

EGU22-3359

<https://doi.org/10.5194/egusphere-egu22-3359>

EGU General Assembly 2022

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Observational study of time-varying climate feedback parameter

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The climate sensitivity is the central metric for evaluating the amplitude of climate change. It is inversionally proportional to the climate feedback parameter which can be estimated with observations of surface temperature (T), radiative forcing (F) and Earth energy imbalance (EEI). Since EEI is proportional to the time derivative of the ocean heat content, EEI can be derived from in situ temperature/salinity measurements or, equivalently, from the thermosteric component of sea level rise. Here we use a regression method applied to T, F and in situ temperature as well as thermosteric sea level to estimate the climate feedback parameter over the 20th century. Several recent climate studies have shown that the feedback parameter changes with time, because of the spatial pattern of warming. We evaluate the time variations of the climate feedback parameter over 1900- 2020 by applying the regression method to different periods within the 20th century. For the first time, we confirm with observations that the climate feedback parameter does change with time, and responds to external forcings such as major volcanic eruptions, as well as to climate internal variability. We also demonstrate that we need a consistent and reliable observing systems across time to derive a credible climate feedback parameter time series.