Data Mining for Climate Change Model Intercomparison and Phenoregions

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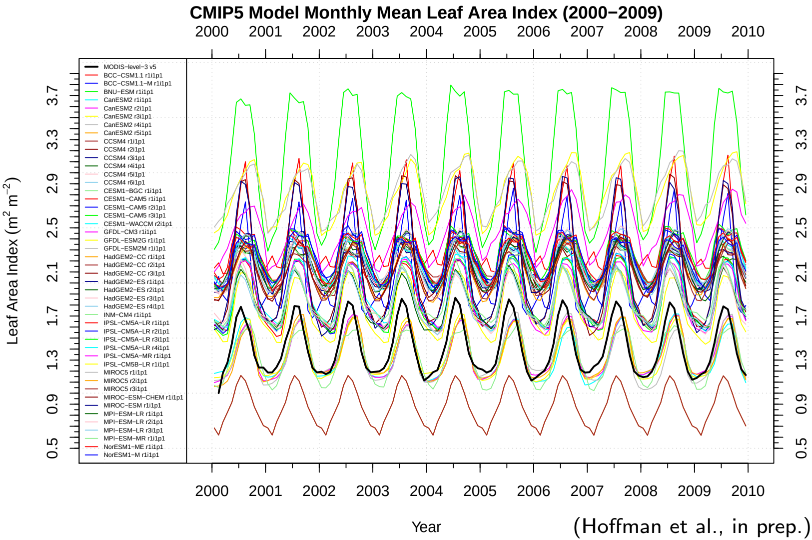
Data Mining for Climate Change Model Intercomparison

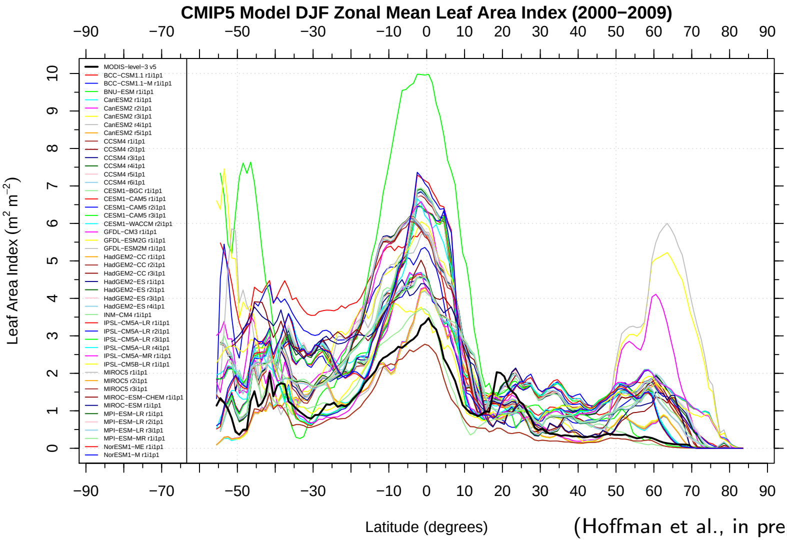
Hoffman et al. (2005)

Global LAI for 47 CMIP5 Simulations Compared to MODIS



(Hoffman et al., in prep.)

Zonal LAI for 47 CMIP5 Simulations Compared to MODIS



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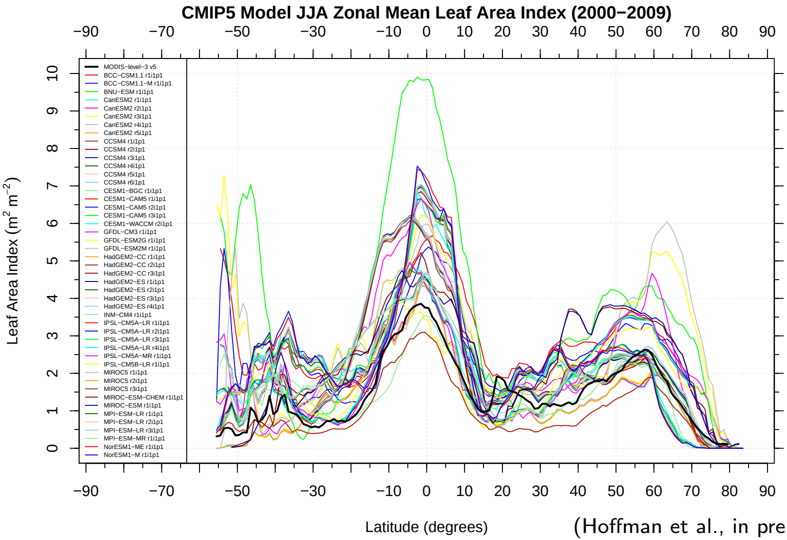
Zonal LAI for 47 CMIP5 Simulations Compared to MODIS

