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Interpretations of the EPICA Dome C Ice Core data using Hilbert-Huang Transform

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The novel data analysis technique, Hilbert-Huang Transform (HHT), is applied to study the high-resolution proxy temperature profile from a 3270 m-length ice core drilled by the European Project for Ice Coring in Antarctica (EPICA) Dome Concordia (Dome C) region. The proxy temperature record, covering eight successive glacial-interglacial periods (about 800,000 years), is the oldest ice core so far retrieved, hence allows more deep investigation of the Antarctic temperature variations on the improved time scales. In this study, the HHT-EEMD (Ensemble Empirical Mode Decomposition) methods are used to identify (1) the energy-distribution characteristics of the Dansgaard-Oeschger (DO) events during last glacial period; (2) the difference between the two recent glacial-interglacial periods on the millennial and orbital time scales; and (3) the phase relationship between the ice core data and the orbital cycle during the last 800 k-years. The main finding of the work is to show the phase, especially the phase coupling among different orbital cycles is one of the critical elements for understanding the paleoclimate variations, which can explain up to 50% variability of the EPICA Dome C Ice Core proxy temperature records, the left nearly 50% variance is due to the dynamics of the Earth System itself.