

Communicating water-related climate change hazards to local stakeholders

Laura Müller and Petra Döll



1. Background

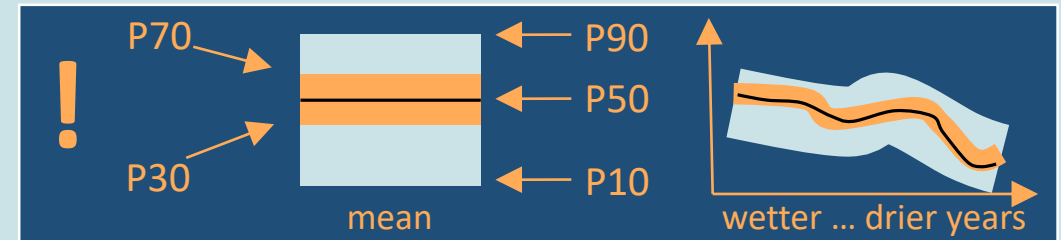
Local stakeholders: simulated, hydrological changes and their uncertainty need to be assessed for and communicated to them.

2. Methods

- Multi-model ensemble (8 GHMs, 4 GCMs)
- Potential changes under 2 emissions scenarios in 2 future time periods

3. Communication

- Visualization: 2 types of graphs (see below)
- Oral presentation: at least X% of the multi-model ensemble simulates ...



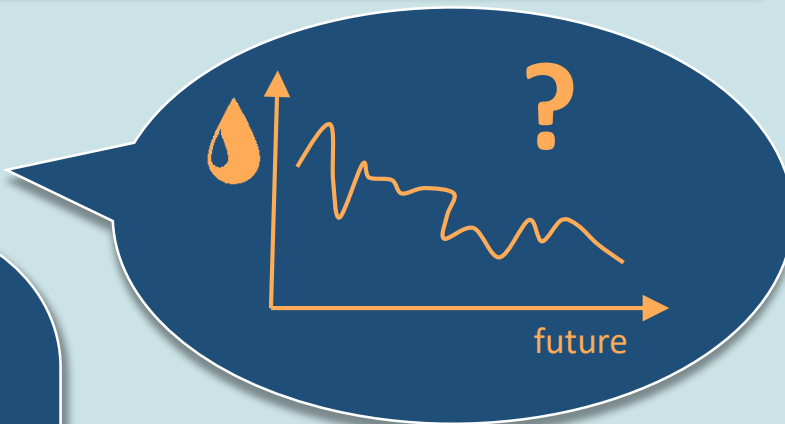
4. Evaluation

5. Conclusions

- Evaluation: Better understanding of water-related potential changes and of their uncertainties?
- Conclusions: the visualization is still complex and needs further explanations but uncertainty can be communicated successfully.

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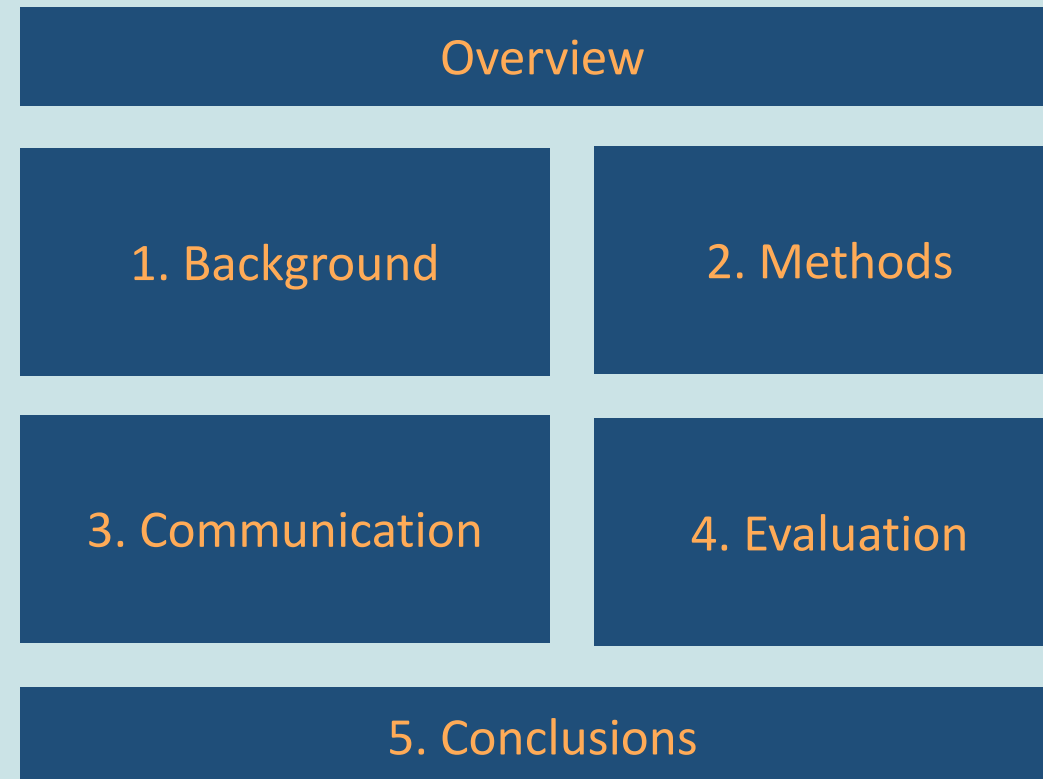
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Navigation

