

Remote Sensing for the Study and Management of Water Resources in Mediterranean Landscapes (Tensift Watershed, Marrakech, Morocco)



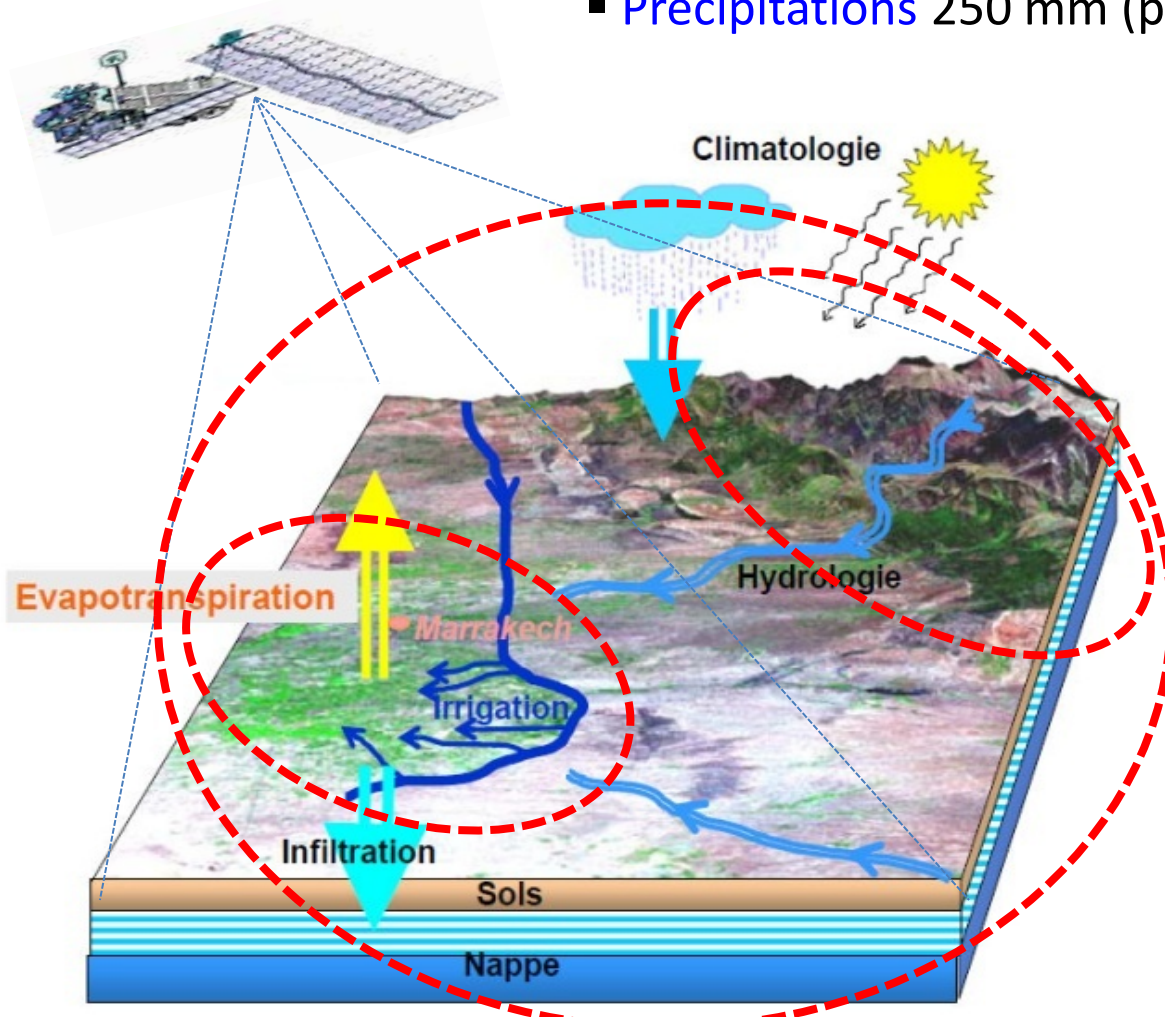
Objectives of the TREMA Laboratory

Understanding the hydrological functioning of semi-arid watersheds to design management tools and study the impact of global changes

The Tensift Watershed (Marrakech, Maroc)

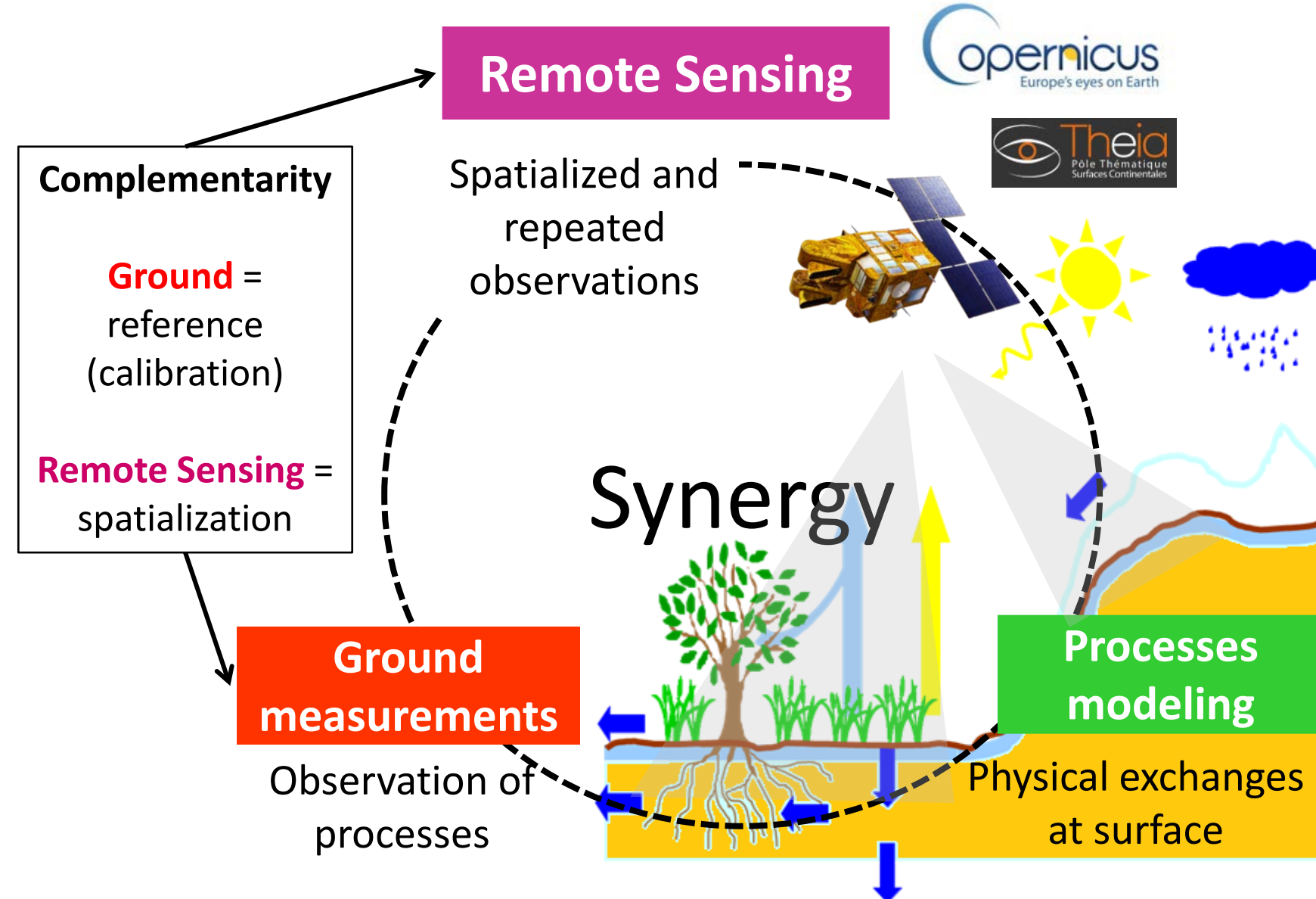
➤ A typical South Mediterranean hydro-system

