Predicting Impact of Climate Change on Groundwater Dependent Ecosystems

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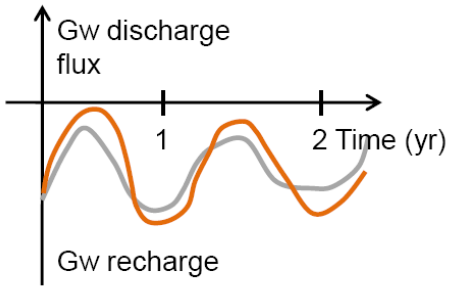
Introduction & objective

Importance of groundwater:

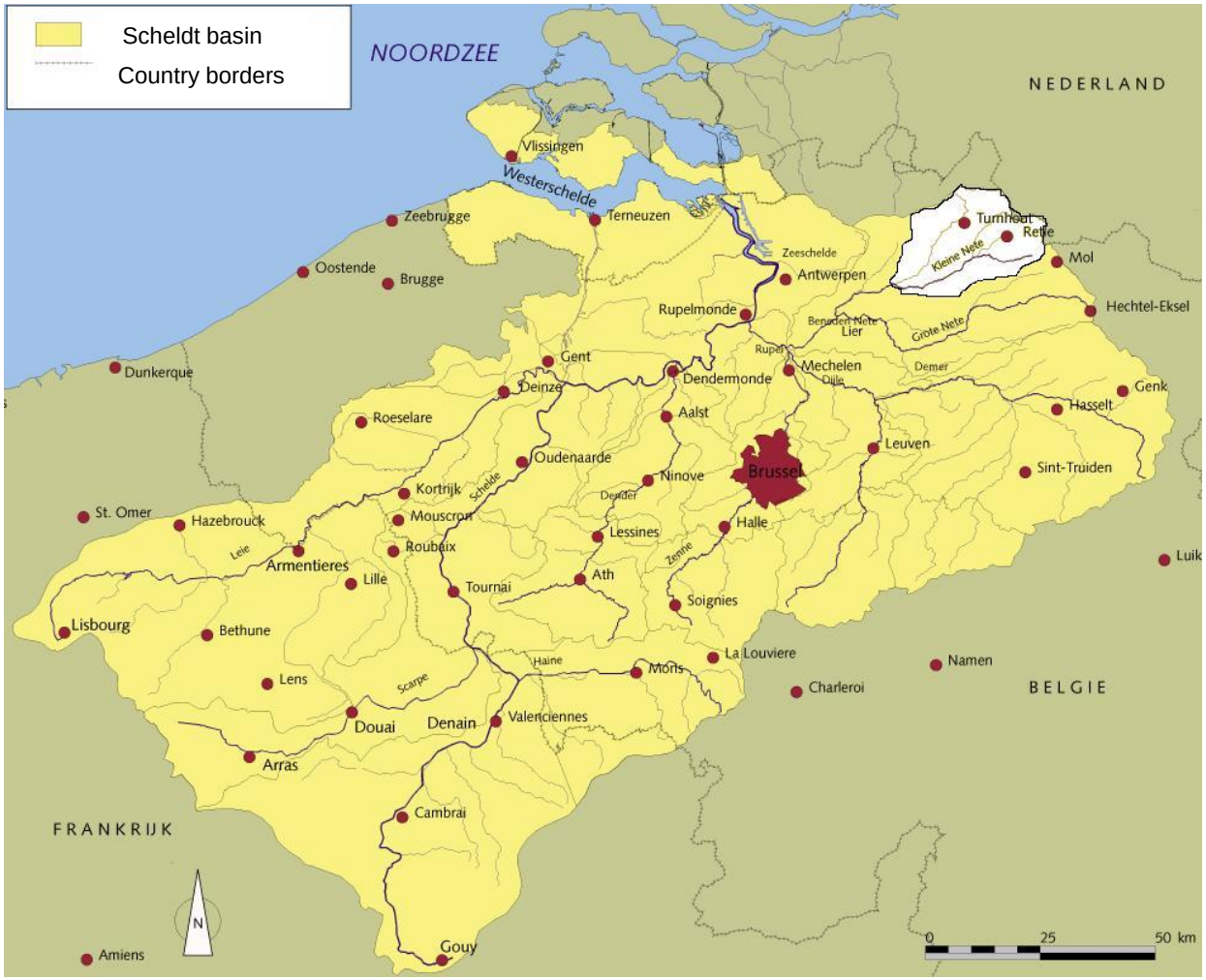
- Source of drinking water
- Maintaining the ecological value of natural reserves
- River ecology
- …

Future groundwater system?

- Land-use change
- Climate change

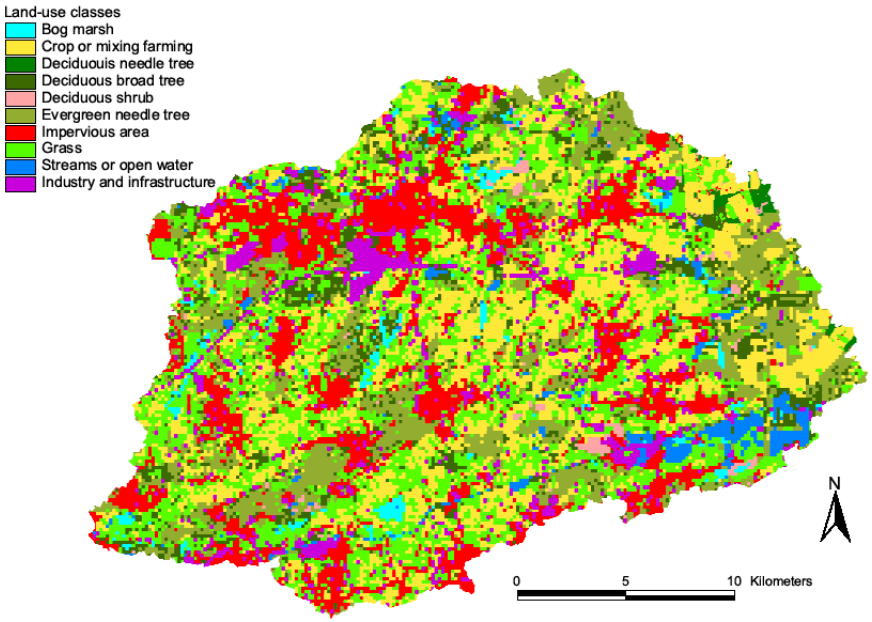


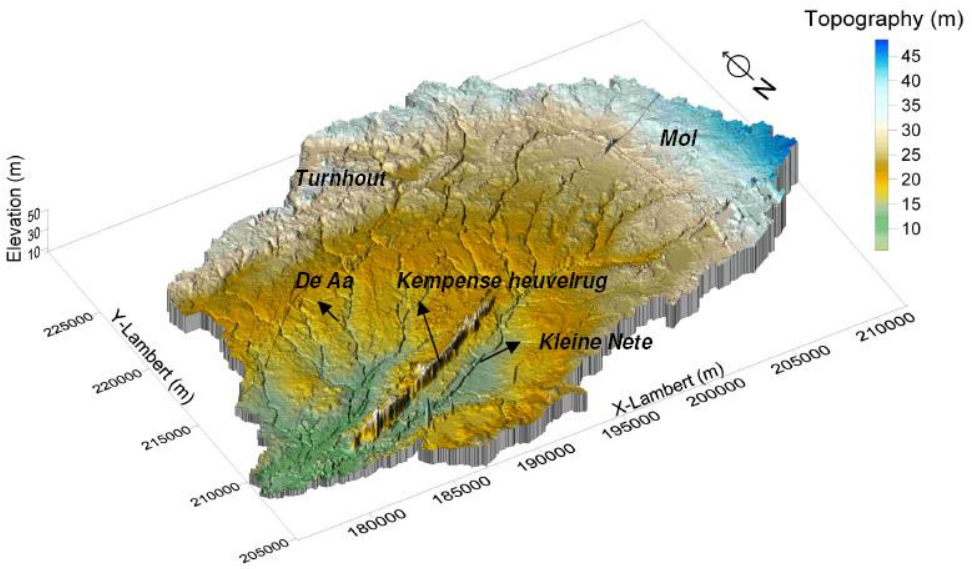
Study area



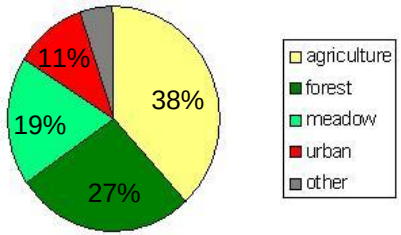
- Kleine Nete
- Part of the Scheldt Basin
- Area of 580 km²
- Mostly sand soil (72%)
- Most important aquifer formed by Neogene sand deposits with a thickness up till 200 m

