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Linking ICT and Society in Early Warning and Adaptation to Hydrological Extremes in Mountains

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The assessment of the societal impact of hydrological extremes is particularly important in mountains regions, which can act both as their generators and victims. ICT can provide a powerful tool for transmitting hydrometeorological information to predict, prepare and adapt to such events, yet in remote regions, such as mountains, the poles, deserts and islands, this is limited by data availability and existing data networks. As many hydrometeorological measuring stations have been closed in mountain regions in the last decade, with few new ones being established, it may be increasingly important to involve society in political and funding issues to ensure sufficient data input for research. This is not always simple, since data availability and distribution is sometimes hampered by conflicts of interest between research, politics and industry. Beyond that, the type and context of hydrological extremes has to considered. In ICT research and grids for E-science, one can presume an emphasis on floods and flood-related events, since these are easier to define and predict than droughts, based on routine quantitative and observational data. In terms of impact assessment, both the determination of flooded areas and economical loss is relatively straightforward to model due to their confinement to valleys and fans. However, for droughts or water scarcity problems, definitions and measurements are not necessarily clear-cut and early warning systems are not readily available within ICT. For this reason, the EC issued a call for gap analysis for water scarcity and droughts in the EU in 2010. Several factors have to be considered: firstly, the variables and data sets involved are more complex, secondly the geographical extend is larger and thirdly, the time scales involved are longer, often making it difficult to determine or predict exact thresholds. Whereas floods are spatially restricted, droughts can effect entire catchments with each vegetation or hydrographic zone playing a different buffer role. Economic impacts of droughts are difficult to evaluate due to unpredictable time lags involved, especially in complex mountain terrain with highly variable land use. Therefore, apart from classical hydrometeorological data, other causal factors included in biological, agricultural, pedological, remote sensing and anthropogenic data, such as water demand, have to be obtained. Where data is sparse, data and knowledge needs to be transferred from other catchments. In particular, the impacts of drought and water scarcity on stakeholders have to be known and quantified and their adaptation measures understood and discussed. There is a vast potential for improving research on application of stakeholder knowledge related to hydrological disasters and for developing data interfaces to integrate it. The use of qualitative data and its transformation into quantitative data, especially with relation to vulnerability to hydrological extremes, is still underrepresented in ICT to date. Early warning and adaptation to hydrological extremes is as much an ICT as a societal challenge in mountains.