



Project Summary

Literature Review of Greenhouse Gas Emissions from Biogenic Sources

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and J.A. Probert

A literature review is presented of estimates of biogenic emissions of five greenhouse gases: CO_2 , CH_4 , CO , N_2O , and NO_x . Results of the review include data and information from about 170 sources published over the past 10 years. The report's two sections cover greenhouse gases containing (1) carbon and (2) nitrogen. Within each section, emissions estimates are grouped by type of source or sink in a series of tables. First, *emission factors* are given as a rate in units of mass per unit area per unit time (e.g., $\text{kg ha}^{-1} \text{yr}^{-1}$), except for NO_x and N_2O produced by lightning. Second, *budget estimates* are provided in units of mass per unit of time (e.g., g yr^{-1}). Finally, a few authors provided *reservoir estimates* in units of mass per land area (e.g., kg m^{-2}); these represent the potential amount of a greenhouse gas that is stored in a specific ecosystem or type of biota. Other data presented in the report are specific to the gas or source and are used to calculate a total budget estimate (e.g., land estimates for CH_4 emitted from rice paddies).

This Project Summary was developed by EPA's Air and Energy Engineering Research Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

This report is an overview of the quantitative estimates of biogenic emissions of five greenhouse gases: carbon dioxide (CO_2), methane (CH_4), carbon monoxide (CO), nitrous oxide (N_2O), and nitrogen oxides (NO_x). The information in the report

was developed by surveying the literature and through discussions with researchers who have published recently in this field. Although it does not represent an exhaustive search of all research and studies conducted to date, it does contain a considerable amount of data and information from about 170 readily available sources published over the past 10 years.

The report is divided into two sections, covering (1) the carbon-containing greenhouse gases and (2) the nitrogen-containing greenhouse gases. Within each section, the emission estimates are grouped by type of source or sink in a series of tables (see Table 1). A brief explanatory text on each greenhouse gas is provided within the tables.

Three quantitative emission estimates are provided in the tables. First, *emission factors* are given as a rate, usually in units of mass per area per unit of time (e.g., $\text{kg ha}^{-1} \text{yr}^{-1}$). The one exception is in the estimates of NO_x and N_2O produced by lightning, for which the emission factors are given in terms of mass per lightning stroke or mass per unit of energy (e.g., molecules per joule).

The second estimates provided are *budget estimates*, for which the units are mass per unit of time (e.g., kg yr^{-1}). A reservoir estimate represents the potential amount of a greenhouse gas that is stored in a specific ecosystem or type of biota. For example, reservoir estimates of carbon stored in various ecosystems are cited. These represent the amount of carbon which would be released, primarily as CO_2 , if the biomass were burned.

Other data presented in this report are specific to a gas or source and are used to calculate a total budget estimate. Examples are the number of animals per unit area, for methane emissions from ruminants, and



land area estimates, for methane emitted from rice paddies.

No judgments were made as to the quality or validity of the data included in the report; data were derived from a wide range of approaches, including field measurements, laboratory measurements, mass balance calculations, and theoretical calculations. Although the "comments" column in each table in the report provides some indication of the origins of the estimates, the reader is strongly advised to refer to the original reference before using any of the data presented in this report.

In some cases, summary tables from review articles were used. These are clearly noted in the report, and the primary author and date are provided. Although the original reference is not cited in the reference list, it can be found by referring to the review article.

Journals published prior to February 1990 were included in the literature survey; most attention was given to major journals concerned with biogeochemical processes. These include *Global Biogeochemical Cycles*, the *Journal of Geophysical Research*, the *Journal of Atmospheric Chemistry*, and *Atmospheric Environment*.

Table 1. Tables Included in Full Report

Table No.	
2-1	CO ₂ Emitted from Terrestrial Biota
2-2	The Ocean As a Sink for CO ₂
2-3	CH ₄ Emitted from Rice Paddies
2-4	CH ₄ Emitted from Wetlands
2-5	CH ₄ Emitted from Tundra
2-6	CH ₄ Emitted from Animals (Ruminants)
2-7	CH ₄ Emitted from Termites
2-8	CH ₄ Emitted from Biomass Burning
2-9	CO Emitted from Biomass Burning
2-10	CO Emitted from Oceans
2-11	Soil As a Sink for CO
2-12	CO Emitted from the Tropics
2-13	CO Emitted from Rice Paddies
3-1	N ₂ O Emitted from Fertilizer Use
3-2	N ₂ O Emitted from Soils
3-3	N ₂ O Emitted from Aquifers
3-4	NO _x Emitted from Soils
3-5	NO _x Emitted from NH ₃ Oxidation
3-6	NO _x and N ₂ O Emitted from Biomass Burning
3-7	NO _x and N ₂ O Emitted from Lightning
3-8	NO _x and N ₂ O Emitted from Oceans

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Jullan W. Jones is the EPA Project Officer (see below).

The complete report, entitled "Literature Review of Greenhouse Gas Emissions from Biogenic Sources," (Order No. PB890-274085/AS; Cost: \$17.00, subject to change) will be available only from:

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
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