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Climate-economy feedbacks, temperature variability, and the social cost of carbon

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* The views expressed in this presentation do not necessarily reflect the views of NERA Economic Consulting.

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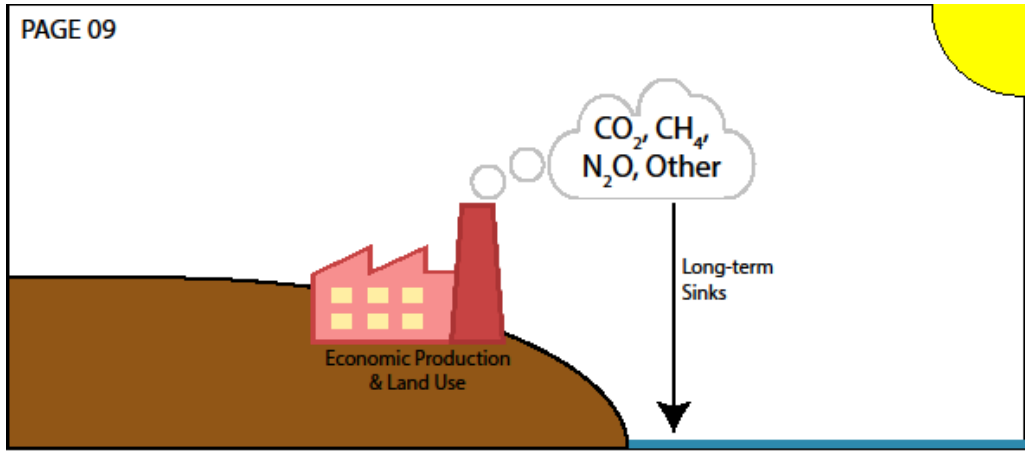
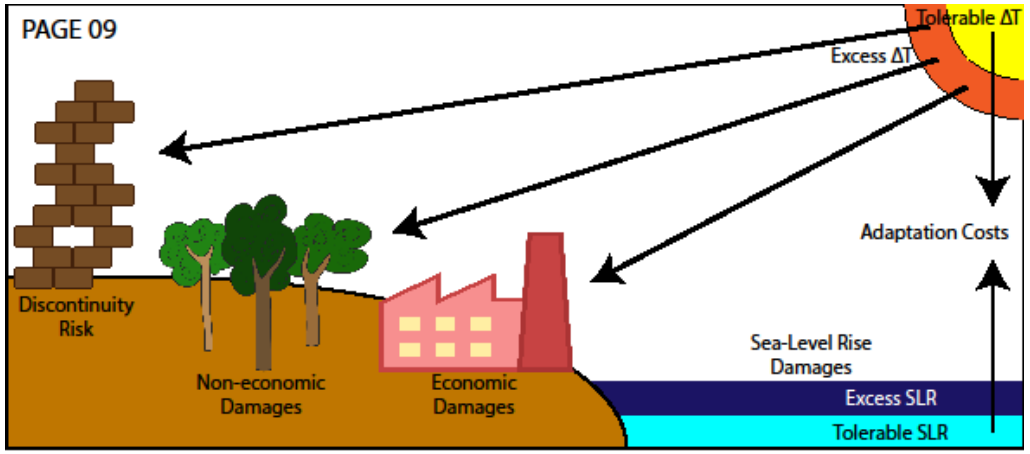
Study setup


