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2. Österreichischer Sachstandsbericht zum Klimawandel
2nd Austrian Assessment Report on Climate Change

# Global Warming Levels in AAR2

Rationale, Application and Guidelines for Authors

Herbert Formayer and Benedikt Becsi
(Chapter 1)

26.05.2023

# Aims of the webinar

## Learning outcomes

**Understanding…**

…the concept and rationale of global warming levels

…the method used in AAR2 to link ÖKS15-derived results to GWL

## Skills

**How to…**

… identify the information in your chapter where GWLs can be applied

… distinguish between two different ways of linking your chapter results to GWLs

… look up the allocated time period for each ÖKS15 model and GWL

… apply the common framework of GWL mapping

# Contents

Part I: The concept of global warming levels

- Why use global warming levels?
- Method applied in AAR2
- Which results can be displayed as GWL?
- Implications and uncertainties
- Q&A Session part I

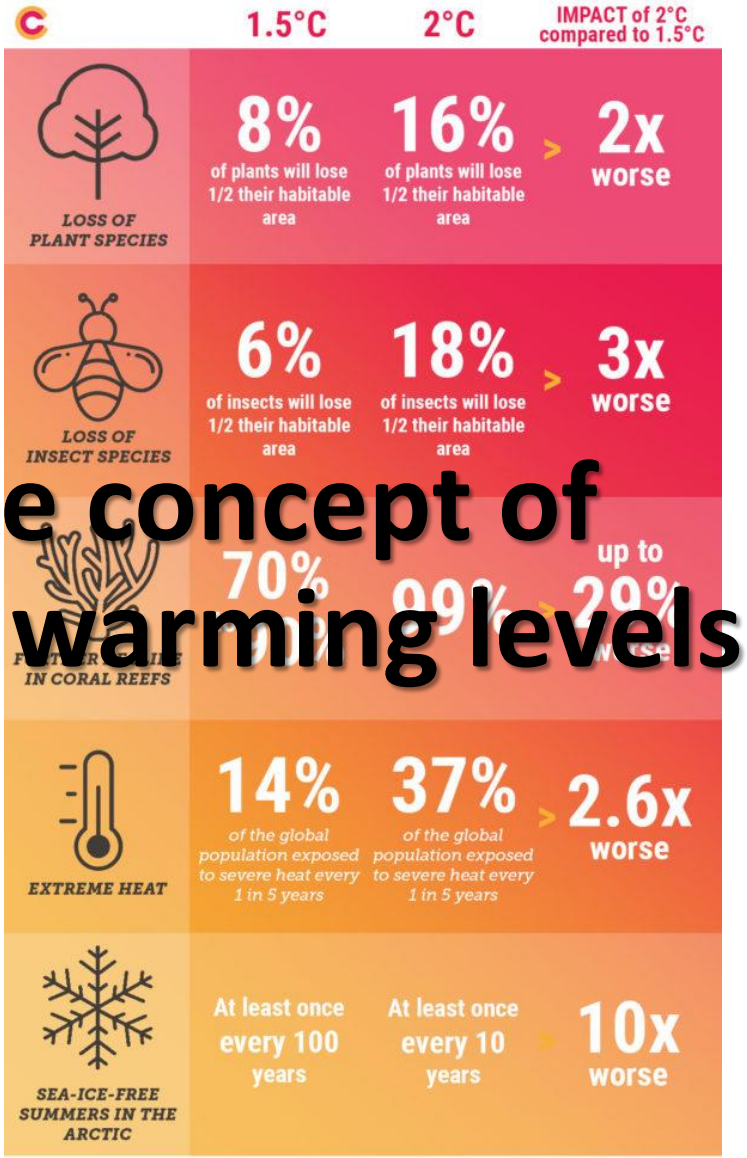
Part II: GWLs in AAR2

- Results for the ÖKS15-Ensemble
- Application for transient results
- Application for fixed time periods
- List of possible indicators
- Preview: GWLs in CMIP6
- Q&A Session part II

Part III: Interactive session

- How to interpret your chapter results in light of GWLs

# Part I: The concept of global warming levels




Source: Climate Council
https://www.climatecouncil.org.au/resources/infographic-the-difference-between-1-5-and-2-degrees-warming/

# Why use global warming levels?

- GWLs represent a shift in the political and scientific debate.
- From emissions or concentrations perspective
  towards impacts perspective:

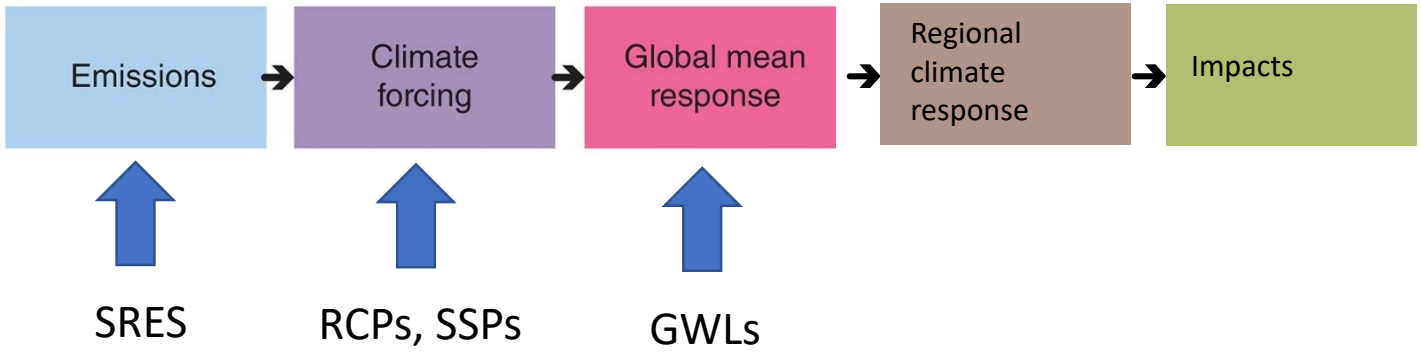
How will the climate system react to specific emissions/concentrations of GHG in the atmosphere?

vs.

What impacts emerge at a certain level of global warming?

# Why use global warming levels?

- GWLs represent a shift in the political and scientific debate.
- From emissions or concentrations perspective towards impacts perspective:

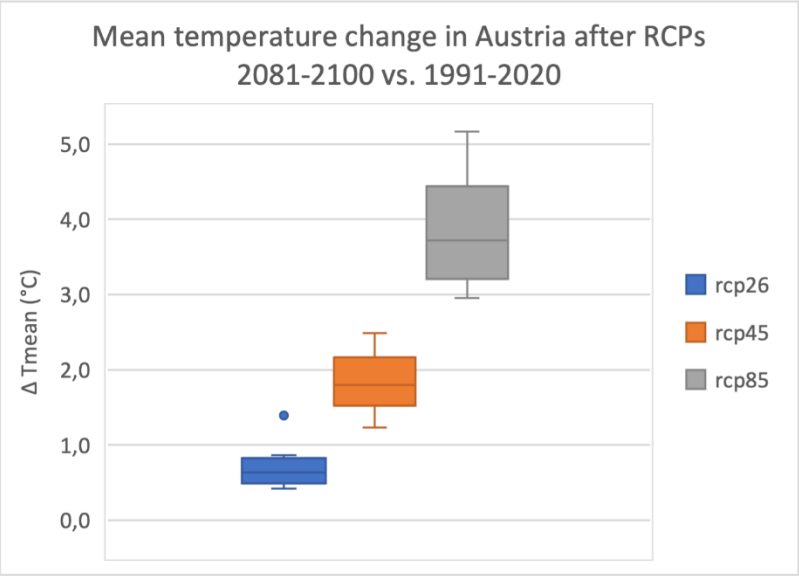


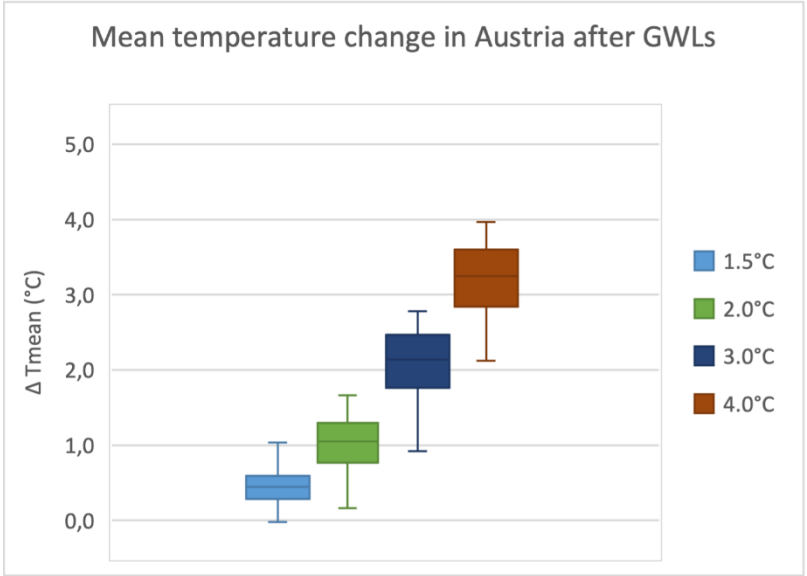

Source: Adapted after James et al. 2017, Figure 4

# Why use global warming levels?

Example for Austria:

- How does mean temperature in AUT change until 2050 for different GHG scenarios (RCPs)?
- What are the mean temperatures in AUT in a 2.0°C or 3.0°C warmer world relative to the current climate (1991-2020)?

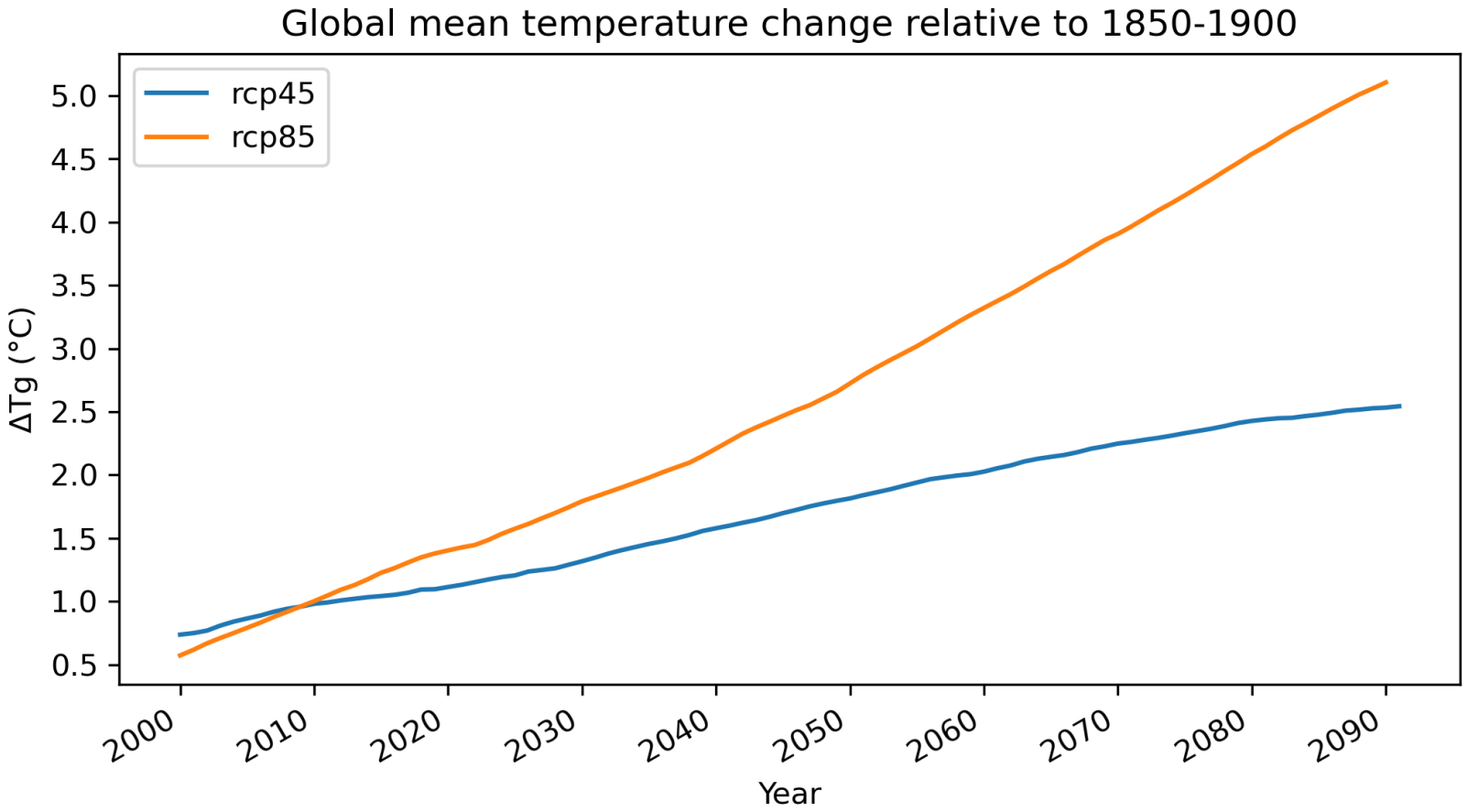


# Method applied in AAR2

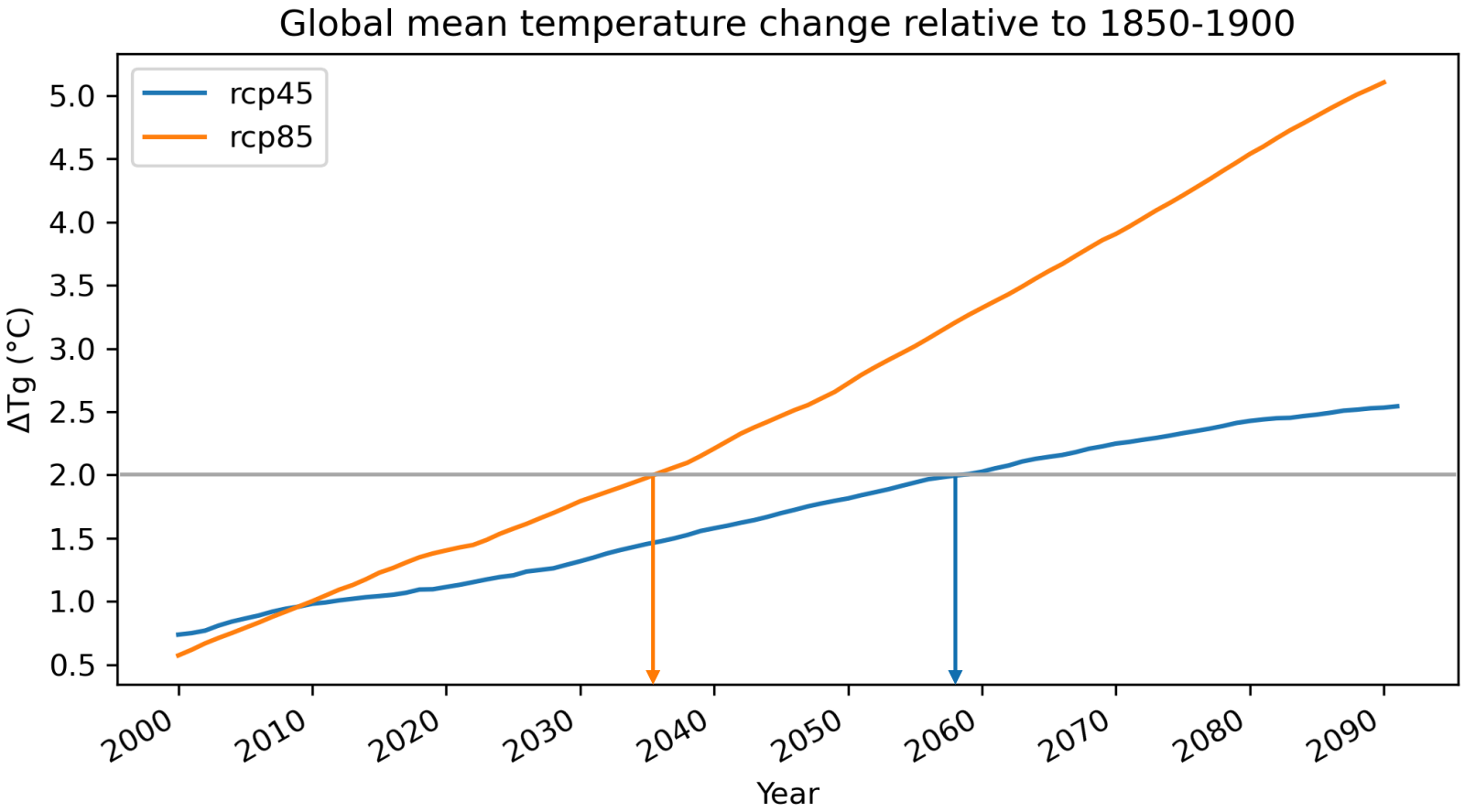
- There are different methods of linking regional climate information to GWLs
- Connection of ÖKS15 to global models needs to be established
- Directly possible for CMIP5, only indirectly for CMIP6
- Time sampling of each ÖKS15 model according to $\Delta T_g$ of background GCM

