Dendroclimatology of coastal Atlantic White cedar in the northeastern United States

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I. Background

Atlantic White cedar (AWC), *Chamaecyparis thyoides* (Fig.1), is a rare and valued species found within 200 km of the Atlantic coastline of the United States. AWC is exceptional amongst eastern trees in that its annual growth rings have been shown to correlate significantly with temperature from its northern range limit in Maine to New Jersey [1](Fig. 2; Fig. 3).

AWC often occupy coastal moraine features, such as kettle holes [2]. Cape Cod, Massachusetts is a glacially formed landscape that hosts numerous AWC swamps within 1km of the ocean, exposing them to salt water spray and brackish water. Hydrology is one of the most important factors controlling the health of AWC wetlands, and many AWC stand's deaths are attributed saline incursion [2].

In this study coastal AWC stands are analyzed for climate signals in their annual rings and compared to the temperature sensitivity previously established for inland AWC throughout New England.

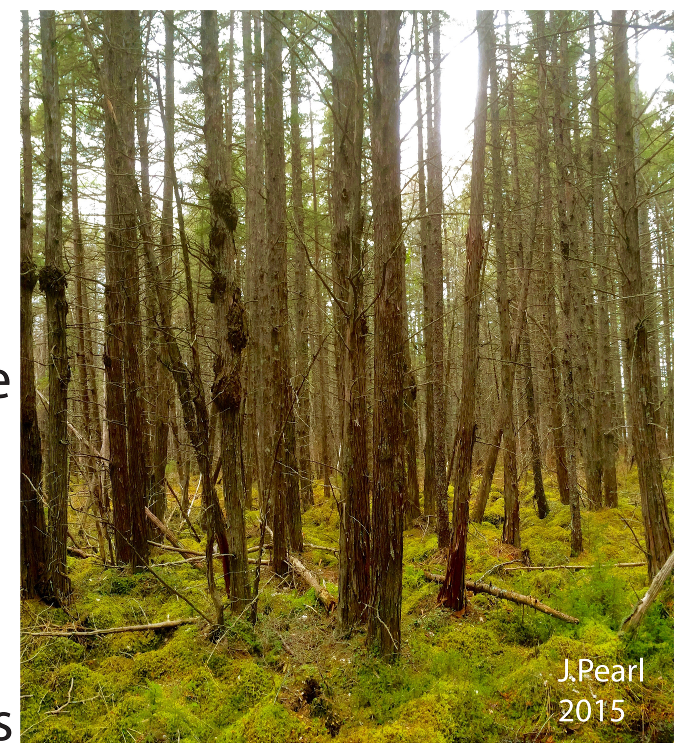

Figure 1. Atlantic White cedar swamp in Appleton, ME, USA

II. Methods

* 3 AWC sites previously developed [1] in Maine and Massachusetts and 3 coastal (less than 1 km from the ocean) AWC sites in Cape Cod, Massachusetts, were sampled in 2014-2015.

* Total ring width measurements were compiled and detrended using ARSTAN and RCSsignalfree software [3][4]. The chronologies were fit with a negative exponential curve.

* The MATLAB program Seascorr [5] was used to compute seasonal correlations with climate data

* Field correlations were computed using point correlation, with significance values computed to account for autocorrelation.

*Temperature data was taken from GISS Surface Temperature Analysis, precipitation data from GPCC v.7, and PDSI from Climate Data Interface v.1.6.3

