Observations of our Changing Planet: The View from Space

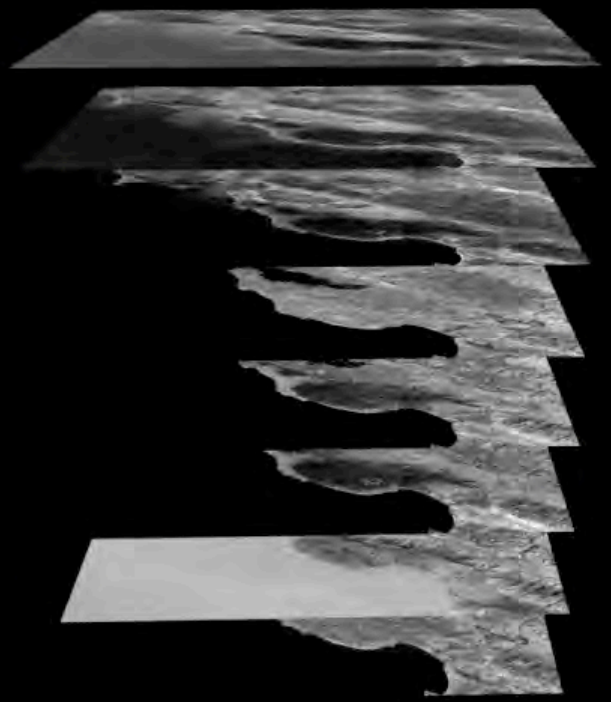
Michael D. King
EOS Senior Project Scientist
NASA Goddard Space Flight Center

- Observations of the Earth's environment from space
  - Satellite orbital coverage
  - Remote sensing concepts
- Land cover & land use change
- Hurricanes & natural hazards
- Fires
  - Carbon monoxide & aerosols
- Surface & atmospheric temperature
- Snow & sea ice
- Urban sprawl
- Earth at night
- Summary and Resources

NASA Earth Science Satellite Fleet

Remote Sensing Principles - Landsat 7 ETM+

ETM+ Band	Wavelength (um)	
1	0.450 - 0.515	Blue
2	0.525 - 0.605	Green
3	0.63 - 0.69	Red
4	0.75 - 0.90	Near Infrared
5	1.55 - 1.75	Infrared
7	2.09 - 2.35	Shortwave Infrared
6	10.40 - 12.50	Thermal Infrared
8	0.52 - 0.90	Panchromatic

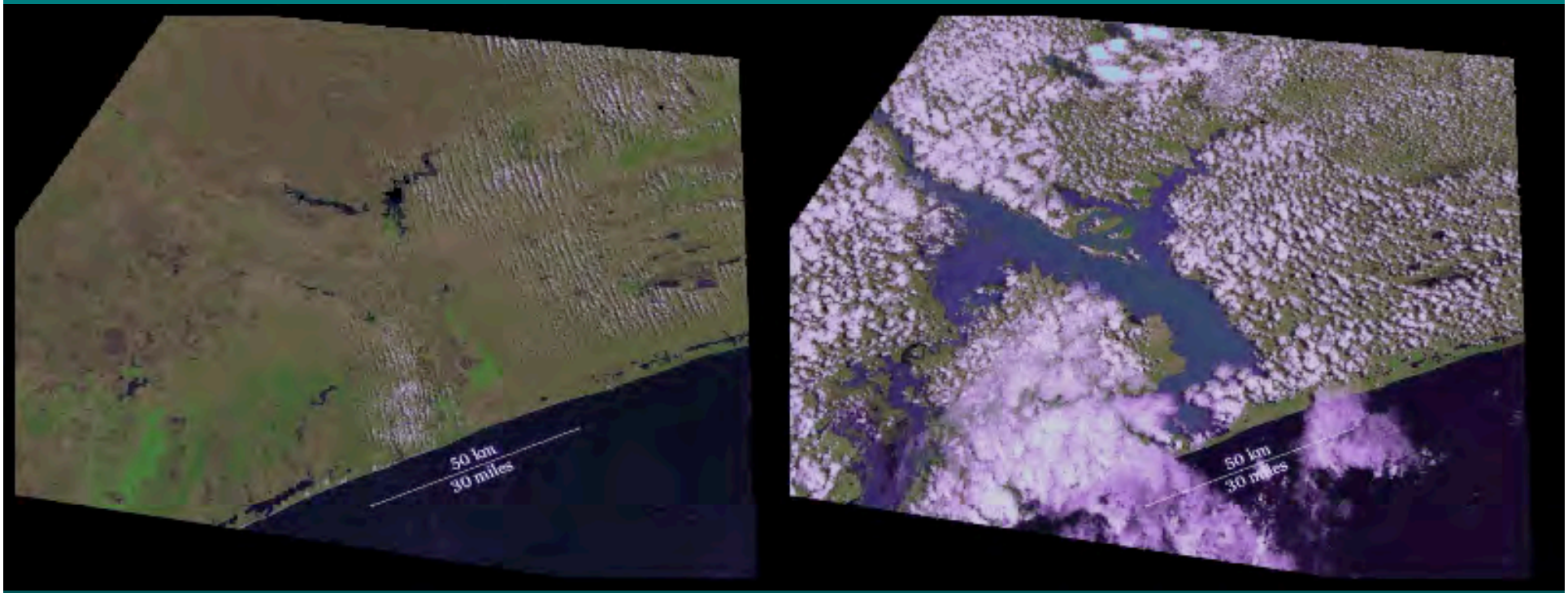


Cape Town, South Africa

Limpopo River, Mozambique

August 22, 1999

March 1, 2000

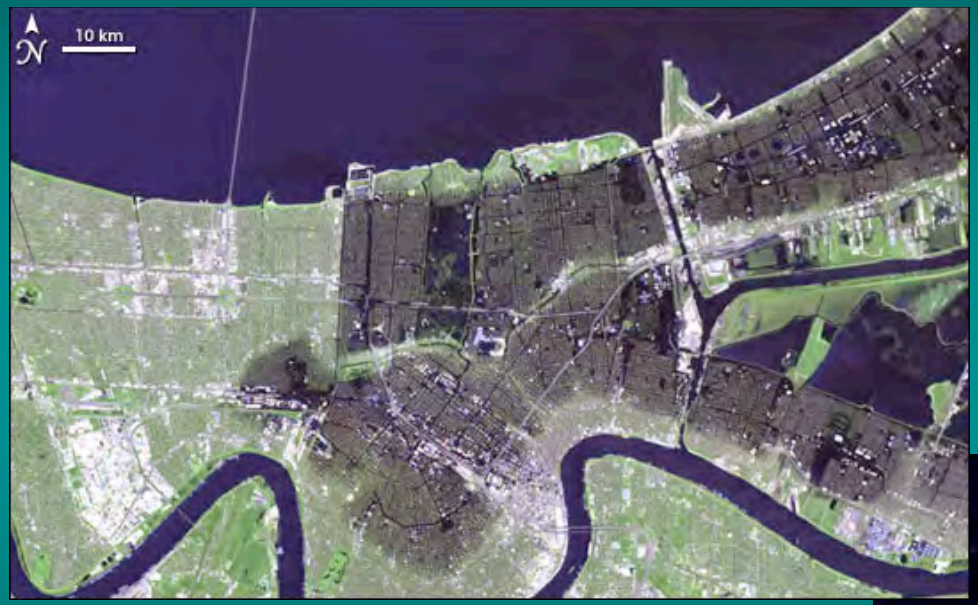


- The Limpopo River in Mozambique before and after the flooding from Cyclone Eline
- About 700 people were killed and thousands were displaced by this event

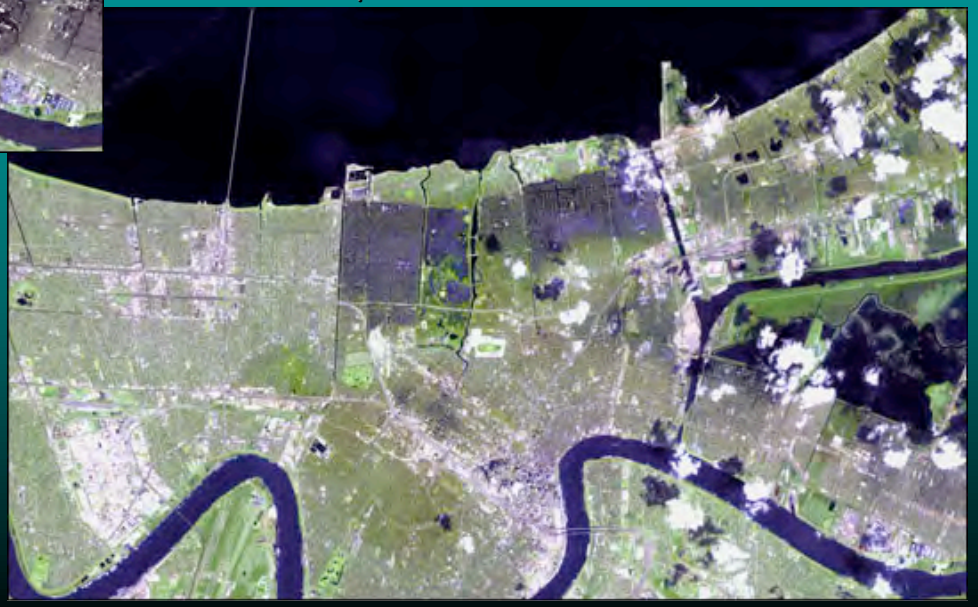
Landsat 7 Observes Flooding in New Orleans

