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Modelling the hydromechanical response in the neighbourhood of Koyna reservoir (India): Results of the initial filling period

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We present here a homogeneous poro-elastic model derived from the analysis of the first years of seismicity following the construction of the Koyna dam, in 1962. The appearance of seismicity is clearly related to the water impoundment of the dam. A numerical model has been developped in order to link the water level fluctuations and the seismicity. 86 relocated events and 8 years of water level records have been used here to develop our model. Starting from a discretized lake, we calculate the displacement and the associated stress field resulting from water level change and we calculate the pore pressure change resulting from both the undrained and the diffusive responses of the medium. Then, we examine the condition under which the Coulomb stresses may trigger the seismic events and we compare the Coulomb stress variations with the set of relocated events. We show that more than 80 $\%$ of the relocated events are well described by this poro-elastic model and a suitablediffusivity $c_p = 0.2m^2/s$ is derived. After the large (M 6.3) event of December 10, 1967, we model the response of the system by comparing the variation of the co-seismic stress field with (1) the spatio-temporal characteristics of the relocated post-seismic events and (2) the aftershocks decay with time. We show that the diffusivity derived previously does not allow to describe the aftershocks decay with the appropriated Omori exponent.Taking the time dependence of the whole sequence of aftershocks into account has led us to derive a diffusivity after the M 6.3 event around $c_p = 2.5m^2/s$. This could indicate an increase of permeability consecutive to the major event. However, in his turn, this model does not manage to describe the late events (t $\simeq$ 9 months after the main shock). These results are discussed and we propose an alternative hydrologic model with two compartiments with contrasted permeabilities to describe the post-seismic response.