# Method applied in AAR2



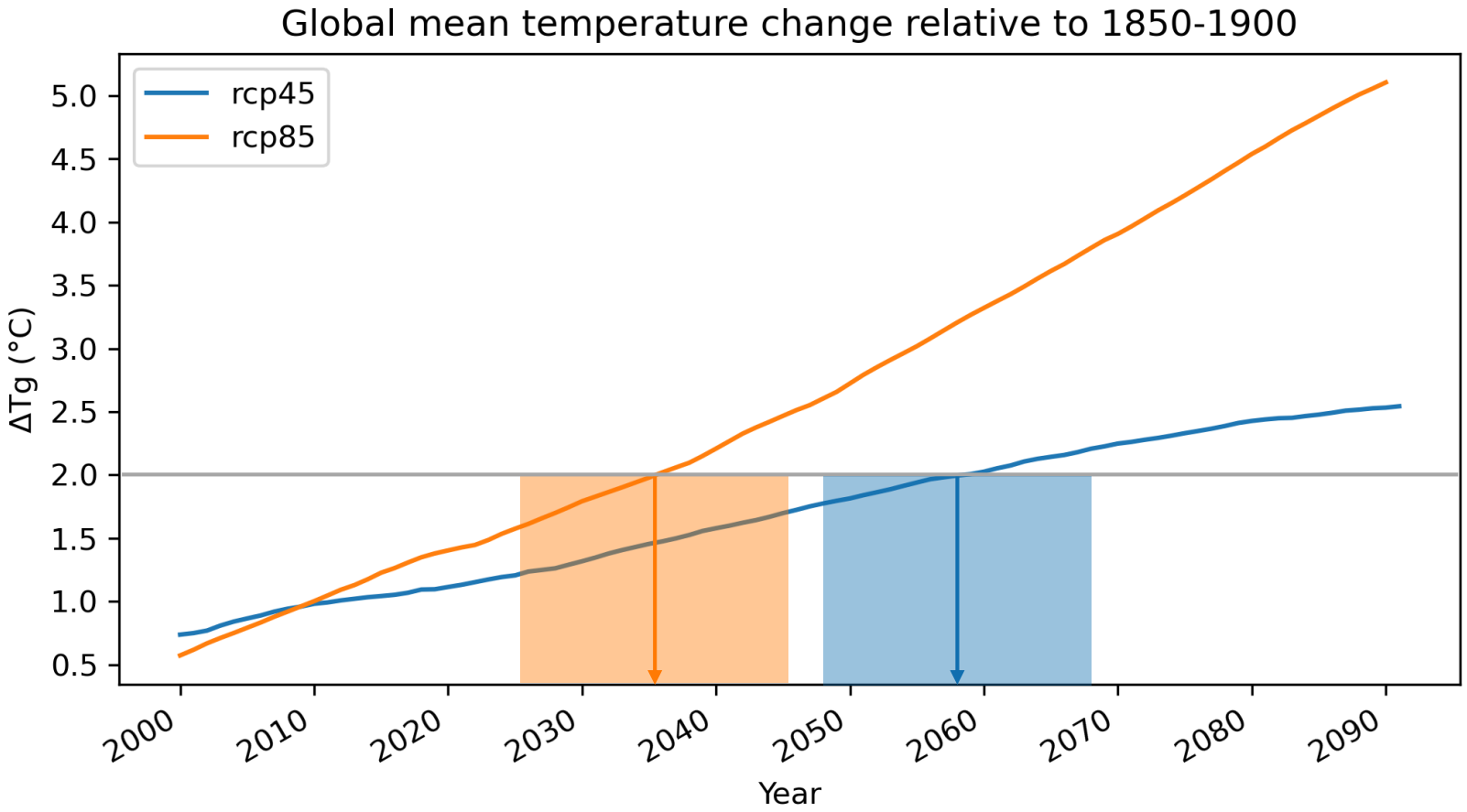

Source: Adapted after James et al. 2017, Figure 2(d)

# Method applied in AAR2



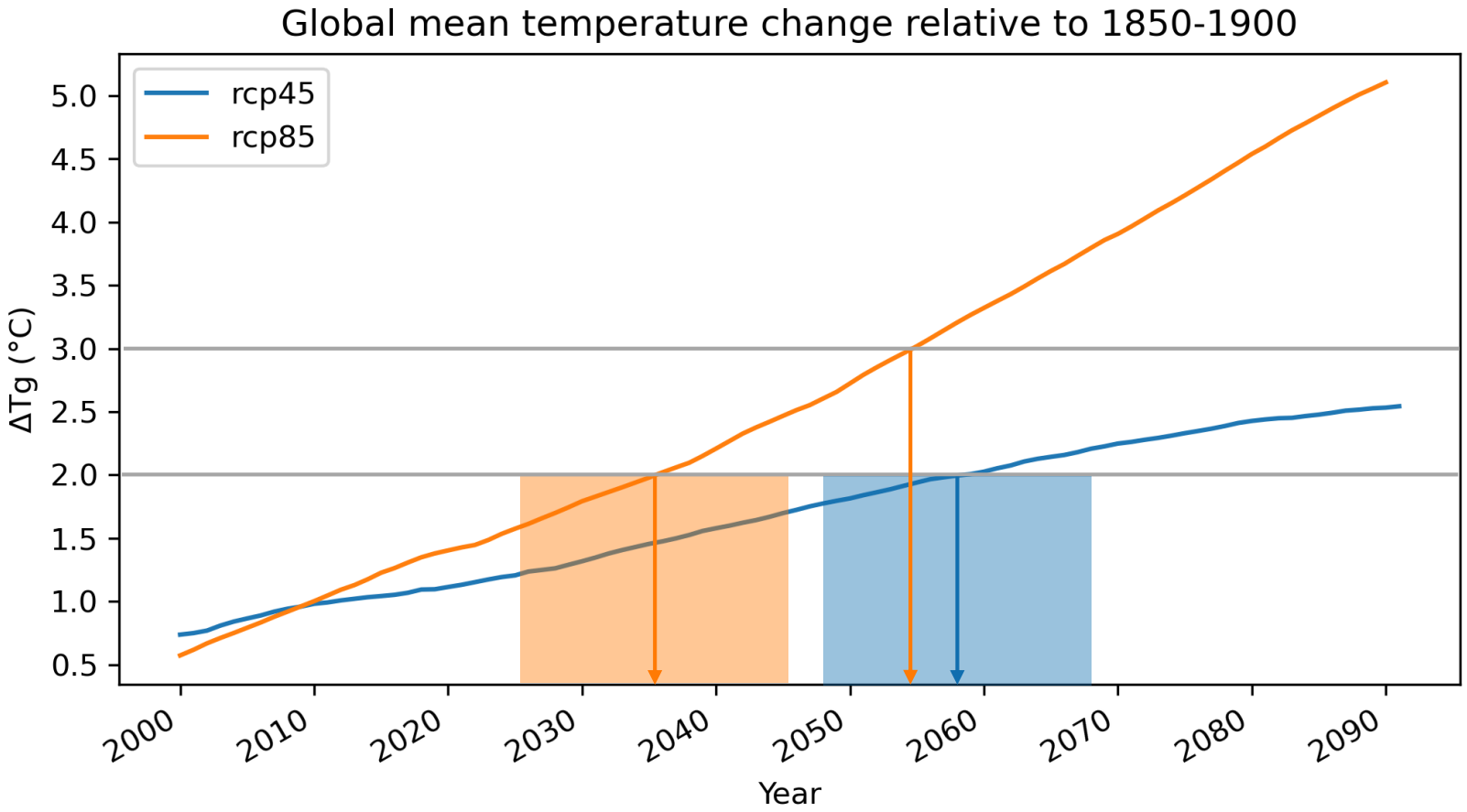

Source: Adapted after James et al. 2017, Figure 2(d)

# Method applied in AAR2




Source: Adapted after James et al. 2017, Figure 2(d)

# Method applied in AAR2

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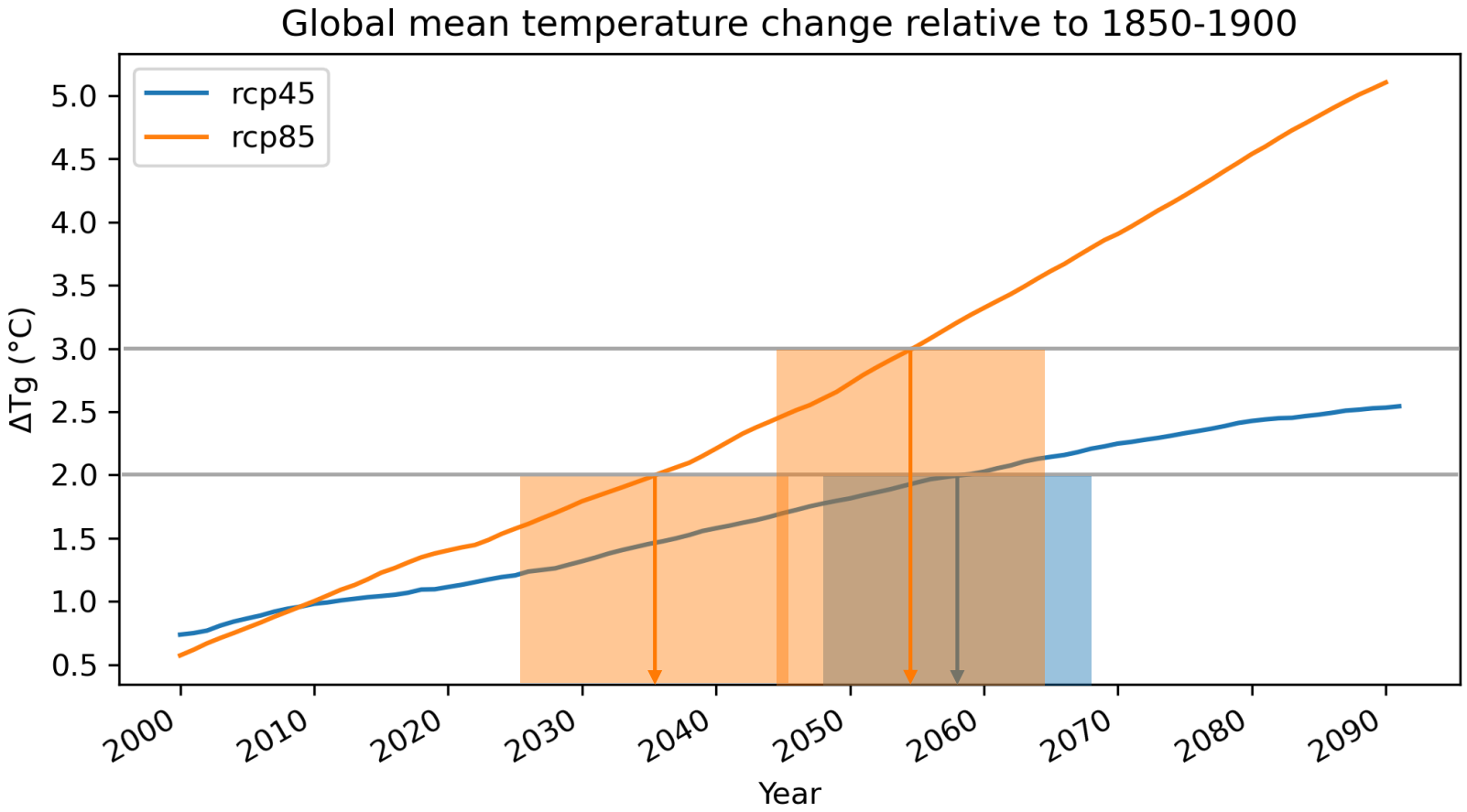



Source: Adapted after James et al. 2017, Figure 2(d)

# Method applied in AAR2

Two linking approaches:

- Time period corresponding to specific GWL (1.5°C, 2.0°C, 3.0°C, 4.0°C)
- GWL corresponding to a specific time period (2030, 2050, 2085)

# Which results can be represented as GWL?

- All existing indicators or impact studies based on ÖKS15 with a known time period, e.g.:

  - ClimaMap
  - FuseAT
  - StarcImpact
  - SECURES
  - Windfalls
  - …

# Implications and uncertainties

- The concept of GWLs provides a different way of looking at existing data
- No data manipulation is needed to use GWLs
- Two approaches: Fixed time periods and fixed GWLs

# Implications and uncertainties

The GWL concept shifts…

… the questions we can ask of the data:

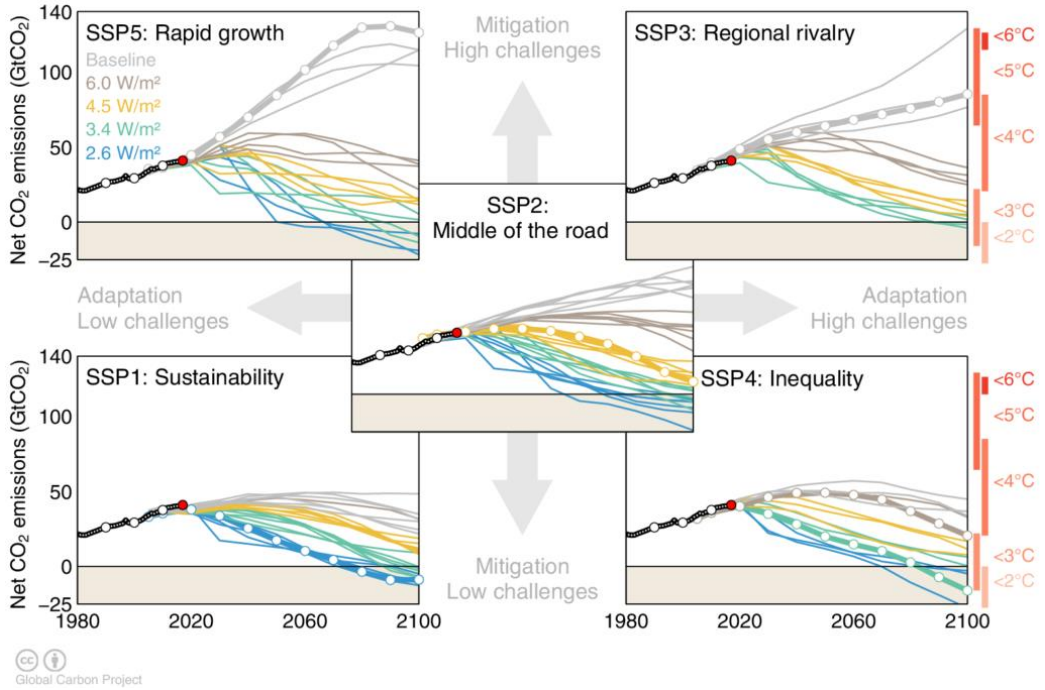
- From emissions perspective to impacts perspective
- What happens under global climate stabilisation?

