

Integrated Modelling and Remote Sensing Approach for Semi-Arid Hydrology : the SUDMED program

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The **SudMed** project is an international, multidisciplinary project whose objective is to understand the **integrated hydro-ecological functioning of a semi-arid basin** in central Morocco through combination of **process modeling and multispectral / multiresolution remote sensing data**.

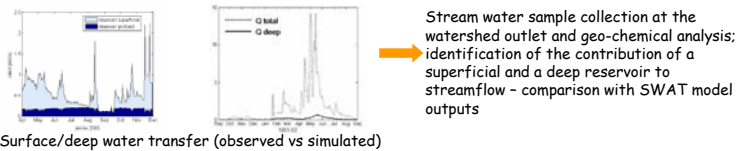
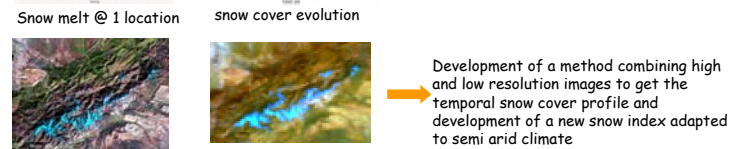
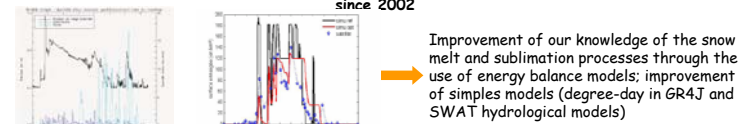
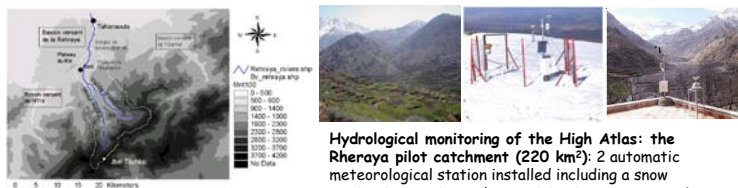
This project is led by IRD/CESBIO as part of a long term bilateral collaboration frame with Moroccan partners, benefiting from support of the European Commission and other international programmes.

The scientific experiments and results, will be used as basis to provide guidance and tools to managers, decision makers and stake holders for sustainable management of water resources in the basin

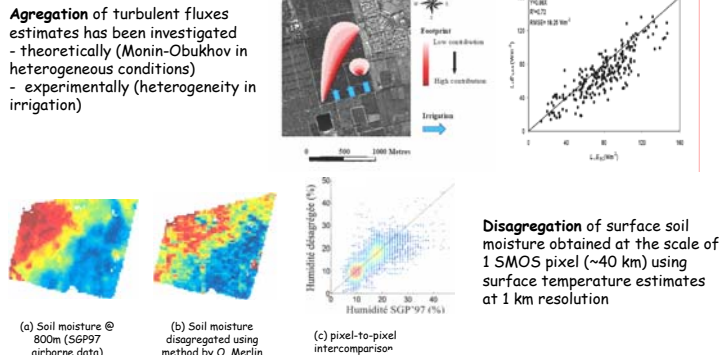
SPECIFIC OBJECTIVES

1. What are the changes that occurred in the basin during the past 30 years or so, and what drove these changes and what are the impact on water and vegetation resources in a semi-arid basin?
2. Describe in integrated manner, the dominant processes that control the overall hydrological functioning of the basin by making full use of recent technological and scientific developments (Modelling, Remote Sensing, Assimilation)
3. Develop scenarios in terms of the sustainability of water and vegetation resources in response to different hypothesis associated with natural and/or human induced environmental changes.
4. Provide operational tools to managers while assuring compatibility between level of technology and the user's ability.

