INNOMED PROJECT - INNOVATIVE OPTIONS FOR WATER RESOURCES MANAGEMENT IN THE MEDITERRANEAN-BONIS CATCHMENT STUDY CASE-ITALY

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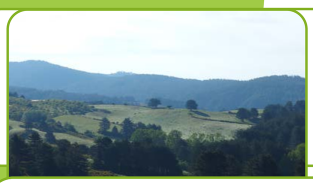
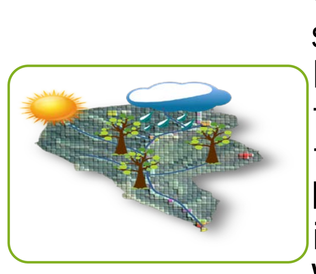
Innomed

Project : INNOMED-A 36-months research project co-funded under the ERA-NET WaterWorks2015 Call of the European Commission. INNOMED aims to develop and apply a multidisciplinary approach to quantify the physical and economic effects of alternative management options in forestry and agriculture on the catchment's water balance. The INNOMED project brings together partners from Spain (CSIC), Cyprus (CyI), Italy (POLIMI and CNR-ISAFOM), Portugal (NOVA.ID.FCT), France (CIRAD-UMR-CIRED) and Moldova (RIFC).



Study case : Bonis catchment-Calabria southern Italy



Objectives : In the INNOMED project in the Bonis catchment are to simulate the water balance of the catchment under different land use / management scenarios, combined with climate change forcings to quantify the effect of alternative management options on the land-water cycle. To this purpose, the FEST spatially distributed hydrological model will be used. Field campaigns will be carried out in order to characterize soil properties within the Bonis catchment. We aim to implement/couple a module for forest simulation within the FEST model.

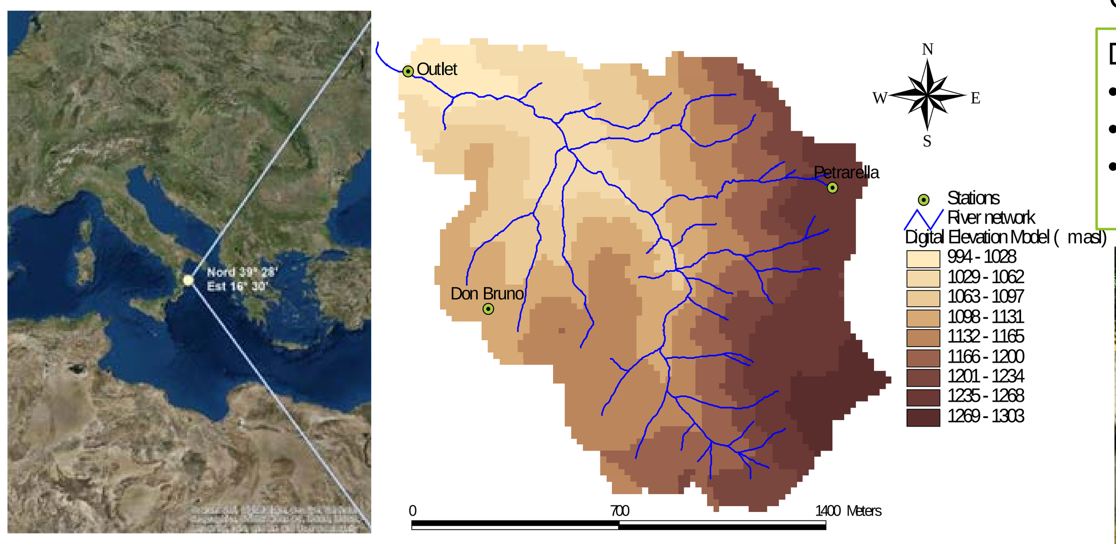


Figure 1- Digital elevation model of the Bonis basin with stations

Catchment characterization-Meteorological data

Data from 1986 were collected from 3 Meteorological stations:

- **Basin outlet** (Outlet: 975 m a.s.l.)
- **Petrarella**: 1258 m a.s.l.) located in the north-eastern of the catchment
- **(Don Bruno**: 1175 m a.s.l.) located in the southwestern part of the catchment.

Figure 2-Thomson weir to measure river discharge

In May 2003 a tower for the measurement of fluxes with the Eddy covariance technique was installed in a plantation of 44-year old Laricio pines, in Cozzarella – Don Bruno location. The runoff is measured at the outlet of the watershed using a gauging structure.

