GC: Carbon Feedbacks in the Climate System

to understand how biogeochemical cycles and feedbacks control CO_2 concentrations and impact on the climate system

chaired by Tatiana Ilyina & Pierre Friedlingstein

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)?

Activities:

1. GC Carbon approved by JSC, May 2016
2. Kick-off meeting Nov 2016 (Hamburg). Report on WCRP website
3. Workshop on carbon feedbacks framework and Emergent constraints, to be held in Bern, March-April 2018.
4. GC-carbon − GC-decadal discussions on decadal predictability of the carbon cycle

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Extra slides

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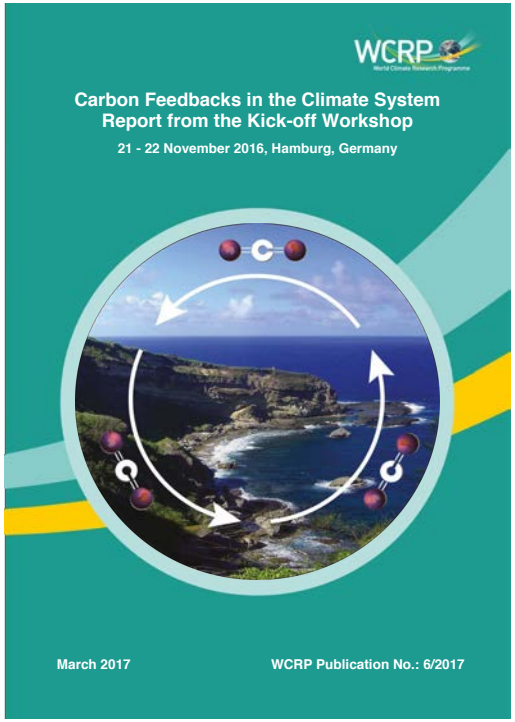
KO workshop in November 2016

40 participants covering a wide range of expertise



Outcomes:

- The potential for exploring near-term (annual to decadal) predictability of the carbon cycle was discussed. The current near-term prediction efforts focus on the predictability of the physical climate system only.
- Our understanding of predictability of the carbon cycle is still in its infancy.
- Predictability of the carbon cycle can be addressed jointly with the Grand Challenge on ‘Near-Term Climate Prediction’.

Feedback workshop

Extending the Climate-Carbon Cycle Feedback Framework and Developing Emergent Constraints

Format

- 30-40 participants
- Couple of keynote presentations on state-of-the art
- Brainstorming parallel sessions (land, ocean, EC) making use of CMIP5 (early CMIP6)

Expected outcomes:

- Extension of the existing carbon feedback framework (b g, concentration-carbon response and climate-carbon response), to recognize different timescales (especially for the ocean), reduce the scenario-dependence of the diagnosed feedback parameters, include the water cycle as measure of feedback, etc.
- Development of emergent constraints on the new model-dependent sensitivity parameters that appear within this framework.

Product: High profile publication (hopefully)

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Potential for Near-Term Predictions of the Carbon Cycle

- Paris Agreement and Global Stocktake: Where will we be in 2030?
- Given national INDCs, what is the likely/range of carbon sinks, atmospheric CO2 increase and climate response to be expected by 2030, when accounting for natural variability?
- Carbon cycle has pronounced interannual (mainly land) to decadal (mainly ocean) variability. Is the variability of the carbon cycle predictable on annual to decadal timescales?
- How well can we reproduce past variability (hindcast) of the coupled climate and carbon cycle system?

Potential for Near-Term Predictions of the Carbon Cycle

Land and ocean carbon cycle components are being included in ESM-based decadal prediction systems

- Currently, about 5 ESMs (as of May 2017) include / plan to include carbon cycle components in their decadal prediction systems
- Carbon cycle output is requested from DCPP
- IPCC AR6 will "*very likely*" heavily rely on CMIP6 simulations (incl. DCPP, C4MIP, etc) for assessment of climate projections, compatible emissions, TCRE, etc. Temporal scale ranges from decadal to centennial.
- Advances in observational techniques (e.g. argo floats, satellite data) for establishing and verification of the prediction skill
- Urgent need to have better understanding of variability of the carbon cycle and its effects on the climate system.