



POLITECNICO
MILANO 1863

Seminar CS³@DICA

CLIMATE-RELATED RISKS AND EXTREME EVENTS

Milano – 19.11.2020

Giovanni Ravazzani⁽¹⁾, Mouna Feki⁽¹⁾, Tommaso Caloiero⁽²⁾, Gaetano Pellicone⁽²⁾

(1) Politecnico di Milano

(2) CNR-ISAFOM

The response of the Bonis Catchment in Calabria, Southern Italy,
to different management options under climate change scenarios



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 (Cyl), Italy (POLIMI and CNR-ISAFOM), Portugal (NOVA.ID.FCT), France (CIRAD-UMR-CIRED) and Moldova (RIFC)



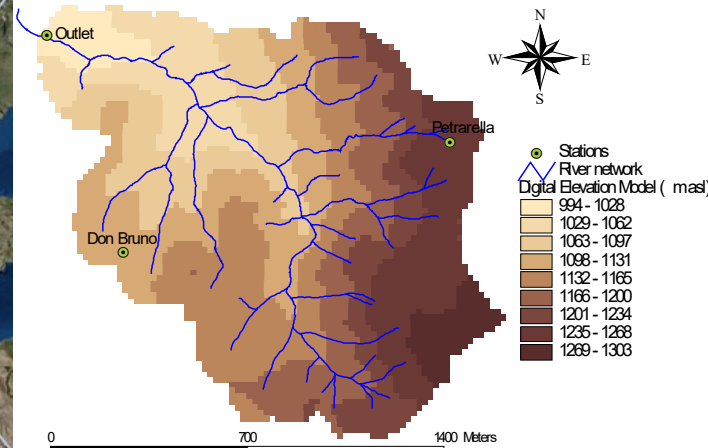
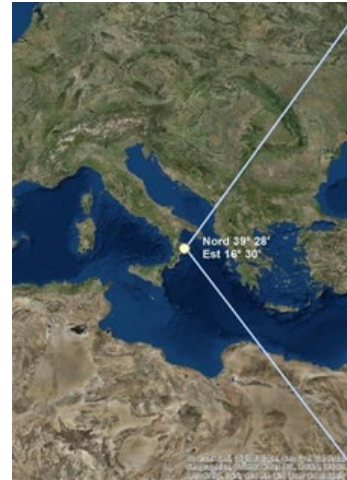
Catchment characterization-Meteorological data

Area: 1.4 km²

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.



Best method : Infiltration measurement in-situ

1 Initial soil water content measurement



2 Pouring a known volume of water



3 Register the infiltration time



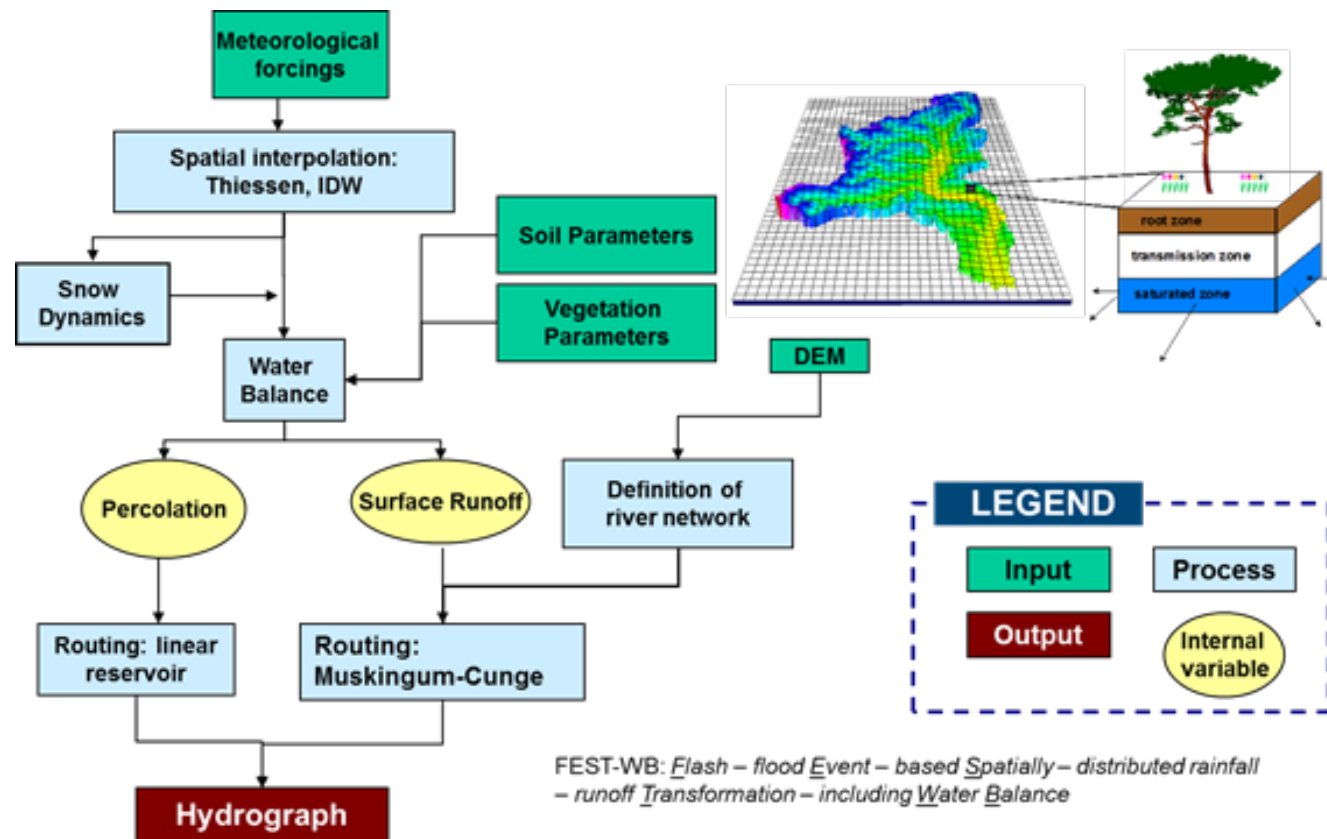
4 Measurement of the soil water content at the end of the measurements



