Towards Consistent Land Use Distribution in IAM and CLM

Xiaolin Ren

EASM Tutorial

Aug 13, 2014

NCAR is funded by the National Science Foundation

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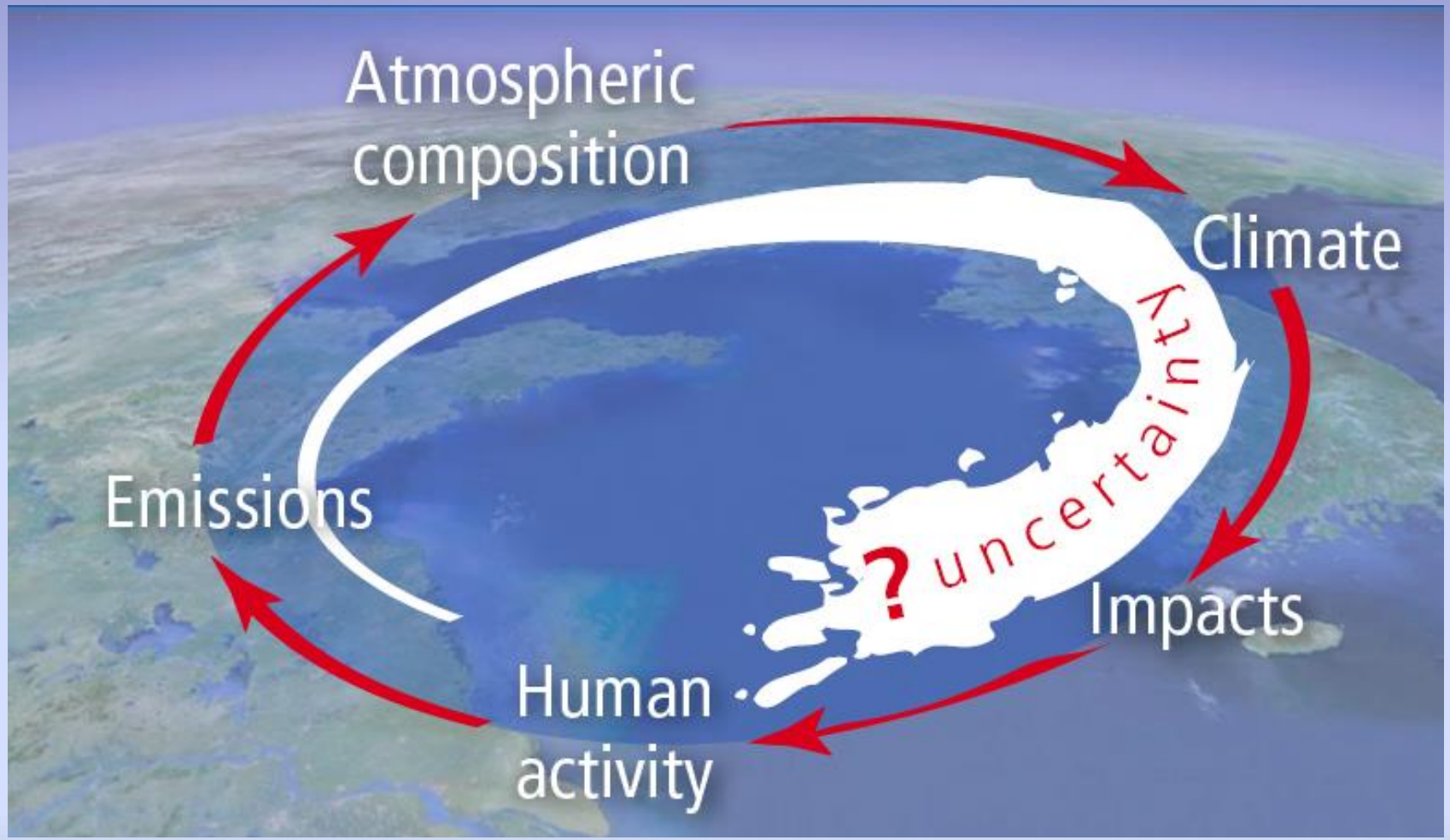
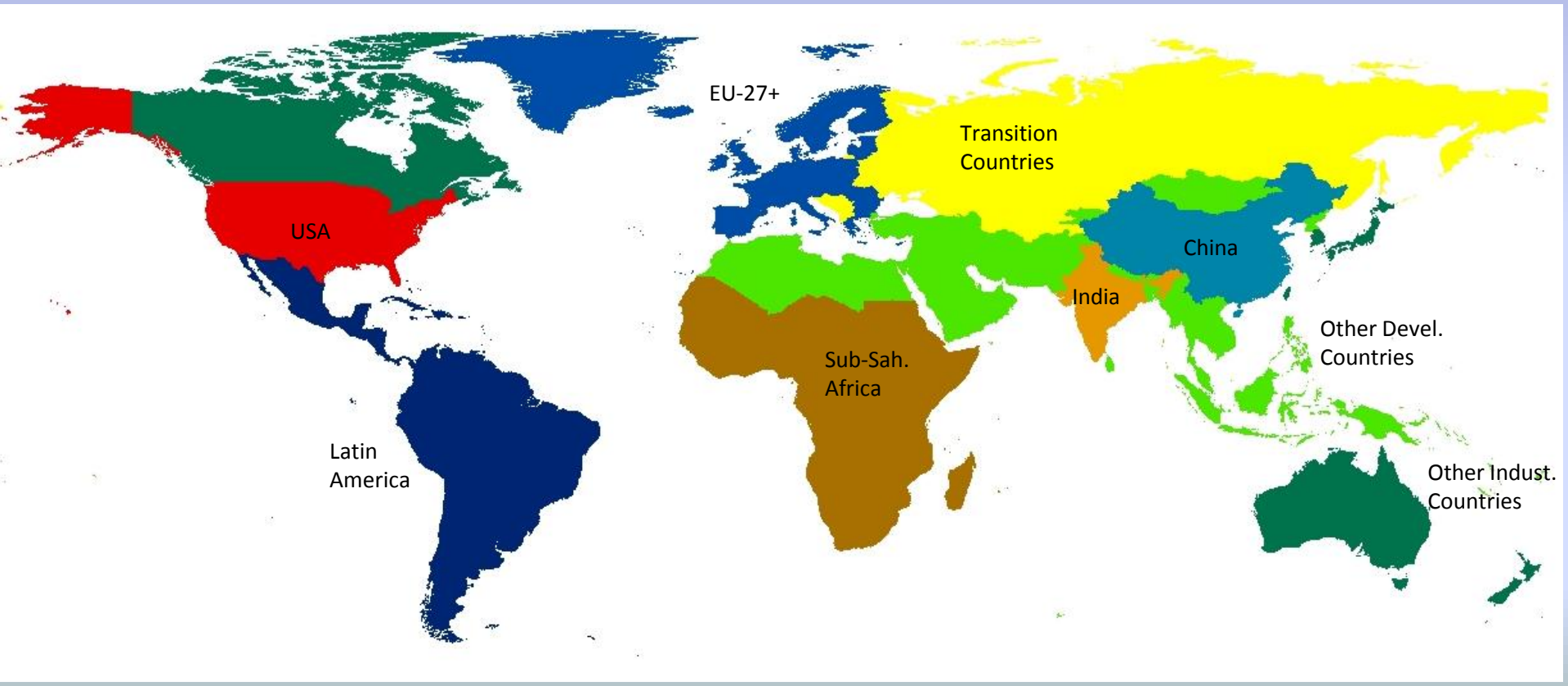
What is integrated assessment modeling?



