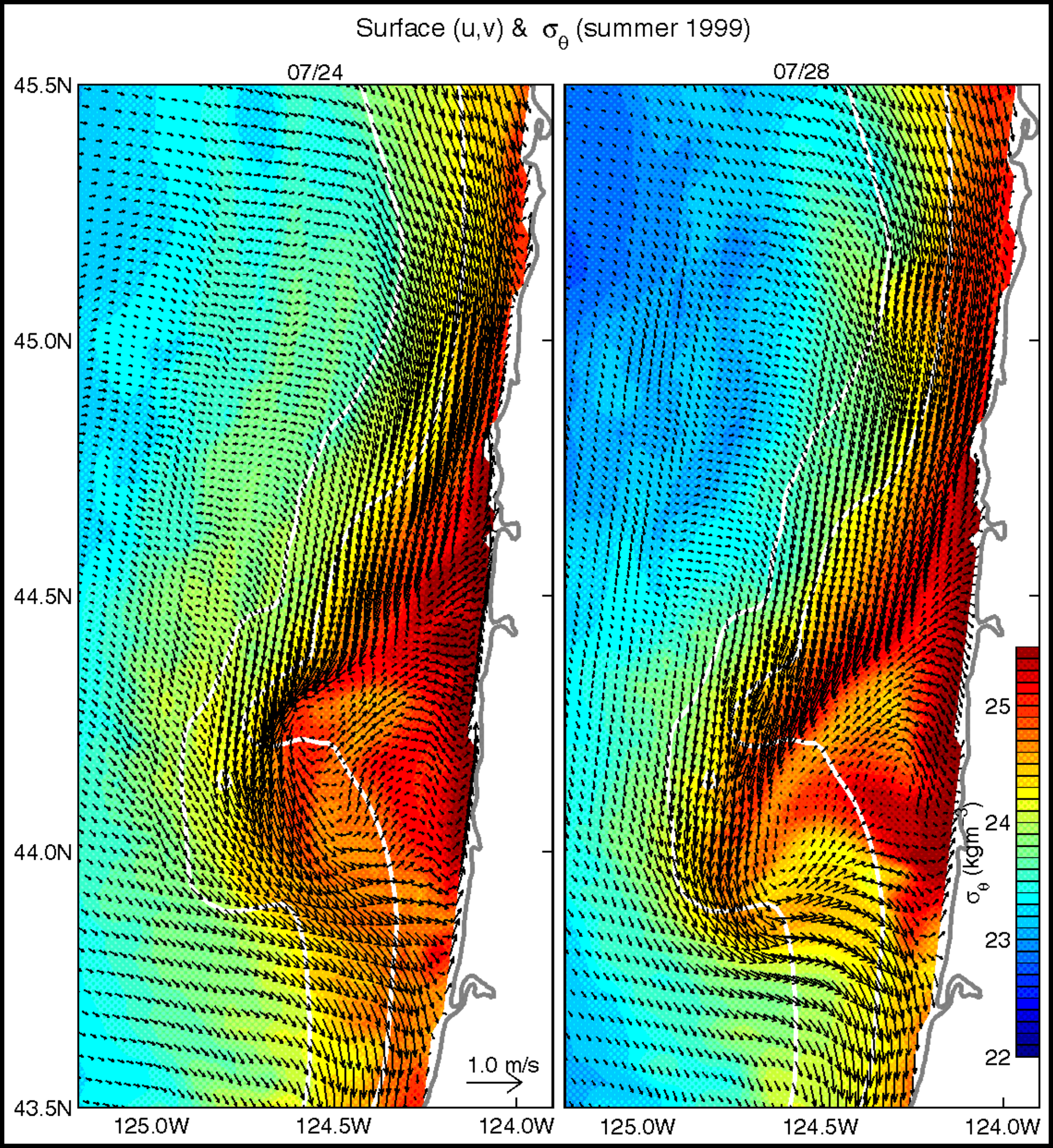
Data as Input to Assimilating Models



Work by researchers at COAS (Allen, Egbert, Miller, Oke, Kurapov, Erofeeva, etc) have lead field in data assimilating coastal models and their use in synthesizing measurements and exploring dynamics of wind-driven flow, tidal variability, influence of topography, etc.

Gary Egbert will discuss in detail.

CIOSS Research Themes

Sensors & Techniques
- (6) Freilich: Windsat Validation
- (21) Letelier: Ocean Optics
- (2) Strutton: Hyperion/HES-CW Evaluation
- (16-17) Davis: HES Design Evaluation
- (15) Davis: MOBY II Evaluation

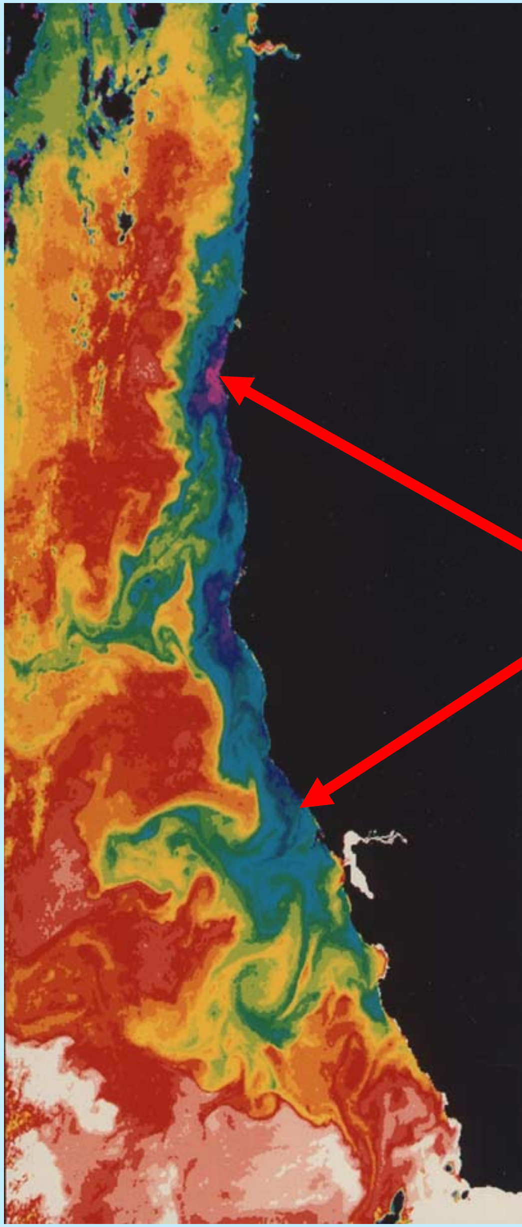
Fields & Fluxes
- (13) Chang: Hi-Res Winds
- (4) Chelton: SST-Wind Interaction
- (19) Strutton: HAB Fields
- (22) Coakley: Surface Radiation
- (23) Strub: Mesoscale Circulation G
- **Chelton-Reynolds SST**
- **Chelton-Wind Climatology**

Modeling/DA
- (5) Kurapov: Current Predictions
- (9) Allen: Data Assimilations G
- (7) Samelson: Coupled Coastal Models
- (10) Batchelder: Ecosystem Models G
- (20) Allen: Model Analyses

Analysis
- (3) Barth: Frontal Analyses
- (11) Kosro: Coastal Currents G
- (12) Strub: Basin-Boundary Linkages G

Education & Outreach
- (1) Davis-Butts: SMILE
- (18) Phipps: HMSC Pilot Display
- (8) Milliff: WFC SCAT Use
- (14) Letelier: CDR Requirements
- Scientific Workshops

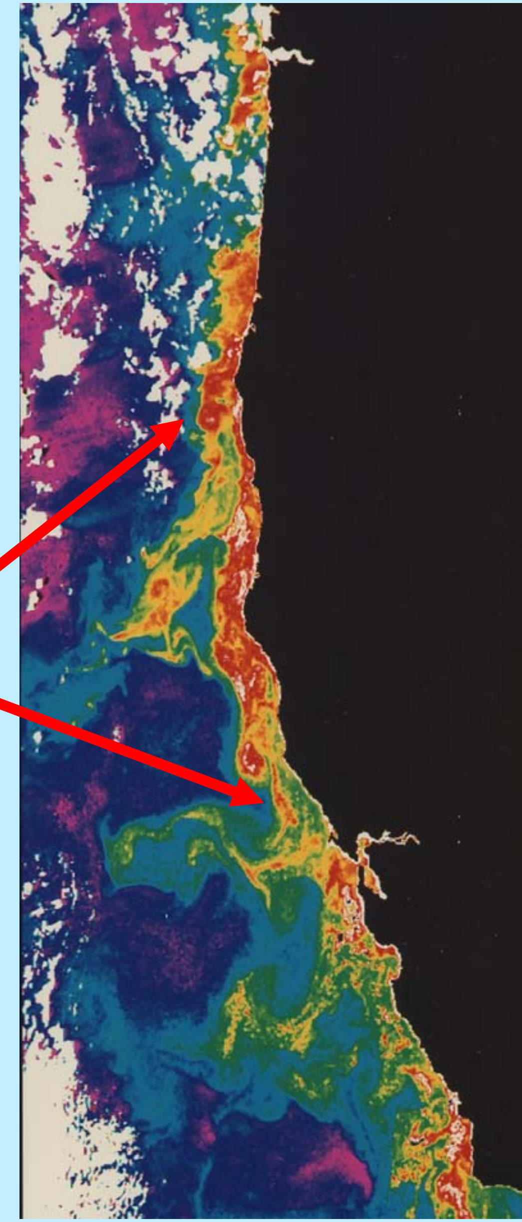
Legend
- GOES-R
- Vector Winds
- Modeling/DA
- Product Development
- NMFS Sat Data Use



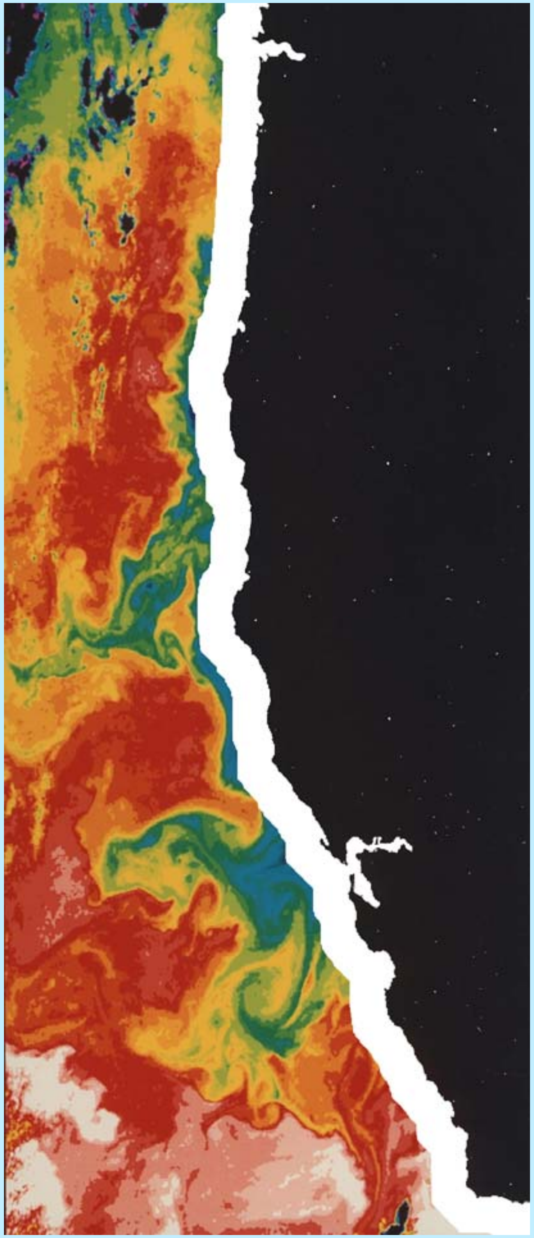
Temperature

Summer CZCS Image of
US West Coast

Equatorward winds cause coastal upwelling
- -- Low SST near coast
- -- High productivity
- -- Complex air-sea interaction



Pigment

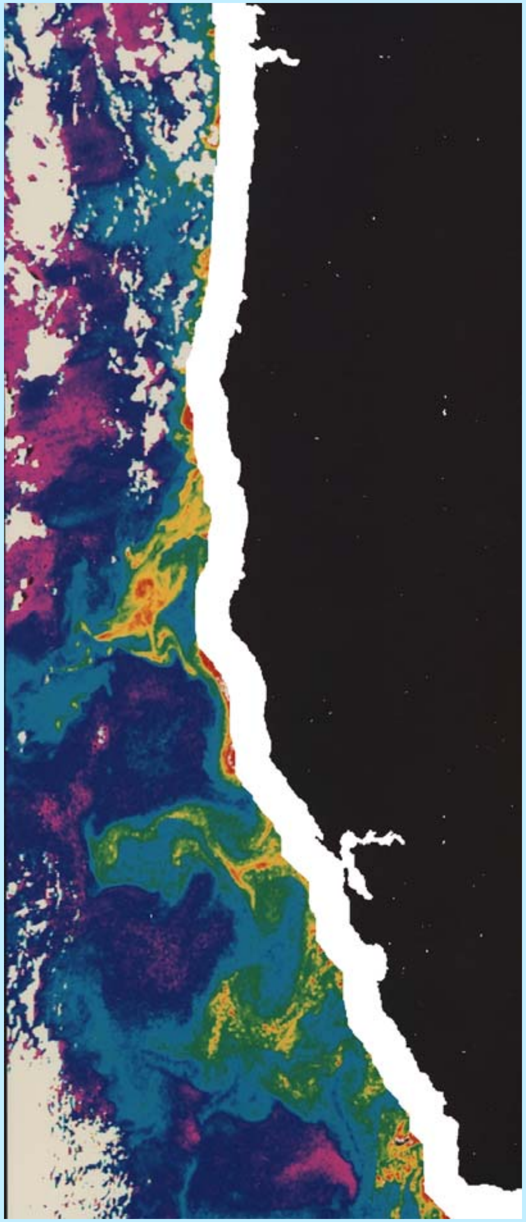


Temperature

Effect of 30 km scatterometer land mask

NO accurate wind data over the critical upwelling region

High resolution winds will allow study of air-sea interaction in coastal upwelling areas



