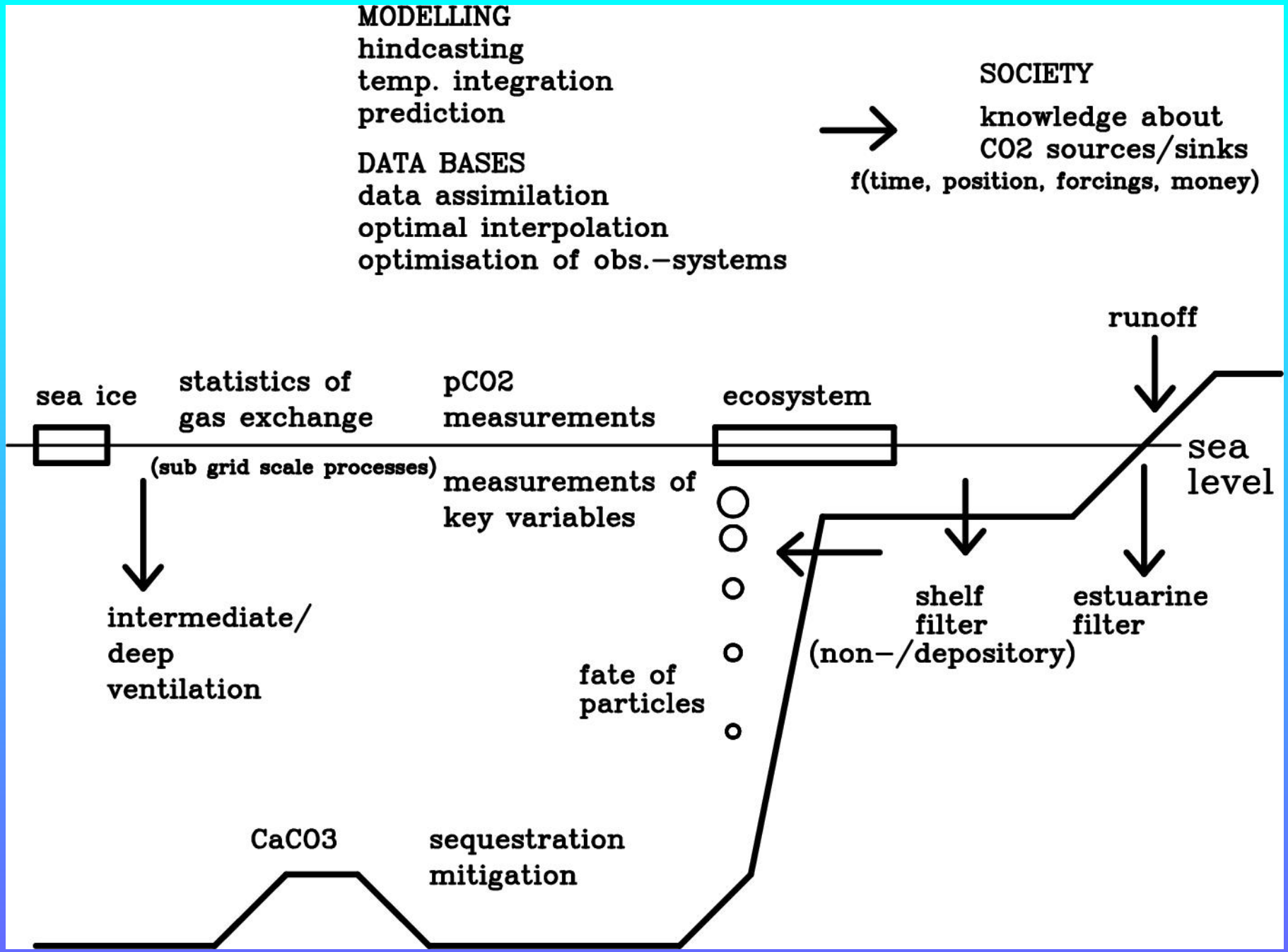
47 participating groups (partners, asscociated collaborators)

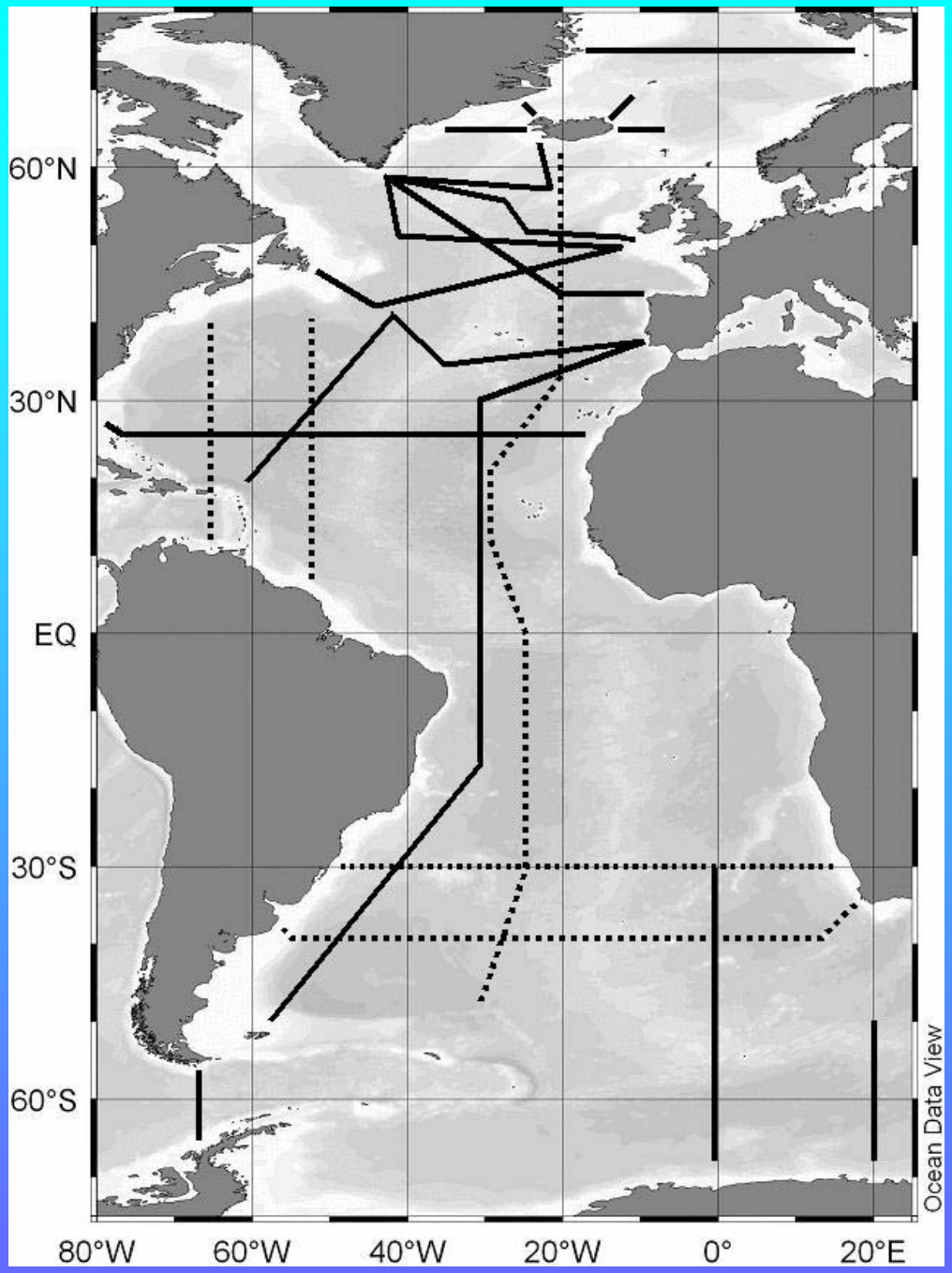
CARBO-OCEAN Partners

Co-ordinator: University of Bergen (Christoph Heinze)

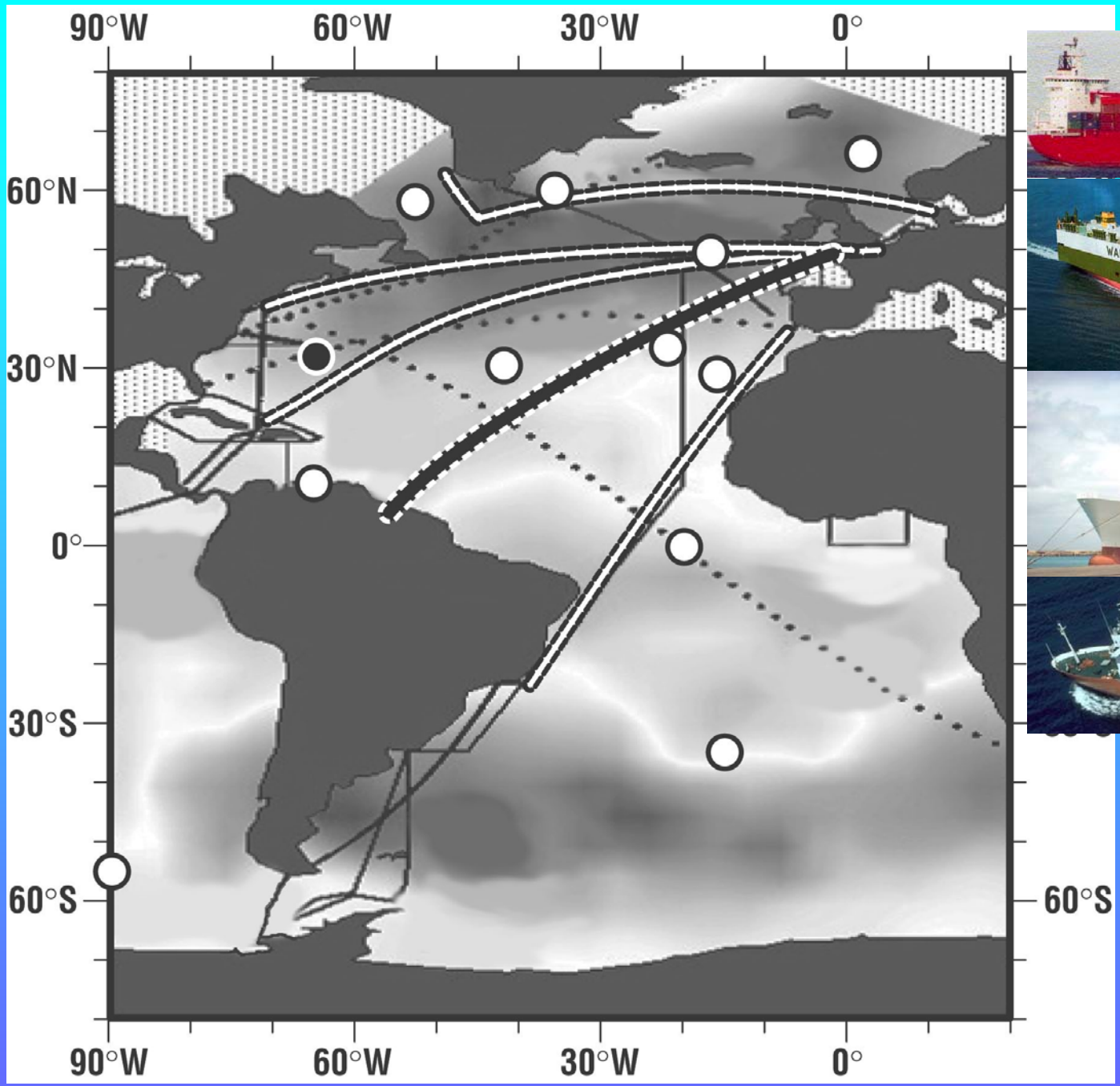
1) **Forty European partners**
2) **Seven US partners**
3) **(includes NOAA labs at Miami and Seattle, SIO)**

