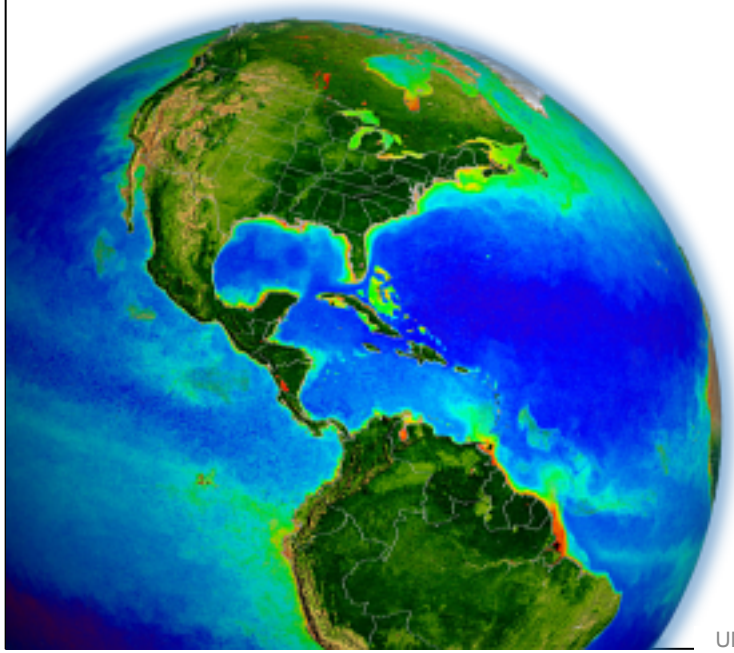
SeaDAS lab



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NASA Goddard Space Flight Center

UMaine Ocean Optics Summer Course
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Acknowledgements: Aynur Abdurazik, Sean Bailey, Matt Elliot, Danny Knowles, & Don Shea

by the end of this lab, I hope you will …

understand the organization & flow of satellite ocean color data

be comfortable with SeaDAS & without fear of breaking it

what is SeaDAS?

SeaWiFS Data Analysis System (SeaDAS)

http://seadas.gsfc.nasa.gov

http://oceancolor.gsfc.nasa.gov

image analysis package for processing, displaying, analyzing, & QC'ing satellite ocean color data

available for use with all NASA Ocean Biology Processing Group (OBPG) supported sensors: MODIS-Aqua & -Terra, SeaWiFS, OCTS,& CZCS, plus VIIRS, MERIS, HICO, etc.

general scientific imagery & data analysis package

why SeaDAS?

conceived of to fill a need in the post-CZCS, pre-SeaWiFS era when common tools did not exist to:

- display satellite ocean color data
- reproduce (& refine) the operational NASA products

still uncommon for agencies to distribute source code to replicate operational satellite data processing

SeaDAS development timeline

conceived of in the mid-1990's, referred to as "SeaPAK"

renamed "SeaDAS" circa the launch of SeaWiFS in 1997

stimulated development of the ESA BEAM software package to visualize ENVISAT (MERIS) data products circa 2002

awarded NASA Software of the Year in 2003

built on an IDL (Interactive Data Language) infrastructure through June 2012 (version 6.4)

recast as an integrated tool with the ESA BEAM software package in Spring 2013 (version 7)

SeaDAS 7

collaboration with BEAM (Brockmann Consult, Germany)

- look & feel of BEAM
- functionality & processing capabilities of SeaDAS 6.4

officially released in April 2013

this is the first training event!

we will break something at some point today – this is ok

lab organization

morning lecture: introduction & bookkeeping

afternoon lecture: satellite data processing

instructor-led demonstrations on:

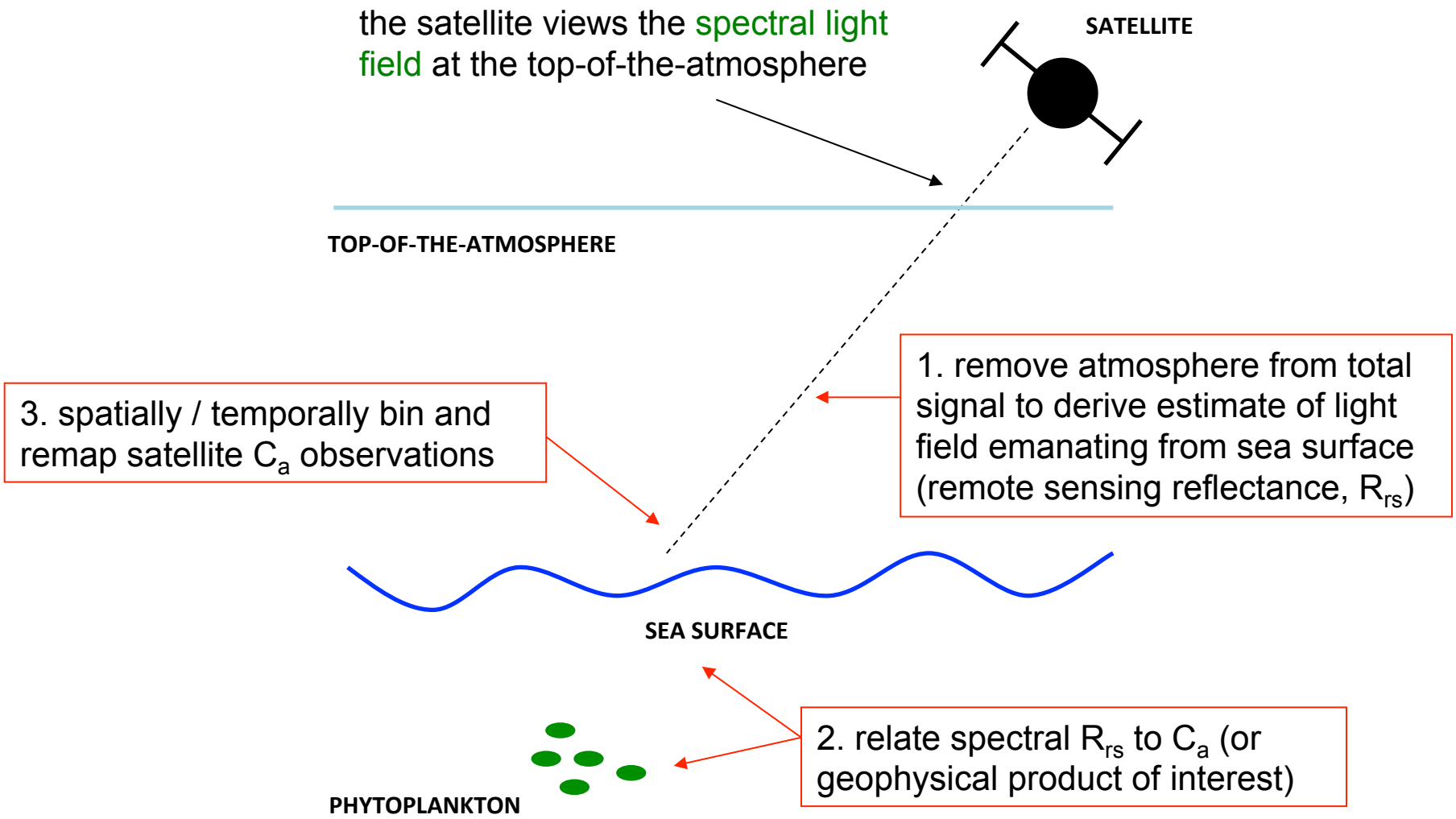
- the SeaDAS environment & visualizing data
- flags & masks
- data analysis tools
- satellite data processing
- comparing satellite & *in situ* measurements