BEST method : Beerkan estimation of soil hydraulic properties

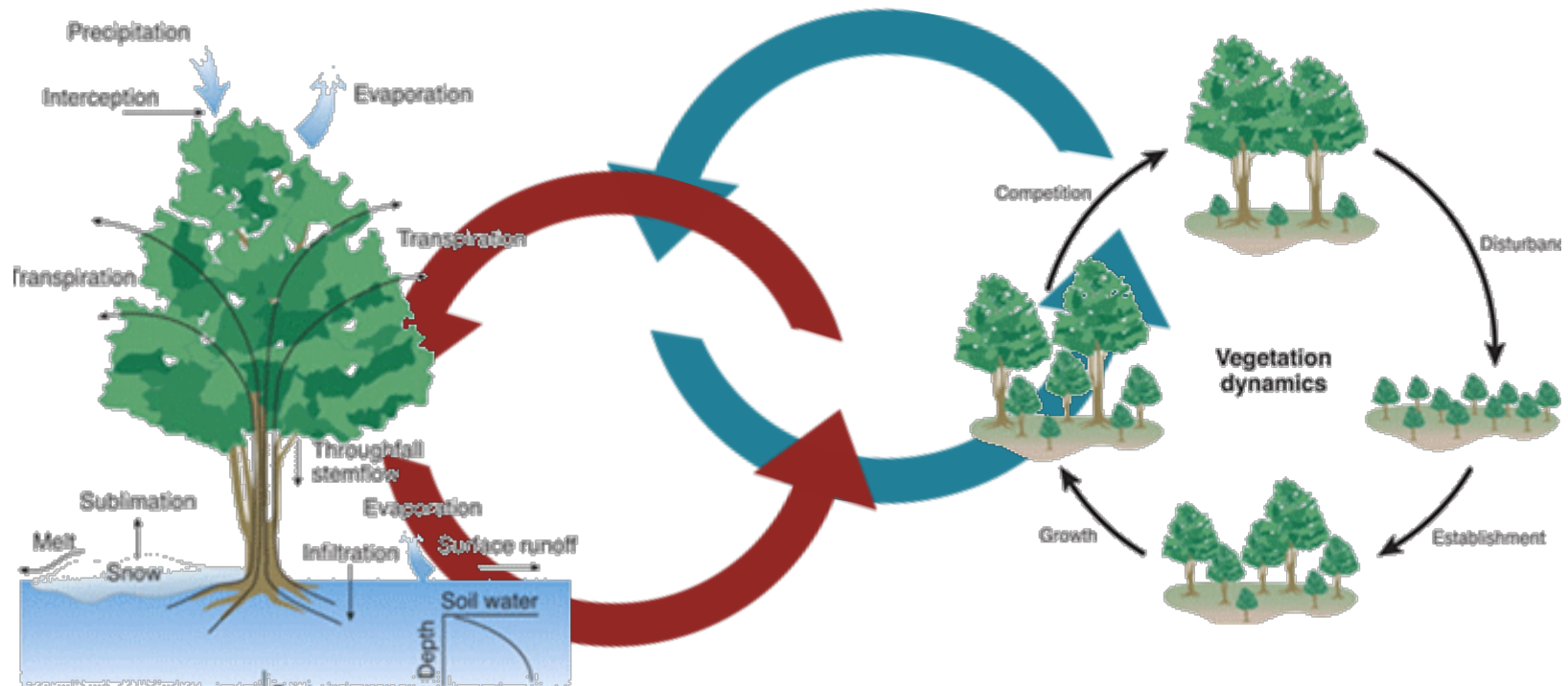
Advantages of this method :
easy, robust, and inexpensive way of
characterizing the hydraulic behavior of
soil

The FEST-WB spatially distributed hydrological model



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.

