<u>Splinter Session 3:</u> Geostationary Ocean Colour Radiometry

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The splinter session on Geostationary Ocean Colour Radiometry was organized into three themes, each with a series of short presentations followed by brief discussions as indicated below:

1. Geostationary Products and Applications:
   - Overview of GOCI mission (J.-K. Choi)
   - Dynamics of suspended particulate matter in river plumes using GOCI (D. Doxaran)
   - Estimating PAR from GOCI (R. Frouin)
2. Geostationary Data Processing Techniques:
   - GOCI atmospheric correction applications (S. Son for M. Wang)
   - Specificities in geostationary ocean colour radiometry processing (C. Mazeran)
3. New Geostationary Missions and Synergy:
   - Korean geostationary new mission synergy (J.-H. Ryu)
   - NASA GEO-CAPE Status (A. Mannino)
   - European GEO – OCAPI (D. Antoine)
   - MODIS-SEVIRI Synergy Product (Q. Vanhellemont)

At the conclusion of all the presentations, a series of provocative questions were posed to elicit a more in depth discussion on each of the session themes. There were approximately 40-50 attendees at our session.

Discussion questions and overview:

- What new products can be derived from geostationary ocean colour data?
  - Surface currents; sediment transport; particle tracking
  - Event tracking such as oil spills, ship waste disposal activity, harmful algal blooms, sea fog, storms, forest fires, volcanic eruptions, etc.
  - Daily PAR derived from multiple GOCI's 8 hourly measurements yield a much improved PAR product compared to a single daily value.
- What new processes can we describe?
  - Tidal dynamics, eddies, fronts
  - Diel evolution of traditional ocean colour products
  - Direct net primary production and net community production
  - Phytoplankton bloom dynamics
  - Exchange of materials at the land-sea interface
  - Exchange at the air-sea interface
  - Rapidly evolving phenomena such as river and aerosol plumes
  - New users would include modellers
- What are the new challenges for geostationary data processing?
  - Sun glint appears to be a minor issue

    - Side and forward scattered light to the TOA must be taken into account
    - Backscattering geometry for GEO, for more extreme angles, will limit the capability for aerosol model selection and aerosol optical thickness estimations and thus application of atmospheric corrections.
    - Geostationary will improve coverage due to optimization for clouds, i.e., cloud clearing from multiple scanning opportunities throughout each day.
    - High air mass fractions (AMF) and extreme viewing angles will pose challenges for ocean radiometry retrievals.
        - Atmospheric corrections for AMF>4 exceed current processing specifications.
        - Retrievals within a 60-degree viewing angle will be
        - The measured radiances from geostationary (GEO) sensors will contain a larger volume of aerosols and trace gases compared to low earth orbit (LEO) sensors such as SeaWiFS, MERIS and MODIS.
    - Approaches for atmospheric corrections at high AMF need to be evaluated.
        - Uncertainty in corrections for the air-sea interface at high sun/viewing zenith angles (>75-degrees) due to wave-induced shadows.
        - Corrections for earth curvature at edges of scan may not be possible
        - Spherical shell model for atmospheric correction is being studied.
    - Bidirectional reflectance distribution function (BRDF) increases rapidly with viewing angle and poses additional challenges for geostationary ocean colour radiometry.
    - Limitations in the modulation transfer function (MTF), scale of details observable by a sensor, will limit the spatial resolution that can be obtained from geostationary orbit.
- How should GEO and LEO be designed to optimize synergy?
- Do we need a global GEO constellation?
- Potential for synergy in combining measurements from multiple platforms such as (1) merging SEVIRI and MODIS example presented by Vanhellemont and (2) Korean GOCI-II ocean colour, GEMS atmospheric trace gas profiler and MI-II meteorological sensors.
- Should we attempt to harmonize multi-agency requirements such as spectral bands, signal-to-noise ratio (SNR), etc.?
- GEO poses stringent trade-offs in requirements among spatial resolution, temporal resolution, SNR, spatial coverage, spectral resolution, etc.
- Current technology limits sensor designs to three categorical solutions
    - 2D frame capture multispectral sensors (GOCI, SEVIRI, ABI, etc.)
    - 1D - single slit multi- or hyperspectral sensors with very wide field of view
    - 1D - multiple slit multi- or hyperspectral sensors

The presentations were quite informative and relevant to the session themes. The community is just beginning to see the potential value in geostationary ocean colour radiometry observations with GOCI data, as well as other sources of geo data (e.g. combining SEVIRI with MODIS). The release of IOCCG Report #12 on geostationary ocean-colour radiometry will

promote a greater understanding and facilitate future splinter session discussions on this topic. The following recommendations are suggested for future splinter sessions on this topic:

Recommendations:

1. Broader distribution and application of GOCI data to demonstrate the utility of geostationary ocean colour radiometry data.
2. Additional activities on geostationary ocean colour radiometry are needed to inform the IOCS community, other scientists, managers and public on the utility of such observations through:
    - sessions at future meetings (IOCS, Ocean Optics, AGU, EGU, etc.);
    - articles in various publications (IOCCG newsletter, EOS, peer-review articles, etc.)
3. More extensive discussions on geostationary ocean colour radiometry are required to:
    - address and consider solutions to issues of atmospheric correction and BRDF;
    - consider novel products and applications;
    - discuss how to engage users both on research and applications and;
    - discuss how the community can advocate for such missions.