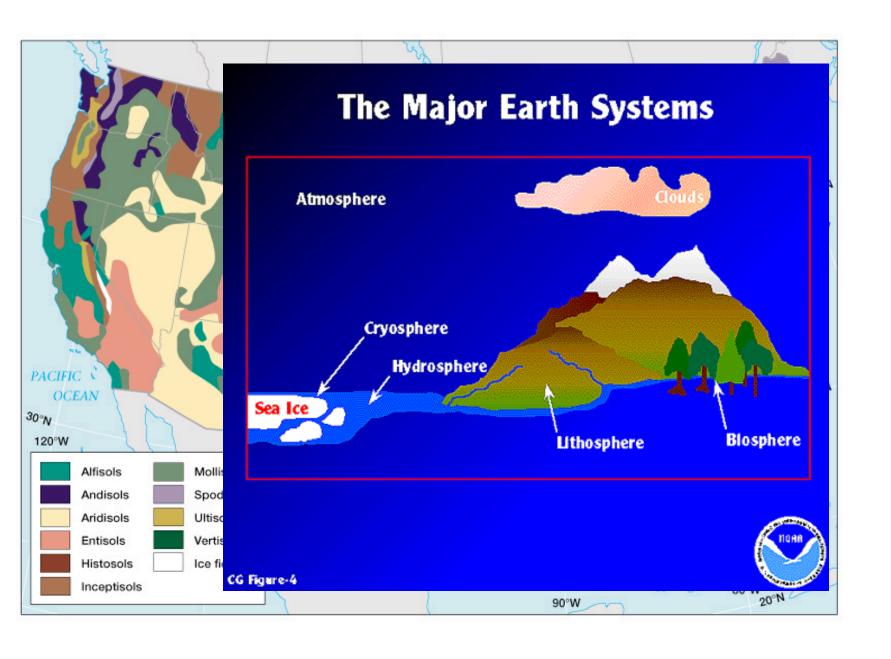
Agriculture and Greenhouse Gas (GHG) Emissions

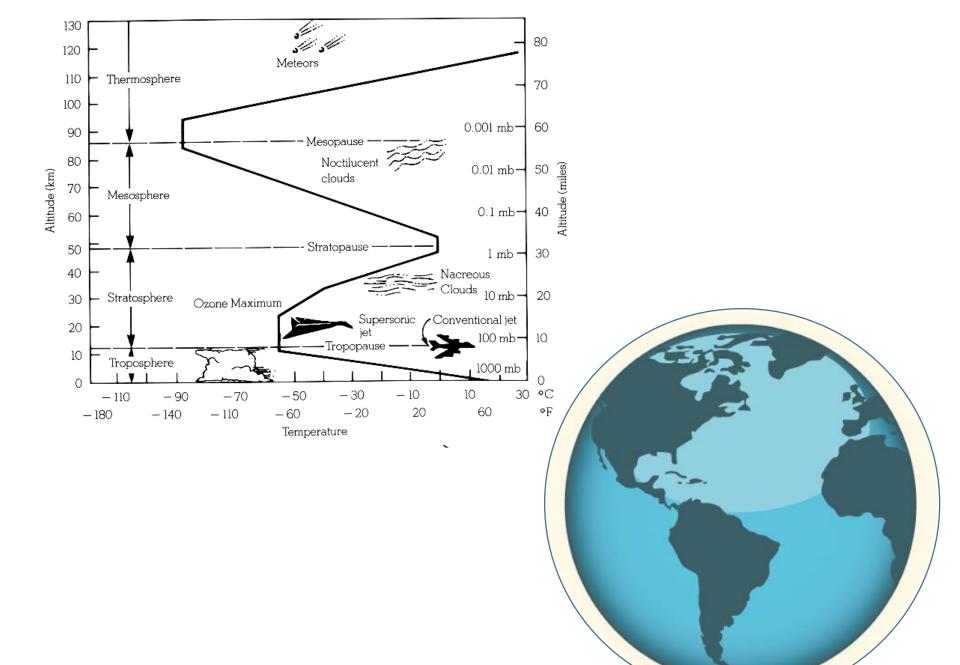
Dr. Ronald Turco, Professor of Agronomy and Assistant Dean College of Agriculture