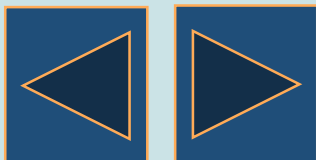
Clickable links: text or symbols which are blue, underlined and a mouse is pointed to it

Example: [Overview](#)

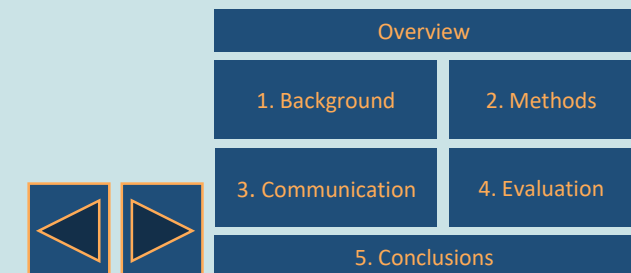
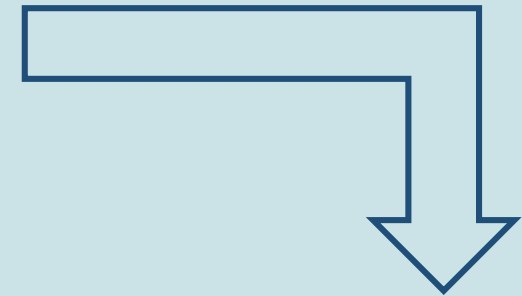
To jump from section to section, you can also use these buttons.



Either scroll, use the arrow keys of your keyboard or these arrows to go to the next or the previous slide



You can find this navigation on the bottom right of every slide.



1. Background: Motivation

- Climate change changes the water cycle and can therefore trigger hazards. This requires adaptation in water management in many regions (Milly et al., 2008; Döll et al., 2015).
- Potential, **hydrological changes** are best assessed with multi-model ensembles (MME; multiple hydrological models are driven by the output of multiple climate models) to take into account the **uncertainty** of climate and hydrological models (Döll et al., 2015).
- In many regions, no or only one regional hydrological model is available. Then, the best option (for monthly and yearly values) is to use a MME of global models.
- The MME output needs to be translated into meaningful information for local stakeholders who need to identify adaptation measures.
- Transdisciplinary project “KlimaRhön” aims at addressing this.

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1. Background: Transdisciplinary project „KlimaRhön“



- Aim: assessing water-related risks due to climate change and developing adaptation measures in water management
- Study area: UNESCO Biosphere Reserve Rhön (BRR) in Central Germany, area of only 2433 km² (Zaenker and Reiss, 2015)
- Methods:
 - **Stakeholder dialogue**
 - **Assessing water-related risks and its uncertainties**
 - Assessing risk perception and adaptation willingness of the population

Zaenker and Reiss (2015)



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2. Methods

Addressing uncertainties of the models

- Percentage changes in
 - 2 future 30-year periods relative to a
 - 30-year reference period
- Multi-model ensemble which consists of
 - 8 global hydrological models which were run in a consistent way and were all driven by the same
 - 4 global climate models

