



Spectral response of plants on technogenic loadings

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Laboratory spectrometers



PSR-1100
Portable Spectroradiometer



PSR-3500
Field spectroradiometer



Spectral Range	320-1100nm
Spectral Resolution	3.2nm
Sampling Bandwidth	1.5nm
Spectrometer Type	4° field of view lens or 25° fiber optic input, Diffraction Grating
Slit	50µm
Detector Type	Tall 512 element Si photodiode array 25µ x 2.5mm pixel dimension
A/D Converter	16 bit
λ Reproducibility	0.1nm
λ Accuracy	0.5nm
Calibration	Factory calibrated for radiance using NIST traceable source
Targeting	Internal red laser
Power	6-12V; 0.5W
Dimensions	7.0" x 3.25" x 5.75"
Weight	less than 4 pounds

General Parameters



<u>Wavelength Range</u>	350 to 2500 nm
<u>Spectral Resolution</u>	3.5 to 22 nm
<u>Spectrum Band</u>	UV, VIS, NIR
<u>Integration Time</u>	0.5 s
<u>Detector</u>	InGaAs, Silicon
<u>Scan Speed</u>	100 ms
<u>Spectral Sampling Bandwidth</u>	1.5 to 6 nm

Physical Properties

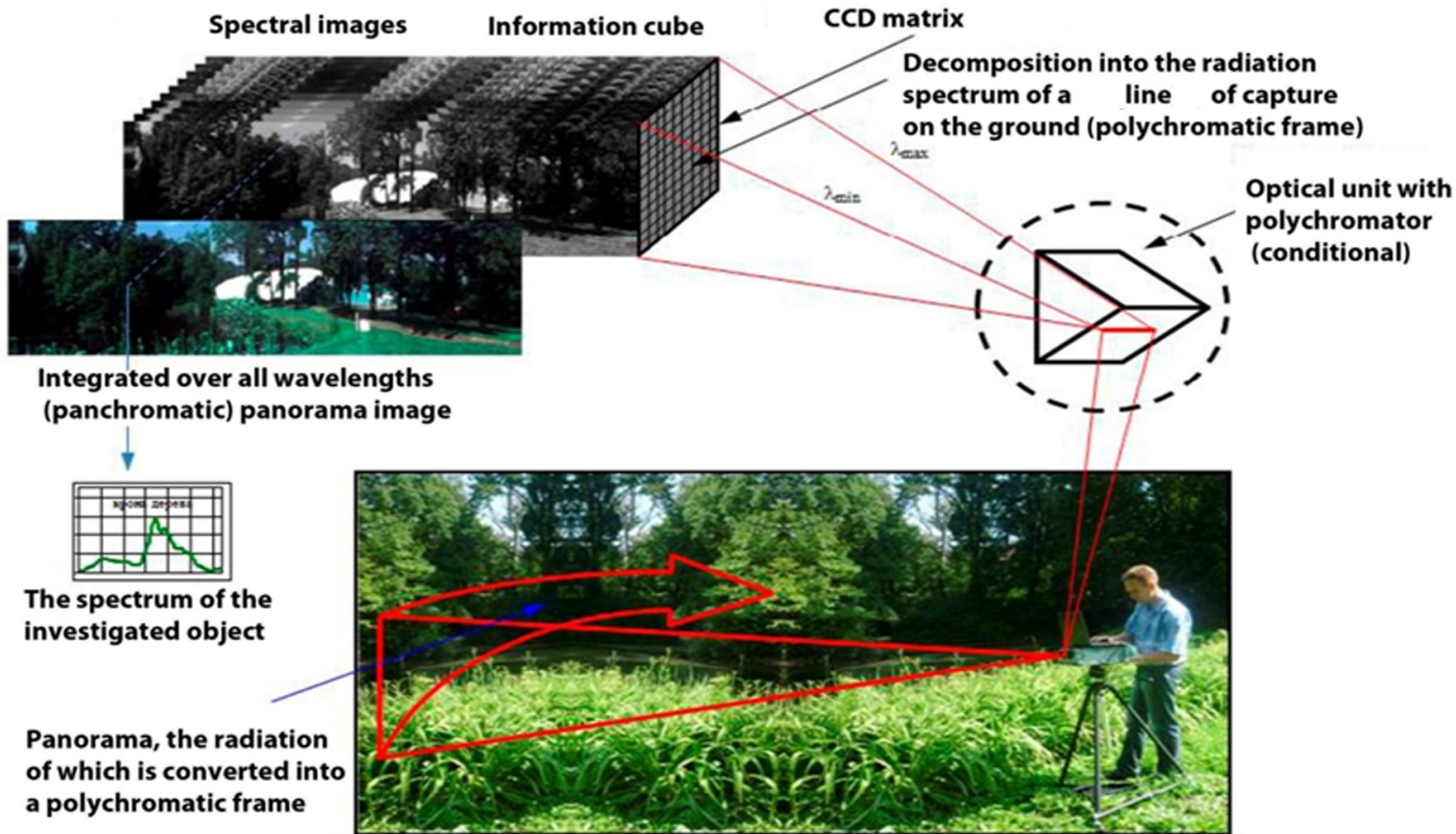
<u>Weight</u>	7.3 lbs
<u>Dimension</u>	215.9 x 292.1 x 82.55 mm (8.5" x 11.5" x 3.25")

