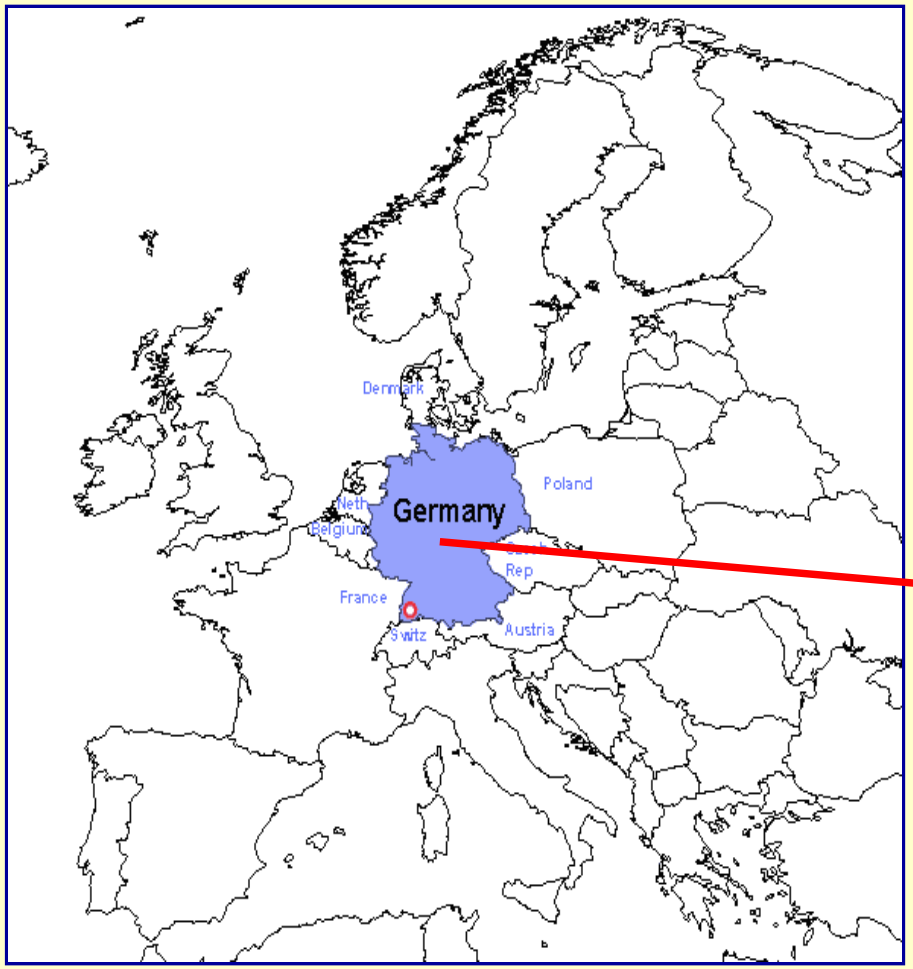
Konrad Miegel

Soil water availability and groundwater as plant growth factors

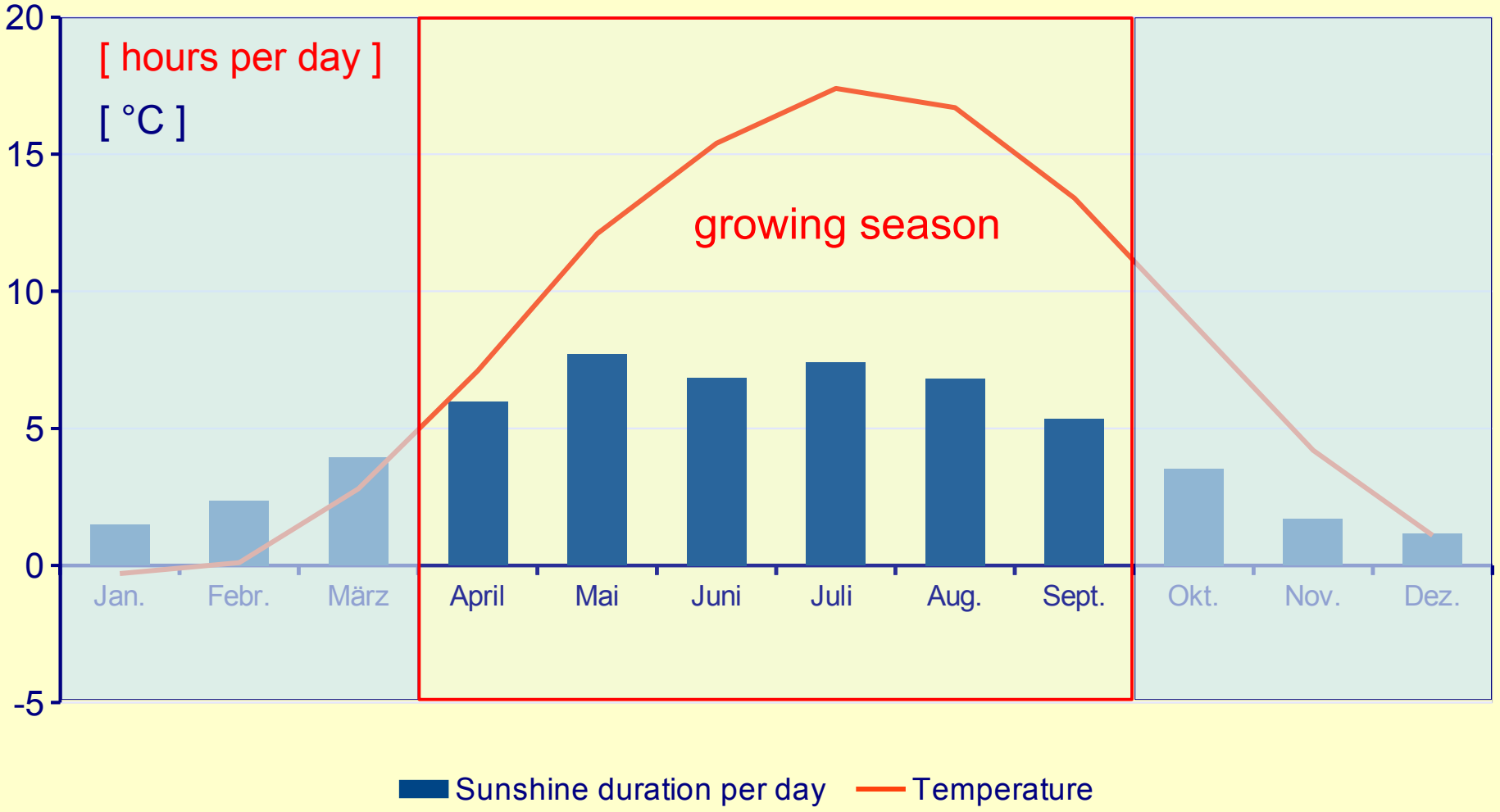
Meeting in Cuba, March 2014

The State Mecklenburg-Vorpommern

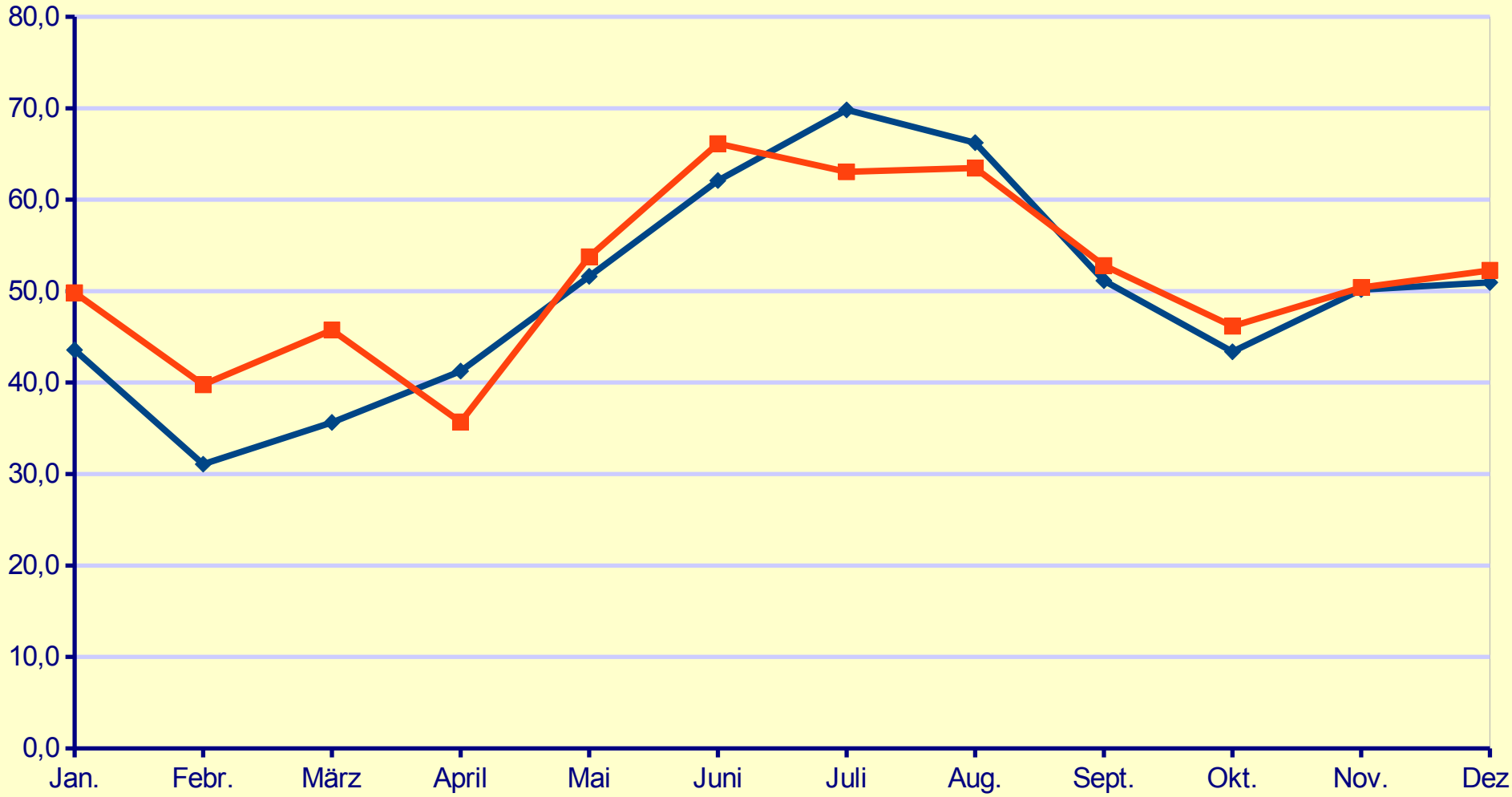


Position of Germany in Europe

Mean monthly temperature and sunshine duration in Mecklenburg-Vorpommern



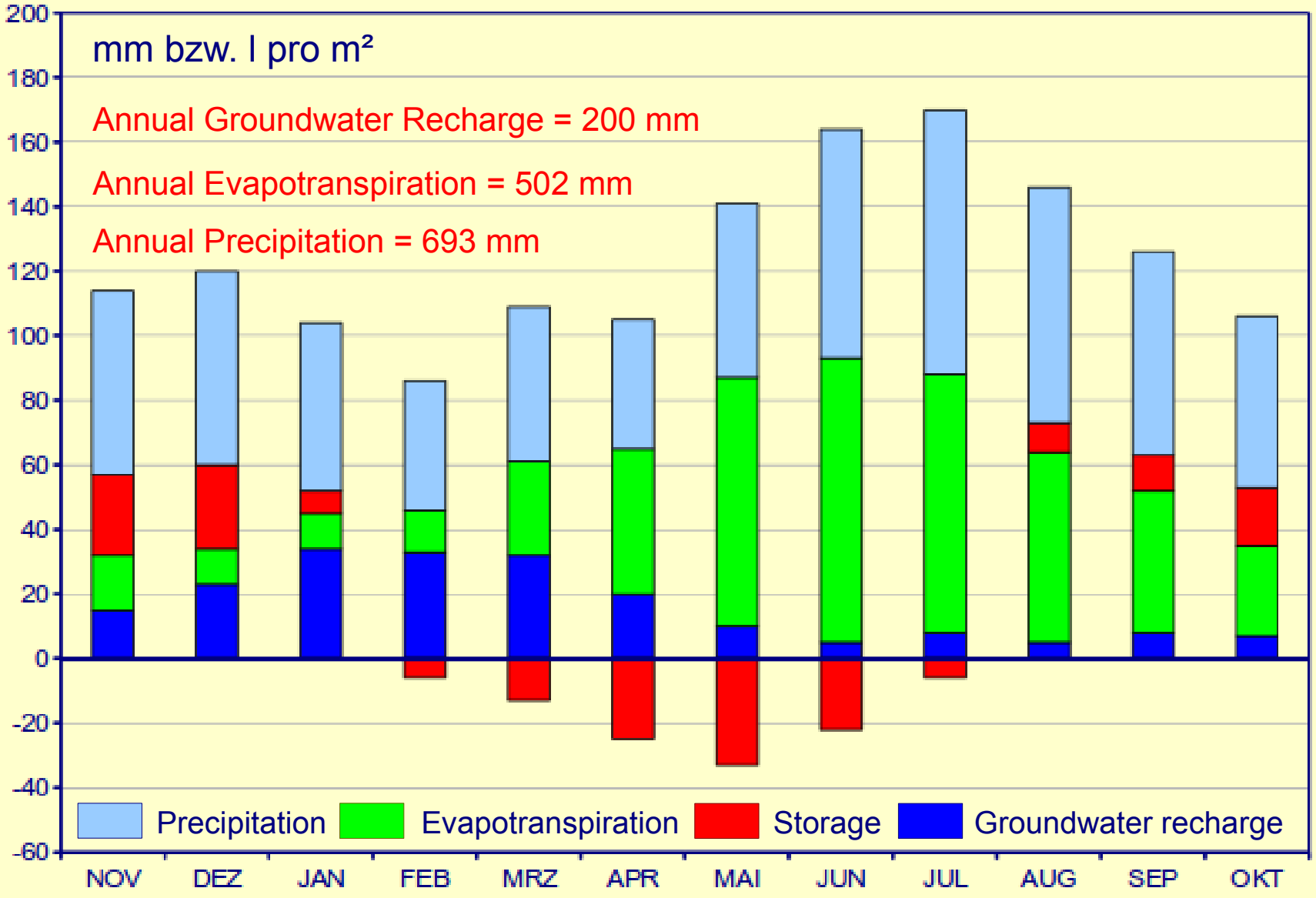
