

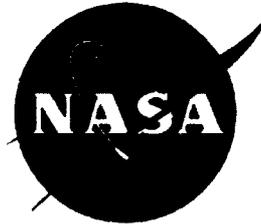
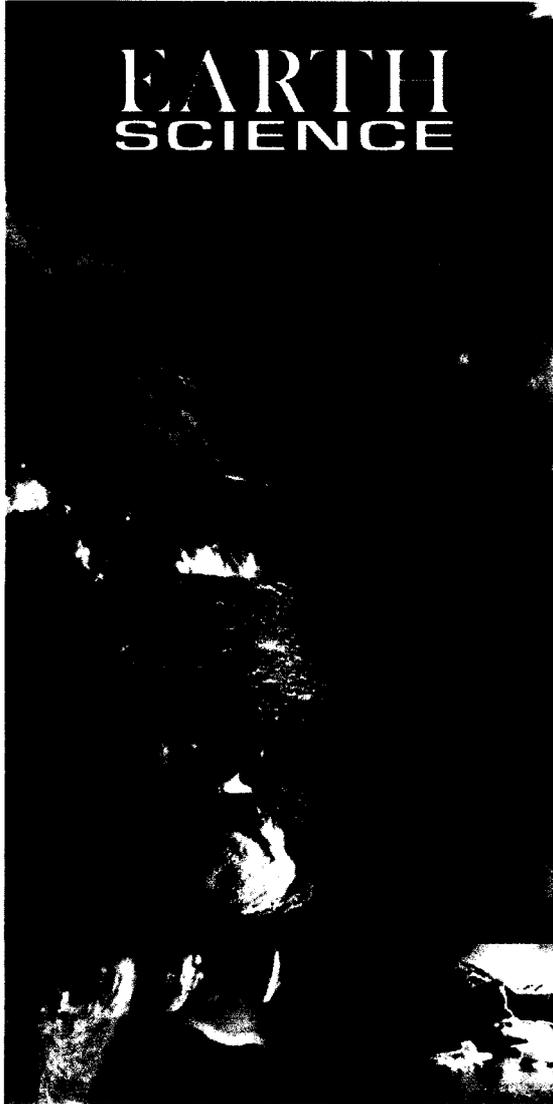


JPL

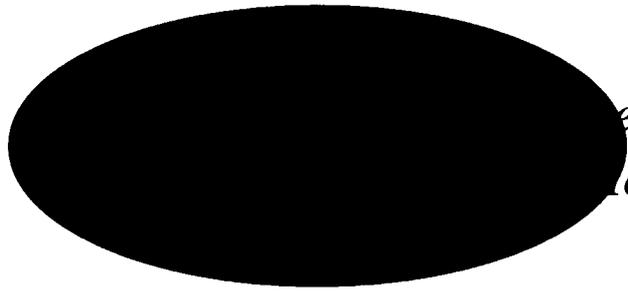
TOPEX, Jason-1, and GRACE: Missions that Study Our Earth

Jet Propulsion Laboratory





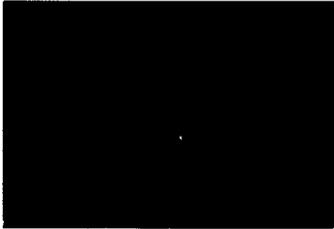
TOPEX/Poseidon
Jason-1
GRACE



er/Climate → *Predictions*
odels

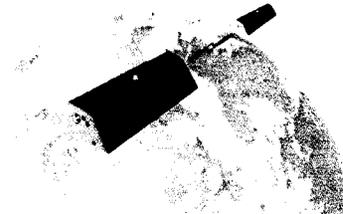


Why Does NASA Study Oceans?



-Earth is a water planet --
70% is water

-The interaction of ocean
and atmosphere drive
weather patterns and
control climate change.

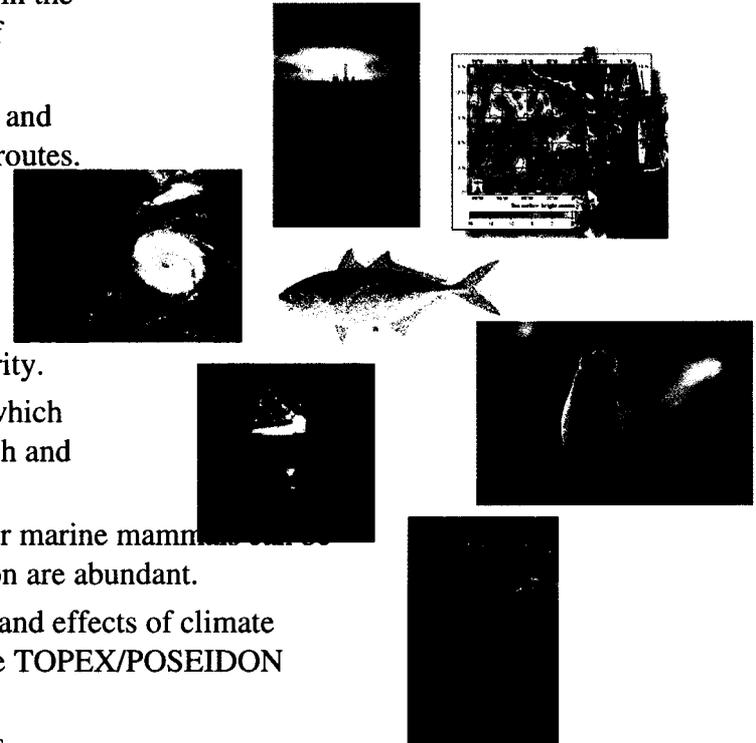




Applications



- **Climate Research:** By modeling changes in the distribution of heat in the ocean with TOPEX/POSEIDON & Jason-1 data, scientists can study patterns of evaporation and resultant precipitation in the ocean system.
- **Ship Routing:** Maps of currents and eddies from TOPEX/POSEIDON and Jason-1 are used in commercial shipping and recreational yachting to optimize routes.
- **Offshore Industries:** Cable-laying vessels and offshore oil operations require accurate knowledge of ocean circulation patterns to minimize impacts from strong currents.
- **Hurricane Forecasting:** Altimeter data are incorporated into atmospheric models for hurricane season forecasting and individual storm severity.
- **Fisheries Management:** Altimeter data identifies ocean eddies which bring an increase in organisms that comprise the marine food web, attracting fish and fishermen.
- **Marine Mammal Research:** Sperm whales, fur seals, and other marine mammals are tracked, and therefore studied, around ocean eddies where nutrients and plankton are abundant.
- **El Niño & La Niña Forecasting:** Understanding the pattern and effects of climate cycles such as the El Niño Southern Oscillation (ENSO) is a primary goal of the TOPEX/POSEIDON and Jason-1 missions.
- **Coral Reef Research:** Altimeter data is used to monitor and assess coral reef ecosystems, which are sensitive to changes in ocean temperature due to large-scale climate variability.
- **Ocean Debris Tracking:** Altimeter data can be used to calculate ocean currents to identify likely locations of marine debris which can pose a hazard to coral reefs, marine mammals, and oceangoing vessels.
- **Snow Pack & Polar Ice Sheet Studies:** Glacial flow monitoring; seasonal snow pack variation





TOPEX/Poseidon

Launched: August 10, 1992



TOPEX/Poseidon

- Measure sea level with accuracy <5 centimeters
- Provide a 3-year global view of the global ocean topography
- Increase understanding of ocean circulation
- Improve forecasting of global climate
- Improve knowledge of Earth's gravity field

- 3 year Prime mission; Extended mission to 6 years
- 10-day repeat of ground track (± 1 km accuracy)
- Covers 95% of ice-free oceans every 10-days
- Global data coverage between 66°N and 66°S latitude
- Orbital altitude of 1336 km, circular, 66° inclination
- Has provided unprecedented data set for 9 years!



Jason-1

Launched: December 7, 2001



Jason-1

- Follow on to TOPEX/Poseidon (T/P)
- Extend ocean topography measurements for understanding and predicting climate change with sea level measurement accuracy <4.2 centimeters
- Provide a 5-year global view of the global ocean topography
- Increase understanding of ocean circulation and seasonal changes
- Improve forecasting of events such as El Niño
- Measure global sea-level change

- Beginning of operational satellite altimetry
- 10-day repeat of ground track (± 1 km accuracy)
- Covers 95% of ice-free oceans every 10-days
- Global data coverage between 66°N and 66°S latitude
- Orbital altitude of 1336 km, circular, 66° inclination
- Data available through Physical Oceanography Distributed Active Archive Center and AVISO (French)



**Gravity Recovery and Climate Experiment
Scheduled Launch: March 5, 2002**



The Gravity Recovery and Climate Experiment (GRACE) is twin satellites that will be used to map Earth's gravity field.

Variations that GRACE will measure include changes due to ocean circulation, groundwater storage, polar ice, and variations of mass within the Earth.

