Forest Management Adaptation to Climate Change and Extreme Events

Jin Huang\textsuperscript{1, 2} and Bob Abt\textsuperscript{2}

\textbf{Abstract:} The objective of this paper is to examine forest managers’ adaptation to climate change and climate-change-related discrete extreme events (e.g. hurricanes, floods, and wildfires) in the managed forests of the southern U.S. There is an extensive literature focused on agricultural adaptive response to climate change. There is also literature that examines forest ecosystem impacts of climate change and forest manager’s adaptation to risks from wildfires or other discrete events that are correlated with climate change. This paper will provide an integrated analysis of forest management response to a likely known trend in changing climate in addition to a lesser known risk from discrete events. Unlike agriculture with annual time steps, forest management occurs on a temporal scale that implies that decisions today will be influenced by climate change expectations 20 to 40 years in the future. The adaptive actions considered in this paper include choice of species, intermediate treatments (prescribed burning, fertilization), change of rotation age and purchase of forestry insurance. Adaptive actions are examined using two approaches; a Markov Decision Process (MDP) approach and Decision Simulation (DS) approach. In our DS model the probability density function of the timing of discrete events (including harvest) on a forest stand is developed and the benefit function is optimized with respect to the decision variables. The MDP approach models stochastic transition between different stand states. Forest managers’ decisions change the transition probabilities between stand states. Both methods are applied to the pine plantations in the southern eastern U.S. using Forest Inventory and Analysis (FIA) data. Results from the two models are examined and compared. One important contribution of this paper is that it studies human adaptation to both continuous climate change and discrete extreme events.

\textsuperscript{1} Corresponding author and presenter, jhuang@ncsu.edu.
\textsuperscript{2} Department of Forestry and Environmental Resources, College of Natural Resources, North Carolina State University.