Hurricane Katrina

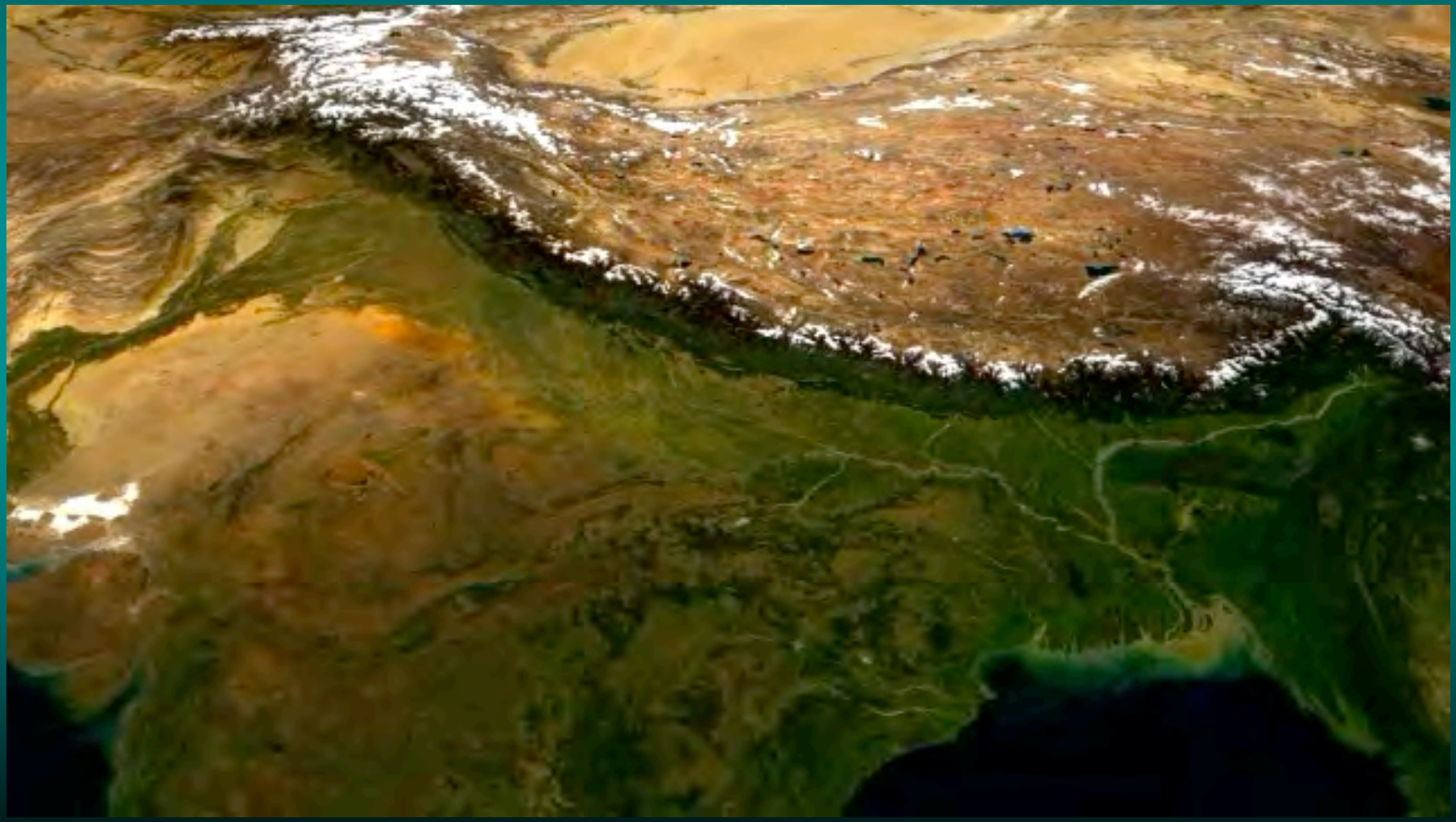
September 7, 2005



September 15, 2005

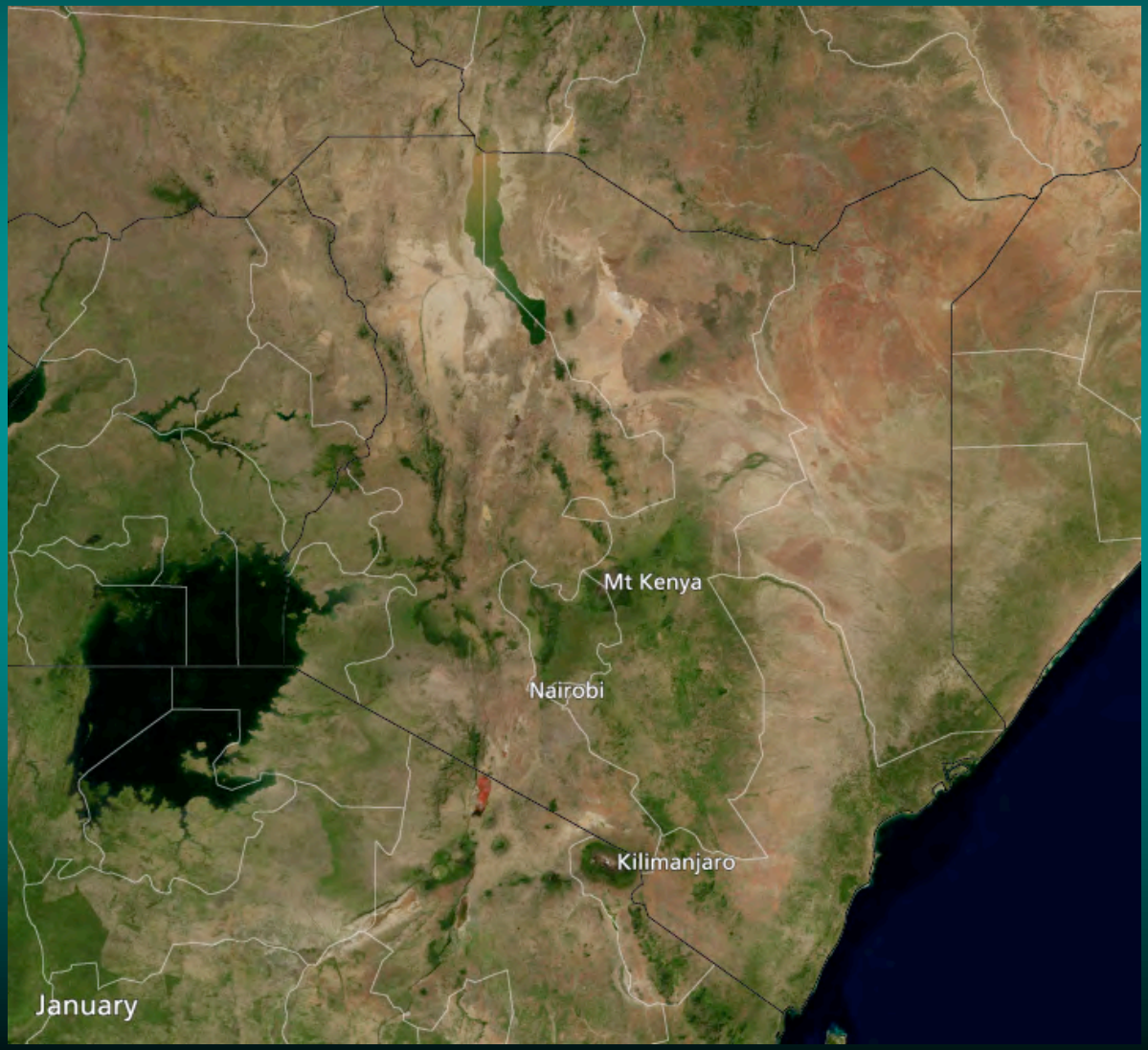


MODIS Flyby of the Himalayas & Ganges Valley

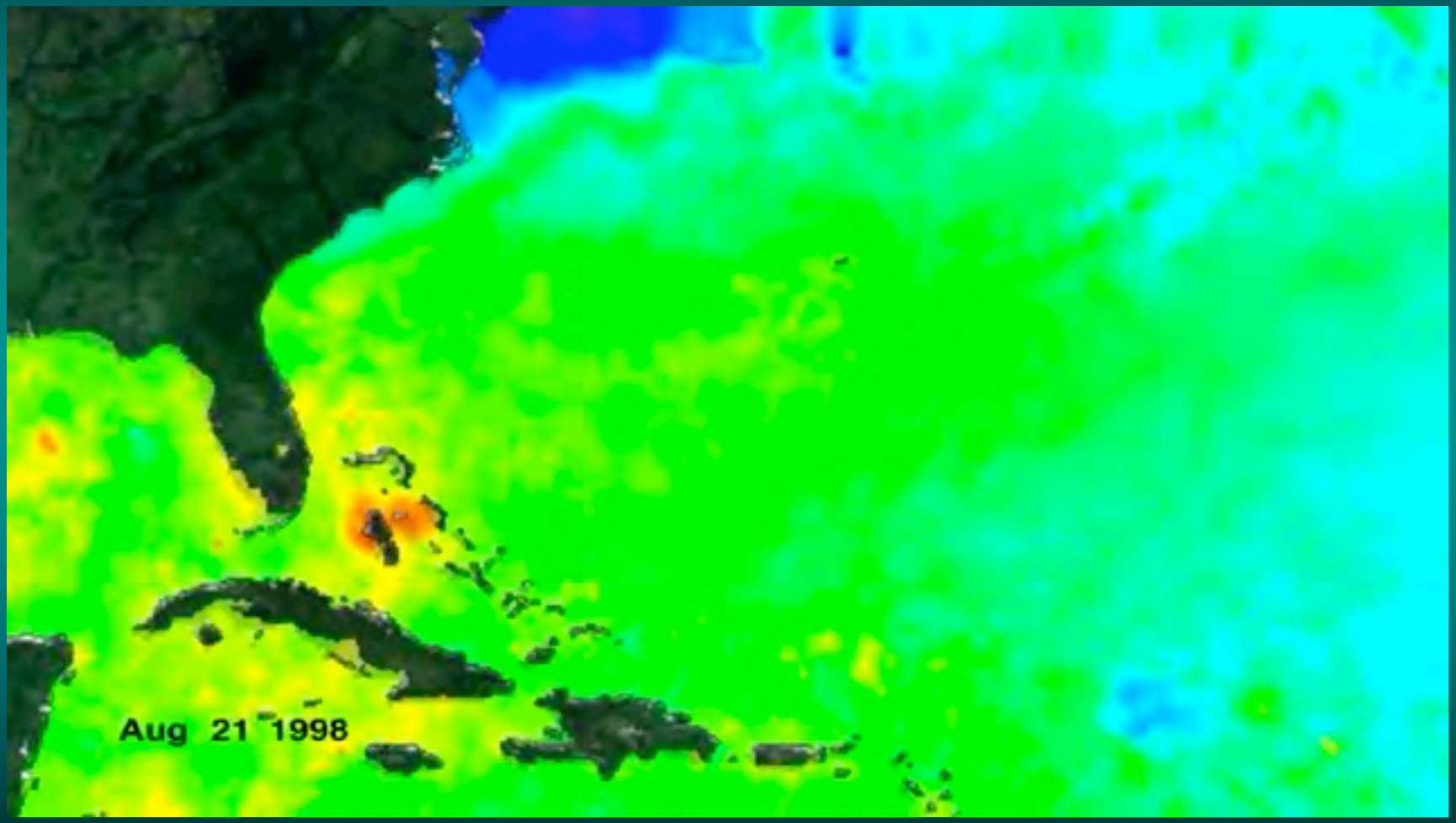


