Applying Uncertainties to Ocean Colour Data

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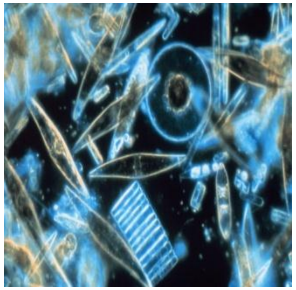
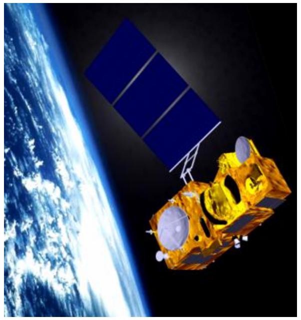
Sentinel-3 overview

- Sentinel-3: an operational mission for oceanography & global land applications; an element of the European Global Monitoring for Environment and Security (GMES) programme.
- Provides continuity of existing missions, delivering:
  - Sea/Land colour data (at least MERIS quality)
  - Sea/Land surface temperature (at least AATSR quality)
  - Sea surface topography data (at least Envisat RA quality)
- Applicable Sentinel-3 user requirements identified through surveys conducted within the relevant user groups:
  - Operational and Institutional Oceanography Groups
  - Oceanographic Research Users
  - Land Users
- A series of satellites, each designed for a lifetime of 7 years, shall provide an operational service over 15 to 20 years





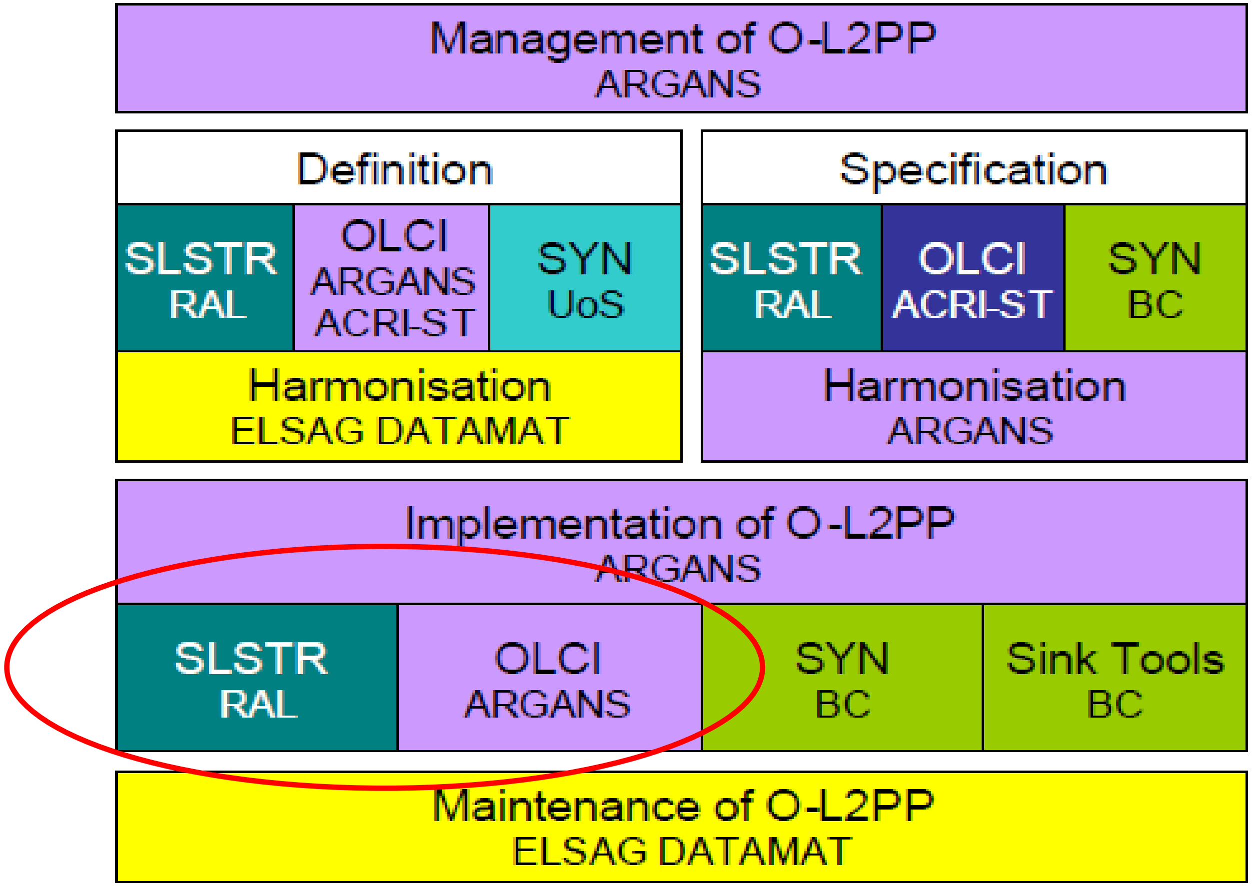
Sentinel-3 OLCI Ocean Colour requirements
Source, Mission Requirements Document

