



ReKliEs-De
Regionale Klimaprojektionen Ensemble
für Deutschland

Comparing diversity: Communicating CMIP3 and CMIP5 results

H. Huebener K. Bülow, K. Keuler, K. Warrach-Sagi, A. Spekat, C. Menz, C. Steger



Brandenburgische
Technische Universität
Cottbus - Senftenberg



GERICS
Climate Service Center
Germany



Deutscher Wetterdienst
Wetter und Klima aus einer Hand



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From CMIP3 to CMIP5

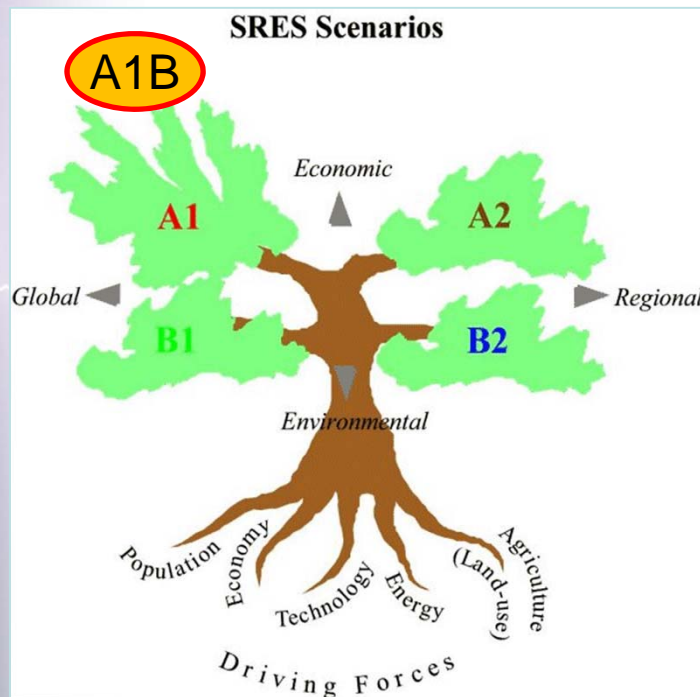
- **CMIP3:** Most users (impact research, policy, economy, ...) are used to SRES (mainly A1B) results
- **CMIP5:** New models, new model versions, larger ensemble, higher resolution, ...
 - Results change from CMIP3 to CMIP5
 - **In some cases / regions / variables, simulated change signals for RCP8.5 are not significantly different from SRES A1B results, even though the RCP8.5 scenario prescribes a stronger forcing!**
- How should the users treat these different results?
- How can we support the users in combining results obtained with SRES A1B with new results using RCP-scenarios?

Navigation

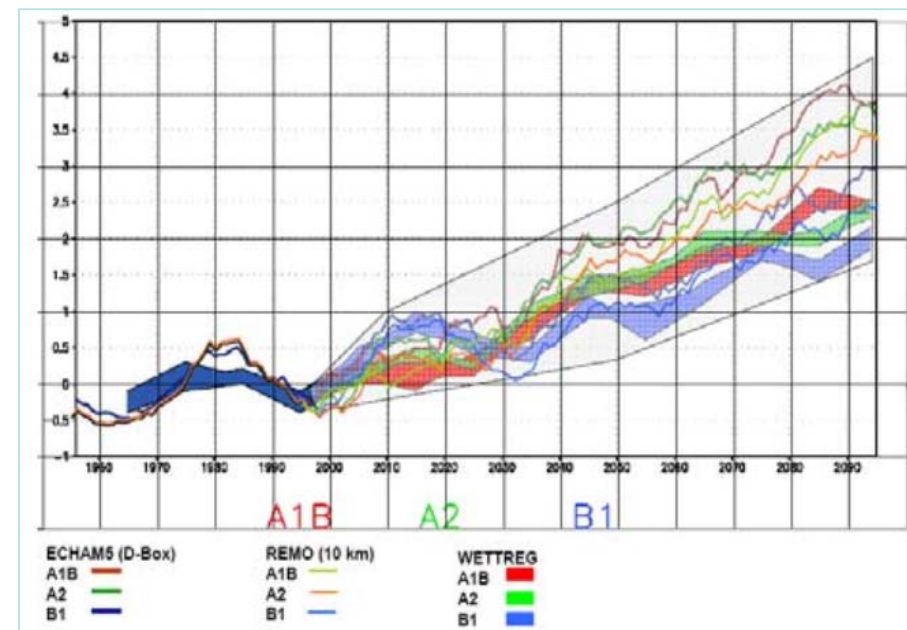
- ▶ **Background** – picking up people where they are
- ▶ **Problem** – comparing SRES and RCP
- ▶ **CMIP3 and CMIP5** – apples and oranges?
- ▶ **Surprises**
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Background: Pick up the people where they are

