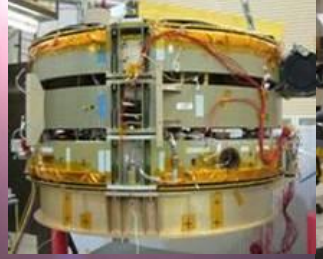
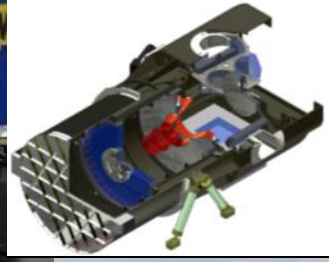
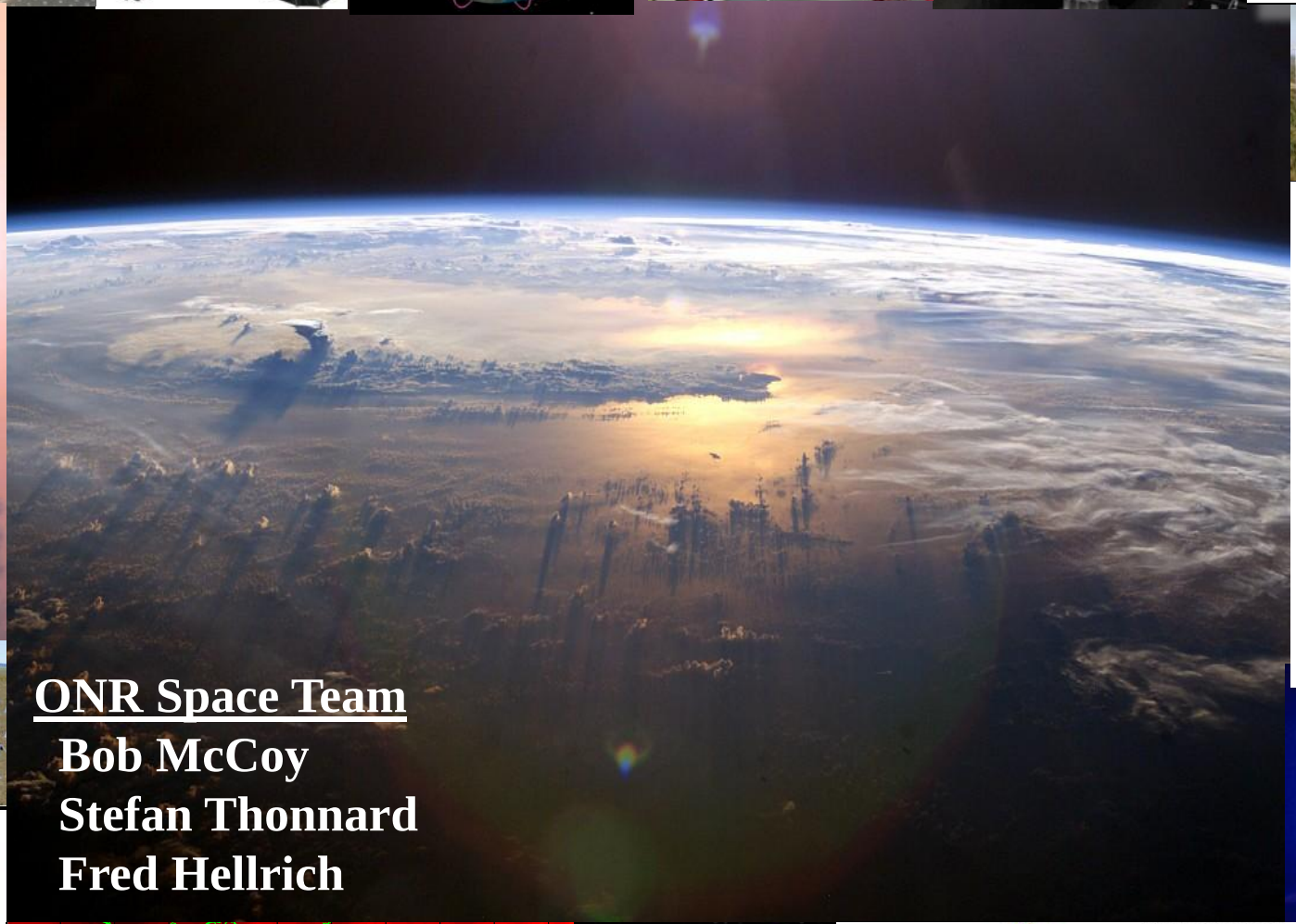
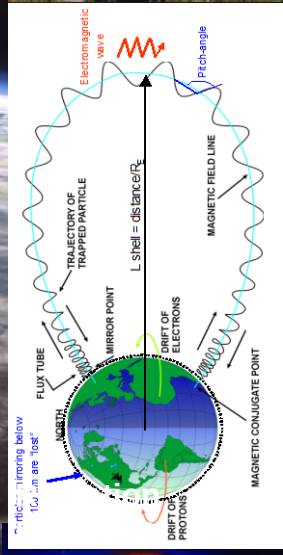
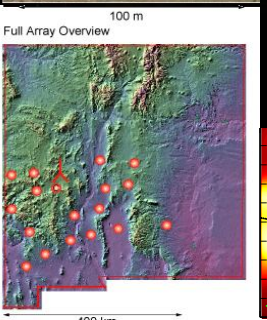








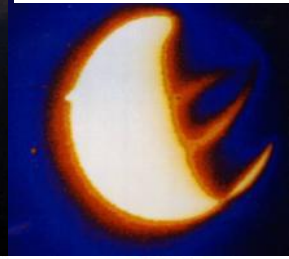


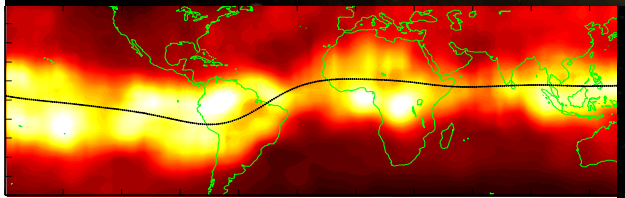
ONR Space Team

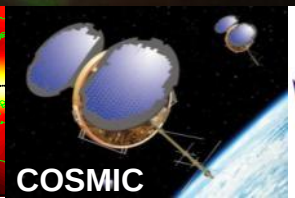
Bob McCoy

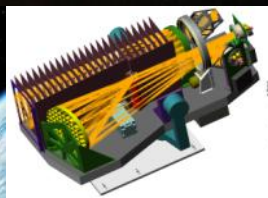
Stefan Thonnard

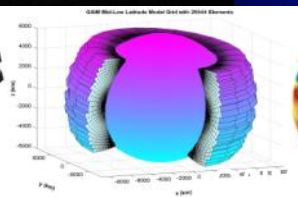
Fred Hellrich

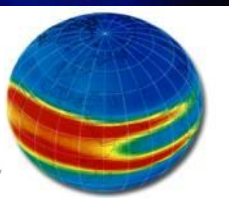




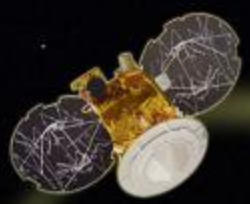




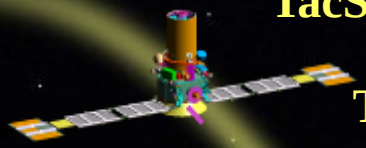




Tactical Space Innovative Naval Prototype (INP)



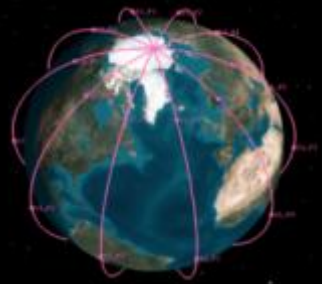
TacSat-1



TacSat-2

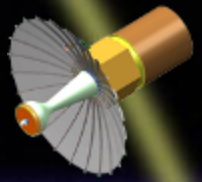
TacSat-3

ISS



GLADIS

SIV



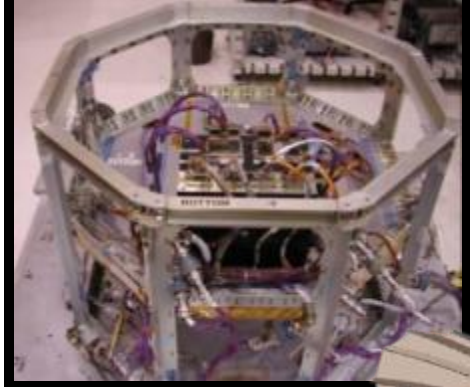
TacSat-4

Dr. Robert McCoy
Stefan Thonnard
Fred Hellrich 703 696 5117
Frederick.hellrich.ctr@navy.mil
ONR 322 SP

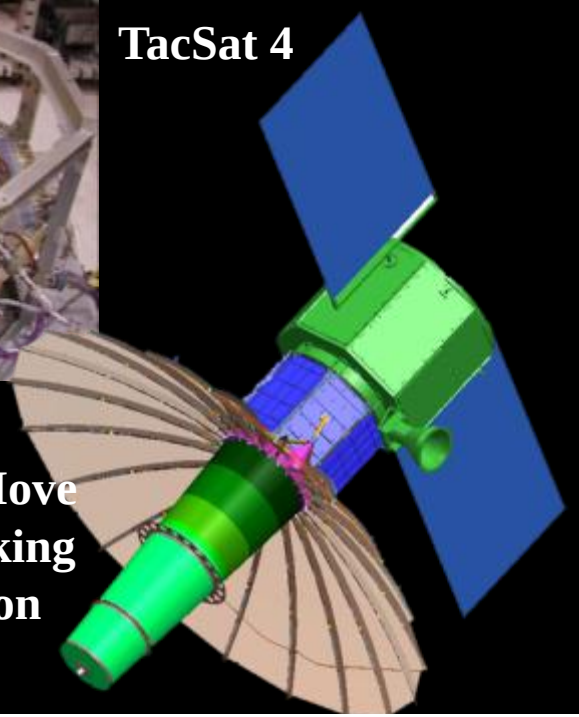
MDA
Ship Tracking
Cross Platform
Precision
Geolocation

