

Use of ecohydrological simulations for sustainable forest management: Bonis catchment case study

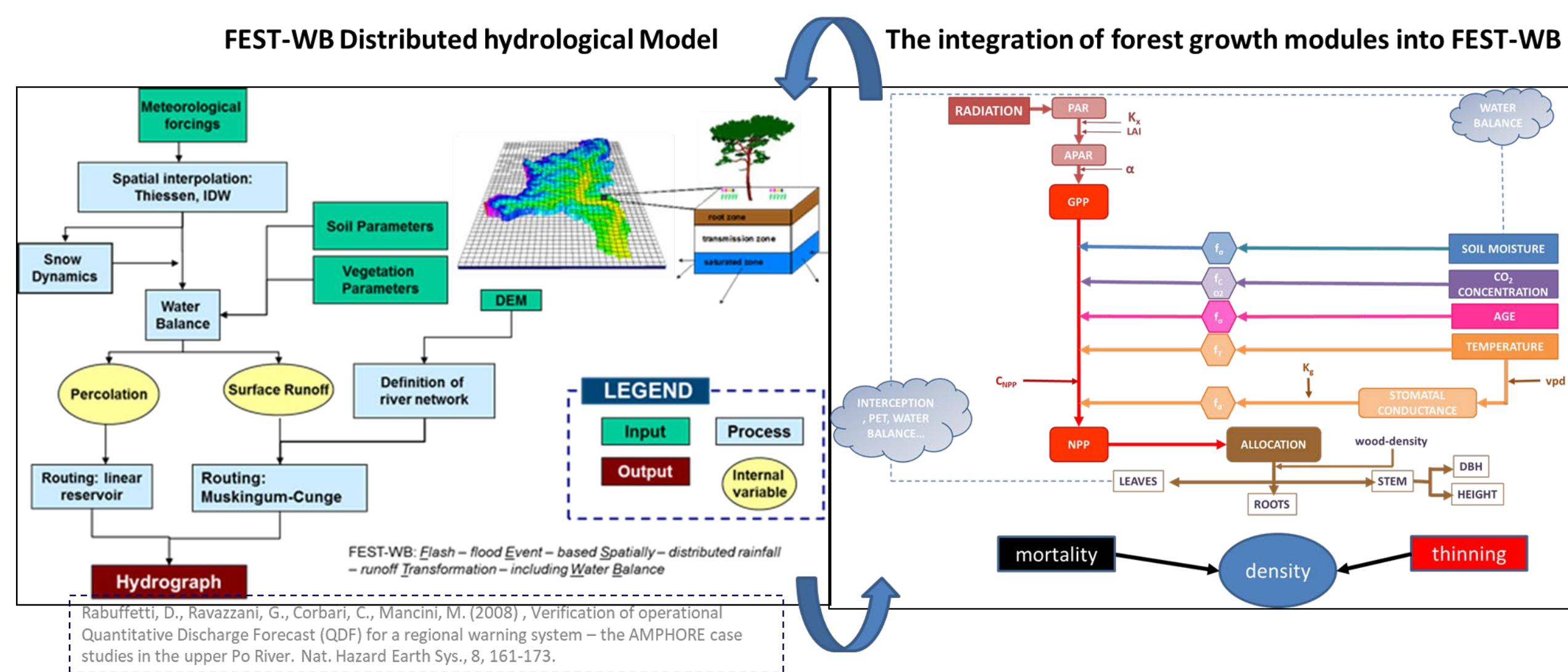
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Sommario/Abstract

Integrated forest management is a concept that allows to consider the interplay between the forest ecosystem services and natural resources conservations. Forests are exposed to different forms of disturbances induced by human activities, management strategies, and climate change. The objective of INNOMED project, for the Italian case study, is to understand the response of forest to different silvicultural practices under climate change conditions. The study site is the Bonis catchment located in the mountain area of Sila Greca (39°25'15"N, 16°12'38"W), in the Calabria region (southern Italy). Almost 93% of the total area of this catchment is covered by forest stand, dominated by about 50-year-old Calabrian pine (*Pinus laricio* Poir.) forests. In order to simulate the response of the catchment to different climate and management scenarios, FEST-WB distributed hydrological model was used. Within the framework of this project, FEST-FOREST module has been implemented in order to consider vegetation dynamics interactions with the hydrological response of the watershed. Since 1986, the basin was monitored through the installation of different instruments. Runoff was measured at the outlet of the catchment using a gauging structure. These data were used for the calibration and validation of the model before being implemented for future scenarios simulations. The results of these simulations delivered the potential impacts and the vulnerability of the Bonis catchment to different scenarios. These outcomes provided for the stakeholders a scientifically based and solid information for a sustainable management of the catchment.

