German Insurance Association

Challenge Climate Change

Answers and Demands of German Insurers

Scenarios for Germany

Climate Change Impacts on the Loss Situation of Germany's Insurance Industry

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German Insurance Association (GDV)

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Outline

1. Climate problem
2. Insurance data basis
3. Methodical approach
4. Model validation / loss scenarios
5. Conclusions and demands

Climate problem

How do we define climate?

Climate is defined as a complex statistical description of relevant climate parameters (as temperature or precipitation) which refer to a place / a region and a given time scale (in general at least 30 years).

Source: Hupfer & Chmilewski 1990

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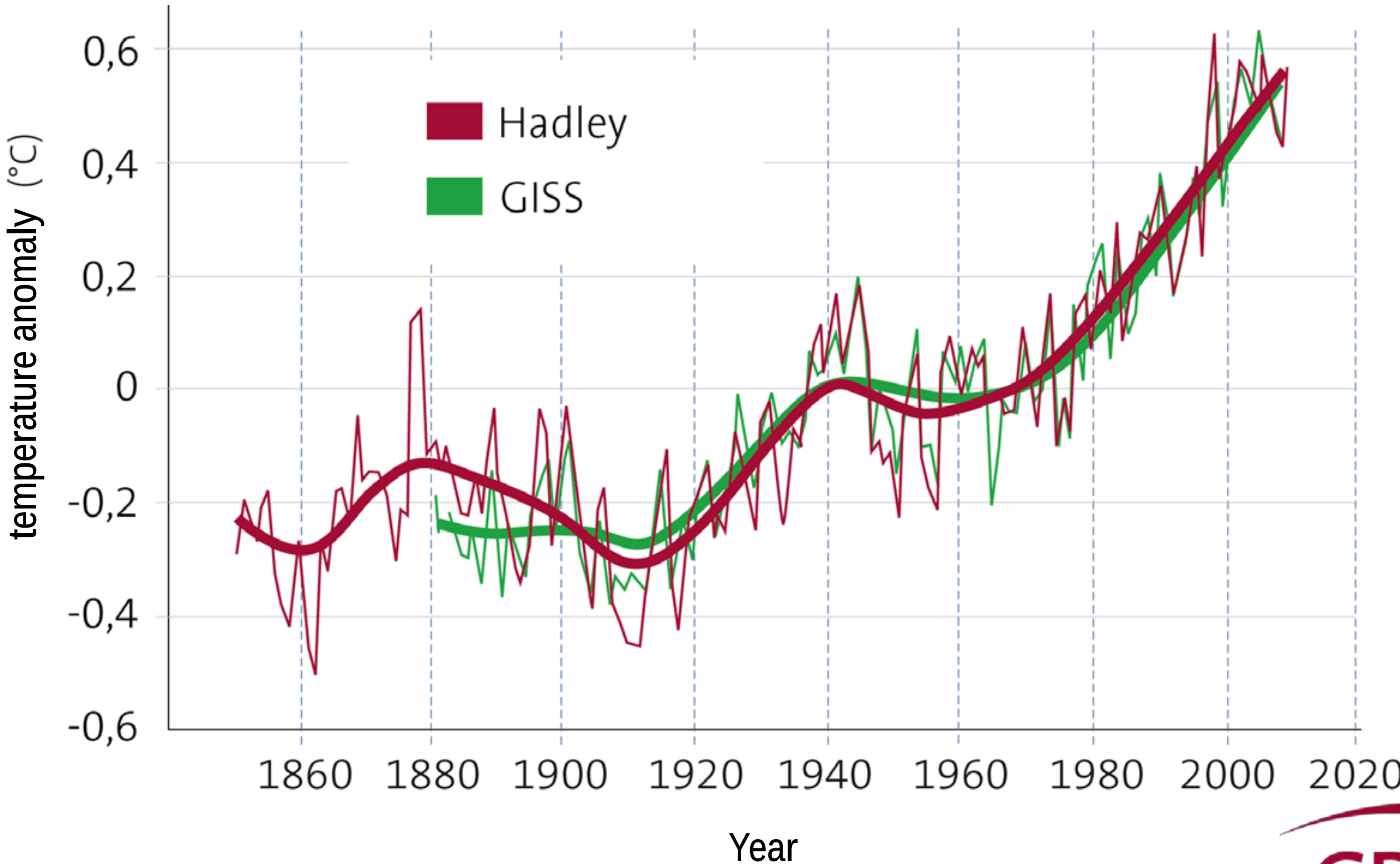
Climate problem

Rise of mean global temperature since 1850



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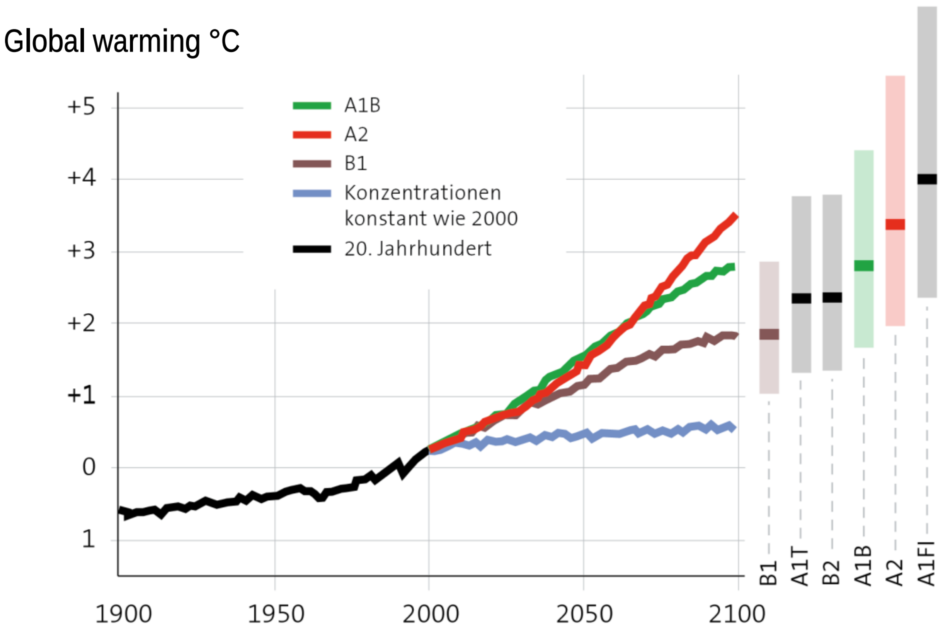
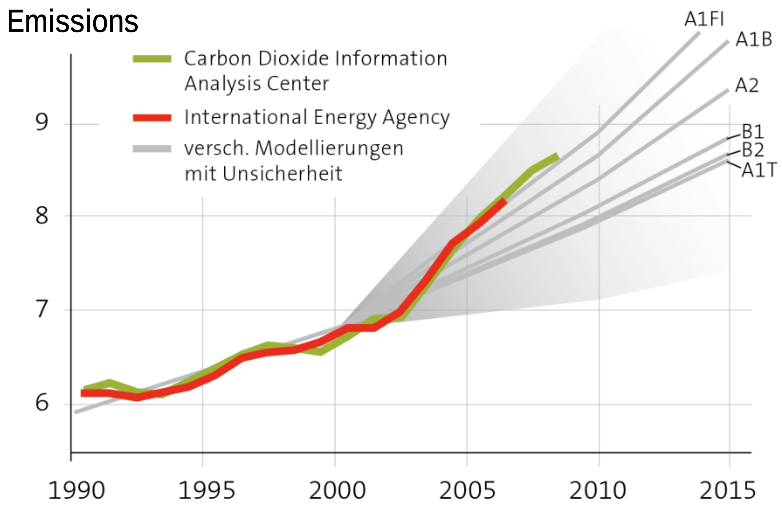
Climate problem

Future greenhouse gas emissions and temperature according to IPCC scenarios

- Recent emissions exceed the worst case scenario A1FI





Source: IPCC, PIK

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Climate problem

Winter storms, hail storms, floods

Storm
Kyrill 18.01.2007

Elbe flood August 2002

Hail storm
Villingen-Schwenningen 28.06.2006

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Insurance data basis

Within property insurance we have learnt how to deal with weather driven natural hazards. For example residential buildings insurance:

- Storm and hail
- Extended natural hazards
  - Floods
  - Heavy rainfall and flash floods
  - Earthquakes

From the actuarial point of view natural hazards are quite challenging. Rare but extreme events cause high cumulated losses:

- Storms (e.g. a spate of storms in 1990, storm Kyrill 2007)
- Floods (e.g. Elbe flood in 2002)

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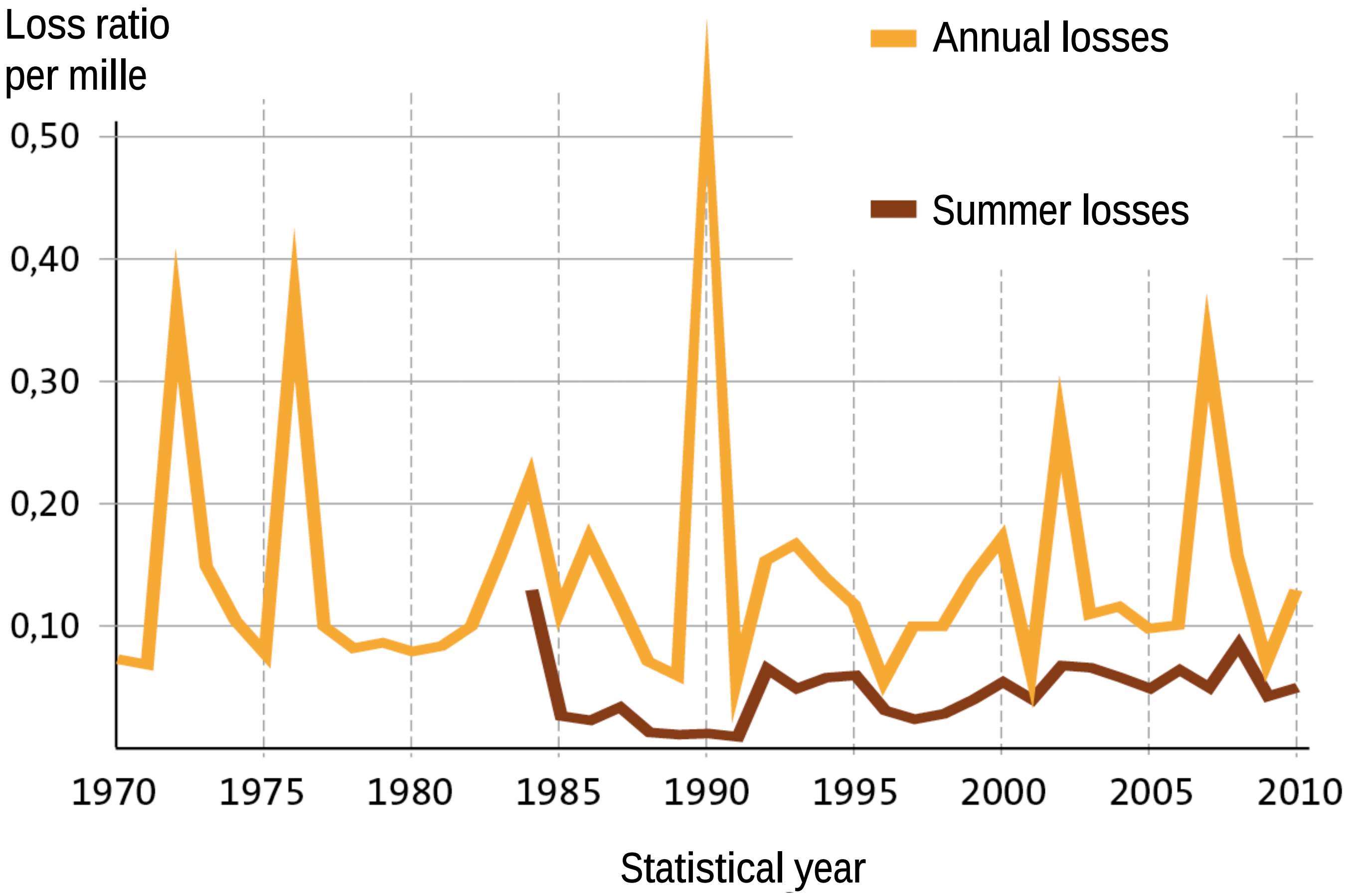
Insurance data basis

