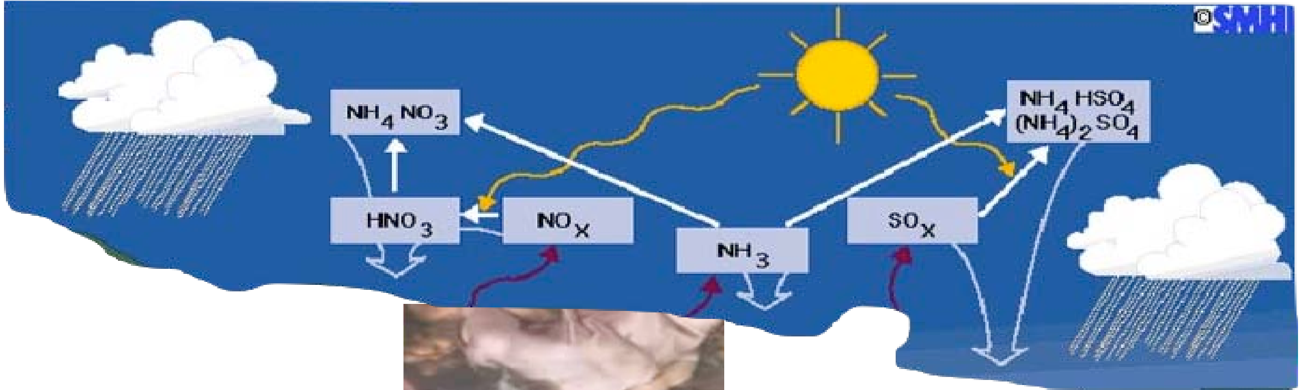
Introduction to Biogeochemistry-Climate/Chemistry Joint Session

Peter Hess (Cornell University)

