Preliminary evaluation of CoastColour MERIS data products for Chesapeake Bay

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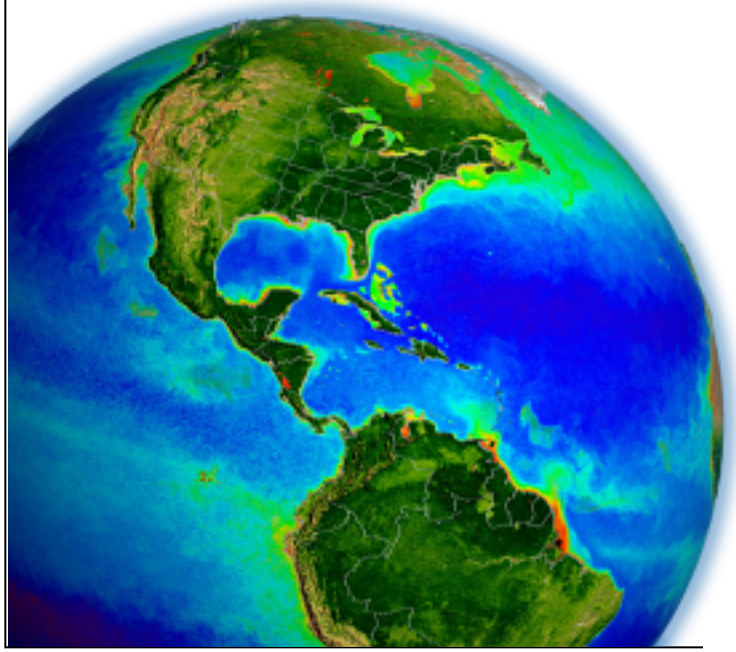


study site

Fig. 1 from Kemp et al. (2005)

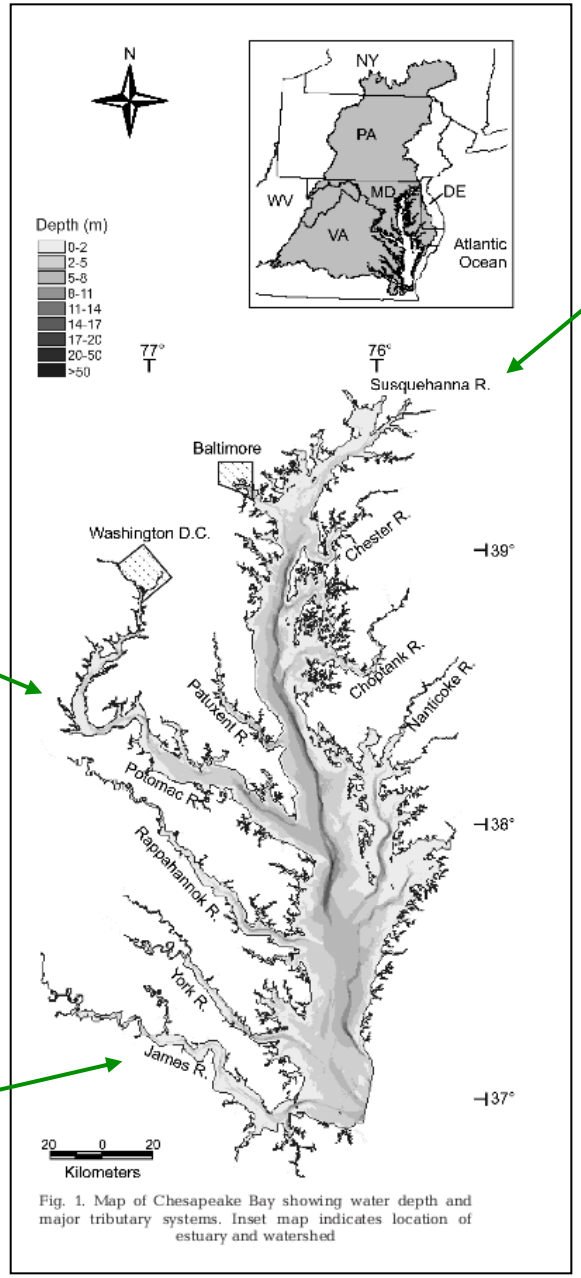


Fig. 1. Map of Chesapeake Bay showing water depth and major tributary systems. Inset map indicates location of estuary and watershed

