MINUTES OF KICK-OFF MEETING WG IOCCG ON ATMOSPHERIC CORRECTION OVER OPTICALLY-COMPLEX WATERS

The members of this IOCCG WG gathered on May 14-15, 2014 at the Laboratoire d'Océanologie et de Géosciences located in Wimereux, France. Five members were present in Wimereux: Julien Brajard, Cédric Jamet, Palasinamy Shanmugam, Knut Stamnes, Sindy Sterckx. Thomas Schroeder was on video-conference for the entire meeting and Xianqiang He was present on video conference on the afternoon of May 14. Sean Bailey, Kevin Ruddick and Menghua Wang were not available.

The kick-off meeting lasted one and half days (the agenda is at the end of the document). Half of the meeting concerned presentations of each member showing their activities on the atmospheric correction over optically-complex waters but also their participation in this working-group.

Julien Brajard: algorithm provider for MERIS, synthetic dataset using neural networks, participation to intercomparison exercise.

Cédric Jamet: chairman, algorithm provider, management of the WG, inter-comparison analysis, collection of in-situ datasets in European, South American and Vietnamese coastal waters.

Xianqiang He: algorithm provider, improve release of AC code to public, generate RT simulated dataset based on PCOART model.

Thomas Schroeder: algorithm provider for SeaWiFS, MODIS and MERIS, collection of in-situ datasets along Australian coasts, RT code for simulated datasets.

Palasinamy Shanmugam: algorithm provider for SeaWiFS, MODIS and MERIS, collection of in-situ datasets in Indian Ocean.

Knut Stamnes: algorithm provider for SeaWiFS, MODIS and MERIS, atmosphere-ocean RTM for simulation of the top-of-atmosphere and water-leaving radiance.

Sindy Sterckx: literature review of adjacency effects, application of SIMEC algorithm, collection of VNIR/SWIR in-situ datasets, validity of SWIR black pixel assumption.

For M. Wang, K. Ruddick and S. Bailey, hereafter are my views:

M. Wang: experience sharing from report #10, algorithm provider (NIR/SWIR, Wang et al. (2012)

K. Ruddick: in-situ datasets, literature review, algorithm provider, link with his IOCCG WG

S. Bailey: NASA in-situ datasets + implementation of AC in SeaDAS + algorithm provider

The second part of the meeting concerned different topics:

- **Refinement of the goal and purpose of the working group**

The participants agreed to limit the scope of this WG to only non-zero NIR water-leaving reflectances. A specific chapter will be dedicated to the adjacency effects but also to other issues when dealing with optically-complex waters as a literature review (Sun glint, sensor saturation, cloud masking). It will be a complementary report of report #10 from Menghua Wang.

The codes of the atmospheric correction algorithms used in the WG will be released to public as much as possible. It will be a recommendation to the algorithm providers. The simulated datasets developed in the frame of the WG will also be released to public.

The goal of the WG is to systematically assess, understand the advantages, limitations and applications of each selected atmospheric correction for providing guidance to end-users and to improve the development of new schemes.

- **Datasets**

This topic was the first focus of the discussions. Three datasets will be used: in-situ, simulated and satellite images.

A first action will be to gather all the available in-situ datasets of the water-leaving reflectances inside the WG (as long as the IOPs when available) in the visible and near-infrared wavelengths. This dataset will contain measurements in Eastern English Channel/North Sea, French Guiana, Vietnamese coasts, Indian Ocean, Australian coasts from the members of the WG (+ NOMAD/SeaBASS).

We will seek as much as possible to collect datasets from a large variety of waters to assure covering the largest variability in term of optically-complex waters.

We need high-quality NIR measurements.

ACTION (C. Jamet): Contacting PI of datasets inside the MERis MAtch-up Database (MERMAID).

ACTION (C. Jamet): Contacting PI of AERONET-OC stations

ACTION (C. Jamet): Contacting K. Ruddick for his dataset

The second dataset will be simulations of the top-of-atmosphere radiance as measured by the remote sensor. The participants are able to provide an atmosphere-ocean couple radiative transfer code/model. As there is no use to develop three simulated datasets, it

has been decided to compare the outputs of the three RTM with a small samples of test situations.

ACTION (K. Stamnes): Providing publications and benchmarks for testing the three RTM. Results provided before the end of October

Once the RTM will be fixed, top-of-the-atmosphere radiance will be simulated, as well as the Rayleigh-corrected, aerosol, aerosol-Rayleigh and water-leaving radiances. The choice of the aerosol and bio-optics models will be discussed at the next meeting. Warning to the parameter provided to algorithm's provider (radiance, luminance)

The satellite images will be chosen for specific region of interests over a selection of dates.

ACTION (C. Jamet): Asking each participant to provide images on their region of expertise, with careful attention to sensor saturation.

- **How to inter-compare**

This topic was the second focus of the discussions. There are many ways to compare the atmospheric correction algorithms. The water-leaving radiance in the visible and NIR will be compared, as well as the aerosol optical properties (aerosol optical thickness and Angström coefficient). Thereafter is the list in order of priority:

  - Match-up analysis (Δt=+/- 2-3h, spatial homogeneity criteria on τ + nLw (<0.15 or 0.20), 3x3 pixel box, all valid pixels + >6 pixels over the 3x3 box) with a focus on the NIR values. Both nLw and aerosol optical properties. Metrics: RMSE, relative error, R^2, bias, slope and intercept of linear regression
  - Images analysis: comparison of aerosol properties and nLw patterns over selected regions of interest, Transects from coasts to case-1 waters, impact of longitude/latitude
  - Sensitivities studies using simulated datasets:
    - Fixed aerosols→ Variation/change of the bio-optical model
    - Fixed bio-optical model → Variation/change of the aerosol models
    - Impact of observation angles
  - Sensitivity as a function of optical water type
  - Using the estimated aerosol optical properties to simulate the path reflectance using a RTM and then reconstructing the Rayleigh-corrected (or top-of-the-atmosphere) radiance to compare with the measured value

ACTION (C. Jamet): Contacting CCI Ocean Color project manager for sharing experience on round-robin for case-1 waters + next for case-2 waters (only MERIS sensor)

The error budget and propagation, uncertainties analysis will not be done, as another IOCCG WG is in charge of this activity.

