

## FlorNext® 1.0

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# *User's Manual*

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English version

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## Introduction

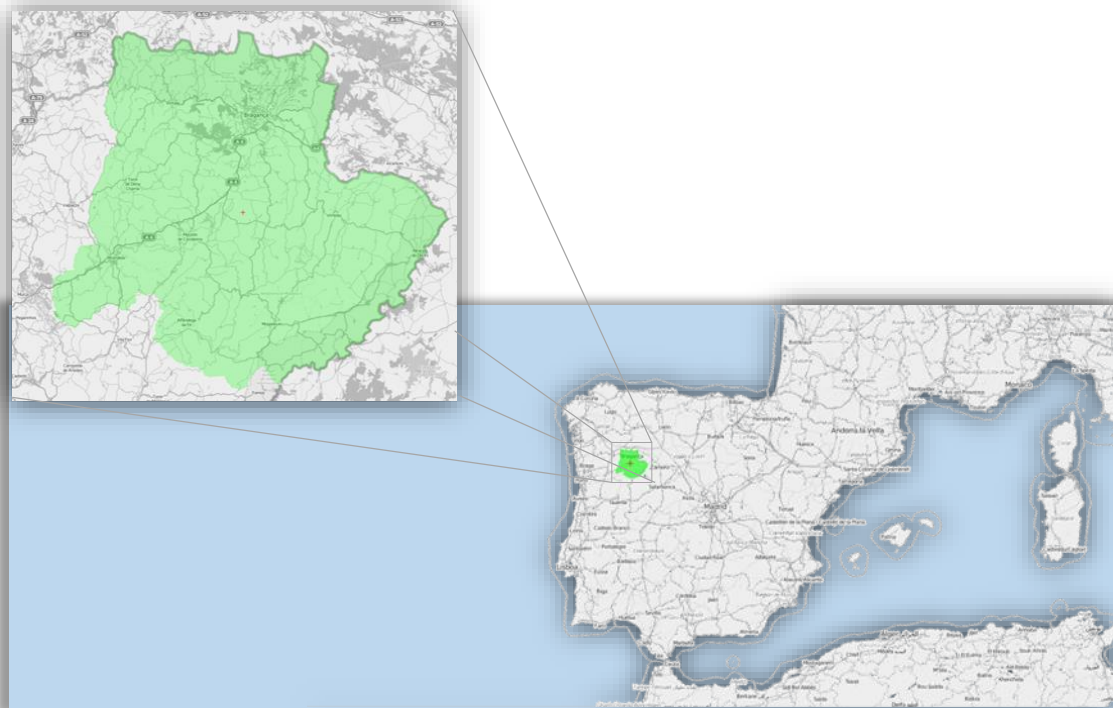
The forest management helps to get the maximal economical incomes, but the management is important too in environmental and social terms. A forest WELL management present a good sanitary state, and there are minor risks of fire, and if it will produce, the forest could be minor affected.

Apply a good management it's no difficult if have the tools necessary for do it. There are equations for predict the growth, yield, etc. This equation was built by researchers using empirical data. The transfer of this knowledge provides the base of create a better forest, wining all the stakeholders.

FlorNext® was developed to use complex equations but with friendly forms, in a cloud computing version, accessibly by any browser in any platform (computer or mobile).

### Region of application

The models implemented has created for the region of North-Eastern of Portugal (district of Bragança), so the uses of this application are restricted for this region.



## Development characteristics

FlorNext® is a cloud computing application developed to simulate growth and production of *Pinus pinaster* Ait. in North-eastern Portugal.

The application implements a dynamic model of growth and production which integrates different transition functions for dominant height (site index curves), and basal area, along with equations or tree and stand volume and structural models to planning thinning under different magnitudes.

FlorNext® has been programmed in Visual Studio Web 2013 Express, using MVC technology. The languages used were C# and XML for models, drivers and configuration and Razor, HTML, JavaScript and CSS for displays. There are Portuguese, Spanish and English versions of the application.

## Development team

### Development and design team:

- Fernando Pérez Rodríguez
- João Azevedo
- Luis Nunes
- Angelo Sil

### Institution development:

Polytechnic Institute of Bragança (www.ipb.pt)



### Address:

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Apartado 172 5301-854 Braganca (Portugal)

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## Access to application

FlorNext® was developed as a public cloud application, i.e., to be accessible via the Internet. Therefore, no specific installation is required and it can be freely accessed from any Internet-connected device (desktops, laptops, mobile phones, smartphones, tablets, etc.) from the address <http://flornext.esa.ipb.pt>.

