POLITECNICO
MILANO 1863

Impatto del cambiamento climatico e della gestione forestale sulla produzione di biomassa del bacino sperimentale del torrente Bonis

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Innomed

Innovative Options for Integrated Water Resources Management in the Mediterranean

http://innomed.csic.es/

INNOMED aims to develop and apply a multidisciplinary approach to quantify the physical and economic effects of alternative management options in forestry and agriculture on the catchment's water balance under climate change scenario. The INNOMED project brings together partners from Spain (CSIC), Cyprus (CyI), Italy (POLIMI and CNR-ISAFOM), Portugal (NOVA.ID.FCT), France (CIRAD-UMR-CIRED) and Moldova (RIFC)

The study case: the Bonis river basin

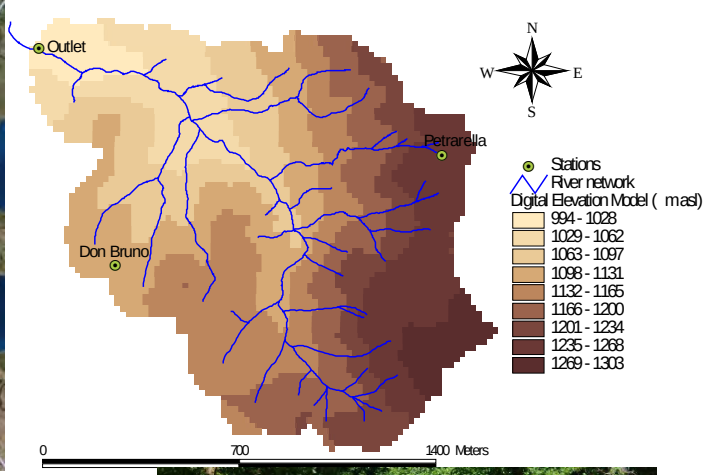
Catchment characterization-Meteorological data

Area: 1.4 km^2

Annual precipitation > 1000 mm

Data from 1986 were collected from 3 Meteorological stations:

- **Basin outlet** (Outlet: 975 m a.s.l.)
- **Petrarella**: 1258 m a.s.l.) located in the north-eastern of the catchment
- (**Don Bruno**: 1175 m a.s.l.) located in the southwestern part of the catchment.



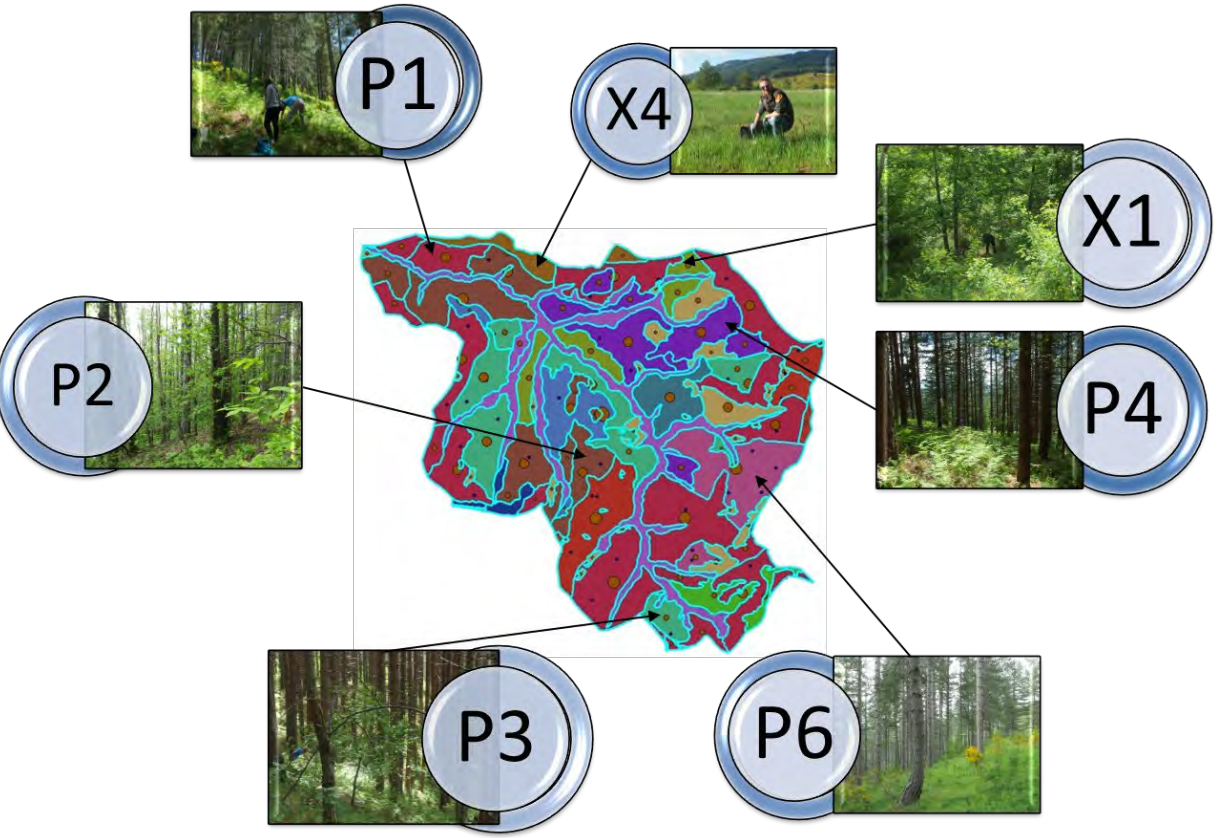
In May 2003 a tower for the measurement of fluxes with the Eddy covariance technique was installed in a plantation of 44-year old Laricio pines, in Cozzarella – Don Bruno location.

The runoff is measured at the outlet of the watershed using a gauging structure.

Stakeholders meeting

Figure 5: Participants of the stakeholders meeting at the Bonis catchment case-study in the Calabria region

Bonis catchment land use map and sampling points locations



USO
- aree nude e roccia affiorante
- ceduo di castagno
- formazioni ripariali a ontano e pioppo
- popolamenti artificiali di castagno
- popolamenti artificiali di pino e castagno
- popolamenti artificiali di pino laricio degradati
- popolamenti artificiali di pino laricio percorsi dal fuoco
- popolamenti artificiali di pino laricio rado
- popolamenti artificiali di pino laricio, con cerro nel piano dominato
- popolamenti artificiali puri di pino laricio
- popolamenti di pino laricio naturali + artificiali
- popolamenti naturali di pino laricio (<densi)
- popolamenti naturali di pino laricio (>densi)
- seminativi

Field campaign for soil hydrological parameter assessment

Best method : Infiltration measurement in-situ

1 Initial soil water content measurement

2 Pouring a known volume of water

3 Register the infiltration time

4 Measurement of the soil water content at the end of the measurements

BEST method : Beerkan estimation of soil hydraulic properties

Advantages of this method :
easy, robust, and inexpensive way of characterizing the hydraulic behavior of soil

