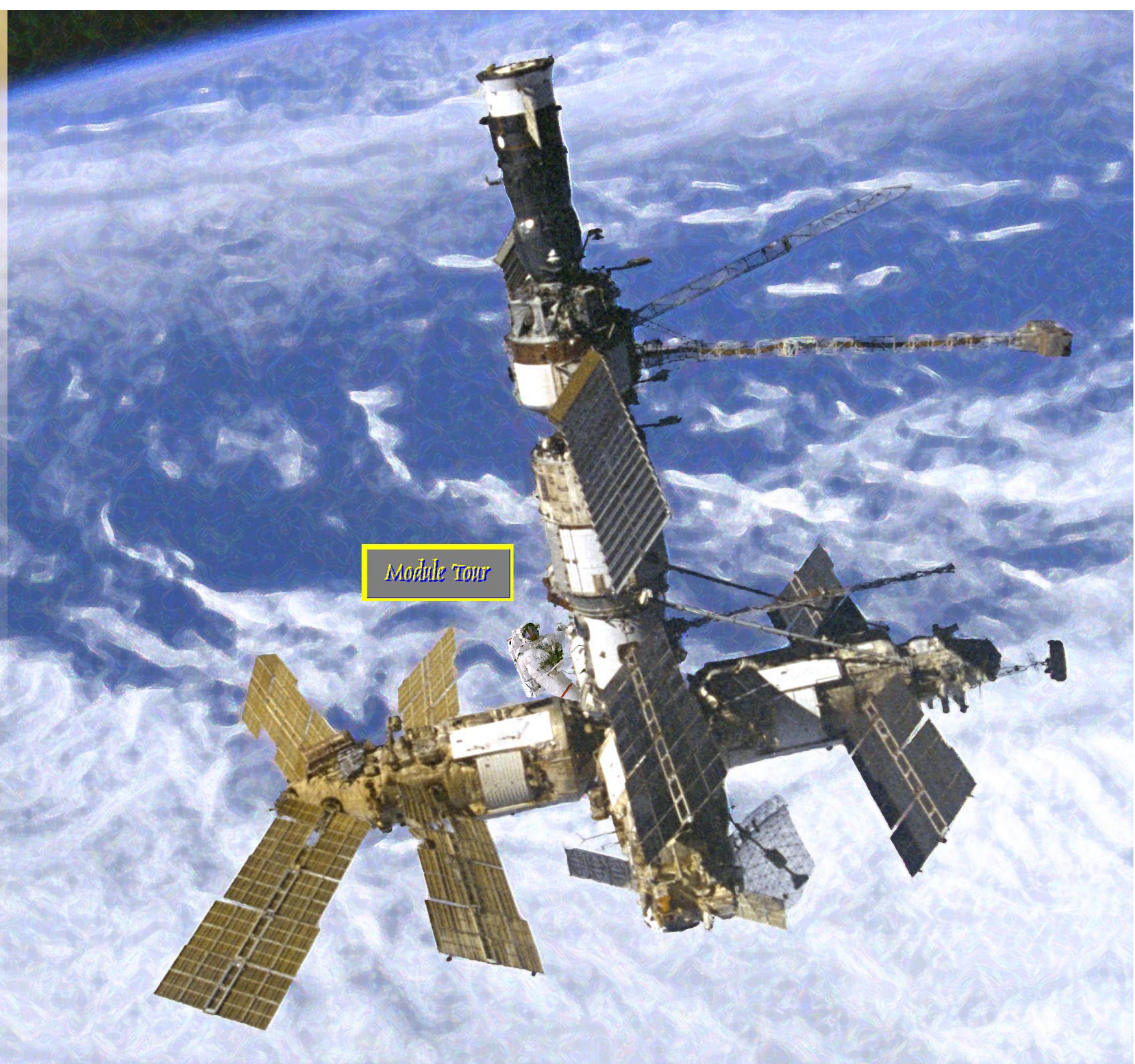


# Phase 1: A Journey to Mir 1994~1998



*Module Tour*

*List of Experiments*

*List of Experiments by Increment*

# EARTH SCIENCES

## REGIONAL AND TEMPORAL VARIABILITY OF PRIMARY PRODUCTIVITY IN OCEAN SHELF WATERS (COLOR)

This investigation is part of NASA's Mission to Planet Earth. Ocean shelf (coastal) waters are monitored to study the possible overestimation of primary coastal productivity occurring through conventional satellite techniques. Test sites may be imaged throughout the diurnal cycle, thereby permitting the investigation of short period phenomena. The investigation utilizes the unique capabilities of MOZ-Obzur, a remote sensing, ocean color instrument aboard the Priroda module. MOZ-Obzur, combined with the U.S.'s Sea Wide Field Sensor (SeaWiFS) will yield critical insights on the role of aerosols and dissolved solids in shelf and river plumes.