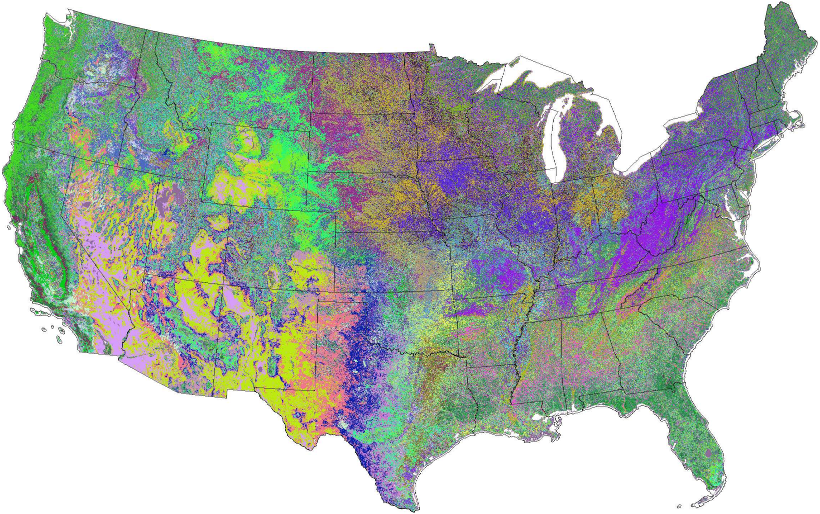


(Hoffman et al., in prep.)

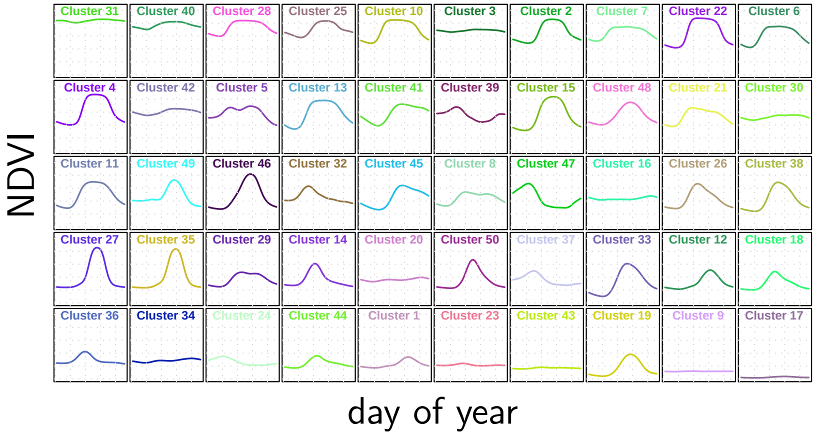
Clustering MODIS NDVI into Phenoregions

- Hoffman and Hargrove previously used *k*-means clustering to detect brine scars from hyperspectral data (Hoffman, 2004) and to classify phenologies from monthly climatology and 17 years of 8 km NDVI from AVHRR (White et al., 2005).
- This data mining approach, using high performance computing, was applied to the entire body of the high resolution MODIS NDVI record for the continental U.S.
- $>$80B NDVI values, consisting of $\sim$146.4M cells for the CONUS at 250 m resolution with 46 maps per year for 12 years (2000–2011), analyzed using *k*-means clustering.
- The annual traces of NDVI for every year and map cell are combined into one 323 GB single-precision binary data set of 46-dimensional observation vectors.
- Clustering yields 12 maps in which each cell is classified into one of *k* phenoclasses, and phenoregions form representative prototype annual NDVI traces.

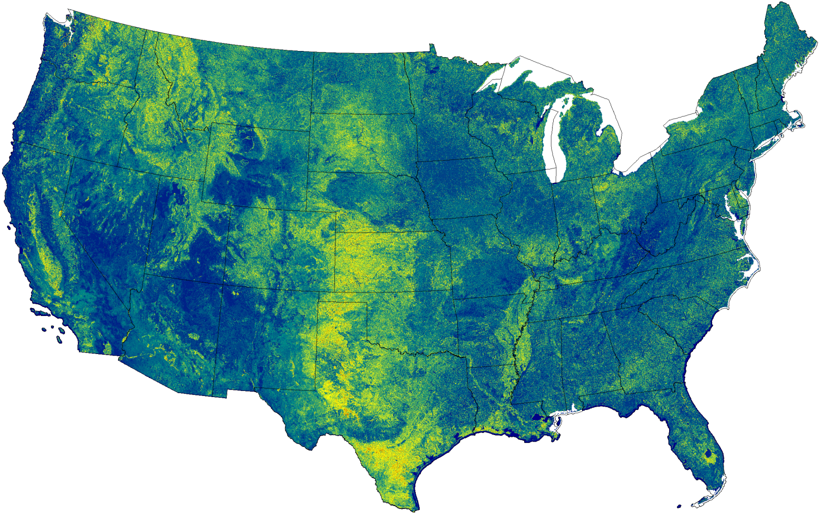
50 Phenoregions for year 2011 (Random Colors)



