

A satellite image of Earth showing a large body of water with a prominent eddy or storm system. The eddy is depicted with a color gradient from blue (low values) to red and yellow (high values), indicating a low-pressure center. The surrounding ocean is shown in various shades of blue and green. The text is overlaid on a dark blue rectangular background in the upper left quadrant.

Exploiting the Capabilities of NASA's Giovanni System for Oceanographic Education

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A satellite image of Earth showing ocean color and cloud cover. The ocean is colored in shades of blue, green, and yellow, indicating different levels of chlorophyll concentration. Clouds are shown in white and grey. The landmasses are visible in brown and green.

✓ Where to find Giovanni !

Giovanni:

<http://giovanni.gsfc.nasa.gov/>

Ocean Color Giovanni:

<http://reason.gsfc.nasa.gov/Giovanni/>

Laboratory for Ocean Color Users (LOCUS)

<http://disc.sci.gsfc.nasa.gov/oceancolor/locus/index.shtml>



GOALS OF THIS PRESENTATION:

- ✓ Describe the Giovanni system
- ✓ Demonstrate Giovanni output types

A satellite image of Earth's oceans with a color overlay representing ocean color data. The colors range from blue (low chlorophyll) to red and yellow (high chlorophyll), indicating areas of high biological productivity. The overlay is most prominent in the central and eastern equatorial Pacific and the Indian Ocean.

✓ The Giovanni system

Giovanni is a Web-based data exploration system that enables **rapid** data access, analysis, and visualization online – users do not have to download data files to their own system before initiating analysis and research

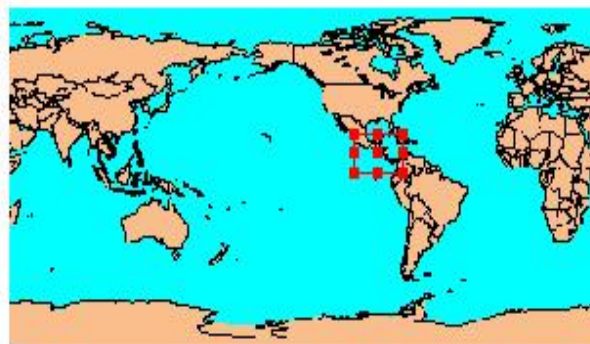
Ocean Color Giovanni contains data from the SeaWiFS and MODIS-Aqua missions; other “instances” of Giovanni have data from other satellite missions, and supplemental data sets

✓ The Giovanni system

The main components of the Giovanni interface are:

- interactive map for region-of-interest selection;
- menu of available data products;
- calendar menu for time-period selection;
- menu of visualization options;
- visualization-specific options (color palette, axis values);
- menu of output options

Click and drag to select area; or input latitudes (-90, 90) and longitudes (-180.0 ~ 180.0) or
[Click for non Java/JavaScript version](#)
[More information on supported browsers and platforms](#)



North latitude

23.0 N

West

East

102.0 W

72.0 W

South latitude

2.0 N

Zoom In

Zoom Out

Parameters:

- Chlorophyll a concentration
- Angstrom coefficient 510 to 865 nm
- Diffuse attenuation coefficient at 490 nm
- Normalized water-leaving radiance at 555 nm
- Aerosol optical thickness at 865 nm

Data Type: Parameter

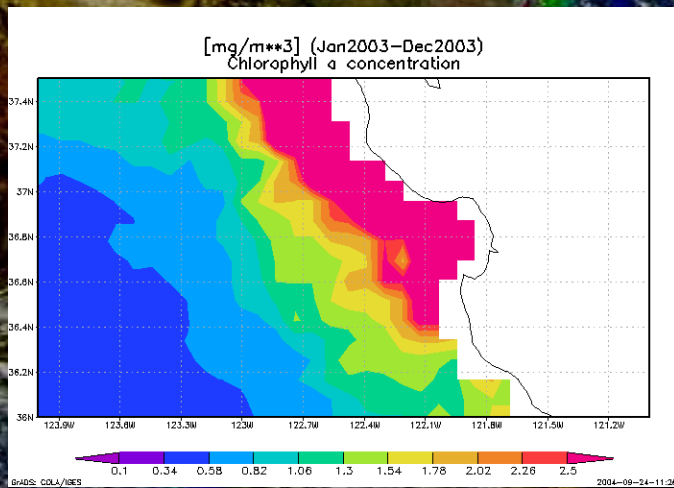
Plot Type: Lat-Lon Map, Time-averaged

Begin Year: 2000 Begin Month: February (Date Begin: 1997/09/01)

End Year: 2000 End Month: February (Date End: 2006/05/31)

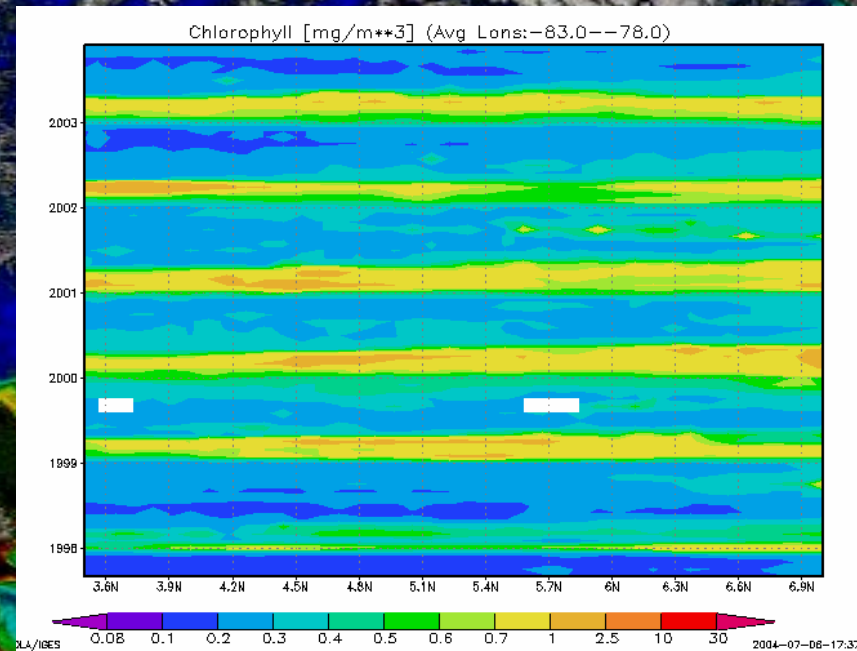
✓ Giovanni output types

Area plot

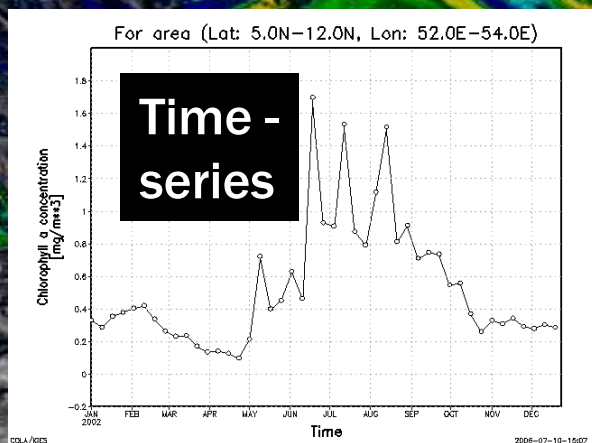


Animations display successive area plots

Hövmoller plots

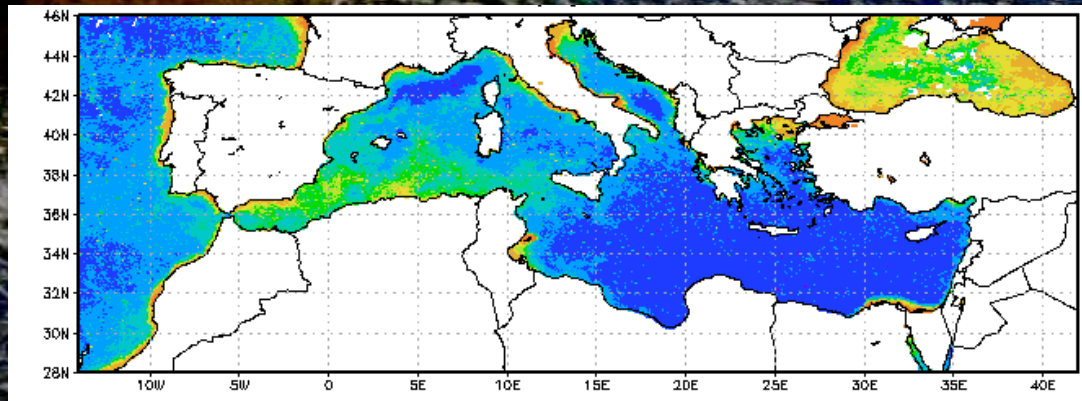


ASCII text output currently available; next-generation Giovanni will provide ASCII and HDF file output

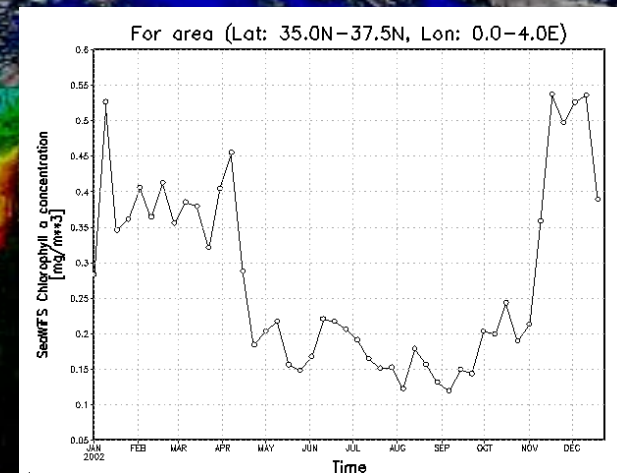


✓ Giovanni output types:
Examples of visualization-specific options

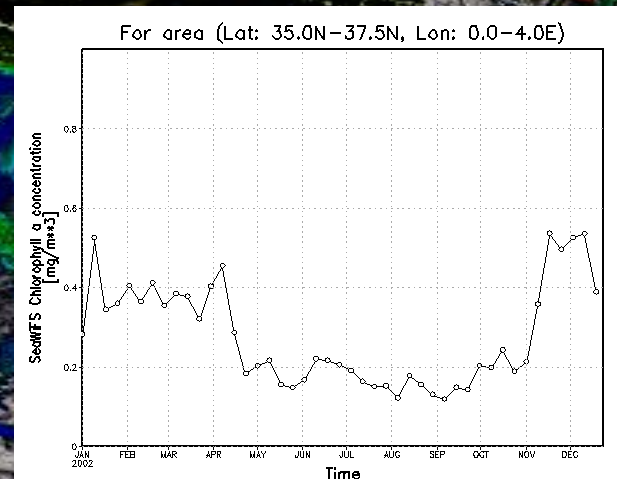
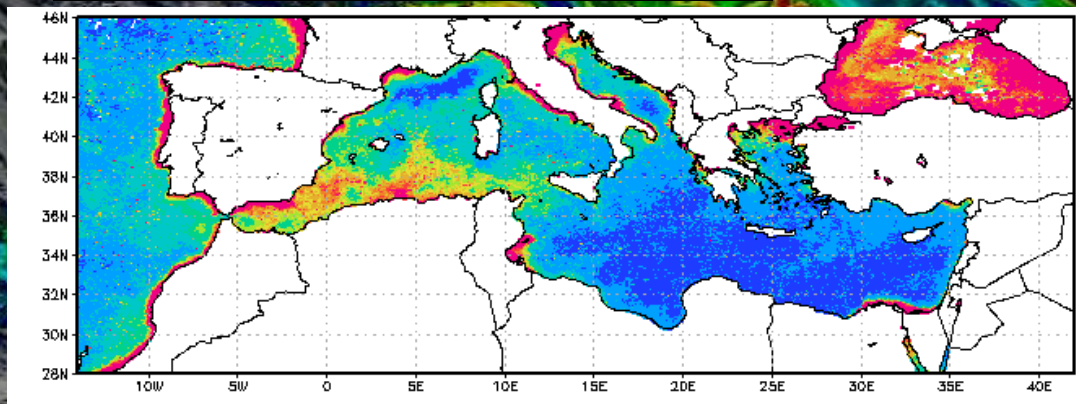
Pre-defined color palette



