

→ 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



- 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 E04SD 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

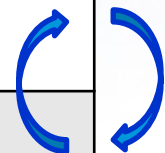


Objective and program



- 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

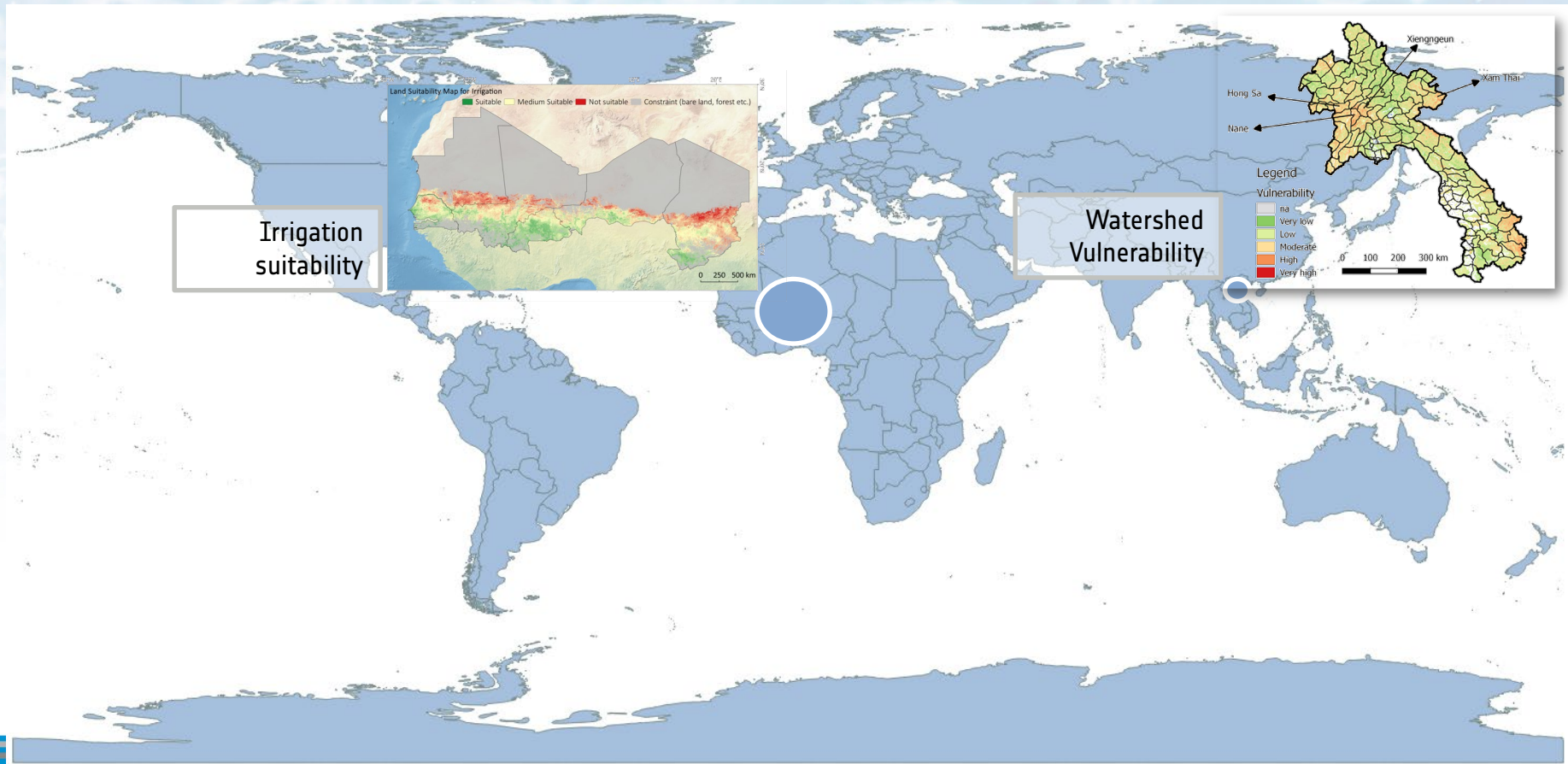
Time	Title	Speaker
10.30 – 11.15	EO in support for project identification/preparation	Christian Tøttrup, DHI GRAS
11.15 – 12.00	Optimize agricultural water use efficiency	Remco Dost, eLEAF
12.00 – 13.30	Lunch	
13.30 – 14.15	Earth Observation for Integrated Water Resource Management and SDG monitoring	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



- 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

- 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

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



A satellite map of the Sahel region, showing a mix of green vegetation, brown and tan arid/semi-arid land, and a large body of water on the left. A semi-transparent dark grey box with a white border is centered over the map, containing the title text.

Groundwater potential, Sahel

■ 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**

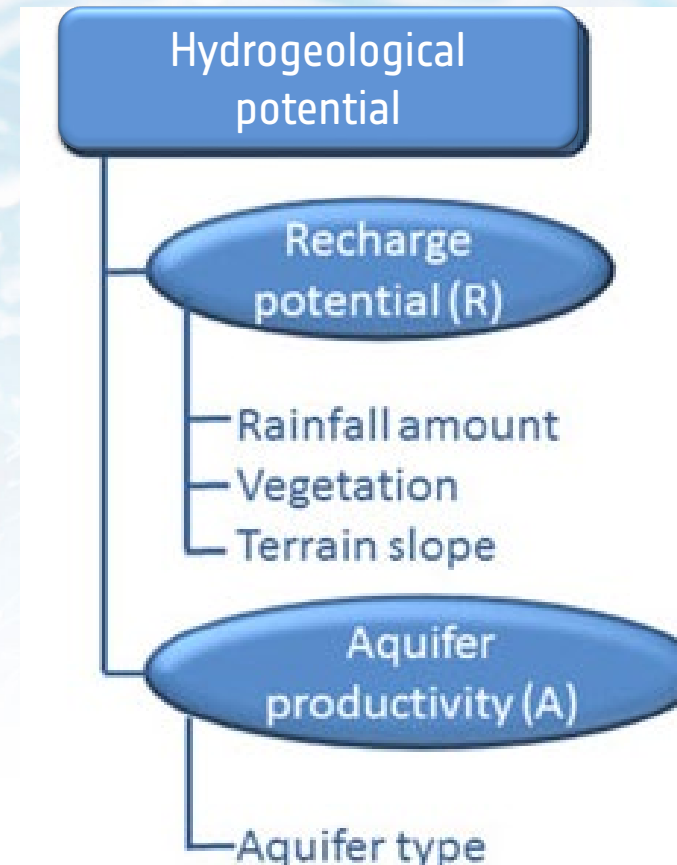


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- Factors that affect the suitability of an area for groundwater irrigation potential include **biophysical** (e.g., climate, soil characteristics, land use type, and topography) and **socio-economic** (e.g., market access such as proximity to a road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

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

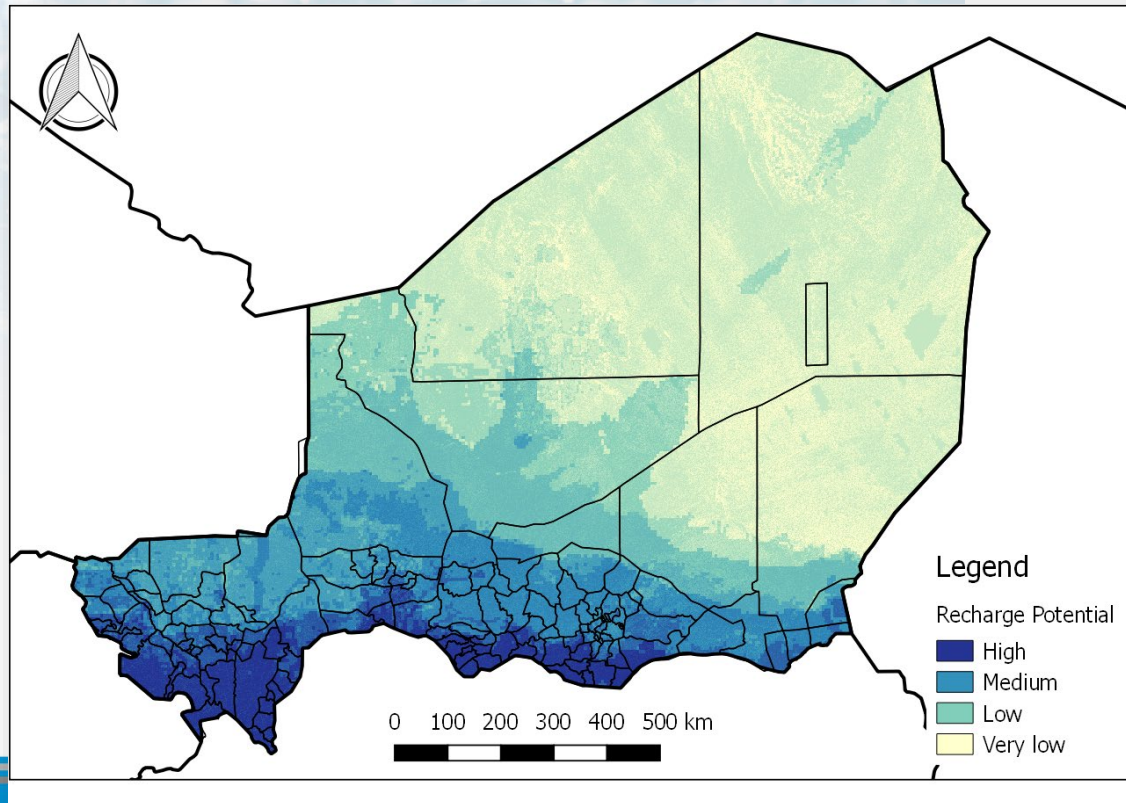
- A very important determining factor in groundwater (non-)availability is the capacity of the subsurface, or the aquifers, to produce water
- Here, this is determined from a combination of recharge potential (R) and the inherent aquifer productivity (A)



