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**GEOLOGICAL MAPPING AND SOIL CHARACTERIZATION IN
IDENTIFYING AGRICULTURAL RELATED HAZARDS USING
FREELY-AVAILABLE COPERNICUS-SENTINEL DATA, LEADING
TO BEST-PRACTICES FOR SUSTAINABLE AGRICULTURE IN
TABULAR MIDDLE ATLAS/MOROCCO, BY**

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Plan

- ◆ **Introduction**
- ◆ **Methods and materials**
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- ◆ **Discussion**
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Introduction

- ❖ **Currently, 1.2 billion people live in Africa, in 2050 we will be 2.4 billion,**
- ❖ **Many limitations for african farmers lead to low productivity and low incomes,**
- ❖ **Some sub-saharan African countries don't get 25 % potential farmland output,**
- ❖ **In Africa , farming is rain fed activity which makes it much vulnerable to climate change .**



Introduction (next)

- ❖ **Low smallholder farmer's productivity and incomes lead to poverty, hunger and lack of development.**
- ❖ **In 2000, Morocco lost 1-1.4 % GDP due to water problem issues and 0.3-0.6 % GDP due to Soil and forest deteriorations,**
- ❖ **Mitigation and adaptation require infrastructures and best technologies,**
- ❖ **Sentinel data for best agriculture practices and ensure the quality of water and environmental protection,**



Introduction (next)

- ❖ **Tabular Middle Atlas (TMA)/Morocco holds the main source of water,**
- ❖ **It is used for agriculture, sanitation, construction , gardening, etc.**
- ❖ **Geologically TMA is dominated by carbonated rocks,**
- ❖ **These rocks have developed sinkholes by which fertilizers and herbicides penetrate, reach water reservoirs and affect the health of millions of people.**
- ❖ **Witnessed by chemicals, clay, minerals and turbidity found in Springs water,**

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Results

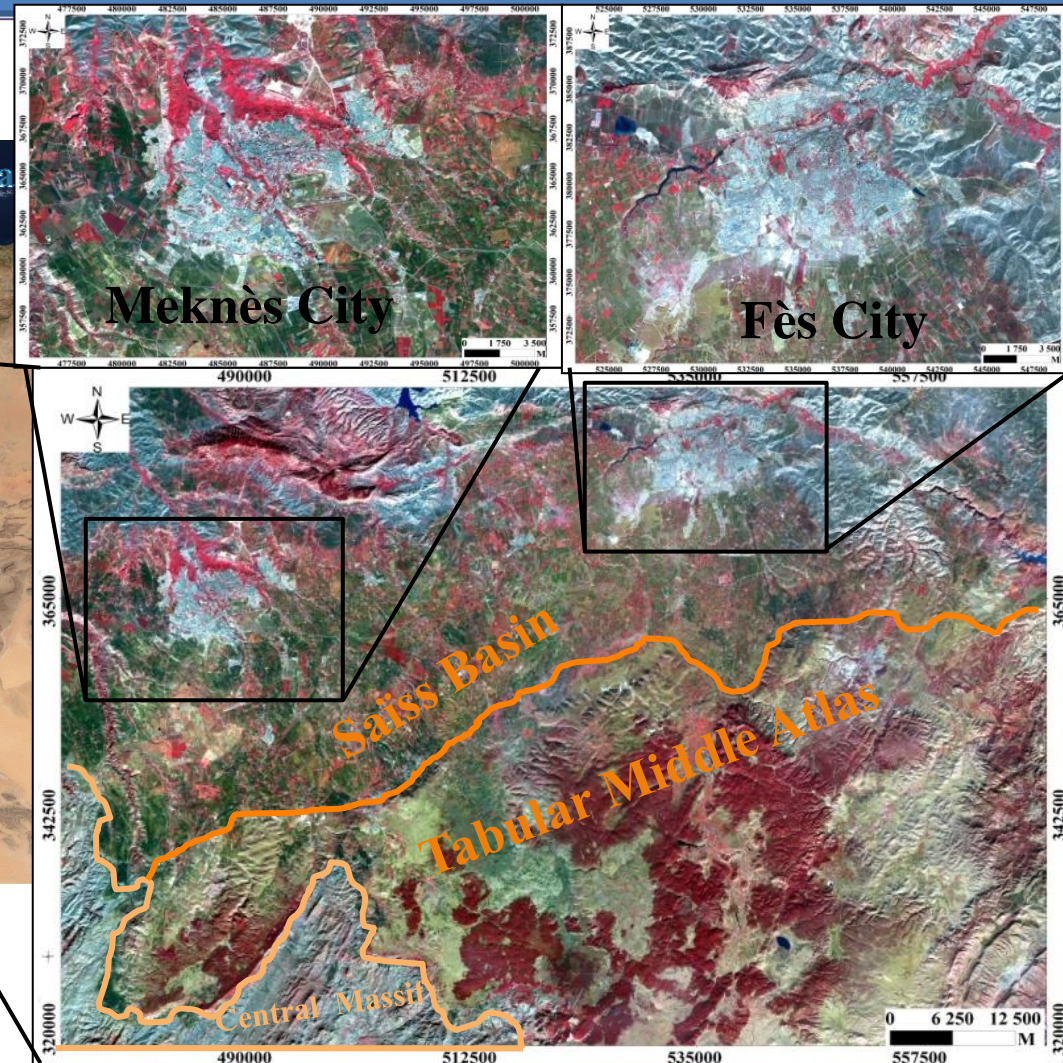
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Introduction (next)

Area of Study



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Methods and materials

- ❖ We mapped the geology and soil characteristics ,
- ❖ To do so we use Copernicus data, available archives and other satellites images ,
- ❖ Using QGIS and SNAP desktop softwares we processed Copernicus Sentinel-2A,
- ❖ We first perform atmospheric corrections using QGIS and after SNAP desktop
- ❖ Bottom of Atmospherere reflectance found to distinguish the landcover objects,
- ❖ Soil reflectance : 400 to 1450 nm, vegetation : 675 nm and carbonate rocks: 345 to 2500 nm



