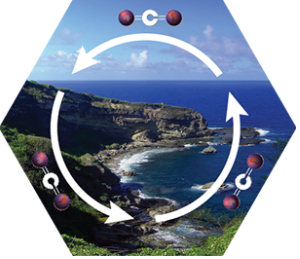

GC-Carbon Report

Pierre Friedlingstein and Tatiana Ilyina

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GC-Carbon

- Endorsed at the JSC-37
- GC SSC
- GC Carbon kick off meeting (Hamburg, November 2016)
- Planned activities for 2017 (and 2018)
- Response to JSC-37 requests

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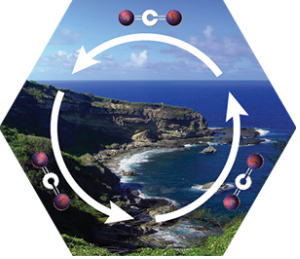

GC-Carbon

Aim: *to understand how biogeochemical cycles and feedbacks control CO_2 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 21st 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)?

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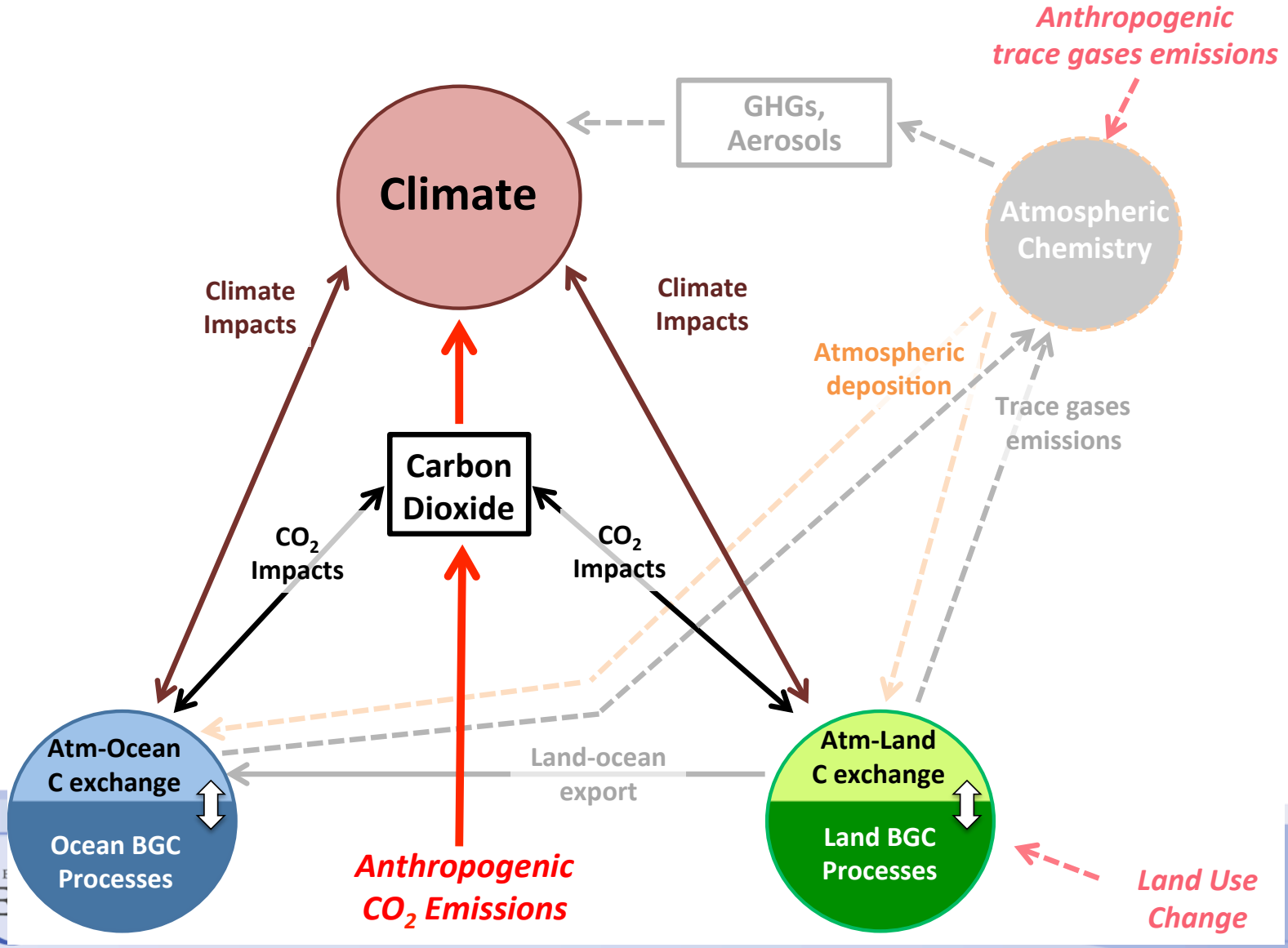
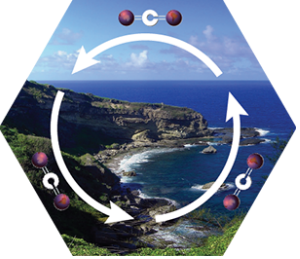
GC-Carbon