Sviluppo del modello della foresta: FEST-FOREST Il modello idrologico

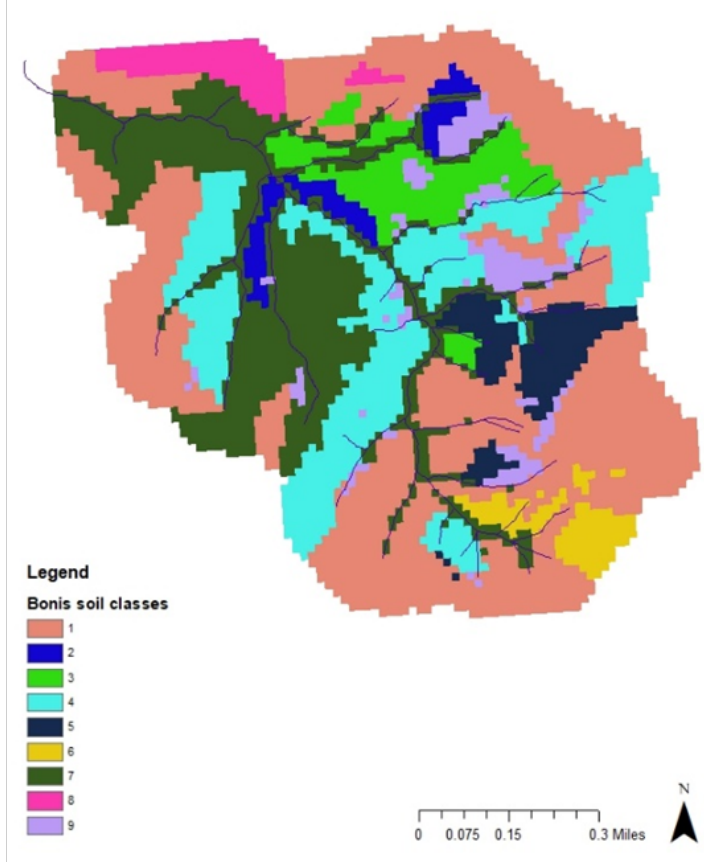


La calibrazione del modello idrologico

RESULTS

Zambrano-Bigiarini HYDRO-PSO

Landuse map of Bonis catchment



We carried out the automatic calibration considering the different landuses of catchment.