Mean monthly precipitation in Mecklenburg-Vorpommern



blue line: 1951 – 1980

red line: 1981 – 2010

Water Balance of the Lysimeterstation Groß Lüsewitz



Lysimeter station Groß Lüsewitz nearly by Rostock

Rotation of the lysimeters: Rye, wheat (after harvest) and maize

Lysimeter Station Groß Lysewitz

Entry to the cellar

Features:

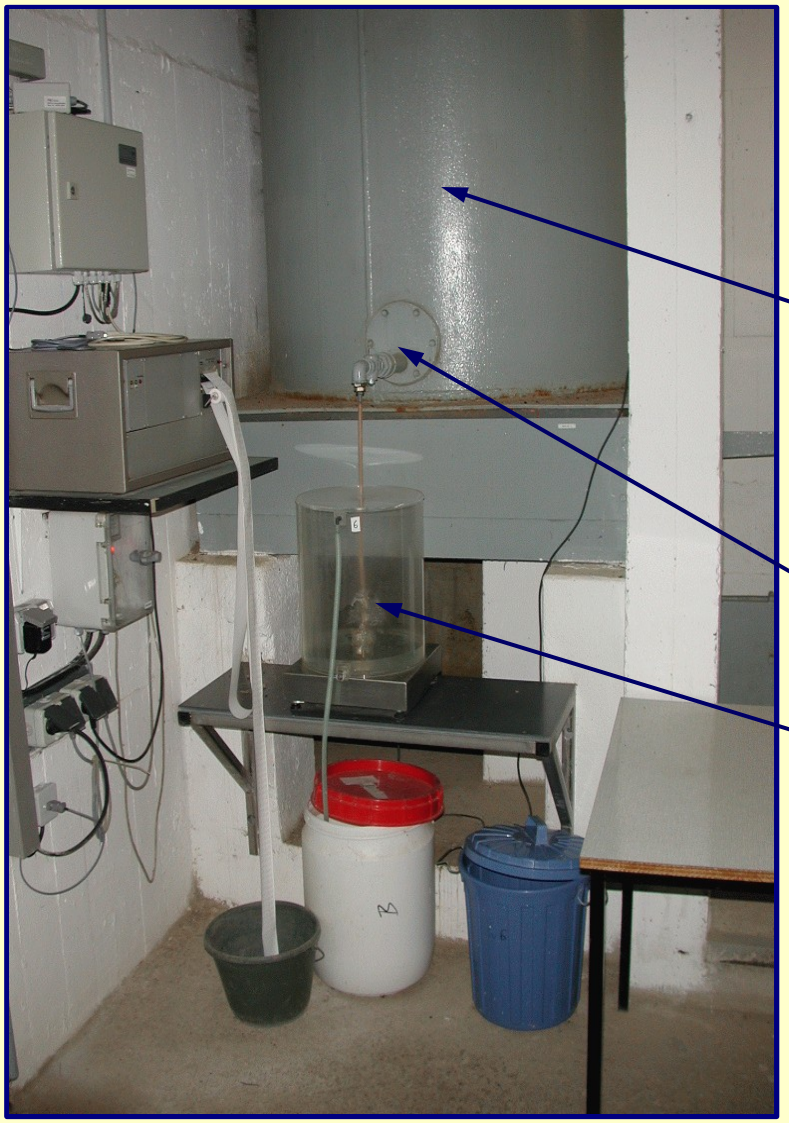
Depth 2,5 m

Surface 1 m^2

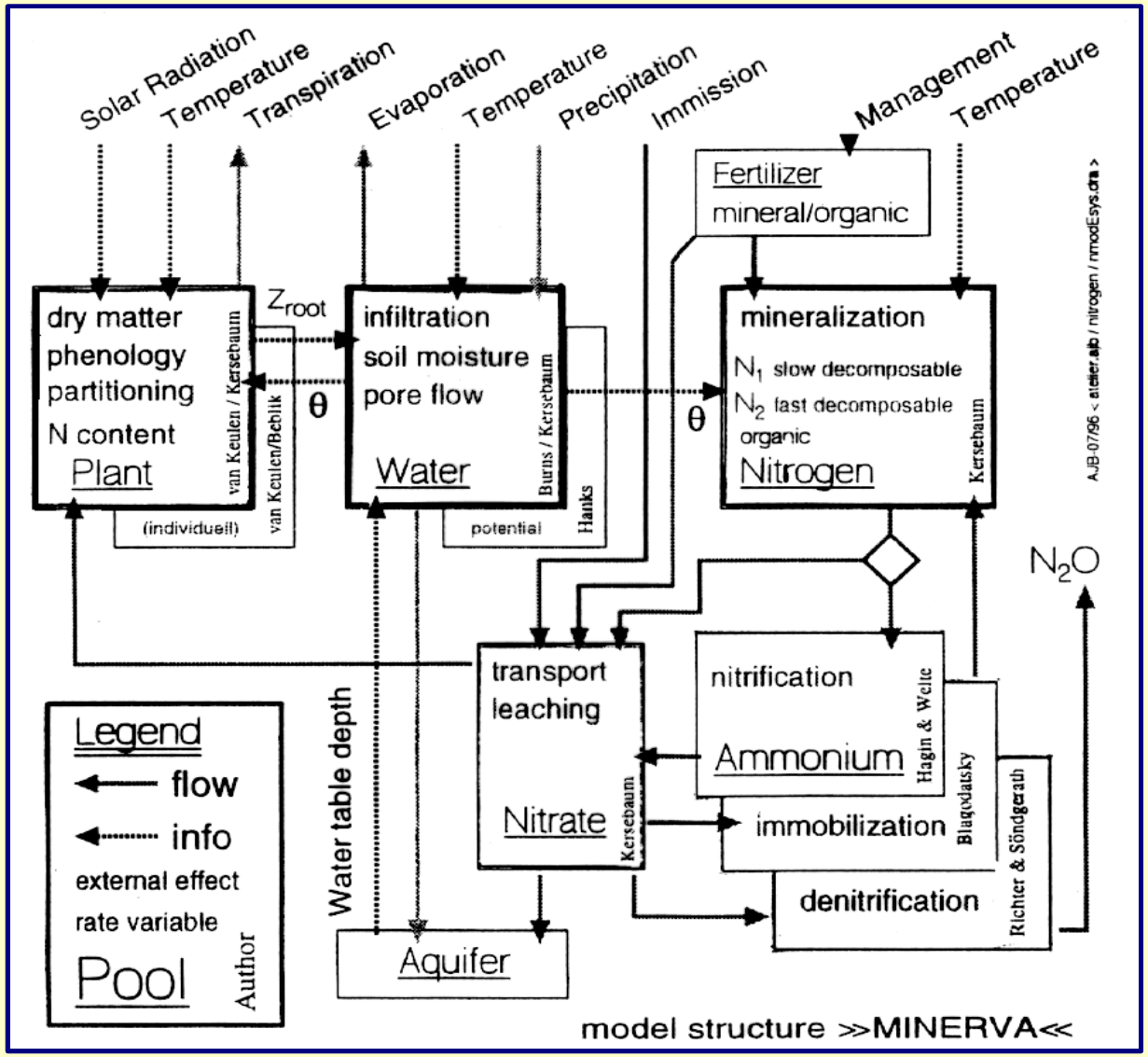
Soil: sandy loam.