Y-axis customization



Customized color palette

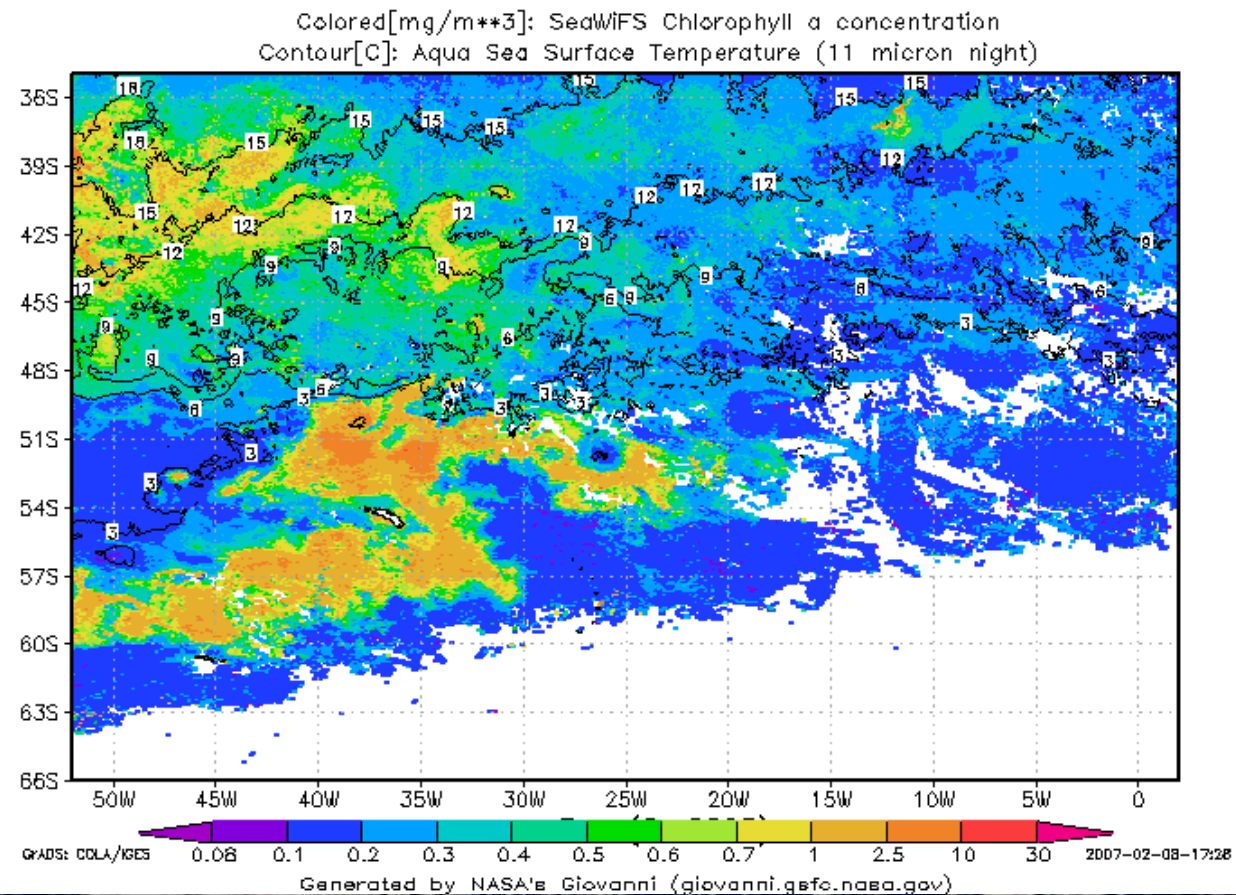


✓ Giovanni output types

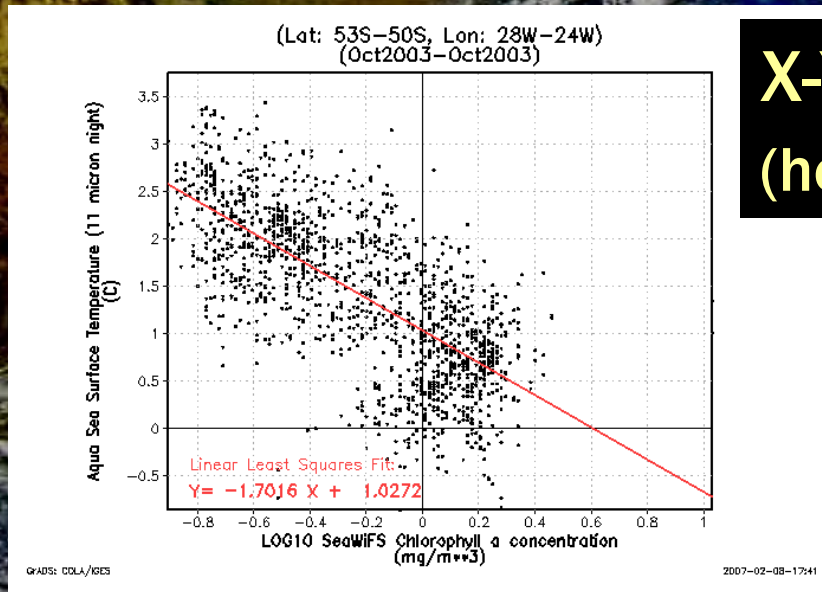
The Multi-Dataset Intercomparison Interface available in Ocean Color Giovanni (similar capabilities are being developed for other Giovanni interfaces) provides additional output types

Multiple data
product
area plot:

Sea surface
temperature
(contours) and
chlorophyll
concentration
(color scale)

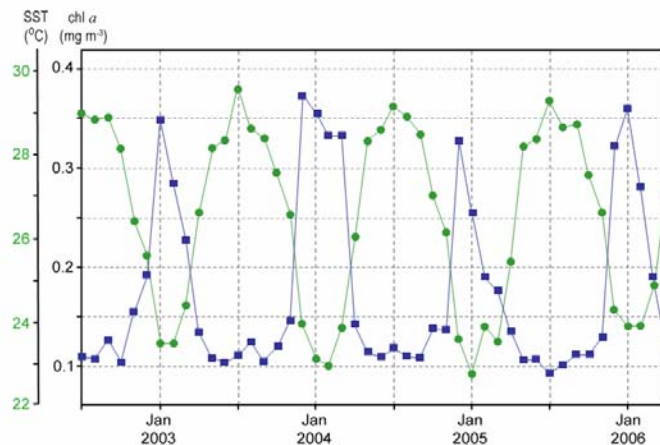


✓ Giovanni output types



X-Y scatter plots
(here, SST vs. chlorophyll)

Multiple data product
time-series
(here, SST vs. chlorophyll,
in a Giovanni output figure
adapted for publication)



A satellite image of the ocean showing various colors representing different data products. A semi-transparent grey box with a black header is overlaid on the image. The header contains a white checkmark and the text 'Giovanni output types'. Below the header, a list of seven data products is presented, each preceded by a green diamond symbol. The background image shows a mix of blue, green, and brownish colors, indicating different oceanographic conditions.

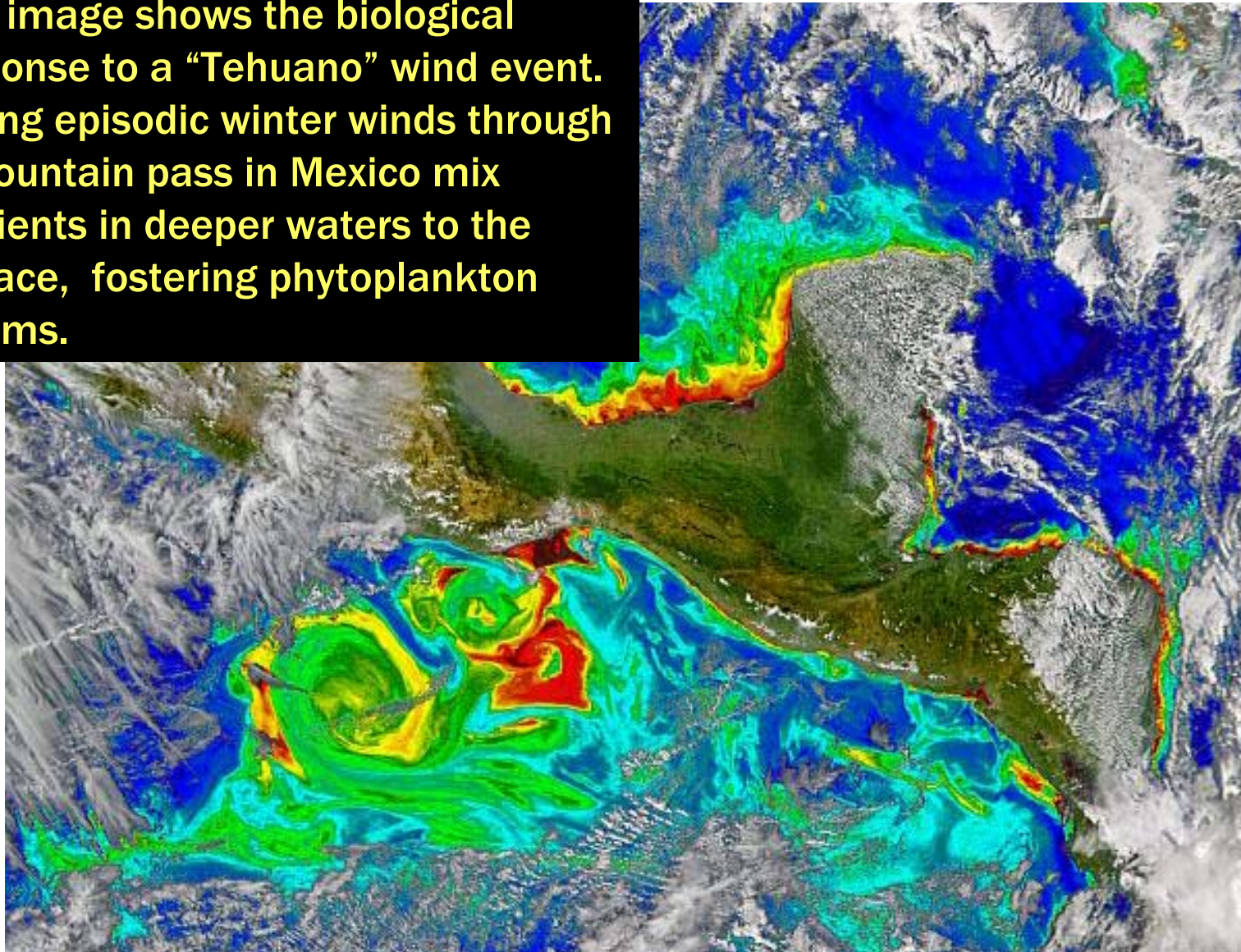
✓ Giovanni output types

Ocean Color Giovanni currently provides these oceanographic data products for visualization and analysis:

- ❖ Chlorophyll concentration
- ❖ Diffuse attenuation coefficient at 490 nm
- ❖ Normalized water-leaving radiance at 555 nm (SeaWiFS) or 551 nm (MODIS)
- ❖ Absorption coefficient of dissolved and detrital matter at 443 nm
- ❖ Particulate backscatter coefficient at 443 nm
- ❖ Sea surface temperature (MODIS)
- ❖ Assimilated chlorophyll and other output fields from the NASA Ocean Biogeochemical Model (NOBM)

What are we looking at here?

This image shows the biological response to a “Tehuano” wind event. Strong episodic winter winds through a mountain pass in Mexico mix nutrients in deeper waters to the surface, fostering phytoplankton blooms.





Schematic showing process of upwelling in the eastern equatorial Pacific region

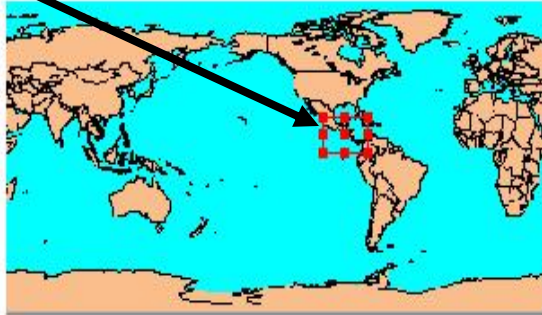
Demonstration Project : Central America (Wind-driven productivity and El Niño anomalies)

Goal: Create chl *a* anomaly plots and Hovmöller plots

First: "Back" to entry page; select SeaWiFS Monthly data. Then:

1. Choose the Region
2. Select February 2000
3. Generate the Lat/Lon map
4. Change "Data Type" to Anomaly
5. Change the month to February 1998
6. Generate the Lat/Lon map
7. Choose a region inside a jet
8. Change "Data Type" to "Time-Lon Hovmöller, Lat-Averaged"
9. Choose Oct 97-Dec 2000
10. Generate the plot

Click and drag to select area; or input latitudes (-90, 90) and longitudes (-180.0 ~ 180.0) or [Click for non Java/JavaScript version](#)
[More information on supported browsers and platforms](#)



North latitude:

West: East:

South latitude:

Parameters:

Angstrom coefficient 510 to 865 nm
Diffuse attenuation coefficient at 490 nm
Normalized water-leaving radiance at 555 nm
Aerosol optical thickness at 865 nm

Data Type:

Plot Type:

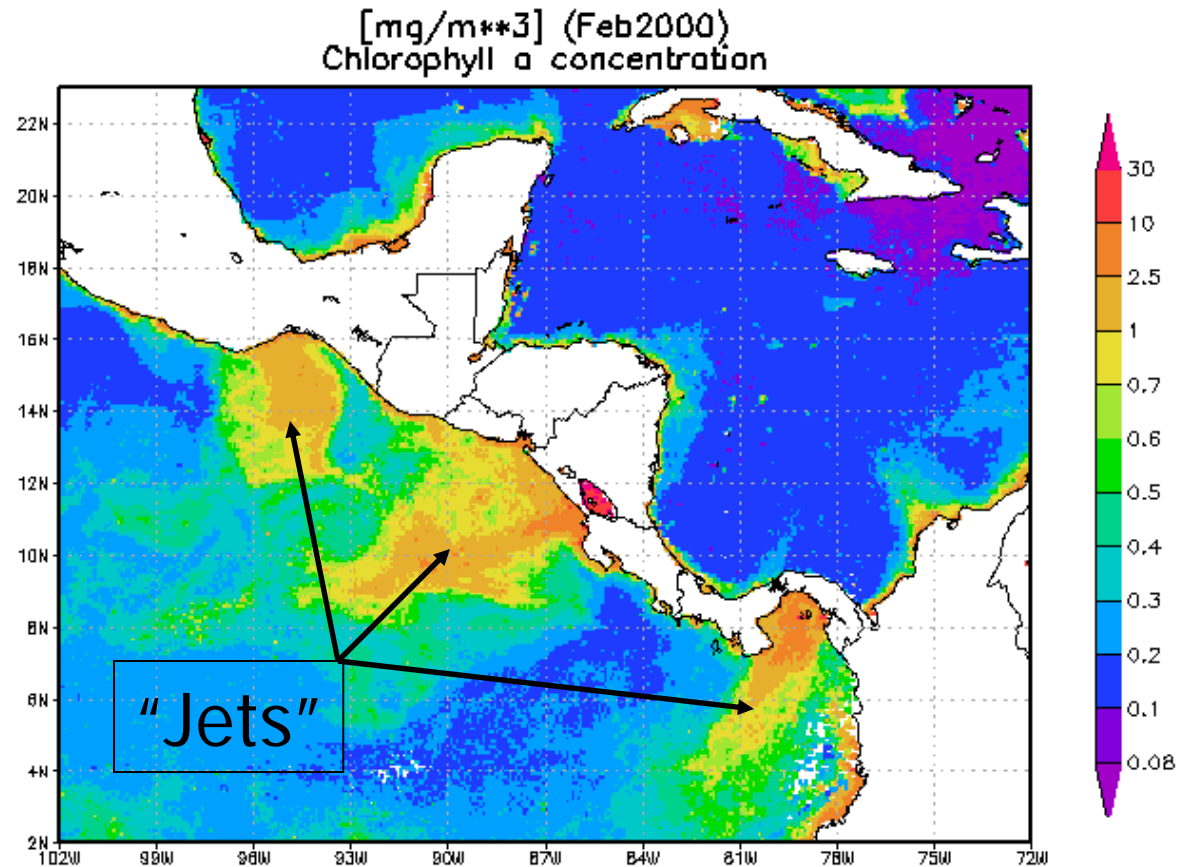
Begin Year: **Begin Month:** (Date Begin: 1997/09/01)

