Advancing Useable Drought Prediction to Improve Urban Forest Ecosystem Drought Resilience

Christy Rollinson, The Morton Arboretum
M. Ross Alexander, Argonne National Lab, University of Chicago CASE
Trent Ford, Illinois State Water Survey, University of Illinois, Urbana-Champaign

Project Team

The Morton Arboretum | THE CHAMPION of TREES

Research: Dr. Christy Rollinson, Dr. Luke McCormack, Dr. Jake Miesbauer, Brendon Reidy, Abby Tumino, Marvin Lo

Plant Clinic: Spencer Campbell

Zach Wirtz, Dr. Lindsay Darling, (Lydia Scott)

ILLINOIS
Illinois State Water Survey
PRAIRIE RESEARCH INSTITUTE

Dr. Trent Ford

THE UNIVERSITY OF CHICAGO

Argonne NATIONAL LABORATORY

Dr. M. Ross Alexander

Unfunded Collaborators

PURDUE UNIVERSITY

Dr. Lindsay Darling

Duke UNIVERSITY

Dr. Renata Poulton Kamakura

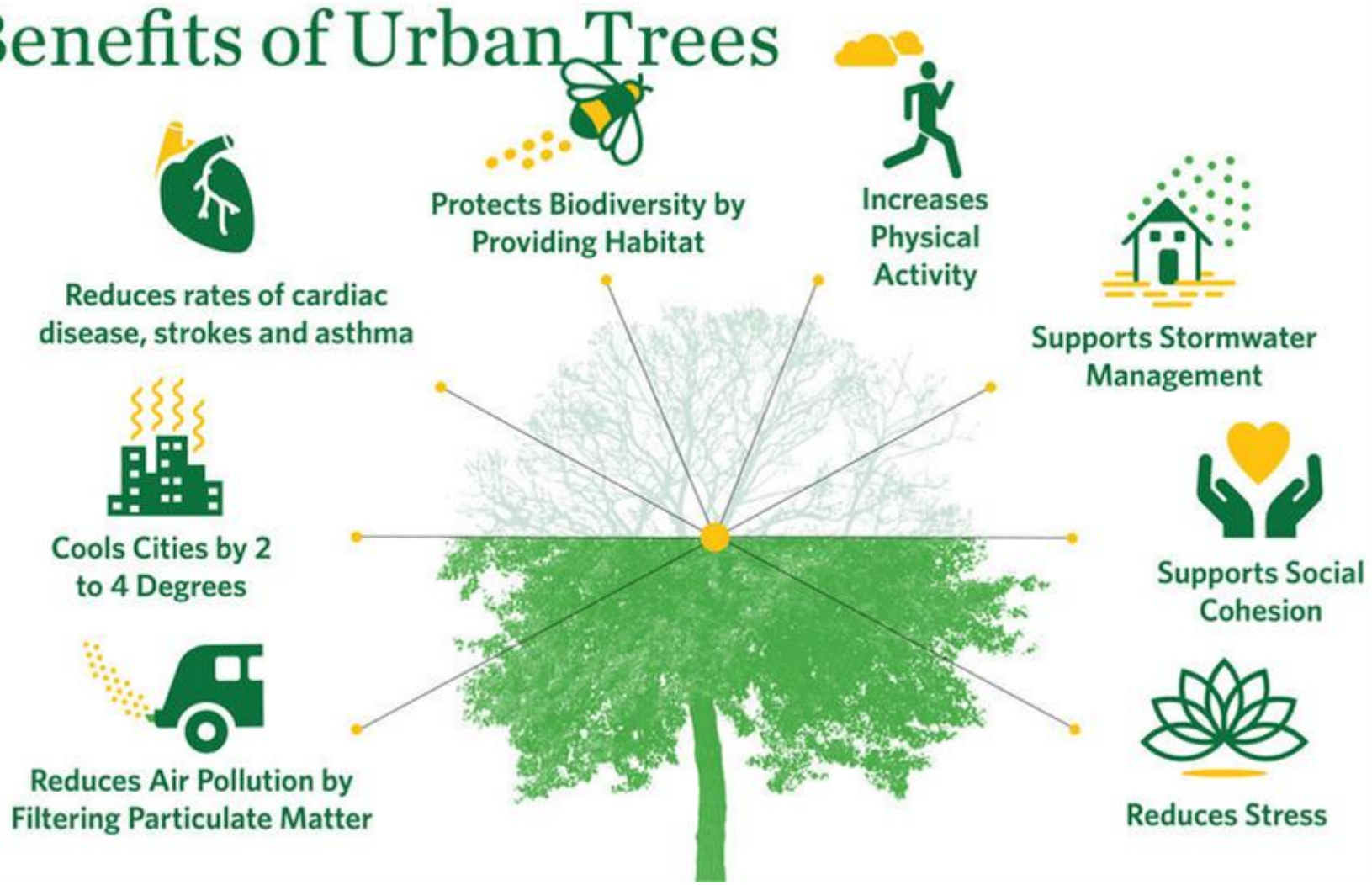
CUNY THE CITY UNIVERSITY OF NEW YORK

Dr. Ayo Deas

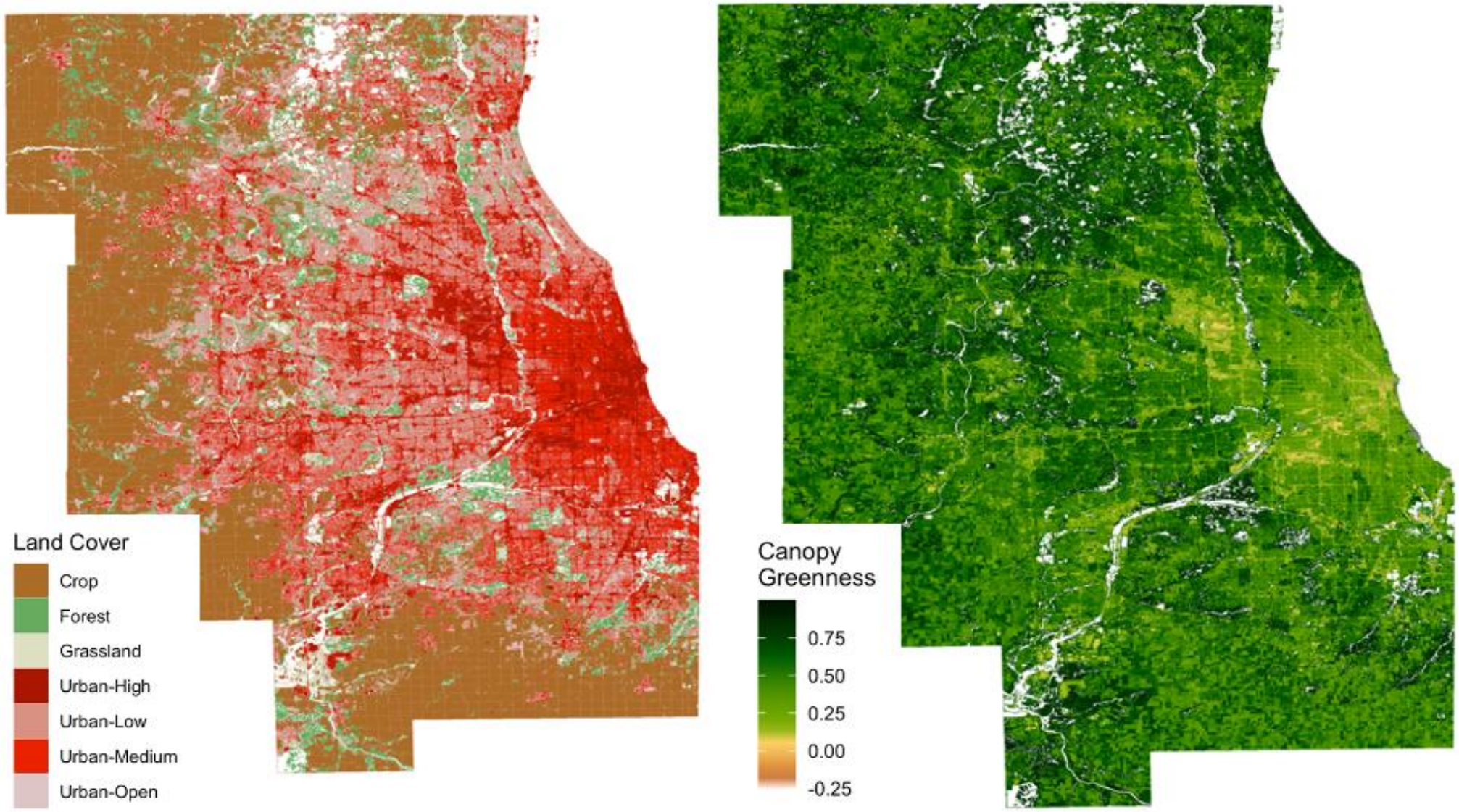
Benefits of urban trees requires healthy trees.

- Global cities are spending millions to plant trees
- Resources and information needed to ensure those trees provide benefits

The Nature Conservancy



Variation in Greenness = Landcover + Weather (simplified version)

