

Synthesis of a complete land use/land cover data set for the conterminous United States emphasizing accuracy in area and distribution of agricultural activity

N. Best^{1,2} M. Mihir¹ J. Elliott²

¹Department of Geography & Environmental Studies
Northeastern Illinois University

²Computation Institute
University of Chicago



Association of American Geographers
Annual Meeting, 2011



Outline

1 Introduction

2 Objectives

3 Data Sets

4 Data Processing

5 Comparison and Adjustment



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Introduction

CIM-EARTH



<http://www.cimearth.org/>

**Community
Integrated
Model of
Economic
and
Resource
Trajectories for
Humankind**



Introduction

PEEL model



Partial Equilibrium Economic Land Use

For forecasting...

- Land use conversion to/from cropland
- Choice among locally viable crops for cultivation under profit maximization



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PEEL model



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Objectives

Data Set Synthesis

Requirements

- 5 arc-minute resolution
- Sub-pixel analysis
- Global extent (eventually)
- Annual time series (eventually)



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Reproducible Research

Advantages

- Analysis runs like a program
- Final output is a publication-quality PDF
- Maps, charts, tables updated in place
- Source code and base data subject to review



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Reproducible Research

Software Tools

LATEX



- LATEX
(typesetting)
- R
(analysis)
- Sweave
(preprocessing)
- other R add-on
packages
(raster, ggplot2)



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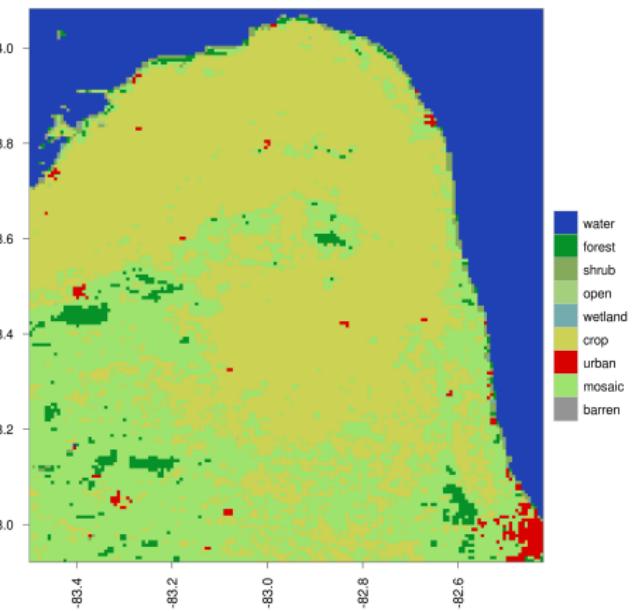
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Data Sets

MODIS Land Cover Type (MLCT)

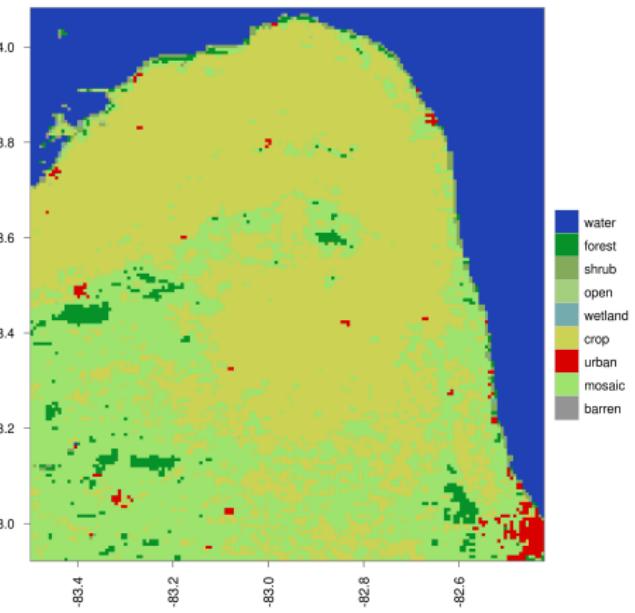


- Resolution: ~500 m (15'')
- 17 classes simplified to 9
- Mosaic contains 40–60% crop
- Annual time series 2001–2008
- 3 layers
 - Primary class
 - Secondary class
 - Confidence level



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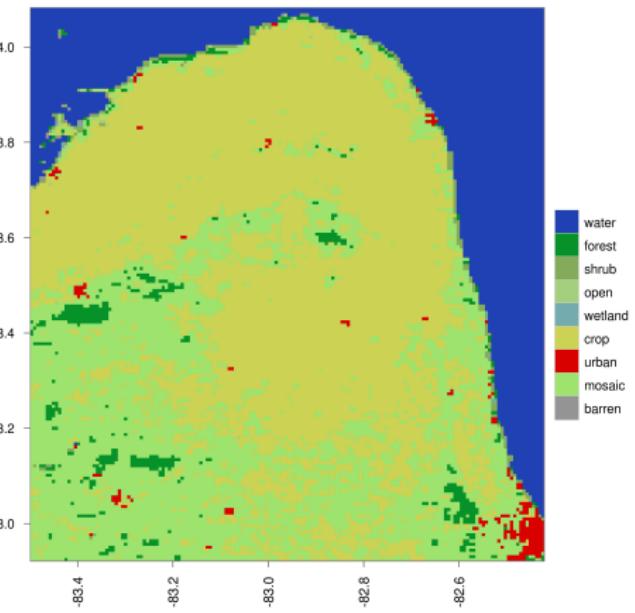


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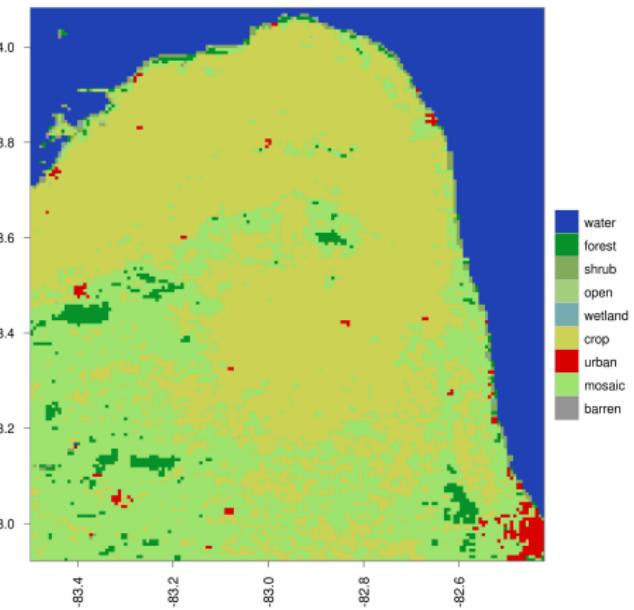


