

The Potential Impact of Surface Ozone on **Crops due to Climate Change in Taiwan**

International Degree Program in Climate Change and Sustainable Development

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This study aims to study the regional impacts of surface ozone on Taiwan's cash crops and its future projection. To estimate the potential risk of ozone exposure under climate change, we simulated the spatial-temporal distribution of ozone around Taiwan.

To estimate the potential risk to crops, the simulated ozone fields are converted to the concentration-based index called AOT40 and the metrics of stomatal uptake by the accumulated phytotoxic ozone dose (POD). These indices are further overlaid with land-use information to quantify changes in crop yield between current and future conditions. The average estimated POD (AOT40) relative yield loss of wheat, potato, tomato was 18.2% (8.64%), 5.3% (1.05%) and 26.4% (6.15%), respectively.

RESULT

MOTIVATION

How climate change would influence O_3 and its vegetation impacts over Taiwan?

- Regional air quality model (WRF and CAMQ) are used to simulate O₃ concentration under pseudo global warming scenarios in Taiwan.
- Adopting AOT40 and POD for setting critical levels to quantify the O_3 impact.
- Analyze regional O_3 distribution and potential risk.

METHODOLOGY

Pseudo Global Warming O₃?

 $PGW_{forcing} = ERA5 + \Delta_{CMIP5}$

(2°c global warming)

MONTHLY MEAN O₃ DIFF (PGW-CTRL)





AOT40 RELATIVE YIELD (%)





AOT40 is defined as the sum of hourly O_3 over the threshold of 40 ppb.

THE LINEAR RELATIONSHIPS (AOT40 and POD)



SIMULATED REGIONAL O₃



POD (phytotoxic ozone dose) estimates the stomatal uptake O_3

The mean yield loss in AOT40 accounted for 5.26% of the RY in current climate run. Both metrics showed comparable spatial and temporal patterns, where significant RY reduction occurred in western, especially the inland plain areas in spring and fall. The PGW scenario suggests a significant increase in ozone by 4 ppb and decrease in crop yields by 2 to 10% over the western plain areas, while the eastern regions remain relatively unchanged.