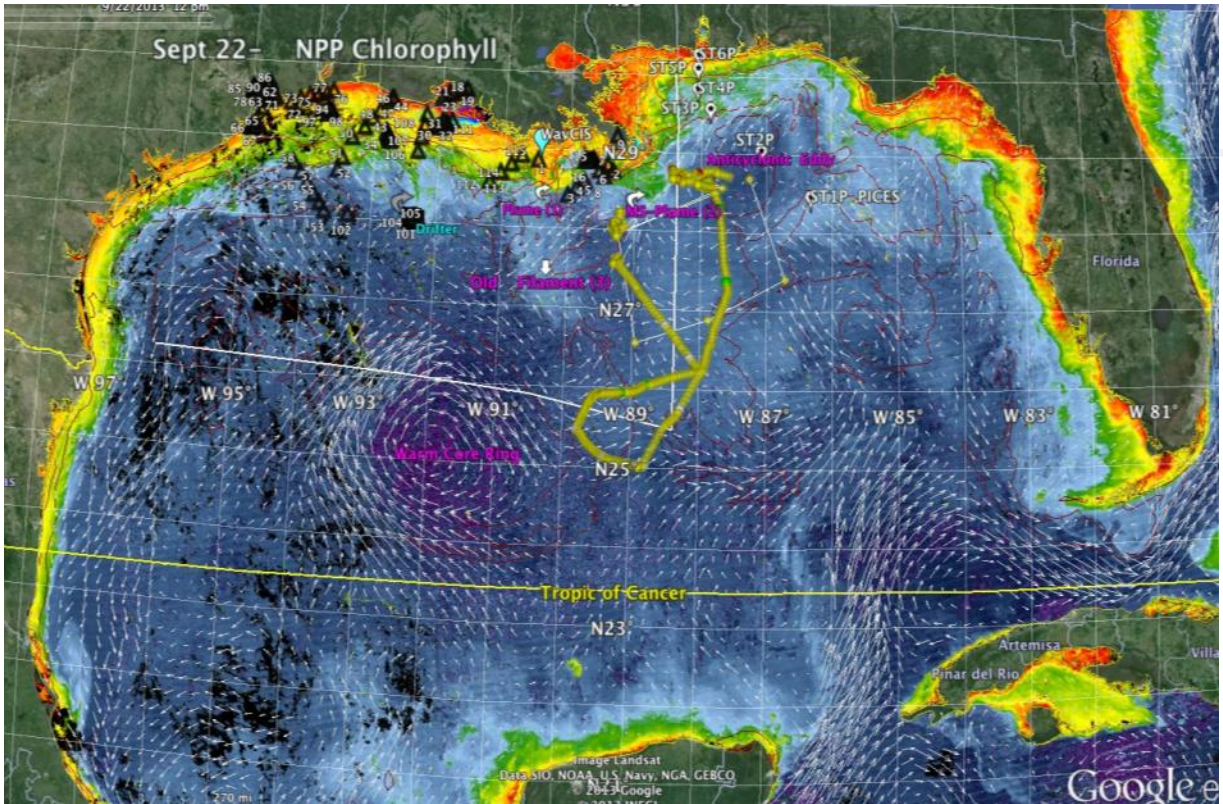
“Characterizing physical and ecological exchange processes in coastal and open waters using the VIIRS – Suomi NPP sensors”



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Stennis Space Center
3. QNA- Corporation
4. STAR – NESDIS – NOAA

Feb 2014
Ocean Sciences

Objective:

- Coastal freshwater filaments impacts the exchange processes across coastal Shelf
  " Impacts the Physical and Biological processes of the ecosystem
- Filaments provide pathways between water mass onshore- offshore exchange
- Applications of NPP – Color and SST products to track exchange processes
  1) Continuity ocean Satellite coastal products for monitoring
  2) Defining the products uncertainty
  3) Defining the subsurface physical – bio-optical structures
- Tracking Filaments using satellite products with ocean models

- How are filaments linked to volume transport across the shelf ?

Approach:

- Coastal products validation
- Coupling satellite surface bio-optical and HYCOM and NCOM products
  Insitu Ship and glider ..

Approach - Real Time Ocean Monitoring Assembling and integrating

Ocean Observations

Satellite Remote Sensing

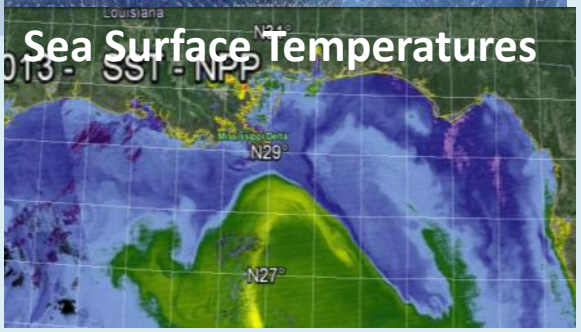
Ocean Color
- Biology – Chlorophyll;
- Backscatter – Particles
- Absorption,CDOM, Detritus

Sea Surface Temperature
Sea Surface Salinity

Insitu

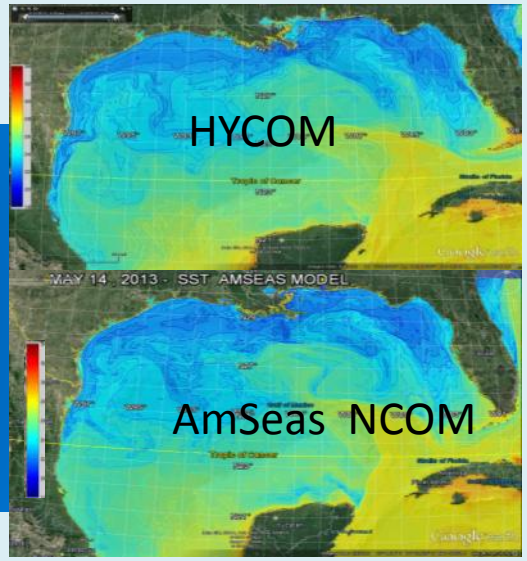
Gliders,

Ship profile Cruises

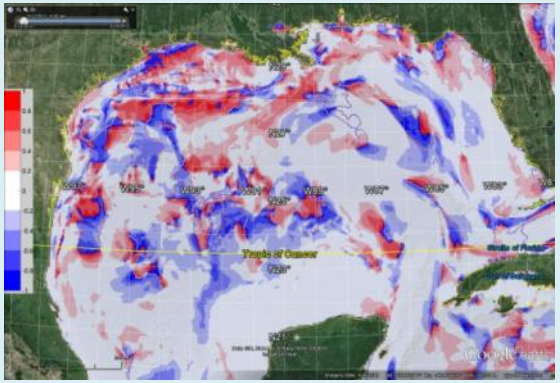


Ocean Models

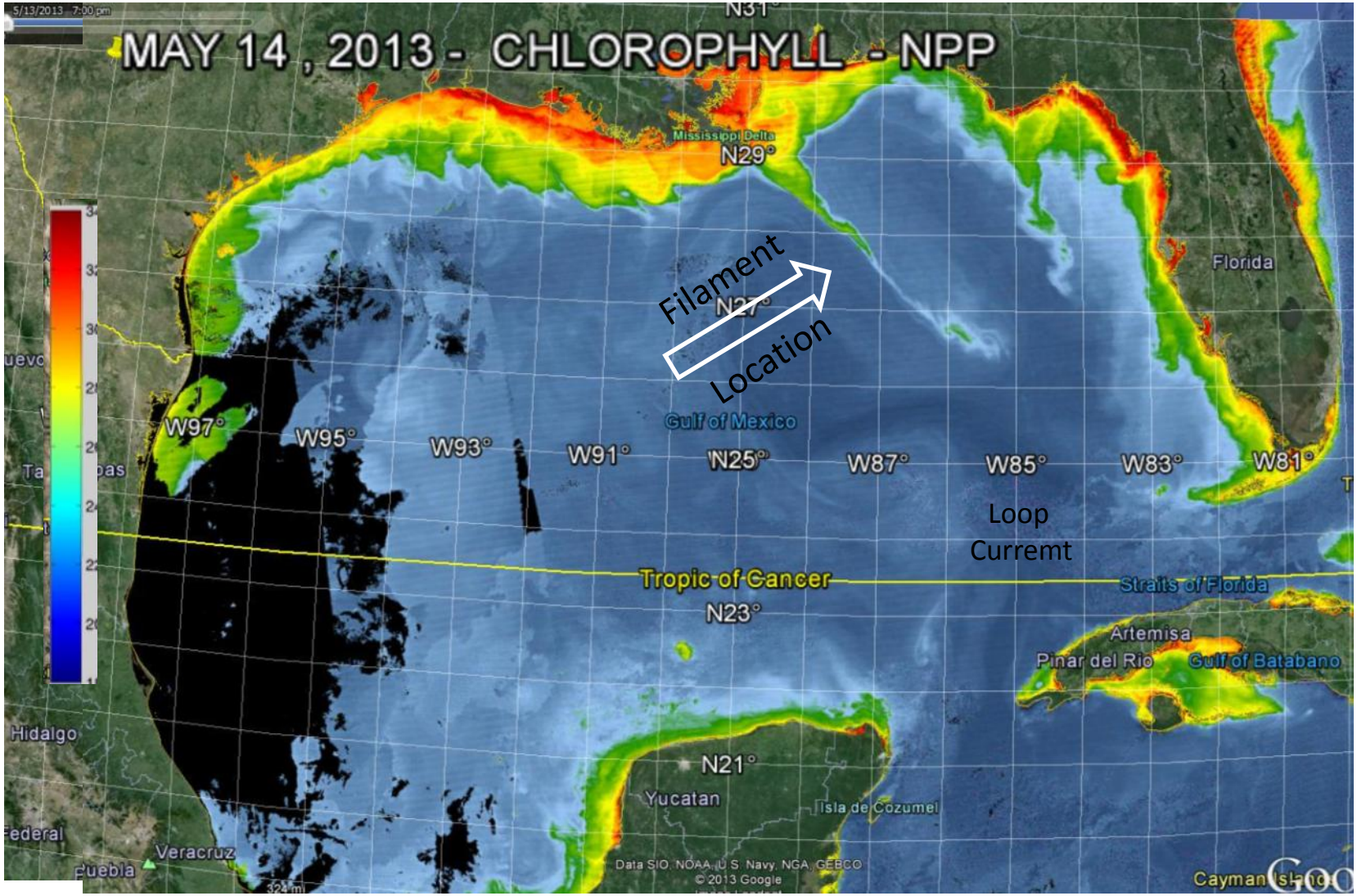
Physical Circulation
- Surface Currents
- SST , Salinity
- Mixed layer Depth



