



Airborne and Remote Monitoring of Water Quality

**Evaluation of Remote Sensing Techniques for real
time control of water quality in surface bodies**

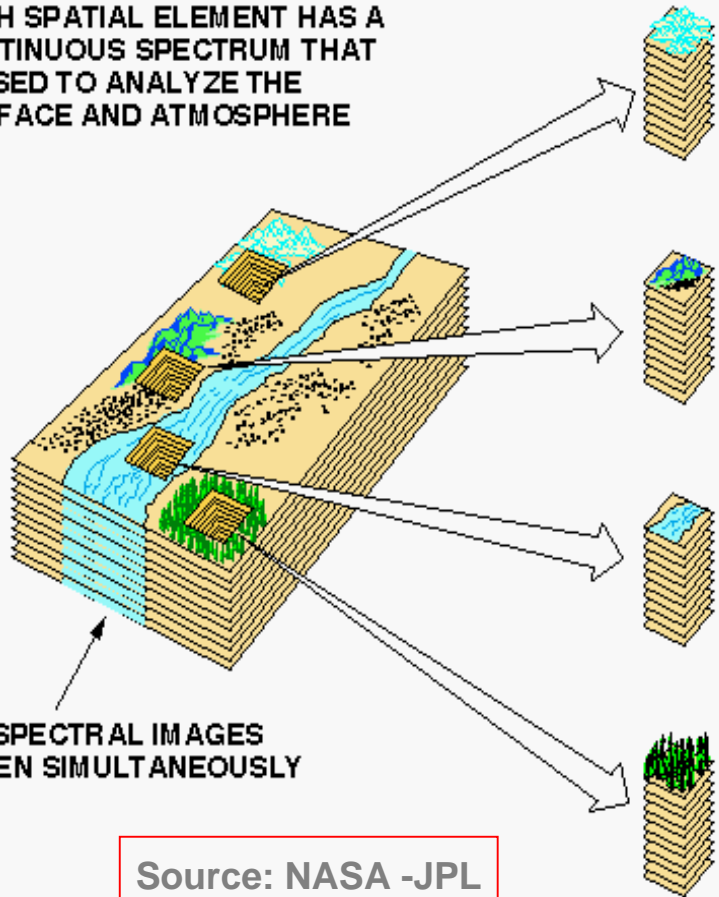
Arnold G. Dekker¹, Anatoly Gitelson² and Eyal Ben-Dor³

