Application of an artificial neural network to generate wave projections at southern African coasts

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Motivation
In the past decades, the co-occurrence of storm surges, wind waves, heavy precipitation and resulting runoff led to critical high water levels at the coasts of southern Africa and as a consequence to property damage and loss of human life. As these compound events at southern African coasts are dominated by wind waves, it is of great importance to investigate the regional wave climate with focus on wave forcing and the origin of wave energy. The understanding of the processes enables us to improve our future wave climate projections and, in a next step, drives flood risk assessment forward.

Model Chain
The aim of this study is the application of a hybrid approach to estimate future wave climate and to downscale the waves to the coast. First, we use mean sea level pressure data as input for an artificial neural network (ANN) to predict offshore wave data (blue point in fig. 1). Second, we apply the numerical wave propagation model SWAN to transform the offshore waves nearshore (green point in fig. 1). Due to computational limitations we only transform a selection of waves to the coast and then use radial bias functions for reconstructions of complete nearshore time series. The focus of this poster is the prediction of offshore waves by the ANN.

First training results of the ANN
The ANN is established by the input data mentioned above. Afterwards 6 hourly significant wave heights of 2010 are predicted and compared with the CAWCR hindcast as shown in fig. 4. There is a good agreement for small and large wave heights. The correlation is $R^2=0.79$ with a RMSE of 0.60m.

Conclusion and Outlook
As shown the ANN is a suitable method to predict future wave hydrographs from mean sea level pressure data. The comparison with the hindcast already shows a high correlation although the training period of 9 years is still small which could be one reason for the elevated RMSE. In a next step, we will apply a larger training period to the ANN and refine the time delay and the area of wave generation to further improve the predictions. Afterwards we will be able to use robust projections of the mean sea level pressure to estimate future wave hydrographs which in turn will be the input for improved flood risk assessments.