Pigment

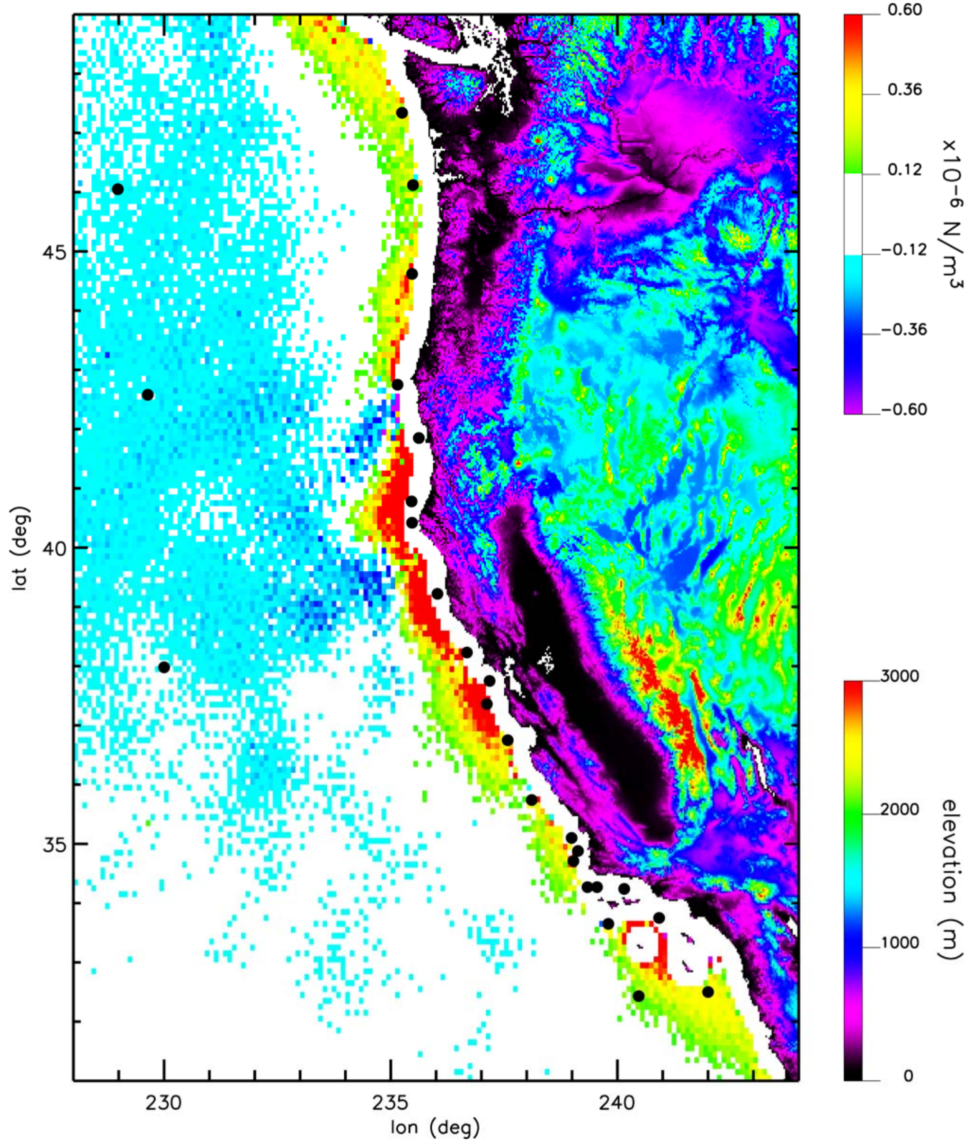
5-year Mean Summer Wind Stress Curl from QuikSCAT Science Data

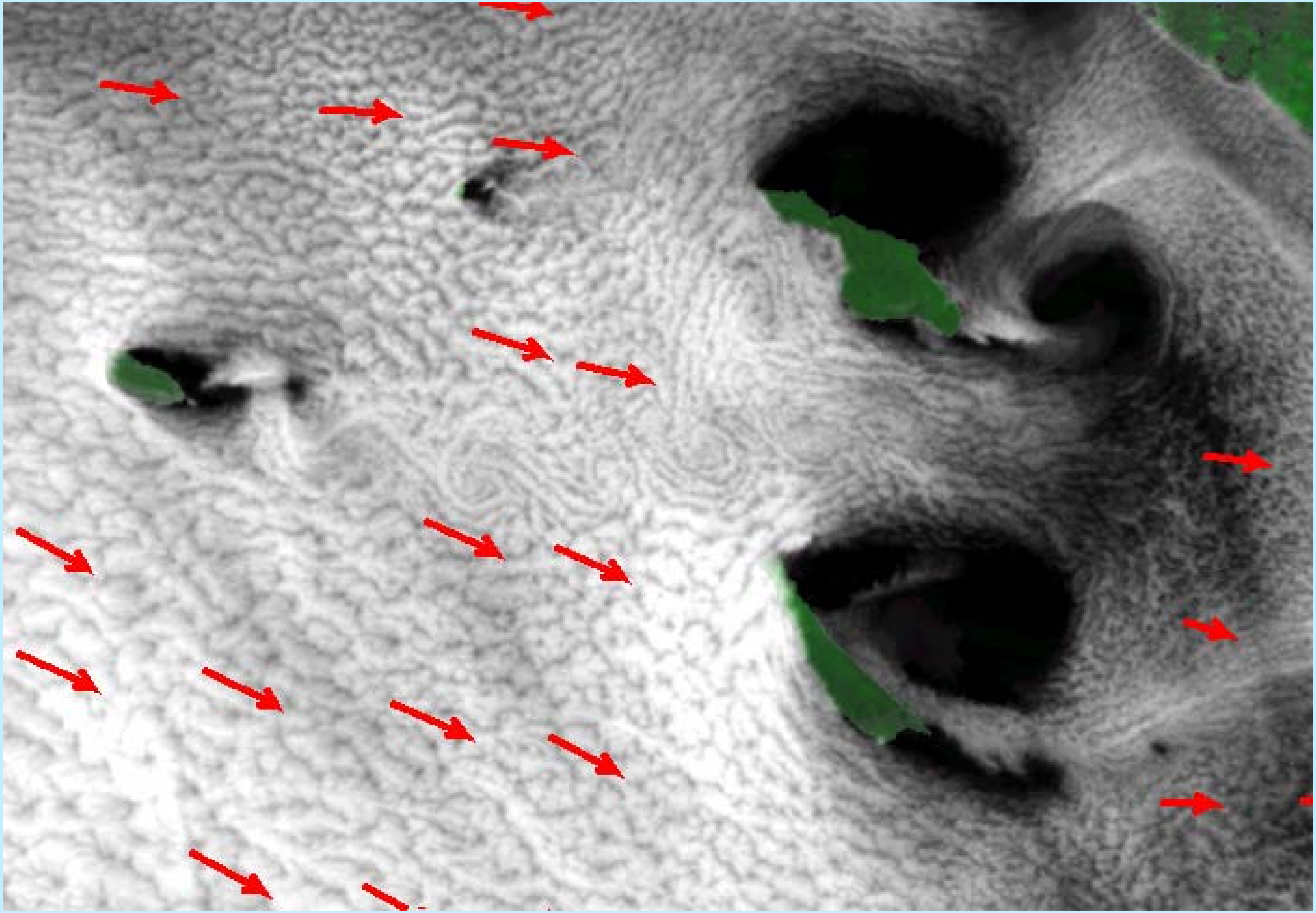
1999-2004 mean June-Sept wind stress curl

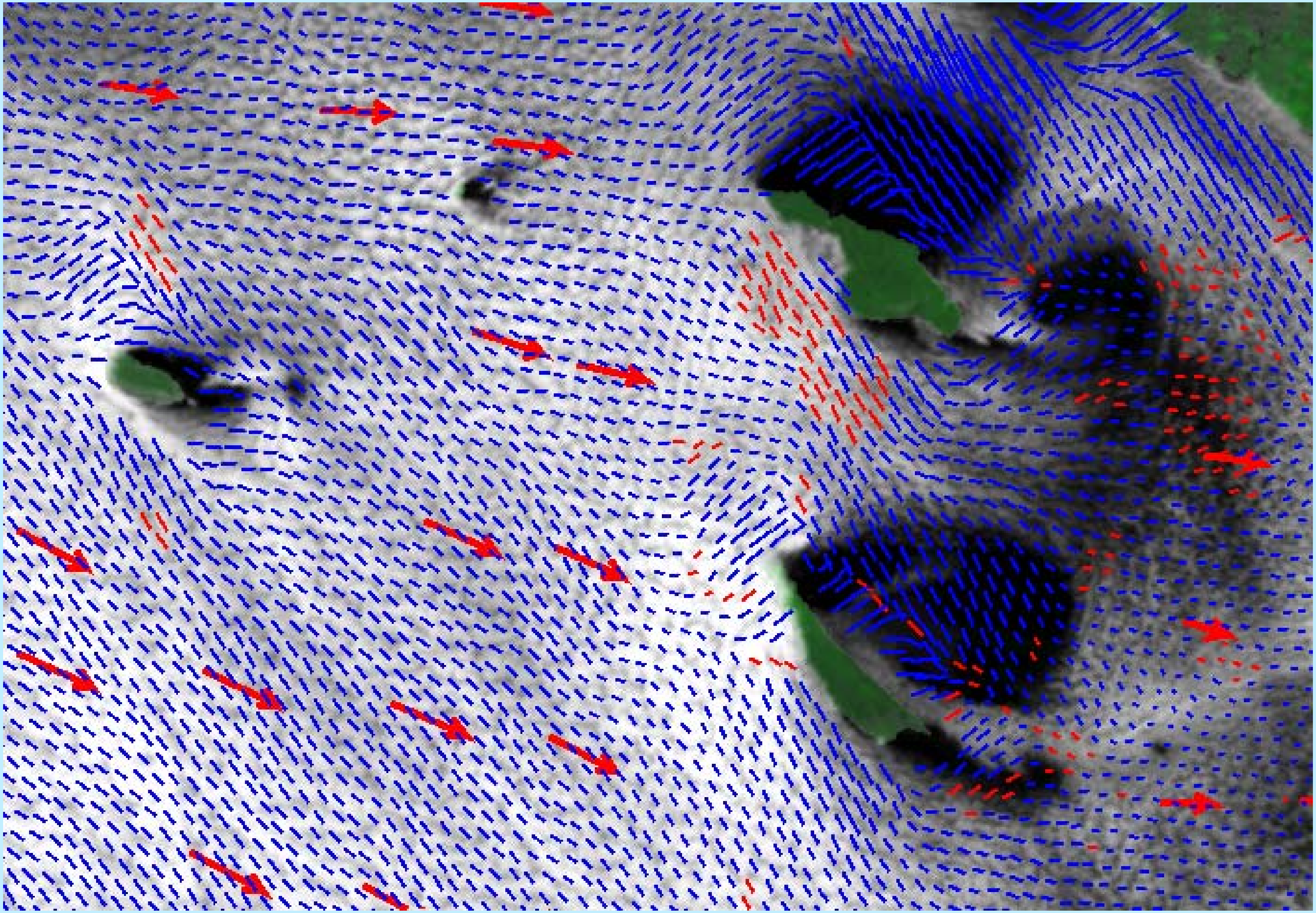
From QSCAT 25 km data

NDBC buoy locations as ●

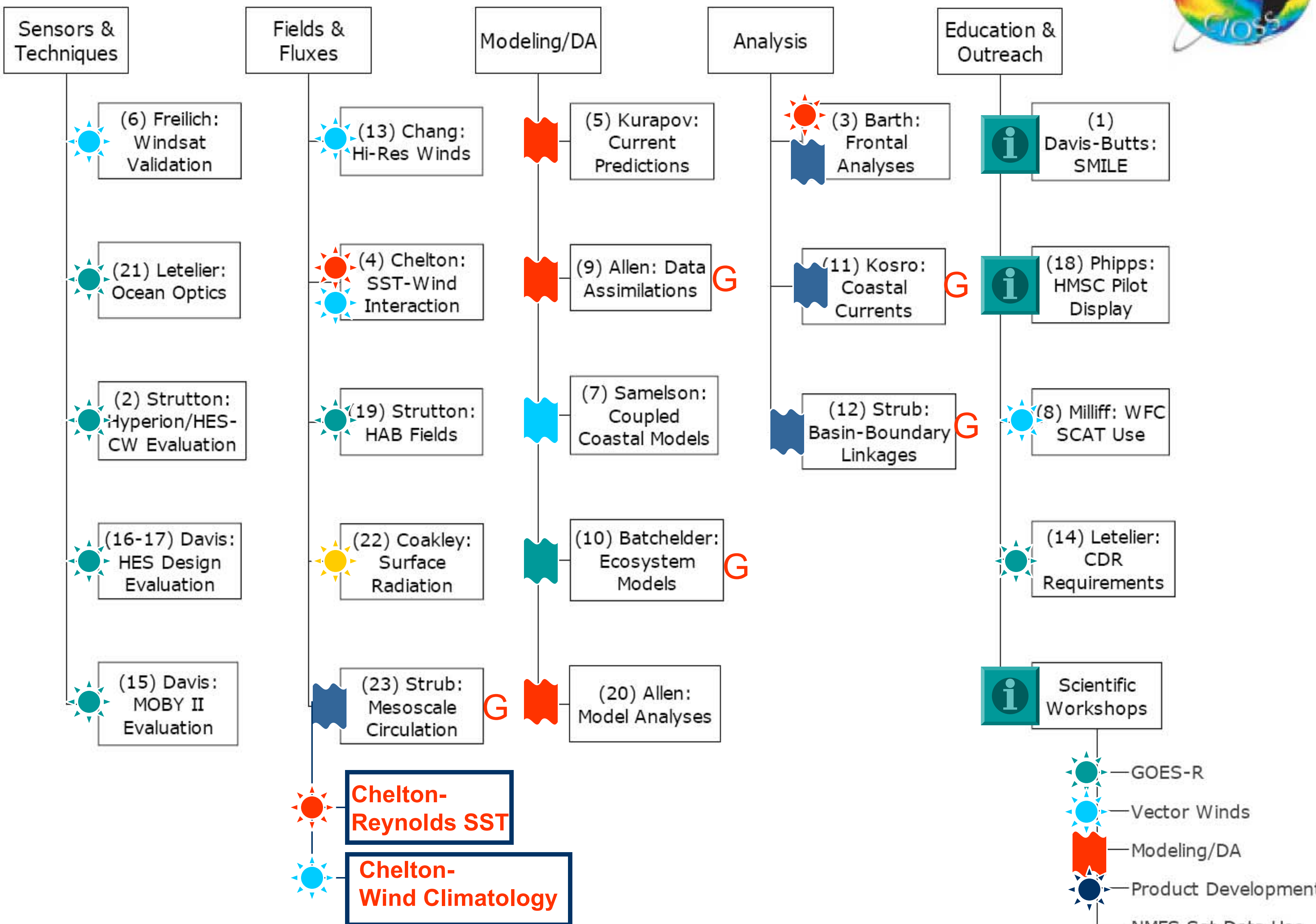
Transition from negative offshore curl to strong positive nearshore curl is barely evident outside landmask; little data within Southern California Bight





