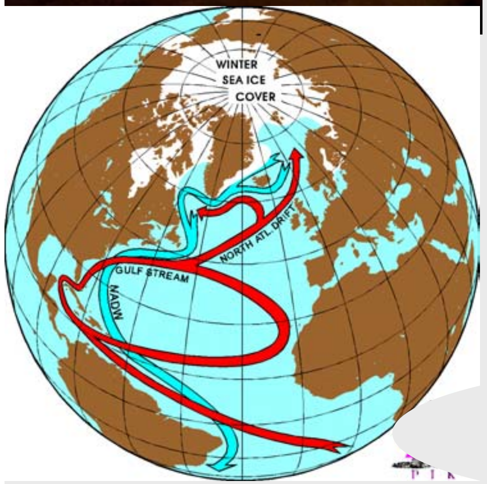


J.P. Kropp
Potsdam Institute for Climate Impact Research

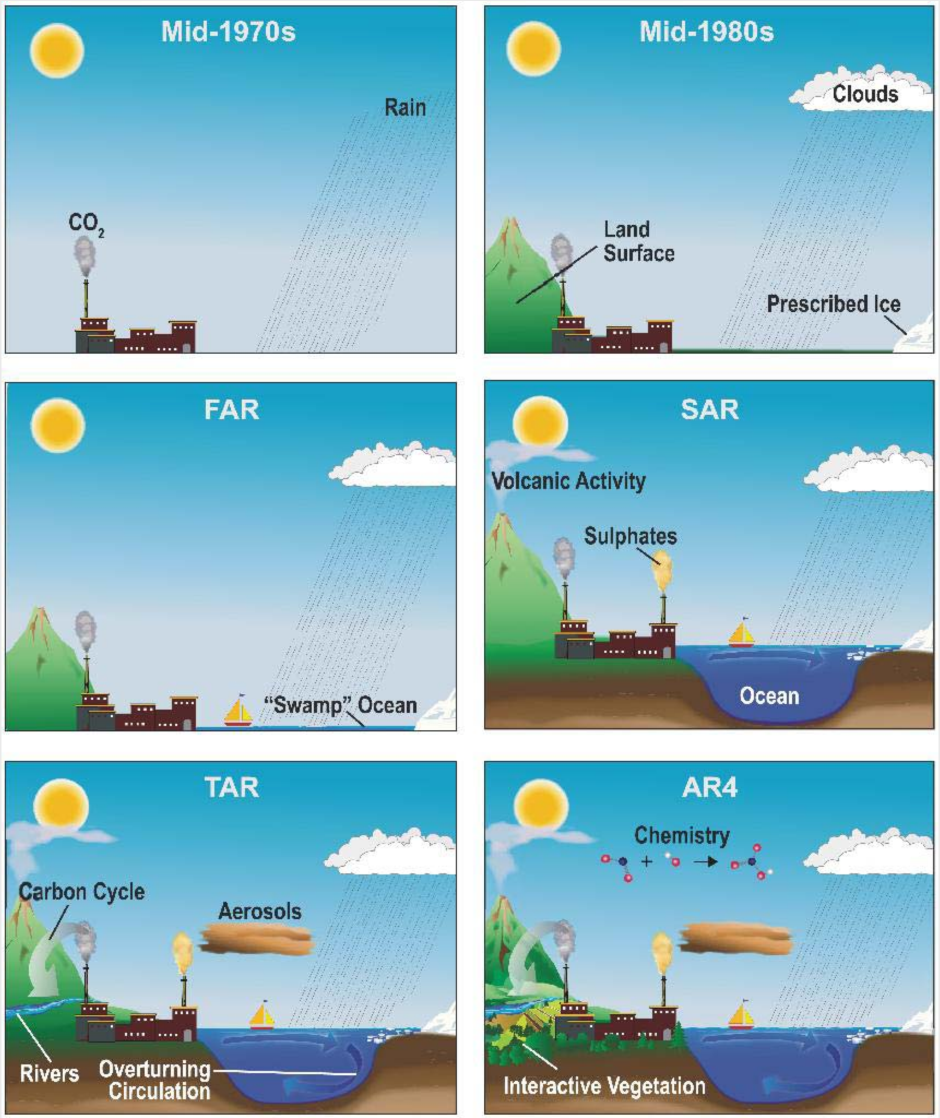
The 4th Assessment Report of the IPCC: what does it imply for adaptation to adverse effects of CC in the Baltics?

Structure

1. Introduction
2. The “News” from the IPCC
3. Climate Change Scenarios: what can we learn?
4. Sea level rise: should we adapt or should we flee?
5. Summary

kropp@pik-potsdam.de

Improvement of Knowledge



Grid size: 500 km ⟶ 110 km
Smaller grid sizes need additional downscaling (statistical/dynamical)

kropp@pik-potsdam.de

A few words about uncertainties......

Confusion arises between weather and climate when scientists are asked how they can predict climate 50 years from now when they cannot predict the weather a few weeks from now!

Chaotic nature of weather makes it unpredictable beyond a few days. Projecting changes in climate (30yr average weather) due to changes in atmospheric composition is a very different and much more manageable issue.

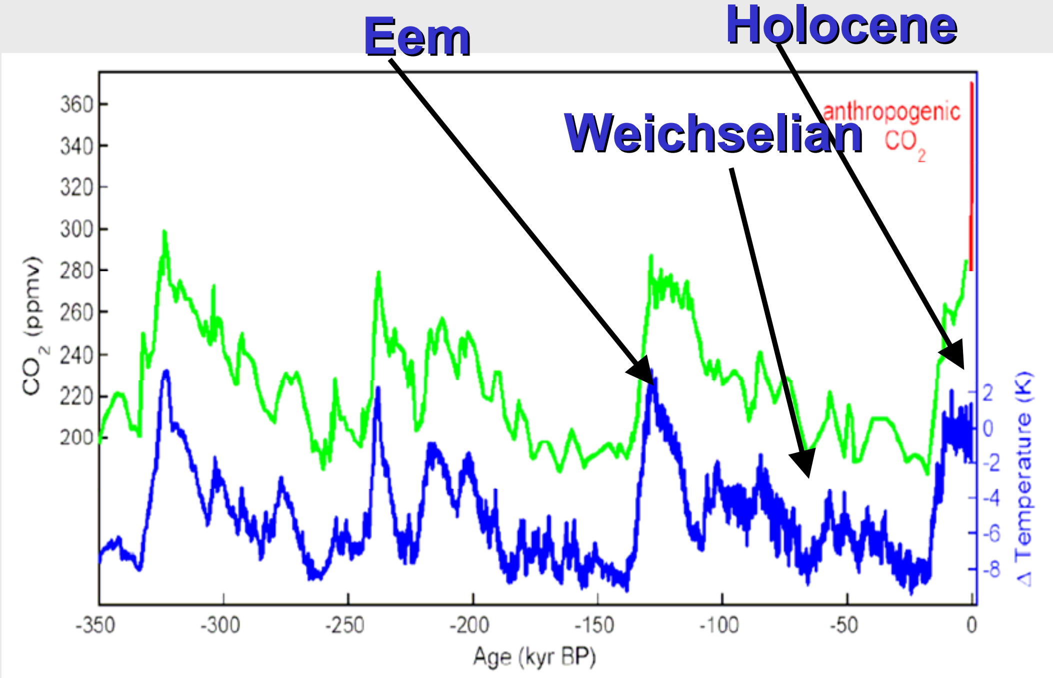
As an analogy, while it is impossible to predict the age at which any particular man will die, we can say with high confidence that the average age of death for men is about 75.

It is largely the uncertainty of *"anthropogenic forcing"* which determines the range of possible scenarios and which makes them unsuitable for concrete short-term and local-scale related decision making!

kropp@pik-potsdam.de

Atmospheric CO_2 Concentration

CO_2 concentration for the last „700.000 yrs“ (Milancovitch cycles)
Average for glacials: 185 ppm, duration approx. 90.000 yrs
Average for interglacials: 280 ppm, duration 10-15.000 yrs
Current: 385 (400) ppm (35%! highest value since 700 kyrs)
Temperature: follows with a delay of decades