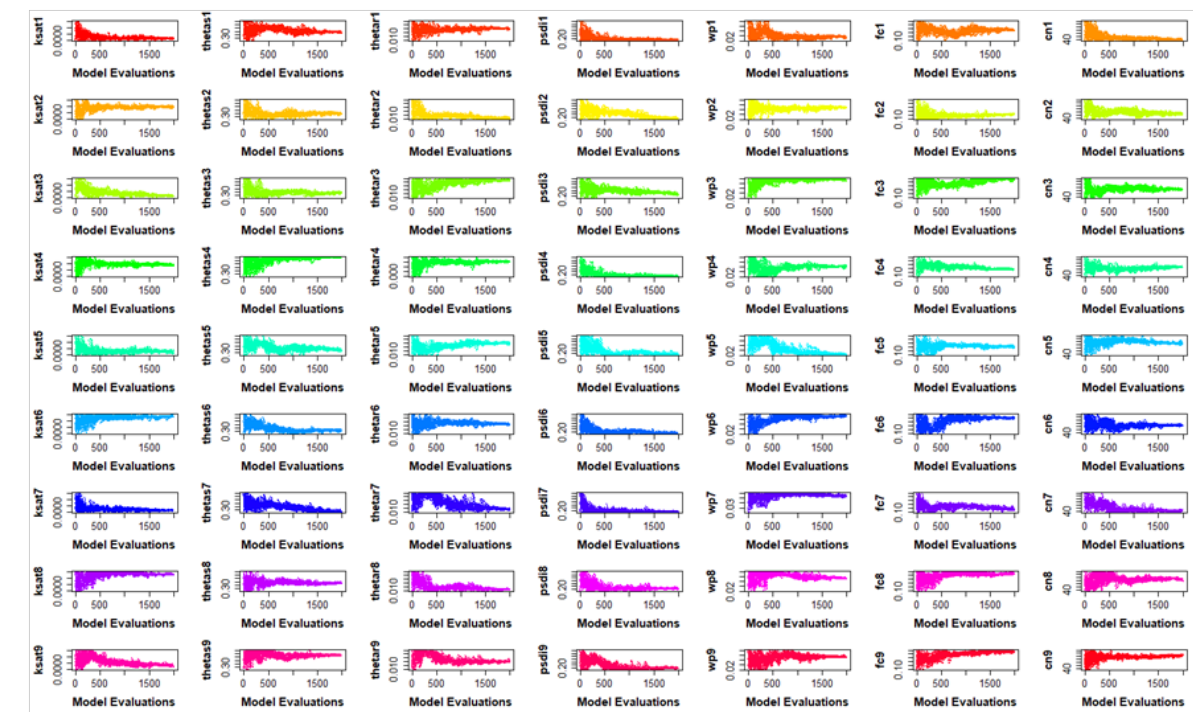


Figure results of soil parameters calibration using HydroPSO model

La calibrazione del FEST-FOREST

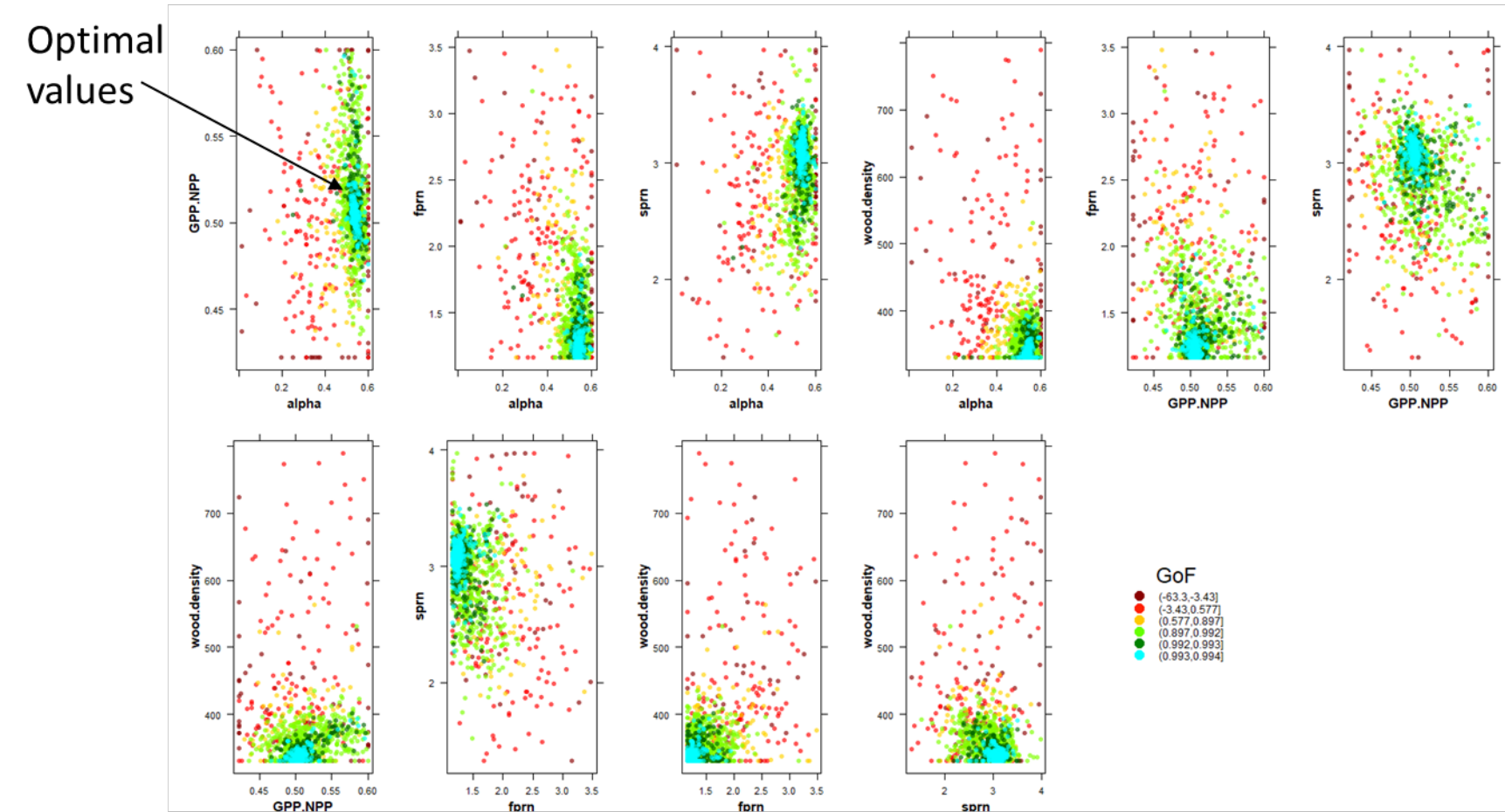