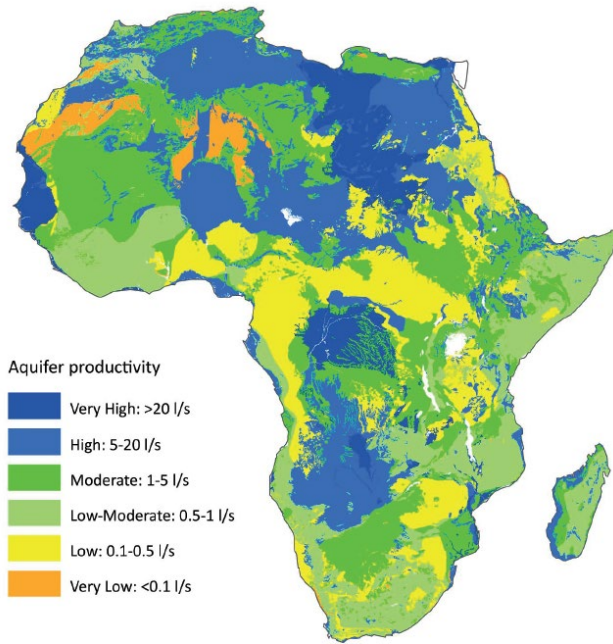
Recharge potential

- 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	
NDVI ^c	≥1,500	5	0.35
	<0.1.99	1	
	0.2–0.39	2	
	0.4–0.49	3	
	0.5–0.59	4	
Slope (degrees)	≥0.6	5	0.15
	<2.49	5	
	2.5–4.99	4	
	5–7.49	3	
	7.5–9.99	2	
	≥10	1	

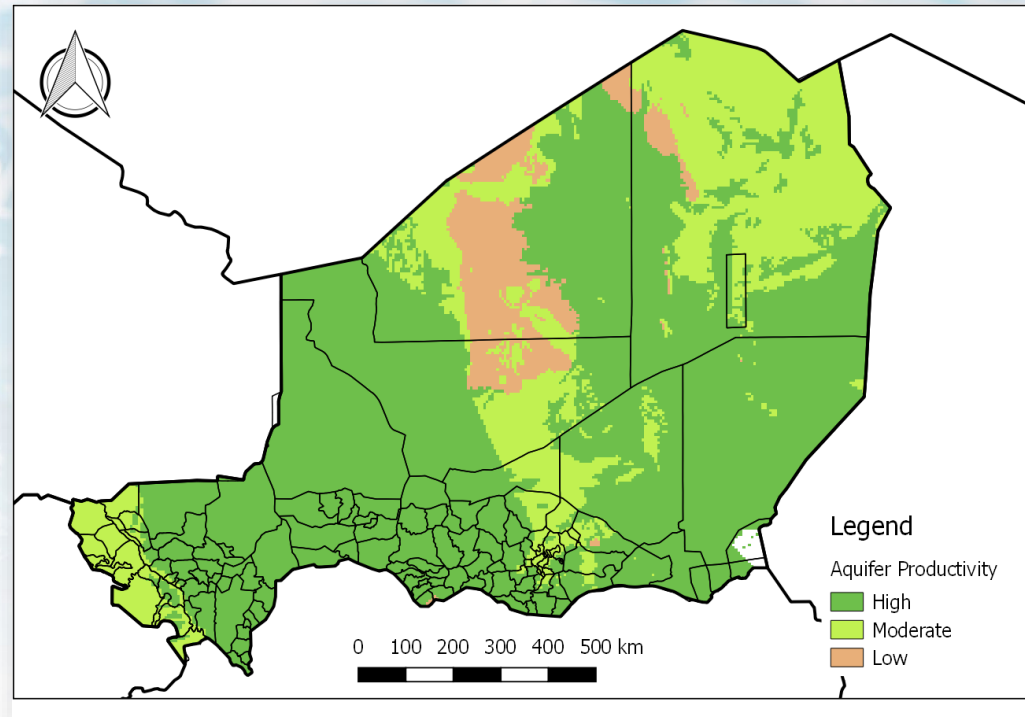


Aquifer productivity

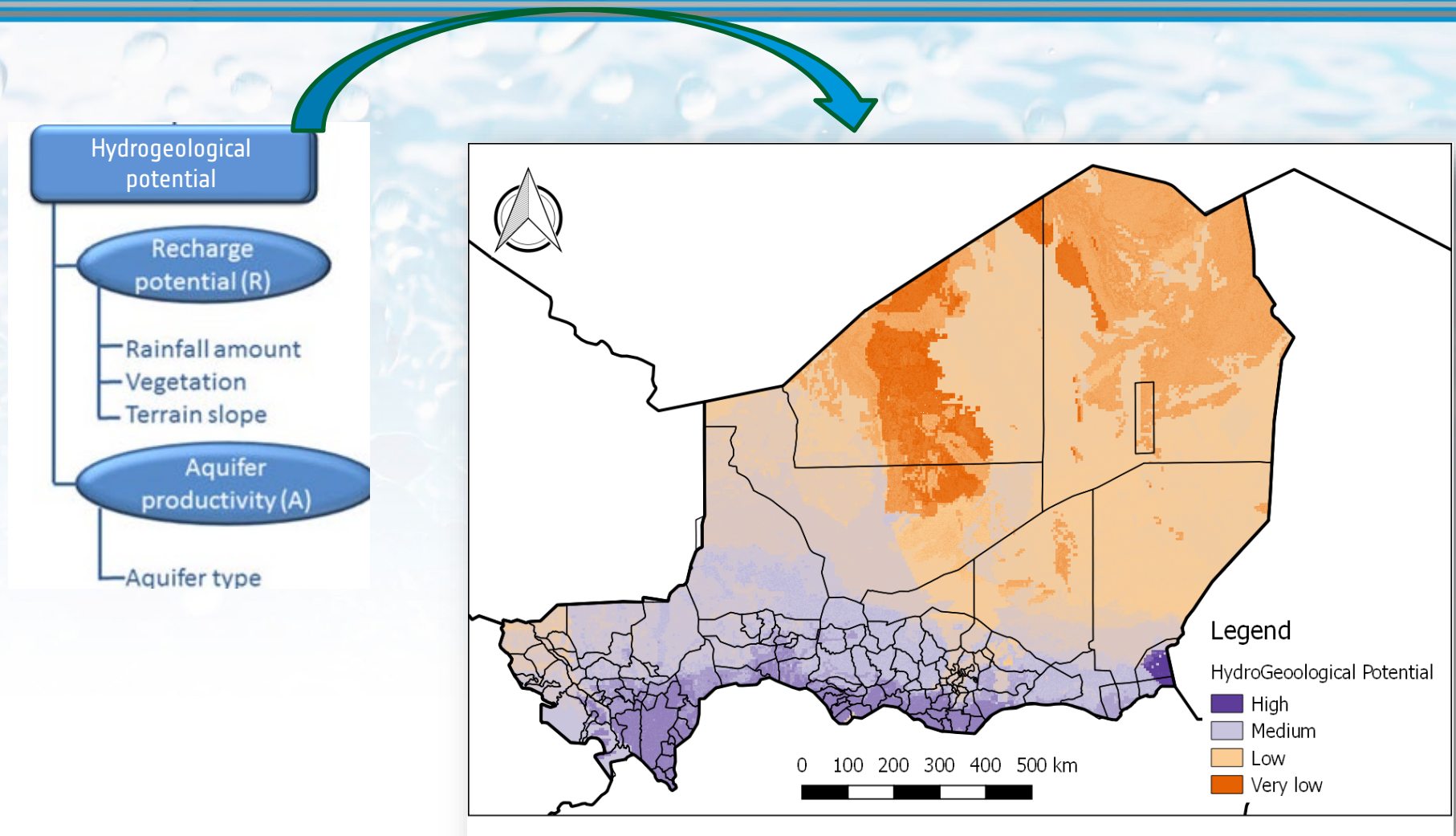


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Boundaries of surficial geology of Africa, courtesy of the U.S. Geological Survey.
Country boundaries sourced from ArcWorld © 1995-2011 ESRI. All rights Reserved