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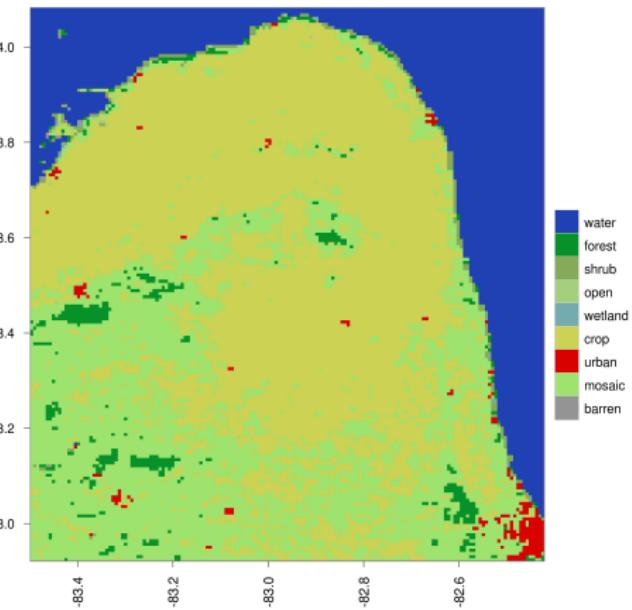


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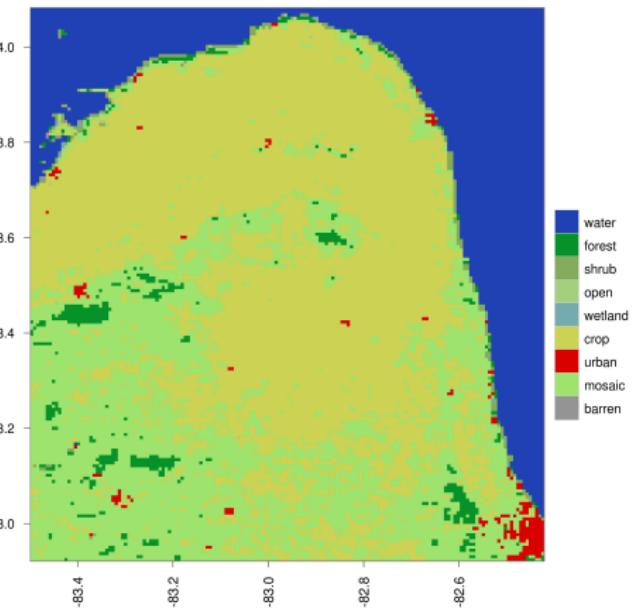


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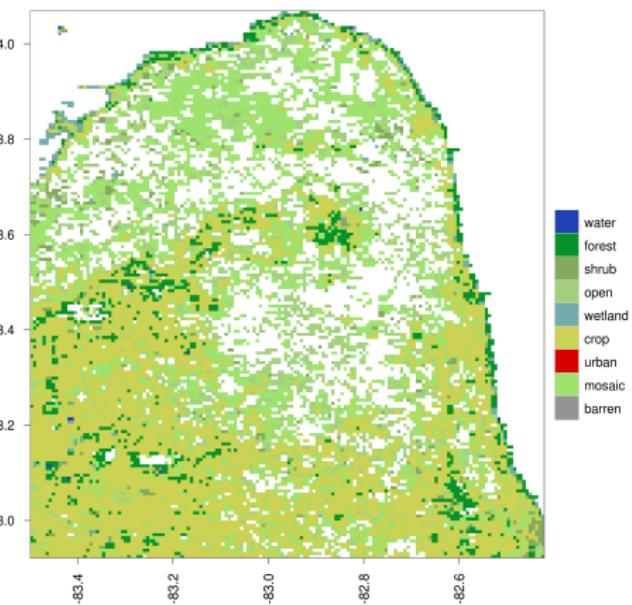


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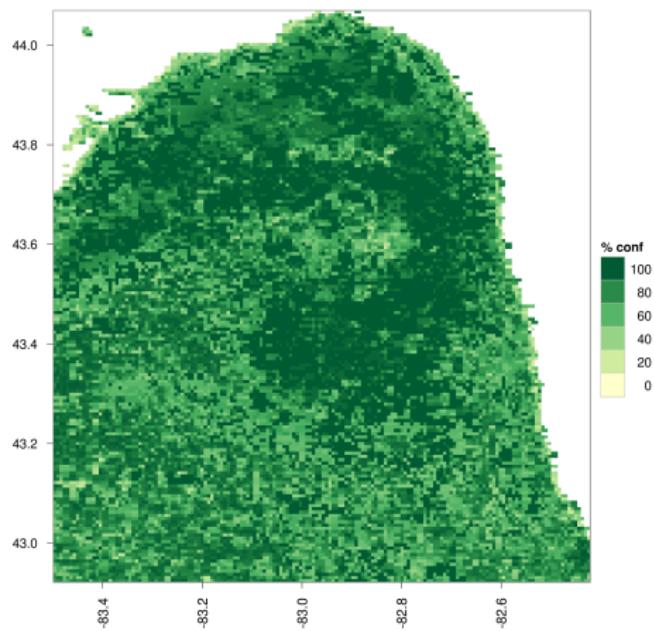


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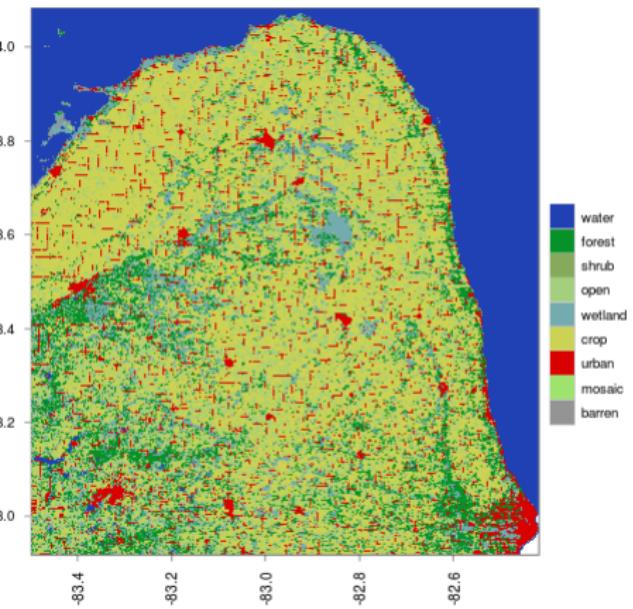


