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Performance assessment of models to forecast induced seismicity

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Managing and mitigating induced seismicity during reservoir stimulation and operation is a critical prerequisite for many GeoEnergy applications. We are currently developing and validating so called 'Adaptive Traffic Light Systems' (ATLS), fully probabilistic forecast models that integrate all relevant data on the fly into a time-dependent hazard and risk model. The combined model intrinsically considers both aleatory and model-uncertainties, the robustness of the forecast is maximized by using a dynamically update ensemble weighting.

At the heart of the ATLS approach are a variety of forecast models that range from purely statistical models, such as flow-controlled Epidemic Type Aftershock Sequence (ETAS) models, to models that consider various physical interaction mechanism (e.g., pore pressure changes, dynamic and static stress transfer, volumetric strain changes). The automated re-calibration of these models on the fly given data imperfection, degrees of freedom, and time-constraints is a sizable challenge, as is the validation of the models for applications outside of their calibrated range (different settings, larger magnitudes, changes in physical processes etc.). Here we present an overview of the status of the model development, calibration and validation. We also demonstrate how such systems can contribute to a quantitative risk assessment and mitigation of induced seismicity in a wide range of applications and time scales.