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

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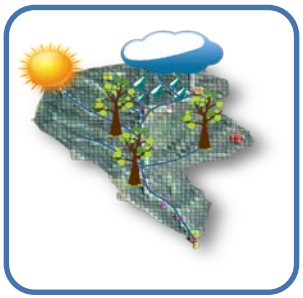
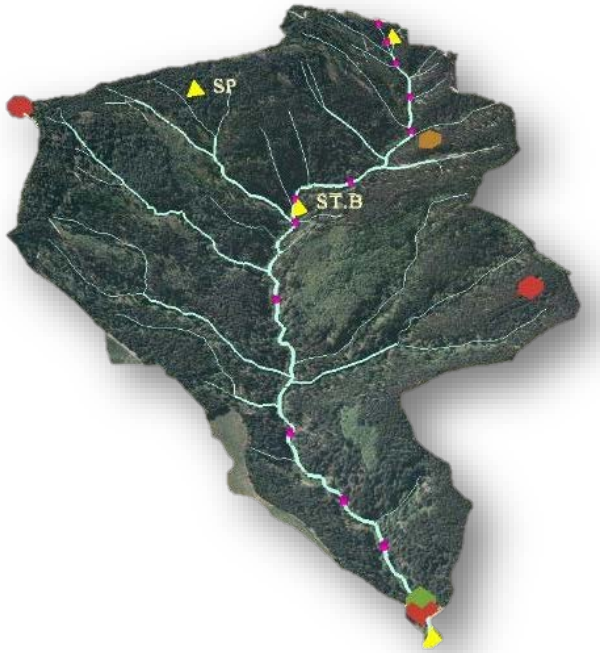
Project : INNOMED

Study case : Bonis catchment-Calabria southern Italy



Objectives: In the INNOMED project in the Bonis catchment are to simulate the water balance of the Bonis catchment under different land use / management scenarios, combined with climate change forcings to quantify the effect of alternative management options on the land-water cycle.



Bonis catchment

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Work flow diagram

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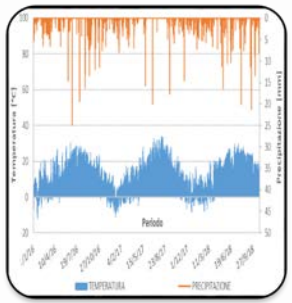

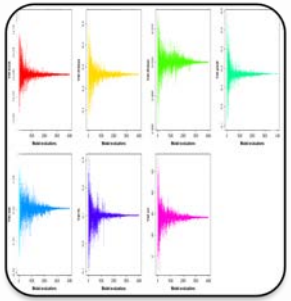

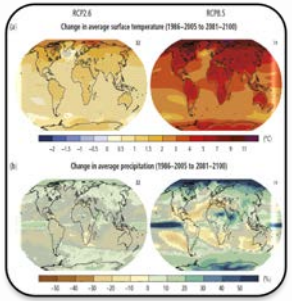

Catchment characterization- Meteorological data	Soil characterization	Hydrological model FEST-WB SET UP	Automatic and Manual Model calibration	Insertion of forest growth module	Simulate different land use / management scenarios coupled with climate change forcing
DONE	DONE	DONE	DONE	DONE	

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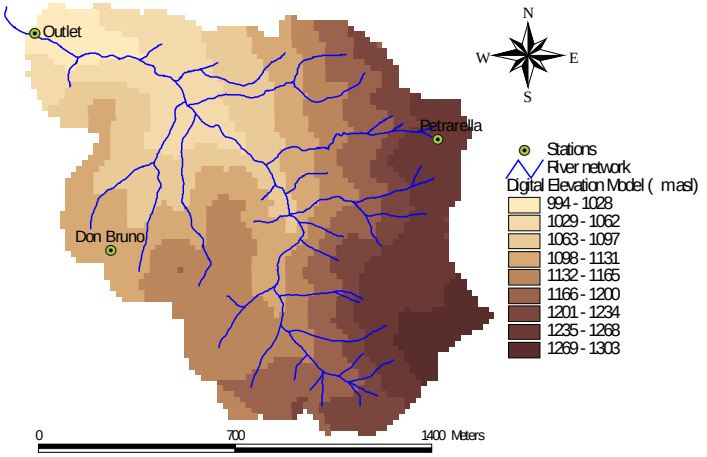
Catchment characterization-Meteorological data

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.