Field campaign for soil hydrological parameter assessment

Laboratory measurements

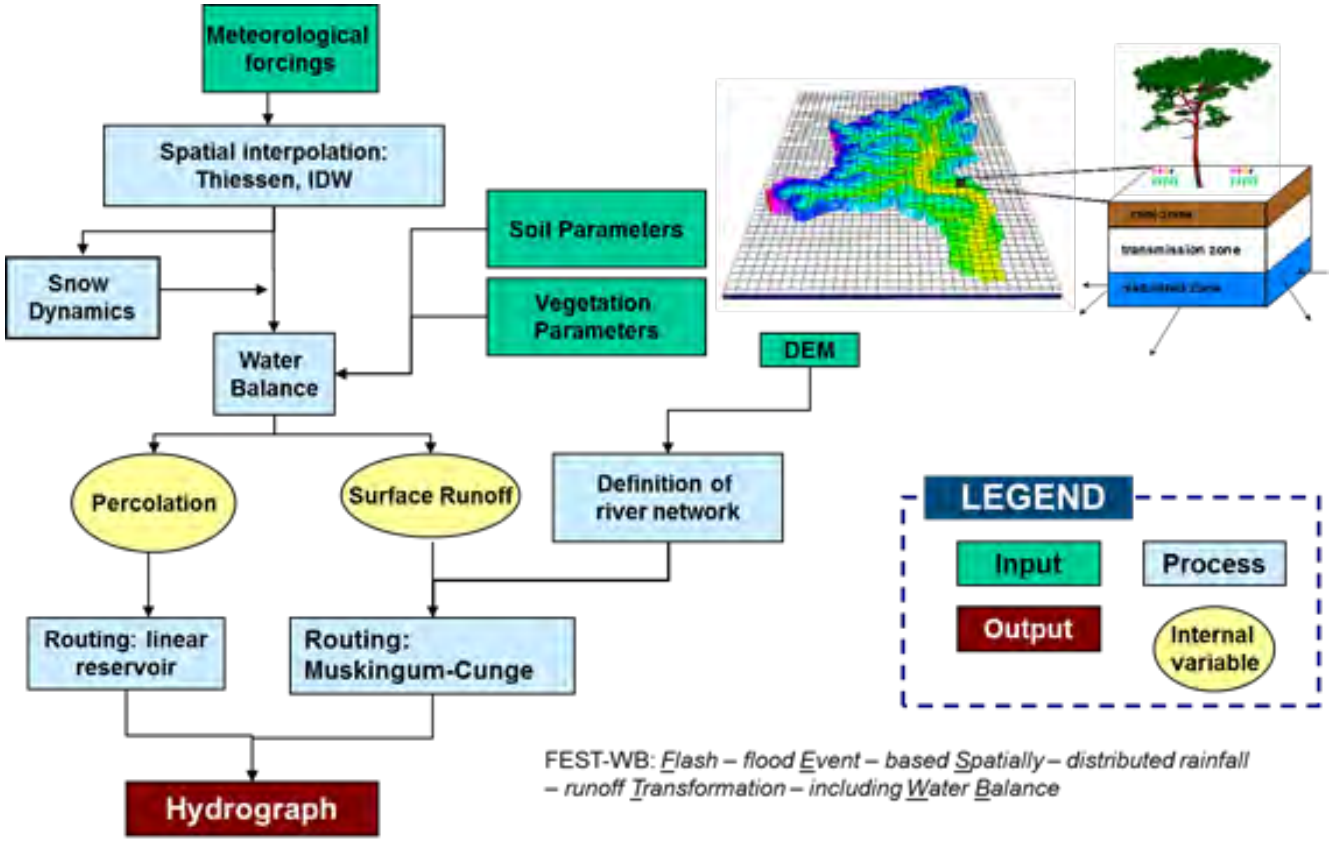
Collected undisturbed soil samples

KSAT-UMS instrument

HYPROP-UMS instrument

PARIO-METER instrument

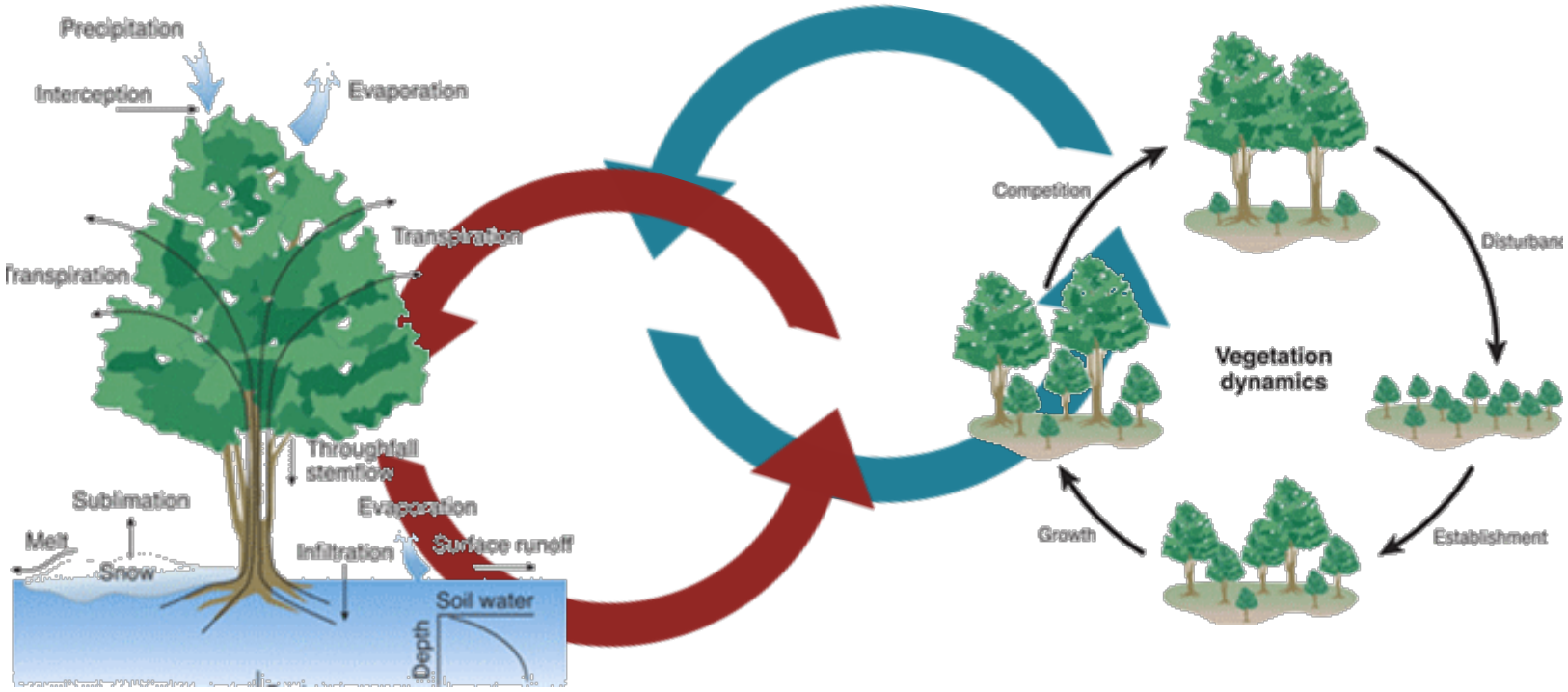
The FEST-WB spatially distributed hydrological model



FEST-WB: *Flash – flood Event – based Spatially – distributed rainfall – runoff Transformation – including Water Balance*

Rabuffetti, D., Ravazzani, G., Corbari, C., Mancini, M. (2008) , Verification of operational Quantitative Discharge Forecast (QDF) for a regional warning system – the AMPHORE case studies in the upper Po River. Nat. Hazard Earth Sys., 8, 161-173.