FEST-WB Distributed hydrological Model

Integrated water resources management at the catchment scale, considering the full water cycle as manageable, is a primary approach to improve water use efficiency and promote sustainable water management solutions. To this purpose, advanced modelling tools are required to quantify the physical and economic effects of alternative land management options. FEST-WB a spatially distributed physically based hydrological model will be used to simulate the hydrological response of the Bonis experimental watershed located in the mountain area of Sila Greca (southern Italy). FEST is physically-based and accounts for evapotranspiration, infiltration, surface runoff, subsurface flow, flow routing and snow melt and accumulation. The computational domain is discretized with a regular-squared mesh. The hydrological model computes soil moisture fluxes by solving the water balance equation at each grid-point. The model will be used for evaluating different land use / management scenarios, combined with climate change forcing, to quantify the effect of alternative management options on the land-water cycle.

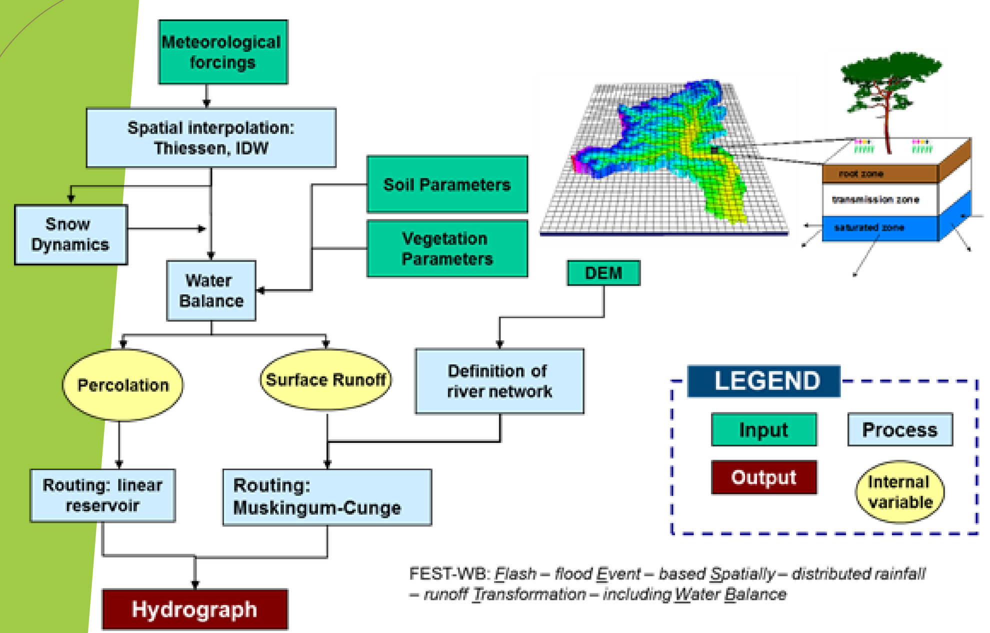


Figure 3-Fest-wb diagram

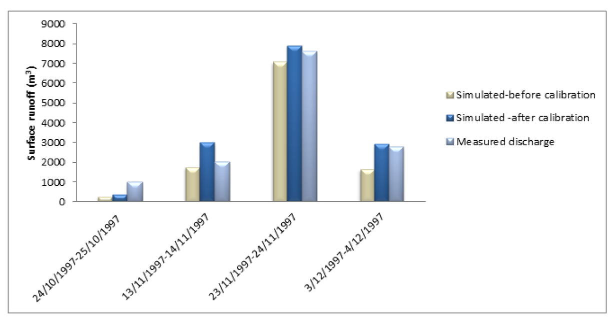
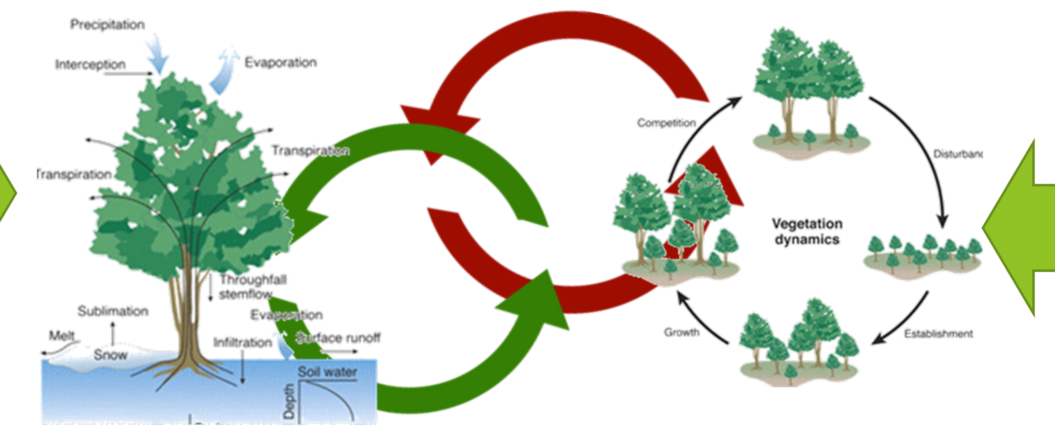
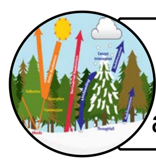


