Crop Impacts from Stratospheric Aerosol Climate Intervention: A Multi-Scenario Overview

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Outline

- Introduce model
- Scenarios overview
- Global crop impacts
- Regional impacts
- Individual climate variable impacts
- Future directions

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Model

- Results here are from fully coupled CESM2-CLM5crop simulations
- 0.95° × 1.25° latitude-longitude resolution
- CLM5crop simulates diffuse radiation fertilization and includes a surface ozone parameterization that is the same for all crops
- Yield and production are calculated using year 2000 constant cropping area

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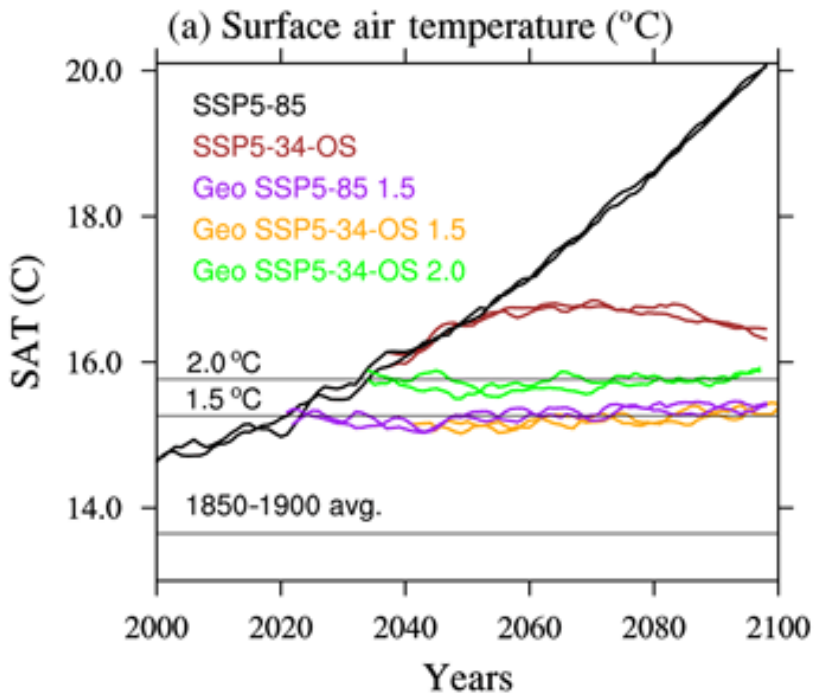
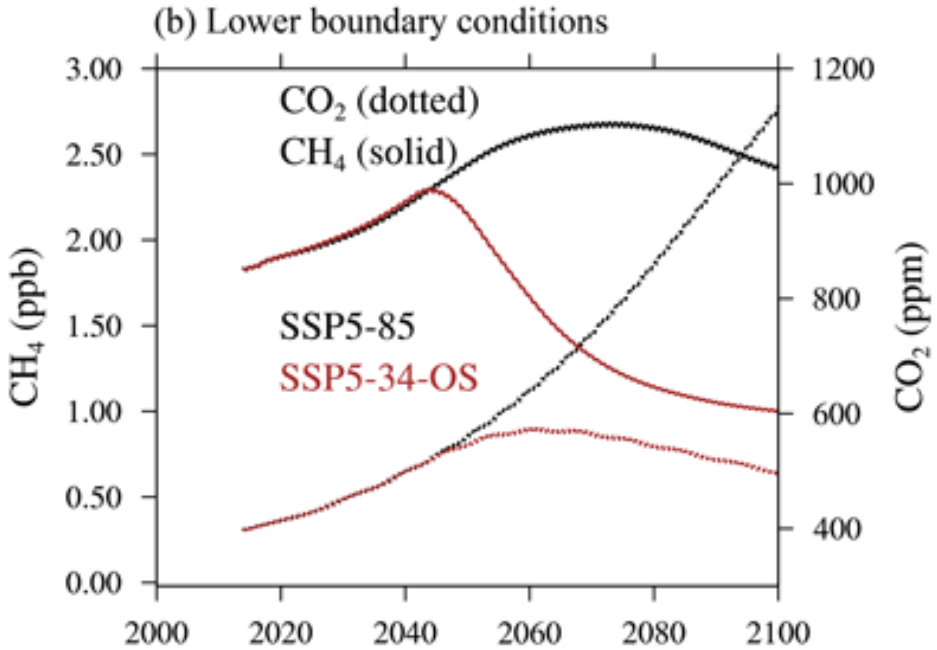
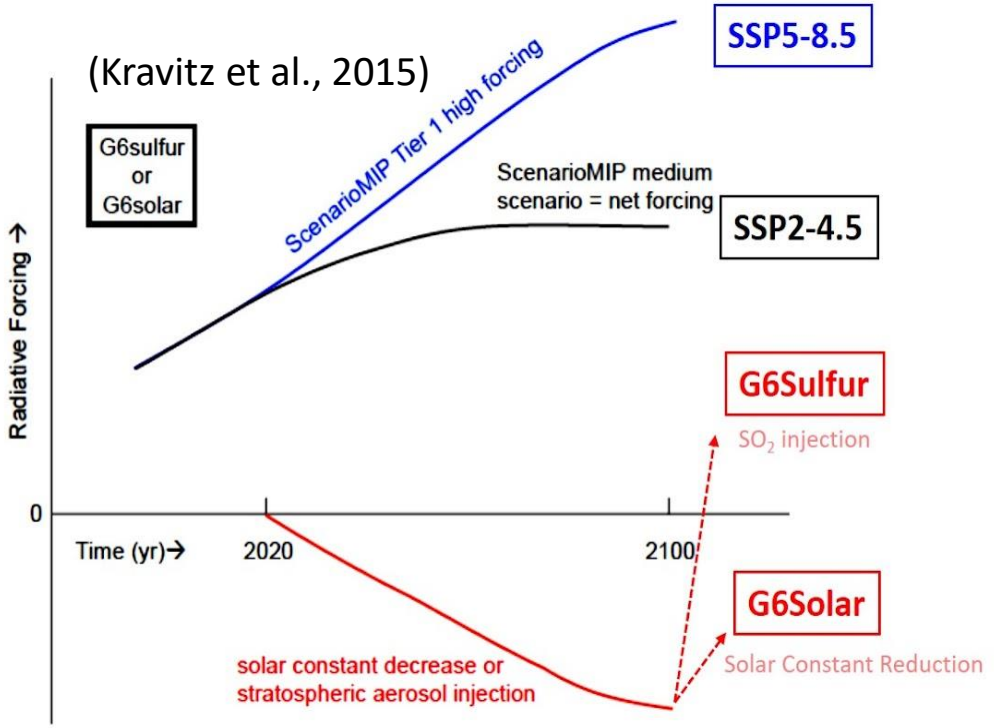
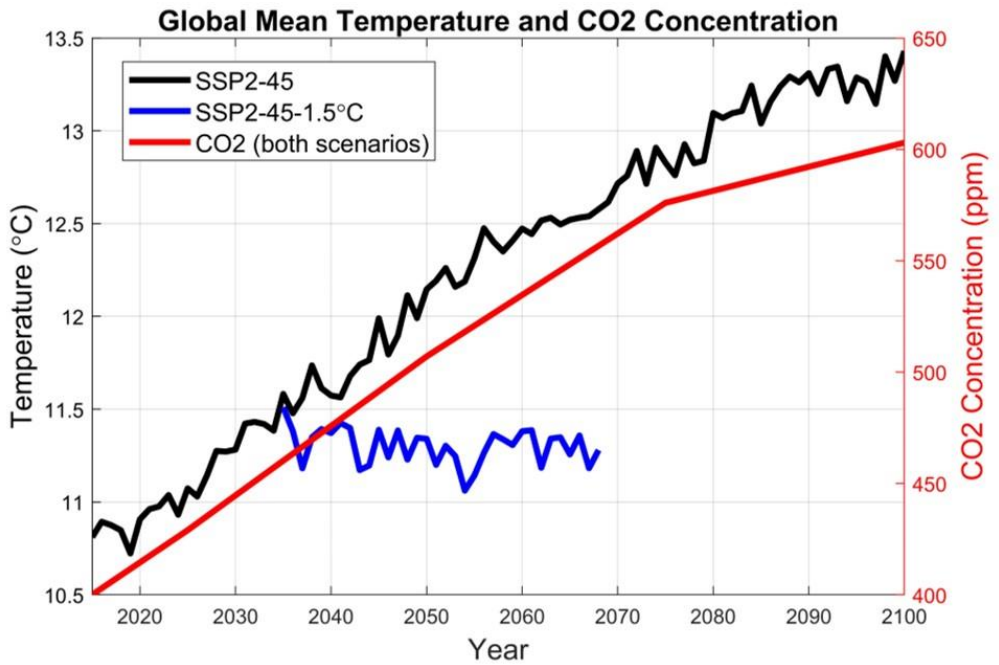


