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Simulating Earth's Past and Future Greenhouse Climates

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Earth's climate has experienced dramatic changes through geologic time. Specific intervals in the geologic record indicate climates that were much warmer than the past few thousand years. These warm climates, or greenhouse climate, are associated with times of elevated levels of carbon dioxide relative to current levels. For a number of these greenhouse climates major perturbations to ocean circulation occurred, which had significant impacts on marine life. Our ability to simulate these past climates with global climate models provide tests for models that are used to project Earth's future climate. I will present simulations of greenhouse climates of the past using a comprehensive global climate model, the Community Climate System Model. I will then present simulations of Earth's potential climate for the end of the 21st century. I will show how our understanding of simulations of past greenhouse climates can provide information on where Earth's climate is heading for the end of this century and beyond. I will also indicate how Earth's greenhouse effect has evolved over Earth's history and how these past changes provide a context for future changes in Earth's greenhouse effect.