Coordinating and integRating state-of-the-art Earth Observation Activities in the regions of North Africa, Middle East and Balkans and Developing Links with GEO related intiatives toward GEOSS

A brief overview of soil spectroscopy

Capacities and Skills: Towards the provision of EO services in the Balkans

T4.2 – Improved Food Security and Water Extremes Management

June 1st, i-BEC premises, Thessaloniki

i-BEC INTERBALKAN ENVIRONMENT CENTER

European Commission

GEO GROUP ON EARTH OBSERVATIONS

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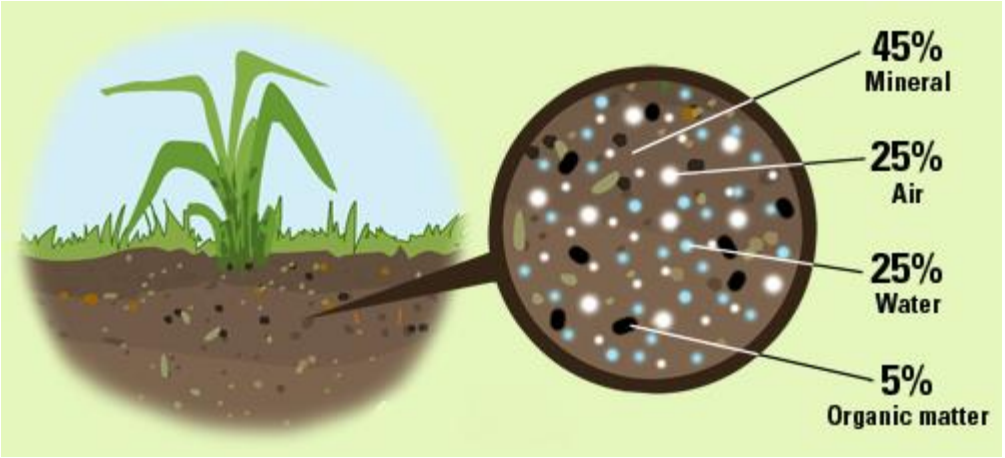
Importance of soil

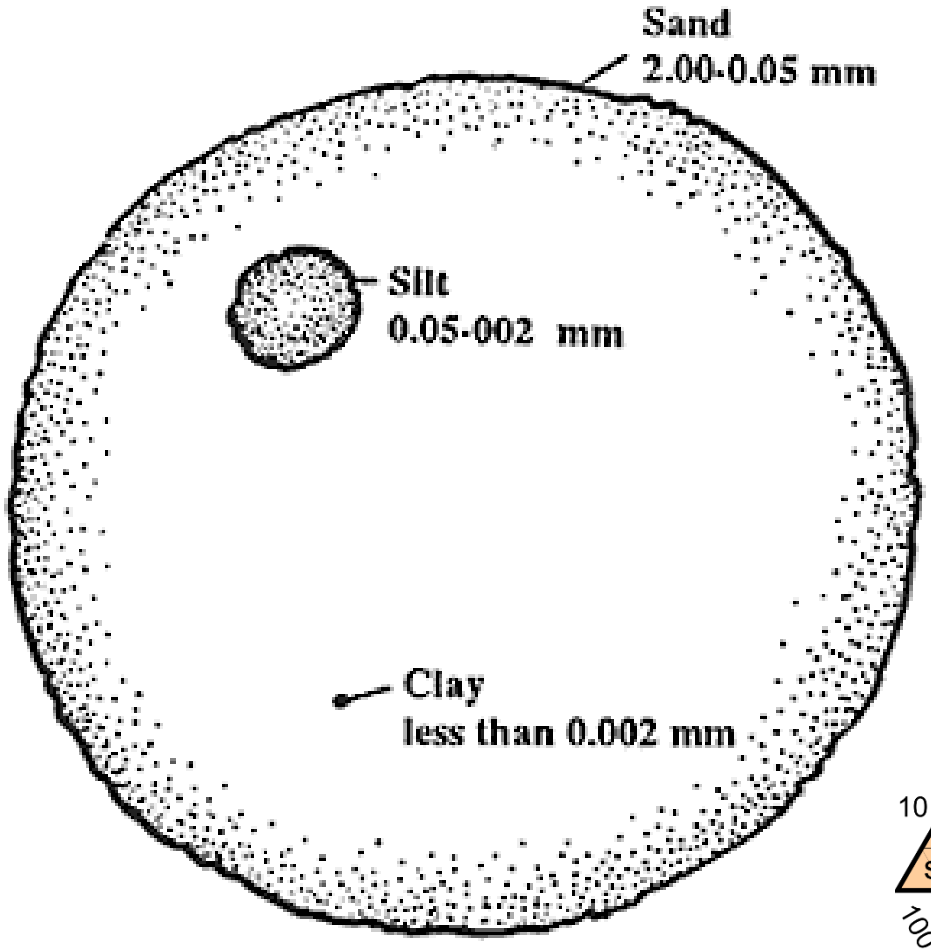
- Fundamental natural resource
- Healthy soils ⟹ Sustainable agriculture
- Potential sink for carbon
- Environmental filter

