

SUMMARY

- **The Global Change Assessment Model (GCAM) projects annual land use distribution for each of 151 bioclimatically-defined land units**
 - » Each land unit is assumed to have uniform, average vegetation productivity
 - » These land units are constant throughout simulations
- **Climate change will cause constant land units to become heterogeneous**
 - » This violates the assumption of uniform, average productivity
- **Primary initial conditions for GCAM land use projections:**
 - » crop production, crop harvested area, and land rent value
- **Different sets of land units generate different sets of initial conditions**
 - » 151 original bioclimatic land units (1961-1990 climate)
 - » 184 projected bioclimatic land units (1971-2100 climate)
- **Global distributions of initial crop production and harvested area differ between original and projected land unit sets**
 - » This is likely to generate differences in projected land use distributions,
 - » and differences in agriculture and energy markets and climate feedbacks

METHODS

Figure 1. Bioclimatic land units: Original (1961-1990) and Projected (2071-2100)

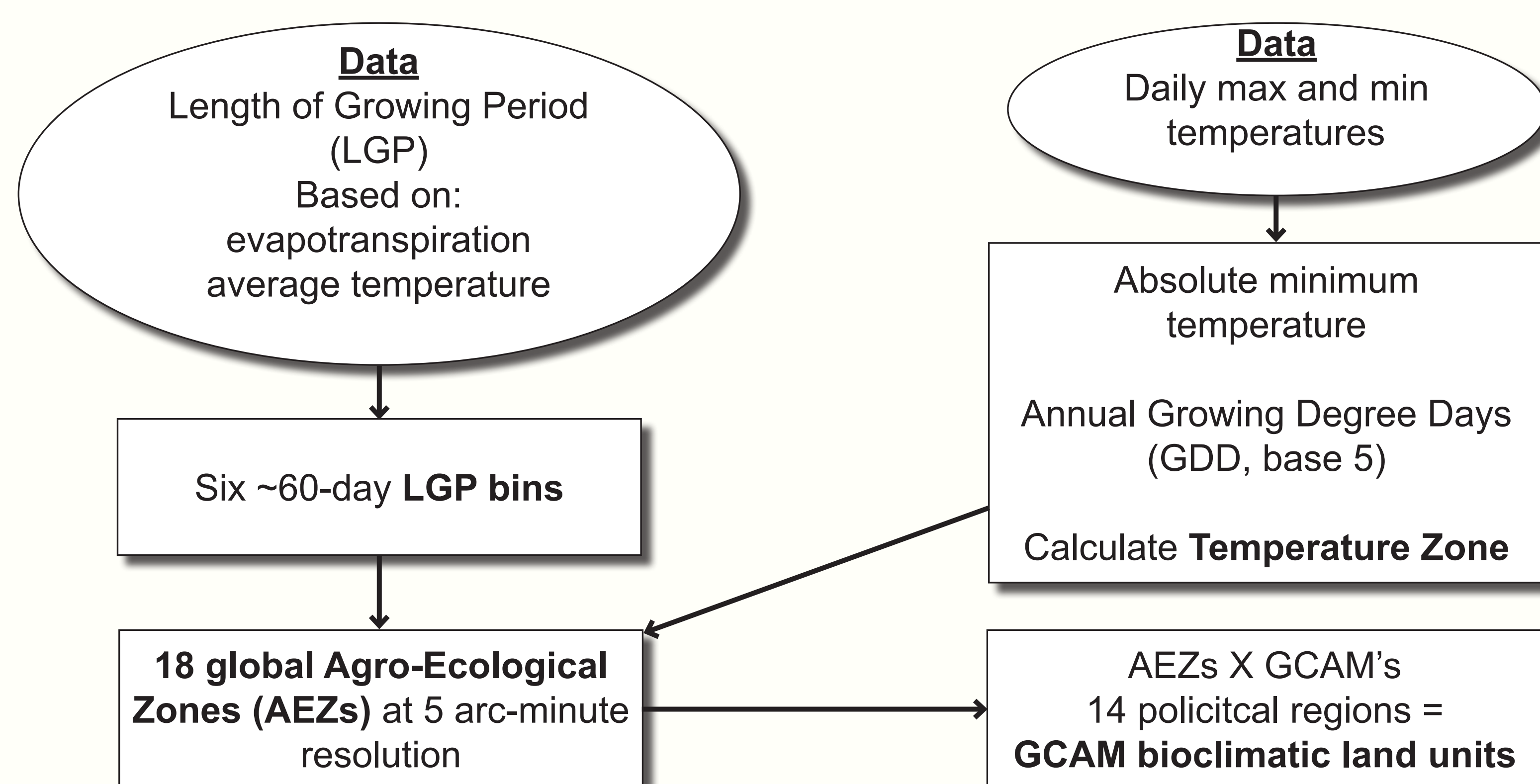
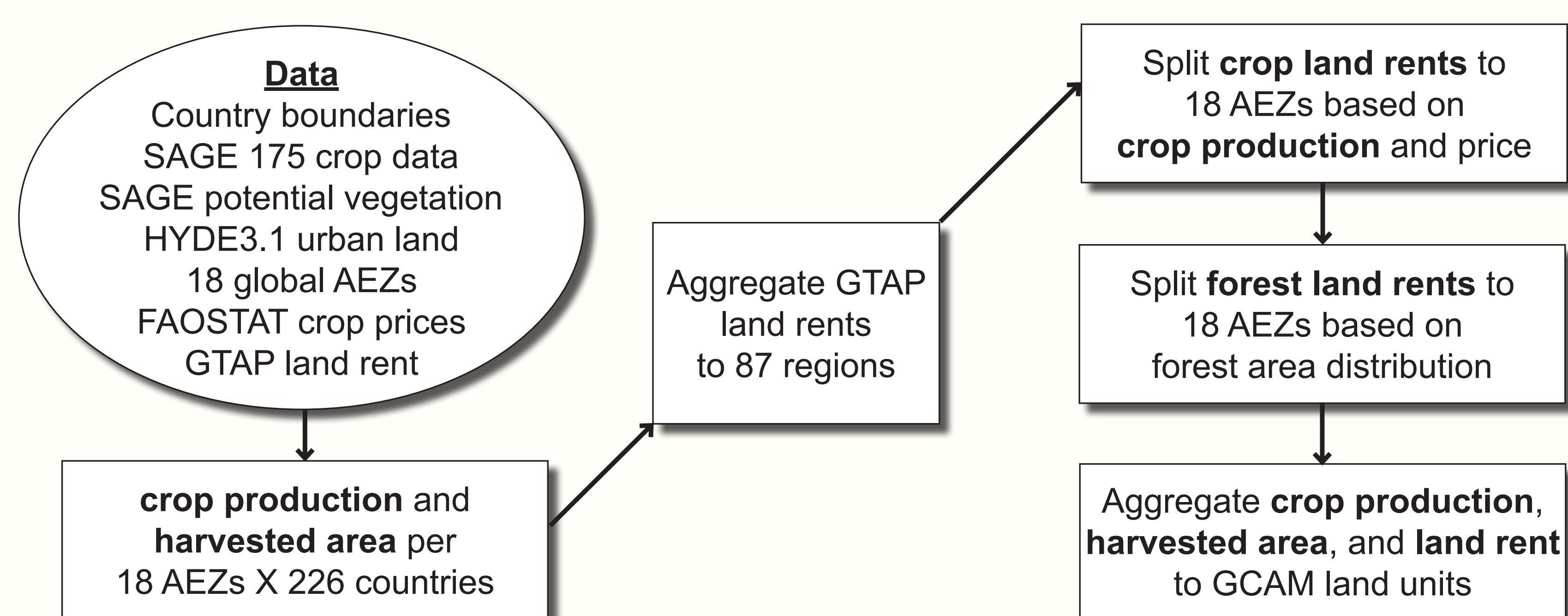


Figure 2. Initial conditions for GCAM bioclimatic land units



GTAP: Global Trade and Analysis Project land use database v2.1
 ECHAM: European Centre for medium-range weather forecasts - HAMburg model
 SRES A2: Special Report on Emissions Scenario A2
 SAGE: center for Sustainability And the Global Environment
 HYDE3.1 urban land: History Database of the global Environment
 FAOSTAT: Food and Agriculture Organization online statistics database

These methods follow the procedures and data used to generate the GTAP land use database, which GCAM uses to define and initialize its 151 original land units

RESULTS

Figure 3. Agro-Ecological Zone (AEZ) shifts during the 21st century. Projected (2071-2100, ECHAM SRES A2) minus original (1961-1990, GTAP) AEZ categories overlain by the original 151 GCAM land unit boundaries.

