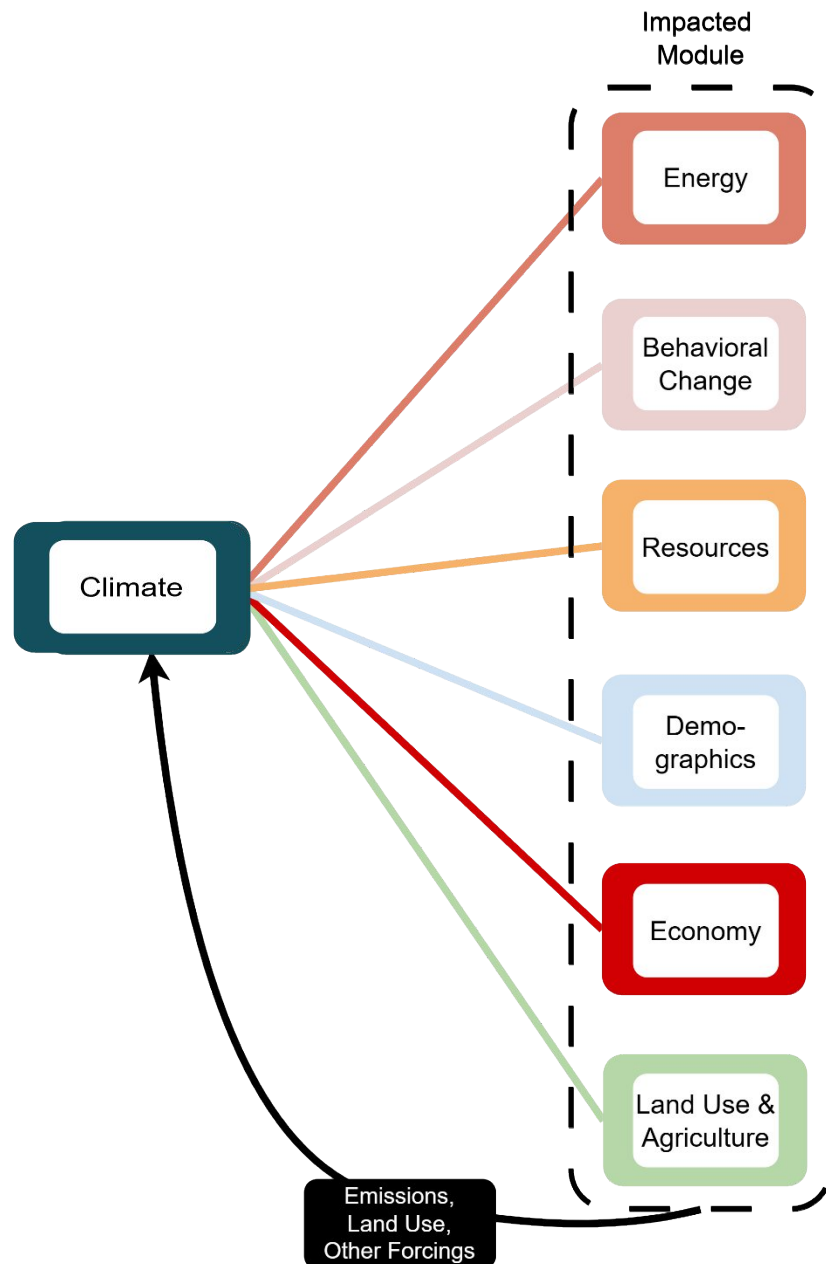


In ting ISIMIP-derived global climate damage functions in the new Integrated Assessment Model

FRIDA

Christopher Wells, Christopher Smith, Benjamin Blanz, Lennart Ramme, Beniamino Callegari, Adakudlu Muralidhar, Jefferson Rajah, Jannes Breier, Axel Eriksson, William A. Schoenberg (+ many others)



