Potential of DESIS data to characterize solar photovoltaic (PV) systems

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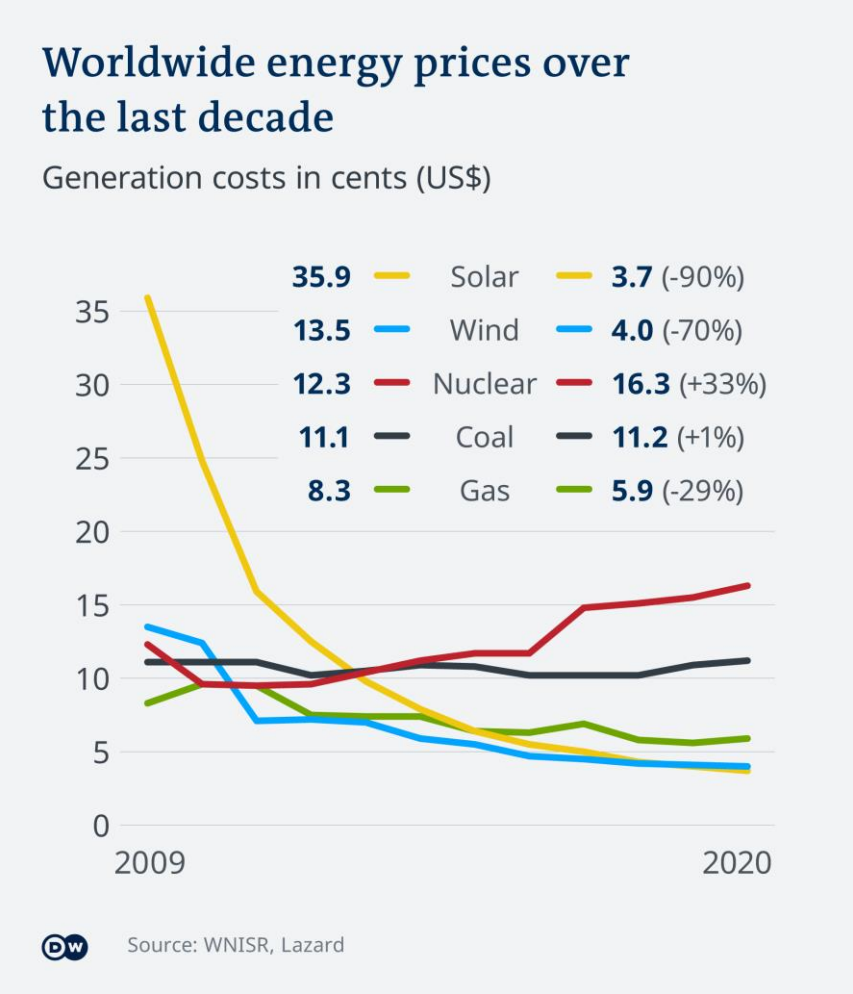
[4] DLR, Institute of Solar Research

