



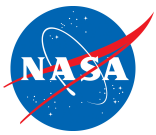
Part I: SST for NWP

Part II: Decadal Strategic Plan for USGCRP



David Halpern
Adjunct Professor

3 Nov 2011



Part I: Sea Surface Temperature for Numerical Weather Prediction

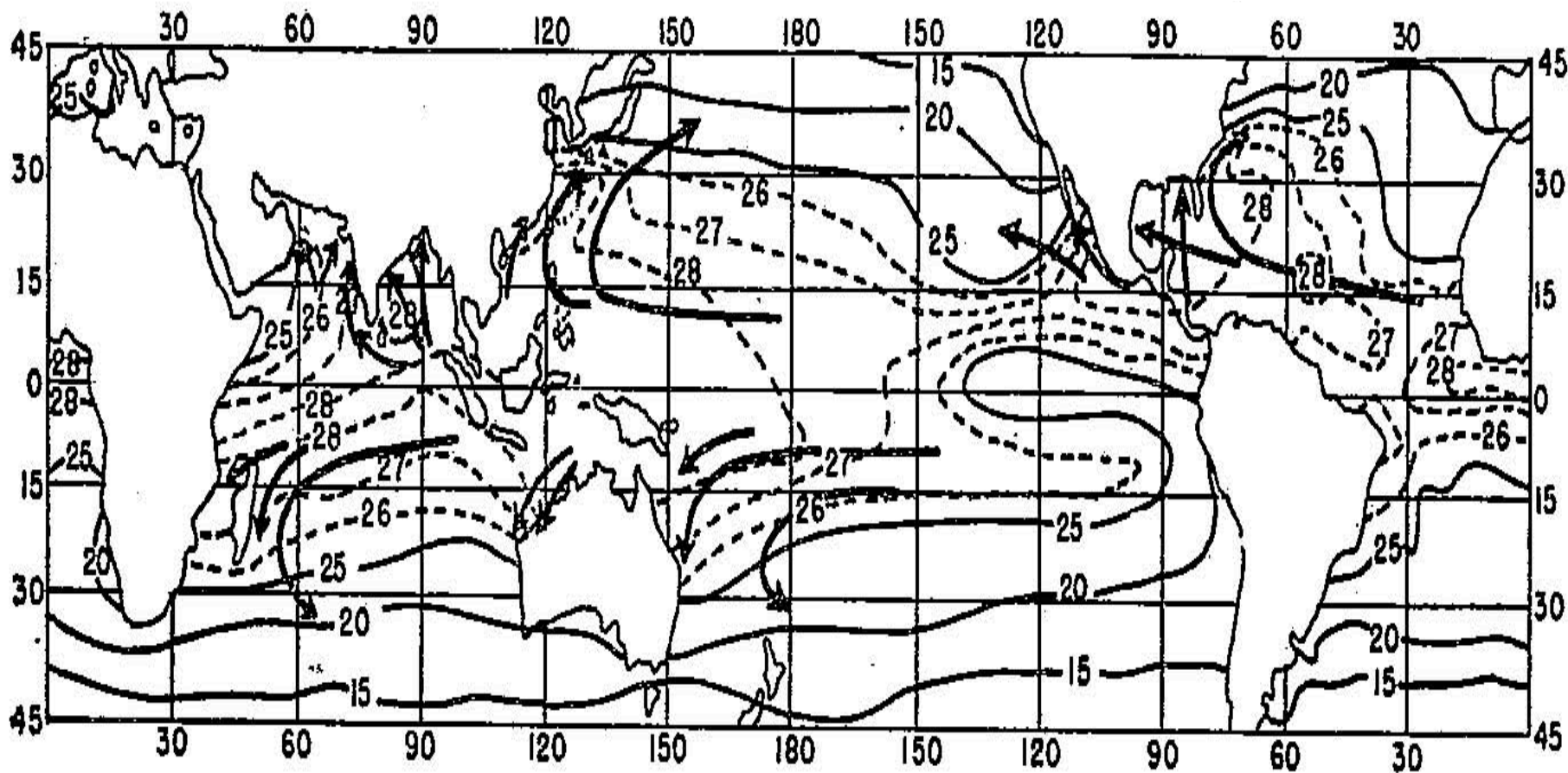
David Halpern
Senior Advisor, Earth Science Research
Earth Science Division
NASA Headquarters
Washington, USA

Representing
Intergovernmental Oceanographic Commission of UNESCO
Paris, France

Presented at 39th Meeting of
Coordination Group for Meteorological Satellites (CGMS)
3-7 October 2011, Saint Petersburg, Russia

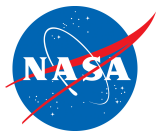


Principal Hurricane Paths and SST During Warmest Season)



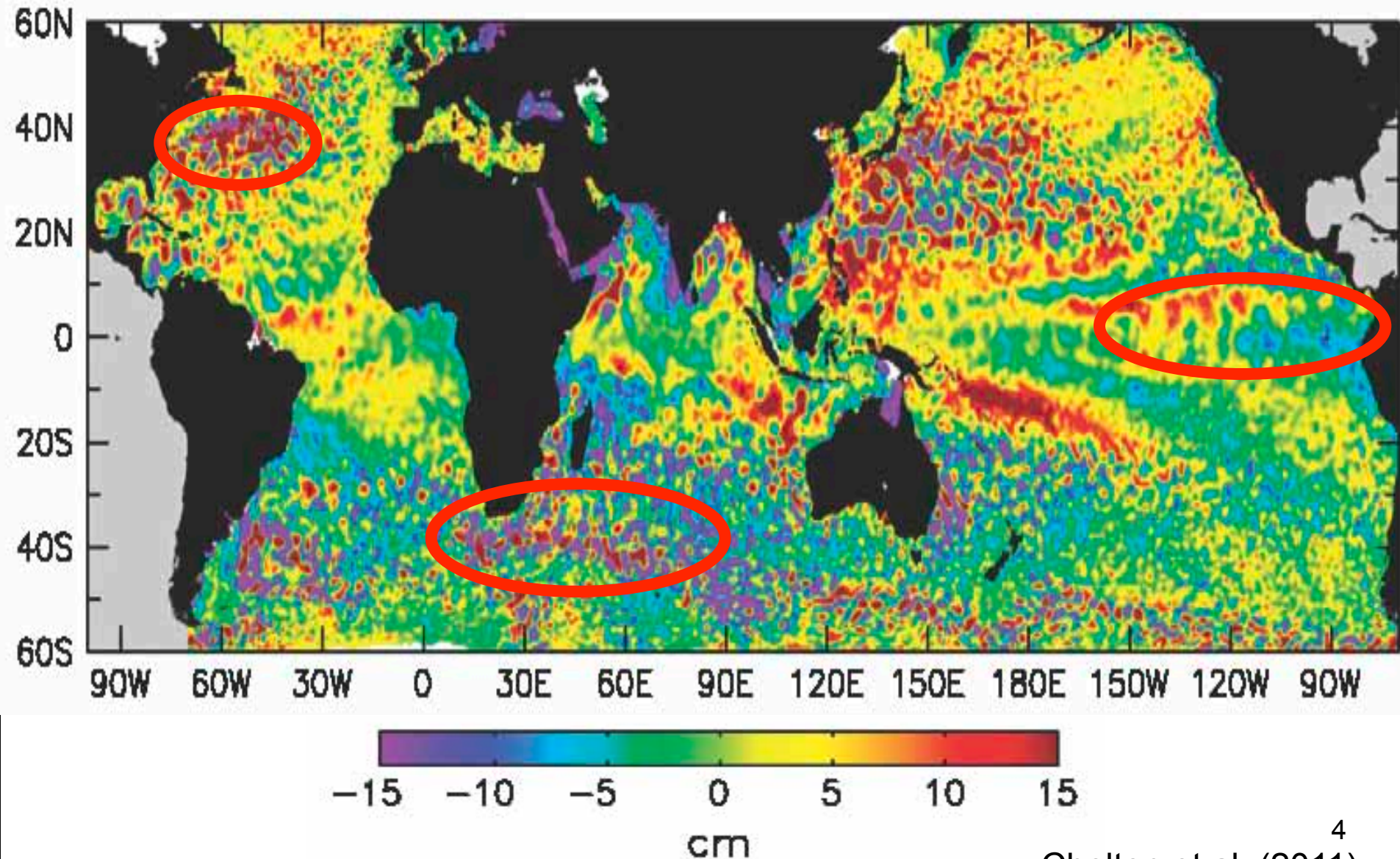
Hurricanes form only in oceanic regions outside the vicinity of the equator where $SST > 26-27\text{ }^{\circ}\text{C}$.

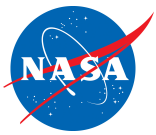
A strong vortex can form in the area of converging air when $|f| >$ critical value [$f = 0$ at the equator].