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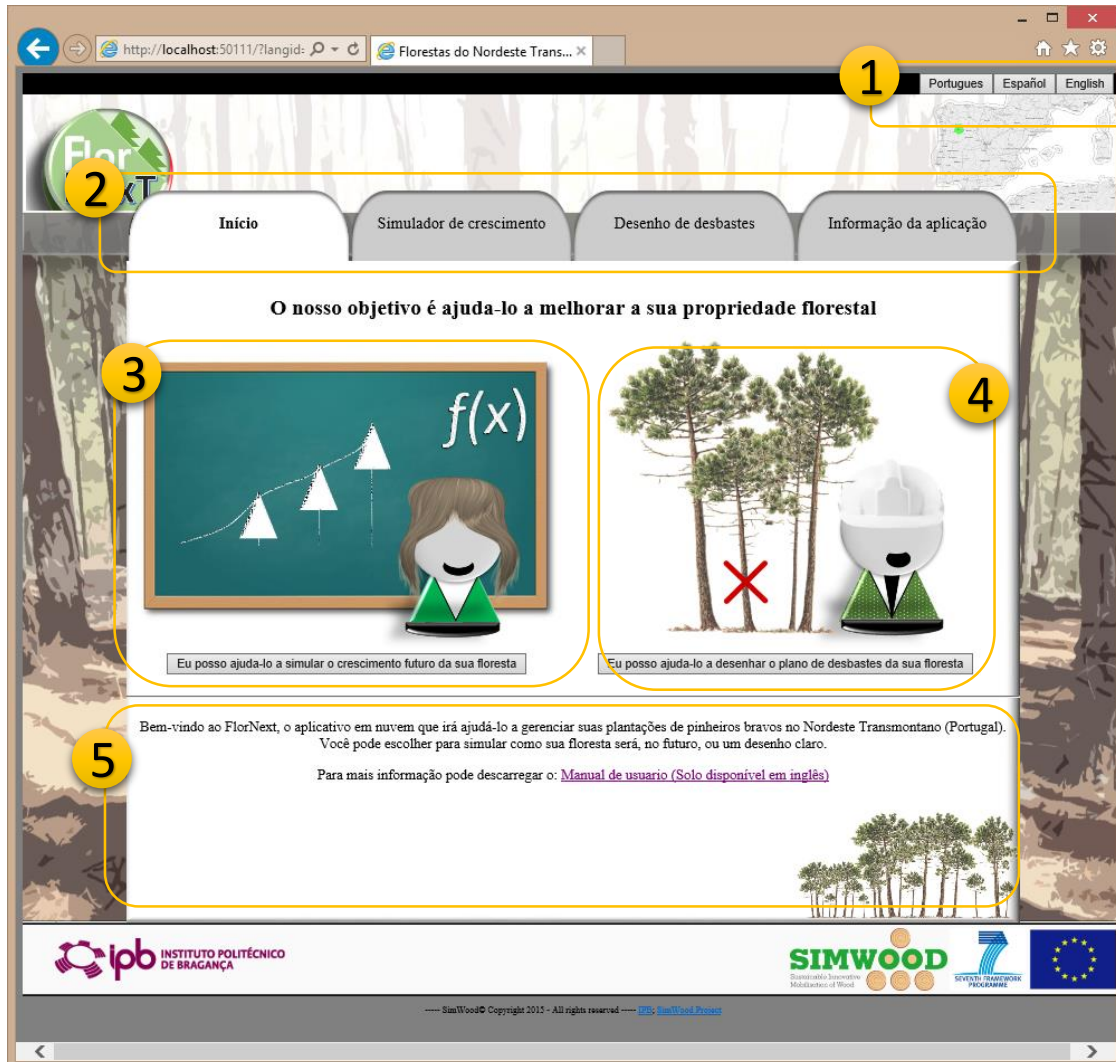


<http://flornext.esa.ipb.pt>

FlorNext® is compatible with the most common (Chrome, Firefox, Opera, Safari) browsers although, some incompatibilities with Internet Explorer have been found.

FlorNext® is hosted in a server owned by the public institution which has developed the application: the Polytechnic Institute of Bragança (<http://www.ipb.pt>).