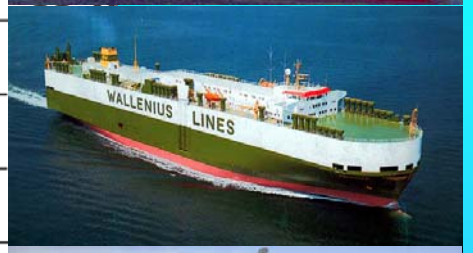

Deliverable:
Assessment with smallest possible uncertainties
Theme 1
North Atlantic and South Ocean CO_2 air-sea exchange
Theme 2
Detection of decadal-to-centennial Atlantic and Southern Ocean carbon inventory changes
Theme 3
Carbon uptake and release at European regional scale
Theme 4
Biogeochemical feedback on the oceanic carbon sinks
Theme 5
Future scenarios for marine carbon sources and sinks
Prediction
Long-term assessment
Short-term assessmer
3 over-arching activities
5 Core Themes


MODELLING
hindcasting
temp. integration
prediction
DATA BASES
data assimilation
optimal interpolation
optimisation of obs.–systems
SOCIETY
knowledge about
CO2 sources/sinks
f(time, position, forcings, money)
runoff
sea ice
statistics of
gas exchange
pCO2
measurements
ecosystem
sea
level
(sub grid scale processes)
measurements of
key variables
intermediate/
deep
ventilation
shelf
filter
estuarine
filter
(non–/depository)
fate of
particles
CaCO3
sequestration
mitigation



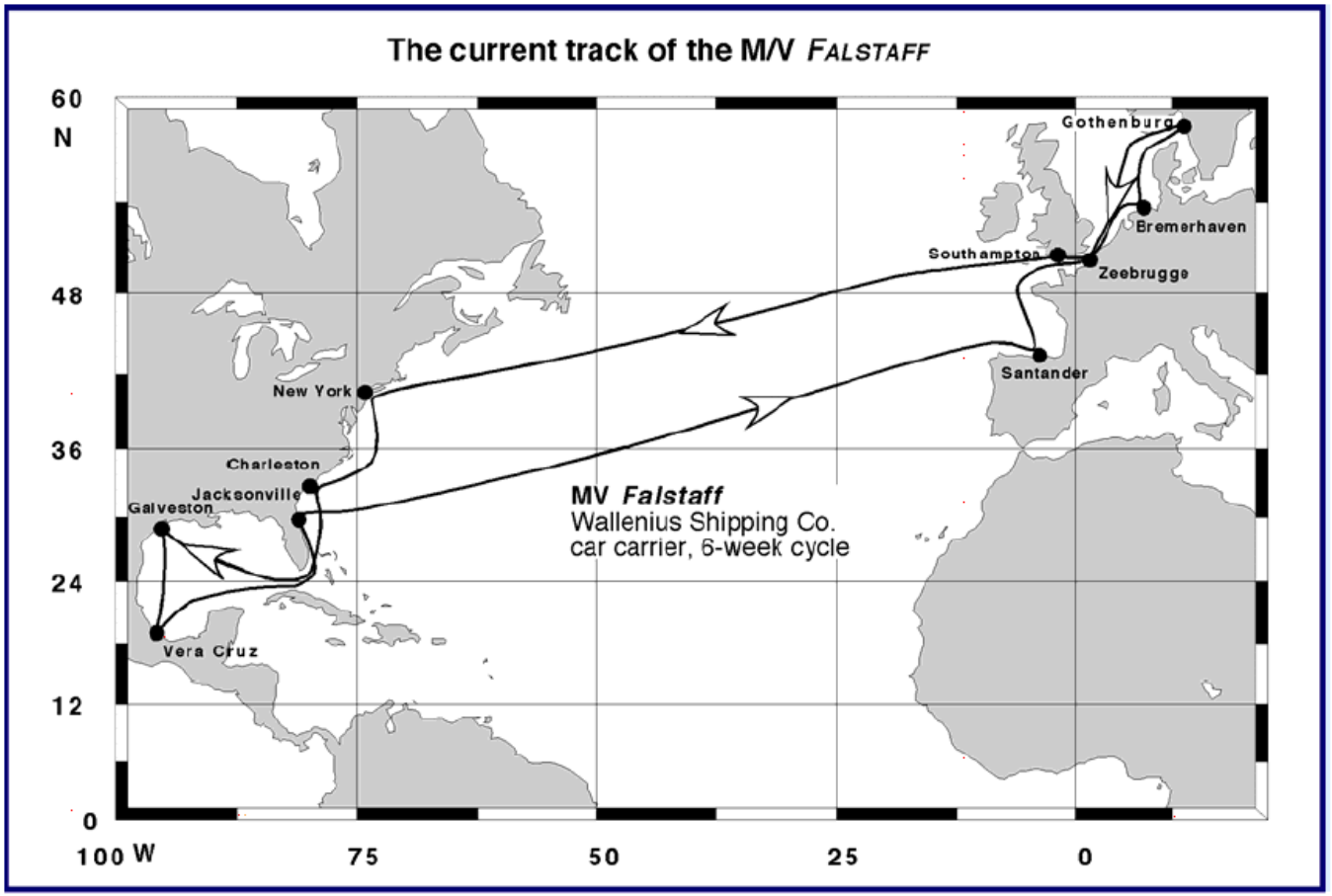
deep sections,
core theme 2



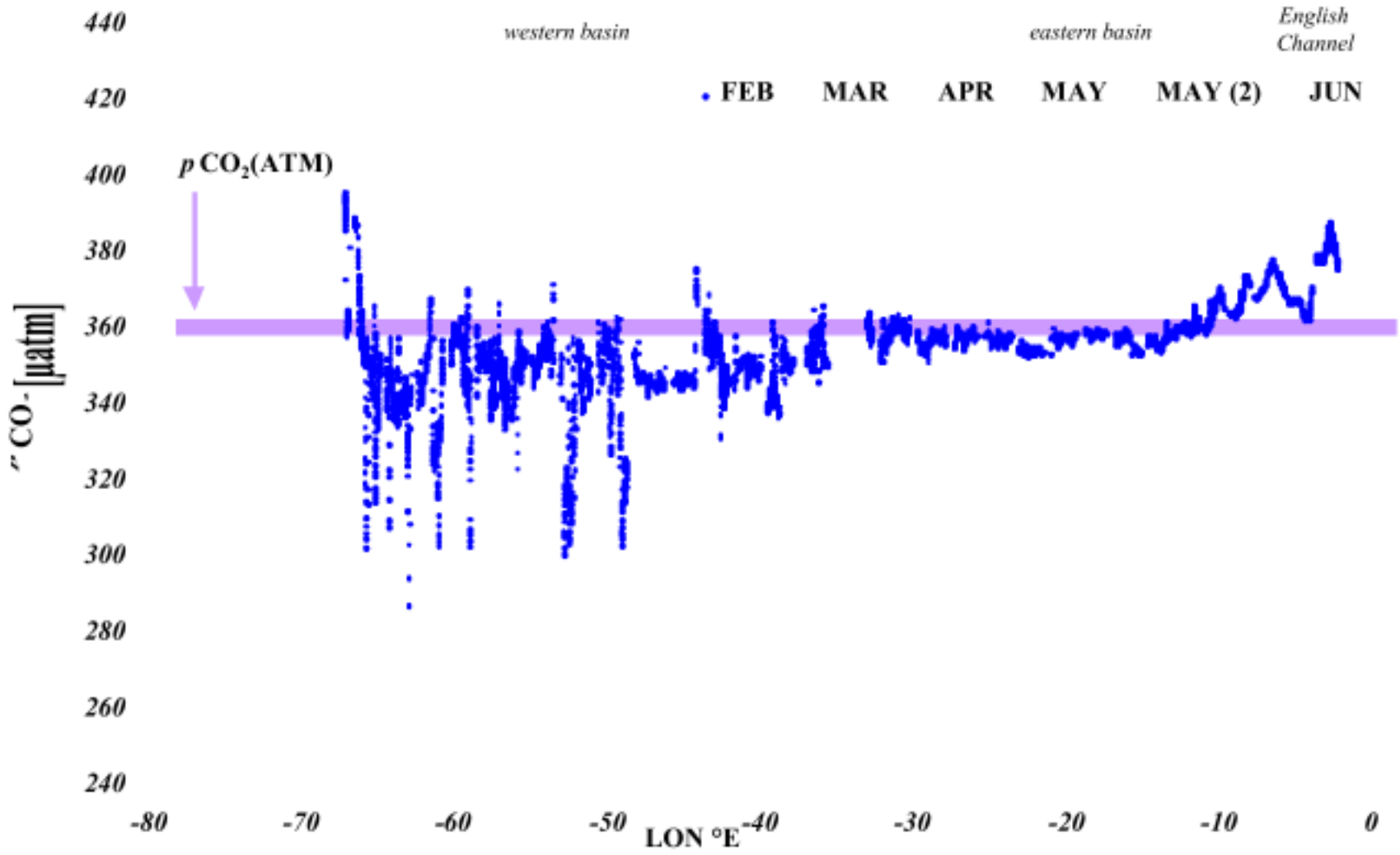


Surface program, core theme 1

Comparison of recent, well-resolved data with models.



Cavassoo data from I.F.M., University of Kiel (Wallace, Koertzinger et al).



