

# MICROWAVE DATASETS

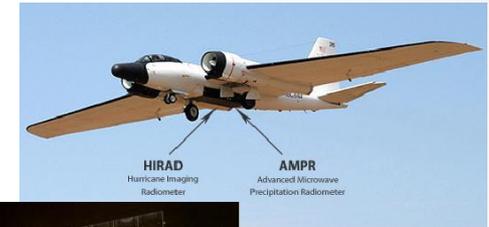
Marilyn Drewry  
Data Management Lead  
[mdrewry@itsc.uah.edu](mailto:mdrewry@itsc.uah.edu)

Presented at the GHRC User Working Group Meeting  
September 25-26, 2014



# Presentation Overview

- Data Management Group Team
- Microwave Data at GHRC
- Satellite Microwave Datasets
  - SSM/I, SSMIS
  - Climatologies
  - TMI Wentz Ocean Products
  - MSU, AMSU
- Airborne Microwave Datasets
  - AMPR
  - HIRAD
- Summary Dataset Slide



# Data Management Team

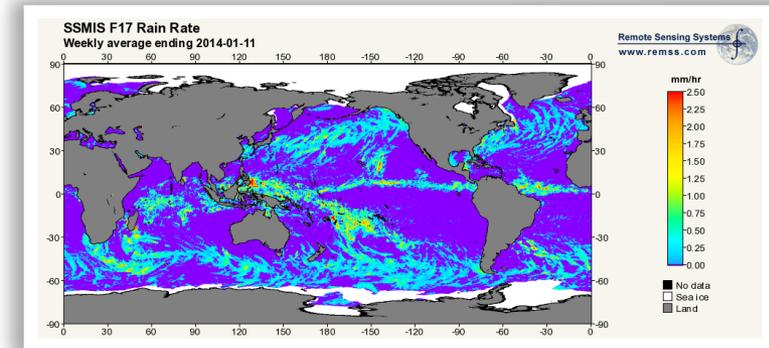
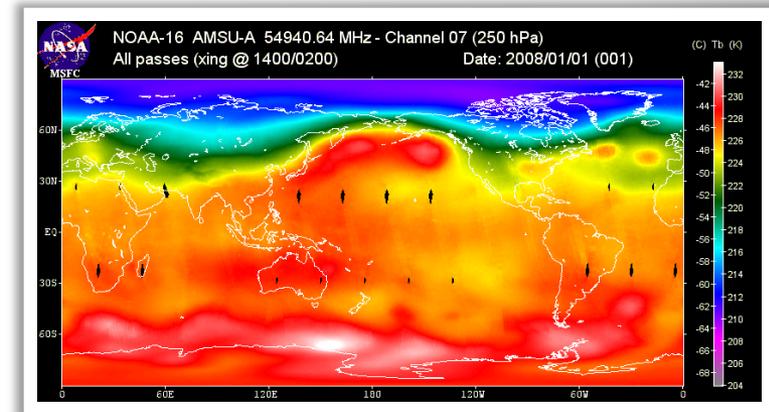
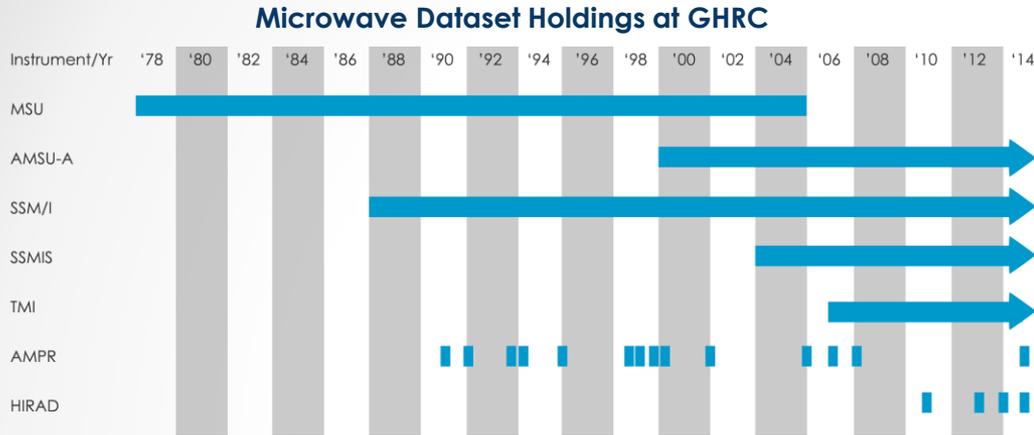
- Data/Metadata – *Marilyn Drewry, Kaylin Bugbee*
  - Review data (format, naming convention, version)
  - Define metadata for search engines: [metadata survey](#)
- Database Administration – *Mary Nair*
  - Catalog metadata and publish to search engines
  - Metrics
- Documentation – *Sam Ayers (student assistant)*
  - Create user documentation; include links to investigator-provided documents
- User Services Support – *Sherry Harrison*
  - Field user questions, coordinating with PI's as needed
- Archive – *Lamar Hawkins*
  - Manage on-line data stores and archive

Instructions: The GHRC Web and Data Management Teams will be assisting you with the web portal, and ingesting, archiving and distributing the data and/or quicklooks you collect during the MC3E experiment. The following information will help us provide for your real-time requirements during the experiment and for the final inclusion of your datasets into the MC3E Field Catalog and GHRC archive. You may provide any additional information in the comment section (Question 17) below for any useful information not specifically requested. Return this document, or address any questions to the GHRC Data Management Group at [ghrc-dmg@itsc.uah.edu](mailto:ghrc-dmg@itsc.uah.edu) and [MC3E\\_Tech@itsc.uah.edu](mailto:MC3E_Tech@itsc.uah.edu).

1. **Dataset/Instrument (i.e., full name and acronym):**
2. **Principal Investigator w/ Institution:**
3. **Co-Investigator(s) w/ Institution:**
4. **Instrument Type (e.g., radiometer, Doppler radar, lidar, radiosonde)**
5. **Platform during MC3E (e.g., ER2, Citation, Ground, Spacecraft,,)**
6. **Brief Description of Instrument and Function**
7. **List each instrument product to be *uploaded during mission* that will have data, quick-look and/or browse. These files will be available online through the MC3E portal to campaign participants.**
  - a. **Product name**
  - b. **Type (data/browse/both)**
  - c. **File size per day or mission (whichever is appropriate)**
  - d. **Ingest frequency**
  - e. **Data format**
8. **Number of Datasets to be archived and made public for distribution after the campaign. If quicklook or browse files were uploaded during mission, specify if new images will be uploaded to replace those made during the mission.**
9. **Approximate data and volume per day (or per flight mission) to be archive**
10. **Direct products/parameters measured (e.g., radiances, atmospheric state variables, aerosol scattering, particle size distribution)**
11. **Derived products/parameters: (e.g., temperature and water vapor profiles, aerosol backscattering coefficients)**
12. **Temporal resolution (if applicable)**
13. **Spatial resolution (if applicable):**
14. **Website for additional information/documentation**
15. **Refereed publication reference**
16. **List additional Data products required by instrument in real time during the mission (this should include time, aircraft navigation, specific types of data).**
  - a. **List where needs to be visible (i.e., RTMM, portal, aircraft, location...)**
  - b. **Will these just be images, data or both?**
  - c. **Estimated Size and frequency of ingest**
  - d. **Data format (txt, hdf, png, jpg..)**
17. **Additional information or comments**

# What we serve

## Microwave Data



- GHRC and its predecessor programs have been ingesting, processing, archiving and distributing microwave data for over 35 years
  - MSU, SSMI, AMSU, AMPR, TMI, AMSR-E
- This climate sensitive data record extends back to 1978 providing an unbroken inventory of climate information that continues today

**GHRC is also recognized as one of the primary data centers for microwave data**

# DISCOVER MEaSUREs Project

## *a key source for microwave data*

**D**istributed **I**nformation **S**ervices for **C**limate and **O**cean  
Products and **V**isualizations for **E**arth **R**esearch

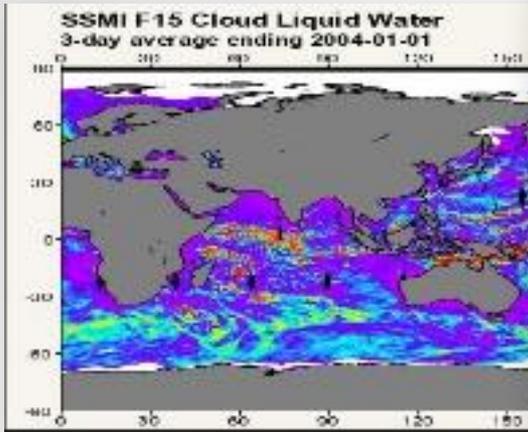
A NASA MEaSUREs project to create Earth system data records

- Frank Wentz (RSS), PI, with MSFC and UAH
- Science Objective: providing highly accurate, long-term ocean and climate products, and services
- Information technologies provided by UAH

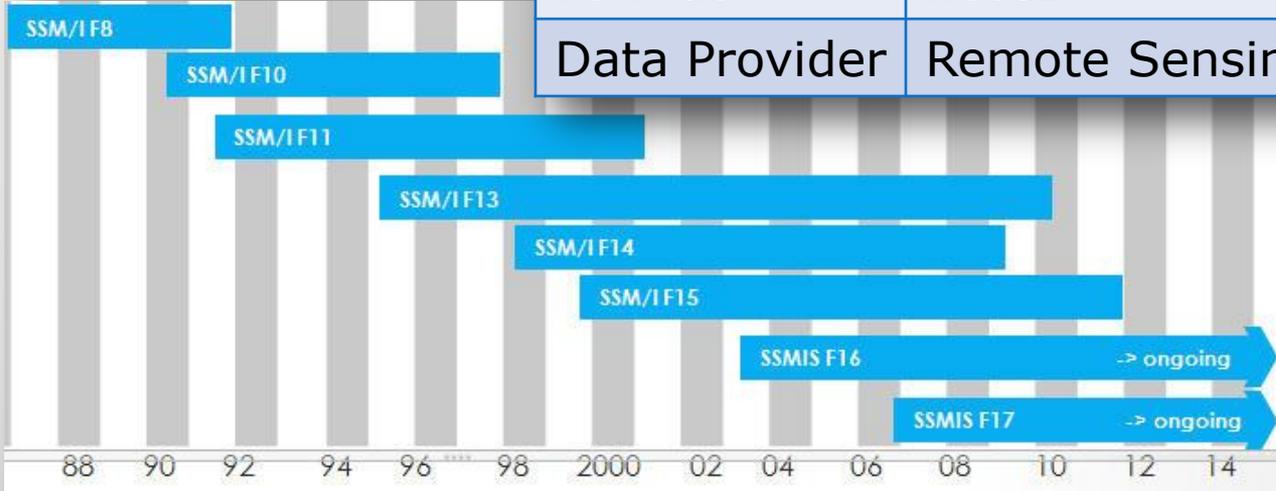
Data archived at GHRC – DISCOVER products from satellite microwave sensors going back to 1987

