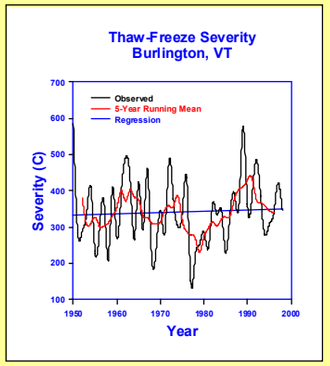
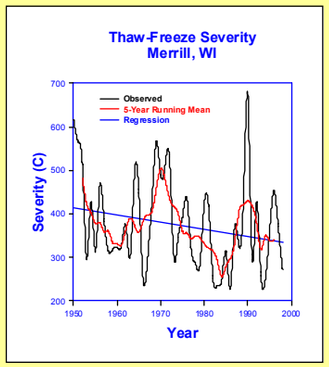
Monitoring the Effects of Extreme Climate Disturbances On Forest Health in the Northeast U.S.

Allan N. D. Auclair
RAND Environment
Arlington, VA

Warren E. Heilman
USDA Forest Service
North Central Research Station
East Lansing, MI

Trend Analyses





Trends in thaw-freeze and extreme cold occurrence and severity are being analyzed. Note the 15-20 yr. cycle in thaw-freeze severity at Burlington, VT and Merrill, WI. Identifying periodicity can improve predictability.

National Forest Health Monitoring Program

Concept:

- Determines status, changes, and trends in forest conditions annually.
- Uses ground plots and surveys, aerial surveys, and other biotic and abiotic data sources.
- Develops analytical approaches to address issues on sustainability of forest ecosystems.

Issue:

- Field results delayed 12-24 months; interpretation only after well-defined patterns emerge.
- Managers need advance warning of when and which injuries are likely.

Objective and Goals of Current Project

Objective:

To predict forest health outcomes using physical data on weather, climate, and air quality.

Goal 1:

Develop a series of climate indicators that evaluate changing risk to forest health.

Goal 2:

Develop formal decision support system to assist managers in making timely and accurate choices.

Project Approach

Develop archive of GIS maps of FHM, climate disturbance, and air quality data.

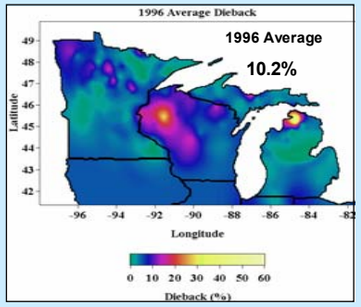
Focus initially on two symptoms: Crown dieback and Bioindicators.

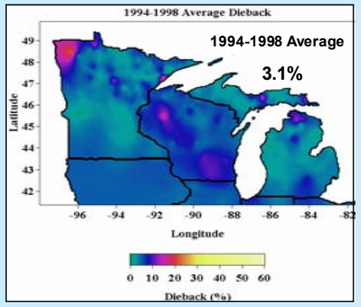
Design and test a series of climate indices to correlate with FHM data.

Develop an early warning capability.

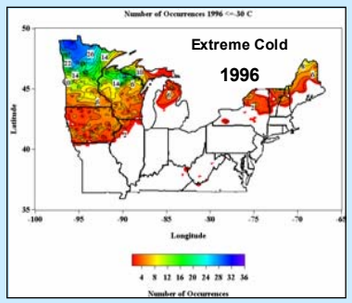
Crown Dieback, Extreme Cold, and Thaw-Freeze Patterns

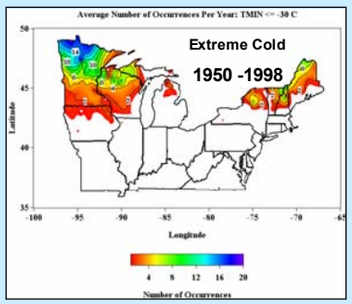
Crown dieback patterns have been mapped for years 1994-1998 for the north central and northeastern U.S. Shown below is the 1996 dieback pattern compared to the 1994-1998 average dieback for the north central U.S.