TacSat 2, 1A

ELINT
SEI
AIS

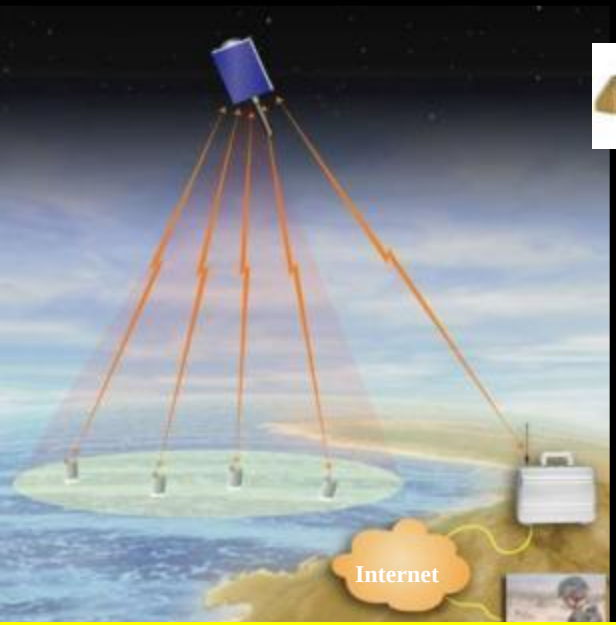


TacSat 4



Comms on the Move
Blue Force Tracking
Data Exfiltration

vmoc



Two-way
Data
Exfiltration

TacSat 3
TacSat 4
SIV

Ocean Data Telemetry Microsatellite Link (ODTML)

Maritime Hyperspectral Imaging

International
Space Station
Japanese
Experiment
Module
(JEM)

HICO

TacSat-4 Mission Overview

TacSat–4: Providing Communications and Enabling ORS

Augment National SATCOM with:

- 10 Legacy UHF Channels
- COMMS-on-the-Move without User Antenna Pointing
- Networked COMMS on SIPRNET
- A Single MUOS-like Wideband Channel for Early Testing
- UHF Blue Force Tracking (BTF), now "Friendly Force Tracking" (FFT), Collection in Underserved Areas
- Data Exfiltration from Unattended Ground & Maritime Sensors

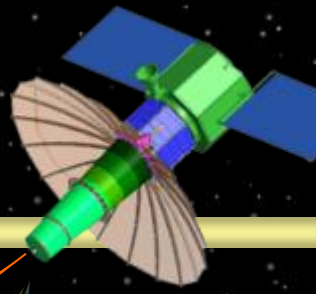
PRC-117 f/g

PSC-5

PRC-152

PRC-148 MBITR

And other SATCOM radios, as tested.



Low-HEO Orbit
2+ Hour Dwell

C2 Link

NRL's Blossom Point Ground Station, Maryland

UHF Bent-pipe (285 – 415 MHz)

Comms on the Move
Legacy(5 kHz/25 kHz), Networked, Wideband (5 MHz)

Friendly Force Tracking

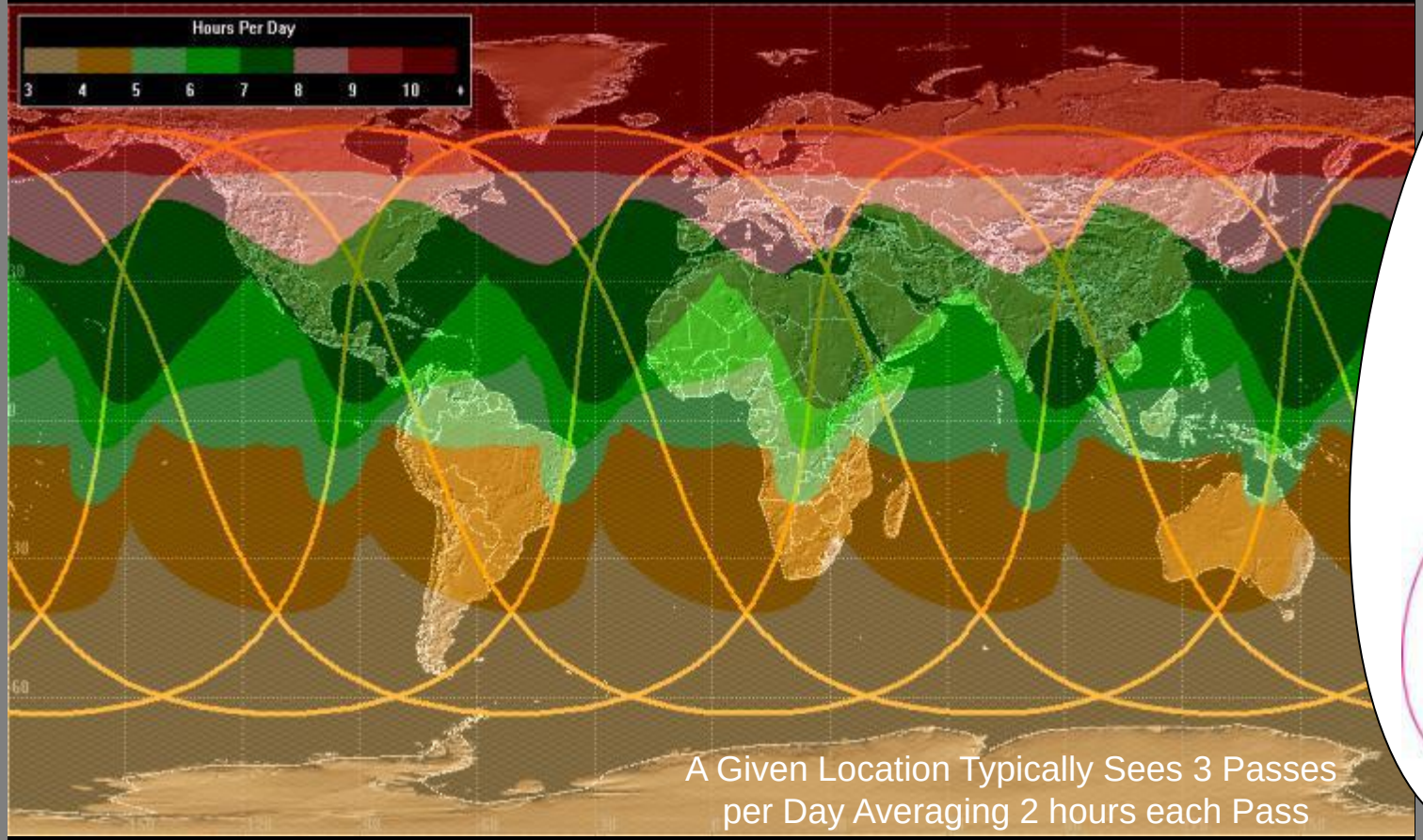
Data Exfiltration

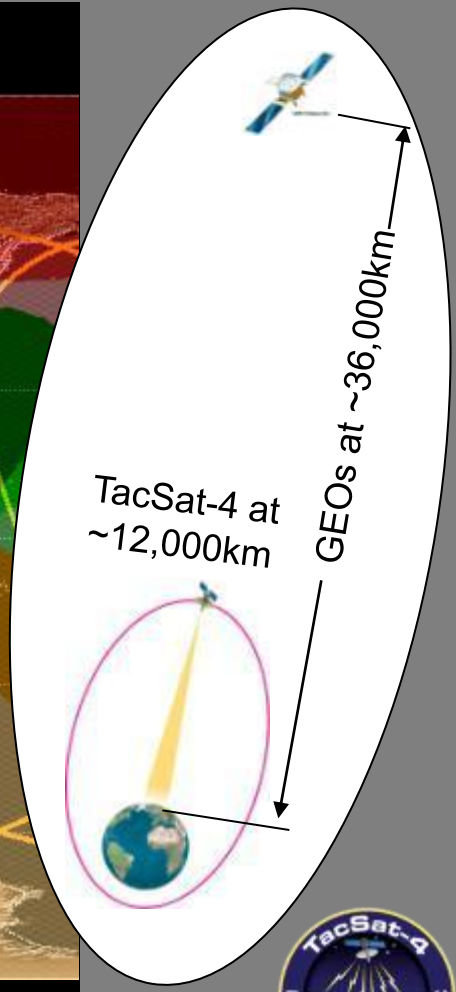
2000-4000 NM Diameter FOV

TacSat-4 Ground Terminal (for Networked COMMS)