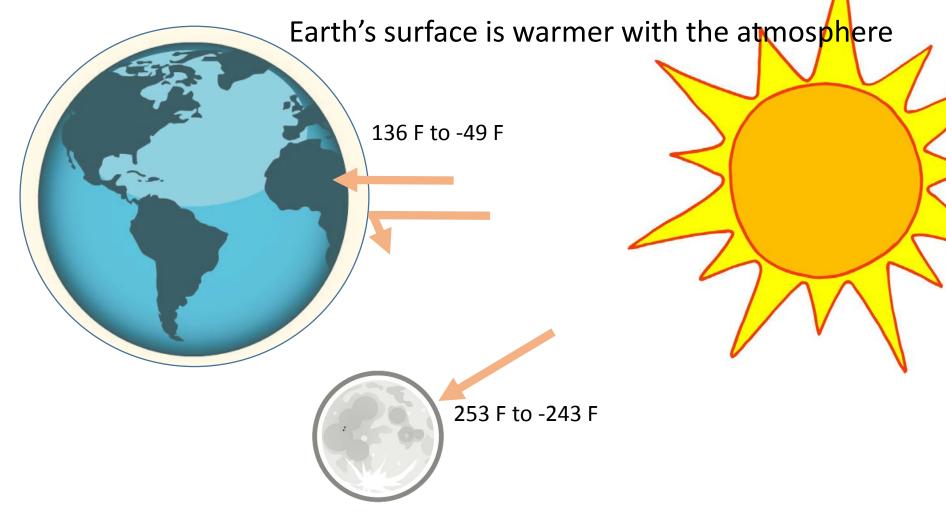
Melissa Widhalm, Operations Manager,
Purdue Climate Change Research Center
Purdue University

An overview of GHG emissions.

- What do we know from science?
- What are the GHG contributions from agriculture relative to other sources?
- What are the farm sources: crops/soil vs livestock?
- Options to mitigate GHG?



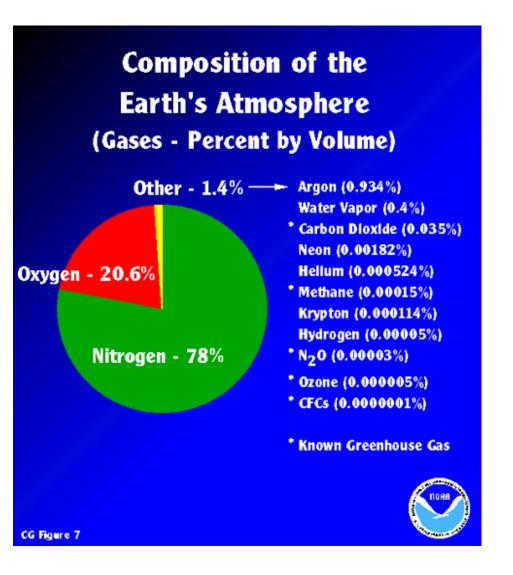




The Earth surface receives "energy" from two sources

- The Sun
- The Atmosphere

The glass panels of the greenhouse (the atmosphere) lets in light but keep heat from escaping



78% nitrogen

20.6% oxygen

Not GHG

< 1% argon

traces gases: Ne, He, Kr, H,

Ozone (O_3)

Water Vapor

Carbon Dioxide

Methane, Nitrous Oxide

Chlorofluorohydrocarbons

Shortwaves – High Energy wavelengths hit the earth Incoming energy is converted to heat CO₂, N₂O, CH₄ infrared **Infrared** (warming) High energy, visible Visible light passes through atmosphere. "Hot items" on earth emit infrared photons back to the atmosphere Infrared photons warm the greenhouse gases Greenhouse gases emit infrared back to earth Surface absorbs visible light and emits thermal radiation in infrared Greenhouse gases hold heat in atmosphere

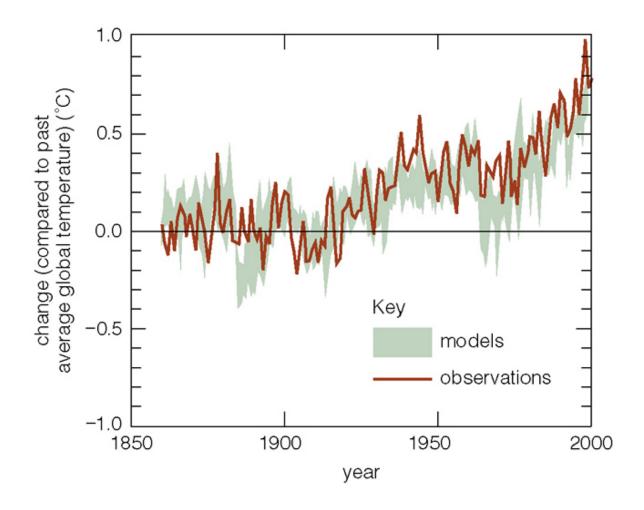
Infrared would escape to space (without GHG)

The greenhouse effect: is the trapping of infrared photons by greenhouse gases (water vapor) in the atmosphere – warming the atmosphere and the earths surface.

The greenhouse effect: stabilizes temperatures on earth The greenhouse effect: one of the most important natural process we have.

The greenhouse effect is a function of the amount of greenhouse gas that is trapping the infrared photons and warming the atmosphere and the earth surface.