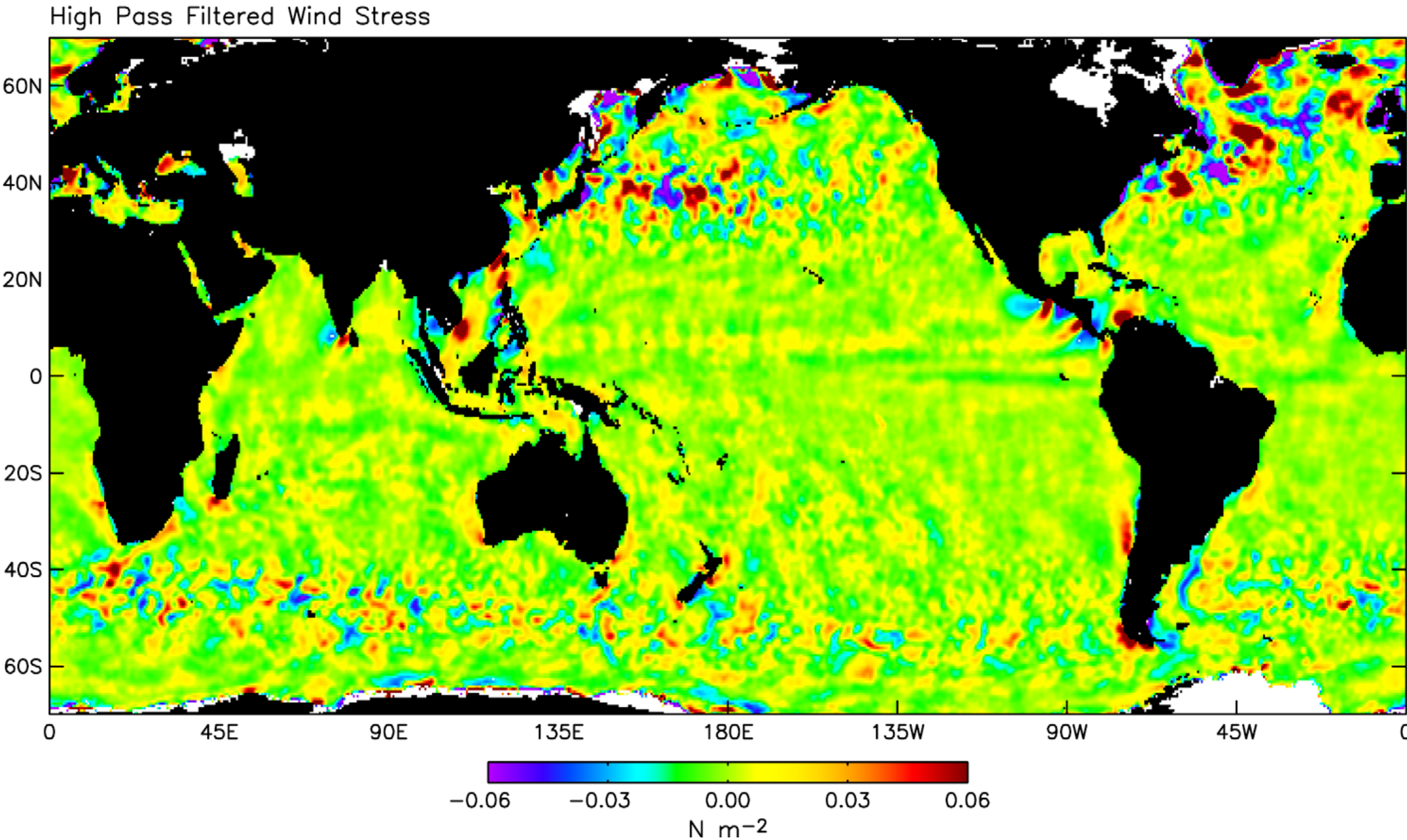


CIOSS Research Themes



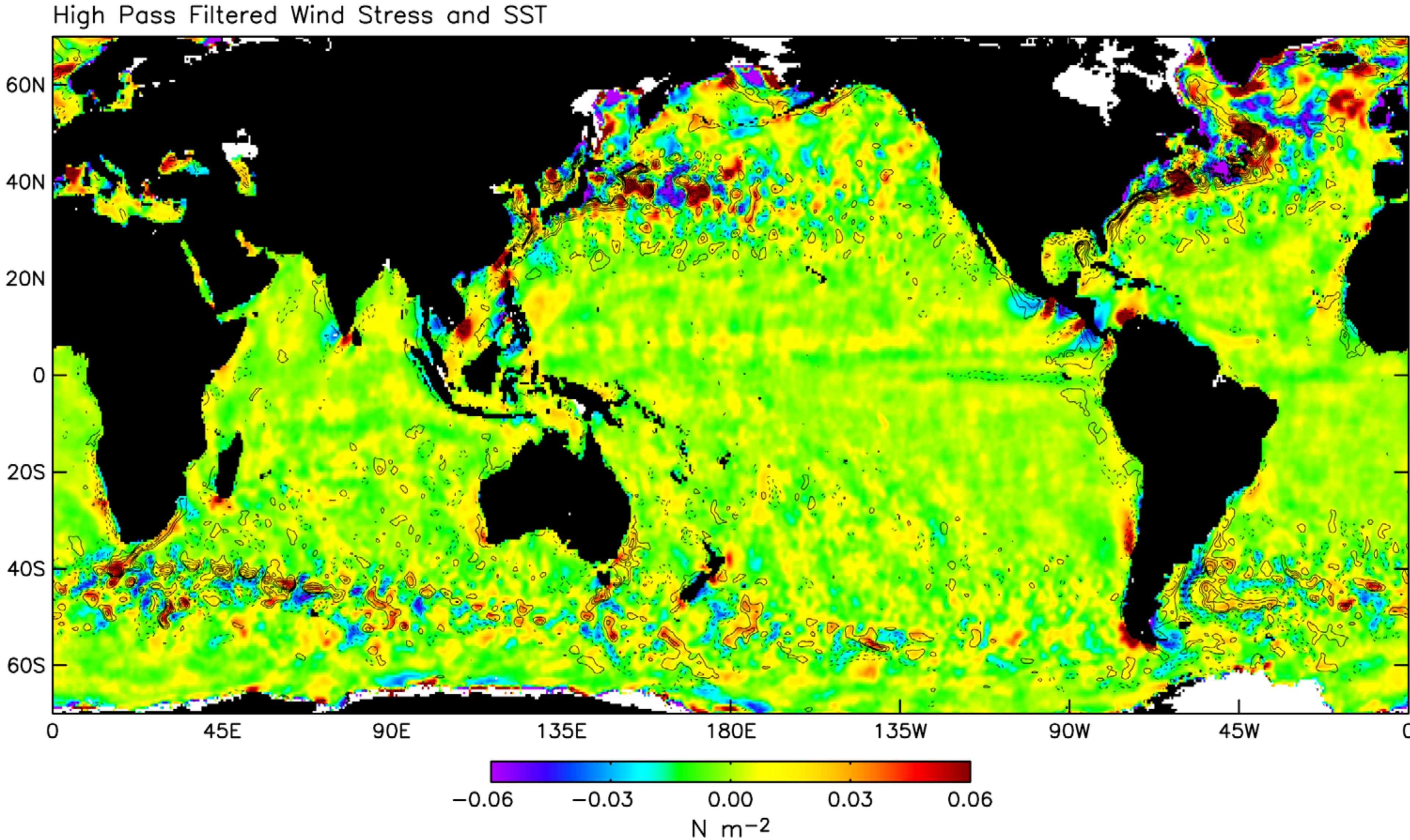
Spatially High-Pass Filtered Wind Stress Magnitude