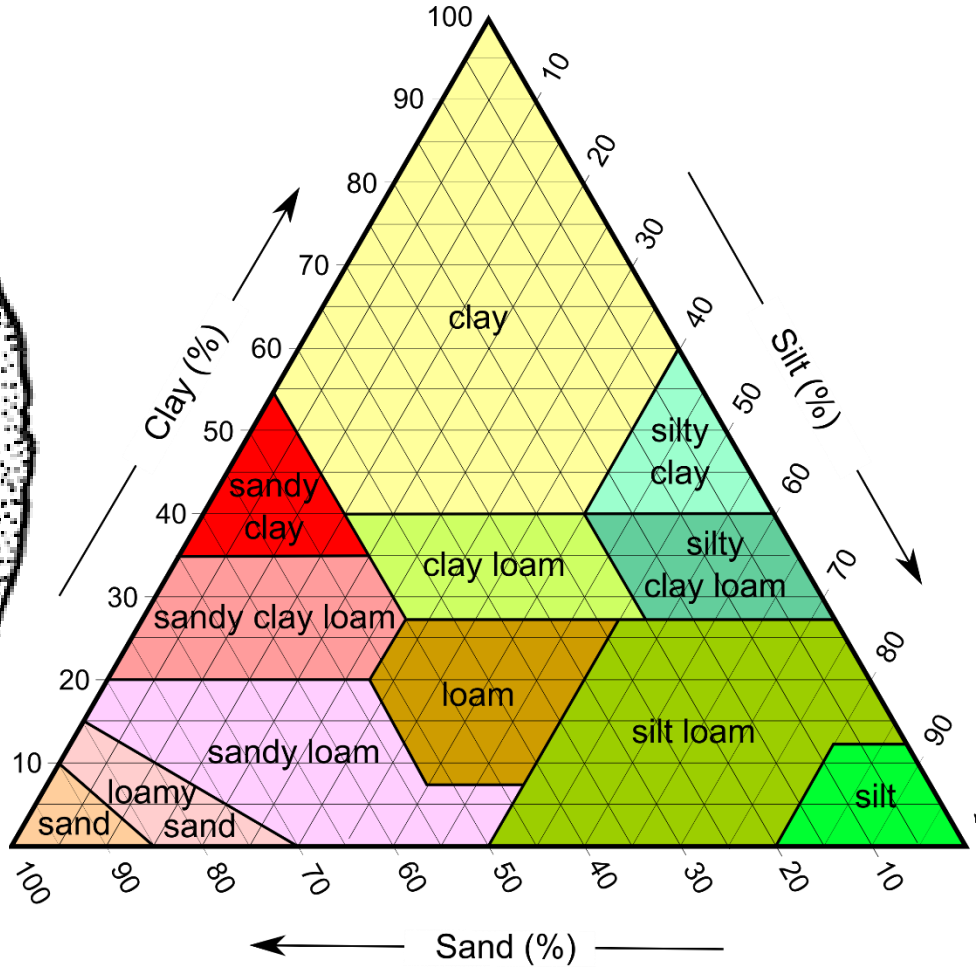
Basic definitions

- Soil is made of: mineral matter, organic material, pore space (air and water), organisms (fauna)
- Soil texture (ratio of sand, silt, and clay)
- Soil structure
- The soil profile

