From satellite imagery to hydrogeological survey maps of Chad

M. Aubert*, A. Kraiem*, Y. Haeberlin*, F. Zwahlen**

*UNOSAT, United Nations Institute for Training and Research (UNITAR)
Palais des Nations, CH-1211 Genève

** CHYN Centre d'hydrogéologie,
rue Emile-Argand 11, 2009 Neuchâtel

11th Swiss Geoscience Meeting
Lausanne, November 16, 2013

- Actors and objectives

Funding

REPUBLIQUE DU TCHAD

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Project management

MINISTERE DE L'HYDRAULIQUE RURALE ET URBAINE

unitar

Partners

swisstopo

RésEAU project objectives

1. Develop a Water Resource Information System (SIRE): Improved knowledge of water resources to strengthen and develop initiatives in the sector
2. Strengthen national capacities in geology, hydrogeology and GIS

= **Support Chad water resource management**

→ **For a better management of water resources in Chad**

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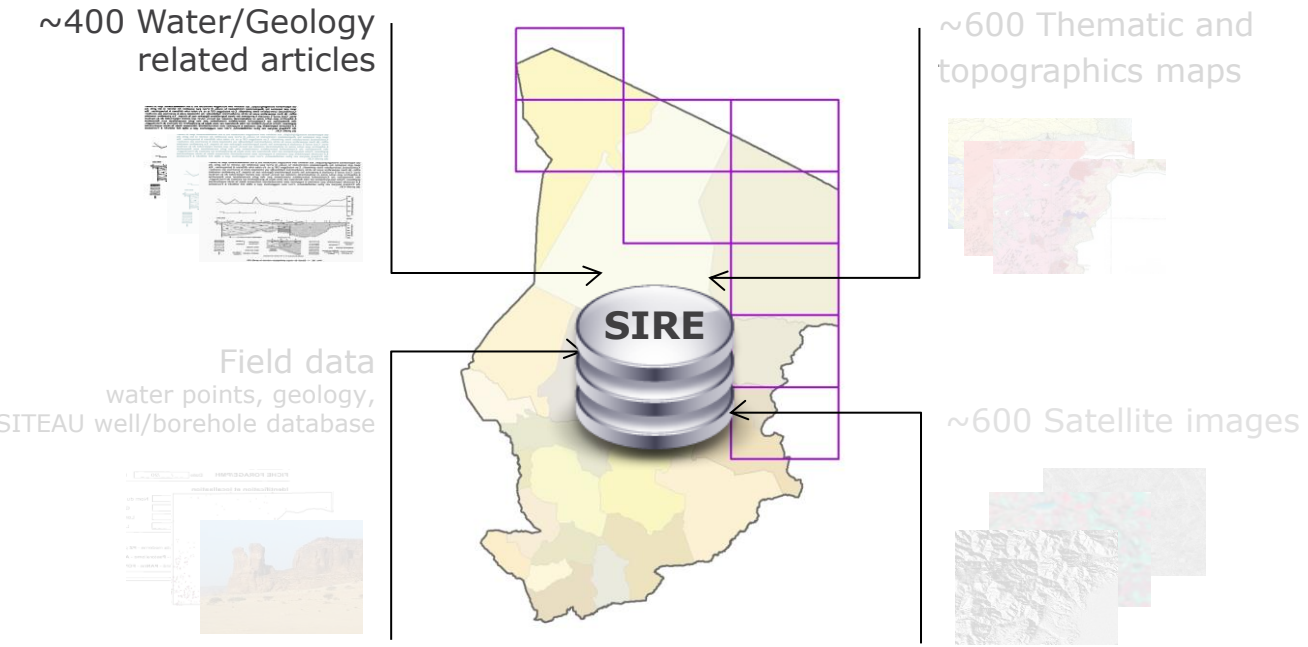
- SIRE Geodatabase

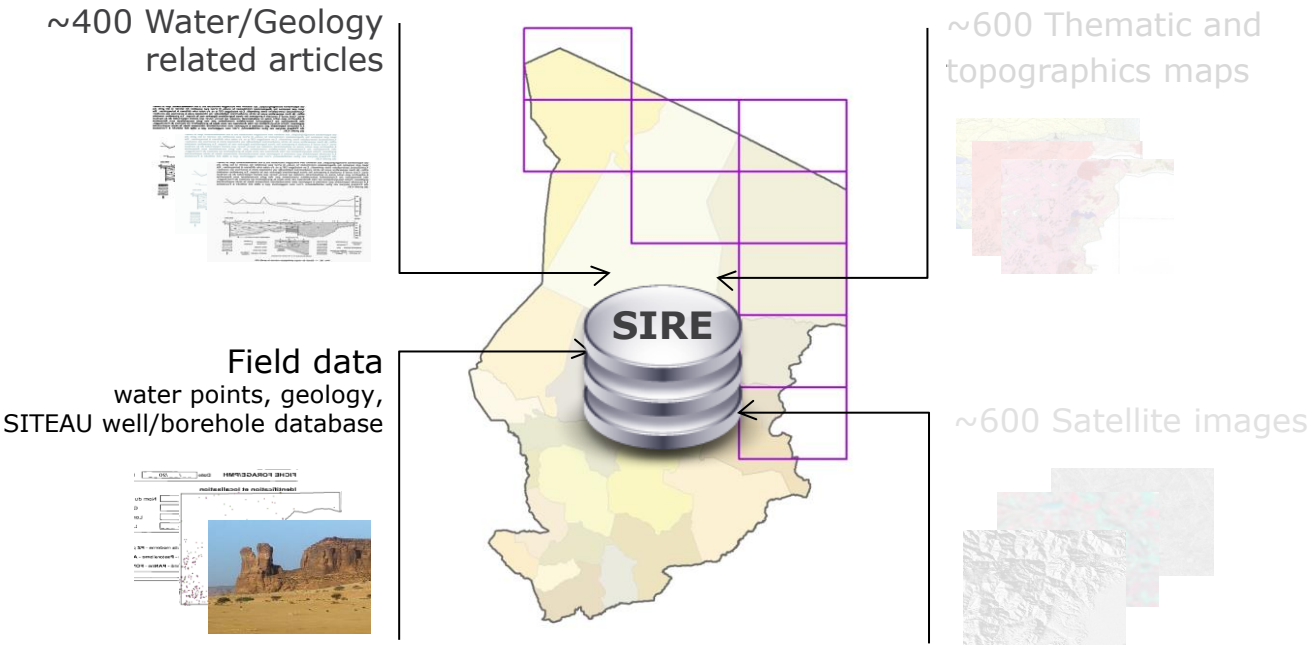


Weaknesses of data collection

- Information is scattered, actors might be reluctant to share it.
- Data is outdated, spatial coverage is heterogeneous.

= More accurate and exhaustive (coverage) data are necessary

- SIRE Geodatabase



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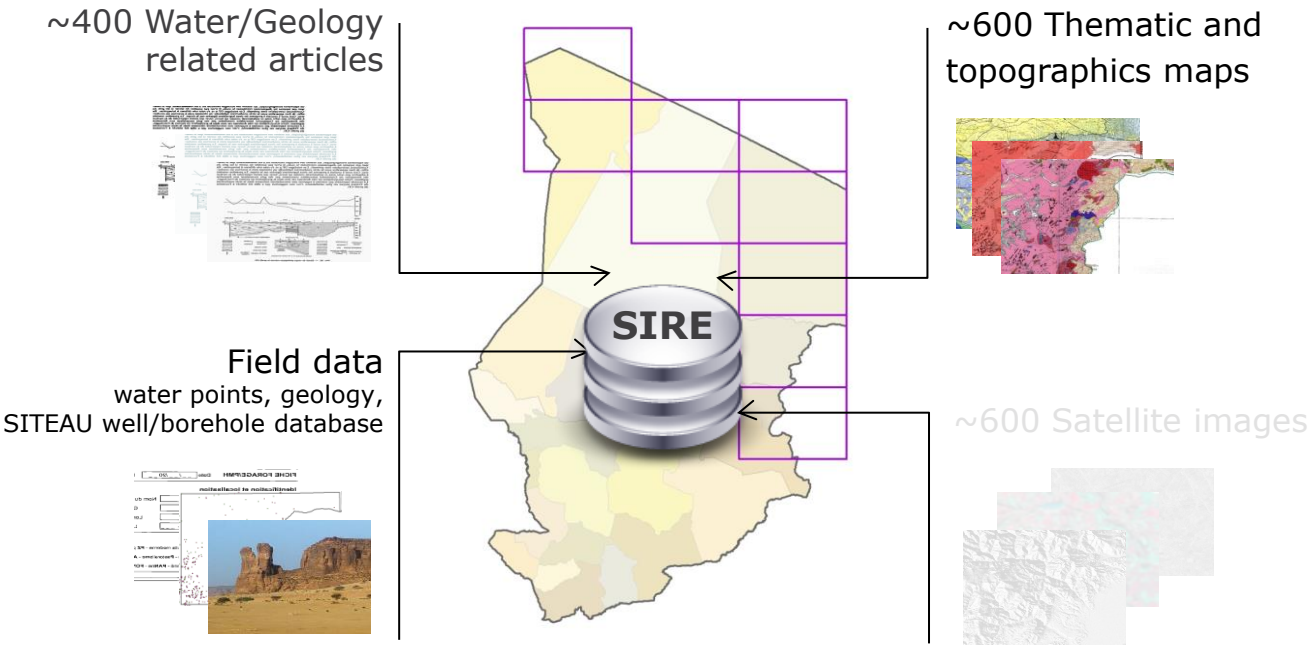