Figure. Model performance (NSE) projected onto the parameter space.

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

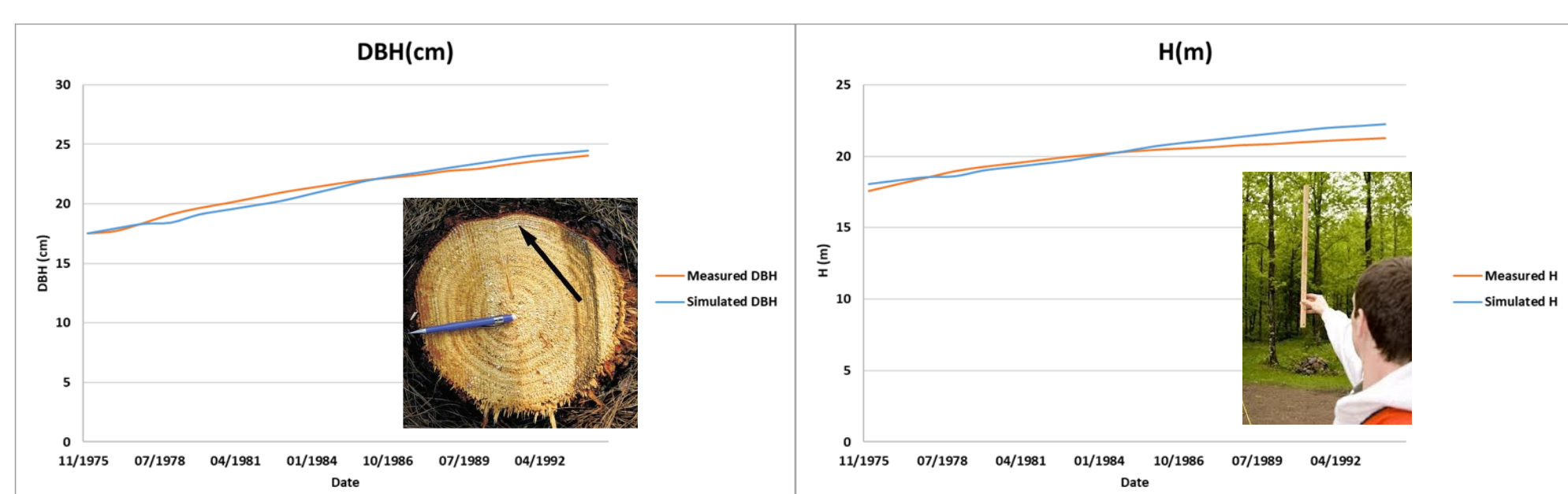
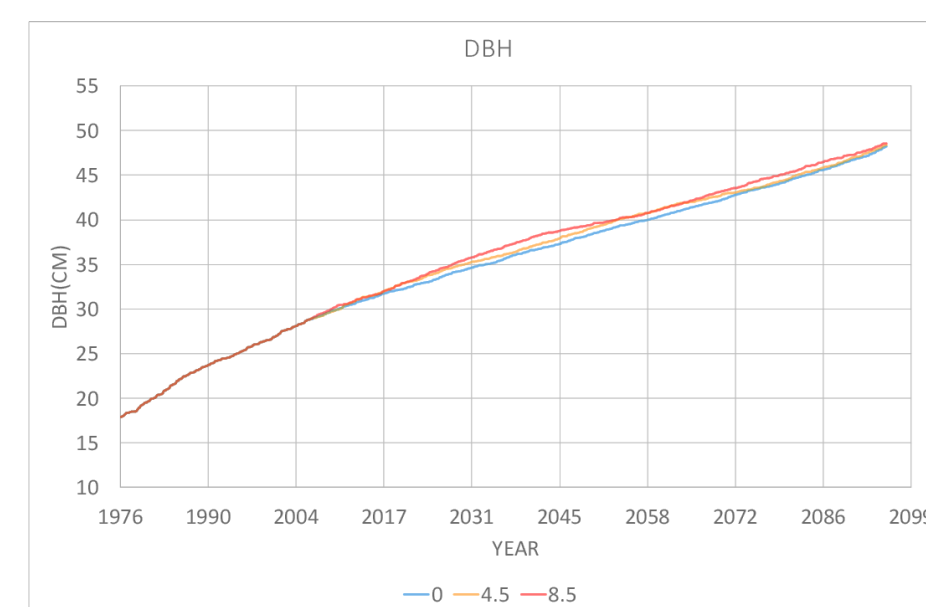


