The time scale of resilience-based forecasts and their potential use

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

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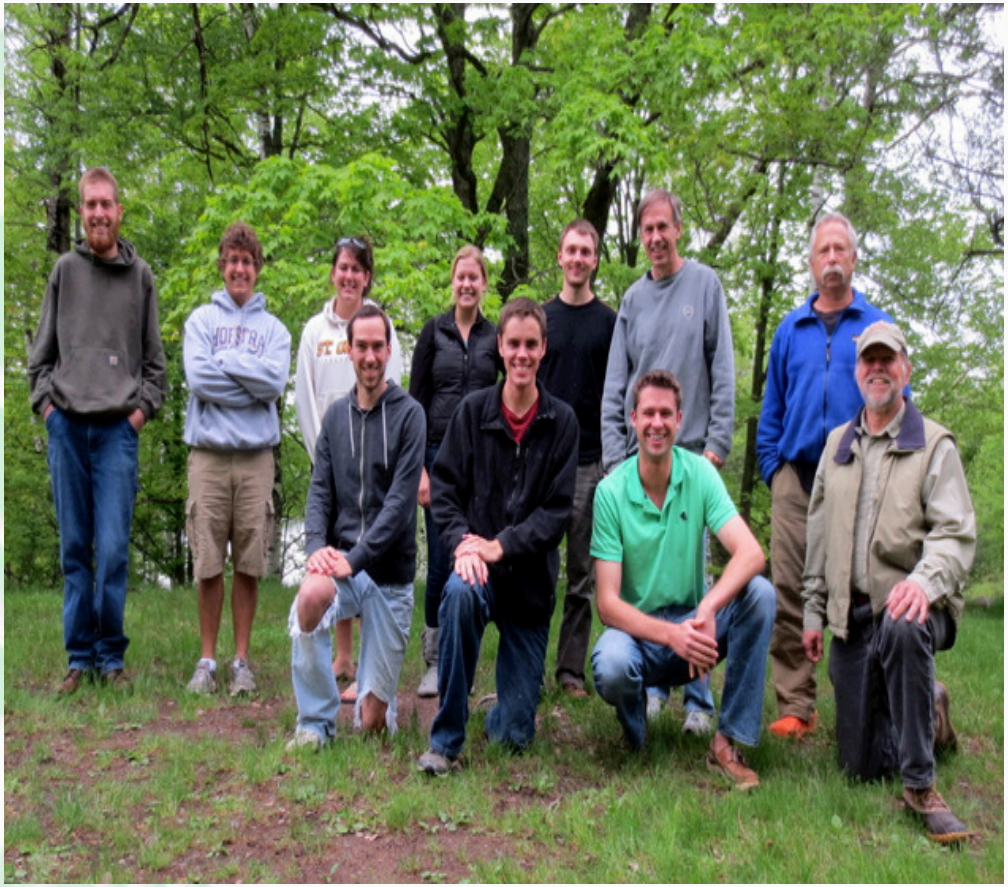
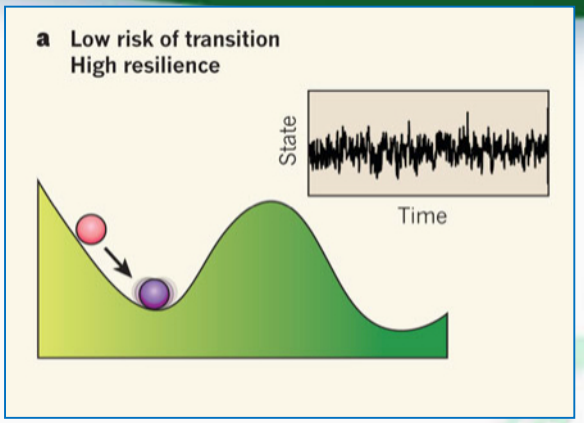
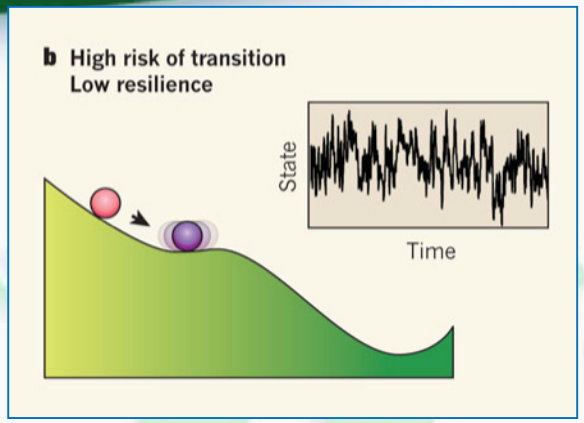
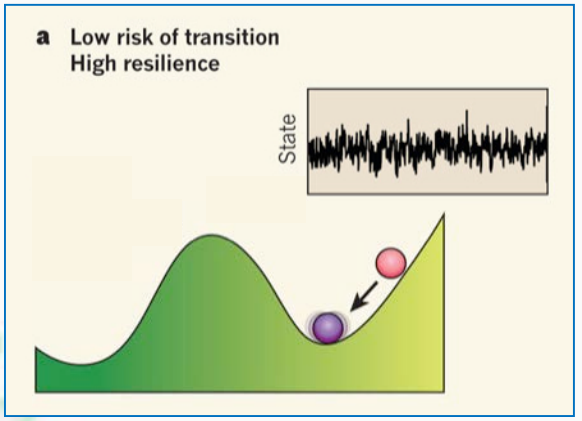