PV transferred solar energy

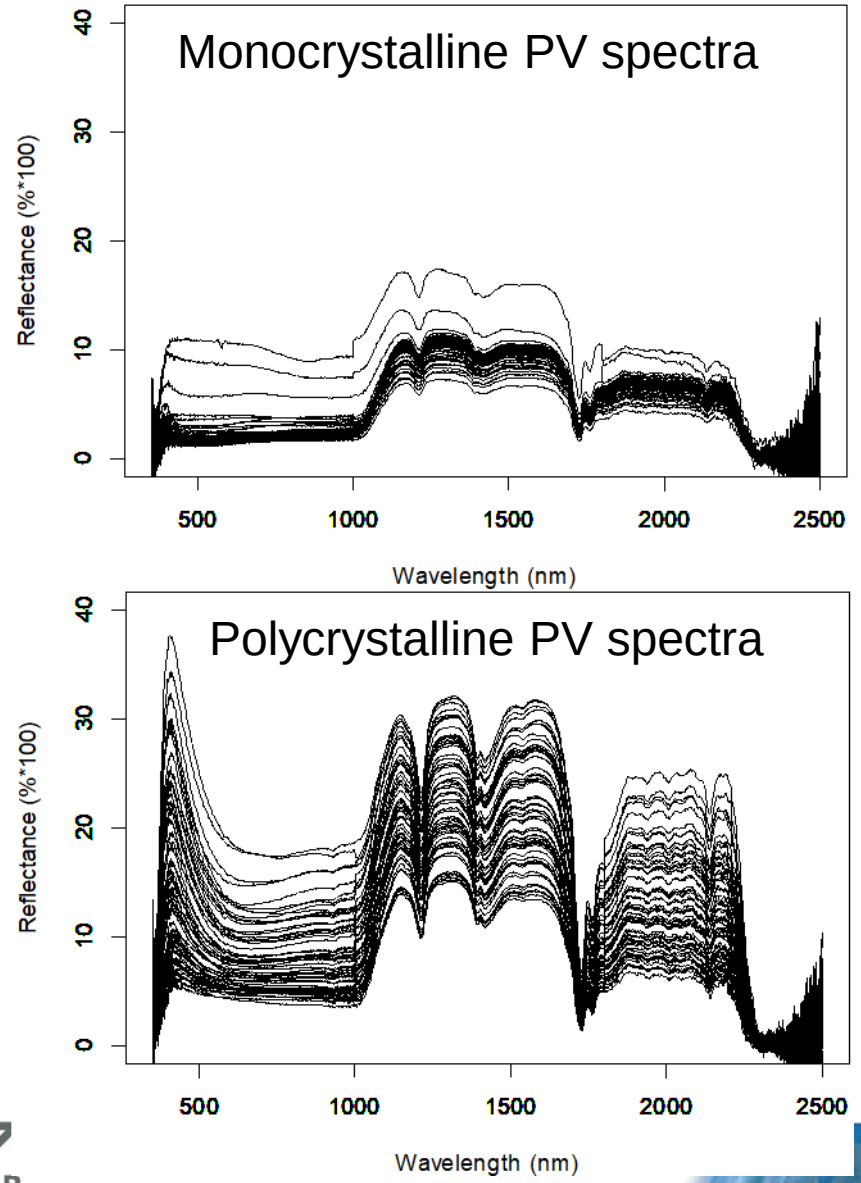


Stakeholders or governments are interested in:

- Where are PV power plants installed?
- Which size do PV power plants have?
- What are the environmental factors that impact the efficiency of PV power plants?
- How does installed PV surface evolve with time?
- How often is it necessary to clean PV power plants to avoid soiling impacts?

https://ecotality.com/climate-change-report-how-advantages-of-solar-energy-help/
https://www.worldnuclearreport.org/The-World-Nuclear-Industry-Status-Report-2020-HTML.html