student exercises following each demonstration

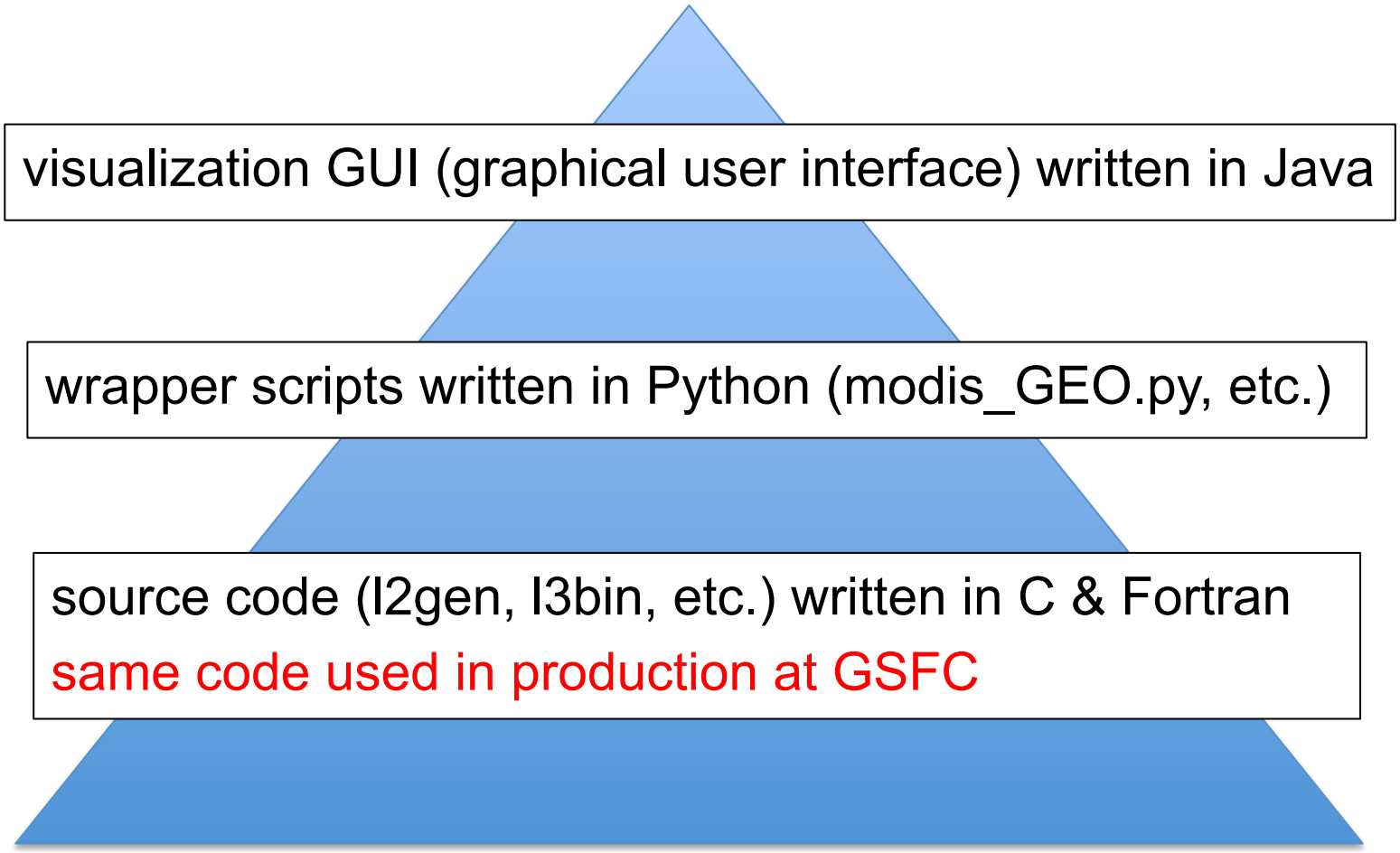
has anyone used SeaDAS 6 or 7 before?

what would you like to learn to do in SeaDAS 7?

satellite ocean color



SeaDAS infrastructure



requirements

SeaDAS 7.0 is currently available for Linux, Mac OS X, and Windows. The Windows version currently does not support the science data processing code. The SeaDAS source code is publicly available.

Suggested Hardware Requirements:

Platforms:	Linux Intel Mac OS X
Memory:	256MB minimum, 1GB+ suggested
Disk:	SeaDAS software package (display only version): ~200MB SeaDAS software package (with processing capabilities for all sensors): ~5B 10GB of free space is also suggested for rudimentary data processing and storage.
Display:	15" Console or X-terminal with 20MB memory 1280x1024 resolution 24-bit X display plane depth 256 colors display minimum

Requirements:

The core visualization package of SeaDAS 7 is written in Java. A minimum Java JRE of version 1.6 is required. A suitable JRE is packaged with the Windows distributions. The MacOSX distribution relies on the Apple delivered Java

Operating Systems:	**Linux:** tested on various versions of CentOS, Fedora, and Ubuntu **Intel Mac:** OS X 10.7 and 10.8
Optional Compilers:	gcc/g++/gfortran (version 4.5 or higher) or Intel Compilers

Program	***Version***	***Notes***
Java	JRE 1.6 or above	Windows distributions comes with a suitable JRE; MacOSX uses the Apple default JRE
Bash	4.x	version 3.x should work, but not tested necessary only for science code, thus not required for Windows distributions
Python	2.6.5 or above	necessary only for science code, thus not required for Windows distributions; not (yet) compatible with version 3 and above
Git	1.7.x or above	necessary only for science code install/update option, thus not required for Windows distributions
cURL	7.x or above	necessary only for science code install/update option, thus not required for Windows distributions

satellite ocean color file formats

HDF & netCDF

http://www.hdfgroup.org/

http://www.unidata.ucar.edu/software/netcdf/

self-describing & machine independent file structure

layers of array-oriented data proceeded by global attributes that describe the data & provide metadata

SeaDAS resources

SeaDAS Web site – online help & instructions
http://seadas.gsfc.nasa.gov

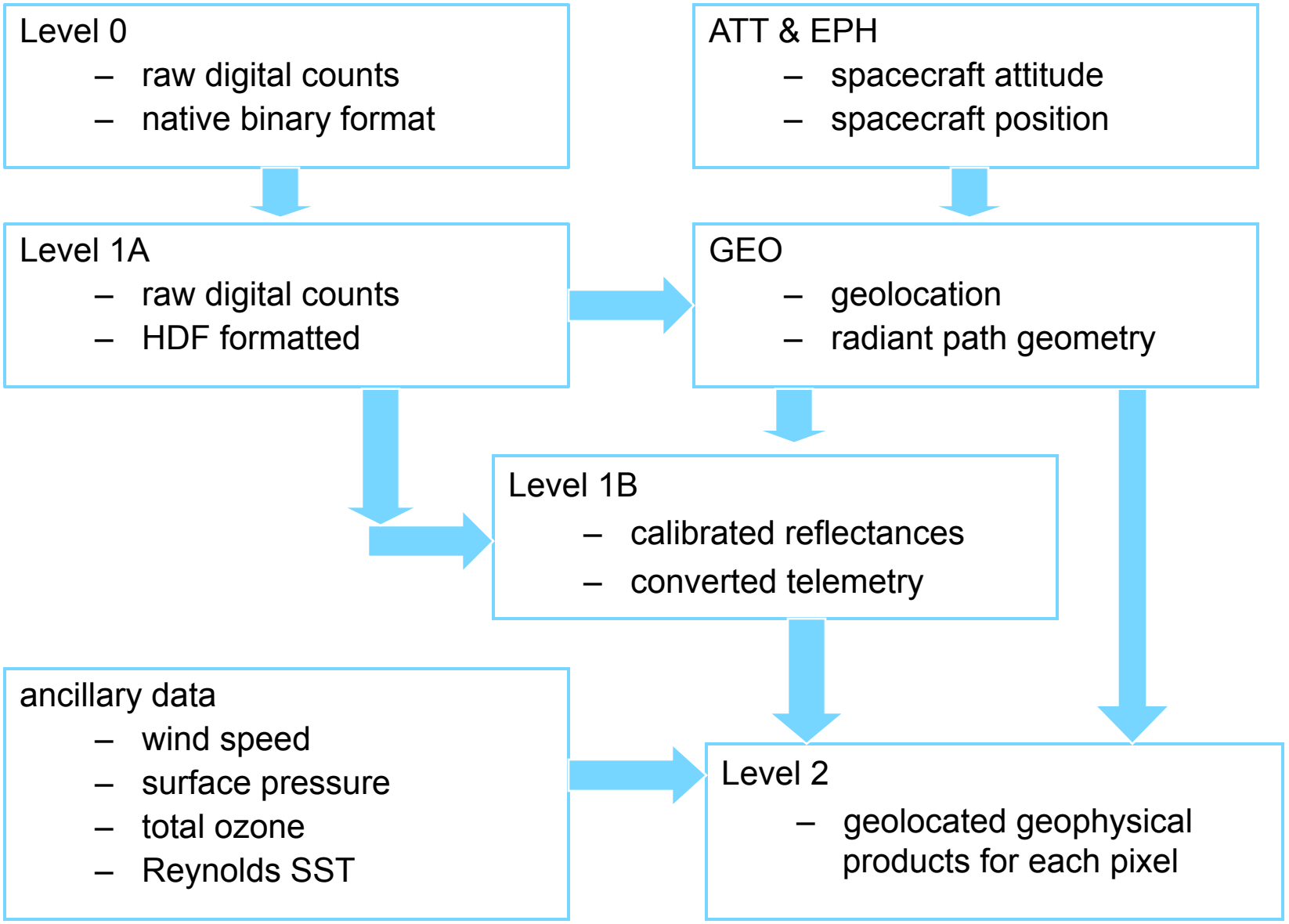
OceanColor online forum – SeaDAS-specific boards
http://oceancolor.gsfc.nasa.gov/forum/oceancolor/forum_show.pl

