



A Land Use Data Base for GTAP

**Presented by
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**Building on collaborative work with Navin Ramankutty, Brent
Sohngen and Huey-Lin Lee**

Outline

- **Motivation**
- **Key dimensions of the data base**
- **Potential uses**
- **References**

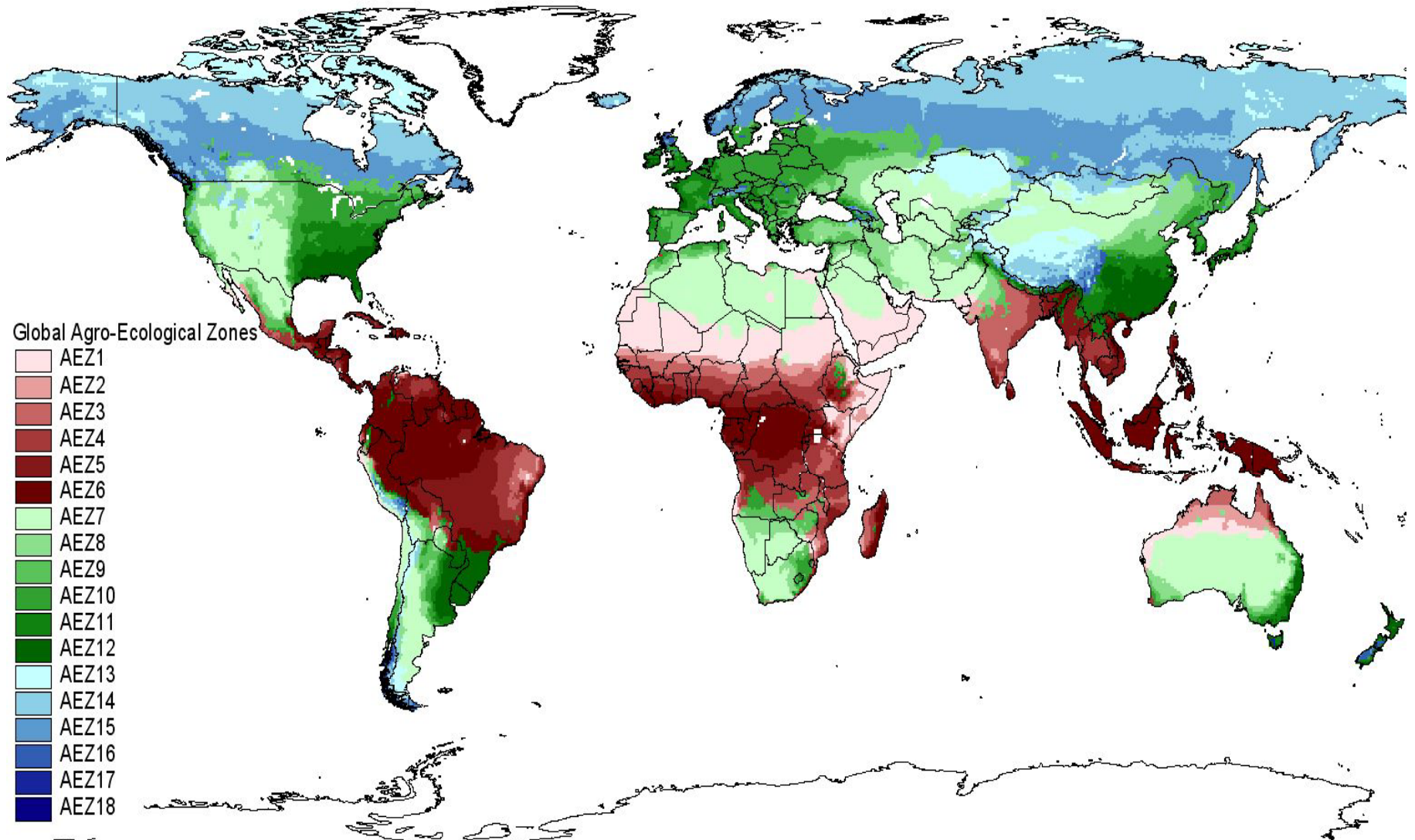
Motivation

- **Demand -- increasing interest in global environmental issues tied to land use:**
 - Deforestation
 - Biodiversity
 - Climate change: land use change and land using activities contribute large share of GHG emissions
- **Supply -- data availability:**
 - Global satellite data on land cover
 - Merged with sub-national data on land use from AgroMaps: FAO/IFPRI/SAGE, developed by Navin Ramankutty