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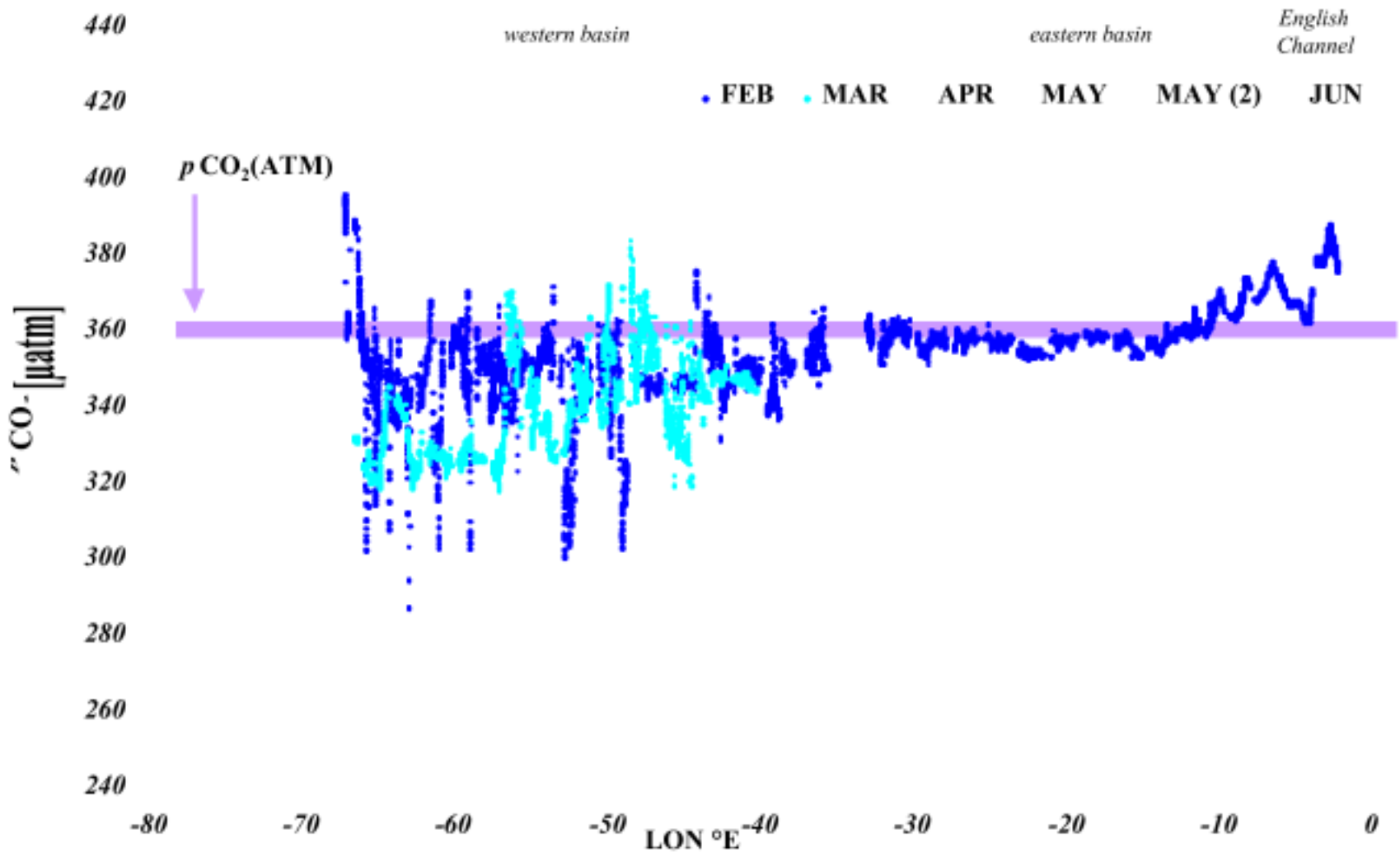

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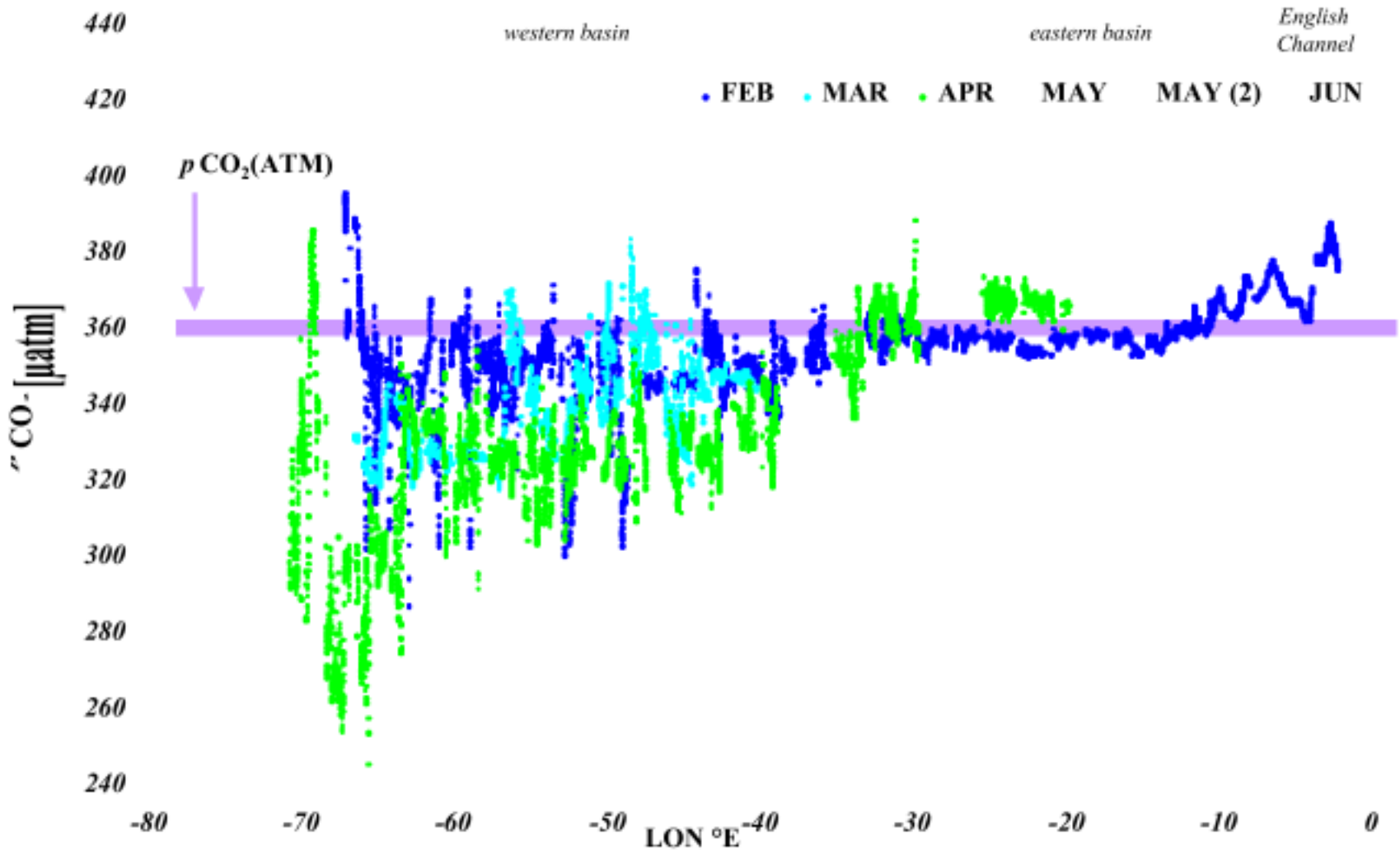

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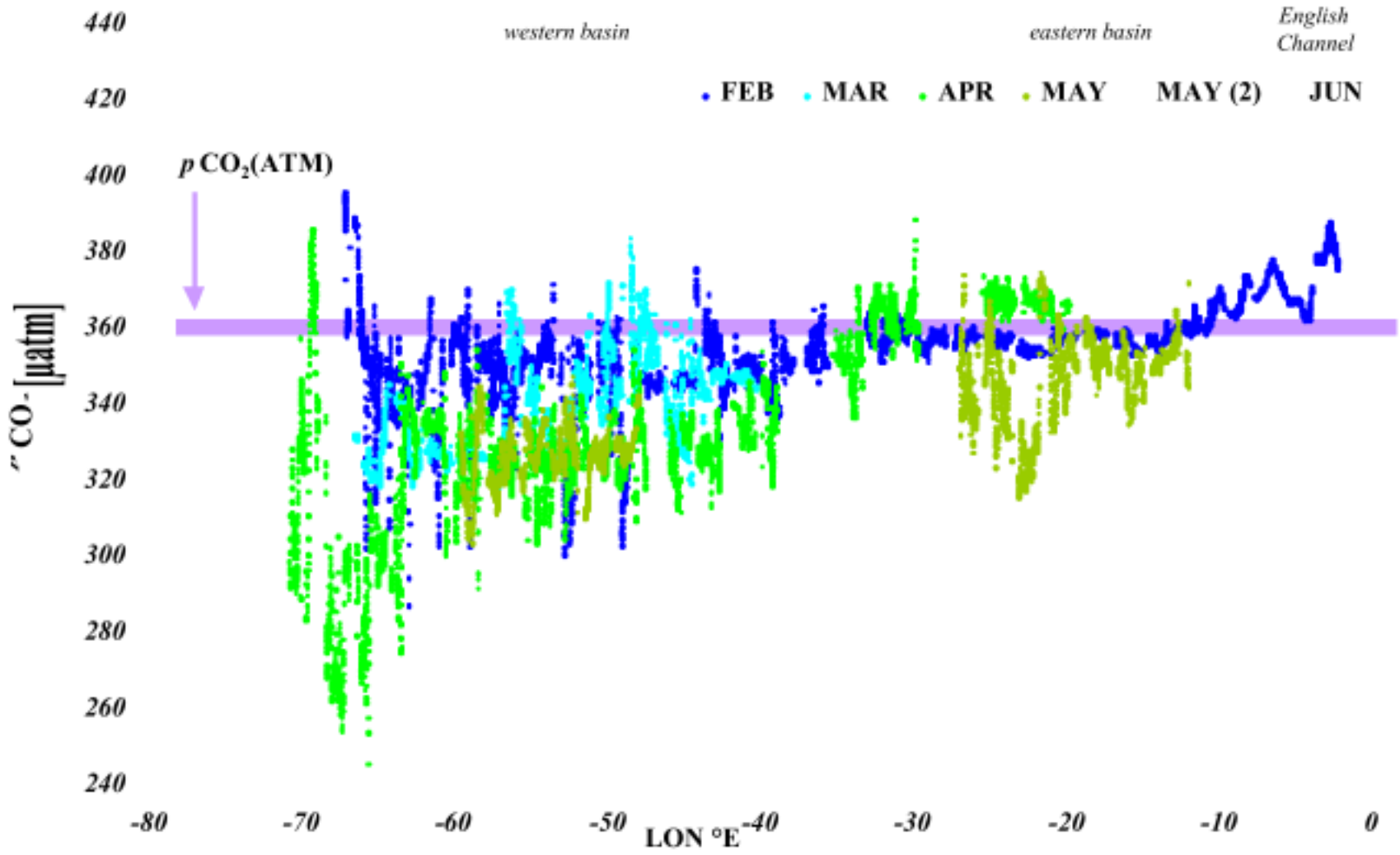

