→ EARTH OBSERVATION FOR SUSTAINABLE DEVELOPMENT

Water Resources Management

Asian Water Forum | Oct. 5th 2018 | Asian Development Bank | Manila, Philippines

Earth Observation in support for project identification/preparation

Christian Tottrup, DHI GRAS

Earth Observation

helping to manage our water sustainably

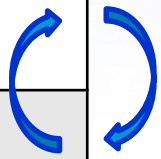
EO4SD -> Background

- Water plays an essential and crosscutting role in the sustainable management of land use in particular in the context of agriculture as 70% of freshwater is used for irrigation
- The successful and sustainable management of water resources requires access to reliable data and information on water related issues
- The main objective of the EO4SD initiative is to demonstrate the benefit and utility of EO-based information in support land and water resource management in the context of international development projects and activities

Objective and program

- To demonstrate how Earth Observation can support water resource management, agriculture and international development assistance incl. the monitoring and reporting requirements of the Sustainable Development Goals

Time	Title	Speaker
10.30 – 11.15	EO in support for project identification/preparation	Christian Tøttrup, DHI GRAS
11.15 – 12.00	Optimize agricultural water use efficiency	Remco Dost, eLEAF
12.00 – 13.30	Lunch	
13.30 – 14.15	Earth Observation for Integrated Water Resource Management and SDG monitoring	Christian Tøttrup, DHI GRAS
14.15 – 15.00	Monitoring and evaluation using Earth Observation	Remco Dost, eLEAF
15:00	Wrap Up and Closing	Paolo Manunta, ESA



Progression

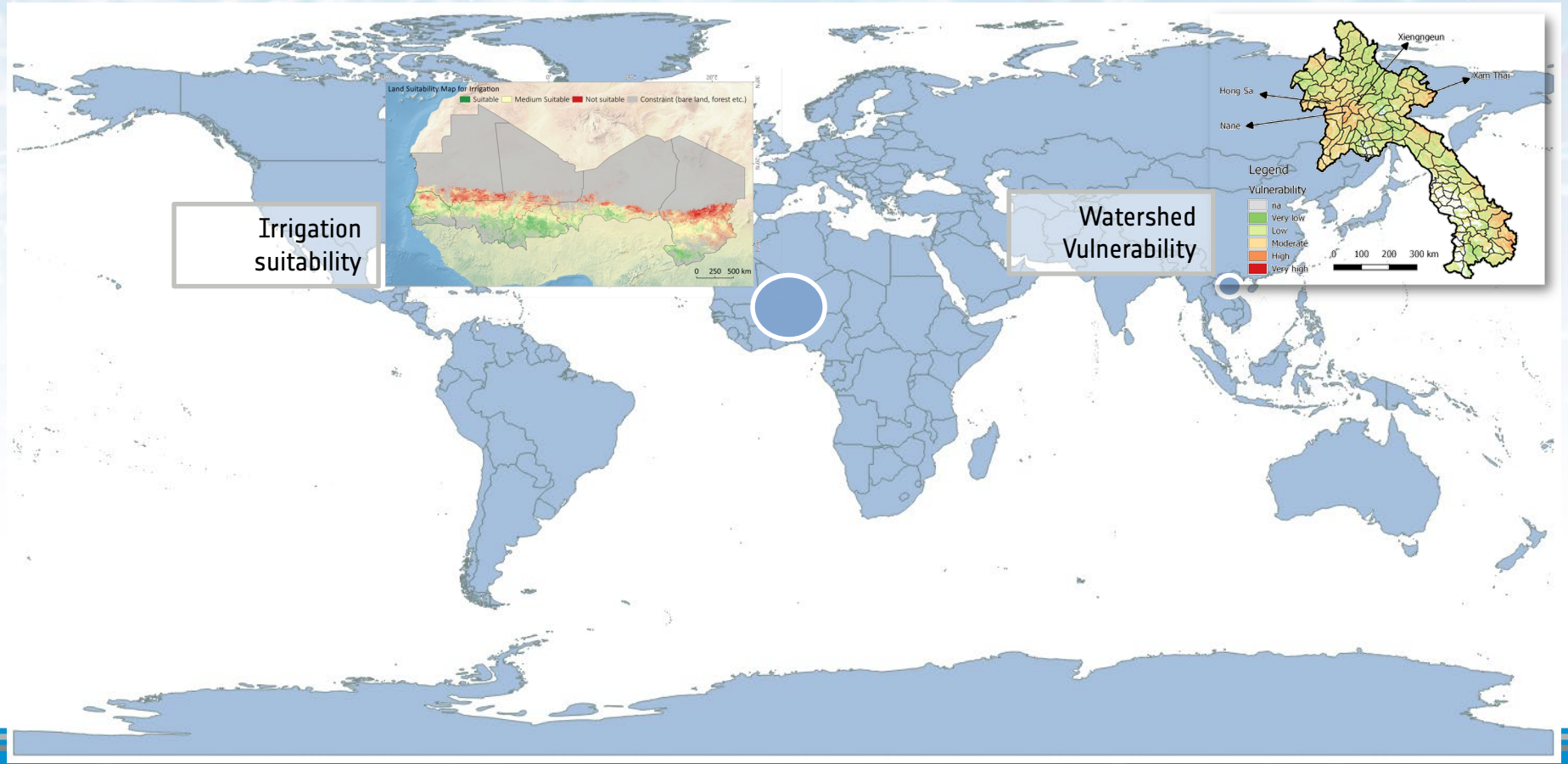
- Multi-scale/Multi-resolution applications
  - Coarse-resolution/ Multi-factor applications for project identification, preparation –> fact finding, hot-spots etc.
  - High resolution applications in support of Agriculture, IWRM and SDG

Stakeholder issues

- Reliable and readily available information on the water cycle, related land (cover/use) processes, climatic facts and socio-demographic developments are fundamental for improving water policies, management and governance effectively
- The lacking capacity to perform rapid assessments of water-relevant issues and facts is identified as a critical gap for project interventions on the ground:
  - Interventions may often occur with out sufficient knowledge of the spatial context i.e. where is the issues most apparent -> hot-spot identification
  - Even when hot-spots are known availability of an unbiased screening tool can be useful for closing out arguments
  - Project justification may also be supported by assessing the potential for scaling up

EO demonstrations

- Provide information and analysis for identification, analysis and reporting of challenges and facts from regional to national level



Groundwater potential, Sahel

Sahel Irrigation Initiative Support Project

- Objective
  - To improve stakeholders' capacity to develop and manage irrigation and to increase irrigated areas, including strengthening of IWRM in all countries and the development of an integrated M&E system
- Information needs:
  - (Irrigated) Crop mapping and monitoring
  - Surface Water Monitoring
  - Irrigation management
  - **Groundwater potential**

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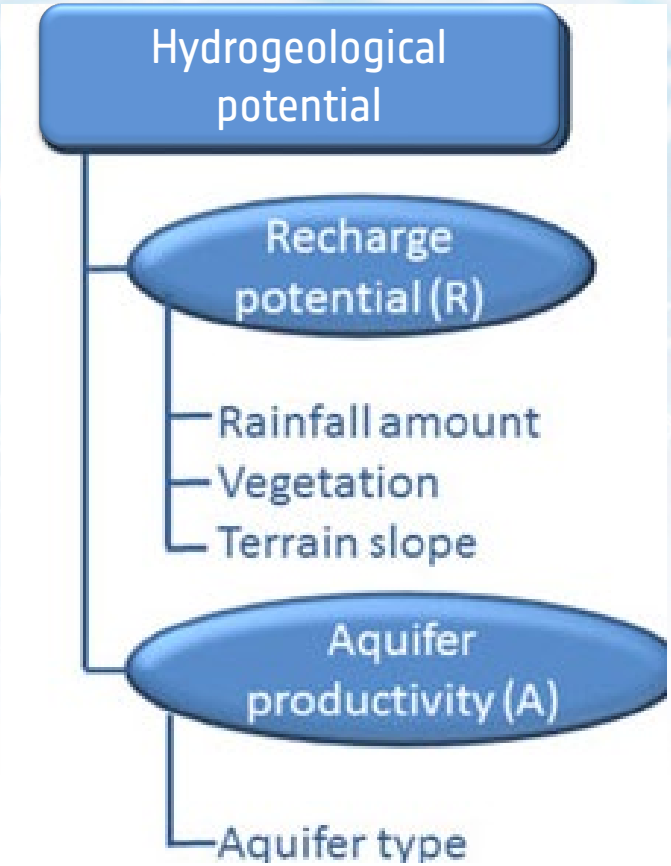
Groundwater potential for irrigation

