cost
EUROPEAN COOPERATION
IN SCIENCE & TECHNOLOGY

COST Action CA15206
PESFOR-W
Payments for Ecosystem Services Forests for Water

Chair of Forestry
Economics and Planning

Training School

Introduction to forest-water interactions

by 3PG-Hydro

6th October 2020, Freiburg, Germany

UNI
FREIBURG

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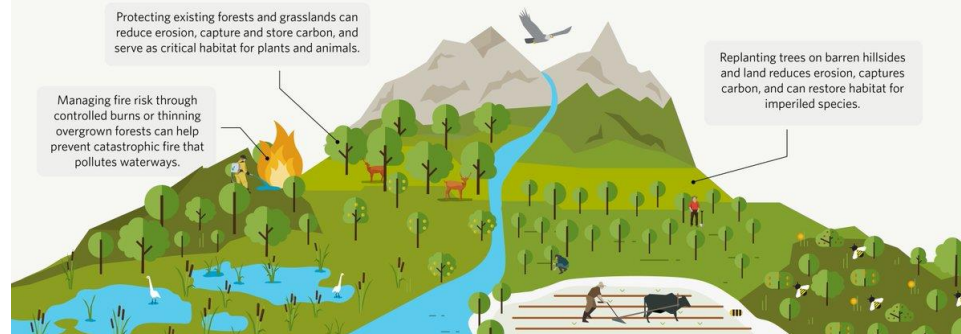Tennenbacher Straße 4, 79106 Freiburg, Germany

3PG-Hydro

HEALTHY LANDS, HEALTHY WATERS
Natural infrastructure as a path to clean water

The lands around our water sources serve as vital infrastructure that can meaningfully improve water quality and quantity for cities around the world.

Protecting existing forests and grasslands can reduce erosion, capture and store carbon, and serve as critical habitat for plants and animals.

Managing fire risk through controlled burns or thinning overgrown forests can help prevent catastrophic fire that pollutes waterways.

Replanting trees on barren hillsides and land reduces erosion, captures carbon, and can restore habitat for imperiled species.

The Nature Conservancy

3PG

Standard 3PG parameters (3PGpjs vsn 2.7, 3-PG vsn 1, September 2010)

Do NOT change the format of this block. You can edit values in the

value columns, or add columns of values to the right for additional species.

Meaning/comments	Name	Units	P. abies
Biomass partitioning and turnover			Subr. 2014
Allometric relationships & partitioning			
Foliage:stem partitioning ratio @ D=2 cm	pFS2	-	1
Foliage:stem partitioning ratio @ D=20 cm	pFS20	-	0,45
Constant in the stem mass v. diam. relationship	aS	-	0,025
Power in the stem mass v. diam. relationship	nS	-	2,5
Maximum fraction of NPP to roots	pRx	-	0,7
Minimum fraction of NPP to roots	pRn	-	0,26
Litterfall & root turnover			
Maximum litterfall rate	gammaFx	1/month	0,016
Litterfall rate at t = 0	gammaF0	1/month	0,001
Age at which litterfall rate has median value	tgammaF	months	24
Average monthly root turnover rate	gammaR	1/month	0,0096
NPP & conductance modifiers			
Temperature modifier (fT)			
Minimum temperature for growth	Tmin	deg. C	-3

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3PG-Hydro: Parameters

New tree specific parameters:

Soil aerodynamic conductance	gAS	m/s	0,02	0,02
Deep Root Processes				
Fraction of deep root transpiration	deepTrans	-		0,15
average mature tree root biomass	avrootbio	kg/tree		50

- gAS is assumed fixed at 0.02 m/s
- deepTrans should not exceed 20% (0.2)
- Avrootbio is tree specific and can be easily found in literature (see guideline)

3PG-Hydro: Parameters

Chair of Forestry
Economics and Planning

Run type : **SingleSite**
Site : Yield table
Species : P. abies
Climate data : Climate
Met station: Daily data
Title : Guideline

