CarbonTracker, a tool to quantify human and natural emissions of greenhouse gases based on atmospheric observations.

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CarbonTracker fills a model of the entire atmosphere with time-varying fields of carbon dioxide (CO2) concentrations that are consistent with observations of atmospheric CO2, with atmospheric transport, and with other known features of the carbon cycle. The latter include photosynthesis and respiration by ecosystems with their seasonal cycles, patterns of air-sea gas exchange, fires, and energy production through the burning of coal, oil, and natural gas. Ecosystem models predict positive ("sources") and negative ("sinks") CO2 emissions based on observed weather. Similarly, sources and sinks of CO2 from the oceans are predicted. An atmospheric transport model derived from weather forecasts then predicts plumes of CO2 propagating in the atmosphere resulting from those sources/sinks. The predicted CO2 is compared everywhere observations are available. Systematic differences between the observed and predicted CO2 fields are used to adjust the sources until optimal agreement with the CO2 observations is reached. In its first release, in March 2007, the system adjusted terrestrial ecosystem and oceanic emissions, whereas emissions from fossil fuel burning and fires were fixed. In future releases CarbonTracker will be developed further to determine fossil fuel emissions, and other greenhouse gases will be added. Especially methane (CH4) is important because of large potential emissions caused by thawing of permafrost soils in the Arctic.