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Two-Stage Ensemble Kalman Filter Approach to Estimate Fracture Parameters in Sub-Surface Formations[1] MICHAEL LIEM, PATRICK JENNY, ETH Zurich — The prime uncertainty in reservoir simulations lies in the permeability field, as only few measurements of reservoir properties are available. When fractures are present, their locations, orientations and sizes greatly influence the resulting flow field. Therefore, it is important to estimate these parameters as precisely as possible. Ensemble Kalman filters (EnKF) are widely used for data assimilation in the context of sub-surface flows in order to estimate parameters, reduce uncertainty and to improve simulation results. In this work, we consider large individual fractures with known orientation, which appear one after the other. We assume that location, length and hydraulic aperture of each fracture are uncertain and that we have prior probabilistic knowledge of those uncertain parameters, e.g. from seismic data. We reduce the uncertainty of the fracture parameters with an Ensemble Kalman filter using empirical information from measurements; here from a reference simulation. A two-stage data assimilation approach is devised. In a first stage, during fracture formation, pressure and flow at in- and outlet are used as measurements. In a second stage, once all fractures are created, a tracer is injected at the inlet and its concentrations at the outlets are used as measurements.

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