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COMMENTARY

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Current Effects of Cloud Forcing in Environment

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Description

The difference between the clear-sky and all-sky radiative energy budgets is what the cloud-radiative forcing is all about. Clear and cloudy observations are included in the all-sky radiant energy values. The greenhouse effect is aided by clouds. They have the ability to absorb and emit infrared radiation, influencing the atmosphere's radiative properties. Liquid clouds, mixed-phase clouds, and ice clouds are among the various types of clouds. Low clouds with negative radiative forcing are referred to as liquid clouds. At subfreezing temperatures, mixed-phase clouds coexist with both liquid water and solid ice, and the liquid content has a significant impact on the radiative properties (optical depth and optical thickness). Ice clouds are mostly high clouds, and their radiative forcing is determined by the number of ice crystals in the cloud, the cloud thickness, and the ice water content. Cloud microphysical properties, such as cloud liquid water content and cloud drop size distribution, have a significant impact on the radiative properties of liquid clouds. Negative radiative forcing will be stronger in liquid clouds with higher liquid water content and smaller water droplets. The contents of cloud liquids are usually linked to surface and atmospheric circulations. The atmosphere is usually rich in water vapor over the warm ocean surface, so the liquid clouds have higher liquid water content. The water content can be much higher when moist air flows converge in the clouds and generate strong updrafts. Aerosols will have an impact on the size distribution of cloud drops. Water droplets in liquid clouds, for example, are more abundant in polluted industrial areas with high levels of aerosols.

Negative radiative forcing is present in mixed phase clouds. Mix-phase clouds have a higher level of uncertainty in their radiative forcing than liquid clouds. One reason is that due to the coexistence of liquid and solid water, microphysics is much more complicated. The Wegener–Bergeron–Findeisen process, for example, can rapidly deplete large amounts of water droplets and enlarge small ice crystals to large ones. When liquid droplets collide with large ice crystals, the Hallett-Mossop process shatters them, resulting in a large number of small ice splinters. Because small ice crystals can reflect much more light from the sun and create much more negative radiative forcing than large water droplets, the cloud radiative properties can change dramatically during these processes. Depending on the cloud thickness, cirrus clouds can either enhance or reduce the greenhouse effect. Cirrus with a thin layer has a positive radiative forcing, while thick cirrus has a negative radiative forcing. Cirrus radiative properties are also affected by ice water content and ice size distribution. Cirrus clouds have a greater cooling effect when there is more ice water in them. Cirrus with smaller ice crystals has a stronger cooling effect than cirrus with fewer and larger ice crystals when cloud ice water contents are equal. Some researchers suggest seeding thin cirrus clouds with cirrus seeding to reduce the size of ice crystals and thus the greenhouse effect, but other studies question its efficacy and regard it as an insufficient way to combat climate change.

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