

“Fitbit” the Forest:

Multivariate forest monitoring, education and outreach

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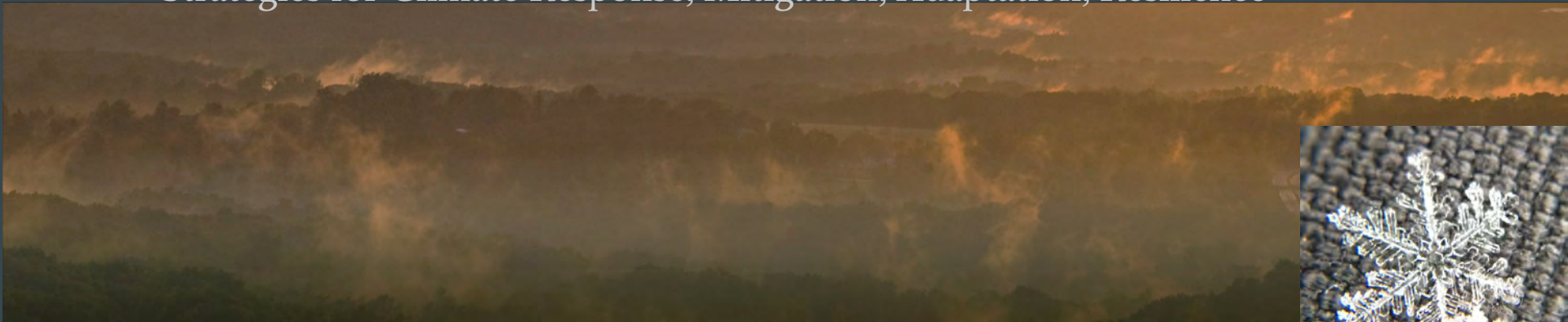
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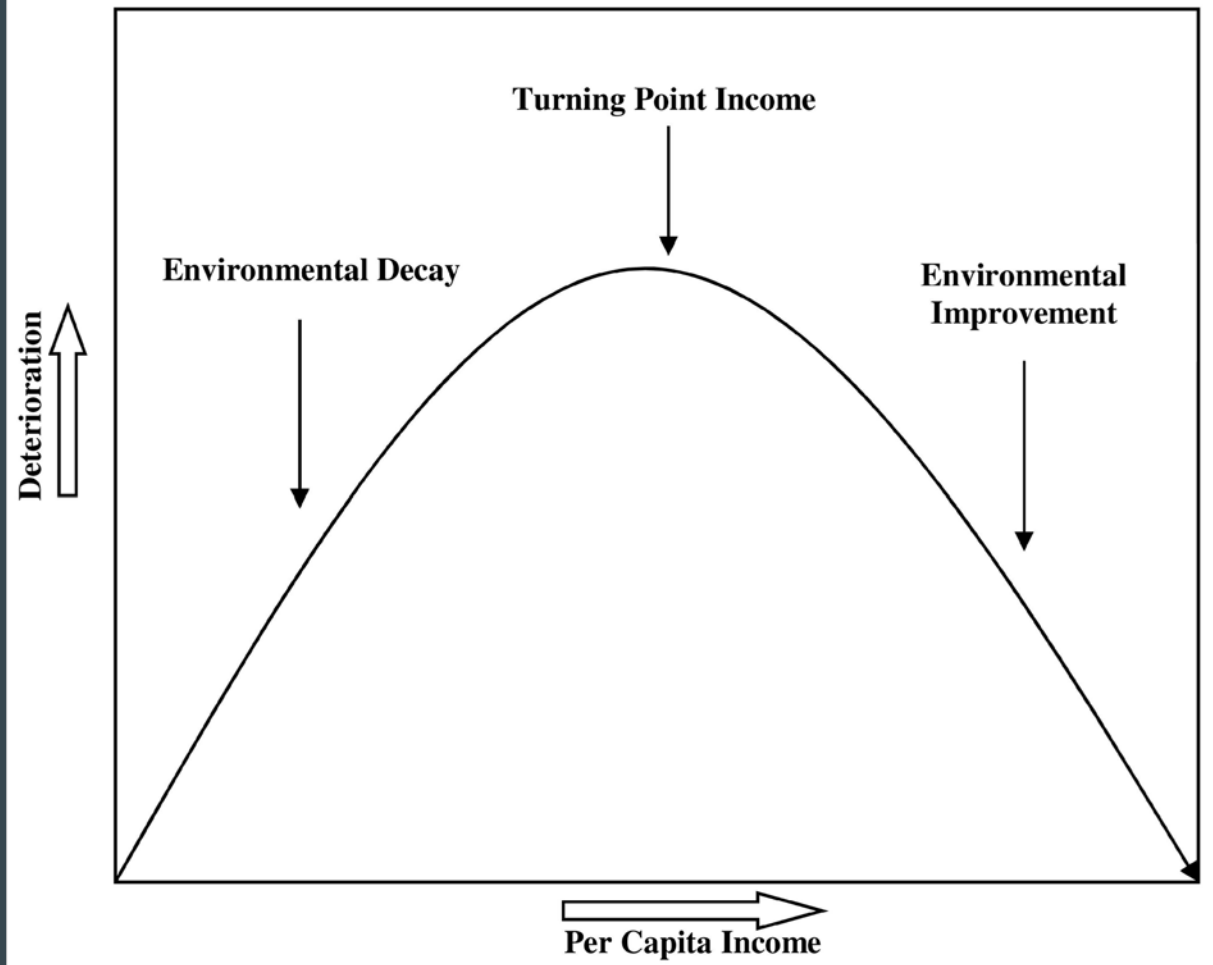