MODIS Land Cover Classification

MODIS True Color Reflectance - East Africa

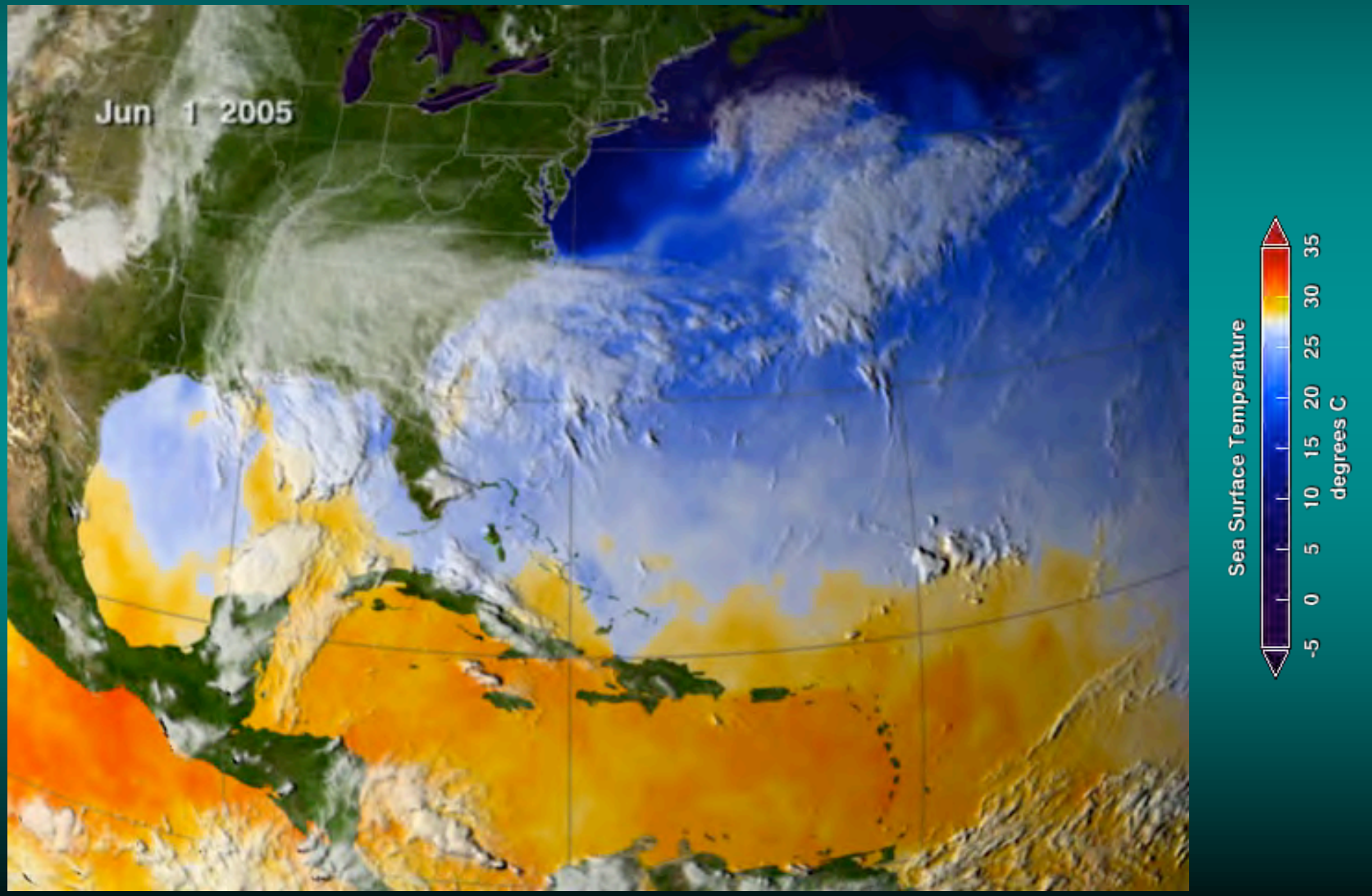


Hurricanes Bonnie & Danielle
Atlantic Sea Surface Temperature

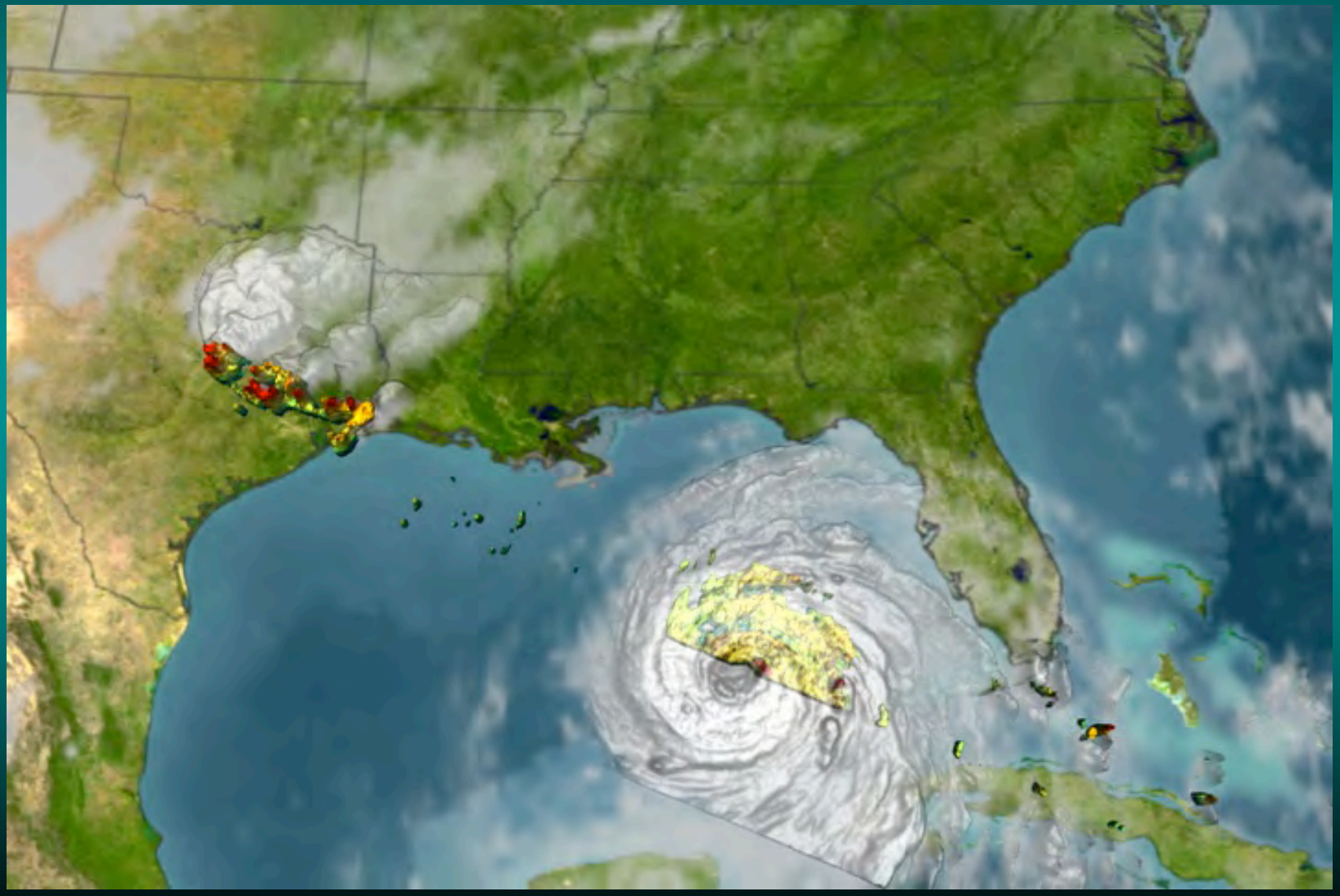


Named Tropical Storms & Hurricanes of 2005

