

Spectral data from synergetic remote sensing system in optical and microwave wavelengths

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Abstract

Remote sensing systems are applied for measuring different characteristics of land covers in optical and radio wavelengths. Over the last years optical devices are extensively do research in laboratory/terrain and have found applications in high significant fields such as environmental monitoring and food security. The spectral response of land covers is associated with target types, their properties and requires solving a number of multidimensional problems. Together with the above parameters for better interpretation and finer data modelling lead the necessity of using data from a variety of sources. The team has the idea to exploit integrated optical multichannel and microwave devices. This approach allows acquiring data from synergetic remote sensing system. For this purpose measuring systems were designed: a portable lab/field VNIR spectrometer integrated with laboratory NIR spectrometer (400-2500) nm and a passive microwave radiometer (between 0.8 cm, and 21 cm). The concept of synergetic use of multispectral and microwave data for creation and validation of new models for environmental monitoring is presented in following steps: - Precise in-situ and laboratory data; - Preliminary data processing such as sensors' calibration errors, data fusion; - Multifeatures object creation in geoinformational databases with access control based on web technologies; - Soil properties, vegetation state modelling, landslides prediction; - Decision support. The joint use of the available remote sensing devices based in Space Research and Technology Institute at Bulgarian Academy of Sciences /SRTI-BAS/ and Kotel'nilov Institute of Radioengineering and Electronics at Russian Academy of Sciences, Fryazino department /FIRE-RAS/ create opportunities especially in follows applications: specification of technical tasks for development of unique equipment; development of technologies in complex analysis and interpretation of satellite data in remote sensing of marine coastal waters; to diagnose the condition by determining the environmental impact of anthropogenic activities and the change of climatic factors over time.

visible (0,4-0,9 um) NIR (0,9-2,5 um) PMR (2-20 cm)

Precise ground and laboratory data

preliminary data processing:
sensors' calibration errors and geocorrection,
endmember selection, data fusion of available data

multifeatures object creation
regional geoinformational
databases with access control
based on web technologies

soil properties, unmixing model of the land covers
vegetation biomass model, landslides prediction,

Decision support and decision making

Practical implementation

The two recently designed measuring systems: a portable lab/field VNIR spectrometer integrated with laboratory NIR spectrometer (400-2500) nm and a passive microwave radiometer (PMR).

Pixels	Wavelength Range	Integration Time
512	900 – 2500 nm	1 ms – 200 ms

Technical data of the NIR spectrometer:

- Detector: Hamamatsu G9208-512W InGaAs linear array
- Entrance aperture: 25 um
- Collimating and focusing mirrors: Gold-coated for enhanced NIR reflectivity
- Computer interfaces: USB 2.0 @ 480 Mbps

