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ForChange
Forest Ecosystem Management Under Global Change

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Predicting site index from climate and soil variables for cork oak (*Quercus suber* L.) stands in Portugal

Acknowledgement

Fundação para a Ciência e a Tecnologia (contract SFRH/BPD/96475/2013)

European Union projects StarTree (grant agreement 311919) and AgForward (grant agreement 613520)





BACKGROUND AND AIM

Background and aim

- ◆ Knowledge regarding tree potential growth and production is essential for the selection of species for new plantations, definition of regional policy measures, adaptation of management options...
- ◆ Maps for *Quercus suber* species potential distribution in Portugal, based on climate and soil thresholds, do not include estimates for tree potential growth or production
- ◆ Aim:
 - research on the influence of climate and soil on the potential growth and production of cork oak tree
 - mapping of potential growth and production of cork

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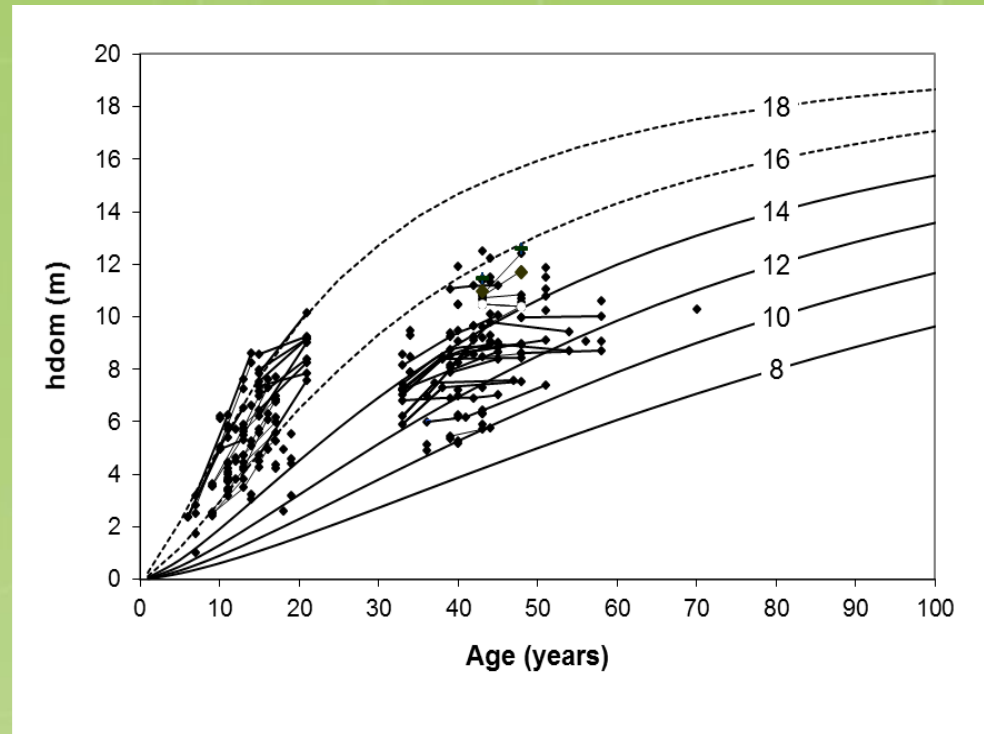


MATERIALS AND METHODS

Material and methods

Dependent variable

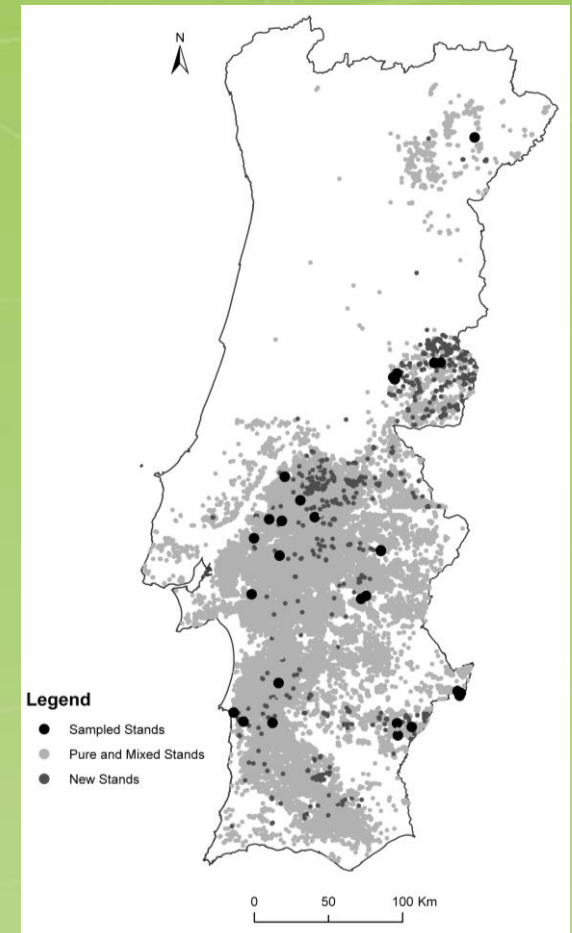
- Site index (dominant height at a base age of 80 years) computed with the Sánchez-González et al. (2005) model