Study area



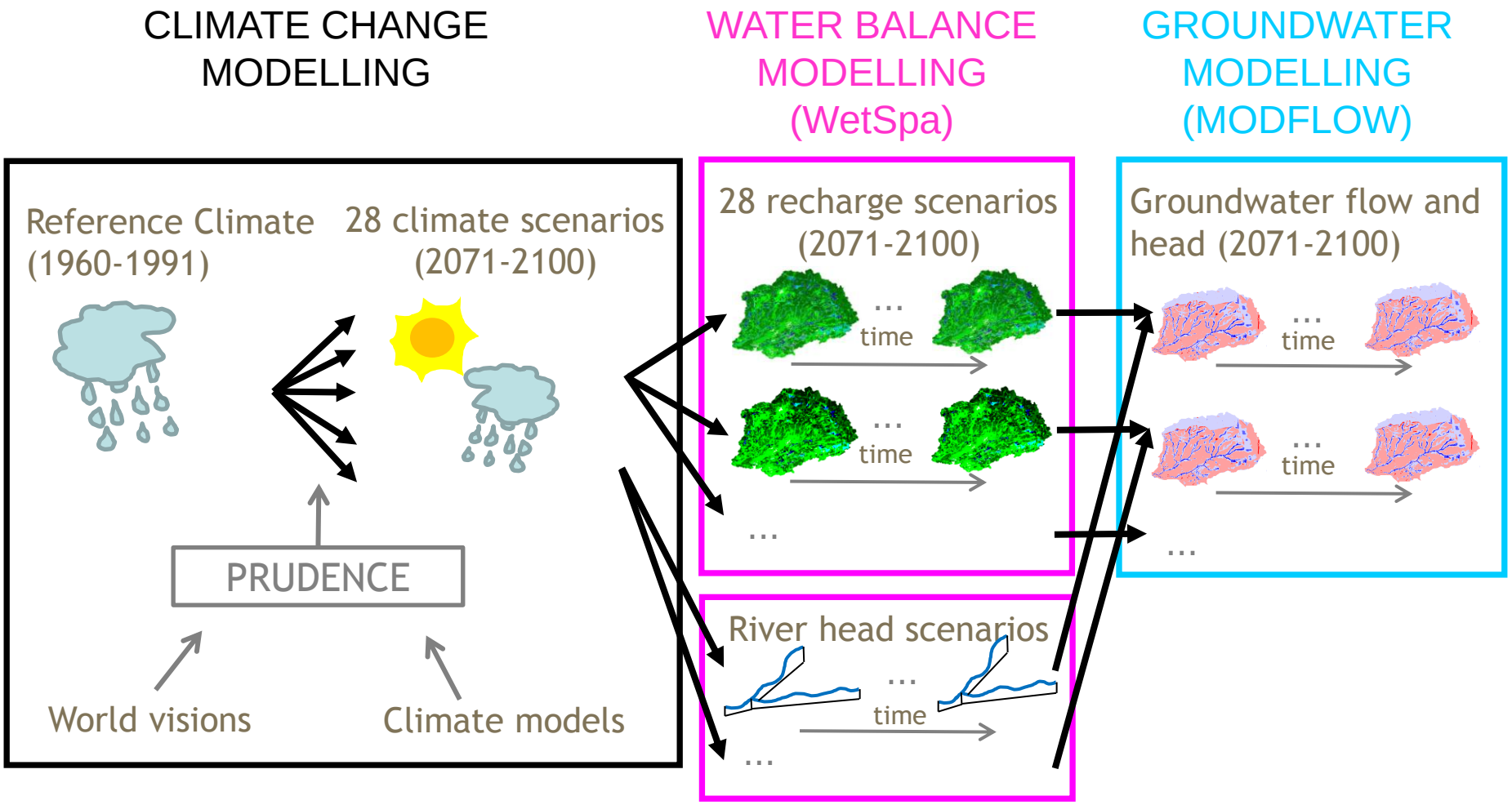


- Land-use



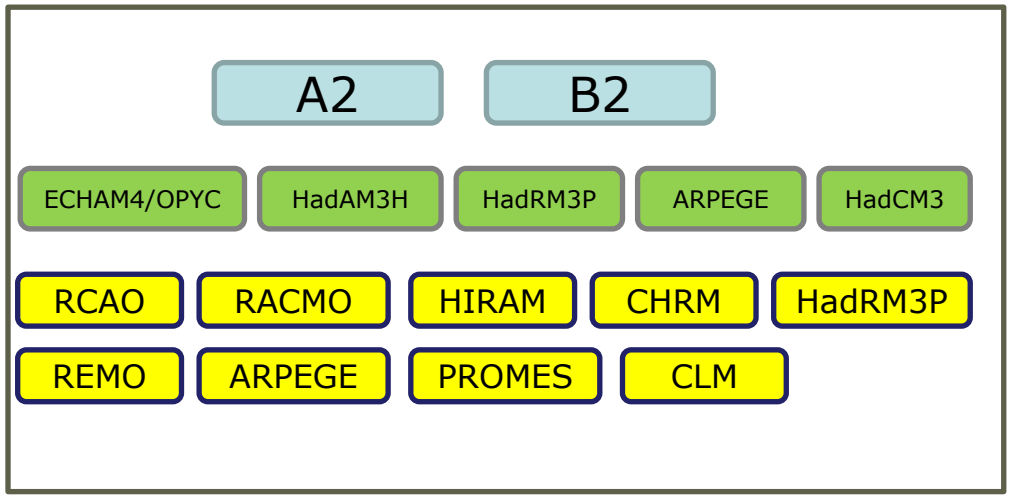
- Flat area, average slope of 0.36%

Overview methodology



Climate change Scenarios

PRUDENCE database



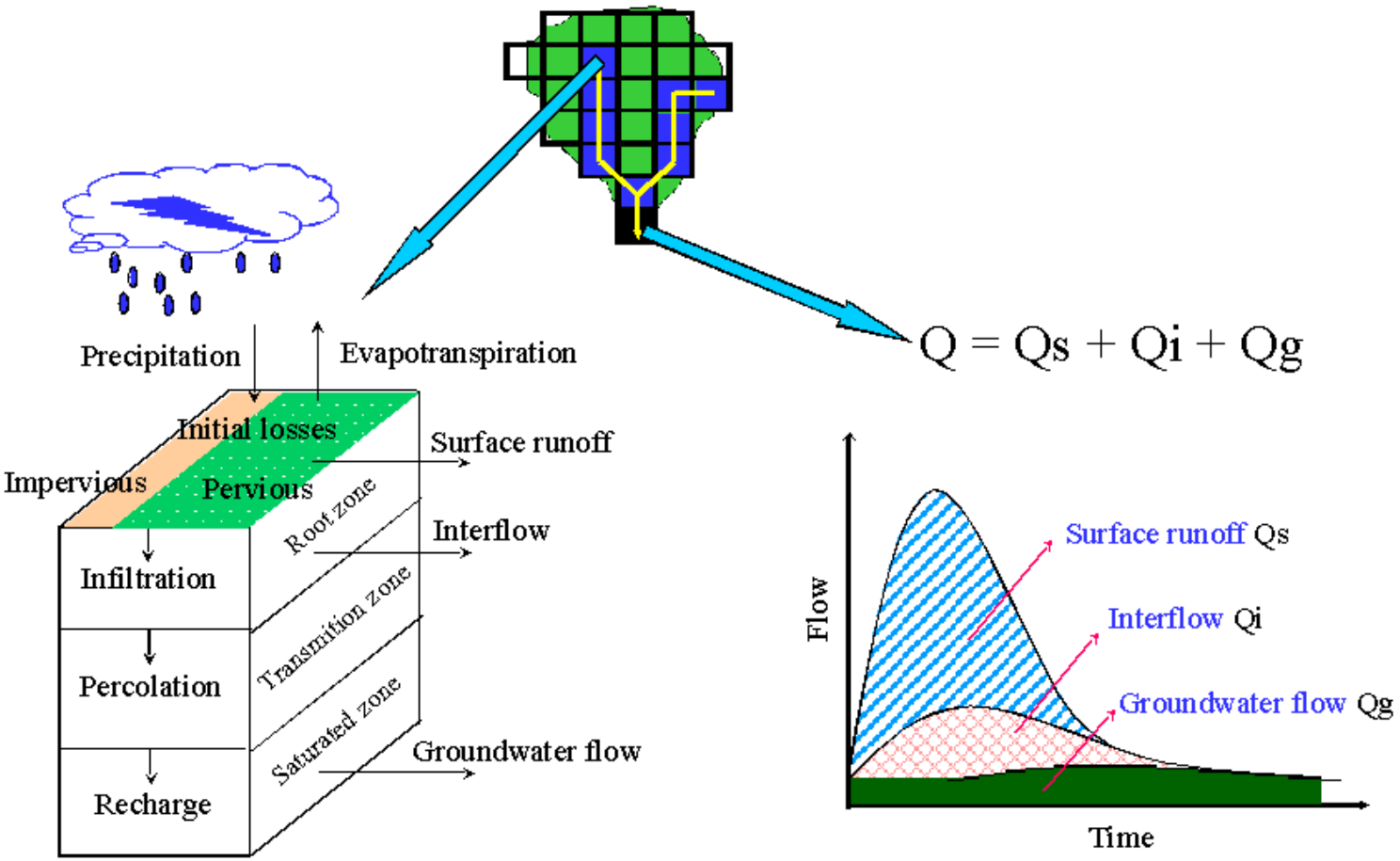
1 PET station (Uccle) and
4 Precipitation stations:

CCI-HYDR pertubation tool (Ntegeka and Willems, 2009)

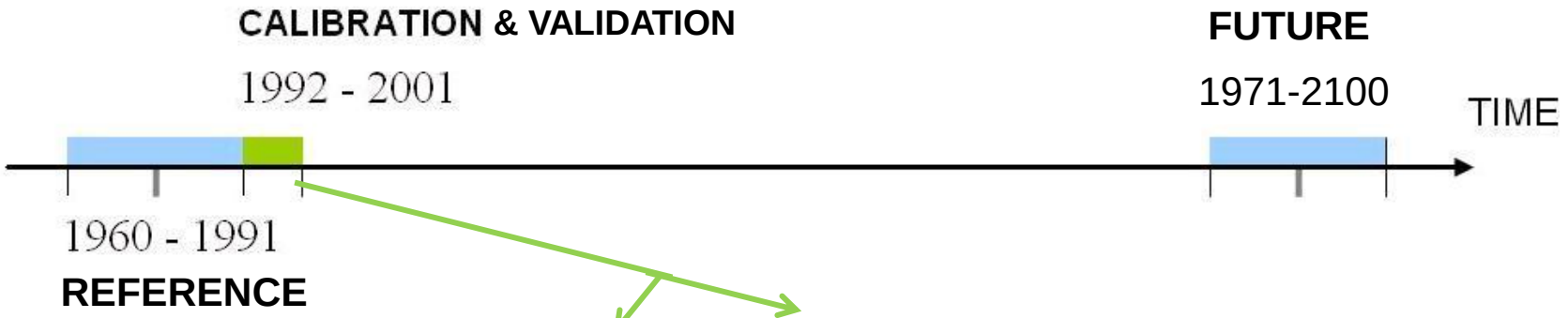
Analyses montly changes between control – scenario runs

Hydrological modelling

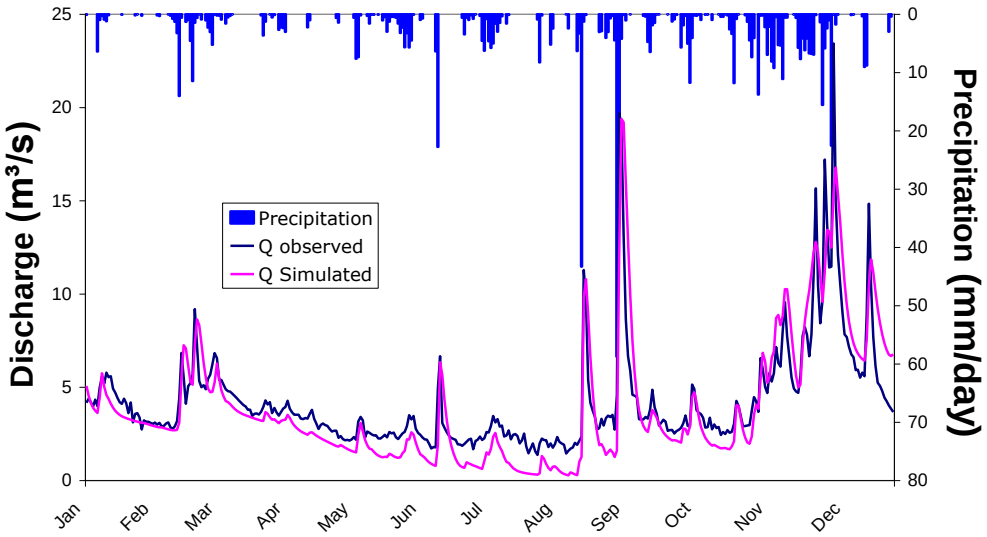
WetSpa (Liu et al., 2004)



