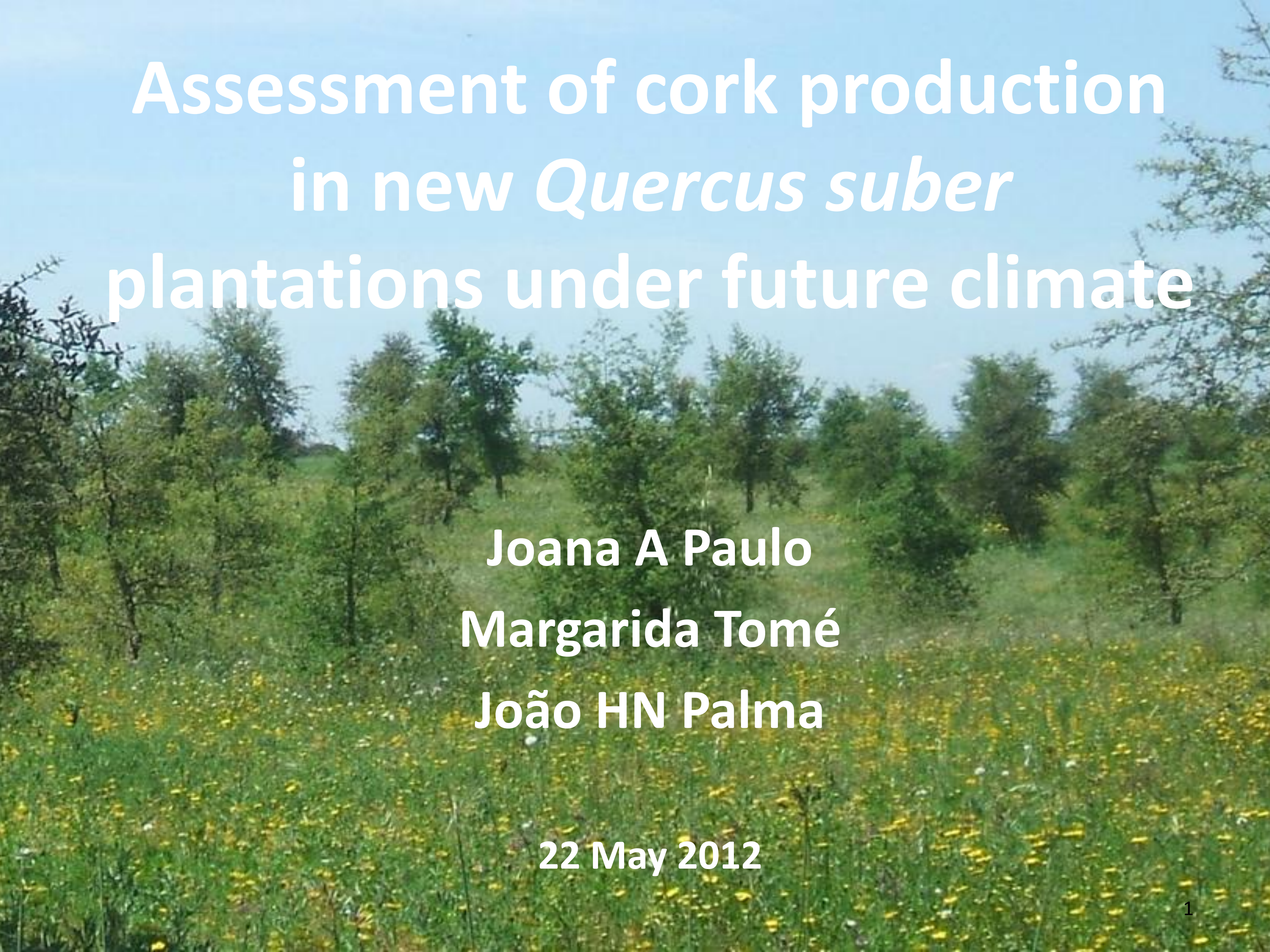

Assessment of cork production in new *Quercus suber* plantations under future climate

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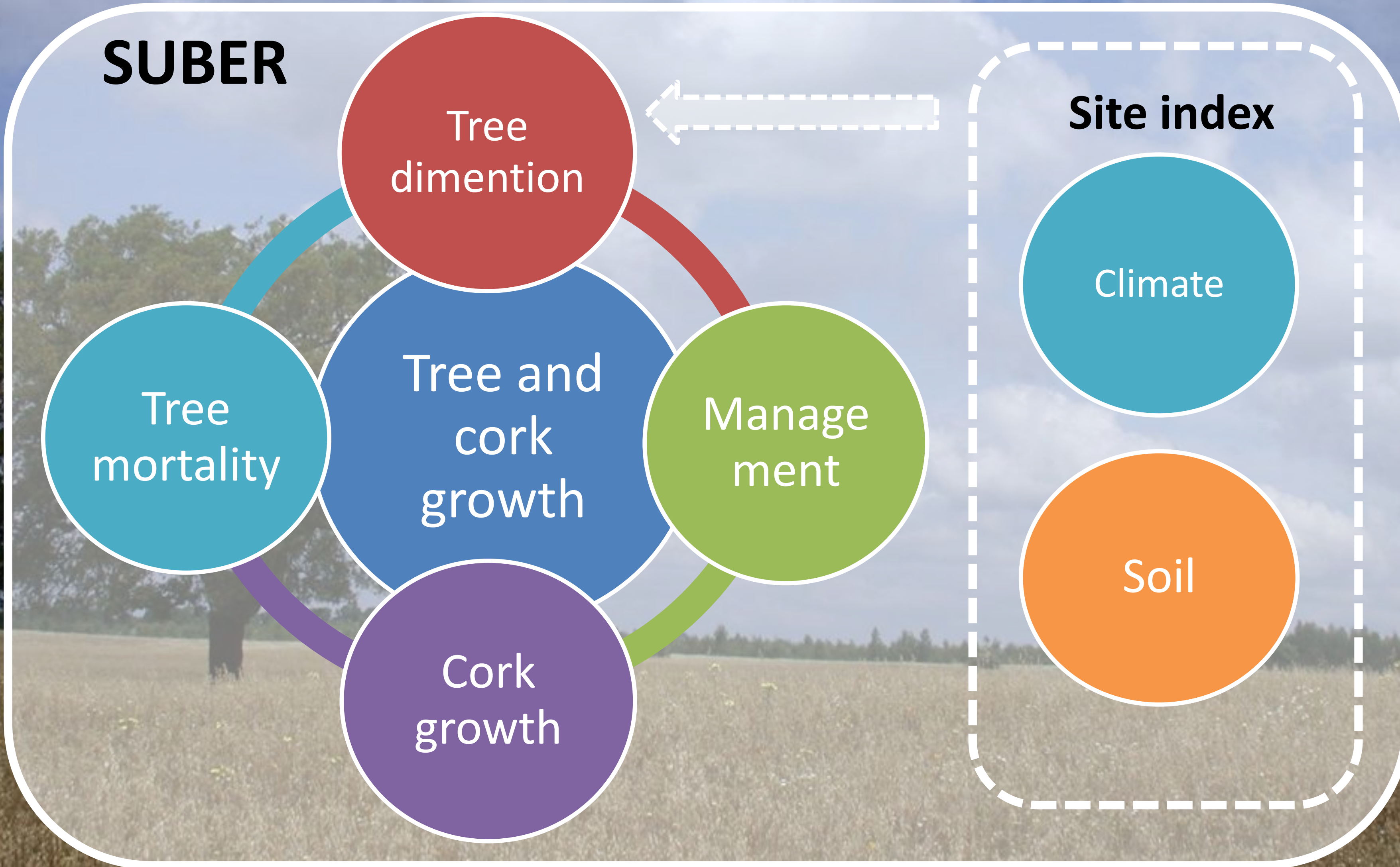
Introduction