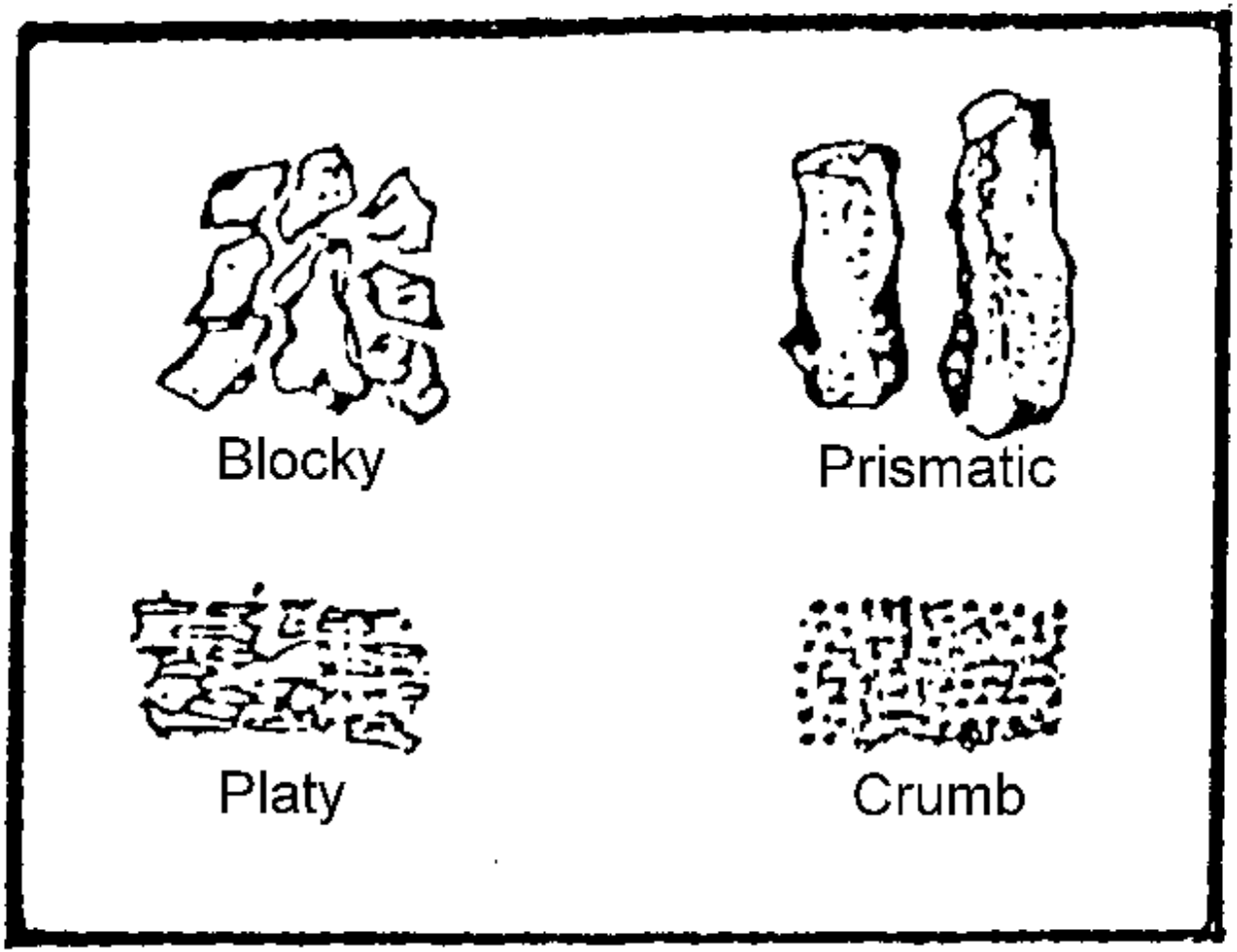


Soil texture





Soil structure



Soil profile

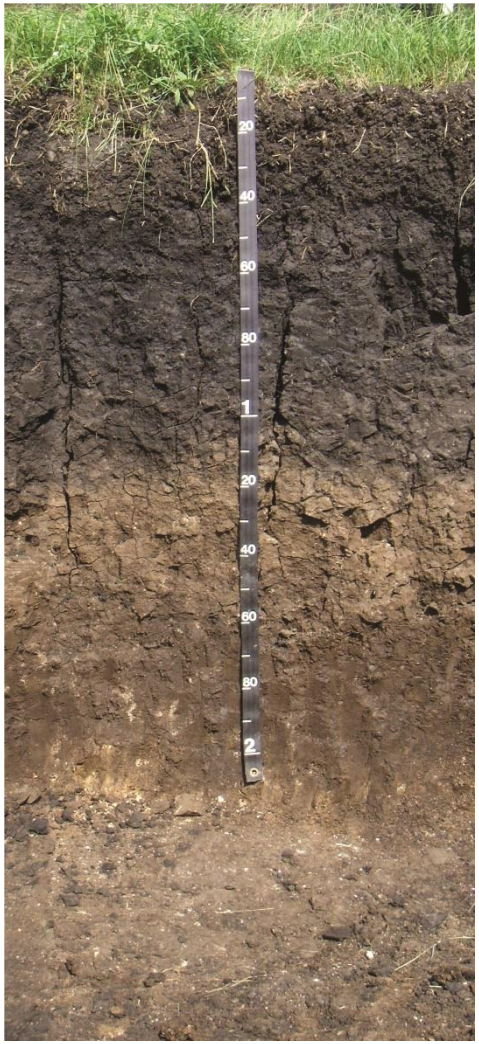


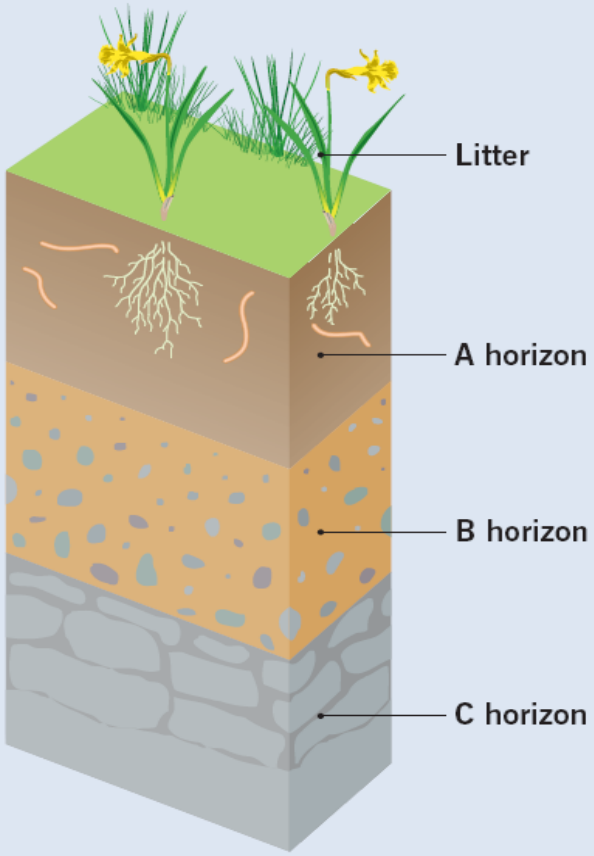
Fig 5.3 A typical soil profile. The horizons differ in colour, texture (particle size) and organic content.

Plant litter

A horizon
This, the upper layer of soil, is called the topsoil. It is dark in colour because it has a high **humus** content. Most of the organisms live in this horizon.

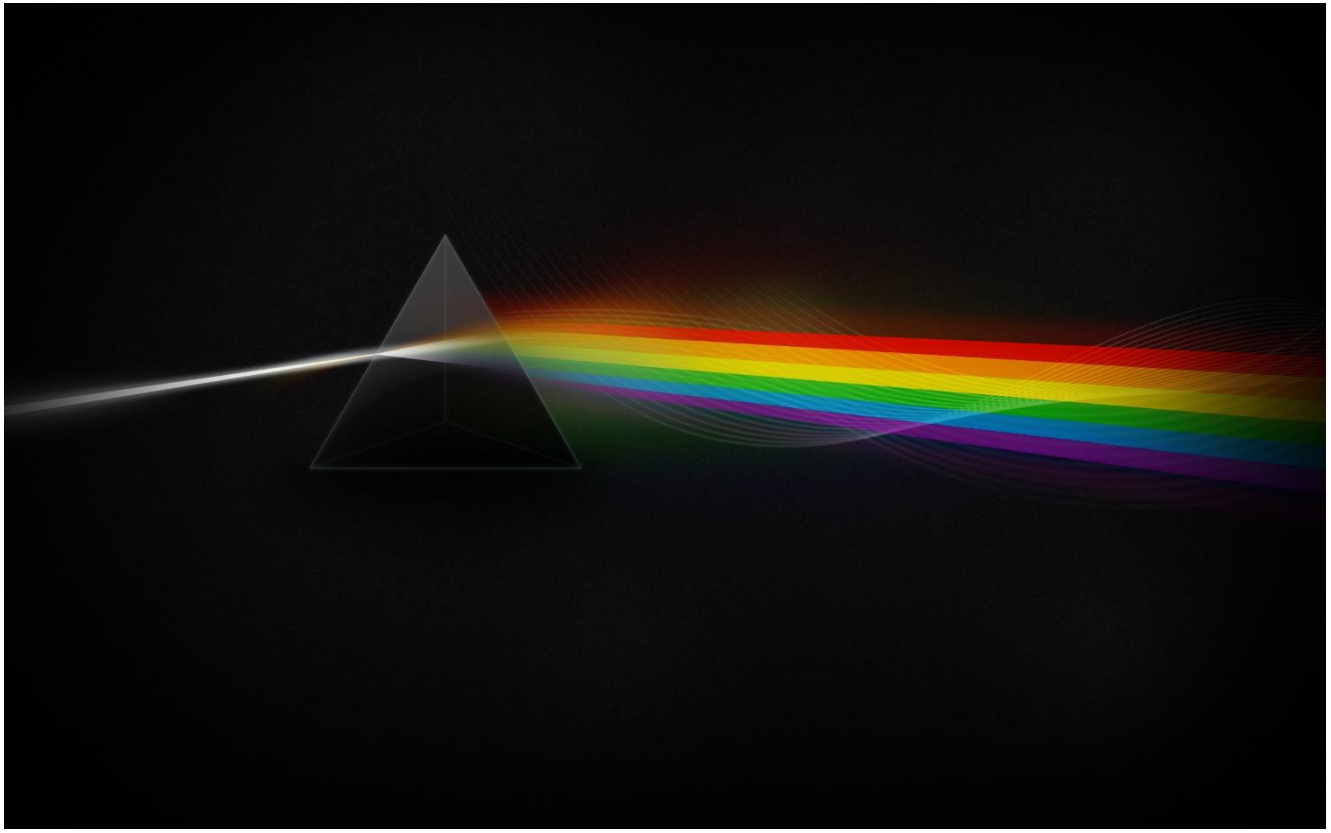
B horizon
Found beneath the A horizon, this is called the **subsoil**. It is lighter in colour because it has less humus. It has more stones than the A horizon because it is closer to the parent material and is also protected from weathering.

C horizon
This consists of the **parent rock** of the soil. It consists of bedrock or rock particles resting on the bedrock.