Atlantic Sea Surface Temperature



Hurricane Katrina
Hot Towers

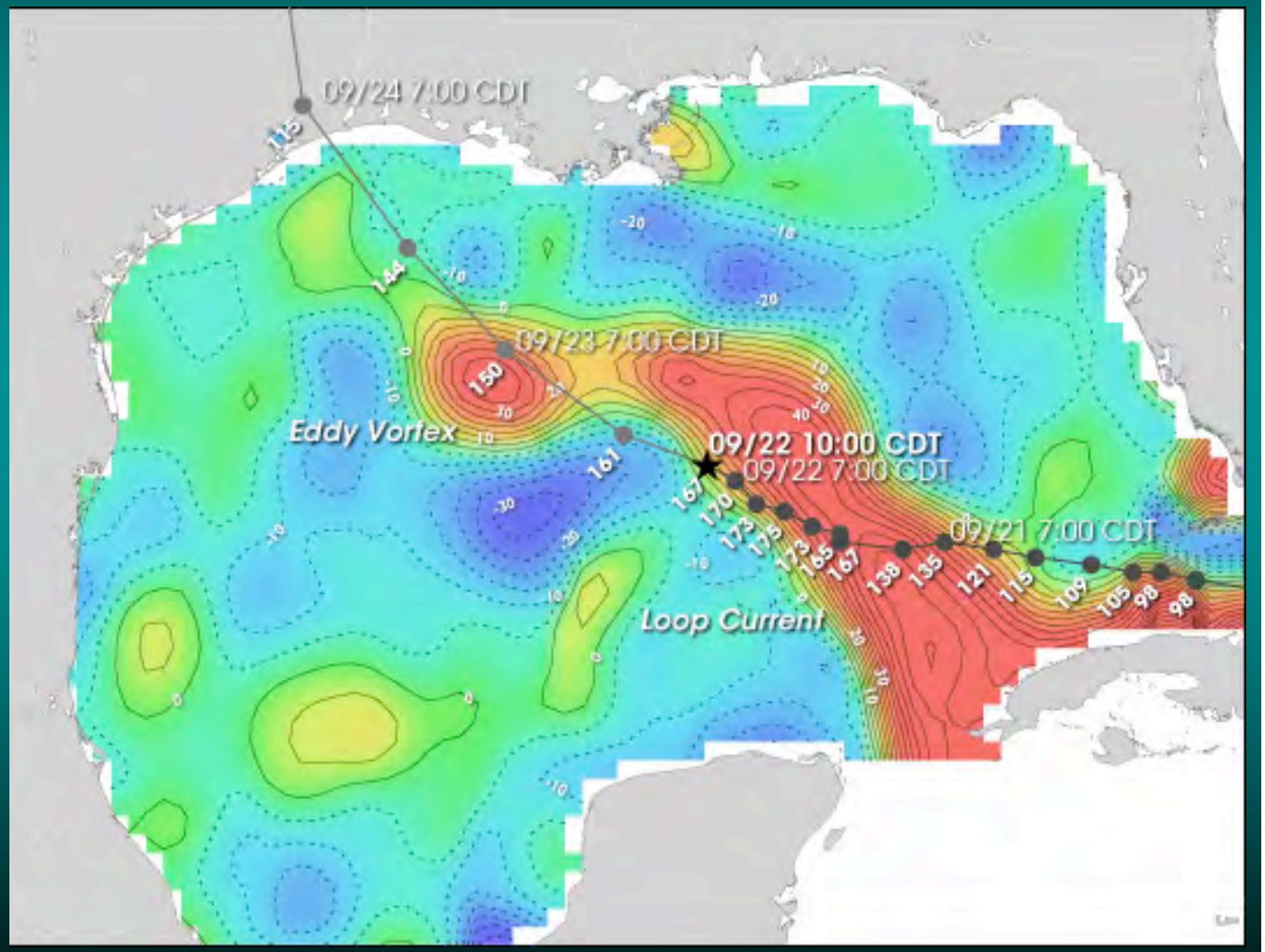


Hurricane Rita Roars through a Warm Gulf

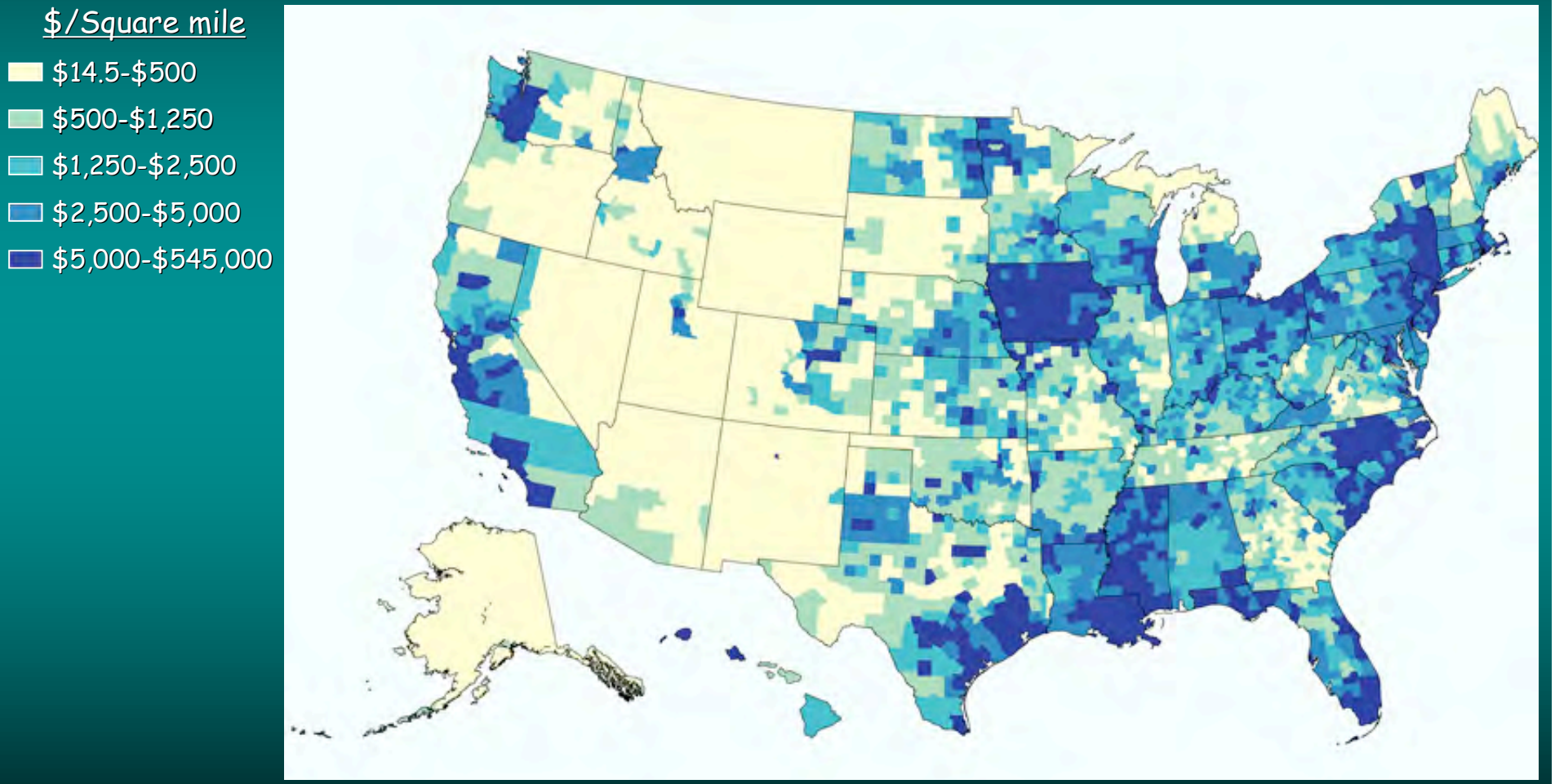
Loop Current has Elevated Sea Surface Height

