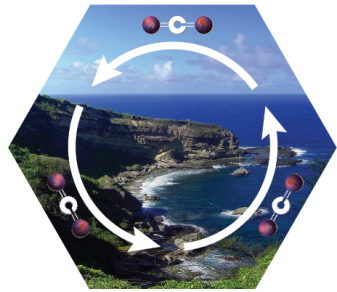


# GC-Carbon

Tatiana Ilyina and Pierre Friedlingstein

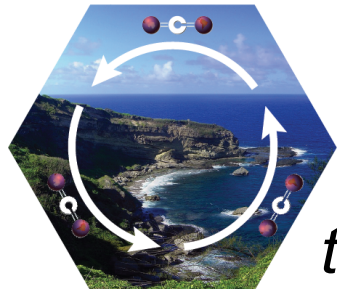
Max Planck Institute for Meteorology

University of Exeter



# GC-Carbon

- Endorsed at the JSC-37. Kick-off meeting Nov. 2016
- Report on activities in 2017 and 2018
- Planned activities for 2018 (and 2019)
- WCRP Strategic and Implementation Plans

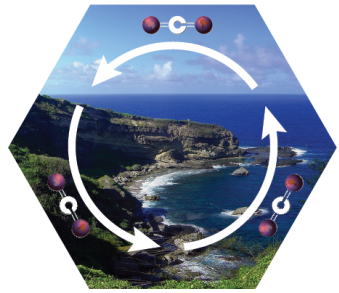


## GC-Carbon Objectives

*to understand how biogeochemical cycles and feedbacks control CO<sub>2</sub> concentrations and impact on the climate system*

### **Guiding questions:**

1. What are the drivers of land and ocean carbon sinks?
2. What is the potential for amplification of climate change over the 21<sup>st</sup> century via climate-carbon cycle feedbacks?
3. How do greenhouse gases fluxes from highly vulnerable carbon reservoirs respond to changing climate (including climate extremes and abrupt changes)?



# GC-Carbon Organization

Co-chairs: Tatiana Ilyina, Pierre Friedlingstein

SSC:

Ashley Ballantyne (U. Montana, USA)

Laurent Bopp (IPSL, France)

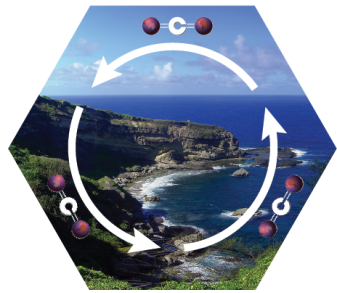
Philippe Ciais (LSCE, France)

Corinne Le Quéré (Tyndall Centre, UK)

Gustaf Hugelius (Stockholm U., Sweden)

Pedro Monteiro (CSIR, South Africa)

Yingping Wang (CSIRO, Australia)



# Activities in 2017 / 2018

## Sessions at international conferences

- **4<sup>th</sup> International Conference on Earth System Modeling, Hamburg**

Carbon feedbacks in the climate system

Convenors: Tatiana Ilyina und Pierre Friedlingstein

Keynote presentations: Anna Michalak (Stanford University, USA) and Pedro Monteiro (CSIR, Pretoria, South Africa).

- **2017 AGU Fall Meeting**

Carbon feedbacks in Earth's climate system: using ocean and land variability to diagnose critical carbon cycle processes”

Conveners: Ash Ballantyne (U Montana, USA), Tatiana Ilyina, Ana Bastos (LSCE, France), Benjamin Poulter (NASA-GSFC, USA).

- **2018 Ocean Science Meeting**

“Ensemble Modeling Approaches in Physical and Biogeochemical Oceanography”

Conveners: Keith B Rodgers (Princeton University), Thomas Froelicher (U. Bern), Tatiana Ilyina, Nicole S Lovenduski (University of Colorado).

# Activities in 2018



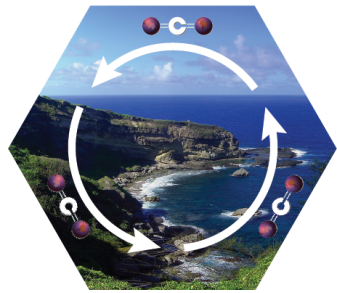
- The goal is to advance our understanding of feedbacks between the climate and the carbon cycle and extend the existing carbon-climate feedback workshop.
- How to make the feedback framework less scenario dependent and recognize different time scales?
- The workshop will bring together 17 leading experts with background in physical climate and carbon cycle.
- Elaborate on the analysis of cmip5 and early cmip6 outcomes.

A core science objective of the WCRP Grand Challenge 'Carbon feedbacks in the climate system', is to advance our understanding of feedbacks between the climate and the carbon cycle. At the Grand Challenge kick-off workshop held in Hamburg in 2016, extension of the current carbon cycle feedback framework was identified as a topic that requires rapid action. This specifically refers to extending the existing carbon feedback framework (concentration-carbon response  $\beta$ , climate-carbon response  $\gamma$ ), to recognize different timescales (especially for the ocean) and to reduce the scenario-dependence of the diagnosed feedback parameters. In addition, it was felt that an improved framework should go beyond global temperature as measure of feedback, for example including the water cycle, and also enabling more informative analysis of regional feedbacks.