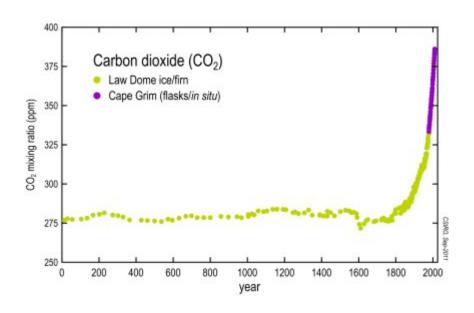
The greenhouse effect is good, an <u>enhanced greenhouse effect</u> has led to excess warming of the planet ..



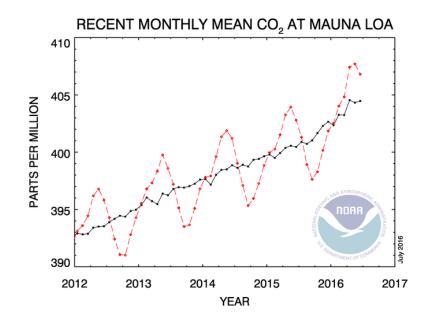
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Earth's atmosphere in the last 100 years it is up about 1°C since 1900

CO₂ in PPM



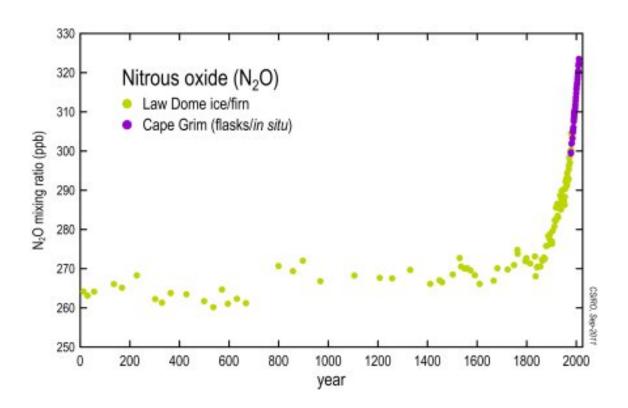
Atmospheric CO₂ at Mauna Loa Observatory 400 Scripps Institution of Oceanography NOAA Earth System Research Laboratory 380 340 320 1960 1970 1980 1990 2000 2010 YEAR



Cape Grim Greenhouse Gas Data

http://www.csiro.au/greenhouse-gases/

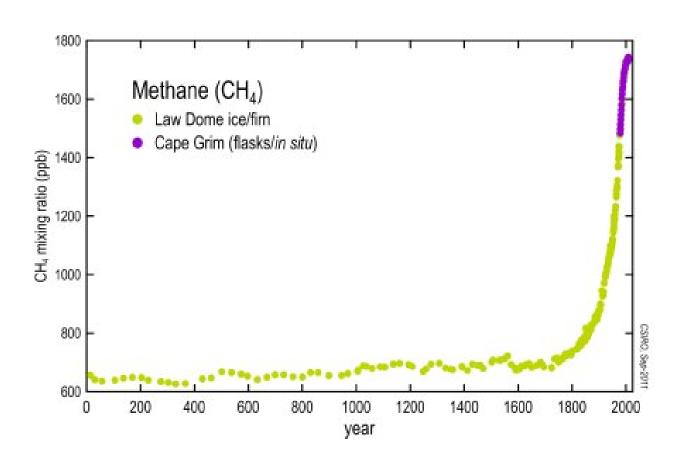




Cape Grim Greenhouse Gas Data

http://www.csiro.au/greenhouse-gases/

CH₄ in PPB



Cape Grim Greenhouse Gas Data

http://www.csiro.au/greenhouse-gases/

Constant level

Water Vapor Up to 70% of GHE

Variable levels

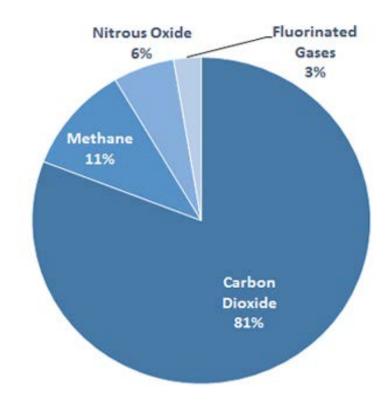
Carbon Dioxide

Methane

Ozone (O_3)