TOPEX/Poseidon & Jason-1
September 21-24, 2005

- The area shown in red is ~35-60 cm higher than the surrounding Gulf
- Loop current has warmer sea surface temperature



Crop and Property Damages from Natural Hazards
1960 – June 2004

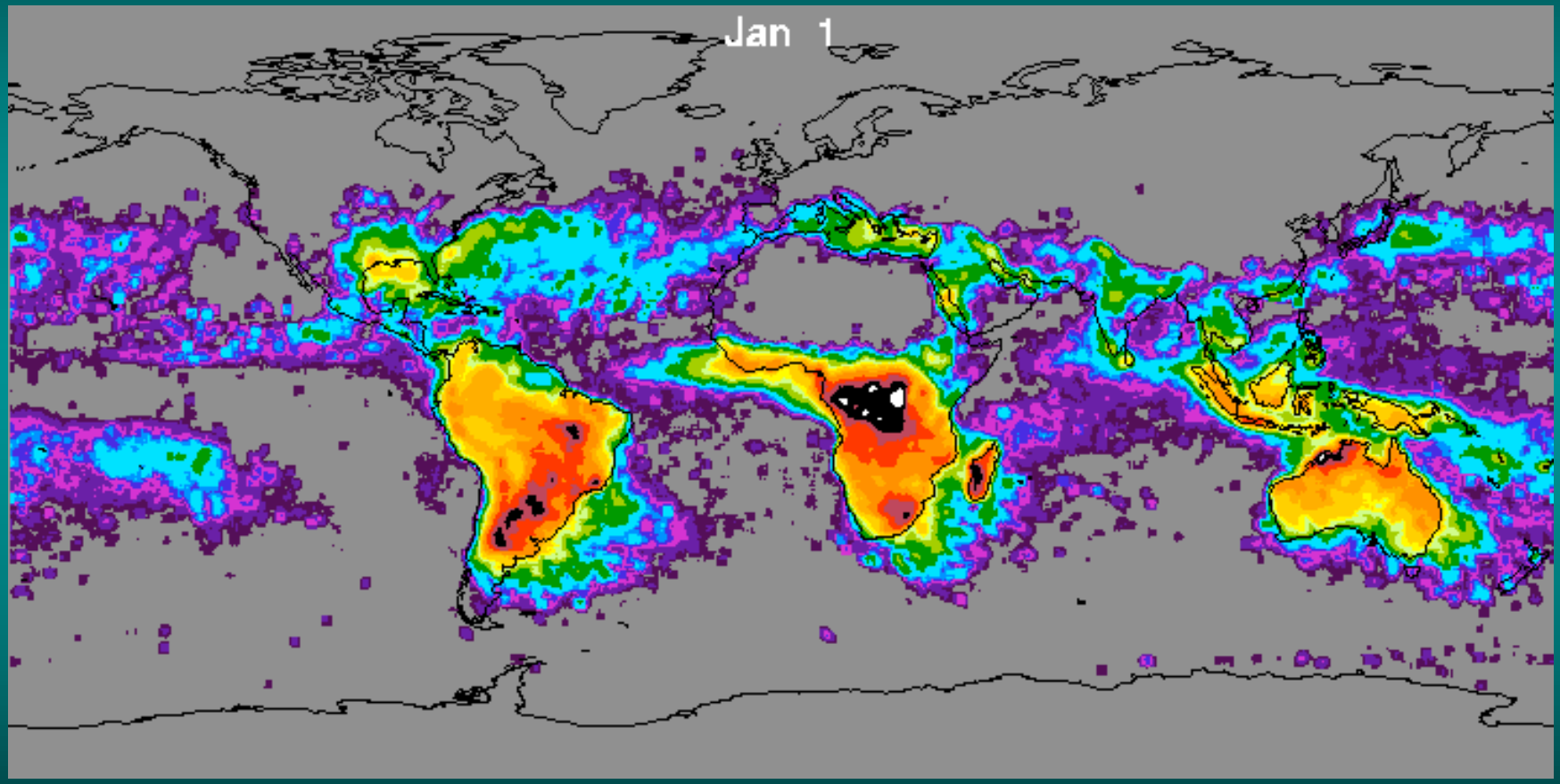


- San Francisco County ($26.8 million/square mile)
- Los Alamos ($16.5 million/square mile)

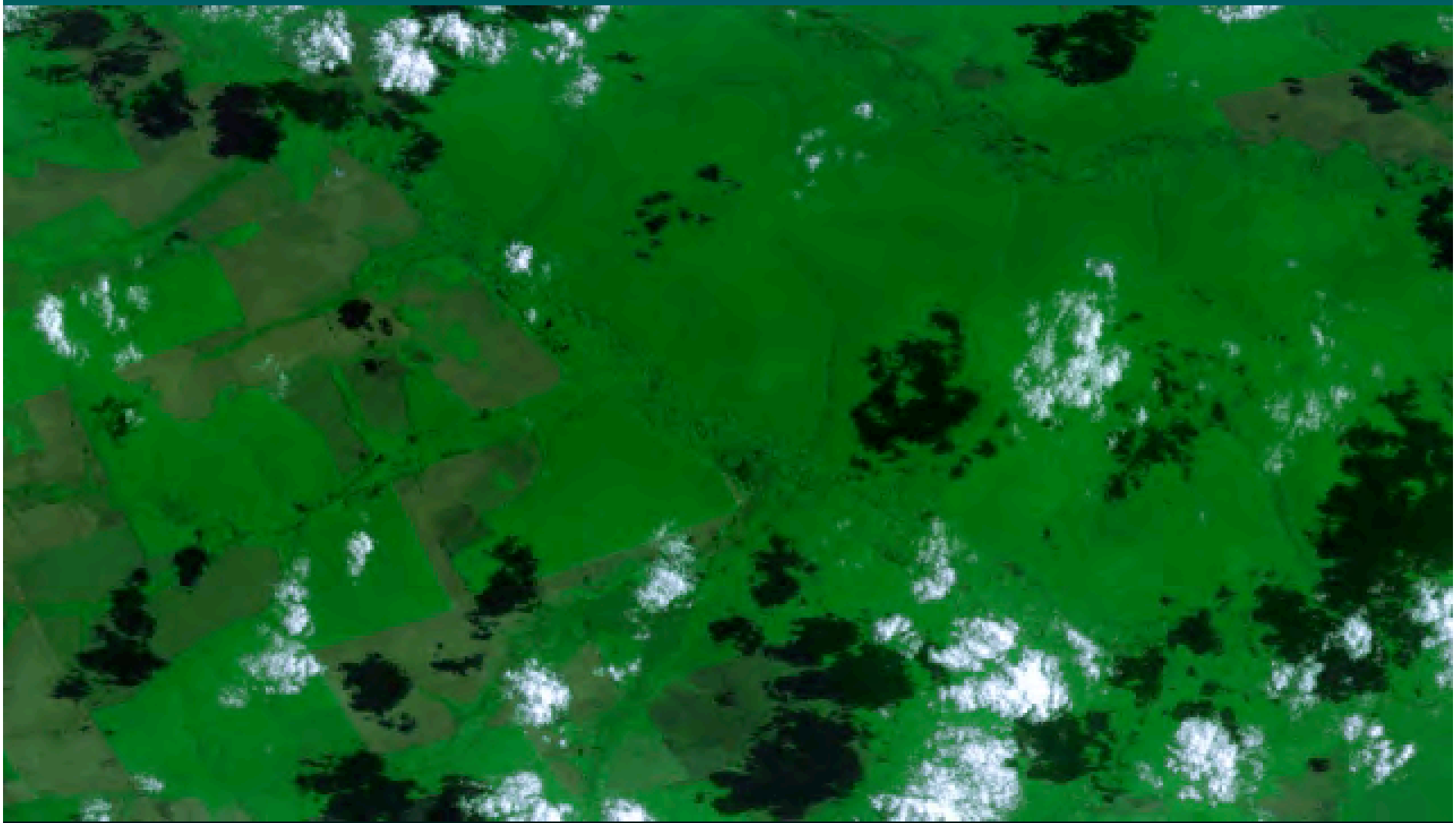
Hazards Research Lab, U of South Carolina

