NOAA Technical Memorandum
OAR AOML-100

Coral Reef and Marine Resource Manager Climate Information Needs Assessment for the Florida Reef Tract

Principal Investigators:

Pamela J. Fletcher
Florida Sea Grant, Miami, Florida

James C. Hendee
NOAA/Atlantic Oceanographic and Meteorological Laboratory Miami, Florida

December 2012

noaa

UNITED STATES DEPARTMENT OF COMMERCE
Dr. Rebecca A. Blank, Acting Secretary

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
Dr. Jane Lubchenco, Undersecretary for Oceans and Atmosphere

OFFICE OF OCEANIC AND ATMOSPHERIC RESEARCH
Dr. Robert S. Detrick, Assistant Administrator

Disclaimer

NOAA does not approve, recommend, or endorse any proprietary product or material mentioned in this document. No reference shall be made to NOAA or to this document in any advertising or sales promotion which would indicate or imply that NOAA approves, recommends, or endorses any proprietary product or proprietary material herein or which has as its purpose any intent to cause directly or indirectly the advertised product to be used or purchased because of this document.

The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the funding agency.

Table of Contents

Coral Reef and Marine Resource Manager Climate Information Needs Assessment for the Florida Reef Track

Pamela J. Fletcher and James C. Hendee

Abstract. This report summarizes the results of a needs assessment conducted with 15 marine resource managers in southeast Florida from December 2011 through May 2012. The purpose of the front-end assessment is to identify the type of climate data needed and the preferred delivery of this information to the target audience (Witkin and Altschuld, 1995). The needs assessment was developed using the methodology from the NOAA/Coastal Services Center (CSC) Product Design and Evaluation training program (NOAA/CSC, 2003). The results can be used to further develop climate-based science communications.

Introduction

The needs assessment is the first phase of a larger NOAA effort to guide the development of a suite of climate science products for use by coral reef and marine resource managers in the U.S. and its territories. The Integrated Marine Protected Area Climate Tool (IMPACT) project promotes the use of NOAA climate data to build capacity among the management community. This technical memorandum contains a synthesis of manager responses to a formal climate information needs assessment survey conducted in south Florida between December 2011 and May 2012.

What is IMPACT?

The IMPACT project convenes climate scientists, ecologists, and managers to develop useful climate data analysis and interpretation products for marine protected area managers. IMPACT1 is the initial phase of the project, consisting of (1) a formal needs assessment to obtain a clear picture of climate information requirements for a pilot project in south Florida, and (2) development of an Internet-based discovery prototype to deliver NOAA science to managers. IMPACT1 is intended to be an iterative process for ongoing feedback and refinement between researchers and end users for the purpose of developing climate information resources for decision makers.

> *The IMPACT1 vision is the realization of a suite of tools (i.e., a "tool box"), developed iteratively among scientists, managers, and stakeholders that provides coral reef resource managers with climate information products for effective decision support to address ecosystem responses to stressors at local scales within the Florida Reef Tract.*

Project Web site: http://www.coral.noaa.gov

Ecological forecast Web site: http://ecoforecast.coral.noaa.gov

The IMPACT1 project begins with interactions during focus group sessions and one-on-one meetings with resource managers and scientists. During these interactions, participants articulate critical management needs, potential science gaps, and offer the use of their science and knowledge to create relevant climate information resources for use in decision making. A systematic approach was used to gather information from reef and marine resource managers in southeast Florida. The needs assessment process is part of the NOAA/Coastal Services Center Program Design and Evaluation training (NOAA/CSC, 2003). The assessment helps identify the criticial information that is used to develop and evaluate a project. In this case, it was used to identify the types of climate information needed by managers within their jurisdictions and how they want to receive this information. The eventual end product is an Internet-based prototype containing climate information consisting of oceanographic, atmospheric, and biological data that can be used to inform decision making along the Florida Reef Tract.

IMPACT1 Needs Assessment Process

A needs assessment is a systematic investigation of an audience to identify aspects of individual knowledge, skill, interest, attitude, or abilities relevant to a particular issue, organizational goal, or objective (NOAA/CSC, 2003). A needs assessment was selected because it is a proven methodology for the design, development, implementation, and evaluation of outreach and extension activities (Witkin and Altschuld, 1995). The IMPACT1 approach used this process to build a base of knowledge to outline information needs and the design/delivery of climate information to resource managers.

The needs assessment was carried out in four steps. *Step 1 Informational Conversations* consisted of site visits to offices responsible for managing or overseeing coral and marine resource management in south Florida. *Step 2 Researcher Capabilities* entailed meeting with researchers to obtain examples of the types of climate information that is or could be produced for IMPACT1 activities. *Step 3 Needs Assessment Tool* included the development of a discussion guide and examples of the climate research products for use during conversations with managers. *Step 4 Needs Assessment* consisted of administering the tool and reporting results obtained by managers identified in step 1.

Resource managers were identified from their previous participation in coral and/or marine resource related projects in the region, such as the Southeast Florida Coral Reef Initiative and the NOAA Coral Reef Conservation Program (NOAA/CRCP, 2009). Informational meetings held during *Step 1 Informational Conversations* of the project were used to confirm participation in IMPACT1 and to identify if additional individuals should be contacted for input in this project. The following individuals participated in the assessment that began in December 2011 and concluded in May 2012:

1. Ken Banks, Natural Resource Specialist IV, Broward County Environmental Protection and Growth Management Department
2. Steve Blair, Chief, Restoration and Enhancement Section, Department of Regulatory and Economic Resources , Miami-Dade County
3. Billy Causey, Regional Director, Southeast Atlantic, Gulf of Mexico and Caribbean Region, NOAA's Office of National Marine Sanctuaries
4. Ernest M. Cowan, Chief Biologist, Florida Park Service
5. Nancy Craig, Natural Resource Specialist III, Broward County Environmental Protection and Growth Management Department
6. Carmelo J. Duesler, Park Service Specialist, John U. Lloyd Beach State Park, Florida Park Service
7. Lou Fisher, Natural Resource Specialist III, Marine Section, Broward County Environmental Protection and Growth Management Department
8. Kathy Fitzpatrick, Coastal Engineer, Martin County Coastal Engineering Department
9. Keith Millie, Environmental Specialist III, Division of Marine Fisheries, Artificial Reef Program, Fish and Wildlife Conservation Commission
10. Sean Morton, Superintendent, NOAA's Florida Keys National Marine Sanctuary
11. Janet Phipps, Coral Reef Ecologist, Palm Beach County Department of Environmental Resources Management
12. Erik Stabenau, Oceanographer, Department of Interior Technical Lead, National Park Service
13. Katherine Tzadik, Environmental Project Coordinator, Coral Reef Conservation Program, Florida Department of Environmental Protection
14. Pat Wells, Park Manager, John Pennekamp Coral Reef State Park, Florida Park Service
15. Tracy Zigler, Fisheries and Marine Biologist, Everglades and Dry Tortugas National Parks

Findings and Recommendations

Informational conversations and the formal needs assessment provided insight to coral and/or marine resource manager needs for climate science in south Florida. The participants shared information on behalf of their agency and also personal interest in climate impacts to marine resources. The needs assessment tool helped achieve a dialogue to assist in the development of recommendations for the IMPACT1 project beyond the scope of the assessment.