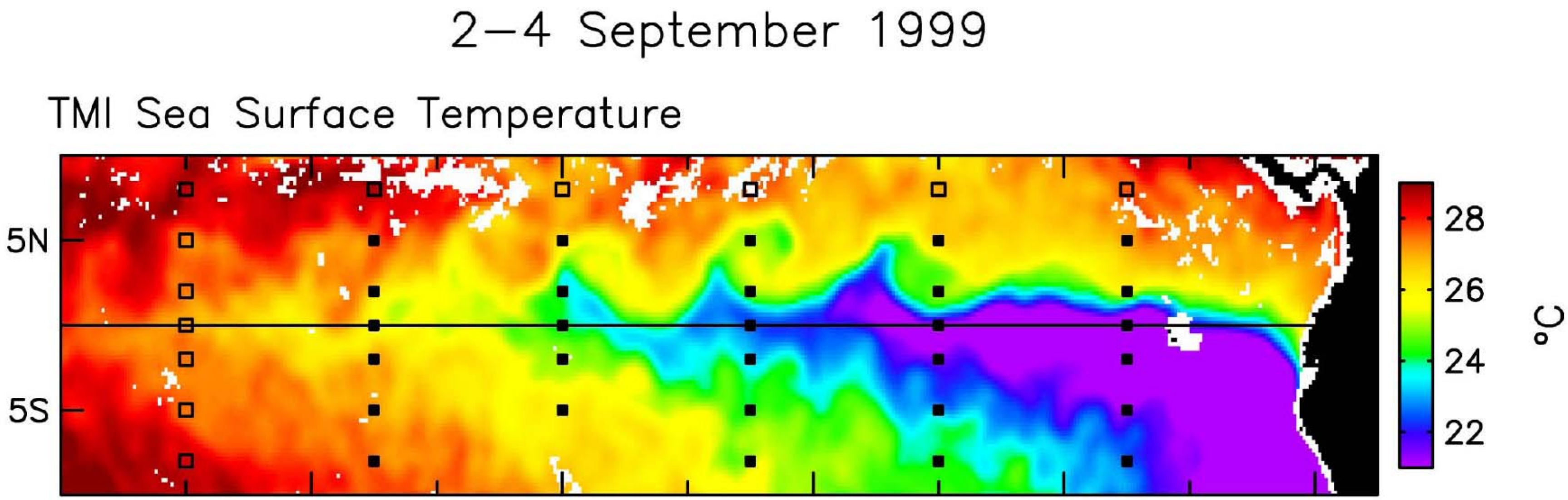
QuikSCAT, January–February 2003

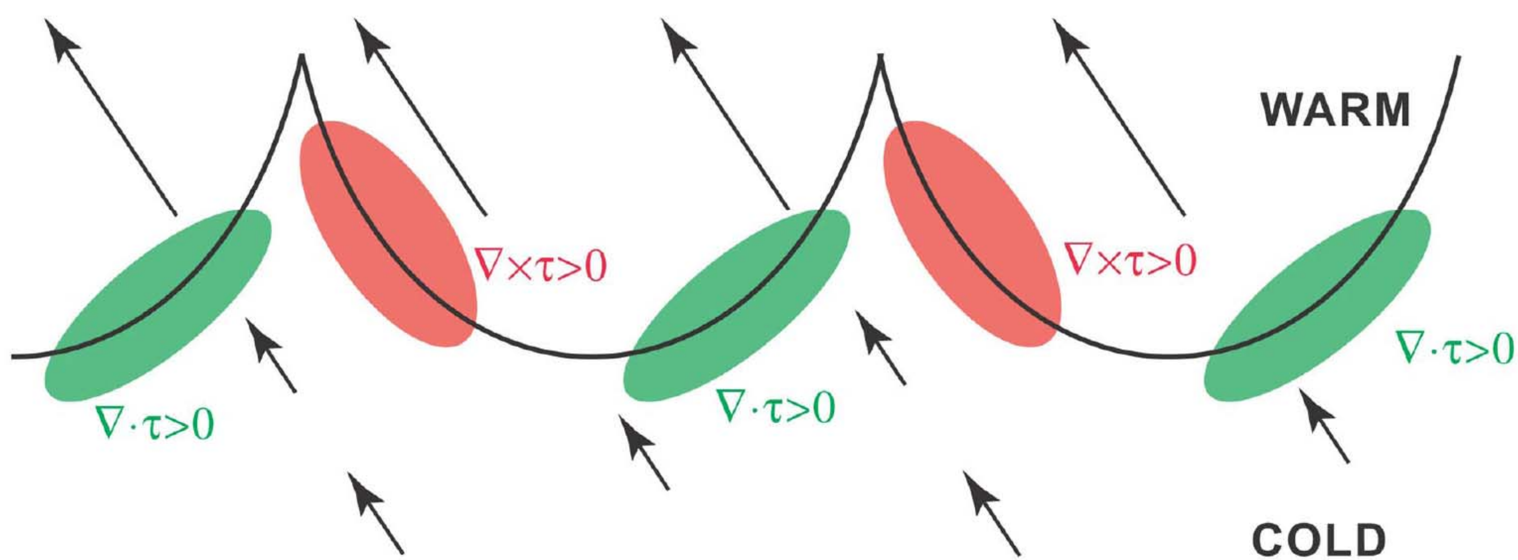


Spatially High-Pass Filtered Wind Stress Magnitude and SST Contours

QuikSCAT, January–February 2003




2–4 September 1999
TMI Sea Surface Temperature
5N
5S
28
26
24
22
°C


WARM
COLD
∇×τ>0
∇×τ>0
∇·τ>0
∇·τ>0
∇·τ>0

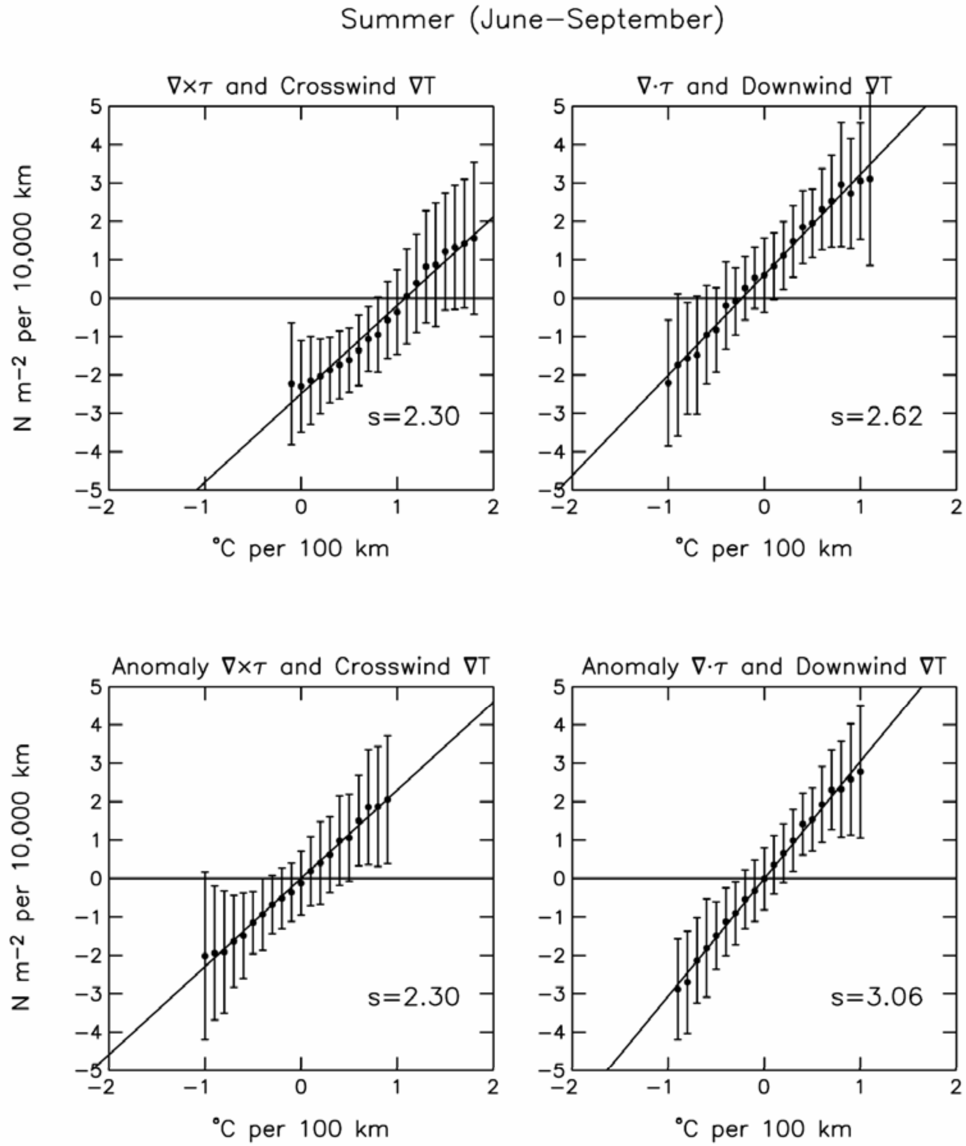
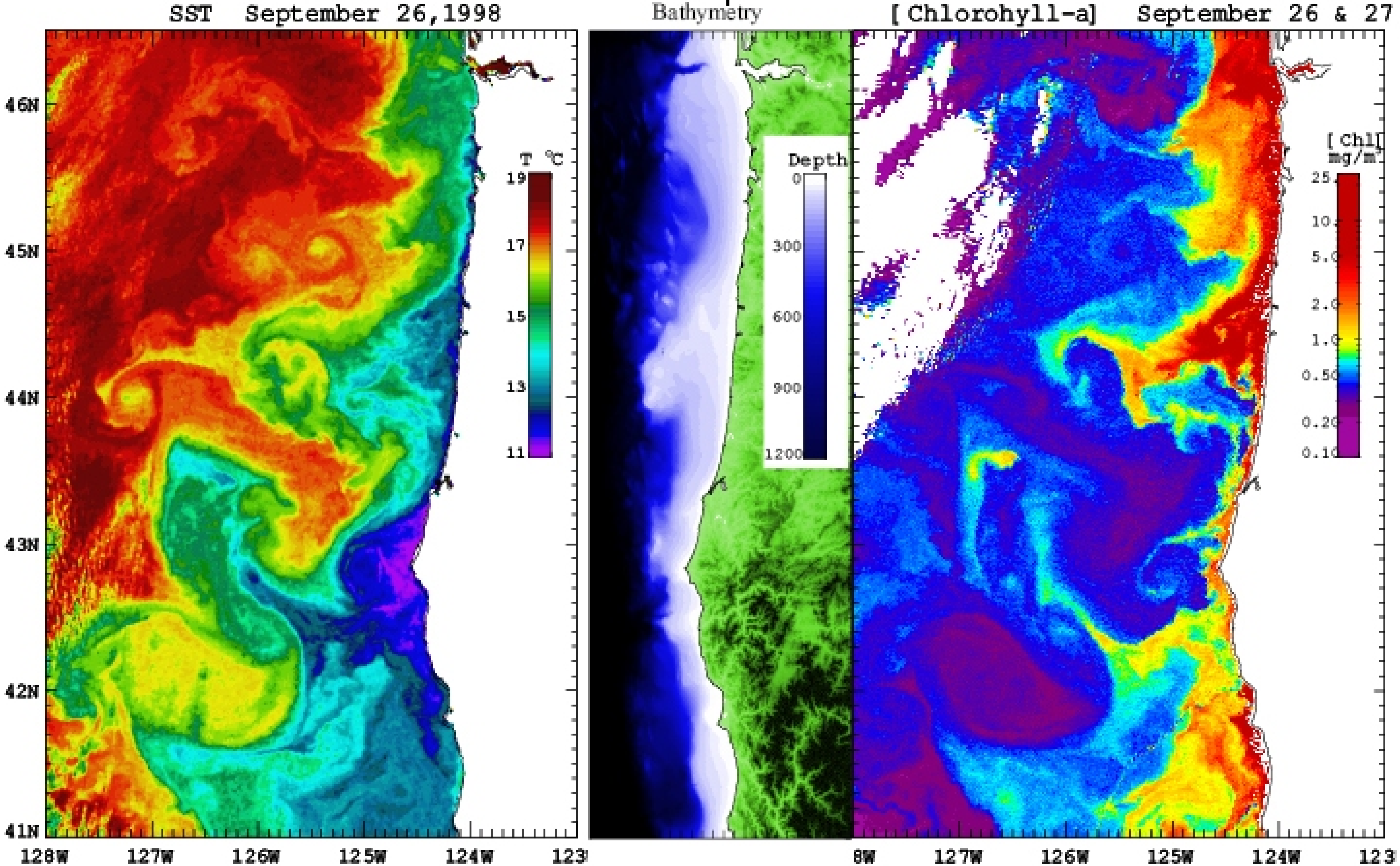


Fig. 7. Binned scatterplots of (left) summertime wind stress curl versus the crosswind component of the SST gradient and (right) summertime wind stress divergence versus the downwind component of the SST gradient. The upper panels are for the total fields and the lower panels are for the anomaly fields, defined to be the deviation of each summertime 29-day average from the overall summertime average. The statistics were computed over the region 36ºN to 43ºN, 128ºW to 122ºW. The points in each panel are the means within each bin computed from overlapping 29-day averages at 7-day intervals in the four June–September time periods during calendar years 2002–2005. The error bars in each panel represent the ±1 standard deviation over all of the individual 29-day averages within each bin. The slope *s* of the least-squares fit line to the binned averages is labeled for each panel.