End Year: **End Month:** (Date End: 2006/05/31)

Demonstration Project : Central America Sea Surface Temperature

- Go to GIOVANNI: <http://reason.gsfc.nasa.gov/Giovanni>
- Choose “OBPG MODIS/AQUA Monthly Global 9 km Products” (JAVA Version)
- Enter the following limits for the area of interest:
23.0 N
102.0 W 72.0 W
2.0 N
- Click on sea surface temperature (11 micron day)
- Enter desired interval and month (Dec 2006 – Feb 2007)
- Click “Customized” color option: Min 25.0, Max 31.0
- Click “Generate Plot” and save image

Demonstration Project: Central America (Wind-driven productivity and El Niño anomalies)

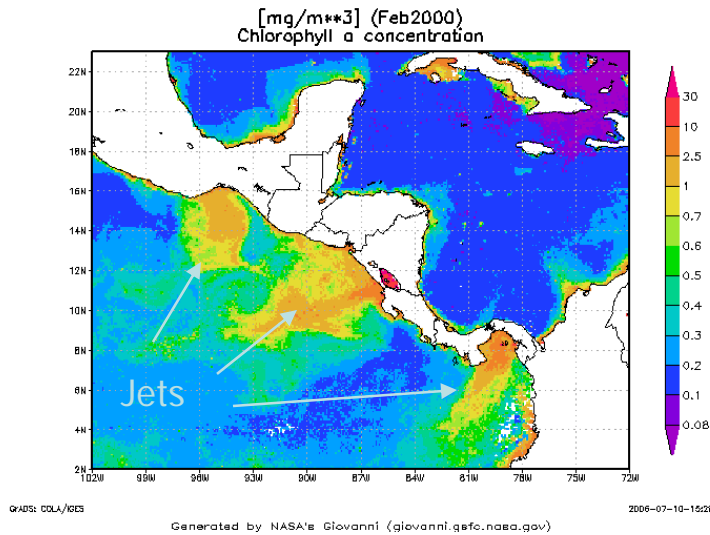


GRADS: CCLM/IGES

Generated by NASA's Giovanni (giovanni.gsfc.nasa.gov)

2006-07-10-15:29

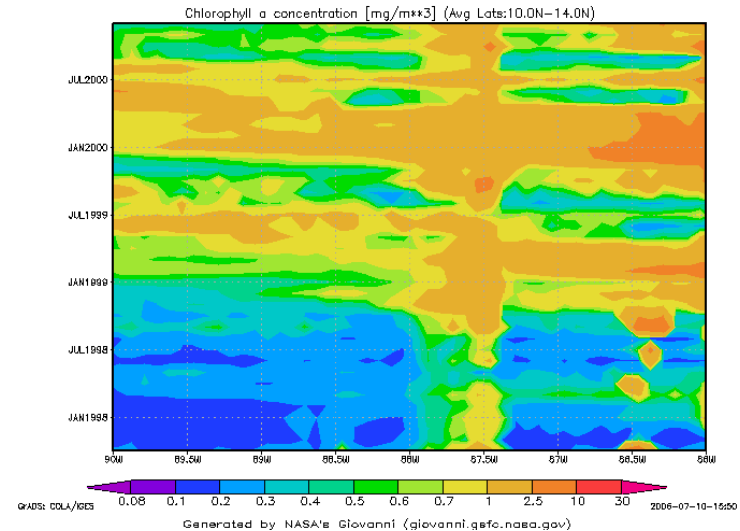
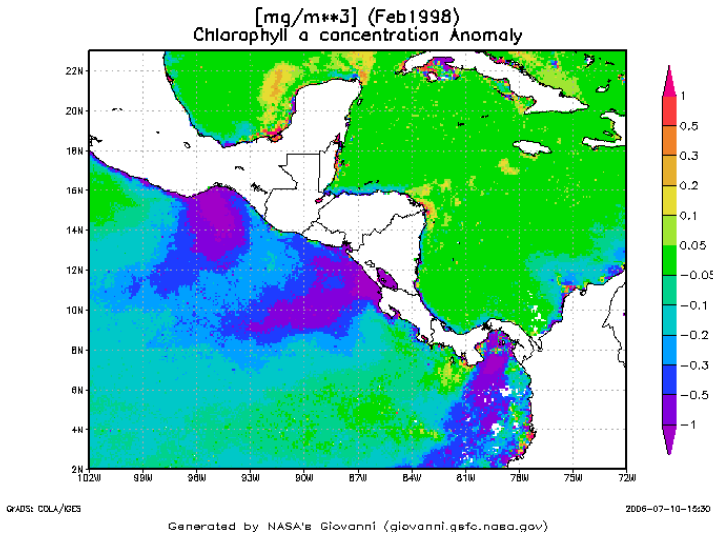
Demonstration Project : Central America (Wind-driven productivity and El Niño anomalies) Output



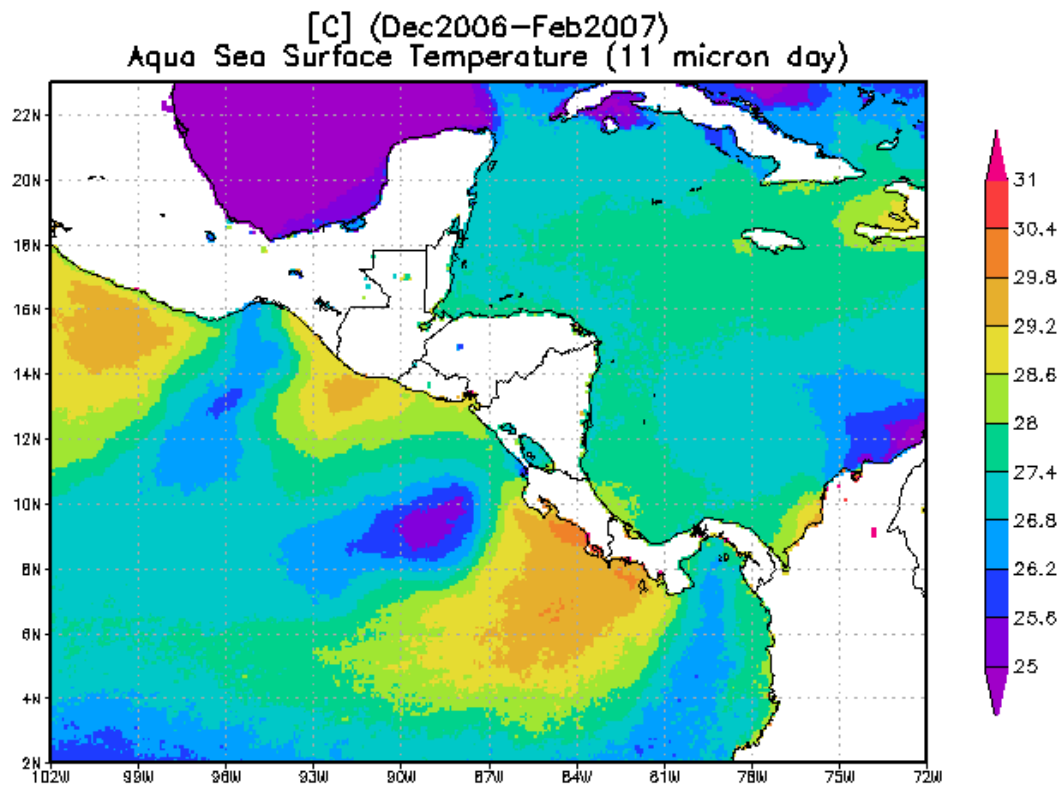
Productivity driven by gap winds dominates this region during normal winter months

During the 1997-1998 El Niño, productivity was markedly suppressed due to increased thermocline depth (negative anomalies are blue and purple)

The Hovmöller plot demonstrates the seasonality of the phenomenon and the effect of the 1997-1998 El Niño



There is also a clear, recognizable sea surface temperature signature of these events.



GRADS: CCLM/IGES

Generated by NASA's Giovanni (giovanni.gsfc.nasa.gov)

2007-07-12-21:46

The wind events only persist for a few days at a time, but this is enough to cool the waters sufficiently so that the SST “signature” appears in the monthly averaged data. Actually, when the winds ebb, the cold water sinks, and only appears again when the next wind event occurs.

Exploration of Satellite-Derived
Ocean Color and Sea Surface
Temperature Data:
*The Southwest Monsoon
in the Arabian Sea*

NASA's Ocean Color Online
Visualization and Analysis System

<http://reason.gsfc.nasa.gov/Giovanni>

Observing the Arabian Sea Monsoon

- Monthly averages of MODIS Chlorophyll a and sea surface temperature for April through September 2004
- Strong southwesterly monsoon winds drive upwelling along the coasts of Somalia and Oman
- High concentrations of Chlorophyll a (plankton) are correlated with cold upwelled water

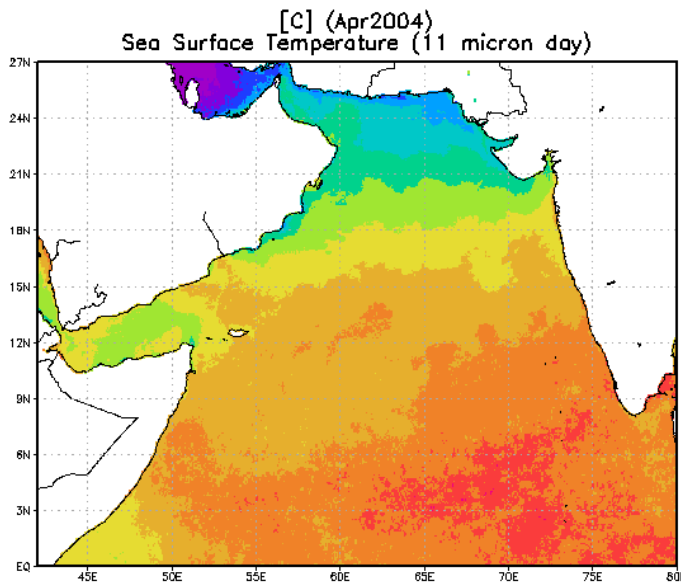
Southwest Monsoon Study

Step-by-Step Instructions

- Go to GIOVANNI: <http://reason.gsfc.nasa.gov/Giovanni>
- Choose “OBPG MODIS/AQUA Monthly Global 9 km Products” (JAVA Version)
- Enter the following limits for the large area of interest:
27N
42E 80E
0.0N
- Click on sea surface temperature (11 micron day)
- Enter desired year and month (2004 April)
- Use the “customized” color option, and set the Min and Max limits to 24 and 32
- Click “Generate Plot” and save image
- Generate these plots for each month, April through September 2004.

April 2004

SST

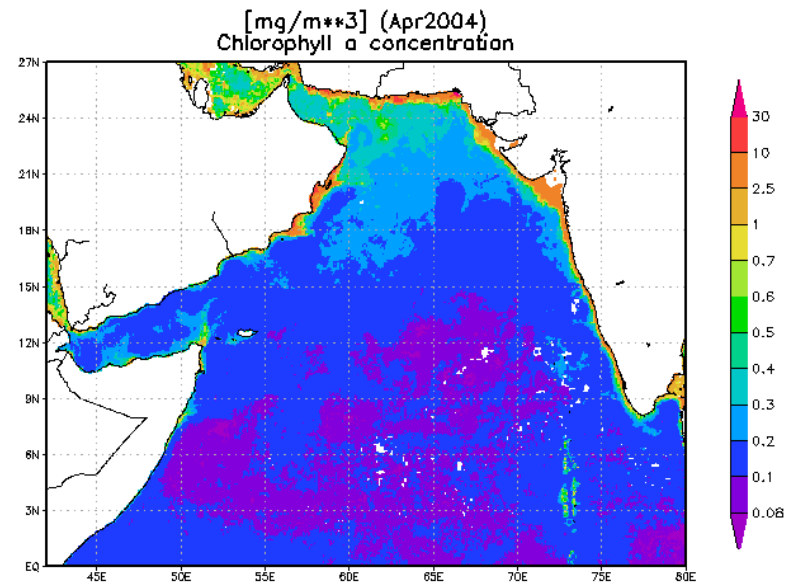


QADS: CDLA/ICES

Generated by NASA's Giovanni (giovanni.gsfc.nasa.gov)

2006-07-24-23:13 LA/ICES

Chlorophyll a



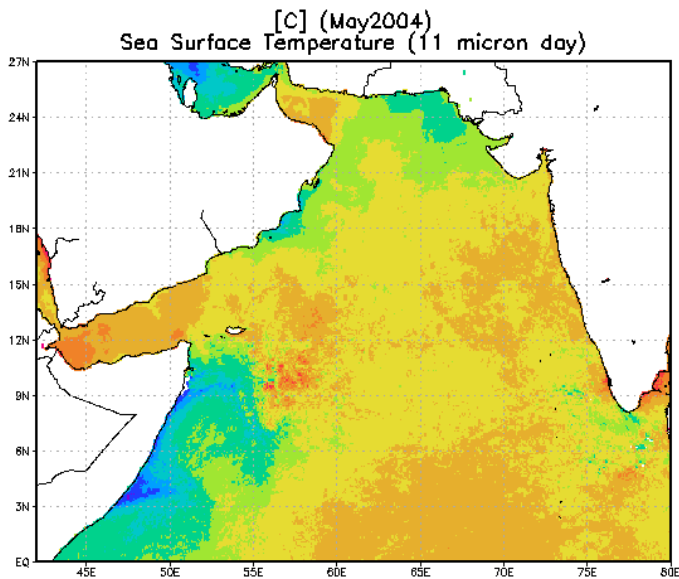
2006-07-24-23:26

Generated by NASA's Giovanni (giovanni.gsfc.nasa.gov)

Transition period between the Northeast (Winter) Monsoon and the Southwest (Summer) Monsoon