Stand initialisation and site factor data

Year planted = 1919
Month planted = Dec
Initial age = 20y 0m
End age = 86
Initial WF= 8
Initial WS= 50,5
Initial WR= 9,5
Initial stocking = 5280

Site specific: depth, skeleton

Snowmelt Factor = 2,5

Depth ER = 0,6 (0-1)
Depth DR = 6
Initial saturation ER = 0,25 (0-0,4)
Initial saturation DR = 0,2 (0-0,4)
Skeleton ER = 0,3
Skeleton DR = 0,5

Initial stocking u = 1
Initial WF u = 1
Initial WS u = 1
Initial WR u = 1
Initial age u = 1y0m

understory parameters

optional

Vol saturation =
Vol residual =
Vol FC=
Vol WP=
VG n=
VG alpha =
K saturated =

Latitude = 50
Fertility rating = 0,5
Atmospheric CO2 = 380
Soil class = SL

4 pre-sets: S, SL, C, CL

d, m or a

Output frequency : m

All variables in the guideline

Output data = a LAI, MAI, StemNo, StandVol, avDBH, mortality, m runoff, m volWer,…

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Yousefpour and Djahangard, 2021?

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3PG-Hydro: Climate data

Climate data resolution is upgraded

Database format : Table format

Met Station= Daily data

date	daily temp	daily temp max	daily temp min	daily rain	daily rad
19500101	-2,9	0	-5	0	0,99
19500102	2,3	5,4	-5,3	6,2	0,82
19500103	2,4	6,2	1,5	6,2	2,31
19500104	2,4	3	1	9	6,15
19500105	6,7	7,2	1,8	0,3	4,30

Outputs

#Output from 3PGpjs 2.7 / 3-PG Hydro-Update Aug2020
Requested data outputs for Yield table

Year & month & day	Stand age	LAI annual mean	MAI [m3/ha]	Stems [/ha]	Stand volume [m3/ha]
1941 - Dec - 31	22	3,556379887	4,298967179	5280	94,57727794
1942 - Dec - 31	23	3,658045498	4,215031348	5280	96,94572099
1943 - Dec - 31	24	3,725211754	4,097840221	5280	98,3481653
1944 - Dec - 31	25	3,856235552	4,147481709	5280	103,6870427

Regard new outputs: Water Yield (wateryield), Soil Hydrology outputs (DP, volWer…)

