



Carbon budgets based on new climate projections of the SSP scenarios and observations

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OSCAR is a reduced-form Earth system model that embeds various physical processes, including some that are rarely accounted for in budgets estimates, such as permafrost thaw and methane emissions from wetlands. It has been recently used to demonstrate a path-dependency of the remaining carbon budgets caused by permafrost thaw (Gasser et al., 2018). Here, OSCAR is used to quantify new carbon budgets using the last generation of IPCC scenarios (the Shared Socio-economic Pathways). As highlighted in the IPCC special report on 1.5°C (Rogelj et al., 2018), the carbon budgets based on CMIP5 models may be underestimated. Millar et al. (2017) use observations to extrapolate new carbon budgets, leading to an extension of the allowable emissions, albeit at the cost of breaking the internal consistency of the model projection. Here, thanks to the probabilistic framework of OSCAR, the observations are directly integrated to constrain the climate projections of the SSP scenarios and their uncertainties. Using this approach, the consistency of the model is respected, improving the robustness of the carbon budgets. Our results are somewhat in-between the older carbon budgets based on CMIP5 models and those of Millar et al. (2017). With a multivariate statistical analysis, we further explore the path-dependency and the role of non-CO₂ forcings on the threshold exceedance and avoidance budgets.

- Gasser et al, 2018: Path-dependent reductions in CO₂ emission budgets caused by permafrost carbon release, *Nature Geoscience*, (DOI: 10.1038/s41561-018-0227-0)
- Millar et al, 2017: Emission budgets and pathways consistent with limiting warming to 1.5C, *Nature Geoscience* (DOI: 10.1038/ngeo3031)
- Rogelj et al, 2018: Mitigation pathways compatible with 1.5°C in the context of sustainable development (IPCC Special Report 1.5C)