

Climate data processing for climate resilience

Tajikistan and Kyrgyzstan

Data access, processing and methodological concepts

Webinar
17. - 27. 11.2020

DAY 06
EO and Climate Change



Objectives of Day 03

Date: 22.11

Presentation: Day05_BigData

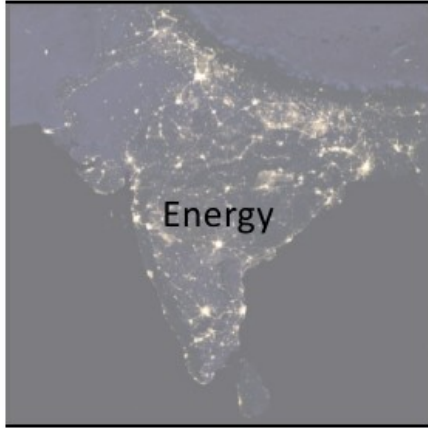
<https://github.com/nilshempelmann/climdatatutorial/blob/master/presentations>

Objectives:

- Wrap up of yesterday
-



Various Applications

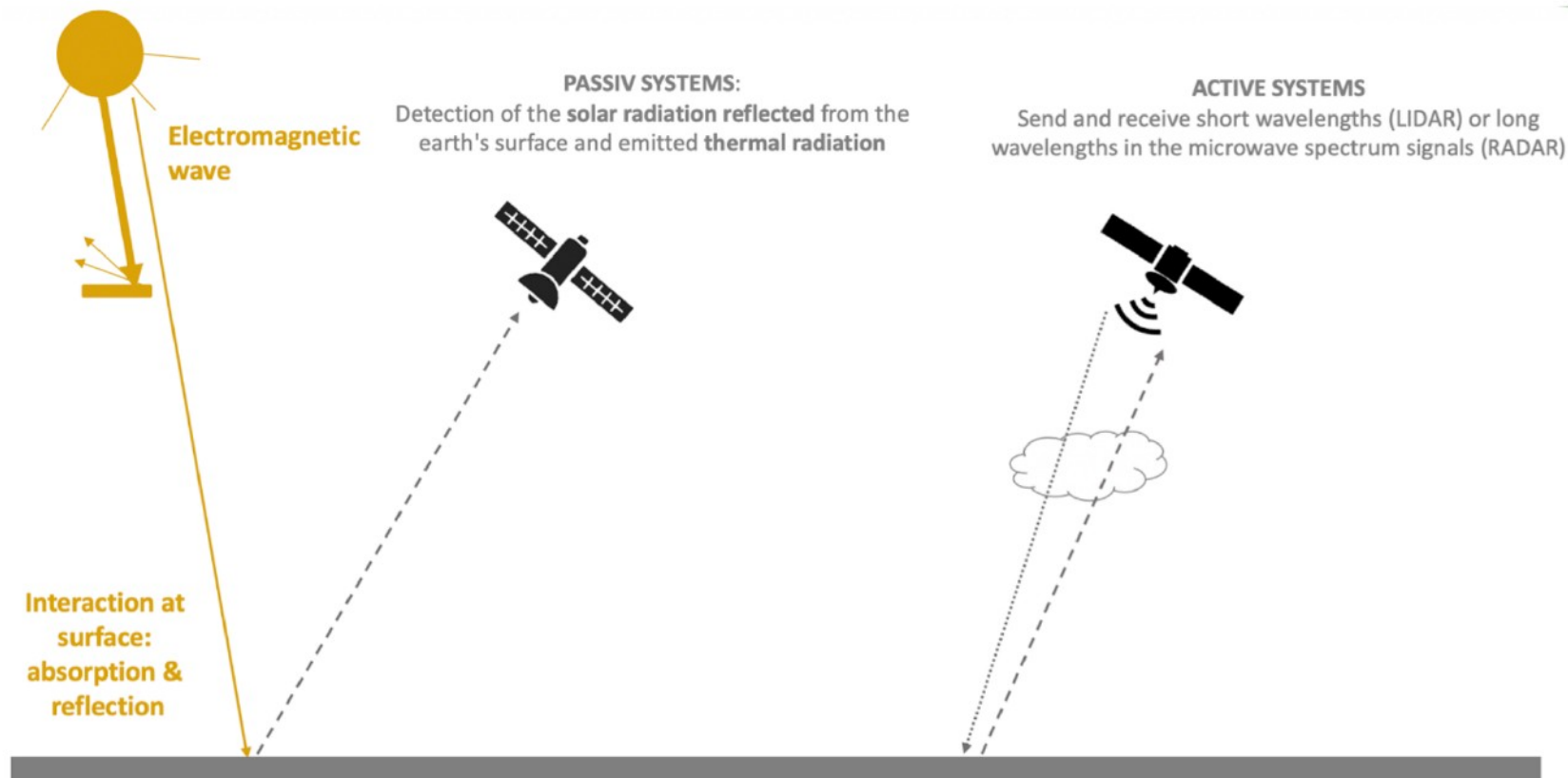


... and many more



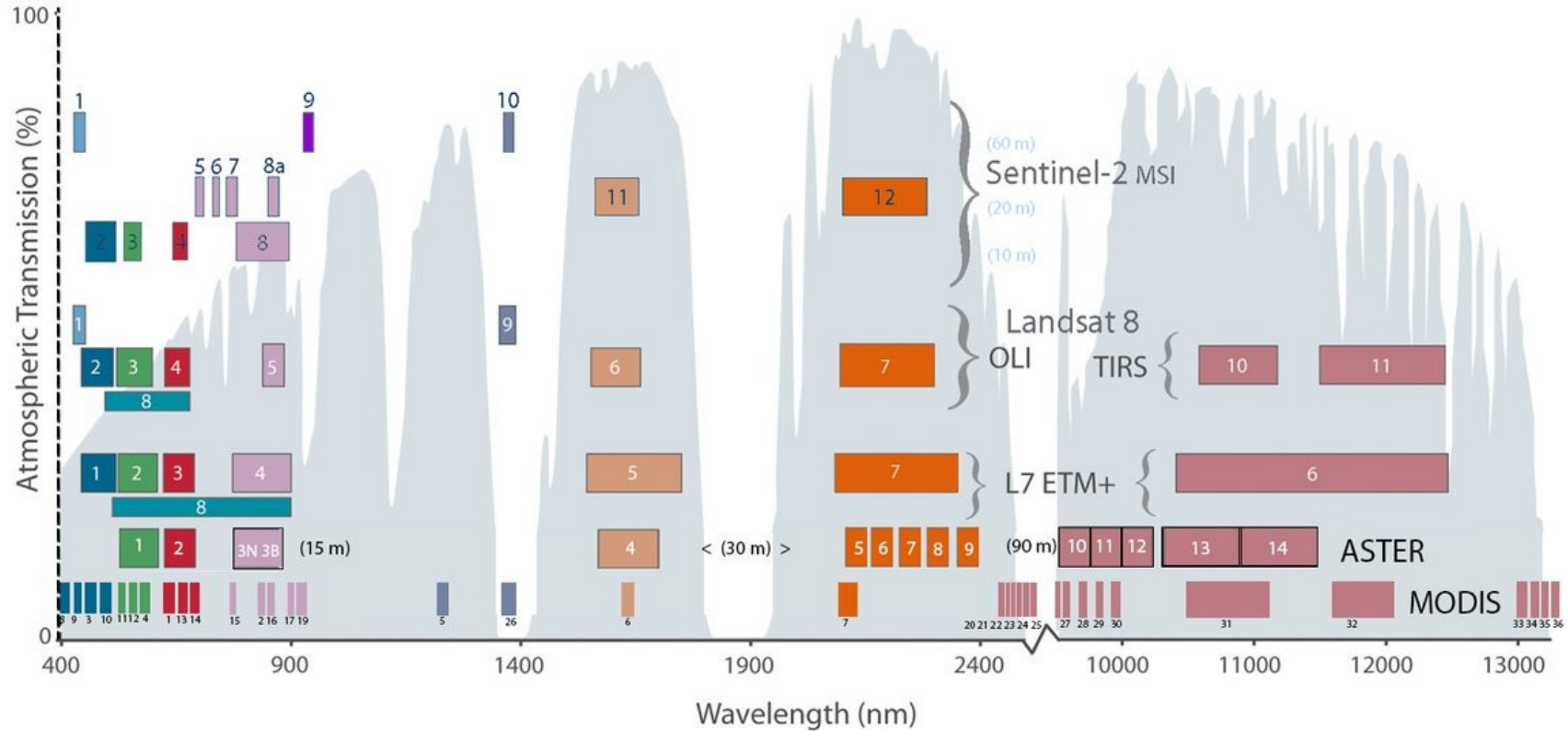
Source: ESA CC BY –SA 3.0 IGO, Sentinel-2, bearbeitet durch MapTailor Geospatial Consulting





