New Developments in Continental-Scale Spring Phenological Modeling

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Quantifying Phenological Coherence and Seasonal Predictability across NEON and USA-NPN Monitoring Sites

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PhotoSource: Ellen Denny, usanpn.org

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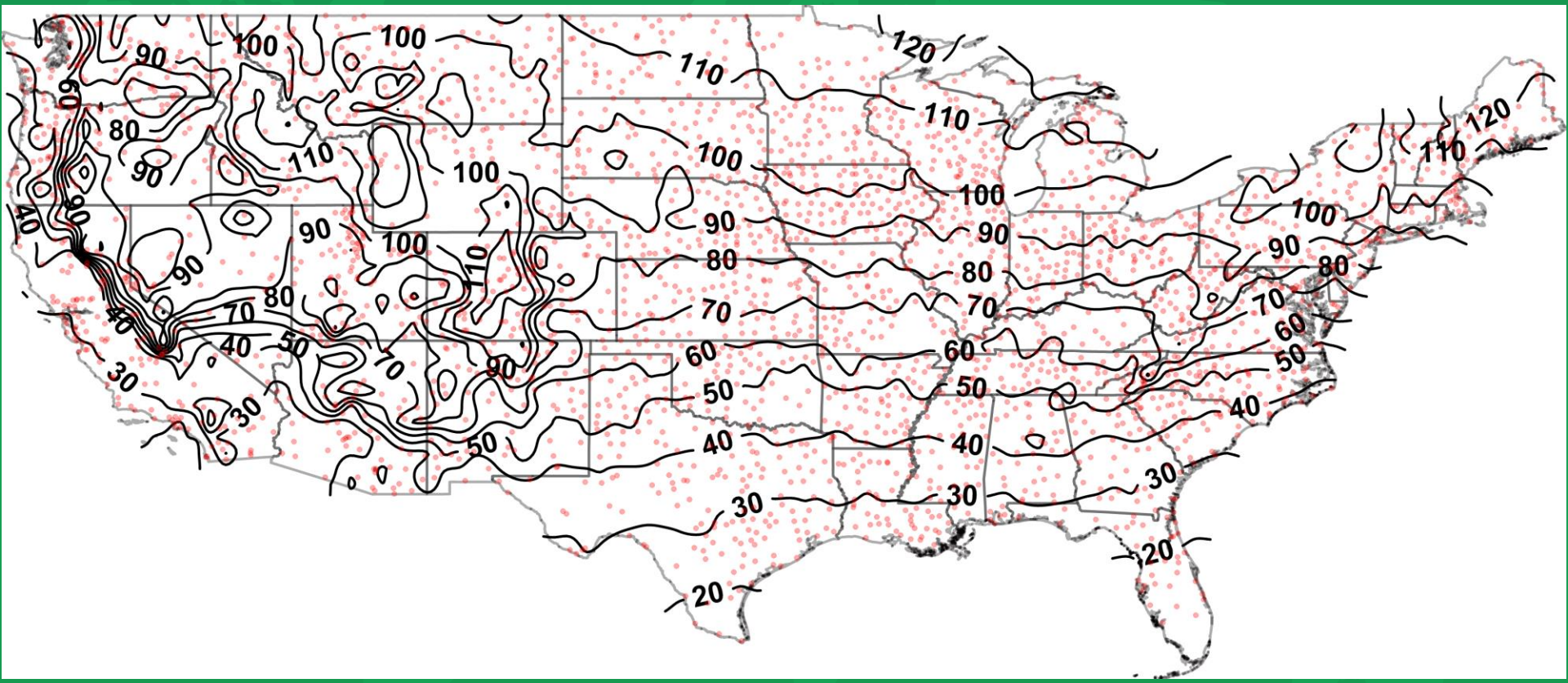
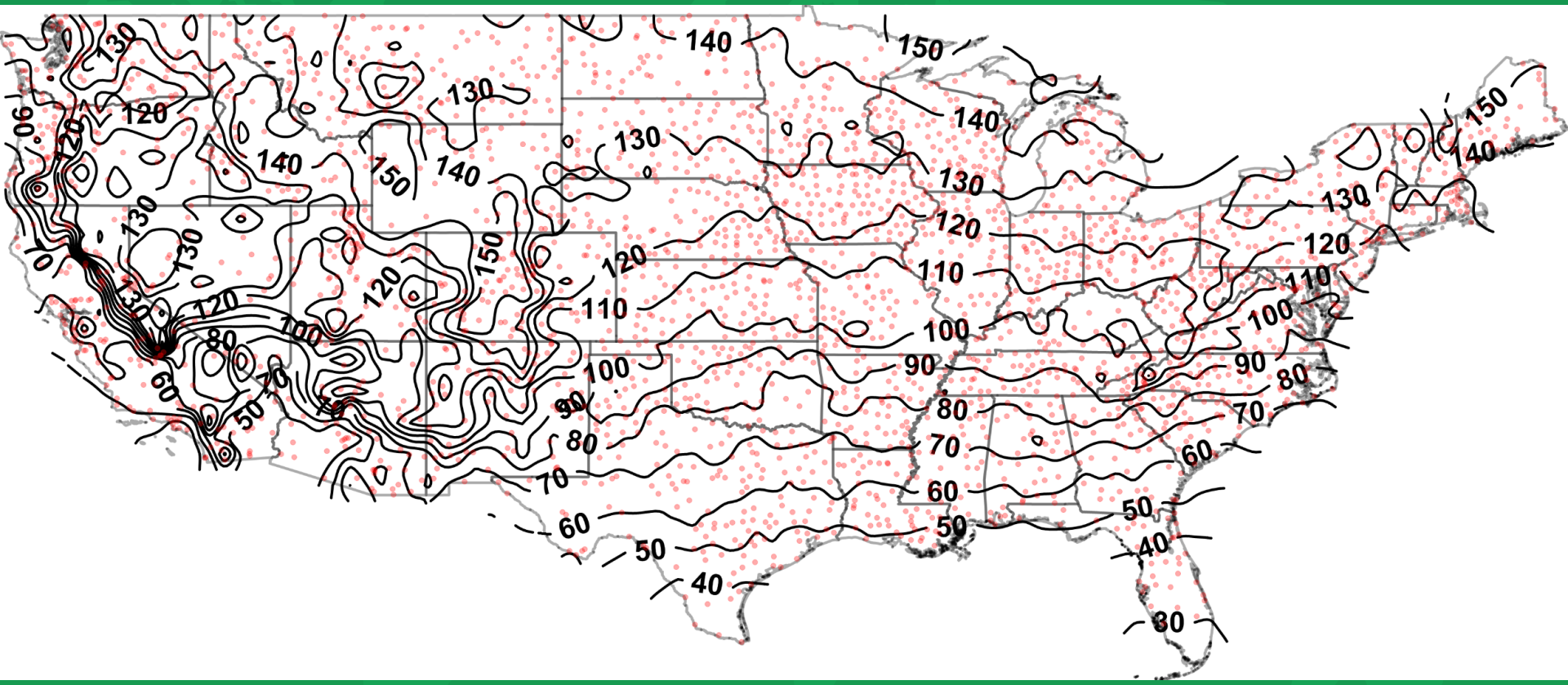
Background