- Factors that affect the suitability of an area for groundwater irrigation potential include **biophysical** (e.g., climate, soil characteristics, land use type, and topography) and **socio-economic** (e.g., market access such as proximity to a road and population density)
- EO based composite mapping analysis GW potential based on biophysical (P) and socio-economic (H) input layers

$$GWP = \sum_{i=1}^{n} w_i P_n + \sum_{i=1}^{n} w_i H_n$$

Hydrogeological potential

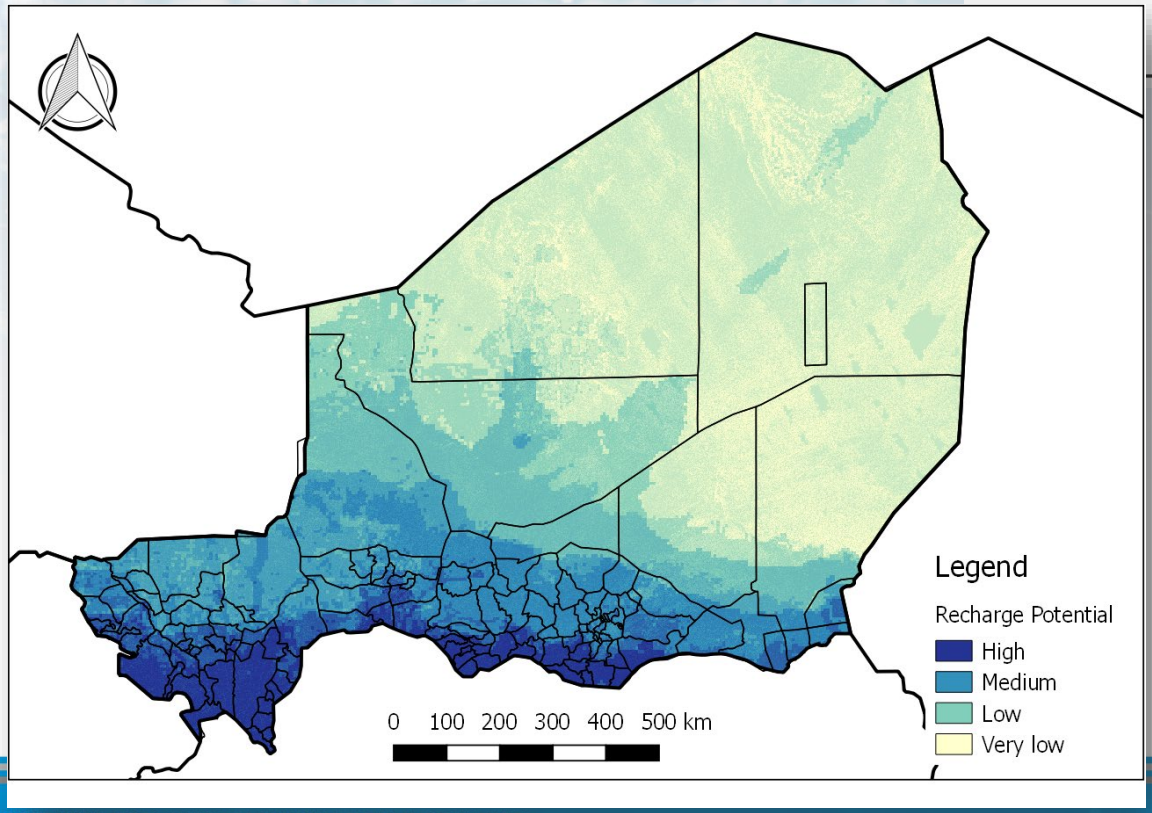
- A very important determining factor in groundwater (non-)availability is the capacity of the subsurface, or the aquifers, to produce water
- Here, this is determined from a combination of recharge potential (R) and the inherent aquifer productivity (A)



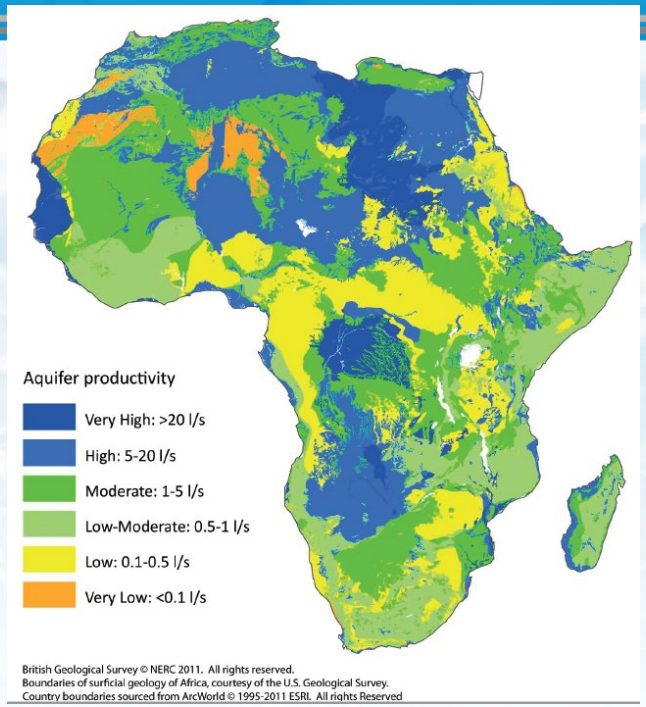
Recharge potential

- Recharge occurs in a distributed sense due to direct infiltration from net rainfall and influenced by vegetation cover, topography, and soil properties

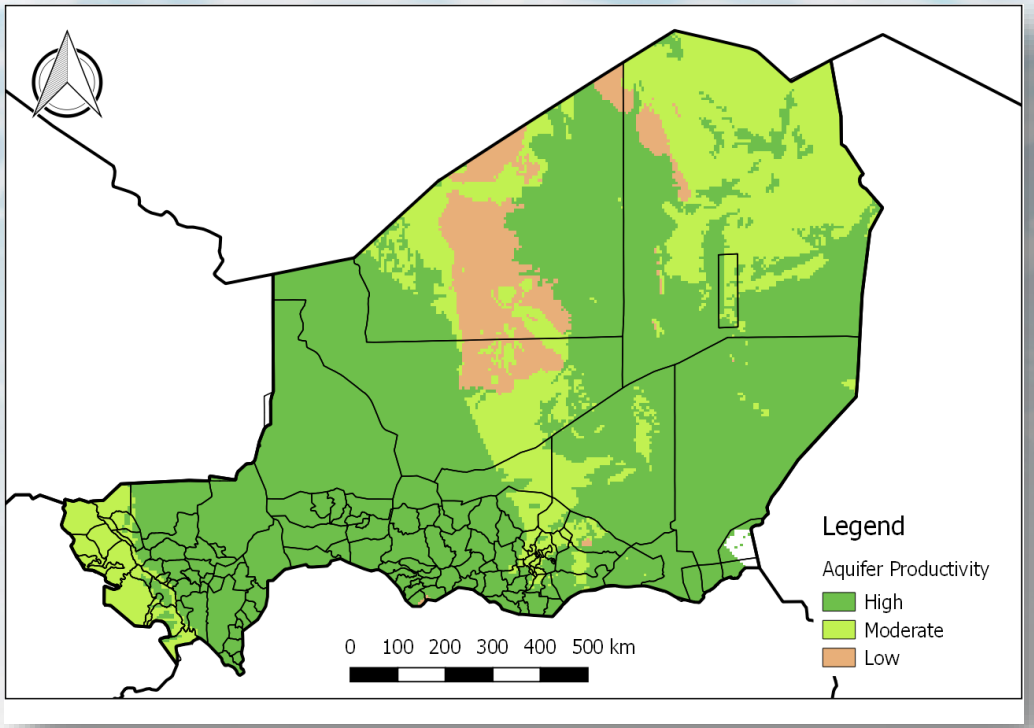
Recharge factor, r_i	Reclassification [a]		Weight
Precipitation (mm/year)	<100	0[b]	0.5
	100–249	1	
	250–499	2	
	500–999	3	
	1,000–1,499	4	
	≥1,500	5	
NDVI[c]	<0.1.99	1	0.35
	0. 2–0.39	2	
	0.4–0.49	3	
	0.5–0.59	4	
	≥0.6	5	
Slope (degrees)	<2.49	5	0.15
	2.5–4.99	4	
	5–7.49	3	
	7.5–9.99	2	
	≥10	1	



