No ocean too wide? Global-scale ocean dispersal simulations support genetic evidence for trans-oceanic dispersal and connectivity in mangroves.

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Mangrove forests provide a broad range of ecosystem services and are among the most productive ecosystems on Earth. Various studies have demonstrated that these intertidal forests are shifting geographically in response to climate change, with important implications for human welfare, ecosystem functioning and the marine and global carbon cycles. Understanding the future of mangrove range dynamics is challenging and requires estimates of the way their hydrochorous (i.e., water-buoyant) propagules disperse via tidal, near-shore, and open-ocean surface currents. Here we use a high-resolution (1/24° × 1/24°), eddy- and tide-resolving numerical ocean model to simulate mangrove propagule dispersal across the global ocean and generate connectivity matrices between mangrove habitats using a range of floating periods. Our numerical approach allowed identifying mangrove dispersal routes, barriers, and stepping-stones, as well as connectivity between regions globally, and supports findings from genetic studies. Results show high rates of along-coast transport, and transoceanic dispersal routes across the Atlantic, Pacific, and Indian Ocean. The American and African continents present important dispersal barriers. Archipelagos, such as the Galapagos and those found in Polynesia, Micronesia, and Melanesia, act as critical stepping-stones for dispersal across the Pacific Ocean. Direct and reciprocal dispersal routes across the Indian Ocean via the South Equatorial and seasonally-reversing monsoon currents, respectively, allow connectivity between Western Indian Ocean and Indo-West Pacific sites. We demonstrate the isolation of the Hawaii Islands and help explain the presence of mangroves on the latitudinal outlier Bermuda. Finally, we find that dispersal distance and connectivity are highly sensitive to the minimum and maximum floating period. We anticipate that our findings will guide future research agendas to quantify biophysical factors determining mangrove dispersal and will help improve our understanding of observed mangrove species distributions and expected range shifts under climate change.

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