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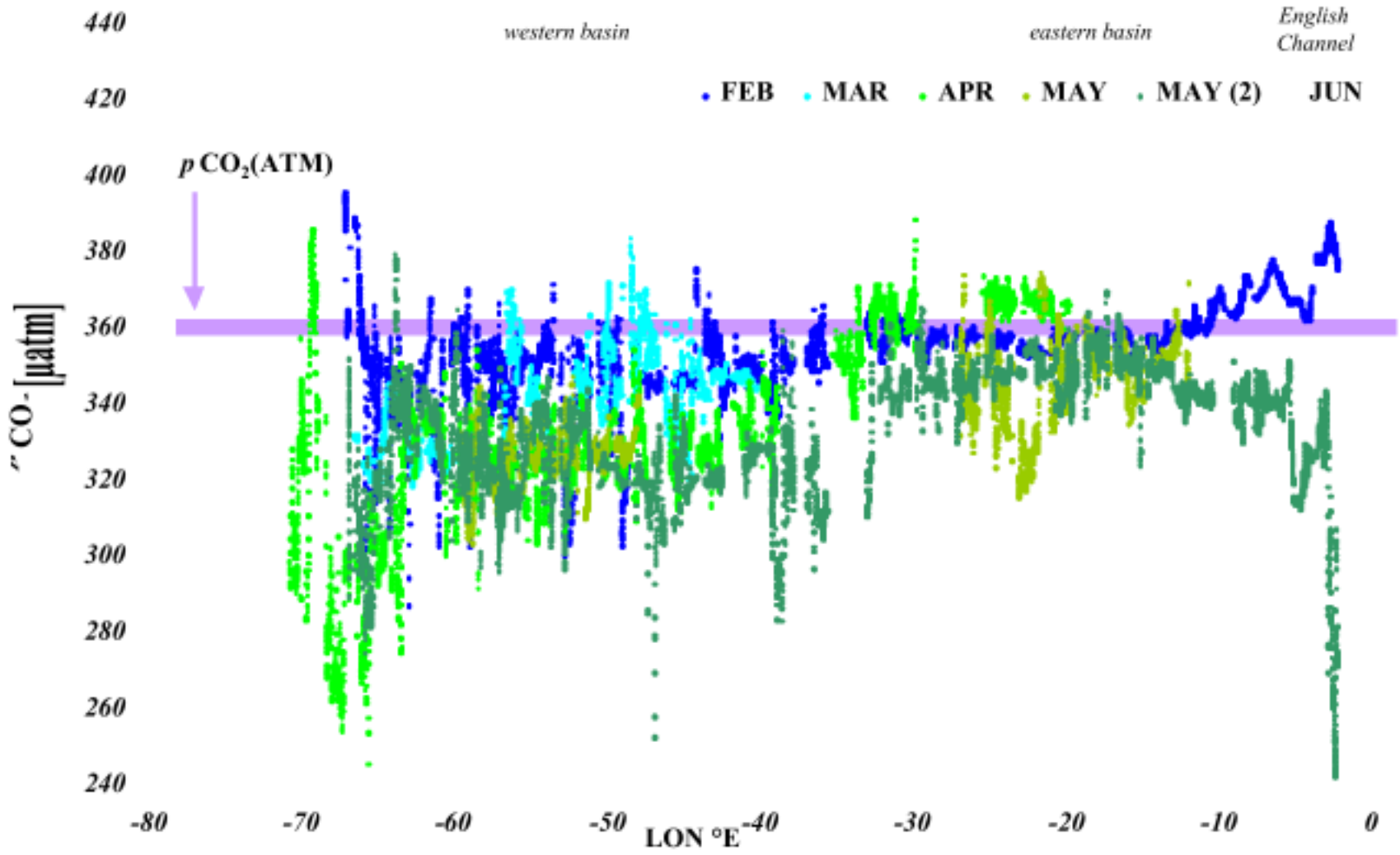

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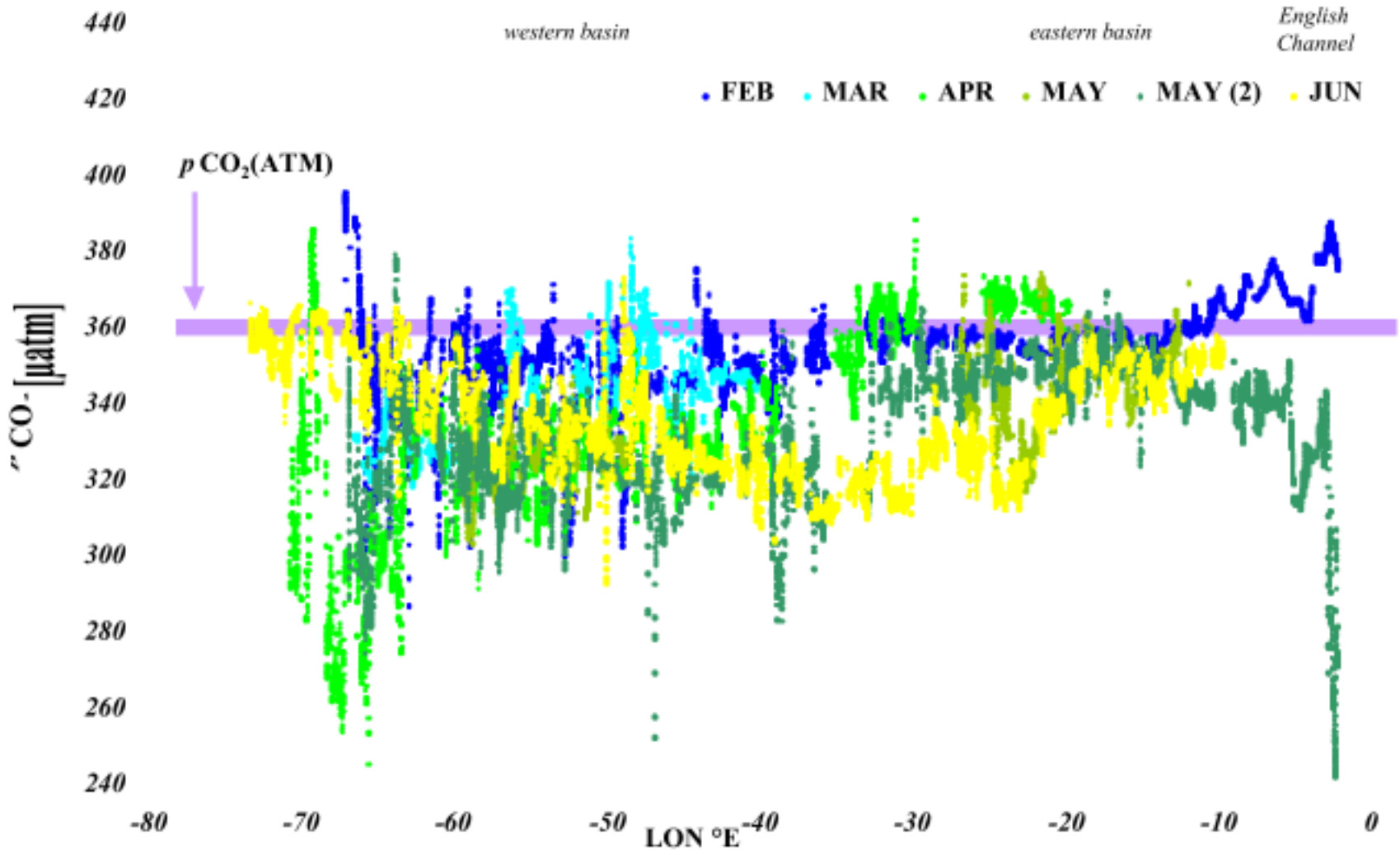

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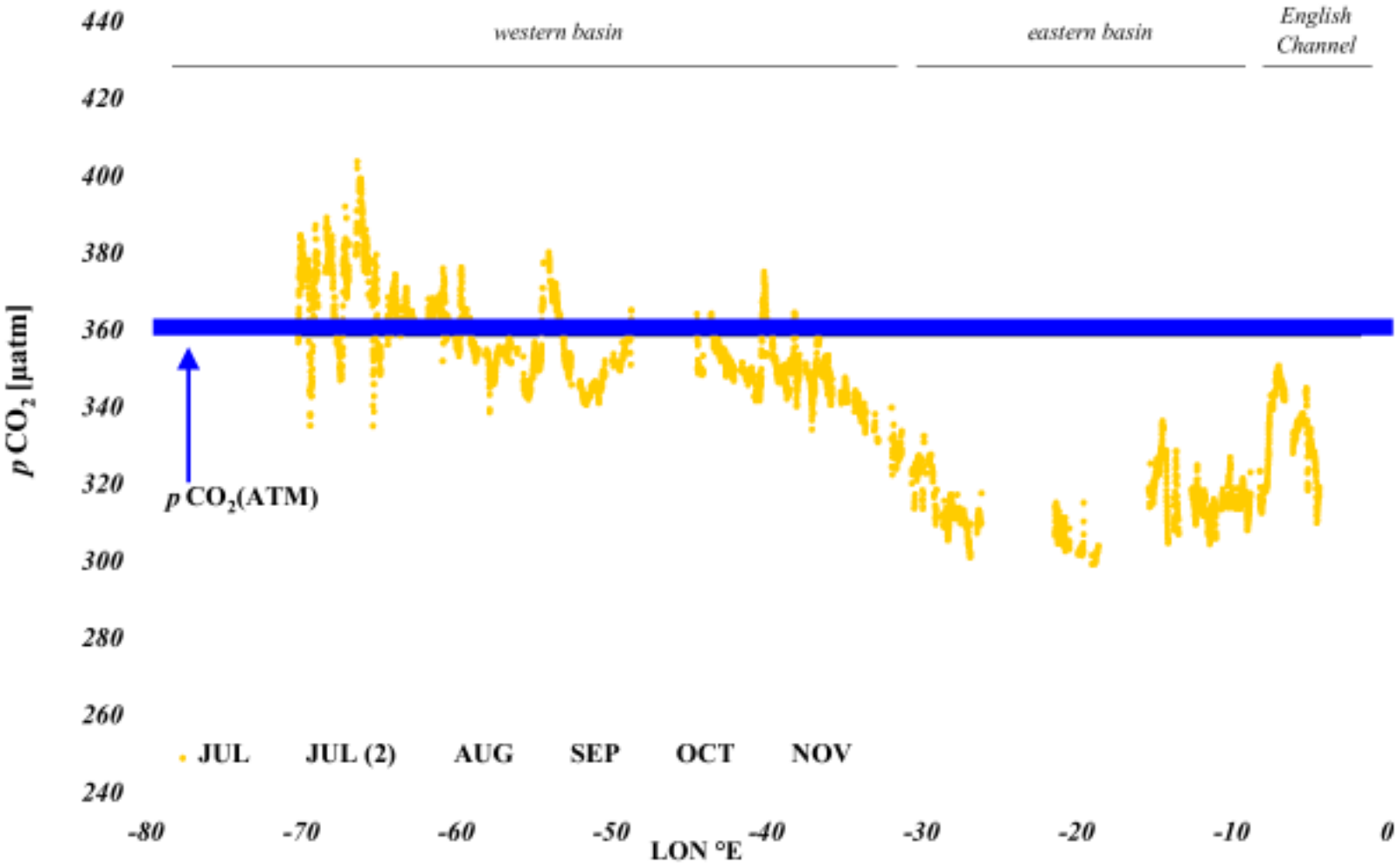

