



# Time series of satellite images

**Mati Kahru**

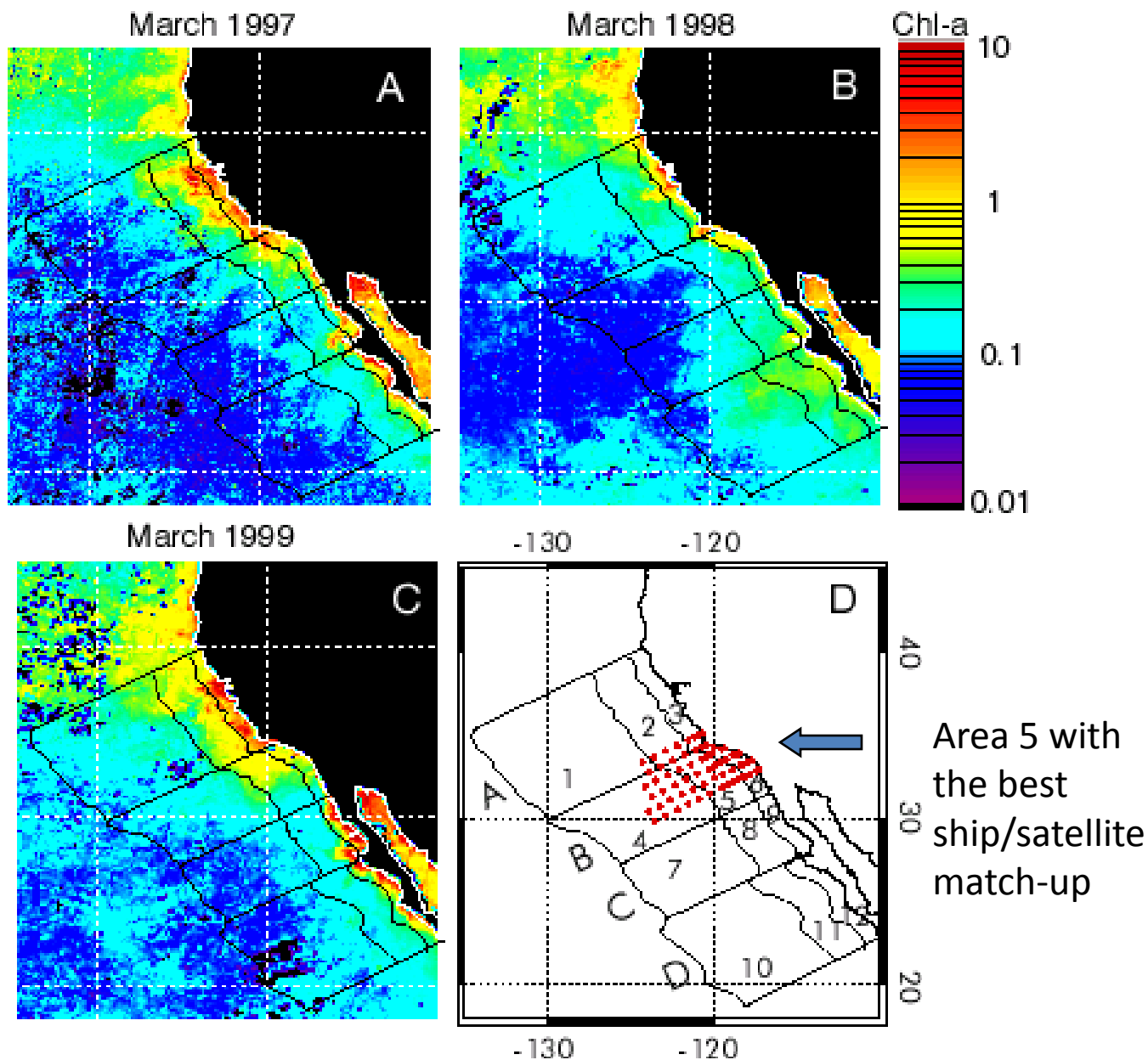
WimSoft, <http://www.wimsoft.com>, [wim@wimsoft.com](mailto:wim@wimsoft.com)  
also at

*Scripps Institution of Oceanography*  
*University of California San Diego*  
*La Jolla, CA 92093-0218, USA*  
[mkahru@ucsd.edu](mailto:mkahru@ucsd.edu)





Kahru, M., B.G. Mitchell, Influence of the 1997-98 El Niño on the surface chlorophyll in the California Current, Geophysical Research Letters, Vol. 27, No. 18, 2937-2940, 2000.





- [S19972441997273.L3m MO CHLO.Z](#)
- [S19972441997273.L3m MO K490.Z](#)
- [S19972441997273.L3m MO L412.hdf.Z](#)
- [S19972441997273.L3m MO L443.hdf.Z](#)
- [S19972441997273.L3m MO L490.hdf.Z](#)
- [S19972441997273.L3m MO L510.hdf.Z](#)
- [S19972441997273.L3m MO L555.Z](#)
- [S19972441997273.L3m MO L670.hdf.Z](#)
- [S19972741997304.L3m MO CHLO](#)
- [S19972741997304.L3m MO K490](#)
- [S19972741997304.L3m MO L412.hdf](#)
- [S19972741997304.L3m MO L443.hdf](#)
- [S19972741997304.L3m MO L490.hdf](#)
- [S19972741997304.L3m MO L510.hdf](#)
- [S19972741997304.L3m MO L555](#)
- [S19972741997304.L3m MO L670.hdf](#)
- [S19973051997334.L3m MO CHLO.Z](#)
- [S19973051997334.L3m MO K490.Z](#)
- [S19973051997334.L3m MO L412.hdf.Z](#)
- [S19973051997334.L3m MO L443.hdf.Z](#)
- [S19973051997334.L3m MO L490.hdf.Z](#)
- [S19973051997334.L3m MO L510.hdf.Z](#)
- [S19973051997334.L3m MO L555.Z](#)
- [S19973051997334.L3m MO L670.hdf.Z](#)
- [S19973351997365.L3m MO CHLO.Z](#)
- [S19973351997365.L3m MO K490.Z](#)
- [S19973351997365.L3m MO L412.hdf.Z](#)
- [S19973351997365.L3m MO L443.hdf.Z](#)
- [S19973351997365.L3m MO L490.hdf.Z](#)
- [S19973351997365.L3m MO L510.hdf.Z](#)
- [S19973351997365.L3m MO L555.Z](#)

Large numbers of satellite images...

11-years of **SeaWiFS** data (8 bands, multiple derived products):

>120 monthly composites;

>11\*42 8-day composites;