Integrated Population-Economy-Technology-Science (iPETS) Model: 9-Regions, with Trade

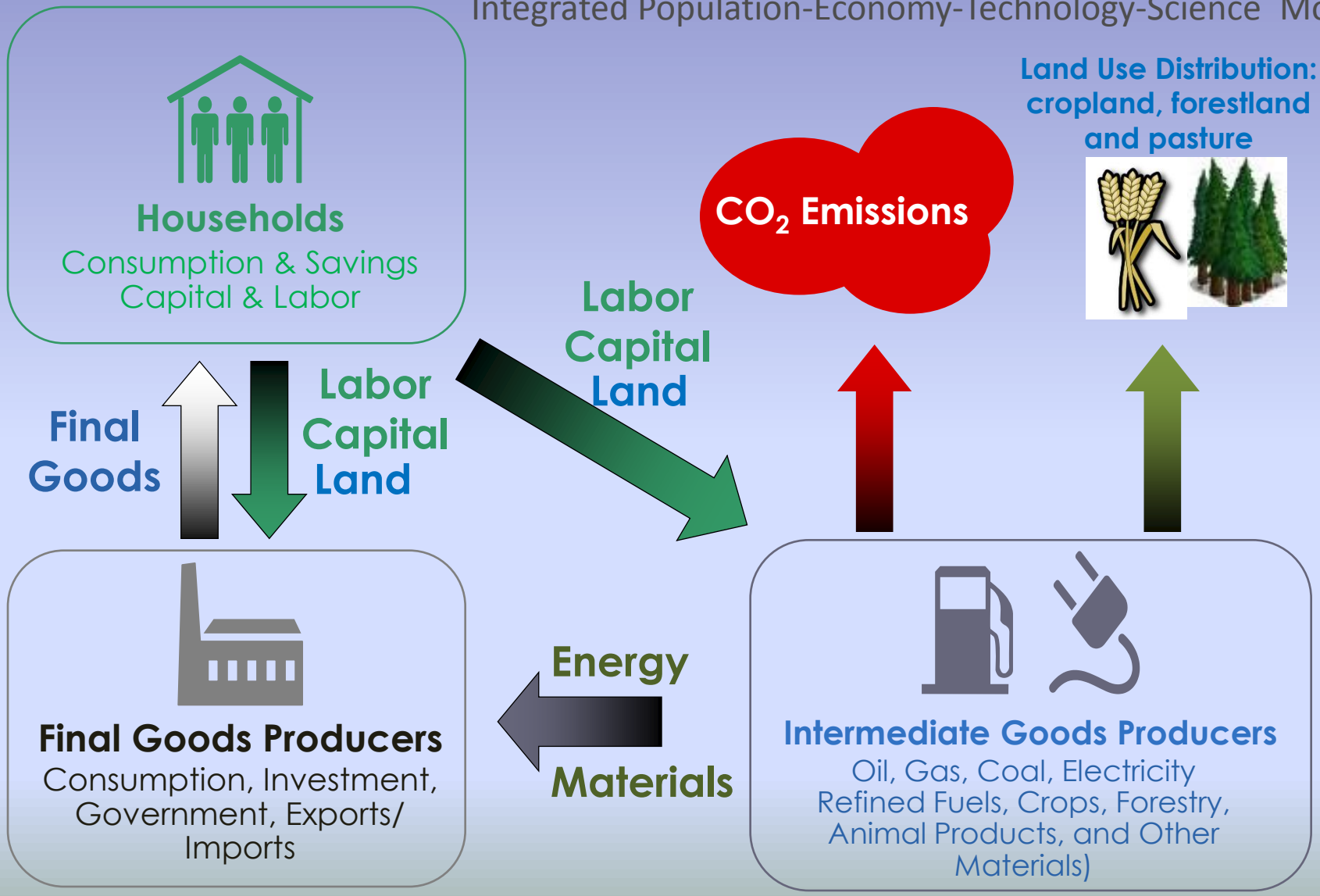
External Collaborators: M. Dalton (NOAA); A. Jain (U. Illinois); R. Fuchs, S. Pachauri (IIASA); E. Balistreri (Col. School of Mines)

Community orientation: Code freely available



Economic Model: iPETS

Integrated Population-Economy-Technology-Science Model



Toward Consistent IAM-Earth System Model Interactions

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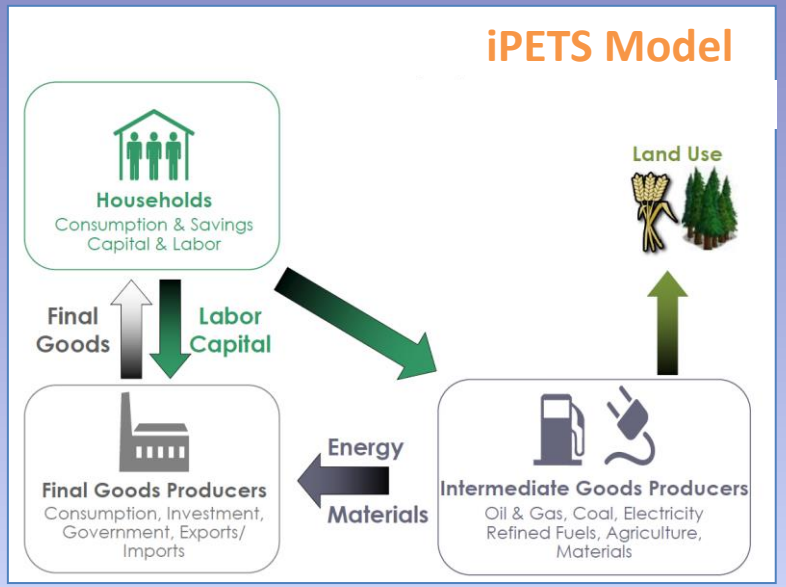
Integrated Assessment Model



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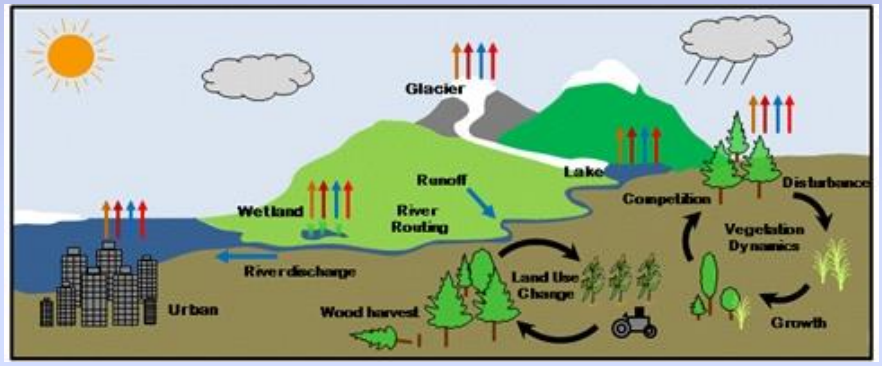
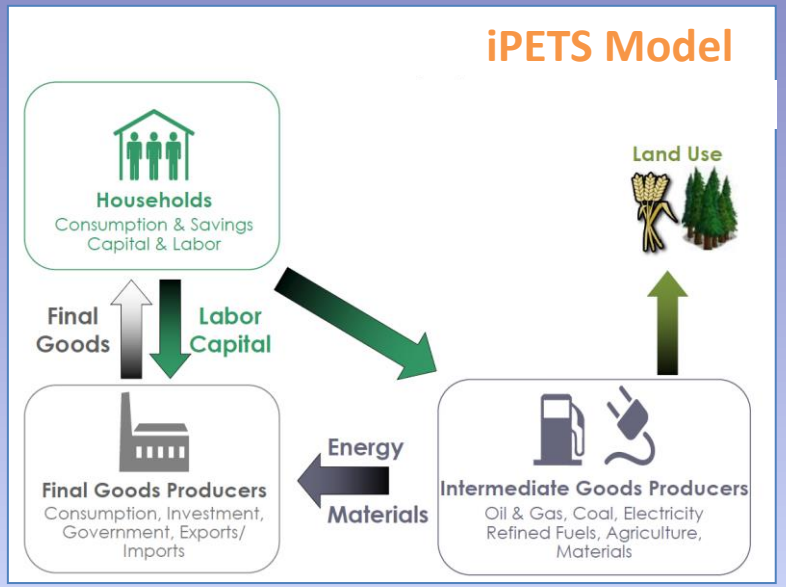


Community Land Model (CLM)

Integrated Assessment Model



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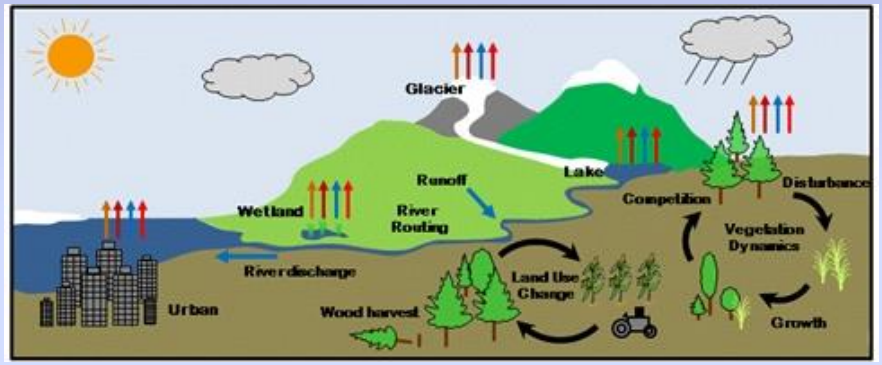
Aggregated yield change