- Most users are familiar with climate scenarios and climate models in general and have worked with **SRES A1B**, mainly.
- Still, many impact research results exist, using a **limited GCM-RCM ensemble** (or only one combination of GCM and RCM)



Special Report on Emission Scenarios, Nakicenovic et al., 2001



Deutsche Anpassungsstrategie an den Klimawandel, UBA, 2008. Only one GCM (ECHAM5) and two (or four, in later graphics in the report) RCMs/ESDs are used.

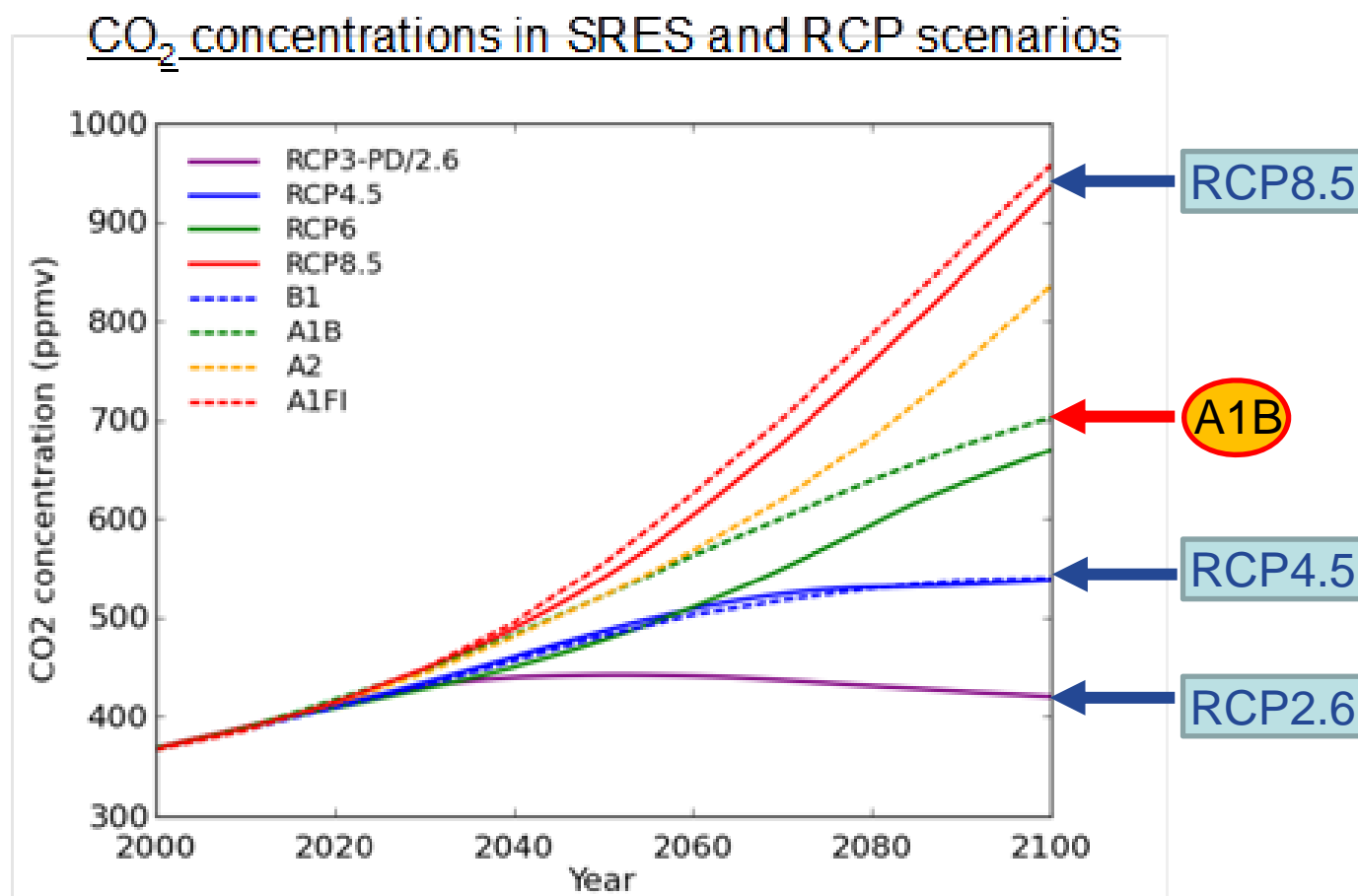
ReKliEs-De: where we are now

- Since IPCC AR5, all new simulations use RCP-scenarios
- ReKliEs-De complements EURO-CORDEX and provides an unprecedented set of high resolution climate projections.

GCM + RCP	CCLM	REMO	WRF	WR13	STARS3	RCA4	RACMO	HIRHAM5
EC-EARTH RCP2.6	EURO-CORDEX				ReKliEs-De	EURO-CORDEX	EURO-CORDEX	EURO-CORDEX
HadGEM2-ES RCP2.6					ReKliEs-De	EURO-CORDEX	EURO-CORDEX	
MPI-ESM-LR RCP2.6	ReKliEs-De	EURO-CORDEX	ReKliEs-De	ReKliEs-De	ReKliEs-De	EURO-CORDEX		
MPI-ESM-LR RCP8.5	EURO-CORDEX	EURO-CORDEX	EURO-CORDEX	ReKliEs-De	ReKliEs-De	EURO-CORDEX		
CNRM-CM5 RCP8.5	EURO-CORDEX	ReKliEs-De		ReKliEs-De	ReKliEs-De	EURO-CORDEX		
