International Ocean Colour Science Meeting 2015 | Advancing Global Ocean Colour Observations

Breakout 3:

Understanding and Estimating Uncertainty in Ocean Colour Remote Sensing Data and Derived Products

Plenary Report

Co-Chairs

Part I – Kevin Turpie (UMBC), Emmanuel Boss (U. Maine),

Part II – Stéphane Maritorena (UCSB), Frédéric Melin (JRC ISPRA),

Part III – Jeremy Werdell (NASA GSFC)

San Francisco, California USA

16 June 2015

AGENDA

Part I: *Theory and overview*

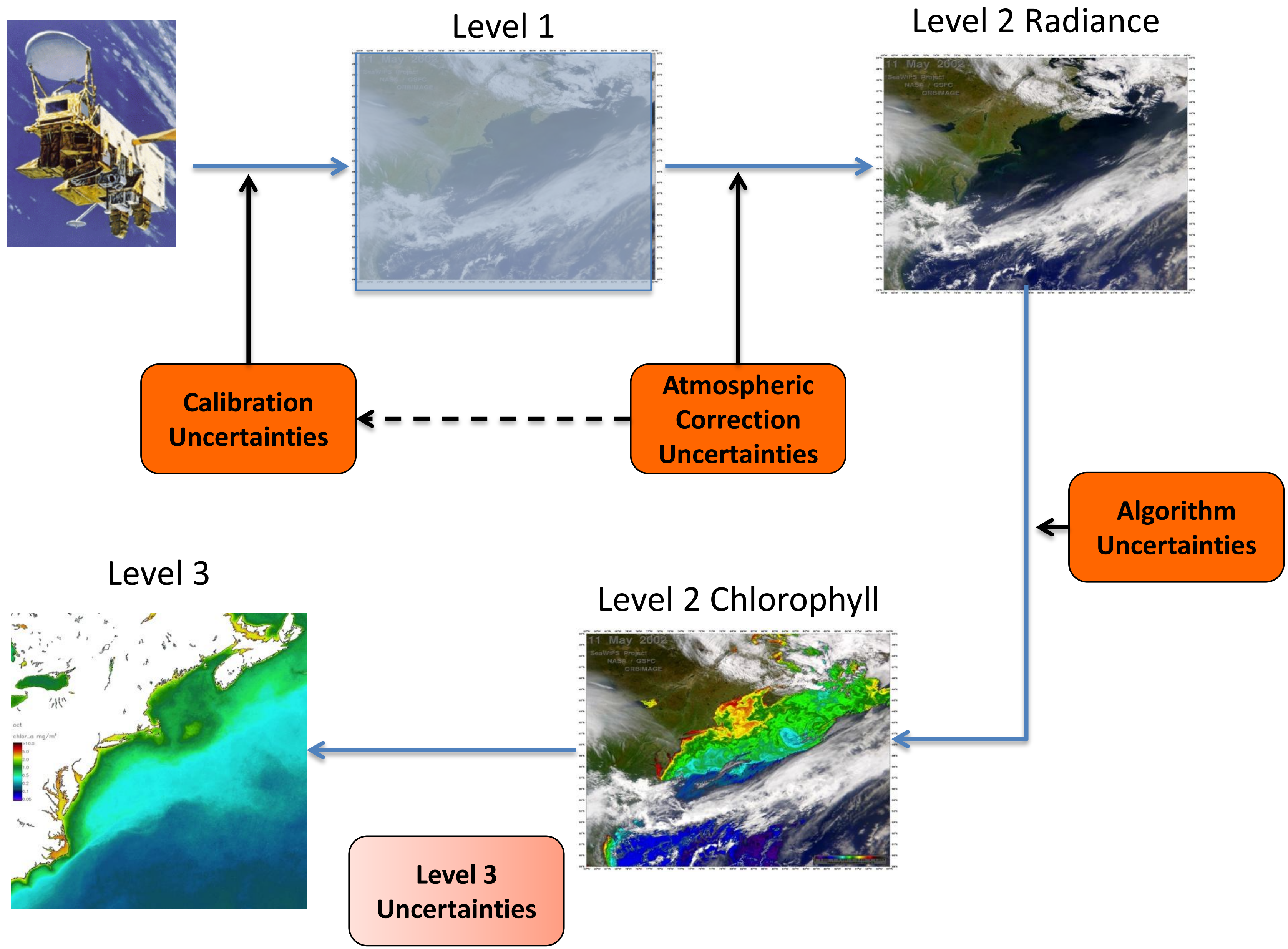
14:30-14:45	**Uncertainty definitions and theory** Kevin Turpie (UMBC)
14:45-14:50	**IOCCG/CEOS/GCOS context** Frédéric Mélin (JRC ISPRA)