Edge of the Lysimeters

Cellar of the lysimeters



Structure of the model MINERVA



Model calibration on the basis of comprehensive field experiments

Long lasting measurements by lysimeters:

measurement of different parameters of soils, soil water and soil nitrogen

Experiments on lots at different research stations:

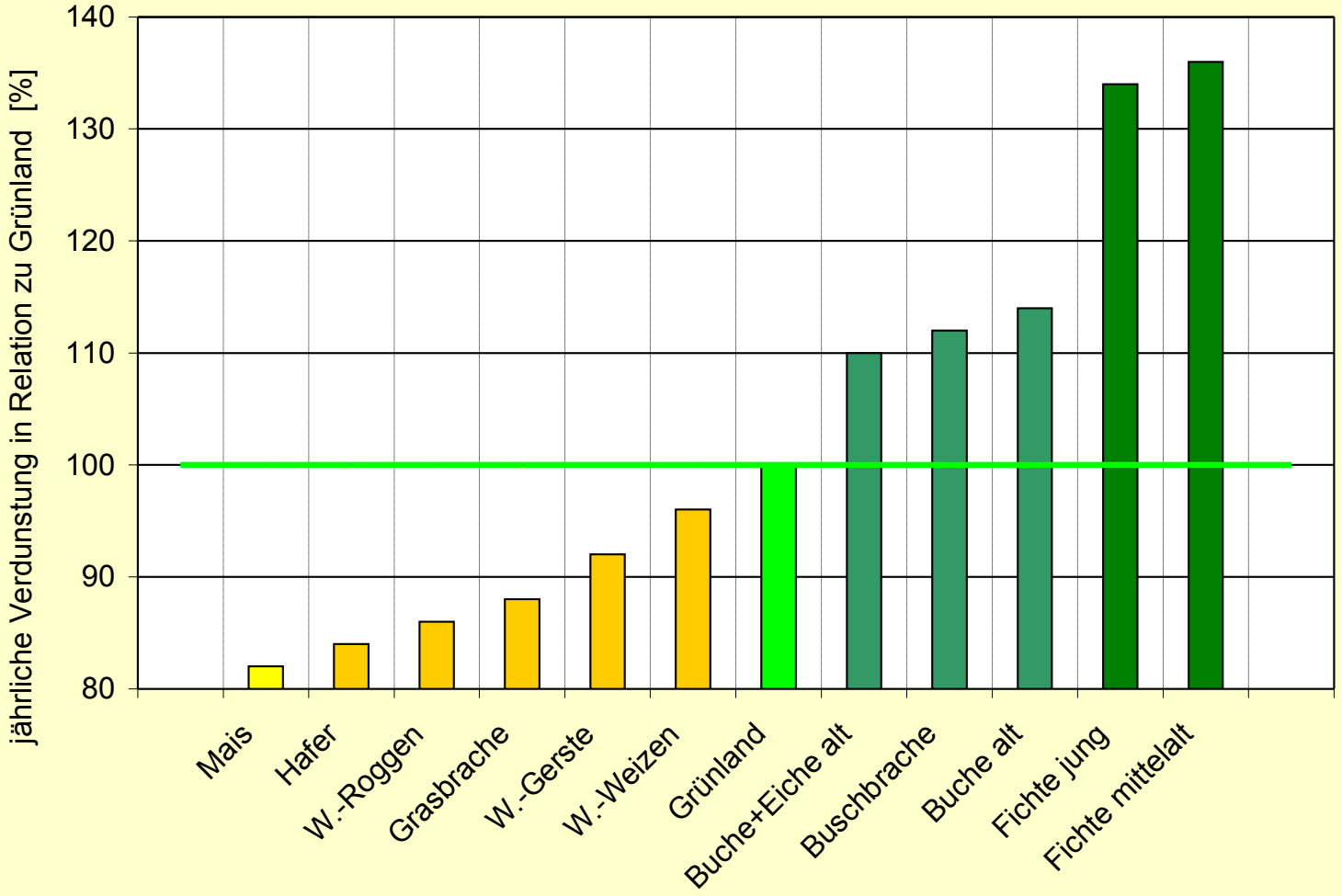
investigation of plant parameters during the vegetation period and of nitrogen uptake by plants

Field experiments under conditions of farmers practice

Model test and model validation

3. Influence of land use on soil water balance

Dependence of evapotranspiration on vegetation compared to a grass stock in % (ATV-DVWK, 2002)



Influences:

plant properties,

root distribution,

canopy closure,

length of the growing season,

stage of develop-ment,

age of trees,

hight of interception

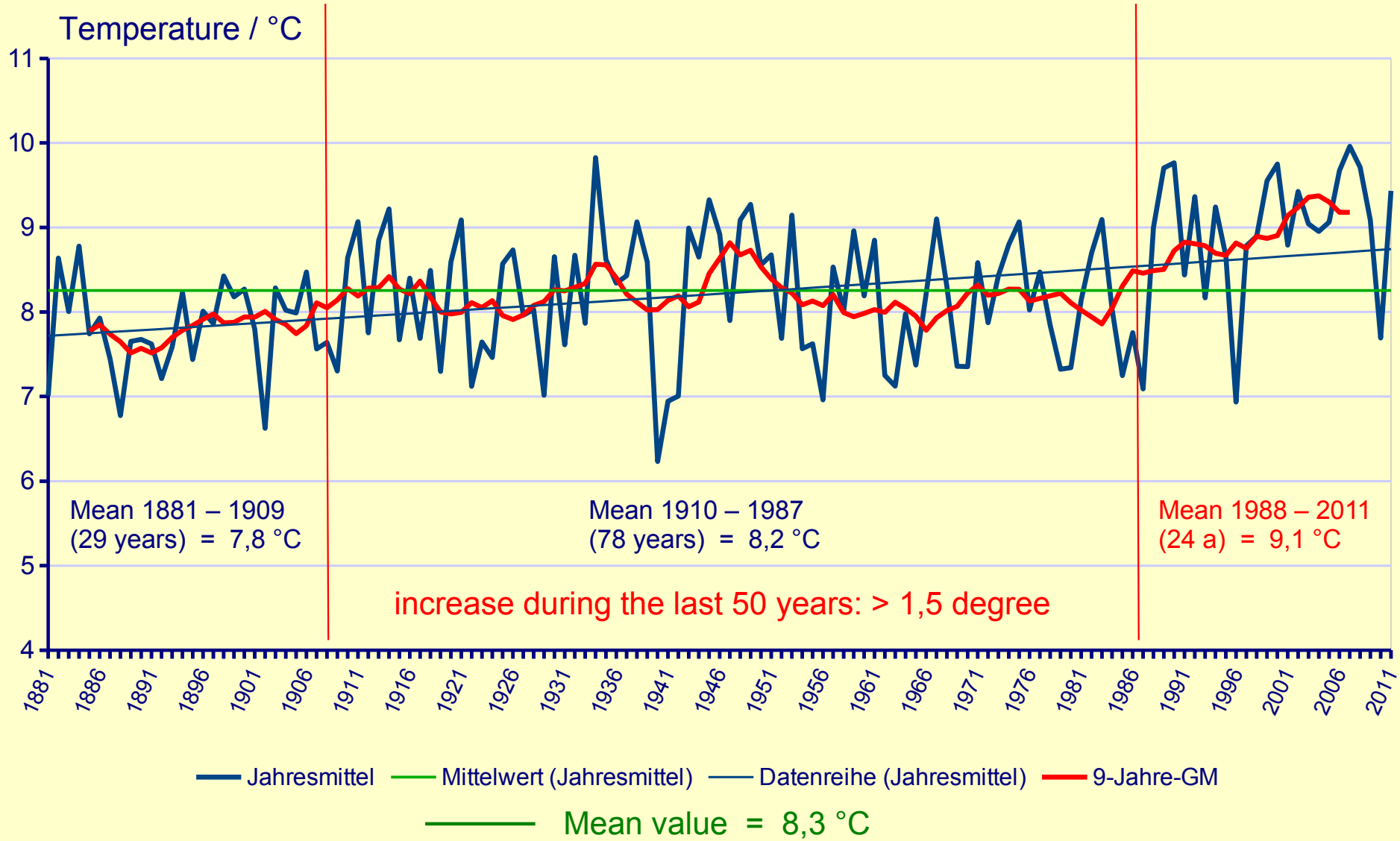
and others.

3. Influence of land use on soil water balance

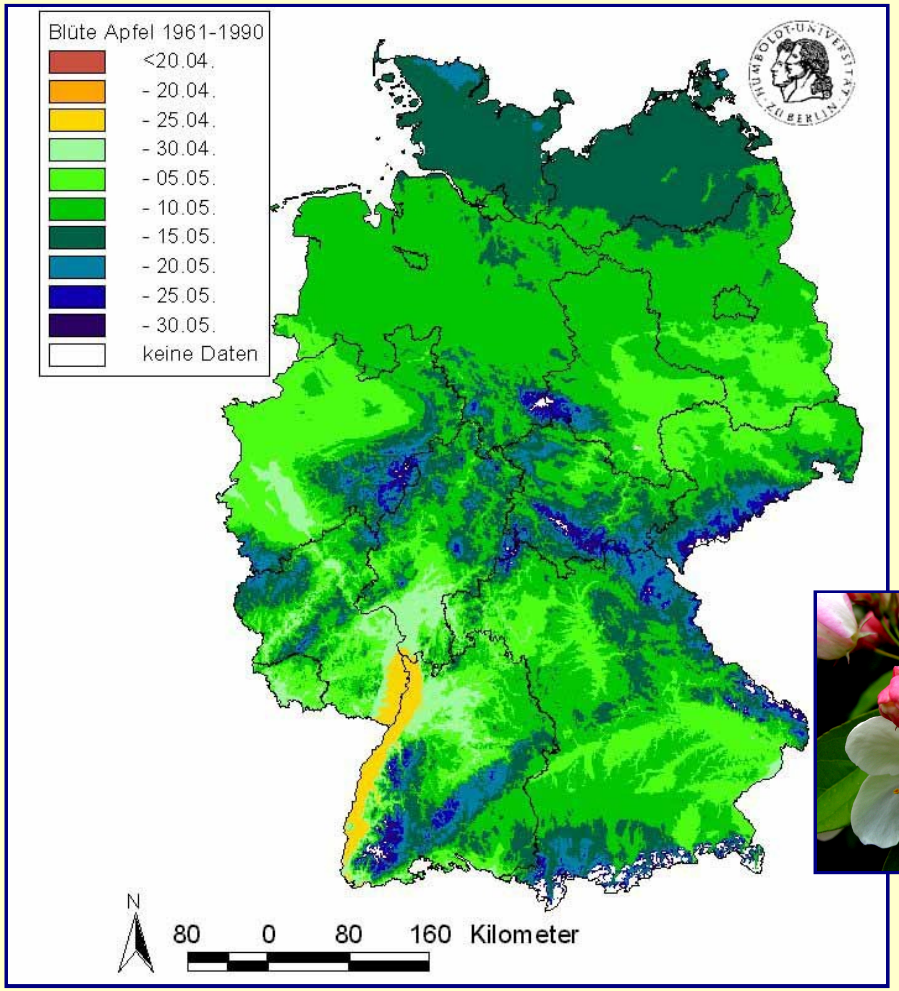
Water consumption during the growing season (Günther, 2002)

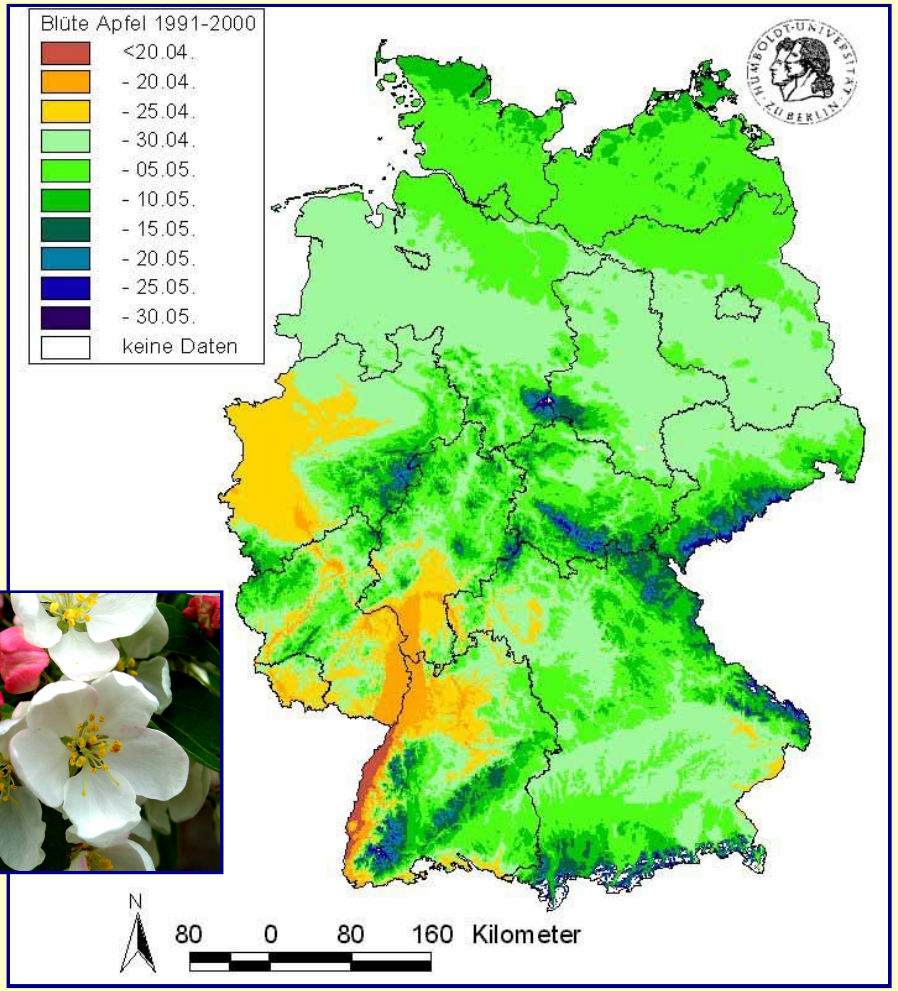
vegetation	years of investigation	water consumption during the growing season (mm)	duration of the growing season [d]	mean daily evapo-transpiration [mm]
perennial ryegrass	1990	522	349	1,5
winter wheat	1983, 1987, 1992	489	160	3,1
sugar beans	1984, 1988	430	177	2,4
summer barley	1985, 1989	331	149	2,2
potatoes	1986, 1991	243	106	2,3
onions	1999	312	112	2,8
cabbage	1997	305	105	2,9
bush bean	1995	233	68	3,4
wild herbages	1994	454	133	3,4
phacelia	1994	566	122	4,6