Residential building insurance storm/hail: loss ratio series 1970-2010



Insurance data basis

Preferably long term data on high spatial and time-scale resolution are needed for the analysis

- Which original data for storm and hail analysis are available?
  - Data since 1981 on a spatial level of administrative districts
  - Daily losses since 1984
- Winter:
  - Mainly characterized by rare and extreme storms (cumulated loss events)
  - Source of high annual fluctuation of storm losses
- Summer:
  - Mainly characterized by hail losses
  - Share of long term annual losses: 1/3 to 1/4
  - Some years show higher losses in summer than in winter
- Loss scenarios can be analyzed separately in summer and winter

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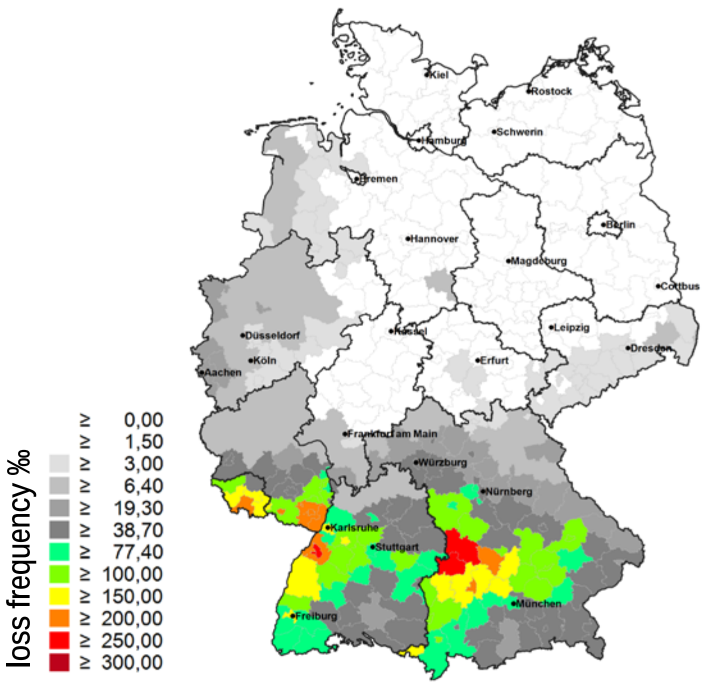
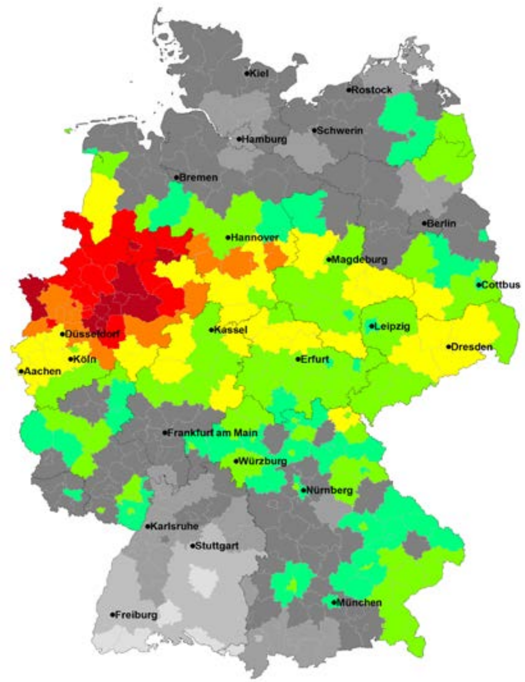
Insurance data basis

Examples for loss events in summer and winter



storm Lothar (25.-26.12.1999)
800 Mio. EUR



storm Kyrill (18.-19.01.2007)
2,4 Mrd. EUR

hailstorm Villingen-Schwenningen
(28.06.2006) 250 Mio. EUR

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Methodical approach

German insurers pose crucial questions how climate change will impact the insurance industry and its actuarial practice:

- How will changing climatic conditions influence the loss situation caused by natural hazards as storm and hail or floods?
  - What are the changes in annual loss expectancy?
  - What are the changes in cumulated loss expectancy?
- Is there a high or a reasonable degree of robustness of our estimations?
- Which scenario might be the most probable one due to our secured state of knowledge?

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Methodical approach

Answers to these questions can only be given in cooperation with climate change scientific community

⇨Set-up of the project „PIK-I“: Climate change impacts on the loss situation in Germany‘s insurance industry“

- Necessary expertise for a successful project:
  - Research + Science: Climate Change and Climate Impact Research
    - Potsdam Institute for Climate Impact Research
    - Freie Universität Berlin
    - University Köln
  - Insurance industry: modeling know-how from insurance and reinsurance companies (members of the GDV) as well as the GDV

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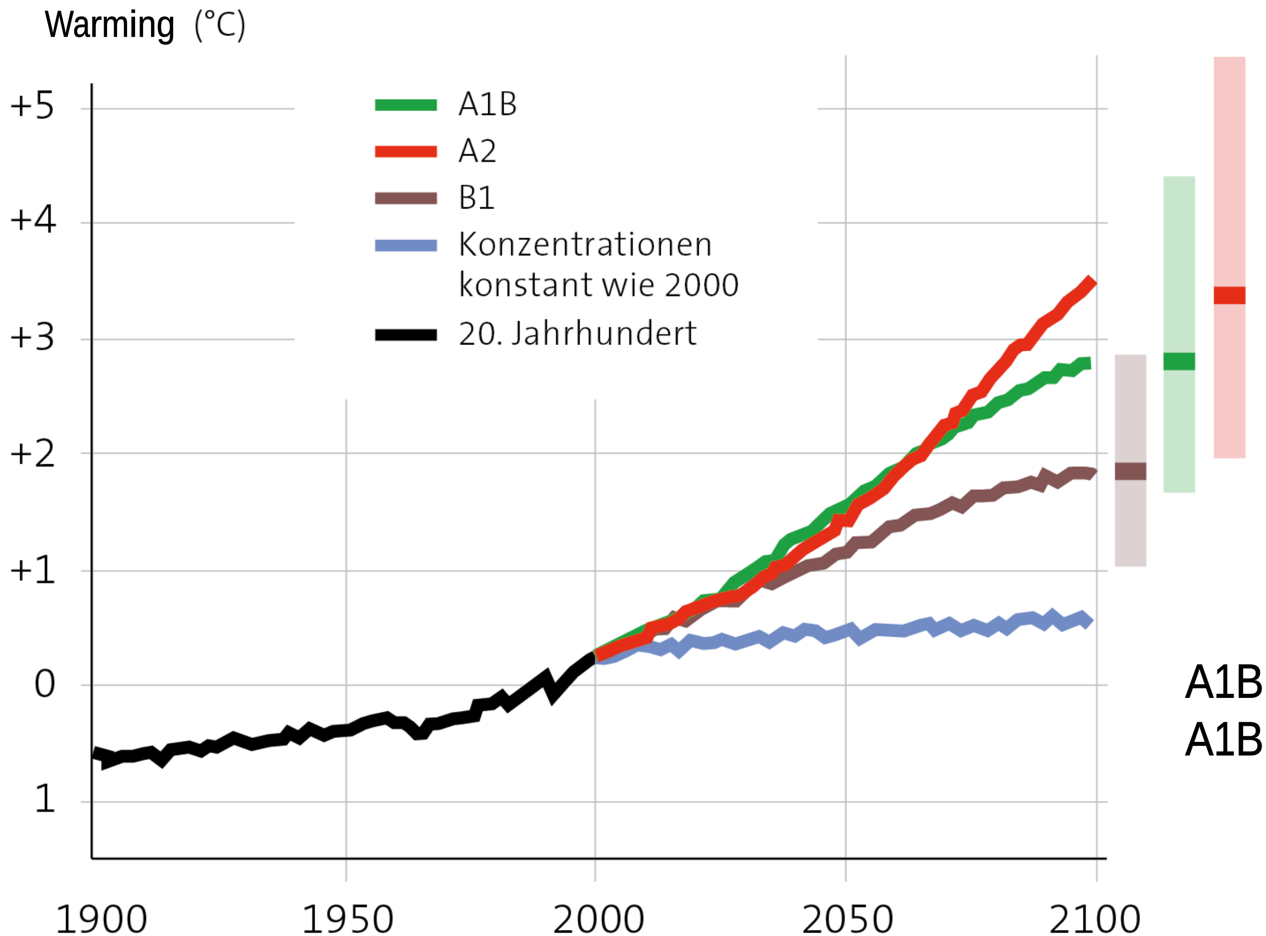
Methodical approach

Assumed temperature forcings according to IPCC scenarios B1, A1B und A2



A1B:	storm, hail
A1B, B1, A2:	floods

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Methodical approach

Climate models

Statistic climate model

many runs in a short time

Dynamic climate model

new developments

Statistic-dynamic climate model

+

combination

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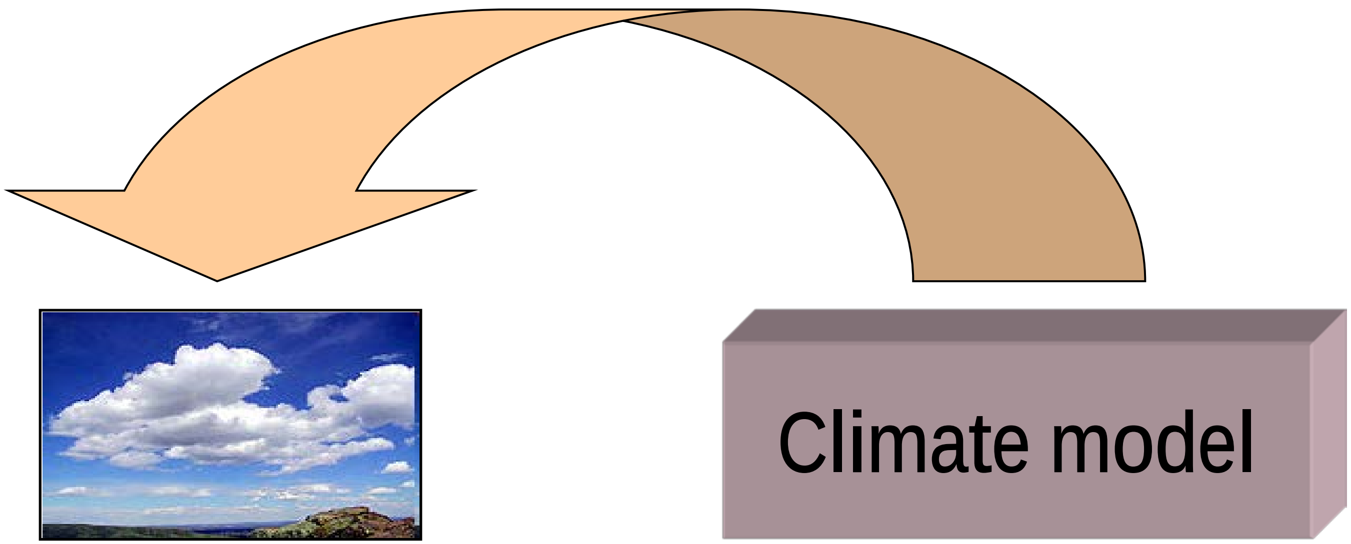
Methodical approach

Workflow

Step 1: Re-simulation of the well-known past

If the model is able to explain the past plausibly, then there is a high probability for a feasible depiction of the future