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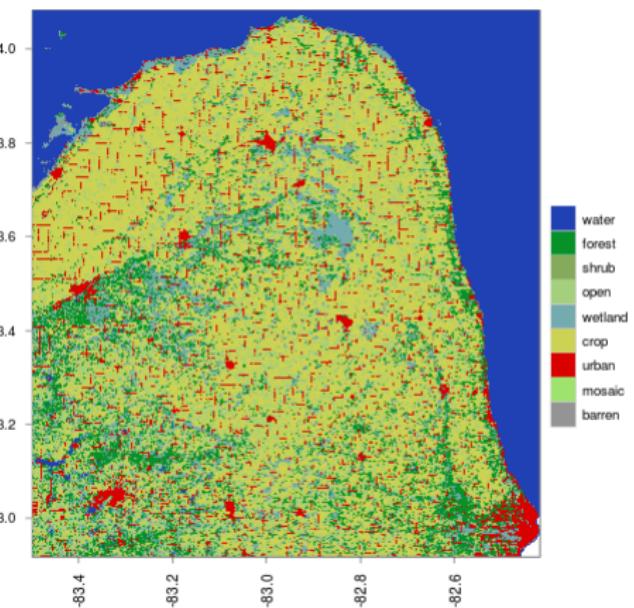


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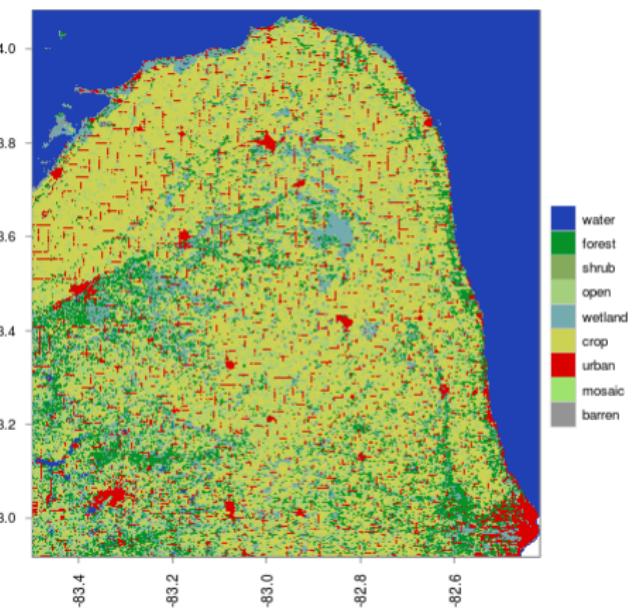


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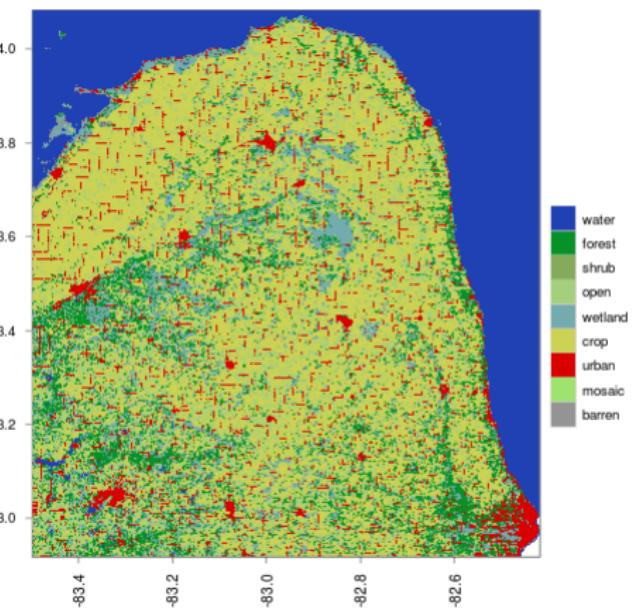


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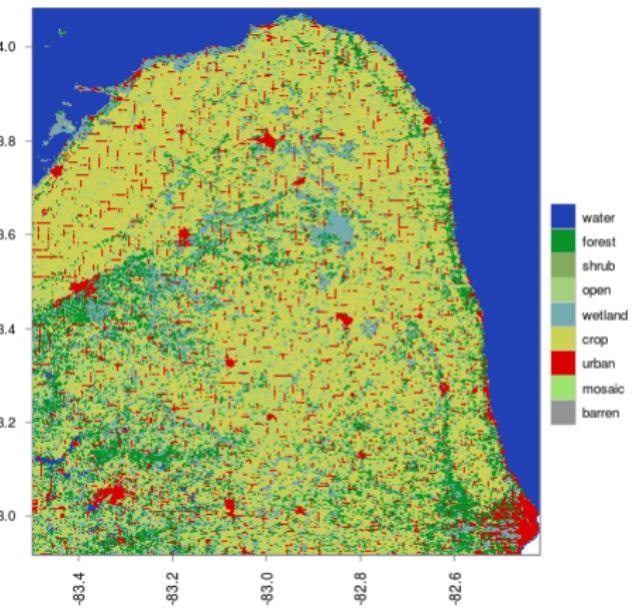


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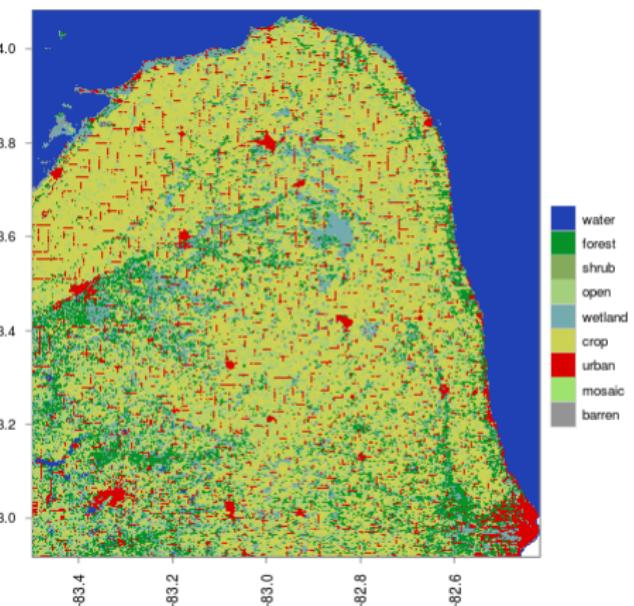