### SCIENCE OBJECTIVES

1. Quantify role of continental margins in global BGC.
2. Investigate physical and chemical factors controlling production.
3. Investigate trajectory of materials supplied by upwelling and river discharge.
4. Compare MOZ-Obzur and SeaWiFS data.
5. Investigate use of MOZ-Obzur to correct SeaWiFS Data for aerosol distribution.
6. Assure data compatibility between Priroda and SeaWiFS.

### FUNCTIONAL OBJECTIVES

Comparison of MOZ-Obzur and other satellite data together with sea data.

### ASSOCIATED HARDWARE

Priroda Earth Observation Sensors

### SPECIFIC SITE LOCATIONS REQUIRED

Amazon plume dispersal region  
Caribbean Sea  
Maracaibo Lake  
Gulf of Mexico, emphasis on West Florida  
Mississippi Delta  
Chesapeake and Delaware Bay  
Bermuda (JGOFS Station)  
Gulf of California  
Lanai, Hawaii (SeaWiFS site)  
Thyrennic Sea (Gulf of Naples)  
Northern Adriatic  
Baltic Sea (Bight of Gdansk)  
Equatorial Pacific Ocean  
U.S. East Coast

## CALIBRATION AND VALIDATION OF PRIRODA MICROWAVE SENSOR (IKAR)

This investigation is part of NASA's Mission to Planet Earth. The calibration and stability of Priroda microwave sensors will be documented and parameter retrievals will be validated by comparisons with other satellite and airborne sensors. The investigation utilizes the IKAR, a suite of Priroda microwave sensors that study atmospheric moisture and land and ocean surface properties. The main goal of the project is to cross-calibrate the IKAR with U.S. sensors so that a variety of scientific projects can be undertaken using time series data from multiple sources. U.S. sensors include the operational Special Sensor Microwave/Imager (SSM/I) and previously flown sensors such as the Scanning Multispectral Microwave Radiometer (SMMR).

### SCIENCE OBJECTIVES

1. Document sensor characteristics.
2. Validate sensor retrieval algorithms.

### FUNCTIONAL OBJECTIVES

1. Compare IKAR-D and other sensor data to SSM/I observations taken in near simultaneity.

2. Verify geolocation through identification of specific features.
3. Use flights of opportunity to compare IKAR-D and other data to airborne sensor observations and ground data.

### ASSOCIATED HARDWARE

Priroda Earth Observation Sensors

### SESSION SCENARIO

Priroda Earth observation sensors are activated via ground-based commanding and data recorded.

### SPECIFIC INSTRUMENTS REQUIRED

IKAR-N, -D, and -P

Though no specific site locations are required, a representative collection of Earth locations (oceans, desert tropical forest, sea ice) is needed.

## WATERSHED HYDROLOGIC STUDIO (SAILWET)

This investigation is part of NASA's Mission to Planet Earth and will study large watershed hydrology in various climatic regimes. Microwave remote sensing (using the Priroda module's IKAR sensor suite) will be evaluated as a source of information on large watershed hydrology. The primary test site is the American southwest. Data from this investigation will be used to support the International GEWEX Programme of the World Climate Research Programme.

### SCIENCE OBJECTIVES

1. Develop and validate algorithms to retrieve hydrologic properties and fluxes in various climatic regimes.
2. Assess value of specific frequencies.
3. Assess value of long term observation series.

### FUNCTIONAL OBJECTIVES

1. Collect multifrequency observations with IKAR-P and IKAR-N for long time series over instrumented test sites.
2. Use ground truth radar, other satellite observations, and airborne observations to validate parameter retrievals.
3. Use R-400, TRAVERS SAR, ISTOK-1, MOS-A, MOS-B, and MSU-SK for ancillary data.

### ASSOCIATED HARDWARE

Priroda Earth Observation Sensors

### SESSION SCENARIO

Priroda Earth observation sensors are activated and data recorded.

### SPECIFIC PRIRODA SENSORS NEEDED IN ORDER OF PRIORITY

1. IKAR-P and -N
2. IKAR-D and R-400
3. SAR-TRAVERS
4. ISTOK-1, Thermal Data
5. MOS-A/B
6. MSU-SK

### SPECIFIC SITE LOCATIONS

1. Little Washita River, OK
2. Walnut Gulch, AZ
3. GCIP Mississippi Basin

### Principal Investigators:

REGIONAL AND TEMPORAL VARIABILITY OF PRIMARY PRODUCTIVITY IN OCEAN (COLOR)

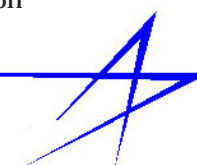
F. E. Muller-Karger

CALIBRATION AND VALIDATION OF PRIRODA MICROWAVE SENSOR (IKAR)