- Continental-Scale Extended Spring Indices ("SI-x") Leaf and Bloom Models
- Operational annual tracking of SI @ usanpn.org
- Experimental annual forecasting of SI @ Cornell U.

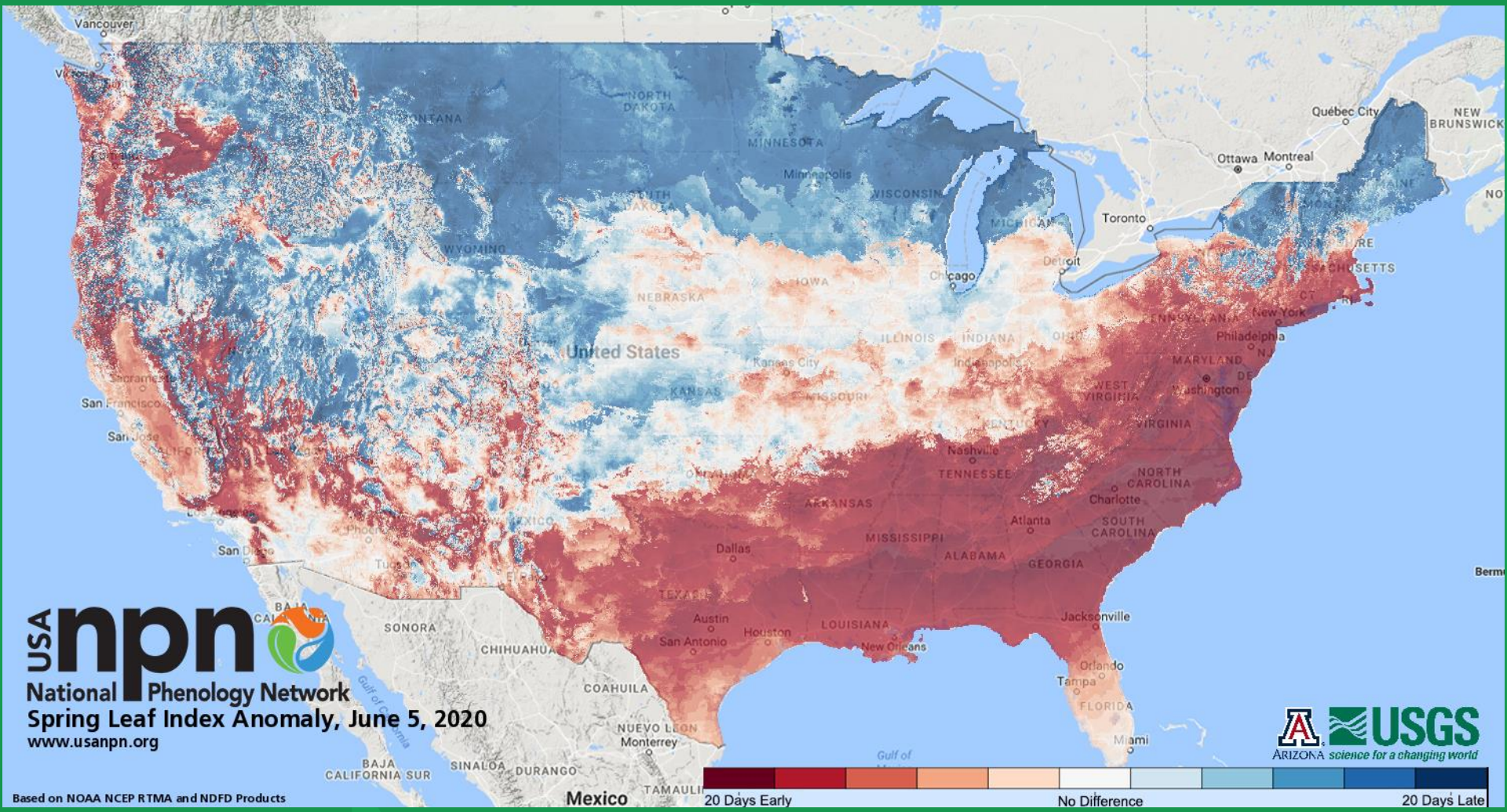
SI-x Leaf Mean Date, 1981-2010



SI-x Bloom Mean Date, 1981-2010

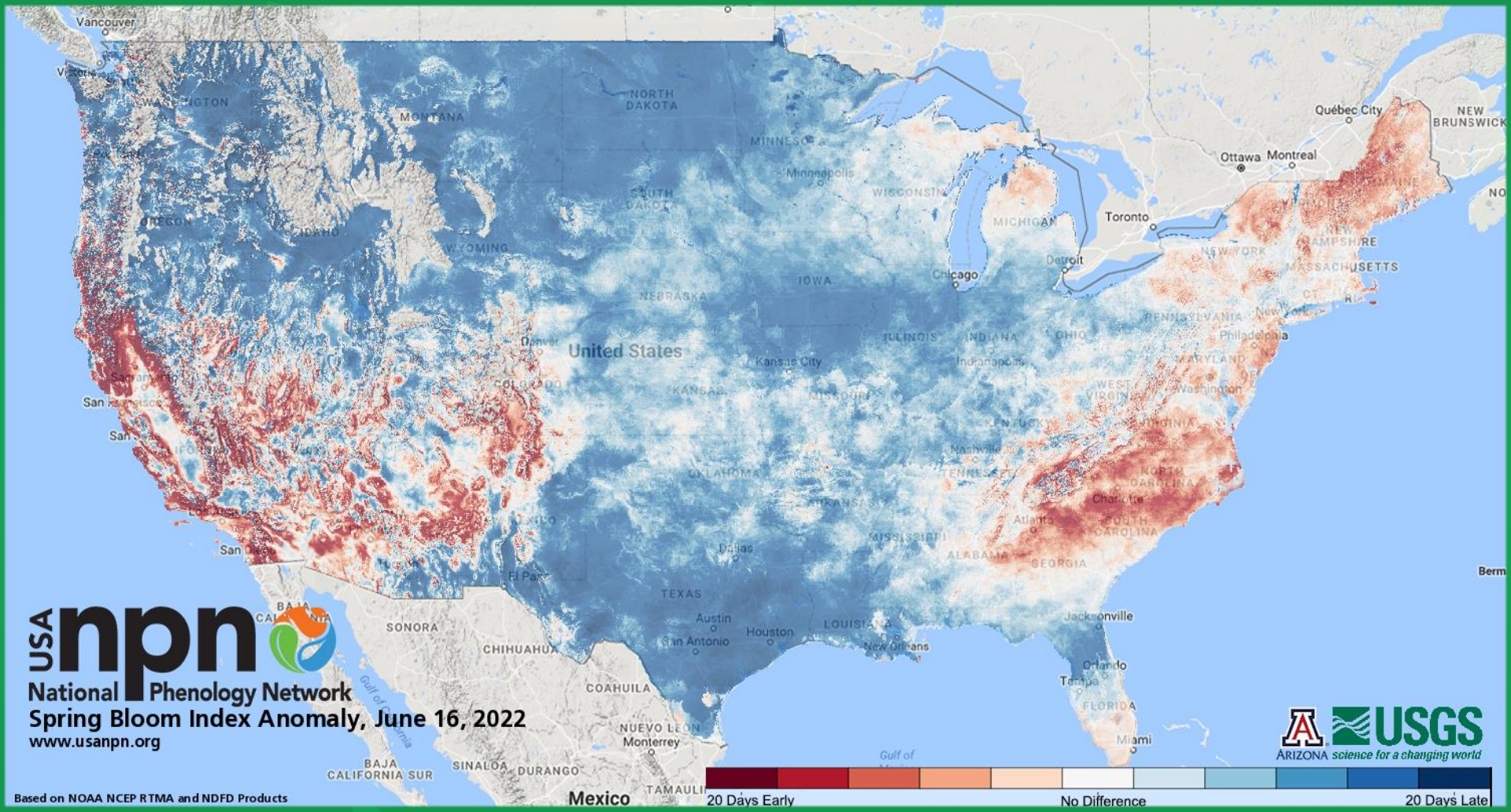