Mission

- **5-year mission**
- **International partner: Germany**

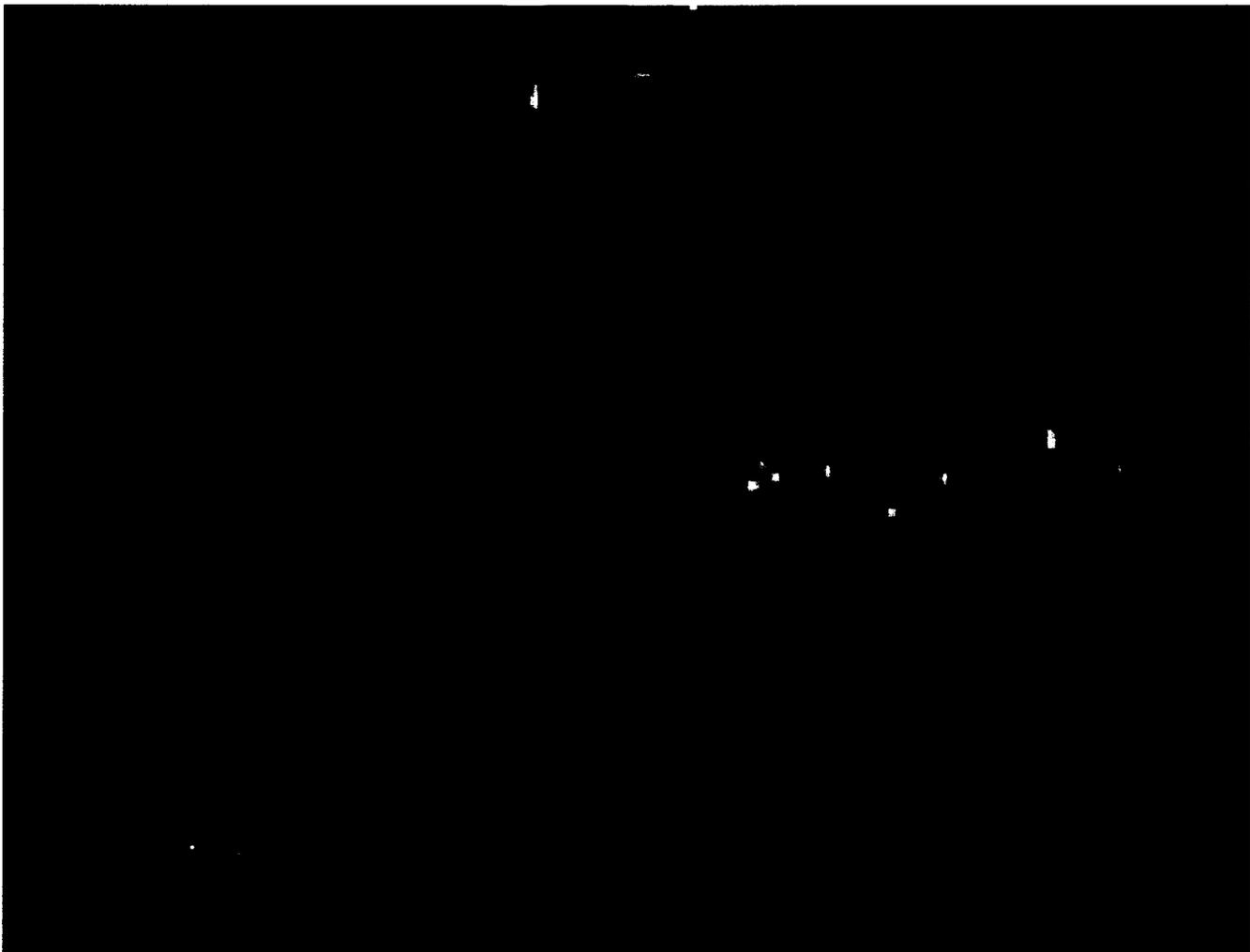
Science

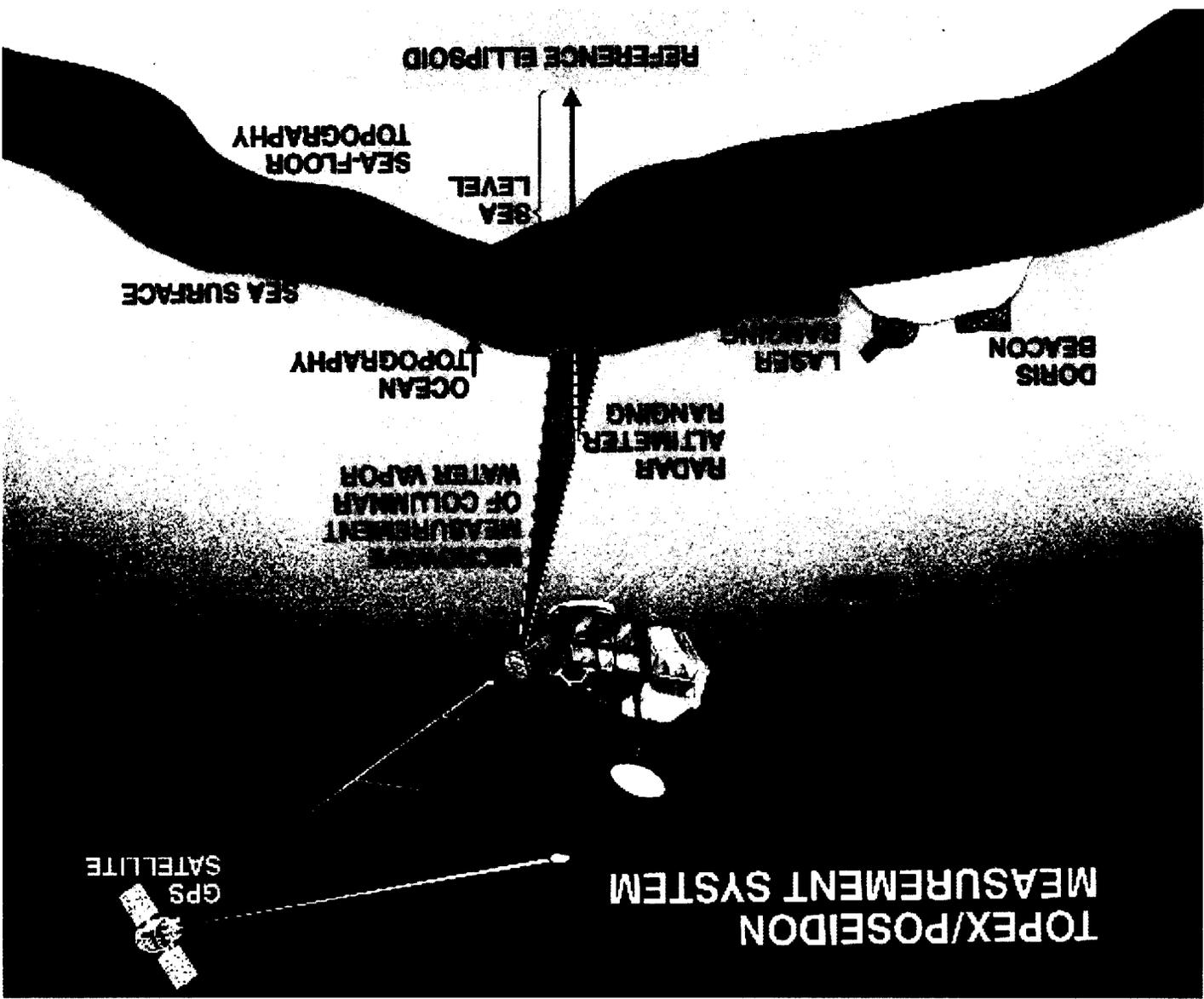
- **New model of the Earth's gravity field every 30 days**
- **Enables monitoring of ocean heat transport**
- **Potential to track the storage of water in the Hydrologic Cycle**



TOPEX/Poseidon Launch 08/10/92

JPL





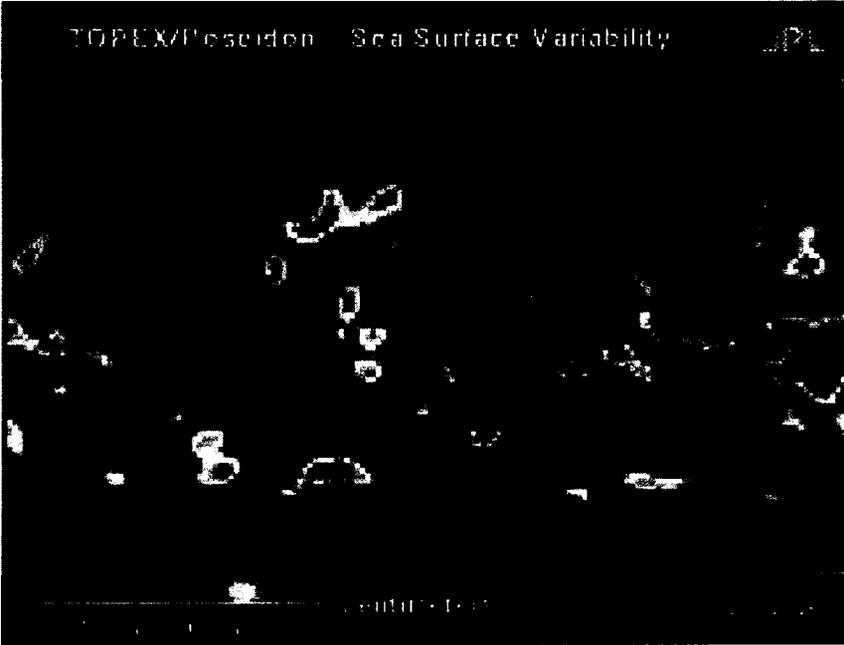
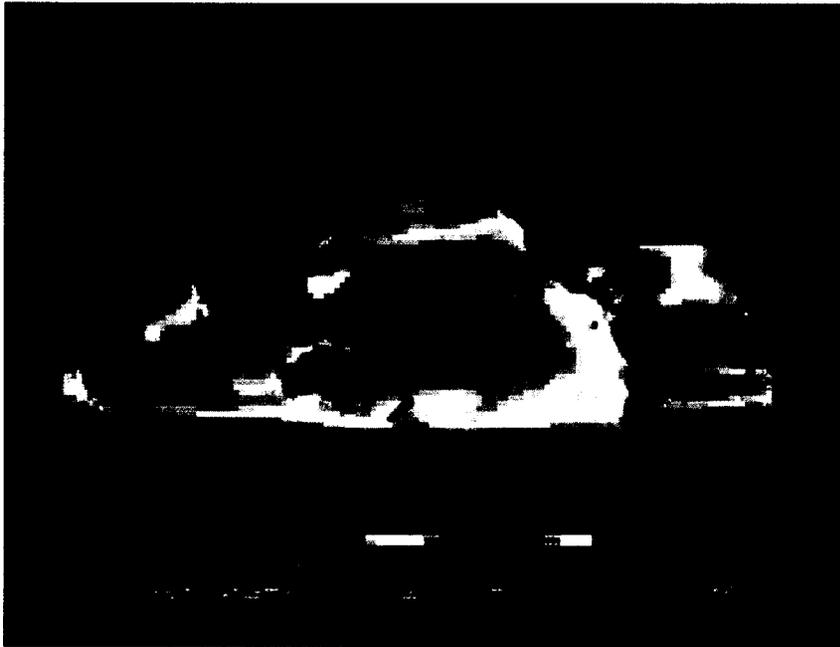
TOPEX Remote Sensing Technique

