The Increased Potential for LDCM to be Used for Constituent Retrieval in Case 2 Waters

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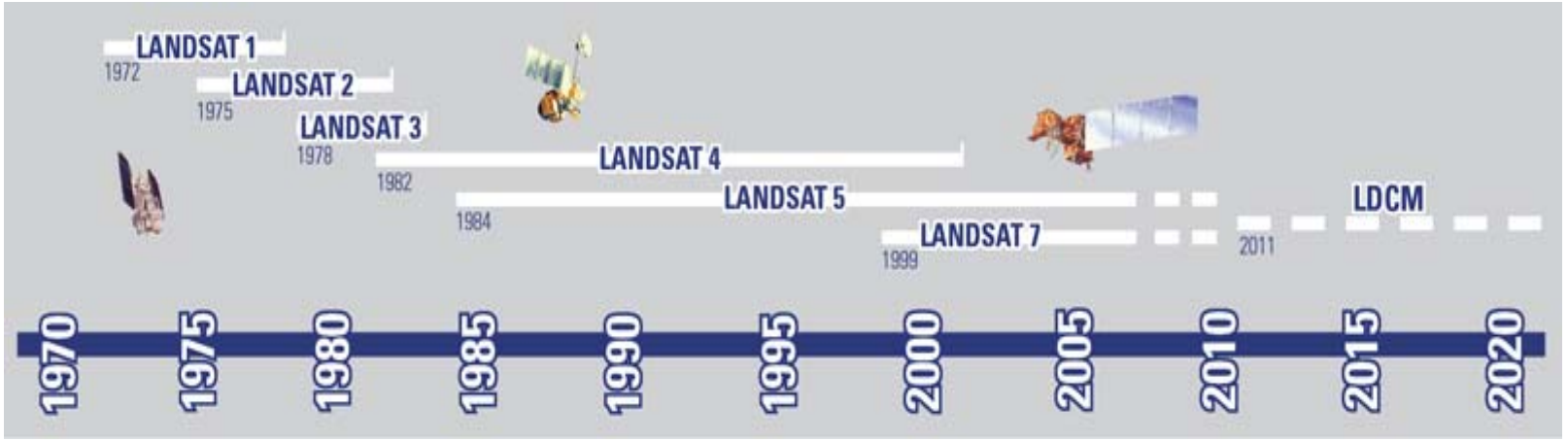
Sponsor: USGS

Case 2 Waters

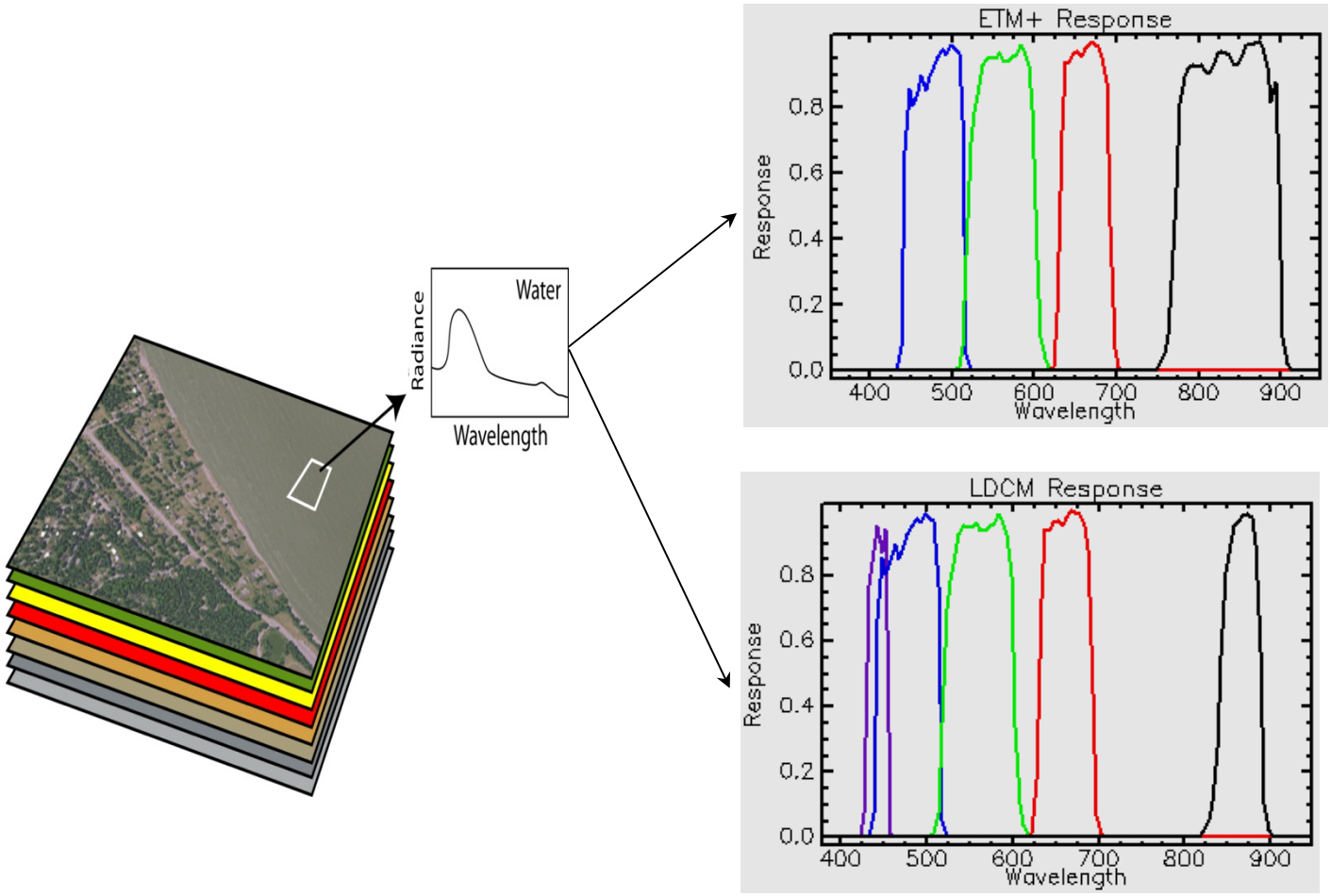
- **Horizontal variability of water's constituents are on the order of tens of meters…not kilometers.**
- **Constituent Retrieval**
- **We don't currently have a satellite that is ideal for studying these waters…Landsat 7 vs. SeaWiFS**