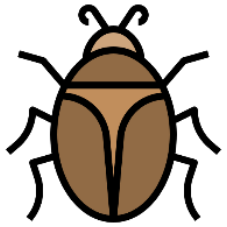




Drought Impacts on Trees

Water Limitations

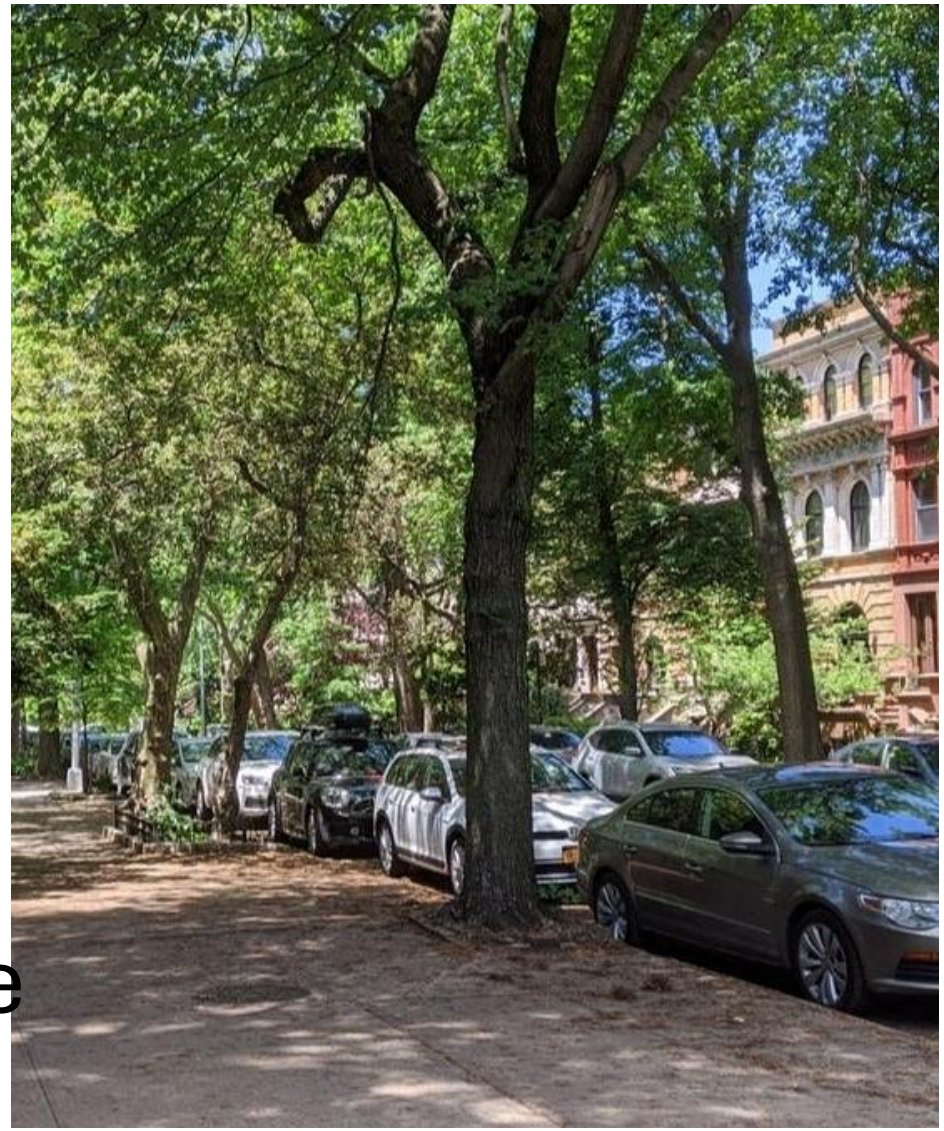
More Evaporative Demand



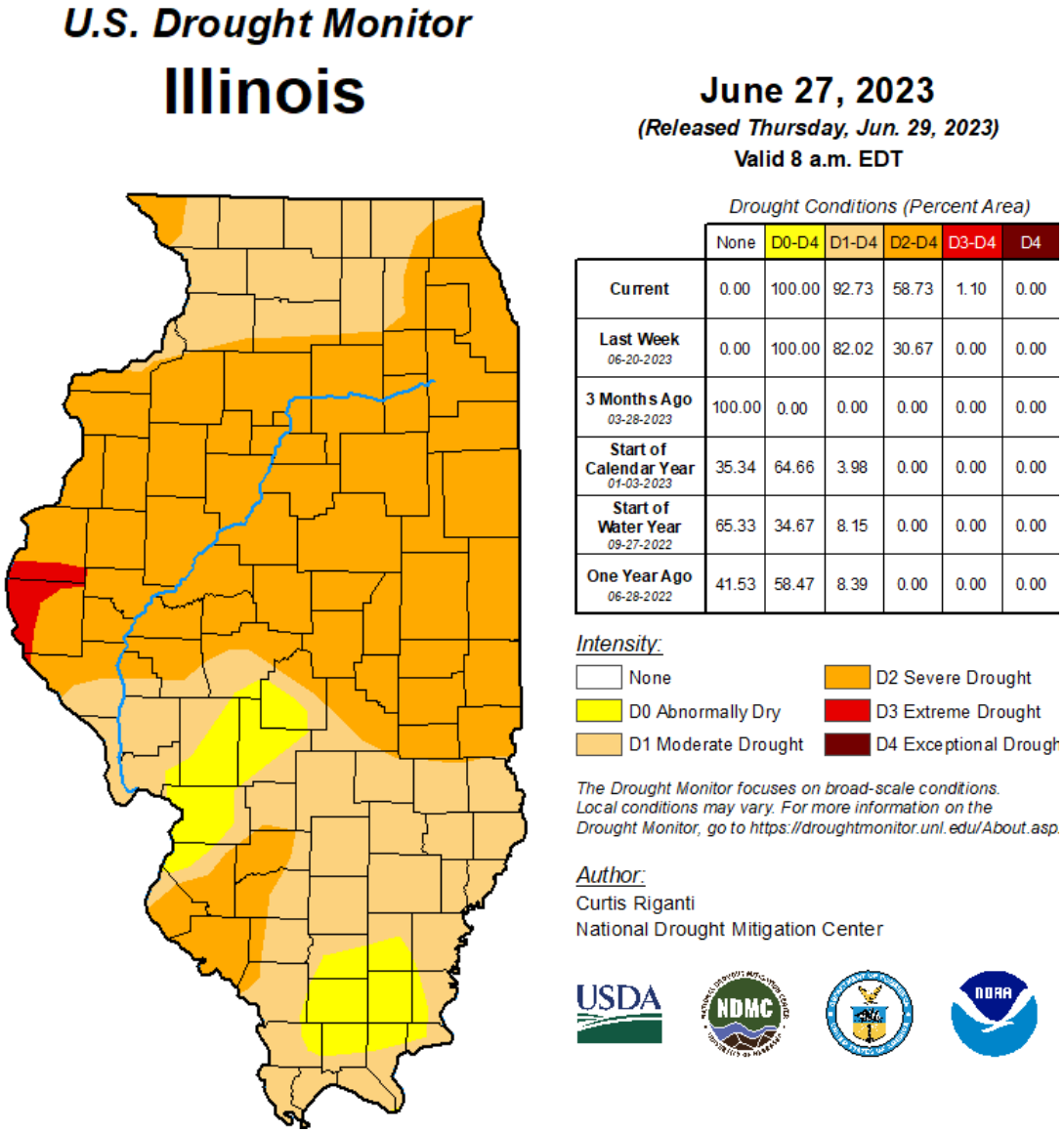
