CHARTER

ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR-
UND MEERESFORSCHUNG

Providing relevant climate information to Arctic reindeer herding communities

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CHARTER – Drivers and Feedbacks of Changes in Arctic Terrestrial Biodiversity

CHARTER intends to advance the adaptive capacity of Arctic communities to climatic and biodiversity changes. This is done through state-of-the-art synthesis of mostly existing datasets from previous projects. We will model Arctic change with major socio-economic implications and feedbacks. The project has three central aims:

- Better understand past and ongoing responses of Arctic terrestrial social-ecological systems to changes in the cryosphere across decadal and centennial timescales
- Simulate the future effects of social-ecological changes for indigenous and local communities and traditional livelihoods out to 2050
- Work with Arctic communities to co-develop strategies and policy pathways for livelihoods such as herding, hunting and fishing

- one approach made towards the last two points: interviews with herders on criteria that make conditions for reindeer herding good or bad
- take these criteria and try to produce information on possible future pathways based on model output, in a first step the CMIP6 model ensemble data was used (availability, many models, uncertainty assessment)

Good and bad conditions

for reindeer herding

April – May (spring)

good:
- snow melt starts latest May 18^{th}, early formation of snow free patches
- Hankikeli (Finish for thin hard snow layer on top of snow) forms afterwards

bad:
- snow melt starts later than May 24^{th}, no snow free patches
- hard top layer of snow pack forms in April or early May

May – June (spring-summer, <u>calving</u>)

good:
- dry and warm weather

bad:
- 2-3 days of continuous rain/ wet snow

June/July (<u>calf marking</u>)

good:
- enough mosquitos (winds below 10km/h, temperature above 10°C)
- dry weather
- cool nights

bad:
- temperatures above 20°C
- no mosquitos (winds above 10km/h, temperatures below 10°C)

July – August (summer)

good:
- normal summer
- west wind

bad:
- cold
- long continuous rain
- long periods over 25°C

August – September (summer-autumn)

good:
- enough rain for mushrooms to grow

bad:
- dry conditions

September - October (<u>rutting time</u>)

good:
- some rain/snow in the beginning of October, fog
- bad weather

bad:
- dryness
- snow and temperatures below 0°C starting in mid October

October – November/December (late autumn/ round ups)

good:
- ground freezes first (temperature below 0°C in October already)
- rivers & lakes freeze
- snow season starts in of November, no melt
- temperature -10 to -20°C

bad:
- snow on wet ground
- rain on frozen ground
- temperature fluctuates between above and below freezing
- lots of rain
- no snow
- rivers & lakes have not frozen

December – March (winter)

good:
- little snow (below 50cm)

bad:
- lots of snow (2m), especially in late winter
- long winter
- mild temperatures (around freezing) in January/February
- Hankikeli formation

