# Vcal requirements for operational services

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# Heritage Operational Paradigm

- There is a prevailing perception that operational satellite missions need only support near-real time (NRT) applications with NRT data, and that quality is not a primary driver for the data services
- With the emergence of Operational Oceanography this paradigm is increasingly outdated
- It does not fully meet the extent of actual operational user requirements
  - NRT applications (e.g. anomaly products are often needed which require long-term time series)
  - non-NRT applications
  - continuous data records (spanning NRT and non-NRT long-term time series)
- It can exclude some users (research-oriented users, non-NRT users, anomalies)
- It can preclude important activities from taking place (e.g. cal/val activities, reprocessings, orbital maneuvers)
- It can lead to data of sub-optimal quality and utility

# Evolving Operational Paradigm

- In the research *and* operations mode, operational missions must provide
  - routine and sustained data of the highest possible quality
  - support for operational applications and research
  - data on time-scales spanning from NRT to climate
  - services to the broad range of user needs and requirements
- Toward this goal, operational missions need to implement and maintain the necessary supporting infrastructure and scientific and technical activities

# Operational Ocean Colour

- Ocean colour data users, applications and products are very diverse
- Timescales for most applications are much longer than the standard NRT operational paradigm → distribute NRT data and consistent long-term measurement time series
- The quality of operational ocean colour data is of critical importance → ensure state of the art calibration and algorithms
- Data continuity and sustainability of product delivery need to be assured → secure long-term programmes

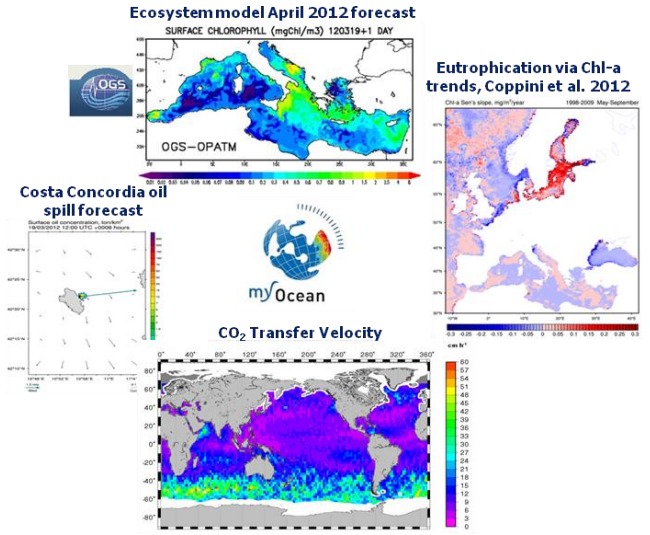
**Coupled ocean-atmosphere and coupled physical-biogeochemical modelling and NWP link**
air-sea heat fluxes – phytoplankton absorption, optical turbidity
air-sea $CO_2$ exchange – carbon flux, $CO_2$ sources, sinks and transport
ecosystem models

**Climate**

**Science**

**Marine environment monitoring**
detection and early warning of harmful algal blooms
impacts of natural disasters and human activities
sediment load and transport, water transparency
monitoring of oil spills
eutrophication

**Marine resource management**
fisheries management and research
sustainable aquaculture
tourism
water resource forecasting
water quality



# Criticality of Vicarious Calibration for Operational Ocean Colour Data Services

- Need to assure that vcal infrastructure will meet the requirements of marine services for decades to come
- The most critical investment in field measurements to assure service quality
- One of a kind investment
- Responsibility of EO programmes
- Requires sustainable resources
- Crucial expertise and experience available

**Vicarious calibration requirements**

**need to correspond to the requirements of the mission**

< 5% total system uncertainty on surface reflectances (instrument and algorithms)

- instrument uncertainties: SI-traceable
- algorithm uncertainties: environmental conditions which are the simplest to model, marine and atmospheric
- matchup uncertainties: low natural variability, spatial and temporal, marine and atmospheric

