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Assessing a probabilistic model for guiding storm surge barrier maintenance

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Storm surge barriers provide flood protection to many major coastal cities in estuaries around the world. Maintenance of these assets is critical to ensure they remain reliable and continue to comply with protection standards. To ensure safe working conditions, there are often critical thresholds of environmental conditions, beyond which maintenance work cannot be carried out. However, as storm surge barriers age and with climate change effects such as sea-level rise and changes in storminess, periods when environmental conditions exceed set thresholds will occur more frequently, thus making it more challenging to carrying out the required work in available maintenance windows. Probabilistic models using ensemble forecasts of upcoming water levels determine the likelihood of conditions exceeding the threshold and so can inform on decision making regarding maintenance. Here we evaluate a probabilistic model currently in operational use by Rijkswaterstaat, the Dutch Ministry of Infrastructure and Water Management, to guide maintenance decisions at the Maeslant barrier in the Netherlands. Sixteen years of historic highwater level forecasts from a combination of European Centre for Medium-Range Weather Forecasts and Dutch Continental Shelf Model v5 are used with observations from the Hoek van Holland tide gauge to evaluate and sensitivity test the probabilistic model. Binary classification is used to assess the performance of the probabilistic model. Findings show that the model is conservative with 33.1% of outcomes resulting in a False Alarm. Changing the baseline parameters of critical probability and water level threshold impacts the balance between False Alarm and Miss outcomes. Increasing the critical probability reduces the number of False Alarms but increases the Miss situations, emphasising the trade-off between acceptable risk and time available to carry out maintenance work. This study highlights the delicate balance between model parameter selection and the associated risk with respect to the maintenance of storm surge barriers.