JPL





TOPEX Data Products





TOPEX & EL NIÑO

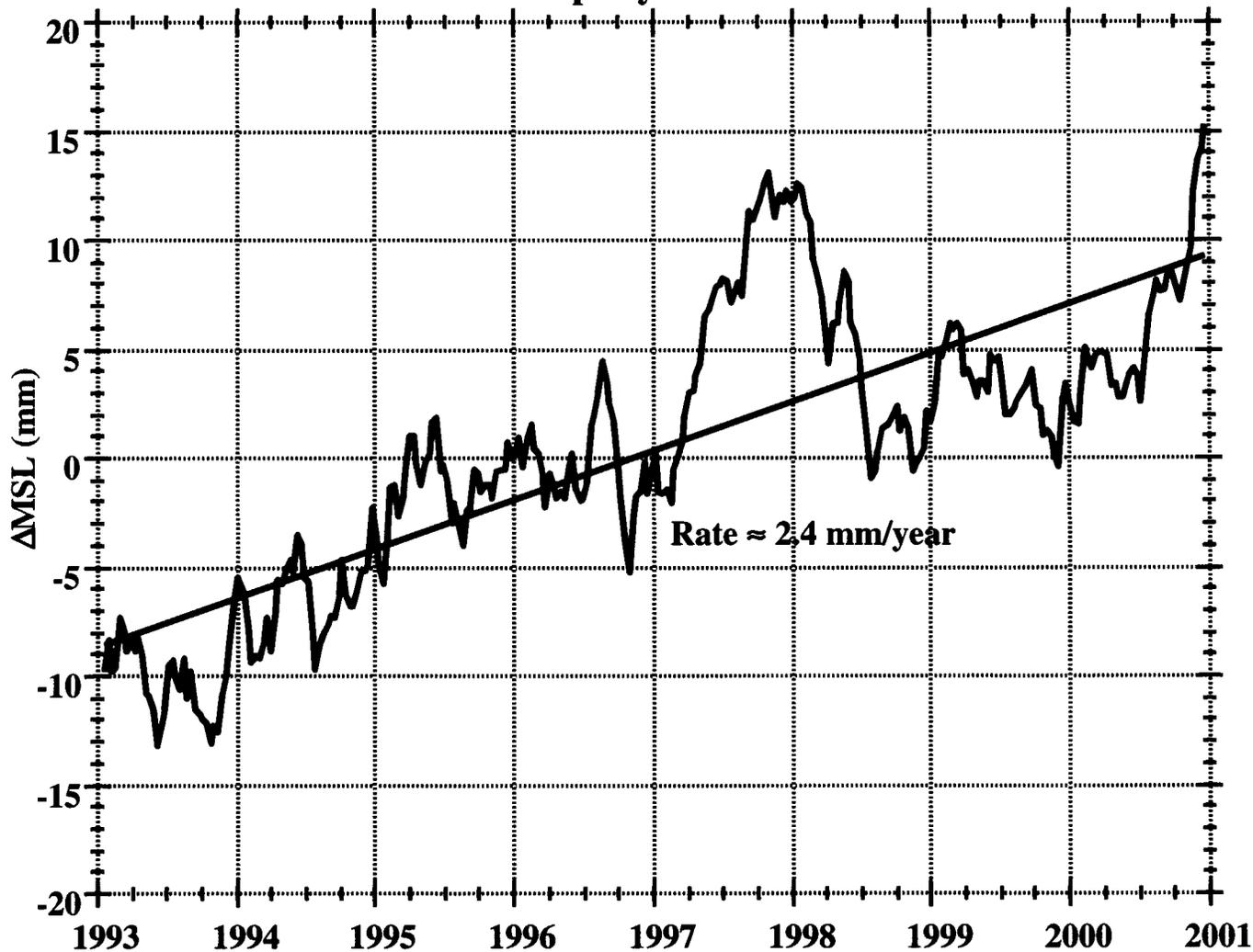




GLOBAL MEAN SEA LEVEL VARIATION



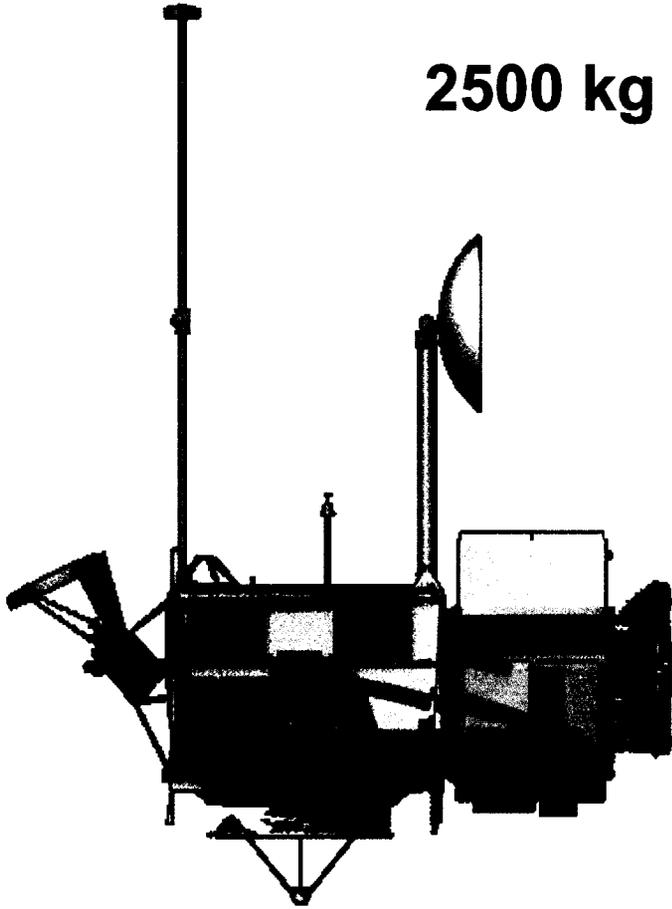
Global sea level has increased at an average rate (red line) of 2.4 millimeters per year from 1993-2001.