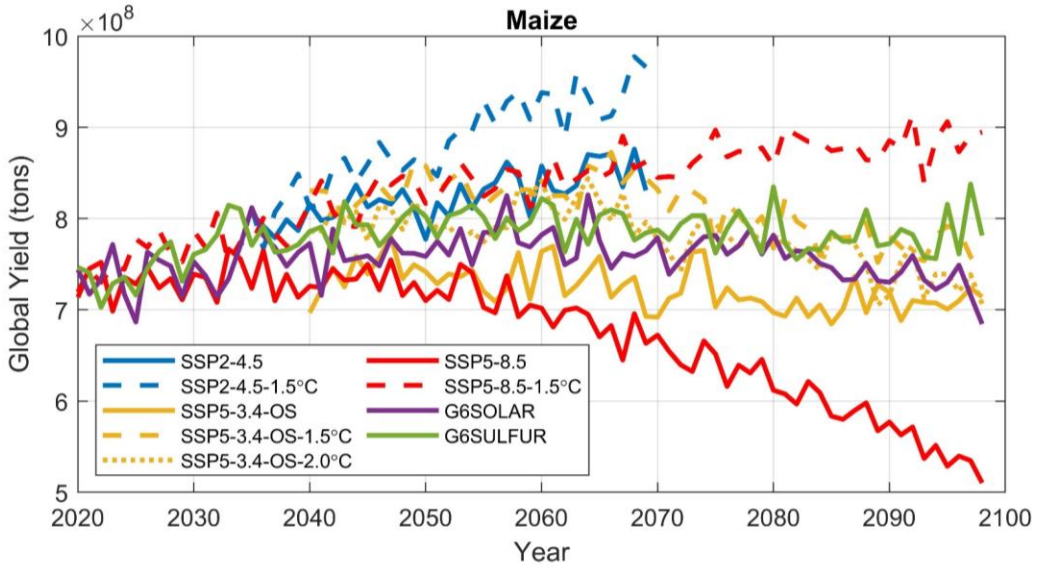


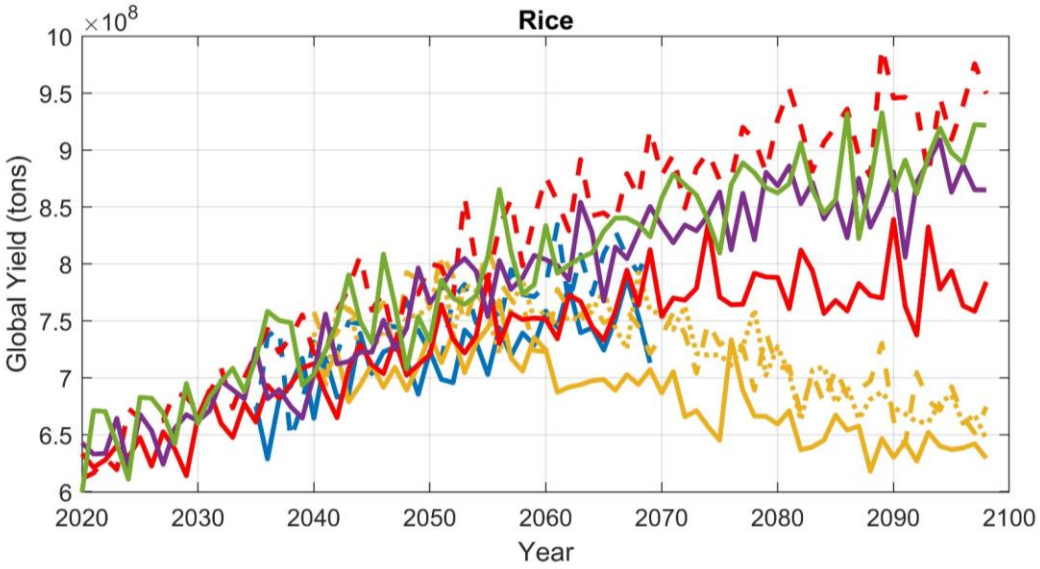
(Tilmes et al., 2020)

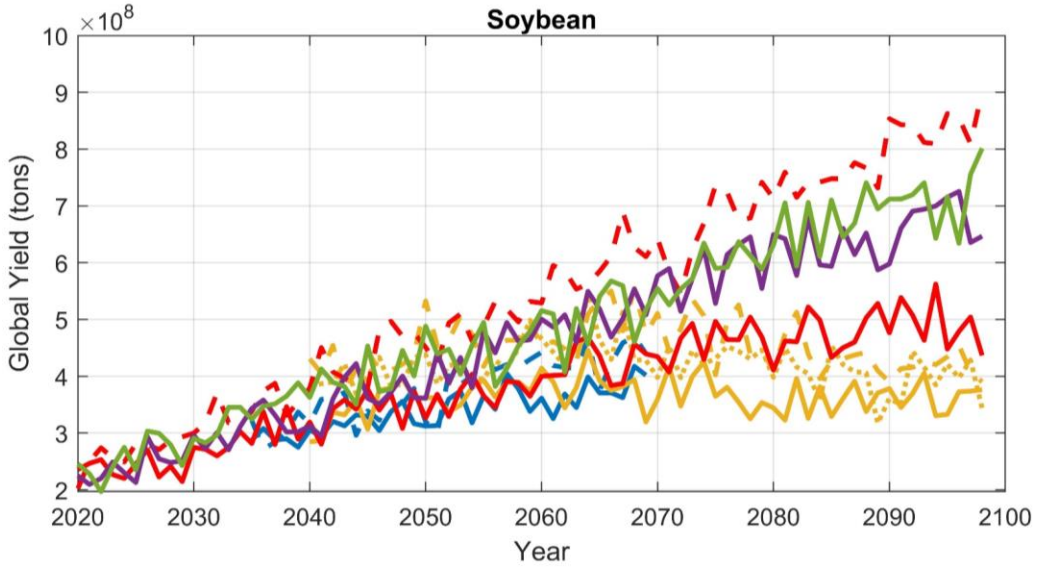
(Kravitz et al., 2015)