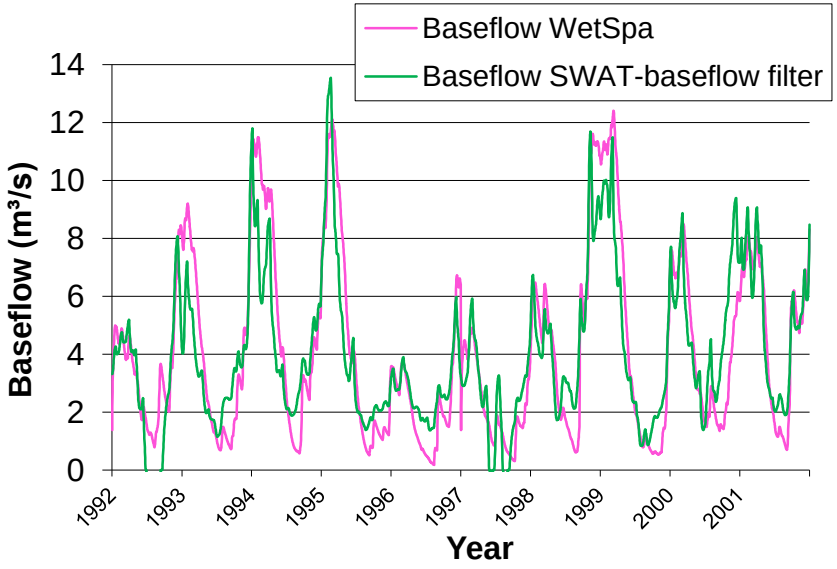
Hydrological modelling



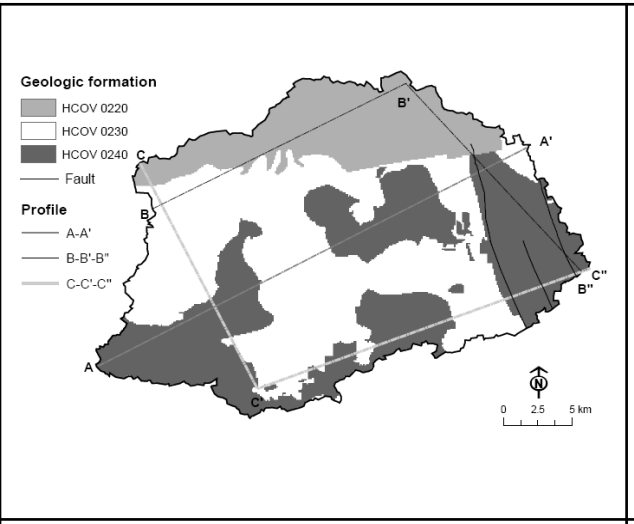
Validation river discharge 1996

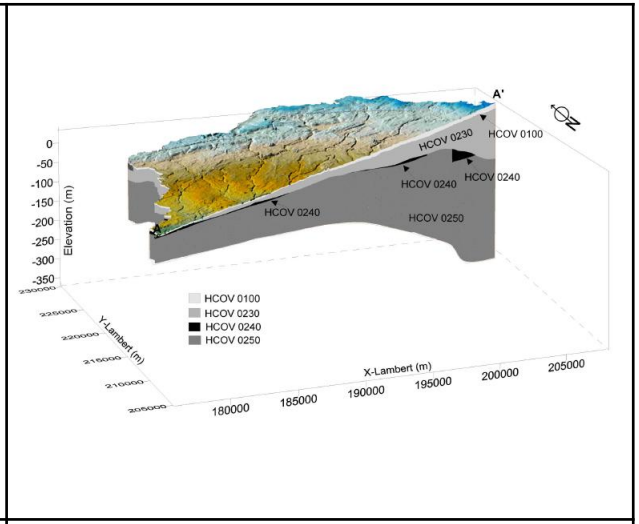


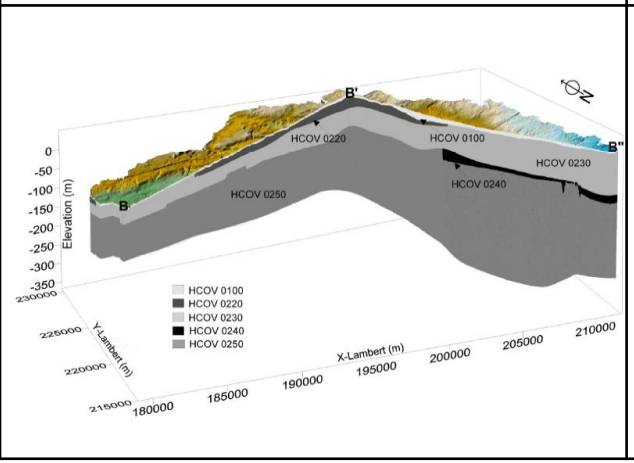
WetSpa simulated baseflow vs filterd baseflow (Kleine Nete – Grobbendonk)

