DETECTION OF SEVERE STORM SIGNATURES IN LOBLOLLY PINE USING SEVEN-YEAR PERIODIC STANDARDIZED AVERAGES AND STANDARD DEVIATIONS

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A loblolly pine plantation near Eagletown, Oklahoma was used to test standardized tree ring widths in detecting snow and ice storms. Widths of two rings immediately following suspected storms were standardized against widths of seven rings following the storm (Stan1 and Stan2). Values of Stan1 less than -0.900 predict a severe (usually ice) storm when Stan2 is less than -0.290. Values of Stan1 between 0.000 and -0.900 and Stan2 between 0.000 and -0.290 indicate a mild (usually snow) storm.

In 1998 a growth study was established in a loblolly pine stand planted in 1975. Height and diameter data was collected from 18 fifth-acre plots in January 1999 and again in January 2000. The Christmas 2000 ice storm heavily damaged the stand. Increment cores were collected in February 2002 and heights and diameters again measured in January 2003 and March 2004. In February 2005 new height and diameter measurements were made and a second set of increment cores collected. The stand was harvested in 2005.

Total ring width series were made (Stevenson and others 2015) using COFECHA (Holmes 1983) and converted to chronologies using ARSTAN (Cook and Holmes 1986) with a logarithmic decay and straight-line-of-negative-slope as the first and second detrending models respectively, division option. A seven-year running average and standard deviation were calculated for each year and the six years following it from 1985 to 1998.

We created a variable, Stan1, by standardizing the ring width from each growing season using the computed seven-year averages and standard deviations. We then created a second variable , Stan2, by substituting the ring width of the second growing season in place of that from the first season.

Standardization recalculates the mean and standard deviation every year. Stan1 and Stan2 are standardized, resetting them to a new base that reflects the stand's reduced ability to respond to new injuries. By requiring maximum standardized ring width values in both the first and second year following the storm, we separate a severe winter storm from an ordinary winter storm.

Ice storms always produced threshold values of Stan1 less than -0.900 (Stevenson and others 2015). Unfortunately, so did some years that had no ice storms. Likewise, ice storms produced threshold values of Stan2 of less than -0.290, but so did some years that had no ice storms. In the Eagletown data, Stan1 and Stan2 both fell below their respective thresholds in 1985, 1995 and 1996. The Stan1 value for 1985 was -1.181 with a Stan2 value of -0.298. The historical record (NCDC Feb 1987 - Feb 1997) showed severe storms in 1985 and 1995, but none in 1996. The Christmas 2000 ice storm was too recent for Stan1 and Stan2 to be calculated.

Storms in 1987, 1988, 1993, 1995 and 1997 all exceeded at least one of the threshold values. It is unknown whether the storms of 1987 and 1988 were snow or ice storms, but those of 1993, 1995 and 1997 were all snow storms with little ice accumulation. Records from a nearby on-going growth-and-yield study (Saud and others 2015) showed no stem breakage in any of these years, indicating no ice damage, but leaving open the possibility of snow damage. NCDC records for 1993, 1995 and 1997 (NCDC Feb 1987 - Feb 1997) indicate mostly snow with little ice.

Our method predicted two severe storms (1985 and 1995) that were confirmed by weather records and one (1996) that was not. In addition, it detected five moderate storms (1986, 1987, 1988, 1993 and 1997),

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Citation for proceedings: Schweitzer, Callie J.; Clatterbuck, Wayne K.; Oswalt, Christopher M., eds. 2016. Proceedings of the 18th biennial southern silvicultural research conference. e–Gen. Tech. Rep. SRS–212. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 614 p.

probably snow storms. This is a large number of storms and may be due either to species or age differences. Determining which may allow the effects of tree/stand age to be taken into account when examining tree ring series for climate and weather information.

1. Our method of detecting severe winter storms in tree ring widths works for loblolly pine.
2. The large number of storms indicated in loblolly pine may indicate a greater susceptibility to ice and snow damage among young loblolly stands.

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