More Vulnerable to Pests

Slowed Growth

Risk of Wildfire & Wind Damage



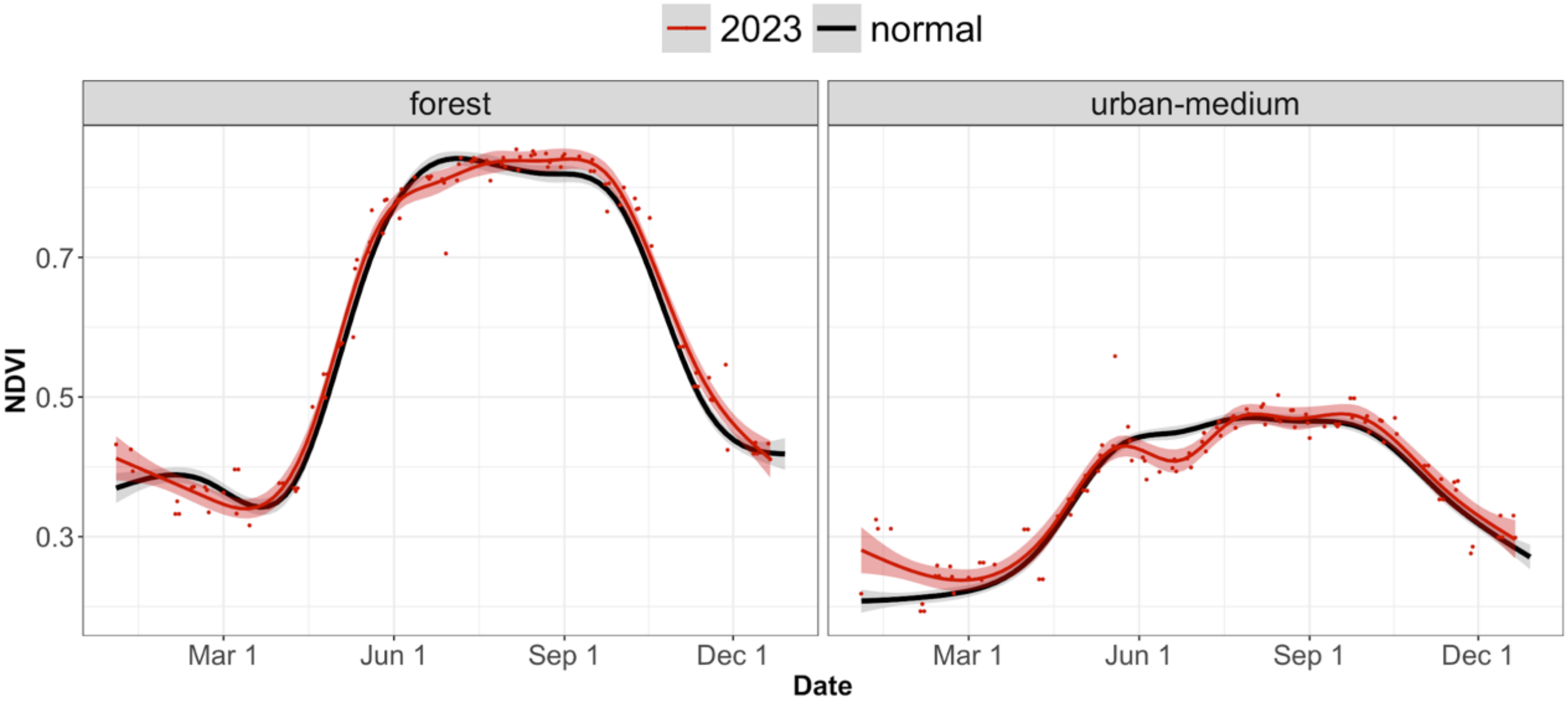
Early Warning Largely Misses Urban Ecological Drought