Ocean Eddies

Radius 100 km, Average Lifetime 32 weeks





Divergence and Curl of the Wind Generated by SST Gradients

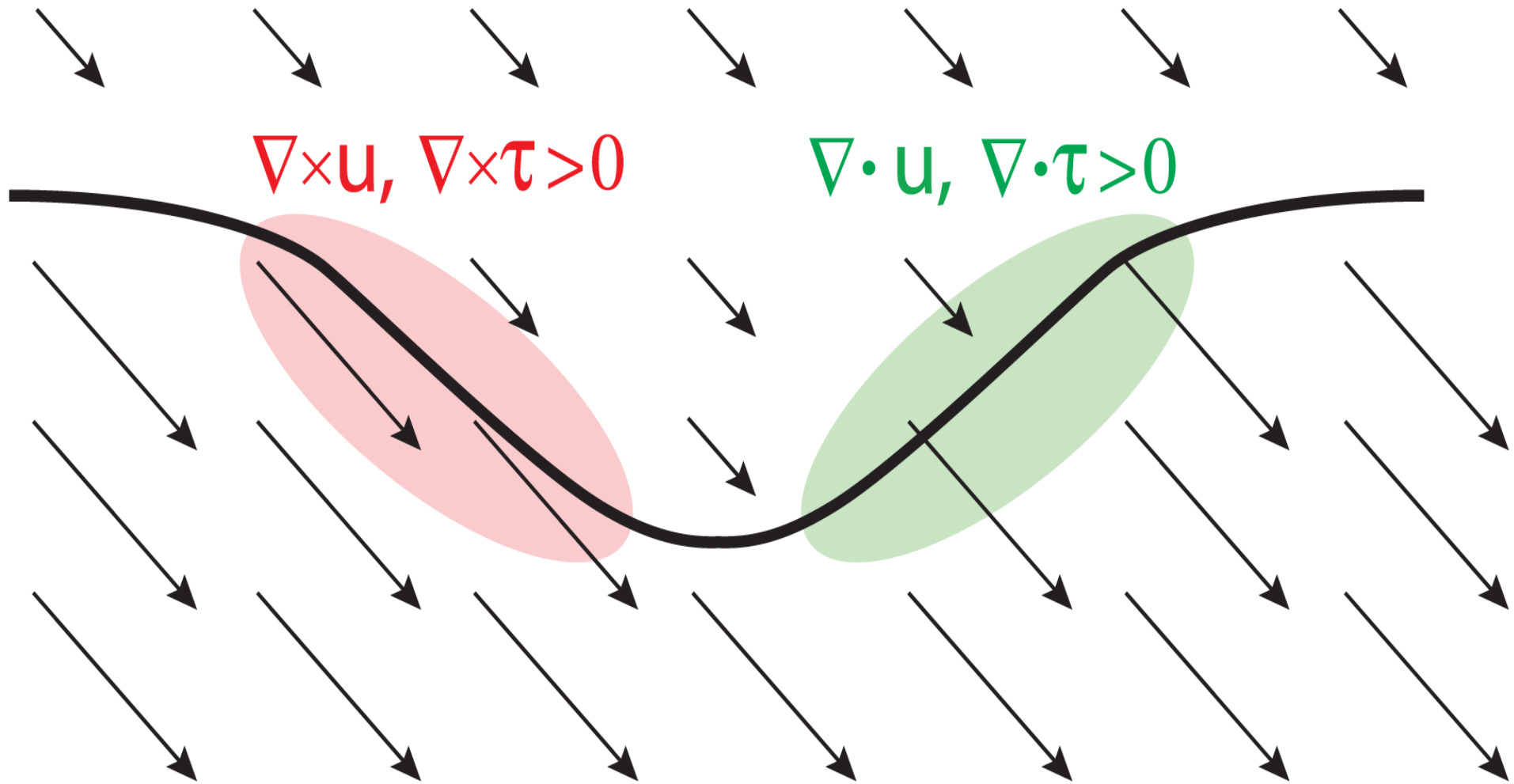
COOL

$$\nabla \times \mathbf{u}, \nabla \times \boldsymbol{\tau} > 0$$

$$\nabla \cdot \mathbf{u}, \nabla \cdot \boldsymbol{\tau} > 0$$

WARM

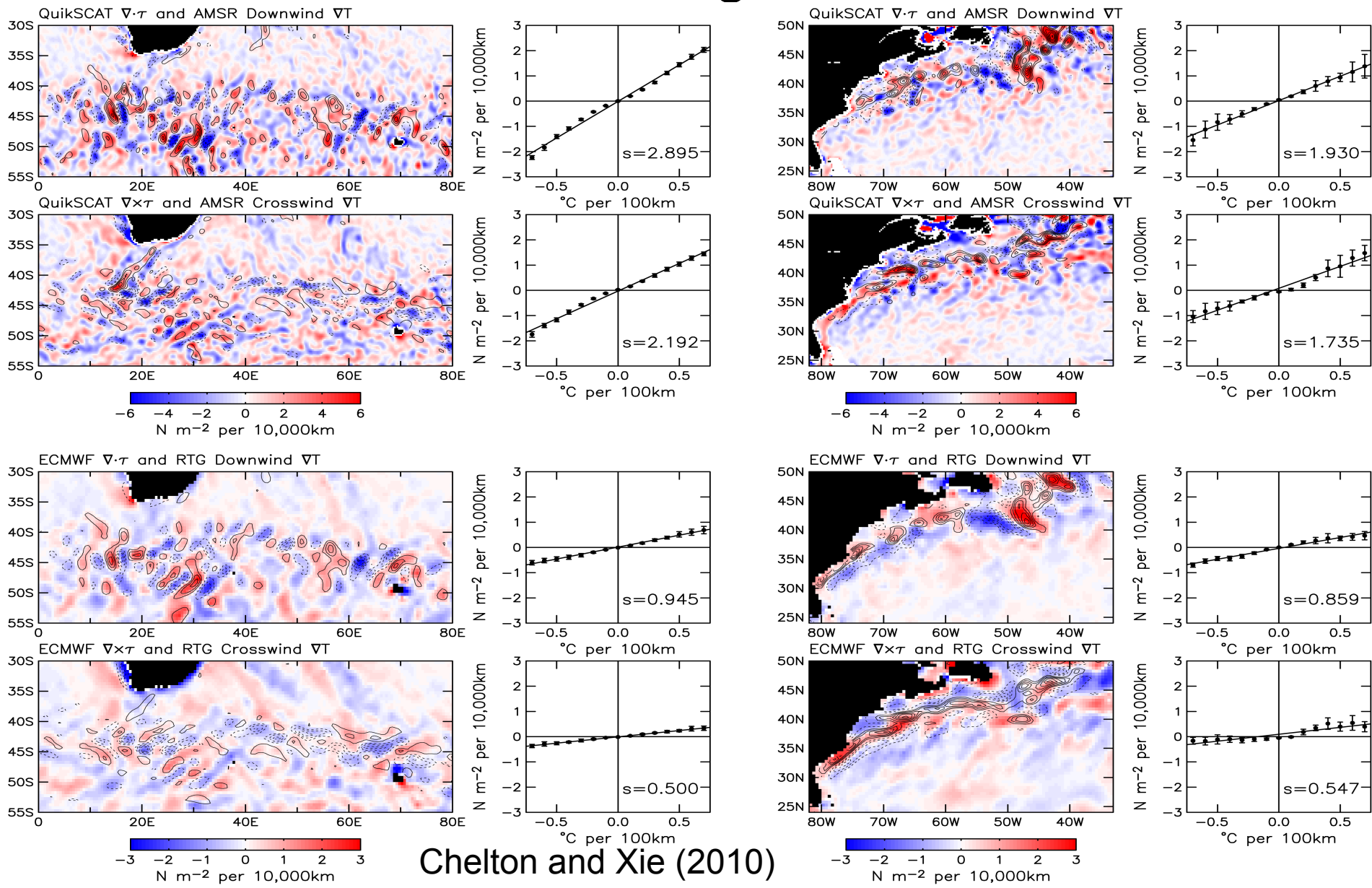
Chelton and Xie (2010)

