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Design and testing of a plot scale rainfall simulator in Sardina, Italy for calibration of a distributed hydrologic model

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In semi-arid regions with the Mediterranean climate of cool, wet winters and hot, dry summers, precipitation timing and amount, vegetation growth, and surface runoff are tightly intertwined. In the experimental site of Sardinia, the main source of water is surface reservoirs that are recharged by surface runoff in the rainy winter season. However, changes in climate are expected to bring both an overall decrease in winter precipitation and increased interannual variability of precipitation to this region. These changes may affect characteristics of the water-limited vegetation growth such as timing and production, and consequently change the amount of overland flow and reservoir recharge. Currently, there is little research on the combination of these effects; therefore, the goal of this research is to assess the runoff response of the land surface with varying vegetation states to ultimately predict how changes in the climate of Mediterranean watersheds may affect the needs of water resource management. A 4 m by 4 m rainfall simulator was designed, constructed, and tested as the first stage of this research. The rainfall simulator consisted of four independent lines of low-cost pressure washing nozzles operated at a pressure of 80 mbar, with the number of nozzles determining the rainfall intensity delivered to the plot. The rainfall intensity of the simulator varies from approximately 26 to 52 mm/h with a coefficient of uniformity ranging from 0.40 to 0.59. For the initial field testing of the unit, measurements taken include surface runoff using a tipping bucket flow meter and soil moisture throughout the plot. Literature models for surface runoff predictions (Philips, Horton, Green Ampt, Soil conservation Service model, bucket model) are widely tested highlighting the typical hortonian behavior of this soil. Aside from these initial results, the simulator will be used to monitor changes in the surface runoff throughout the growing season as the vegetation changes.