Annual temperatures in Mecklenburg-Vorpommern (1881 bis 2011) compared with moving avarage over 9 years



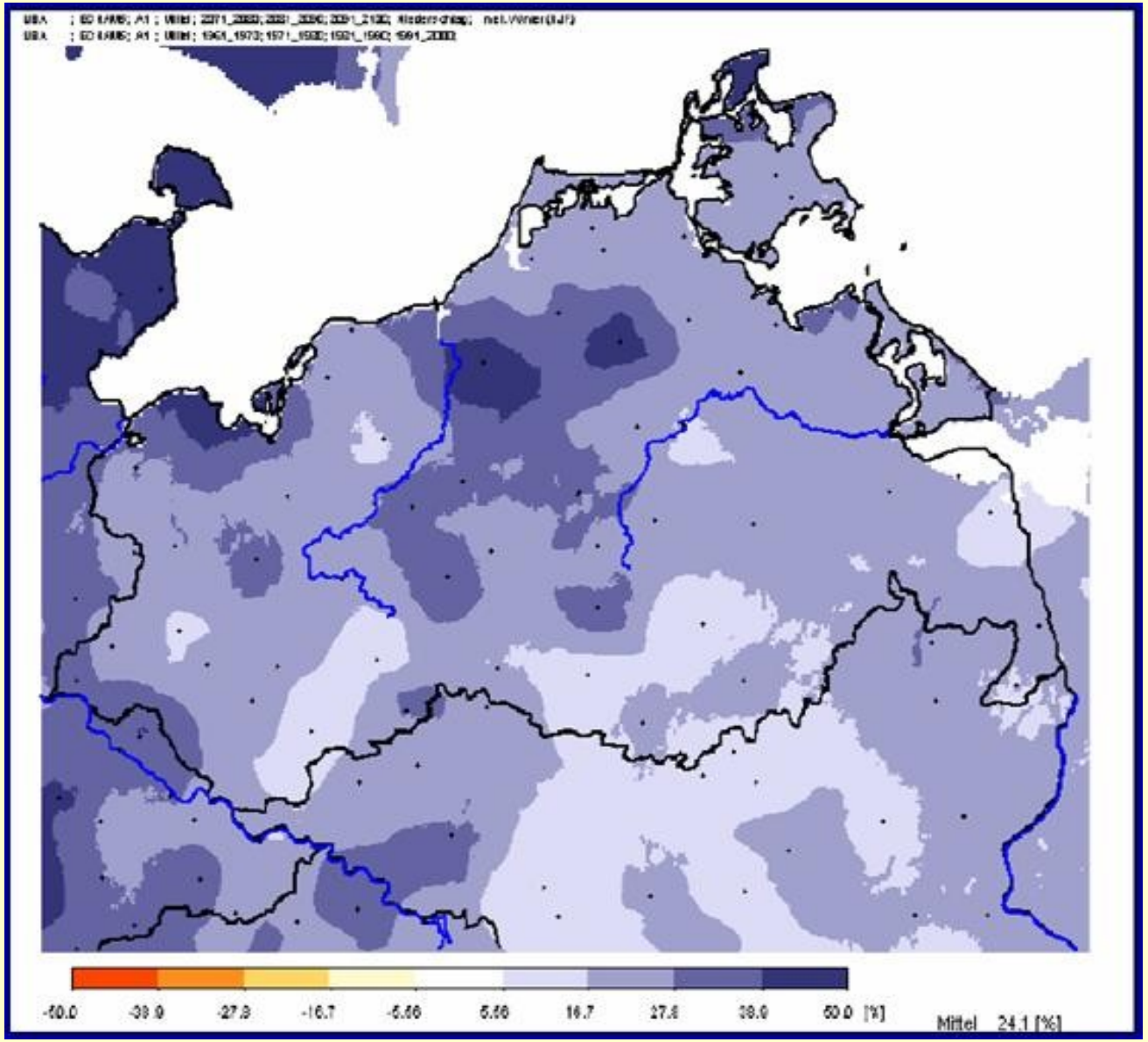
Mean beginning of apple tree blossom in Germany





