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Estimation of Crop Production Loss due to Ozone over Europe by CMAQ Model

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Ozone is a secondary air pollutant in the atmosphere and long-term exposure of high concentrations causes significant damage to plant and crops. A UNECE (2010) study showed that ozone pollution reduced annual yield by 3 -16 % with an impact of 14-26 billion dollars. The spatial and temporal variations of ozone are significant due to its precursors and meteorological conditions. Air quality modeling is one of the most widely used methods to understand this variability. There are many of the studies focused on quantifying the impact of ozone pollution on crops by using regional or global models with coarse spatial resolution. The aim of this study is to determine crop production loss (CPL) and economic damage (ED) with high spatial resolution modeling framework (30 km x 30 km) for wheat production over Europe. For this purpose, we designed WRF/CMAQ modeling system to assess the risk of O_3 in the growing season (May - July) of 2009 using three different ozone exposure indices: W126, which is cumulative exposure index over a period of months; AOT40, which is accumulated dose of ozone over a threshold of 40 ppb and M7, which is the average of ozone over a period of months. This is the first time where high-resolution WRF/CMAQ modeling system is applied to estimate the crop production loss and economic damages due to high level of ozone across Europe. Simulated and observed ozone concentrations' mean normalized bias was found lower ($\sim$ 0.01) in the study. Our preliminary findings showed that the highest total estimated CPL was calculated with M7 method and lowest total CPL was estimated with W126 approach. The highest fractional loss was estimated for Italy, Croatia and Bosnia with W126 and AOT40. France, Germany and Russia are the following countries. The regional analysis showed that Central Europe and Eastern Europe have the highest CPL and ED. Findings of the analyses will be discussed in details.

Keywords: WRF/CMAQ, Crop Production Loss, Ozone Exposure Indices, Europe