



MULTI-MODEL APPROACH TO EVALUATE THE IMPACT OF A FUTURE WELL FIELD ON FOREST PRODUCTION (SOUTH-WEST OF FRANCE)

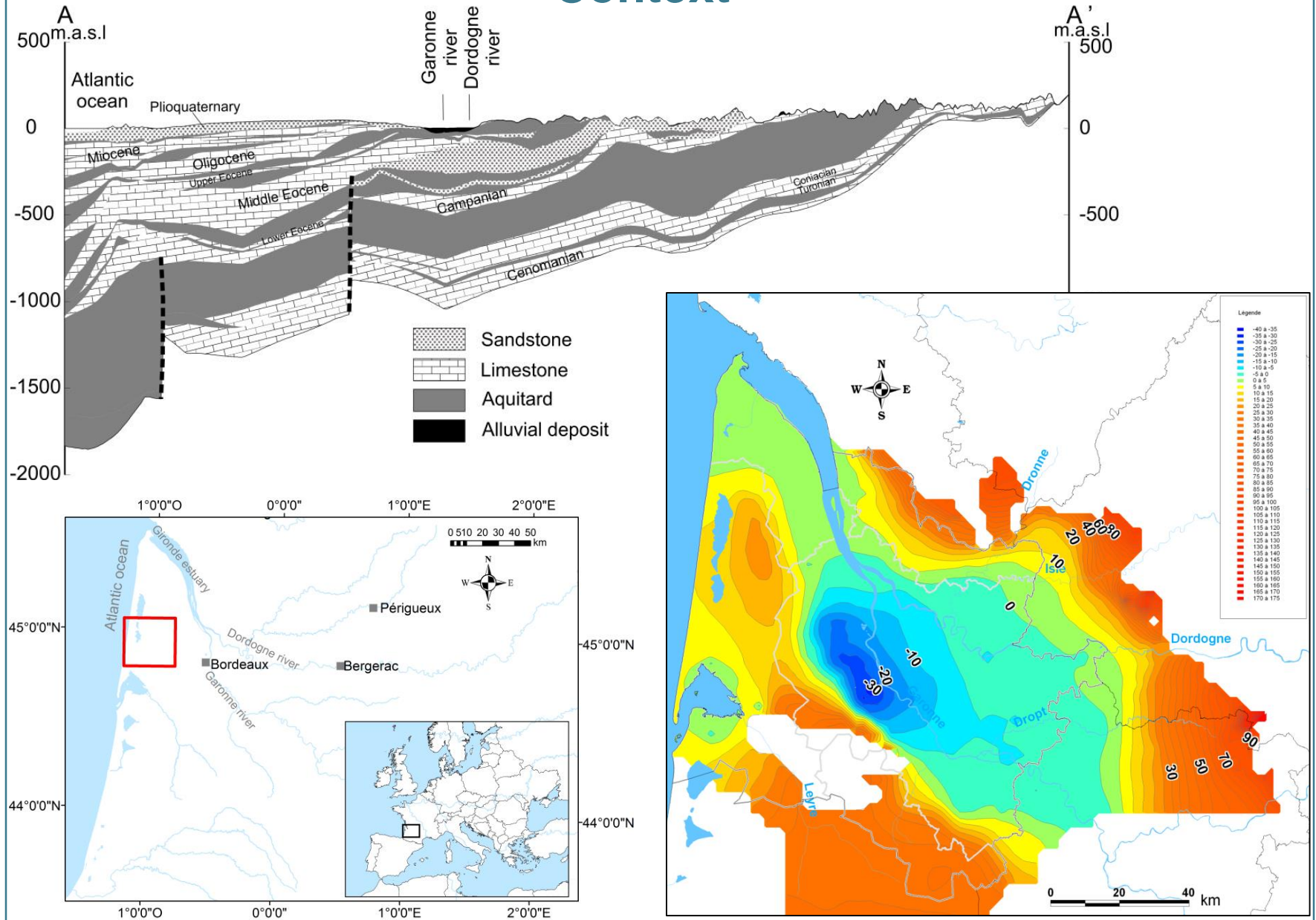
Marc SALTEL¹, Delphine PICART², Denis LOUSTAU², Nicolas PÉDRON¹

¹ **BRGM, DAT/Aquitaine**
(Parc Technologique Europarc, 24 avenue Léonard de Vinci, 33 600 Pessac - France)