PAGE 09
CO_2, CH_4, N_2O, Other
Long-term Sinks
Economic Production & Land Use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Tolerable ΔT
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Adaptation Costs
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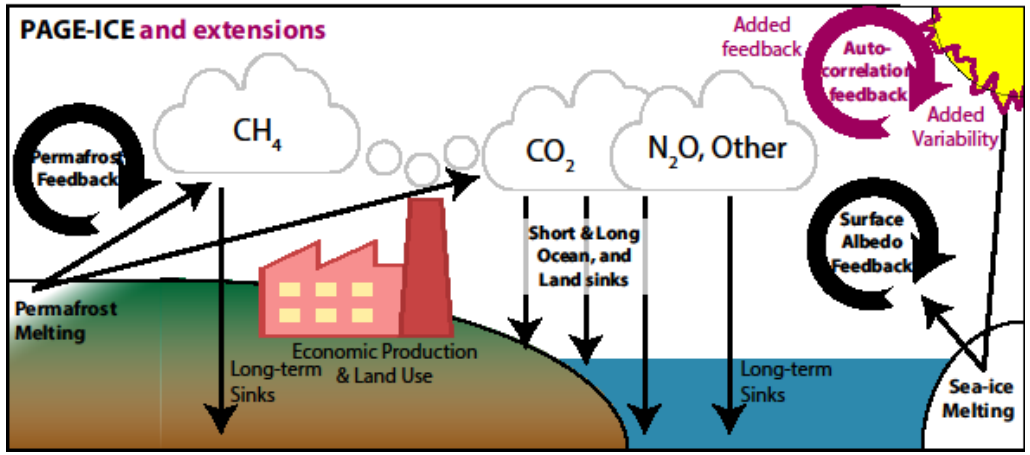
Non-economic Damages
Economic Damages
Sea-Level Rise Damages
Excess SLR
Tolerable SLR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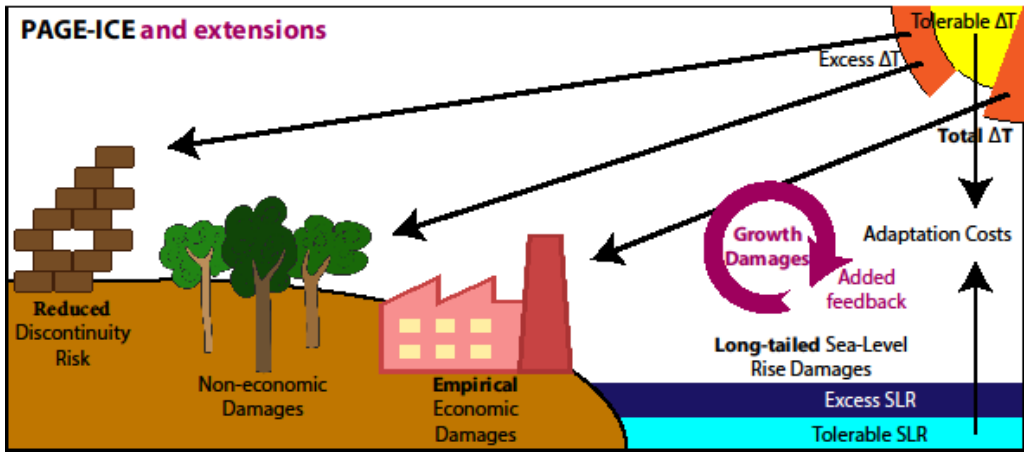
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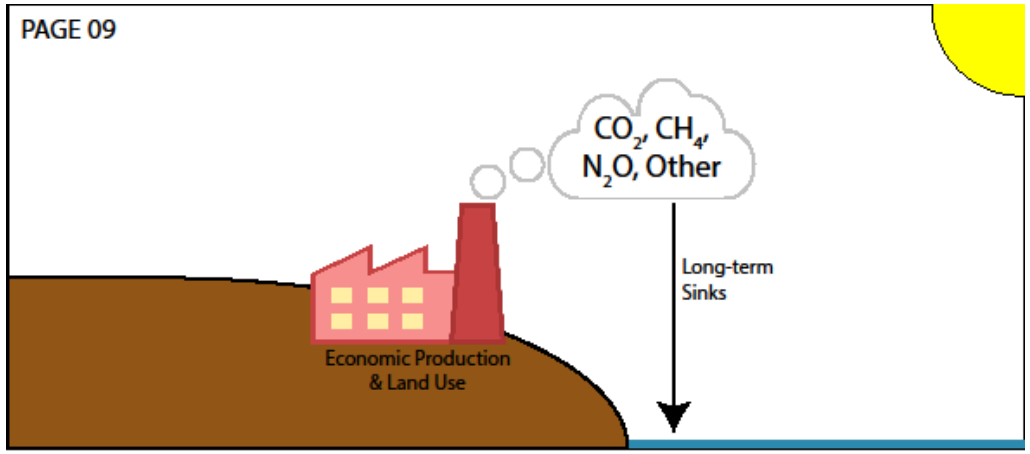
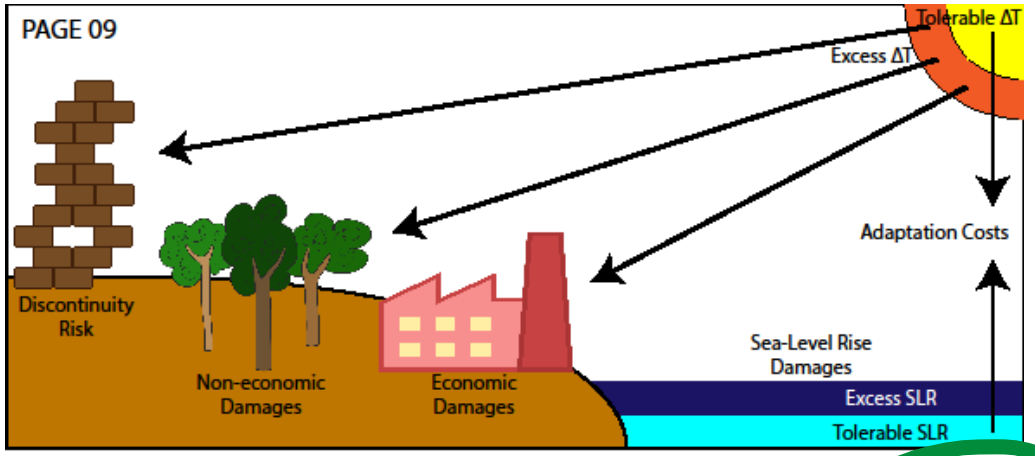
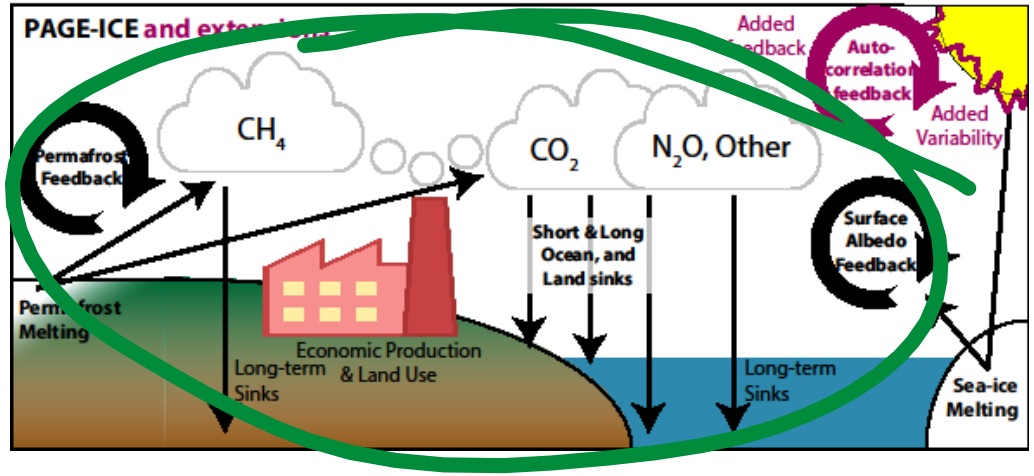
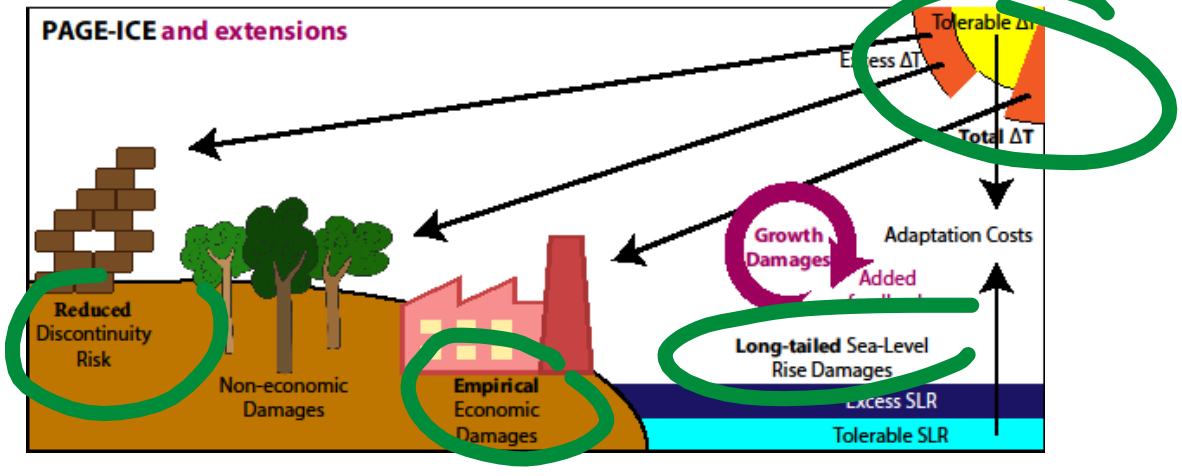
Alterations in PAGE-ICE





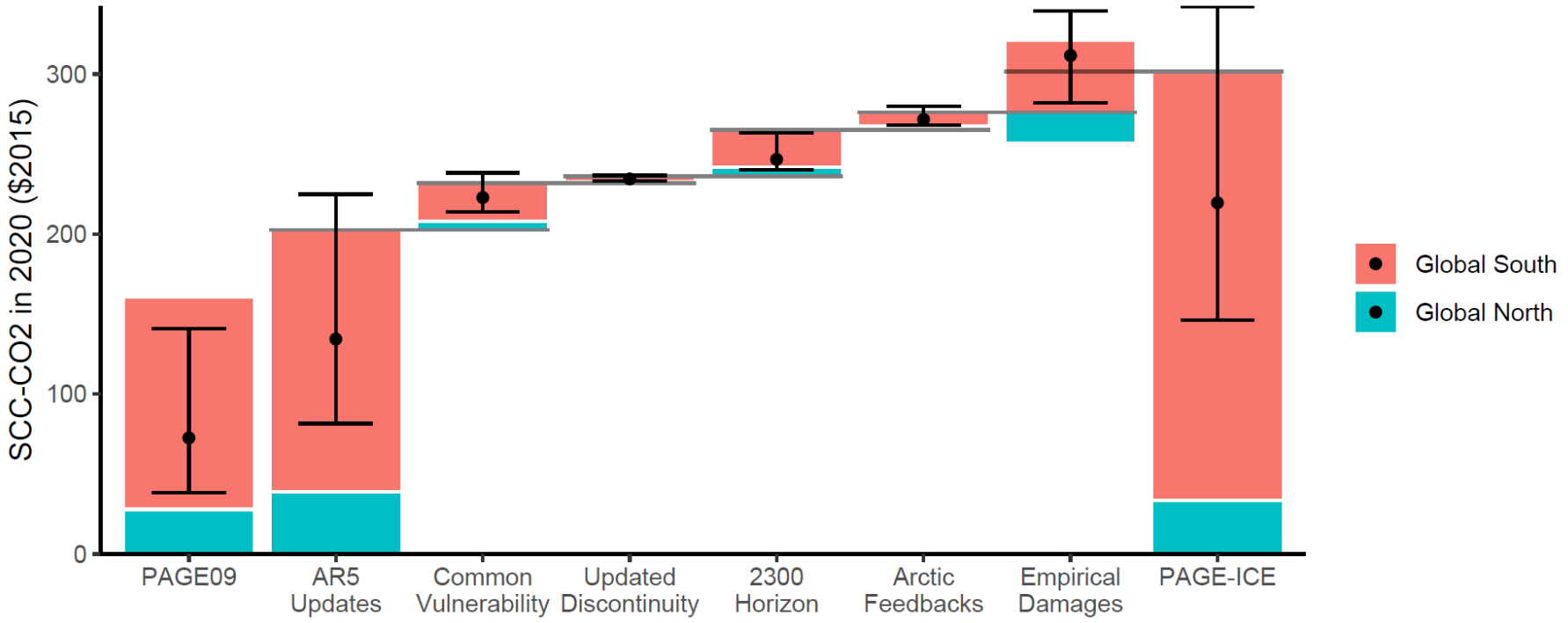




Hope, C. (2013). Critical issues for the calculation of the social cost of CO2: why the estimates from PAGE09 are higher than those from PAGE2002. *Climatic Change*, *117*(3), 531–543. https://doi.org/10.1007/s10584-012-0633-z