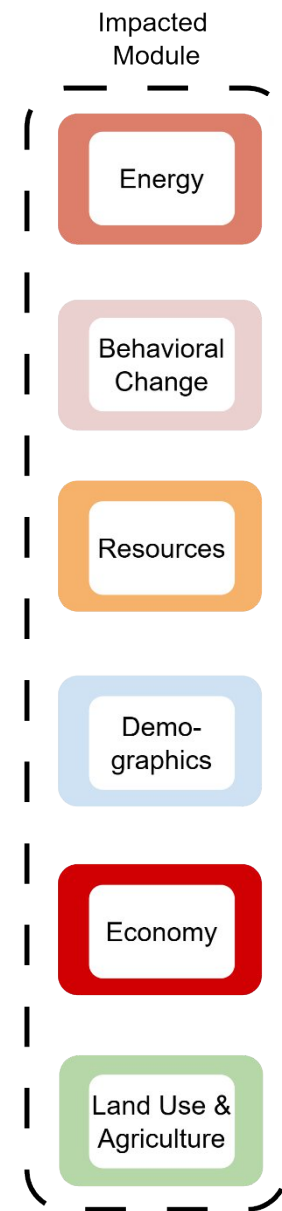
Most IAM work and frameworks generally don't include climate damages.

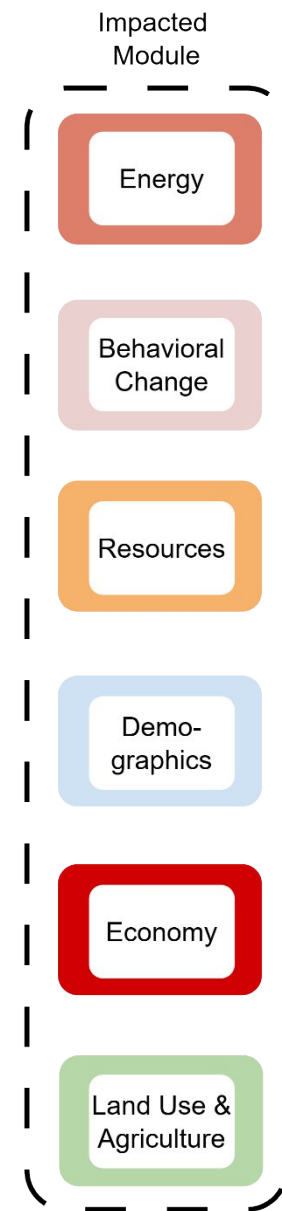
FRIDA v2.1 is a new global IAM based on System Dynamics – emphasising **feedback loops** over process-detail.

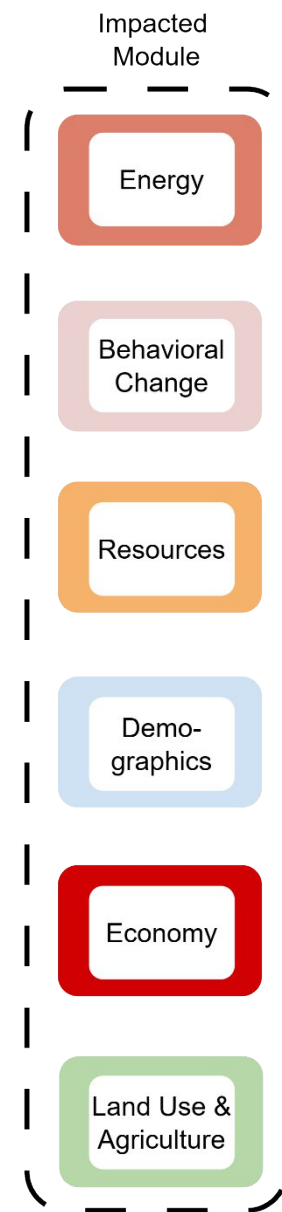
Hence need to **build process-level simplified damage functions**.