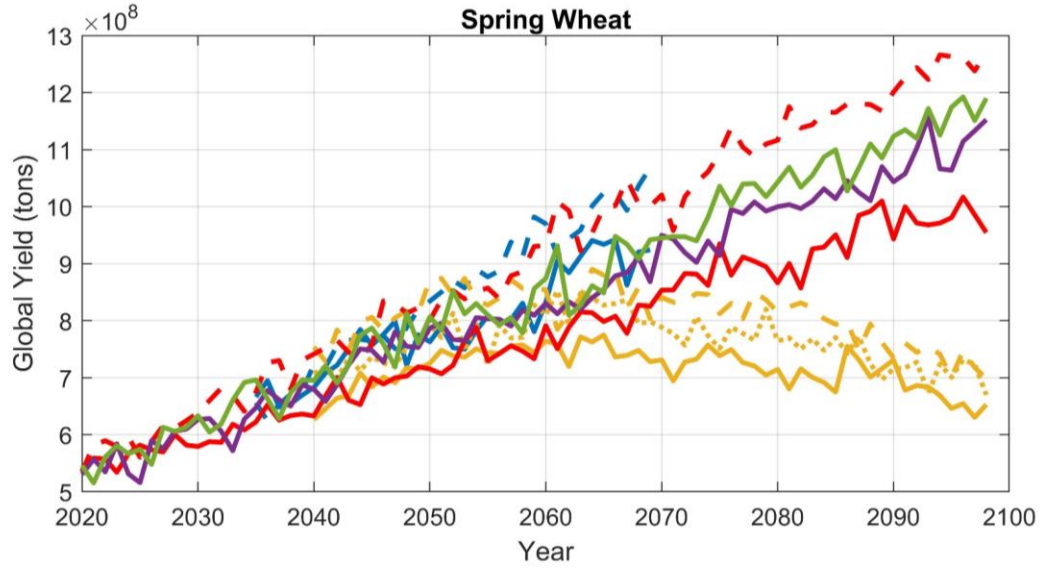












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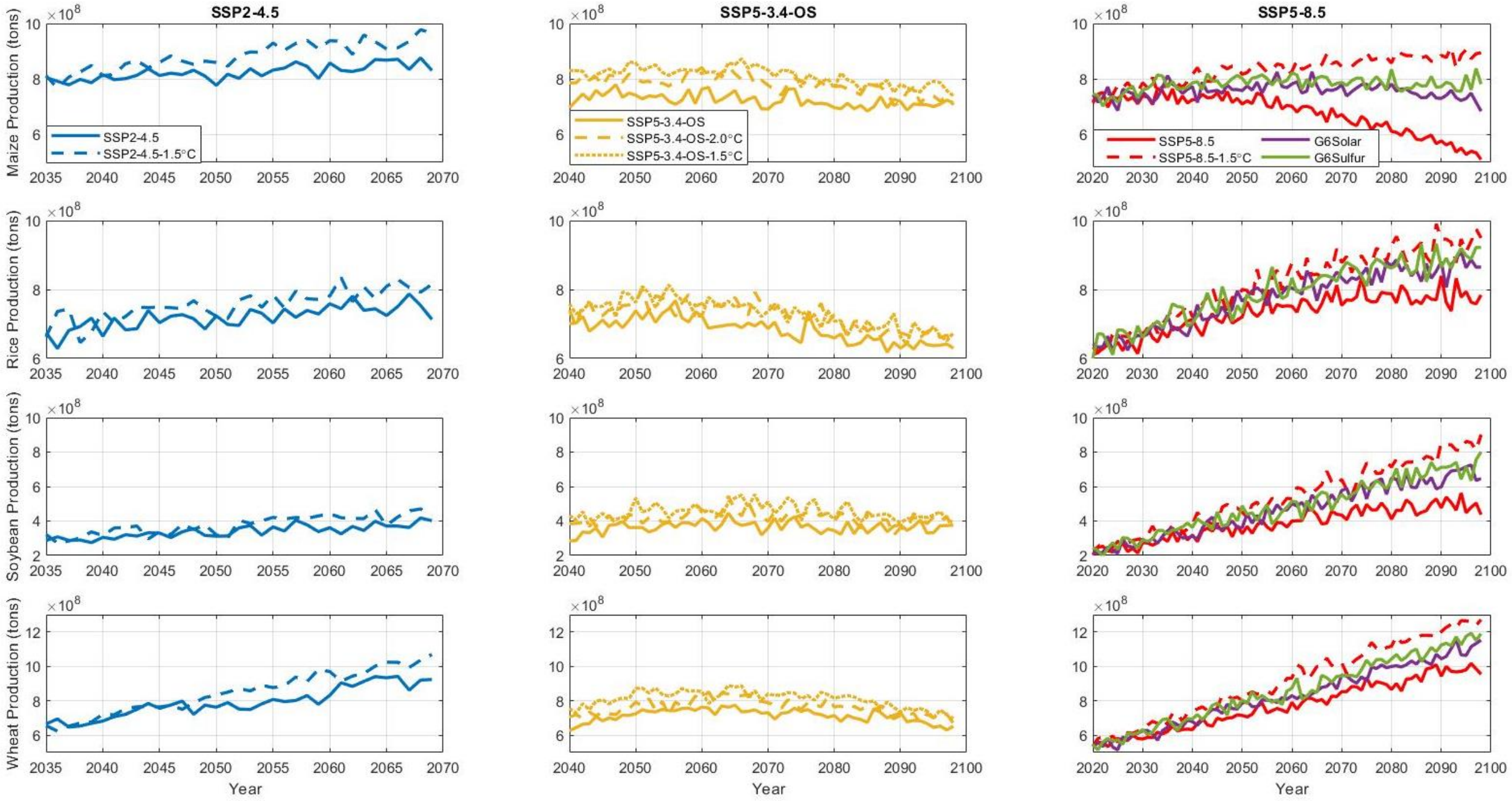