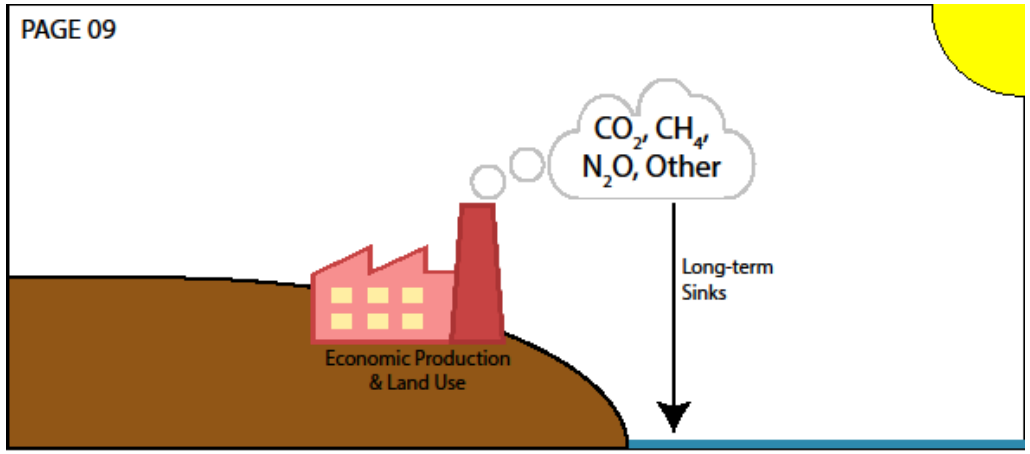
Yumashev, D., Hope, C., Schaefer, K., Riemann-Campe, K., Iglesias-Suarez, F., Jafarov, E., … Whiteman, G. (2019). Climate policy implications of nonlinear decline of Arctic land permafrost and other cryosphere elements. *Nature Communications*, *10*(1), 1900. https://doi.org/10.1038/s41467-019-09863-x

Updating the social cost of carbon for amongst others AR5, SAF, PCF, and empirical damages (SSP2-4.5)



- Arctic feedbacks are not a large contributor to the SCC compared to other socioeconomic updates
- Increases in damages in the Global South make up for almost the entire increase in the SCC