Difference



Chlorophyll and Sea Surface Temperature Filament Location "HYCOM" & "America Sea's Model" with NPP- Satellite



Monitoring the Gulf Ecology Dynamic Filament History May – Sept 2013

1 - S-NPP – Satellite Ocean Cal – Val program

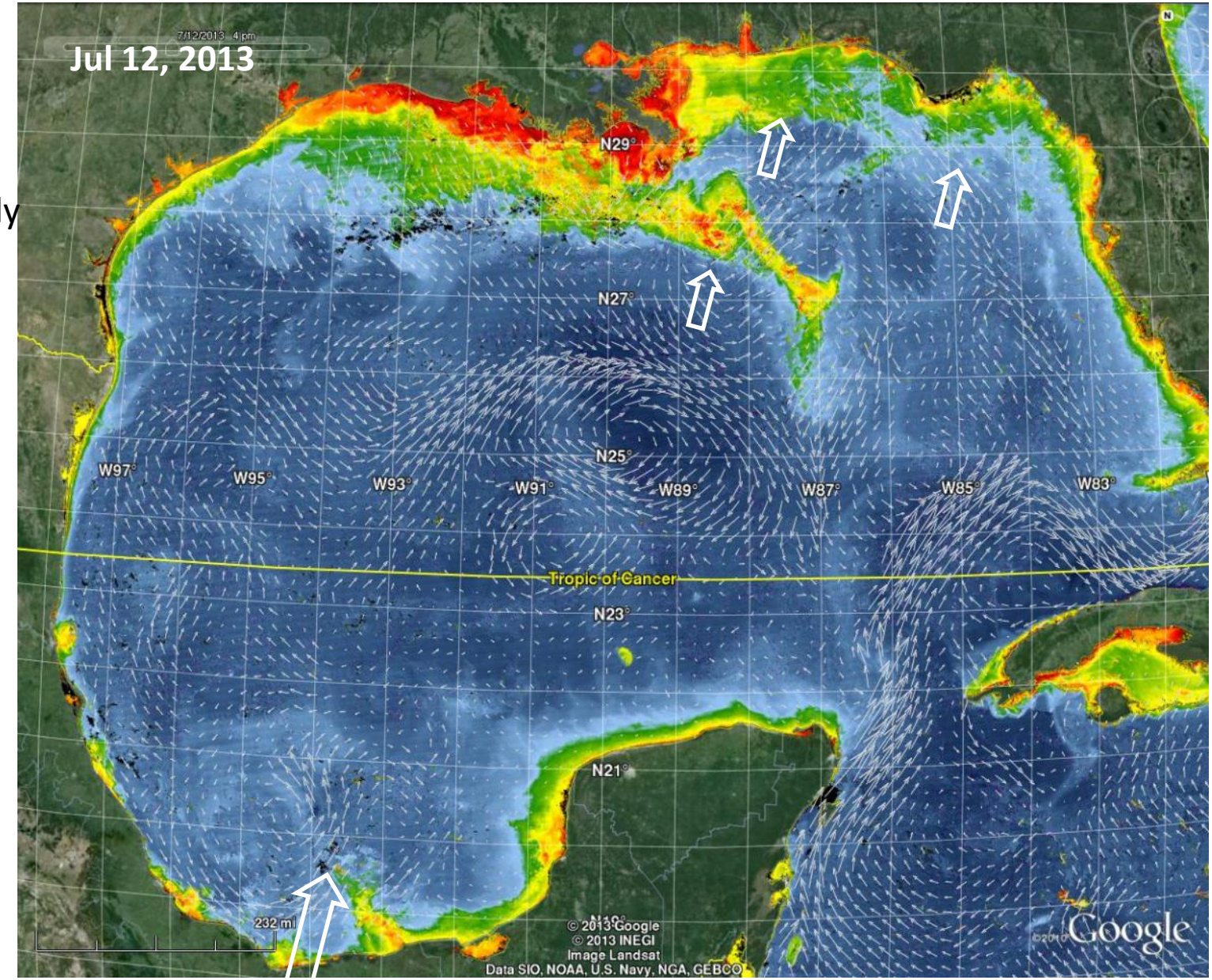
2- Coupled with Surface Currents (HYCOM and NCOM)