 - Forestry data from Brent Sohngen
- **Funding: Support from US-EPA climate change group**

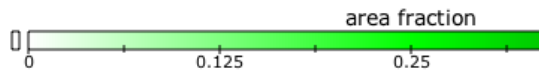
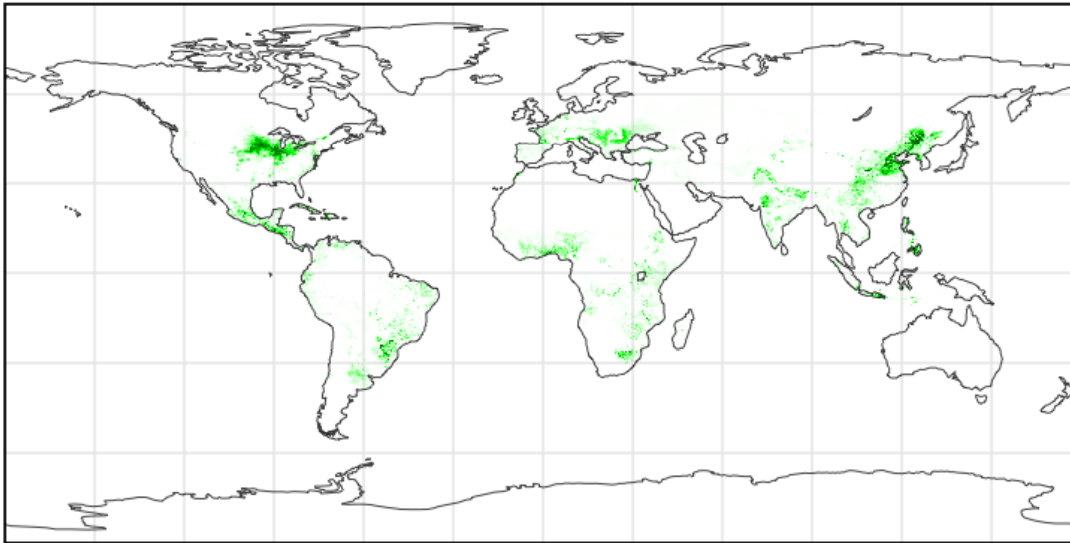
Key Features of Data Base

- **Built up from 0.5 degree grid cell data (260,000 on the globe)**
- **Aggregated into Agro-Ecological Zones (AEZs: IIASA/FAO):**
 - **Three climatic zones: boreal, temperate, tropical**
 - **6 to 36 LGPs = # days with adequate temperature and soil moisture to grow crops**
- **Instead of one land endowment, now many land endowments (AEZs):**
 - **not explicitly spatial**
 - **these may shift over time with climate change (Darwin et al.),**
- **Land use for 175 FAO crops (Monfreda, Ramankutty and Foley, 2007)**