Poster presented at the
IUPAC Congress/General Assembly
July 2001

Imaging Spectroscopy Concept

The most advanced remote sensing technique

EACH SPATIAL ELEMENT HAS A CONTINUOUS SPECTRUM THAT IS USED TO ANALYZE THE SURFACE AND ATMOSPHERE



Source: NASA -JPL

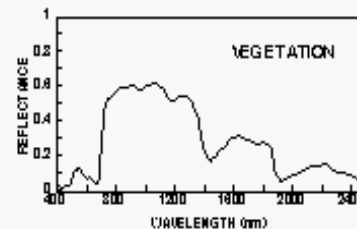
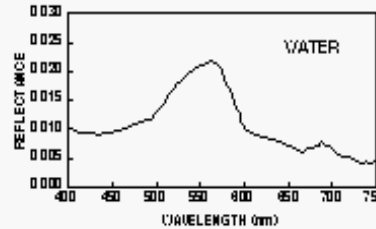
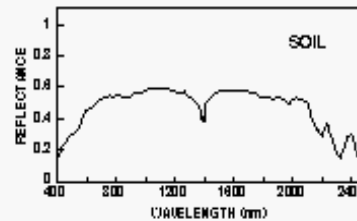
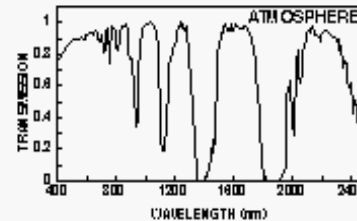
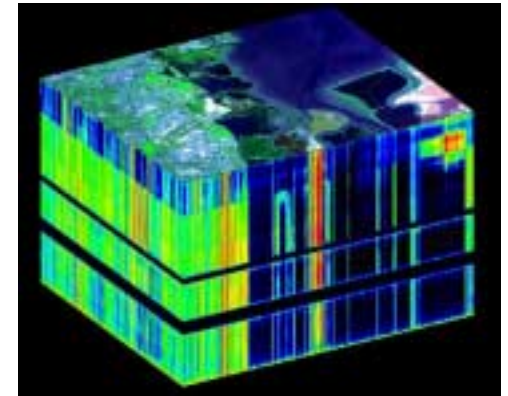
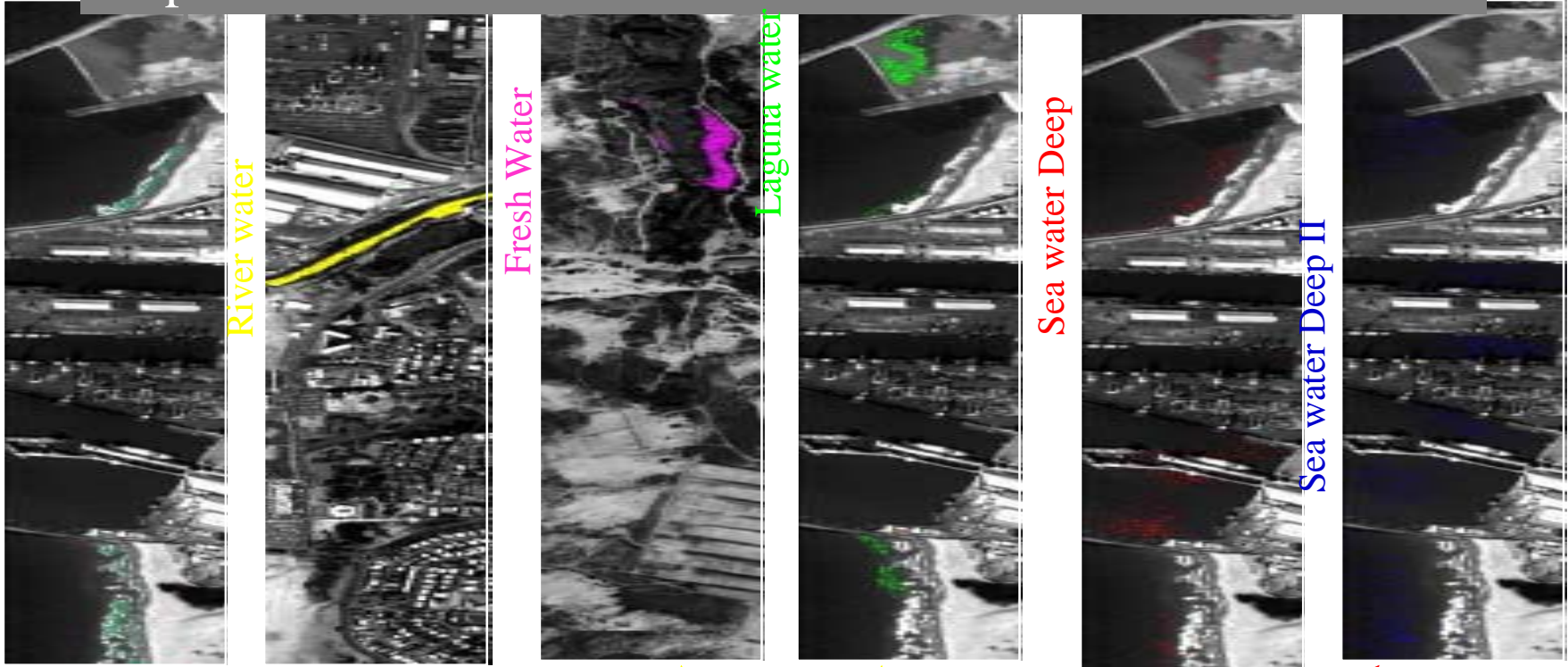


