Uncertain about uncertainties?

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Abstract: The presence of uncertainty in any physical process precludes the exact prediction of the system's evolution, which can therefore only be represented probabilistically. The link between uncertainty and probability is relatively straightforward within the two classical probabilistic frameworks, frequentist and subjectivist. Notably, each framework considers a single type of uncertainty, although the nature of that uncertainty differs between the two. Natural systems, however, pose a particular challenge in this respect. Uncertainties are not only pervasive and unavoidable, but also diverse in nature. Translating these different types of uncertainty into a coherent probabilistic representation is therefore far from straightforward and raises fundamental scientific and philosophical questions. Major challenges include the lack of a common framework for classifying different types of uncertainty, shared quantitative procedures for incorporating them into forecasts, and effective approaches for supporting decision-making under uncertainty. Drawing on examples from a range of natural hazards, including seismic, volcanic, flood, and climate-related hazards, in this talk I show that different fields face common challenges in the definition, interpretation, quantification, and communication of uncertainty. I then argue that these challenges can be addressed within a unified probabilistic framework, leading to the concept of a complete forecast: a forecast that explicitly represents and keeps distinct all recognized types of uncertainty. Finally, I illustrate how this framework can be applied to real-world examples across different natural hazards and risks, with the broader aim of promoting more transparent, testable, and decision-relevant hazard and risk forecasts.

Bio: Warner Marzocchi is professor of Geophysics and of Natural Hazard Forecasting at the University of Naples *Federico II* and at the Scuola Superiore Meridionale. He has coordinated, at different levels, many national, European, and international projects focused on earthquake and eruption forecasting and (multi)hazard assessment. He is member of the *Academia Europaea*, he is author of more than 200 papers on journals listed in the Web of Science and SCOPUS (H-index 54 in WoS and 54 in SCOPUS) and has been listed since 2019 in the *world's top 2% scientists* in all fields (https://elsevier.digitalcommonsdata.com/datasets/btchxktzyw/7). He has served as

chairman and member in many international scientific organizations and advisory committees, co-chairman of the seismic hazard center at INGV, and he has been member of the International Commission on Earthquake Forecasting (ICEF) appointed by the Italian government after L'Aquila earthquake.

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