James C. Shiue

WATERSHED HYDROLOGIC STUDIO (SAILWET)

Thomas J. Jackson



**VALIDATION OF BIOSPHERE -  
ATMOSPHERE INTERCHANGE  
MODEL FOR NORTHERN PRAIRIES  
(PRAIRIES)**

This investigation is part of NASA's Mission to Planet Earth and seeks to validate a model of land atmosphere interactions. The Biosphere Atmosphere Transfer Scheme (BATS) focuses on the diurnal and seasonal time scales and is driven by passive microwave measurements. The validation program will utilize NASA ground truth radar on the northern prairie of North America and Priroda microwave sensor observations.

**SCIENCE OBJECTIVES**

Validate Biosphere-Atmosphere Interchange Model of Northern Prairies.

**FUNCTIONAL OBJECTIVES**

1. Acquire IKAR-D covering the diurnal cycle on a seasonal basis.
2. Acquire contemporaneous SSM/I data.
3. Validate biosphere-atmosphere model using satellite data and antecedent weather data.

**ASSOCIATED HARDWARE**

Priroda Earth Observation Sensors

**SESSION SCENARIO**

Priroda Earth observation sensors are activated and data recorded. Coordinates to be provided in separate fax.

**COMPARISON OF ATMOSPHERIC  
CHEMISTRY SENSORS ON PRIRODA  
AND AMERICAN SATELLITES  
(CHEMISTRY)**

This project is part of NASA's Mission to Planet Earth and seeks to establish the relationships among measurements obtained by various satellite sensors designed for studies of atmospheric chemistry. The Ozone-Mir, Istok-1, and MOZ-Obzur on Priroda will be compared with TOMS, SBUV/2, SSBUV, SAGE II, POAM II and various sensors on UARS to determine how to best use their complementary capabilities in long term studies. Understanding of these relationships will permit the conduct of other studies using a combination of these sensors to extend time series or to provide complementary information.

**SCIENCE OBJECTIVES**

Comparison of contemporaneous data from multiple sensors.

**FUNCTIONAL OBJECTIVES**

1. Acquire near simultaneous data over selected regions.
2. Exchange data.

**ASSOCIATED HARDWARE**

Priroda Earth Observation Sensors

**SESSION SCENARIO**

Priroda Earth observation sensors are activated and data recorded.

**SPECIFIC SENSORS REQUIRED IN  
ORDER OF PRIORITY**

1. Ozone-Mir
2. Istok-1
3. MOZ-Obzur

Priroda sensors will collect data globally (no specific site locations).

**VALIDATION OF PRIRODA RAIN  
OBSERVATIONS (RAIN)**

This investigation is part of NASA's Mission to Planet Earth. The goal of this project is to validate the Priroda determination of precipitation rates over the ocean using NASA ground-based resources developed for the Tropical Rainfall Measuring Mission (TRMM). A secondary goal is to utilize Russian ground radar to validate precipitation rates over the ocean from the joint NASA-Japanese TRMM.

**SCIENCE OBJECTIVES**

Validate rain rate estimations from Priroda sensors.

**FUNCTIONAL OBJECTIVES**

1. Acquire Priroda data over U.S. test site in Melbourne, FL.
2. Compare to rain radar data.

**ASSOCIATED HARDWARE**

Priroda Earth Observation Sensors

**SESSION SCENARIO**

Priroda Earth observation sensors are activated and data recorded. Data will be collected using the MOZ-Obzur sensors.

**SPECIFIC INSTRUMENTS REQUIRED IN  
ORDER OF PRIORITY**

1. IKAR-N, -D, and -P
2. MSU-SK and MSU-E
3. SAR

**SPECIFIC SITE LOCATIONS**

1. Central Florida, around Melbourne

**TEST SITE MONITORING (TEST)**

This experiment involves environmental monitoring by way of coupled data collection (visual and film-based observations and data from Priroda sensors) over four test sites. We propose to routinely collect data over the Aral Sea; Galveston Bay, Tx; South Florida and the Bahamas; and the Panama Canal Zone. The data will include observations and imagery by astronauts and cosmonauts, as well as imagery collected by mounted sensors such as the KFA-1000 camera, and the MSU-SK and MSU-E sensors on the Priroda module. These data, collected at least seasonally, will allow us to monitor these rapidly changing regions which are exemplary of several interdisciplinary processes. The data will also allow us to extrapolate observations from our historical database and ground-based studies to produce a more comprehensive assessment of the nature and rate of the changes. Each site has a significant historical archive which will serve as a baseline for the observations collected onboard Mir.

Opportunities for data collection, which will occur at least monthly for each site, will be planned based on orbit trajectory, attitude and weather constraints.

