



The French Observatory AgrHys : an outdoor laboratory to study hydrological and hydrochemical fluxes and processes in agricultural catchments

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In 2001, the French Ministry for Scientific Research created the Research Observatories in Environment (Observatoires de Recherche en Environnement –ORE). AgrHys is one of these 21 OREs. The main objective of AgrHys ORE is to observe and to understand the response times of hydrological and hydrochemical fluxes to the evolution of agro-hydro system. An agro-hydro system is a catchment where the dynamics of chemical elements and water are modified by agricultural activities. The Observatory AgrHys is an original and outstanding tool with an average 10 year long and high frequency records of chemical and hydrological internal and global variables, following in some sites a 30 year long records of some hydrochemical variables.

The Observatory is composed of two sites located in Brittany region (Western France) region characterized by an oceanic, humid and temperate climate and by an highly intensive stock farming. The first site is the Kervidy-Naizin catchment (5 km²) underlain by schist. The second site, the Plomelin-Quimper site, is composed of three small catchments underlain by granite, the Kerbernez (0.12 km²), the Kerrien (0.1 km²) and the Le Puits (0.5 km²), the latter including the two others. The concept of variable source area represents well the storm flow generation in the ORE AgrHys catchments: at the yearly scale, about 90% of the stream flow comes from shallow, permanent and free surface groundwater contained in the weathered part of bedrock.

Soil structure and distribution, topography, lithology have been extensively surveyed, studied and mapped. Extensive agricultural practice surveys including cropping systems, amount of chemical fertilisers, amount and quality of slurry and manure inputs,

cattle grazing management and crop yields are performed in the two sites. Activity is essentially livestock farming (dairy cows and breeding sows) involving high rate of organic fertilization. The main crops are fodder maize, winter cereal and grassland.

Hydrologic monitoring network is composed of automatic stream gauge stations, weather stations and piezometers. A weather station in every site records the main meteorological variables (rainfall, air and soil temperature, wind velocity and direction, global radiation). More than 70 piezometers in the Plomelin-Quimper site and than 20 piezometers in the Kervidy-Naizin catchments were installed. Water table depth in piezometers is either measured manually or recorded by water level sensors and dataloggers.

Hydrochemical monitoring concerns stream water and groundwater. Water sample collection frequency ranges from daily to weekly in streams and weekly to every three months in groundwater. Samples are analyzed for major anionic and cationic elements, dissolved organic carbon and trace elements. Parameters such as temperature, pH, redox potential and electrical conductivity are measured in situ at each sampling point.

Hydrological and hydrochemical data collected in the Observatory's sites are validated, eventually corrected, and stored in a database, the AgrHys database. The data is made accessible via the web (<http://rennet.rennes.inra.fr/hysae/index.php>). Numerous others variables are studied during field campaigns, depending on specific programs.

The Observatory AgrHys exemplifies how extensively equipped and monitored catchments represent real outdoor laboratories where different scientific issues involving many scientific disciplines (hydrology, geochemistry, soil sciences, agronomy. . .) are addressed. The current issues addressed through experiments and observations in the sites concern:

- Response time of hydrosystems to the evolution of agricultural activities
- solute transfer in the vadose zone-groundwater continuum,
- hydrologic control on nitrate export,
- nitrogen dynamics in soils and wetlands,
- sediment dynamics in stream,
- tracing the origin and fate of organic matter in watershed using the molecular approach,
- interaction between biology and hydrology

- role of seasonal and interannual hydroclimatic variability on the cycling and transport of DOC and trace metals across the wetland-stream transition,

More information is available at <http://www.caren.univ-rennes1.fr/ORE-AgrHyS/>