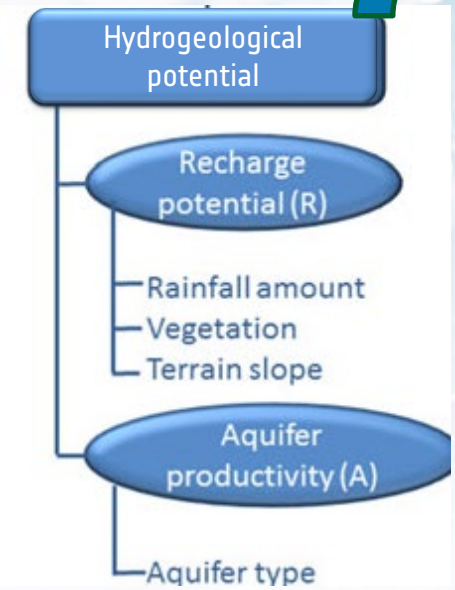
Aquifer productivity

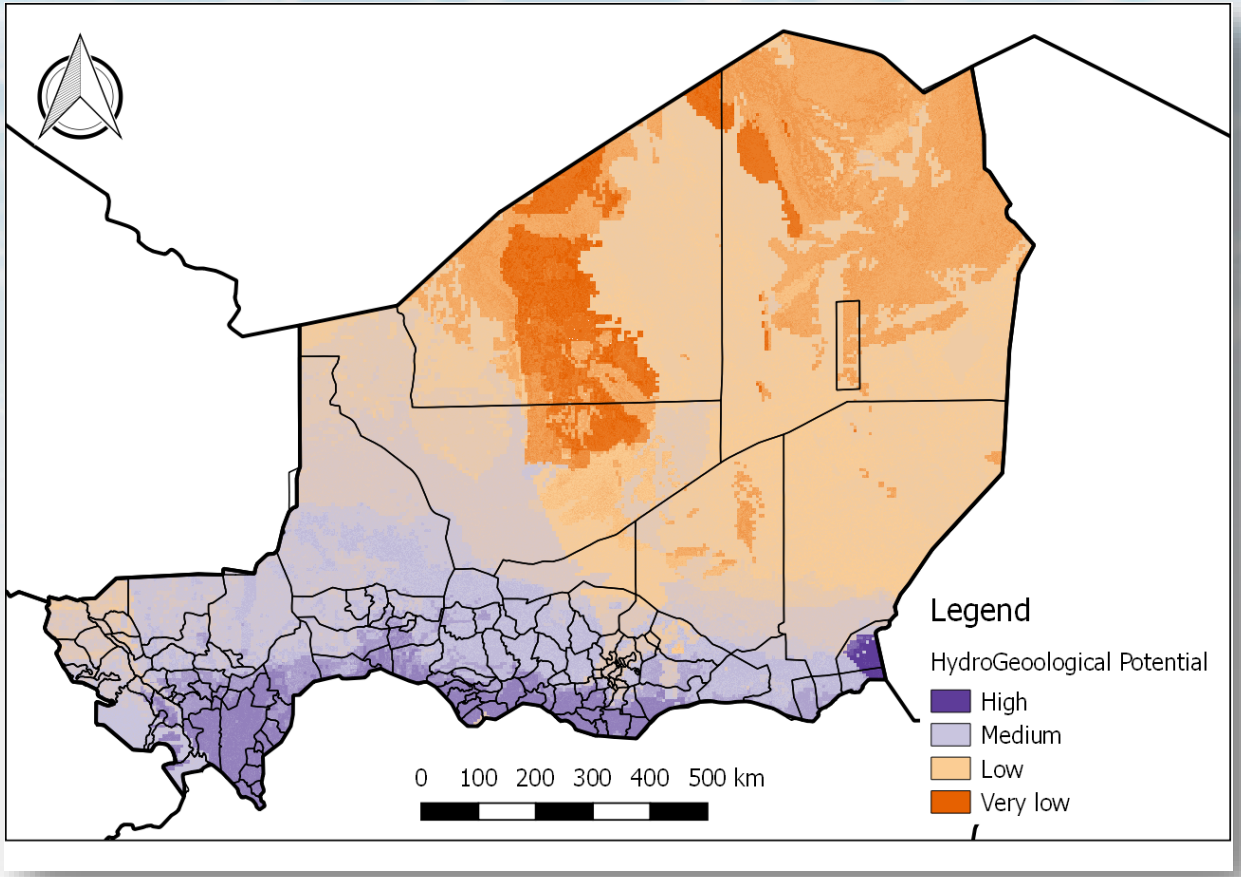


British Geological Survey



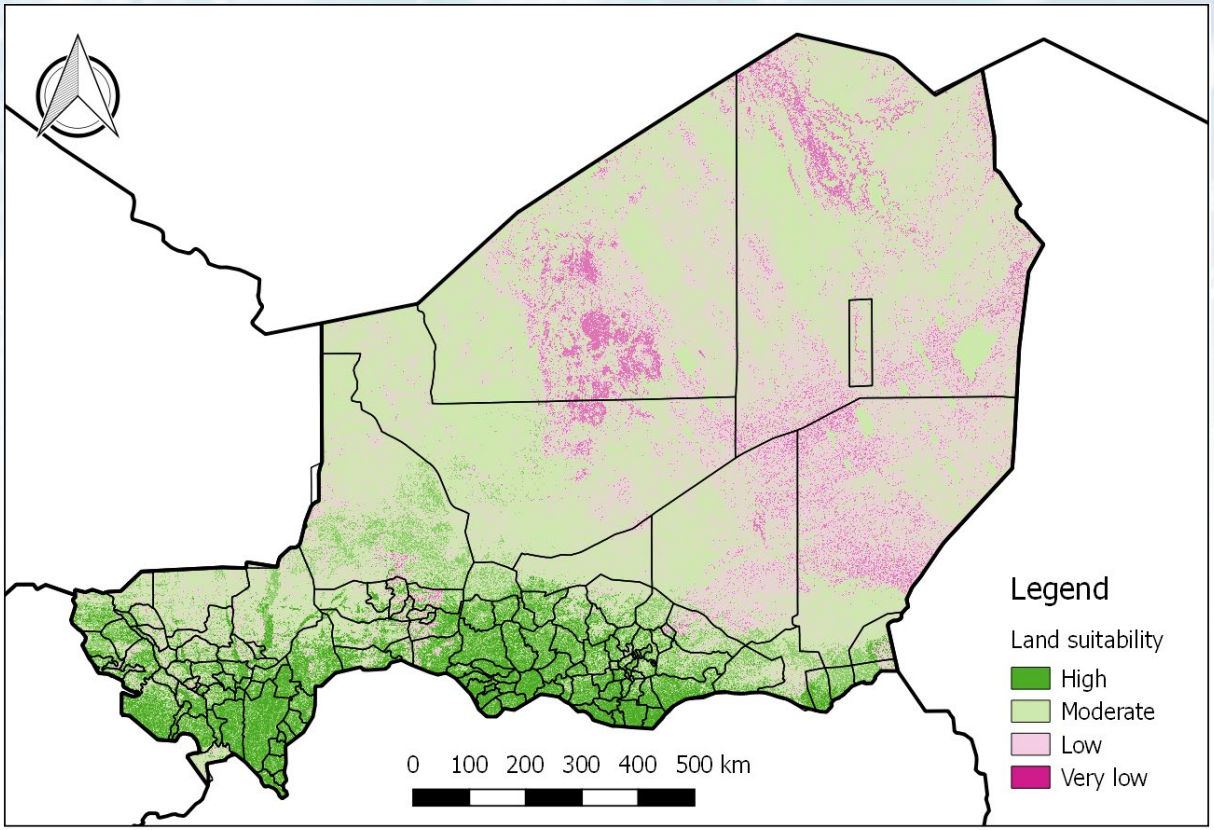
Hydrogeological potential



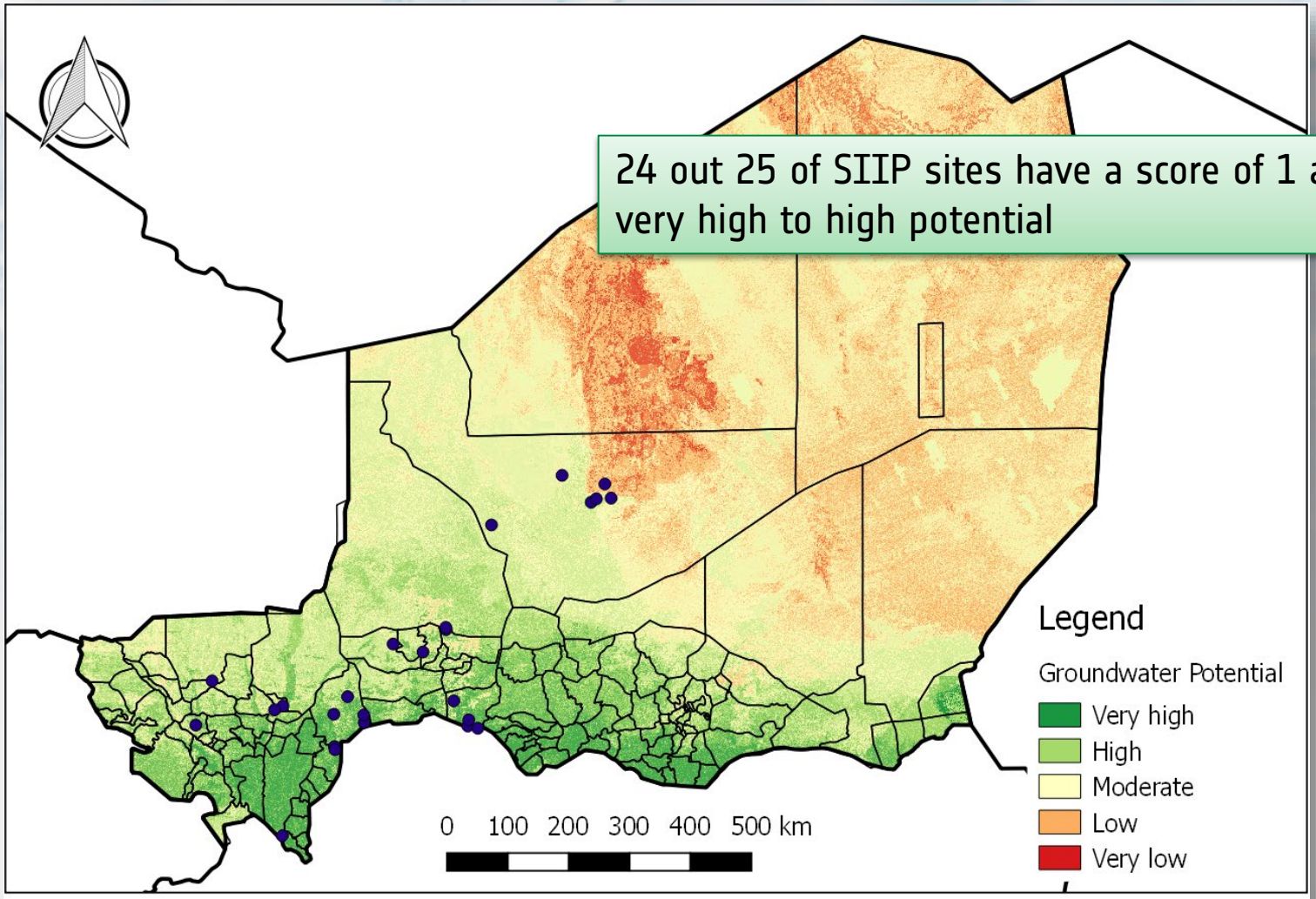


Land suitability

Class
Class S1: Highly suitable
Class S2: Moderately suitable
Class S3: Marginally suitable
Class S4 (N1): Currently not suitable