Figure 4- Primary simulations results-Observed and CN simulated (before and after calibration) surface runoff (m3)

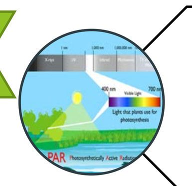


A module that allows simulating the forest dynamics in interaction with the energy, hydrology and vegetation is going to be implemented into FEST model. This module is going to take into consideration different factors inducing the forest dynamics: thinning, growth, mortality…etc, following a simplified approach allowing its implementation not only as a research tool but also as decision support tool for ecosystem services. This module was inspired from the combination of three forest models: 3-PG, 3D-CMCC FEM and ECH2O together with SWAT model.



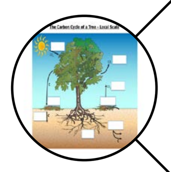
Rainfall interception

The canopy interception is implemented in order to return the effective rainfall and adjust the actual evapotranspiration



PAR calculation

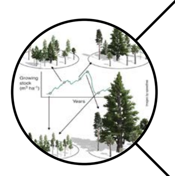
The amount of light available for the plant is going to define its growth rate. The light that the plant could absorb is determined according the canopy cover. The amount of absorbed photosynthetically active radiation (APAR) is usually defined following Lambert-Beer law allowing calculating APAR.



NPP and GPP calculation

The amount of carbon is defined through the intercepted radiation by the canopy (previously computed).

We considered in these calculations that Carbon assimilation is constrained by the temperature, water content, atmospheric co2 and vapor pressure deficit. GPP is adjusted to NPP according to these different modifiers as well as the canopy quantum efficiency coefficient



Forest growth: carbon allocation

The model allows to simulate the carbon allocation to roots, stem and foliage. This step will permit to follow the forest change

in subsequent years according to the value of NPP previously calculated. The carbon allocation considers the foliage loss due to water and temperature, root turnover, crowding factor according to the number of the trees, in case of competition it is supposed that tree mortality increase.

Bonis Catchment characterization

Even though the area Bonis catchment is considered as small (1.39 km2), it presented 16 different land uses. We decided to select different sampling points of the catchment with main land uses (occupying from 31% to 4% of the total area of the basin). We will try to evaluate the effect of each land use on soil parameters. These later are usually considered as main controlling parameters while modeling soil water movement. The need for an accurate description of soil hydraulic properties is apparent in order to reduce the uncertainty associated with model prediction. We will try to get an appropriate description of water retention and hydraulic conductivity curves by combining both laboratory and field measurements. The techniques we implemented to define different soil parameters are listed below.