# Special Sensor Microwave Imager (SSM/I)

## Special Sensor Microwave Imager/Sounder (SSMIS)



Satellites	SSM/I: DMSP F8, 10, 11, 13, 14, 15 SSMIS: F16, 17 ( <i>future F18</i> )
Parameters	Cloud liquid water/ice, Precipitation, Surface winds, Water vapor
Coverage	Global over oceans; 1987 - present
Gridded Avg	Daily, 3-Day, Weekly, Monthly
Format	netCDF-4
Data Provider	Remote Sensing Systems



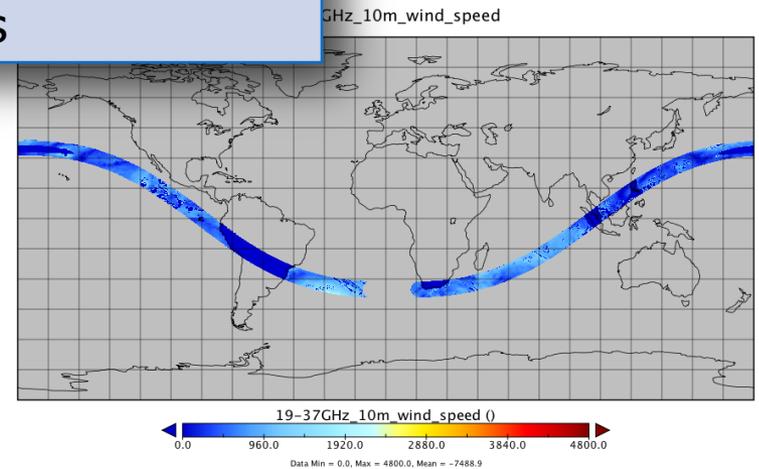
[http://ghrc.nsstc.nasa.gov/uso/ds\\_docs/ssmi\\_netcdf/ssmi\\_ssmis\\_dataset.html](http://ghrc.nsstc.nasa.gov/uso/ds_docs/ssmi_netcdf/ssmi_ssmis_dataset.html)

# TRMM Microwave Imager

## Wentz Ocean Products

Parameters	Cloud liquid water/ice, Precipitation, Surface winds, Water vapor, Sea Surface Temperature
Coverage	Tropical over oceans, 38N to 38S 2006 – present
Format	Swath data in HDF-EOS2
Data Provider	Remote Sensing Systems

*TMI from Version 7 of RSS algorithm coming soon!*



[http://ghrc.nsstc.nasa.gov/uso/ds\\_docs/tmiwop/tmiwop\\_dataset.html](http://ghrc.nsstc.nasa.gov/uso/ds_docs/tmiwop/tmiwop_dataset.html)

# Climatology Datasets

## *DISCOVER MEaSUREs Merged Products*

Monthly 1-degree merged products from RSS

- Available from RSS as a single 1.7 GB file
- Available from GHRC as a set of files (monthly grids, climatology file and cumulative trends file)

[http://ghrc.nsstc.nasa.gov/uso/ds\\_docs/tpw/rssm1tpwn\\_dataset.html](http://ghrc.nsstc.nasa.gov/uso/ds_docs/tpw/rssm1tpwn_dataset.html)

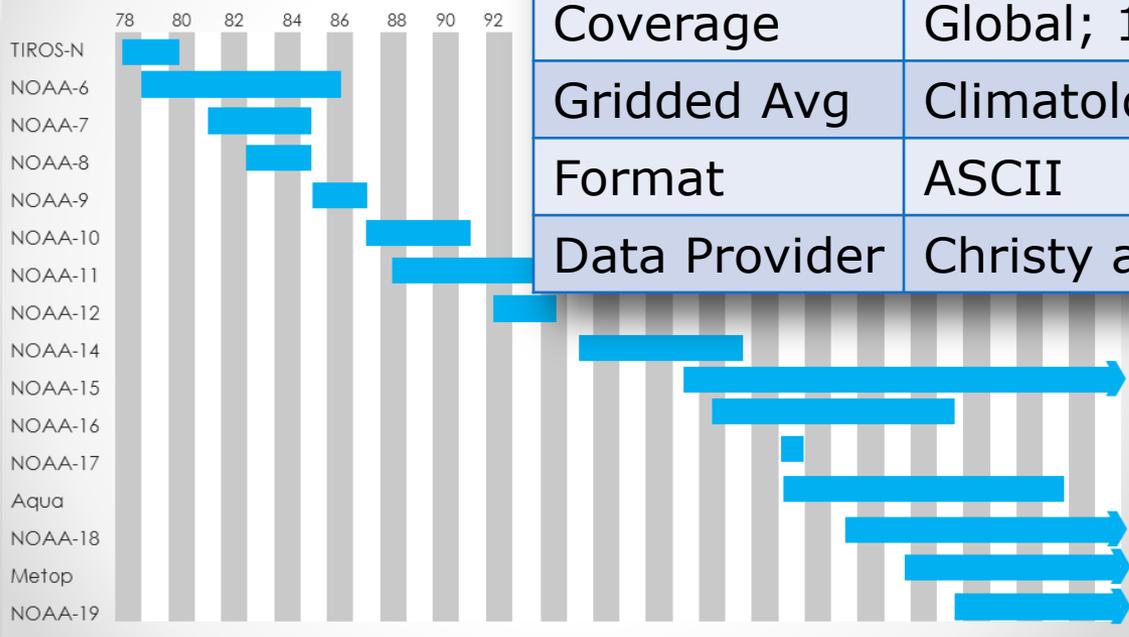
Instruments (Satellites)	AMSR-E (Aqua) SSM/I, SSMIS (DMSP series) WindSat (Coriolis)
Coverage	Global over oceans; 1988 - present
Grids included	20-year climatology (1988 – 2007) Monthly averages Cumulative trends
Datasets / Parameters	Precipitable water, water vapor – <i>available</i> Winds – <i>metadata in review</i> Rain – <i>future</i>
Format	netCDF-3, netCDF-4
Data Provider	Remote Sensing Systems

# Microwave Sounding Unit

## Advanced Microwave Sounding Unit

### Temperature Anomalies

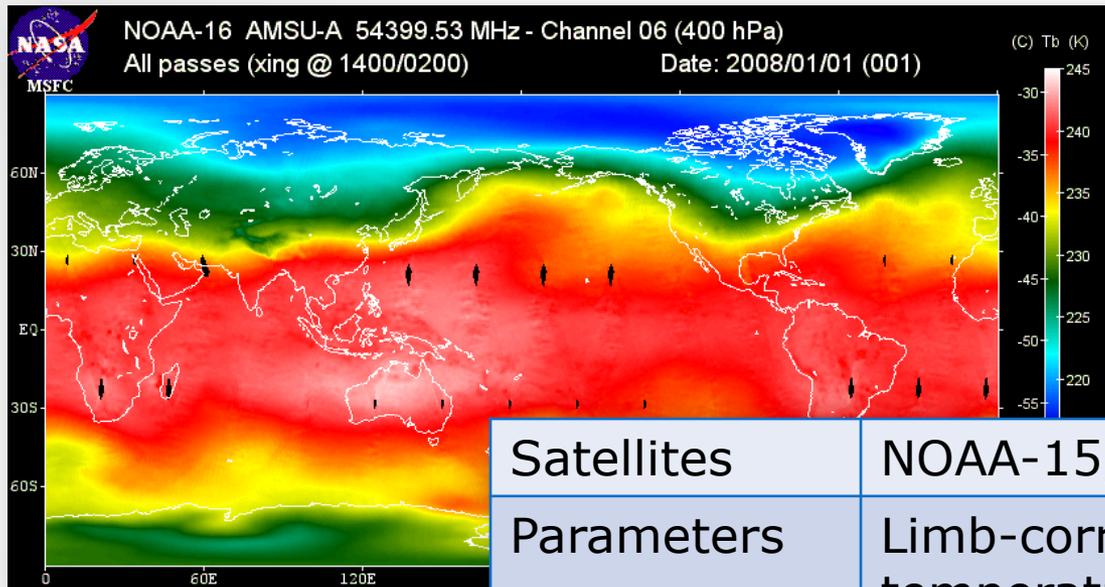
Satellites	TIROS-N, NOAA-6 - 19, Aqua, Metop
Parameters	Atmospheric layered temperature anomalies (Low Troposphere, Mid Troposphere, Low Stratosphere)
Coverage	Global; 1978 - present
Gridded Avg	Climatology, monthly averages
Format	ASCII
Data Provider	Christy and Spencer, UAH



*Version 6  
coming soon*

[http://ghrc.nsstc.nasa.gov/uso/ds\\_docs/msu/msu190\\_dataset.html](http://ghrc.nsstc.nasa.gov/uso/ds_docs/msu/msu190_dataset.html)

# Advanced Microwave Sounding Unit Atmospheric Temperatures



Satellites	NOAA-15, NOAA-16, NOAA-17
Parameters	Limb-corrected atmospheric temperatures
Coverage	Global; 1999 - present
Format	Swath data in HDF-EOS2
Data Provider	Spencer and Braswell, UAH

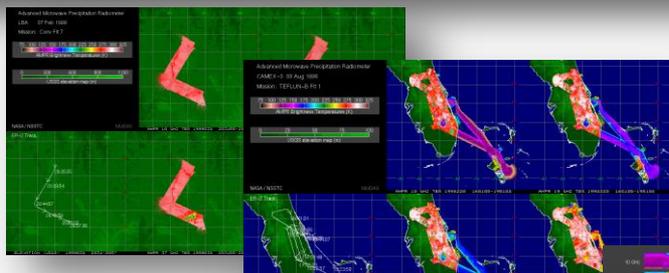
[http://ghrc.nsstc.nasa.gov/uso/ds\\_docs/amsu\\_a/amsu-a\\_dataset.html](http://ghrc.nsstc.nasa.gov/uso/ds_docs/amsu_a/amsu-a_dataset.html)

# Microwave Data – Airborne

## Advanced Microwave Precipitation Radiometer (AMPR)

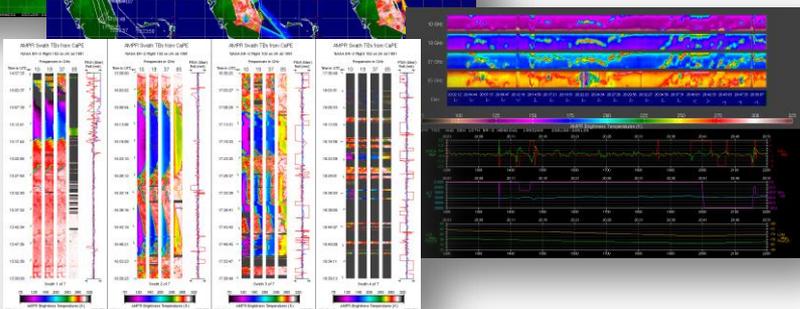
Aircraft	NASA ER-2, NASA DC-8
Parameters	Brightness Temperatures
Format	Level-1B swath data in ASCII
Data Provider	Brent Roberts, NASA MSFC (orig. Robbie Hood)

