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Comparison and diagnosis of modeled permafrost extent for the present and future

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Permafrost is an integral part of the Arctic, for example it can control hydrologic regimes, impacts vegetation patterns and biogeochemical cycling as well as dictating building practices. Recent observations show that in general, permafrost is warming and in many places active layers are getting thicker. However, the fate of permafrost over the next century remains uncertain. All models suggest degradation, but extent and timing of degradation varies widely. The NCAR Community Earth System Model (CESM) includes a land model which has received several permafrost specific improvements in recent years. This model projects a large loss of near-surface permafrost by the year 2100. There is a question as to whether the large scale degradation of permafrost in CESM is due more to the present and future surface climate of the model, or whether aspects of the land model may be responsible for the pattern of change. To investigate this matter, we use alternative models of permafrost such as those based on frost indices or equilibrium conditions (Kudryatsev method). Firstly, compare the present-day permafrost-relevant climate and permafrost extent in CESM to that of the new-generation reanalyses (e.g. JRA-25, NASA-MERRA, NOAA-CFSRR, ERA-Interim and the NOAA/CIRES 20th Century Reanalysis). Secondly, we assess how the CESM projections of permafrost degradation compare to the alternative models when forced by future climates. We use 3 of the CMIP5 climate scenarios: RCP_2.6, RCP_4.5 and RCP_8.5 which span moderate warming through to a strong anthropogenic caused climate change. Initial results indicate that the simple models project similar permafrost degradation to that of CESM.