Mean date: 7 th May 30 th April

4. Consequences of Climate Change



Increase of winter precipitation

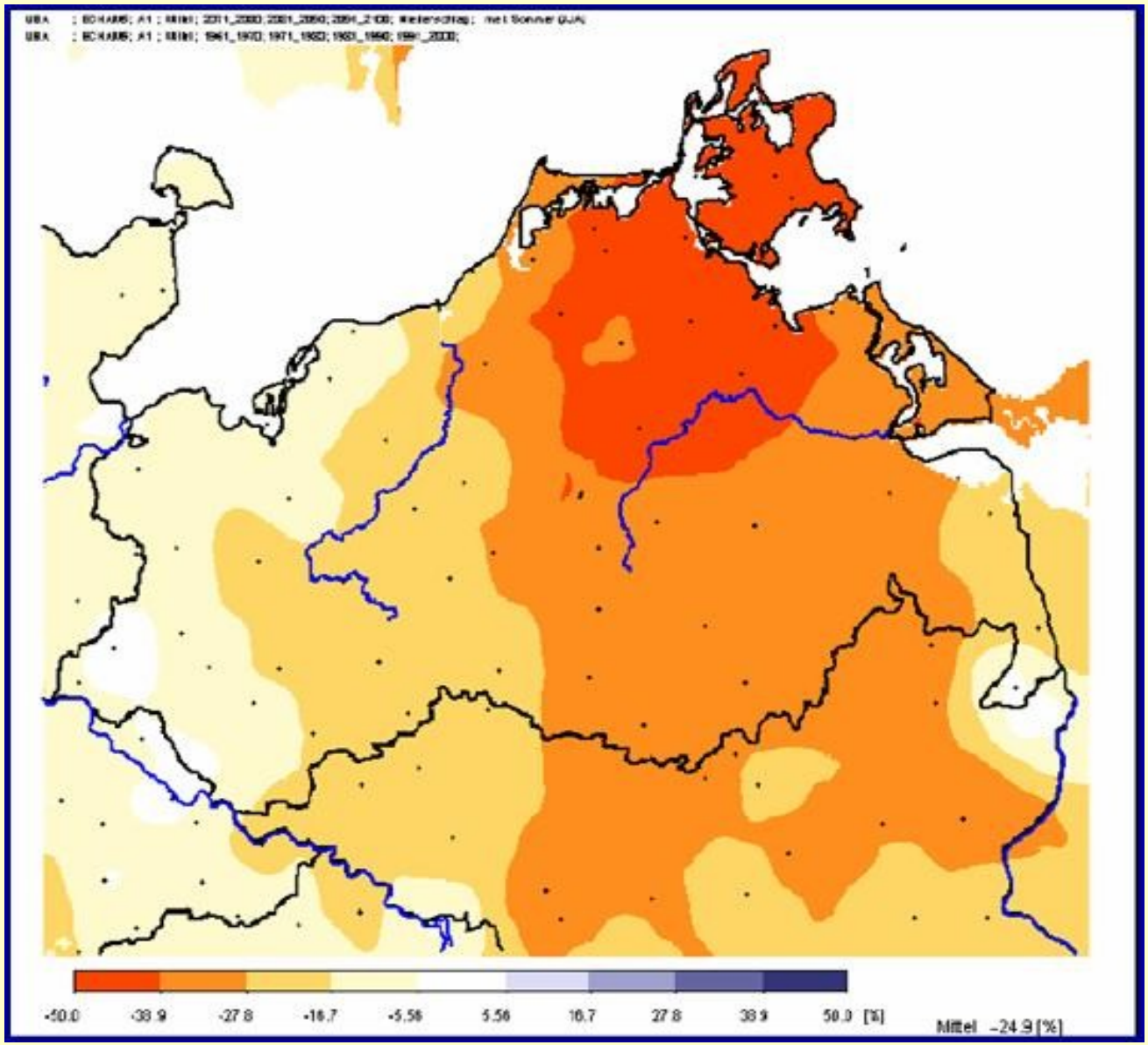
+ 5 . . . + 50 %

A1B-Szenario,

Regional Downscaling by WETTREG

Comparison 2071 bis 2100 against 1961 bis 2000

4. Consequences of Climate Change



Decrease of summer precipitation

0 . . . – 50 %

A1B-Szenario,

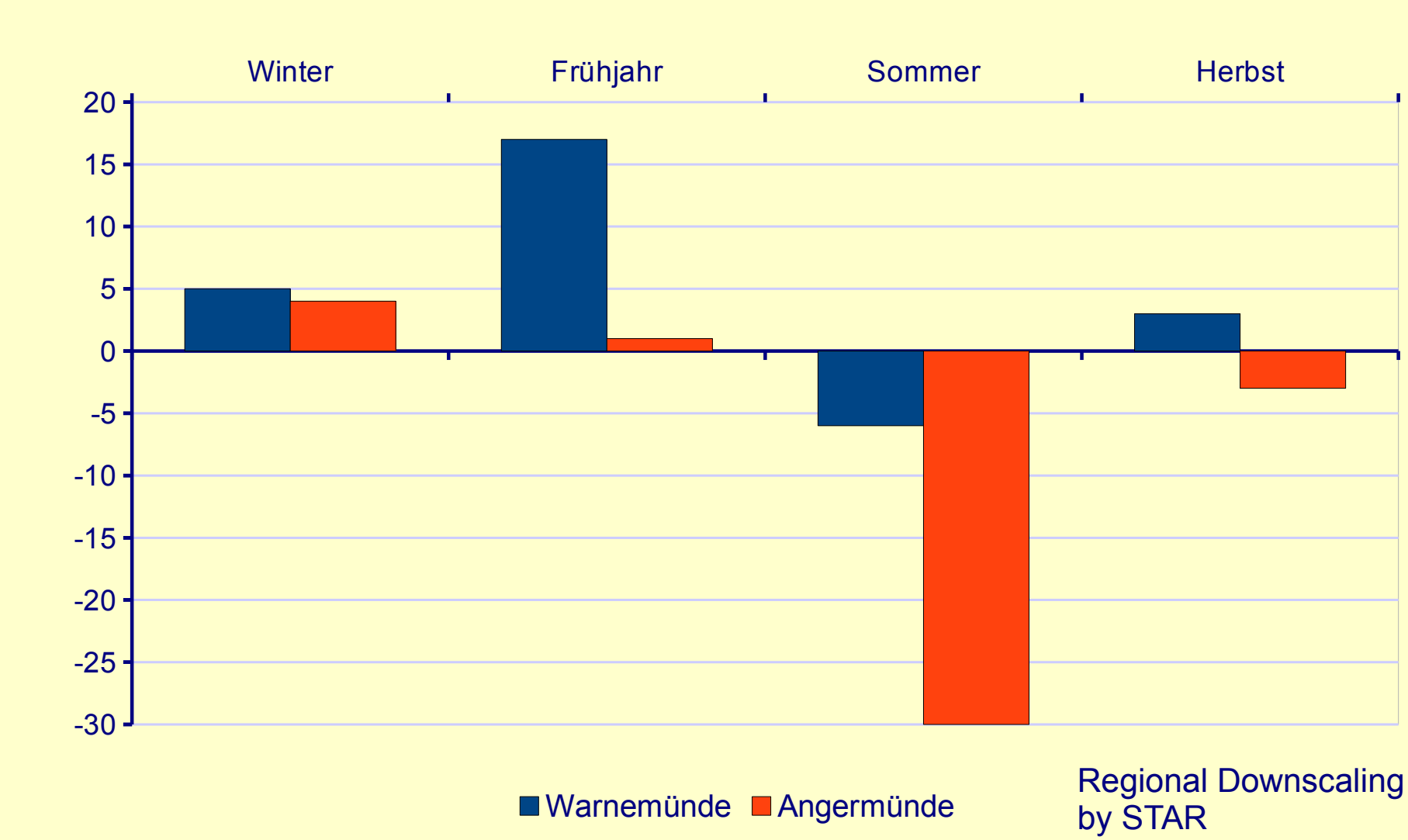
Regional Downscaling by WETTREG

Comparison 2071 bis 2100 against 1961 bis 2000

Higher demand of irrigation water in agriculture

Increase of erosion by heavy rains

Annual evapotranspiration of two station in the west (blue) and east (red) of Mecklenburg-Vorpommern (2004- bis 2055 compared with 1952 - 2001)



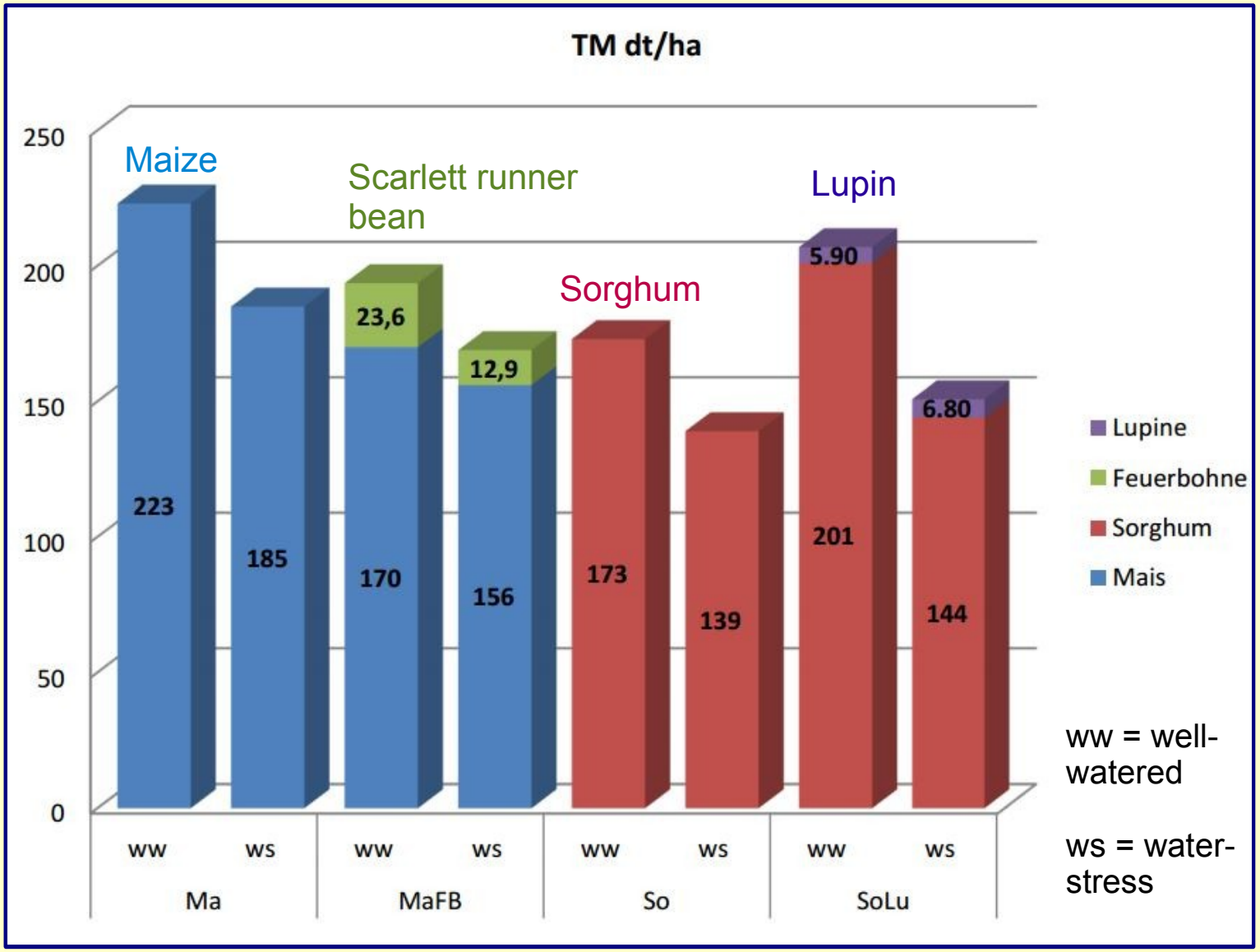
Investigation of mixed crops under water stress conditions (1)

Investigation of mixed crops under water stress conditions (2)

water stress condition

well-watered

Yield in dependence on water supply and vegetation



Flooded wetland near the coast of the Baltic Sea

(17. August. 2011)