Material and methods

Soil data

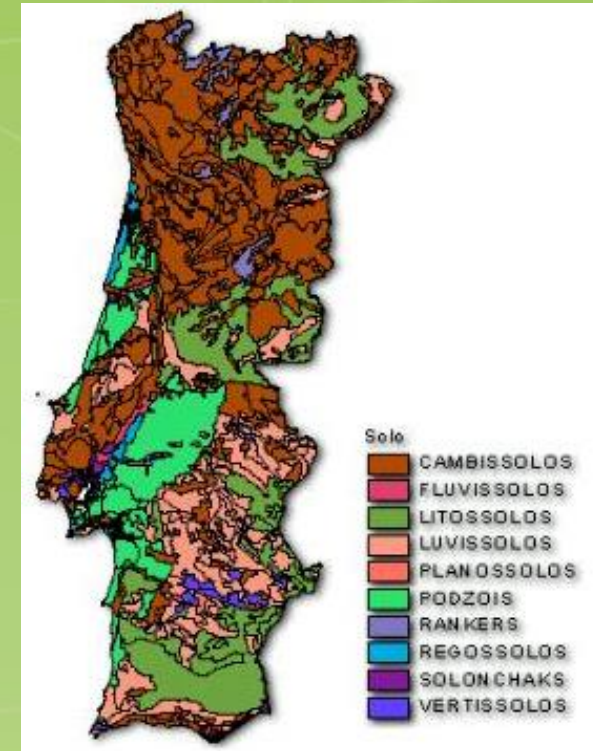
- 100 soil pits described and classified
 - soil textural class, coarse elements percentage, thickness of the A horizon, soil depth
 - Slope, position on slope, aspect
 - Topographic wetness index (Sorensen et al. 2005)



Material and methods

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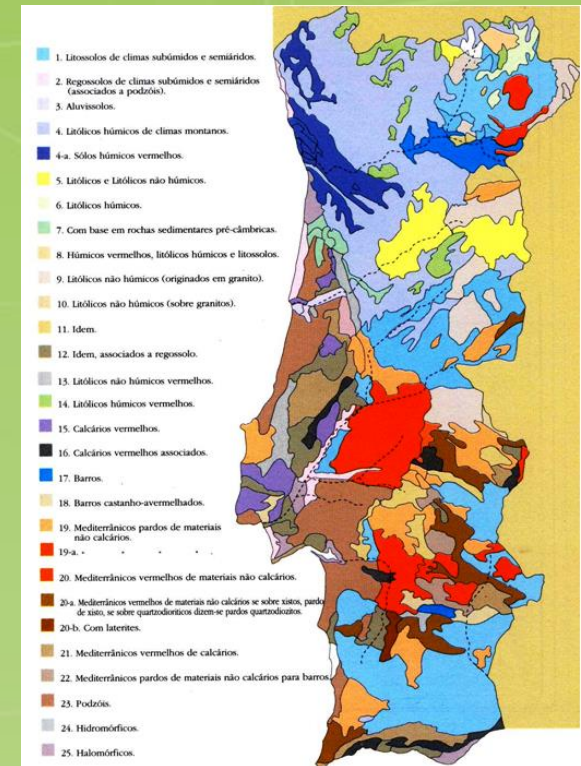
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 - Lithology (Silva, 1983): locally assessed (8 classes) and from Atlas do Ambiente (18 classes)