Study setup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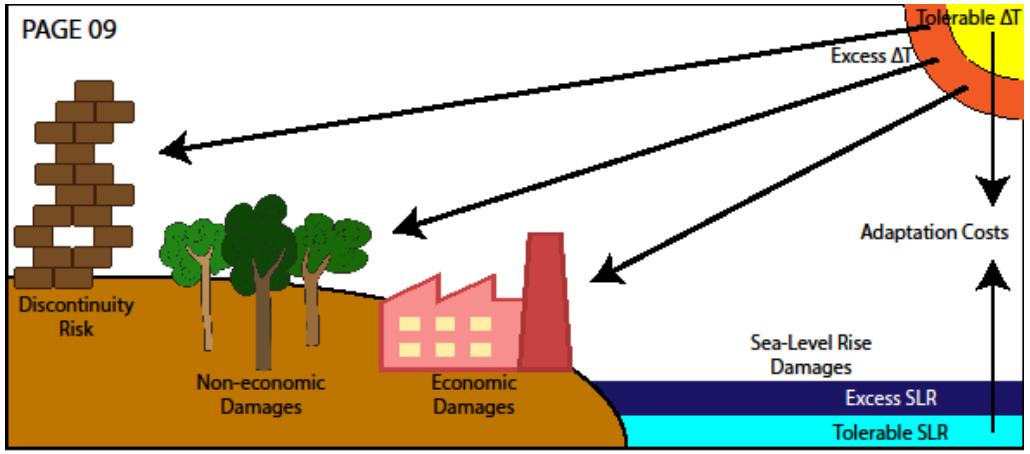
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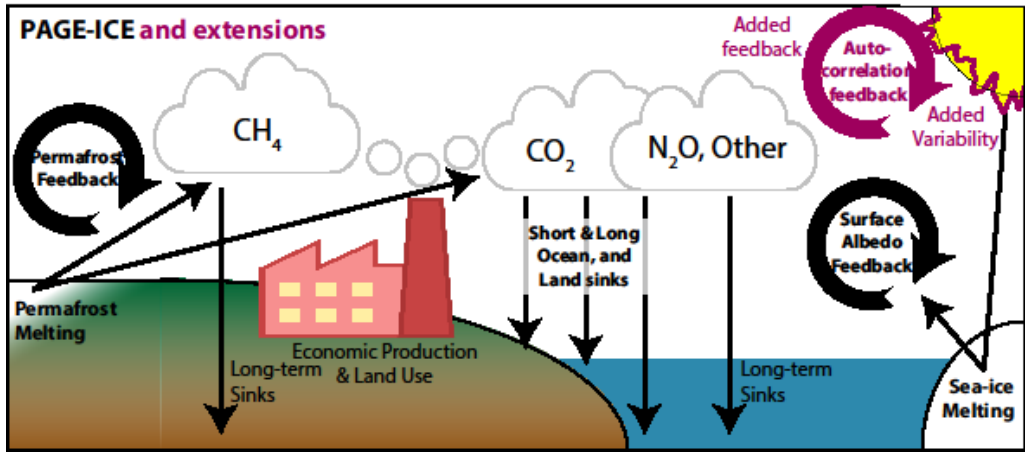
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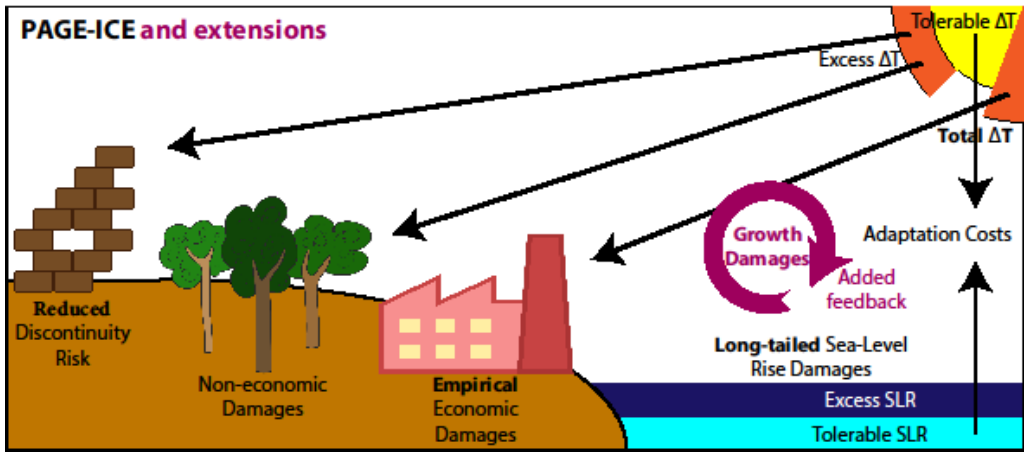
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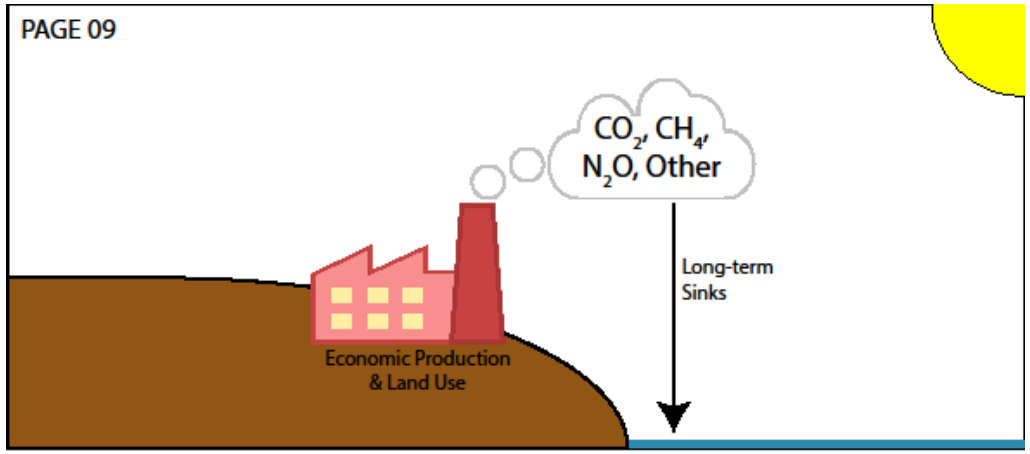
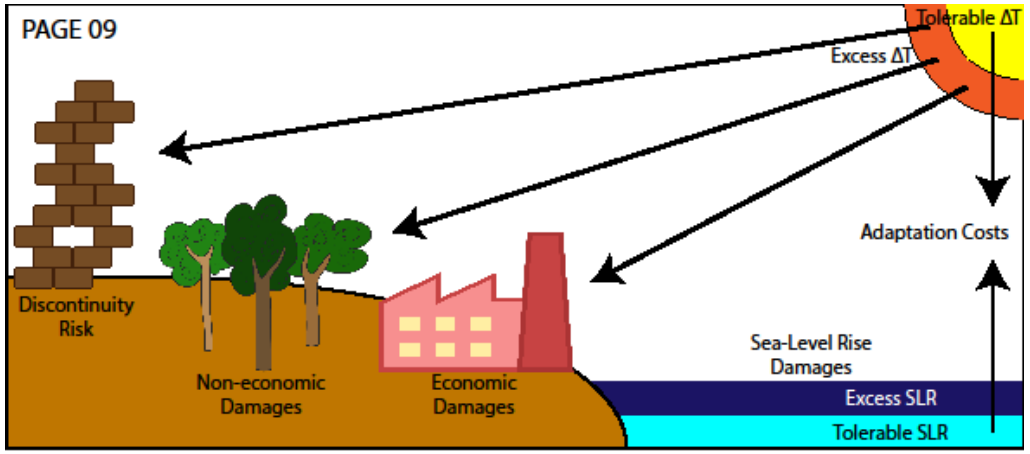
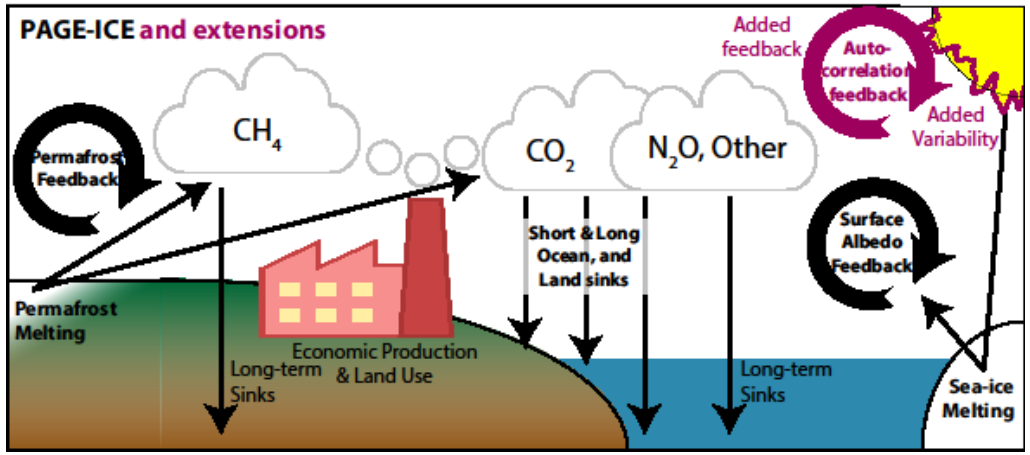
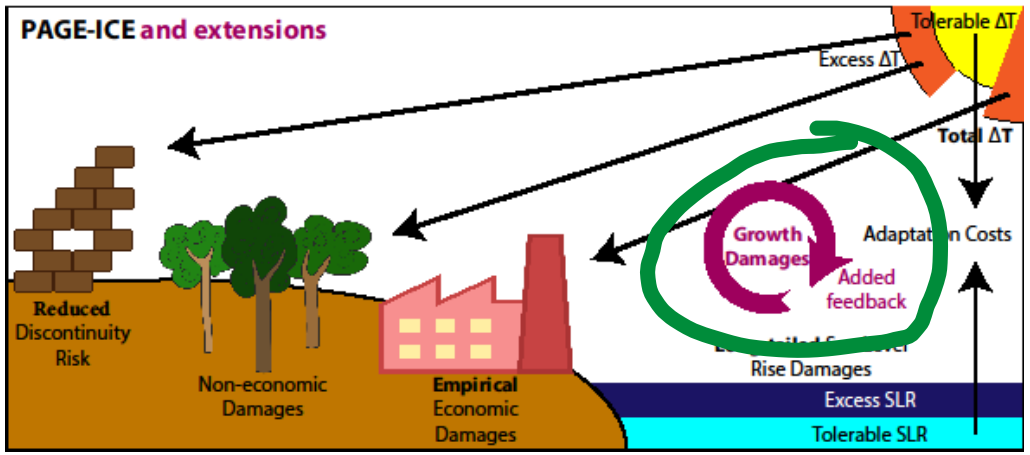
Excess SLR
Tolerable SLR