May 2004

SST



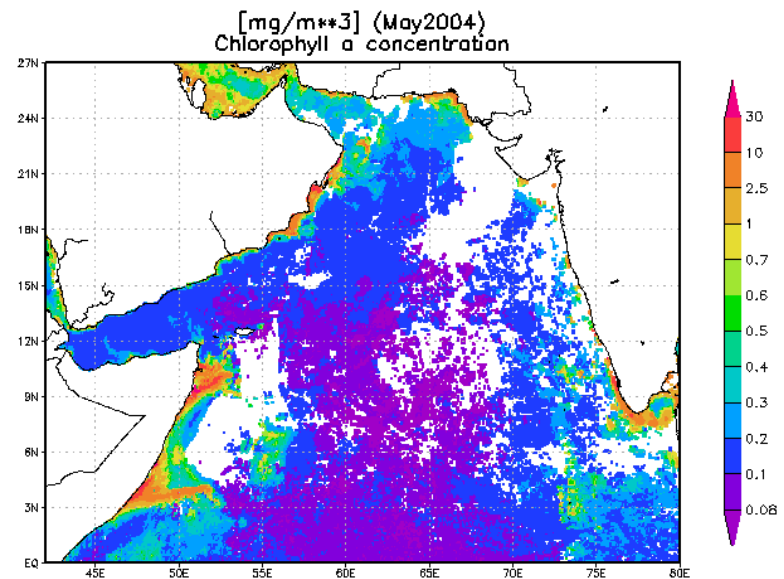
GRADS: COLA/IGES

Generated by NASA's Giovanni (giovanni.gsfc.nasa.gov)

2006-07-24-23:12

DLA/IGES

Chlorophyll a



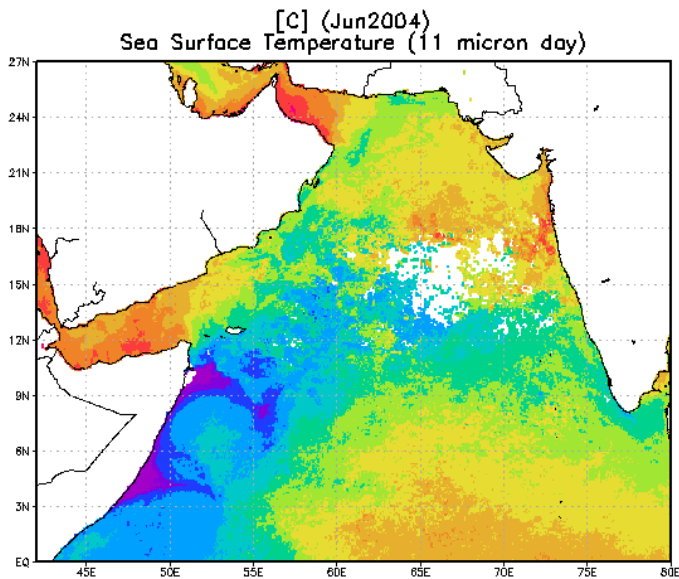
Generated by NASA's Giovanni (giovanni.gsfc.nasa.gov)

2006-07-24-23:26

Wind-driven upwelling begins along the coasts of Somalia and Oman, as evidenced by cold water and increased chlorophyll concentrations

June 2004

SST



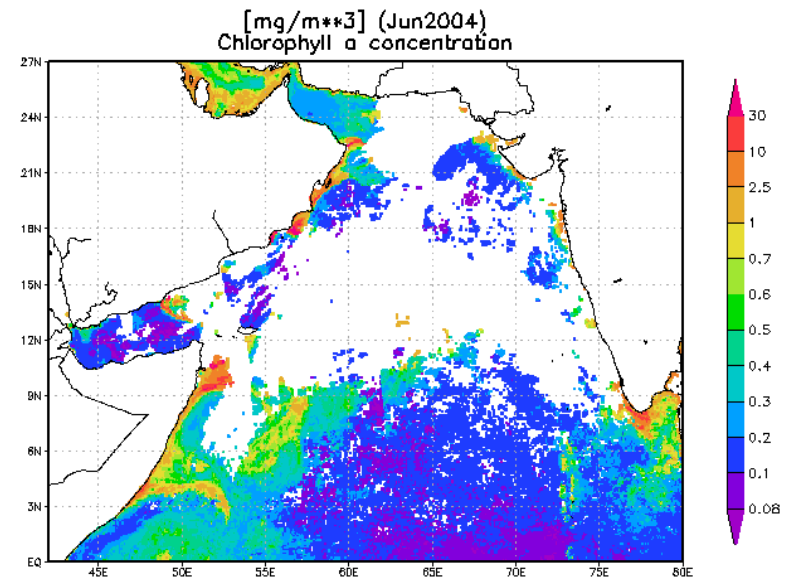
GRADS: COLA/IGES

Generated by NASA's Giovanni (giovanni.gsfc.nasa.gov)

2006-07-

GRADS: COLA/IGES

Chlorophyll a



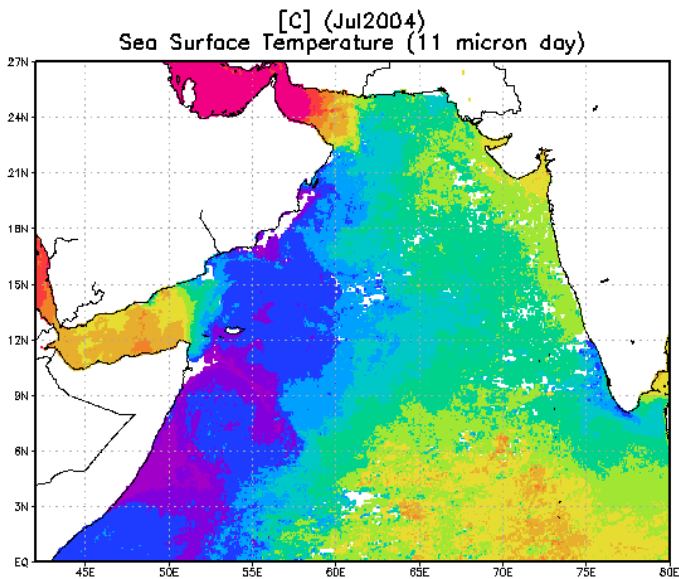
2006-07-24-23225

Generated by NASA's Giovanni (giovanni.gsfc.nasa.gov)

Upwelling increases; coastal upwelling jets are evident in SST and chlorophyll concentrations

July 2004

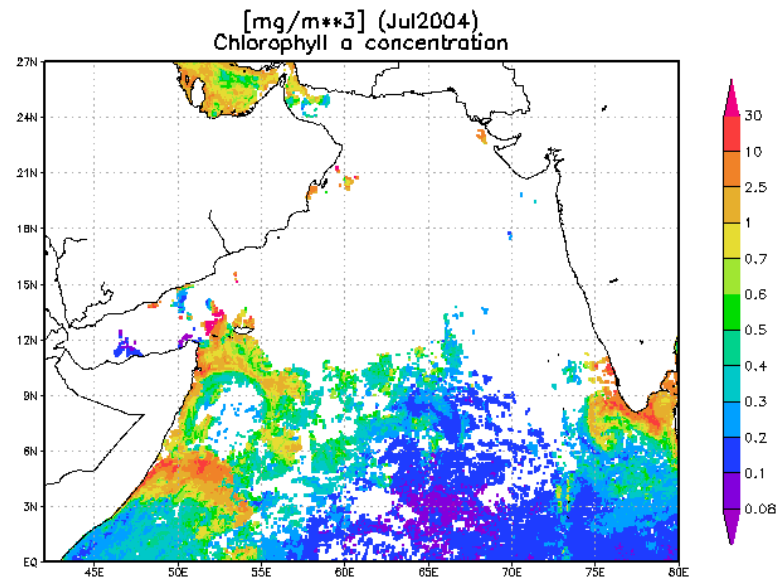
SST



GRADS: COLA/IGES

Generated by NASA's Giovanni (giovanni.gsfc.nasa.gov)

Chlorophyll a



2006-07-24 GRADS: COLA/IGES

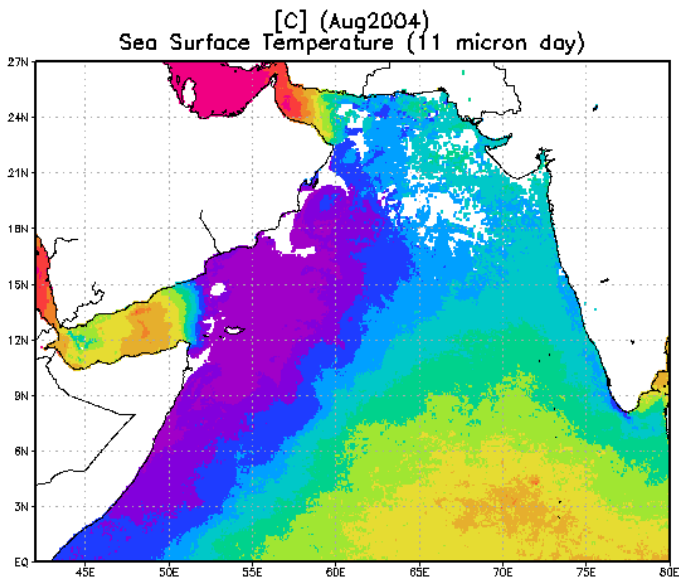
Generated by NASA's Giovanni (giovanni.gsfc.nasa.gov)

2006-07-24-2324

Upwelling is much stronger; elevated chlorophyll concentrations extend further out into the Arabian Sea. Monsoon cloud cover is extensive.

August 2004

SST



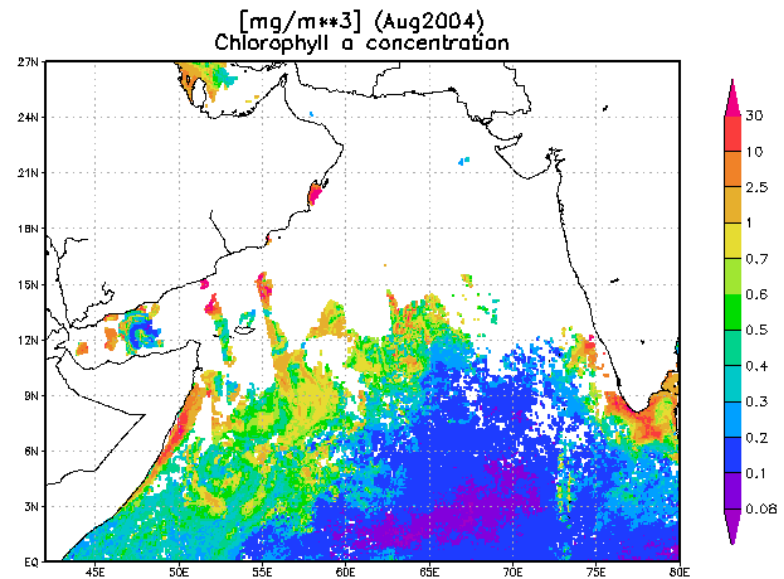
GRADS: COLA/IGES

Generated by NASA's Giovanni (giovanni.gsfc.nasa.gov)

2006-07-2

GRADS: COLA/IGES

Chlorophyll a



GRADS: COLA/IGES

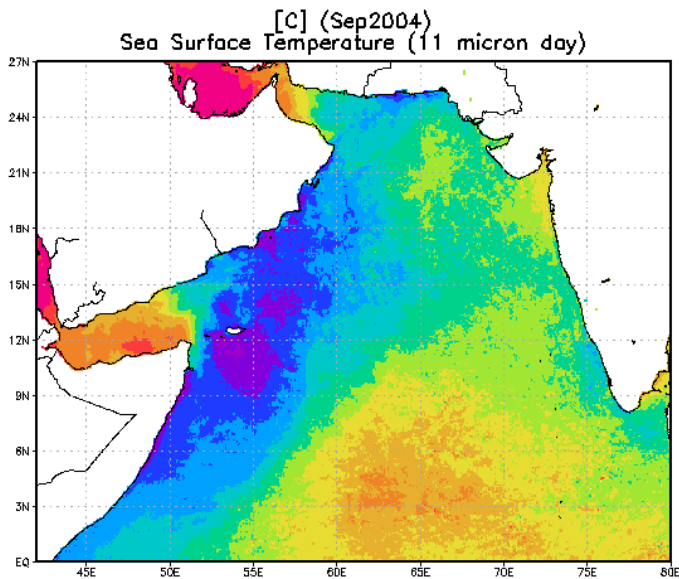
Generated by NASA's Giovanni (giovanni.gsfc.nasa.gov)

2006-07-24-2324

Cold water extends across the western Arabian Sea.
“Peeks” through the clouds indicate high concentrations of chlorophyll along the coast of Oman.

September 2004

SST

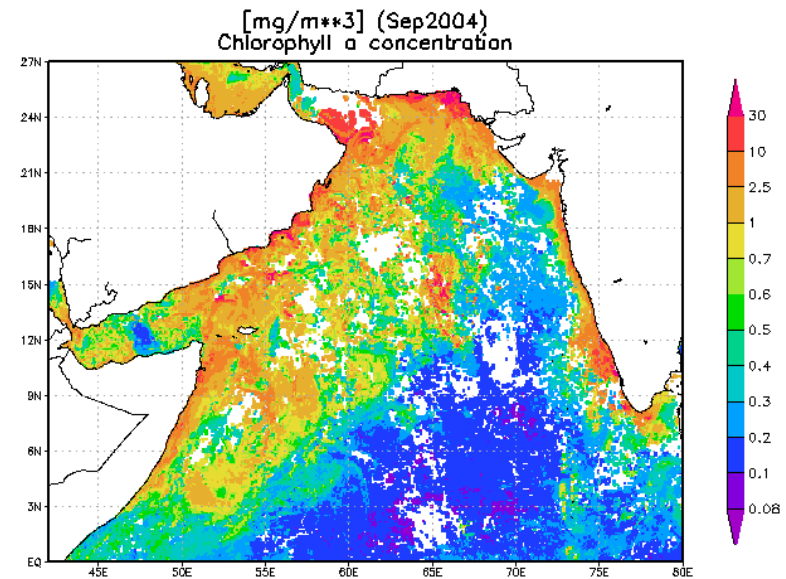


GRADS: COLA/IGES

Generated by NASA's Giovanni (giovanni.gsfc.nasa.gov)

2006-07-- GRADS: COLA/IGES

Chlorophyll a



2006-07-24-23223

Generated by NASA's Giovanni (giovanni.gsfc.nasa.gov)

Upwelling and cloud cover diminishes; high concentrations of chlorophyll extend throughout the northern and western Arabian Sea.