Operationalizing resilience-based forecasts

- Resilience-based forecast primer
- Time scale of an early warning
- How do we hope to use these warnings?



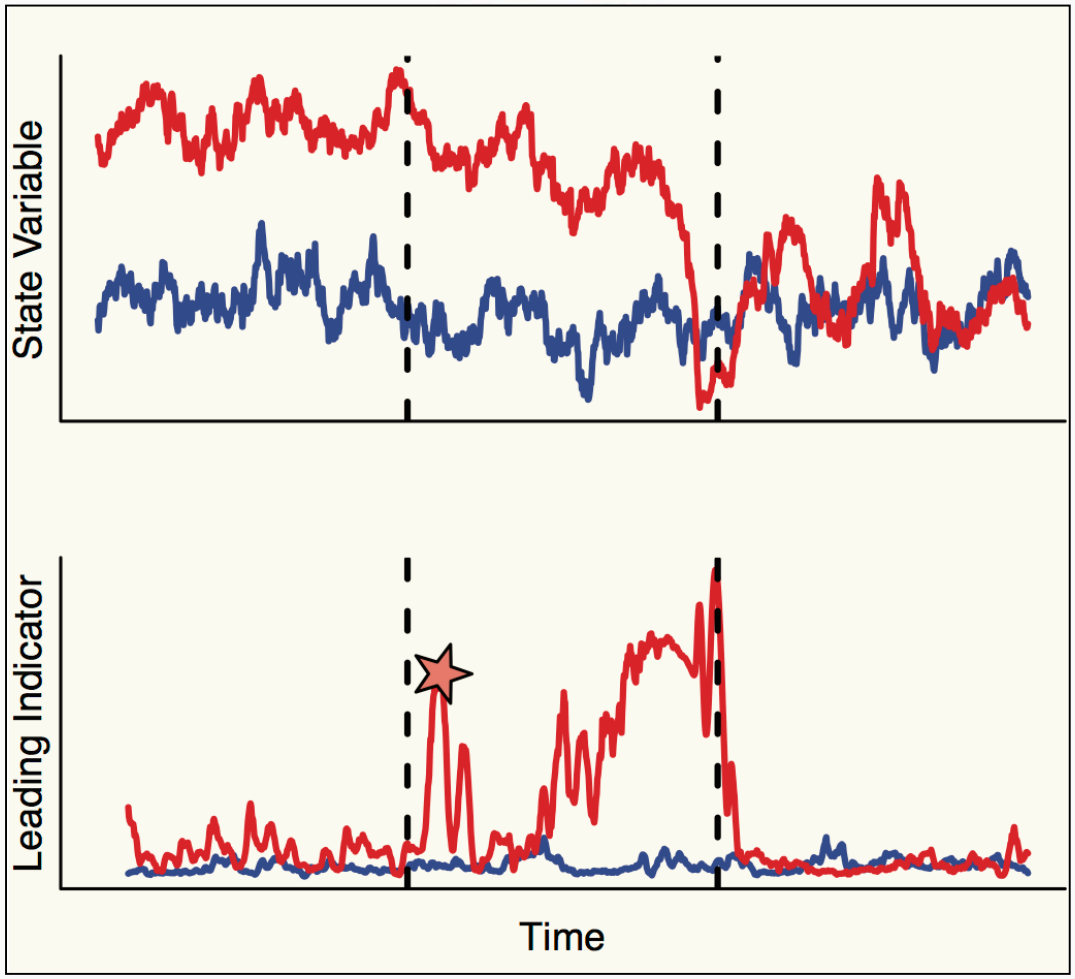




- Low resilience period
- Warnings in autocorrelation, variance

Scheffer et al. 2009 Nature

Statistical warning before state change



Batt et al. 2013 PNAS

ANTONIO SCORZA/AFP/GETTY

The shores of Rodrigo de Freitas Lake in Brazil are littered with fish killed by algal overgrowth in March 2000.

From patterns to predictions

Truly generic signals warning of tipping points are unlikely to exist, warn **Carl Boettiger** and **Alan Hastings**, so researchers should study transitions specific to real systems.

