“Fitbit” the Forest:
Multivariate forest monitoring, education and outreach

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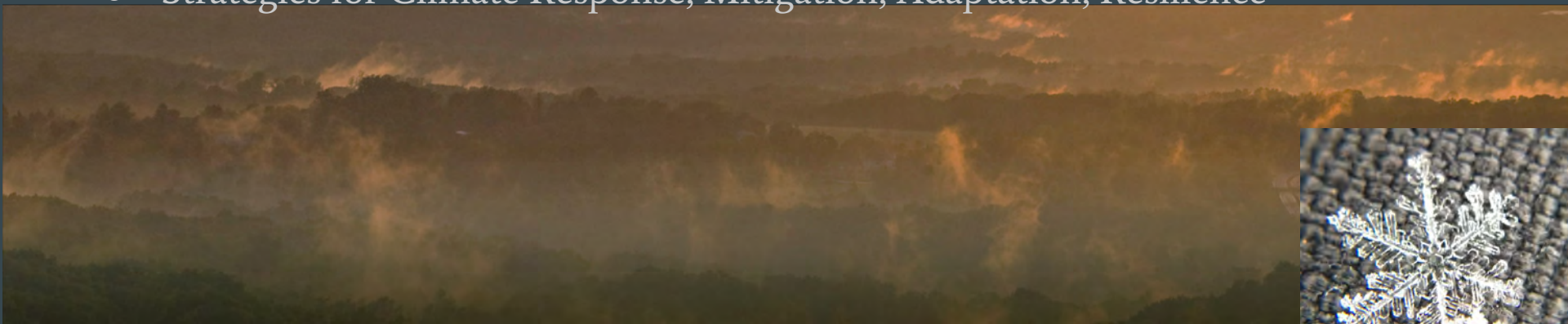
IPCC Summary for Policymakers (SPM 2018)

- 1.5 °C threshold
- Profound impacts on ecosystem services and eco-capital stocks
- Decadal-scale interventions needed
- Need for developing methods for turning research into practice
- Necessity to train next generation of practitioners
- Monitoring, measuring, modeling, management
- Strategies for Climate Response, Mitigation, Adaptation, Resilience