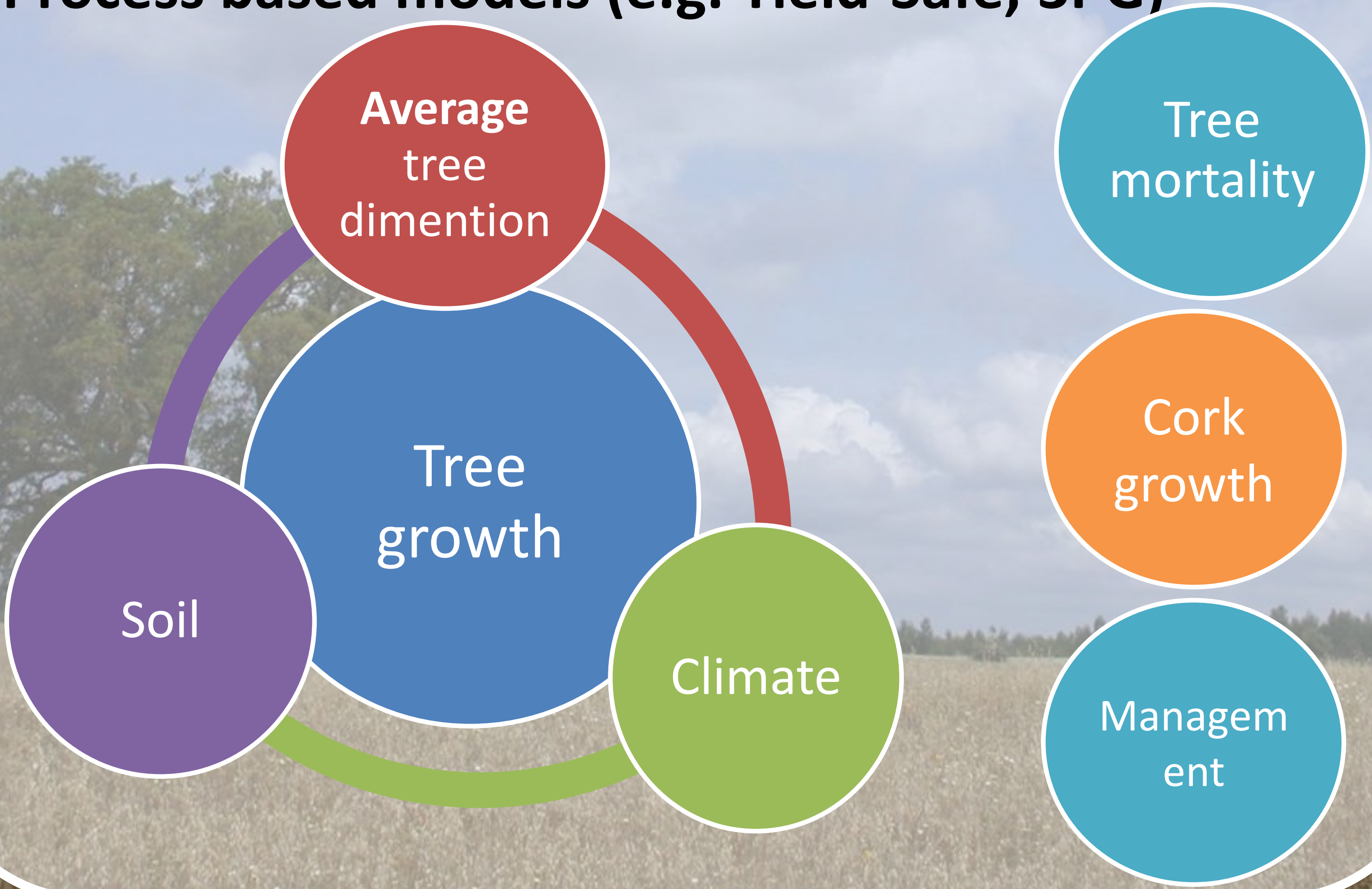
- Climate is related to several variables that affect individual tree and stand cork production:
  - Tree growth rates
  - Tree vitality / mortality
  - Cork growth rates
  - Management options like:
    - cork debarking rotation (period between two consecutive cork extraction operations – a minimum of 9 years according to the Portuguese law)
    - Cork debarking intensities (maximum values regulated by the Portuguese law)

Introduction



Introduction

Process based models (e.g. Yield-Safe, 3PG)

