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Effect of climate and ice-flow transients on ice-divide position and ice-core records

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Transients in accumulation and in ice flow can drive ice-divide migration. However, it is likely that dynamical changes initiated near the ice-sheet margin control ice-divide position. Interior ice exhibits a rapid response to modern marginal changes, and larger marginal changes during glacial-interglacial transitions likely led to a larger response. We investigate how flux variations that drive ice-divide migrations on hundreds to tens of thousands of year timescales can affect the depth-age scale, the layer-thickness profile, and the ice-temperature profile at ice-core sites at or near a stable divide position. For this study we use a 2.5-D ice-flow model that sufficiently captures the broad-scale behavior of ice-sheet interiors including ice-divide migration. A simpler 1-D or 2-D model is often used to interpret ice-core records and we compare our flowband behavior to calculations with these models. We apply our ice-flow models to ice-sheet settings similar to 1) Central West Antarctica near the WAIS Divide ice-core site and to 2) Central Greenland near the GRIP and GISP2 ice-core sites. These interior sites may have experienced divide migrations of at least tens of kilometers and they have provided valuable ice-core records. While we do not know the actual migration histories at these sites we will explore the response to plausible changes in accumulation and ice flow on various timescales. We assess the degree to which upstream affects may need to be considered in order to characterize ice-sheet history at an ice-core site. In addition to using the ice-flow models with prescribed forcing to aid in the interpretation of ice-core records, the measured depth-age scale and ice-temperature profile may be used as additional data to constrain an inverse problem to infer histories of accumulation rate, ice thickness, and ice-divide position from radar-observed internal layers; it is important to understand the sensitivity of the measured values to the unknown values that we seek to infer. Assessing model realizations of ice-core records that have been generated with different ice-sheet histories is groundwork for this inverse problem.