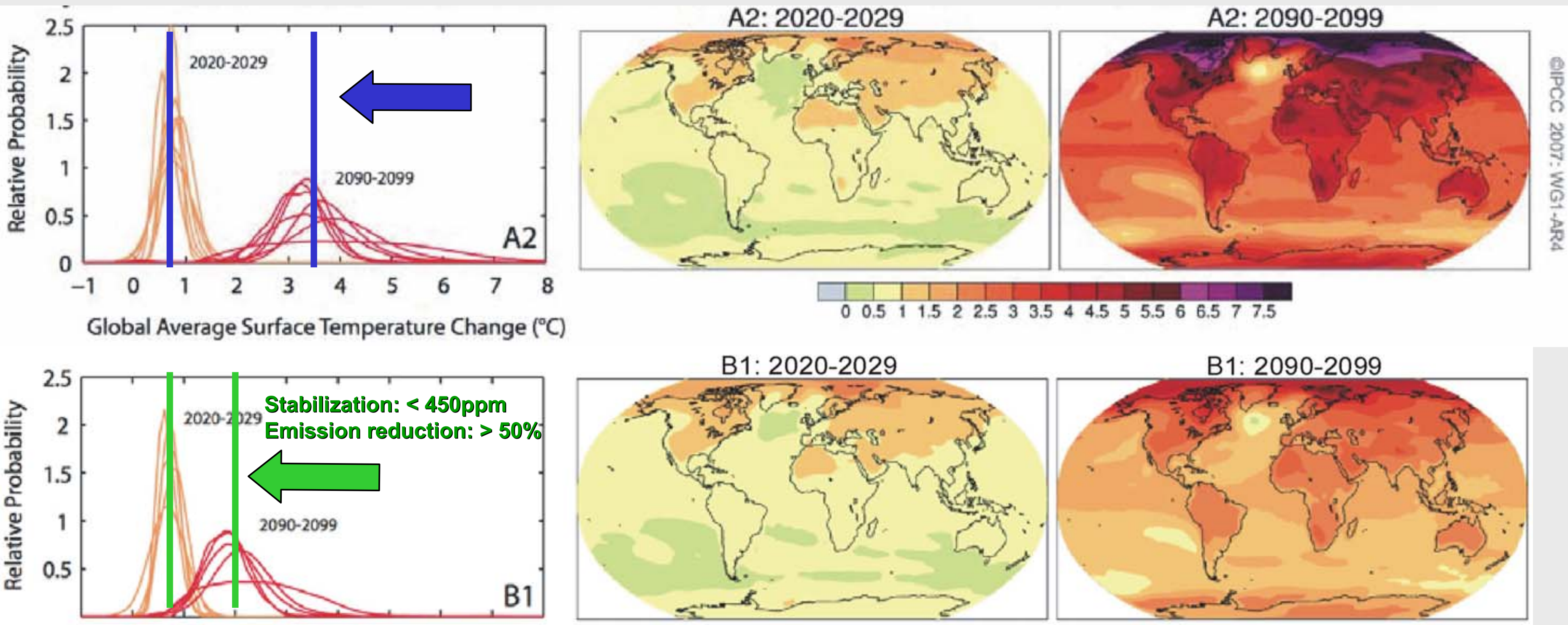
Epica 2004

kropp@pik-potsdam.de

We are on the way to future....
FAR - IPCC SRES B1/A2

The anthropogenic forcing:

A2: heterogeneous world, economic growth local (income ratio: A1/NA: 4.2), introduction of technology: fragmented and slow, wealth gap remains, increasing population (~15 bn, 2100)



B1: Convergent world (sustainability!), resource-efficient technologies, north-south equity (income ratio: A1/NA: 1.8), emphasis on global solutions, stable population (~7 bn, 2100)

IPCC 2007

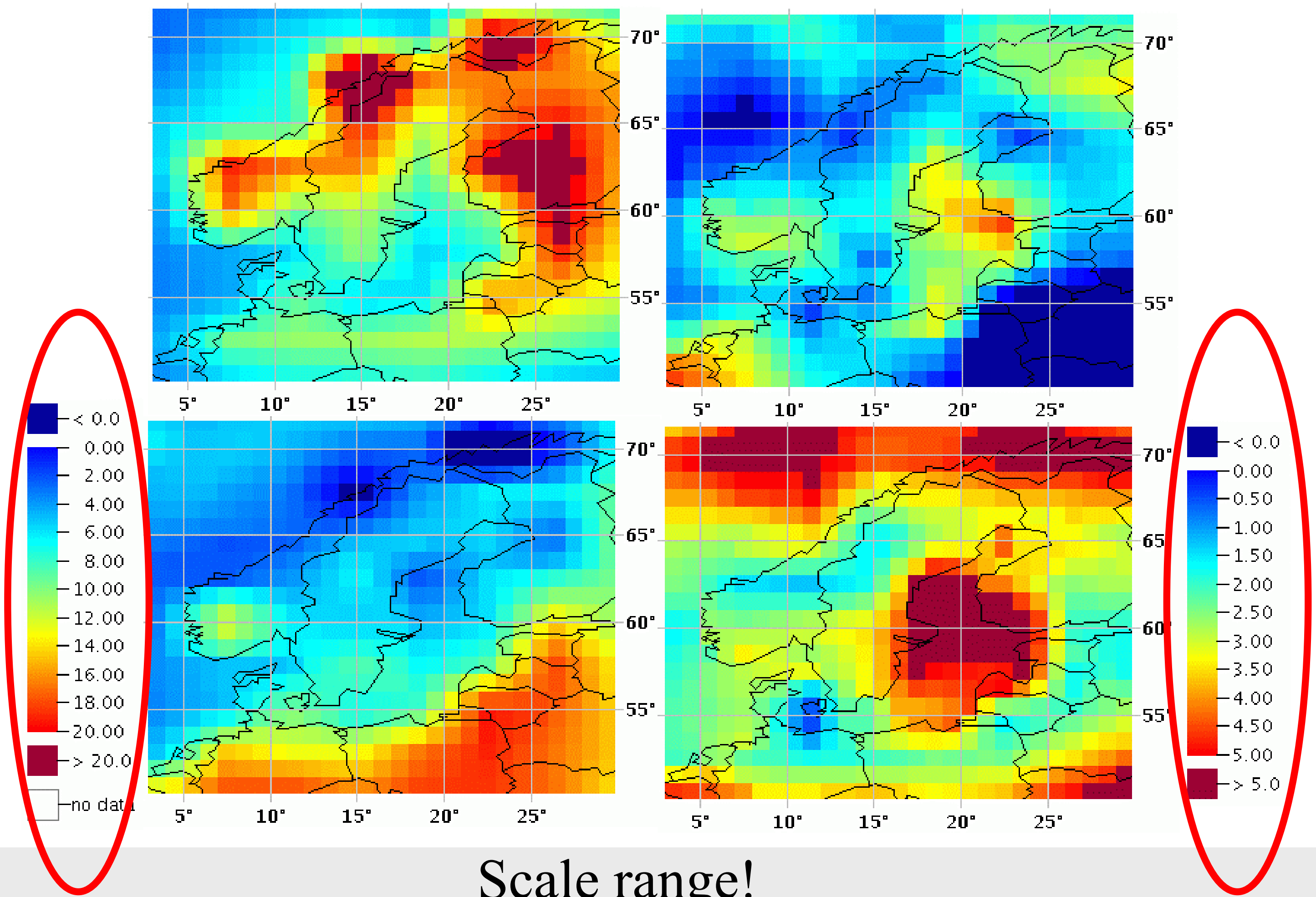
kropp@pik-potsdam.de

AR4 comparison B1/A2 : ΔT(2100-2000) (model HadCM3, 1º)

Annual Avg. Min. T   Annual Avg. Max. T

B1

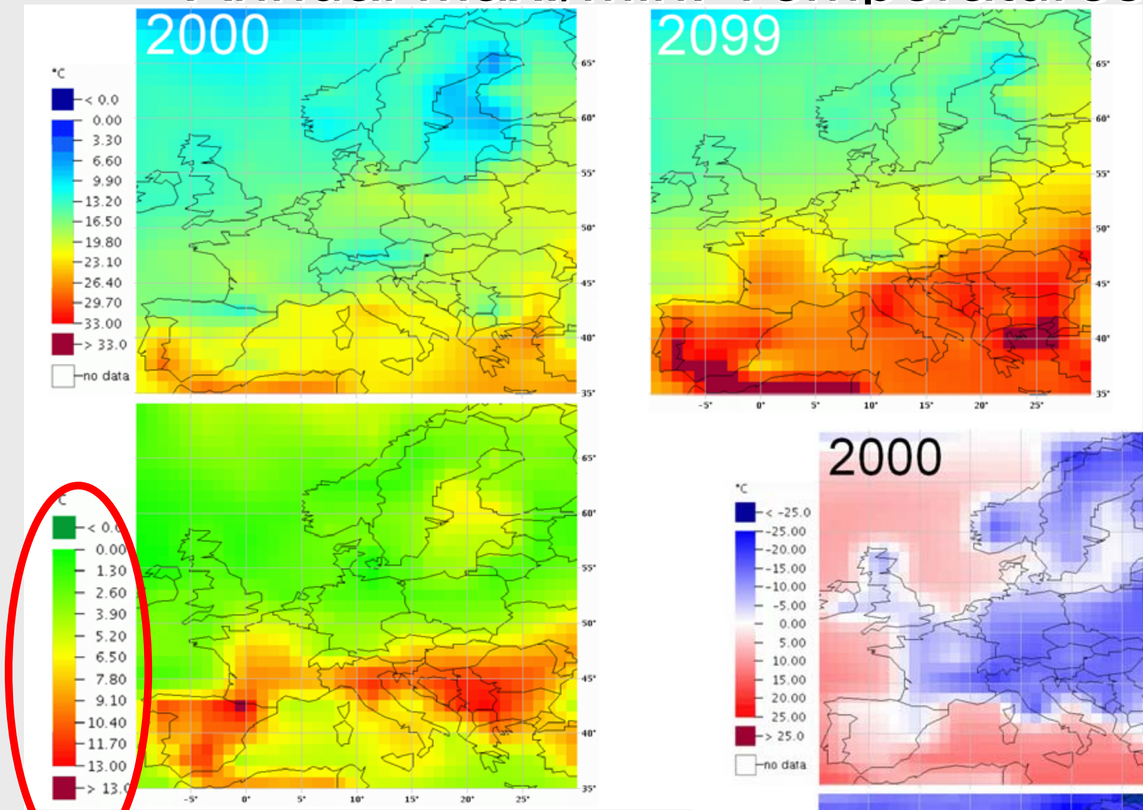
A2



Scale range!

