EO-1 and its potential coastal applications

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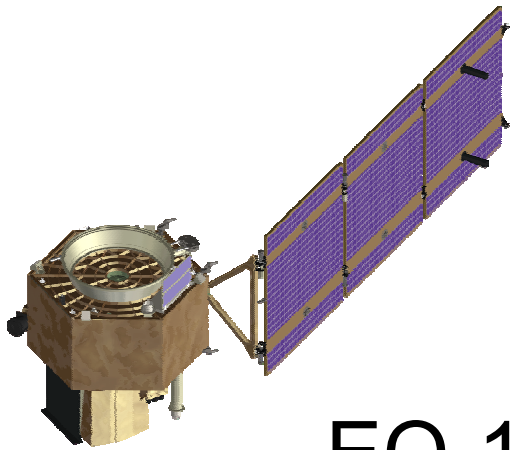
Outline:

- Project description
  - sensors
  - objectives
  - participants
- Project status
  - examples of Hyperion collections
  - example of processed Hyperion data

3. Preliminary findings
4. Next

- Project description: a. sensors on EO-1



EO-1

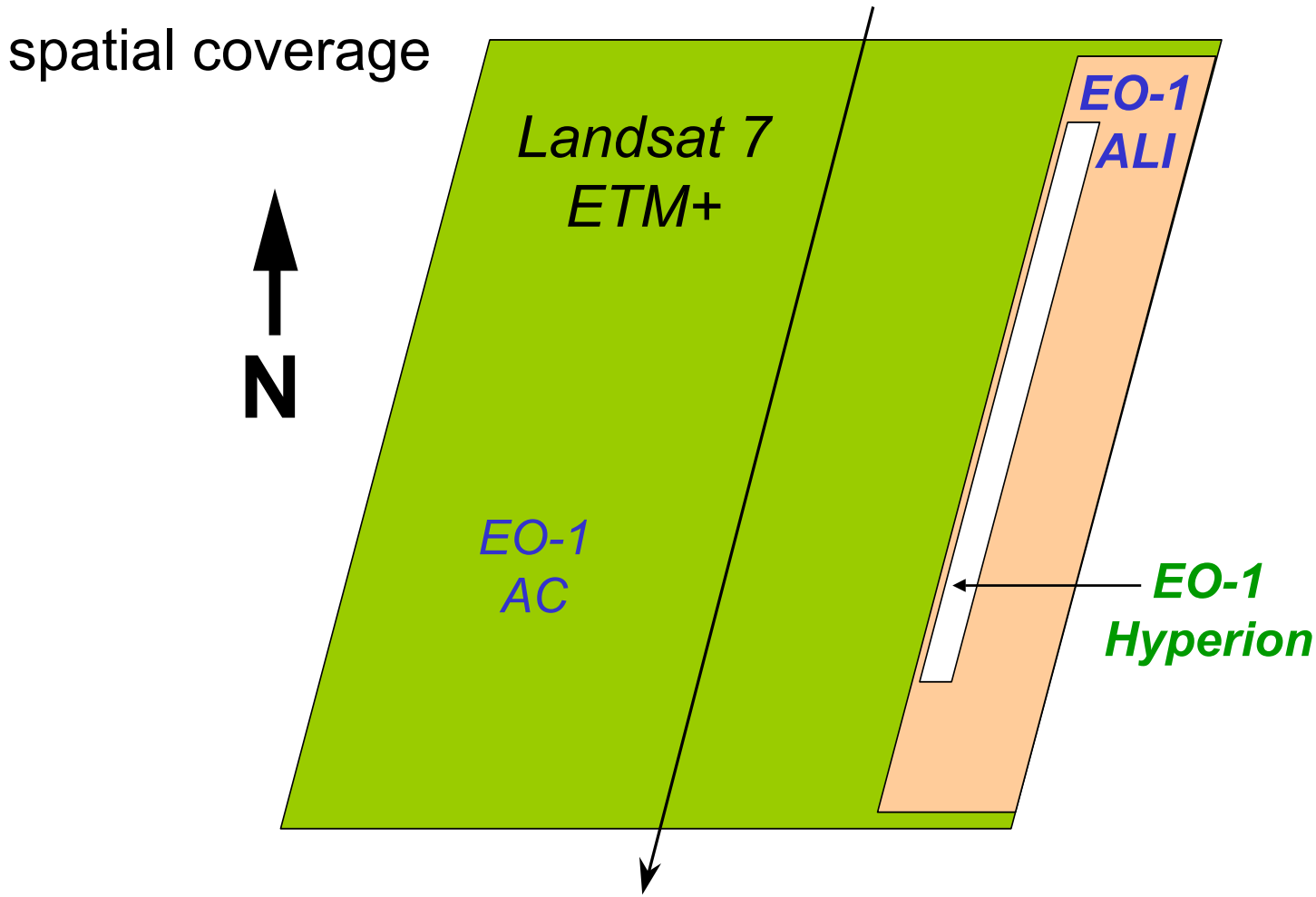
Launched on November 21, 2000, **for land applications**.

