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The European Drought Monitor – EO-powered 1-km daily drought monitoring with 6-day latency

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Droughts are among the costliest of natural disasters in Europe resulting, with average reported losses of about 621 million euros per event [1]. Yet seamless drought monitoring, modelling, and forecasting across spatial scales and time remains a major challenge in hydro-meteorological sciences, in particular when information is needed at actionable kilometre-scale resolution and with low latency.

We address this need with the high-resolution European Drought Monitor (EDM, https://www.ufz.de/index.php?en=52233) as part of the European Space Agency funded DTE Hydrology Next project. EDM provides continentwide products at 1 km resolution, daily updates, and an operational latency of about 6 days. EDM builds on the precursor system of the German Drought Monitor [2, 3] and on a series of European-scale mHM demonstrations [4–10].

EDM runs the mesoscale Hydrologic Model (mHM, https://mhm-ufz.org) on a single pan-European domain. Near-real-time meteorological forcing is taken from ERA5-Land and downscaled to 1 km using external drift kriging (EDK), followed by bias correction using the EMO dataset. Operational production is implemented on an ecFlow backend. EDM provides daily gridded states and fluxes and delivers the soil moisture index (SMI) drought indicator as a core product.

We evaluate EDM against independent observations across multiple components of the terrestrial water balance. Median streamflow skill is Kling–Gupta efficiency (KGE) = 0.38 across 1466 GRDC gauges. Modeled evapotranspiration shows very high agreement with gridded FLUXNET products (correlation = 0.99). Further evaluation uses Earth observation-based (EO) datasets: ESA CCI soil moisture (correlation = 0.54) and GRACE/GRACE-FO total water storage (correlation = 0.61). Together, these results demonstrate that EDM provides spatially and temporally consistent drought diagnostics across Europe at high resolution.

Planned developments include (i) upgrading soil moisture physics by replacing the current infiltration-capacity approach with a Richards equation representation [11] to improve volumetric water content realism, (ii) incorporating atmospheric EO products for near-real-time model initialisation, and (iii) exploiting EO constraints for irrigation water-use estimation and reservoir state verification. By providing EO-informed, kilometre-scale drought surveillance, EDM supports the Sendai Framework's call for improved hazard monitoring and enables timely, locally relevant

drought warnings for Europe.

References

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