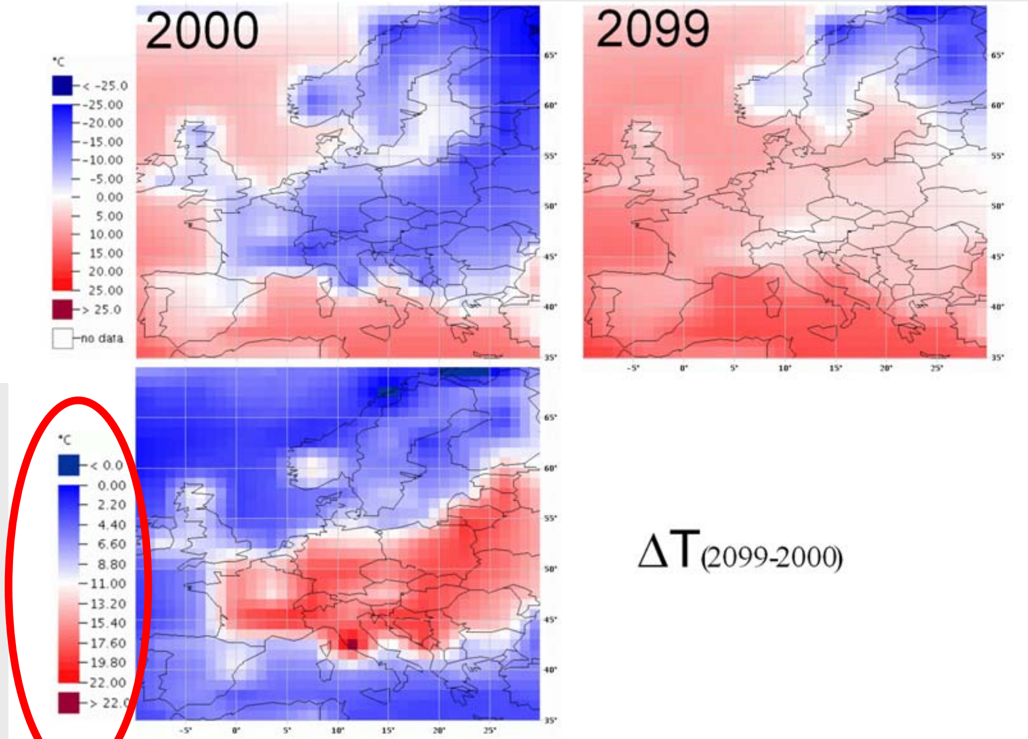
kropp@pik-potsdam.de

AR4 Calculations: Europe A2/HadCM3
Annual Max./Min. Temperatures („Extremes“)



Max.

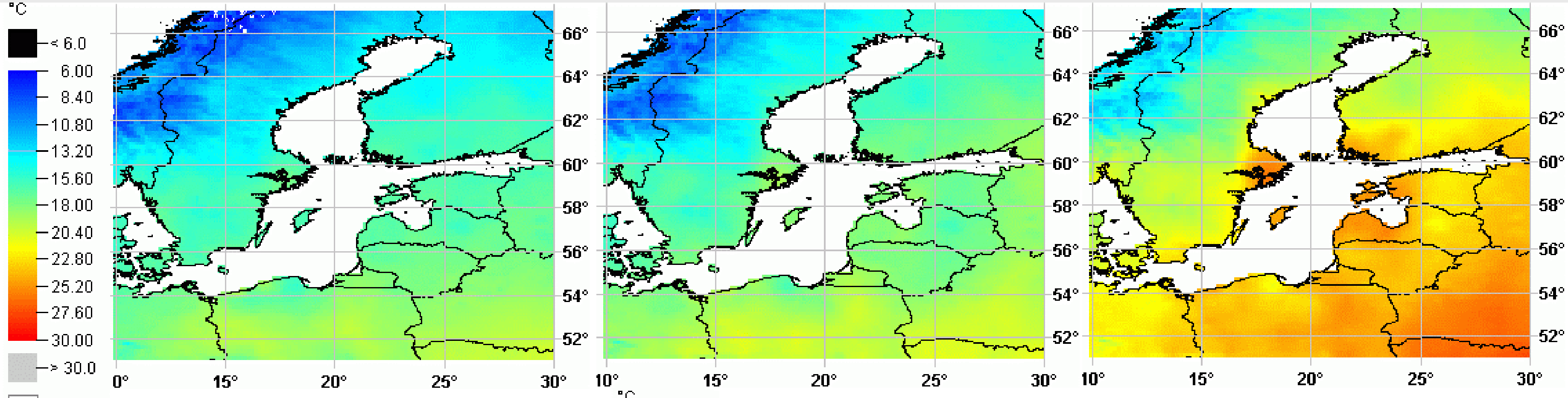
Min.

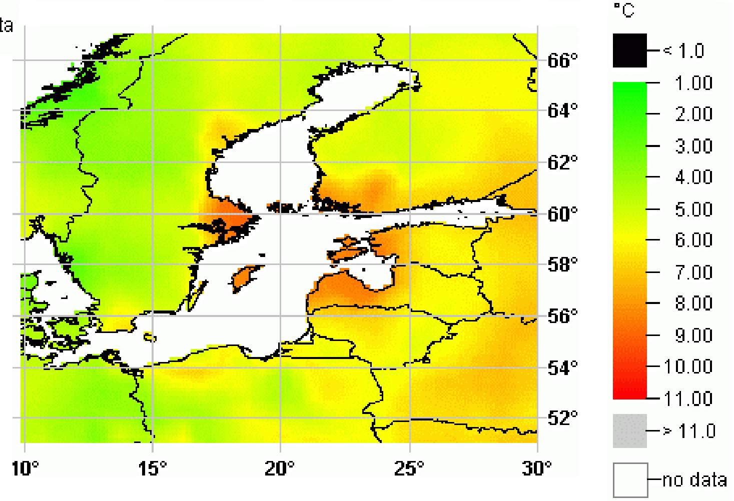


Scale range!

$\Delta T_{(2099\text{-}2000)}$

Mean Summer Temperatures (SRES-A2)



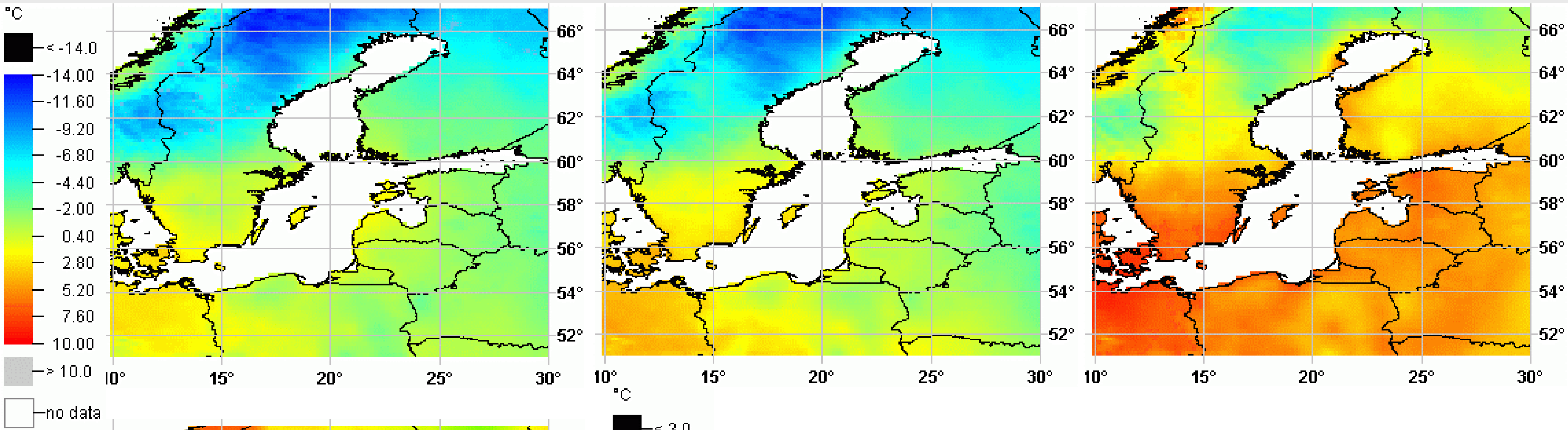


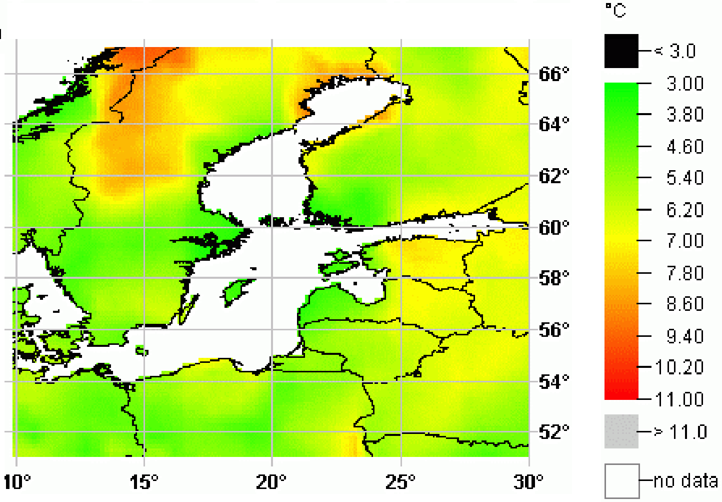
June, July, August (JJA): 2000, 2050, 2100