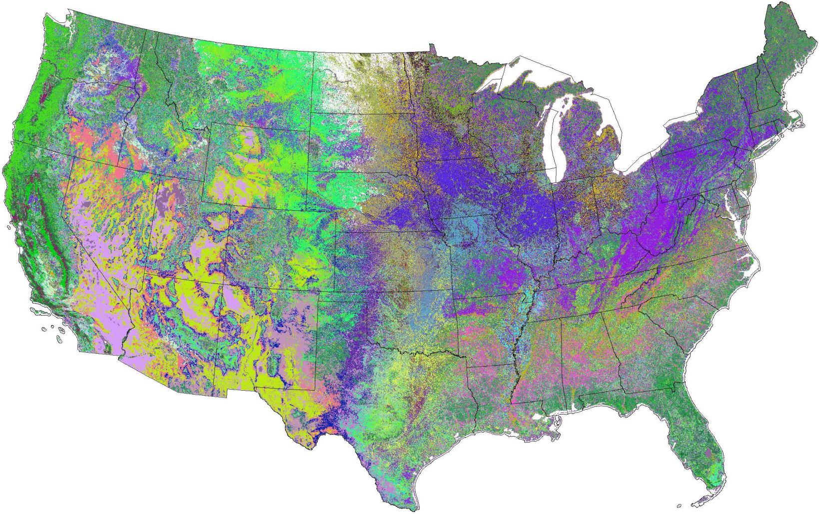
50 Phenoregion Prototypes (Random Colors)



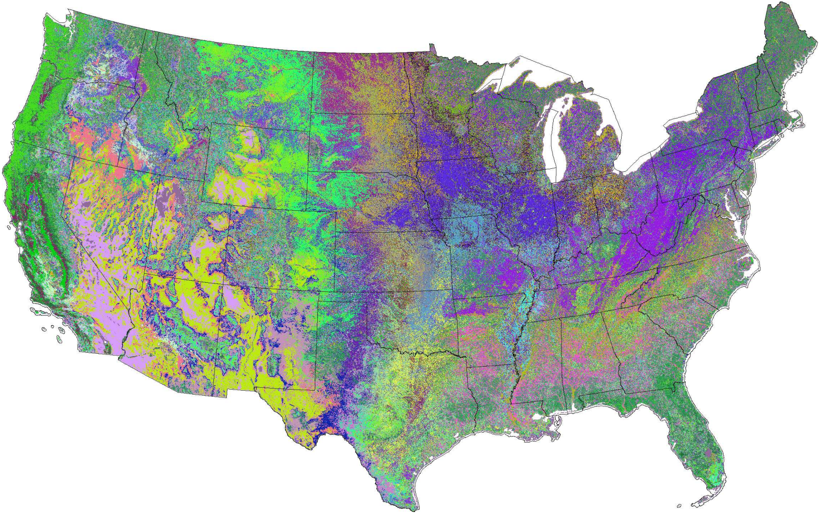
50 Phenoregions Persistence (Random Colors)



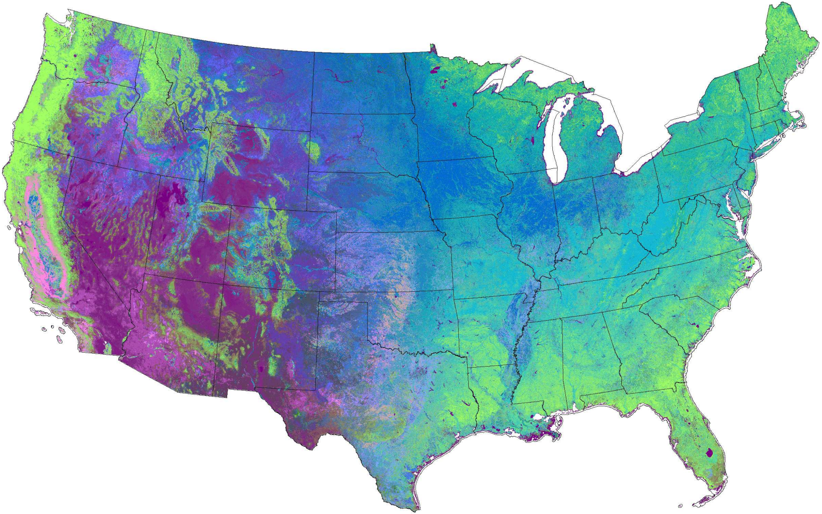
50 Phenoregions Mode (Random Colors)