Field Campaigns	
Jacksonville	1990
CaPE	1991
TOGA COARE	1993
CAMEX-1	1993
CAMEX-2	1995
FIRE ACE	1998
CAMEX-3	1998
TRMM LBA	1999
KWAJEX	1999
CAMEX-4	2001
TCSP	2005
TC4	2007
MC3E	2011
IPHEX	2014



**LBA  
CAMEX-3**

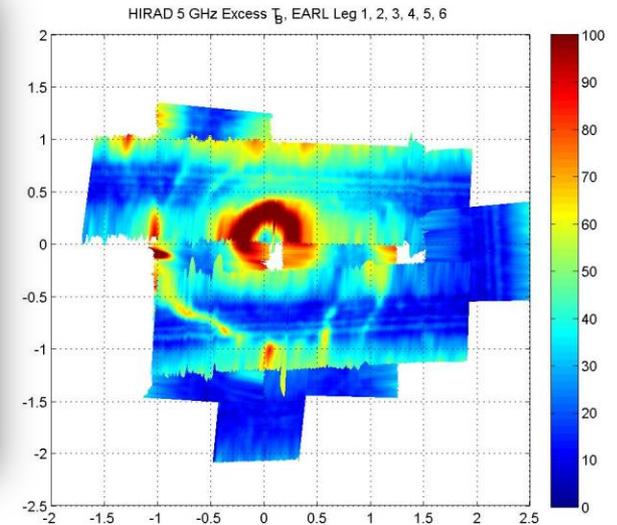
**CaPE  
CAMEX-1**



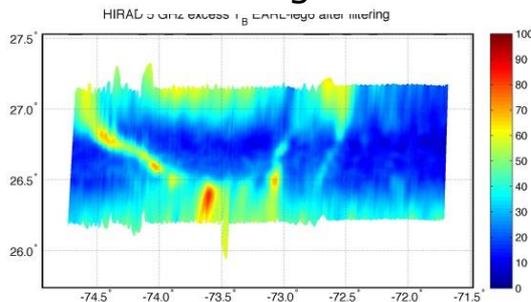
[http://ghrc.nsstc.nasa.gov/uso/ds\\_docs/ampr/ampr\\_dataset.html](http://ghrc.nsstc.nasa.gov/uso/ds_docs/ampr/ampr_dataset.html)

# Microwave Data – Airborne Hurricane Imaging Radiometer (HIRAD)

Aircraft	WB-57, Global Hawk
Parameters	Brightness Temperatures, Precipitation Rate, Surface Winds
Format	netCDF
Data Provider	Dan Cecil, NASA MSFC (orig. Tim Miller, Robbie Hood)



9/1/2010  
Earl Leg 1



Earl Legs 1-6

Field Campaigns	
GRIP	2010
HS3	2011 (preliminary flights) 2012-2014

[http://ghrc.nsstc.nasa.gov/uso/ds\\_docs/grip/griphirad/griphirad\\_dataset.html](http://ghrc.nsstc.nasa.gov/uso/ds_docs/grip/griphirad/griphirad_dataset.html)

# Microwave Dataset Reference

Instrument	Product	Platform	Start Date	Stop Date	Location	Format
SSM/I	Daily Average: 3-Day Weekly Monthly	DMSP F8 F10 F11 F13 F14 F15	1987-07-07 1990-12-06 1991-12-01 1995-05-01 1997-05-06 1999-12-16	1991-12-31 1997-11-14 2000-05-16 2009-11-04 2008-08-08 2011-12-31	Near Global over Oceans	netCDF
SSMIS	Daily Average: 3-Day Weekly Monthly	DMSP F16 F17 F18 – future	2003-10-26 2006-12-14	present present	Near Global over Oceans	netCDF
Merged products water vapor, winds (in work), rain (future)	Climatology Monthly average	Aqua DMSP series Coriolis	1988-01-01	present	Near Global over Oceans	netCDF
TMI	Wentz Ocean Products	TRMM	2006-09-17	present	Tropical Oceans	HDF-EOS2
MSU, AMSU	Monthly Temp. Anomalies & Annual Cycle: - Low Stratosphere - Low Troposphere - Mid Troposphere	MSU: TIROS-N NOAA series Aqua Metop	1978-01-01	present	Global	ASCII
AMSU	Atmospheric Temperatures	NOAA-15 NOAA-16 NOAA-17	1999-06-11 2001-05-27 2003-01-07	present 2008-03-04 2003-12-12	Global	HDF-EOS2 HDF-EOS2 Binary
AMPR	Brightness Temperature	Aircraft	1990	2014	Mission Dependent	ASCII
HIRAD	Brightness Temp. Precipitation Rate Surface Winds	Aircraft	2010	2014	Mission Dependent	netCDF

# REGIONAL AIR-SEA INTERACTIONS (RASI)

## Interactive Climatology System

Ken Keiser, Xiang Li, Shannon Flynn  
University of Alabama in Huntsville

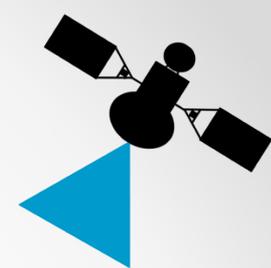
Deborah Smith

Remote Sensing Systems

Presented at the GHRC User Working Group Meeting  
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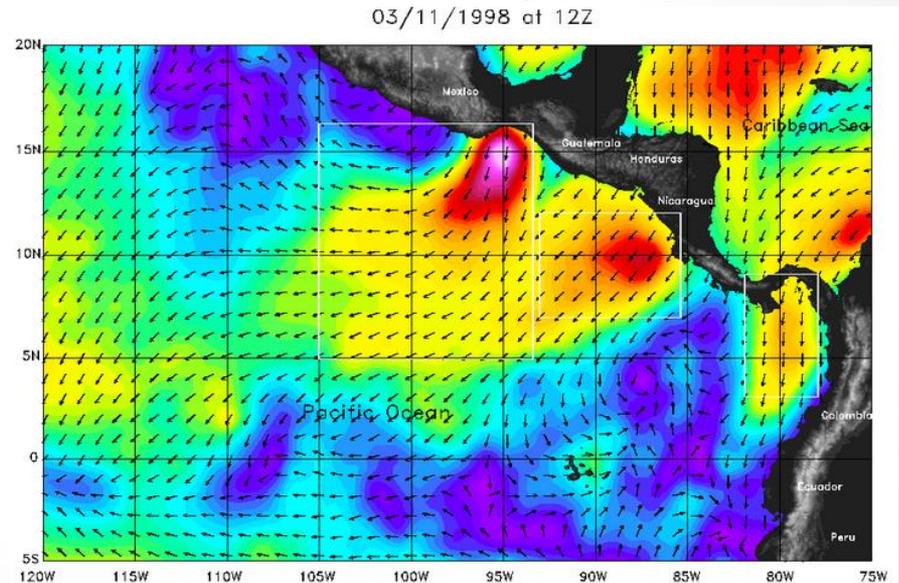


Remote Sensing Systems



# Overview

- Project Information
- Event Detection and Climatology Generation
- Demonstration of Interactive Climatology System



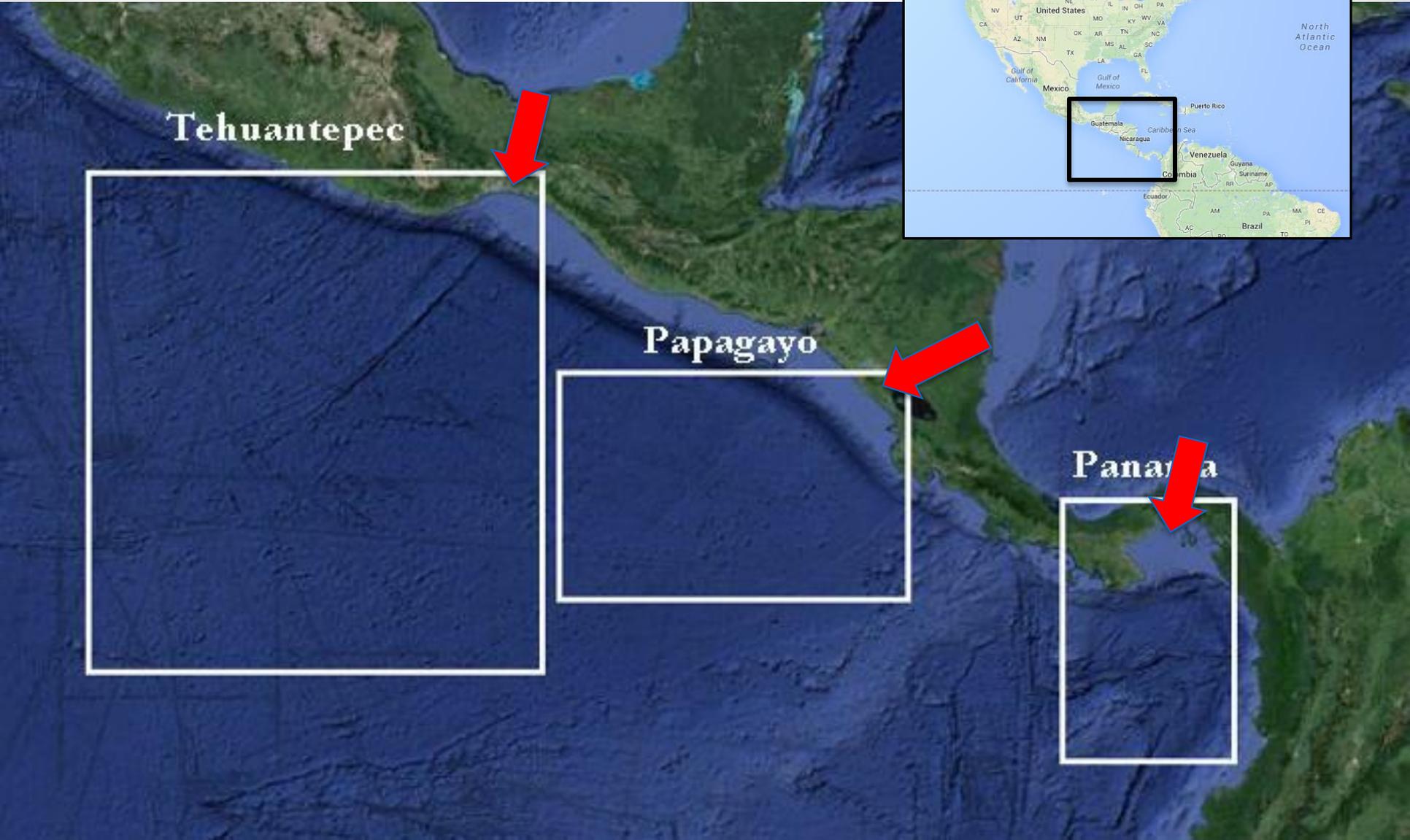
CCMP winds showing gap winds at Tehuantepec on 03/11/1998