HadGEM2-ES RCP8.5	EURO-CORDEX	ReKliEs-De	ReKliEs-De	ReKliEs-De	ReKliEs-De	EURO-CORDEX	EURO-CORDEX	
EC-EARTH RCP8.5	EURO-CORDEX	ReKliEs-De	ReKliEs-De	ReKliEs-De	ReKliEs-De	EURO-CORDEX	EURO-CORDEX	EURO-CORDEX
Can-ESM2 RCP8.5	ReKliEs-De	ReKliEs-De		ReKliEs-De	ReKliEs-De			
MIROC5 RCP8.5	ReKliEs-De	ReKliEs-De	ReKliEs-De	ReKliEs-De	ReKliEs-De			
IPSL-CM5A RCP8.5			EURO-CORDEX			EURO-CORDEX		

Problem: comparing SRES with RCP results

- CMIP5-GCM simulations mostly use RCP8.5, RCP4.5 or RCP2.6
- No scenario (and simulations) comparable to SRES A1B



<https://www.climatechangeinaustralia.gov.au/en/climate-projections/climate-futures-tool/experiments/>,
 after Collier et al., 2011.

Problem: comparing SRES with RCP results

- Users mostly expect climate change to be proportional to the forcing strength
- This is approximately true for global mean temperature
- It is not necessarily true for changes in limited areas or in other variables.
- Thus, simply scaling impacts from one scenario to another according to the respective forcing strength is no solution.
- But still, the users (and most of the climate data providers also) expect larger climate change signals with stronger forcing

CMIP3 and CMIP5 – apples and oranges?