Nerem, 2001



TOPEX SPACECRAFT

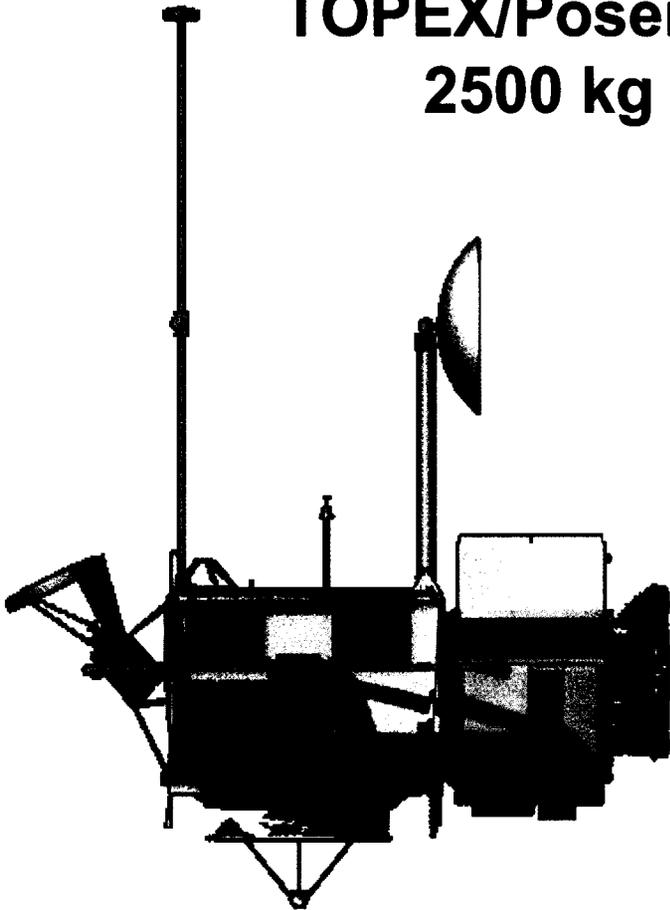




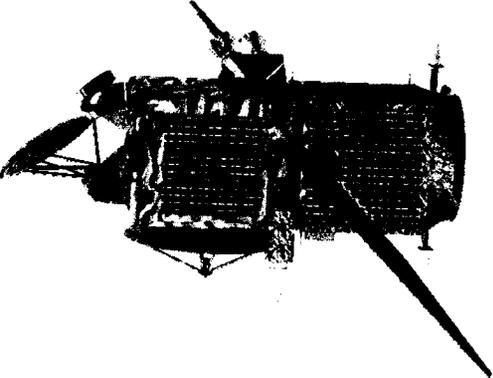
SPACECRAFT COMPARISON



TOPEX/Poseidon
2500 kg

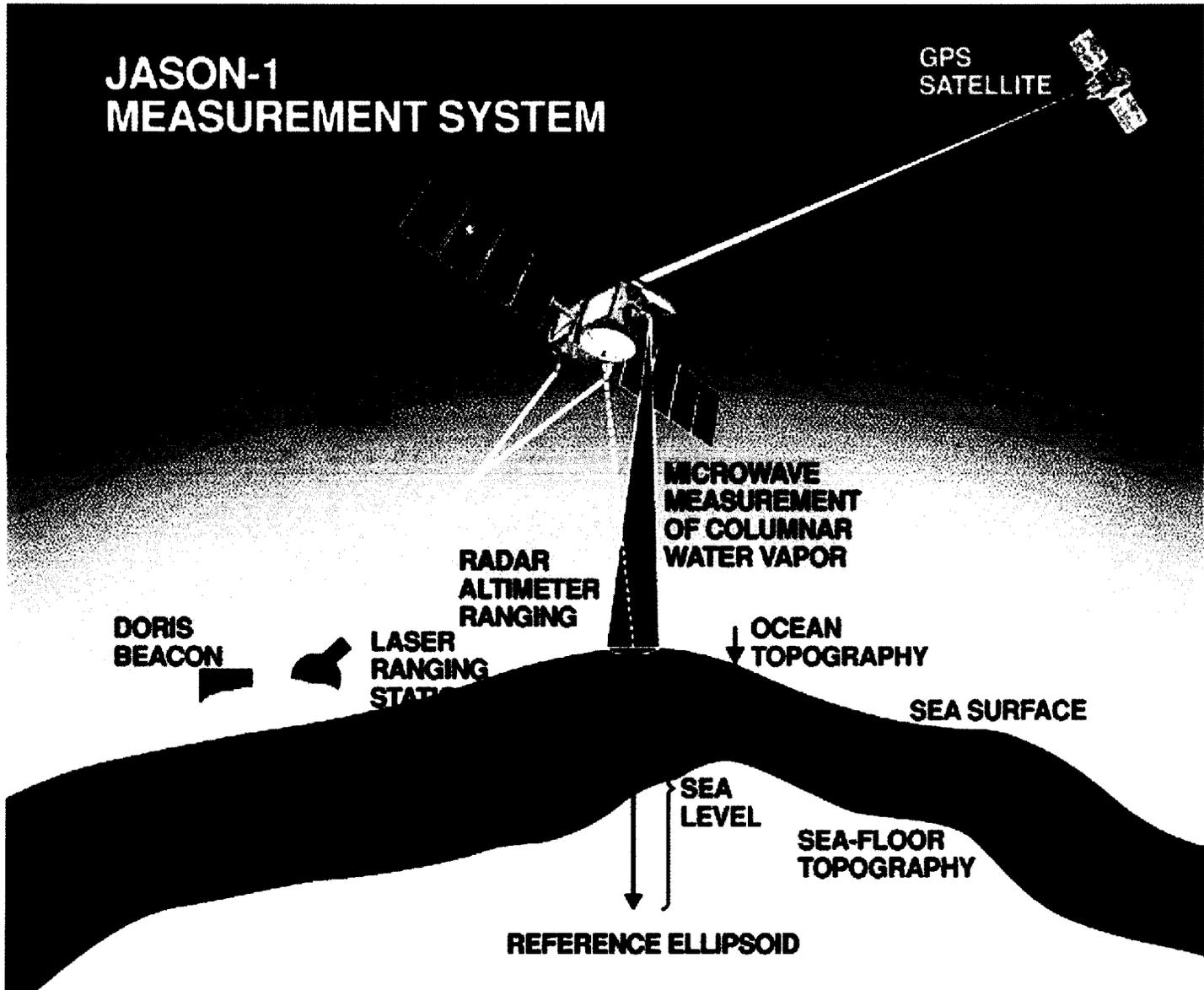


Jason-1
500 kg



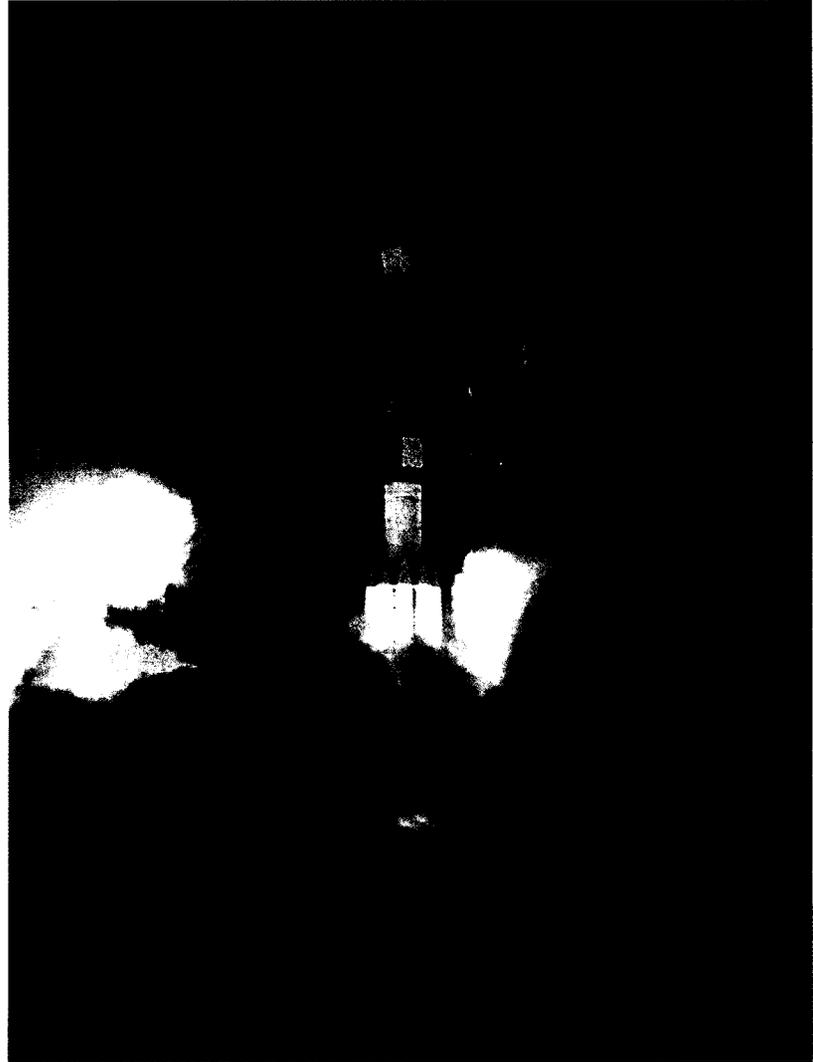
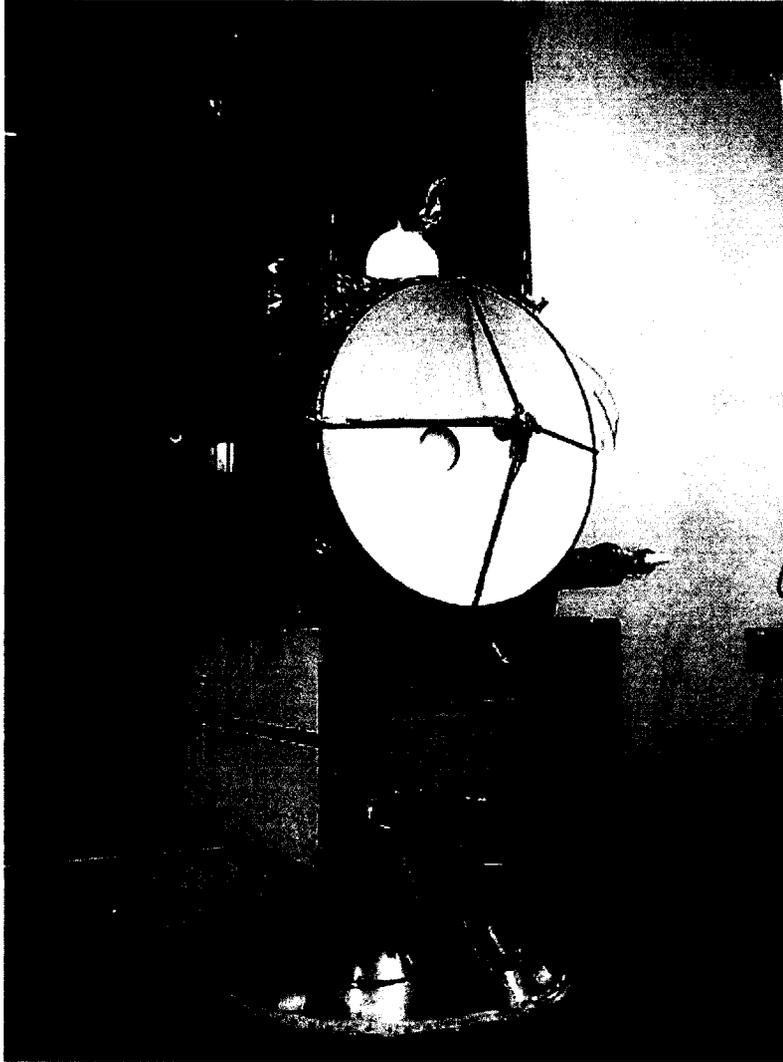