Image Cube

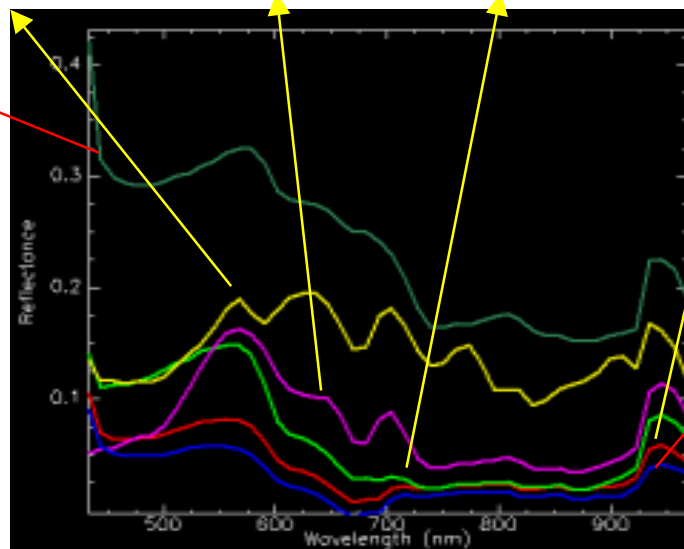


Spectral Classification of Water Bodies over Urban Areas

Sea water



CASI Sensor
October 1999



THE REMOTE SENSING
AND G.I.S. LABORATORIES

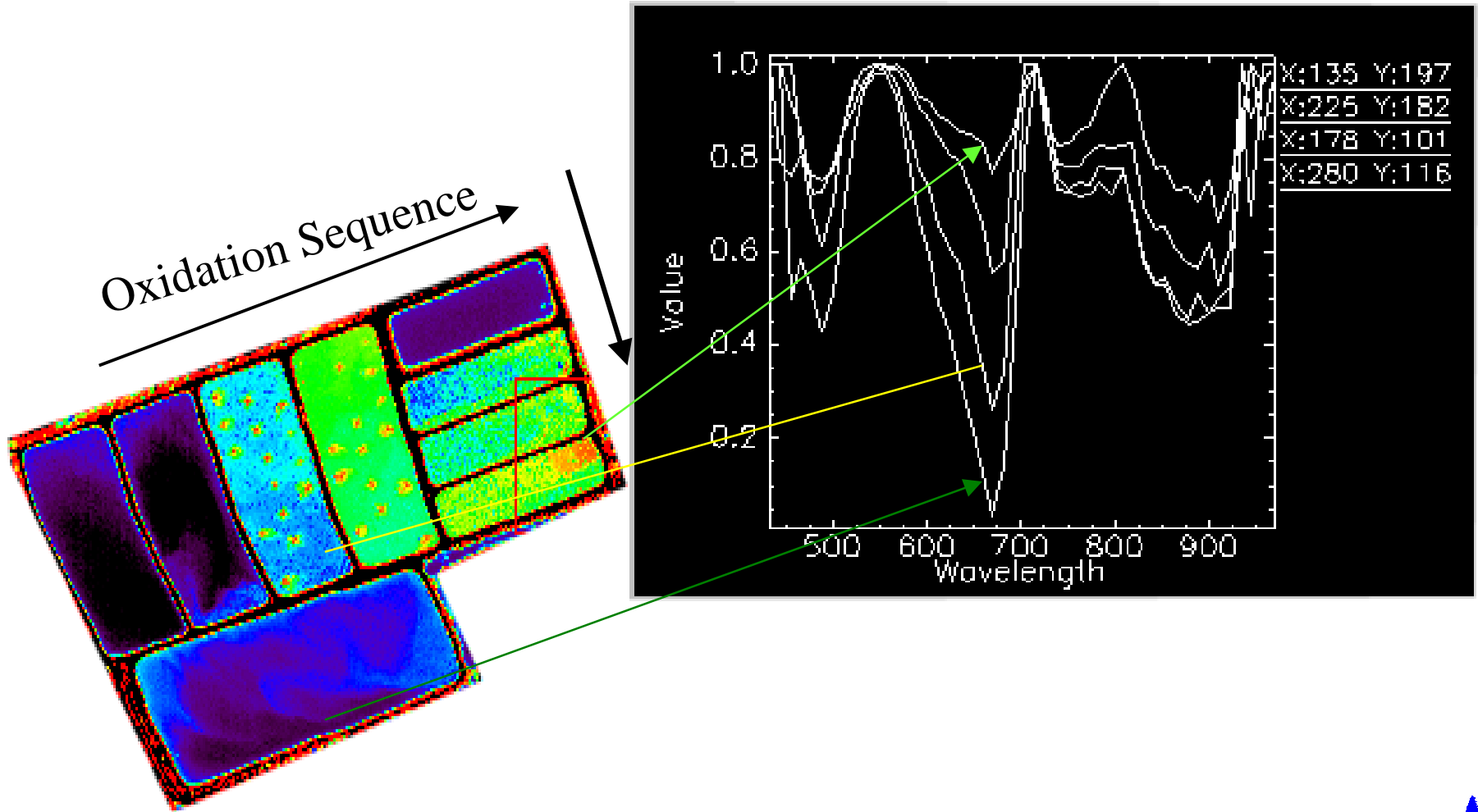


Dr. Eyal Ben-Dor

