Abstract

Tropospheric ozone is a criteria air pollutant that affects plant growth, acts as a green house gas and is toxic to humans. The harmful effects start manifesting strongly at levels greater than 30-40 ppbv. In this study we examine a high quality two year in-situ dataset of ozone at a suburban site called Mohali in the N.W. Indo-Gangetic Plain between 2011-2013. Ozone was measured using UV absorption photometry at a time resolution of 1 measurement every minute with an accuracy better than 3%, and overall uncertainty less than 6%. Quality assurance of the large dataset was accomplished by regular calibrations using a NIST traceable ozone primary standard generator and frequent zero drift tests. In order to calculate the crop yield losses, exposure metrices such as AOT40, M7, M12 and W126, of ozone, were calculated and inter-compared for the crop growing seasons of Kharif (January-March) and Rabi (July-August). The relative yield (RY) for wheat, rice, maize and cotton were calculated using ozone dose-exposure functions for these crops. The relative yield loss (RYL), crop production loss (CPL) and economic cost loss (ECL) were calculated for these crops for two financial years (2011-2012, 2012-2013) using the relative yield. The range of the total relative yield losses for the crops were as follows: wheat: 0.11-0.26 RYL; rice: 0.08-0.10 RYL; maize: 0.01-0.02 RYL; cotton : 0.03-0.10 RYL. The range of the total economic cost losses for the crops were as follows: wheat: 860.07-2355.78 Million US dollars (MUSD); rice: 355.17-424.36 MUSD; maize: 0.41-2.01 MUSD; cotton : 113.45-328.43 MUSD, respectively. The range of the total economic cost loss amounts to 1326-3110 MUSD (∼ 0.5-1.1% of the All India GDP, 2009) for all four crops in Punjab and Haryana. Mitigation of high surface ozone which would require relatively little investment in comparison to economic losses incurred presently, would therefore yield massive benefits to both the national crop yield and the economy.