Susquehanna River - contributes >50% of freshwater input annually to Bay

increasing salinity

Upper Bay

oligohaline

Middle Bay

mesohaline

Lower Bay

polyhaline

the Bay suffers from regular, seasonal eutrophication resulting from anthropogenic sources of N & P

freshwater input, circulation patterns, & basin shape enable strong vertical stratification & long N,P residence times

challenges for remote sensing of estuaries

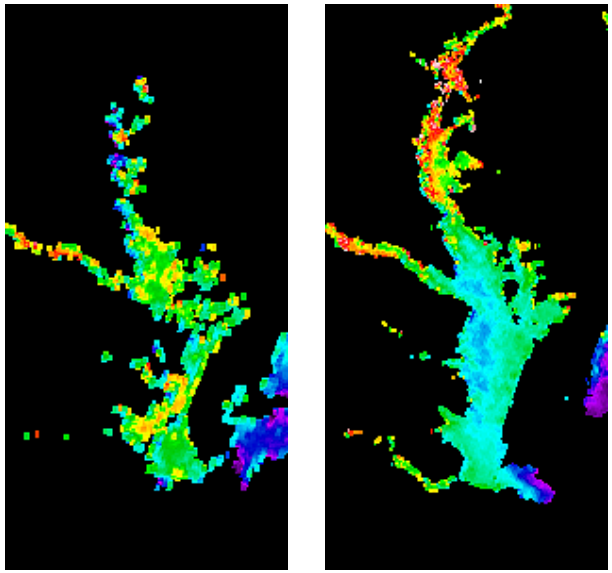
temporal & spatial variability
- satellite sensor resolution
- satellite repeat frequency
- validity of ancillary data (SST, wind)
- resolution requirements & binning options

straylight contamination (adjacency effects)

non-maritime aerosols (dust, pollution)
- region-specific models required?
- absorbing aerosols

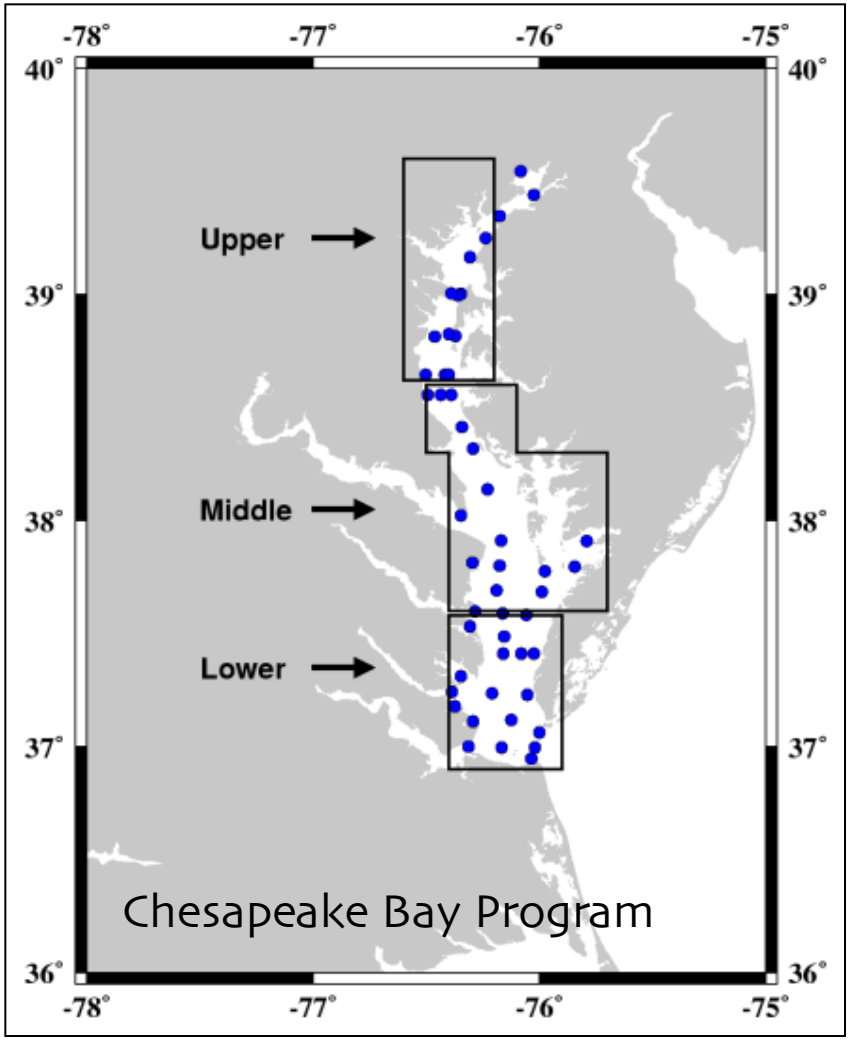
suspended sediments & CDOM
- complicates estimation of R_{rs}(NIR)
- complicates BRDF (f/Q) corrections
- saturation of observed radiances

anthropogenic emissions (NO_2 absorption)



pixel size depends on viewing geometry; in this analysis, we only considered scenes such as this one