Chlorophyll in a Waste Basin of Urban Area

CASI Sensor

October 1999

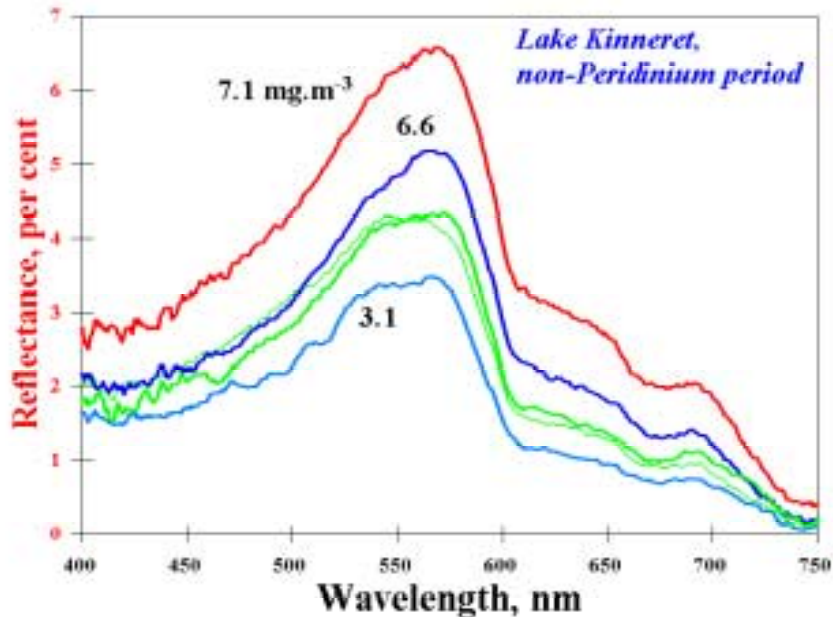


200m

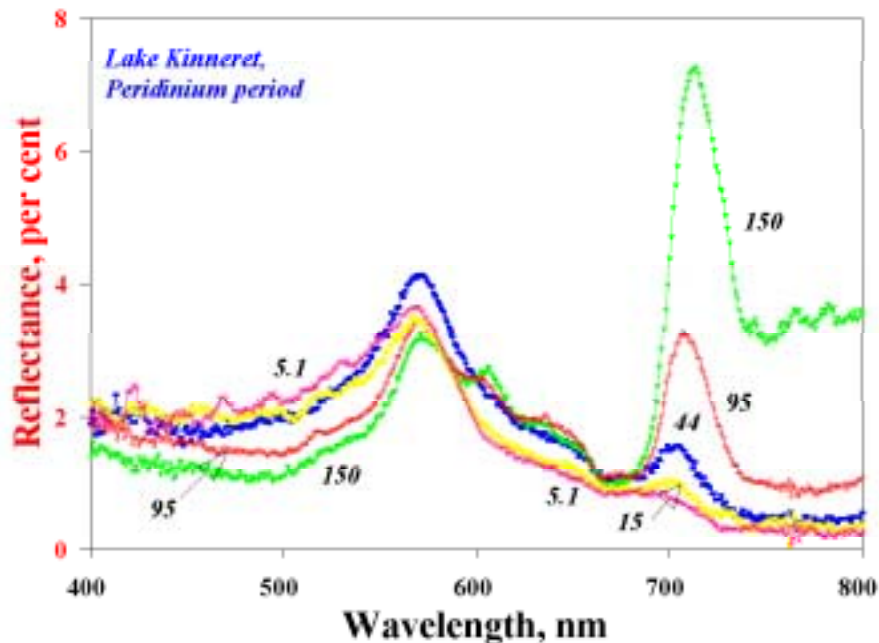
THE REMOTE SENSING
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Dr. Eyal Ben-Dor