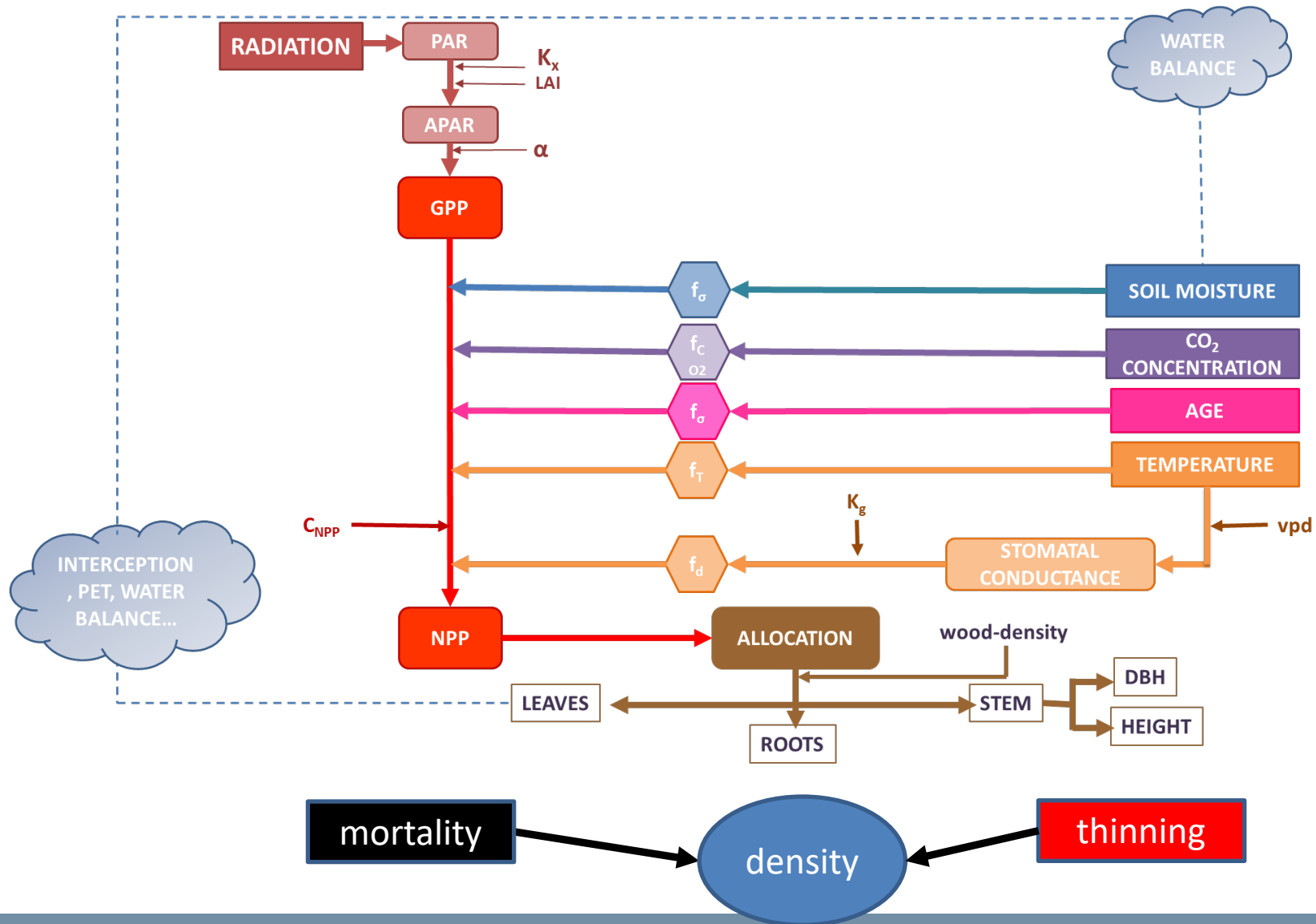
Forest dynamics modelling



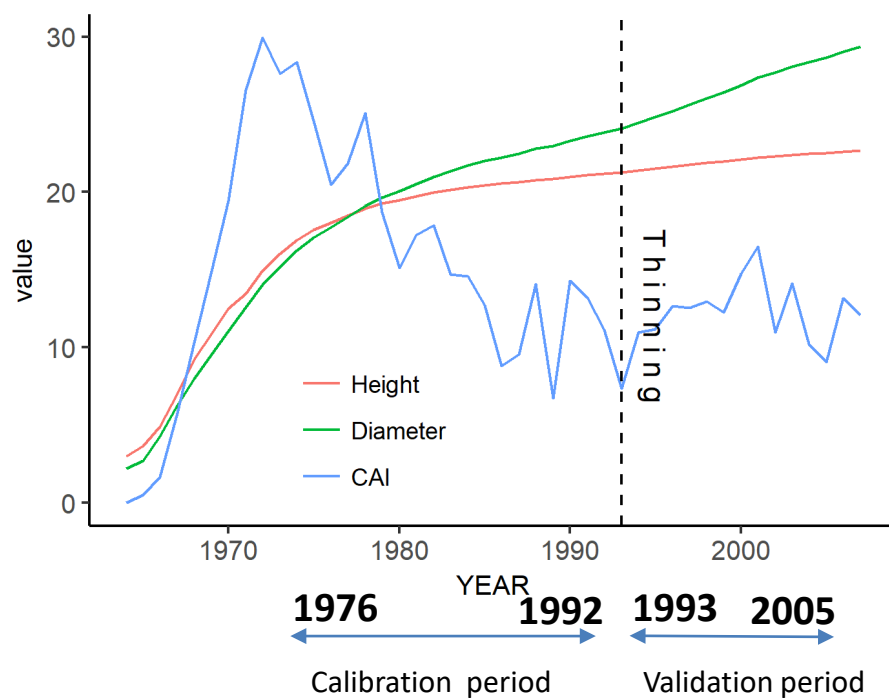
3D-CMCC CNR – Forest Ecosystem Model (Collalti et al., 2014)

EcH₂O (Maneta & Silverman, 2013)

Development of FOREST module



Historical data from Bonis catchment

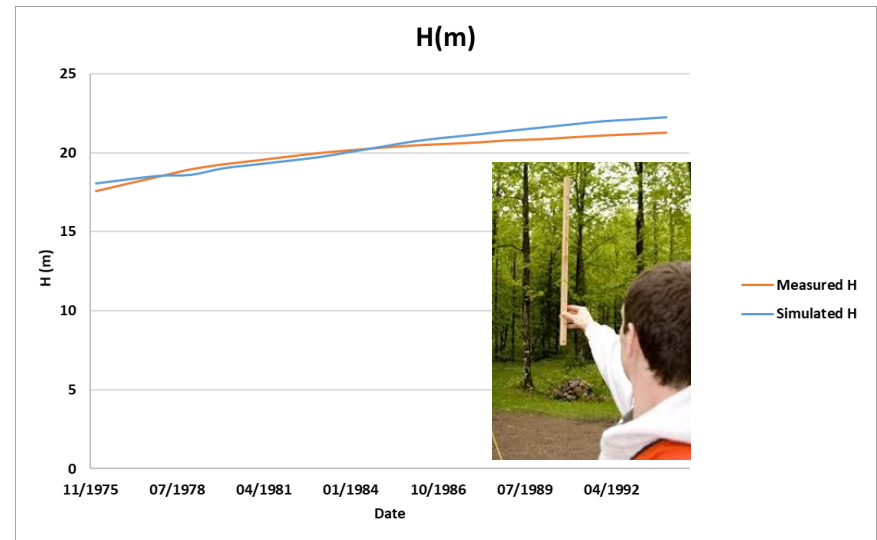
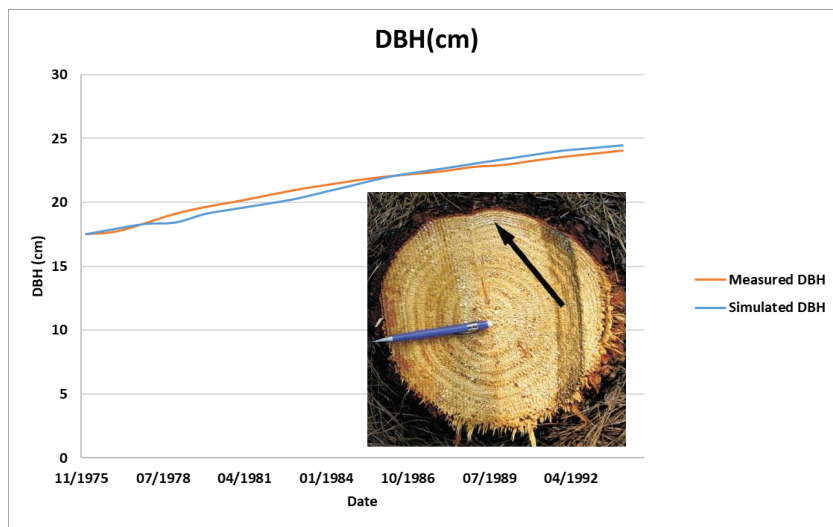


YEAR	Variables	Values
1986	Plant number (N/ha)	1120
	Basal area (m ² /ha)	43.2
	DBH (cm)	20.2
1993*	Plant number (N/ha)	1100
	Basal area (m ² /ha)	46.6
	DBH (cm)	21.8
1993**	Plant number (N/ha)	700
	Basal area (m ² /ha)	32.4
	Diameter (cm)	22.8
1999	Plant number (N/ha)	690
	Basal area (m ² /ha)	45.8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

(Pellicone, 2018)