- Very little soil moisture information available in forested areas
- Many remote sensing tools tuned to cropland dynamics
- Impact reports hard to come by

These issues are even worse in urban areas

Greenness as an Early Warning Indicator

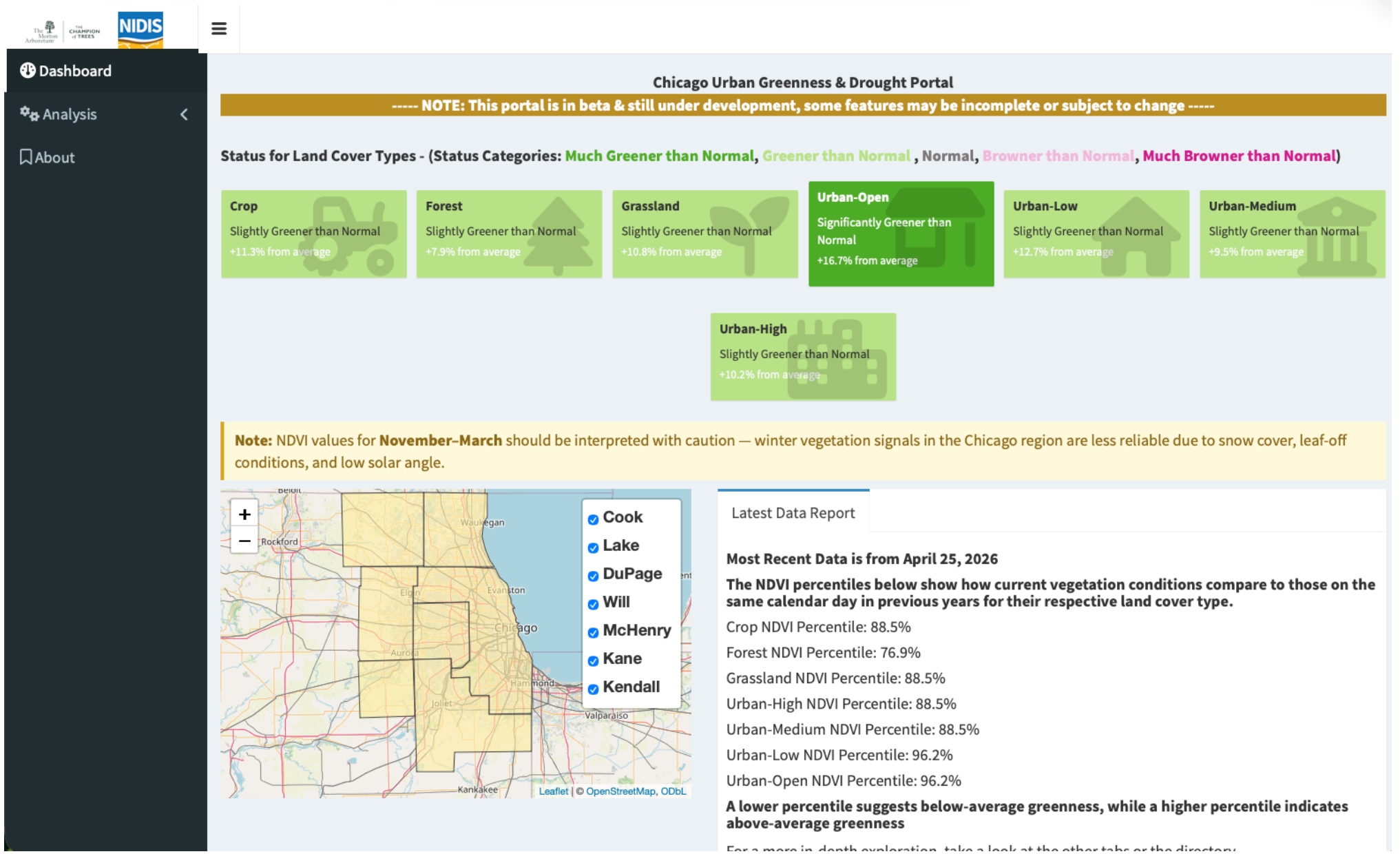


Meeting Stakeholder Needs

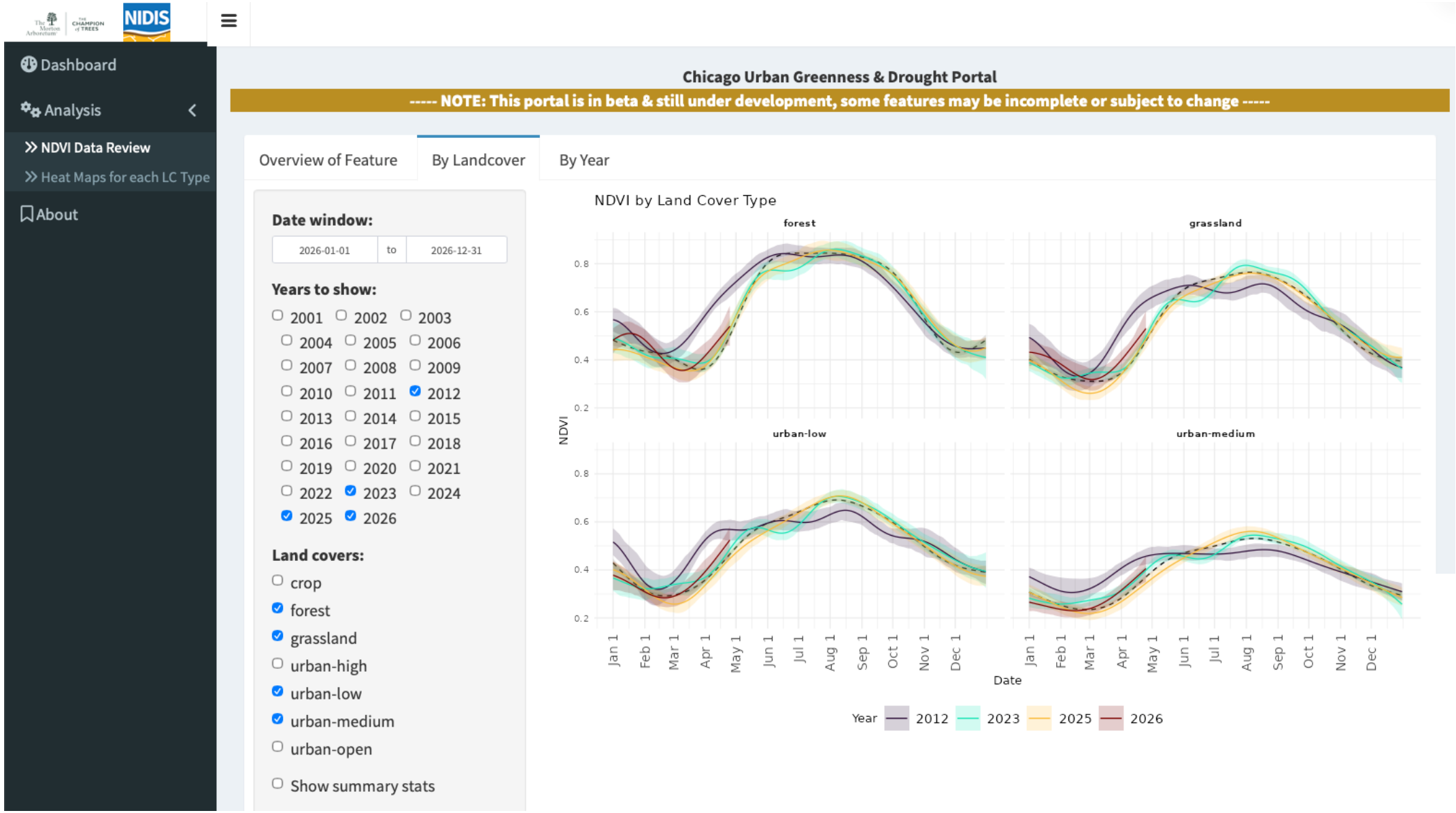