Introducing the possibility of persistent damages









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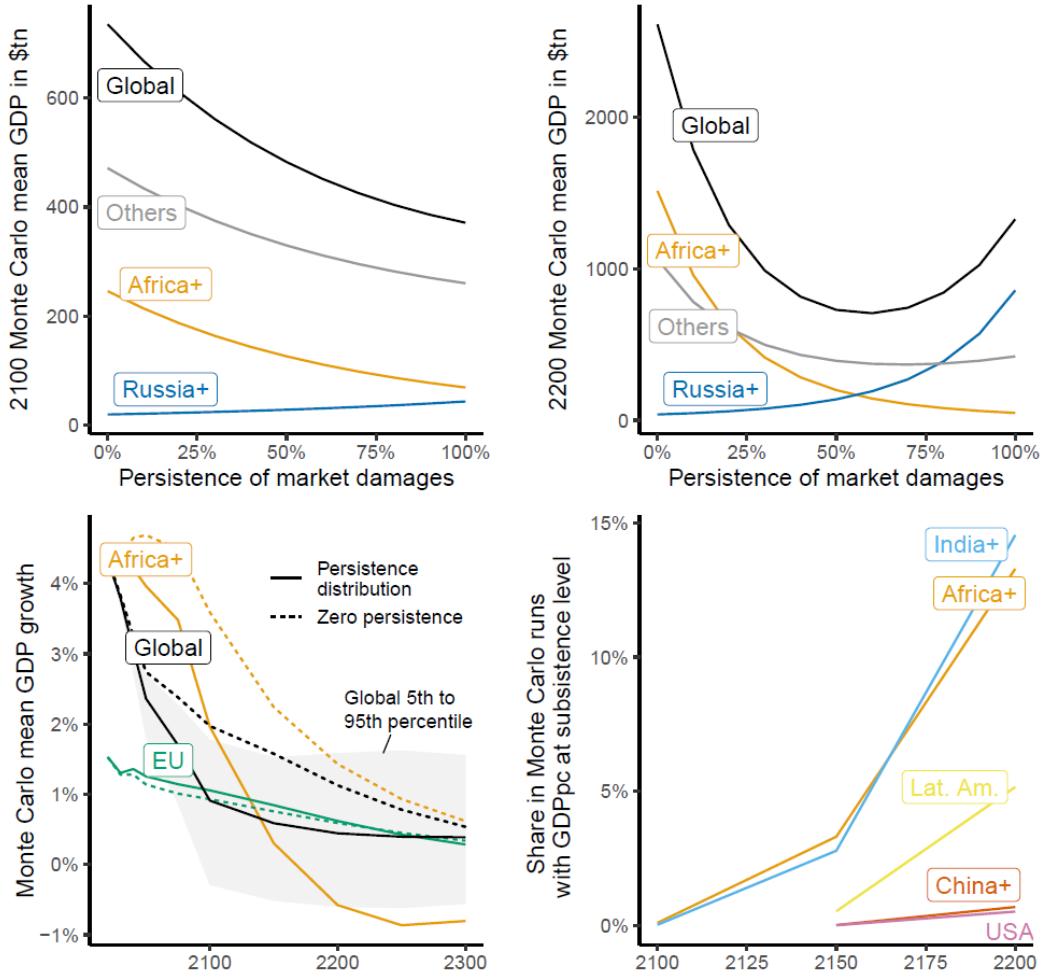
Growth effects (SSP2-4.5) – adjusted GDP pathways



- GDP pathways are strongly moderated with increased levels of damage persistence
- Growth effects are regionally heterogeneous
- From 2100 on, a share of the model runs sees global GDP contraction
- In 2150, South Asia, Africa and the Middle East, and Latin America hit mean GDP/cap levels that are equal to absolute poverty levels for a considerable share of model runs.

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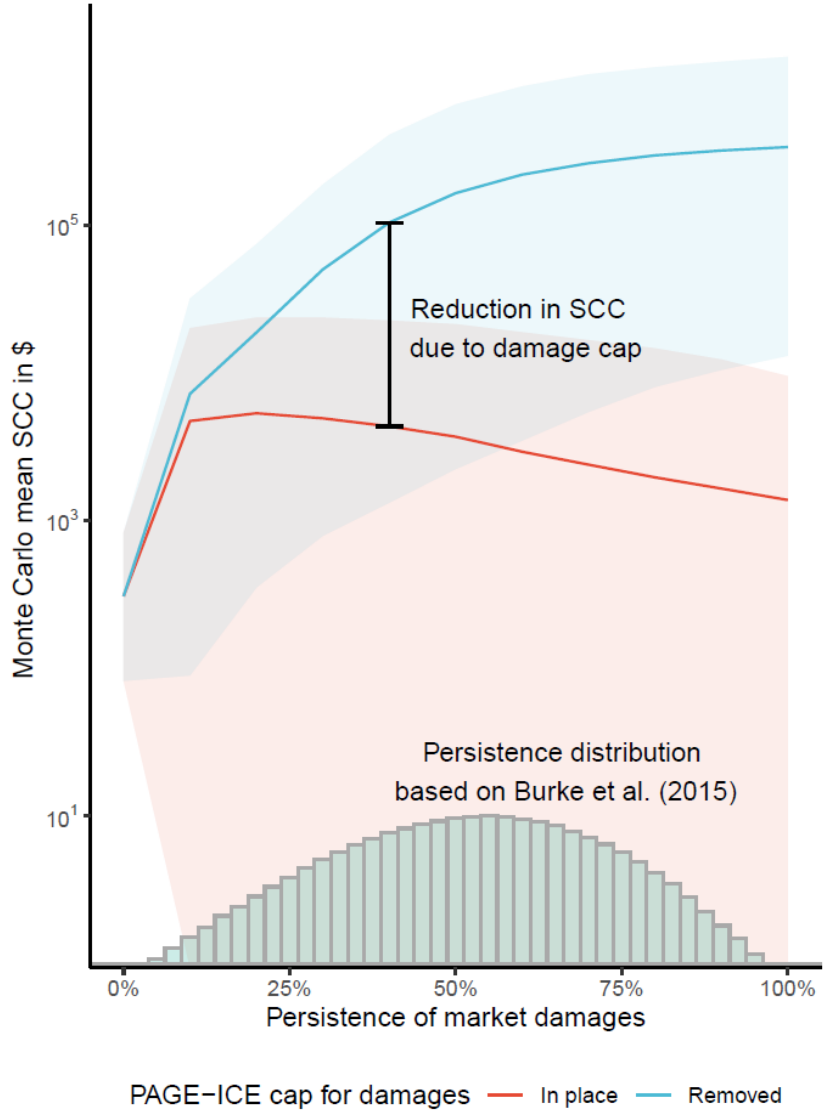
Growth effects (SSP2-4.5) – effect on the SCC



- With one lag, the implied damage persistence equals 52.8% of the immediate impact.
- Even if a minor share (10%) of damages persist in the next year, the SCC increases 15x.
- For higher levels of persistence, an increasing share of model runs produce an SCC of zero as damages before the CO2 pulse already reach PAGE-ICE's cap on total damages ("statistical value of civilization")
- Growth effects, or damage persistence, deserves as much discussion in the SCC debate as discounting and climate sensitivity