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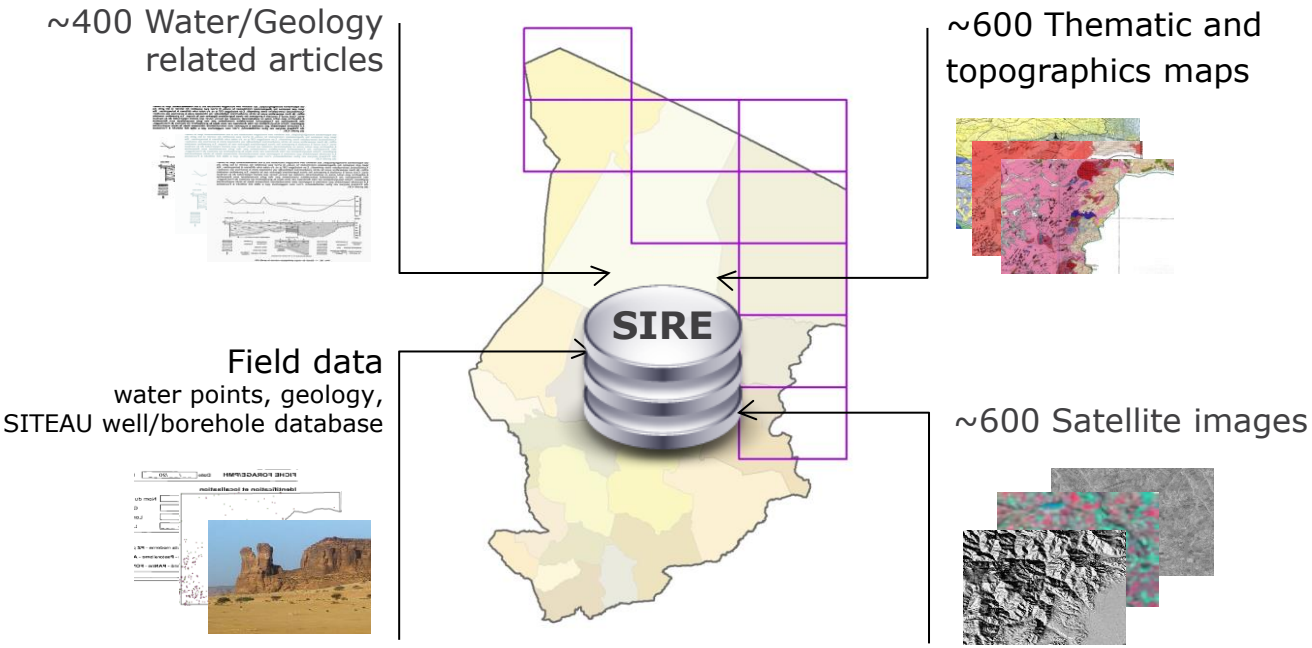

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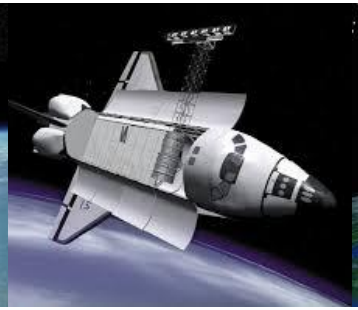
- New data acquisitions

Field work

+ True data

- Punctual data

Remote sensing tools



Optical

+ Geology, Landcover

RADAR+ DEM

+ Structure, Moisture, Faults, Morphology

SIRE consolidation

- New satellite image acquisitions
- Field observations and measurements for validation

= Powerful tools to improve water information over Chad and understand the different aquifers

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Field work

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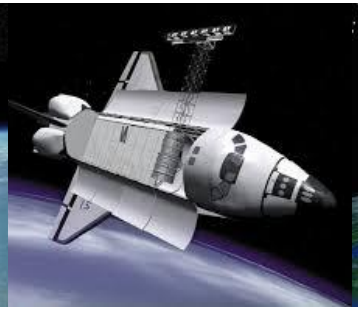

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Tools limited to:
Rocks varnish over bare soil or scarse vegetation cover

SIRE consolidation

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- Field observations and measurements for validation

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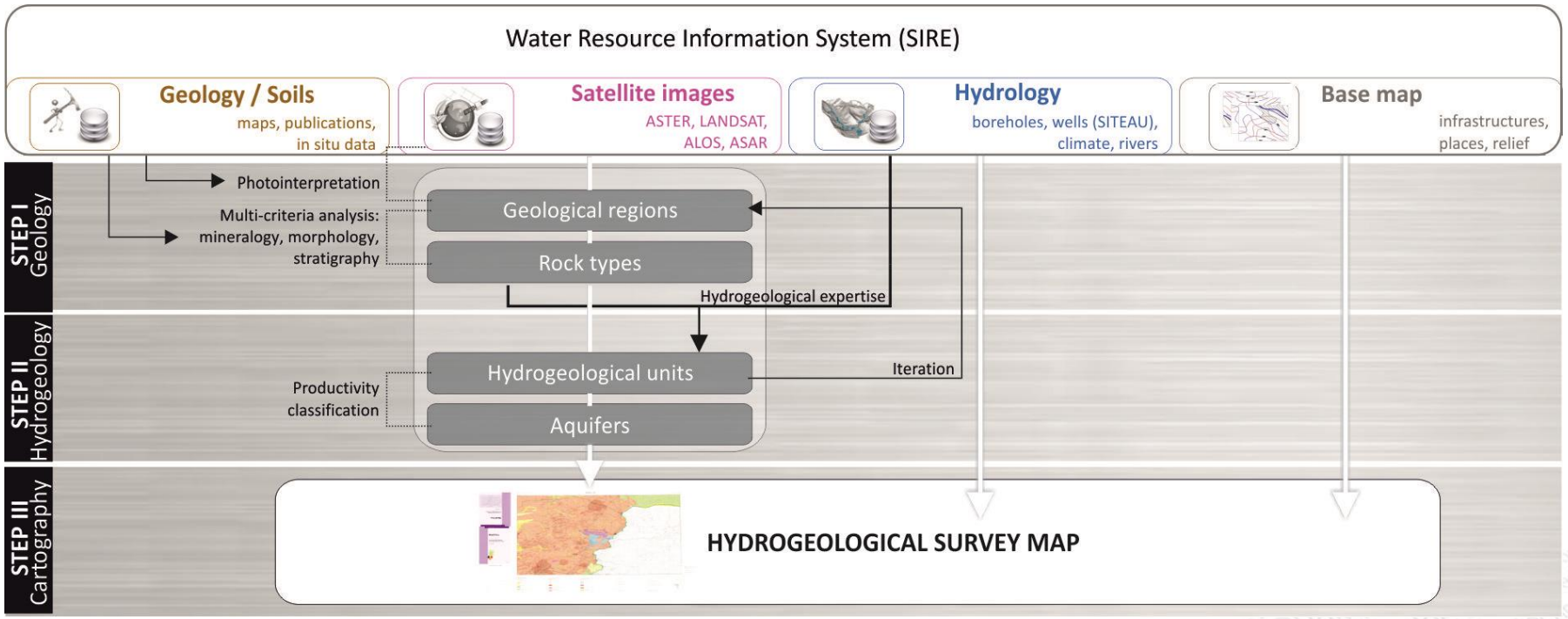
II. Mapping process

1. SIRE database
2. Process line



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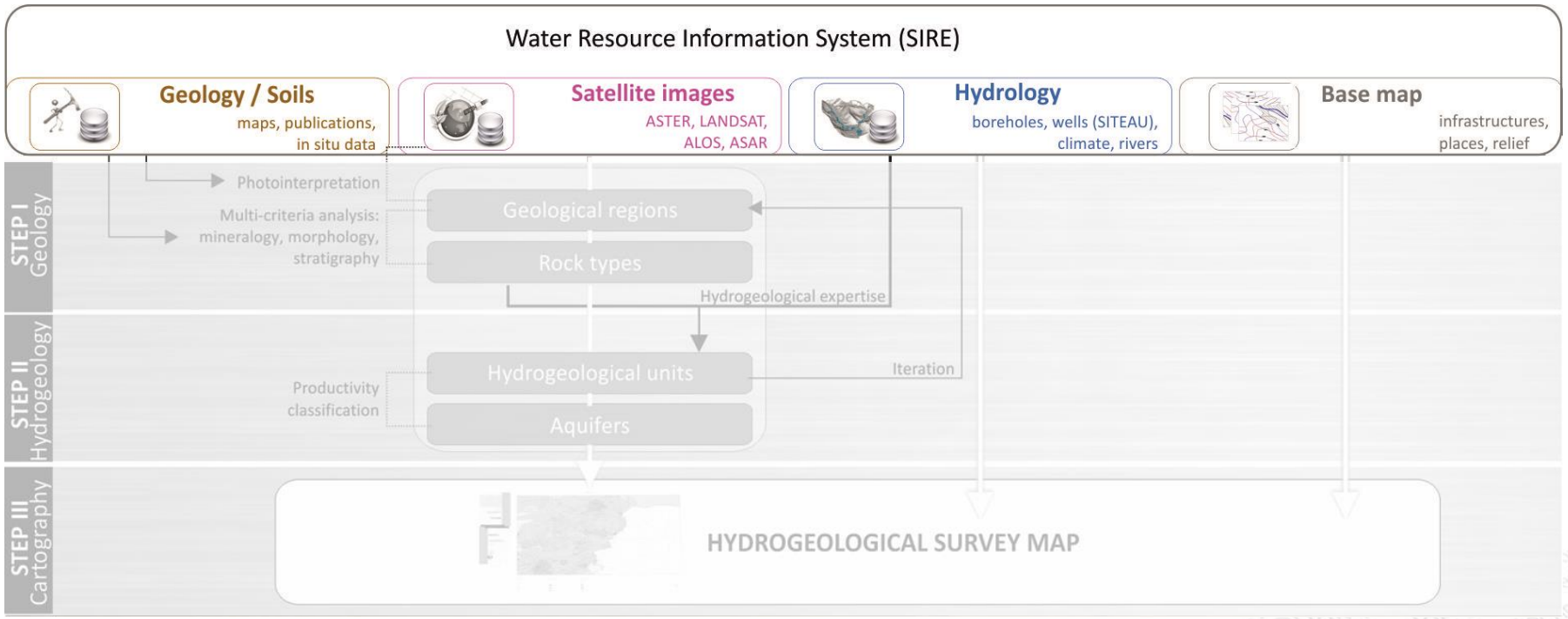