Video hyper-spectrometers (imaging spectrometers)



Main parameters	 wide angle	 narrow angle
The focal length of the input lens, mm	19,2	100
Relative bore	1:4	1:4
The width of the entrance slit, mm	0,1 или 0,05	0,1
Field of view, degrees	28,2 x 0,3	5,5 x 0,15
Instant field of view, mrad	1,0	0,2
Spectral range, mkm	0,4-1,0	0,5-1,1
Spectral resolution, nm	3,5	
Linear dispersion, mm/mkm	14	
Information flow,	approximately 1,5 MB/s	
Mass, no more, kG	8	5
Power consumption, W	10	10
Dimensions (height x length x width), mm	500x400x150	350x400x150

Ground based video-hyperspectral imaging system



Examples of ground based video-hyperspectral images



Four monochrome images of a test site with a lawn and bushes of Thunberg barberry for wavelengths A - 530nm, B - 586nm, C - 734nm and D - 737nm.



The results of field observations*

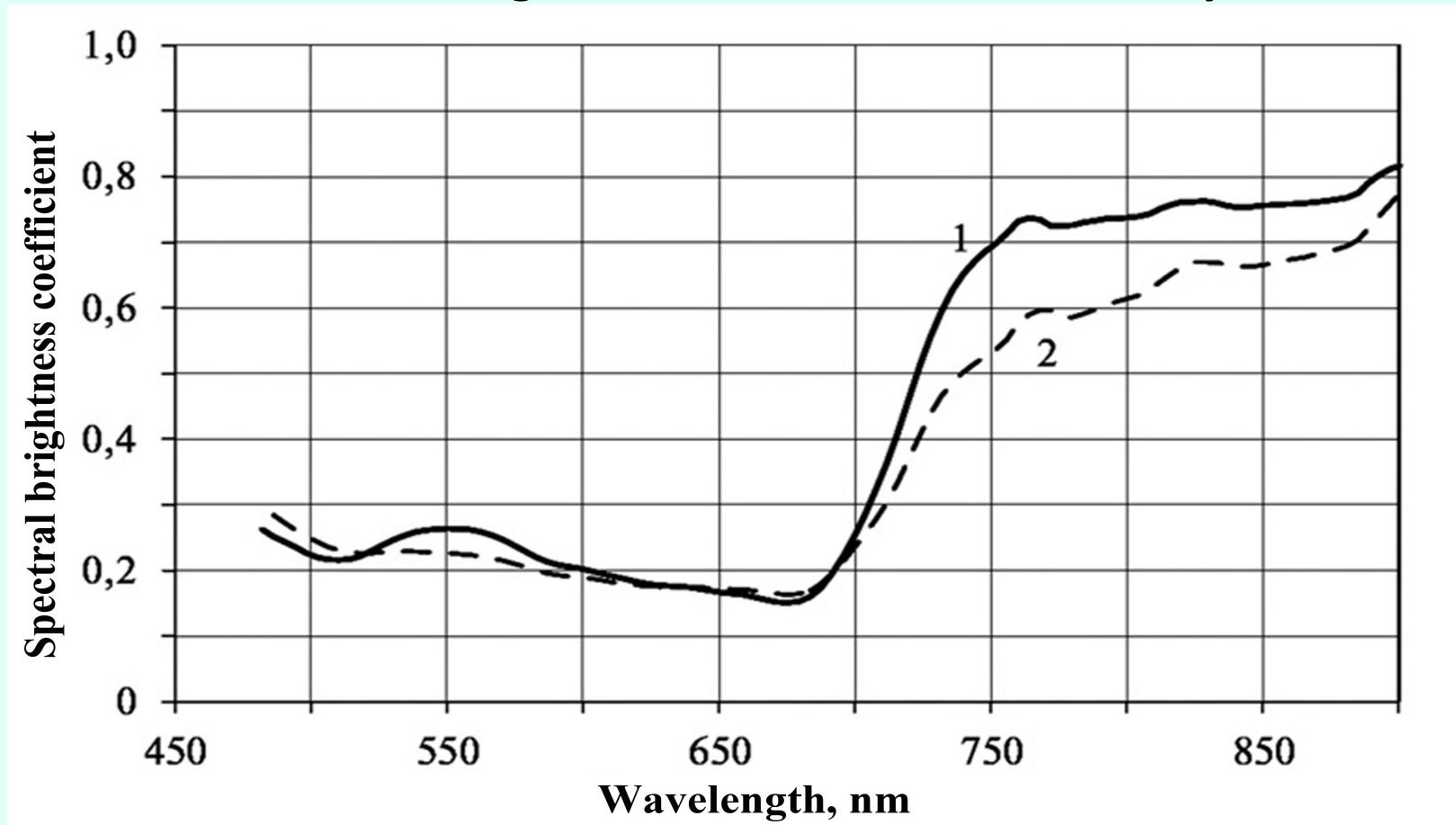
* O.V. Grigorieva, I.V. Drozdova, B.V. Shilin. *Experimental substantiation of the capabilities of videospectral remote indication of short-term vegetation stress // Sovremennye problemy DZZ iz kosmosa. 2018. Vol. 15. No. 7. P. 78–88. http://d33.infospace.ru/d33_conf/sb2018t7/78-88.pdf*