**SCIENCE OBJECTIVES**

Monitor changes in land cover and condition, lake levels, etc., at selected test sites in support of the U.S. EOS Program and global change research.

**FUNCTIONAL OBJECTIVES**

1. Acquire data from long and medium focal length film cameras and multispectral scanners.
2. Provide copies to EOS Test Site Program.
3. Describe environmental changes using these and other EOS Test Site data.

**Principal Investigators:**

VALIDATION OF BIOSPHERE -  
ATMOSPHERE INTERCHANGE  
MODEL FOR NORTHERN  
PRAIRIES (PRAIRIES)

A. W. England

COMPARISON OF  
ATMOSPHERIC CHEMISTRY  
SENSORS ON PRIRODA AND  
AMERICAN SATELLITES  
(CHEMISTRY)

Jack A. Kaye

VALIDATION OF PRIRODA RAIN  
OBSERVATIONS (RAIN)

Otto W. Thiele

TEST SITE MONITORING (TEST)

Cynthia Evans  
Kamlesh Lulla

## ASSOCIATED HARDWARE

Diskettes  
Mir Interface to Payload Systems-2 (MIPS-2)  
Hasselblad 70-mm Camera System (NASA)  
KFA 1000  
Priroda Earth Observation Sensors  
70 mm film

## SITE LOCATIONS

Texas-Louisiana Gulf Coast  
Goals: landuse, features in inland and coastal waters (e.g. sediment plumes, turbidity, oil seeps)

S. Florida - N. Bahamas  
Goals: landuse, coastal features (algae growth, turbidity, whittings)

Panama Canal Zone  
Goals: changing forest cover, lake levels and lake sediment  
Aral Sea  
Goals: water levels, dust, agriculture

## VISUAL EARTH OBSERVATIONS (OBS)

This experiment is designed for routine monitoring of the Earth from space using astronaut and cosmonaut observations and photography. Earth photography will be time-tagged with camera databacks and logged on an Earth observations electronic file. The continuous presence in low-Earth orbit will allow for observations of jointly selected sites to document geologic structures using variable sun angles, seasonal events such as biomass burning, longer-term changes such as the rise and fall of lake levels, gradual changes in land-use patterns, dynamic patterns in the ocean surface waters and globally-distributed episodic events like tropical storms, floods, forest fires, volcanic eruptions, and dust storms. Site selection will be based on longer-term planning of known regions of interest, and near term replanning of targets based on current events, weather patterns and trajectory and attitude information.

Communication with the crew about new sites will occur weekly, but special events will be requested in real-time. The film-based data will be exchanged

with Russian counterparts, and screened and archived by both sides.

## SCIENCE OBJECTIVES

Monitor changes observable on Earth's surface, and image ephemeral events (hurricanes, plankton blooms, volcanic eruptions) to complement 30+ year database of human observations.

## FUNCTIONAL OBJECTIVES

Astronauts and cosmonauts use onboard camera and imaging systems to document global events and changes.

## ASSOCIATED HARDWARE

Camcorder System (NASA)  
Diskettes  
Mir Interface to Payload Systems-2 (MIPS-2)  
35mm film w/container  
Hasselblad 70mm Camera System (NASA)  
Nikon F3 Camera System  
MIPS-2 Laptop  
Payload General Support Computer (PGSC)  
70mm Camera Bag  
70mm film  
Magneto-Optical Cartridge (MIPS)  
Nikon F4 Camera (STS)  
Camcorder (STS)  
Hasselblad 70mm Camera System (STS)  
Betacam (Russian)  
Nikon F4 Camera (ESA)  
Earth Observation Floppy

## SITE LOCATIONS

Multiple sites around the world. See Mir IPRD.

## SESSION SCENARIO

Crewmember photographs regions using Hasselblad camera and documents aerosol and cloud cover characteristics. Crewmember logs observations on Earth Sciences file on MIPS.



STS86-722-000B

Figure ES-1 Earth Observations of a Delta

## HARDWARE DESCRIPTIONS

Earth Observations hardware includes a suite of camera systems. The primary hardware is the NASA Hasselblad system with data-recording modules and 250mm and 100mm lenses. Ancillary data may be recorded on the NASA Nikon F3 35mm camera, any of the Russian camera systems, and the NASA Canon L2 camcorder. However, because data recording on the film is crucial for data interpretation, the NASA Hasselblad is to be used except in cases of camera malfunction.

In addition to the camera systems, the crew enters data on any Earth photography on a shared laptop computer, the MIPS-2. \*

## Principal Investigators:

VISUAL EARTH OBSERVATIONS (OBS)

Cynthia Evans, Ph.D.  
NASA/Johnson Space Center

Kamlesh Lulla