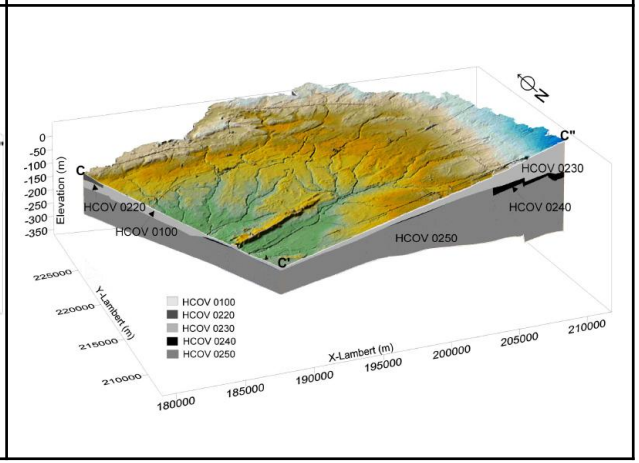


Groundwater modelling







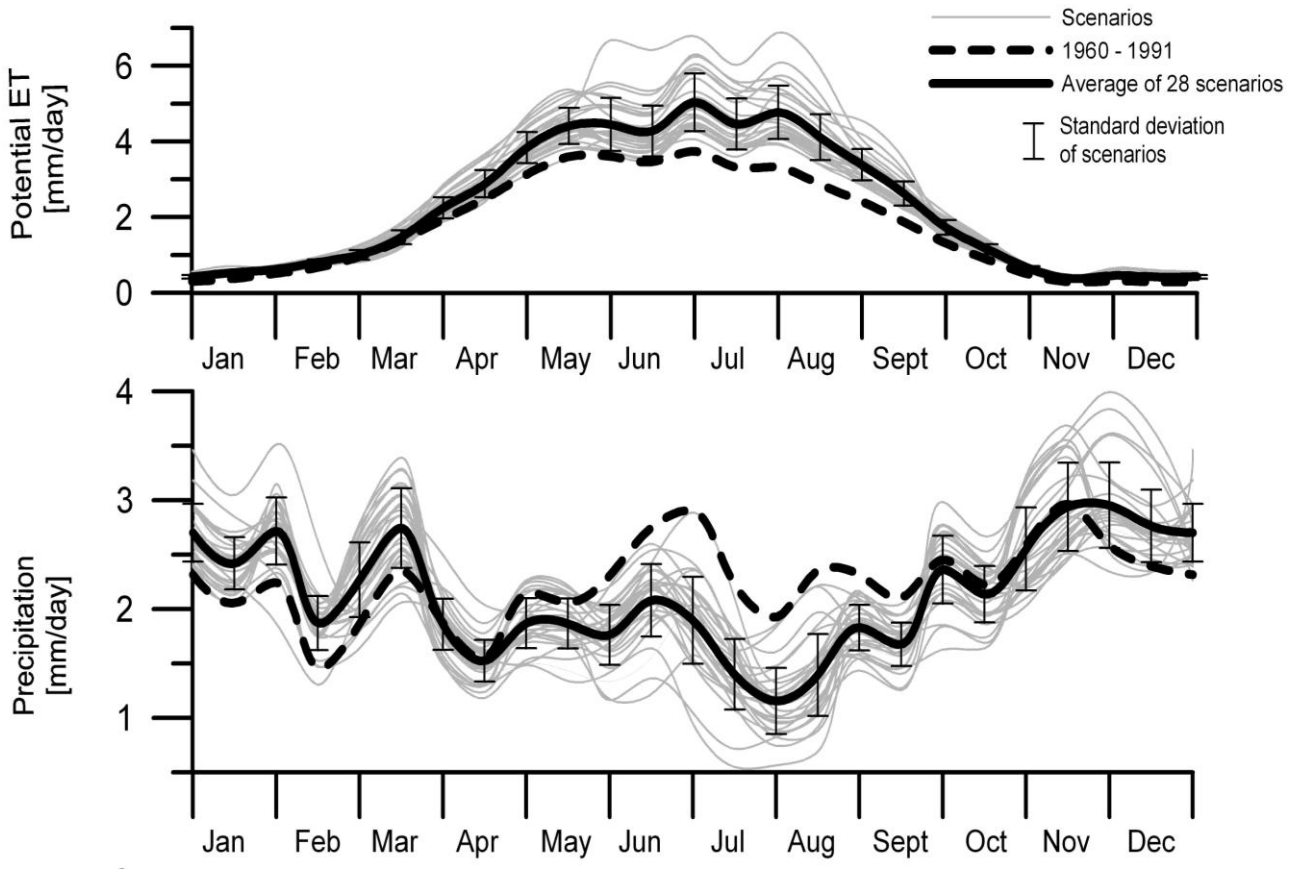


Conceptual MODFLOW model

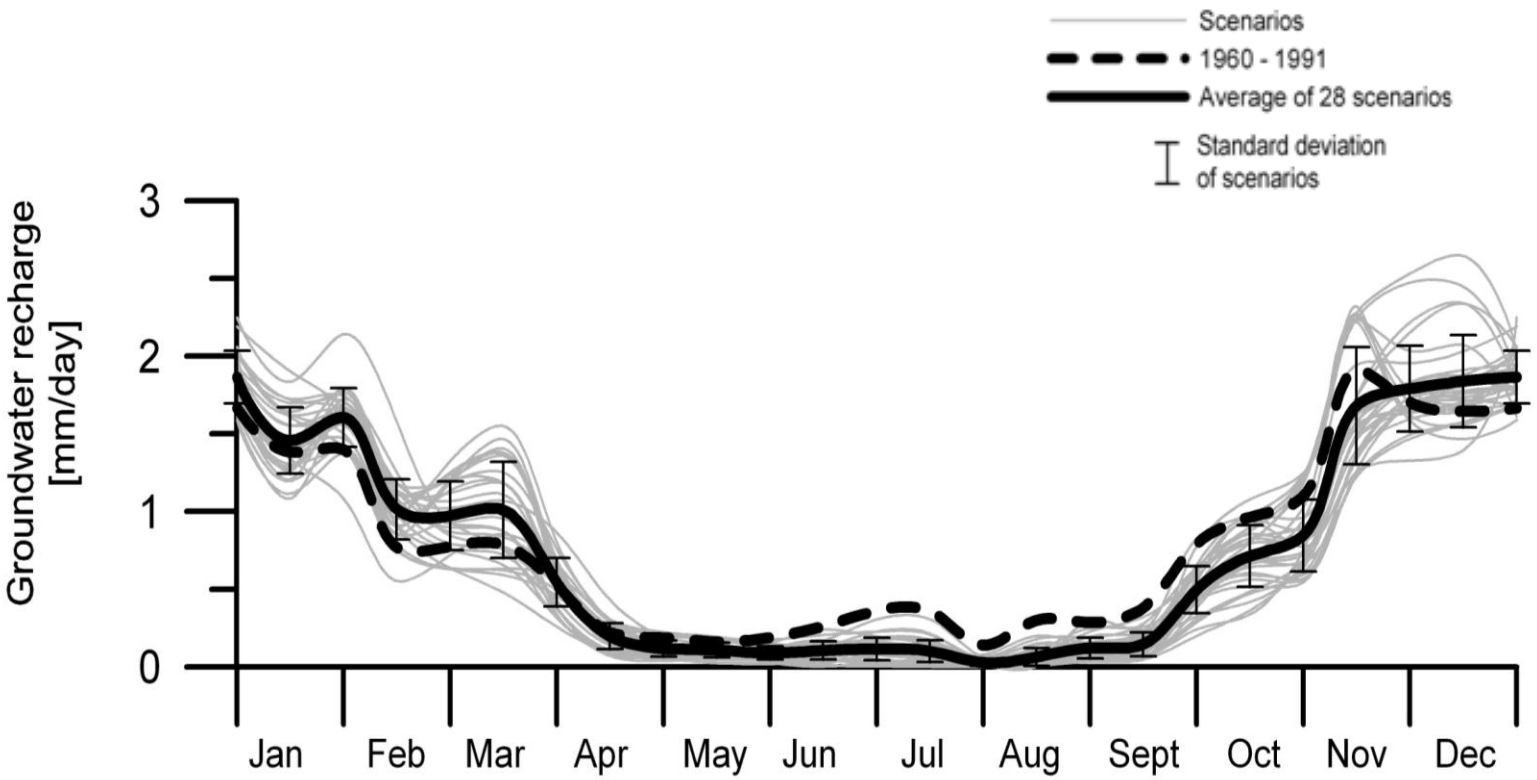
- 2 layer
- Transient: 768 half-monthly stressperiods (32 years)
- Wetspa recharge map and river head for each stressperiod

Aquifer code (HCOV)	Aquifer name	Avg. hydraulic conductivity (m/d)
0100	The Quaternary aquifer systems	4.8
0220	The clay-sand-complex of the Kempen	9.4
0230	The Pleistocene and Pliocene aquifer	20.5
0240	The Pliocene clayey layer	0.1
0250	The Miocene aquifer system	14.1