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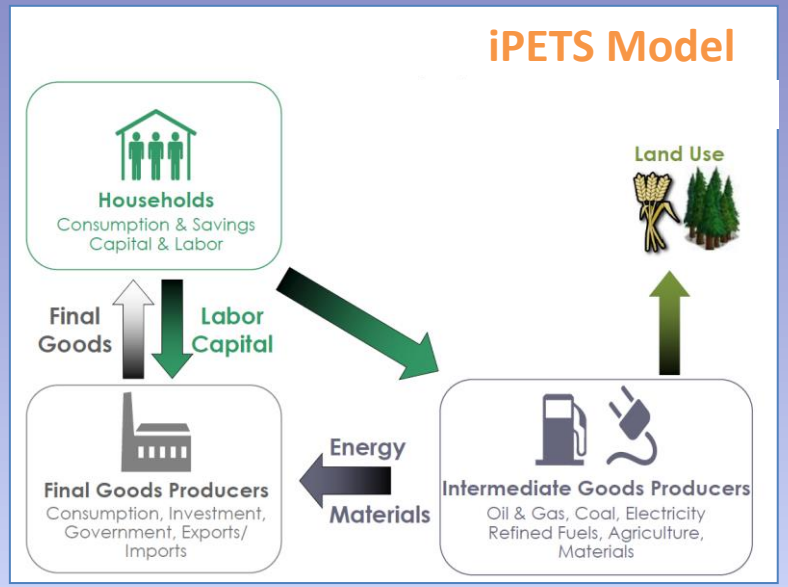

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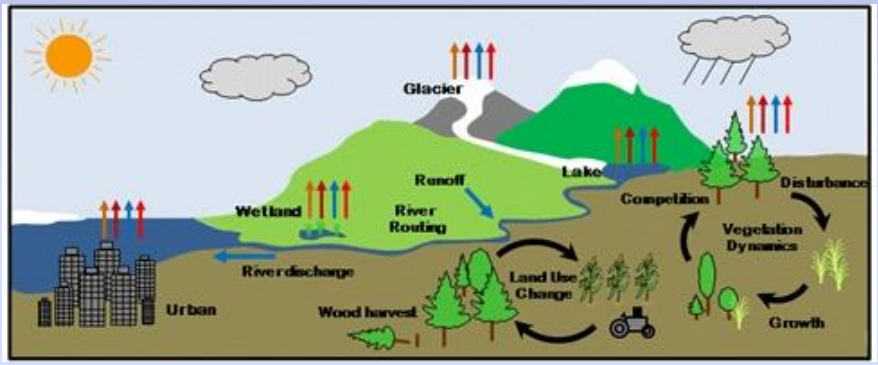

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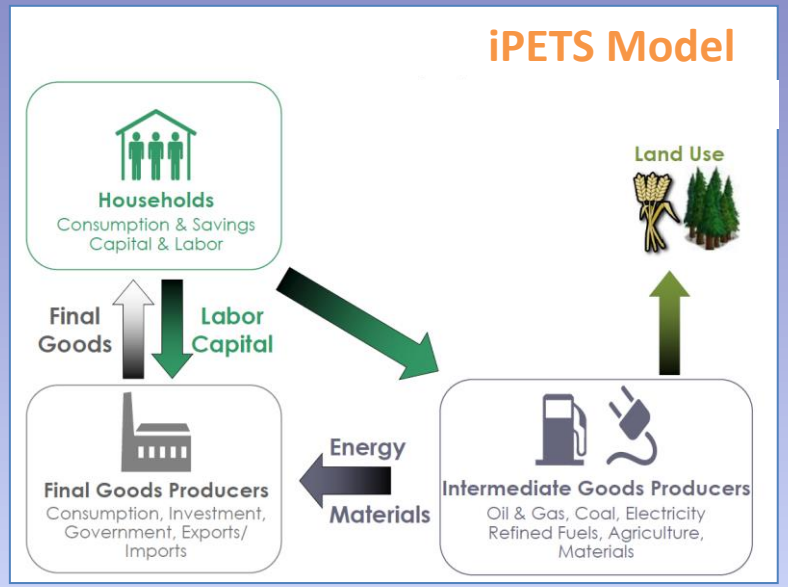

Aggregated land use

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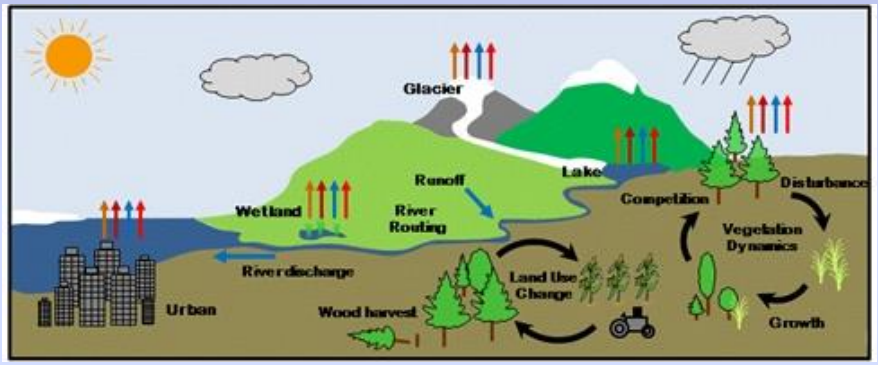

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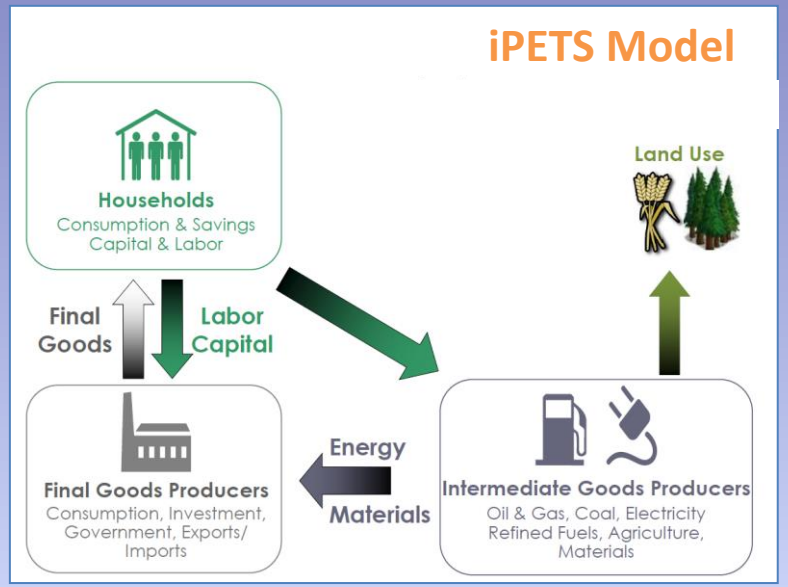

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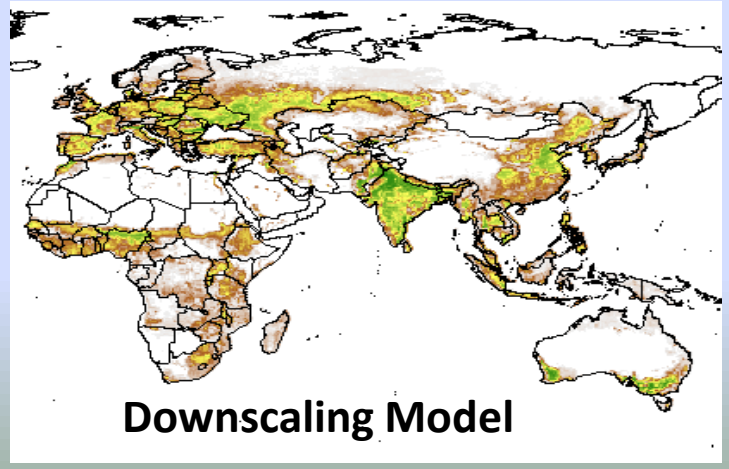

Downscaling Model

Toward Consistent IAM-Earth System Model Interactions

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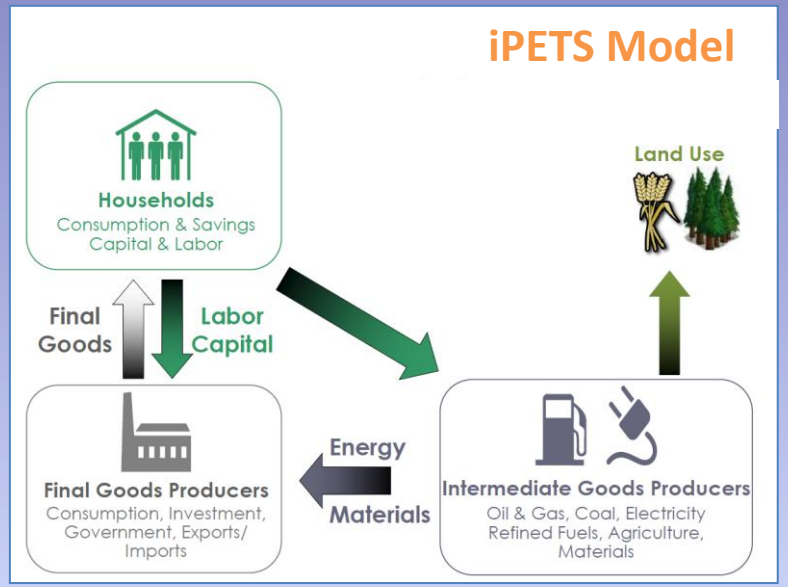

