

# Predicting future latitudinal limits of mangroves in South-Africa with species distribution modelling

K. Quisthoudt<sup>1</sup>, C. Randin<sup>2</sup>, J. Adams<sup>3</sup>, F. Dahdouh-Guebas<sup>1,4</sup> & N. Koedam<sup>1</sup>

<sup>1</sup>Laboratory of Plant Biology and Nature Management, Vrije Universiteit Brussel, Pleinlaan 2, B-1050 Brussels, Belgium. Web-site: [www.vub.ac.be/APNA](http://www.vub.ac.be/APNA), E-mail: [kquistho@vub.ac.be](mailto:kquistho@vub.ac.be)

<sup>2</sup>Institute of Botany, Universität Basel, Schönbeinstrasse 6, 4056 Basel, Switzerland.

<sup>3</sup>Department of Botany, Nelson Mandela Metropolitan University, PO Box 77000, 6031 Port Elizabeth, South-Africa.

<sup>4</sup>Laboratory of Systems Ecology and Resource Management, Department of Organism Biology, Faculty of Sciences, Université Libre de Bruxelles - ULB, Avenue Franklin Roosevelt 50, B-1050 Brussels, Belgium.

## Abstract

In South-Africa, mangrove forests occur along the east coast and reach their southern latitudinal limit of the West-Indian Ocean at 32.6°S. These mangrove forests consist of three species: *Avicennia marina*, *Bruguiera gymnorhiza* and *Rhizophora mucronata*. Due to coastal geomorphology and wave action, mangroves are restricted to estuaries. Hence, the mangrove distribution of South-Africa is an ensemble of fragmented, small forest patches. The drivers of the regional distribution had not been identified yet. Today we present (1) whether and how climate may affect the patchy distribution and the latitudinal limits of the mangrove forest and its species in South-Africa, and (2) if and where global warming will create climatically suitable sites for mangroves beyond the current limits by using species distribution modelling (SDM). SDM is a tool to explain observed patterns of species occurrences by using environmental information in correlative models. We used three modelling techniques: generalized linear, generalized additive models and gradient boosting machines. Three climate variables were selected as predictors in the SDMs: (1) monthly minimum temperature of the coldest month, (2) growing degree days (GDD) and (3) water balance. Climate variables for the future projections were derived from climate projections for two socio-economic scenarios (A2a and B2a). All modelling techniques accurately predicted the current leading edge of the mangrove species and forest. GDD turned out to be the most important variable to project the distribution of the mangrove forest and species in South-Africa by the majority of the modelling techniques we applied. Hence, a too short growing season is likely to limit the distribution of mangrove species in South-Africa. Global warming will create climatically suitable sites south of the current latitudinal limits for the mangrove species *A. marina* and *B. gymnorhiza*, but for the latitudinal limit of *R. mucronata* different outcomes were projected depending on the modelling techniques and climate scenarios.

## Keywords

biogeography, climate change, niche, range edge