The development of modelling methods to assess the combined threat of ozone and climate extremes on ecosystems

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Extreme climate and ground level ozone air pollution stress are likely to co-occur and affect ecosystems. This is due to elevated ozone episodes being more frequent under hot, dry sunny conditions as well as in rural agricultural regions (downwind of source ozone precursor pollutant emissions). Most pollution risk assessment studies have used methods that relate damage to ambient ozone concentrations rather than stomatal ozone flux, now widely accepted as the most suitable predictor of damage. Even where stomatal ozone flux is used, studies rely on whole season accumulations from which to determine yield losses even though ozone will be compromising photosynthetic capacity over shorter time-periods (hours to days) as well as over whole growing seasons. Advances in climate modelling provide opportunities to use a combination of finer spatially and temporally resolved meteorological data (for both current and future projected climates) in conjunction with a new photosynthetic based ozone deposition and stomatal flux model (DO_3SE) to produce novel methods to assess the effects of interactions between nitrogen availability (soil fertility), heat, drought and ozone on photosynthesis, crop growth and yield. These efforts will focus on regions in Asia, where high O_3 concentrations and climate extremes are already threatening crop productivity in a food insecure region. These new risk assessment methods will be able to inform policy through evaluating a number of emission storylines to identify those most likely to mitigate the effects of both ozone pollution and climate change. The work will also develop new ozone damage crop modelling methods that can be easily incorporated into existing photosynthesis-based crop modelling methods for application among the wider crop modelling community.