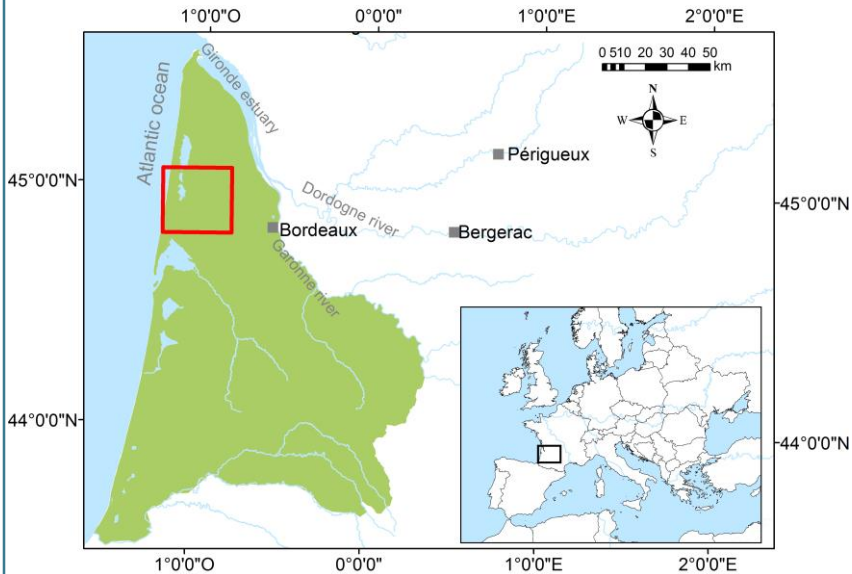
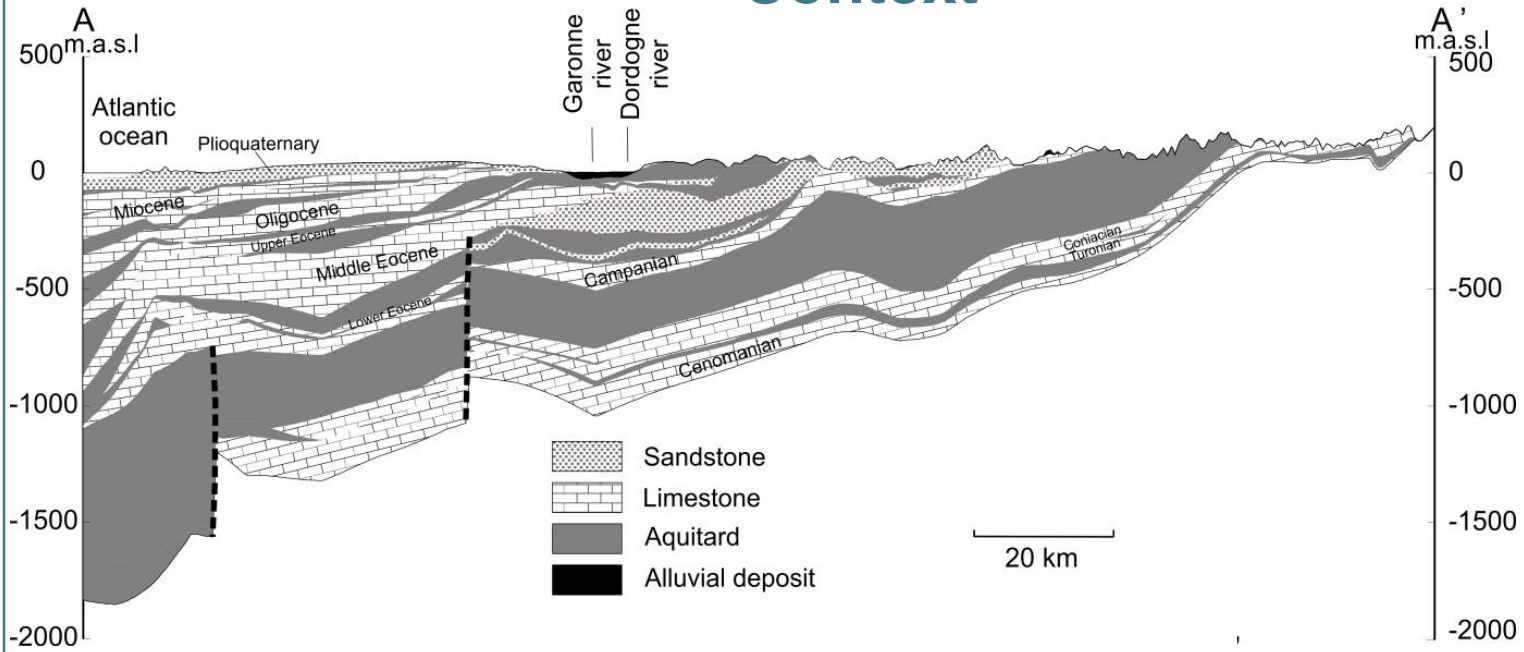
² **INRA UMR ISPA - Interactions Sol Plante Atmosphère
ICOS Ecosystem Thematic Centre**
(Centre de Bordeaux-Aquitaine, 71 av. Edouard Bourlaux, CS 20032 33 882 Villenave d'Ornon Cedex - France)