Difference: 2000/2100

kropp@pik-potsdam.de

Mean Winter Temperatures (SRES-A2)





December, January, February (DJF): 2000, 2050, 2100

Difference: 2000/2100

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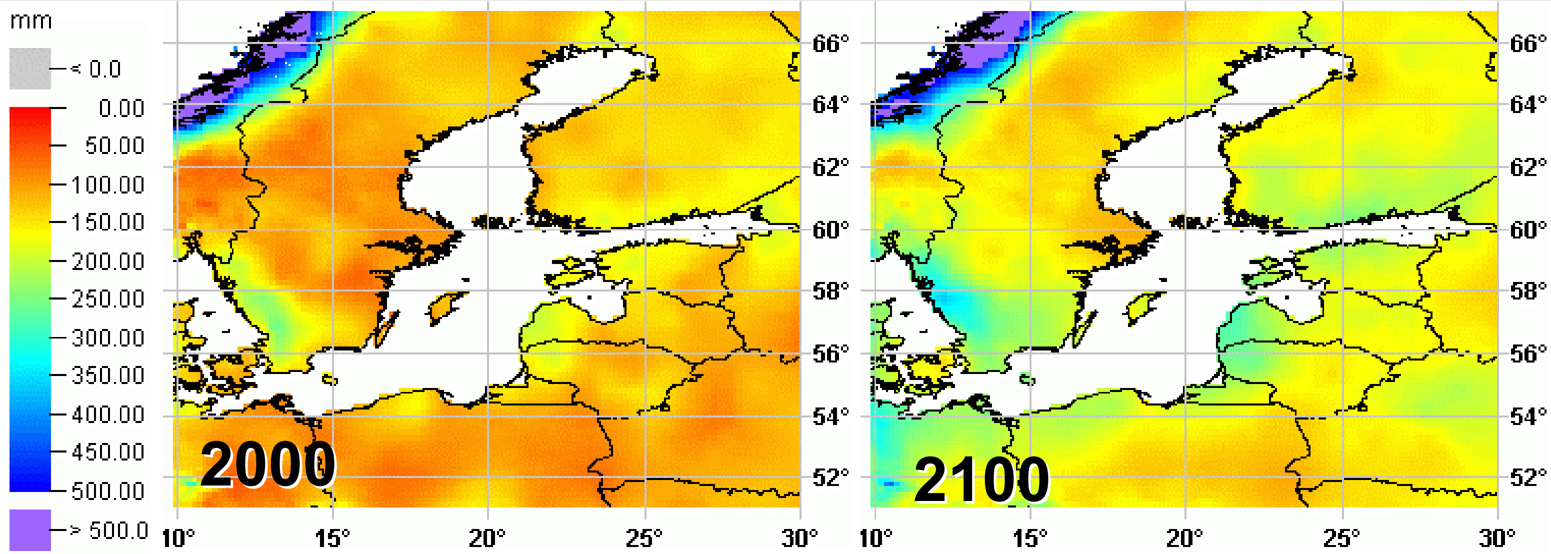
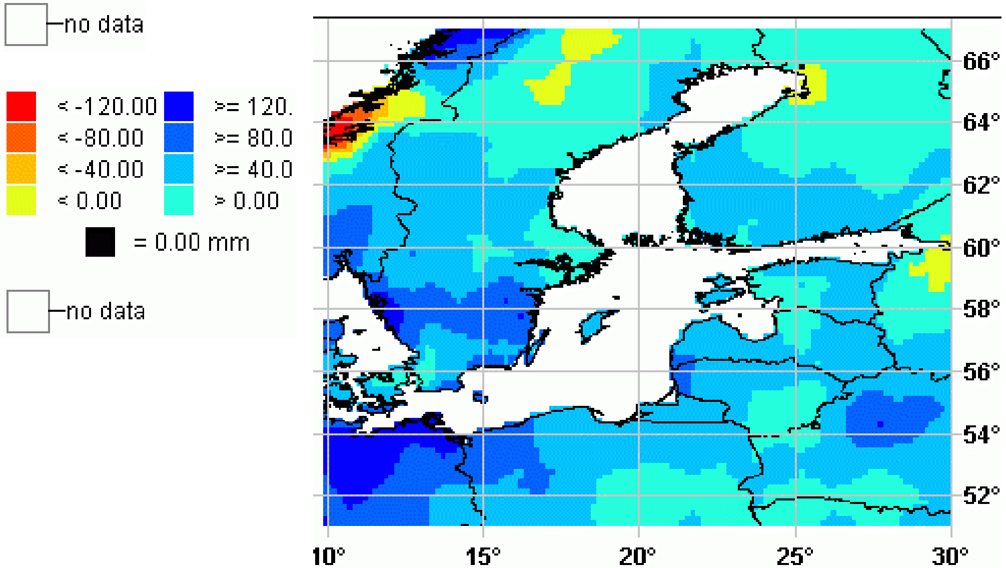
DJF sum: winter precipitation (SRES-A2)



