Approaches to Ocean Color Studies using SeaDAS

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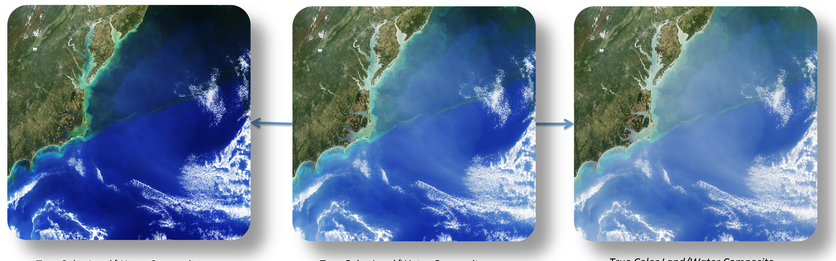
This Poster illustrates some of the capabilities of SeaDAS for ocean color satellite data image visualization and analysis. Though specific in nature, the approaches, images and results presented here contain concepts which are readily adaptable by the user to their own specific applications. SeaDAS is NASA's ocean color specific extension to ESA's BEAM software, (and in the future the Sentinel Toolbox).



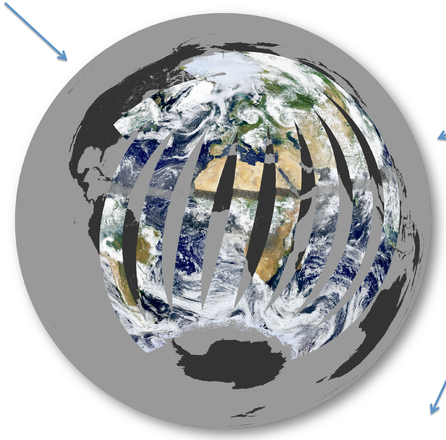
True Color Land/Water Composite
Highlights high reflectance water
Water: atan (ρ_{off}=0.03 , ρ_m=60)
Land: atan (ρ_{off}=0.05 , ρ_m=20)
(same scene as image to right)

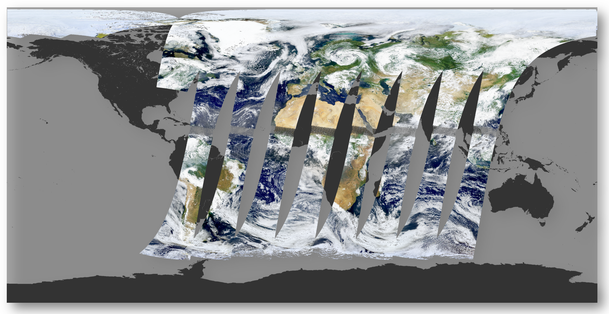
True Color Land/Water Composite
Highlights standard reflectance water
Water: atan (ρ_{off}=0.015 , ρ_m=60)
Land: atan (ρ_{off}=0.05 , ρ_m=20)
MODIS Aqua scene (A2010283180500.L1A_LAC)

True Color Land/Water Composite
Highlights low reflectance water
Water: atan (ρ_{off}=0.003 , ρ_m=60)
Land: atan (ρ_{off}=0.05 , ρ_m=20)
(same scene as image to left)

Map Projections & Multi-File Mosaic

Multiple level-2 files may be stitched together into a single file which retains all coincident bands (products). A variety of map projections are available.





