

The Global Terrestrial Observing System: existing observations and perspectives for the future

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Fossil fuel combustion and land-use change are the primary causes for the 35+% rise in atmospheric CO₂ since 1750. Recently, the rate of CO₂ emissions growth has increased significantly, and it appears that the fraction of emissions that remain in the atmosphere has increased.

Neither the current state of the science nor our observational systems can account for the growth rate and inter-annual variations of atmospheric CO₂. The variability of the year-to-year growth in atmospheric CO₂ cannot be explained by the variability in fossil fuel use; rather it appears to reflect primarily changes in terrestrial ecosystems that are connected with large-scale weather and climate modes.

The overall pattern is important, and we do not understand it. This issue and other important challenges of climate change require a renewed approach to global science and space-based Earth observations.

The contribution addresses some of the challenges of developing integrated Earth observations and models with sufficient credibility and robustness to address these challenging issues.