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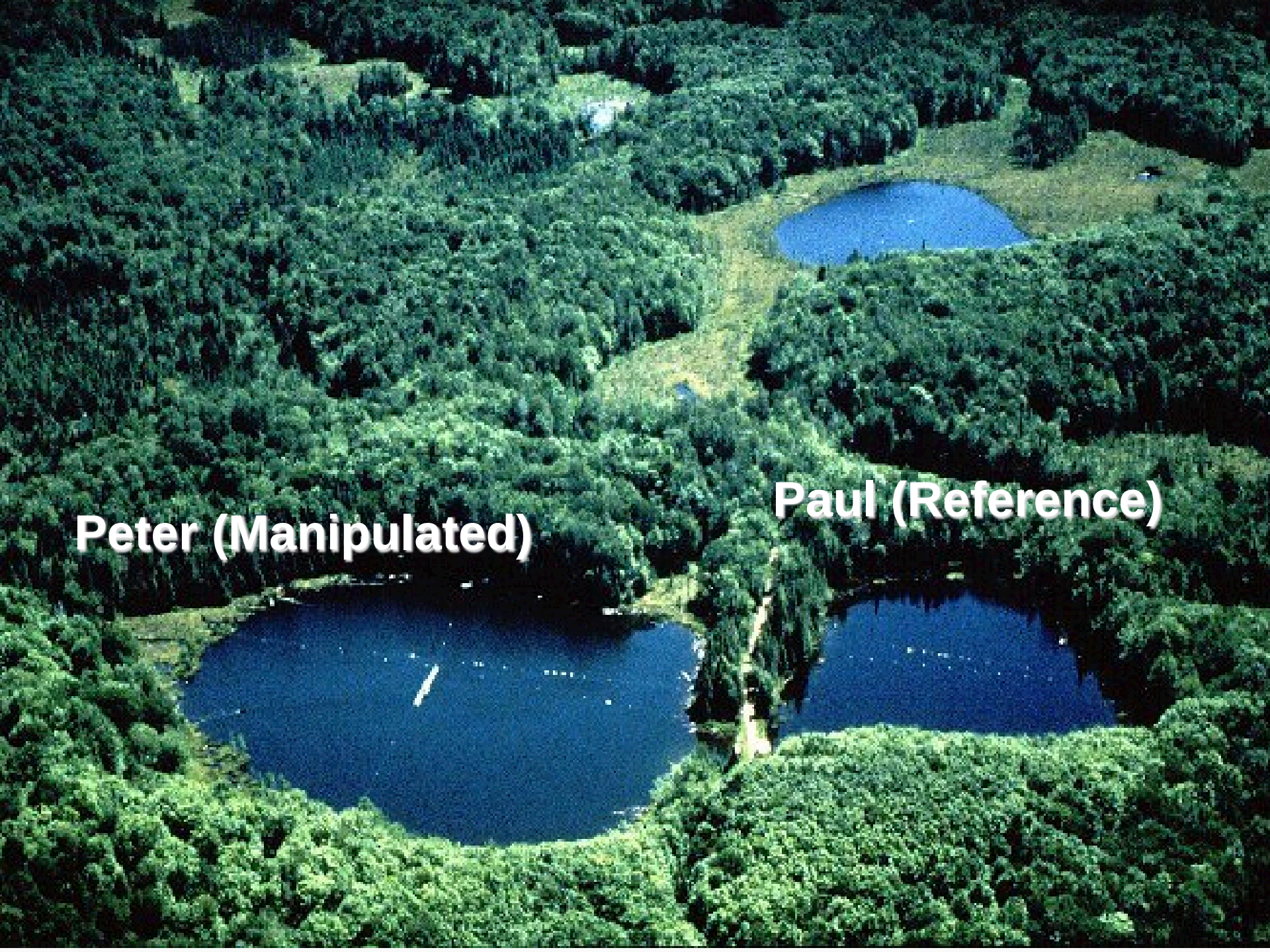
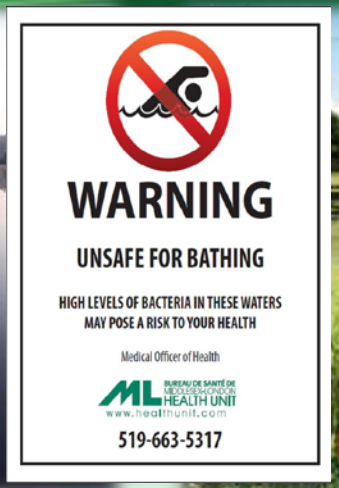
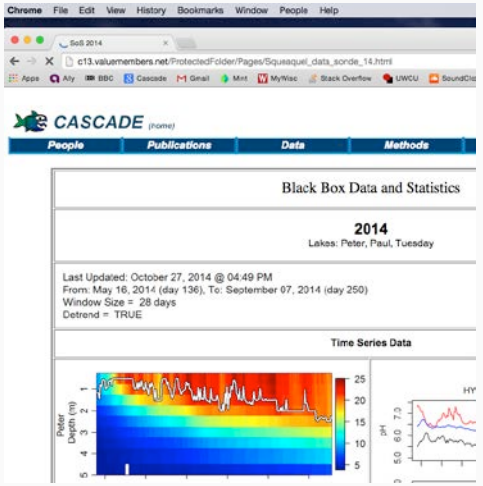

Peter (Manipulated)
Paul (Reference)