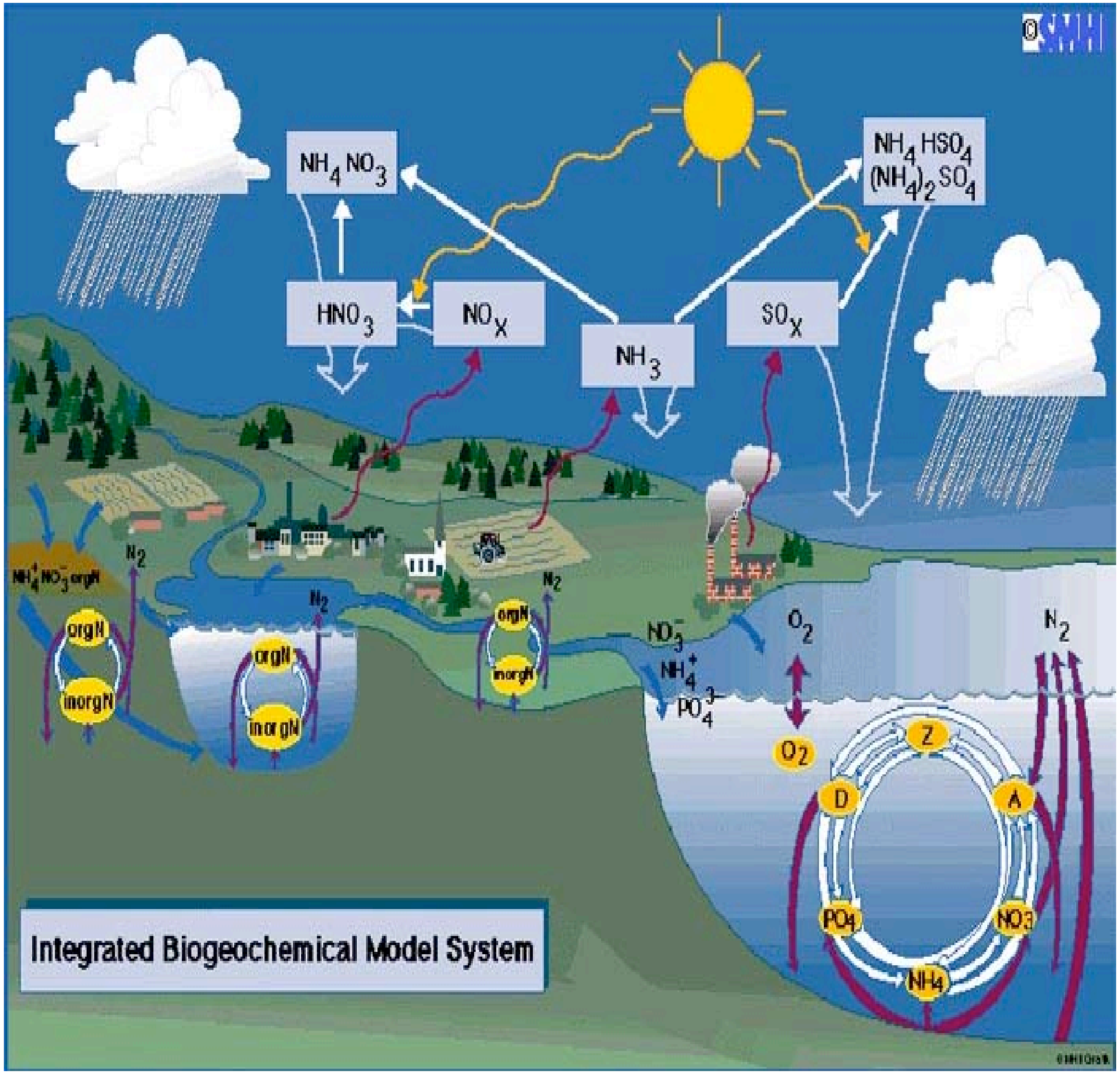


Atmosphere

Deposition

Emissions

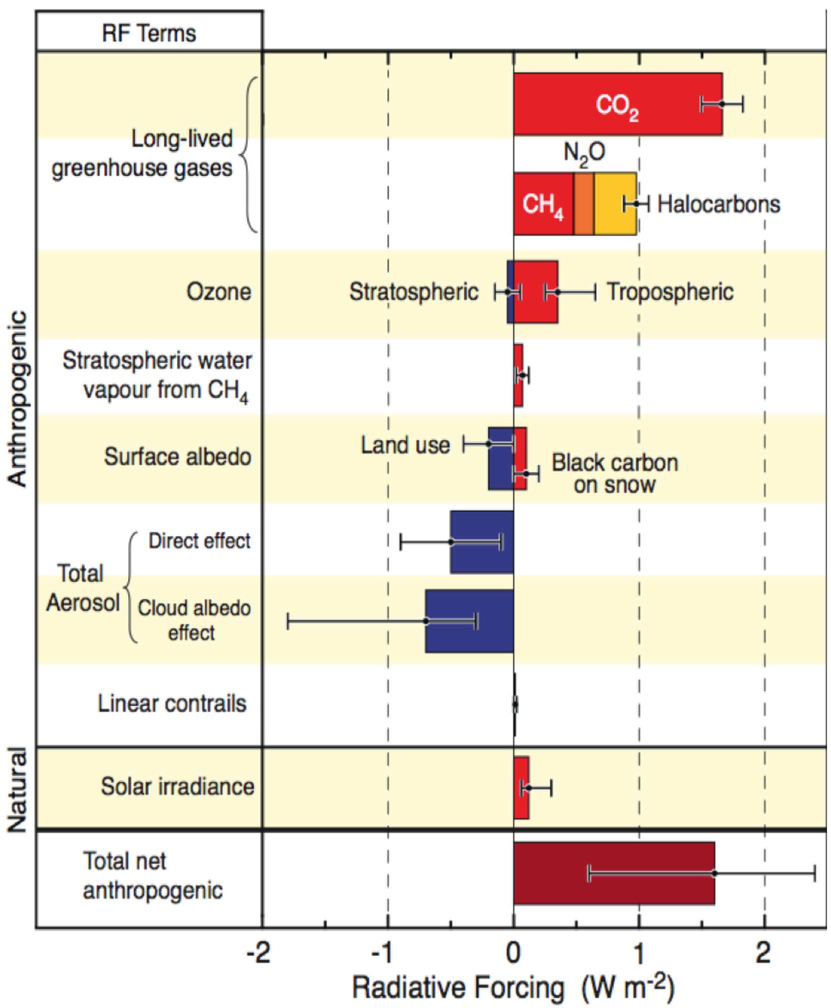
Land/Ocean



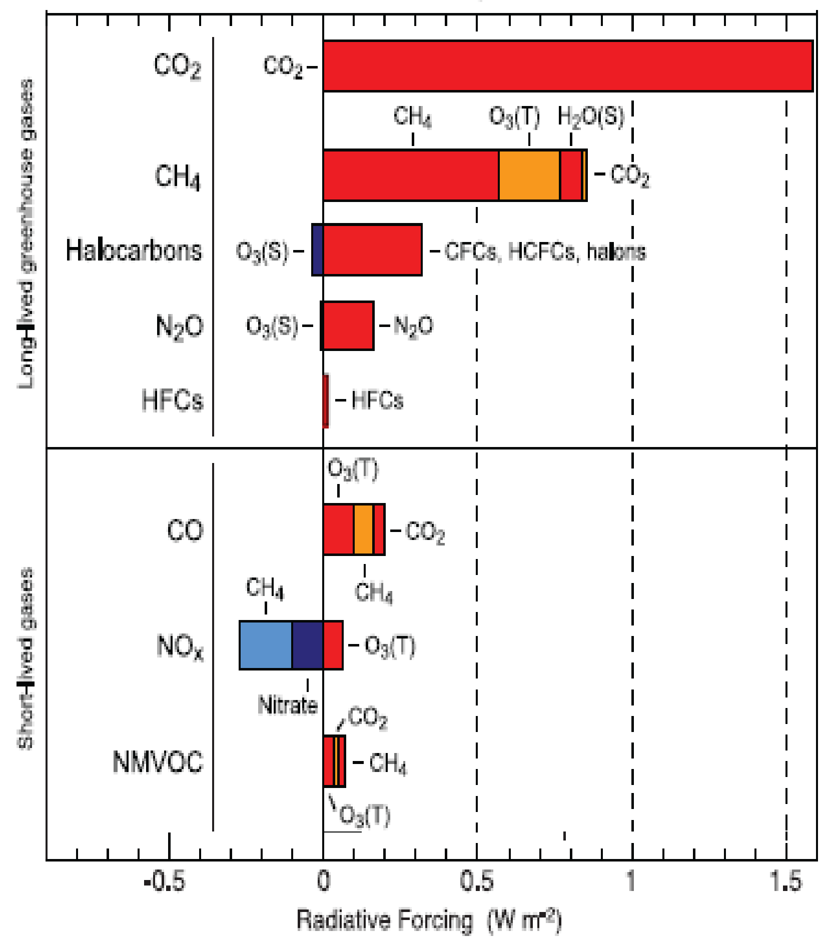
Feedbacks between land-ocean and atmospheric components

Atmosphere measurements:
-Provide important clues to land/ocean processes
-Integrate the impacts of local and regional processes

