



Observed change for the atmosphere and surface, and for extremes

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The evidence of climate change from observations of the atmosphere and surface has grown significantly during recent years. Advances in the global climate observing system (in particular using satellites and reanalyses) have contributed to improved monitoring capabilities. At the same time, new dataset developments since AR4 have improved understanding of data issues and observational uncertainties. Developing homogeneous long-term global and regional data records from different sources remains a challenge.

Instrumental observations since about 1850 and satellite observations since 1979 indicate changes in atmospheric composition, radiation budgets, temperature, the hydrological cycle (including precipitation and clouds) and atmospheric circulation. Each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850. Confidence in precipitation change averaged over global land areas since 1901 is low prior to 1951 and medium afterwards.

Changes in many extreme weather and climate events (such as cold spells, heat waves, heavy precipitation events, droughts and tropical cyclones) have been observed since about 1950, consistent with the warming. For some of these extremes, a revised global-scale assessment from previous IPCC reports is provided. Especially for extremes, assessments of recent observed changes are hampered by limited availability of long-term observations, changes in observing capabilities and practices over time, and methodological differences in the assessed studies.