Forest dynamics modelling

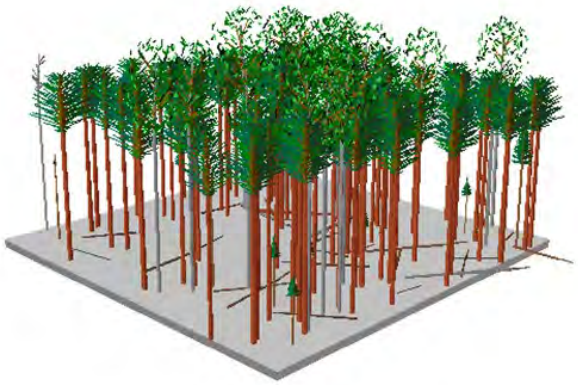


3D-CMCC CNR – Forest Ecosystem Model (Collalti et al., 2014)

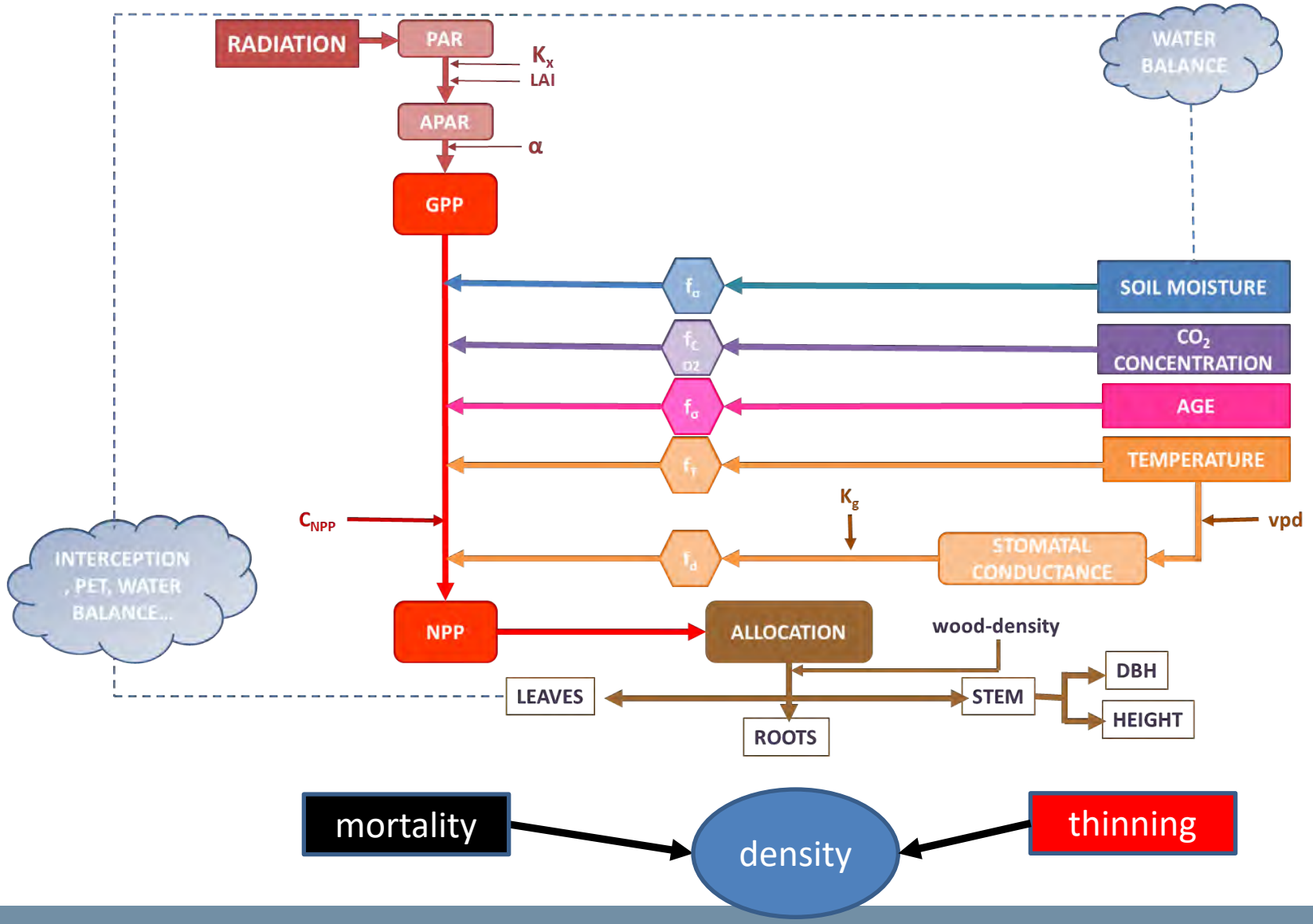
EcH_2O (Maneta & Silverman, 2013)

The integration of forest growth modules into FEST-WB

Different species can be simulated using FEST-WB. The group of plants of the same species that are born during the same year are classified into different cohorts. **One single species of one cohort per cell**