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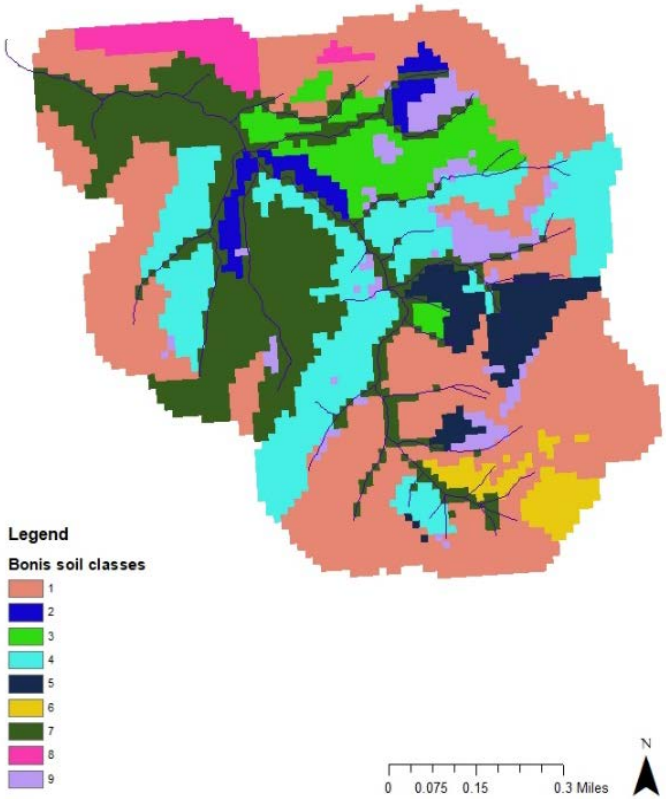
RESULTS

Landuse map of Bonis catchment



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

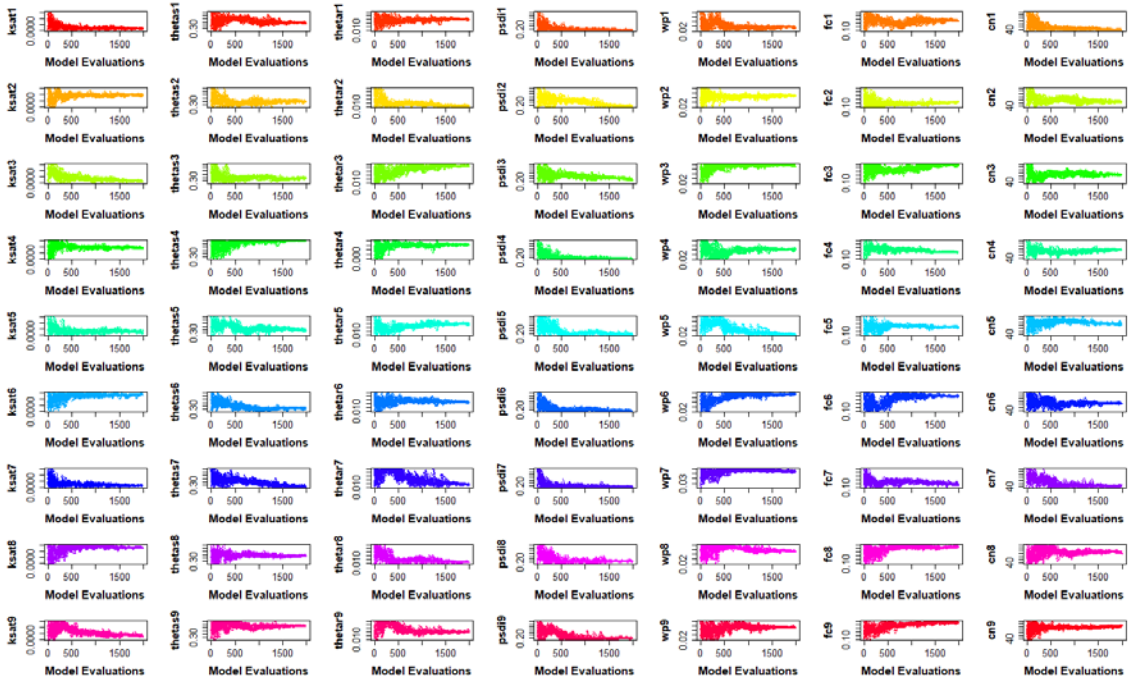


Figure results of soil parameters calibration using HydrPSO model

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Results of hydrological simulation

