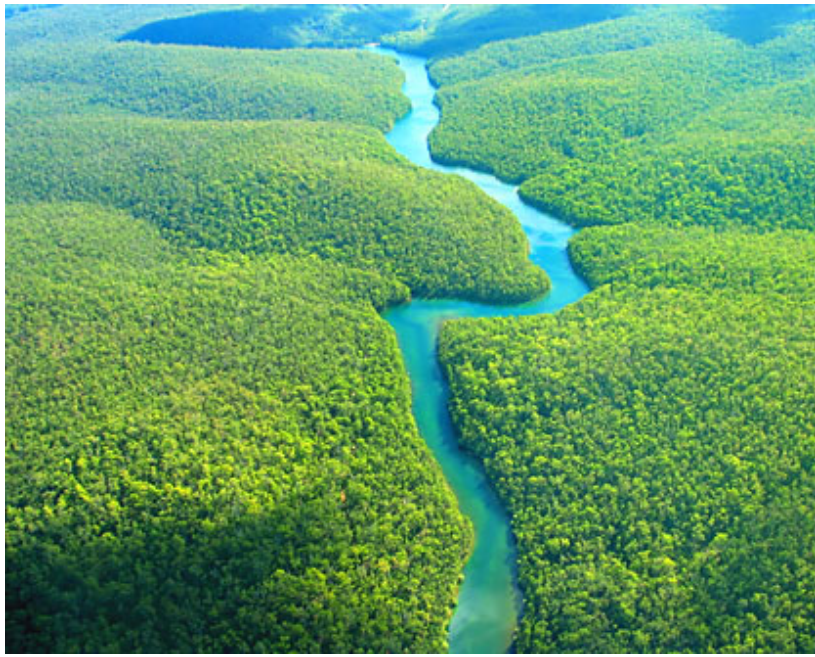
Research Priorities for Tropical Ecosystems Under Climate Change Workshop

June 4-5, 2012; Bethesda, MD

BERAC
October 16, 2012



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Terrestrial Ecosystem Sciences

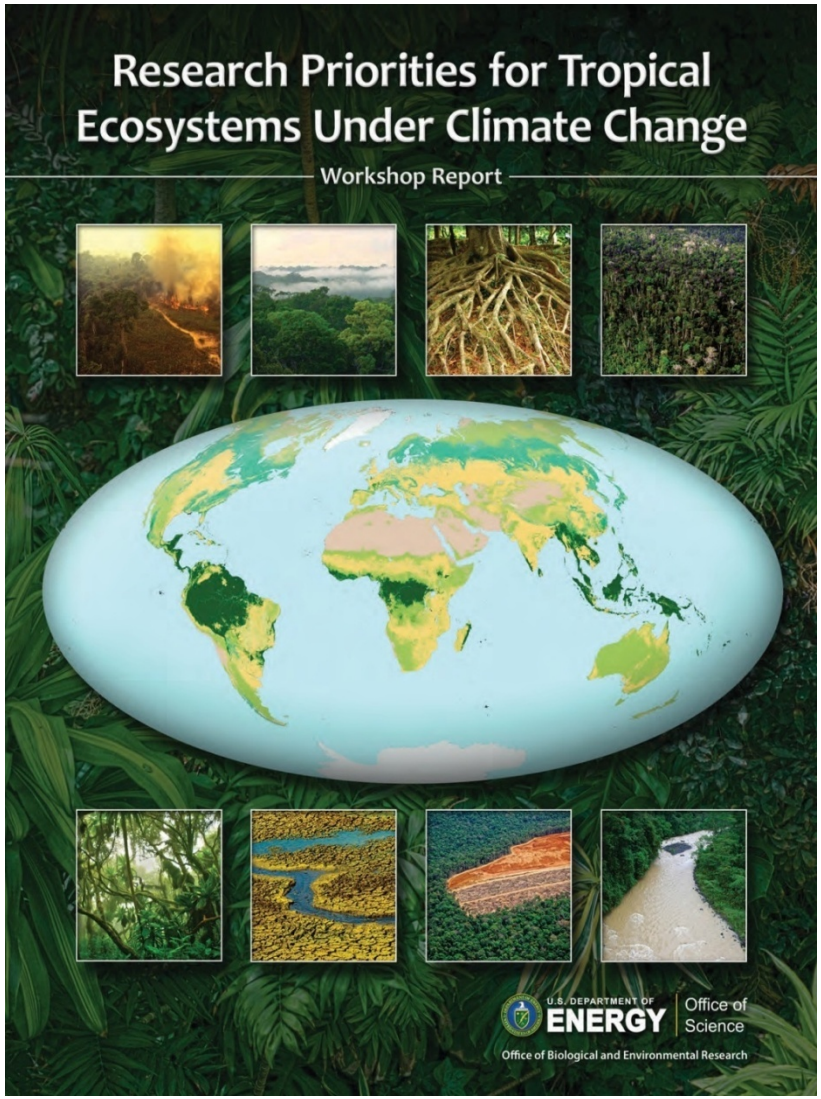
Why a workshop focused on the Tropics?

