12 Controls on Methane Flux from Terrestrial Ecosystems

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Research on CH₄ dynamics has been stimulated in recent years by the finding that atmospheric CH₄ has been increasing at approximately 1% yr⁻¹ (4 times as fast as CO₂; Bouwman, 1989) and that it is approximately 30 times as effective a greenhouse gas as CO₂ (Bouwman, 1989). Methane has other critical roles in atmospheric chemistry: it reacts with the OH radical, a key species in atmospheric oxidation chemistry; and CH₄ oxidation is a major source of stratospheric H₂O vapor as well (Schütz et al., 1991). The importance of atmospheric CH₄ and its increase has challenged our understanding of the CH₄ cycle and posed the following questions: (i) What are CH₄ fluxes to and from the atmosphere?, (ii) How have the fluxes changed since preindustrial times?, and (iii) How will fluxes change over the next several decades?

What might be called the first phase of global CH₄ research has focused on tightening estimates of CH₄ sources and sinks, with a fair degree of success (Cicerone & Oremland, 1988; Khalil & Rasmussen, 1990; Fung et al., 1991). While some uncertainties still exist, it has become clear that net CH₄ fluxes from soils (predominantly wetlands) are approximately 180 to 220 Tg yr⁻¹ and that they comprise about 40 to 43% of the total global source (Cicerone & Oremland, 1988; Fung et al., 1991). Soil sources are dominated by rice (Oryza sativa) paddies (100 Tg) and natural wetlands (115 Tg, of which...