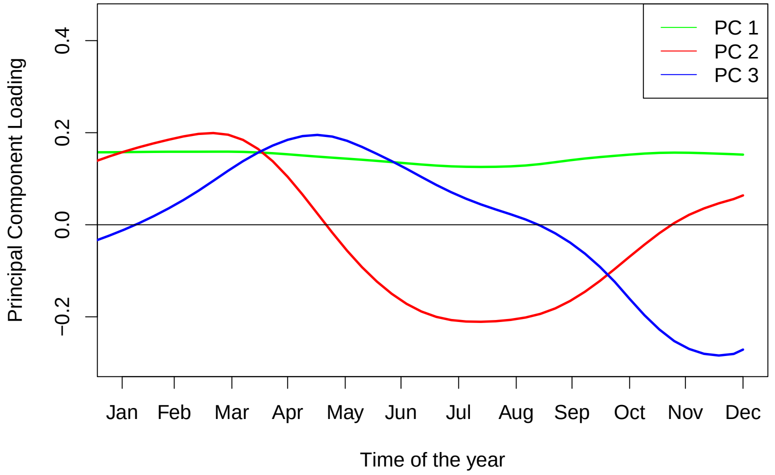
50 Phenoregions Max Mode (Random Colors)



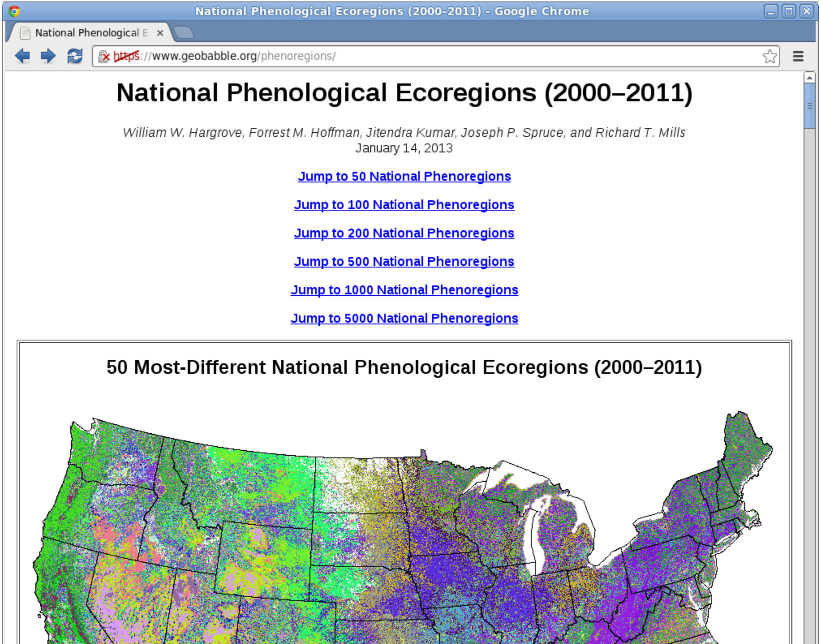
50 Phenoregions Max Mode (Similarity Colors)



50 Phenoregions Max Mode (Similarity Colors Legend)



Phenoregions Clearinghouse



Acknowledgments

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References

F. M. Hoffman. Analysis of reflected spectral signatures and detection of geophysical disturbance using hyperspectral imagery. Master's thesis, University of Tennessee, Department of Physics and Astronomy, Knoxville, Tennessee, USA, Nov. 2004.

F. M. Hoffman, W. W. Hargrove, D. J. Erickson, and R. J. Oglesby. Using clustered climate regimes to analyze and compare predictions from fully coupled general circulation models. *Earth Interact.*, 9(10):1–27, Aug. 2005. doi:10.1175/EI110.1.

M. A. White, F. Hoffman, W. W. Hargrove, and R. R. Nemani. A global framework for monitoring phenological responses to climate change. *Geophys. Res. Lett.*, 32 (4):L04705, Feb. 2005. doi:10.1029/2004GL021961.