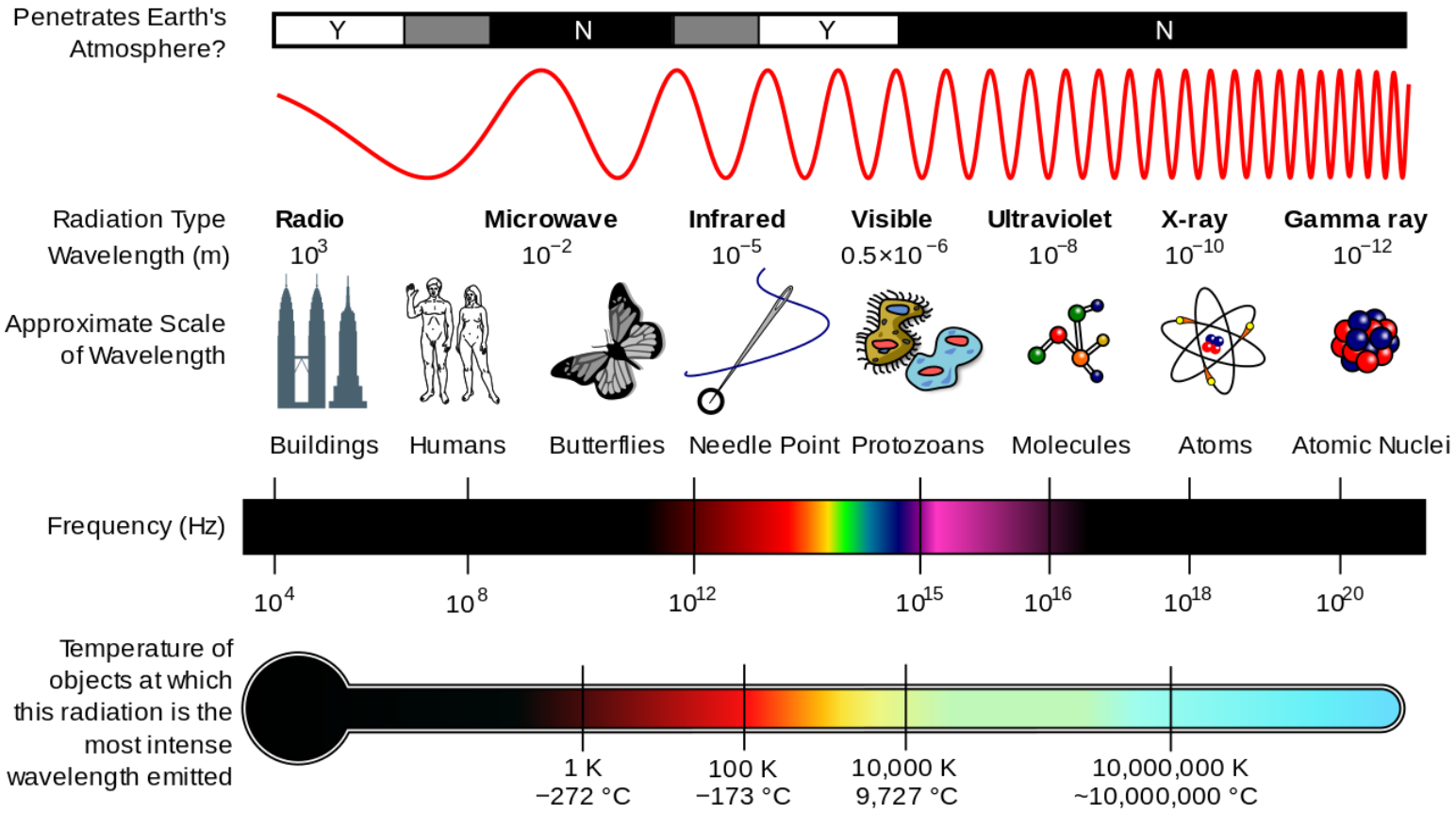


Spectroscopy

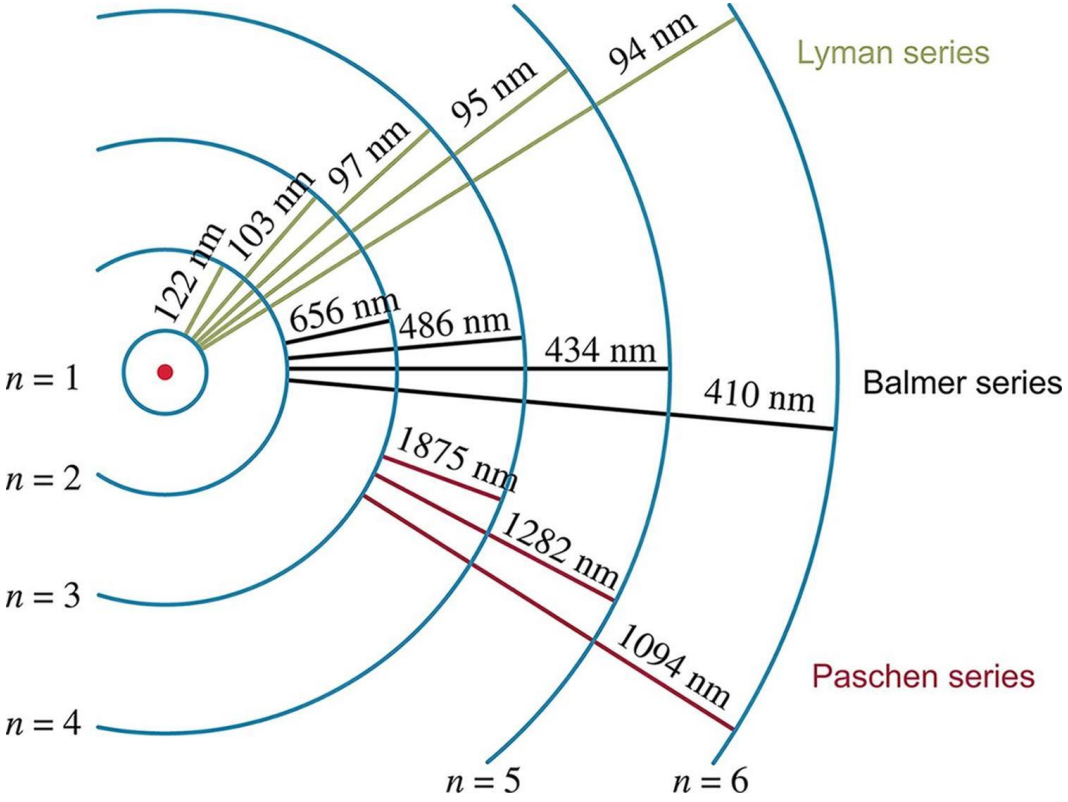
- Interaction between matter and light
- Particle-wave duality