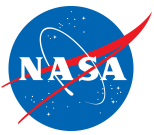




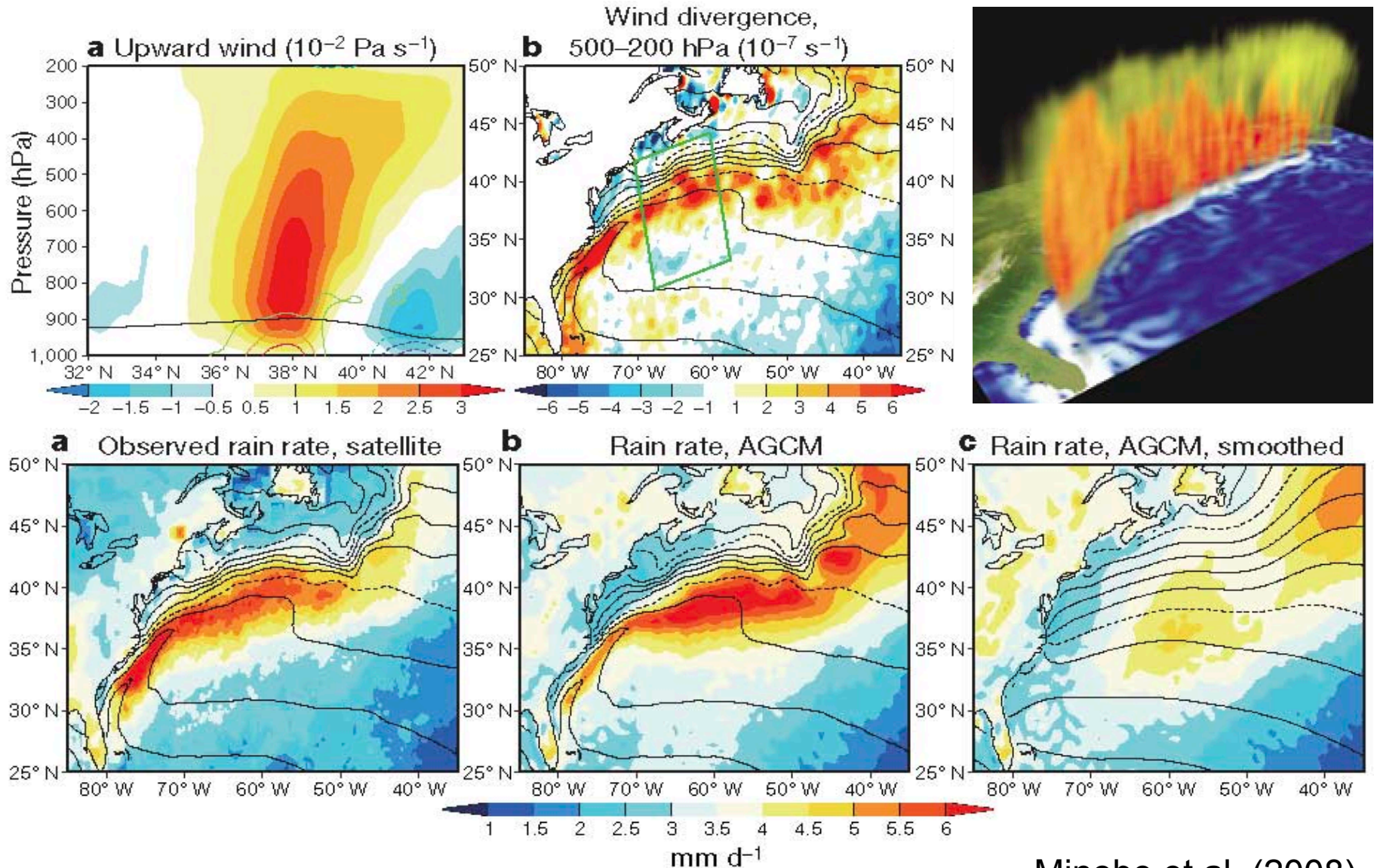
Wind Stress Curl & SST Gradient

Wind Stress Divergence & SST Gradient





Divergence and Curl of the Wind Generated by SST Gradients





Infrared and Microwave SST Distributions

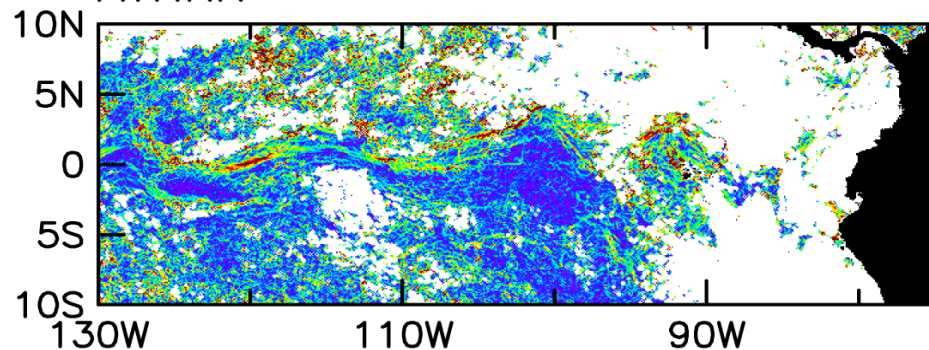
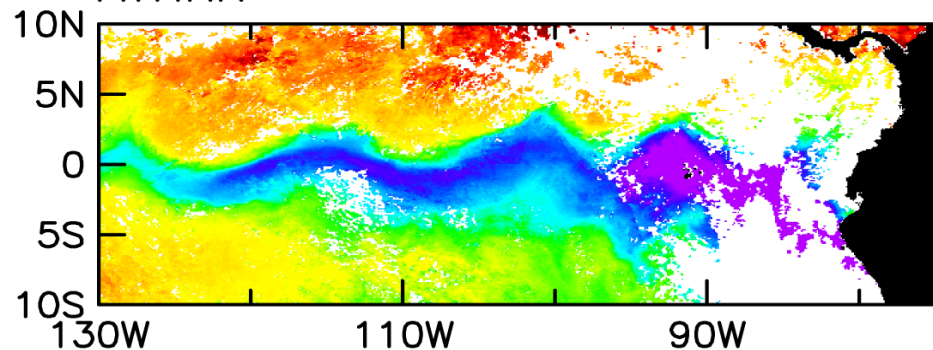
28 May 2003

SST

SST Gradient

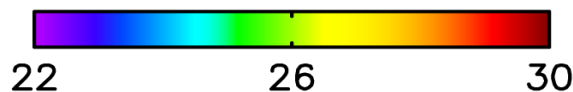
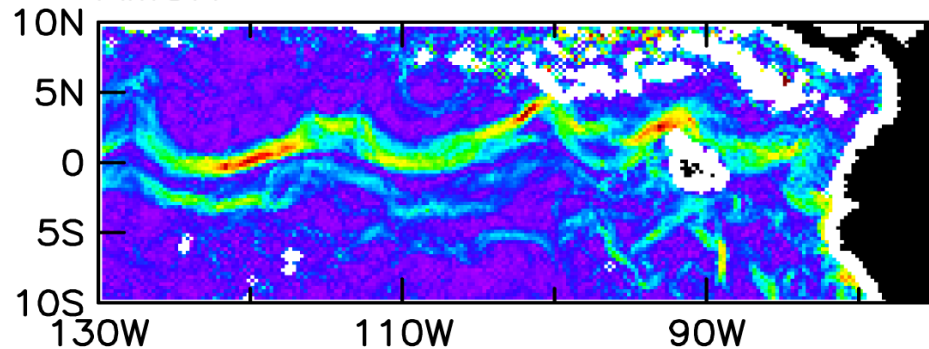
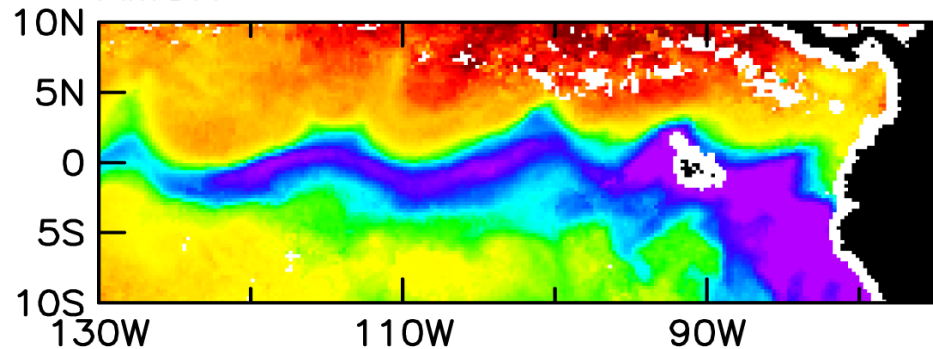
AVHRR

AVHRR



AMSR

AMSR



26
°C

Chelton and Wentz (2005)



°C per 100 km



Infrared and Microwave SST Distributions

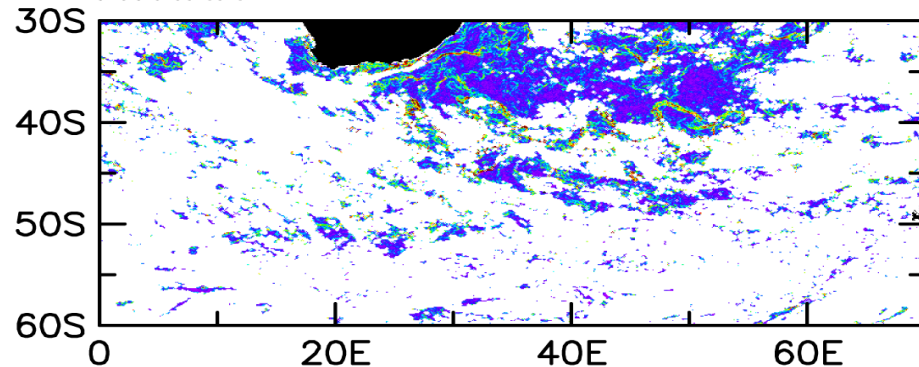
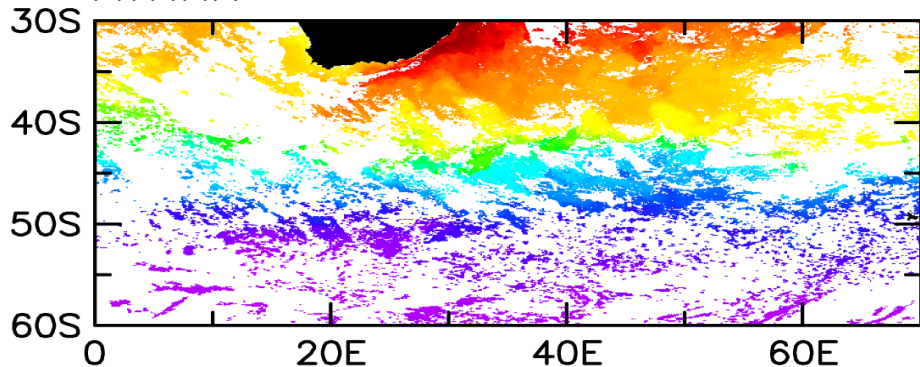
5 July 2002

