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Carbon dioxide and the early Eocene climate of western North America

B. Thrasher and L. Sloan

University of California, Santa Cruz, USA (thrasher@pmc.ucsc.edu / Phone: +1 831-4593504)

Concentrations of atmospheric greenhouse gases play an important role in determining the climate by way of emitting longwave radiation towards the Earth, thereby increasing the temperature of the surface and lower atmosphere above that which would be measured in the absence of these constituents. Carbon dioxide, a well-mixed greenhouse gas, is naturally added to the atmosphere through aerobic biological respiration and decay, volcanic eruptions, and dissociation from ocean water. Meanwhile, it is removed from the atmosphere through photosynthesis, chemical weathering, and diffusion into the ocean. All of these factors make it difficult to pinpoint the concentration of carbon dioxide in the distant past. Indeed, estimates of carbon dioxide concentration during the early Eocene vary widely, from 300 ppm to upwards of 2000 ppm. This study employs a regional climate model to examine the effects of different carbon dioxide levels on temperature and precipitation under early Eocene conditions. The region of interest, western North America, contains fossil evidence from the early Eocene that suggests regional rainfall and temperature were substantial enough to support subtropical vegetation, whereas today the region is primarily characterized by desert and steppe.