British Geological Survey



Hydrogeological potential



Land suitability

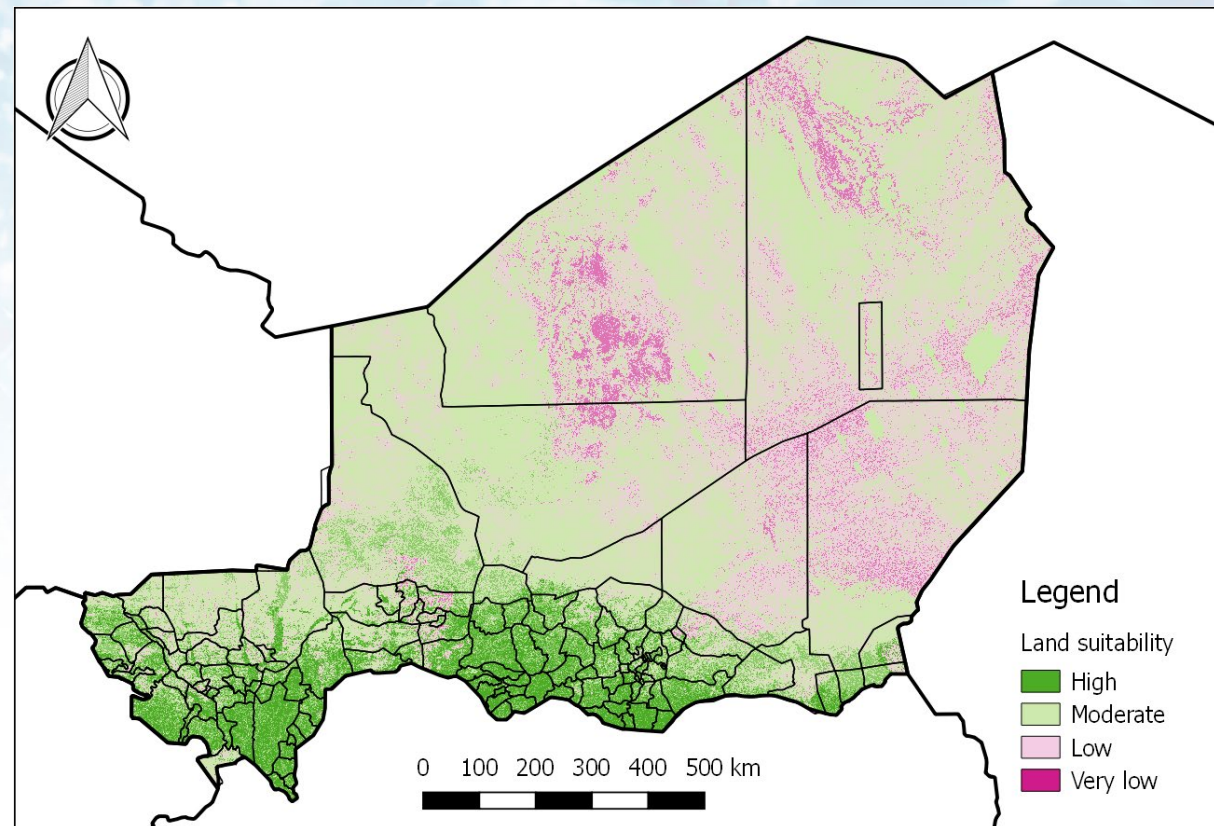
Class

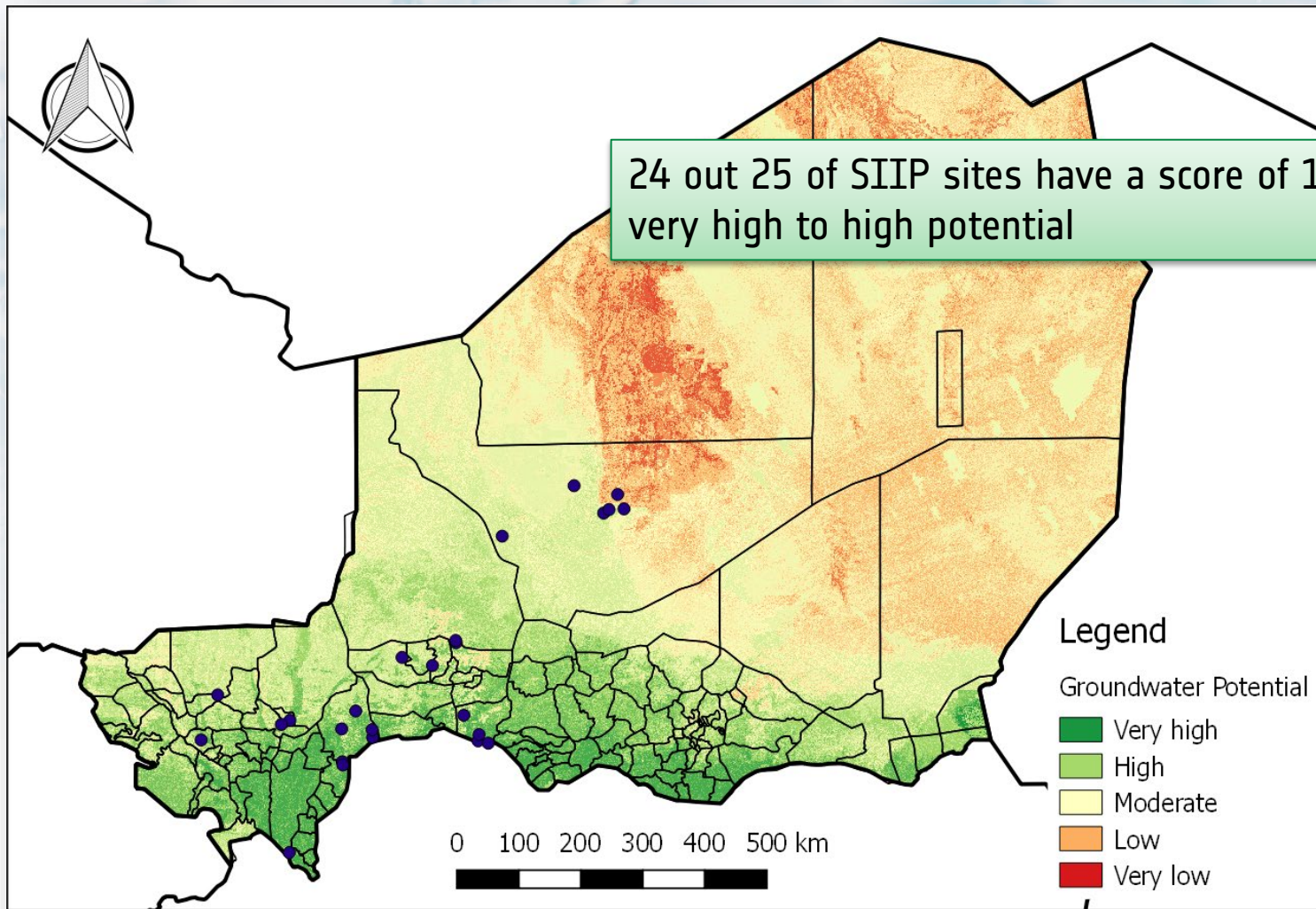
Class S1: Highly suitable

Class S2: Moderately suitable

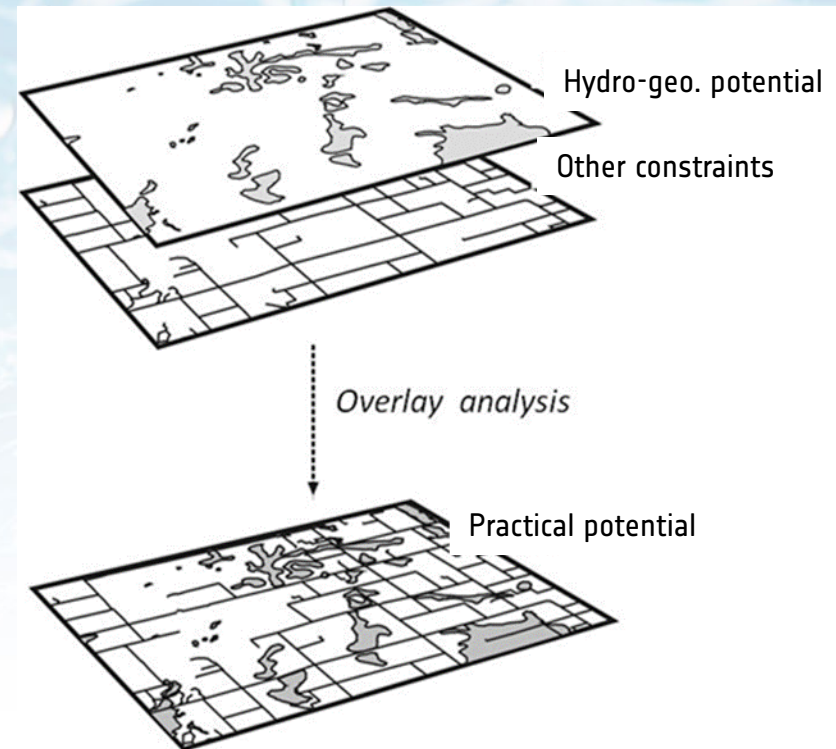
Class S3: Marginally suitable

Class S4 (N1): Currently not suitable



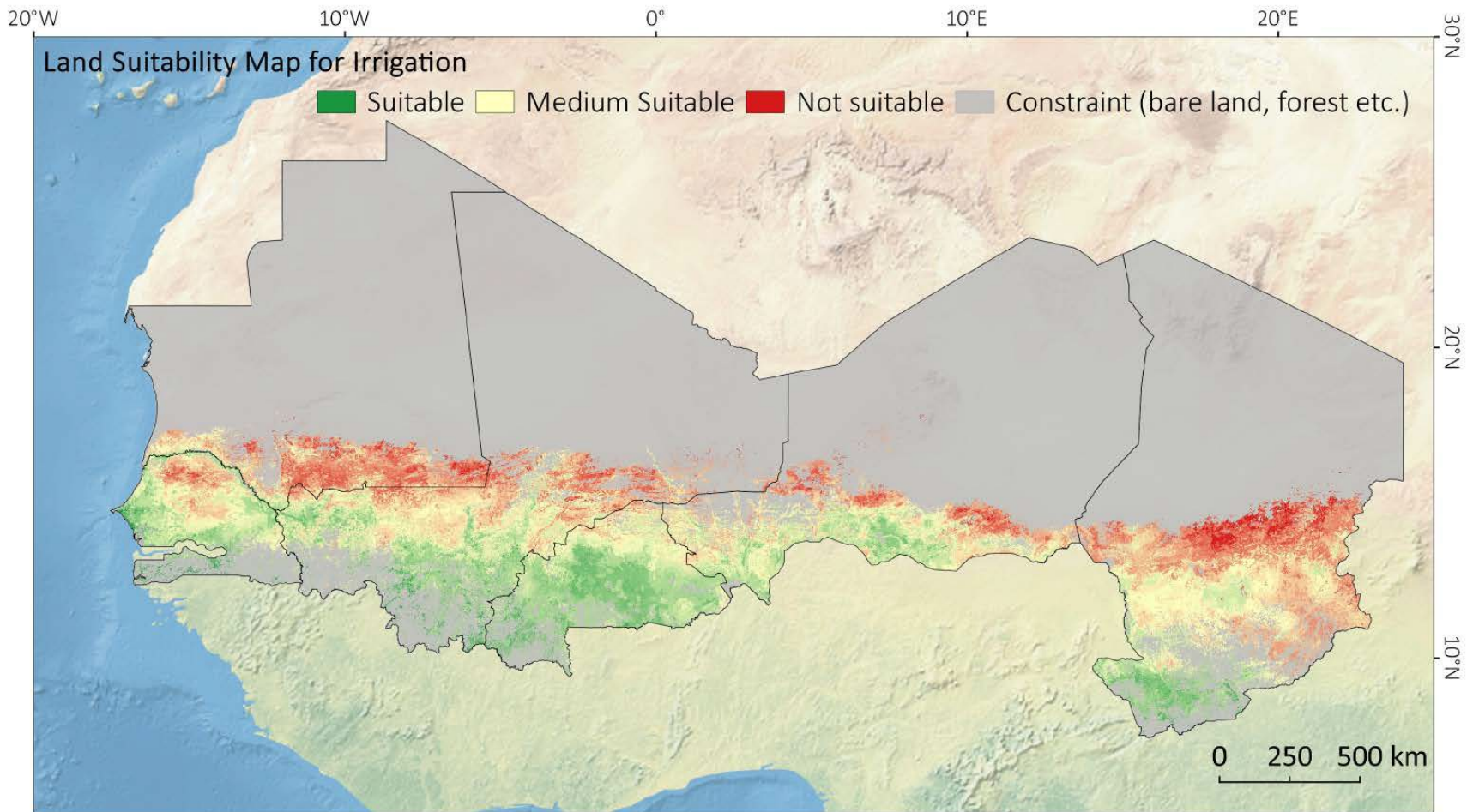


- Theoretical potential
 - > Bio-physical factors only
- Practical potential
 - > Include socio-demographic factors as well
 - Population distribution
 - Infrastructure
 - Conservation areas



Groundwater potential

A first line assessment tool for groundwater development



(Source: DHI GRAS/EO4SD)

- Benefits

- A cost-effective first-line assessment tool to give decision makers and practitioners 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

A satellite map of a watershed in Lao PDR. The map shows a complex network of rivers and streams, with a prominent white river winding through the center. The surrounding land is covered in dense green vegetation, with some areas of brown and tan indicating different land uses or vegetation types. The map is overlaid with a semi-transparent dark grey box containing the title.