EO data monitor PV



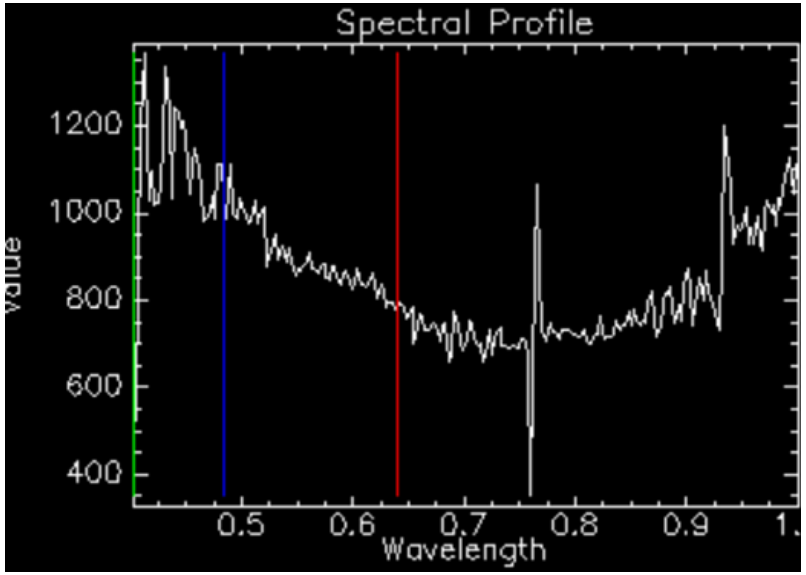
Reseachers are interested in

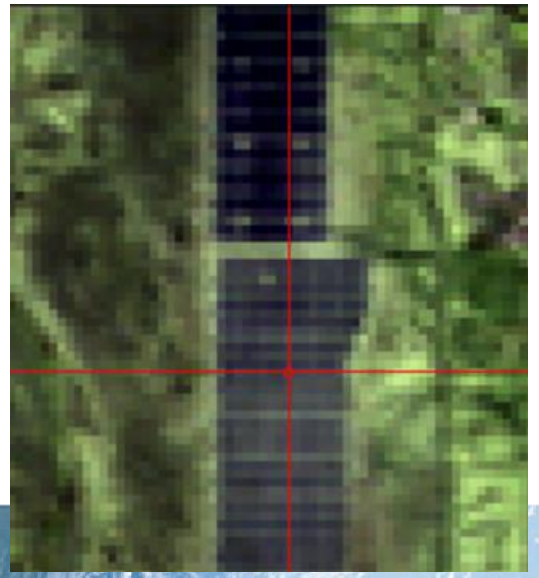
- What are the spectral signatures of the different PV power plant installations?
- What is the spectral effect of different orientations of PV panels?
- What does the environment look like (in terms of potential soiling impact)?