Material and methods

Climate data

- ◆ 30 years averages of the closest meteorologic stations of the Portuguese Meteorological Service (1961 a 1990)
 - Mean minimum and maximum temperature
 - Mean temperature
 - Mean monthly precipitation
 - Mean number of days with precipitation per month
 - Mean monthly evaporation
 - Mean number of days with frost per month
 - Martonne index

Material and methods

Modelling approach

- ◆ Several statistical approaches used and compared in the literature:
 - **multiple regression**
 - spline smoothing functions
 - **tree based regression**
 - contingency tables and correspondence analysis
 - regression kriging
 - **partial least squares**

Material and methods

Modelling approach

◆ Partial least squares

- Large number of correlated variables
- ‘Reduced’ number of observations
- Can avoid collinearity problems frequently encountered when using ordinary least squares

- ◆ Two models (full and reduced), differentiated by the demand of soil pit information or alternatively soil information collected in the Portuguese Atlas do Ambiente



RESULTS

Results

Full model (variables locally assessed)

Validation results

| Model | \bar{r}_i | $ \bar{r}_i $ | p5 | p95 | <u>ef</u> |
|-------------|---------------|---------------|---------------|--------------|--------------|
| Full | -0.007 | 0.972 | -2.301 | 1.818 | 0.745 |
| Reduced | -0.001 | 1.259 | -2.494 | 2.310 | 0.442 |

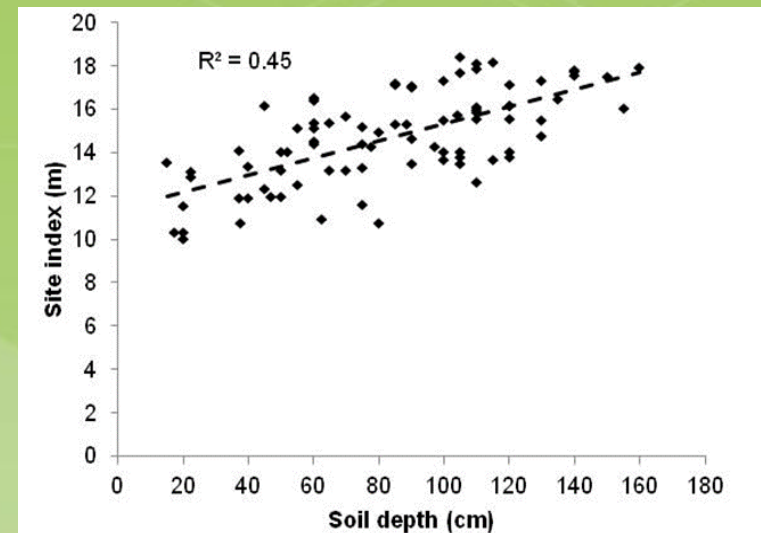
\bar{r}_i - mean of the value of the press residuals; $|\bar{r}_i|$ - mean of the absolute value of the press residuals; p5 - 5th percentile value of the press residuals; p95 - 95th percentile value of the press residuals; ef – model efficiency.

Results

Full model (variables locally assessed)

Variables included

- Soil FAO groups
- Soil lithology classes (18 classes grouped in 6 classes)
- Soil depth
- Soil textural class (positive effect of coarse textures)
- Thickness of the A horizon (positive effect)
- Mean monthly evaporation (negative effect)
- Mean number of days with frost per month (negative effect)



Results

Reduced model (variables assessed by available cartography)

