The build-up of greenhouse gases in the atmosphere is resulting in a warming of the planet. The radiative forcing (***F***, W m^{-2}), largely driven by CO_2, causes other elements of the climate system to respond to either dampen or amplify the warming. This response is referred to as feedback and quantified by the radiative feedback parameter ($\boldsymbol{\lambda}$, W m^{-2} $°C^{-1}$). It is therefore a combination of forcings and feedbacks which determines the warming the planet will experience. This can be expressed as $\Delta \boldsymbol{T} = -\boldsymbol{F} / \boldsymbol{\lambda}$. A useful single number proxy for how sensitive the planet is to forcing by CO_2 is given by the equilibrium climate sensitivity (ECS, ° C). ECS is defined as the temperature rise associated with a doubling of CO_2 once the planet has come to equilibrium (which takes more than 1000 years).

Some feedbacks have a relatively low uncertainty. For example, as the planet warms blackbody emissivity increases (Planck feedback), which dampens warming through a strong negative feedback. However, cloud feedbacks are much more uncertain, exhibiting substantial model-to-model variability (Zelinka et al., 2020; Andrews et al., 2019; Gettelman et al., 2019; Tan et al., 2016). Cloud feedbacks are one of the dominant factors in determining the spread in ECS estimates (Ceppi et al., 2017) and correlate with the cloud feedback parameter (see Fig. 1). There are numerous cloud feedbacks which are represented in the overall cloud feedback parameter including feedbacks associated with cloud altitude, cloud amount and cloud albedo.

The feedback associated with shallow clouds which exist between 0 and about -35°C in the middle to high latitudes is of particular relevance for this paper. Clouds which contain ice tend to have depleted liquid water paths and therefore lower albedo. Hence, in a warmer world ice will become less prevalent and its albedo will increase; this is the basis of the cloud-phase feedback. There have been significant changes in climate models between CMIP5 and CMIP6, with some models reporting much greater ECS. These higher ECS values are correlated with more positive shallow middle- to high-latitude cloud feedbacks in the CMIP6 models, but uncorrelated in the older CMIP5 models (see Fig. 1).