Optical and microwave data from synergetic remote sensing system in monitoring of land covers

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Dedicated to the inspiring SCIENTIST, PERSON and FRIEND
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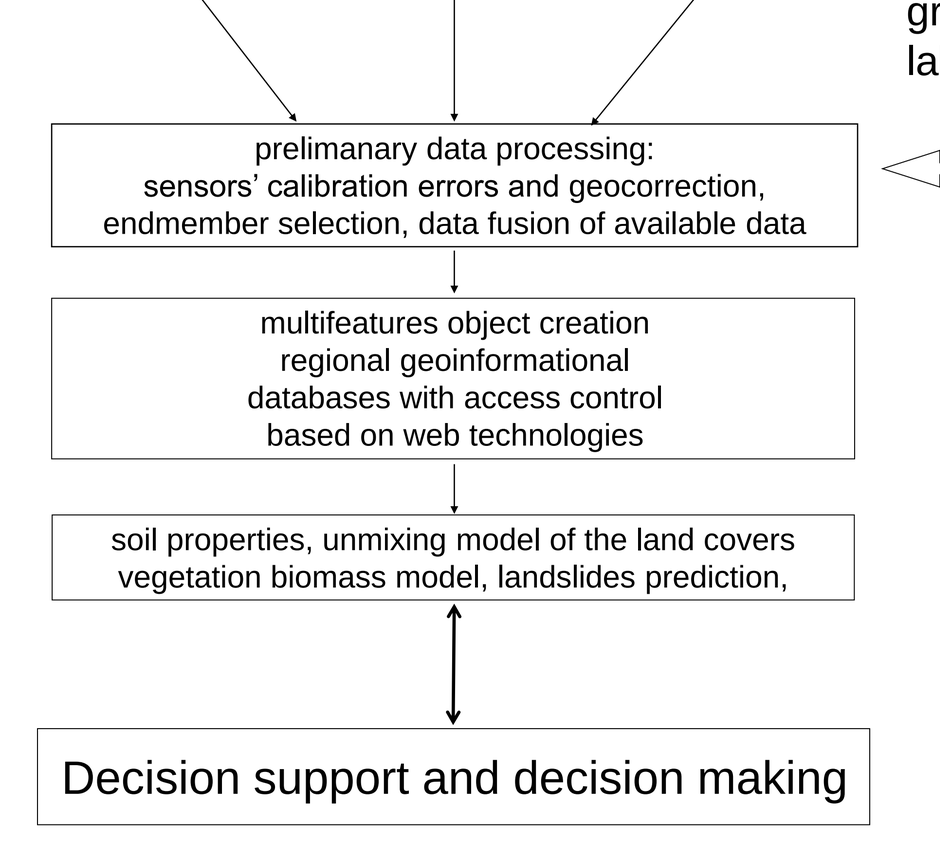
Abstract

Remote sensing systems have many applications for measuring different characteristics of natural environments in optical and radio wavelengths. Over the last years optical devices are extensively used in the researching in laboratory/terrain and have found applications in high significant fields such as environmental monitoring and food security. The spectral response of land cover is associated with target types, their properties and requires solving a number of multidimensional problems. A 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 data obtained by 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 /PMR/ (between 2cm and 21cm). 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: - Defined the territory for monitoring; - Precise in-situ and laboratory data; - Prelimanary 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/, Kotel'nilov Institute of Radioengineering and Electronics at Russian Academy of Sciences, Fryazino department /FIRE-RAS/ and Space Research Institute at Russian Academy of Sciences /SRI-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 and land cover; to diagnose the condition by determining the environmental impact of anthropogenic activities and the change of climatic factors over time.



Practical implementation

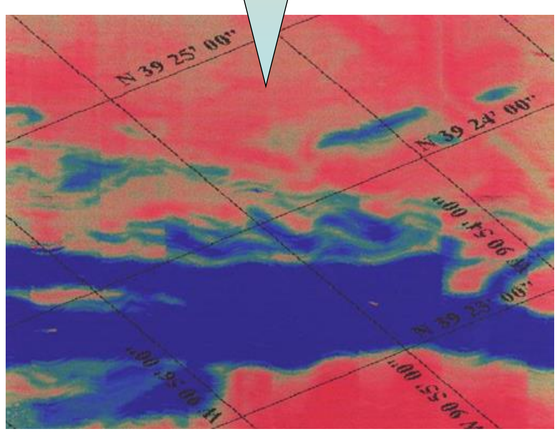
The two recently designed measuring systems: a portable lab/field VNIR spectrometer integrated with laboratory NIR spectrometer (400-2500) nm and a passive microwave radiometer (PMR).

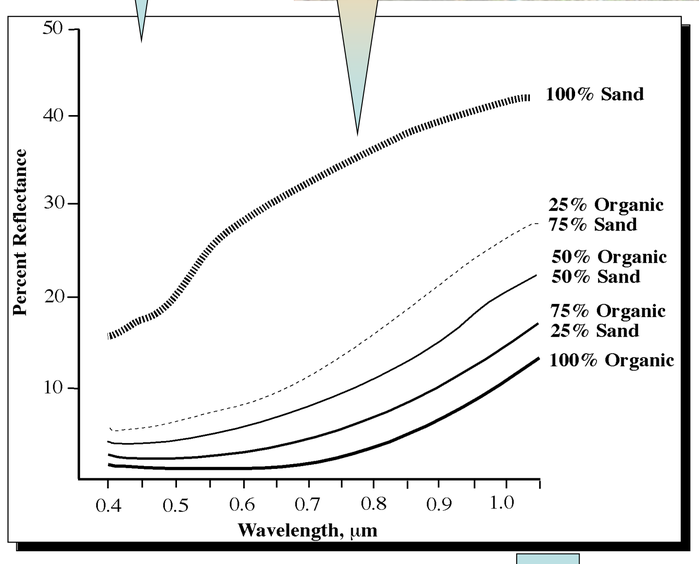
Pixels	Wavelength Range	Integration Time
512	900 – 2500 nm	1 ms – 200 ms

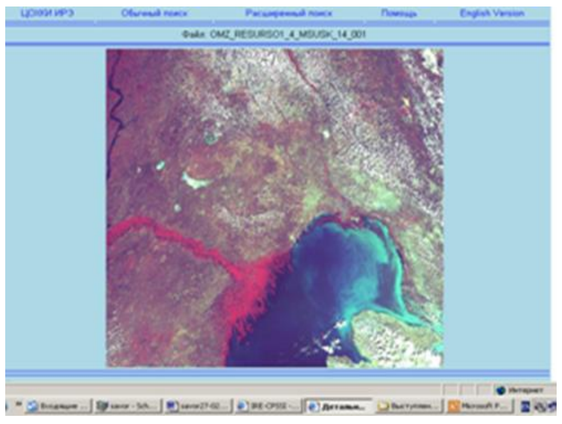
Technical data of the NIR spectrometer:
- Detector: Hamamatsu G9208-512W InGaAs linear array
- Entrance aperture: 25 um
- Collimating and focusing mirrors: Gold-coated for enhanced NIR reflectivity
- Computer interfaces: USB 2.0 @ 480 Mbps

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)cm^2.

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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