SST

Depth

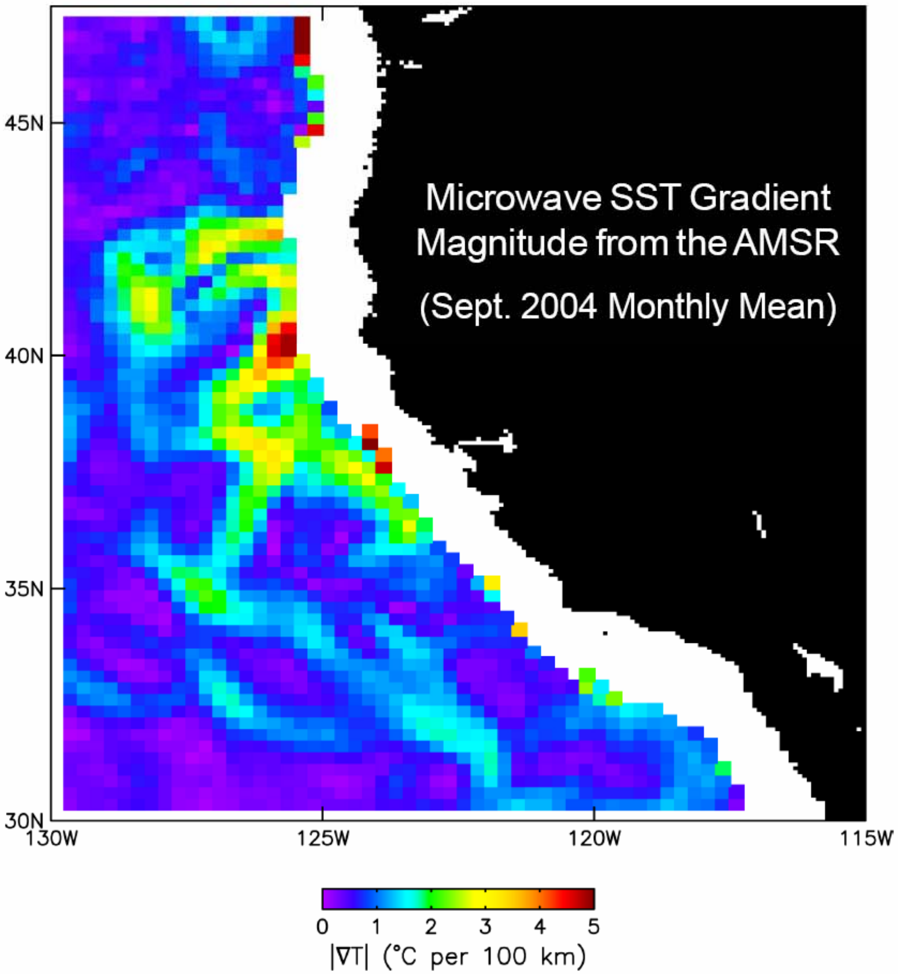
Chlorophyll-a

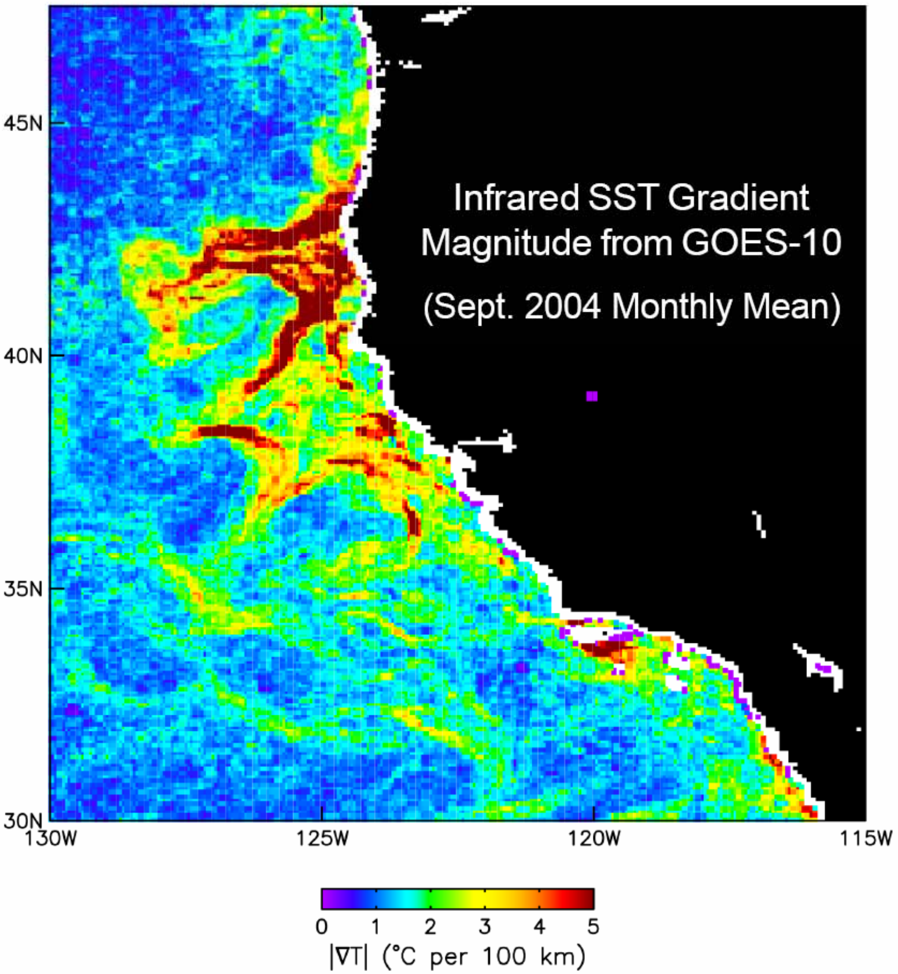


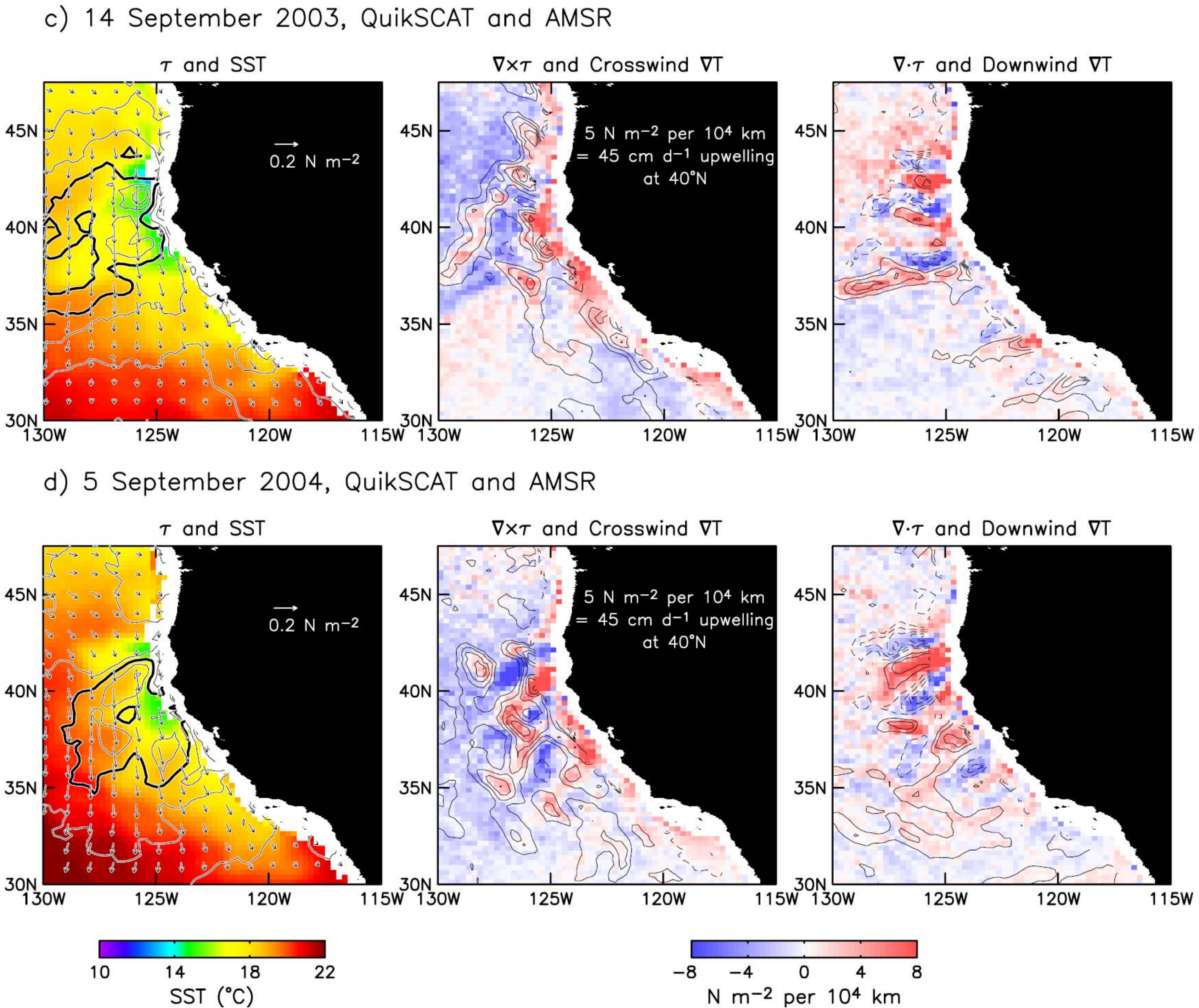
Resolution and Land Masking

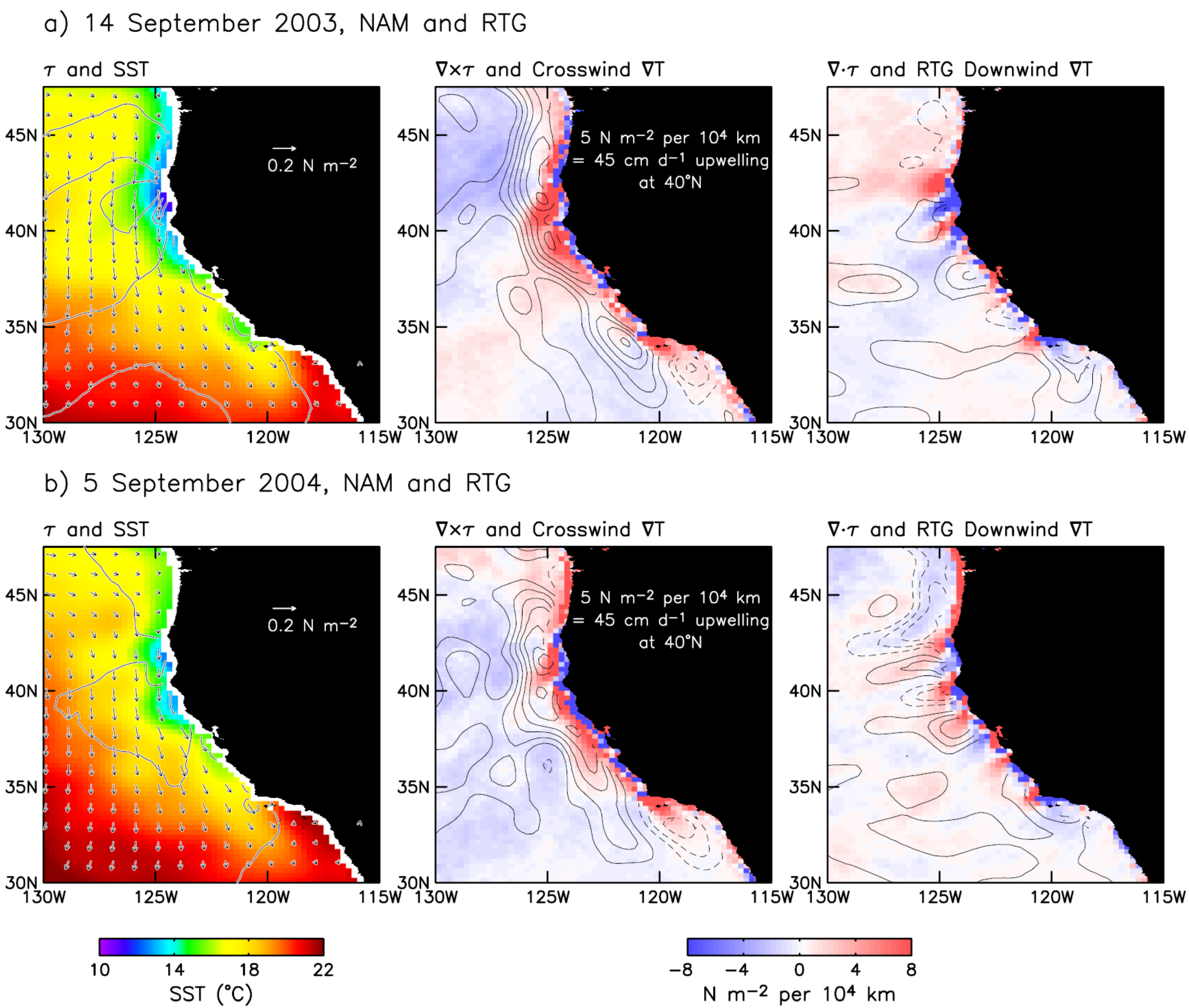
The primary limitations of microwave estimates of SST are:

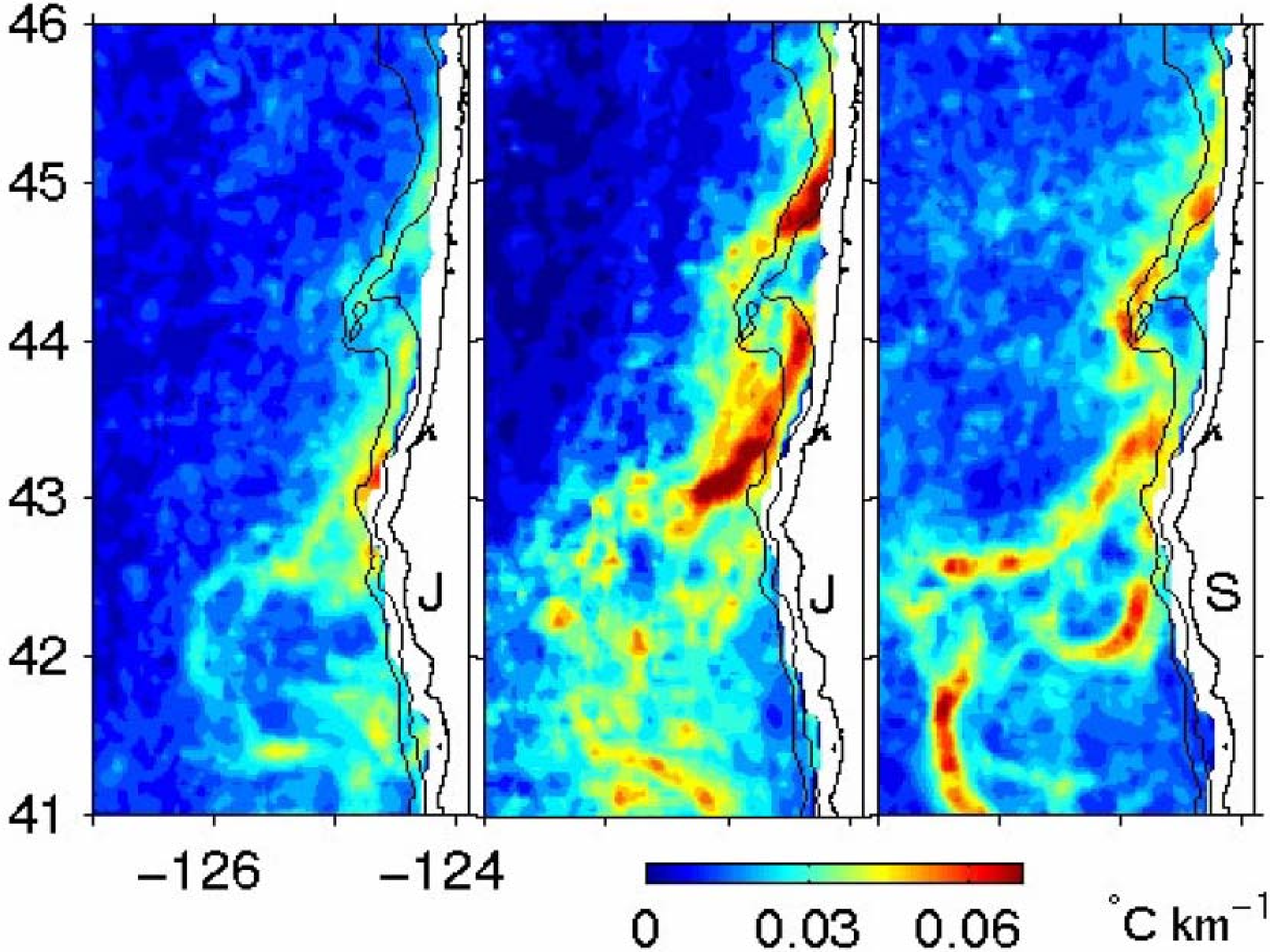
- *the large footprint size of ~50 km, compared with ~1 km for infrared estimates of SST.*
- *the inability to measure SST closer than about 1.5 footprints from land because of antenna sidelobe contamination.*






c) 14 September 2003, QuikSCAT and AMSR
τ and SST
∇×τ and Crosswind ∇T
∇·τ and Downwind ∇T
0.2 N m−2
5 N m−2 per 10⁴ km
= 45 cm d−1 upwelling
at 40°N
45N
40N
35N
30N
130W
125W
120W
115W
d) 5 September 2004, QuikSCAT and AMSR
τ and SST
∇×τ and Crosswind ∇T
∇·τ and Downwind ∇T
0.2 N m−2
5 N m−2 per 10⁴ km
= 45 cm d−1 upwelling
at 40°N
10
14
18
22
SST (°C)
−8
−4
0
4
8
N m−2 per 10⁴ km