As Peridinium (=dinoflagellate) concentrations increase reflectance in the Visible decreases and in the NIR increases



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Brief Methodology

With **remote sensing** from aircraft or satellites it is possible to measure (parts of) spectra. Because they are gathered two-dimensionally it is called **imaging spectrometry** (or multiband spectrometry).

Spectra panels above and left

Spectral analysis panel right

Concentration maps of directly measurable variables

panels below and left below

Concentration maps of inferred variables such as PCB's

panel right below

(also: primary production, eutrophication; dispersion of effluent plumes etc.)

Contribution from the IUPAC Chemistry and Environment Division - Commission on Soil and Water Chemistry

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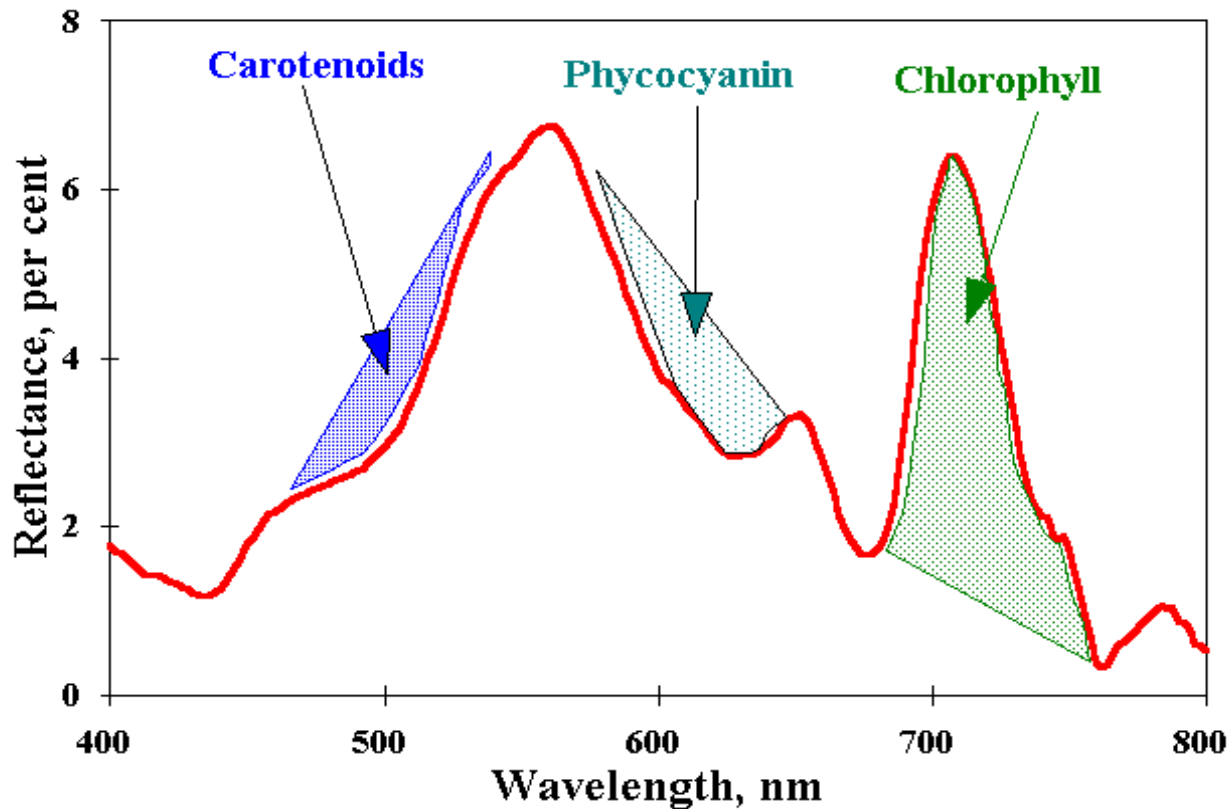
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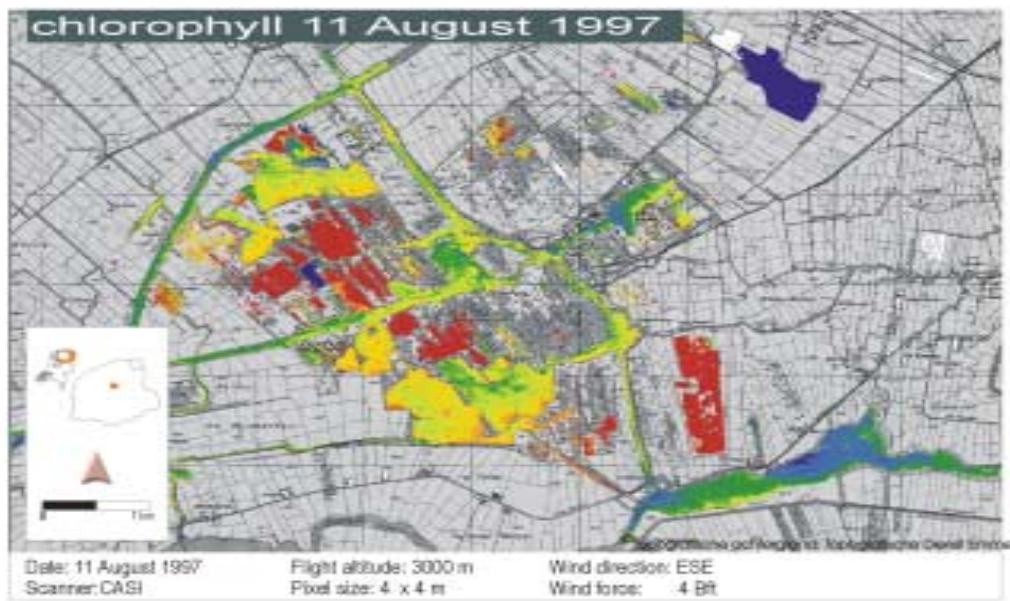
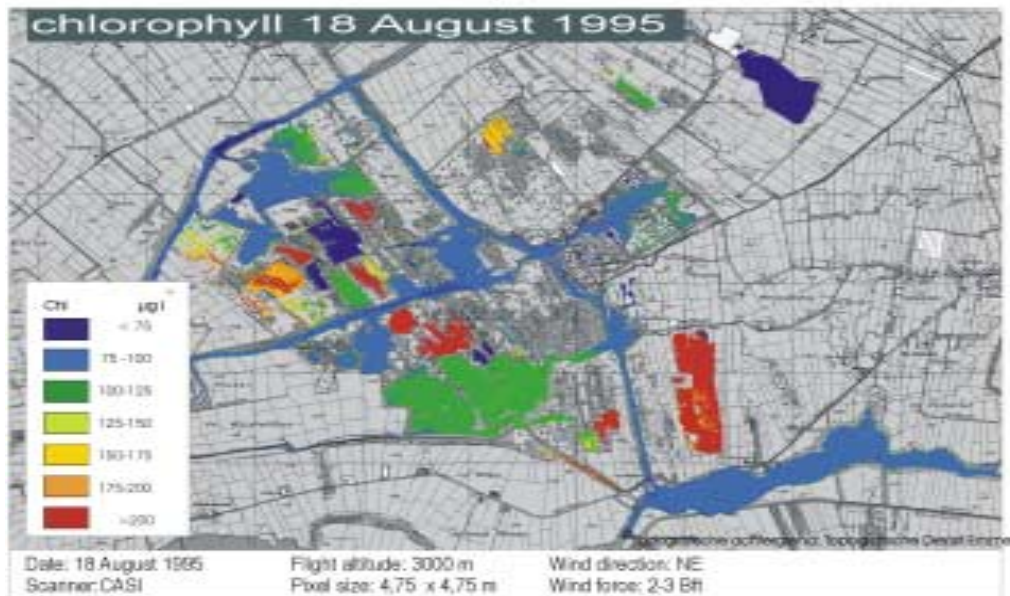
The algorithms for pigment estimation



