Remote Sensing for Algal Blooms

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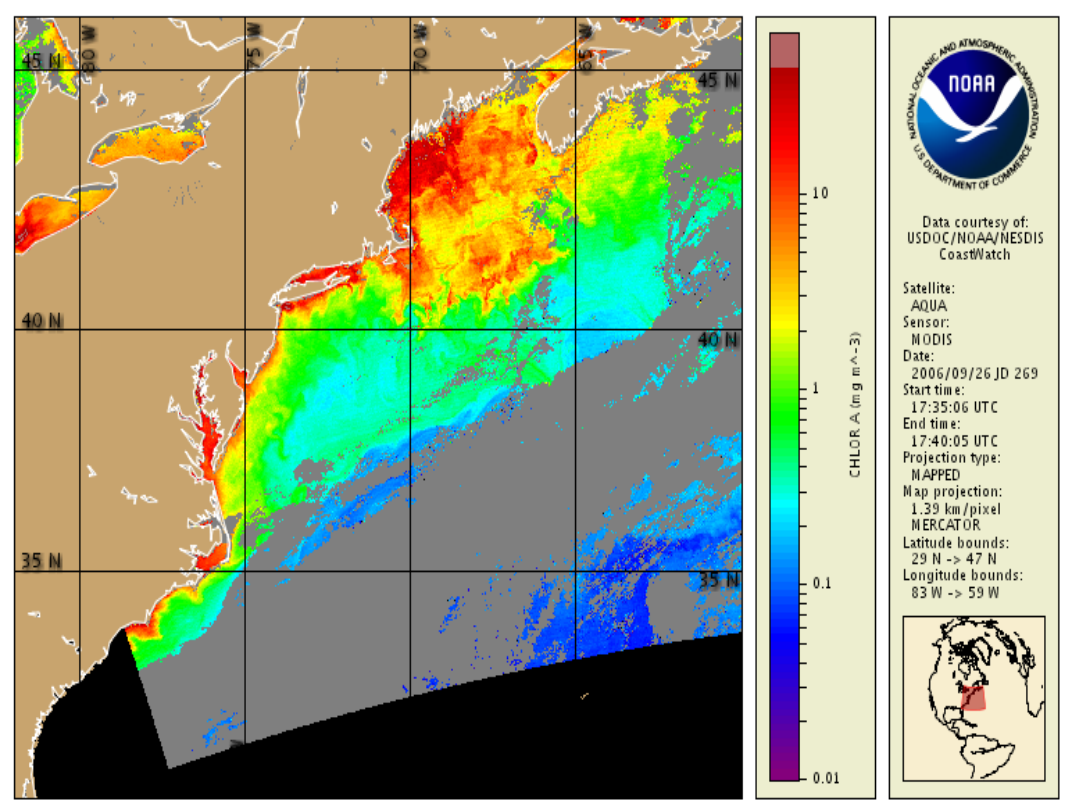
Current Satellite Imagery for Chlorophyll *a*

- Best satellite imagery is 250m resolution, easily accessible imagery is 1km or greater
- The resolution is not adequate for small back bay waters
- Algorithms do not work in back bays or near shore coastal waters



Aircraft Remote Sensing

- Low Altitude flight gives better resolution, at 500 feet we can cover a circle with a diameter of 132 feet.
- With simultaneous boat sample collection and flight data, algorithms specific to the area's waters can be developed
- Sensor equipment costs less than $5,000