The Landsat Data Continuity Mission

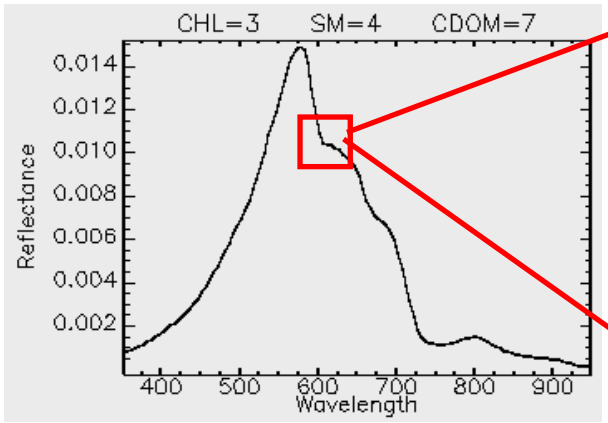


- Over 35 years of continuous data.
- LDCM instrument scheduled for launch in Dec. 2012.
- Historically, Landsat has been true to its name.
- Improved features of OLI instrument are particularly appealing in regards to constituent retrieval.

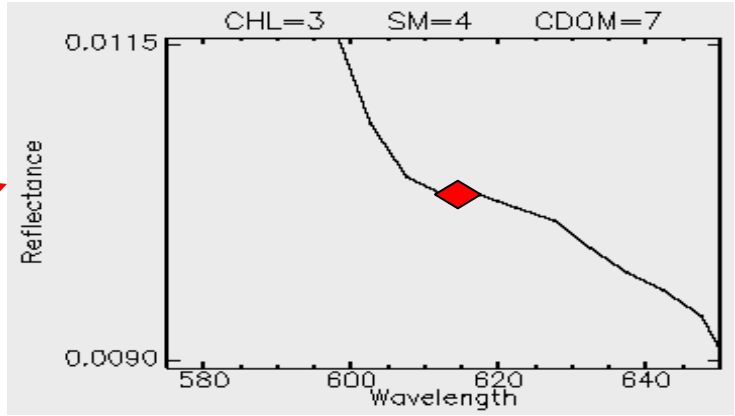
LDCM Features: Spectral Coverage



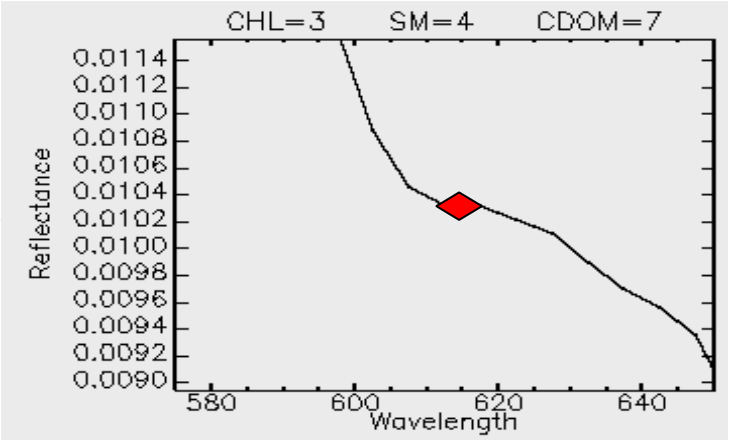
LDCM Features: Quantization



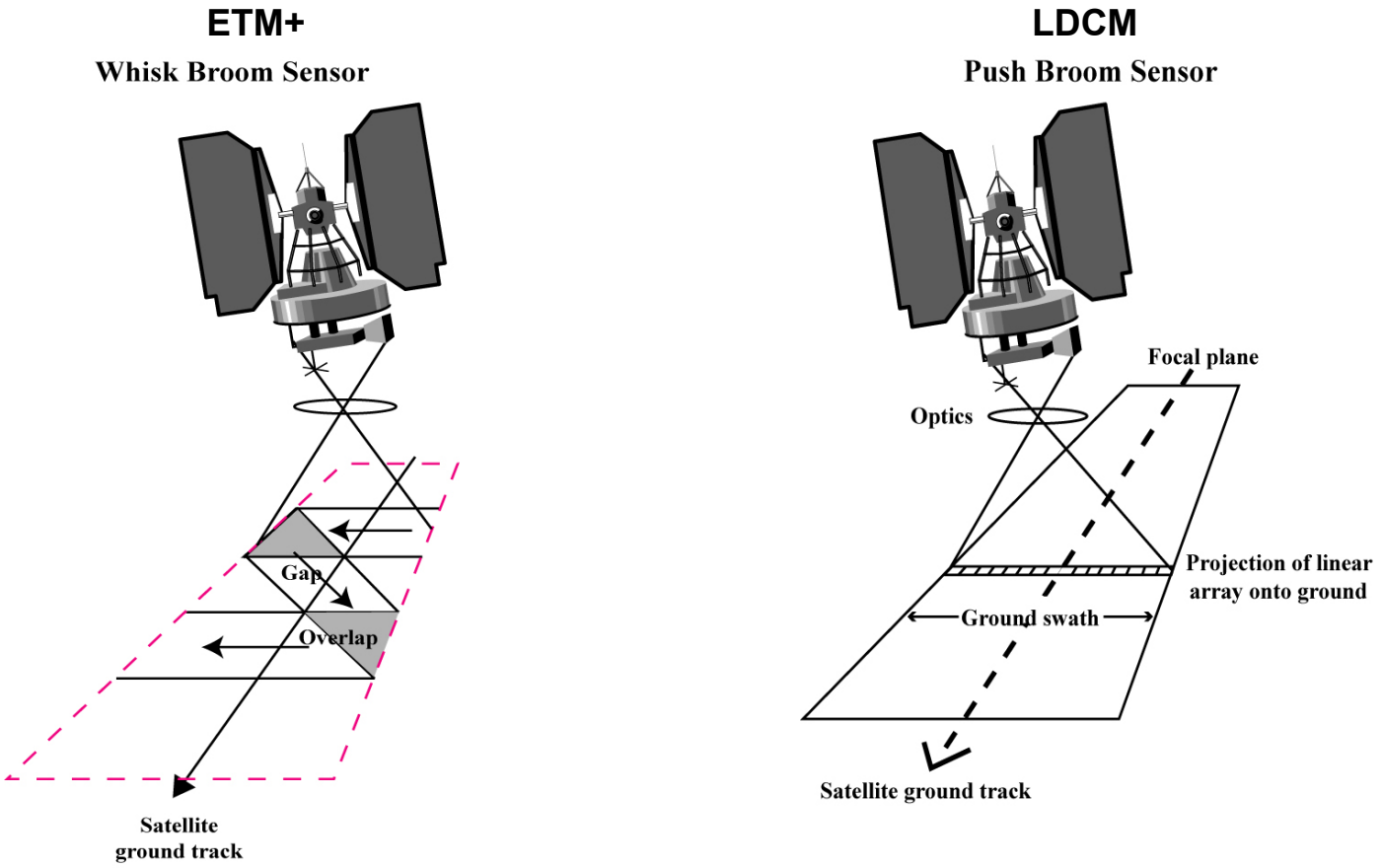
ETM+ (8-bit)