# RASI objectives

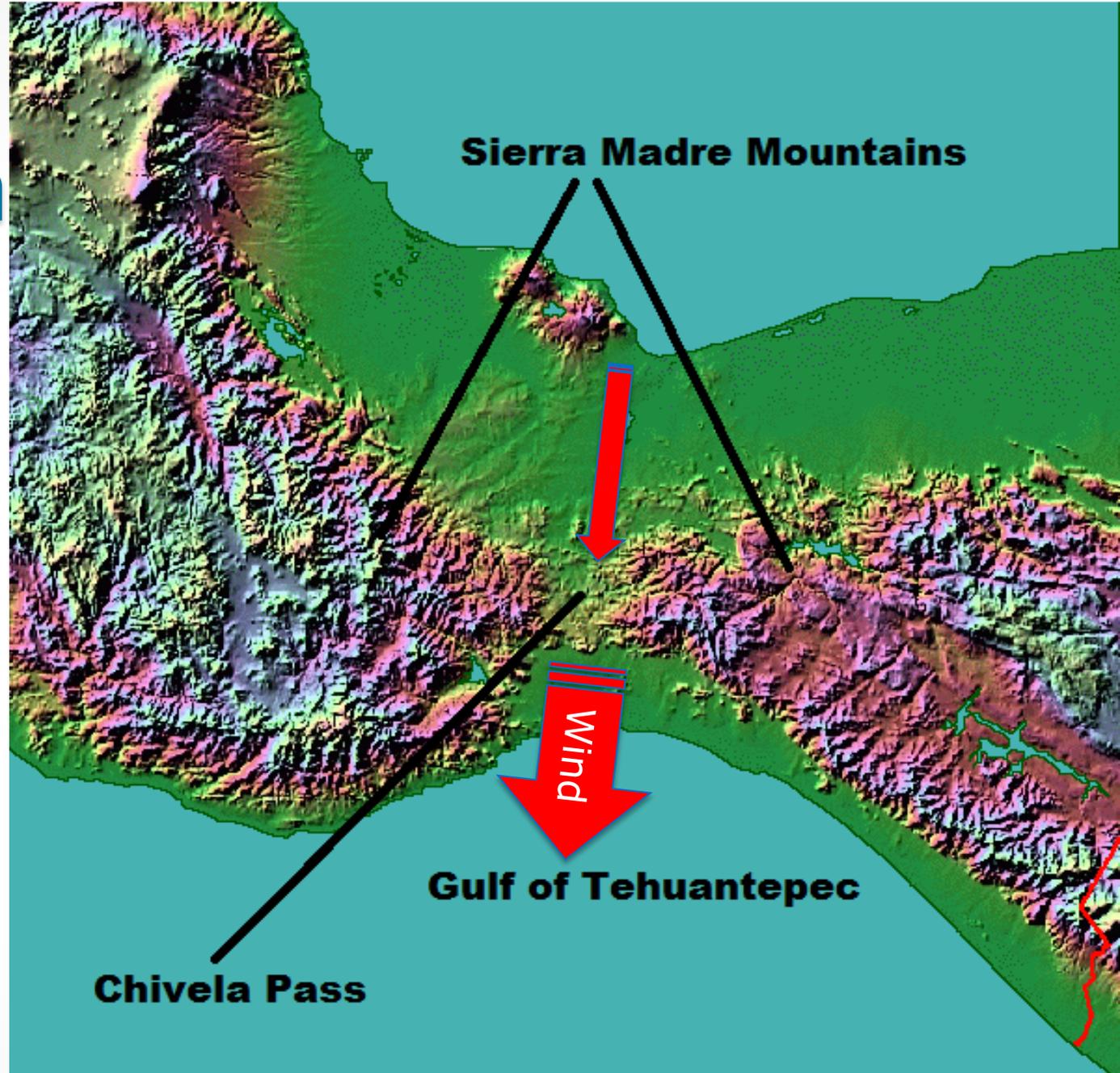
## Regional Air-Sea Interactions (a DISCOVER MEaSUREs tool)

- Develop **automated mining solution to extract gap wind and SST (sea surface temperature) events** using microwave products.
- **Generate gap wind and SST event climatology** using the automated algorithms.
- **Distribute event climatology** to users through an interactive web application.