Global Distribution of AEZs



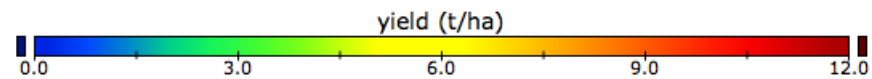
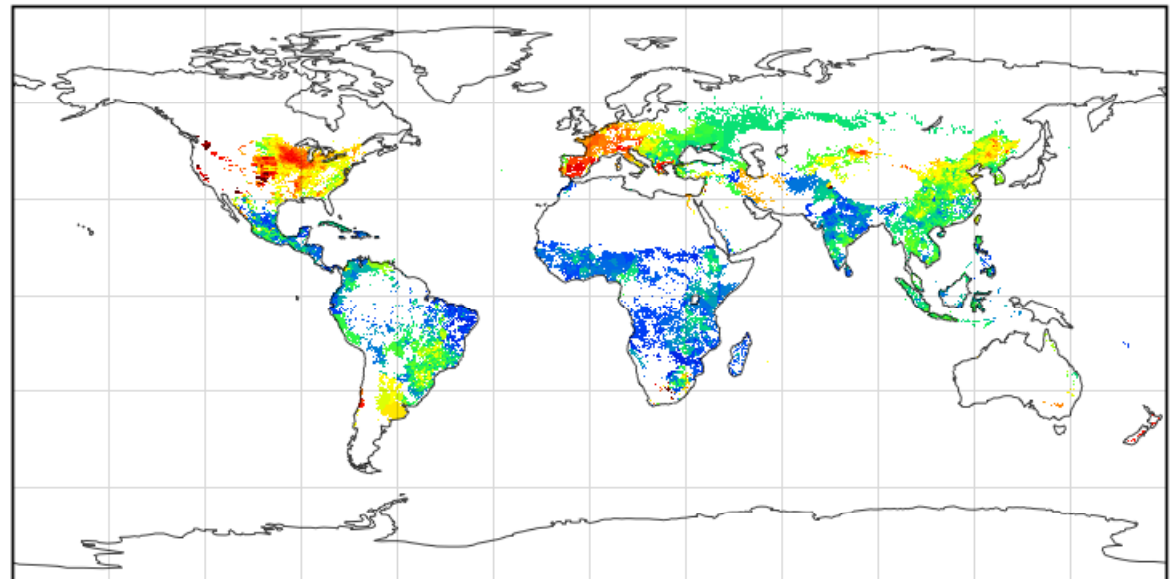
Maize