Table 5: Geophysical parameter and accuracies for Ocean Colour (under clear daytime conditions)

Parameter	**Range**	**Accuracy Case 1 water**	**Accuracy Case 2 water**
Marine Reflectance [at 442 nm]	0.001 – 0.04	5×10^{-4}	5×10^{-4}
Chlorophyll [mg/m^3]	0.001 - 150	threshold 30 % goal 20 %	threshold 70 % goal 30 %
Suspended matter [g/m^3]	0.0 - 100	threshold 30 % goal 20 %	threshold 70 % goal 30 %
Dissolved organic matter (a_{412} [m^{-1}])	0.01 - 2	threshold 50 % goal 20 %	threshold 70 % goal 30 %
Harmful Algae bloom [mg/m^3] (same req. as chlorphyll)	0.1 - 100	threshold 30 % goal 20 %	threshold 70 % goal 30 %

Sources: RD19, RD20 and references therein.

Project Management Structure



Has changed with ACRI taking the lead on OLCI (based on the MEGS MERIS heritage) and ARGANS undertaking SLSTR LST & FRP. Also ODESA will be the GUI interface for all the processors.

OLCI Level 2 processing – Algorithm Theoretical Baseline Documents (ATBDs)

- OLCI Pixel classification
- OLCI Gas corrections, instrumental corrections and confidence check
- OLCI Water vapour product
- OLCI White caps & glint correction
- OLCI Standard Atmospheric Correction (SAC) over clear and turbid (bright) waters
- OLCI Alternative AC (AAC) – use of a Neural Net to perform the atmospheric correction including a glint correction
- OLCI Ocean colour for clear and turbid waters plus transparency products
- OLCI PAR (Photosynthetically Active Radiation)
- OLCI FAPAR (Fraction of Absorbed PAR)
- OLCI OTCI (Terrestrial Chlorophyll Index)

Adopted ATBDs to be implemented over a longer timescale:

- OLCI ICOL - adjacency correction

OLCI & SLSTR Level 2 processing – Algorithm Theoretical Baseline Documents (ATBDs)

