Calibration and Validation for Ocean Color Remote Sensing
8 July – 2 August, 2013
Darling Marine Center, University of Maine, Walpole ME

Meals: breakfast – 0730; lunch – 1200; dinner – 1800; weekends will be posted
Class starts at 0800, except Saturday 13 July (start at 0900); also some days in weeks 3&4 (see below)
Most mornings will start with a student synthesis of data, findings, and questions from previous days lab (schedule is flexible)

Week 1 (Introduction + IOPs)

Day 1 (Mon) – July 8
Welcome to Maine and the Darling Center
Logistics and overview
Introductions
Lecture 1:   Light and Radiometry (CM)
Lecture 2:   Overview of light in water (CR)
Labs: Introductions, part II
                   Playing with Light (All)

Day 2 (Tue) – July 9
Lecture 3:   Absorption physics; overview of absorption spectra for water, CDOM,
                   NAP, phytoplankton, etc (CR)
Lecture 4:   Phytoplankton – pigments, photo-adaptation, and taxonomic
                   classification (MJP)
Labs: Absorption by dissolved material (ac-9 / ac-s and spectrophotometer);
                   Beer's Law in a tank

Day 3 (Wed) – July 10
Lab report: CDOM lab synthesis and summary
Lecture 5:   What is scattering and how is it measured (EB)
Lecture 6:   The VSF and Models for Scattering (CM)
Labs: Absorption by particulate material (ac-9 / ac-s and spectrophotometer)

Day 4 (Thu) – July 11
Lab report: Particulate absorption lab synthesis and summary
Lecture 7:   Beam attenuation (EB)
Lecture 8:   POC and other proxies-optical properties for phytoplankton and
                   community composition (MJP)
Labs: Scattering by particulate material (b and b_b)
After dinner data lab: walk through ac-9 calculations

Day 5 (Fri) – July 12
Lab report: Temperature corrections ac-9, ac-s
Lecture 9:   Inelastic scattering – Raman, $CaCO_3$ & other minerals, CDOM (KV)
Lecture 10:   Fluorescence by phytoplankton pigments (MJP)

Labs: Fluorescence of CDOM and chlorophyll

Day 6 (Sat) – July 13 (start at 0900)
Lab report: Scattering lab synthesis and summary
Synthesis of first week: critique process of learning, Q&A on any topic; tie up loose
               ends (staff)
Student U tube project (building on 2011 portfolio)
Chlorophyll fluorescence in-class exercise: without answers and with answers
Finish chlorophyll analyses from Friday lab
Bar-B-Que at DMC

Week 2 (Radiometric quantities and AOPs):

Day 1 (Mon) – July 15
Lab report: Fluorescence report
Lecture 11:   Introduction to AOPs (will cover R, Rrs, K's, mubars); BRDF and
                 Lambertian Surfaces (CM)
Lecture 12:   Radiometric quantities and their measurement (KV)
Labs: Radiometric measurements: in-water and above-water (KV)

Day 2 (Tue) – July 16
*Lab report: Synthesis and summary of radiometry field data and above-water
                reflectance from dock*
Lecture 13:   Link between particle properties (size, packaging, composition, shape,
                 internal structure) and IOPs (EB)
Lecture 14:   Polarization (KV)
Labs: Mie theory and modeling (EB)

Day 3 (Wed) – July 17
<mark>*Lab report*</mark>:   *Continued synthesis of radiometry lab*
Lecture 15:   The Radiative Transfer Equation; Introduction HydroLight (CM)
Lecture 16:   (1030) Barney Balch, Guest Lecture
Labs: HydroLight Lab 1: Guided Simulations (simple simulations) (CM)
                 Faculty planning meeting for Week III cruises

Day 4 (Thu) – July 18
<mark>*Lab report*</mark>:   *Brief report from HydroLight Lab 1*
                *Brief report on topics selected for Student Projects – individual or small
                group project*
Lecture 17:   Primary production; optical and remote sensing models (MJP)
Lecture 18:   Closure and HydroLight Advanced Features (CM)
Labs: HydroLight Lab 2: Guided Simulations (advanced simulations) (CM)

Day 5 (Fri) – Jul 19
Lab report: *Report from HydroLight Lab 1I*
Lecture 19:   Rrs inversion methods a: statistical methods to obtain [chl] and/or IOPs
              (ratio, Neural Network; CM)
Lecture 20:   Rrs inversion methods b: semi-analytical models to obtain IOPs (CR)
Labs: Semi analytical Rrs inversion lab (CR)
Dinner in Whitefield Maine at MJP's home; need to carpool

Week 3 (Field measurements and models)

Day 1 (Mon) – July 22
Group A – R/V Ira C (RZ, EB, KV)
Group B – SeaDAS in lab (JW)

Day 2 (Tues) – July 23
Lecture 21:   Uncertainty analysis and propagation of error (EB)
Lecture 22:   Introduction to ocean color satellite remote sensing; basic atmospheric
              corrections for remote sensing; black pixel assumption and adjacency
              effect (JW)
Labs: Analysis of Monday cruise data
              Work on student projects

Day 3 (Wed) – July 24
Group B – R/V Ira C (RZ, EB, CM)
Group A – SeaDAS in lab (JW)

Day 4 (Thur) – July 25
Lab reports: *Preliminary reports on analysis of radiometry and IOPs*
Lecture 23:   *In situ* data satellite - QA/QC requirements, vicarious calibration, optical
              weighting for validation and algorithm development, how data are used
              in satellite processing system (JW)
Lecture 24:   Estimating uncertainties of inversion products. Effect of non-elastic
              scattering on Rrs. (EB)
Labs: Group B – Analysis of radiometry (KV/JW)
              Group A – Analysis of IOPs (RZ)

Day 5 (Fri) – July 26
(breakfast at 0815)
9:00am: Arduino board lab
10:30am: *Updates on Student Projects*
              Updates on analysis of radiometry and IOPs
Labs: Continued data analysis of radiometry and IOPs
              Exploration of optical phenomena (instructors)
              Ken Voss f/Q chalk talk
Lobster dinner – leave at 4:40 PM and carpool and caravan to lobster wharf

Week 4 (Synthesis)

Day 1 (Mon) – July 29
Lab reports: *Updates on analysis of radiometry and IOPs*
Lecture 25: PFT and PSD inversions from Rrs (JW)
Lecture 26: Design of field campaigns and other sampling strategies (traditional ship,
            moorings, in-line, autonomous vehicles and drifting platforms), including
            calibration and cross calibration (MJP & EB)
Labs: Instrumental closure using cruise data (working in small groups with
            instructors)

Day 2 (Tues) – July 30
Lab report: *Field data and closure*
Lecture 27: Monte Carlo (CM) (moved to after lunch)
Lecture 28: Sources of variability in mass-specific attenuation coefficients (Paul Hill)
Labs: Data processing, submission to SeaBASS, portfolios (videos, etc.), etc.

Day 3 (Wed) – July 31
Start at 0900 (breakfast at 0815)
Lecture 29: QA/QC (Steve Ackleson)
Labs: Data processing, submission to SeaBASS, portfolios (videos, etc.), etc.

Day 4 (Thur) – August 1
Start at 0900 (breakfast at 0815)
Lecture 30: Rrs inversion methods for shallow-water remote sensing (spectrum
            matching methods of Lee, Mobley, and others; CM)
Labs: Data processing, submission to SeaBASS, portfolios (videos, etc.), etc.

Day 5 (Fri) – August 2
Start at 0900 (breakfast at 0815)
            Presentations

Day 6 (Sat) – August 3
            Clean and vacate room by 10:00am; other directions from Ali