Bands

Comparison of Landsat 7 and 8 bands with Sentinel-2



Source: <https://gis.stackexchange.com/questions/276871/conversion-of-spectral-indices-formulas-from-landsat-to-sentinel>



COPERNICUS AND ITS SENTINELS

European Earth Observation Programme Copernicus: observing our planet for a safer world

-  Known as **GMES** until 2012 - Global Monitoring for Environment and Security
-  **30** Public and Private missions are also contributing data
-  **16 years** of development and testing
-  **Sentinel-Missions** at the heart of the space component
-  **Civil Security.** Allowing early warning and crisis prevention in conflict and disaster areas
-  **Emergency Management.** Accurate and timely data for emergency plans and rescue for disaster management
-  **Land Surface Monitoring.** Geographical information on land cover, related variables and urban development
-  **Marine Environmental Monitoring.** Observations and forecasts on the state of the physical oceans and regional seas
-  **Climate Change Monitoring.** Helps to understand the reason for climate change, rising sea levels and melting ice caps
-  **Earth Atmosphere Monitoring.** Daily information on the global atmospheric composition and when Sentinel-4 is in service this will be hourly

SENTINEL-1



- **All-weather, day-and-night radar imaging satellite for land and ocean services**
- Able to "see" through clouds and rain
- Data delivery within 1 hour of acquisition
- Airbus Defence and Space developed C-band radar instrument

SENTINEL-2



- **Medium Res Multispectral optical satellite for observation of land, vegetation and water**
- 13 spectral bands with 10, 20 or 60 m resolution and 290 km swath width
- Global coverage of the Earth's land surface every 5 days
- Airbus Defence and Space prime contractor for satellites and instruments

SENTINEL-3



- **Measures sea-surface topography with a resolution of 300 m, sea and land surface temperature and colour with a resolution of 1 km**
- Measures water vapour, cloud water content and thermal radiation emitted by the Earth
- Determines global sea surface temperatures with an accuracy greater than 0.3 K
- Airbus Defence and Space supplies Microwave Radiometer

SENTINEL-5P



- **Global observation of key atmospheric constituents, including ozone, nitrogen dioxide, sulphur dioxide and other environmental pollutants**
- Improves climate models and weather forecasts
- Provides data continuously during five-year gap between the retirement of Envisat and the launch of Sentinel-5
- Airbus Defence and Space prime contractor for satellite and TROPOMI instrument

SENTINEL-4



- **Provides hourly updates on air quality with data on atmospheric aerosol and traces gas concentrations**
- Spatial sampling is 8 km and spectral resolution between 0.12 nm and 0.5 nm
- Airbus Defence and Space prime contractor for spectrometer
- Carried aboard EUMETSAT's Meteosat Third Generation (MTG) satellites

SENTINEL-5



- **Measures air quality and solar radiation, inventories stratospheric ozone and the climate**
- Global coverage of Earth's atmosphere with an unprecedented spatial resolution
- Airbus Defence and Space prime contractor for instrument
- Carried aboard EUMETSAT's MetOp Second Generation satellites

SENTINEL-6



- **Observes changes in sea surface height with an accuracy of a few centimeters**
- Global mapping of the sea surface topography every 10 days
- Enables precise observation of ocean currents and ocean heat storage; vital for predicting rises in sea levels
- Airbus Defence and Space prime contractor for satellite

2014

2020

Source: <https://www.airbus.com/public-affairs/berlin/en/our-topics/space.html>



Band Indices

Many many more:

<https://www.indexdatabase.de/>

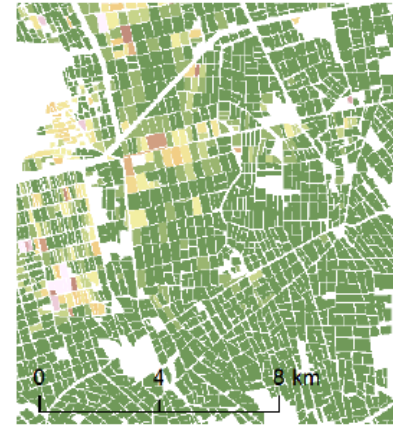
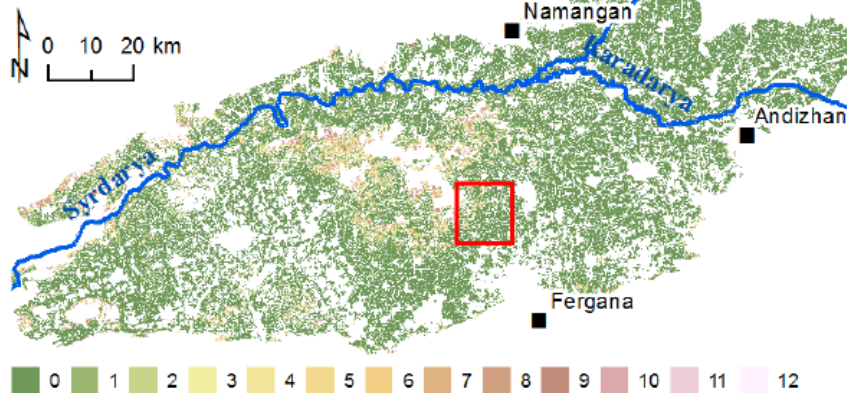
109	Normalized green red difference index, Visible Atmospherically Resistant Indices Green (Vlgreen)	NGRDI	$\frac{GREEN-RED}{GREEN+RED}$
110	Normalized Difference MIR/NIR Normalized Difference Vegetation Index (in case of strong atmospheric disturbances)	NDVI	$\frac{MIR-NIR}{MIR+NIR}$
111	Normalized Difference NIR/Blue Blue- normalized difference vegetation index	BNDVI	$\frac{NIR-BLUE}{NIR+BLUE}$
112	Normalized Difference NIR/Green Green NDVI	GNDVI	$\frac{NIR-GREEN}{NIR+GREEN}$
113	Normalized Difference NIR/MIR Modified Normalized Difference Vegetation	MNDVI	$\frac{NIR-MIR}{NIR+MIR}$



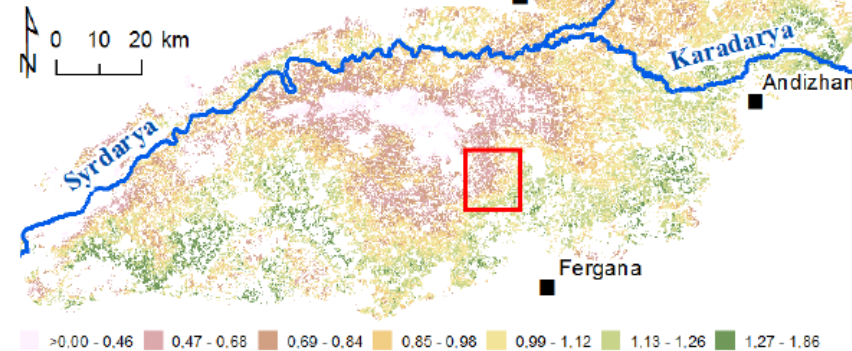
Agriculture monitoring

Source: Löw, F., Biradar, et al. 2017. Int. J. Appl. Earth Obs. Geoinf. 59, 118–134.

Cropping frequency (CF)