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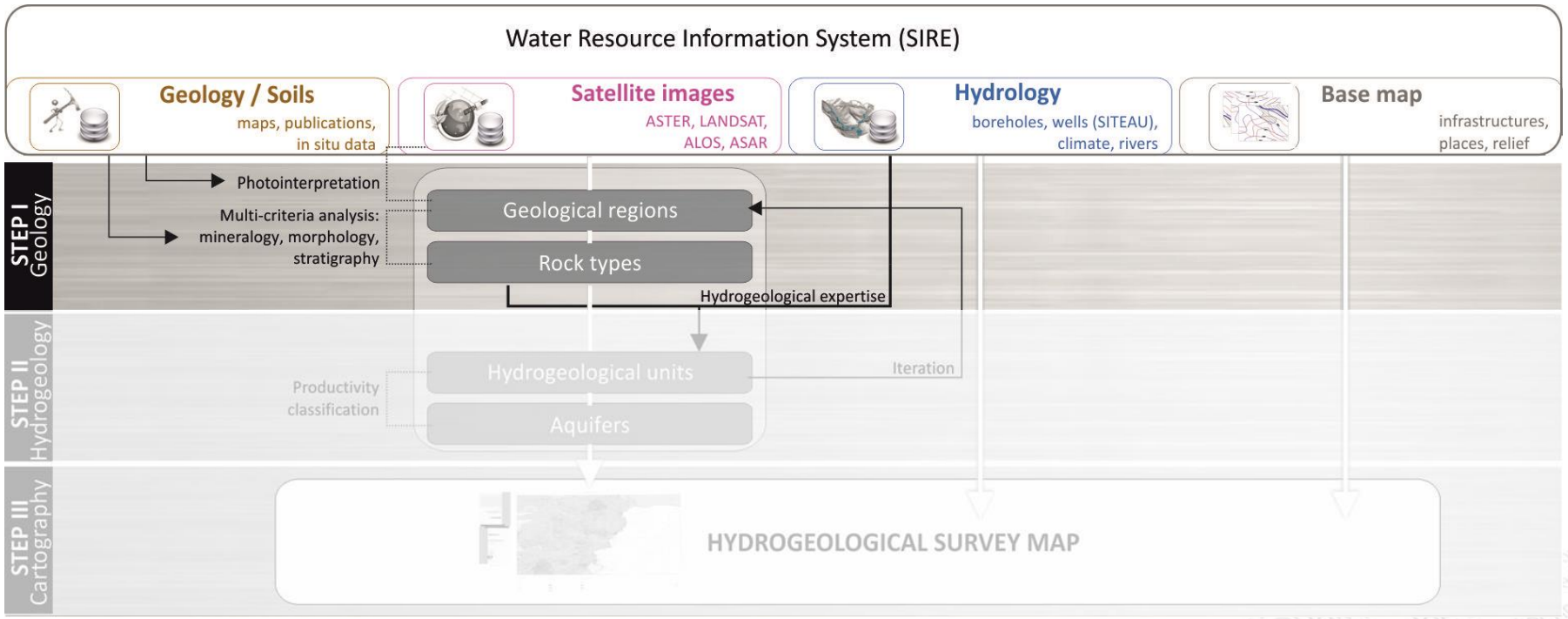

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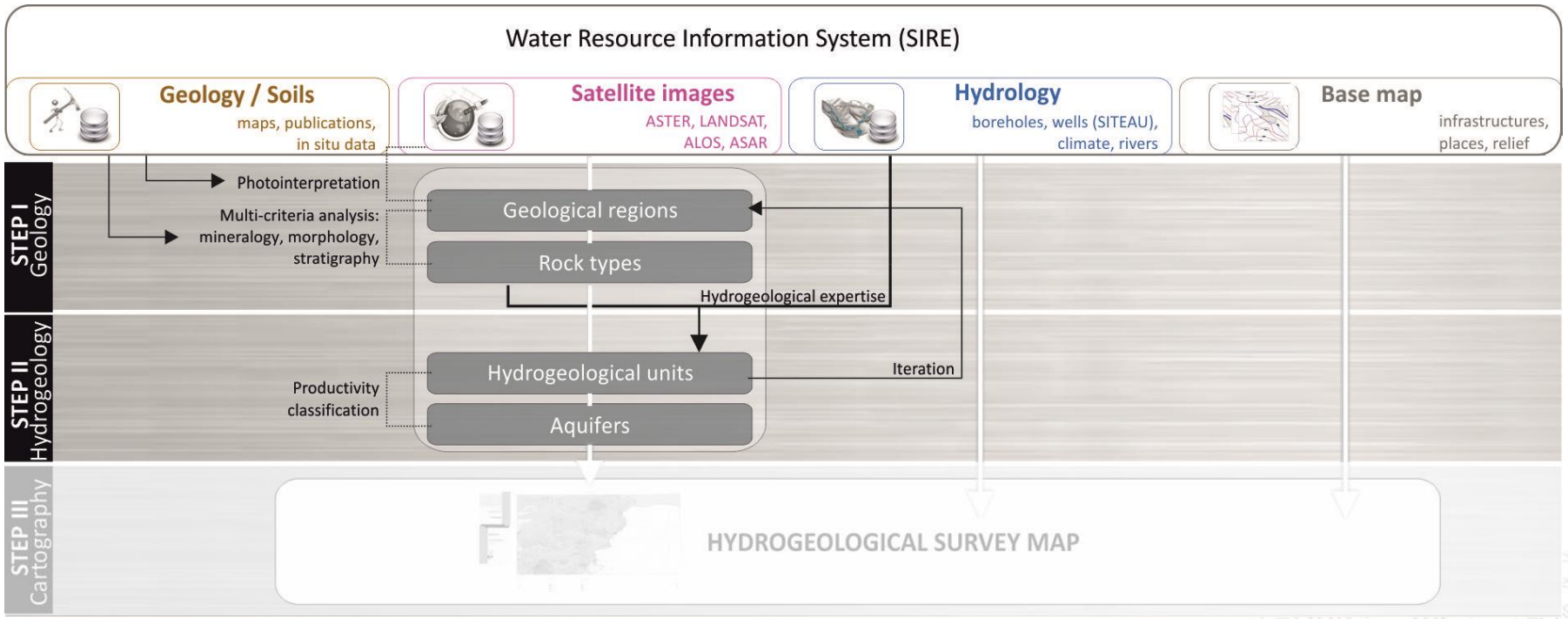

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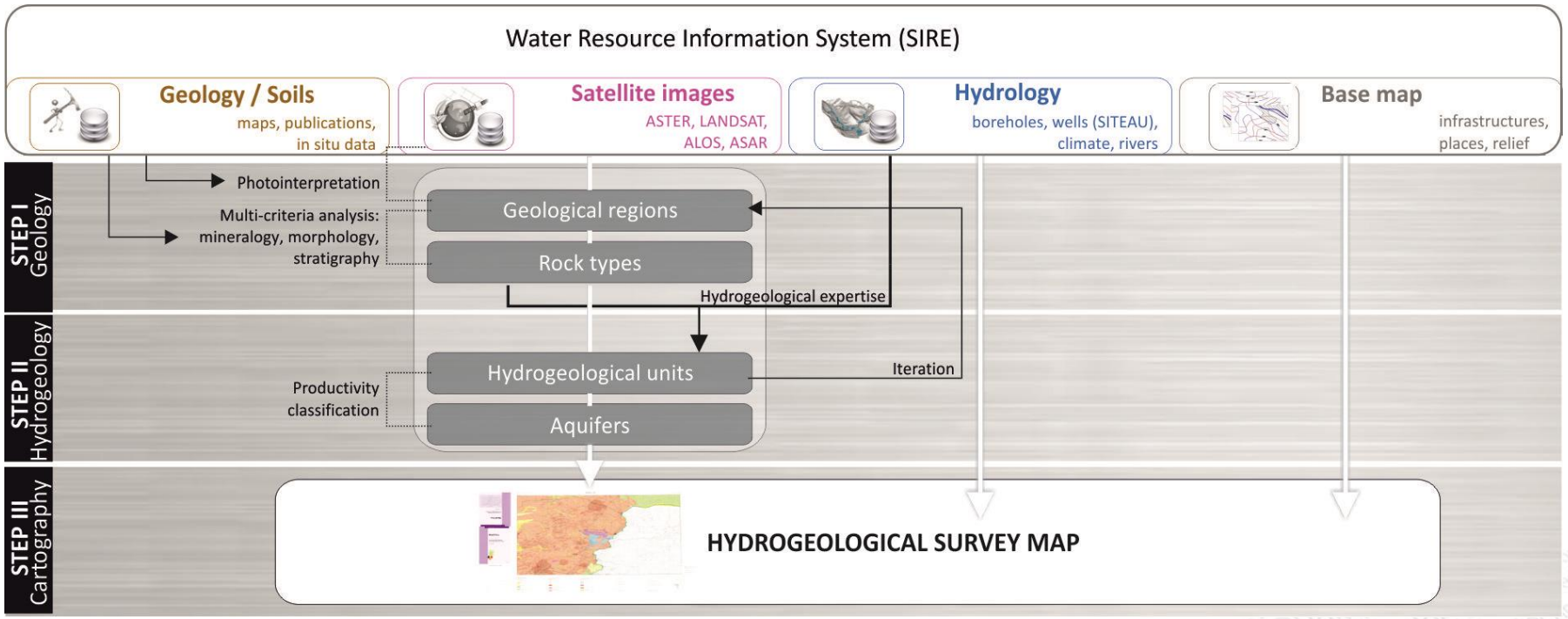

- Image acquisitions

Google Earth

BING

150 ASTER

3 VNIR, 5 SWIR, 5 TIR
Resolution: 15 à 90 m
Size: 60x60km
Low cost

> 61 LANDSAT-7

4 VNIR, 2 SWIR, 1 TIR
Resolution: 15 à 120 m
Size: 185 x185 km
Free

> 61 LANDSAT-8

4 VNIR, 2 SWIR, 1 TIR
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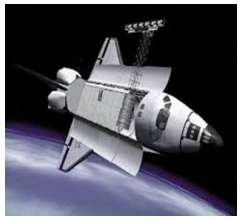

SRTM

Resolution: 90 m
Free

400 ASAR

C (~5 GHz)
Resolution: 30 m
Scene : 100x100 km
Free

50 ALOS/ PALSAR

L (~1.5 GHz)
Resolution: 24 m
Scene: 40x70 km
Low cost

SIRE database potential

Sensor choosen because of their:

- low cost
- appropriate spatial resolution for 500'000 or 200'000 mapping
- spectral diversity (VNIR, SWIR, TIR, HF)

= Exhaustive database to support hydrogeological mapping

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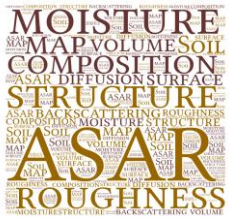

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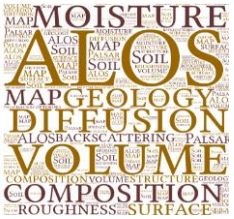

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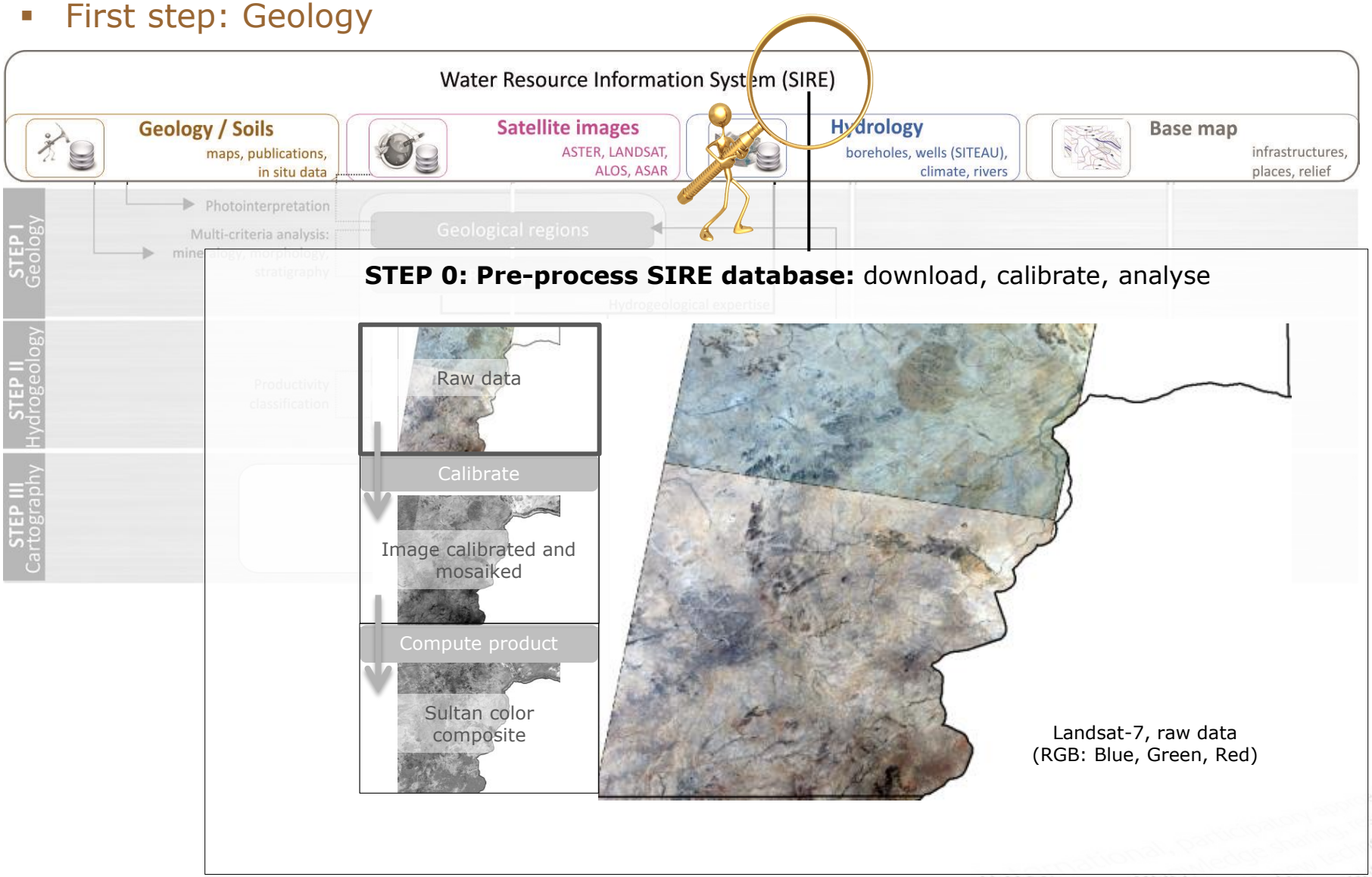

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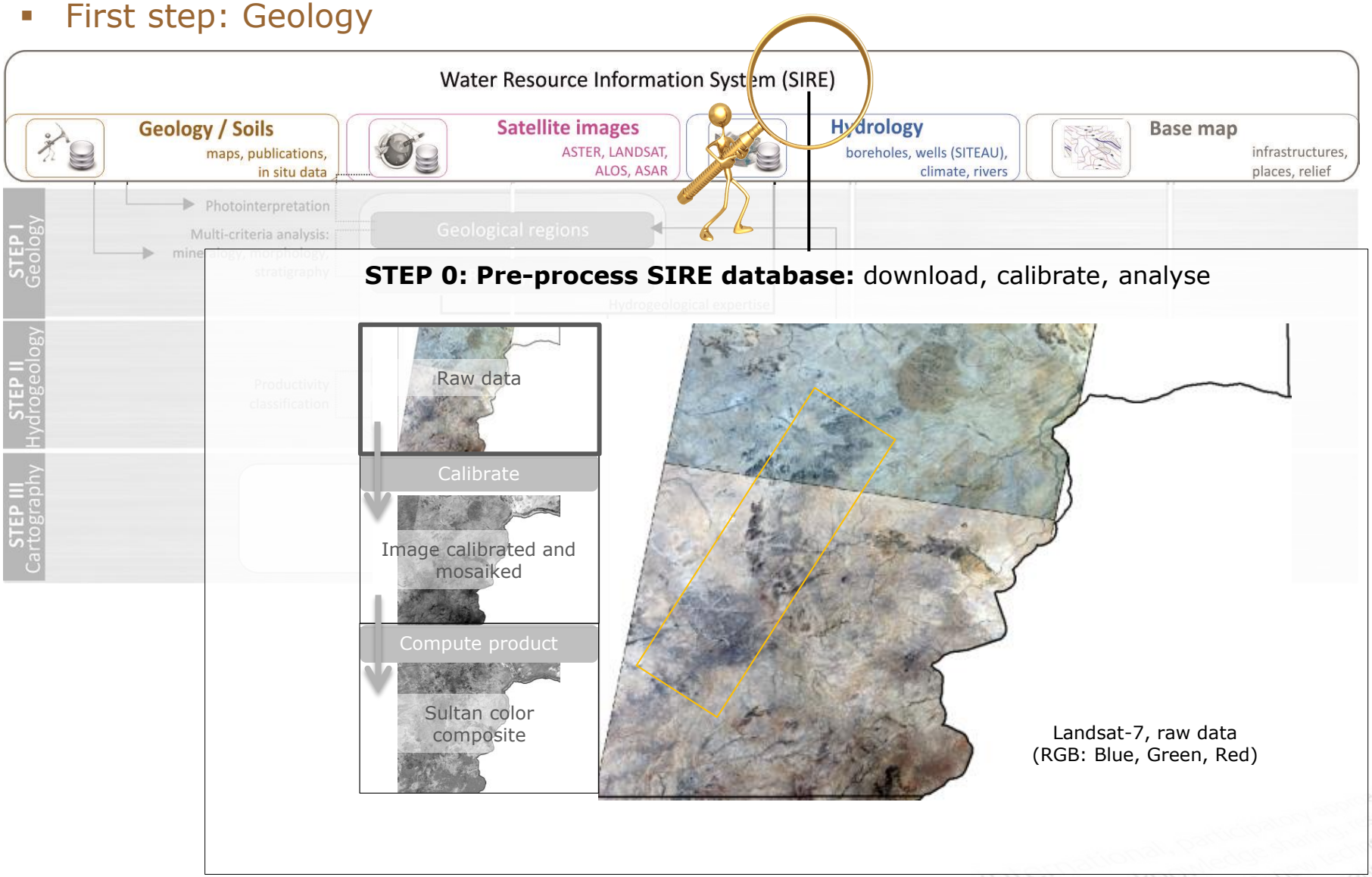