LDCM (12-bit)

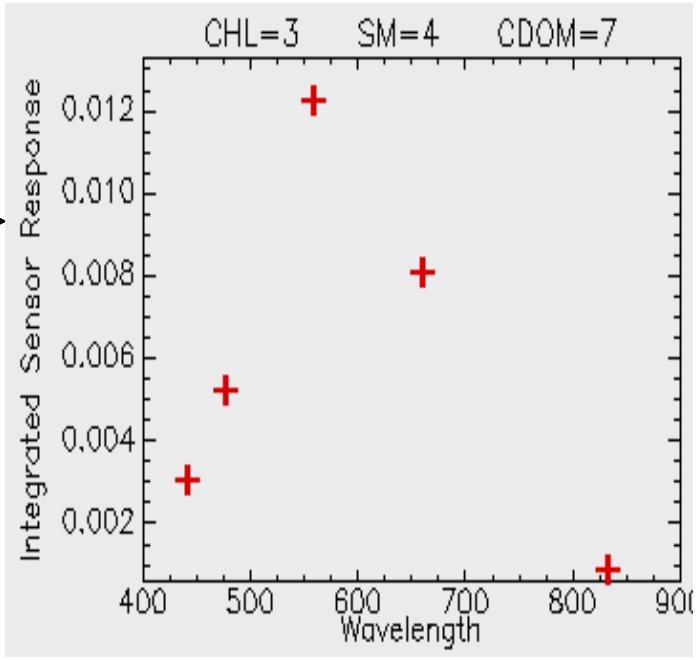


LDCM Features: Signal to Noise

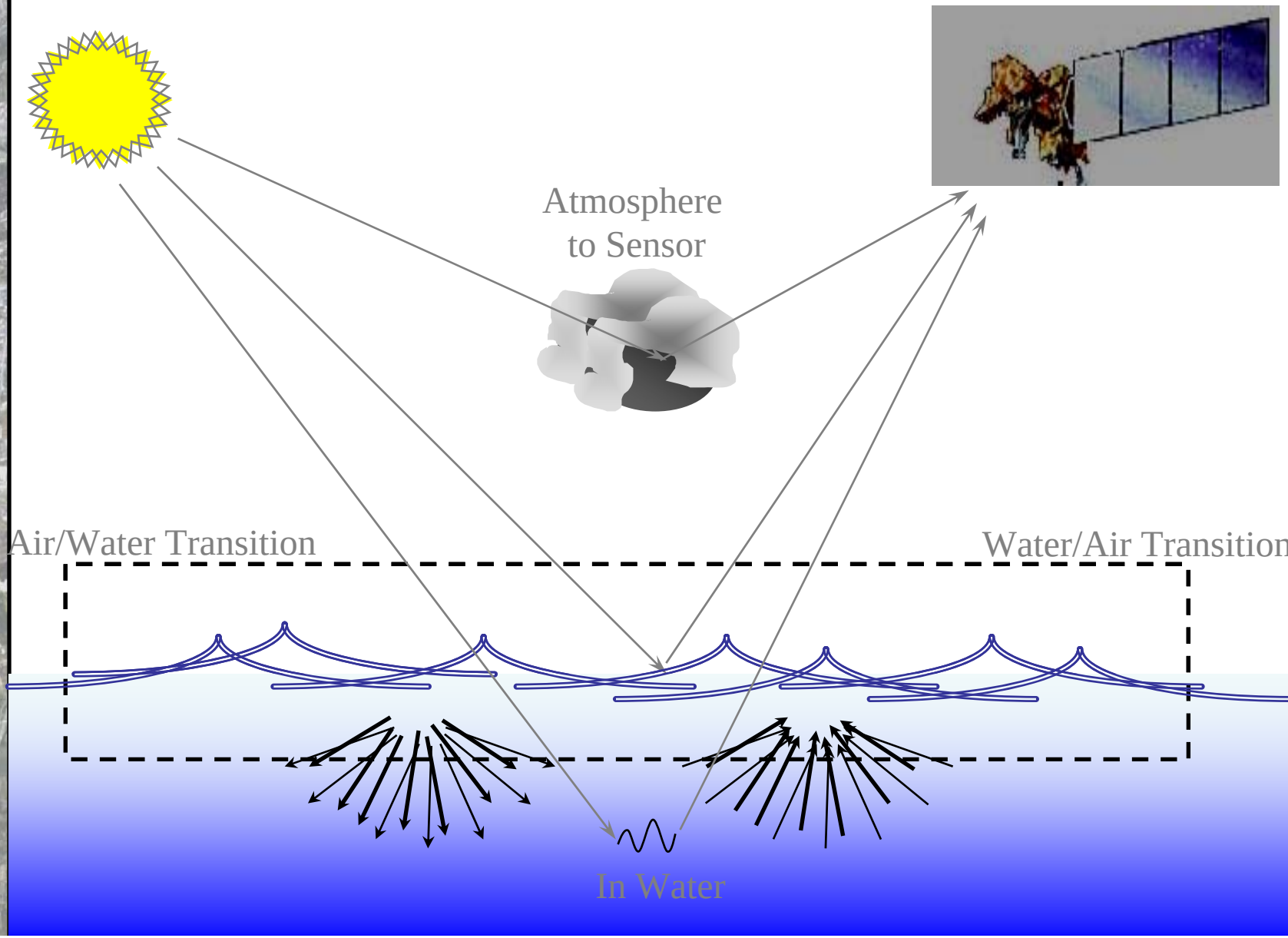


- Approximately a factor of 5 improvement in SNR.

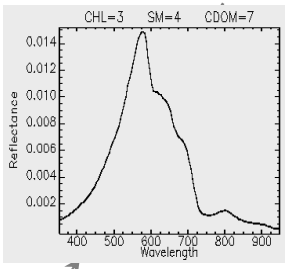
Modeling the Constituent Retrieval Process