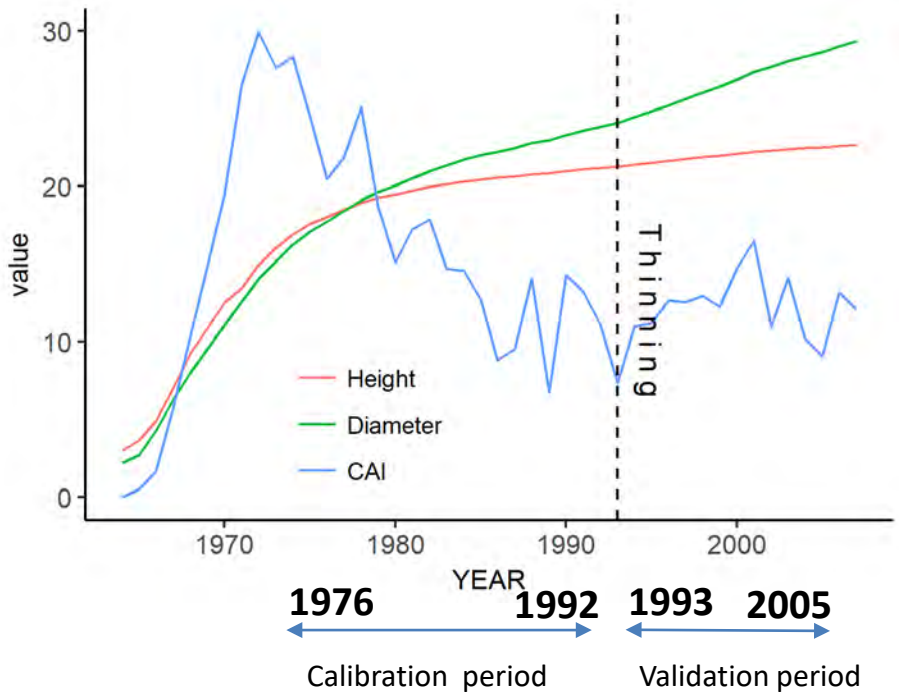


Development of FOREST module



Available data for model calibration/validation

Historical data from Bonis catchment



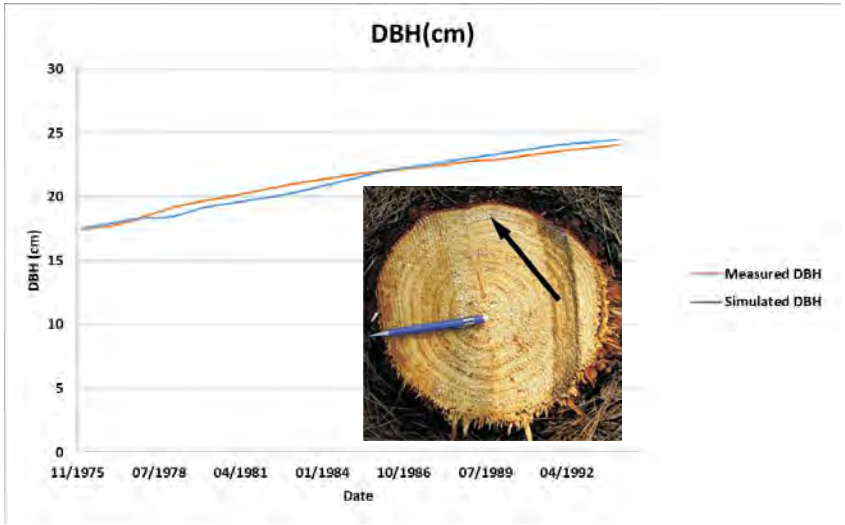
YEAR	Variables	Values
1986	Plant number (N/ha)	1120
	Basal area (m^2/ha)	43.2
	DBH (cm)	20.2
1993*	Plant number (N/ha)	1100
	Basal area (m^2/ha)	46.6
	DBH (cm)	21.8
1993**	Plant number (N/ha)	700
	Basal area (m^2/ha)	32.4
	Diameter (cm)	22.8
1999	Plant number (N/ha)	690
	Basal area (m^2/ha)	45.8
	DBH	27.4

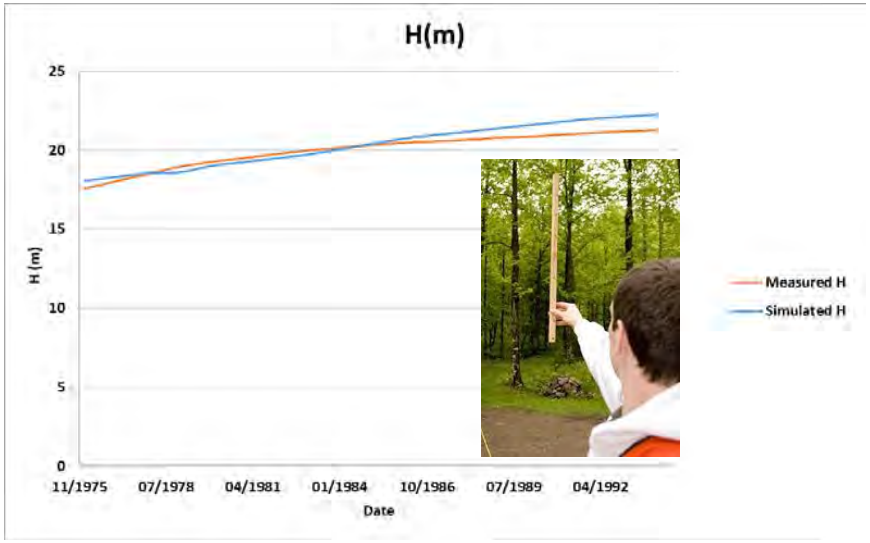
(Pellicone, 2018)

Historical dendrological analysis. 1993* represents the dendrological measure before the thinning, while 1993** the dendrological data right after the thinning (DBH = diameter at breast height).

Calibration results

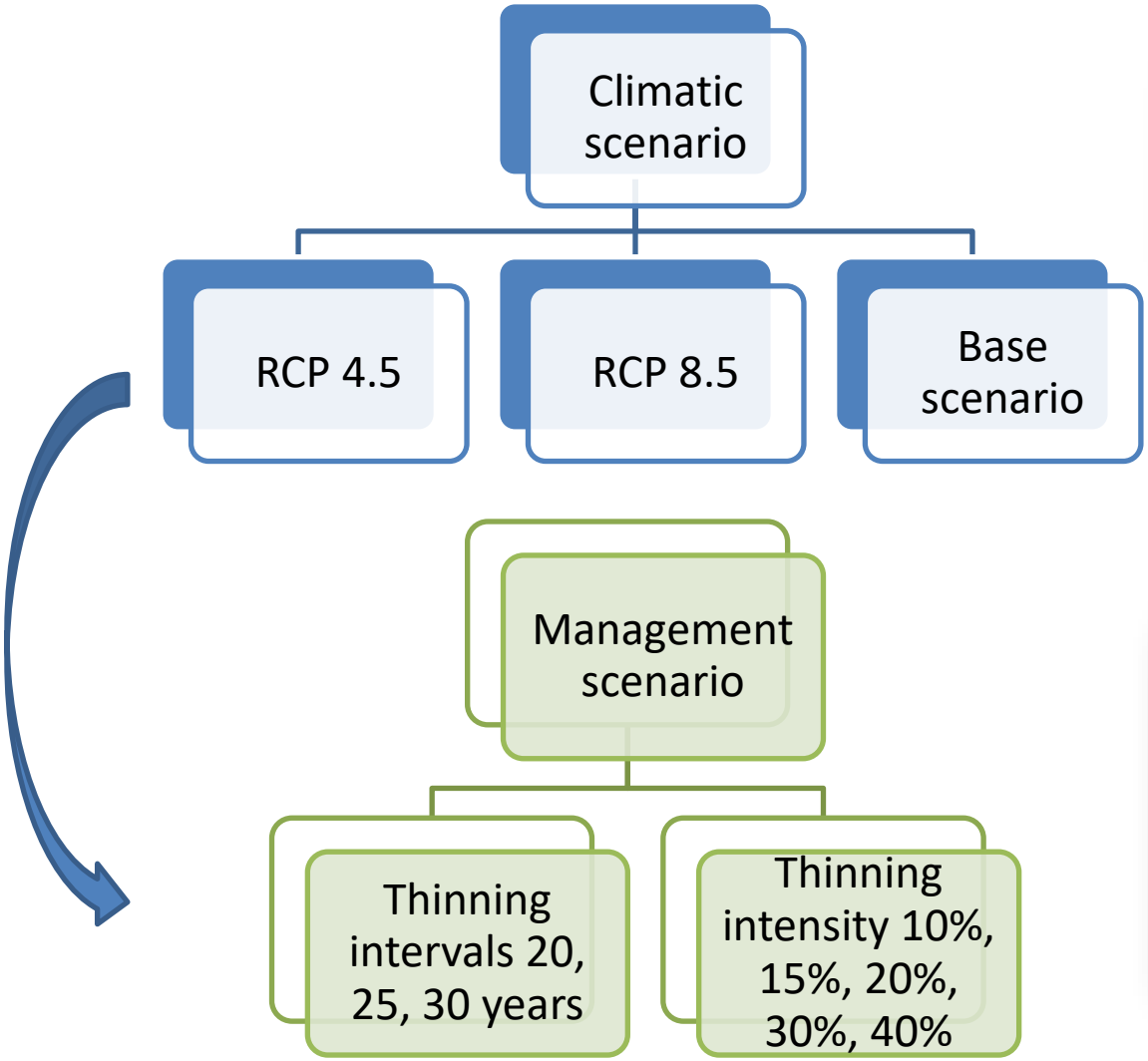
Results of DBH and Height simulations using FEST-WB Vs measurements (simulation period 1976-1993-before the thinning)