! Evolution and dissipation of Multiple Filaments

Filament History - Monitoring the Gulf Ecology May – Sept 2013

May –July

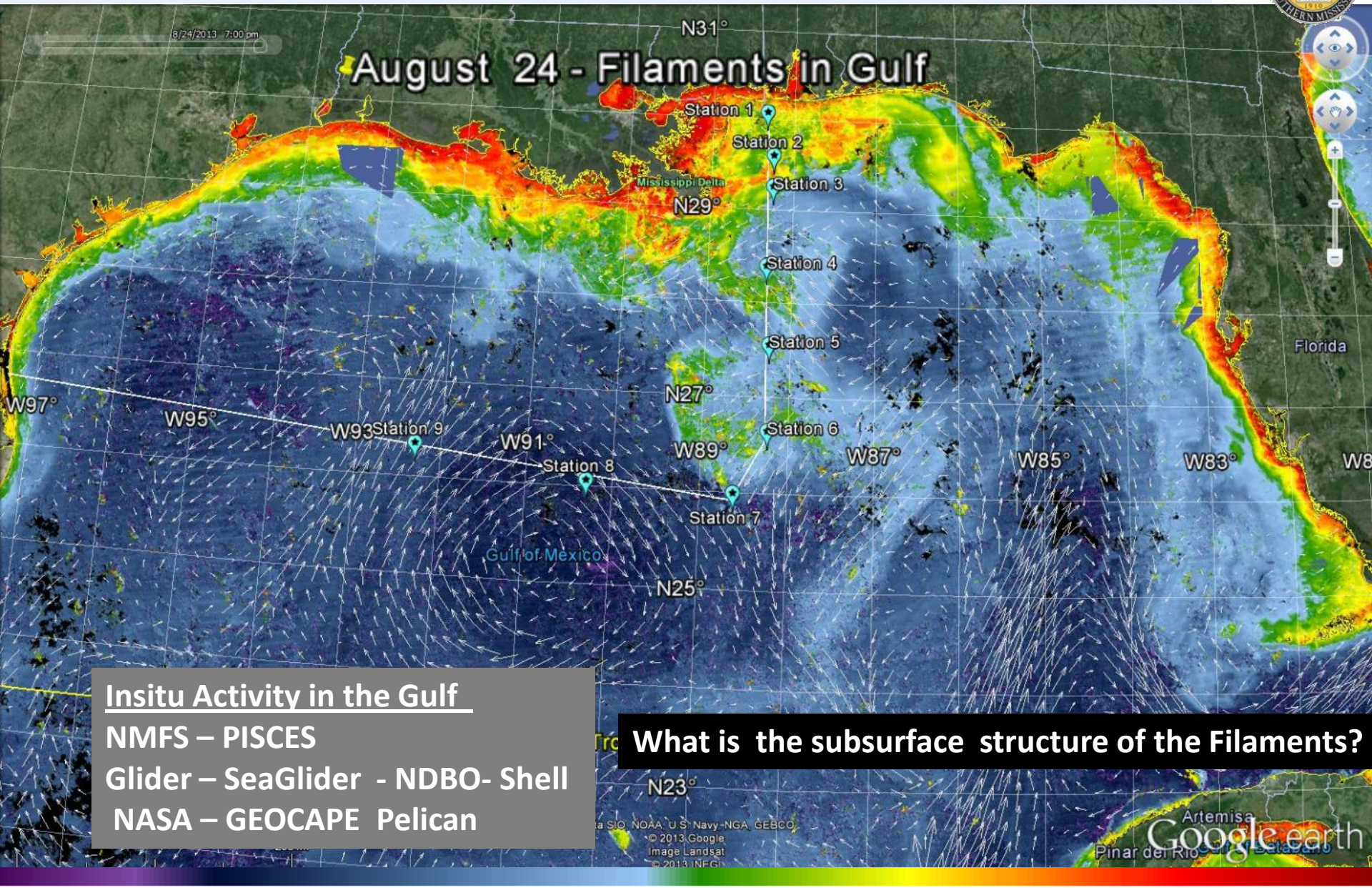
AMSEA – Surface Currents



Chlorophyll Concentration (mg m^-3), OC3 algorithm

Back

Ocean Monitoring



Insitu Activity in the Gulf

NMFS – PISCES

Glider – SeaGlider - NDBO- Shell

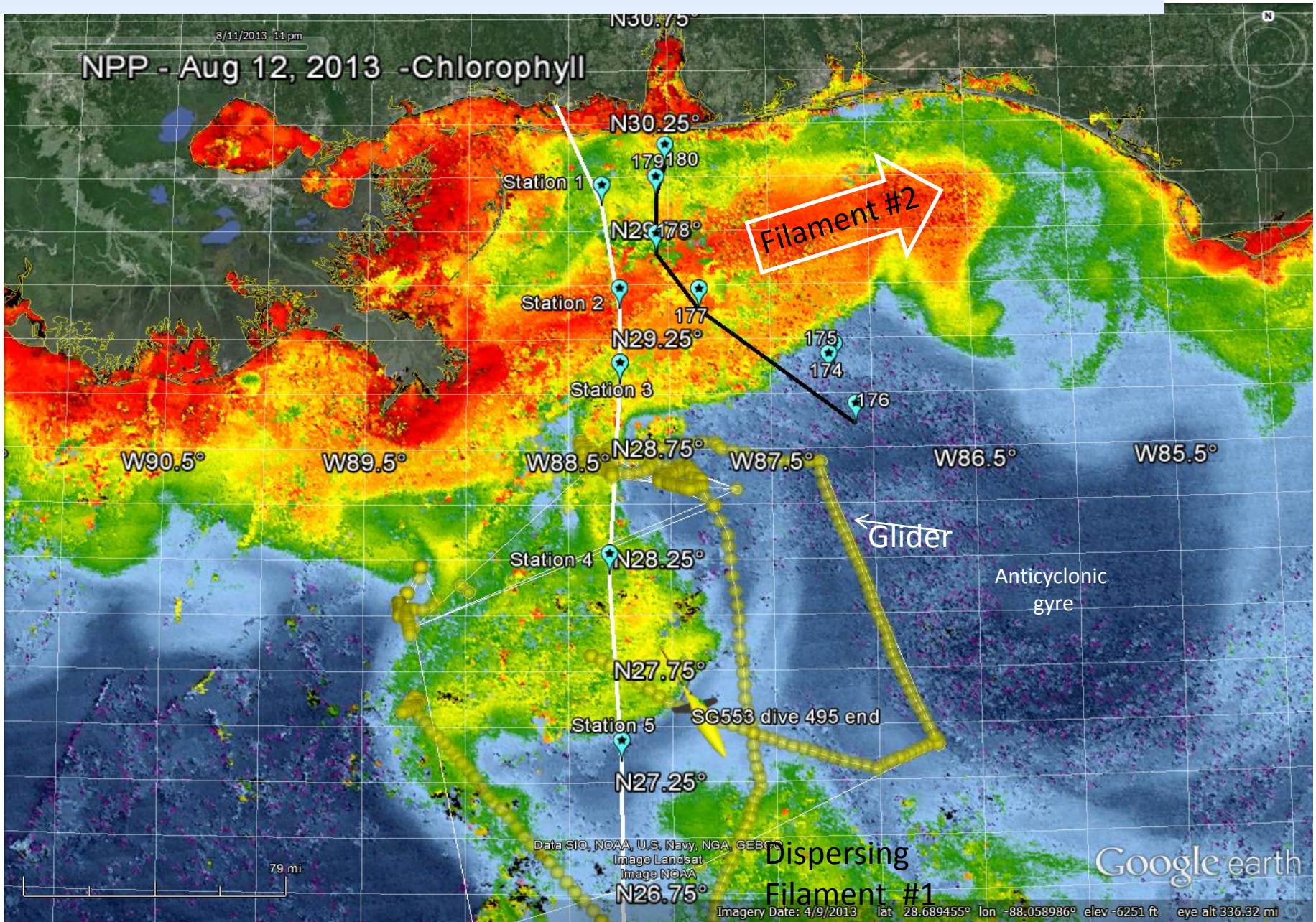
NASA – GEOCAPE Pelican

What is the subsurface structure of the Filaments?

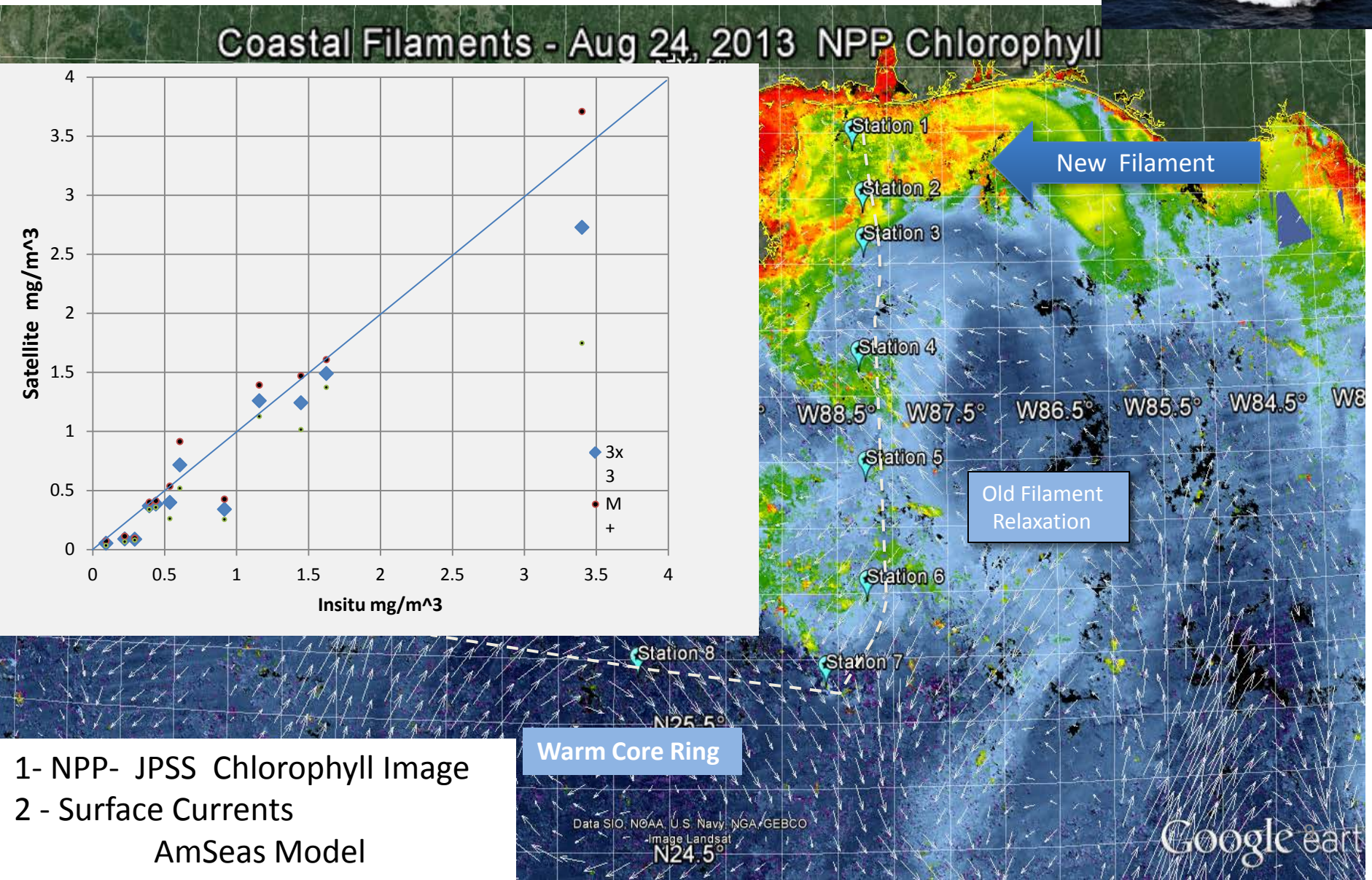
0.01 0.054 0.29 1.6 8.4 45

Chlorophyll Concentration (mg m^-3), OC3 algorithm

Gulf of Mexico – Active season



PISCES Cruise Track Pascagoula to Brownsville
STATION LOCATIONS Aug 22 – 25
"NMFS – Glenn Zapfe"