Consequences

higher storm surges

flooding of lower river sections

waterlogging and re-wetting by subterranean flow processes

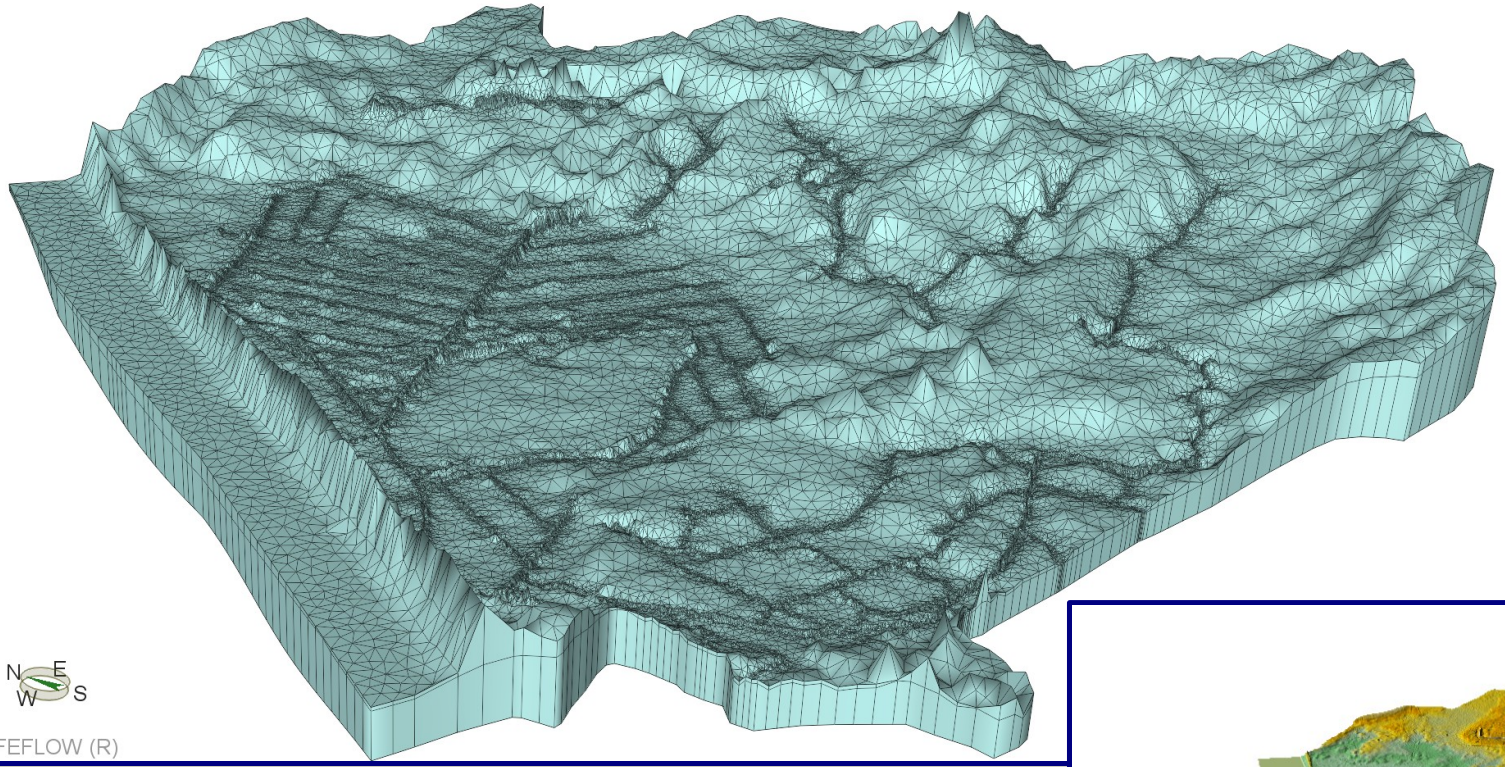
salinization of ground water

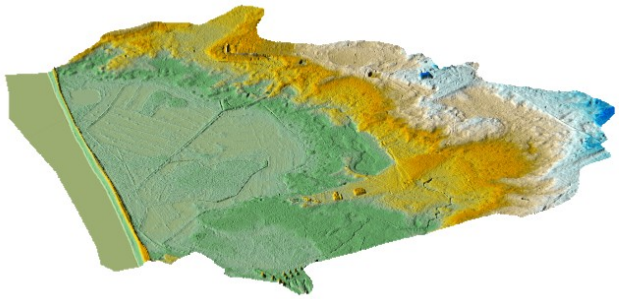
changes of land use and vegetation

Investigation area „Hütelmoor“ in summer 2011

Foto: Anne Hohlbein

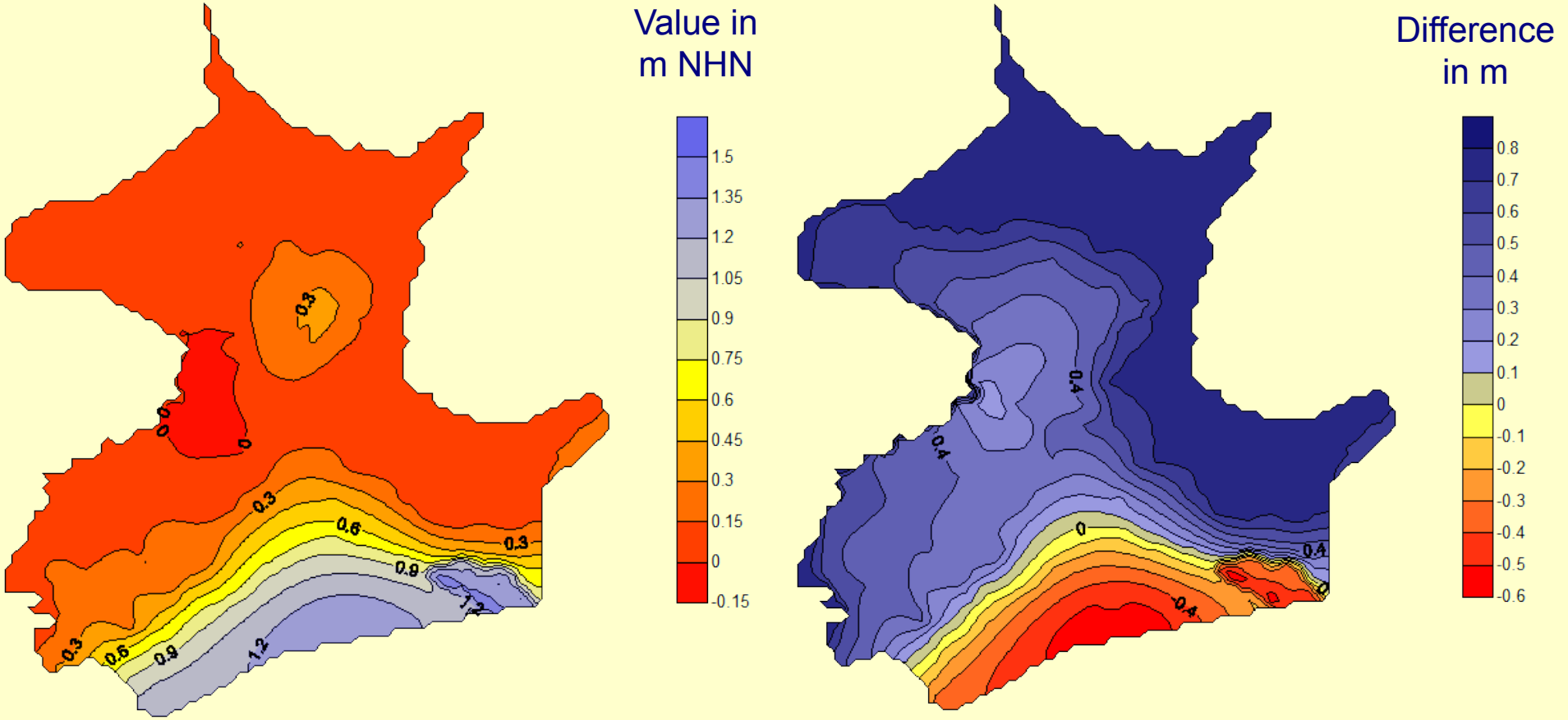
Investigation area „Hüttelmoor“ – groundwater model and digital terrain model (small picture)





Editor: Anne Hohlbein

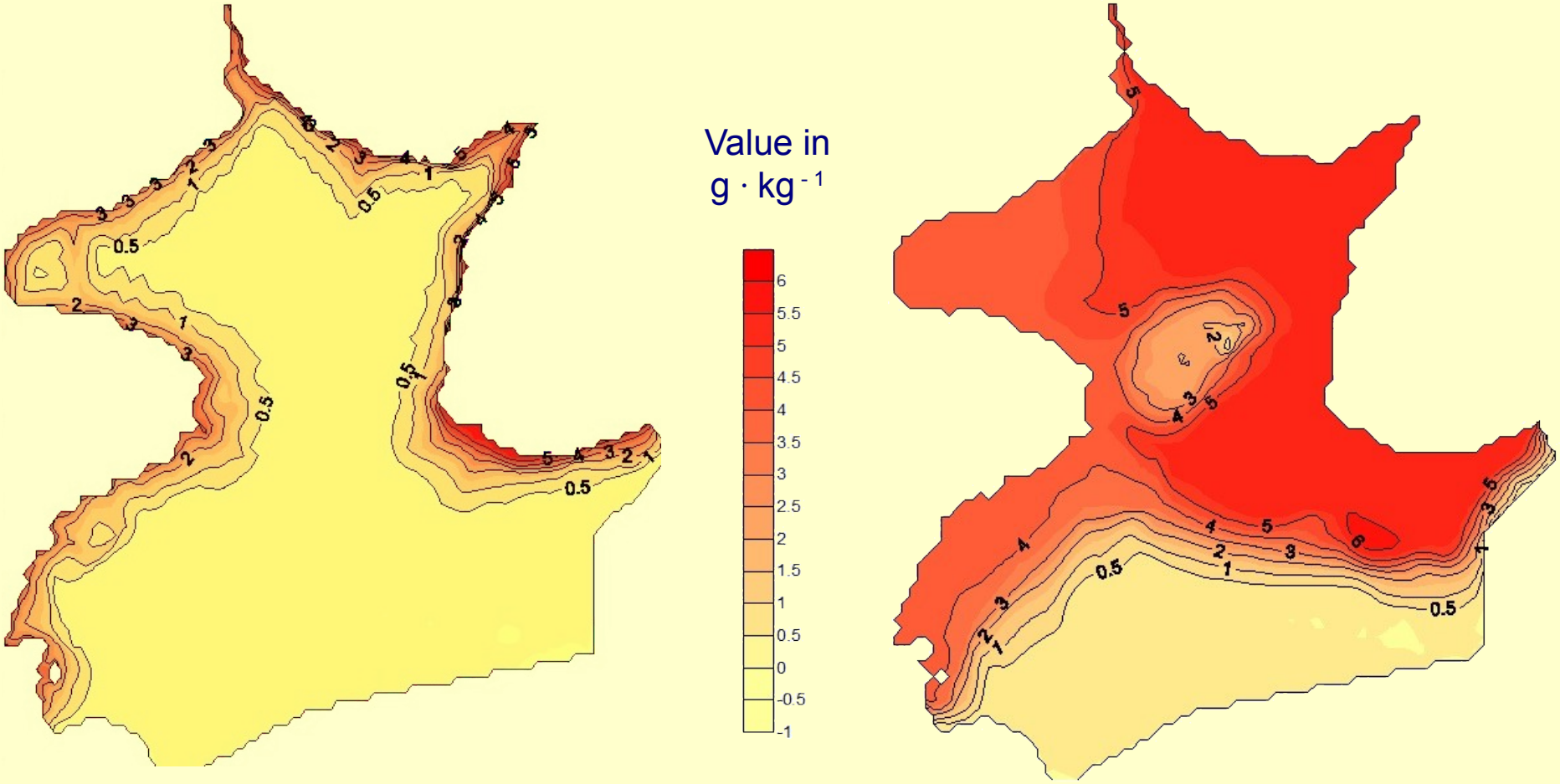
Groundwater table in Michaelsdorf



Present state
(1983 to 2012)

Future conditions (1971 – 2000)
compared to the present state

Salt water concentrations in Michaelsdorf



Present state
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Future conditions (1971 – 2000)
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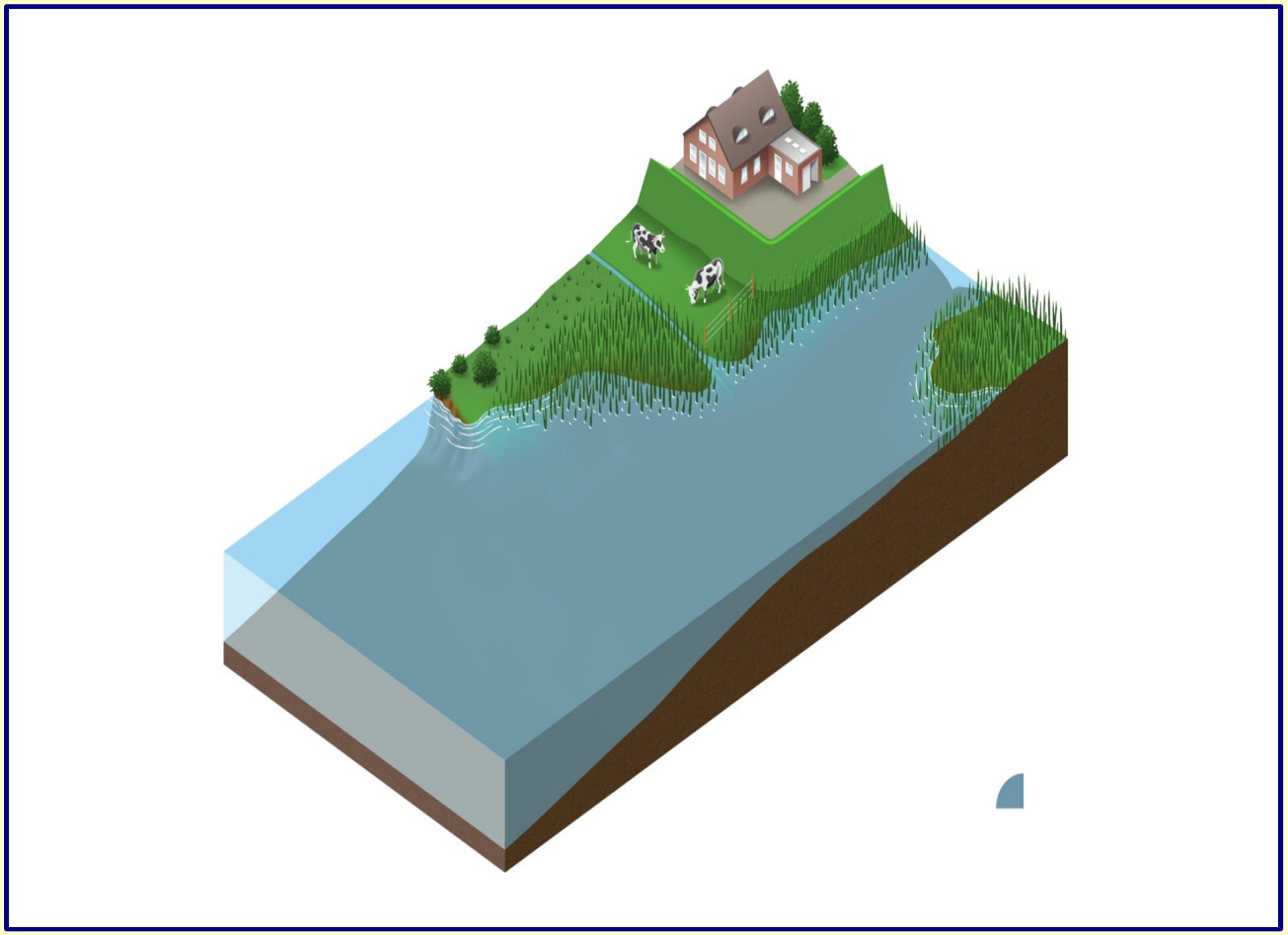
Possible future strategies to manage coastal near lowlands