- Zoom listening sessions with tree professionals and residents
- In-person workshop with tree professionals and municipal managers

Keep it Simple & Useable

https://mortonarb-forestecology.shinyapps.io/urban_drought_app/



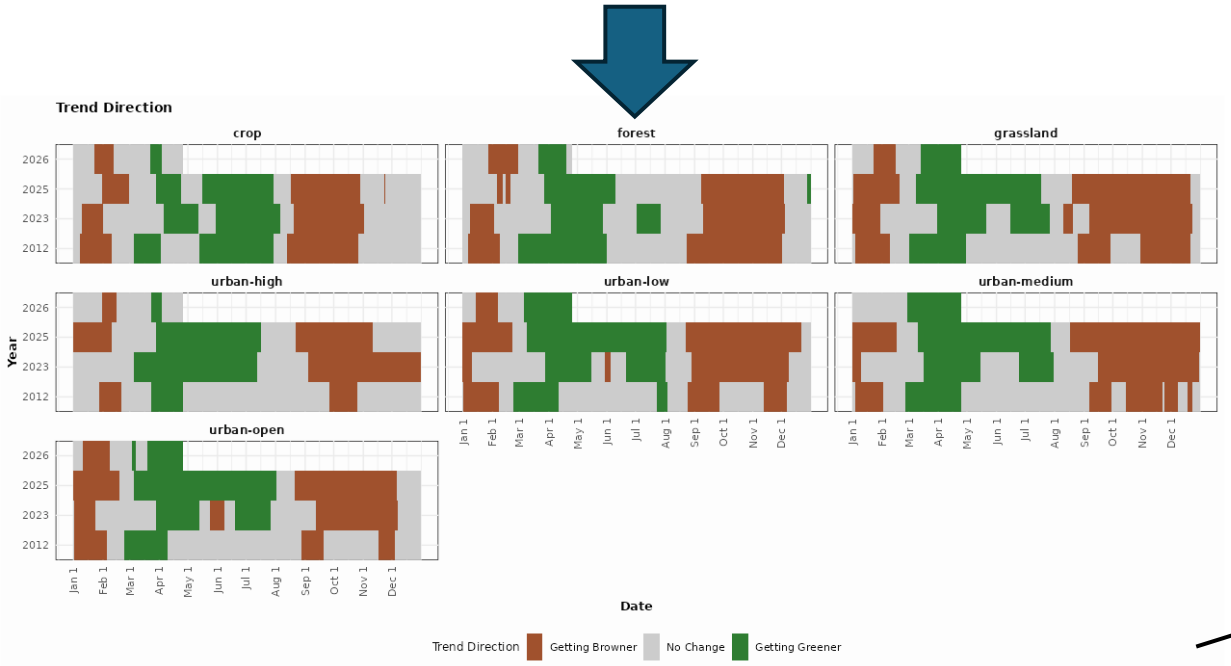
https://mortonarb-forestecology.shinyapps.io/urban_drought_app/