Management responsibilities: All participants confirmed that they had some level of responsibility to manage marine and/or reef resources in the region. Variations in the aspect of management ranged from federal mandates to preserve, protect, and conserve resources, to permit requirements tied to monitoring, and also included coordinating regional planning and management efforts tied to the Florida Reef Tract. Management actions also varied from policy development and implementation, to in-water activities such as mooring buoy installation and maintenance, beach nourishment, and water quality monitoring.

Existing resources used for science-based management: Resources currently used for science-based management, or research reports, consist of printed material and Web-based information such as peer-reviewed research, state guidance documents, agency protocols, listservs, web-based notifications and reporting, geodatabases, agency technical documents, libraries, meetings, online databases (e.g., water quality), forums, personal communications with colleagues and project partners, and Google Earth maps. Of these resources, participants liked the ability to scan through documents or receive listserv or email notices while sitting at their desks—this provided an easy way to choose items of interest. The timeliness of electronic publications and communications was valuable to managers. Listservs present an opportunity to not only receive science from their colleagues and stakeholders, but also show management responsiveness if warranted. Dislikes associated with science-based management or research reports consisted of broken Web links, and the general disconnect between ecosystem components and multiple interactions that result in some effect on the reef or marine environment. For example, there may be an algal bloom on the reef, but not all of the contributing factors (e.g., temperature, nutrient levels, etc.) are included as an ecosystem response to multiple impacts. A few examples of climate products appear in Appendix 1. An expanded list of climate information currently being used by resource managers is included in Appendix 2.

New climate resources from IMPACT: IMPACT researchers provided examples of climate information products for review with need assessment participants. The appeal and utility of the design of the research products was subjective to each viewer. A visual element was described as being a critical element in presenting any resource—be it a map, a picture, or a simplified graph—that helped to deliver richer content and context for some of the more abstruse environmental features or concepts. Respondents favored receiving email alerts, immediate response messages about conditions either on the Florida Reef Tract or those that could impact the region. The email alerts could contain Web links to PDF files, databases, and more information detailing current conditions, past conditions, and long-term datasets. For example, delivering today's conditions, last year's conditions, and the last five to ten years of data puts climate information in perspective and illustrates trends in available data. Specific comments collected during the needs assessment are listed below to highlight (1) manager climate data needs, (2) recommendations for the design and delivery of climate information, and (3) recommendations for refining the examples of climate information provided during the needs assessment.

Manager climate data needs

- Data needs to be examined regularly and kept current
- Sea-level rise
- Reef species information that provides notice of subtle changes in distribution
- Atmospheric CO_2 (drops in pH in the ocean)
- Multi-disciplinary information (ecosystem)
- Sea surface temperature at finer scales
- Microbial activity
- Coastal current data
- Reef crest information—something to reflect reef conditions (note: this is not necessarily climate, but helps improve the understanding of current reef conditions)
- Current research findings, best management practices, and damage minimization procedures or recommendations
- Tide data—gauges need to be more abundant and delivery of this information needs to be improved
- Ability to parse out data to get what is required or needed at local/region scales
- Gulf Stream information
- Benthic mapping and expansion of *Acropora* spp. and *Dendrogyr*a
- Water quality at specific nutrient levels (detection limits)
- NOAA's Atlantic Oceanographic and Meteorological Laboratory (AOML) water quality data (Florida Area Coastal Environment program)
- Integrate knowledge to causative factors—help identify the cause and effect relationships tied to reef health and climate change
- Events—include information about events (e.g., harmful algal blooms, bleaching, etc.) and also the consequences of those events
- Biological information
- Products like CanViz—visioning sea-level rise for south Florida
- Climate scenarios to help relay the climate message to constituents
- Geographically downscale the products to the region

- Patterns of rainfall from climate change and impacts on water supply and delivery to the coast
- Vulnerability analysis (e.g., sea-level rise)
- Meteorological data
- Water quality data (e.g., information from the South Florida Water Management District)
- Atmospheric data (e.g., airports, etc.)
- Existing weather stations (Nova Southeastern University, airports, etc.)
- Physical oceanography
- Fisheries for all life stages, but particularly younger year classes
- Spatial resolution compatibility (Gulf of Mexico to one island in the Keys) to get local and regional perspectives

Recommendations for the design and delivery of climate information

- Use a Web-based interface with email alerts and an email newsletter
- Develop a standardized quality control protocol for data; if data are available for download, flag that data with an explanation of the strengths and weaknesses of the database (a pop-up window with a message)
- Reduce the need to hunt for data, consider making "collections" of information by topic that link to other databases or information sources
- Consider end users in the design and delivery of information to address the varying levels of users' technical knowledge
- Conduct surveys to identify what is effective and what is ineffective during the course of this project and beyond
- Address data gaps (e.g., a lack of information for the Southeast Florida Coral Reef Initiative region as compared to the Florida Keys National Marine Sanctuary)
- Consider having teams that include both managers and researchers working together to develop content to ensure that any product is appropriate for a diverse audience
- Identify where and how information will be stored if substantial amounts of (computer) space is needed (data management architecture and protocol)
- Develop a forum or blog to provide a means for communication

- Visuals are important, maps are fantastic, and Google-like features are effective because they're something that most end users are intuitive with using on a somewhat regular basis
- Conduct personal meetings and follow ups to the assessment
- Hold seminar presentations about research as Webinars or in person to allow for feedback
- Keep a balanced view: relaying information with a balanced view is critical in delivering climate science
- Consider delivering some information via newspapers and newsletters
- Consider bar charts versus line graphs to relay information in "chunks" of time
- Include a search function on project Web pages
- Confirm fisheries data are being integrated into some research products; if they are not, there would be great value in including them with climate data
- Use both social media (so long as it is maintained) and email alerts for varying levels of involvement
- Consider multiple end users for a Web-based product that is easy to understand (public and permit seekers and reviewers)
- Develop a status report that includes the previous month and last ten years of data (e.g., hot links to supporting research at Florida International University's Southeast Environmental Research Center)
- Encourage multi-layered reporting and data availability (e.g., Web sites, email alerts, email newsletters, and visuals with little text)

Recommendations for refining the climate information examples shared during assessment

- Include the entire Florida Reef Tract
- Make ocean flux a one-page document and available as an email alert
- Make everything Web based
- Use a listserv
- Use email alerts with PDF and Web links
- Social media cannot be accessed by all, consider multiple streams of information (blog, email, Web)