Nitrous Oxide

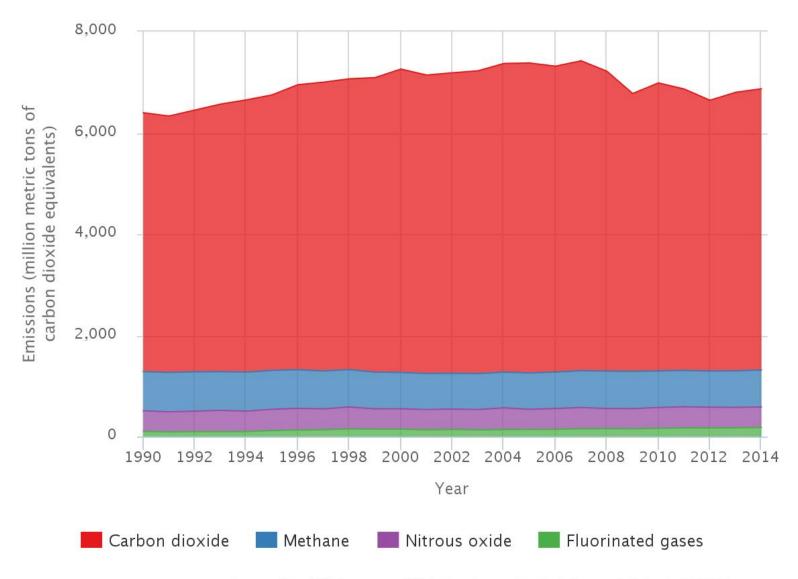
CFCs (Fluorinated Gases)



1 unit	Unit CO _{2e}
CO ₂	1
CH ₄	25
N ₂ O	298
SF ₆	22800
CF ₄	7390

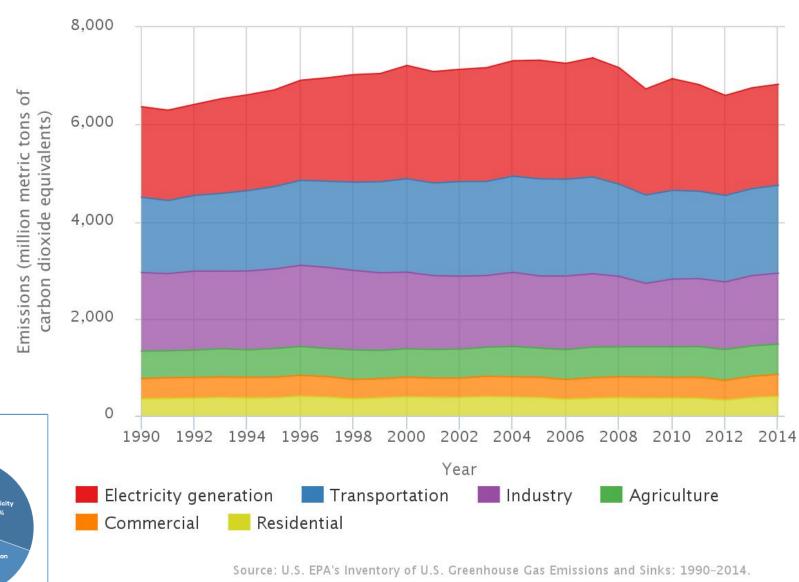
Equivalent units, data are expressed on units of CO₂ Related to holding heat

U.S. Greenhouse Gas Emissions by Gas, 1990-2014



Source: U.S. EPA's Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2014. http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html

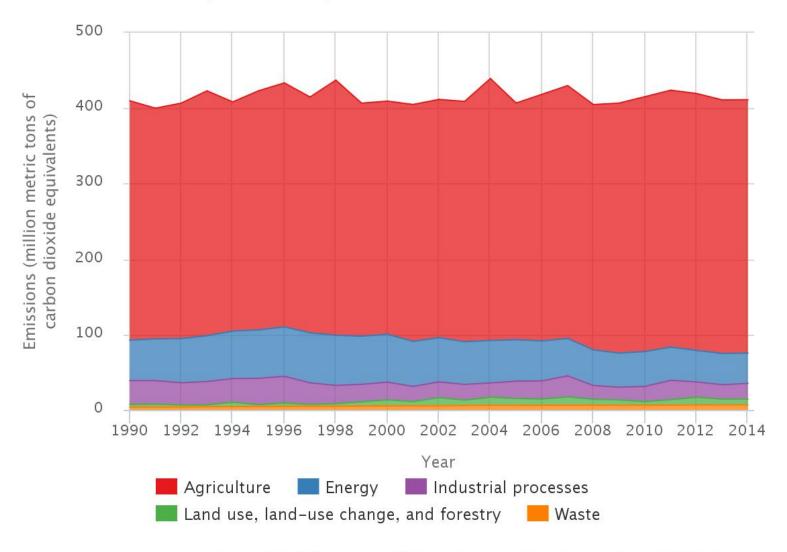
U.S. Greenhouse Gas Emissions by Economic Sector, 1990-2014