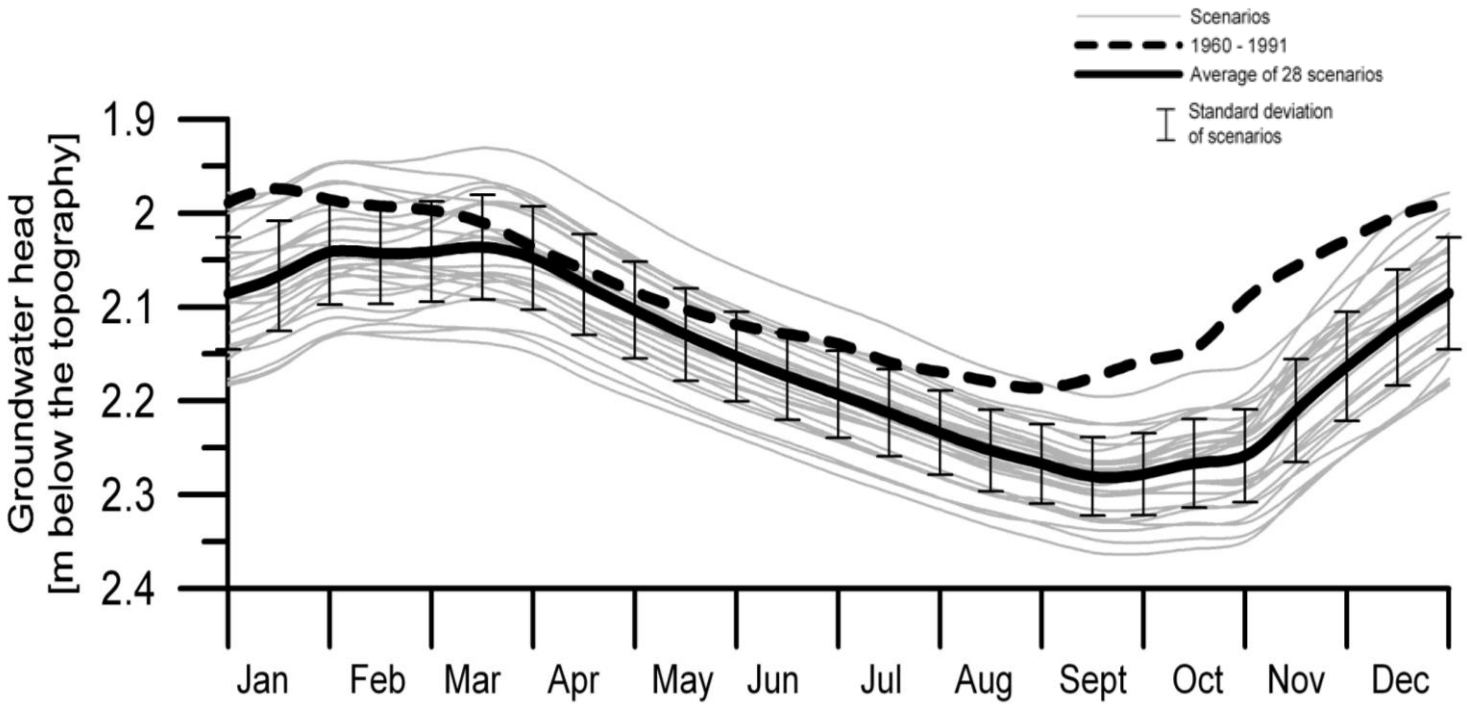
Results climate scenarios



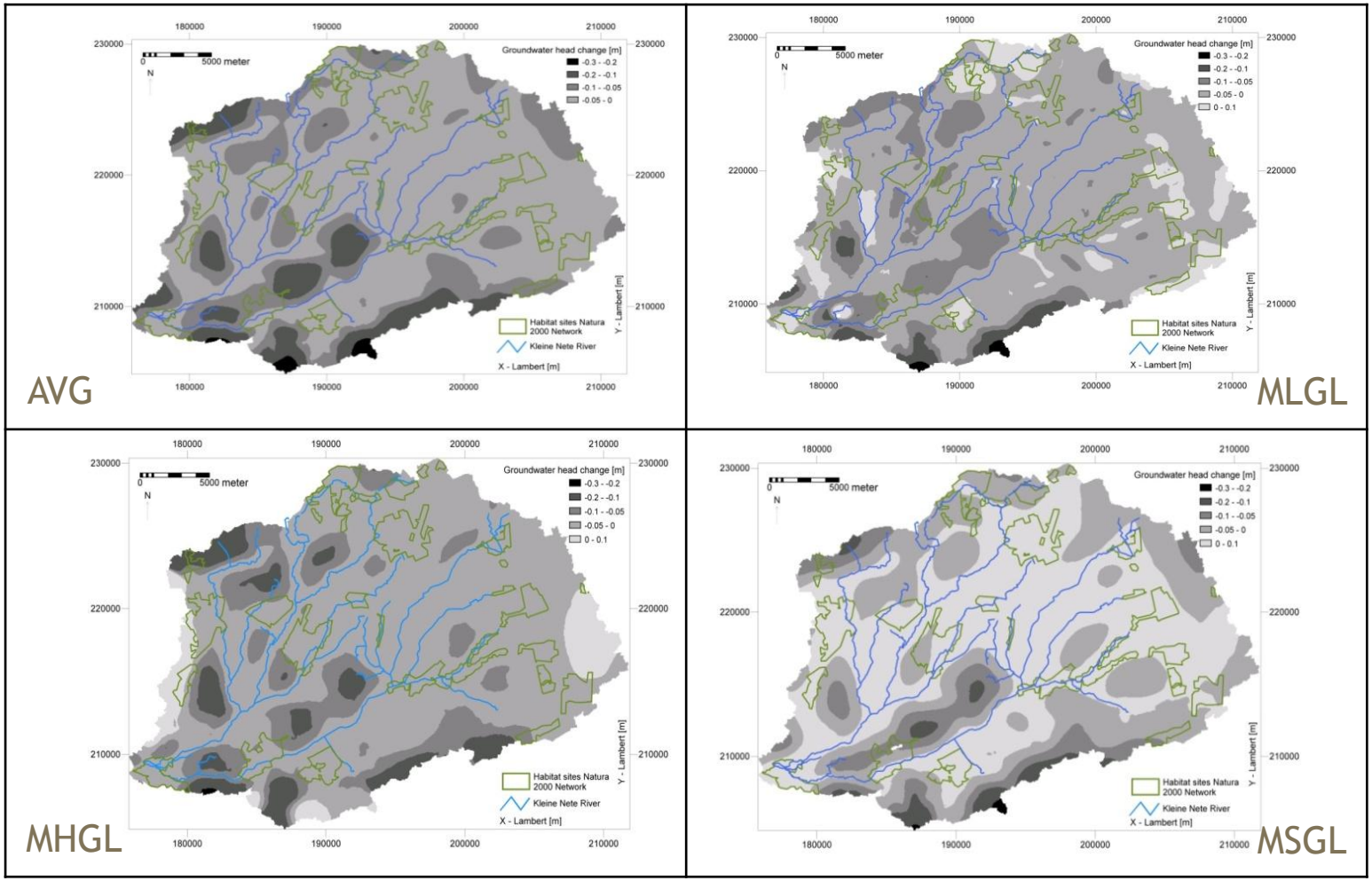
Results groundwater recharge



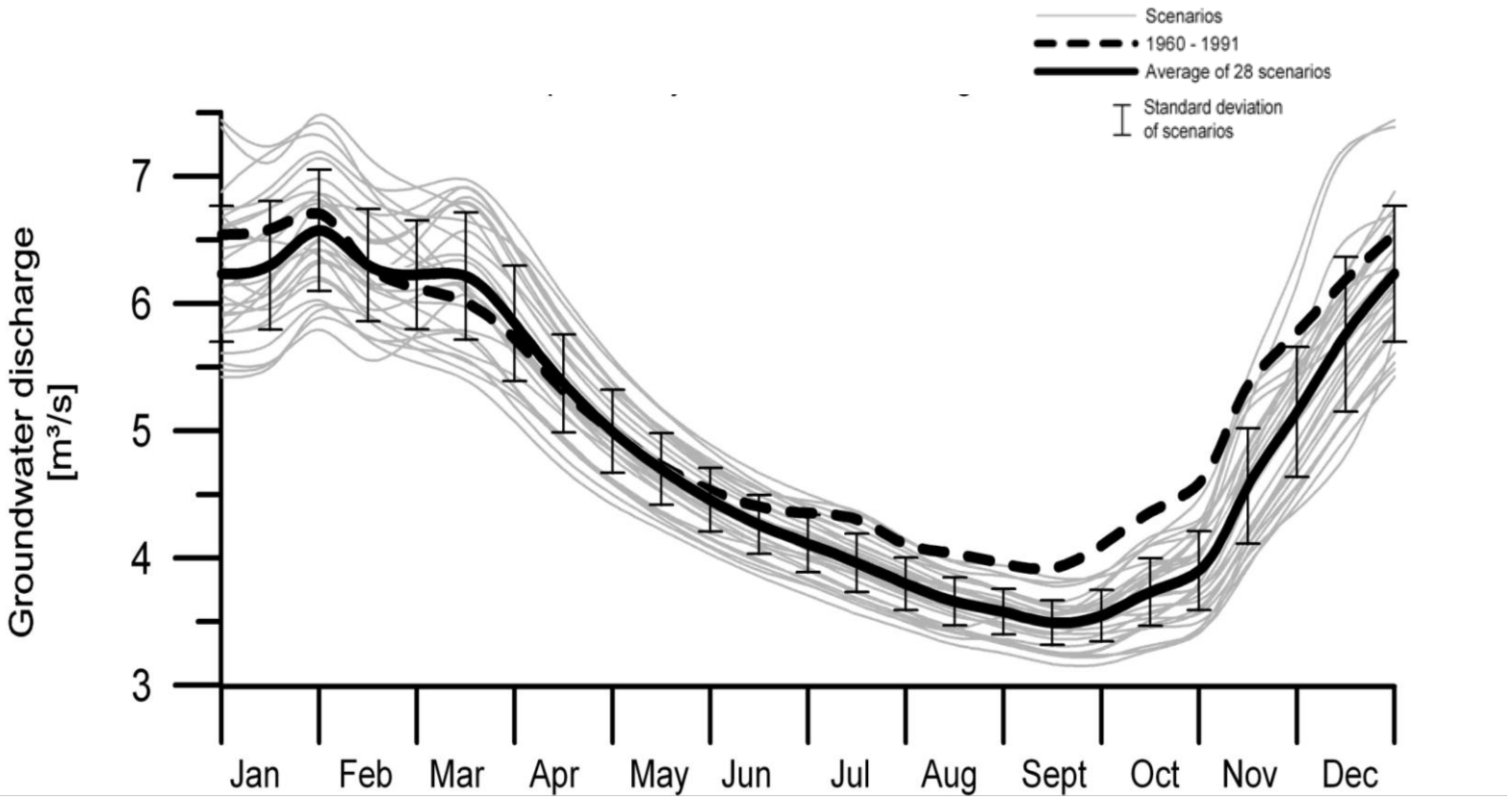
Results groundwater level



Results groundwater level



Results groundwater flux



Conclusions

- Coupling of water balance models - groundwater model
- Climate change reduced recharge, groundwater head and baseflow
- Impact of climate change on groundwater level larger on interfluves
- Important inter-annual changes caused by climate change