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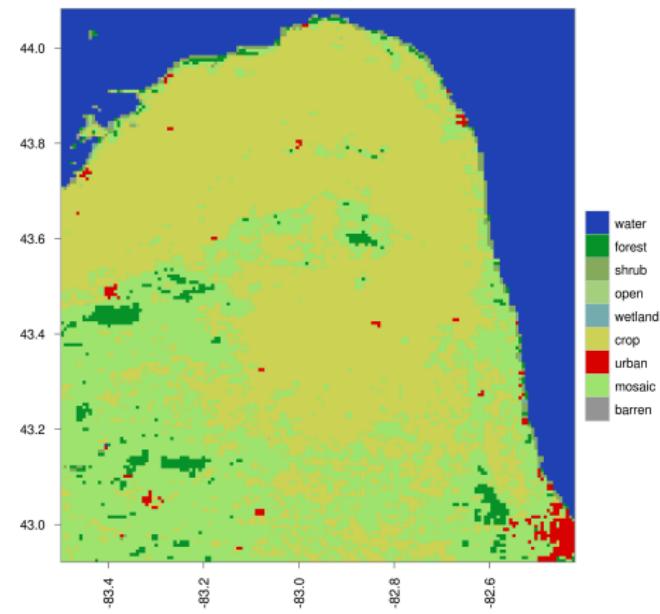
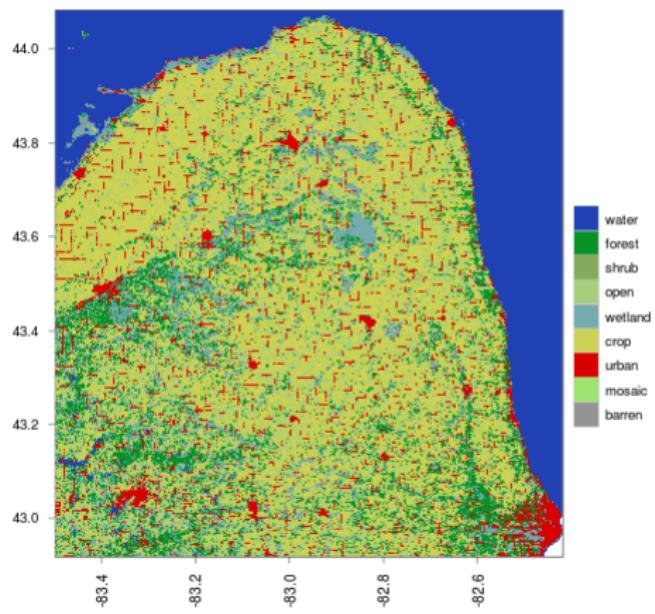


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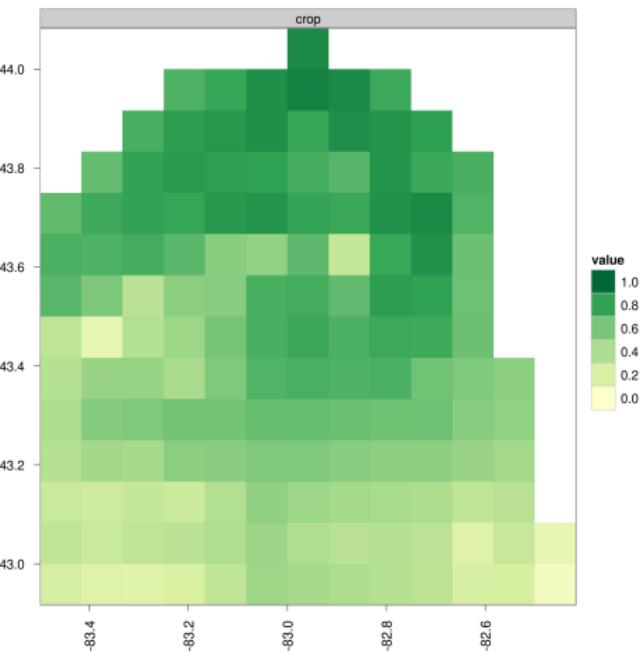
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Comparison of MLCT Primary and NLCD



Data Sets

Agland2000 (Ramankutty, et al.; 2008)



- Advantages

- Census-based
- 5' resolution
- Global extent

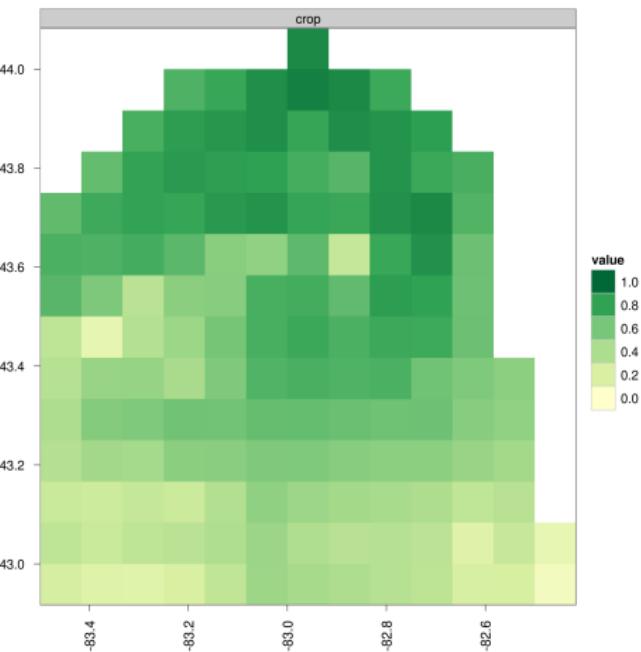
- Challenges

- Different land mask
- Be aware of circularity w/MLCT!



