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Seasonal forecast of agricultural drought in the Mekong Delta

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The Mekong Delta is the most productive agricultural area within Vietnam. The high productivity is based on fertile soils in combination with a monsoonal climate providing sufficient water for most parts of the year. During the dry season lasting from January to April, rainfall is practically zero and the agricultural production depends on irrigation water extracted from the dense network of river branches and canals. In the coastal area salinity intrusion may, however, cause severe problems in the cultivation of paddy rice, the most grown crop in the Delta, and other agricultural crops and lead to an agricultural drought. Therefore a seasonal prediction of salinity intrusion is of high importance for the famers, their livelihoods and the agriculture economy in the Mekong delta.
The magnitude of the salinity intrusion and thus the agricultural drought is essentially determined by the flow of the Mekong during the dry season, which is in turn ruled by the strength of the monsoon of the previous rainy season. This opens the path for a prediction of the drought via indicators of the monsoon strength and/or the dry season discharge. In this study a simple model based on Logistic Regression (LR) was developed to predict the average salinity during dry season in the Ben Tre coastal province of Ben Tre of the Mekong delta. The model applied Standardized Streamflow Indexes (SSI) for a short term prediction of a few months lead time, and ENSO indexes (as proxies for the monsoon strength) for a long term prediction. The model itself predicts the likelihood of exceeding two thresholds, i.e. 3 and 4 g/l of mean salinity, indicating a moderate and severe salinity intrusion for Ben Tre. The results show that the model can predict the exceedance of the thresholds with high skill (ROC score > 0.8, up to 0.96 for the lower threshold) for lead times up to 10 months using $ENSO_34$ index as predictor. For the longer lead times the skill is higher for the lower salinity threshold. For short lead times, the model skill further improved up to ROC scores > 0.9 also for the higher threshold using multi-monthly SSI's indexes. The best skill is obtained using the 3-monthly SSI of October to December just before the dry season. The skill of the predictions using ENSO indexes decreases with shorter lead times, as the correlation of ENSO with the monsoon strength (and thus rainy season discharge) is decreasing later in the season.
The proposed novel prediction model can be considered as a simple and easy-to-apply method for seasonal drought prediction in the coastal areas of the Mekong delta. The model can provide timely warnings for the government and farmers enabling them to modify their cropping patterns in due time and thus reducing the probability of crop losses.