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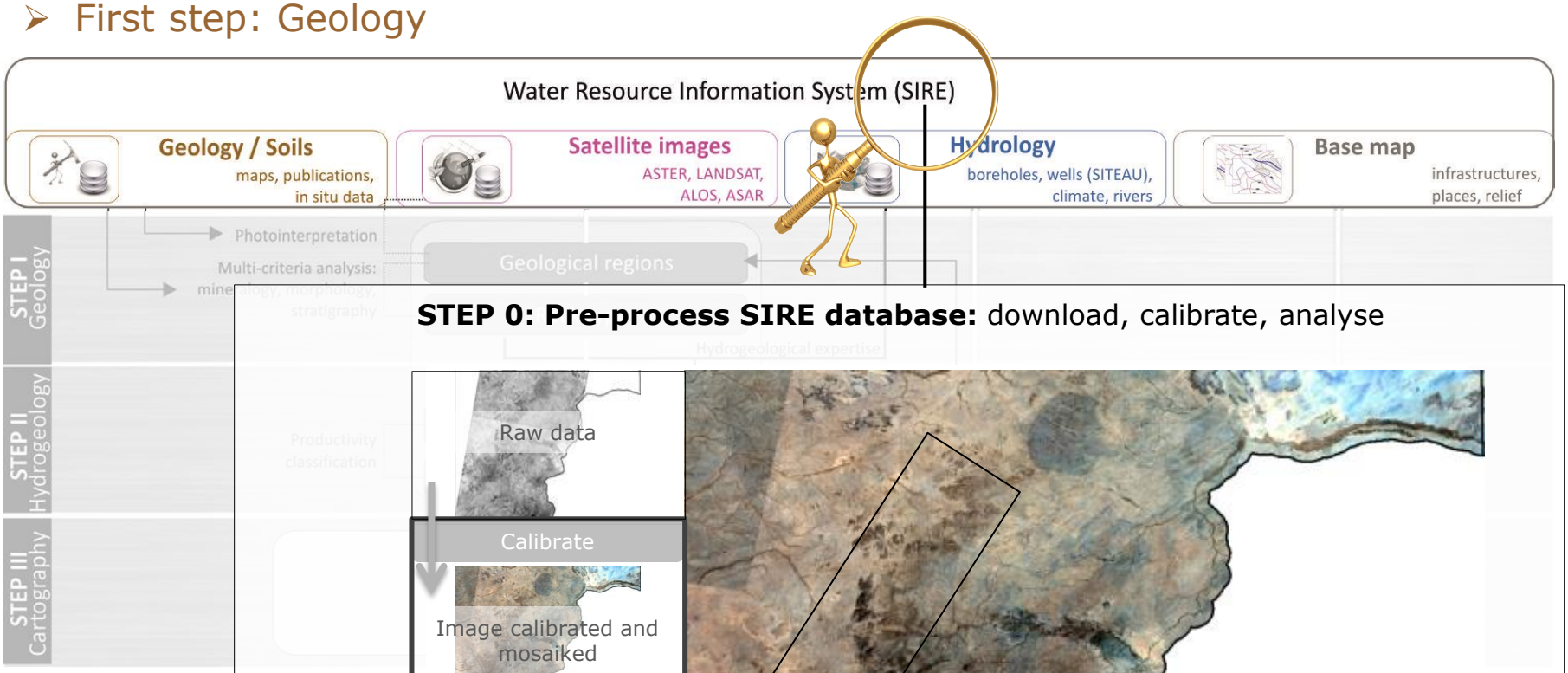
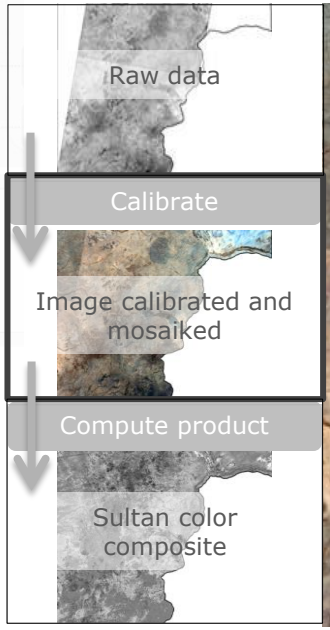
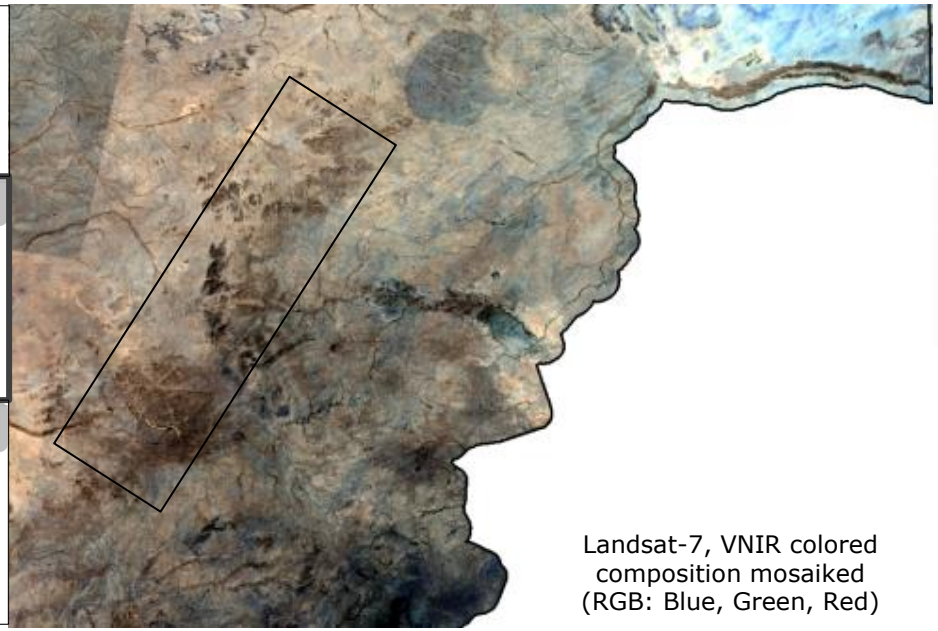


STEP 0: Pre-process SIRE database: download, calibrate, analyse





Landsat-7, VNIR colored composition mosaiked (RGB: Blue, Green, Red)

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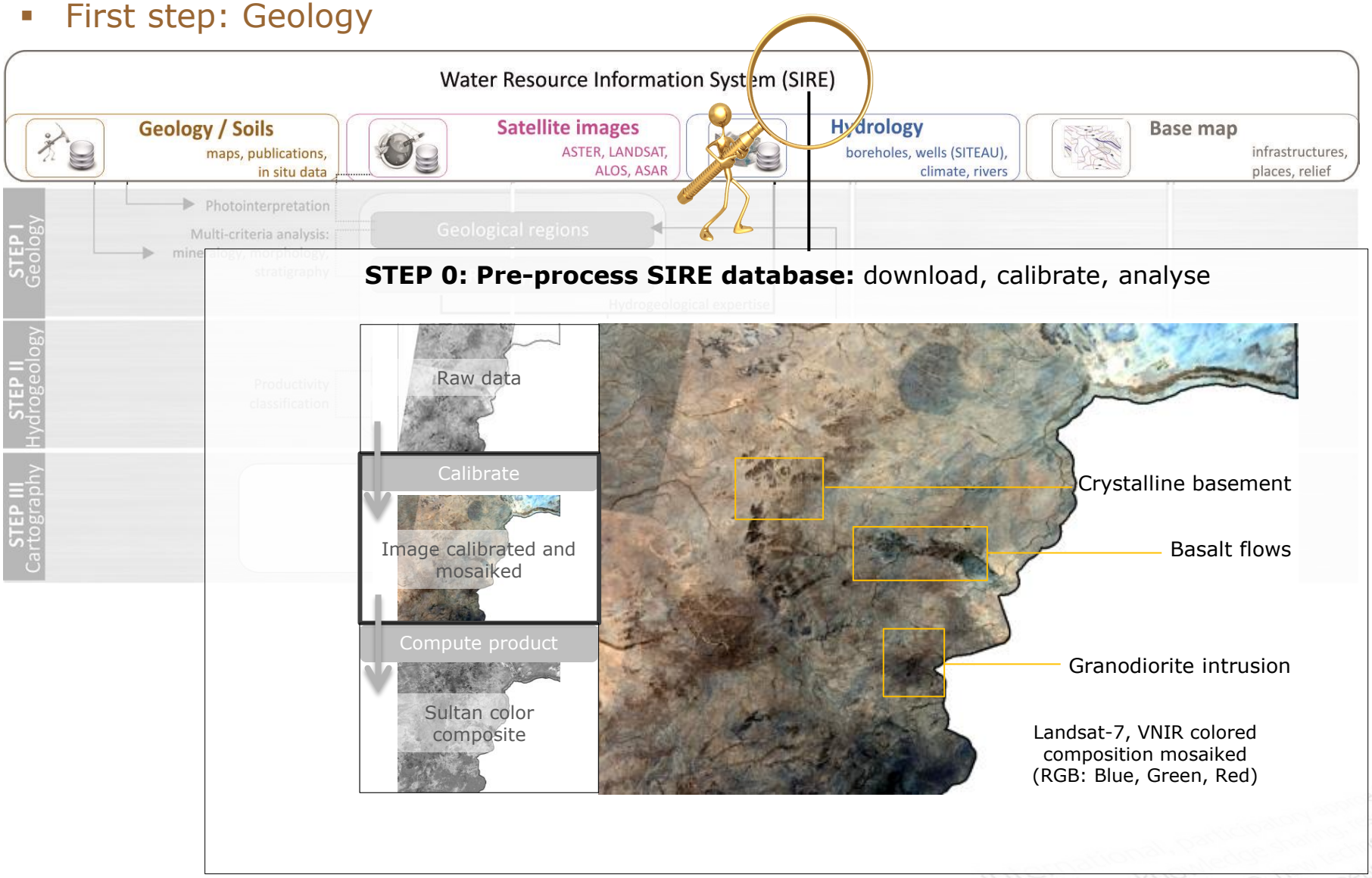