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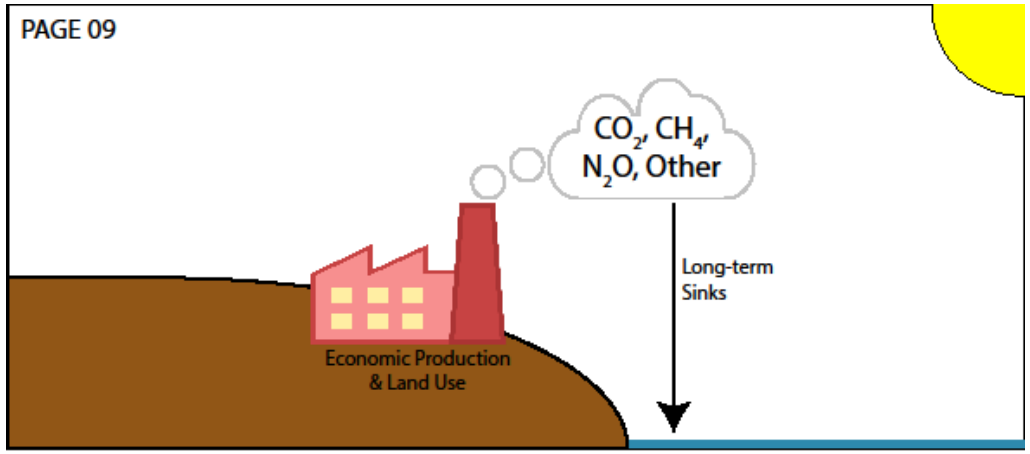
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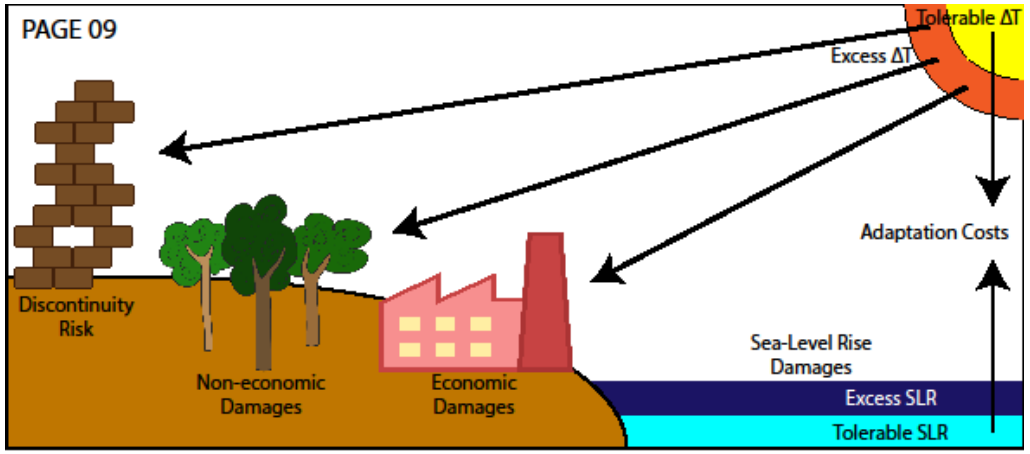
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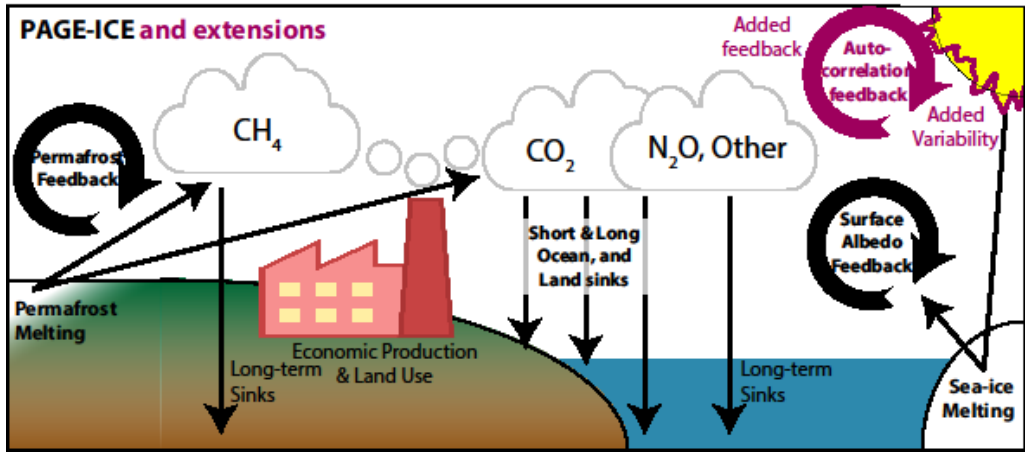
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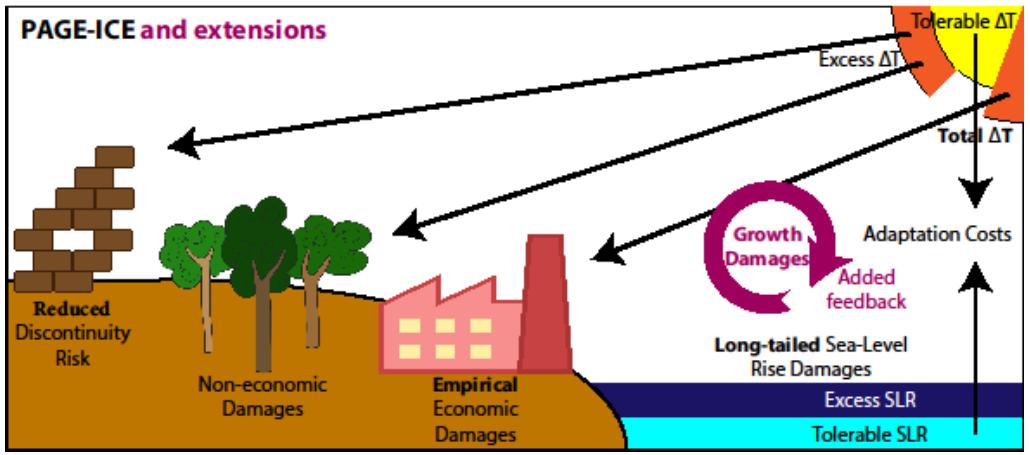
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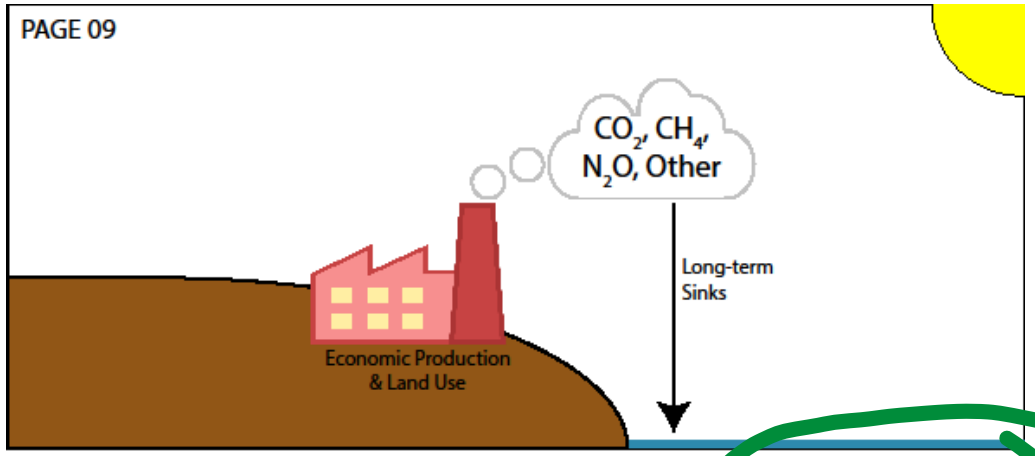
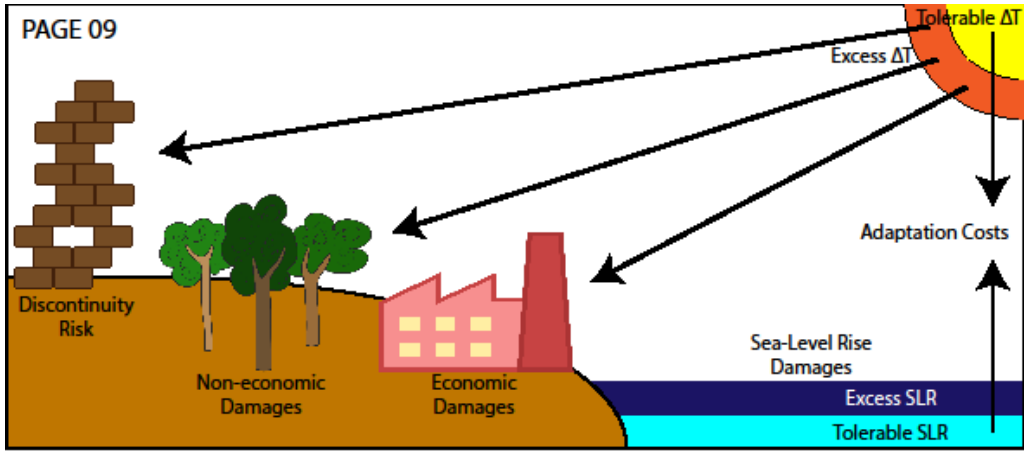
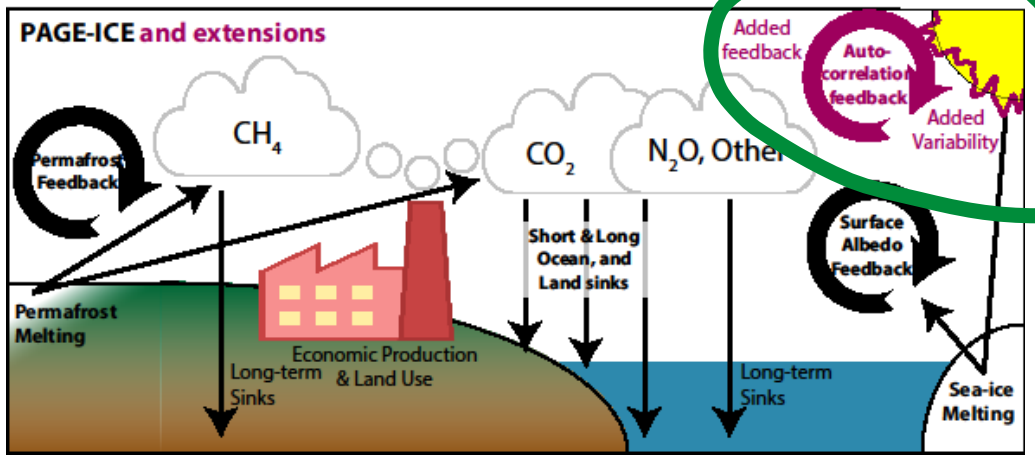
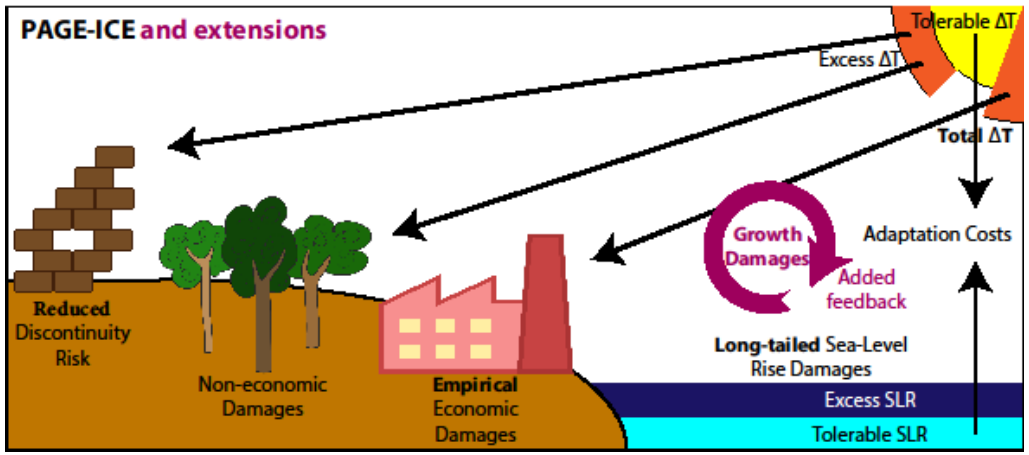
Introducing climate variability