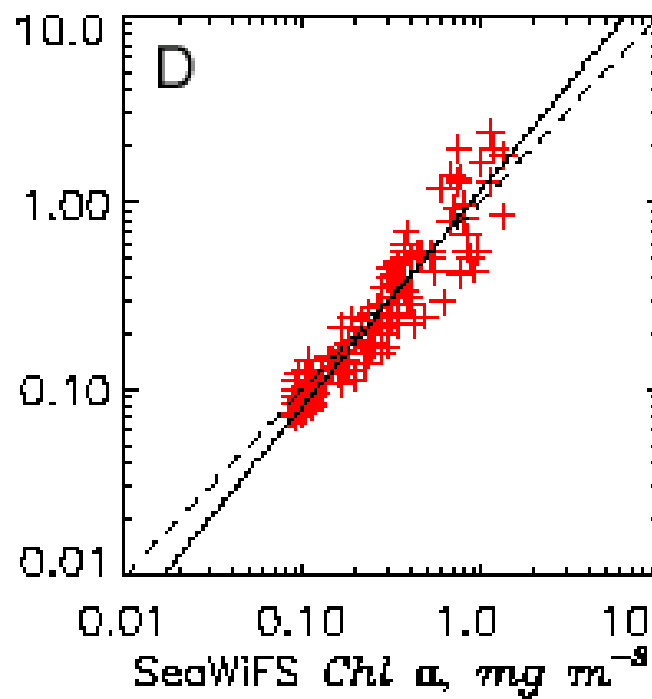
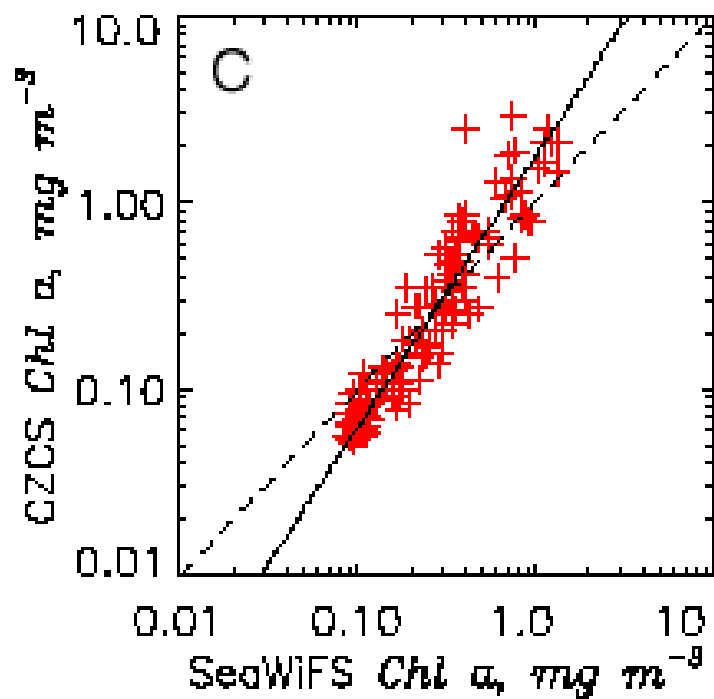
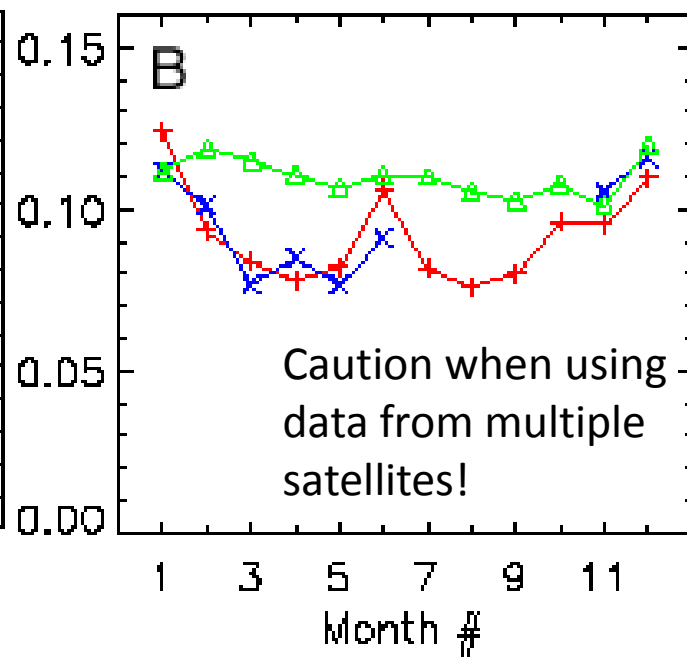
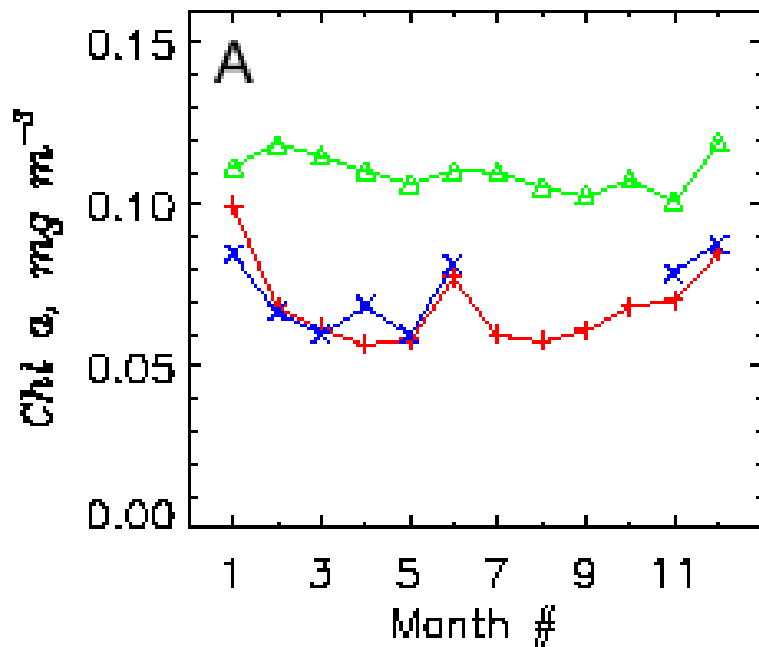
>11\*365 daily composites;

+ OCM, MODIS-Terra, MODIS-Aqua, MERIS, MOS, OSMI, ....

Several **AVHRR** sensors in orbit since 1978... => tens of thousands of daily passes;

SSM/I and other sensors.



