20th century trends in the H_2O_2 ice core record from West Antarctica: contributions from accumulation variability and stratospheric ozone depletion

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An array of centennial-scale ice core records of hydrogen peroxide (H_2O_2) was recently developed using shallow cores drilled at 24 different locations across the West Antarctic Ice Sheet (WAIS). H_2O_2 is a major atmospheric oxidant that is closely linked to chemical feedback mechanisms controlling the composition of the atmosphere. Ice core records of H_2O_2 offer the potential to reconstruct past changes in the oxidation capacity of the atmosphere if the processes controlling deposition and long-term preservation are quantitatively understood. Comparison of the 1900-50 with the 1950-2000 time period shows in all cores increases of >40% in mean H_2O_2 during the latter half of the 20th century. Atmospheric concentration, seasonal timing and rate of snow accumulation, as well as the site temperature largely determine the amount of H_2O_2 preserved in an ice core. Sensitivities of the long-term H_2O_2 record to changes in annual accumulation and temperature quantified with a semi-empirical deposition model suggest that interannual variability in H_2O_2 is dominated by the accumulation signal under the current WAIS temperature regime. However, observed trends can only be explained in part by changes in accumulation rate and timing. Recent field and model experiments in West Antarctica showed a negative correlation between stratospheric ozone and summer levels of atmospheric H_2O_2. Using the NASA-Goddard Flight Center (GSFC) point photochemical model the magnitude of atmospheric H_2O_2 enhancement due to changes in surface UV radiation over the past decades was estimated and compared to the H_2O_2 residual not accounted for by the deposition model. We suggest that part of the observed H_2O_2 increase in the core record is due to the occurrence of the spring time ozone hole since the 1970s.