Hydrogeological potential



Roll-out results– with more factors

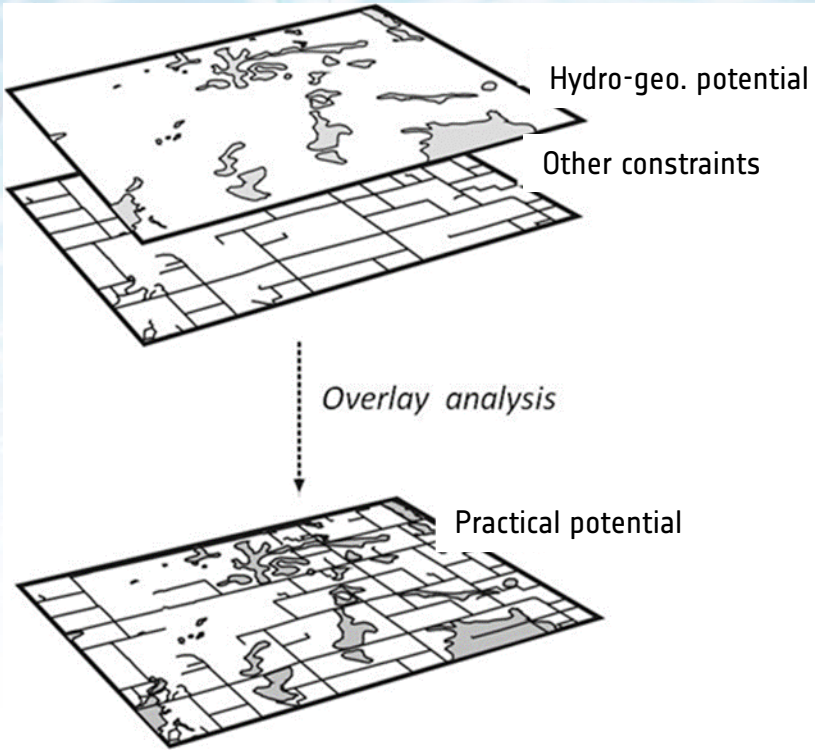
- Theoretical potential

  -> Bio-physical factors only

- Practical potential

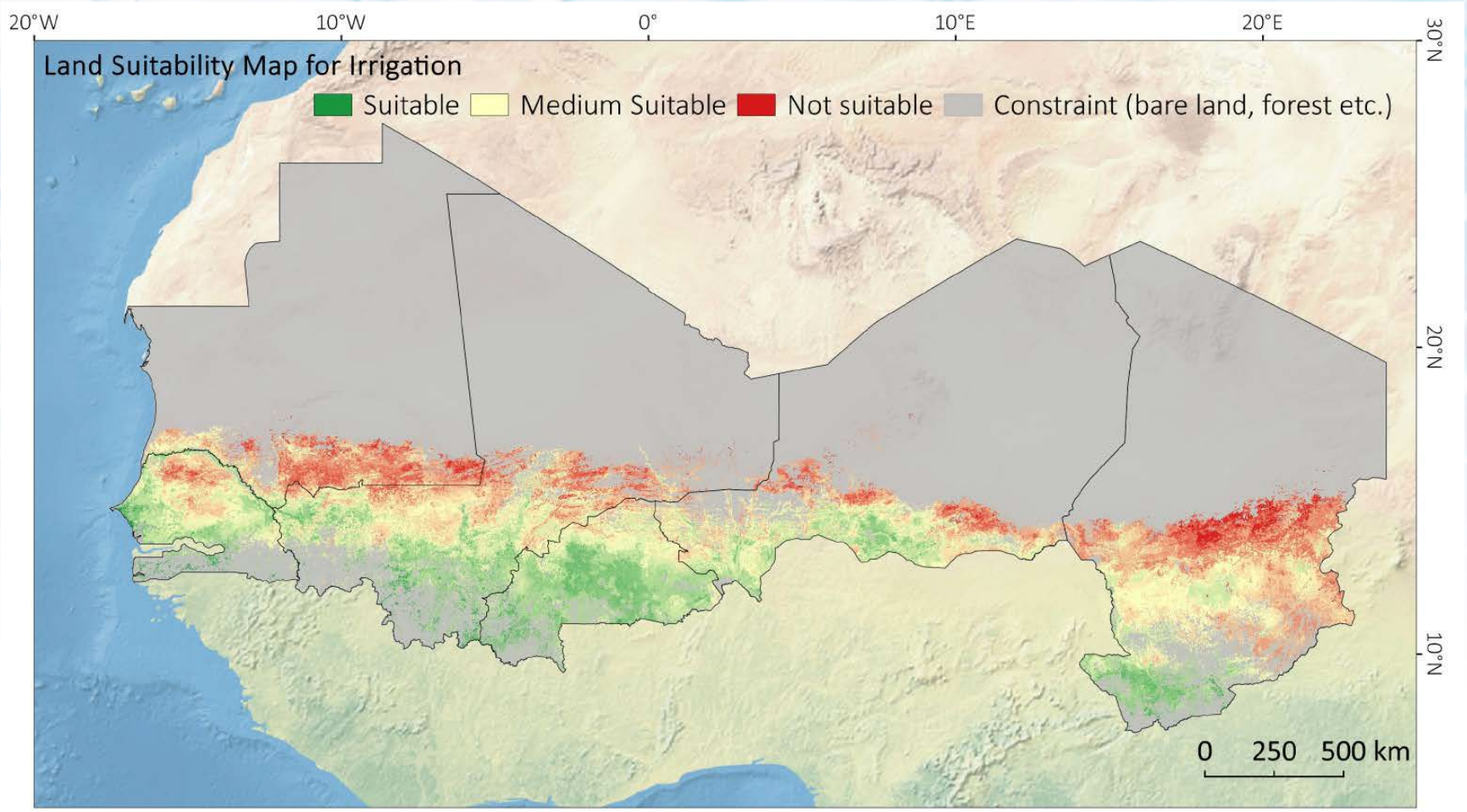
  -> Include socio-demographic factors as well

  - Population distribution
  - Infrastructure
  - Conservation areas



Groundwater potential

A first line assessment tool for groundwater development



(Source: DHI GRAS/EO4SD)

Impacts and benefits

- Benefits
  - A cost-effective first-line assessment tool to give decision makers and practioners a good initial indicator of where to focus further investigations
- Impacts
  - Serve as input for the political discourse on ground water exploration
  - Cells that show higher (Physical) Groundwater potential could be potential areas where to focus the efforts on groundwater development, and vice versa

Watershed vulnerability, Lao PDR

Sustainable Rural Infrastructure and Watershed Management Project (Lao PDR)

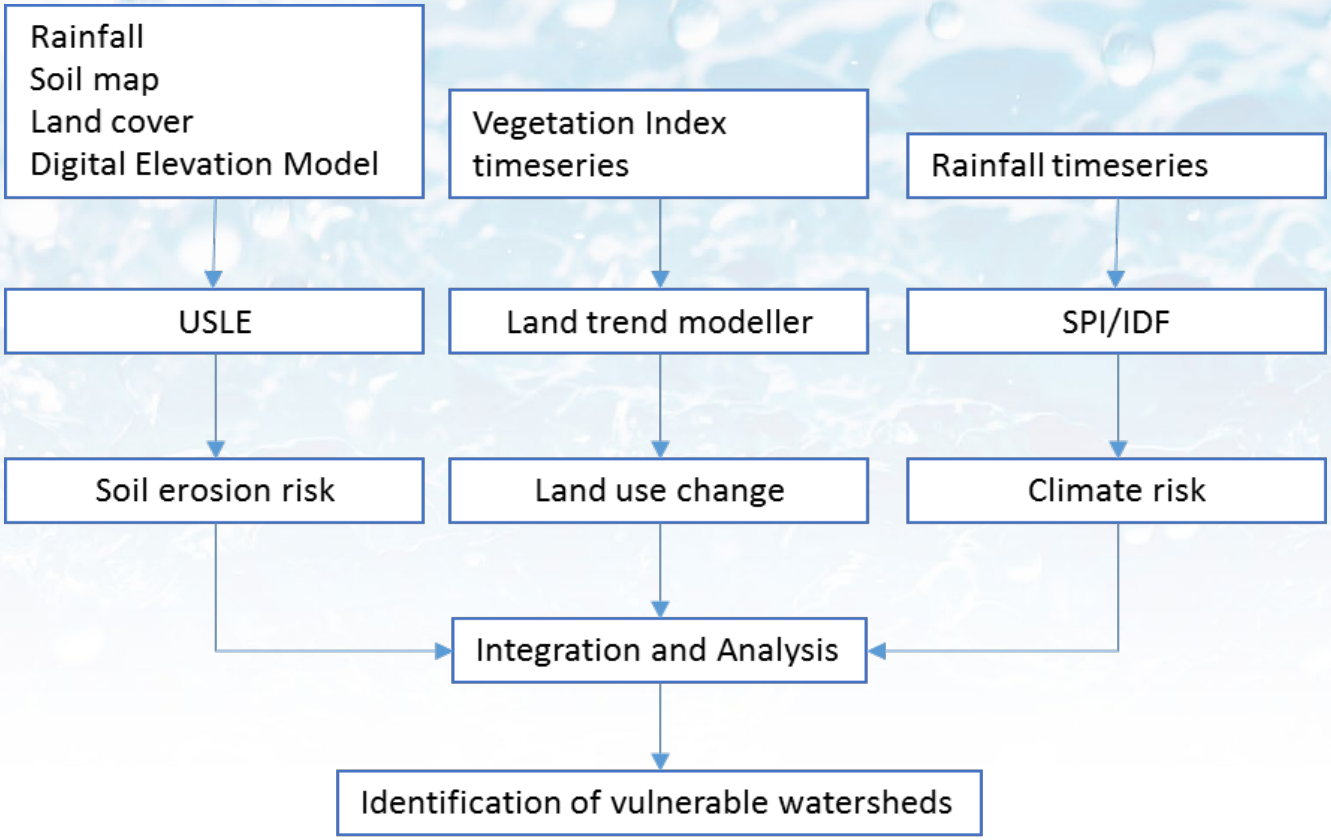
- Sustainable rural development is a major challenge for Lao PDR and agriculture is expected to contribute substantially to economic growth over the next decade
- Watershed health is critical for agricultural production
- Deforestation, Watershed degradation and effects of climate change will lead to an increase in hydro-meteorological driven damage and destruction
  - Need for EO services to better understand the bio-physical risks and their spatial distribution

