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A generalized multivariate regression model for modelling ocean wave heights

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In this study, a generalized multivariate linear regression model is developed to represent the relationship between 6-hourly ocean significant wave heights (Hs) and the corresponding 6-hourly mean sea level pressure (MSLP) fields. The model is calibrated using the ERA-Interim reanalysis of Hs and MSLP fields for 1981-2000, and is validated using the ERA-Interim reanalysis for 2001-2010 and ERA40 reanalysis of Hs and MSLP for 1958-2001. The performance of the fitted model is evaluated in terms of Pierce skill score, frequency bias index, and correlation skill score. Being not normally distributed, wave heights are subjected to a data adaptive Box-Cox transformation before being used in the model fitting. Also, since 6-hourly data are being modelled, lag-1 autocorrelation must be and is accounted for. The models with and without Box-Cox transformation, and with and without accounting for autocorrelation, are inter-compared in terms of their prediction skills.

The fitted MSLP-Hs relationship is then used to reconstruct historical wave height climate from the 6-hourly MSLP fields taken from the Twentieth Century Reanalysis (20CR, Compo et al. 2011), and to project possible future wave height climates using CMIP5 model simulations of MSLP fields. The reconstructed and projected wave heights, both seasonal means and maxima, are subject to a trend analysis that allows for non-linear (polynomial) trends.