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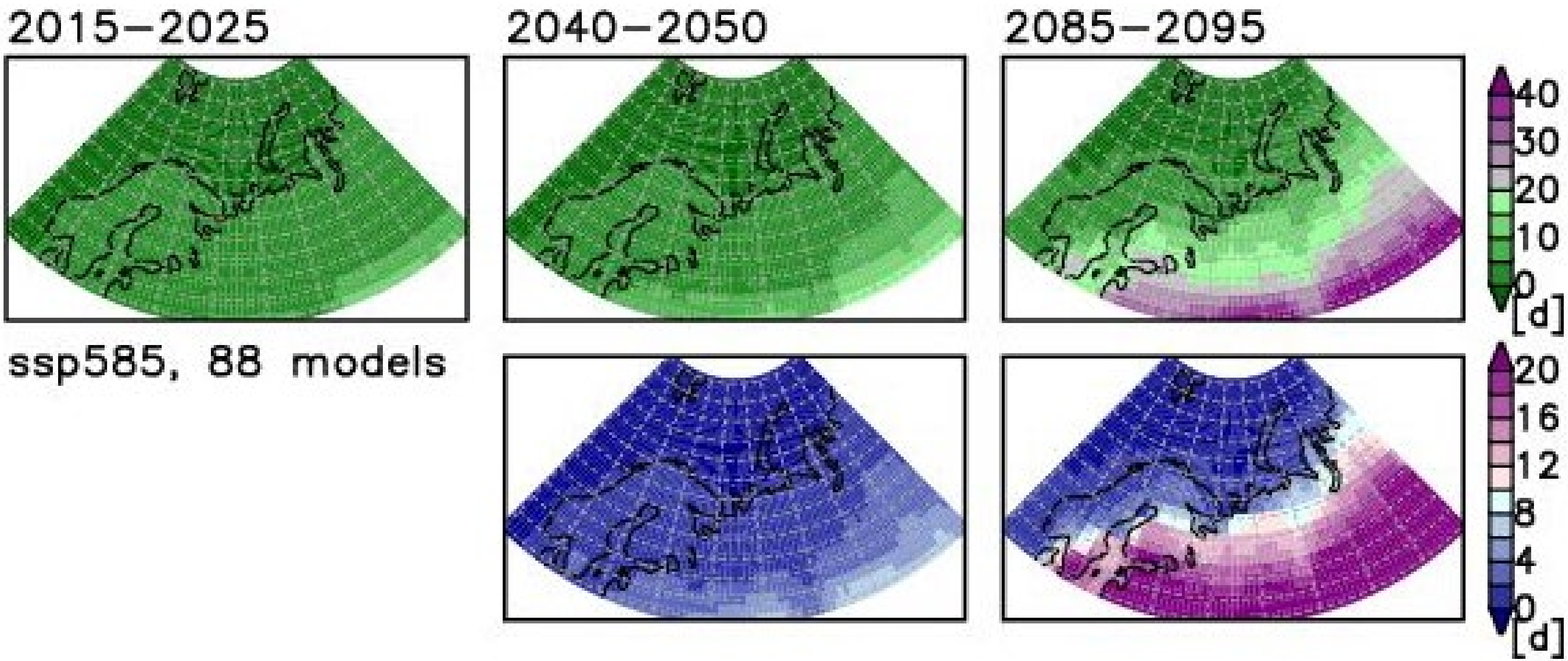
What does long mean? -> for now, we ignore this

daily mean temperature

- approach: we count **days with daily mean temperature above 25°C (tas25)**
- scenarios we agreed upon**: SSP1 2.6, SSP2 4.5, SSP5 8.5**

classical climate scientist approach 1: compare averages over specific time slices with a base period



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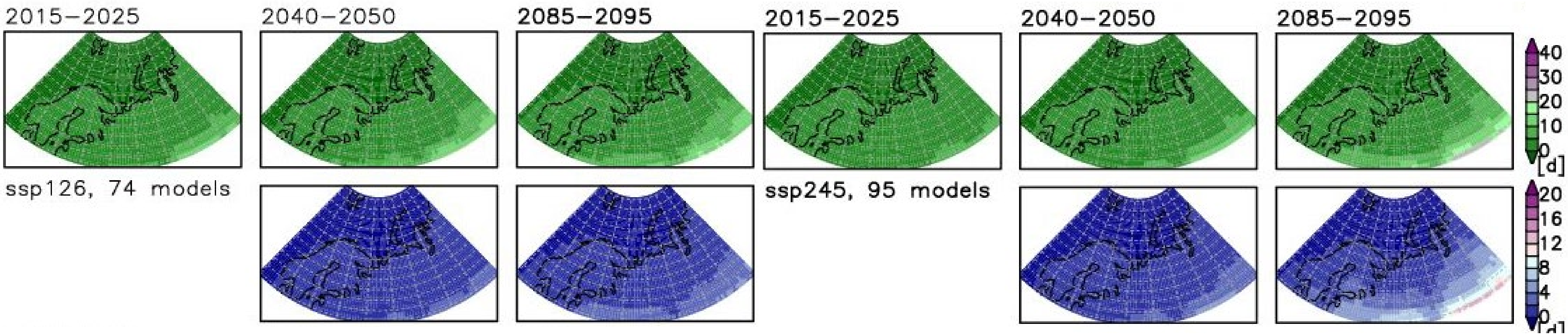