V.N. Gruzdev, I.V. Drozdova, A. U. Kouznetsov, B.V. Shilin. *Solving the problems of environmental safety by video spectral method // Sovremennye problemy DZZ iz kosmosa. 2018. Vol. 15. No.1. P. 9–17. http://d33.infospace.ru/d33_conf/sb2018t1/9-17.pdf*

The spectral response of Thunberg barberry leaves to loading by copper sulphate



Date of loading: June 29. Measurements: 40 days after

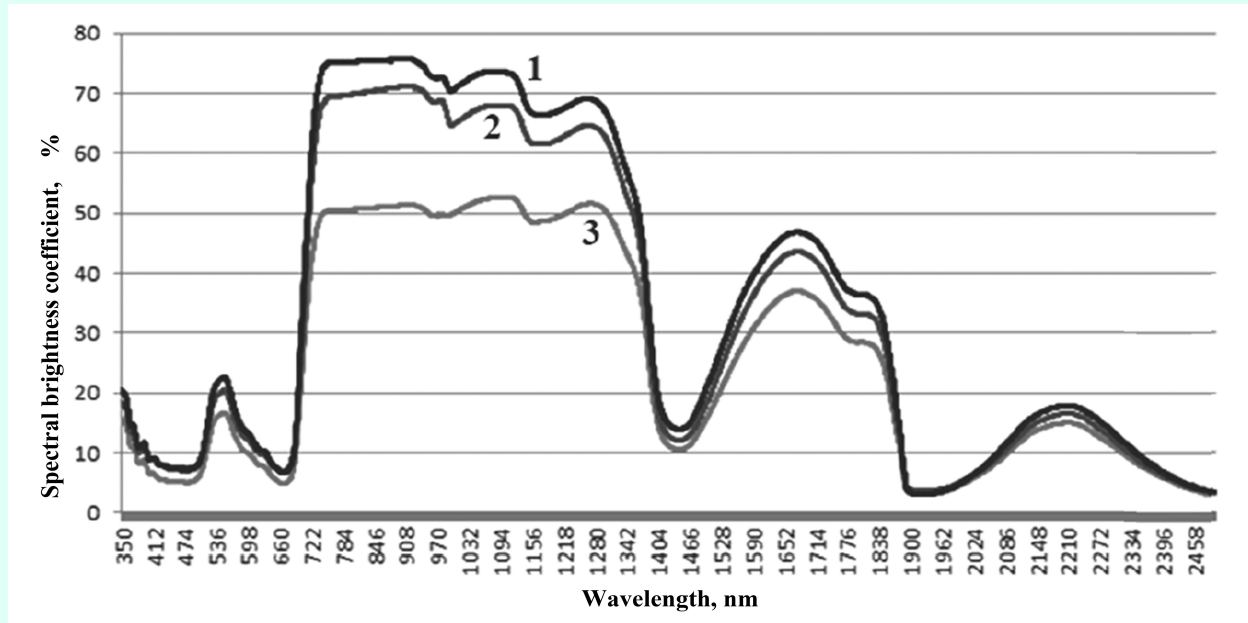


1 - control site, 2 - contaminated site. Imaging spectrometer «Fregat»

The spectral response of White mustard to load by nickel salt



Loading: December 14, 2017; Measurements: December 18, 2017.