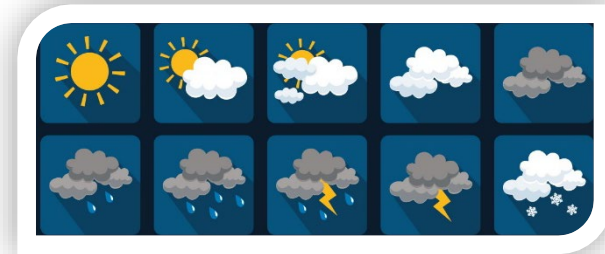
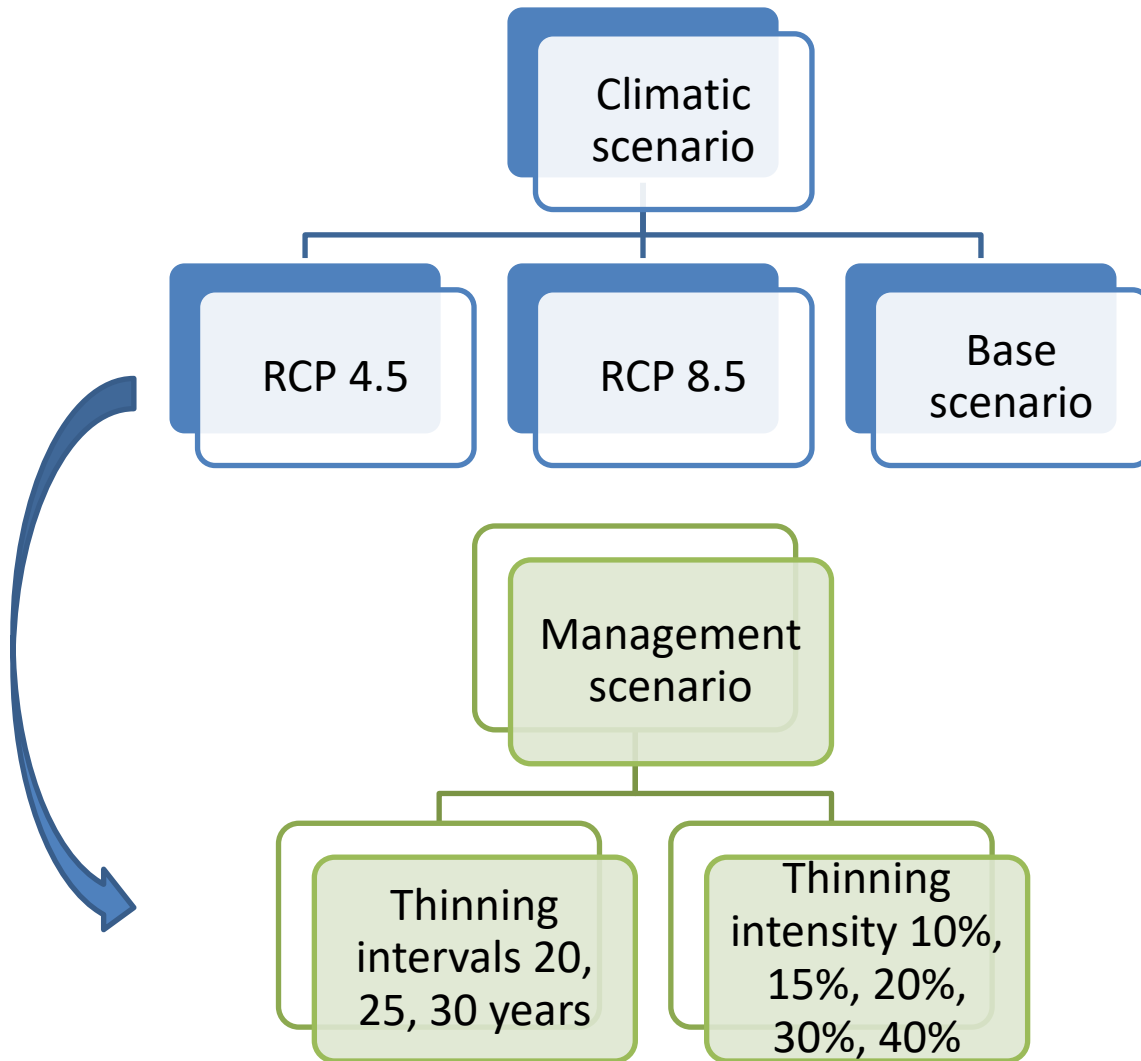
Historical dendrological analysis. 1993* represents the dendrological measure before the thinning, while 1993** the dendrological data right after the thinning (DBH = diameter at breast height).

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

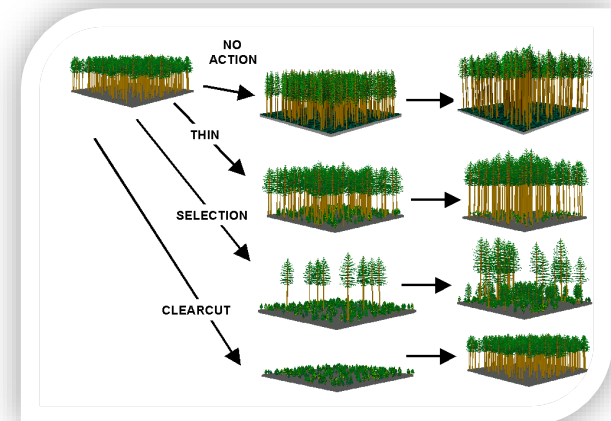


Model showed to reproduce satisfactorily the observed patterns for each year
for tree height, tree diameter

Climate and management scenarios



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



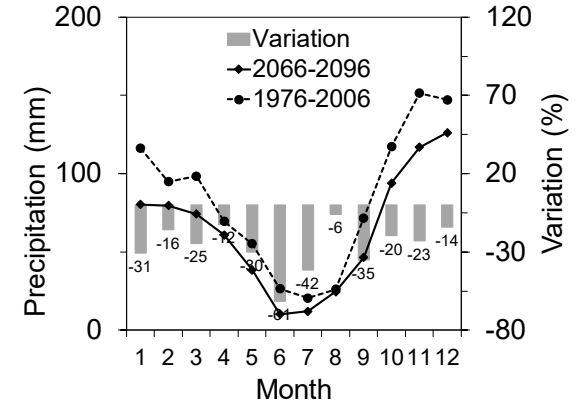
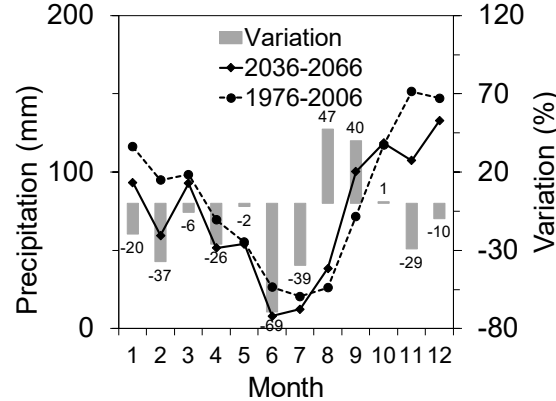
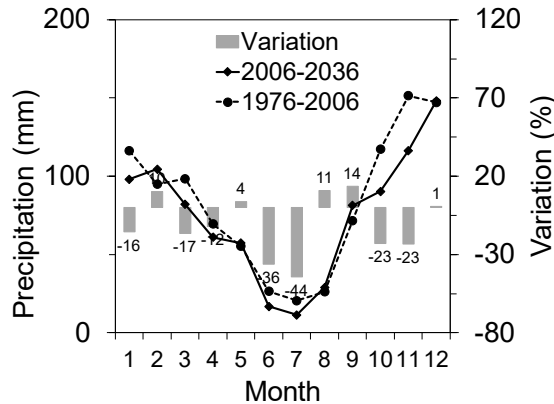
Monthly precipitation trend

