The Role of the Global Carbon Cycle in Climate Dynamics: Why CO_2 Emission Rates must be reduced.

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Human activities add roughly 8.8 Pg of carbon to the global carbon cycle each year, and about 4.1 Pg remains in the atmosphere, causing the CO_2 concentration of air to increase from 318ppm in 1958, to 394ppm today. The IPCC 4th Assessment found that the net change in radiative forcing of the planet was $+1.6$ Wm^2, almost entirely caused by increasing greenhouse gases. Consequences of this energy imbalance are now obvious throughout the Earth Climate System. Air temperatures are rising worldwide, >90% of all glaciers are retreating, and ocean temperature and acidity is increasing. The terrestrial response is more complic ated, with global forest carbon sinks increasing, but also forest disturbance rates increasing from wildfire and typhoons. Human management of the global terrestrial carbon budget will increasingly focus on three competing ecosystem services. First is glob al food production as the world population increases from 7 to 9 billion people in the next decades. Second is maintaining or enhancing terrestrial carbon sinks to slow atmospheric CO_2 increase. Third is the demand for bioenergy production to contribute 20-30% of future global energy needs. I envision there will be very difficult and contentious policy choices in how to optimally satisfy these three carbon cycle based services for humanity. My lecture will summarize current trends, global monitoring capabil ities, and policy options that will frame the future of global terrestrial carbon management.