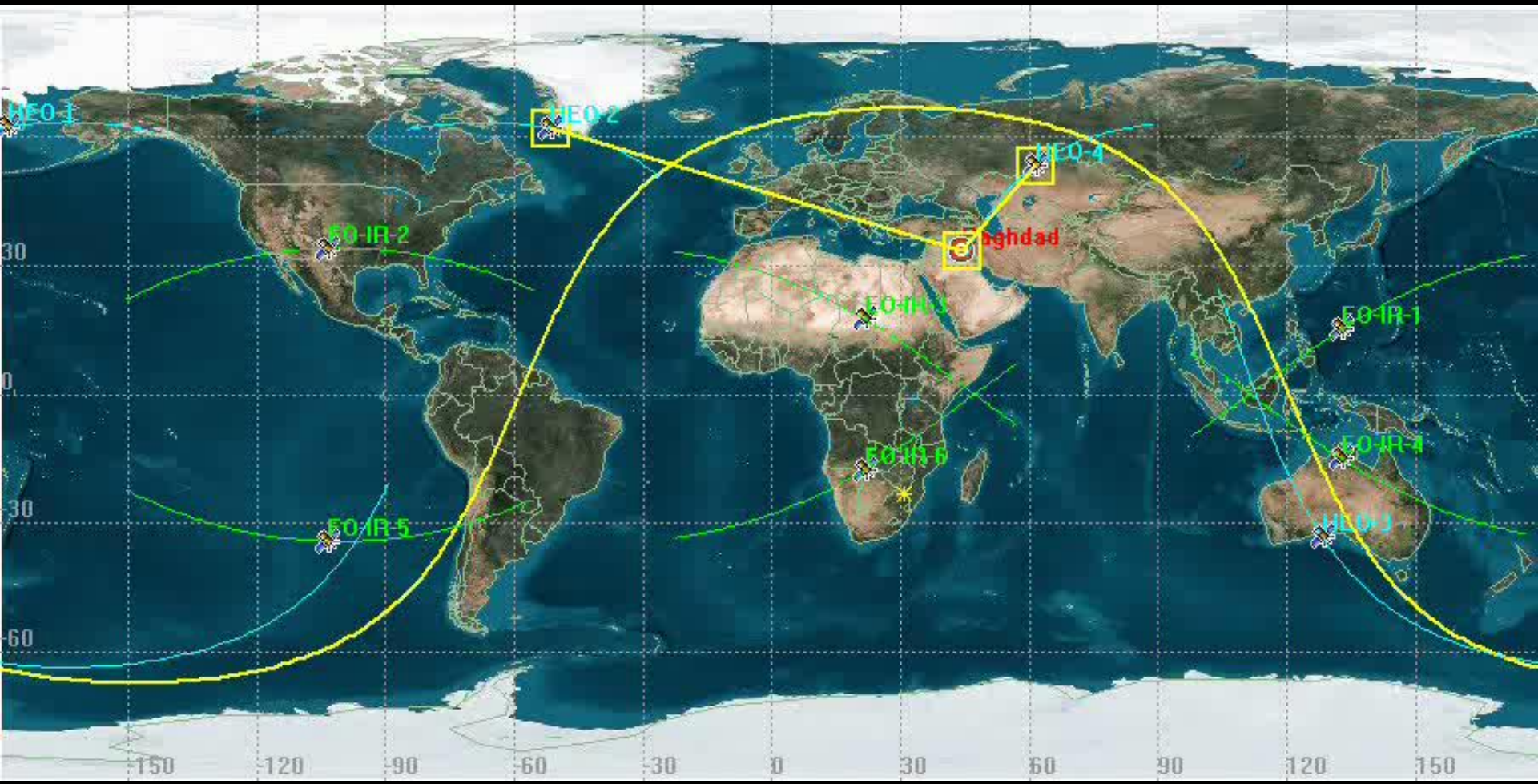
TacSat-4 Orbit and Global Coverage

Maximum Hours per Day for a Given Location





USCENTCOM Example
4 HEO Comms + 6 LEO ISR

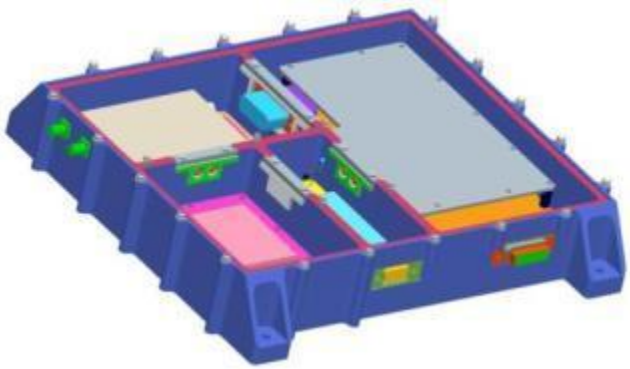


Space Vehicle Status – Launch Schedule May 2011

COMMx in Storage

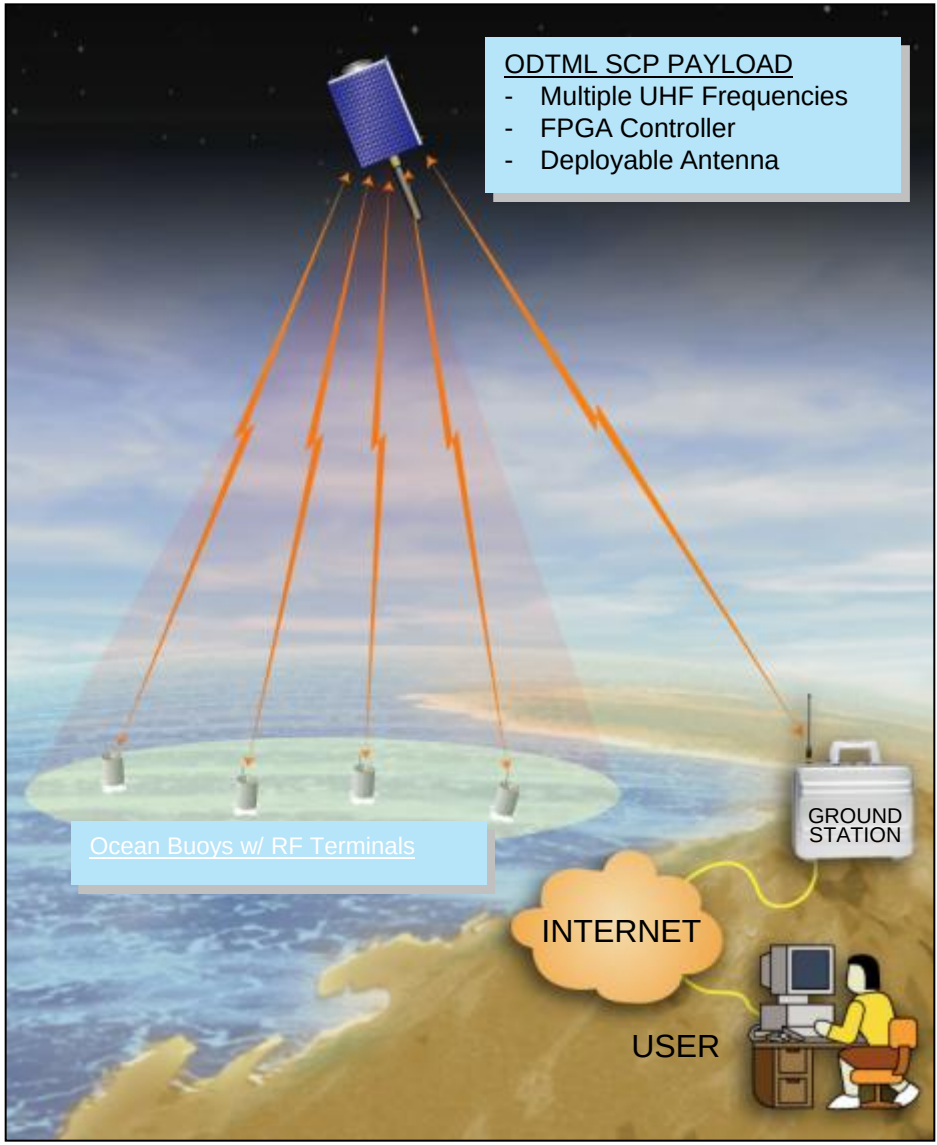
Ocean Data Telemetry Microsatellite Link (ODTML)