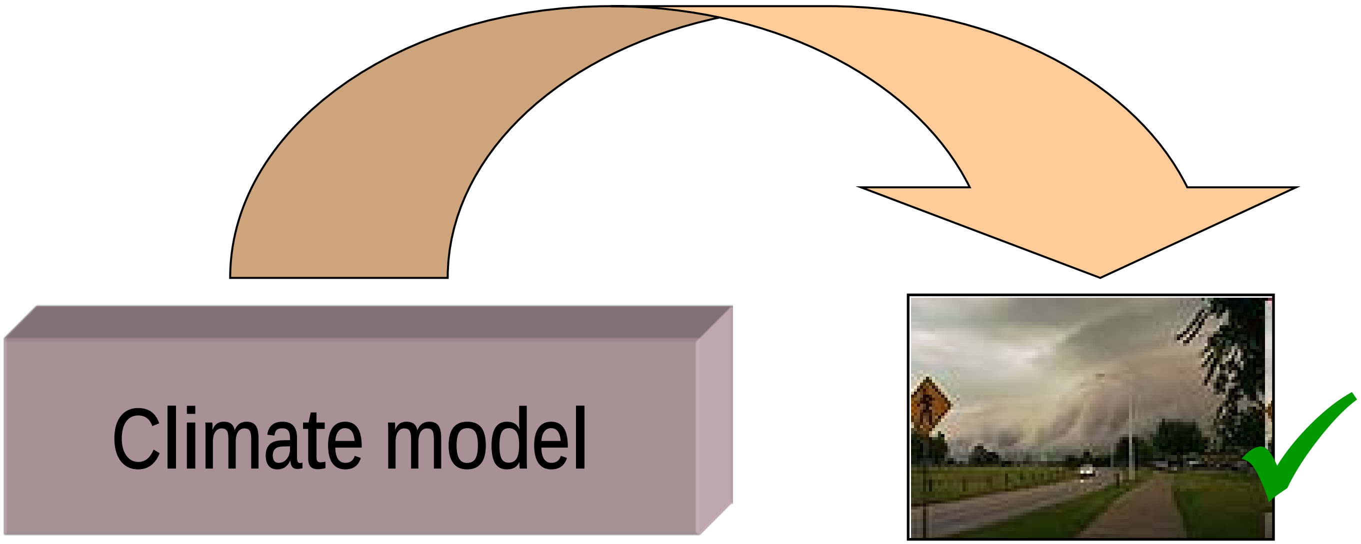
e.g. 1970-2000

Methodical approach

Workflow

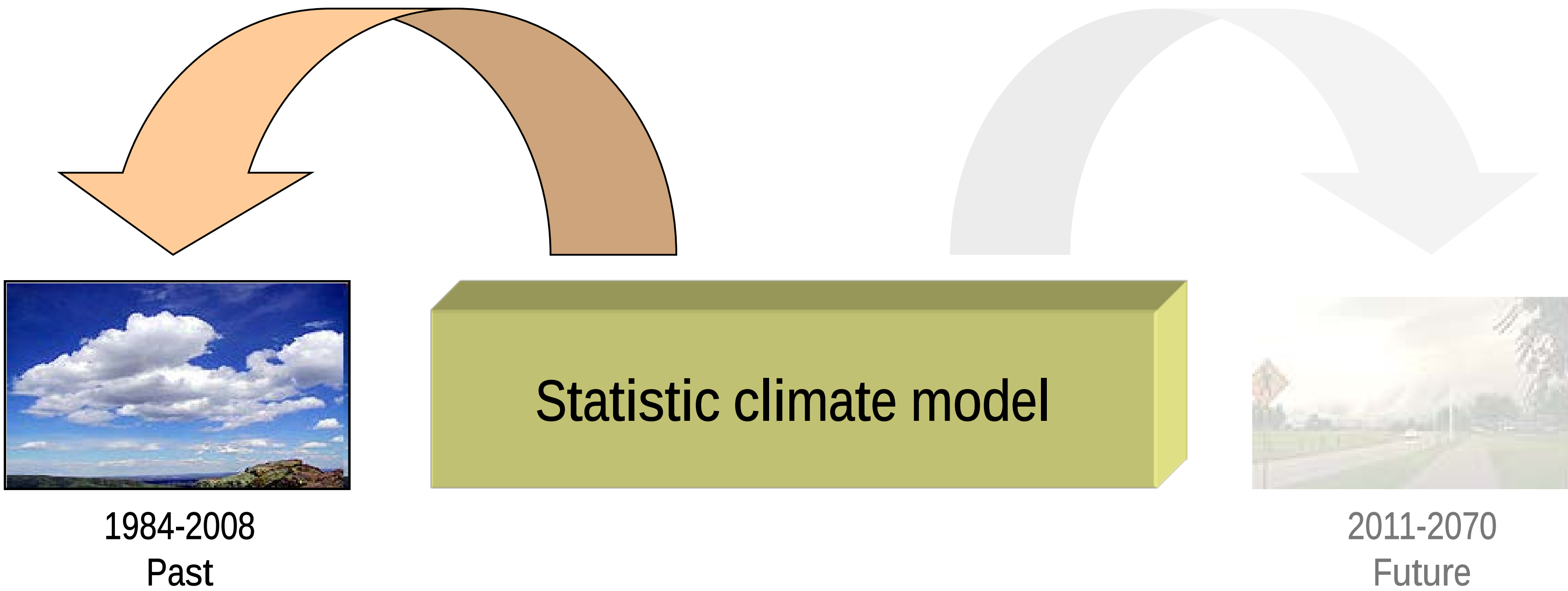
Step 2: Simulation of the future

If the model is able to plausibly explain the past, then there is a high probability for a feasible depiction of the future



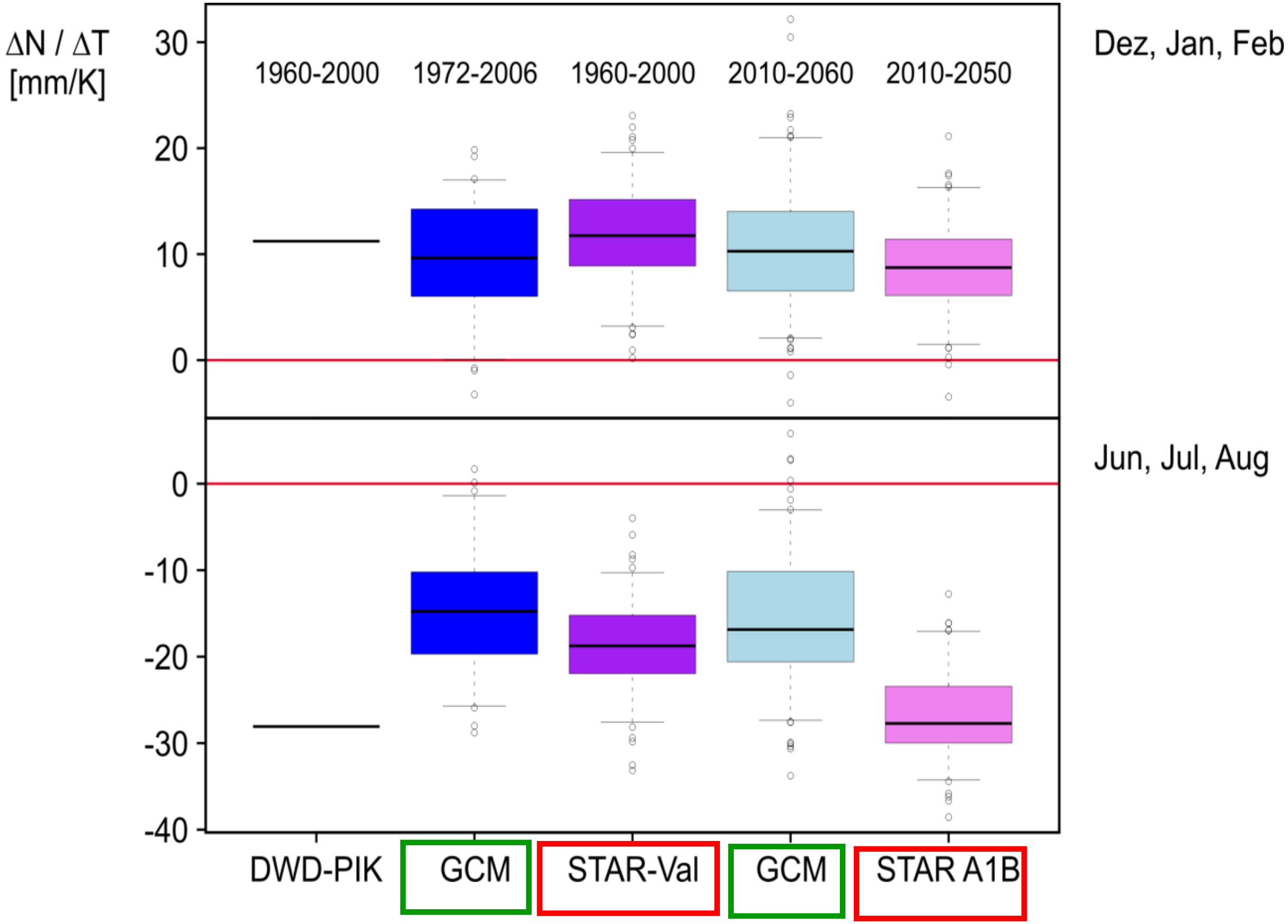
2011-2100

Statistical climate model



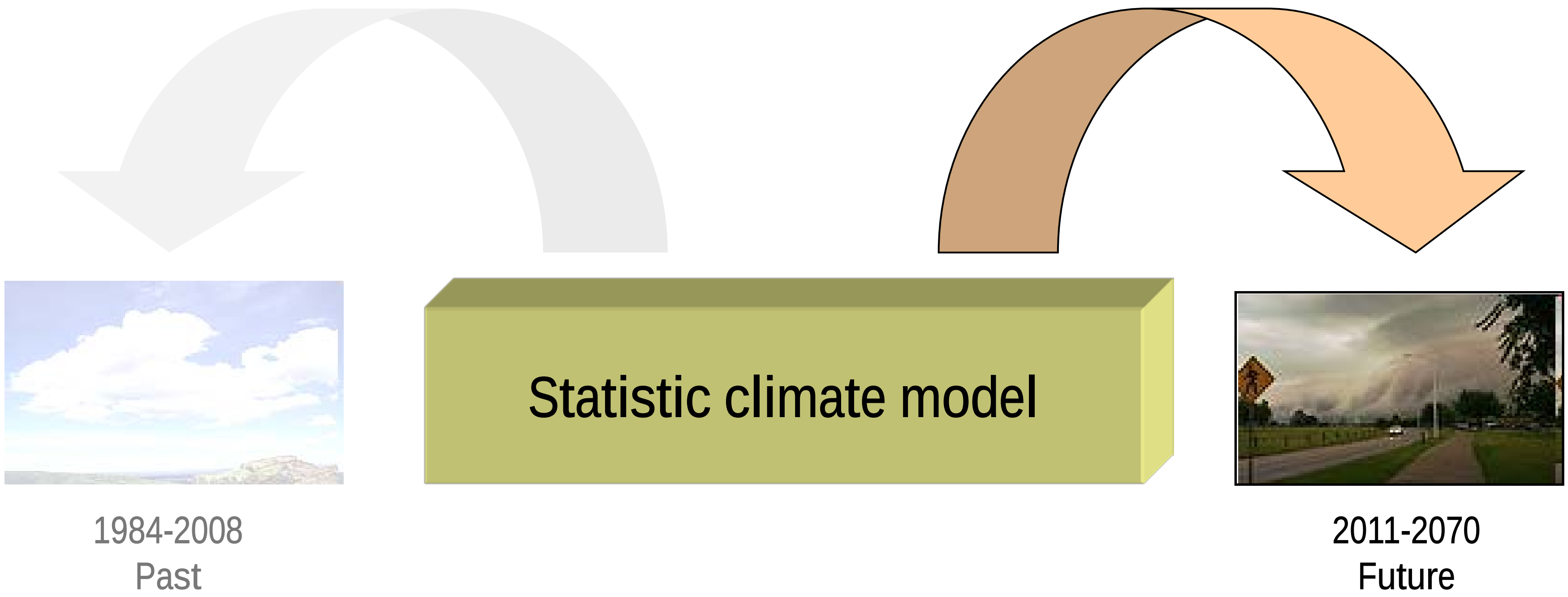
Model validation

Changes in precipitation every degree °C temperature rise



Good agreement: statistical climate model is within range of 23 global climate models