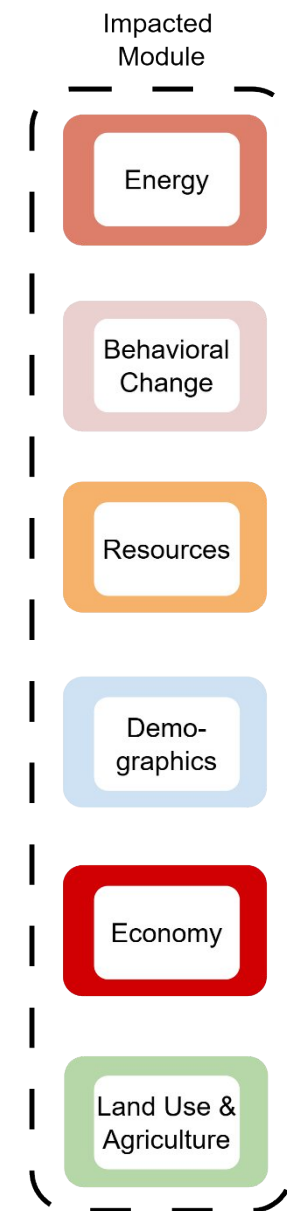
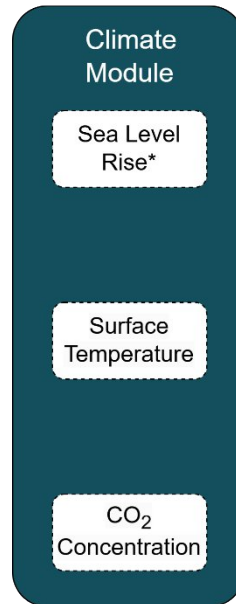
Including climate damages allows us to track cascading impacts through the fully coupled human-Earth system.

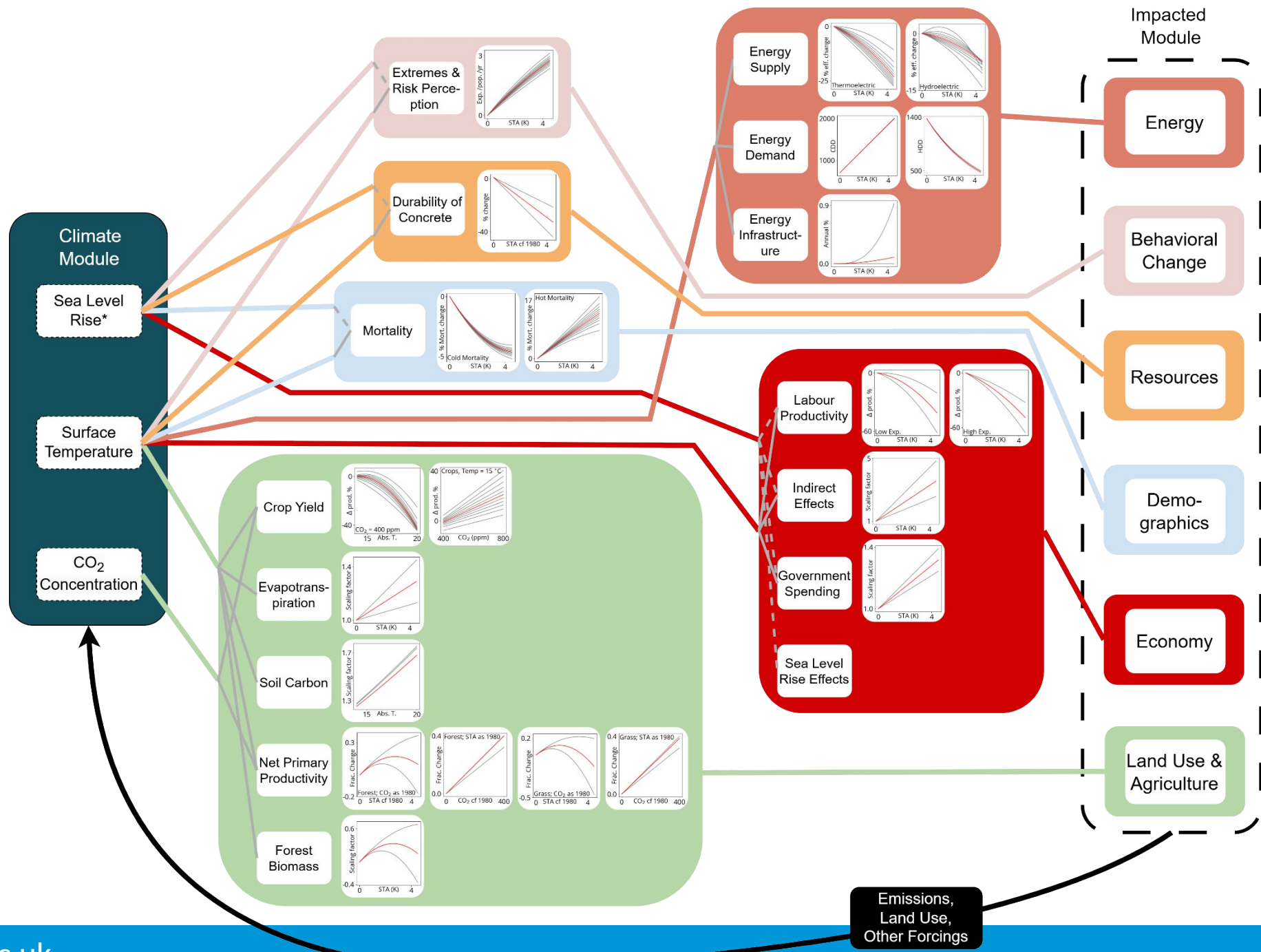
These abstracted damage functions may be useful to others.