- **Low Cost Demo of Global Satellite Message Relay System**

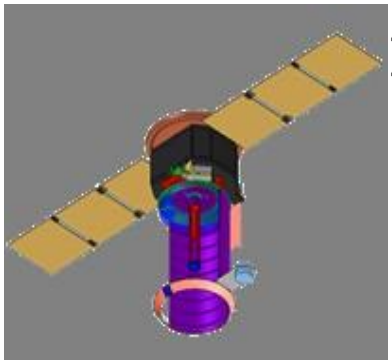


In Space…
10” X 9.9” X 1.8”; 4.5 kg

In the water…on the ground: Transceiver + Computer; GPS + Encryption available

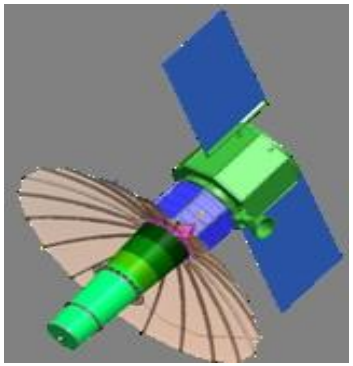


ODTML Manifested on 3 Space Platforms



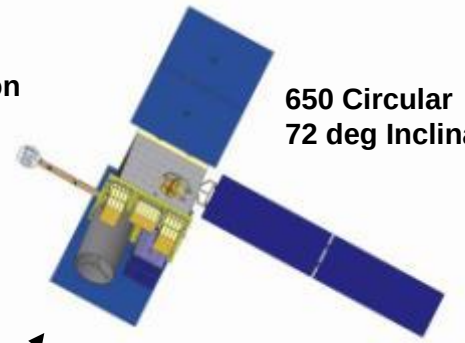
460 Circular
40.5 deg Inclination

TacSat-3
May 24, 2009



12,000 Elliptical
63 deg Inclination

TacSat-4



650 Circular
72 deg Inclination

STPSat-2

Satellite Communications Payload

ATDL

RF Ground Terminal

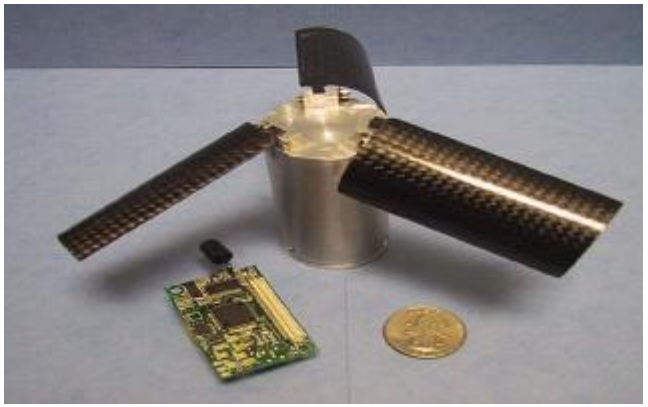
PRC-117

Portable Ground Station

Core Technology: ODTML

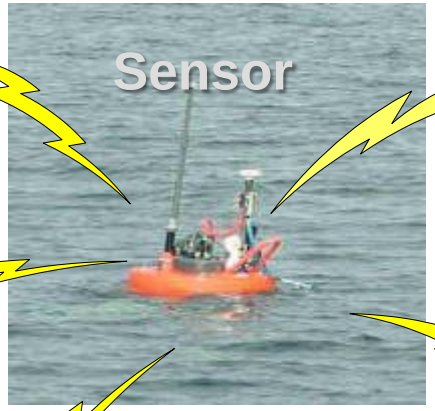
Ocean Data Telemetry MicroSat Link (ODTML) transceiver on TACSAT 3 and 4

- **ODTML technology developed under Small Business Innovative Research grant by ONR.**
- **Uplinks from in-situ sensors: ocean environment instruments outfitted on NOAA weather buoys.**



International Constellation

- **Persistent wide-area surveillance • Extracting data from sensors in "unwired regions" • Leveraging industry—government partnerships • 30 Nanosats**



RIVERINE AND INTERCOASTAL OPERATIONS (RIO) JCTD

- River-based criminal/terrorist activities represent a significant Operational and MDA challenge to Combatant Commanders
- Rivers are a primary lines of communication - drug trafficking and kidnapping generate tremendous revenues for terrorists

- Initial RIO focus and lessons learned will apply to Riverine challenges across multiple Combatant Commands:

May 2010: ODTML Successfully communicates with TacSat 3 multiple times through triple canopy in Panama

RIO JCTD Exercise in Panama

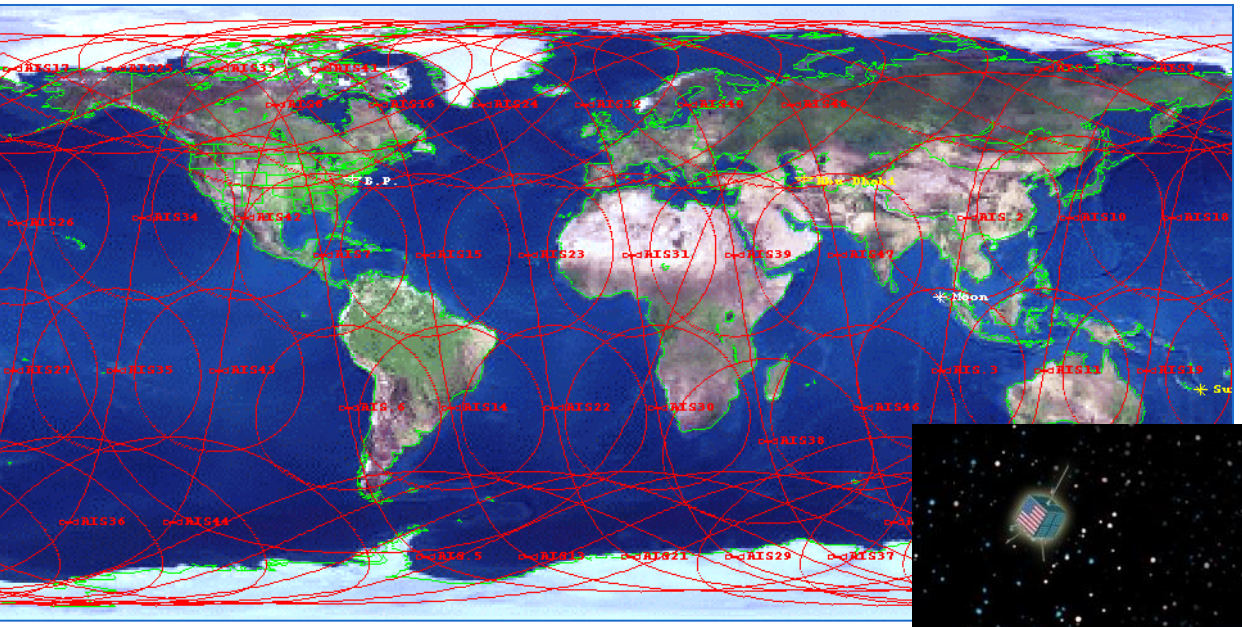
What If Some One Wants to Use ODTML?

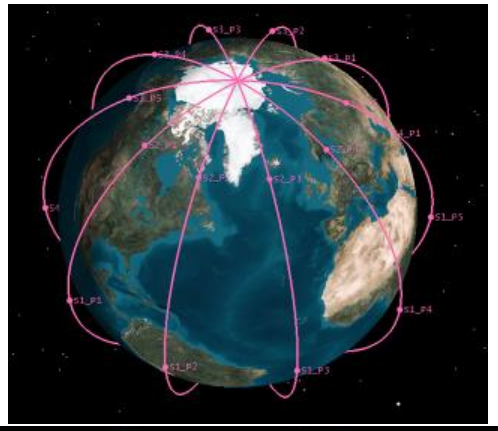
- **What Equipment Is Needed to Use ODTML?**
  - **Miniaturized Terminal from Praxis**
  - **RS-232 or RS-422 I/O Port on Your Remote Sensor**
  - **Internet Connection**

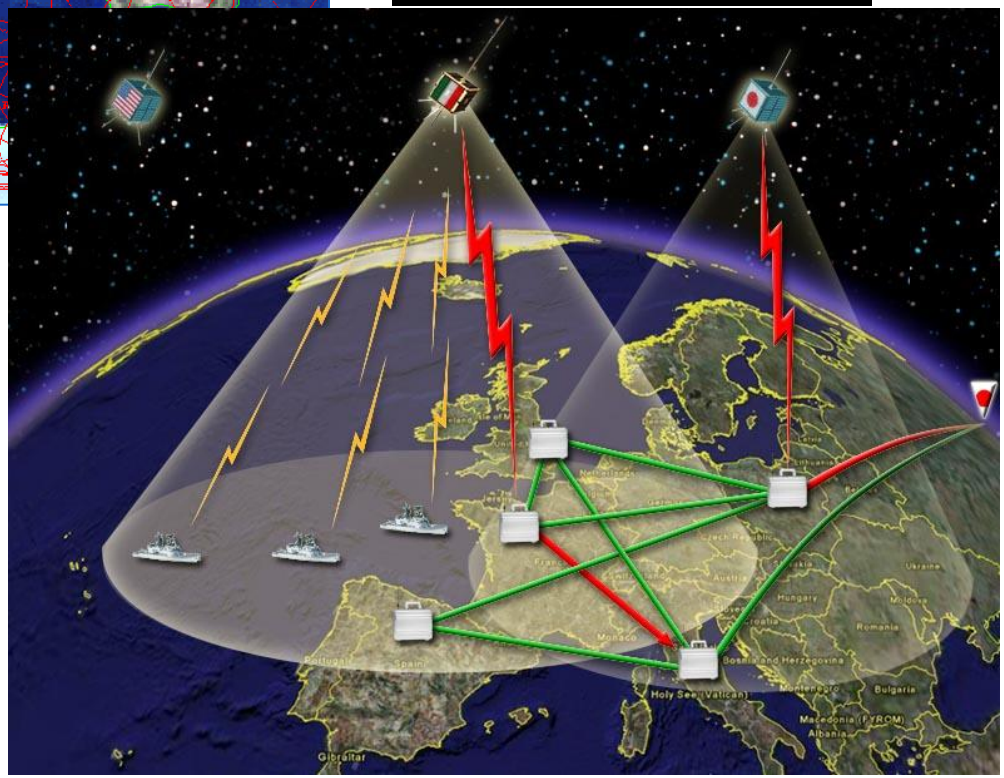
- **What Does It Take to Put ODTML On Your Platform?**
  - **2” x 3” x 0.75” Space for the Mini Terminal**
  - **12 V (or higher) Power Supply, Or Space for a Battery**
  - **Area to Mount a Small Antenna**
  - **An RS-232 or 422 Connection To Your Data Source**

- **How Do You Use the System?**
  - **Write a Small Program to Pass Your Data Over an RS-232,422 Connection With the GSCT**
  - **Get Password for ODTML Internet Site**
  - **Log On and Download Data**

GLADIS – A Potential Transition Path for ODTML







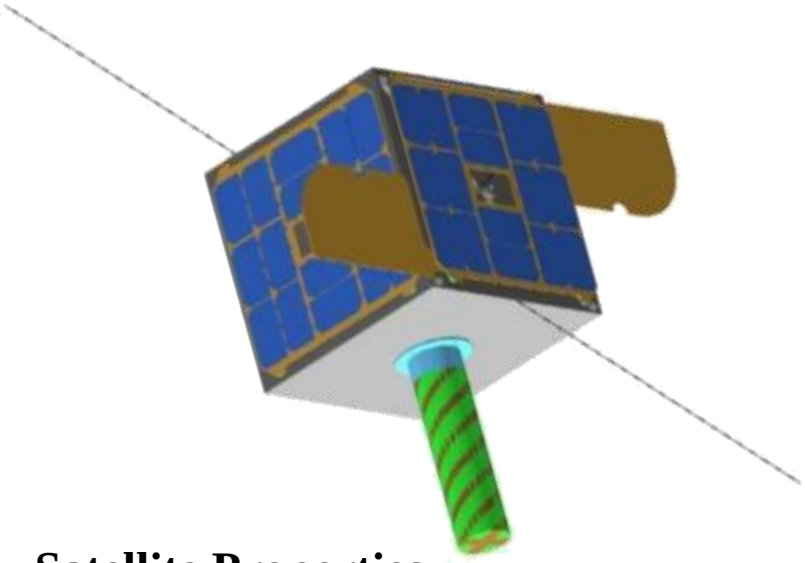
Exfiltrate data from unattended maritime & terrestrial sensors

Collect Automatic Identification System (AIS) signals from space.