## Main menu



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- 1 Language selector: Portuguese, Spanish and English
- 2 Labels for access to different sections: “Main menu”, “Growth simulator”, “Thinning design” and “Info of application”.
- 3 Direct access to “Growth simulation” section
- 4 Direct access to “Thinning design” section
- 5 Welcome message and access to User’s guide

## Growth Simulation section

In the “Growth simulation” section, calculations use average data of forest stands to estimate volume, biomass, carbon content, average and current annual volume increment and site index.

### Models implemented

The models used in FlorNext was tested and validated with data of National Forest Inventory 5. The list of models are:

- Increment of dominant height in time: Tome *et al.* (2001)
- Increment of basal area in time: Diéguez-Aranda *et al.* (2009).
- Estimation of initial basal area: Diéguez-Aranda *et al.* (2009).
- Mortality: not included in model, but an equation of the self-thinning line from Luis & Fonseca (2004) was used.
- Stand volume: Luis & Fonseca (2004).

### References:

Tomé, M., (2001) Tabela de produção geral para o pinheiro bravo desenvolvida no âmbito do projecto PAMAF 8165 “Regeneração, Condução e Crescimento do Pinhal Bravo das Regiões Litoral e Interior Centro”. Relatórios técnico-científicos do GIMREF RT9/2001. Centro de Estudos Florestais, Instituto Superior de Agronomia, Lisboa.

Dieguez-Aranda et al. (2009) Diéguez-Aranda U., Rojo-Alboreca A., Castedo-Dorado F., Álvarez-González J.G., Barrio-Anta M., Crecente-Campo F., González-González J.M., Pérez-Cruzado C., Rodríguez-Soalleiro R., López-Sánchez C.A., Balboa-Murias M.A., Gorgoso-Varela J.J., Sánchez-Rodríguez F. 2009. Herramientas selvícolas para la gestión forestal sostenible en Galicia. Consellería do Medio Rural, Xunta de Galicia. 268 pp + CD-Rom.

Luis, J. F. S., Fonseca, T. (2004) The allometric model in the stand density management of *Pinus pinaster* Ait. in Portugal. *Annals of Forest Science*, Springer Verlag 61 (8):807-814.



## Inputs section

Portugues Español English

Inicio Simulador de crescimento Desenho de desbastes Informação da aplicação

**1**

Bom dia! Sou a sua consultora florestal e vou ajuda-lo a obter uma simulação do crescimento da sua floresta num futuro próximo. Só tem que preencher os campos em branco na folha ao lado com os dados relativos à sua floresta.

**2**

Como é a sua floresta?

Pinheiro bravo

Idade:  anos

Altura dominante:  m

Densidade:  árvores/ha

Área basal:  m<sup>2</sup>/ha

Projeção de crescimento:  anos

Definir plano de desbastes (Opcional)

Simular

Aumentar a precisão (com opção posters em mais domínios)

**3**

**Perguntas frequentes:**

Posso utilizar estes modelos na minha floresta? Como se faz a estimativa do crescimento futuro da floresta? Porque é necessário gerir as florestas?

**4**

**Os modelos utilizados:**

Model	Ref	Complete ref
Transition H <sub>0</sub>	Tomé (2001)	Tomé, M., (2001) Tabela de produção geral para o pinheiro bravo desenvolvida no âmbito do projecto PAMAF 8165 "Regeneração, Condução e Crescimento do Pinhal Bravo das Regiões Litoral e Interior Centro". Relatório técnico-científico do GIMREF RT9/2001. Centro de Estudos Florestais, Instituto Superior de Agronomia, Lisboa. [in Portuguese]
Transition G	Diéguez-Aranda et al. (2009)	Diéguez-Aranda U., Rojo-Albornoa A., Castedo-Dorado F., Álvarez-González I.G., Barrio-Anta M., Crescenzo-Campo F., González-González J.M., Pérez-Cruzado C., Rodríguez-Soalleiro R., López-Sánchez C.A., Balboa-Murias M.A., Gorgoso-Varela J.J., Sánchez-Rodríguez F. 2009. Herramientas selvícolas para la gestión forestal sostenible en Galicia. Consellería do Medio Rural, Xunta de Galicia. 268 pp = CD-Rom.
Max density	Luis & Fonseca (2004)	Luis, J. F. S., Fonseca, T. (2004) The allometric model in the stand density management of Pinus pinaster Ait. in Portugal. Annals of Forest Science, Springer Verlag 61 (8):807-814.
Initialisation G	Diéguez-Aranda et al. (2009)	Diéguez-Aranda U., Rojo-Albornoa A., Castedo-Dorado F., Álvarez-González I.G., Barrio-Anta M., Crescenzo-Campo F., González-González J.M., Pérez-Cruzado C., Rodríguez-Soalleiro R., López-Sánchez C.A., Balboa-Murias M.A., Gorgoso-Varela J.J., Sánchez-Rodríguez F. 2009. Herramientas selvícolas para la gestión forestal sostenible en Galicia. Consellería do Medio Rural, Xunta de Galicia. 268 pp = CD-Rom.
Volume with cork	Luis & Fonseca (2004)	Luis, J. F. S., Fonseca, T. (2004) The allometric model in the stand density management of Pinus pinaster Ait. in Portugal. Annals of Forest Science, Springer Verlag 61 (8):807-814.