-> The project needs to know which watersheds are prone to degradation and where investments in PRI should be prioritized

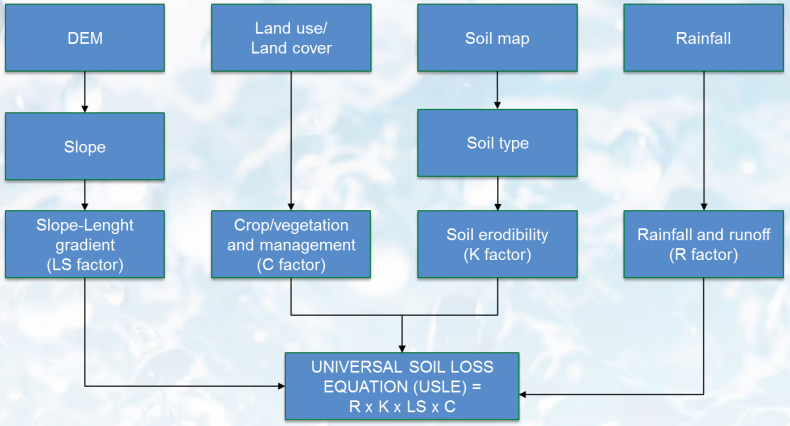
Integrated Climate and Watershed Vulnerability Analysis

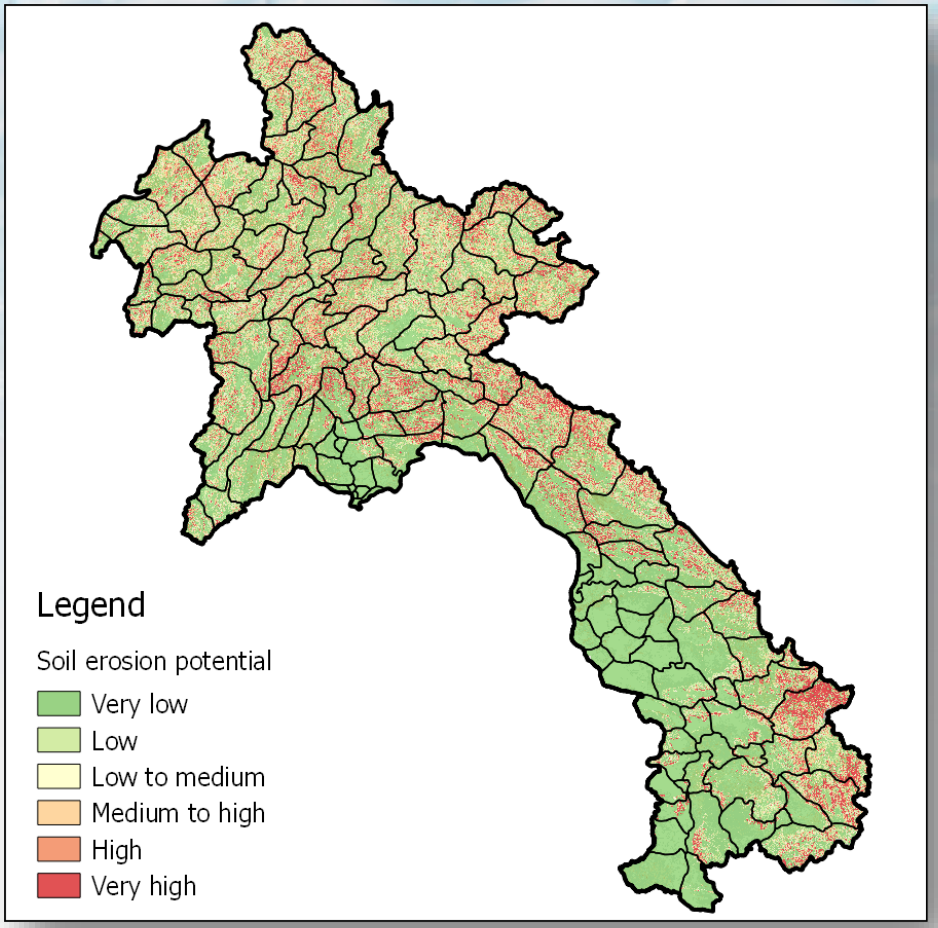
- **Content**
  - Provide a large area climate and watershed vulnerability analysis to support planning and prioritization of watershed development (e.g. irrigation) at the national/regional level
- **Geographic coverage**
  - Northern and Central parts of Lao PDR
- **Temporal resolution**
  - Most recent
- **Spatial resolution**
  - Blend (30 m -> 5 km)
- **Input (EO) data**
  - Multiple Earth Observation data sources providing information on rainfall, topography, land cover and vegetation changes

Method

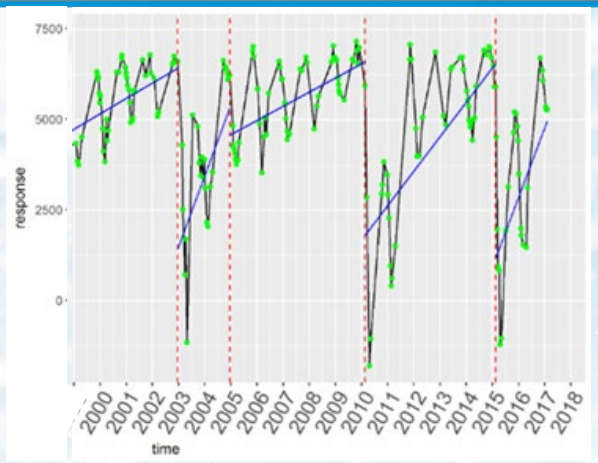

Rainfall
Soil map
Land cover
Digital Elevation Model
Vegetation Index timeseries
Rainfall timeseries
USLE
Land trend modeller
SPI/IDF
Soil erosion risk
Land use change
Climate risk
Integration and Analysis
Identification of vulnerable watersheds

Soil erosion

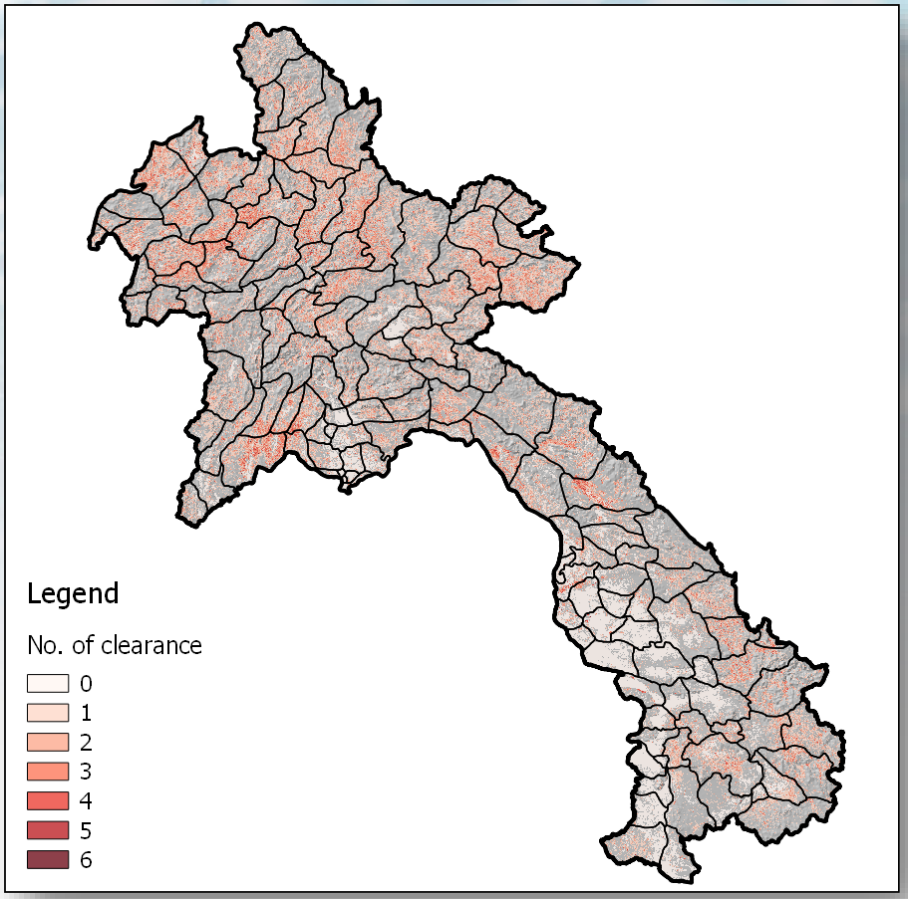




Vegetation index trend analysis



MODIS NDVI time series analyses



Weighted mapping 2000-2017

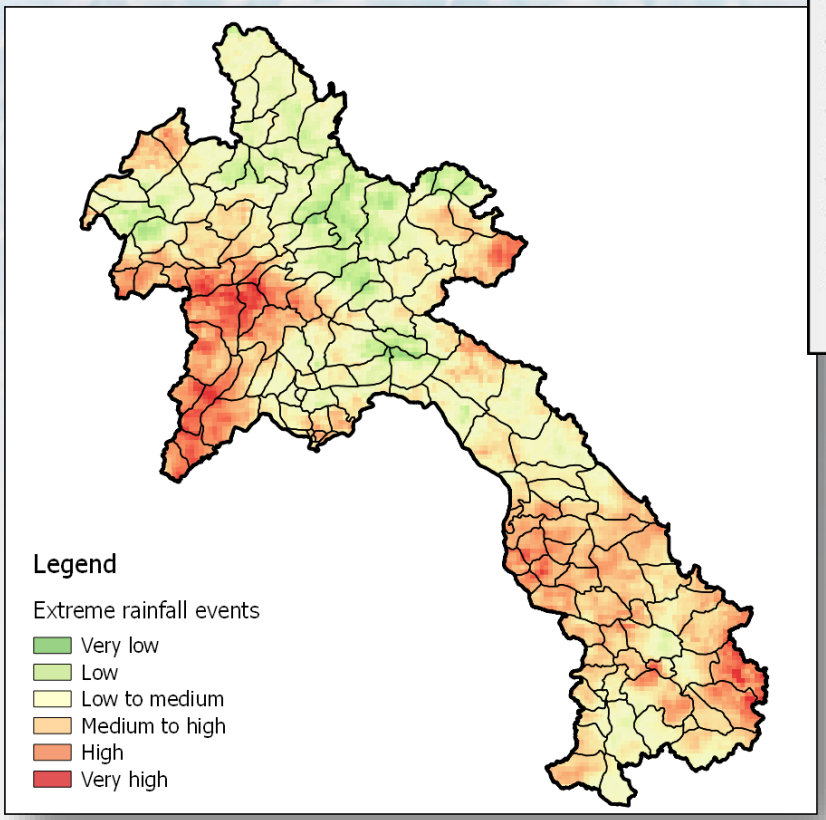
-land clearance number (0.5)