Possible Strategies

Business as usual with adapted flood protection

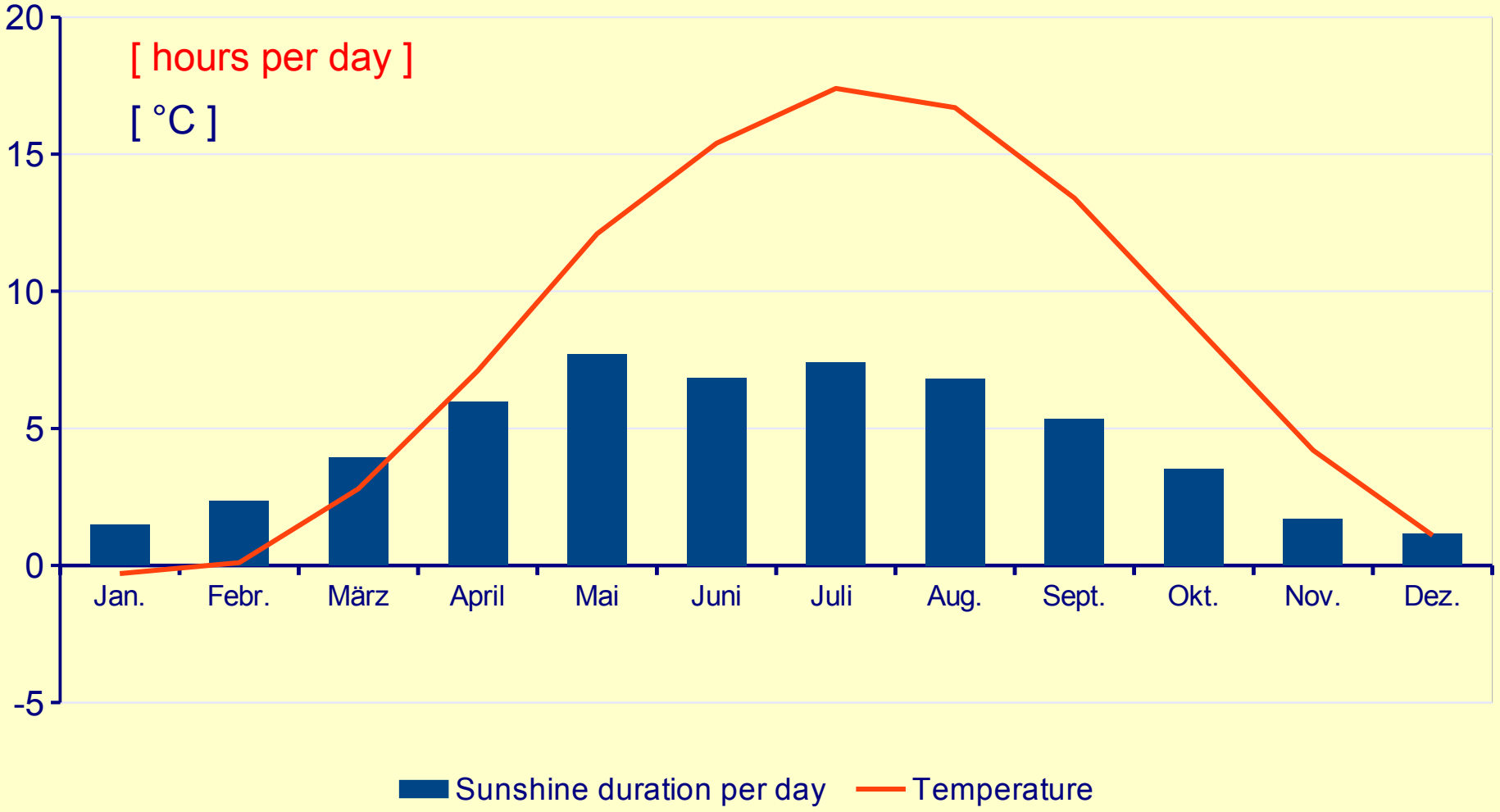
Water management and flood protection by polders

Rewetting and carbon sequestration by reed and peat growth

Stakeholder = management as requested

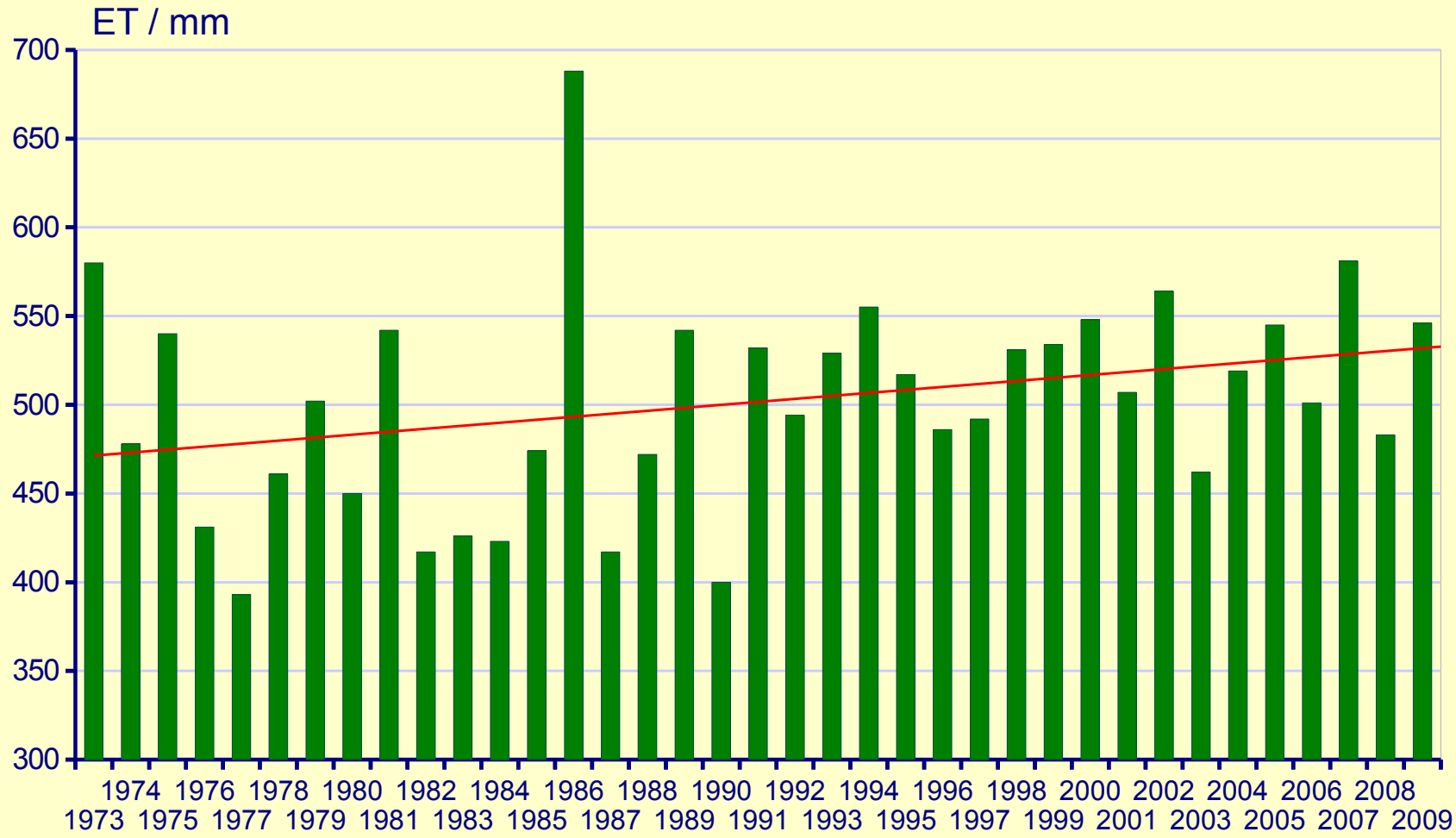
Thank you very much for your attention !

Mean monthly temperature and sunshine duration in Mecklenburg-Vorpommern



Annual evapotranspiration at the lysimeter station Groß Lüsewitz

(balanced in periods from November to Oktober)