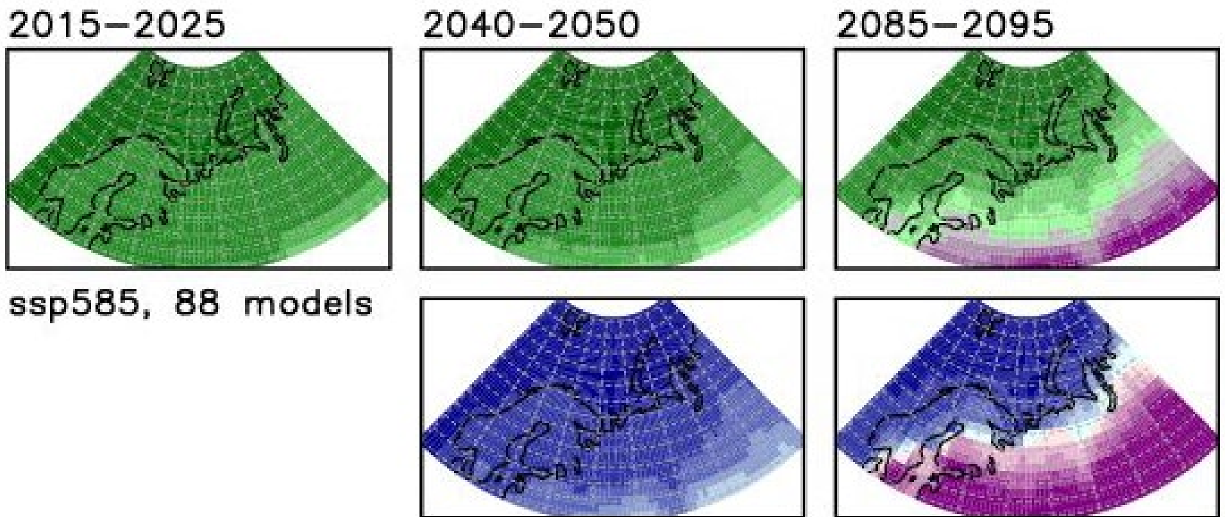

- representation of spatial variability
- changes are small for SSP1 2.6 and SSP2 4.5 if we only look at the mid century time slice

