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Overshooting warming targets – temperature reversibility and implications for impacts, adaptation needs and near-term mitigation

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Limiting global mean temperature increase to politically agreed temperature limits such as the 1.5°C threshold in the Paris Agreement becomes increasingly challenging. This has given rise to a class of overshoot emissions pathways in the mitigation literature that limit warming to such thresholds only after allowing for a temporary overshoot. However, substantial biogeophysical uncertainties remain regarding the large-scale deployment of Carbon Dioxide Removal technologies required to potentially reverse global warming. Additionally, beyond global mean temperature very little is known about the benefits of declining temperatures on impacts and adaptation needs. Here we will provide an overview of the current state of understanding regarding the reversibility of global warming, as well as impacts and adaptation needs under overshoot pathways.

We highlight the characteristics of the overshoot scenarios from the literature, and especially those that are compatible with identified sustainability limits for Carbon Dioxide Removal deployment. We will compare those characteristics with uncertainties arising from the Earth System's response which may complicate the efforts to achieve a decrease in Global Mean Temperature after peak warming is reached. This part will include latest results of the permafrost carbon feedback under stylized overshoot scenarios. Eventually, we will summarise the state-of-the-art knowledge and present new results regarding the impacts of overshoot scenarios for non-linear and time-lagged responses such as sea-level rise, permafrost and glaciers. This will allow for a preliminary assessment of the impact and adaptation benefits of early mitigation compatible with a no or low overshoot pathways.