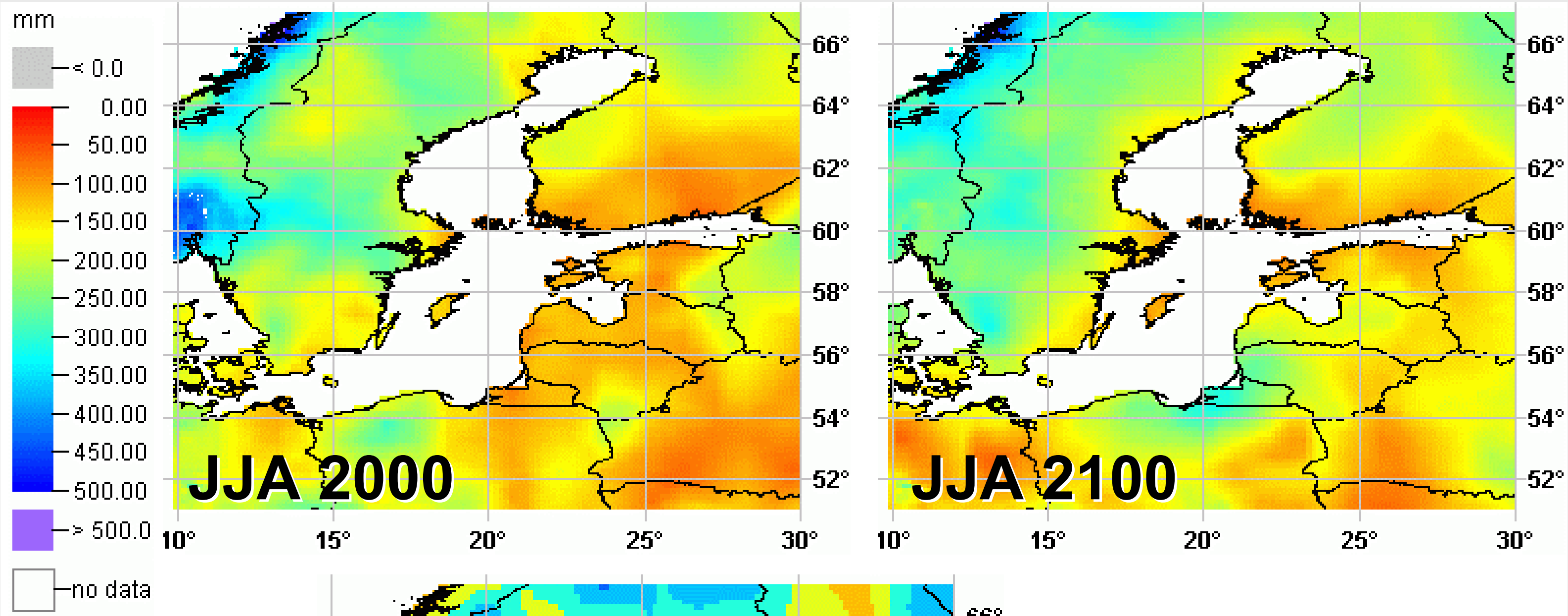


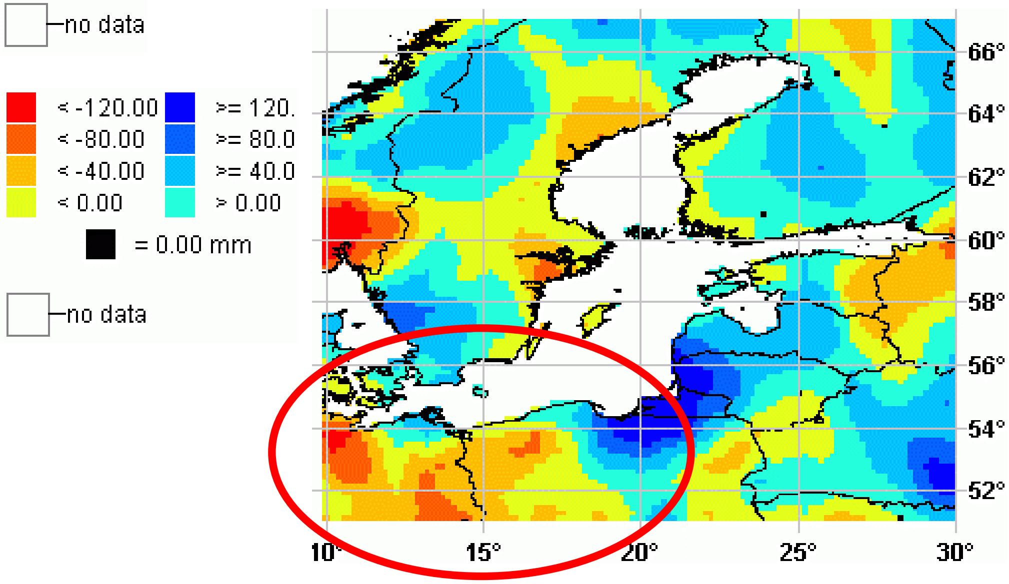
Difference

„wetter“

kropp@pik-potsdam.de

JJA sum: precipitation (SRES-A2)



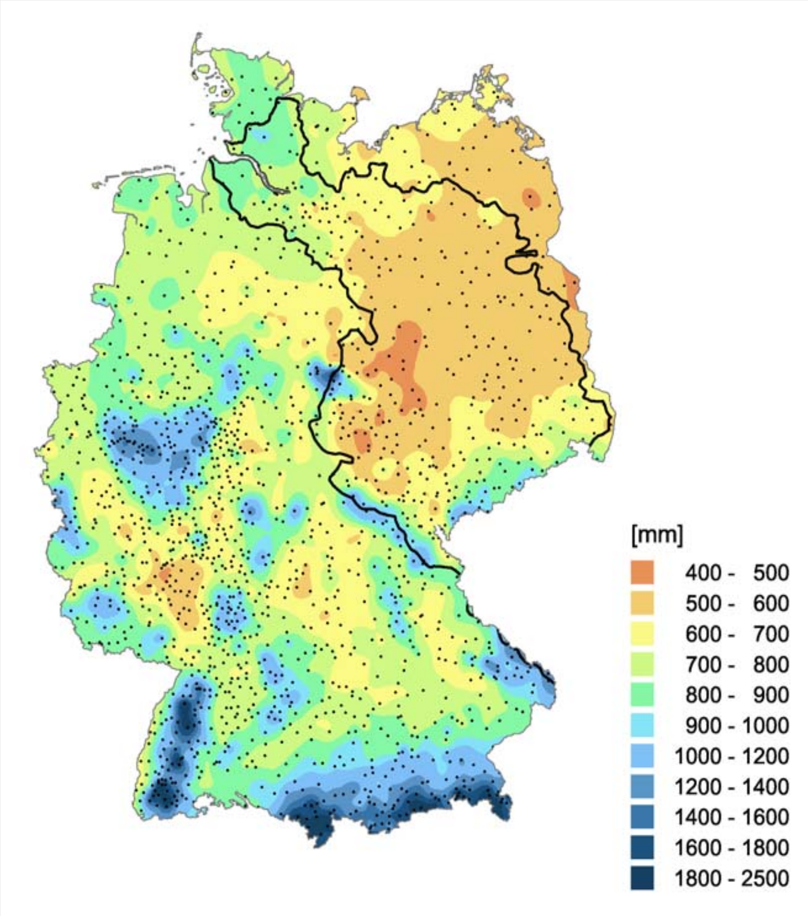


Difference

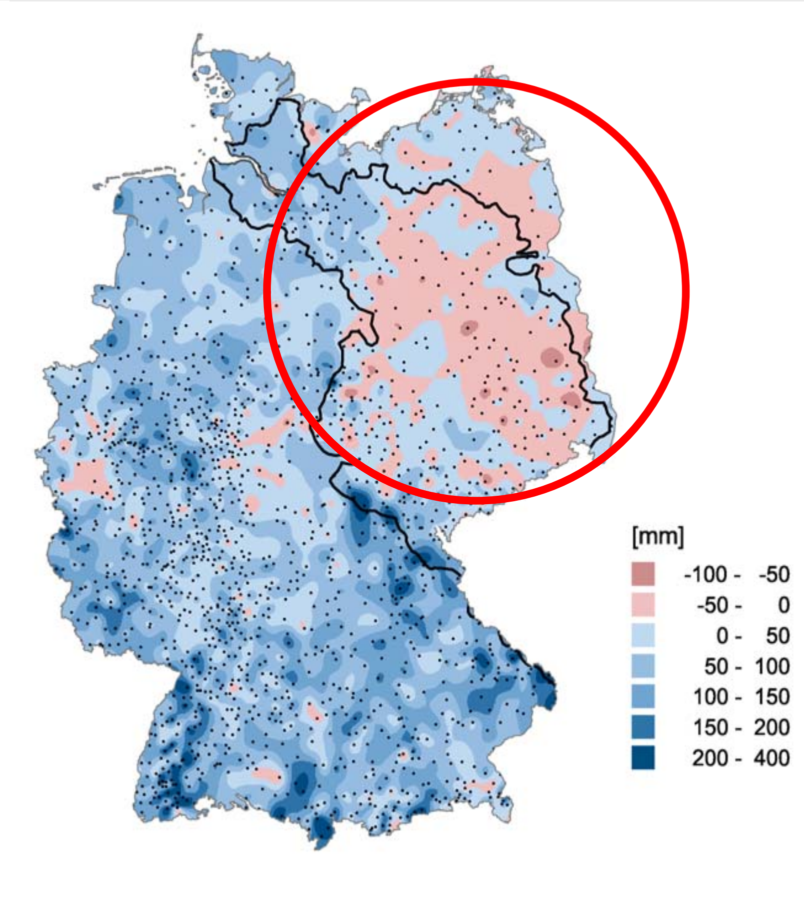
dryer or approx. constant

Annual (not shown): wetter, but pronounced seasonality shift

Empirical measured trend of precipitation in Germany



Precipitation average: 1951-2000

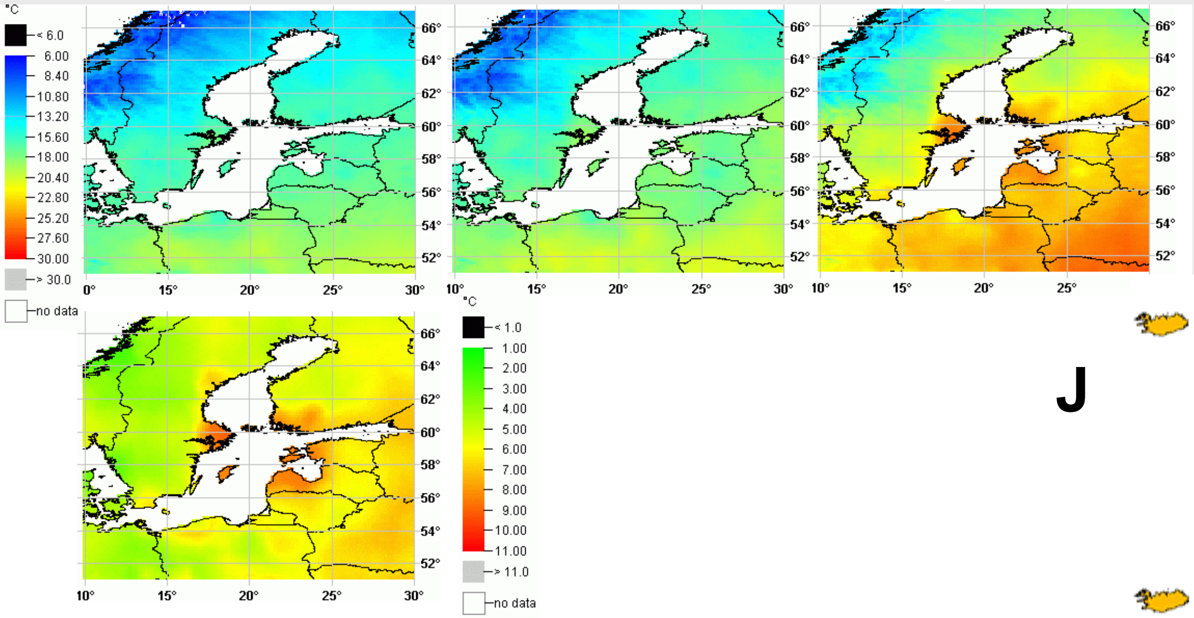


Trend of precipitation 1951-2003
⇒ decrease in eastern Germany
⇒ increase in western Germany