True color Lambert azimuthal equal area map projection (above) and Geographic Lat/Lon (WGS 84) projection (below) of the SeaWiFS July 30 2004 GAC recorder downlink (orbits #37231 - #37239)

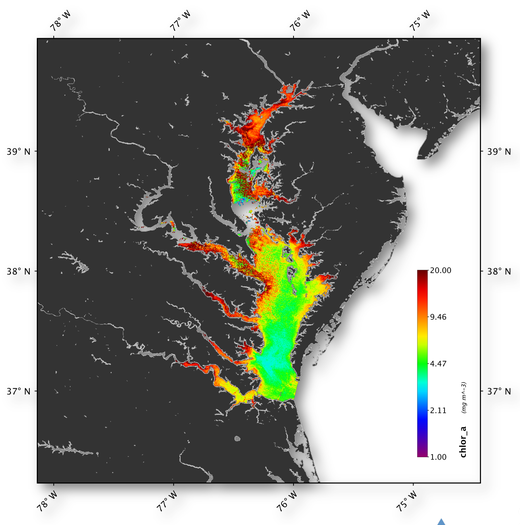
Land, Water, Cloud True Color Composite

SeaDAS can create true color images using a range of algorithm/ coefficients based on whether pixels are land, water or cloud. Having different options for different groups allows features to be delineated that would otherwise be obscured due to the dynamic ranges of reflectances.

Two useful algorithm forms:
$f(x) = log10(\rho/\rho_{min}) / log10(\rho_{max}/\rho_{min})$
$f(x) = A\ atan(\rho_m\ (\rho - \rho_{off})) + B$

Ocean Color, True Color Composite

Visual images can be a composite of any ocean color product(s) and a true color image.



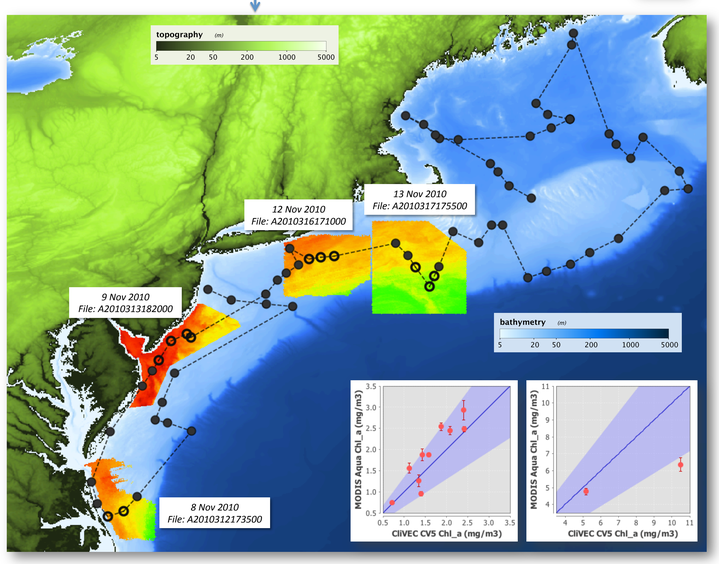
Chlorophyll in Chesapeake Bay (masked with a polygon geometry)
MERIS scene 9 Oct 2010 15:31 UTC (M2010282153101.L2_FRS_OC)

True Color Composite
Antarctica: atan (ρ_{off}=0.015, ρ_m=1.5)
Land (no cloud): atan (ρ_{off}=0.015, ρ_m=10)
Remainder: log (min=.01, max=1.0)
SeaWIFS GAC scene 11 Dec 2010
(S2010345050519.L1A_GAC)

Chlor_a true color composite of a SeaWiFS scene
atan (ρ_{off}=0.05 , ρ_m=20)
Ocean color product Chlor_a overlay on water
9 Oct 2010 19:41 UTC (S2010282194101.L1A_MLAC)

Integration Of Field Measurements

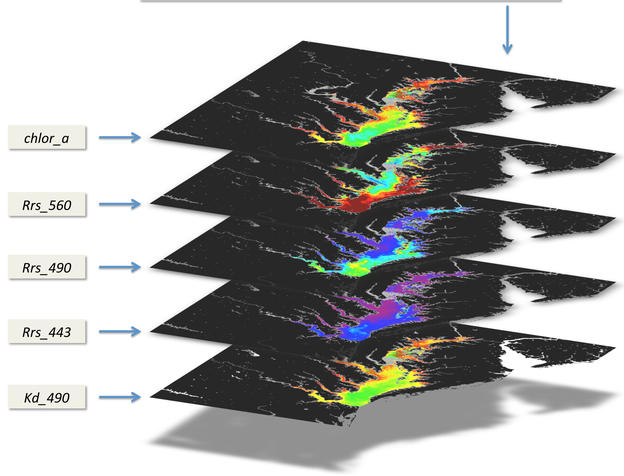
SeaBASS field measurement files can be directly loaded into SeaDAS. This enables a visual display of the ship's geographical journey across a satellite derived image, as well as a correlation analysis between any relevant satellite products and their respective field measurements.



