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Simulating long-term Caspian Sea level changes: the impact of Holocene and future climate conditions

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To improve our understanding of the relationship between climate change and variations in Caspian Sea level (CSL), we performed simulations of annual CSL for the period 8 ka (thousand years ago) to 2100 AD using a coupled model setup representing climate, hydrology and sea level. We forced our climate model with long-term changes in orbital parameters and atmospheric greenhouse gas concentrations, using the IPCC A1b scenario for the 21^{st} Century. Our simulations produce an orbitally forced, long-term decline in CSL of 5 m from 5.5 to 0 ka, caused by a decrease in river runoff and over-sea precipitation that is not fully compensated by a decrease in over-sea evaporation. Superimposed on this long-term downward CSL trend we simulated centennial-scale fluctuations of up to 4 m and decadal-scale variations of up to 2 m, caused by the internal variations of our modelled climate system, amplified by the sensitivity of CSL to small changes in river runoff and in the over-sea P-E budget. The A1b anthropogenic emission scenario causes a 4.5 m fall in CSL in the 21^{st} Century, due to a pronounced increase in over-sea evaporation that is stronger than the enhanced river discharge. This decline in CSL is of the same order of magnitude as the orbitally-forced millennial-scale downward CSL trend simulated for the last 8000 years. Our results are generally consistent with CSL estimates based on geological, historical and measured data, as well as with most other model studies.

Reference: Renssen, H., Lougheed, B.C., Aerts. J.C.J.H., de Moel, H., Ward, P.J., Kwadijk, J.C.J. (2007). Simulating long-term Caspian Sea level changes: the impact of Holocene and future climate conditions. Earth and Planetary Science Letters 261, 685-693.