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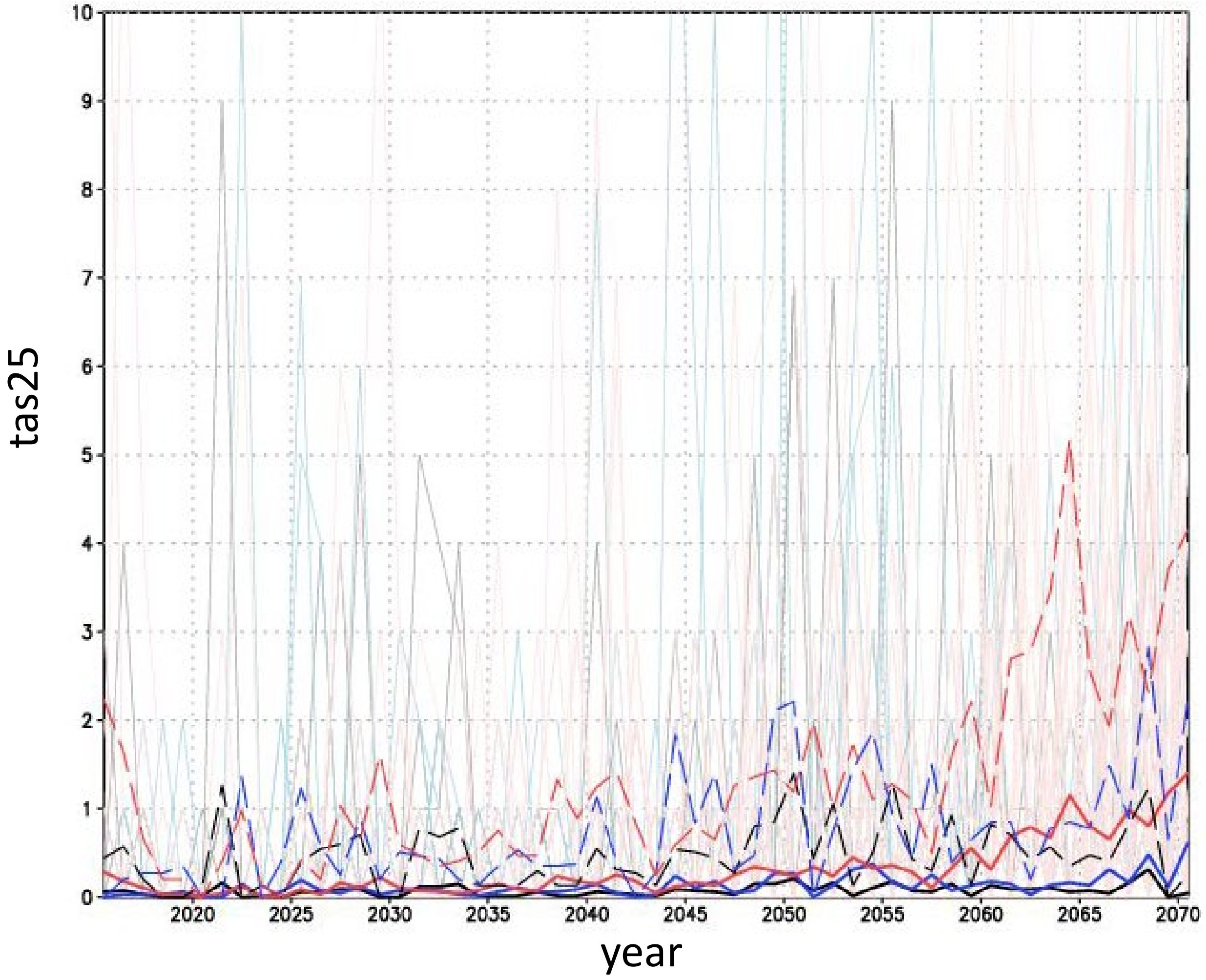
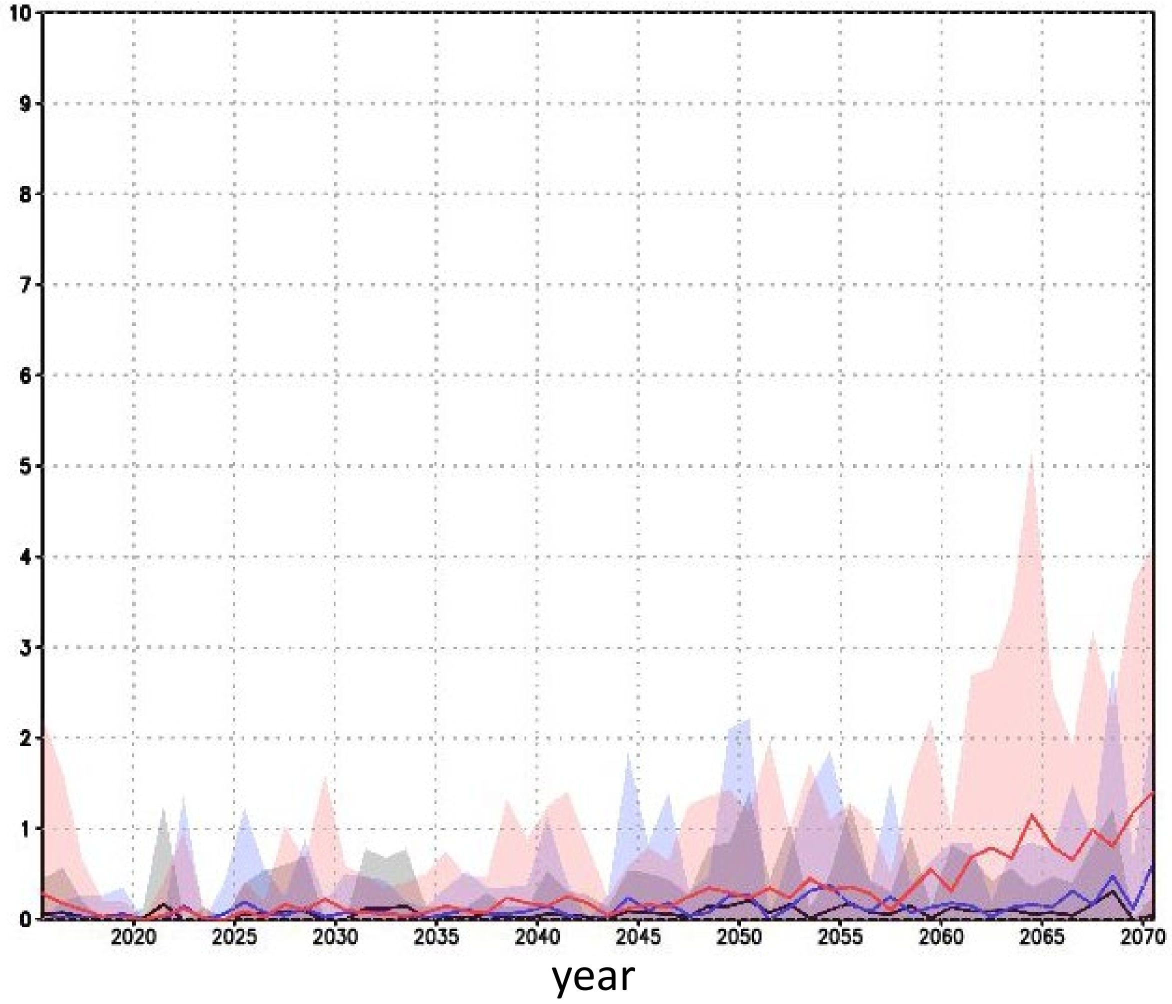
classical climate scientist approach 2: time series for specific points, eg **Rovaniemi**