Anthropogenic
trace gases emissions
GHGs,
Aerosols
Climate
Atmospheric
Chemistry
Climate
Impacts
Climate
Impacts
Atmospheric
deposition
Trace gases
emissions
Carbon
Dioxide
CO_2
Impacts
CO_2
Impacts
Atm-Ocean
C exchange
Ocean BGC
Processes
Land-ocean
export
Atm-Land
C exchange
Land BGC
Processes
Anthropogenic
CO_2 Emissions
Land Use
Change



GC-CARBON ORGANISATION

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GC-Carbon SSC

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)

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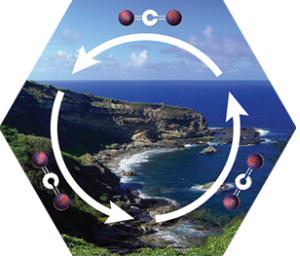

GC-CARBON KICK-OFF MEETING

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GC-Carbon kick-off meeting

- Meeting held in Hamburg, 21-22 November 2016
- 35 participants, covering a wide range of expertise such as plant physiology, marine biology, atmospheric inversions, land and ocean biogeochemistry, paleo-climate, Earth system modelling, etc

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GC-Carbon kick-off meeting

- Format
  - Intro WCRP GC (David Carlson)
  - Intro GC-Carbon (Tatiana and Pierre)
  - Inspirational talks (Nikki Gruber and Chris Jones)
  - 4 Break-out groups (process understanding on land; process understanding in the ocean; learning from the existing record; and towards improving projections)
  - Report from BG and Synthesis

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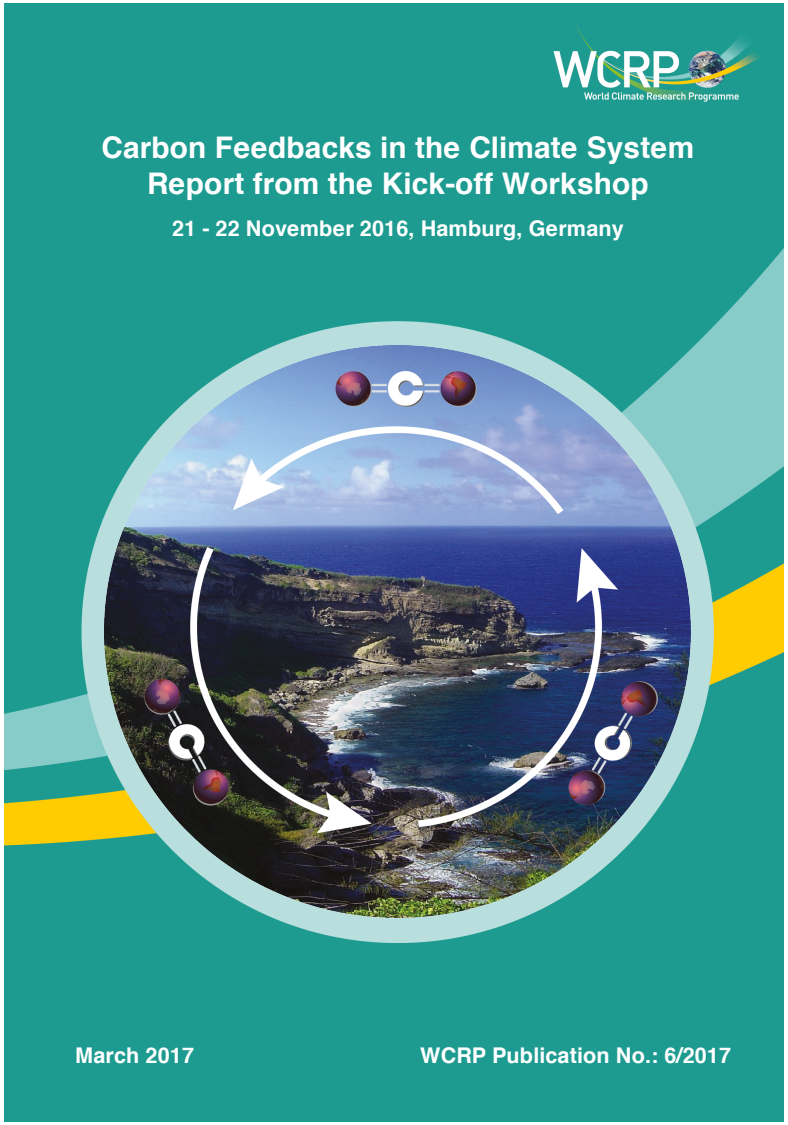

