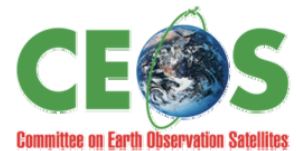
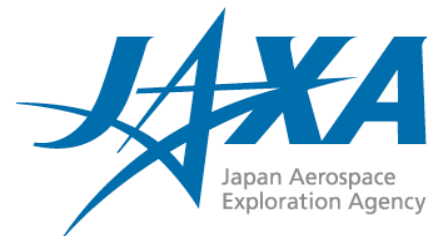


# Ocean Color Radiance (OCR) Virtual Constellation (VC) *Implementation Strategy and Plan*

Mark Dowell – EC / JRC

Hiroshi Murakami - JAXA

Jim Yoder & Venetia Stuart - IOCCG

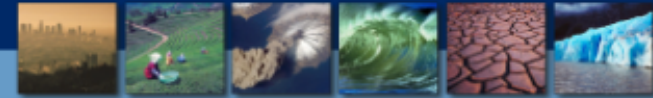


# What is the Mission of the OCR-VC ?



- ❖ The OCR-VC will provide long time series of calibrated ocean color radiance (OCR) at key wavelength bands from measurements obtained from multiple satellites.
- ❖ OCR-VC activities will include calibration, validation, merging of satellite and *in situ* data, product generation, as well as development and demonstrations of new and improved applications.
- ❖ NASA's *SIMBIOS*, ESA's *GlobColour*, POGO-GEO-GOOS's *ChloroGIN* and CSA/GEO *SAFARI* projects are examples and prototypes of programs the OCR-VC will require to meet its objectives.