Norway spruce

GlobePlants

Picea abies | Norway spruce
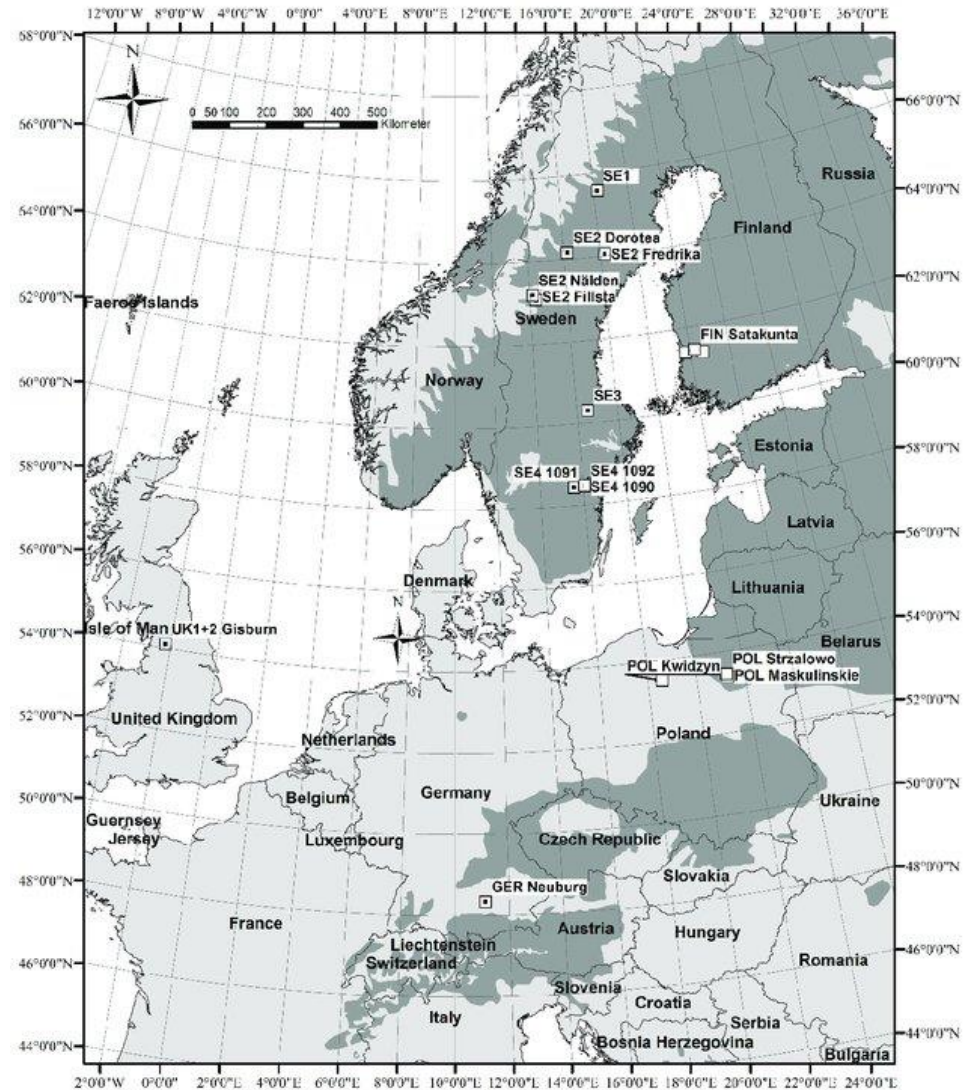
Norway spruce
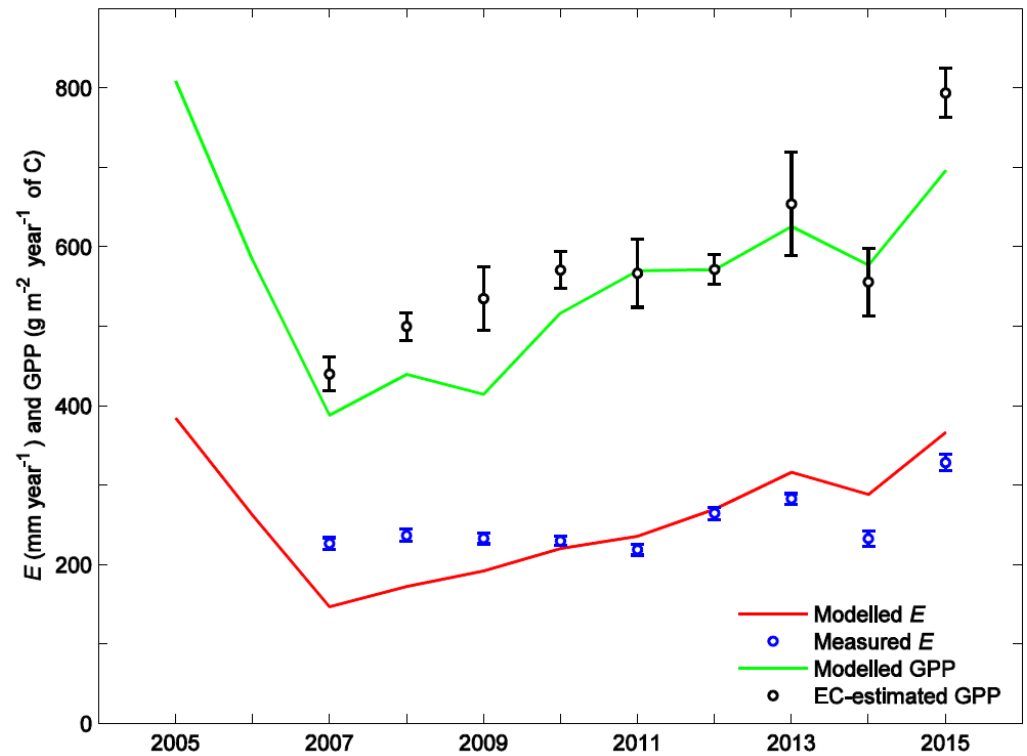