… the underlying uncertainties:

- Decadal variability of climate variables on the local level
- All meteorological variables are assumed to depend on climatological mean temperature
- Accumulating effects can not be considered (e.g. glacier retreat, sea level rise)

# Implications and uncertainties

- Classical approach to classify data according to emission pathways becomes confusing with SSPs




Source: Glen Peters and Robbie Andrews, Global Carbon Project
https://www.carbonbrief.org/explainer-how-shared-socioeconomic-pathways-explore-future-climate-change

# Implications and uncertainties

Uncertainties in specific models vs. model ensemble

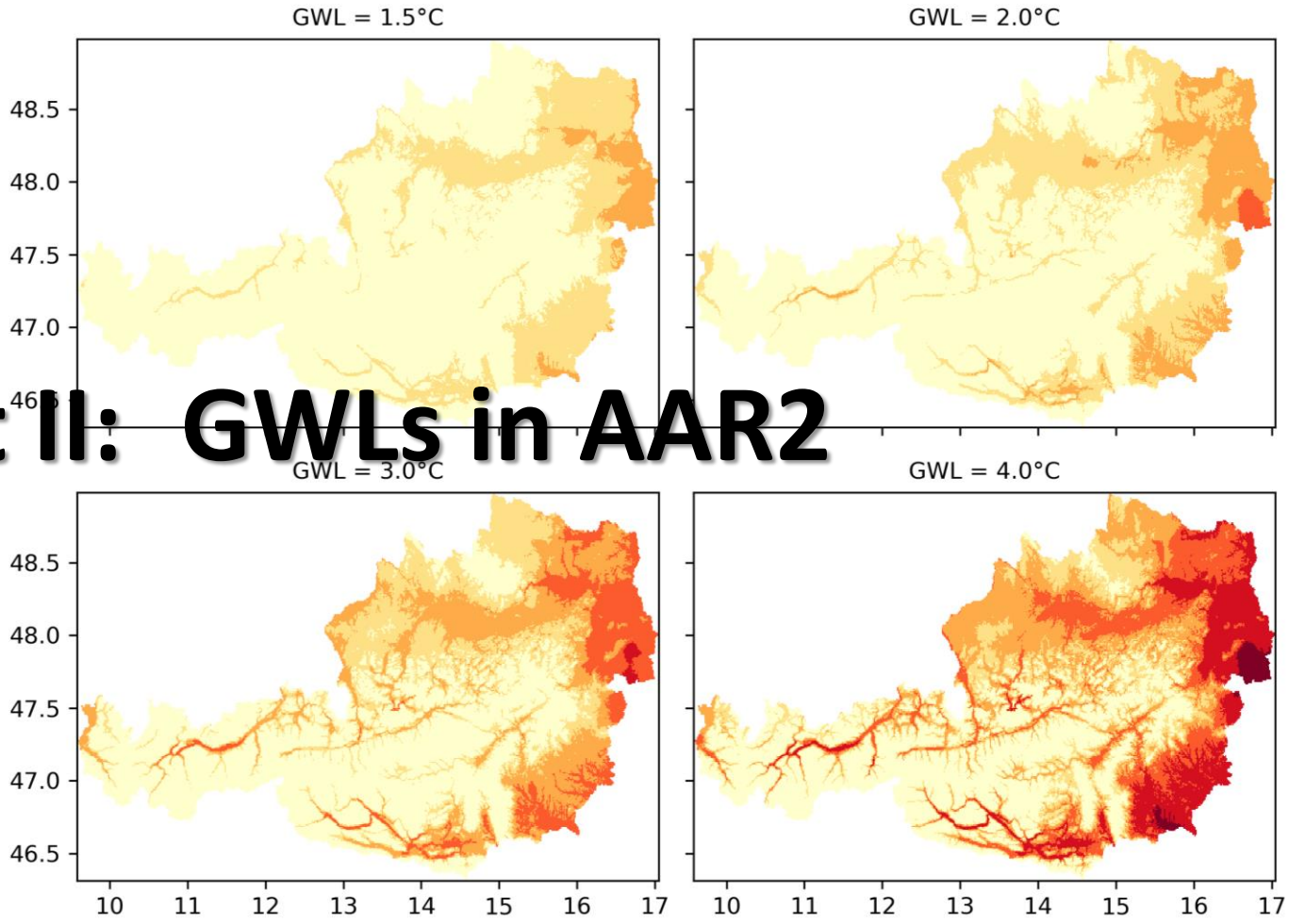
| Specific model(s) | | |
|---|---|---|
| | SRES/RCP/SSP | GWL |
| Time period | ✓ | ✓ |
| Emission pathway | ✓ | ✓ |
| Global Tmean | ✓ | ✓ |
| Transient availability | ✓ | ✗ |
| Model variability for variable/indicator | ✗ | ✗ |

| Model ensemble | | |
|---|---|---|
| | SRES/RCP/SSP | GWL |
| Time period | ✓ | ✗ |
| Emission pathway | ✓ | ✗ |
| Global Tmean | ✗ | ✓ |
| Transient availability | ✓ | ✗ |
| Model variability for variable/indicator | ✓ | ✓ |

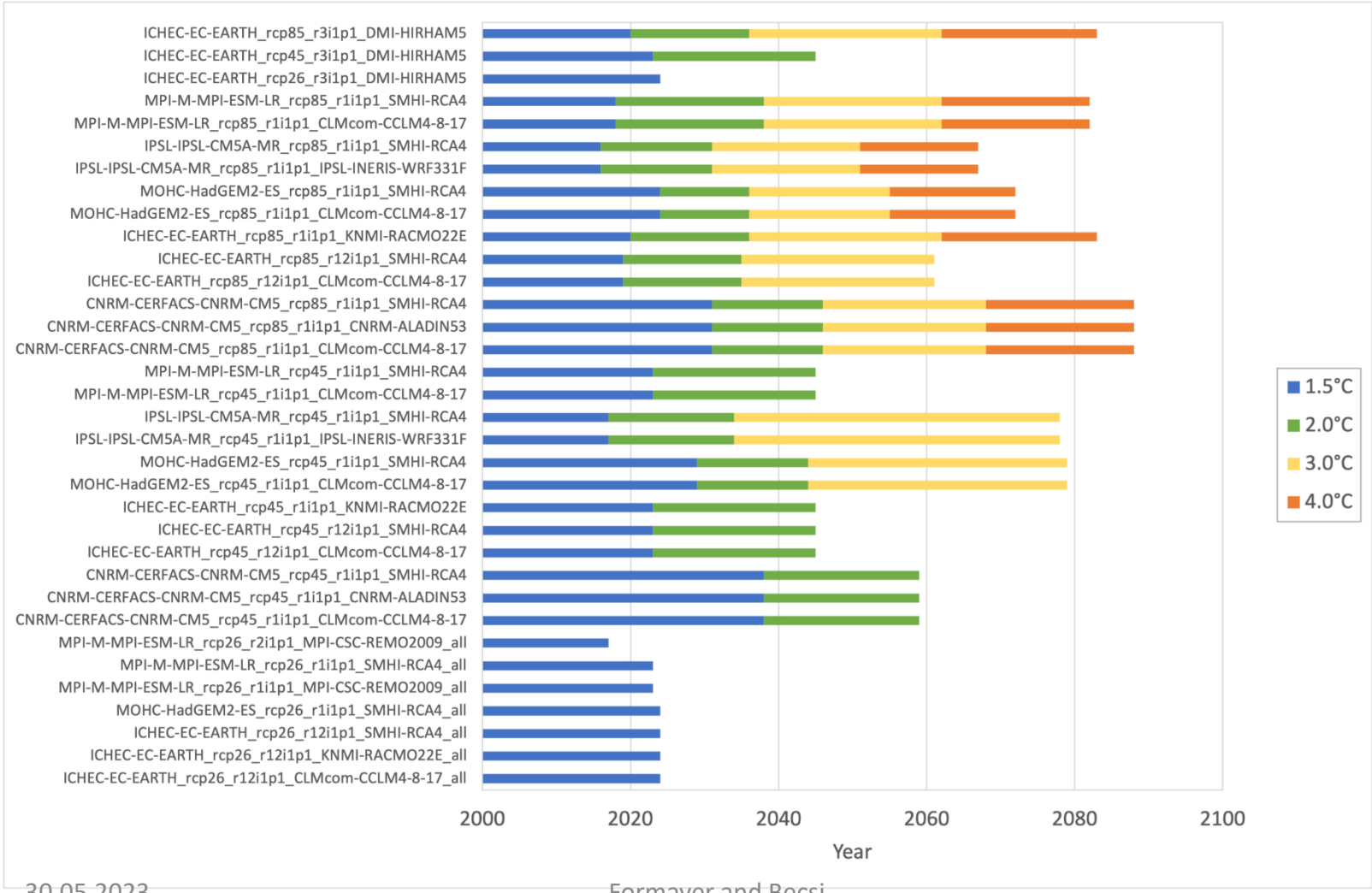
# Q&A Session part I

30.05.2023

# Part II: GWLs in AAR2



# Results for the ÖKS15-Ensemble



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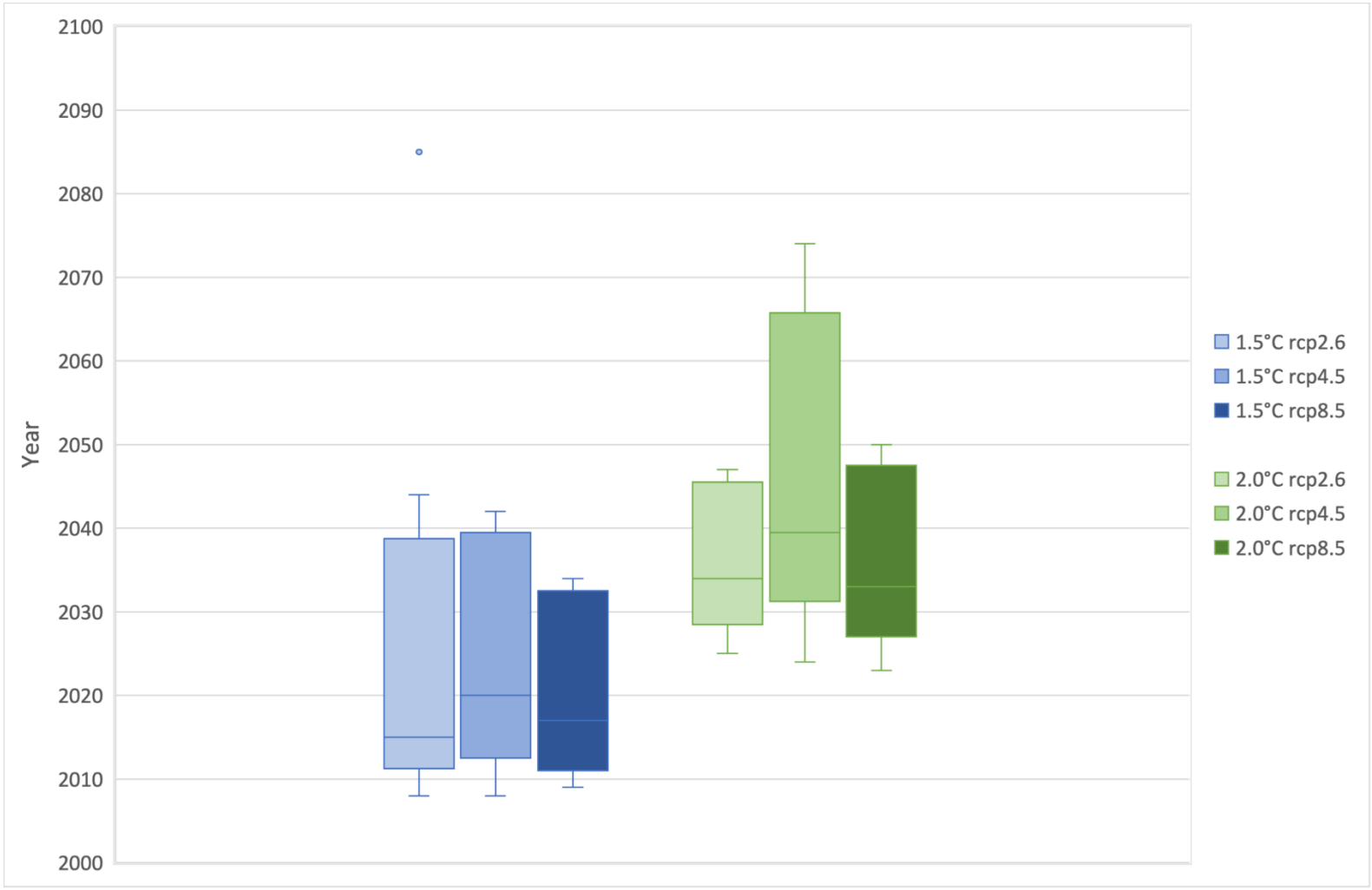
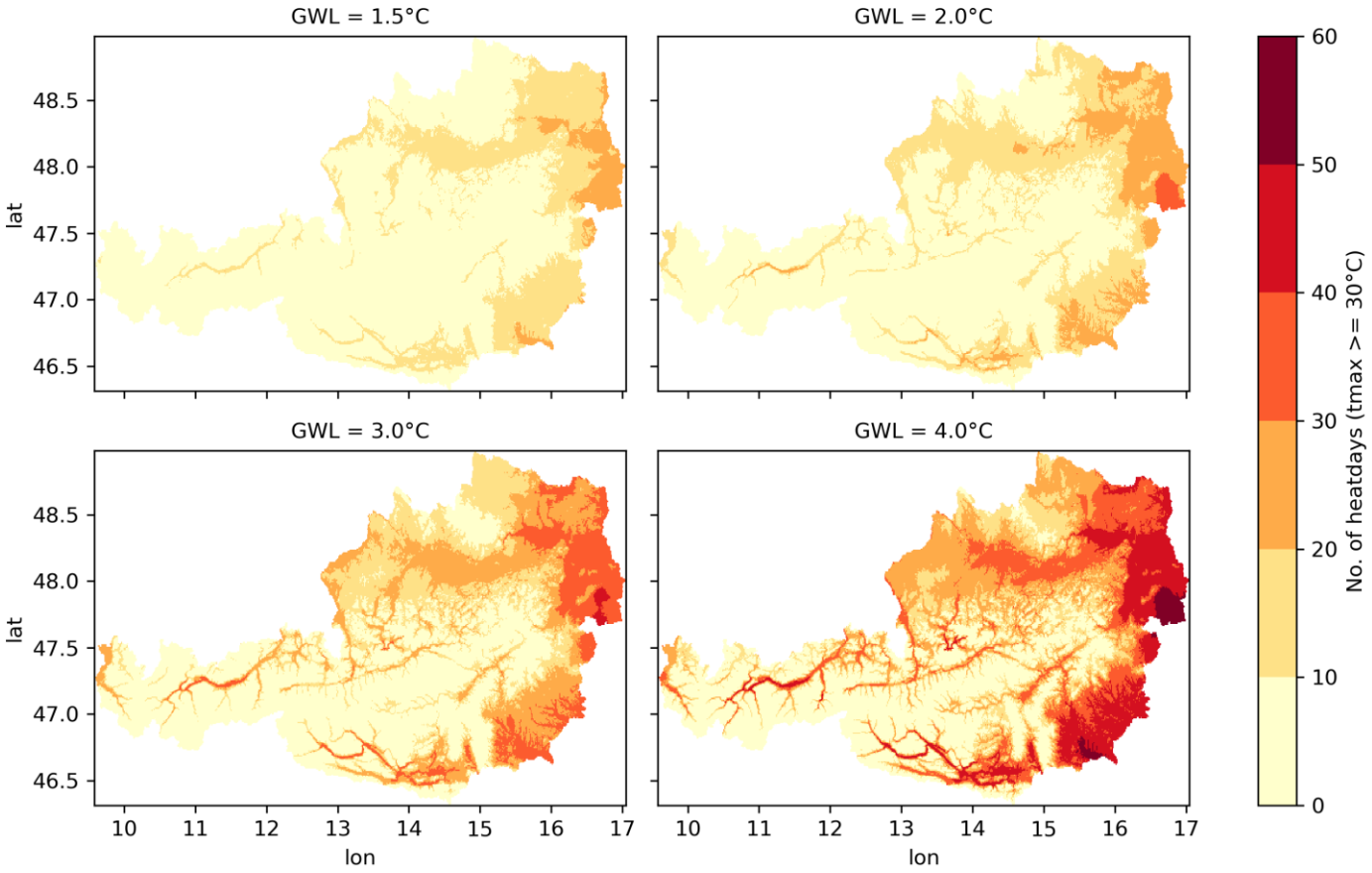