- Reference Evapotranspiration 1600 mm/year
- Precipitations 250 mm (plain) to 600 mm (montagne)



- Water production in mountains (altitudes 500-4167m), especially as snow.
- Water use in plain is mainly for irrigation (85%)
- Overexploited aquifers (agriculture, domestic use => decrease ~1m/an) => Integrated watershed modeling.

The scientific approach

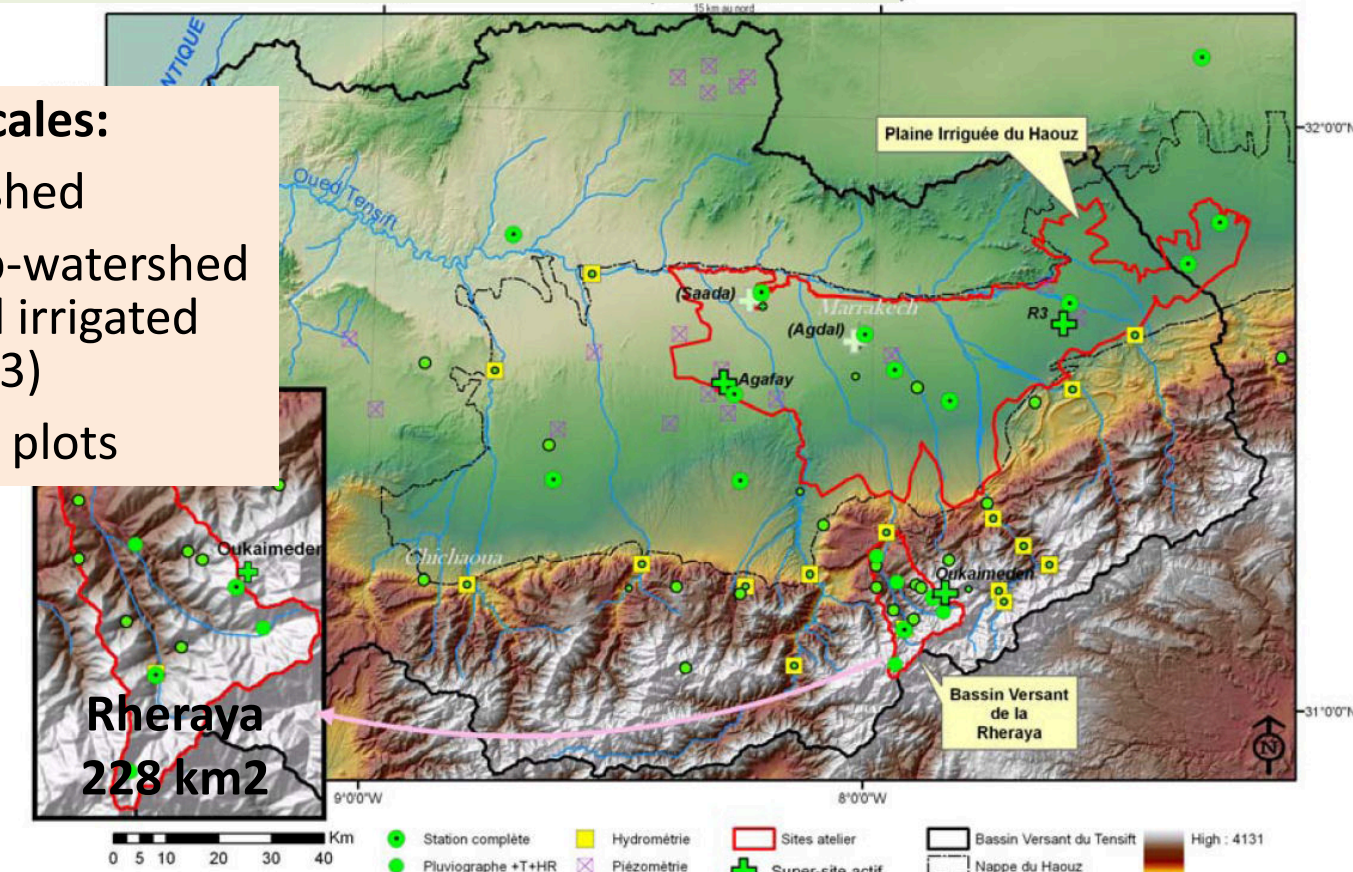


The Tensift hydro-meteorological observatory

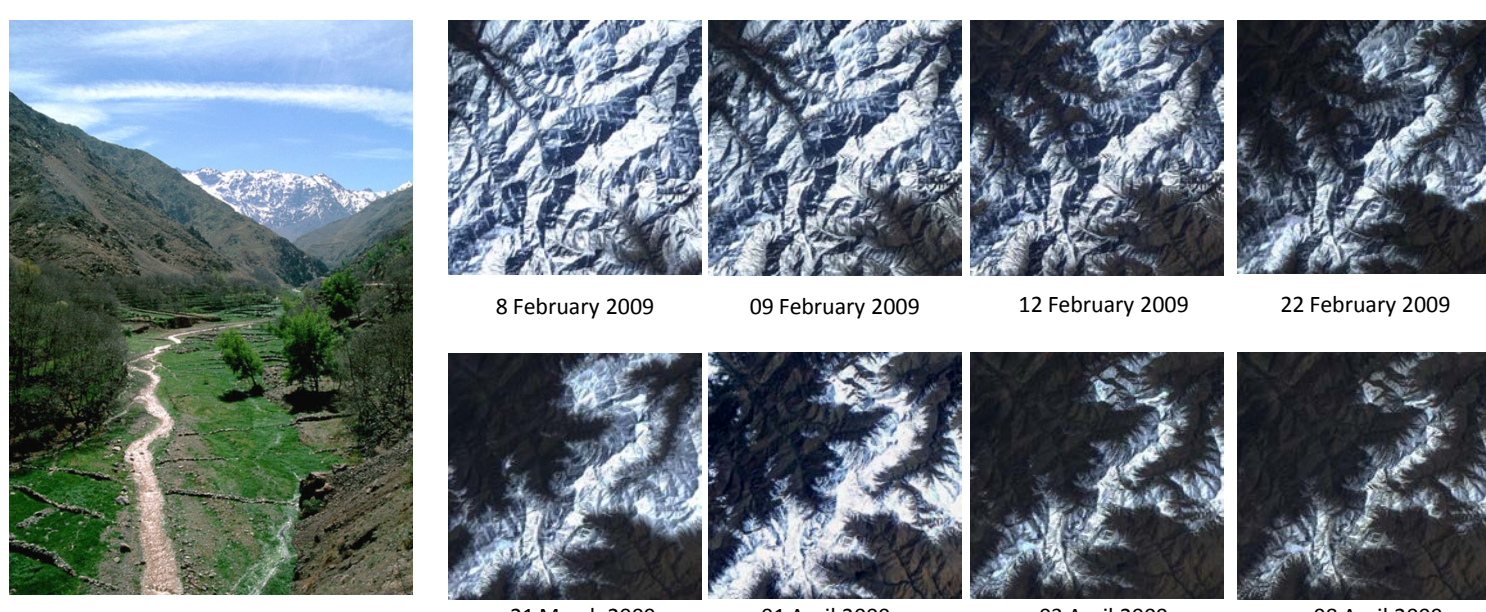