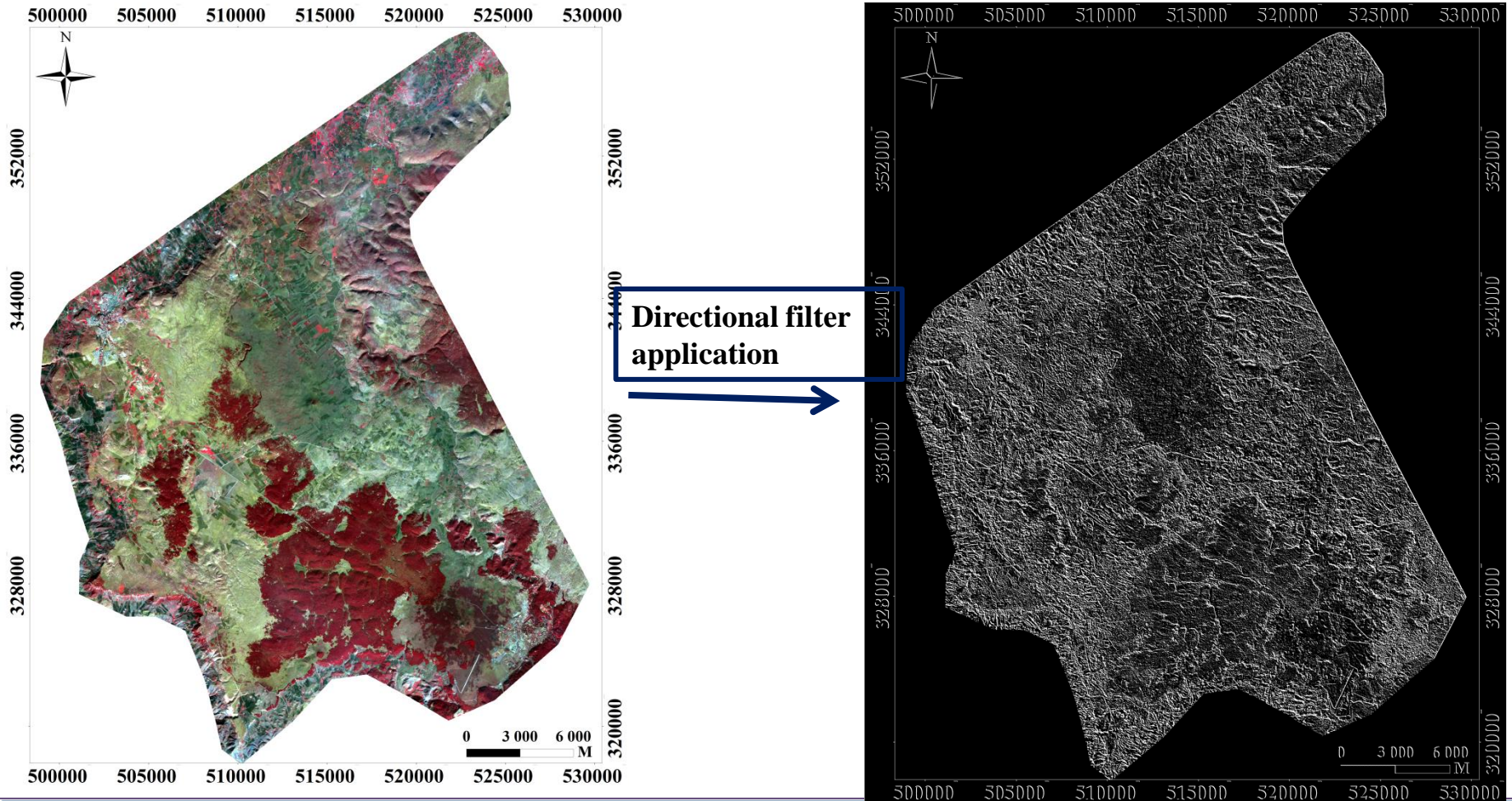
Methods and materials

❖ These values helped us choose bands for band combination, band ratio and band math techniques to map geology, soil moisture (NDWI: normalized difference water index) and vegetation health (NDVI: normalized difference vegetation index).

❖ Filter image techniques (directional filter:Sobel) were used to extract the lineaments along with photo-interpretation technique we got fractures in carbonate rocks which are involved in hydrogeologic and karstic systems of TMA.

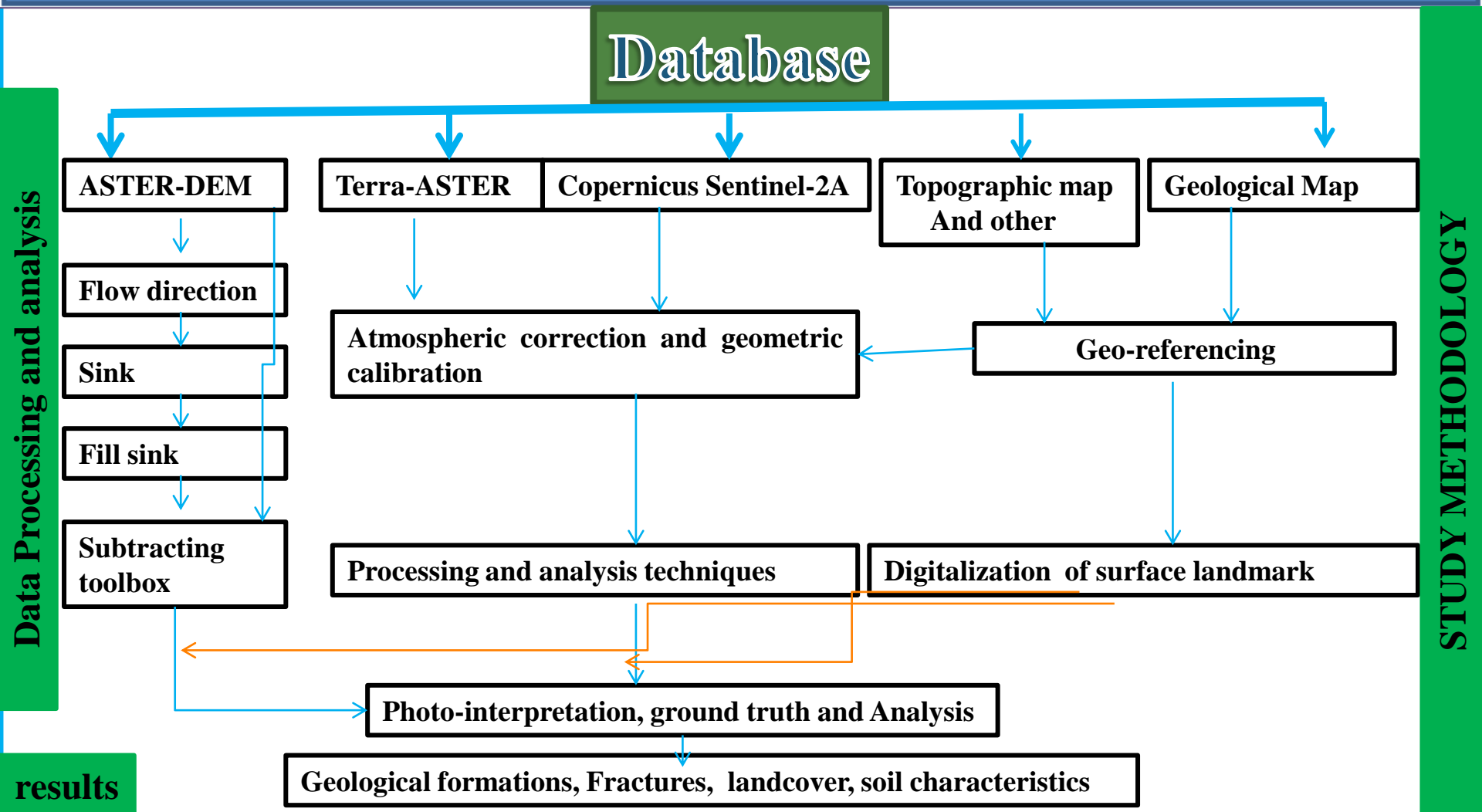


Methods and materials (next)





Methods and materials (next)