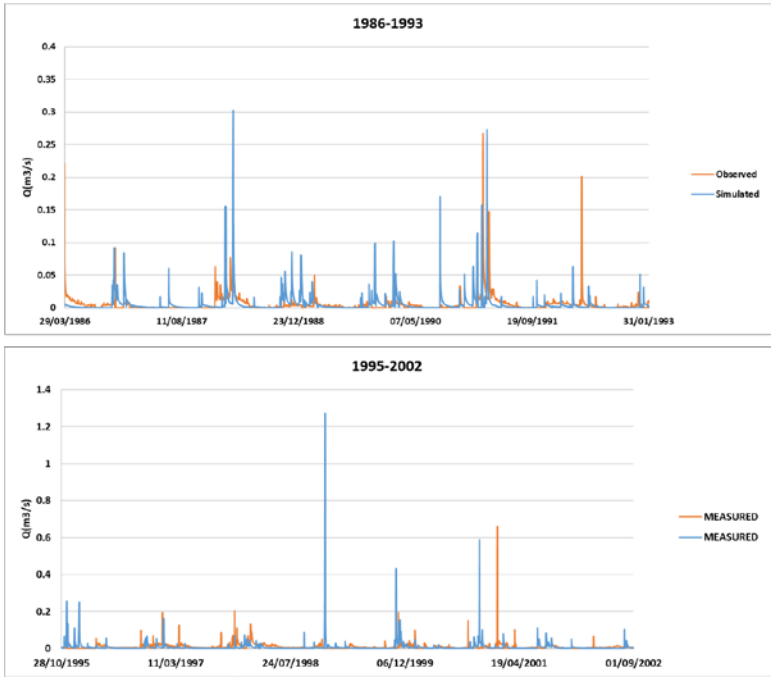
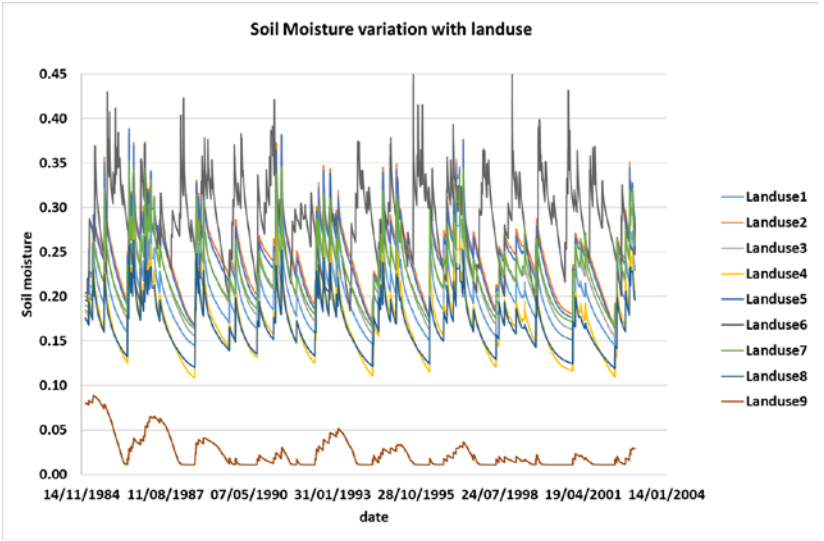


Figure. Simulated Vs observed surface runoff



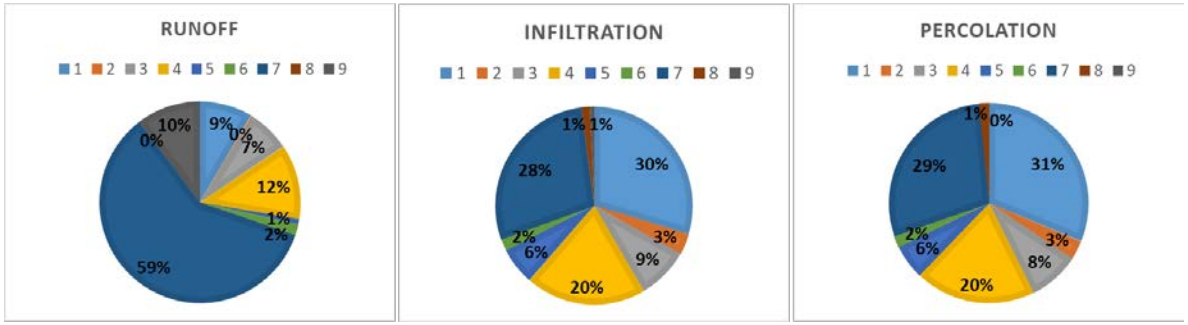


Figure. Contribution of each landuse to surface runoff, infiltration and percolation