- Around 10 complete meteorological stations
- Crop fluxes stations, 2 to 3 campaigns each year
- Runoff, piezometry, rainfall (ABHT, ORMVAH)
- One photometer (Aeronet network)

Several spatial scales:

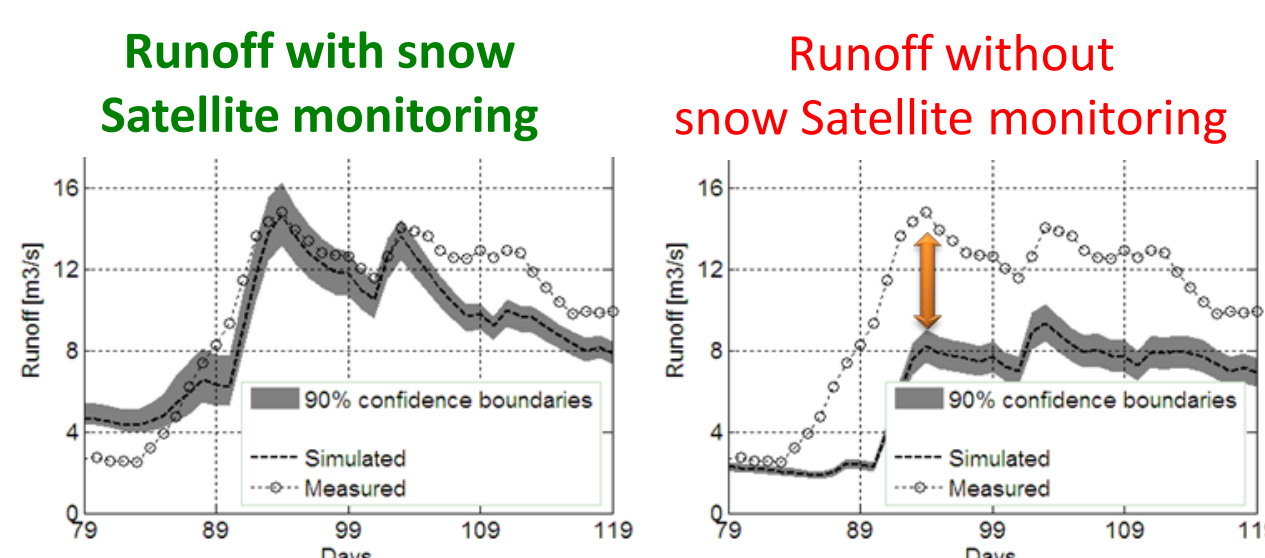
- Whole watershed
- Mountain sub-watershed (Rheraya) and irrigated perimeters (R3)
- Instrumented plots



Monitoring water resources in mountains



Snow cover monitoring with VIS-NIR data (Sentinel2, Landsat, etc.)