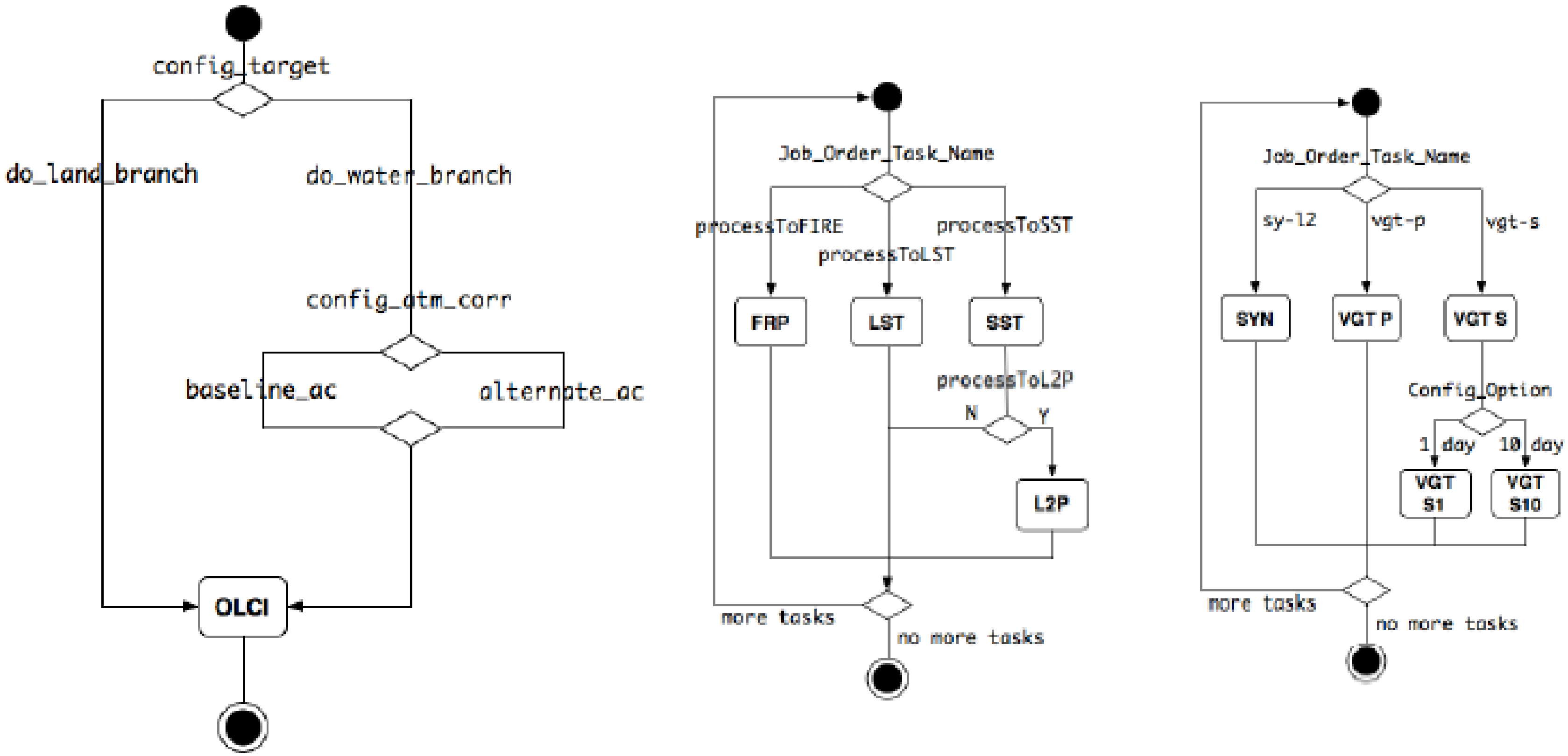
- SLSTR SST (Sea Surface Temperature) including GHRSST L2P product
- SLSTR LST (Land Surface Temperature)
- SLSTR FRP (Fire Radiative Power)

- OLCI & SLSTR combined VGT and SYN products

There are >20 ATBDs in total, which describe one or more algorithms including a methodology to determine a quality indicator i.e. error/uncertainty estimate.

As the science is at different levels of maturity the proposed algorithms and quality indicators span a range operational readiness e.g. L2P is already used by the operational community (GHRSST) whilst the SYN products have been the subject of a recently concluded ESA study.

Processing Branches



QA4EO guideline

- Requirement: need to assign to all data / information products a Quality Indicator (QI), which allows stakeholders to *unequivocally* evaluate the products' *suitability* for a particular application.
- Definition of QI: should be based on a quantitative assessment of its traceability to an agreed reference or measurement standard (ideally SI), but can be presented as numeric or a text descriptor, providing the quantitative linkage is defined.
- Inputs:
  - User/ Mission requirements
  - Historical knowledge of previous sensor performance
  - Reference standards and methods to enable traceability to be established