SST

SST Gradient

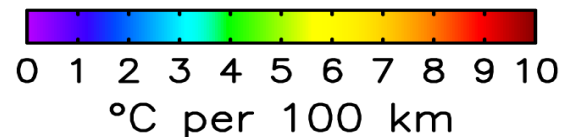
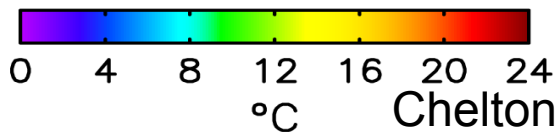
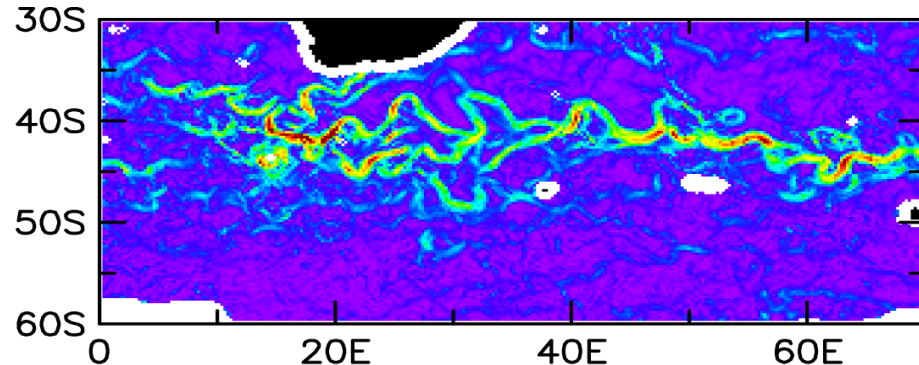
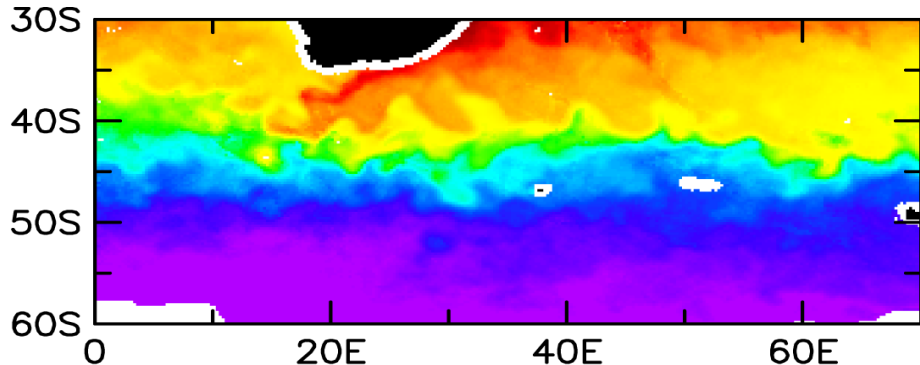
AVHRR

AVHRR



AMSR

AMSR



Chelton and Wentz (2005)



Infrared and Microwave SST Distributions

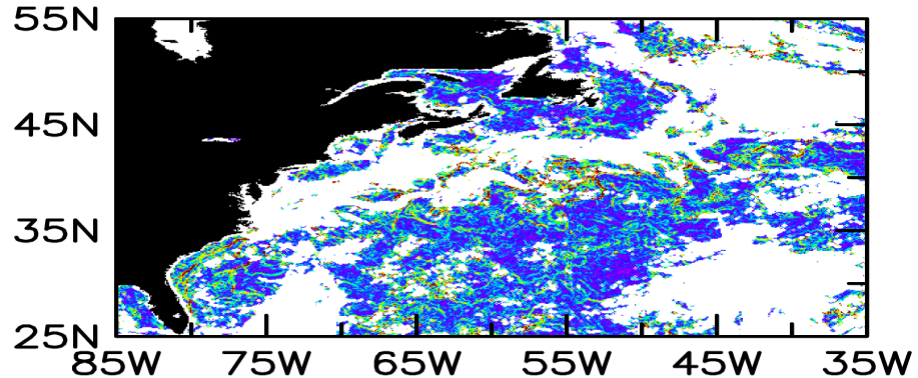
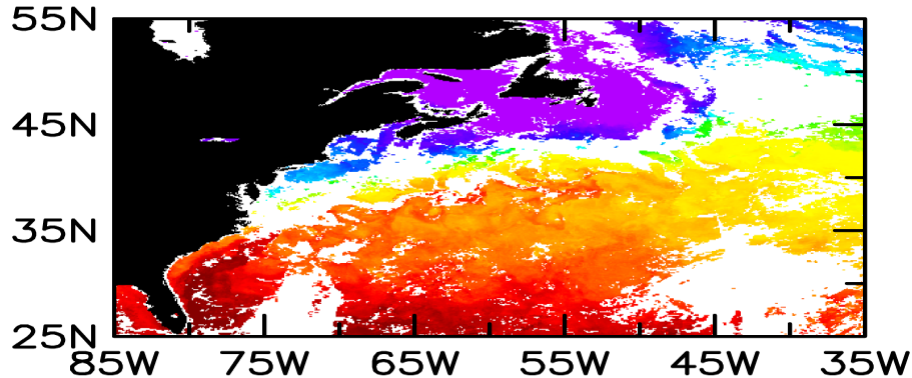
1 May 2003

SST

SST Gradient

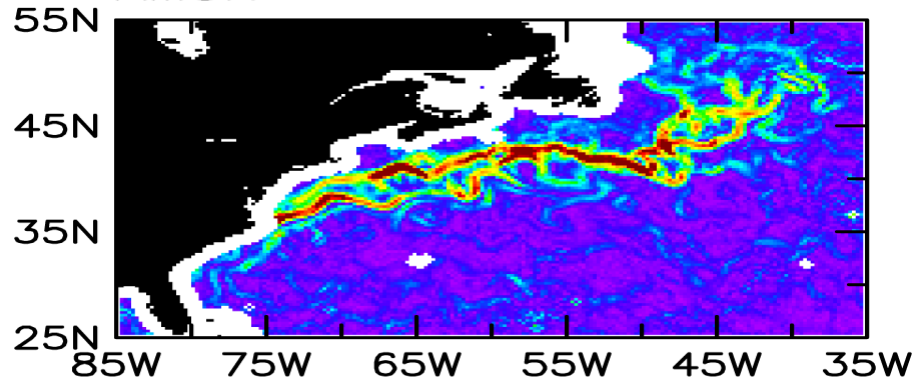
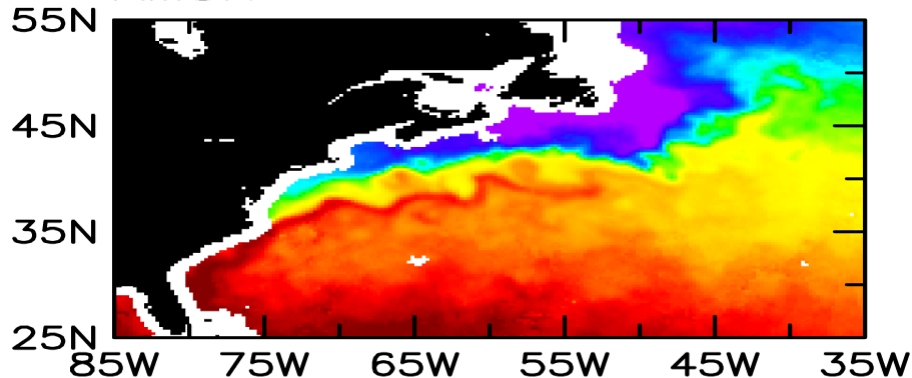
AVHRR

AVHRR



AMSR

AMSR



5 10 15 20 25

°C

Chelton and Wentz (2005)