Equirectangular projection centered on 0.0°E

Maize area and yield

Maize



Equirectangular projection centered on 0.0°E

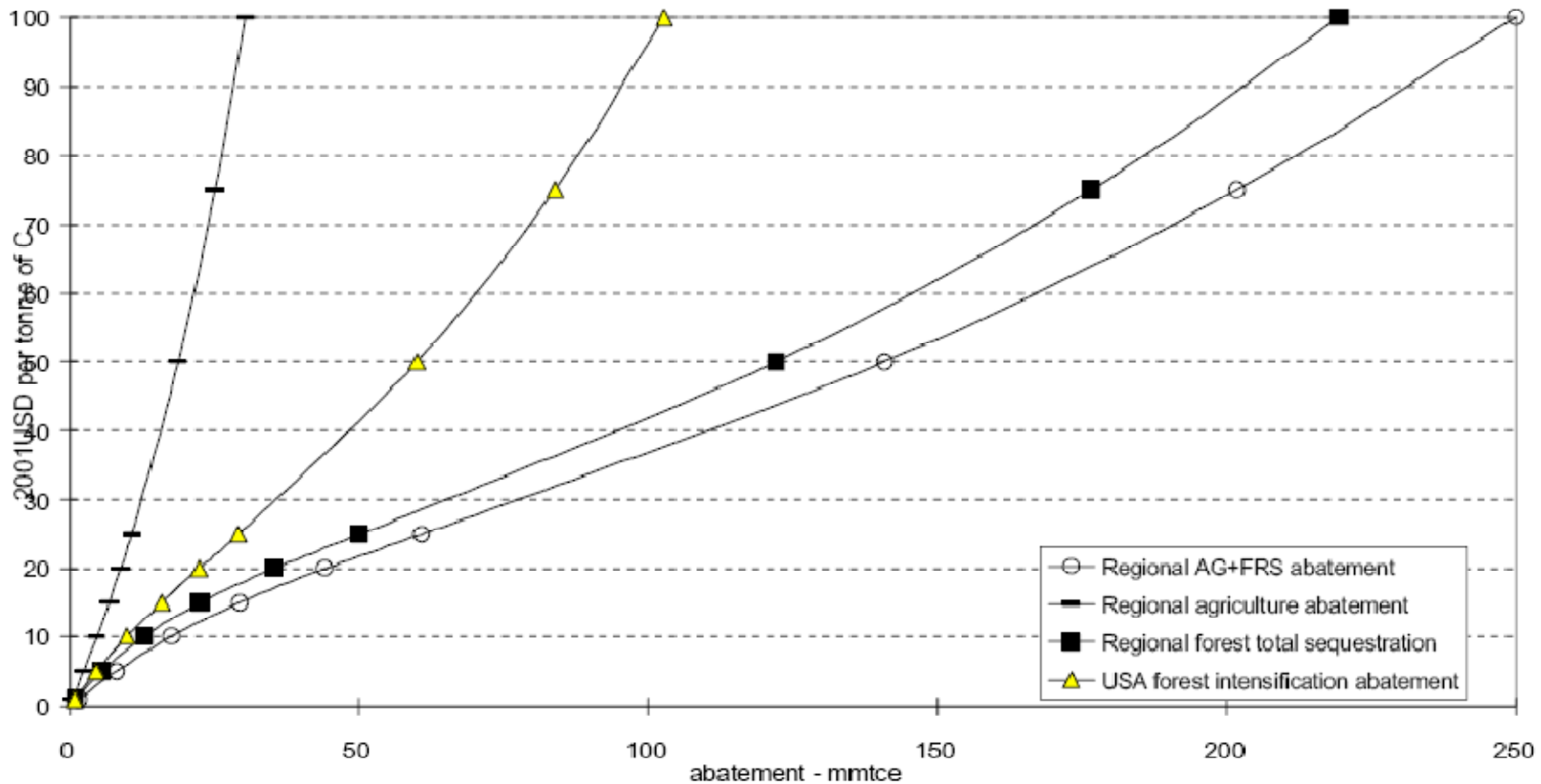
Data Min = 0.0, Max = 21.7

**Source: Monfreda,
Ramankutty and
Foley, 2007**

Applications (1): GHG mitigation

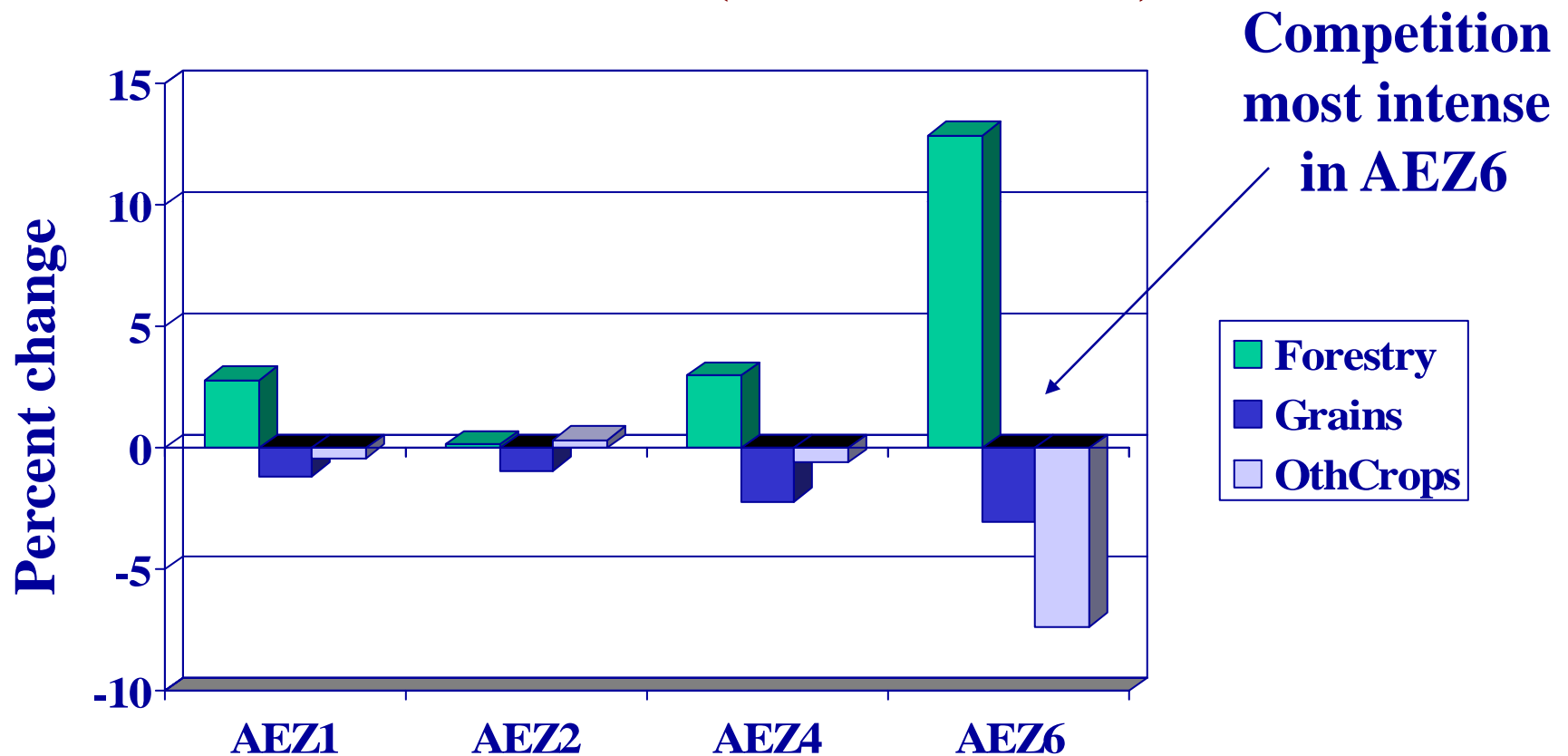
- **Supplement with data on:**
 - **GHGs (methane and nitrous oxide from agriculture; soil and forest carbon sequestration)**
 - **PE MACs for individual activities**
- **Generate regional and global GE MACs for GHG abatement**
- **Examine competition for land in different AEZs**

USA GE-GHG abatement supply schedules: USA-only carbon tax



Source: Hertel et al., 2007

Changes in rental-share-weighted land use for selected AEZs in USA: USA only carbon tax (\$100/MTCE)