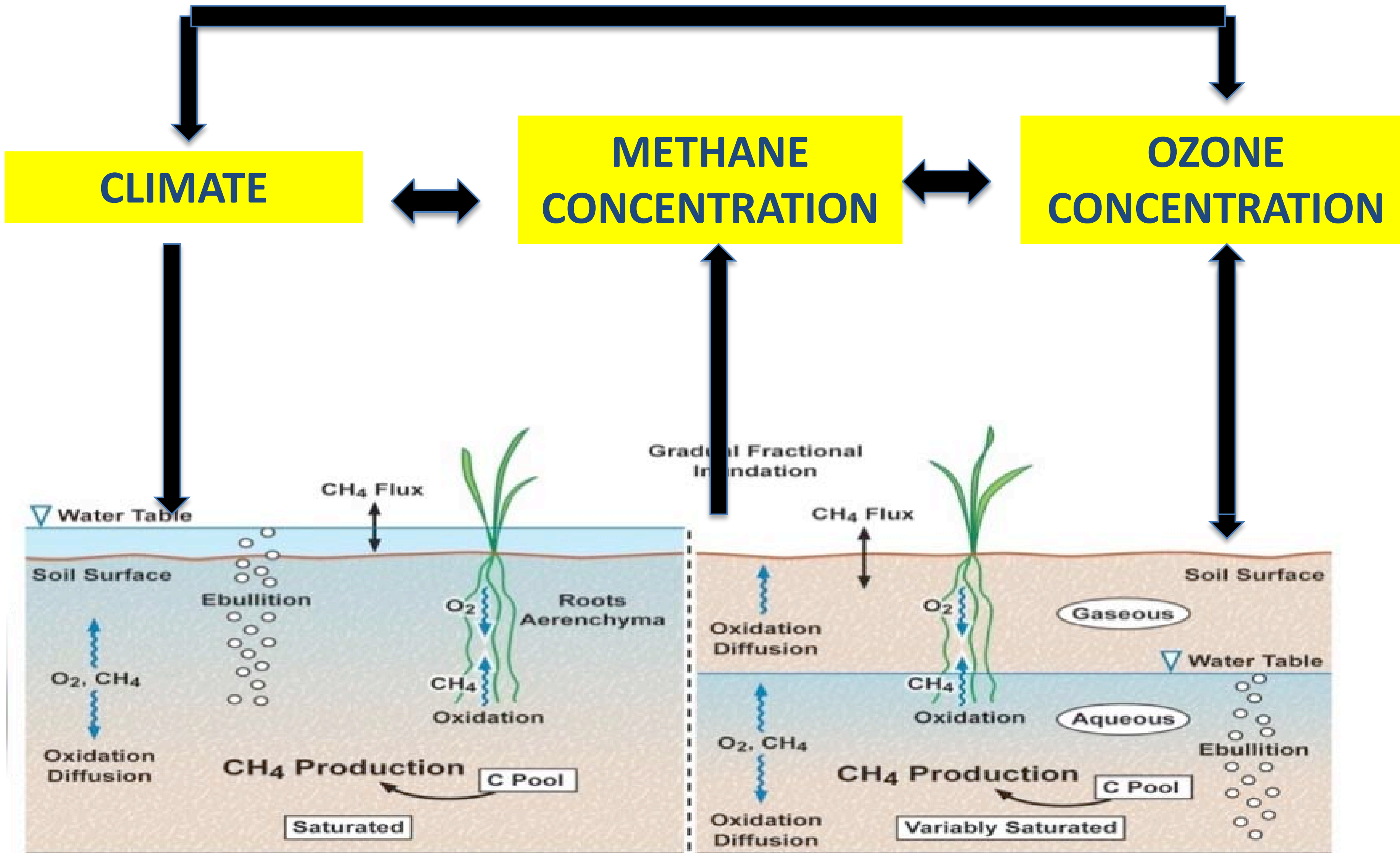
Radiative Forcing (Concentration)



Radiative Forcing (Emissions)