# Baseline Minimum Requirements



**Table 1.** Major instrument parameters and characteristics of the SeaWiFS ocean color sensor.

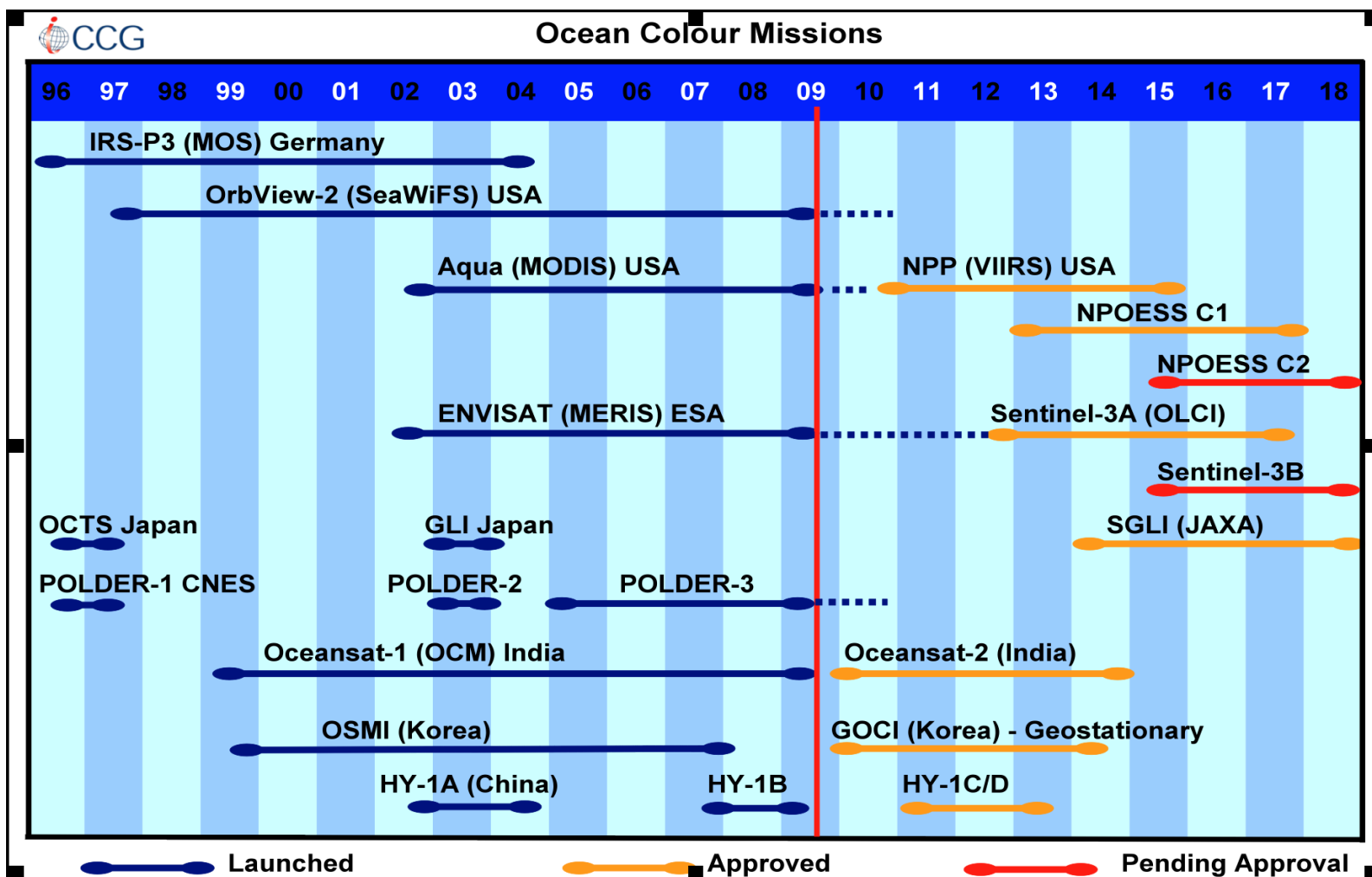
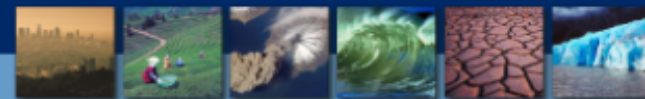
<i>Instrument Bands</i>				
Band	Wavelength FWHM [nm]	Saturation Radiance <sup>1</sup>	Input Radiance <sup>1</sup>	SNR <sup>2</sup>
1	402–422	13.63	9.10	499
2	433–453	13.25	8.41	674
3	480–500	10.50	6.56	667
4	500–520	9.08	5.64	640
5	545–565	7.44	4.57	596
6	660–680	4.20	2.46	442
7	745–785	3.00	1.61	455
8	845–885	2.13	1.09	467
<i>Sensor Accuracy</i>				
Radiance Accuracy: <5% absolute each band				
Relative Precision: <1% linearity				
Between Band Precision: <5% relative band-to-band (over 0.5–0.9 full scale)				
Polarization: <2% sensitivity (all angles)				
Nadir Resolution: 1.1 km LAC; 4.5 km GAC				
<i>Mission Characteristics</i>				
Orbit Type: Sun Synchronous at 705 km				
Equator Crossing: Noon ±20 min., descending				
Saturation Recovery: <10 samples				
MTF <sup>3</sup> : ≥0.3 at Nyquist				
Swath Width (at equator): 2,801 km LAC (±58.3°) 1,502 km GAC (±45.0°)				
Scan Plane Tilt: +20°, 0°, -20°				
Digitization: 10 bits				

1. Units of  $\text{mW cm}^{-2} \mu\text{m}^{-1} \text{sr}^{-1}$ .

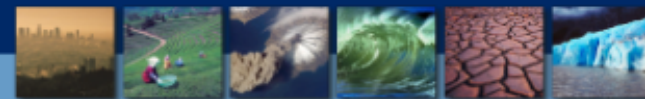
2. Minimum values measured at input radiances.