- 1: Calculating concentrations from SRES and emissions from the RCPs is not trivial and includes some bandwidth.
- 2: Most CMIP5-GCMs are “next generation” of CMIP3-GCMs
- 3: Some new GCMs are added to CMIP5 compared to CMIP3
- 4: Different numbers of realizations
- 5: Some models use higher resolution
- 6: Different RCMs / ESDs used
- 7: Points 2-5 also apply to RCMs / ESDs



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https://en.wikipedia.org/wiki/File:Oranges_Market_1.JPG

CMIP3 and CMIP5 – apples and oranges?

- Unfortunately, no focus was given to simulating RCP6.0, which would have been at least remotely comparable to SRES A1B
- A systematic comparison between model generations can usually be found “elsewhere in the literature” → not easily accessible and understandable for users
- No clear, straight forward answer to the impact of horizontal resolution on the results.
- Often users are left alone with interpreting the changes in signals between the different ensembles and scenarios.
- Some results might be surprising:

Surprises

- In some models, the climate sensitivity changed between model generations

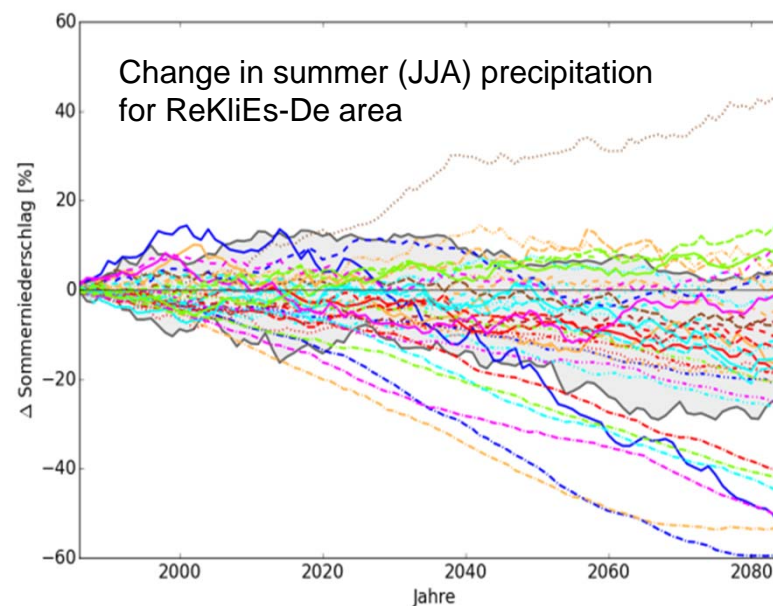
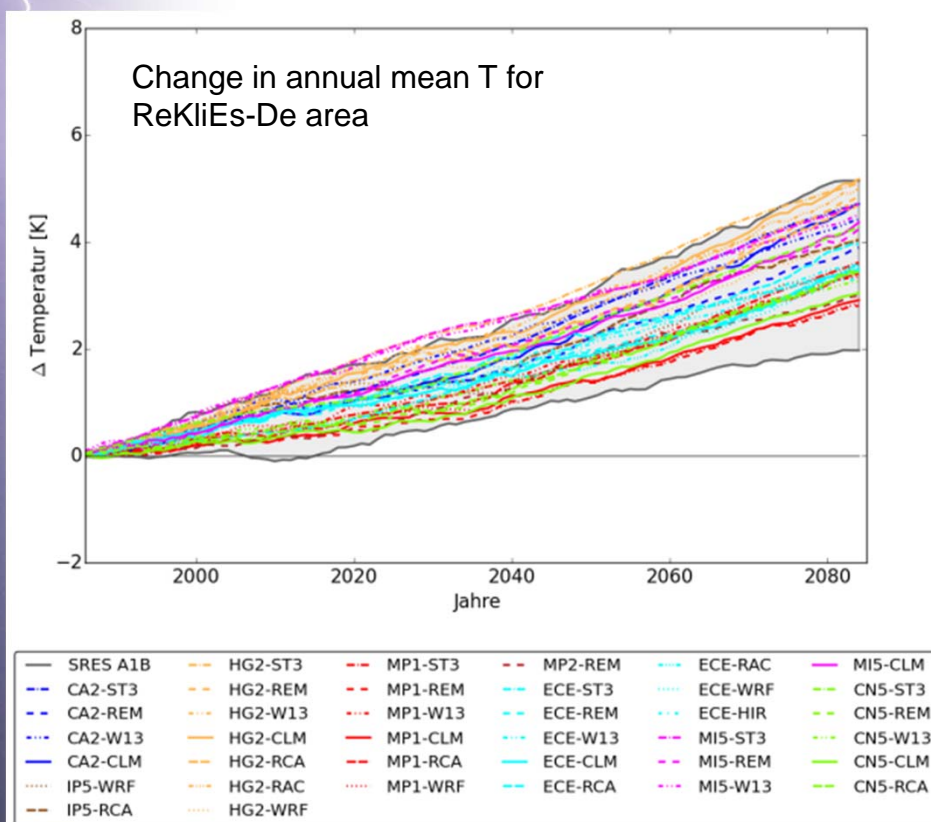
Transient Climate Response