Education Modules

- Laboratory for Ocean Color Users (LOCUS):

<http://daac.gsfc.nasa.gov/oceancolor/locus/index.shtml>

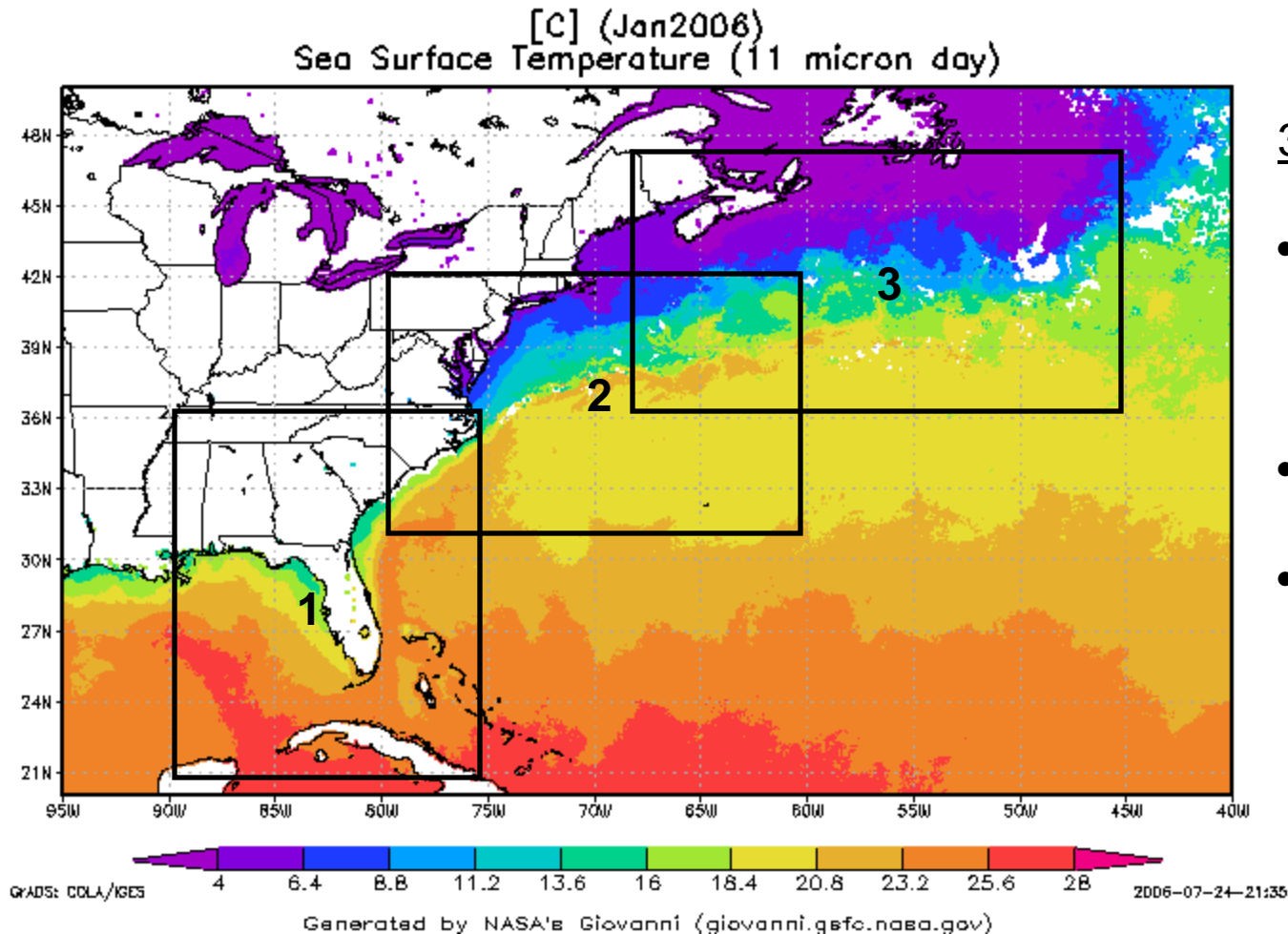
- See “Seasonal Variability”

Exploration of Satellite-Derived Ocean Color and Sea Surface Temperature Data: *The Gulf Stream*

NASA's Ocean Color Online
Visualization and Analysis System

<http://reason.gsfc.nasa.gov/Giovanni>

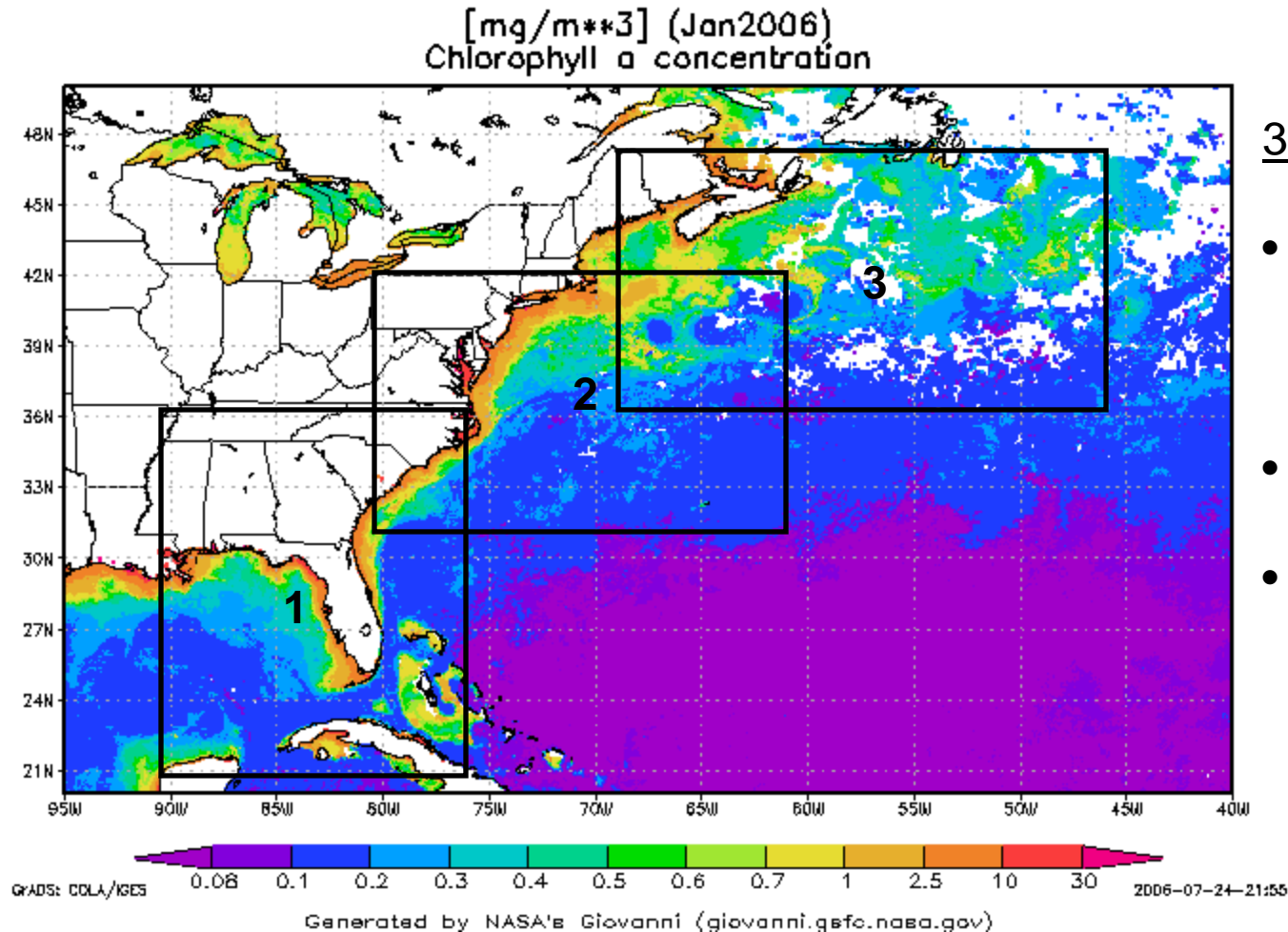
Observing the Gulf Stream: MODIS Sea Surface Temperature



3 Major Sections:

- Loop Current and Start of Gulf Stream
- Transition Zone
- Open Ocean

Observing the Gulf Stream: MODIS Ocean Color



3 Major Sections:

- Loop Current and Start of Gulf Stream
- Transition Zone
- Open Ocean

Observing the Gulf Stream

- MODIS chlorophyll a and sea surface temperature data for January 2006
- The warm waters of the Loop Current and Gulf Stream are very low in chlorophyll a (plankton) concentration
- Warm eddies (“Gulf Stream Rings”) are also regions of very low chlorophyll a concentration. The rings are sometimes easier to see in the ocean color data.

Gulf Stream Study

Step-by-Step Instructions

- Go to GIOVANNI: <http://reason.gsfc.nasa.gov/Giovanni>
- Choose “OBPG MODIS/AQUA Monthly Global 9 km Products” (JAVA Version)
- Enter the following limits for the large area of interest:

50N

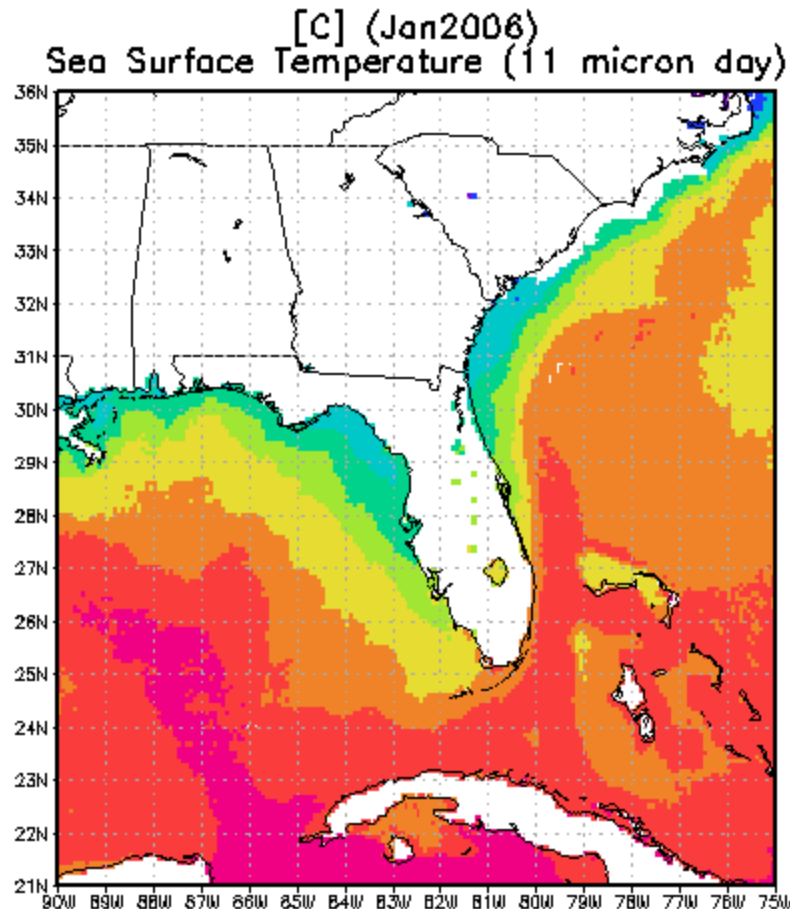
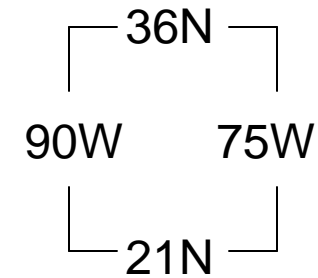
95W

40W

20N

- Click on sea surface temperature (11 micron day)
- Enter desired year and month (2006 Jan)
- Click “Pre-Defined” color option
- Click “Generate Plot” and save image
- Repeat process, substituting “Chlorophyll a concentration” for “sea surface temperature” in the Parameters box.

The Loop Current and the Start of the Gulf Stream

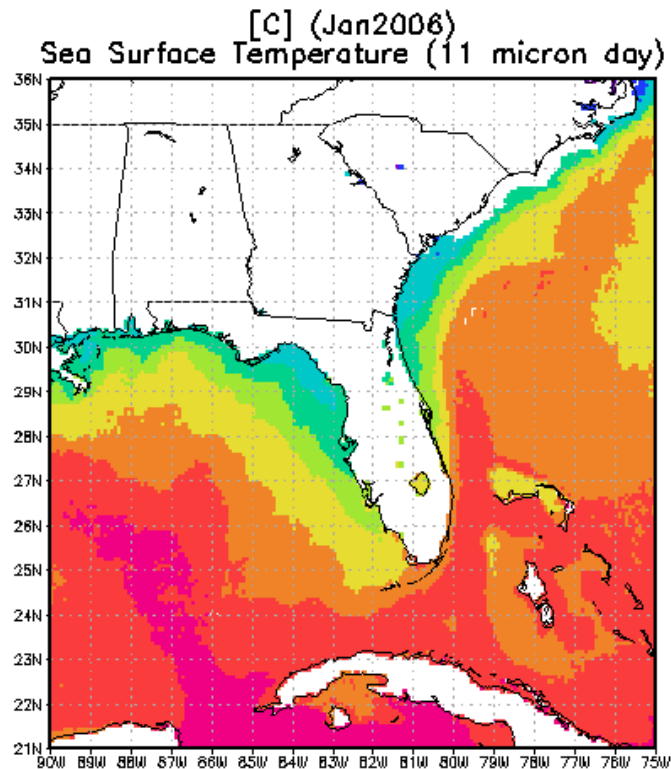


The warm loop current flows from the Gulf of Mexico through the Florida Straits, and becomes the Gulf Stream.

As it flows northward along Florida, Georgia, South Carolina, and North Carolina, the Gulf Stream is relatively straight and narrow.