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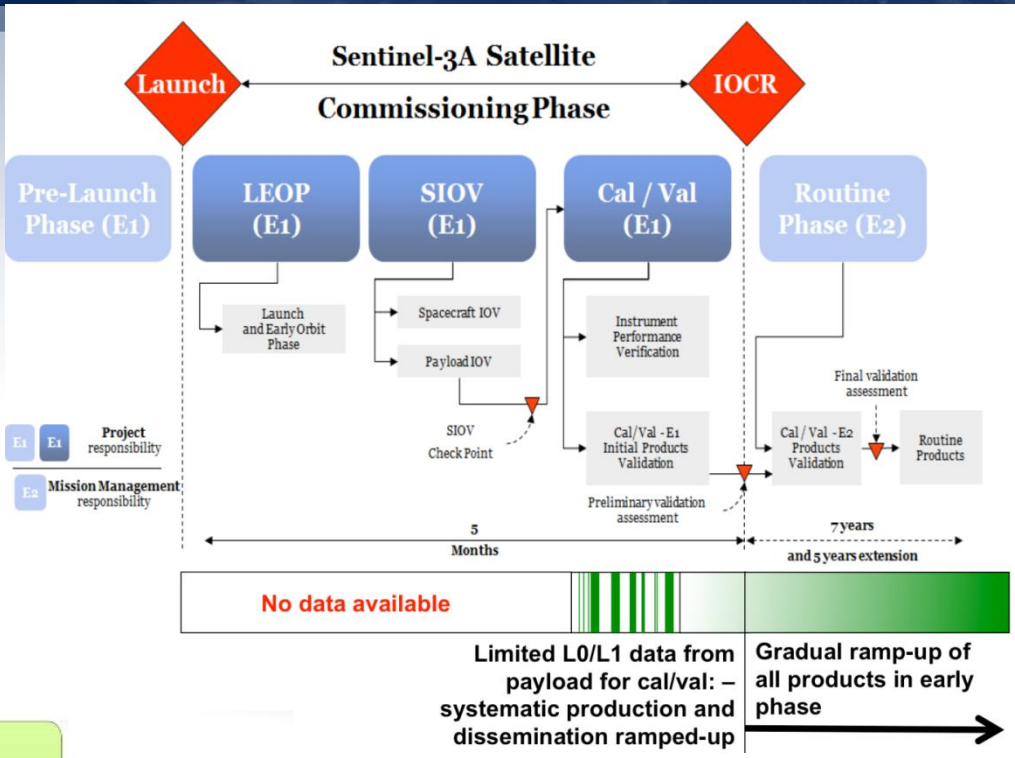
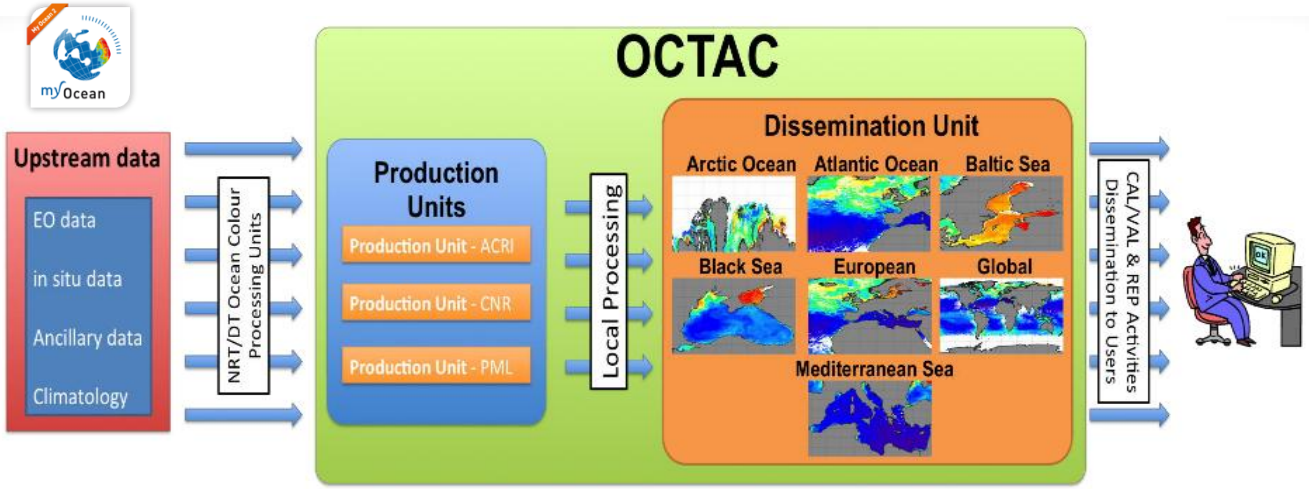
# Operational Constraints for Ocean Colour Services