- Develop a fact sheet about climate impacts to south Florida, explaining it for the entire region with specific examples at smaller geographic areas
- Consider expanding the flux report, if possible, as a potential tool for why water quality changes (Gulf Stream meanders)
- Identify if real-time data can be made available for the Gulf Stream
- Consider children as an end user
- Investigate the possibility of making this interactive, i.e., a Web-based product where fishers/divers provide water temperature data (put dot on map and provide real-time information)
- Expand the weather typing example to include more information and background rationale
- Consider using Marine and Estuarine goal Setting for South Florida, MARES-styled diagrams for delivering information
- Categorize data into time periods of 10 or 50 years to see where a single event fits into the longer scheme of things
- Expand on the weather typing project (chlorophyll-a isn't really an indicator of reef health (here macroalgae), and it is a huge undertaking to look where there are algal blooms (patchiness and scale are hard to handle for reef tract))
- Add salinity to the weather typing product
- Make a smaller grid size for the reef flux report

Examples of how current climate science is used to inform decisions and improve understanding of climate impacts on the Florida Reef Tract

- Climate science is used to inform the Florida Keys National Marine Sanctuary Advisory Council and resource managers in the region. The climate science varies from broad-scale information such as coral bleaching events to localized projects such as projected sea-level rise in the Florida Keys and the Florida Reef Resilience Program. This information helps improve the understanding of impacts to reef ecosystems and assists in determining the location of monitoring sites and protocols.
- Events such as the Deepwater Horizon oil spill resulted in maps that were helpful in illustrating the circulation and strength of currents. This information, when placed alongside other data such as air temperature, is valuable in management planning and response efforts when events occur.

Conclusions

The IMPACT1 needs assessment is recognized as a beginning step in the development of climate information products. The results provide insight into the types of climate data and information needed by managers within their current roles at local, state, and federal agencies within the Florida Reef Tract region. This information will be useful to the development of researcher products and both the design and delivery of climate information.

Acknowledgments

The authors wish to thank all of the individuals who contributed to this report: we thank you for your time, knowledge sharing, and contributions. The IMPACT project teams thanks the primary funder, the NOAA Coral Reef Conservation Program, for providing support for grant award C085-ID647. We thank Gail Derr at NOAA's Atlantic Oceanographic and Meteorological Laboratory for her support in developing this technical memorandum.

References

NOAA/CRCP. 2009. Florida's Coral Reef Management Priorities. Available from http://coralreef.noaa.gov/aboutcrcp/strategy/reprioritization/managementpriorities/resources/florida_mngmnt.pdf (Accessed 1 June 2012)

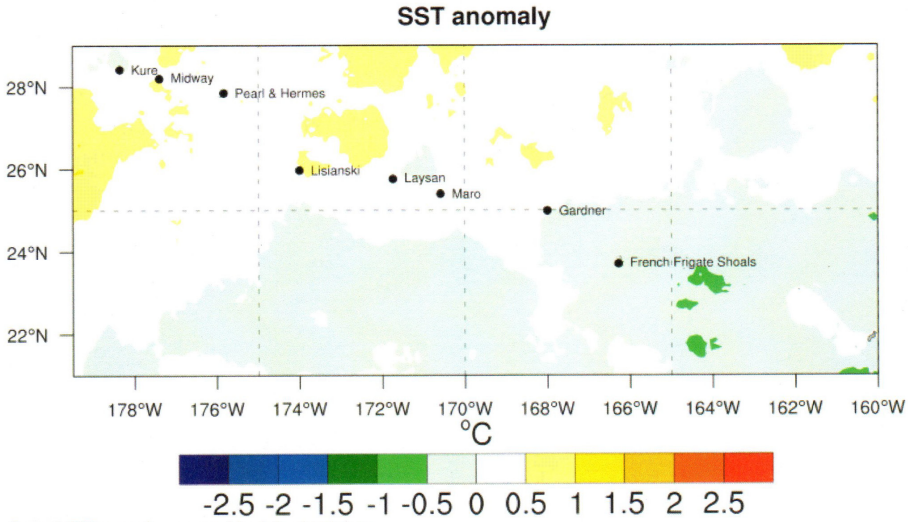
NOAA/CSC. 2003. Product Design and Evaluation. Course Training Manual. Updated periodically. Course information at http://www.csc.noaa.gov/training/. Charleston, SC. (Accessed 4 June 2012)

Witkin, BR and JW Altschuld. 1995. Planning and conducting needs assessment: A practical guide. Thousand Oaks, CA: Sage Publications, Inc., 302 pp.

Appendix 1 – Prototype Climate Products

Sea Surface Temperature
(Ruben van Hooidoink, NOAA/Atlantic Oceanographic and Meteorological Laboratory)

DHWs and SST anomalies for the Papahānaumokuākea Marine National Monument



Current SST anomaly compared to daily climatology.

Methodology

Degree Heating Weeks (DHW) were calculated from daily optimal interpolated ~.09 Degree (~9 kilometer) data. This product combines microwave SSTs from the AMSR-E sensor, the TRMM Microwave Imager (TMI) and infrared SSTs from the MODerate Resolution Imaging Spectroradiometer (MODIS). This data was retrieved from ftp://ftp.discover-earth.org/sst/daily/mw_ir/.

DHWs were calculated by first averaging daily SST values to weekly values. Secondly all positive anomalies above the MMM for the past 12 weeks were summed.

For more information on the input data see:
http://www.ssmi.com/sst/microwave_oi_sst_data_description.html#data_file_format

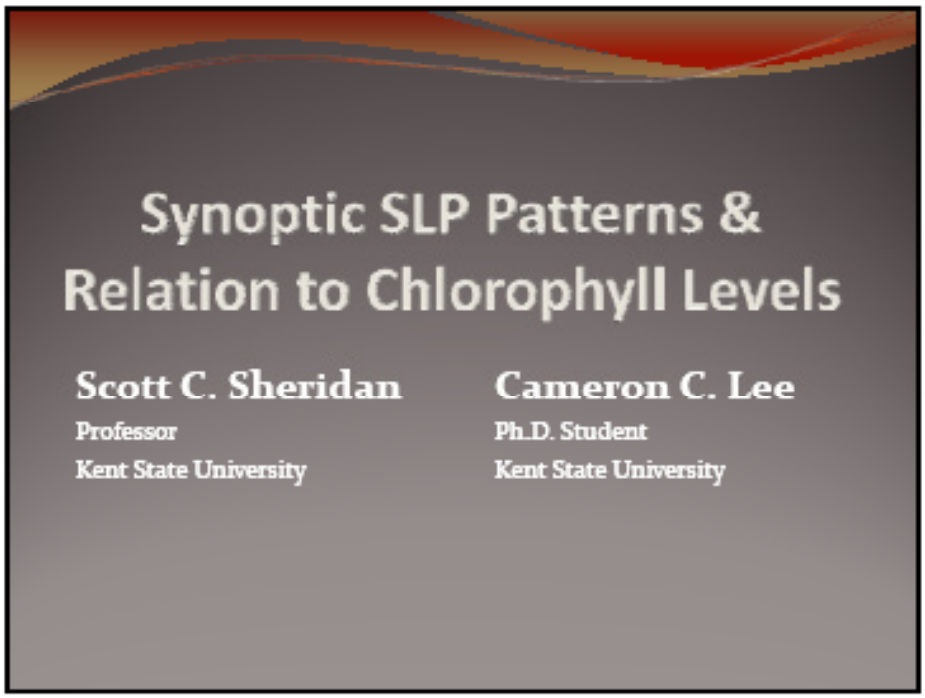
The climatology used is interpolated from 1 degree monthly file to 0.09 degree daily grid file. The base period is 1971-2000. This climatology is described in:
http://www.cpc.noaa.gov/products/predictions/30day/SSTs/sst_clim.html