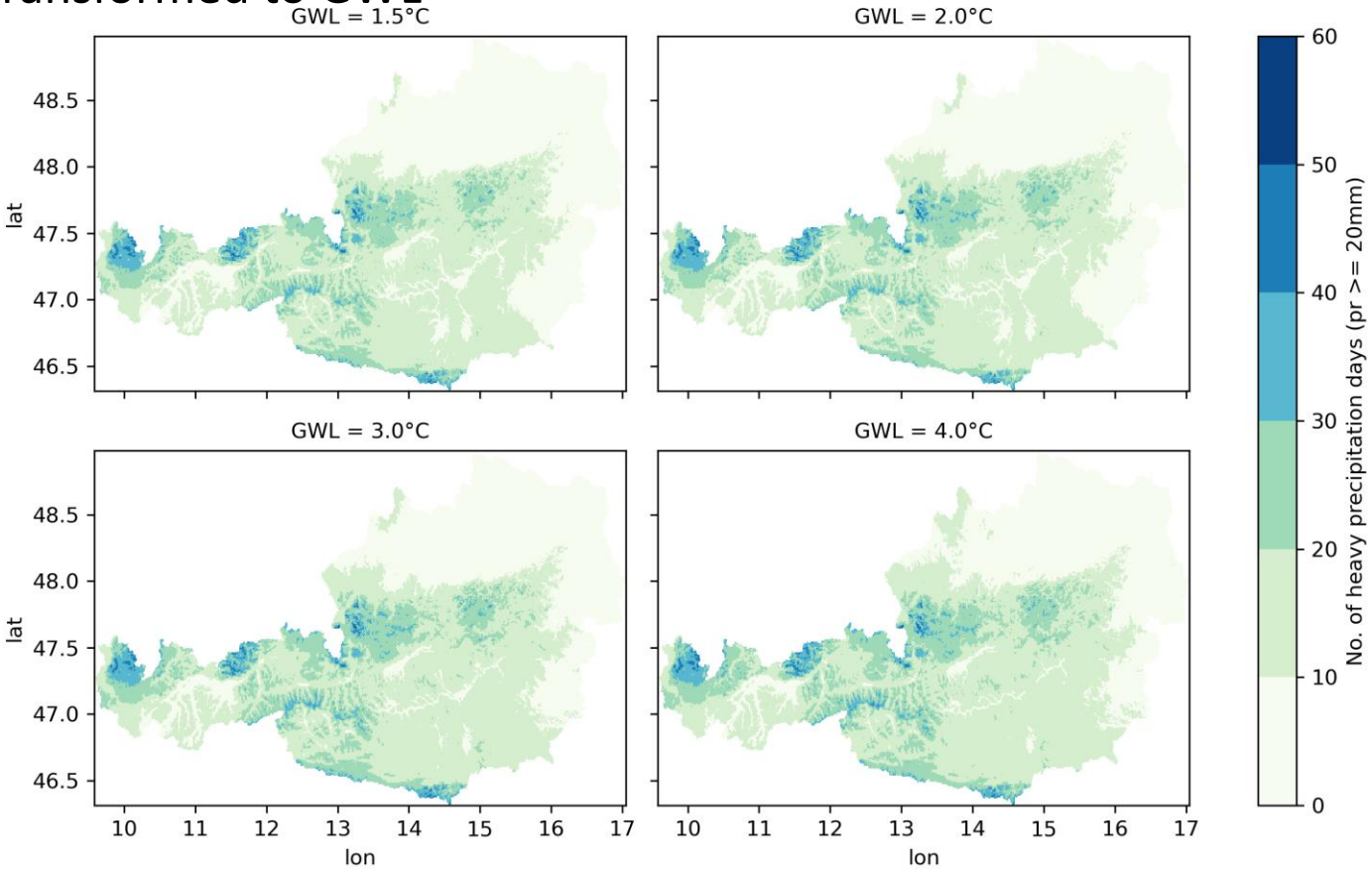
# Results for the ÖKS15-Ensemble

- Case study: Climate indicator ‘heat days’ transformed to GWL



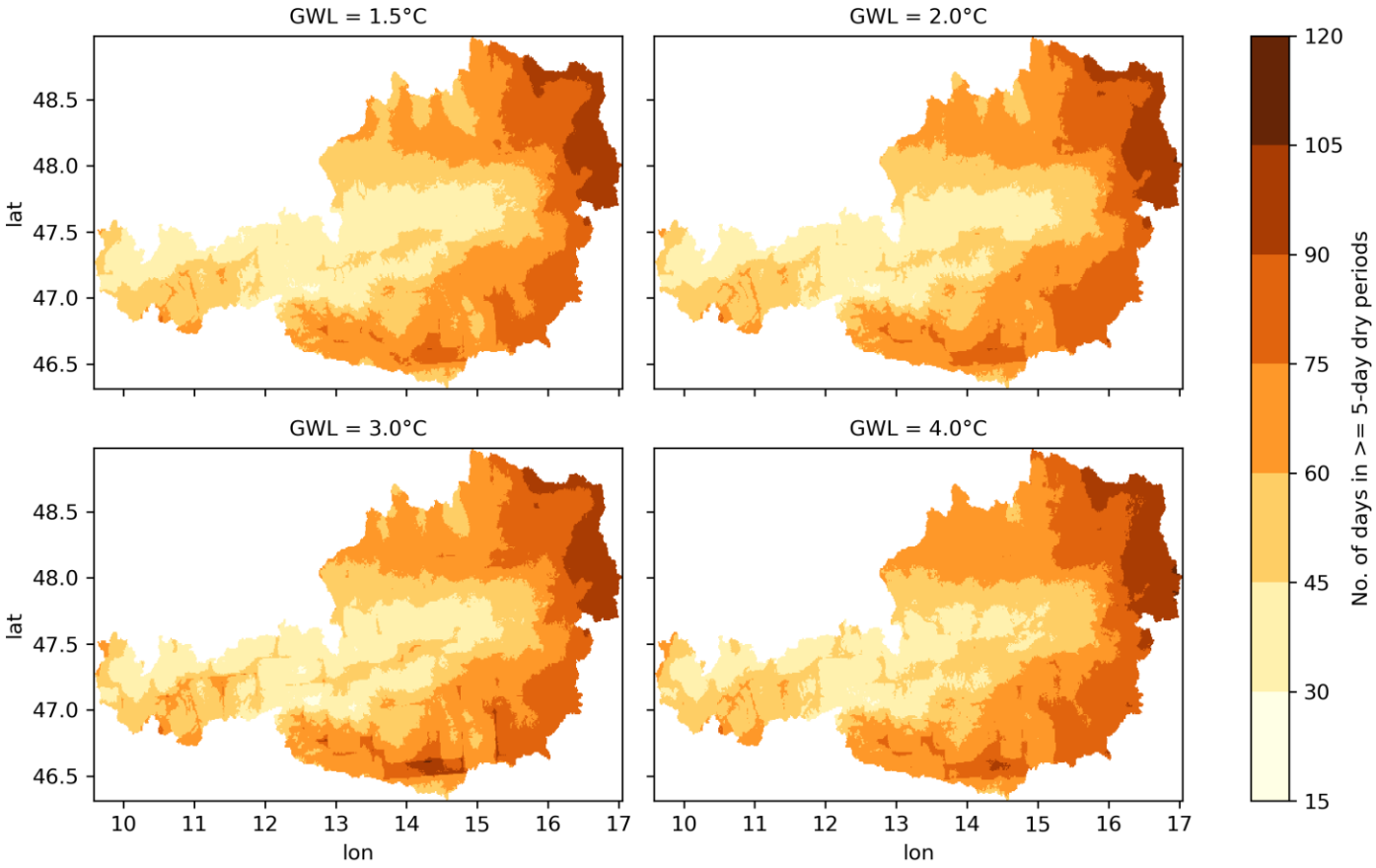
# Results for the ÖKS15-Ensemble

- Case study: Climate indicator ‘days with heavy precipitation’ transformed to GWL



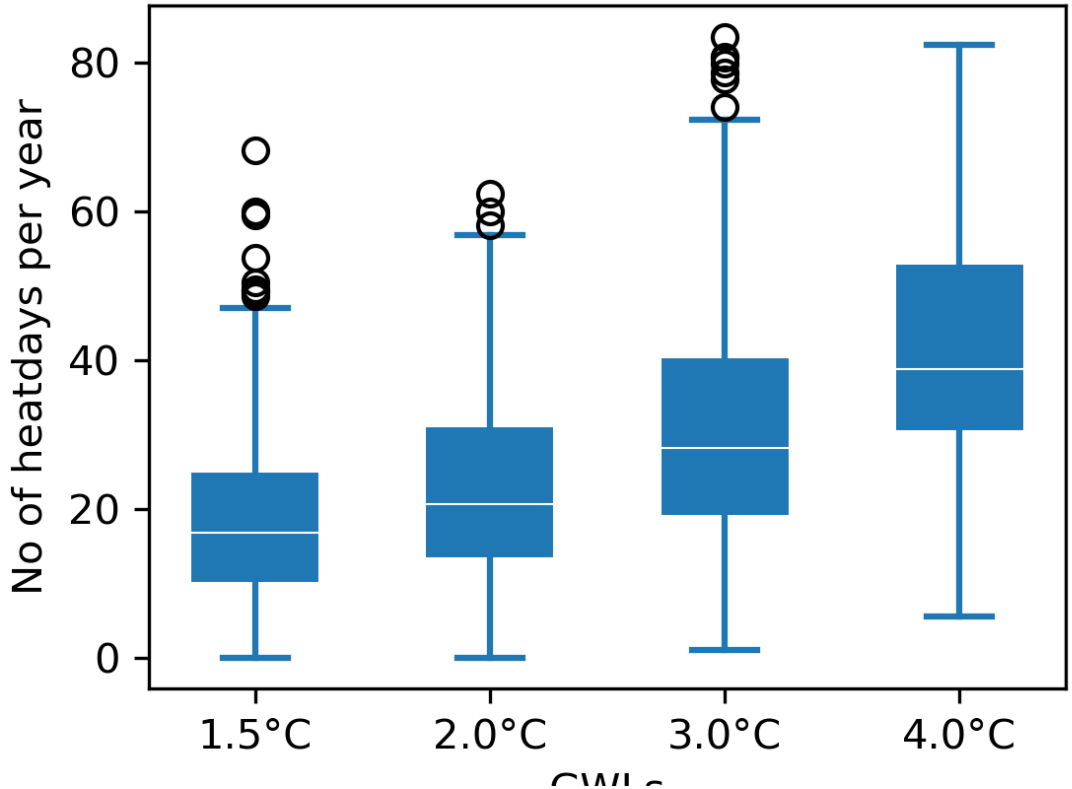
# Results for the ÖKS15-Ensemble

- Case study: Climate indicator ‘consecutive dry days’ transformed to GWL



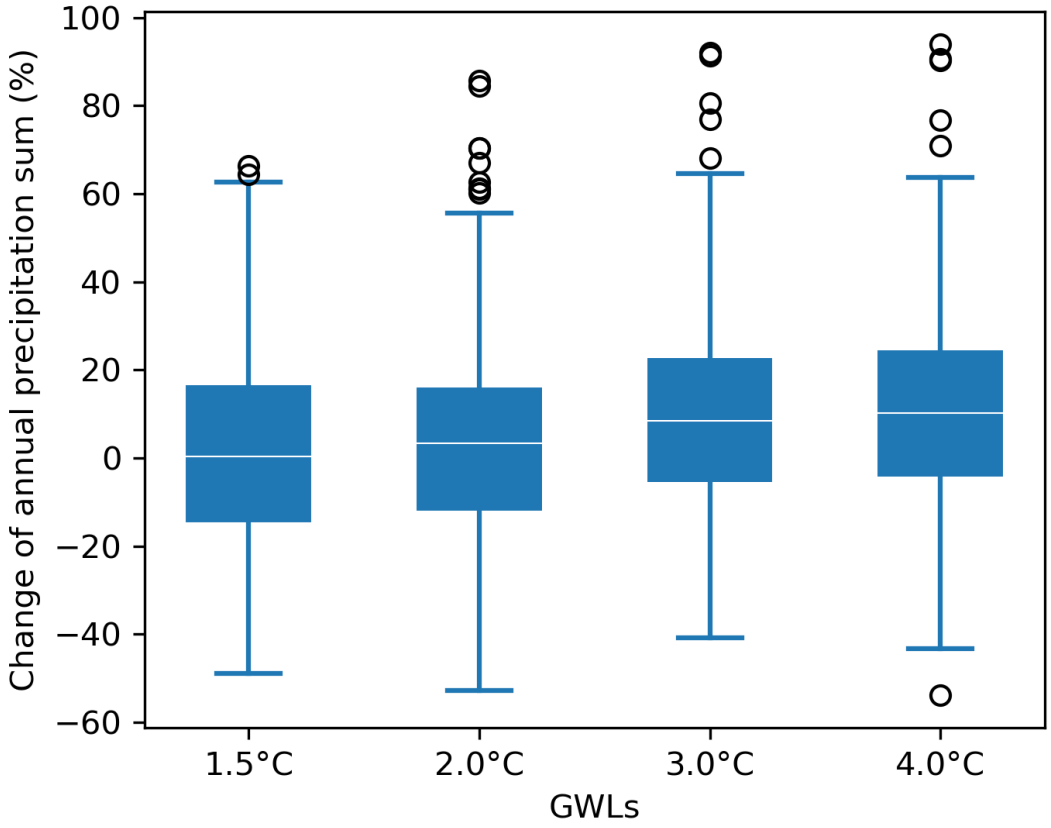
# Results for the ÖKS15-Ensemble

- Case study: Climate indicator ‘heat days’ in Vienna transformed to GWL



# Results for the ÖKS15-Ensemble

- Case study: Climate indicator ‘change of precipitation sums’ relative to the current climate (1991-2020) in Vienna transformed to GWL