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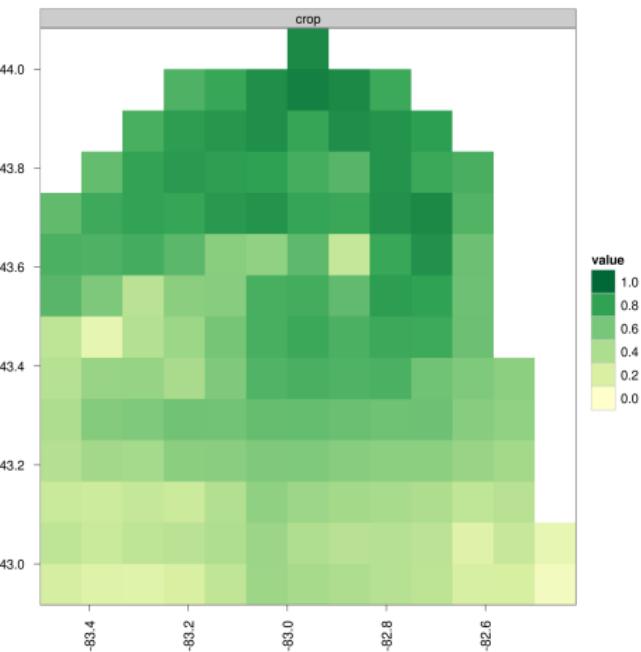
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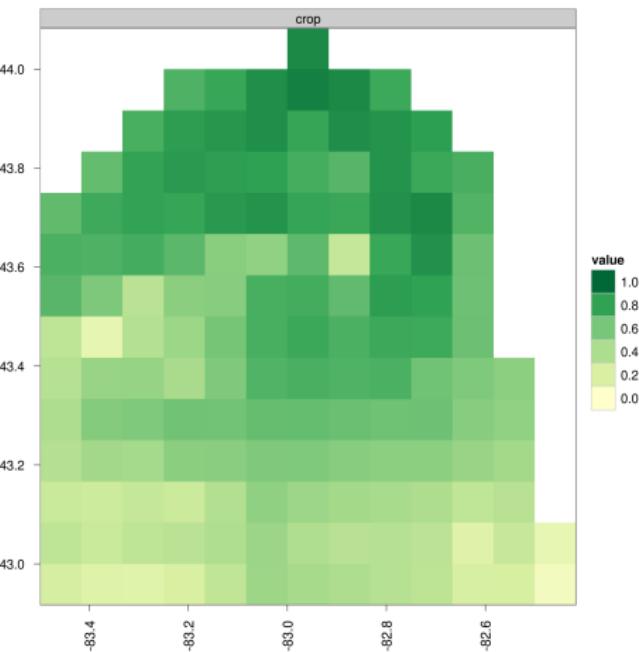
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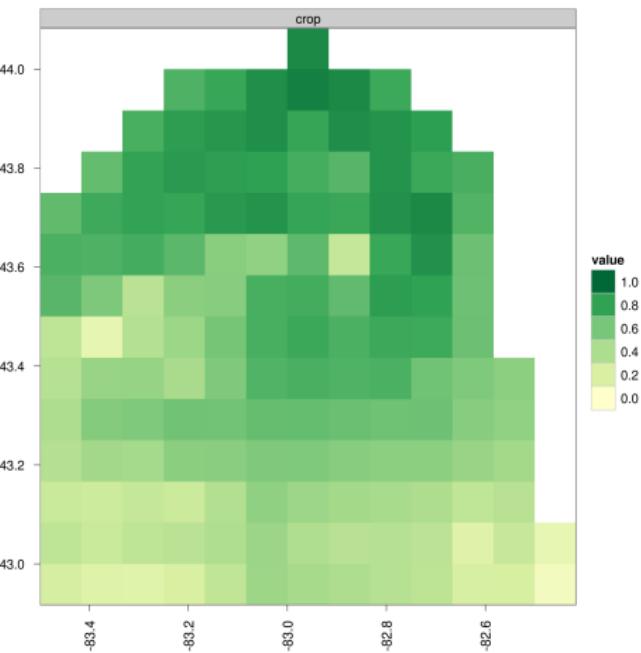
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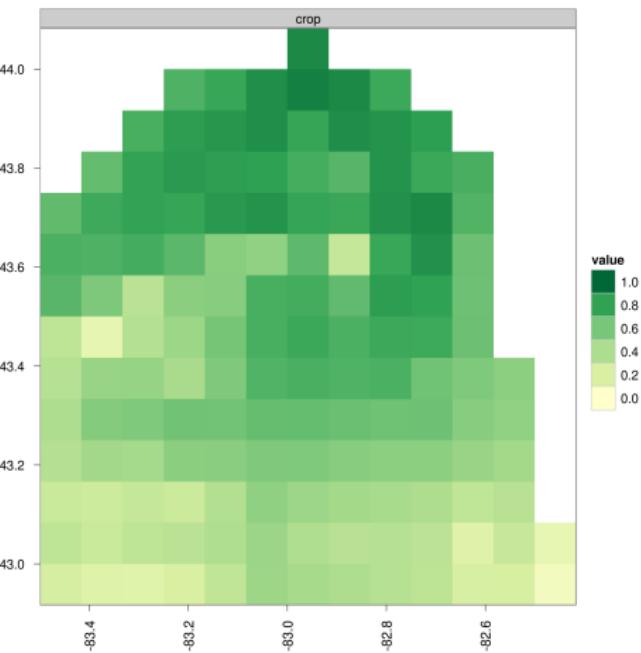
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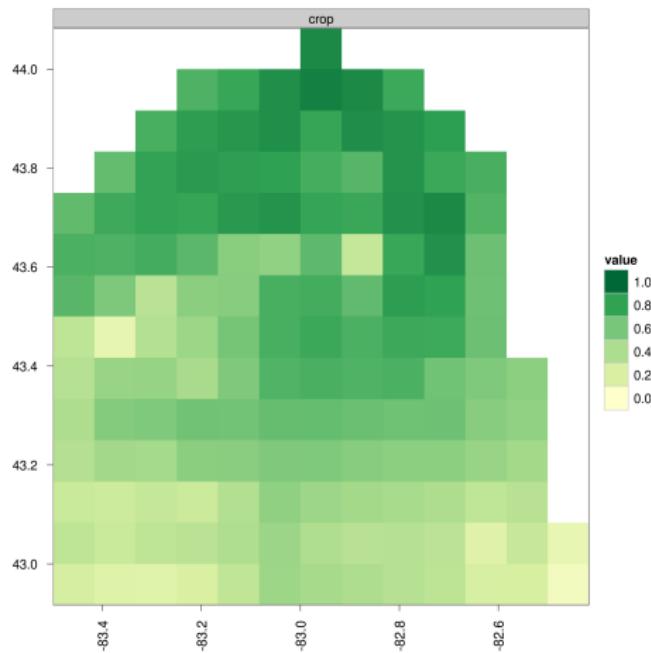
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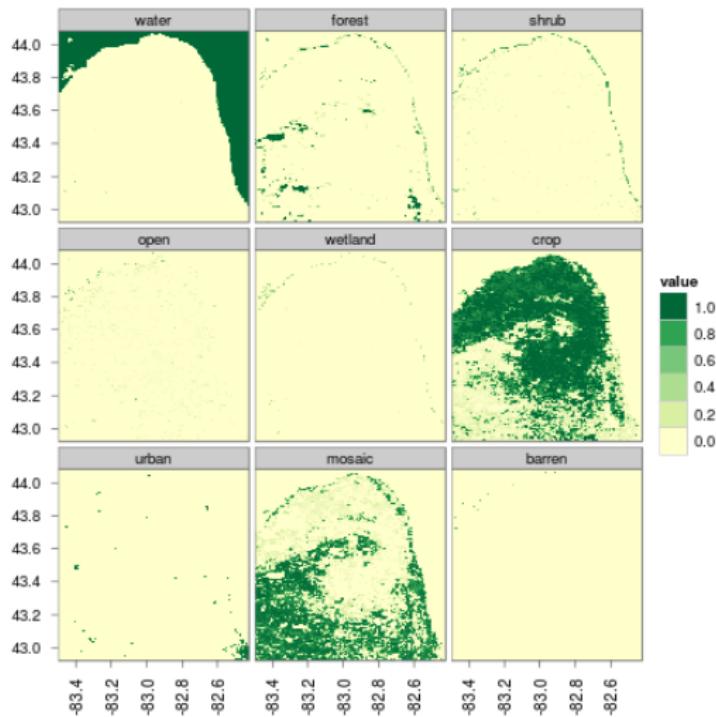
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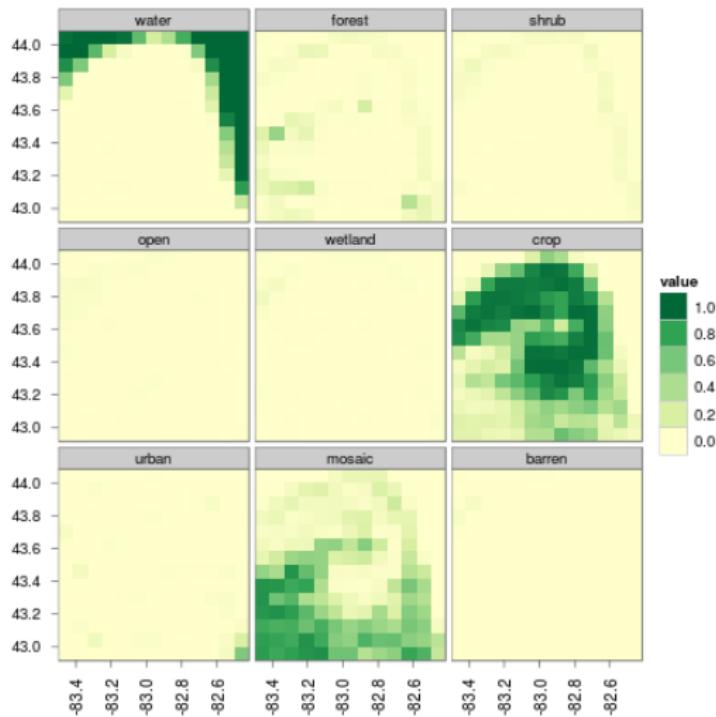
Data Processing