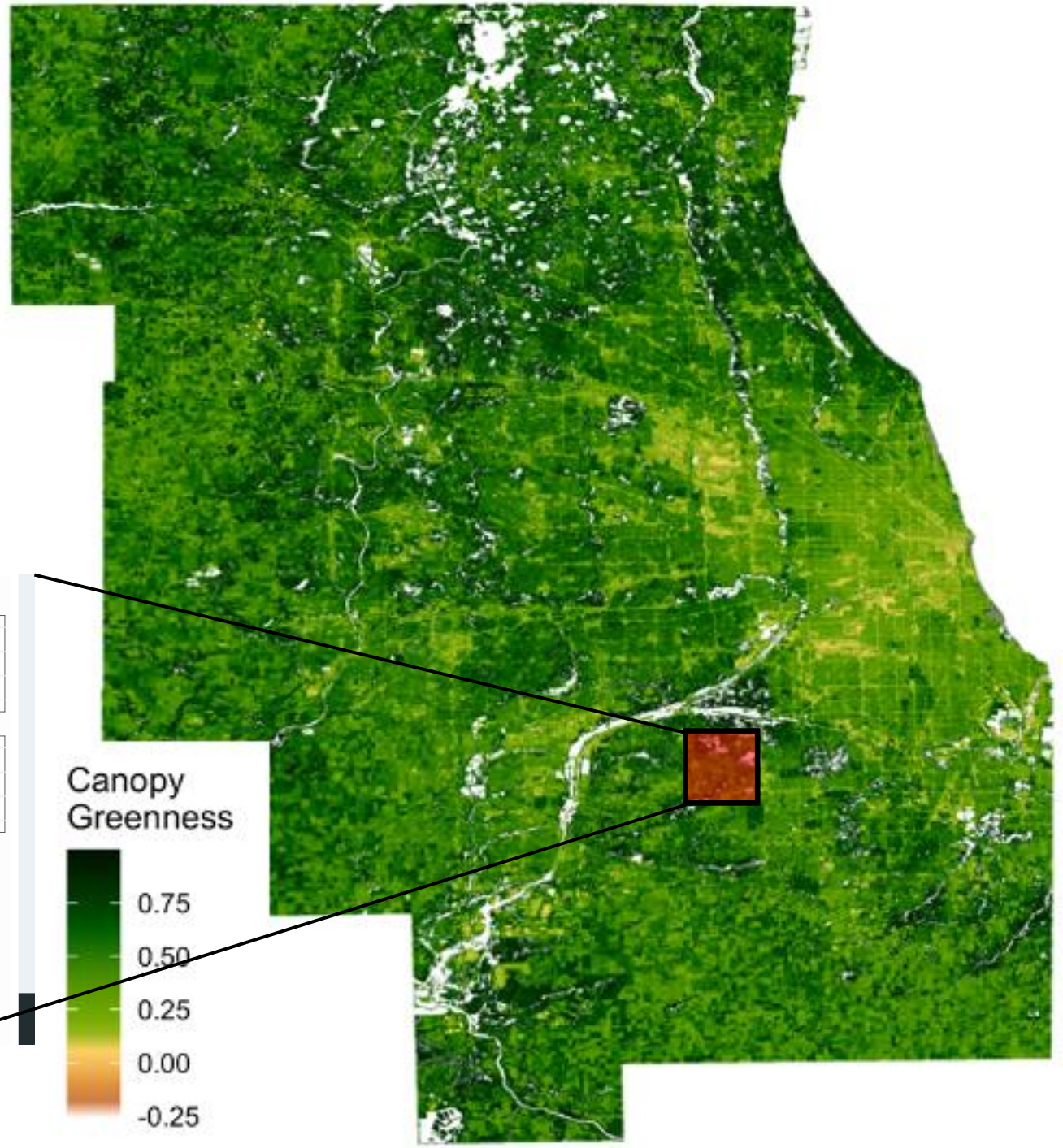


Ongoing Advancements: Spatially Resolved Greenness Forecasts

ECMWF

Extended Range Forecasts



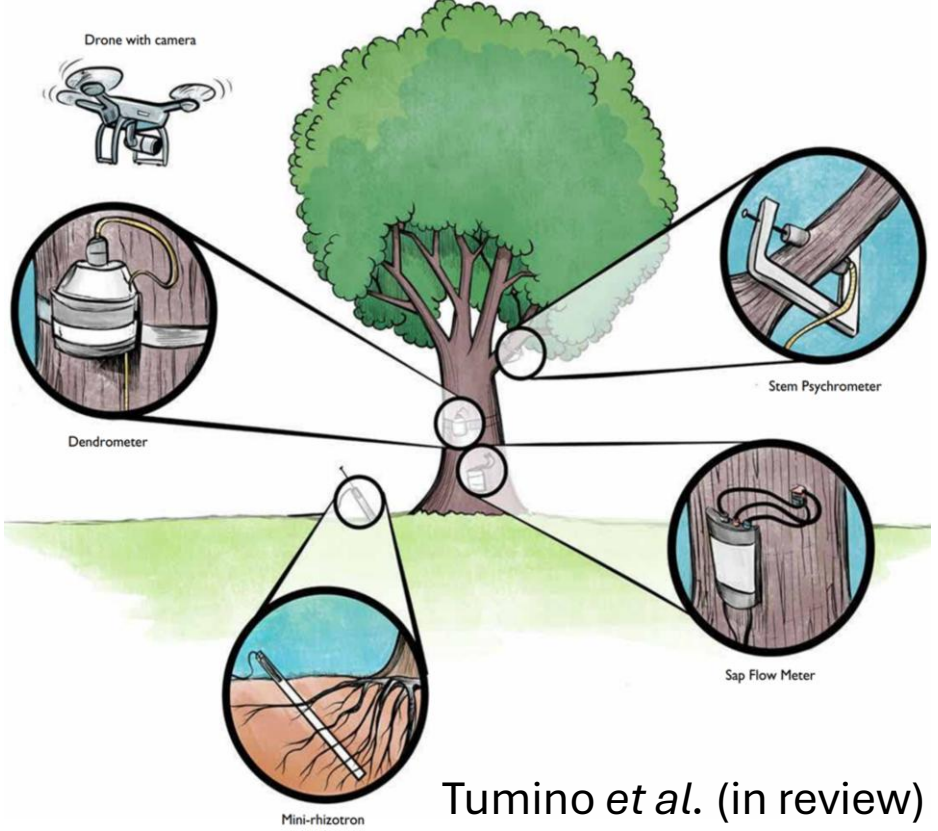


Urban forest resilient requires connecting system-level exposure to tree-scale sensitivity.