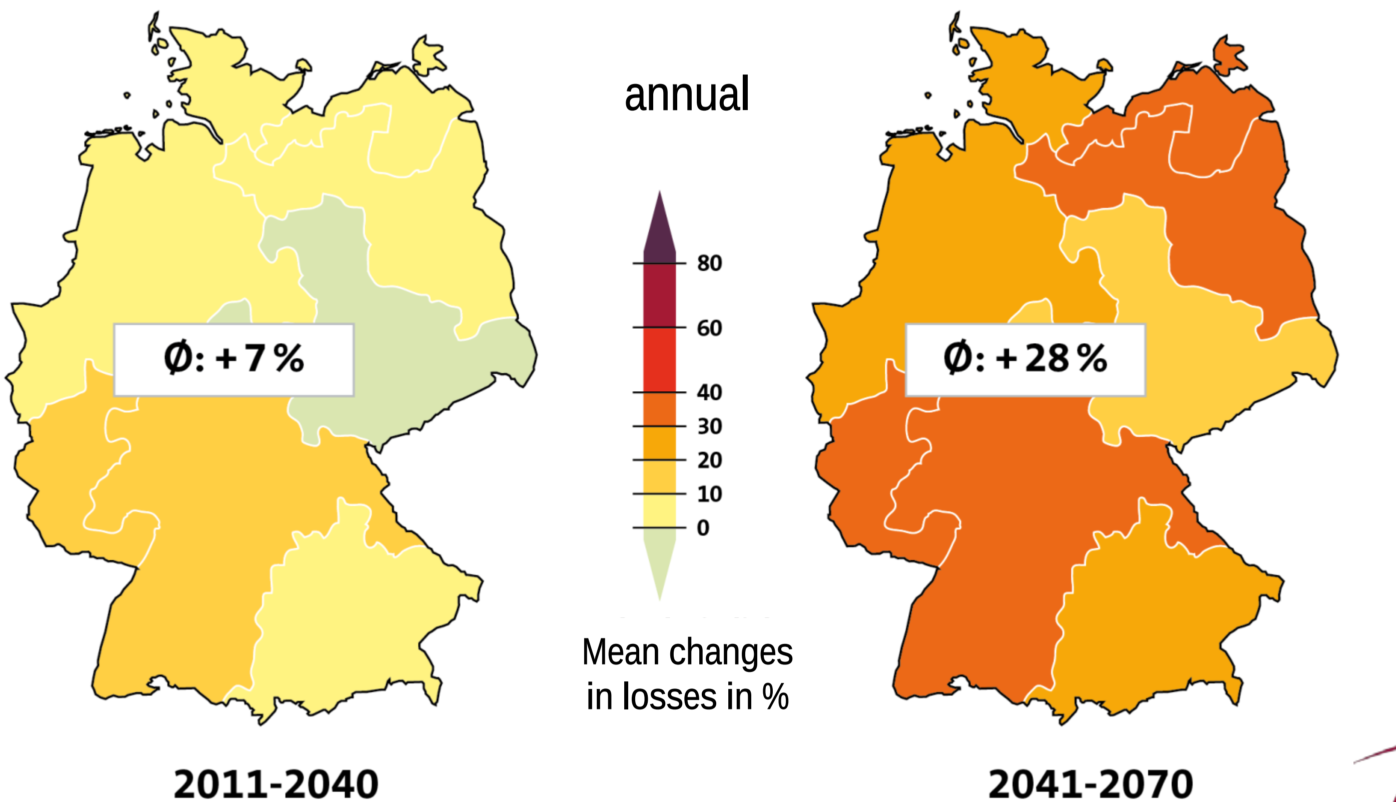
Statistical climate model



Loss scenarios

PIK: statistical loss model for storm/hail

- Spatial distribution of loss ratios and their changes in the A1B scenario when compared to 1984-2008; mean values for a 30-year time period



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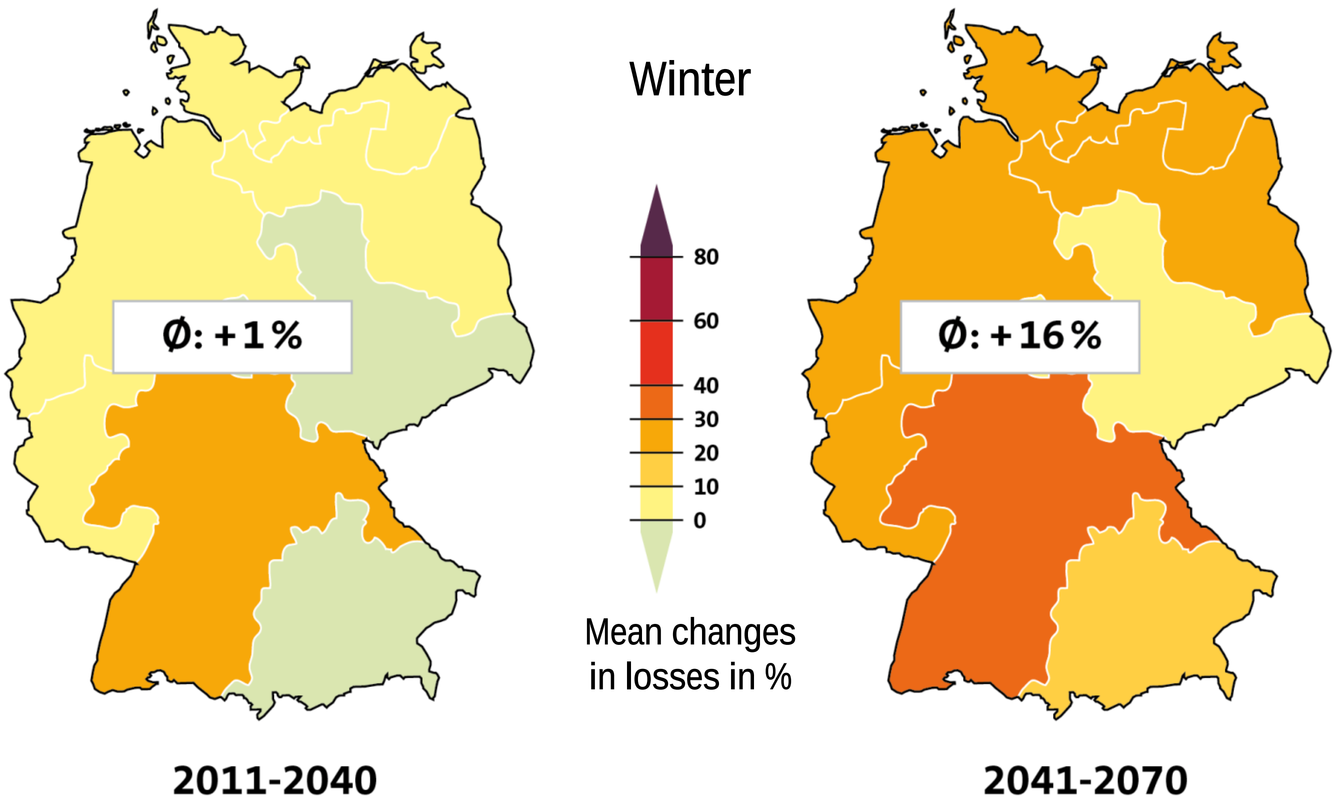

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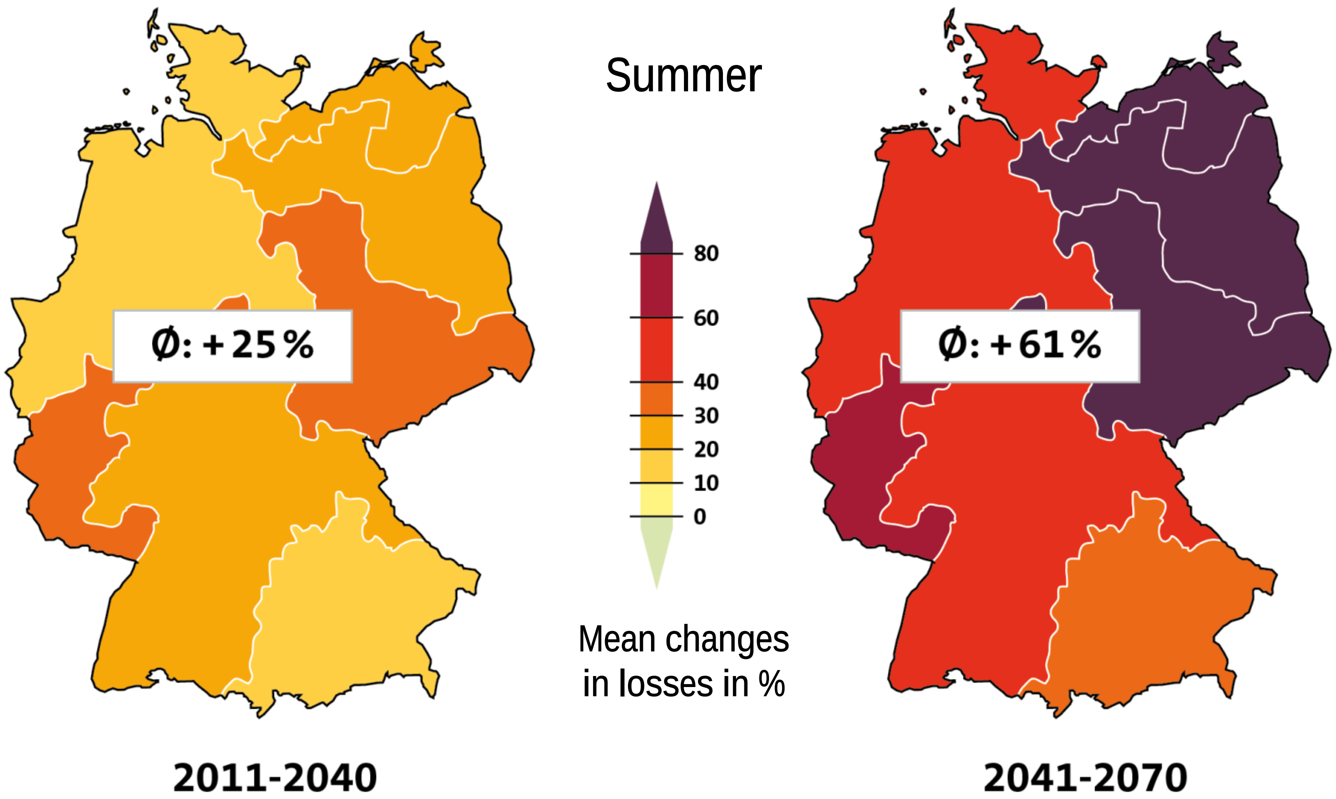