Chlorophyll

Blue-green algae



Early Warnings of an Algal Bloom

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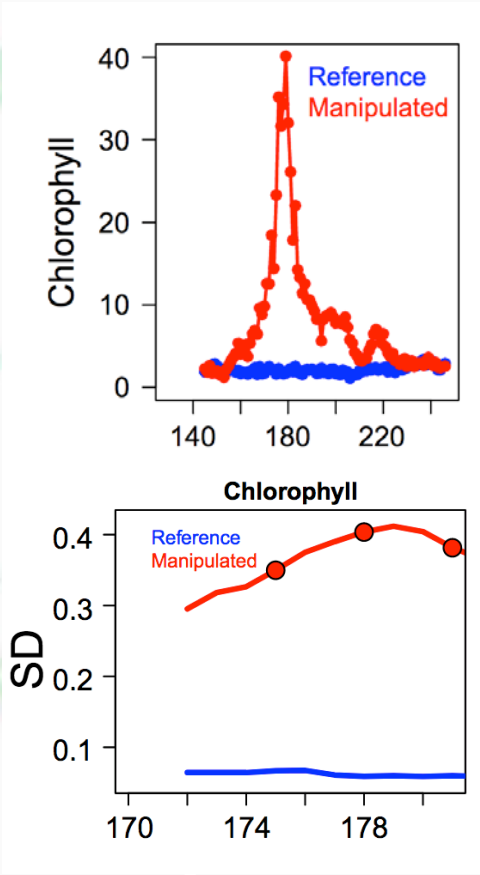
Peter (Manipulated)

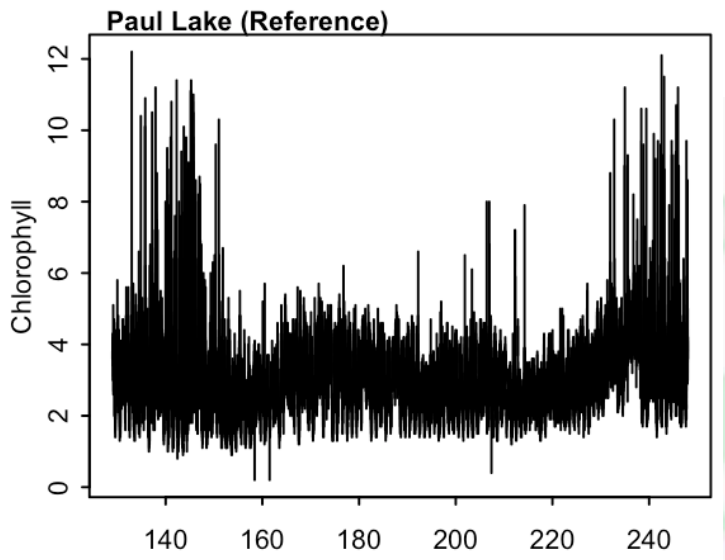


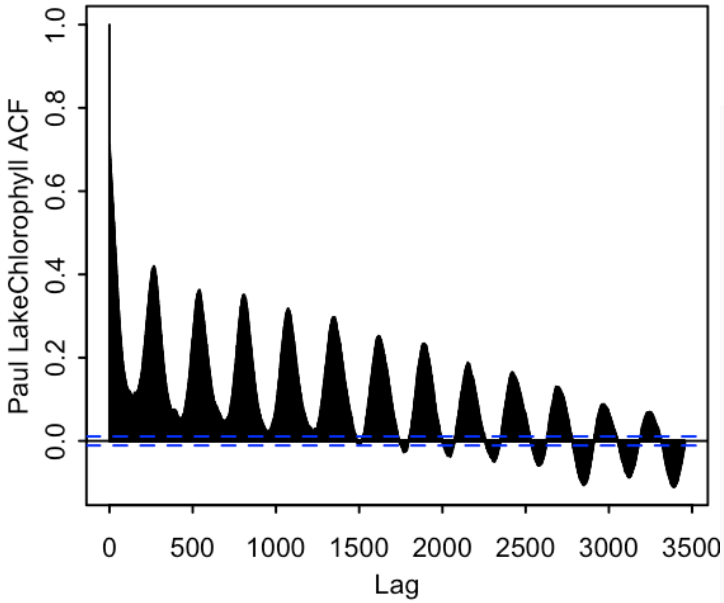
Pace et al. 2017 PNAS
Wilkinson et al. 2018 Ecological Monographs