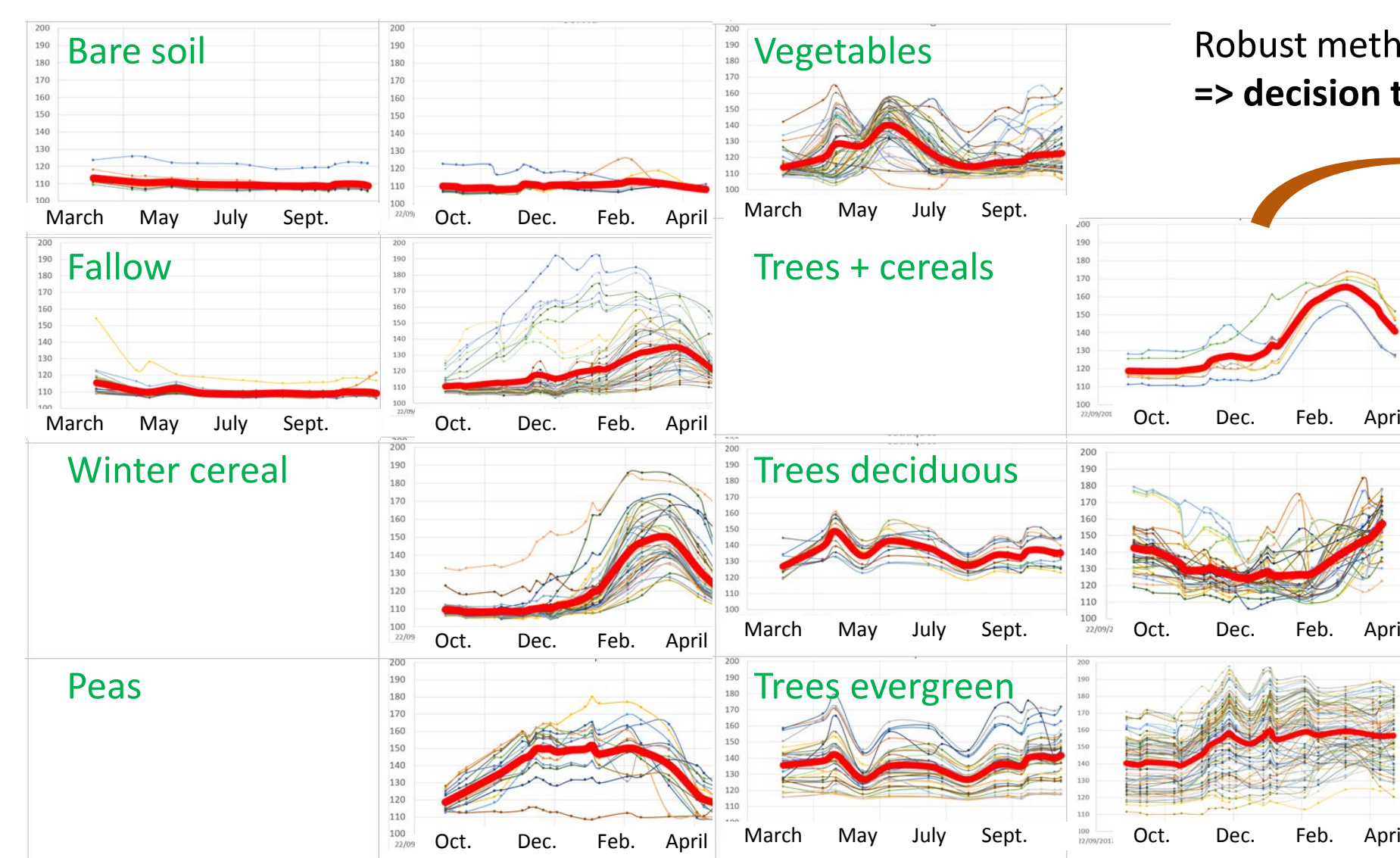


➔ Improving the functioning of hydrological models

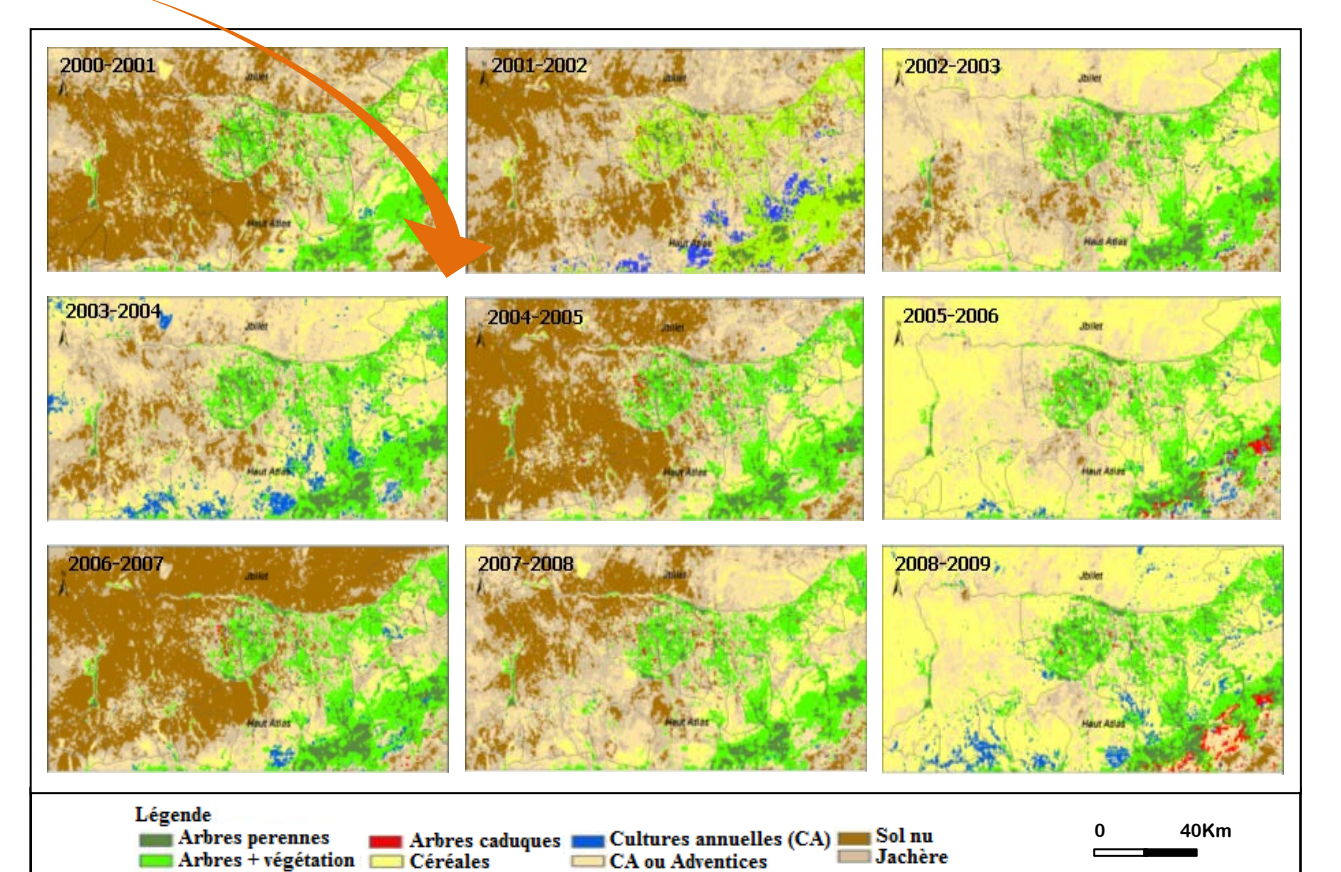
➔ Satellite monitoring compensate for gaps in the ground observation network