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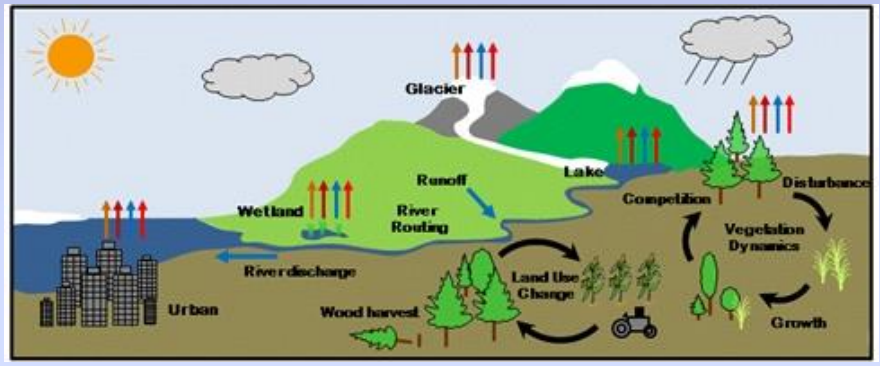
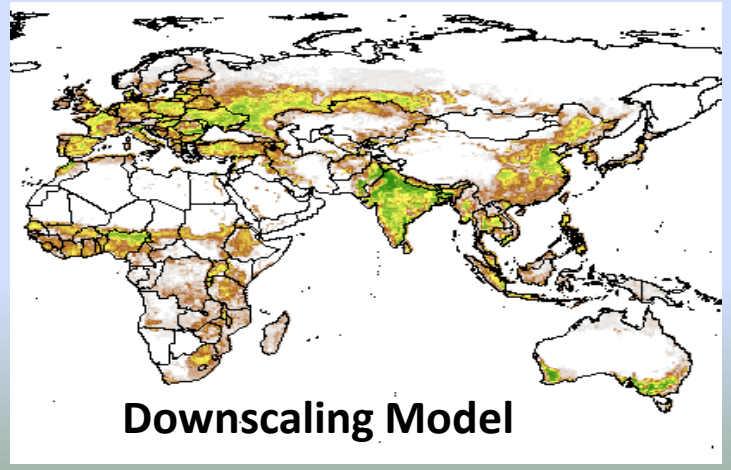


Community Land Model (CLM)

Aggregated land use

Spatial land use distribution



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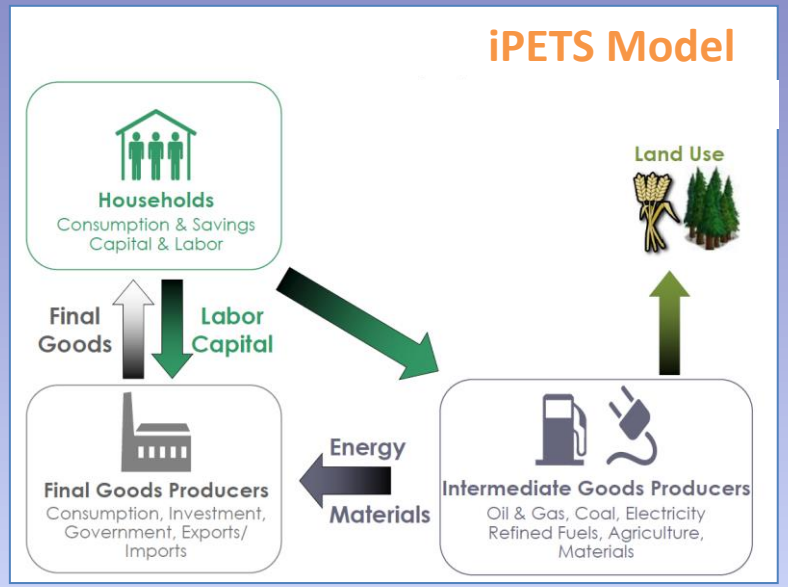

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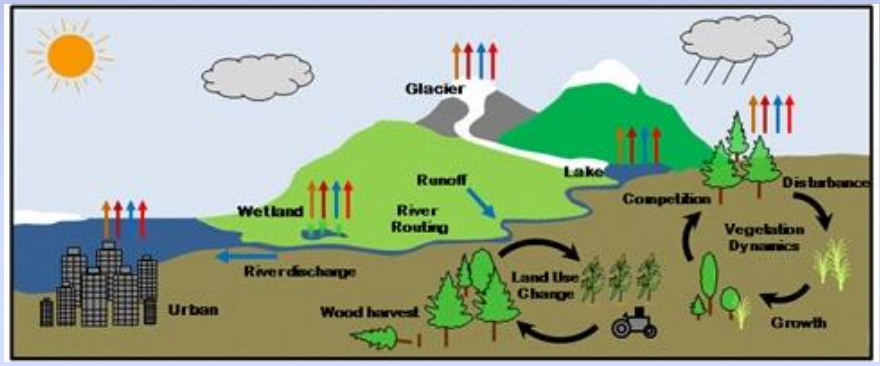


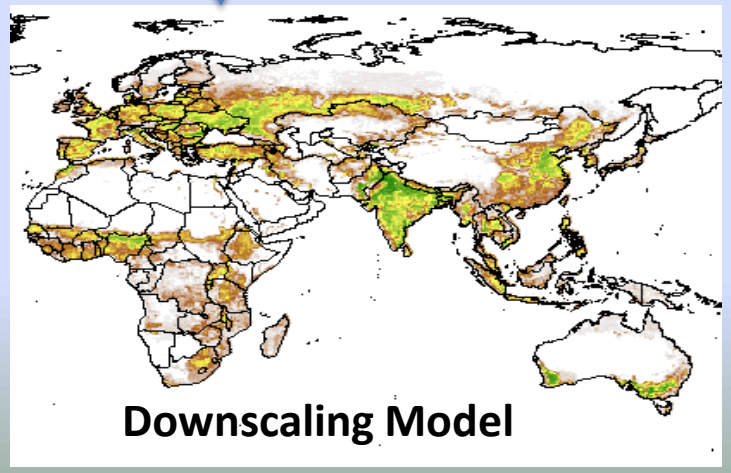
Community Land Model (CLM)

Social - Economic Info

Aggregated land use

Spatial land use distribution

Biophysical Info



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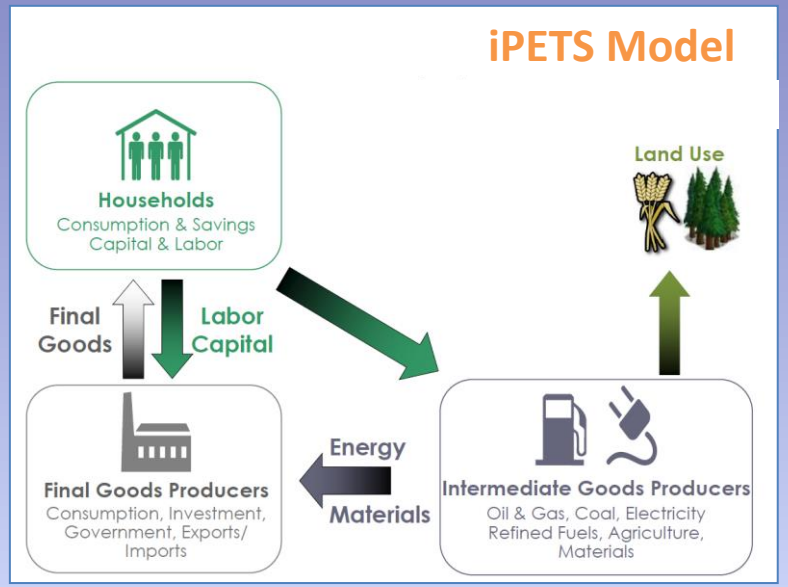