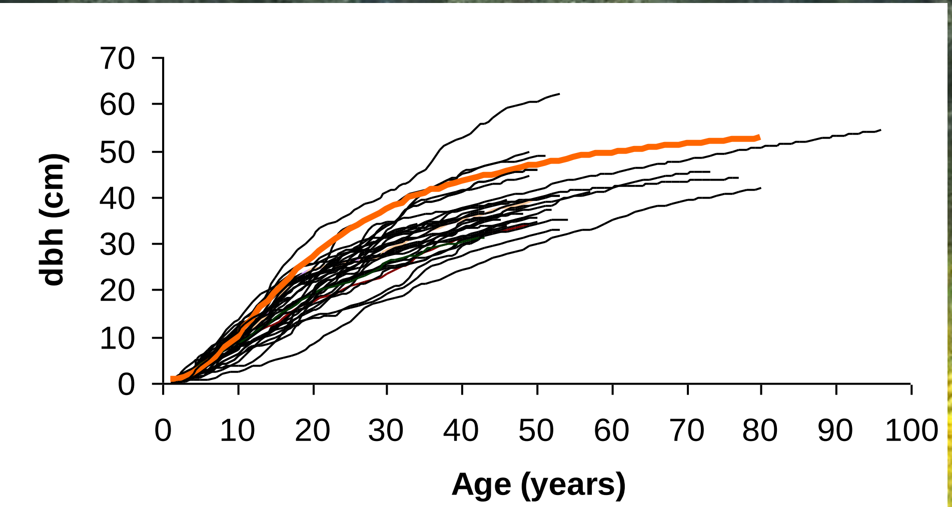


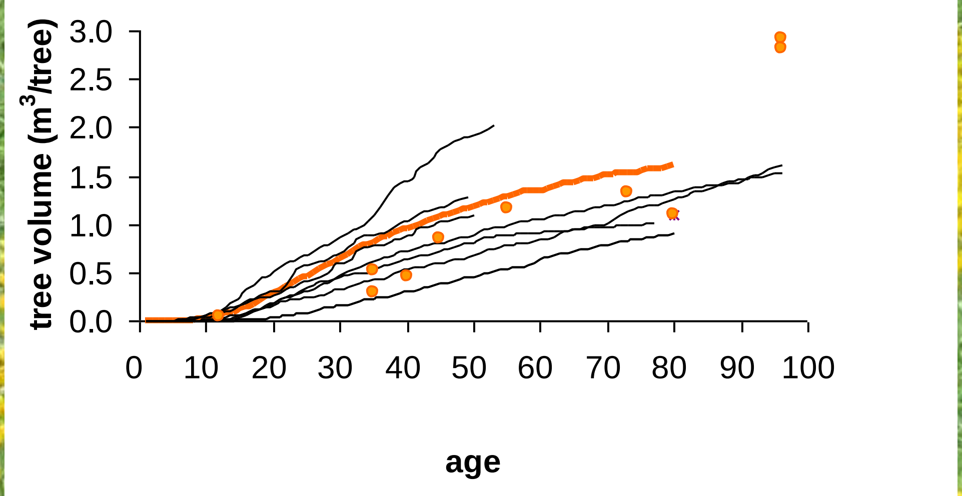
Objectives

- Explore a methodology that allows the hybridization of the Yield-Safe 'big leaf' process based model and the empirical individual tree growth model for *Quercus suber* L.: SUBER model
- Simulate stand growth and stand cork production variations under future climate, in new plantations

Material and Methods

- Yield-Safe calibration for tree potential dbh, volume and biomass growth using:
  - dbh (tree rings measurements on stem discs)
  - Volume and biomass measures (dots)



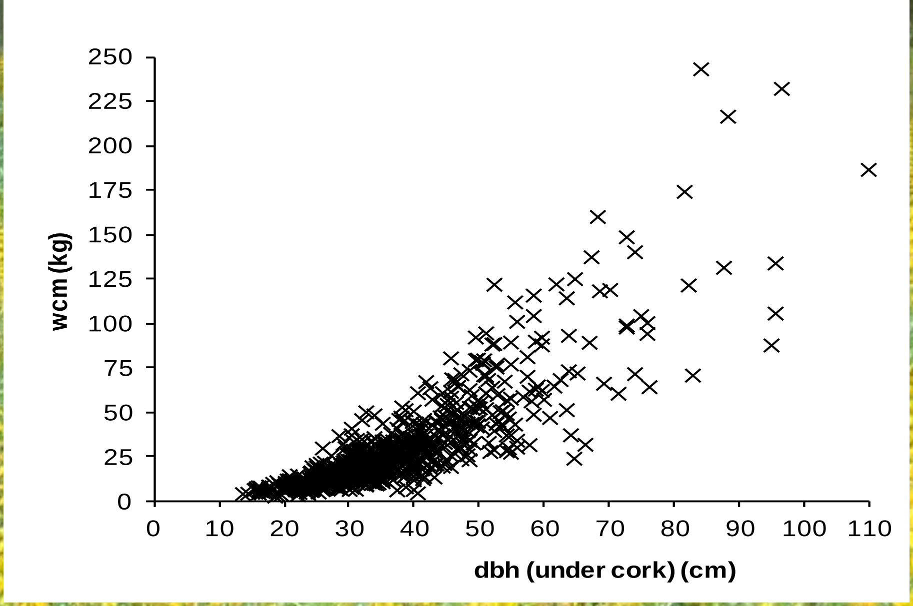


Material and Methods

- Assumptions for Yield-Safe simulations:
  - The number of trees per hectare in the stand at 15 years of age, is equal to the number of trees per hectare measured in the forest inventory in 2007
  - New plantations are managed for cork production:
    - high number of trees per hectare
    - no agro or pastoral activities
    - no fertilization
    - no irrigation
    - periodical understory removal

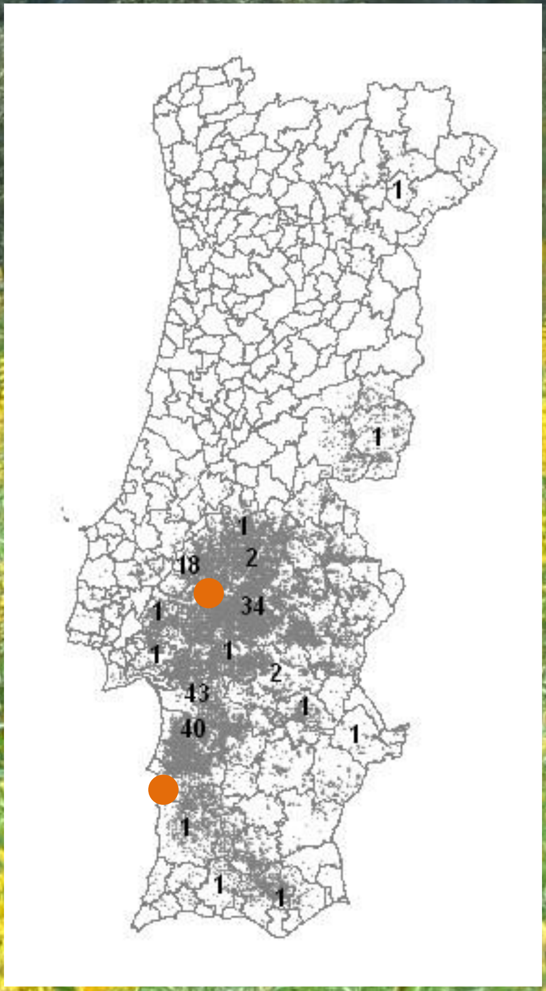
Material and Methods

- SUBER allometric equation for tree cork production depending on:
  - tree size variables (dbh and number of main branches)
  - management options variables (debarking intensity)
- Estimates of cork production assume:
  - Debarking intensity equal for all trees in the stand
  - 9 year interval between consecutive cork extractions in the same stand