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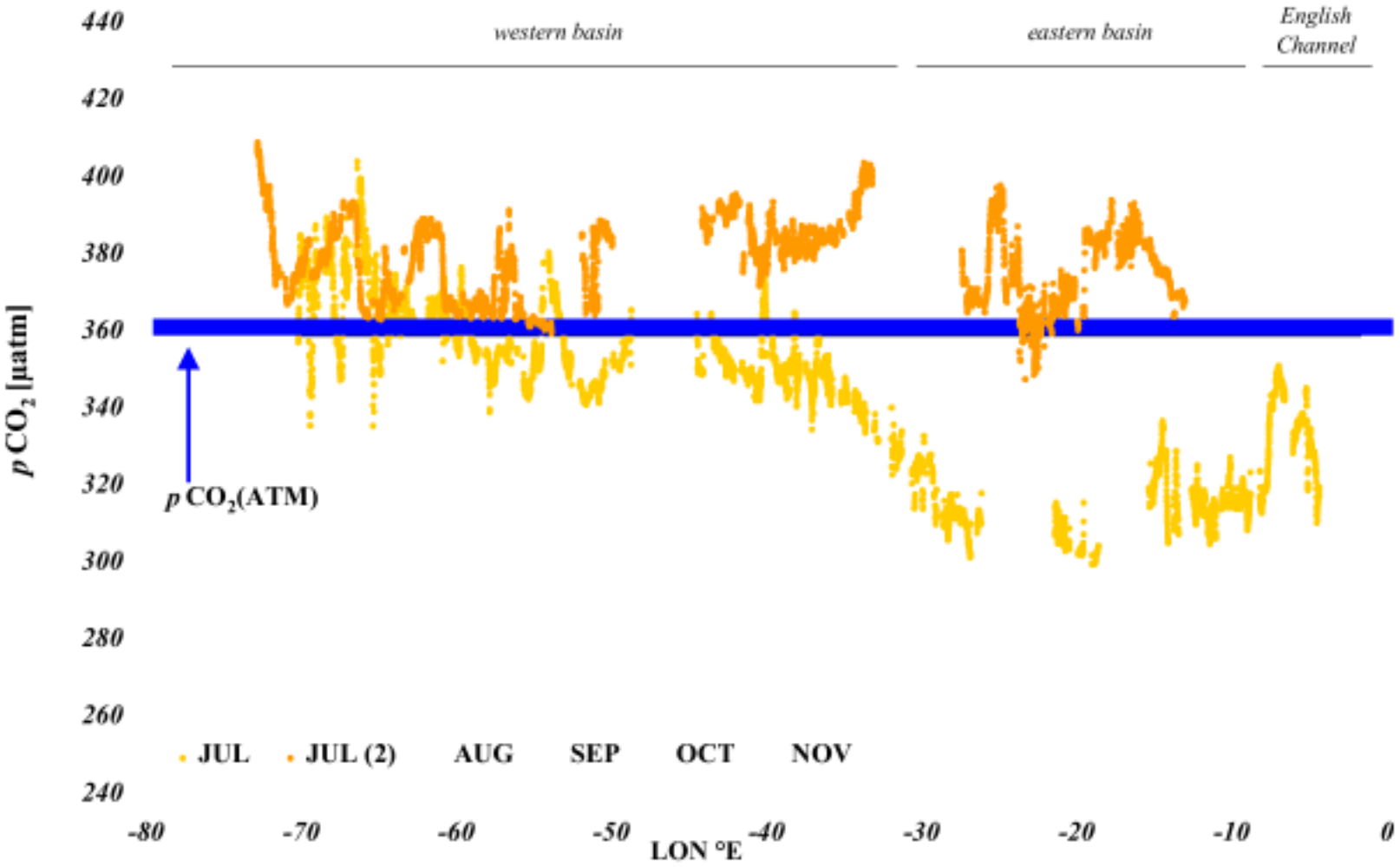

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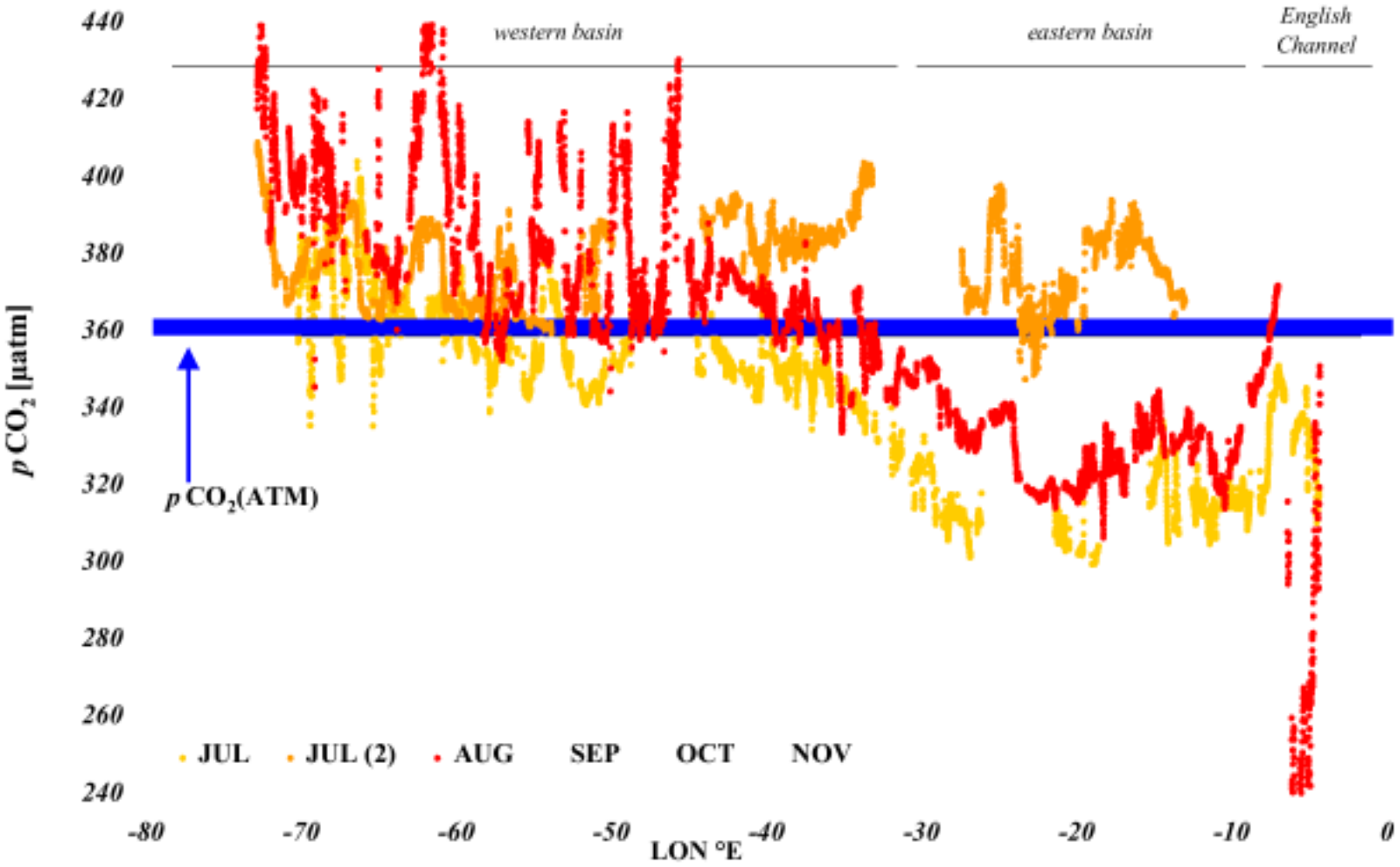