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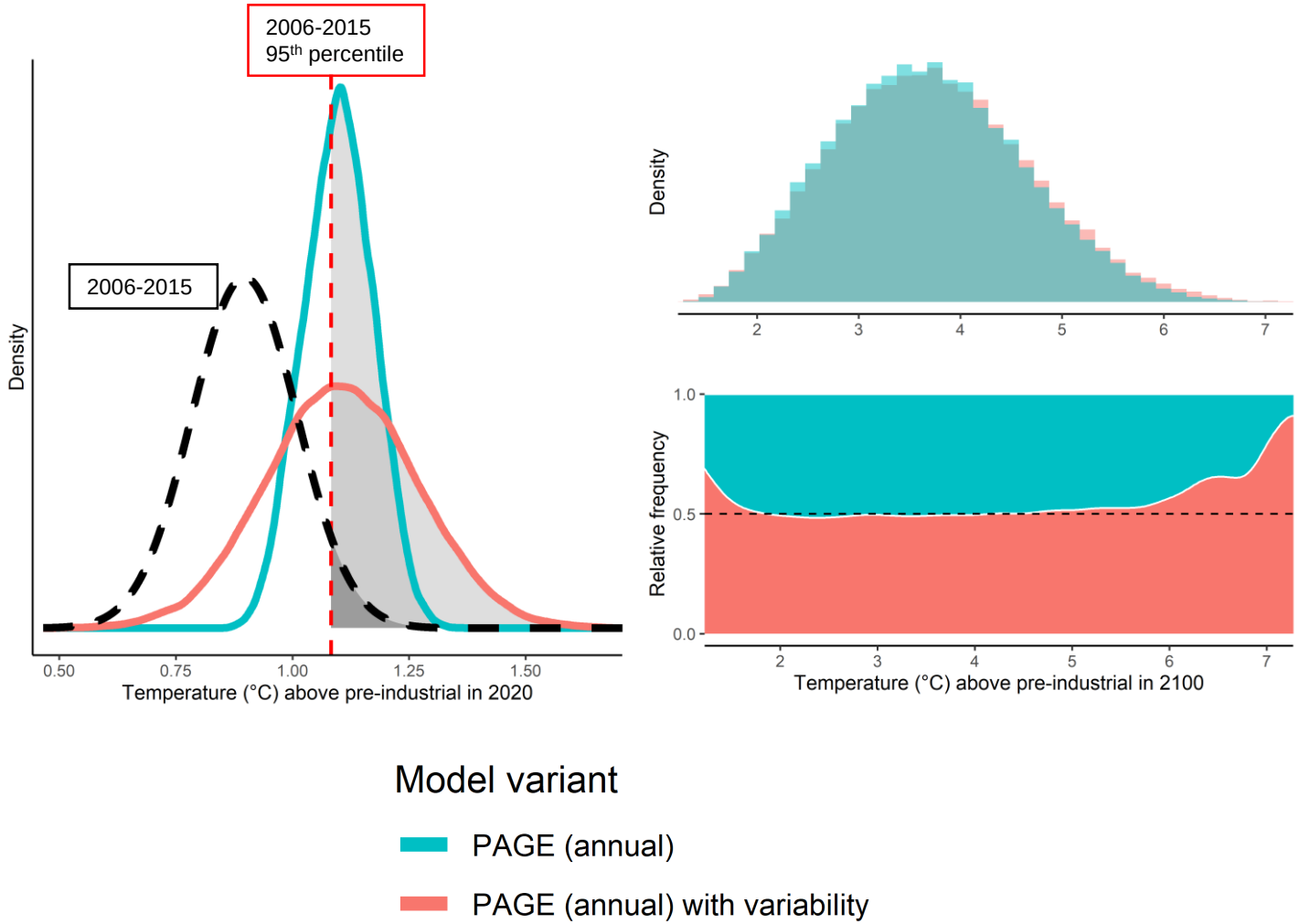
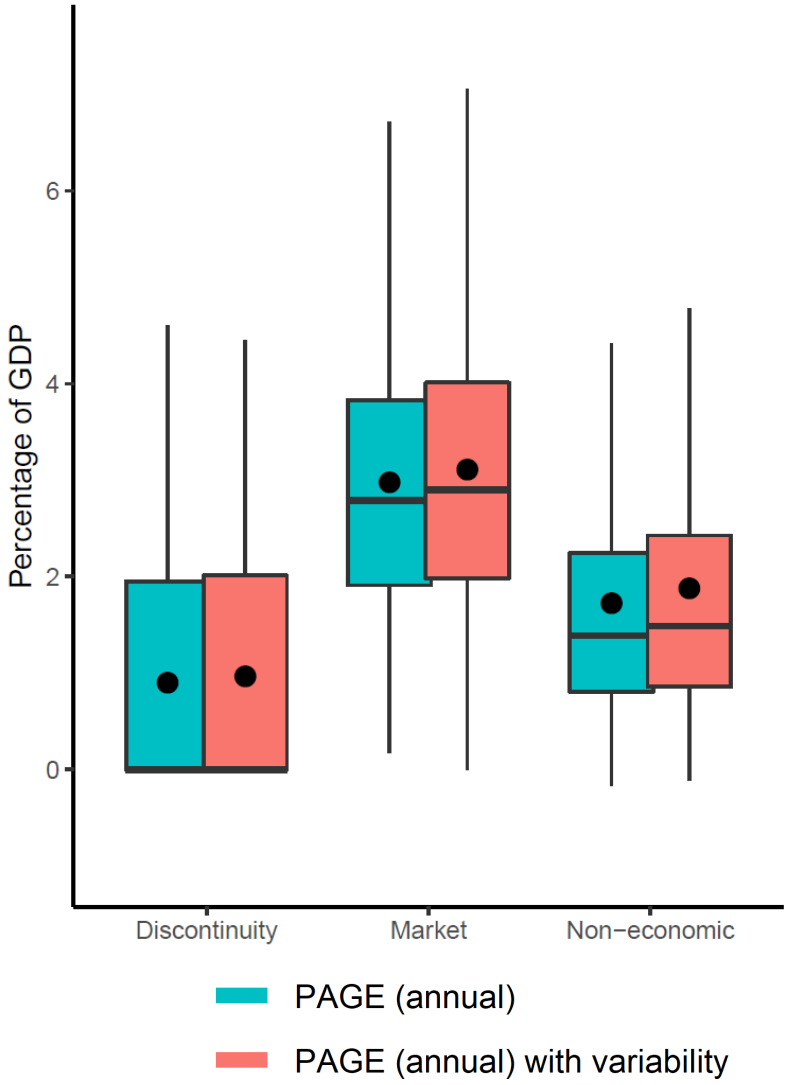
Temperature anomalies (SSP2-4.5)