Questions?
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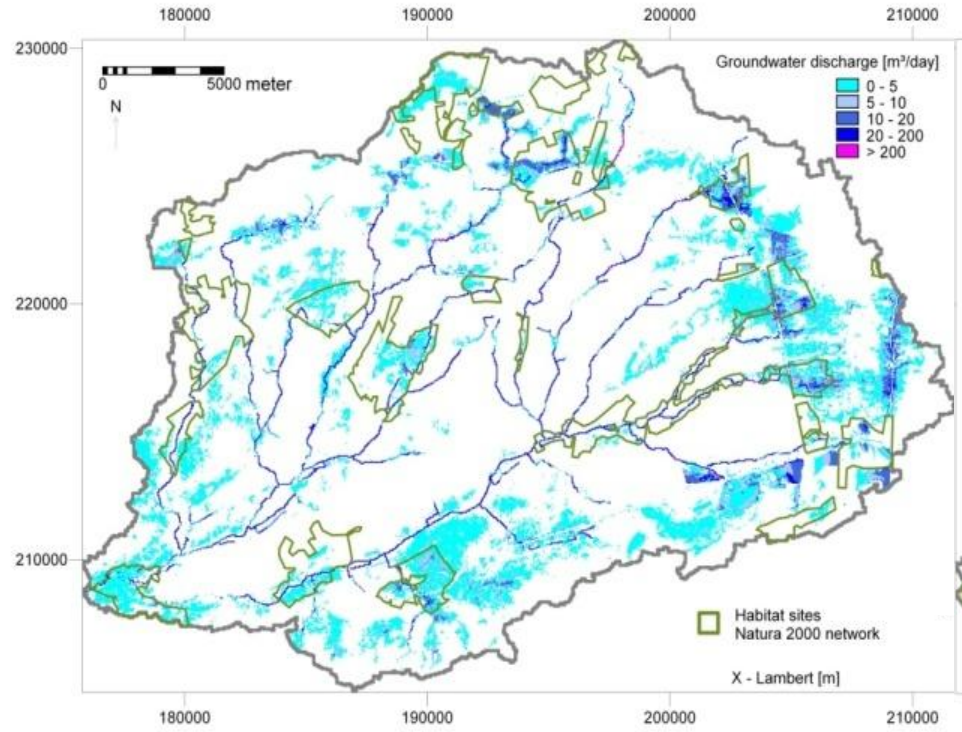
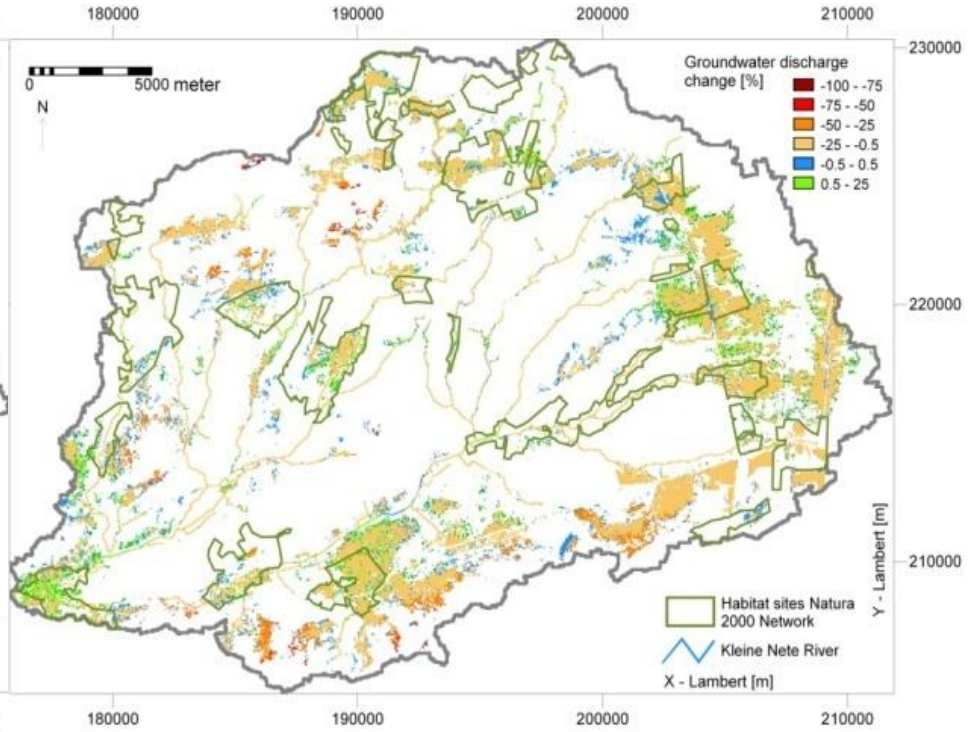
Results groundwater flux