Context



Context



A regional policy to manage groundwater

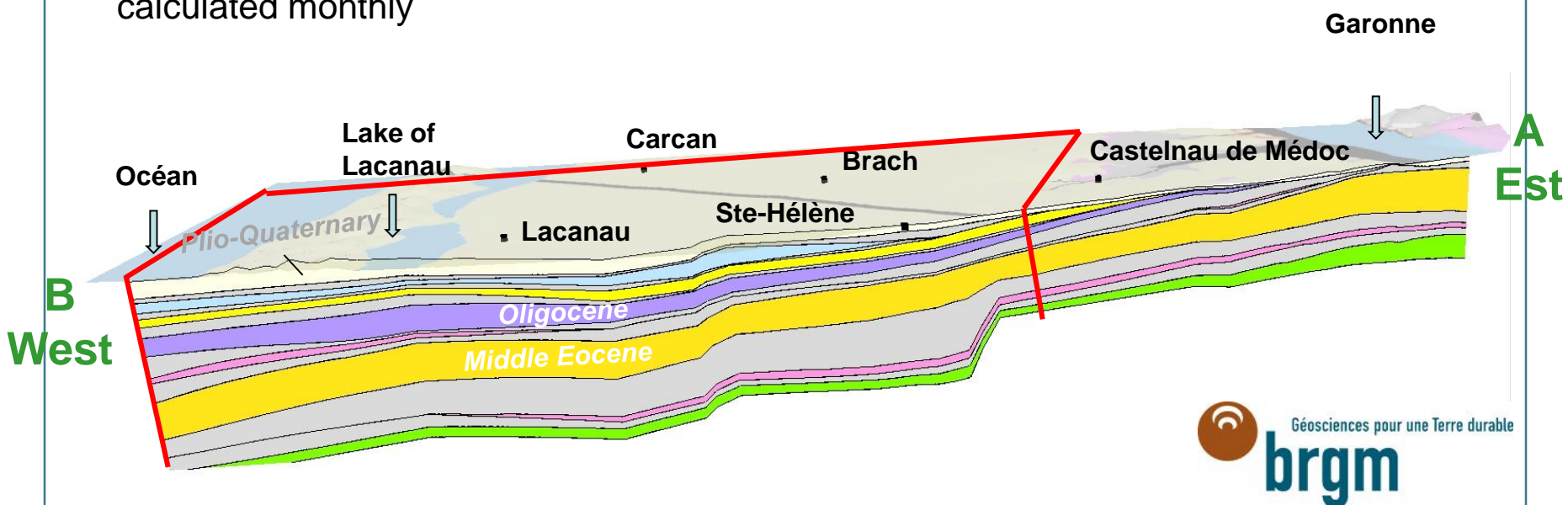
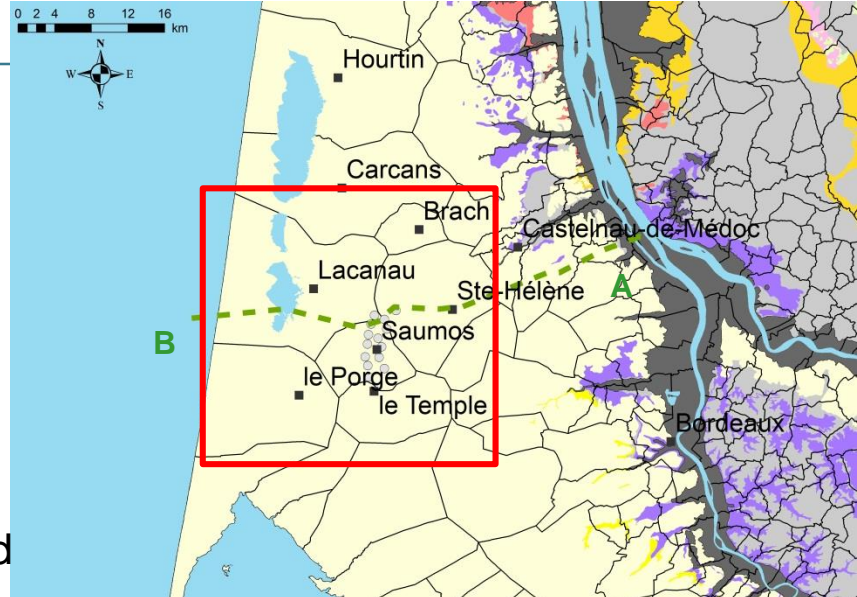
- > Around Bordeaux, a **SAGE** (Schéma d'Aménagement et de Gestion des Eaux –Water Management Plan) has been approved in 2003 in order to improve groundwater exploitation.

- > The strategy consist in:
 - Reducing water demand by raising awareness of population and by reducing water losses during transportation.
 - Creating new well fields will permit a better distribution of the impacts related to the withdrawal on groundwater