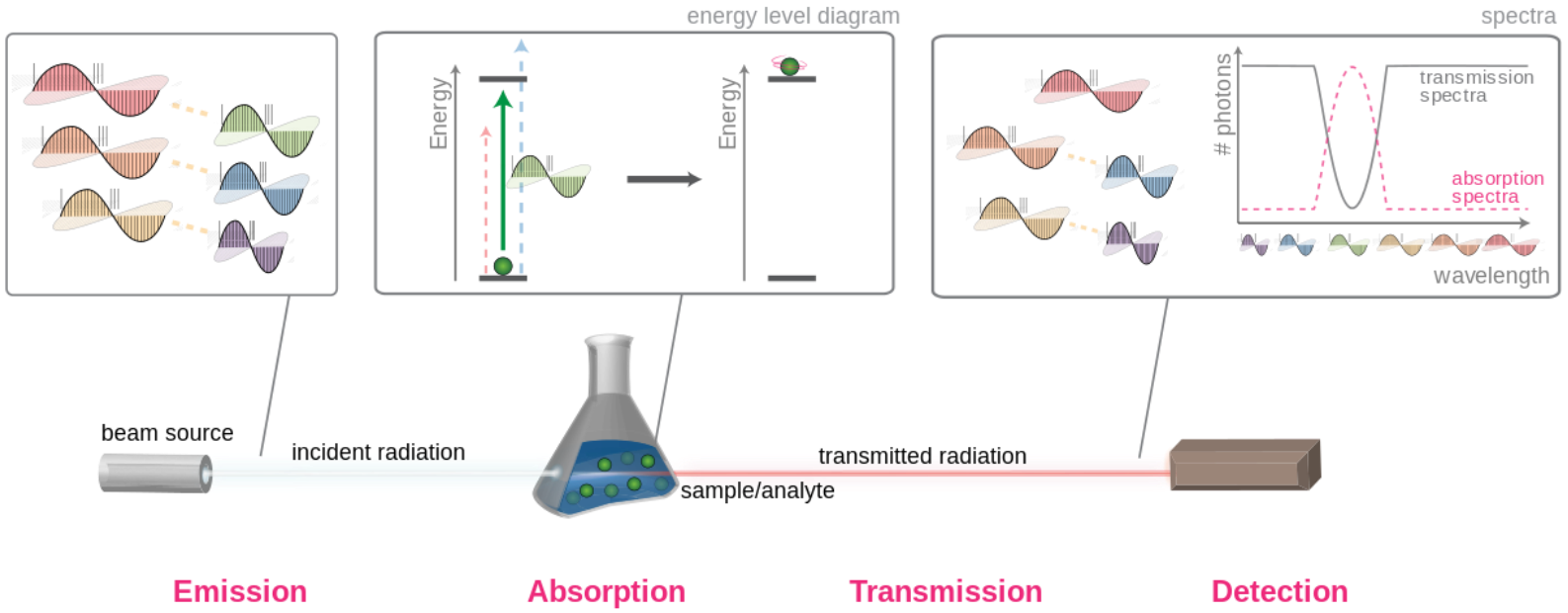
The E/M spectrum



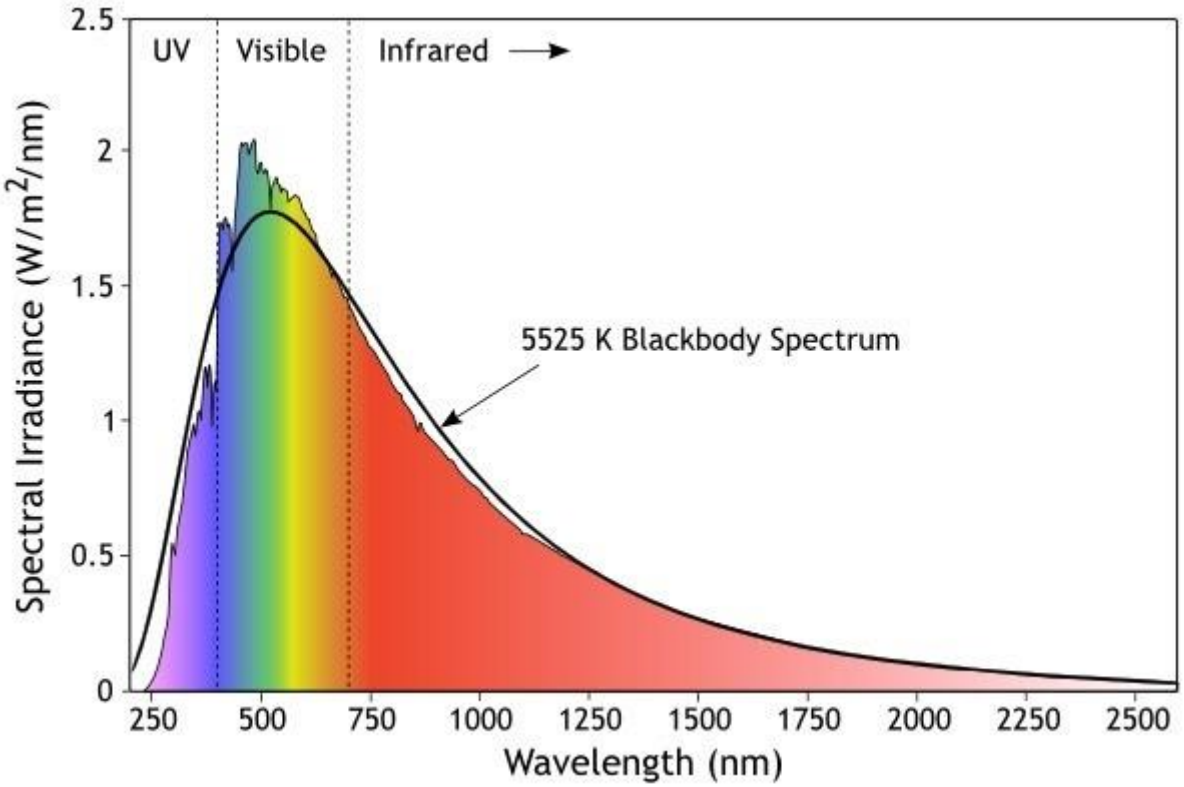
Emission spectra



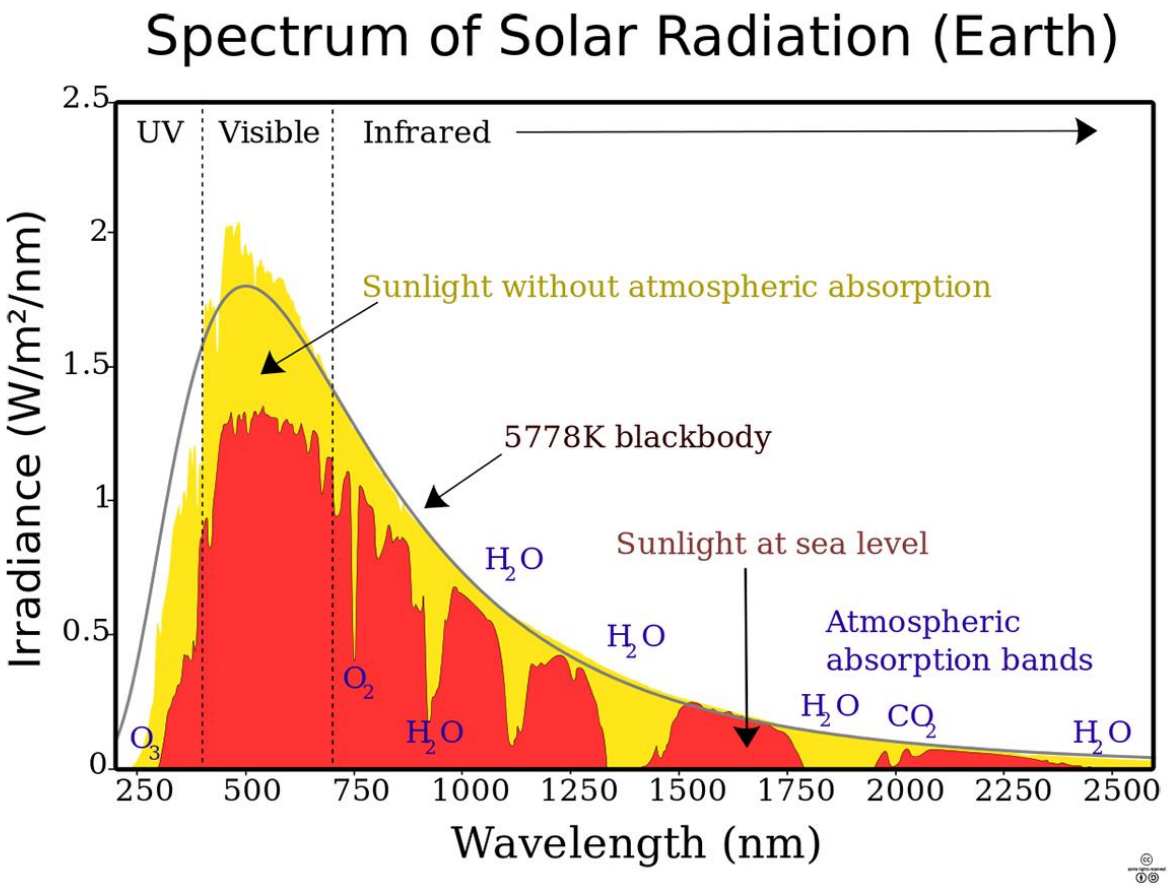
Absorption spectra