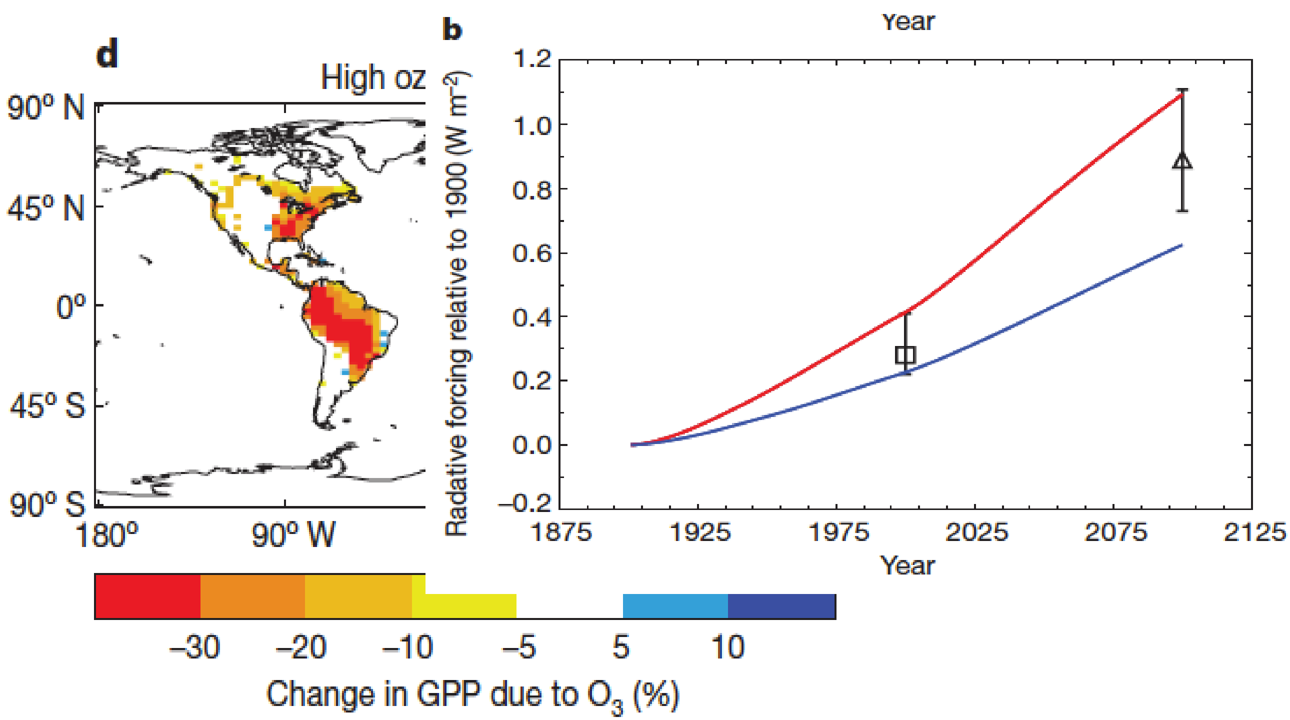
Methane


CLIMATE
METHANE CONCENTRATION
OZONE CONCENTRATION
Water Table
CH_4 Flux
Soil Surface
Ebullition
Roots Aerenchyma
O_2
O_2, CH_4
CH_4
Oxidation
Oxidation Diffusion
CH_4 Production
C Pool
Saturated
CH_4 Flux
Oxidation Diffusion
O_2
Soil Surface
Gaseous
Water Table
CH_4
Oxidation
Aqueous
Ebullition
O_2, CH_4
CH_4 Production
C Pool
Oxidation Diffusion
Variably Saturated

Ozone

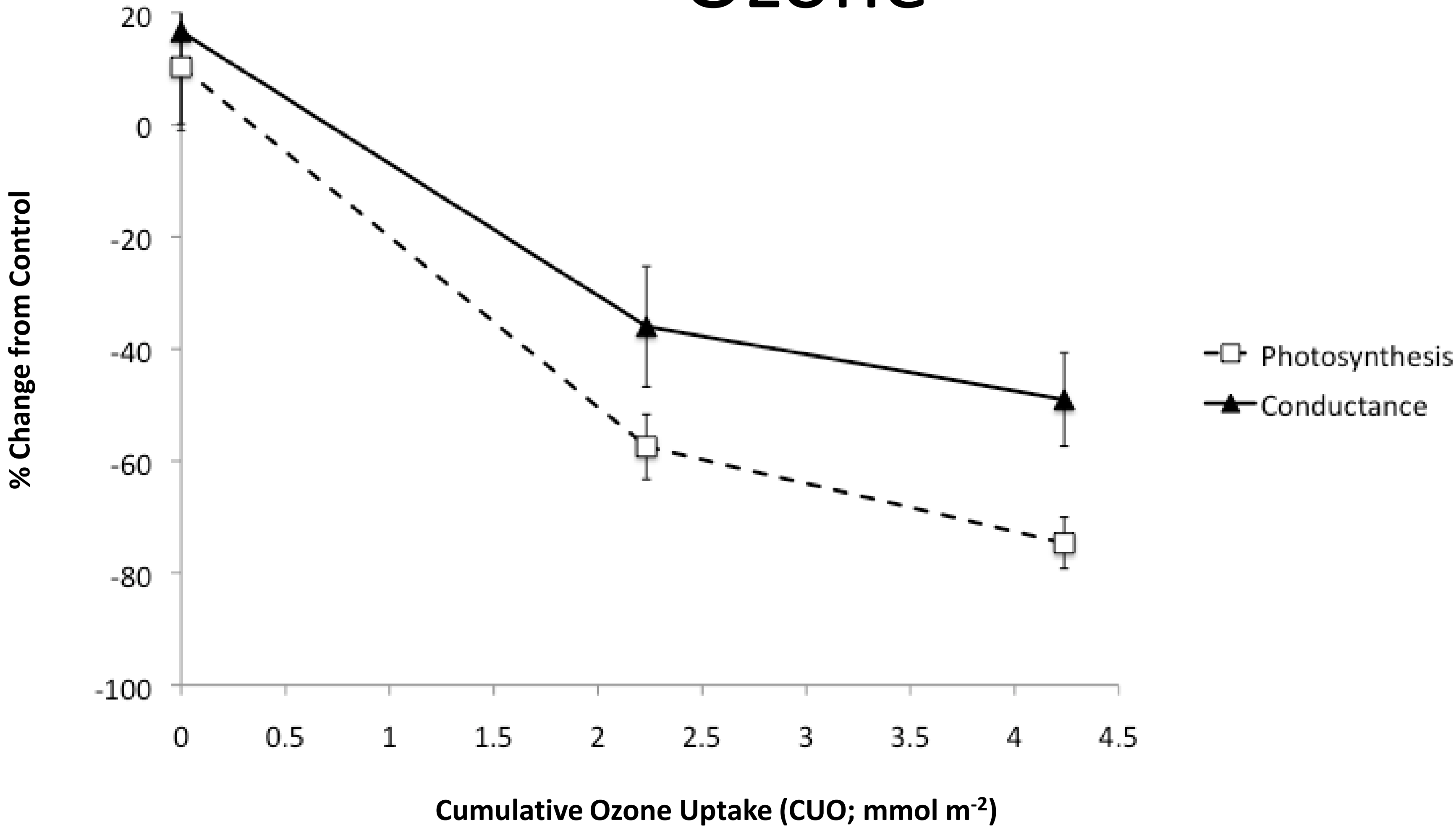
CLIMATE ⟷ METHANE CONCENTRATION ⟷ OZONE CONCENTRATION

RBON CYCLE



Sitch et al., Nature (2007)