SeaDAS 7 interactive help (buttons within the GUI)

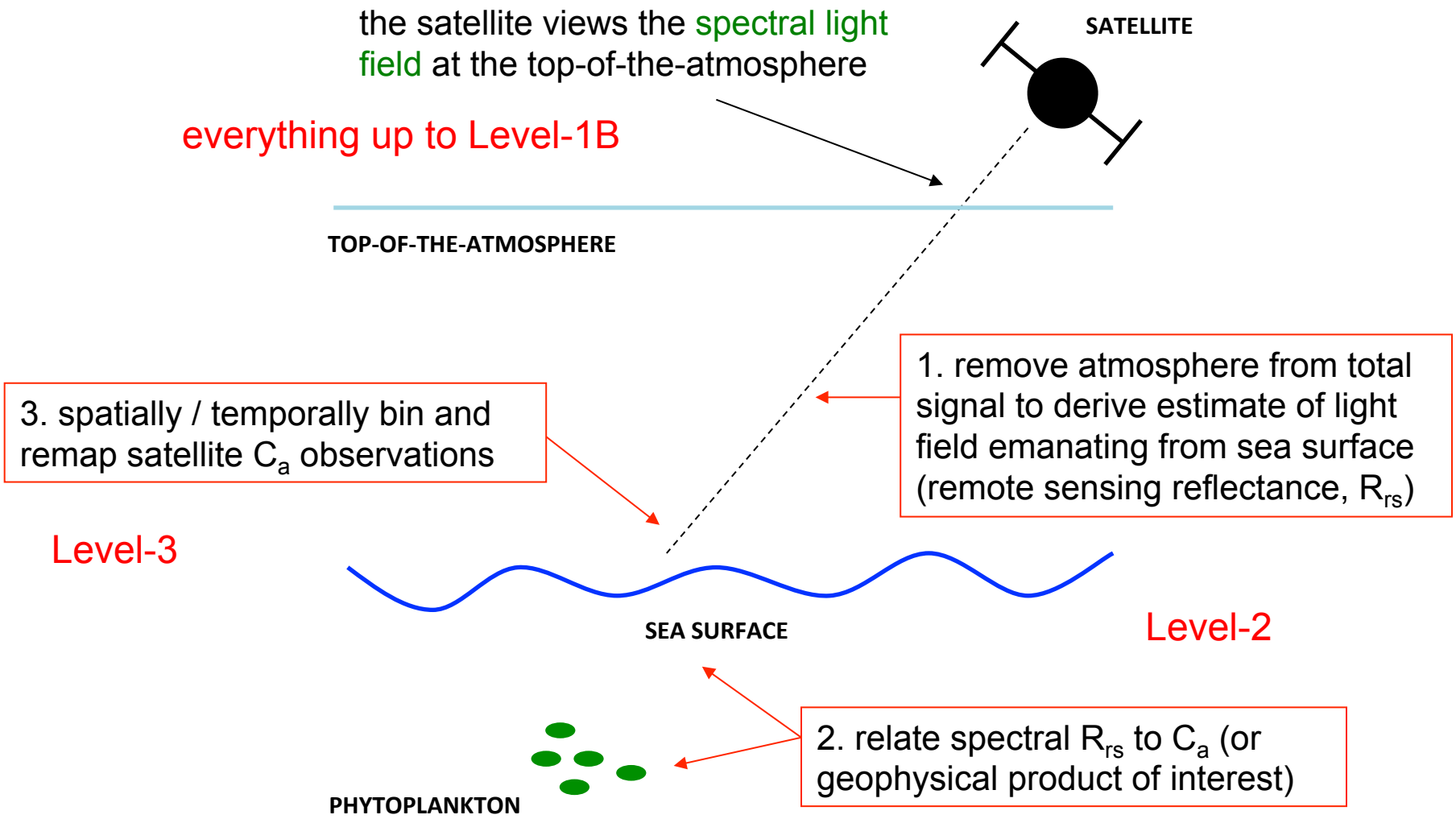
email
seadas@seadas.gsfc.nasa.gov

lecture break

MODIS data levels & flow



satellite ocean color

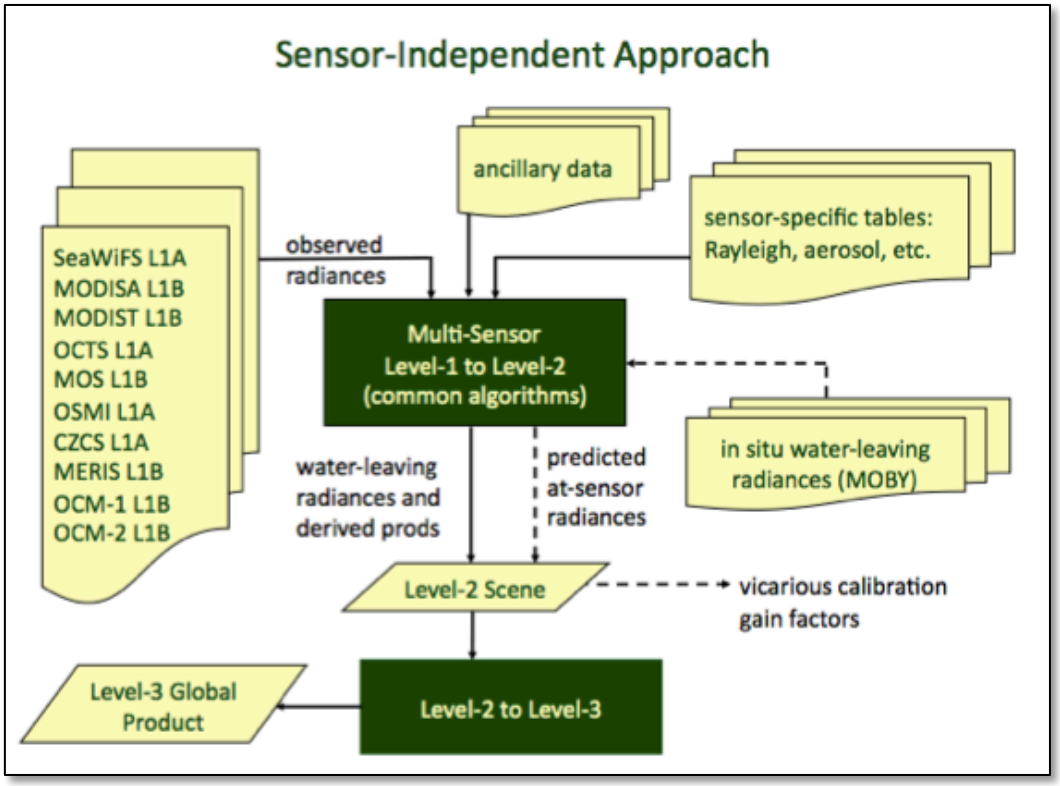


Level-2 processing (l2gen)

common software for Level-2 processing of MODIS, SeaWiFS, MERIS, & other sensors in a consistent manner

supports a multitude of product algorithms and processing methodologies

- standard products
- evaluation products
- user defined products
- run-time selection



Level-2 processing (l2gen)

as data is processed by l2gen from Level 1 to Level 2, checks are made for different defined conditions

when certain tests and conditions are met for a given pixel, a flag is set for that pixel for that condition

a total of 31 flags can be set for each pixel

these l2gen processing flags are stored in the Level 2 data file as the "l2_flags" product

the storage method sets bits to 0 or 1 in 32-bit integers that correspond to each pixel