Part II: *Surface reflectance uncertainty estimation methods*

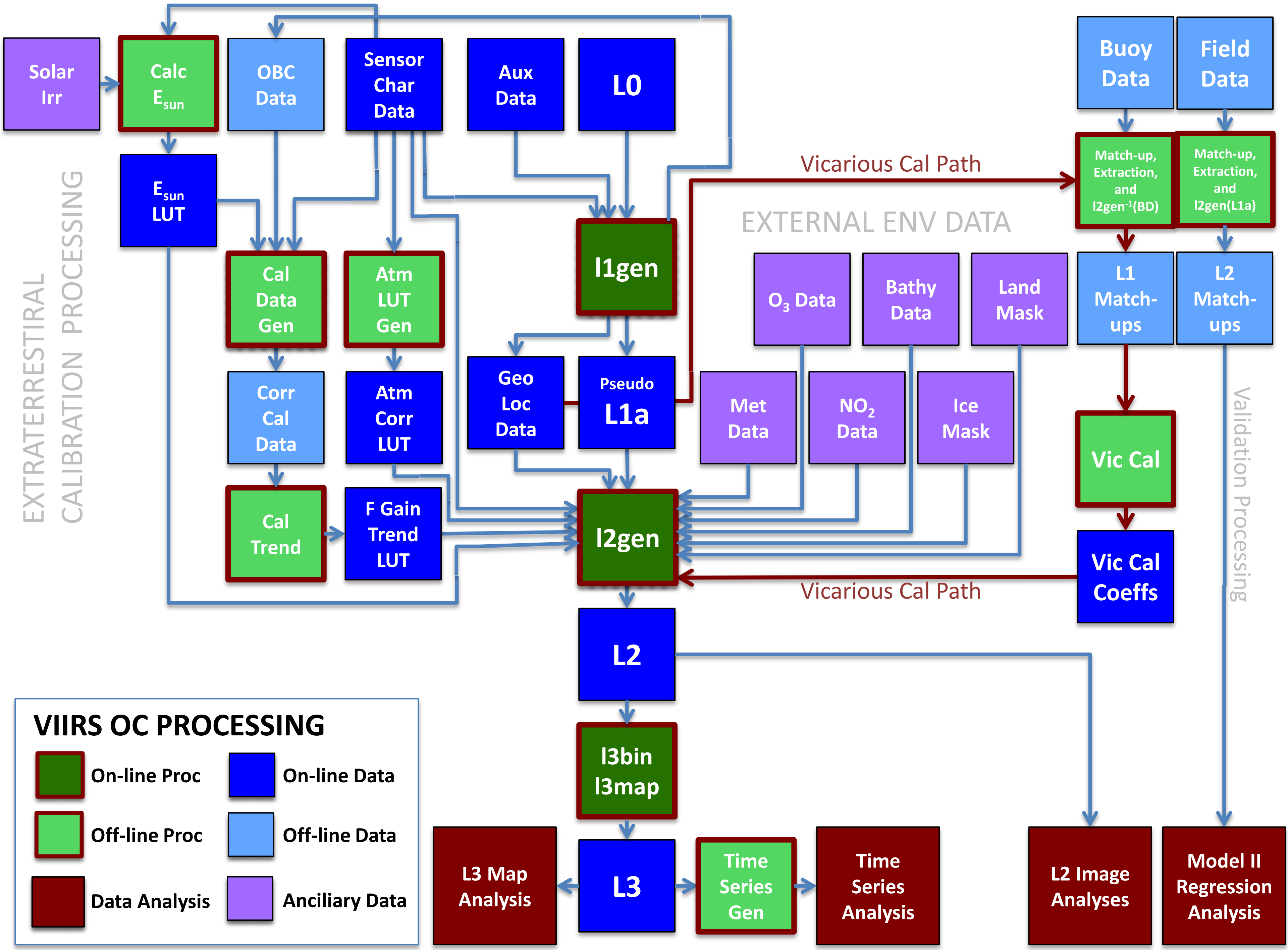
14:50-15:00	**Synthesis of published methods and collocation approach** Frédéric Mélin (JRC ISPRA)
15:00-15:10	**Uncertainties from the Bayesian method** Robert Frouin (UCSD)
15:10-15:20	**Uncertainty propagation** Philippe Goryl (ESA)
15:20-15:30	**Neural networks and Rrs uncertainty** Roland Doerffer (Helmholtz Zentrum Geesthacht)