32 model combinations
in the multi-model ensemble

Data was derived by ISIMIP2b: Lange, Stefan (2019), www.isimip.org

[More methods...](#)

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2. Methods

Addressing uncertainties of the course of anthropogenic emissions and potential changes on different temporal scales

- 2 emissions scenarios:
RCP 2.6, RCP 8.5
- Temporal assessments:
yearly mean of
 - whole year (annual),
 - 3 summer months (June, July, August: JJA),
 - 3 winter months (December, January, February: DJF)

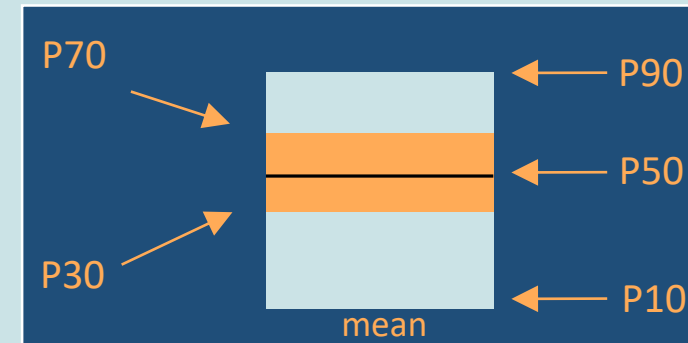
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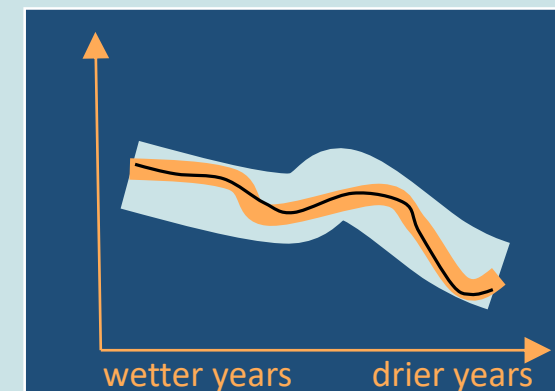
3. Communication

- 5 multi-model ensemble percentiles show uncertainty:
P10, P30, P50 (= median), P70, P90
PX: X% of model simulations (of the multi-model ensemble) are below PX

- 3.1 Mean change:
Visualization and oral presentation



- 3.2 Changes in different years:
Visualization and oral presentation



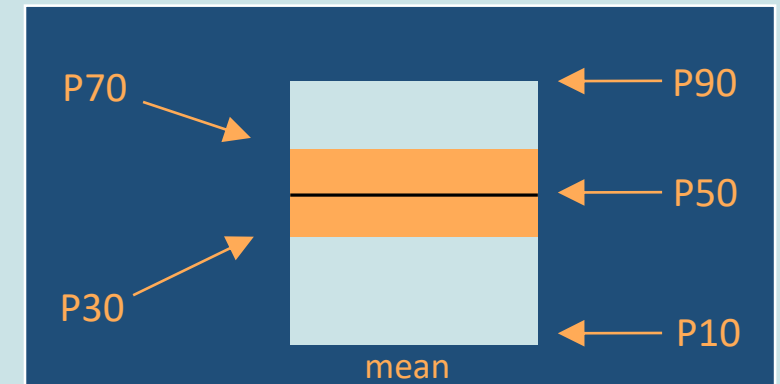
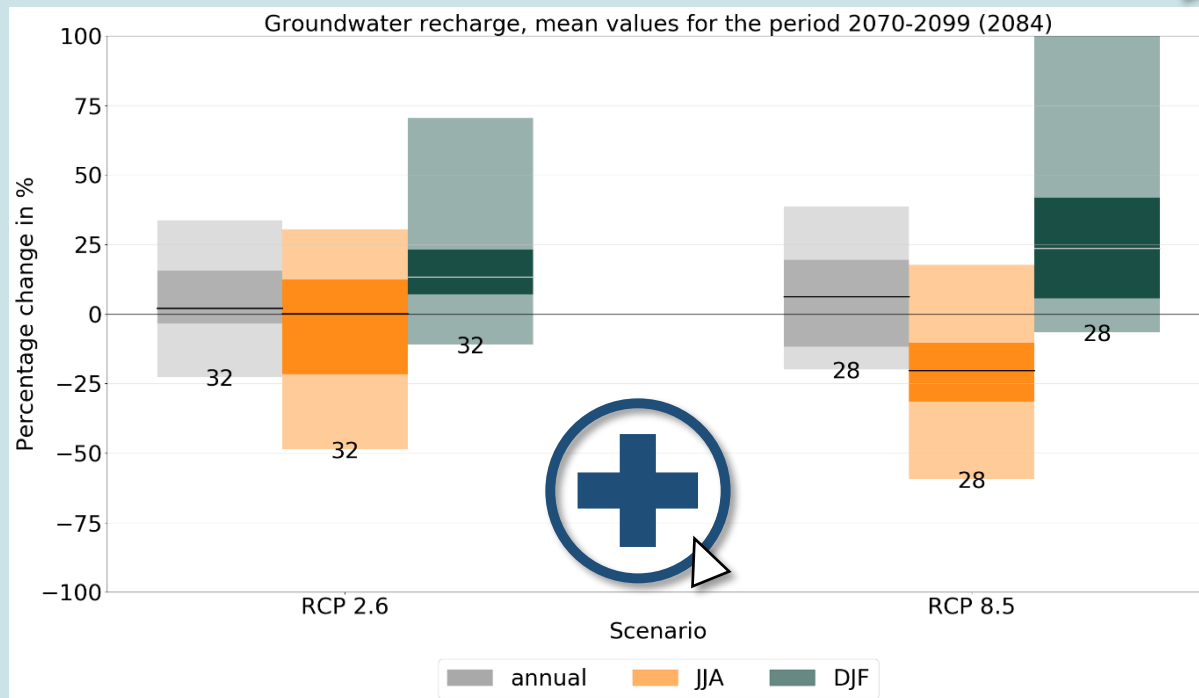
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3. Communication