i. Atmosphere Corrector (AC)
ii. Advanced Land Imager (ALI)
iii. Hyperion

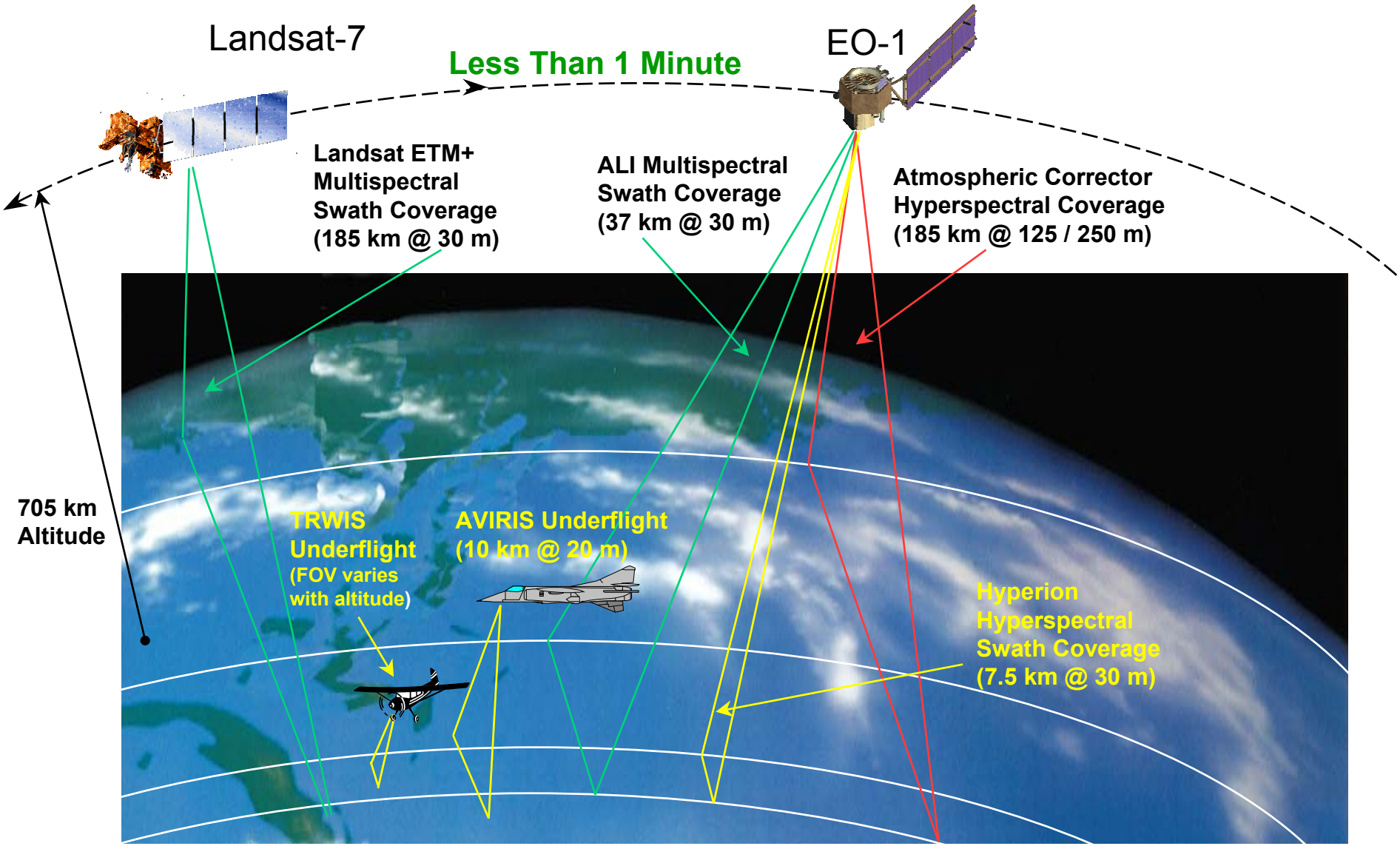
- Sensor continued:

Parameters	EO-1		
	AC	ALI	**Hyperion**
Spectral Range	0.9 – 1.6 um	0.44-2.4 μm	**0.43-2.4 μm**
Spectral Resolution	2.8 – 9 nm	Variable	**~10 nm**
Spectral Coverage	Continuous	Discrete	**Continuous**
Total # of Bands	256	10	**220**
Spatial Resolution	250m	30m	**30m**
Swath Width	185 km	37Km	**7.7Km**

EO-1 and Landsat 7 Descending Orbit Ground Tracks



Orbit of EO-1 and Landsat



Characters of **Hyperion**:

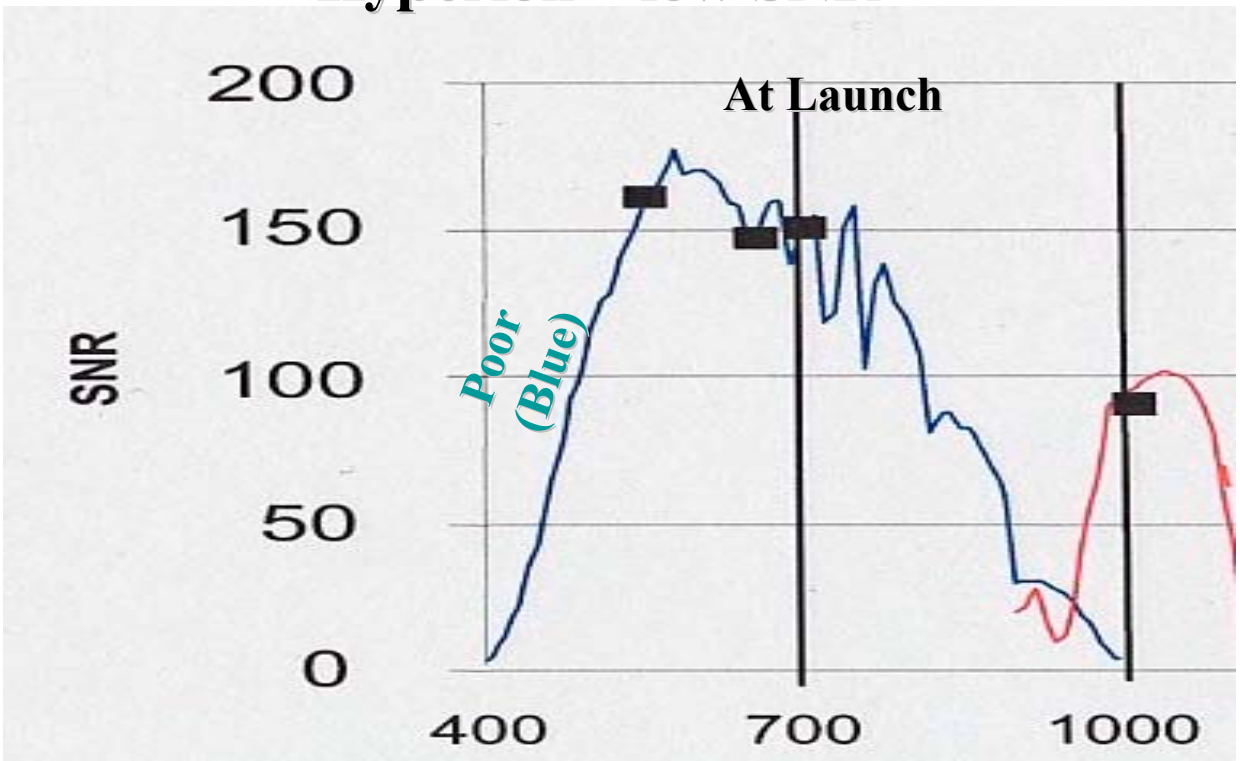
NASA's only hyperspectral sensor in orbit!!!

