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# Preliminary use of YieldSAFE model to assess *Eucalyptus globulus* productivity in Portugal under future climate

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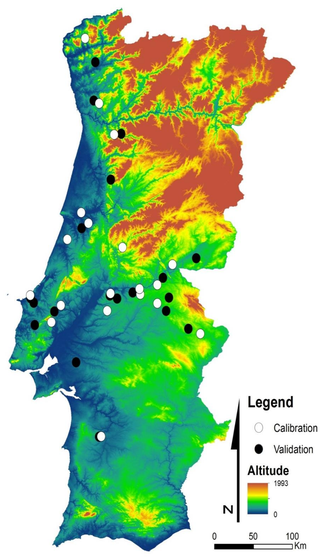
## Introduction

Under the umbrella of the EU Project AGFORWARD (Agroforestry that will Advance Rural Development, 2014-2017), initial workshops with stakeholders identified a potential eucalyptus Agroforestry System (AF) not being practiced in Portugal.

Currently, *Eucalyptus globulus* Labill occupies about 700 000 ha mainly in monoculture plantations for pulp production and a mixed tree-crop-livestock combination could bring new practices and supply new services for forest industry and society.

The YieldSAFE model (wan der Welf, 2007) is a parameter-sparse model developed for agroforestry systems. Nevertheless, the model can also be used for tree or crop monocultures systems. As a first stage in the use of the model for agroforestry systems we tested 1) the response of the model against measured data of eucalyptus monocultures and, once we are dealing with a process based model, 2) the response of the model to future climate scenarios.

## Materials and Methods




Yield-SAFE model was used to project tree and crop yields according to light and water availability.

Tree measured data was used in two independent datasets, each one containing 19 plots. One was used for calibration and the other for validation (Fig 1). Four variables were considered: Diameter at breast height (DBH), height, total biomass, and total volume.

The soil information (texture and depth) was extracted from the European Soil database v2 (2004).

**Figure 1:** Location of datasets for calibration and validation

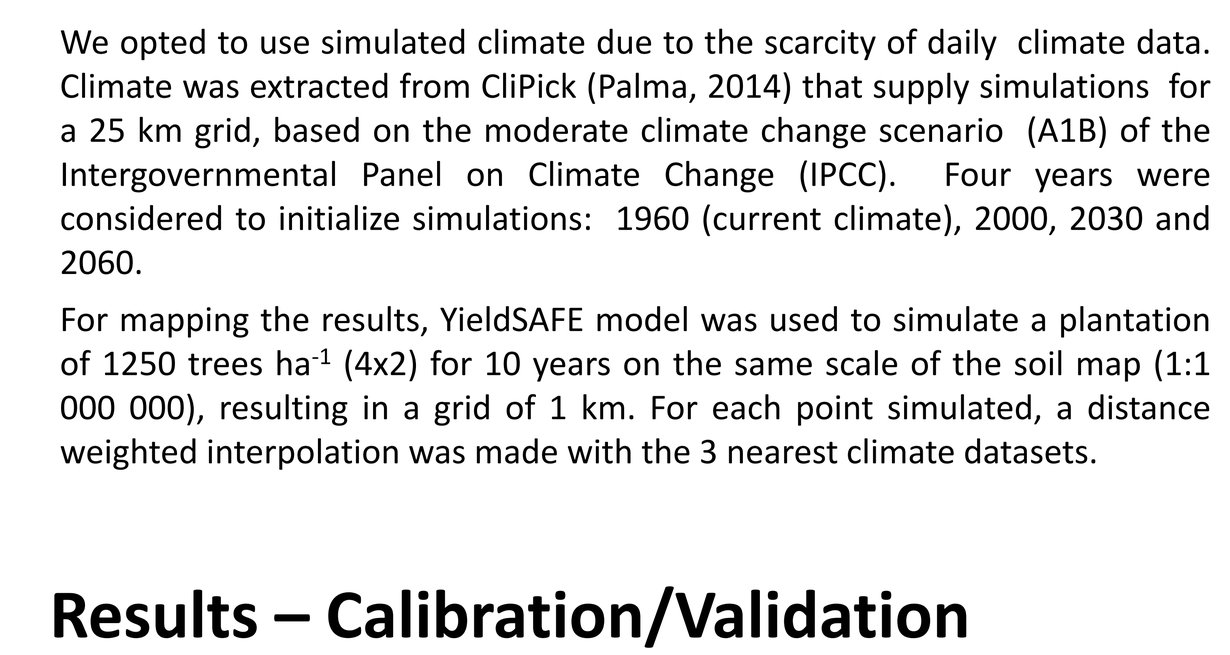
We opted to use simulated climate due to the scarcity of daily climate data. Climate was extracted from CliPick (Palma, 2014) that supply simulations for a 25 km grid, based on the moderate climate change scenario (A1B) of the Intergovernmental Panel on Climate Change (IPCC). Four years were considered to initialize simulations: 1960 (current climate), 2000, 2030 and 2060.

For mapping the results, YieldSAFE model was used to simulate a plantation of 1250 trees $ha^{-1}$ (4x2) for 10 years on the same scale of the soil map (1:1 000 000), resulting in a grid of 1 km. For each point simulated, a distance weighted interpolation was made with the 3 nearest climate datasets.