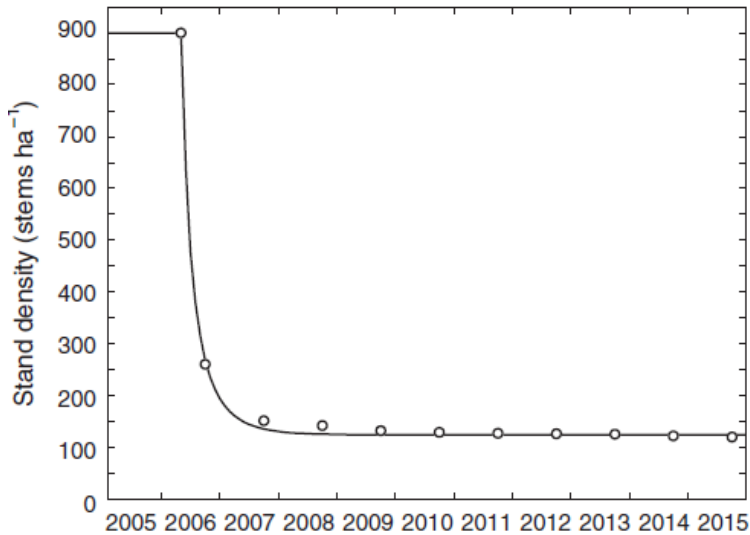
How does stand management (thinning) effect the forest hydrology?