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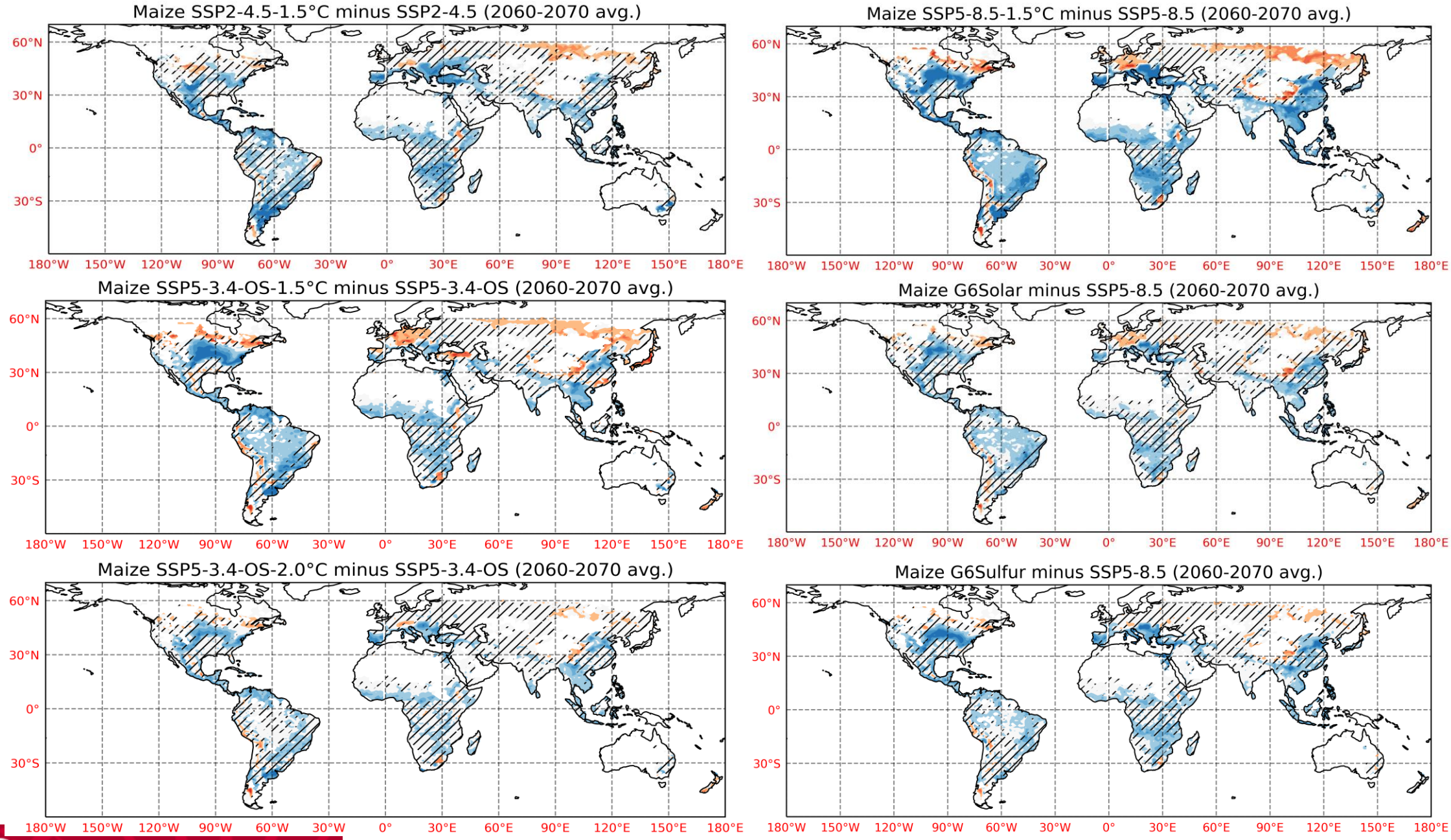