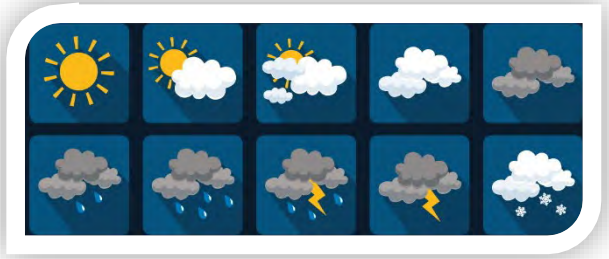




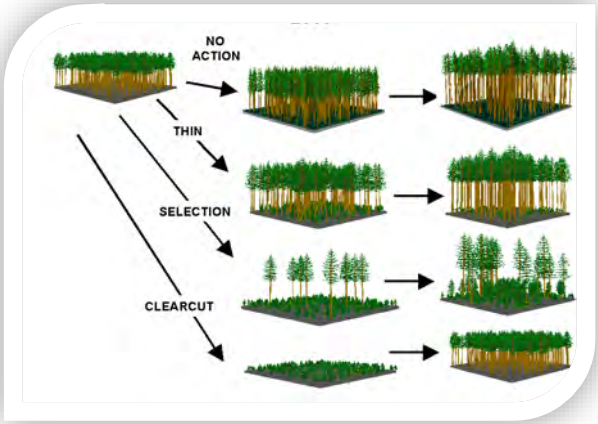
Model showed to reproduce satisfactorily the observed patterns for each year for tree height, tree diameter

Climate and management scenarios



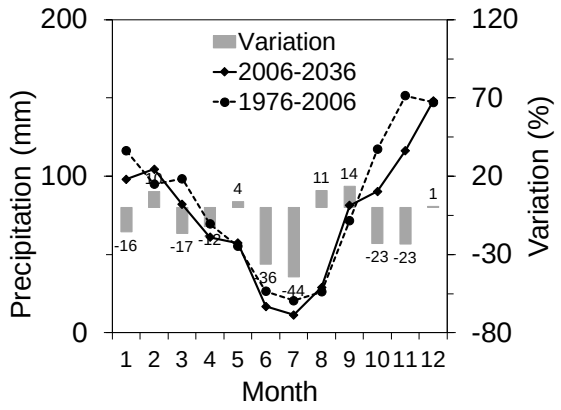


Data provided by *Fondazione Centro Euro-Mediterraneo sui Cambiamenti Climatici*" (CMCC)