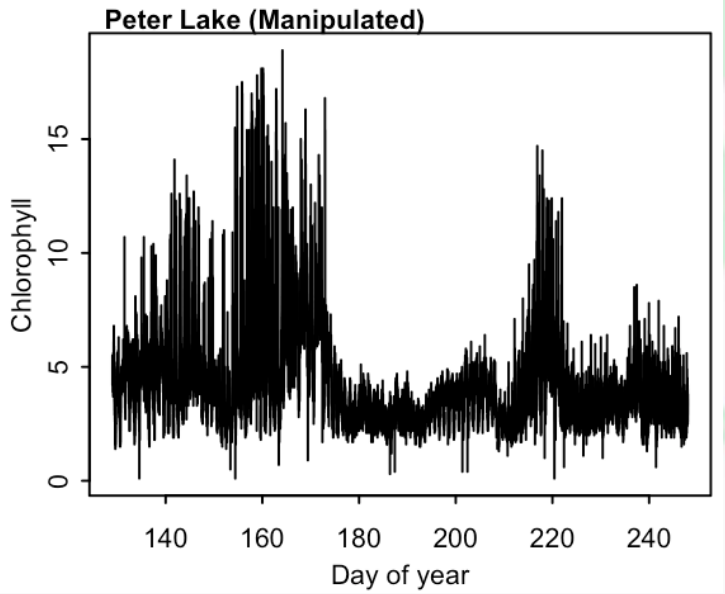
Are signals present across time scales?

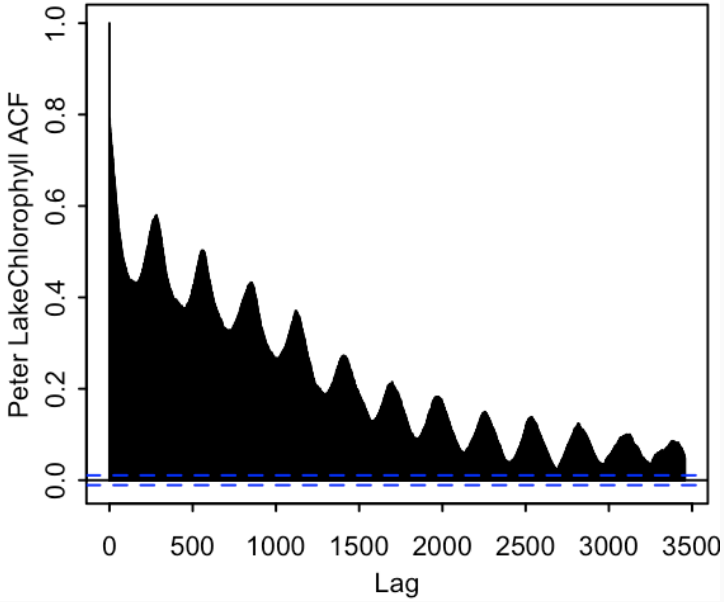
- Lag-1 autocorrelation
- Seconds or centuries?