Material and Methods

- Data from 2 cork oak plantations installed in 1992 and measured in 2007 (15 years old stands):
  - Soil information:
    - Texture
    - Soil depth
  - Number of trees per hectare at plantation
  - Forest inventory data collected in 2007:
    - Diameter at breast height
    - Total heigh
  - No cork inventory data (cork thickness or cork quality) – in 2007 stands had still not been debarked



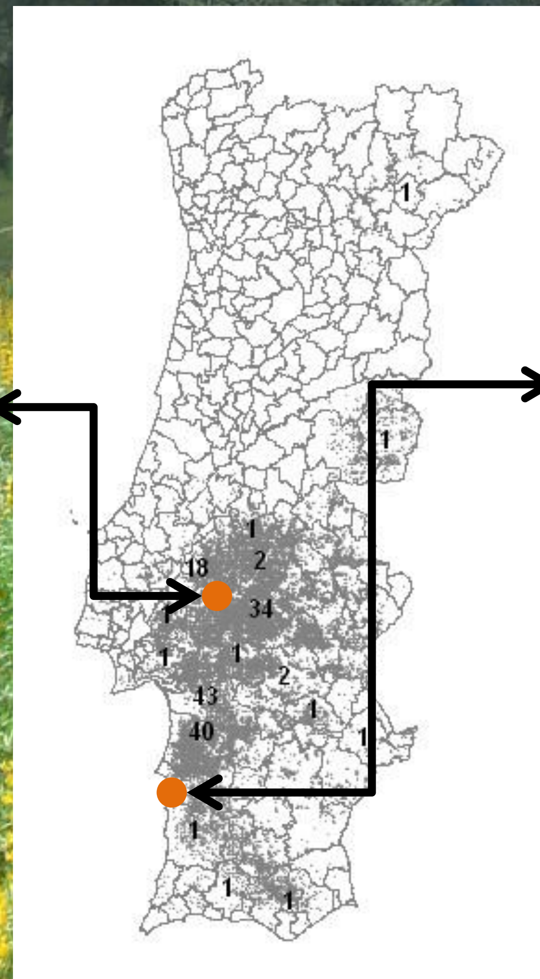
Material and Methods

Coruche (Inland)

Arenosols

Medium soil texture

135 cm soil depth



Sines (Seashore)

Luvisols

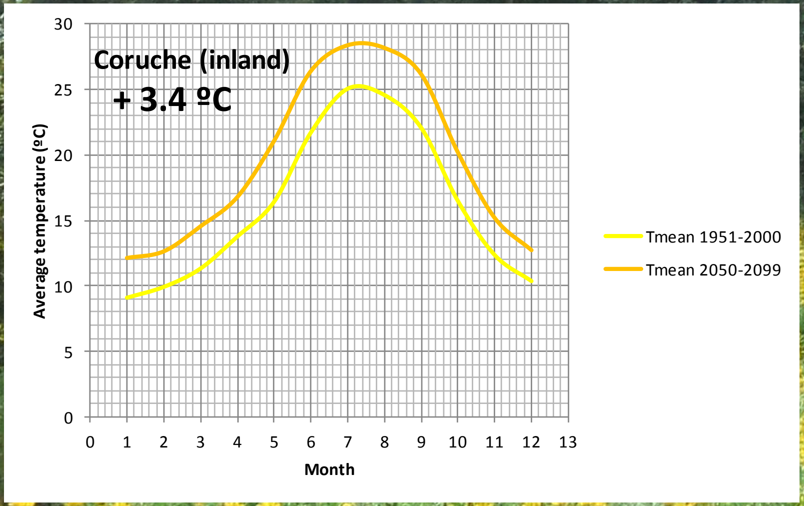
Fine soil texture

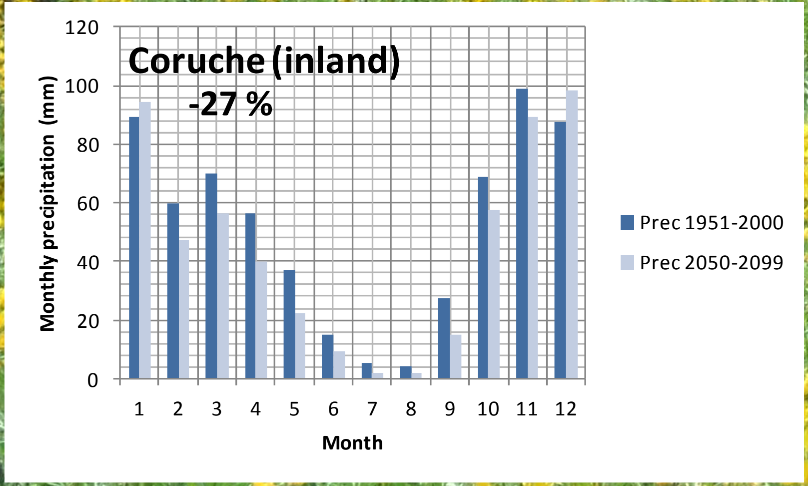
150 cm soil depth

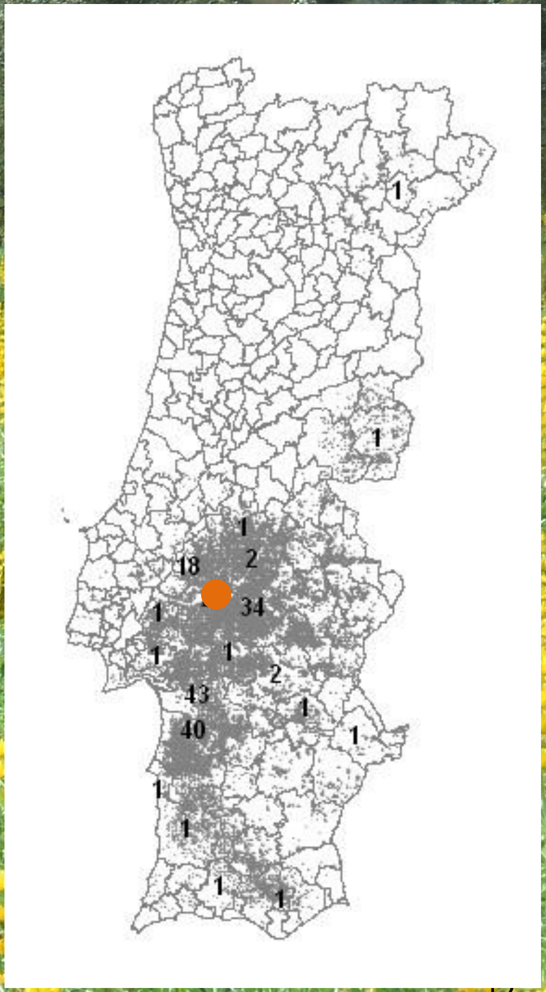
Material and Methods

- Climate daily data:
  - total shortwave radiation
  - precipitation
  - mean temperature
- Data source:
  - HadRM3Q0 A1B (ENSEMBLES EU project: Hadley Center Regional Model Normal sensitivity)
  - IPCC scenario A1B
  - Daily data from 1951 to 2099:
    - 1951-2000
    - 2001-2050
    - 2050-2099