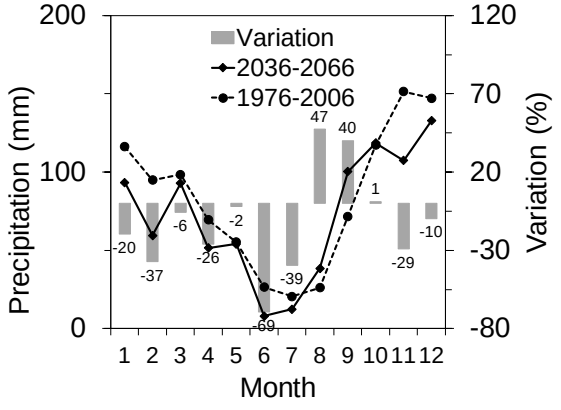


Monthly precipitation trend

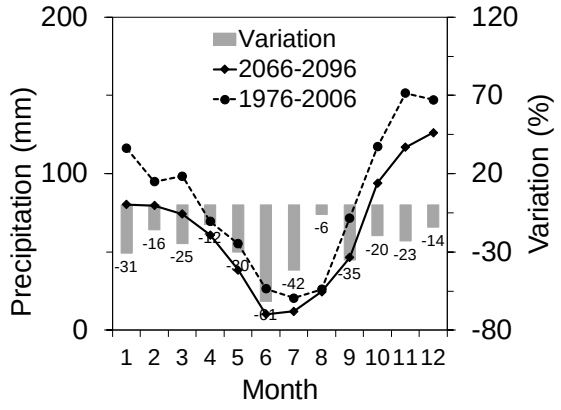
2006-2036



2036-2066

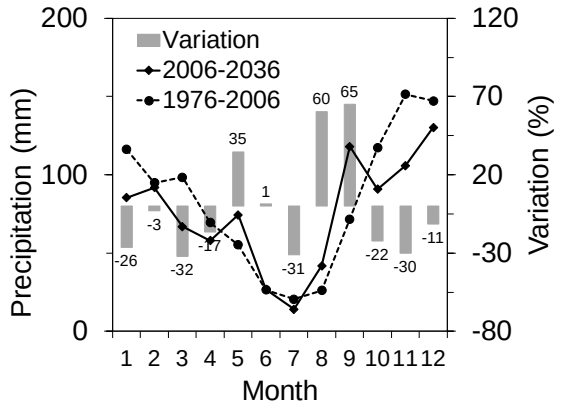


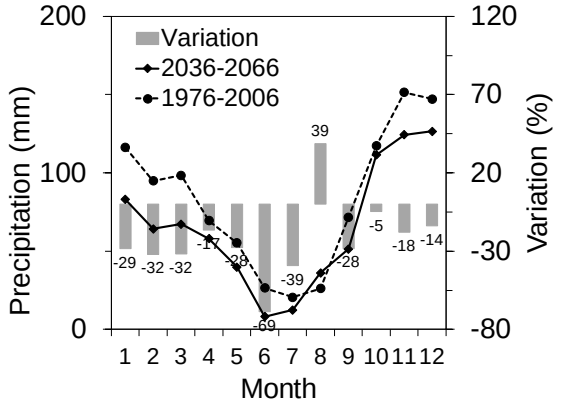
2066-2096

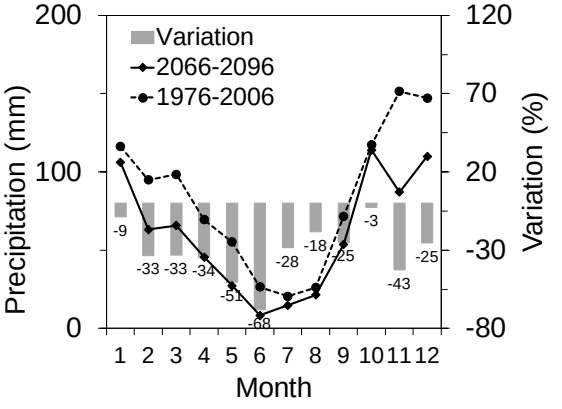


RCP 4.5

RCP 8.5







2006-2036

2036-2066

2066-2096

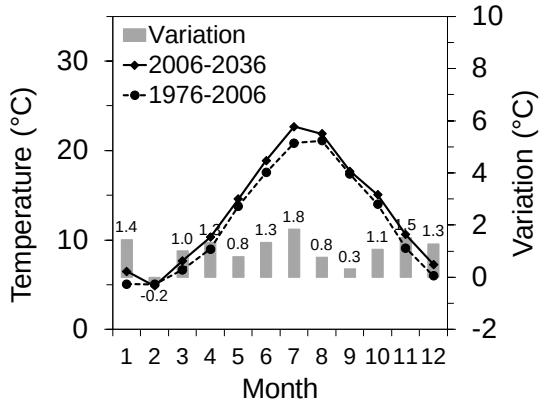
Monthly temperature trend

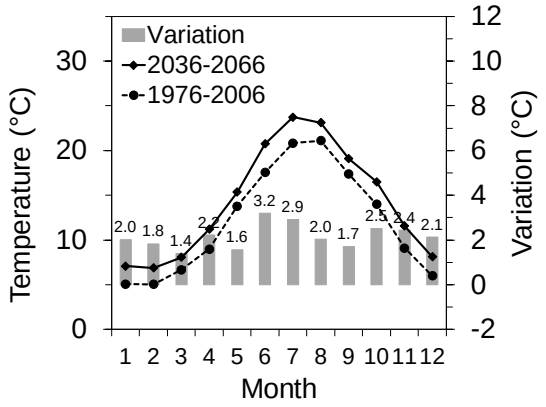