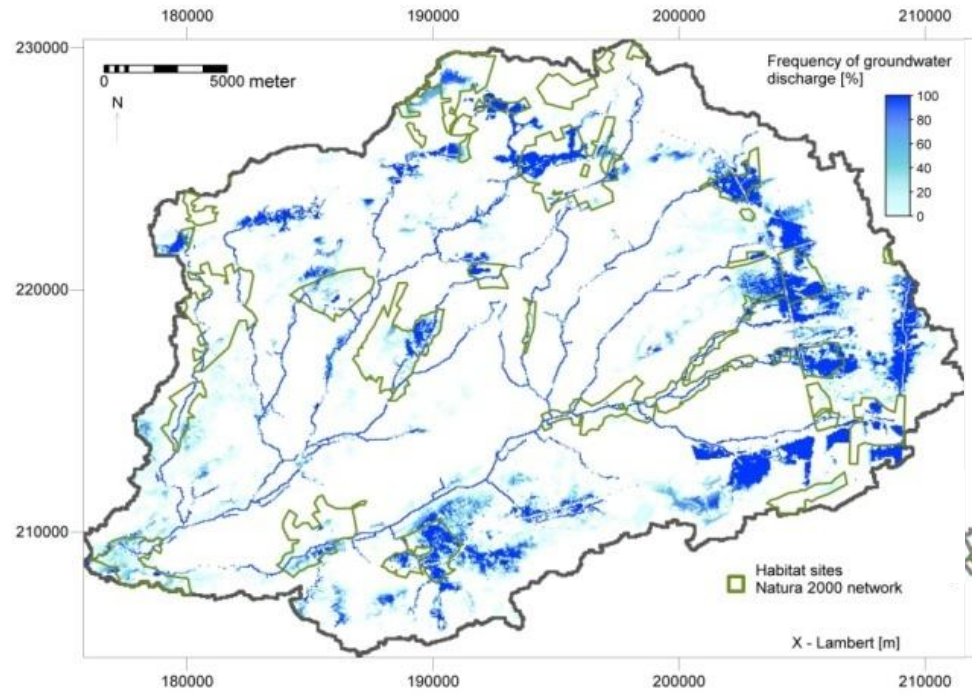


Average groundwater discharge quantity

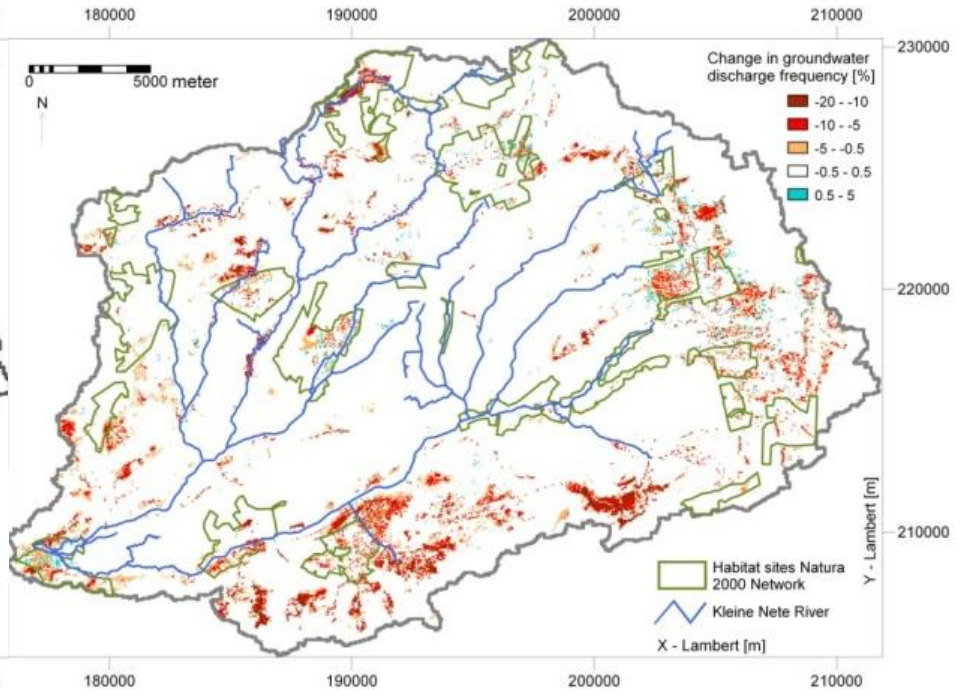


Change in groundwater discharge quantity

Results groundwater flux

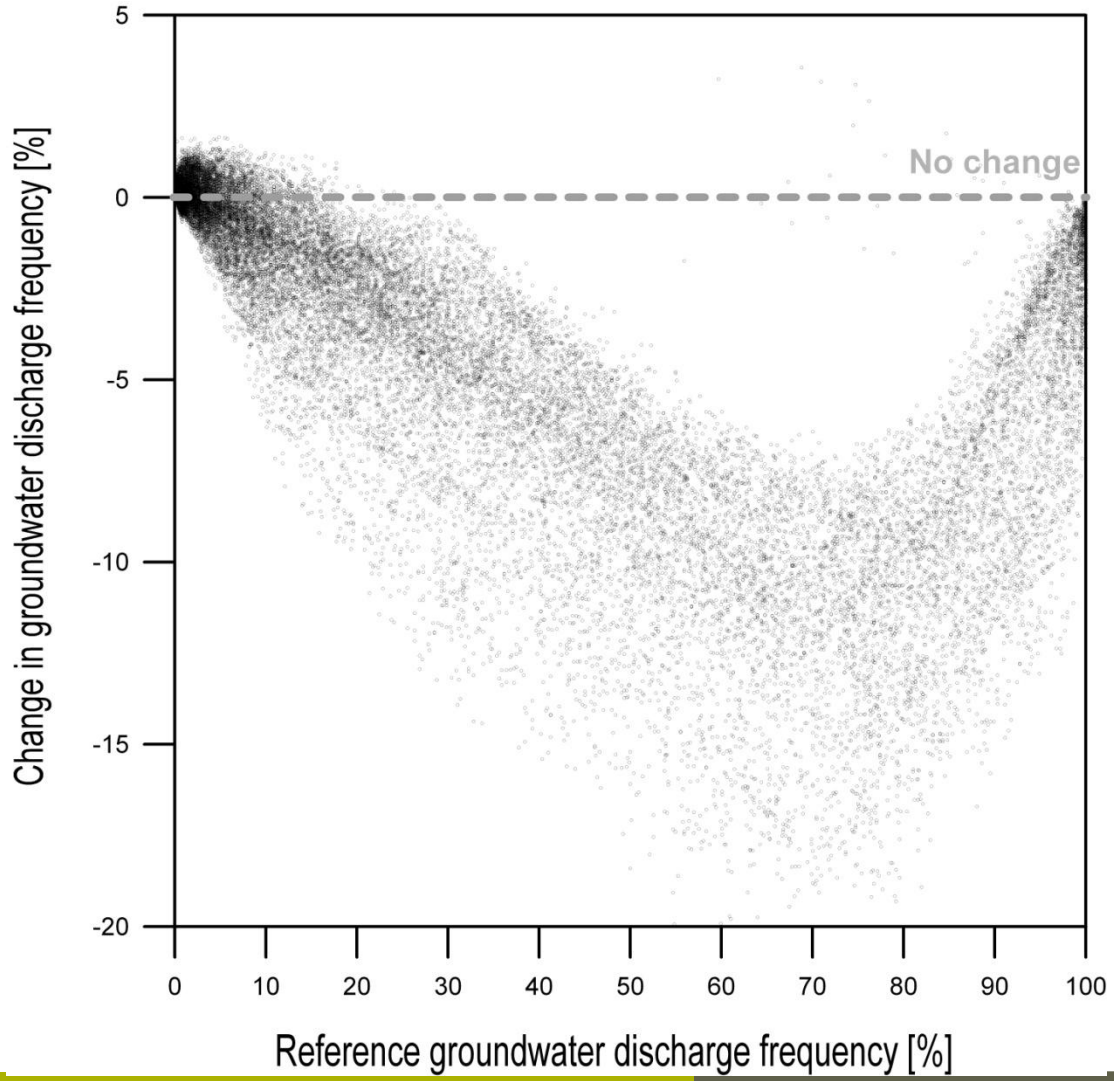


Average groundwater discharge frequency

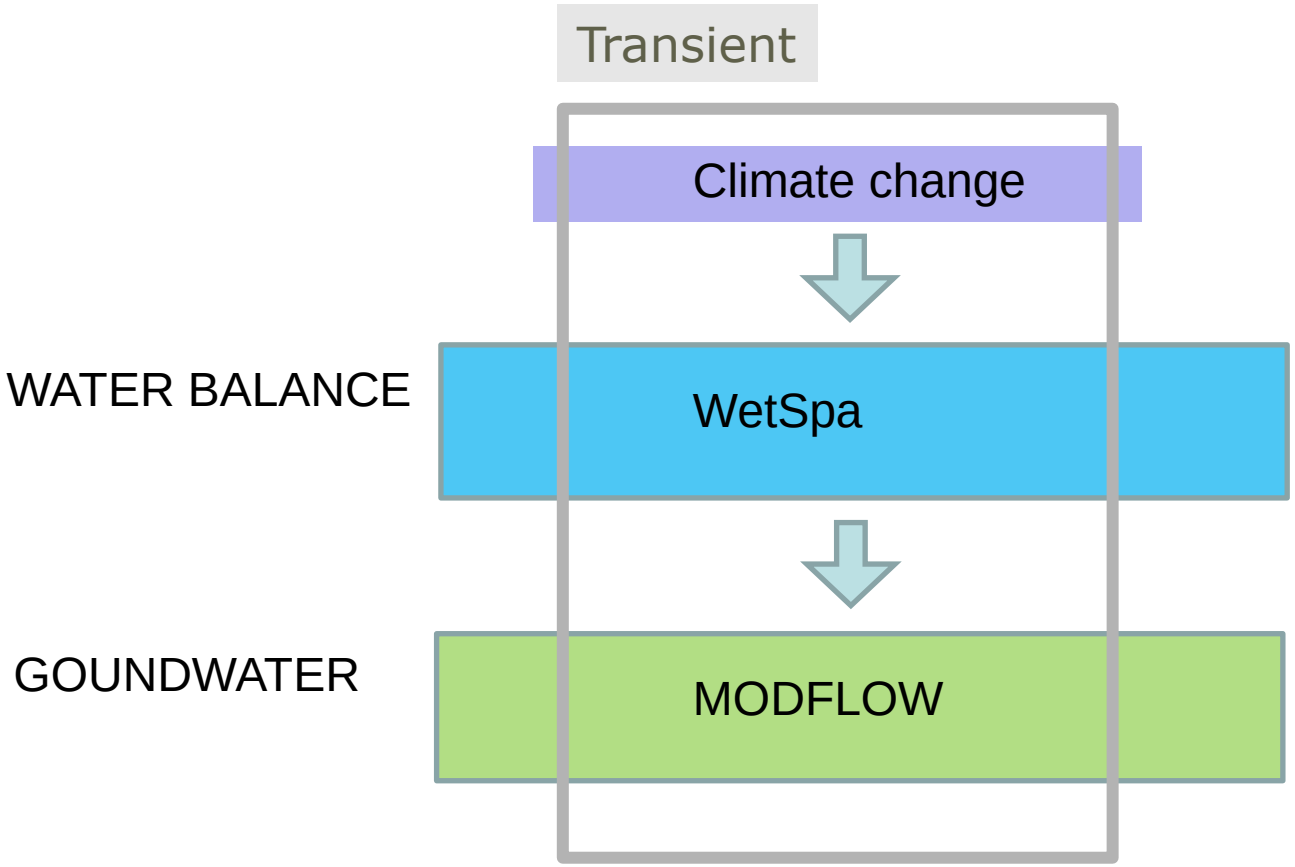


Change in groundwater discharge frequency

Results groundwater flux



Overview


Transient
Climate change
WATER BALANCE
WetSpa
GOUNDWATER
MODFLOW

Climate scenarios

IPCC SRES scenarios:
A2 and B2

GCM:
ECHAM4-OPYC / HadAM3H / HadAM3P / ARPEGE

RCM:
RCAO / RACMO / HIRHAM / CHRM / HadRM3P / REMO / ARPEGE / CLM / PROMES

CONTROL	SCENARIO	SCENARIO	GCM	RCM
SMHI	SMHI-MPI-A2	A2	ECHAM4/OPYC	RCAO
	SMHI-MPI-B2	B2	ECHAM4/OPYC	
	SMHI-HC-22	A2	HadAM3H	
	SMHI-A2	A2	HadAM3H	
	SMHI-B2	B2	HadAM3H	
KNMI	KNMI	A2	HadAM3H	RACMO
METNO	METNO-A2	A2	HadAM3H	HIRHAM
	METNO-B2	B2	HadAM3H	
DMI	DMI-S25	A2	HadAM3H	HIRHAM
	DMI-ecsc-A2	A2	ECHAM4/OPYC	
	DMI-ecsc-B2	B2	ECHAM4/OPYC	
	DMI-HS1	A2	HadAM3H	
	DMI-HS2	A2	HadAM3H	
	DMI-HS3	A2	HadAM3H	
ETH	ETH	A2	HadAM3H	CHRM
HC	HC-adhfa	A2	HadAM3P	HadRM3P
	HC-adhfe	A2	HadAM3P	
	HC-adhff	A2	HadAM3P	
	HC-adhfd-B2	B2	HadAM3P	
MPI	MPI-3005	A2	HadAM3H	REMO
	MPI-3006	A2	HadAM3H	
CNRM	CNRM-DC9	B2	ARPEGE	ARPEGE
	CNRM-DE5	B2	HadCM3	
	CNRM-DE6	A2	ARPEGE	
	CNRM-DE7	A2	ARPEGE	
GKSS	GKSS-SN	A2	HadAM3H	CLM
UCM	UCM-A2	A2	HadAM3H	PROMES
	UCM-B2	B2	HadAM3H	