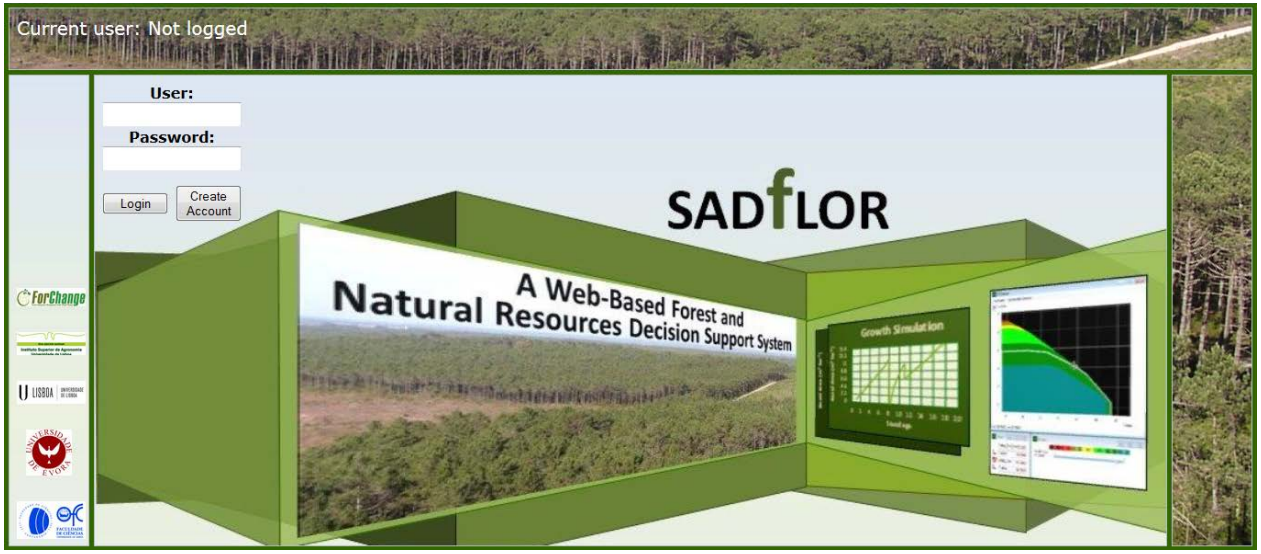
International Union of Forest Research Organizations
XXIV WORLD CONGRESS | OCT 5-11 2014 Salt Lake City, USA

Architecture of a decision support system to address climate change (SADfLOR)



Jordi Garcia-Gonzalo, José Borges,

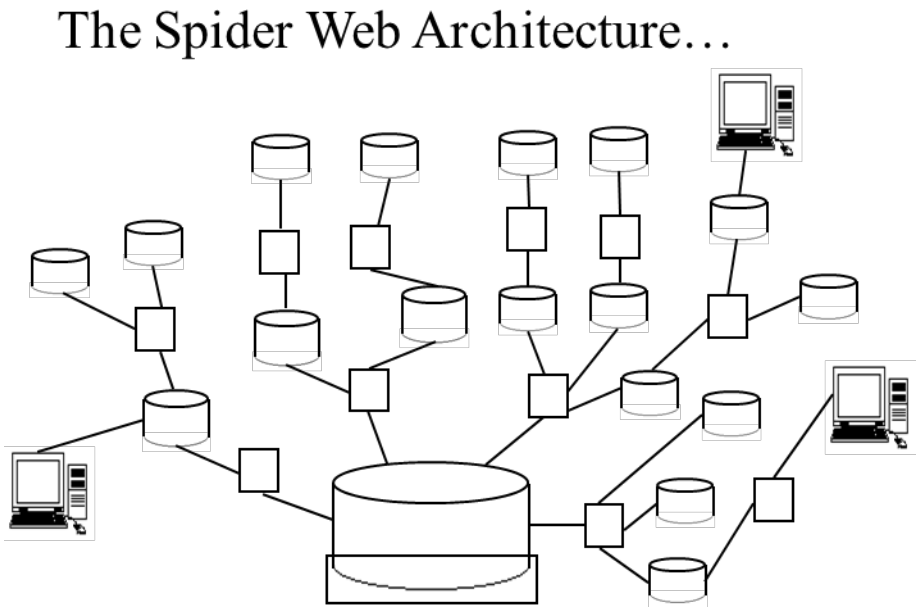
IUFRO UnitS: 4.04.04. Sustainable forest management scheduling
4.04.06. Nature Conservation Planning
http://www.iufro.org/science/divisions/division-4/40000/40400/40404/

