Biomass Burning in the Tropics: Impacts on Atmospheric Chemistry and Biogeochemical Cycles

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What is…?

- **Biomass**- Wood, Agricultural Waste (table 26.1, page 308)
- **Trace particles**- Carbon compounds, Nitrogen gases, Sulfur gases, Smoke (table 26.2, page 309)
- **Tropics**- Parts of Africa, India, South America
- **Biogeochemical Cycles**- Nitrogen cycle, Carbon Cycle, Hydrologic Cycle

What are the authors saying?

- Humans are burning biomass, especially in the tropics
- Large amounts of trace gases and aerosol particles are being released into the atmosphere effecting biogeochemical cycles
- The article serves as an update of quantitative estimates of biomass burning (review article)

Deconstructing the Units

- Petagrams= 10^{15} grams
- Teragrams= 10^{12} grams
- Tg Dm= teragrams of dry matter

Why is biomass being burned?

- Clearing of forests and brushlands for agricultural use
- Control of pests, insects and weeds
- Prevention of brush and litter accumulation to preserve pasturelands
- Nutrient mobilization
- Game hunting
- Production of charcoal for industrial use
- Energy production for cooking and heating
- Various religious and aesthetic reasons

Consequences of Emissions

- Atmospheric Chemical Effects
- Climatic
- Ecological

Atmospheric Chemical Effects

- Long range transport of smoke plumes
  - Gases from biomass burning
  - Plumes drift
  - Recording of chemical measurements

http://www.daac.ornl.gov/S2K/s2k_photo_pages/fire_studies/smoke_plumes.html

Atmospheric Chemical Effects

- Photochemical Smog Chemistry
  - Production of CO_2, ozone (O_3), OH radicals
  - Relationship to smoke plumes (fig. 26.2, pg.314)
  - Concentration Cycle

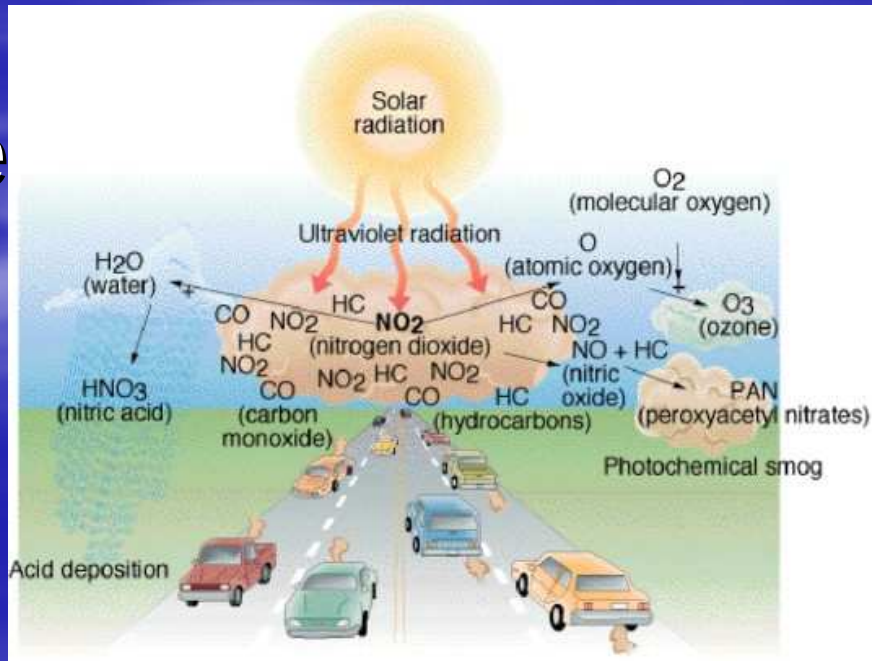


Image: www.uwm.edu/.../Chapter02/ air_quality04.htm

Atmospheric Chemical Effects

- Perturbation of Oxidation in the Troposphere
  - Change in chemical behavior in the troposphere
  - Low OH and positive feedback
  - Biomass burning and negative feedback

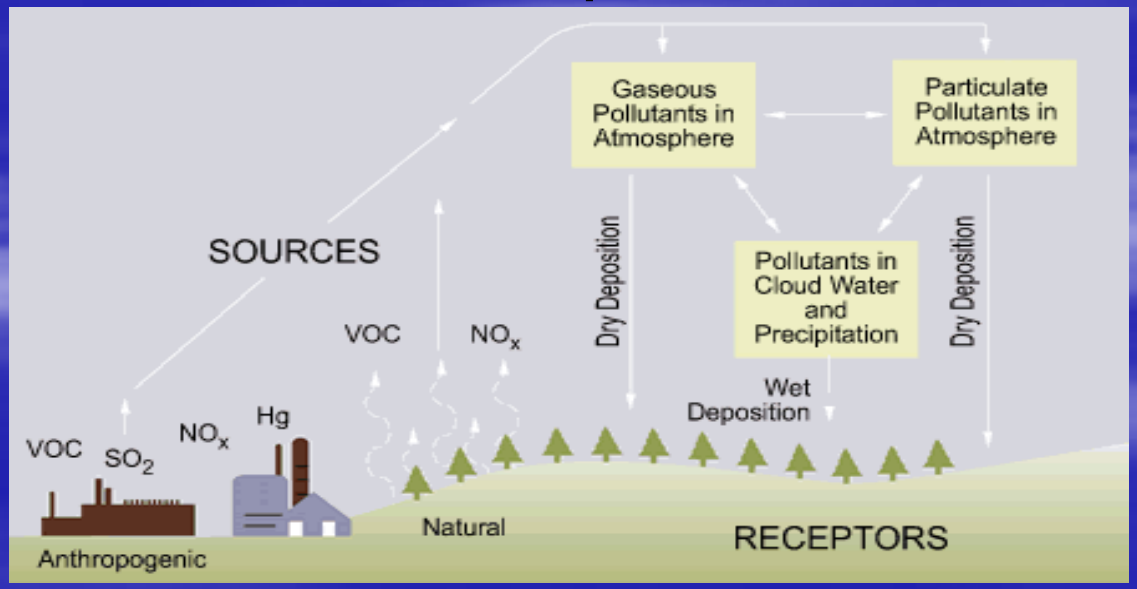
Climatic and Ecological Effects

- Climate Change
  - Greenhouse effect
  - Smoke Aerosols
  - Cloud Formation (CCN)
  - Deforestation and Desertification

Image:www.climatechange.gc.ca/.../ earth.asp

Climatic and Ecological Effects

- Acid Deposition
  - Acid rain in tropics
  - Biomass burning and rain acidity
  - Acid deposition and forest damage
  - Research still needed in the tropics



www.meteor.iastate.edu/gccourse/acid/images.html

Climatic and Ecological Effects

- Alteration of Nutrient Cycles and Effects of Soil Degradation
  - Nitrogen Cycle
  - Carbon Cycle

Conclusions

- Analysis of tropical biomass burning is still uncertain
- Quantitative Knowledge of Biogeochemical Effects Needs to Improve Considerably

Conclusions

- Biomass burning is a major source of trace gases
- Emissions are altering the chemical makeup of the atmosphere

Conclusions

- Biomass burning is an important source of smoke particles
- Potential harm in the global biogeochemical cycles