III. AWC Temperature Correlation

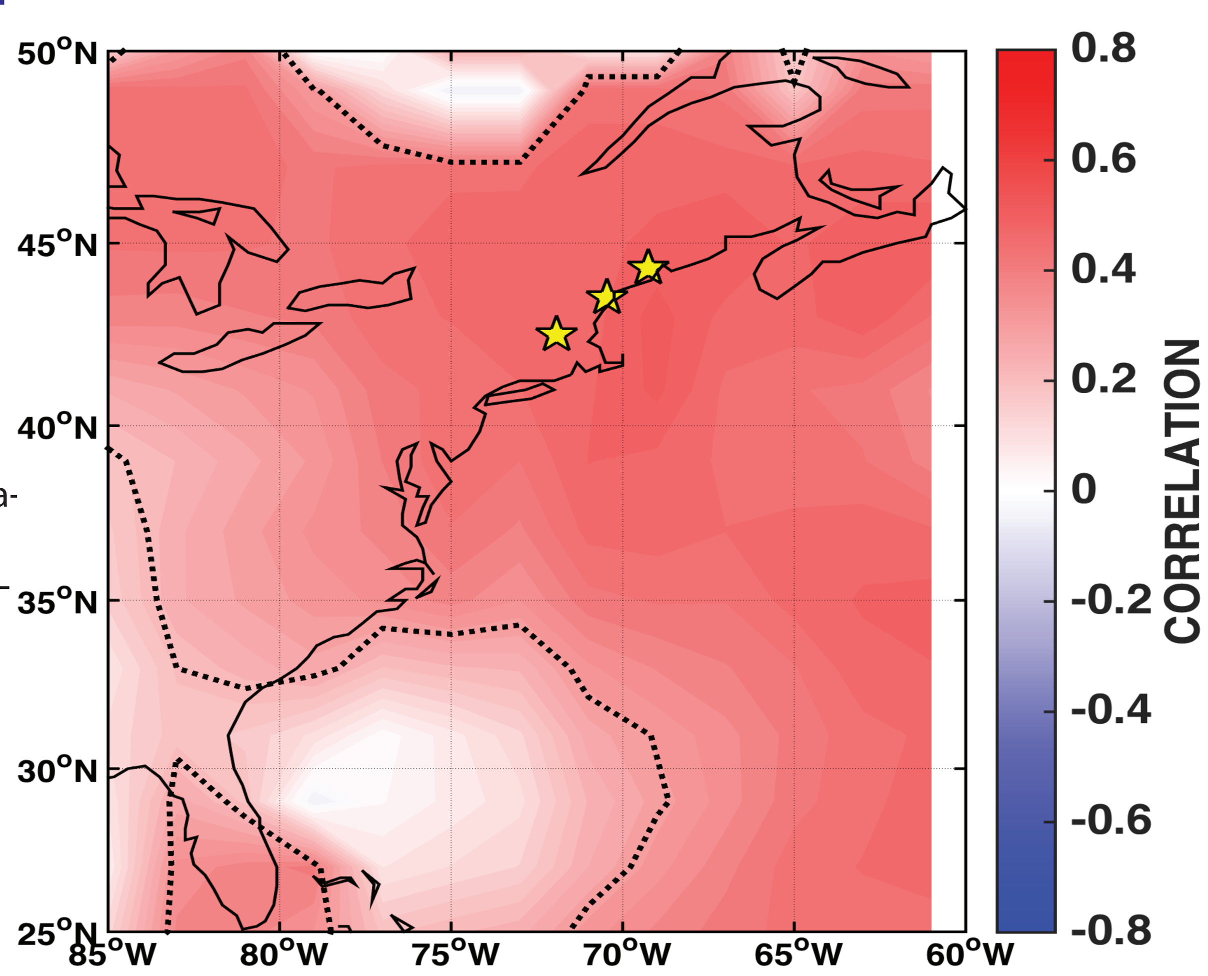

Figure 2. Correlation map of re-collected inland AWC sites (yellow stars) and temperature. Dashed contour represents areas of significance (p<0.05)

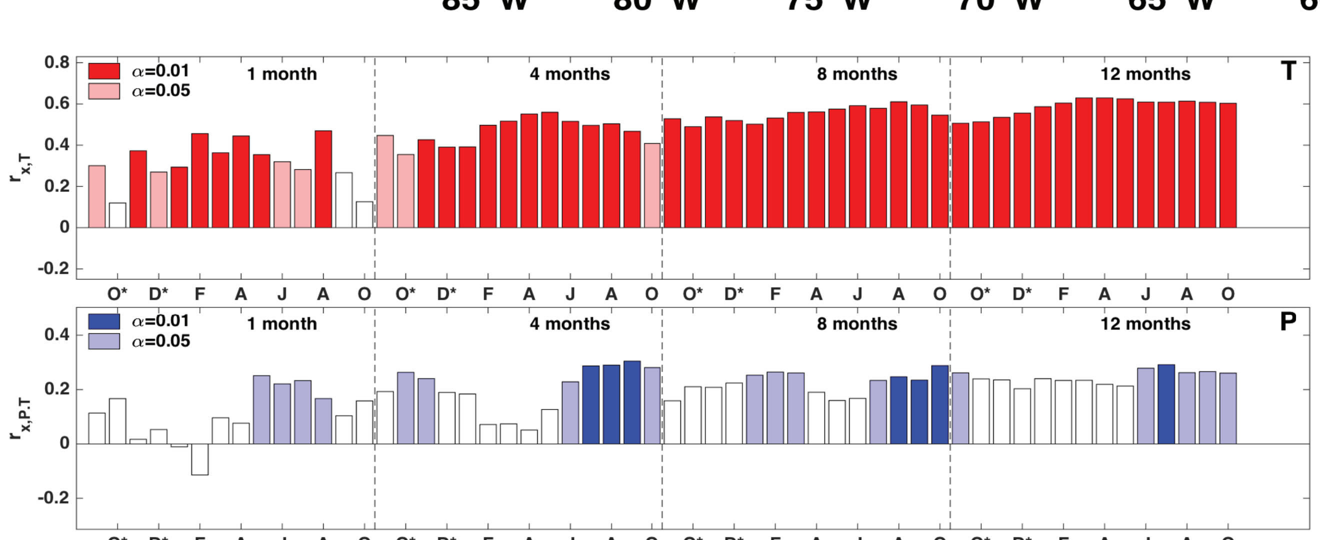

Figure 3. Correlations and partial correlations of Inland AWC chronologies from 1904-2013. In red: simple (Pearson) correlation between the chronology with monthly temperatures. In blue: the partial correlations between the chronologies with monthly precipitation.