The Loop Current and the Start of the Gulf Stream

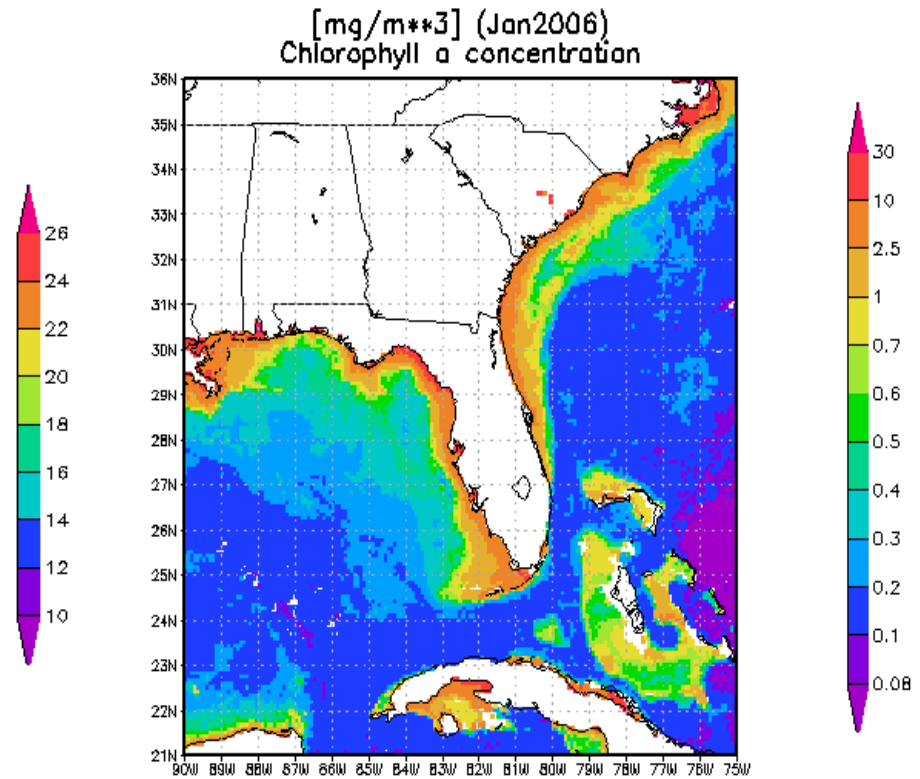
SST



Generated by NASA's Giovanni (giovanni.gsfc.nasa.gov)

2006-1

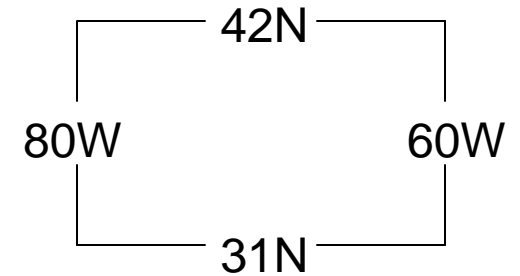
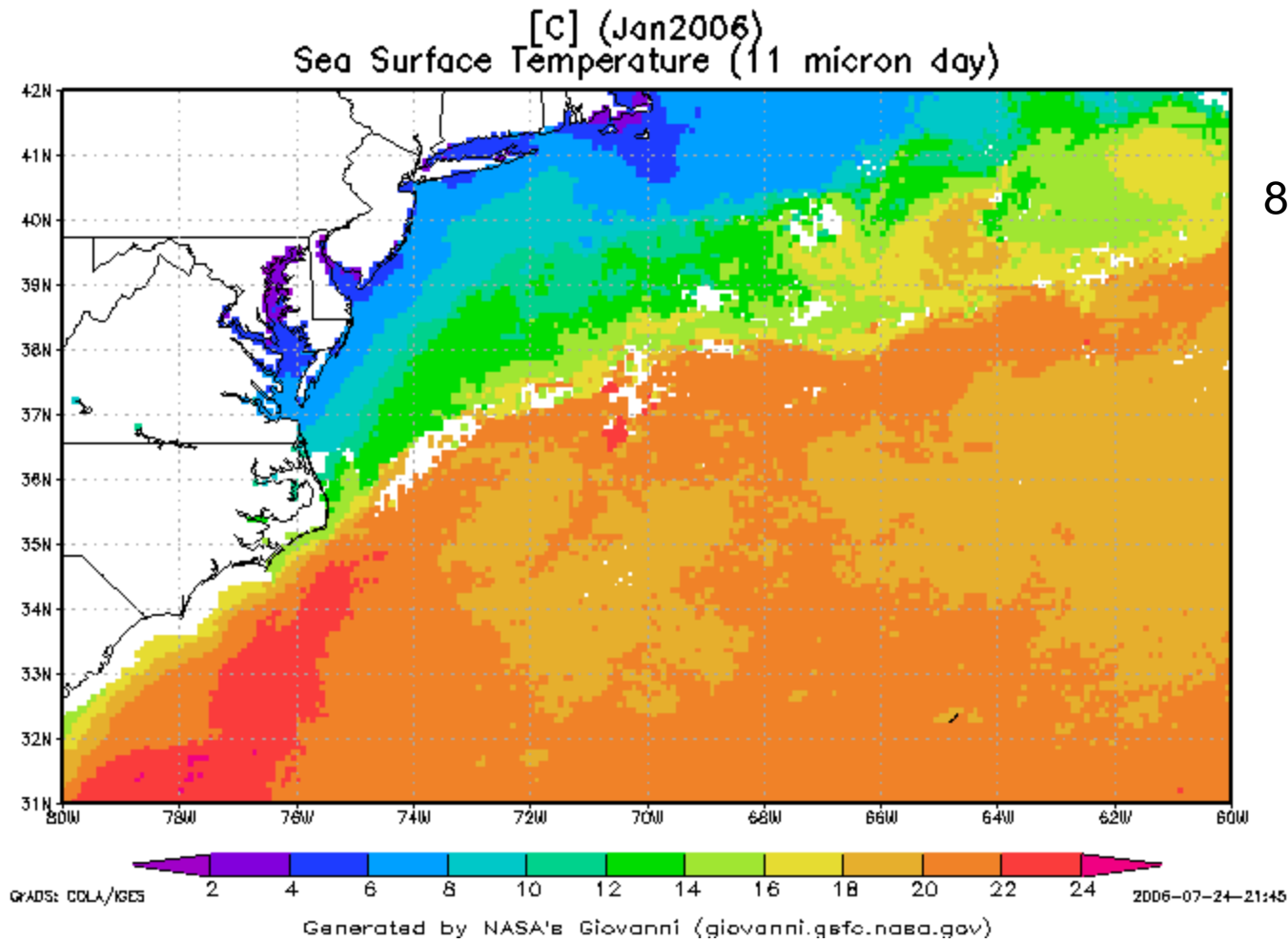
Chlorophyll a



Generated by NASA's Giovanni (giovanni.gsfc.nasa.gov)

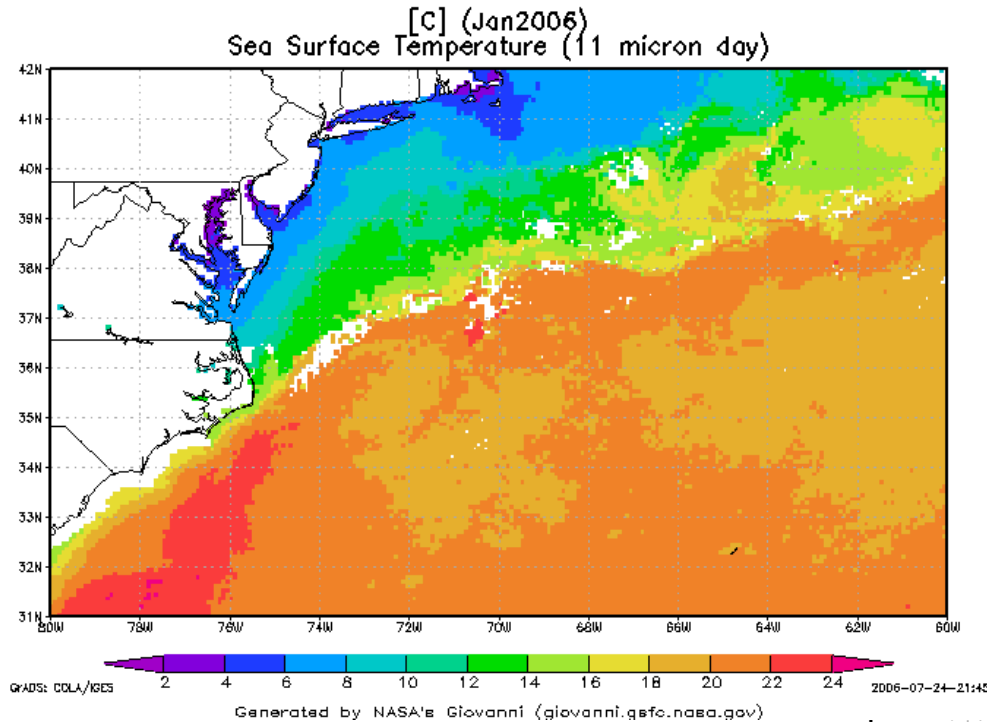
2006-07-24-21:52

Transition Zone: Departure from Coast at Cape Hatteras

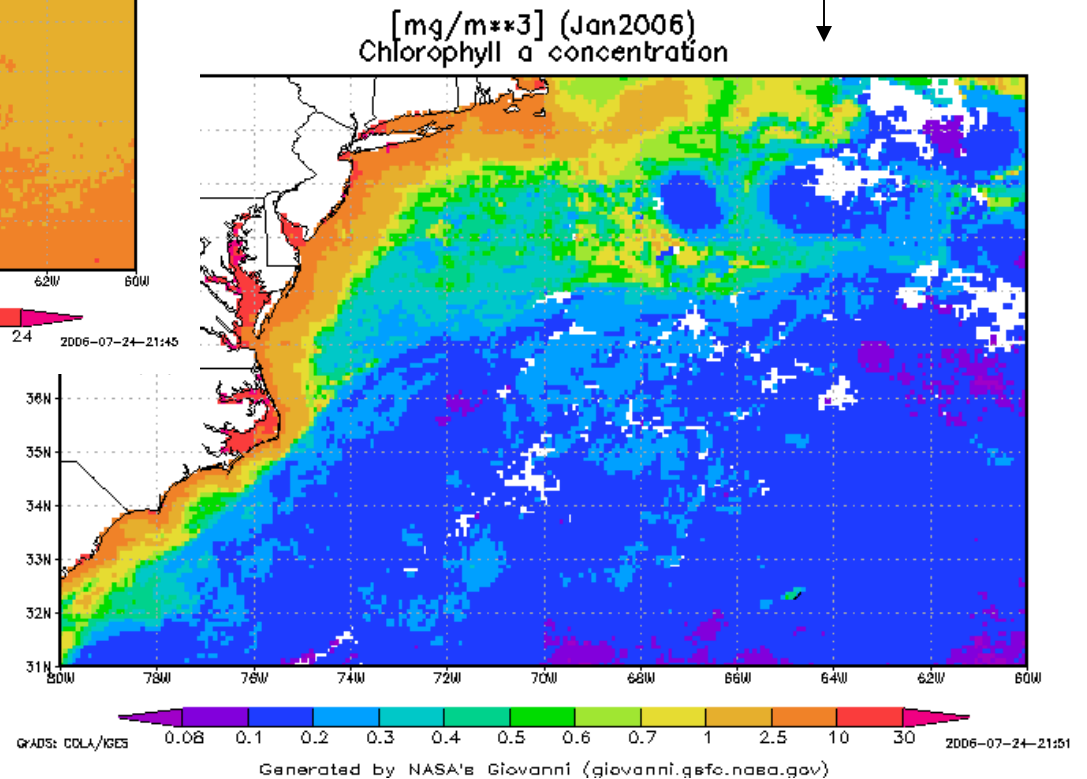


Near Cape Hatteras, the Gulf Stream leaves the coast and pushes eastward into the Atlantic

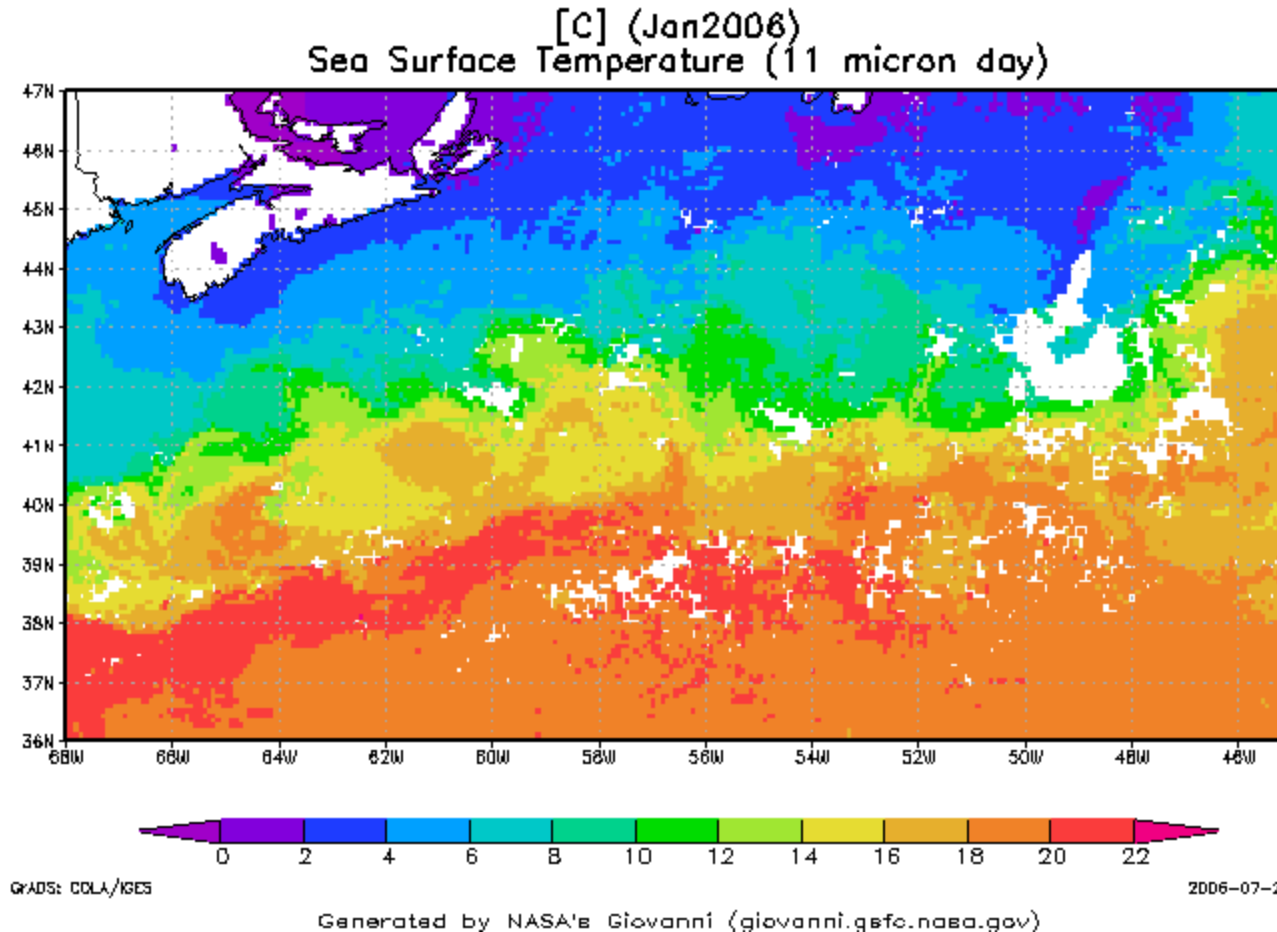
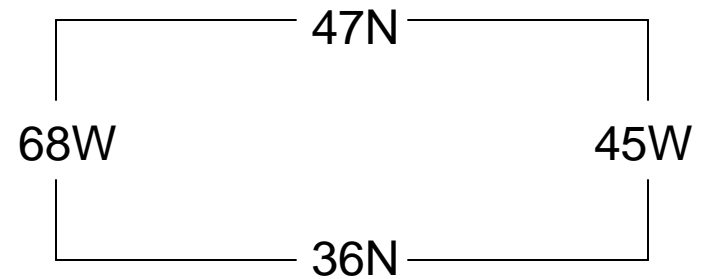
Transition Zone: Departure from Coast at Cape Hatteras