Land cover mapping

Exploiting the repetitivity of sentinel-2 time series

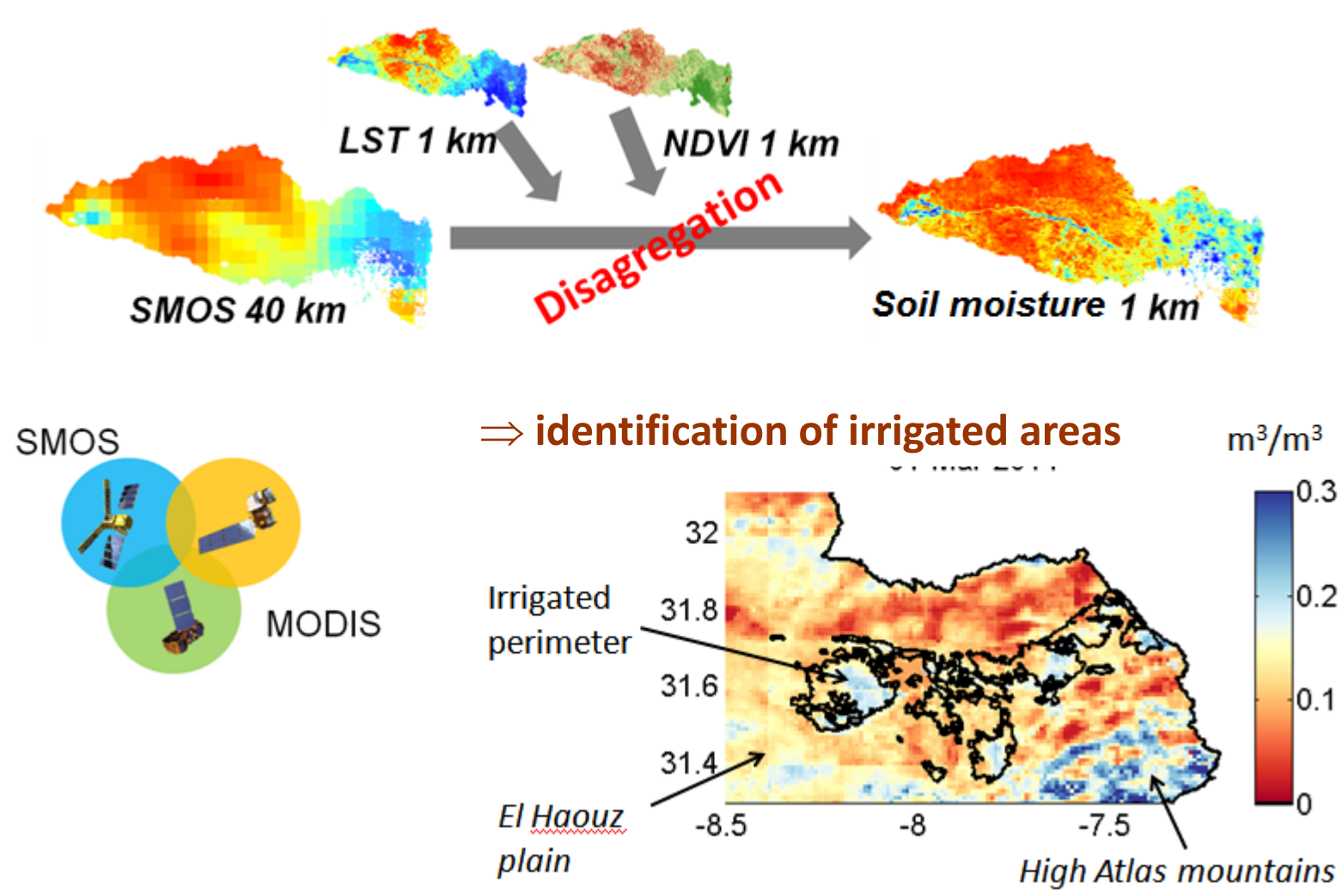


Robust methods to cope with the strong vegetation variability => decision trees based on expert rules (no annual training required)



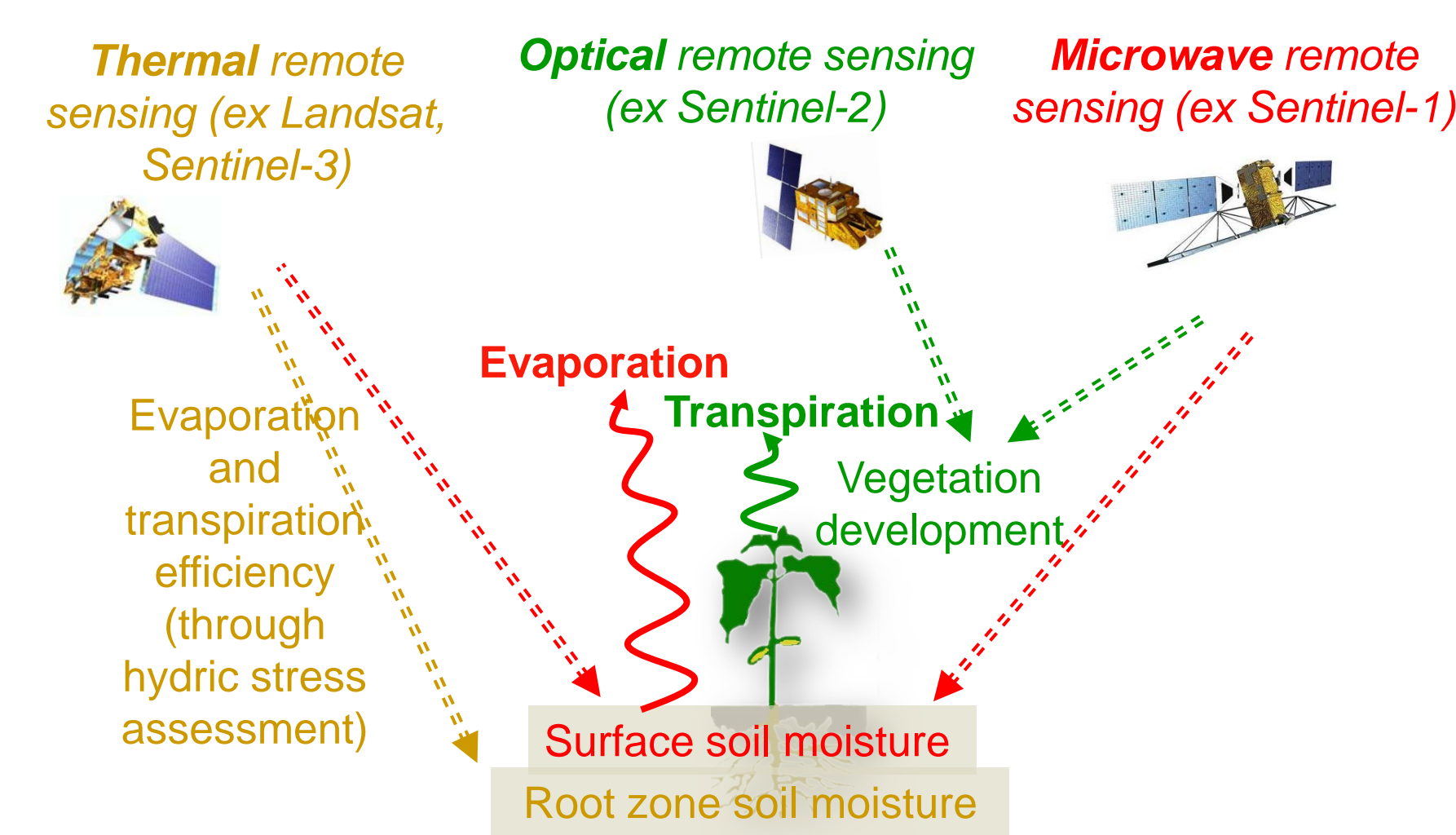
Soil surface moisture monitoring

DISPATCH Soil Moisture Product Available since 2010



Monitoring the water budget of cultivated areas

Principle: exploiting synergies between sensors to monitor crops functioning



Research oriented towards operational applications

1- Analyzing the efficiency of irrigated systems

- Ratio between transpiration (useful for photosynthesis) and evaporation ("loss")
- Percolation (excess water returning to the aquifer)
- Diagnostic of drip irrigation versus gravity irrigation

2- Designing tools for irrigation water management

- SAT-IRR (field scale), providing the date and dose of the next irrigation input
➔ Useful for the farmer to minimize water use
- SAMIR (scale of irrigated perimeters), providing past consumption and future requirements
➔ Useful for irrigation or watershed managers