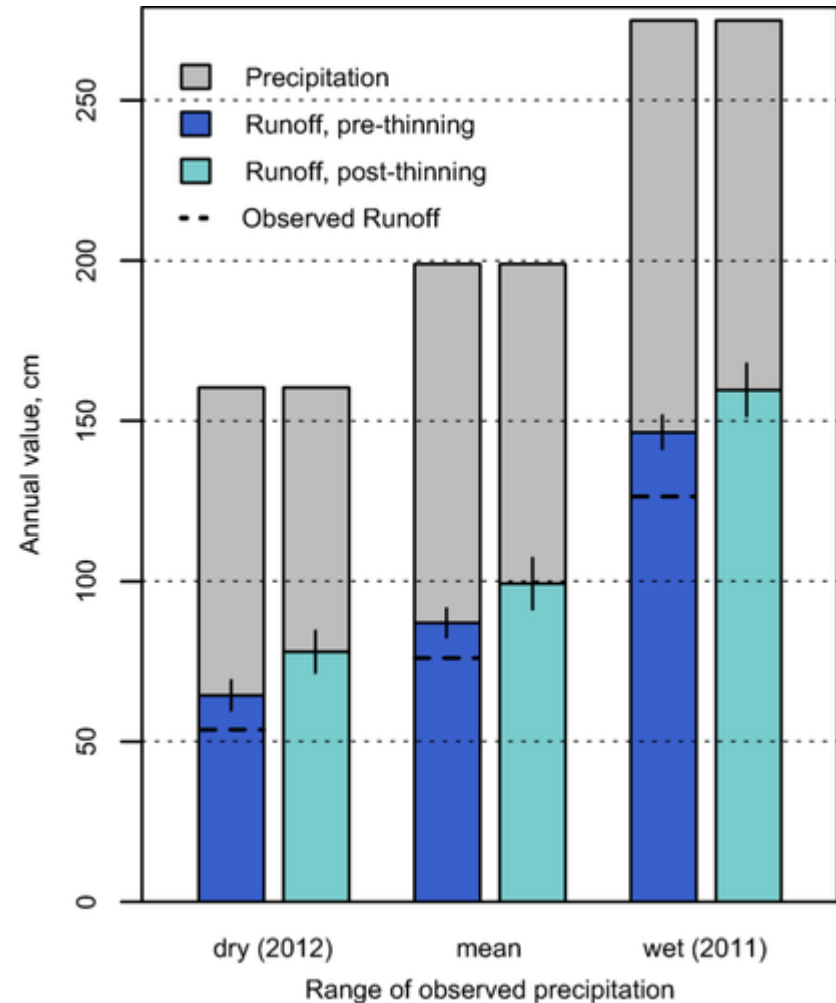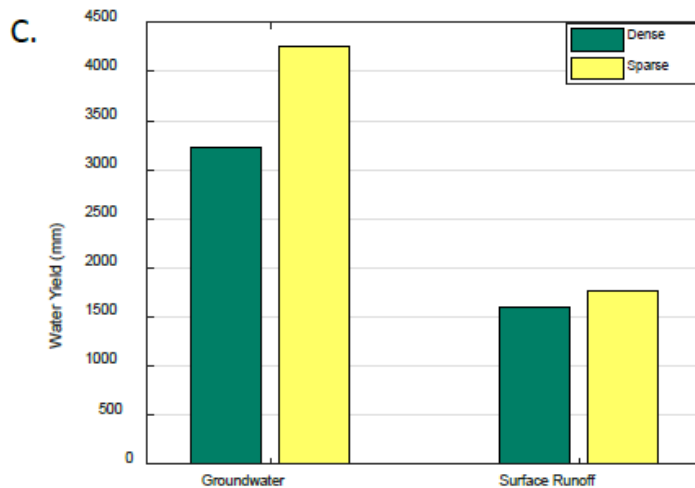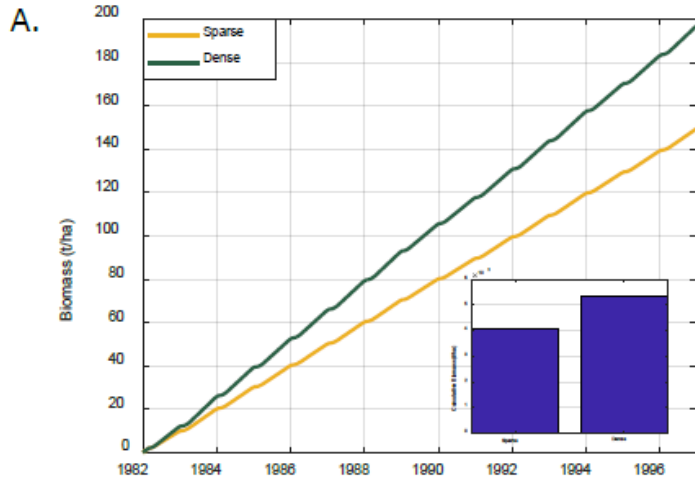
Exercise 3: Climate change