Cassie Xu, Margie Turrin
Office of Education and Outreach, LDEO
Arthur Lerner-Lam
Deputy Director, Lamont-Doherty Earth Observatory

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

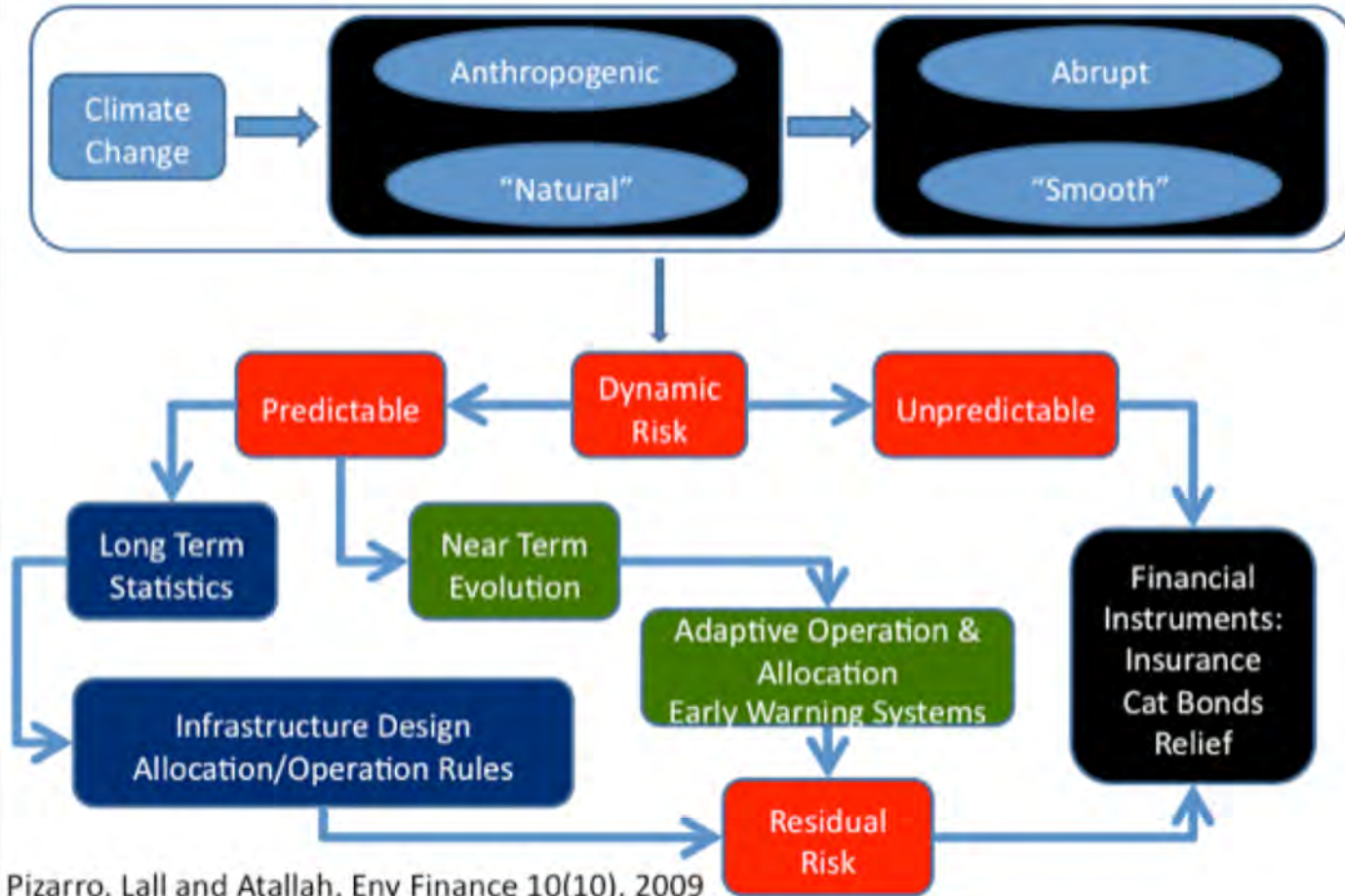




Managing Climate Risk

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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



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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Mammals and Habitats




Mammals and Habitats Module




Authors:
Jeffrey Kidder
Katherine Pavlis

Description: In this module, students become citizen researchers by taking part in a longitudinal study to identify Black Rock Forest mammals in various habitats. Over the years, these habitats will