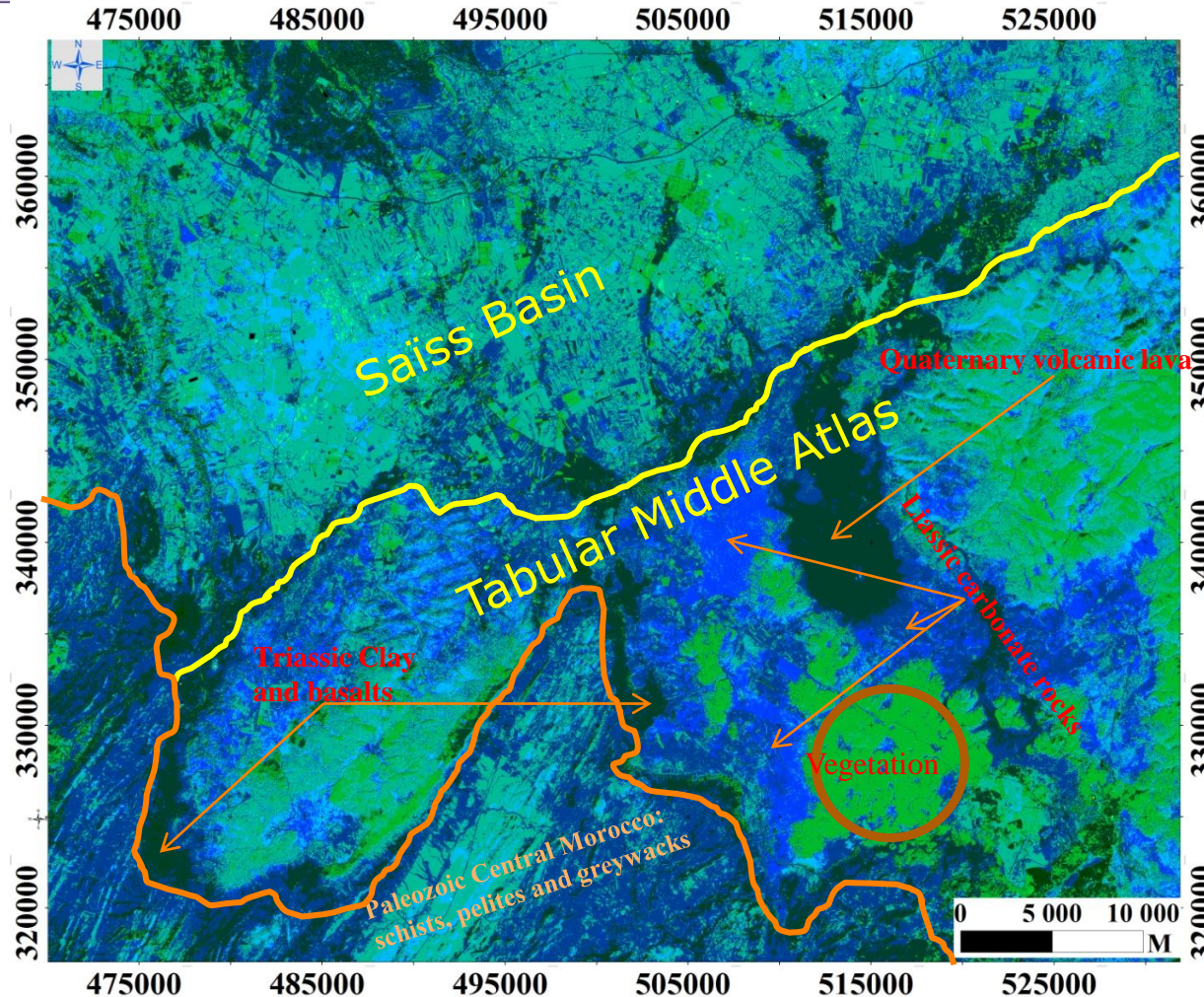
Data Processing and analysis

STUDY METHODOLOGY

results



Results



Soil-parent material mapping in TMA using Sentinel data shows :

- 53 % carbonate rocks,
- 15 % soil in basalts and clays,
- 30 % vegetative cover (forest, farming areas and other vegetation),
- 0.9 % artificial construction and water surface for the rest.

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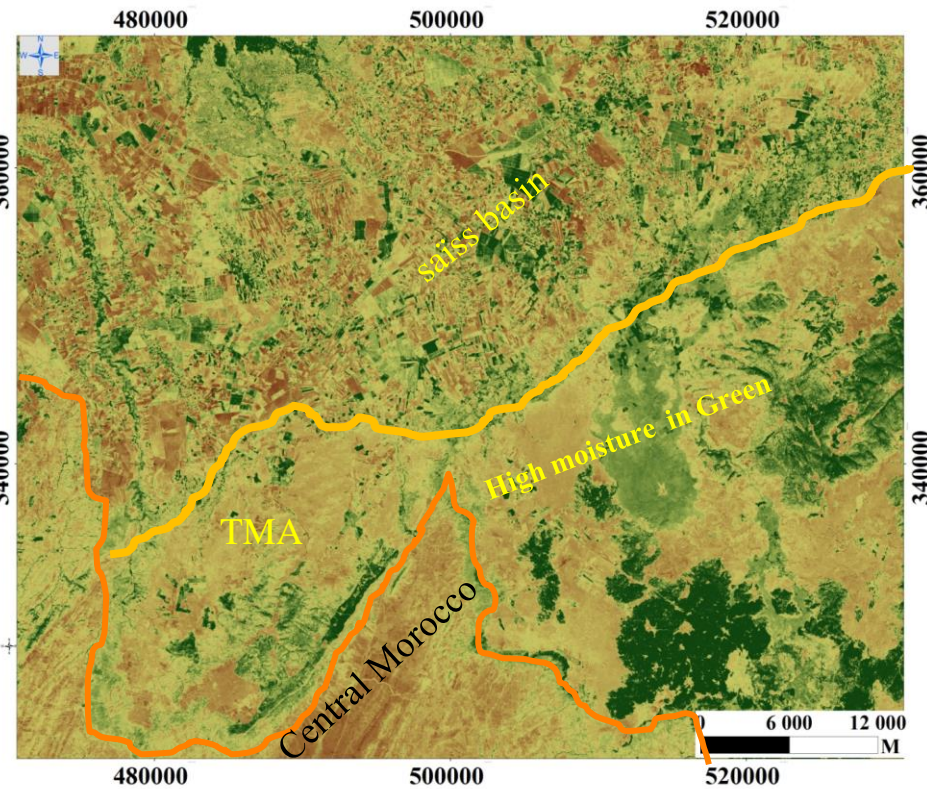
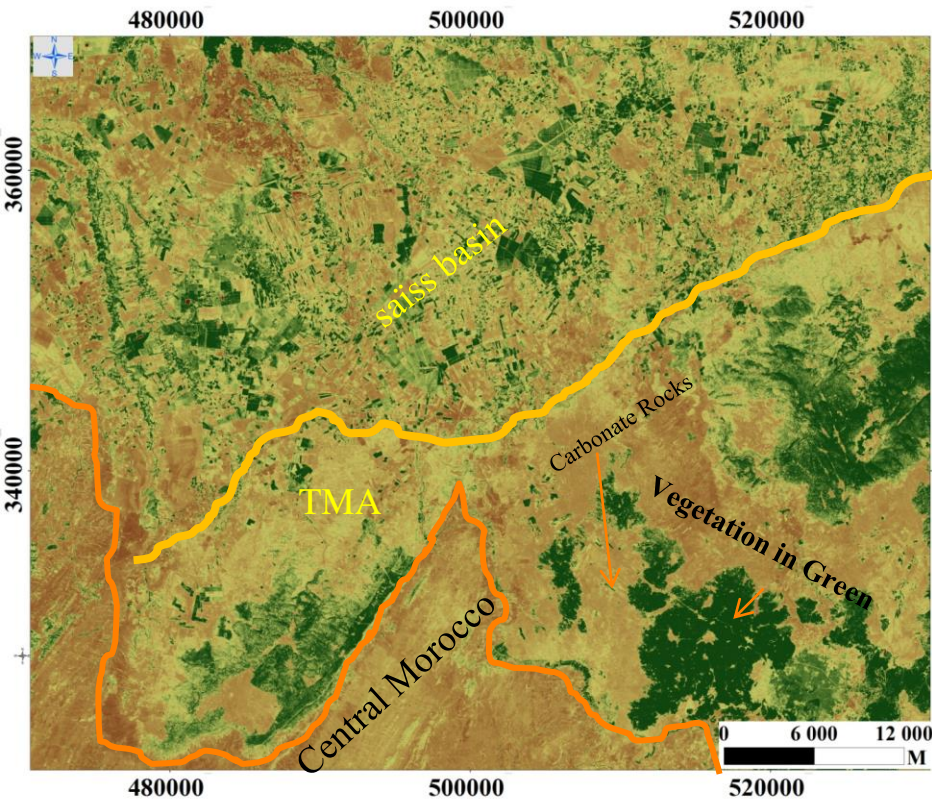
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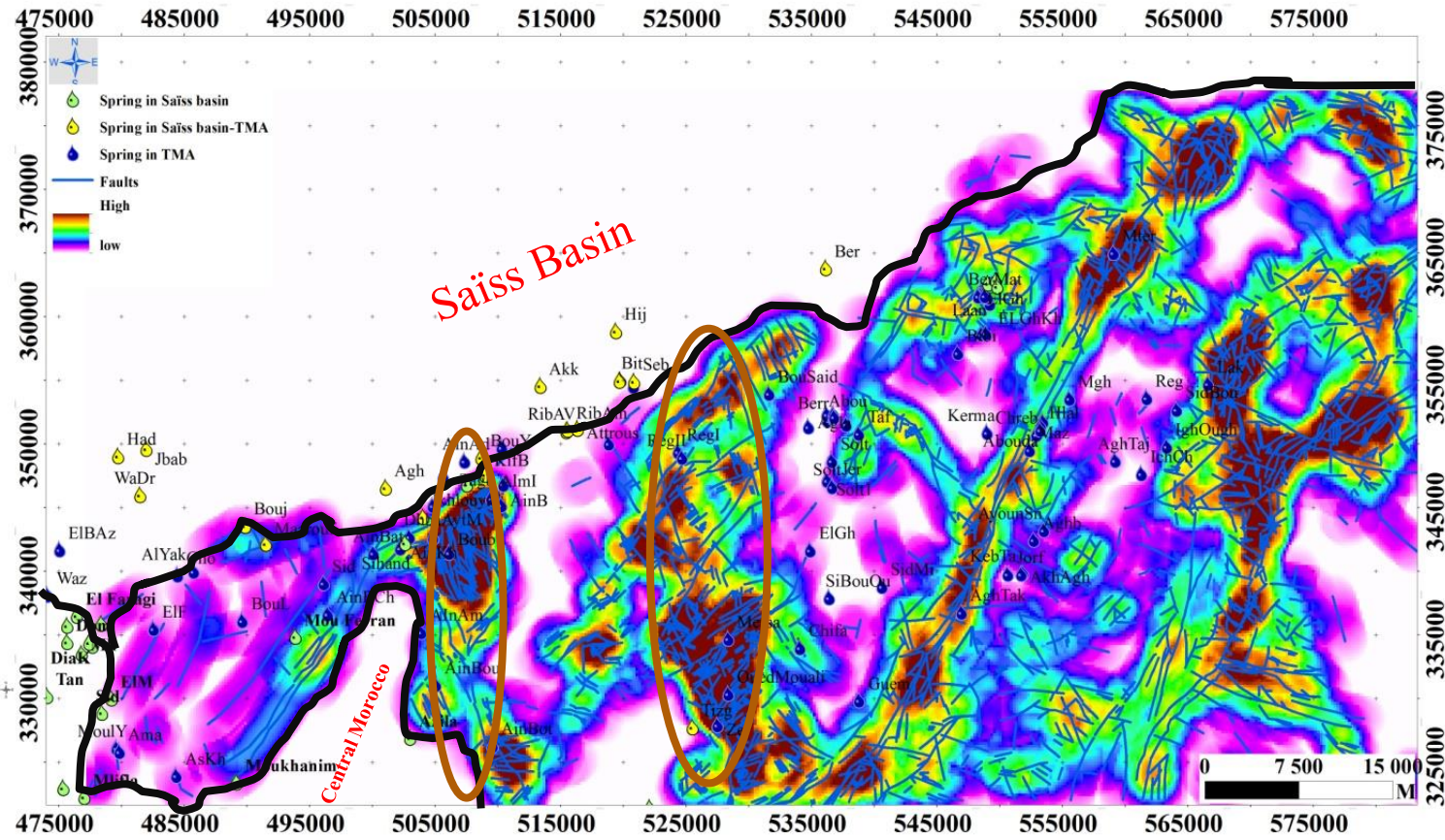
$NDVI = (B8 - B4) / (B8 + B4)$ estimated from Copernicus Sentinel-2A of 30 October 2016.