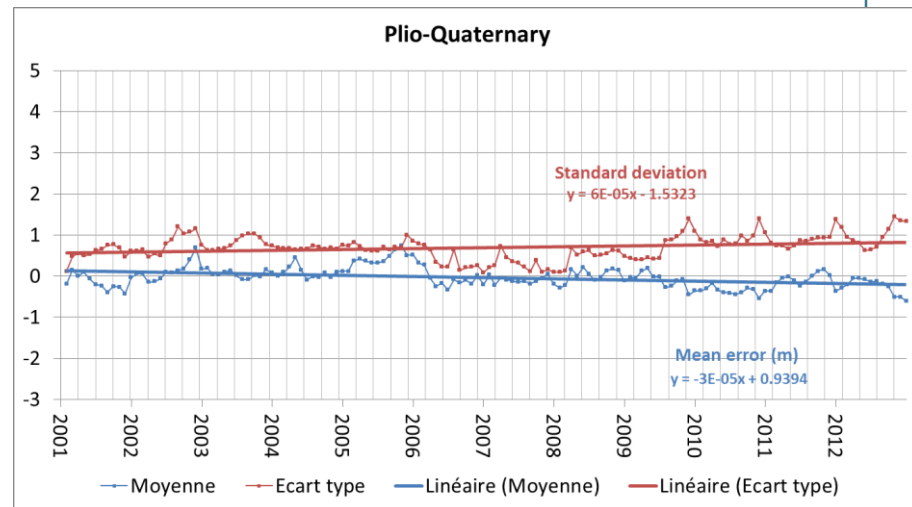
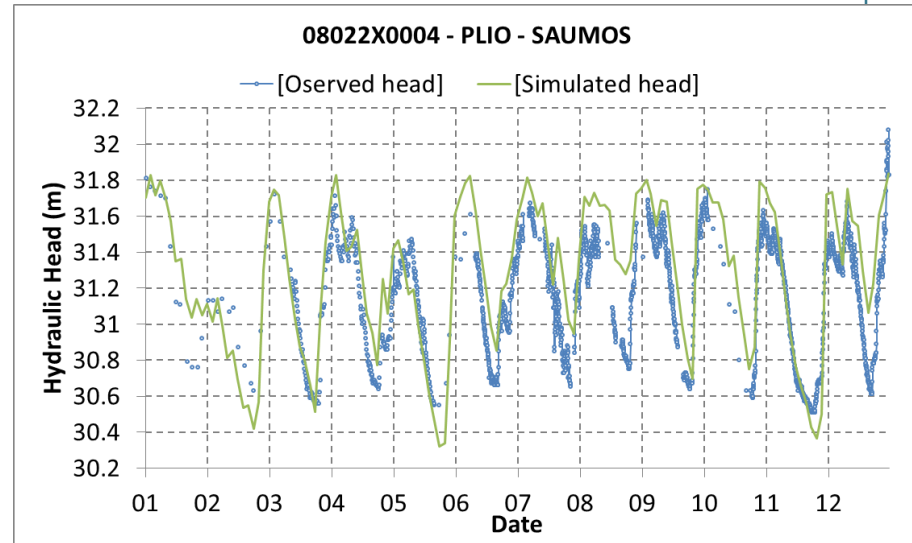
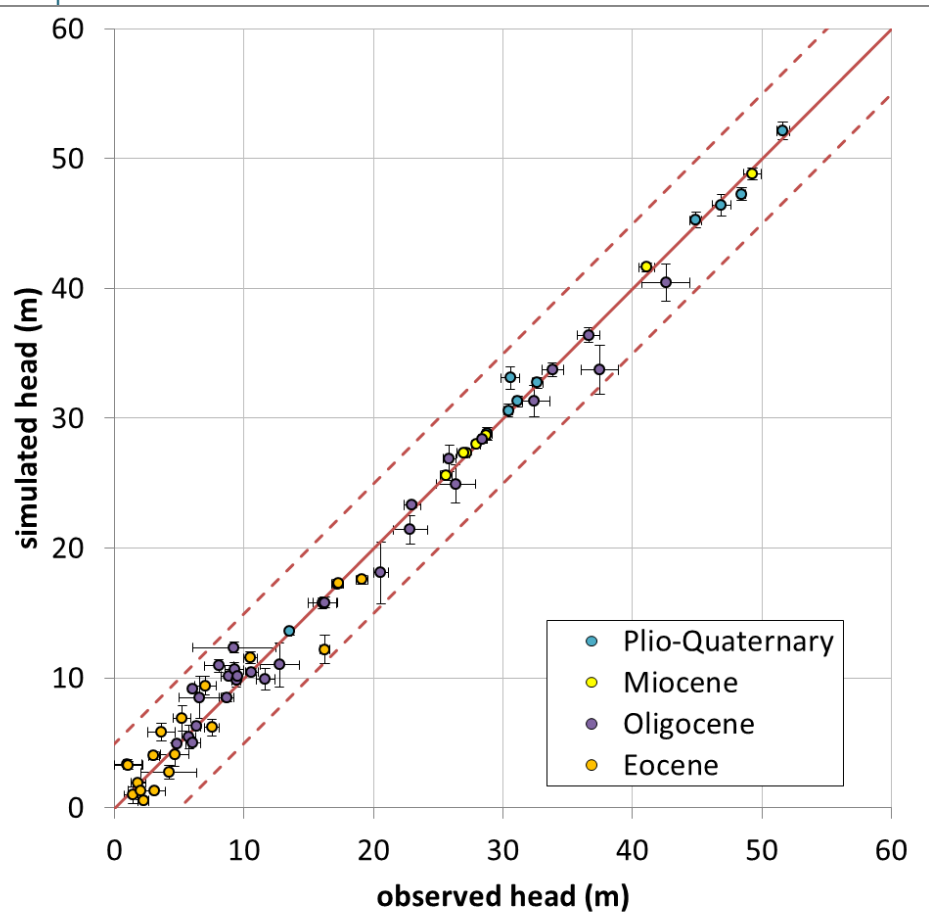
- > Groundwater modelling at a regional scale is used to plan and design the future facilities (well field)
 - A future well field is planned in the west of Bordeaux (14 wells and 10 million m³/year)
 - Various simulations have shown a potential impact on the phreatic aquifer
 - A local model has been designed to evaluate more precisely the impacts on the phreatic aquifer

Characteristics of the hydrodynamic model

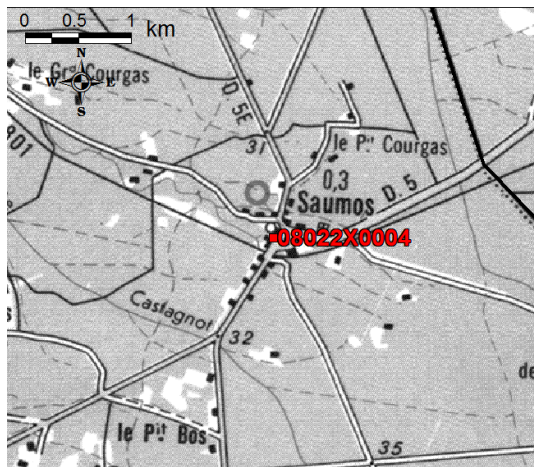
- 15 layers :
 - 8 aquifers (1 unconfined aquifer and 7 confined aquifers)
 - 7 confining layers (aquitards)
- Total surface of 3 600 km²
- Creation of a nested grid on the area concerned by the project (960 km²) with a cell size of 100 m in dimension
- Groundwater recharge is calculated daily while groundwater level is calculated monthly