← SST
Chlorophyll a



Open Ocean: Meanders and Rings

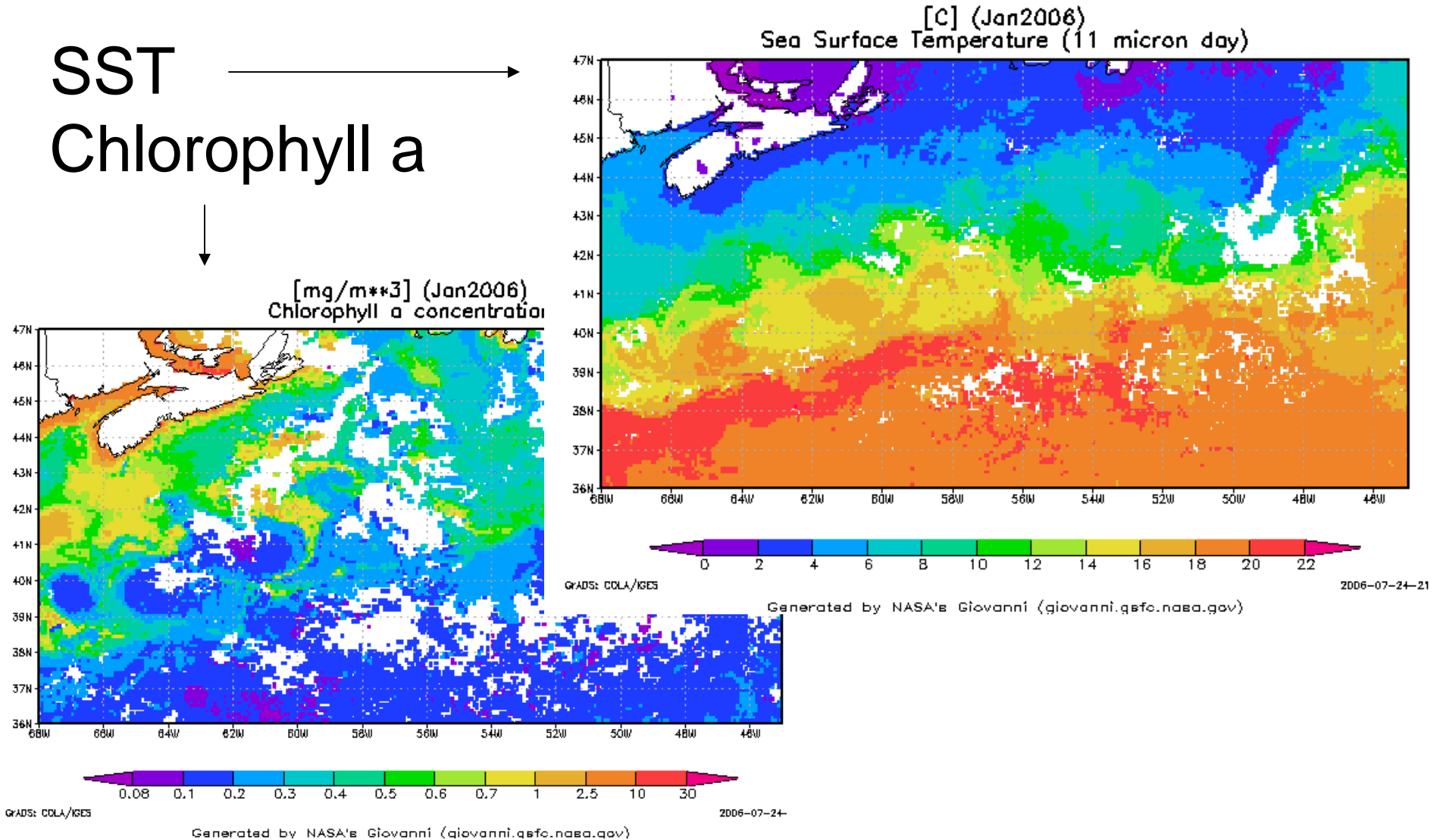


As the Gulf Stream travels eastward across the northern Atlantic, meanders develop and occasionally break off, forming Gulf Stream “rings”, 200-300km in diameter.

Like oases in a desert, cold rings are usually nutrient rich and high in chlorophyll. Warm rings are usually devoid of nutrients required for plankton blooms.

Open Ocean: Meanders and Rings

SST →
Chlorophyll a ↓



Education Modules

- Laboratory for Ocean Color Users (LOCUS):
<http://daac.gsfc.nasa.gov/oceancolor/locus/index.shtml>
- See “Introduction to Ocean Color and SST Analysis with the Gulf Stream”

A satellite image of the Pacific Ocean with a color-coded overlay. The overlay uses a rainbow spectrum (blue, green, yellow, red) to represent different oceanographic data, likely sea surface temperature or chlorophyll-a concentration. The colors are concentrated in the central and eastern Pacific, with a prominent red and yellow area in the upper right quadrant. The background is a grayscale satellite image of the ocean's surface, showing cloud patterns and sea surface features.

✓ **Demonstration project 2**

Investigate the effects of monsoonal circulation near the Taiwan Strait and Luzon Strait

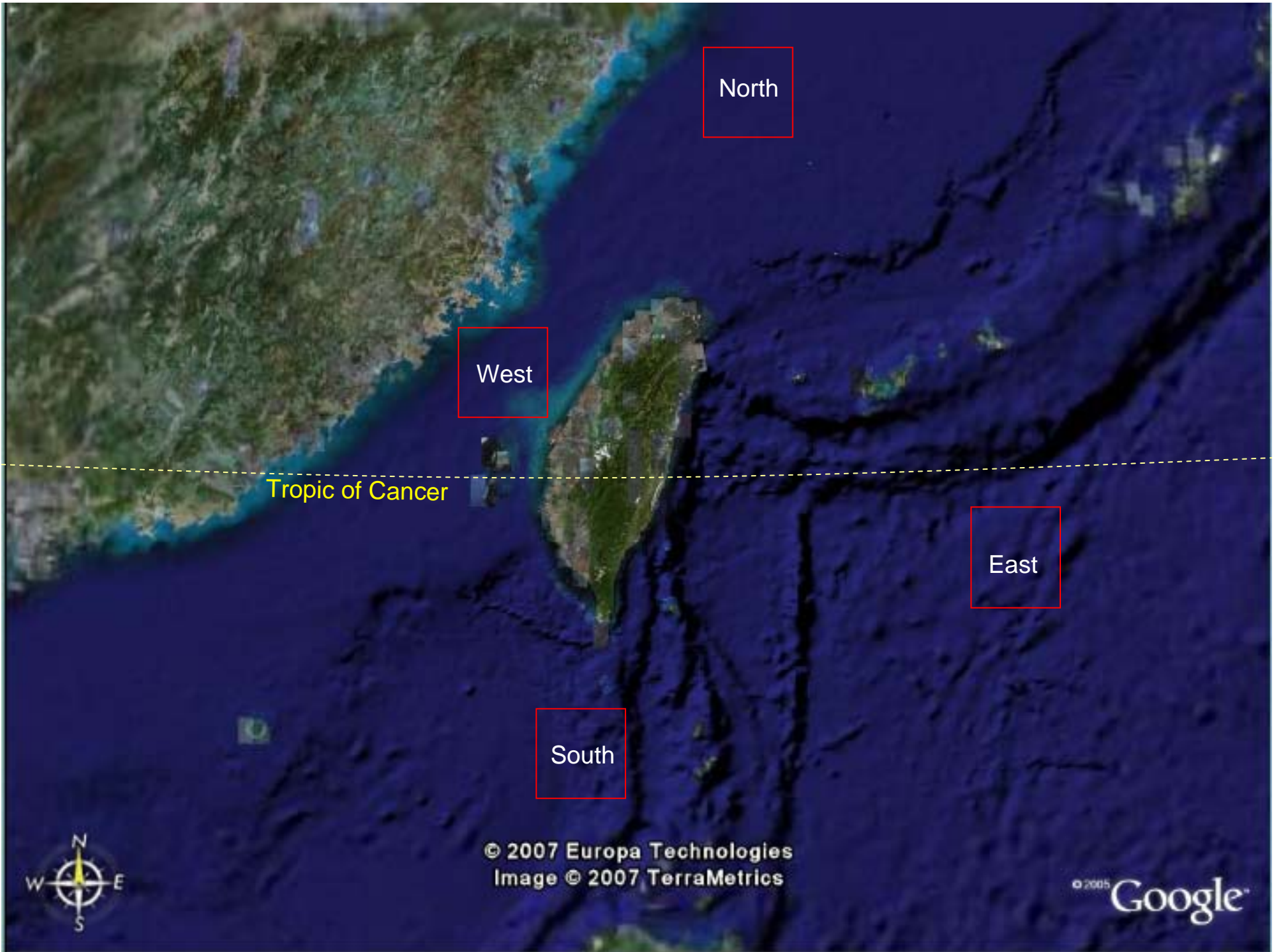
Three student groups were assigned a region to investigate; Cmdr. Petruncio investigated a fourth region as an example.