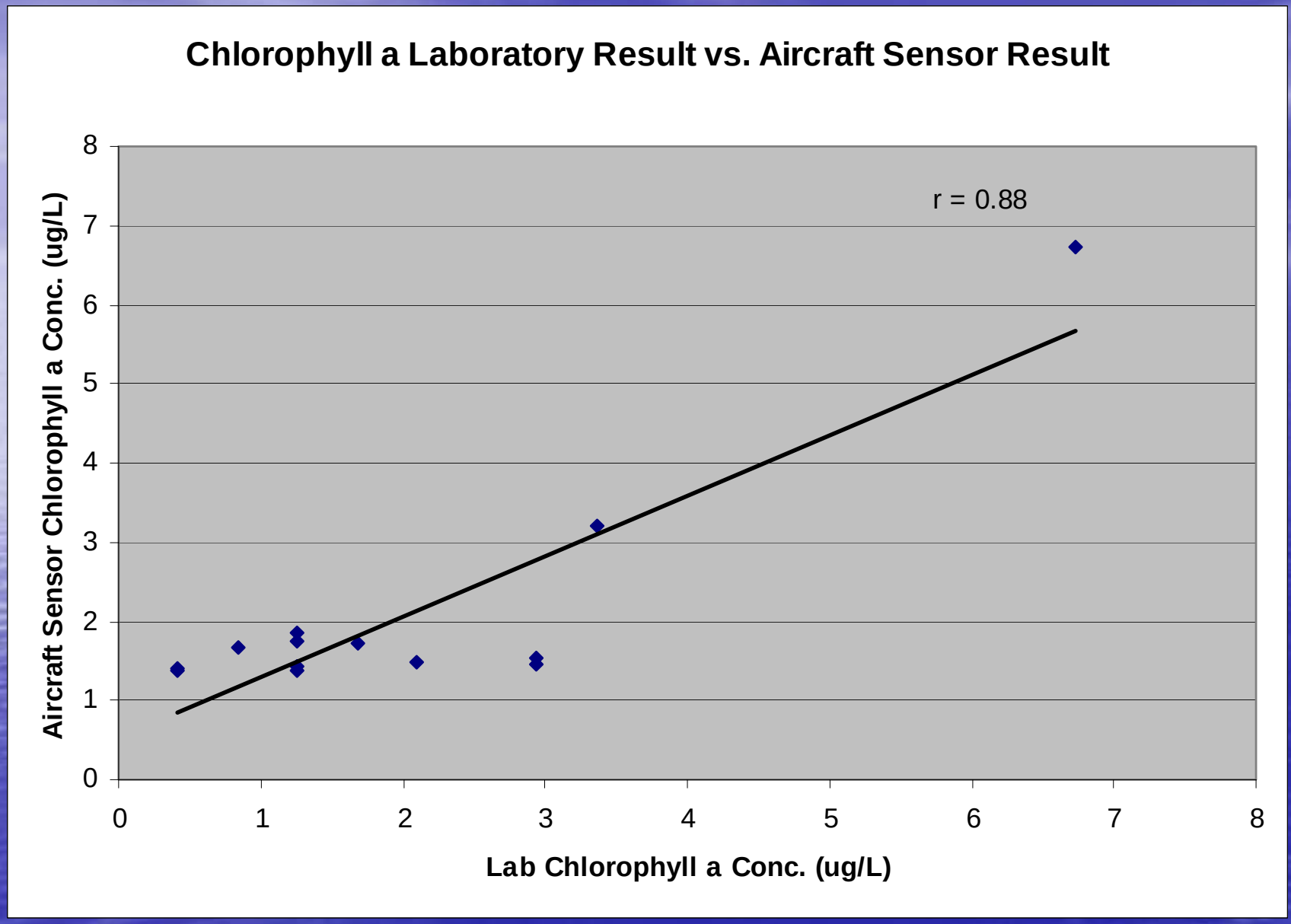
The Sensor

Ocean Optics USB2000 Fiber Optic Spectrometer

Detector:	Toshiba TCD1304AP Linear CCD array
Detector range:	200-1100 nm

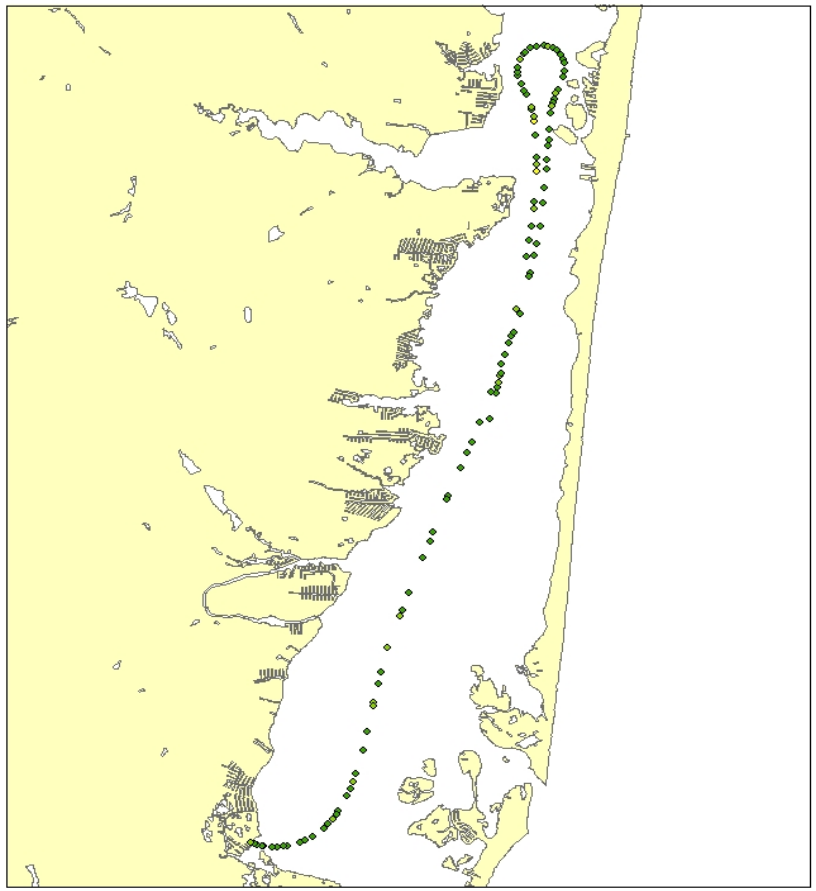
2006 Aircraft Remote Sensing

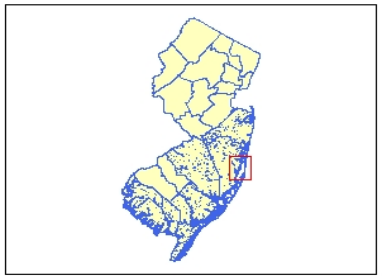
- Seven flights were performed
- Two flights were used to collect samples for algorithm development
- A second order equation was developed using a 667nm and 678nm MODIS wavelength ratio
- Current data collected has been supported by other Bureau data sources



More data needed for algorithm development/verification, especially at higher Concentrations.

