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Influence of convective processes on the isotopic composition (O18 and D) of precipitation and atmospheric water in the tropics: a 1-D numerical study with Emanuel's convection scheme

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Isotopic records in polar ice cores have long been used in paleo-climatology for past temperature reconstructions. In tropical ice cores, however, climatic interpretation of isotopic records is more controversial. Indeed, most of the tropical precipitation is related to atmospheric convection processes, whose influence on the isotopic composition of precipitation remains poorly understood. Since most of the precipitation falling on tropical glaciers originates from tropical oceans, a better understanding of the influence of convection on the isotopic composition of precipitation and atmospheric water on tropical oceans would be useful. For this purpose, isotopes have been introduced into Emanuel's convection scheme, and then into a single-column model. Unidimensional simulations of the tropical atmosphere, in the idealized case of radiative-convective equilibrium over ocean, have been performed for different boundary conditions. The relative influence of some climatic variables such as the sea surface temperature or the precipitation amount on the isotopic composition of precipitation and atmospheric water is investigated. In the Tropics, the precipitation amount is shown to be the main factor controlling isotopic composition. The physical processes explaining the observed relationship between precipitation amount and precipitation composition, known as the "amount effect", are explored. Our results emphasize the crucial role of some convective processes (such as rain re-evaporation or precipitation conversion) in explaining this relationship. Our simulations also highlight the importance of using a detailed representation of some convective and microphysical processes to accurately simulate the isotopic composition of atmospheric and precipitation water

in the Tropics.