2006-2036

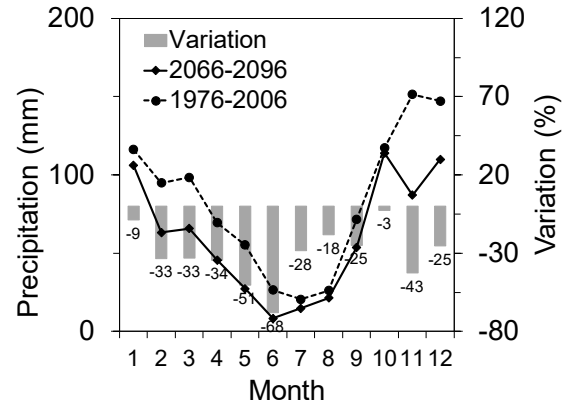
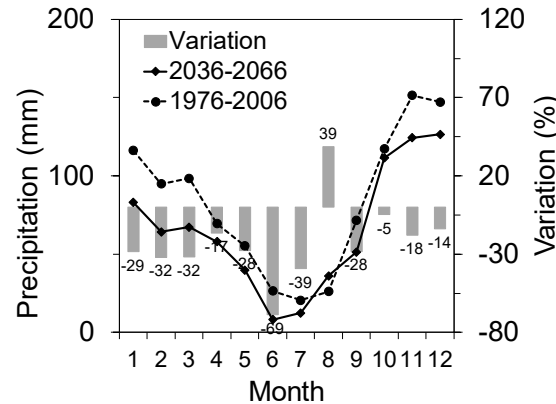
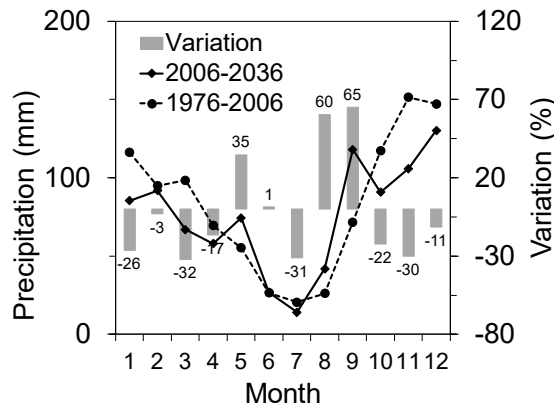
2036-2066

2066-2096

RCP 4.5



RCP 8.5



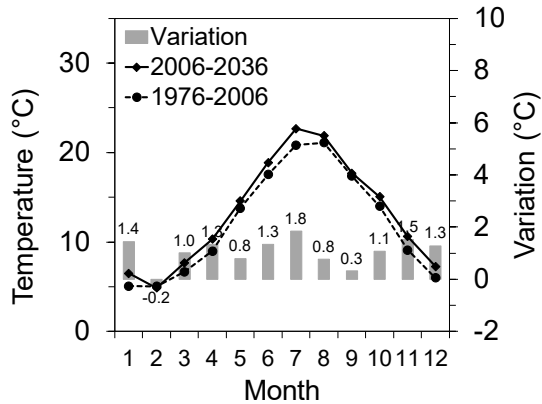
2006-2036

2036-2066

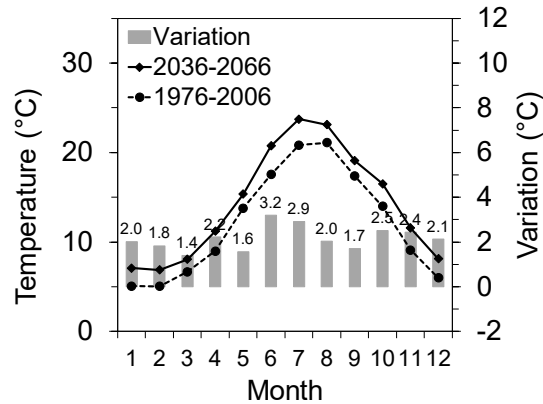
2066-2096

RCP 4.5

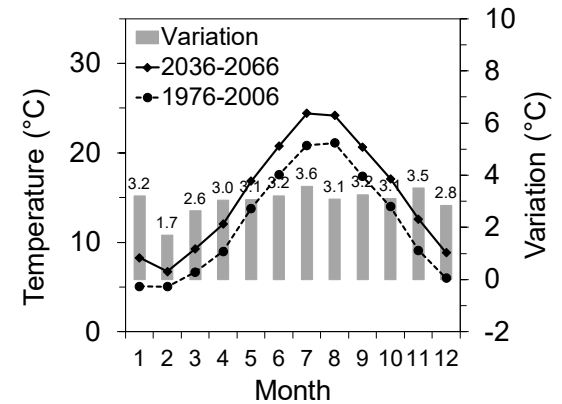
2006-2036



2036-2066

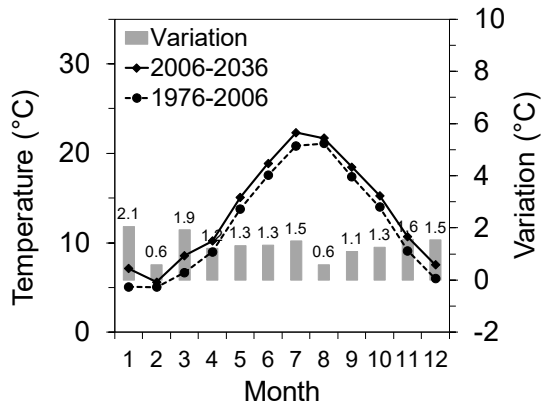


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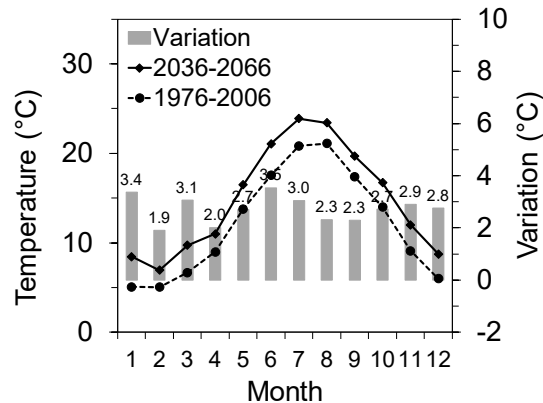


