

REPORT ON REVISIONS TO
5TH EDITION AP-42
Section 14.1
Soils

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14.1 Soils - Discussion

AP-42 Section 14.1 addresses nitrous oxide (N₂O) emissions from soils. Emission factors are presented for N₂O emitted from agricultural and non-agricultural soils. To estimate emissions of nitrogen oxides (NO_x) from soils, readers are referred to the U.S. Environmental Protection Agency's (EPA's) Biogenic Emissions Inventory System (BEIS).¹

The N₂O emission factor for agricultural soils is presented as an equation, and was taken directly from the U.S. EPA (1995) *State Workbook* and the *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 - 1993*.^{2,3} For agricultural soils, emissions of N₂O are affected by the use of nitrogen-containing fertilizers. The equation to estimate N₂O emissions associated with fertilizer application is:

$$\text{N}_2\text{O Emissions} = (\text{FC} * \text{EC} * 44/28)$$

Where: FC = Fertilizer consumption (tons N-applied);
EC = Emission coefficient (0.0117 tons N₂O - N/ton N-applied); and
44/28 = The molecular weight ratio of N₂O to N₂O as N (N₂O/N₂O-N).

If information is not available on the tons of nitrogen applied, guidance is provided on the average nitrogen content (percent by weight) of some commonly used fertilizers. Default values were obtained from the Fertilizer Institute. The Agricultural Research Service of U.S. Department of Agriculture provided the N₂O emission coefficient of 0.0117 tons N₂O-N/ton N applied. This is equivalent to 1.17 percent of the nitrogen applied as fertilizer being released into the atmosphere as N₂O. The equation is rated "D" because no information is presented on how the emission coefficient was determined.

Emissions of N₂O from non-agricultural soils are estimated using emission factors in units of lbs N₂O/acre/year. The emission factors vary by ecosystem type because emissions are dependent on the soil's nutrient level and moisture content.⁴ The emission factors are mean values of N₂O flux measurements from various sources and were assigned an "E" rating because there is a great deal of variability between soil types and soil moisture levels within each ecological region.⁵⁻⁸ The emission factors are based on test data from primarily undisturbed soils. The data are shown in Table 1.

TABLE 1. SOIL N₂O EMISSION FACTOR DATA⁴

Cover Type	Measurement-Derived Emission Factor (lb N ₂ O-N/acre/yr)	Comments
Temperature Forests		
Coniferous	0.013 ± 0.019 Midpoint = 0.029	NE coniferous (red pine stand)
	2.165	Wisconsin coniferous (pine plantation, red)
	0.312 to 0.625	Throughout central European forest (predominantly coniferous)
Deciduous	0.021 ± 0.022	NE deciduous (Black Oak, birch, maple)
	0.133	New Hampshire deciduous
	0.422	Wisconsin deciduous
	min = 0.235 max = 0.860	West Germany deciduous
	1.254	New York state deciduous; mineral soils over 1 year
	0.205	New Hampshire hardwood forest (n=29)
Tropical Forests		
	min = 1.23 midpoint = 1.563 max = 1.899	Amazon clay soils (Terra Firma)
	0.234	Amazon sand soils
	0.078	Amazon floodplain soils (Varzea)
	1.398	Florida everglades, organic soil over 1 year
	5.346	Brazil tropical hardwoods (annual means)
	3.495	Brazil tropical moist forest
	5.141	Puerto Rico, dry season, subtropical moist forest
	2.879	Amazon undisturbed tropical soils
	1.016	Amazonian forests: 3 types of ecosystems
Savanna		
	0.349 ± 0.575	Tropical savanna site I (n=63)

TABLE 1. SOIL N₂O EMISSION FACTOR DATA⁴

(continued)

Cover Type	Measurement-Derived Emission Factor (lb N ₂ O-N/acre/yr)	Comments
	2.056 ± 0.658	Tropical savanna site II (n=29)
	3.515 ± 2.138	Semi-deciduous tropical savanna forest-day time (n=34)
	2.076 ± 1.522	Semi-deciduous tropical savanna forest-night time (n=15)
Savanna (continued)	1.295 ± 1.604	Transitional savanna forest (between Savanna and semi-deciduous forest) (n=20)
	0.513	Undisturbed tropical savanna soil during dry season
	0.205	Undisturbed tropical savanna soil during dry season after 4 days of simulated rainfall
Temperate		
Grassland	0.740	Clovergrass in Canberra, Australia, over 5 months
	1.172	Natural shortgrass prairie, Colorado
Sclerophyllous		
Shrublands	1.563	Chaparral ecosystem, pre-burn

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