Assessing the Potential of Different Formulations to Quantify the Error on Facies Data for the Calibration of Stratigraphic Forward Models

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Abstract

Data acquired during exploration provide valuable information on sedimentary basins. These data include properties measured at wells such as sediment thickness and facies concentration, and information derived from seismic acquisitions (e.g. most probable facies maps in each stratigraphic unit). However, these data are generally insufficient to completely characterize the basin properties. Stratigraphic forward modeling can then be considered to go deeper in the estimation of their characteristics through the identification of models reproducing the available data. To do so, the model input parameters are perturbed until the simulated output properties fit the data. However, this calibration process can be very time consuming. Indeed, the number of parameters to be tuned can be very large. In addition, several models may reproduce the data, and they need to be identified to properly quantify the associated exploration risk. Generic solutions exist in the literature to assist in the resolution of such an inverse problem. Typically, a minimization algorithm can be used to drive automatically the perturbation of the model input parameters in order to reduce the error between the simulated properties and the corresponding data. However, this requires first to identify an adapted formulation for the quantification of this error: it should clearly distinguish good models from bad ones, but also efficiently drive the minimization algorithm towards the best models. In particular, the quantification of the error on facies data is a challenging problem for which only a few formulations have been proposed until now. The specificity of these data lies in their categorical nature. We propose here to address this issue by conducting tests on a lacustrine

pre-salt carbonate reservoir in the Campos Basin. Different geological scenarios have been proposed to characterize the Barra Velha Formation, from microbial carbonates to stromatolites buildups. We propose to compare different formulations and estimate the potential for both model ranking and assisted calibration.