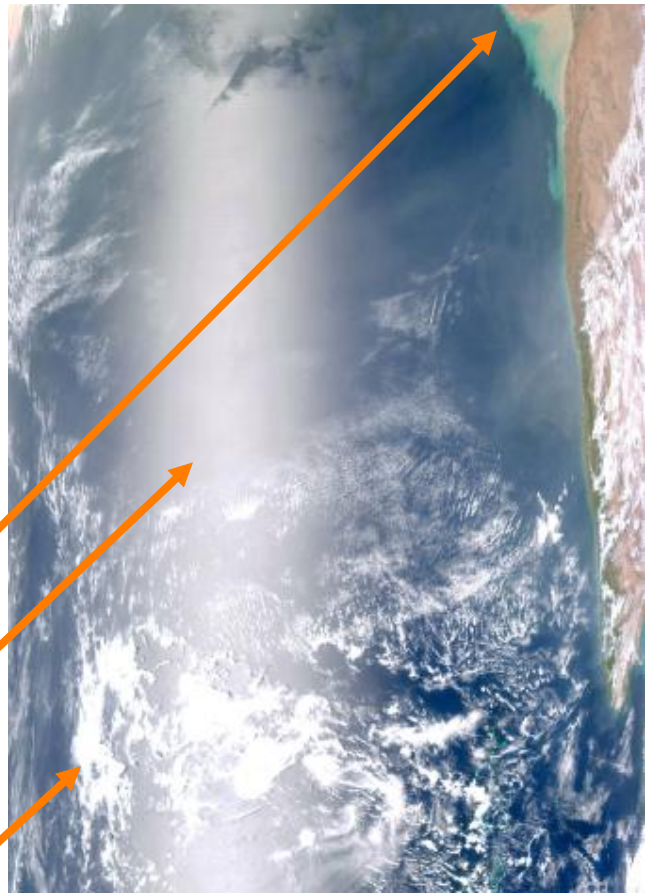
Level-2 processing flags

Bit	Name	Description
01	ATMFAIL	Atmospheric correction failure
02	LAND	Pixel is over land
03	BADANC	Reduced quality of ancillary data
04	HIGLINT	High sun glint
05	HILT	Observed radiance very high or saturated
06	HISATZEN	High sensor view zenith angle
07	COASTZ	Pixel is in shallow water
08	NEGLW	Negative water-leaving radiance retrieved
09	STRAYLIGHT	Straylight contamination is likely
10	CLDICE	Probable cloud or ice contamination
11	COCCOLITH	Coccolithofores detected
12	TURBIDW	Turbid water detected
13	HISOLZEN	High solar zenith
14	HITAU	High aerosol optical thickness
15	LOWLW	Very low water-leaving radiance (cloud shadow)
16	CHLFAIL	Derived product algorithm failure

Bit	Name	Description
17	NAVWARN	Navigation quality is reduced
18	ABSAER	possible absorbing aerosol (disabled)
19	TRICHO	Possible trichodesmium contamination
20	MAXAERITER	Aerosol iterations exceeded max
21	MODGLINT	Moderate sun glint contamination
22	CHLWARN	Derived product quality is reduced
23	ATMWARN	Atmospheric correction is suspect
24	DARKPIXEL	Rayleigh-subtraced radiances is negative
25	SEAICE	Possible sea ice contamination
26	NAVFAIL	Bad navigation
27	FILTER	Pixel rejected by user-defined filter
28	SSTWARN	SST quality is reduced
29	SSTFAIL	SST quality is bad
30	HIPOL	High degree of polarization
31	spare	spare
32	OCEAN	not cloud or land

Level-2 flags & masks

RGB Image

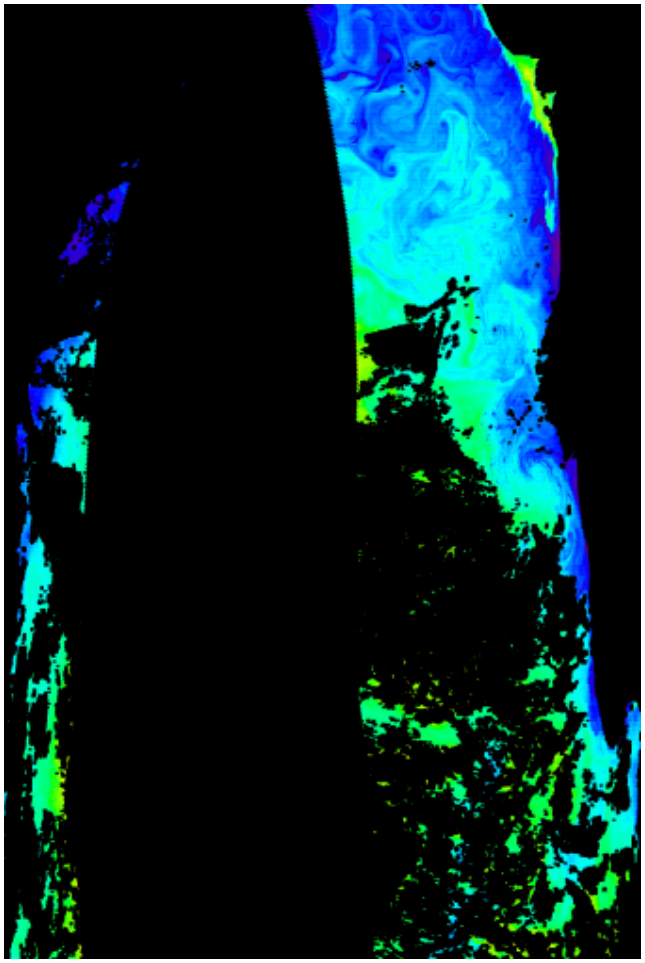


sediments

glint

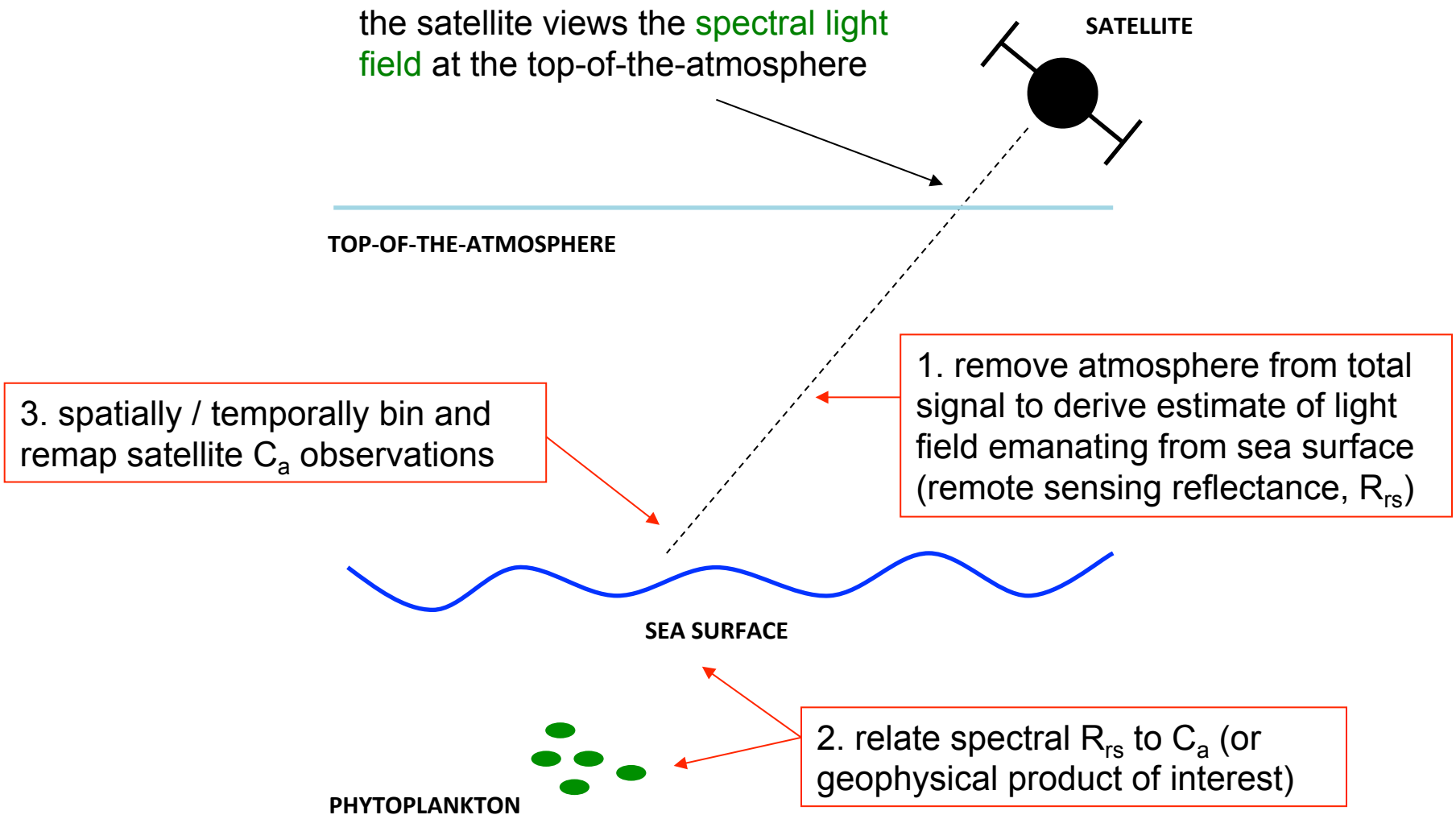
cloud

nLw (443)



add masking for straylight

satellite ocean color



MODIS Level-3 processing

Level 2
- geolocated geophysical products for each pixel

Level 3 binned
- geophysical products averaged spatially and/or temporally
- sinusoidally distributed, equal area bins