- Can we detect the type and degree of soiling?
- Can we assess/model the influence of soiling to efficiency of PV panels?

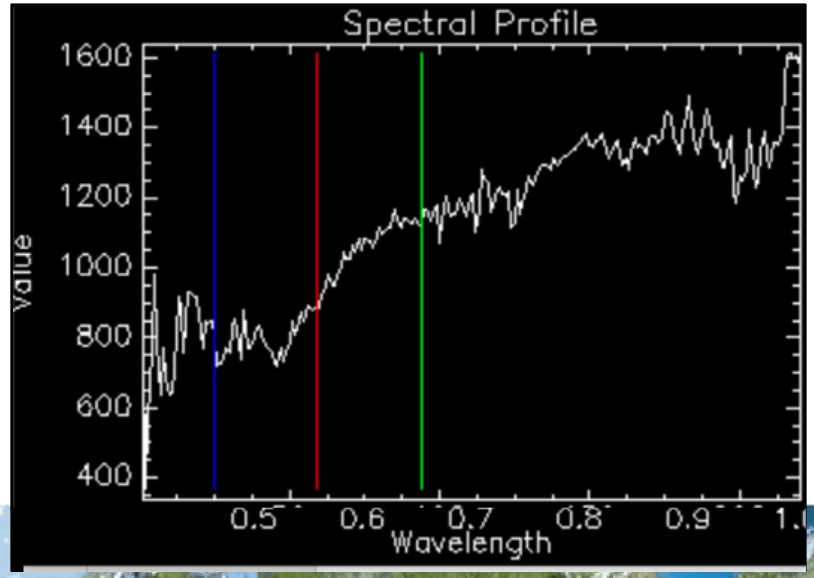
PV from: Prof. Gerd Heilscher;
Data from: Martin Gutwinski, Uta Heiden, Andreas Hueni

Factors of the PV spectra

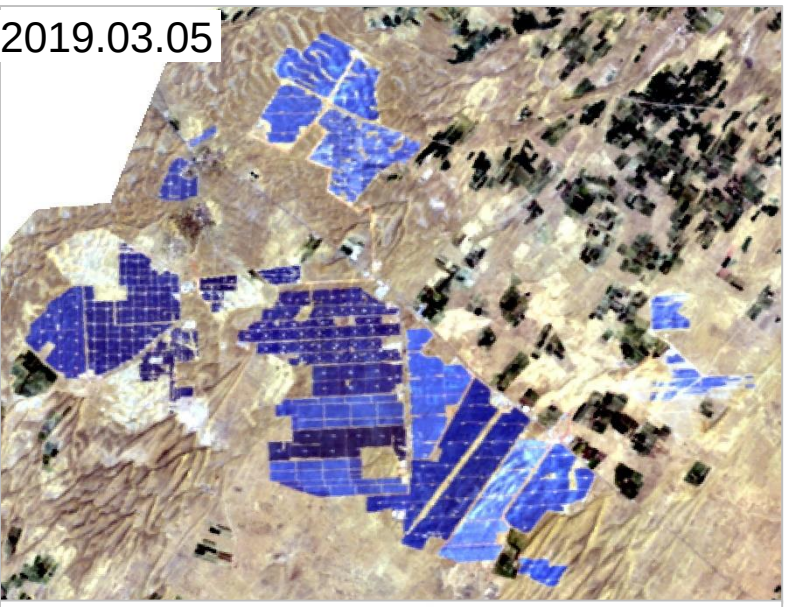
- Types of PV
- PV backgrounds
- Soiling with dust or pollen