in situ data sources



Chesapeake Bay Program
A Watershed Partnership

http://www.chesapeakebay.net

routine data collection since 1984
12-16 cruises / year

49 stations
19 hydrographic measurements

algal biomass
water clarity
dissolved oxygen
others

data & experimental approach

reference ("sea-truth") data

in situ chlorophyll-a (Chl), total suspended matter (TSM), & CDOM absorption at 443 nm (adg443) from Chesapeake Bay Program

run multiple long-term satellite time-series

MERIS: ~ Level-2 files for 2006 provided by CoastColour

SeaWiFS: ~ 1 km^2 spatial resolution @ nadir, Sep 1997 – Dec 2009

MODIS-Aqua: ~ 1 km^2 spatial resolution @ nadir, Jun 2002 – Dec 2009

QC metrics: exclude cloudy days & high sensor zenith angles

final analyses consider ~13 "useful" days per month

analyses

monthly time-series

seasonal frequency distributions

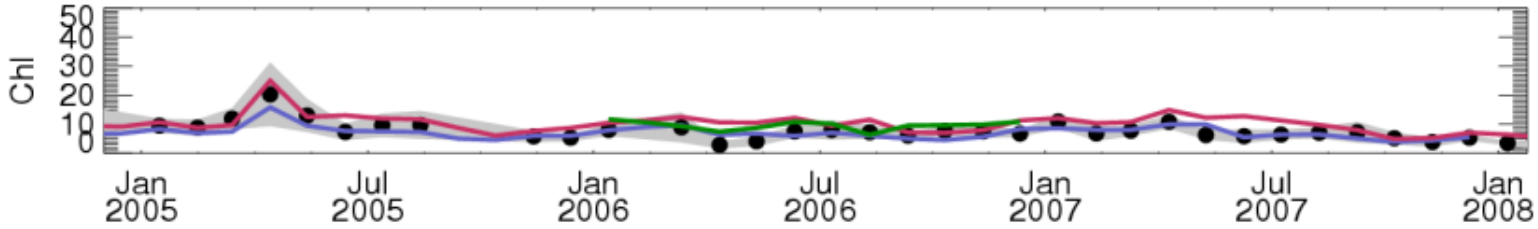
P.J. Werdell et al., "Regional and seasonal variability of chlorophyll-a in Chesapeake Bay as observed by SeaWiFS and MODIS-Aqua," Rem. Sens. Environ. 113, 1319-1330 (2009)

spatial stratification

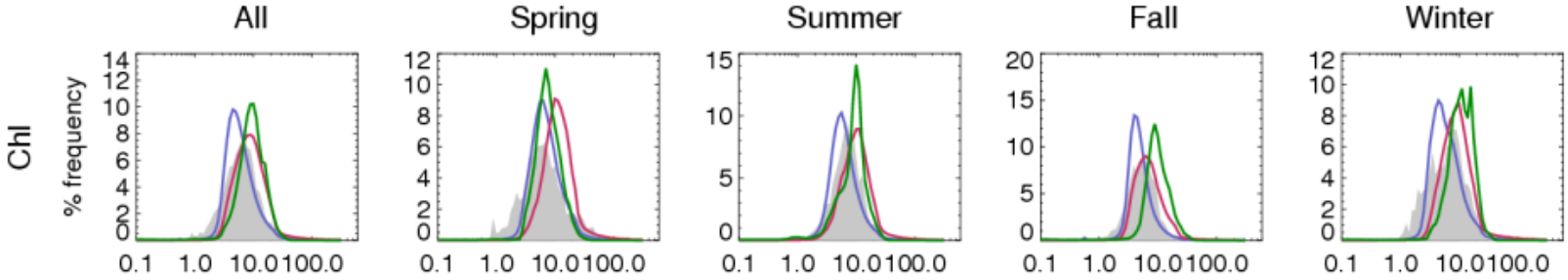
Lower/Middle 37.6°N & Middle/Upper 38.6°N

example analysis

monthly time-series
satellite: color coded solid lines
in situ: solid black circles = median, grey shaded = standard deviation