5/18/2006 Flight Results





Legend

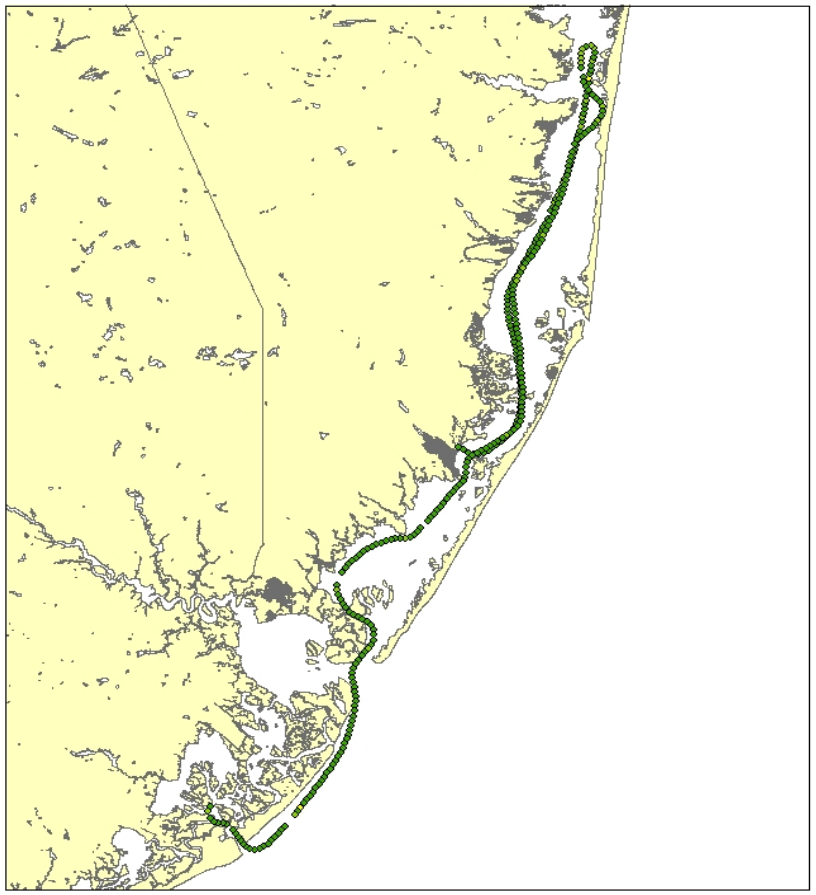
5182006

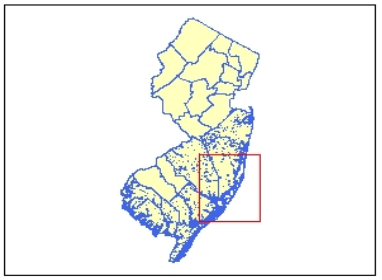
Est_Chloro

- 0 - 3
- 3 - 6
- 6 - 12
- 12 - 24
- > 24

coastlnd

5/24/2006 Flight Results





Legend

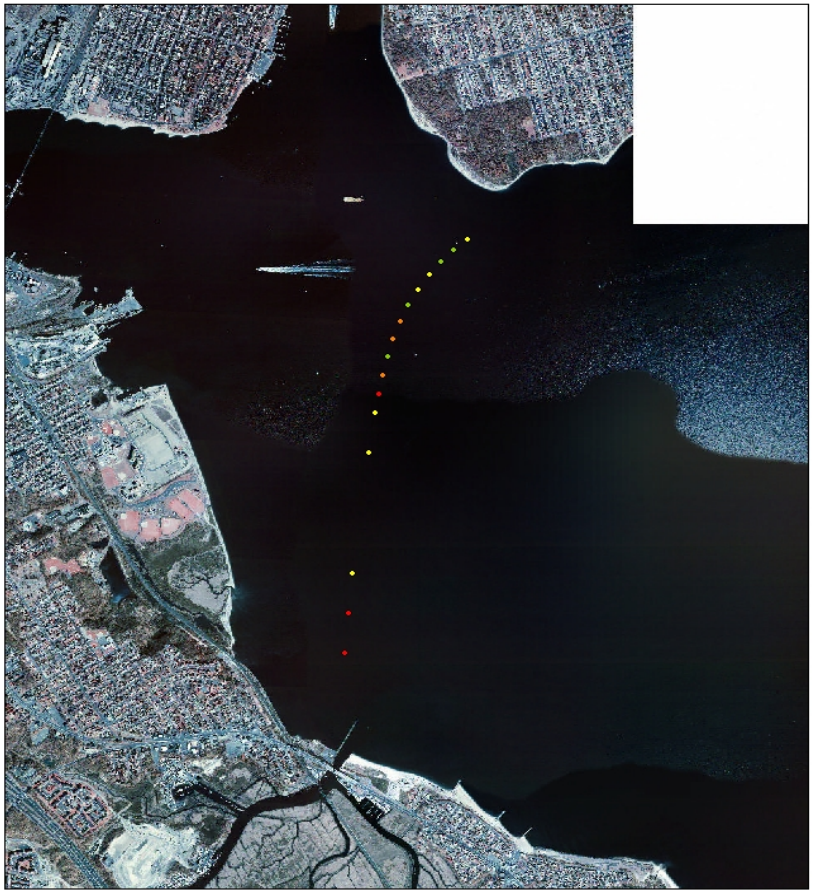
5242006

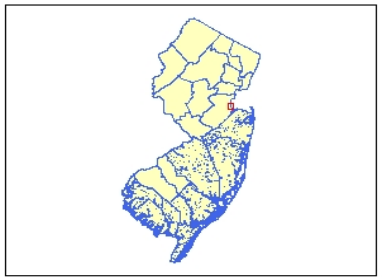
Estimated

- 0 - 3
- 3 - 6
- 6 - 12
- 12 - 24
- > 24

coastlnd

5/31/2006 Flight Results





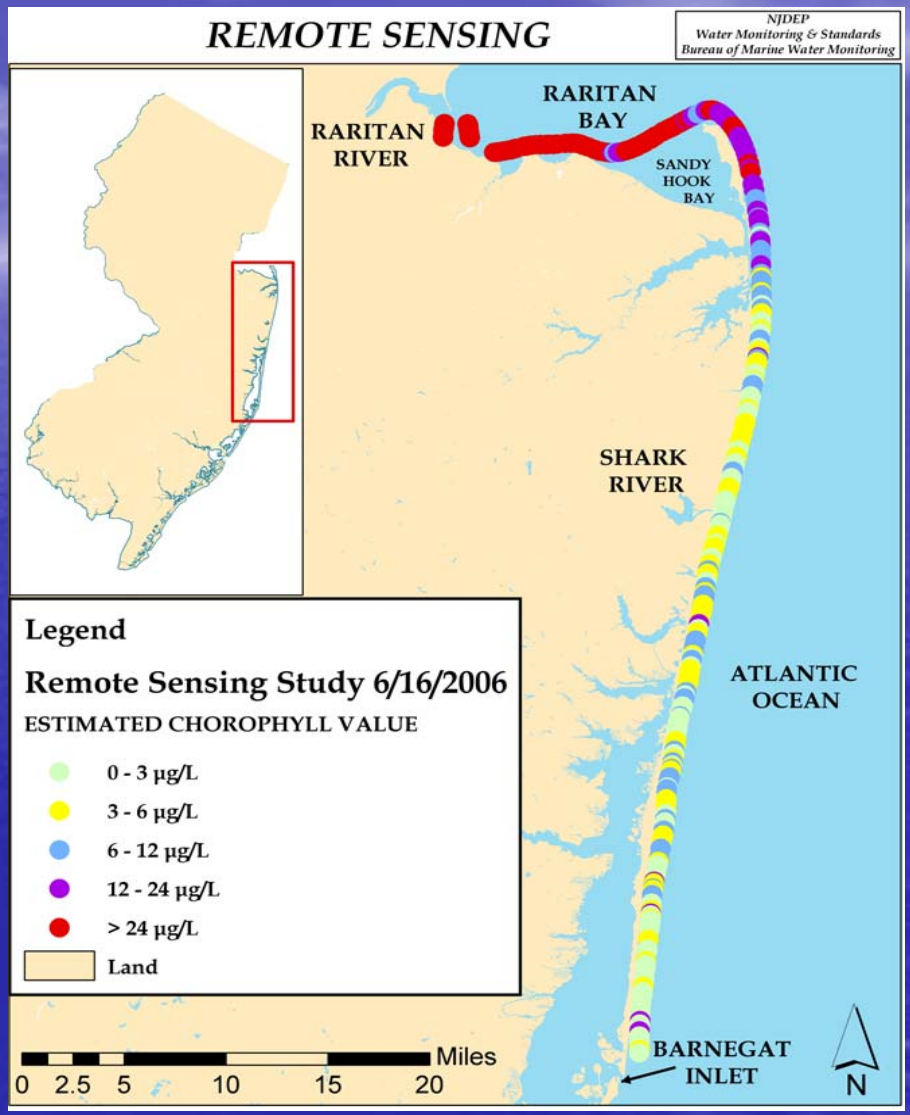
Legend

5312006

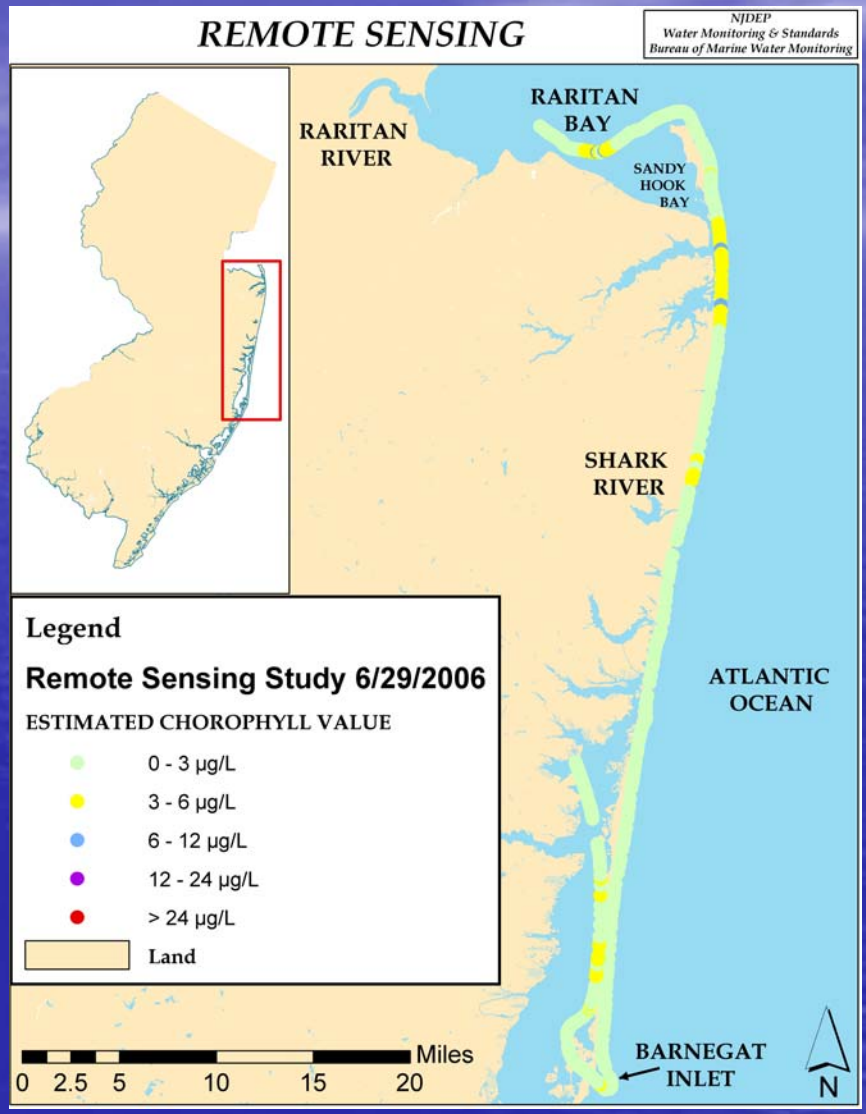
Estimated