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impact focussed approach 2: exposure multiplication factors for specific points, eg **Rovaniemi**

exposure definition:
- exposure is the number of events of a specific kind that a person is exposed to during their work life
    - depends on:
        1. the number of years a person works (eg 55 years)
        2. the year a person starts their work life

        eg, we sum up the number of days with daily mean temperature above 25°C from 1960 to 2014
    - this approach creates a time series with an exposure value for each year

exposure multiplication factor
- in order to compare different exposures over time, we define a base exposure, eg a person who started their work life in 1960
- the exposure for all years is then given as a multiplicator of the base exposure, allowing us to say a person starting their professional life in 2020 will have a x times higher exposure to a specific event compared to a person starting their work life in 1960

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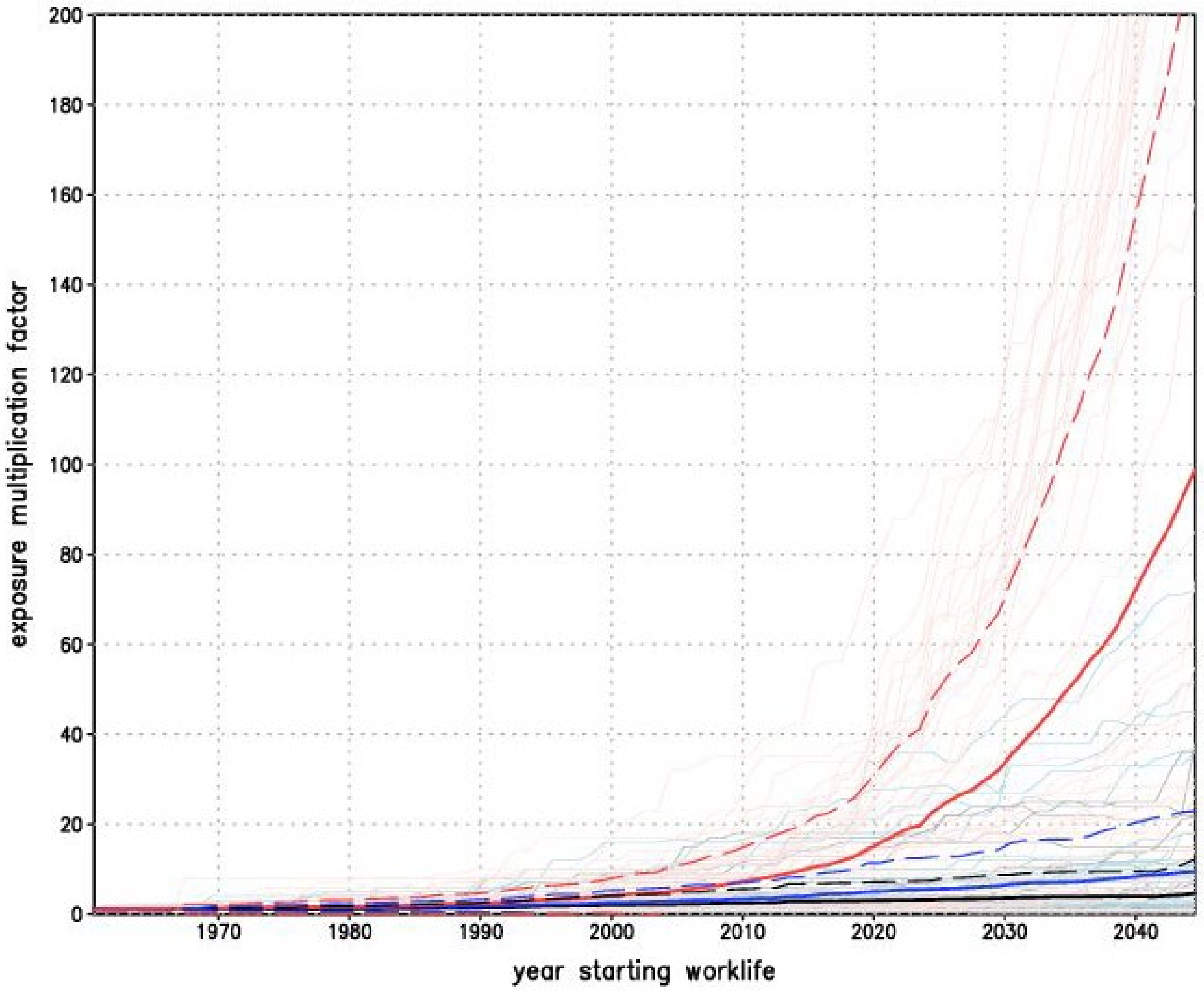