Loss scenarios

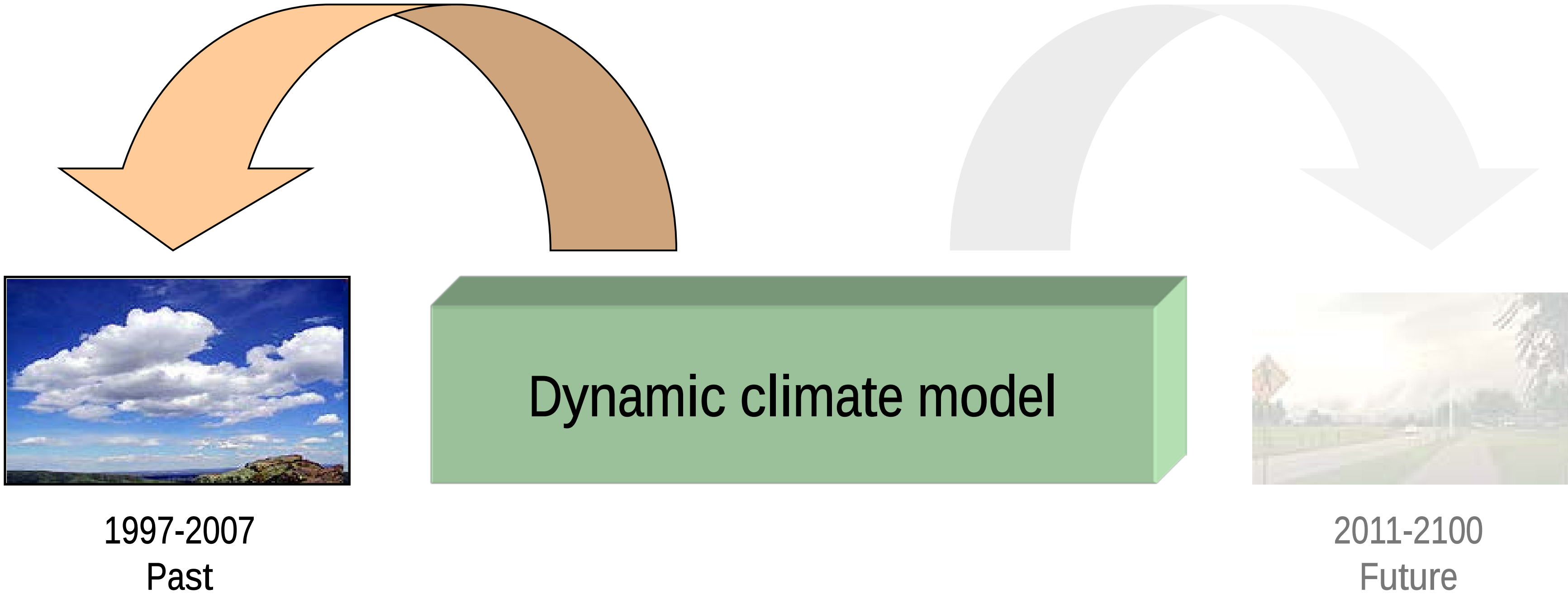
PIK: statistical loss model for storm/hail

Insured annual losses of the reference period when compared to the future losses under the A1B-scenario.

Dramatic shortening of return periods 1971-2000 vs. 2041-2070:

20-year losses turn to 10 year losses • 50-year losses occur every 25 years

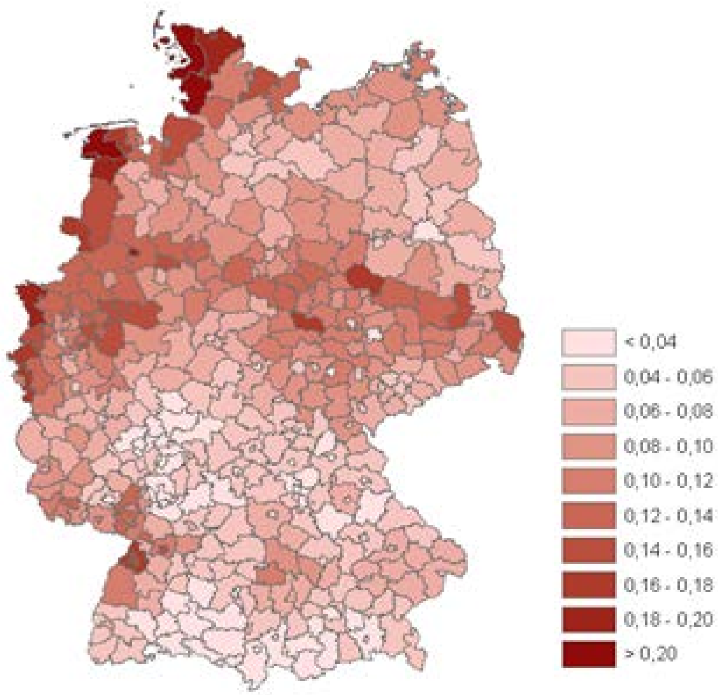
Dynamic climate model



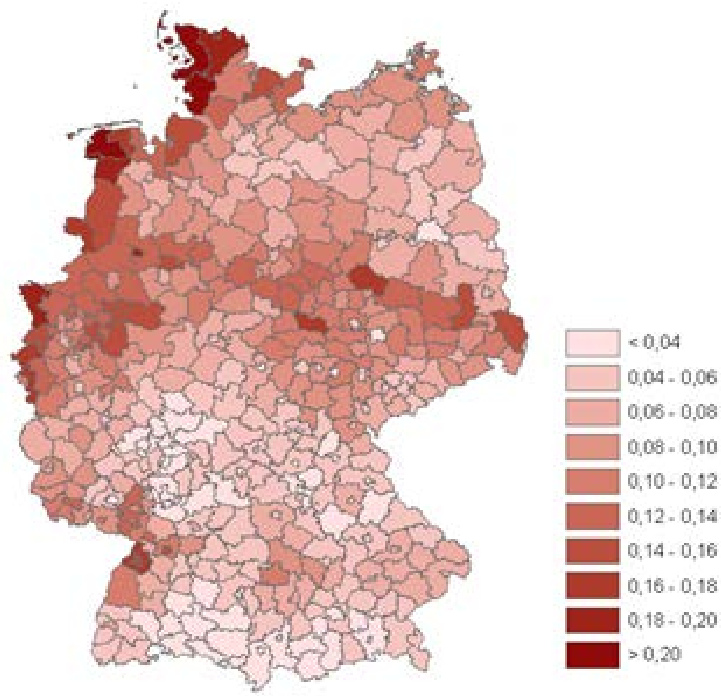
Model validation

FU Berlin: dynamic storm loss model

- Very high concord between observed data (GDV) and simulated data (FUB) (correlation 0,98)
- Comparison of mean annual loss ratio calculated from winter storm losses 1997-2007



observed losses
GDV [‰]

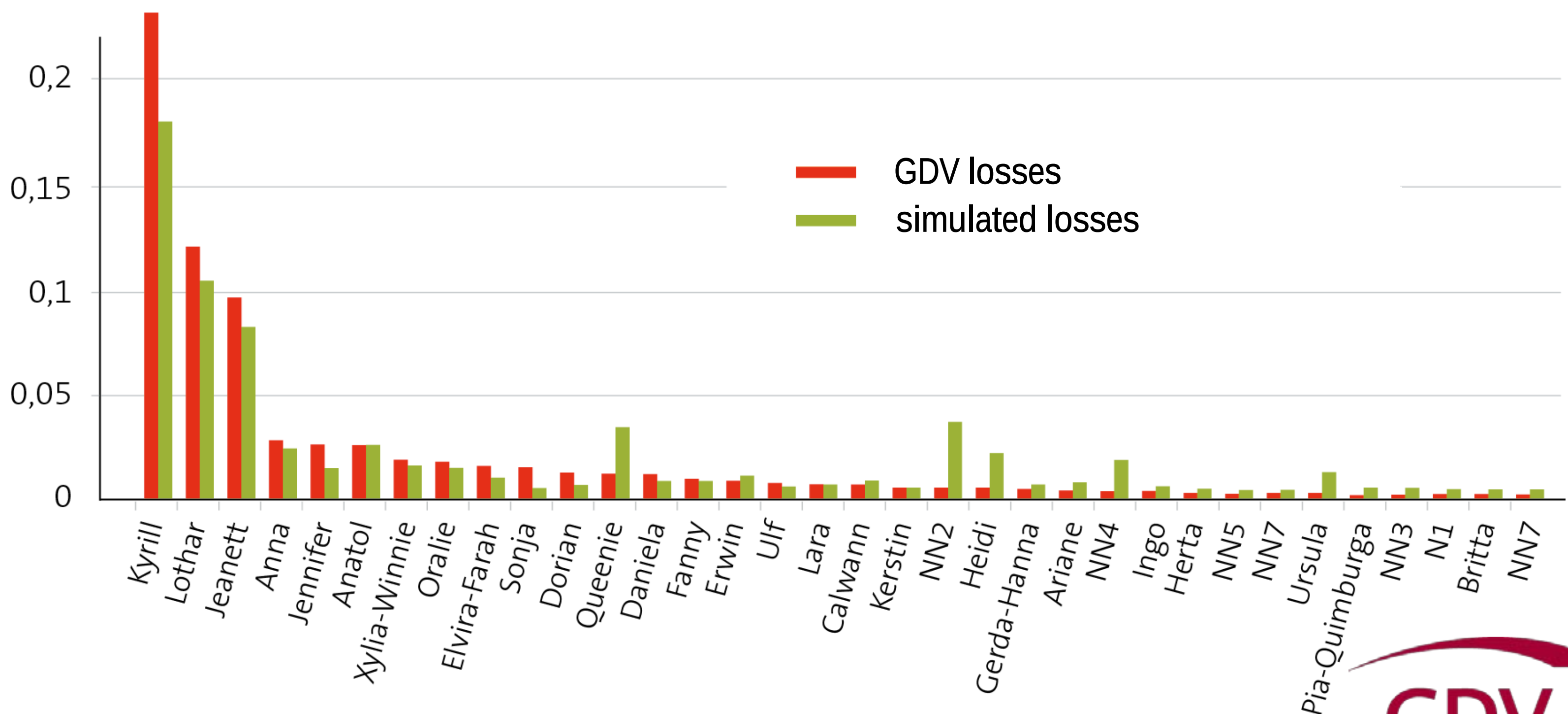


simulated losses by
the storm loss model [‰]

Model validation

FU Berlin: dynamic storm loss model

- Loss model with specific regional loss characteristics
- High concord between loss model and GDV's observed losses (loss ratio ‰)



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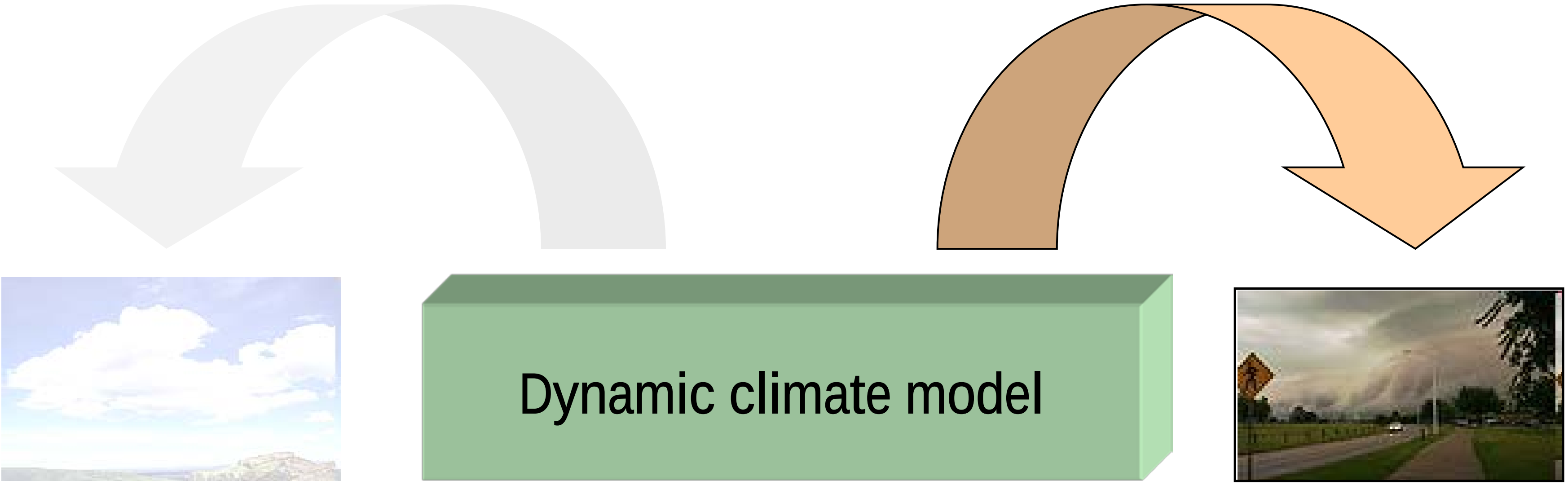
Dynamic climate model