Level 3 mapped
- images created by mapping and scaling binned products
- user-friendly, cylindrical equiangular projection

Bin resolution 4.6 x 4.6 km^2

Mapped resolution
- 0.042-deg
- 0.084-deg

Composite Periods
- Daily
- 8-day
- Monthly
- Seasonal
- Yearly
- Mission

Level-3 terminology

projection - any process which transforms a spatially organized data set from one coordinate system to another

mapping - process of transforming a data set from an arbitrary spatial organization to a uniform (rectangular, row-by-column) organization, by processes of projection & resampling

binning - process of projecting & aggregating data from an arbitrary spatial & temporal organization to a uniform spatial scale over a defined time range

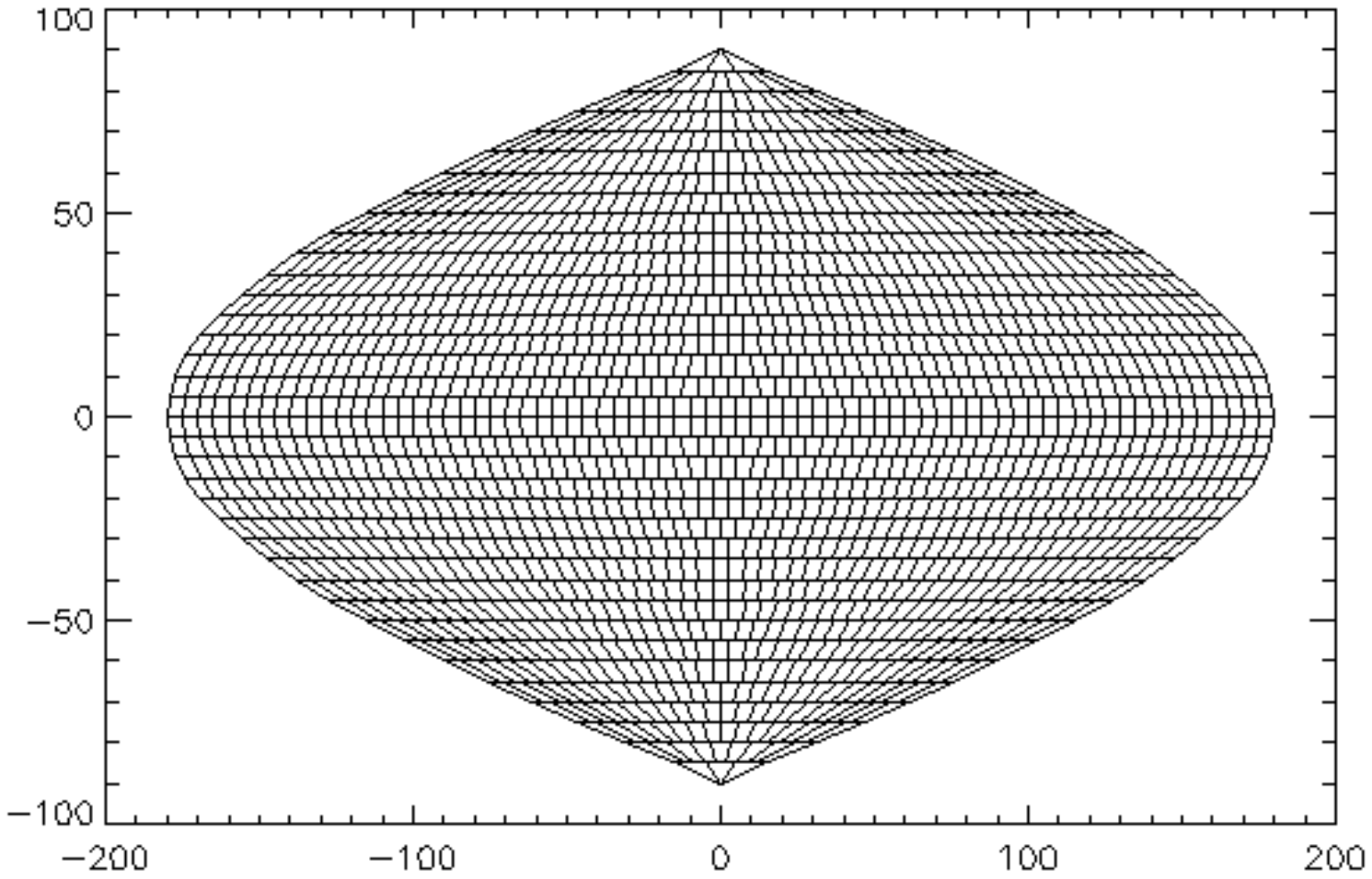
ocean color projections

equal-area - sinusoidal with equally space rows & number of bins per row proportional to sine of latitude

equal-angle - rectangular (Platte Carre) with rows and columns equally spaced in latitude and longitude

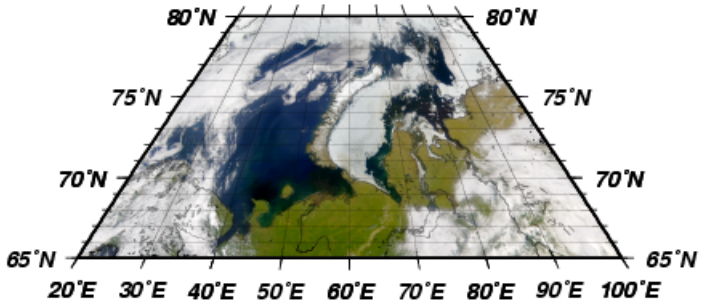
equal-area & -angle projections are equivalent at the equator