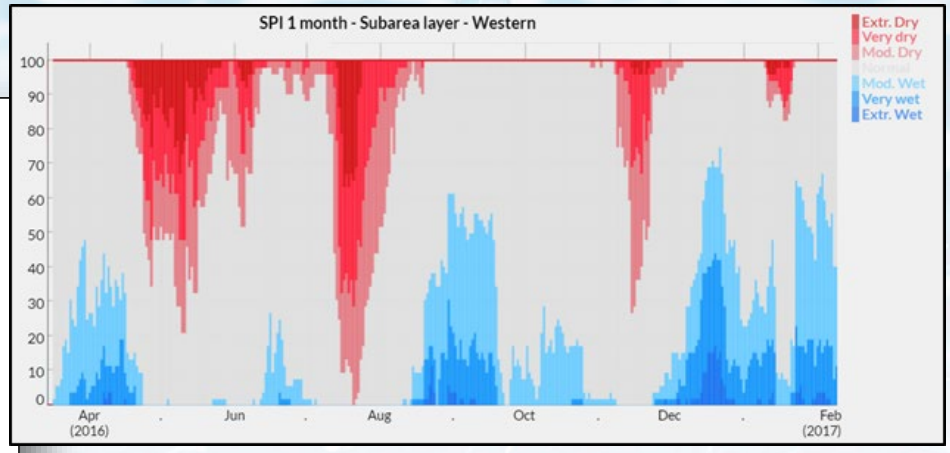
-significant NDVI trend (0.25)

-Hansen tree loss map (0.25)

Rainfall timeseries

- Identify watersheds susceptible to extreme rainfall events

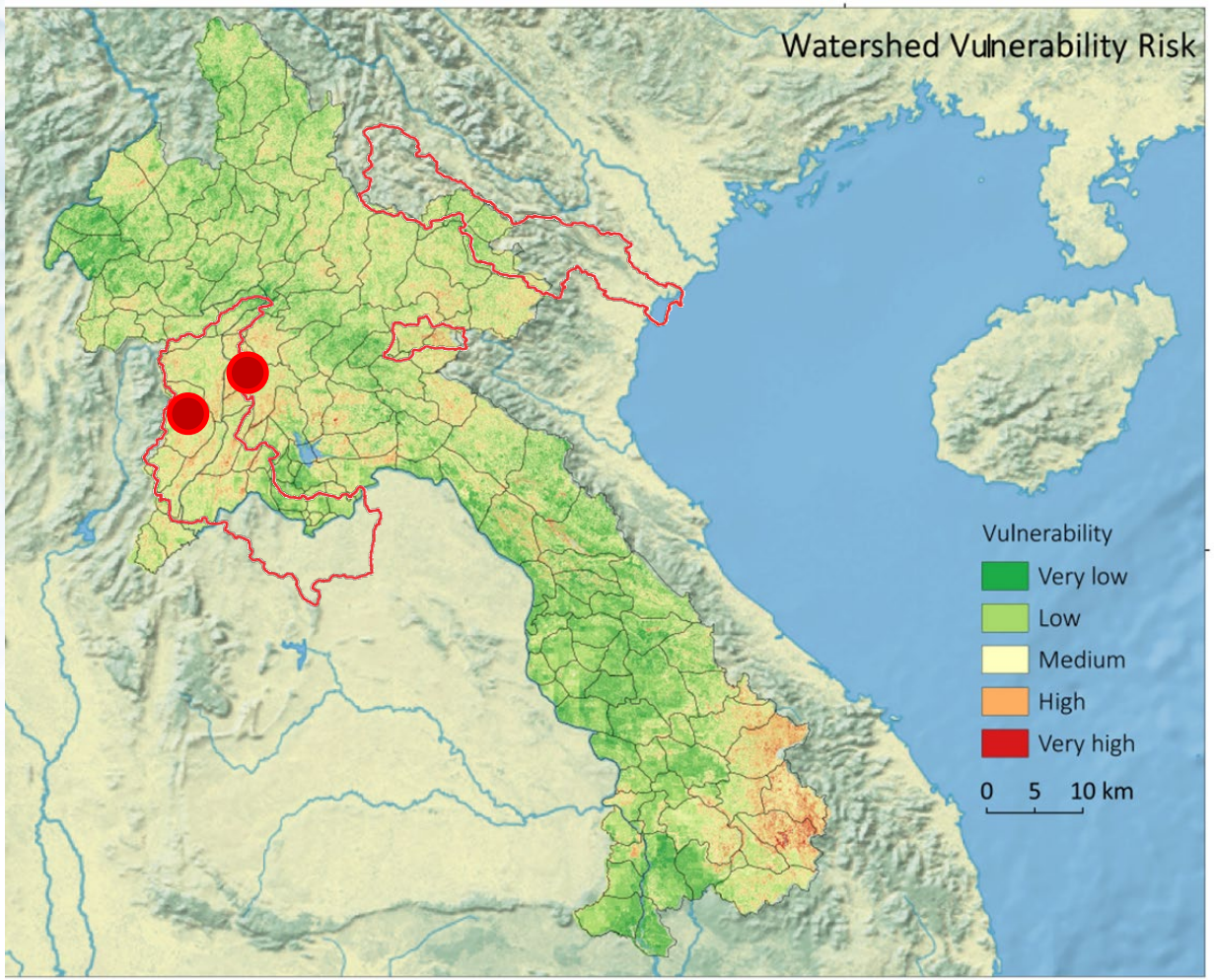




The Standardized Precipitation Index (SPI) is a widely used index to characterize unusually wet and dry conditions

Indicator: 6-month SPI
-status: count of dry/wet anomaly
-change: trend of annual dry/wet anomaly count
Weighted mapping from status (0.5) and change (0.5)

Watershed vulnerability:
(soil erosion + vegetation change + rainfall extremes)



- First-line assessment tool for obtaining a national overview and as an initial indicator for interventions and investments in PRI to improve agriculture efficiency

Previous Case Studies

- Vulnerability mapping of Cape Verde in order to identify (i) erosion risk areas; (ii) location of drought prone areas and (iii) their interaction with extent of irrigation.

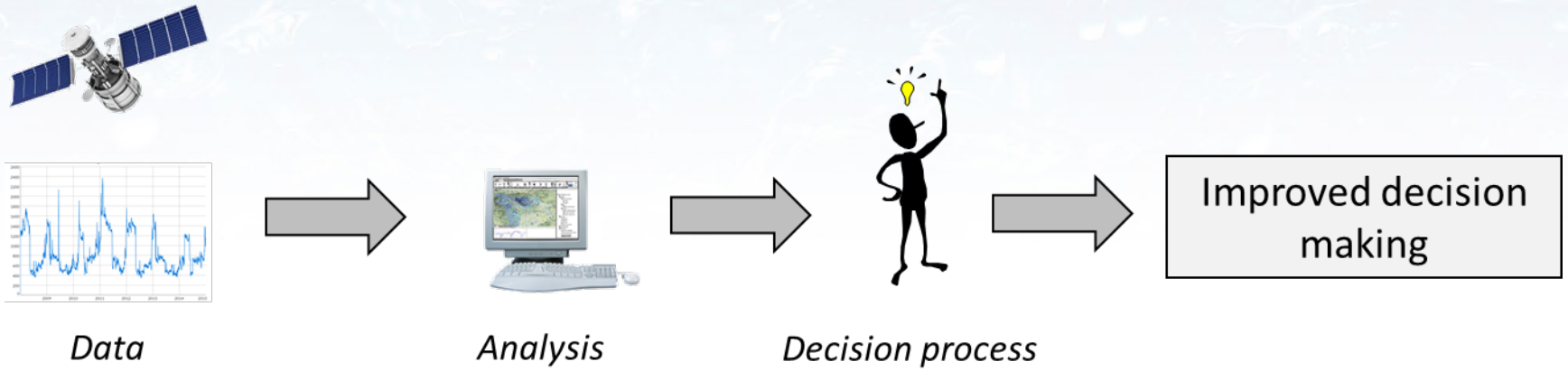
- *used to target interventions by identifying vulnerable islands*
- *2 out of 10 was selected*
- ***objective and transparent decision process!***

Flood & Drought portal - demonstration

Flood & Drought Management portal

- Supporting technical activities within flood and drought planning in transboundary basins where base data is often lacking

- Data availability is a key issue in planning
  - Data availability is a key concern in many countries and basins
  - Availability of a “basic” set of data for planning is critical
  - Satellite data should be used to support available station data