The algorithms use **unique spectral features** of reflectance:

- **carotenoids:** gap near 500 nm;
- **phycocyanin:** minimum near 625 nm;
- **chlorophyll-a:** peak near 700 nm.

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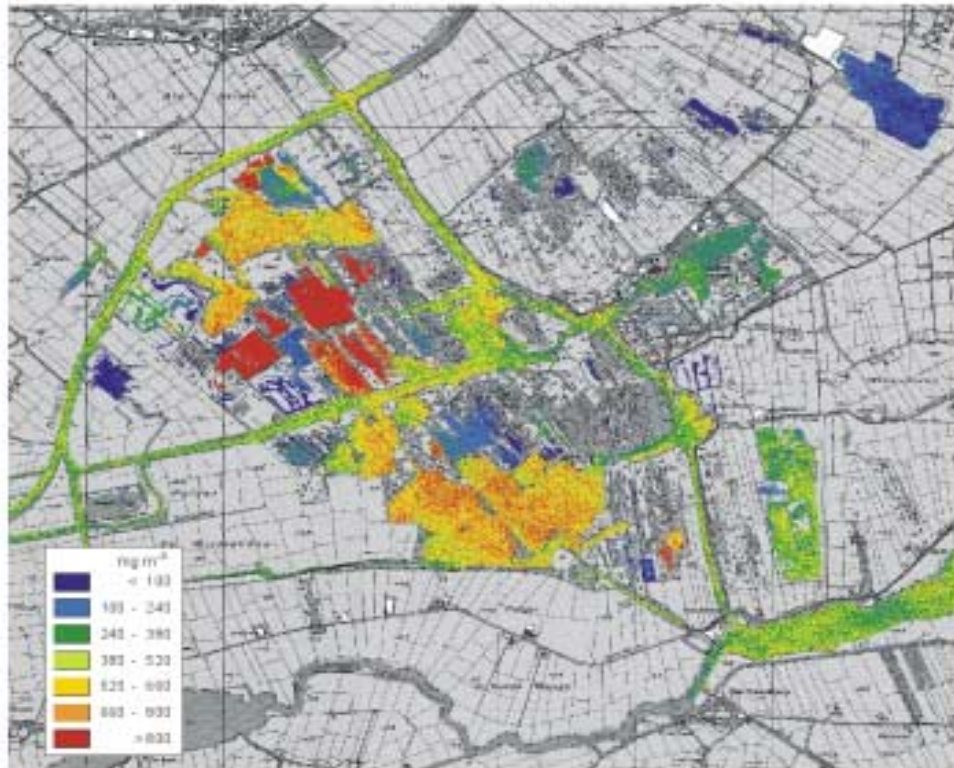
Airborne Imaging Spectrometry derived multi-temporal chlorophyll images of a nature reservation wetland lake area - *De Oude Venen*- in The Netherlands

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Inst. Environm. Studies - Vrije
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Thematic chlorophyll maps of the Oude Venen wetlands making use of CASI hyperspectral data on 18 August 1995 and 11 August 1997. The images were atmospherically corrected prior to the application of the same analytical chlorophyll algorithm. Thus, only one legend is required and the maps are directly comparable. In addition, the data was georeferenced and formatted into ARC/INFO format.