LIS & OTD Lightning Flash Rate

April 1995 – December 2002



MODIS Airborne Simulator - Brazil

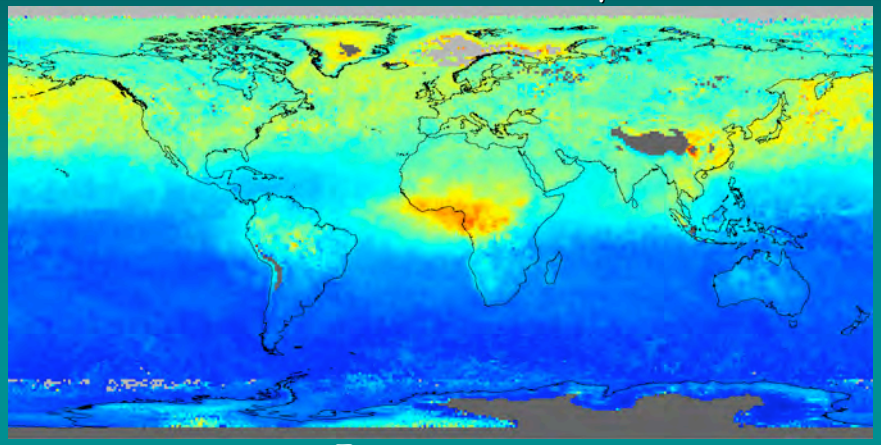


MODIS Fire Occurrence

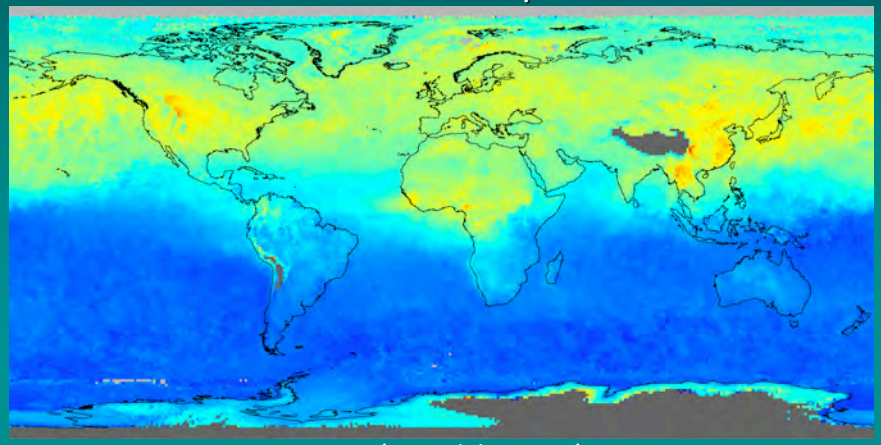
May – December

Seasonal Measurements of CO at 700 hPa from MOPITT

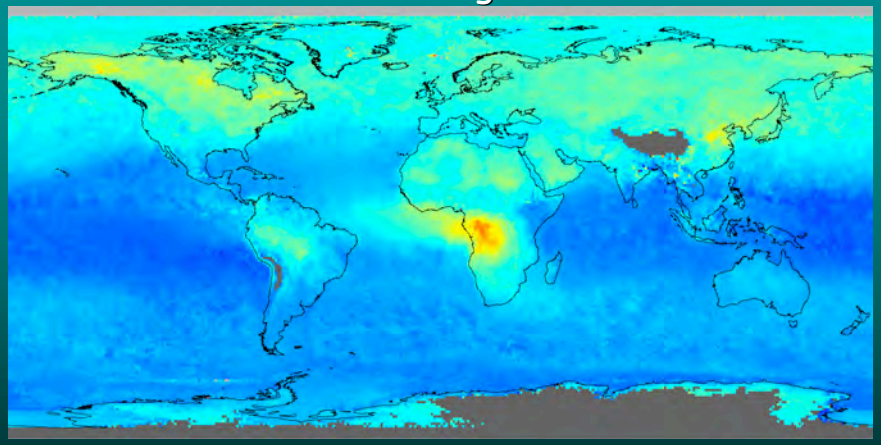
December-February