INSTITUTO SUPERIOR DE AGRONOMIA Universidade de Lisboa | IUFRO | MEDfOR | ForEAdapt | forestDSS | LISBOA UNIVERSIDADE DE LISBOA

Outline

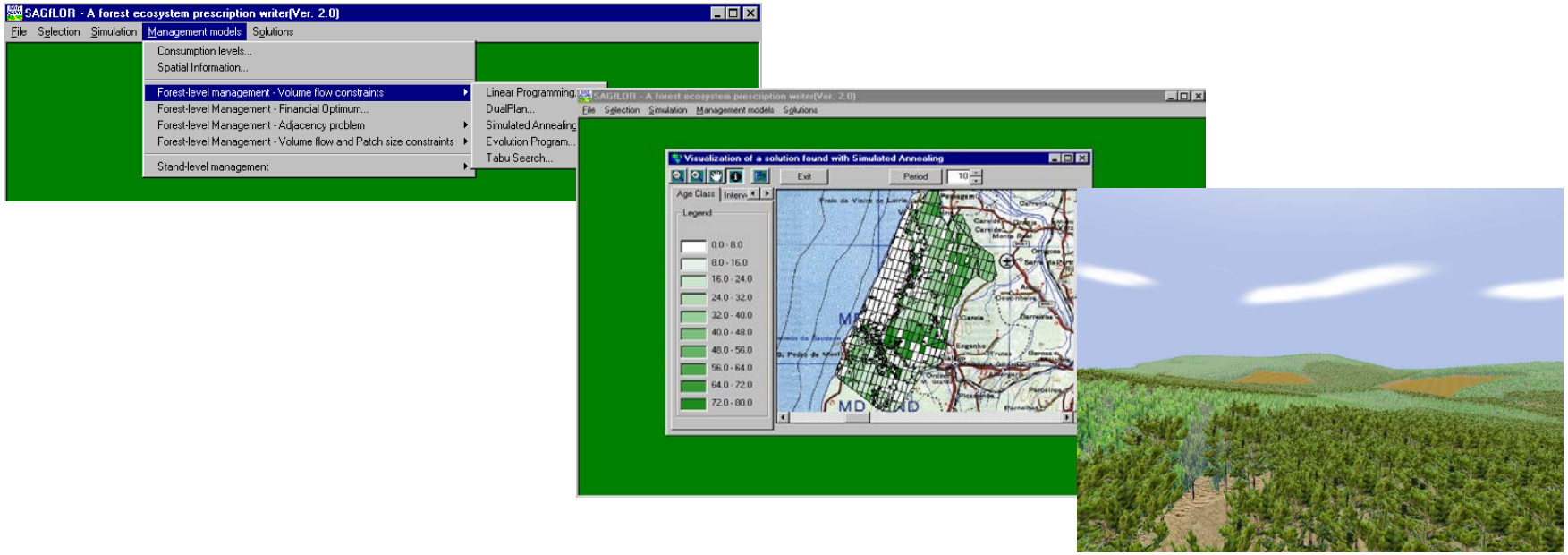
- I. Background/History
- II. Material and Methods
  - Participatory approach to Design a regional forest management planning decision support toolbox
- III. The DSS architecture
- IV. Discussion

Architecture?