Data: Wodinski, Gerstengarbe und Werner, PIK Potsdam

kropp@pik-potsdam.de

Comparison with Empirical Data
Heatwave 2003/Temperature (SRES-A2)



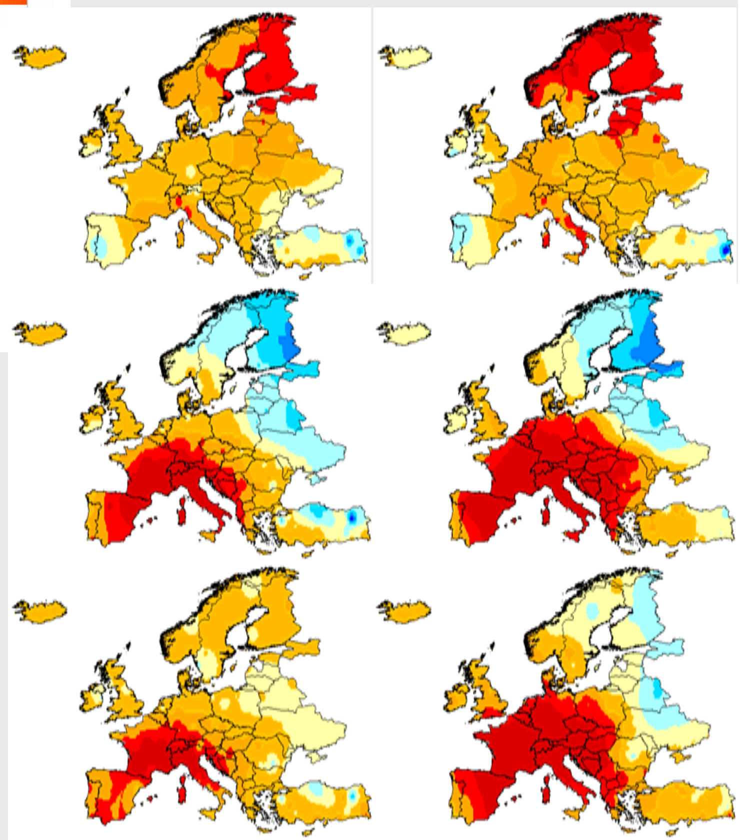
Kropp and others, Ann.For.Sci. 63: 569ff, 2006

T_{min} T_{max}

J

J

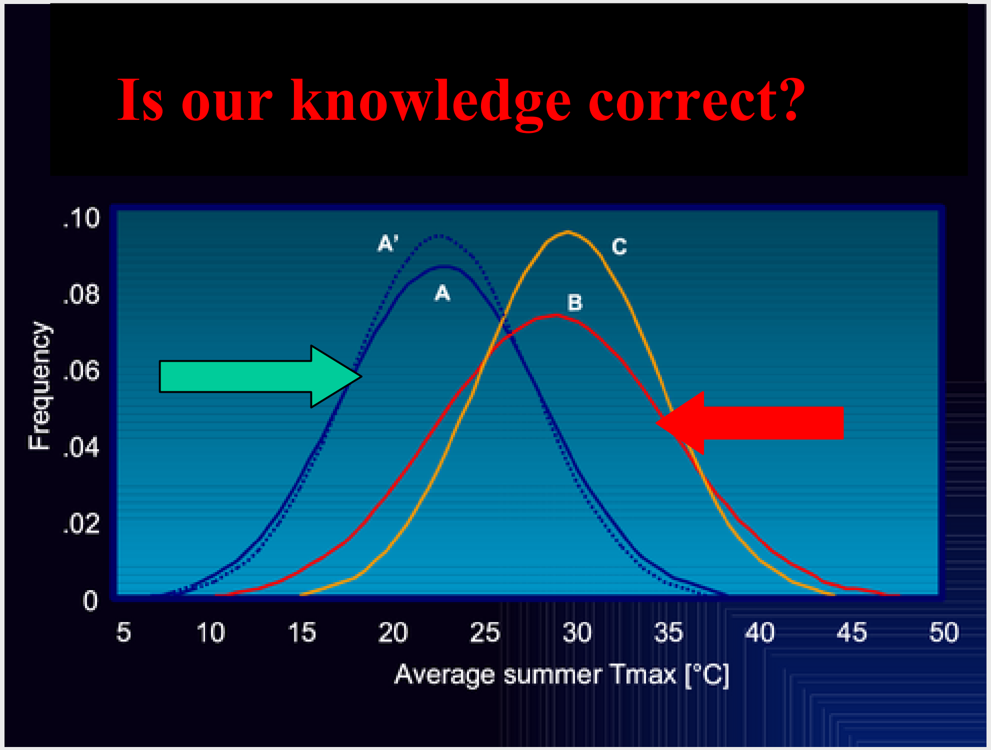
A



$\Delta T_{(61-90)}$

Max. T: 4 ºC higher than normal, in some regions more than 6 ºC

kropp@pik-potsdam.de



Gaussian distributions of mean summer max. temperatures at Basle/Switzerland (1961-1990, A); A': HIRHAM4 Model), 2071-2100 A2 Scenario simulation (B) and for 2003 summer heatwave (C).

Extreme in 2003, normal in 2050 and beyond.....

kropp@pik-potsdam.de

Intermediate Summery

I hope that I have made clear
.....the underlying ideas of climate change scenarios
.....the advantages and shortcomings of these projections
.....isolated views on scenarios does not make sense
.....proactive decision making must review similar examples

In detail for the Baltics:
.....summer will be dryer, winter will be wetter
.....increase in min. T will be larger than in max. T
.....highest temperature rise will occur in the North

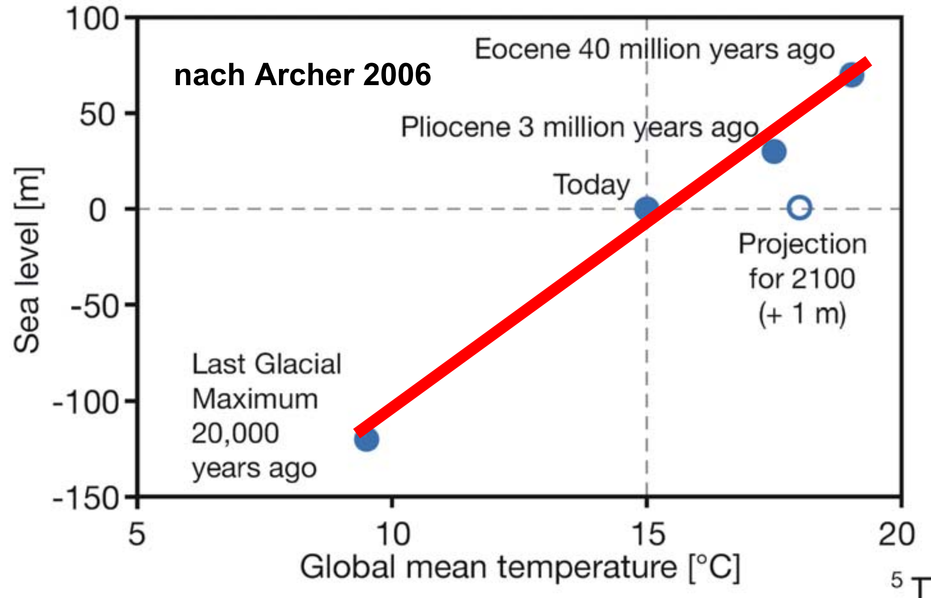
kropp@pik-potsdam.de

The bridge between climate impact and adaptation:
Vulnerability

Example SLR in the Baltics

kropp@pik-potsdam.de

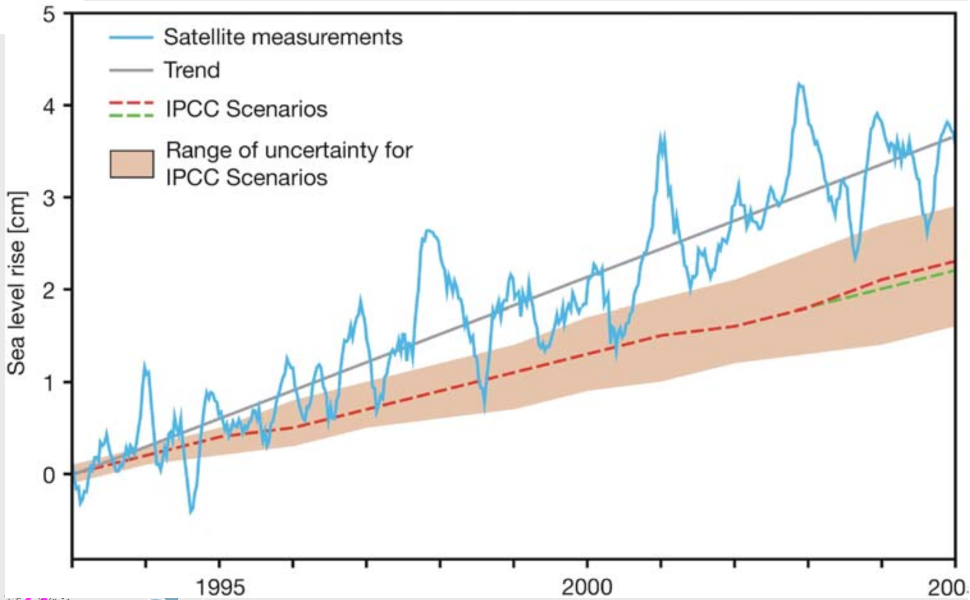
Geological time scales.....