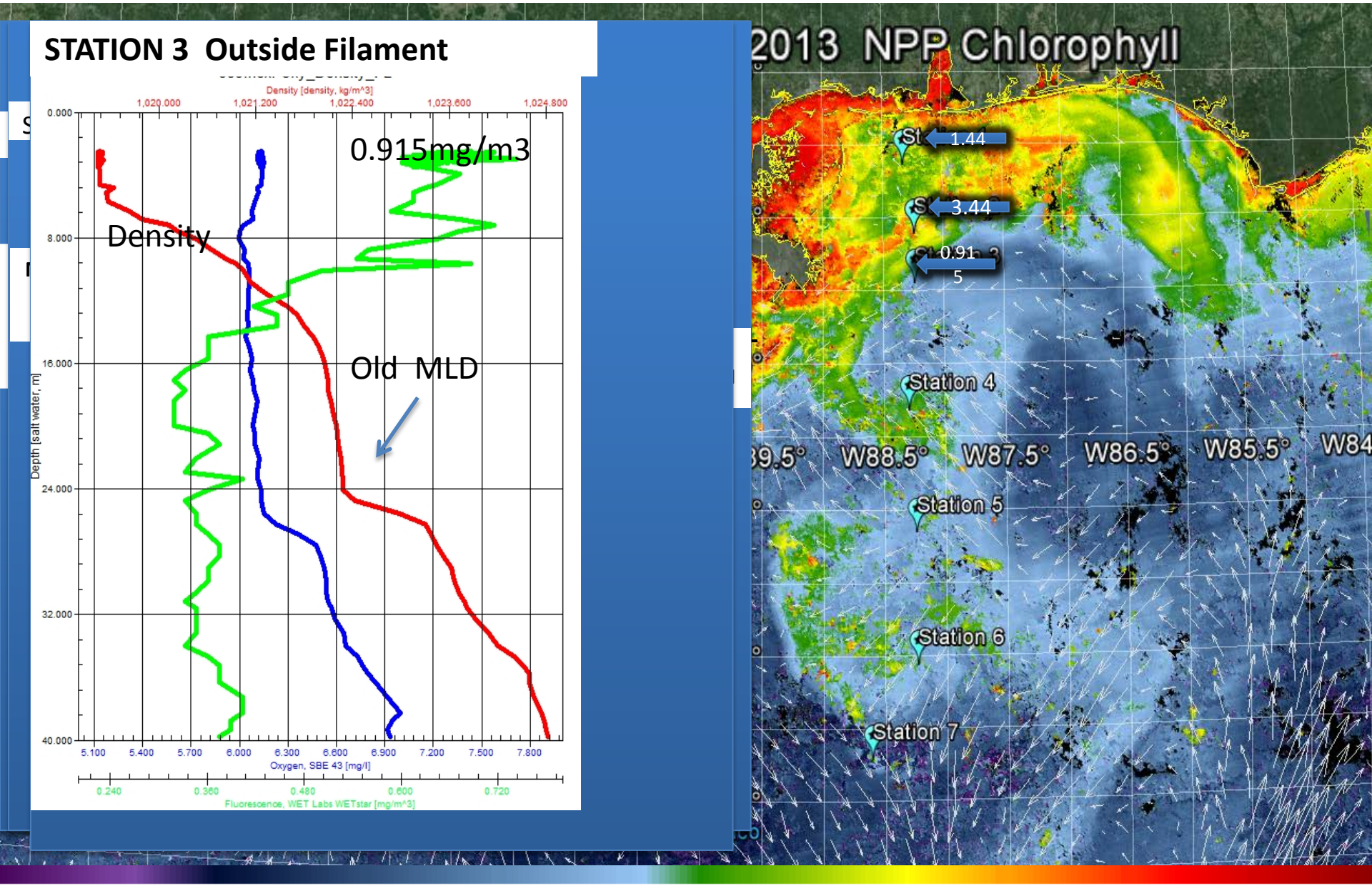


1- NPP- JPSS Chlorophyll Image

2 - Surface Currents

AmSeas Model

Vertical Structure Aug 23, 2013 – Chlorophyll __ NPP VIIRS



PISCES Cruise Track Pascagoula to Brownsville
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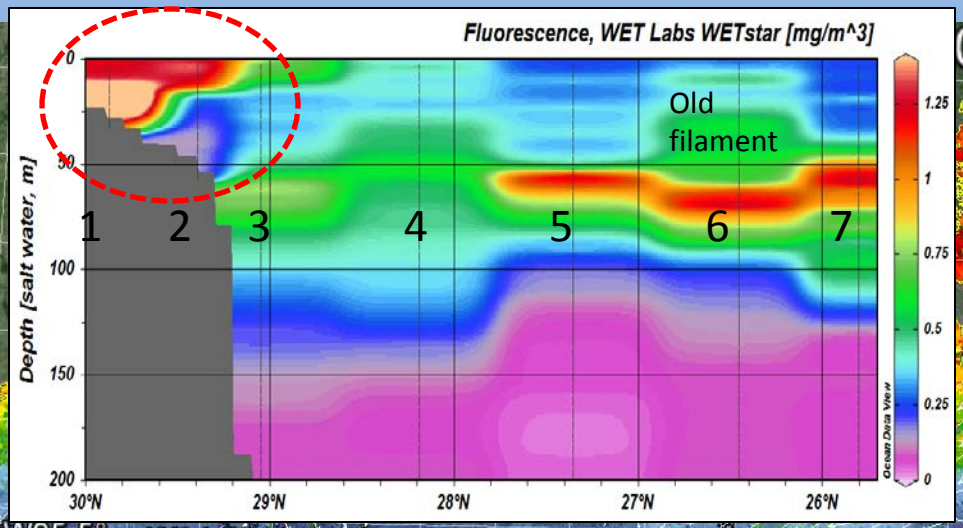
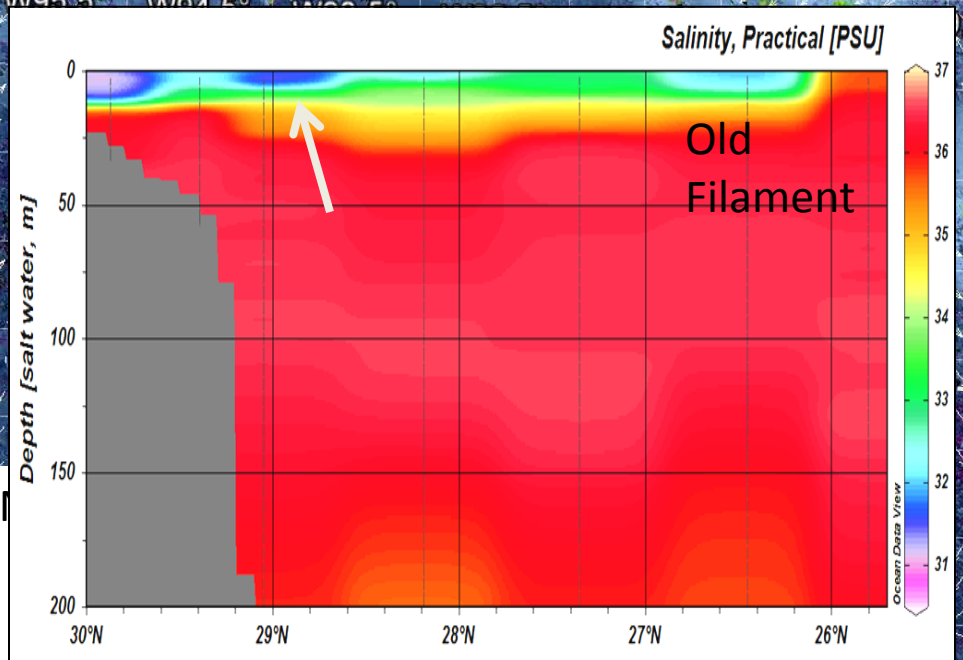
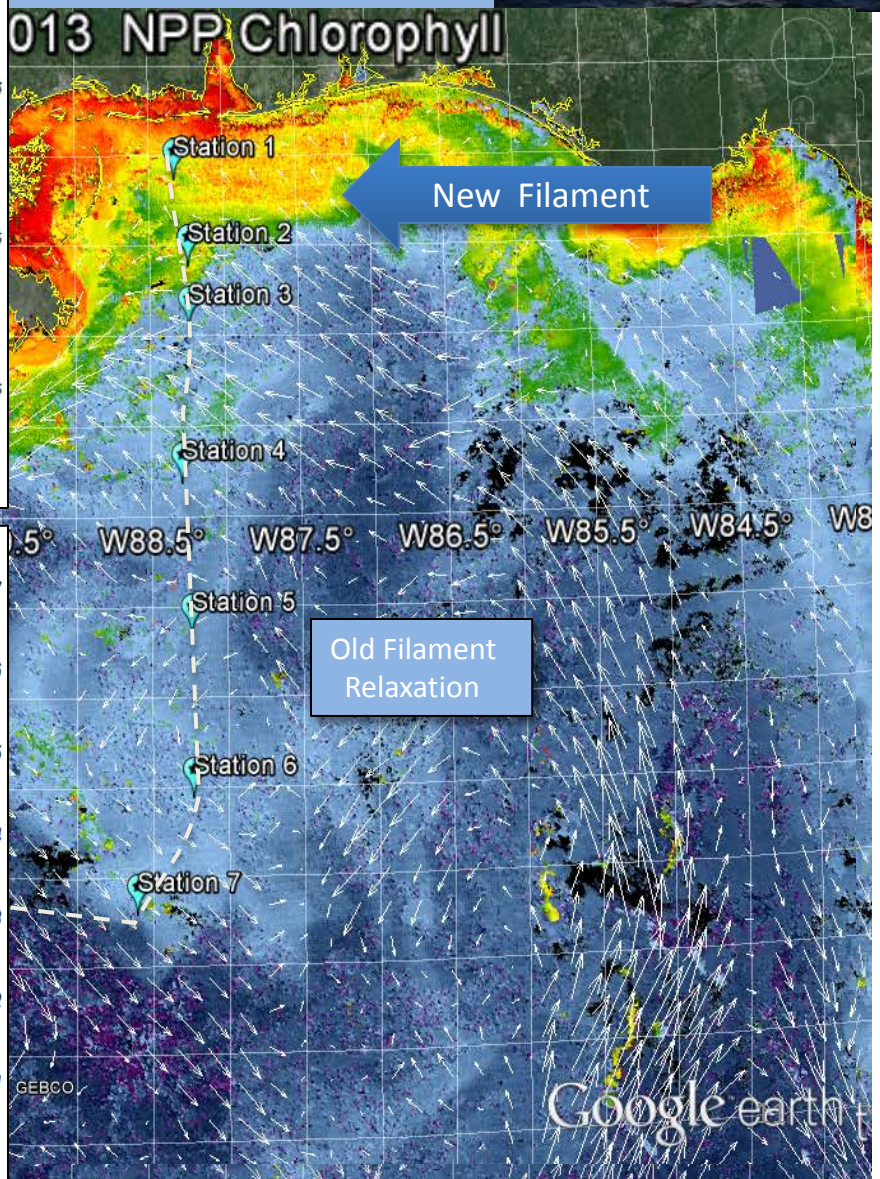






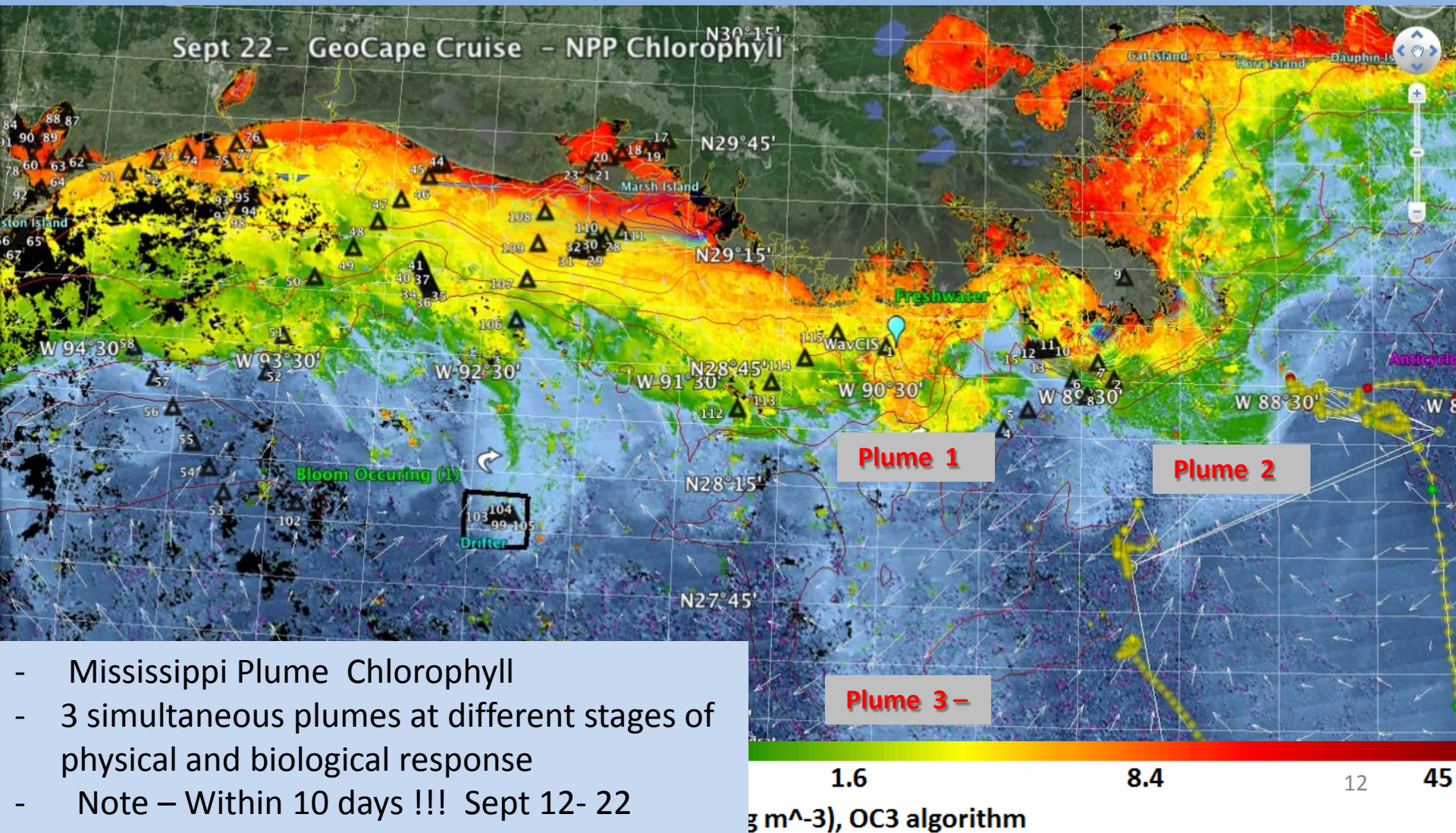
1- I

2 -

River Plumes have multiple Pathways (Bio-chem- physical Pulses to the ecosystem)