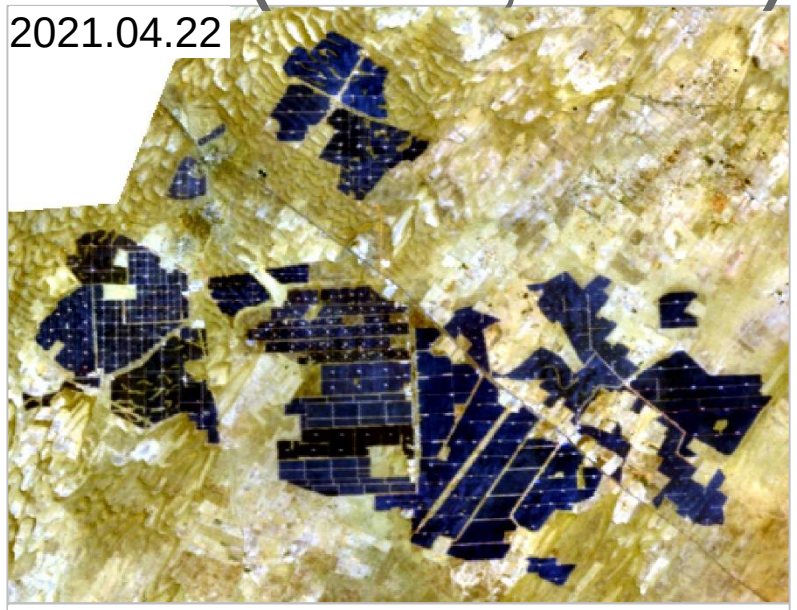


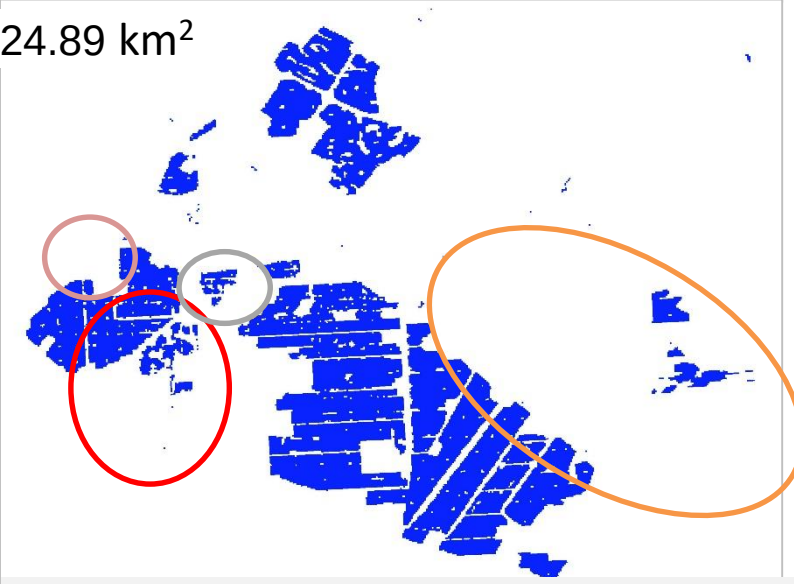




Time series of PV installations (27°33'N, 71°58'E)