Part III: *Derived product uncertainty methods*

15:30-15:40	**Status report on in situ uncertainties** Emmanuel Boss (U. Maine)
15:40-15:50	**Overview of methods for remotely-sensed IOP uncertainties** Suhyb Salama (U. Twente)
15:50-16:00	**Spatial, temporal, and content considerations for Level-3 uncertainties** Tim Moore (U. New Hampshire)
16:00-17:15	**Moderated Community Discussion**



Level 1
Level 2 Radiance
Calibration Uncertainties
Atmospheric Correction Uncertainties
Algorithm Uncertainties
Level 3
Level 2 Chlorophyll
Level 3 Uncertainties



Solar Irr
Calc E sun
OBC Data
Sensor Char Data
Aux Data
L0
Buoy Data
Field Data
E sun LUT
EXTRATERRESTIRAL CALIBRATION PROCESSING
Vicarious Cal Path
Match-up, Extraction, and l2gen-1(BD)
Match-up, Extraction, and l2gen(L1a)
EXTERNAL ENV DATA
l1gen
Cal Data Gen
Atm LUT Gen
O3 Data
Bathy Data
Land Mask
L1 Match-ups
L2 Match-ups
Geo Loc Data
Pseudo L1a
Corr Cal Data
Atm Corr LUT
Met Data
NO2 Data
Ice Mask
Vic Cal
Validation Processing
Cal Trend
F Gain Trend LUT
l2gen
Vic Cal Coeffs
Vicarious Cal Path
L2
VIIRS OC PROCESSING
On-line Proc
On-line Data
Off-line Proc
Off-line Data
Data Analysis
Anciliary Data
l3bin l3map
L3 Map Analysis
L3
Time Series Gen
Time Series Analysis
L2 Image Analyses
Model II Regression Analysis

Methods producing spatially-resolved uncertainty estimates for R_{RS}:

- **Class-based approach** — Moore et al. *RSE* 2009, 2015; Jackson et al., *in prep*
- **Bayesian methods** — Frouin & Pelletier *RSE* 2015
- **Uncertainty propagation** — ESA ATBD; Neukermans et al. *OE* 2009, *RSE* 2012
- **Algorithm-based method** — Hu et al. *RSE* 2013
- **Colocation approach** — Mélin, *IEEE GRSL*, 2010; Mélin & Franz 2014; Mélin et al. *RSE* submit

based on different assumptions,
covering different facets of the uncertainty budget

Take Aways

Matchups are not a measure of uncertainty for ocean. The sample is too small to account for all conditions under which satellite measurements are taken.

There is a wide range of activities in the community, but no clear, goal-oriented direction.

Need clearly defined language for uncertainty. Are GUM and VIM being used universally by the community?

There is some controversy regarding whether or not or how to report uncertainty based on systematic measurement errors.

Take Aways

Community is still in a mode of exploration, no consensus yet on methodology or metrics.

Space agencies would like to fully quantify uncertainty, but currently can only partially quantify uncertainty (limited resources → limited accounting of error sources and effects?).

Uncertainty products that users (modelers) want are not necessarily what space agencies require.

Upcoming OLCI and MERIS reprocessing will use an error propagation scheme (from TOA to surface reflectance). [Bourg and Goryl]

Take Aways

To first order, validation error can be view as a sum of contributing errors :
$\varepsilon_{val} = \varepsilon_{PME} + \varepsilon_{IME} + \varepsilon_{agg} + \varepsilon_{in} + \varepsilon_{s}$.

Need to leverage work done by existing fields (e.g., atmospheric sciences and closure studies).

Need more discussion regarding temporal and spatial variability in uncertainty.

Need additional exploration of propagating R_{rs} uncertainties into bio-optical algorithms.

Need additional exploration of propagating *in situ* measurement uncertainties into bio-optical algorithms.

Need additional exploration of propagating uncertainties from Level-2 to -3 files. What uncertainties should be produced? Do they mean what we think they mean?

Need more exploration of propagating uncertainties from L3 to regional and global time series.