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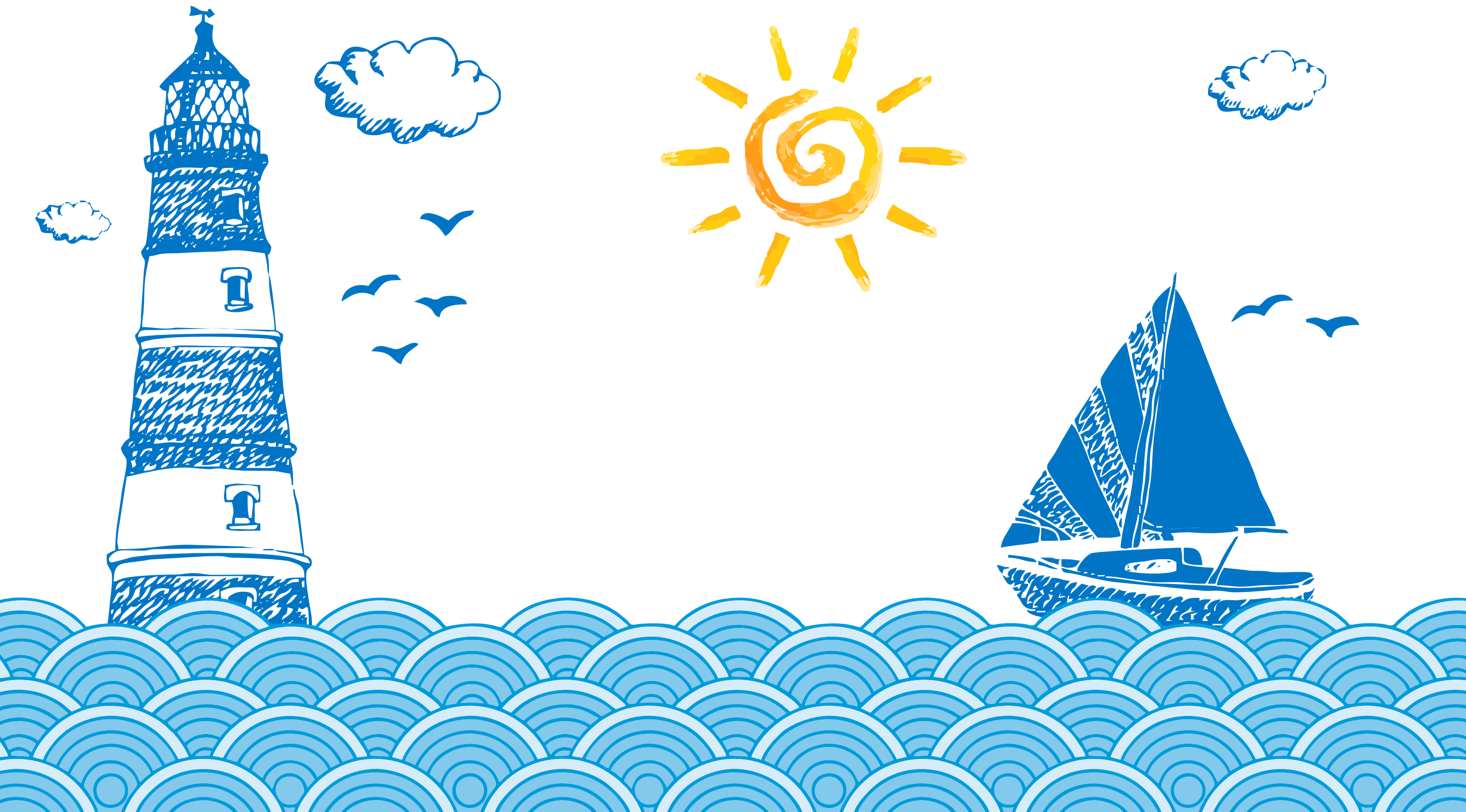

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Quantification of large-scale groundwater resources in karst aquifers within the Mediterranean region under the light of long-term shifts in climate

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The Mediterranean region is one of the “hotspots” of predicted shifts in climate and will be affected by increasing water scarcity in the near future. Karstified aquifers are vulnerable to changes in the hydrological cycle. We here present a numerical model of the Western Mountain Aquifer (WMA), a transboundary aquifer between Israel and the Palestinian Territories, with a size of 9,000 km2 Due to a high politically-driven data scarcity a stochastic modelling concept using the MODFLOW is developed that considers the aquifer development and changes in climate of the last 5 Mio. Years BP and also the future.

For the design of the karst network it was necessary to reconstruct the karst development. Carbonate rocks of the WMA were folded during the Oligocene into several NNE-SSW-trending anticlines and subsequent erosion resulted in today’s recharge areas. Major changes in sea-level, especially during the Messinian Salinity Crisis, drove the formation of deep, multi-layer karst conduit systems (Laskow et al. 2011). Vertical distribution of conduits was controlled by i) sea-level changes and ii) the depths of new canyons draining the entire catchment. Especially within the coastal plain highly permeable karst was developed, explaining the low South-North trending hydraulic gradient. Karst conduits also cross the aquitard connecting Upper and Lower Aquifer.

Parameterization and location of the karst features are defined with a stochastic prediction of the karst networks distribution using a new pseudo-genetic algorithm (Stochastic Karst Simulator SKS, Borghi, 2012) and then transferred into probability density functions (PDF). Based on the PDFinformation, a karst conduit network is generated that connects the recharge areas with discharge points. Locations of assumed individual karst conduits and the geometry of the karstified horizons are calibrated by geophysical borehole data.

The different degrees of karstification are converted into hydraulic parameter fields. This process results in a catalogue of groundwater models. The stochastic concept is suitable to parameterize large-scale groundwater systems with only a limited number of data available and depends less on the availability of high-quality observation time series.

Climate projections show that during winter temperatures will rise in the recharge area by 2°C increasing evaporation rates. However, total precipitation will decrease by 20%. Climate modelling indicates that a larger proportion of rainfall will occur during extreme events with an increase of the total amount of 10% affectingly mostly the Northern recharge area. We therefore expect, that the impact of regional shifts in climate on recharge rates and groundwater resources will be impressive. Therefore, based on the calibrated groundwater model the response of the groundwater system to predicted changes in climate is analyzed. For this purpose, climate data from a high-resolution (~2 km grid) regional climate model between 2041-2070 are currently investigated and coupled with the groundwater model.