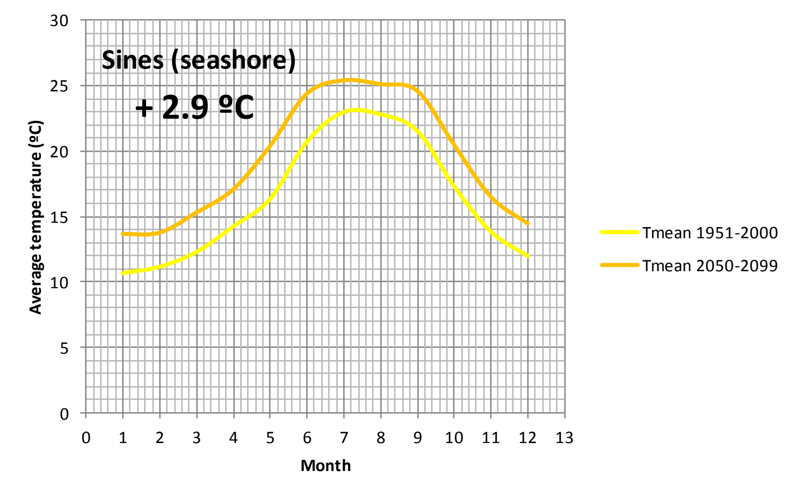
Material and Methods

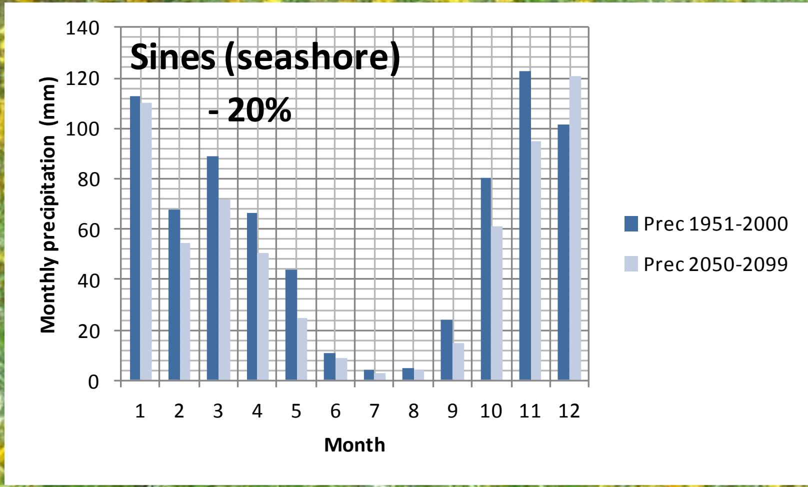


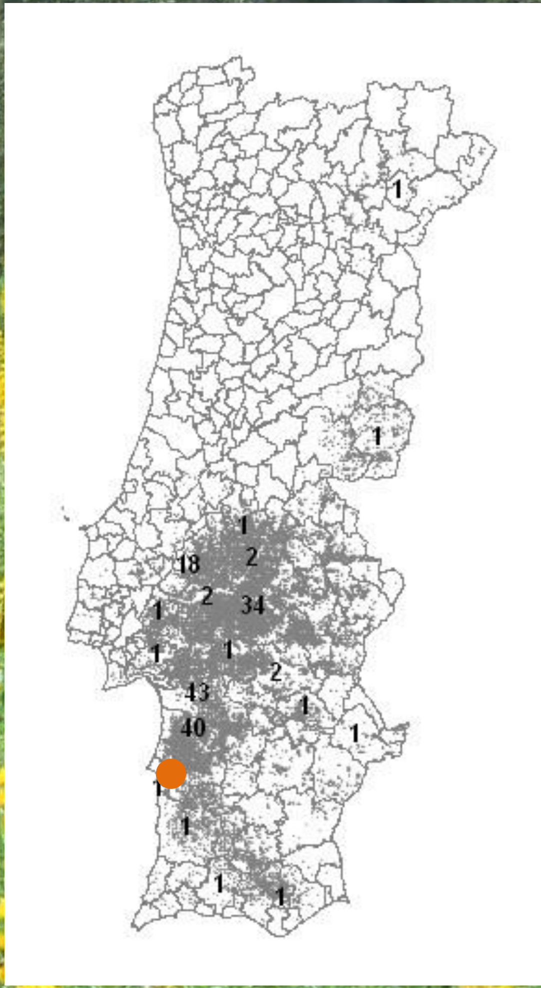




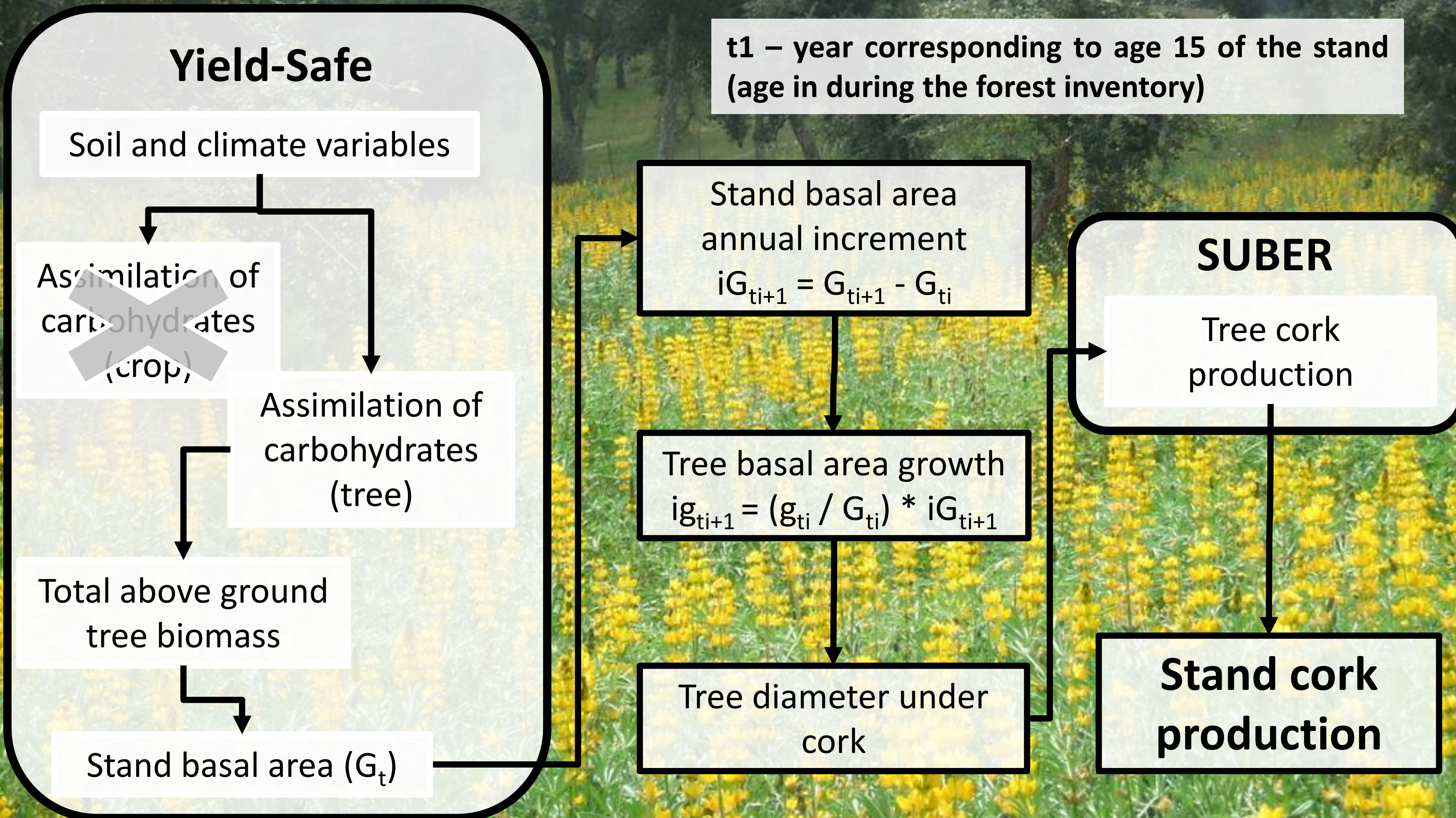
Material and Methods