3.1 Mean change: Visualization

- Mean changes simulated by all models of the MME are presented in a box
- Example of mean change in the BRR, the [study area](#):



[3.1 Oral presentation](#)

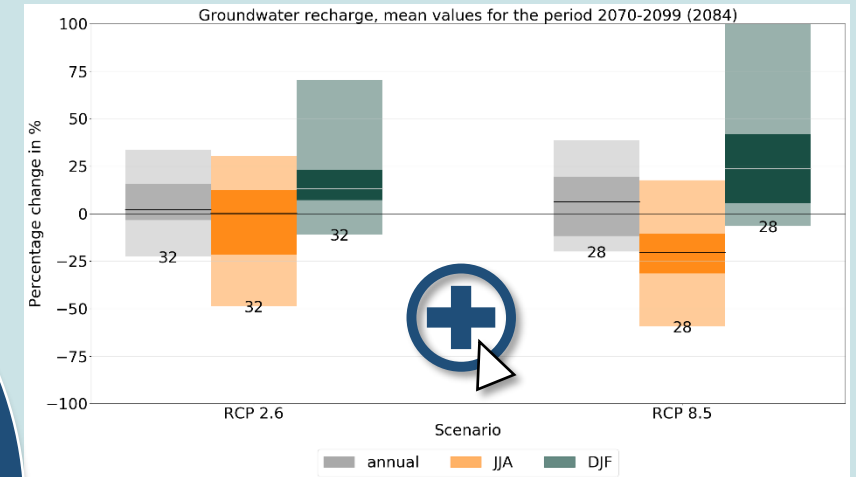
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3. Communication

3.1 Mean change: Oral presentation

“For the annual mean values, the dark grey box is never completely above or below 0% and the median lies near 0%. This means that $\approx 50\%$ of the MME estimates a decrease and $\approx 50\%$ an increase. In the summer and winter months, you can see a better tendency: The dark green box of the winter months is completely above 0%. This means that at least 70% of the MME estimates an increase in the winter months. For the summer months (under RCP 8.5), at least 70% of the MME estimates a decrease because the dark orange box lies completely below the 0% line. This indicates a potential hazard, in e.g. the drinking water supply, in summer months in the future.”