Sub-pixel Areas and Aggregation



Data Processing

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Data Processing

Mosaic Decomposition

- Mosaic land is 50% crop land
- Remainder is blend of forest, open, and shrub (by definition)
- That blend is proportional to their presence elsewhere in the same 5'' grid cell (our assumption)
- If none of those classes are represented we assume an equal blend of all three



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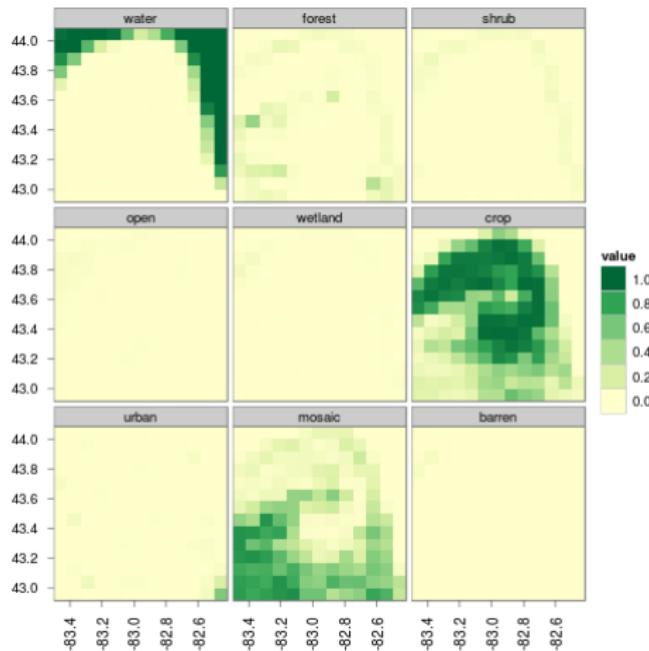
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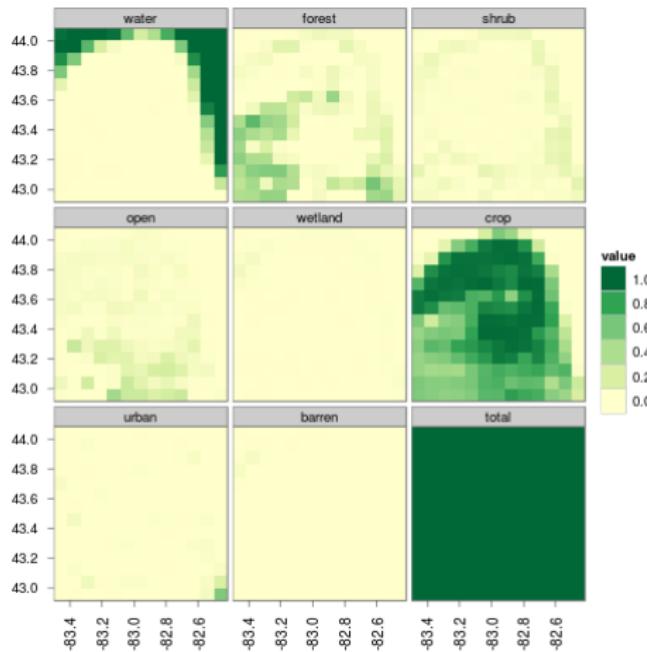
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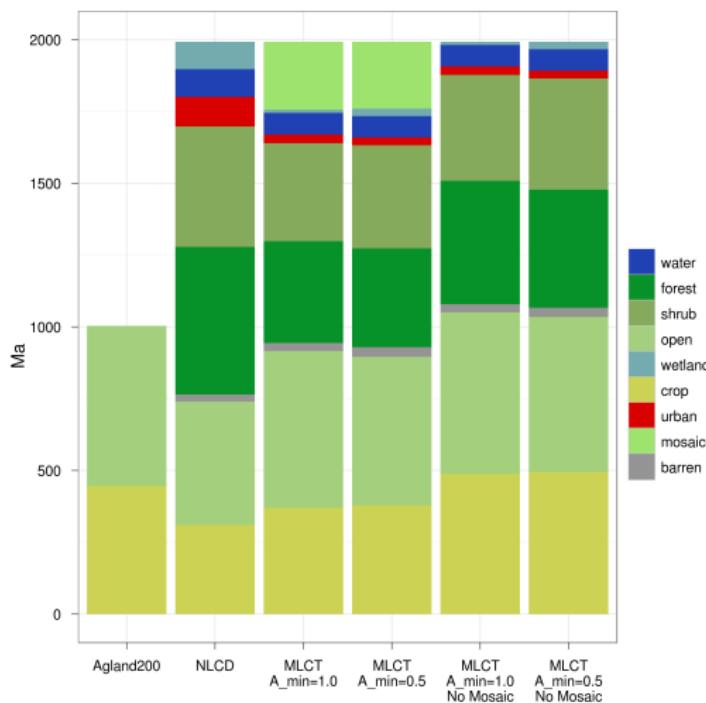
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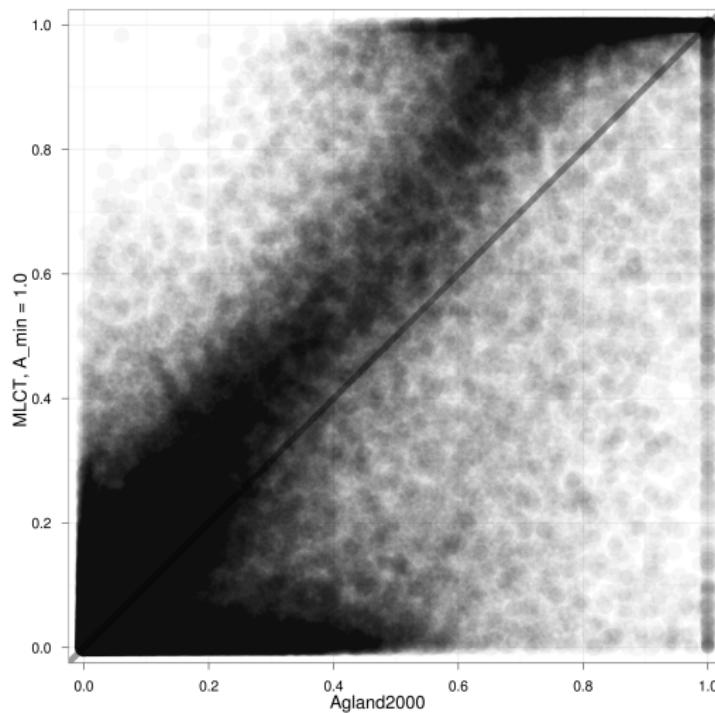
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Total Areas