GCM	TCR (°C)	TCR (°C)
	CMIP3	CMIP5
CNRM-CM	1.6	2.1
HadGEM	1.9	2.5
MIROC	2.1	1.5
MPI-ESM	2.2	2.0

- But global climate sensitivity might not conform with regional climate change signal:
 - While global TCR for MPI-ESM is larger than for MIROC5, regional warming in the ReKliEs-De area (Germany and river catchments draining into Germany) is smaller in MPI-ESM than in MIROC (see red and pink lines on next slide).

Surprises

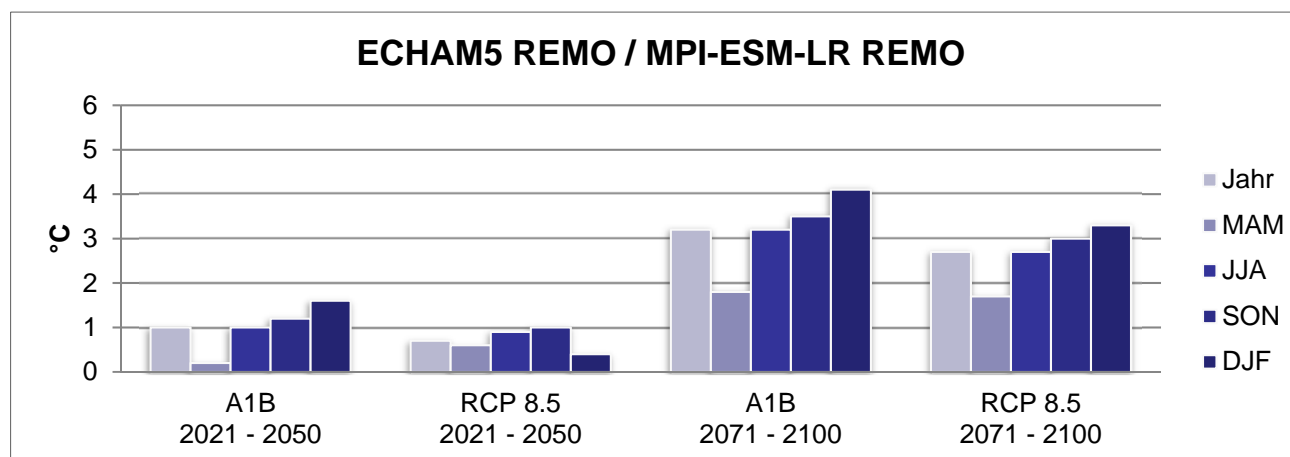
- In the ReKliEs-De area, some climate change signals simulated with the strong forcing scenario RCP8.5 are not much stronger than signals simulated with the previous generation of GCMs under the moderate emissions scenario SRES A1B.