sinusoidal equal area projection



Level-3 binned vs. mapped

bin file grid



Sinusoidal

map file grid

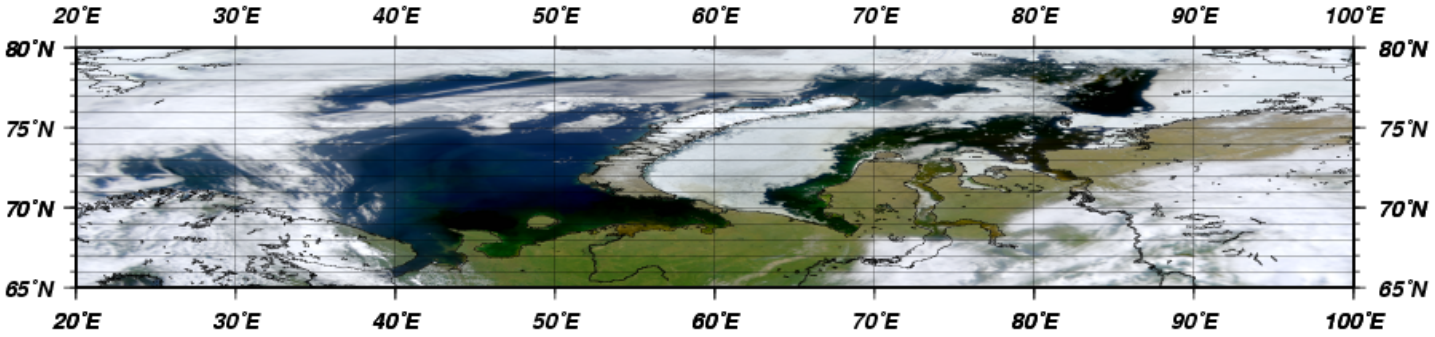
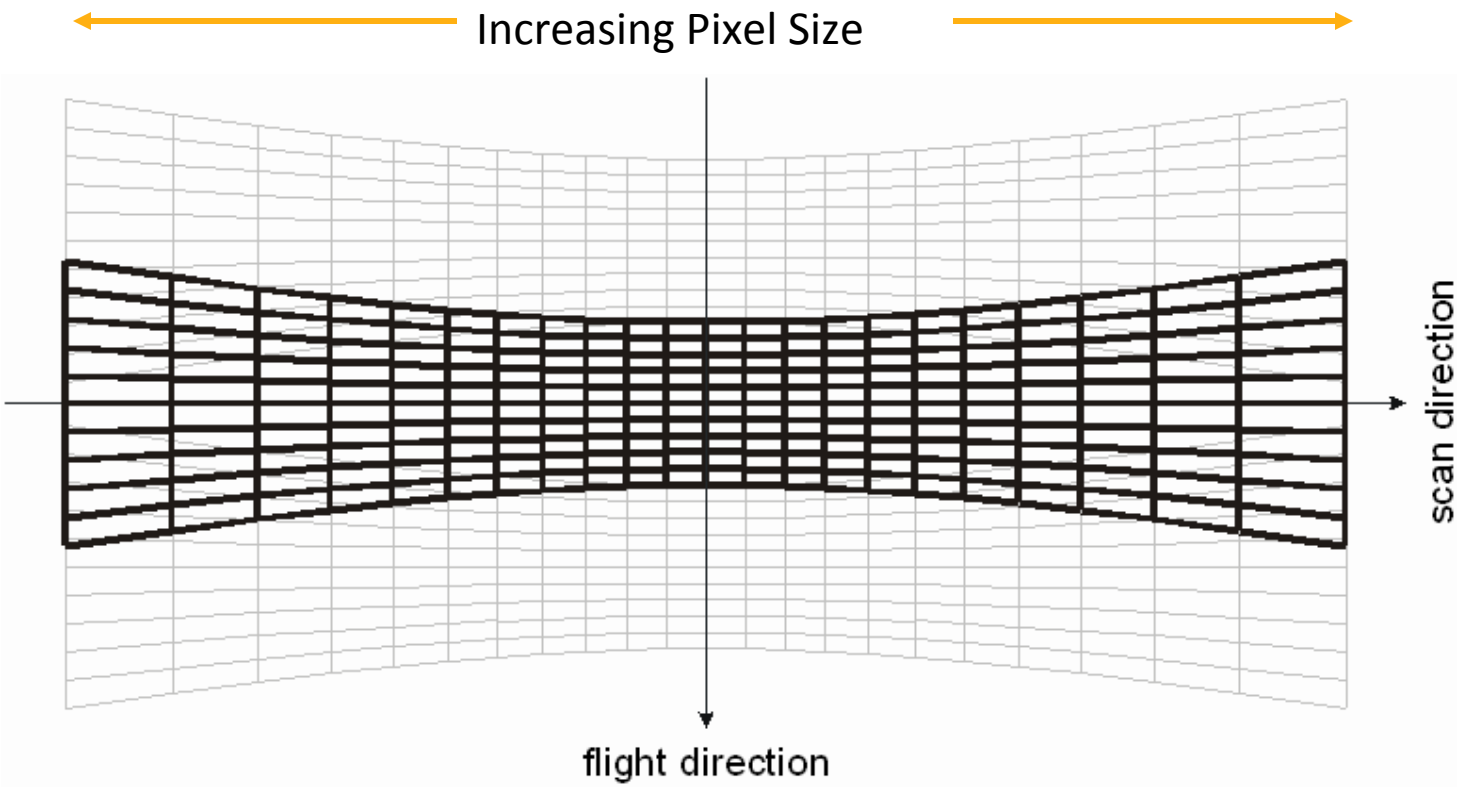
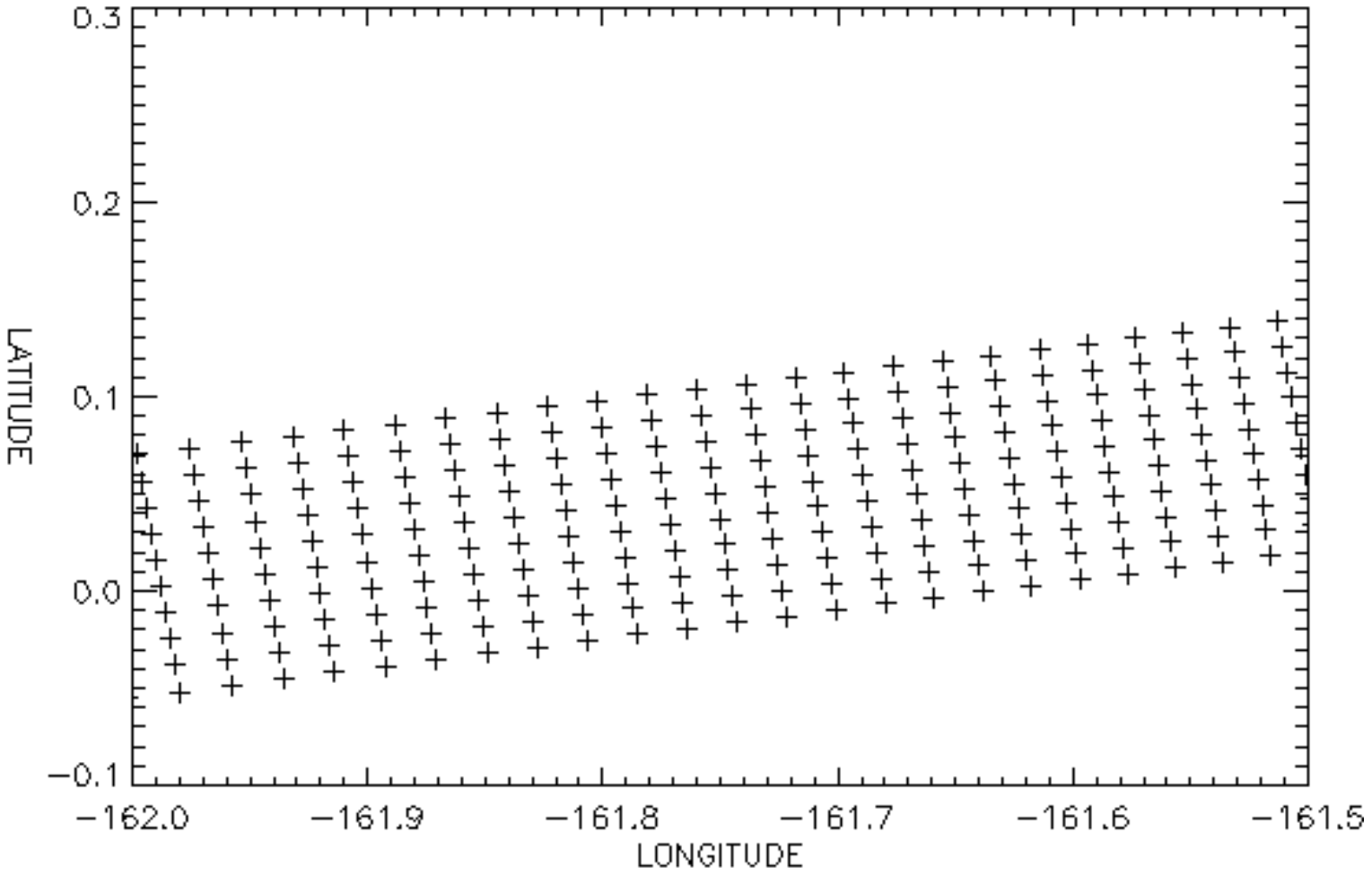