0 1 2 3 4 5 6 7 8 9 10

°C per 100 km



Components of GHRSSST Ensemble Median Global SST Distribution

UKMO Operational Sea Surface Temperature and Sea Ice Analysis

US NCEP Real-time Global Sea Surface Temperature Analyses

US NOO Level 4 K10_SST Global 1 Meter SST Analysis

JMA Merged satellite and in situ Global Daily Sea Surface Temperatures

RSS Microwave Sea Surface Temperature

RSS Microwave and Infrared Sea Surface Temperature

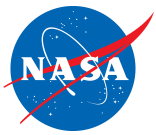
USN FNMOC High Resolution SST/Sea Ice Analysis for GHRSSST

EU Marine Environment and Security for the European Area Ocean Data
Analysis System

US NOAA Optimum Interpolation 1/4 Degree Daily Sea Surface Temperature
Analysis

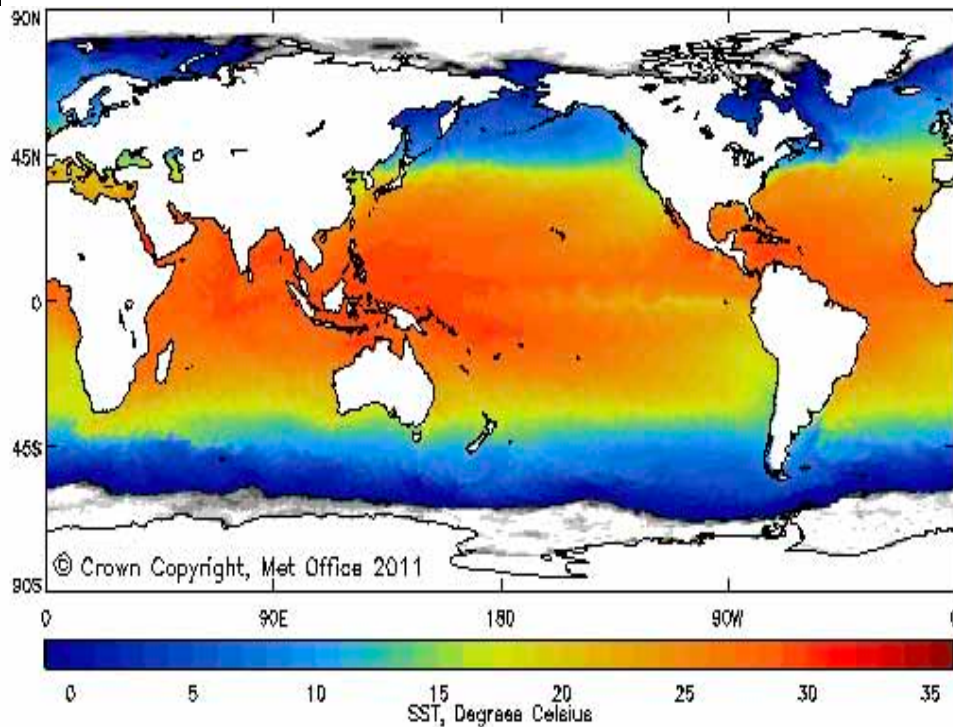
Canadian Meteorological Center Sea Surface Temperature Analysis

Australia BoM Global Australian Multi-Sensor Sea Surface Temperature Analysis



Daily GHRSSST Products

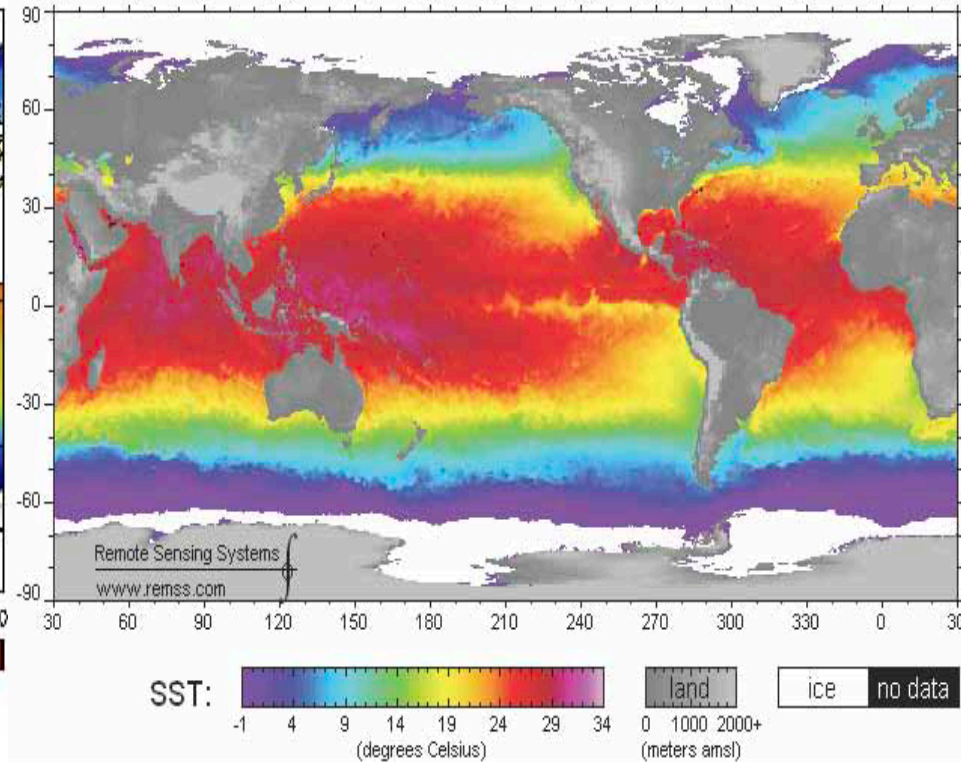
Daily Ensemble Median SST



0.5° lat x 0.5° long

01 Nov 2011

Daily RSS MW+IR Fusion



0.09° lat x 0.09° long

03 Nov 2011

http://ghrsst-pp.metoffice.com/pages/latest_analysis/sst_monitor/daily/ens/index.html

http://www.remss.com/sst/sst_data_daily.html?sat=mw_ir2

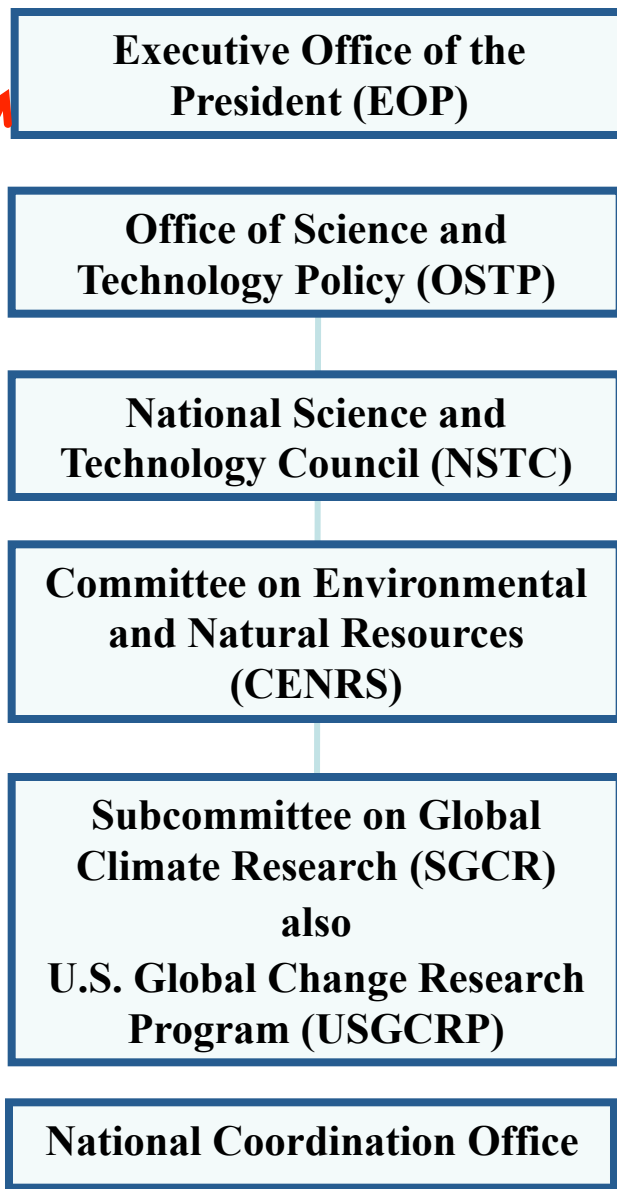


Part II: Decadal Strategic Plan for USGCRP

USGCRP (Brief) History

- National Climate Program Act of 1978
- Presidential initiative in 1989
- Congress enacted Global Change Research Act of 1990
 - Provide for development and coordination of a comprehensive and integrated United States research program which will assist the Nation and the world to understand, assess, predict, and respond to human-induced and natural processes of global change

Governance





SGCR Members and Objectives

Coordinates Federal research to better understand and prepare the Nation for global change

Prioritizes and supports cutting edge scientific work in global change

Assesses the state of scientific knowledge and the Nation's readiness to respond to global change

Communicates research findings to inform, educate, and engage the global community

Fosters the integration of global change knowledge across 13 Agencies or Departments

USGCRP Agencies and Departments



Department of Agriculture



Department of Commerce



Department of Defense



Department of Energy



Department of Health and Human Services



Department of the Interior



Department of State



Department of Transportation



Environmental Protection Agency



National Aeronautics and Space Administration



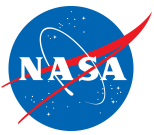
National Science Foundation



Smithsonian Institution



United States Agency for International Development



USGCRP Vision and Mission

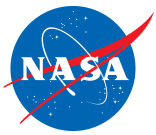
- **Vision** – “A nation, globally engaged and guided by science, meeting the challenges of climate and global change.”
- **Mission** – “To build a knowledge base that informs human responses to climate and global change through coordinated and integrated federal programs of research, education, communication, and decision support.”