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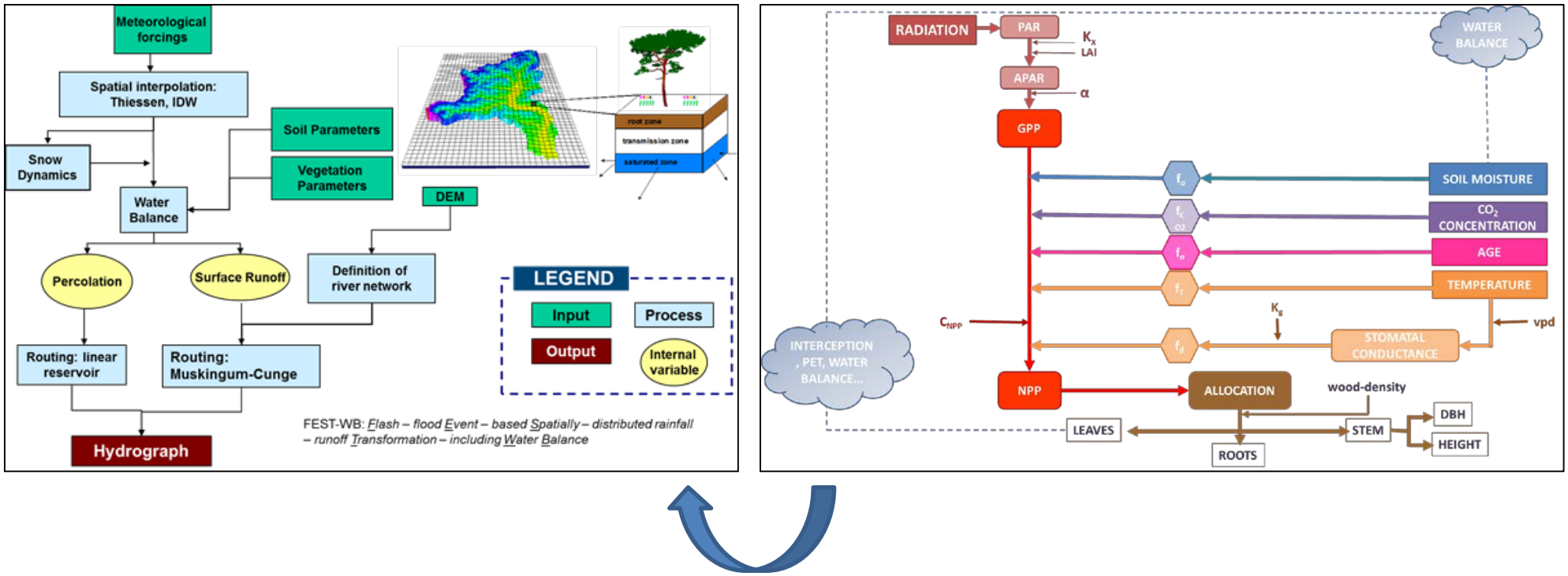
The integration of forest growth modules at FEST-WB