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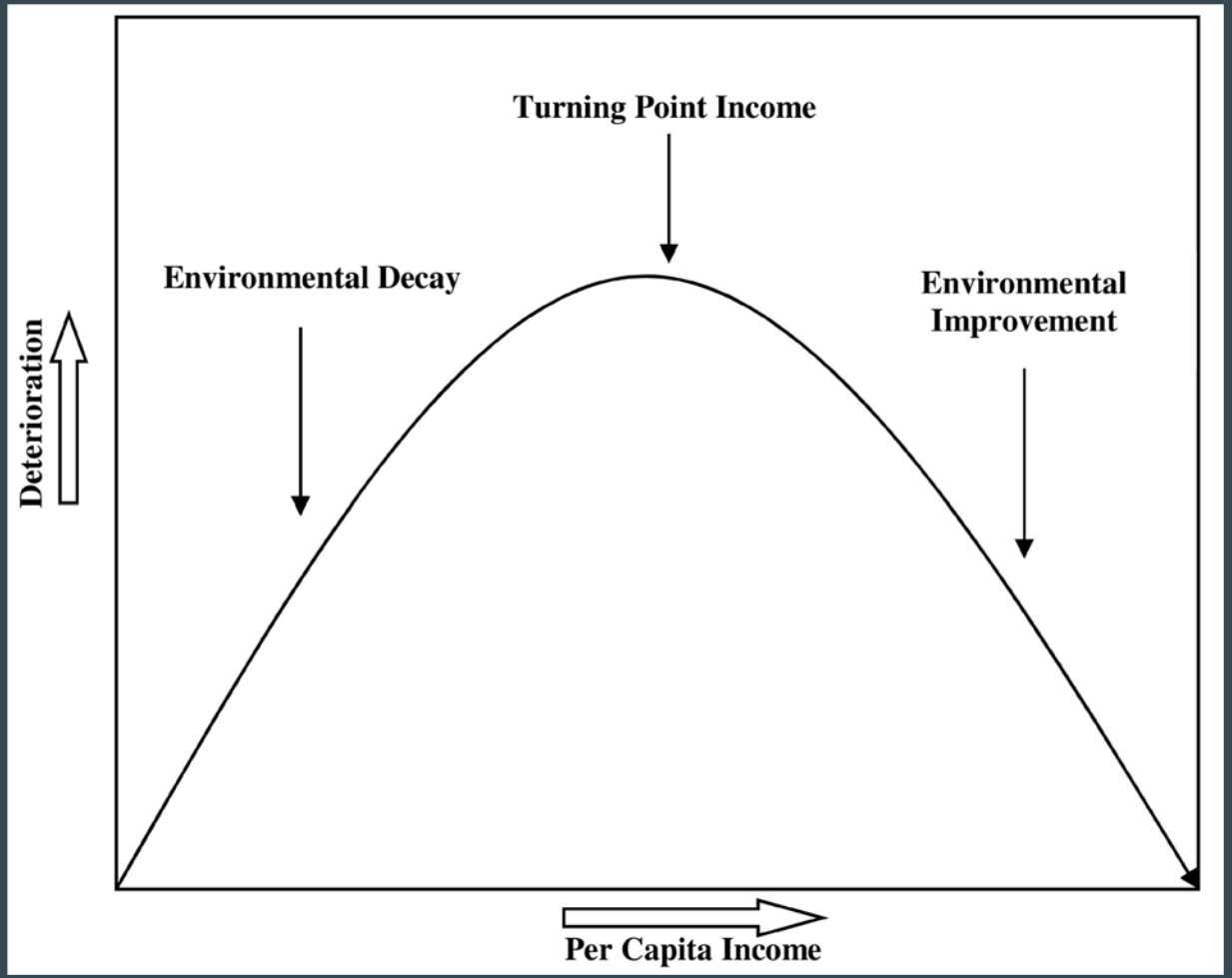
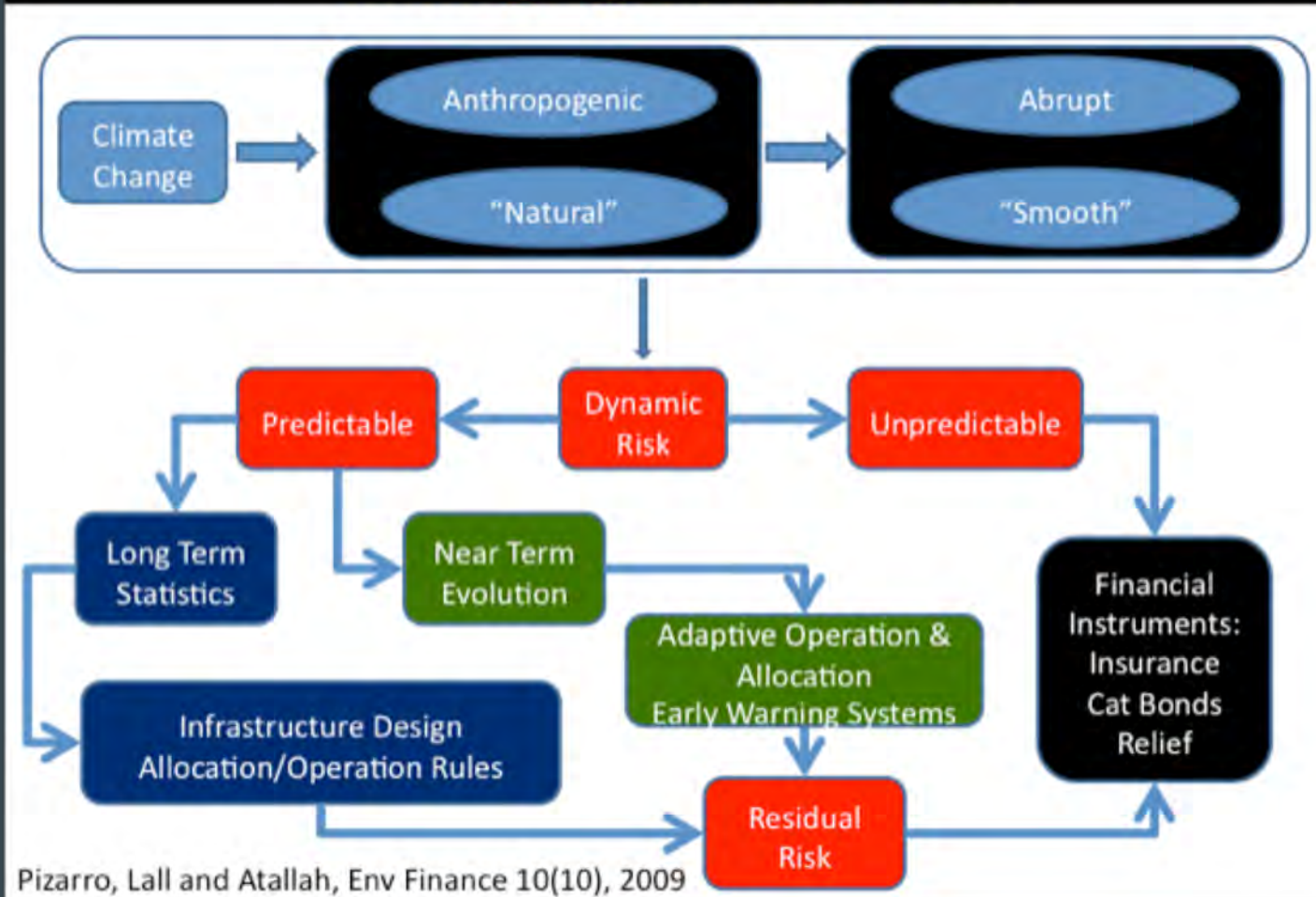