1 - control plant.

2 - pollution of the root system 9 maximum permissible concentration (MPC).

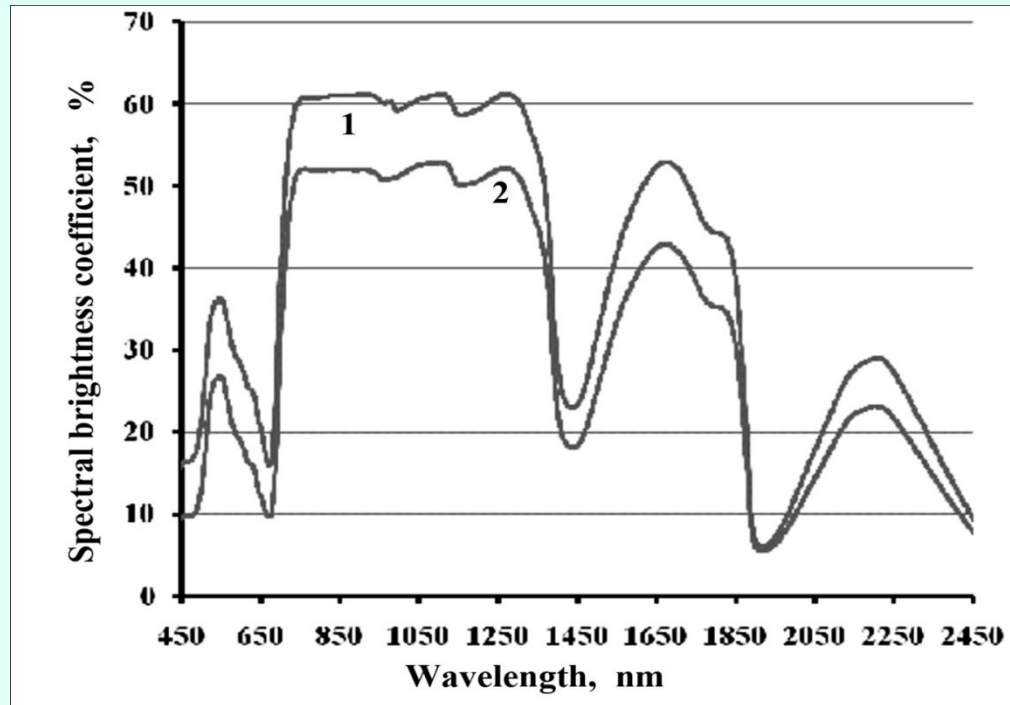
3 - aerosol pollution of the leaf surface 6 MPC.

One can clearly see the significantly greater inhibitory effect of air-pollution (3) compared with irrigation even with a large MPC value.