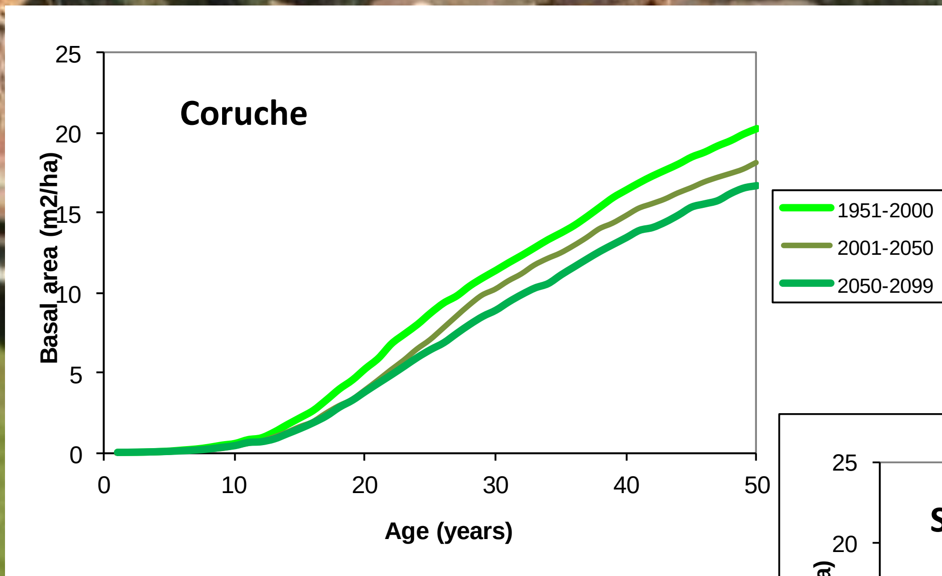


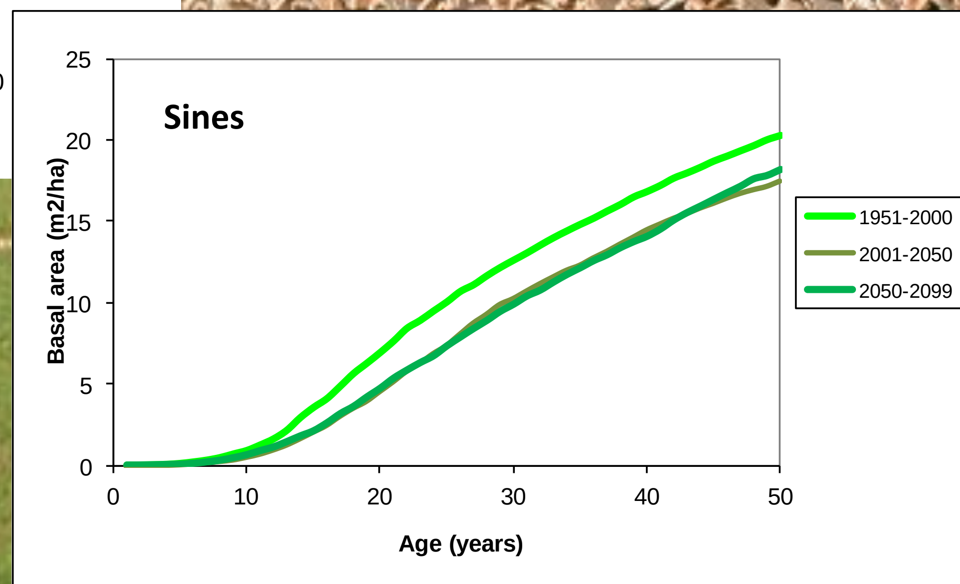


Hybridization scheme



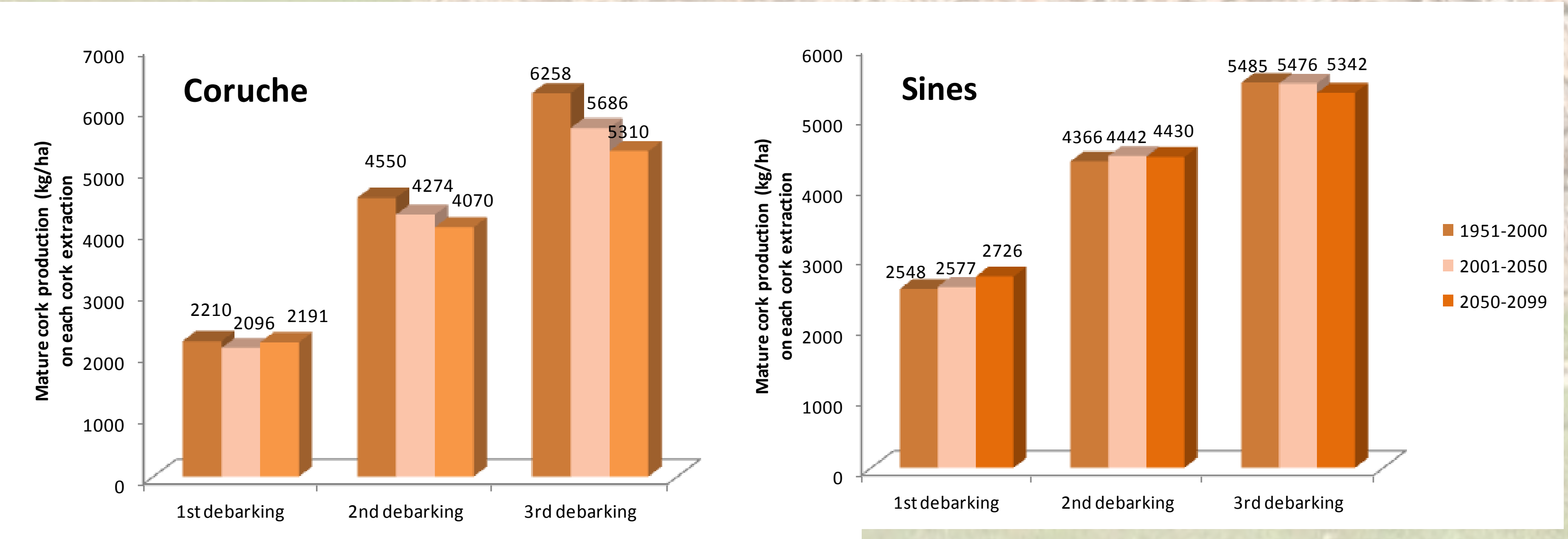
Results: basal area evolution





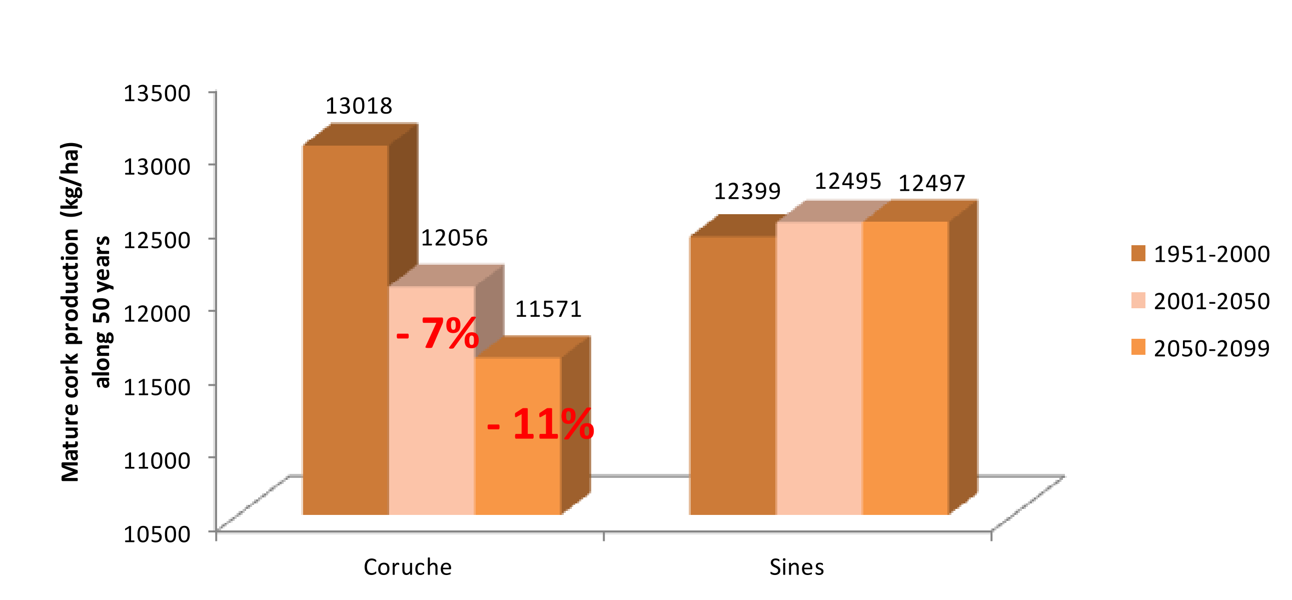
Results: mature cork production

- The effect of climate scenario on cork production differs between the two sites:
  - Reduction of cork production in Coruche (inland)
  - No large variation of cork production in Sines (seashore)