Collaborate with International Partners in Consortium to share data.

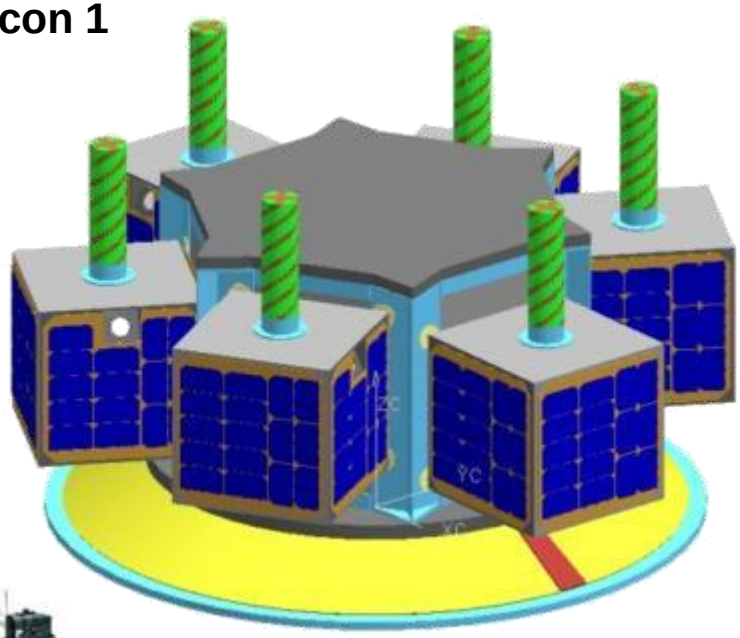
Global Awareness Data Extraction International Satellite (GLADIS) Constellation

GLADIS 103
Satellite, Dispenser, Ground Terminal



Satellite Properties
- **Mass: 10-15 kg**
- **Size: 30 cm cube**
- **Solar Power: 21 W max**
- **UHF and VHF RF Payloads**

Six Satellite Dispenser - Compatible with Minotaur I and Falcon 1



Inexpensive, portable UHF ground terminals

Continuing to pursue collaboration with DHS, NOAA & Army SMDC

Radio Frequency Digital Payload (RDP)

- **Objectives**
  - **In Theater And On-Orbit Re-Programming**
  - **Low Power Processing**
  - **High (512 kbps) Data Rate Communications**
  - **Communications Bandwidth, Frequency, & Data Rate Flexibility**
  - **Use of Open Standard Spacecraft Interfaces**

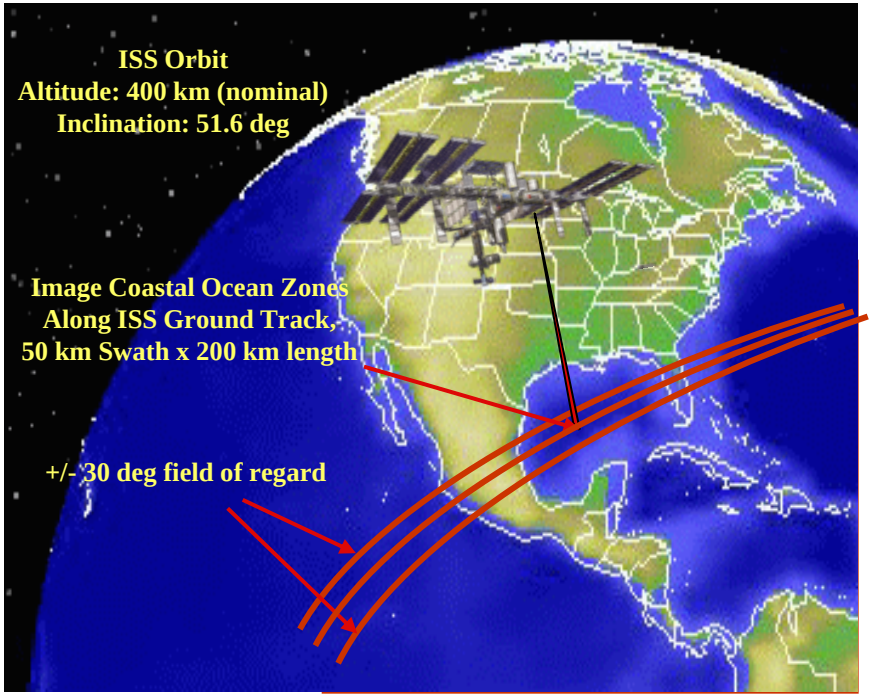
- **Mechanical**
  - **Size: ~ 9 x 6 x 12**
  - **Weight: ~ 19 lbs**
  - **Power: 25-100W**

- **Description**
  - » **RF Tunability 100 to 1700 MHz**
  - » **RF BW: 20 MHz; 0.3 MHz (Selectable)**
  - » **NF: < 4.7 dB (With Diplexer Preamp)**
  - » **SFDR: ~ 65 dB**
  - » **TX Power Out: 10 dBm**
  - » **FPGA Resource**
  - » **SW Core Framework: Modified JTRS**
  - » **Processor (Each): 32 Bit Sparc V8, > 40 Mips, 32 KB PROM, 256 MB SDRAM,**
  - » **User Interface: Spacewire and HDLC**
  - » **Control and Status: Web Based Ground Station Control**

- **Prototype Developed in FY07/08**
- **Study completed in FY09 for extending its use and using in a classified application**

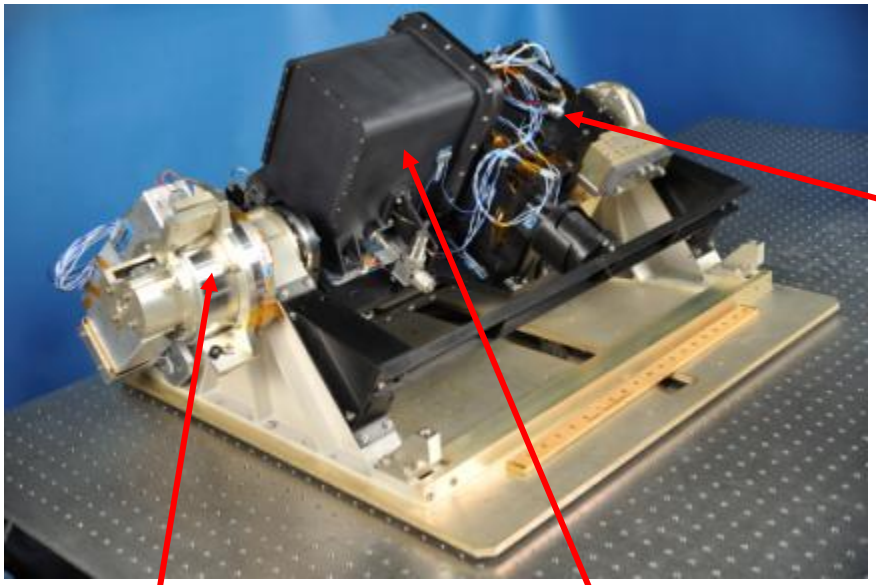
The Naval Research Laboratory Announces the Launch of "HICO"

- *Maritime Hyperspectral Imaging for Coastal monitoring , surveillance and research*
- *Unique capability for Coastal characterization (bathymetry, trafficability, water properties, etc.)*
- *Pathfinder for utility of Maritime Hyperspectral from space*
- *Controlled and operated by NRL –*
- *Launch to the International Space Station – "September 2009"*
- *100 m Ground Sample Distance*
- *128 channels (380 to 1000 nm)*



Commercial Components Enabled Fast-Paced HICO Program

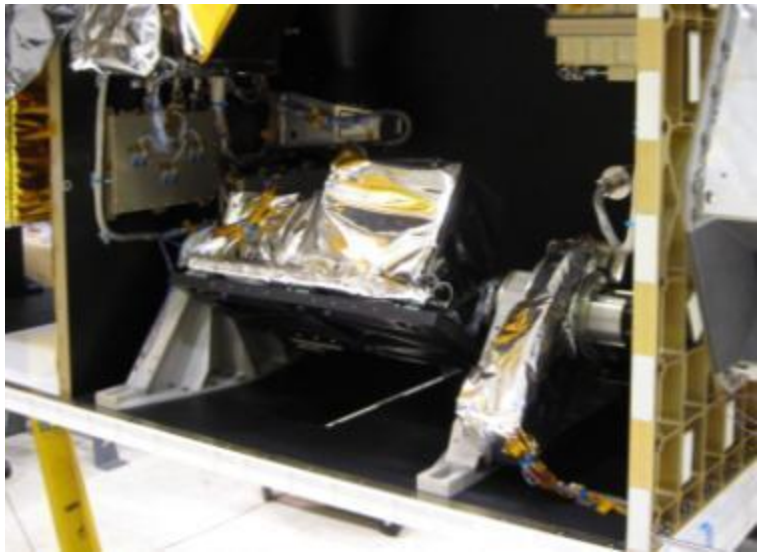
HICO Imager During Laboratory Calibration