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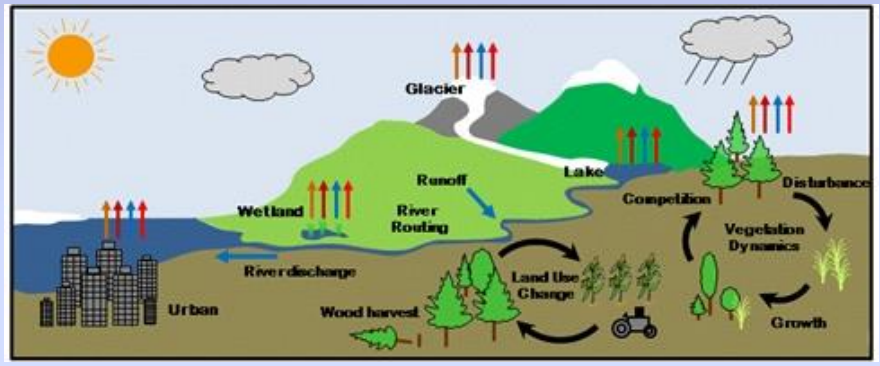

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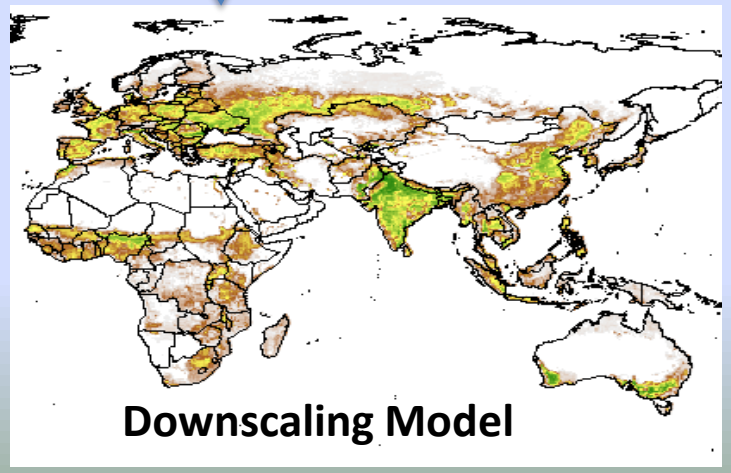

Downscaling Model

Climate Impacts

- Total amount of land available for production
  - Length of Growing Period: Number of days suitable for crop growth at each grid cell
    - Average daily temperature > 5^{o}C
    - Soil water balance
- Land Productivity Coefficient
  - Technology change
  - Management practice
  - Extreme events
  - Diseases/pests
  - CO_2 fertilization
  - Productivity change due to climate impact such as temp&precip

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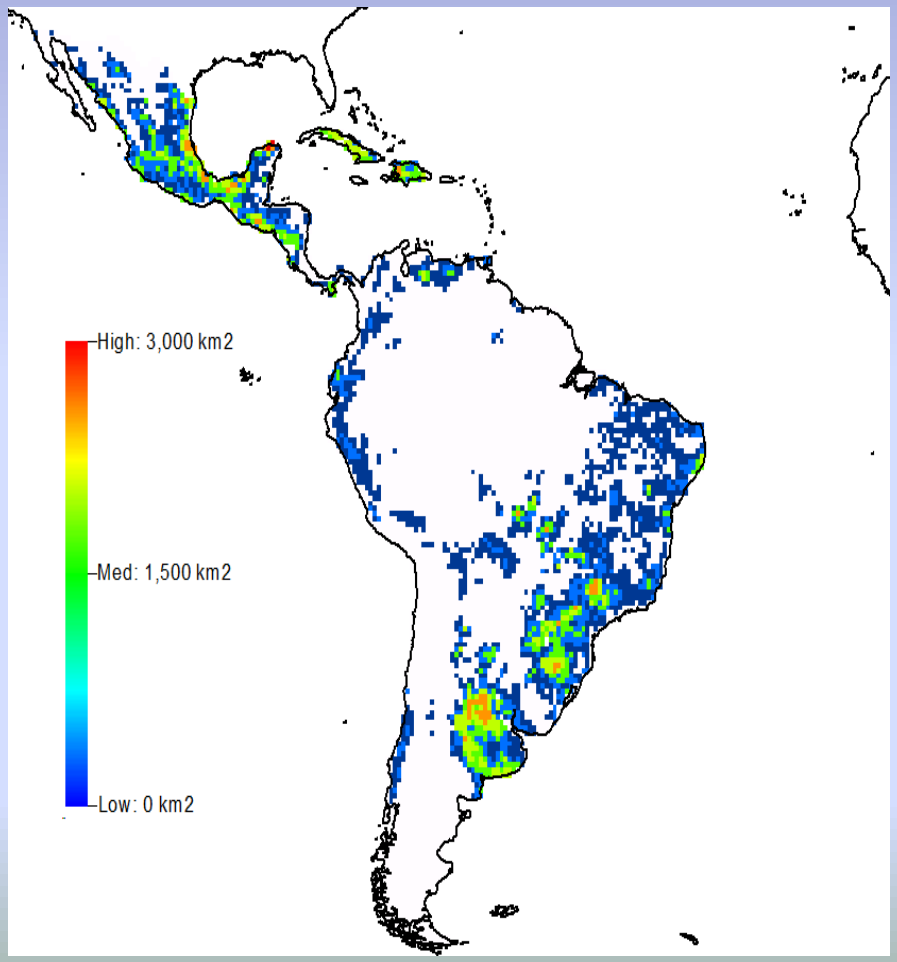
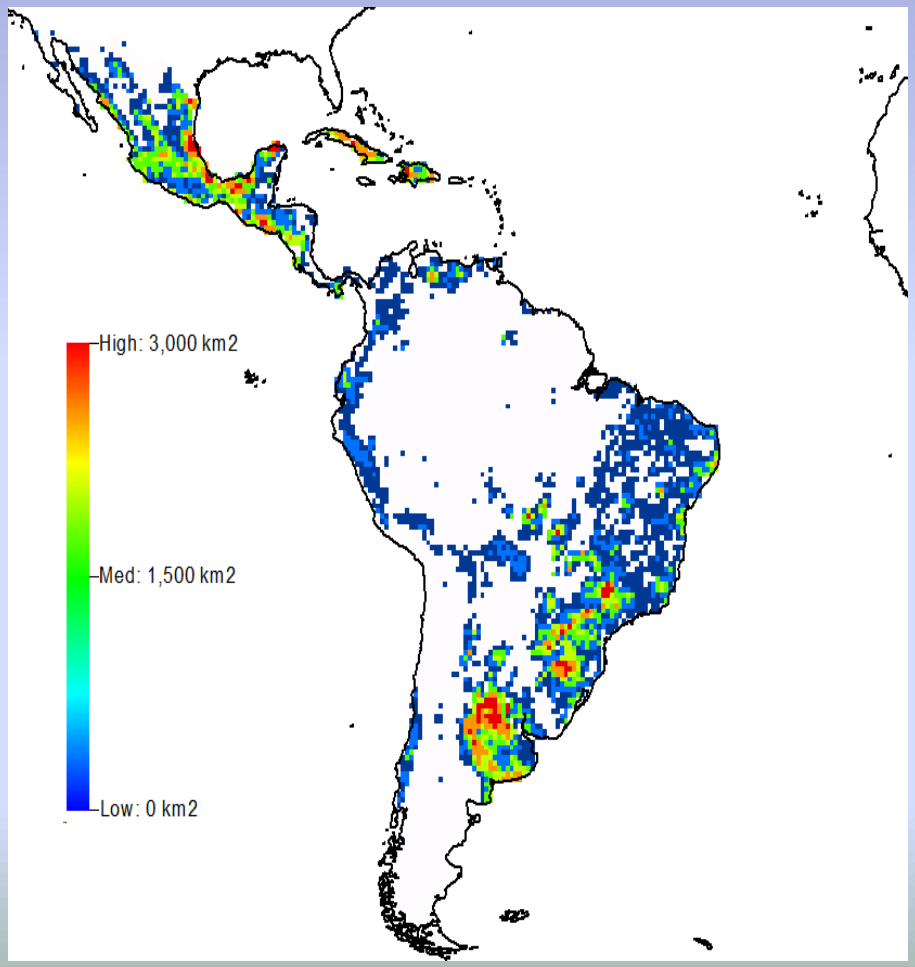
iPETS baseline-SSP5