Calibration

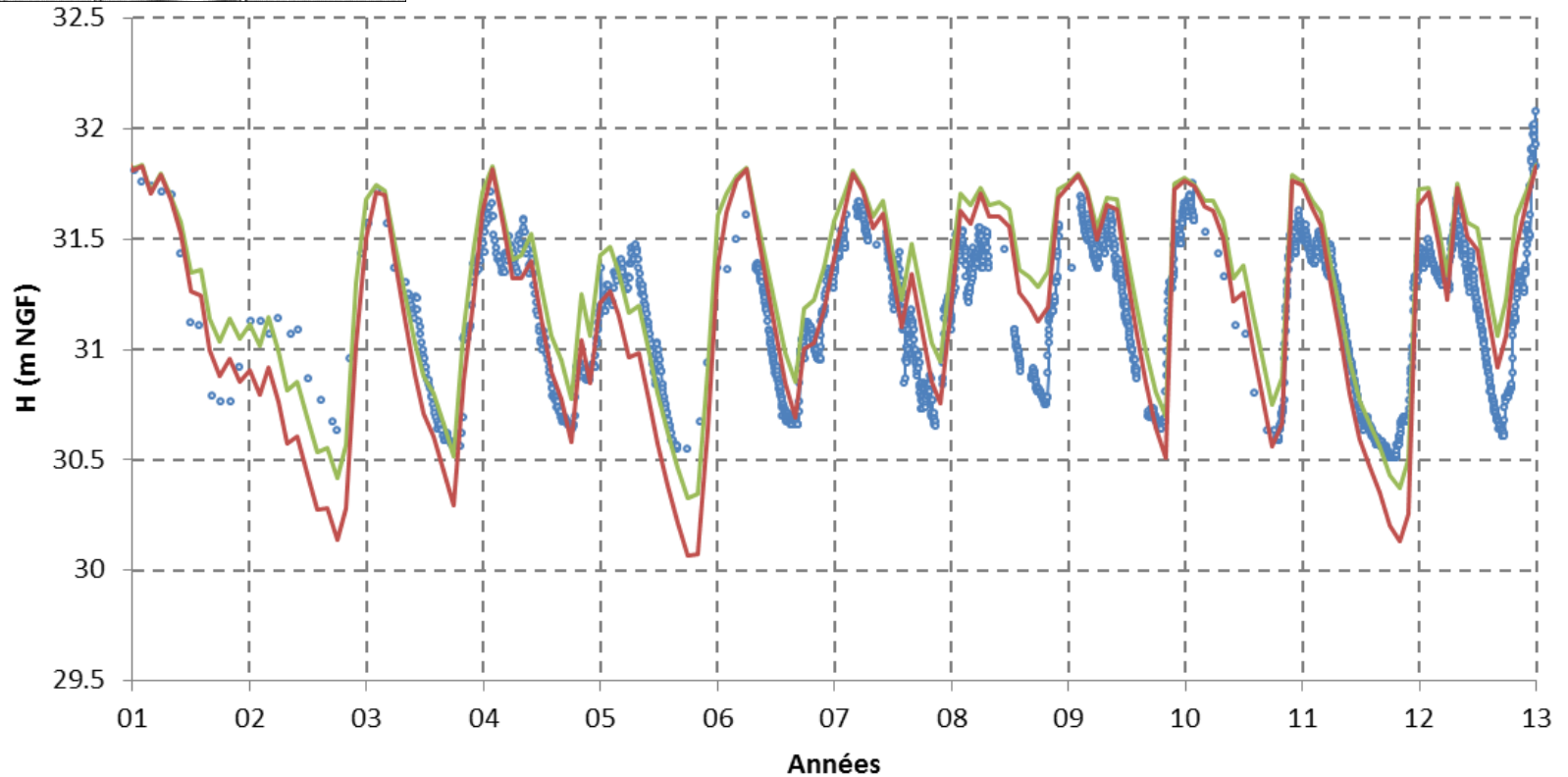


Impact of the well field on the Plio-Quaternary aquifer (unconfined aquifer)