Gravity irrigation



Drip irrigation



Tools for irrigation management

Sat-IRR (Satellite for IRRigation scheduling)

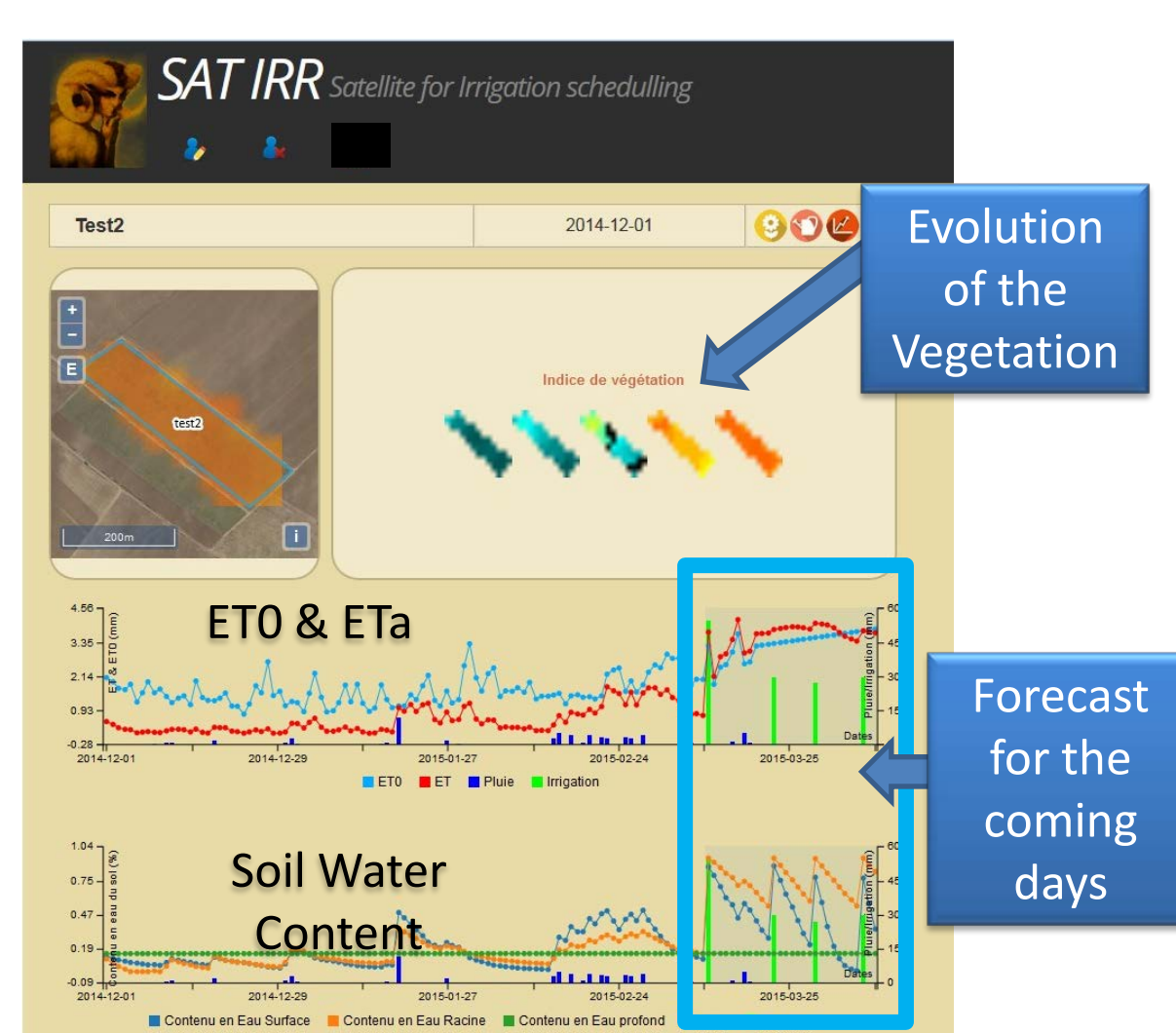
An online tool for plot scale irrigation advisory (<http://osr-cesbio-ups-tlse.fr/Satirr/>)



➔ The farmer introduces basic information regarding his field (crop type, soil type, previous irrigations)

➔ SAT-IRR collects satellite images and meteorological data on the web and provides an irrigation recommendation for the plot (date and dose)

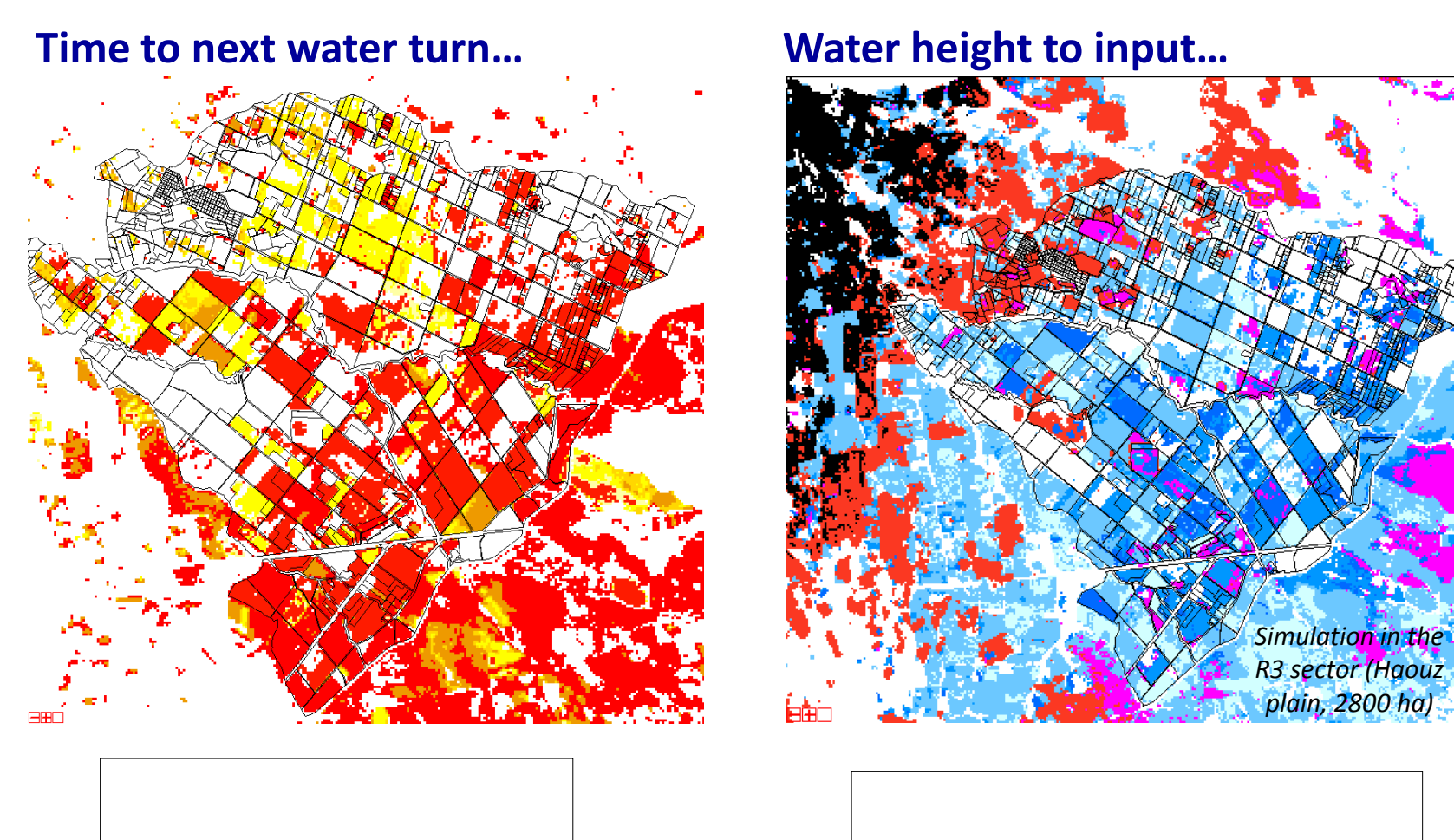
➔ No field sensor required !