Figure. Results of DBH and Height simulations using FEST-WB Vs measurements (simulation period 1976-1993-before the thinning)

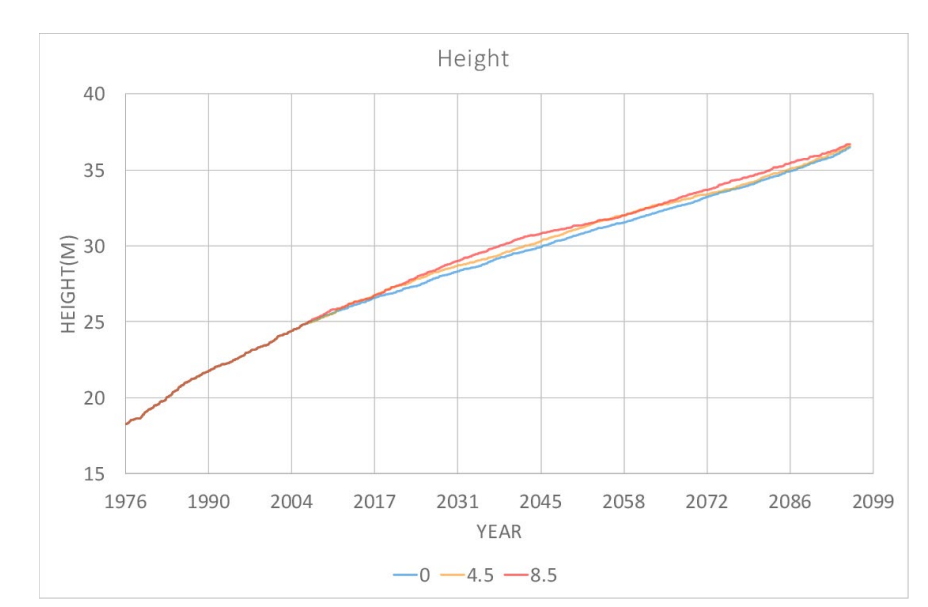
Scenari climatici

Time	Climate Scenario		Temperature trend	Time	Climate Scenario		Temperature trend
	RCP 4.5	RCP 8.5			RCP 4.5	RCP 8.5	
2006-2095	RCP 4.5	RCP 8.5	Precipitation trend	2006-2095	RCP 4.5	RCP 8.5	Temperature trend
First 30 years	-9%	-9%		First 30 years	+1°C	+1.3°C	
Last 30 years	-23%	-28%		Last 30 years	+3°C	+5°C	