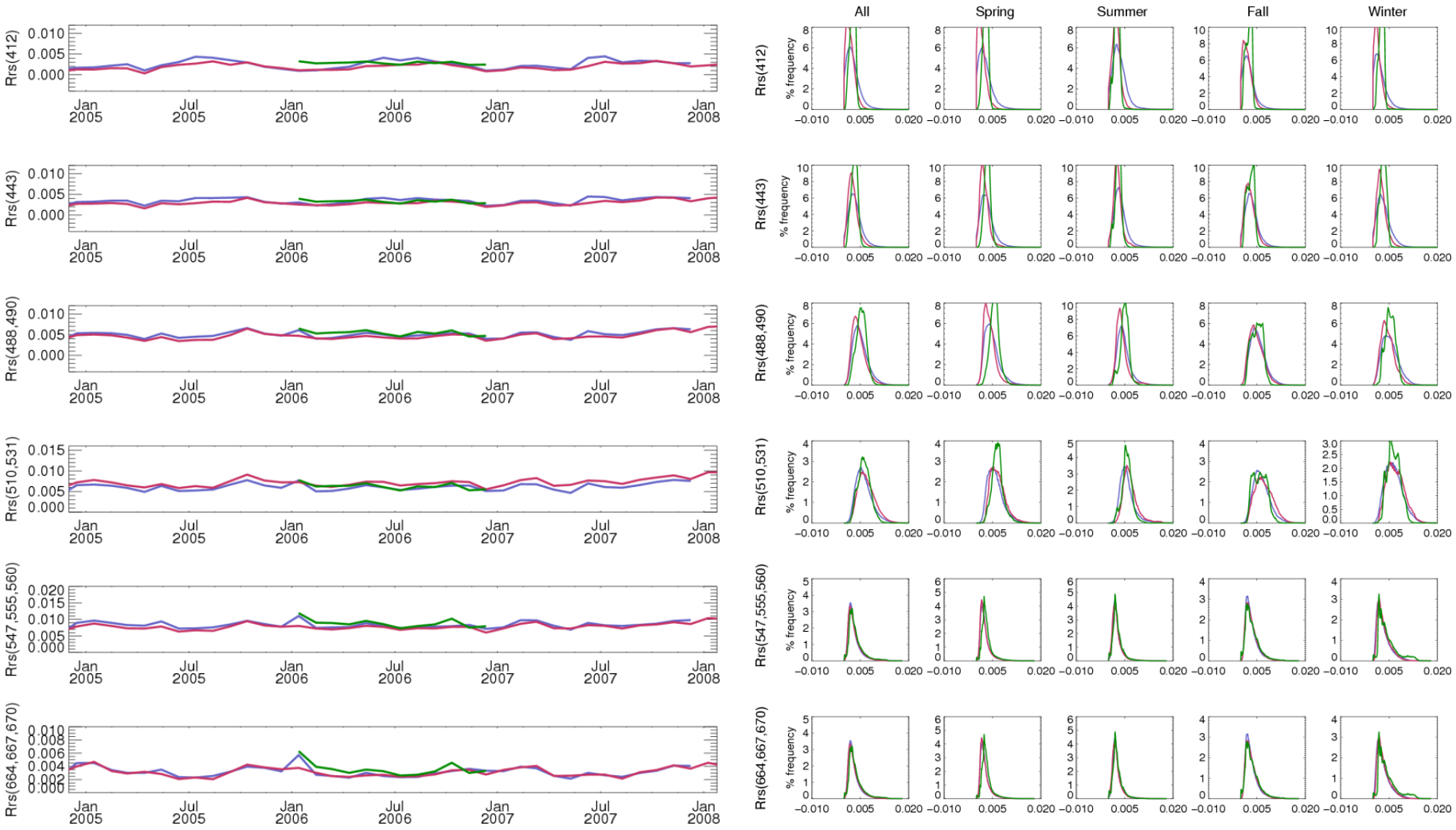


season frequency distributions
satellite: color coded solid lines
in situ: grey shaded