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[Go to 3.2 Changes in different years](#)

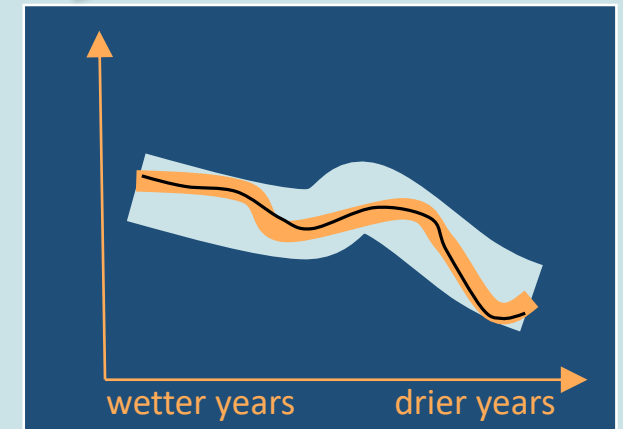
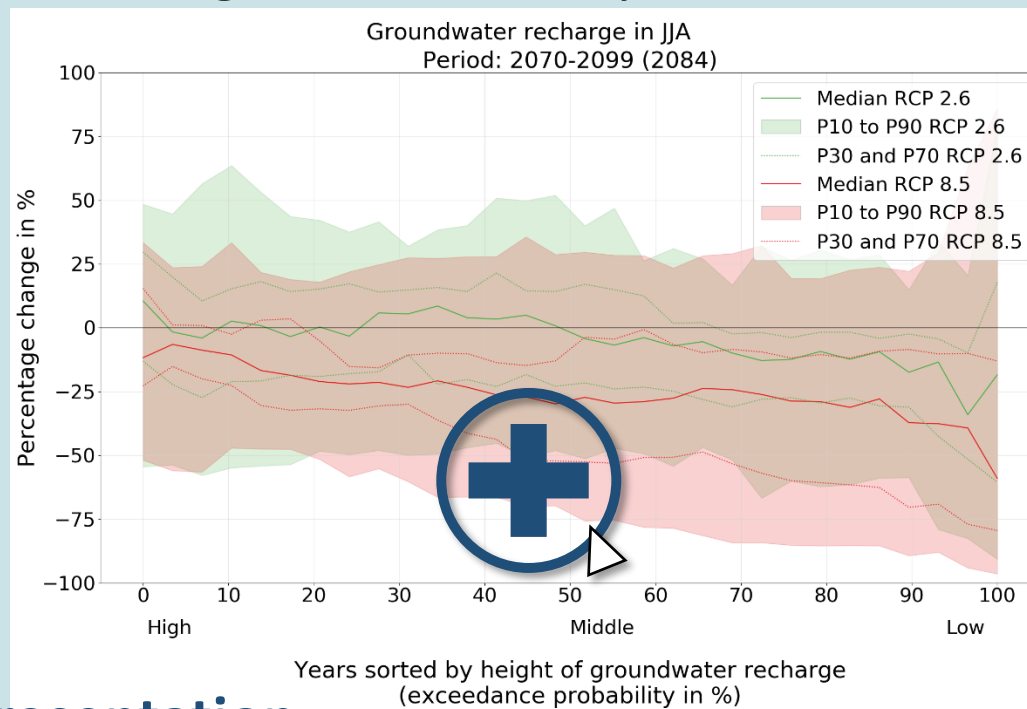
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3. Communication

3.2 Changes in different years: Visualization

- Changes in drier, average and wetter years simulated by all models of the MME are presented in a “continuous box”
- Example of changes in different years in the BRR, the study area:



3.2 Oral presentation

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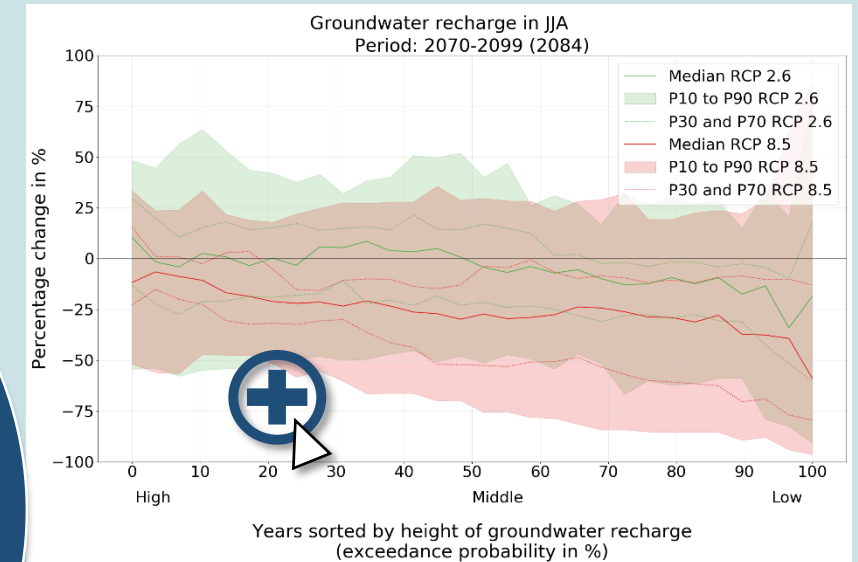