Coloured lines: RCP8.5 results,
grey envelope: A1B results

Surprises

- Particularly, comparing CMIP3 and CMIP5 results from one single model combination can lead to counter-intuitive conclusions



Change in annual mean and seasonal T for Hesse, Germany, w.r.t 1971-2000:

- A1B simulation using the CMIP3-GCM ECHAM5-MPI-OM and RCM REMO
- RCP8.5 simulation using the CMIP5-GCM MPI-ESM-LR and RCM REMO

The RCP8.5 model chain is the new generation of the A1B model chain.

Surprise:

Resulting temperature change for this model chain and area is smaller in RCP8.5 compared to SRES A1B!

I could show you more such surprises, if you like ...

Communication: hurdles

Of course, a simple comparison of CMIP3 and CMIP5 results is not allowed.

Of course, the models have changed.

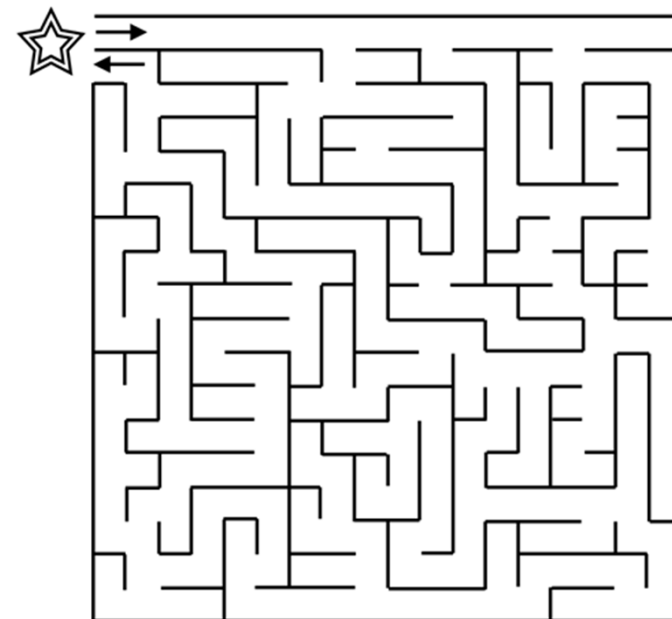
Of course, the change signals are still in the uncertainty range.

Of course, users shouldn't use only one model chain!

BUT:

Users will – understandably – expect no such surprises!

It's a maze ...



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<https://en.wikipedia.org/wiki/Maze>

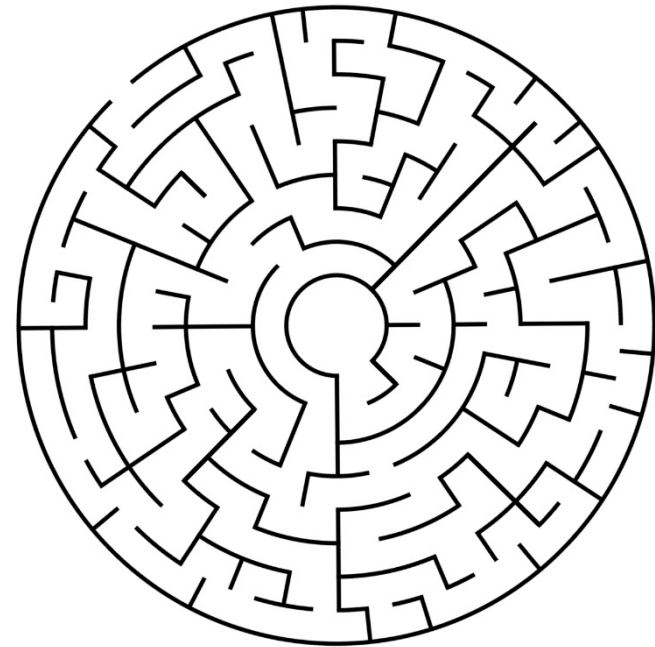
Communication: hurdles

Users of climate change data (impact researchers, policy advisers, ...) need condensed information.

They don't need (and want) to understand every detail of climate modelling.

So, how do we communicate complex information, like how to interpret the SRES A1B results versus RCP8.5 results when using different ensembles?

... get to the central point!

