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Functional comparisons between unimodal and bimodal analytical relationships in terms of water balance predictions for the case study of the Vesuvius volcanic area (Naples, Southern Italy).

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Optimal performance of large-scale numerical modeling of the soil-vegetation-atmosphere (SVA) system mandates accurate assessment and description of the soil hydraulic properties, namely the water retention (WRF) and hydraulic conductivity (HCF) functions. These functions are commonly described by simple unimodal analytical relations that guarantee mathematical flexibility with few parameters in the majority of soil types. However, other soils, like volcanic soils, are characterized by a complex structure yielding a bimodal or even a multimodal distribution of pore sizes. In these cases, reliable hydrologic predictions can be obtained resorting to more complex hydraulic functions, yet more accurate and robust ones. To overcome some drawbacks of the classic unimodal hydraulic relationships, Romano et al. (2011) have developed closed-form bimodal lognormal relations for improving the description of both WRF and HCF. However, the reliability of this description of the soil hydraulic behavior is often tested at the curve fitting level only. Comparisons between unimodal and bimodal soil hydraulic relationships are more effective and informative when performed in functional terms. Therefore, as the primary objective of this study, we used a hydrological balance model to quantify and compare soil moisture flow and storage regimes for 14 years (1999-2012), when characterized by unimodal or bimodal approximations of 39 measured soil water retention and hydraulic conductivity characteristics collected in volcanic Vesuvian soil located in the Campania Region Plain (Naples, Southern Italy).