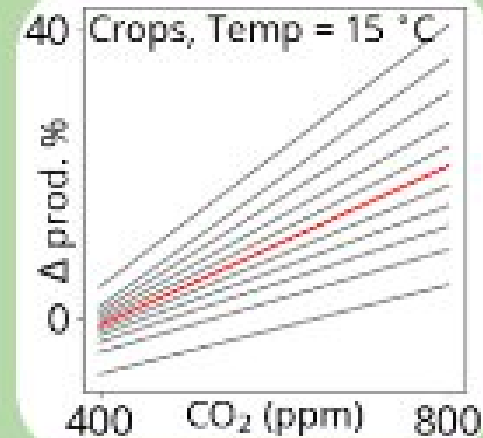
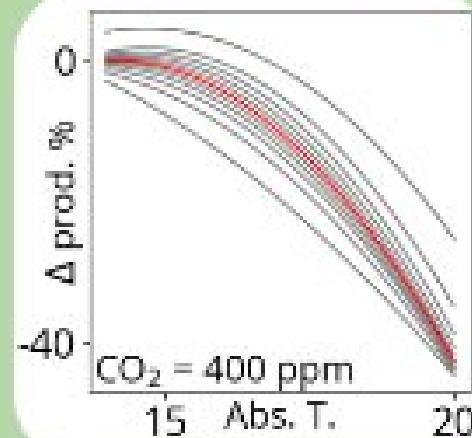


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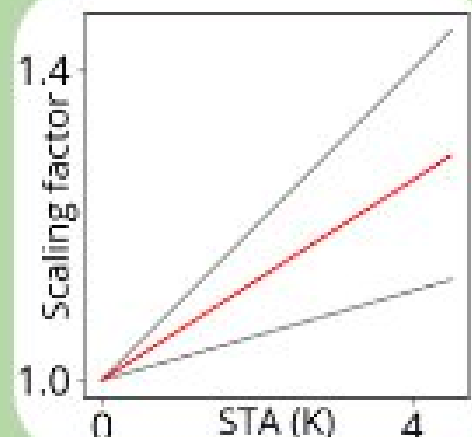
2