- **High spectral capability (430 – 2400 nm, ~every 10 nm)**
- **High spatial resolution - 30m GSD**
- **Low Signal-to-Noise Ratio (SNR ~50 - 160)**
- **Narrow swath coverage (7 km)**
- **Repeat time (16 days for same coverage area)**
- **Not real time capability – (~20-day delay)**

SIGNAL-TO-NOISE

Hyperion VS SeaWiFS

Hyperion – low SNR



SeaWiFS Designed for Ocean Applications

?	SNR
412:	499
443:	674
490:	667
510:	640
555:	596
670:	442
765:	455
865:	467

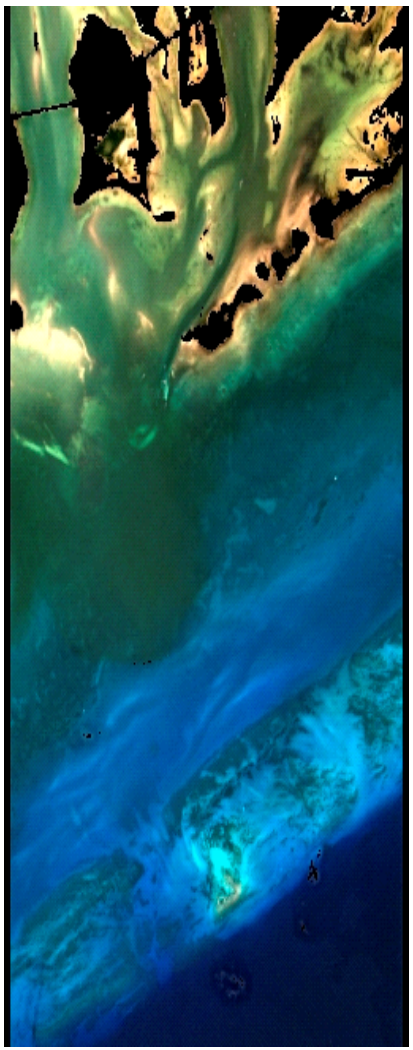
High SNR

Question:

Are there any potentials for ocean/coastal applications?

Example of Hyperion image

(TOA radiance)



(Looe Key, FL)

What does the color difference mean?

Different water?

Different bottom?

Or different depth?

Can they be separated??

and get meaningful quantities.

- Project description: b. objectives

i. Evaluate EO-1 potentials for coastal waters

ii. Develop/compare atmosphere correction

iii. Compare retrieved environmental properties

- Project description: c. participants

Robert Arnone	NRL
Bo-Cai Gao	NRL
Curtis Davis	NRL
Dennis Clark	NOAA
Knut Stamnes	SIT
Marcos Montes	NRL
John Pereira	NOAA
ZhongPing Lee	NRL

2. Project status:

Over 30 Scenes Ordered and Collected for Coastal areas

- 7 co-incident field cruises
  - Looe Key (FL Keys) - Clear Waters
  - Horn Island (MS) - Turbid waters
  - Apalachicola Bay - Clear/turbid waters
  - Fort Lauderdale – Clear/turbid waters
  - Chesapeake Bay – turbid waters
  - MOBY – clear waters
  - Oahu bay -
- Measurements include (not necessary ALL):
  - water IOP/AOP
  - Laser bathymetry
  - Atmosphere properties