Results: mature cork production

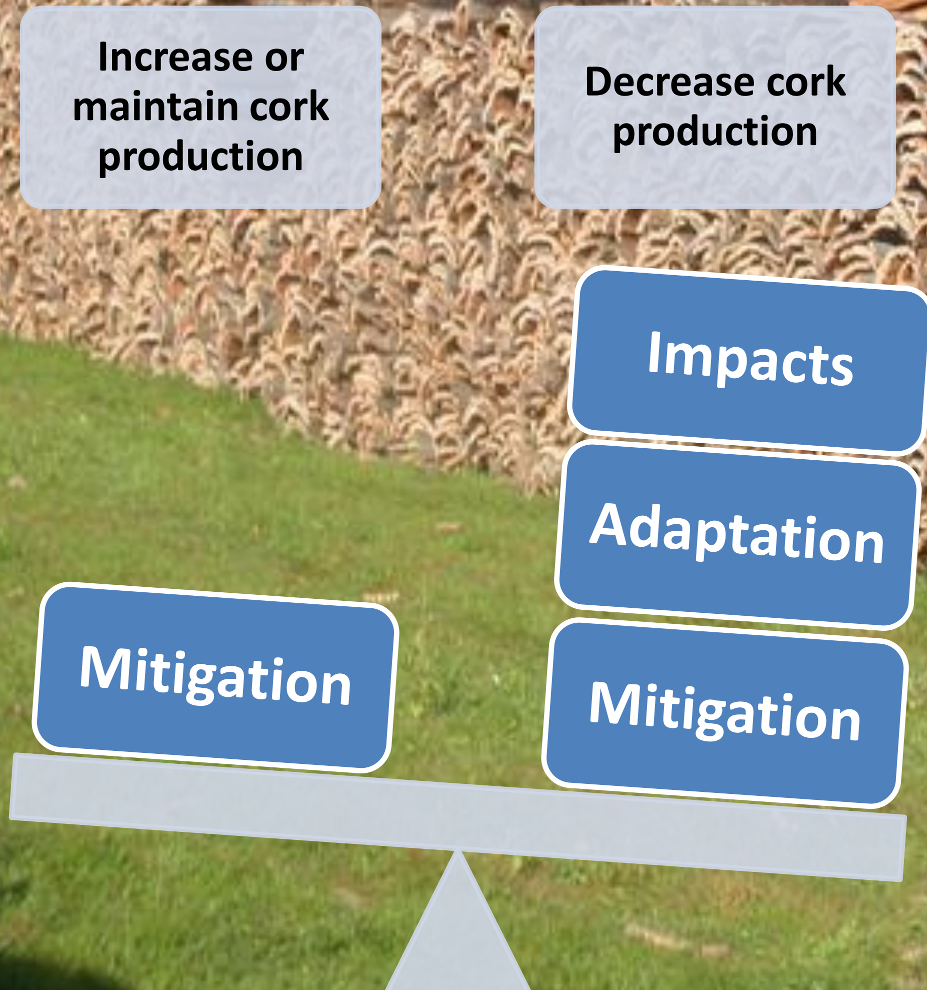
- Mature cork production variation along the 50 years simulation period:
  - Until less 11% in cork production in Coruche considering the 2050-2099 climate data instead of the 1951-2000 data
  - Close to zero cork production variation in Sines despite the climate data



Results:
Impacts ↔ Mitigation ↔ Adaptation

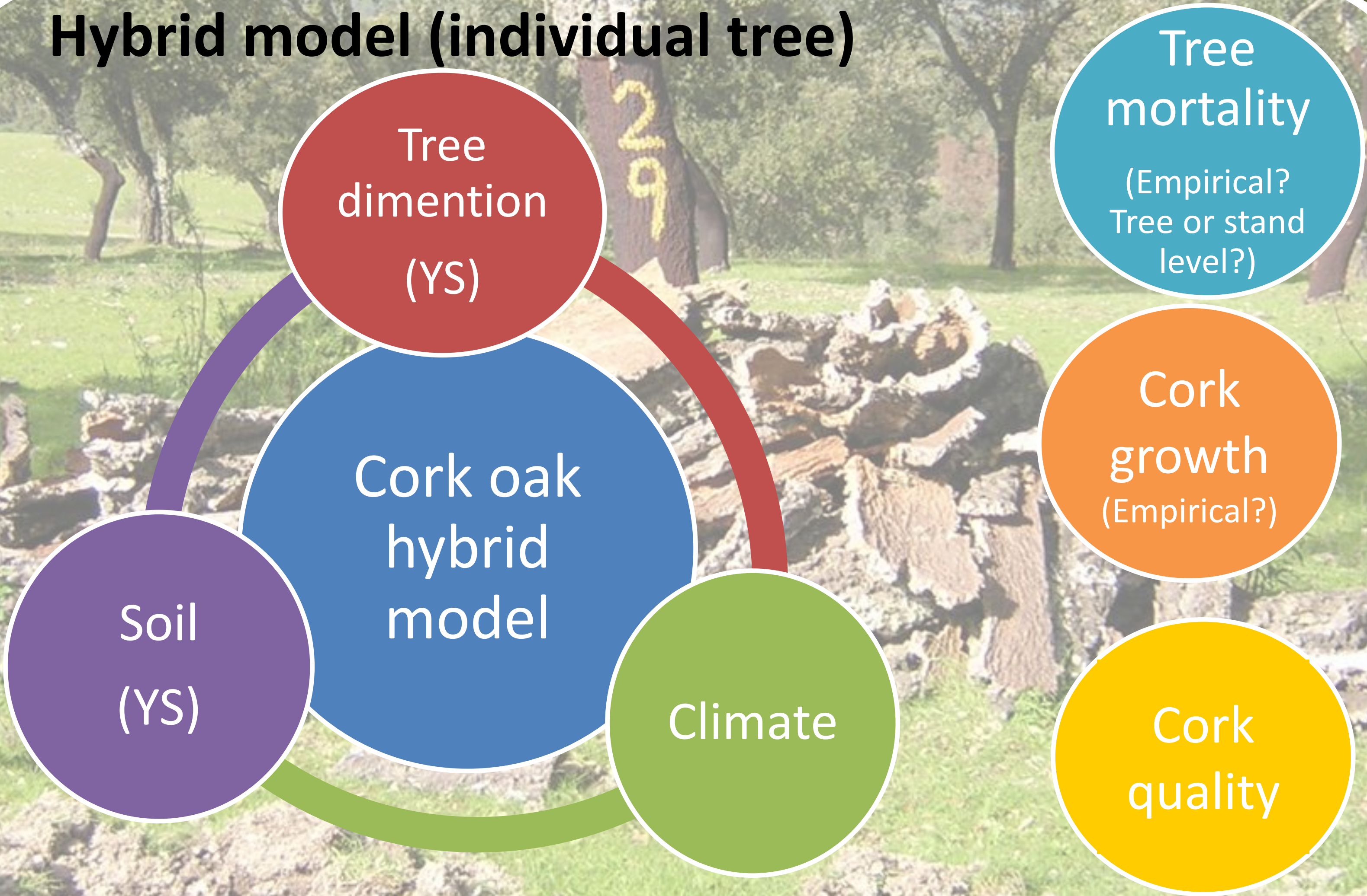
- Impacts:
  - Climate will affect tree growth, and consequently, cork production, in quantities varying between sites, namely soil characteristics ↓
  - Climate will affect cork growth, and consequently cork thickness (cork quality?) ↓
  - Climate is already affecting tree mortality rates (stress, pests and diseases) ↓
- Mitigation:
  - Reduction of the debarking intensities ↓
  - Increase of the debarking rotation periods ↓
  - New plantations in land areas traditionally used for agricultural activities, with ‘better’ soil characteristics ↑
- Adaptation:
  - Selection of new tree species and mixed stands more resistant and well adapted to climate conditions ↓

Results:
Impacts ↔ Mitigation ↔ Adaptation



Future chalenges

Hybrid model (individual tree)



Thank you