Refer to Arati Paul: The area has solar irradiation of 5.72kWh/m²/day

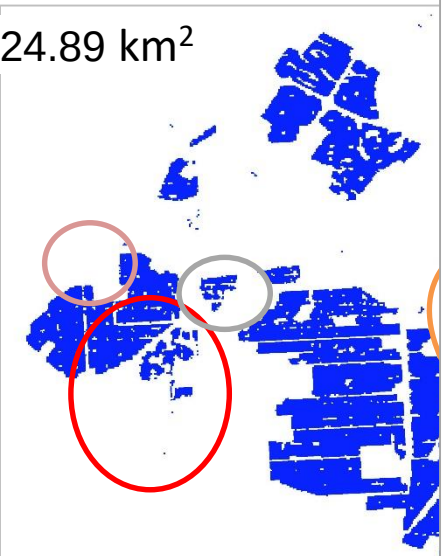
Total solar irradiation 2019:
24.89 * 10^6 m² * 5.72 =
142,37 GWh/day

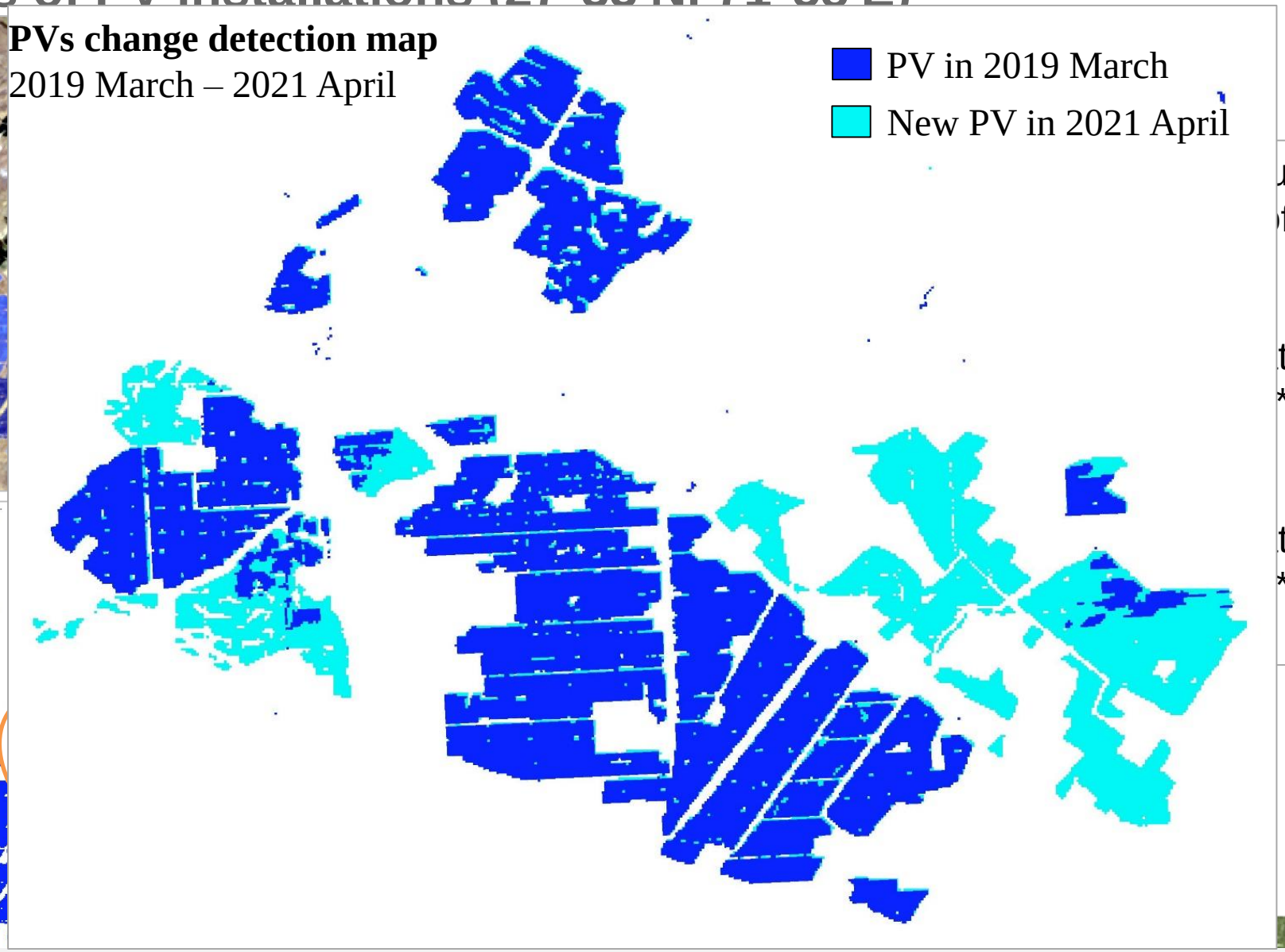
Total solar irradiation 2021:
37,21 * 10^6 m² * 5.72 =
212,8 GWh/day