# Current Climatology Sites Central America



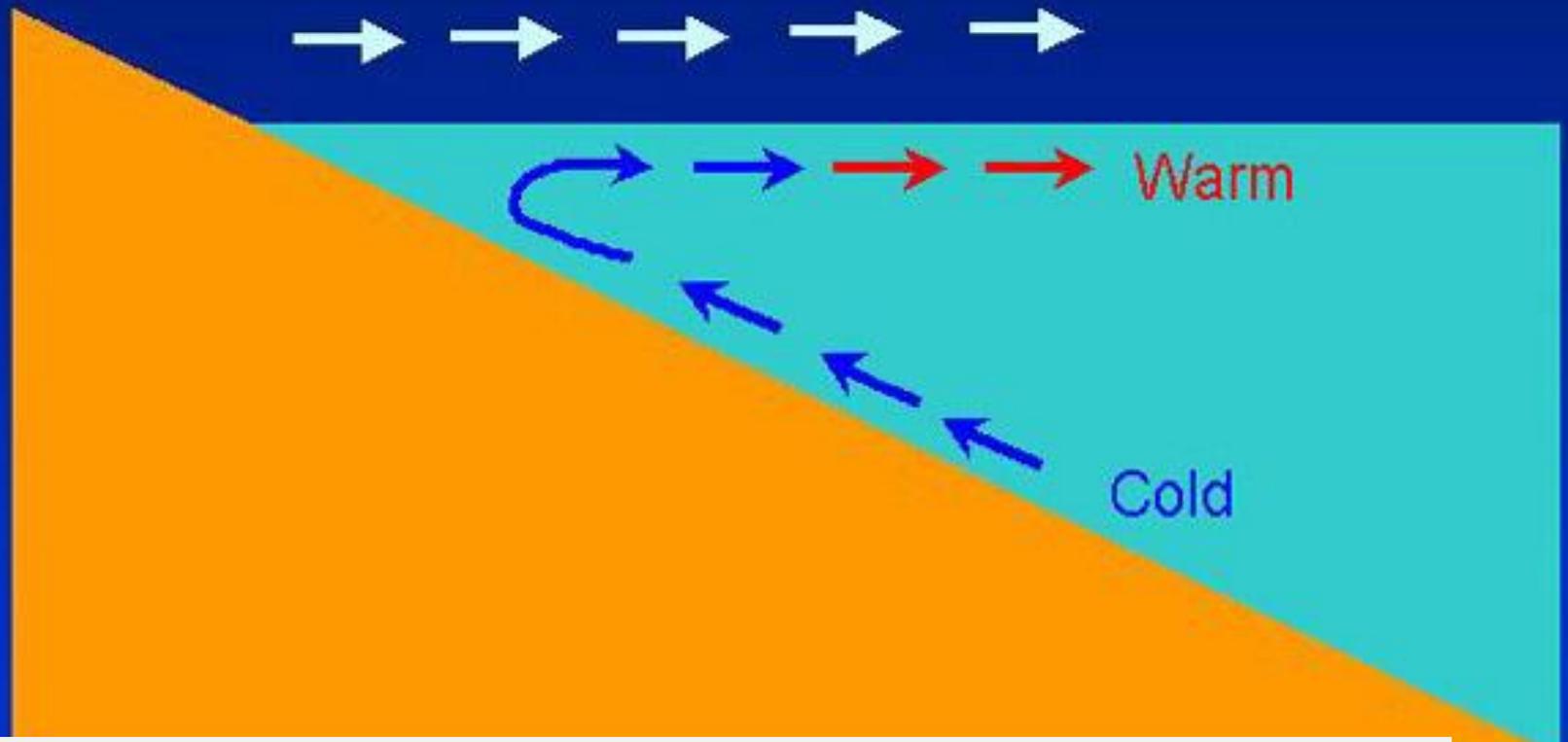
# Mountain Gap Effect



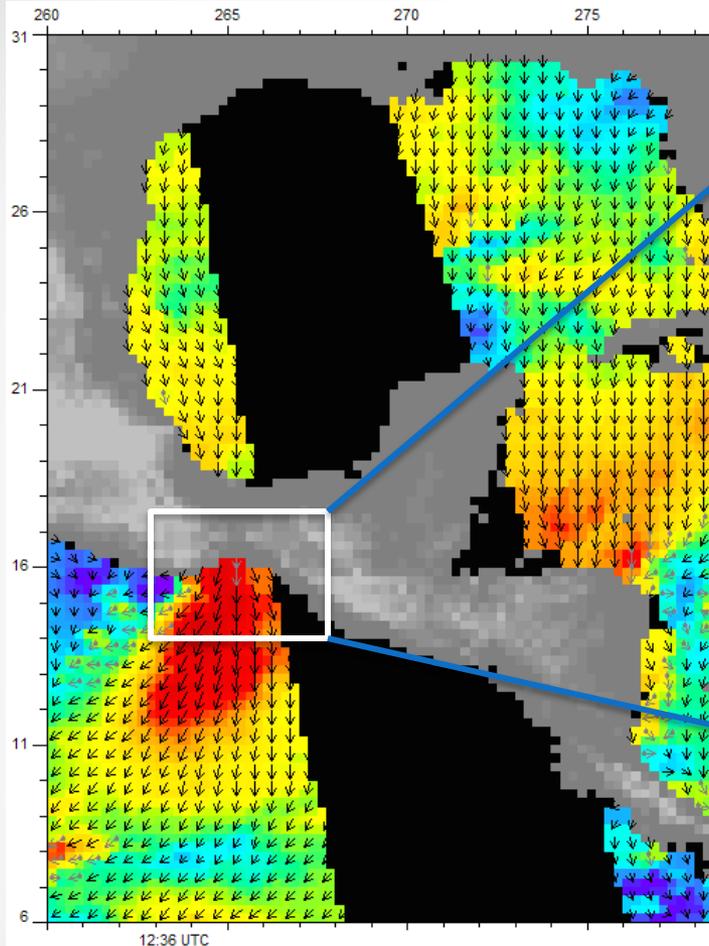
# Coastal Upwelling

## Wind Driven Upwelling

Offshore Wind

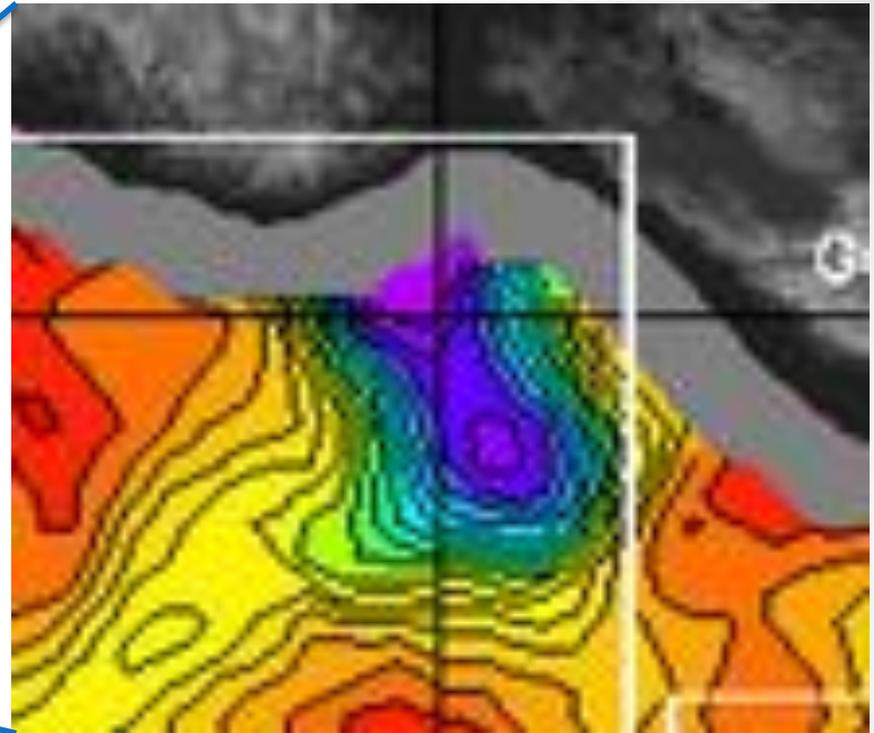


# Regional Air-Sea Interactions (RASI) in Central America



QuikScat wind vectors for 01/22/2001(morning pass)

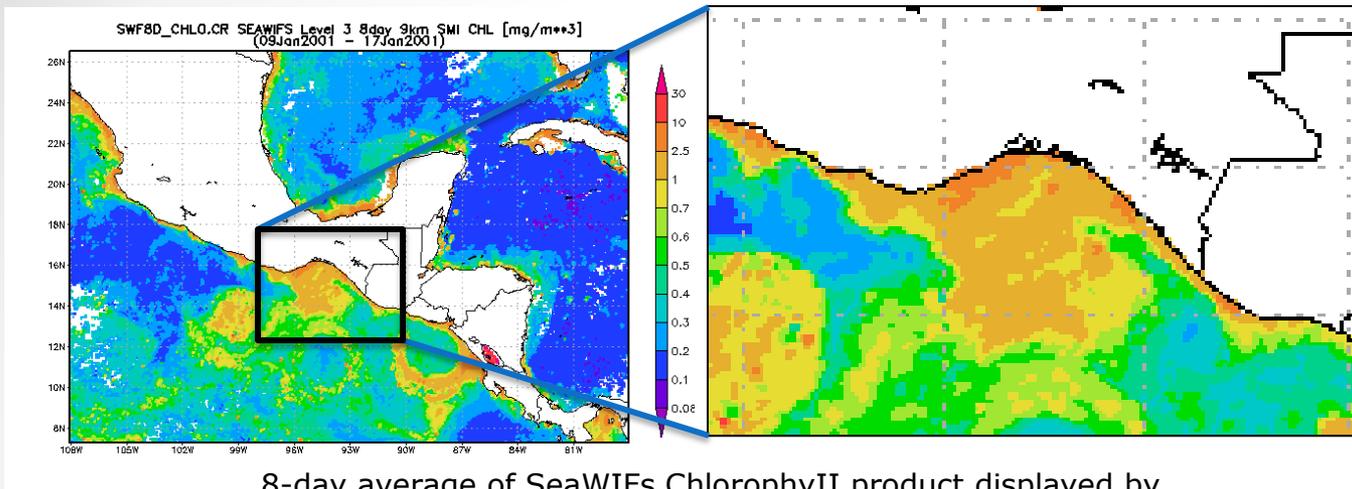
Strong **gap wind** over Gulf of Tehuantepec was observed from morning pass of QuikScat wind field on 01/22/2001.



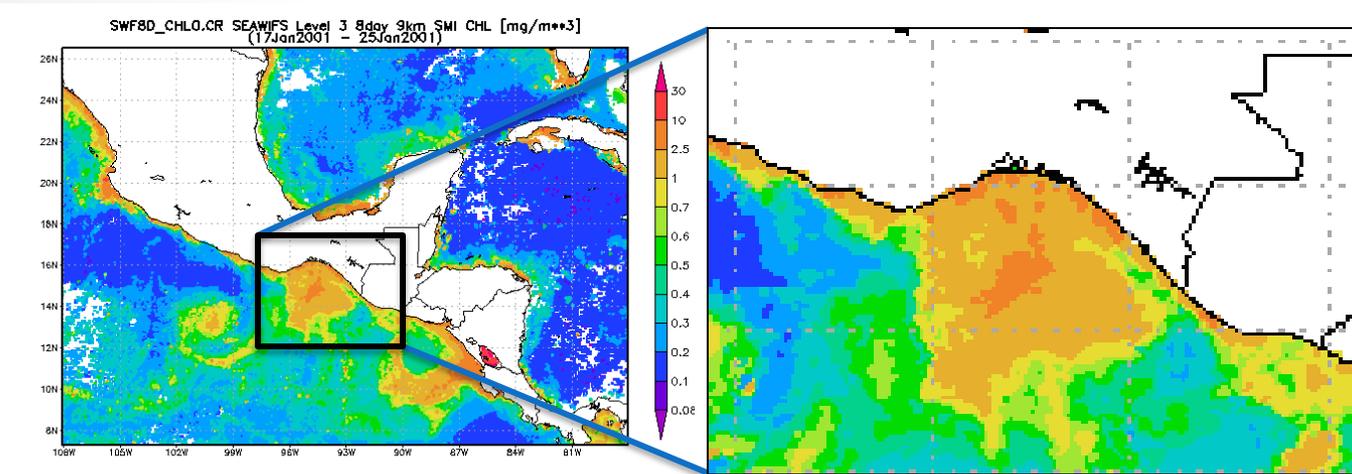
Ocean cooling on MW OISST product 01/22/2001

**Coastal upwelling** occurs when strong gap winds trigger intense vertical mixing of the ocean. Warm surface water was pushed by wind jet away from the coast and deep cold water and nutrients rise to the surface.

# RASI Climatology Impacts/Uses



8-day average of SeaWiFS Chlorophyll II product displayed by NASA's Giovanni application (01/09/2001 - 01/17/2001)

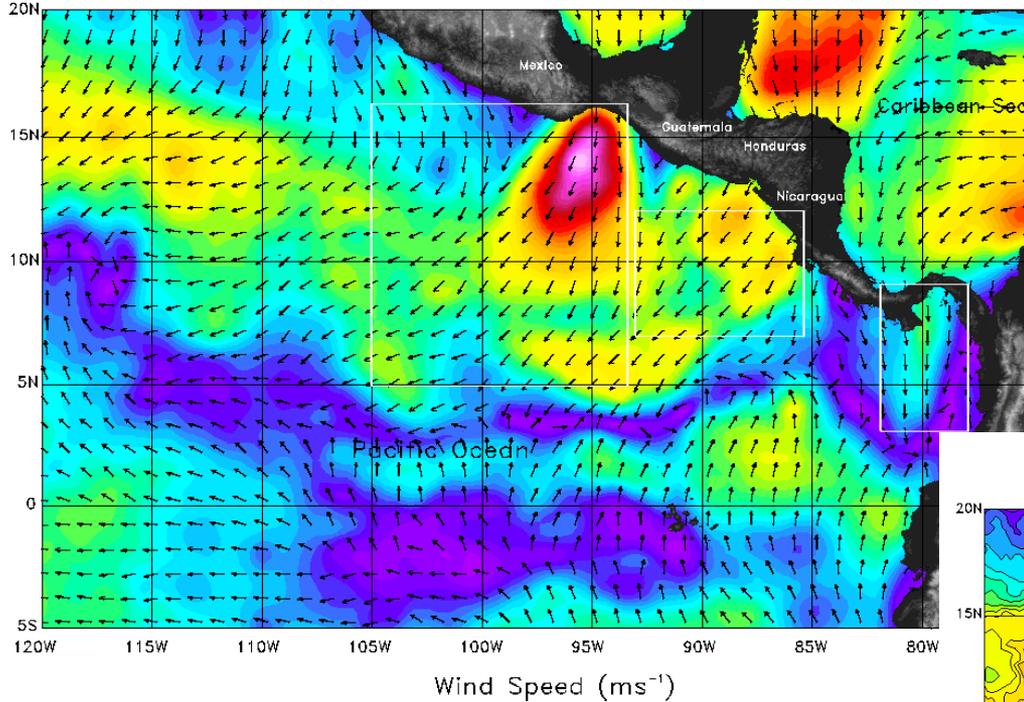


8-day average of SeaWiFS Chlorophyll II product displayed by NASA's Giovanni application (01/17/2001 - 01/25/2001)

- **Gap wind-triggered air-sea interactions** may have long-lasting effects in both the ocean and atmosphere (Xie et al. 2005).
- Documentation of this orographically-induced air-sea coupled phenomena can serve as a **benchmark for accurately evaluating coupled atmospheric-ocean models** (Xie et al. 2005).
- This air-sea interaction process significantly **changes the regional nutrient distribution** and local ecological environment.
- **10-year climatology of gale- and storm-force Tehuano wind events** were produced using 25 km QuikSCAT wind product (Brennal et al. 2010).

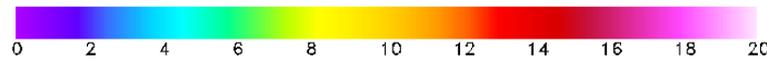
# Data Products Used For RASI Analysis

01/22/2001 at 12Z



## Cross-Calibrated Multi-Platform (CCMP) ocean surface winds product

- Combining wind measurements from SeaWinds, AMSR-E, TMI, SSM/I and SSMIS on DMSP using a 4D variational analysis model.
- Global high resolution (25 km) over ocean surface.
- 6-hourly gridded data at 0, 6, 12 and 18 Z.