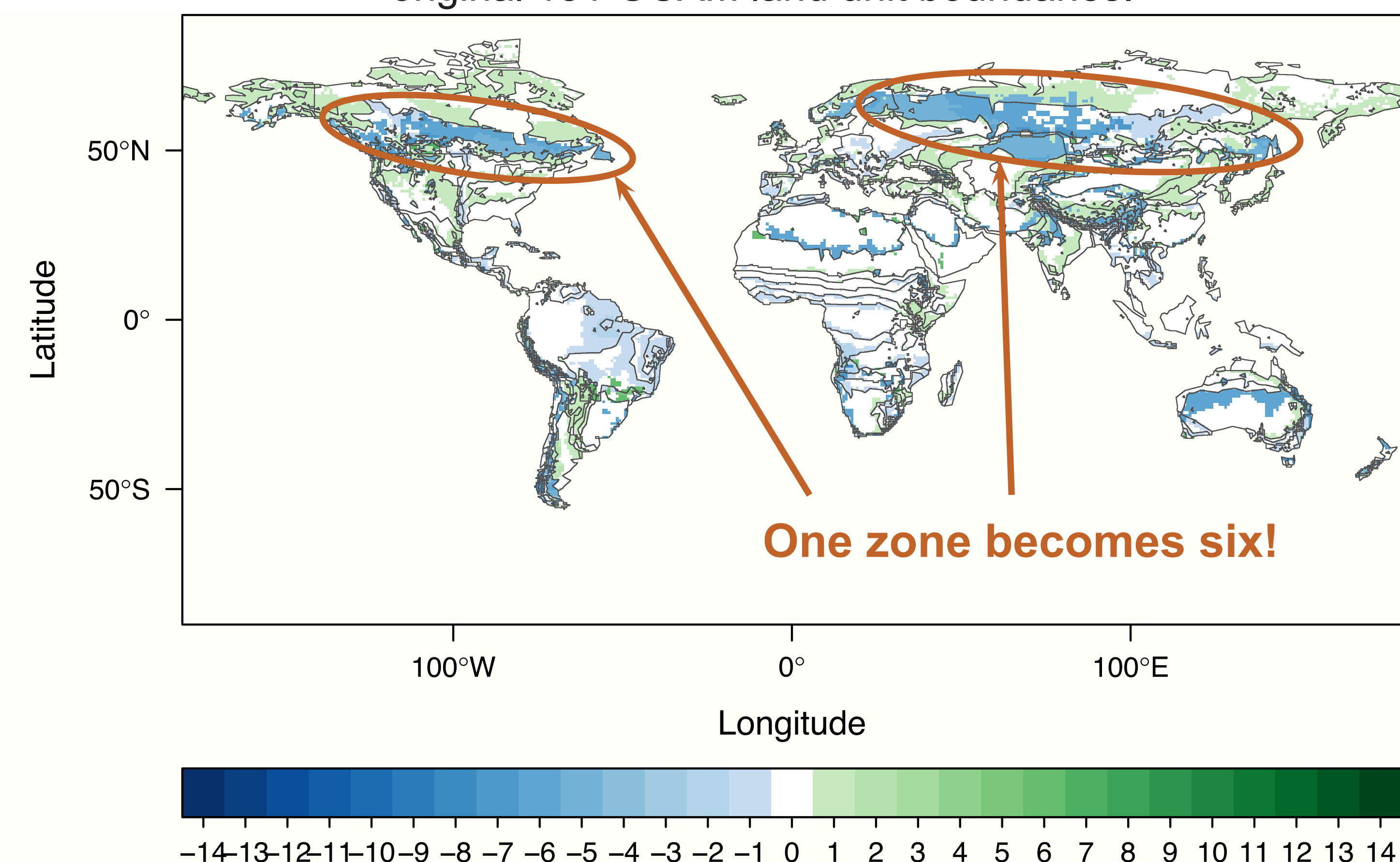