~50%

Method refers to: Ji, C., et.al, 2021. Solar photovoltaic module detection using laboratory and airborne imaging spectroscopy data. Remote Sensing of Environment.

Time series of PV installations (27°33'N, 71°58'E)





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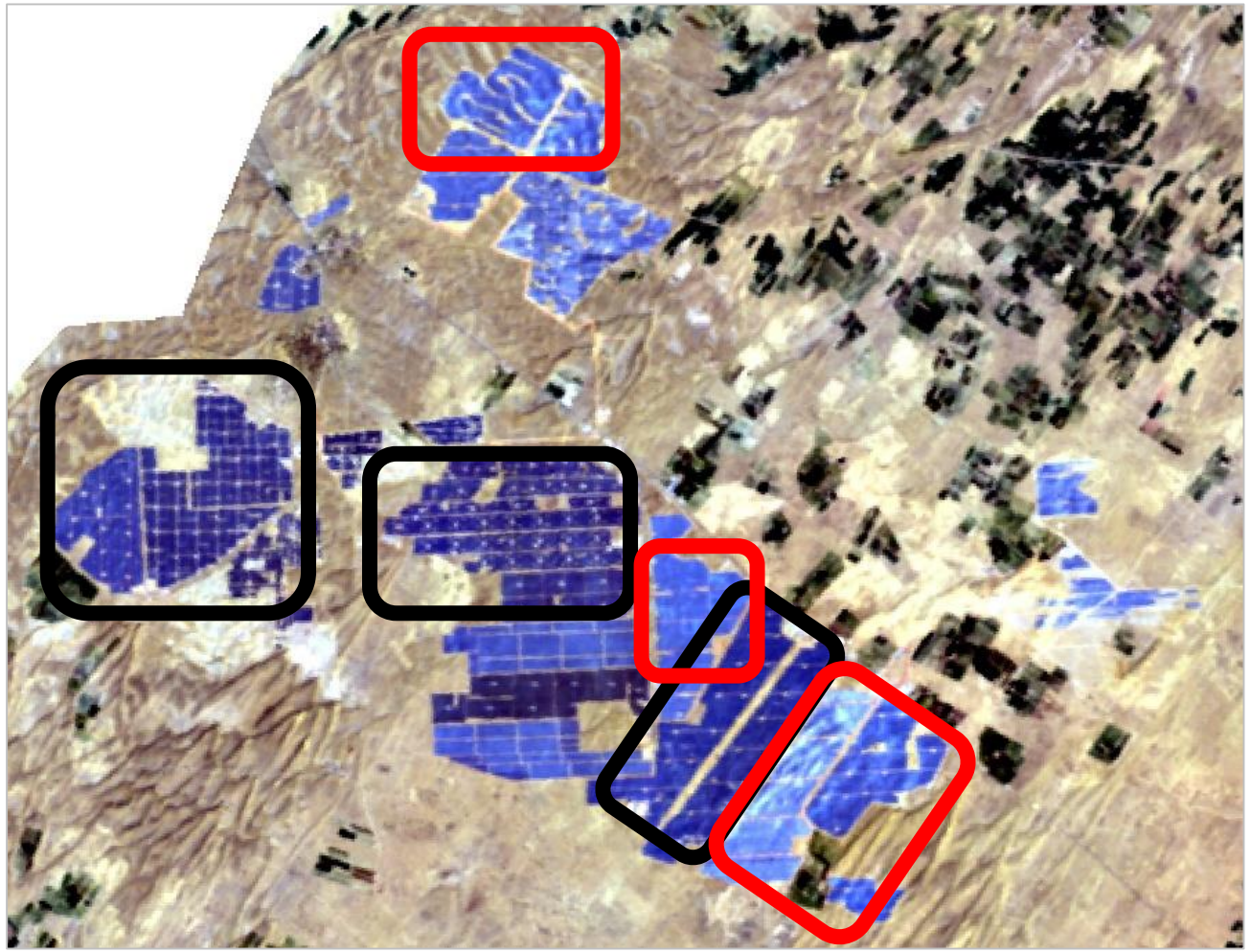
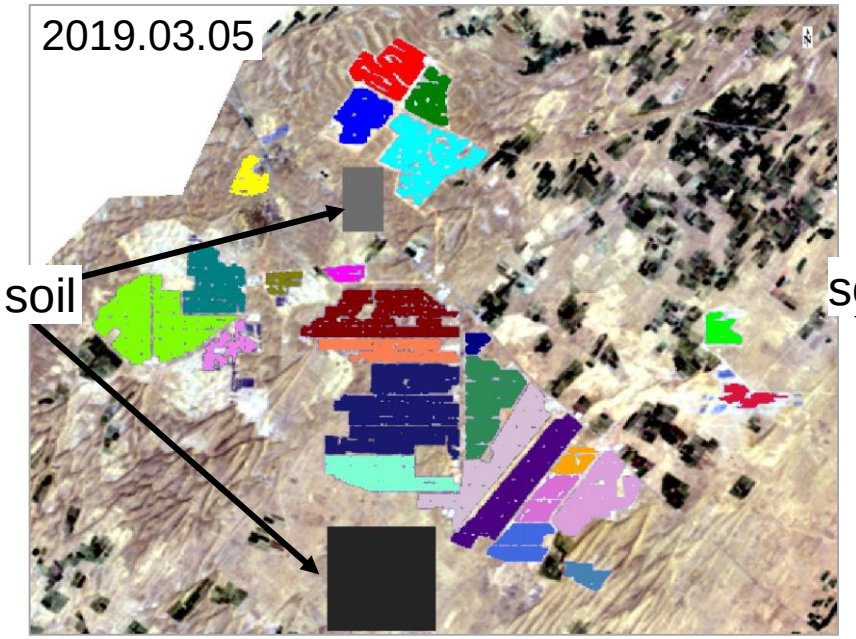
‘Diverse PV modules’