In the earlier stage of data processing

-atmosphere correction
-Water/bottom property retrieval
-Comparison/validation

2.1 Example of Hyperion collections:

Chesapeake Bay, 6 Sep '02

Looe Key, FL 26 Oct '02

Florida Bay 3/19/04

Smith Island 3/12/04

2.2 Example of processed Hyperion data

1. Calibrated Level-1 absolute radiance data are provided through USGS.

TOA radiance accuracy is within 5%

(Barry et al. 2001)

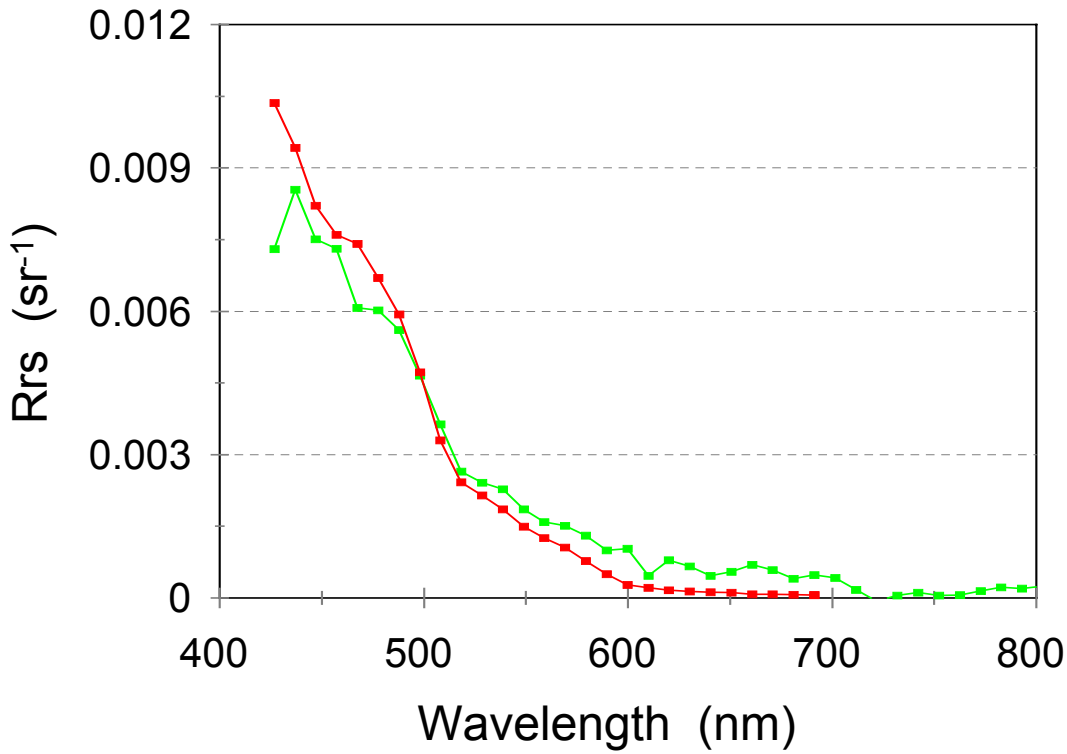
2. Atmosphere correction → Rrs

testing different algorithms

3. Rrs → water/bottom properties

One example …

Rrs comparison



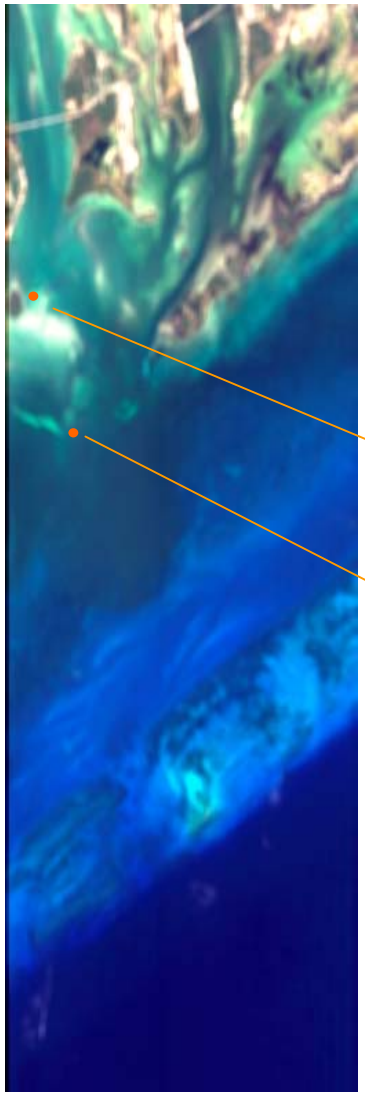
Red : *insitu* Rrs

Green: Hyperion Rrs

("MOBY")

Retrieve shallow-water Properties

(Hyperion Rrs)



(Hyperspectral **O**ptimization **P**rocess cod**E**)

(*Lee et al*. 1999, 2001)

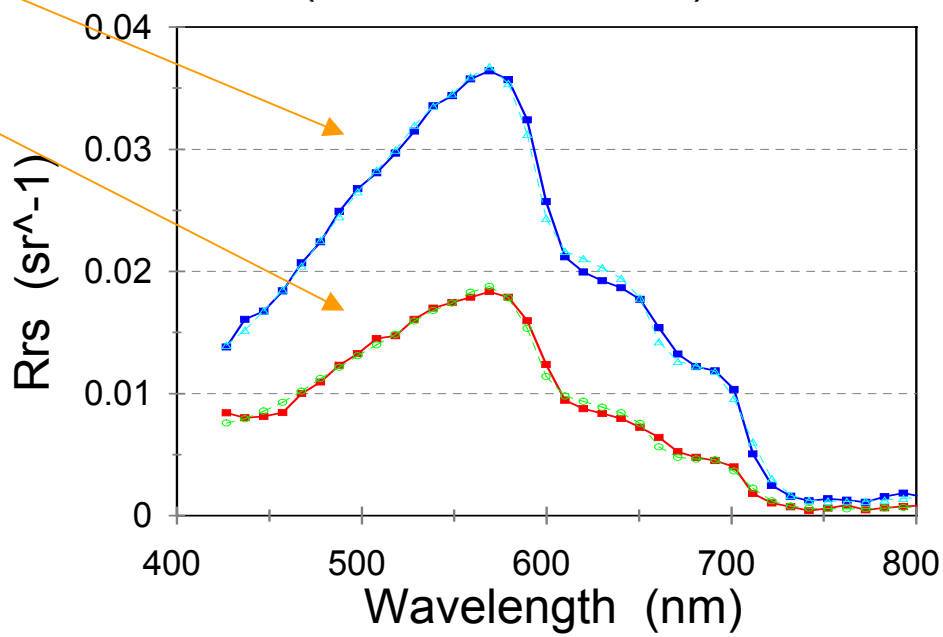
HOPE

(H, IOP, …)