Agriculture Commercial & Residential Electricity Transportation

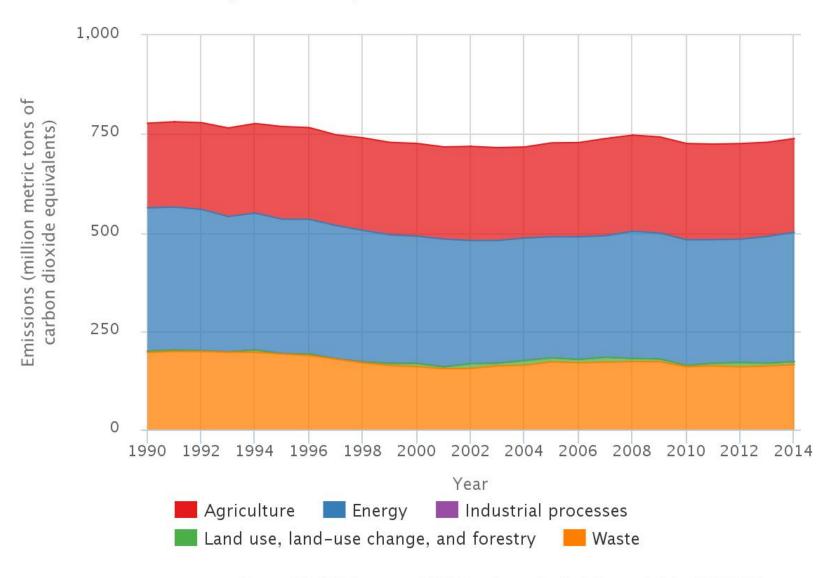
http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html

U.S. Emissions of Nitrous Oxide by Inventory Sector, 1990-2014



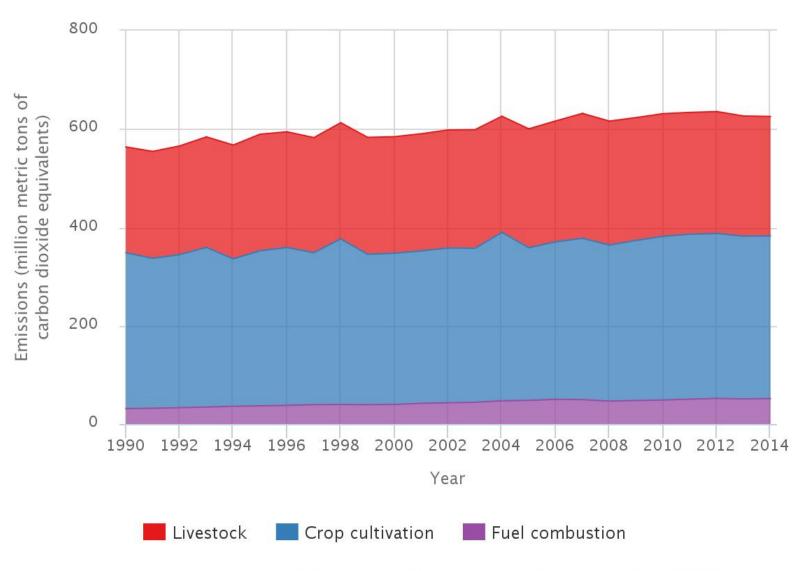
Source: U.S. EPA's Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2014. http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html

U.S. Emissions of Methane by Inventory Sector, 1990-2014



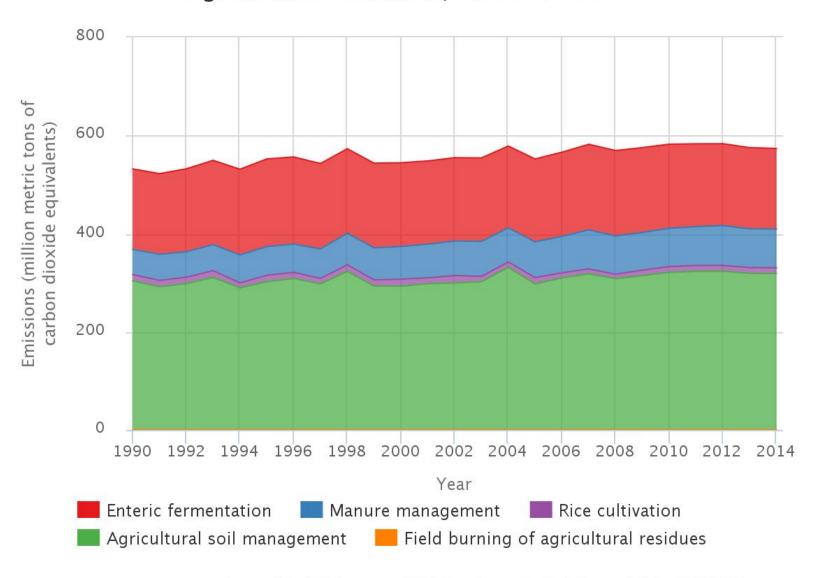
Source: U.S. EPA's Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2014. http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html