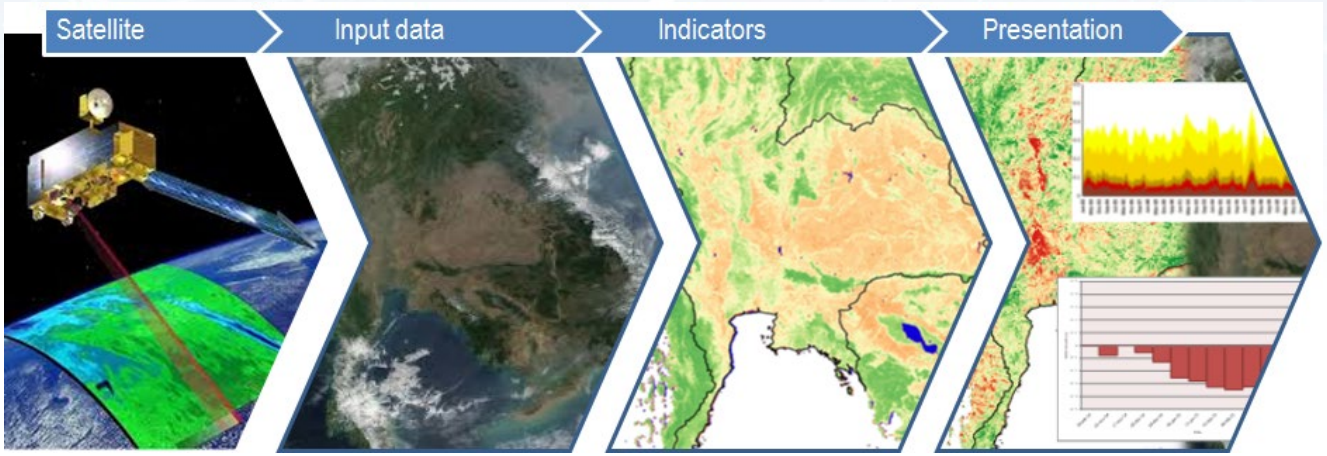
How can Remote sensing data be used?

Why use RS data?

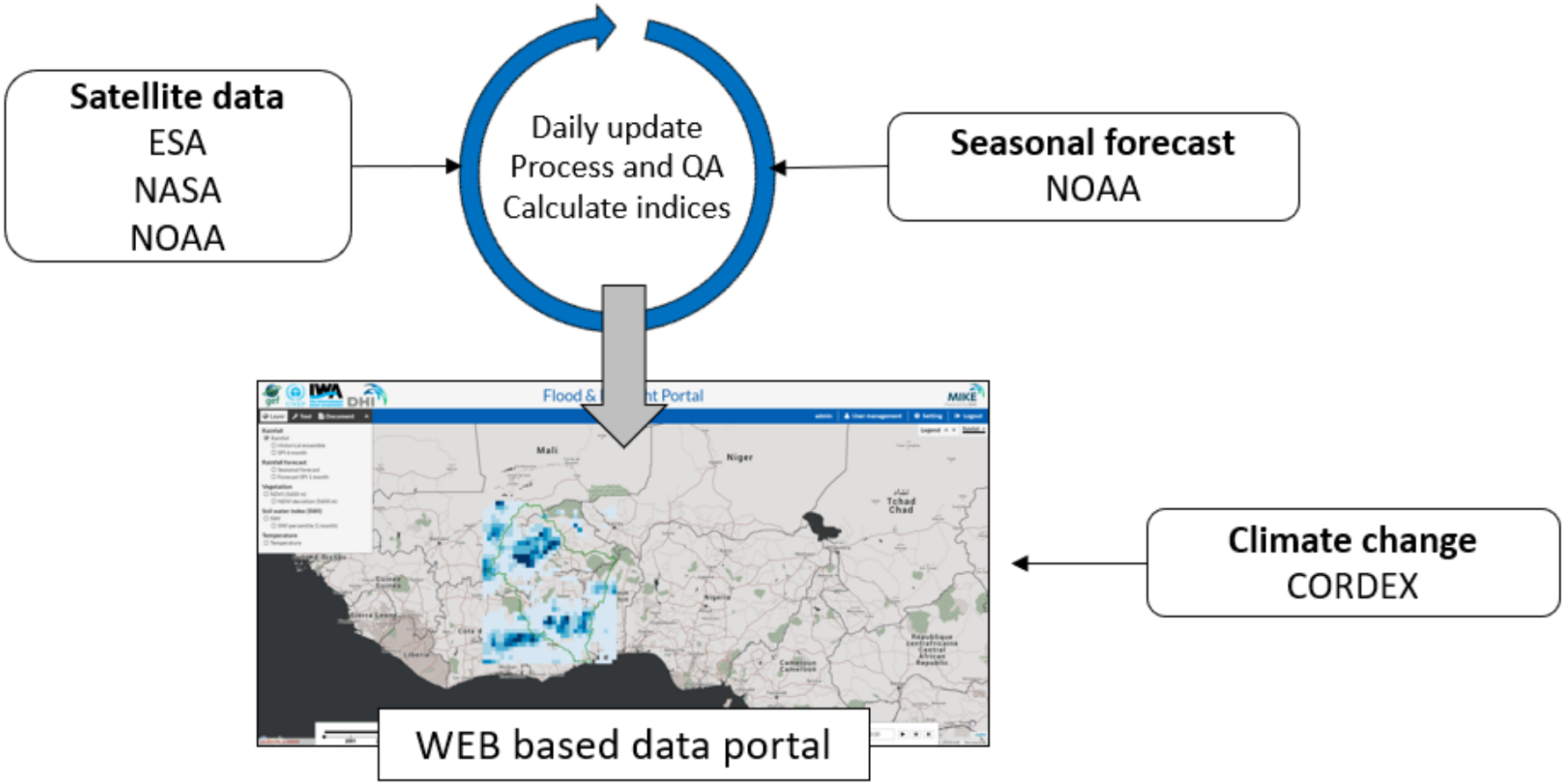
- Global or regional coverage
- Free data available
- Almost available in real time
- Many data sets available for the last 10 to 15 years

Why are RS data not used more often?

- Difficult to identify the data source to use
- Different providers and data locations
- Strange data formats
- Difficult to analyse and use the data



Web portal enabling access to basic data set for planning



Technical overview - Data

Climate data:

- TRMM, CHIRPS, CRU, GPM rainfall
- Temperature and PET

Forecast and climate change

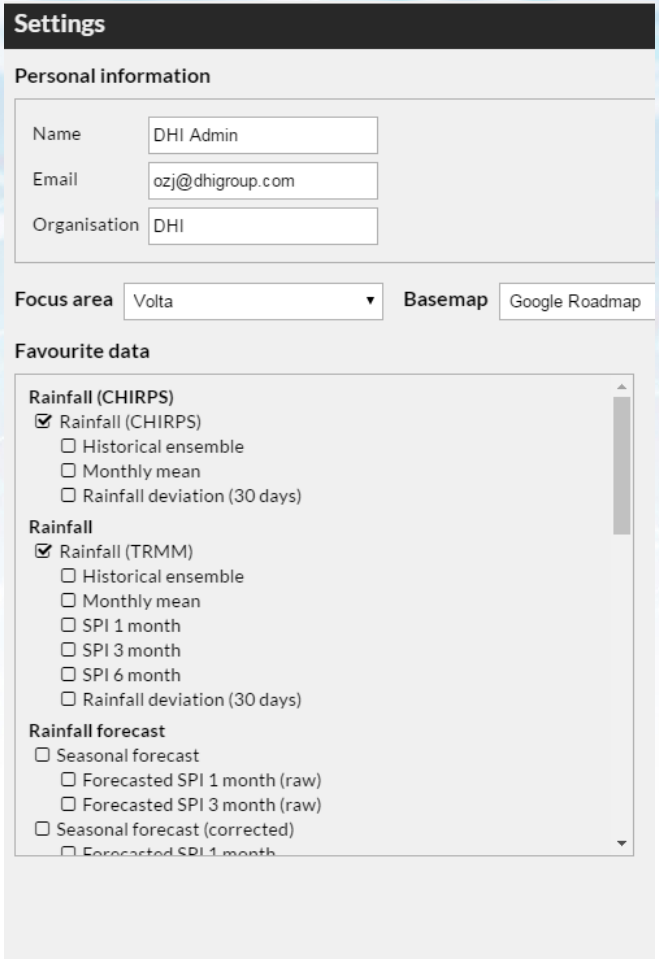
- Seasonal and 2-week forecast
- Climate change (CORDEX)

Vegetation and soil moisture

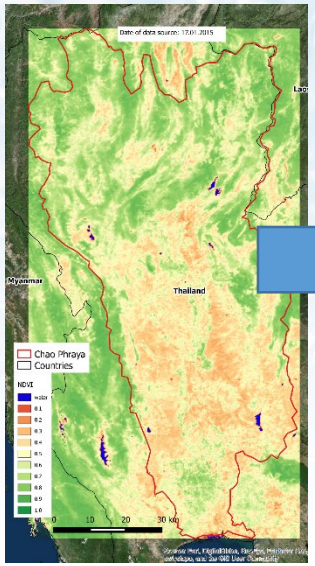
- NDVI
- Soil Water Index

Lakes and reservoirs

- JASON data



Indices are essential for linking data with assessment



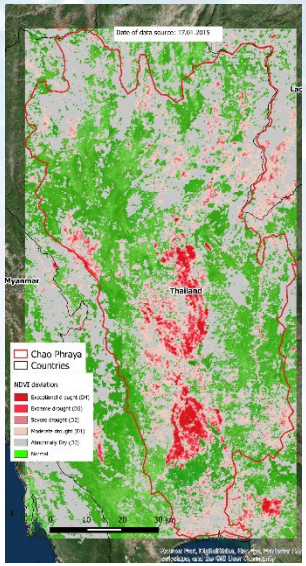
Satellite data

Index

How are the current values compared to the historical values?

Expressed as a deviation, anomaly, percentile etc.

A number of different indices are maintained.