- Covers 40% of Earth's surface
- Dominates carbon cycle
- Vulnerable to small climate changes
- Regulates major climate feedbacks affecting entire planet
- Inadequately represented in Earth system models

- **The next major NGEE will focus on the Tropics**
- **Workshop outputs will help define the scientific priorities**

Workshop Goal and Outputs

- Goal: Summarize what we do and don't know about the interdependence of tropical ecosystems and climate change
- Themes discussed
  - Soil biogeochemistry and hydrology
  - Natural and anthropogenic disturbance
  - Tropical forest ecophysiology
  - Cross-cutting issues



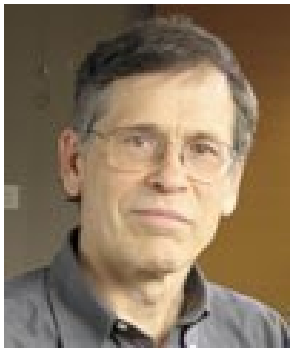
Workshop Co-Chairs

Rich Norby
ORNL

Rosie Fisher
NCAR

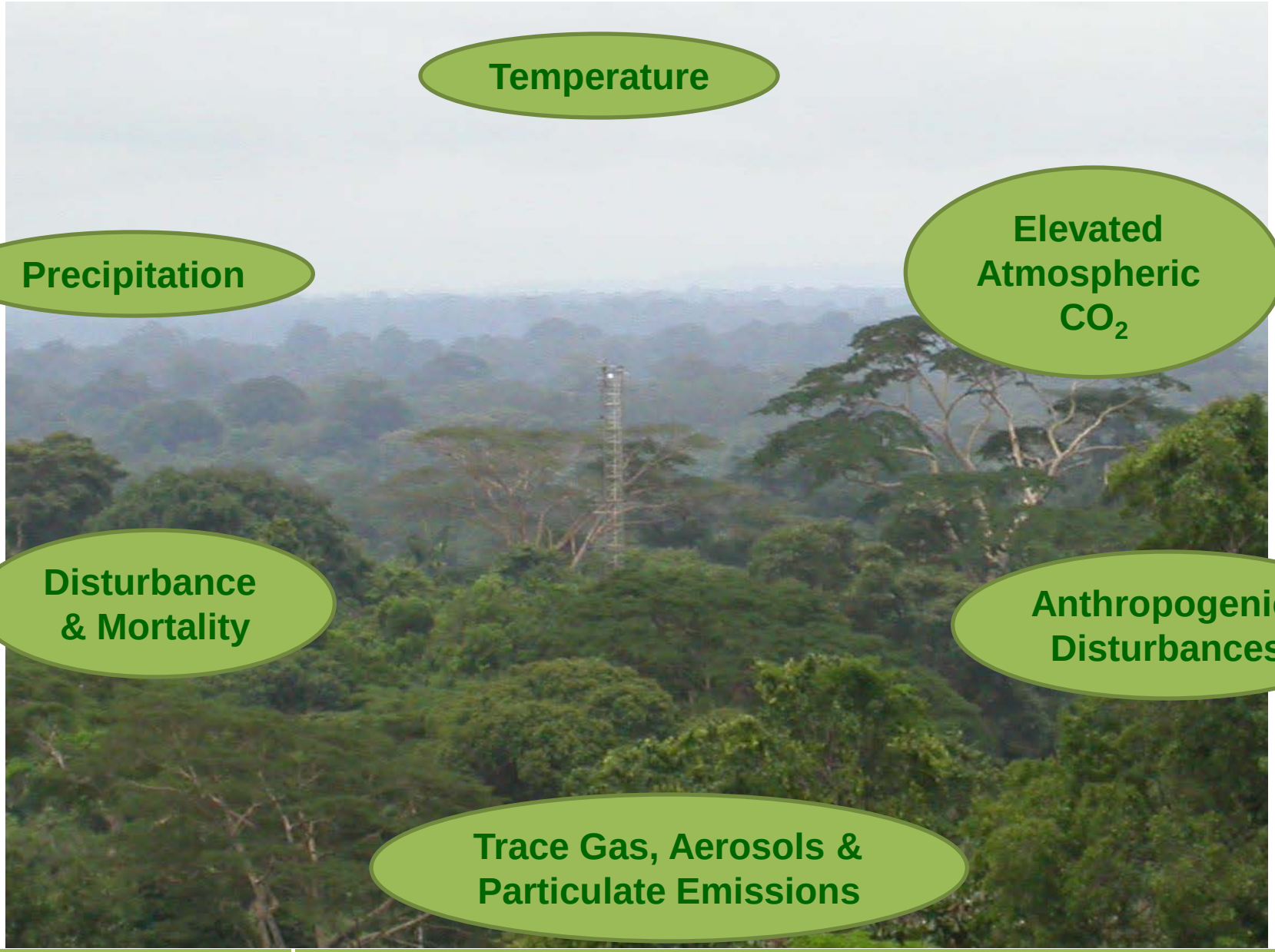
Jeff Chambers
LBNL

Jefferson Hall
Smithsonian Institution

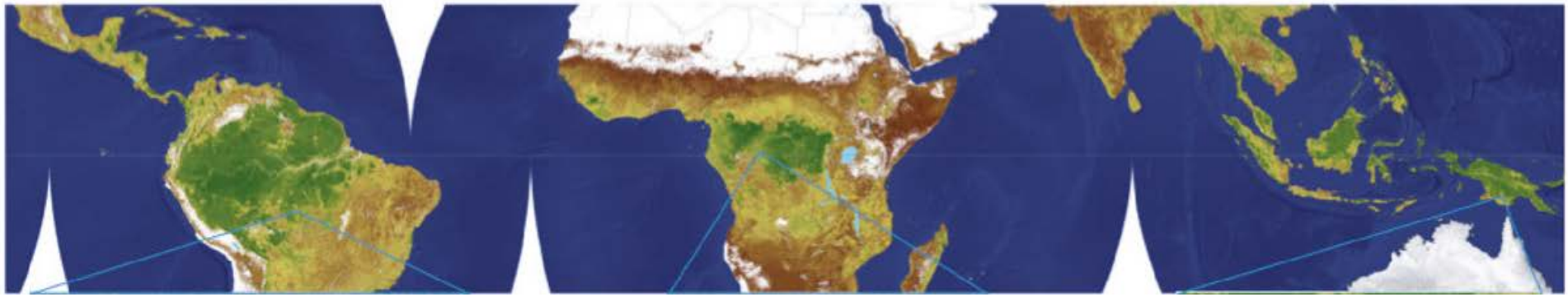


Steven Wofsy
Harvard University

Major Themes and Uncertainties discussed



Geography

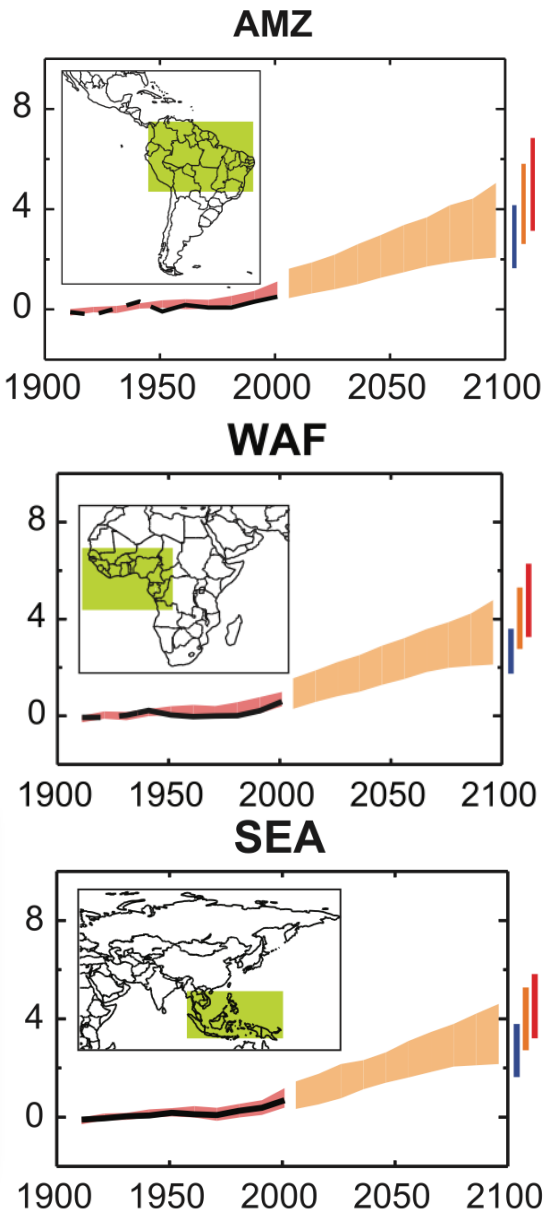


Workshop focused on three major regions

- **Neotropics**
  - South America, Central America, and the Caribbean
- **Afrotropics**
  - sub-Sahara Africa
- **Indo-Malay-AustralAsia tropics**
  - Southeast Asia, parts of India, southern China