Jason-1 Remote Sensing Technique





Jason-1 Launch





Tandem Mission

JPL





Deep Ocean Circulation and Heat Transport

JPL





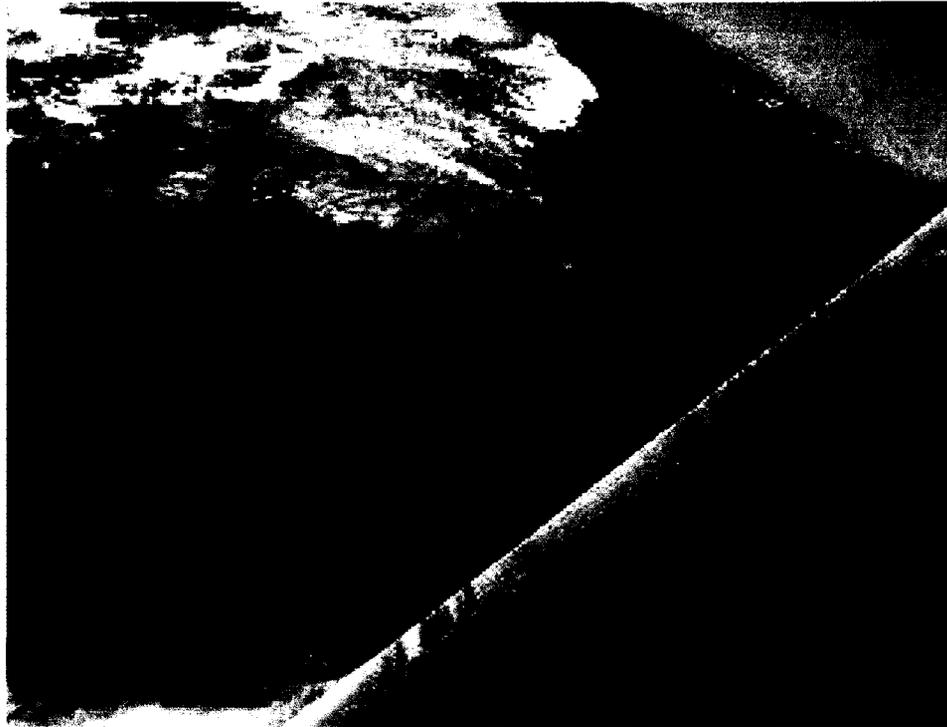
Twin GRACE Spacecraft





GRACE Remote Sensing Technique

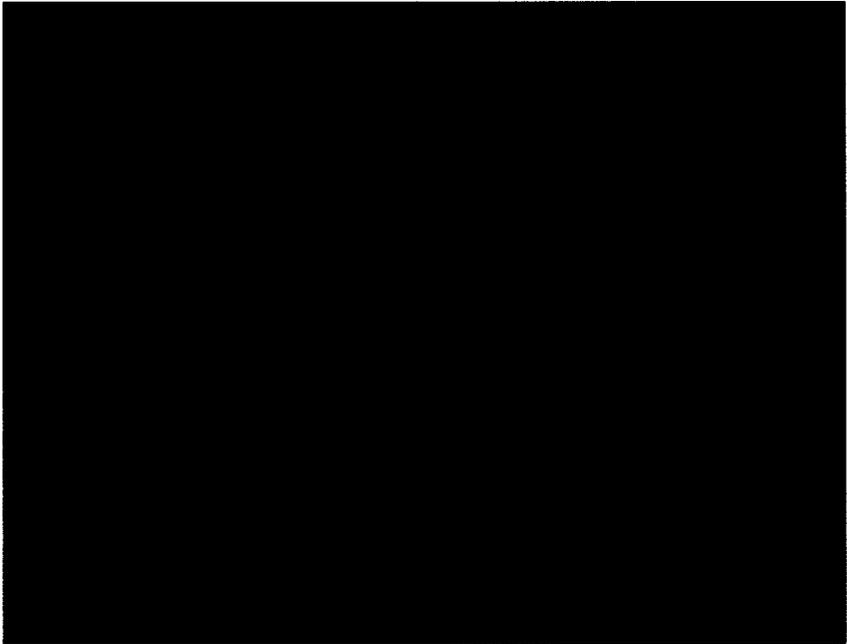
JPL



- Measure Spacecraft to Spacecraft distance to a few millionths of an inch
- Requires extremely sensitive instruments (star camera, accelerometer)



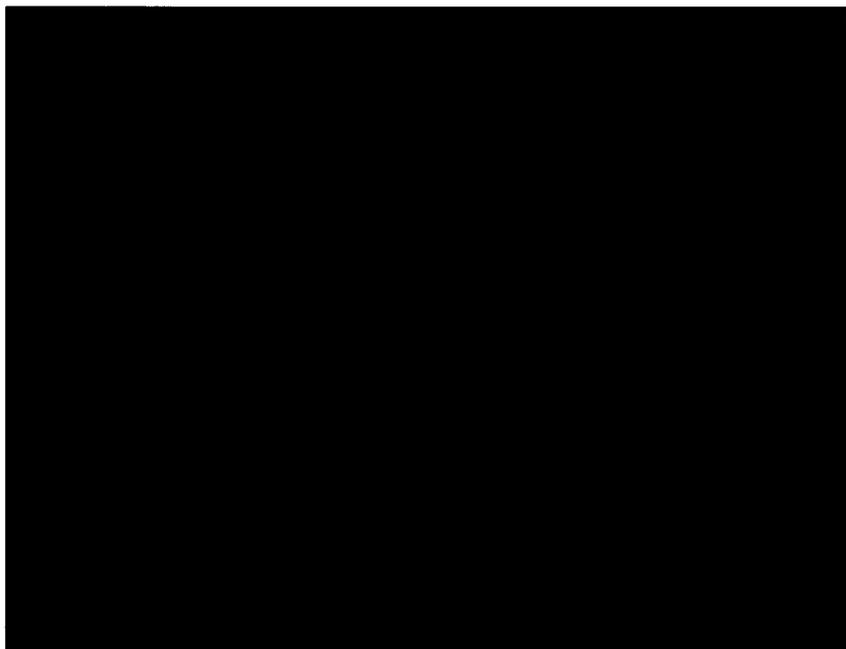
GRACE Remote Sensing Technique



MOVIE



GRACE Applications



MOVIE



GRACE Sensitive to 1 cm change
in large US Aquifer depths



GRACE World View





GRACE Remote Sensing of the Atmosphere (Radio Occultation)

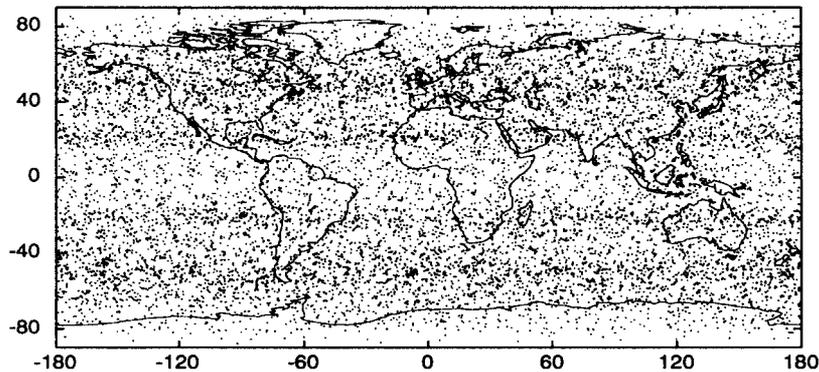
JPL



MOVIE



GRACE Remote Sensing of the Atmosphere (Radio Occultation)

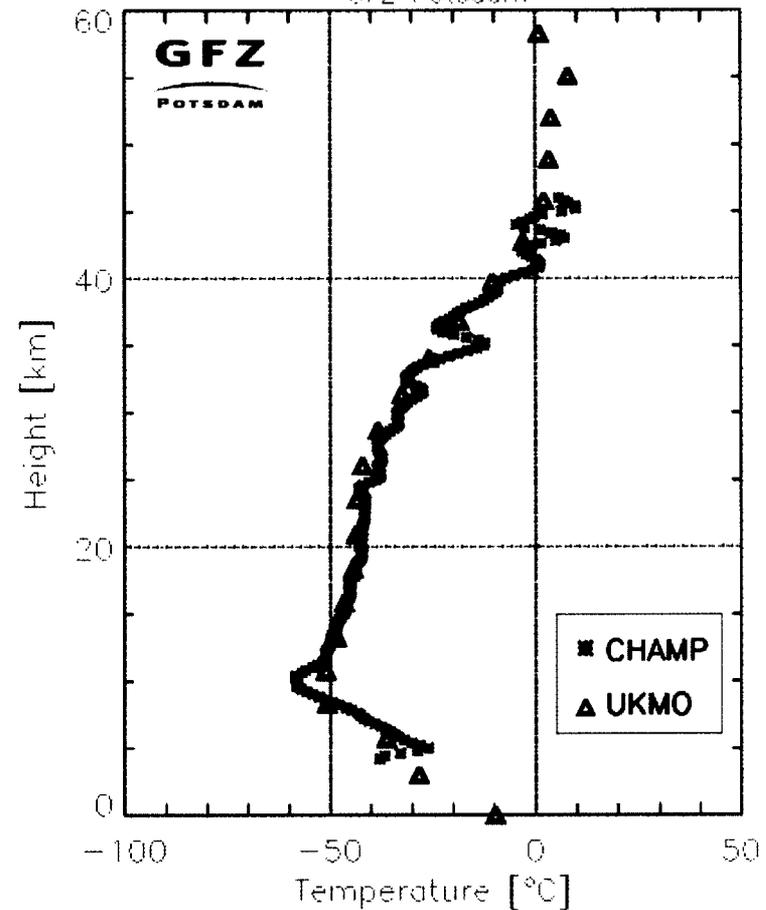


CHAMP GPS Occultation Experiment

First Temperature Profile (11/02/01)