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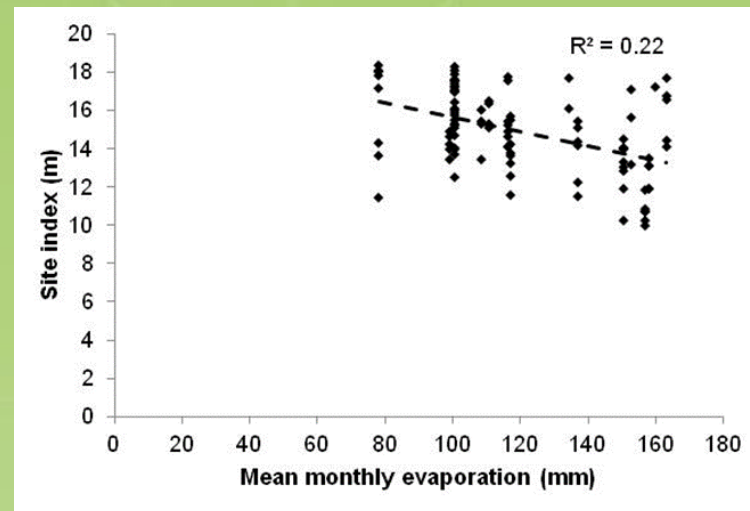
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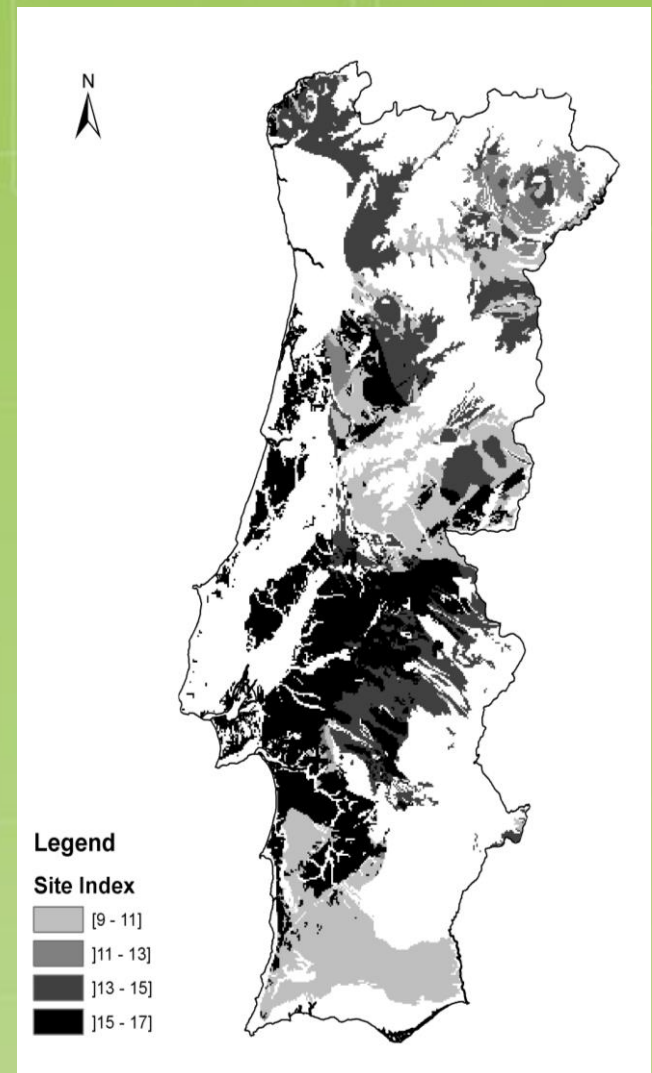
Variables included

- Soil lithology classes (8 classes)
- Mean monthly evaporation (negative effect)
- Mean number of days with frost per month (negative effect)



Results

- ◇ Mapping of site index value distribution along the potential distribution area of the species in Portugal, using the reduced model
- ◇ Estimated values extending from 9.5 m to 16.8 m with average value of 13.4 m

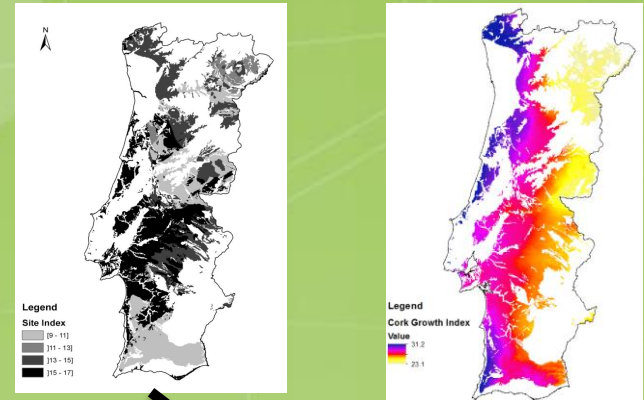




CONCLUSIONS AND ONGOING RESEARCH

Conclusions and ongoing research

- Importance of the assessment of local soil characteristics previously to the installation of new plantations
- Research/modelling of cork growth distributions at the local and regional scales
- Production of a combined index for tree and cork production



Combined index for tree and cork production



THANK YOU!