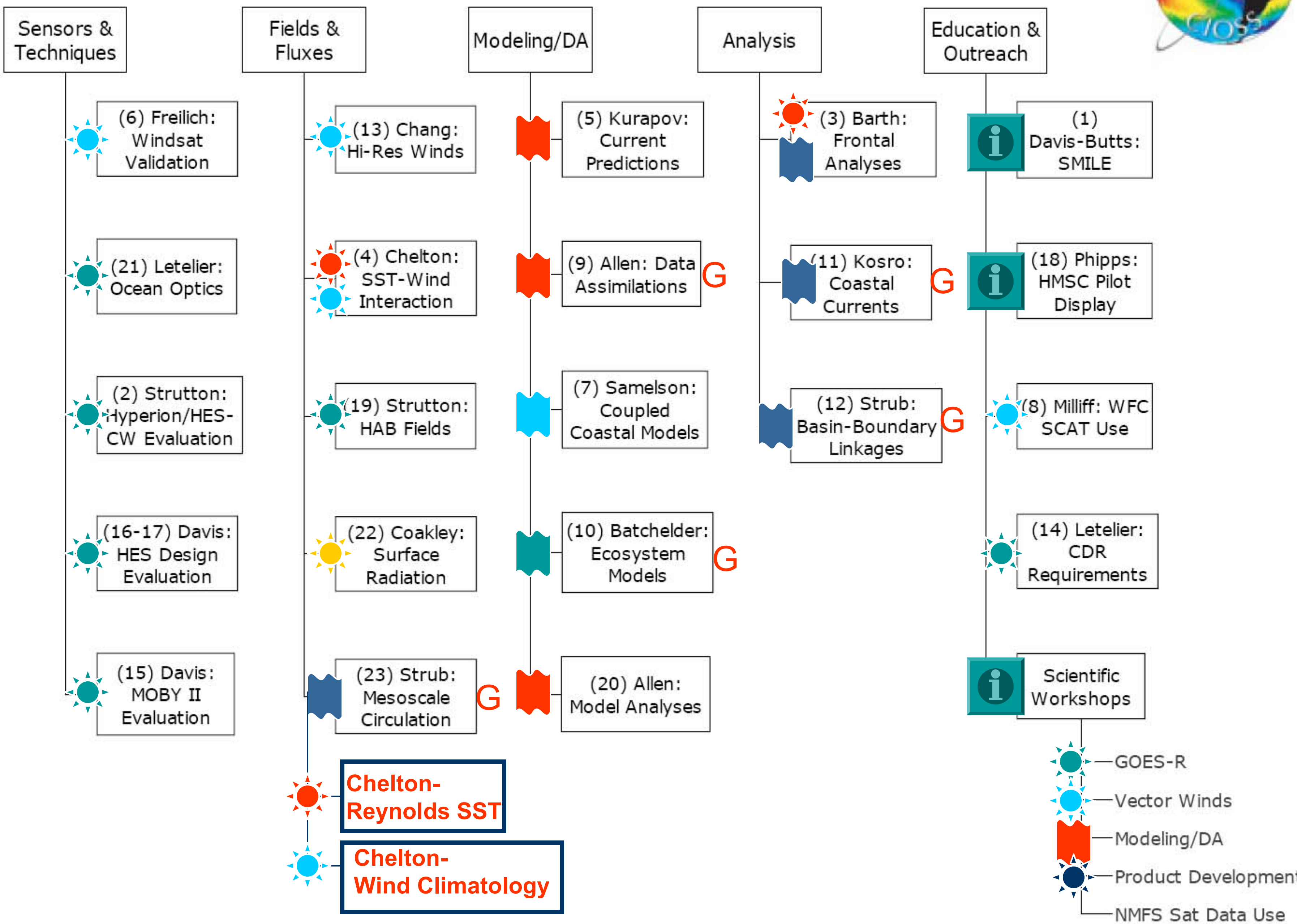

a) 14 September 2003, NAM and RTG
τ and SST
∇×τ and Crosswind ∇T
∇·τ and RTG Downwind ∇T
0.2 N m−2
5 N m−2 per 104 km
= 45 cm d−1 upwelling
at 40°N
45N
40N
35N
30N
130W
125W
120W
115W
b) 5 September 2004, NAM and RTG
τ and SST
∇×τ and Crosswind ∇T
∇·τ and RTG Downwind ∇T
0.2 N m−2
5 N m−2 per 104 km
= 45 cm d−1 upwelling
at 40°N
10
14
18
22
SST (°C)
−8
−4
0
4
8
N m−2 per 104 km



GOES SST

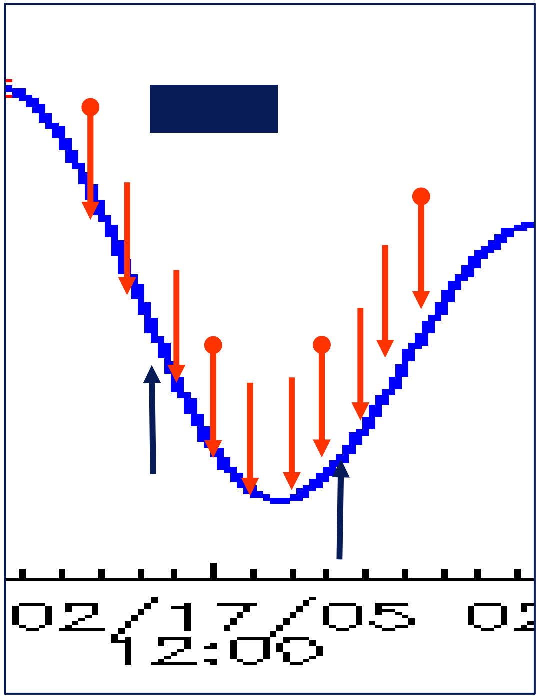
Figure 1 - SST gradient magnitude off Oregon during June, July and September 2001

CIOSS Research Themes



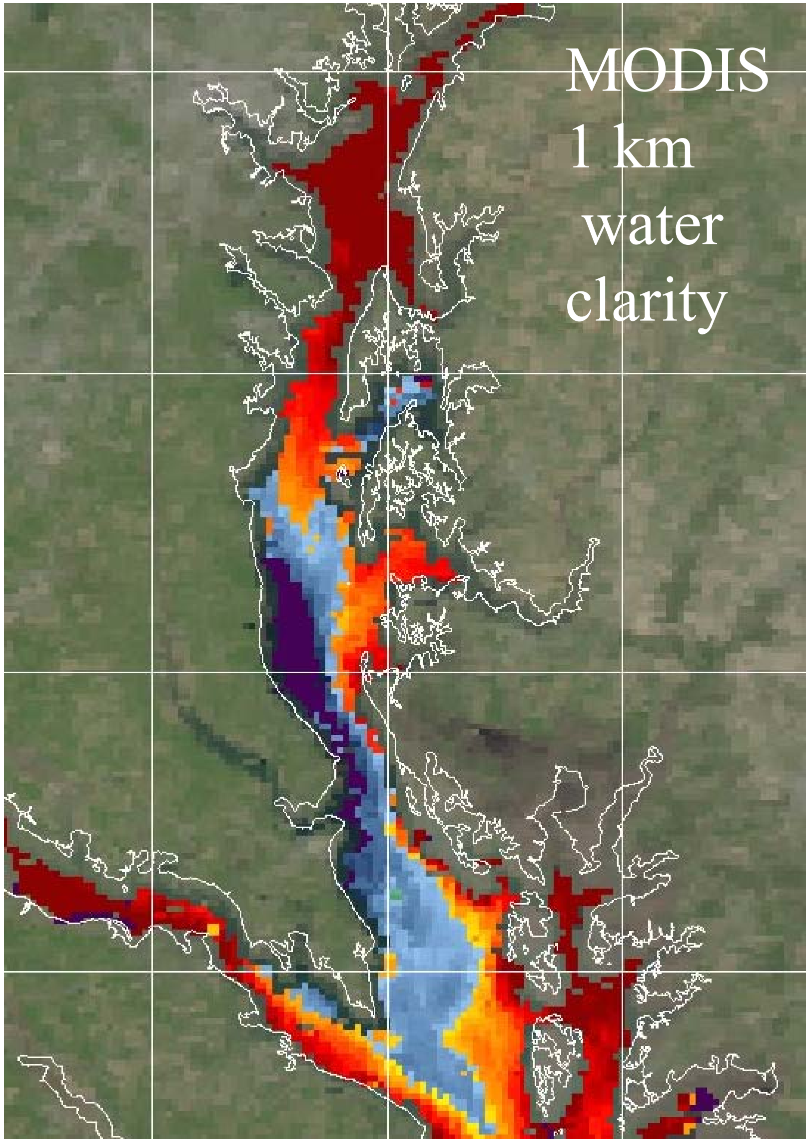
HES-CW: Frequency of Sampling and Prioritizing Goal Requirements

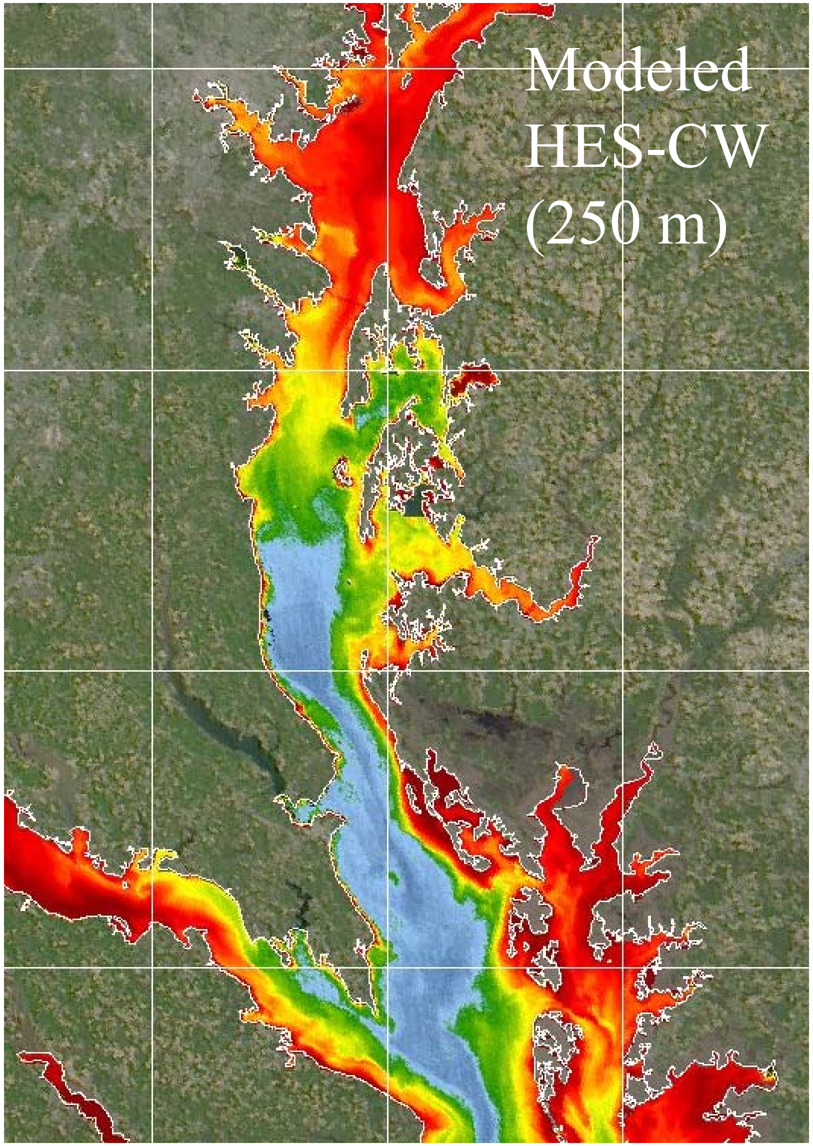
- **Threshold requirement is to sample all Hawaii and Continental U. S. coastal waters once every three hours during daylight**
  - **Plus additional hourly sampling of selected areas**
- **Goal requirement is hourly sampling of all U.S. coastal waters is strongly recommended, for cloud clearing and to better resolve coastal ocean dynamics.**
- **Goal requirements compete with each other, e.g. higher spatial resolution makes it harder to increase sampling frequency or SNR.**
- **COAST top priority goals are:**
  - **Higher frequency of sampling**
  - **Goal channels for atmospheric correction**
  - **Hyperspectral instead of multispectral**



HES-CW built to the threshold requirements will be a dramatic improvement over present capabilities for coastal imaging.

HES-CW higher spatial resolution critical to monitor complex coastal waters





COAST Summary

- HES-CW will provide an excellent new tool for the characterization and management of the coastal ocean.
- Risk Reduction activities focus on calibration and algorithm development;
  - Initially provide SeaWiFS and MODIS heritage calibration and algorithms;
  - 2006-2008 field experiments to develop example HES-CW data for
    - algorithm development and testing,
    - Coordination with IOOS for in-situ data and coastal ocean models,
    - Demonstrate terabyte web-based data system.
  - Major focus on developing advanced algorithms that take advantage of HES-CW unique characteristics.
- Efforts coordinated with NOAA ORA, NMFS and NOS with a focus on meeting their operational needs.