emerge and be represented as colorful overlays over the Forest map. This project was made possible thanks to a generous grant ...



Water Chemistry Module


Description: The Graphing Tool allows you to graph various parameters such as rainfall, water temperature, pH, and dissolved oxygen. The tool uses real 2009 data from ...



Paleoecology Module


Description: This module has two activities centered on data from a sediment core sample taken from Sutherland Pond in Black Rock Forest.

In ...



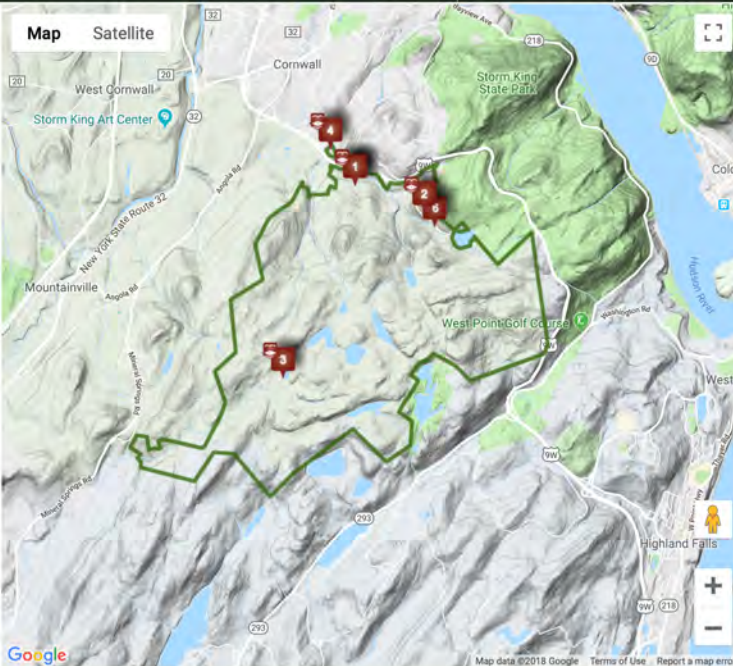
Tree Respiration Module

Description: The Tree Respiration module allows students to explore concepts related to respiration, an important physiological process that regulates life on Earth. The interactive graphing feature ...



