<u>Splinter Session 9:</u> Climate Variables and Long Term Trends

<u>Co-Chairs</u>: Mark Dowell (JRC, EU), Stephanie Dutkiewicz (MIT, USA) and Jim Yoder (Woods Hole, USA)

Splinter Session 9 referenced the keynote address given by Frederic Melin entitled, "*In search of long-term trends in the ocean colour record*" and also included 3 short talks:

- Mark Dowell (JRC) that discussed the complex relations involving international bodies like CEOS/SIT/GEO/GCOS, space agencies, and scientists related to climate variables.
- James Yoder (WHOI) discussed the goals and activities of the IOCCG Essential Climate Variable (ECV) Task Team.
- Stephanie Dutkiewicz (MIT) discussed interactions between the ocean colour and biogeochemical modeling communities, including what each community can learn from the other.

A key message in Mark Dowell's presentation was how important it is for the ocean colour community to be aware of the expectations of the national and international agencies as to how ocean colour measurements can support better understanding of climate change and its impacts. Senior managers in the space agencies are generally present at international meetings of groups like the Committee on Earth Observing Satellites (CEOS). Having ocean colour science well represented in these forums can demonstrate how our research contributes to understanding climate change and its impacts as well as to other societal benefit areas of interest to international agencies. For example, IOCCG promoted the formation of the Ocean Colour Radiometry Virtual Constellation (OCR-VC) within CEOS to promote cooperation among national programs for sustained global ocean colour coverage, improved data access, joint calibration and validation programs, training programs and other activities. Reports of the OCR-VC are included with those of other VCs (including VCs for SST, sea surface height and ocean vector winds) at every important CEOS meeting.

Jim Yoder reported on the recently formed IOCCG ECV Task Team. Co-Chairs are J. Yoder and N. Hoepffner, and the members include S. Henson, H. Murakami, S. Maritorena, B. Franz, M. Wang, E. Kwiatkowska, F. Melin, A. Mangin and H. Loisel. The charge to the task team is to determine how to produce basin to global scale ECV time series of ocean color products (specifically nLw or Rrs and derived products) for climate-related studies. In particular the task team is considering the results from 4 projects:

- NASA-GSFC project to produce nLw and Chl time series involving multiple sensors (SeaWiFS, Aqua, Terra and MERIS);

- NASA-funded MEaSUREs project which uses the GSM model to time series of inherent optical properties (IOPs) and other variables from SeaWiFS, Aqua and MERIS data;
- GLOBColour project which is also using GSM model to produce a time series of ocean color products from merged data from SeaWiFS, Aqua and MERIS data at 4.6km resolution; and
- ESA's CCI program which is producing a time series based on SeaWiFS, Aqua and MERIS data as described in the plenary talk by F. Melin.

A characteristic of all of the projects is the emphasis on understanding bias and other uncertainties, and how to determine quantitative measures of both. The task team plans to establish a common data base of the products from these 4 projects to allow all groups to try various approaches for comparison and calculation of uncertainties.

Stephanie Dutkiewicz first discussed the products most commonly used by numerical modelers. She reported that global modelers tend to use only Level 3 products and prefer chlorophyll to other products. Modelers choose chlorophyll, and then primary production, because they are more familiar with these variables and know how to convert them into the units required by their respective models. Modelers are less familiar with other products such as particulate carbon.

Modelers use ocean colour products in 3 different ways:

- sea-truth with which to compare model output;
- assimilate or merge ocean colour and models to "fill in" space and time for missing data;
- provide feedback to the ocean colour scientists to inform requirements and limitation for ocean color time series.

For example, recent modeling studies suggest that we will need a 30-year time series of satellite ocean colour data to determine the existence of long-term trends. Other modeling studies illustrate how data gaps will require even longer time series to observe long-term trends. There was a lively discussion following the presentations. A lot of the discussion focused on how to calculate uncertainties and what they mean, as well as how models can inform studies of long-term data records.

Take-home messages include:

- importance of collecting satellite ocean colour data and sustaining the observations is well established within the international bodies that are involved in setting and meeting requirements for observing the global ocean;

- there is considerable interest in long ocean colour time series and what the results are showing and/or will show;
- there is general recognition of the importance of calculating uncertainties, including bias, in the time series of ocean colour products, space agencies should ensure resources are made available to support these developments;
- interactions between global biogeochemical modelers and those producing long time series of ocean colour products benefit both communities, and;
- interactions between climate modelers and ocean colour scientists help ensure that the ocean colour time-series and models are appropriately used in describing the optical feedbacks on the numerical physical and biogeochemical/ecosystem models.