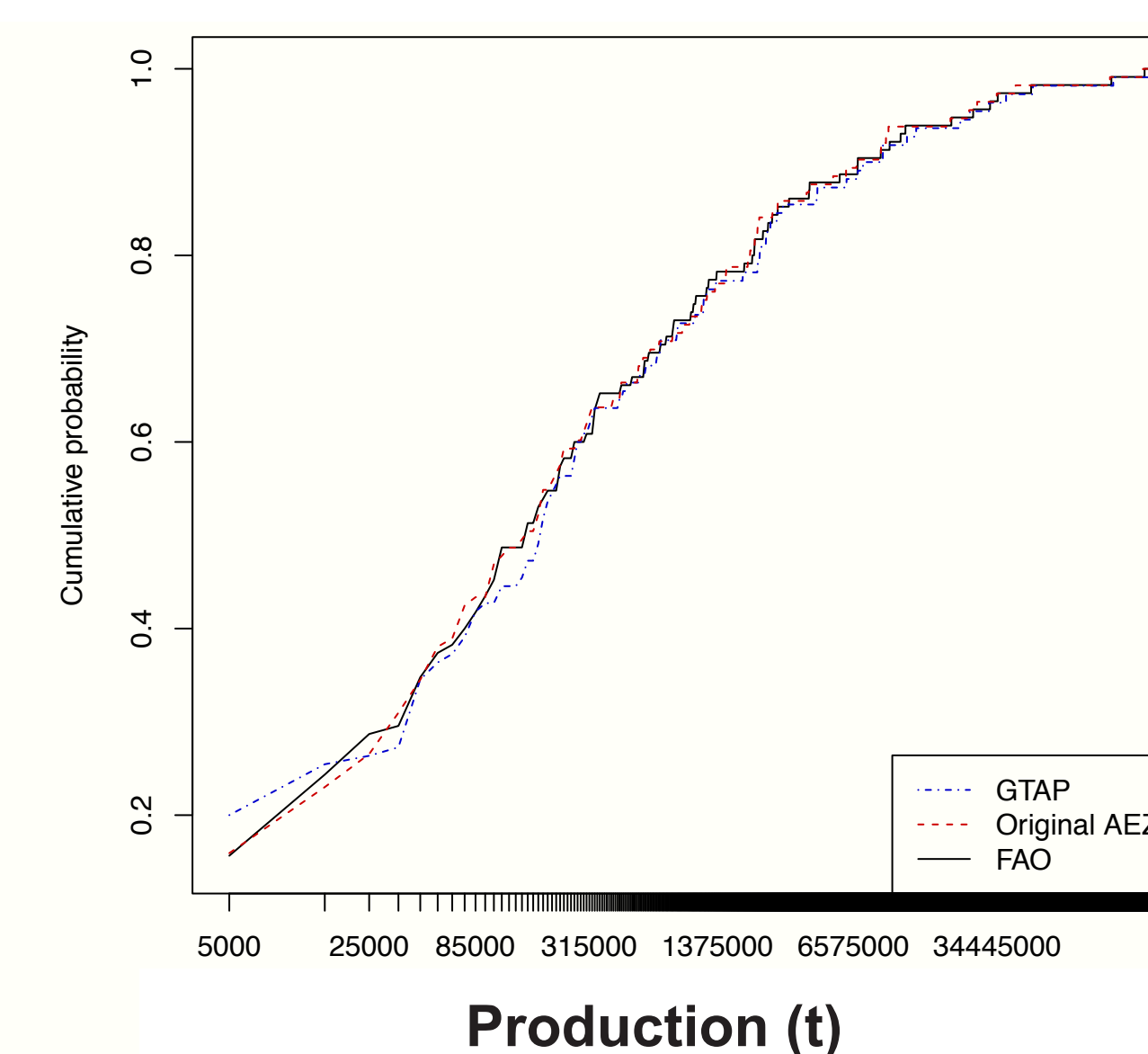


