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The role of remotely sensed precipitation datasets in flood forecasting

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Precipitation is a key geophysical parameter: knowledge of precipitation and its underlying processes is required in a number of research and application disciplines related to global energy and water cycle. This includes climate, meteorology, hydrology, oceanography, transportation, agro-meteorology, numerical weather prediction, nowcasting, flood forecasting, and water resources management. Moreover, these areas are expected to have a growing socioeconomic impact in the future, following societal adaptation to climate change. It's therefore incumbent on the scientific community to understand precipitation better. Multiple platforms mean that more of the Earth can be seen at once, increasing the temporal and spatial resolution of precipitation events knowledge. In this presentation, the related increase in flood forecasting capabilities, with the associated benefits in reducing the dramatic impact of hazardous storms on human activities, will be discussed. Flood forecasting requires a combination of meteorological and hydrological aspects, but there is considerable difficulty associated with the quantitative aspect of precipitation measurements and forecasts. While in large catchments upstream discharge measurements may enable the prediction of a flood, in medium sized and small catchments rainfall measurements and forecasts are needed to predict a flood with a lead time large enough to permit civil protection measures and, therefore, to reduce the associated losses. Flash flood forecasting in small catchments requires hydrologists to use Quantitative Precipitation Forecasts (QPFs) as input to timely forecast a flood. In coupling meteorological and hydrological models, two major sources of uncertainty arise: the uncertainty at the meteorological scale per se and the uncertainty at the interface between meteorology and hydrology. At the meteorological scale, QPFs derived from Numerical Weather Prediction models can highly benefit of new space sensed data availability in both the initialization and validation phases. To address the uncertainty associated with the gap between meteorological and

hydrological scales is one of the research challenges in hydrology. In the absence of a full understanding of the physics of precipitation, a common practice to estimate rainfall at small scales is based on downscaling. It provides stochastic realizations of the small-scale precipitation field that are consistent, in a statistical sense, with QPF large-scale properties. To have any hope of success, this approach requires two crucial steps. First is the characterization of the small-scale spatio-temporal statistical properties of precipitation fields for different synoptic conditions and geographic areas. This should be achieved by the statistical analysis of spatio-temporal data provided by radars, rain gauges, and satellites. Second is the construction of a physically-motivated, albeit empirical, stochastic downscaling model able to reproduce the statistical properties of precipitation fields. While downscaling is essential to measure results within a probabilistic framework, any forecasting chain can take great advantage from real-time and historical satellite observations of rainfall and other meteorological variables. A possible procedure is anticipated, which highlights the paramount importance of frequent satellite observations to understand the processes for the parameterisation and refinement of models able to bridge the gap between meteorology and hydrology, and to overcome limitations associated with ground-based measurements.