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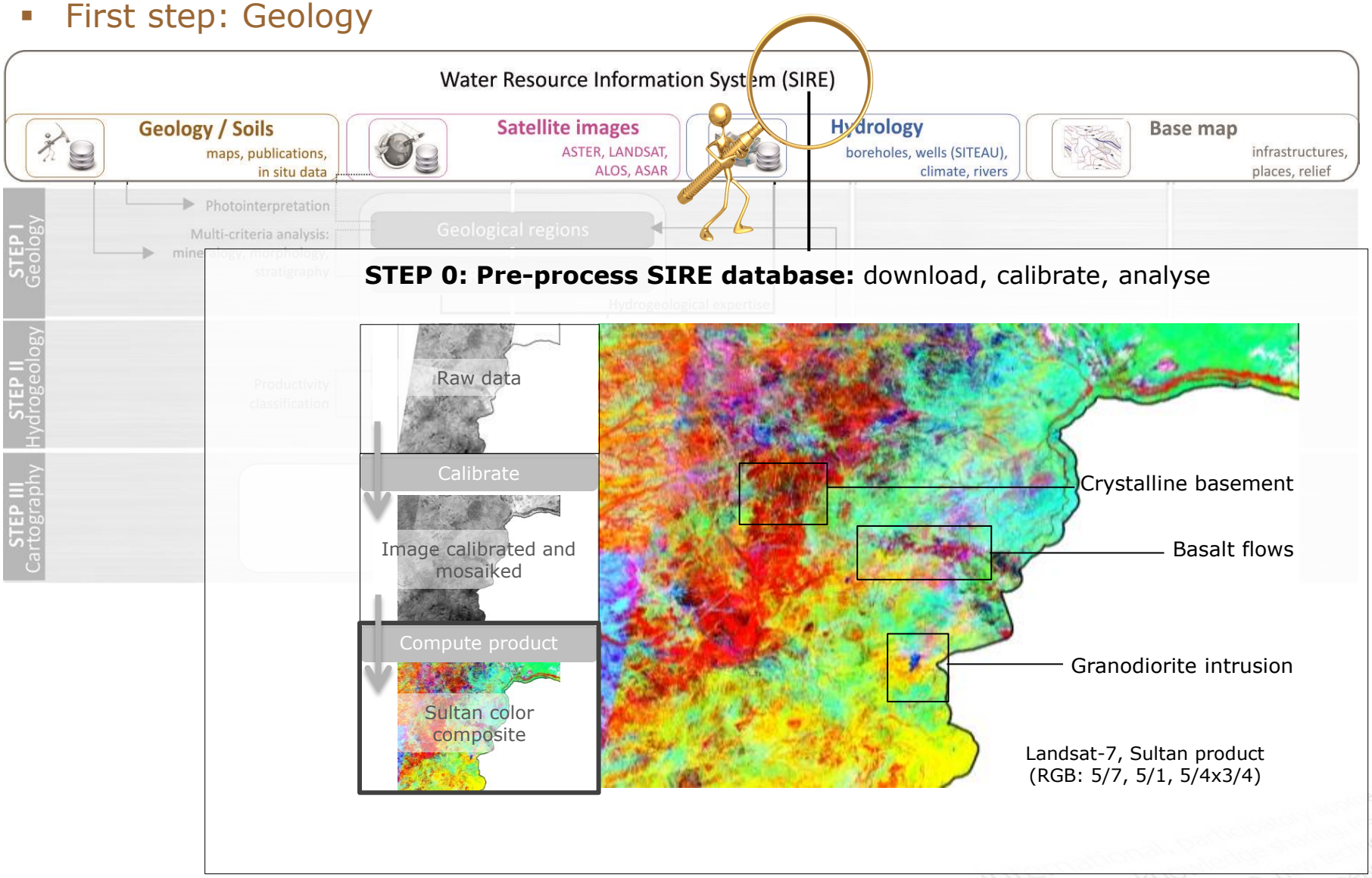

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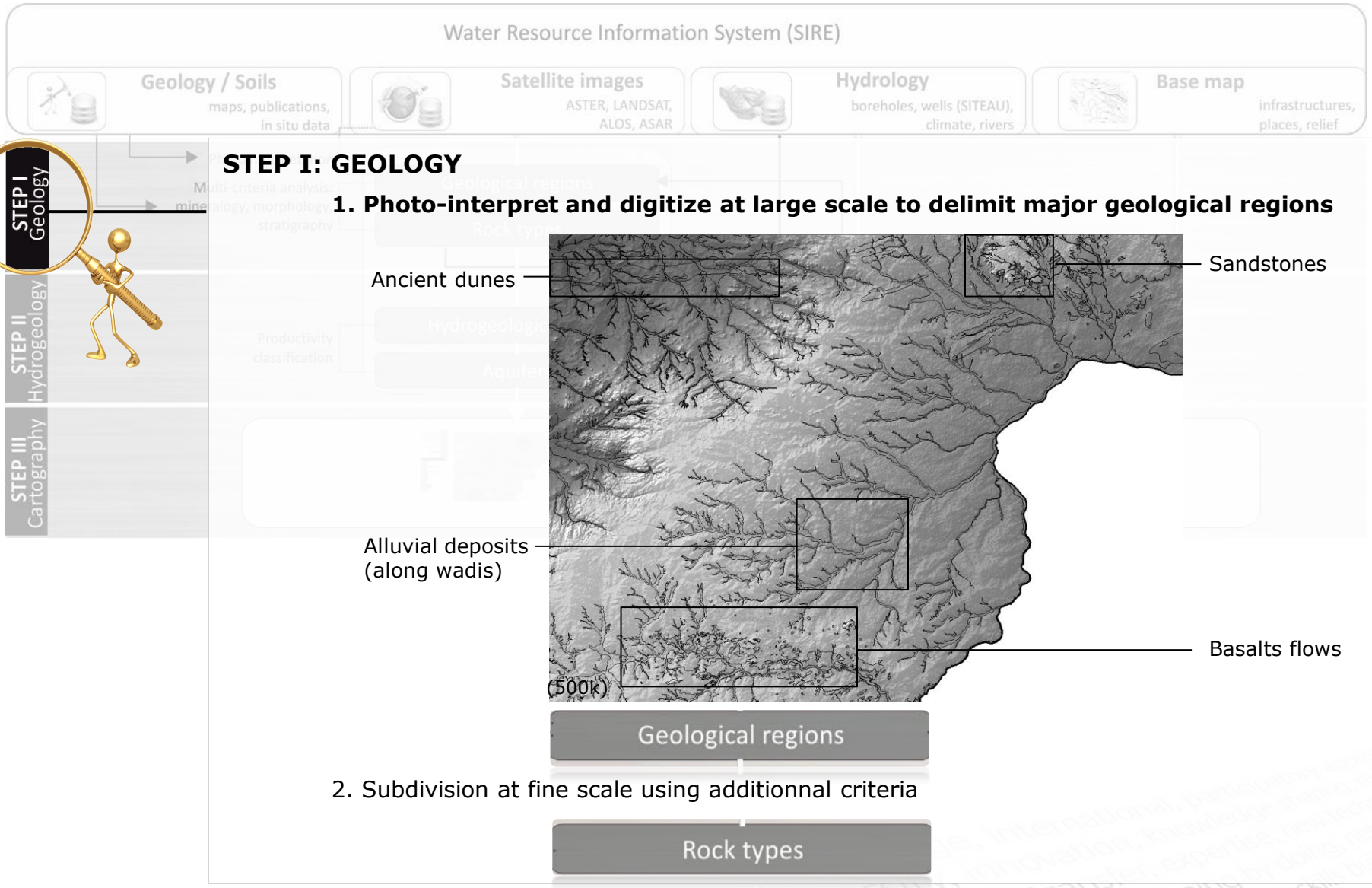