U.S. Greenhouse Gas Emissions from the Agriculture Sector, 1990-2014

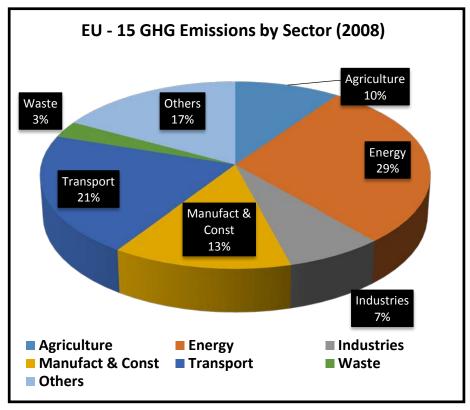


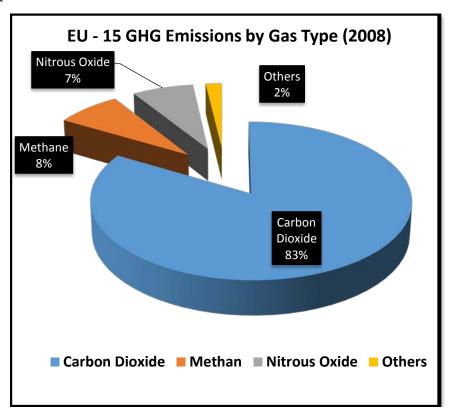
Source: U.S. EPA's Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2014. http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html

U.S. Greenhouse Gas Emissions from Agricultural Activities, 1990-2014

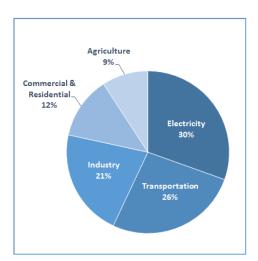


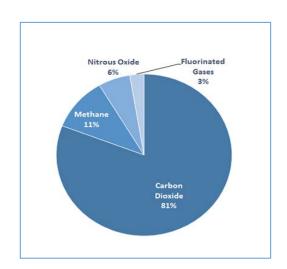
Examining the Environmental Impact of EU ETS: an Input Output Approach - Lawan Usman Ali





Data Source: European Environment Agency (EEA) 2008



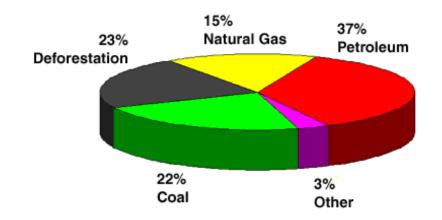


Carbon dioxide

Human / animal / microbial respiration Industrialization Burning of fossil fuels (coal, petrol, diesel, and kerosene)

Burning of forest (lesser trees)

CO₂ is now ¹/₃ more than before Industrial Revolution 60% of the enhanced greenhouse effect



Methane

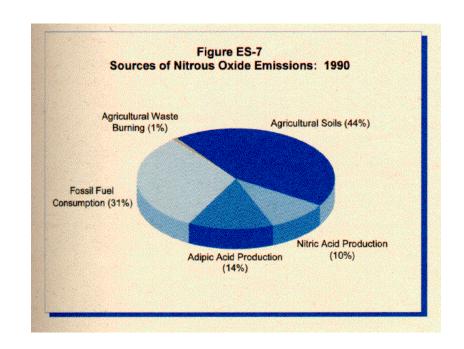
Atmosphere lifespan: 10-12 years. (Less than other greenhouse gases

Livestock and rice production have led to an increase in atmospheric methane.

Other sources are the extraction of fossil fuels, landfill sites and the burning of biomass.

Nitrous Oxide

Burning fossil fuels and wood
Use of fertilizers
Soil processes
Sewage treatment plants
Long lifetime in the atmosphere







Soil is Complex:

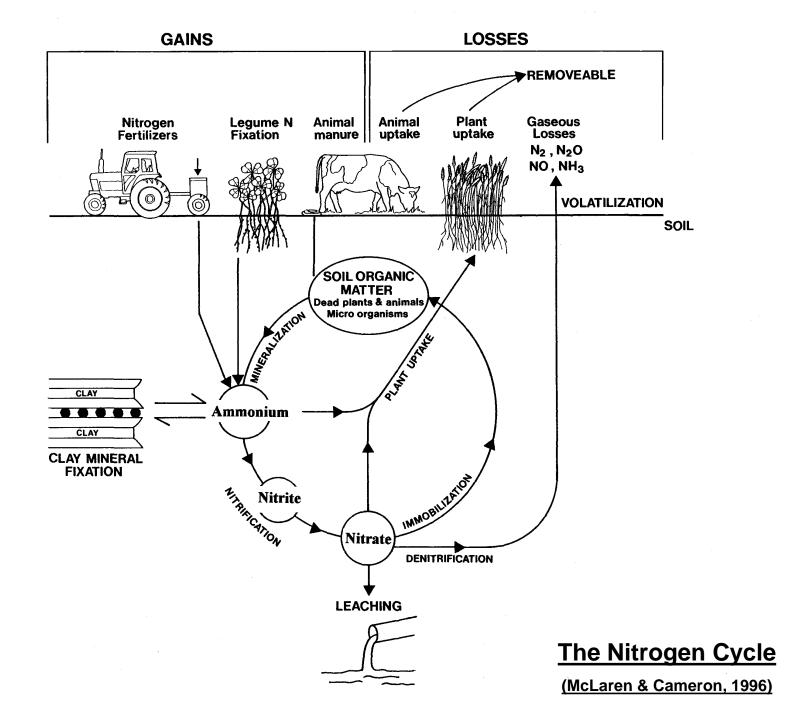
Hard to separate the biology from their environment