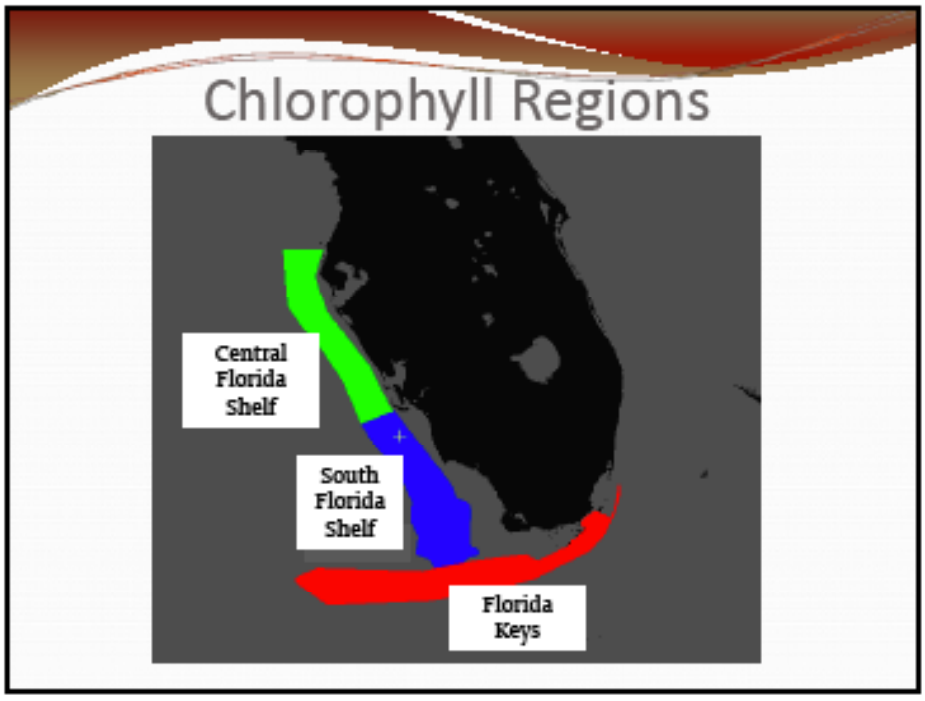
and in:
Xue, Y., T. M. Smith, and R. W. Reynolds, 2003: Interdecadal changes of 30-yr SST normals during 1871-2000. J. Climate, 16, 1601-1612.

To calculate the Maximum Monthly Mean (MMM, the warmest monthly temperature from climatology at each location) first the daily climatology was averaged to a monthly climatology, than for each location the warmest month was selected.

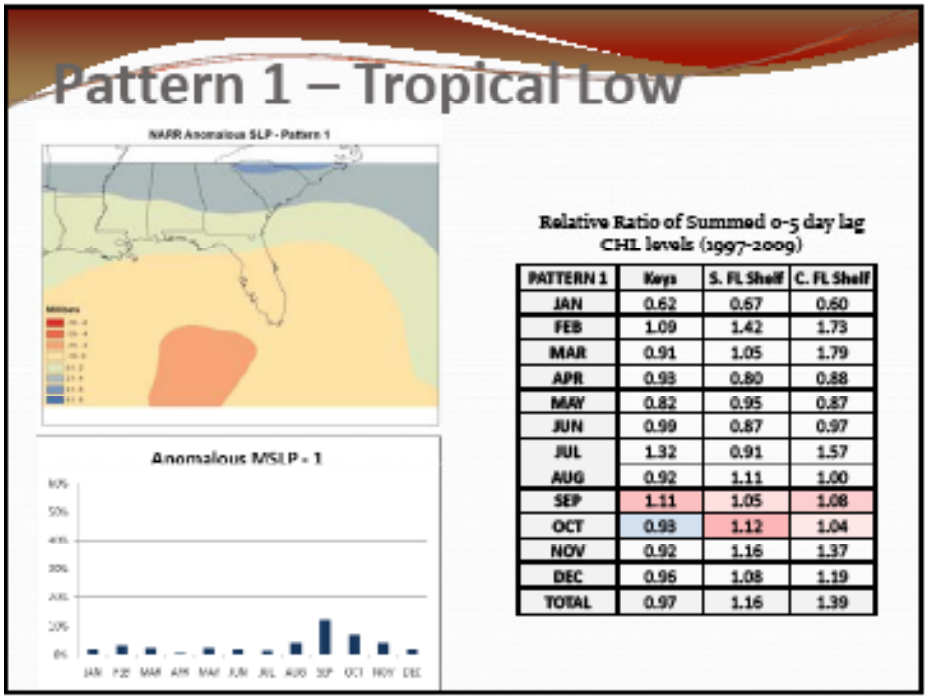
Location graph	DHW file	Anomaly file
French Frigate Shoals	dhw file	anomaly file
Gardner	dhw file	anomaly file
Maro	dhw file	anomaly file
Laysan	dhw file	anomaly file
Lisianski	dhw file	anomaly file
Pearl and Hermes	dhw file	anomaly file
Midway	dhw file	anomaly file
Kure	dhw file	anomaly file

Weather Typing
(Scott Sheridan and Cameron Lee, Kent State University)



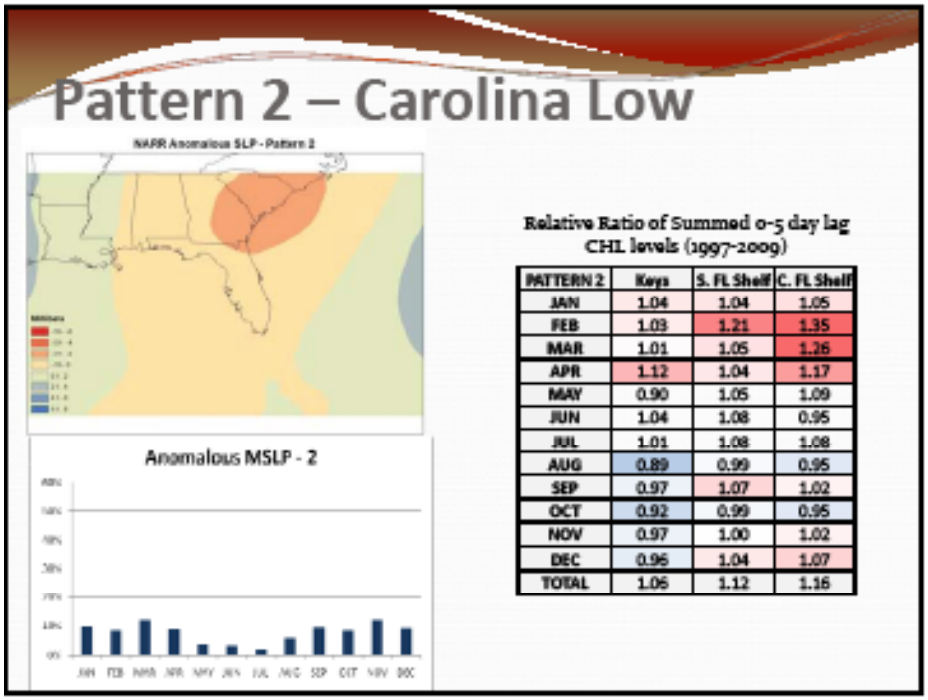


Weather Typing (continued)
(Scott Sheridan and Cameron Lee, Kent State University)