Plate Carrée

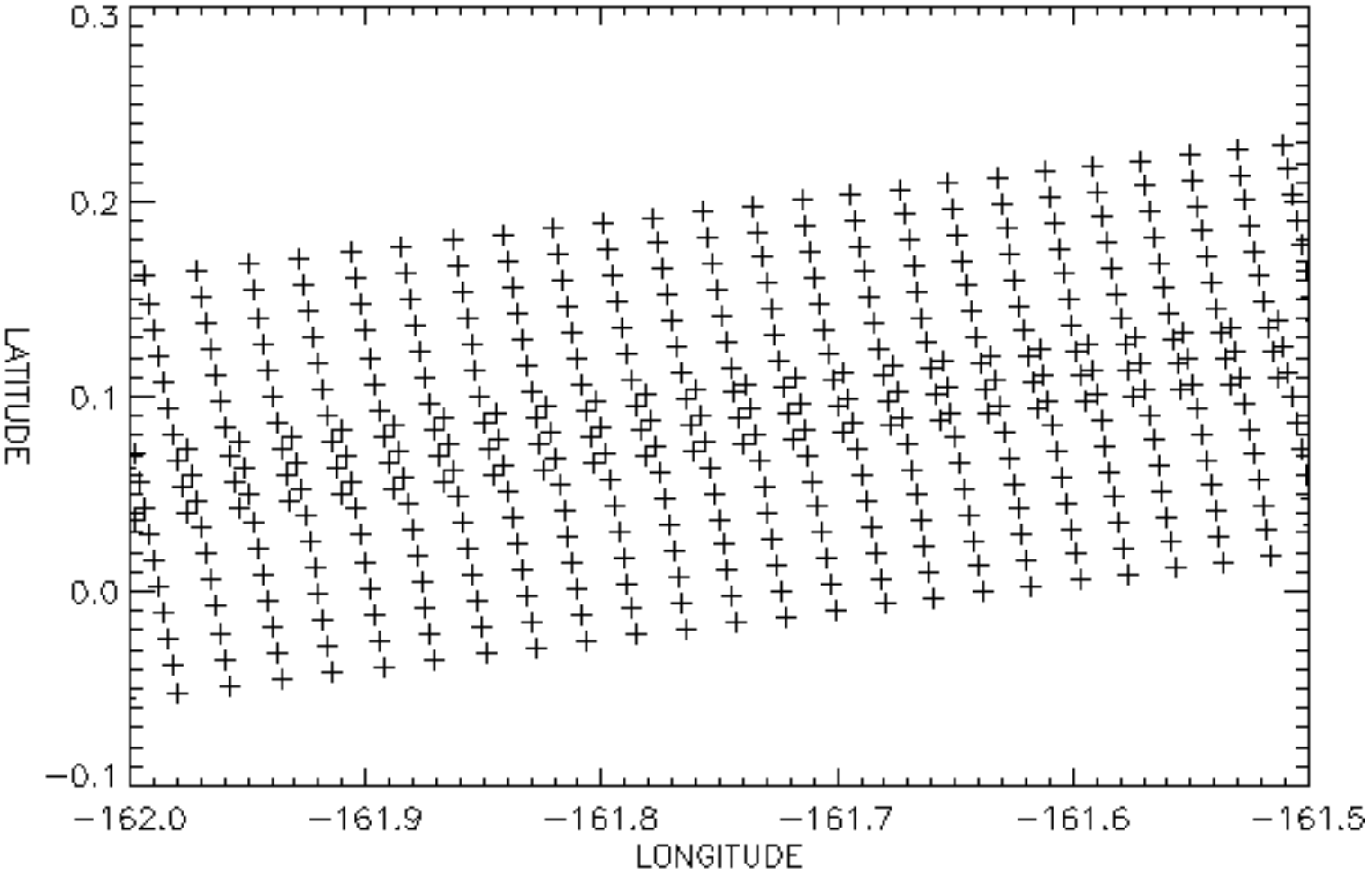
MODIS “bow-tie” effect



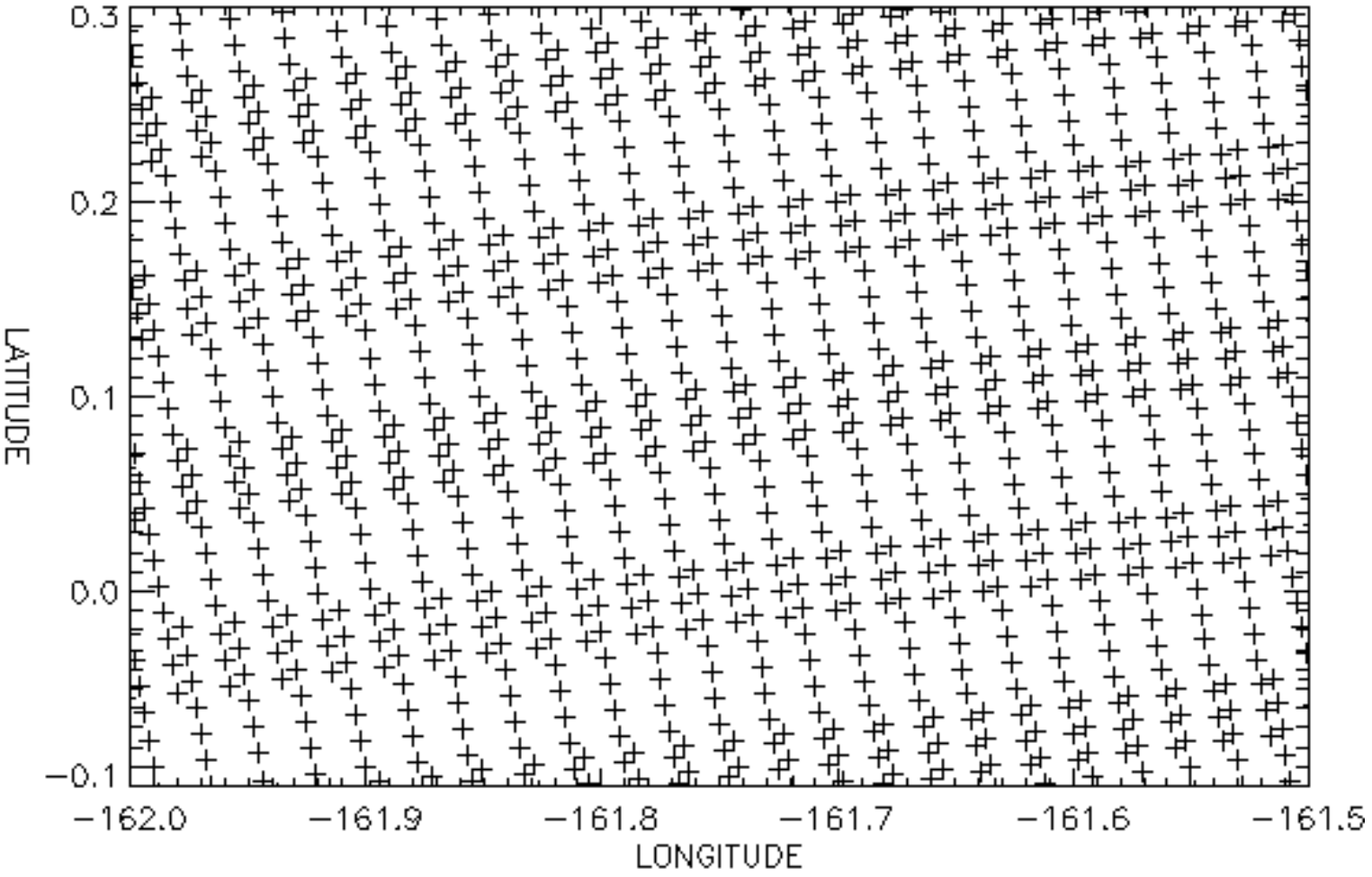
one MODIS scan at ~45 degrees scan angle



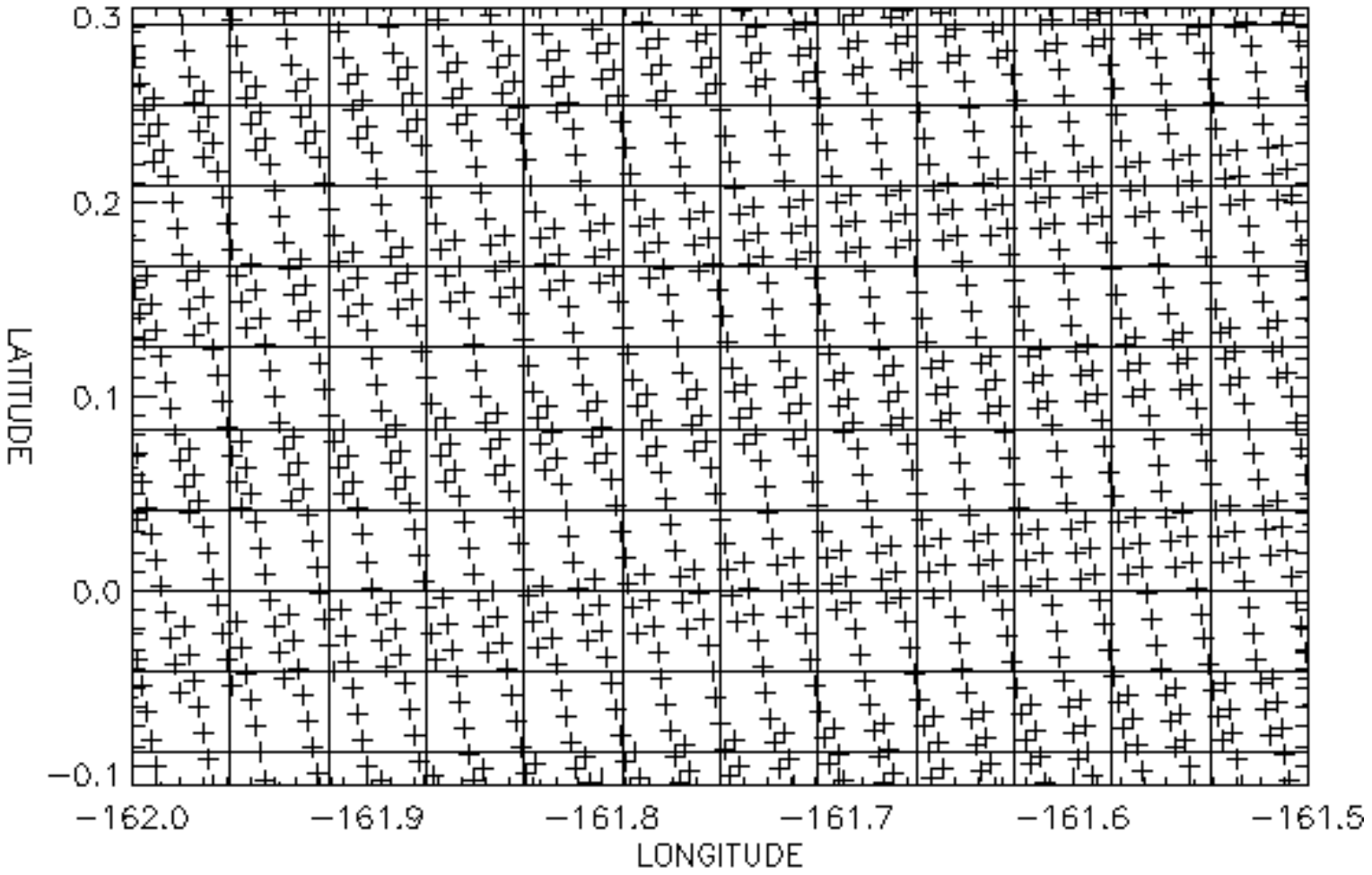
two MODIS scans showing overlap of pixels