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**

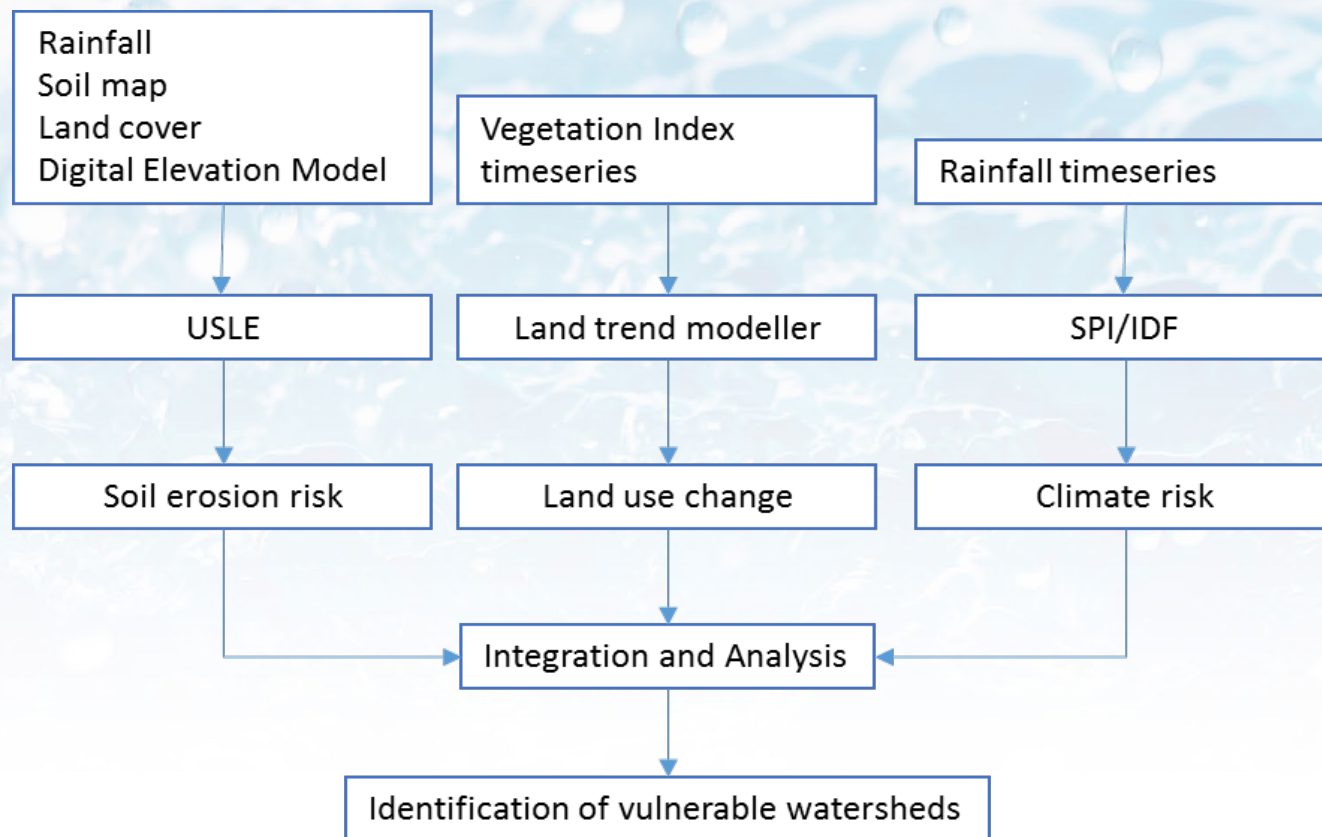
- Most recent

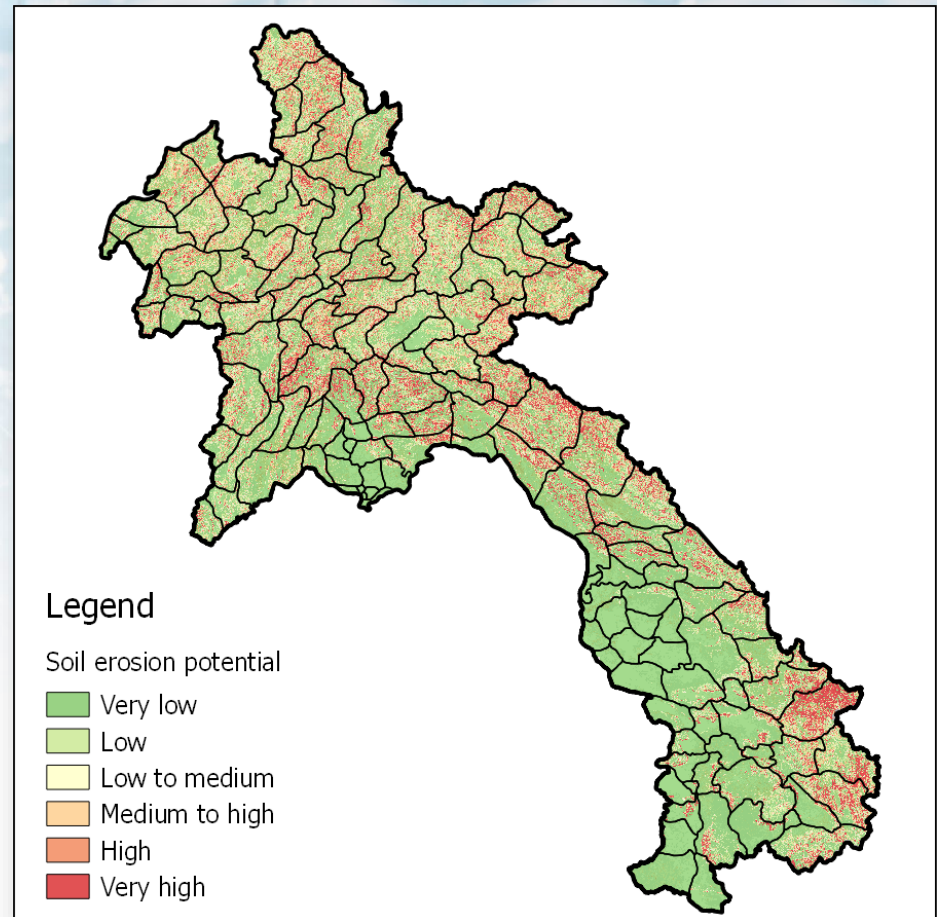
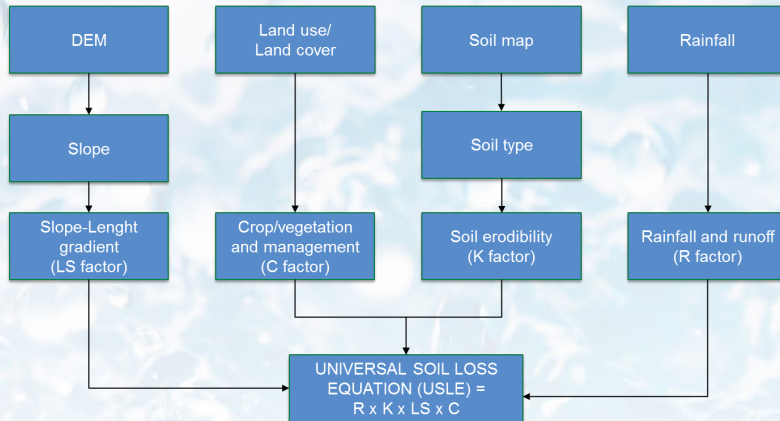
- **Spatial resolution**

- Blend (30 m -> 5 km)

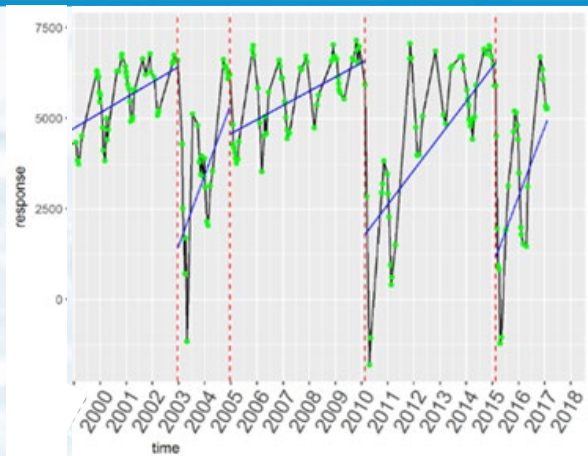
- **Input (EO) data**

- Multiple Earth Observation data sources providing information on rainfall, topography, land cover and vegetation changes