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Sensitivity analysis

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ParameterNmbr	Parameter Name	Filename	Row.Number	Col.Start	Col.End	DecimalPlaces
1	k	PlantsSpecies.ini	9	6	12	2
2	alpha	PlantsSpecies.ini	10	10	17	3
3	GPP-NPP	PlantsSpecies.ini	11	12	18	2
4	cra	PlantsSpecies.ini	12	8	11	0
5	crb	PlantsSpecies.ini	13	8	13	2
6	crc	PlantsSpecies.ini	14	8	12	1
7	as	PlantsSpecies.ini	15	7	13	2
8	ns	PlantsSpecies.ini	16	7	13	2
9	dbhdcmin	PlantsSpecies.ini	20	13	19	3
10	dbhdcmax	PlantsSpecies.ini	21	13	19	3
11	denmin	PlantsSpecies.ini	22	11	15	0
12	denmax	PlantsSpecies.ini	23	11	16	0
13	agemax	PlantsSpecies.ini	24	11	15	0
14	phi-theta	PlantsSpecies.ini	28	14	16	0
15	phi-ea	PlantsSpecies.ini	29	11	16	2
16	fpra	PlantsSpecies.ini	35	9	16	3
17	fprn	PlantsSpecies.ini	36	9	15	2
18	spra	PlantsSpecies.ini	37	9	15	2
19	sprn	PlantsSpecies.ini	38	9	15	2
20	tcold-leaf	PlantsSpecies.ini	44	15	17	0
21	sla	PlantsSpecies.ini	45	8	15	3
22	hdmax	PlantsSpecies.ini	46	10	15	1
23	hdmin	PlantsSpecies.ini	47	10	15	1
24	albedo	PlantsSpecies.ini	48	11	17	2
25	laimax	PlantsSpecies.ini	49	11	13	0
26	canopymax	PlantsSpecies.ini	50	14	21	3
27	wood-density	PlantsSpecies.ini	51	17	22	0

All required inputs for FEST-FOREST

- S.A was carried out using the HydroPSO model.
- This later was carried out with regard to the DBH parameter

Parameters considered for the calibration

RankingNmbr	ParameterName
1	wood-density
2	sprn
3	fprn
4	GPP-NPP
5	alpha
6	hdmin
7	agemax
8	albedo
9	k
10	fpra
11	spra
12	phi-theta
13	phi-ea
14	hdmax
15	sla
16	dbhdcmax
17	denmax
18	tcold-leaf
19	canopymax
20	laimax
21	dbhdcmin
22	denmin
27	cra
27	crb
27	crc
27	as
27	ns

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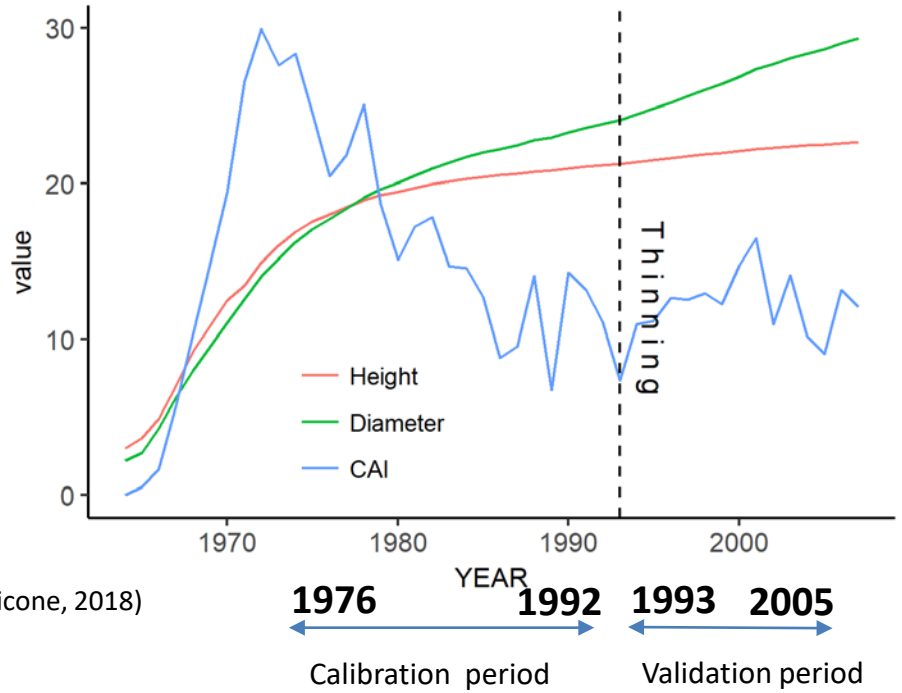
Calibration

Historical data from Bonis catchment



(Pellicone, 2018)

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

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).