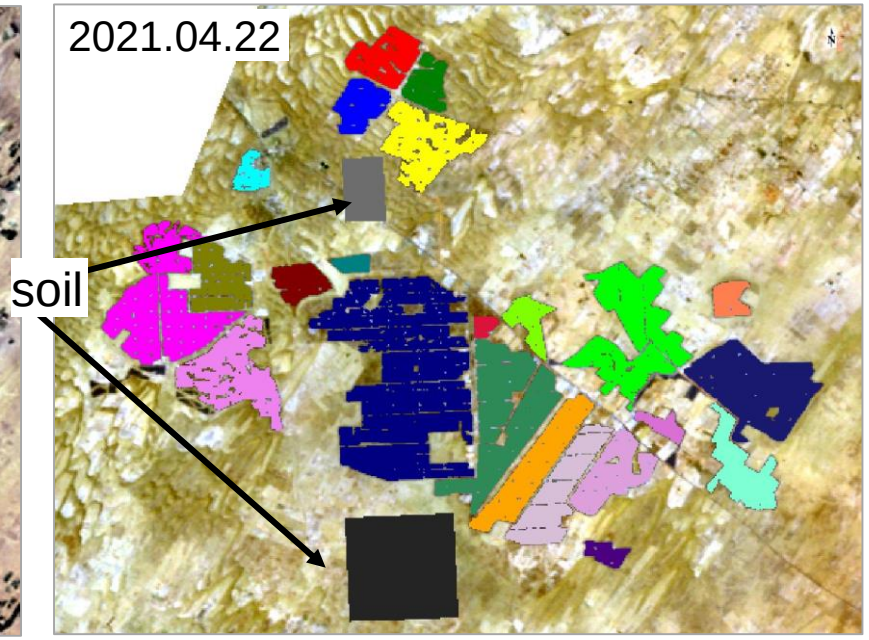
Bright blue PVs

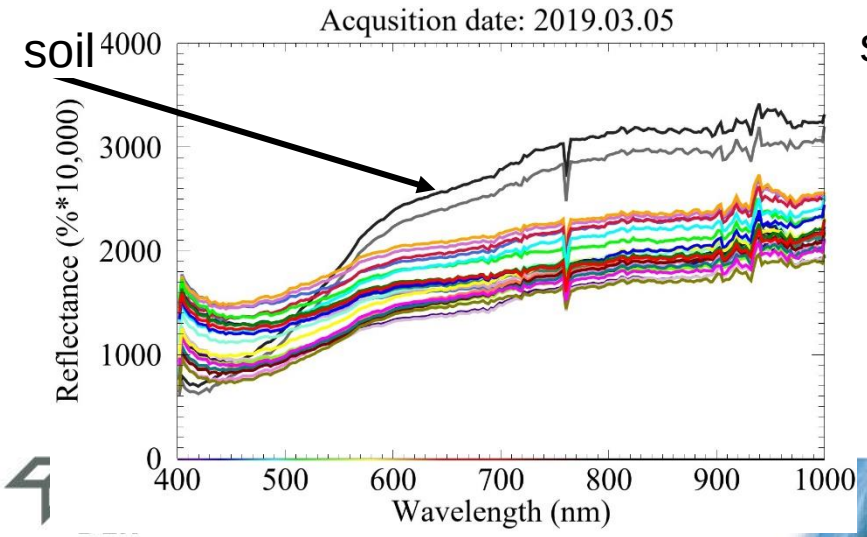
Dark blue PVs

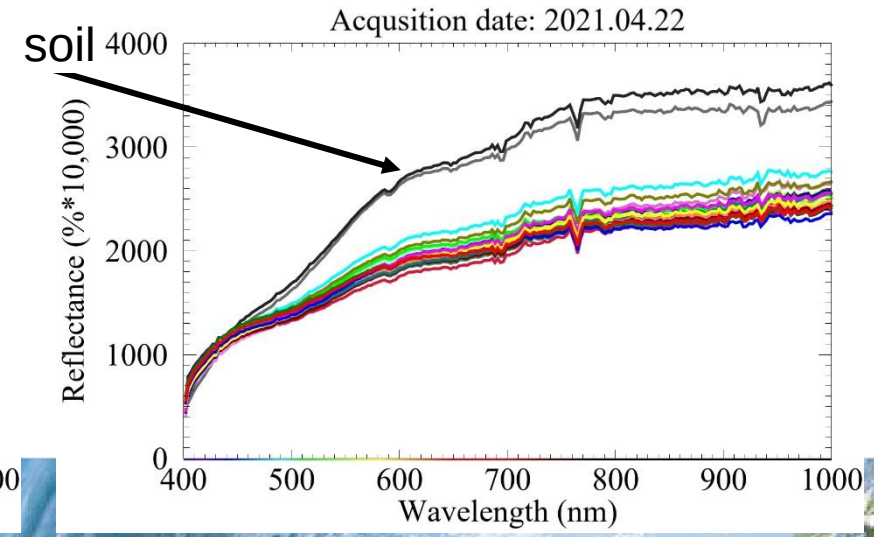
Acqusition time (Indian local): 10:51;
Solar zenith angle: 44.88;
incidence angle scene center: 12.6



Acqusition time (Indian local): 14:21;
Solar zenith angle: 27.98;
incidence angle scene center: 8.48







Possible factors:

Acqusition time of the day
~Solar zenith angle
Incidence angle
~BRDF
Calibration

Summary and Outlook

- Time series of PV modules installation
- The spectral collection of the PV modules
- Showing spectral differences at different time

- We are looking for:
  - A collection of spectra with PV surrounding surface materials, especially PV-based ground
  - Combining with the certain local solar irradiation, so we can estimate energy generation ability
  - Spectral change over time, to model soiling effect on PV modules
  - Different types of PV modules, e.g., monocrystalline vs. polycrystalline PV modules

Thank you!

Look forward to your comments!