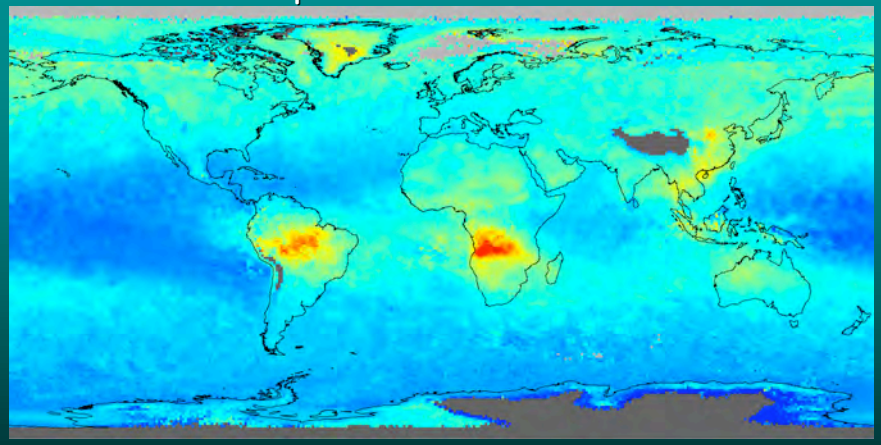
March-May



June-August



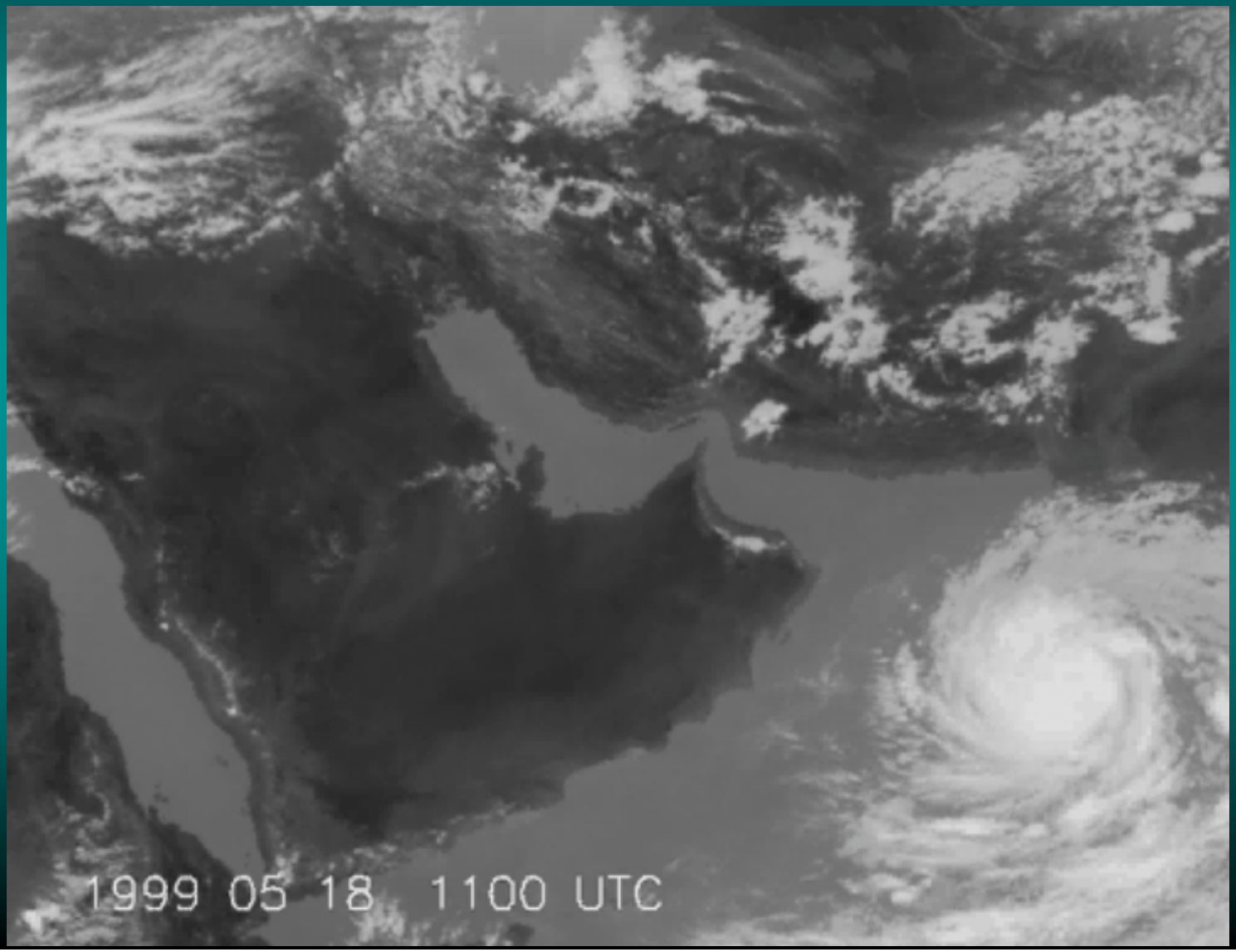
September-November



Carbon Monoxide Concentration (parts per billion)

Meteosat Dust Storm in Middle East

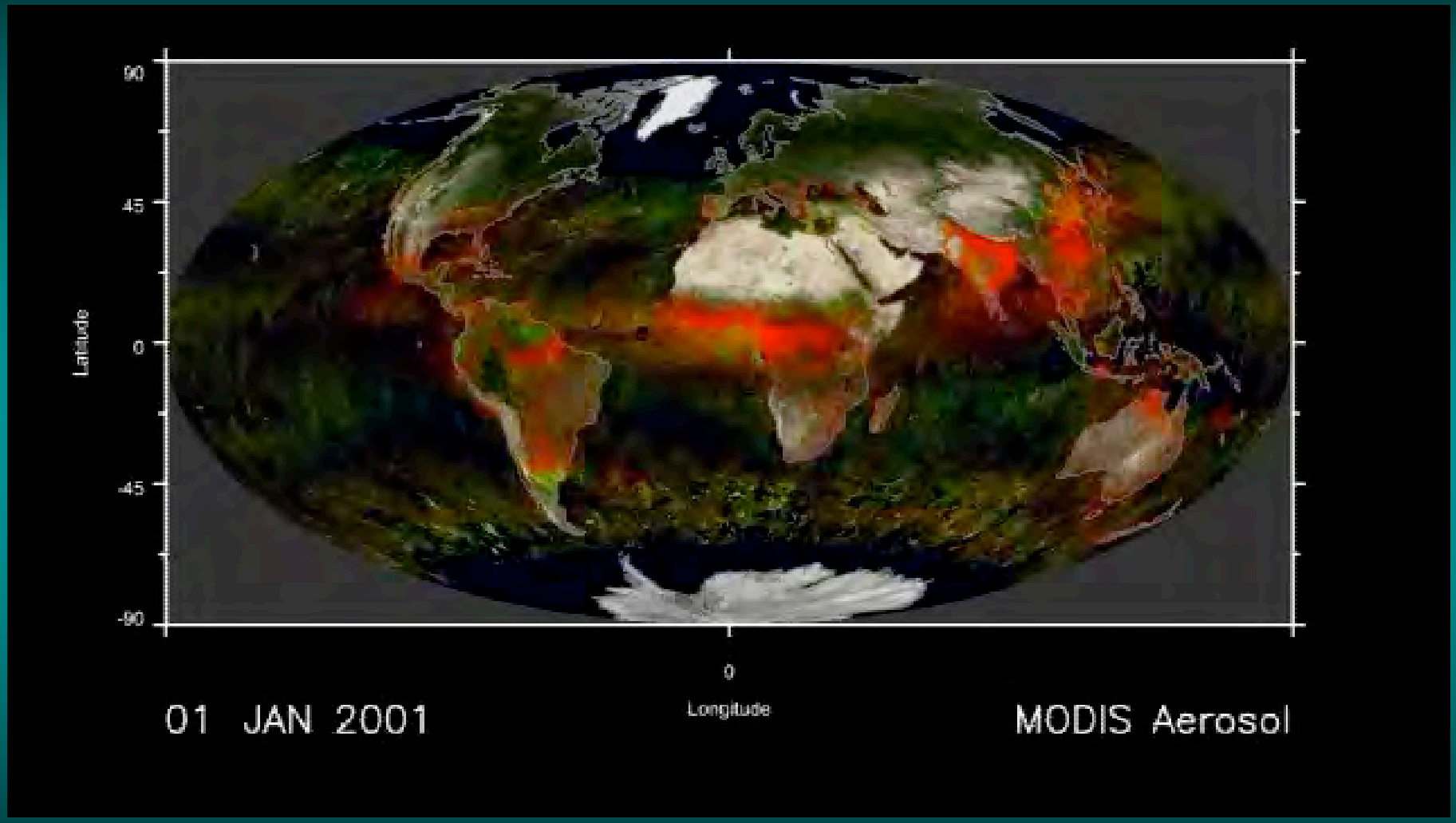
May 1999



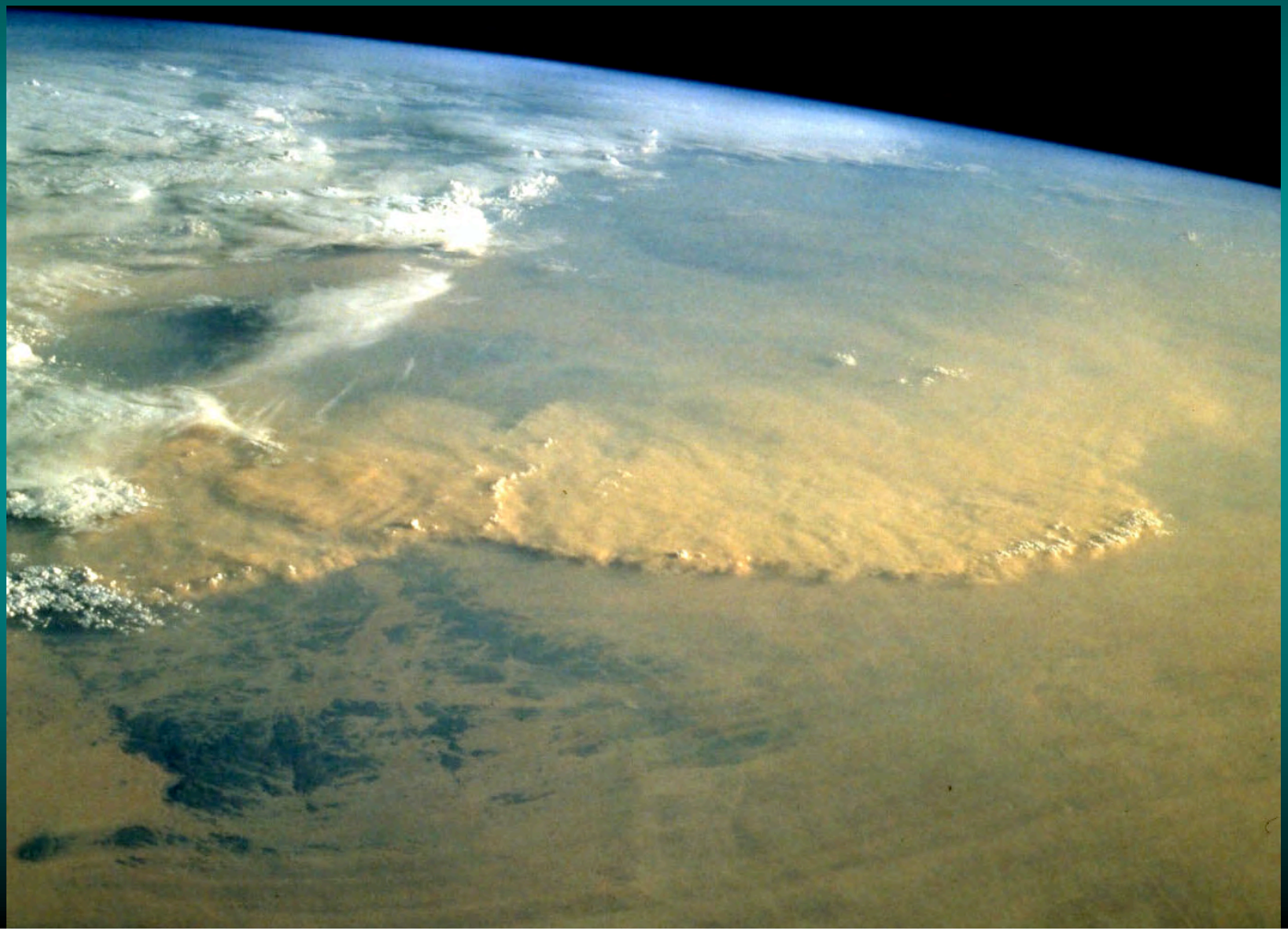
Shamal Dust Front over the Air Base in Al Asad, Iraq