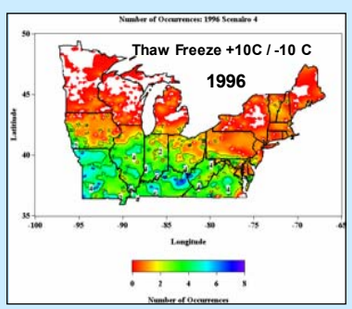


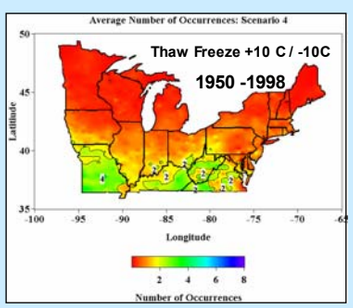
Extreme cold patterns have been mapped for years 1950-1998 for the north central and northeastern U.S. Shown below is the 1996 extreme cold occurrence (T < -30C) compared to the 1950-1998 average.



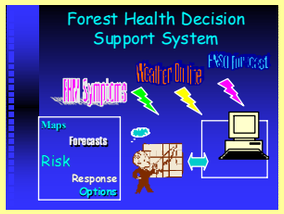


Thaw-freeze patterns have been mapped for years 1950-1998 for the north central and northeastern U.S. Shown below is the 1996 (Dec.-Mar.) thaw-freeze occurrence (+10C/-10C) compared to the 1950-1998 average.

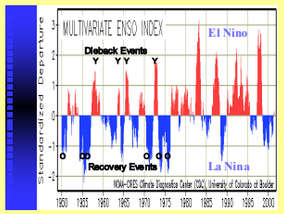


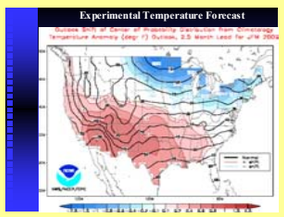


Decision Support System



The proposed Forest Health Decision Support System would consist of a series of models that capture historical observations in relationships linking specific FHM symptoms to climate, air quality, and other parameters known to result in injury or damage to the tree population. It would also tap into several streams of real-time information such as weather and El Niño-Southern Oscillation (ENSO) forecasts, and on-going FHM observations. The output would identify the nature, location, and levels of risk to forest health, and suggest some options for action.





ENSO forecasts provide the exciting possibility of assessing risk 3 to 6 months in advance of actual weather conditions. There is evidence that dieback in the Northeast is strongly affected by ENSO. Prior to 1976, recovery tended to occur in La Niña years, dieback in El Niño years. With persistent, severe El Niños in and after 1976, dieback was over twice historical (pre 1975) levels. An example of an ENSO-based forecast (Winter 2002) is given showing a colder than average winter season. Further work is required to translate the forecasted seasonal anomalies into forecasted frequency and severity of extreme cold and thaw-freeze events.

SUMMARY

Prediction of Forest Health Outcomes

This 3-year project started in the Spring of 2001. It proposes to develop a series of climate and air quality indicators that quantify the risks to forest health.

The concept is, that in addition to monitoring, FHM has a capability for predicting certain kinds of climatic-related injuries. The benefits to forest managers of continuous, real-time risk evaluation and advance warning of potential damage to trees is large, including early action and prevention.

The strategy is to start small (two symptoms, 2-3 States) and to develop, test, and refine a method that can be applied in other regions and include additional symptoms.

Progress to Date

We are focused on crown dieback in the Midwest and on two indicators – extreme cold (<-30 °C), and winter thaw-freezes. Both have known links to dieback in Northern Hardwoods.

Dieback in Wisconsin in 1996 was 3 times the 1994-1998 average (10.2 vs 3.1%). Both extreme cold and thaw-freeze frequencies in 1996 were also over 3 times their long-term norm.

We are proposing to develop an on-line Forest Health Decision Support System that enables frequent updates of FHM symptoms, climate stresses, and ENSO seasonal forecasts of pending climate disturbances. This is at an experimental stage. There is evidence in the Northeast, that ENSO, Arctic Oscillation and North Atlantic Oscillations enable 3 to 6 months advance warning of certain kinds of climatic stress. The objective is to achieve early warning of potential health problems and test the system under operational conditions .