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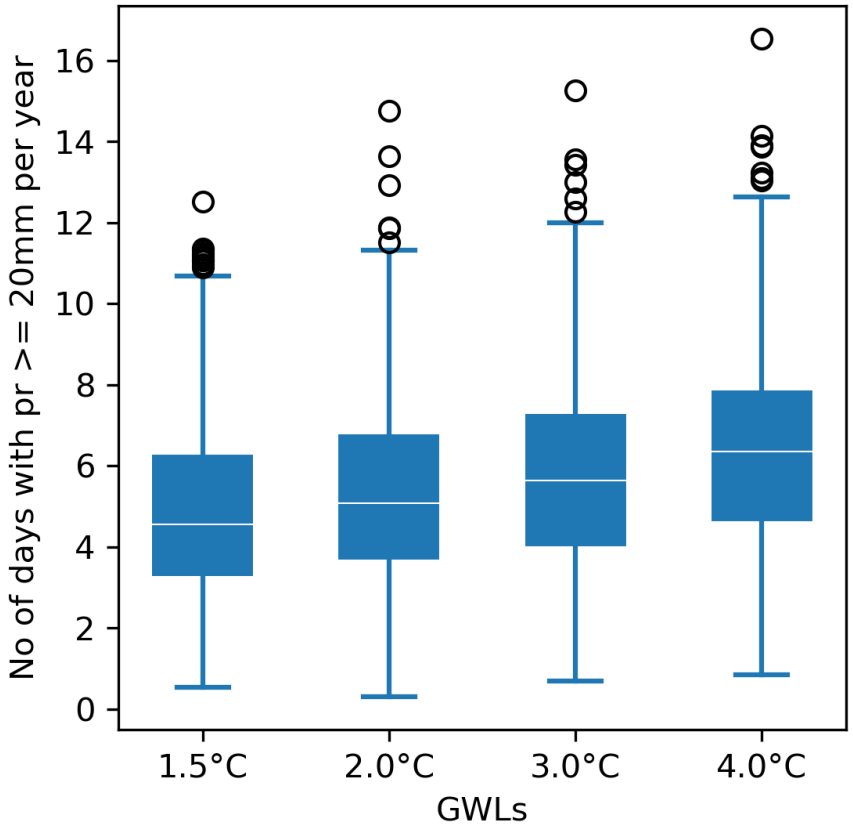
- Case study: Climate indicator ‘days with heavy precipitation’ in Vienna transformed to GWL



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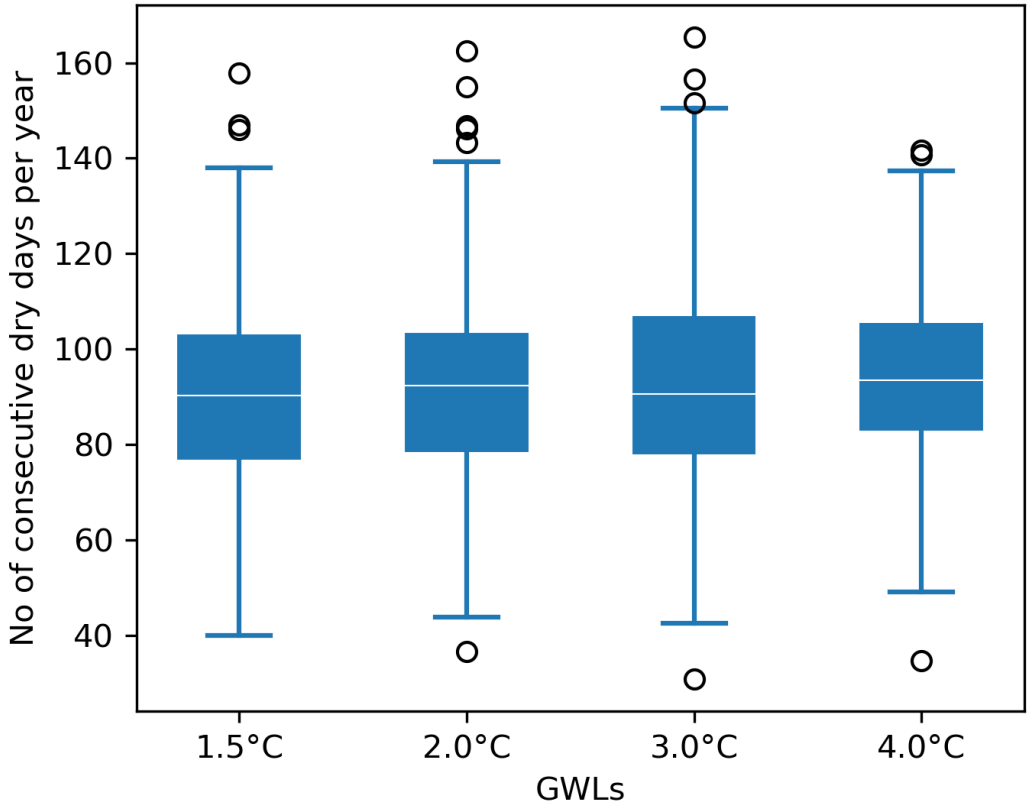

# Application for transient results

| OEKS15 ensemble member | 1.5°C | 2.0°C | 3.0°C | 4.0°C |
|---|---|---|---|---|
| SDM_ICHEC-EC-EARTH_rcp26_r12i1p1_CLMcom-CCLM4-8-17_all | 2014-2033 | | | |
| SDM_ICHEC-EC-EARTH_rcp26_r12i1p1_KNMI-RACMO22E_all | 2014-2033 | | | |
| SDM_ICHEC-EC-EARTH_rcp26_r12i1p1_SMHI-RCA4_all | 2014-2033 | | | |
| SDM_MOHC-HadGEM2-ES_rcp26_r1i1p1_SMHI-RCA4_all | 2014-2033 | | | |
| SDM_MPI-M-MPI-ESM-LR_rcp26_r1i1p1_MPI-CSC-REMO2009_all | 2013-2032 | | | |
| SDM_MPI-M-MPI-ESM-LR_rcp26_r1i1p1_SMHI-RCA4_all | 2013-2032 | | | |
| SDM_MPI-M-MPI-ESM-LR_rcp26_r2i1p1_MPI-CSC-REMO2009_all | 2007-2026 | | | |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp45_r1i1p1_CLMcom-CCLM4-8-17 | 2028-2047 | 2049-2068 | | |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp45_r1i1p1_CNRM-ALADIN53 | 2028-2047 | 2049-2068 | | |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp45_r1i1p1_SMHI-RCA4 | 2028-2047 | 2049-2068 | | |
| SDM_ICHEC-EC-EARTH_rcp45_r12i1p1_CLMcom-CCLM4-8-17 | 2013-2032 | 2035-2054 | | |
| SDM_ICHEC-EC-EARTH_rcp45_r12i1p1_SMHI-RCA4 | 2013-2032 | 2035-2054 | | |
| SDM_ICHEC-EC-EARTH_rcp45_r1i1p1_KNMI-RACMO22E | 2013-2032 | 2035-2054 | | |
| SDM_MOHC-HadGEM2-ES_rcp45_r1i1p1_CLMcom-CCLM4-8-17 | 2019-2038 | 2034-2053 | 2069-2088 | |
| SDM_MOHC-HadGEM2-ES_rcp45_r1i1p1_SMHI-RCA4 | 2019-2038 | 2034-2053 | 2069-2088 | |
| SDM_IPSL-IPSL-CM5A-MR_rcp45_r1i1p1_IPSL-INERIS-WRF331F | 2007-2026 | 2024-2043 | 2068-2087 | |
| SDM_IPSL-IPSL-CM5A-MR_rcp45_r1i1p1_SMHI-RCA4 | 2007-2026 | 2024-2043 | 2068-2087 | |
| SDM_MPI-M-MPI-ESM-LR_rcp45_r1i1p1_CLMcom-CCLM4-8-17 | 2013-2032 | 2035-2054 | | |
| SDM_MPI-M-MPI-ESM-LR_rcp45_r1i1p1_SMHI-RCA4 | 2013-2032 | 2035-2054 | | |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp85_r1i1p1_CLMcom-CCLM4-8-17 | 2021-2040 | 2036-2055 | 2058-2077 | 2078-2097 |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp85_r1i1p1_CNRM-ALADIN53 | 2021-2040 | 2036-2055 | 2058-2077 | 2078-2097 |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp85_r1i1p1_SMHI-RCA4 | 2021-2040 | 2036-2055 | 2058-2077 | 2078-2097 |
| SDM_ICHEC-EC-EARTH_rcp85_r12i1p1_CLMcom-CCLM4-8-17 | 2009-2028 | 2025-2044 | 2051-2070 | |
| SDM_ICHEC-EC-EARTH_rcp85_r12i1p1_SMHI-RCA4 | 2009-2028 | 2025-2044 | 2051-2070 | |
| SDM_ICHEC-EC-EARTH_rcp85_r1i1p1_KNMI-RACMO22E | 2010-2029 | 2026-2045 | 2052-2071 | 2073-2092 |
| SDM_MOHC-HadGEM2-ES_rcp85_r1i1p1_CLMcom-CCLM4-8-17 | 2014-2033 | 2026-2045 | 2045-2064 | 2062-2081 |
| SDM_MOHC-HadGEM2-ES_rcp85_r1i1p1_SMHI-RCA4 | 2014-2033 | 2026-2045 | 2045-2064 | 2062-2081 |
| SDM_IPSL-IPSL-CM5A-MR_rcp85_r1i1p1_IPSL-INERIS-WRF331F | 2006-2025 | 2021-2040 | 2041-2060 | 2057-2076 |
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| SDM_MPI-M-MPI-ESM-LR_rcp85_r1i1p1_CLMcom-CCLM4-8-17 | 2008-2027 | 2028-2047 | 2052-2071 | 2072-2091 |
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| SDM_ICHEC-EC-EARTH_rcp26_r3i1p1_DMI-HIRHAM5 | 2014-2033 | | | |
| SDM_ICHEC-EC-EARTH_rcp45_r3i1p1_DMI-HIRHAM5 | 2013-2032 | 2035-2054 | | |
| SDM_ICHEC-EC-EARTH_rcp85_r3i1p1_DMI-HIRHAM5 | 2010-2029 | 2026-2045 | 2052-2071 | 2073-2092 |

# Application for transient results

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| SDM_CNRM-CERFACS-CNRM-CM5_rcp45_r1i1p1_SMHI-RCA4 | 2028-2047 | 2049-2068 | | |
| SDM_ICHEC-EC-EARTH_rcp45_r12i1p1_CLMcom-CCLM4-8-17 | 2013-2032 | 2035-2054 | | |
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| SDM_ICHEC-EC-EARTH_rcp26_r3i1p1_DMI-HIRHAM5 | 2014-2033 | | | |
| SDM_ICHEC-EC-EARTH_rcp45_r3i1p1_DMI-HIRHAM5 | 2013-2032 | 2035-2054 | | |
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# Application for transient results

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|---|---|---|---|---|
| SDM_ICHEC-EC-EARTH_rcp26_r12i1p1_CLMcom-CCLM4-8-17_all | 2014-2033 | | | |
| SDM_ICHEC-EC-EARTH_rcp26_r12i1p1_KNMI-RACMO22E_all | 2014-2033 | | | |
| SDM_ICHEC-EC-EARTH_rcp26_r12i1p1_SMHI-RCA4_all | 2014-2033 | | | |
| SDM_MOHC-HadGEM2-ES_rcp26_r1i1p1_SMHI-RCA4_all | 2014-2033 | | | |
| SDM_MPI-M-MPI-ESM-LR_rcp26_r1i1p1_MPI-CSC-REMO2009_all | 2013-2032 | | | |
| SDM_MPI-M-MPI-ESM-LR_rcp26_r1i1p1_SMHI-RCA4_all | 2013-2032 | | | |
| SDM_MPI-M-MPI-ESM-LR_rcp26_r2i1p1_MPI-CSC-REMO2009_all | 2007-2026 | | | |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp45_r1i1p1_CLMcom-CCLM4-8-17 | 2028-2047 | 2049-2068 | | |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp45_r1i1p1_CNRM-ALADIN53 | 2028-2047 | 2049-2068 | | |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp45_r1i1p1_SMHI-RCA4 | 2028-2047 | 2049-2068 | | |
| SDM_ICHEC-EC-EARTH_rcp45_r12i1p1_CLMcom-CCLM4-8-17 | 2013-2032 | 2035-2054 | | |
| SDM_ICHEC-EC-EARTH_rcp45_r12i1p1_SMHI-RCA4 | 2013-2032 | 2035-2054 | | |
| SDM_ICHEC-EC-EARTH_rcp45_r1i1p1_KNMI-RACMO22E | 2013-2032 | 2035-2054 | | |
| SDM_MOHC-HadGEM2-ES_rcp45_r1i1p1_CLMcom-CCLM4-8-17 | 2019-2038 | 2034-2053 | 2069-2088 | |
| SDM_MOHC-HadGEM2-ES_rcp45_r1i1p1_SMHI-RCA4 | 2019-2038 | 2034-2053 | 2069-2088 | |
| SDM_IPSL-IPSL-CM5A-MR_rcp45_r1i1p1_IPSL-INERIS-WRF331F | 2007-2026 | 2024-2043 | 2068-2087 | |
| SDM_IPSL-IPSL-CM5A-MR_rcp45_r1i1p1_SMHI-RCA4 | 2007-2026 | 2024-2043 | 2068-2087 | |
| SDM_MPI-M-MPI-ESM-LR_rcp45_r1i1p1_CLMcom-CCLM4-8-17 | 2013-2032 | 2035-2054 | | |
| SDM_MPI-M-MPI-ESM-LR_rcp45_r1i1p1_SMHI-RCA4 | 2013-2032 | 2035-2054 | | |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp85_r1i1p1_CLMcom-CCLM4-8-17 | 2021-2040 | 2036-2055 | 2058-2077 | 2078-2097 |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp85_r1i1p1_CNRM-ALADIN53 | 2021-2040 | 2036-2055 | 2058-2077 | 2078-2097 |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp85_r1i1p1_SMHI-RCA4 | 2021-2040 | 2036-2055 | 2058-2077 | 2078-2097 |
| SDM_ICHEC-EC-EARTH_rcp85_r12i1p1_CLMcom-CCLM4-8-17 | 2009-2028 | 2025-2044 | 2051-2070 | |
| SDM_ICHEC-EC-EARTH_rcp85_r12i1p1_SMHI-RCA4 | 2009-2028 | 2025-2044 | 2051-2070 | |
| SDM_ICHEC-EC-EARTH_rcp85_r1i1p1_KNMI-RACMO22E | 2010-2029 | 2026-2045 | 2052-2071 | 2073-2092 |
| SDM_MOHC-HadGEM2-ES_rcp85_r1i1p1_CLMcom-CCLM4-8-17 | 2014-2033 | 2026-2045 | 2045-2064 | 2062-2081 |
| SDM_MOHC-HadGEM2-ES_rcp85_r1i1p1_SMHI-RCA4 | 2014-2033 | 2026-2045 | 2045-2064 | 2062-2081 |
| SDM_IPSL-IPSL-CM5A-MR_rcp85_r1i1p1_IPSL-INERIS-WRF331F | 2006-2025 | 2021-2040 | 2041-2060 | 2057-2076 |
| SDM_IPSL-IPSL-CM5A-MR_rcp85_r1i1p1_SMHI-RCA4 | 2006-2025 | 2021-2040 | 2041-2060 | 2057-2076 |
| SDM_MPI-M-MPI-ESM-LR_rcp85_r1i1p1_CLMcom-CCLM4-8-17 | 2008-2027 | 2028-2047 | 2052-2071 | 2072-2091 |
| SDM_MPI-M-MPI-ESM-LR_rcp85_r1i1p1_SMHI-RCA4 | 2008-2027 | 2028-2047 | 2052-2071 | 2072-2091 |
| SDM_ICHEC-EC-EARTH_rcp26_r3i1p1_DMI-HIRHAM5 | 2014-2033 | | | |
| SDM_ICHEC-EC-EARTH_rcp45_r3i1p1_DMI-HIRHAM5 | 2013-2032 | 2035-2054 | | |
| SDM_ICHEC-EC-EARTH_rcp85_r3i1p1_DMI-HIRHAM5 | 2010-2029 | 2026-2045 | 2052-2071 | 2073-2092 |

