New Methods to Measure Photosynthesis from Space

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Introductions, rules of the game and potential questions

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Outline

- Introductions
- Objectives of the workshop and study program
- Scope
- Structure of workshop and suggestions for productive interaction
- Potential questions!

Introductions

- Ian Baker - Colorado State University
- Joseph Berry - Carnegie Institution for Science
- Kevin Bowman - JPL
- Saulo Castro-Contreras - University of Alberta
- Maria Pilar Cendrero-Mateo - University of Arizona
- Alexander Damm - University of Zurich
- Darren Drewry - JPL
- Bethany Ehlmann - Caltech
- Joshua Fisher - JPL
- Jaume Flexas - Universitat de les Illes Balears
- Christian Frankenberg - JPL
- John Gamon - University of Alberta
- Bernard Genty - CNRS CEA Cadarache
- Luis Guanter - University of Oxford
- Thomas Hilker - Oregon State University
- Joanna Joiner - NASA Goddard Space Flight Center
- Martin Jung - Max Planck Institute for Biogeochemistry
- Jung-Eun Lee - JPL
- Junjie Liu - JPL
- Anna Michalak - Carnegie/Stanford
- Charles Miller - JPL
- Christopher O'Dell - Colorado State University
- Nicholas Parazoo - JPL
- Albert Porcar-Castell - University of Helsinki
- Sassan Saatchi - Caltech/JPL
- Christopher Schwalm - Northern Arizona University
- Christian Van der Tol - ITC-University of Twente
- Paul Wennberg - Caltech
- Debra Wunch - Caltech

Objectives

- We want to investigate/discuss…
  - …how the fluorescence signal is related to gross primary production.
  - …how the new global (though coarse in space and time) measurements can be used in global carbon cycle research.
  - …how the signal can be best exploited in conjunction with atmospheric CO_2 measurements.
  - Missed something?

- Our goals are to…
  - …identify pitfalls in current interpretations
  - …identify new avenues in global carbon cycle research (e.g. separating respiration and GPP)
  - …discuss the “optimal” measurement from space
  - …convince the wider research community of the usefulness of fluorescence (lots of skepticism out there).

Objectives - continued

- A successful outcome at the end of the workshop:
  - we will have a solid understanding of fluorescence principles
  - we will have built a small research community interested in fluorescence
  - we will have a good understanding of what can be done and what OCO-2 will achieve
  - we will have extended the more local focus of the FLEX community to the global carbon cycle (distinguishes this workshop from the FLEX concept, avoiding "*bad blood*" and focusing on what can done now and with OCO-2

‘global’ vs. ‘local’

- FLEX main goal as we understand it:
  - Focus on small-scale features, guiding, e.g. agriculture
  - Global carbon cycle community not heavily involved

- Our goal here:
  - Focus on the global carbon cycle (a necessity as we neither have mapping nor fine spatial resolution BUT high noise)
  - Use the synergy with atmospheric CO_2 measurements (and the fact that the carbon cycle community is already heavily involved through GOSAT/OCO-2)
- Identify ways to separate net fluxes into GPP and respiration.

Structure of workshop

- Discussion sessions are structured to have a lead-in talk, followed by a moderated discussion session
  - we plan to begin by formulating relevant questions then proceeding to discuss them in detail

- We need volunteers (*!thank you!*) to take notes in each discussion session

- We have some room to make adjustments in our agenda, expand or change discussion topics

Guidelines/suggestions

- Productive discussion is key to our success
- Please share what you know (and don't fear to speak up if you don't know something)
- Help formulate the relevant questions and discussion topics
- Do not be dismissive; if we are discussing a moot point, help us understand it too (then help us form the right question)
- Postdocs/students: you are part of our core group. Ask questions, participate in discussions

Potential questions

- Fluorescence from space
  - Can we ever "*validate*" it and do we need to (at GOSAT spatial scales)?
  - How well are fluorescence principles known and what is needed to consolidate the models?
  - How direct a proxy for GPP is it (under what conditions does it break down)?
  - What is the impact of canopy structure (canopy RT)?
  - How well (and linear) does it indicate stress (e.g. moisture vs. light vs. ozone vs. other)?

Potential questions

- Fluorescence from space (continued)
  - Can net CO_2 fluxes be separated into GPP and respiration using fluorescence and XCO_2?
  - Fluorescence through (thin) clouds: what could this enable?
  - Satellite: Sun-synch or not? Advantages of fixed vs. variable local time (e.g. for OCO-3 on the ISS). What could a geostationary satellite do?
  - Others?