Ozone

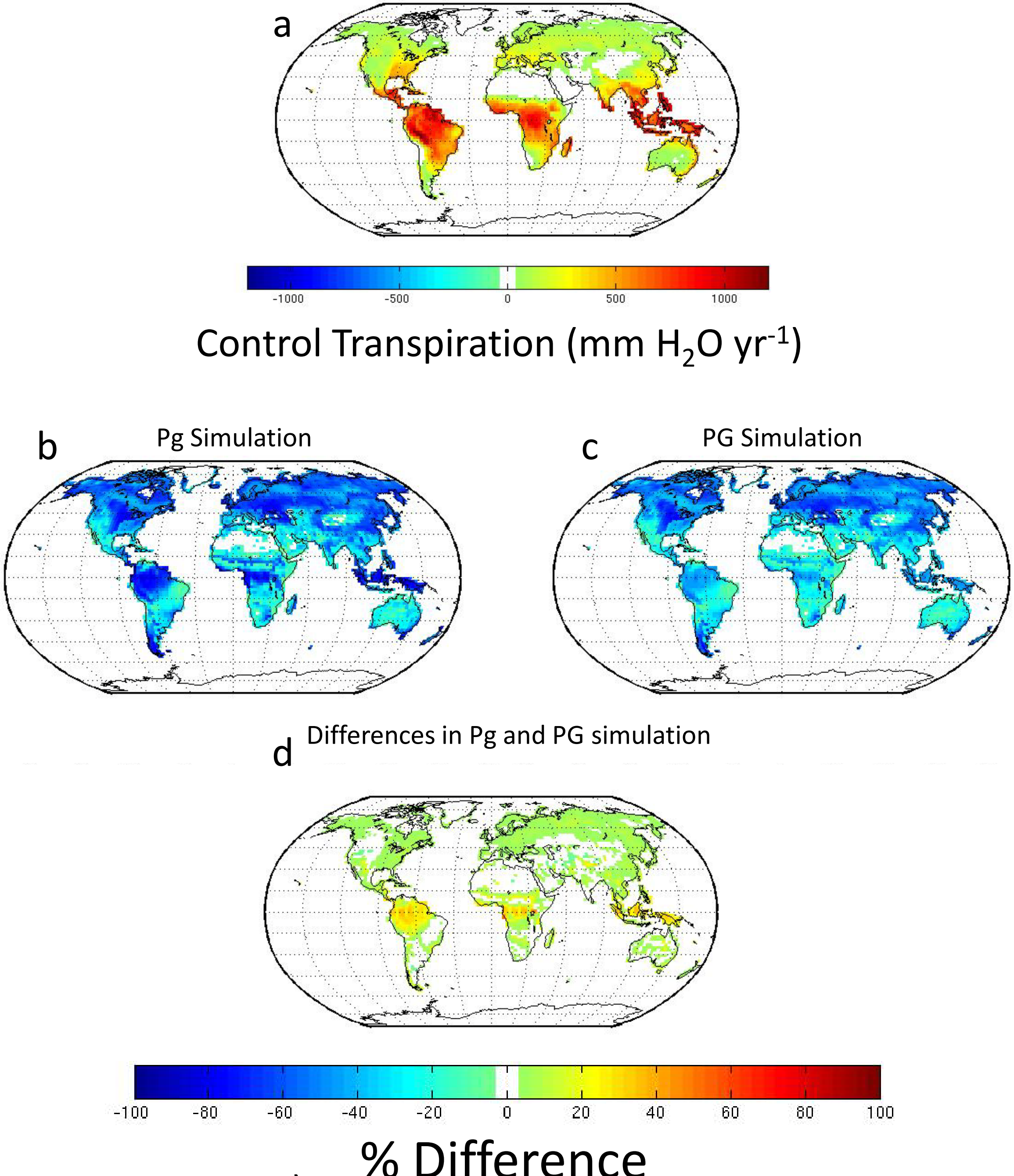


Ozone exposure causes a decoupling of conductance and photosynthesis: implications for the Ball-Berry stomatal conductance model.

Danica Lombardozzi, and Jed P. Sparks (Cornell University)

Gordon Bonan and Samuel Levis (NCAR)