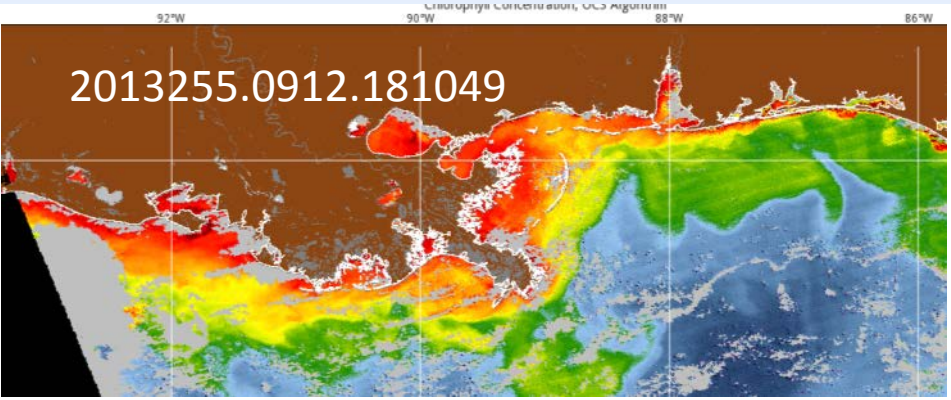
GEOCAPE Cruise - Science for New Geostationary Satellite !

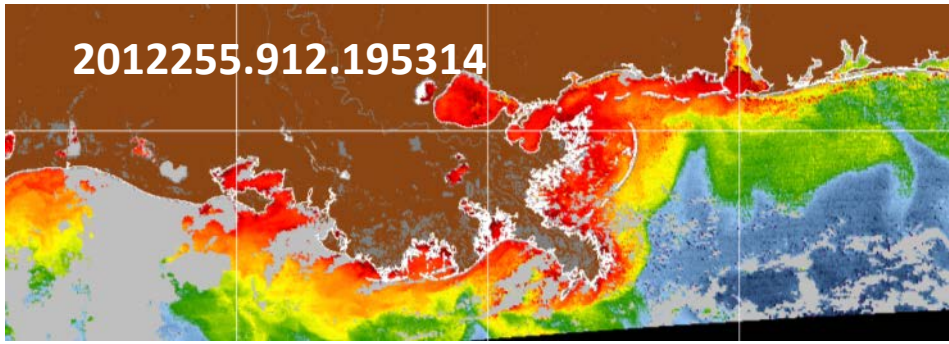
Characterizing Changes in Bio-optics and geochemistry

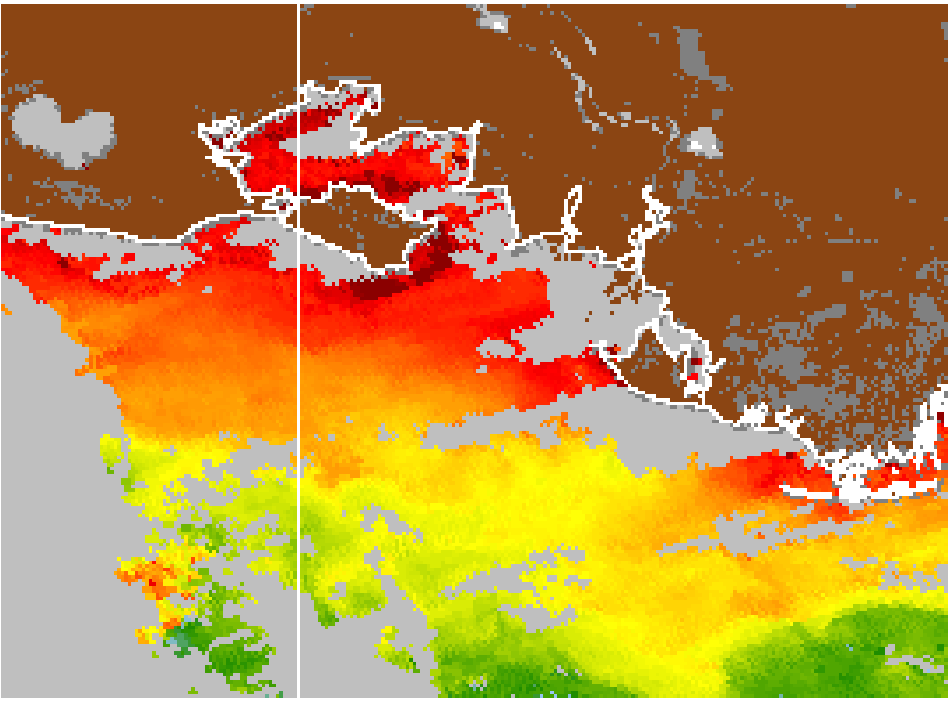


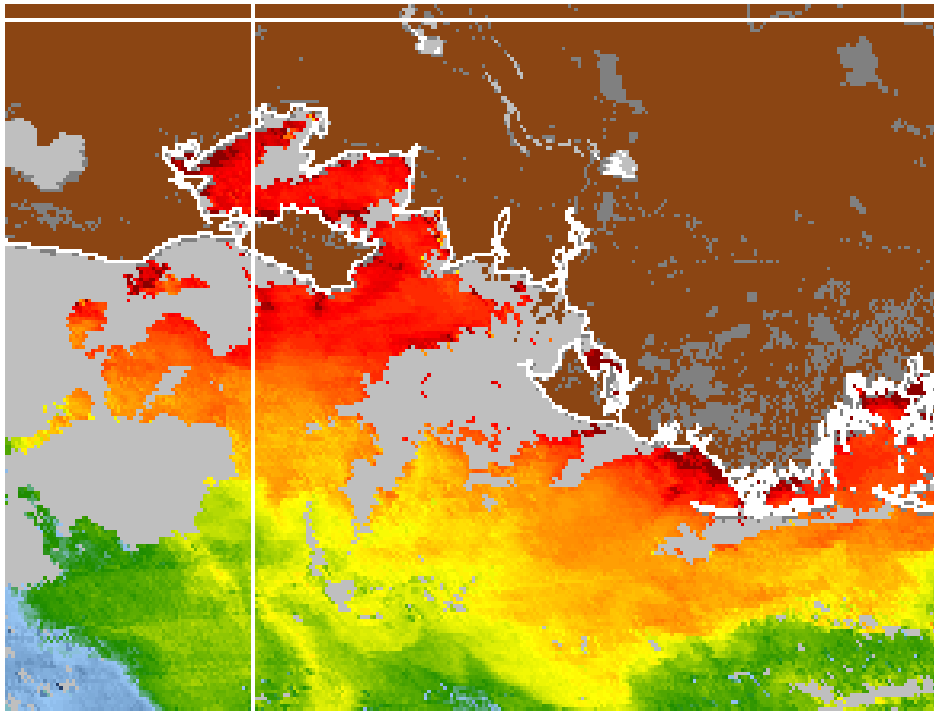
- Mississippi Plume Chlorophyll
- 3 simultaneous plumes at different stages of physical and biological response
- Note – Within 10 days !!! Sept 12- 22