RCP 8.5

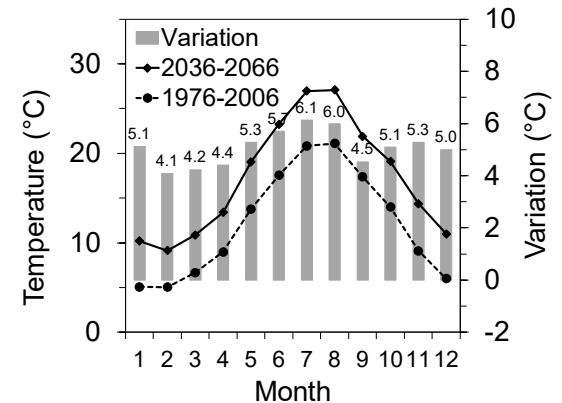
2006-2036



2036-2066



2066-2096



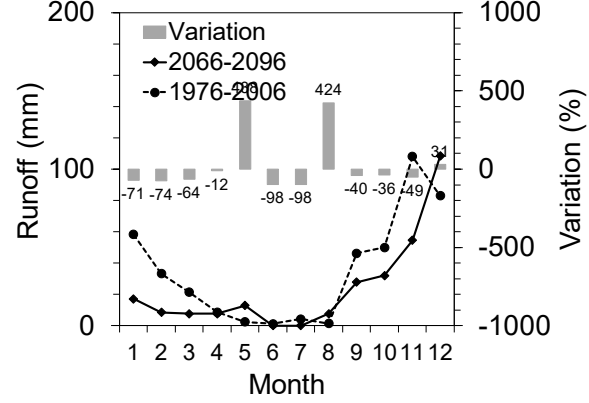
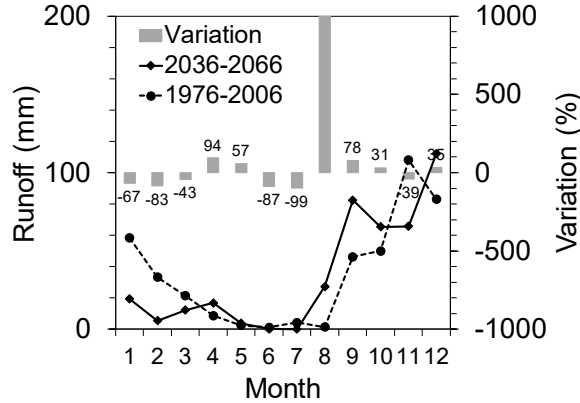
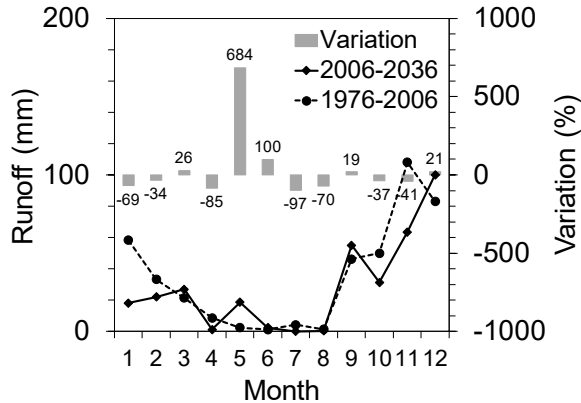
Monthly runoff trend (no forest management)

2006-2036

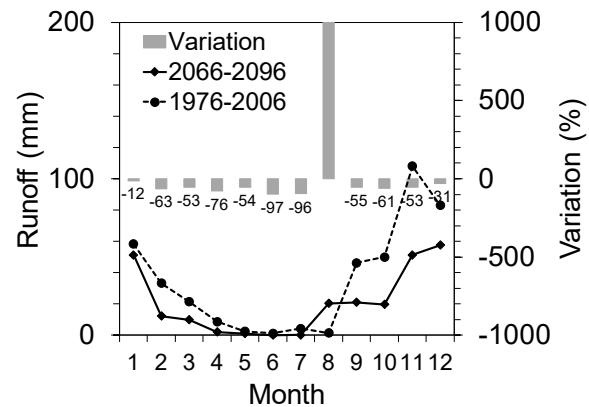
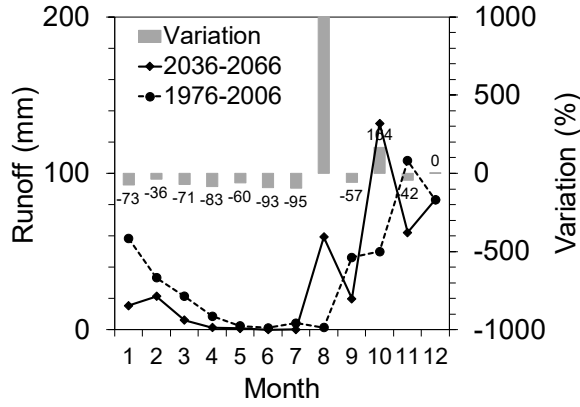
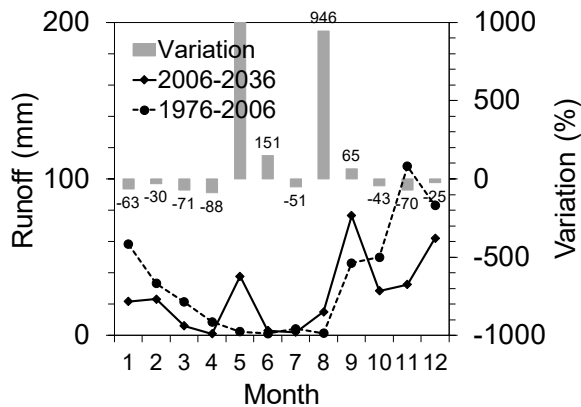
2036-2066