ipb INSTITUTO POLITÉCNICO DE BRAGANÇA

SIMWOOD Sustainable Innovative Mobilisation of Wood

SEVENTH FRAMEWORK PROGRAMME

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- 1** Information panel
- 2** Inputs panel
- 3** Frequent questions
- 4** Information of models used in the application

## Inputs variables

This requires the following information:

- Stand age (yrs).
- Density (number of trees/ha).
- Dominant height (m), estimated as average height of the 100 thickest trees per hectare of the stand.
- Optionally, the user can input the stand basal area (m<sup>2</sup>/ha), but it can be estimated if this value is not included or is zero, although larger errors could be obtained, being recommendable to introduce real values from an inventory.
- The user is able to choose from the “growth simulator” section a thinning planning scheme (low, moderate, moderate-high or high) according by a Wilson Factor of 0.16, 0.20, 0.23 and 0.27, respectably. The Wilson Factor (Wf) is the relationship between the density and the dominant height:  $Wf = 100/(\sqrt{N} \cdot H_0)$ . In addition, the user can choose the frequency and number of thinning. The default options are “moderate” and “10 year frequency”.
- Finally, the user can increase the precision level of the estimates by checking the check box at the end of the form. If uncheck, the simulation process uses the stand volume equation and if checked, the volume is calculated yearly based on the forest structure, the diametrical distribution and the individual tree volume equation. The latter can result in longer processing time.

## Outputs section

The screenshot shows the 'Simulador de crescimento' interface. It features a navigation menu with 'Início', 'Simulador de crescimento', 'Desenho de desbastes', and 'Informação da aplicação'. The main content area is divided into several sections:

- 1 Inputs information:** A section titled 'A caracterização da sua floresta é:' (The characterization of your forest is:) containing forest parameters: Idade 12 anos, Altura dominante: 8 m, Densidade: 2500 pes/ha, Área basal: 18 m<sup>2</sup>/ha.
- 2 Table of results:** A table with columns: t, N, H<sub>0</sub>, VCC, W, C, CM, CC, Ne, Ve, info. It displays simulation data for years 12 to 26.
- 3 Legend:** A section defining parameters: t = edad (anos); N = densidad (nº de arvores por hectar); H<sub>0</sub> = altura dominante; VCC = volume con cortiça (m<sup>3</sup>); CM = Crecimento meio; CC = Crecimento Corrente; Ne = Numero de pes estimados que son extraidos no desbaste; Ve = Volume estimado que é extaido no desbaste.
- 4 Panel to create new simulation, modified inputs, or design a thinning for current inputs framework:** Two buttons: 'Quer fazer uma nova simulação? ou Quer modificar a atual?' and 'Se quiser posso desenhar um desbaste para a idade atual da floresta'.

- 1 Inputs information
- 2 Table of results
- 3 Legend
- 4 Panel to create new simulation, modified inputs, or design a thinning for current inputs framework

## Outputs

- The output of the Growth Simulation is a table with stand variables for each year of the simulation and the result of the application of the thinning plan.

## Thinning design section

### Models used

The models used in FlorNext was tested and validated with data of National Forest Inventory 5. The list of models are:

- Relationship average diameter vs dominant diameter: Fonseca (2004).
- General diameter - height relationship: Almeida (1999).
- Tree volume with cork: Nunes *et al.* (2010).

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### References:

Fonseca, T., (2004) Modelação do crescimento, mortalidade e distribuição diamétrica, do pinhal bravo no Vale do Tâmega. University of Trás-os-Montes e Alto Douro, PhD Thesis, Vila Real, Portugal, pp. 248.

Almeida (1999) Almeida, L.F.R. (1999) Comparação de metodologias para estimação de altura e volume em povoamento s de pinheiro bravo no Vale do Tâmega, Relatório final de estágio. UTAD, Vila Real, 114 pp.