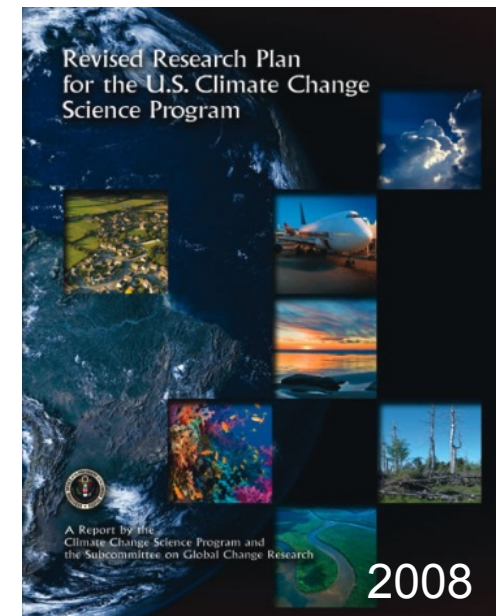
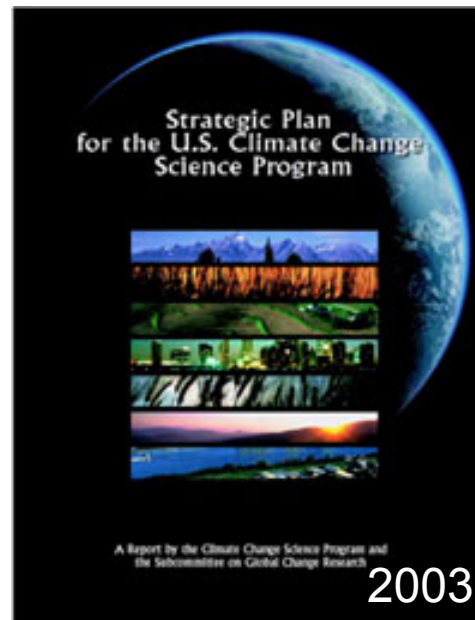
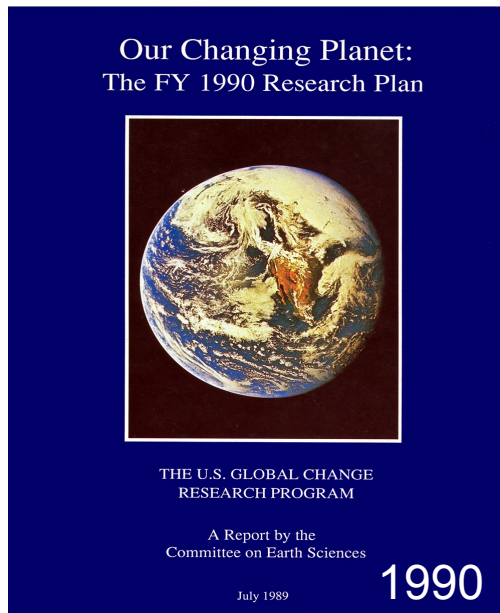
Apollo 17, 7 Dec 1972



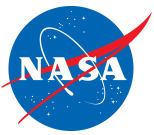
Kaguya, 6 Apr 2008



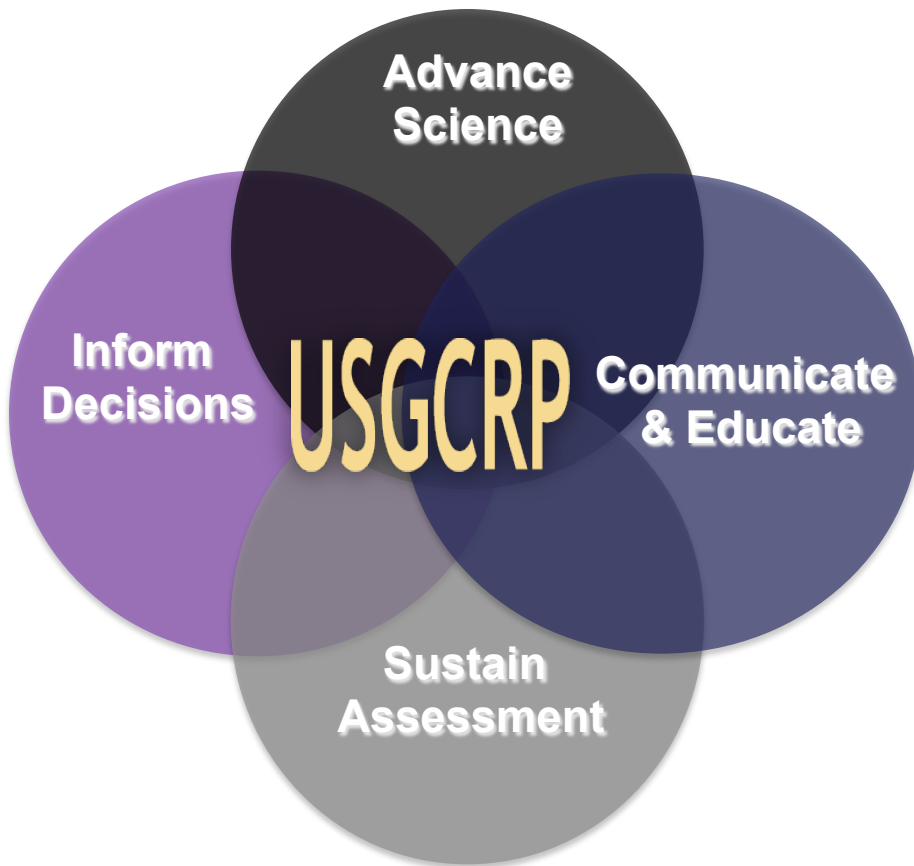
USGCRP Strategic Plans



- Strategic Plans in 1990, 2003, and 2008 focused on improving knowledge of Earth's changing environment through observations, modeling, and prediction
- New Strategic Plan
 - integrates core research strengths (developed in previous years) with human dimensions
 - creates framework for contributions of fundamental global change research to societal decision support

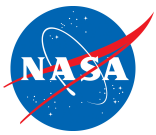


Draft Strategic Plan Characteristics: Overview



Current Strategic Plan Outline

- I. Introduction
- II. Vision and Mission
- III. Goals and Objectives
 - Goal 1 - Advance Science
 - Goal 2 - Inform Decisions
 - Goal 3 - Sustained Assessments
 - Goal 4 - Communicate and Educate
- IV. Coordinating with Other Nations and International Organizations
- V. Implementation Planning



Draft Strategic Plan Characteristics: Goals

1 Advance Science

- 1.1 Earth System Understanding
- 1.2 Science for Adaptation and Mitigation
- 1.3 Integrated Observations
- 1.4 Integrated Modeling
- 1.5 Information Management and Sharing



2 Inform Decisions

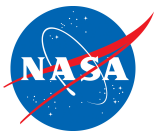
- 2.1 Inform Adaptation Decisions
- 2.2 Inform Mitigation Decisions
- 2.3 Enhancing Climate Services
- 2.4 Enhancing International Partnerships

3 Sustain Assessment

- 3.1 Scientific Integration
- 3.2 Ongoing Capacity
- 3.3 Inform Responses
- 3.4 Evaluate Progress

4 Communicate and Educate

- 4.1 Strengthen Communication and Education Research
- 4.2 Reach Diverse Audiences
- 4.3 Increase Engagement
- 4.4 Cultivate Workforce



Draft Strategic Plan Characteristics:

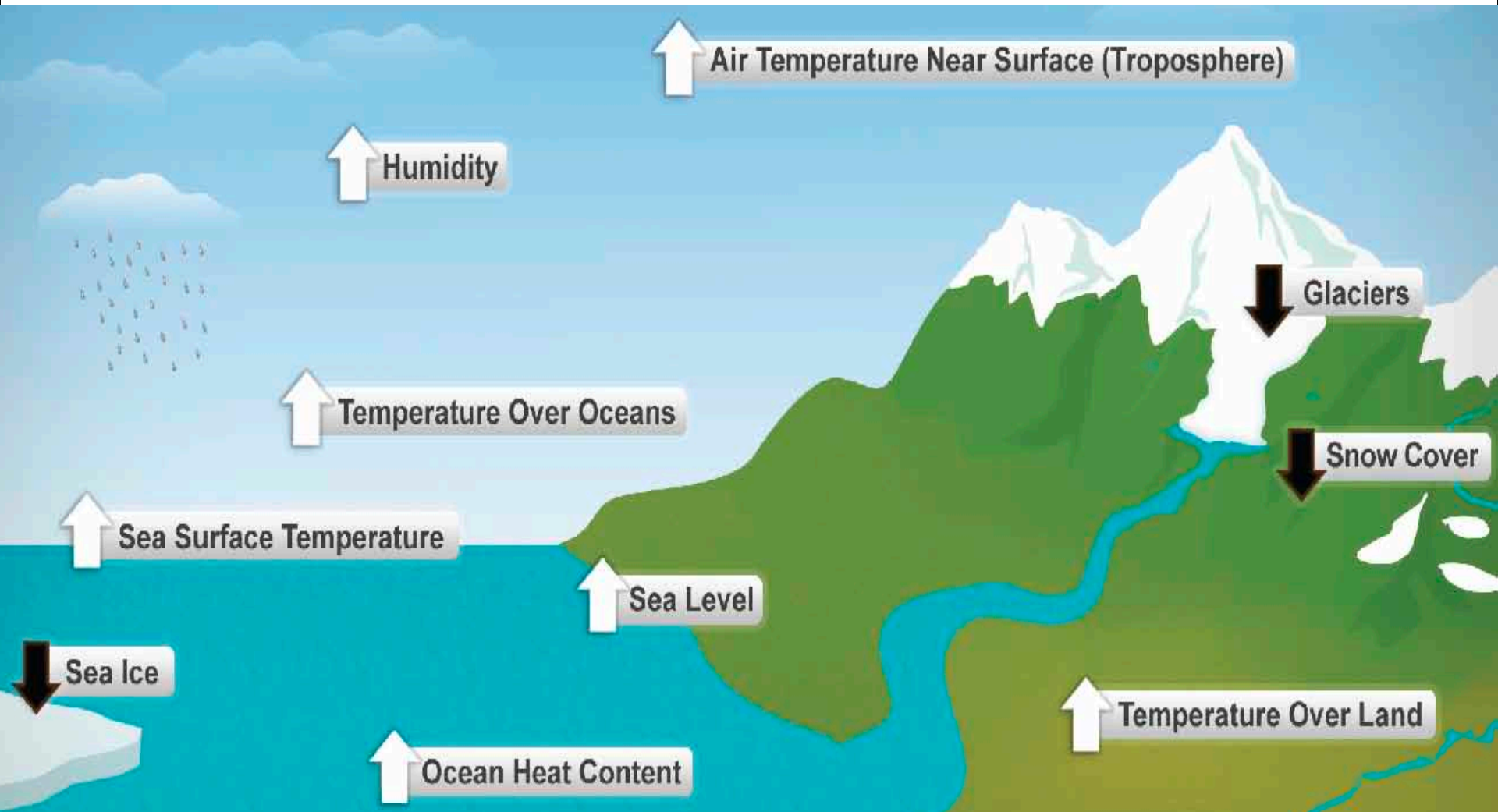
Goal 1.1 Earth System Understanding

- Role of aerosols on regional variations and change
 - Direct and indirect effects
- Role of short-lived radiative forcing agents
 - Quantify contributions and uncertainties
- Stratosphere and surface climate
- Interface and boundary layer interaction
 - Clouds and land feedbacks
 - Climate-biology feedbacks
- Integration of observations and models
 - Coupled data assimilation
- Process studies for fundamental understanding
- Thresholds and tipping points



Draft Strategic Plan Characteristics: Goal 1.3 Integrated Observations

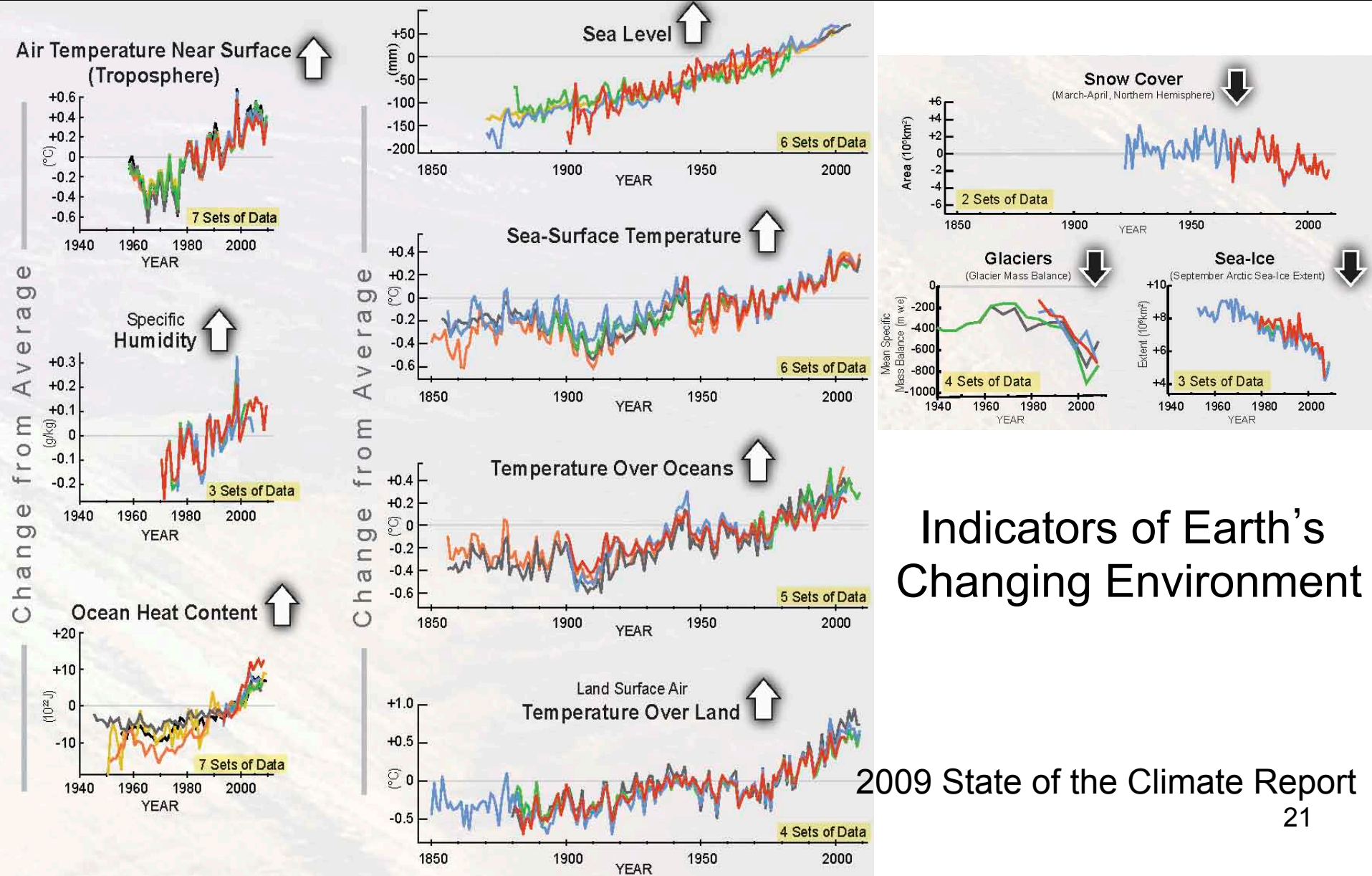
Indicators of Earth's Changing Environment





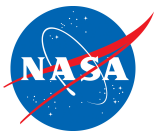
Draft Strategic Plan Characteristics:

Goal 1.3 Integrated Observations



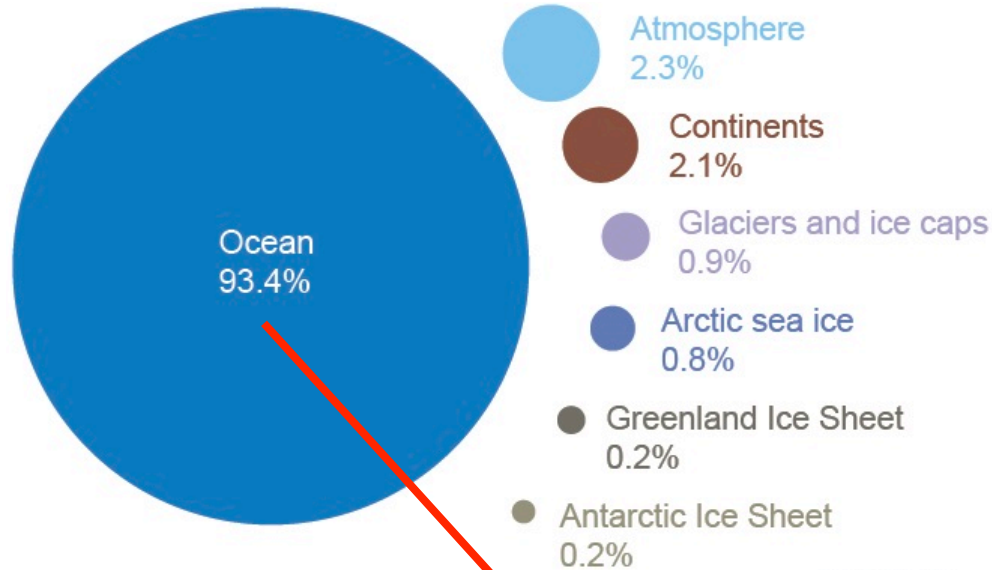
Indicators of Earth's Changing Environment