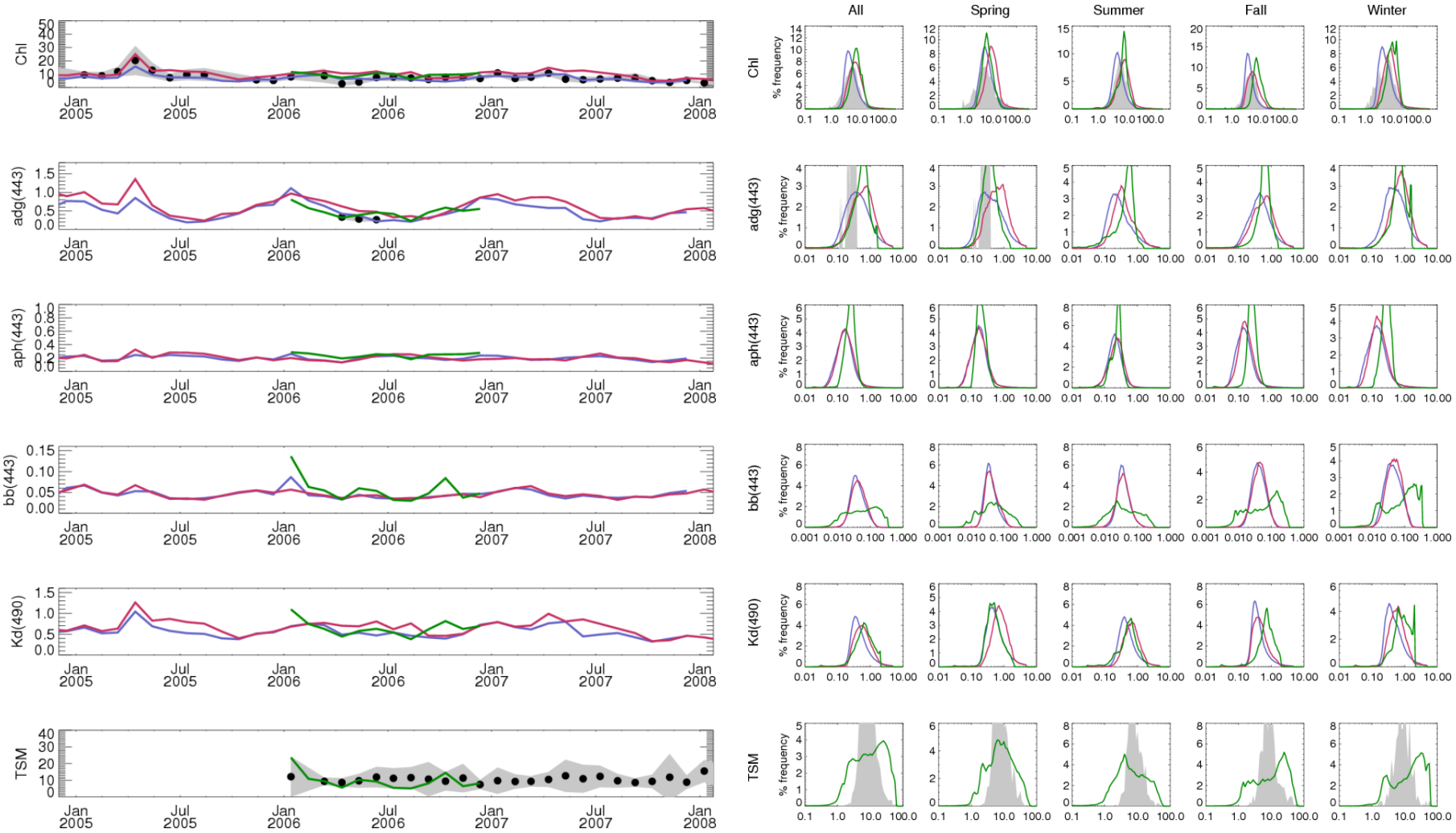
color key: in situ, SeaWiFS, MODIS-Aqua, MERIS CC

Lower Bay remote-sensing reflectances



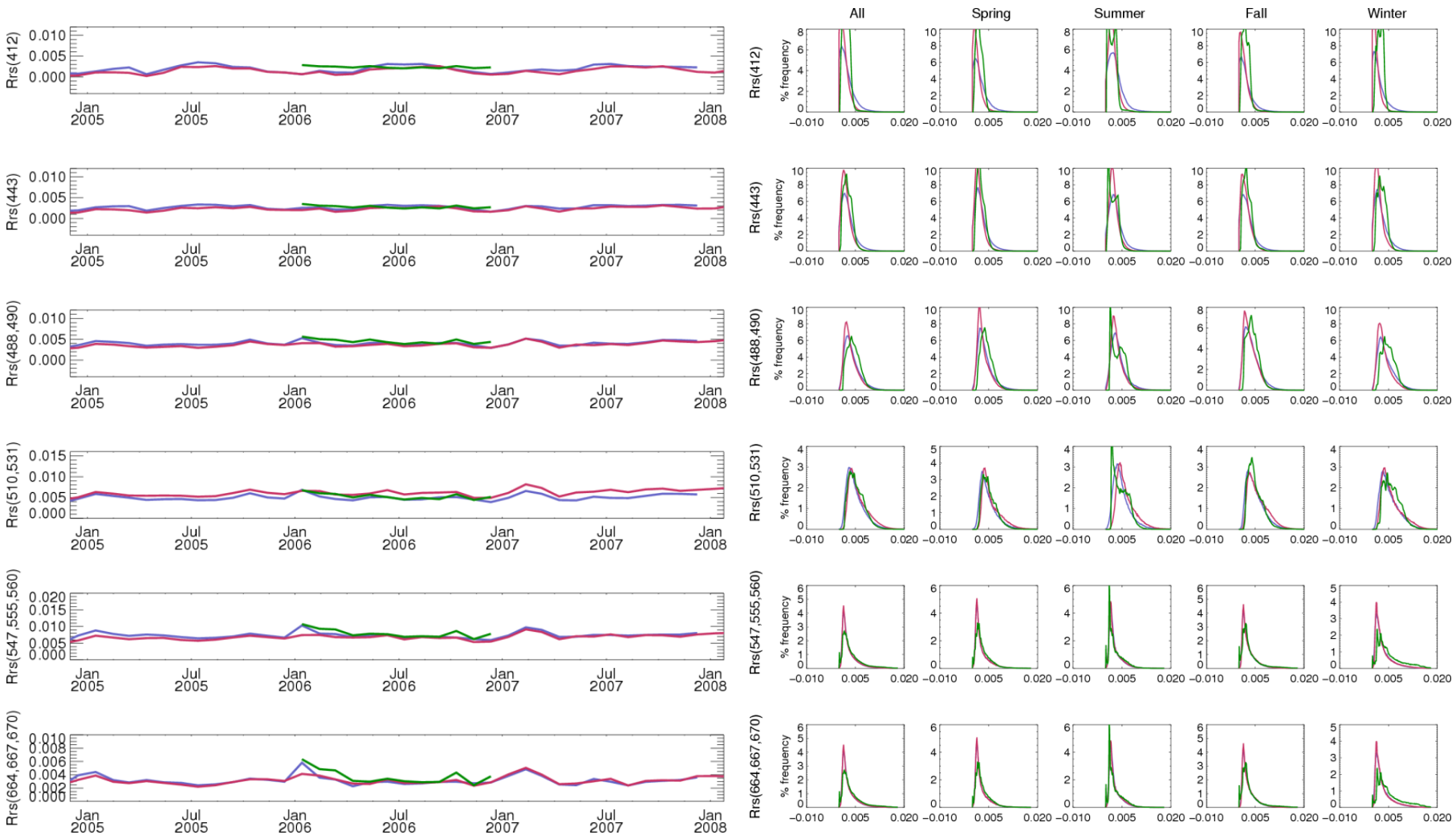
color key: in situ, SeaWiFS, MODIS-Aqua, MERIS CC