SI-x Leaf Index Anomaly, June 5, 2020



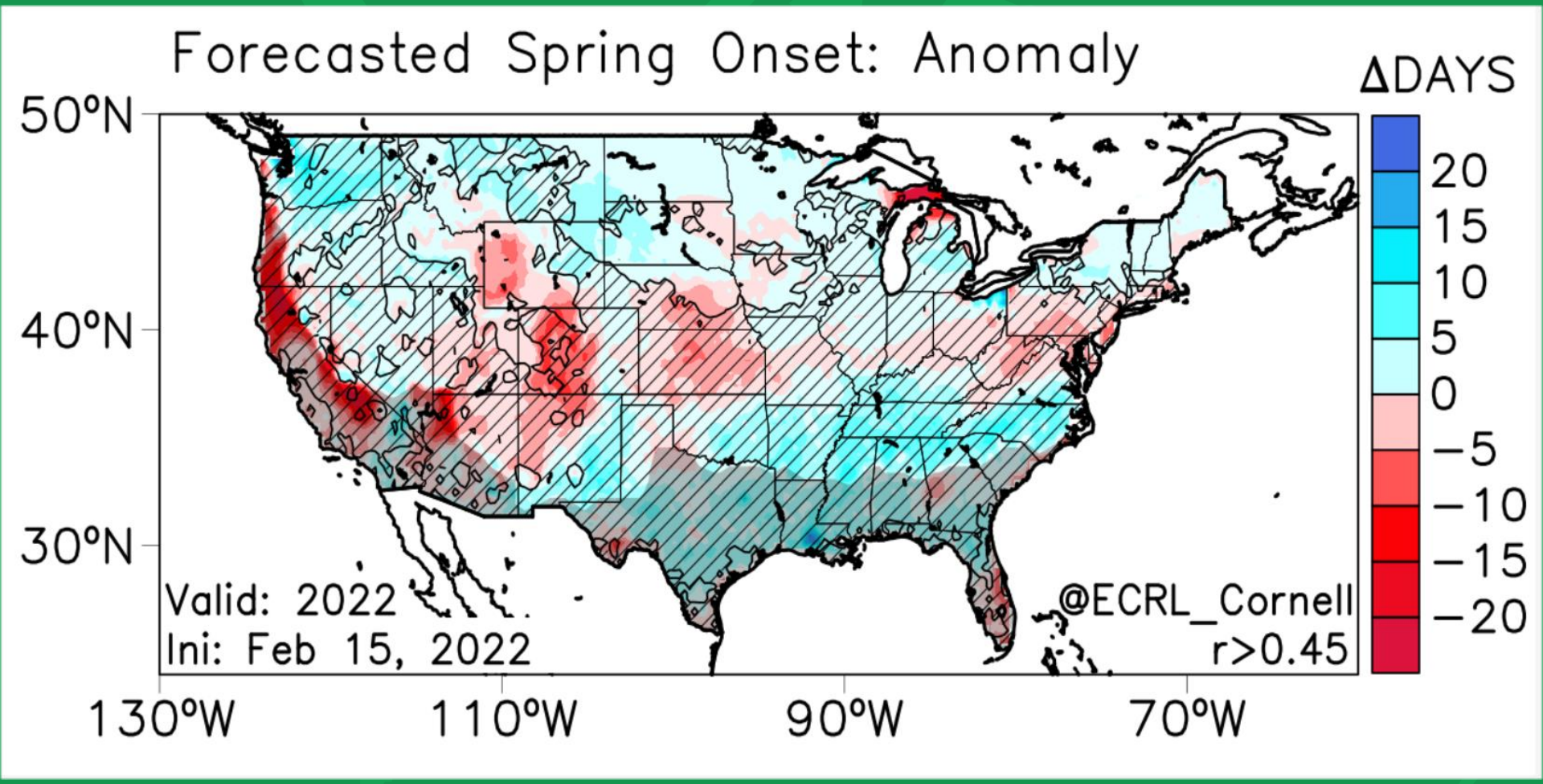
Source: https://www.usanpn.org/files/npn/maps/six-leaf-index-anomaly.png