The spectral response of on syngonium Leaves to load by ionizing radiation

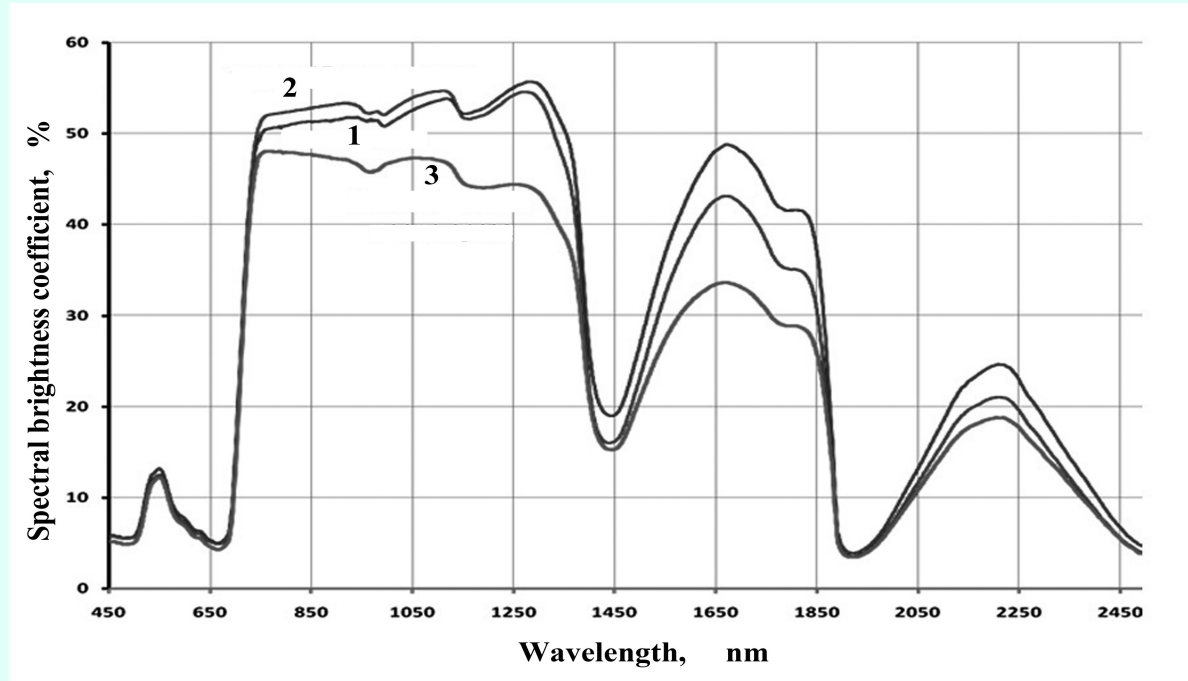


Dose: 140 microR / hour per 3 days.



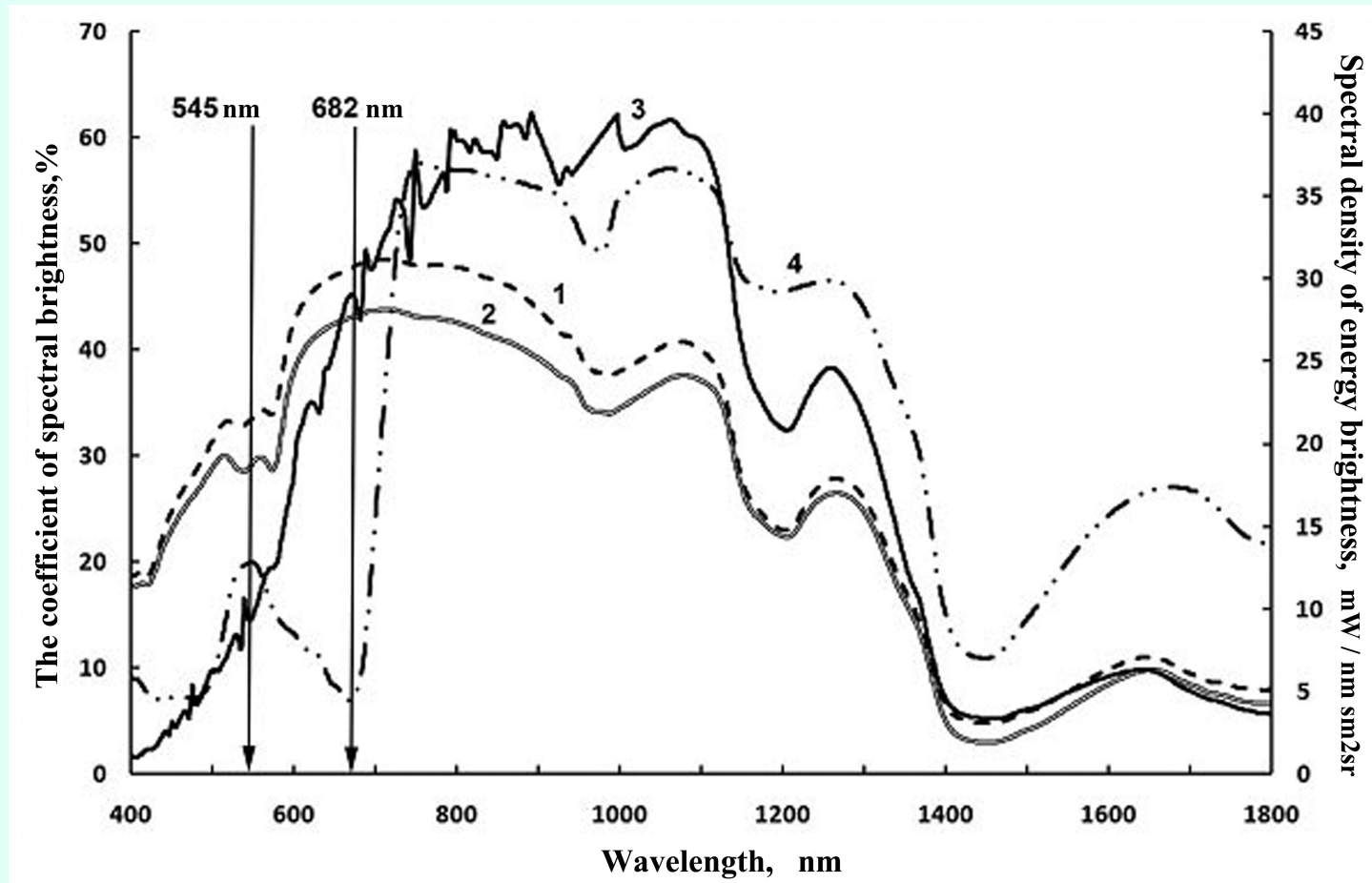
1. Control blank sheet. 2. Measurements after 10 days.
Spectroradiometer PSR 3500