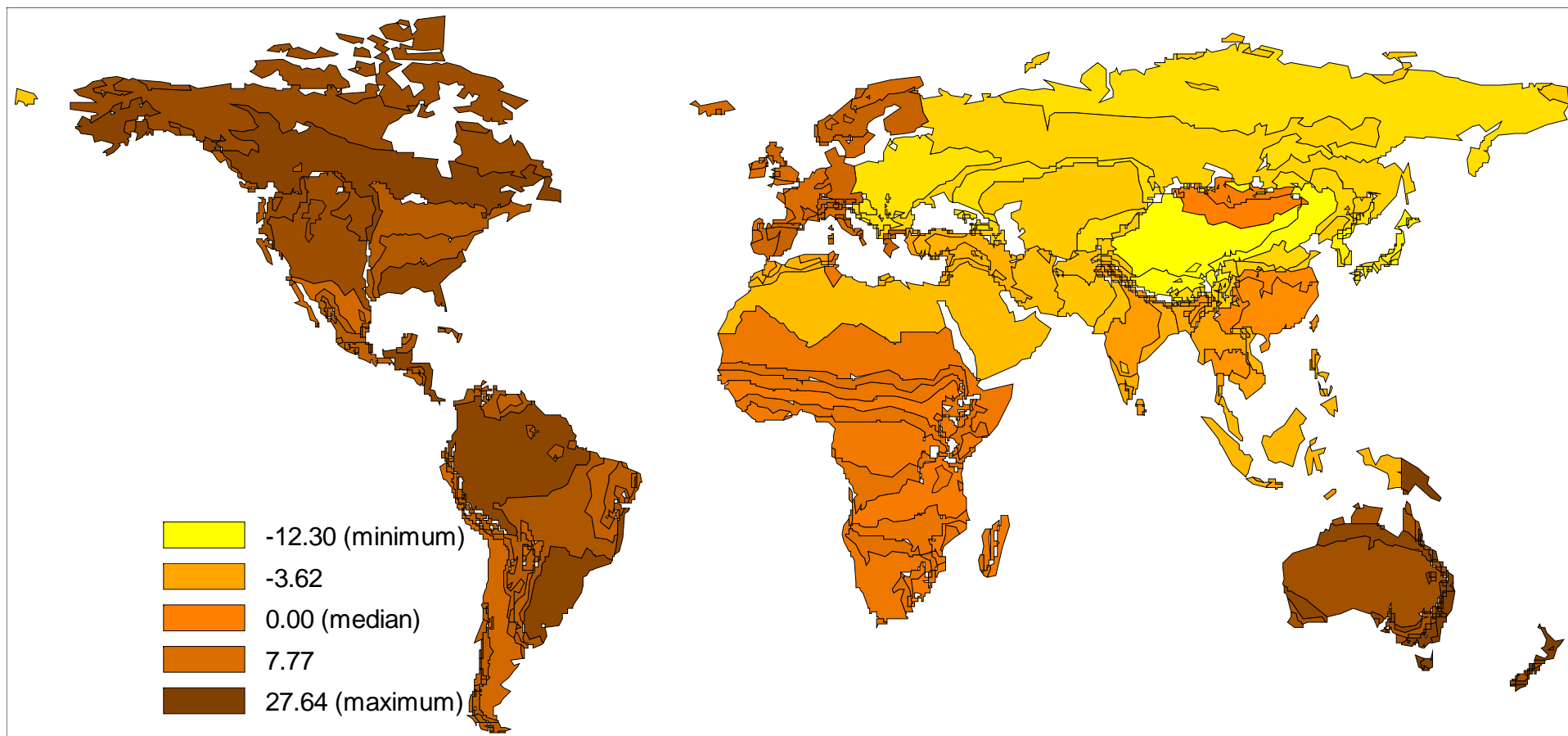


Source: Hertel et al., 2007

Applications (2): Baseline Projections of Land Use

- **Embed in dynamic GTAP model with modified consumer demands and “intensification” options**
- **Add investment decision to access new forest lands**
- **Focus on changes in land use (and emissions) as global pattern of demands changes**

Rental-share-weighted change in crop land use by AEZxRegion: 1997-2025



Source: Golub et al., 2007

Applications (3): Biofuels (in progress)

- **Combine with bio-fuels-enhanced version of GTAP-E which permits inter-fuel substitution**
- **Examine impact of subsidies/higher energy prices on ethanol and bio-diesel demand**
- **Model translates increased demand into production of maize, oilseeds or sugar cane**
- **Land use module predicts which crops will be displaced, where deforestation might occur**
- **Examine impact on food prices and environmental degradation**

Future Directions and References

- **Currently revising GTAP Tech Paper #25 to reflect new MRF and forestry data bases**

- **Editing book on this topic:**

Economic Analysis of Land Use in Global Climate Change Policy, Publisher: Routledge, Editors: Tom Hertel, Steven Rose, Richard Tol

- **In summary: Lots of potential for basic applied research as well as policy applications**