2009 State of the Climate Report

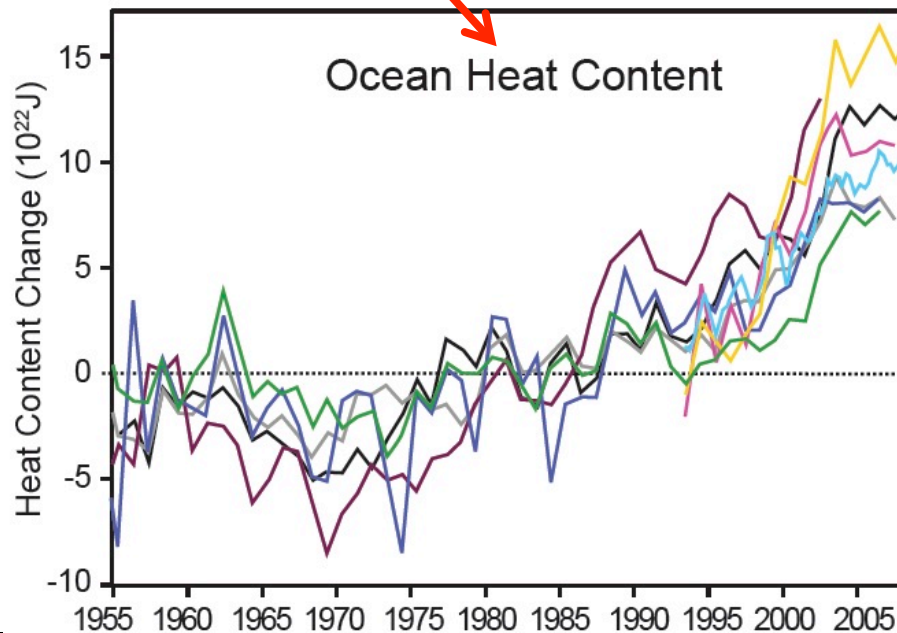


Draft Strategic Plan Characteristics:

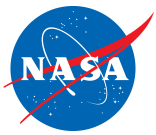
Goal 1.3 Integrated Observations



Heat Reservoirs Over Past 50 Years



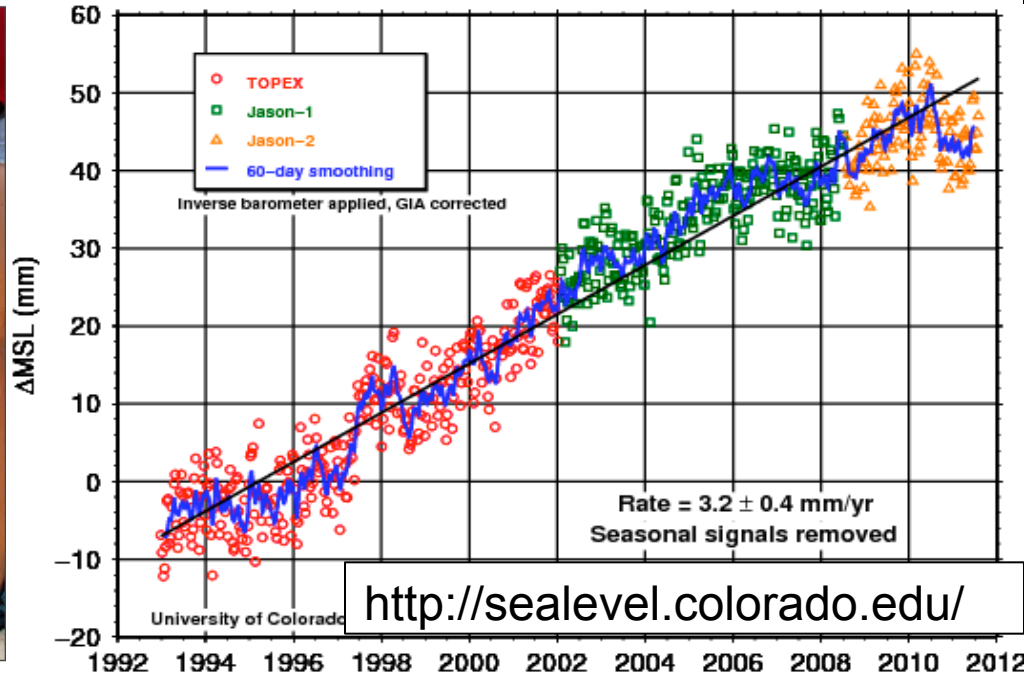
- Palmer et al. (2007)
- Smith and Murphy (2007)
- Domingues et al. (2008)
- Gouretski and Reseghetti (submitted)
- Levitus et al. (2009)
- Ishii and Kimoto (2009)
- Lyman and Johnson (2008)
- Willis et al. (2004)



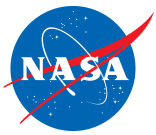
Draft Strategic Plan Characteristics

Goal 2: Inform Decisions

Advance science (Goal 1) to inform and enable timely decisions on adaptation (Goal 2.1) and mitigation (Goal 2.2)



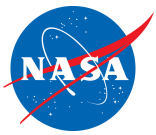
Every year hundreds of adult female endangered green sea turtles migrate to the beaches of the French Frigate Shoals to lay their eggs. Female sea turtles can live for over 50 years and throughout their mature lives return to the same nesting grounds they were born at to lay their egg clutches. The French Frigate Shoals are amongst the many Northwestern Hawaiian Islands that could be inundated by **rising sea levels** and thus affect green sea turtle reproduction.



Draft Strategic Plan Characteristics: Goal 3 Sustained Assessments

Build sustained assessment capacity that improves the Nation's ability to understand, anticipate, and respond to global and climate change impacts and vulnerabilities



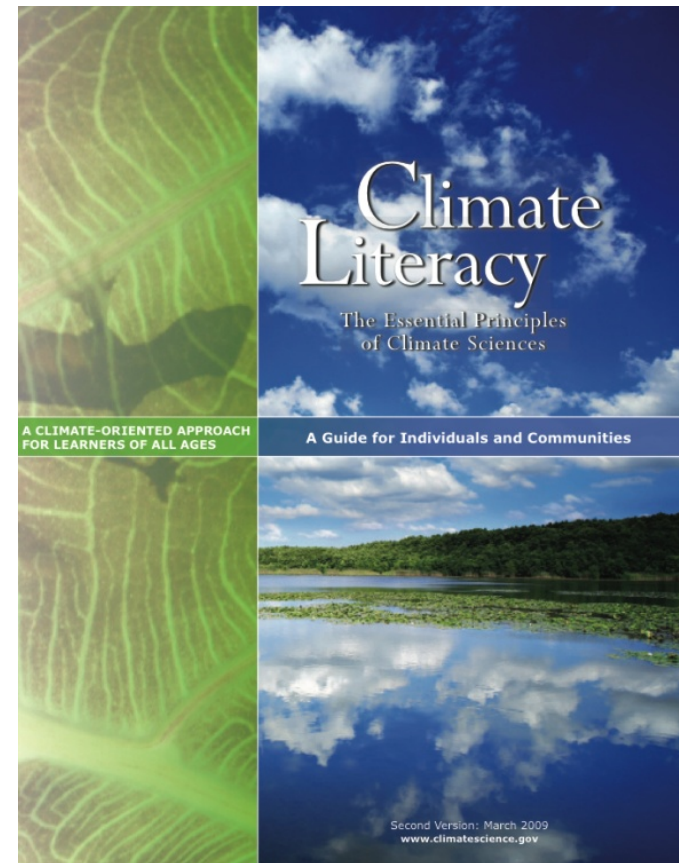


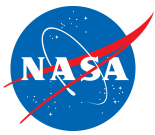
Draft Strategic Plan Characteristics: Goal 4 Communicate and Educate

Advance communications and education to broaden public understanding of climate and global change, and empower the workforce of the future



High school students attending a “Science Careers in Search of Women” conference.
Credit: *NSF image.*





USGCRP Wants To Hear From You

- Draft Strategic Plan is available for public review and comment at **www.globalchange.gov**
- Deadline is 29 November 2011
- Respond to the following questions
 - How successful is the draft strategic plan at addressing the 10-year needs of the Nation in performing and utilizing global change research?
 - Does the strategic plan sufficiently address the need to provide authoritative, understandable, and actionable information to decision makers?
 - Are there areas necessary to achieve the mission and goals underrepresented or missing from the draft strategic plan?



Conclusions: Two Challenges

- 1 Determine effect of high-resolution SST in climate models
- 2 Prepare an integrated graduate student response of USGCRP draft strategic plan

Thank you.