$NDWI = (B8A - B11) / (B8A + B11)$ estimated from Copernicus Sentinel-2A of 30 October 2016

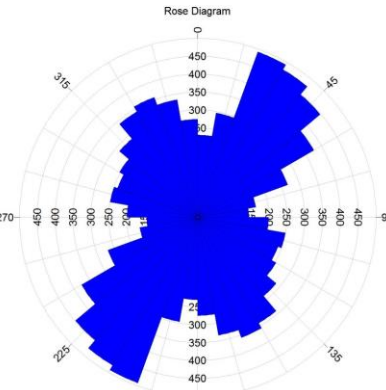
NDVI values (0.3-0.8) for health vegetation, (0.1-0.2) for soil and 0 for water. NDWI indicates the moisture of soil and is involved in water cycle



Results (next)



2 directions of fractures: NE-SW and NW-SE. High density in Carbonate rocks



Intensity of fractures extracted on Copernicus Sentinel-2A .

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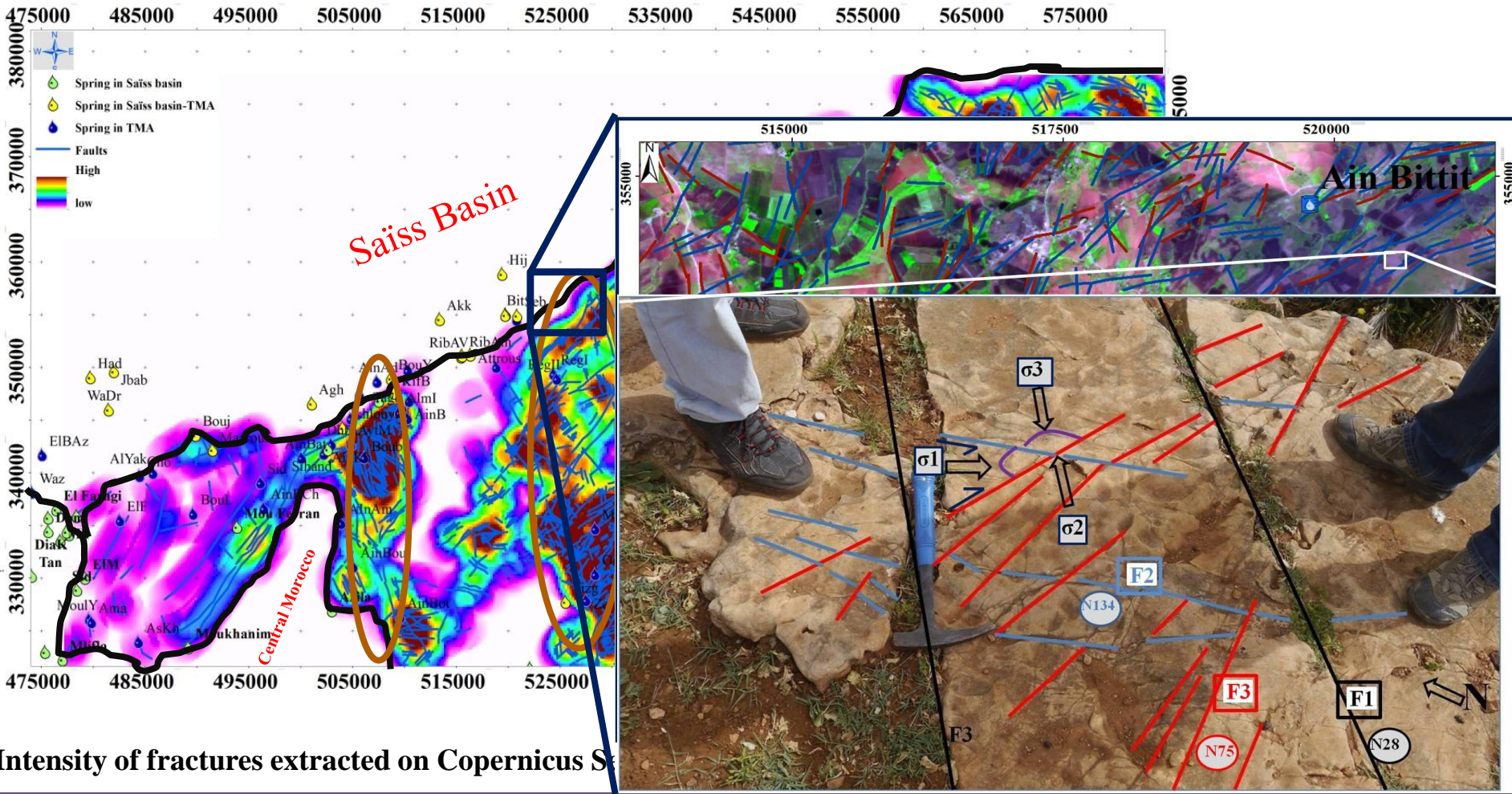
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Intensity of fractures extracted on Copernicus S