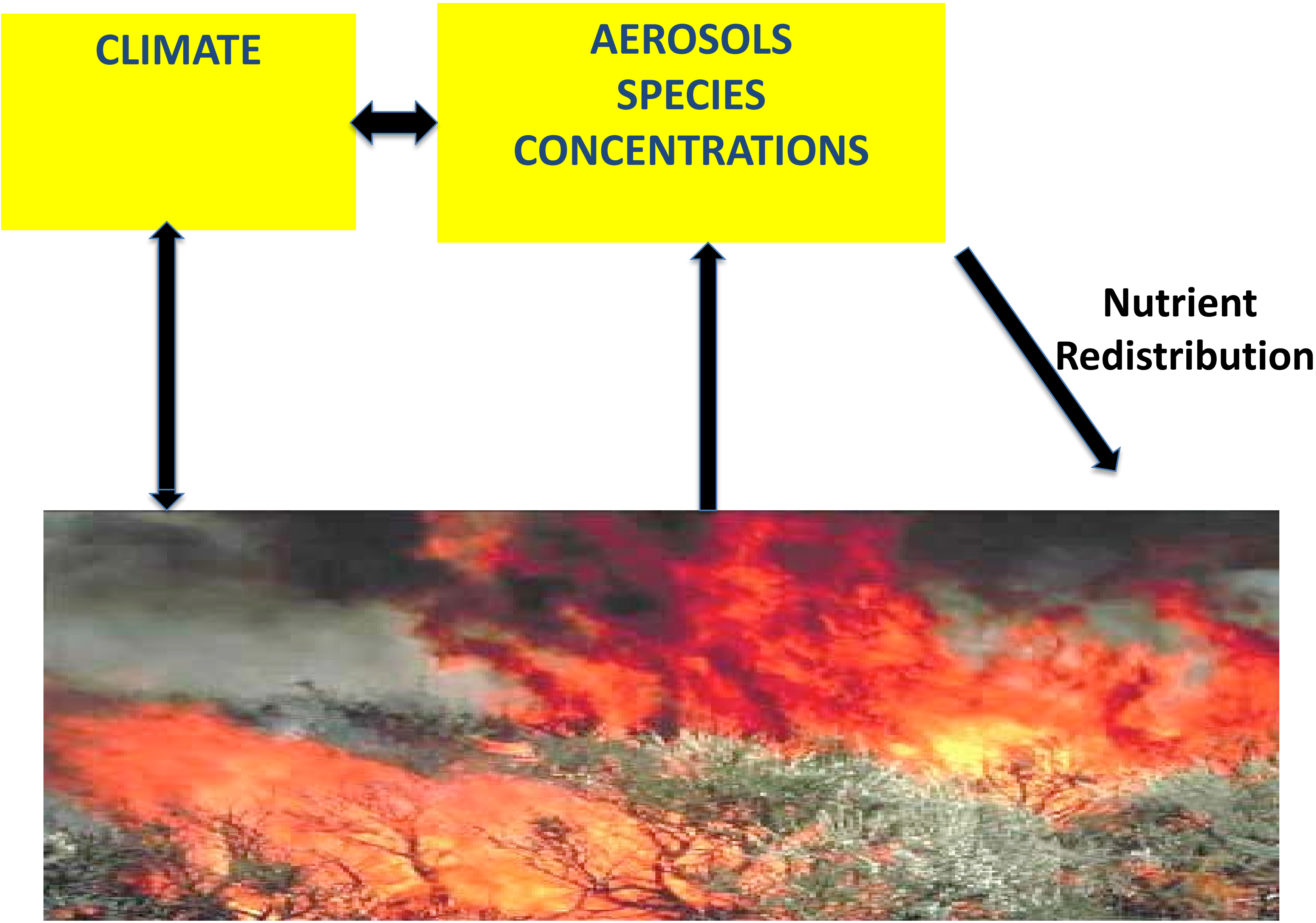
Sitch Conductance Controlled by Photosynthesis



Lombardazzi Conductance Decoupled from Photosynthesis

(Danica Lombardozzi, Cornell University)