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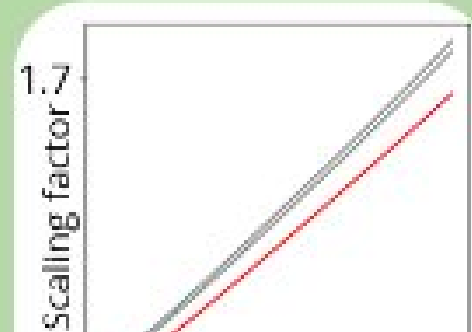
Crop Yield



Evapotranspiration



Soil Carbon



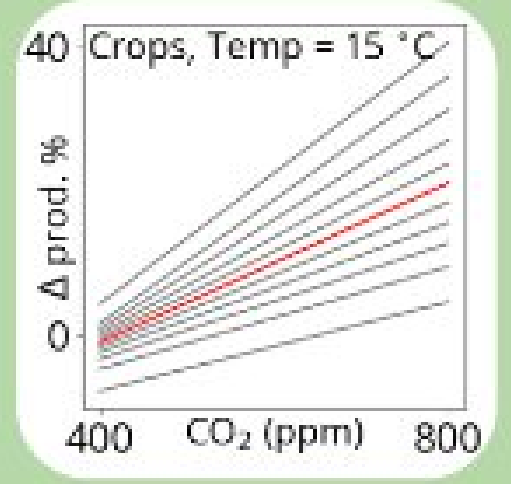
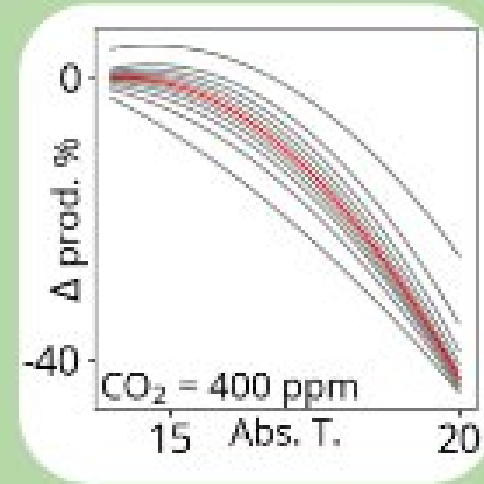
1/3: Crop Yield changes modelled as:

$$\Delta P = a + bC + cT + dT^2$$

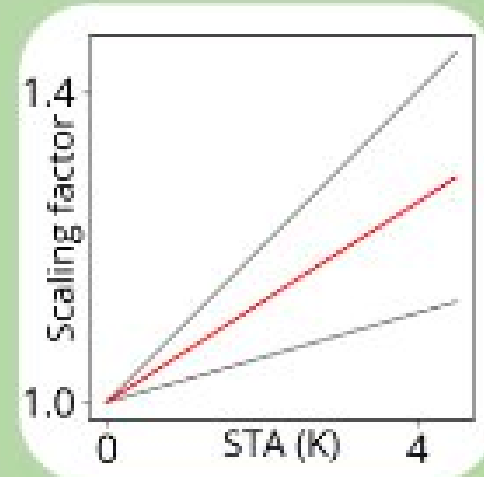
With coefficients – including uncertainty
– calibrated from ISIMIP2b data via
Franke et al. (2020).