Summer Monsoon May - September



Winter Monsoon November - March





North

West

Tropic of Cancer

East

South

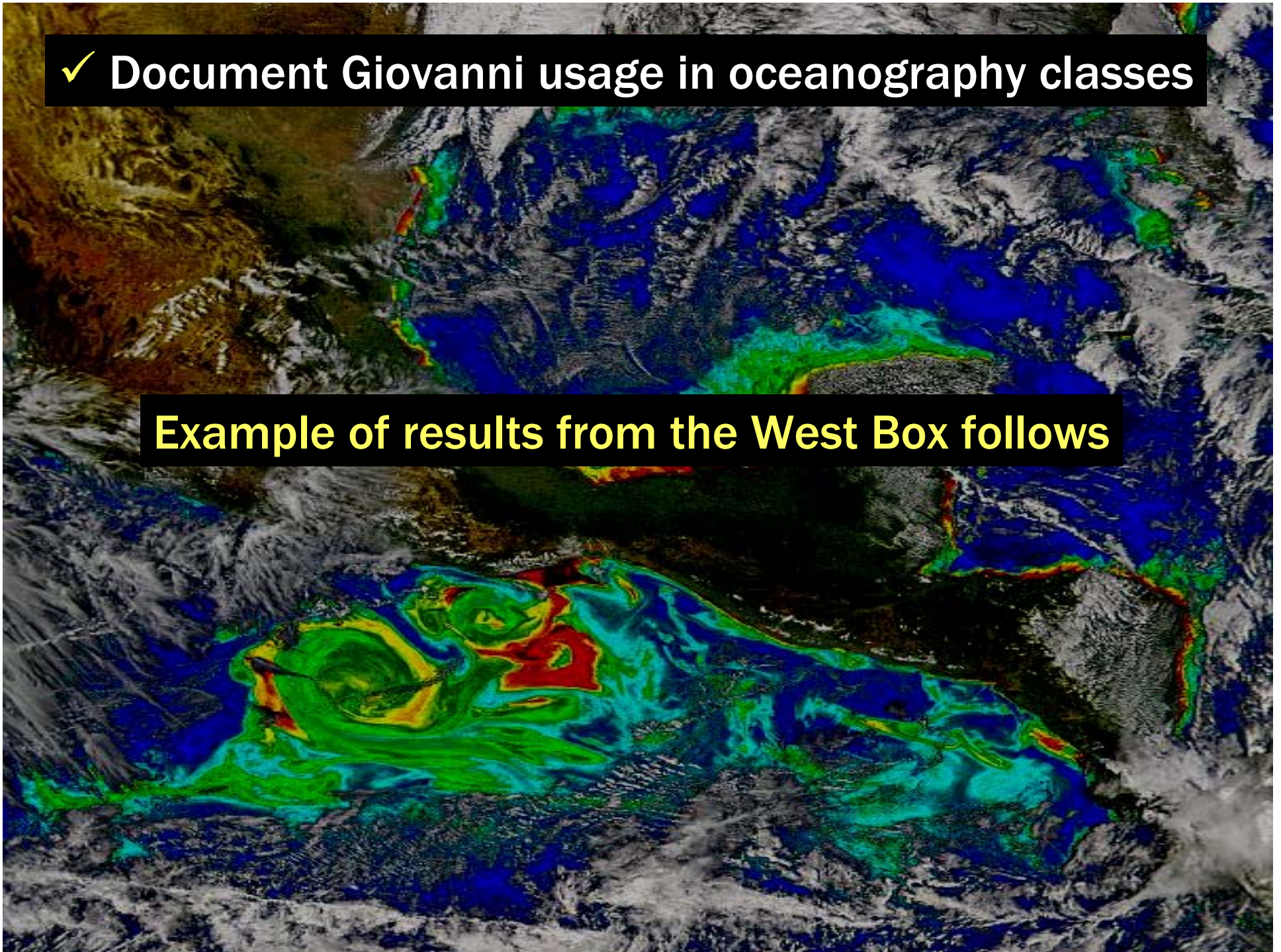


© 2007 Europa Technologies
Image © 2007 TerraMetrics

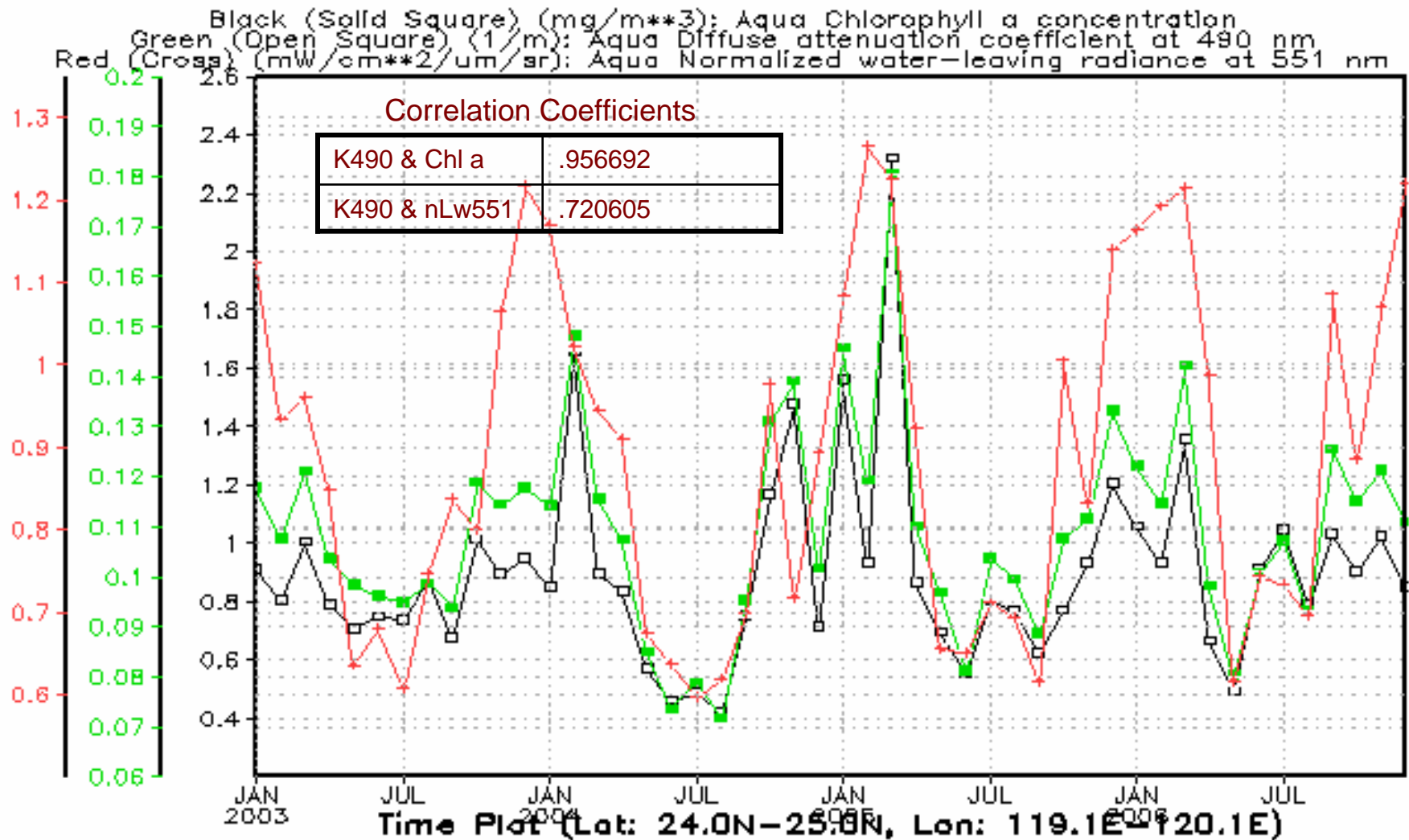
© 2005 Google

✓ Document Giovanni usage in oceanography classes

Example of results from the West Box follows

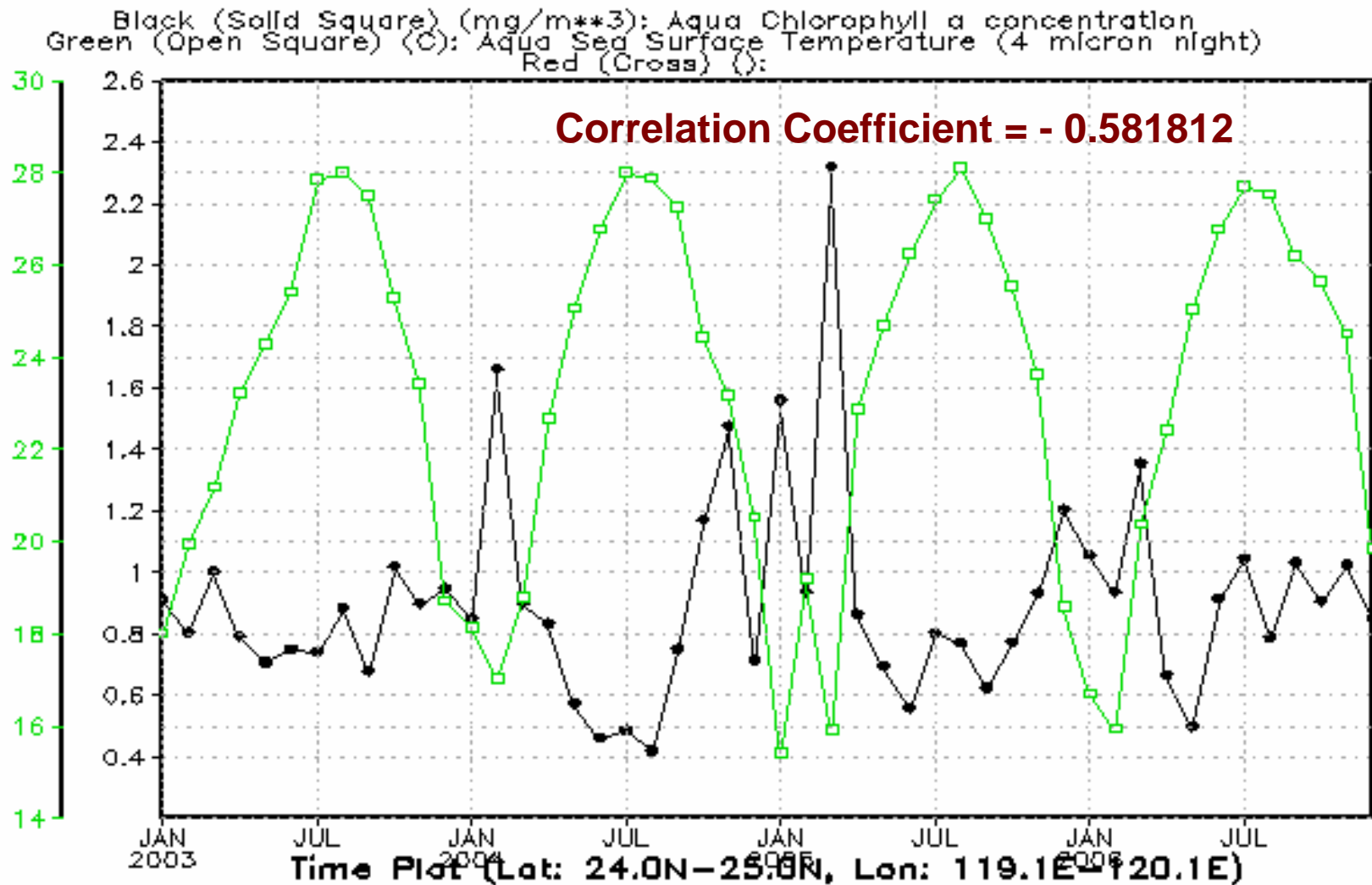


West Box: Chl a, K490, nLw551



Generated by NASA's Giovanni (giovanni.gsfc.nasa.gov)

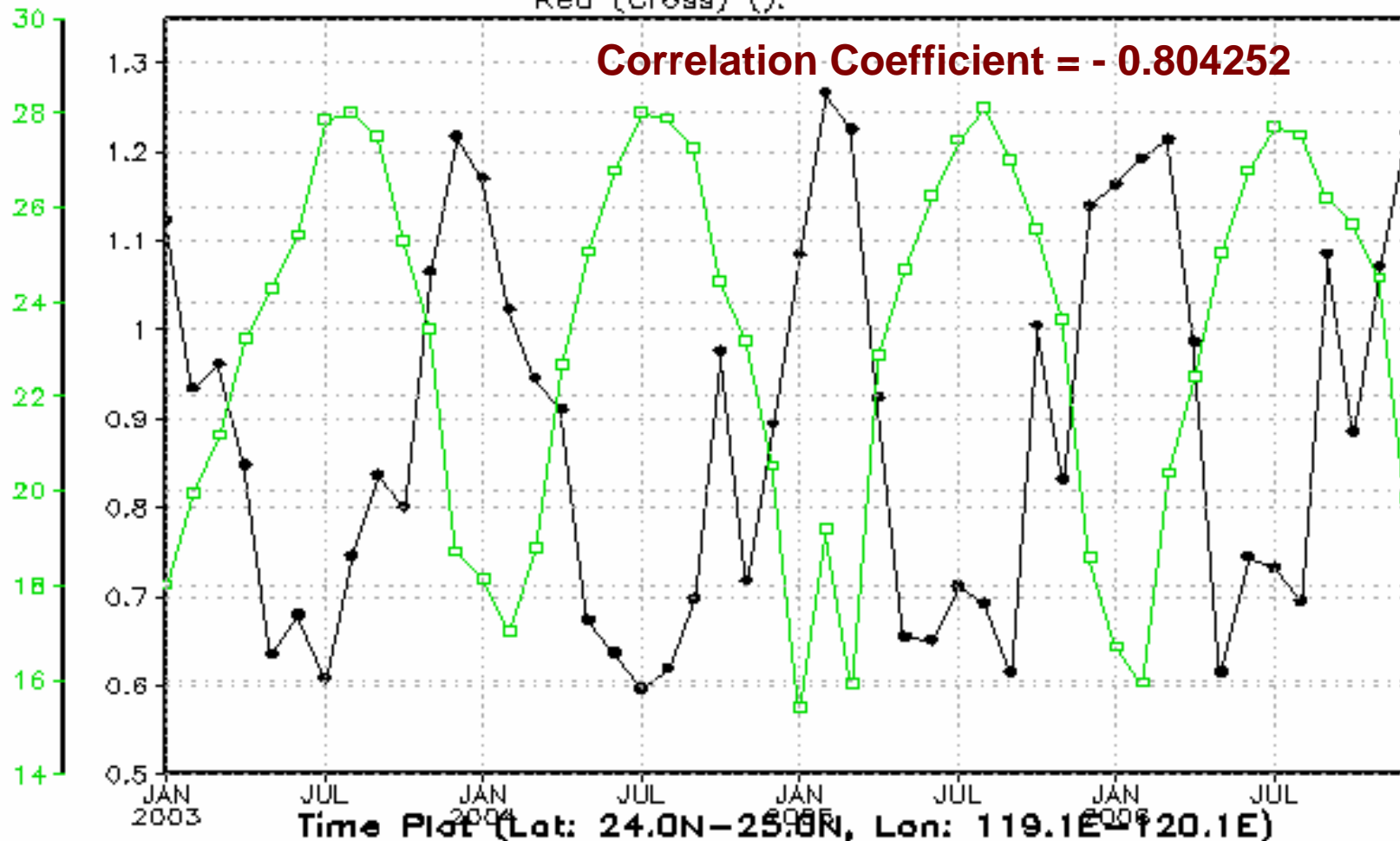
West Box: Chl a and SST



Generated by NASA's Giovanni (giovanni.gsfc.nasa.gov)

West Box: nLw551 and SST

Black (Solid Square) (mW/cm**2/um/sr): Aqua Normalized water-leaving radance at 551 nm
Green (Open Square) (C): Aqua Sea Surface Temperature (4 micron night)
Red (Cross) ():



Generated by NASA's Giovanni (giovanni.gsfc.nasa.gov)

A satellite image of the ocean, showing various colors representing different water temperatures or depths. A semi-transparent grey text box is overlaid on the image, containing text. At the top of the image, there is a black banner with a white checkmark and text.

✓ Document Giovanni usage in oceanography classes

Examples of student conclusions:

- Monsoonal variability in SST observed at all four locations. Greater range in SSTs in Taiwan Strait and north of Taiwan, with much colder SSTs during winter monsoon.
- nLw551 is relatively high and negatively correlated with SST in the North and West boxes, much weaker and more variable in the East and South boxes

A satellite image of the ocean, showing various colors representing different oceanographic parameters. A semi-transparent grey text box is overlaid on the image, containing text about Giovanni usage and student conclusions. The background image shows a mix of blue, green, and red colors, likely representing chlorophyll a and sea surface temperature data.

✓ Document Giovanni usage in oceanography classes

More student conclusions:

- Strong correlation at all locations between K490 and Chl a.
 - In Taiwan Strait, K490 is also strongly correlated with nLw551. Chl a algorithm in Taiwan Strait may be inaccurate due to presence of suspended sediments, likely advected southward from the Yellow Sea during the winter monsoon.
- West Box
 - Moderate negative correlation between SST & Chl a, strong negative correlation between SST & nLw 551