Lower Bay derived products



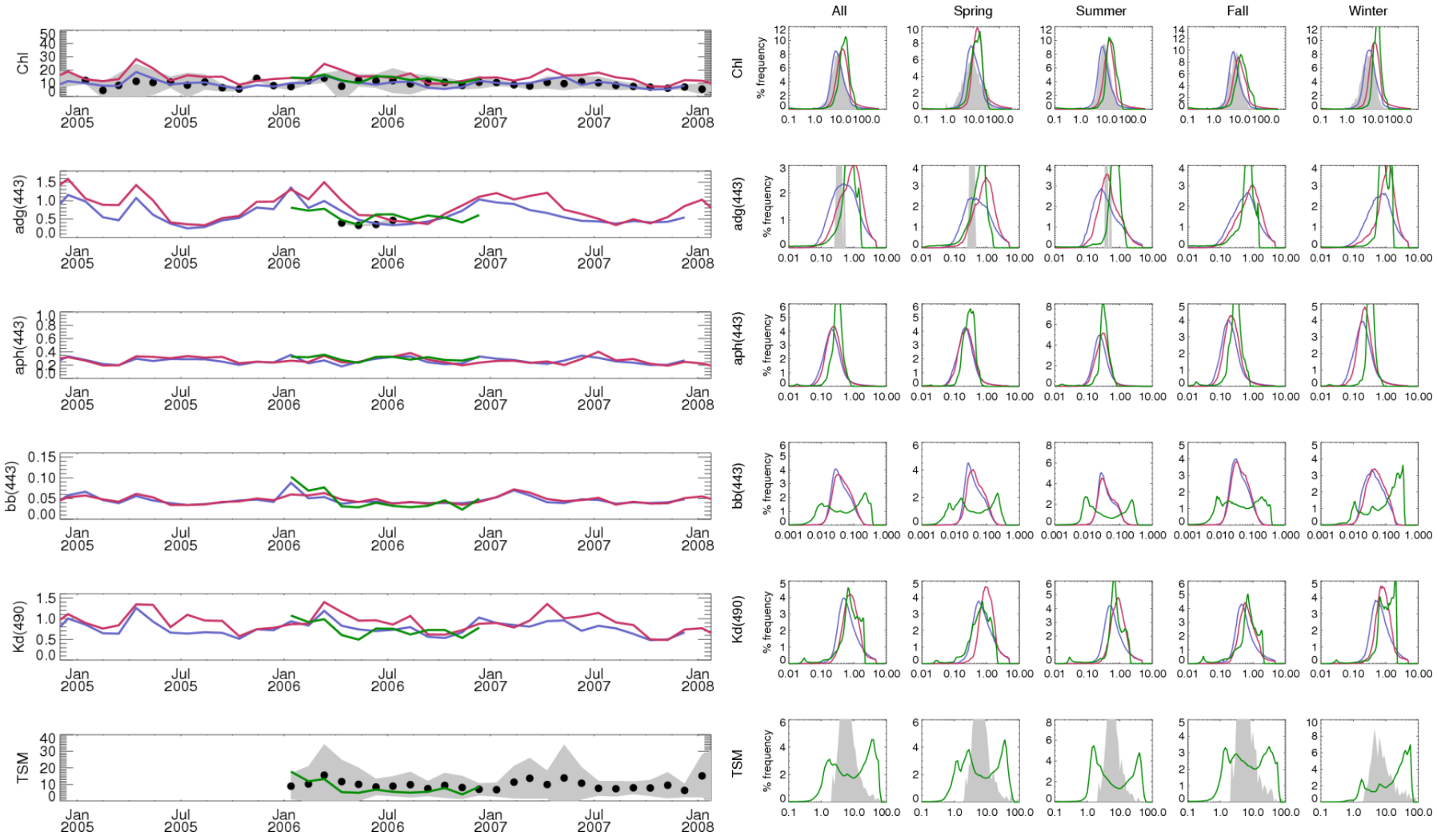
color key: in situ, SeaWiFS, MODIS-Aqua, MERIS CC