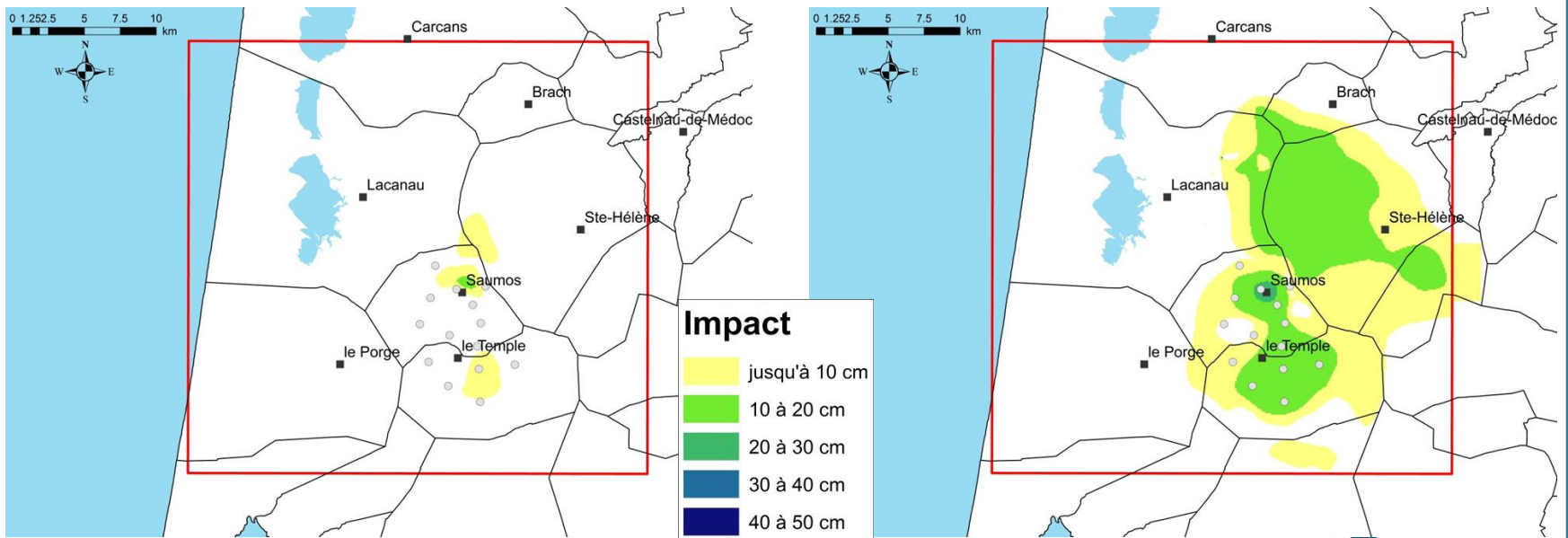
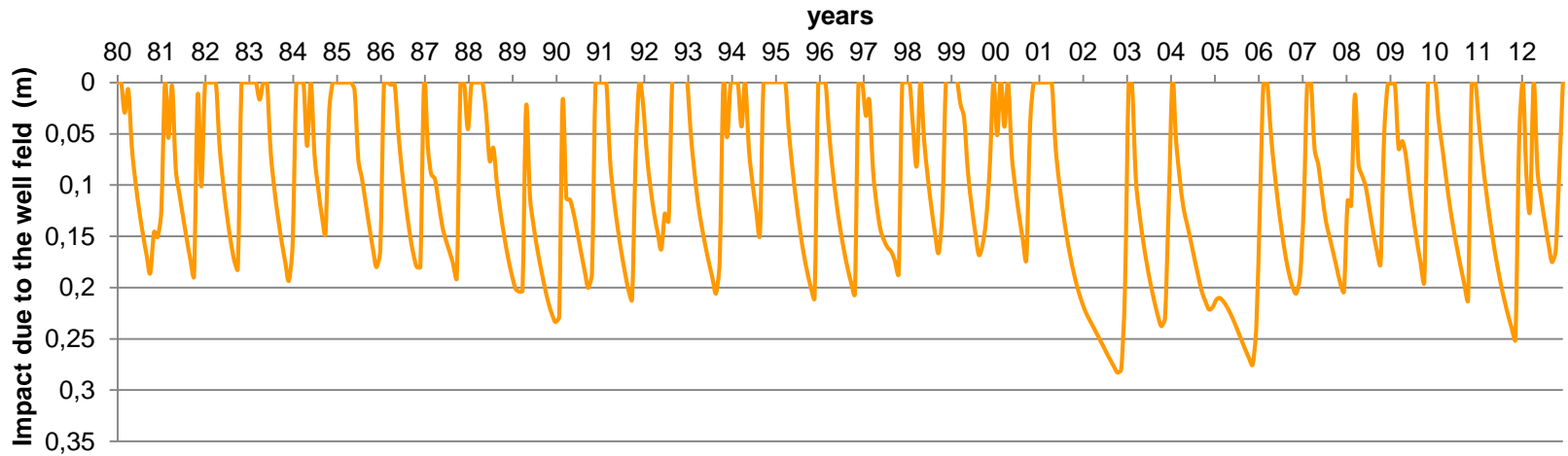


08022X0004 - PLIO - SAUMOS

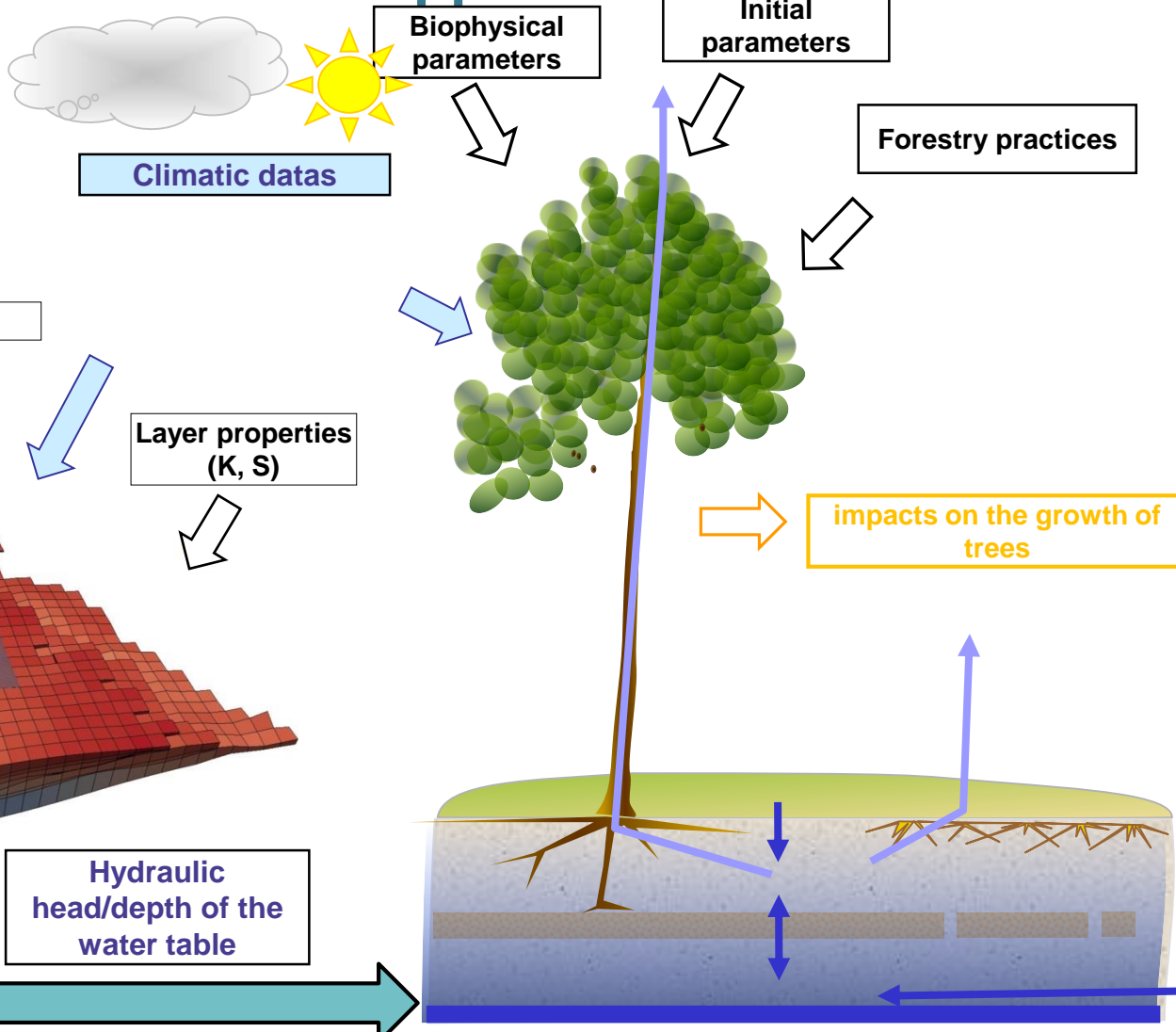
—○— [OBS] — Without well field — With well field