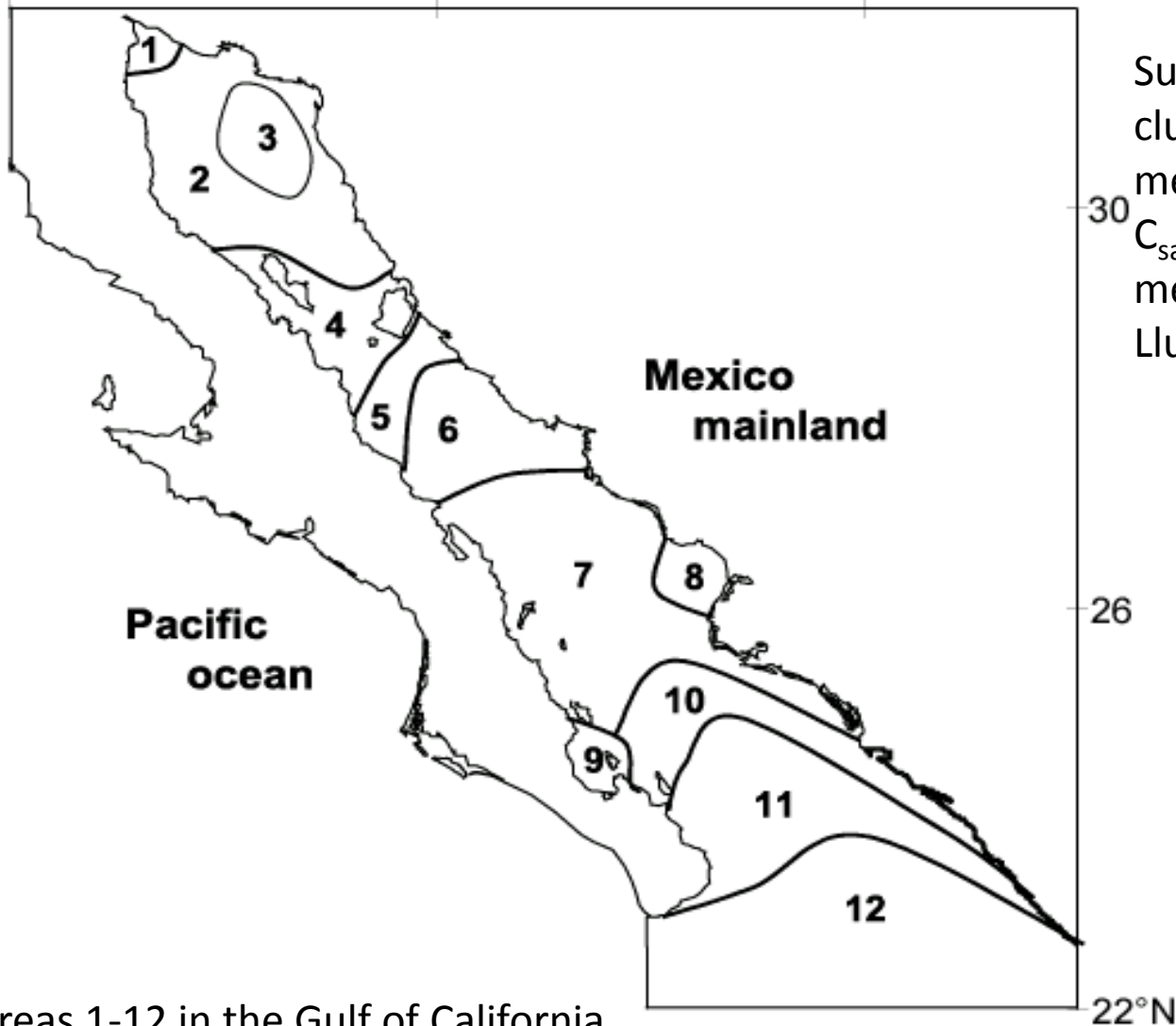




116°W

112

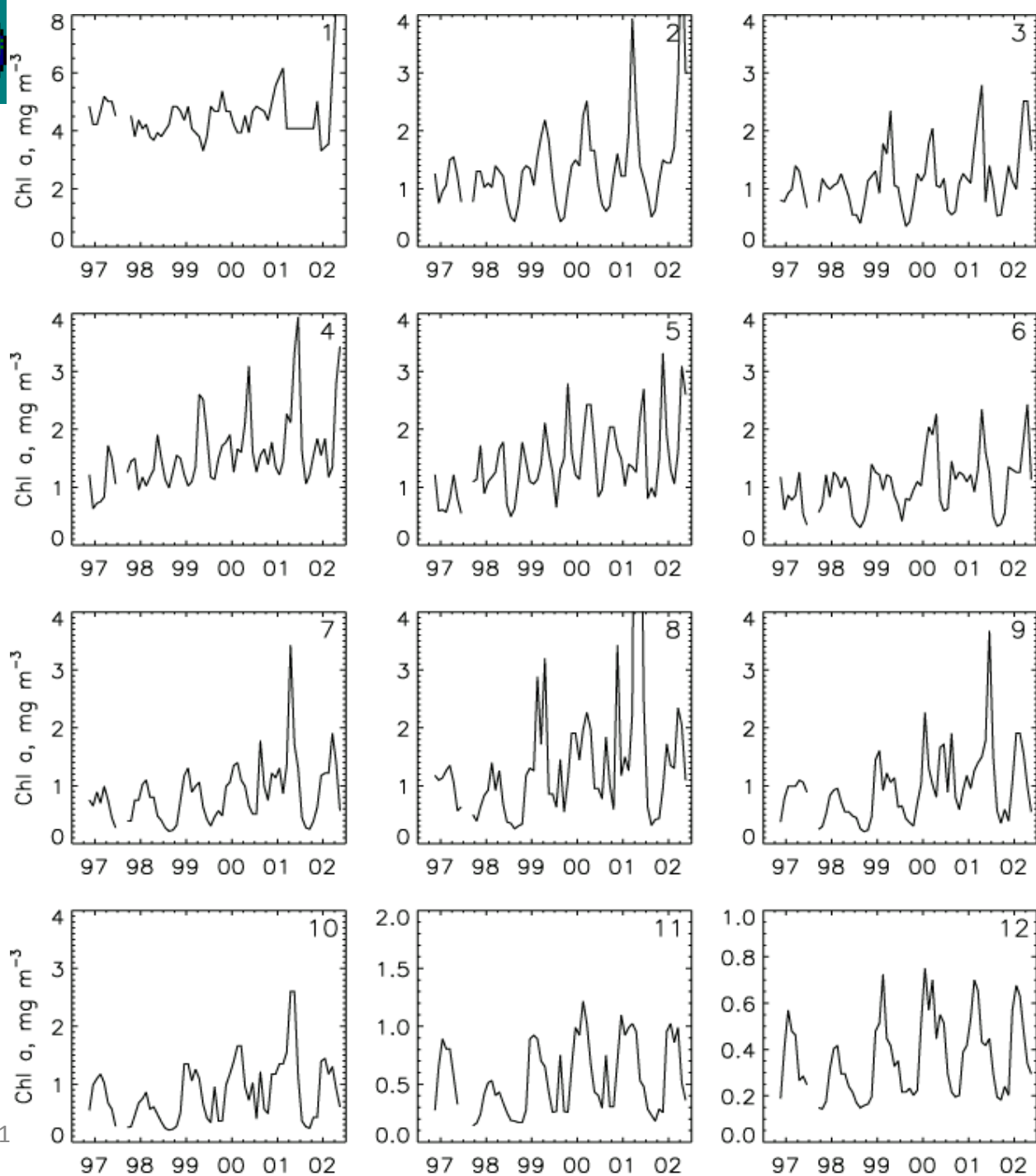
108



Sub-areas defined by cluster analysis of the mean annual cycle in  $C_{\text{sat}}$  based on CZCS measurements (S.E. Lluch-Cota).

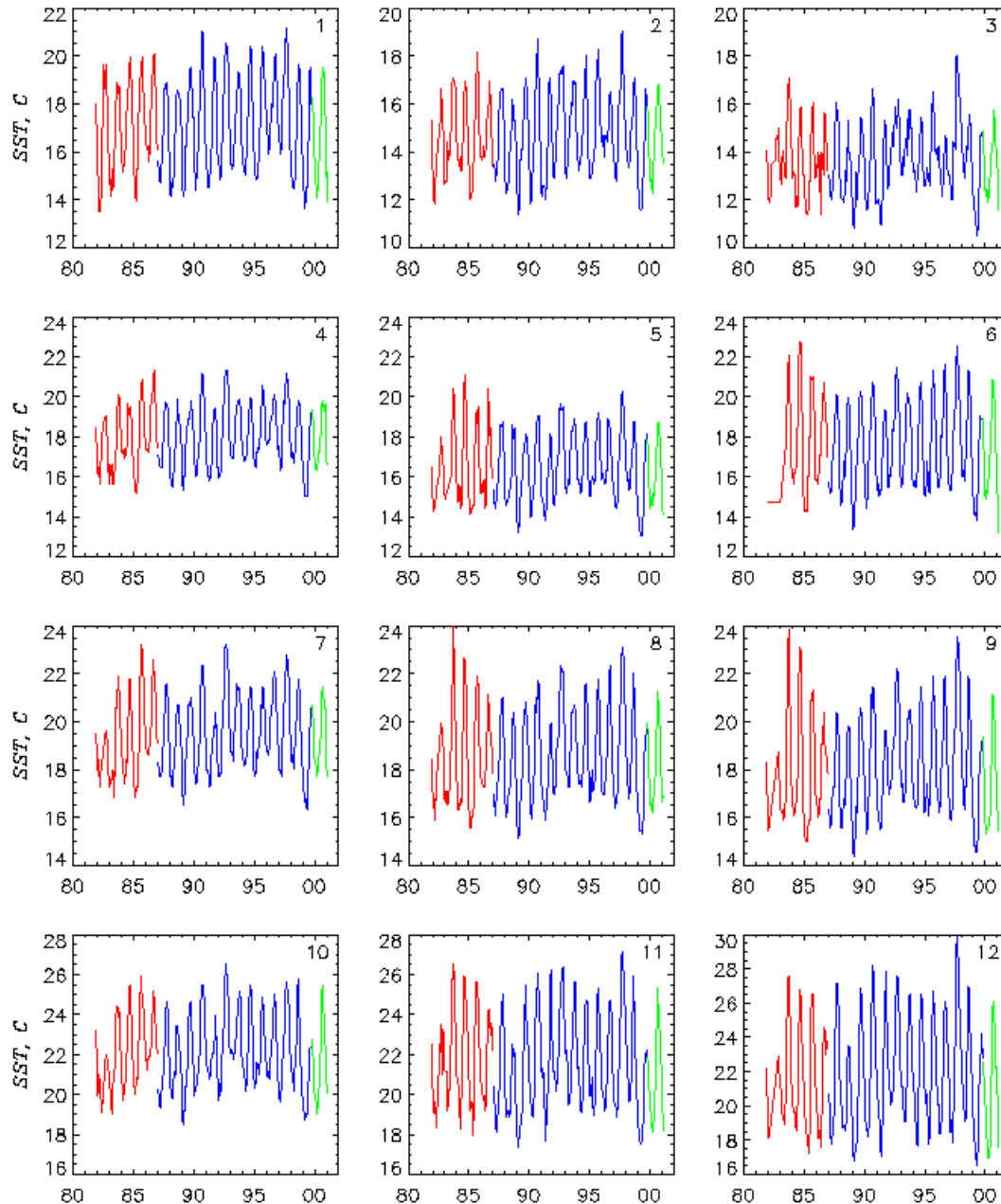
Sub-areas 1-12 in the Gulf of California.