The spectral response of sunflower leaves to mechanical loading



1 — control. 2 - torn sheet after 45 minutes. 3 - cut sheet after 2 hours.

Spectra of human skin

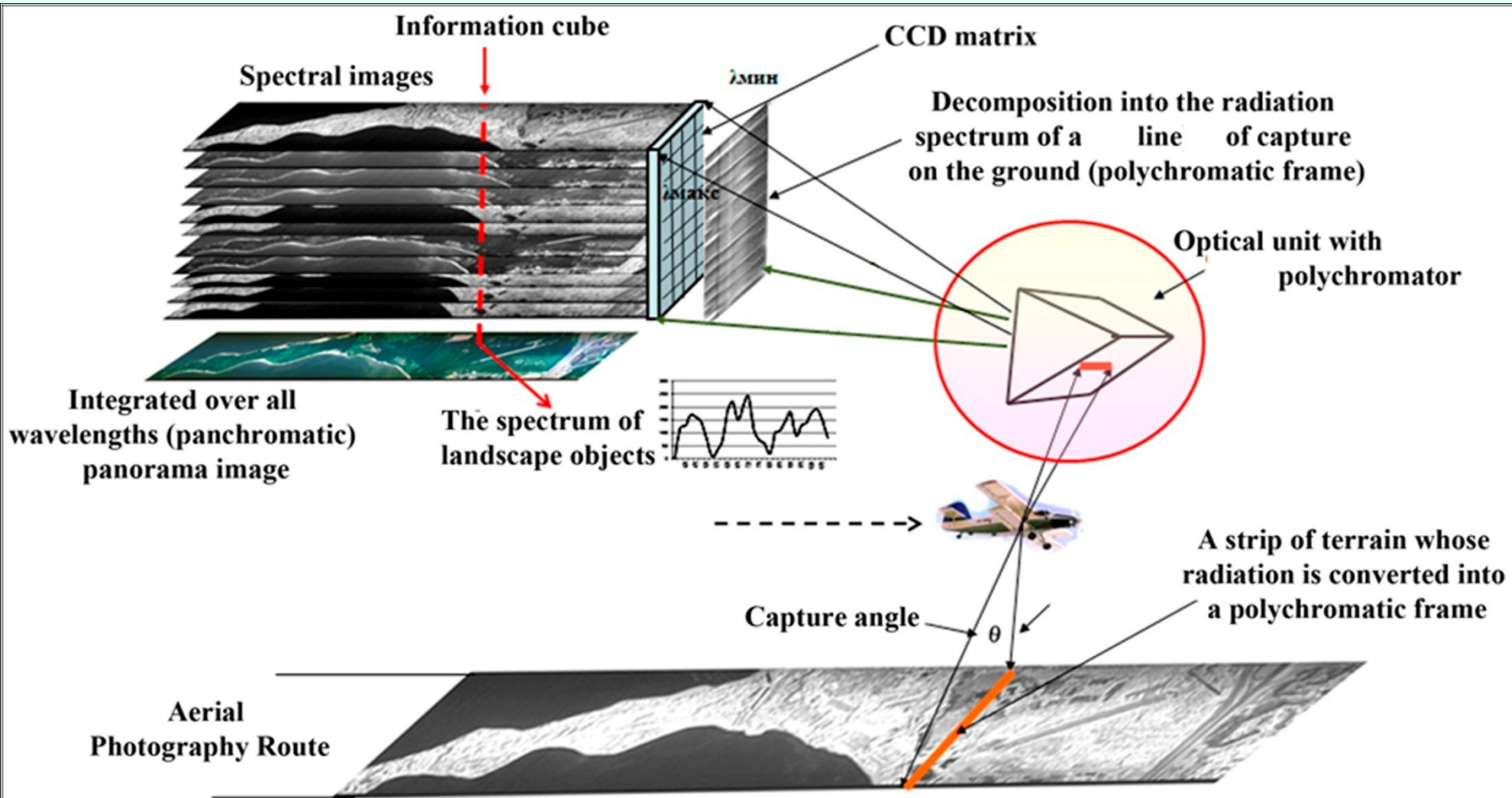


1 - SJS of the skin of the shoulder of the athlete before training; 2 - SJS of the skin of the shoulder of the athlete after training (stress); 3 - SPEI of the skin of the shoulder of the athlete before training; 4 - SFC vegetation. Spectroradiometer PSR 3500