# Application for transient results

| OEKS15 ensemble member | 1.5°C | 2.0°C | 3.0°C | 4.0°C |
|---|---|---|---|---|
| SDM_ICHEC-EC-EARTH_rcp26_r12i1p1_CLMcom-CCLM4-8-17_all | 2014-2033 | | | |
| SDM_ICHEC-EC-EARTH_rcp26_r12i1p1_KNMI-RACMO22E_all | 2014-2033 | | | |
| SDM_ICHEC-EC-EARTH_rcp26_r12i1p1_SMHI-RCA4_all | 2014-2033 | | | |
| SDM_MOHC-HadGEM2-ES_rcp26_r1i1p1_SMHI-RCA4_all | 2014-2033 | | | |
| SDM_MPI-M-MPI-ESM-LR_rcp26_r1i1p1_MPI-CSC-REMO2009_all | 2013-2032 | | | |
| SDM_MPI-M-MPI-ESM-LR_rcp26_r1i1p1_SMHI-RCA4_all | 2013-2032 | | | |
| SDM_MPI-M-MPI-ESM-LR_rcp26_r2i1p1_MPI-CSC-REMO2009_all | 2007-2026 | | | |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp45_r1i1p1_CLMcom-CCLM4-8-17 | 2028-2047 | 2049-2068 | | |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp45_r1i1p1_CNRM-ALADIN53 | 2028-2047 | 2049-2068 | | |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp45_r1i1p1_SMHI-RCA4 | 2028-2047 | 2049-2068 | | |
| SDM_ICHEC-EC-EARTH_rcp45_r12i1p1_CLMcom-CCLM4-8-17 | 2013-2032 | 2035-2054 | | |
| SDM_ICHEC-EC-EARTH_rcp45_r12i1p1_SMHI-RCA4 | 2013-2032 | 2035-2054 | | |
| SDM_ICHEC-EC-EARTH_rcp45_r1i1p1_KNMI-RACMO22E | 2013-2032 | 2035-2054 | | |
| SDM_MOHC-HadGEM2-ES_rcp45_r1i1p1_CLMcom-CCLM4-8-17 | 2019-2038 | 2034-2053 | 2069-2088 | |
| SDM_MOHC-HadGEM2-ES_rcp45_r1i1p1_SMHI-RCA4 | 2019-2038 | 2034-2053 | 2069-2088 | |
| SDM_IPSL-IPSL-CM5A-MR_rcp45_r1i1p1_IPSL-INERIS-WRF331F | 2007-2026 | 2024-2043 | 2068-2087 | |
| SDM_IPSL-IPSL-CM5A-MR_rcp45_r1i1p1_SMHI-RCA4 | 2007-2026 | 2024-2043 | 2068-2087 | |
| SDM_MPI-M-MPI-ESM-LR_rcp45_r1i1p1_CLMcom-CCLM4-8-17 | 2013-2032 | 2035-2054 | | |
| SDM_MPI-M-MPI-ESM-LR_rcp45_r1i1p1_SMHI-RCA4 | 2013-2032 | 2035-2054 | | |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp85_r1i1p1_CLMcom-CCLM4-8-17 | 2021-2040 | 2036-2055 | 2058-2077 | 2078-2097 |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp85_r1i1p1_CNRM-ALADIN53 | 2021-2040 | 2036-2055 | 2058-2077 | 2078-2097 |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp85_r1i1p1_SMHI-RCA4 | 2021-2040 | 2036-2055 | 2058-2077 | 2078-2097 |

➢ Result: Fixed time period to select for each GWL

| | | | | |
|---|---|---|---|---|
| SDM_IPSL-IPSL-CM5A-MR_rcp85_r1i1p1_IPSL-INERIS-WRF331F | 2006-2025 | 2021-2040 | 2041-2060 | 2057-2076 |
| SDM_IPSL-IPSL-CM5A-MR_rcp85_r1i1p1_SMHI-RCA4 | 2006-2025 | 2021-2040 | 2041-2060 | 2057-2076 |
| SDM_MPI-M-MPI-ESM-LR_rcp85_r1i1p1_CLMcom-CCLM4-8-17 | 2008-2027 | 2028-2047 | 2052-2071 | 2072-2091 |
| SDM_MPI-M-MPI-ESM-LR_rcp85_r1i1p1_SMHI-RCA4 | 2008-2027 | 2028-2047 | 2052-2071 | 2072-2091 |
| SDM_ICHEC-EC-EARTH_rcp26_r3i1p1_DMI-HIRHAM5 | 2014-2033 | | | |
| SDM_ICHEC-EC-EARTH_rcp45_r3i1p1_DMI-HIRHAM5 | 2013-2032 | 2035-2054 | | |
| SDM_ICHEC-EC-EARTH_rcp85_r3i1p1_DMI-HIRHAM5 | 2010-2029 | 2026-2045 | 2052-2071 | 2073-2092 |

# Application for fixed time periods

| OEKS15 ensemble member | 2021-2040 | 2041-2060 | 2081-2100 |
|---|---|---|---|
| SDM_ICHEC-EC-EARTH_rcp26_r12i1p1_CLMcom-CCLM4-8-17_all | 1.6 | 1.8 | 1.8 |
| SDM_ICHEC-EC-EARTH_rcp26_r12i1p1_KNMI-RACMO22E_all | 1.6 | 1.8 | 1.8 |
| SDM_ICHEC-EC-EARTH_rcp26_r12i1p1_SMHI-RCA4_all | 1.6 | 1.8 | 1.8 |
| SDM_MOHC-HadGEM2-ES_rcp26_r1i1p1_SMHI-RCA4_all | 1.7 | 2.0 | 1.9 |
| SDM_MPI-M-MPI-ESM-LR_rcp26_r1i1p1_MPI-CSC-REMO2009_all | 1.6 | 1.8 | 1.7 |
| SDM_MPI-M-MPI-ESM-LR_rcp26_r1i1p1_SMHI-RCA4_all | 1.6 | 1.8 | 1.7 |
| SDM_MPI-M-MPI-ESM-LR_rcp26_r2i1p1_MPI-CSC-REMO2009_all | 1.7 | 1.9 | 1.7 |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp45_r1i1p1_CLMcom-CCLM4-8-17 | 1.3 | 1.8 | 2.5 |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp45_r1i1p1_CNRM-ALADIN53 | 1.3 | 1.8 | 2.5 |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp45_r1i1p1_SMHI-RCA4 | 1.3 | 1.8 | 2.5 |
| SDM_ICHEC-EC-EARTH_rcp45_r12i1p1_CLMcom-CCLM4-8-17 | 1.7 | 2.2 | 2.7 |
| SDM_ICHEC-EC-EARTH_rcp45_r12i1p1_SMHI-RCA4 | 1.7 | 2.2 | 2.7 |
| SDM_ICHEC-EC-EARTH_rcp45_r1i1p1_KNMI-RACMO22E | 1.7 | 2.1 | 2.6 |
| SDM_MOHC-HadGEM2-ES_rcp45_r1i1p1_CLMcom-CCLM4-8-17 | 1.6 | 2.3 | 3.0 |
| SDM_MOHC-HadGEM2-ES_rcp45_r1i1p1_SMHI-RCA4 | 1.6 | 2.3 | 3.0 |
| SDM_IPSL-IPSL-CM5A-MR_rcp45_r1i1p1_IPSL-INERIS-WRF331F | 1.9 | 2.4 | 3.1 |
| SDM_IPSL-IPSL-CM5A-MR_rcp45_r1i1p1_SMHI-RCA4 | 1.9 | 2.4 | 3.1 |
| SDM_MPI-M-MPI-ESM-LR_rcp45_r1i1p1_CLMcom-CCLM4-8-17 | 1.7 | 2.1 | 2.5 |
| SDM_MPI-M-MPI-ESM-LR_rcp45_r1i1p1_SMHI-RCA4 | 1.7 | 2.1 | 2.5 |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp85_r1i1p1_CLMcom-CCLM4-8-17 | 1.5 | 2.2 | 4.0 |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp85_r1i1p1_CNRM-ALADIN53 | 1.5 | 2.2 | 4.0 |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp85_r1i1p1_SMHI-RCA4 | 1.5 | 2.2 | 4.0 |
| SDM_ICHEC-EC-EARTH_rcp85_r12i1p1_CLMcom-CCLM4-8-17 | 1.9 | 2.6 | |
| SDM_ICHEC-EC-EARTH_rcp85_r12i1p1_SMHI-RCA4 | 1.9 | 2.6 | |
| SDM_ICHEC-EC-EARTH_rcp85_r1i1p1_KNMI-RACMO22E | 1.8 | 2.5 | 4.3 |
| SDM_MOHC-HadGEM2-ES_rcp85_r1i1p1_CLMcom-CCLM4-8-17 | 1.8 | 2.8 | 5.0 |
| SDM_MOHC-HadGEM2-ES_rcp85_r1i1p1_SMHI-RCA4 | 1.8 | 2.8 | 5.0 |
| SDM_IPSL-IPSL-CM5A-MR_rcp85_r1i1p1_IPSL-INERIS-WRF331F | 2.0 | 3.0 | 5.1 |
| SDM_IPSL-IPSL-CM5A-MR_rcp85_r1i1p1_SMHI-RCA4 | 2.0 | 3.0 | 5.1 |
| SDM_MPI-M-MPI-ESM-LR_rcp85_r1i1p1_CLMcom-CCLM4-8-17 | 1.8 | 2.6 | 4.3 |
| SDM_MPI-M-MPI-ESM-LR_rcp85_r1i1p1_SMHI-RCA4 | 1.8 | 2.6 | 4.3 |
| SDM_ICHEC-EC-EARTH_rcp26_r3i1p1_DMI-HIRHAM5 | 1.6 | 1.8 | 1.8 |
| SDM_ICHEC-EC-EARTH_rcp45_r3i1p1_DMI-HIRHAM5 | 1.7 | 2.1 | 2.6 |
| SDM_ICHEC-EC-EARTH_rcp85_r3i1p1_DMI-HIRHAM5 | 1.8 | 2.5 | 4.3 |

# Application for fixed time periods

| OEKS15 ensemble member | 2021-2040 | 2041-2060 | 2081-2100 |
|---|---|---|---|
| SDM_ICHEC-EC-EARTH_rcp26_r12i1p1_CLMcom-CCLM4-8-17_all | 1.6 | 1.8 | 1.8 |
| SDM_ICHEC-EC-EARTH_rcp26_r12i1p1_KNMI-RACMO22E_all | 1.6 | 1.8 | 1.8 |
| SDM_ICHEC-EC-EARTH_rcp26_r12i1p1_SMHI-RCA4_all | 1.6 | 1.8 | 1.8 |
| SDM_MOHC-HadGEM2-ES_rcp26_r1i1p1_SMHI-RCA4_all | 1.7 | 2.0 | 1.9 |
| SDM_MPI-M-MPI-ESM-LR_rcp26_r1i1p1_MPI-CSC-REMO2009_all | 1.6 | 1.8 | 1.7 |
| SDM_MPI-M-MPI-ESM-LR_rcp26_r1i1p1_SMHI-RCA4_all | 1.6 | 1.8 | 1.7 |
| SDM_MPI-M-MPI-ESM-LR_rcp26_r2i1p1_MPI-CSC-REMO2009_all | 1.7 | 1.9 | 1.7 |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp45_r1i1p1_CLMcom-CCLM4-8-17 | 1.3 | 1.8 | 2.5 |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp45_r1i1p1_CNRM-ALADIN53 | 1.3 | 1.8 | 2.5 |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp45_r1i1p1_SMHI-RCA4 | 1.3 | 1.8 | 2.5 |
| SDM_ICHEC-EC-EARTH_rcp45_r12i1p1_CLMcom-CCLM4-8-17 | 1.7 | 2.2 | 2.7 |
| SDM_ICHEC-EC-EARTH_rcp45_r12i1p1_SMHI-RCA4 | 1.7 | 2.2 | 2.7 |
| SDM_ICHEC-EC-EARTH_rcp45_r1i1p1_KNMI-RACMO22E | 1.7 | 2.1 | 2.6 |
| SDM_MOHC-HadGEM2-ES_rcp45_r1i1p1_CLMcom-CCLM4-8-17 | 1.6 | 2.3 | 3.0 |
| SDM_MOHC-HadGEM2-ES_rcp45_r1i1p1_SMHI-RCA4 | 1.6 | 2.3 | 3.0 |
| SDM_IPSL-IPSL-CM5A-MR_rcp45_r1i1p1_IPSL-INERIS-WRF331F | 1.9 | 2.4 | 3.1 |
| SDM_IPSL-IPSL-CM5A-MR_rcp45_r1i1p1_SMHI-RCA4 | 1.9 | 2.4 | 3.1 |
| SDM_MPI-M-MPI-ESM-LR_rcp45_r1i1p1_CLMcom-CCLM4-8-17 | 1.7 | 2.1 | 2.5 |
| SDM_MPI-M-MPI-ESM-LR_rcp45_r1i1p1_SMHI-RCA4 | 1.7 | 2.1 | 2.5 |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp85_r1i1p1_CLMcom-CCLM4-8-17 | 1.5 | 2.2 | 4.0 |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp85_r1i1p1_CNRM-ALADIN53 | 1.5 | 2.2 | 4.0 |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp85_r1i1p1_SMHI-RCA4 | 1.5 | 2.2 | 4.0 |
| SDM_ICHEC-EC-EARTH_rcp85_r12i1p1_CLMcom-CCLM4-8-17 | 1.9 | 2.6 | |
| SDM_ICHEC-EC-EARTH_rcp85_r12i1p1_SMHI-RCA4 | 1.9 | 2.6 | |
| SDM_ICHEC-EC-EARTH_rcp85_r1i1p1_KNMI-RACMO22E | 1.8 | 2.5 | 4.3 |
| SDM_MOHC-HadGEM2-ES_rcp85_r1i1p1_CLMcom-CCLM4-8-17 | 1.8 | 2.8 | 5.0 |
| SDM_MOHC-HadGEM2-ES_rcp85_r1i1p1_SMHI-RCA4 | 1.8 | 2.8 | 5.0 |
| SDM_IPSL-IPSL-CM5A-MR_rcp85_r1i1p1_IPSL-INERIS-WRF331F | 2.0 | 3.0 | 5.1 |
| SDM_IPSL-IPSL-CM5A-MR_rcp85_r1i1p1_SMHI-RCA4 | 2.0 | 3.0 | 5.1 |
| SDM_MPI-M-MPI-ESM-LR_rcp85_r1i1p1_CLMcom-CCLM4-8-17 | 1.8 | 2.6 | 4.3 |
| SDM_MPI-M-MPI-ESM-LR_rcp85_r1i1p1_SMHI-RCA4 | 1.8 | 2.6 | 4.3 |
| SDM_ICHEC-EC-EARTH_rcp26_r3i1p1_DMI-HIRHAM5 | 1.6 | 1.8 | 1.8 |
| SDM_ICHEC-EC-EARTH_rcp45_r3i1p1_DMI-HIRHAM5 | 1.7 | 2.1 | 2.6 |
| SDM_ICHEC-EC-EARTH_rcp85_r3i1p1_DMI-HIRHAM5 | 1.8 | 2.5 | 4.3 |