Monthly time series of  $C_{\text{sat}}$  in sub-areas 1-12 showing the median for each sub-area.

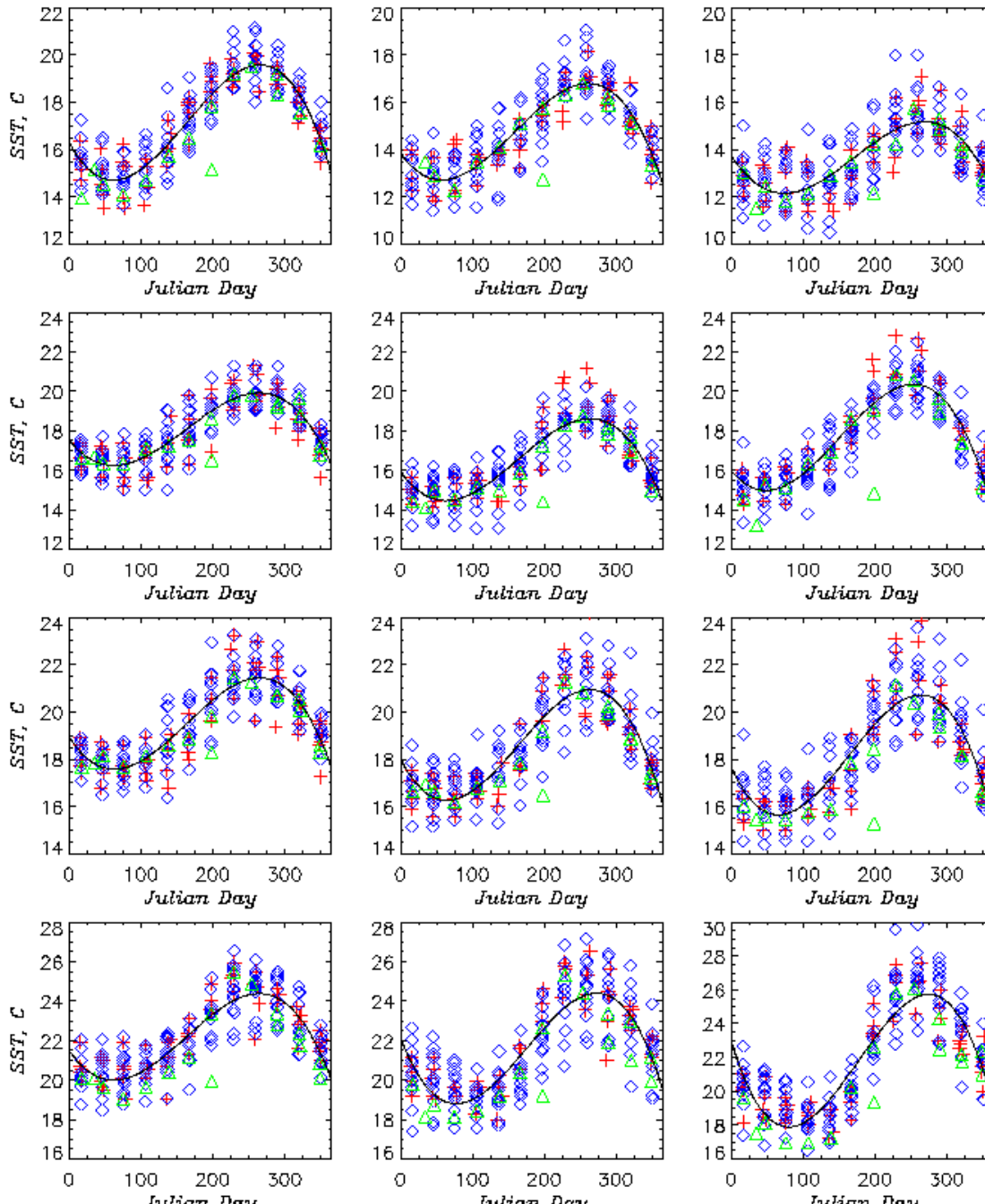




Monthly time series of SST in sub-areas of the CC showing the median for each sub-area using multiple AVHRR satellites and multiple datasets (different colors)

tahdi /apio>Last.pro Mon Apr 16 11:04:29 2001 meti

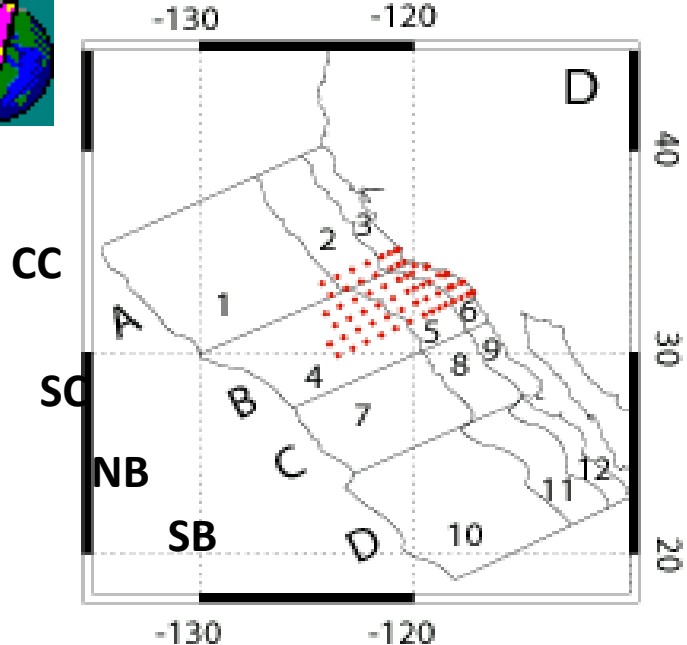




Create mean annual cycle to get anomalies versus the mean cycle.