Airborne video-hyperspectral mapping

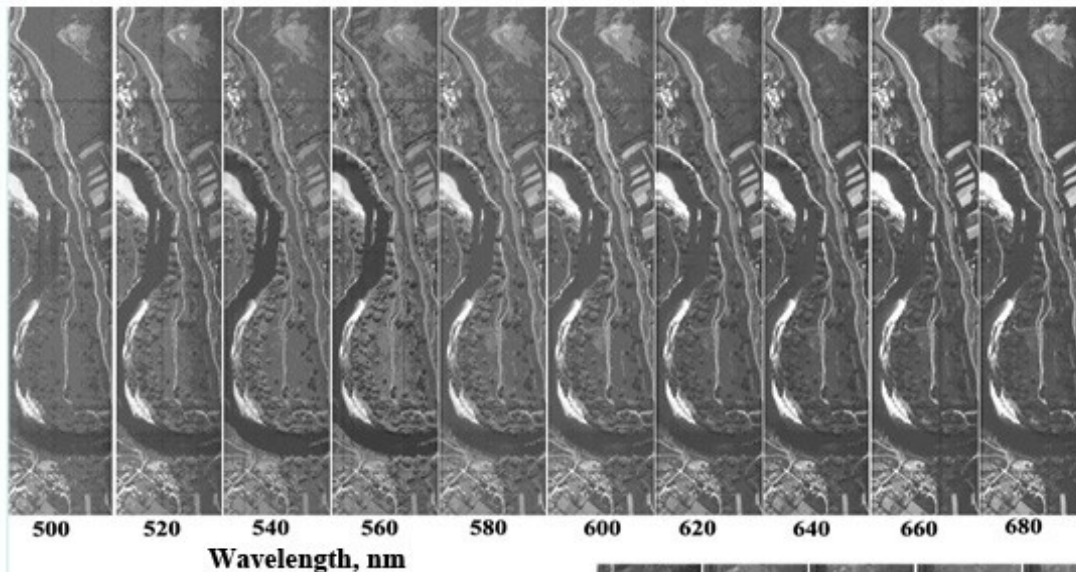
The structural diagram of the airborne video-hyperspectral scanner



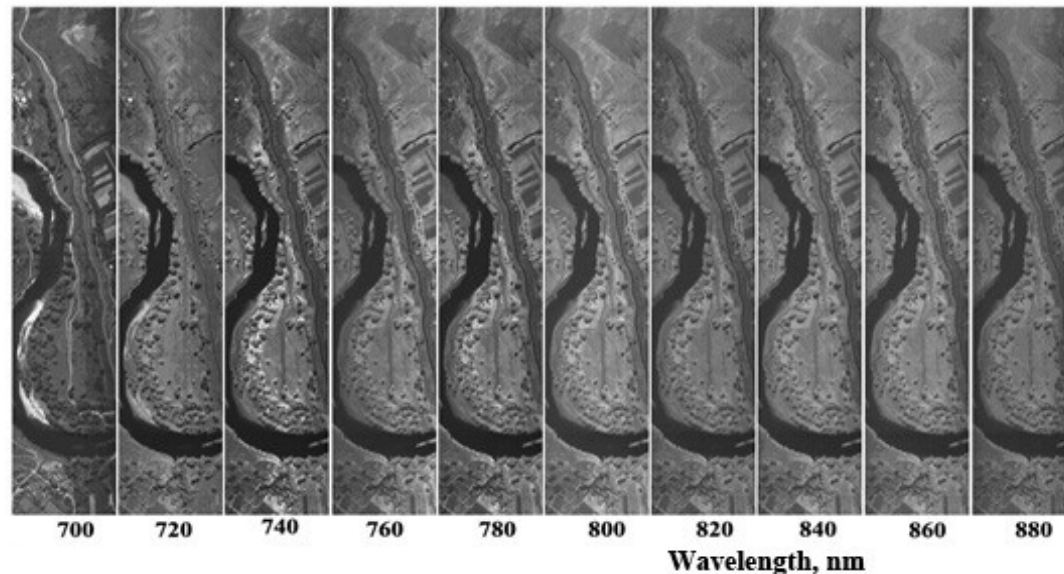
Results of video-hyperspectral airborne survey