Time scales: autocorrelation

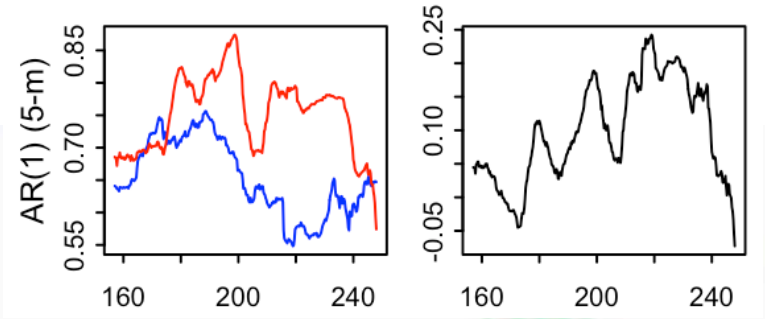








Time scales: autocorrelation dynamics



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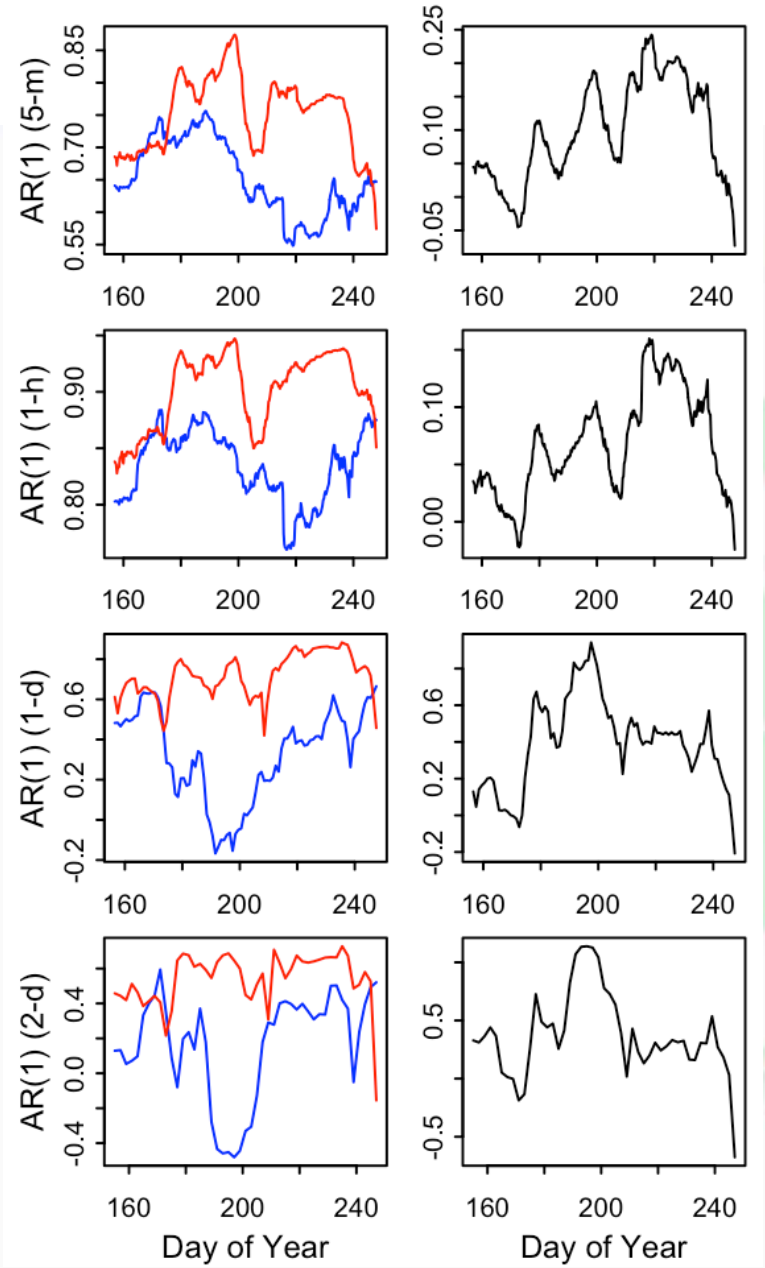