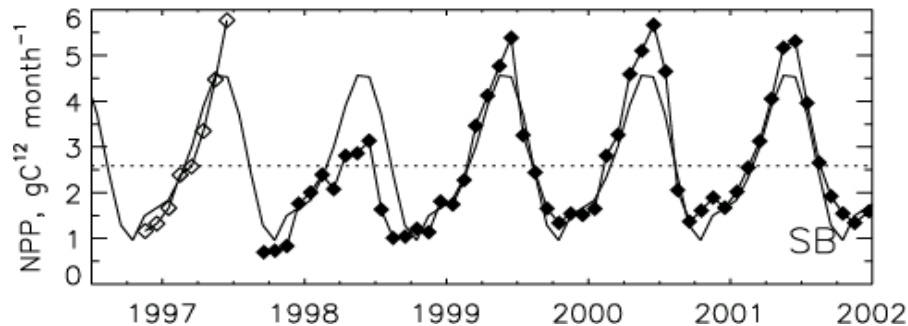
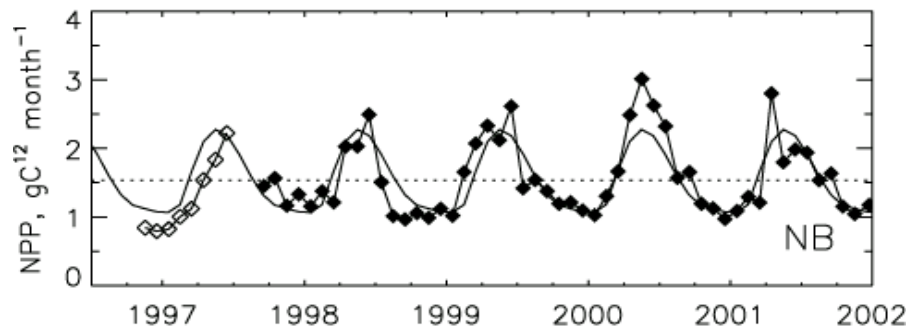
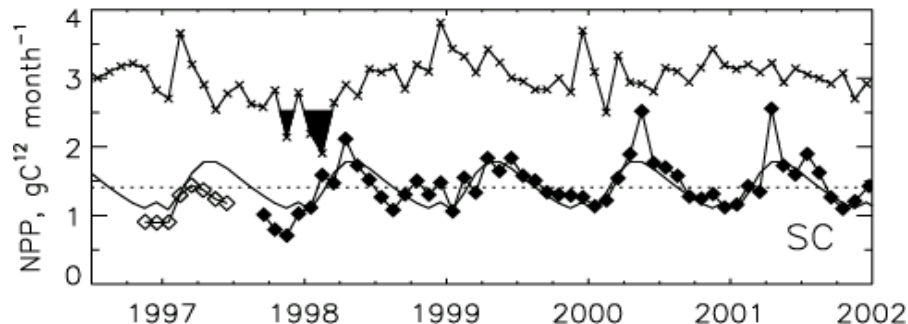
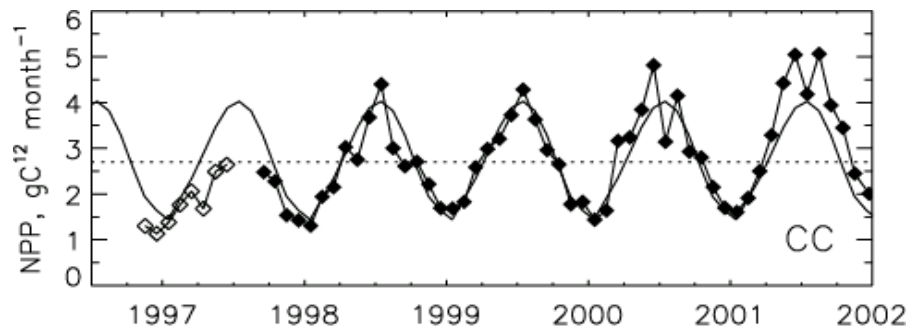
tahdt/seploc>Last.pro Mon Apr 16 11:04:29 2001 mazi





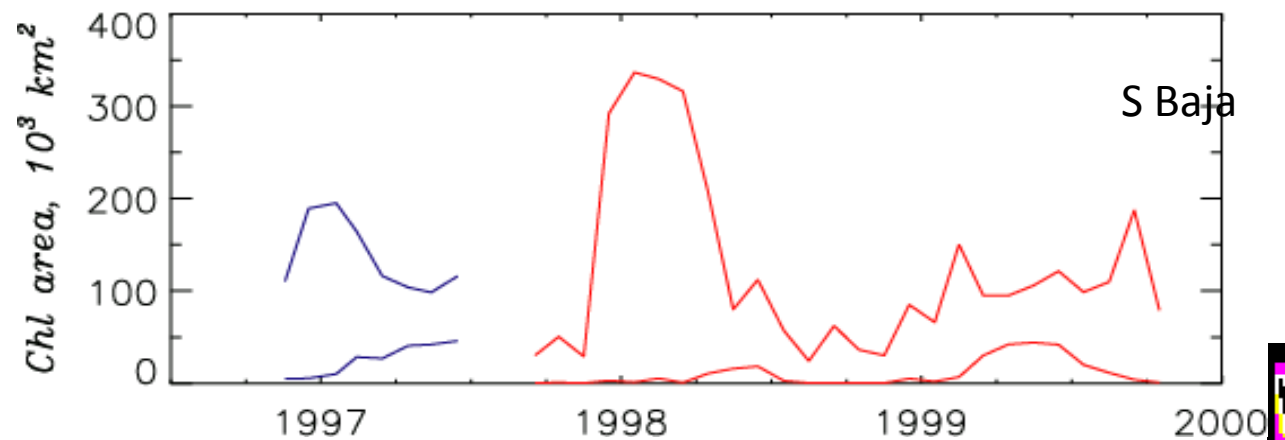
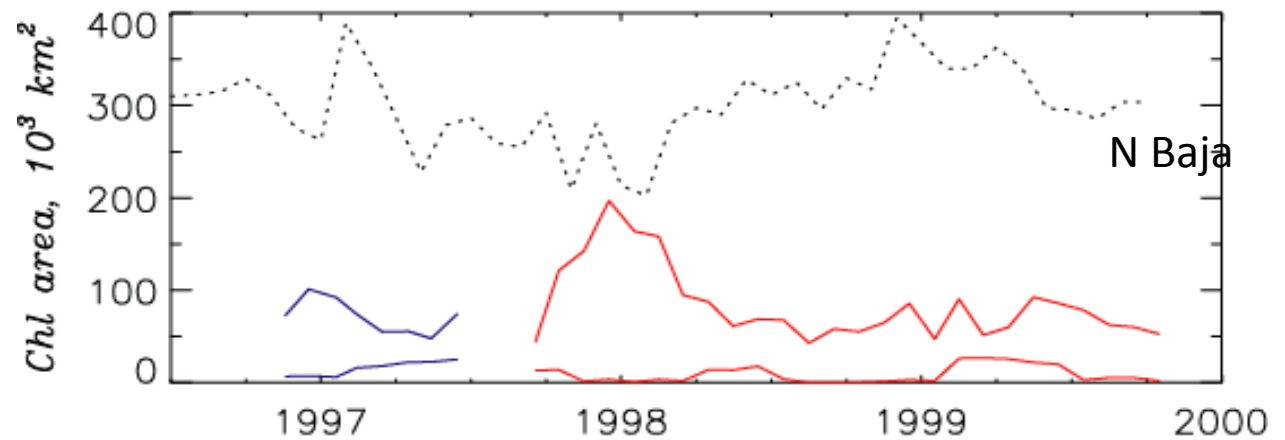
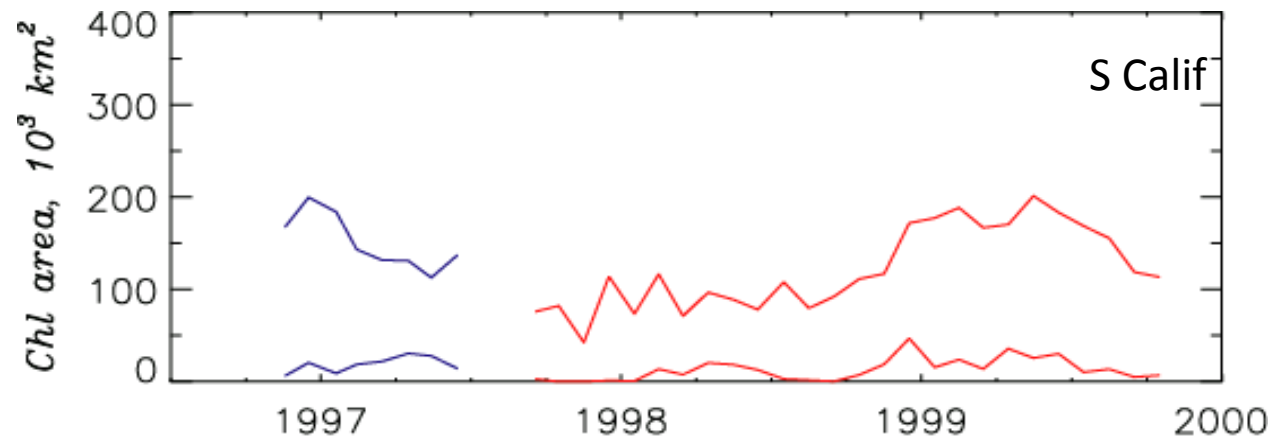
Time series of NPP in **0-100** km band in zones CC, SC, NB, SB calculated with Csat from OCTS ( $\diamond$ ) and SeaWiFS ( $\blacklozenge$ ) and compared with the mean annual cycle (solid line). The dotted horizontal line is the long-term mean. Minima in the Northern Oscillation Index ( $\times$ , relative scale) correspond to peaks in the El Niño (filled black areas).

