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An alternative cosmic-ray neutron detector for hydrological observations: from limitations to emerging opportunities

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In the last decade the measurements of secondary cosmic ray neutrons has been established as a unique approach for intermediate scale observation of land surface hydrogen pools. Originally developed for soil moisture measurements, it has shown also promising applications for snow, biomass and canopy interception. The measurements are generally performed based on moderated proportional counters filled with Helium-3 or Boron. The moderation is created by adding shielding material (mostly polyethylene) around the counter.
In the present contribution, we show the development and the tests conducted on an alternative detector based on scintillators. Nine months of lab and field tests will be presented. The first six months have been conducted in Potsdam (Germany), lab and field tests in lowland. The second set of measurements was performed at the Environmental Research Station Schneefernerhaus near the summit of Zugspitze mountain (Germany). The results show slightly lower neutron counting rate of the new detector in comparison to the commercial proportional gas tube limiting its applicability to detect fast temporal changes in the hydrogen pools (e.g., canopy interception). The new detector, however, shows also the capability to identify different neutron energies ranges and additional particle (gamma) providing new opportunities for hydrological observations at different spatial scales. In addition, the use of high energy particles for correcting the signal from atmospheric variations (air pressure and primary cosmic-ray flux) is explored.
Finally, the economical scalability of this type of detectors and their possible use in practical applications is discussed.