Relative Ratio of Summed 0-5 day lag CHL levels (1997-2009)

PATTERN 1	Keys	S. FL Shelf	C. FL Shelf
JAN	0.62	0.67	0.60
FEB	1.09	1.42	1.73
MAR	0.91	1.05	1.79
APR	0.93	0.80	0.88
MAY	0.82	0.95	0.87
JUN	0.99	0.87	0.97
JUL	1.32	0.91	1.57
AUG	0.92	1.11	1.00
SEP	1.11	1.05	1.08
OCT	0.93	1.12	1.04
NOV	0.92	1.16	1.37
DEC	0.96	1.08	1.19
TOTAL	0.97	1.16	1.39

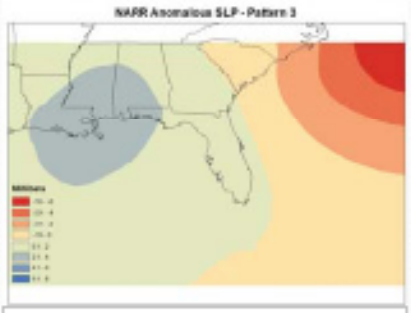


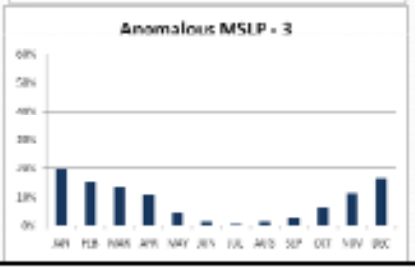
Relative Ratio of Summed 0-5 day lag CHL levels (1997-2009)

PATTERN 2	Keys	S. FL Shelf	C. FL Shelf
JAN	1.04	1.04	1.05
FEB	1.03	1.21	1.35
MAR	1.01	1.05	1.26
APR	1.12	1.04	1.17
MAY	0.90	1.05	1.09
JUN	1.04	1.08	0.95
JUL	1.01	1.08	1.08
AUG	0.89	0.99	0.95
SEP	0.97	1.07	1.02
OCT	0.92	0.99	0.95
NOV	0.97	1.00	1.02
DEC	0.96	1.04	1.07
TOTAL	1.06	1.12	1.16

Weather Typing (continued)
(Scott Sheridan and Cameron Lee, Kent State University)

Pattern 3 – Nor'easter

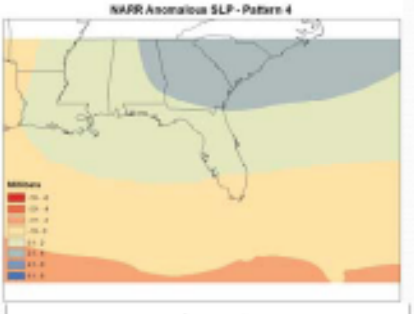


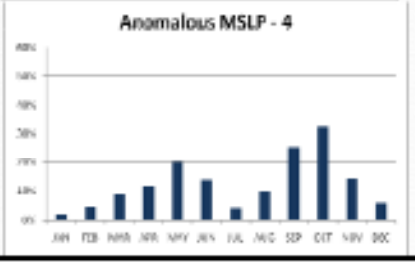


Relative Ratio of Summed 0-5 day lag CHL levels (1997-2009)

PATTERN 3	Keys	S. FL Shelf	C. FL Shelf
JAN	1.04	1.05	1.08
FEB	1.11	1.15	1.19
MAR	1.03	1.01	1.40
APR	1.03	1.01	1.18
MAY	1.01	1.10	1.28
JUN	0.72	0.75	0.50
JUL	1.20	1.06	1.43
AUG	0.98	0.95	1.02
SEP	0.97	0.83	0.93
OCT	1.01	0.99	1.00
NOV	1.00	0.98	0.97
DEC	1.02	1.05	1.13
TOTAL	1.18	1.11	1.18