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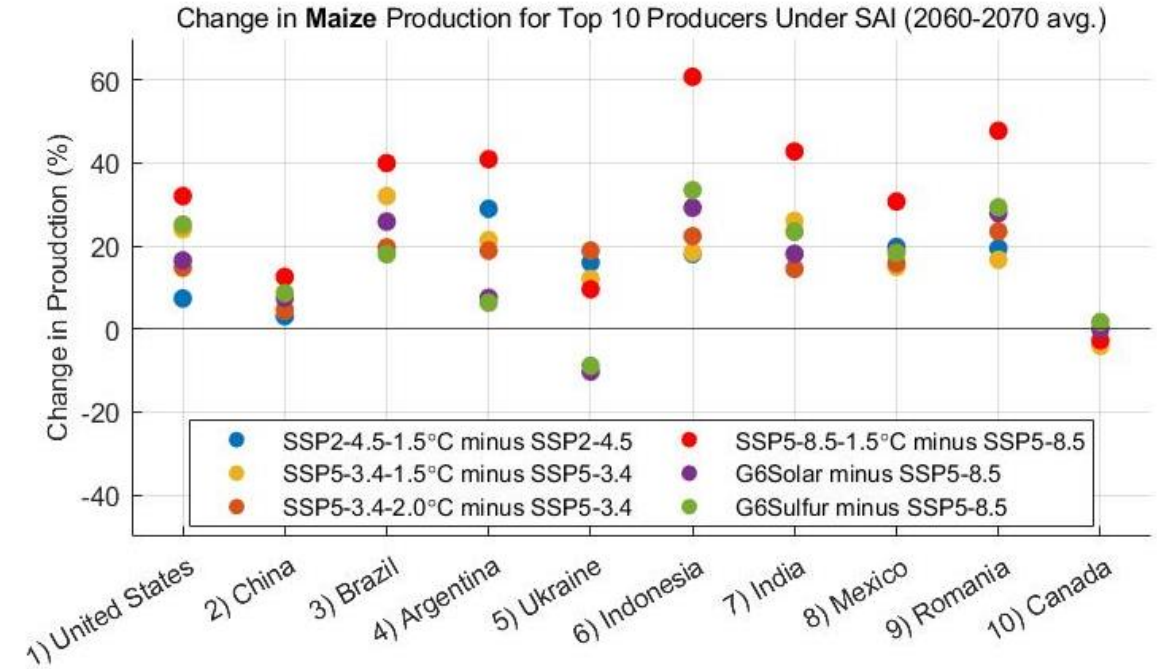
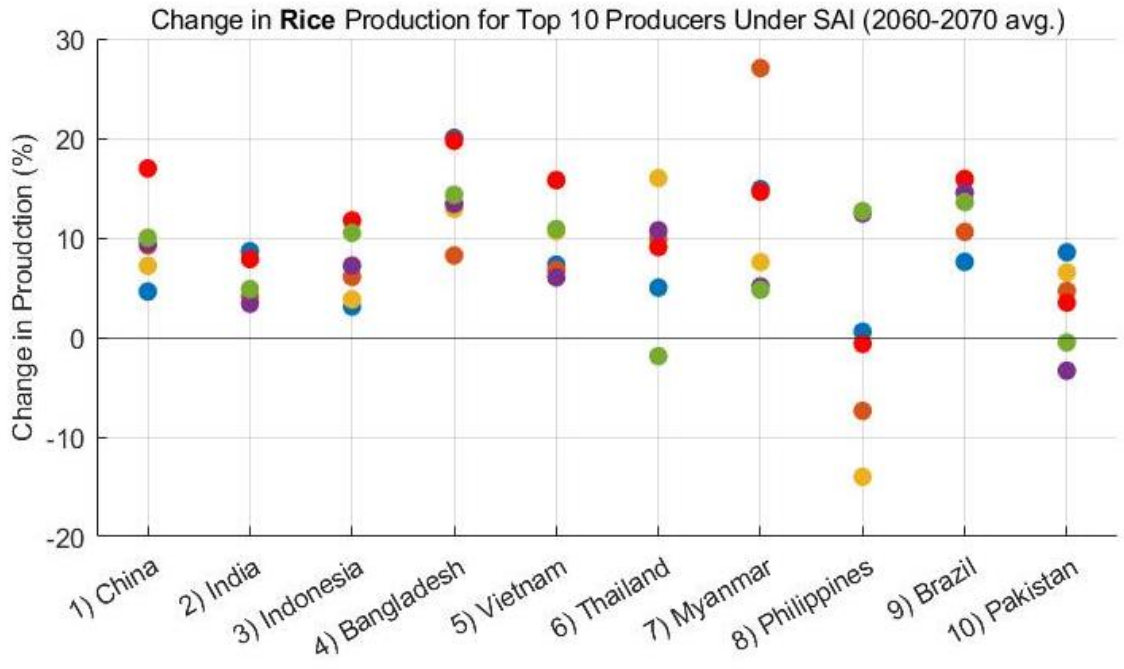
