LocustTrack: Forecasting the Impact of Climate Change and IOD on the Distribution of Schistocerca gregaria (Desert Locust)

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Schistocerca gregaria (desert locust) is the world's most destructive migratory pest and a serious threat to food security. Existing locust-control tools use real-time field data to monitor swarms for immediate control operations. However, these tools do not account for long-term climatic and marine influences like the Indian Ocean Dipole (IOD) that significantly impact wind and locust migration patterns. LocustTrack is a novel tool that combines a short-term Breeding Model with a long-term Species Distribution Model (SDM) to predict locust distribution by assessing whether ecological and climatic conditions are favorable to locust survival, breeding, and gregarization (swarming). The SDM was trained on adult locust occurrence, climate, crop, and anthropogenic footprint, achieving an AUC of 0.979 on the testing data. Future predictions were made under four carbon emission scenarios (SSP 126 to SSP 585). As climate change intensifies, the SDM predicts that the probability of locust invasions increases globally not only in existing areas but also in previously unaffected regions (such as Central Asia, Southern Europe, and Southern Africa). The Breeding Model was trained on young locust occurrence data as well as environmental, wind circulation, and IOD index data and used to identify locust breeding hotspots. A Gaps in Intervention index was also created by comparing the spatial distribution of swarms to that of control operations to identify vulnerable areas underserved by government intervention. Overall, LocustTrack is a low-cost tool that offers critical lead time for proactive locust control measures, timely procurement of safe biopesticides, and early harvesting of mature crops, thus ensuring food security for locust-affected areas.

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