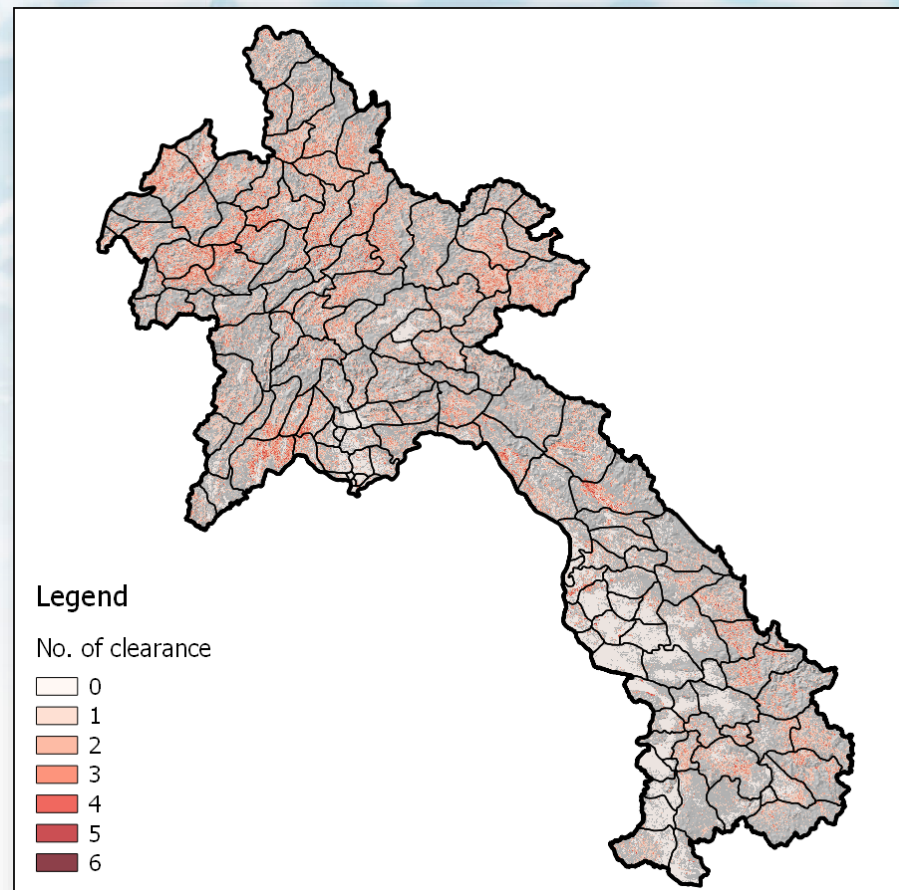
Vegetation index trend analysis



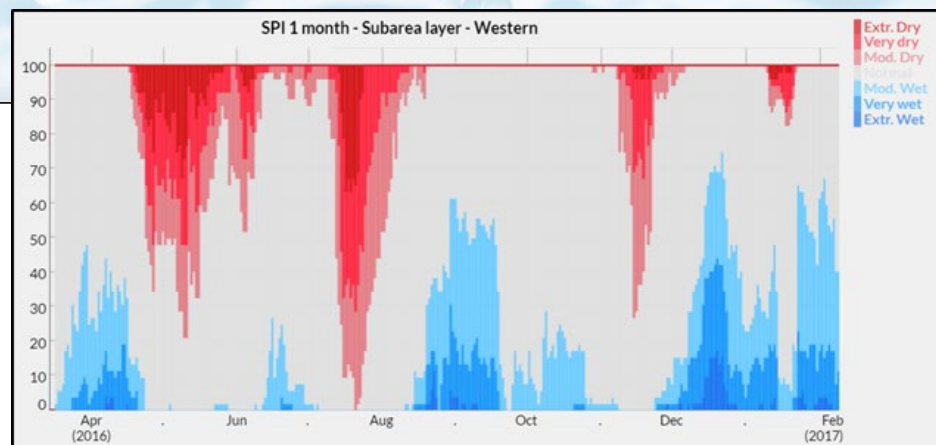
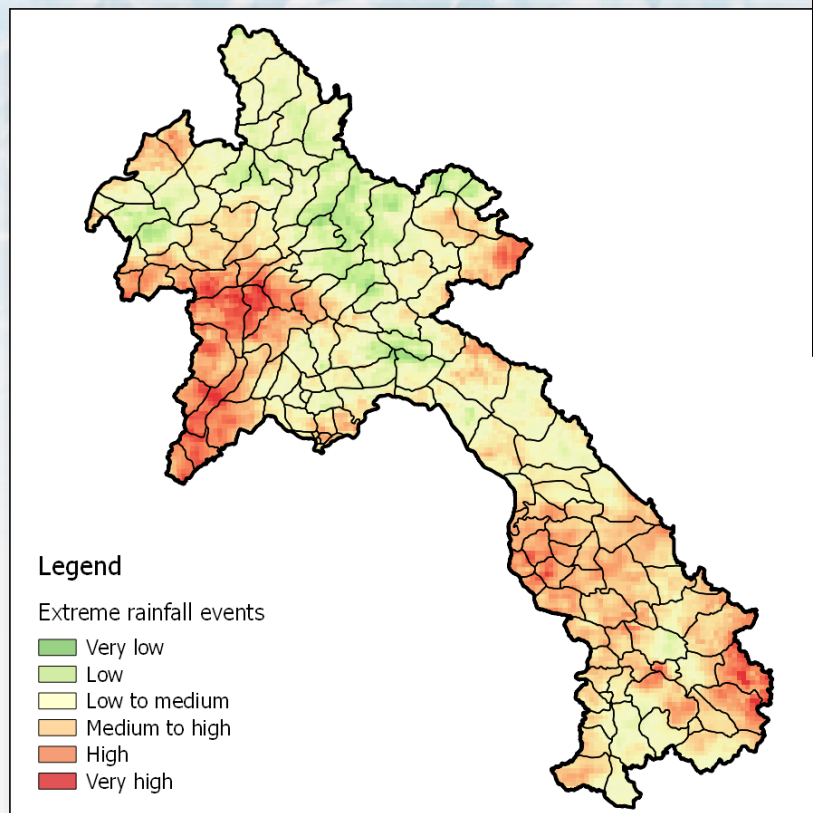
MODIS NDVI time series analyses

Weighted mapping 2000-2017

- land clearance number (0.5)
- significant NDVI trend (0.25)
- Hansen tree loss map (0.25)



- Identify watersheds susceptible to extreme rainfall events



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

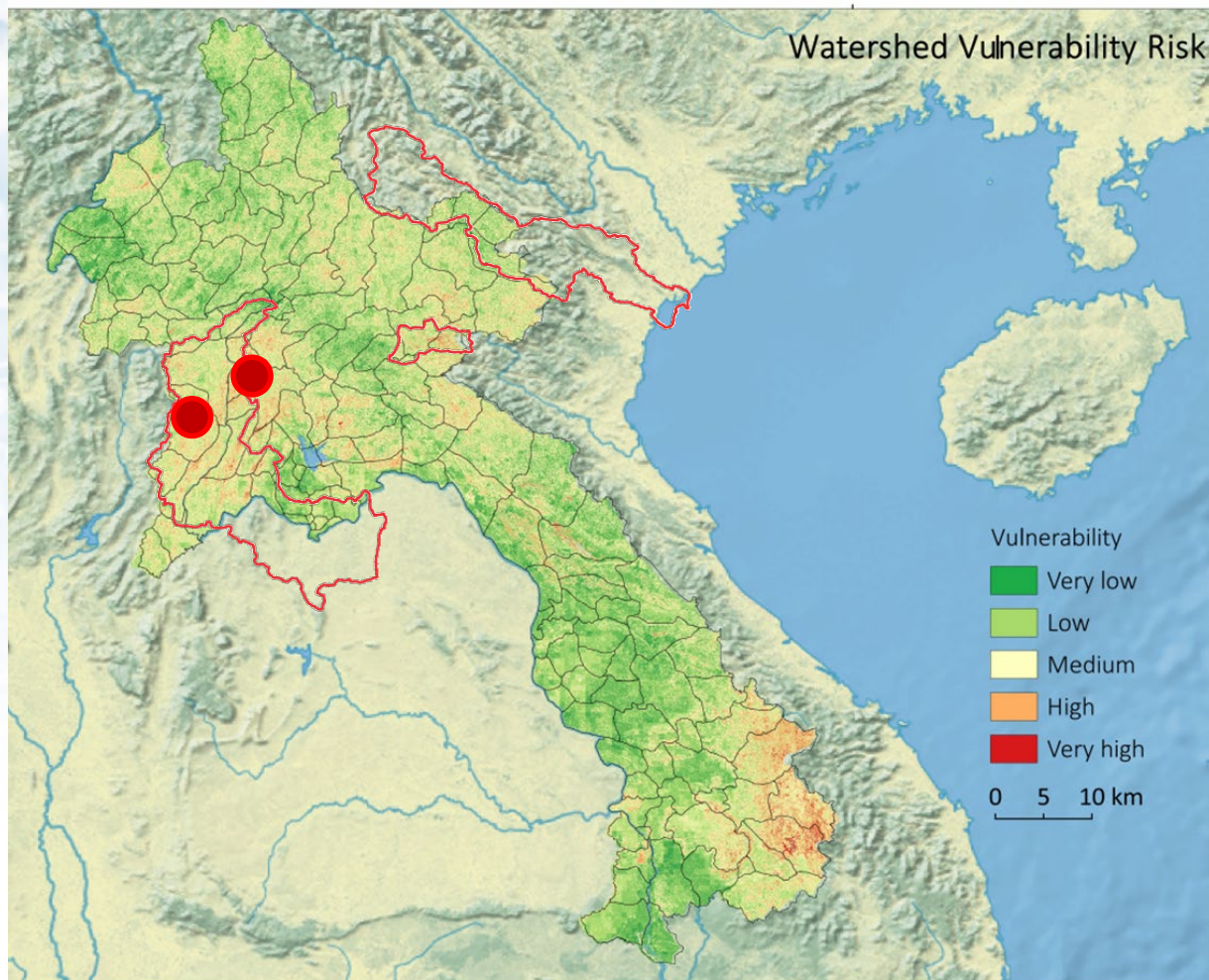
Indicator: 6-month SPI

-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



- 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!**

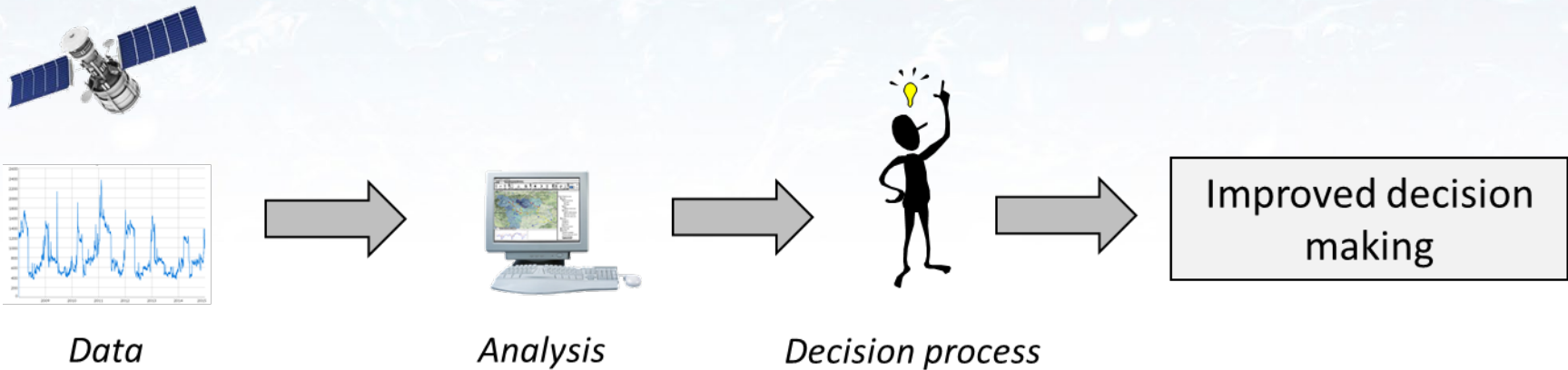
A satellite map of a coastal region, likely the Mediterranean, showing a mix of green land, blue water, and white sandy areas. A semi-transparent dark grey box with a white border is centered over the map.