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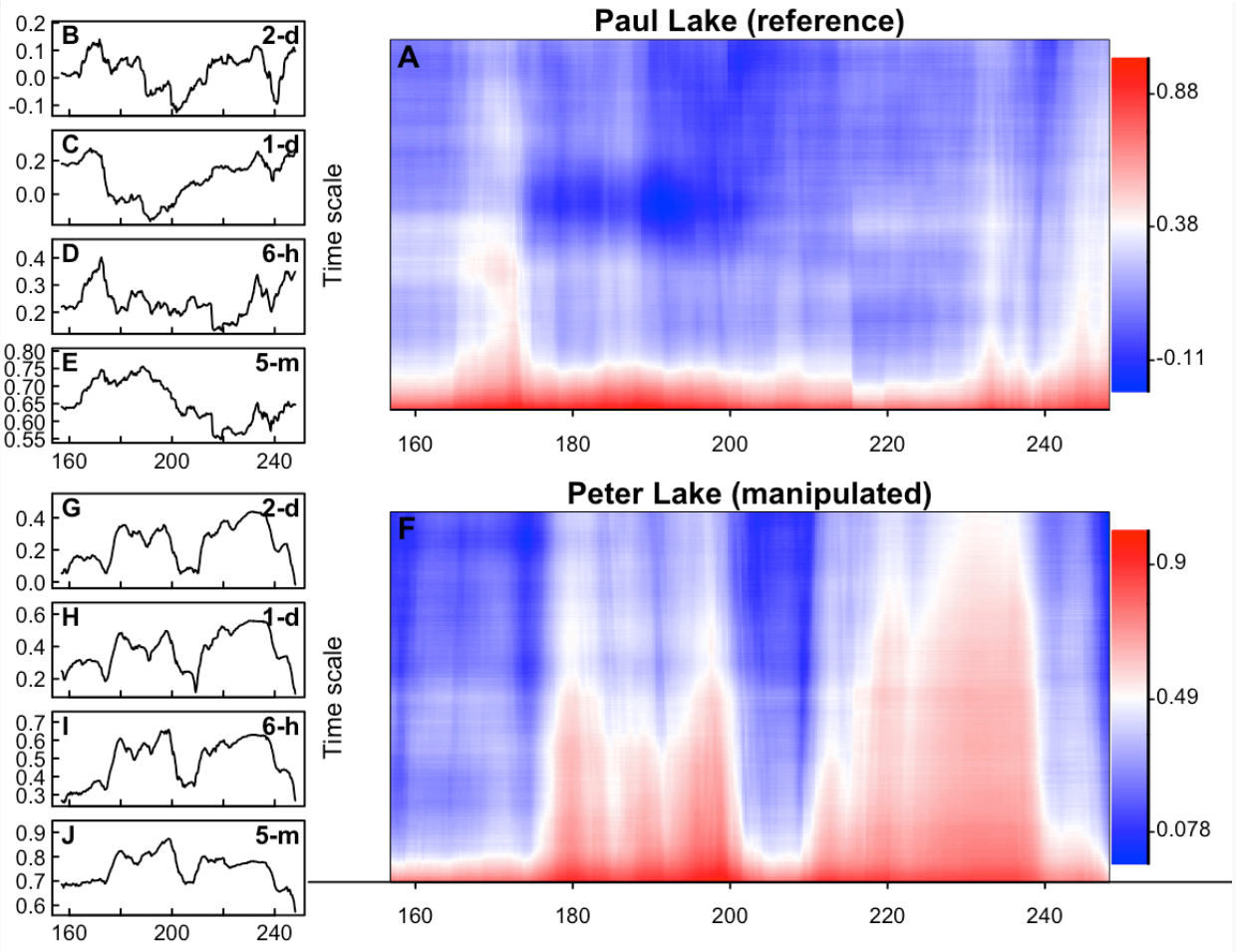

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Time scale of warnings & use cases

Current (react)

- Warning time scale = short
- Long-term solution well-known
- How will forecasts be used?

Short Term (react)

Long Term (prevent)

Disclaimer

The views expressed in this presentation are those of the author and do not represent the views or policies of the U.S. Environmental Protection Agency.

Questions?

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY

Early Warnings Present, but Need Work

Before

Intervention

After

Successes

- Created Bloom
- Found Warnings
- Reversed Bloom

Challenges

- Field & Analytical Choices
- Interpreting Conflicting Signals
- Quantifying Confidence