Pattern 4 – East Coast High

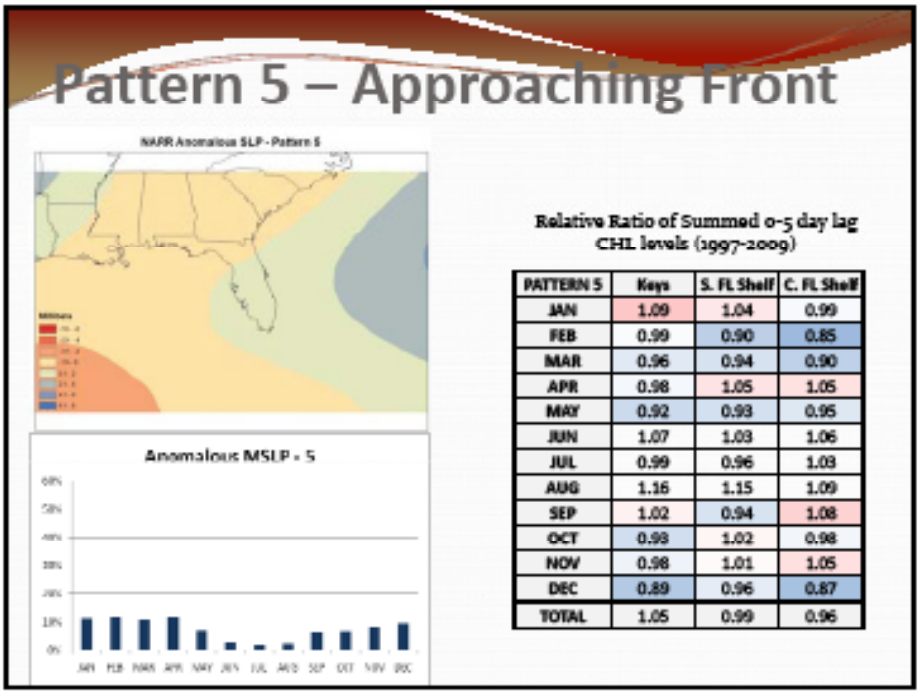




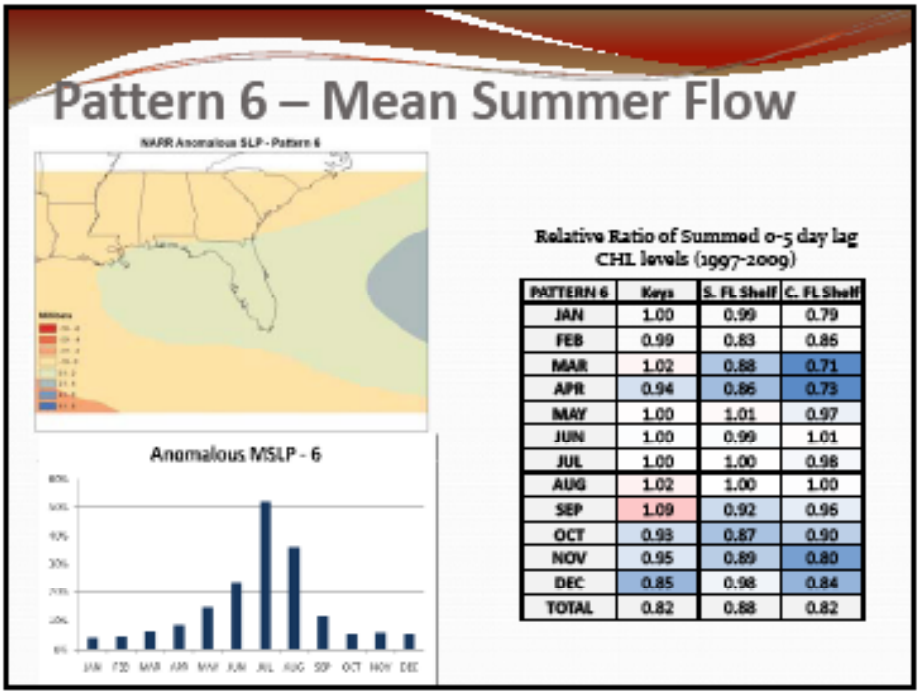
Relative Ratio of Summed 0-5 day lag CHL levels (1997-2009)

PATTERN 4	Keys	S. FL Shelf	C. FL Shelf
JAN	0.72	0.78	0.79
FEB	0.94	0.90	1.31
MAR	0.87	0.85	0.71
APR	0.99	0.89	0.89
MAY	1.10	0.97	0.94
JUN	0.94	0.96	0.95
JUL	1.00	1.02	1.03
AUG	0.95	0.99	0.97
SEP	0.95	1.02	1.03
OCT	1.11	0.94	0.91
NOV	1.01	1.07	1.11
DEC	0.95	0.98	0.96
TOTAL	1.01	0.98	1.02

Weather Typing (continued)
(Scott Sheridan and Cameron Lee, Kent State University)

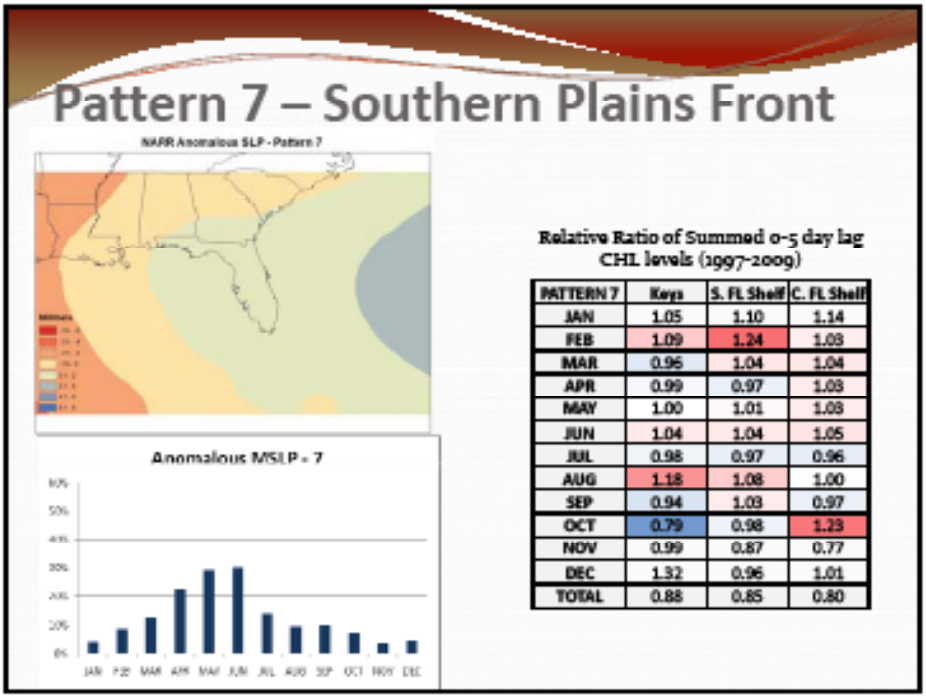


PATTERN 5	Keys	S. FL Shelf	C. FL Shelf
JAN	1.09	1.04	0.99
FEB	0.99	0.90	0.85
MAR	0.96	0.94	0.90
APR	0.98	1.05	1.05
MAY	0.92	0.93	0.95
JUN	1.07	1.03	1.06
JUL	0.99	0.96	1.03
AUG	1.16	1.15	1.09
SEP	1.02	0.94	1.08
OCT	0.93	1.02	0.98
NOV	0.98	1.01	1.05
DEC	0.89	0.96	0.87
TOTAL	1.05	0.99	0.96



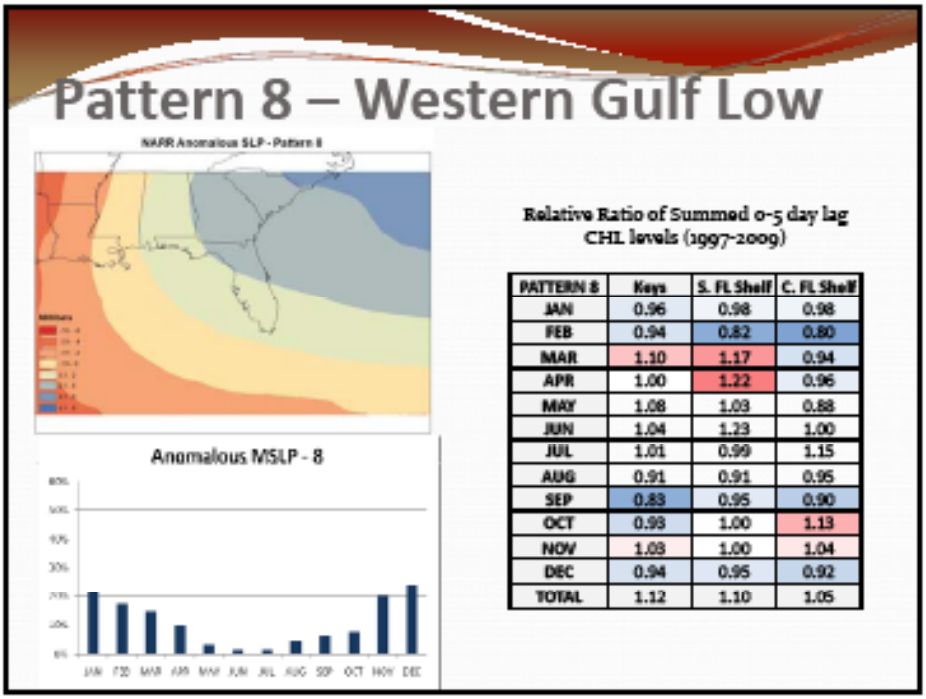
PATTERN 6	Keys	S. FL Shelf	C. FL Shelf
JAN	1.00	0.99	0.79
FEB	0.99	0.83	0.86
MAR	1.02	0.88	0.71
APR	0.94	0.86	0.73
MAY	1.00	1.01	0.97
JUN	1.00	0.99	1.01
JUL	1.00	1.00	0.98
AUG	1.02	1.00	1.00
SEP	1.09	0.92	0.96
OCT	0.93	0.87	0.90
NOV	0.95	0.89	0.80
DEC	0.85	0.98	0.84
TOTAL	0.82	0.88	0.82