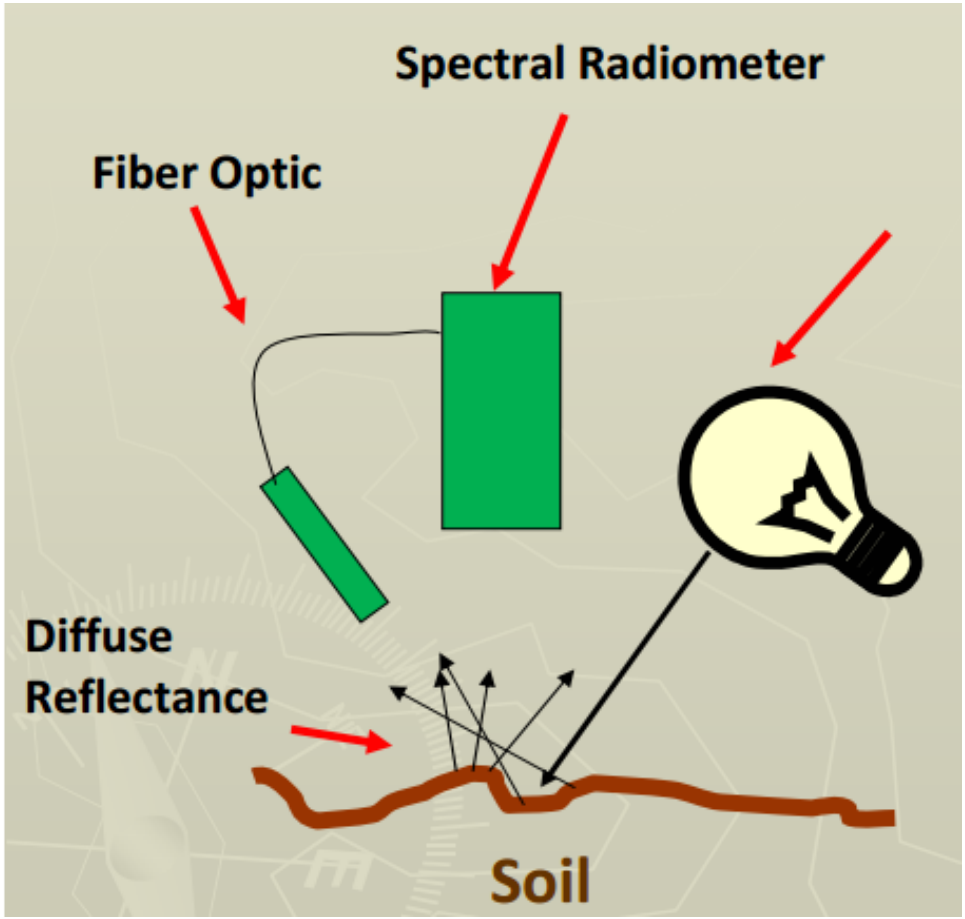
Black-body radiation



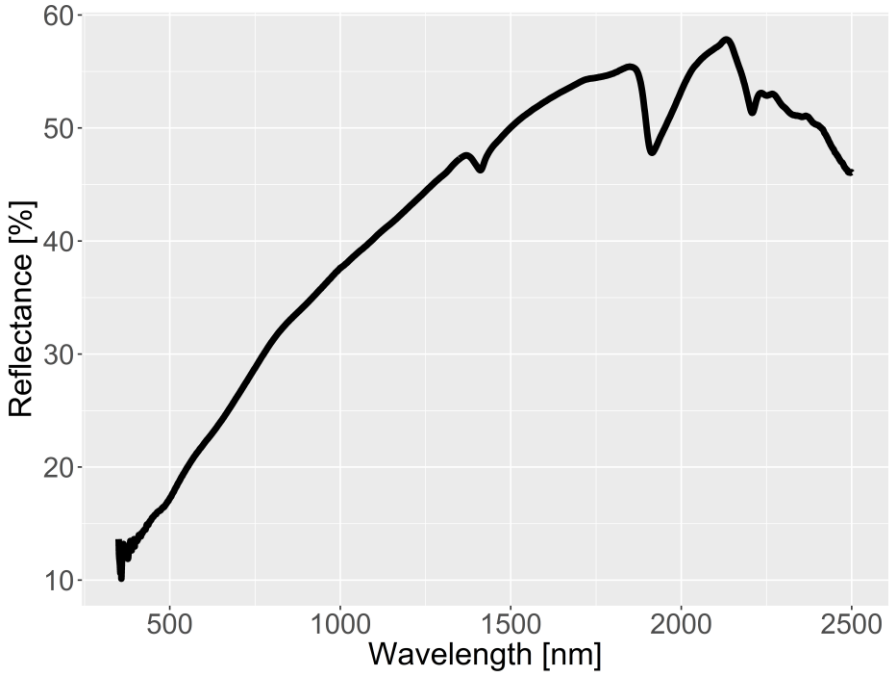
The sun's spectrum

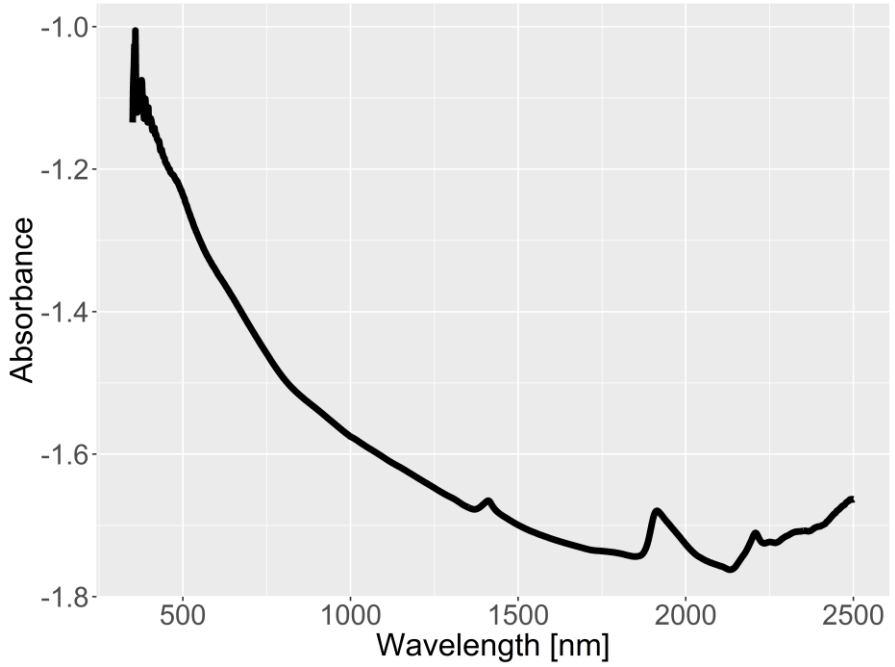


Soil spectroscopy I



Soil spectroscopy II