FIRE


CLIMATE
AEROSOLS
SPECIES
CONCENTRATIONS
Nutrient
Redistribution

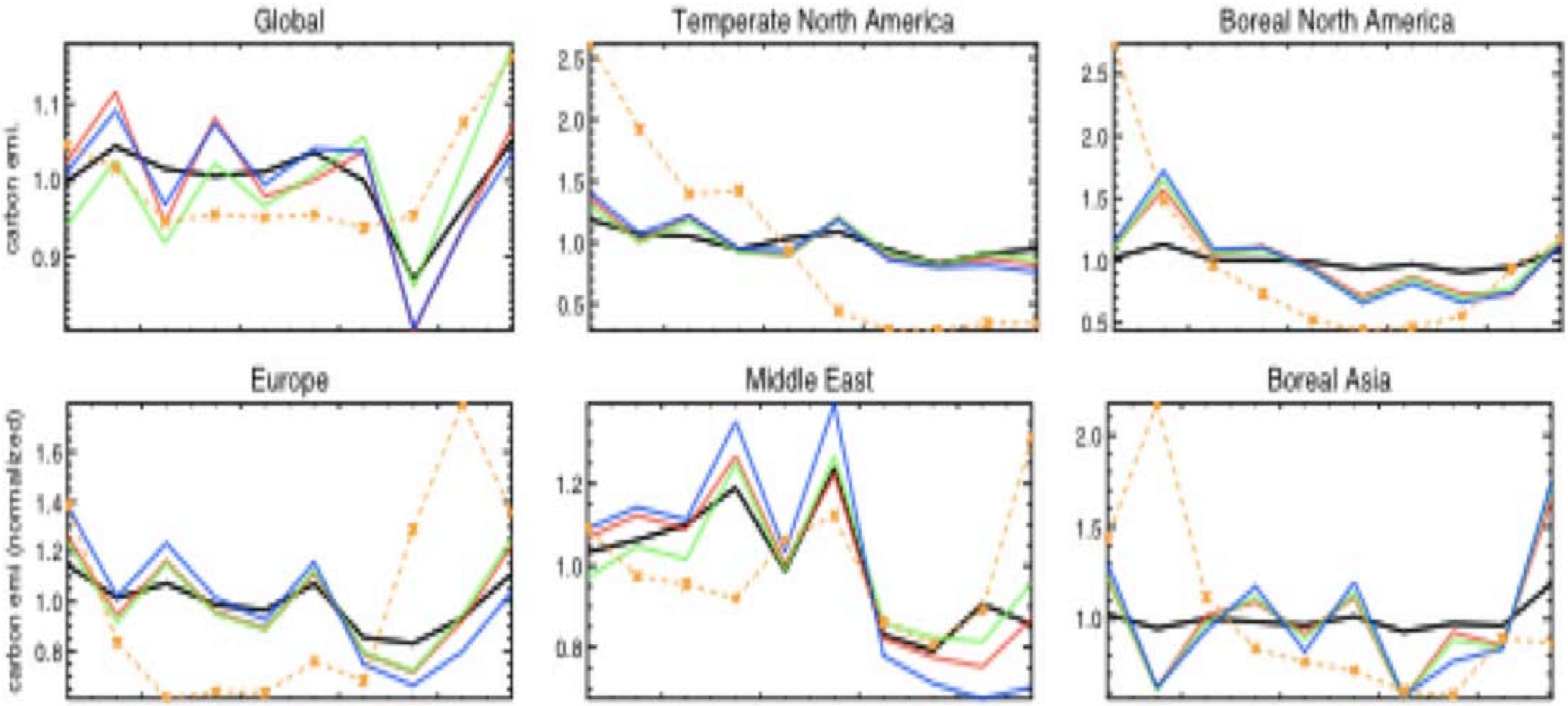
Prognostic Fire in the CESM

- Fire is an Earth System Process:
- Sensitive to climate/vegetation:
  - Requires litter/vegetation for fuel
  - Soil moisture must be low
  - Ignition based on lightning/convection
- Sensitive to humans
  - Ignition from humans
  - Fire suppression based on human density
- Impacts climate
  - Carbon balance changes
  - Emissions of aerosols, gases
  - Changes vegetation type (in real life, not in model right now)
  - Changes surface albedo (in real life not well described in model right now)
- Ongoing work
  - Estimate future fires using different climate model predictions (Kloster et al., in prep)
  - Estimate radiative forcing of fires
  - Couple fires in carbon/climate/aerosol model to see impact on carbon cycle

Kloster, Mahowald, Randerson, Ward,

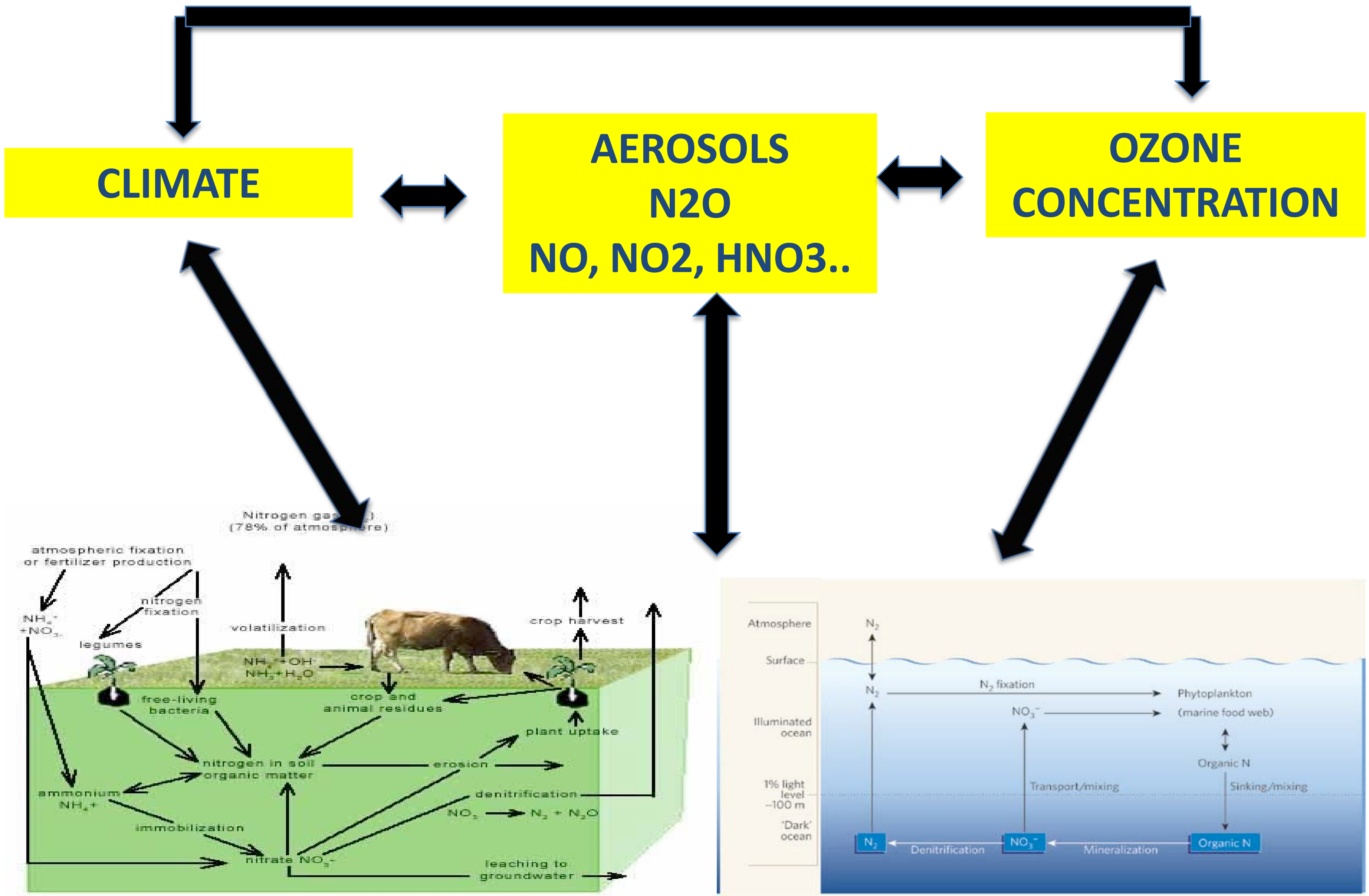
Model can predict trends in emissions from climate change and other factors

Normalized Fire Emissions: Solid Model Simulations, Dashed Observations (GICCHIST)



S. Kloster, N. Mahowald, J. T. Randerson, P. E. Thornton, F. M. Hoffmann, S. Levis, P. J. Lawrence, J. J. Feddema, K. W. Oleson, D. M. Lawrence, Fire dynamics during the 20th century simulated by the Community Land Model, Biogeosciences, y, 1877-1902, 2010. http://www.biogeosciences.net/7/1877/2010/.