Franke et al. (2020): The GGCM Phase 2 emulators:
Global gridded crop model responses to changes in
CO₂, temperature, water, and nitrogen (version
1.0), <https://doi.org/10.5194/gmd-13-3995-2020>

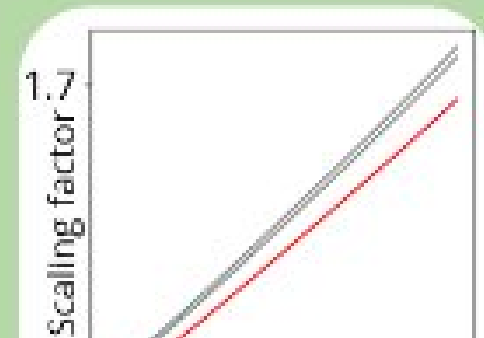
Crop Yield



Evapotranspiration



Soil Carbon



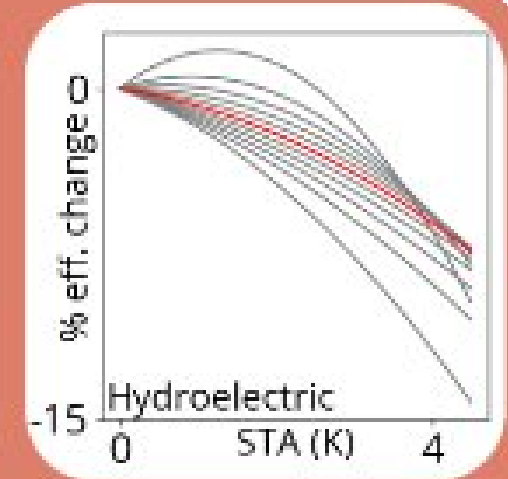
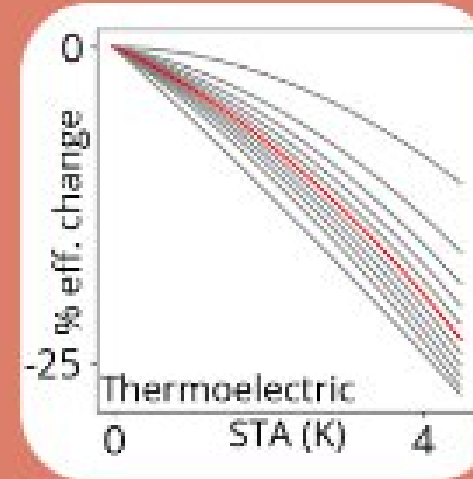
2/3: Energy supply efficiency changes modelled as:

$$\Delta E = aT + bT^2$$

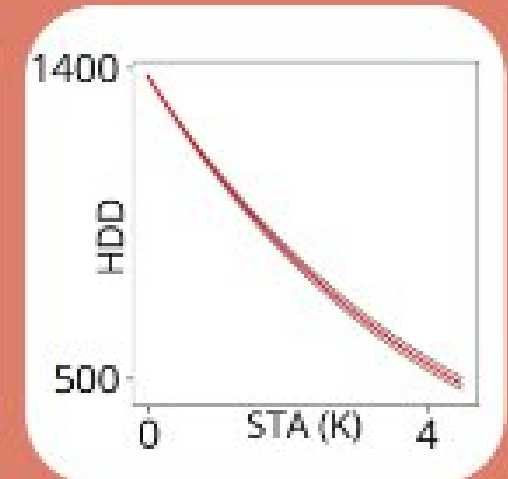
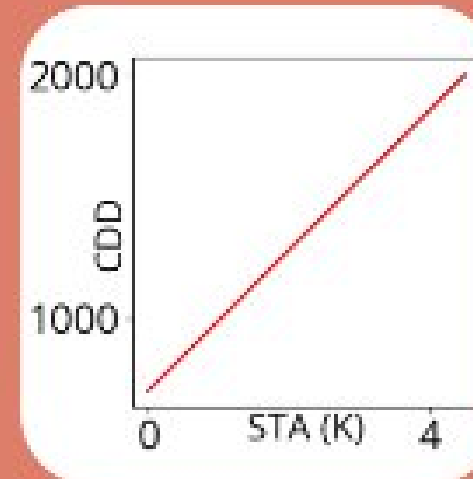
With coefficients – including uncertainty – calibrated from ISIMIP FastTrack climate data-driven data from van Vliet et al. (2016).