2005

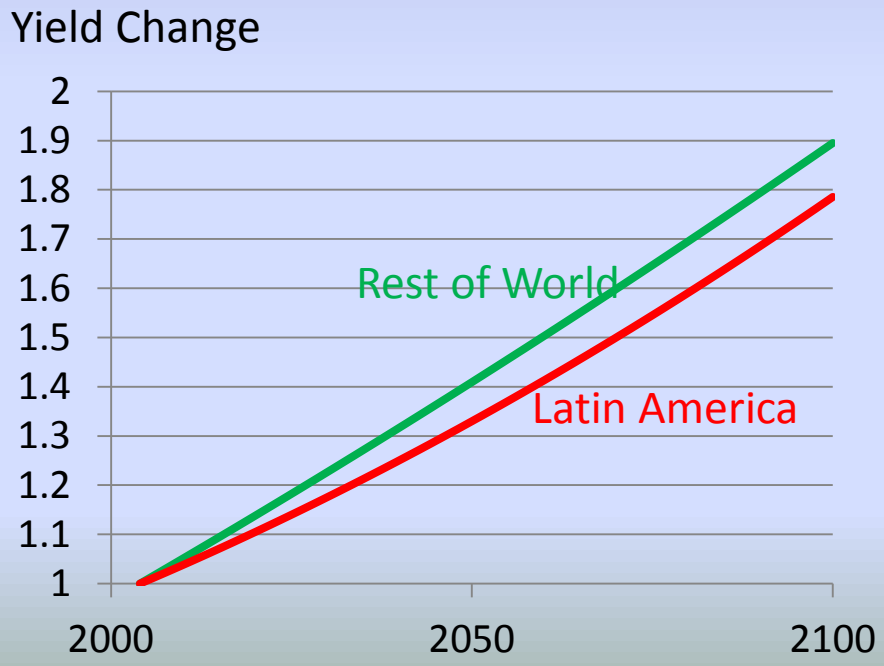


2050



Climate Impact on Crop Yield-Round 1

- Yield change data from
  - Crop model: Community Land model (CLM)
  - Climate: CESM RCP 8.5
  - No CO_2 fertilization
- Yield Change vs. 2004 over time



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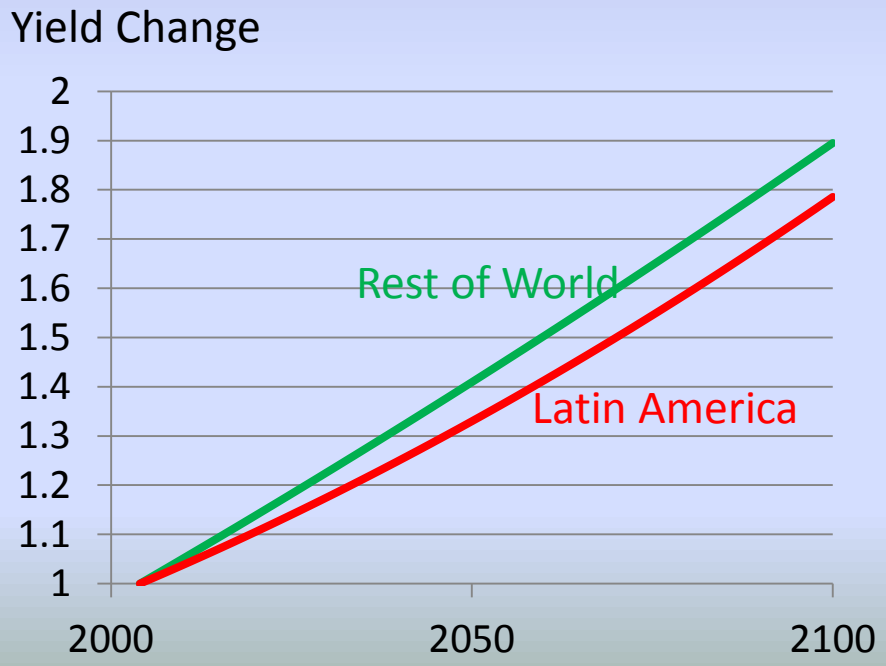

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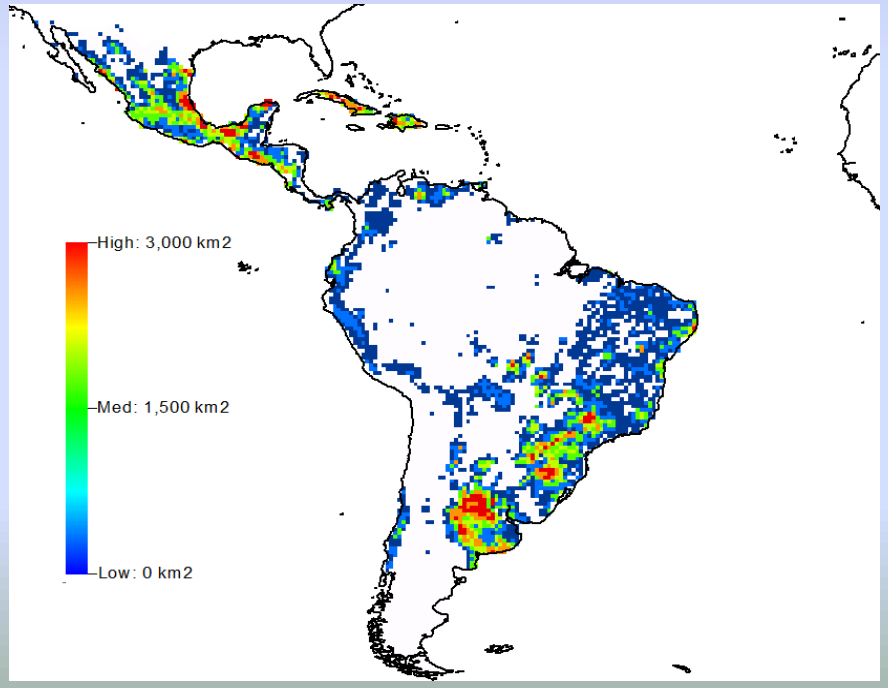
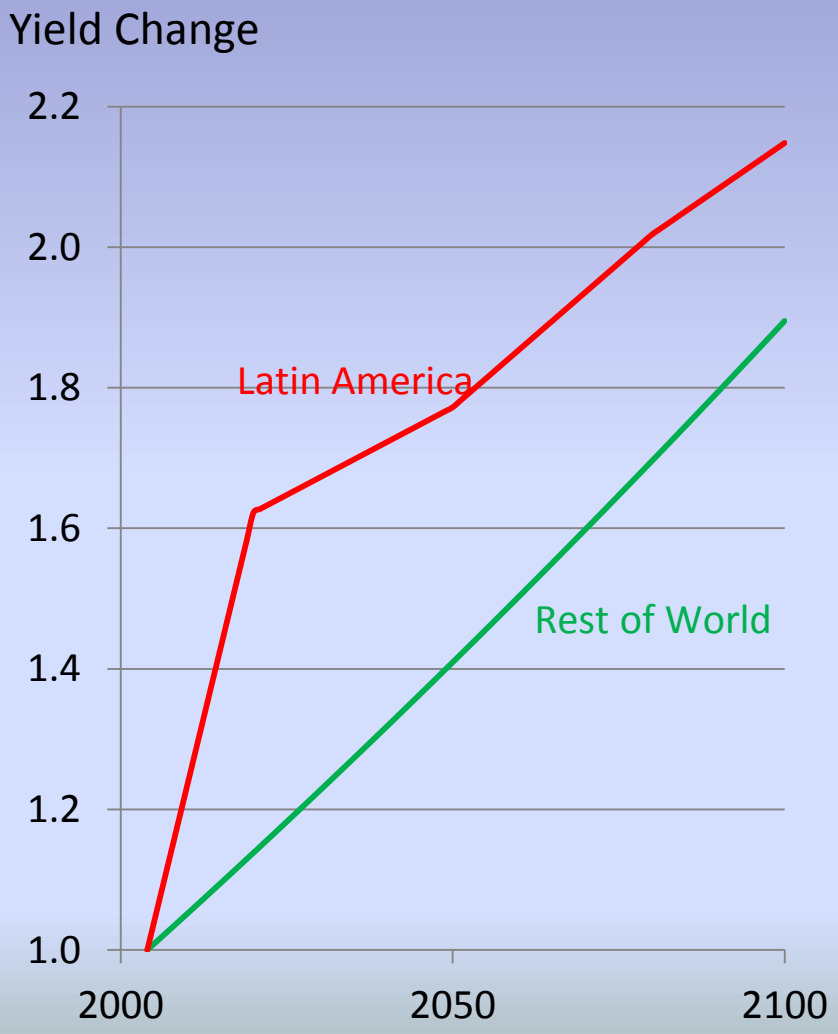