## Results – Calibration/Validation

The Yield-SAFE model produced a reasonable fit for DBH and total biomass but lower fit when estimating height and volume (Fig 2).

**Figure 2:** Observed vs Predicted plots for the calibration (A) and validation (B)

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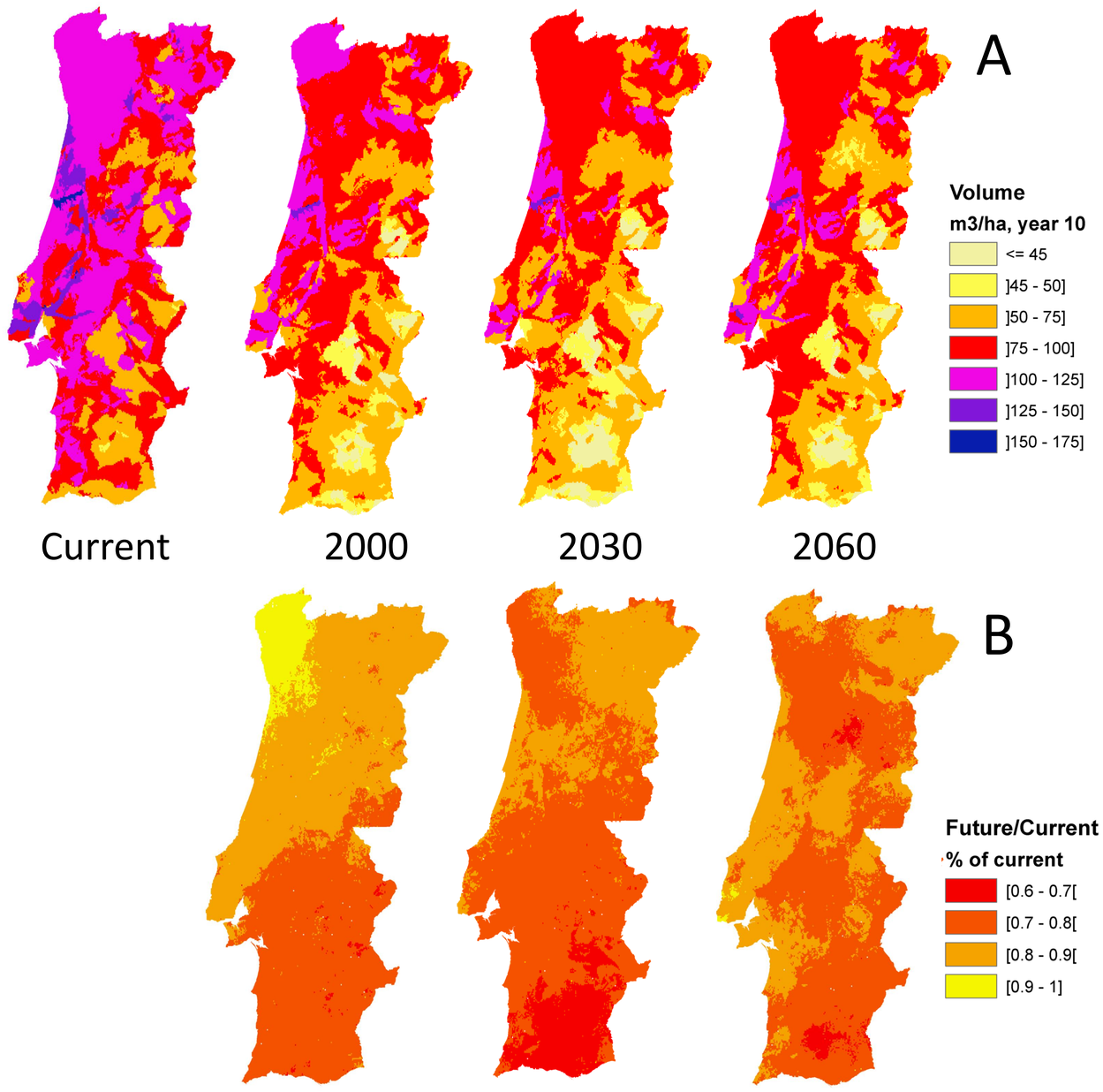
## Results – Simulations

Maps of stand volume at year 10 were produced for comparing current and future climate (Fig 3):

**Figure 3**: A) *Eucalyptus globulus* stand volume at year 10 estimated by YieldSAFE for current and future climate; B) Yield reduction cause by future climate.




## Discussion

Although the calibration of the model is still at preliminary stages (more data can be used for calibration/validation), there are good indications that the model is trendily responding to observed data. There are exceptions. Some plots, especially in the validation dataset, are currently being identified as fertility experimental plots. A further refinement and increase number of the sites can improve these preliminary calibration and validation results.

The main productivity output of the model (tree biomass) is already providing an interesting fitting, which is a strong work baseline to account for resource allocation in future application of the model in new agroforestry systems with this species.

The mapping result, in one hand, is aligned with maps done with empirical models. However, important factors for this species such as altitude and frost days are not accounted in this map. These may change the tree distribution and increase mortality (reducing volume estimated). Nevertheless, 1) the current productivity trends are present and 2) the future spatial reduction in yields is aligned with literature (i.e. Santos & Miranda, 2006).

## References

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