# Application for fixed time periods

| OEKS15 ensemble member | 2021-2040 | 2041-2060 | 2081-2100 |
|---|---|---|---|
| SDM_ICHEC-EC-EARTH_rcp26_r12i1p1_CLMcom-CCLM4-8-17_all | 1.6 | 1.8 | 1.8 |
| SDM_ICHEC-EC-EARTH_rcp26_r12i1p1_KNMI-RACMO22E_all | 1.6 | 1.8 | 1.8 |
| SDM_ICHEC-EC-EARTH_rcp26_r12i1p1_SMHI-RCA4_all | 1.6 | 1.8 | 1.8 |
| SDM_MOHC-HadGEM2-ES_rcp26_r1i1p1_SMHI-RCA4_all | 1.7 | 2.0 | 1.9 |
| SDM_MPI-M-MPI-ESM-LR_rcp26_r1i1p1_MPI-CSC-REMO2009_all | 1.6 | 1.8 | 1.7 |
| SDM_MPI-M-MPI-ESM-LR_rcp26_r1i1p1_SMHI-RCA4_all | 1.6 | 1.8 | 1.7 |
| SDM_MPI-M-MPI-ESM-LR_rcp26_r2i1p1_MPI-CSC-REMO2009_al | 1.7 | 1.9 | 1.7 |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp45_r1i1p1_CLMcom-CCLM 8-17 | 1.3 | 1.8 | 2.5 |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp45_r1i1p1_CNRM-ALADIN | 1.3 | 1.8 | 2.5 |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp45_r1i1p1_SMHI-RCA4 | 1.3 | 1.8 | 2.5 |
| SDM_ICHEC-EC-EARTH_rcp45_r12i1p1_CLMcom-CCLM4-8-17 | 1.7 | 2.2 | 2.7 |
| SDM_ICHEC-EC-EARTH_rcp45_r12i1p1_SMHI-RCA4 | 1.7 | 2.2 | 2.7 |
| SDM_ICHEC-EC-EARTH_rcp45_r1i1p1_KNMI-RACMO22E | 1.7 | 2.1 | 2.6 |
| SDM_MOHC-HadGEM2-ES_rcp45_r1i1p1_CLMcom-CCLM4-8-17 | 1.6 | 2.3 | 3.0 |
| SDM_MOHC-HadGEM2-ES_rcp45_r1i1p1_SMHI-RCA4 | 1.6 | 2.3 | 3.0 |
| SDM_IPSL-IPSL-CM5A-MR_rcp45_r1i1p1_IPSL-INERIS-WRF331F | 1.9 | 2.4 | 3.1 |
| SDM_IPSL-IPSL-CM5A-MR_rcp45_r1i1p1_SMHI-RCA4 | 1.9 | 2.4 | 3.1 |
| SDM_MPI-M-MPI-ESM-LR_rcp45_r1i1p1_CLMcom-CCLM4-8-17 | 1.7 | 2.1 | 2.5 |
| SDM_MPI-M-MPI-ESM-LR_rcp45_r1i1p1_SMHI-RCA4 | 1.7 | 2.1 | 2.5 |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp85_r1i1p1_CLMcom-CCLM4-8-17 | 1.5 | 2.2 | 4.0 |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp85_r1i1p1_CNRM-ALADIN53 | 1.5 | 2.2 | 4.0 |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp85_r1i1p1_SMHI-RCA4 | 1.5 | 2.2 | 4.0 |
| SDM_ICHEC-EC-EARTH_rcp85_r12i1p1_CLMcom-CCLM4-8-17 | 1.9 | 2.6 | |
| SDM_ICHEC-EC-EARTH_rcp85_r12i1p1_SMHI-RCA4 | 1.9 | 2.6 | |
| SDM_ICHEC-EC-EARTH_rcp85_r1i1p1_KNMI-RACMO22E | 1.8 | 2.5 | 4.3 |
| SDM_MOHC-HadGEM2-ES_rcp85_r1i1p1_CLMcom-CCLM4-8-17 | 1.8 | 2.8 | 5.0 |
| SDM_MOHC-HadGEM2-ES_rcp85_r1i1p1_SMHI-RCA4 | 1.8 | 2.8 | 5.0 |
| SDM_IPSL-IPSL-CM5A-MR_rcp85_r1i1p1_IPSL-INERIS-WRF331F | 2.0 | 3.0 | 5.1 |
| SDM_IPSL-IPSL-CM5A-MR_rcp85_r1i1p1_SMHI-RCA4 | 2.0 | 3.0 | 5.1 |
| SDM_MPI-M-MPI-ESM-LR_rcp85_r1i1p1_CLMcom-CCLM4-8-17 | 1.8 | 2.6 | 4.3 |
| SDM_MPI-M-MPI-ESM-LR_rcp85_r1i1p1_SMHI-RCA4 | 1.8 | 2.6 | 4.3 |
| SDM_ICHEC-EC-EARTH_rcp26_r3i1p1_DMI-HIRHAM5 | 1.6 | 1.8 | 1.8 |
| SDM_ICHEC-EC-EARTH_rcp45_r3i1p1_DMI-HIRHAM5 | 1.7 | 2.1 | 2.6 |
| SDM_ICHEC-EC-EARTH_rcp85_r3i1p1_DMI-HIRHAM5 | 1.8 | 2.5 | 4.3 |

# Application for fixed time periods

| OEKS15 ensemble member | 2021-2040 | 2041-2060 | 2081-2100 |
|---|---|---|---|
| SDM_ICHEC-EC-EARTH_rcp26_r12i1p1_CLMcom-CCLM4-8-17_all | 1.6 | 1.8 | 1.8 |
| SDM_ICHEC-EC-EARTH_rcp26_r12i1p1_KNMI-RACMO22E_all | 1.6 | 1.8 | 1.8 |
| SDM_ICHEC-EC-EARTH_rcp26_r12i1p1_SMHI-RCA4_all | 1.6 | 1.8 | 1.8 |
| SDM_MOHC-HadGEM2-ES_rcp26_r1i1p1_SMHI-RCA4_all | 1.7 | 2.0 | 1.9 |
| SDM_MPI-M-MPI-ESM-LR_rcp26_r1i1p1_MPI-CSC-REMO2009_all | 1.6 | 1.8 | 1.7 |
| SDM_MPI-M-MPI-ESM-LR_rcp26_r1i1p1_SMHI-RCA4_all | 1.6 | 1.8 | 1.7 |
| SDM_MPI-M-MPI-ESM-LR_rcp26_r2i1p1_MPI-CSC-REMO2009_al | 1.7 | 1.9 | 1.7 |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp45_r1i1p1_CLMcom-CCLM 8-17 | 1.3 | 1.8 | 2.5 |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp45_r1i1p1_CNRM-ALADIN | 1.3 | 1.8 | 2.5 |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp45_r1i1p1_SMHI-RCA4 | 1.3 | 1.8 | 2.5 |
| SDM_ICHEC-EC-EARTH_rcp45_r12i1p1_CLMcom-CCLM4-8-17 | 1.7 | 2.2 | 2.7 |
| SDM_ICHEC-EC-EARTH_rcp45_r12i1p1_SMHI-RCA4 | 1.7 | 2.2 | 2.7 |
| SDM_ICHEC-EC-EARTH_rcp45_r1i1p1_KNMI-RACMO22E | 1.7 | 2.1 | 2.6 |
| SDM_MOHC-HadGEM2-ES_rcp45_r1i1p1_CLMcom-CCLM4-8-17 | 1.6 | 2.3 | 3.0 |
| SDM_MOHC-HadGEM2-ES_rcp45_r1i1p1_SMHI-RCA4 | 1.6 | 2.3 | 3.0 |
| SDM_IPSL-IPSL-CM5A-MR_rcp45_r1i1p1_IPSL-INERIS-WRF331F | 1.9 | 2.4 | 3.1 |
| SDM_IPSL-IPSL-CM5A-MR_rcp45_r1i1p1_SMHI-RCA4 | 1.9 | 2.4 | 3.1 |
| SDM_MPI-M-MPI-ESM-LR_rcp45_r1i1p1_CLMcom-CCLM4-8-17 | 1.7 | 2.1 | 2.5 |
| SDM_MPI-M-MPI-ESM-LR_rcp45_r1i1p1_SMHI-RCA4 | 1.7 | 2.1 | 2.5 |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp85_r1i1p1_CLMcom-CCLM4-8-17 | 1.5 | 2.2 | 4.0 |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp85_r1i1p1_CNRM-ALADIN53 | 1.5 | 2.2 | 4.0 |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp85_r1i1p1_SMHI-RCA4 | 1.5 | 2.2 | 4.0 |
| SDM_ICHEC-EC-EARTH_rcp85_r12i1p1_CLMcom-CCLM4-8-17 | 1.9 | 2.6 | |
| SDM_ICHEC-EC-EARTH_rcp85_r12i1p1_SMHI-RCA4 | 1.9 | 2.6 | |
| SDM_ICHEC-EC-EARTH_rcp85_r1i1p1_KNMI-RACMO22E | 1.8 | 2.5 | 4.3 |
| SDM_MOHC-HadGEM2-ES_rcp85_r1i1p1_CLMcom-CCLM4-8-17 | 1.8 | 2.8 | 5.0 |
| SDM_MOHC-HadGEM2-ES_rcp85_r1i1p1_SMHI-RCA4 | 1.8 | 2.8 | 5.0 |
| SDM_IPSL-IPSL-CM5A-MR_rcp85_r1i1p1_IPSL-INERIS-WRF331F | 2.0 | 3.0 | 5.1 |
| SDM_IPSL-IPSL-CM5A-MR_rcp85_r1i1p1_SMHI-RCA4 | 2.0 | 3.0 | 5.1 |
| SDM_MPI-M-MPI-ESM-LR_rcp85_r1i1p1_CLMcom-CCLM4-8-17 | 1.8 | 2.6 | 4.3 |
| SDM_MPI-M-MPI-ESM-LR_rcp85_r1i1p1_SMHI-RCA4 | 1.8 | 2.6 | 4.3 |
| SDM_ICHEC-EC-EARTH_rcp26_r3i1p1_DMI-HIRHAM5 | 1.6 | 1.8 | 1.8 |
| SDM_ICHEC-EC-EARTH_rcp45_r3i1p1_DMI-HIRHAM5 | 1.7 | 2.1 | 2.6 |
| SDM_ICHEC-EC-EARTH_rcp85_r3i1p1_DMI-HIRHAM5 | 1.8 | 2.5 | 4.3 |

# Application for fixed time periods

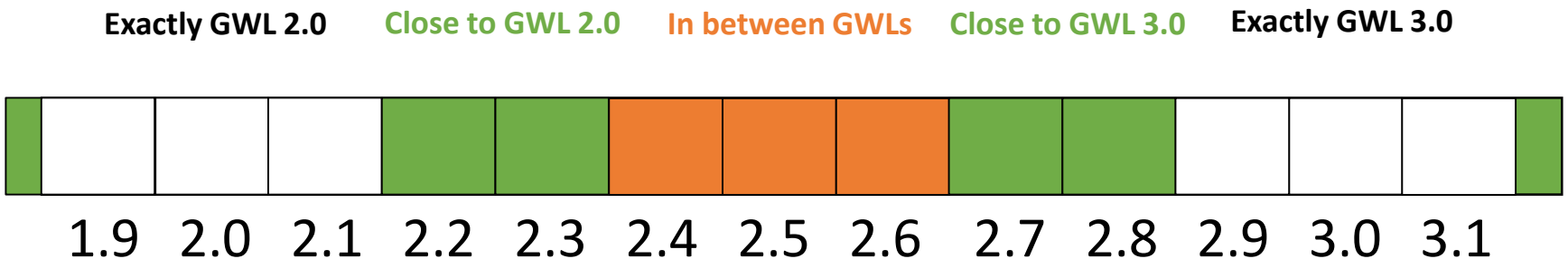
| OEKS15 ensemble member | 2021-2040 | 2041-2060 | 2081-2100 |
|---|---|---|---|
| SDM_ICHEC-EC-EARTH_rcp26_r12i1p1_CLMcom-CCLM4-8-17_all | 1.6 | 1.8 | 1.8 |
| SDM_ICHEC-EC-EARTH_rcp26_r12i1p1_KNMI-RACMO22E_all | 1.6 | 1.8 | 1.8 |
| SDM_ICHEC-EC-EARTH_rcp26_r12i1p1_SMHI-RCA4_all | 1.6 | 1.8 | 1.8 |
| SDM_MOHC-HadGEM2-ES_rcp26_r1i1p1_SMHI-RCA4_all | 1.7 | 2.0 | 1.9 |
| SDM_MPI-M-MPI-ESM-LR_rcp26_r1i1p1_MPI-CSC-REMO2009_all | 1.6 | 1.8 | 1.7 |
| SDM_MPI-M-MPI-ESM-LR_rcp26_r1i1p1_SMHI-RCA4_all | 1.6 | 1.8 | 1.7 |
| SDM_MPI-M-MPI-ESM-LR_rcp26_r2i1p1_MPI-CSC-REMO2009_al | 1.7 | 1.9 | 1.7 |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp45_r1i1p1_CLMcom-CCLM 8-17 | 1.3 | 1.8 | 2.5 |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp45_r1i1p1_CNRM-ALADIN | 1.3 | 1.8 | 2.5 |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp45_r1i1p1_SMHI-RCA4 | 1.3 | 1.8 | 2.5 |
| SDM_ICHEC-EC-EARTH_rcp45_r12i1p1_CLMcom-CCLM4-8-17 | 1.7 | 2.2 | 2.7 |
| SDM_ICHEC-EC-EARTH_rcp45_r12i1p1_SMHI-RCA4 | 1.7 | 2.2 | 2.7 |
| SDM_ICHEC-EC-EARTH_rcp45_r1i1p1_KNMI-RACMO22E | 1.7 | 2.1 | 2.6 |
| SDM_MOHC-HadGEM2-ES_rcp45_r1i1p1_CLMcom-CCLM4-8-17 | 1.6 | 2.3 | 3.0 |
| SDM_MOHC-HadGEM2-ES_rcp45_r1i1p1_SMHI-RCA4 | 1.6 | 2.3 | 3.0 |
| SDM_IPSL-IPSL-CM5A-MR_rcp45_r1i1p1_IPSL-INERIS-WRF331F | 1.9 | 2.4 | 3.1 |
| SDM_IPSL-IPSL-CM5A-MR_rcp45_r1i1p1_SMHI-RCA4 | 1.9 | 2.4 | 3.1 |
| SDM_MPI-M-MPI-ESM-LR_rcp45_r1i1p1_CLMcom-CCLM4-8-17 | 1.7 | 2.1 | 2.5 |
| SDM_MPI-M-MPI-ESM-LR_rcp45_r1i1p1_SMHI-RCA4 | 1.7 | 2.1 | 2.5 |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp85_r1i1p1_CLMcom-CCLM4-8-17 | 1.5 | 2.2 | 4.0 |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp85_r1i1p1_CNRM-ALADIN53 | 1.5 | 2.2 | 4.0 |
| SDM_CNRM-CERFACS-CNRM-CM5_rcp85_r1i1p1_SMHI-RCA4 | 1.5 | 2.2 | 4.0 |