SI-x Bloom Index Anomaly, June 16, 2022



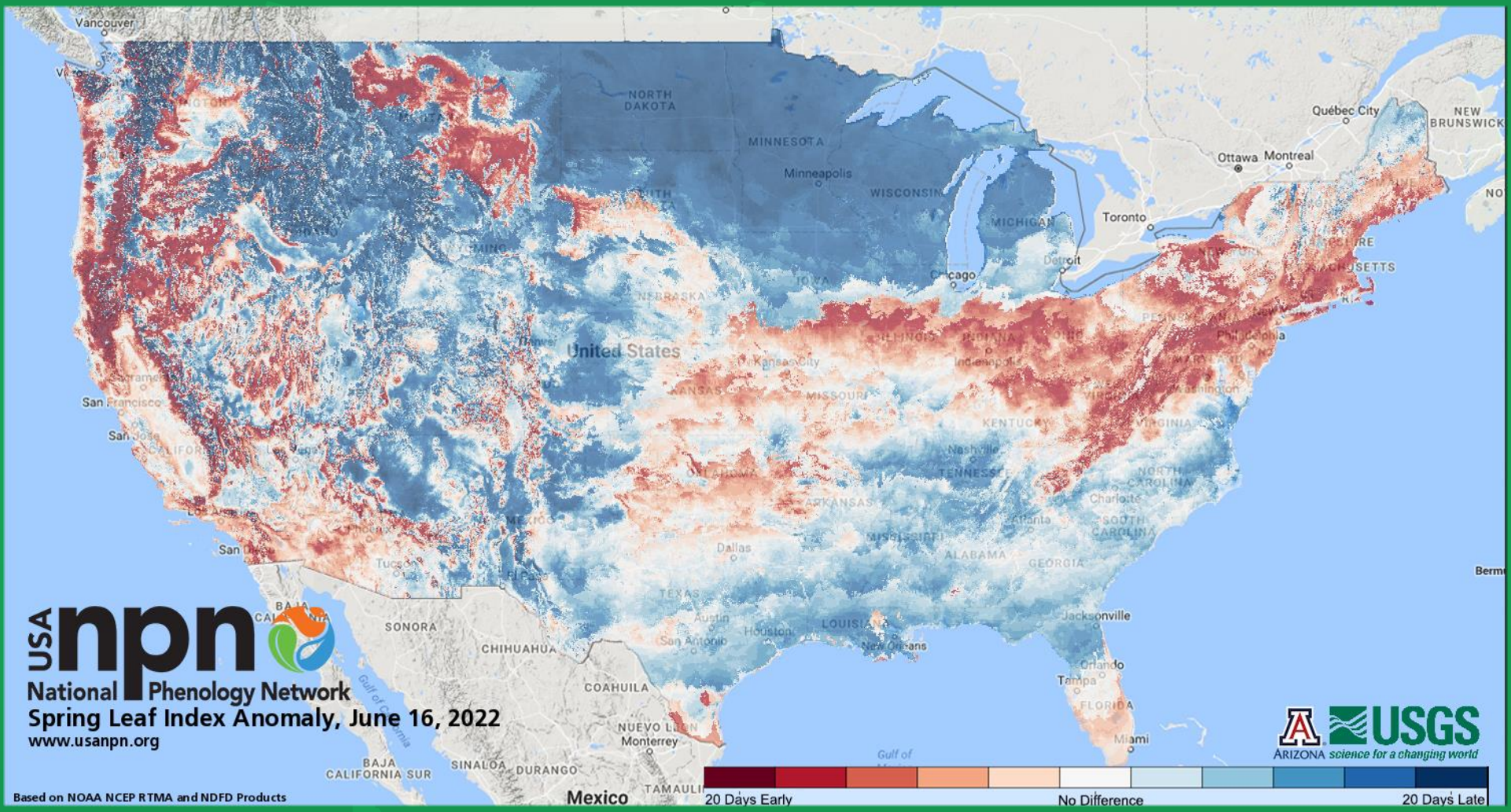
Source: https://www.usanpn.org/files/npn/maps/six-bloom-index-anomaly.png

SI-x Leaf Forecast 2022



Source: Carlos M. Carrillo and Toby R. Ault, Cornell University

SI-x Leaf Index Anomaly, June 16, 2022



Source: https://www.usanpn.org/files/npn/maps/six-leaf-index-anomaly.png

Overview of Project Goals (1)

- Develop and validate more accurate continental-scale models of spring plant growth stages (by incorporating spatial and temporal variations in environmental drivers) for dozens of species using data collected at NEON and USA-NPN monitoring sites
- Test macrosystem theory implications by evaluating the performance of individual species phenology models using historical climate datasets, and GCM projections
- Combine these new species models to create 3-5 compatible cohorts based on similar environmental response (as done to create SI-x). Collectively, these will form a "suite" of "spring development" (SD) indicators.