3. Communication

3.2 Changes in different years: Oral presentation

“Here, in summer, let’s focus on RCP 2.6 (green). The median drops to the right - on the right are drier years! In wetter years (on the left), the median lies near 0%. So, $\approx 50\%$ of the MME estimates a decrease and $\approx 50\%$ an increase in wetter years.

In drier years (on the right), you can see that even P70 (the upper dashed line) drops below 0%. This means that 70% of the MME estimates a decrease in summer months in drier years. Here, you see a difference in consensus of the MME on the sign of potential changes between wetter and drier years. In drier years, the likelihood of an emerging hazard (less groundwater recharge in summer months than historically) is higher than in wetter years.”



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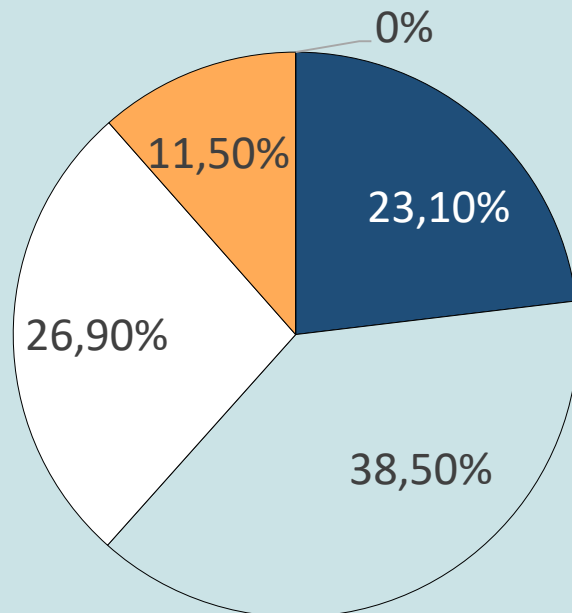
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4. Evaluation

On average, stakeholders gained a better understanding of uncertainty than of the changes themselves.

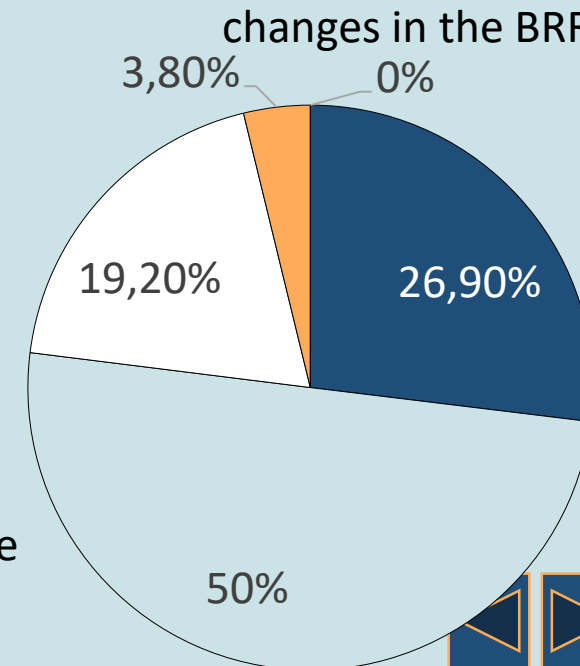
Through the scientific input, I gained a better understanding of the potential changes to water resources due to climate change in the BRR.



Number of answers by local stakeholders = 26

- I totally agree
- I rather agree
- I neither agree nor disagree
- I rather do not agree
- I do not agree at all

Through the scientific input, I gained a better understanding of the uncertainties of the estimated changes in the BRR.