- Additional critical considerations for operational missions:

1. Provision of quality ocean colour data early in the mission
2. Provision of quality ocean colour data at NRT (or in the short-term delayed mode)




**Operational services**
sustained long-term, routine and uninterrupted provision of quality ocean colour satellite data for a variety of diverse and evolving applications

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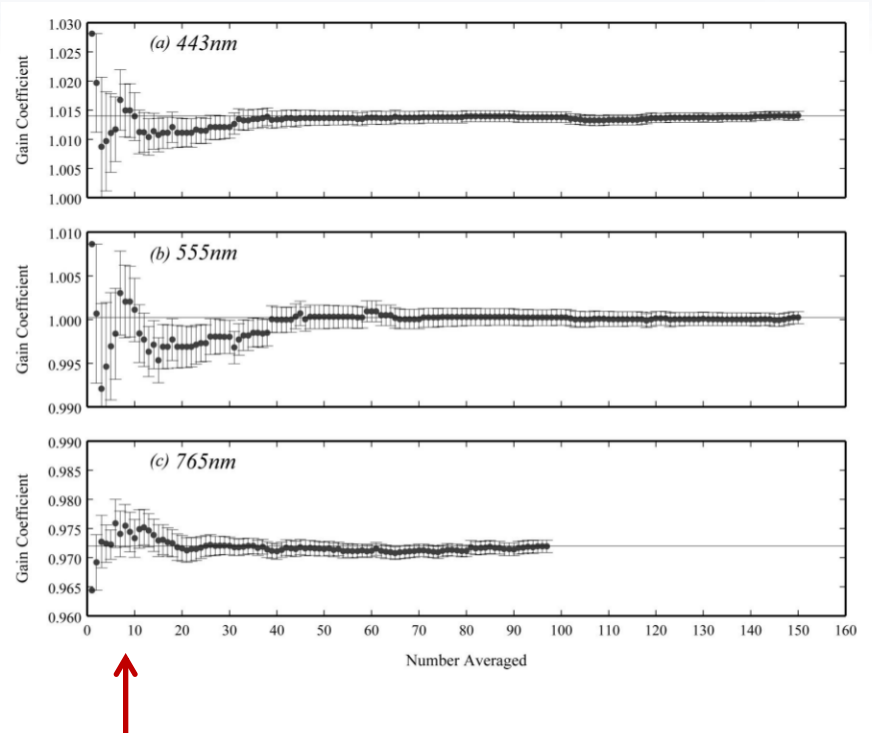
# Vicarious Calibration early in the mission

- Vicarious calibration gains require > 2 years to converge (MOBY only)
  - standard error of gains ~ 0.1%
- Knowledge of on-orbit instrument is not complete




**Beginning of operational phase of the S3 mission**

- Recommendations, vcal NIR and VIS
  1. Methodologies
  2. Sites
- NIR vcal proposals for early mission:
  - spectral slope, assume Angstrom
  - 4 or more sites, or more statistics from SPG
- VIS vcal proposals for early mission:
  - inter-calibration to climatologies or contemporary missions, bio-optical models
  - oligotrophic sites, NASA / CNES choices

# Vicarious Calibration in support of NRT services

- Emphasis on continuous instrument calibration and characterization efforts
  - pre-launch, throughout the mission lifetime, and beyond
  - continuous mission performance monitoring
  - instant response to instrument degradation
  - reprocessings (once a year – acceptable frequency for MyOcean)
  - IOCCG references: Report 13, INSITU-OCR White Paper
- Standardization of vicarious calibration