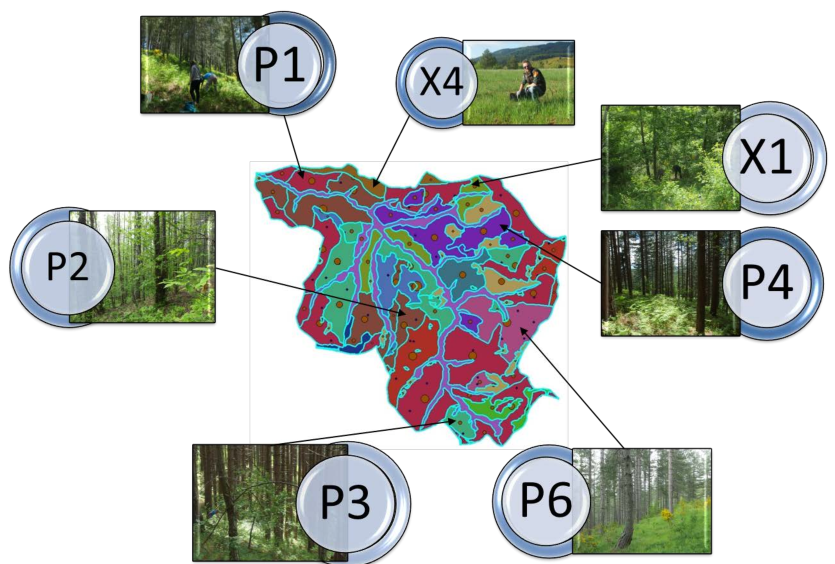


Figure 5-Bonis catchment land use and sampling points location

1-Collection of disturbed and undisturbed soil samples

3-Determination of bulk density

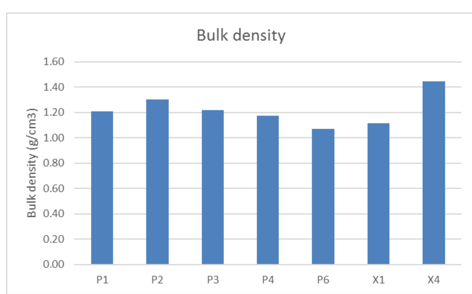


Figure 6-Bulk density of the different sampling locations

4-Determination of soil hydraulic parameters in the laboratory

Figure9- KAT-UMS and Evaporation method-HYPROP UMS

2-Determination of soil hydraulic parameters in-situ

Figure 7 -Infiltration Experiments—BEST method

BEST method : Beerkan estimation of soil hydraulic properties

Advantages of this method

easy, robust, and inexpensive way of characterizing the hydraulic behavior of soil

Required input parameters

Soil texture PSD, Bulk density, initial water content, water content at saturation, infiltration measurements data

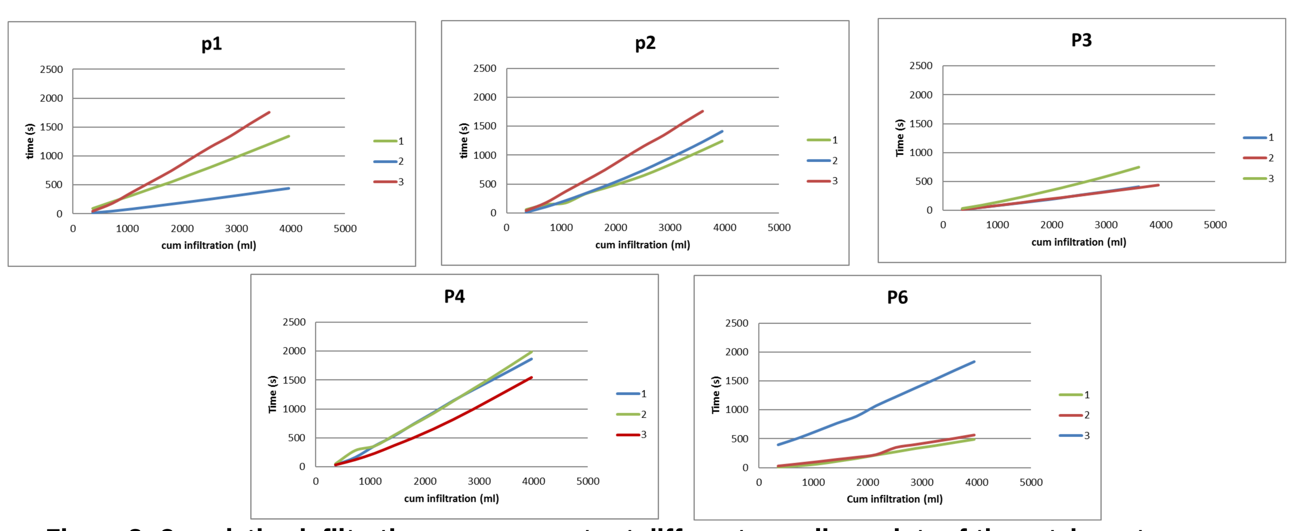


Figure 8- Cumulative infiltration measurements at different sampling points of the catchment

5-Litter layer characterization

Figure10- Some samples Collected liffer

Litter samples were collected from different sampling points of the catchment, percolation test through the litter samples will be carried out in the laboratory under different rainfall intensities.

6-Determination of particle size distribution

For these analysis we combined both sieving method and hydrometer tests using collected disturbed soil samples from the field

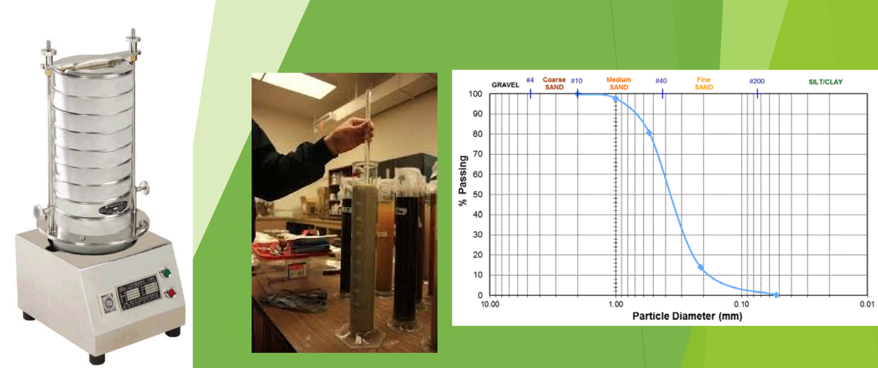


Figure10- Laboratory determination of particle size distribution

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