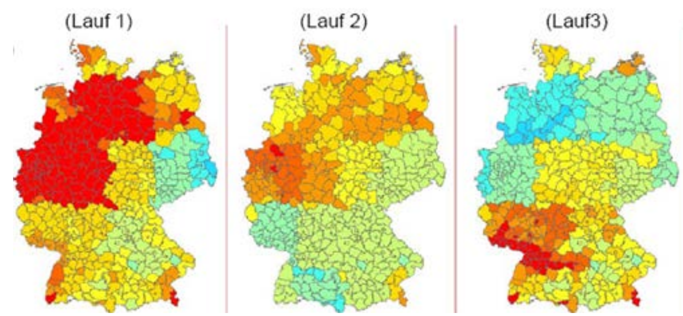
1997-2007
Past

2011-2100
Future

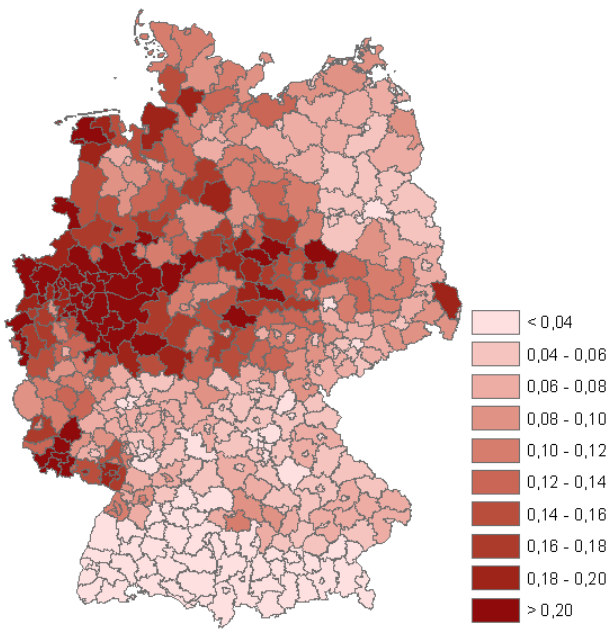
Loss scenarios

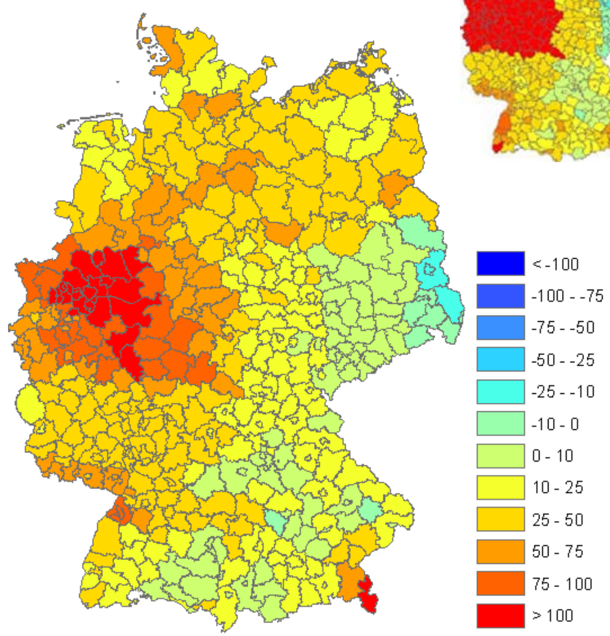
FU Berlin: dynamic storm loss model

- Statements of future changes in winter storm losses are now possible
- Relative changes in 2071-2100 under the A1B scenario when compared to simulated loss ratio 1961-2000
- Changes compared to today: by up to 100 %



global climate model
ECHAM5





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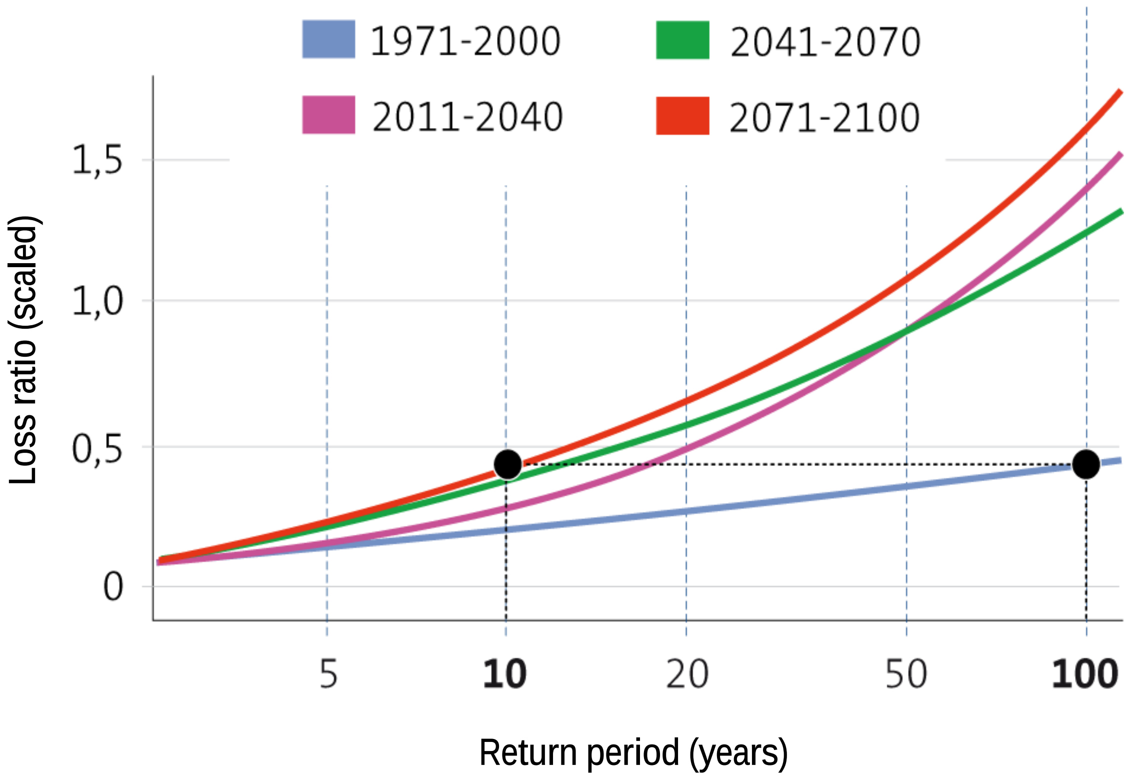
Loss scenarios

FU Berlin: dynamic storm loss model



Insured annual losses of the reference period when compare to the future losses up to 2100 under the A1B-scenario.

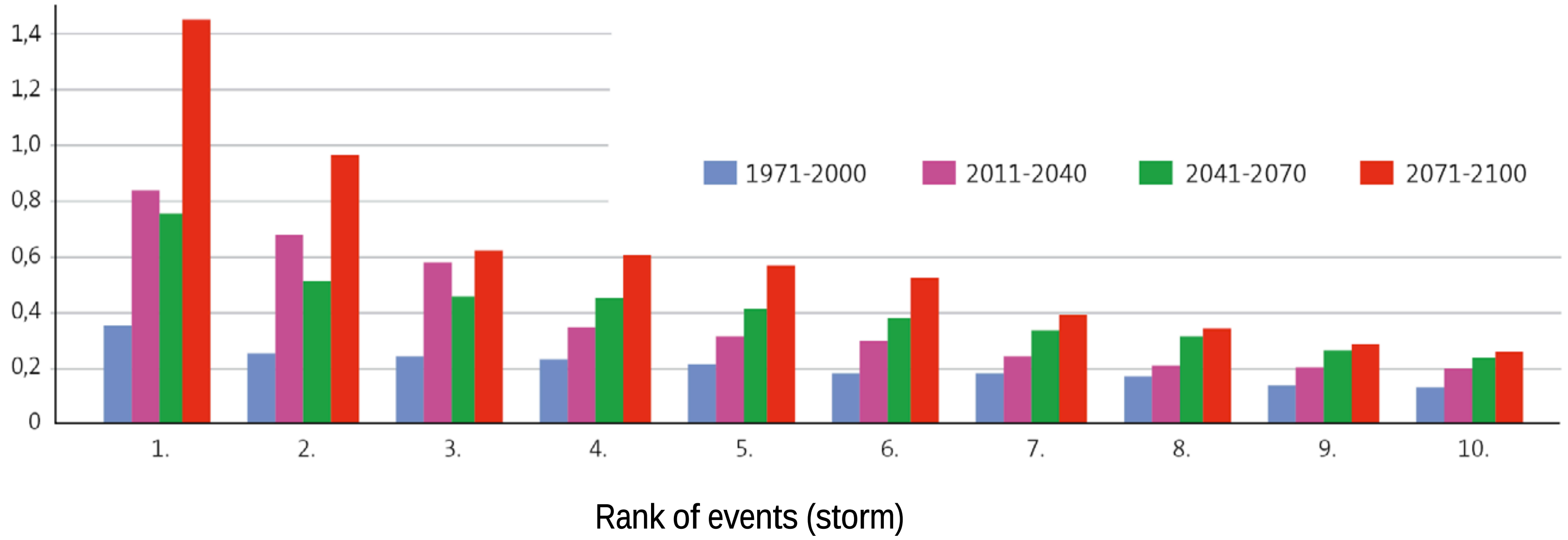
Dramatic shortening of return periods 1971-2000 vs. 2071-2100:

20-year losses turn to 6-year losses • 50-year losses turn to 9-year losses• 100-year losses turn to 12-year losses

Loss scenarios

FU Berlin: dynamic storm loss model

- With ECHAM5 simulated losses of the reference period and the future up to 2100: Increase of the most extreme storms at otherwise relatively unmodified storm events