https://www.wcrp-climate.org/gc-carbon-feedbacks-documents

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GC-Carbon kick-off meeting

Report from BGs

- **Processes on Land**
  - CO_2 fertilisation and role of nutrients
  - Carbon turnover time and response to climate change
- **Processes in the ocean**
  - Ocean mixing, stratification and carbon uptake
  - Biological pump and carbon export
- **Learning from existing records**
  - New ocean products for comprehensive spatio-temporal variability
  - Synthesis of surface and satellite measurements as well as manipulative experiments
  - Focus on interannual to decadal variability not just mean
- **Improving projections**
  - Extended climate-carbon feedback framework
  - Decadal prediction of the carbon cycle

Planned activities (2017)

Climate-carbon Feedback framework

Current β/γ framework is scenario dependent, bases on global temperature only, ignores different time-scales, and regional responses.

A workshop is proposed to develop an extended climate-carbon cycle feedback framework.

This workshop would bring together mathematicians, experts in climate feedbacks, the carbon cycle and Earth System feedbacks

P. Cox (U. Exeter) and T. Froelicher (ETH) will co-organize.

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Planned activities (2017)

Decadal prediction of the carbon cycle

Growing scientific interest in investigating interannual (land) to decadal (ocean) predictability of the carbon cycle. Potentially highly policy relevant (INDCs pledges)

It is proposed to have initial discussions and a meeting between the global carbon (GC-Carbon, GCP) and the decadal (GC-NTCP, DCPP) communities to explore the feasibility, the scientific and potential societal interests in near term predictions of the carbon cycle.

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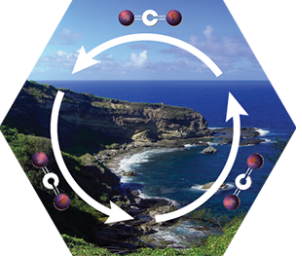

Planned activities (2018)

Ocean physics and biogeochemistry

A workshop is proposed on the ocean boundary layer and its impact on the carbon cycle focusing on mixing parameterizations in models, variation in stratification from data and projected trends with climate change.

Ecosystems turnover time

A focused meeting is proposed in order to provide robust observation-based estimates of vegetation and soil carbon fluxes, pools and turn-over times and to design a ^{14}C global modelling framework for evaluation of land carbon dynamics.

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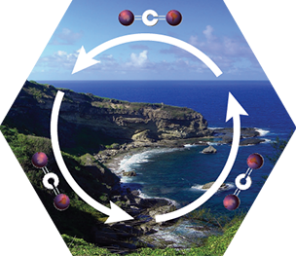

RESPONSES TO JSC-37 REQUESTS

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JSC requests to GC-Carbon

Change title to clarify its focus

- Done. Title changed from “Biogeochemical cycles and climate change” to “Carbon feedbacks in the climate system”

JSC requests to GC-Carbon

Explicitly describe partnership with leading carbon community

GC-Carbon SSC

Tatiana Ilyina (C4MIP, SCOR/FeMIP, IOC GO2NE)
Pierre Friedlingstein (GCP annual carbon budget, C4MIP)

Laurent Bopp (IMBER, C4MIP)
Philippe Ciais (GCP, annual carbon budget)
Corinne Le Quéré (GCP, annual carbon budget)
Gustaf Hugelius (Int'l Soil C network, Int'l Permafrost network)
Pedro Monteiro (CLIVAR)

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JSC requests to GC-Carbon

Explicitly describe partnership with leading carbon community

In addition Kick off meeting had representatives from

iLEAPS (A. Arneth)

AIMES (P. Cox, V. Brovkin)

LUMIP (V. Brovkin)

WMO GAW (S. Houweling)

SOCCOM (N. Gruber)

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JSC requests to GC-Carbon

Develop and elaborate a management plan to emphasize policy relevance, and the relevance and future connection/challenge with physical science.

