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Predicting drought-induced cracks in dikes with machine learning algorithms

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During intense periods of drought, the development of cracks is observed in peat and clay dikes. Asset managers of the dikes increase the inspection frequency in times of drought to be able to monitor these cracks. Significant development of the cracks contributes to the development of different failure mechanisms. In this study, the occurrence of the cracks is predicted at a large spatial scale. An inspection database in which the observations from the last three years are stored is used as the basis. The database contains hundreds of observed cracks including the location and time in which they were observed. The database was extended with attributes such as the precipitation deficit, the peat width at the surface, the orientation of the dike body, the subsidence of the dike body and the soil stiffness. Decision tree algorithms were then used to classify which circumstances will lead to cracks and which circumstances will not. From the resulting decision trees it was deduced that high precipitation deficits, low soil stiffness and the peat width can be used as the main predictors for the occurrence of cracks. Both subsidence of the foundation and the dike body being orientated to the sunny side are also contributors, although less prominent. Time-independent cracking criteria were then used to classify which regions are prone to cracking. Dikes which are rich in peat with a low stiffness were thus highlighted. The Mathews correlation coefficient was used as performance criteria resulting in a 0.3 value for the obtained tree. Application of a random forest increased the coefficient to 0.8. An important conclusion is that proper monitoring of the peat width, soil stiffness and precipitation may result in better asset management.