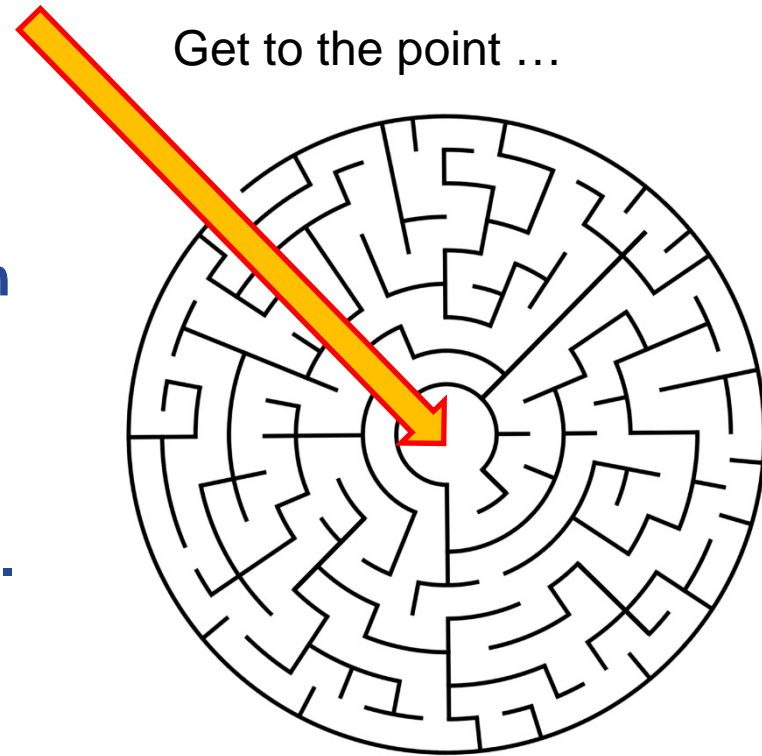


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What we should tell the users:

1. “In general, results for RCP8.5 show stronger change signals compared to SRES A1B results (but not necessarily in each region).”
2. “The general result is true, even if some models show smaller change signals in their new (CMIP5) version.”
3. “Your A1B-results are still valid. We have, up to now, not found any A1B results lying outside the new projection envelope.”
4. “However, if RCP8.5 comes true, your estimations might be too optimistic.”

Get to the point ...



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What we should tell the users:

5. “When in view of conflicting results between CMIP3 and CMIP5 results: Trust the new model generation over the old model generations → models have become better.”
6. “Don’t be overconfident: We understand a lot, but our knowledge still has limitations and new research might still alter some points.”
7. “If you still have questions: Ask you local climate service provider.”

And then for us again: Keep it simple!



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ReKliEs-De Presentations at EGU- Conference 2018:



ReKliEs-De
Regionale Klimaprojektionen Ensemble
für Deutschland

EGU2018-12882 | Orals | CL5.06

Climate change alternatives for central Europe. K. Keuler et al., Fri, 13 Apr, 16:45-17:00, Room F2

EGU2018-13490 | Posters | CL5.06

Weather extremes in an ensemble of downscaled CMIP5 simulations for Germany from 1971-2000. V. Mohr et al., Fri, 13 Apr, 17:30–19:00, Hall X5, X5.497

EGU2018-8992 | Posters | CL5.06

Climate change in Europe at global mean temperature increases of 1.5 and 2°C above pre-industrial conditions according to EURO-CORDEX RCM simulations. E. Kjellström et al., Fri, 13 Apr, 17:30–19:00, Hall X5, X5.463

EGU2018-12968 | PICO | CL5.13

Comparing diversity: Communicating CMIP3 and CMIP5 results. H. Huebener et al., Fri, 13 Apr, 10:50–10:52, PICO spot 5a

More information on ReKliEs-De: <http://reklies.hlnug.de/>

Data download via ESGF or

https://swift.dkrz.de/v1/dkrz_a88e3fa5289d4987b4d3b1530c9feb13/ReKliEs-De/Internet-ReKliEs-De/startseite.html