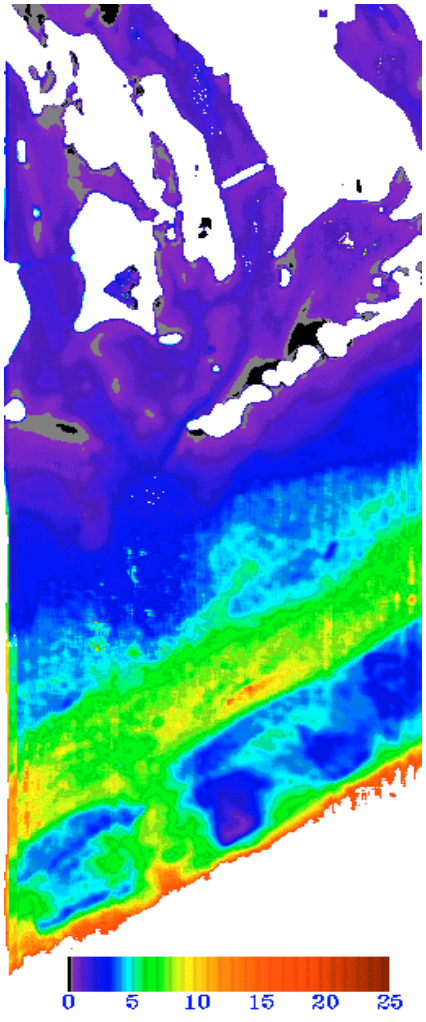
bathymetry

Optical properties

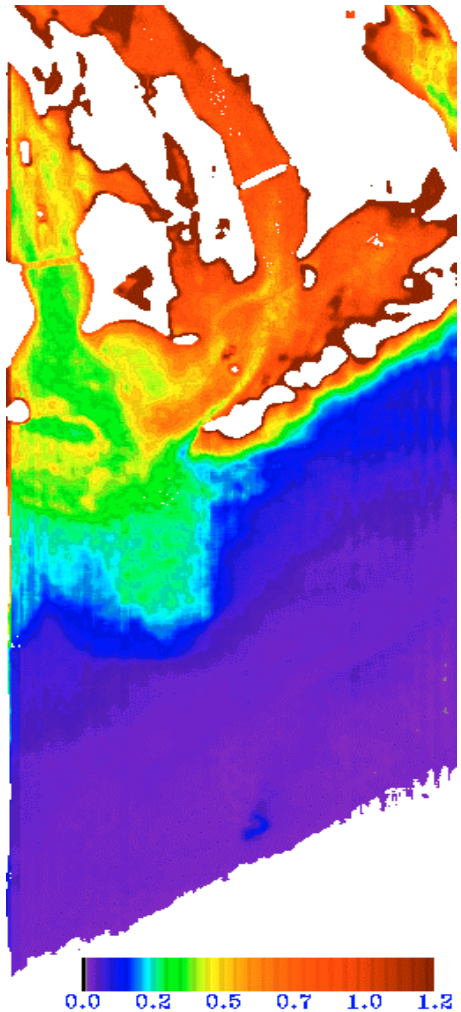
(mea. vs mod. Rrs)



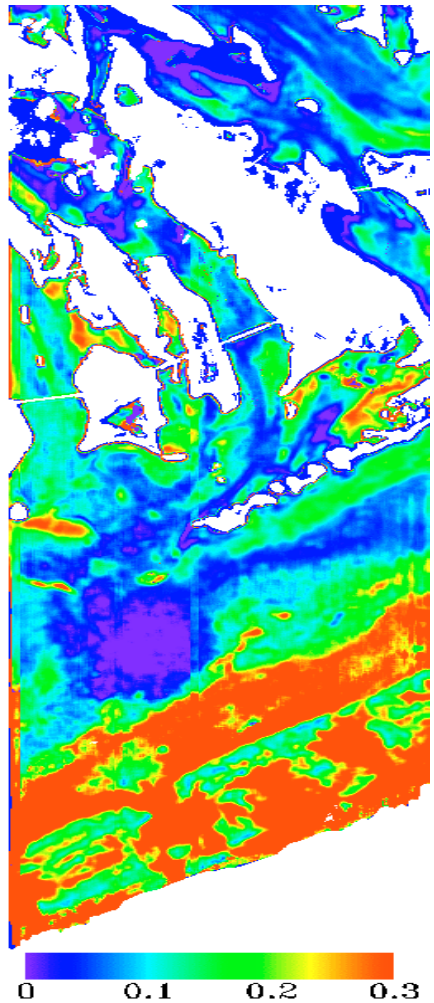
Results from Hyperion



Bottom depth (m)