Forest Sampling Design and Optimization Tool

[Map](#) [Satellite](#)



Map data ©2018 Google Terms of Use Report a map error

Real-Time Data Collection

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Graphing Tool

Graph Notes

Zoom 1w 1m 3m YTD All

From Jan 1, 2018 To Oct 8, 2018

Reset selections

Black Rock Forest

S1 Oak 1

S1 Oak 2

S1 Oak 3

S1 Oak 4

S1 Oak 5

Site 1 AVG

S2 Oak 1

S2 Oak 2

S2 Oak 3

S2 Oak 4

S2 Oak 5

Site 2 AVG

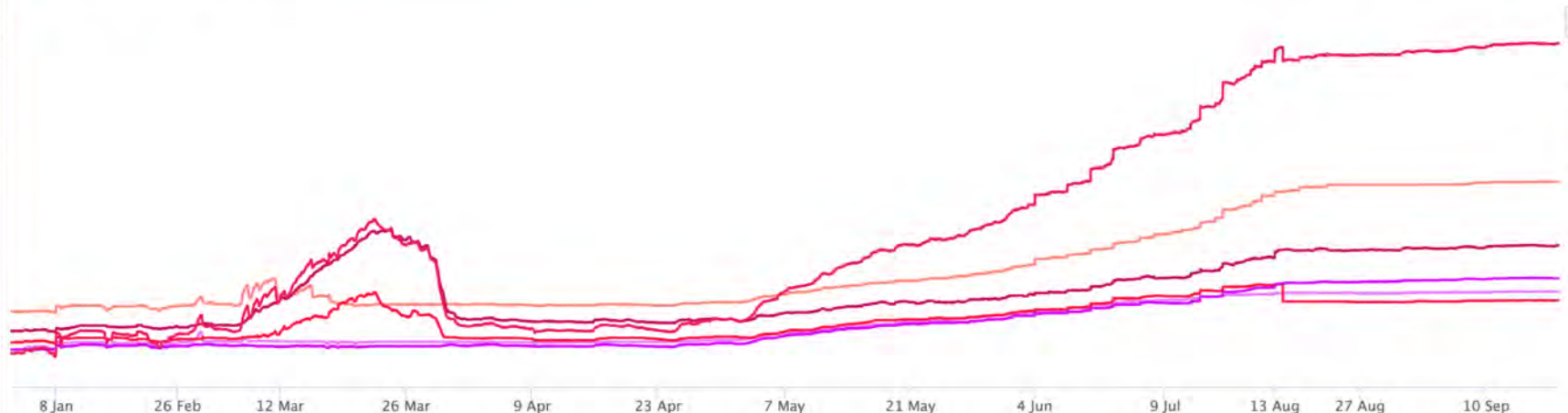
AvgTEMP_C

AvgVP

TotalRain

SoilM 5cm

AvgPAR_Dwn

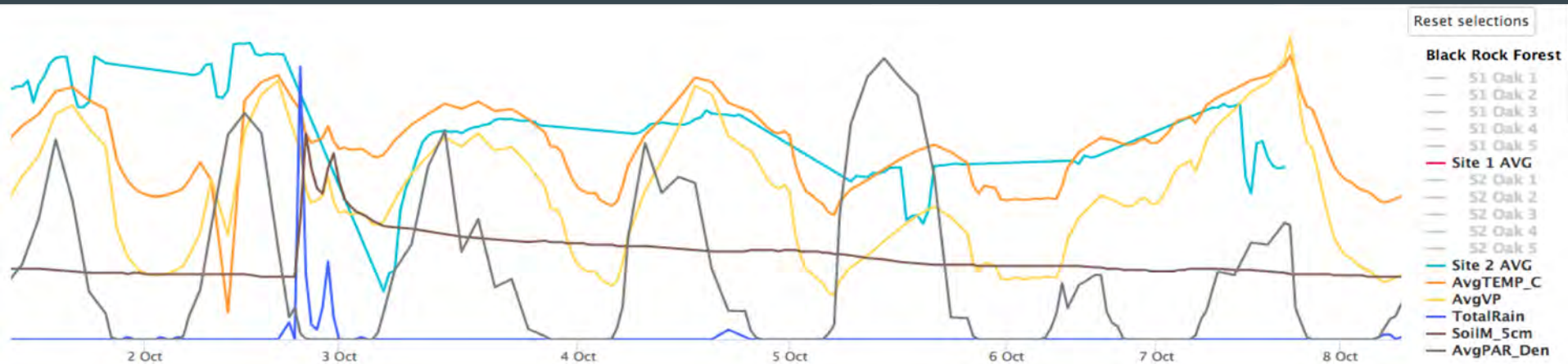


The navigator graph displays the Site 1 AVG.

Highcharts.com

Real-Time Data Collection

- 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



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
- CO₂ 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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