Water quality of the Oude Venen by remote sensing

Cyanophycocyanin



Airborne Imaging Spectrometry derived cyanophycocyanin image of the *Oude Venen* indicative of the concentration of potentially toxic cyanobacteria

Meta information



K&M



Institute for Environmental Studies
ivS - Vrije Universiteit Amsterdam

Date: 11 August 1997
Solar time: 11:00
Scanner: CASI
Altitude: 3000 m
Pixel size: 4 x 4 m
Sun zenith: 39
Sun azimuth: 155
Wind direction: ESE
Wind speed: 1.81

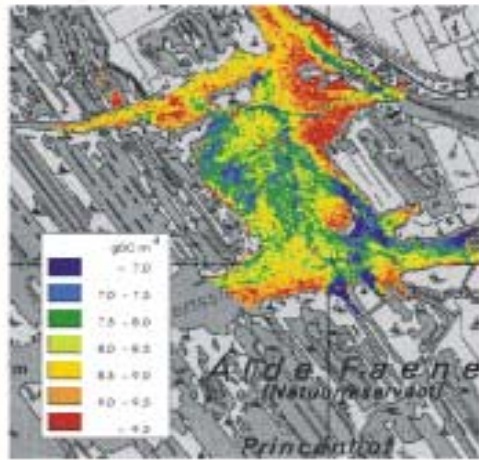


Atm. correction: MODTRAN/Toolkit
midlatitude summer model,
rural aerosol type,
no clouds or rain,
horizontal visibility: 30 km
WQ algorithm: Dekker (1990)

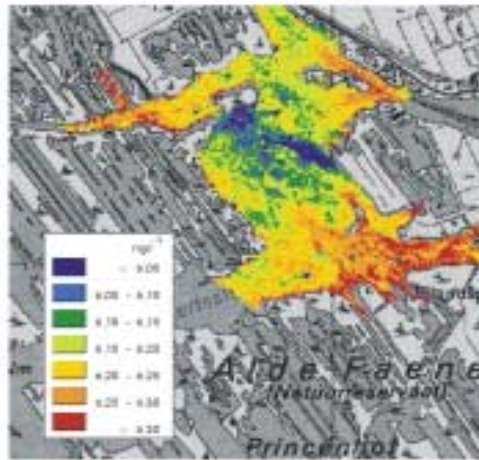
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Estimates of Water Column PCB's in Oude Venen Wetlands

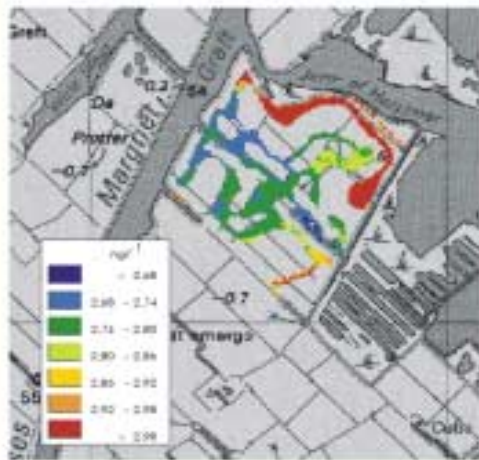
Organic Carbon in Lake Zandmeer



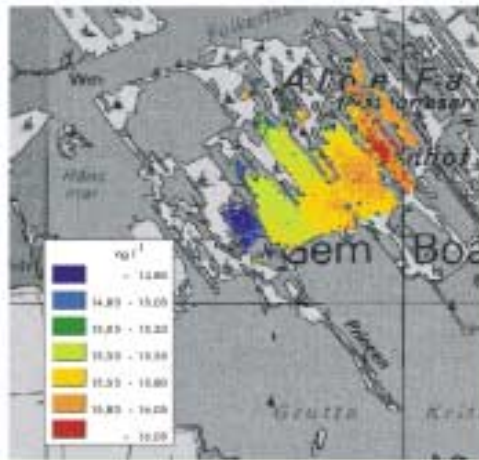
PCB's in Lake Zandmeer



PCB's in Lake 't Bii



PCB's in Lake Princeshof



Ancillary data

Ancillary data section containing logos for K&M and the Oude Venen Wetlands, a scale bar (Scale 1:1000), a north arrow, flight details (11 April 1997, Sensor: CASI), and a map of the Netherlands showing the location of the Oude Venen Wetlands.

Airborne Imaging Spectrometry derived images of Possible PCB distribution in the water column through PCB bin-ding to organic carbon (by estimating algal biomass, dissolved organic matter and dead organic detrital matter for the *Oude Venen*

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