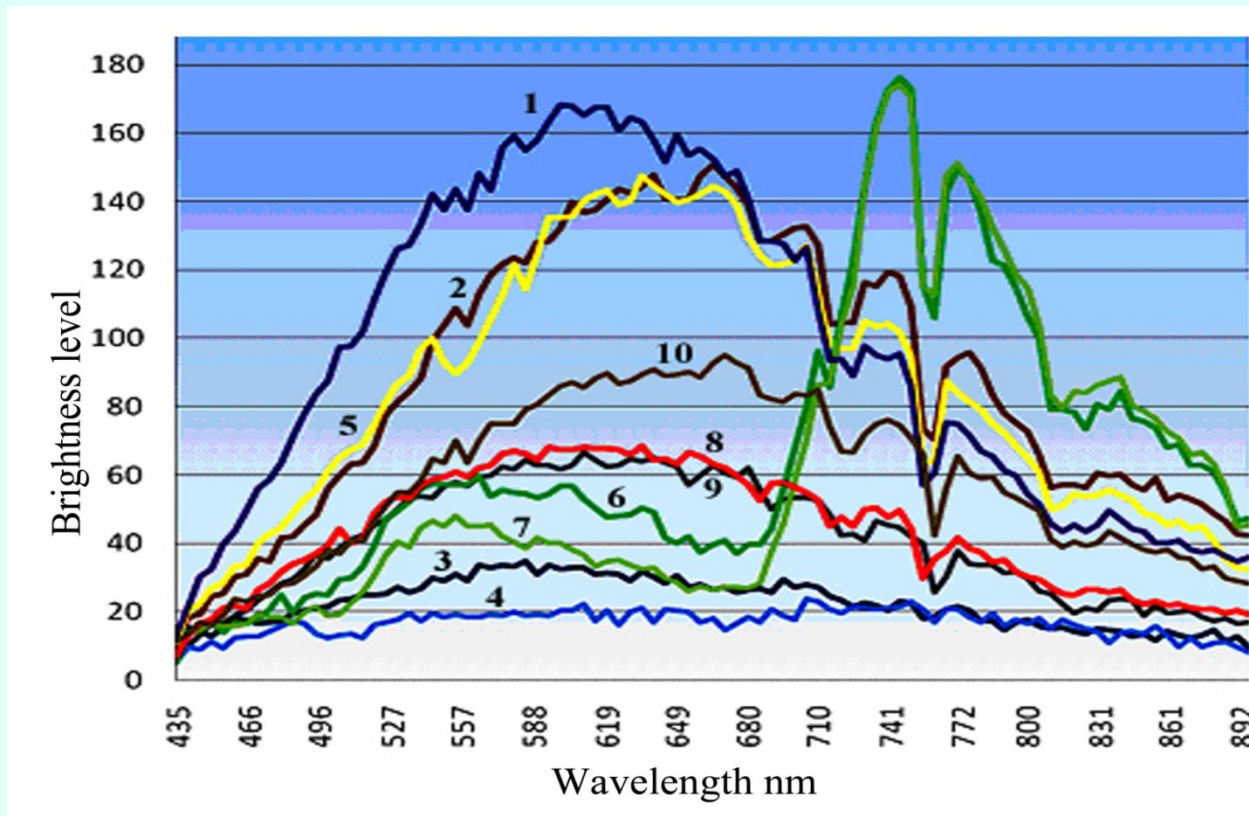
Aerial Photography Route



A series of spectral images of the terrain from 500 to 800 nm through 20 nm



Spectra of natural objects measured by video-hyperspectral airborne survey*



1 - railway track
2 - dirt road
3 - river
4 - pond
5 - beach
6 - tree crown
7 - meadow
8 - the roof is dark
9 - the roof is bright
10 - arable land

* B.V. Shilin, V.N. Gruzdev. On-board and field tests of an imaging spectrometer for a small spacecraft // *Sovremennye problemy DZZ iz kosmosa*. 2016.Vol. 13. No. 2. P. 224–232.
http://d33.infospace.ru/d33_conf/sb2016t2/224-232.pdf

These studies lay the fundamental foundations for the interpretation of video hyperspectral aerospace data in solving environmental safety problems.