Example: Atmospheric Correction

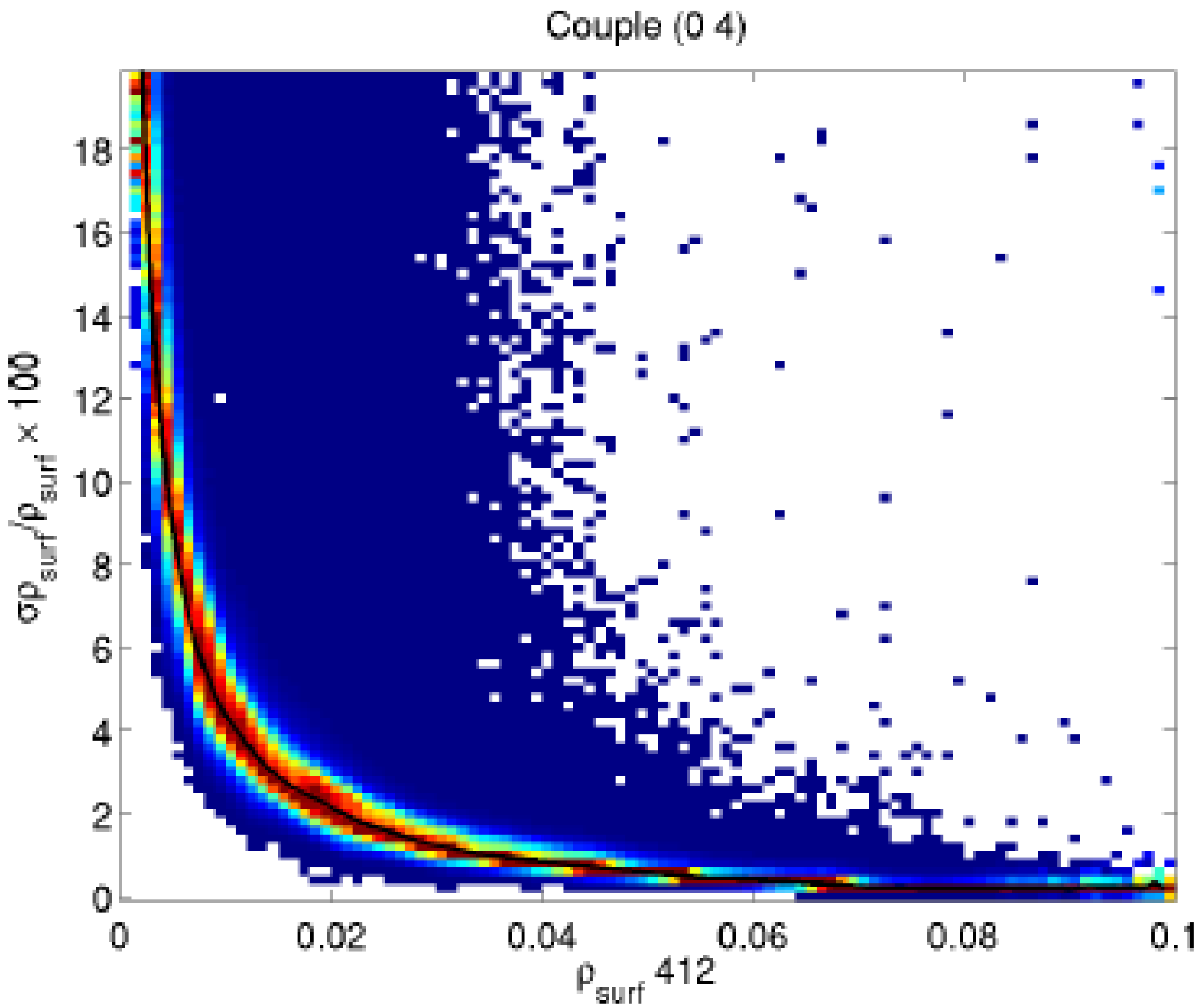
• Computation of output uncertainties from noise simulation is very time consuming in near-real time > the aim is to create Look-Up-Tables (LUTs)

• A preferred method is based on an equation linking the water-leaving reflectance to the atmospheric path (Rayleigh + aerosol) reflectances and transmission as it directly relates the error in the NIR to output reflectances at other wavelengths.

• The tabulation of the relationships between these quantities and the aerosol optical depth has been tested and show that water-leaving reflectance can accurately be determined by a comparison between computed and simulated uncertainties for a single bracketing pair of aerosol models (4,8).

• Further analysis and optimizations are currently being investigated to evaluate this method for all aerosol couples (thus all oceanic pixels).

Example: Atmospheric Correction



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Summary and Conclusions

- Determination of Quality Indicators is not easy, but is seen as a real benefit to the eventual users of the data. Therefore, they have been included where the science has matured sufficiently / a method has been proposed by the ATBD authors.
- Assumption that **Level 1** will derive uncertainties so that these can feed into Level 2, but uncertainties will also be needed for **auxiliary data** and the **modelling process (at each step)** itself.
- There should also be a consideration of variability at sub-pixel scales.

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