3. Modulation Transfer Function.

- SeaWiFS radiometric specifications are a good baseline for minimum specifications for an OCR instrument in the OCR-VC.
- The preferred Equatorial crossing time is local noon but crossing times ranging from 1030 to 1330 are acceptable.
- Both ascending and descending sun-synchronous orbits are acceptable.
- The ability for a sensor to tilt so that it can observe the ocean looking away from the sun, and thus minimize sun glint, is preferred but nadir-viewing instruments are acceptable.

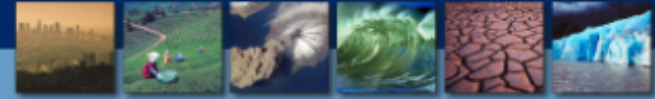


# Two Phases of Implementation Plan



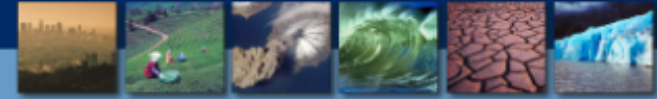
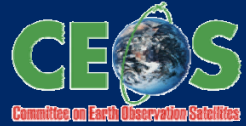
- ❖ **Phase 1: 2008 through the launch of Sentinel-3 (late 2012) –document submitted to SIT**
- ❖ **Phase 2: Post-launch Sentinel 3 also including VIIRS on NPOESS, GCOM-3 and overlap with sensors still operating from Phase 1 (e.g. OCM-2)**

# Timeline for preparation of document



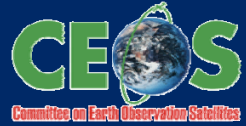
- ❖ Preparation of draft version before IOCCG meeting April 2009
- ❖ Presentation and feedback received from Agencies representative to the IOCCG
- ❖ Revised version prepared delivered to SIT 10<sup>th</sup> August 2009
- ❖ Some recent development not included in submitted document, e.g. results from prioritisation exercise of ESA CCI

# Objective 1: Ensuring OCR continuity



- ❖ Activities to improve VIIRS (Bontempi, NASA and DiGiacomo, NOAA).
- ❖ GCOM-C Phase 1 development (Murakami, JAXA).
- ❖ OCM-2. Launch of ISRO's OCM-2 is anticipated for 2009. ISRO and other agencies have agreed to work together in broad areas of Cal/Val and OCM-2 data processing for Level-2 and Level-3 product generation. (Kumar, ISRO, Bontempi, NASA).
- ❖ Pre-launch activities for Sentinel-3 (Regner, ESA).

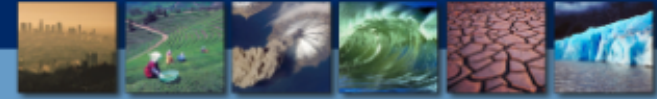
## Objective 2: Provide high quality data sets



- ❖ **Continue support for MOBY (bio-optical buoy) (Digiaco, NOAA).**
- ❖ **Continue interaction between NASA and ESA related to MERIS calibration and characterization and extend to Sentinel-3 (Bontempi, NASA and Regner, ESA).**
- ❖ **Support ChloroGIN - (Dowell and Hoepffner, JRC).**