...we are not in an equilibrium!

on longer time scales sea level will be much higher
2300 (3ºC): 2.5-5.1m (WBGU 2006)

TAR projection 2001 (light red)
measured Cazenava & Nerm 2006
Greenland Ice Melting: 2003-2005
- 155 Gt loss/yr
- 54 Gt gain/yr
(ESA/NASA GRACE Mission 2006)

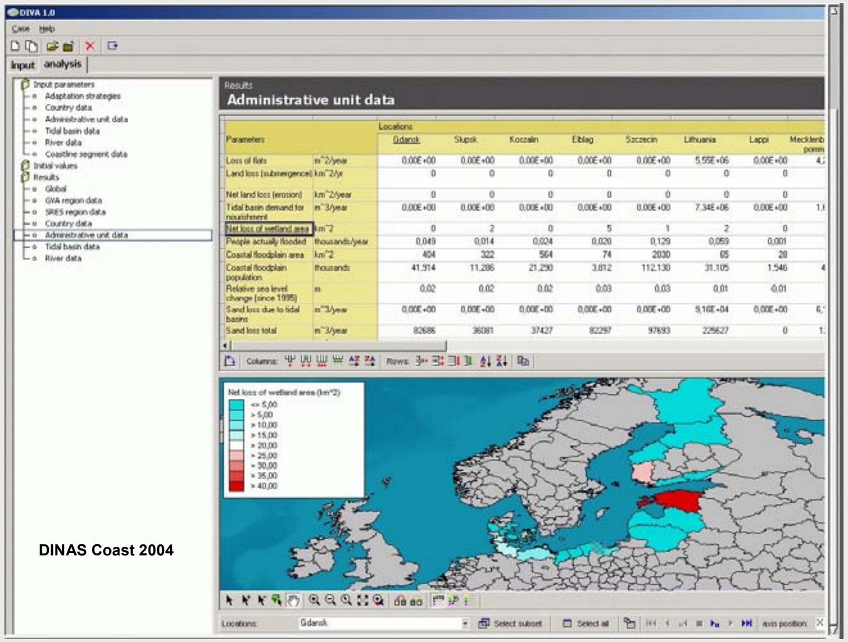


Is sea level rise underestimated?

Observations:		Model Ensembles AR4
1900-2000:	1-2 mm/yr	--
1961-2003:	1.8 mm/yr	1.2 mm/yr
1993-2003:	3.1mm/yr	2.6 mm/yr

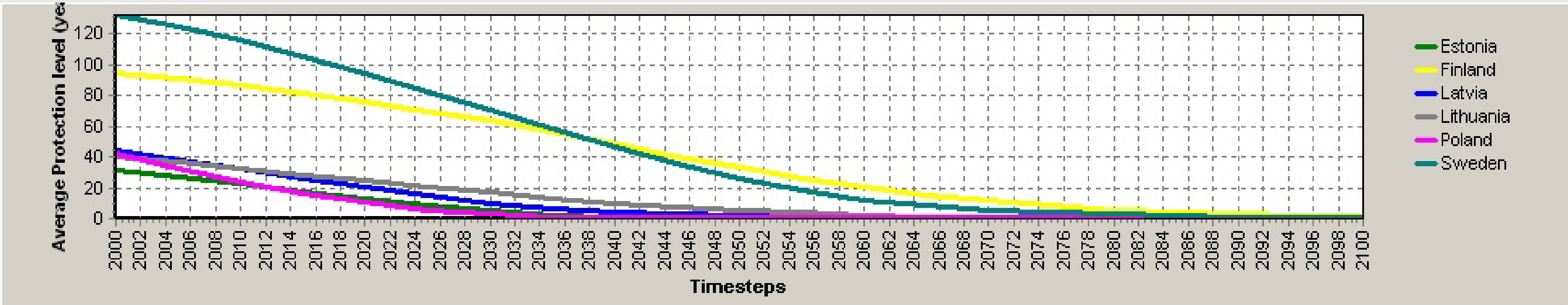
Sea level rise up to 50% larger than assumed!
Europe: 5-15cm more than average due to dynamical effects (THC)
Uncertainty interval is substantially larger than 18-59 cm!

kropp@pik-potsdam.de

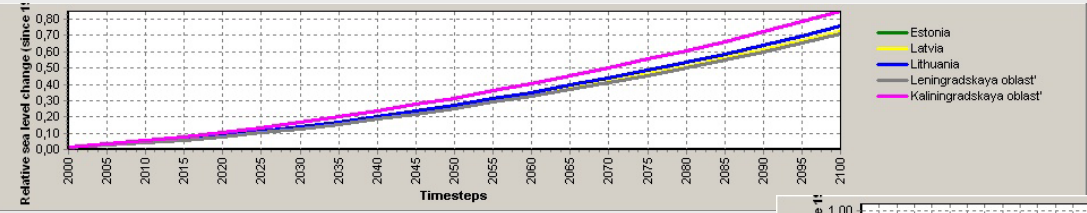


Vulnerability
Risks and Costs of SLR

Business of usual (A2): return level 100yr storm surge

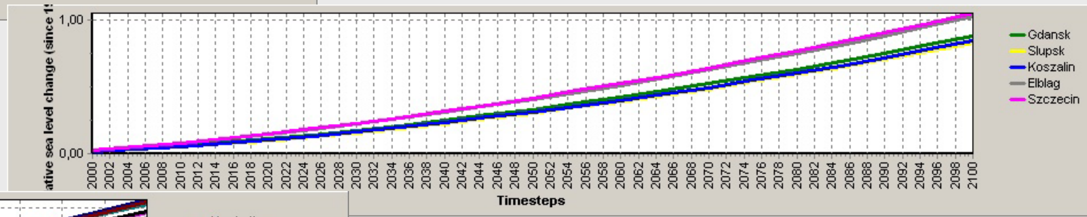


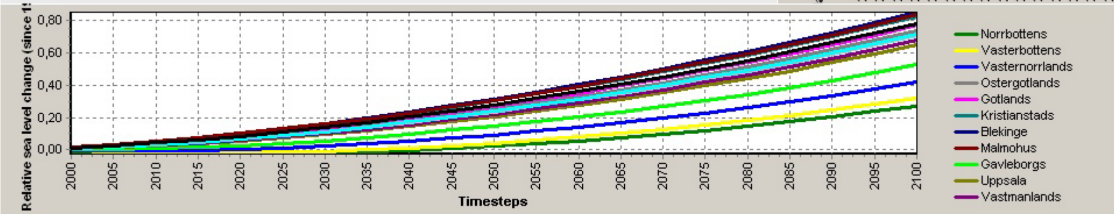
Regional Sealevel Rise: 1995-2100
SRES-A2



Estonia, Latvia, Lithuania, Russia

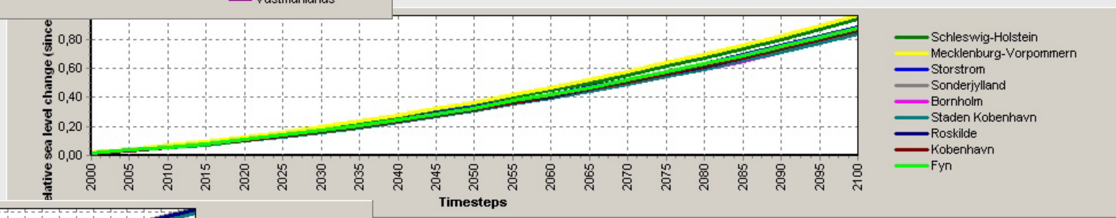
Poland

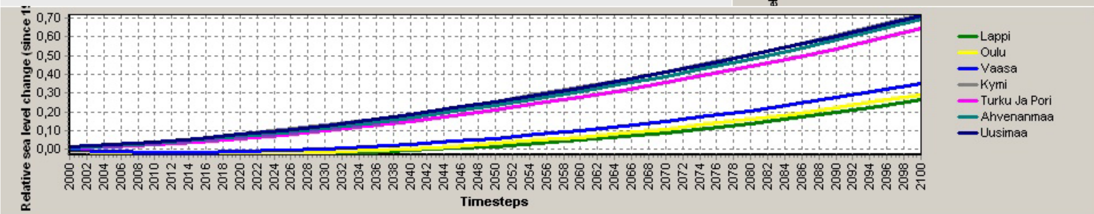




Sweden

Germany, Denmark





Finland

Can countries benefit from investments in adaptation? (or in other words should we adapt or should we flee?)

