Records of atmospheric greenhouse gases derived from ice cores are used in climate model simulations and to reveal the long term natural and anthropogenic influences on their biogeochemical cycles. The role of climate feedbacks on the atmospheric concentrations of CO2 and CH4 is one of the largest sources of uncertainty regarding future climate.

The two millennia leading up to the anthropocene is a highly relevant period to estimate these sensitivities. Factors such as sea level, ice sheet extent and orbital settings were similar to present conditions. Evidence of atmospheric composition changes can be obtained from ice cores, and climate observations and proxies are relatively abundant and well calibrated. Importantly, the climate and gas changes occurred on comparable timescales to the present time, but are not obscured by the overwhelming anthropogenic emissions. The main difficulties involve reconstructing the relatively small atmospheric composition changes and the climate perturbations that were possible causes of them with sufficient time resolution.

We will review the recent ice core evidence of atmospheric CO2 and CH4 concentrations and isotopes over the past 2000 years and their model interpretations. We will also present new measurements from Law Dome and preliminary CO2 simulations by coupled climate carbon models. The atmospheric record found from ice cores during events such as the Little Ice Age depends on the measurement precision, data density and the extent of smoothing during air enclosure which must be carefully considered in any attempts to derive climate sensitivities and rates of CO2 exchange.