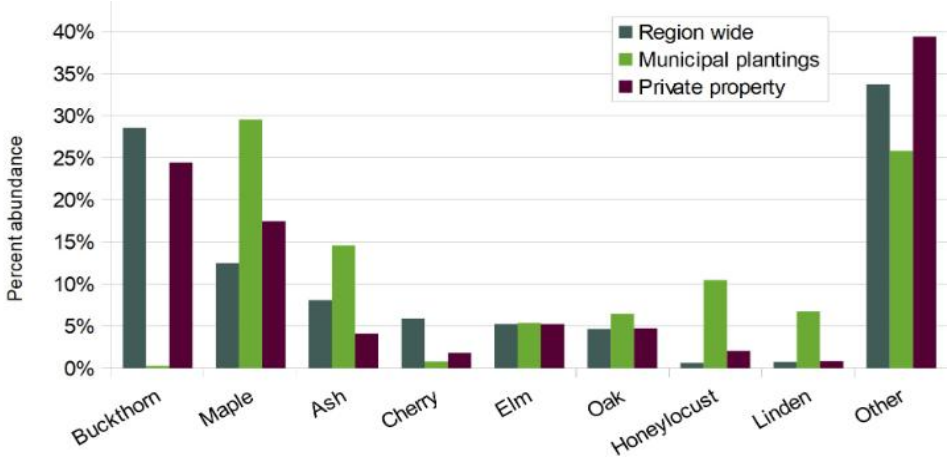
Photo Credit: The Morton Arboretum

Assessing Tree-Scale Drought Response

- Sampling dozens of sentinel species at four sites across Chicagoland
  - 2 urban: UIC campus
  - 2 suburban: Morton Arb
- Turgor pressure is highly correlative of tree drought response
- Leaf water potential at turgor loss point is a robust way of characterizing drought tolerance



Tumino *et al.* (in review)



ILLINOIS
Illinois State Water Survey
PRAIRIE RESEARCH INSTITUTE

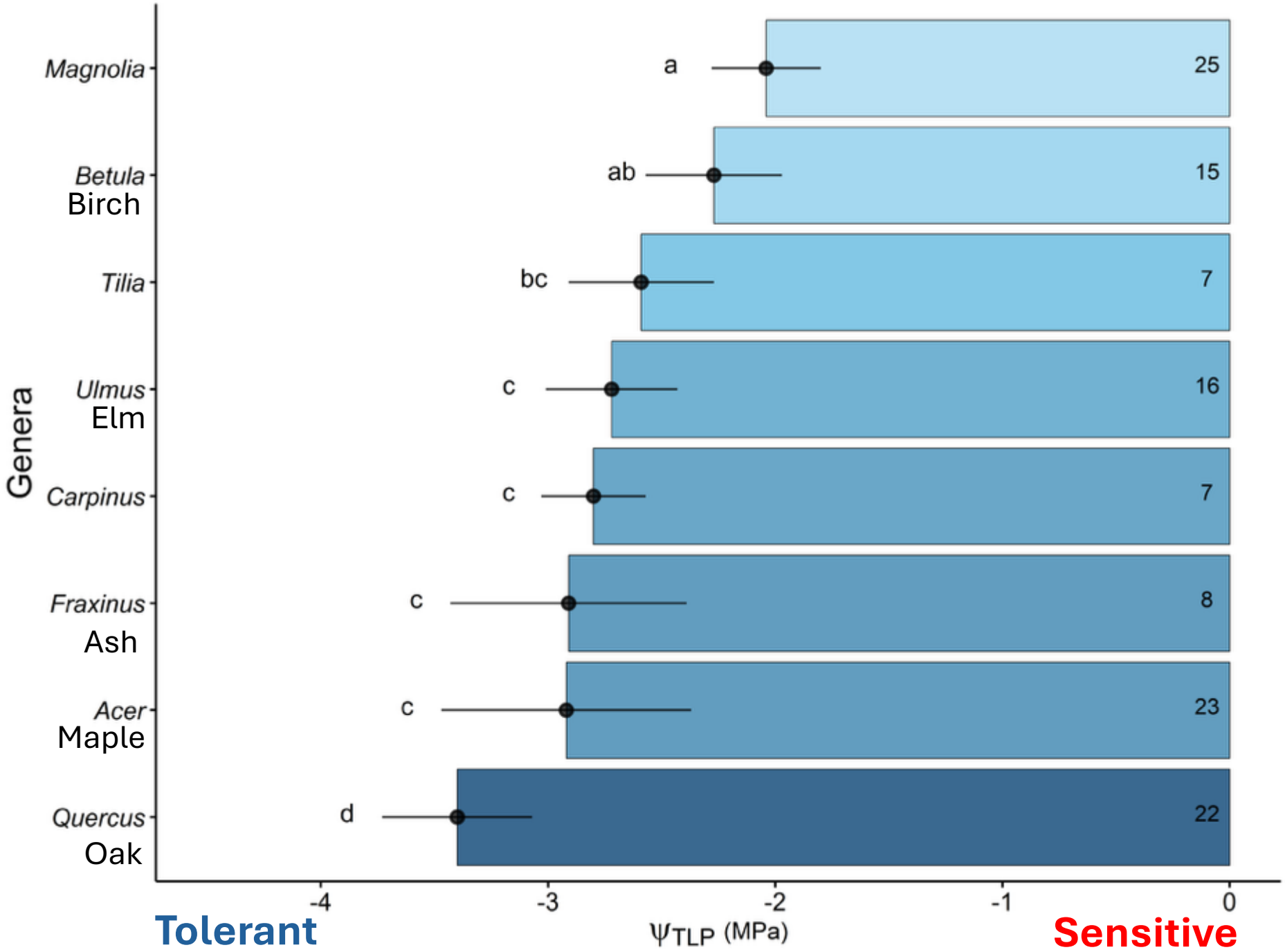
The Morton Arboretum® | THE CHAMPION of TREES

CHICAGO REGION TREES INITIATIVE

Quantitative trait data can *help*.

Ψ_{TLP} is how much tension on the water column the tree can tolerate before it wilts.