Classification

Summary

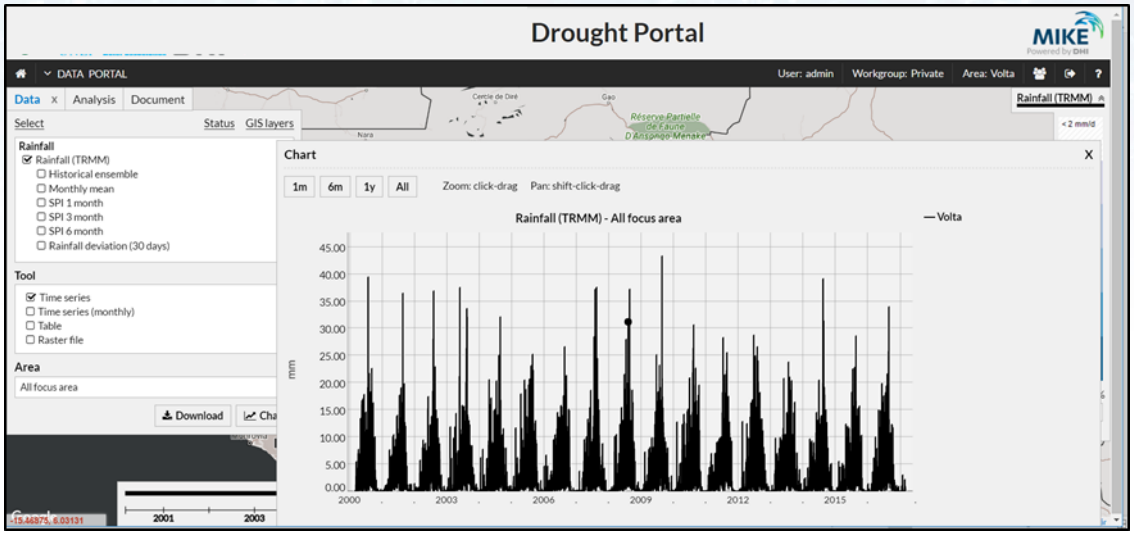
- Daily update of relevant satellite based data sources
- Calculation of relevant drought indices
- Indices available through web based drought portal
- Identify location and severity of drought hazard based on drought indices

Daily update

Download on global scale
QA of data quality

Data processing

Calculate indices
QA and monitor process
Push to web-server

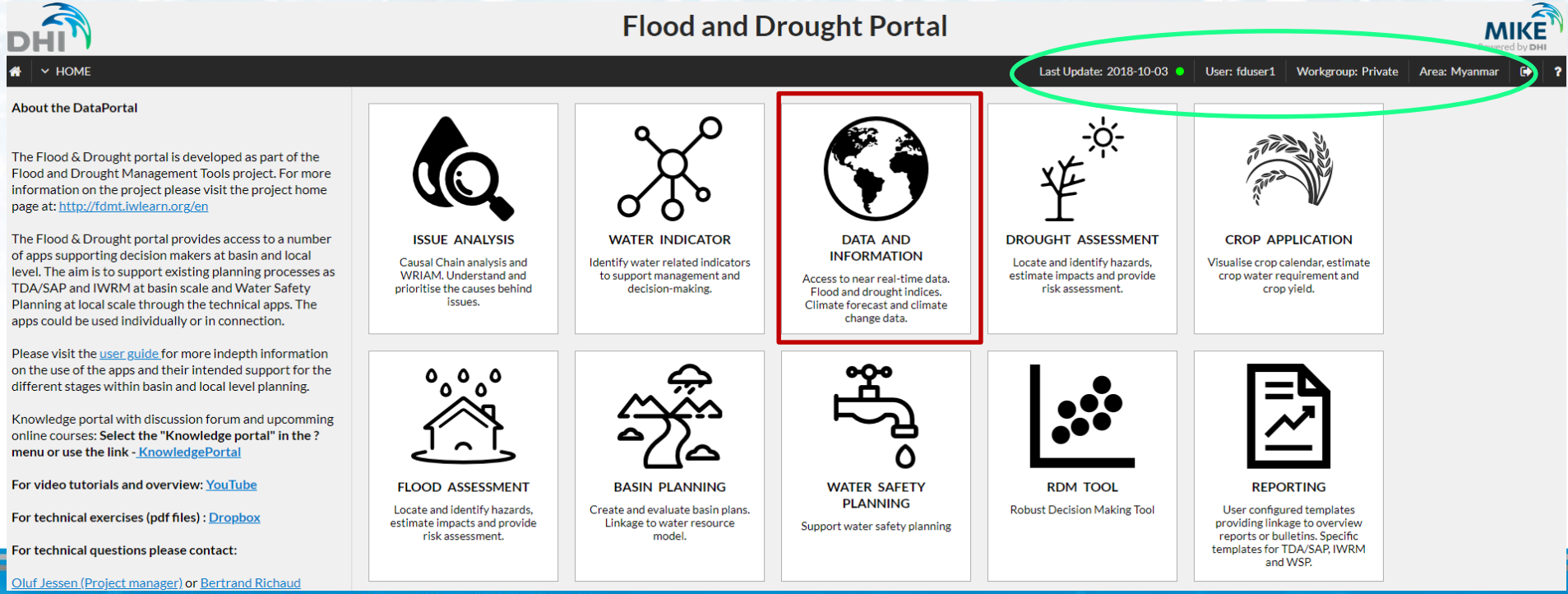


Your turn -> How to Access

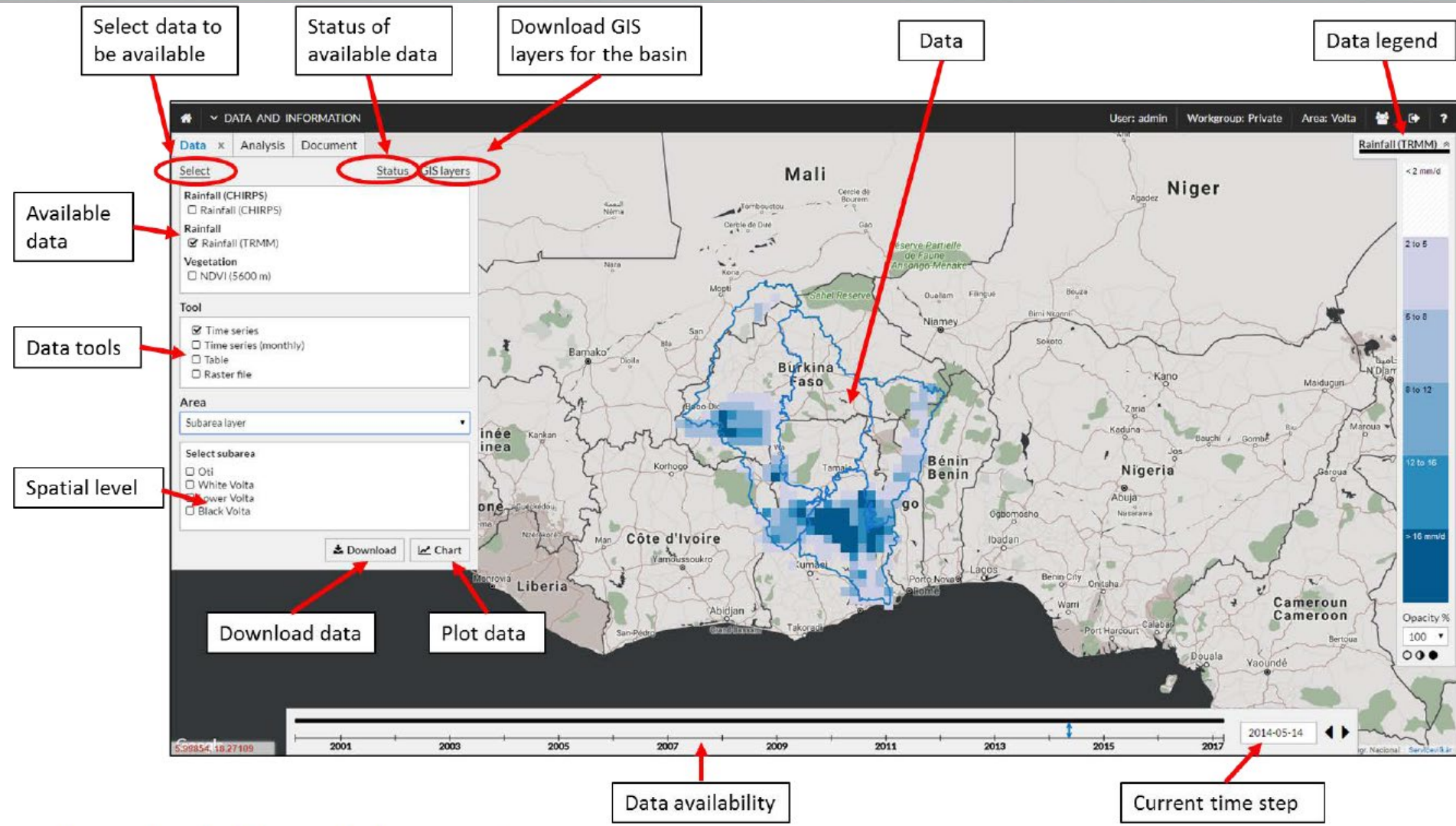
- Open the Flood and Drought portal through: www.flooddroughtmonitor.com and log in:

  Username: fduser1, fduser2, …, fduser15

  Password: dhigras



Basic functionality



Use case examples - Myanmar

- **Flood in Mon region, July 2017**

1. Effective Flood Index (EFI)
2. Time series
3. 2018-07-01 –> no-flood risk
4. 2018-07-30 –> flood risk

- **Drought in Magway region, 2014**

1. Effective Drought Index (EDI)
2. Column chart
3. Subarea layer -> Magway
4. Chart
5. Zoom chart 2014

More information

http://eo4sd-water.net

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