Overview of Project Goals (2)

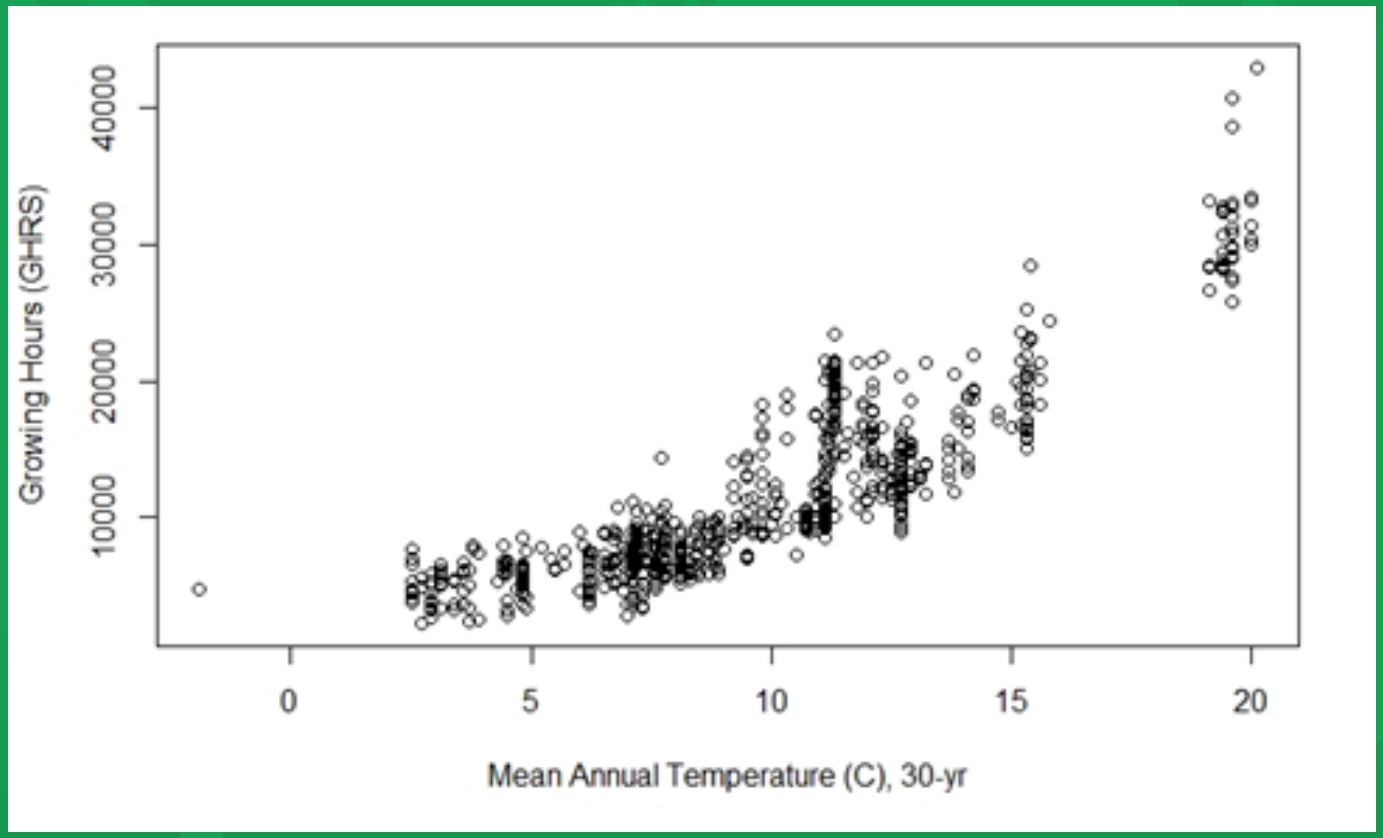
- Characterize coherent large-scale patterns of variability in meteorological and ecological phenomena using the suite of SD indicators with historical climate datasets
- Evaluate the potential predictability of phenological events at NEON and USA-NPN monitoring sites at long lead (weeks to seasons) time horizons, and the presence of variability in phenological responses across latitude, longitude, and elevation gradients.

Initial “Thermal Time” Leaf Model Error

MAE	*Species*
8.6	*Acer rubrum* (Red Maple)
6.8	*Acer saccharum* (Sugar Maple)
6.0	*Lonicera maackii* (Amur Honeysuckle)
9.8	*Prunus serotina* (Black Cherry)
9.0	*Populus tremuloides (*Trembling Aspen*)*
18.0	*Quercus alba (*White Oak*)*

Variable GDH accumulation by MAT

MAE: <10 (5.8); 10-16 (9.3); >16 (16.5)



Thanks for your attention!