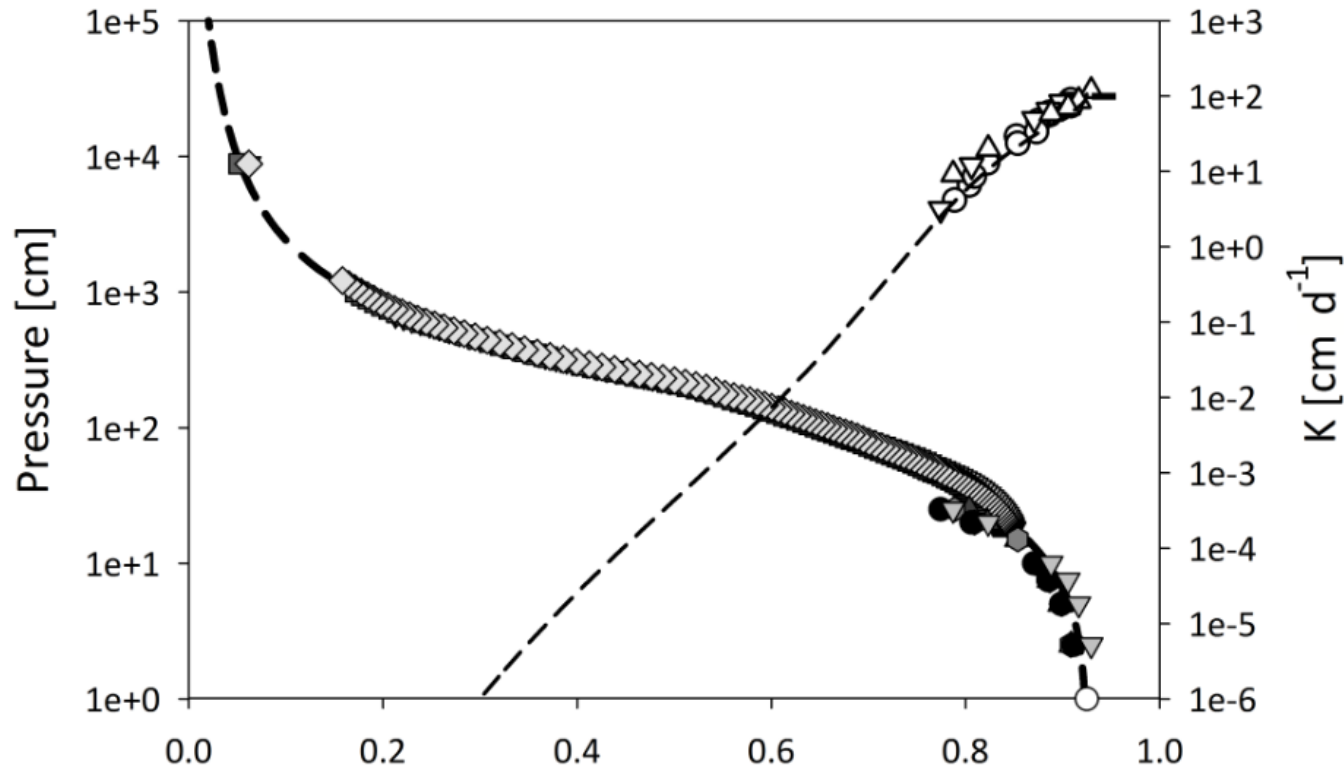How does climate change (RCP8.5 T and P) effect forest hydrology?