- 75% of lines of code just move data from system to system, form file to file
- Each data item is stored redundantly 10,8 times in 129 files
- The portfolio de information systems of many organizations may render them inefficient, ignorant, retarded, schizofrenic...

The context (or a bit of history)



Reynolds, K.M., M. Twery, M. J. Lexer, H. Vacik, D. Ray, G. Shao and Jose G. Borges. 2008. Decision support systems in natural resource management. In: F. Burstein and C. Holsapple (Ed.) Handbook on Decision Support Systems. Springer, International Handbooks on Information Systems Series, Handbook on Decision Support System 2: 499-534

Borges, J. G., A. Falcão, C. Miragaia, P. Marques and M. Marques. 2003. A decision support system for forest resources management in Portugal. In: G. J. Arthaud and T. M. Barrett (Eds.) System Analysis in Forest Resources. Springer, Managing Forest Ecosystems Vol. 7: 155-164.

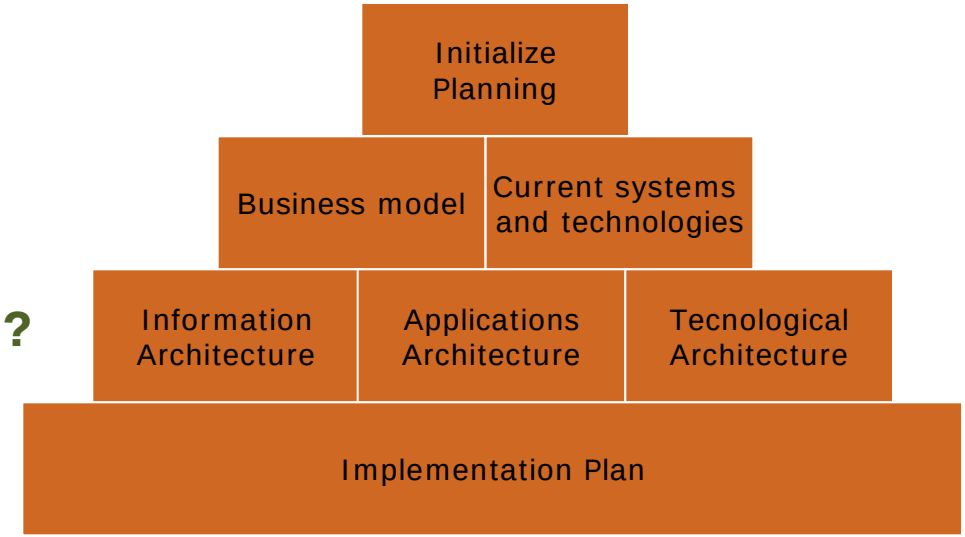
Architecture?

How do we work?

Where are we ?

Where do we want to get to ?

How to get there ?



Marques, A. F., Borges, J. G., Garcia-Gonzalo, J., Lucas, B. and Melo, I. 2013. A participatory approach to design a toolbox to support forest management planning at regional level. *Forest Systems* 22: 340-358. DOI http://dx.doi.org/10.5424/fs/2013222-03120

Marques, A., J. G. Borges, P. Sousa and A. M. Pinho 2011. An entreprise architecture approach to forest management decision support design. An application to pulpwood supply management in Portugal. *European Journal of Forest Research* 30: 935-948

Stakeholders' engagement plan and a participatory planning approach

Stakeholders selection

- 1st meeting (stakeholders groups identification)
- Stakholders clustering into categories
- Contacts with stakeholders
- Kick-off meeting

Individual decison processes

- Modelling tool
- 1st PA session (context diagram)
- 2nd PA session (decision processes)
- Questionaire
- Data Repository & report
- Report validation by stakeholders

Integrated stakeholders analysis

- 1st meeting (integrated context diagram)
- 2nd meeting (overall RFMP framework)
- Matrix with questionaire consolidation

Regional Toolbox components

- Decison-support tools
- Data elements
- Data ownership matrix
- Components validation by stakeholders
- Final meeting