Nunes, L.; Tomé, J.; Tomé, M. (2010) A system for compatible prediction of total and merchantable volumes allowing for different definitions of tree volume. Canadian Journal of Forest Research. ISSN 1208-6037. 40:4, p. 747-760.

## Inputs section

The screenshot shows the 'Desenho de desbastes' (Harvest Design) section of the FlorNext 1.0 web application. The interface is divided into four numbered sections:

- 1** Welcome panel and information: A central panel with a tree icon and a speech bubble that says: "Bom dia! Sou o seu consultor florestal e vou ajuda-lo a obter a estimativa do volume de desbaste da sua floresta de pinheiro bravo. Só tem que preencher os campos em branco na folha ao lado com os dados relativos à sua floresta."
- 2** Inputs panel: A form titled "Como é a sua floresta?" (How is your forest?) and "Quanto quer cortar?" (How much do you want to cut?). The form includes input fields for "Idade" (Age) in years, "Altura dominante" (Dominant height) in meters, "Densidade" (Density) in trees/ha, and "Área basal" (Basal area) in m<sup>2</sup>/ha. It also has radio buttons for "Nº Árvores" (Number of trees) and "% Árvores" (Percentage of trees), a "Pelo baixo" (By the bottom) checkbox, and a "De maneira sistemática" (Systematically) checkbox. A "Simular" (Simulate) button is at the bottom.
- 3** Frequent questions: A section titled "Perguntas frequentes:" (Frequent questions) with three checkboxes: "Posso utilizar estes modelos na minha floresta?", "O que é um desbaste sistemático e como se aplica?", and "O que é um desbaste pelo baixo e como se aplica?".
- 4** Information of models used in application: A section titled "Os modelos utilizados:" (Models used) with a table of references.

Model	Ref	Complete ref
Relation d-dd	Fonseca (2004)	Fonseca, T., (2004) Modelação do crescimento, mortalidade e distribuição diamétrica, do pinhal bravo no Vale do Tâmega. University of Trás-os-Montes e Alto Douro, PhD Thesis, Vila Real, Portugal, pp. 248.
Relation d-h	Almeida (1999)	Almeida, L.F.R. (1999) Comparação de metodologias para estimação de altura e volume em povoamento s de pinheiro bravo no Vale do Tâmega. Relatório final de estágio. UTAD, Vila Real, 114 pp.
Individual volume with cork	Nunes et al (2010)	Nunes, L.; Tomá, J.; Tomá, M. (2010) A system for compatible prediction of total and merchantable volumes allowing for different definitions of tree volume. Canadian Journal of Forest Research, ISSN 1208-6037, 40:4, p. 747-760.

The footer of the application includes logos for IPB (INSTITUTO POLITÉCNICO DE BRAGANÇA), SIMWOOD (Sustainable Innovative Mobilisation of Wood), and the SEVENTH FRAMEWORK PROGRAMME (EUROPEAN UNION).

- 1** Welcome panel and information
- 2** Inputs panel
- 3** Frequent questions
- 4** Information of models used in application

## Inputs variables

In the “Thinning design” section (Fig. 3) is required the following inputs:

- Stand age (yrs)
- Number of trees/ha or density
- Optionally, the user can input the stand basal area ( $m^2/ha$ ), but it can be estimated if this value is not included or is zero, although larger errors could be obtained, being recommendable to introduce real values from an inventory.
- For thinning, the user can fill the number or proportion of the trees that wants to extract, or, if the user don't know how many, can to check the option for establishment the number for the Wilson Factor of moderate thinning.

## Outputs section

**1** A caracterização da sua floresta é:

- Idade 12 anos
- Altura dominante: 12 m
- Densidade: 2500 árvores/ha
- Área basal: 18 m<sup>2</sup>/ha

Sugiro-lhe que corte:

- 625 árvores (de maneira sistemática)
- 0 árvores (pelo baixo)

**2** Em primeiro lugar gostaria de lhe dizer que a sua floresta tem uma qualidade boa, à qual lhe estimo um volume de 92.44 m<sup>3</sup> por hectare

Segundo os meus cálculos o volume que se poderá extrair no desbaste que quer fazer é de 4.54 m<sup>3</sup>, extractando-se uma área basal de 1.15 m<sup>2</sup>/ha.