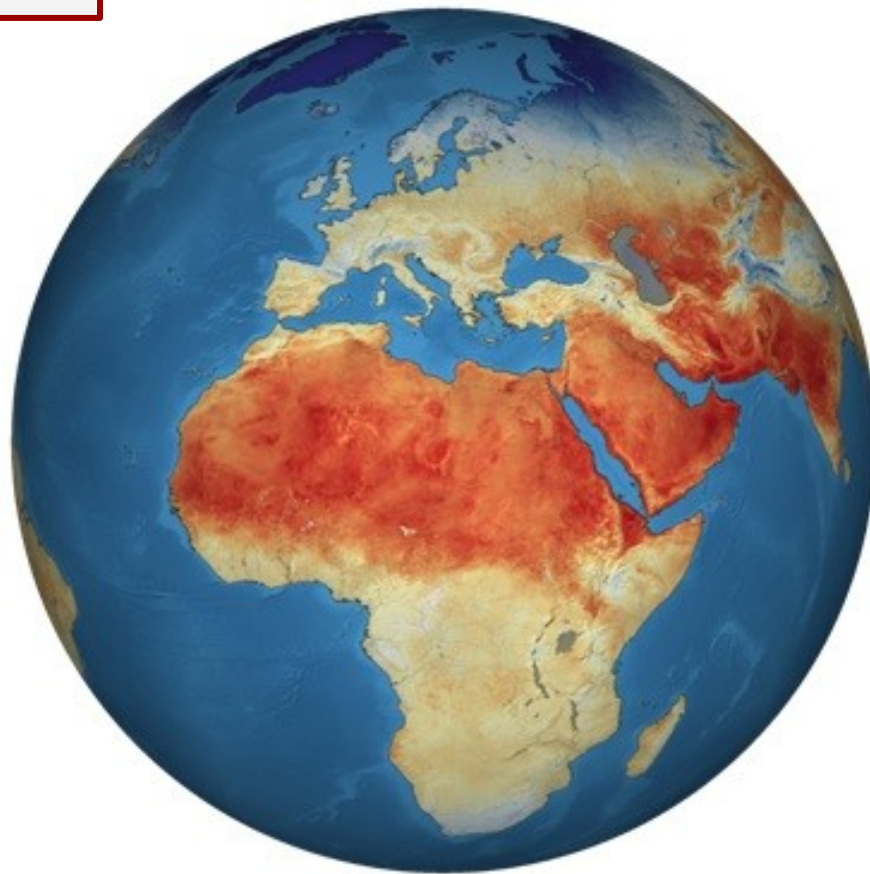


Relative improvement of wheat yield compared to baseline



Climate Change monitoring

Global Land Surface
Temperatures from
Sentinel-3/SLSTR data (2018).
(Credit: ESA)



Air quality / emissions

→ NDC – strategy

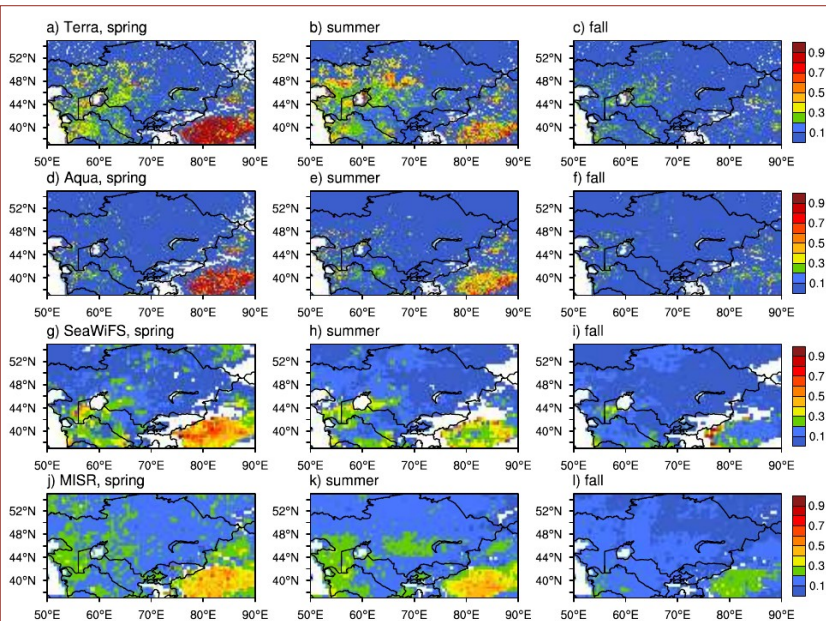
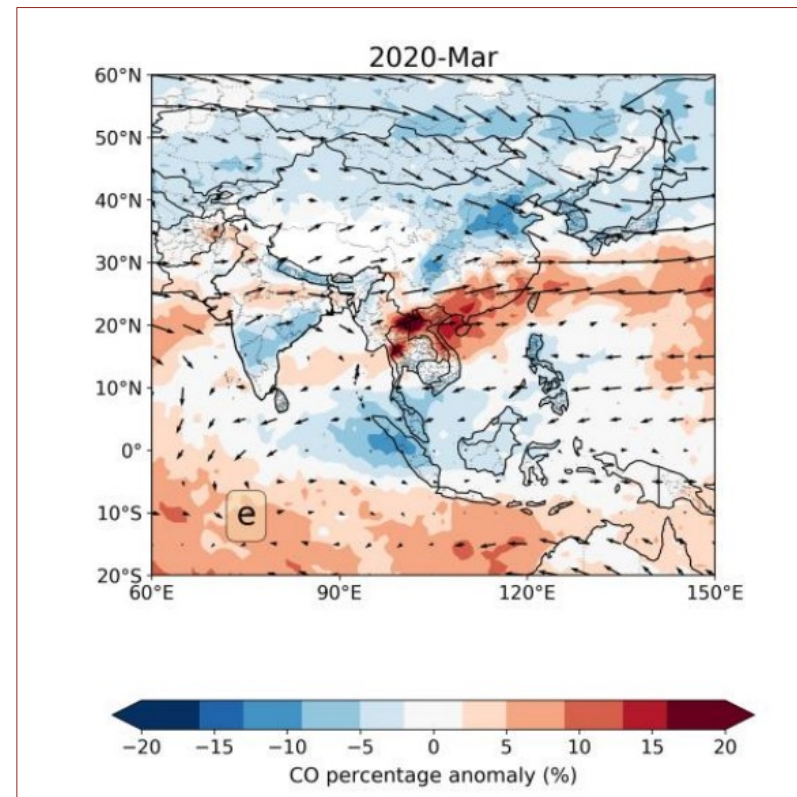