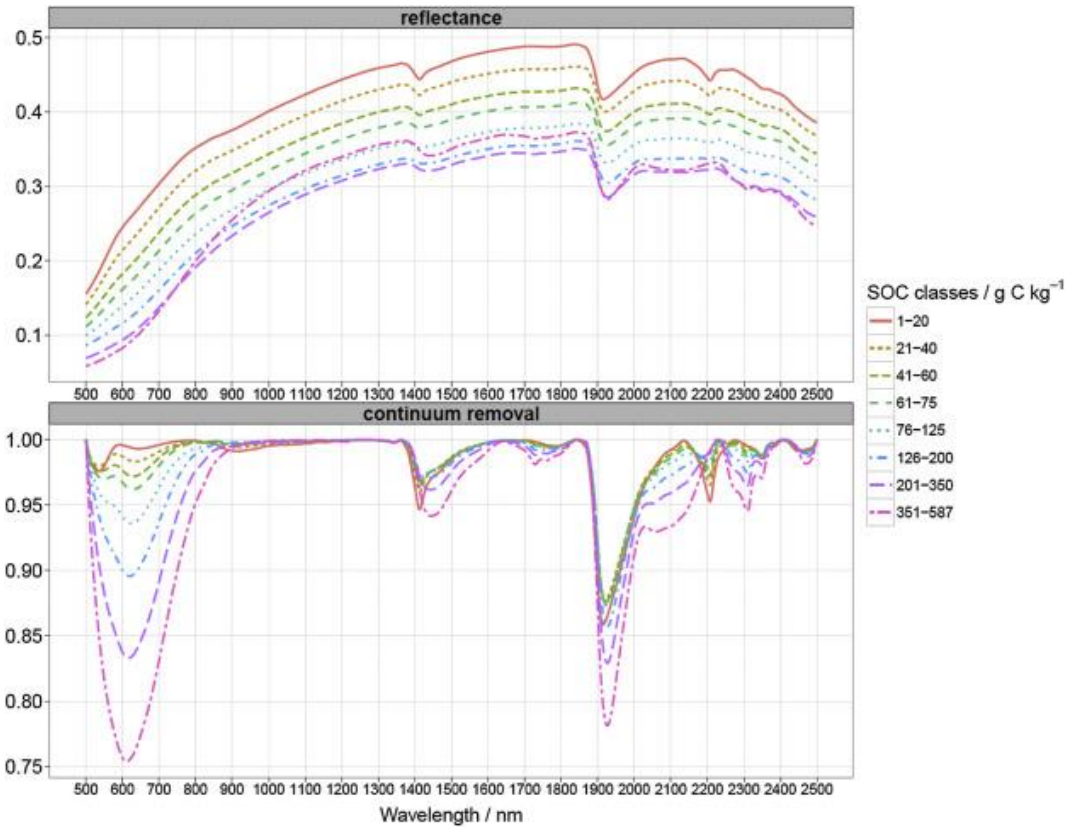




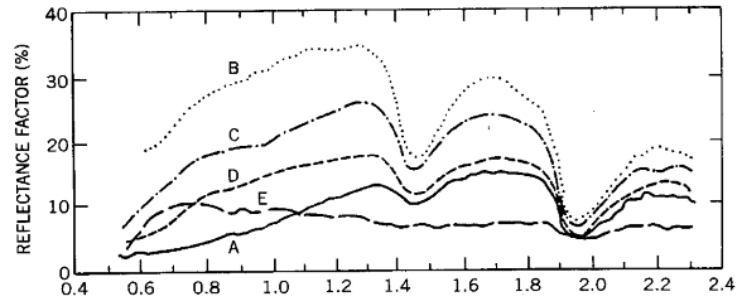
Absorption occurs at the resonant (i.e. vibrational) frequency of molecules and at the overtones and combinations thereof