Modeling the Constituent Retrieval Process

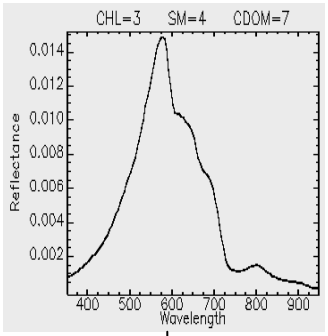


Modeling the Constituent Retrieval Process: Hydrolight

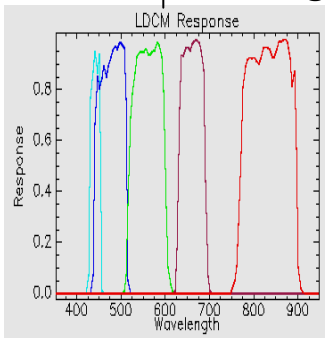


In Water

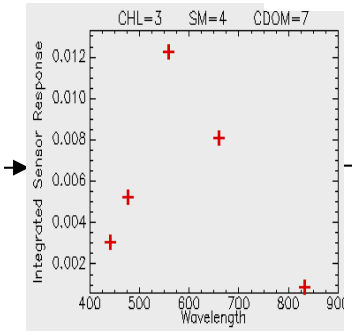
Modeling the Constituent Retrieval Process: At The Sensor