SAMIR (Satellite Monitoring of IRRigation)

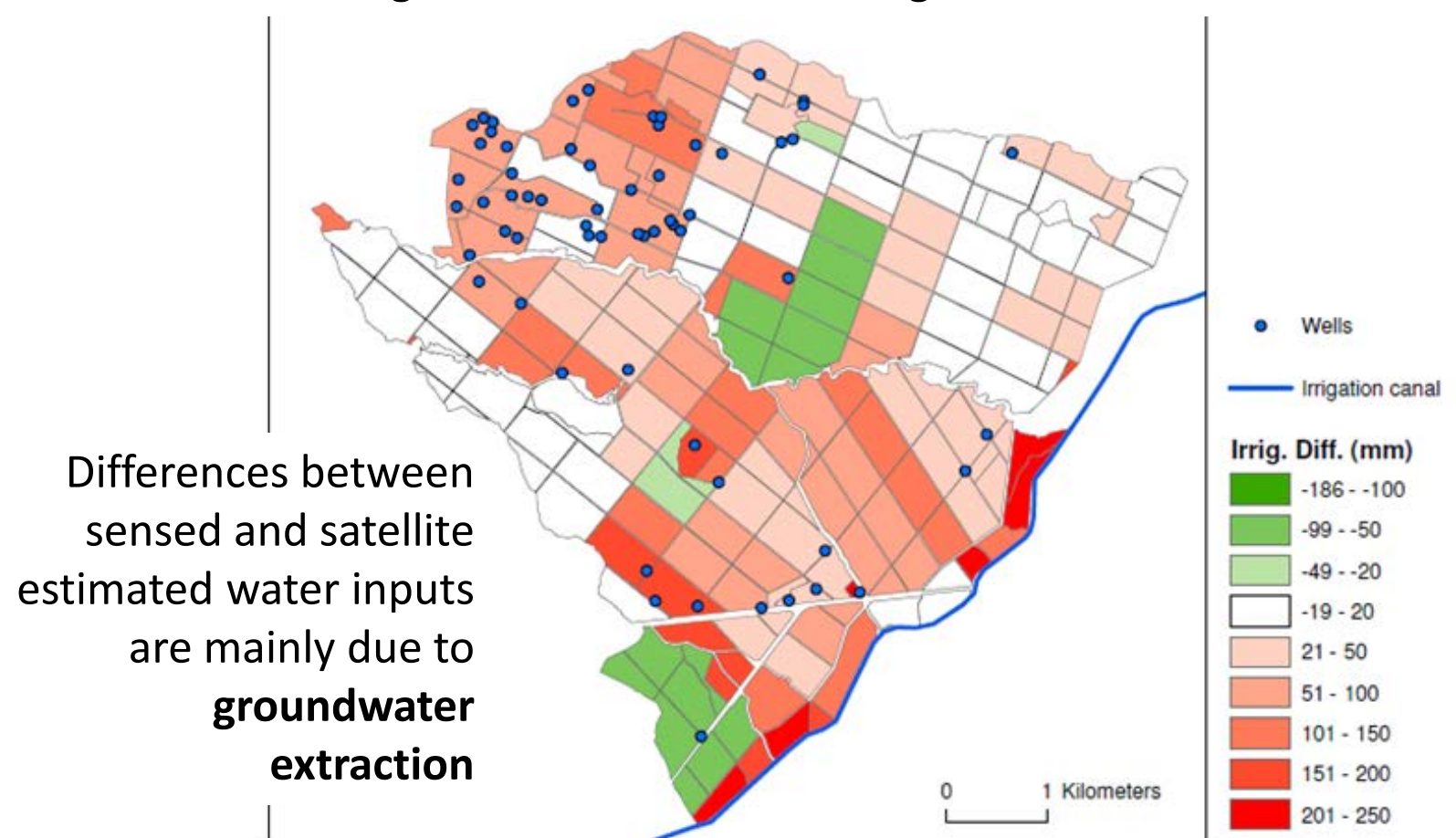
A tool for irrigated perimeters water budget monitoring

Decision support system for water distribution inside irrigated perimeters



Groundwater extraction monitoring

A major issue in semi-arid areas.
=> Remote sensing is a solution to estimate ground water extraction