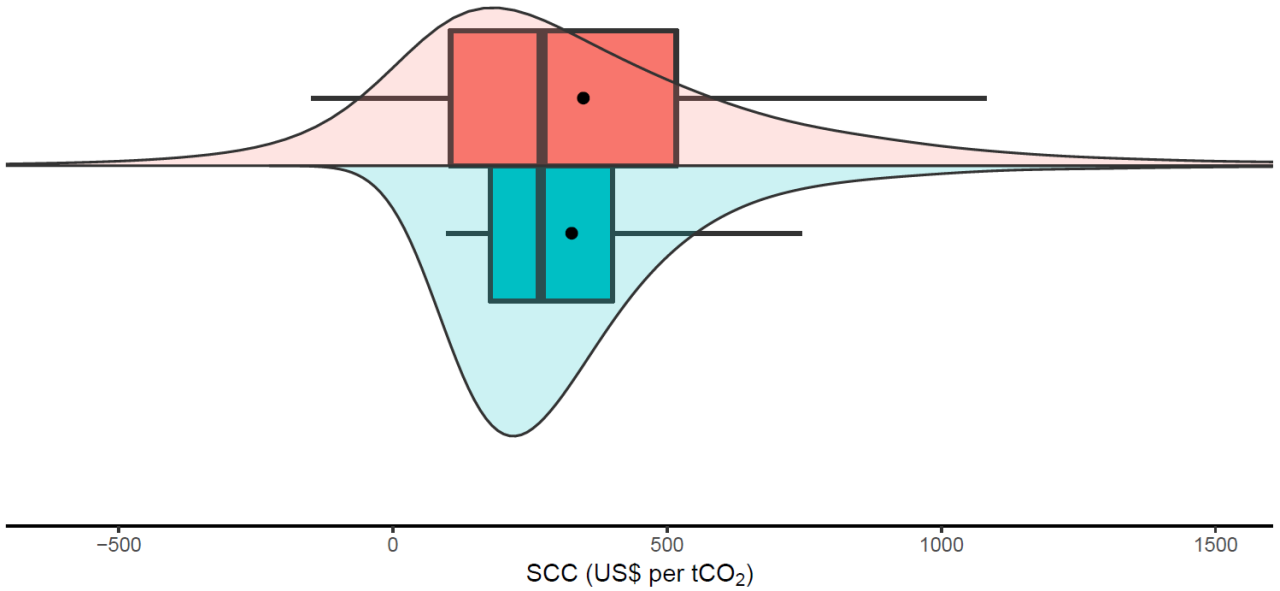


- Including temperature anomalies leads to a more realistic representation of possible temperature realisations
- This includes higher relative frequency of extreme mean annual temperatures throughout the modelling period.

Temperature anomalies (SSP2-4.5) – economic damages



- Previous estimates underestimated climate impacts by not including temperature variability
- Temperature anomalies interact with other uncertain parameters and change the resulting SCC distribution significantly



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Thank you for your time.

Any questions?

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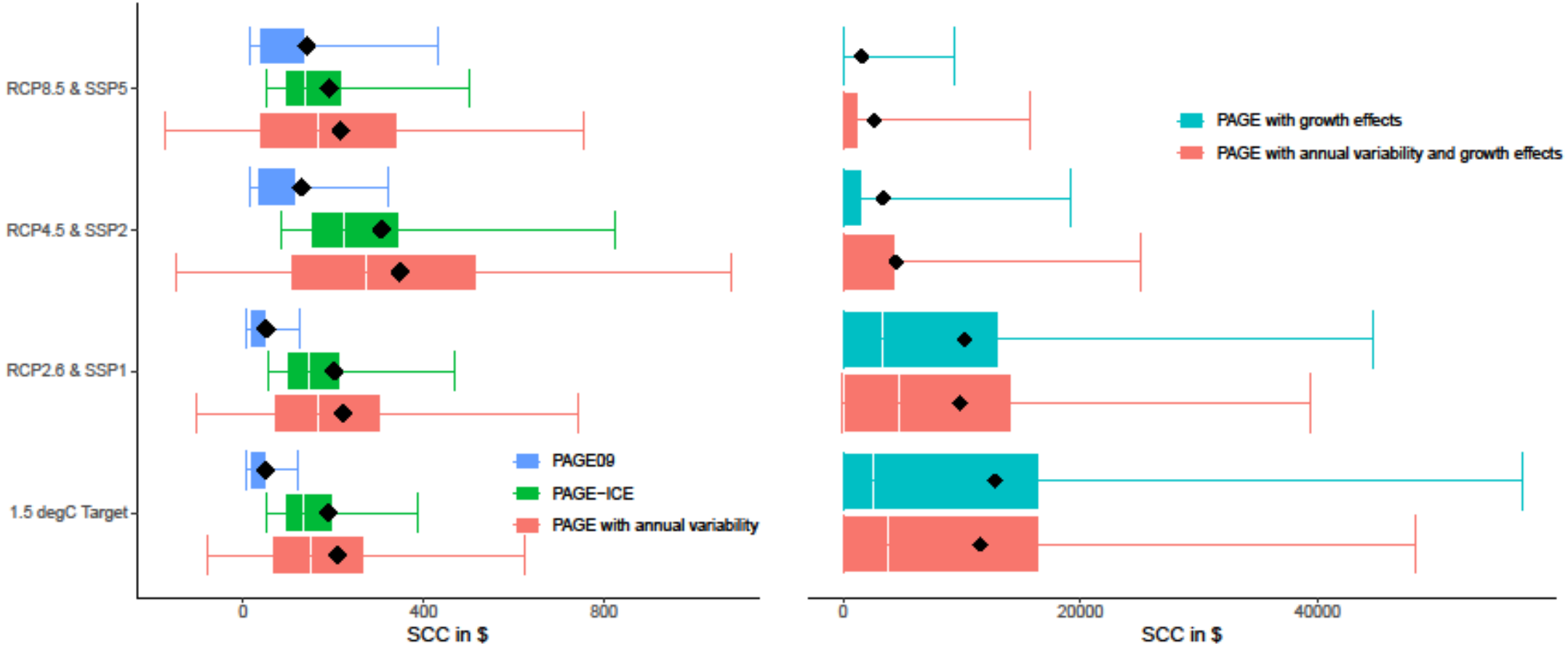
Overview of SCC values under different climate and socioeconomic pathways



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GDP projections under growth effects (50,000 runs)