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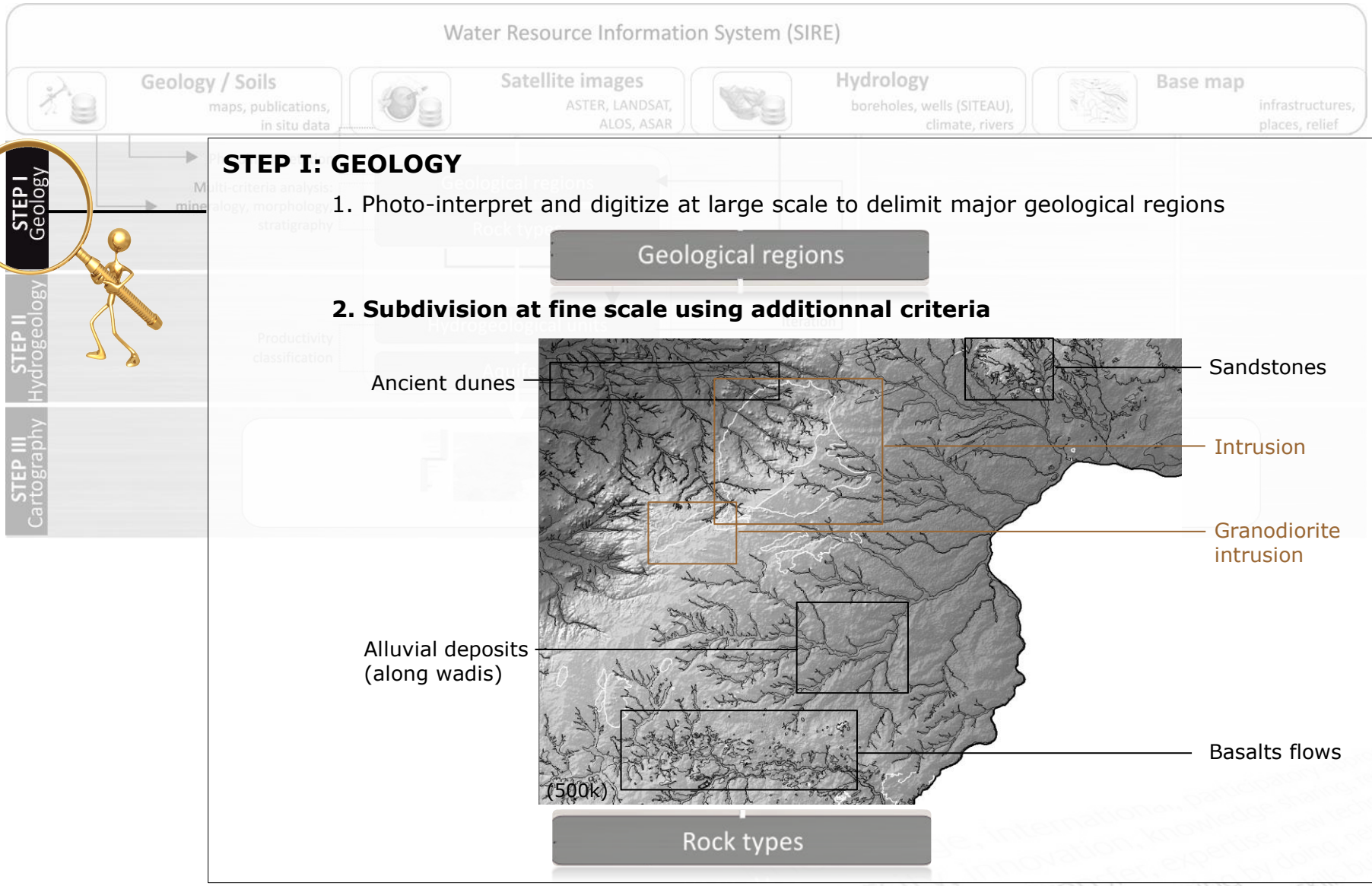
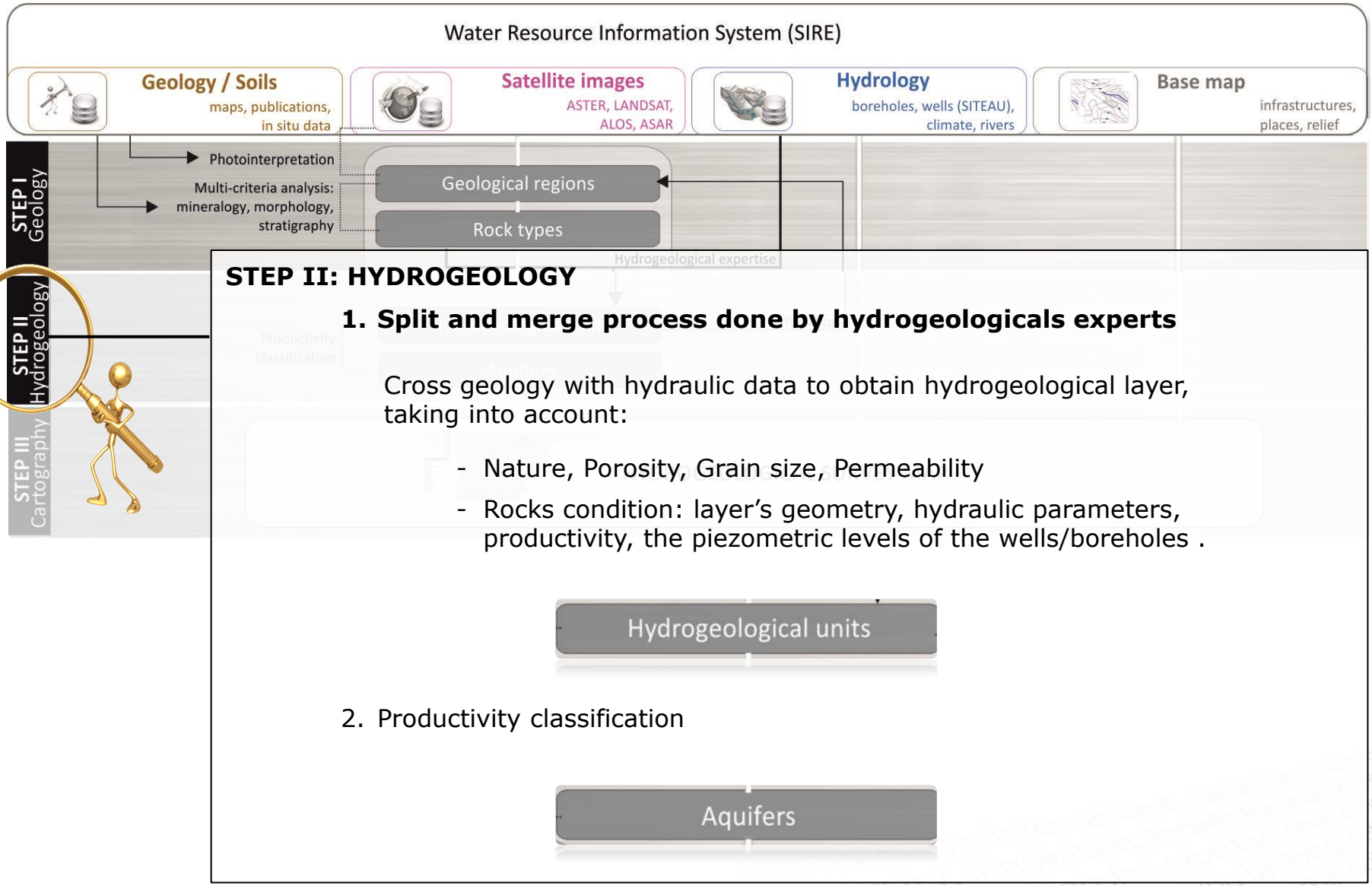


- Second step: Hydrogeology



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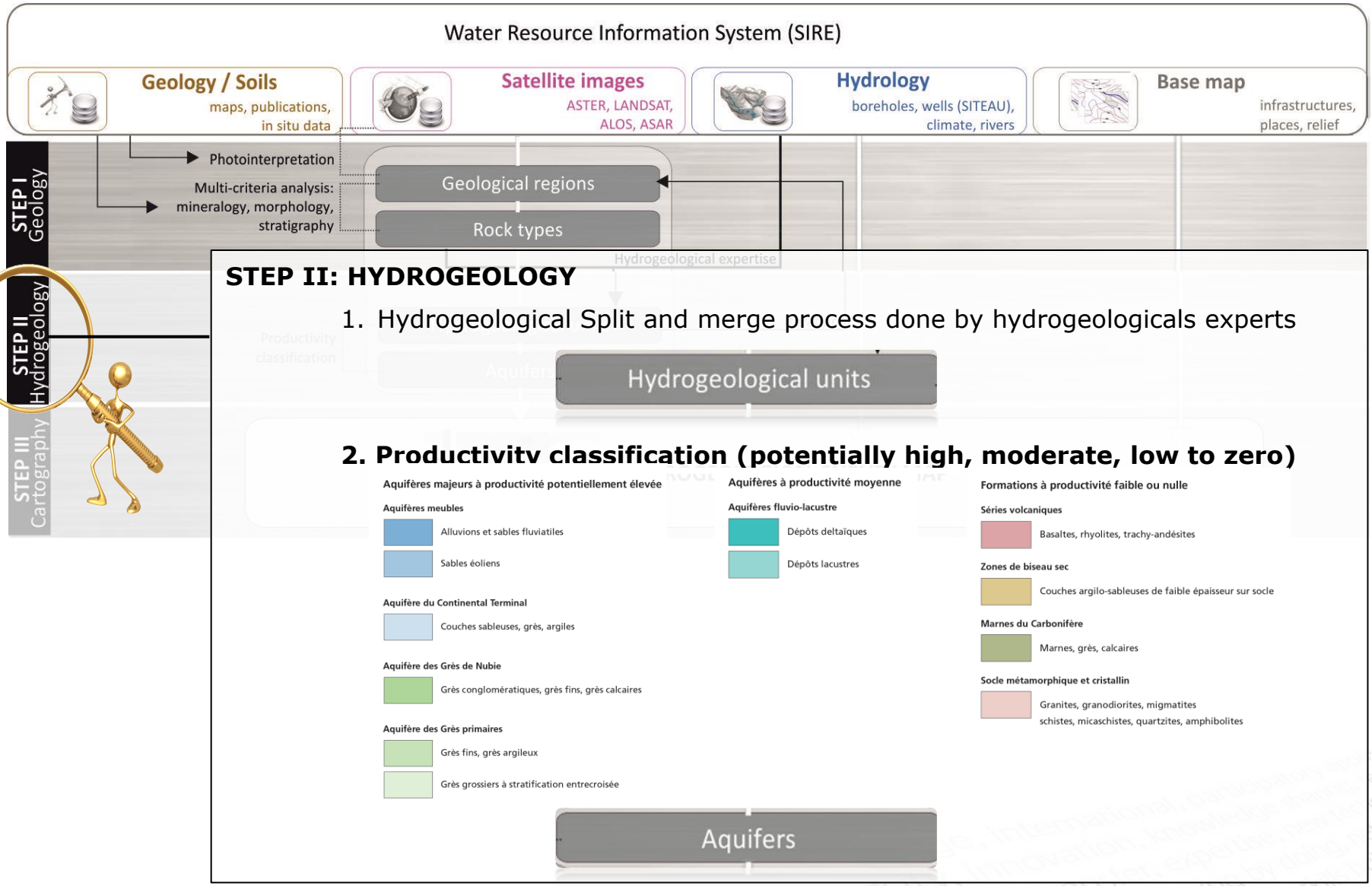
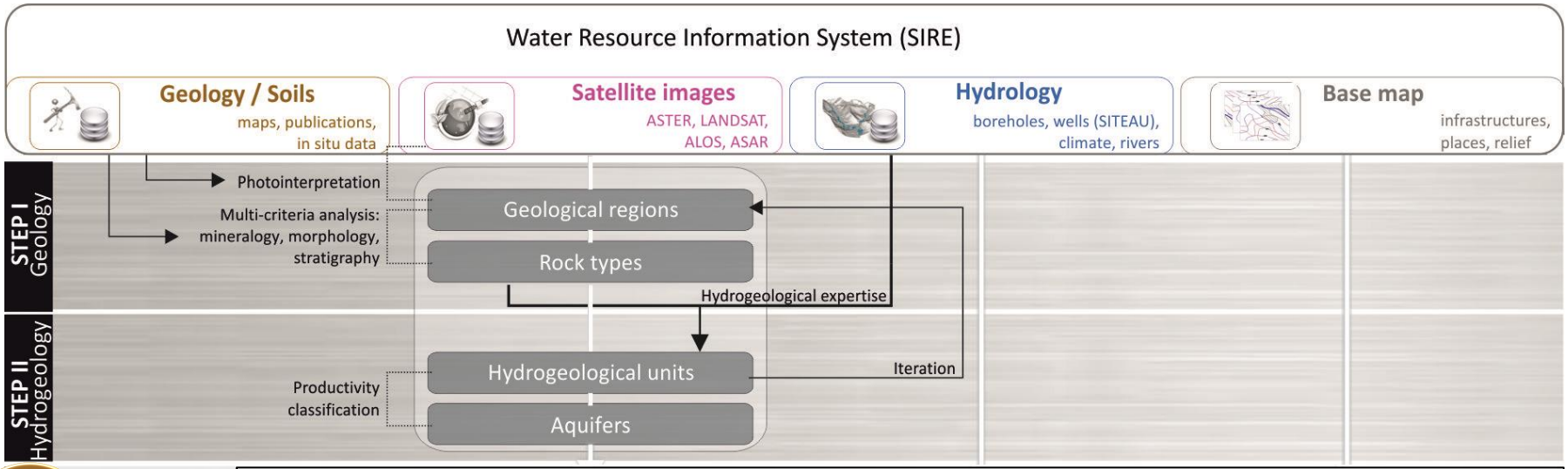
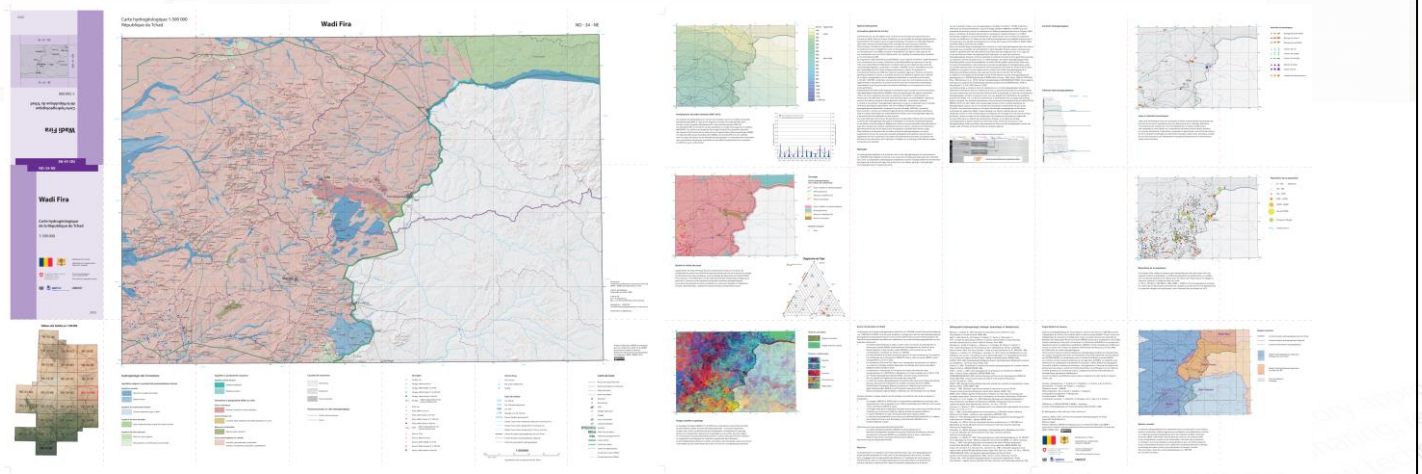