- Policy relevance
  - WCRP View ahead document, Marotzke NatureCC (2017). Question 1: Where the carbon goes?
  - IPCC AR5 "Cumulative emissions of CO_2 largely determine global mean surface warming by the late 21st century and beyond.". Concept of limited carbon budget is now been used worldwide

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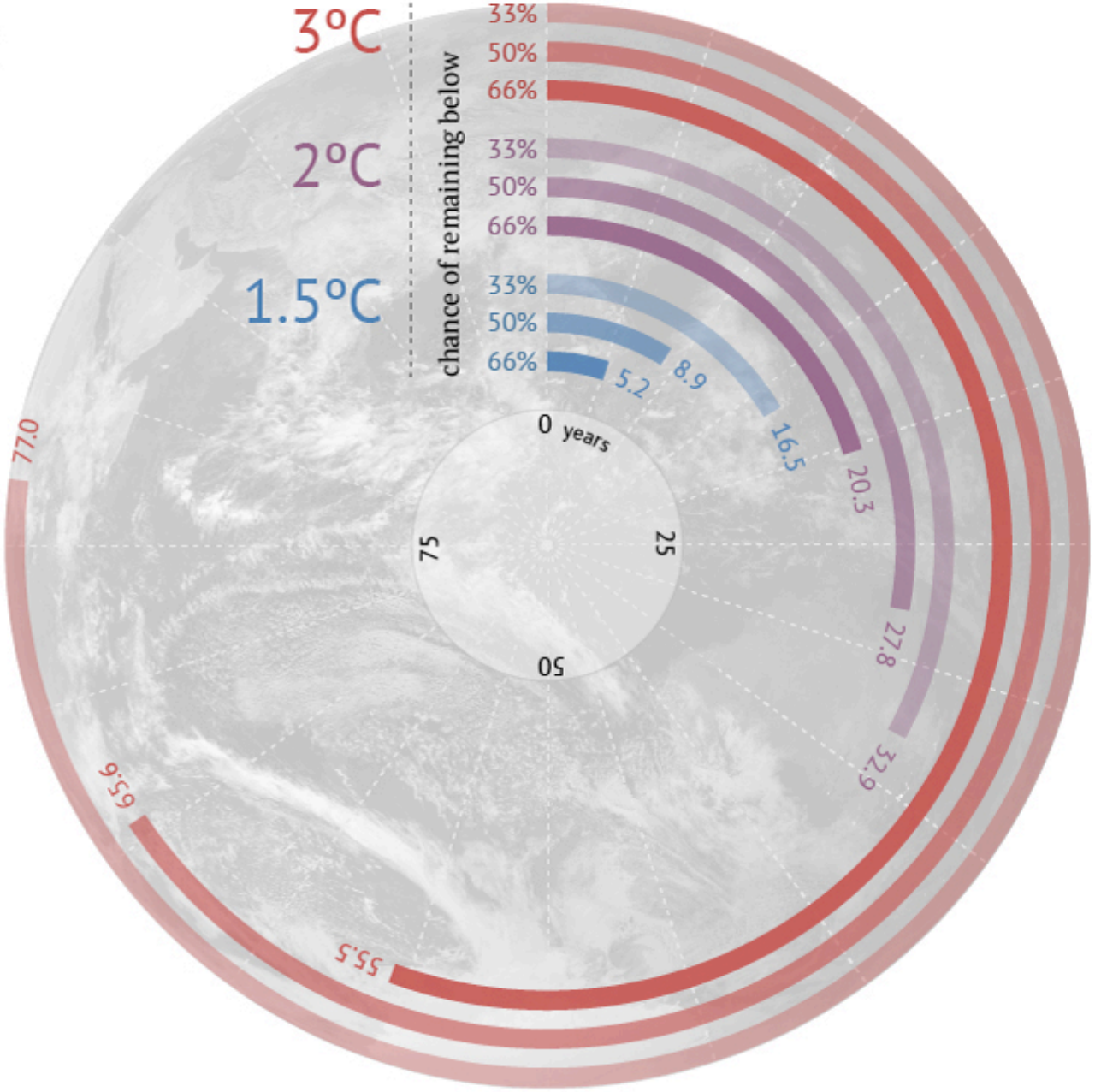
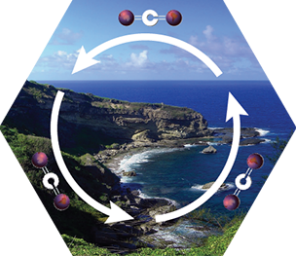
Carbon Countdown