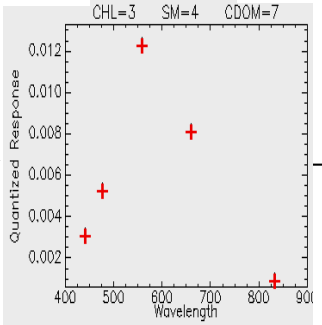
Spectrally Sample Signal

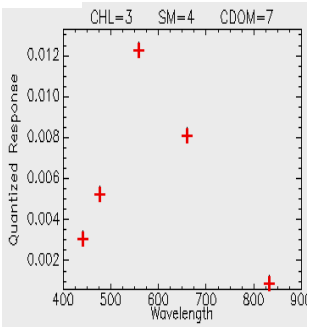


Add Sensor Noise



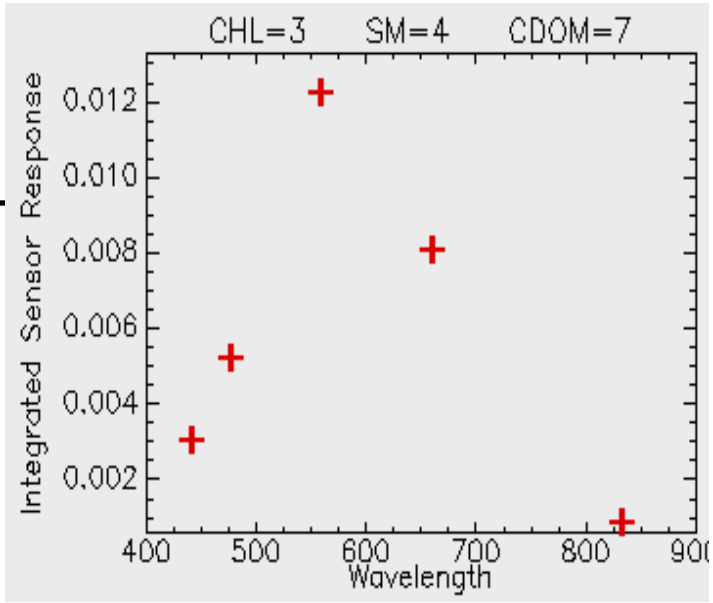
Quantize Signal





Modeling the Constituent Retrieval Process: The Scene

Modeling the Constituent Retrieval Process

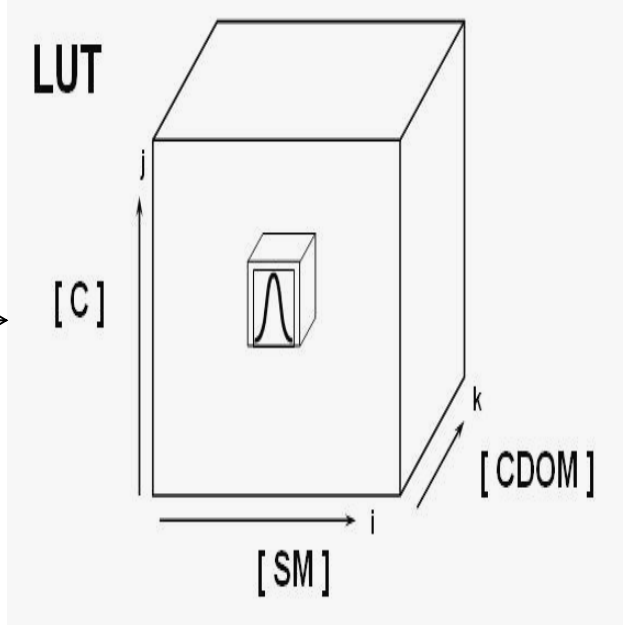


- **Determine remote-sensing reflectance and use bio-optical model to obtain water constituents.**

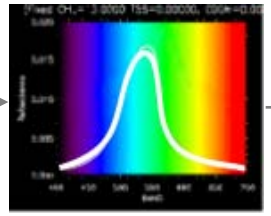
LUT Development

C(μg/L)	SM(mg/L)	CDOM(1/m)
0	0	0
.5	.5	.5
1	1	.75
3	2	1
5	4	2
7	8	4
12	10	7
24	14	10
46	20	12
68	24	14

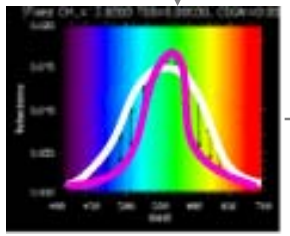
Hydrolight



Amoeba Process



λ

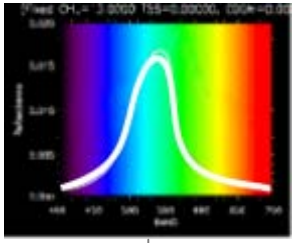


S_Q Error

$\min [(S_T - S_P)^2]$

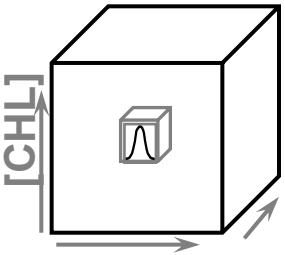
TRUE

FALSE

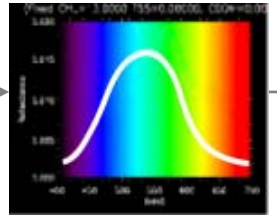


[CHL] [SM] [CDOM]

LUT

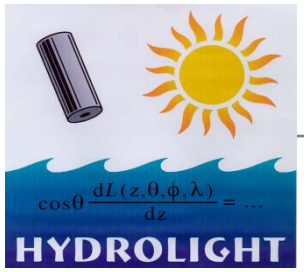


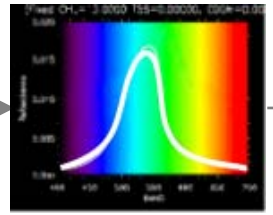
[CHL] [SM] [CDOM]