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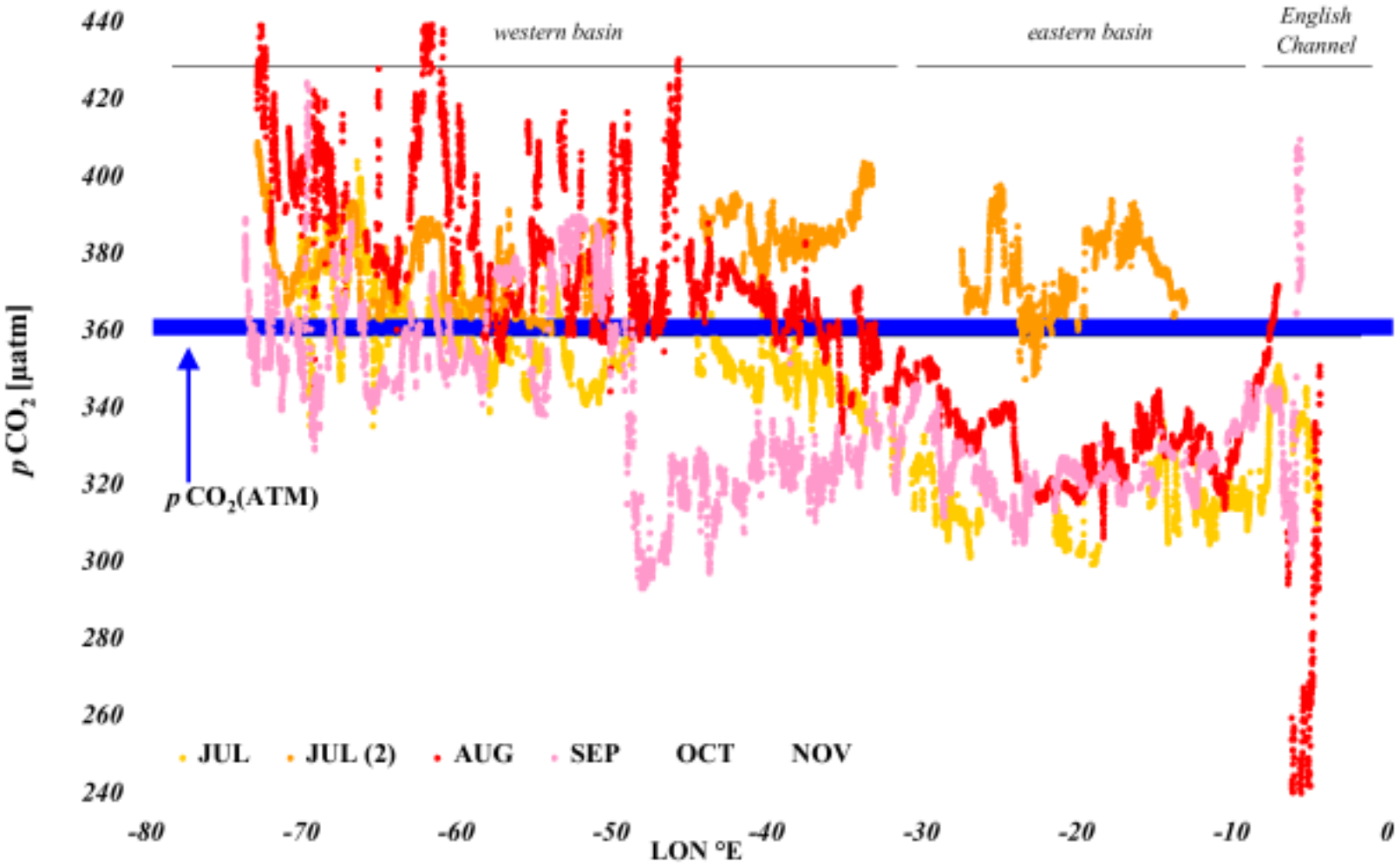

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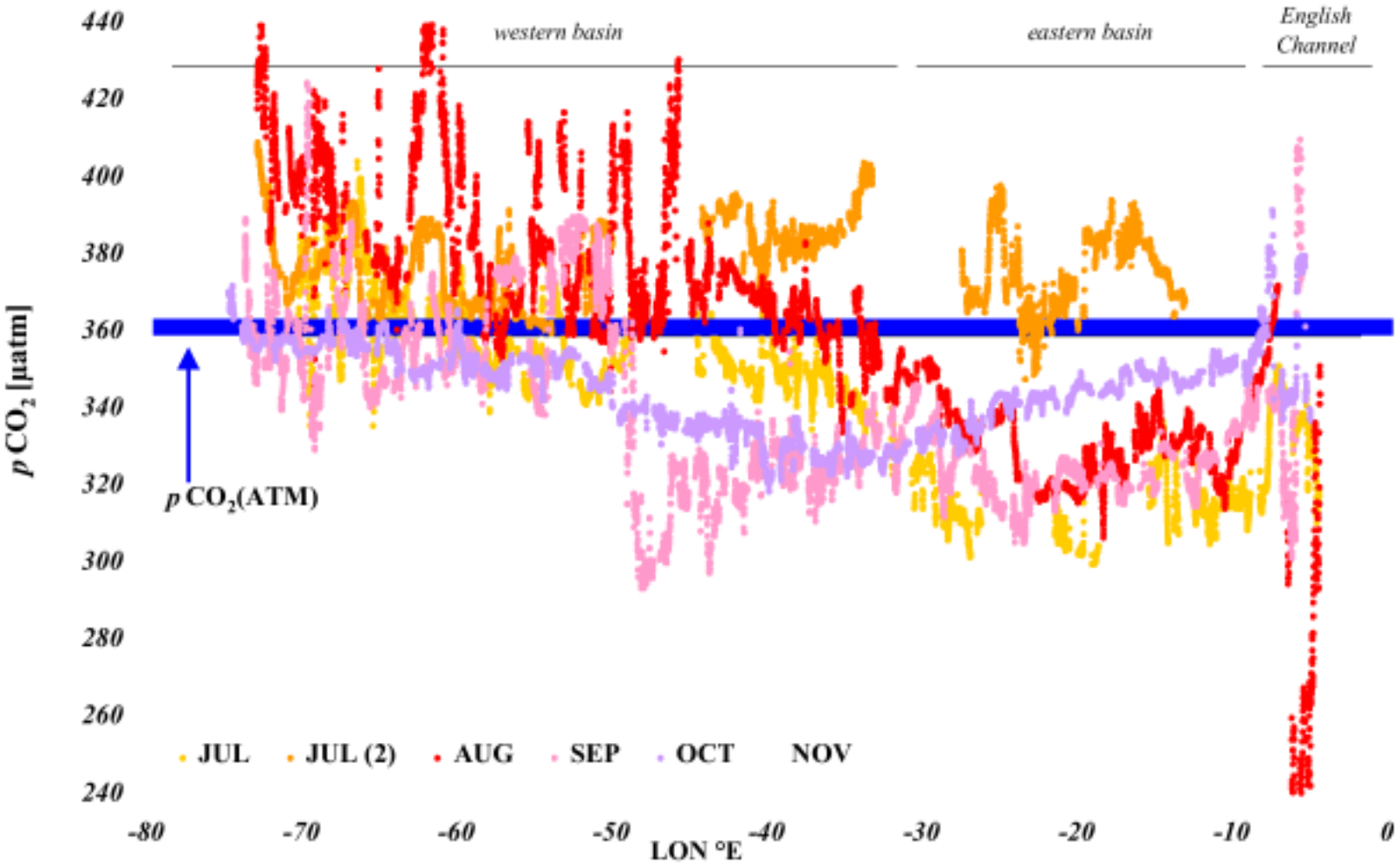

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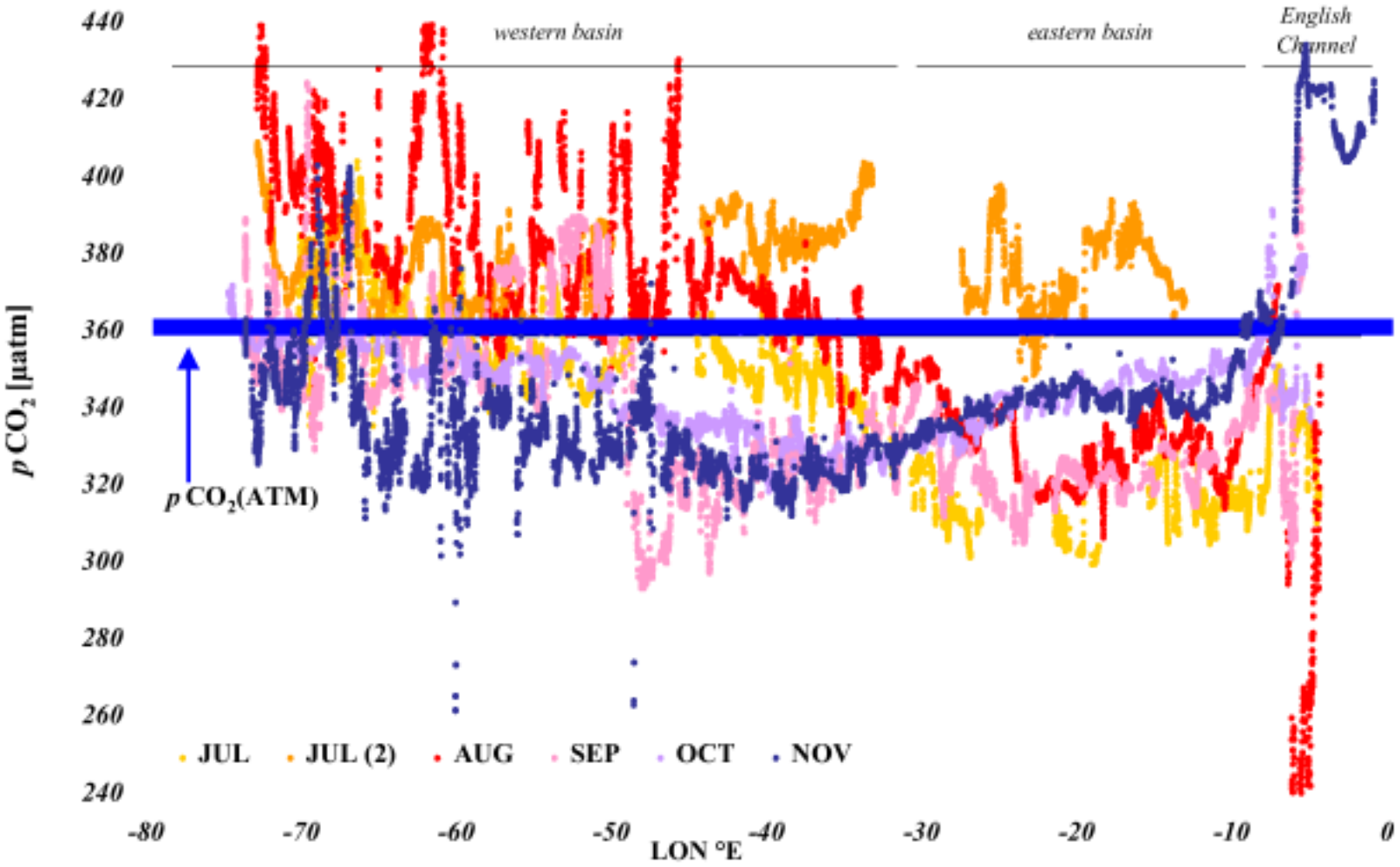
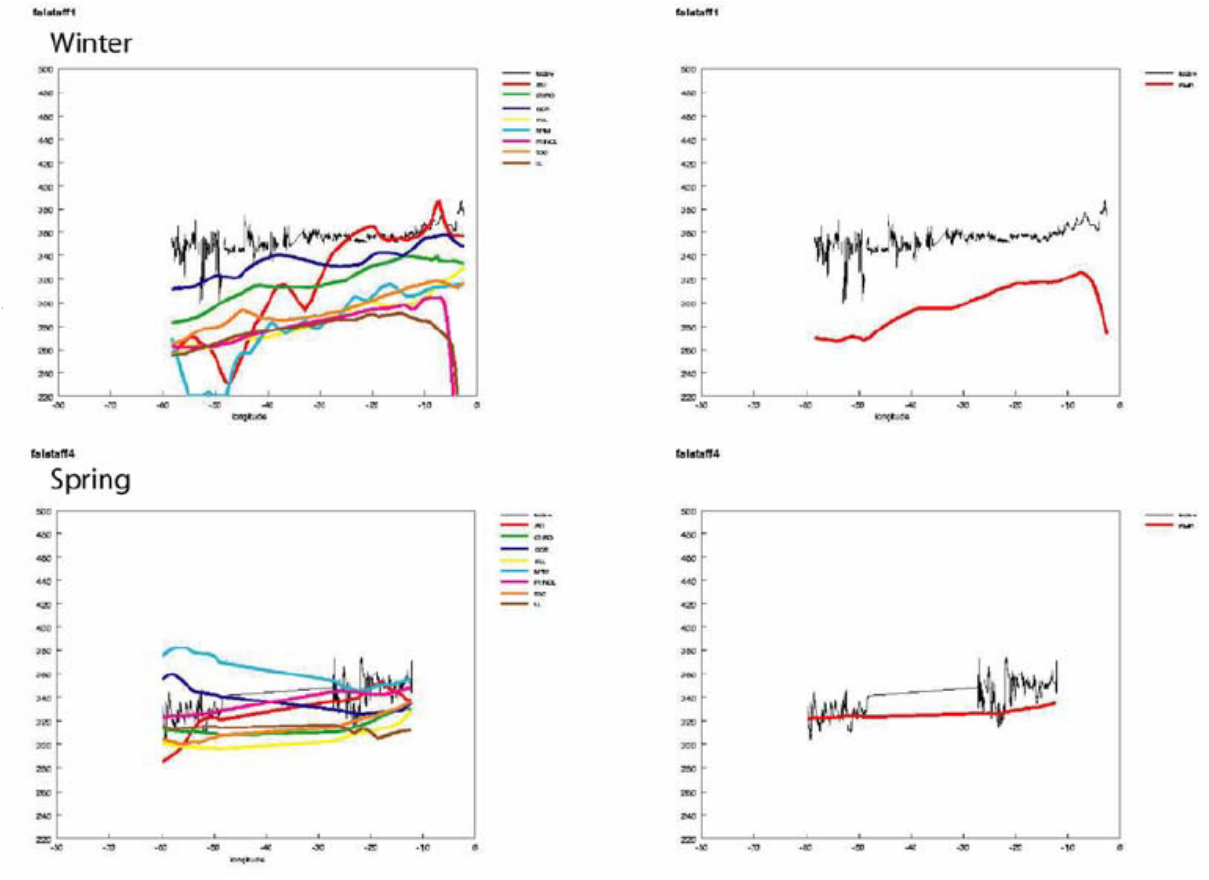


