Effects of Climate Change on Trans-Pacific Ozone Using IGSM-CAM/GEOS-Chem Framework

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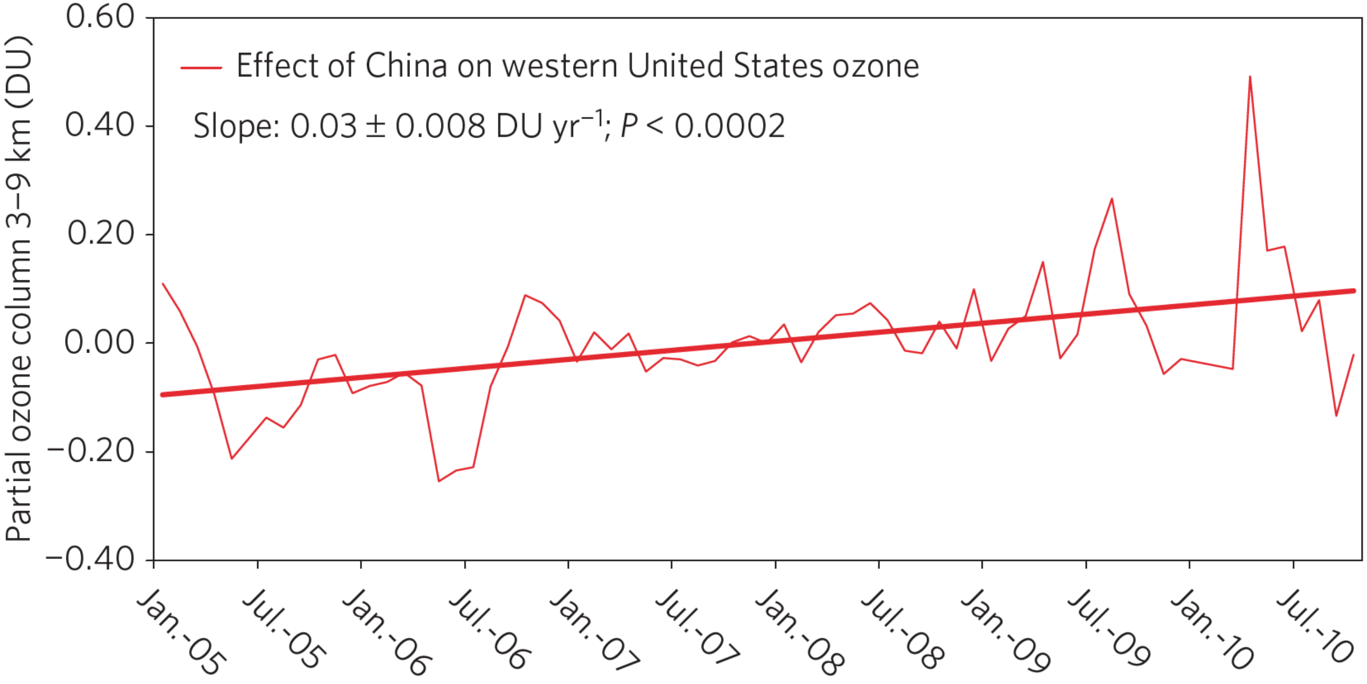
Transport of ozone and its precursors from China in tropospheric ozone over western U.S. has been increasing in 2005-2010

Deseasonalized tropospheric O_3 in the western US from China



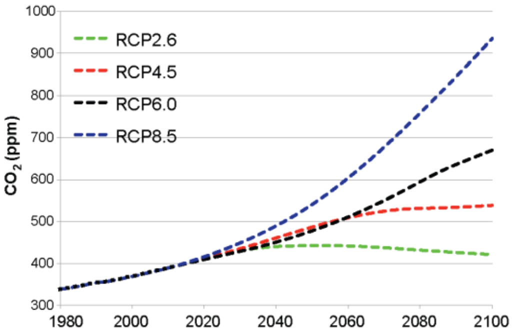
Verstraeten et al. (2015)

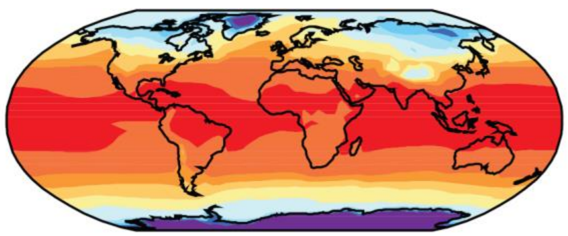
How would trans-Pacific ozone be influenced by climate change?