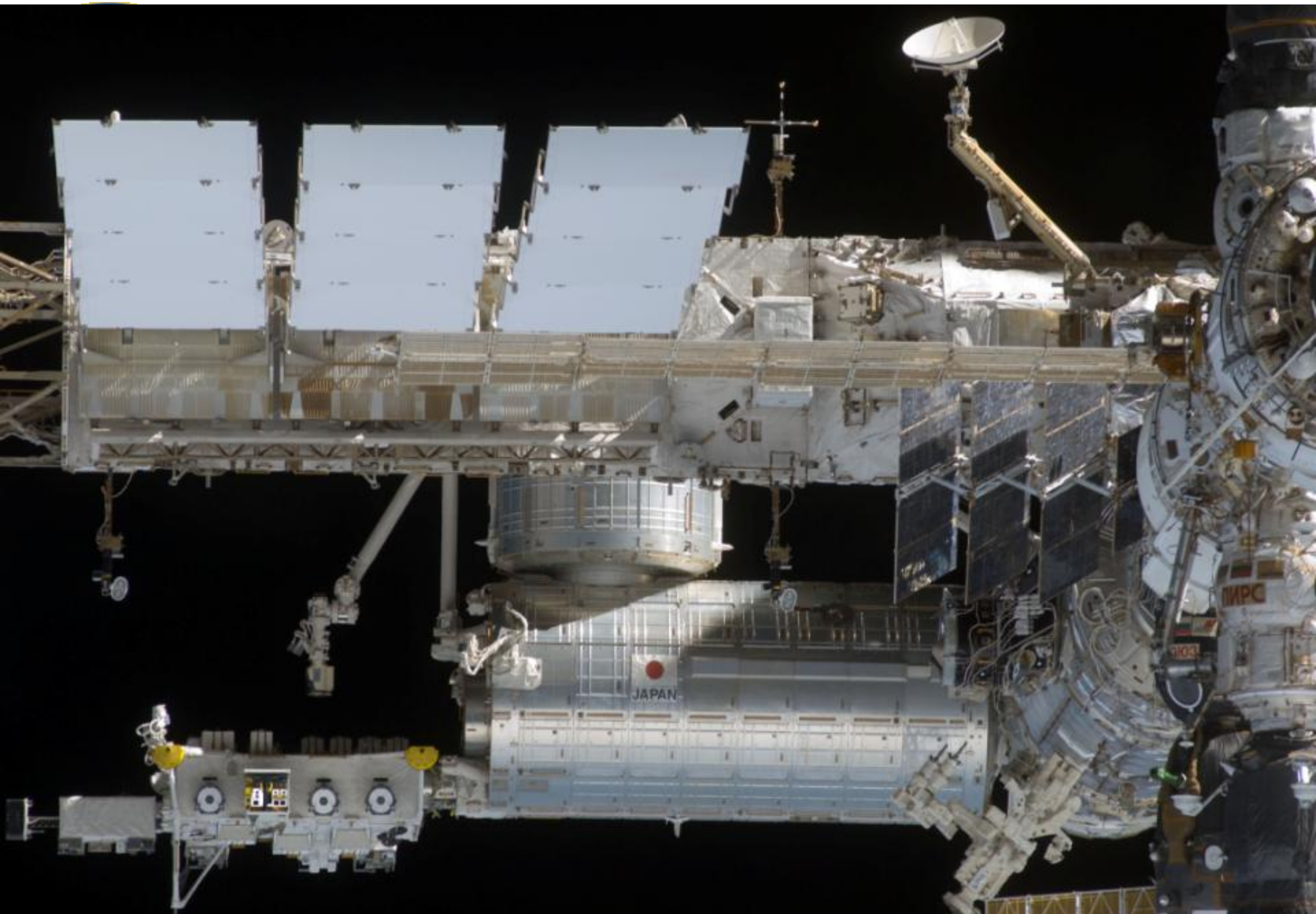
Commercial Spectrometer

Commercial Rotary Stage

Commercial CCD Camera



HICO Space Payload



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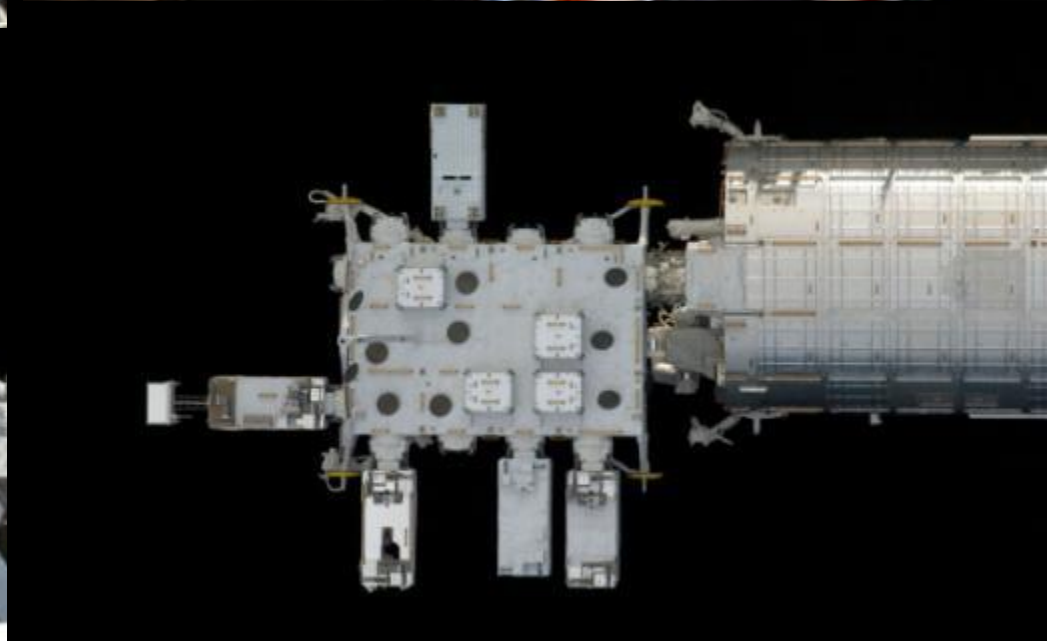
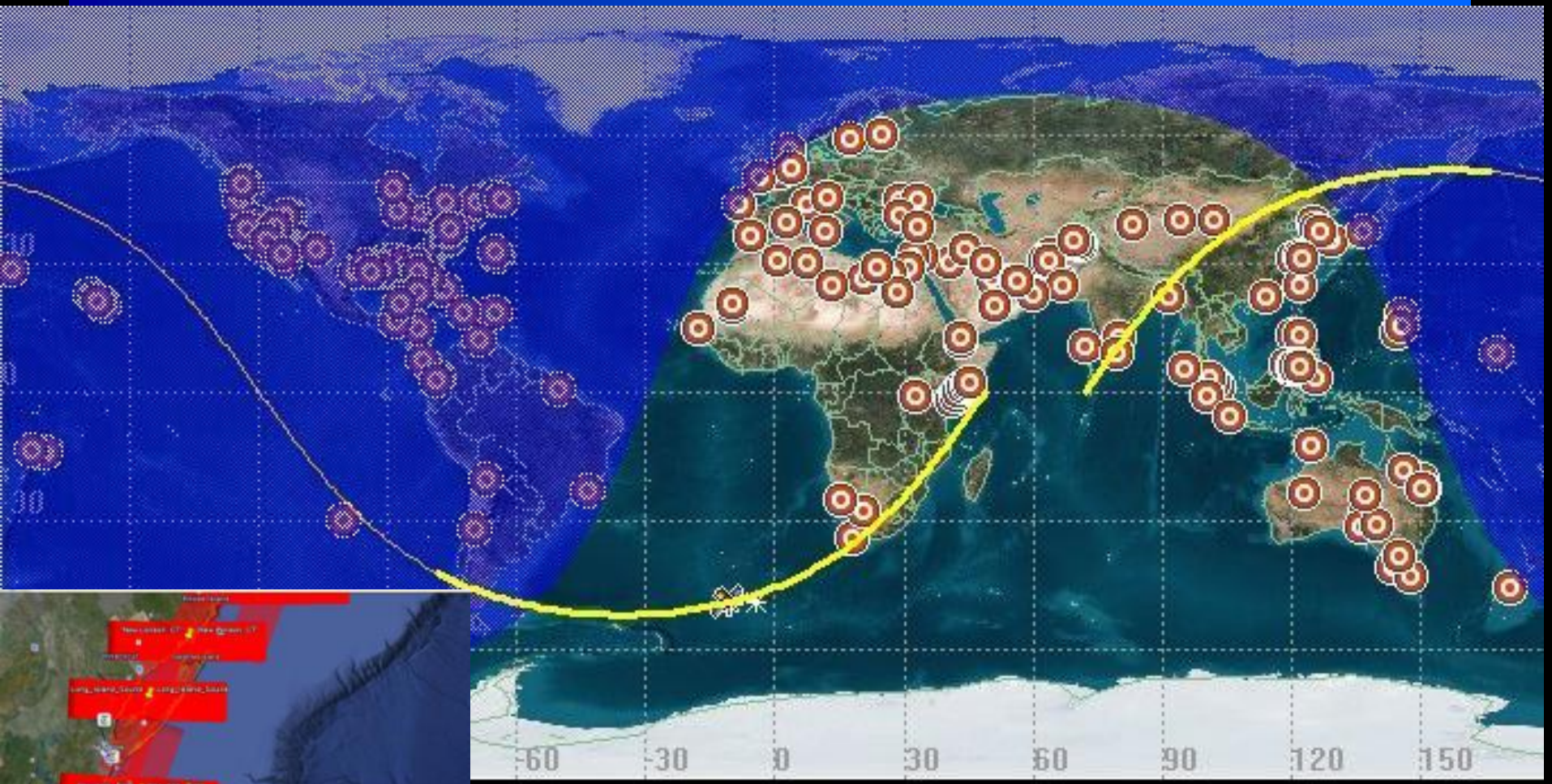
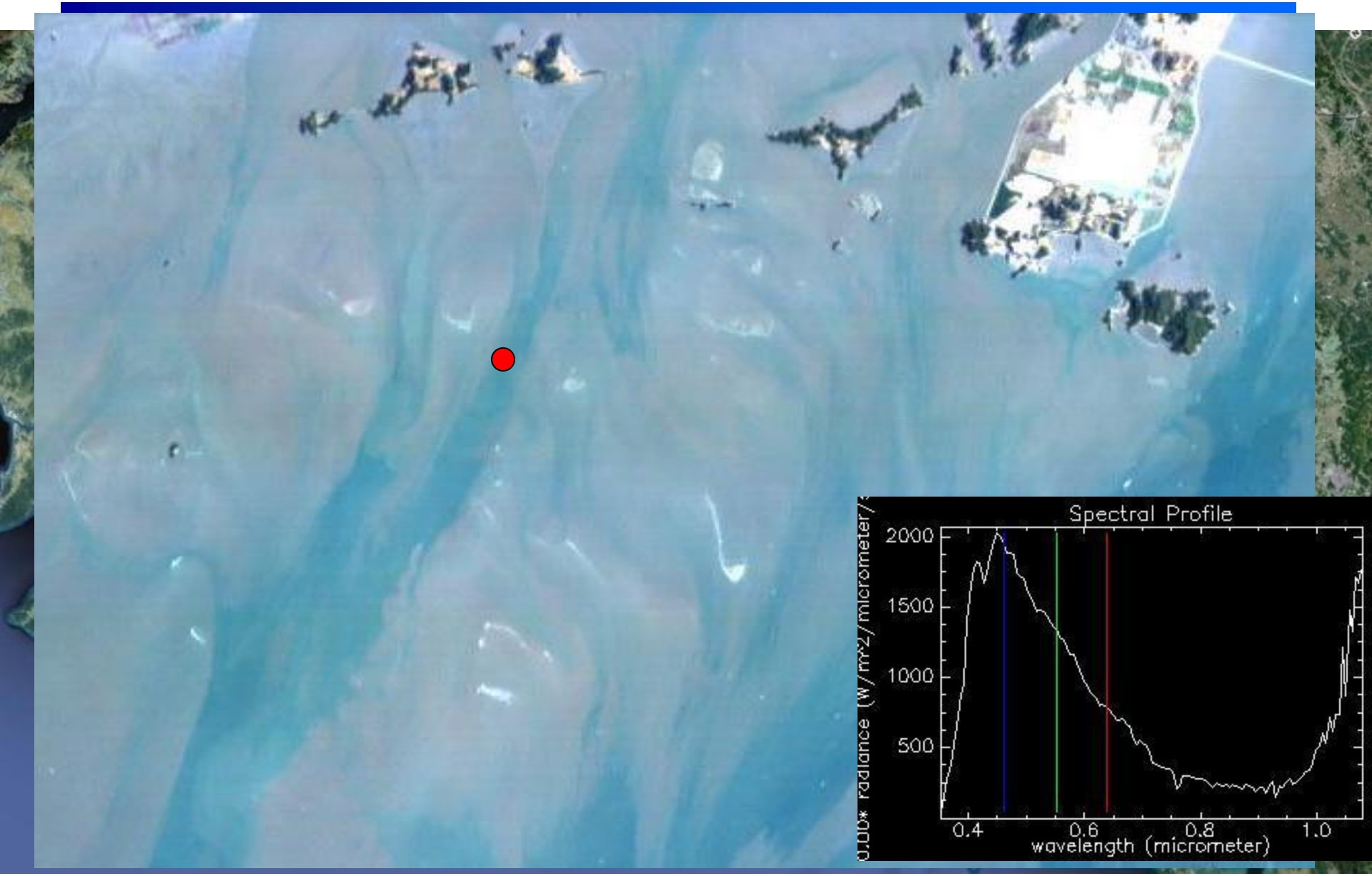
ISS021E030638