Middle Bay remote-sensing reflectances



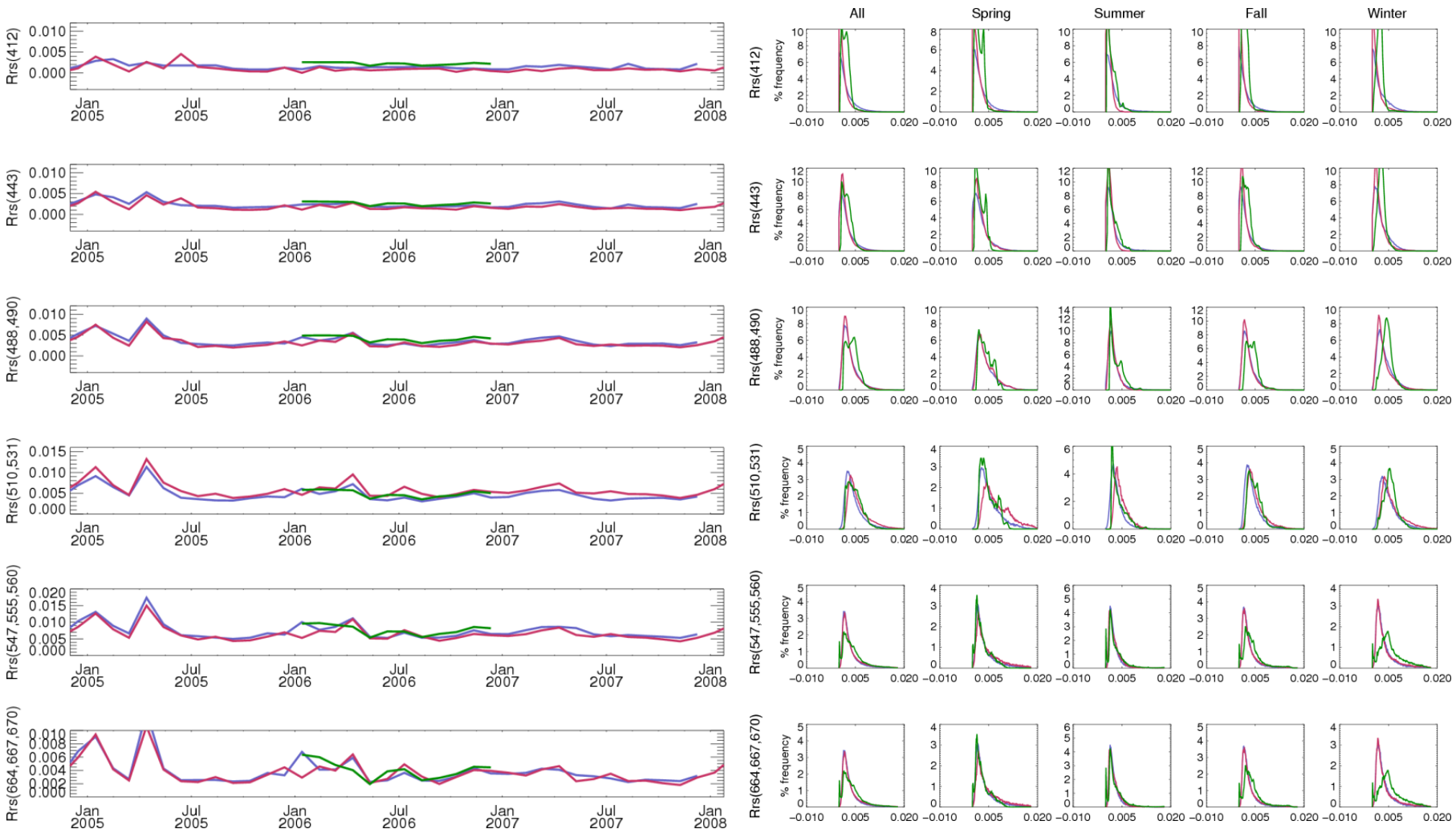
color key: in situ, SeaWiFS, MODIS-Aqua, MERIS CC