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5. Conclusions

- Despite the efforts of enhancing the comprehensibility, the graphs are still complex and need further explanations.
- Uncertainty has been successfully communicated. Stakeholders can decide on which potential change they want to adapt depending on their risk aversion.
- If the MME projects both increases and decreases of e.g. run-off, the stakeholders might have more difficulties to draw conclusions.

[See References](#)

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References

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Acknowledgements

We would like to thank the Hessian Agency for Nature Conservation, Environment and Geology (HLNUG) and its Centre on Climate Change and Adaptation (FZK) for funding the project KlimaRhön.



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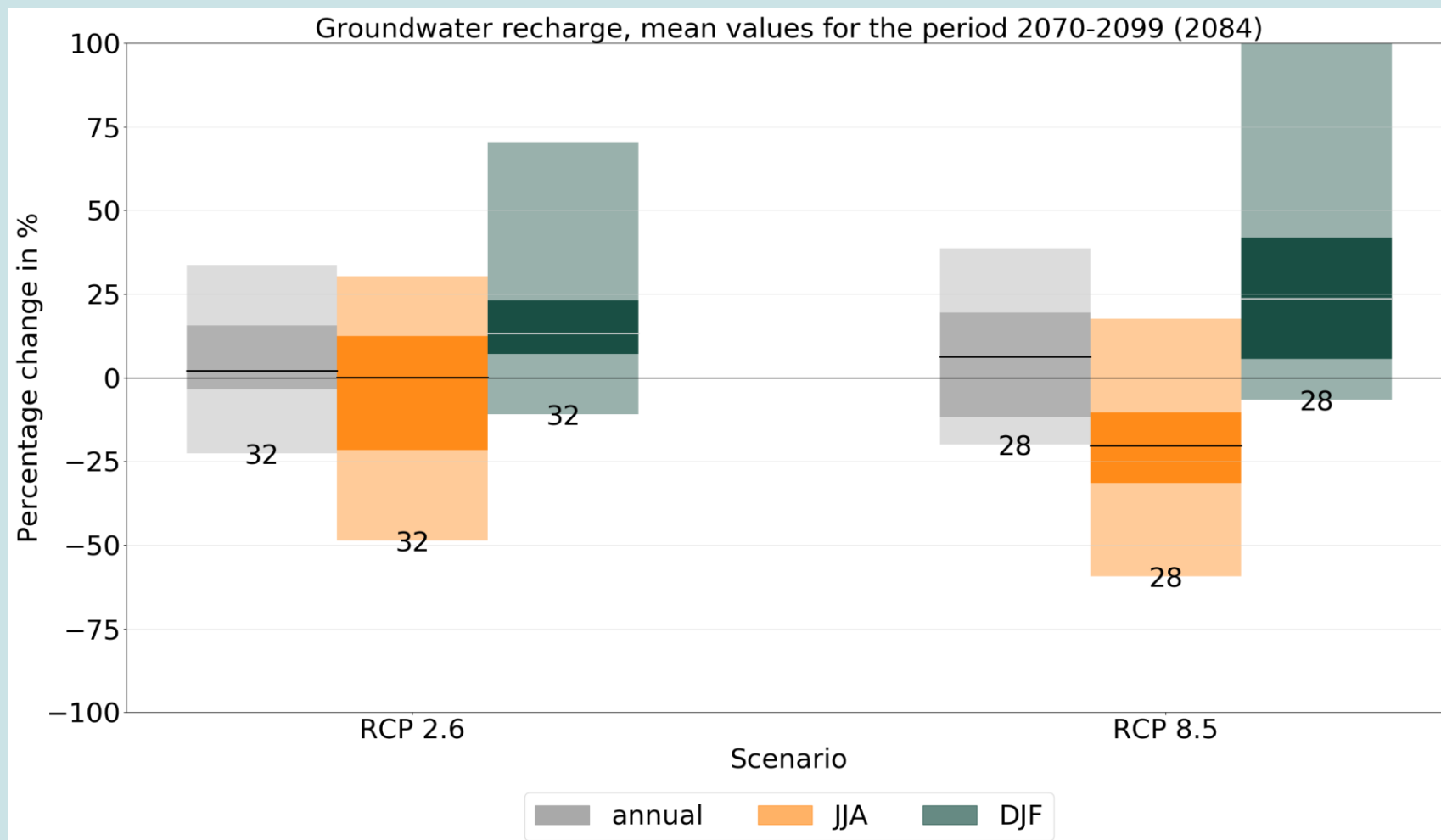