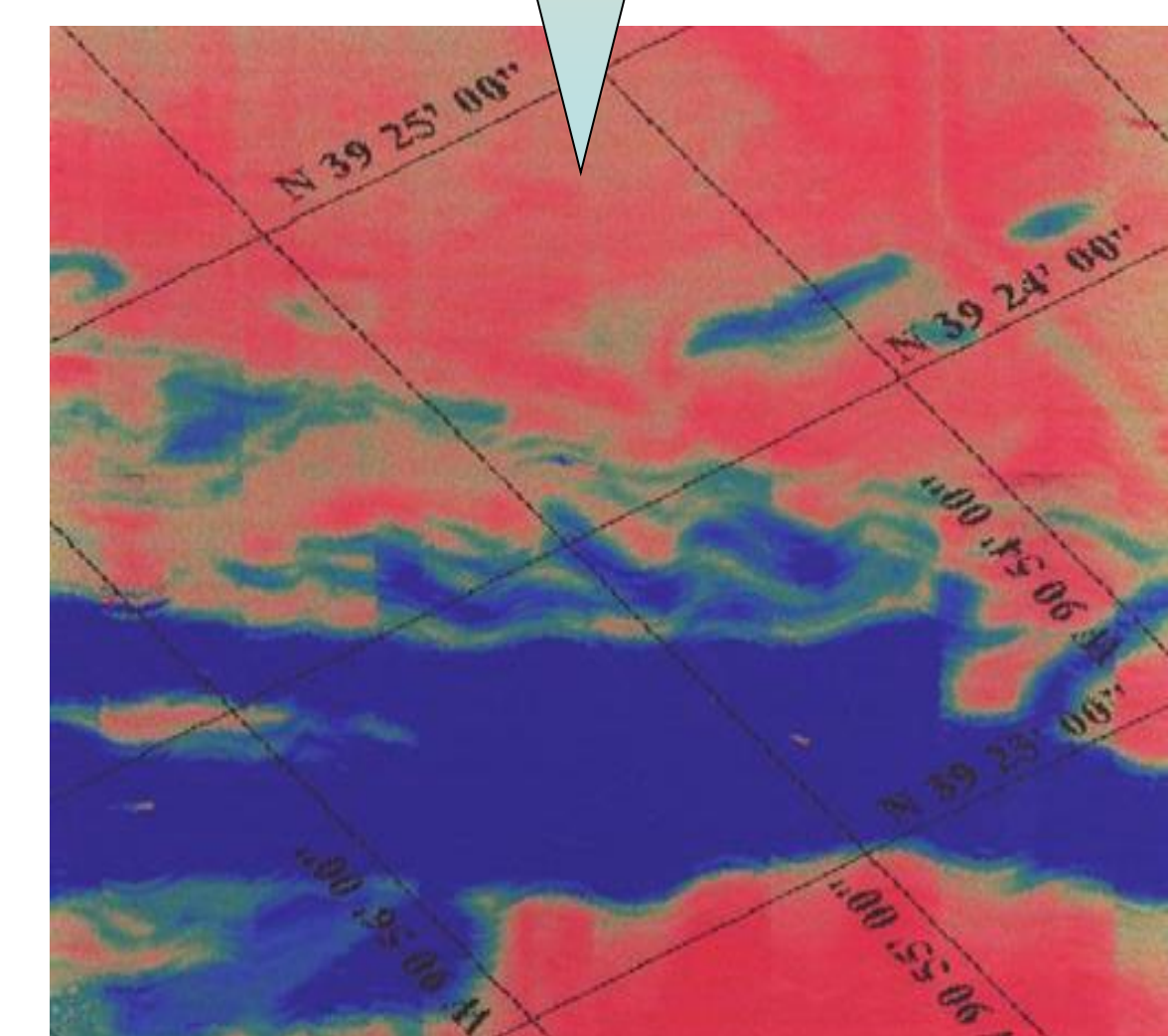
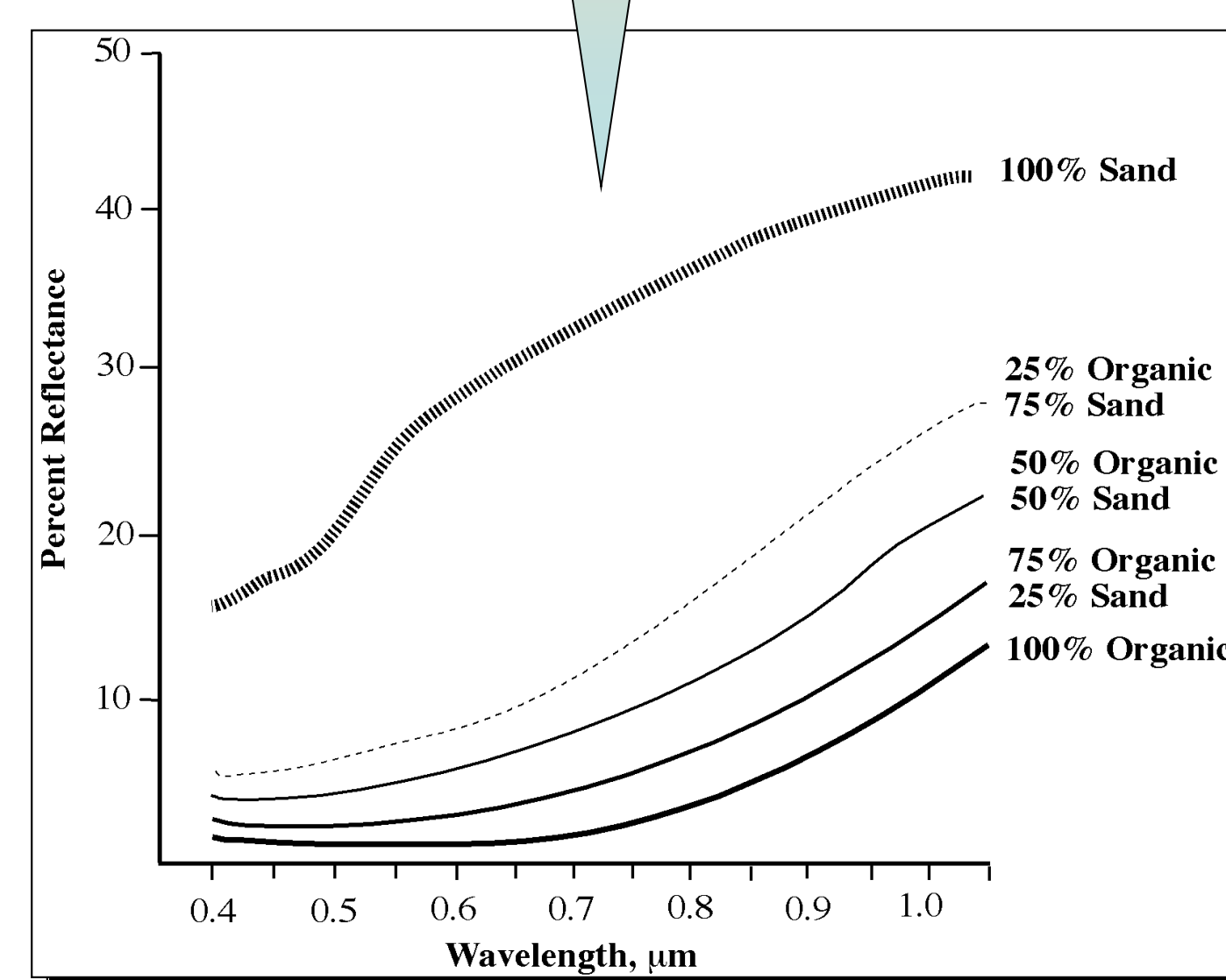


Technical data of the VNIR spectrometer:

- 1) number of spectral channels (64÷128);
- 2) spectral range for measurements (450÷900)nm;
- 3) period of autonomous registration (1÷30)min;
- 4) spatial resolution (1÷25)cm².



The radiometer operates in three different wavelengths - 2cm, 6cm and 21cm, which allows measurements of the soil moisture content up to 2m depth.



Application	Operating Range	Max Abs Error
Soil Moisture Content	0.02 - 0.5 g/cc	0.05 (biomass < 2kg/m ²) 0.07 (biomass > 2kg/m ²)
Depth to Shallow Water Table	0.2 - 2 m (humid area) 0.2 - 5 m (dry area)	0.3 - 0.6 m
Biomass Above Wet Soil	0 - 3 kg/m ²	0.2 kg/m ²
Salinity and Pollution of Water	1 - 300 ppt	1 - 5 ppt
Yield model	200 – 500 kg/dca	2 – 6 kg/dca

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