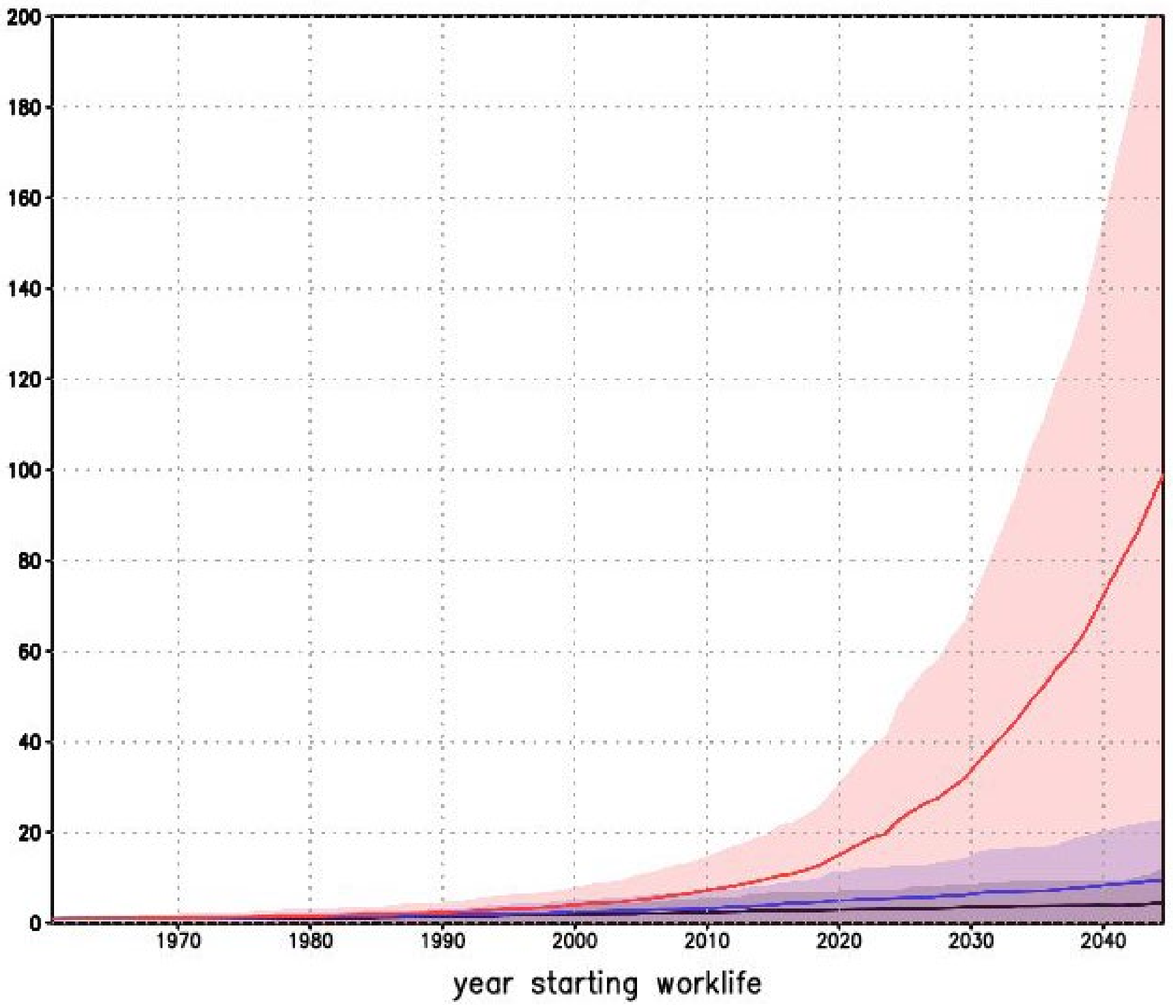

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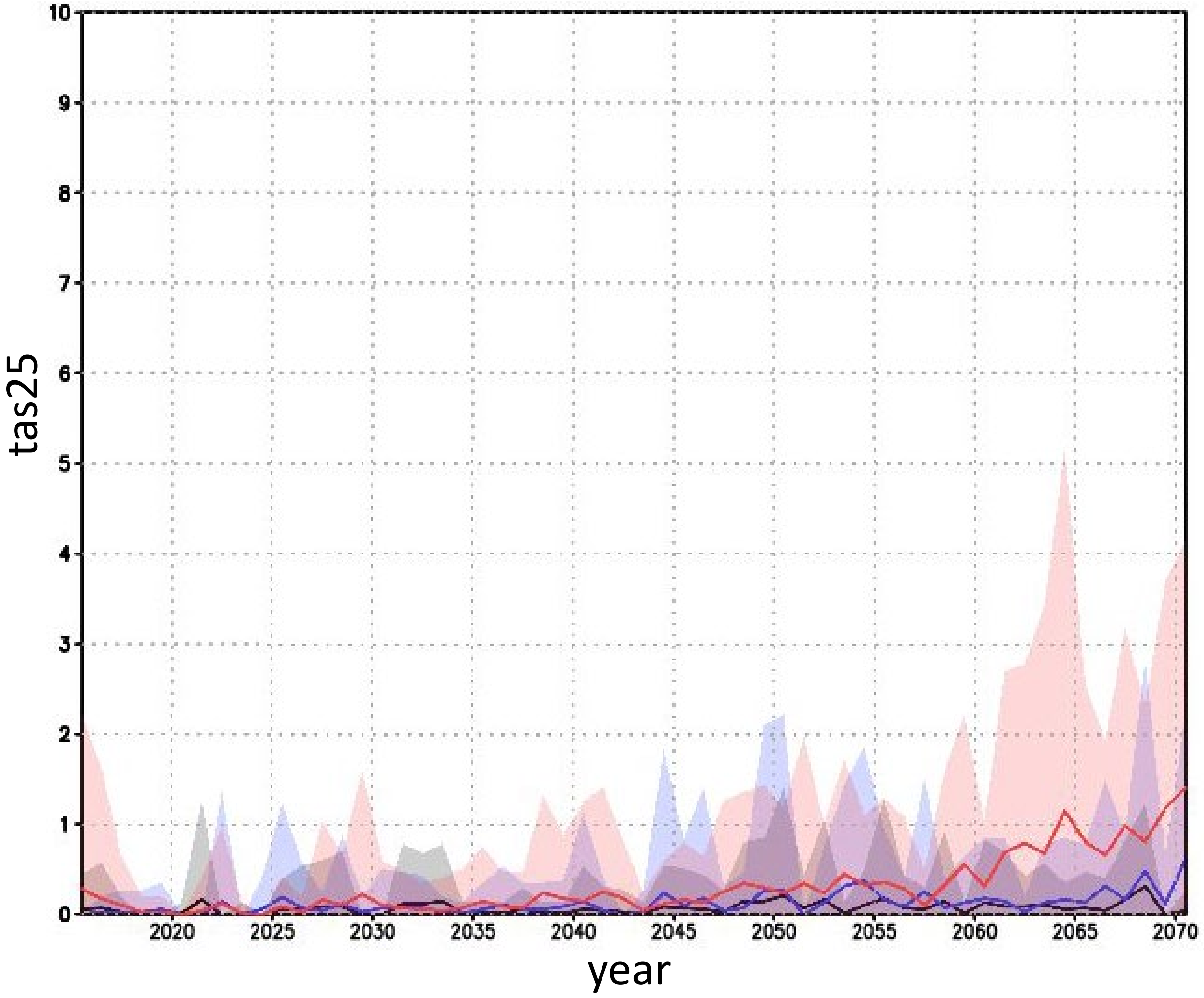