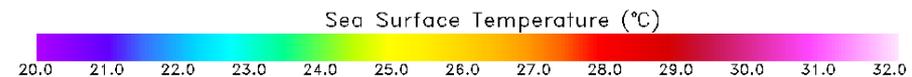
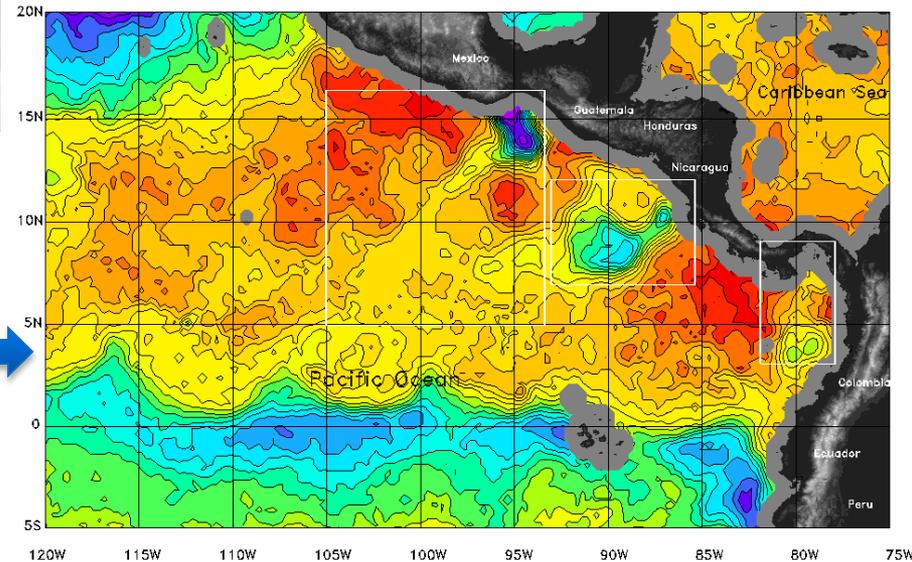


- **Microwave Optimally Interpolated Sea Surface Temperatures (OISST)**

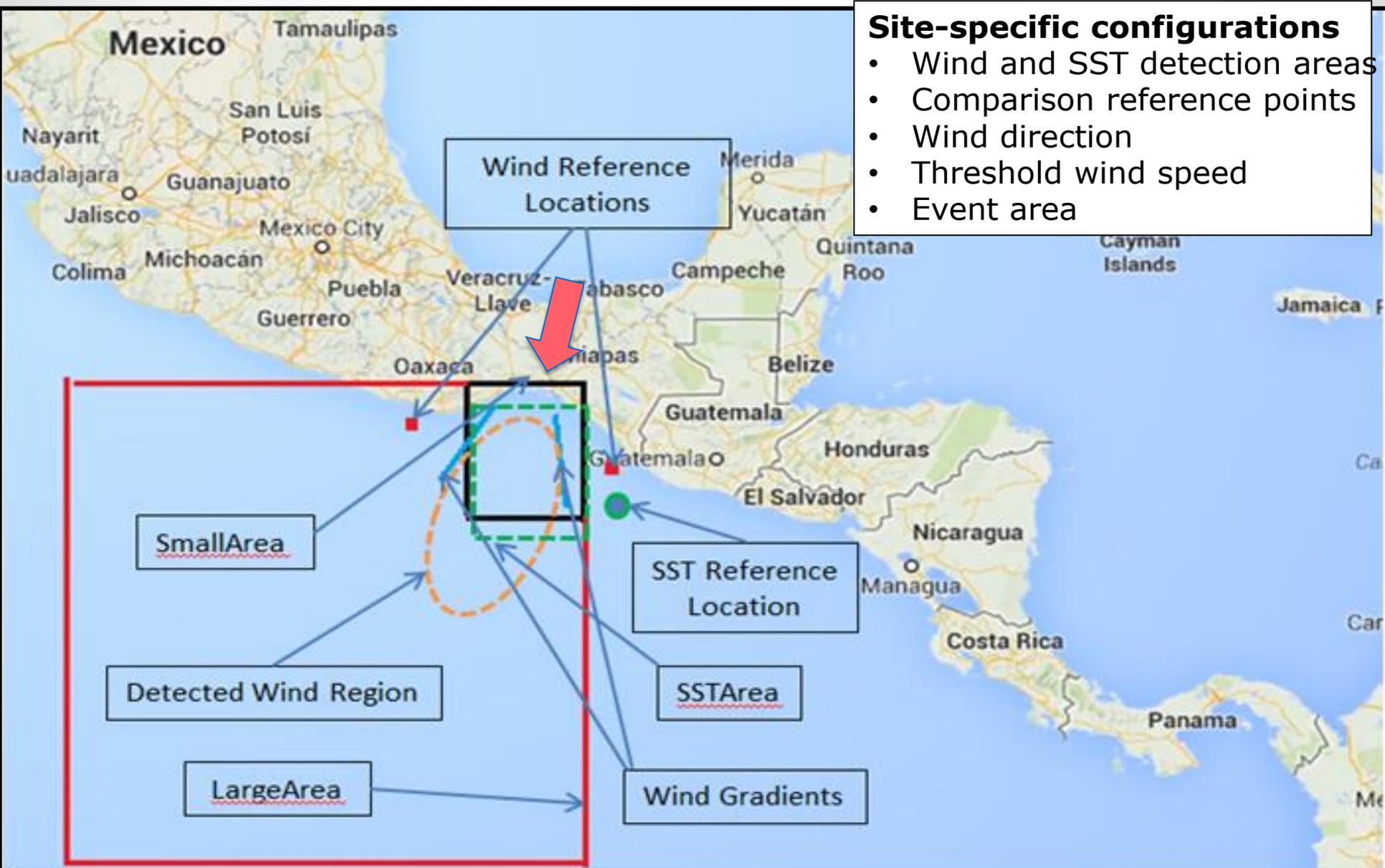
- Daily SST data at 0.25 degree resolution.
- Data available **1998** to present

- **Event climatology currently covers 1998 to 2011**

01/22/2001

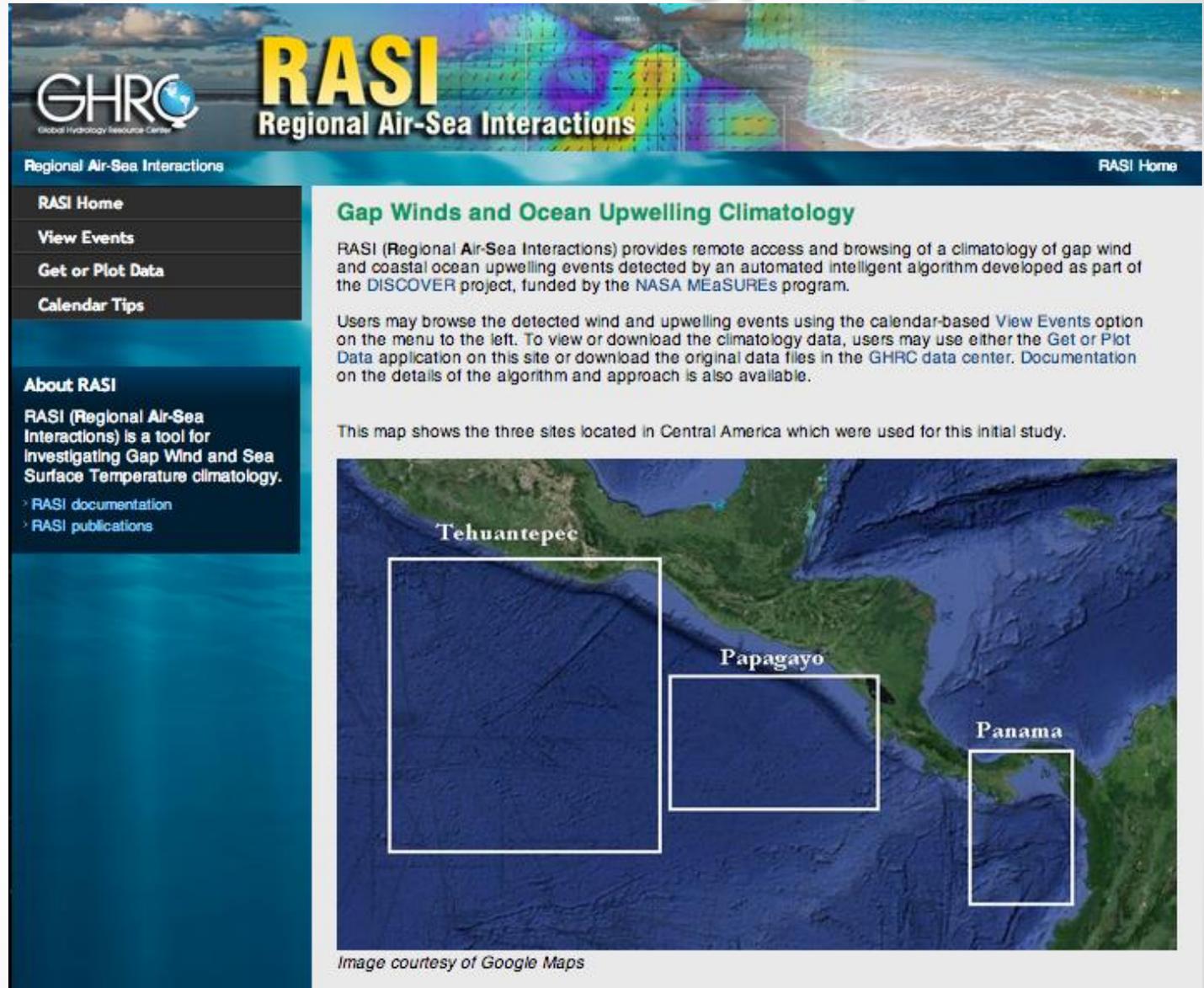


# Event Identification Algorithm Approach



# RASI Interactive Climatology System

**Online exploration and access** to the climatology to support ongoing and future research



The screenshot shows the RASI website interface. At the top, there is a banner with the GHRC logo and the text "RASI Regional Air-Sea Interactions". Below the banner, there is a navigation menu with options: "RASI Home", "View Events", "Get or Plot Data", and "Calendar Tips". To the right of the menu, there is a section titled "Gap Winds and Ocean Upwelling Climatology" with a description of the system and its purpose. Below this, there is a map of Central America showing three study sites: Tehuantepec, Papagayo, and Panama. The map is a satellite-style image with white boxes highlighting the study areas. The text "Image courtesy of Google Maps" is at the bottom of the map.

**GHRC**  
Global Hydrology Resource Center

## RASI

Regional Air-Sea Interactions

Regional Air-Sea Interactions RASI Home

- RASI Home
- View Events
- Get or Plot Data
- Calendar Tips

### About RASI

RASI (Regional Air-Sea Interactions) is a tool for Investigating Gap Wind and Sea Surface Temperature climatology.