van Vliet et al. (2016): Power-generation system vulnerability and adaptation to changes in climate and water resources,
<https://doi.org/10.1038/nclimate2903>

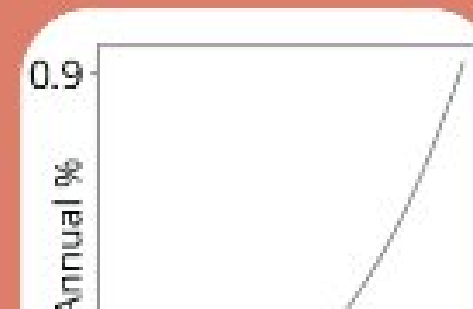
Energy Supply



Energy Demand



Energy Infrastruct-

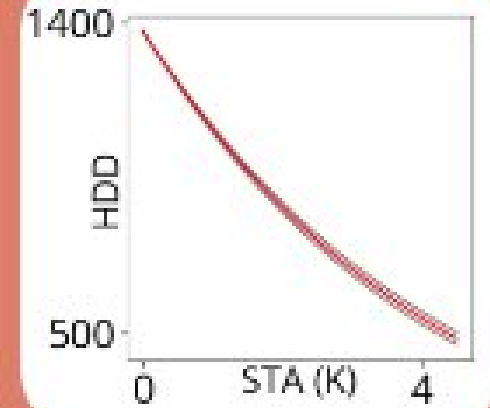
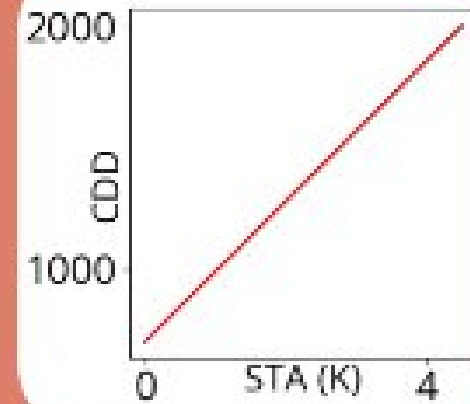


3/3: Energy demand; population-weighted Cooling and Heating Degree Days changes modelled as Linear (CDD) and Exponential decay (HDD).

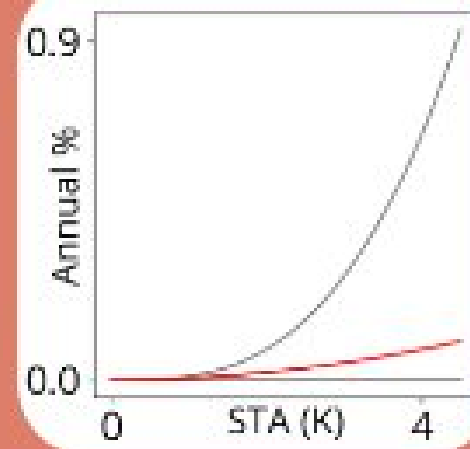
With coefficients calibrated from ISIMIP 3b climate data as processed by Werning et al. (2024). Note other studies used for downstream energy demand effects.

Werning et al. (2024): Global warming level indicators of climate change and hotspots of exposure, *Environmental Research: Climate*, 3, 045015, <https://doi.org/10.1088/2752-5295/ad8300>, 2024.

Energy Demand



Energy Infrastructure



Conclusions and considerations:

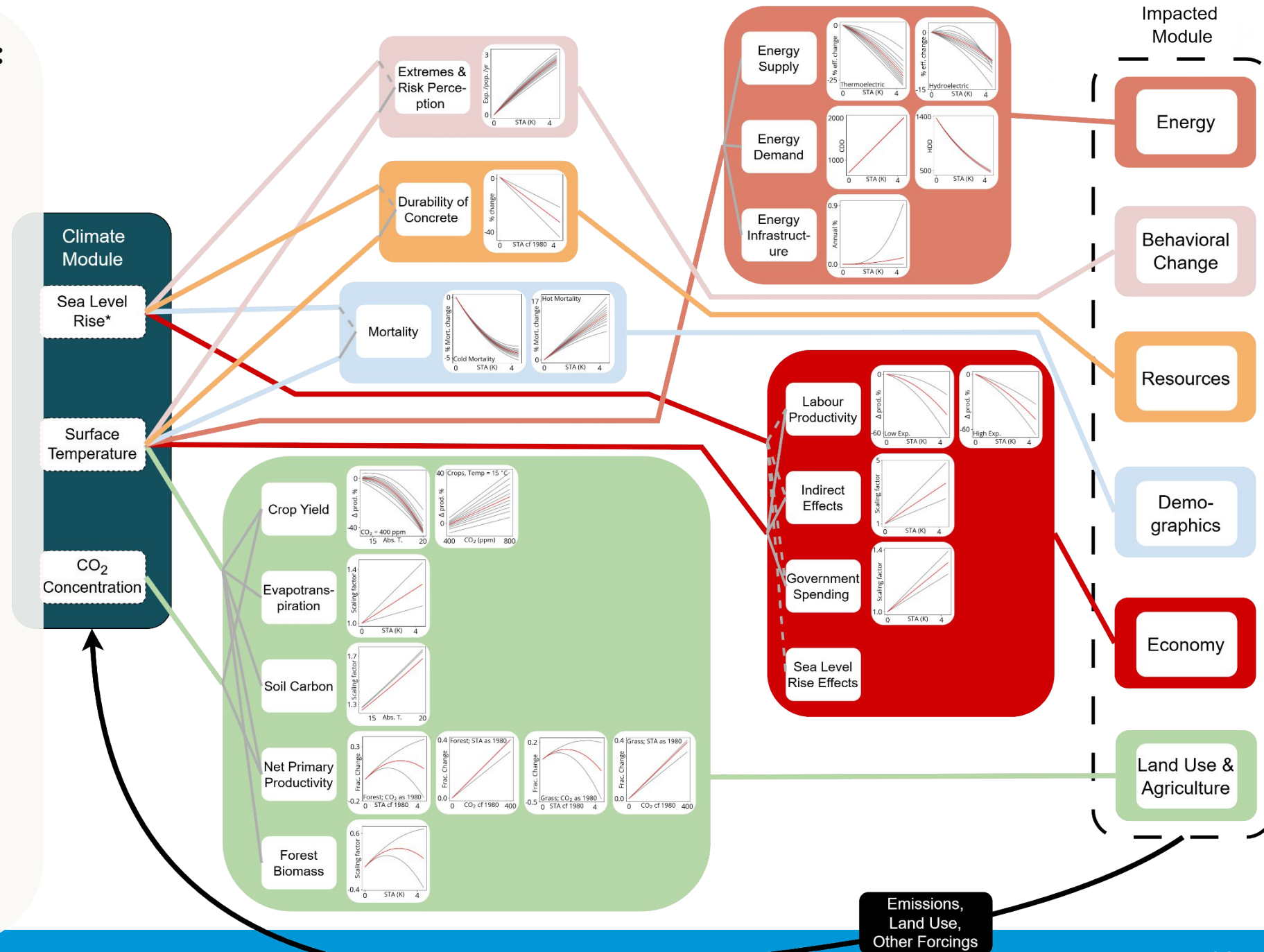
3 climate impact channels in FRIDA are contributed to by ISIMIP data.

Only 1 uses ISIMIP output data; the others use studies which used the bias-corrected ISIMIP climate data.

Many studies used for the other impact channels still use non-bias corrected climate data.

Adaptation (to crop changes) modelled separately, in an idealised way.

Can we use ISIMIP data better and in more ways? (Fire, Fisheries...)



Emissions,
Land Use,
Other Forcings

Conclusions and considerations:

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