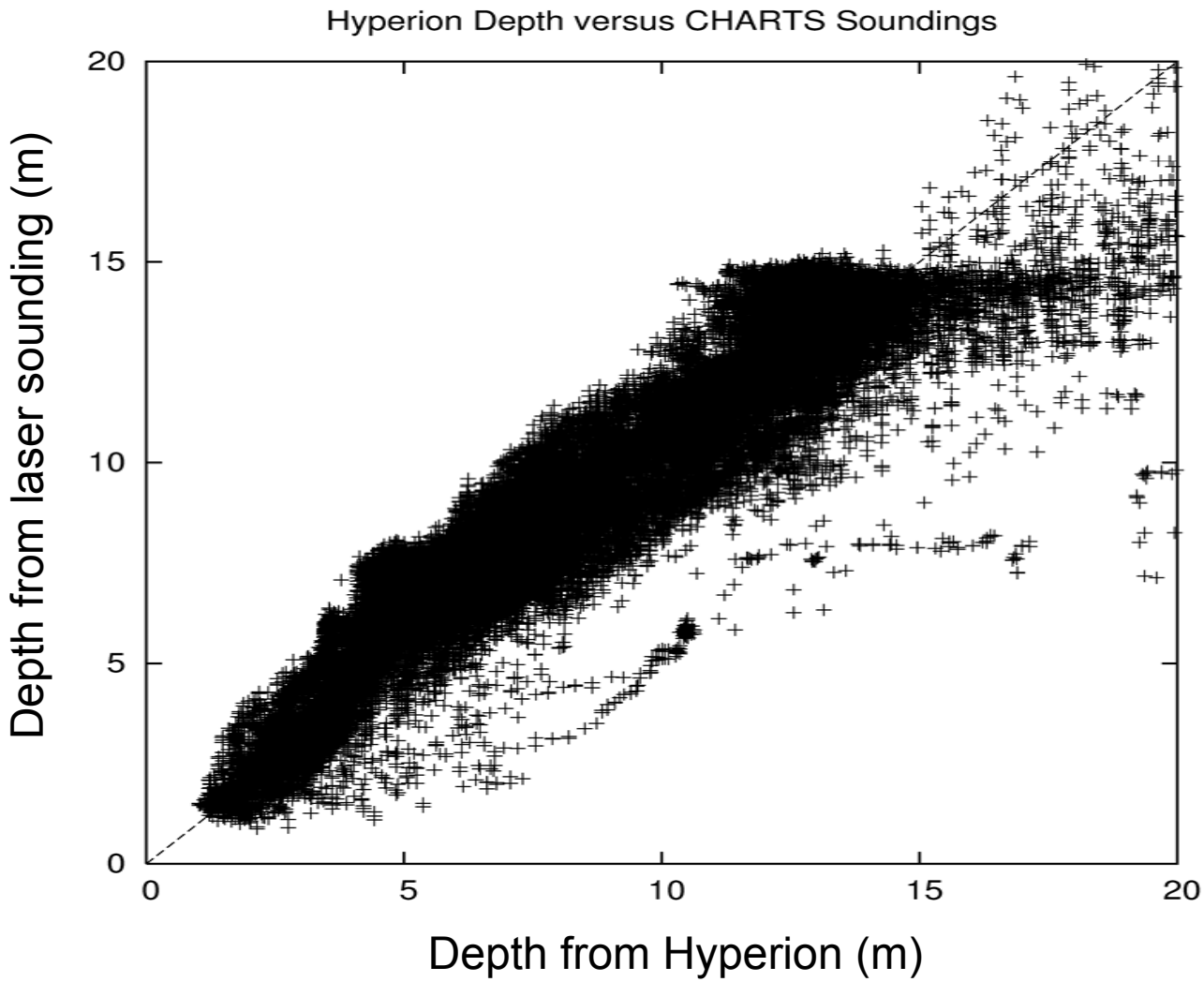
Water absorption at 440 nm (m^{-1})



Bottom reflectance

Different patterns!

Results using Hyperion Rrs



3. Preliminary findings:

a. **Hyperion DOES have the sensitivity for many coastal applications**.

b. Water and/or bottom properties could be well retrieved when high-quality Rrs are derived.

Issues:

a. No effective bands below 430 nm
b. TOA radiance error is ~5%
c. Lacking information for accurate georeference
d. No automatic system for atmosphere correction … **yet**

4. Next:

- Validate Hyperion results
- Apply the above process methods to other Hyperion data
- Try/Test with ALI data
- Analyze the limits of Hyperion/ALI data and the process methods
- **Make recommendations regarding future space-borne hyperspectral sensors**

To be continued …