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Results

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

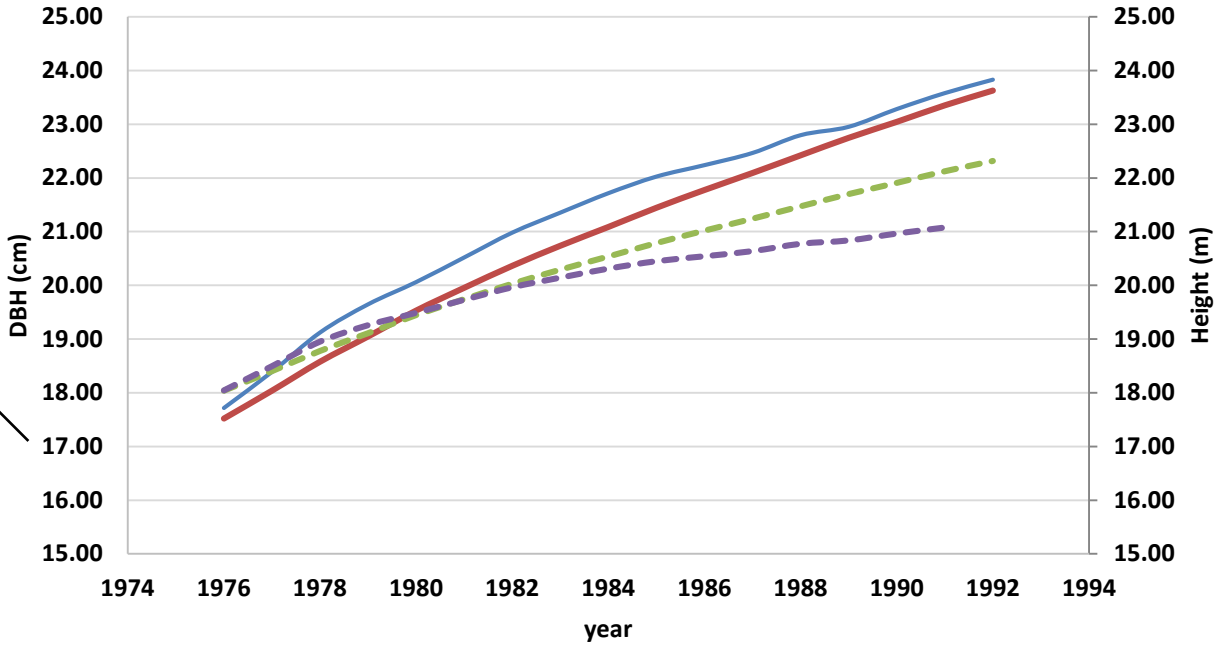

Figure. Results of DBH and Height simulations using FEST-WB Vs measurements

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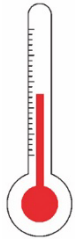
Climate change and management scenarios considered in the simulations

Climate



Temperature trend

Time	Climate Scenario	
2006-2095	RCP 4.5	RCP 8.5
First 30 years	+1°C	+1.5°C
Last 40 years	+2°C	+3.5°C

Precipitation trend

Time	Climate Scenario	
2006-2095	RCP 4.5	RCP 8.5
First 30 years	-2%	-11%
Last 40 years	-14%	-21%

Management

- Thinning frequency and density reduction
- Rotational practices
- Different reforestation frequency and density

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Considering the projected trends of variation of temperature and precipitations, we are expecting more drought conditions at Bonis catchment, so the management options should take into consideration these projections.
Some of the management options that could be taken into consideration by the stockholders to cope with the effects of the climate change, were tested by the different simulations.
Each of these management options simulations results are currently under assessment not only on the forest growth and carbon assimilation but also considering the impacts on different components of the water balance namely : surface runoff, and soil moisture

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THANK YOU FOR YOUR ATTENTION

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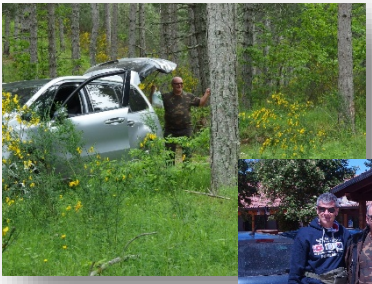





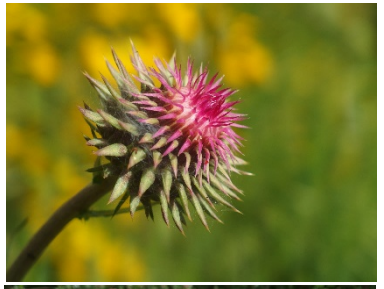


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