Validation and Ocean Color Uncertainty
Sept 12 , 2013 - Overlap







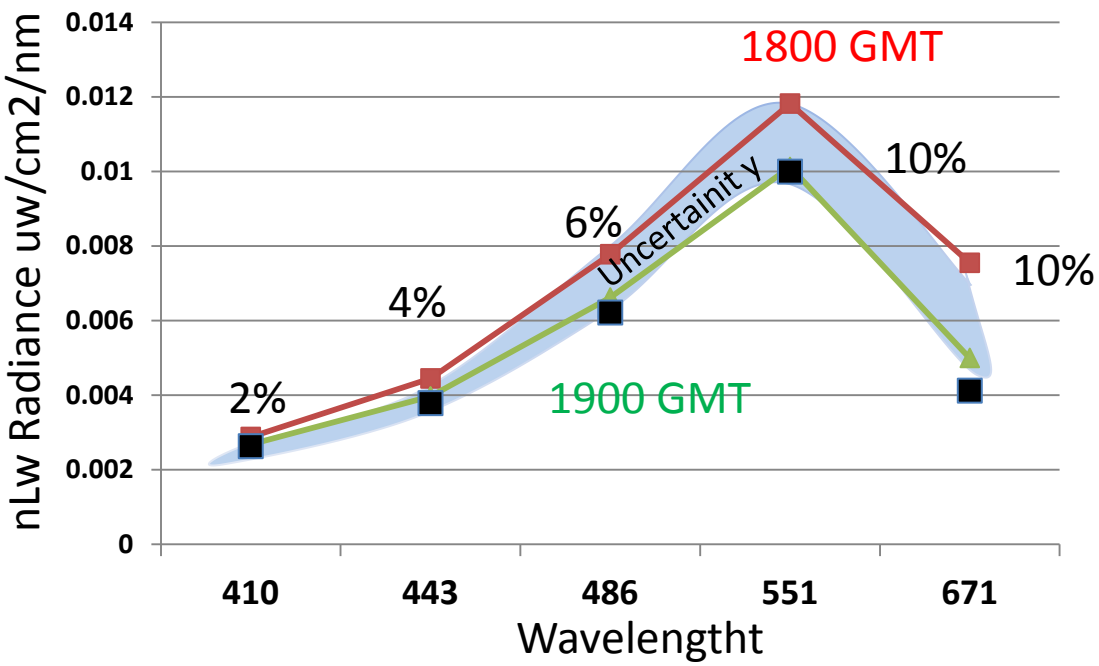


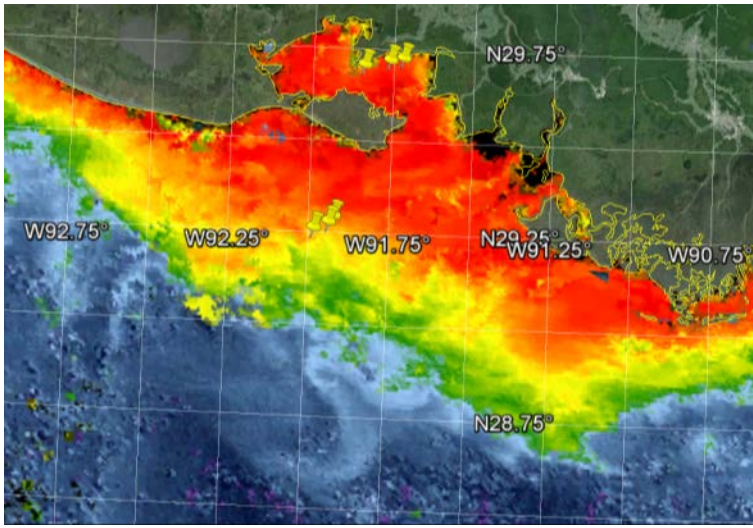
100 Minutes separation between orbital overlap – left and right side of swath.

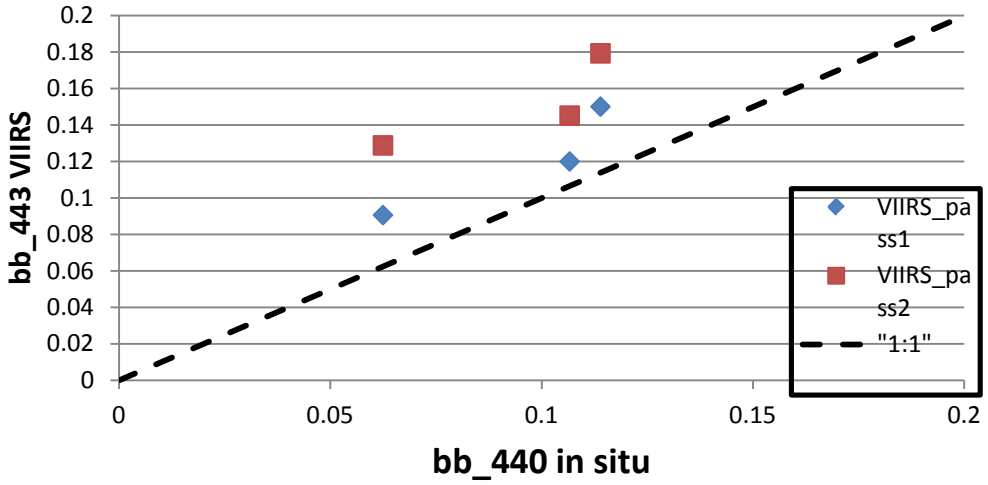
What is the product uncertainty between these NPP products?