Flood & Drought portal - demonstration

- 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



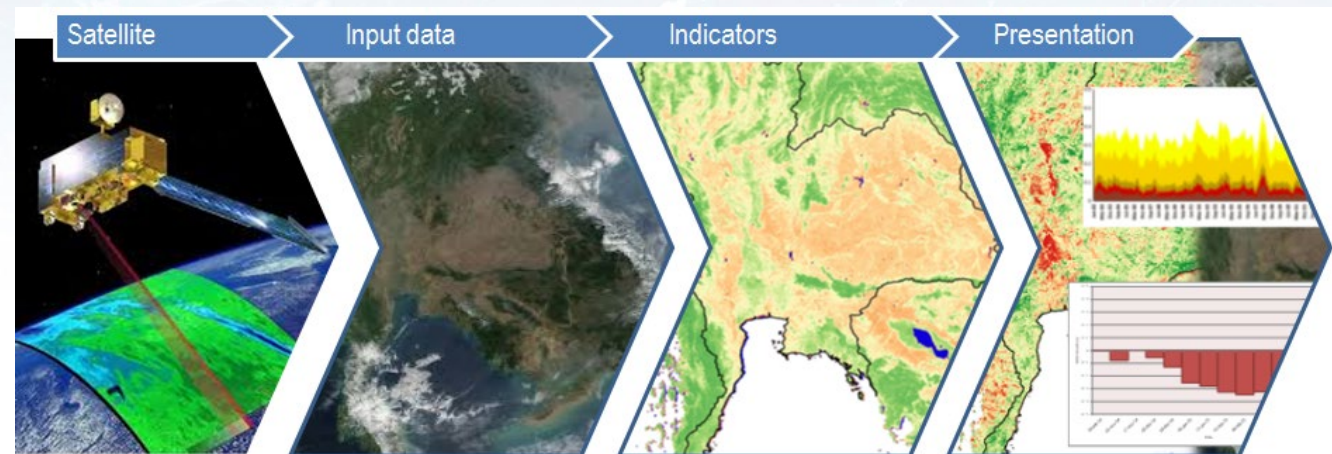
How can Remote sensing data be used?

Why use RS data?

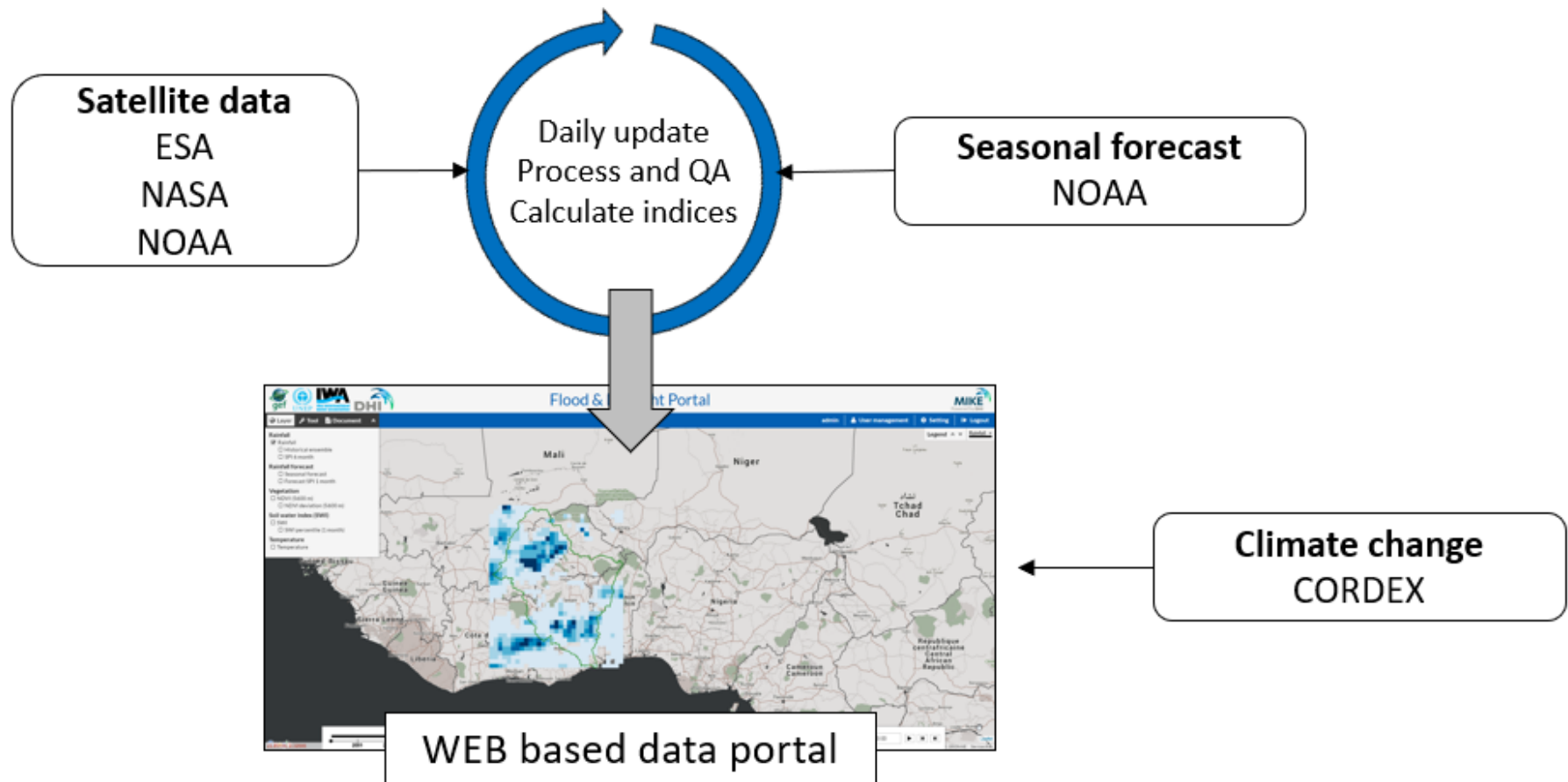
- Global or regional coverage
- Free data available
- Almost available in real time
- Many data sets available for the last 10 to 15 years

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



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

Settings

Personal information

Name

DHI Admin

Email

ozj@dhigroup.com

Organisation

DHI

Focus area

Volta

Basemap

Google Roadmap

Favourite data

Rainfall (CHIRPS)

☒ Rainfall (CHIRPS)

☐ Historical ensemble

☐ Monthly mean

☐ Rainfall deviation (30 days)

Rainfall

☒ Rainfall (TRMM)

☐ Historical ensemble

☐ Monthly mean

☐ SPI 1 month

☐ SPI 3 month

☐ SPI 6 month

☐ Rainfall deviation (30 days)

Rainfall forecast

☐ Seasonal forecast

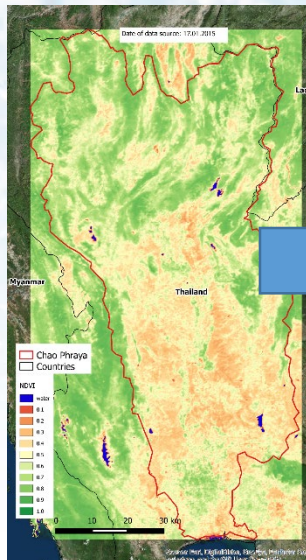
☐ Forecasted SPI 1 month (raw)

