Megacity Aerosol Pollution & Crop Yield

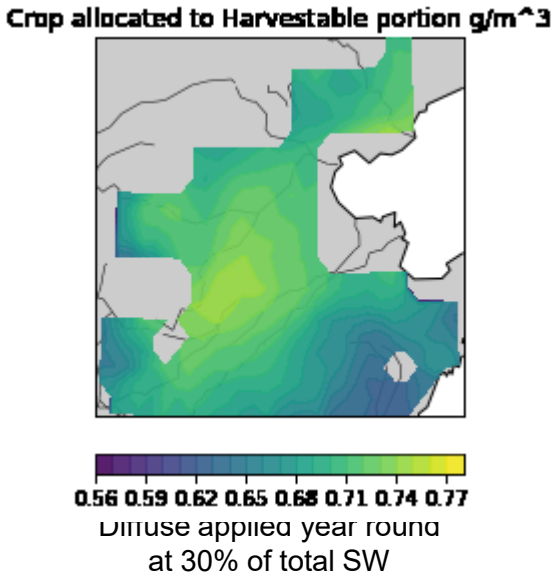
Diffused Light Fertilisation Effect

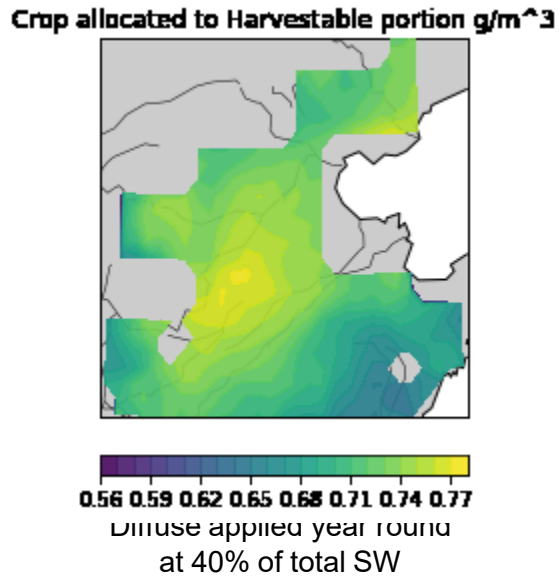
- Deposition of PM as dust affects photosynthesis rates:
  - Reduces light interception
  - Reduces stomatal conduction
  - Increases leaf temperature

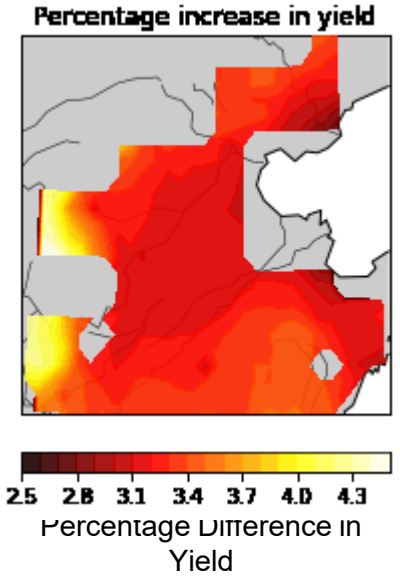
- Diffuse light fertilisation effect increases the proportion of light intercepted by lower leaves and reduces sunspot incidence

Effects of Diffuse Light

- North China Plains region at 0.25° resolution
- Increasing the percentage of diffuse light whilst keeping total SW constant increases crop yield
- When diffuse light for the year is set to a constant of 40% of total SW, this increases yield by 3-4% over a fixed diffuse fraction of 30%

