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Monitoring the Earth's Evolving Climate from Space.[1]

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Since the 1960s, NASA has deployed a growing fleet of satellites to study the Earth. This fleet now includes 17 platforms carrying dozens of sensors that measure surface and atmospheric temperatures, humidity, solar and thermal radiation, aerosols, clouds, precipitation, soil moisture and water storage, ice cover and thickness, sea level, ocean color, land cover, biological productivity, ozone and other reactive gases, and long-lived greenhouse gases. As the NASA fleet has grown and its capabilities increased, it has documented an accelerating series of changes in our environment. It has revealed rising temperatures, showing that we are living in the warmest years of the warmest decade on record. These increasing temperatures have been accompanied by the increasing incidence, intensity and area of wildfires. Higher temperatures have also contributed to record losses in sea ice as well as the retreat of glaciers and ice sheets on land, which is driving increasing rates of sea level rise. As the air warms, it can hold more water, contributing to more record-setting hurricanes, typhoons and mid-latitude supercell storms and derechos. Land surface measurements by NASA and its partners in Japan and Europe have also recorded losses in the acreage and productivity of tropical forests that were offset by larger increases in the forest productivity at higher latitudes, thought to be associated with higher temperatures and longer growing seasons. Climate models show that the primary driver of these changes is the buildup of carbon dioxide (CO_2), methane (CH_4) and other greenhouse gases in the atmosphere. Over the past decade, fossil fuel combustion and other human activities have added about 35 billion tons of carbon dioxide and about 366 million tons of methane to the atmosphere each year. NASA and its partners in Japan and Europe are now monitoring these gases with the precision, accuracy, resolution, and coverage needed to quantify the sources that emit them into the atmosphere and the natural processes that remove them. Here, we will review these observations and summarize some recent discoveries made by this fleet of satellites.

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