- Third step: Cartography



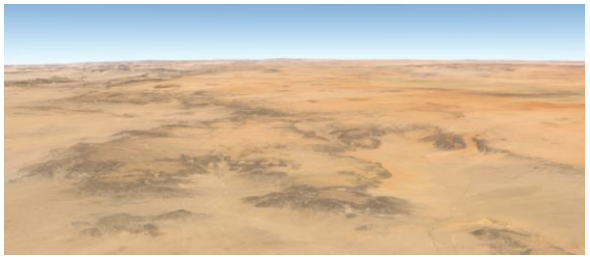
STEP III: CARTOGRAPHY



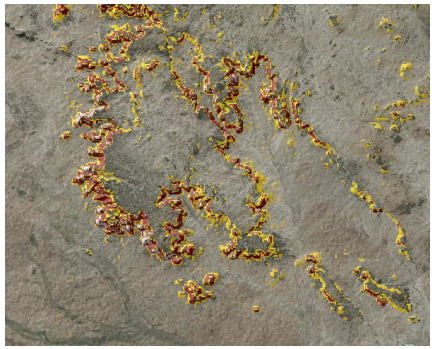
Wadi Fira hydrogeological survey map at 500k scale (**right**: front side of map; **left**: explanatory note on back side)

- Extract of SIRE database results on a « sandstone » request

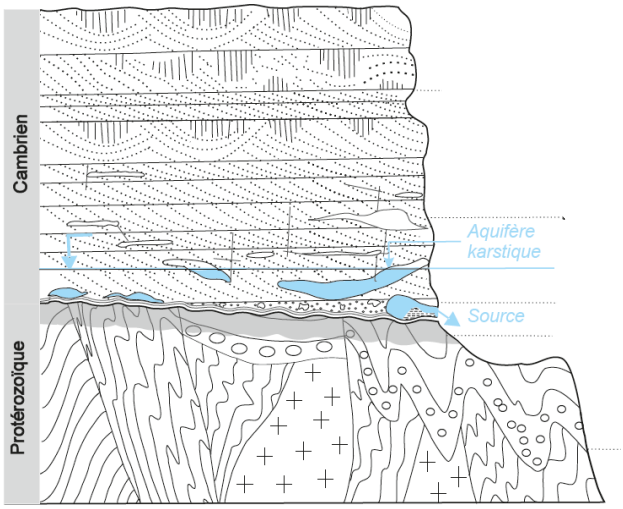
Sandstone field and macro views



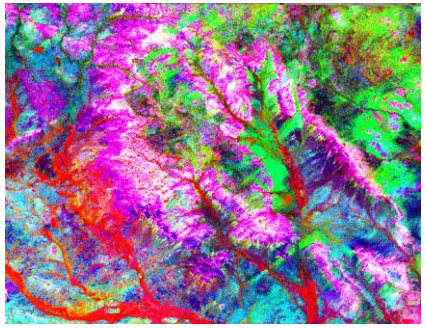
Google earth 3D view



SRTM slope map (200k)



Landsat-7 SUltan (200k)



Sandstone aquifer potential

Sandstone aquifer = high potential of productivity at the basement

- Current results & publications

Provide up-to-date and relevant water-related informations: SIRE

Hydrogeological maps

Improve the knowledge of different aquifers for a better management and further drilling programs.

Knowledge transfer : Professionnal Master 1 HydroSIG

UNOSAT training

- Further steps (to be planed)

Support Chad in water management, keeping in mind their sustainable development :

- Phase II: Water quality,
- Phase III: Water Management

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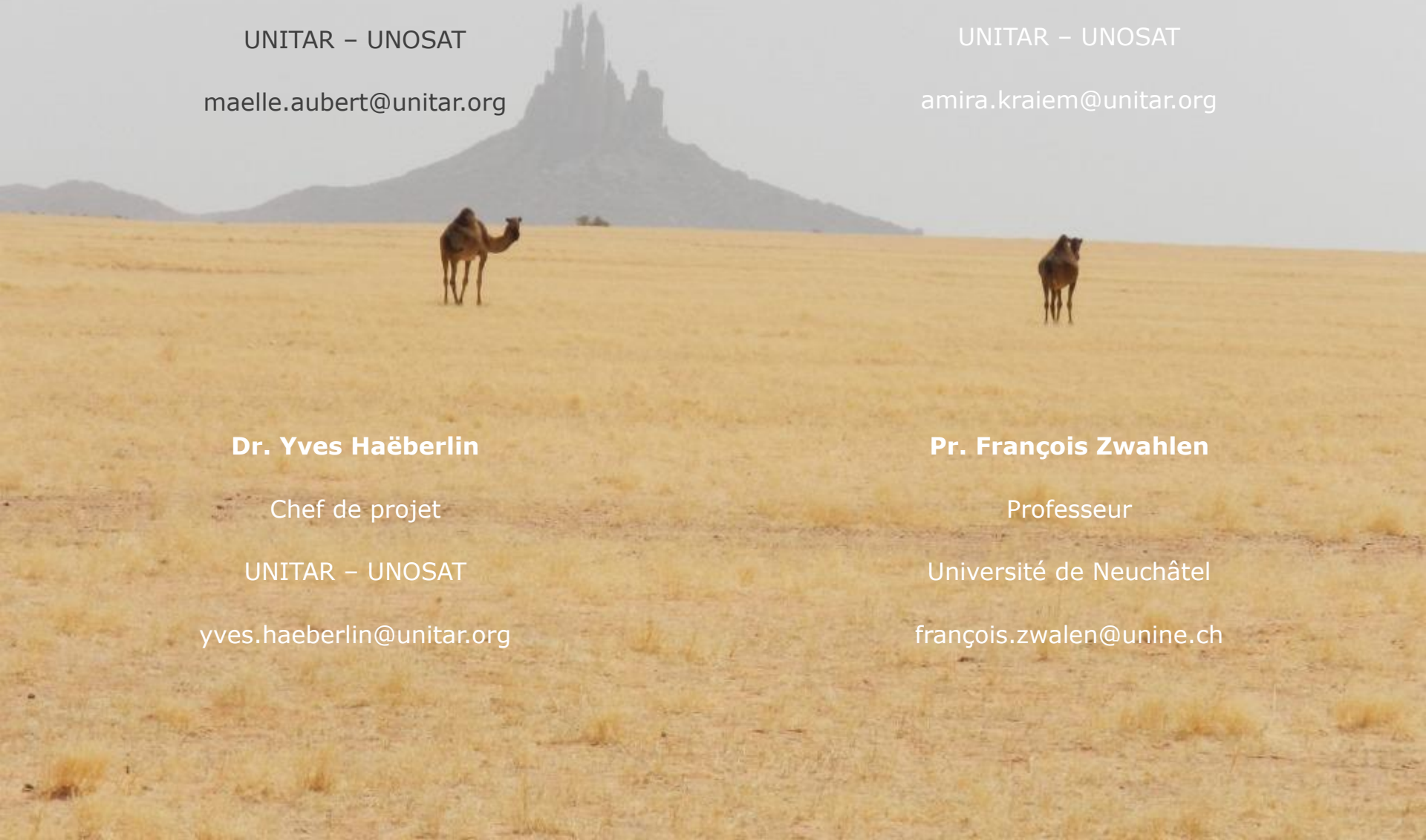

Dr. Yves Haëberlin

Chef de projet

UNITAR – UNOSAT

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Pr. François Zwahlen

Professeur

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