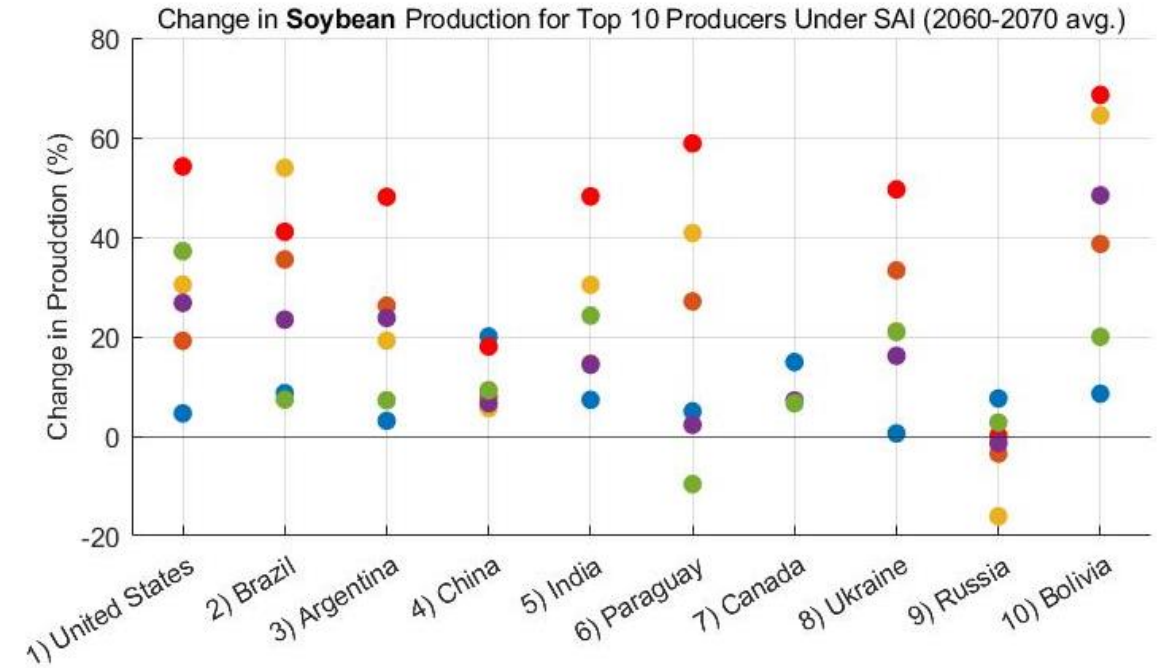
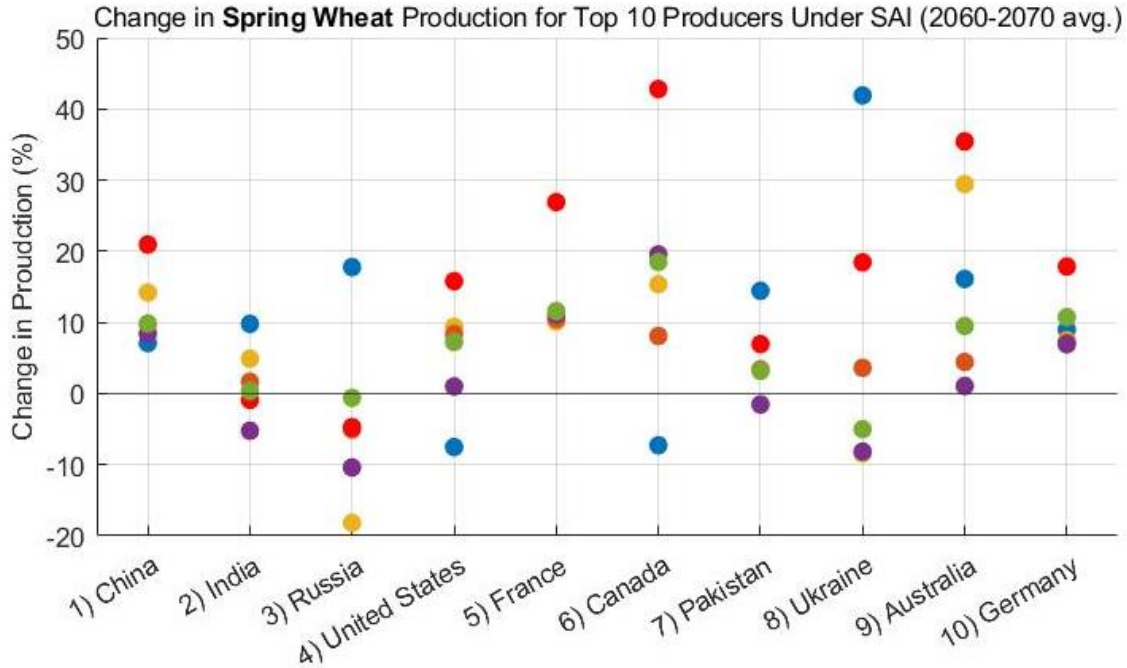
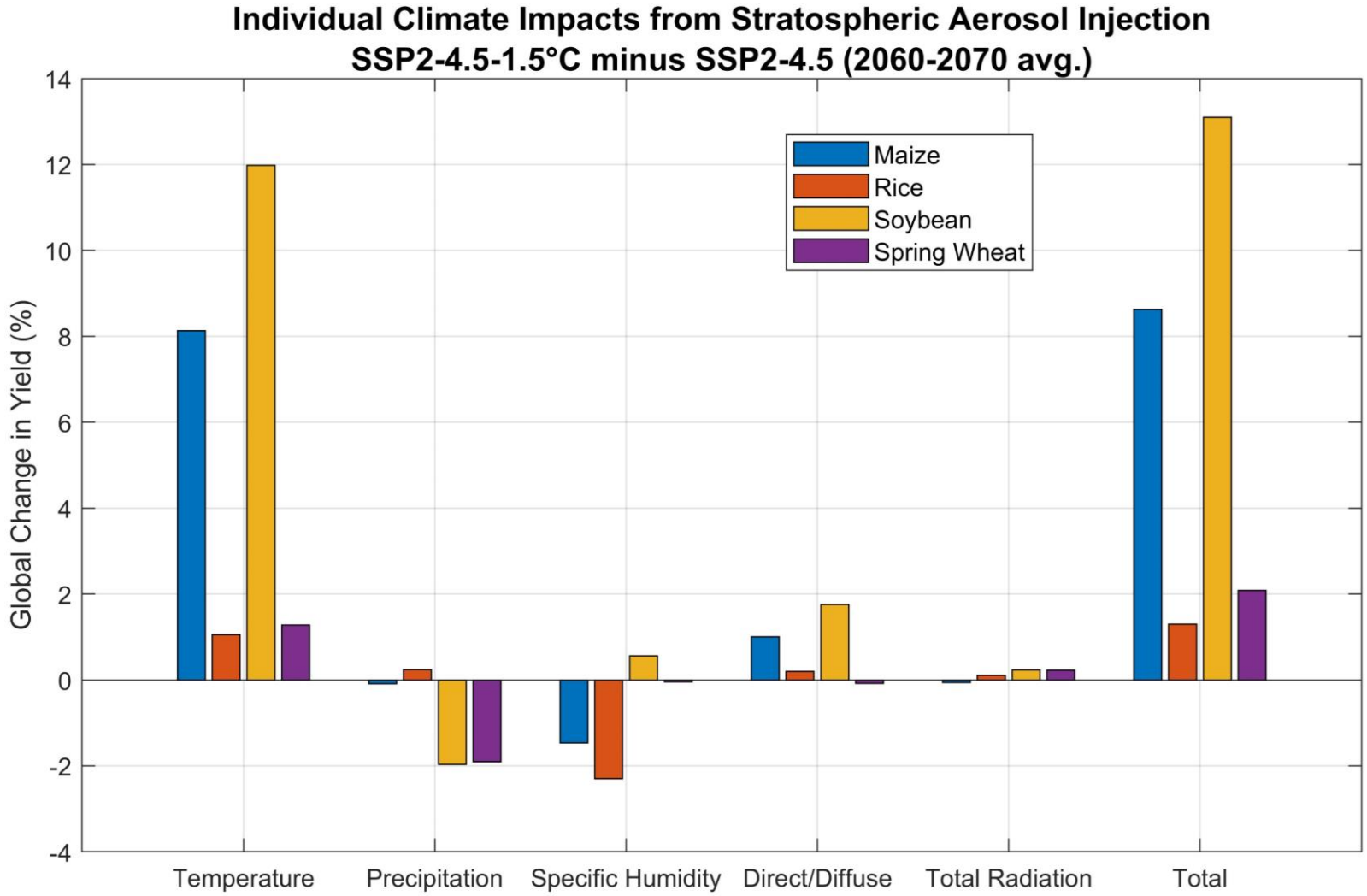