Cropland Distribution-Round 2



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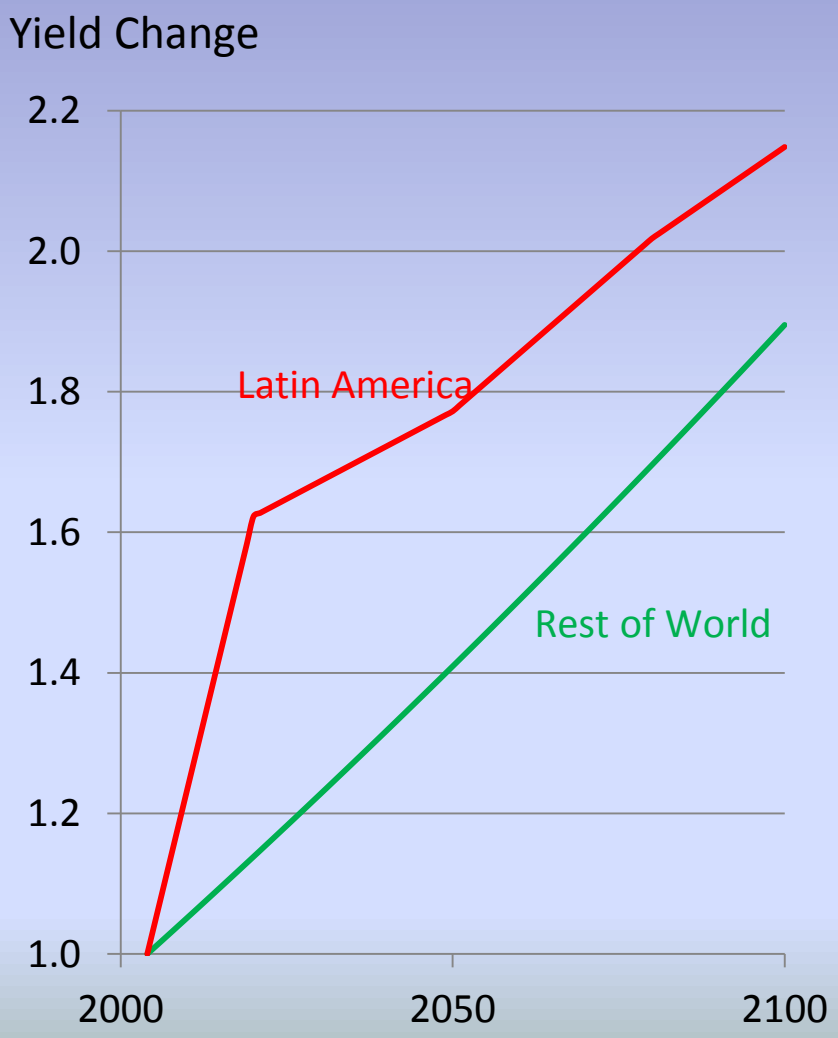
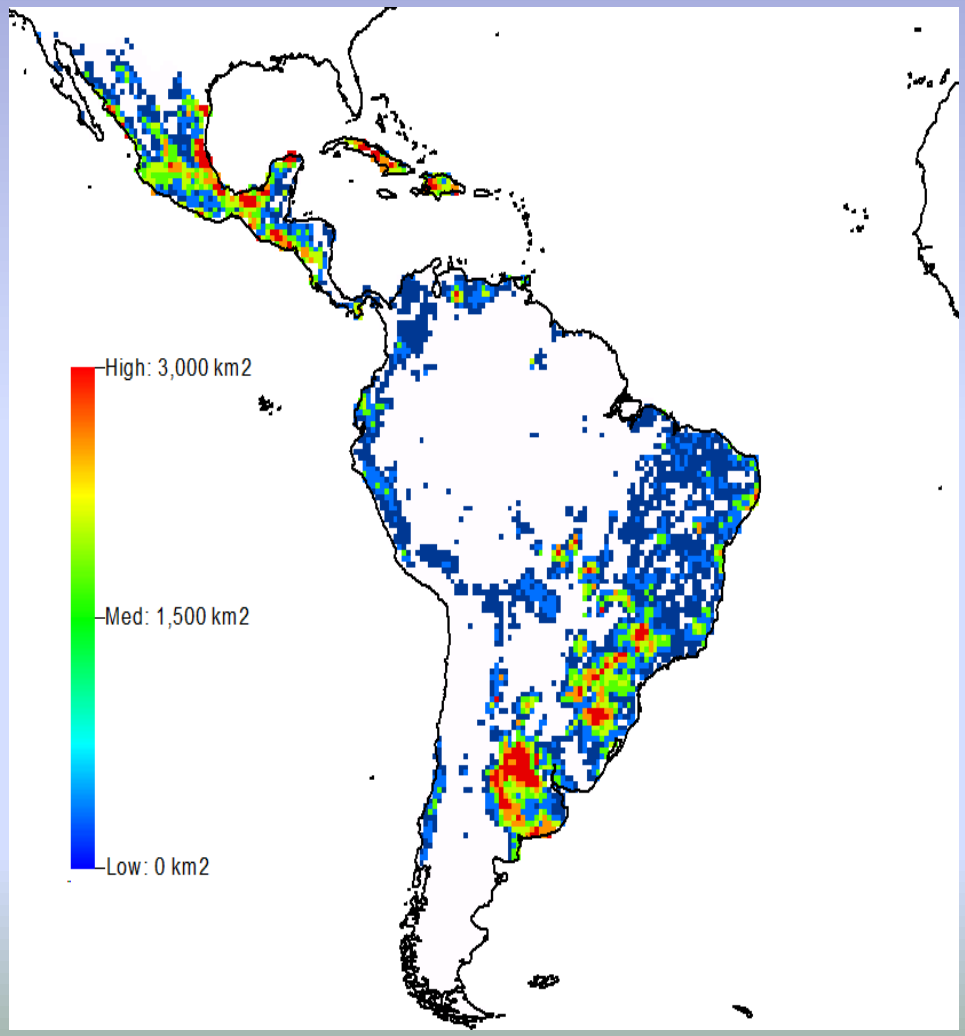
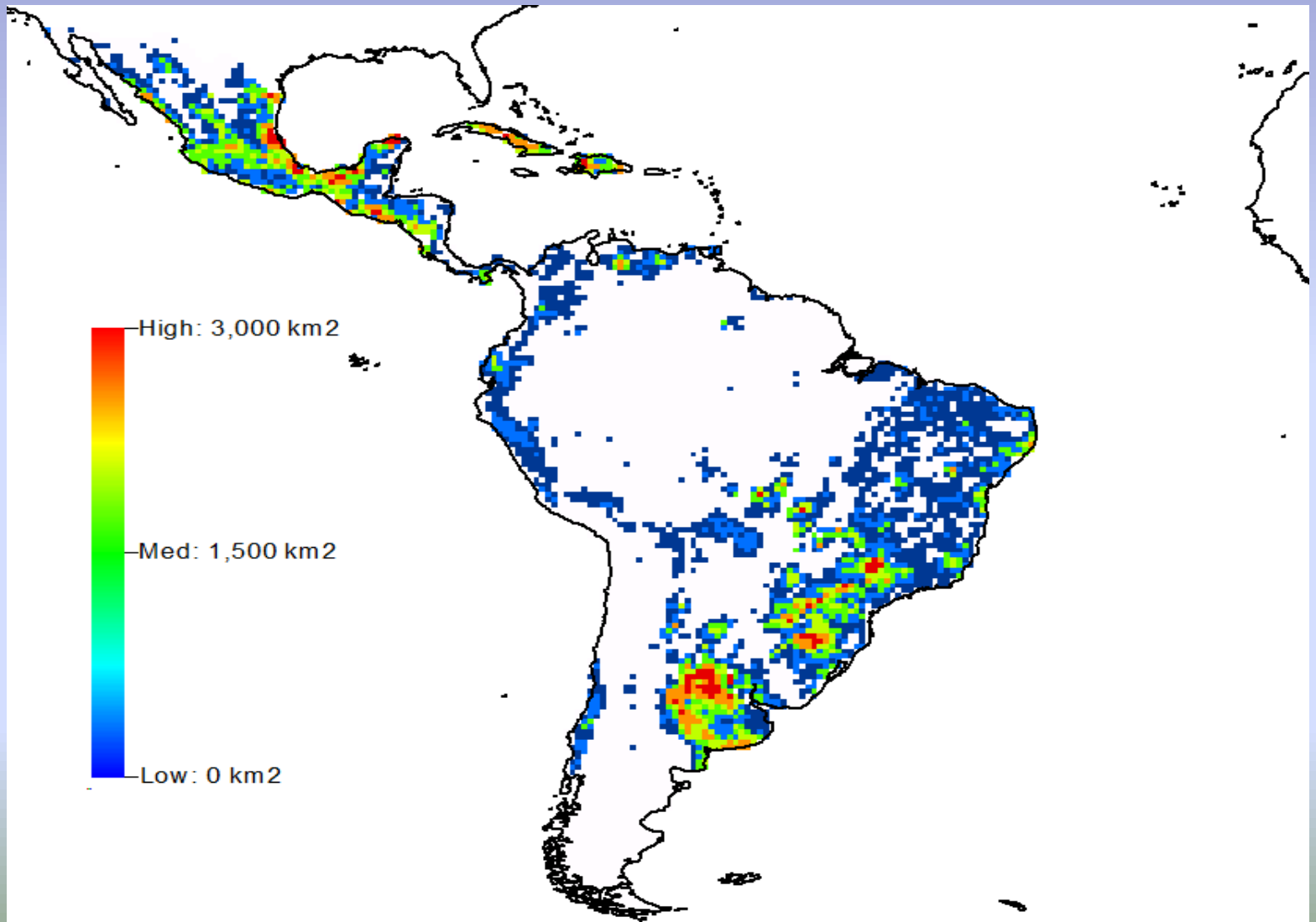