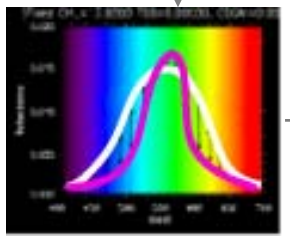
S_p predicted

Amoeba Process





λ



S_Q Error

min $[(S_T - S_P)^2]$

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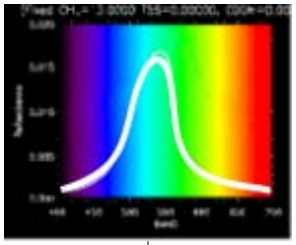
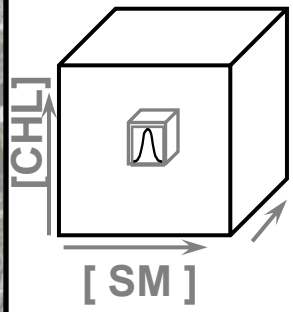
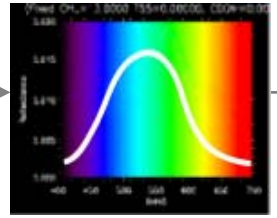


[CHL] [SM] [CDOM]

LUT

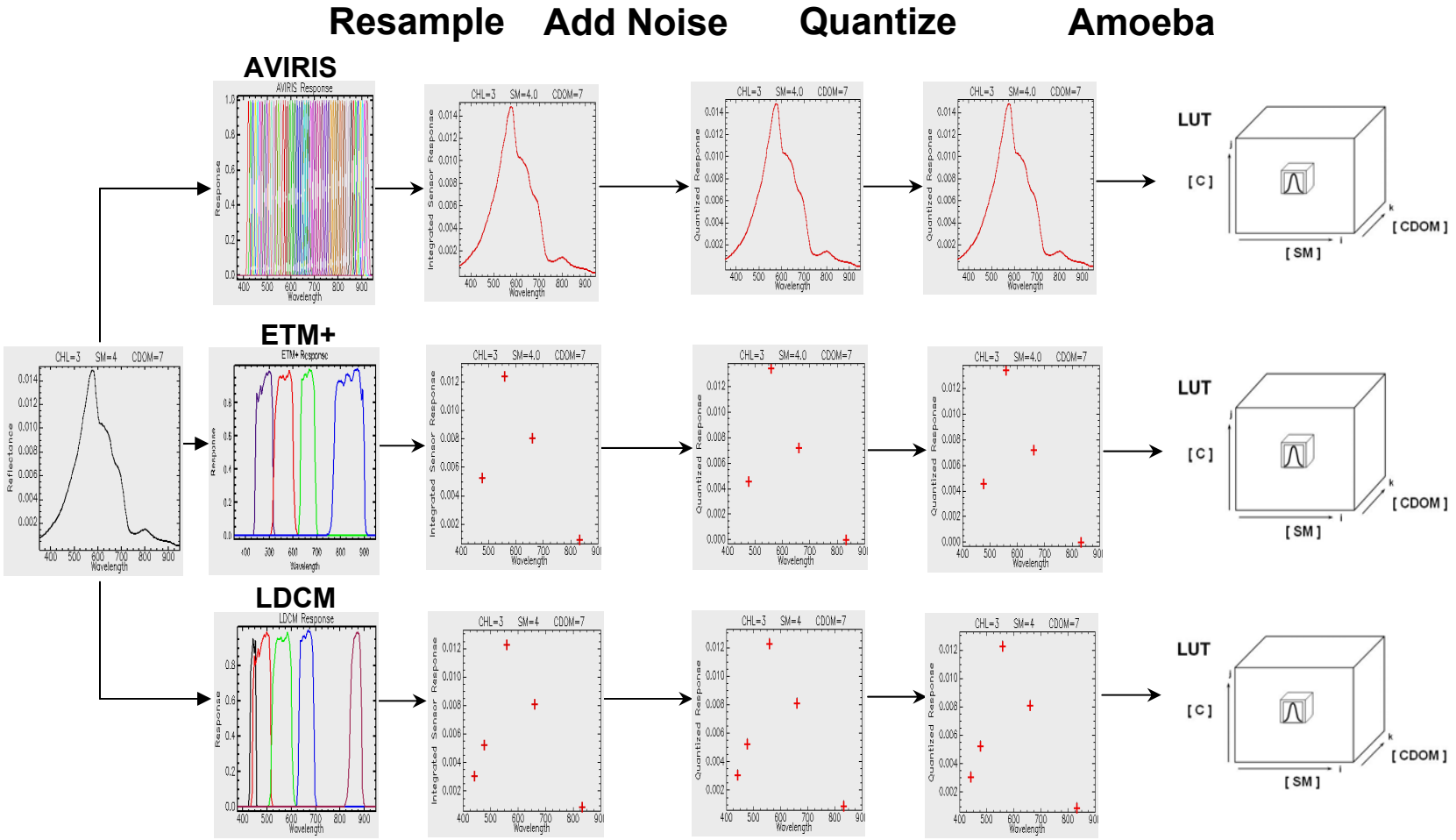


[CHL] [SM] [CDOM]



S_p predicted

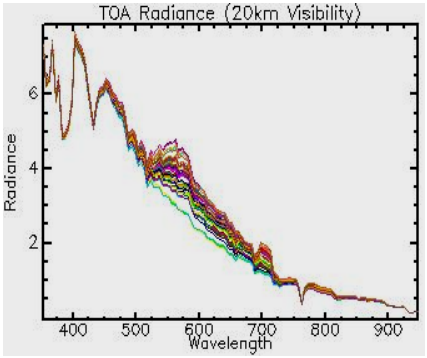
Process Summary

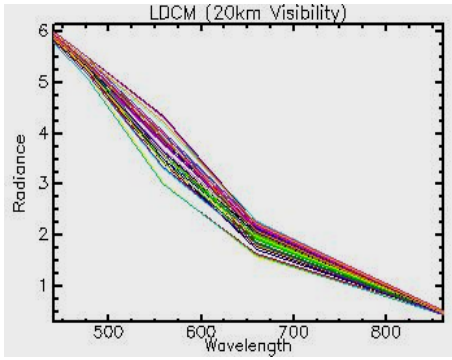


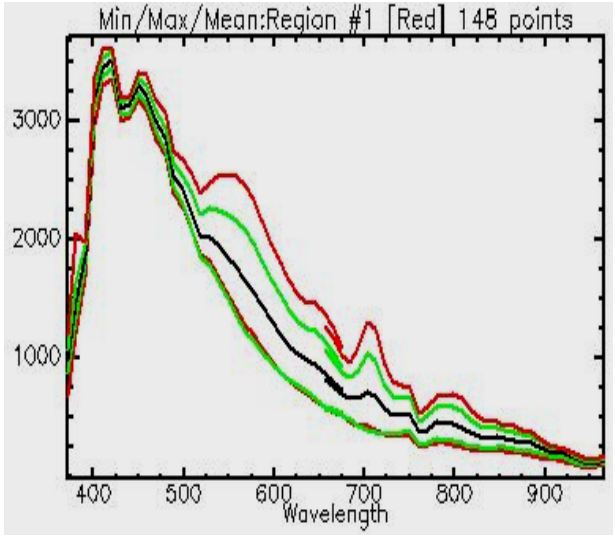
Results (Percentage of Range)

	CHL(μg/L)		SM(mg/L)		CDOM(1/m)	
Spectral coverage:						
AVIRIS	.5	0.7%	.1	0.4%	.1	0.7%
ETM+	.5	0.7%	.6	2.5%	.2	1.4%
LDCM	.5	0.7%	.5	2.1%	.1	0.7%
Quantization:						
ETM+	5.7	8.4%	2.8	11.7%	1.7	12.1%
LDCM	1.2	1.8%	.6	2.5%	.2	1.4%
Noise/Quantization:						
ETM+	7.4	10.9%	4.8	20.0%	3.2	22.9%
LDCM	3.7	5.4%	1.2	5.0%	.9	6.4%

Atmospheric Compensation Algorithm:
Only 1 NIR band on LDCM…hmmm







Preliminary Results of Atmospheric Compensation Study

- 2000 randomly generated water pixels
- 22.50km visibility
- Rural aerosols
- Mid-latitude summer
- Spectrally sampled to the LDCM sensor's response function.

	CHL (μg/L)	SM (mg/L)	CDOM (1/m)	Ave. Chosen Visibility
Pixel-by-pixel:				
No Noise	11.7%	5.0%	4.8%	-
N/Q	16.0%	8.5%	7.3%	-
Global Removal:				
No Noise	7.8%	3.6%	4.2%	22.56
N/Q	10.9%	5.0%	5.9%	22.57

Future Work

- Perform constituent retrieval process on real data.
- Investigate how IOPs affect constituent retrieval process.