(leaf water potential at turgor loss point)



Tumino *et al.*, in review

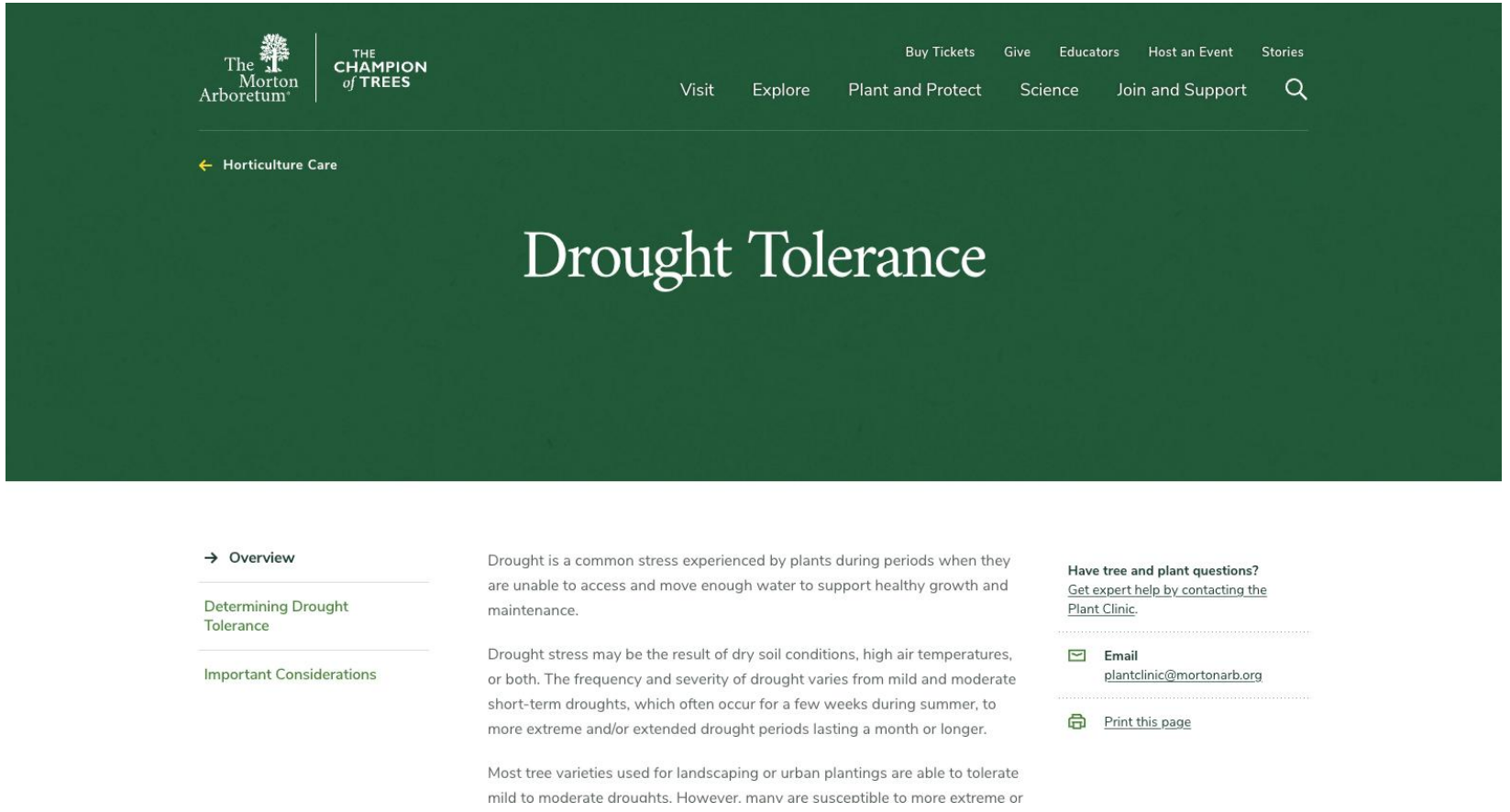
Our designations *for Chicago*

Species	Morton Arb.	Hirons & Sjöman 2019	N. IL Tree Species List	MO Botanic	U MN	USDA
Silver maple	Mod Tolerant	Mod Tolerant	Tolerant	Tolerant	Moderate	Sensitive
White Oak	Mod Tolerant	-	Tolerant	Tolerant	Tolerant	Moderate
Northern Red Oak	Tolerant	Mod Sensitive	Tolerant	Tolerant	Tolerant	Sensitive
American Elm	Tolerant	Mod Tolerant	-	Tolerant	-	-
Black Walnut	Mod Tolerant	Mod Sensitive	Moderate	Tolerant	Moderate	Sensitive
London Planetree	Mod Tolerant	Mod Tolerant	Tolerant	-	-	Moderate

Tumino *et al.*, in review

The Morton Arboretum
Plant Clinic
Drought Tolerance Info

More info available as species info on The Morton Arboretum's website



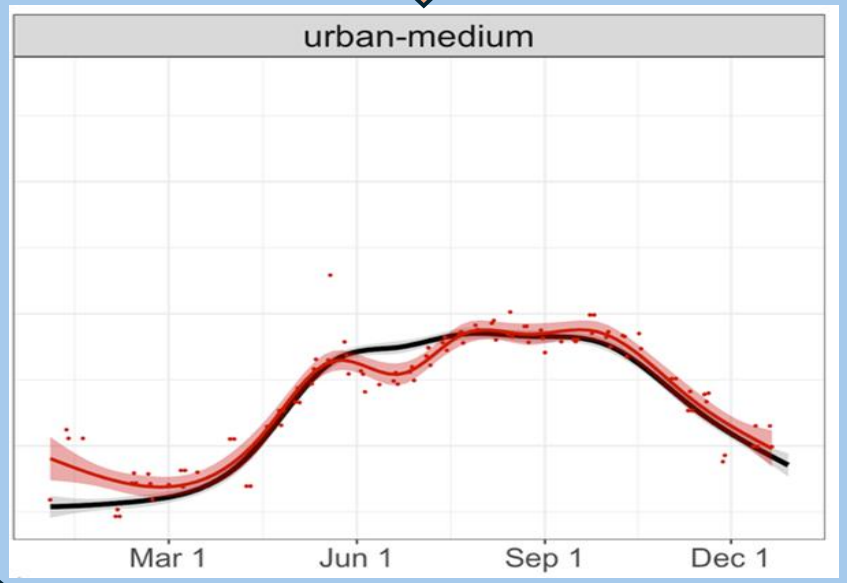
Publication & full table in peer-review (= hopefully coming soon)

The Morton Arboretum
Plant Clinic
Drought Tolerance Info

Connecting It All: Early Warning to Tree Management

Neighborhood-Scale Greenness Forecasts

ECMWF



Targeted Early Warning by Trusted Messengers

The Morton Arboretum | THE CHAMPION of TREES