19:33 UTC Lat: -80.37 Lon: 80.04

GFZ Potsdam

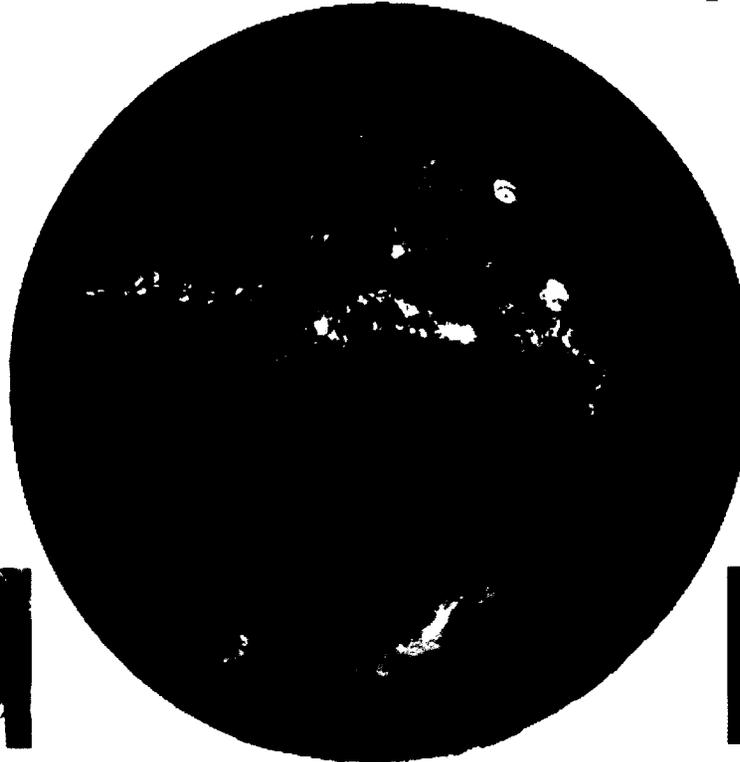




SO WHY DO WE STUDY THE OCEANS...



Because, it's clear that Earth is an ocean planet.



"Climate touches all of us. On a longer time scale, probably the most important determinant of human civilization has been climate."

Dr. William Patzert, NASA/JPL Oceanographer



More Information ...

JPL

JPL's Earth Science Program

<http://www.jpl.nasa.gov/earth>

JPL's Altimetry Missions

<http://sealevel.jpl.nasa.gov>

CNES's Altimetry Missions

[http://www.jason.oceanobs.com/html/portail/
general/welcome_uk.php3](http://www.jason.oceanobs.com/html/portail/general/welcome_uk.php3)

GRACE Mission Home Page

<http://www.csr.utexas.edu/grace>

CHAMP Mission Home Page

<http://op.gfz-potsdam.de/champ>

JPL Media Contact: Alan Buis (Alan.D.Buis@jpl.nasa.gov)



Backups

JPL



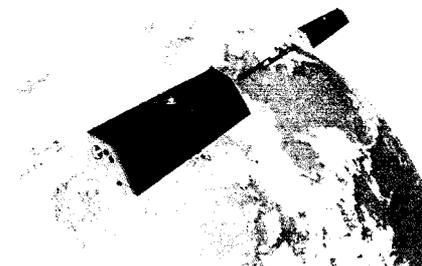
JPL Ocean Missions



TOPEX/Poseidon

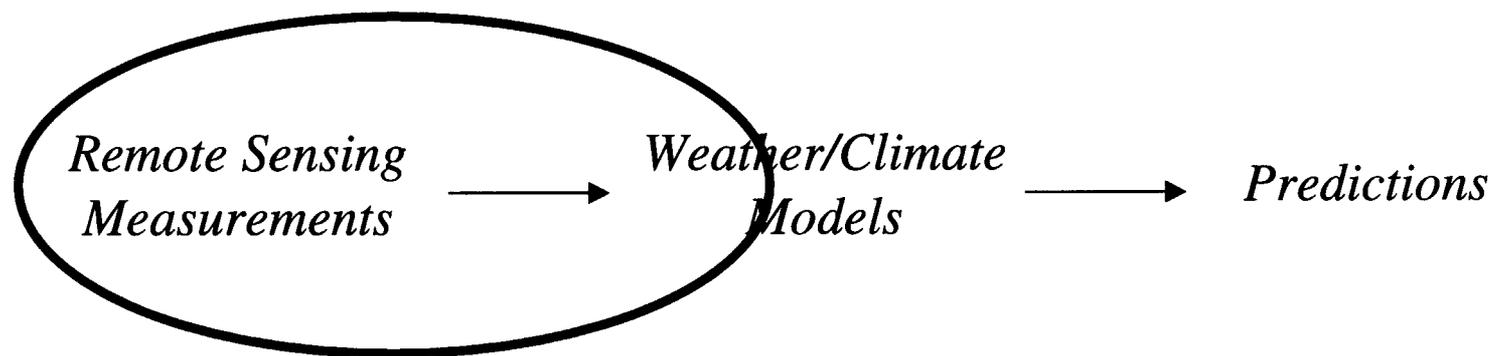


Jason-1



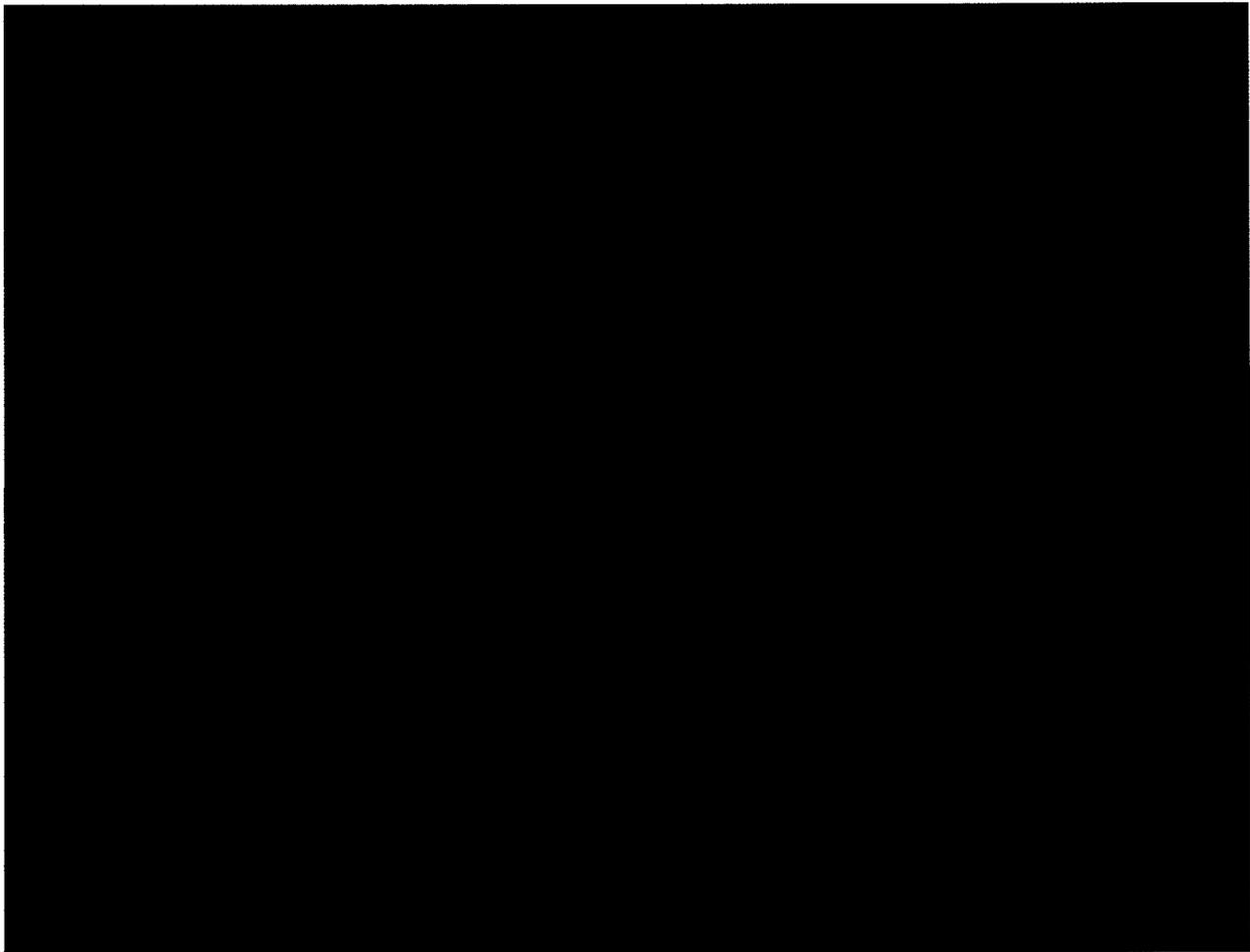
**Gravity Recovery and Climate
Experiment (GRACE)**

JPL missions provide a wealth of information for studying long-term climate, improving weather prediction, and determining the impact of humans on the environment.