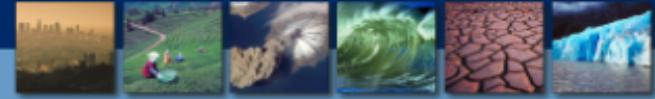


# Objective 3: Data Harmonization



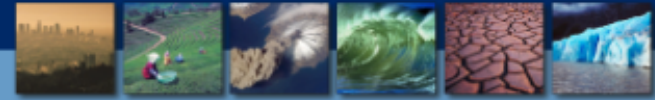
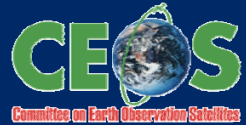
- ❖ Collaboration for a multiple sensor comparison involving MERIS, SeaWiFS, MODIS-Aqua, and OCM-2 (Bontempi, NASA; Navulgund, ISRO; Regner, ESA).
- ❖ ESA's *GlobColour* project demonstrated the benefits of multiple sensor data merger working towards an ocean color Essential Climate Variable (ECV) for global products. ESA is currently planning *CoastColour* for several coastal study areas using MERIS 300-m data. (Regner, ESA)
- ❖ IOCCG Working Groups (WG) for bio-optical sensors on Geostationary platforms (WG Chairs plus Ahn, KORDI, Navalgund, ISRO).
- ❖ IOCCG WG for evaluating possibilities for bio-optical Sensors on ARGO floats (WG Chair: Claustre, Laboratoire d'Océanographie de Villefranche).

## Objective 4: Facilitate timely and easy access to data (user interface)



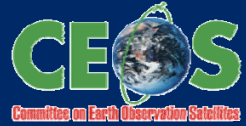
- ❖ **Societal Applications in the Fisheries and Aquaculture using Remotely-Sensed Imagery (SAFARI) to accelerate the assimilation of Earth observation data into fisheries research and ecosystem-based fisheries management on a world scale. (Crevier, CSA and Platt, IOCCG)**
- ❖ **Canadian Space Agency (CSA) has invested in the upgrade of the Canadian ground infrastructure at the Canada Centre for Remote Sensing (CCRS) for the reception and processing of full resolution (300-m) MERIS data (Crevier, CSA).**
- ❖ **Support GEO Coastal Zone Community of Practice-CZCP (DiGiacomo, NOAA and Dowell, JRC).**

# Objective 5: Capacity building and Outreach



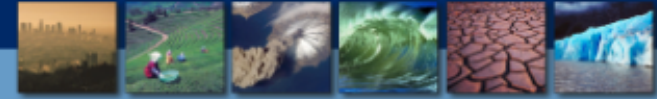
- ❖ **IOCCG and JRC capacity building activities in Africa and elsewhere.**
- ❖ **Present white paper describing the OCR-VC at the Oceanobs09 conference in Venice, September, 2009. See <http://www.oceanobs09.net/>**

# GEO and GCOS Requirements Addressed by the OCR-VC



- ❖ **Products derived from OCR are specified in the GEO 2007-2009 Work Plan, “Towards Convergence” (27 March 2008) under 4 societal benefit areas: climate, agriculture, water and ecosystems.**
- ❖ **The GEO 2009-2011 Work Plan endorses the OCR-VC as providing “scientific data products related to marine ecosystems and ocean biogeochemistry for near-surface global ocean and coastal waters.”**
- ❖ **GCOS lists “Ocean color, and oceanic chlorophyll-a concentration derived from ocean color” as an Essential Climate Variable (ECV) for “ climate [impacts] monitoring” as well as “carbon-cycling including between the ocean and the atmosphere; and ocean particulate carbon estimated from ocean color.”**

# OCR-VC in GEO SBAs



- ❖ **Coastal and Marine topics in GEO cover many different Societal Benefit Areas : Agriculture, Ecosystems, Climate, Water**
- ❖ **The Ocean Colour community is well represented in many of these**
- ❖ **There is need for better networking to avoid duplication of efforts and ensure OCR data is readily available**