Cavassoo data from I.F.M., University of Kiel (Wallace, Koertzinger et al).

What confidence can we have in predictions of future carbon sinks?

Seasonal model-data intercomparison – Hamburg-NewYork



Models: Jim Orr, LSCE
And OCMIP-2 members

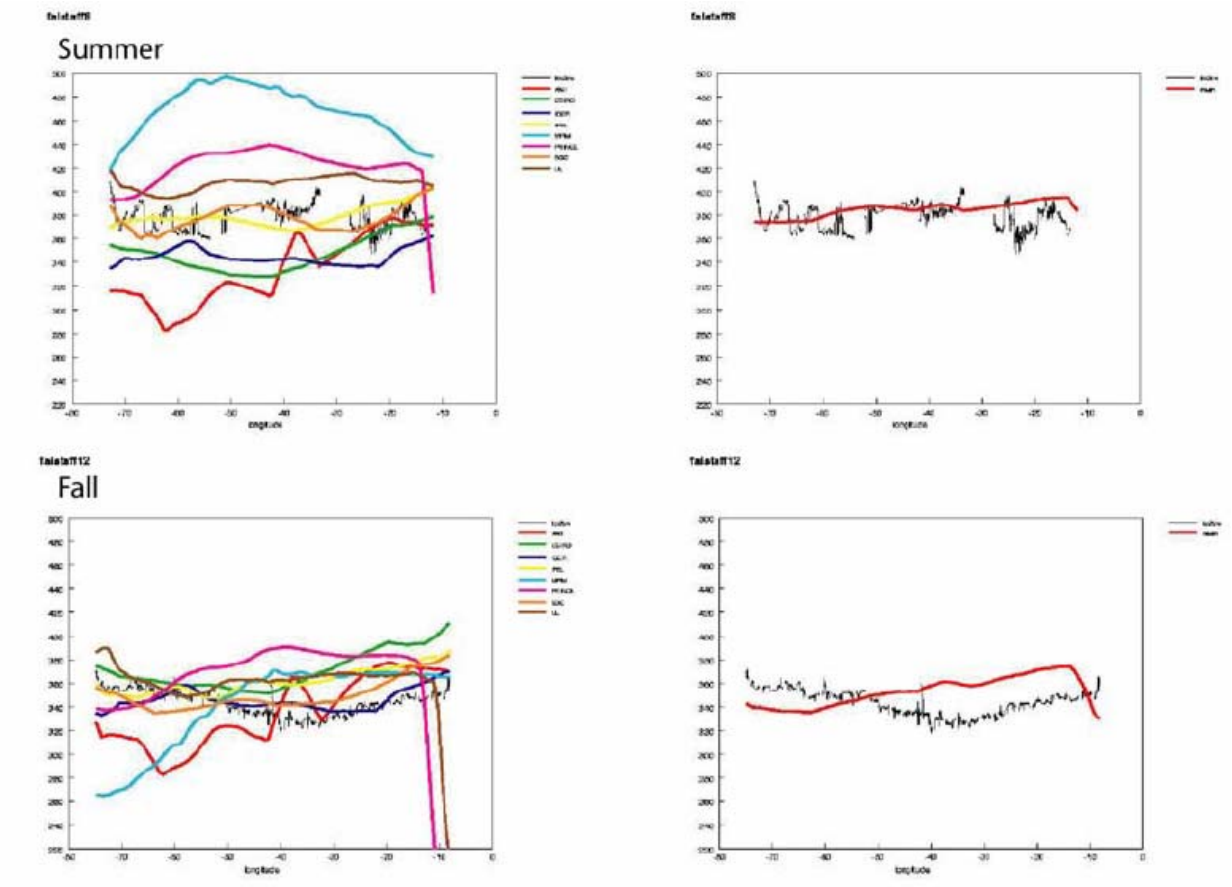
Data: CAVASSOO, CASIX

OCMIP2 models vs data

Mean of models vs data

Models are forced with mean climatological data.

Seasonal model-data intercomparison – Hamburg-NewYork



Models: Jim Orr, LSCE
And OCMIP-2 members

Data: CAVASSOO,
IFM group.