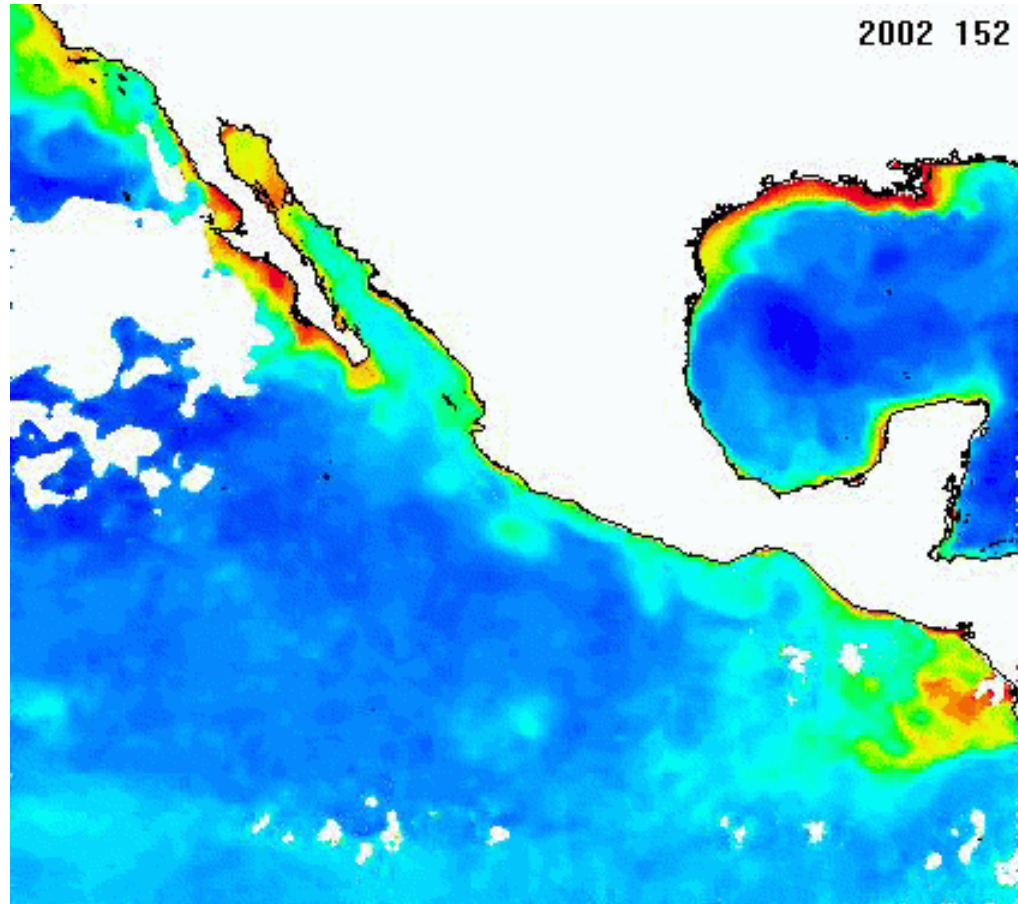
11/9/2008





Areal extent of mesotrophic (top line,  $0.2 < \text{Chl} \leq 1.0$ ), and eutrophic (bottom line,  $\text{Chl} > 1.0$ ) waters in Southern Calif., Northern and Southern Baja derived from OCTS and SeaWiFS data.

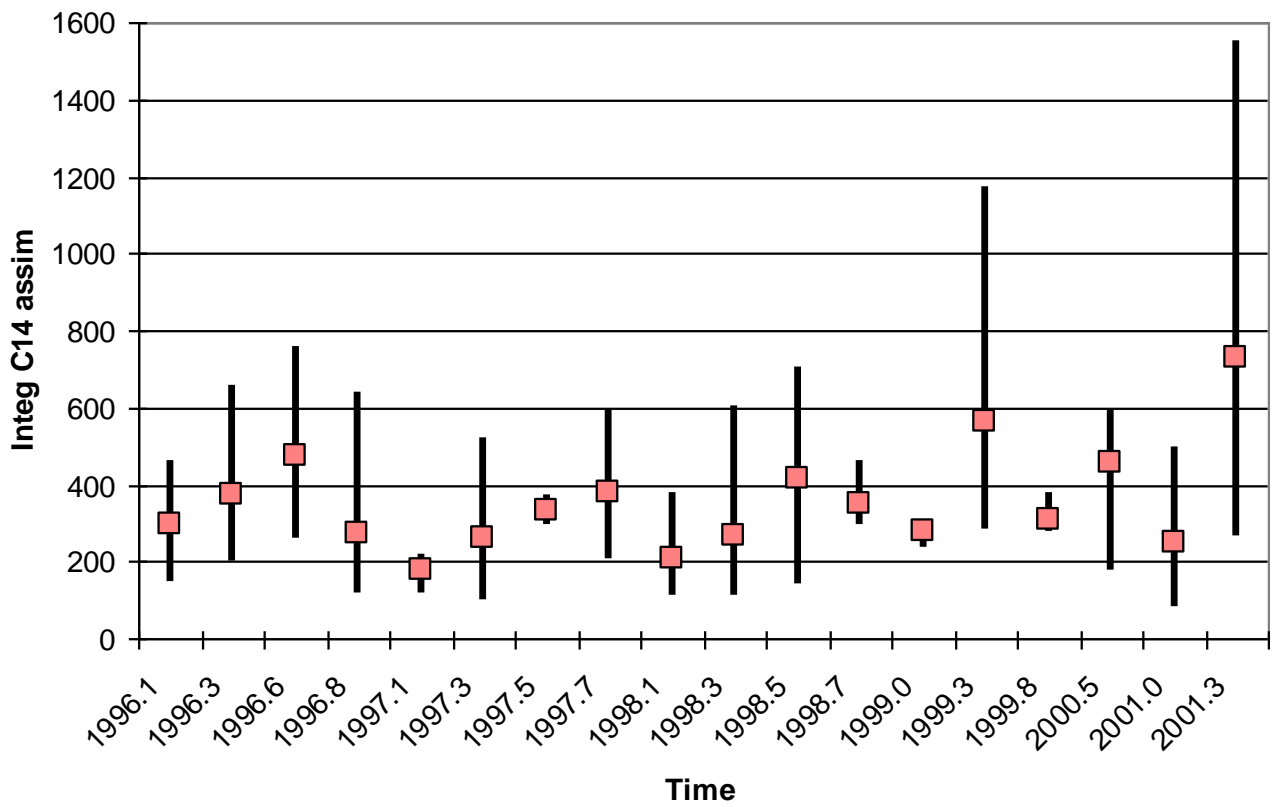
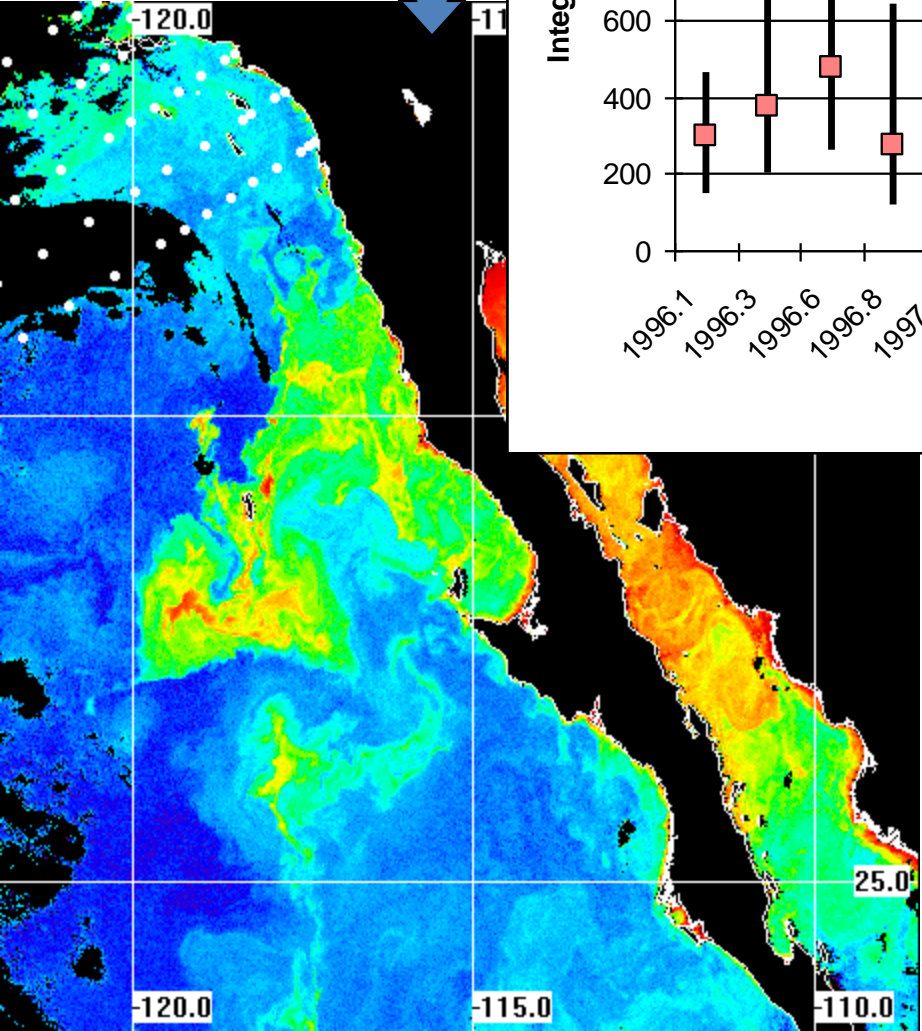






