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Cutting-edge tools for spring monitoring and groundwater characterization in mountain environments

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Mountain aquifers represent one of the largest and most valuable water sources to meet the population's water needs. Over time, they have been threatened by human exploitation activities, which are currently leading to the depletion of aquifers worldwide. Furthermore, the vulnerability of groundwater resources is rapidly increasing due to climate change, urbanization, massive industry production, intensive agriculture, and deforestation.

Knowledge and forecasting about groundwater flow systems are required to guide management and territorial planning strategies, according to the mountain environment evolution taking place. Besides, examining how groundwater storage mechanisms in mountain regions have changed in response to both climate-driven and anthropogenic effects is increasingly crucial.

In remote alpine areas, continuous monitoring and data collection of spring hydrological parameters is still often hampered by technical and logistical problems. In this context, automated techniques and tools need to be applied to monitor springs hydrological parameters, punctually understanding the dynamics of exhausting of the available resources.

The instrumentation and sensors complex, installed in correspondence with the spring catchment basin (Aosta Valley, Italy) allows detailed analyses of the surface and underground hydrogeological system, recording continuously hydrogeological variables entering and leaving the system. A cutting-edge weather station was here combined with a spring monitoring system through snowpack-hydrometeorological sensors installation. This setup, composed of ultrasonic and laser sensors for snow weight and snow depth readings, allows the possibility of a detailed study of the snow layer evolution during each season. The multiparametric probe allows water discharge, temperature and electric conductivity detection.

The high quality of the data provided and the small-size basin features have permitted the study of the variables affecting the system and standing out those are evolving in the relationship between changes in weather conditions and water availability. The study is performing correlations between different hydrogeological and meteorological parameters.

series.

The Mascognaz spring s pilot site could be helpful as an example for other authorities who need to identify suitable instruments, sensors and methods groundwater flow system and hydrogeological structure of a mountain bas