Change in **Maize** Production for Top 10 Producers Under SAI (2060-2070 avg.)
Change in Proudction (%)
60
40
20
0
-20
-40
SSP2-4.5-1.5°C minus SSP2-4.5
SSP5-3.4-1.5°C minus SSP5-3.4
SSP5-3.4-2.0°C minus SSP5-3.4
SSP5-8.5-1.5°C minus SSP5-8.5
G6Solar minus SSP5-8.5
G6Sulfur minus SSP5-8.5
1) United States
2) China
3) Brazil
4) Argentina
5) Ukraine
6) Indonesia
7) India
8) Mexico
9) Romania
10) Canada


Change in **Rice** Production for Top 10 Producers Under SAI (2060-2070 avg.)
Change in Proudction (%)
30
20
10
0
-10
-20
1) China
2) India
3) Indonesia
4) Bangladesh
5) Vietnam
6) Thailand
7) Myanmar
8) Philippines
9) Brazil
10) Pakistan


Change in **Soybean** Production for Top 10 Producers Under SAI (2060-2070 avg.)
Change in Proudction (%)
80
60
40
20
0
-20
1) United States
2) Brazil
3) Argentina
4) China
5) India
6) Paraguay
7) Canada
8) Ukraine
9) Russia
10) Bolivia


Change in **Spring Wheat** Production for Top 10 Producers Under SAI (2060-2070 avg.)
Change in Proudction (%)
50
40
30
20
10
0
-10
-20
1) China
2) India
3) Russia
4) United States
5) France
6) Canada
7) Pakistan
8) Ukraine
9) Australia
10) Germany

- Offline (land only) CLM5crop simulations forced with atmospheric coupler data from SSP2-4.5-1.5°C and SSP2-4.5 fully coupled CESM2 simulations
- More simulations currently being run with UKESM1
- Hope to extend simulations to the end of the century for a larger signal
- Can use atmospheric coupler data to force other crop models



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Conclusion

- Lowering temperature while maintaining elevated CO_2 benefits maize, rice, soybean, and spring wheat on a global average under all stratospheric aerosol injection scenarios
- All scenarios show a yield reduction for multiple top producing countries under stratospheric aerosol injection
  - Who gets to decide to increase production in some countries while decreasing production in others?
- Need to incorporate UV radiation impacts and surface ozone impacts for each crop
- Atmospheric coupler data output from SSP2-4.5-1.5°C and SSP2-4.5 simulations (CESM2 and UKESM1) can be used to force a multi-model assessment of crop impacts from stratospheric aerosol injection
- Currently planning to use CLM5crop, pDSSAT, and LPJmL, but other models are encouraged to participate

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