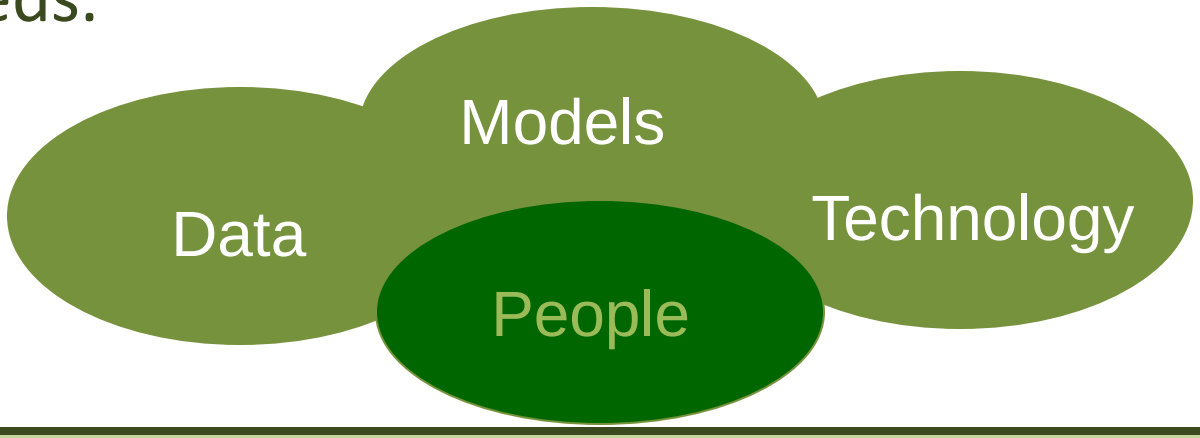
Decision support tools (excerpt with some models and methods)

Decision Support tools	Stakeholders groups													Total
	NIPF	IPF	FIF	FAr	FSP	FA	I	M	FAn	FRC	FF	LC	NGO	
Models/methods:														
Q1. Forest productivity zoning	x	x	x			x	x		x	x				**6**
Q2. Regional growth and yield models	x	x	x	x		x				x				**6**
Q3. Fruit production estimation model	x	x	x	x		x			x	x				**7**
Q4. Cork quality & quantity prediction models	x	x	x	x		x				x				**6**
Q5. Harvesting/stripping opt. Models	x	x	x	x		x				x				**6**
Q6. Impacts of fertilization into production	x	x	x	x		x				x				**6**
Q7. Forest market models	x	x	x	x		x	x		x	x	x		x	**9**
Q8. Product distrib. Routing, storing,…		x	x	x		x	x			x				**5**
Q9. Optimal equipment allocation models		x	x	x		x	x			x				**5**
Q10. Risk prediction models		x	x	x						x				**4**

The proposed approach

How does participation contribute to the development of successful DSS?

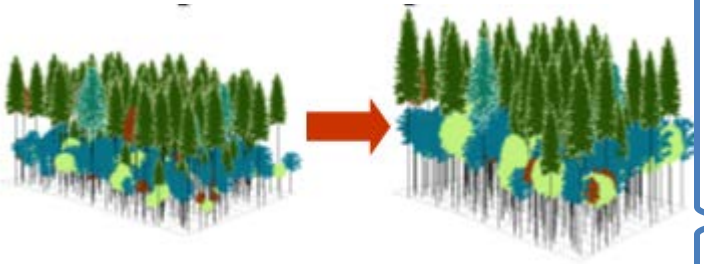
- The DSS's functional requirements emerge from business and information architectures in workshops with the stakeholders. No *a priori* assumptions are made about decision processes so that the DSS may effectively address their needs.