2006-2036

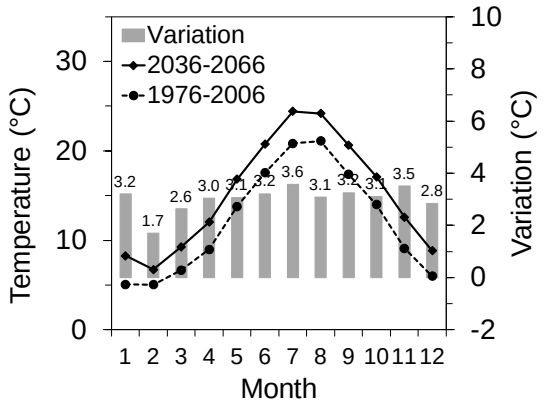
2036-2066

2066-2096

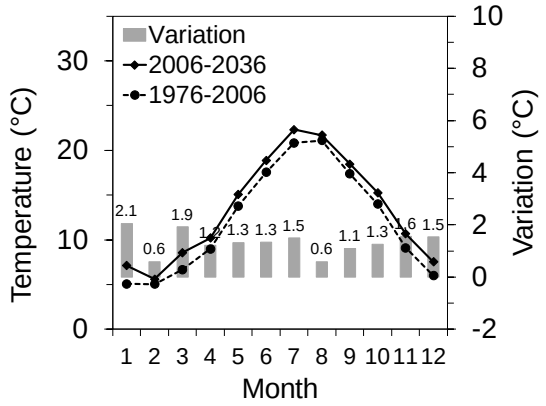
RCP 4.5

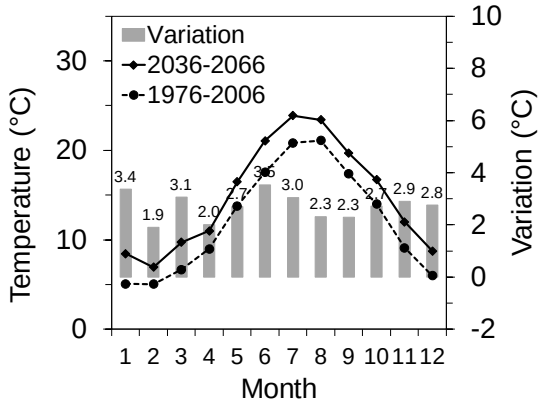


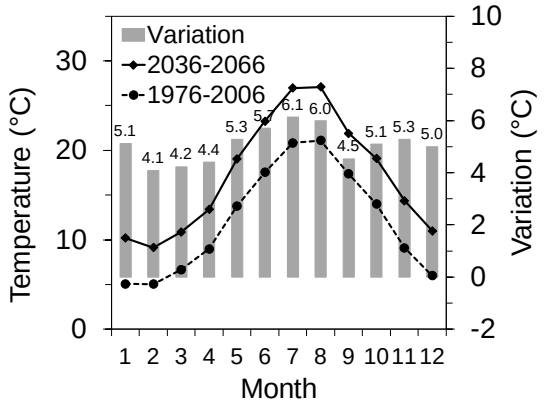




RCP 8.5





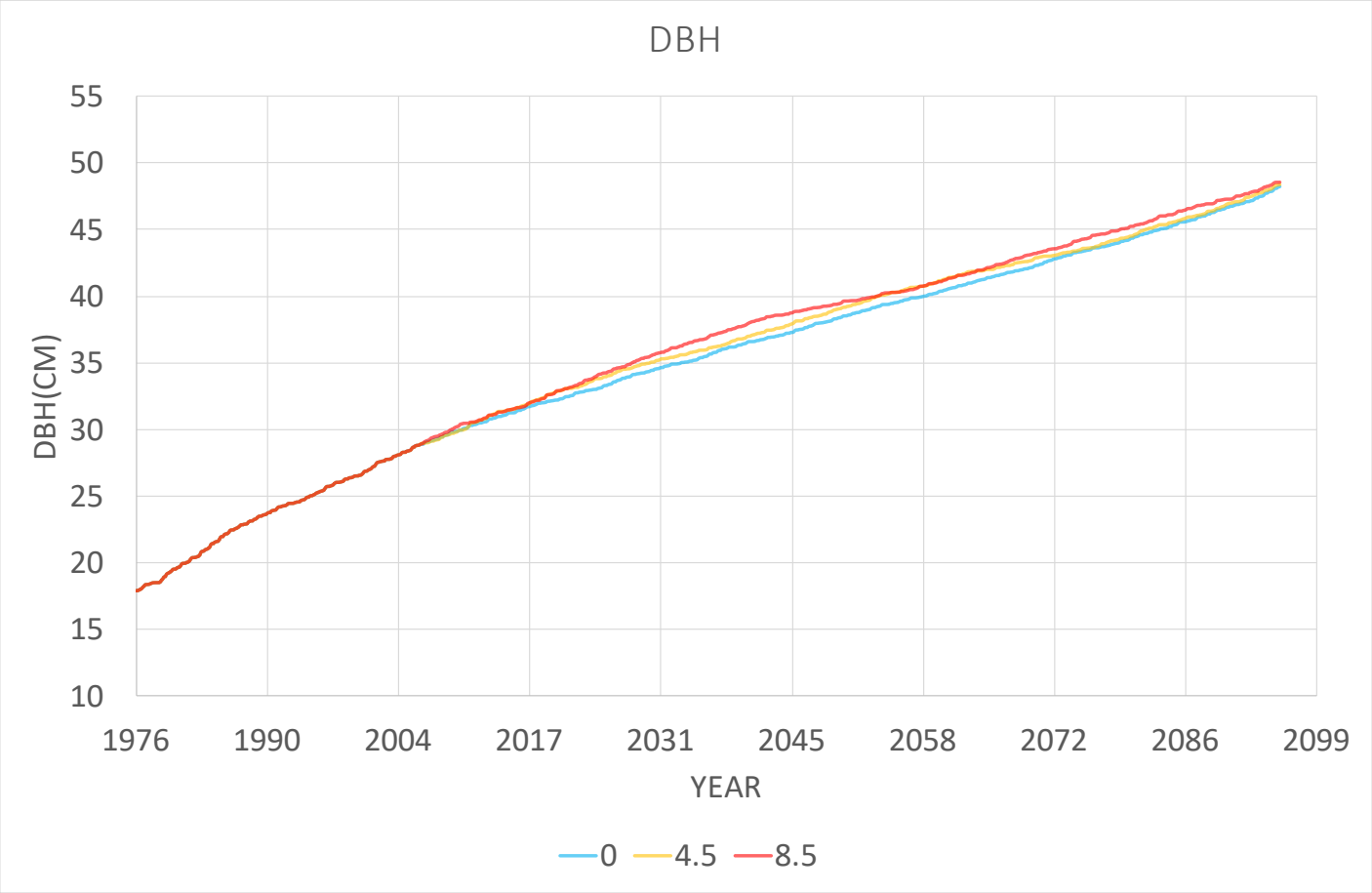


2006-2036

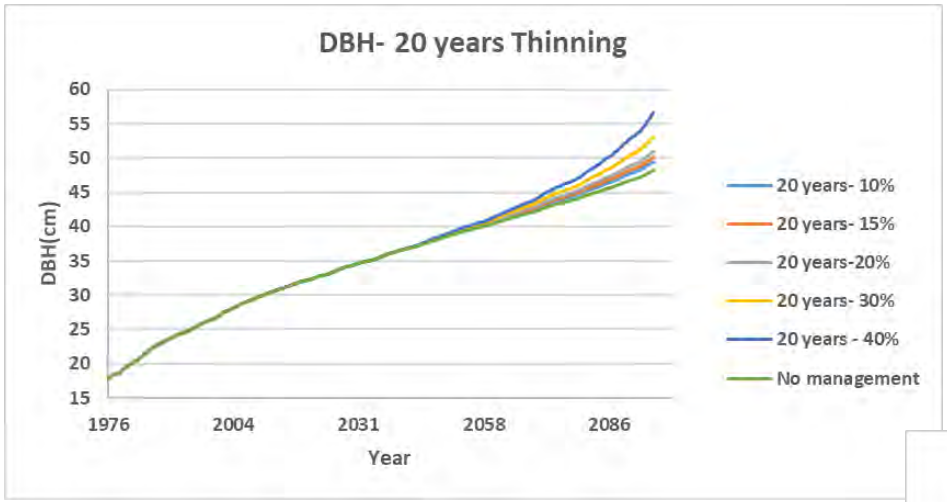
2036-2066

2066-2096

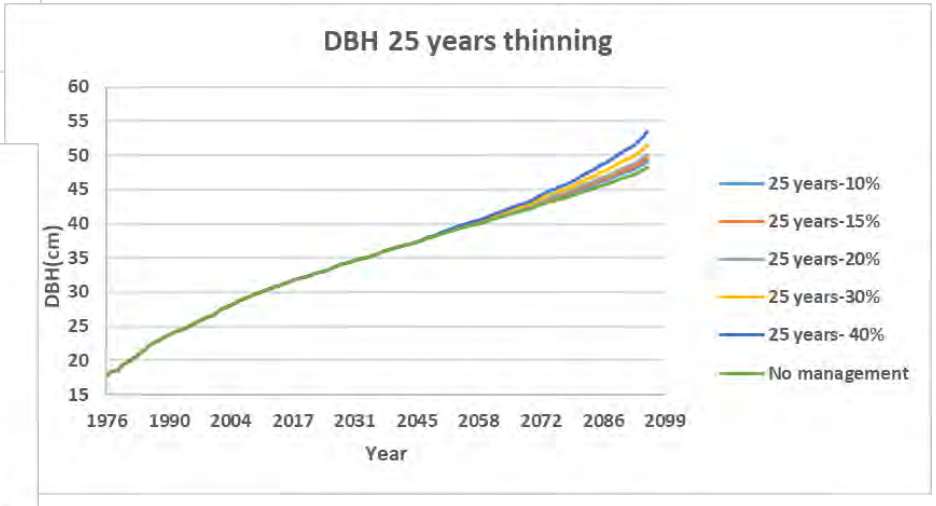
Forest growth under climate scenarios (no forest management)

