TABLE 151e-1 GREENHOUSE GASES: SOURCES, SINKS, AND FORCINGS

Gas	Human Sources	Sink[a]	Radiative Forcing[b] (95% Confidence Interval)
Carbon dioxide (CO_2)	Fossil fuel combustion, deforestation	Uptake by oceans (~30%), plants	1.68 (1.33–2.03)
Methane (CH_4)	Fossil fuel production, ruminant animals, decomposition in landfills	Hydroxyl radicals in the troposphere	0.97 (0.74–1.20)
Nitrous oxide (N_2O)	Fertilizer, fossil fuel combustion, biomass burning, livestock manure	Photolysis in the stratosphere	0.17 (0.14–0.23)
Halocarbons	Refrigerants, electrical insulation, aluminum production	Hydroxyl radicals in the troposphere, sunlight in the stratosphere	0.18 (0.01–0.35)

[a]In this table, a *sink* refers to the place where greenhouse gases are naturally stored or the mechanism through which they are destroyed. [b]*Radiative forcing*, measured in watts per meter squared, refers to how much an entity can alter the balance of incoming and outgoing radiation to and from Earth's atmosphere. It is measured relative to a preindustrial (i.e., 1750) baseline. Greenhouse gases have a positive "forcing"; that is, on balance, they increase the amount of radiation (and specifically infrared radiation) that is retained in Earth's atmosphere. *(Sources: Intergovernmental Panel on Climate Change Fifth Assessment Report, Working Group 1, Chapter 8; American Chemical Society "Greenhouse gas sources and sinks," available at www.acs.org/content/acs/en/climatescience/greenhousegases/sourcesandsinks.html.)*

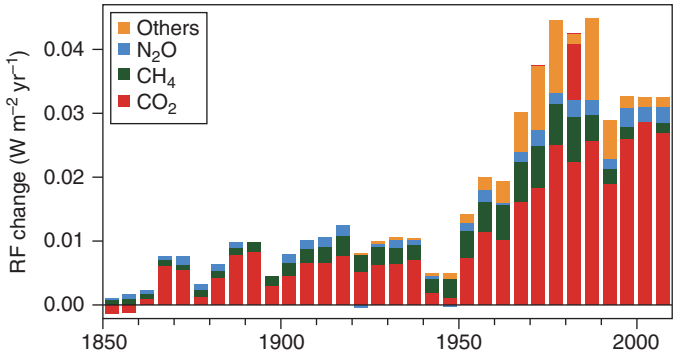

FIGURE 151e-2 Acceleration of radiative forcing (RF) from release of major greenhouse gases, 1850–2011. For definition of *radiative forcing*, see footnote *b* to Table 151e-1. *(From Intergovernmental Panel on Climate Change Fifth Assessment Report, Working Group 1, Chapter 8, Figure 8.6, p. 677.)*

A moderate projection based on the best available scientific evidence suggests that average global temperatures will warm an additional 1.4–3.1°C by 2100 as compared to the period 1986–2005. Because of climate change, extreme heat waves have already become more common and are expected to be even more frequent later in this century. Besides contributing directly to morbidity and mortality in human populations, heat waves wilt crops and are expected to contribute substantially to predicted agricultural losses. For example, the 2010 heat wave in Russia, which was unprecedented in its severity, contributed to hundreds of forest fires that generated enough air pollution to kill an estimated 56,000 people and that burned 300,000 acres of crops, including roughly 25% of the nation's wheat fields. Nutritional deficiencies underlie a substantial portion of the global burden of many infectious diseases.

PRECIPITATION

In addition to changing temperature, the emission of greenhouse gases and the consequent increase in energy in Earth's atmosphere have influenced the planet's water cycle. Since 1950, substantial increases in the heaviest precipitation events (i.e., those above the 95th percentile) have been observed in Europe and North America. While trends over

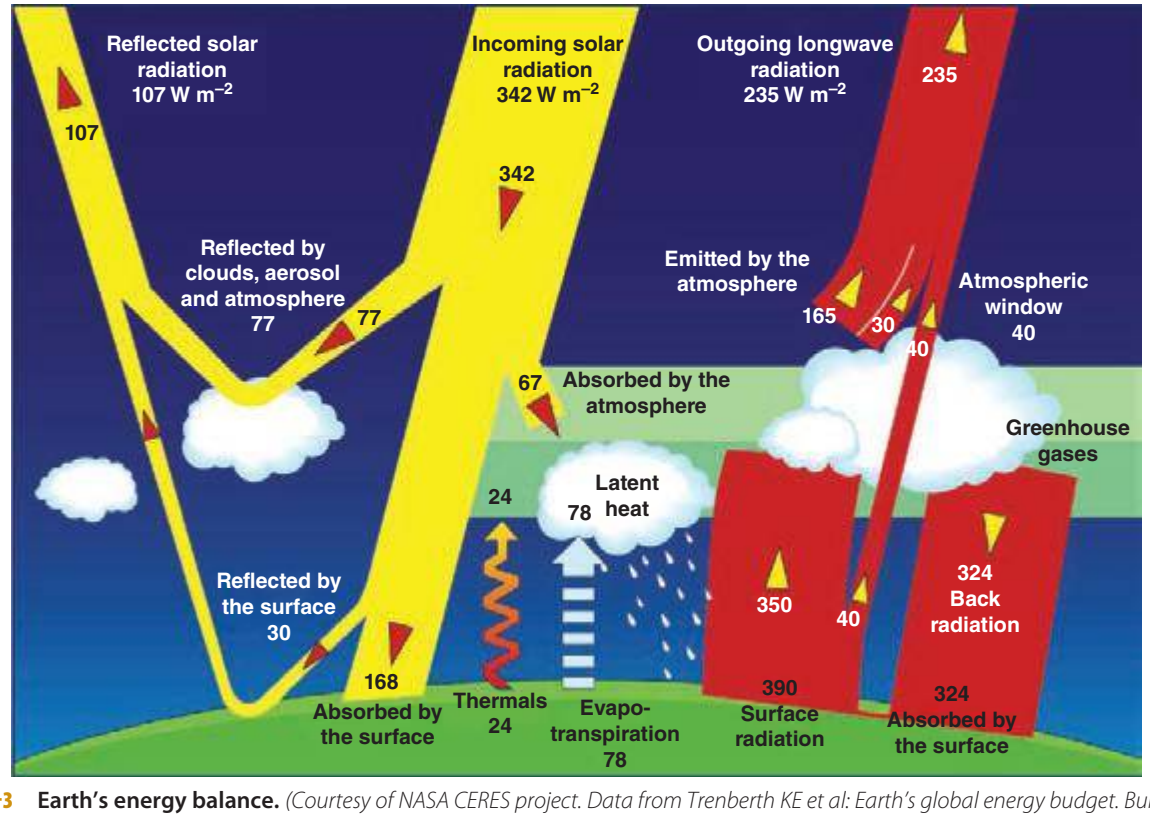

FIGURE 151e-3 Earth's energy balance. *(Courtesy of NASA CERES project. Data from Trenberth KE et al: Earth's global energy budget. Bull Am Meteor Soc 90:311, 2009.)*