Impact of the well field on the Plio-Quaternary aquifer (unconfined aquifer)



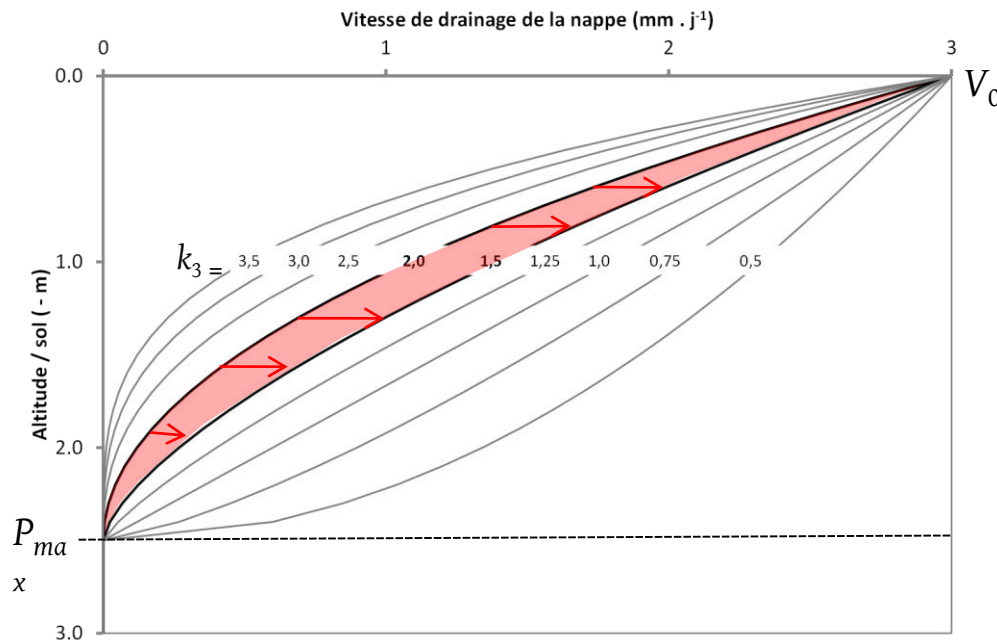
Multi model approach



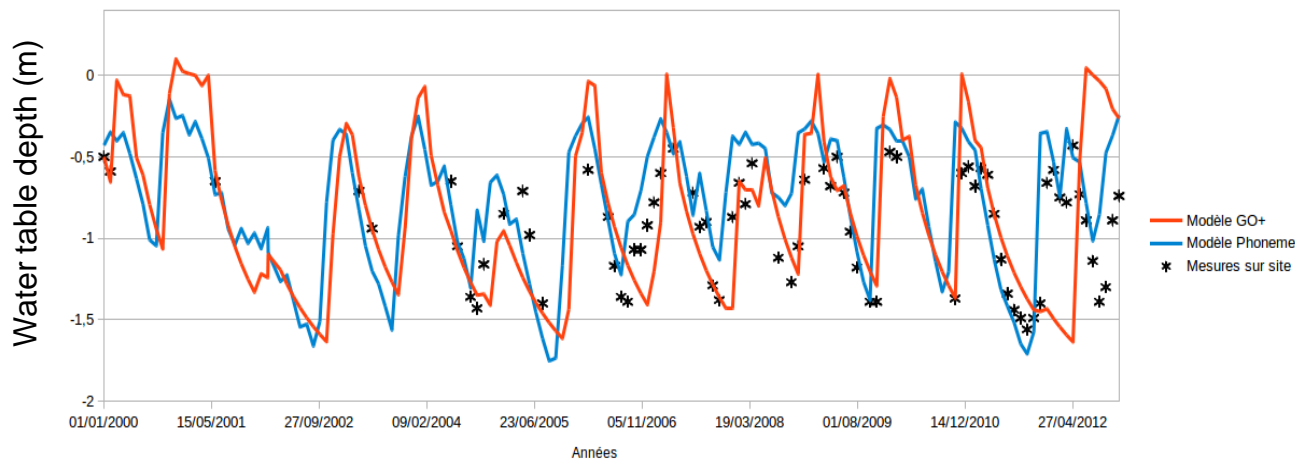
BRGM hydrodynamic model PHONEME

INRA forest growth model GO+

Modeling of the groundwater level in GO+



The model simulates the effects of the well field drainage by accelerating the drainage rate of the layer



INRA forest growth model GO+ : methodology

> Conditions and tested scenarios

- 3 initial groups of age-classes : 2, 17 and 35 years.
- 2 values of usefull available water (0.5 to 1m of soil thickness/root detph).
- 2 forestry models : standard and intensive.
- 2 climatic scenarios (RCP 2.5 and 8.5).
- Periods : 2000 à 2100.