Yandle, Vijayaraghavan and Bhattarai, PERC 02-1, 2002

Managing Climate Risk



Pizarro, Lall and Atallah, Env Finance 10(10), 2009

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Catskill Plateau: Urban-Rural Ecosystem Transition

- Multivariate forest ecosystem monitoring (Black Rock Forest model)
- Opportunistic and citizen-science/secondary school monitoring programs
- New technology and software:
  - Dendrometer development, sensor package R&D
  - Data to information: actionable advice and apps for science, preparedness, response, adaptation
  - Other data streams and data analytics:
    - Microwave-link attenuation, natural language processing of twitter feeds, blockchain provenance and QC

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Simple dendrometer, preliminary deployments

- Point Dendrometer monitors changes in diameters of tree stems (1.4 m above ground) every 60 seconds and recording 20-min averages
- Component of multivariate sensor array in Black Rock Forest [Bill Schuster (BRF), Kevin Griffin and Matt Palmer (CU)]
- Variables displayed via Tree Growth Graphing Tool (Virtual Forest Initiative)
  - Griffin and Palmer
  - Dept of Earth and Environmental Sciences
  - Dept of Ecology, Evolution and Environmental Biology
  - BA, MS/MPA, PhD units
  - New Secondary School applications (Xu)

BRF-CU Virtual Forest Initiative

https://blackrock.ccnmtl.columbia.edu/portal/interactive-map/

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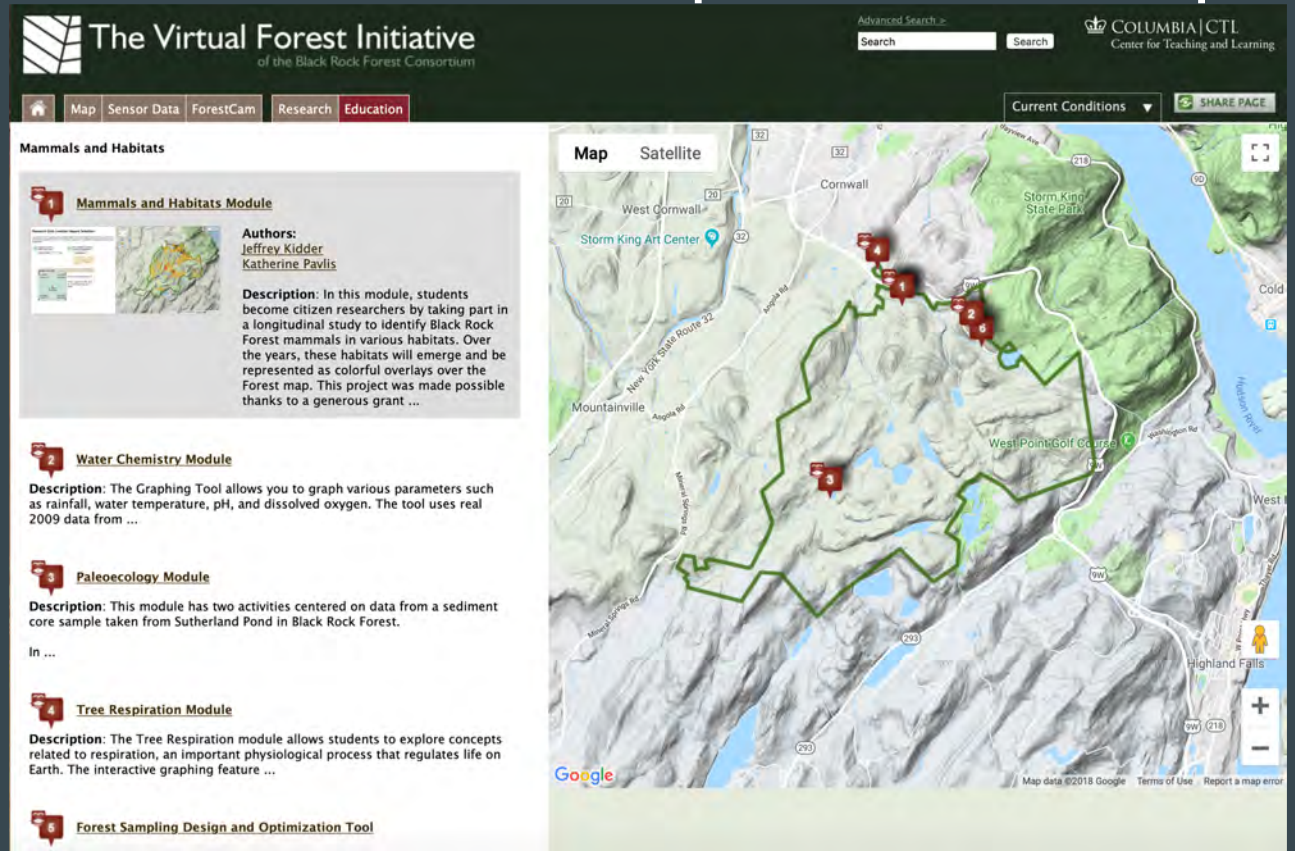

Real-Time Data Collection

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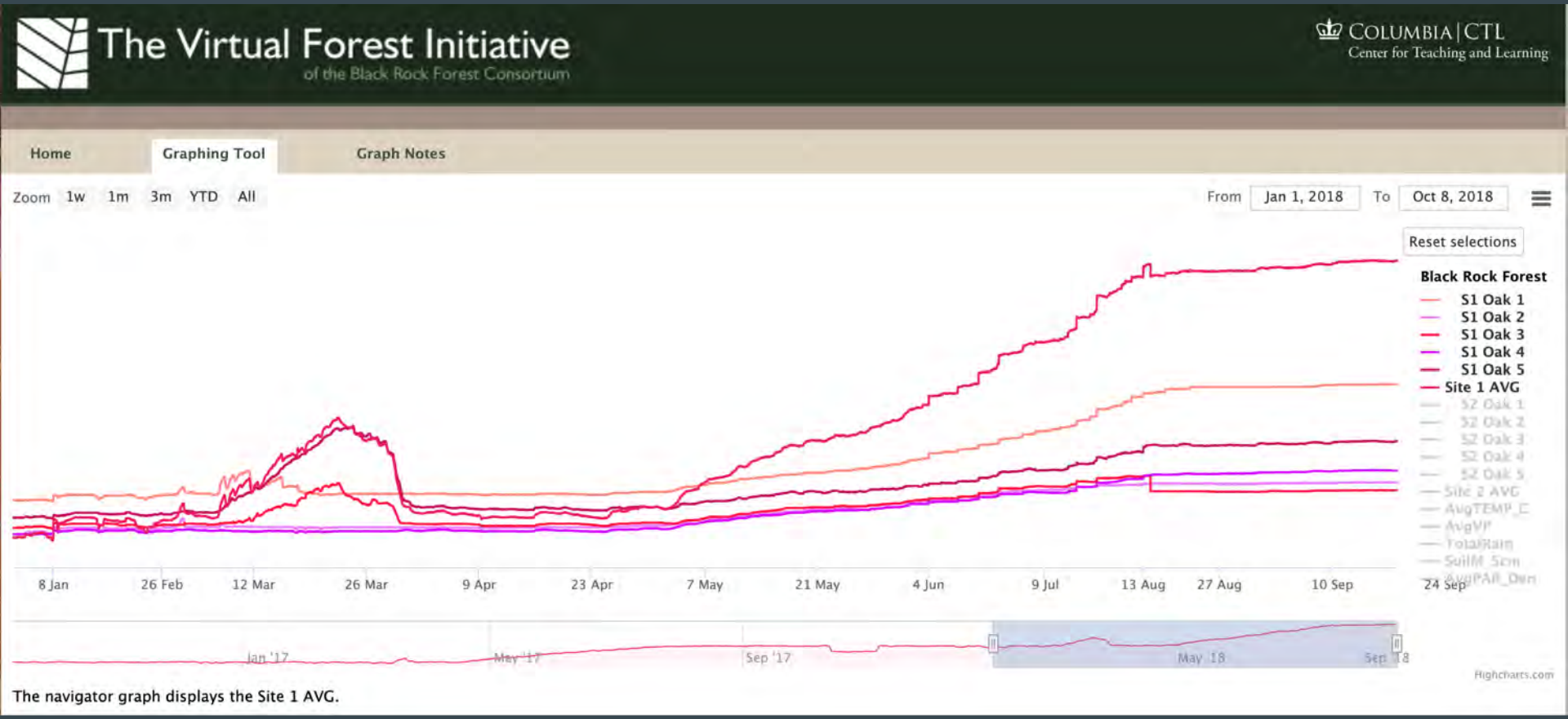