2050



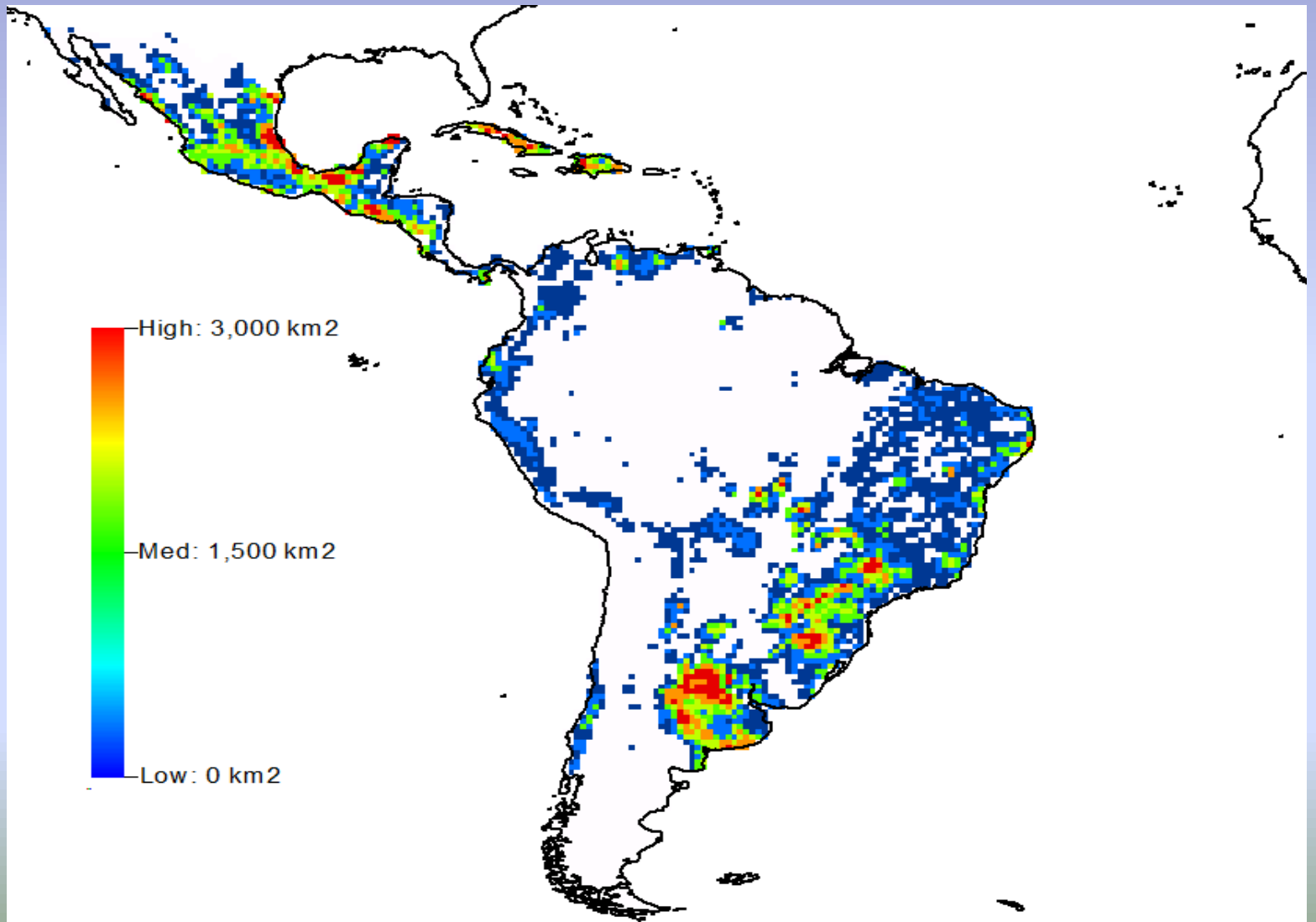
Cropland Distribution-2050

Baseline



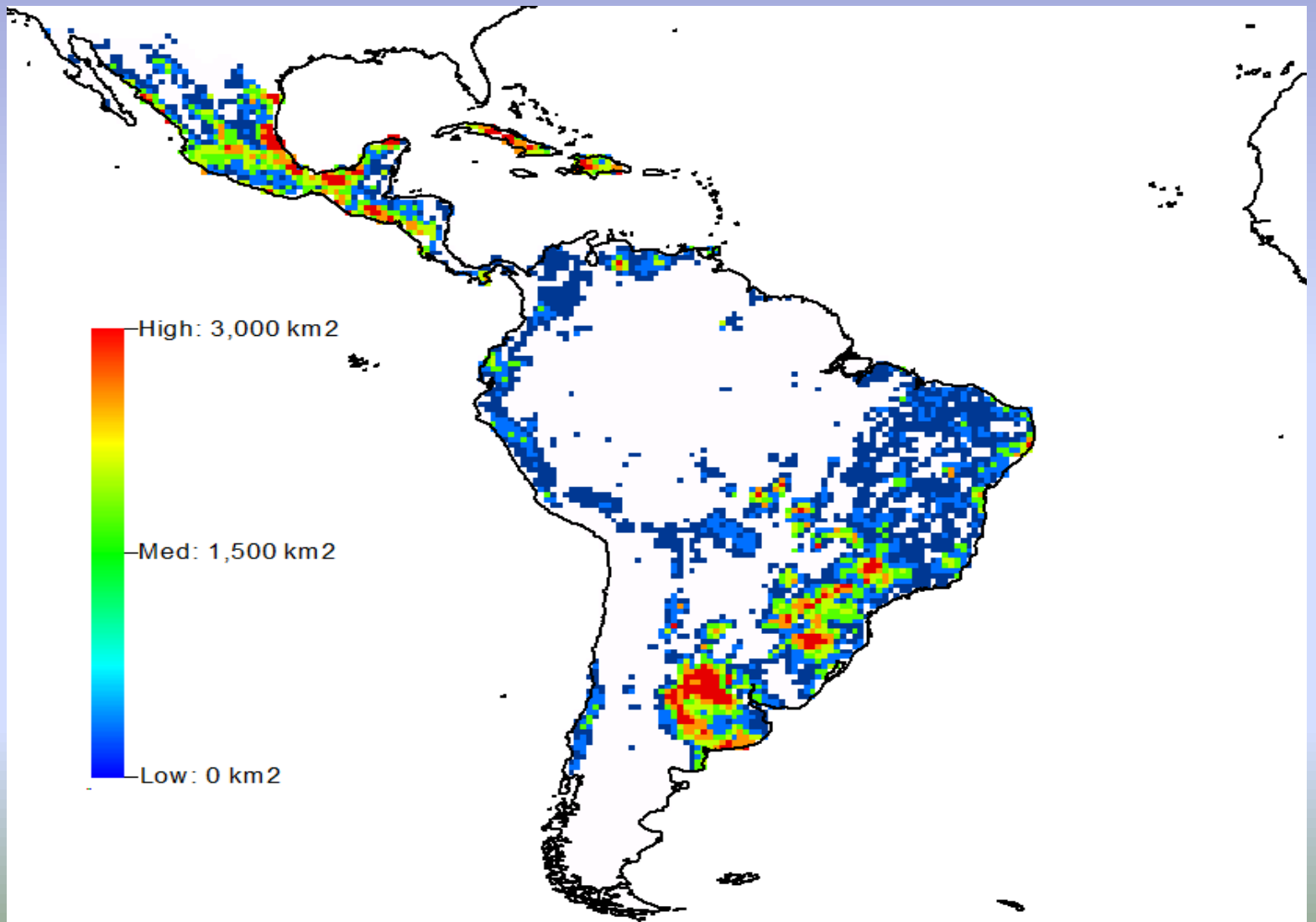
Cropland Distribution-2050

Climate Impact – round 1



Cropland Distribution-2050

Climate Impact – round 2



Conclusion and Discussion

- Iteration needed to insure the productivity consistency between IAM, crop model and downscaling model

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- Iteration needed to insure the productivity consistency between IAM, crop model and downscaling model
- Prelimrary results and future work
  - Corn is used as a representative crop
  - Downscaling method is driving by current social economic information
  - Only productivity in LAC is iterated
  - Feedbacks from land use change on climate