Global Temperature Part I: Observed Trends

Bulletin Synopsis *January 2015*

This bulletin explores how the average global surface temperature has changed historically and how these changes have affected forest ecosystems in the past.

2014 Recap

It is very likely (90.4% probability) that 2014 was one of the five warmest years globally since people began keeping records. Four independent datasets put 2014 at the top of the charts, continuing the upward trend observed over the past several decades.

The Modern Temperature Record

We have direct thermometer measurements of land and ocean surface temperature going back to 1880 (beyond that time we rely on proxy records from sources such as tree rings, lake and ocean sediments, ice cores, and others). Over this period, the average global temperature has risen around 1.53^0F (0.85^0C). For perspective, the difference between the average global temperature today and the depths of an ice age is on the order of 7.2^0F (4^0C) colder.

A Regional View of Global Trends

The earth has not warmed uniformly – we have observed greater warming at high latitudes and greater warming over land than oceans, which is primarily the result of factors such as polar amplification, ocean heat capacity, and internal climate variability.

Ecosystem-Climate Interactions

Long-term temperature changes can profoundly affect vegetation composition, e.g. the movement of forests after the glacial retreat in North America at the end of the last ice age.

However, the effects of *shorter-term climate variability* are most important for the typical timescales of forest management. The El Niño-Southern Oscillation (ENSO) is one of the most well-known examples of an internal cycle that drives short-term (year to year) climate variability – affecting temperature and precipitation throughout the globe. When ENSO is in a warm phase, also known as an El Niño event, it tends to increase global average temperature for the duration of that phase (typically one to three years). It has been linked to altered forest fire regimes, as well as changes in forest carbon sequestration rates, productivity, and phenology.

Things to Consider

Variability in the earth's climate can be separated into two categories:

- *External variability* due to natural and anthropogenic forcing, e.g. sun cycles, enhanced greenhouse effect
- *Internal variability* due to ocean-atmosphere circulation patterns that redistribute heat within the climate system, e.g. ENSO

Internal variability modulates the long-term upward global temperature trend. The interplay between external and internal sources of variability determines the unique climate conditions felt in each region.