


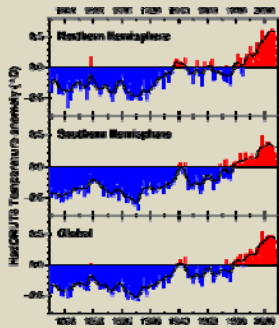

## Grand Challenge Climate change - impacts on agriculture and natural resources

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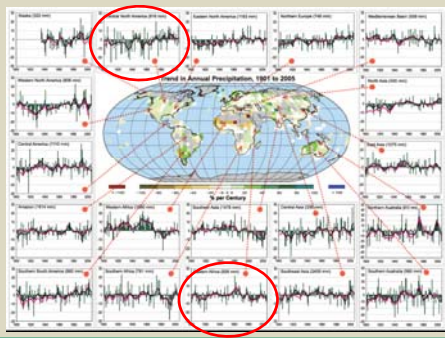



### The challenge

- One of the most significant challenges affecting the mankind today.
- Includes changes in the physical and chemical climate and the associated impacts on agriculture, food security, and feedbacks.





### The challenge: it's regional

### Overview of activity


- Faculty in the department have been doing Climate Change research for many years
- Not all faculty doing research that directly relates to the impacts of climate change have done it with this in mind
- Collaborations common but not broadly across the many disciplines in the department



### Overview of activity: past 5 yrs

**Education/Extension**


- completed or ongoing training of more than 20 graduate students and 9 Post-doctoral researchers
- PhD. program involving the integration of earth sciences towards climate change issues
- Indiana State Climate Office



### Overview of activity: past 5 yrs

**Research**

- At least 29 collaborative projects
- > \$7.5M supported by NSF, USDA, NASA, EPA, NOAA, industry, and DOE
- > 60 refereed publications
- Purdue Climate Change Research Center
- Center for the Environment



## Overview of projects: past 5 yrs

### Climate change activities in dept. grouped by:

- Monitoring activities
- Predicting/modeling activities
- Evaluating impacts
- Adaptation/mitigation strategies
- Education/Extension activities

## Projects: past 5 years

- **Monitoring climate change and effects**
  - at least 14 faculty
  - “Quantifying climate feedbacks from abrupt changes in high latitude trace gas emissions”, (Zhuang..)
- **Predicting/modeling climate change**
  - at least 23 faculty
  - “Understanding the potential for carbon sequestration”, (Brouder, Vyn..)

## Projects: past 5 years

- **Evaluating Impacts of climate change**
  - at least 11 faculty
  - “Diagnoses and prognoses of effects of changes in lake and wetland extent on the regional carbon balance of northern Eurasia” (Bowling,..)

## Projects: past 5 years

- **Adaptation and/or Mitigation strategies to a changing climate**
  - at least 11 faculty
  - “Development of best management practices to conserve water, nitrogen, and reduce degradation of air and water quality”, (Kladivko, Joern, Camberato, Nielsen..)

## Projects: past 5 years

- **Education and Extension of Climate Change information**
  - at least 8 faculty
  - “GIS and web-based Indiana weather/climate database”, Niyogi

## Current situation (1)

### There is now:

- Increased flooding risk from more intense precipitation events and high streamflow
- Decreased drought severity and duration (except West & Southwest).
- Increased growing season length.

## Current situation (2)

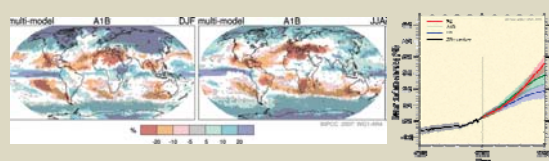
### Resulting in:

- More rapid maturation of grain and oilseed crops.
- Greater risk of crop failures from weather variability.
- More rapid growth of weeds, northward migration of weed species, and greater resistance of weeds to herbicides.
- Invasion by exotic grass species into arid lands.

## Fundamental issues: next 10 years

### It is expected that:

- Predictability of weather/climate will decrease
- Climate variability will increase



## Fundamental issues: next 10 years

### As a result:

- Pests and vector-borne diseases will spread into new areas
- Forage production season will expand.
- Current imbalance of food production between temperate regions and tropical and subtropical regions could increase

## Department capabilities (1)

### General capabilities:

- To monitor and model climate, carbon exchanges and carbon storage
- To model agricultural processes for effective prediction of impacts.
- To understand the changes and susceptibility to change in hydrology/ water availability
- To develop crop cultivars with stress-mitigating traits

## Department capabilities (2)

- To develop best management practices to minimize negative impacts and maximize positive benefits of change
- To develop decision support systems in the Midwest under changing climate
- To disseminate best management practices

## Department capabilities (3)

The department is best positioned for thrusts in

- multi-scale monitoring and modeling
- assessment and development of adaptation strategies.

In addition the department has high credibility in extension for the transfer of useful information to the public.

## Vision for the future

### A two-pronged effort involving

- 1) Development of a team-based 'fully integrated' project in the Midwest leveraging existing capabilities and active research.
- 2) Assessment of needs and development of relationships of faculty with known partners in Africa followed by a few small multidisciplinary (but not fully integrated) demonstration projects in Africa.



## Midwest integration project example

- **Monitoring**
  - Monitor and model carbon exchanges and carbon storage under varying precipitation regimes using in-situ and remote sensing
- **Predicting/modeling**
  - Model effects of changing frequency of precipitation on carbon storage and exchange (including microorganisms)
- **Evaluating impacts**
  - ... of changing carbon storage on soil quality and agricultural production given current and modified management practices



## Midwest integration project example

- **Adaptation/mitigation strategies**
  - Develop of decision support systems (DSS), best management practices (BMP) to protect soil resource and minimize CO<sub>2</sub> losses to the atmosphere under changing climate scenario
- **Education/extension**
  - Distribute DSS and BMPs to producers, inform agricultural policy makers of expected impacts and potential mitigation.



## Africa/Brazil project example

- **Further develop contacts for collaborations**
- **Monitoring:**
  - Monitor soils and vegetation structure using *in-situ* and remote sensing and relate to data from prior studies
- **Predicting/modeling**
  - Model the function of cerrado (Brazil) and miombo (Africa) ecosystems today and make realistic predictions for the future in climate dynamics, vegetation structure, soil quality, and land use change patterns



## Africa/Brazil project example

- **Evaluating impacts**
  - Correlate changes in land use and climate with changes in soils and vegetation.
- **Adaptation/mitigation strategies**
  - none
- **Education/extension**
  - On site and at Purdue training in field methods
  - Bi-weekly seminar on campus
  - Policy workshops for scientists- how to communicate
  - Annual research conference.