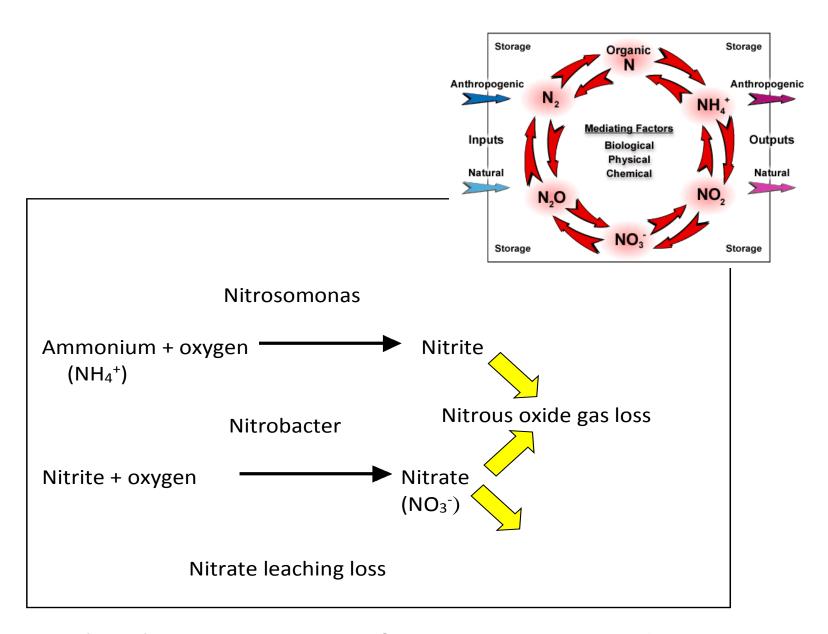
1,000,000,000 bacteria/g soil 7,000,000,000 people on Earth ~ 453,000,000,000 bacteria /lb soil

>7,000 "Species"/g soil
The "collection" changes every few M

The cells are small 0.5- 2 μm

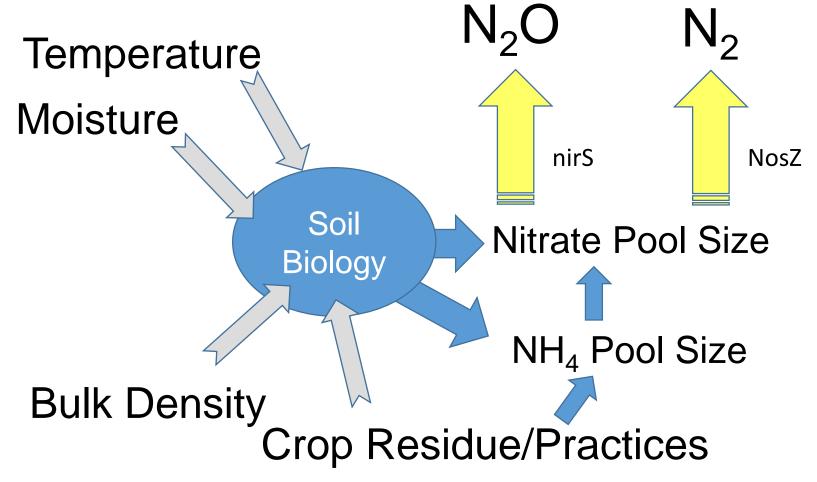
Undescribed as to the total number of potential functions in the system



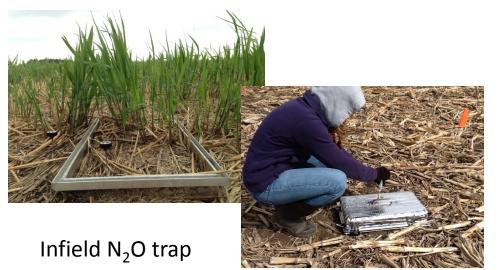


Multiple exit points for Nitrous Oxide

GHG Formation in Soil

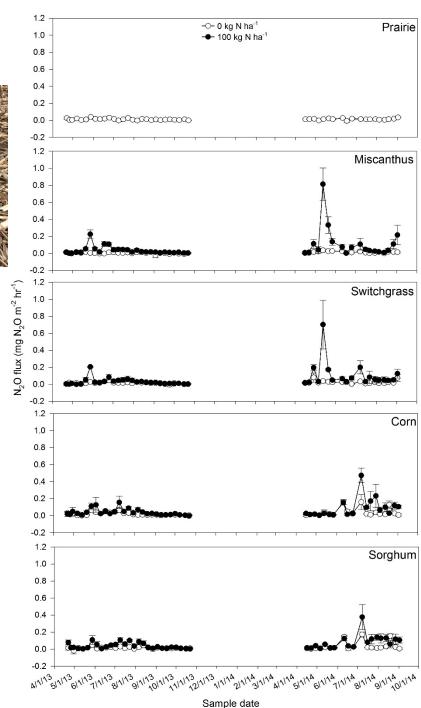


One N_2O equivalent to >300 units of CO_2 .