The “protection level”?

Calculation of a protection level:
Level estimate for a 100 yr flood (*statistical measure*)
Safety surplus (0.5m) (*rule of thumb*)
Wave ramp level (*additionally for sea dikes, experience*)
Wind pressure and main direction (*additionally for sea dikes, experience*)

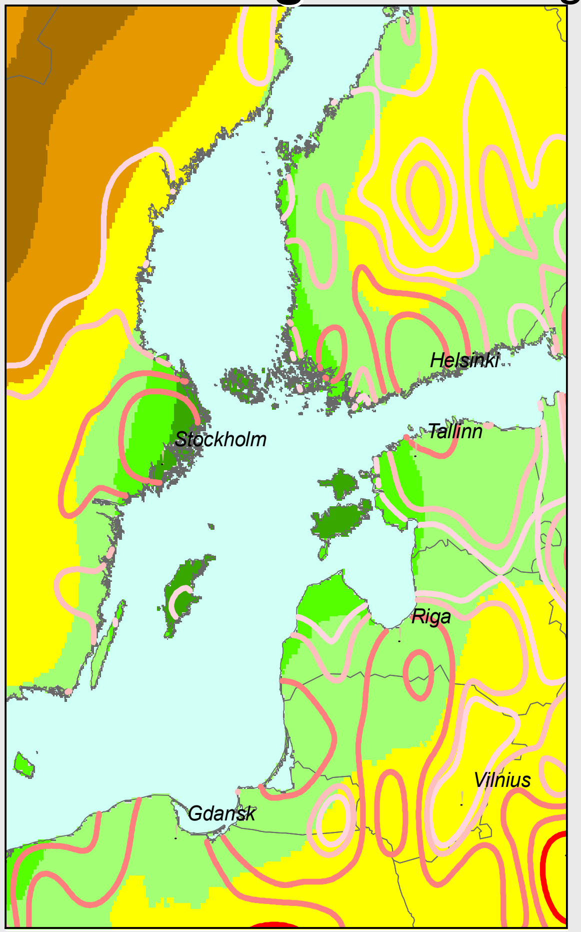
What should protected?

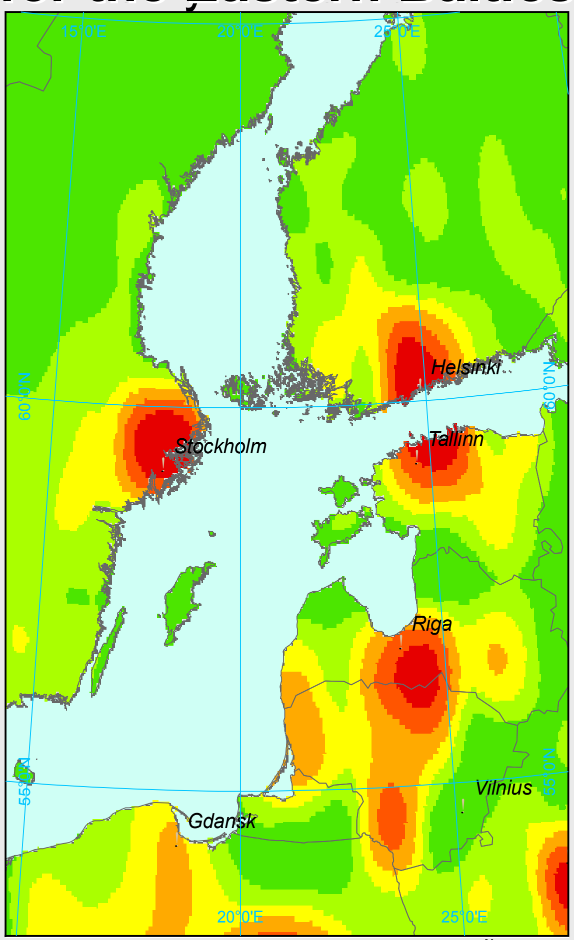
Natural, industrial, private assets:
Power plants
housings
Natural heritages

Costs? (→ willingness to pay → normative decision!)

kropp@pik-potsdam.de

Population Density by Elevation and Gross Cell Product Purchasing Power Parity for the Eastern Baltics





Elevation above sea level

- 0 - 25
- 25 - 50
- 50 - 100
- 100 - 250
- 250 - 500
- 500 - 1000

Population per 1° * 1° grid cell

- 50,000
- 100,000
- 500,000
- 1 mio
- 4 mio

Normalized Index [1)]

- 1.2 - 0.8
- 0.8 - 0.6
- 0.6 - 0.4
- 0.4 - 0.2
- 0.2 - 0
- below 0
- City

[1)] (CellValue - CountryMin) / (CountryMax - CountryMin)

Kropp et al 2007,
Based on GECON

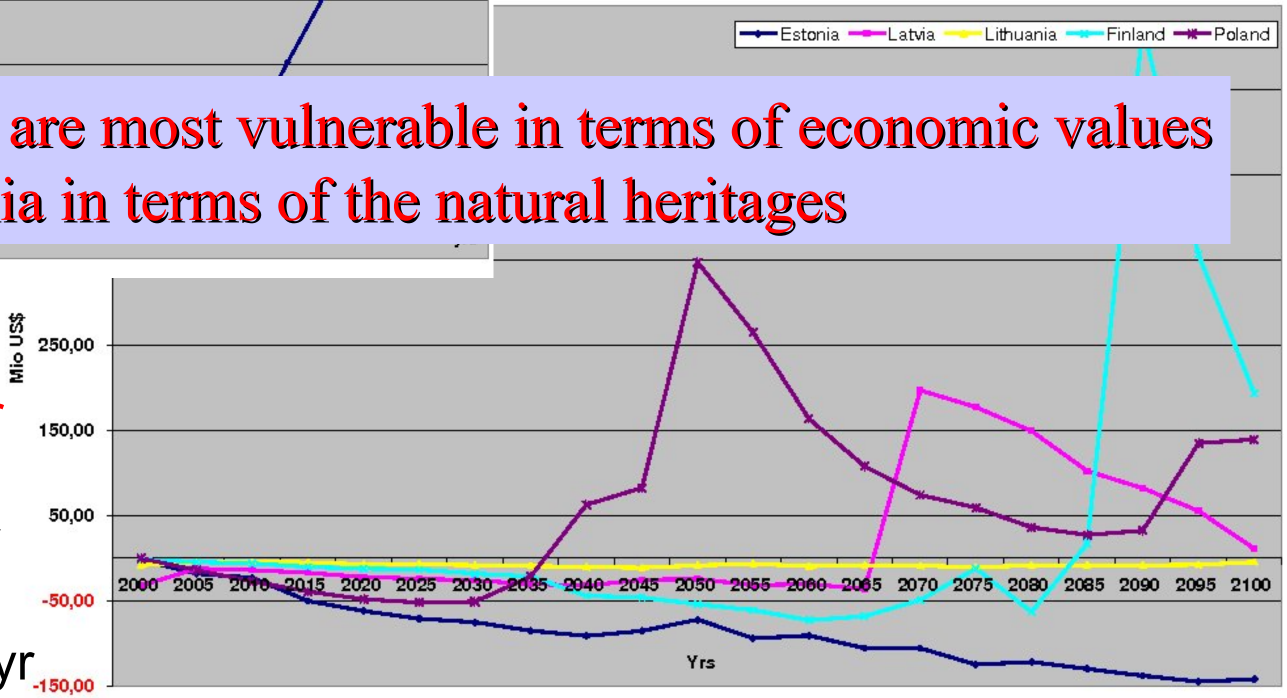
Regional Conference ASTRA
Riga; May 10-11th, 2007

kropp@pik-potsdam.de

Total Costs/Benefits of Adaptation (SRES – A2)

Benefit_{SWE}: 119 Mio US$/yr

Sweden/Finland are most vulnerable in terms of economic values
Lithuania, Estonia in terms of the natural heritages



Costs_{EST}: 18 Mio US$/yr
Benefit_{FIN}: 6 Mio US$/yr
Benefit_{LAT}: 4 Mio US$/yr
Costs_{LIT}: 2 Mio US$/yr
Benefit_{POL}: 12 Mio US$/yr

kropp@pik-potsdam.de

Summary

- Consequences of CC for the Baltics are obvious
- Reduction of GHG gases is necessary (mitigation, global task)
- Proactive decision making under uncertainty (adaptation, local task)
- Identification of hot spots for action (vulnerability assessments)

To tackle the problem of decision making under uncertainty:
Mutual understanding of scientists and stakeholders is needed

- problem understanding, i.e. what should managed on which time scale
- challenge: avoid unmanageable situations, but management of the unavoidable

kropp@pik-potsdam.de

Thank you for your attention

kropp@pik-potsdam.de