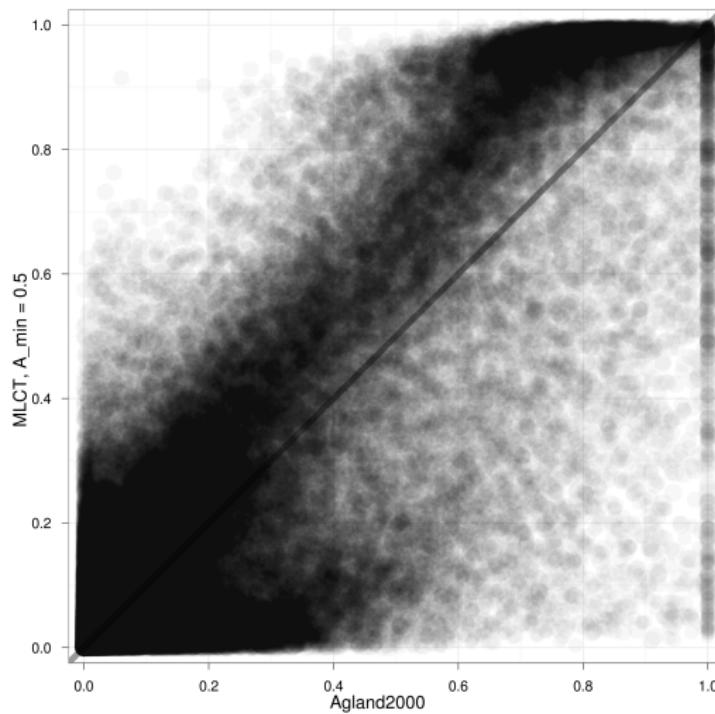
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MLCT Crop vs. Agland2000, $A_{min} = 1.0$



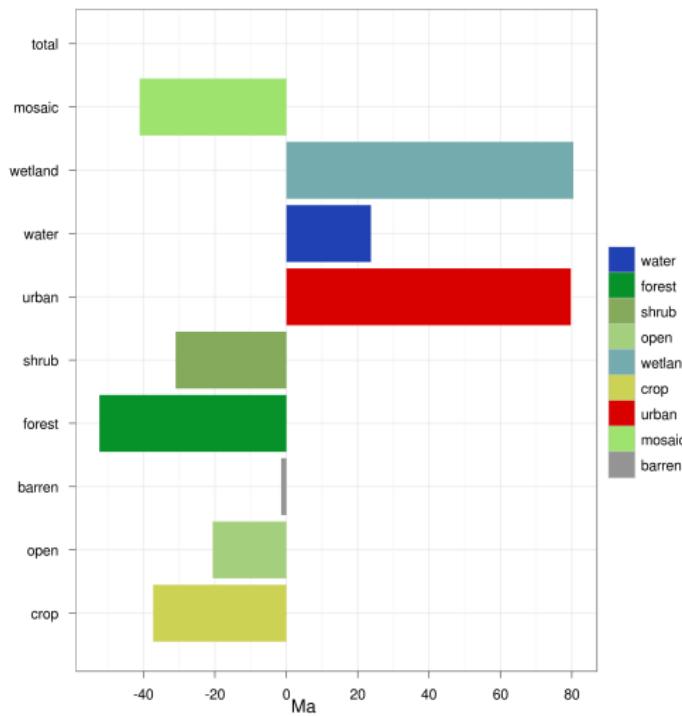
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MLCT Crop vs. Agland2000, $A_{min} = 0.5$



