Starting with SR1.5, some embers regarding the impacts on ocean ecosystems and associated services were assessed against global mean sea surface temperature (hereafter GMSST) considering the fact that sea temperature is a direct driver of these impacts and that the ocean acidification (decreasing pH) is correlated to GMSST (Hoegh-Guldberg et al., 2018). To illustrate ocean risks side by side with land-related embers, a conversion from GMSST to GMT is thus needed. This was not considered in SR1.5, but the SROCC provided a conversion rule: GMT=1.44 GMSST (Sect. 5.2.5 in Bindoff et al., 2019). Is it still a valid rule? Estimating the GMT / GMSST ratio (hereafter GSR) is challenging due to several uncertainty factors. Without a doubt, the GSR is larger than 1: land areas warm more than the ocean, even at equilibrium, a finding supported by available proxy evidence (Eyring et al., 2021; Lee et al., 2021). One of the difficulties is that models consistently project a larger or faster warming of the air above the ocean as compared to surface ocean water, but observational evidence is mixed (CCB2.3 in Gulev et al., 2021). Another issue is that the temperature considered over sea ice is the temperature of the air, but global warming reduces sea ice coverage, increasing the ice-free ocean area and complicating the calculation (CCB2.3 in Gulev et al., 2021).

However, instead of looking for “the best estimate” of the GSR given all information sources, what is needed is consistency with how GMSST was used in the impact analyses. Impacts may depend on local temperature changes, acidification may be an important driver, etc. For future impacts, the link between specific drivers and GMSST is obtained from model projections (Bindoff et al., 2019; Gattuso et al., 2015): estimating GSR from models only is consistent with this approach. Based on key results presented in the SROCC and the AR6, we obtain the estimates of the ratio shown in Table 2.

While the AR6 values are somewhat lower, the difference compared to the SROCC is not significant and is inconsequential compared to the uncertainties involved in these etimates or the risk estimates represented in burning embers (the best estimates of the GSR only differ by 3 % between reports as compared to the 4 % difference between simulations in the SROCC). Within the AR6, the GSR shows no noticeable trend with respect to forcing (Sect. S2), indicating that, given the uncertainties, the use of a constant GSR remains justified. It is an approximation, especially given that the land–sea warming contrast may change with the scenario in complex ways (Herger et al., 2015; Lee et al., 2021). All values are based on the multi-model mean GMT: we did not use the “constrained” projections based on multiple lines of evidence provided in the AR6. Indeed, the objective of these constrained projections is to provide best estimates of GMT for each forcing scenario without re-assessing the link between mean temperature and other variables, which is our focus here. Interestingly, replacing GMSST with air temperature over the ocean gives a ratio of 1.16 (instead of 1.39) for the AR6 projections (Sect. S2): this shows that the difference between air and surface water temperatures plays an important role in these estimates based on model projections (however, as discussed in the main text, there are conflicting lines of evidence on the difference between air warming and water warming, highlighted in Gulev et al. (2021, CCB2.3)). Future risks assessments would benefit from renewed attention to, and precise documentation of, the specific climate variables which drive the studied impact.