Measurements of HPLC derived chlorophyll a (Chlor_a) from the CIiVEC CV5 cruise were used with MODIS Aqua (MODISA) Chlor_a. Circles denote field measurement stations, clear circles where there were successful matchups with satellite data based on criteria from Bailey and Werdell (2006). Data from different MODISA level-2 files (R2013.1) were trimmed and displayed only near valid matchups from the same day. MODISA values (5x5 pixel means) and field measurements are displayed in correlation plots. The purple shaded background denotes 35% correlation.

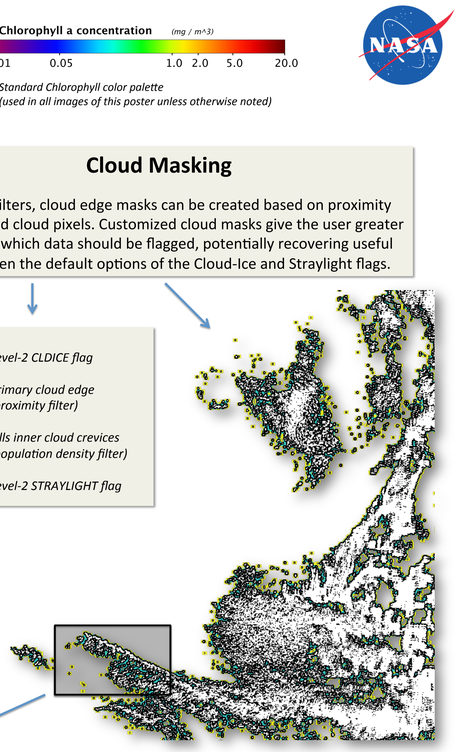
Regional Polygon & Land Masking

Geometric polygons can be used to mask regions. These geometries can be exported and imported for use in other satellite data files. Land masks can be created for any geo-located file.



Layers of products for Chesapeake Bay (masked with a polygon geometry)
MERIS scene 9 Oct 2010 15:31 UTC (M2010282153101.L2_FRS_OC)

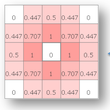
SeaDAS Developers: Aynur Abdurazik, Sean Bailey, Matthew Elliott, Daniel Knowles Jr., Donald Shea
BEAM Developer: Brockmann Consult (ESA)



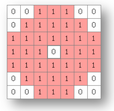
Standard Chlorophyll color palette
(used in all images of this poster unless otherwise noted)

Cloud Masking

Using band filters, cloud edge masks can be created based on proximity to established cloud pixels. Customized cloud masks give the user greater control over which data should be flagged, potentially recovering useful pixels between the default options of the Cloud-Ice and Straylight flags.

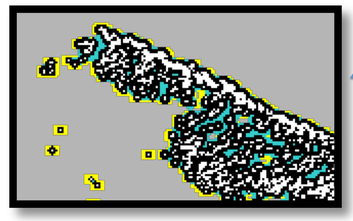


Proximity Filter



Population Density Filter

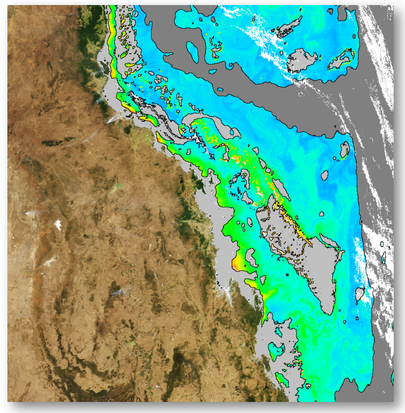
Level-2 CLDICE flag
Primary cloud edge (proximity filter)
Fills inner cloud crevices (population density filter)
Level-2 STRAYLIGHT flag