IGSM-CAM/GEOS-Chem modeling framework

Global System Model: MIT IGSM

General Circulation Model: CAM



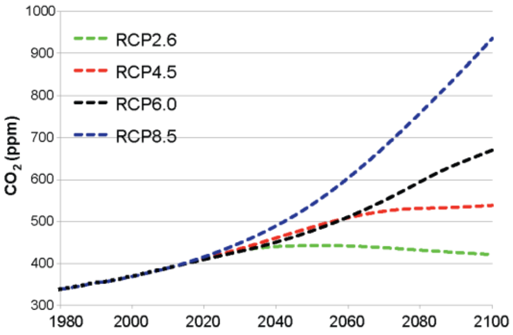


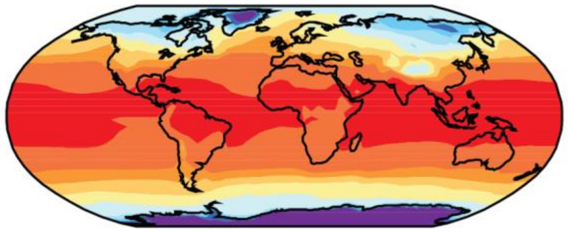
- 3 emission scenarios
  - No climate policy: 2100 radiative forcing = 9.7 W/m^2
  - Policy 4.5: 2100 radiative forcing = 4.5 W/m^2
  - Policy 3.7: 2100 radiative forcing = 3.7 W/m^2
- 4 climate sensitivities: 2.0°C, 3.0°C, 4.5°C or 6.0°C
- 5 different initial conditions

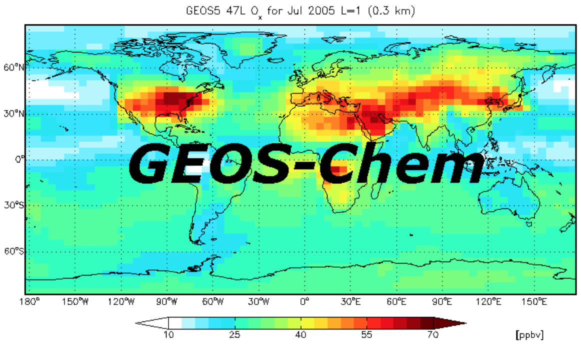
* IGSM-CAM was developed by Monier et al. (2013), and this climate ensemble has been linked with CAM-Chem model (Garcia-Menendez et al., 2015).

IGSM-CAM/GEOS-Chem modeling framework

Global System Model: MIT IGSM → **General Circulation Model: CAM** → **Atmospheric chemistry-transport model: GEOS-Chem**







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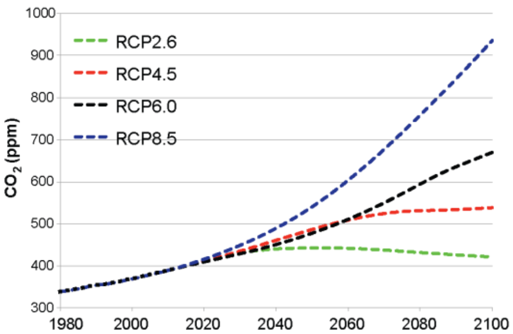
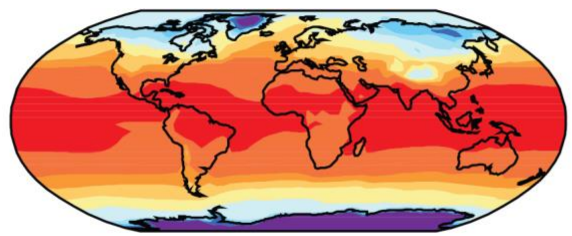
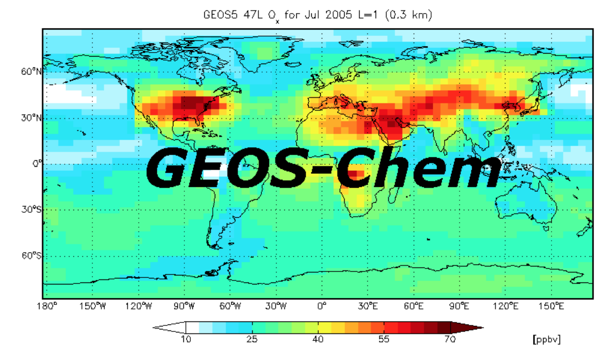
- 5 different initial conditions one initial condition