2066-2096

RCP 4.5



RCP 8.5

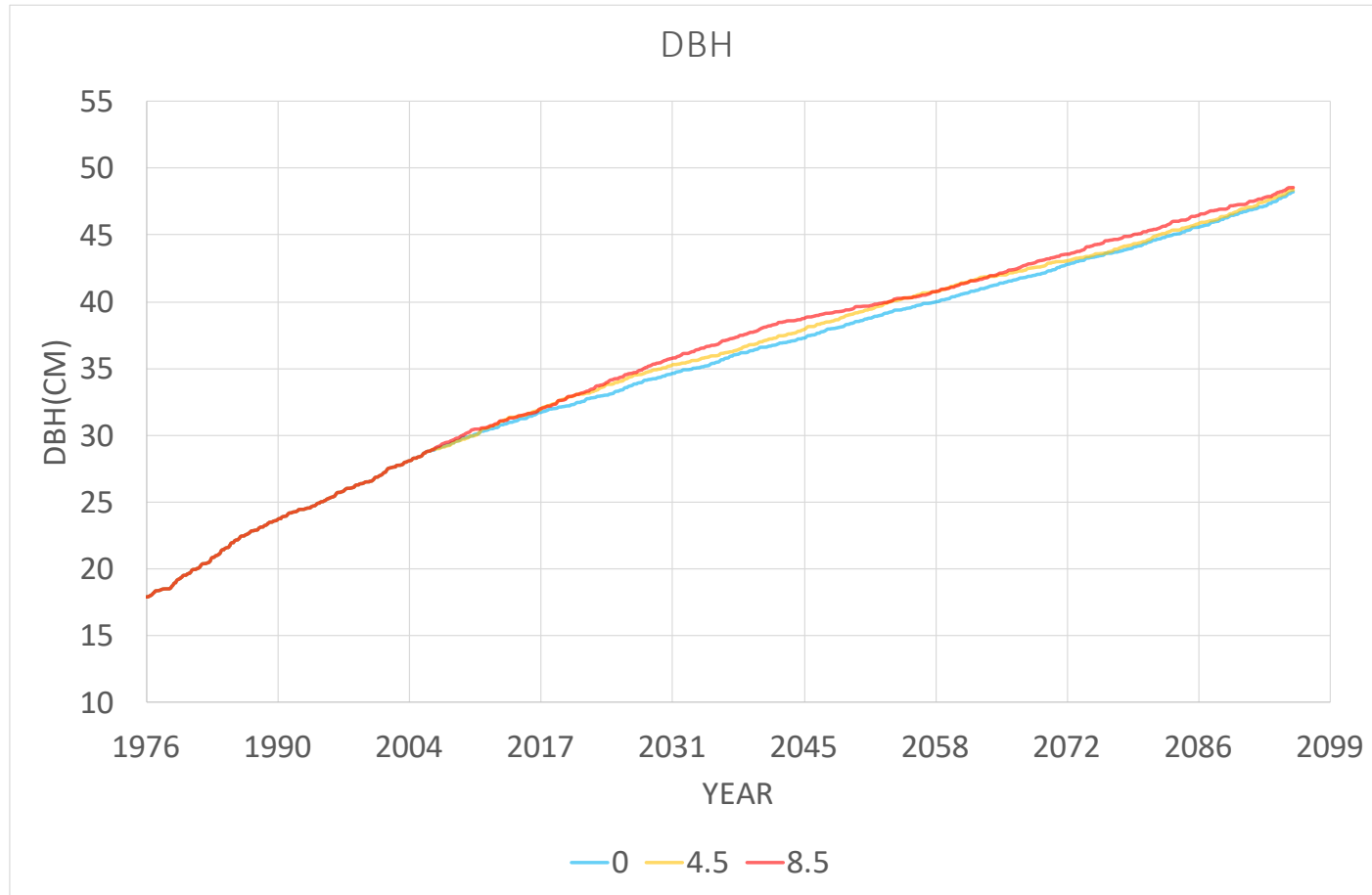


2006-2036

2036-2066

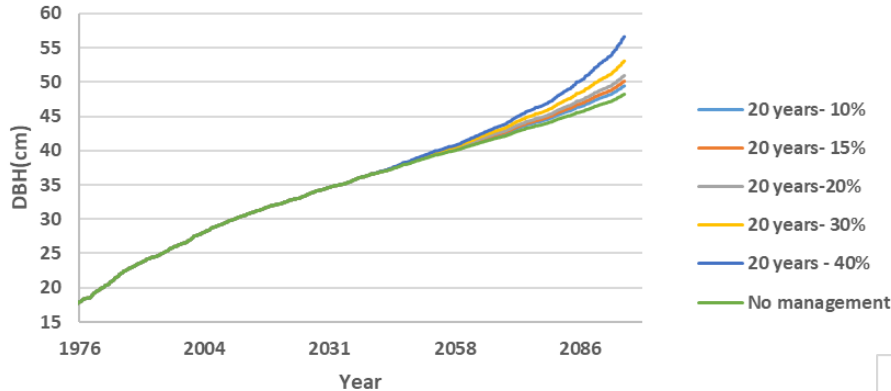
2066-2096

Forest growth under climate scenarios (no forest management)



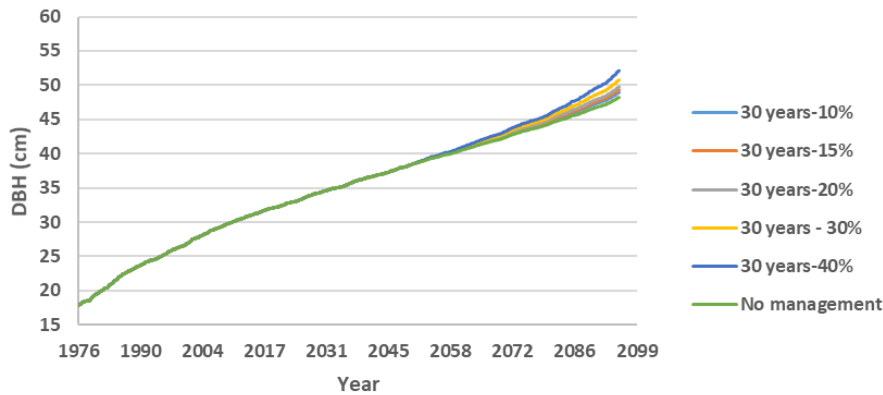
Forest growth for different management options