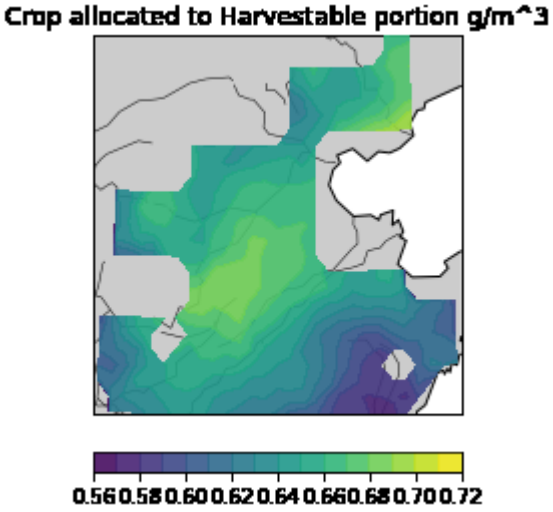




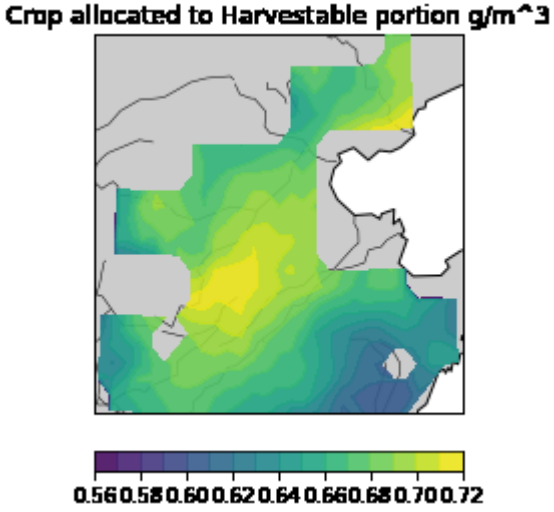


My Work

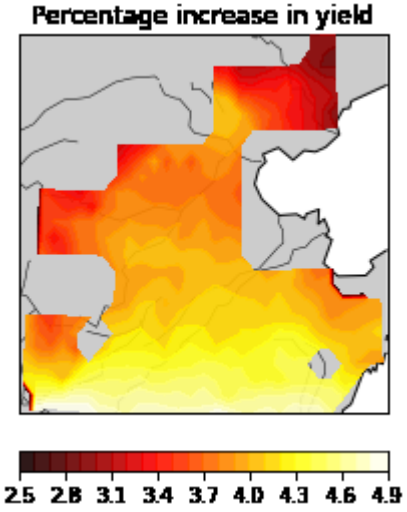
- Assessing impacts of timing and intensity of diffuse light on crop yields in the NCP using met data from 2014-2017
- When applied for one hour a day for the year, we found that diffuse light has greatest impact on the crop grown when applied between 12-1 throughout whole year
- These times align with the smallest zenithal angles during the runs



Diffuse applied between 7am and 8am year round



Diffuse applied between 12pm and 1pm year round

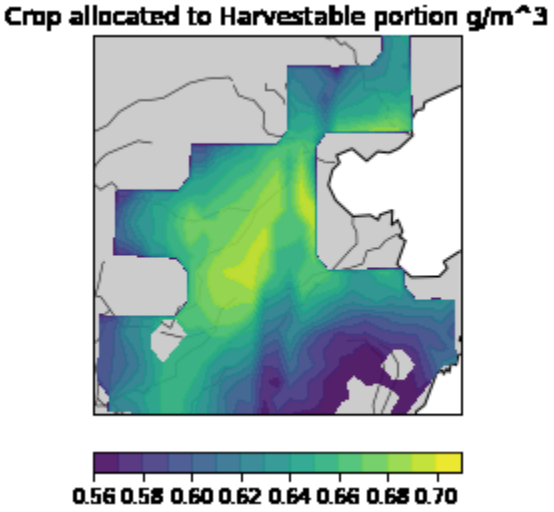


Percentage Difference in Yield

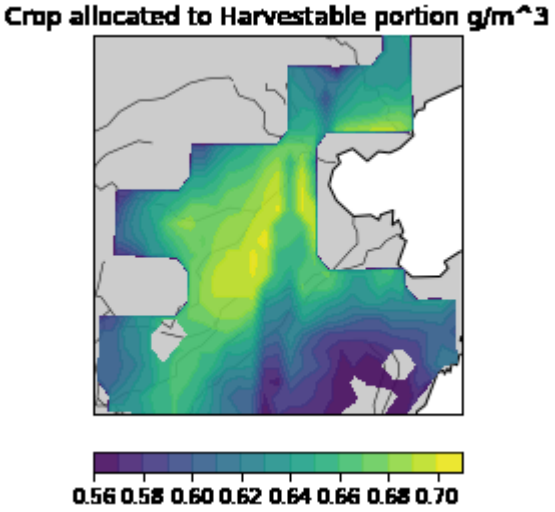
DVI Trigger for Diffuse Light Application

- Greatest impacts on final yield from diffuse light application appear when applied between DVI of 1.0 and 1.5

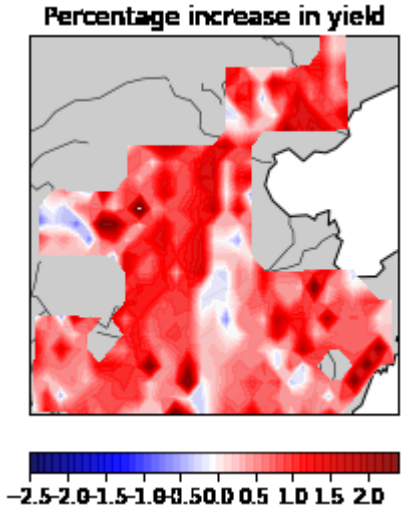
- For example, in 2015, differences of -0.5 - 2.5% in maximum carbon allocation to harvested parts of crop between yields when diffuse is applied from 1.0-1.5 DVI and when diffuse is applied between 0.5 and 1.0 DVI