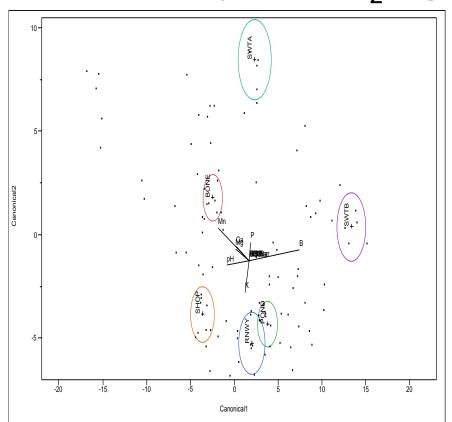


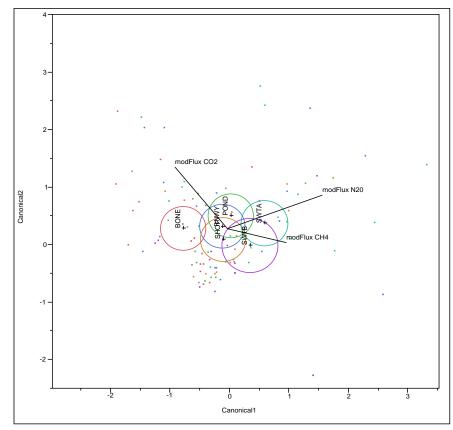


In lab N₂O analysis



Cover Crops and N₂O generation





BONE = cover crop (bean-corn rotation at start)

RNWY = cover crop (corn-corn rotation at start)

POND = cover crop (corn-bean rotation at start)

SHOP = cover crop (corn-corn rotation at start)

SWTA = control no cover (bean-corn rotation at start)

SWTB = control no cover (corn-bean rotation at start)

On Farm Locations

Applying "more than enough N" is no longer cheap "insurance".

Applying "more than enough N" is also not environmentally friendly.

High N fertilizer costs and environmental impacts should encourage growers to critically evaluate their N management program, including application rate, fertilizer material, and timing.

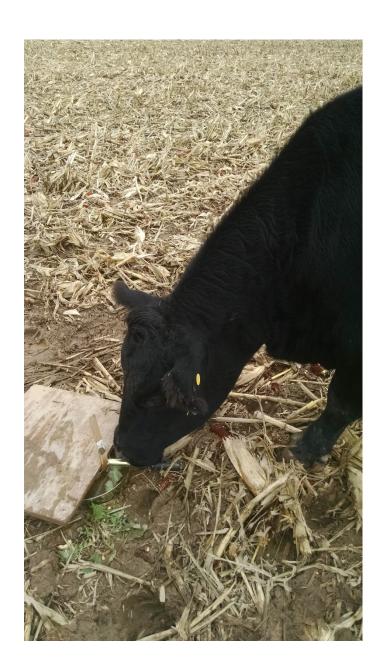
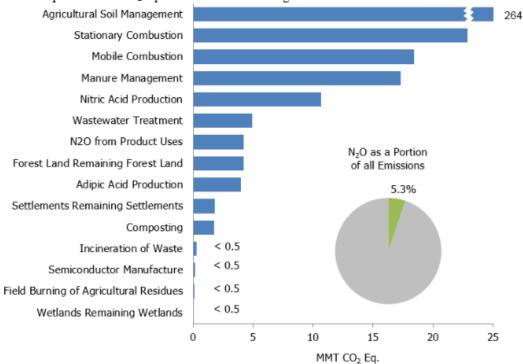


Figure ES-9: 2013 Sources of N2O Emissions

Note: Emissions values are presented in CO2 equivalent mass units using IPCC AR4 GWP values.



(Exiting)	TN load (kg/yr)	TP load (kg/yr)
Illinois	255,337,000	15,043,000
Indiana	212,421,000	6,742,000
lowa	290,402,000	15,558,000

Average composition of selected communities



Phylum

Physican Physican Physican C 2014 (1974)

A 500 below of 2.5 (2014)

A 500 below of 2.5 (2014)

C 500 below of 2.5 (2014)

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Men deather annual (2,27%)

Fall Service (2,27%)

General (2,27%)

General (2,27%)

Fall Service (2,27%)

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DQ(006112, 90, 19%)
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BONE419



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Staptophysic(0.05%;
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Ocenyusia, pr. 69%;
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Recordinatorse(J.Ph.)
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AM91347, 83, 9%)
AB600500, F0, 5%)

DQ129389_5(0.29%)

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SWTA415



Phylam

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