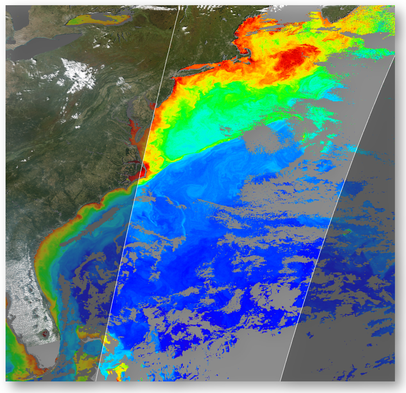
A cloud mask created for MODIS Aqua scene
(true color images of this scene in top center of poster)
10 Oct 2010 18:05 UTC (A2010283180500.L1A_LAC)

Bathymetry Depth & Ocean Floor Masking

SeaDAS integrates bathymetry data which can be used for masking.



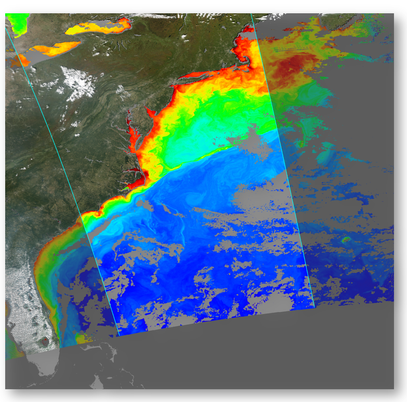
MODIS Aqua Chlor_a scene of the Great Barrier Reef
Ocean floor (light gray): inverse of Kd_490 exceeds bathymetry depth
Deep water (dark gray): bathymetry depth exceeds 1000 meters
9 August 2011 03:55 UTC (A2011221035500.L1A_LAC)



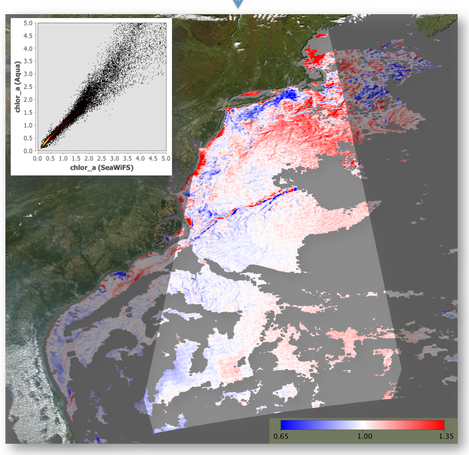
SeaWiFS Chlor_a
10 Oct 2010 19:11 UTC (S2010283191130.L1A_MLAC)
Swath highlighted where zenith angle is constrained to 40°
True color land from MODIS Aqua scene (below)

Cross-Satellite Comparisons

Visual and statistical analysis may be made comparing data from multiple satellite observations.



MODIS Aqua Chlor_a
10 Oct 2010 18:05 UTC (A2010283180500.L1A_LAC)
Swath highlighted where zenith angle is constrained to 40°



Chlorophyll comparison ratio (MODIS Aqua chlor_a / SeaWiFS chlor_a)
Analysis constrained to 40° zenith angle for each sensor
Uses 5x5 pixel mean with slight geo-coding correction
True color land from MODIS Aqua scene (left)

SeaDAS was used to create the images in this poster, as well as to run the OCSSW (Ocean Color Science Software) processing. For more information on the latest versions of SeaDAS, tutorials, downloads, and further documentation relevant to the techniques used in this poster visit the SeaDAS Website:

http://seadas.gsfc.nasa.gov