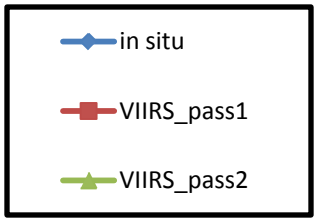
NPP validation

On station example

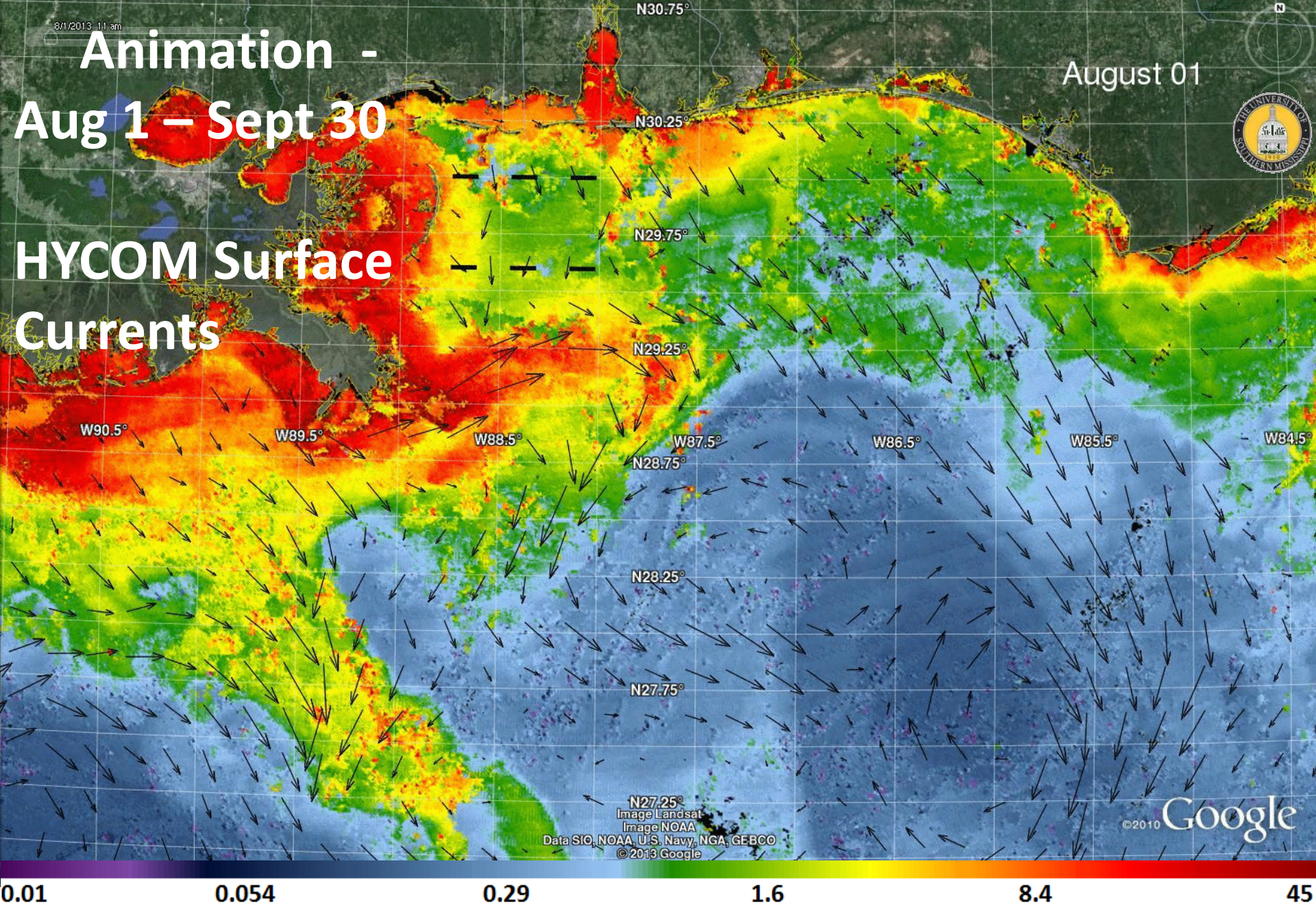








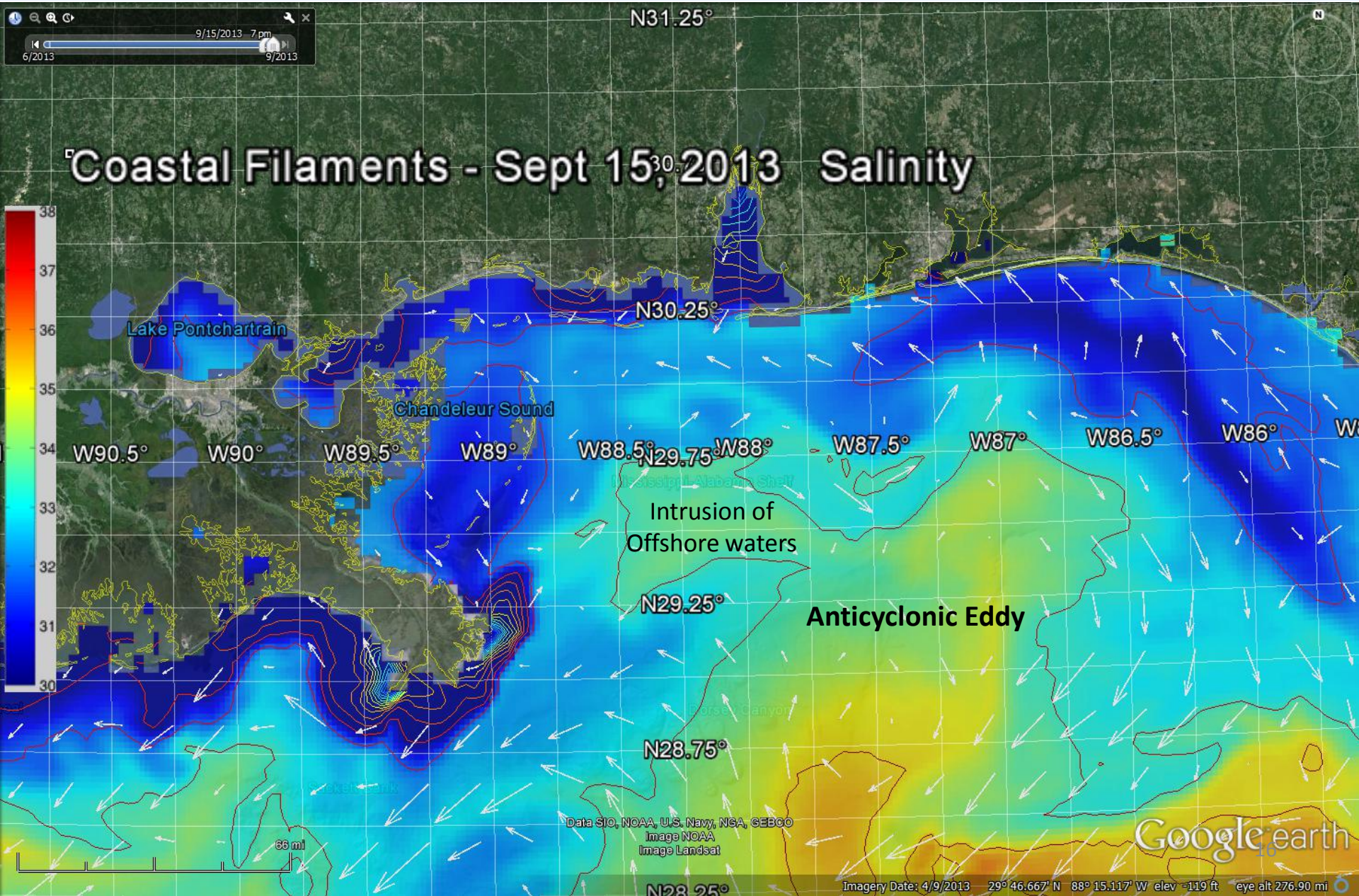
Backscattering



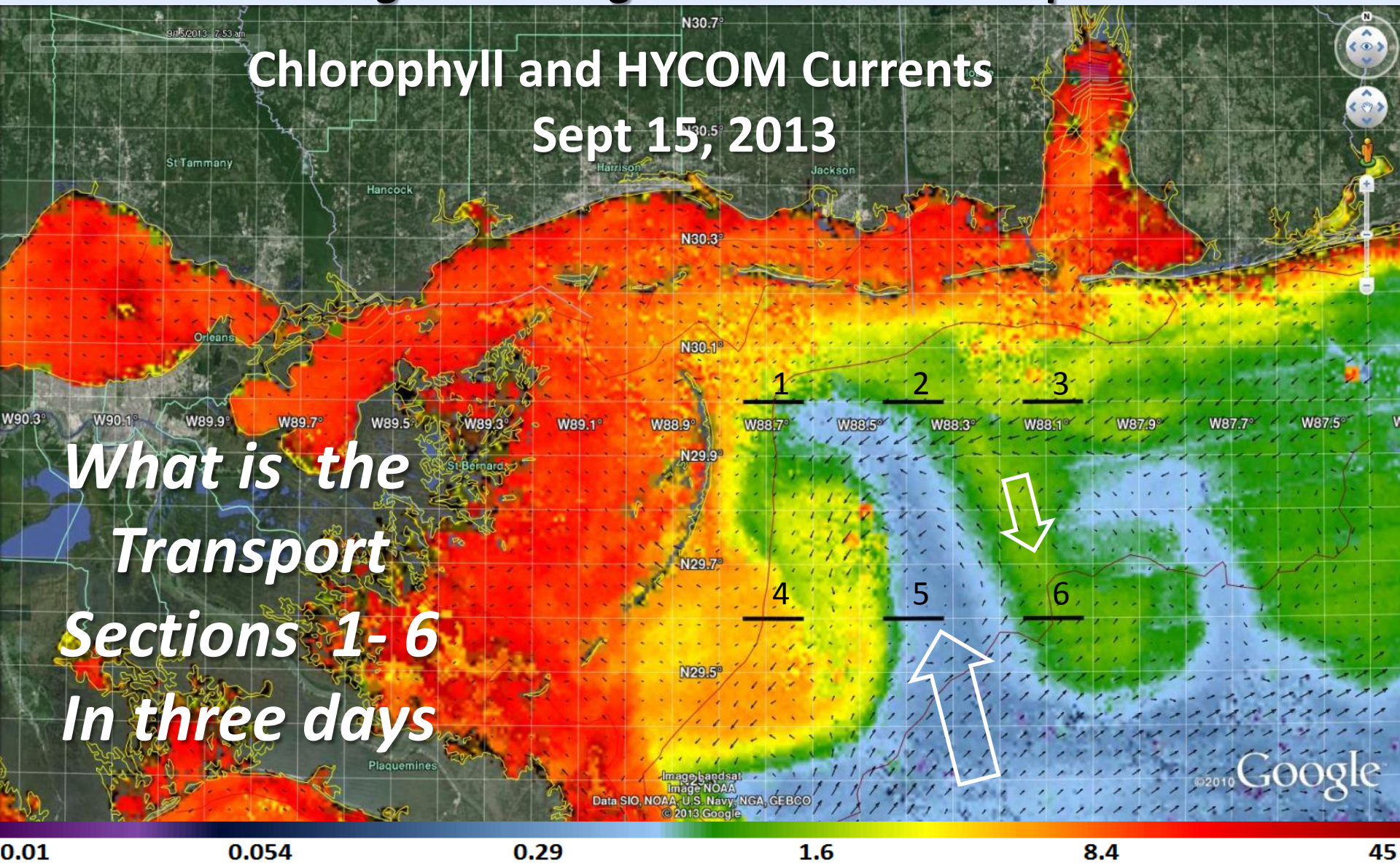
Chlorophyll Concentration (mg m^-3), OC3 algorithm

The Univerity of Southern Mississippi Department of Marine Science
in conjunction with the Naval Research Laboratory, Stennis Space Center, MS

How do Ecological processes interact with Physical processes?



Interaction of Coastal Filaments and offshore waters
Ecological Exchange Processes and transport



Chlorophyll Concentration (mg m^-3), OC3 algorithm

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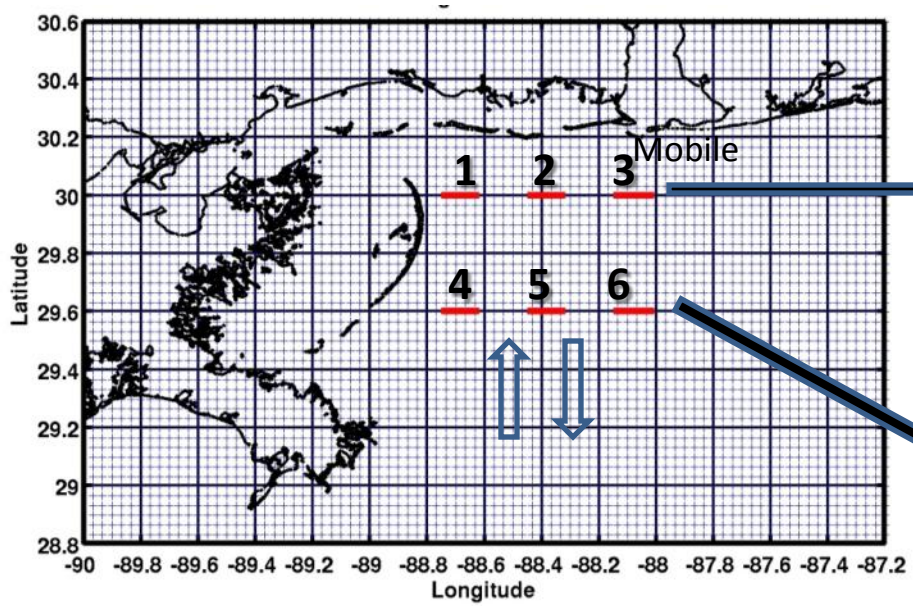
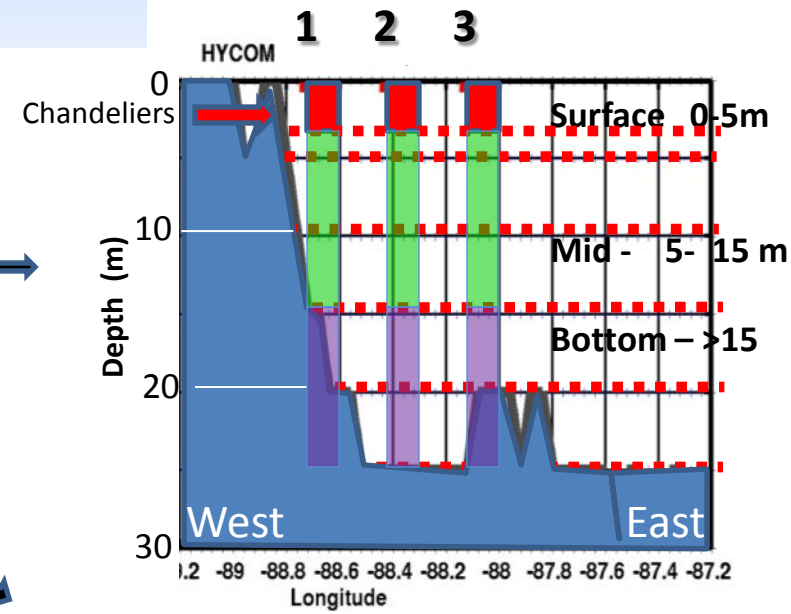
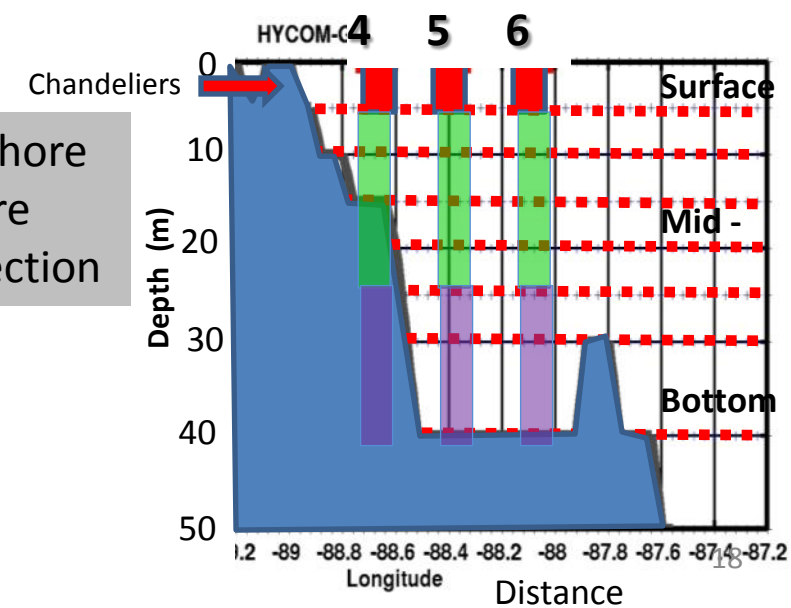
Computing North South Volume Transport Model layers