IV. Results

Coastal AWC sites are strongly correlated with precipitation, temperature, and PDSI (Fig. 4; Fig. 5) in the northeastern United States. Summer (JJA) has the strongest precipitation sensitivity, spring and summer have the strongest temperature signal, and soil moisture is a significant climatic variable through all seasons (Fig. 5).

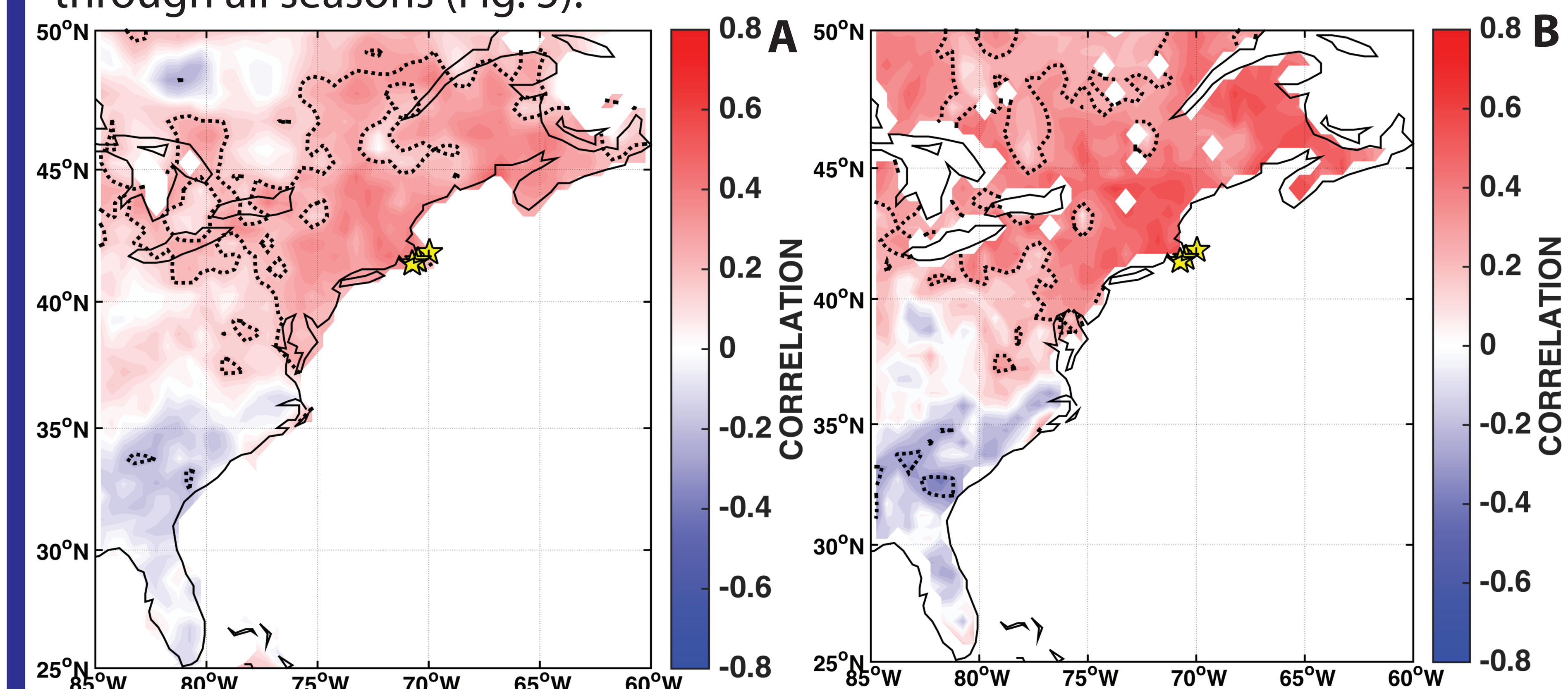

Figure 4. Correlation map of coastal AWC sites (yellow stars) and **A** annual precipitation, **B** annual mean PDSI. Dashed contour represents areas of significance (p<0.05)