> Evaluated parameters

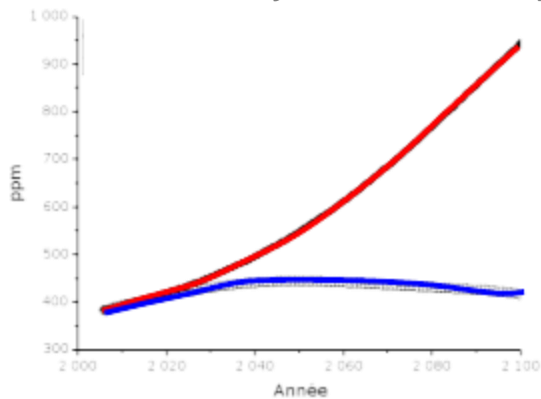
- Net Primary Production of trees, *NPP* (gC.m⁻².an⁻¹)
- Volume of wood production, *Production*, (m³.ha⁻¹.an⁻¹)
- Index of water stress of trees, *Istress*, [0 , 1])
- Soil Moisture Deficit, *SMD*, [0 , 1])
- Evapotranspiration of trees, *ETR*, (mm.an⁻¹)



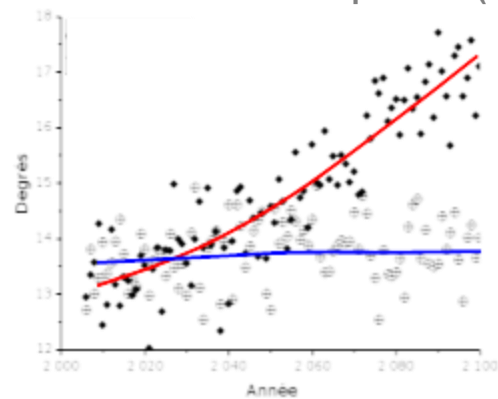
Climatic parameters

RCP 2.6
RCP 8.5

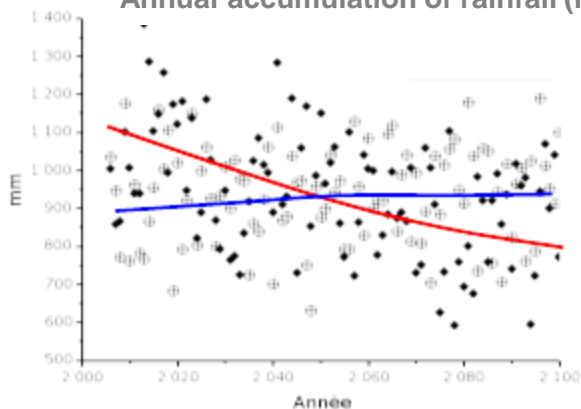
Carbon dioxide concentration (ppm)



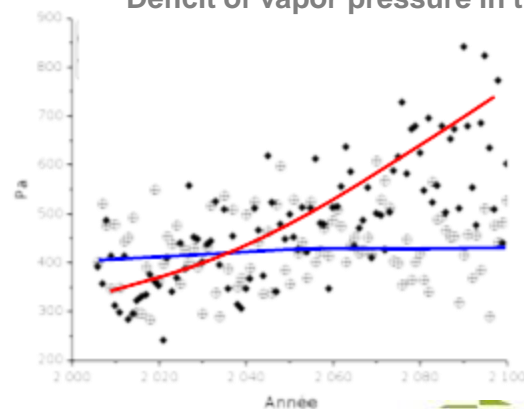
Mean annual temperature (°C)



Annual accumulation of rainfall (mm)



Deficit of vapor pressure in the air (Pa)



Results

> Standard production

Climatic scenarios	Depth of roots (m)	Parameters sensibility (%)				
		ETR	Istress	NPP	Production	SMD
RCP 2.6	0,5	-2.6	2.3	-1.7	-2.1	7.5
	1,0	-4.3	3.7	-2.9	-3.4	10.8
RCP 8.5	0,5	-2.0	1.8	-1.3	-1.6	6.6
	1,0	-4.1	3.2	-2.8	-3.4	9.0

> Intensive production

Climatic scenarios	Depth of roots (m)	Parameters sensibility (%)				
		ETR	Istress	NPP	Production	SMD
RCP 2.6	0,5	-2.0	1.6	-1.4	-1.7	7.8
	1,0	-3.4	3.5	-2.1	-2.6	9.1
RCP 8.5	0,5	-1.6	1.7	-0.9	-1.2	6.1
	1,0	-3.9	3.3	-2.5	-3.0	10.2

Conclusion and Perspectives

> Groundwater model

- Optimization of the well field location in order to minimize the impact of the project on the Plio-Quaternary aquifer
- Taking into account GIEC scenarios to evaluate the impact of the well field
- Improve the evaluation of uncertainties in the groundwater model

> Forest growth model

- Integration of groundwater table from the PHONEME model
- Spatial approach to evaluate the impact of the well field on forest production through GO + by integrating information on the ages of the settlement and their spatial distribution in the study area