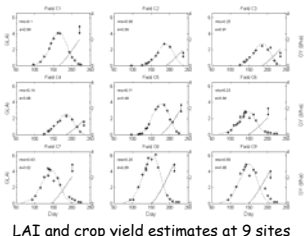
2 * Snow dynamic, rainfall-runoff modelling, surface-groundwater interactions



4* Remote Sensing: Agregation, disagregation and data assimilation

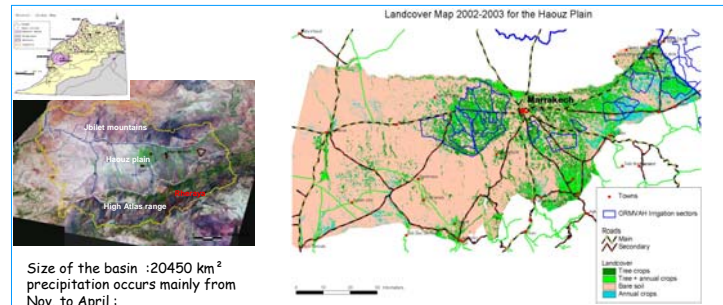


Assimilation of high resolution NDVI time series (SPOT/Landsat TM) into a crop growth model to derive LAI time series and wheat yield estimates



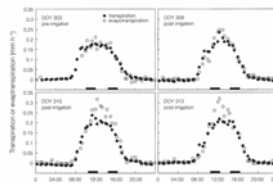
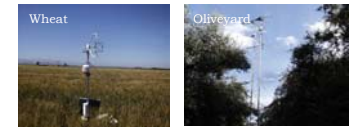
Acknowledgments : this project has benefited from support of the European Commission
 5th FP / INCO-MED programme under the IRRIMED contract (ICA3-CT-2002-10027)

1 * Test area: situation, features and land-use

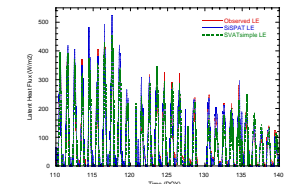


3 * Evapotranspiration: local and regional estimates

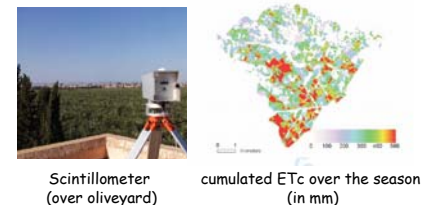
Locally, complex SVAT models are
 - evaluated against a network of water and energy balance monitoring sites, and
 - used as reference tools to develop more simple algorithms;



Eddy correlation measurements (irrigated fields)



Regionally, the FAO 98 method is used to derive spatialized estimates of crop water requirements (ETc); scintillometry is used to evaluate these estimates



5 * Partnership

The SudMed project is led by CESBIO as part of a cooperation programme between :

Institut de Recherche pour le Développement (IRD, France)

And the following partners from the Kingdom of Morocco

- Université Cadi Ayyad de Marrakech (2 Faculties of Sciences : FSS and FST)
- Office de Mise en Valeur Agricole du Haouz (Regional Irrigation districts manager)
- Agence de Bassin Haouz-Tensift (regional Water Basin authority)
- Direction Régionale des Forêts du Haut Atlas (Forest and Soil Conservation service)
- Direction de la Météorologie Nationale (National Met Service)

6 * Education - capacity building

- 9 PhD students (6 from Morocco and 3 from Europe) as well as 12 Masters students have been working on the context of the SUDMED project.
- several training sessions in remote sensing, geographic information systems, micrometeorology were organized in Marrakech this the course of the project. These training sessions were open for students, young scientists and engineers working for different government agencies partners in the project.
- a Decision Support System for better management of irrigation water is under development

CONCLUSION :the research carried out within the **SudMed** project since 2001 led to significant results for the monitoring of the irrigated plain and gave a first glimpse of the complexity of the hydrological processes in the High Atlas ; however, more work is needed to reach our objective, i.e. to fully understand the **integrated hydro-ecological functioning of the Tensift basin**.

Therefore, future research include:

- 1- extending the Rheraya experimental set-up into a Hydrological Observatory of the High Atlas
- 2- assimilating snow cover time series into an hydrological model
- 3- extending the monitoring by using routinely available low resolution data (MODIS, SPOT-VGT, MSG...) in order to assimilate jointly TIR and NDVI data
- 4- using the Tensift dataset to prepare the VENUS mission