- Satellites cover large areas
- Good areal estimates

S1997307200439.L2\_HME

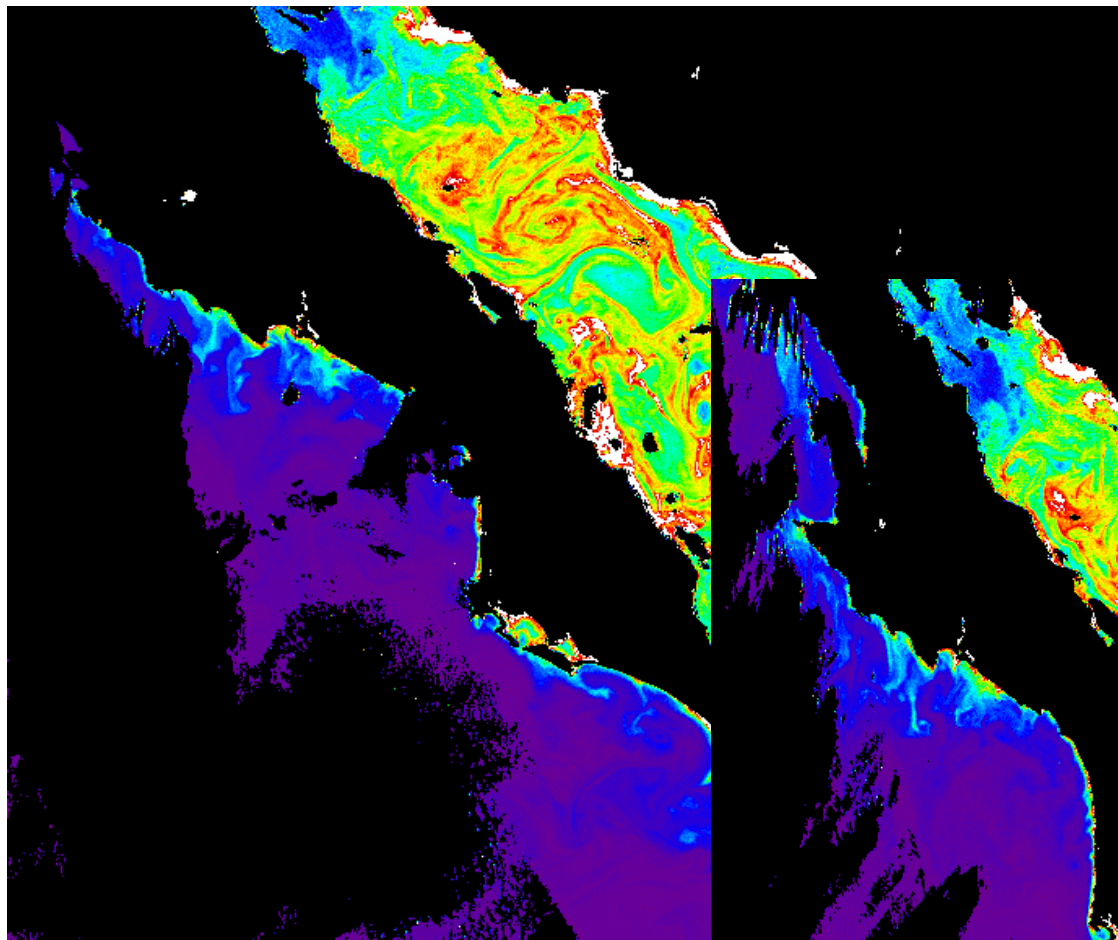


- PP measurements have very high variability
- Very time consuming
- CalCOFI: 1 PP station per day, 3-6 per area #5
- Very hard to get reliable averages over time and space