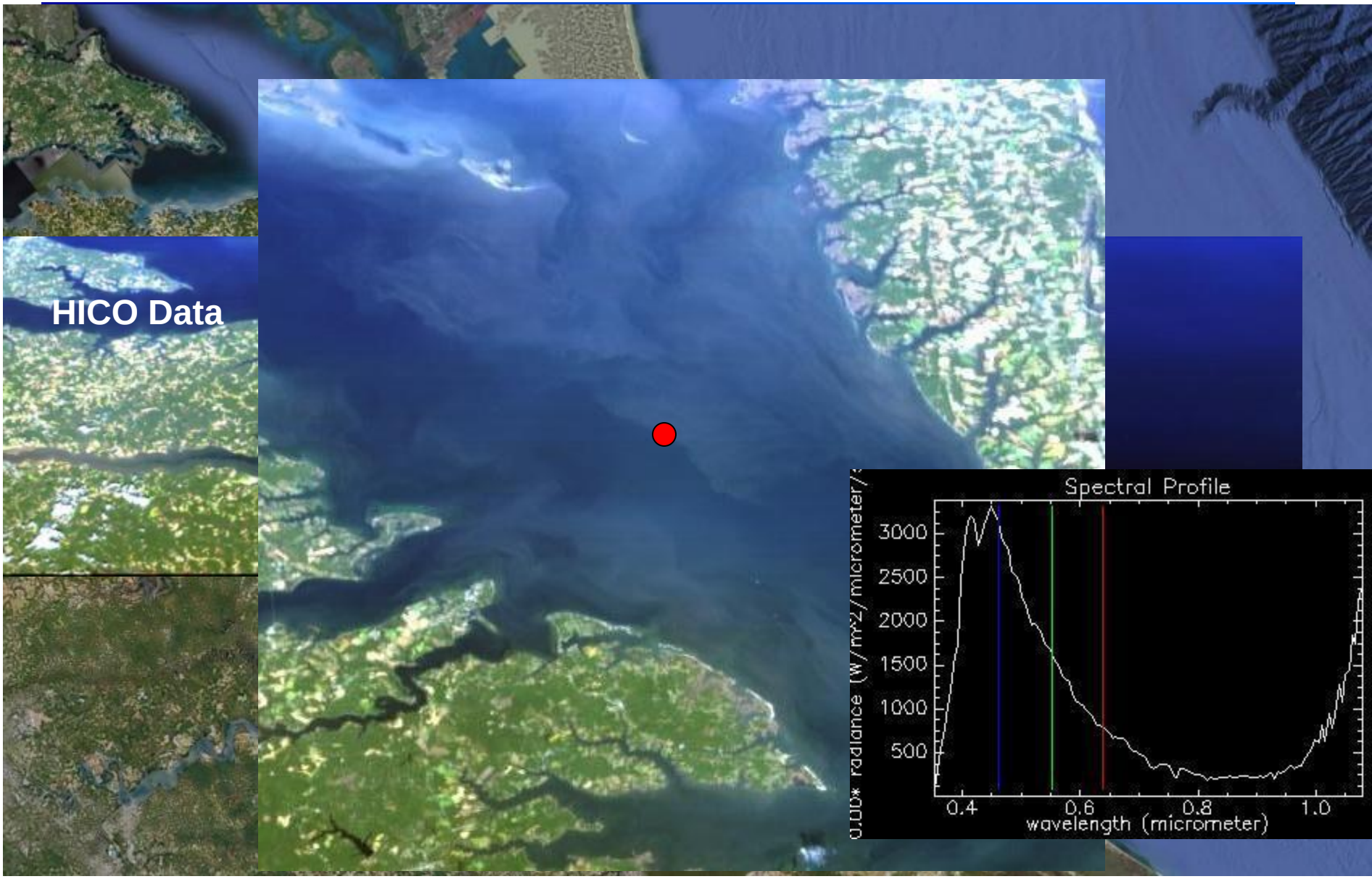
HICO Target Deck



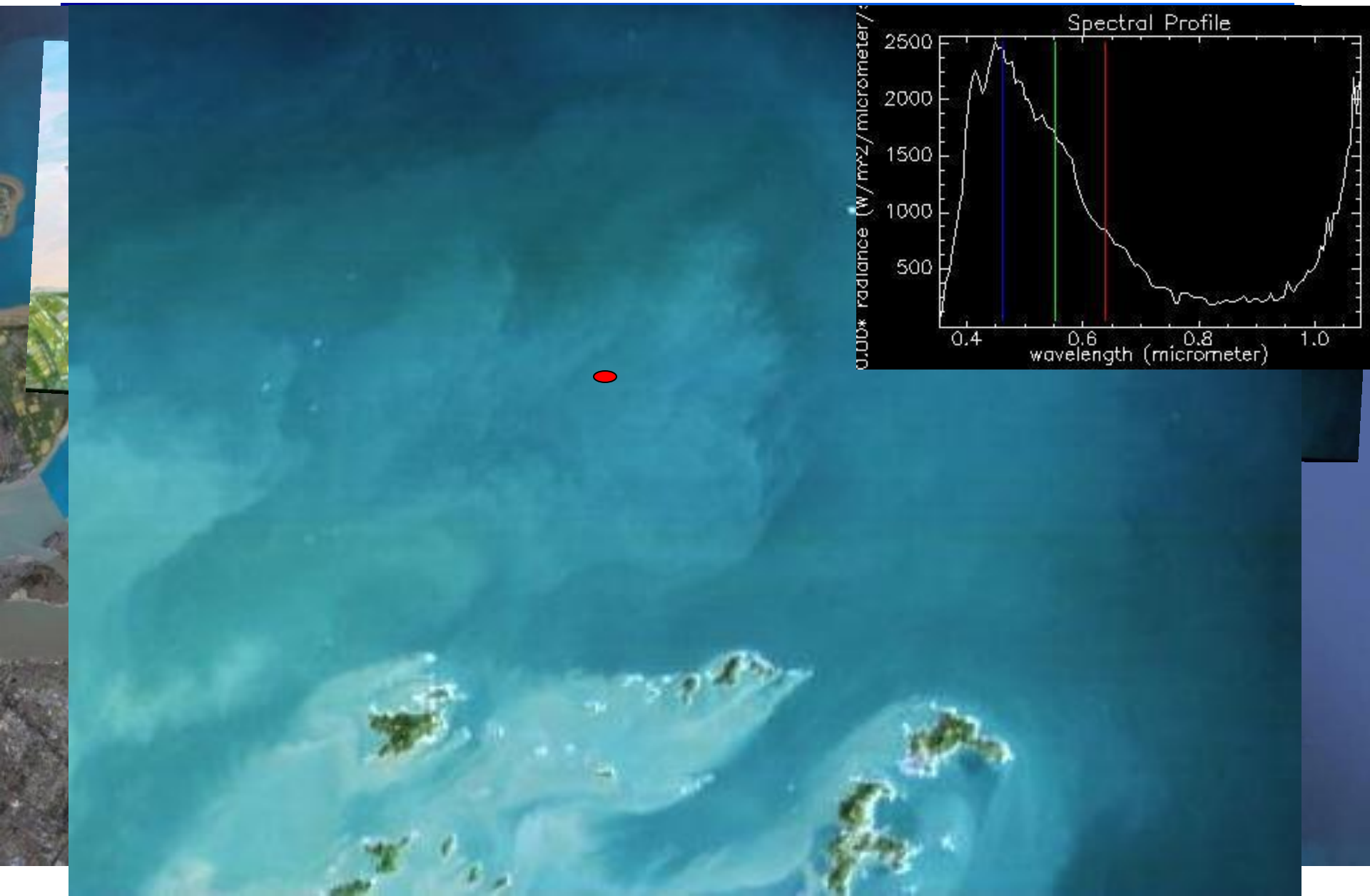
HICO Image
Han River: 10/22/09



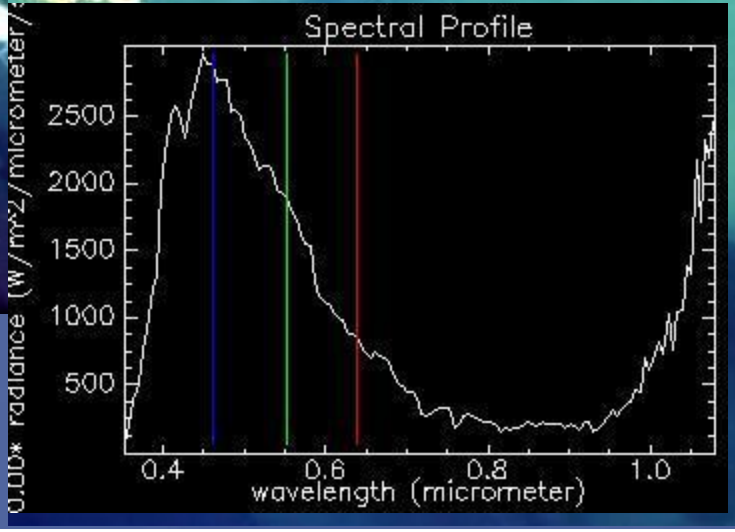
HICO Image
Chesapeake Bay: 10/09/09



HICO Image
Yangtze River: 10/21/09



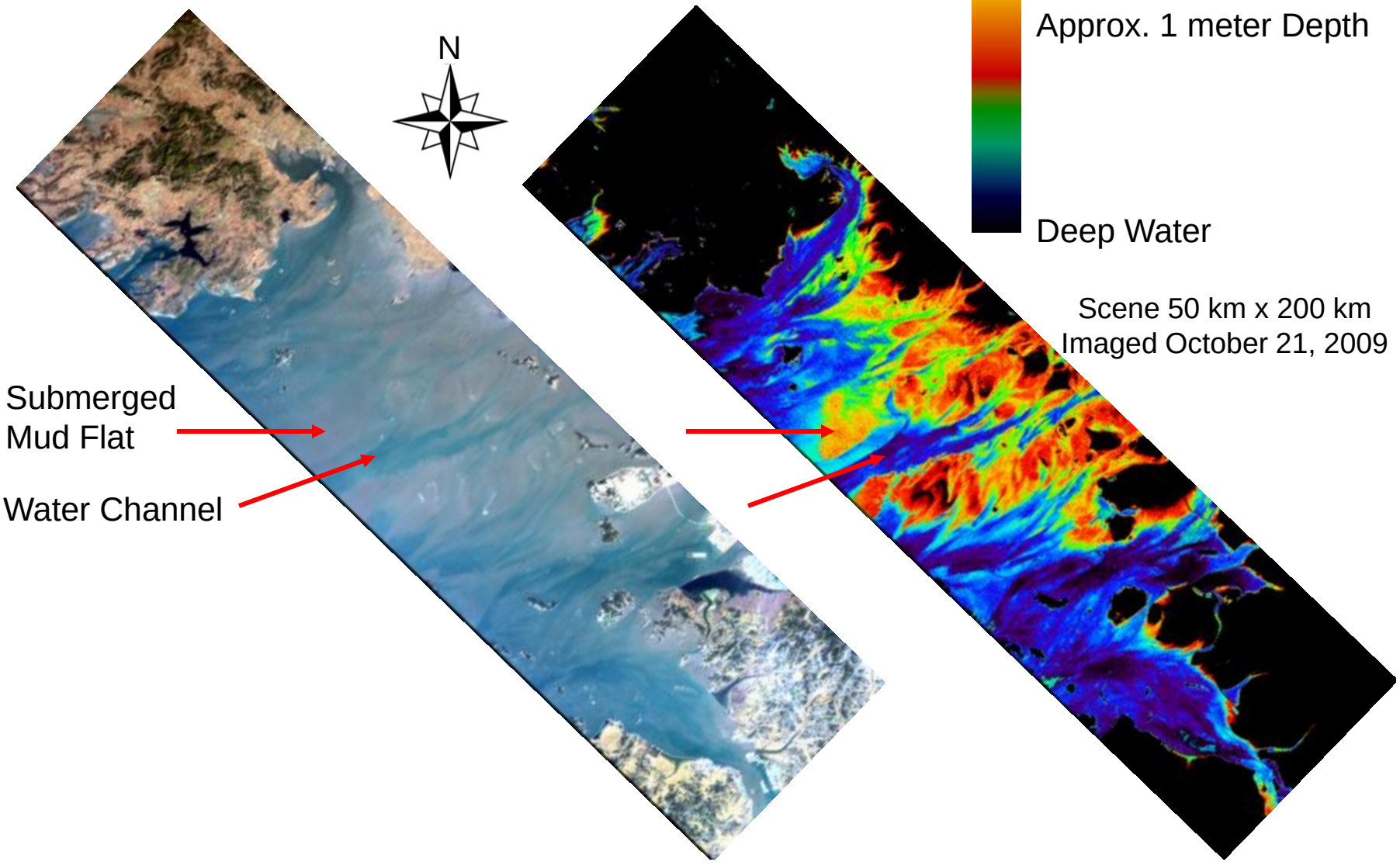
HICO Image
Hong Kong : 10/02/09



Relative Bathymetry (Water Depth) Map in Yellow Sea

HICO Image off Korean Peninsula

Relative Bathymetry Map



Earth Surface Images from HICO

Images are about 43 km wide and 190 km long

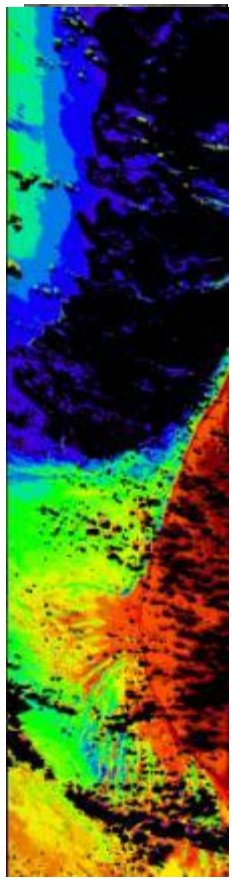
Orientations are given below

Cape Town, South Africa, Oct. 30, 2009. Orientation is from NW at top to SE at bottom. There are clouds over the ocean, but not over the land.

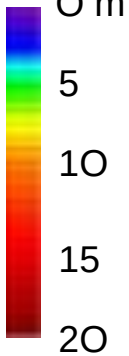
Lower Chesapeake Bay, Oct. 7, 2009. Orientation is from NW at top to SE at bottom. Note the Chesapeake Bay Bridge.

Coast of South China Sea, near Hong Kong, China, Oct. 2, 2009. Orientation is from SW at bottom to NE at top.

Part of the Grand Canyon, Sept. 27, 2009. The center of the image is at 35° 50' N, 111° 23' W and the orientation is from SW at bottom to NE at top.



Taken over the Bahamas, Oct. 22, 2009. Orientation is from NW at top to SE at bottom. Seafloor structures are visible in shallow water.



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