Nitrogen Cycle



CLM-CN Soil Mineral N Budget in 2000

INPUTS	Tg N yr^{-1}
Biological N2 Fixation	120
Atmospheric Deposition	65
OUTPUTS	
Denitrification	137
Leaching	0
Fire	28
Wood Products	2
Storage	17

Should include
-Fertilization
-Cu

Should be speciated
-Nitrates

Should be speciated and
include nitrification flux

Should be significant
-120 Tg N yr^{-1} (Galloway et al.)

Should be speciated
-N2, NO, NH3, organics, ….

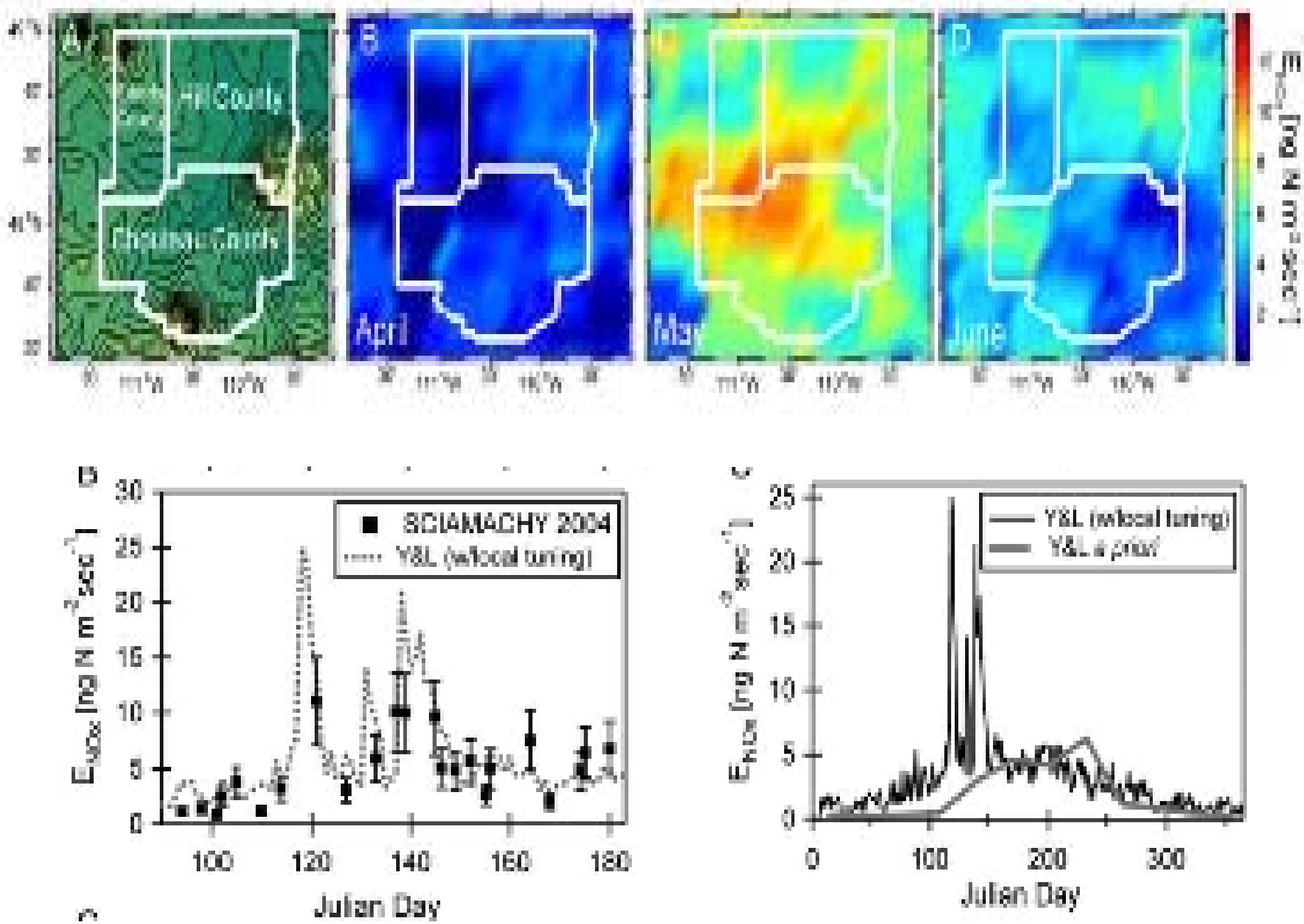
Carbon Cycle will be modified
by above

Where is storage occurring?

Pool	N	C
Soil Organic Matter	33 %	2 %
Vegetation	67 %	98% ~1/4 root
		~3/4 stem

(Cindy Nevison)

MONTANA NOX EMISSIONS FROM SCIAMACHY NO2 COLUMNS



BERTRAM ET AL, GRL, 2005