

UMR EMMAH

Mediterranean environment and modeling of agri-hydrosystems (Environnement méditerranéen et modélisation des agro-hydrosystèmes)

Director
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Research area

The JRU **Mediterranean Environment and modelling of agri-hydrosystems** (formerly **Climate, Soil and Environment-CSE**) conducts research on mass (water, solutes, gases and particles) and energy transport in the groundwater-soil-plant-atmosphere continuum, the coupling of soil transport processes with biogeochemical cycles, and the development of vegetation in cultivated ecosystems in relation to climate, soil properties and farming practices. This targeted research aims at quantifying the environmental impact of global changes (climate, farming practices and land occupation) on the quantity and quality of groundwater, on soil degradation and on the potential of agricultural production zones according to expected climate and environmental changes, mainly in Mediterranean zones.

Website: [http://www.avignon.inra.fr/les_recherches_1/liste_des_unites/_emmah_\(under_construction\)](http://www.avignon.inra.fr/les_recherches_1/liste_des_unites/_emmah_(under_construction))

Research highlights

The unit has developed strong background in:

- Modeling and quantification of soil transport processes (water flow including preferential flow, mass transport (solute, colloids, bacteria, ...), coupling between microbial activity and geochemistry, non-fickian solute transport, soil water uptake by 3D plant root system architecture, ... ;
- Characterization and modeling in the soil-vegetation-atmosphere system (crop production processes, water transport, SVAT models) ;
- Assimilation of remote sensing data (full range of wavelengths) into crop models and SVAT models and extraction of surface biophysical variables, including validation methods for remote sensing products ;
- Direct and inverse radiative transfer modeling inside canopies and soil (solar to μ wave domains) ;
- Evapotranspiration and microclimate mapping ;
- Aquifer modeling for water resources and water pollution assessment, and isotopic analysis of water composition for water origin and age determination.

The unit has developed widely used models (*e.g.* the STICS crop model, the PROSPECT leaf optical property models, the PASTIS model, ...) and measurement methods (*e.g.* the Caneye software for LAI estimation)

Staff profile

	Total permanent staff	Total Scientists*	Scientists with "HDR"	Post-doct fellows	PhD students
Staff	59	30	14	7	14

*Scientists per member institution: 14 INRA, 16 UAPV

Research teams

- Water and Mediterranean Landscapes
http://www.inra.fr/compact/nav/externe/fr/equipes/ecrans/1114_1
- Soil, Transport Processes and Biogeochemistry
http://www.inra.fr/compact/nav/externe/fr/equipes/ecrans/1114_2

Platforms and other tools

Laboratories:

- Five laboratories dedicated to Analytical chemistry, Isotope analyses, Microbiology, Soil hydrodynamic properties, and Plant analysis

Platforms:

- Experimental site dedicated to monitoring soil water and solute transport to groundwater, equipped with a lysimeter, 24 piezometers and associated instruments

- Experimental site dedicated to remote sensing operations and soil-atmosphere exchanges, equipped with a crane and a permanent follow-up structure for soil water status, crop evolution and surface flows (water, energy, CO₂), and associated with climate monitoring following WMO standards.
- Meteorological and micro-meteorological station network for evapotranspiration and microclimate assessment at the landscape scale.
- Platform for remote sensing equipped with thermal and visible spectrum cameras borne by a tethered balloon (the platform can also be borne by a small aircraft)
- Lower atmosphere parameter monitoring platform to be used with the tethered balloon or radioprobing

Measurement devices:

- Large range of measurement devices for field experiments (including a field GC apparatus for soil gas analysis) and a sun photometer connected to the AERONET network

Software:

- GIS, image processing softwares, crop and SVAT models, radiative transfer models, soil transport models (PASTIS, KDW, ...), scientific softwares (Matlab, Mathematica, Comsol...).

Most important international partnerships

The unit has been leading several large international programs, in particular for remote sensing studies: Alpilles-ReSeDA, CYCLOPES, VALERI, WATERMED, and involved in several Earth observation sensors and missions: VEGETATION and VEN μ S (CNES), SPECTRA and SMOS (European Space Agency).

Some of the most important partnerships are listed below.

Argentina: INTA	Japan: NIAES
Canada: CCRS Ottawa	Mexico: Univ. of Michoacan
Chile: Univ. of Talca	Netherlands: ITC
Estonia: Tartu Observatory	Spain : CSIS (Barcelone) / Univ. of Valencia
Finland: Univ. of Helsinki	Germany: Univ. of Sfax
Univ. of Bayreuth / Agrosphere Institut, IGC	USA : Univ. of Boston / NASA Godard Space FlightCenter
4, Jülich	
Italy: Univ. of Milano	

Facts and figures

Publications in international ranking journals

- ❖ 2007 : 31
- ❖ 2006 : 36
- ❖ 2005 : 35

Representative publications

Baret F., Hagolle O., Geiger B. *et al.* 2007. LAI, fAPAR and fCover CYCLOPES global products derived from VEGETATION: Part 1: Principles of the algorithm. *Remote Sensing of Environment*, 110 (3) : 275-286

Doussan C., Pierret A., Garrigues E., Pagès L., 2006. Water uptake by plant roots: II- Modelling of water transfer in the soil plant system with explicit account of the flow within the root system- Comparison with experiments. *Plant and Soil*, 283, 99-117.

Jacobs, A; Lafolie, F; Herry, JM, et al. 2007. Kinetic adhesion of bacterial cells to sand: Cell surface properties and adhesion rate. *Colloids and surfaces B-Biointerfaces* 59 (1) : 35-45

Neel M. C., Abdennadher A., Joelson, M., 2007, Fractional Fick's law: the direct way. *Journal of Physics A- Mathematical and theoretical*. 40, 8299-8314.

Marc V, Robinson M, 2007. The long-term water balance (1972-2004) of upland forestry and grassland at Plynlimon, mid-Wales. *Hydrology and Earth System Sciences* , 11 (1): 44-60

Total annual budget

	Average over the 2003-2006 period
Total annual budget (k€- non including salaries)	729.6
External contracts (k€):	471.6
ANR	24.2
EU	92.7
Private sector and Others	354.7