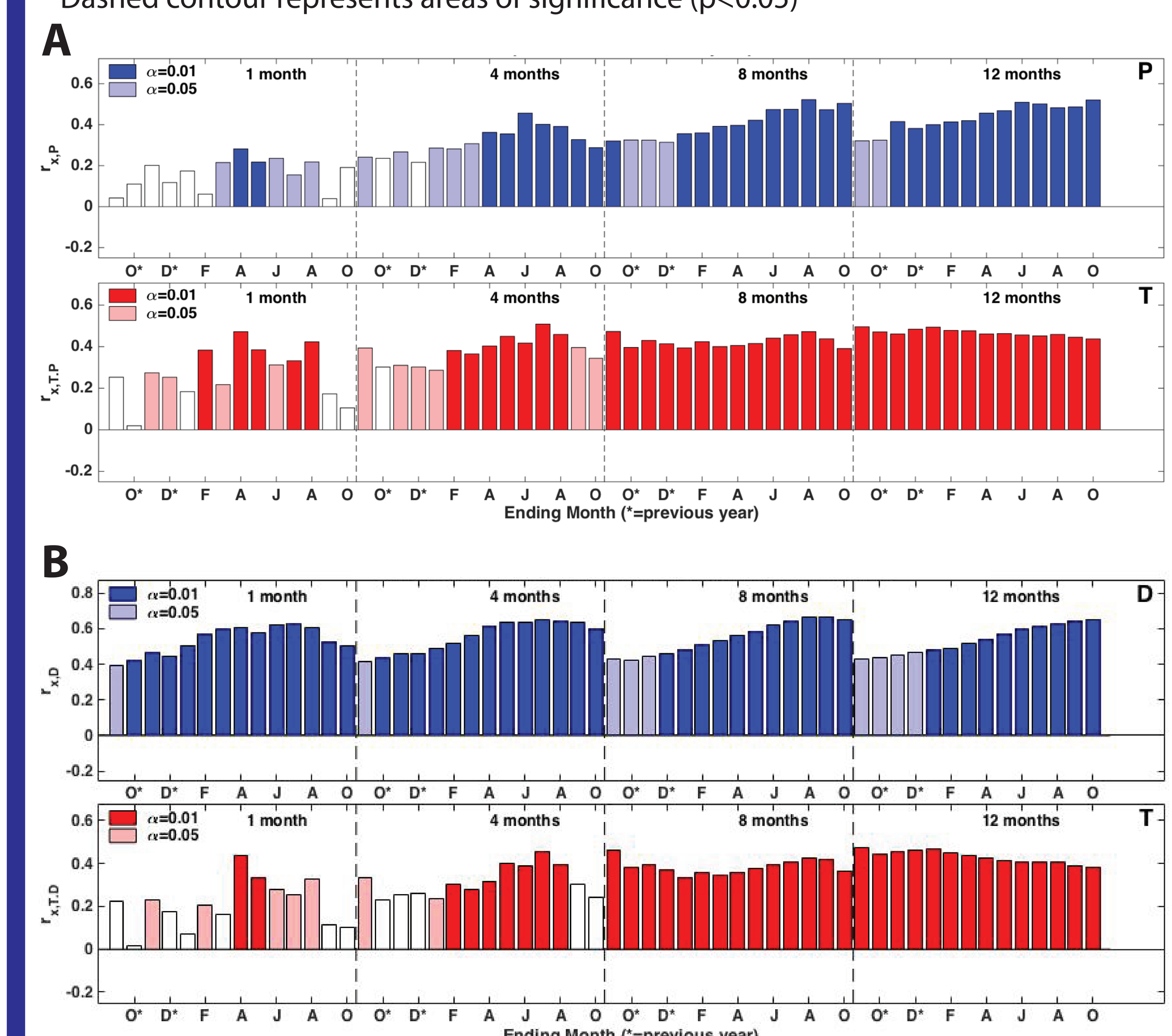

Figure 5. Monthly correlations and partial correlations of Coastal AWC chronologies from 1904-2012. **A.** In blue: simple (Pearson) correlation between the chronology and precipitation. In red: partial corralations between the chronologies with temperatures. **B.** In blue: simple correlation between the chronology with PDSI index values. In red: partial correaltions between the chronologies with temperatures.

V. Conclusions and Future Work

* AWC continues to be a reliable temperature proxy

* Coastal AWC strongly correlates to soil moisture and precipitation of the region, possibly due to AWC's sensitivity to saline water introduced from hurricanes and other large coastal storms

* Future work will reconstruct temperatures of the northeastern United States using the inland AWC network and use superposed epoch analysis on coastal AWC to identify the presence of storm events encoded in the chronologies

VI. Acknowledgements

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VII. References

[1] Hopton, M., and N. Pederson (2005) *Ecology, restoration and management* **[2]** Laderman, A.(1989) *Fish and Wildlife Service Biological Report* **[3]** Cook, E.R. (1985) *Dissertation, University of Arizona, Tucson.* **[4]** Melvin, T., and K. Briffa (2008) Dendrochronologia **[5]** Meko, Toucahn, Anchukaitis (2011) *Computers & Geosciences*