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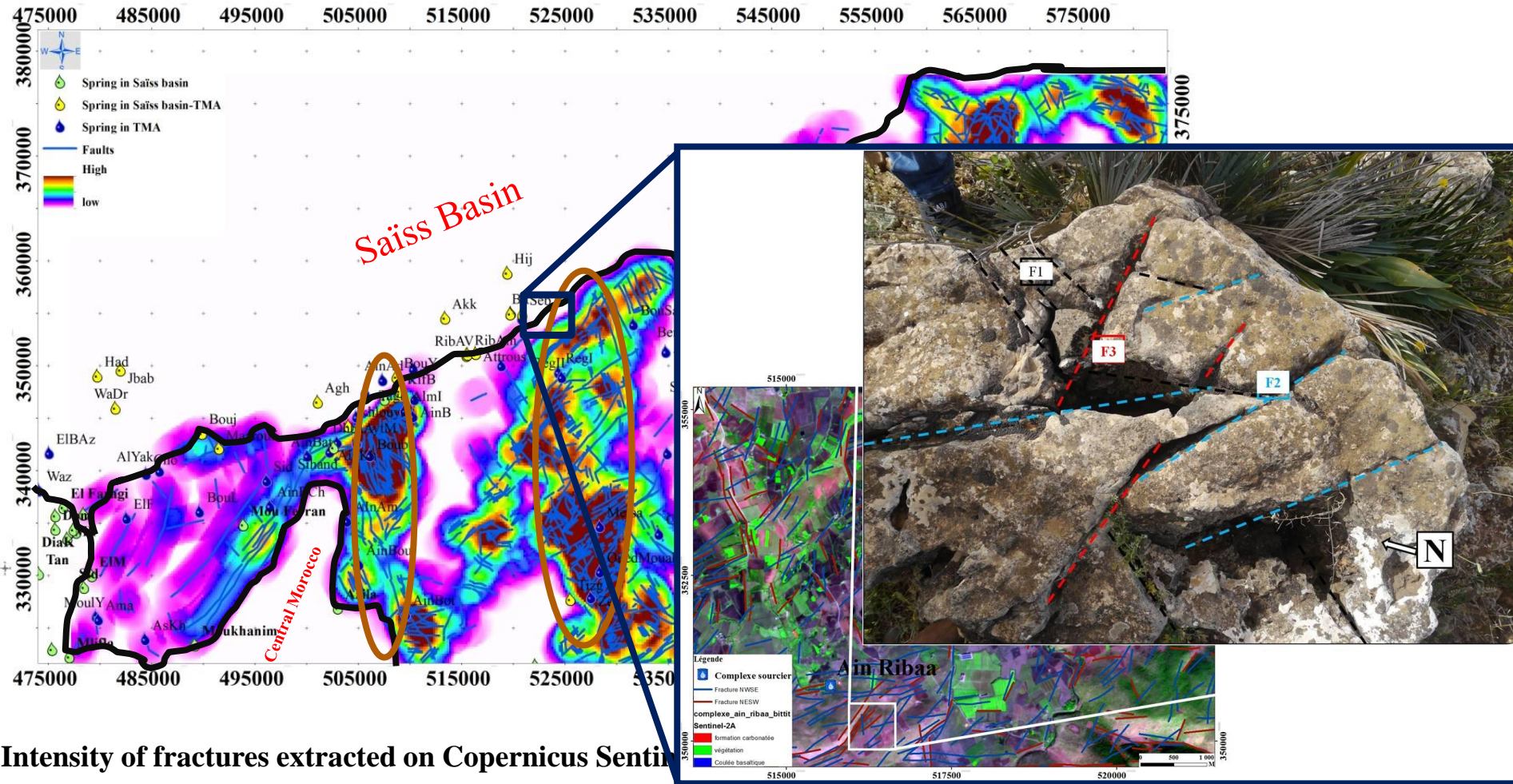
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Intensity of fractures extracted on Copernicus Sentinel-2A

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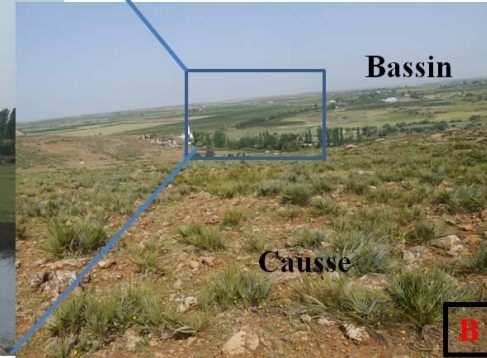
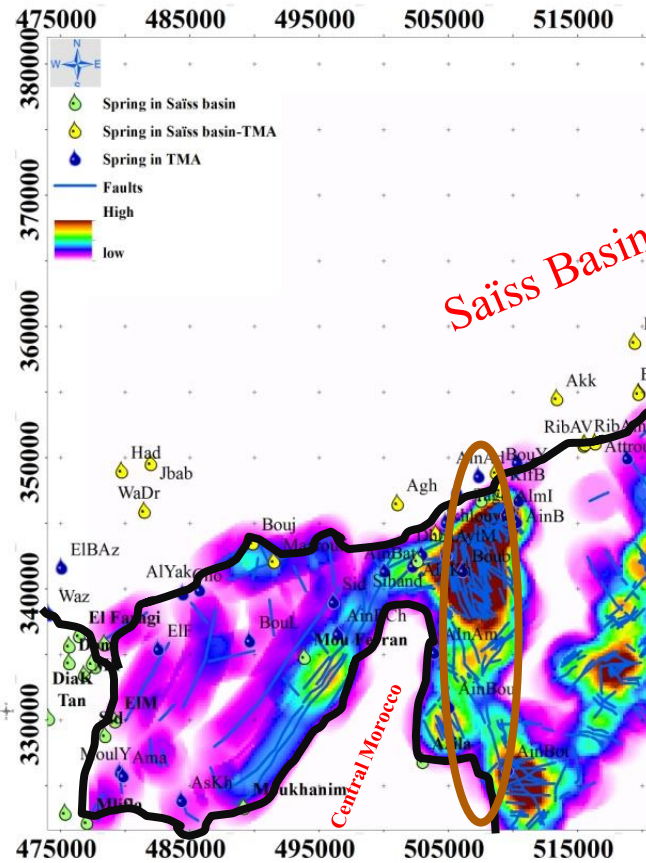
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Intensity of fractures extracted on Copernicus Sentinel data