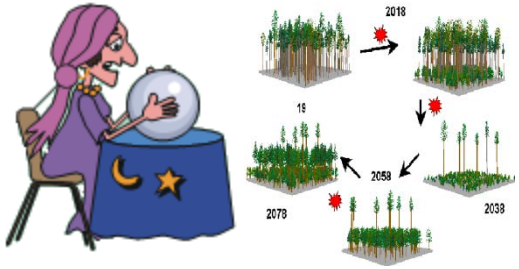
Decision Support System

User friendly tools

Growth modelling

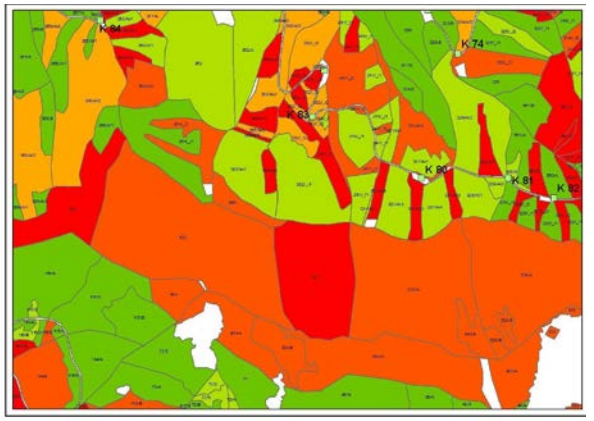


Predict Growth under CC

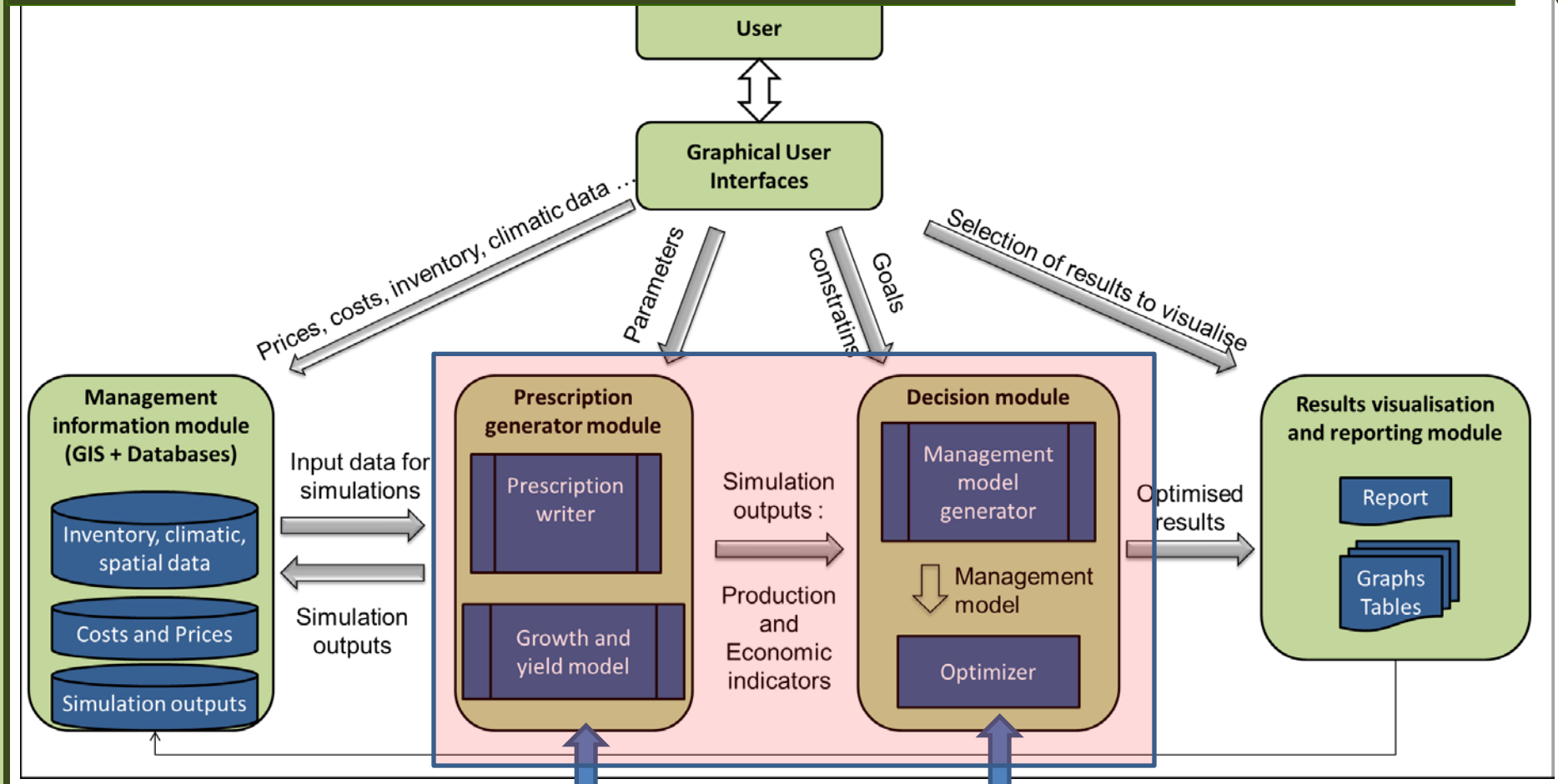


Decision support

Forest management plans



The DSS architecture

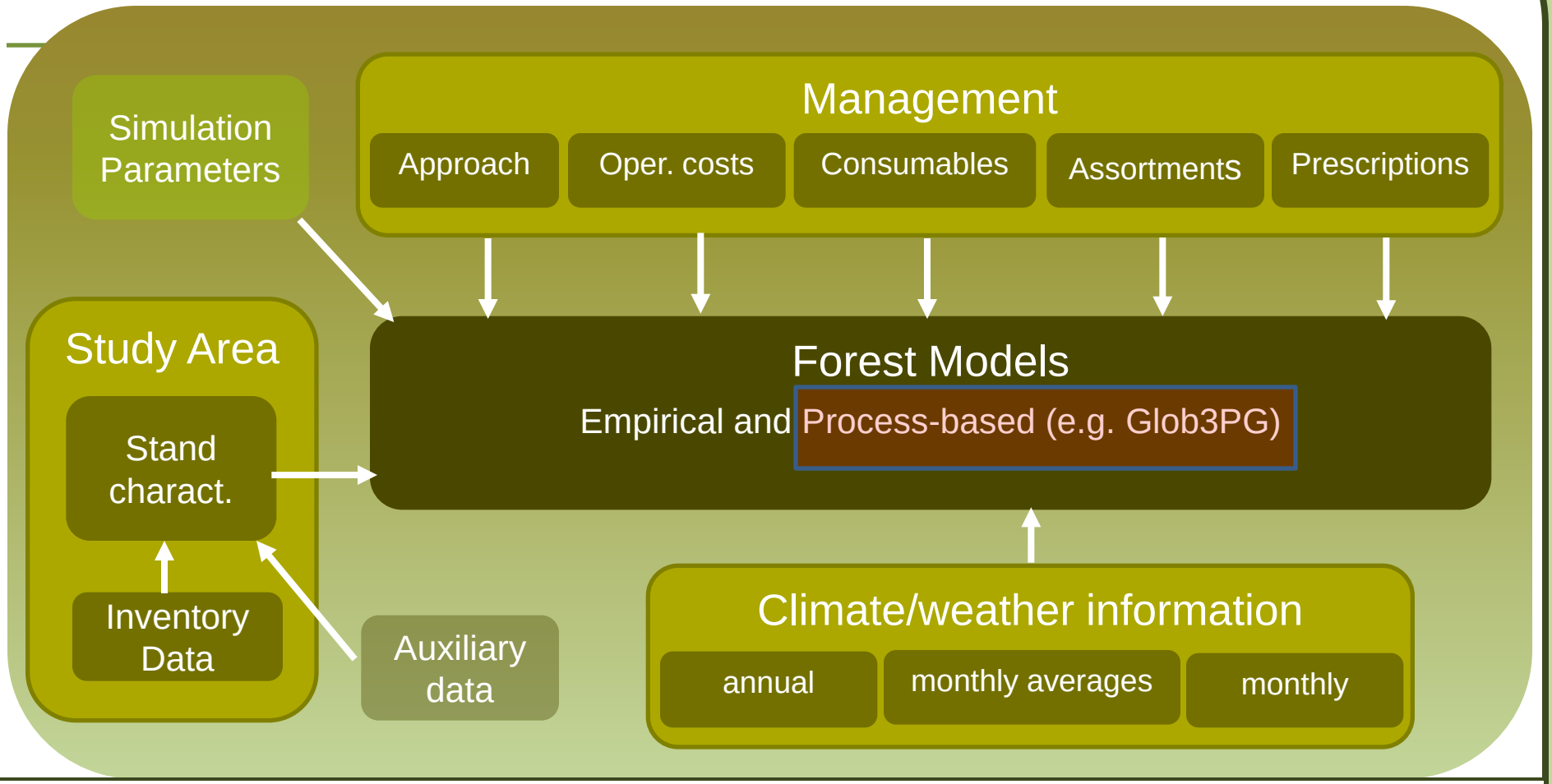


- Process-based models
- Wood Quality models
- Risk and damage models…

- Different mathematical techniques are implemented

Garcia-Gonzalo J., Borges J. G., Palma, J.H.N., Zuzibarreta-Gerendiain. 2014. A decision support system for management planning of Eucalyptus plantations facing climate change. Annals of Forest Science. Volume 71, Issue 2 , pp 187-199.