How many years of current emissions would use up the IPCC's carbon budgets for different levels of warming?



CarbonBrief
CLEAR ON CLIMATE

Photo credit: NASA Goddard Space Flight Center
Stopwatch icon: T-Kot/Shutterstock.com



JSC requests to GC-Carbon

Develop and elaborate a management plan to emphasize policy relevance, and the relevance and future connection/ challenge with physical science.

- Physical sciences
  - Carbon cycle is controlled by physics both on land and in the ocean. Physical biases impact on the carbon cycle.
  - Carbon cycle controls physics (from local: e.g. vegetation phenology, transpiration; to global: atmospheric CO_2)
  - See KO meeting report. Several big questions are challenges for both carbon and physics.

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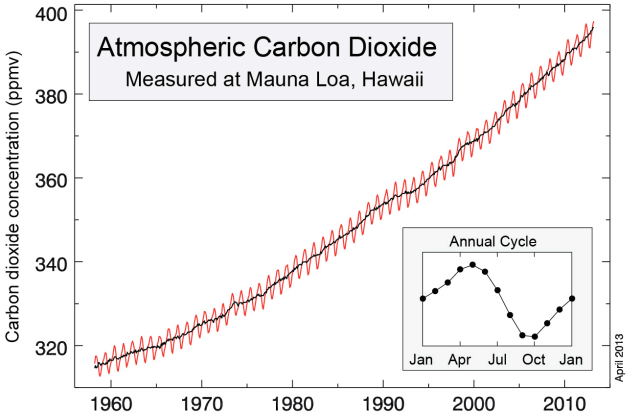
GC-Carbon related publications