Diffuse applied between 0.5 and 1.0 DVI



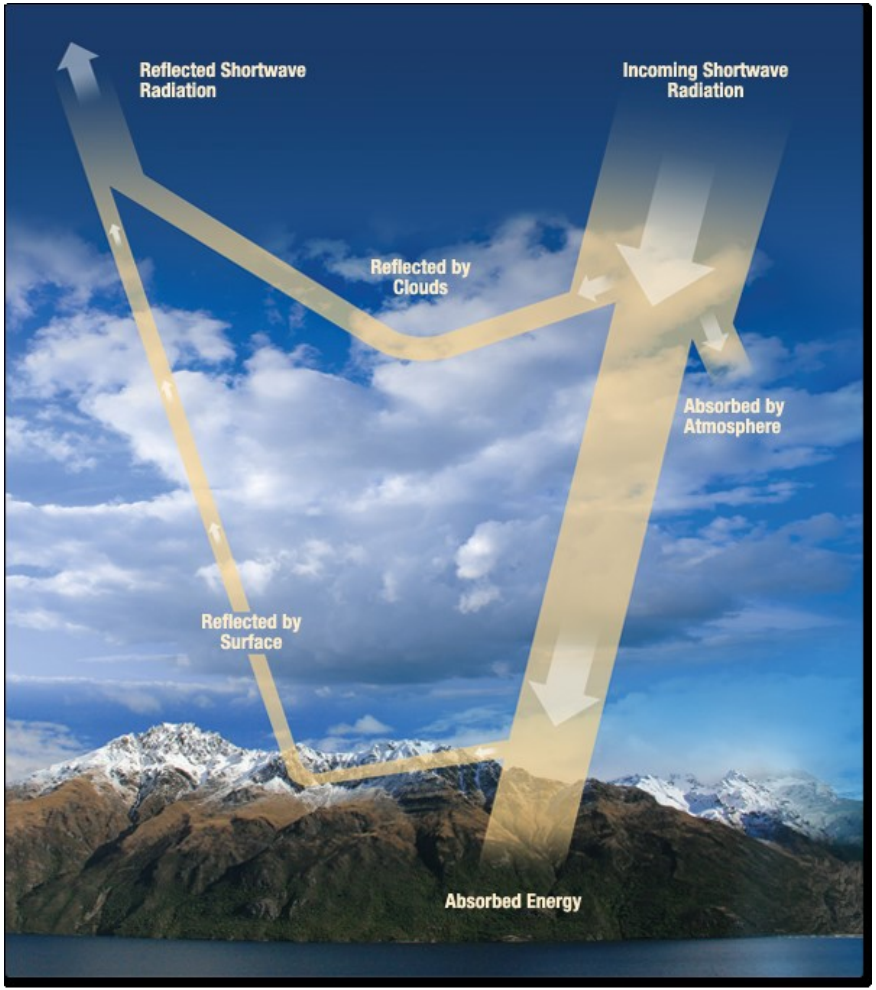
Diffuse applied between 1.0 and 1.5 DVI



Percentage Difference in Yield

Next Steps

- Using a radiative forcing model to account for impacts from reductions to total light by PM
- Generate a response field for crop yield in the region to PM concentration and composition