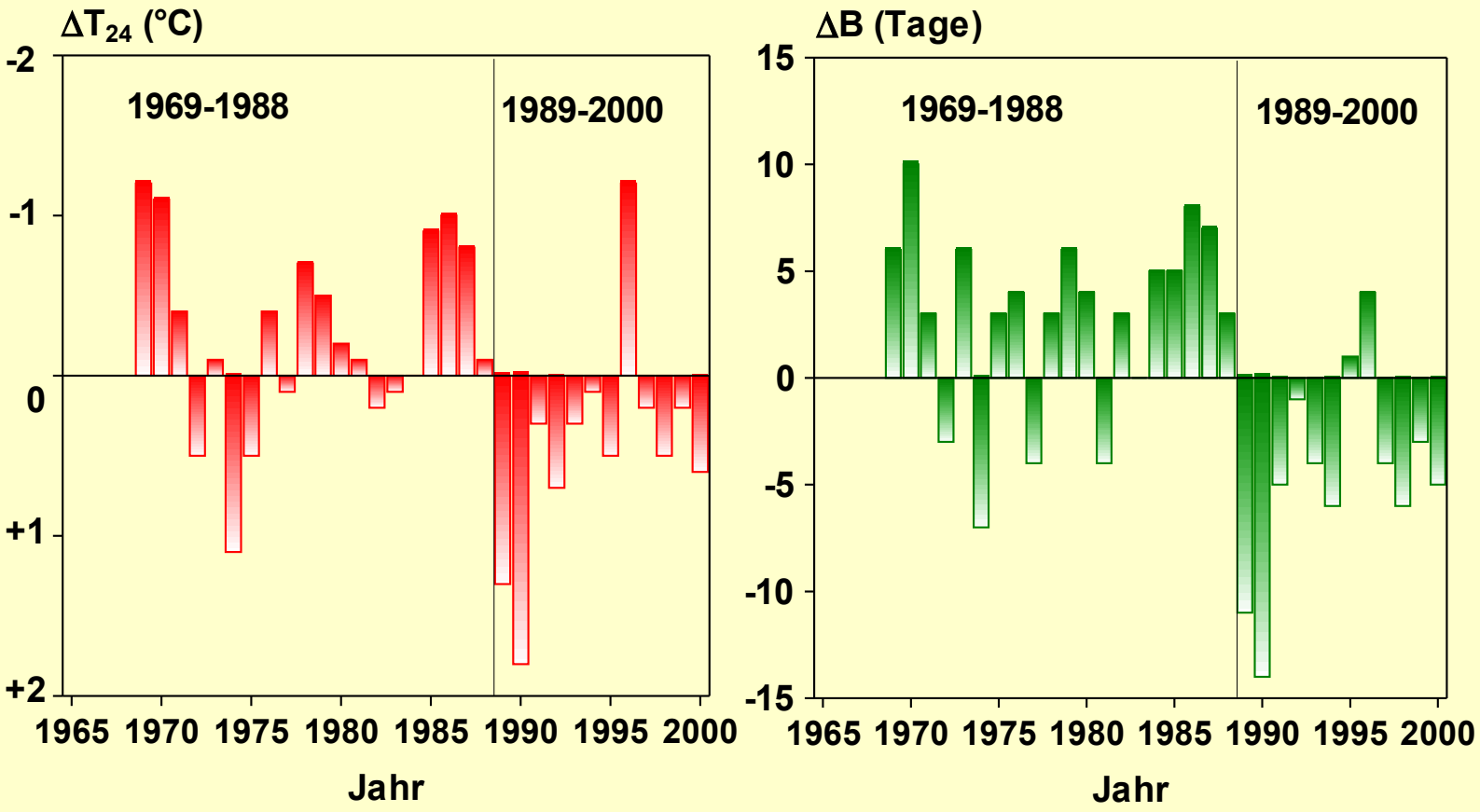


Lysimeter Station Groß Lysewitz

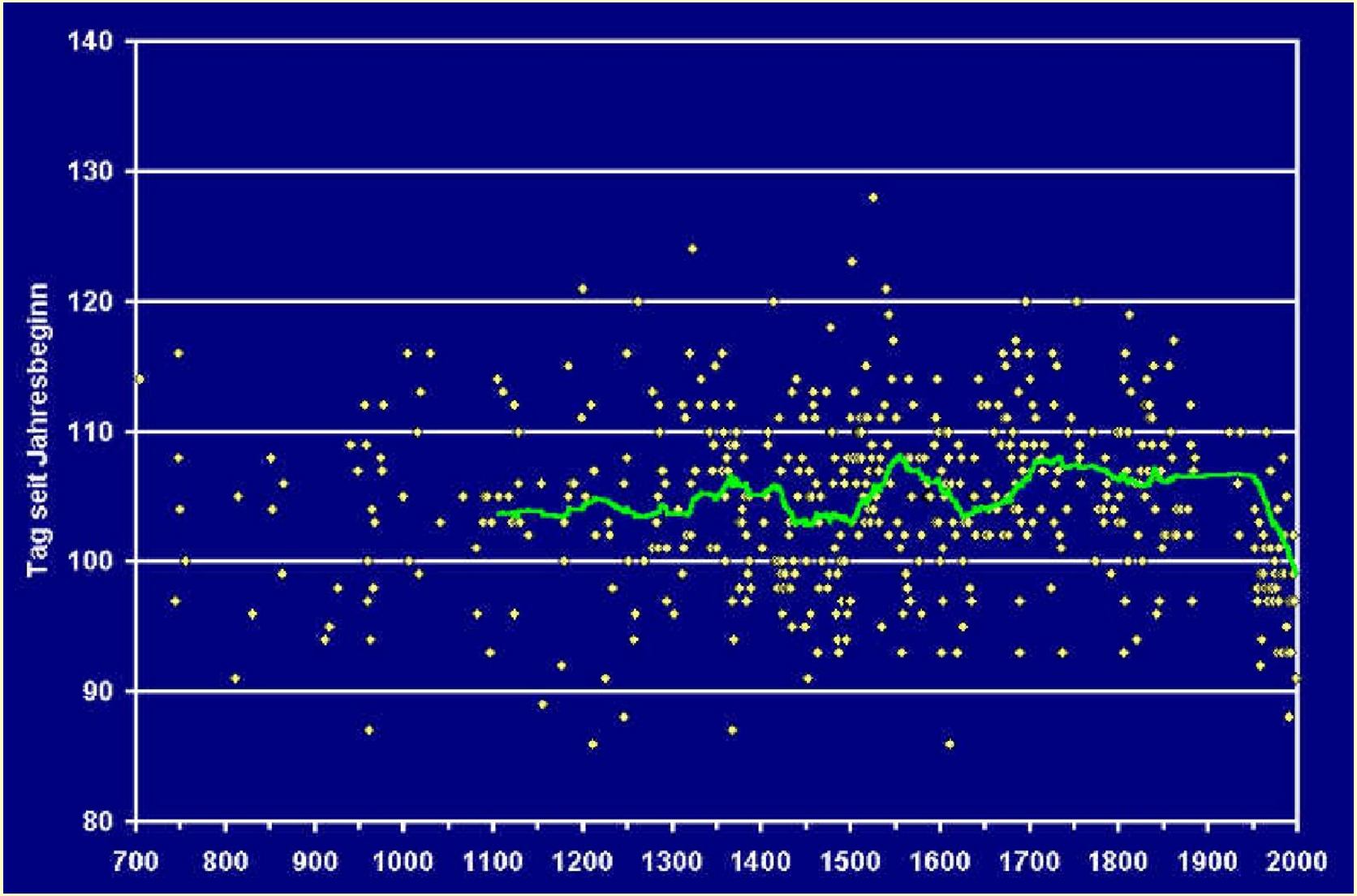
Equipment for measurement of soil moisture

Meteorological measurements

Correlation between change of mean daily temperature T_{24} and the begin of the growing season B (mean value = April 23th) in Europa



Blossom of cherries during the last 1.300 years since 705 in Kioto (Japan)
(green line: moving average over 50 years)

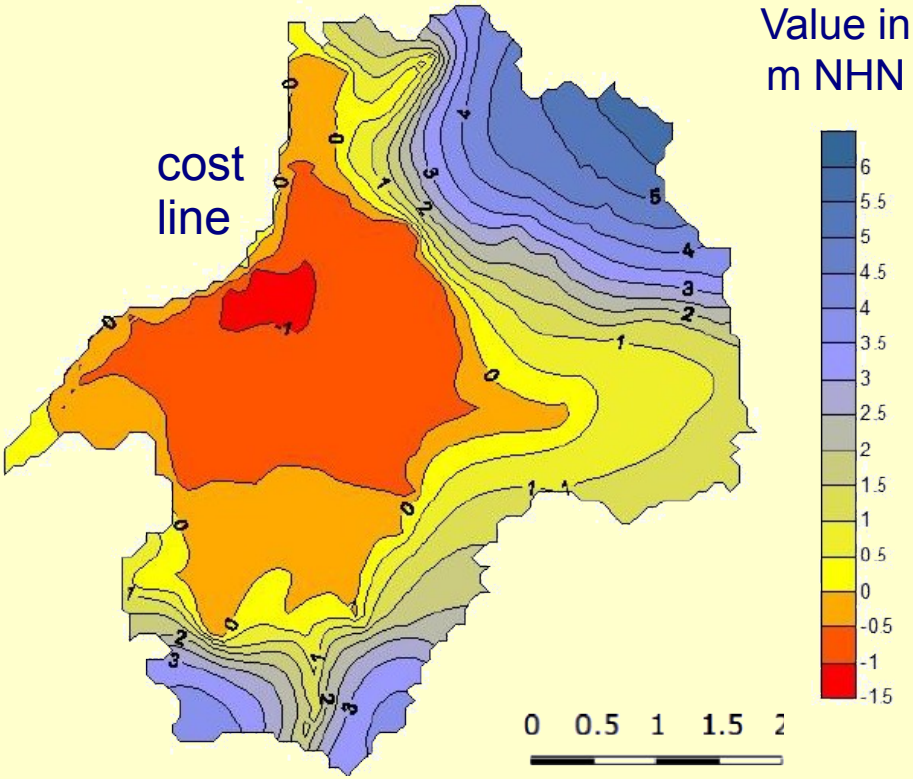


http://www.dmg-ev.de/fachausschuesse/Biomet/phaenologie.htm

Precipitation

Present	673 mm · a $^{-1}$
Future	539 mm · a $^{-1}$

Groundwater table in Neu Bartelshagen



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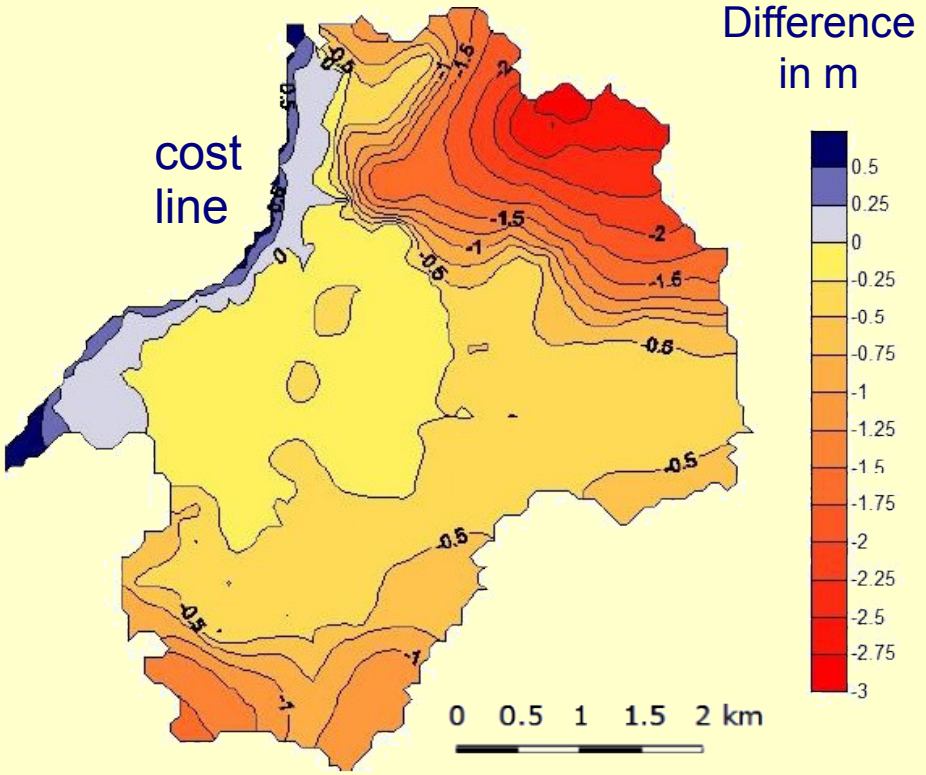
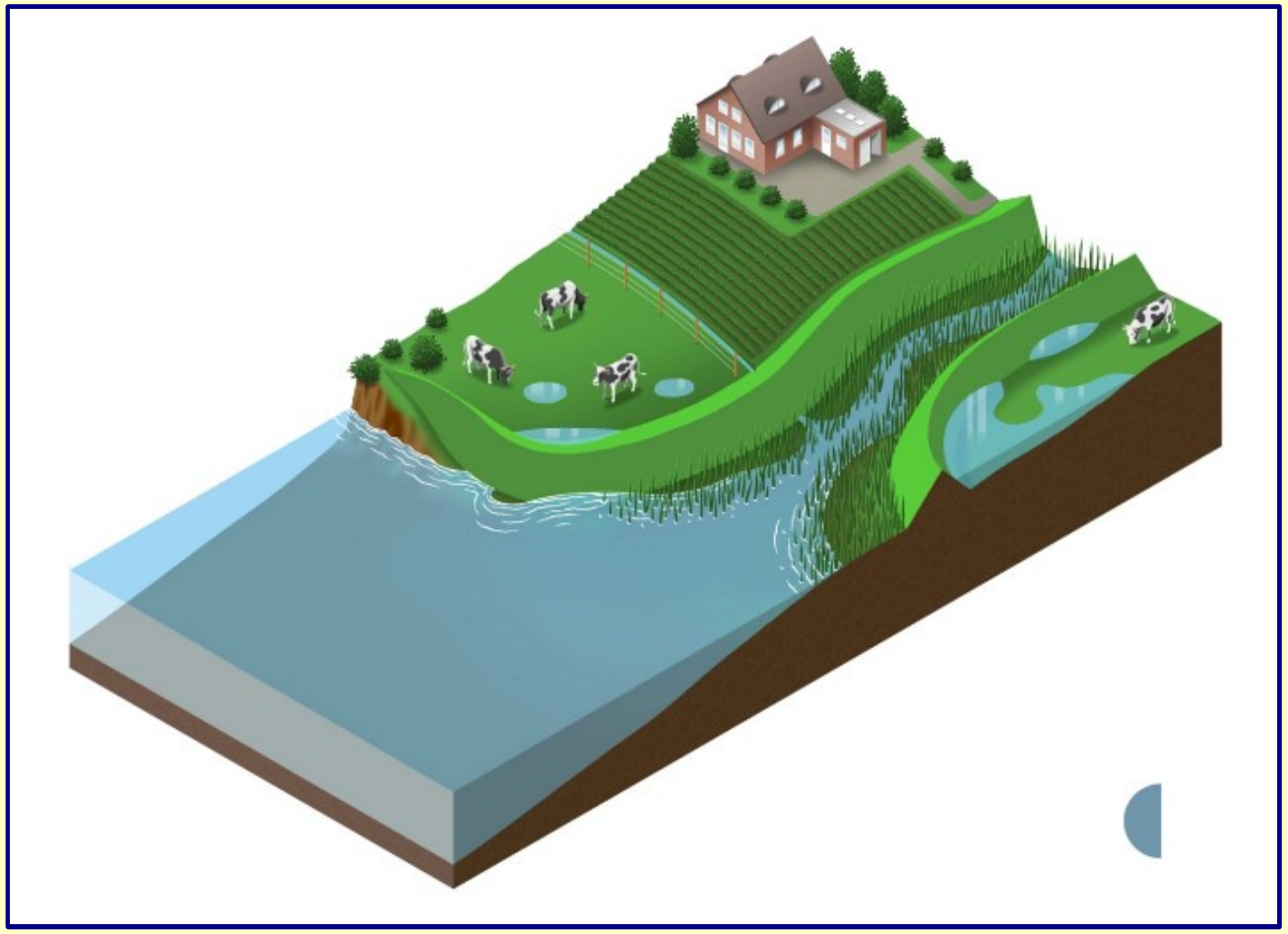


Future conditions (1971 – 2000)
compared to the present state

Possible future strategies to manage coastal near lowlands (1)



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