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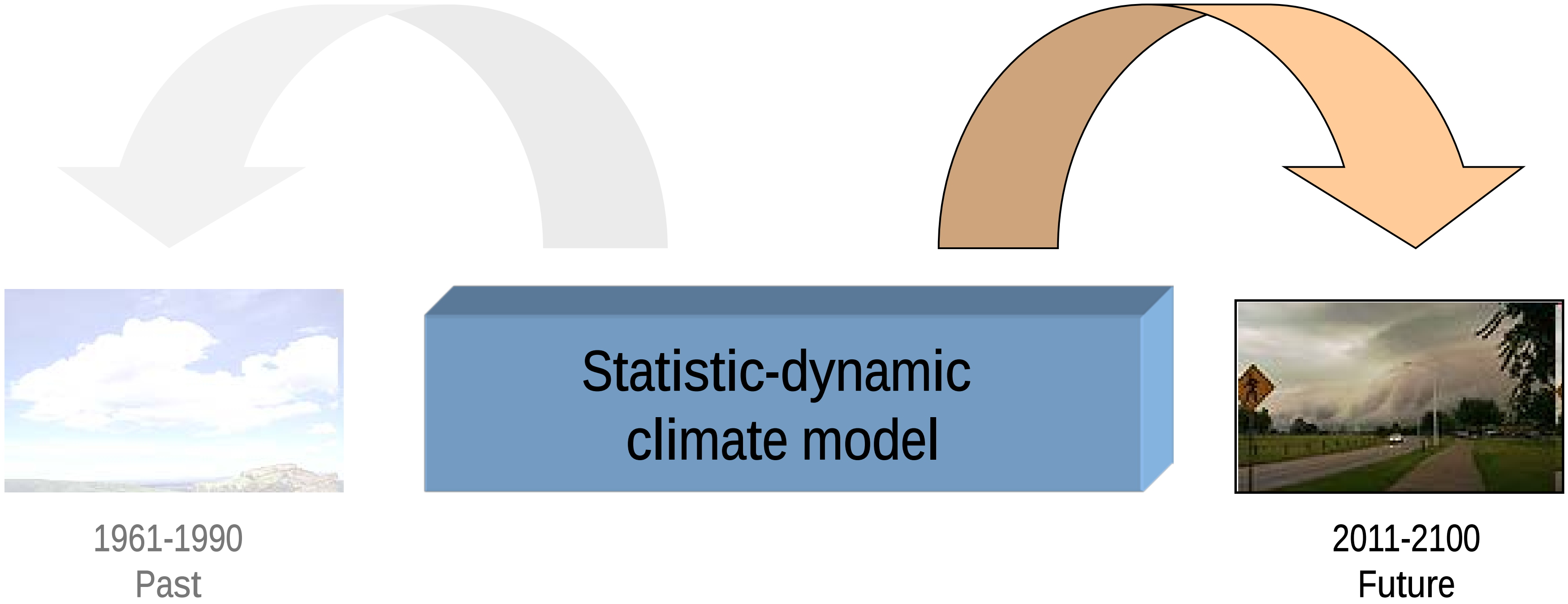
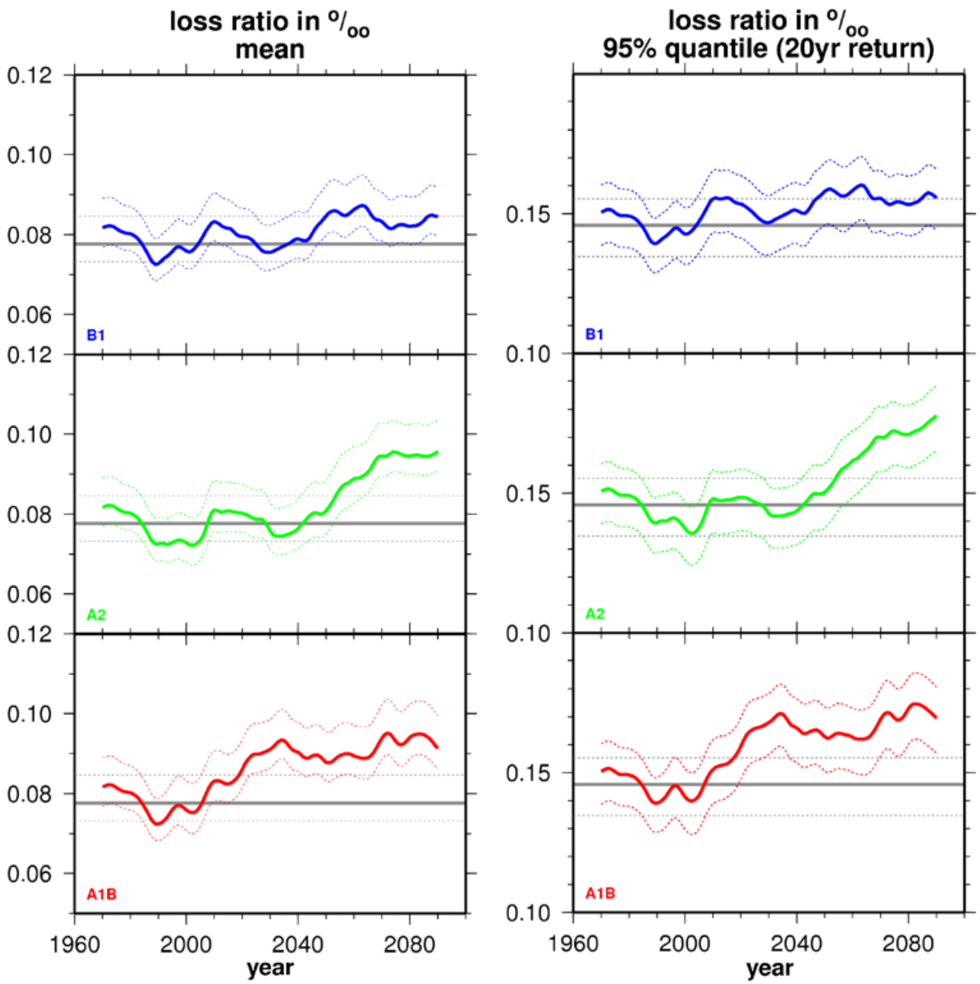
Statistic-dynamic climate model



Loss scenarios

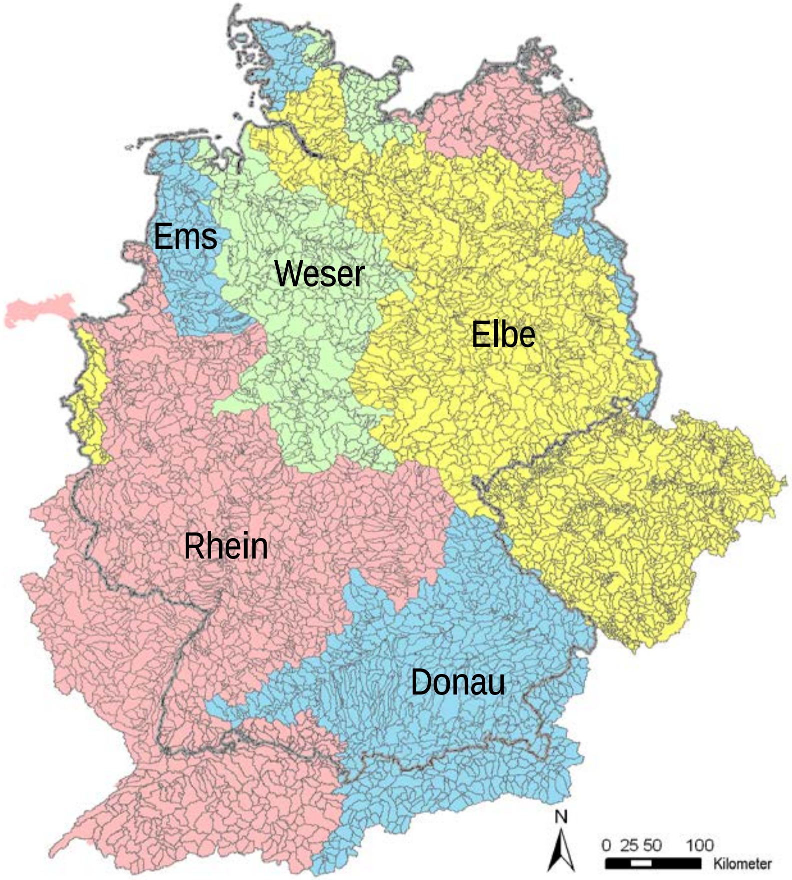
Uni Köln: statistic-dynamic down-scaling approach



This approach confirms as well: stronger storms cause higher losses

Floods

PIK: flood loss model



Analysis of floods along rivers, no heavy rain, no flash floods

5473 analysed parts of the rivers Rhein, Donau, Elbe, Weser and Ems (88 % of the area of Germany)

Used model chain:
global climate model ECHAM5 – regional climate models CCLM/REMO – hydrological model SWIM – flood loss model HQ Kumul

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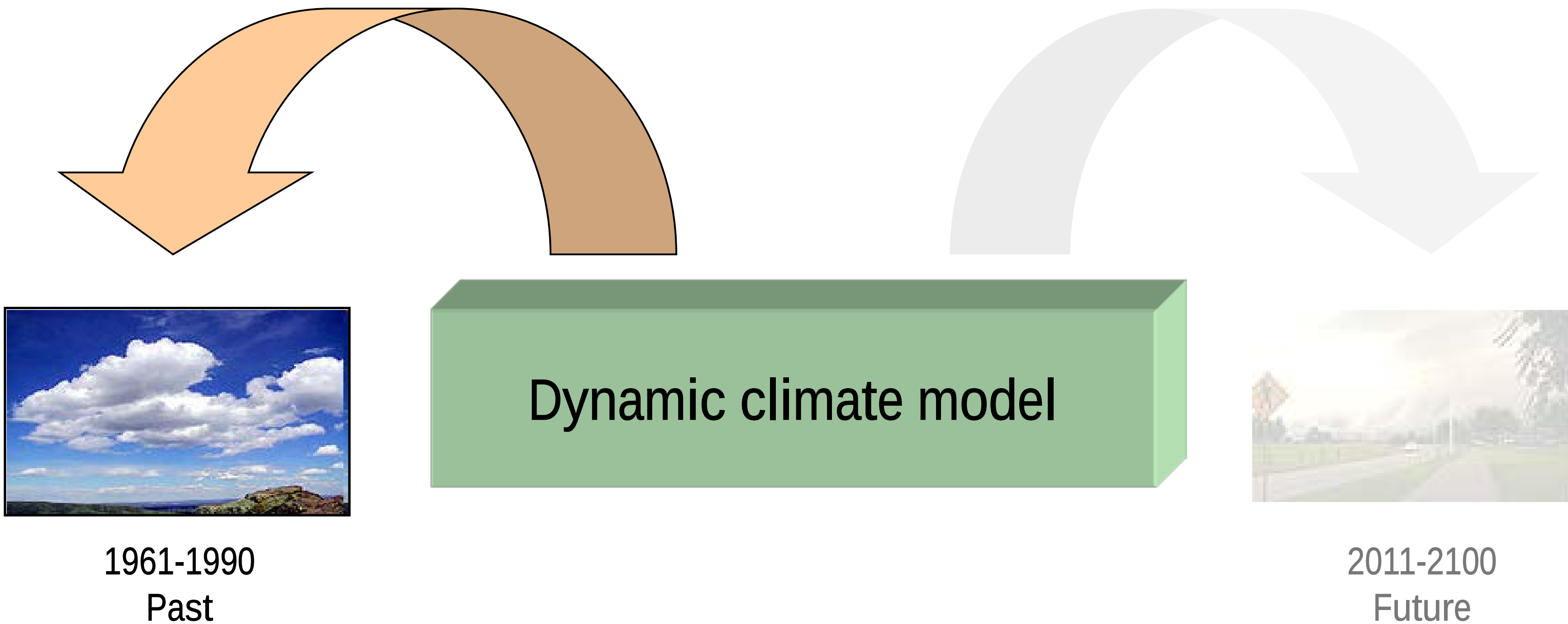
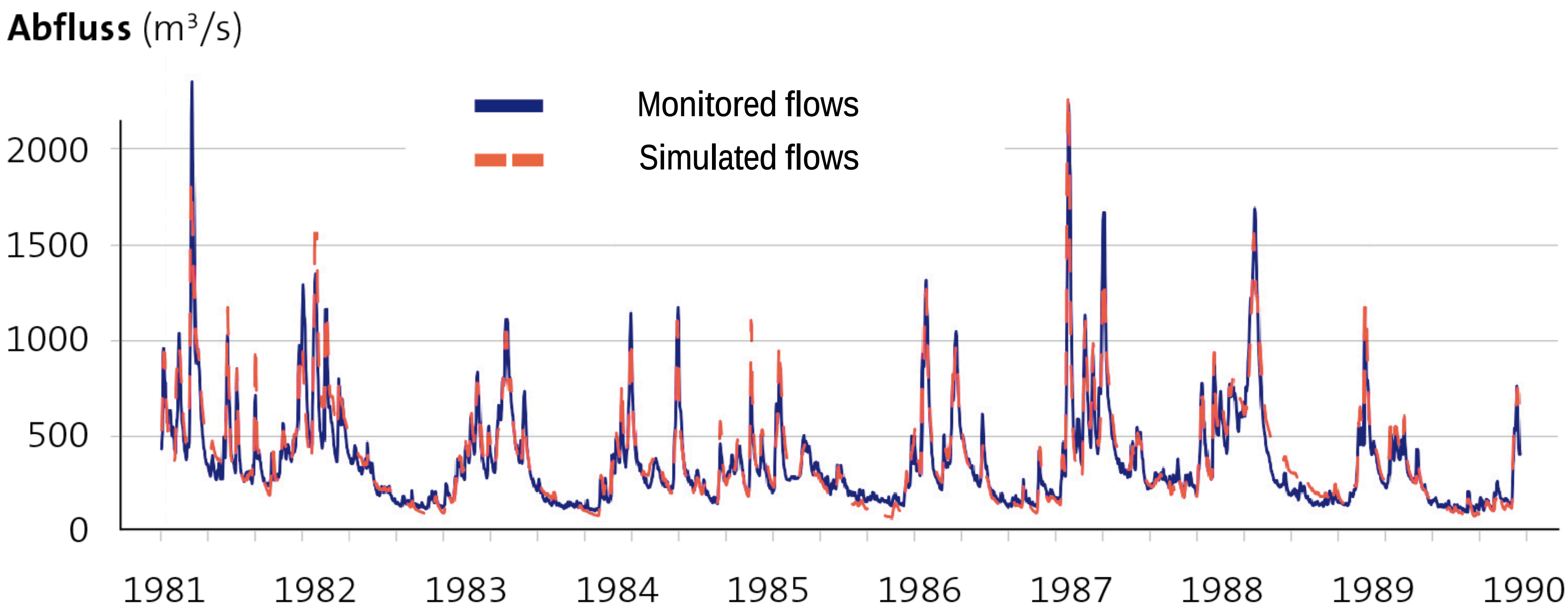
Dynamic climate model