Crescita delle piante: DBH



Crescita delle piante: Altezza



Scenari di taglio



Scenari di crescita DBH

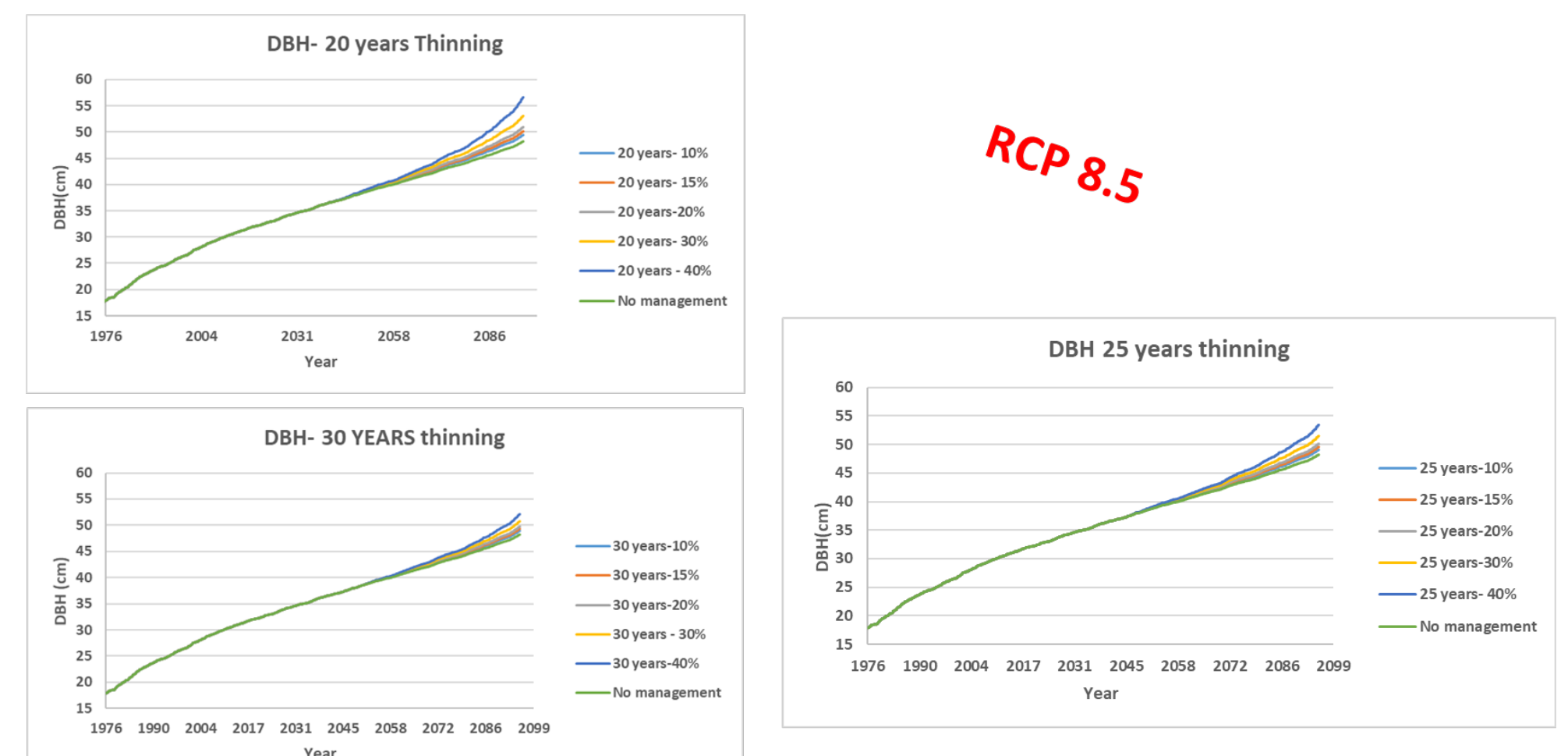


Figure. Results of DBH simulations with different thinning scenarios

Scenari di produzione

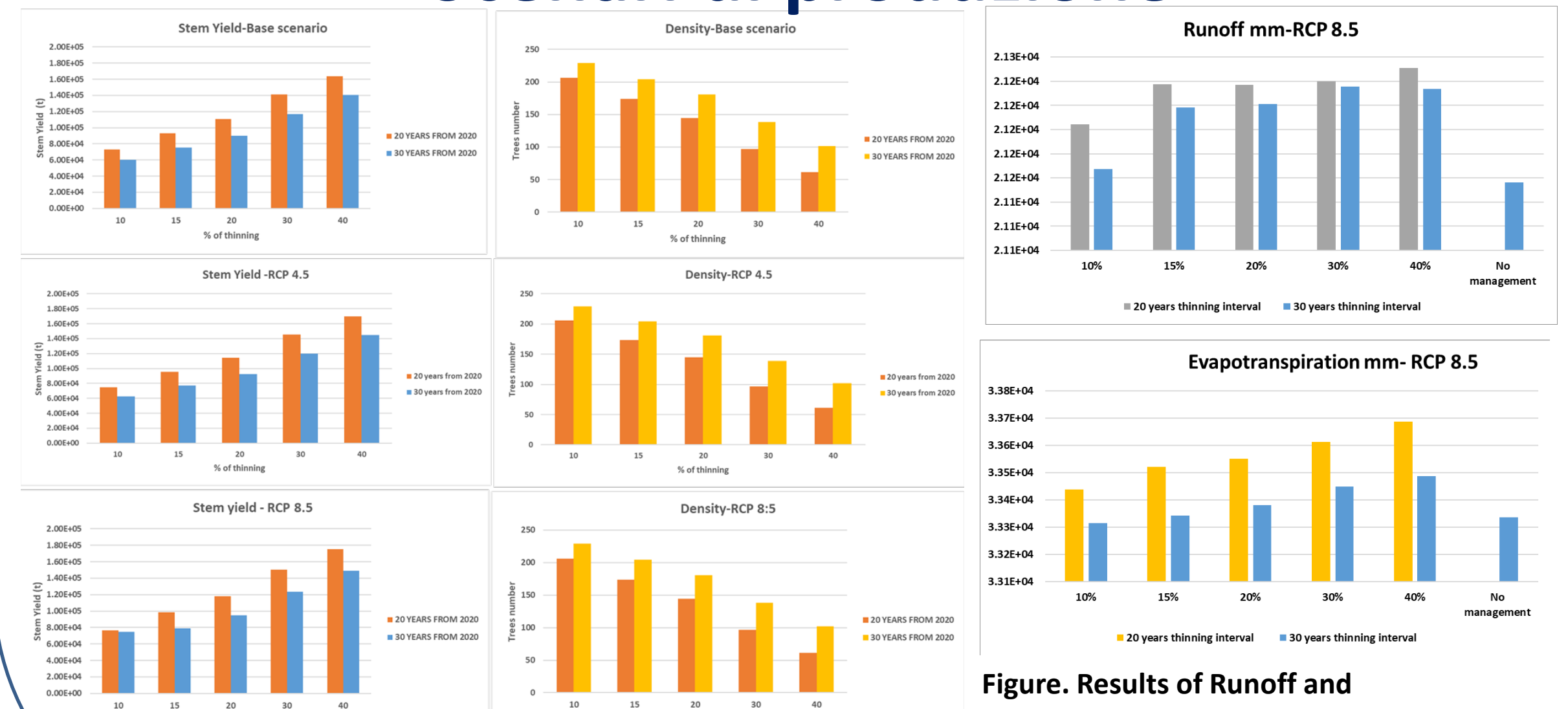


Figure. Results of simulations of stem yield and density with different thinning scenarios

Figure. Results of Runoff and evapotranspiration simulations with different thinning scenarios

Conclusioni

- Le proiezioni climatiche stimano per il futuro una riduzione della precipitazione fino al 28% ed un aumento della temperature di 5 °C rispetto allo stato attuale del bacino del bonis
- La precipitazione comunque sufficiente, unita all'aumento della temperature, soprattutto nei mesi invernali, e l'aumento di CO₂, portano un beneficio nella crescita della foresta.
- Nel futuro la precipitazione nel periodo primaverile ed estivo risulta in diminuzione come valore cumulato, ma concentrata in fenomeni brevi ed intensi, portando ad un incremento del runoff con possibili conseguenze sulle piene fluviali ed erosione del suolo.
- La tendenza all'aumento delle perdite per runoff ed evapotraspirazione, lascia supporre un possibile stato di stress per mancanza di acqua del suolo nel futuro non prossimo.