**3** Quer fazer uma nova simulação? ou Quer modificar a simulação atual?

Se quiser posso projetar o resultado do seu desbaste para o futuro

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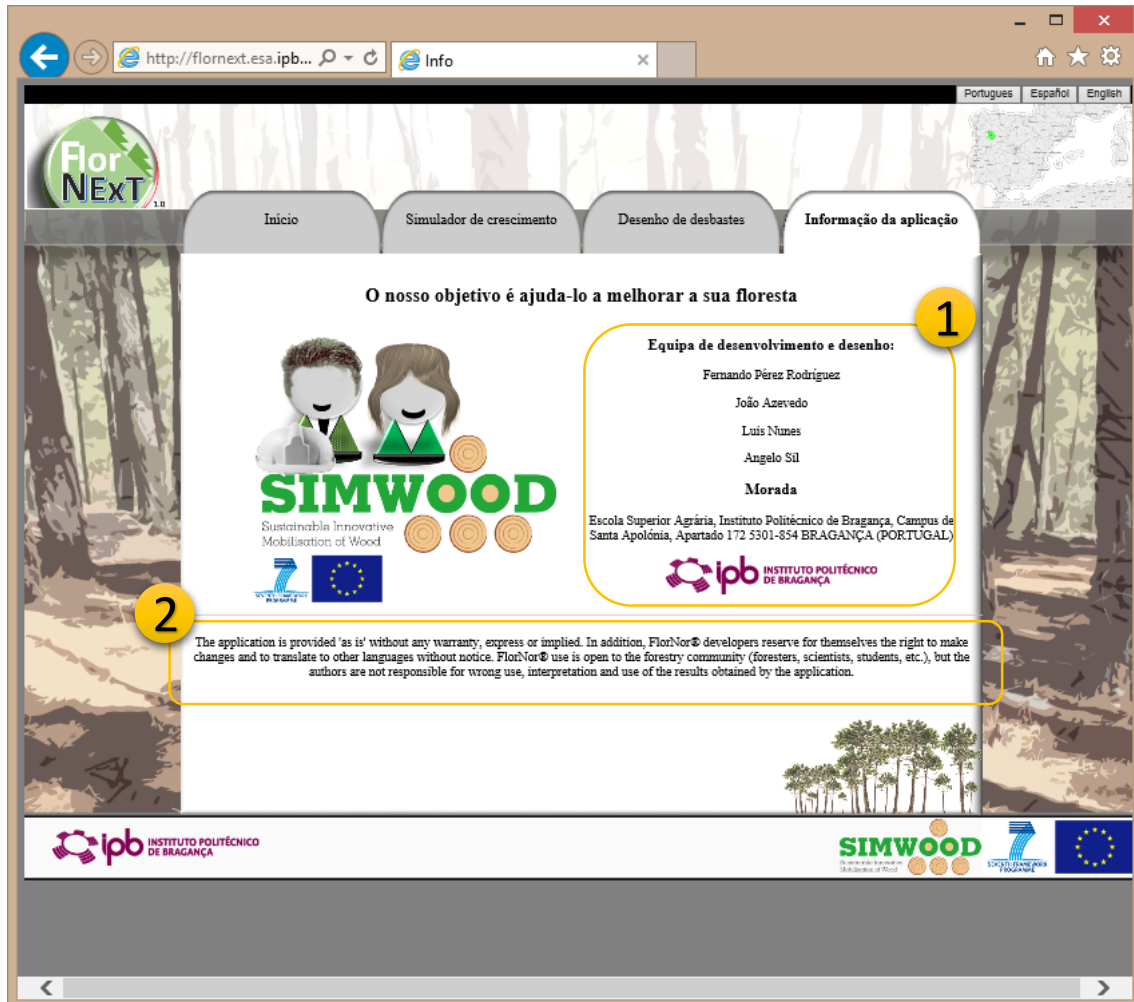
- 1** Inputs variables
- 2** Result panel
- 3** Panel to create new thinning design, modified inputs, or simulate to the future for current inputs framework



## Outputs

The outputs are the evaluation of the thinning, meaning the total and the extracted volume, and the graphic of diametric distribution with the trees extracted by systematic or low thinning.

## Info section



- 1 Team development information and address
- 2 License and guaranty information

## License and guaranty

*The application is provided 'as is' without any warranty, express or implied. In addition, FlorNext® developers reserve for themselves the right to make changes and to translate to other languages without notice.*

*FlorNext® use is open to the forestry community (foresters, scientists, students, etc.), but the authors are not responsible for wrong use, interpretation and use of the results obtained by the application.*

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## Acknowledge

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