# Coastal Zone Community of Practice

**Joint Research Centre**

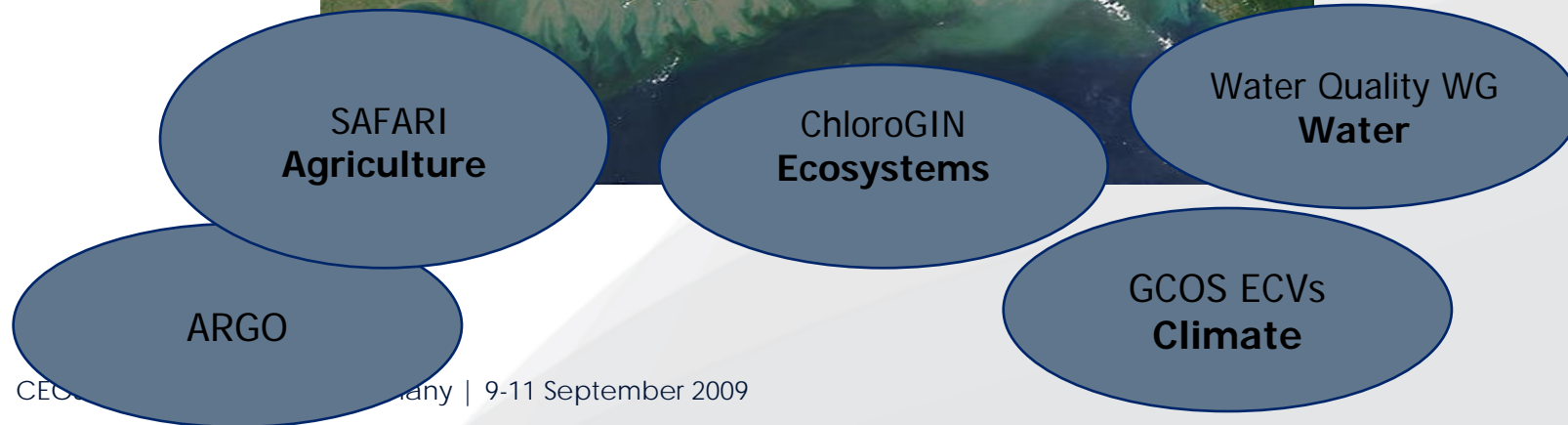
There is initial seed funding for various aspects from national agencies

At present no roadmap for sustained long-term funding

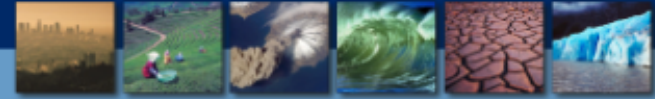


Matrix of OCR involvement (existing and potential) has been produced. Needs to be updated for 2009-2011 WP

CB within SBAs not only horizontal CB Task

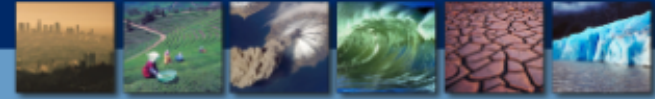


# Accomplished so far in 2009



- ❖ **OCR-VC white paper accepted for OceanObs'09**
- ❖ **JRC Inter-panel GCOS workshop on total biosphere net primary production**
- ❖ **“Inversion procedures in ocean colour remote sensing” training course Hamburg 10-14 August**
- ❖ **NASA & ESA OCR reprocessing ongoing**
- ❖ **In October: Training course “Methods and Applications of Ocean Colour RS in African Coastal and Regional Seas” Tanzania. CB-09-03b\_1**

# Leadership of the OCR-VC



- ❖ IOCCG membership includes representatives from space and other government agencies as well as representatives from scientific and operational user communities.
- ❖ The leadership group for the OCR-VC will come from implementing organizations; specifically those individuals from space and other government agencies serving on IOCCG.
- ❖ To date, the following IOCCG members have confirmed that their agency will participate in the OCR-VC: Yu-Hwan Ahn, (KORDI), Paula Bontempi (NASA), Paul M. DiGiacomo, (NOAA), Nicholas Hoepffner (JRC), Milton Kampel (INPE), Hiroshi Murakami (JAXA), Rangnath R. Navalgund (ISRO), Peter Regner (ESA-ESRIN), Eric Thouvenot (CNES) and others are likely. IOCCG Chair and Exec. Scientist are *ad hoc*.
- ❖ Initially 2 co-chairs from the leadership group JAXA's Hiroshi Murakami and EC/JRC's Mark Dowell will perform the coordinating function and are supported by the IOCCG Chair (currently James Yoder) and IOCCG Executive Scientist (Venetia Stuart) .