Soil spectroscopy III

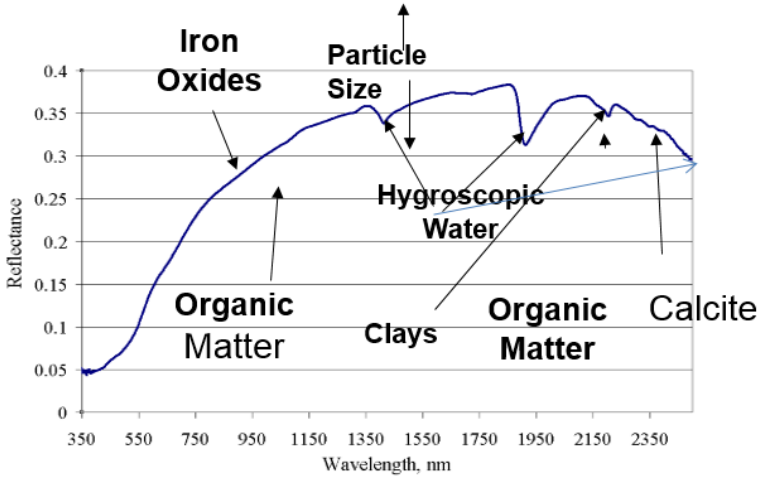
- Chemical chromophores: affect the spectrum at specific wavelengths
- Physical chromophores: affect the spectrum across all wavelengths



Soil spectroscopy IV



Stoner, E.R. and M.F., Baumgardner, 1981. Characteristic variations in reflectance of surface soils. Soil Science Society of American Journal 45: 1161-1165



Soil spectroscopy V

- Soil Spectral Libraries contain thousands of soil samples
- Area must be sampled adequately
- Contain various chemical / physical properties
- Spectra are acquired from dried samples

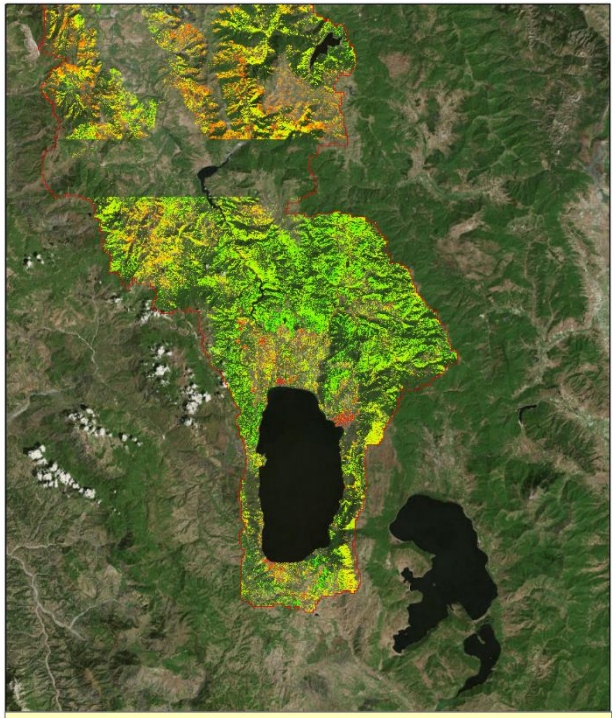
Soil spectroscopy VI

- Machine learning models:
  Spectra ➡ Chemical & Physical soil properties
- Problems
  - Soil is complex and highly variable
  - The curse of dimensionality
  - Big data
- But more on that, on the webinar …
  (Wednesday, June 14th)

Field Spectroscopy

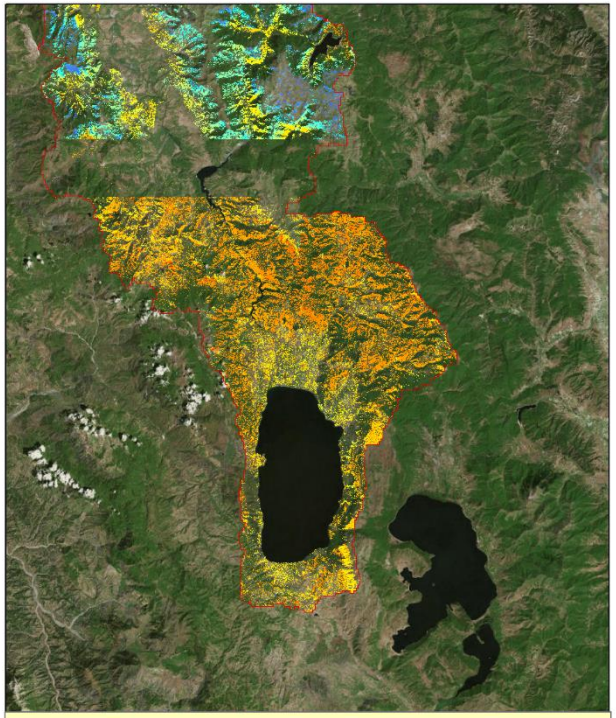
- Spectra acquired in-field using mobile or non-mobile instrumentations
- Difficulties:
  - Soil moisture
  - Ambient light
  - Temperature
  - Dust
  - Contamination
- Demonstrations later on today

Soil Spectroscopy - EO



SWIR - Clay Index

November 2016



Modified NDWI

November 2016

- Drin River Basin
- Collaboration with INCA, CIMA
- Applying Sentinel-2 Copernicus data

SSL in the Balkans

Country	# soil samples	Status
Greece	928	SSL complete
FYROM	125	SSL complete
Bulgaria	-	Soil sampling campaign underway
Albania	-	Soil sampling campaign being scheduled
Serbia	154	Building of SSL in progress

The SSL built in GEO-CRADLE will be a first start for building a large, standardized SSL in the region