- 0 - 3
- 3 - 6
- 6 - 12
- 12 - 24
- > 24

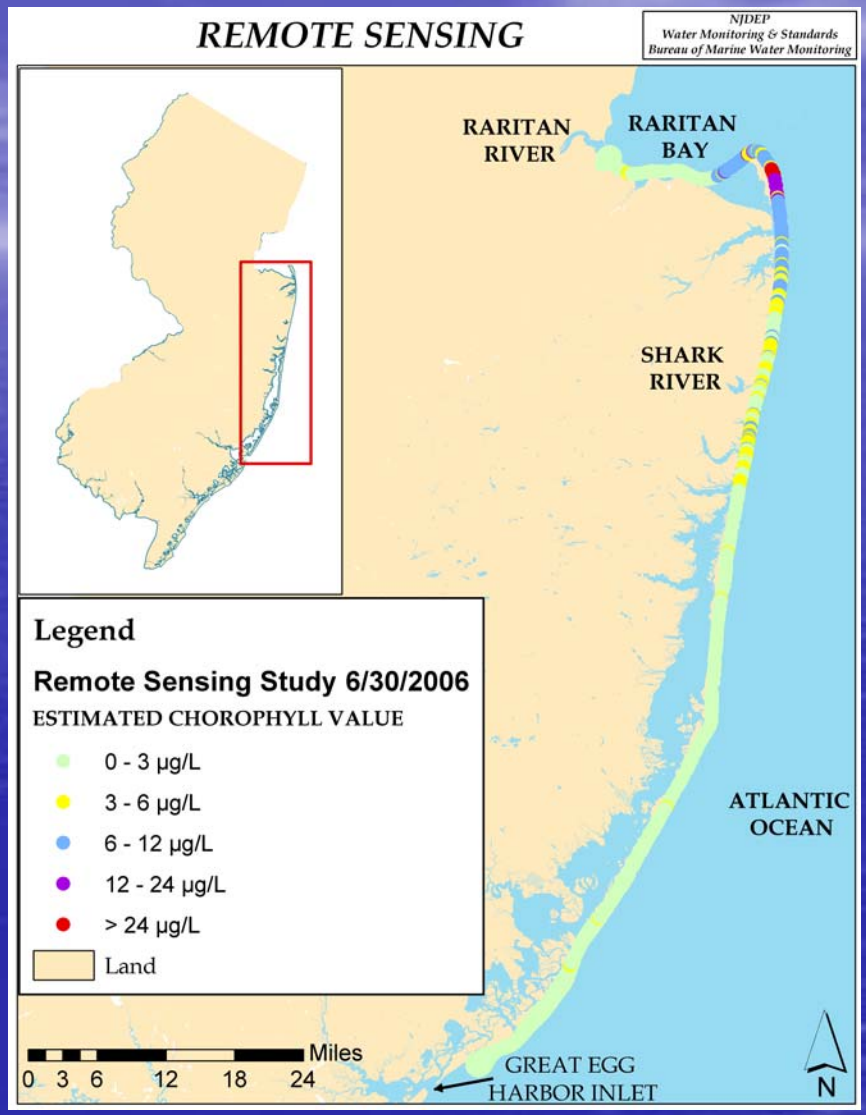
6/16/2006 Flight Results



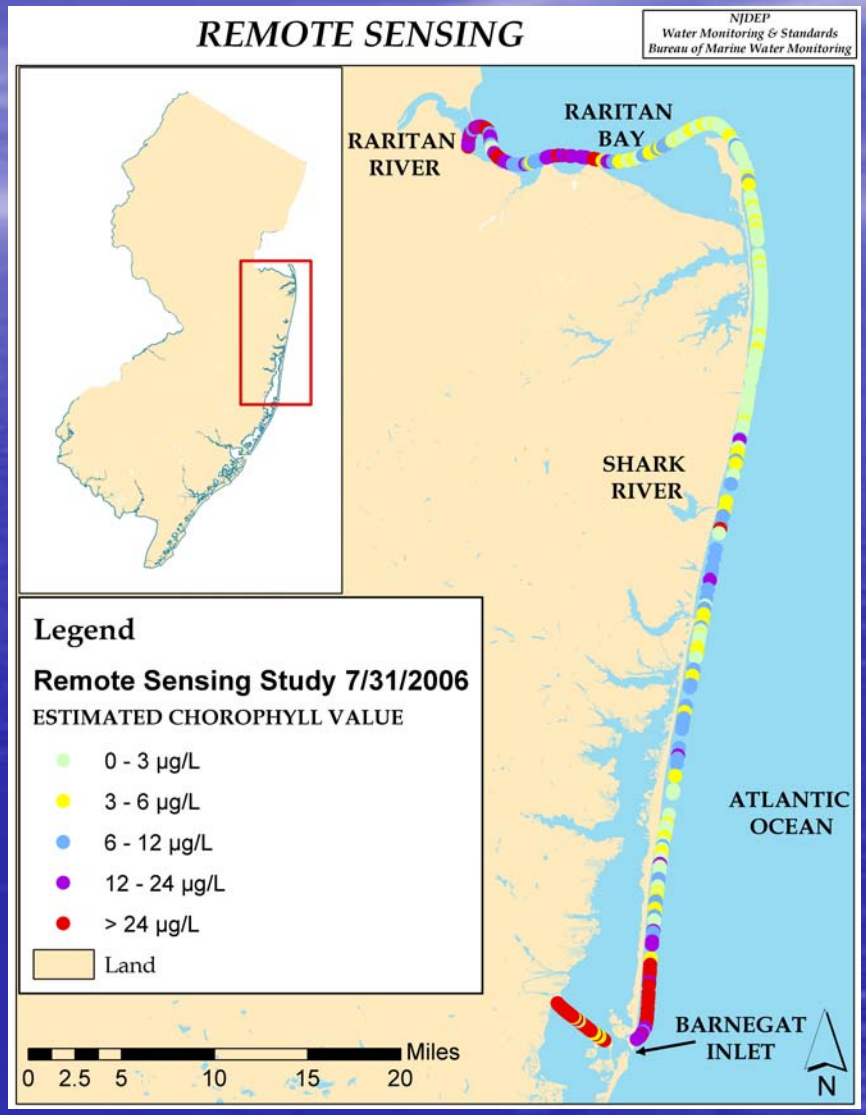
6/29/2006 Flight Results



6/30/2006 Flight Results



7/31/2006 Flight Results



Additional Work

- **Better programming to link the GPS and Sensor data automatically into one file**
- **Easier start up of programs to eliminate additional staff time**
- **More ground truth data of chlorophyll *a*, over a wide range of concentrations. This will be used to adjust the equation for the whole range of concentrations**
- **Map generation and posting to the web, needs development**
- **Possibility of free wave radio or cellular data transmission for real-time data**
- **Establish duplicate system on EPA helicopter**

Conclusions

- **The sensor can differentiate between different concentrations of chlorophyll *a*.**
- **Current results correlate well with ground truth data as well as observations from other projects.**
- **On 6/16/06 remote sensing identified a bloom in Raritan Bay. Boat sampling and lab analysis identified the bloom as non-toxic diatoms.**
- **The data can be effectively used to monitor both near-shore coastal and estuarine waters for algal blooms.**

Acknowledgements

- Bureau staff – Bob Schuster, Ken Hayek
- DEP Parks & Forestry, Forest Fire Service
- EPA Region 2
  - Provided funding for purchase of sensors
  - Providing a second platform (helicopter) for a second sensor
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- NOAA, Coastal Services Center, Charleston, SC