The navigator graph displays the Site 1 AVG.

Real-Time Data Collection

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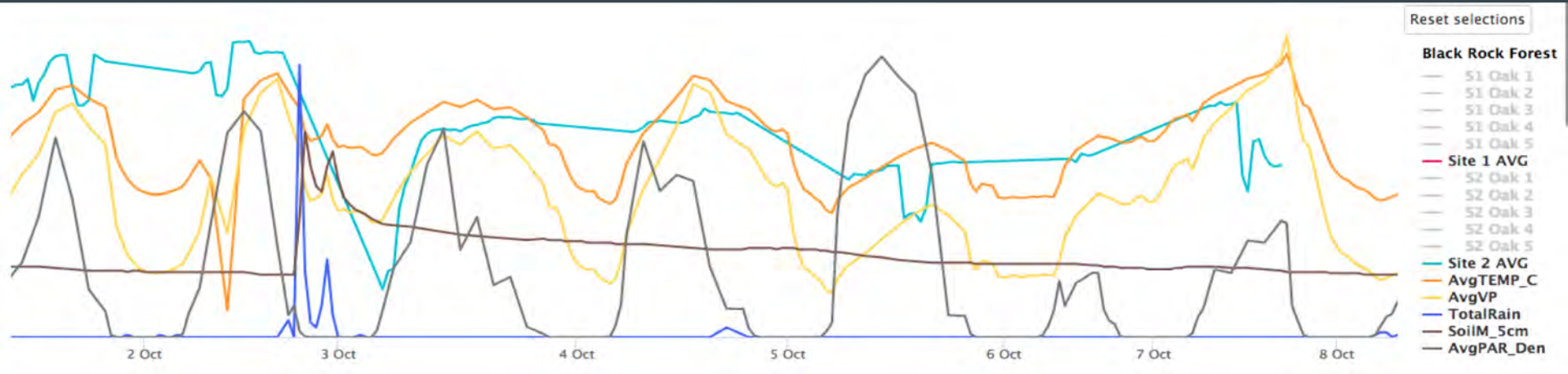
- Real-time wireless transmission allows day-to-day, or even hourly-to-hourly, measurement and archiving of growth parameters for periodic analysis.
- The Virtual Forest Initiative supports and enhances research at Black Rock Forest, a 4000-acre natural living laboratory for field-based scientific inquiry.
- Its website offers downloadable real-time data from sensor stations



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Research questions

- High-frequency variations in physiological response to environmental change, expanding to seasonal, annual and decadal analyses as the observational database grows through time.
- Geographic variation, microclimates and urban-rural transects.
- Longitudinal studies of response to climate variability.
- Comparison with lab and greenhouse experiments
- CO_2 fertilization and environmental limits to forest health

Research/Education Goals

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- Long-term regional forest ecosystem monitoring of urban – peri-urban – rural transition and climate impacts.
- Quantifying climate impacts on ecosystem services.
- Solutions-oriented research providing evidence base for ecosystem management.
- Training next generations of sustainability managers and scientists/engineers.
- Developing interdisciplinary STEM resources for secondary education, “Makerspaces”

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