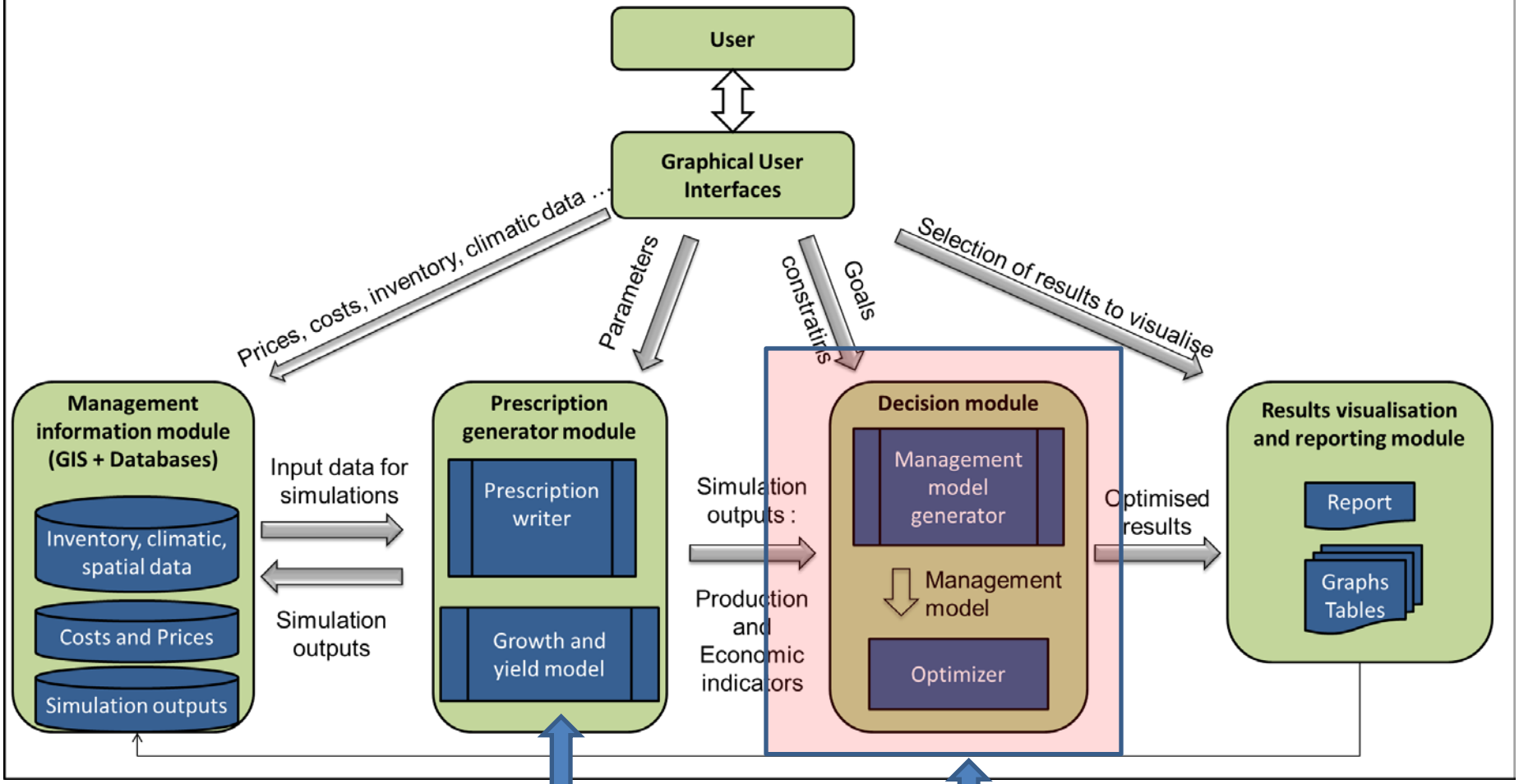
Simulation Module | StandSim



Fontes L, Landsberg J, Tomé J, Tomé M, Pacheco CA, Soares P, Aruajo C (2006) Calibration and testing of a generalized process-based model for use in Portuguese Eucalypt plantations. Can J For Res 36:3209–3221.

Tomé M, Faias S P, Tomé J, Cortiçada A, Soares P, Araújo C (2004) Hybridizing a stand level process-based model with growth and yield models for Eucalyptus globulus plantations in Portugal In: Borralho NMG, Pereira JS, Marques C, Coutinho J, Madeira M, Tomé M (eds) Eucalyptus in a changing world Proc Iufro Conf, Aveiro, 11–15 Oct (RAIZ, Instituto de Investigação da Floresta e do Papel, Portugal), pp 290–297

The DSS architecture



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III. A. DSS – SIMULATION/OPTIMIZATION

EfLOR- a Forest level Simulation Optimization system for Eucalipt

Precriptions Simulation Optimization About Help

Prices
Costs

Production indicators:

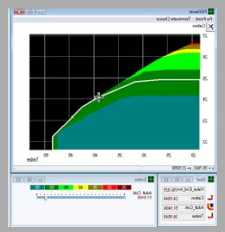
Volume cut
Run-off
Carbon stocks

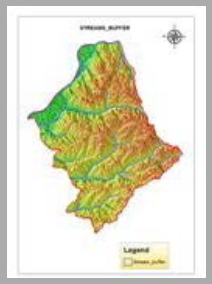
Management models (LP, MIP, GP, Stochastic formulations, Heurist.):

- Maximization of SEV
- Maximization of C seq.
- Minimization run-off
- Multiple objecitves

- Regulation of harvest flows
- Budget constraints

Optimization





Final report with production indicators and preliminary operations scheduling Effects of climate change

Growth and Yield simulations (Process-based model – Glob3PG)

Climate data
Inventory data
List of Prescriptions

Climate picker

PRESCRIPTION WRITER

Status

Sources of funding

- ForEAdapt .- Knowledge exchange between Europe and America on forest growth models and optimization for adaptive forestry FP7-PEOPLE-2010-IRSES-269257
- MOTIVE - Models for adaptive forest management FP7-ENV-2008-1
- SADRI .- Models and Decision Support Systems for Addressing Risk and Uncertainty in Forest Planning (reference: PTDC/AGR-FOR/4526/2012)

THANK YOU!

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