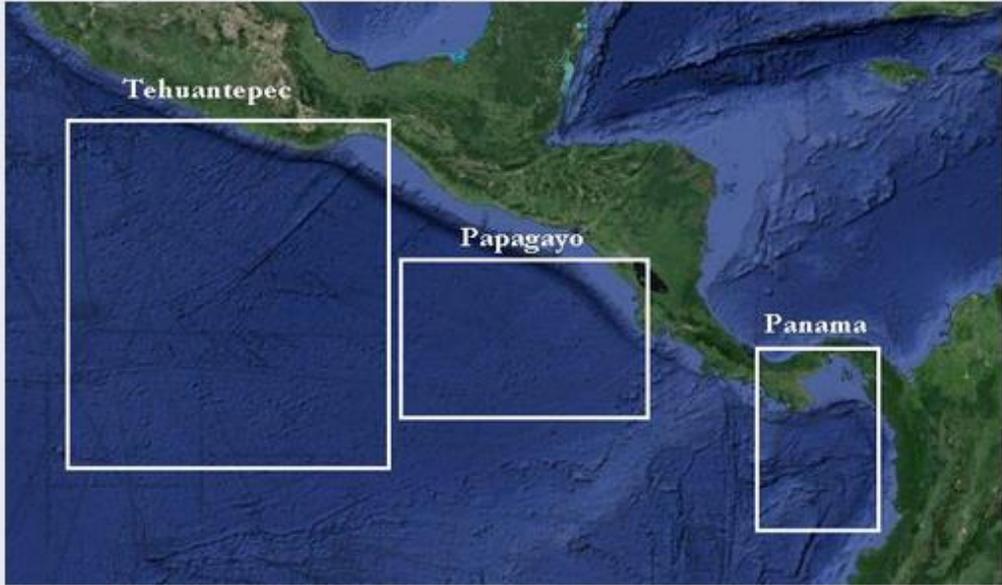
- RASI documentation
- RASI publications

### Gap Winds and Ocean Upwelling Climatology

RASI (Regional Air-Sea Interactions) provides remote access and browsing of a climatology of gap wind and coastal ocean upwelling events detected by an automated intelligent algorithm developed as part of the DISCOVER project, funded by the NASA MEaSUREs program.

Users may browse the detected wind and upwelling events using the calendar-based View Events option on the menu to the left. To view or download the climatology data, users may use either the Get or Plot Data application on this site or download the original data files in the GHRC data center. Documentation on the details of the algorithm and approach is also available.

This map shows the three sites located in Central America which were used for this initial study.



Tehuantepec  
Papagayo  
Panama

Image courtesy of Google Maps

<http://ghrc.nsstc.nasa.gov/rasi>

# RASI Interactive Climatology System

View Events

Get Data

Plot Data

Information

Publications

**GHRC**  
Global Hydrology Resource Center

## RASI

Regional Air-Sea Interactions

Regional Air-Sea Interactions RASI Home

- RASI Home
- View Events
- Get or Plot Data
- Calendar Tips

**About RASI**

RASI (Regional Air-Sea Interactions) is a tool for Investigating Gap Wind and Sea Surface Temperature climatology.

- RASI documentation
- RASI publications

### Gap Winds and Ocean Upwelling Climatology

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This map shows the three sites located in Central America which were used for this initial study.