Comparison and Adjustment

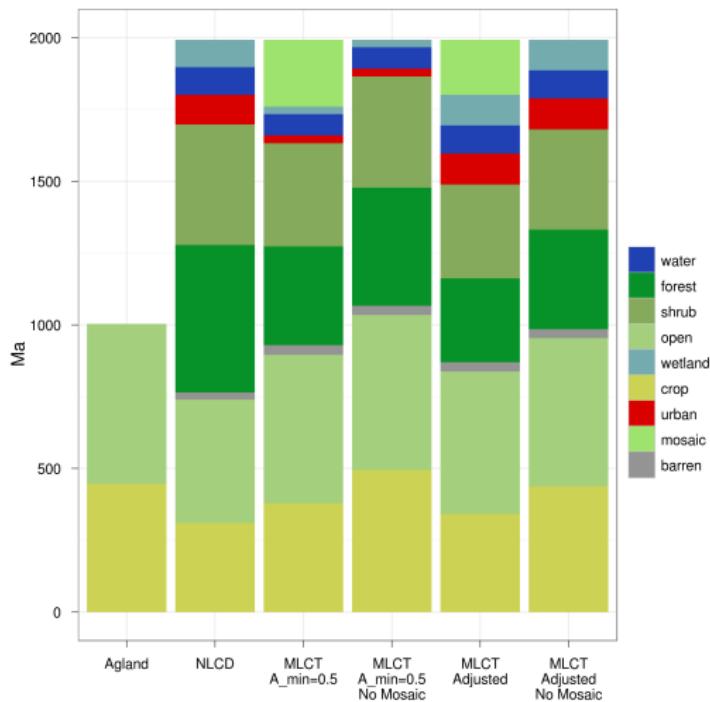
NLCD Offsets



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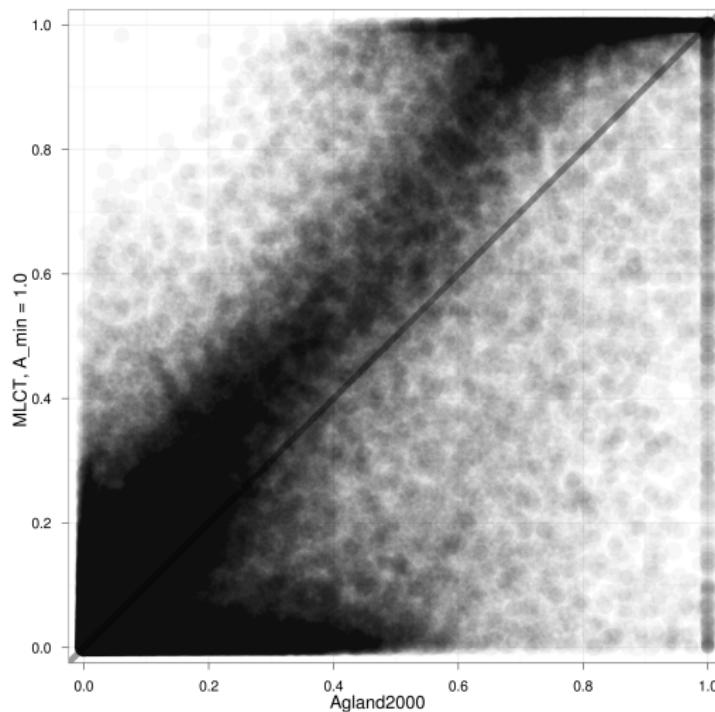
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Total Areas, Adjusted



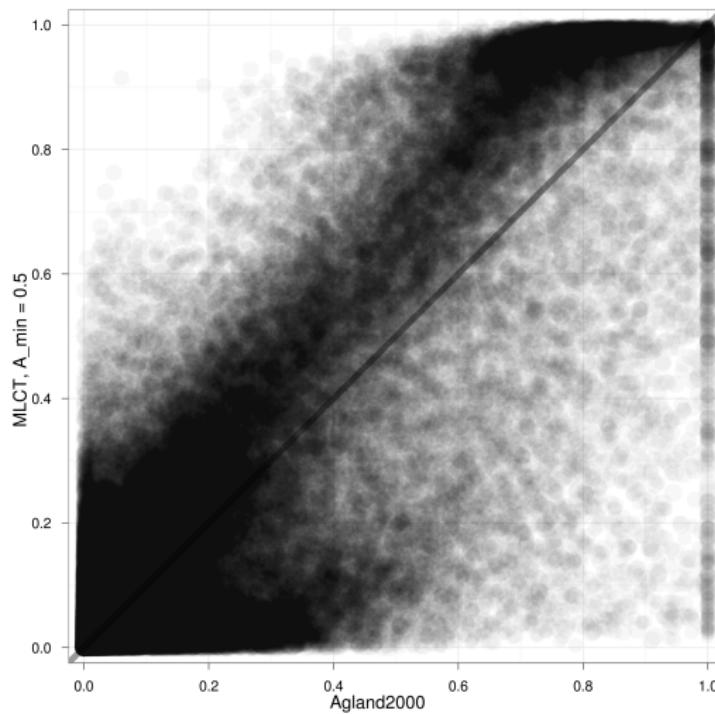
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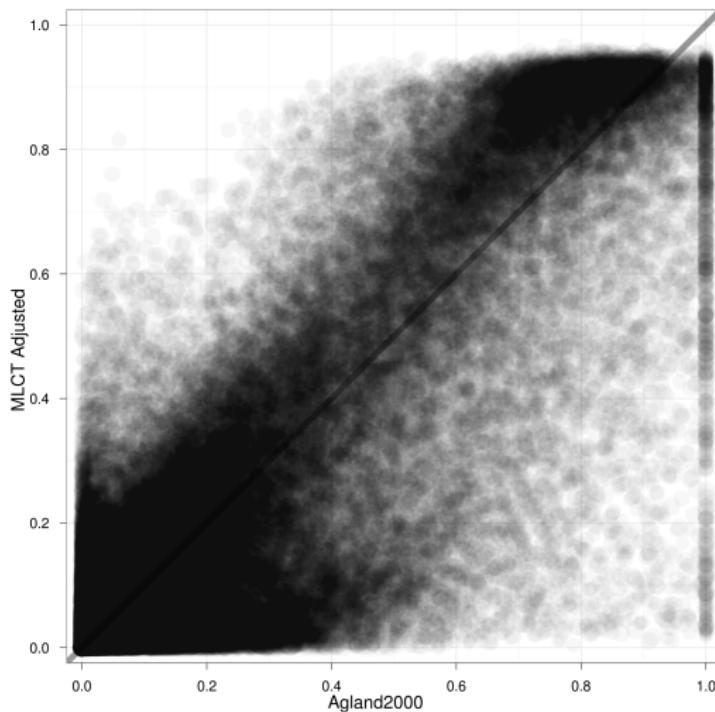
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MLCT Crop vs. Agland2000, $A_{min} = 0.5$



Comparison and Adjustment

MLCT Crop vs. Agland2000, $A_{min} = 0.5$ plus NLCD offsets



Summary

Next steps

- Investigate spatial structure of 100% crop cells in Agland2000
- Evaluate magnitude of cropland area classified by MLCT outside of Agland2000 land mask
- Re-allocate cells where Agland2000 crop fraction does not contradict NLCD offsets, i.e.:
$$A_{crop} \leq 1 - A_{water} - A_{wetland} - A_{urban}$$
- Disaggregate cropland into sub-categories (corn, soy, wheat, rice, other grains, etc.) using 175Crops2000 data set (Monfreda, et al.; 2008)
- Contribute to the underlying software!



Summary

- A rational framework for constructing a hybrid data set
- A basis for adding a time dimension by using the ensuing MLCT maps
- A repeatable mechanism for incorporating adjustments or evaluating alternatives
- A nicely formatted paper ready for publication somewhere!