Figure 4. Seasonal mean of DOD in the spring, summer, and fall during the 2003–2007 period from MODIS onboard Terra (a, b, and c)/Aqua (d, e, and f), SeaWiFS (g, h, and i), and MISR (j, k, and l). White indicates no retrievals available.

Analysis of Dust Aerosol Retrievals Using Satellite Data in Central Asia

Source: Li et. al. 2018: <https://doi.org/10.3390/atmos9080288>



COVID-19 Lockdowns Improve Air Quality in the South-East Asian Regions, as Seen by the Remote Sensing Satellites

Source: Abirlal Metya(2020) in Special Issue on COVID-19 Aerosol Drivers, Impacts and Mitigation (IV)

<https://doi.org/10.4209/aaqr.2020.05.0240>



EO for SDG

Source:
Digital Earth Africa
digitalearthafrika.org/

Target Contribute to progress on the Target, not necessarily the Indicator								Goal	Indicator Direct measure or indirect support to the Indicator					
						1.4	1.5	1 No poverty	1.4.2					
					2.3	2.4	2.c	2 Zero hunger	2.4.1					
				3.3	3.4	3.9	3.d	3 Good health and well-being	3.9.1					
								4 Quality education						
							5.a	5 Gender equality	5.a.1					
		6.1	6.3	6.4	6.5	6.6	6.a	6 Clean water and sanitation	6.3.1	6.3.2	6.4.2	6.5.1	6.6.1	
					7.2	7.3	7.a	7 Affordable and clean energy	7.1.1					
							8.4	8 Decent work and economic growth						
					9.1	9.4	9.5	9 Industry, innovation and infrastructure	9.1.1	9.4.1				
						10.6	10.7	10 Reduced inequalities						
	11.1	11.3	11.4	11.5	11.6	11.7	11.b	11 Sustainable cities and communities	11.1.1	11.2.1	11.3.1	11.6.2	11.7.1	
				12.2	12.4	12.8	12.a	12 Responsible consumption and production	12.a.1					
					13.1	13.2	13.3	13 Climate action	13.1.1					
		14.1	14.2	14.3	14.4	14.6	14.7	14 Life below water	14.3.1	14.4.1	14.5.1			
	15.1	15.2	15.3	15.4	15.5	15.7	15.8	15 Life on land	15.1.1	15.2.1	15.3.1	15.4.1	15.4.2	
							16.8	16 Peace, justice and strong institutions						
17.2	17.3	17.6	17.7	17.8	17.9	17.16	17.17	17 Partnerships for the goals	17.6.1	17.18.1				



Hands ON:
Qgis exercise NDVI calculation