April 26, 2005

Global Aerosol Optical Properties



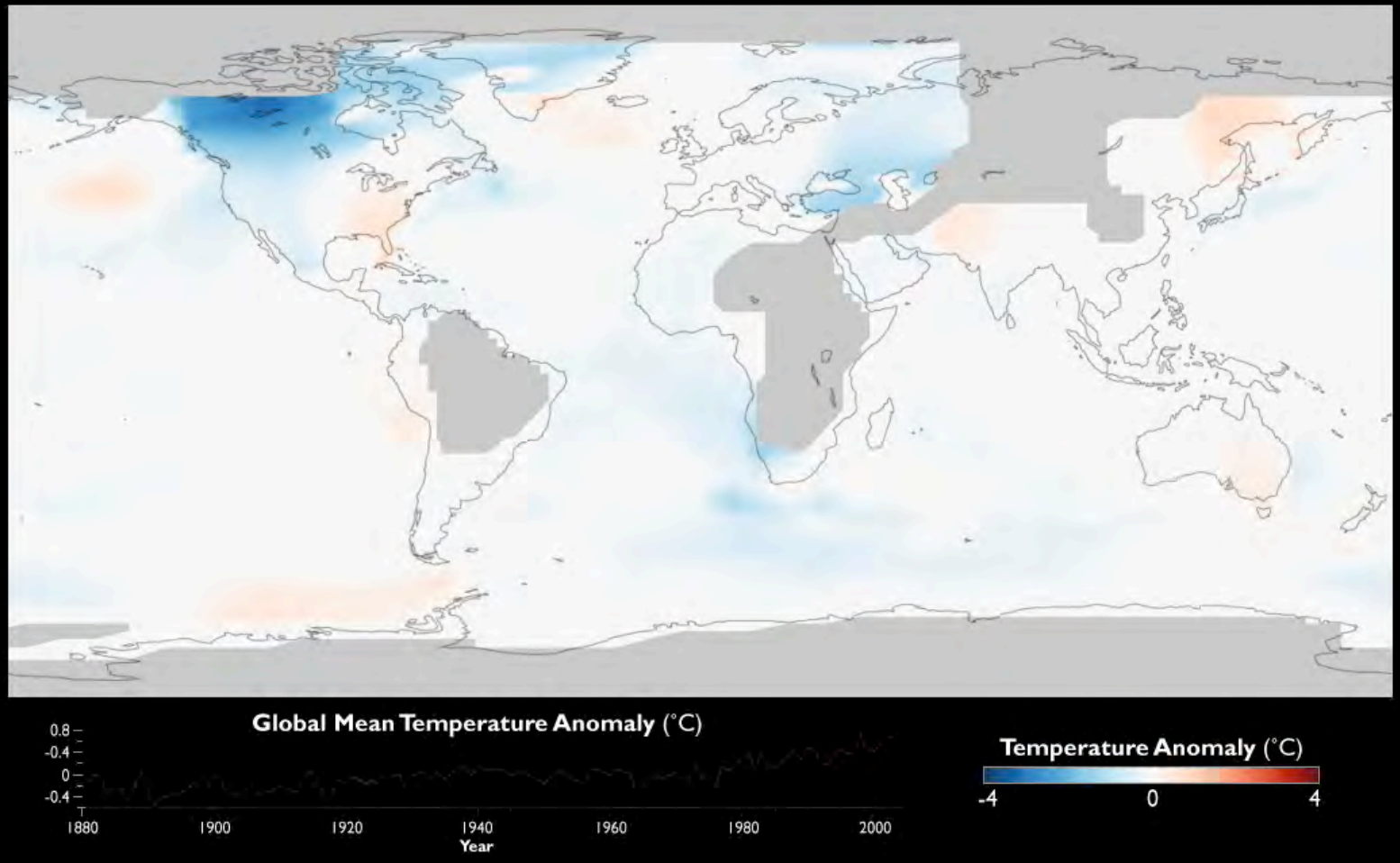
Saharan Dust Front - Algeria



Saharan Dust Over the Caribbean

Surface Temperature Difference from 1951-1980

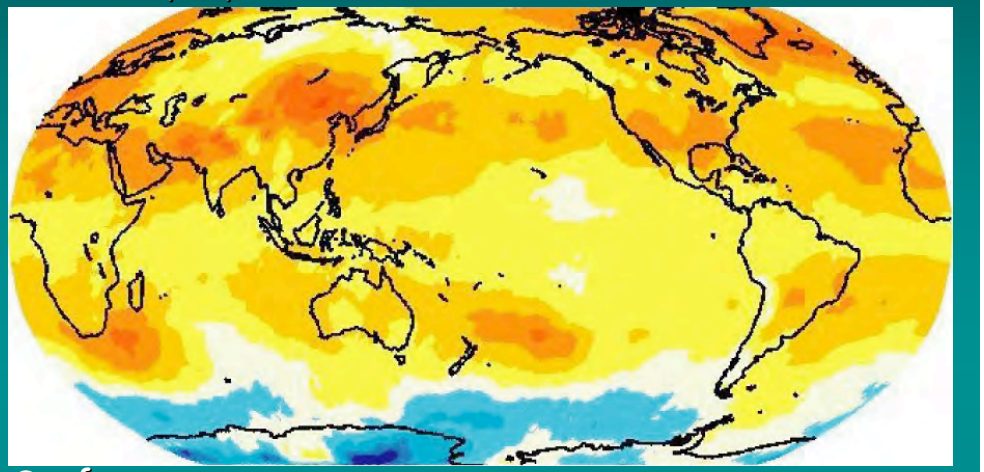
1880-2004



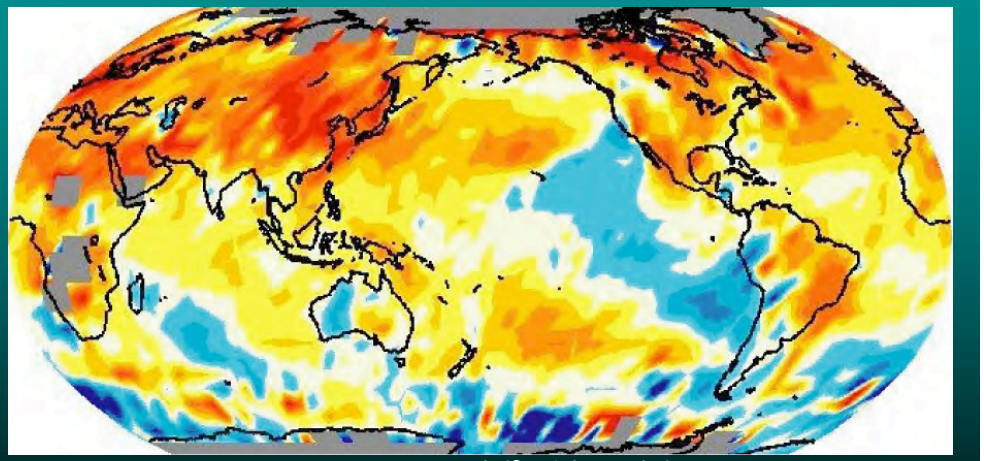
Tropospheric and Surface Temperature Trends

- Temperature increases in the free troposphere and surface are largely in phase
- Large temperature increases are observed in
  - China
  - Western Europe
  - North Africa
  - South Pacific
  - Eastern Brazil and Northern Argentina
  - Alaska
  - Desert Southwest of the United States

Free Troposphere 1979-2004



Surface



Temperature Trend (°C/decade)

-0.6 -0.4 -0.2 0.0 0.2 0.4 0.6

Qiang Fu, University of Washington

MODIS Snow & Ice Occurrence

2002-2003

Urban Sprawl & Water Resources

Visualization by NASA & American Museum of Natural History

North America at Night

Summary and Resources

- NASA's Earth observing satellites have played a crucial role in understanding and documenting global change
  - global surface and atmospheric temperature
  - glacial retreat
  - sea ice extent and change
  - solar radiation into and out of the Earth-atmosphere system
  - atmospheric aerosol and cloud optical properties
  - sources and sinks of carbon in the oceans and land
  - ocean surface topography and winds
  - stratospheric and tropospheric chemical constituents
  - fires
  - precipitation
- Resource on Earth science, including news stories, images of the day, data sets, and natural hazards
  - earthobservatory.nasa.gov