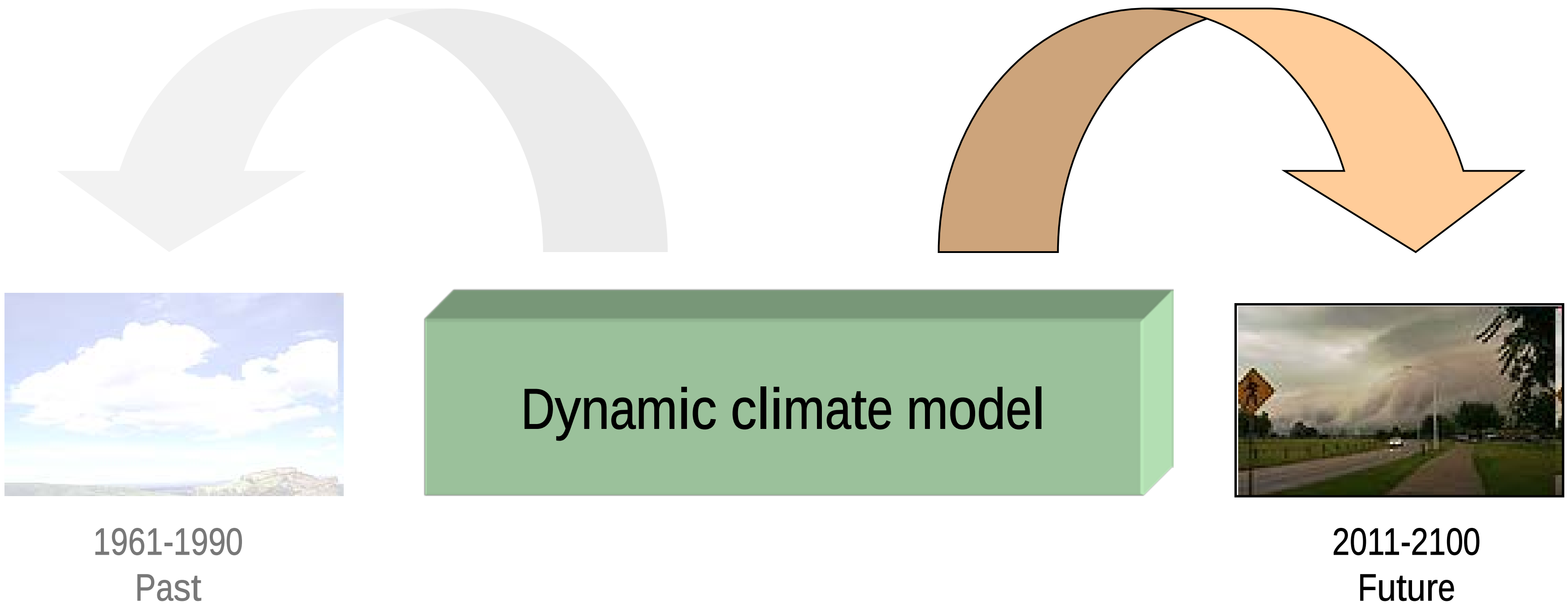
Model validation

PIK: flood loss model

- Hydrological model SWIM provides good results about the monitored flow behaviour
- High concord between simulated and monitored flows



Dynamic climate model



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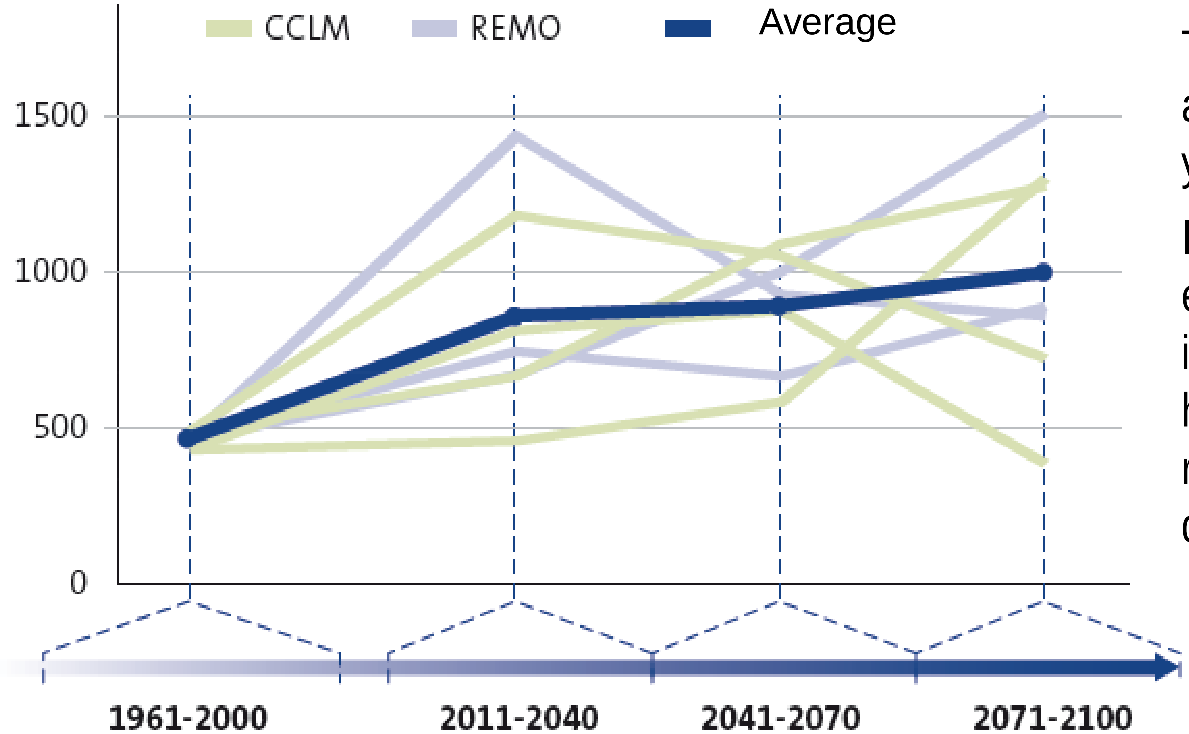
Loss scenarios

PIK: flood loss model

- Development of a long-term loss level: hydrological modelling in different scenarios based on CCLM bzw. REMO climate data. Data in m €



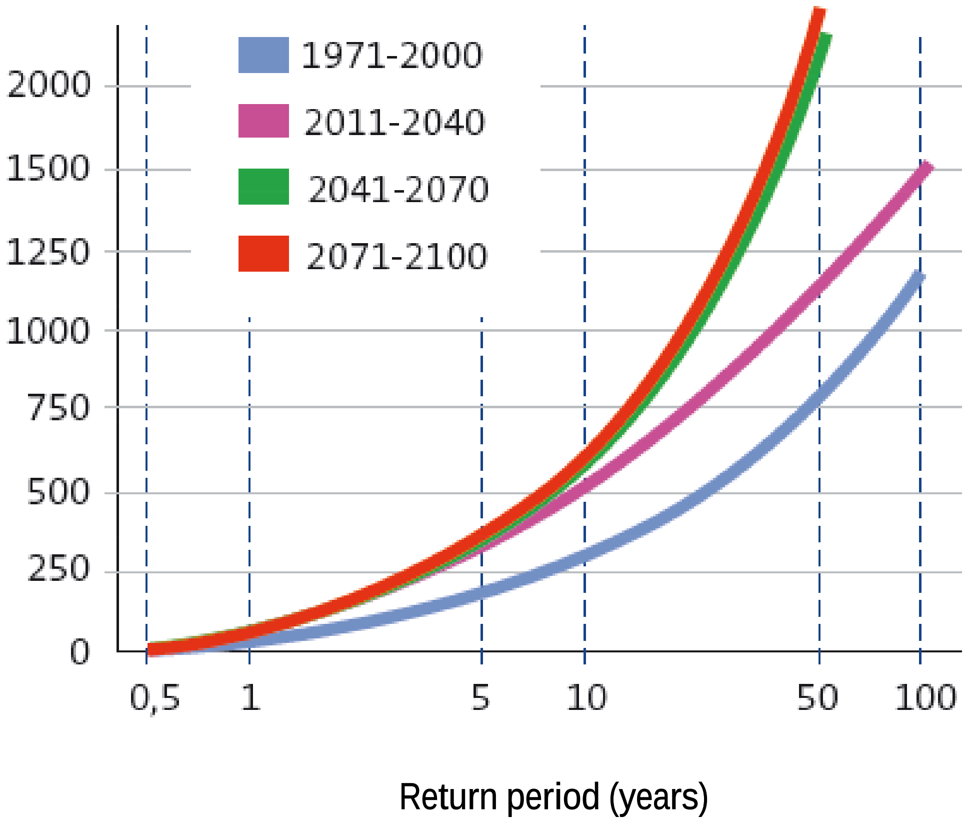
Today we calculate with an average loss of 500 m € per year caused by floods.

In the future this loss expectation should increase considerably. But here are considerable ranges of potential developments possible too.

Loss scenarios

PIK: flood loss model

- Mean loss per return period: mean value of several hydrological modelling. Data in m €



Flood losses, who nowadays return every 50 years and cause losses of approx. 750 m €, could become be twice as expensive in the future.

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Conclusions

Impacts of an A1B-scenario due to the loss situation of the Geman insurance industry

- Winter storms
  - Shortening of the return periods: A 50-year events could turn into a 10-year event in the future
  - Intensification of individual extreme storms at otherwise relatively unmodified storm events
  - Storm losses could increase by more than 50 % until 2100
- Floods
  - Heavy rain, floods and flash floods will increase
  - A 50-year event could turn into a 25-year event in the future
  - Flood losses can be twice or three times as much until 2100

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Conclusions

The good news:

In Germany, natural hazards **will be insurable** in the foreseeable future.

But the there are some **demands** to others.
Insurance will play its part, but won't be able to solve all future problems…

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Demands

What do we demand in the face of the scientific results?

Lawmakers have to be aware of their responsibilities in the protection against natural hazards.

Laws and regulations have to be aimed at future developments and a changing climate.

They have to be reviewed on a regular basis.

Demands

Furthermore the German insurance industry demands:

- The existing **land use planning** must take into account all risk areas - **extremely flood-prone regions are no plots for building.**
- **Retention areas and flood plains** must be clearly **identified** to mitigate the effects of extreme rainfall.
- **Information** about extreme weather events **must be made available** the general public quickly and freely.
- **Curricula** for schools and supportive content for kindergartens must create the pre-condition for a fundamental understanding of the causes and consequences of climate change.
- Measures must be **planned across countries.**

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Demands

Furthermore the German insurance industry demands:

- **Drainage systems** shall be designed in a way that **future amounts** of heavy rainfall can safely be passed along.
- **Roof structures** must be **adapted** to higher wind loads.
- **Upgraded insulation** on houses must be **resistant** against the expected natural hazards such as more powerful hailstorms.
- **Openings** should be **protected** from heavy rain and surface water.

Thank you for your attention!