One idea will be to have all the selected algorithms in the same framework, i.e. software (SeaDAS, BEAM, ODESA, …) so all the pre-processing, LUTs will be the same for all algorithms. The observed differences will come "only" from the atmospheric correction algorithms. It is especially relevant for the algorithms taking the Rayleigh-corrected radiance as inputs.

ACTION (C. JAMET): Contacting S. Bailey for SeaDAS and C. Brockmann for BEAM if it could be done.

- **Which algorithms**

No a priori choice of the algorithms. Algorithm developers will be contacted to participate to the round-robin. The selection will be done depending of the number of answers. We consider, for the moment, to compare the algorithms of:

Brajard et al. (2012), He et al. (2013), Ruddick et al. (2000), Schroeder et al. (2007), Shanmugam (2012), Singh and Shanmugam (2014), Stamnes et al. (2003), standard NASA, Wang and Shi (2007), Wang et al. (2012).

The following algorithms will be considered by contacting their authors:

Chen et al. (2014), Doerffer et al. (2007), Mao et al. (2013), Moore et al. (1999), Steinmetz et al. (2010).

The final choice of the algorithms will be made in Fall 2014.

ACTION (C. Jamet): Contacting potential developers for participating to the round-robin.

ACTION (C. Jamet): Literature review with the inputs and outputs of published atmospheric correction algorithms.

- **Which remote sensors**

It has been decided to start with the MODIS sensor as it is the only to have the SWIR bands. But we will consider the MERIS sensor, with a focus on the next generation, the Ocean and Land Color Imager (OLCI, launch mid-2015).

- **Vicarious calibration**

A short discussion took place about the need to vicarious calibrate or not all the atmospheric correction algorithms involved in the round-robin.

ACTION (C. Jamet): Discussion with Sean Bailey of this issue and to see how it can be done

- **Next meeting**

The next WG meeting will take place on Sunday, 26, October 2014, just before the Ocean Optics conference, as most of the members will be present at the conference. A meeting room has been requested from the meeting organizer.

- **Management of the WG**

Regular teleconference (every 3 months) to discuss progress, issues

2 physical meetings a year (at least), one coupled with international conferences (in 2015, 2nd International Ocean Color Symposium in US)

- **Schedule of the WG**

A rough schedule has been discussed. The priority is to have the in-situ and simulated datasets gathered by the end of 2014 (early 2015 at the very latest). We plan to have a report by Fall 2016.

- October 2014:
  - Ocean Optics conference: possibility to book a meeting space → 6 month progress
    - Results of RTM comparison
    - Collection of in-situ datasets
    - Choice of AC algorithms
    - Tables on AC algorithms (inputs, outputs)
    - Choice of regions of interest
- 2015:
  - Development/gathering synthetic datasets
  - Match-ups and transect analysis
- 2016:
  - Match-ups and transect analysis
  - Sensitivity analysis using synthetic datasets

AGENDA:

Wednesday, 14, May, 2014:

9:00-9:30: Welcome (C. Jamet)

9:30-9:45: Why a new IOCCG WG? Purpose, goals of the WG and the kick-off meeting

9:45-10:15: Inter-comparison of atmospheric correction in moderate turbid waters for SeaWiFS and MODIS-AQUA (C. Jamet)

10:15-10:45: Atmospheric correction using NeuroVaria, (J. Brajard)

10:45-11:00: Coffee break

11:00-11:30: Contribution from Stevens Institute of Technology (K. Stamnes)

11:30-12:00: Sunglint and aerosol correction algorithms for ocean colour sensors: Preliminary results (P. Shanmugam)

12:00-12:30: Contribution from CSIRO (T. Schroeder)

12:30-14:00: Lunch

14:00-14:30: The use of NIR and SWIR wavelengths in the atmospheric and environment correction (S. Sterckx)

14:30-15:00: Atmospheric correction using the ultraviolet wavelength for highly turbid waters (X. He)

15:00: 17:00: Discussions

- Role of each participant
- Scope of the WG
- Previous experience on round-robins
- Lessons learnt from IOCCG report #10, CCI OC, …
- What type of algorithms?
- Which sensors?
- Which datasets? In-situ? Simulated? Satellite? Where?
- Schedule of the WG? Report in 2 years?

17:00: Adjourn

Thursday, 15, May:

9:00-10:30: Discussions

- Simulated datasets: useful? which aerosol models? Which RTE code for atmosphere and ocean? How to define IOPs (link with IOCCG WG K. Ruddick). What to simulate: ρ_{TOA}? $\rho_{rc}= \rho_a+ \rho_{ra}+ t.\rho_w$? Multi-scattering? Which definition of Rrs?
- How to compare?

        - Match-ups?
        - Water-type classification
        - Transects
        - Error propagation
    - Sensitivities studies: fixed aerosol/bio-optical model

10:30-11:00: Coffee break

11:00-12:30: Discussions

- Sensitivities studies: fixed aerosol/bio-optical model
- How to compare?
    - Match-ups?
    - Water-type classification
    - Transects
    - Error propagation
    - Influence of observation angles
    - ????
- Adjacency effects
- Other suggestions

12:30-14:00: Lunch