Weather Typing (continued)
(Scott Sheridan and Cameron Lee, Kent State University)



Relative Ratio of Summed 0-5 day lag CHL levels (1997-2009)

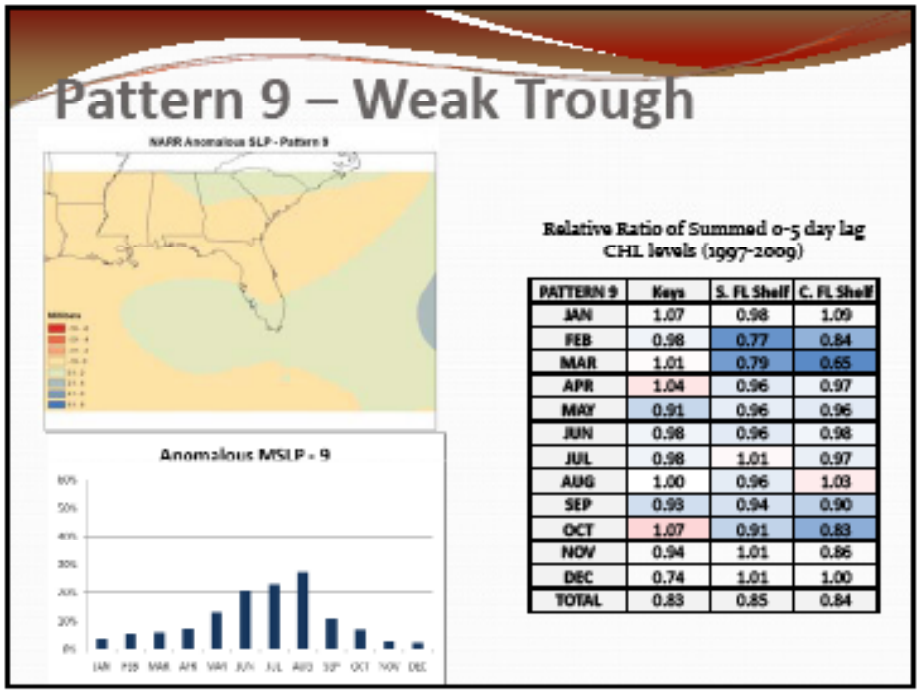
PATTERN 7	Keys	S. FL Shelf	C. FL Shelf
JAN	1.05	1.10	1.14
FEB	1.09	1.24	1.08
MAR	0.96	1.04	1.04
APR	0.99	0.97	1.08
MAY	1.00	1.01	1.08
JUN	1.04	1.04	1.05
JUL	0.98	0.97	0.96
AUG	1.18	1.08	1.00
SEP	0.94	1.03	0.97
OCT	0.79	0.98	1.23
NOV	0.99	0.87	0.77
DEC	1.32	0.96	1.01
TOTAL	0.88	0.85	0.80



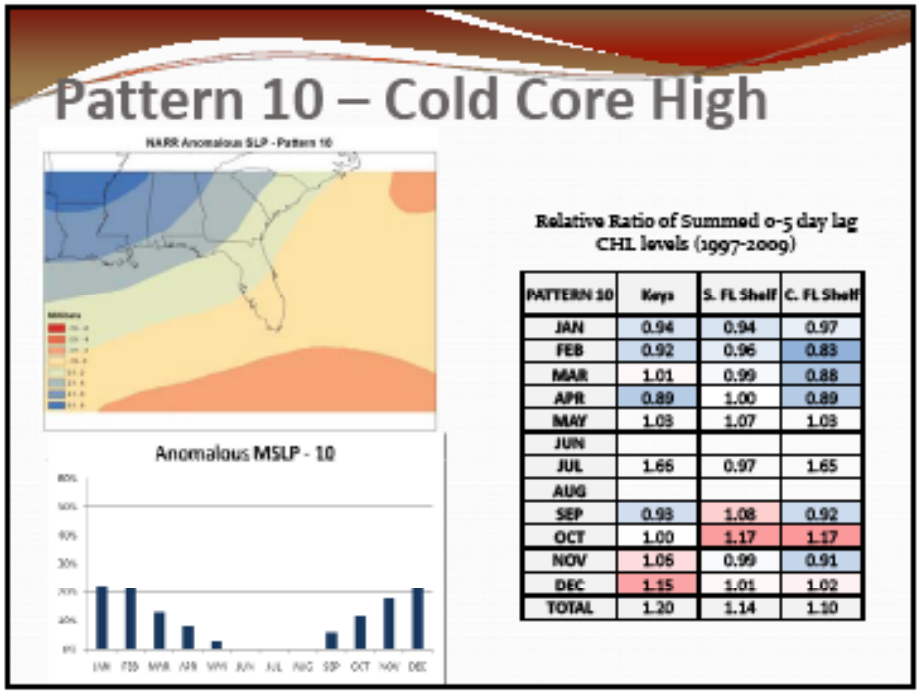
Relative Ratio of Summed 0-5 day lag CHL levels (1997-2009)

PATTERN 8	Keys	S. FL Shelf	C. FL Shelf
JAN	0.96	0.98	0.98
FEB	0.94	0.82	0.80
MAR	1.10	1.17	0.94
APR	1.00	1.22	0.96
MAY	1.08	1.03	0.88
JUN	1.04	1.23	1.00
JUL	1.01	0.99	1.15
AUG	0.91	0.91	0.95
SEP	0.83	0.95	0.90
OCT	0.93	1.00	1.13
NOV	1.03	1.00	1.04
DEC	0.94	0.95	0.92
TOTAL	1.12	1.10	1.05

Weather Typing (continued)
(Scott Sheridan and Cameron Lee, Kent State University)