☐ Forecasted SPI 3 month (raw)

☐ Seasonal forecast (corrected)

☐ Forecasted SPI 1 month

Indices are essential for linking data with assessment



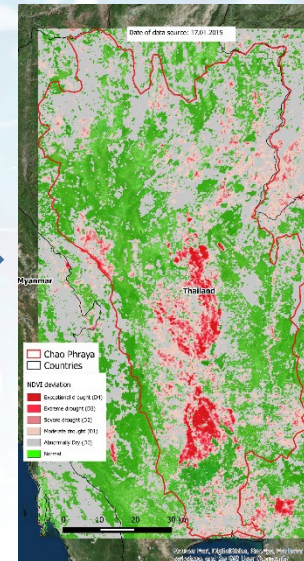
Satellite data

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

- 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



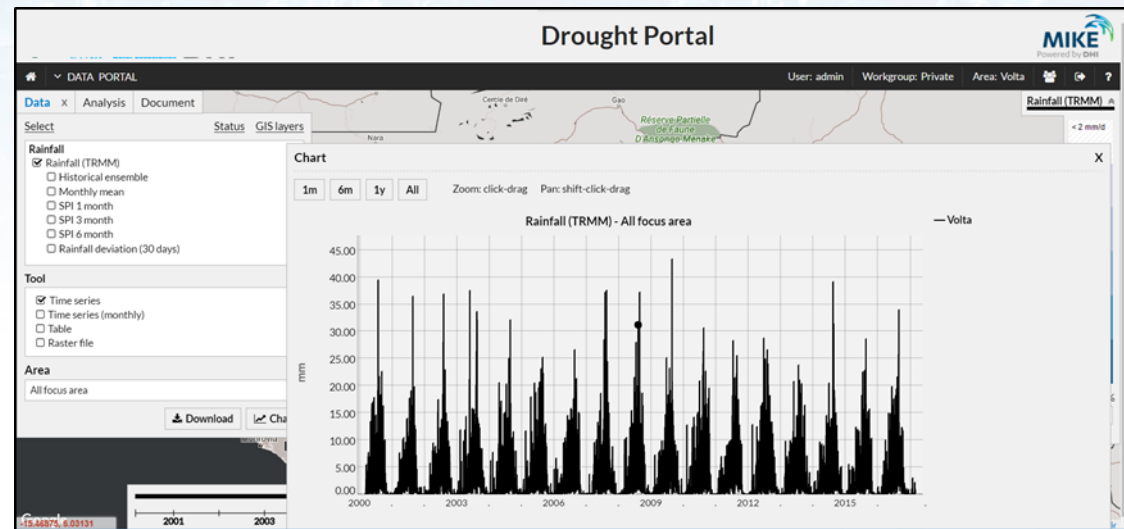
Daily update

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

Flood and Drought Portal

MIKE
powered by DHI

HOME Last Update: 2018-10-03 User: fduser1 Workgroup: Private Area: Myanmar

About the DataPortal

The Flood & Drought portal is developed as part of the Flood and Drought Management Tools project. For more information on the project please visit the project home page at: <http://fdmt.iwlearn.org/en>

The Flood & Drought portal provides access to a number of apps supporting decision makers at basin and local level. The aim is to support existing planning processes as TDA/SAP and IWRM at basin scale and Water Safety Planning at local scale through the technical apps. The apps could be used individually or in connection.

Please visit the [user guide](#) for more indepth information on the use of the apps and their intended support for the different stages within basin and local level planning.

Knowledge portal with discussion forum and upcoming online courses: Select the "Knowledge portal" in the ? menu or use the link - [KnowledgePortal](#)

For video tutorials and overview: [YouTube](#)

For technical exercises (pdf files) : [Dropbox](#)

For technical questions please contact:

[Oluf Jessen \(Project manager\)](#) or [Bertrand Richaud](#)

ISSUE ANALYSIS
Causal Chain analysis and WRIAM. Understand and prioritise the causes behind issues.

WATER INDICATOR
Identify water related indicators to support management and decision-making.

DATA AND INFORMATION
Access to near real-time data. Flood and drought indices. Climate forecast and climate change data.

DROUGHT ASSESSMENT
Locate and identify hazards, estimate impacts and provide risk assessment.

CROP APPLICATION
Visualise crop calendar, estimate crop water requirement and crop yield.

FLOOD ASSESSMENT
Locate and identify hazards, estimate impacts and provide risk assessment.

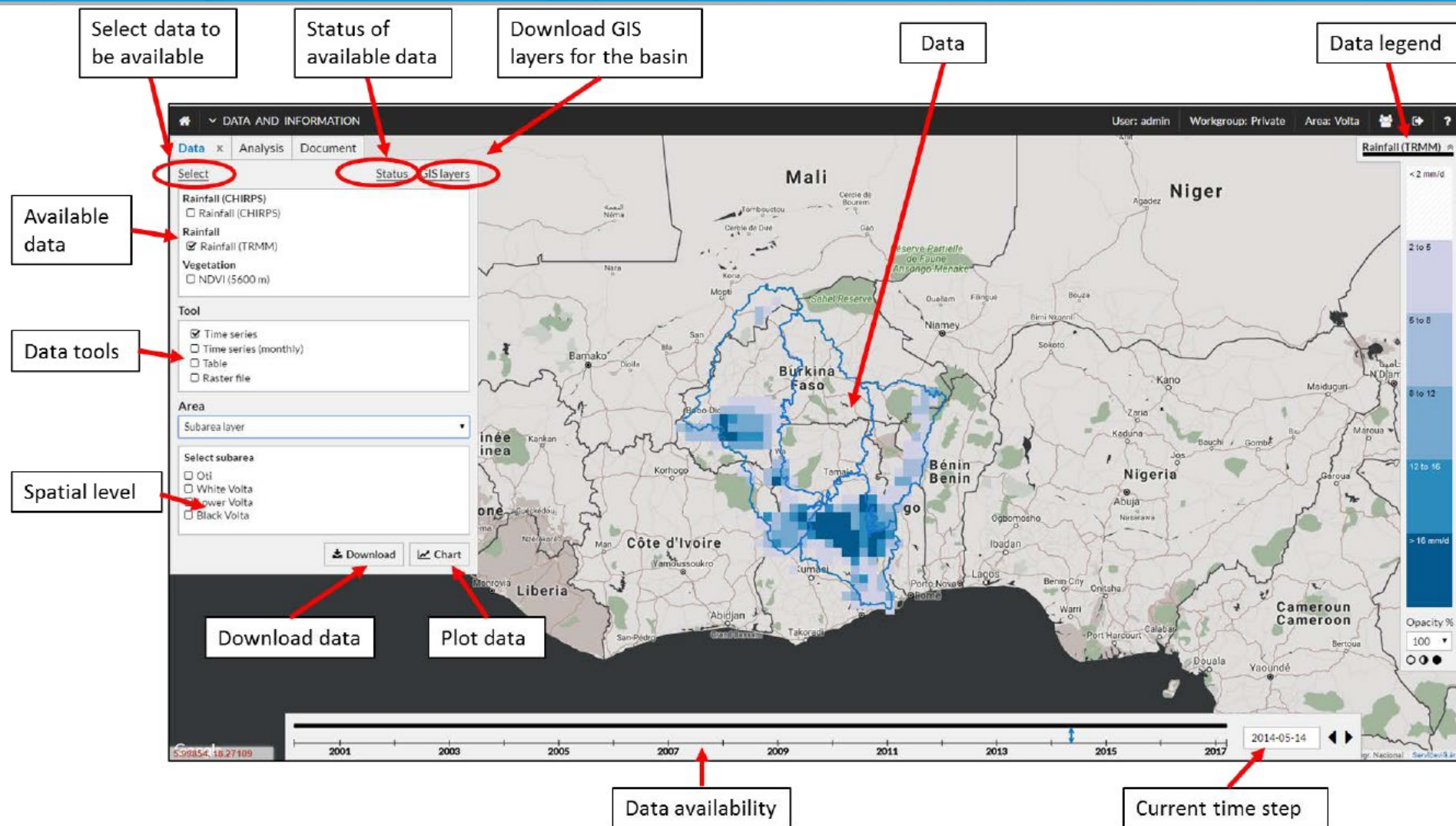
BASIN PLANNING
Create and evaluate basin plans. Linkage to water resource model.

WATER SAFETY PLANNING
Support water safety planning

RDM TOOL
Robust Decision Making Tool

REPORTING
User configured templates providing linkage to overview reports or bulletins. Specific templates for TDA/SAP, IWRM and WSP.

Basic functionality



• 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

<http://eo4sd-water.net>

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