TOPEX & Ocean Eddies





GRACE Spacecraft

JPL

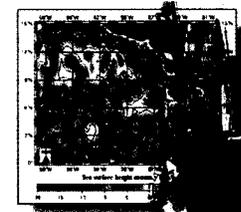
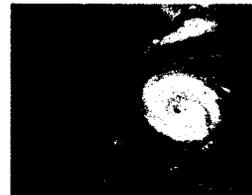




APPLICATIONS



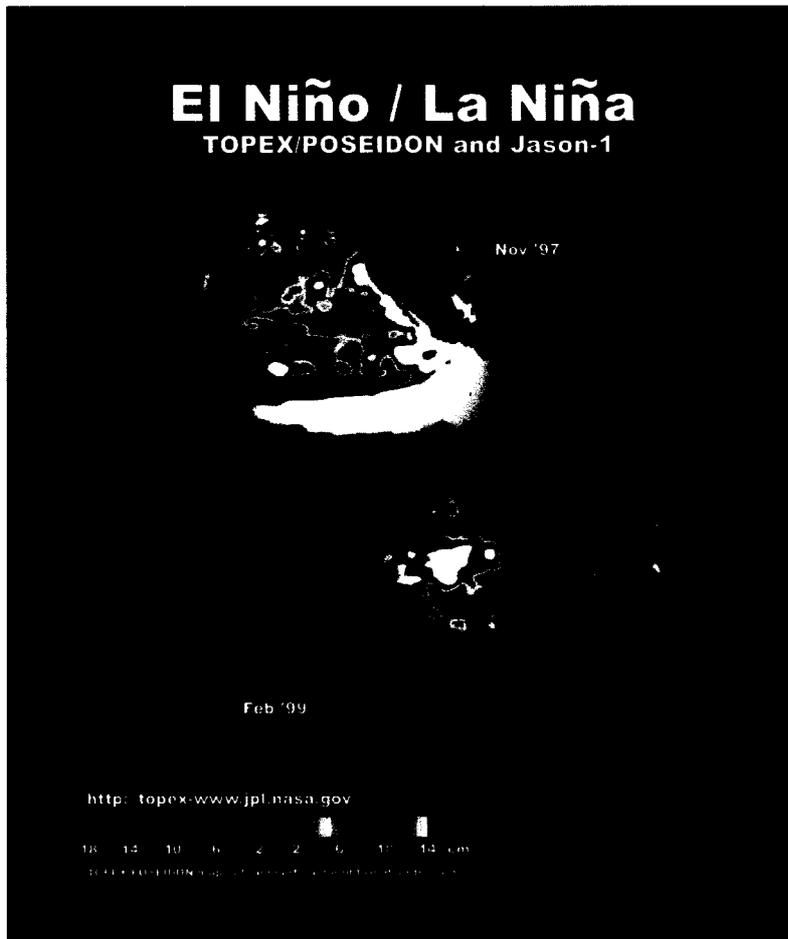
- Climate Research
- Ship Routing
- Offshore Industries
- Hurricane Forecasting
- Fisheries Management
- Marine Mammals Research
- El Niño & La Niña Forecasting
- Coral Reef Research
- Ocean Debris Tracking





EL NIÑO AND LA NIÑA FORECASTING & MONITORING

JPL



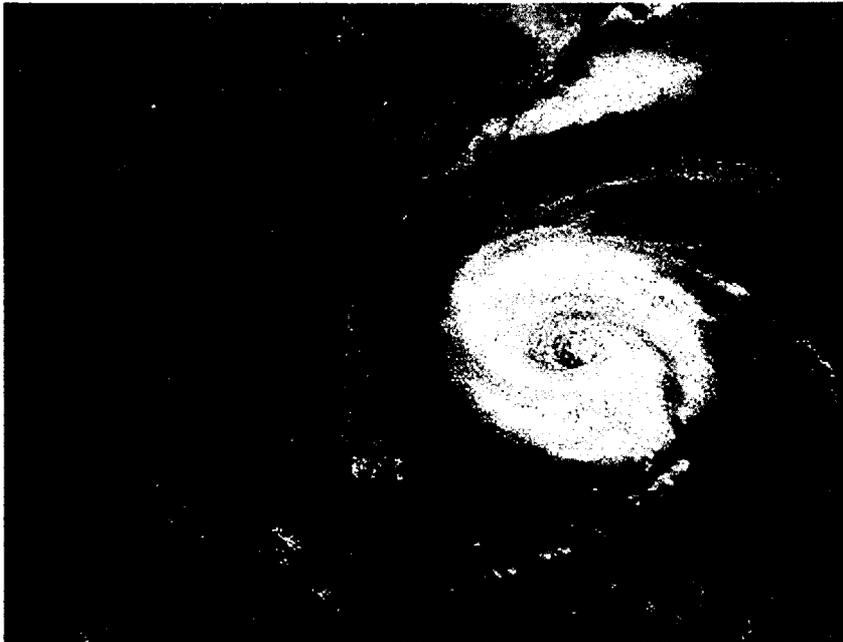
- Monitoring El Niño and La Niña
- NOAA long term climate forecasts: flood control, agricultural strategy, water and energy use planning
- Media use to explain weather and climate to the public
- TOPEX/POSEIDON data have become familiar to more than a billion people worldwide

Images produced by Dr. Victor Zlotnicki, Dr. Lee -Lueng Fu and Akiko Hayashi, of the Oceans Research Element at NASA's Jet Propulsion Laboratory.



HURRICANE FORECASTING

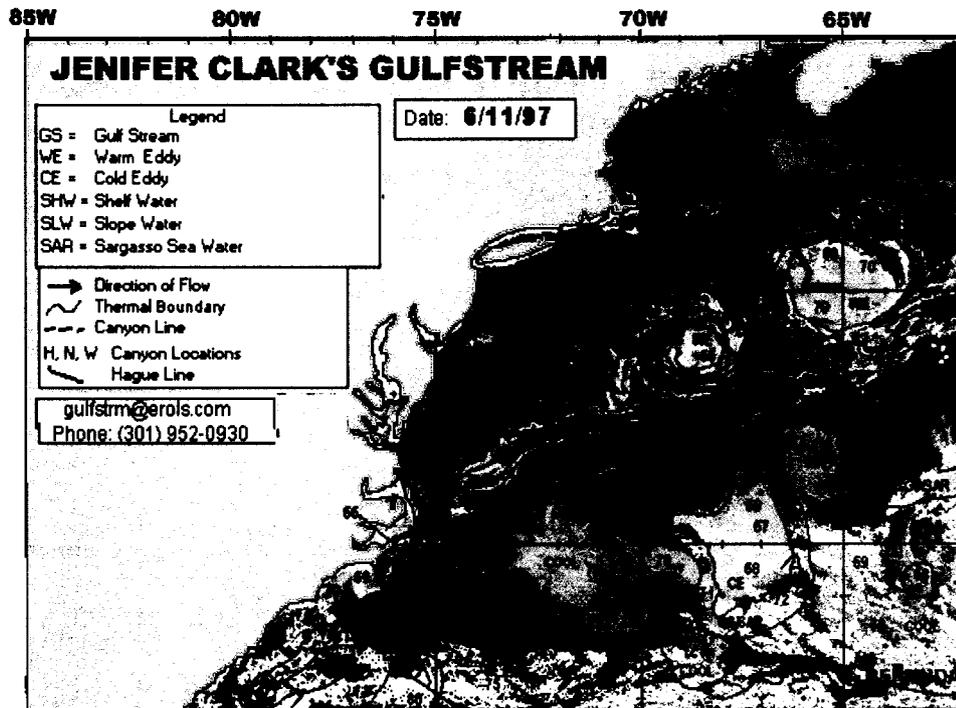
JPL



- **Long-term seasonal forecasts of the numbers and strengths of hurricanes expected in a given hurricane season**
- **Short term forecasts of the strength of individual hurricanes**



SHIP ROUTING



- Private companies make charts of surface height
- Eddies and swift moving currents can be identified
- Transatlantic ship routing, cable laying, and oil exploration use these maps to increase safety and economic return.



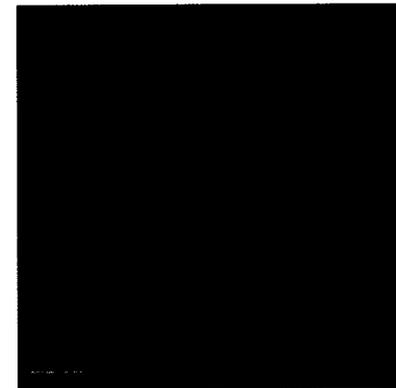
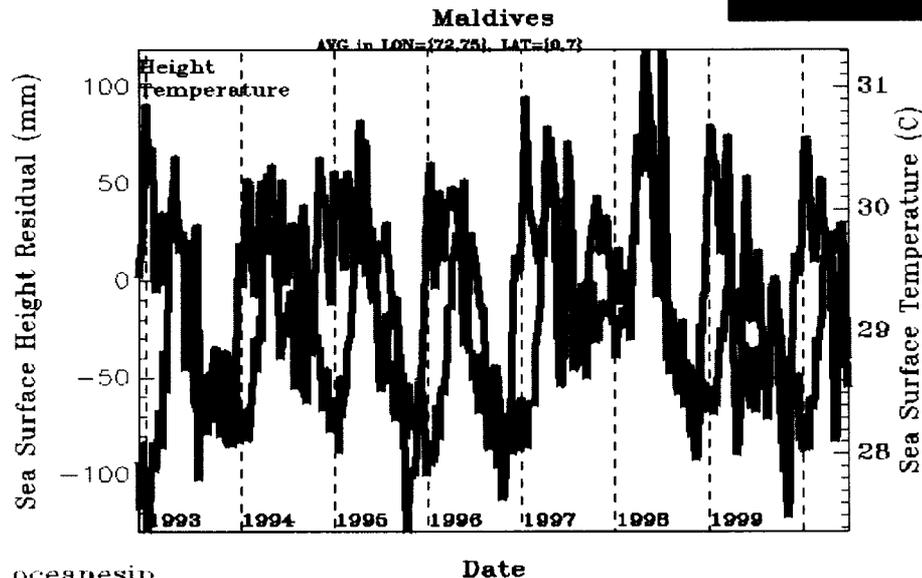
CORAL BLEACHING CLIMATE CHANGE



- TOPEX/POSEIDON altimeter sea level and NOAA AVHRR sea surface temperature data monitor and assess global coral reef environments.
- High and low tropical sea levels and ocean temperatures caused by the '97 to '98 El Niño/ La Niña “bleached” 25% of all coral reefs.