Tehuantepec

Papagayo

Panama

*Image courtesy of Google Maps*

# RASI View Events

Location

Location: Tehuantepec

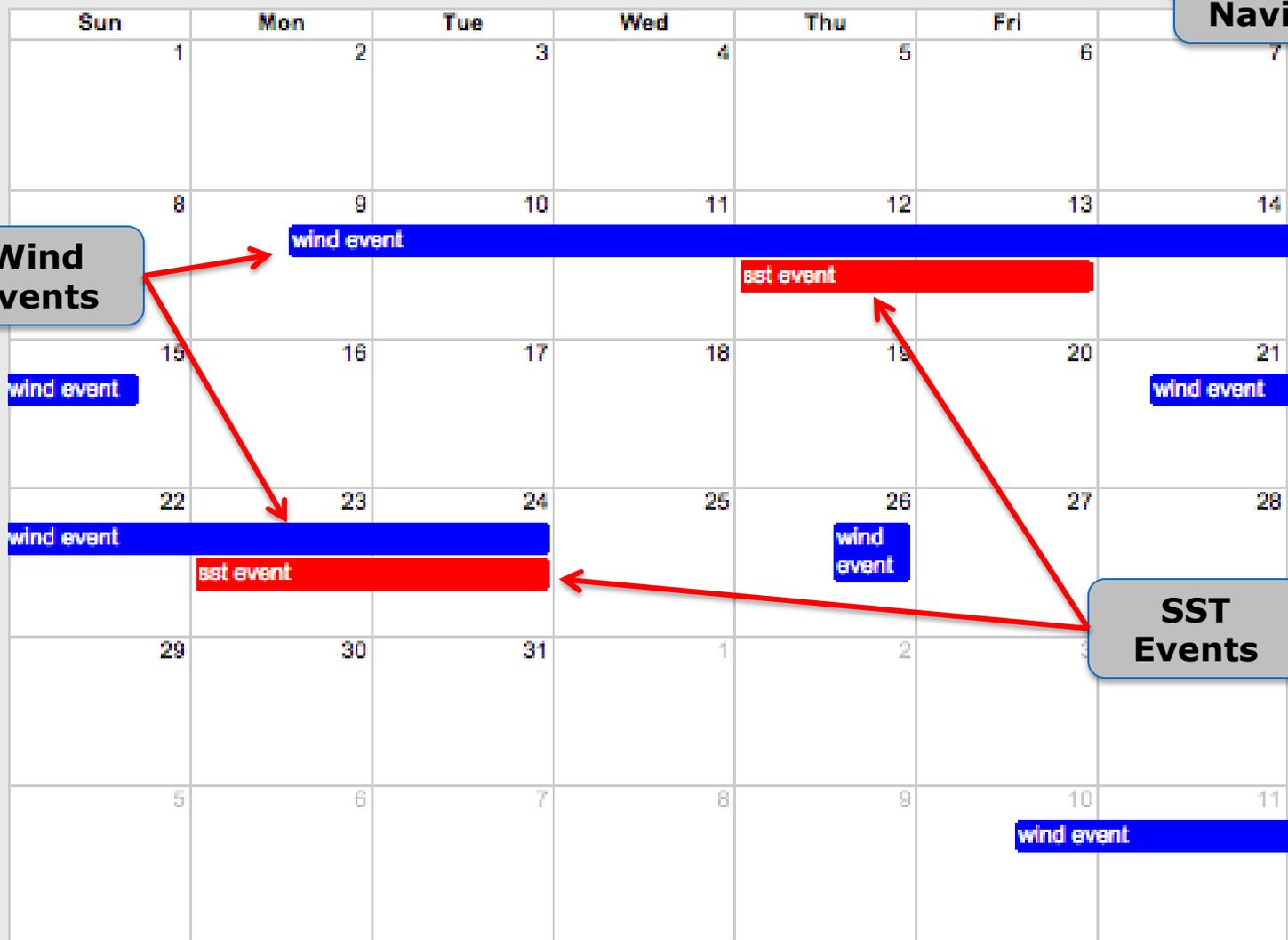
March

1998

Date Navigation

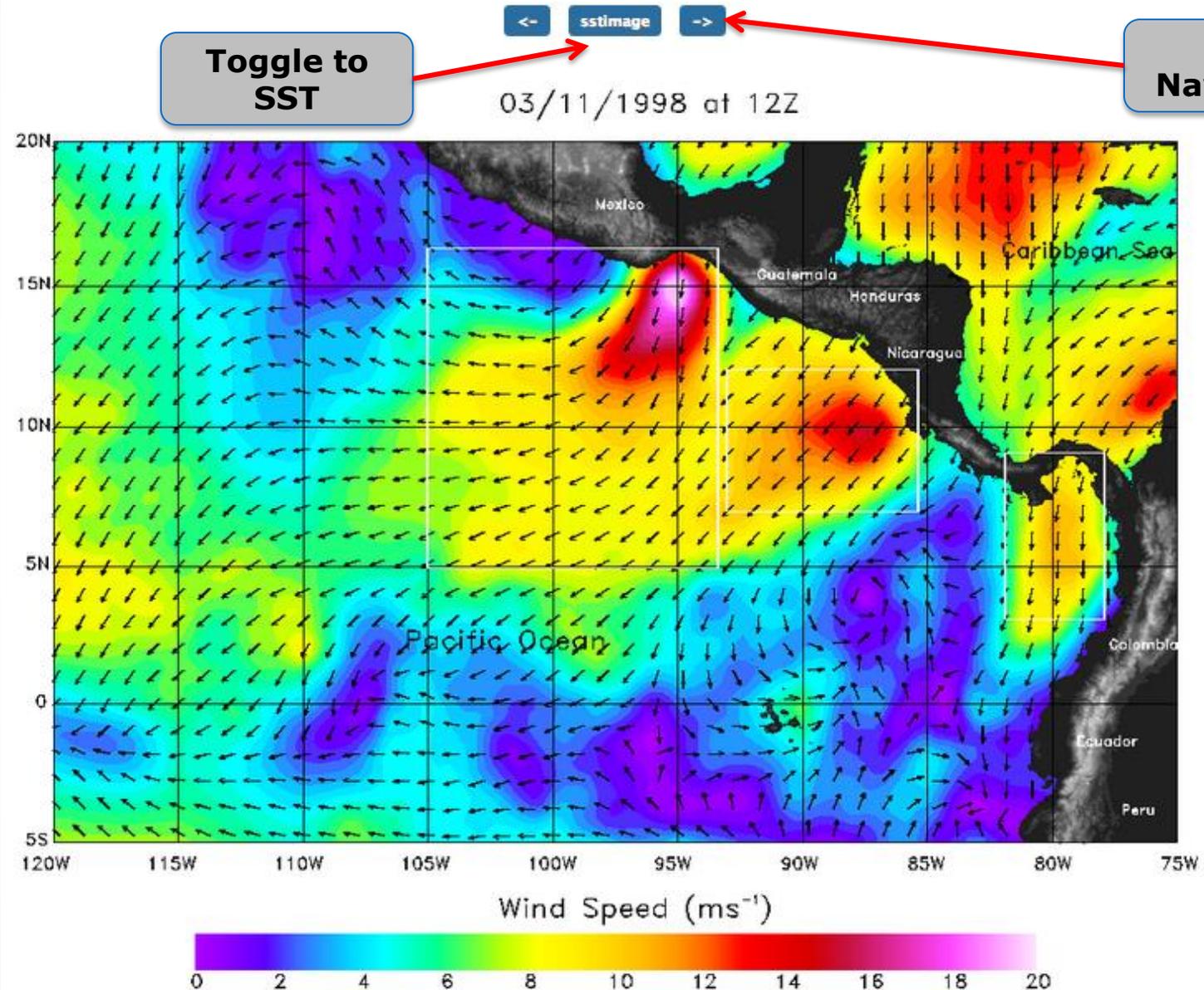
Wind Events

SST Events

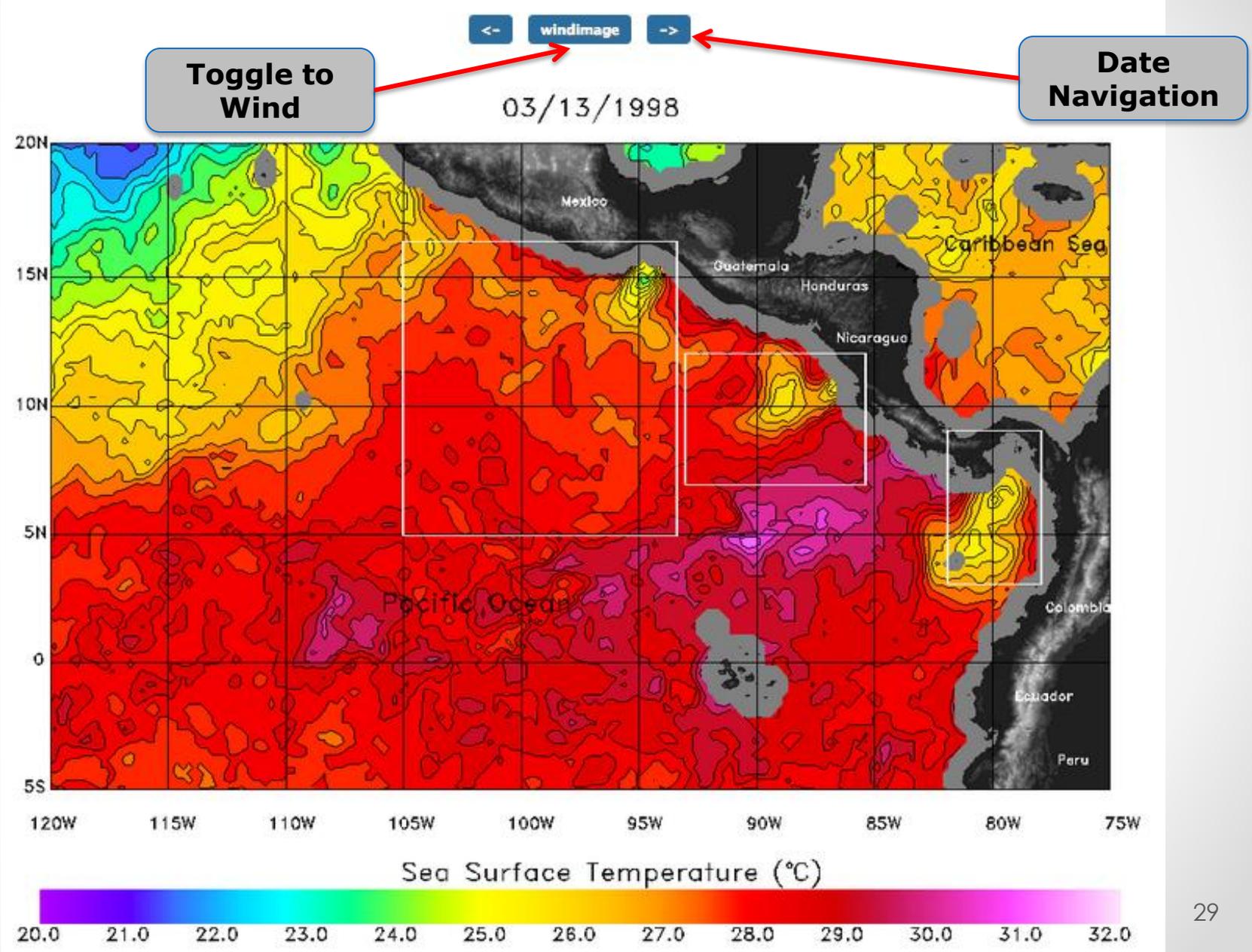


Please note: SST data and images are generated daily, so all SST event records begin and end at midnight. In contrast to this, the wind event data and images are generated in six hour intervals.

# Images of Input Wind Data



# Images of Input SST Data



# Get or Plot Climatology Parameters

The screenshot shows a web interface for retrieving climatology data. It features several sections:

- Location:** A dropdown menu currently set to "Panama".
- Date range:** Fields for "From" (01/01/1998) and "To" (02/01/1998).
- Wind Parameters:** A list of checkboxes for various wind metrics, including "Check All", "Wind Speed Mean", "Wind Speed Standard Deviation", "Wind Direction Mean", "Wind Direction Standard Deviation", "Wind Center Latitude", "Wind Center Longitude", "Wind Region of Interest Size", "Wind Speed Maximum", "Wind Speed Maximum Difference", "Wind Event Flag", and "The wind speed at the wind reference location 1".
- SST Parameters:** A list of checkboxes for various SST metrics, including "Check All", "SST Mean", "SST Standard Deviation", "SST Maximum", "SST Minimum", "SST Latitude", "SST Longitude", "SST Region of Interest Size", "SST Reference", "SST Previous Day Mean", "SST Maximum Decrease", "SST Minimum Decrease", "SST Mean Decrease", "SST Standard Deviation Decrease", "SST Reference Difference", "SST Event Flag", "SST Mean of SSTArea", "SST Standard Deviation of SSTArea", "SST Minimum for SSTArea", and "SST Maximum for SSTArea".
- View gapwind data of different parameters:** A section with a "View Data" button.
- See gapwind data in different output formats:** A section with an "Output format" dropdown set to "Points" and a "Plot Data" button.

Red arrows point from callout boxes to these specific elements: "Location" to the location dropdown, "Wind" to the Wind Parameters list, "SST" to the SST Parameters list, "Date Range" to the date range fields, "View/Get Data" to the "View Data" button, and "Plot Data" to the "Plot Data" button.

# Data and Plots

**Output Options**

CSV PDF Copy Print Excel

**Data Listing**

Show 10 entries

Location: Tehuantepec

Search:

Date	windspeedmax (m/s)	sstmin (deg. C)	sstmaxdecrease (deg. C)
1998-03-12 06:00:00	20.076	24.75	1.65
1998-03-12 12:00:00	20.943	24.75	1.65
1998-03-12 18:00:00	17.034	24.75	1.65
1998-03-13 00:00:00	17.589	24.15	1.2
1998-03-13 06:00:00	12.975	24.15	1.2
1998-03-13 12:00:00	16.573	24.15	1.2
1998-03-13 18:00:00	13.886	24.15	1.2
1998-03-14 00:00:00	11.098	-	-
1998-03-14 06:00:00	15.297	-	-
1998-03-14 12:00:00	14.996	-	-

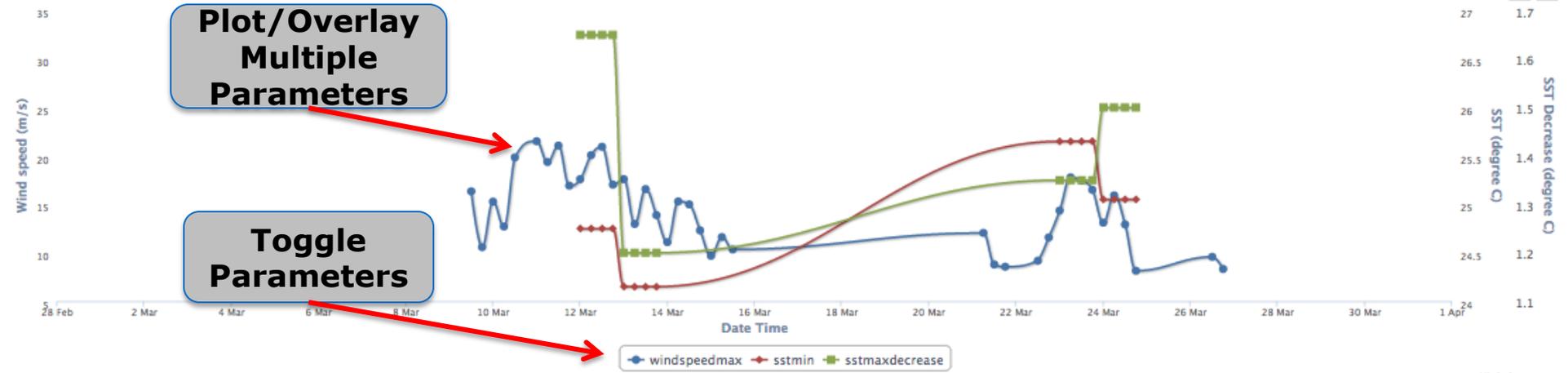
Showing 11 to 20 of 39 entries

◀ Previous Next ▶

**Plot/Overlay Multiple Parameters**

**Toggle Parameters**

Location: Tehuantepec



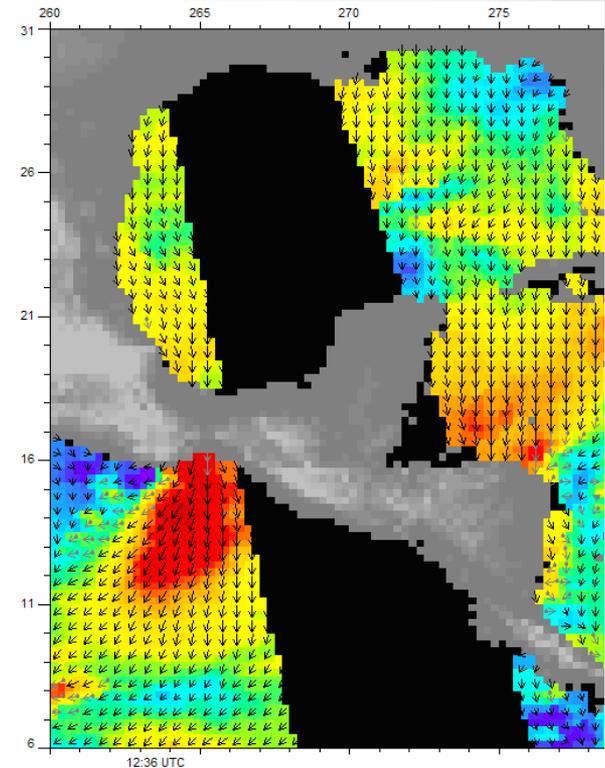
# Discussion

## Microwave Data

- What datasets can be added to supplement the microwave holdings?
- What is your preferred data format?
- How can we improve metadata collection?
- What pertinent information should be added to user guides?

## Tools

- What tools are needed to better serve these datasets?
- Would custom data analysis be useful for other cases?
- What other data services would be useful?



QuickScat wind vectors for  
01/22/2001(morning pass)

Please contact **GHRC User Services** for any help or questions  
[ghrcdaac@itsc.uah.edu](mailto:ghrcaac@itsc.uah.edu)