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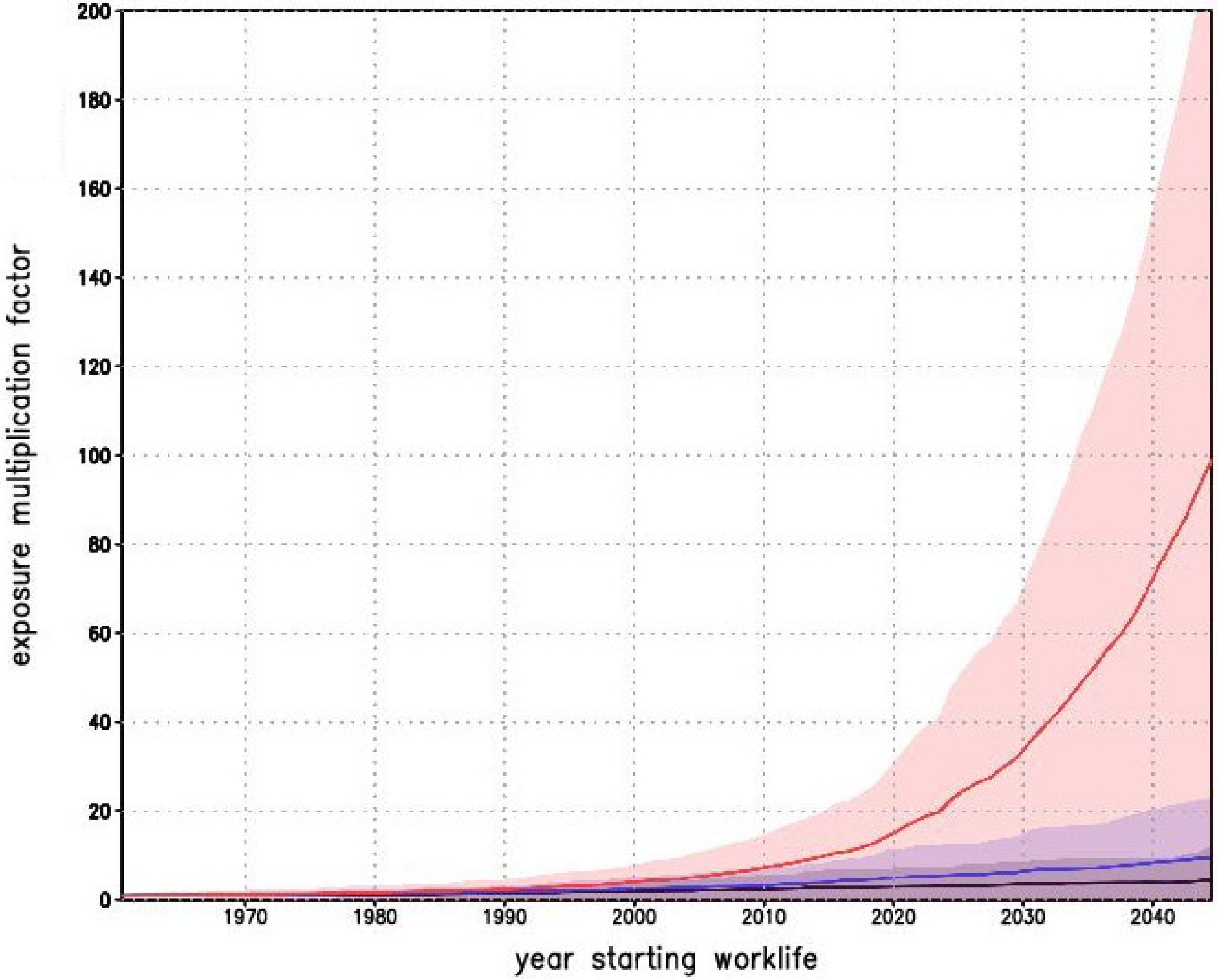

conclusions

- translating criteria into physical variables found in climate model out output
    1. some criteria can be produced from existing CMIP6 model output
    2. for some criteria, proxies can be found
    3. some things might be written by models in the future, if people are made aware that they could be useful
    4. some things are not represented in the models at all

- visualizing the results:
    - ➢ EMF approach was specifically asked for
    - ➢ EMF approach can emphasize changes

- challenge: joint interpretation of criteria eg for one season, are conditions for herding improving or deteriorating

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