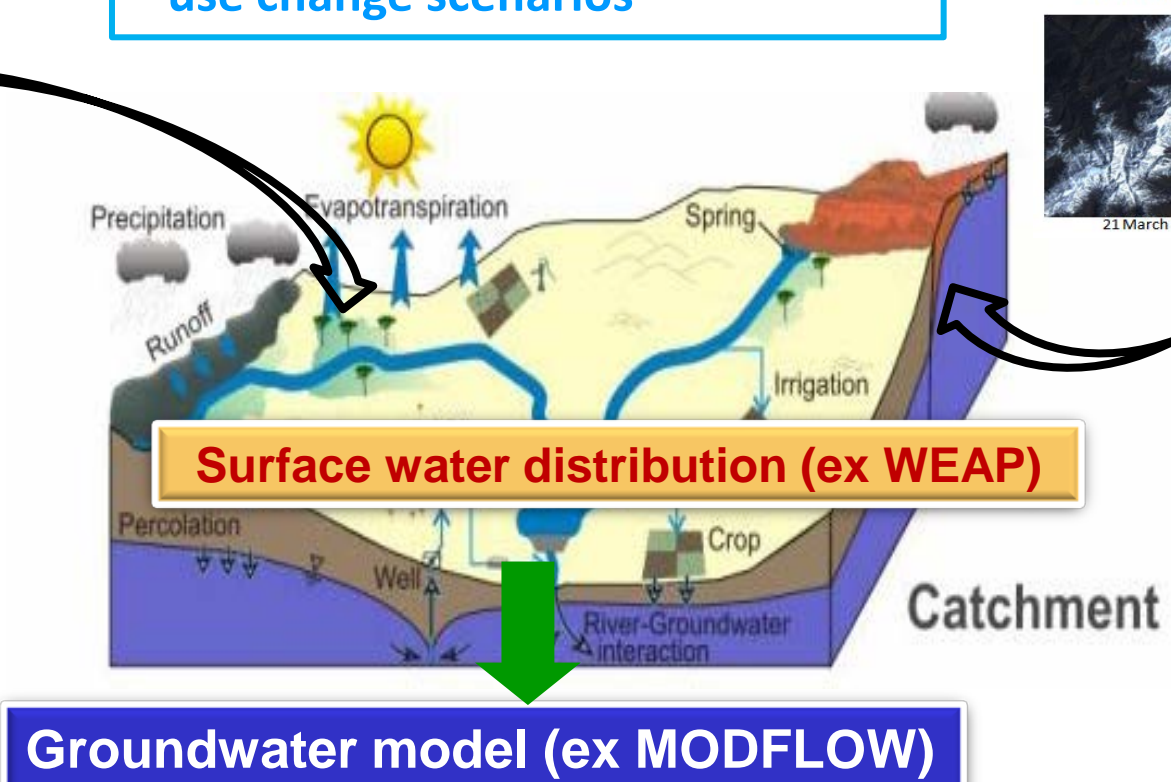
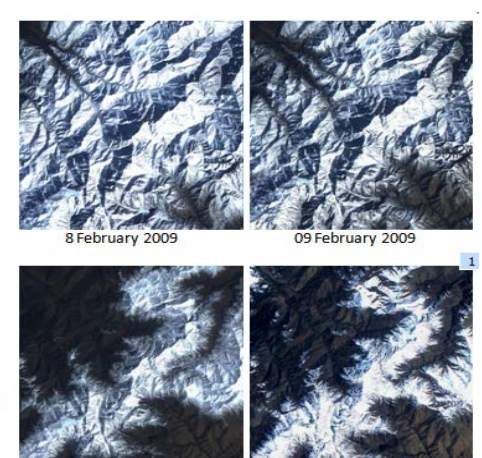


Integrated watershed modeling for groundwater management

Agriculture impact
Difference between known input and actual consumption
↑ Pumpings or Recharge ↓

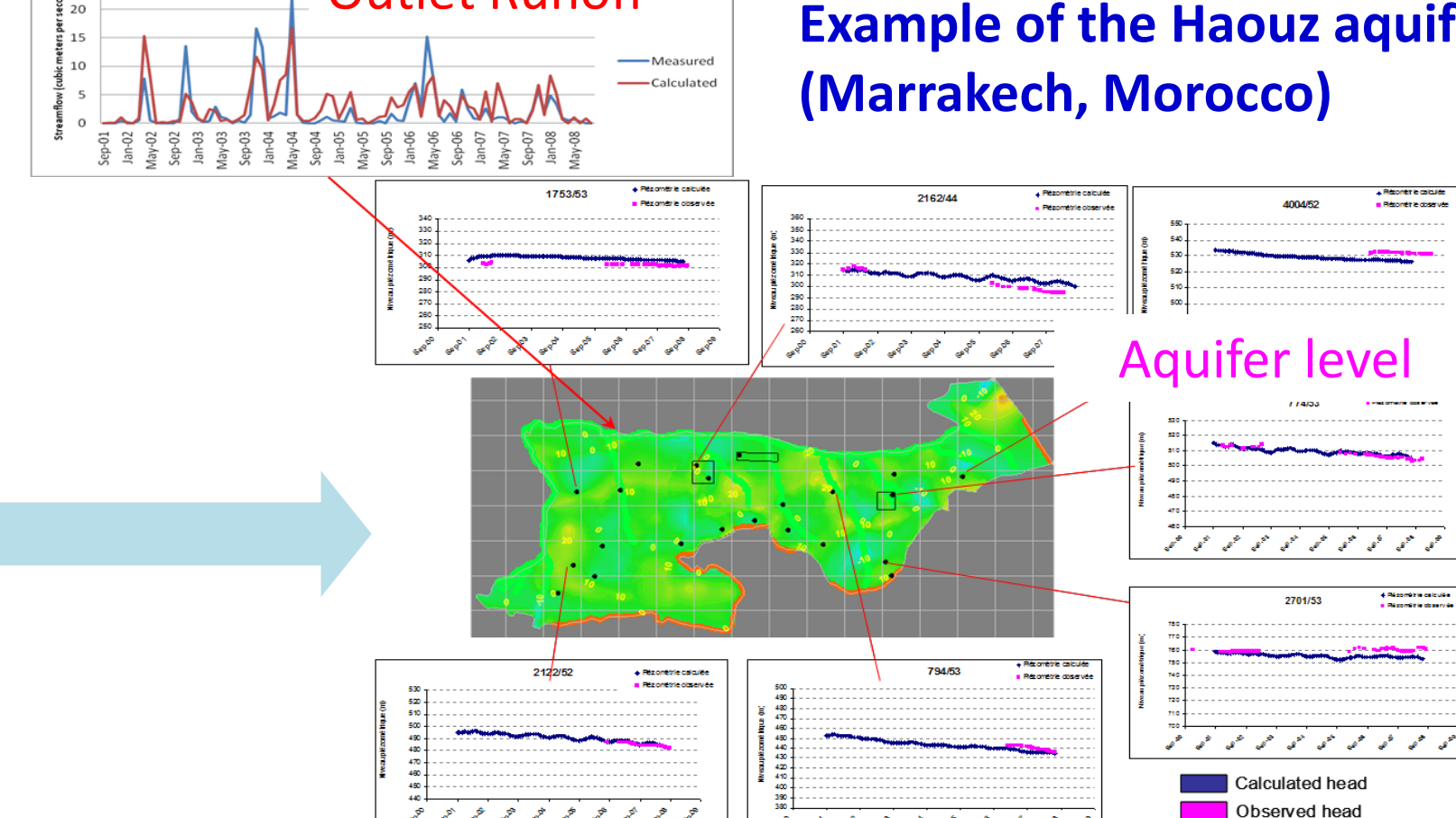
Linking all watershed fluxes
=> Dashboard for water managers
=> Useful to test climate and land use change scenarios

Snow cover monitoring



Outlet Runoff

Example of the Haouz aquifer (Marrakech, Morocco)



This work has been achieved in the frame of the TREMA joint laboratory (Remote sensing and Water Resources in Semi-arid Mediterranean), collaboration IRD-UCAM-ABHT-ORMVAH-DMN-CNESTEN

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