CHANGE IN PRECIPITATION BY END OF 21st CENTURY
inches of liquid water per year

as projected by NOAA/GFDL CM2.1
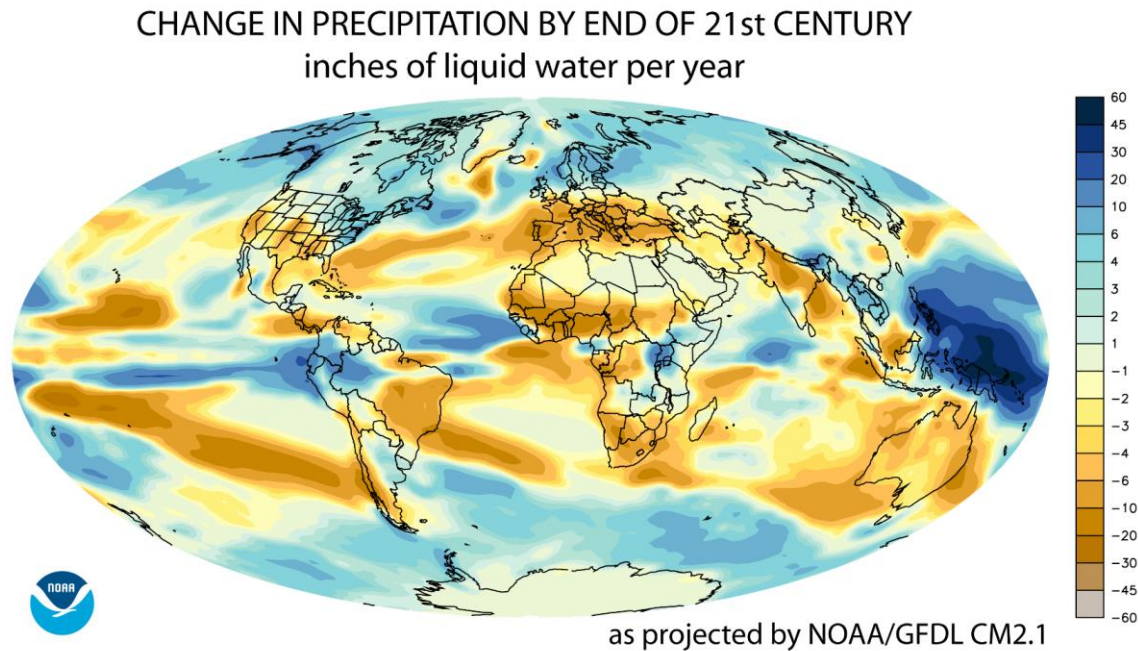
Exercise 2 : Soil characteristics

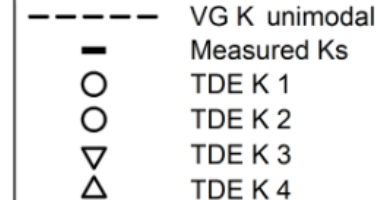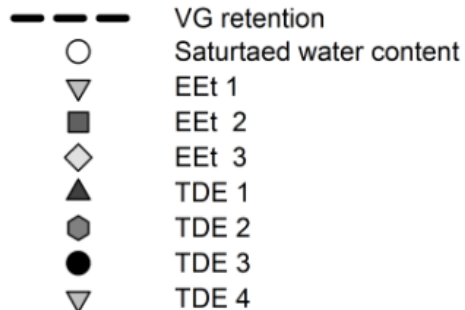How do soil characteristics (texture, skeleton, depth) effect the forest hydrology?