90% Bleached

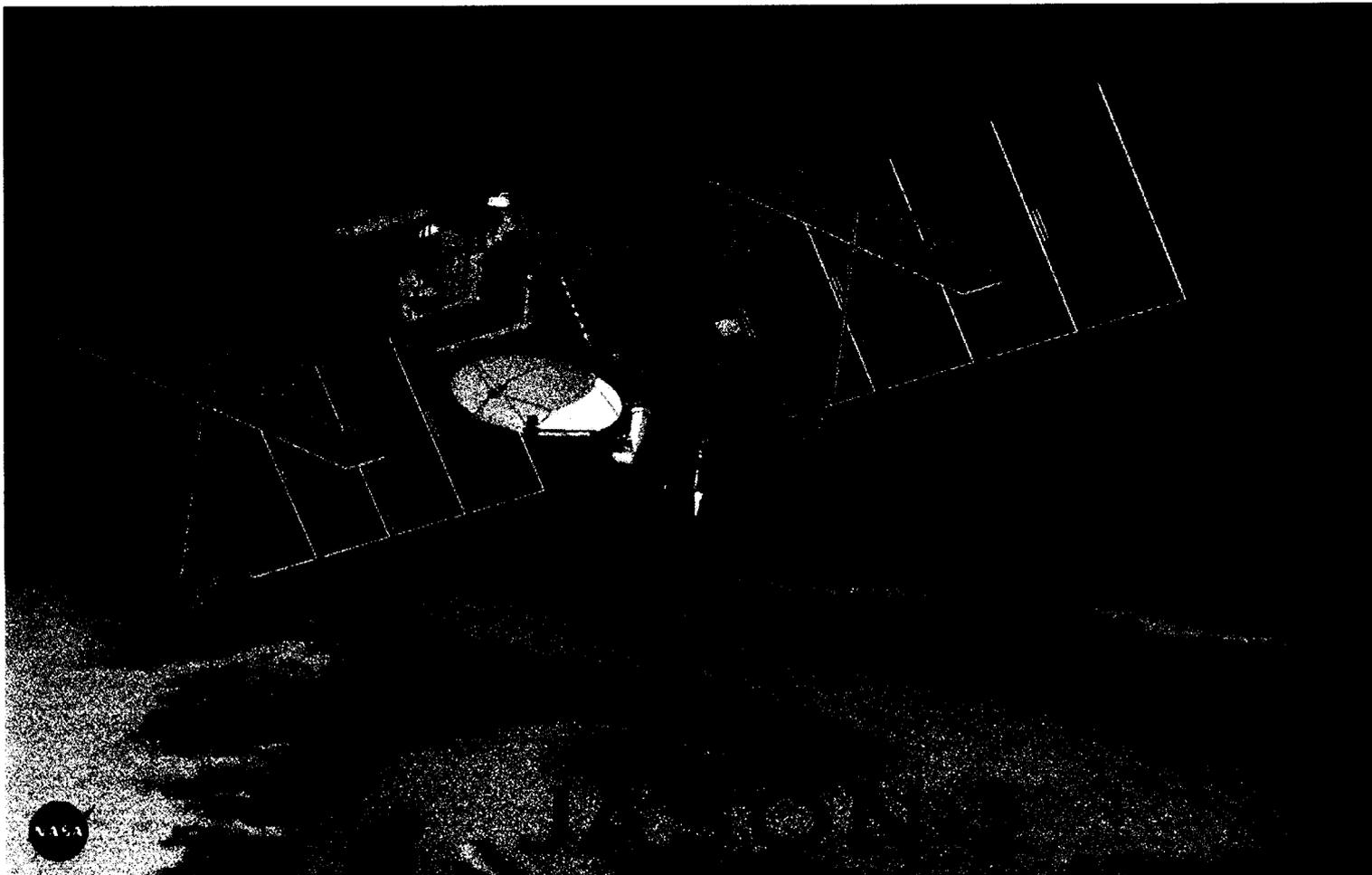




JASON-2

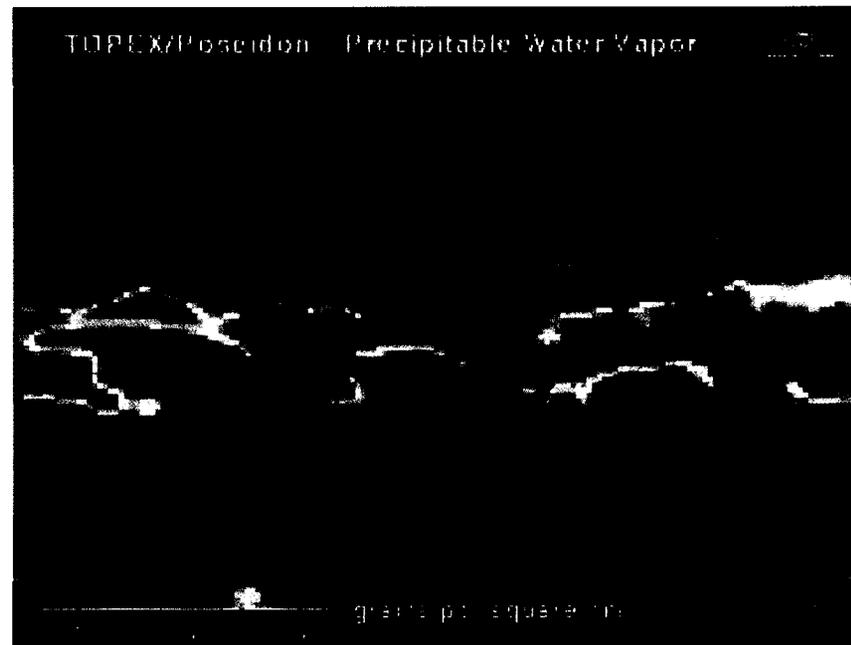
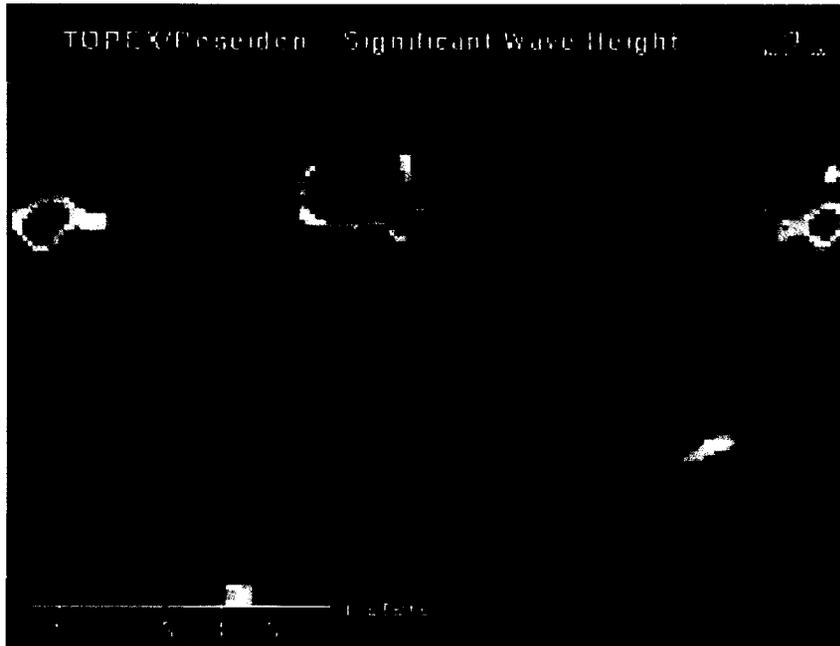
JPL

Jason-1 and its successors will enable critical topographic measurements to continue without interruption, giving us the time scales needed to observe global climate changes.





TOPEX Data Products





JASON-1

JPL





JASON-1

Scheduled Launch: December 7, 2001

JPL

- **Joint Mission with French Space Agency (CNES)**
 - CNES provided satellite; NASA provided launch vehicle; Mission Operations at JPL
- **Follow-on to TOPEX/POSEIDON, Same Circular 1336 km, 66 degree inclination orbit.**
- **Launch Vehicle: Boeing Delta II 7920**
- **Launch Site: Vandenberg AFB, California**
- **Dual Launch: Shared with TIMED, another NASA mission**
 - Jason-1 will separate first
- **Five Instruments:**
 - Altimeter - measures sea level (CNES)
 - Radiometer - Measures water vapor (JPL)
 - DORIS - Satellite tracking (CNES)
 - TRSR - Global Positioning System Receiver (JPL)
 - LRA - Laser Satellite Positioning (JPL)
- **Satellite Mass: 500 kg**
- **Satellite platform: Proteus spacecraft bus**