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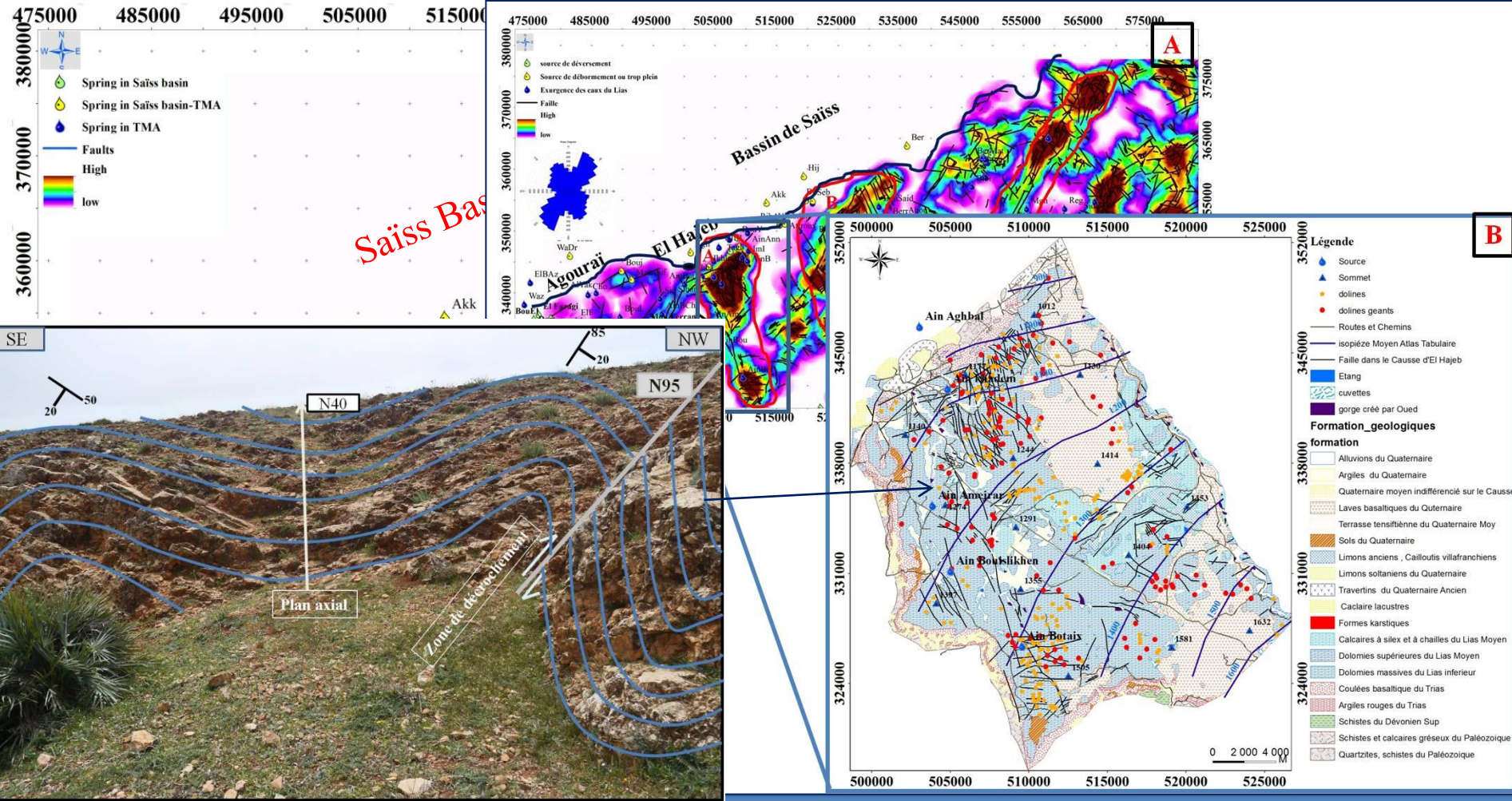
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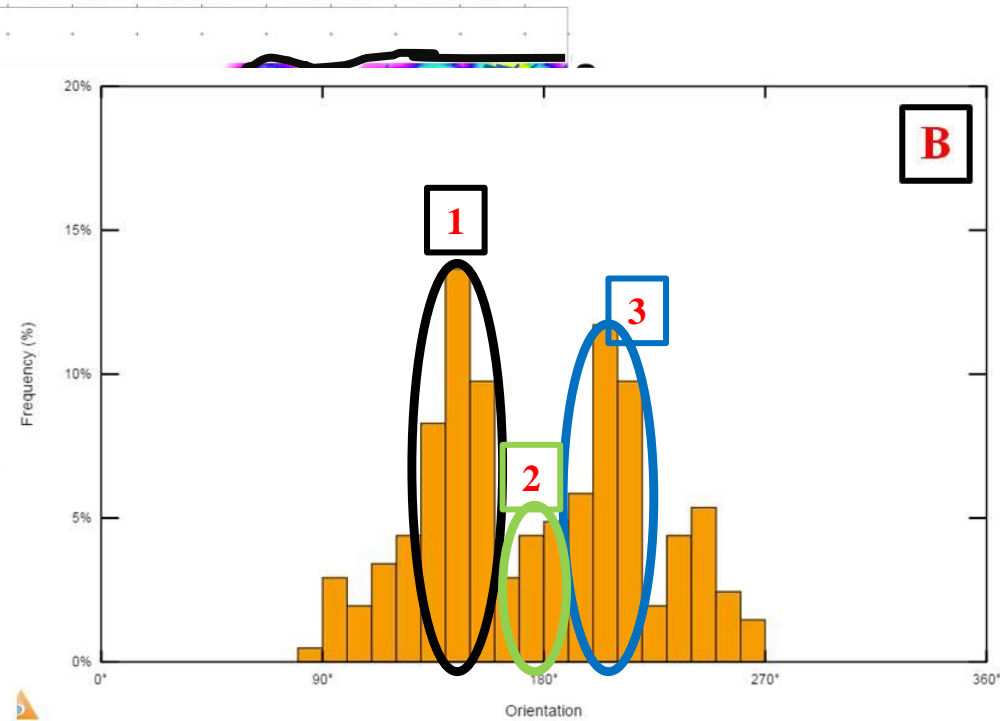
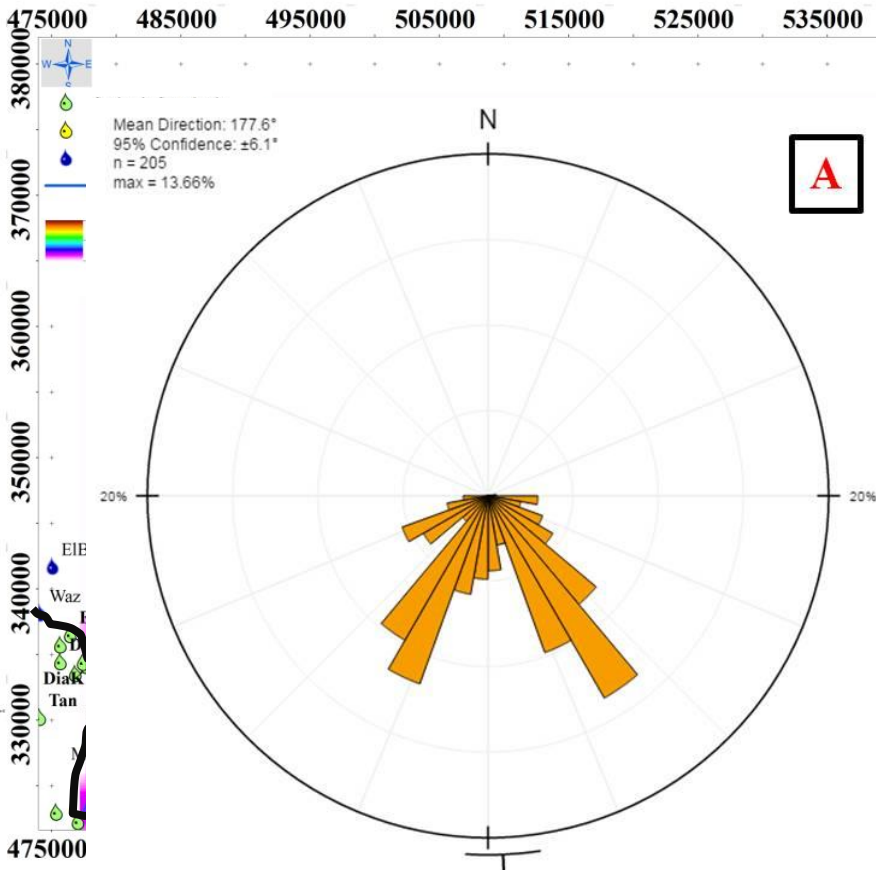


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Results (next)



- 1-NE-SW fault represents 37 %
- 2-Sub-meridian Fault represents 22%
- 3-NW-SE Fault represents 30 %