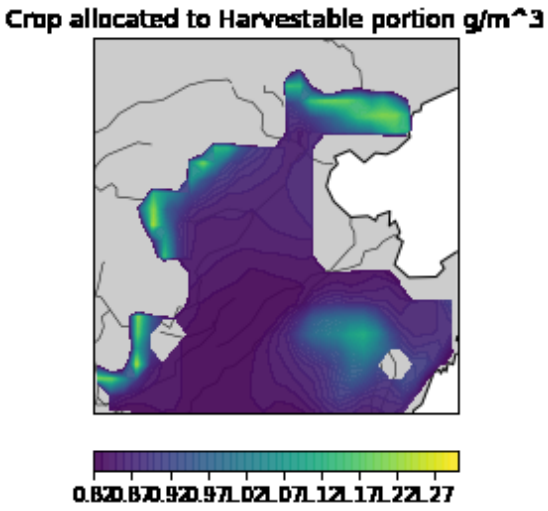


Future Work

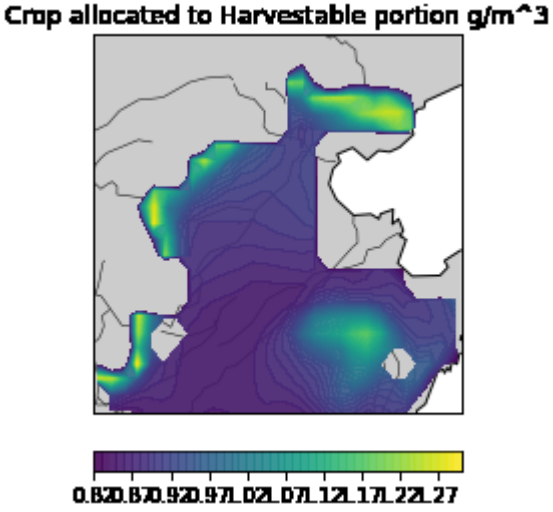
- Policy Implications of effects of PM on crop yields

- Combinatorial effects of PM and Ozone

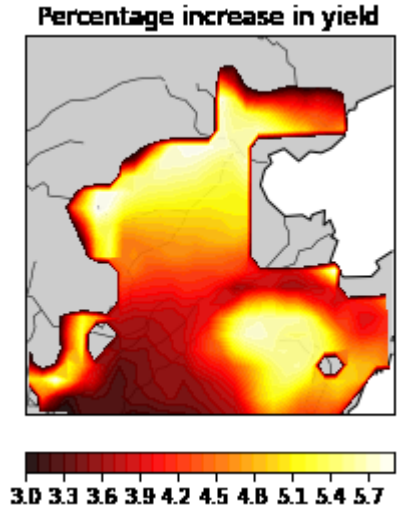
Fixed Temperature



Diffuse applied between
7am and 8am year round

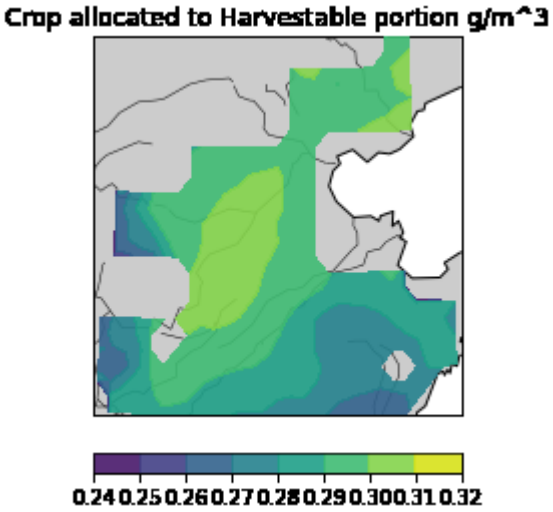


Diffuse applied between
12pm and 1pm year round

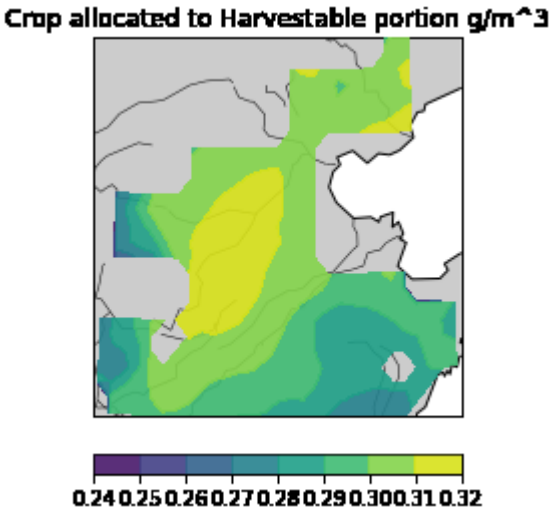


Percentage Difference in
Yield

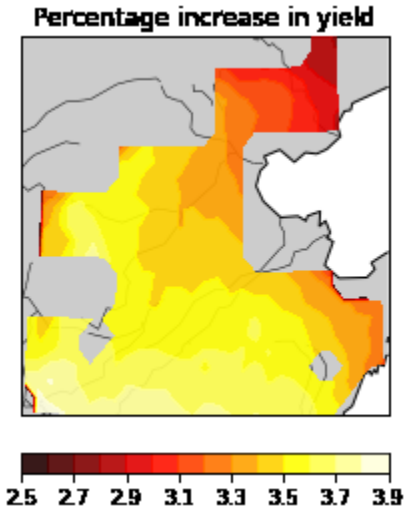
Fixed SW



Diffuse applied between
8am and 9am year round



Diffuse applied between
12pm and 1pm year round



Percentage Difference in
Yield