Key Outcomes – Temperature

- **How will tropical ecosystems respond to increasing temperatures?**
  - 2-5ºC increase in tropical systems by 2100
  - No analogous environments to for comparison
  - Need to understand temperature thresholds and sensitivities
    - Photosynthesis and respiration,
    - Plant allocation,
    - Soil biogeochemical processes,
    - Functional diversity
    - Spatial and temporal variation



Key Outcomes – Precipitation

- **How will tropical ecosystems respond to changes in rainfall?**
  - Models indicate reduced precipitation across most of the tropics
  - Drought vulnerability is poorly understood
  - Need to understand changes in precipitation
    - spatial and temporal drivers
    - feedbacks of drought stress and tree mortality
    - Improve model representation of
      - soil depth, structure, and hydraulic properties, root systems, and stomatal regulation

Key Outcomes – Disturbance and Mortality

- **How will natural disturbance events and mortality increase as a result of climate forcings?**
  - Increased tree mortality can significantly affect the global carbon cycle and net forest CO_2 exchanges
  - Models inadequately represent disturbance regimes
  - Need to understand mechanisms of mortality
    - Relationship with atmospheric convection patterns
    - Extreme events,
    - Shifts in vegetation

Key Outcomes – CO_2

- **How will tropical ecosystems respond to increasing atmospheric CO_2 concentrations?**
  - Integrated response of forest ecosystems and the feedbacks to the atmosphere are difficult to predict

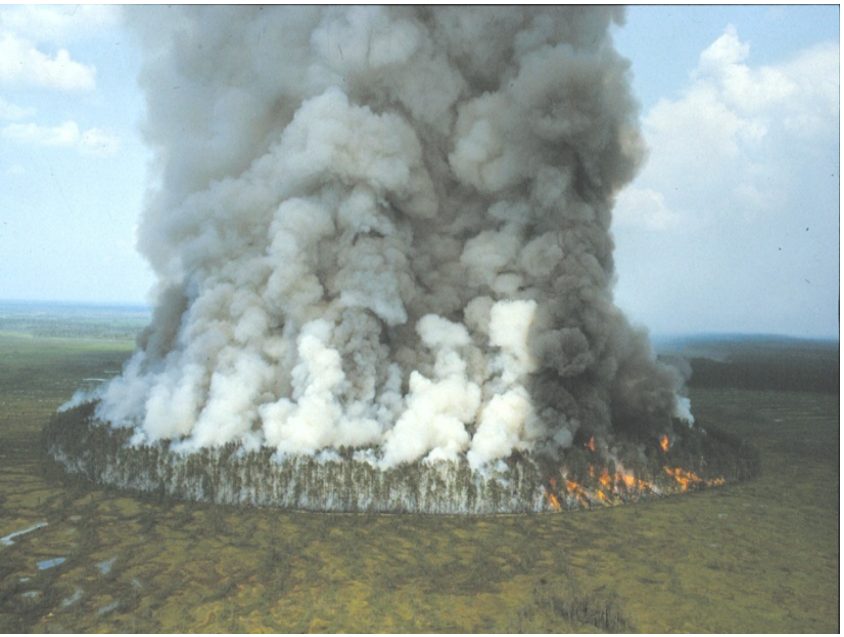
  - Need to understand the response to elevated CO_2 including biogeochemical interactions
    - In order to predict longer-term fate of carbon, models need data on leaf-level gas exchange, nutrient limitations, carbon allocation patterns, belowground responses,
  - Will elevated CO_2 ameliorate drought responses?

Key Outcomes – Aerosol and Particulates

- **What are the interactions between climate change and aerosol/particulate emissions from tropical forests?**
  - Tropical forests are large sources of biological aerosols and trace gases
  - Key uncertainties include physiological and climatic regulation of methane and nitrous oxide production/emission
  - Improved model representation of light quality, storm intensity, cloud-aerosol interactions, nutrient deposition, and ozone effects

Key Outcomes – Anthropogenic Disturbance

- **How will tropical forest interactions with the Earth system shift as a result of anthropogenic disturbance and land-use change?**



- A significant fraction of the tropical forest cover lies in areas recovering from logging or in secondary forests and land abandoned from agriculture
- Need improved understanding of
  - Land use changes and hydrology,
  - Sensible and latent heat fluxes,
  - Impacts on soil biogeochemistry

NGEE Tropics

The overall goal of BER's decade long investment will be to investigate tropical ecosystems, their feedbacks and vulnerabilities to climate change, and to improve the representation of these systems in Earth system models.

- **NGEE Tropics will:**
  - be a model informed field study that results in iterative refinement of high resolution predictive models
  - be based on field studies in the most climate sensitive tropical geographies that provides a high scientific return on investment
  - provide an critical opportunity for collaborating and leveraging National Laboratories, university and other federal investments

Questions?

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