- Result: GWL for some exemplary time periods

| | | | |
|---|---|---|---|
| SDM_IPSL-IPSL-CM5A-MR_rcp85_r1i1p1_IPSL-INERIS-WRF331F | 2.0 | 3.0 | 5.1 |
| SDM_IPSL-IPSL-CM5A-MR_rcp85_r1i1p1_SMHI-RCA4 | 2.0 | 3.0 | 5.1 |
| SDM_MPI-M-MPI-ESM-LR_rcp85_r1i1p1_CLMcom-CCLM4-8-17 | 1.8 | 2.6 | 4.3 |
| SDM_MPI-M-MPI-ESM-LR_rcp85_r1i1p1_SMHI-RCA4 | 1.8 | 2.6 | 4.3 |
| SDM_ICHEC-EC-EARTH_rcp26_r3i1p1_DMI-HIRHAM5 | 1.6 | 1.8 | 1.8 |
| SDM_ICHEC-EC-EARTH_rcp45_r3i1p1_DMI-HIRHAM5 | 1.7 | 2.1 | 2.6 |
| SDM_ICHEC-EC-EARTH_rcp85_r3i1p1_DMI-HIRHAM5 | 1.8 | 2.5 | 4.3 |

# Application for fixed time periods

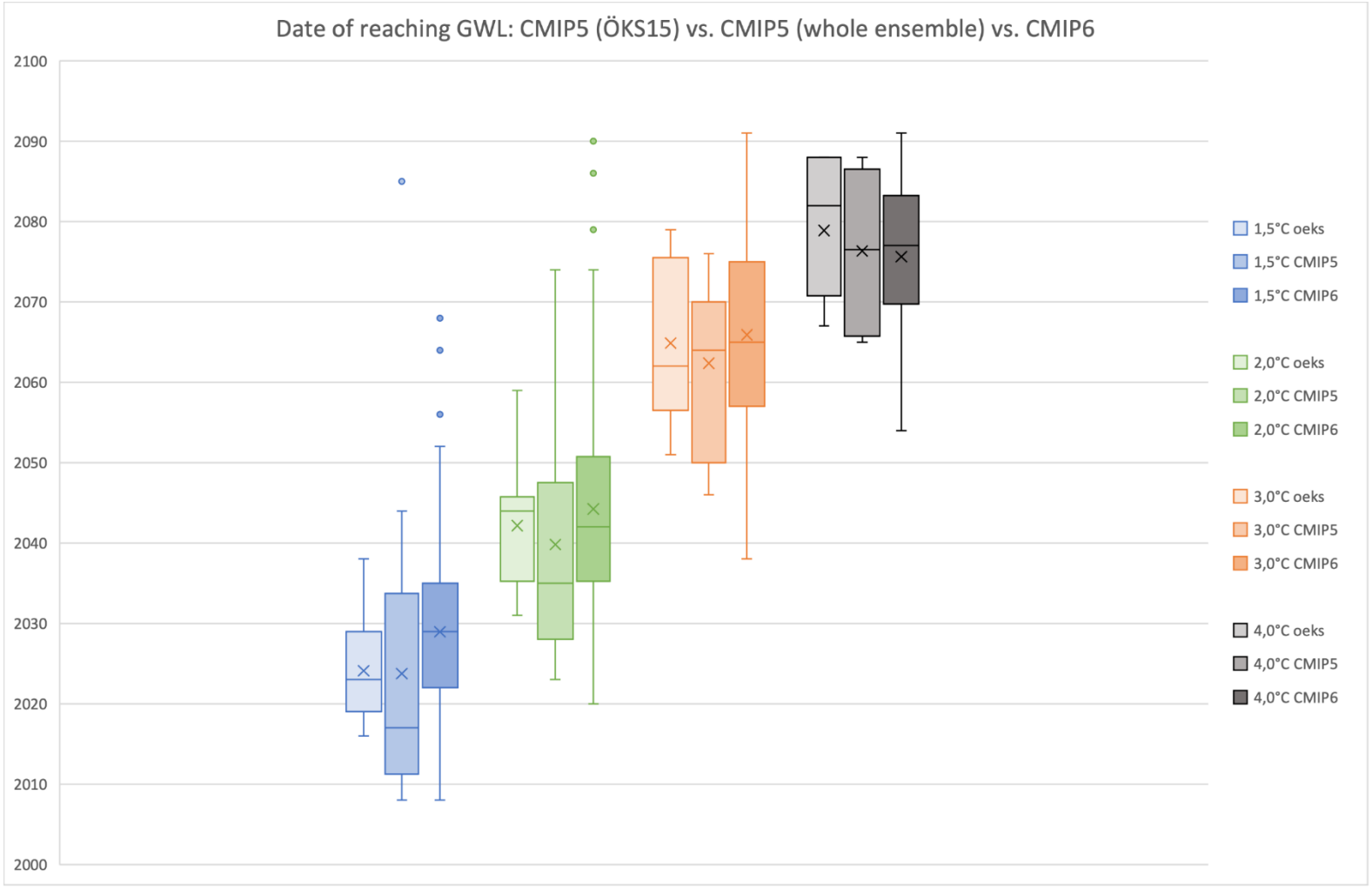
- Result: GWL for some exemplary time periods
- Further need to classify the GWL



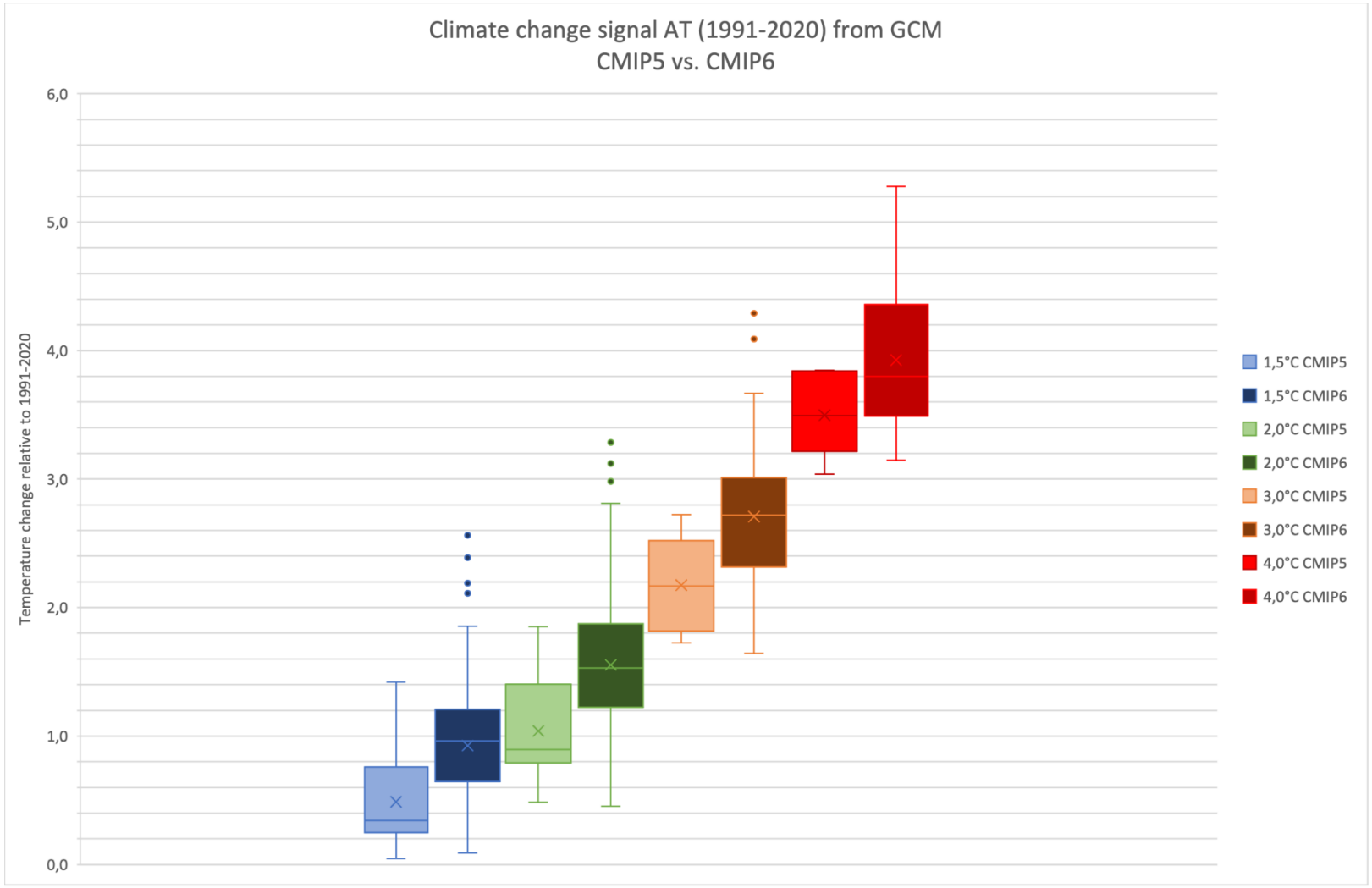
# List of possible indicators

| Indicator Name | Definition |
|---|---|
| **Precipitation thresholds as precursor for landslides** | Exceedance of precipitation intensity thresholds after the Moser-Hohensinn approach ($M = 41.66 * (h^{-0.77}) * h$) for h = 24, 48 and 72 hours |
| **Precipitation intensity** | 99.9 percentile of daily precipitation intensities |
| **Heat days** | Exceedance of 30°C / 40°C daily maximum temperature |
| **Consecutive dry days** | Consecutive 5 and 7-day periods of less than 1mm daily precipitation during April-September |
| **Combinend heat and consecutive dry events** | Days in consecutive dry events with exceedance of 30°C daily maximum temperature |
| **Freeze-thaw-changes** | Number of days with Tmin ≤ 2.2 °C and Tmax ≥ 0°C |
| **Heavy snowfall** | Days with precipitation sums >= 10mm and daily mean temperature <= 0°C |
| **Extreme wind** | Days with exceedance of the 99.9-percentile of daily mean wind speeds of the observation period 1981-2010 |
| **Snow days** | Days with precipitation sums >= 1mm and daily mean temperature <= 0°C |
| **Heat Waves (Duration, Intensity)** | |
| **[…]** | |

# Preview: GWLs in CMIP6



# Preview: GWLs in CMIP6



# Q&A Session part II

# Part III: Interactive Session

# Aims of the webinar

## Learning outcomes

**Understanding…**

…the concept and rationale of global warming levels

…the method used in AAR2 to link ÖKS15-derived results to GWL

## Skills

**How to…**

… identify the information in your chapter where GWLs can be applied

… distinguish between two different ways of linking your chapter results to GWLs

… look up the allocated time period for each ÖKS15 model and GWL

… apply the common framework of GWL mapping

2. Österreichischer Sachstandsbericht zum Klimawandel
2nd Austrian Assessment Report on Climate Change

# Thank you very much for your attention!

26.05.2023

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# Literature


Diedhiou A, Bichet A, Wartenburger R, et al (2018) Changes in climate extremes over West and Central Africa at 1.5 °C and 2 °C global warming. Environ Res Lett 13:065020. https://doi.org/10.1088/1748-9326/aac3e5

Donnelly C, Greuell W, Andersson J, et al (2017) Impacts of climate change on European hydrology at 1.5, 2 and 3 degrees mean global warming above preindustrial level. Climatic Change 143:13–26. https://doi.org/10.1007/s10584-017-1971-7

Hoegh-Guldberg O, Jacob D, Taylor M, et al (2019) The human imperative of stabilizing global climate change at 1.5°C. Science 365:eaaw6974. https://doi.org/10.1126/science.aaw6974

James R, Washington R, Rowell DP (2014) African Climate Change Uncertainty in Perturbed Physics Ensembles: Implications of Global Warming to 4°C and Beyond*. Journal of Climate 27:4677–4692. https://doi.org/10.1175/JCLI-D-13-00612.1

James R, Washington R, Schleussner C, et al (2017) Characterizing half-a-degree difference: a review of methods for identifying regional climate responses to global warming targets. WIREs Clim Change 8:. https://doi.org/10.1002/wcc.457

Orlowsky B, Seneviratne SI (2012) Global changes in extreme events: regional and seasonal dimension. Climatic Change 110:669–696. https://doi.org/10.1007/s10584-011-0122-9

Schleussner C-F, Deryng D, Müller C, et al (2018) Crop productivity changes in 1.5 °C and 2 °C worlds under climate sensitivity uncertainty. Environ Res Lett 13:064007. https://doi.org/10.1088/1748-9326/aab63b

Seneviratne SI, Donat MG, Pitman AJ, et al (2016) Allowable CO2 emissions based on regional and impact-related climate targets. Nature 529:477–483. https://doi.org/10.1038/nature16542

Seneviratne SI, Hauser M (2020) Regional Climate Sensitivity of Climate Extremes in CMIP6 Versus CMIP5 Multimodel Ensembles. Earth's Future 8:. https://doi.org/10.1029/2019EF001474

Seneviratne SI, Rogelj J, Séférian R, et al (2018a) The many possible climates from the Paris Agreement's aim of 1.5 °C warming. Nature 558:41–49. https://doi.org/10.1038/s41586-018-0181-4

Seneviratne SI, Wartenburger R, Guillod BP, et al (2018b) Climate extremes, land–climate feedbacks and land-use forcing at 1.5°C. Phil Trans R Soc A 376:20160450. https://doi.org/10.1098/rsta.2016.0450

Simpson NP, Mach KJ, Constable A, et al (2021) A framework for complex climate change risk assessment. One Earth 4:489–501. https://doi.org/10.1016/j.oneear.2021.03.005

Vautard R, Gobiet A, Sobolowski S, et al (2014) The European climate under a 2 °C global warming. Environ Res Lett 9:034006. https://doi.org/10.1088/1748-9326/9/3/034006

Vogel MM, Hauser M, Seneviratne SI (2020a) Projected changes in hot, dry and wet extreme events' clusters in CMIP6 multi-model ensemble. Environ Res Lett 15:094021. https://doi.org/10.1088/1748-9326/ab90a7

Vogel MM, Zscheischler J, Fischer EM, Seneviratne SI (2020b) Development of Future Heatwaves for Different Hazard Thresholds. J Geophys Res Atmos 125:. https://doi.org/10.1029/2019JD032070