East West
Cross Sections
Vertical Layers





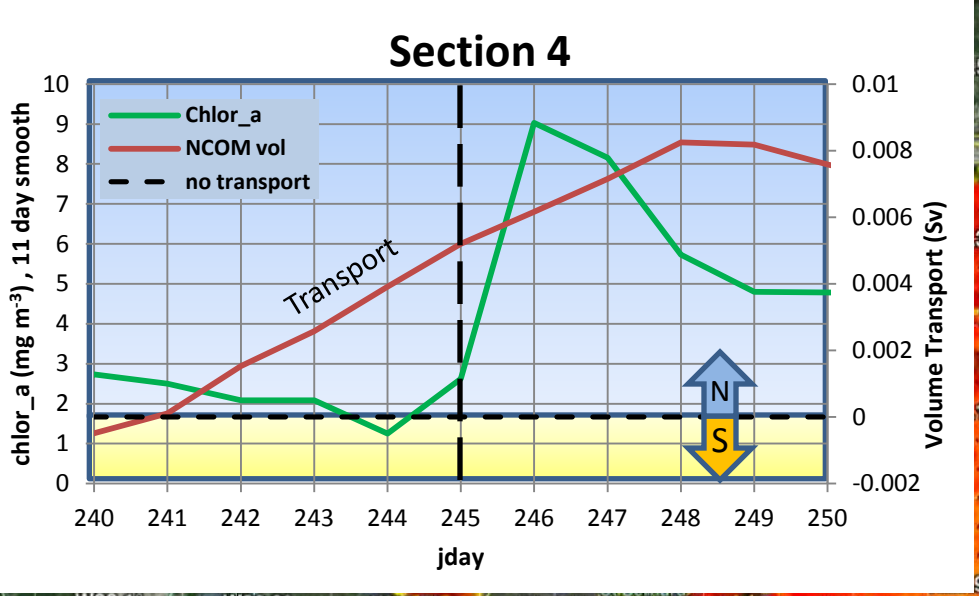


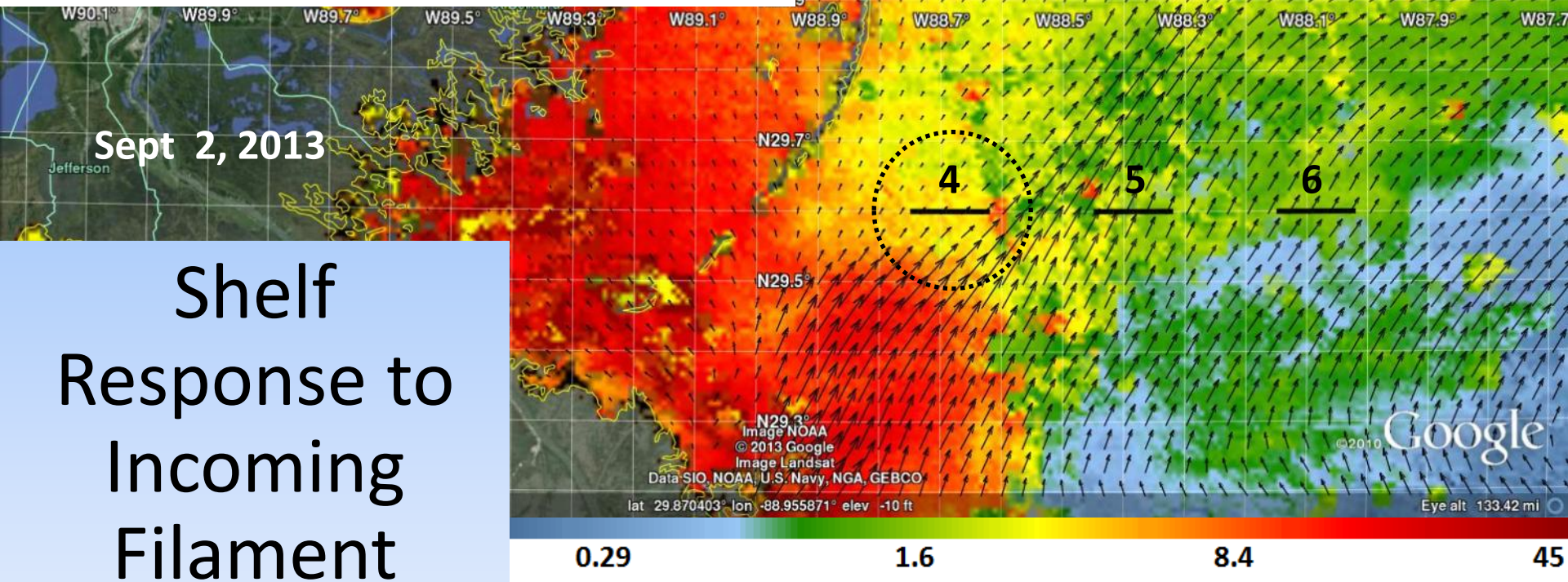
Offshore
Shore
X-Section

Corridors for North South Transport

HYCOM Vertical - 0,5,10,20,25,30,35,40 m
~4 horizontal grid Points (12.5 km)

NCOM Vertical - 0,2,4,6,8,10,12,15,20,25,30,35,40
~5 horizontal grid Points (12.5 km)





0.29 1.6 8.4 45

hyll Concentration (mg m^-3), OC3 algorithm

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Shelf Response to Incoming Filament 10 Day History

Interaction of Coastal Filaments and offshore waters
Ecological Exchange Processes and transport

"Shelf " Mean Flux

(6 sections HYCOM)

Average flux

May – Dec 2013

Surface –

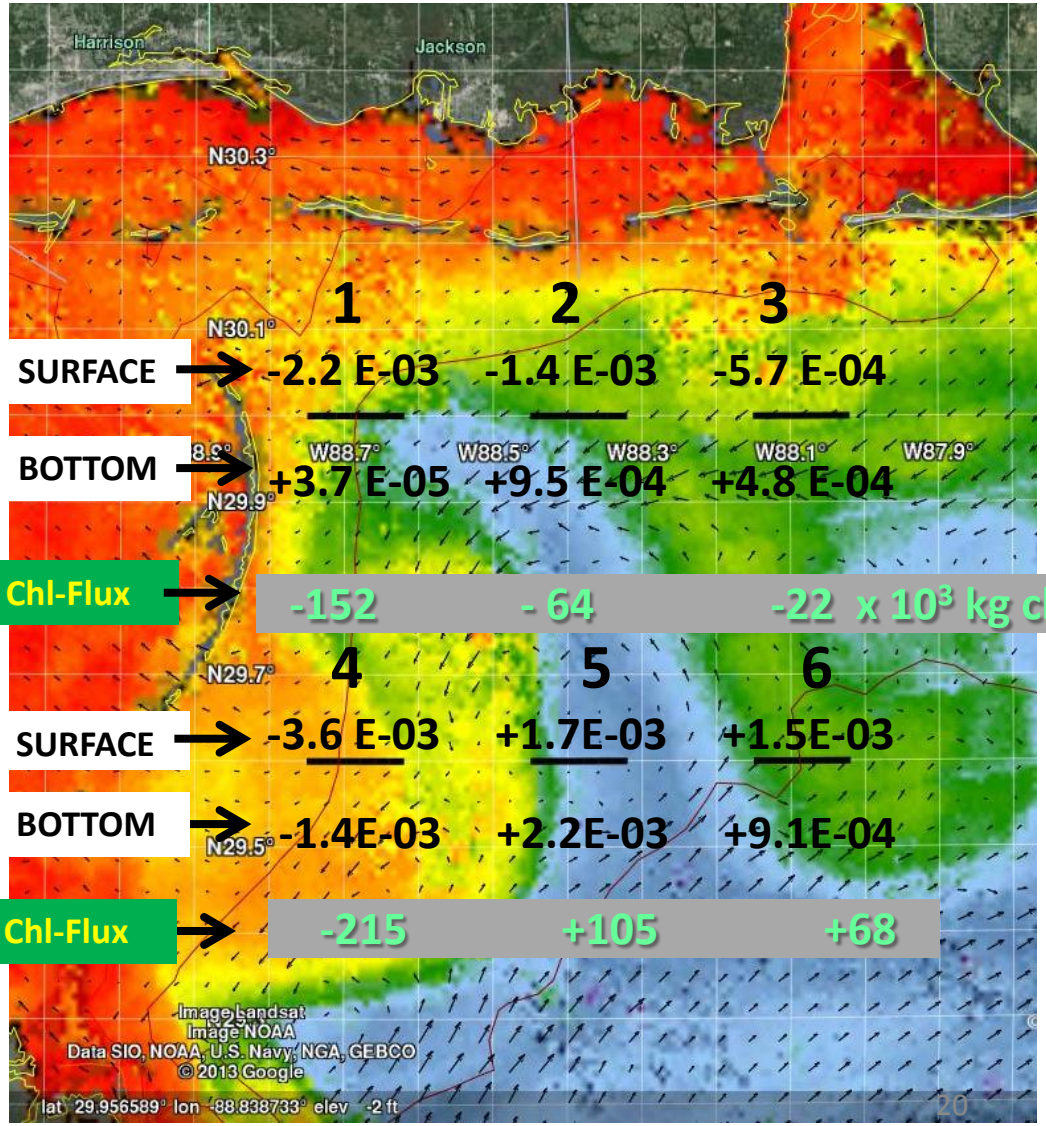
- .00046 Sv *Offshore*

Mid-depth –

- .00095 Sv *Offshore*

Bottom Onshore

+ .00031 Sv



Local River Flux (SV)

Missis s^{-1}

Mobile s^{-1}

Total Biomass Flux (sfc)

- 280 x10³ kg chl

Chl-Flux = Chl(mg/l) * Transport($10^6 m^3 s^1$) * 86400sday^{-1})/1000

Summary:

- ***Demonstrated persistent active filaments in Gulf May Dec 2013***
  - ***Defined offshore – onshore exchanges processes with Satellites and NCOM/ HYCOM and confirmed with insitu***
- ***Identified need adaptive sampling for plumes.***
  - **Coordinate with National Marine Fishers Cruises**
  - **Cal val satellite Activities - building Confidence !**
- ***Importance of freshwater exchanges on both Physical and Bio-optical response***
  - ***Complex "pulses" of multiple plumes affects buoyancy driven flow and ecology !***
- ***Identified "transport corridors" across shelf and tracking biological responses***
  - ***Influences oil transport on exchanges pathways of particles, biological and advective transport.***