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Gamma radiation as a local proxy of soil water content: insights from the Eastern North Atlantic (ENA) facility (Azores)

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Gamma radiation at ground level reflects a wide range of processes acting in several domains including space (cosmic rays), atmosphere (aerosols, precipitation scavenging) and solid earth (terrestrial radionuclides, radon gas exhalation). The temporal variability of gamma radiation at a single location is partly determined by soil water content, which on the one hand attenuates gamma radiation from radionuclides (K, U, Th) buried in the subsurface, and on the other influences the transport of radon gas within the porous media and the subsequent radon exhalation to the atmosphere. Gamma radiation is therefore a potentially useful indicator of soil water content, but disentangling the multiple interacting factors is a challenging task that requires both high-resolution and continuous measurements of gamma radiation as well as high-resolution and co-located measurements of soil and meteorological parameters. In this contribution, the potential of gamma radiation to serve as an indicator of soil water content is examined taking advantage of the meteorological infrastructure available at the Eastern North Atlantic (ENA) atmospheric observatory installed at the Graciosa Island (39 ºN, 28º W) in the Azores under the ARM programme, and of the high-resolution measurements provided by the gamma radiation monitoring campaign taking place at the ENA facility since May 2015. Gamma radiation is measured every 15-minutes with a NaI(Tl) scintillator counting all gamma rays in the range from 475 KeV to 3 MeV. The resulting time series of total gamma counts is dominated by precipitation-driven short-term peaks and a longer-term terrestrial component. After removal of the direct effect of precipitation, the temporal variability of gamma radiation reflects to a large extent the water content of the soil, including very fast (sub-daily) changes in soil moisture conditions.