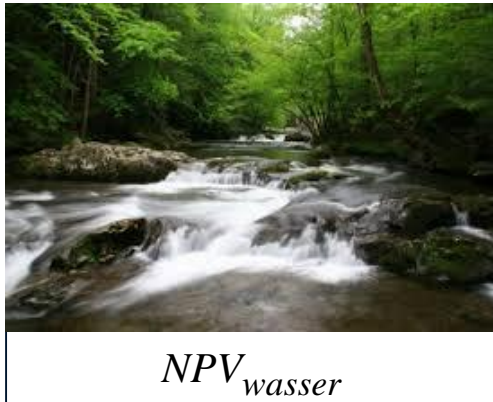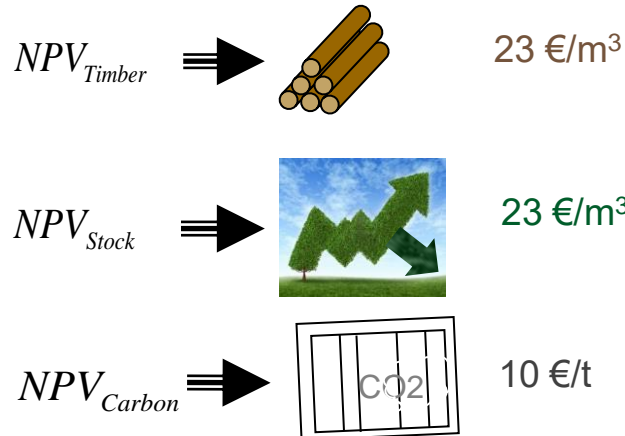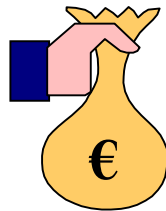Which soil texture gives us the highest water yield?
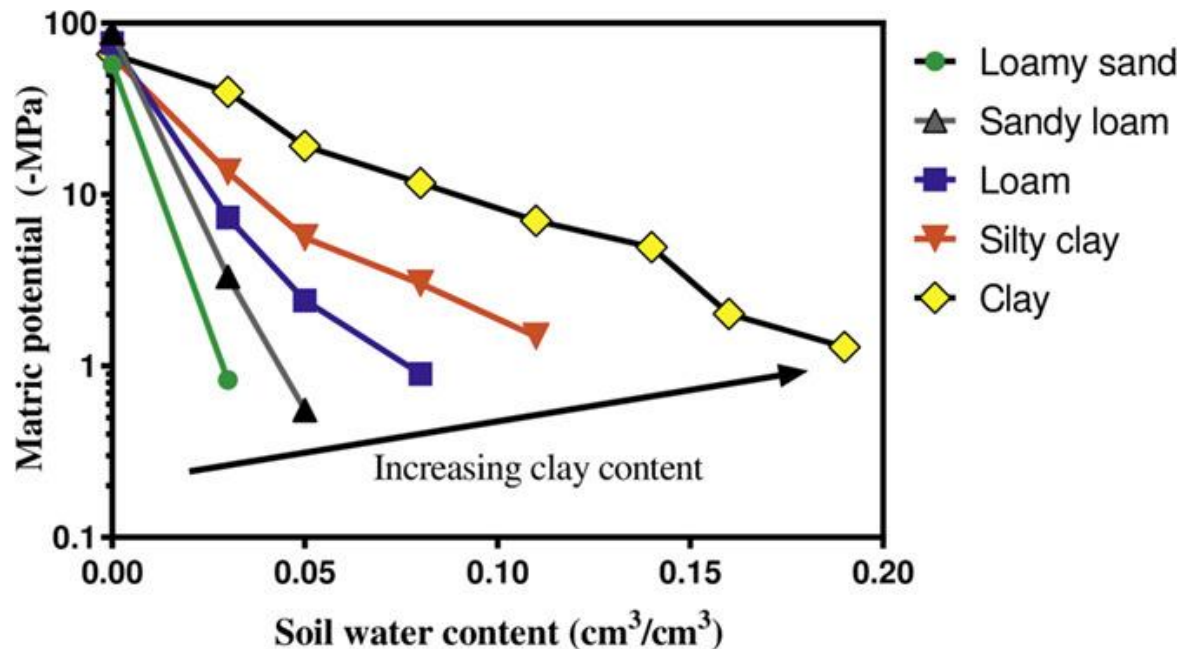
All-Exercises: Opportunity costs of Water services

Net **P**resent **V**alue

$$(NPV) = \frac{Cash_t}{(1+i)^t}$$

t = time from now (year)

I = discount rate (%)

NPV_{Timber} ➡️ 🪵 23 €/m³

NPV_{Stock} ➡️ 🌳 23 €/m³

NPV_{Carbon} ➡️ CO2 10 €/t

NPV_{wasser}

?

Inactive-Area   Active-Area

No Solution

NPV (€)

Water Services
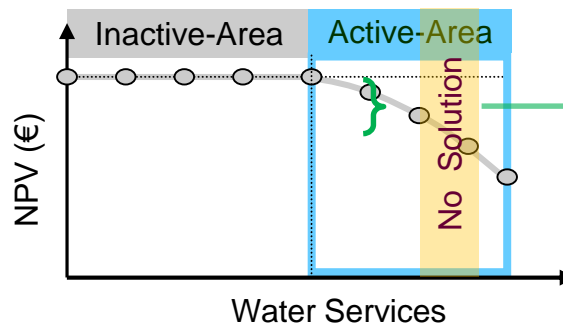
Opportunity Cost (€)

Thank you for attention!

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