Figure 4. Validation of method to generate land unit initial conditions. These circa year 2000 data represent 226 countries. The "Original AEZs" data have been generated as described in the Methods section, using the GTAP 1961-1990 AEZ boundaries.

Paddy Rice Cumulative Distribution Functions



This method agrees well with FAO and GTAP!

Paddy Rice Difference Histograms

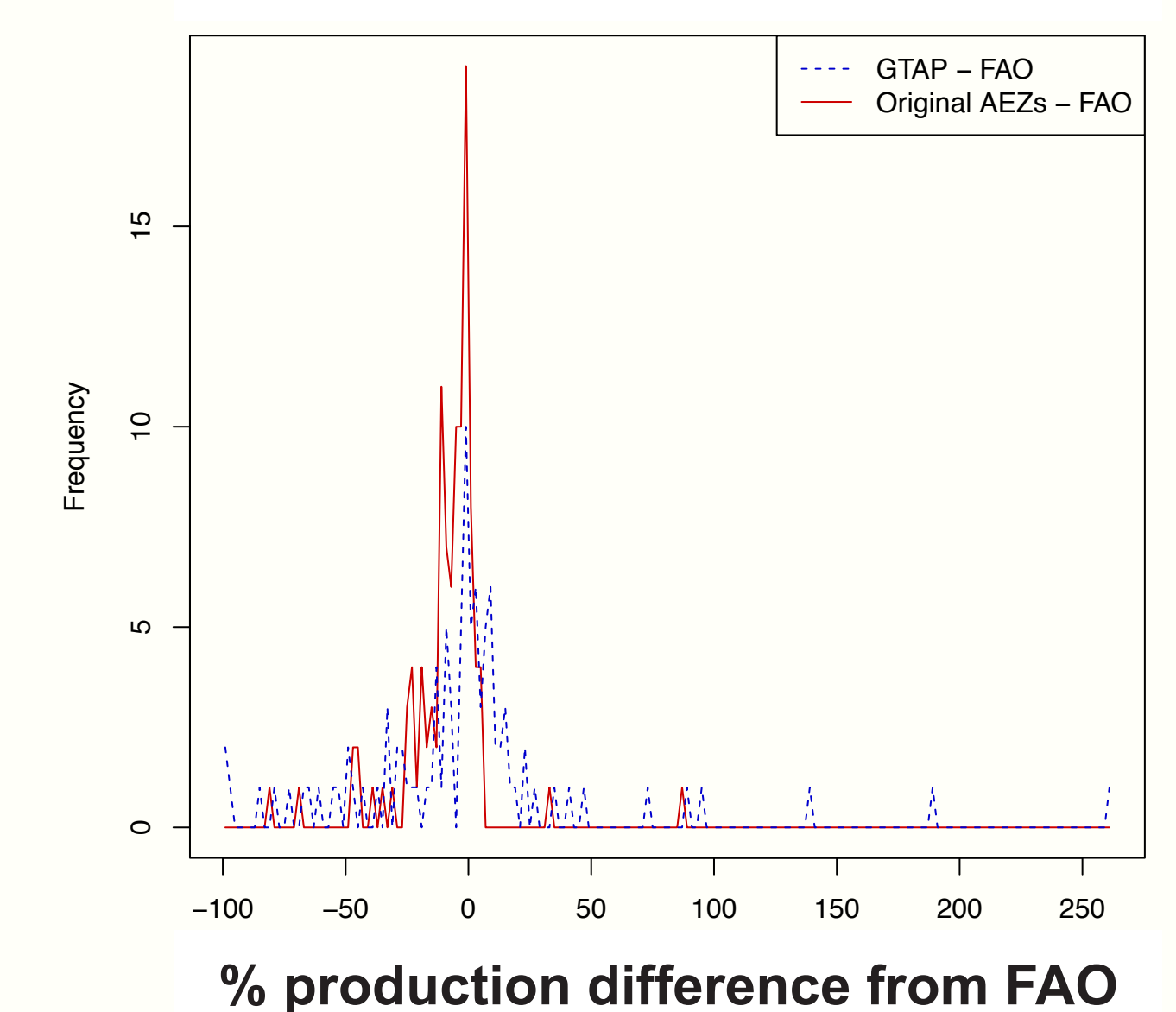
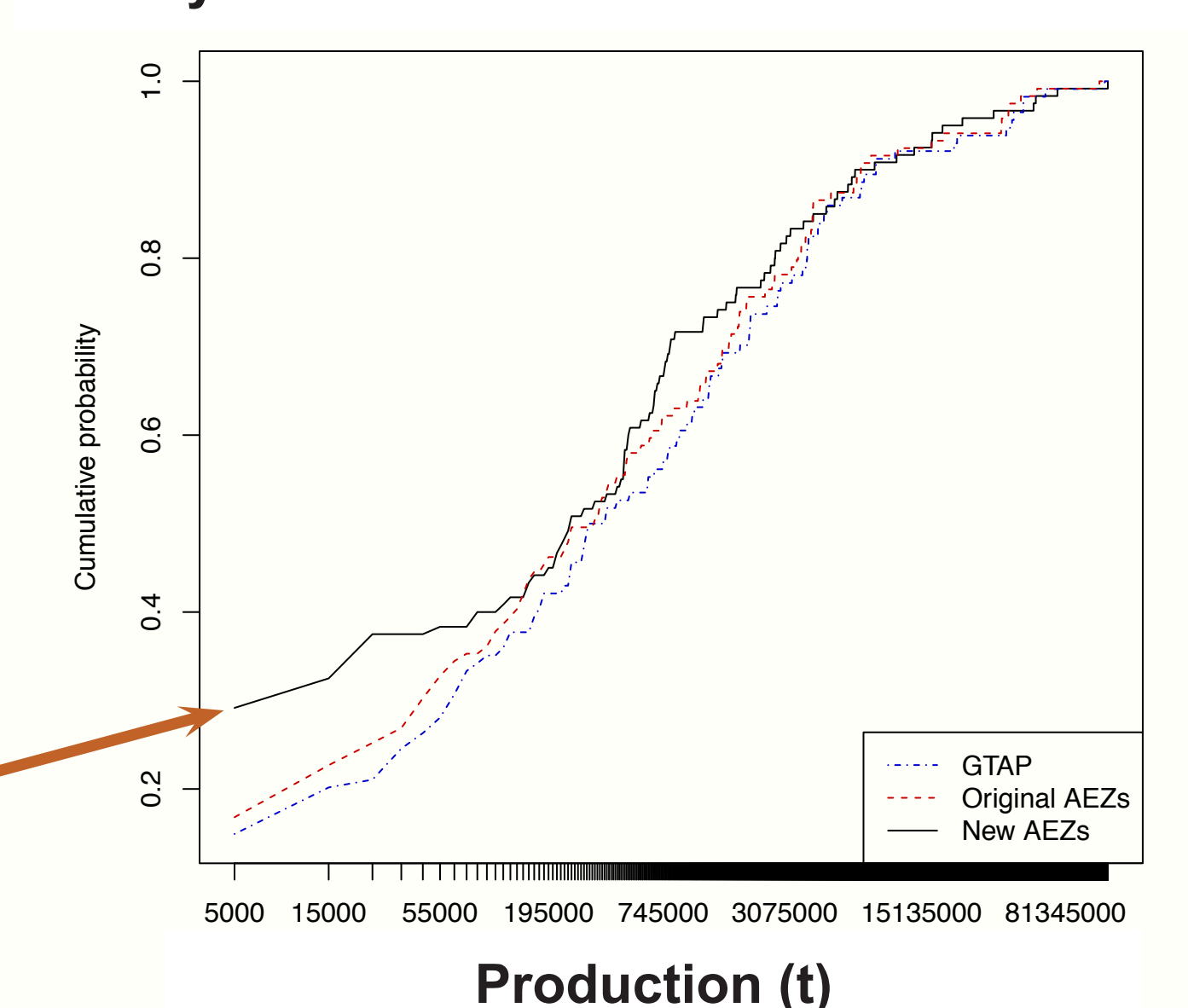


Figure 5. Differences in global distributions of GCAM land unit production due to original versus projected AEZ boundaries. The GTAP and "Original AEZ" data represent the original 151 GCAM land units. The "New AEZs" data represent 184 projected GCAM land units based on the ECHAM model driven by SRES A2.

Paddy Rice Cumulative Distribution Functions



Using a different set of land units gives a different global distribution of year 2000 rice production!

DISCUSSION

- **Changes in Length of Growing Period (LGP) dominate area of zone shifts**
- **LGP has a large influence on annual productivity**
 - » This increases heterogeneity of vegetation productivity within constant land units
- **Inter-crop/vegetation differences within land units drive land use projection**
- **Vegetation responses to climate will further affect land use projections**
 - » Vegetation response to climate is spatially heterogeneous
 - » Different land unit sets will have different average productivity distributions
 - These distributions vary through time
 - » Thus, different land units are likely to mediate climate feedbacks differently