MADALGO
CENTER FOR MASSIVE DATA ALGORITHMICS


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Topographic and Climatic Controls on Global Patterns of Tree Cover

Introduction

Objectives

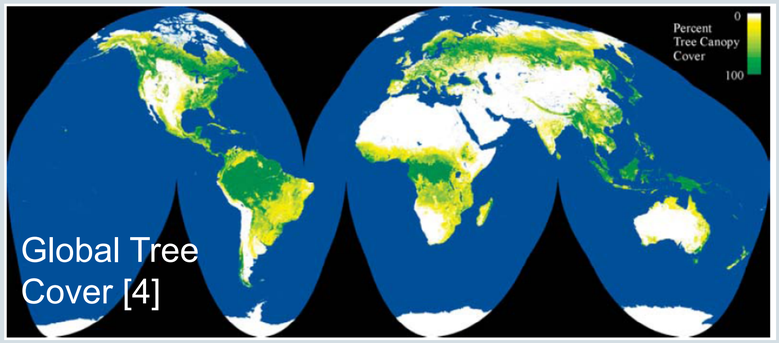
- Perform the first global, high-resolution analysis of controls on tree cover
- Analyze tree cover patterns across a wide range of spatial scales
- Develop a predictive model that can be used to fore- and hindcast tree cover distributions

Background

- Tree cover is a critical feature of landscapes, with important impacts on human activities, maintenance of biodiversity, and global carbon storage
- It is well-known over local scales that tree cover is influenced by topography, hydrology, climate and human land use
- Comprehensive global analyses of these patterns have been lacking, in part due to computational challenges
- The factors that are important in influencing tree cover are likely to change as a function of the spatial scale of analysis
- The confluence of high-quality, high-resolution data and new analytical techniques allows a new and powerful approach to analyzing patterns of tree cover

Data Sources

- Current climate data (temperature, precipitation, Worldclim [1])
- Human influence index [2]
- Topographic map (SRTM CGIAR product) [3]
- Derived topographic and hydrological variables (computed using TerraSTREAM)
- Tree Cover [4]



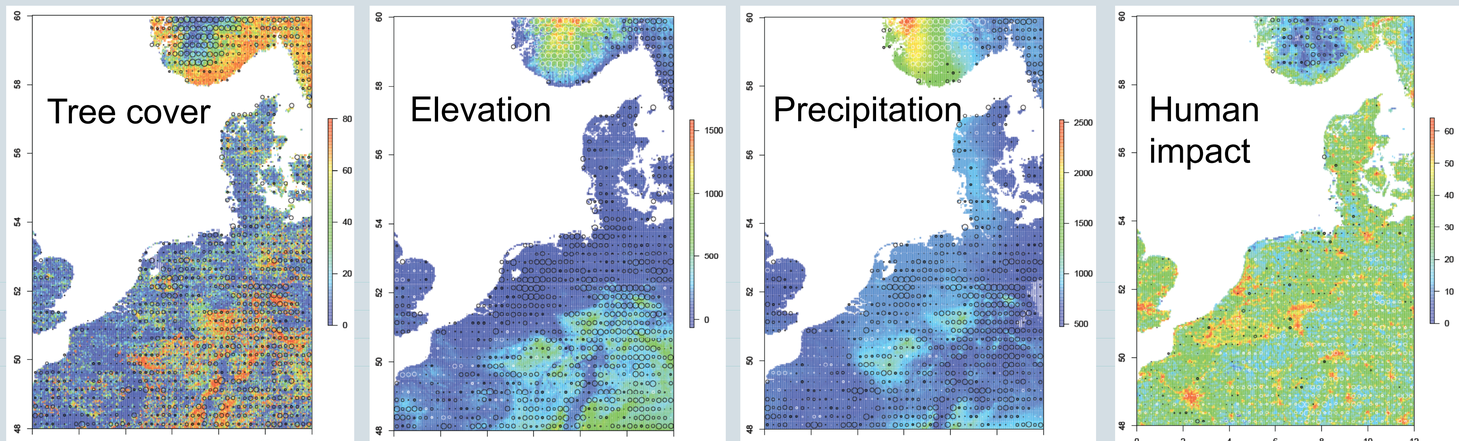
General Approach

- Correlation analysis across a range of spatial scales
- At each scale, divide world into windows of 30 x 30 cells, correlations within windows
- Analyze global distribution of within-window correlations
- Windows range from 15 x 15 km to 1920 x 1920 km

Results

An Example Region

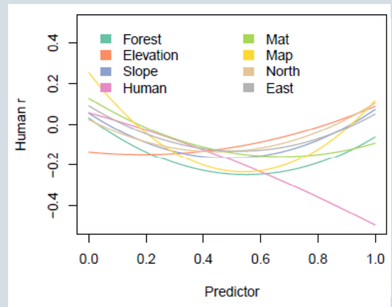
- Example from analysis at 1 km grain size, in 30 x 30 km local windows
- Underlying map shows the named variable
- Black circles show local windows where the named variable is positively associated with tree cover, white circles show the opposite
- Circle size is scaled to the strength of the correlation



- Within this region, tree cover is most often positively associated with elevation and precipitation, and negatively associated with human impacts within 30 x 30 km local windows

Global Patterns

- We can explain variation in these r values, using other predictor variables
- In this case, for example, the influence of humans becomes more negative as human impacts increase, as elevation decreases, and at intermediate values of forest cover and precipitation



Main Conclusions

- At small spatial scales, topographic and hydrological control on tree cover is strong, while climatic factors are most important over large scales
- Multiple factors interact in complex ways across spatial scales to influence tree cover
- These results can be used to create a hierarchical model of tree cover that explains ~85% of the variation in tree cover globally. This model can be used to forecast or hindcast tree cover predictions under climate change and land use scenarios

References

[1] Hijmans, Cameron, Parra, Jones, Jarvis. *Very high resolution interpolated climate surfaces for global land areas.* International Journal of Climatology. 2005.
[2] Sanderson, Jaiteh, Levy, Redford, Wannebo, Woolmer. *The human footprint and the last of the wild.* BioScience. 2002.
[3] CGIAR Consortium for Spatial Information. *SRTM 90m Digital Elevation Data.* 2010.
[4] Hansen, DeFries, Townshend, Carroll, Dimiceli, Sohlberg. *Global percent tree cover at a spatial resolution of 500 metetrs: First results of the MODIS Vegetation Continuous Fields Algorithm.* Earth Interactions. 2003.