DBH- 20 years Thinning

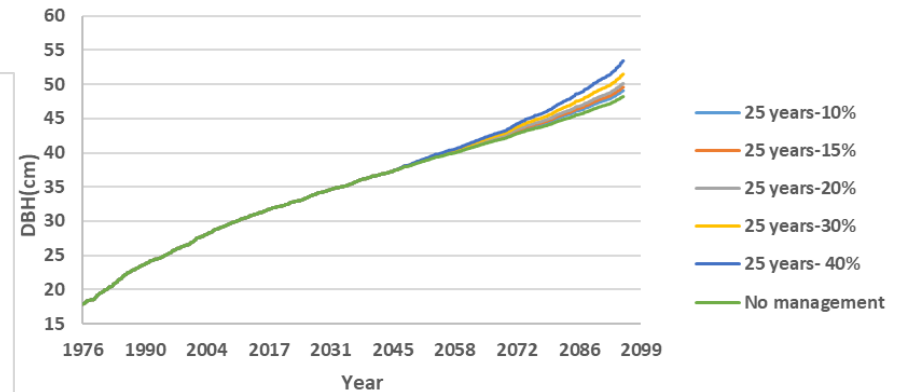


RCP 8.5

DBH- 30 YEARS thinning

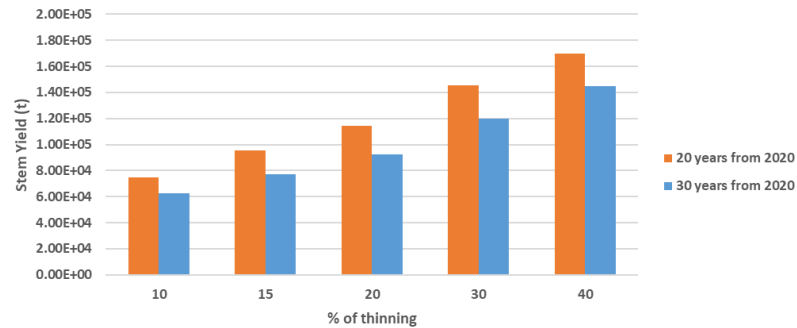


DBH 25 years thinning

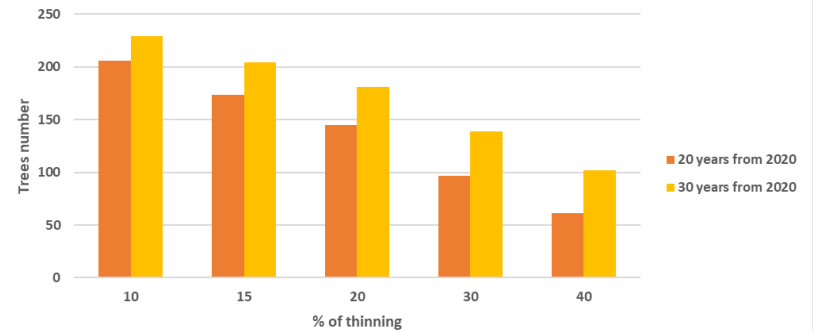


Stem wood yield

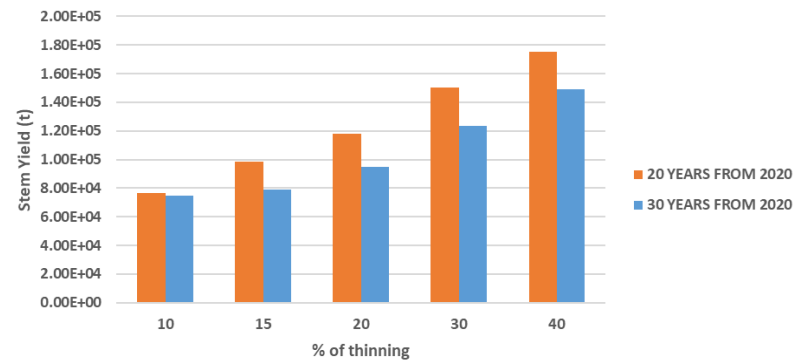
Stem Yield -RCP 4.5



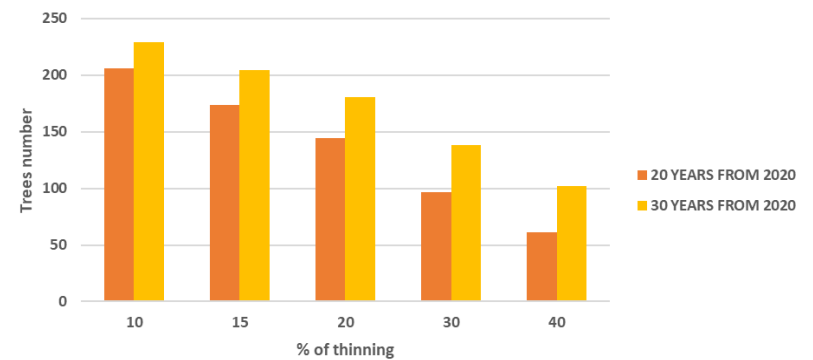
Density-RCP 4.5



Stem yield - RCP 8.5

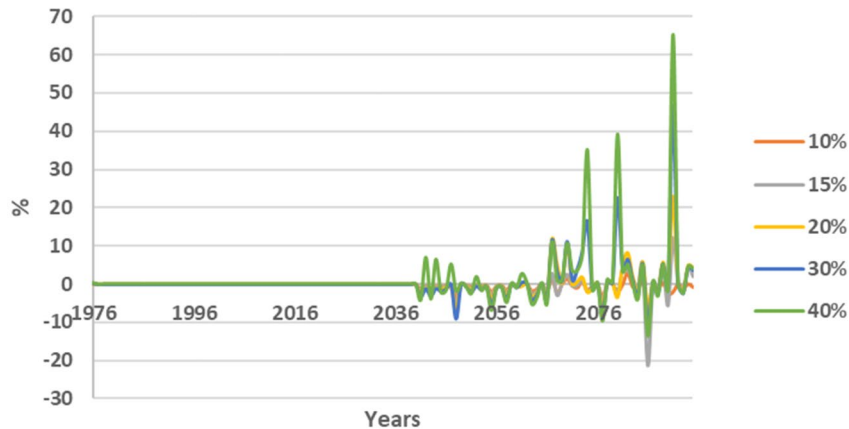


Density-RCP 8:5

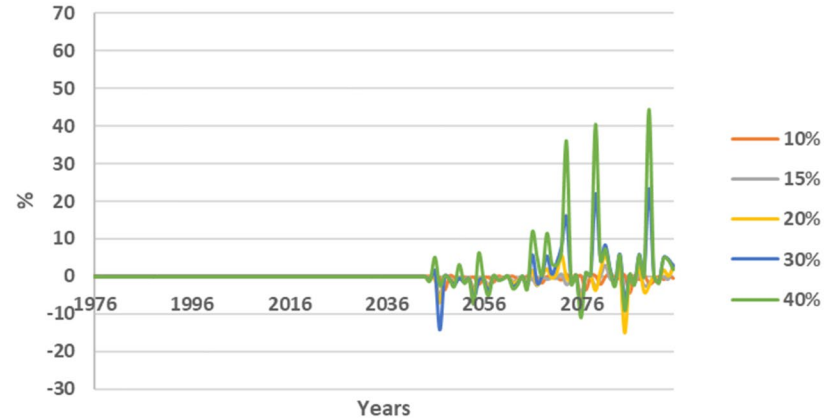


Impact on runoff

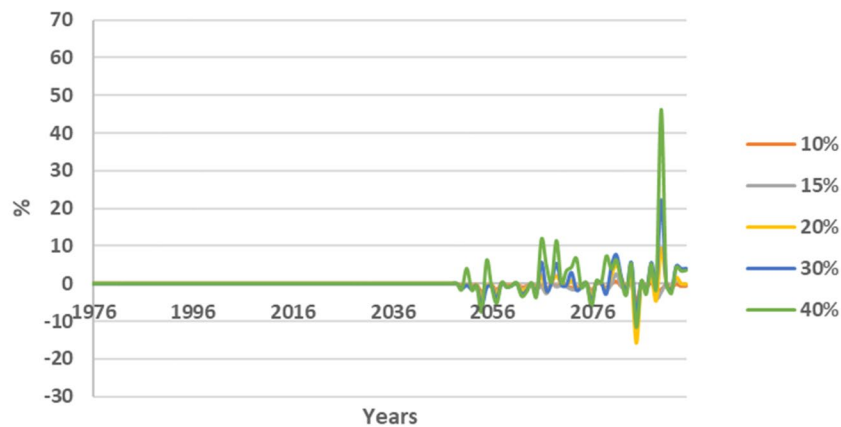
20 Years



25 Years



30 Years



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 CO₂ 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
giovanni.ravazzani@polimi.it