OCMIP2 models vs data

Mean of models vs data

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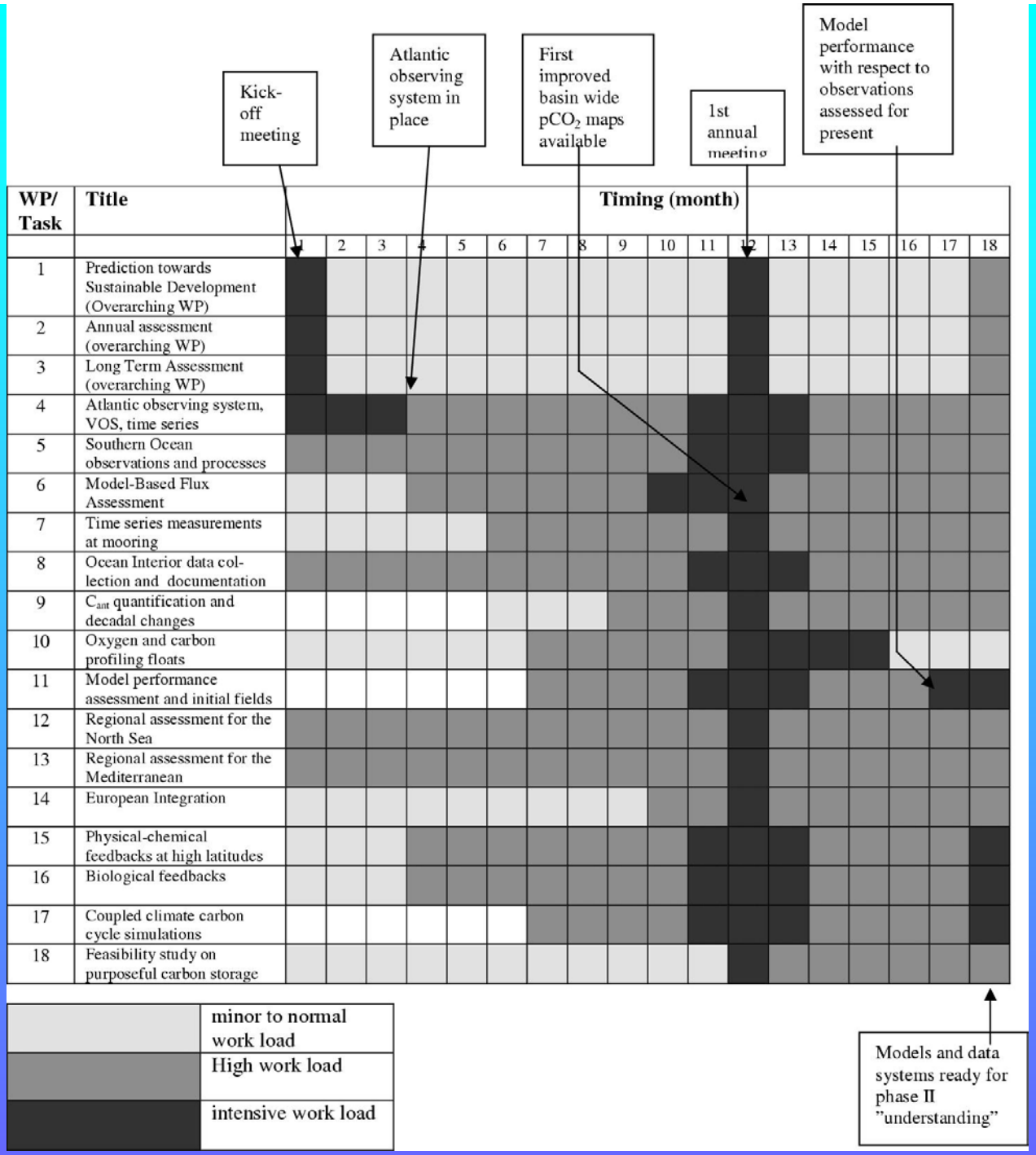
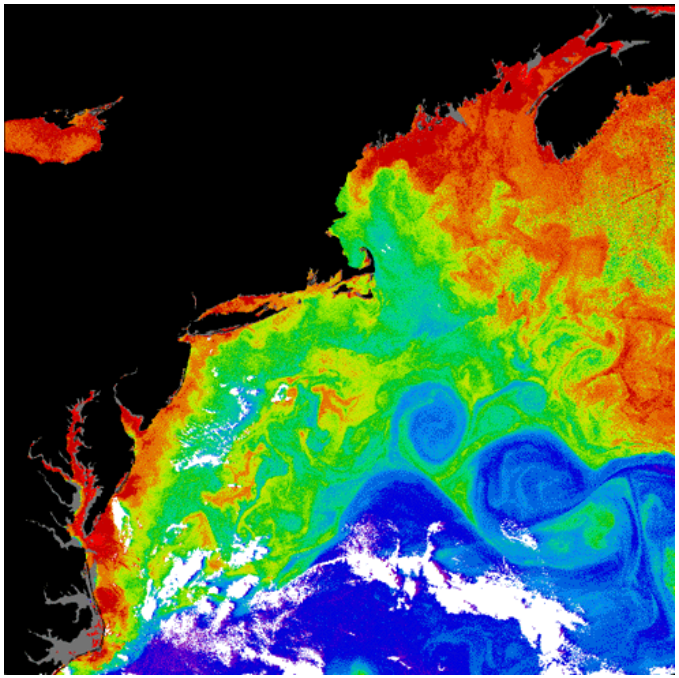
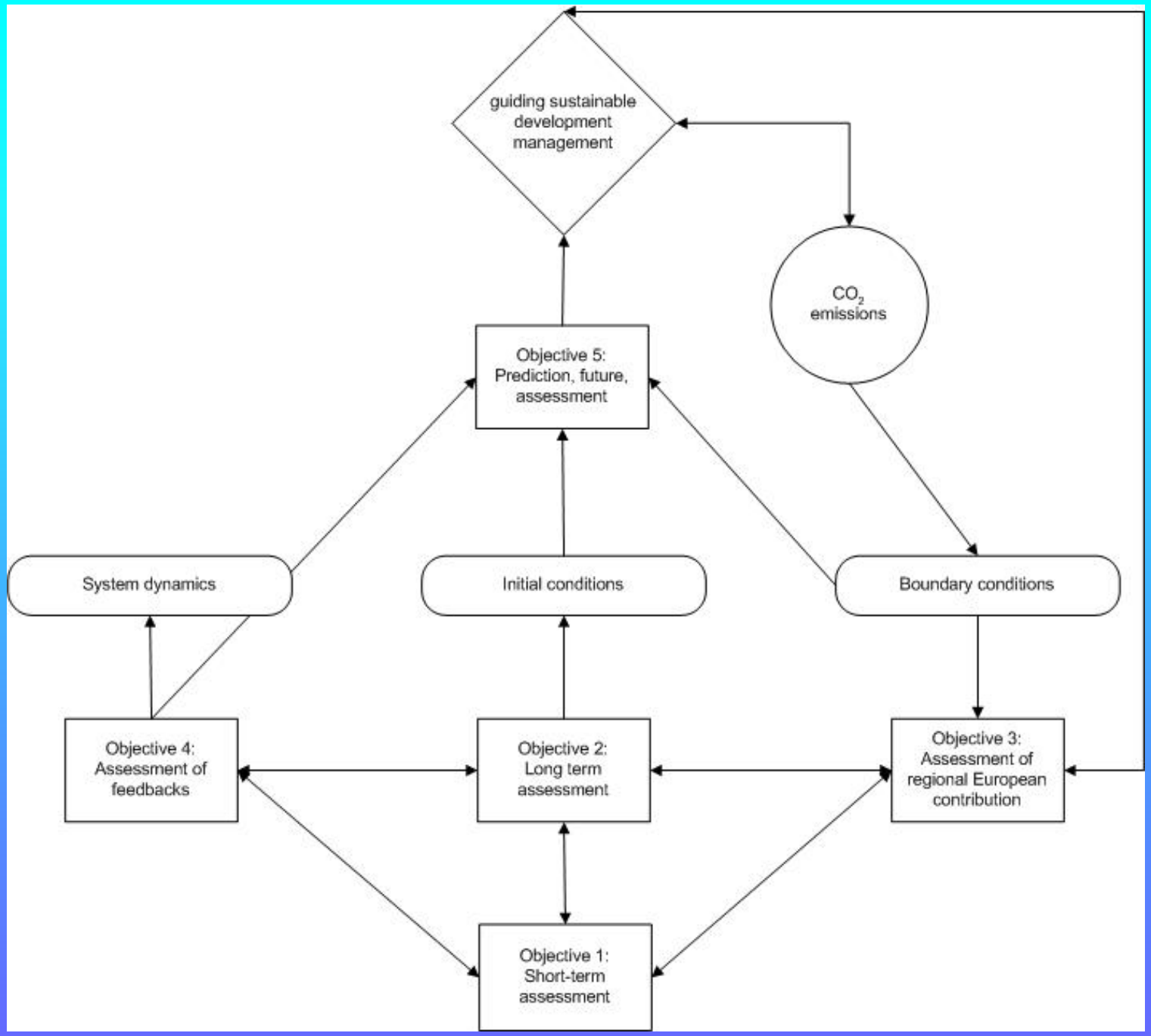


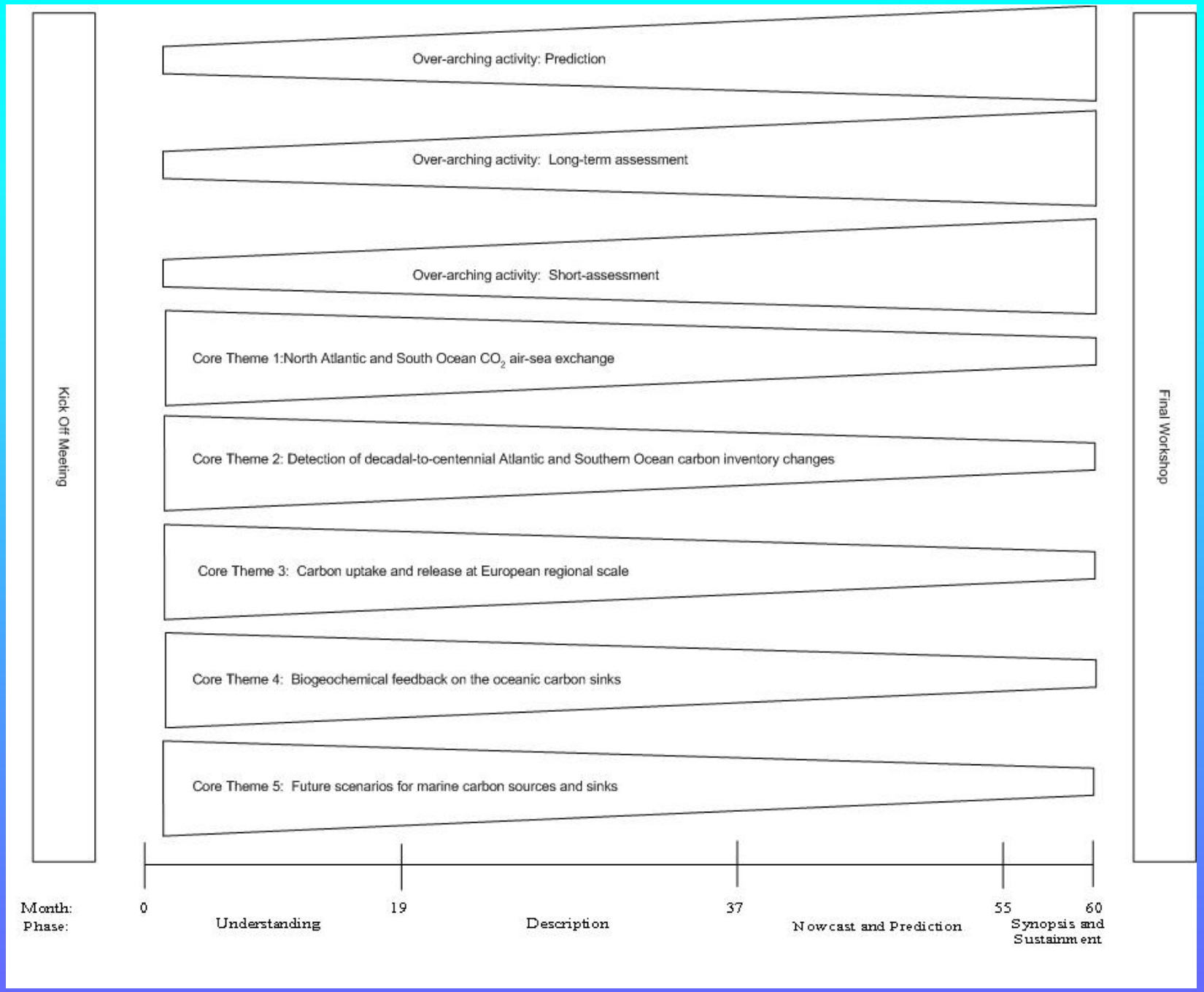
WP/ Task	Title	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	Prediction towards Sustainable Development (Overarching WP)																		
2	Annual assessment (overarching WP)																		
3	Long Term Assessment (overarching WP)																		
4	Atlantic observing system, VOS, time series																		
5	Southern Ocean observations and processes																		
6	Model-Based Flux Assessment																		
7	Time series measurements at mooring																		
8	Ocean Interior data collection and documentation																		
9	C_{ant} quantification and decadal changes																		
10	Oxygen and carbon profiling floats																		
11	Model performance assessment and initial fields																		
12	Regional assessment for the North Sea																		
13	Regional assessment for the Mediterranean																		
14	European Integration																		
15	Physical-chemical feedbacks at high latitudes																		
16	Biological feedbacks																		
17	Coupled climate carbon cycle simulations																		
18	Feasibility study on purposeful carbon storage																		

Remote sensing of SST, Ocean colour to enable Interpolation/ extrapolation of surface CO2 observations



CarboOcean objectives




Kick Off Meeting
Over-arching activity: Prediction
Over-arching activity: Long-term assessment
Over-arching activity: Short-assessment
Core Theme 1:North Atlantic and South Ocean CO_2 air-sea exchange
Core Theme 2: Detection of decadal-to-centennial Atlantic and Southern Ocean carbon inventory changes
Core Theme 3: Carbon uptake and release at European regional scale
Core Theme 4: Biogeochemical feedback on the oceanic carbon sinks
Core Theme 5: Future scenarios for marine carbon sources and sinks
Final Workshop
Month:
Phase:
0
19
37
55
60
Understanding
Description
Nowcast and Prediction
Synopsis and Sustainment