Middle Bay derived products



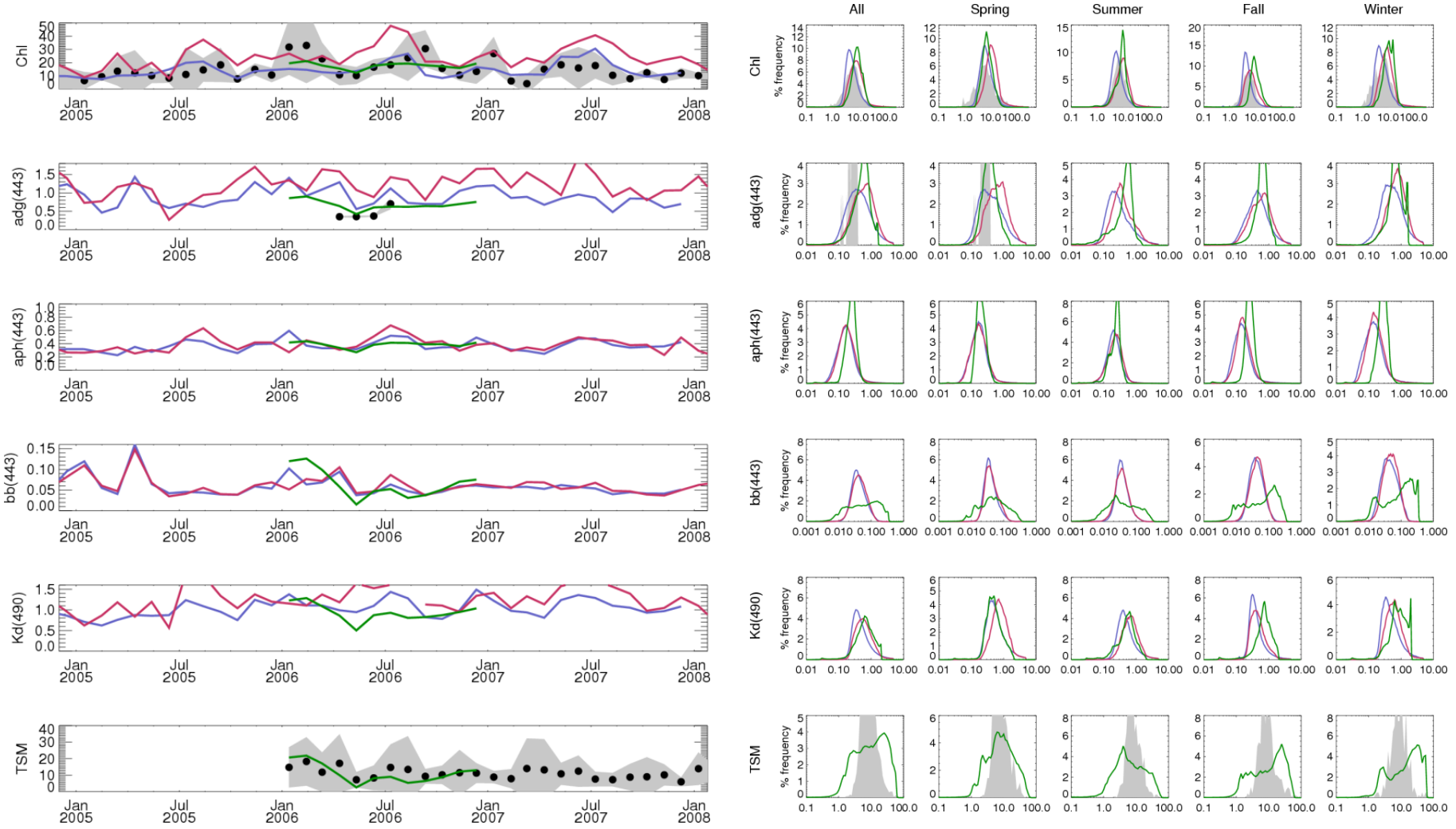
color key: in situ, SeaWiFS, MODIS-Aqua, MERIS CC

Upper Bay remote-sensing reflectances



color key: in situ, SeaWiFS, MODIS-Aqua, MERIS CC

Upper Bay derived products



color key: in situ, SeaWiFS, MODIS-Aqua, MERIS CC

summary

visual inspection suggests:

(1) Rrs(λ) in good agreement
(2) Chl, absorptions, Kd largely similar, with minor biases
(3) curious flat & bimodal distributions for backscattering & TSM, but medians comparable
(4) no major biases obvious in any products

NASA L2GEN will soon support Level-2 processing of CoastColour Level-1 files; analyses will be repeated at that time
(this will enable comparison of SeaWiFS, Aqua, & MERIS Level-2 time-series in the Bay that have been processed using identical algorithms, LUTs, software, etc.)

quantitative, statistical analysis of time-series to follow