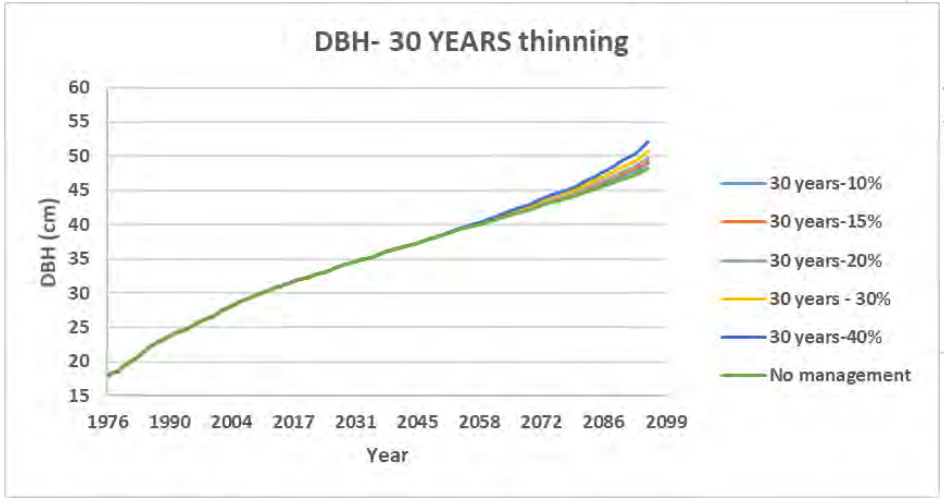


Forest growth for different management options

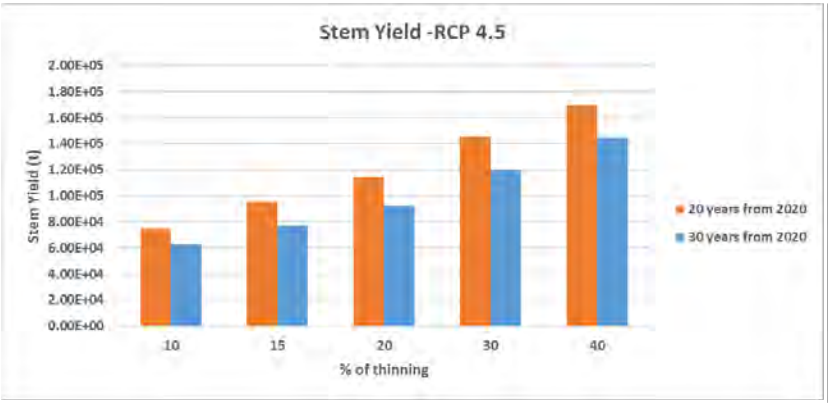


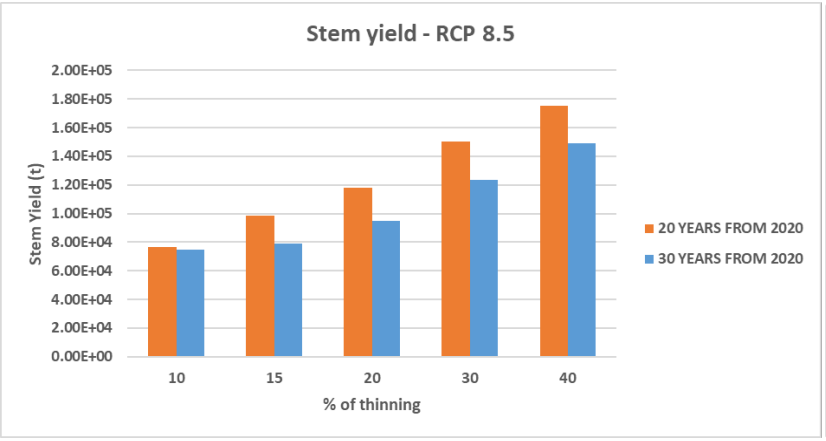
RCP 8.5

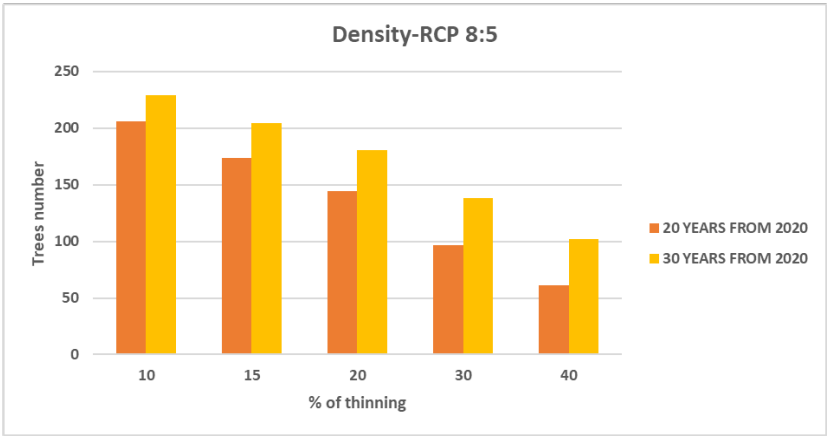




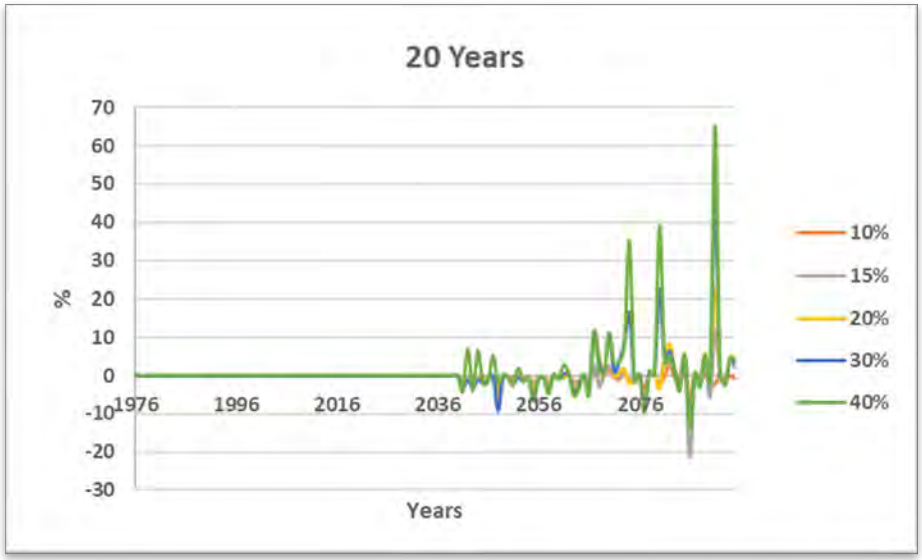
Stem wood yield

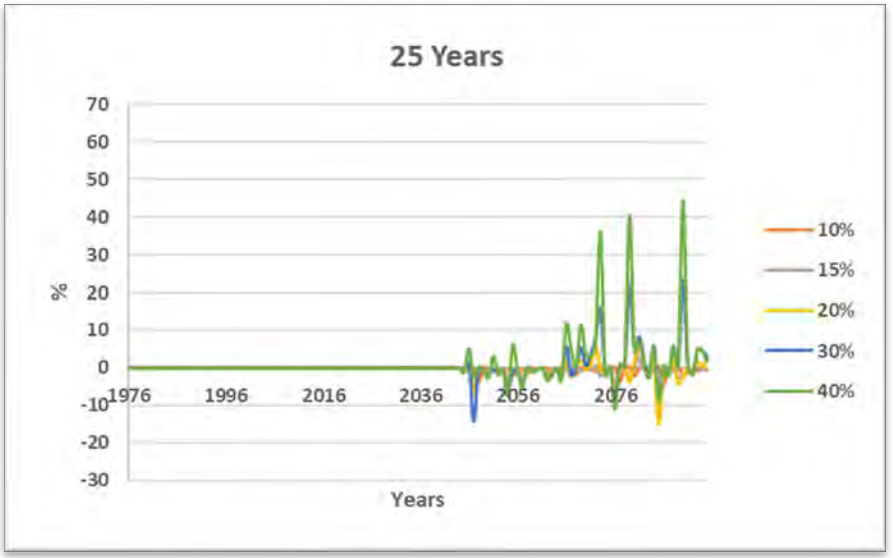


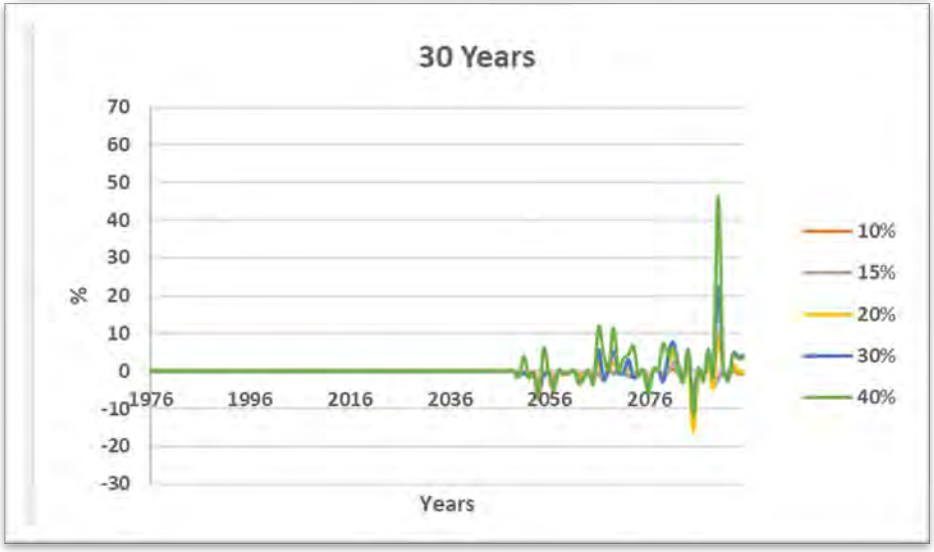




Impact on runoff







In terms of % of variation with respect to no management scenario, we can observe that with the increase of the thinning intensity, higher variation of surface runoff is expected.

The magnitude of variation is lower with larger thinning intervals.

Concluding remarks

- Climate projections show an increase of temperature and a decrease of precipitation
- The increase of temperature and fertilization effect of increase of CO_2 concentration are benefits for forest growth and wood yield in the future
- Increase of runoff due to summer precipitation concentrated in shorter period and forest thinning with possible impact on floods and soil erosion

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THANK YOU FOR YOUR ATTENTION

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