Guo and Coakley

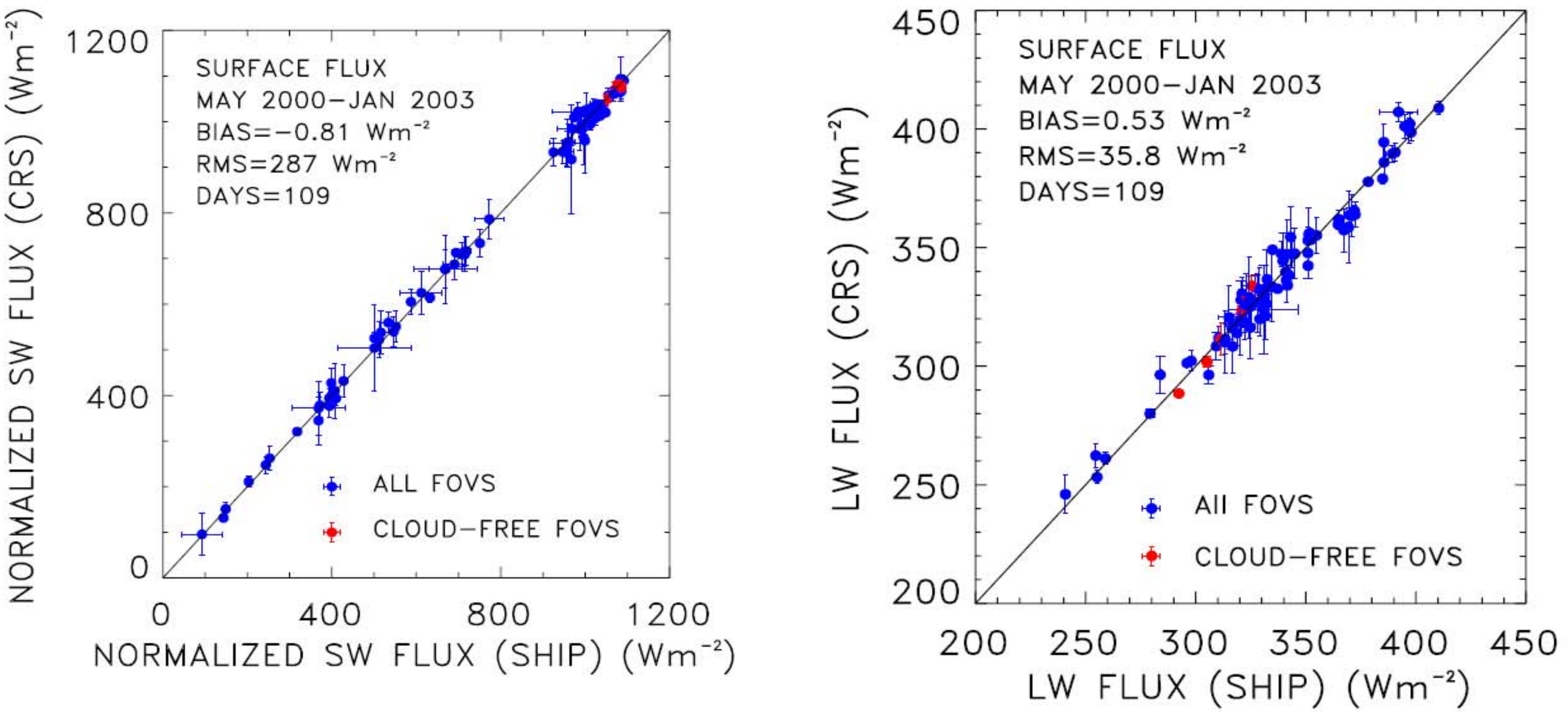
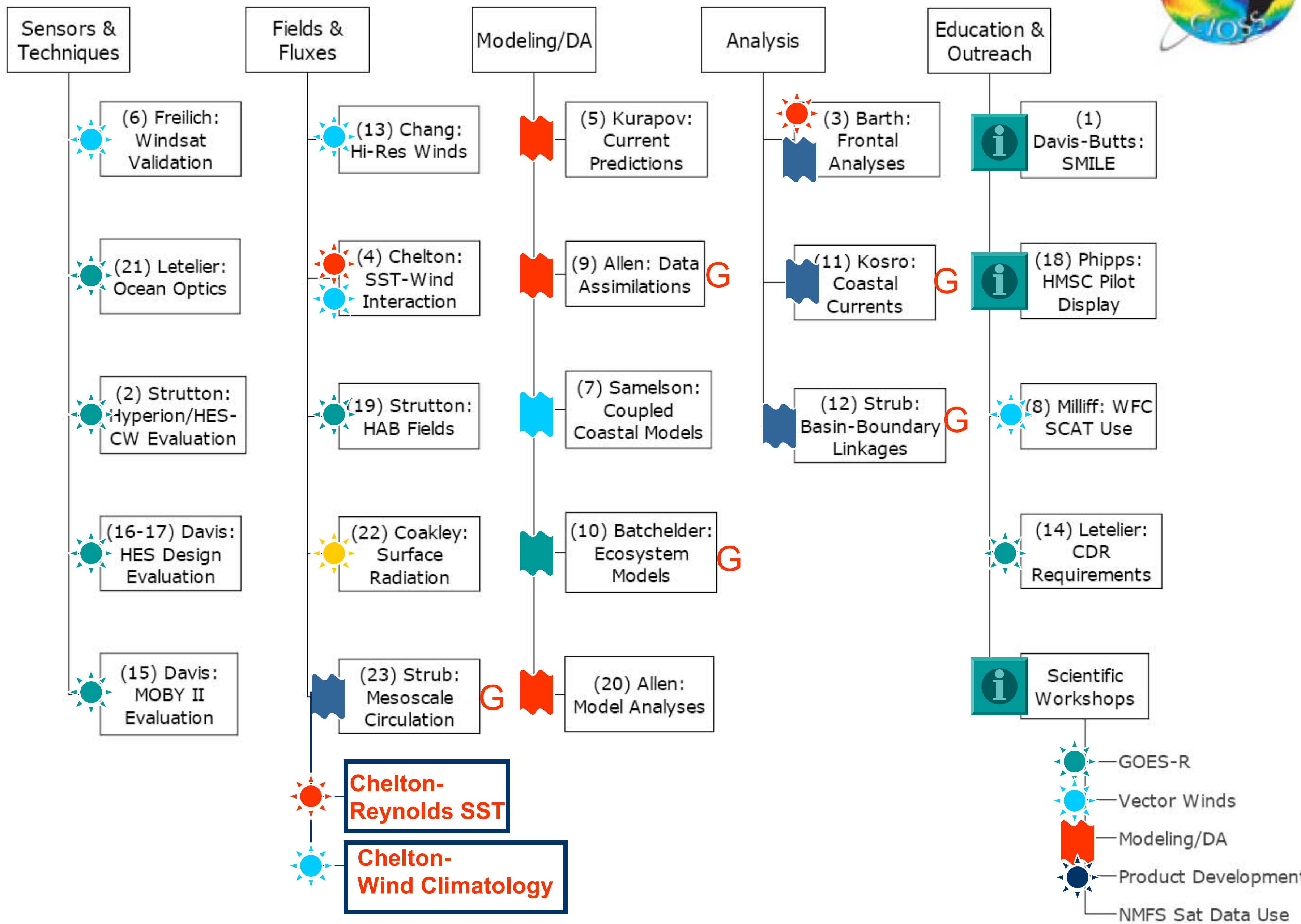
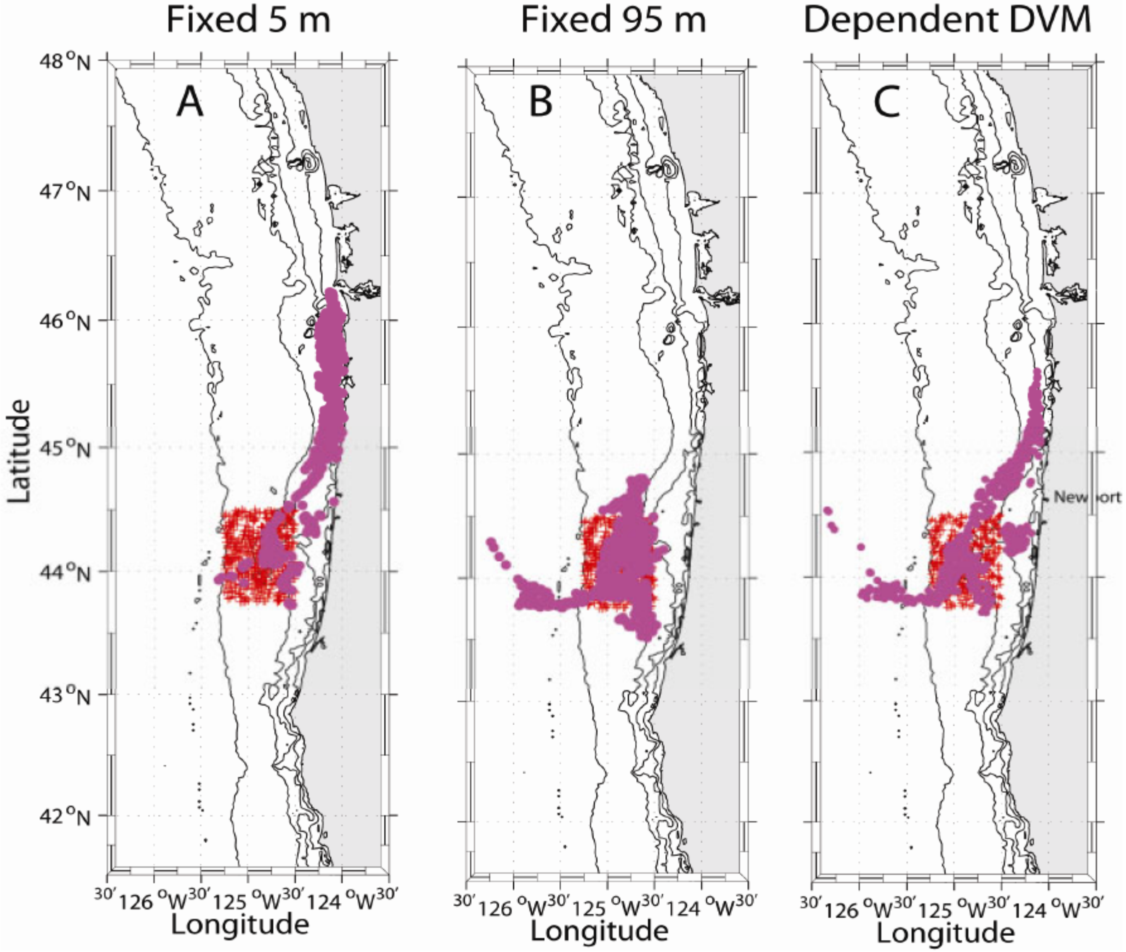


Figure 3. All-sky downward normalized shortwave and longwave radiative fluxes obtained from CERES CRS data and *Wecoma* pyranometer and pyrgeometer data for 109 simultaneous occurrences spanning the period of May 2000 to January 2003. Points give the means and error bars give the standard deviations of the shipboard and CERES observations for the individual occurrences.

CIOSS Research Themes

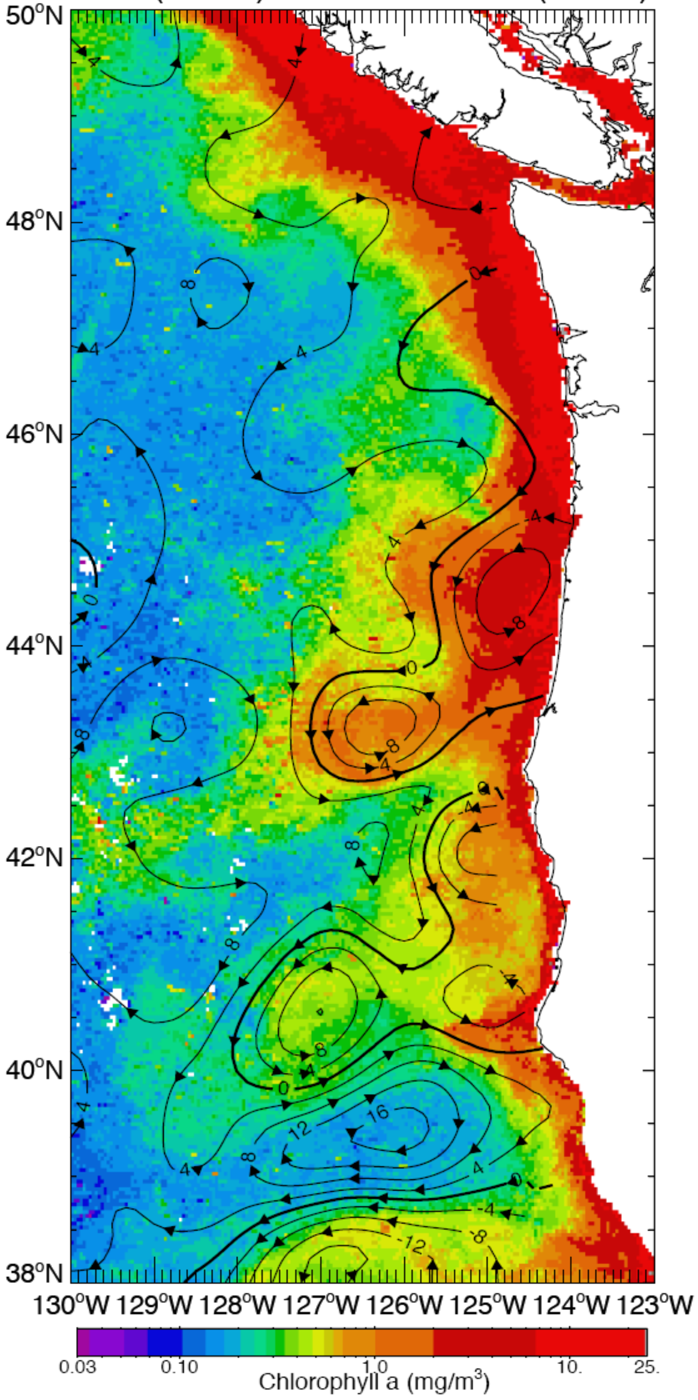




Batchelder

Figure 2. Backwards-in-Time-Trajectory (BITT) simulation result for the euphausiid, *Euphausia pacifica*. Purple dots show locations of particles 20 days prior to arriving at the locations near Heceta Bank identified by the red plus (+) symbols. Panel A shows the locations 20 days earlier for particles whose depths were fixed at 5 m for the duration of the simulation. Panel B shows the locations 20 days earlier for particles whose depths were fixed at 95 m for the duration of the simulation. Panel C shows the locations 20 days earlier for particles that began at the red (+) and had life-stage dependent vertical positions where the development of individuals was controlled by temperature. Youngest stages (eggs and nauplii) are nearsurface (10 m) only, whereas older Furcilia life stages of E. pacifica undergo a DVM that spans from near-surface (10-20 m) at night to 100 m during the day. Since this was a BITT simulation, all individuals began the simulation at the red pluses (+) as Furcilia 7 life-stage, and with time underwent reverse development (proceeding to ever-earlier stages).