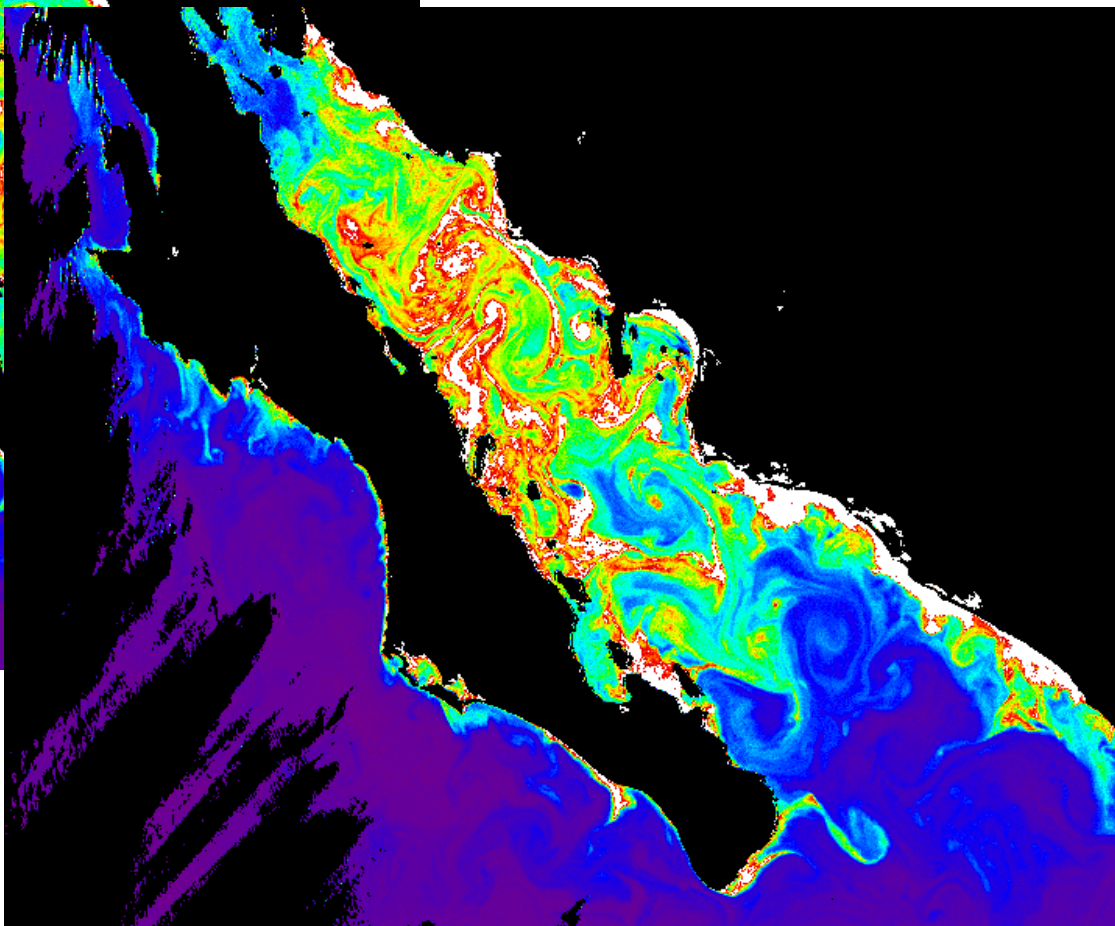




S1999018193513.L2\_HMBR

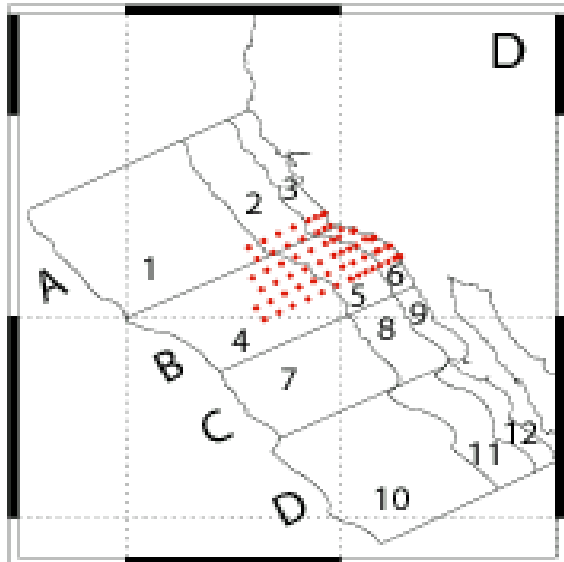
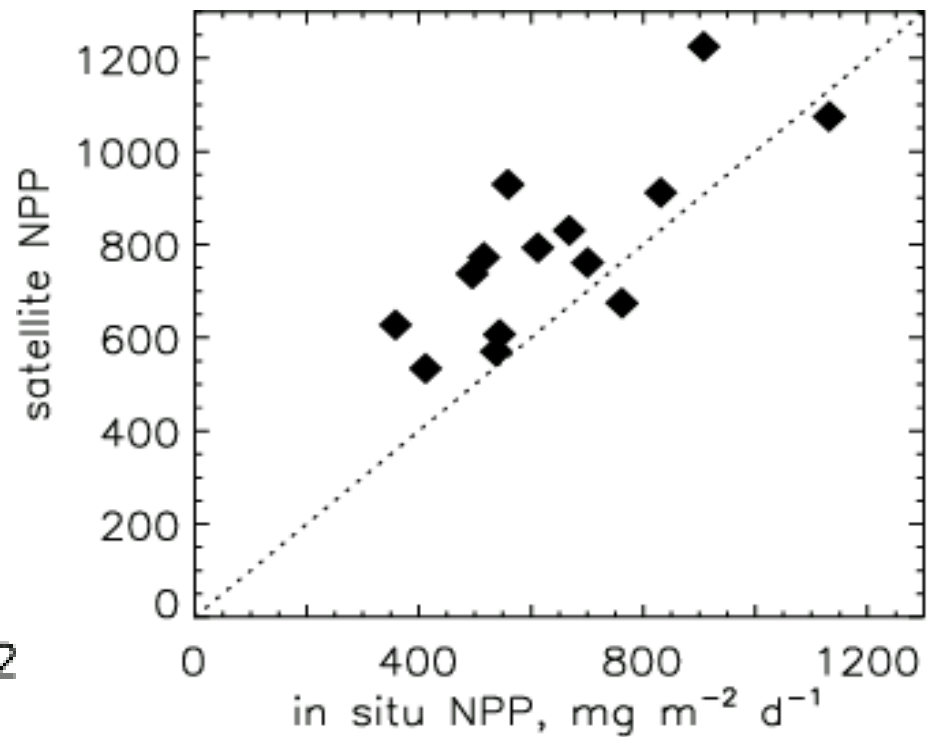
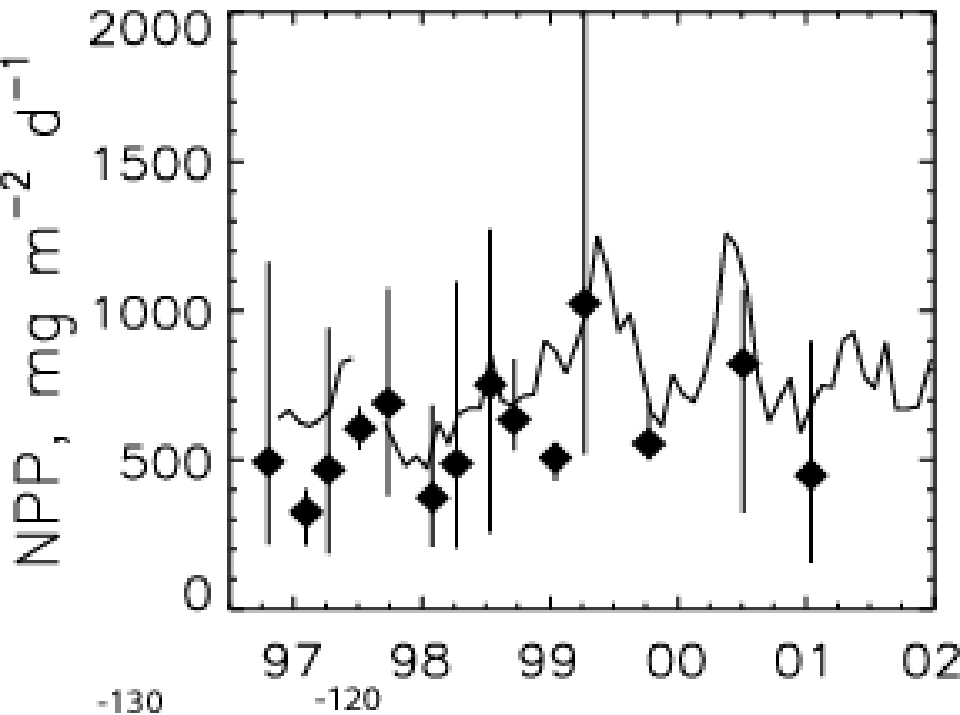


S1999020192603.L2\_HMBR





# Validation of satellite derived NPP vs. CalCOFI in situ



Satellite estimates of NPP versus ship measurements in the 100-300 km band off Southern California (area 5) with CalCOFI stations. The satellite estimate is the median for the area, the ship measurement is the mean of a few stations in that sub-area during a cruise. Reduced major axis regression: intercept = 183, slope = 1.04,  $r^2 = 0.59$ .





# Now is your term!

- Create your own area masks (e.g. on a blank global image, masks have values of 1, 2,...)
- Save the mask image as a HDF file
- Select a time series of images (in the same projection and size as the mask!), create a list file of images with the full pathname
- Run *wam\_statist*
- To make plots in *Excel*, sort the masked areas with *sortmasks*
- Make plots