This workshop will develop an extended carbon cycle feedback framework, and test this new framework against available CMIP5 simulations, and against CMIP6 simulations at a later stage. The outcome of the workshop will be the outline of a position paper on 'An extended climate-carbon cycle feedback framework to analyse Earth System Models projections'.

## AGENDA

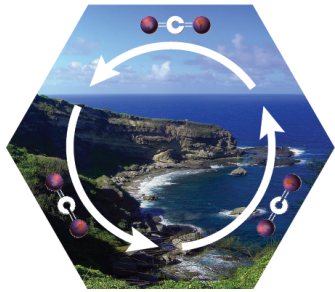
WEDNESDAY	THURSDAY	FRIDAY
12:30 Registration	09:00 Deep dive 3	09:00 BOGs: Session 4
13:00 Welcome Thomas U Bern	Feedbacks, Modeling Reto Knutti, ETH Zürich	10:30 Coffee break
13:15 Grand Challenge, Goals Tatiana MPI-Meteorology	9:30 Individual Talks Session 2 'How to extend and improve carbon cycle feedback framework?'	11:00 Plenary Synthesis and next steps
13:45 Deep dive 1 Land Feedbacks Vivek Arora, Env. Canada	10:30 Coffee break	12:30 End of workshop
14:15 Deep dive 2 Ocean feedbacks Ric Williams, U Liverpool	11:00 BOGs: Session 1 'What are strengths and gaps of the existing CCC-feedback framework?'	<b>Hosts: Thomas Frölicher Tatiana Ilyina Pierre Friedlingstein</b>
14:45 Discussion	12:30 Lunch	<b>Co-supported by</b>
15:00 Coffee break	14:00 BOGs: Session 2 'How to extend the CCC-feedback framework?'	
15:30 Introduction to Break Out Groups (BOGs)	15:30 Coffee break	
15:45 Individual talks Session 1 'How to extend and improve carbon cycle feedback framework?'	16:00 BOGs: Session 3 'How to extend the CCC-feedback framework?'	
18:00 Reception	17:30 Plenary: Report back	<b>Oeschger Centre Climate Change Research</b>
	18:00 Dinner in the city	



## Activities in 2018

Side meeting “Carbon cycle predictions and predictability” at the Boulder Conference in September

- Land and ocean carbon cycle components are becoming standard in decadal and seasonal prediction systems.
- Where are we as community on the topic of carbon cycle predictions?
- Different approaches regarding initialization, data assimilation, and spin up techniques. What are implications for the carbon cycle predictability?
- What are the sources predictability of the carbon cycle well as of the other biogeochemical variables in different prediction systems?
- What are the time scales of predictability for land and ocean carbon sinks?
- Abstract submitted by Ilyina et al. to set up the scene for the side meeting



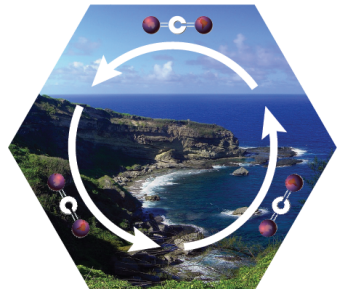
# Plans for 2019

Based on the outcomes of the Boulder side-event we plan a full carbon predictions meeting towards providing relevant analysis for the UNFCCC global stocktakes

- addressing processes determining predictive skill of the land and ocean carbon sinks
- initial state
- ocean physics and biogeochemistry: the ocean boundary layer and its impact on the carbon cycle.
- land ecosystem turnover time: estimates of vegetation and soil carbon fluxes, pools and turn-over times.

Venue: to be determined, maybe Barcelona?





## Plans in 2018/ 2019

### Sessions at international conferences

- **2018 AGU Fall Meeting**

Due to its success at 2017 AGU, it is planned to submit a proposal for the same session “Carbon feedbacks in Earth’s climate system: using ocean and land variability to diagnose critical carbon cycle processes”

Conveners: Ash Ballantyne (U Montana, USA) ...

- **2019 EGU General Assembly**

We plan to submit a session proposal and organize a half-day meeting on GC-Carbon.

# Submitted proposal

- EU H2020 proposal within H2020 LC-CLA-08-2018  
Addressing knowledge gaps in climate science, in support of IPCC reports
- **Title of Proposal: Climate-Carbon Interactions in the Coming Century (CCiCC)**
- **Project coordinator:** Pierre Friedlingstein
- **Partners:** S. Sitch, P. Cox, C. LeQuéré, A. Manning, P. Ciais, P. Peylin, L. Bopp, T. Ilyina, V. Brovkin, P. Landschützer, S. Zaehle, N. Gruber, S. Seneviratne, E. Davin, R. Bernardello, I. Jimenez, V. Eyring, M. Buchwitz, M. Reuter, F. Joos, T. Frölicher, G. Peters, M. Allen
- CCiCC aims at reducing large and persistent knowledge gaps in the climate sensitivity to carbon dioxide emissions.

# WCRP Strategic and Implementation Plans

- Bird-eye-view comments:
  - Overarching Scientific Objectives need to be science driven (**What is the big question?**) AND societal/policy driven (**Why do we need to know?**)
  - Need stronger connection between science (O1-O3) and policy (O4). For example, decadal prediction of climate and carbon for UNFCCC stocktaking, climate and carbon feedbacks for long-term objectives of Paris agreement, etc.
- Many more specific comments already submitted via WGCM