SSH (8/7/03) and Ocean Color (8/6/03)

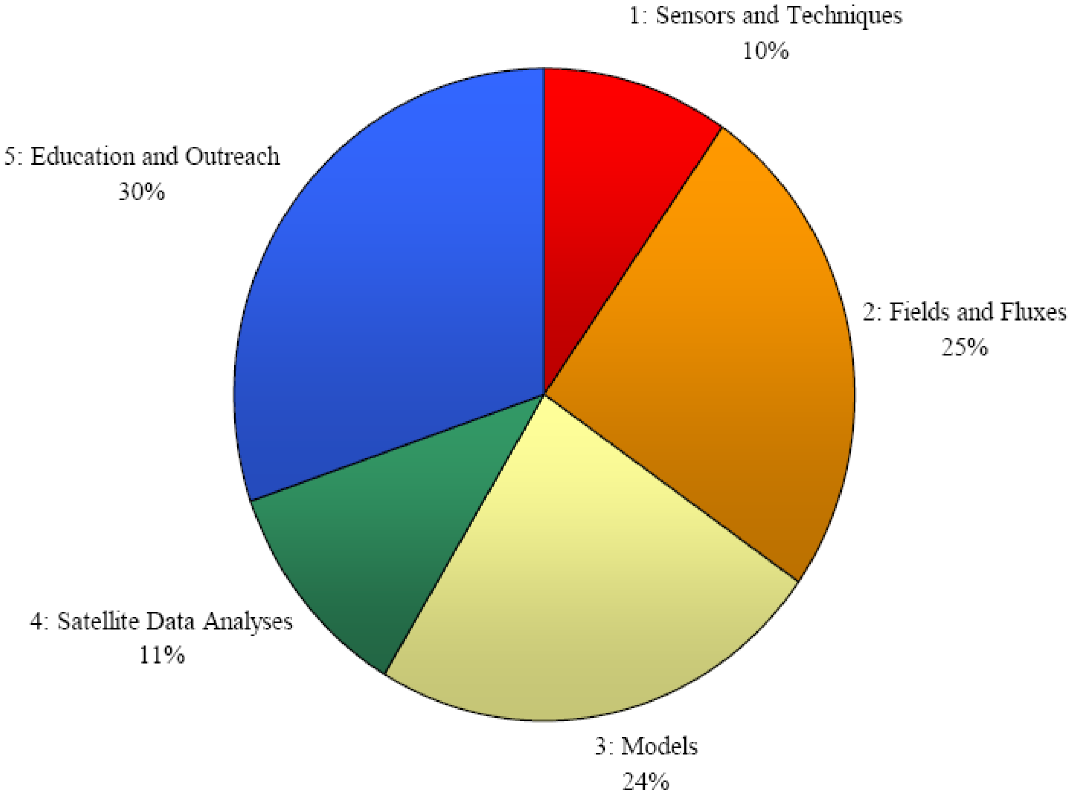


Funding by Year

- **PROPOSED Yr 4: $2.3M**
- **TOTAL Yr 3: $1.9M**
- **TOTAL Yr 2: $0.9M** (Annual+COAST+SMILE)
- **TOTAL Yr 1: $0.9M** (Annual+GIS)

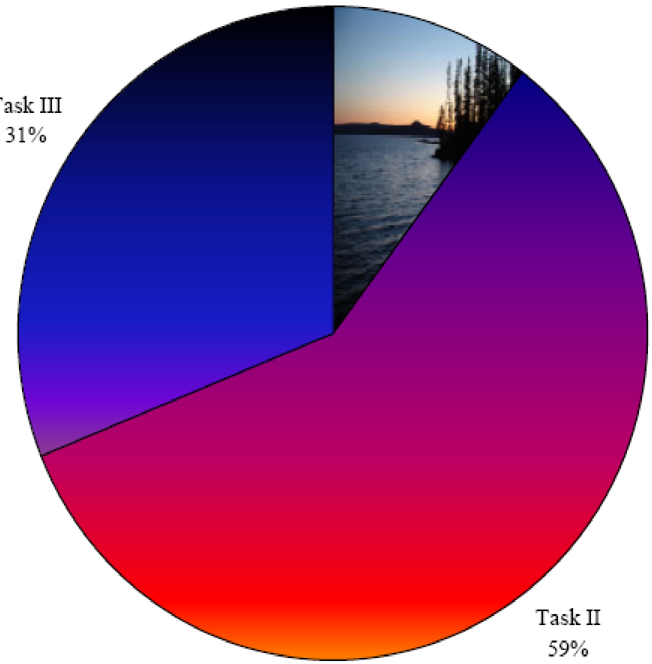
CIOSS Research Theme: $2,060,046 (excluding Administration)

- **Sensors and Techniques: $200,794; 10%**
- **Fields and Fluxes: $515,636; 25%**
- **Modeling: $491,196; 24%**
- **Satellite Data Analyses: $226,616; 11%**
- **Education and Outreach: $625,804; 30%**



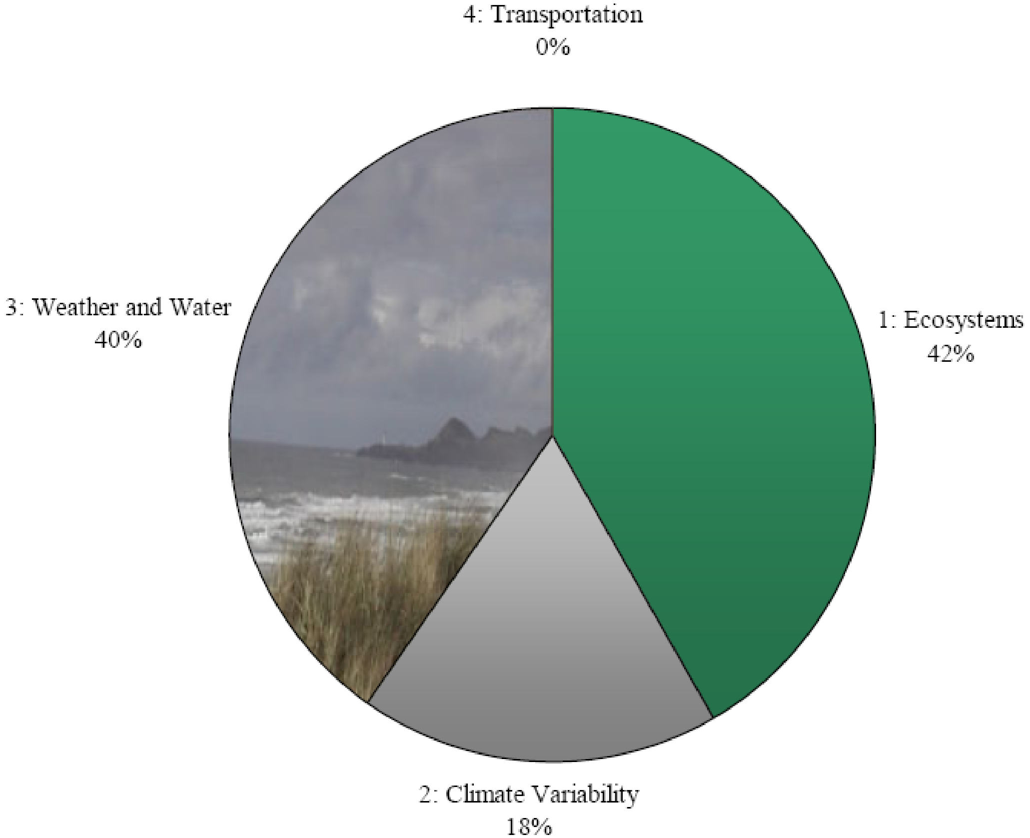
CIOSS Task Number $2,276,102

- I. Administration and Core Outreach: $231,056; 10%
- II. Research & Additional Outreach, NESDIS Funding: $1,337,567; 59%
- III. Research & Additional Outreach, Non-NESDIS Funding: $707,479; 31%



NOAA Mission Goal: $2,276,102

- **1. Ecosystem Mangagement: $950,515; 42%**
- **2. Climate Variability: $407,931; 18%**
- **3. Weather and Water; $917,656; 40%**
- **4. Transportation: $0; 0%**

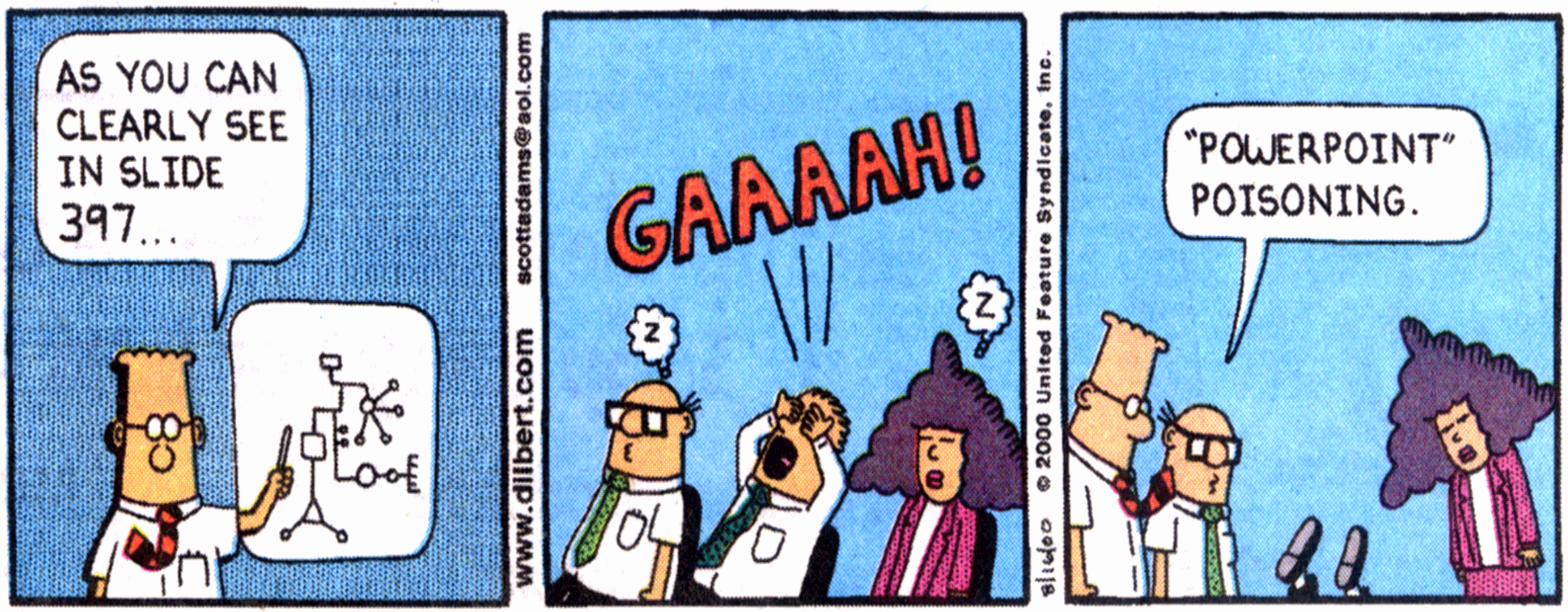


Summary

- In year 3, CIOSS put about 1/3 of its effort into Themes 1 and 2, with a focus on preparing for the next generation of satellites and sensors and developing techniques to improve surface fields and fluxes. This contributes to the NOAA goals in the GOES-R3 and R&O programs.
- It did this while retaining its emphasis on basic research, emphasizing research that will be useful in future IOOS coastal observing & modeling systems, in which CIOSS Fellows are leaders and participants.
- Research funding continues to increase in years 3 and 4. Much of this increase is the realization of plans for field work related to GOES-R Risk Reduction.
- Outreach also continues to increase, with scientific outreach in the form of workshops, along with formal and informal education.

DILBERT

August 16, 2000



Chronology of CIOSS Development

Apr 2005: Year 3 Begins

- Post-Docs (2) end; 1 continues; 3 start
- **Omnibus Prop**
  - 7 new Core Projects proposed (not just post-docs), including SMILE
  - Plus 1 R2O & 4 GLOBEC proposals
- **Supplemental Proposal #1:** 4 Other R2O projects
- **Supplemental Proposal #2:** Funds Curt Davis' participation in HES planning
- COAST activity continues as CIOSS WG – Curt Davis moves to COAS/CIOSS
  - Workshop 3 (Sept 7-9)
  - Color CDR Workshop
  - **Multi-Institutional Proposal: GOES-R Risk Reduction Activities (GOES-R3)**
    - **Submitted Nov (2005) - March (2006)**
- Ocean Vector Winds activity continues as CIOSS WG – CIOSS Core and R2O Funding
- **Executive Board Meets** (August 30-31)
- Four Working Groups Meet (Sept 7-9)
- Additional Outreach – Pilot displays at HMSC
- ***Year 3 Funds Arrive Late-September 2005***

Future of CIOSS Development

Apr 2006: Year 4 Begins

- Continue:
- Propose Core Research Projects (Feb, 2005) – Most continued from Year 3
- HAB Research underway
- COAST Field Work (Monterey, Sept 2006)
- Working Groups
    - COAST – GOES-R3 projects, Workshop (June 2006)
    - Vector Winds – June 2006, 2nd Workshop
    - Dynamics/Modeling/ALT – Workshop 1 (April 2007)
    - Product Development: CoastWatch, CIOSS & IOOS Regional Ass.
- R&O 3 Projects + GLOBEC + Other
- VIIRS ? COAST Involvement with Plans?
- **Major Review:** Mid-October, 2006.
- Propose Year 5 activities, using feedback from the review.

Outreach in Formal and Informal Education

- First, note that the workshops are classified as "Formal Education", but what I'm really talking about is:
- SMILE: Held the third year of activities based on oceanography, mapping and remote sensing.
- SMILE: Held the second High School Challenge based on this material – an exercise in community planning for fisheries management.
- Informal Ed: Is moving from discussions to support for the design and evaluation of public interactive displays of CIOSS/NOAA science at HMSC, in collaboration with Sea Grant, and the PhD program in Informal Ed at OSU.
- Collaborations with CoastWatch and NCDC is resulting in improved and new NOAA products for research and use by managers and the public.