Zaenker and Reiss (2015)

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Example of mean change in the study area



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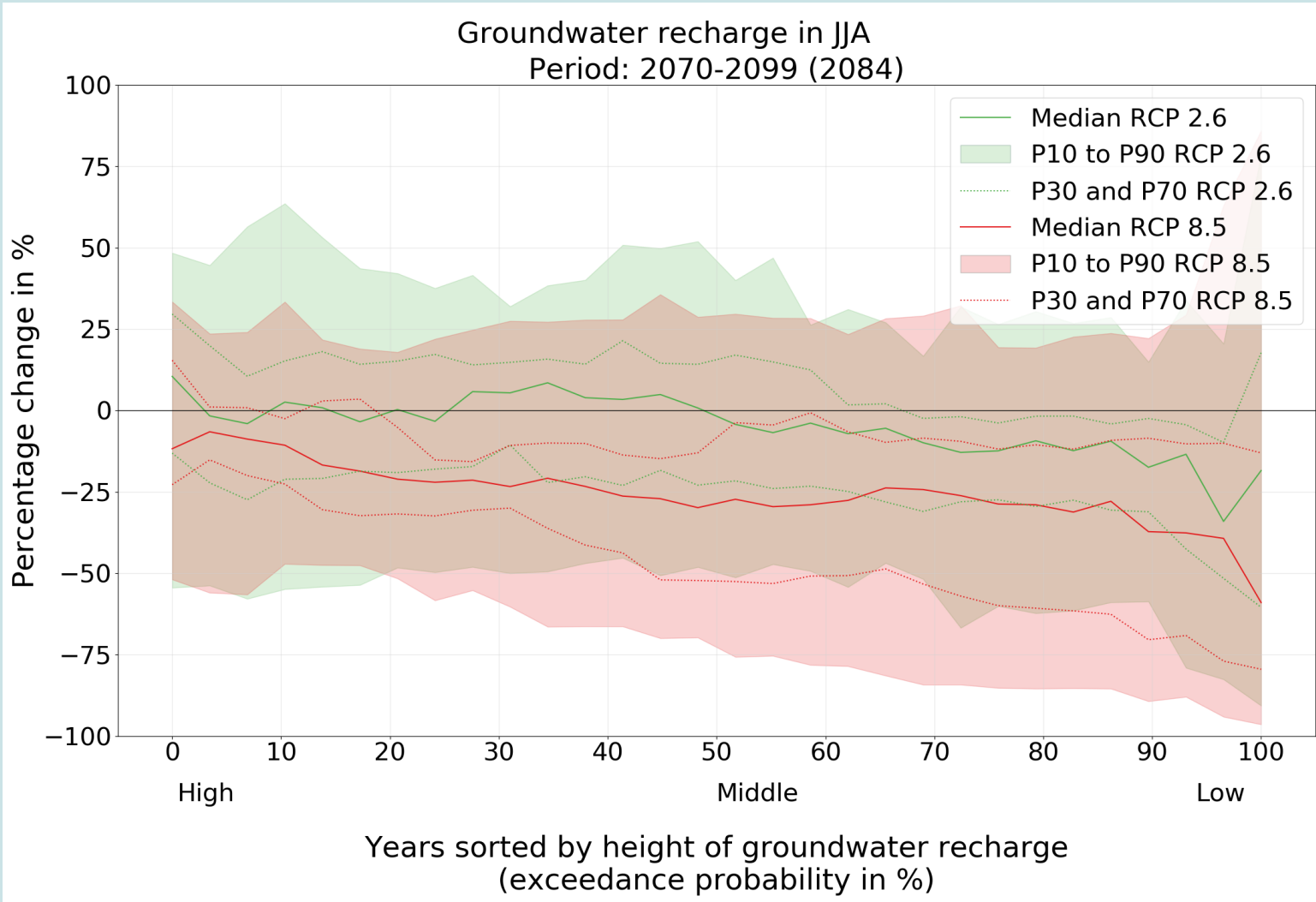
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Example of changes in different years in the study area



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