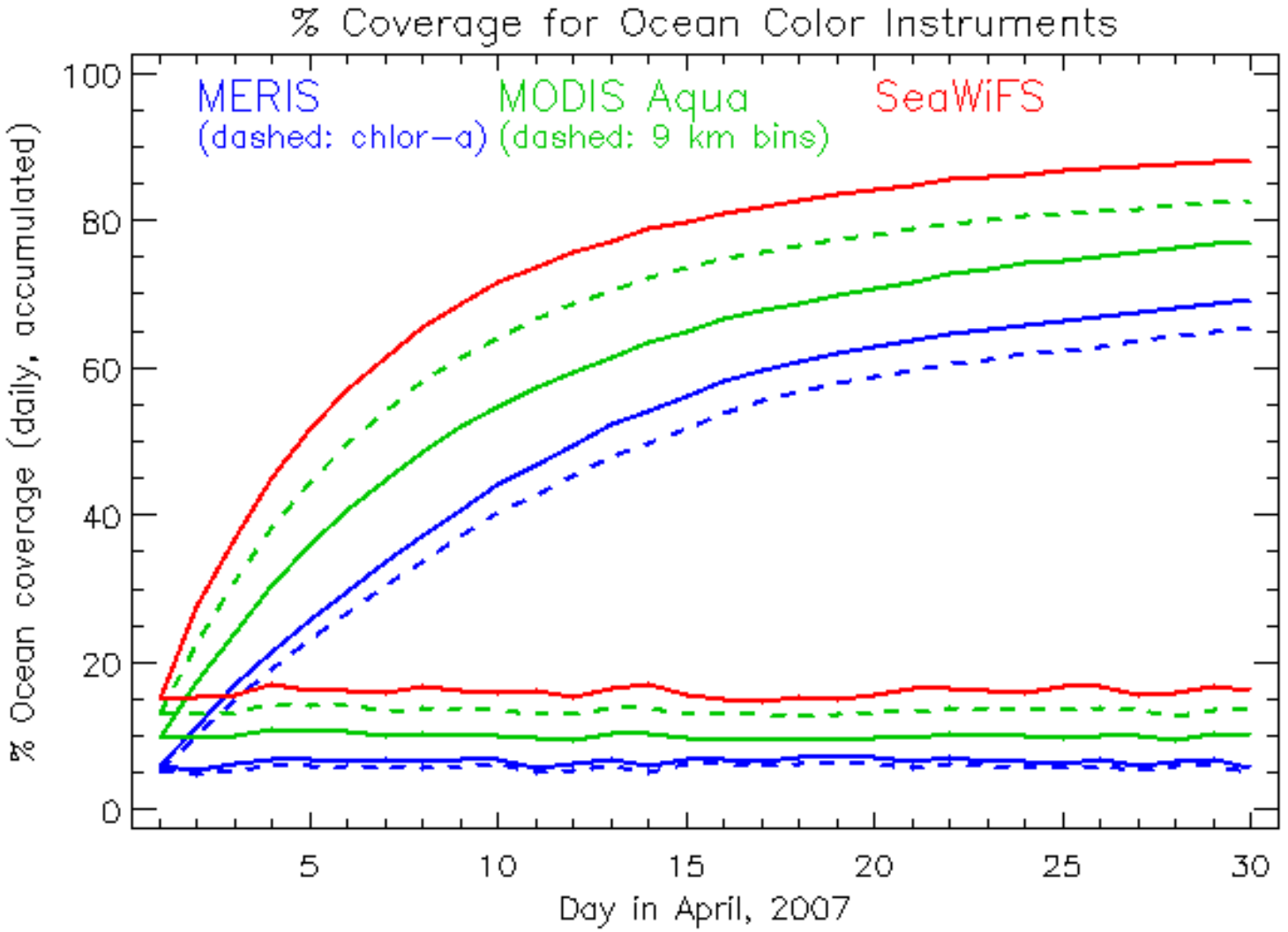
multiple MODIS scans showing pixel overlap



bin boundaries overlaid on pixel locations

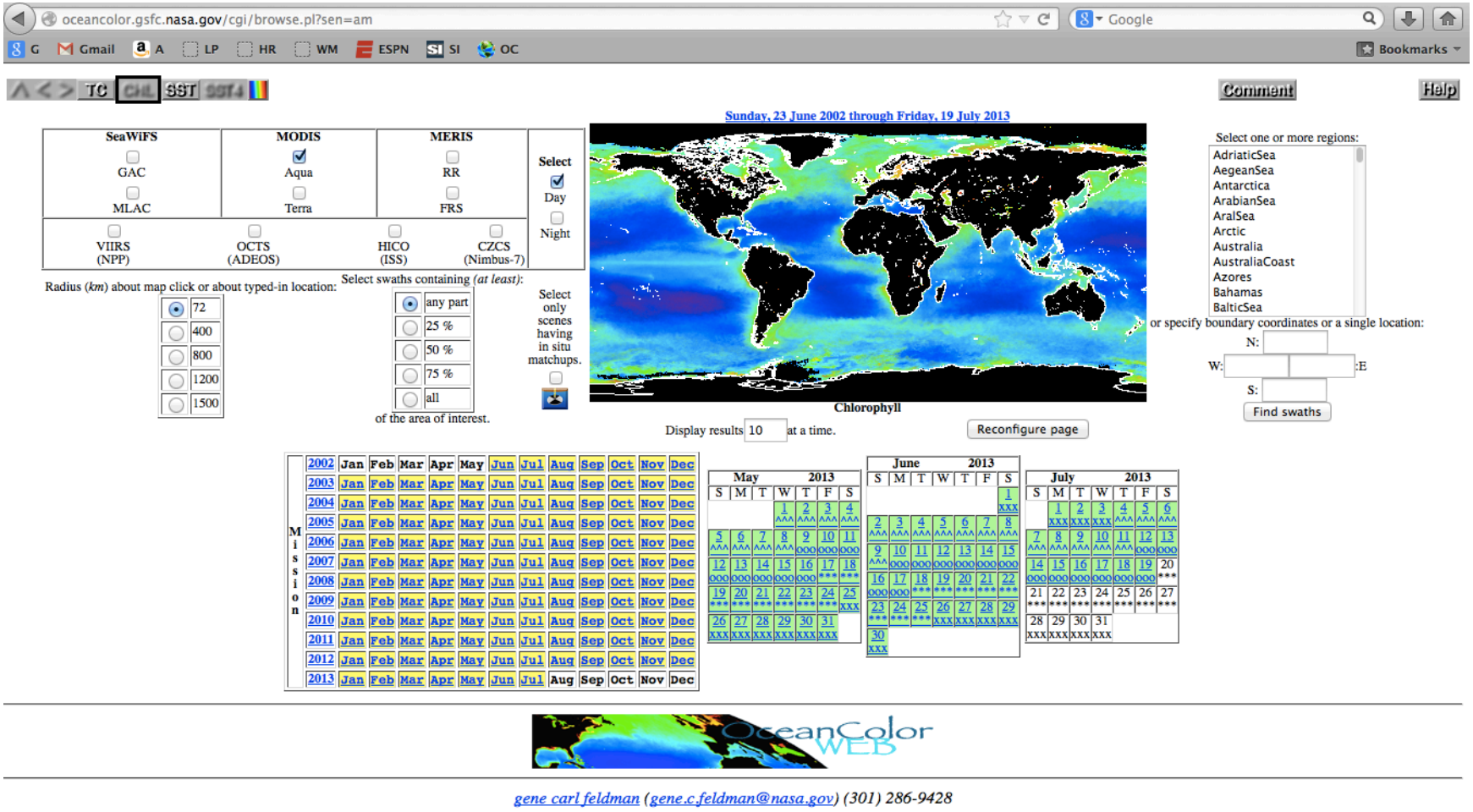


ocean coverage over time for binned files



lecture break

acquiring ocean color data



OceanColor WEB

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http://oceancolor.gsfc.nasa.gov/cgi/browse.pl