Fracturation in the area of Ribaa-Bittit springs

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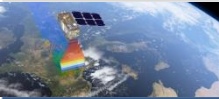
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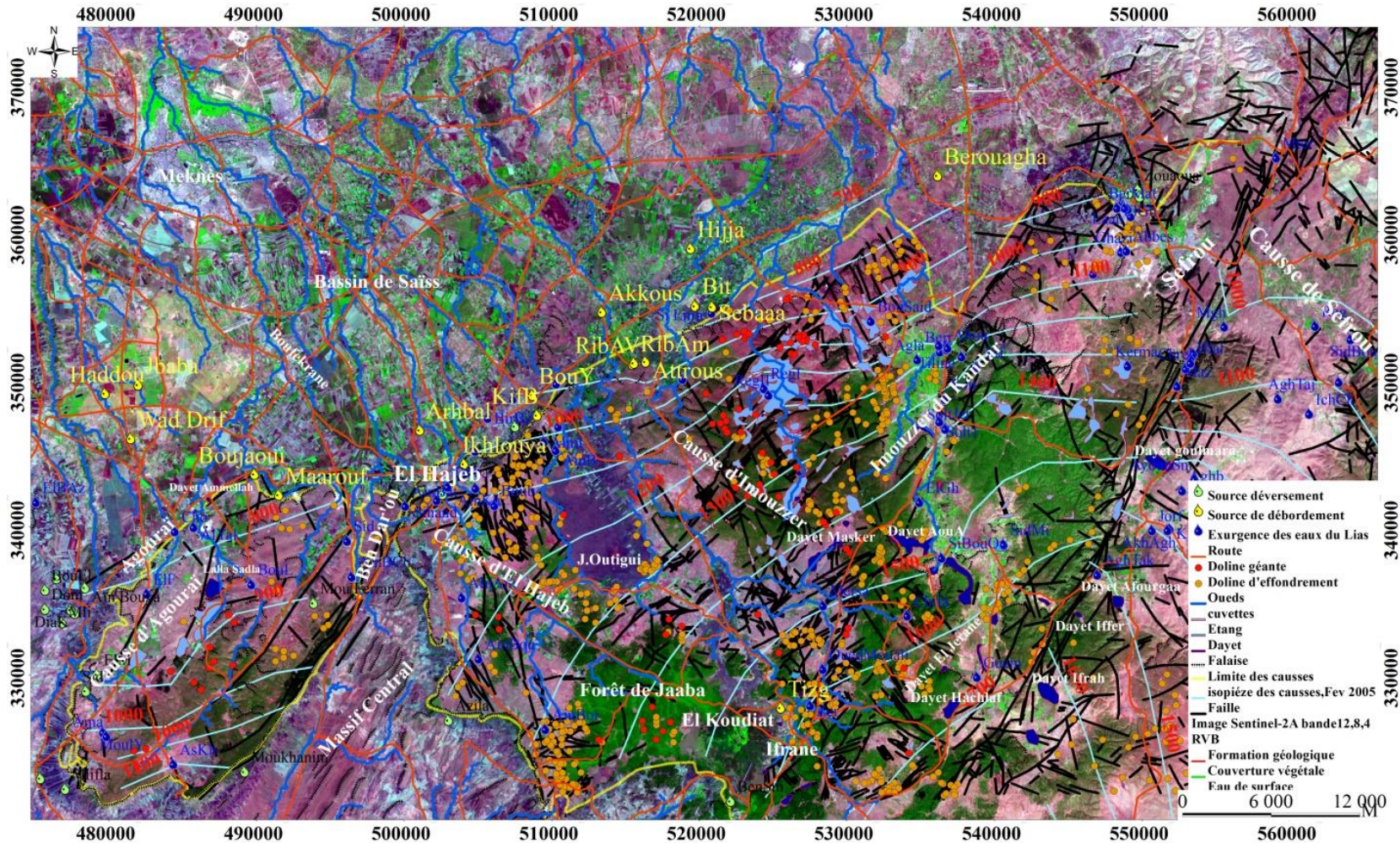
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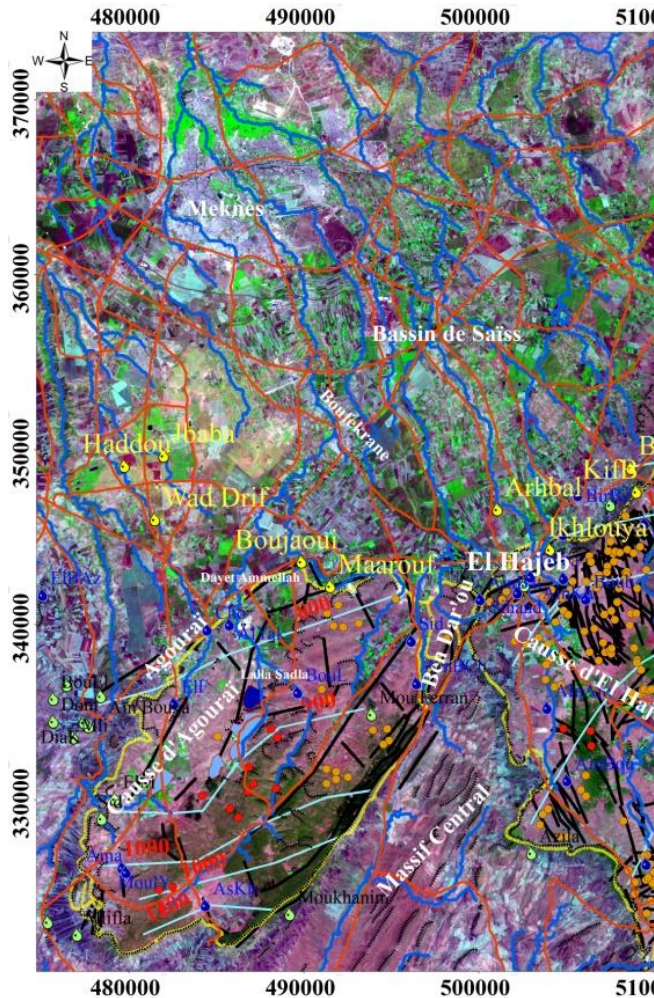
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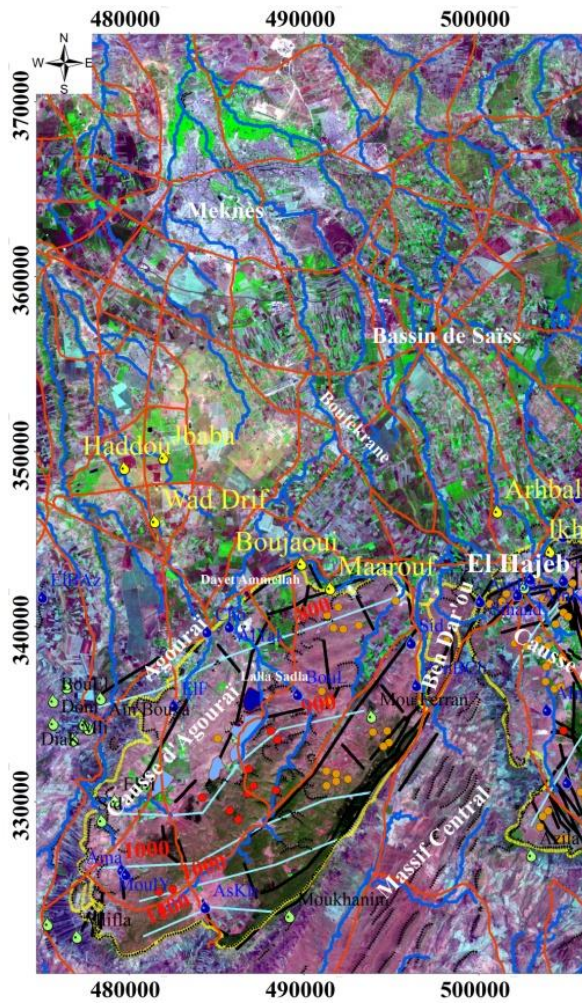
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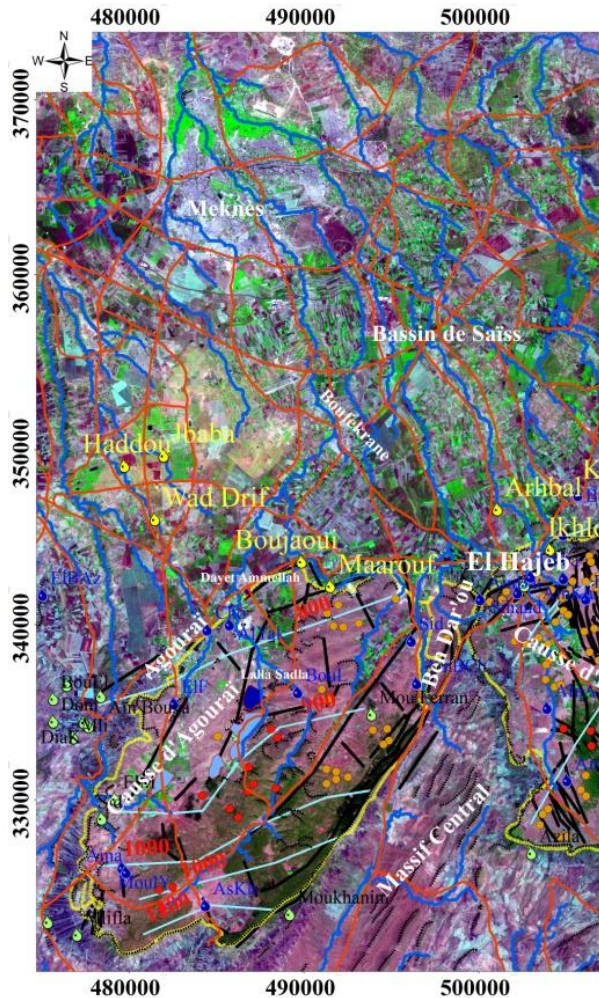
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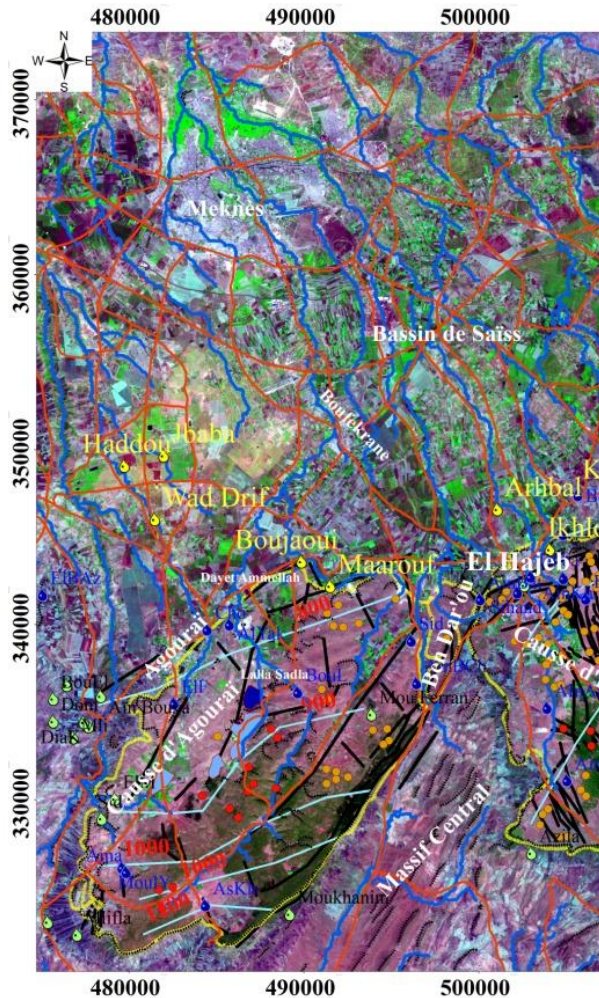
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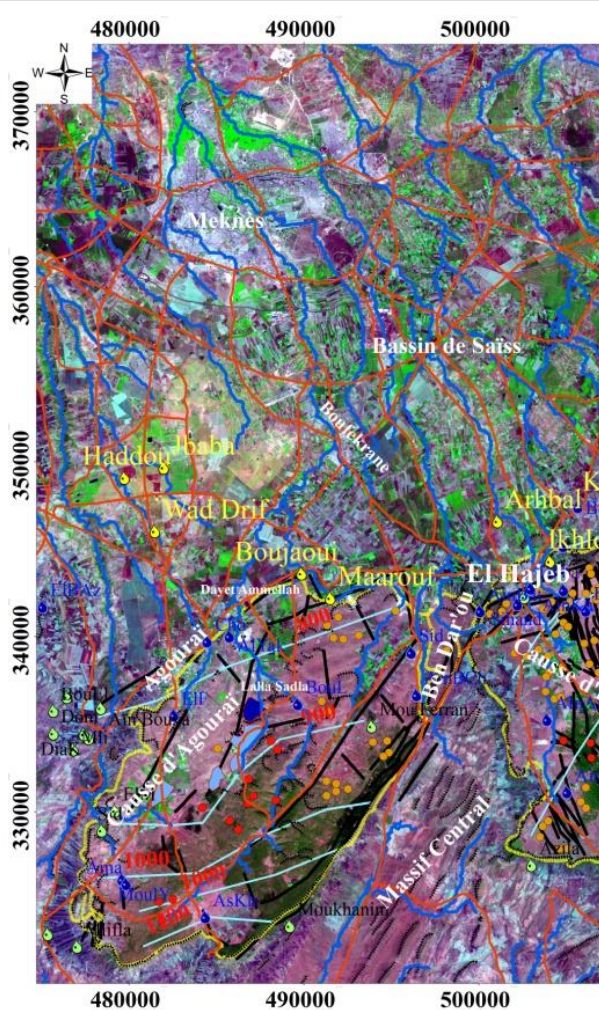
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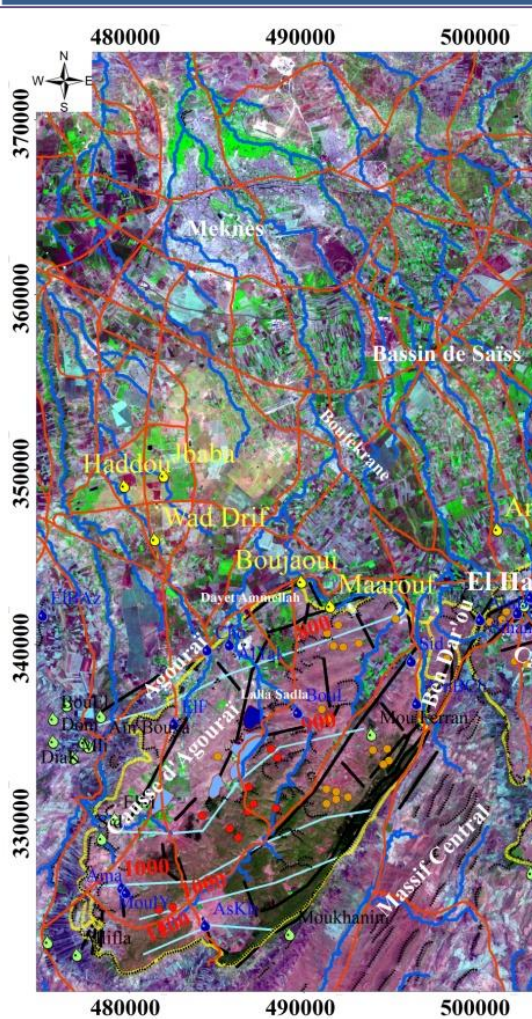
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Discussion



- ❖ **Satellite technology applications for farmers in Africa are limited,**
- ❖ **Probably due to lack of qualified personal or lack of financial capacity,**
- ❖ **Use of open and free data to monitor, protect and manage our environment and our natural resources, will boost productivity and economy,**
- ❖ **This study shows the capacity of space technology to handle hazards related to agriculture, environment or climate change.**



Discussion

Information provided by NDVI and NDWI will help Farmers in Africa reschedule agricultural activities while geologic and soil mapping can be used to minimize and manage environmental hazards and ensure food security.



Conclusion

- ❖ **Sentinel-2A images to map geology and soil characteristics in order to minimize the environmental impact in Meknès-Fès/Morocco.**
- ❖ **We evaluate the soil quality based on physical and chemical characteristics.**
- ❖ **Sinkholes found in which water containing chemicals and turbidity infiltrate and reduce the water quality .**
- ❖ **limited areas that contain these holes to reduce both human and natural activities.**
- ❖ **Contribution to sustainable development and a Safe future for the people**

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