Bayesian Networks Scoping the Climate Change Impact on Winter Wheat Freezing Injury Disasters in Hebei Province, China

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Abstract : Many studies report the winter is getting warmer and the minimum air temperature is obviously rising as the important climate warming evidences. The exacerbated air temperature fluctuation tending to bring more severe weather variation is another important consequence of recent climate change which induced more disasters to crop growth in quite a certain regions. Hebei Province is an important winter wheat growing province in North of China that recently endures more winter freezing injury influencing the local winter wheat crop management. A winter wheat freezing injury assessment Bayesian Network framework was established for the objectives of estimating, assessing and predicting winter wheat freezing disasters in Hebei Province. In this framework, the freezing disasters was classified as three severity degrees (SI) among all the three types of freezing, i.e., freezing caused by severe cold in anytime in the winter, long extremely cold duration in the winter and freeze-after-thaw in early season after winter. The factors influencing winter wheat freezing SI include time of freezing occurrence, growth status of seedlings, soil moisture, winter wheat variety, the longitude of target region and, the most variable climate factors. The climate factors included in this framework are daily mean and range of air temperature, extreme minimum temperature and number of days during a severe cold weather process, the number of days with the temperature lower than the critical temperature values, accumulated negative temperature in a potential freezing event. The Bayesian Network model was evaluated using actual weather data and crop records at selected sites in Hebei Province using real data. With the multi-stage influences from the various factors, the forecast and assessment of the event-based target variables, freezing injury occurrence and its damage to winter wheat production, were shown better scoped by Bayesian Network model.