PATTERN 9	Keys	S. FL Shelf	C. FL Shelf
JAN	1.07	0.98	1.09
FEB	0.98	0.77	0.84
MAR	1.01	0.79	0.65
APR	1.04	0.96	0.97
MAY	0.91	0.96	0.96
JUN	0.98	0.96	0.98
JUL	0.98	1.01	0.97
AUG	1.00	0.96	1.03
SEP	0.93	0.94	0.90
OCT	1.07	0.91	0.83
NOV	0.94	1.01	0.86
DEC	0.74	1.01	1.00
TOTAL	0.83	0.85	0.84



PATTERN 10	Keys	S. FL Shelf	C. FL Shelf
JAN	0.94	0.94	0.97
FEB	0.92	0.96	0.83
MAR	1.01	0.99	0.88
APR	0.89	1.00	0.89
MAY	1.03	1.07	1.03
JUN			
JUL	1.66	0.97	1.65
AUG			
SEP	0.93	1.08	0.92
OCT	1.00	1.17	1.17
NOV	1.06	0.99	0.91
DEC	1.15	1.01	1.02
TOTAL	1.20	1.14	1.10

Weather Typing (continued)
(Scott Sheridan and Cameron Lee, Kent State University)

Summary

- Patterns do a good job of capturing daily SLP variability in the region
  - Further investigation shows precipitation and temperature variability are also captured well
- Chlorophyll levels are highest with low pressure to the North and/or East of study area:
  - Late winter and spring: patterns 2 and 3
    - Especially in the South & Central Florida Shelf regions
  - Autumn: pattern 1
- Chlorophyll levels are lowest in pattern 6
  - High Pressure to the East of study area

Onshore Reef Flux Report
(Lew Gramer, NOAA/Atlantic Oceanographic and Meteorological Laboratory)

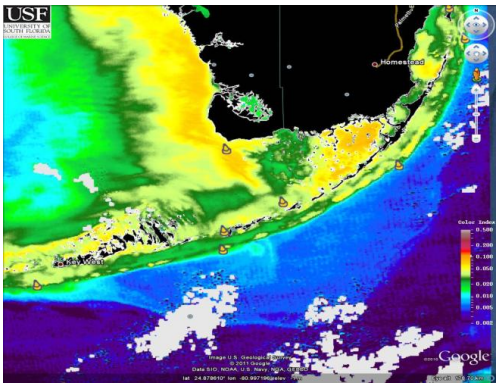
What is Onshore Flux?

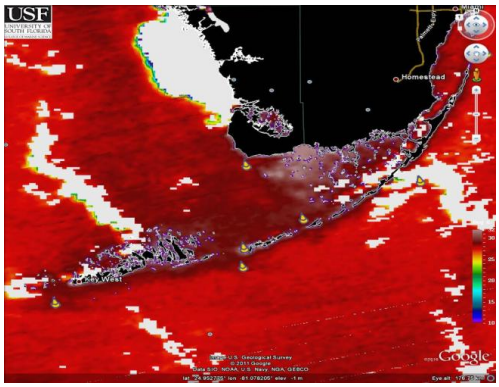
"Onshore Flux" is an automated alert system for resource managers, researchers, and the public. It provides notifications of possible changes in water quality and underwater visibility in the Florida reef tract, including conditions that may precede larger events such as phytoplankton blooms. Onshore Flux is part of a suite of ecological forecasts developed at NOAA Atlantic Oceanographic and Meteorological Laboratories (AOML) in Miami. The system uses artificial intelligence to monitor hourly sea temperature and meteorology from C-MAN stations in the Florida Keys, and satellite products for chlorophyll *a* concentration (from ocean color), sea surface temperature, and ocean circulation. The monthly report you are reading summarizes all the alerts for a month, and provides additional discussion to aid users in interpreting and reacting to future alerts.

Florida Keys Onshore Flux Events for May 2011

May 01-03 Impact: Low (outer reef – Middle Keys)
Conditions: Chlorophyll moderate, sea temperature moderately variable, winds light, few or small eddies.
Discussion: Possibly related to variable winds in late April.

May 08-22 Impact: Moderate (Upper and Lower Keys), Somewhat High (Middle Keys)
Conditions: Chlorophyll locally high, sea temperature variable, winds moderate, large eddy offshore.
Discussion: A large Florida Current eddy lay offshore of the reef tract for two weeks; it impacted the Lower Keys as early as 08 May, and Upper Keys and Biscayne Bay by 14 May. Satellite and C-MAN sea temperature indicate this eddy was drawing much warmer water onto the outer reefs from Hawk Channel and the Bridge Channels (Moser, No. 5, etc.) inshore. On 18-19 May, a bolus of very high-chlorophyll, warmer water 6 km wide appeared near Looe Key, and rapidly moved ENE along the outer reef, dissipating SE of Long Key by 23 May.





To Learn More

Subscribe to email alerts, questions on Onshore Flux: Lew Gramer, lew.gramer@noaa.gov, 305-361-4554
AOML Coral Health and Monitoring Project: Dr. Jim Hendee, jim.hendee@noaa.gov, 305-361-4396
AOML Coral research: http://www.coral.noaa.gov USF satellite imagery: http://optics.marine.usf.edu/

Appendix 2 – Climate-Related Programs and Products Currently Used by Managers in South Florida

- www.Climate.gov
- Department of Interior Climate Center
- Massachussetts Institute of Technology's MUSIC project
- HAB alert for monitoring harmful algal blooms
- Marine Map, an ArcIMS product used during the Deepwater Horizon oil spill
- Marine Science and Review (digest of new science with climate information)
- Florida Reef Resilience Program
- SECREMP data—Southeast Coral Reef Environmental Monitoring Program
- The Coral List
- Caribbean listserv (managed by Bruce Potter)
- Bleach Watch
- Gulf of Mexico Listserv
- Coast Watch
- Mote Marine Laboratory
- Southeast Florida four-county climate compact
- Peer-reviewed literature
- Videos on YouTube (for example, CNN-Anderson Cooper's trip to Cuba)
- International Panel on Climate Change updates
- Web-based information
- Sea surface temperature and Gulf Stream movements
- Frank Muller Karger, University of South Florida (Web-based products)
- University of South Florida's Web pages
- NOAA Web pages
- University of Miami research
- SeaKeys monitoring stations

- SeaWiffs monitoring stations
- Forecasting/bleaching Web sites
- Weather patterns and changes
- Hal Wanless, University of Miami climate scientist
- CanViz—visioning sea-level rise
- SLOSH models—need to add sea-level rise
- NOAA information, e.g., Oceans.org
- Tide data from multiple sources
- Climate Atlas, a Web-based resource (needs to be updated by participant)
- Sea turtle data for worldwide nesting numbers
- Shark list
- Current circulation
- Sea surface temperature, chlorophyll of regions
- Beach closures
- National Data Buoy Center stations (often called CMAN stations)
- Tide gauges
- NOAA modeling efforts from the Biogeography Program
- Oil spill maps are helpful for examining circulation and strength
- Sea level elevation
- CO_2 concentrations in the ocean and atmosphere (peer-reviewed journals)
- Data monitoring stations (Virginia Key and Key West)