Climate dynamics must be considered to achieve carbon neutrality

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The target of carbon neutrality is an integrated and extremely complex issue that is widely associated with climate, ecology, energy, environment, and society. It results from interactions of multiple systems, such as land, atmosphere, ocean, and cryosphere. Among these systems, climate is one of the most important.

Climate is affected by carbon emission yielded by human and nature, and in return, it also affects the carbon emission of human activities and nature. At present, the climate impacts of carbon neutrality policy are still unclear, but to achieve carbon neutrality with relatively small socioeconomic costs, it’s important to take the climate impacts into consideration while designing a reasonable carbon emission path to realize the optimal layout of energy, industry, the ecological environment, and other fields.

To address this issue, the journal Fundamental Research invited Prof. Huang Gang's team from the Institute of Atmospheric Physics of the Chinese Academy of Sciences, together with scholars at Hohai University, to share their views on climate research and carbon neutrality. The article emphasized that the understanding of climate dynamics against the background of carbon neutrality is of great urgency.

According to the article, during rising stages of CO₂ concentration, CO₂ radiative forcing is the main driving force of the climate system. Due to the small heat capacity, land warms rapidly with the increasing of CO₂ radiative forcing; the ocean's response is slow owing to its large heat capacity.

The thermal difference between land and ocean increases, which enhances monsoon circulation. After carbon neutrality is achieved, CO₂ radiative forcing stabilizes or decreases, while the ocean still slowly absorbs heat and warming. The land-ocean thermal contrast diminishes, weakening the monsoon circulation; if the CO₂ concentration decreases dramatically, the deep ocean will release heat to decelerate the cooling of earth surface.

Prof. Huang concluded, "Carbon neutrality is not only a technical issue, but also a scientific issue. More attention should be paid to the feedback of climate system and the impact of non-carbon dioxide on temperature."


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