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A weighting lysimeter for a laboratory experiment on water and energy fluxes measurements and hydrological models verification

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Weighting lysimeters allow a direct measurement of water loss from the soil, determining the soil water balance, and thus providing an interesting tool to validate hydrological models. Lysimeters, which world originates from the greek words “lysis” (movement) and “metron” (to measure) have been used to measure percolation of water through the soils for over 300 years.
The aim of this study is twofold: 1) to perform water and energy flux measurements under different meteorological conditions, irrigation practice (surface flood, drip and groundwater capillary rise), and soil coverage (bare soil and basil crop), 2) to verify hydrological model FEST-EWB parameterization at the lysimeter scale.
A weighting lysimeter has been constructed in the Hydraulic Laboratory of Politecnico di Milano. It consists of a steel box of 1.5 x 1.5 x 1 m containing reconstructed soil. The box is mounted on a scale with four load cells with a nominal weight of 6000 kg and a precision of 0,5 kg. The lysimeter is fully instrumented to measure all the main components of the hydrological cycle. Profiles of soil moisture and temperature are provided by 7 probes; ground heat flux is measured by a heat flux plate and two thermocouples; the drainage flux is measured by a tipping bucket rain gauge; the four components of radiation are provided by a net radiometer; air temperature and humidity are measured by a thermo-hygrometer. Data are collected every 10 minutes on a datalogger. A thermal camera is also installed to provide accurate maps of land surface temperature. The different instruments have been subjected to a rigorous calibration process.
A low cost station is also installed based on an Arduino micro-controller measuring soil moisture and temperature, air humidity and temperature and solar radiation. The idea is to understand whether low cost instruments can be used to monitor the fundamental hydrological variables.
The measured fluxes (e.g. evapotranspiration, soil moisture, land surface temperature) are then used to verify the correctness of the hydrological model FEST-EWB parameterization. A general good accuracy of 2-6 % between observed and modeled fluxes is obtained.