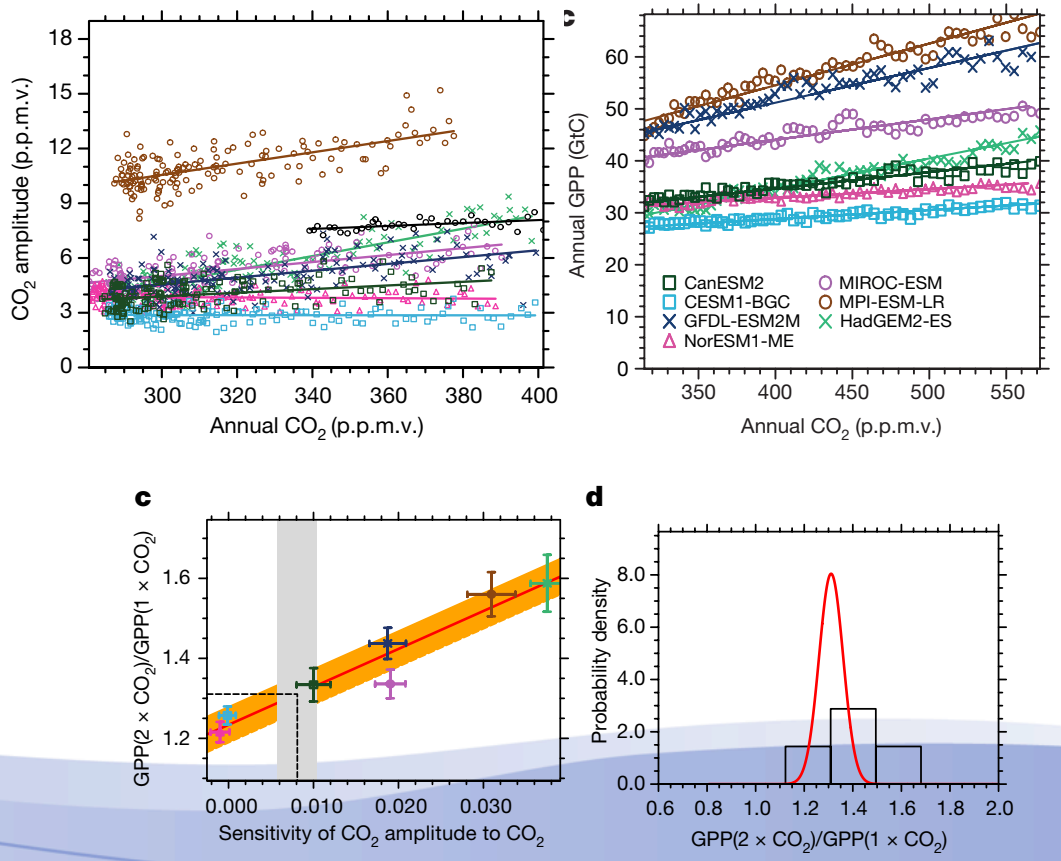
LETTER

doi:10.1038/nature19772

Projected land photosynthesis constrained by changes in the seasonal cycle of atmospheric CO_2

Sabrina Wenzel[1], Peter M. Cox[2], Veronika Eyring[1] & Pierre Friedlingstein[2]





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GC-Carbon related publications

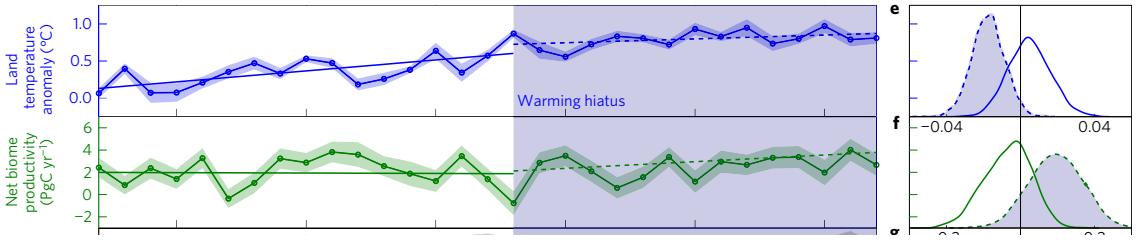
nature climate change

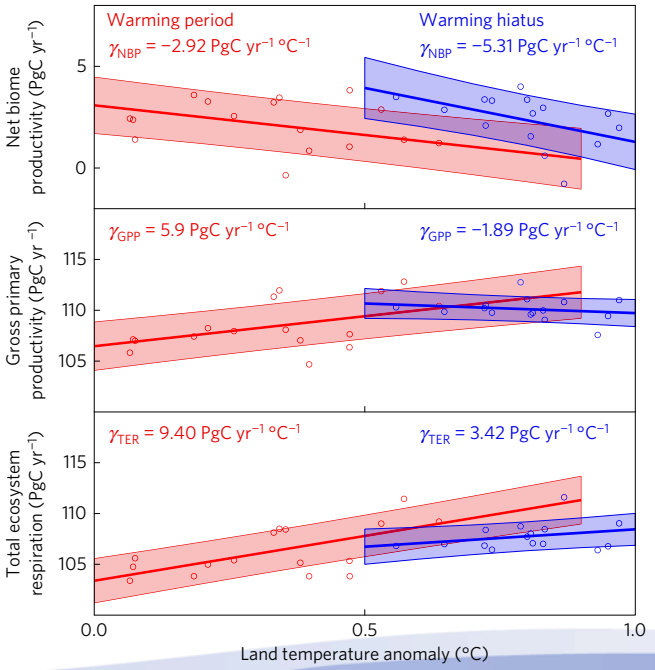
ARTICLES

PUBLISHED ONLINE: 23 JANUARY 2017 | DOI: 10.1038/NCLIMATE3204

Accelerating net terrestrial carbon uptake during the warming hiatus due to reduced respiration

Ashley Ballantyne[1]*, William Smith[2], William Anderegg[3], Pekka Kauppi[4], Jorge Sarmiento[5], Pieter Tans[6], Elena Shevliakova[7], Yude Pan[8], Benjamin Poulter[9], Alessandro Anav[10], Pierre Friedlingstein[10], Richard Houghton[11] and Steven Running[1]





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