49. MoISTuRE: a Digital Twin platform for integrated drought monitoring of agro-forest systems, wetlands and river network

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The growing recurrence and severity of drought events in the Mediterranean area call for integrated monitoring and decision-support tools. This paper presents the methodological framework and architecture of the platform developed within the DiTwin MoISTuRE (Monitoraggio Integrato della Siccità a Tutela della Resilienza Ecologica - A Digital Twin for the Integrated Monitoring of Drought in Support of Ecological Resilience) project, funded by the Italian Space Agency (ASI) under the I4DP_PA programme, with the University of Salerno as lead institution and the Carabinieri Forest, Environmental and Agri-food Units Command (CUFAA) as partner and end user. The platform integrates satellite data (Landsat, Sentinel, COSMO-SkyMed, PRISMA and the national IRIDE constellation), in-situ surveys and a network of Tree Talker IoT sensors, which constantly record plant physiological parameters to calibrate and validate satellite-derived stress indicators. On this basis, the platform computes multi-scale drought indicators (SPI, SPEI, SMA, fAPAR, CDI), classifies the most vulnerable areas using machine learning techniques, and forecasts short-term evolution with ARIMA/SARIMA models and uses Copernicus Climate Change Service (C3S) seasonal outlooks to outline extendedterm projections. The pilot areas cover three study sites spanning two distinct ecosystem types: the Valle delle Ferriere State Nature Reserve (Municipality of Scala), for drought effects on spring-fed wetlands, and the Bianco and Calore Lucano river basins within the Sele hydrographic system, for effects on perennial and intermittent watercourses respectively - distinct hydrological contexts of high ecological value. The paper describes the processing chain, the initial morphometric and forest characterisation of the study areas, and the platform validation plan, conceived as a Decision Support System for early warning.