IGSM-CAM/GEOS-Chem modeling framework

Global System Model: MIT IGSM → **General Circulation Model: CAM** → **Atmospheric chemistry-transport model: GEOS-Chem v9-02**



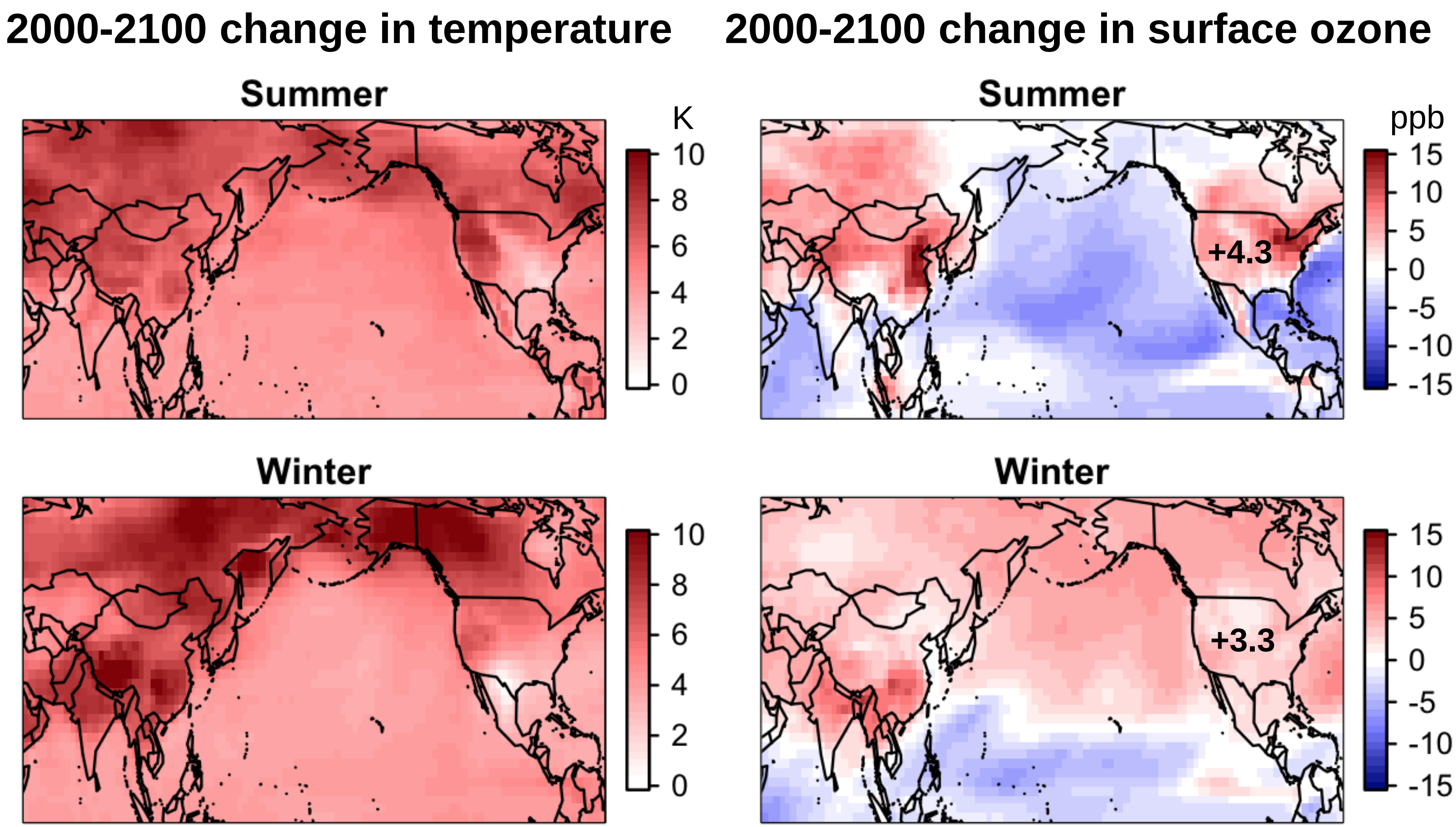




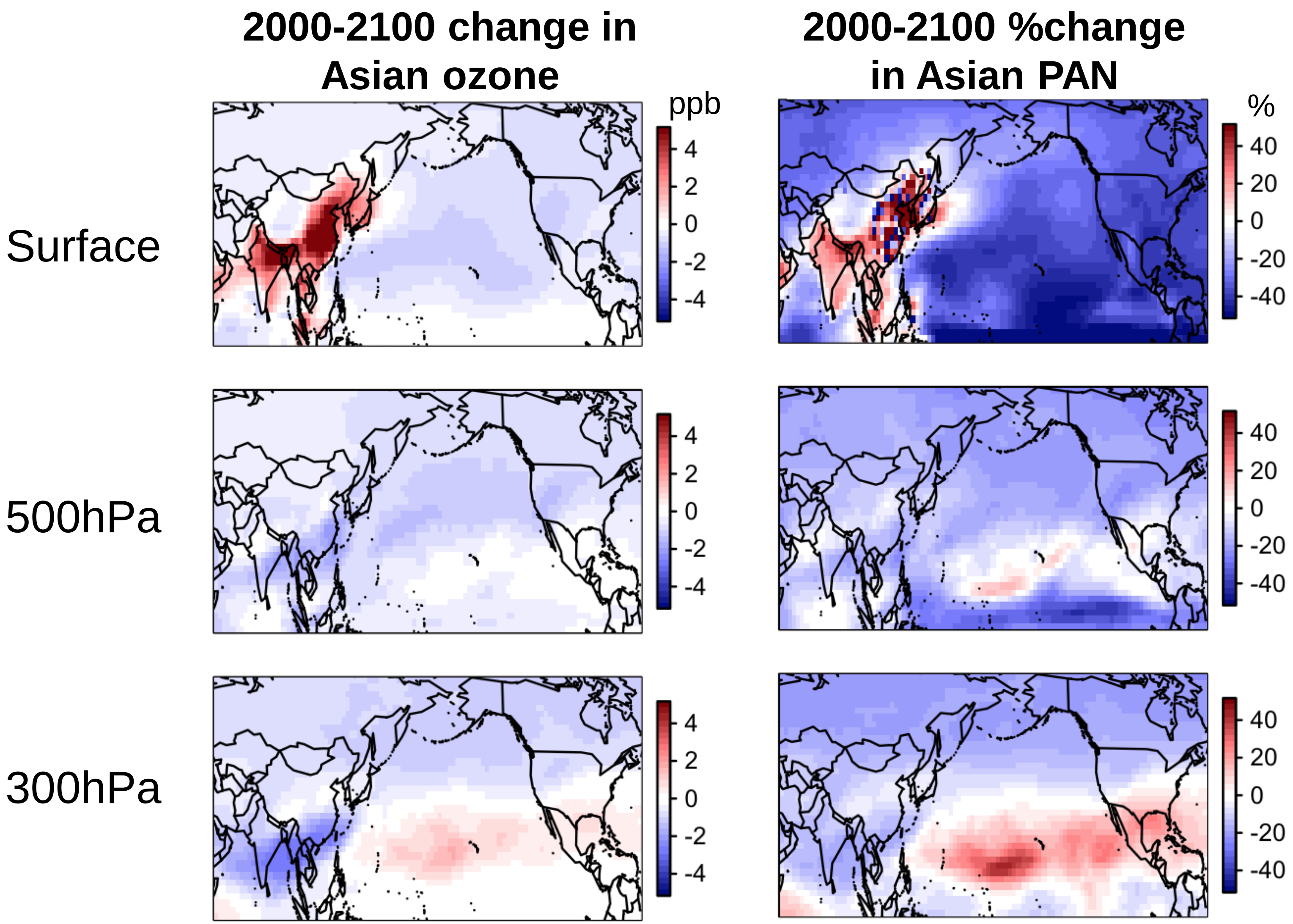
- 20-year GEOS-Chem simulation around 2000 and 2100 under the no-climate-policy scenario
  <u>1991-2010</u>   <u>2091-2110</u>
- Anthropogenic emissions are kept constant at 2006 levels
- Sensitivity simulation which zeros out Asian anthropogenic emissions to separate Asian ozone (only 3 years)

* Linkage between CAM and GEOS-Chem was originally developed by Kim et al. (2015), and updated to v9-02 by Evan Couzo.

Climate penalty of U.S. ozone is around 4 ppb

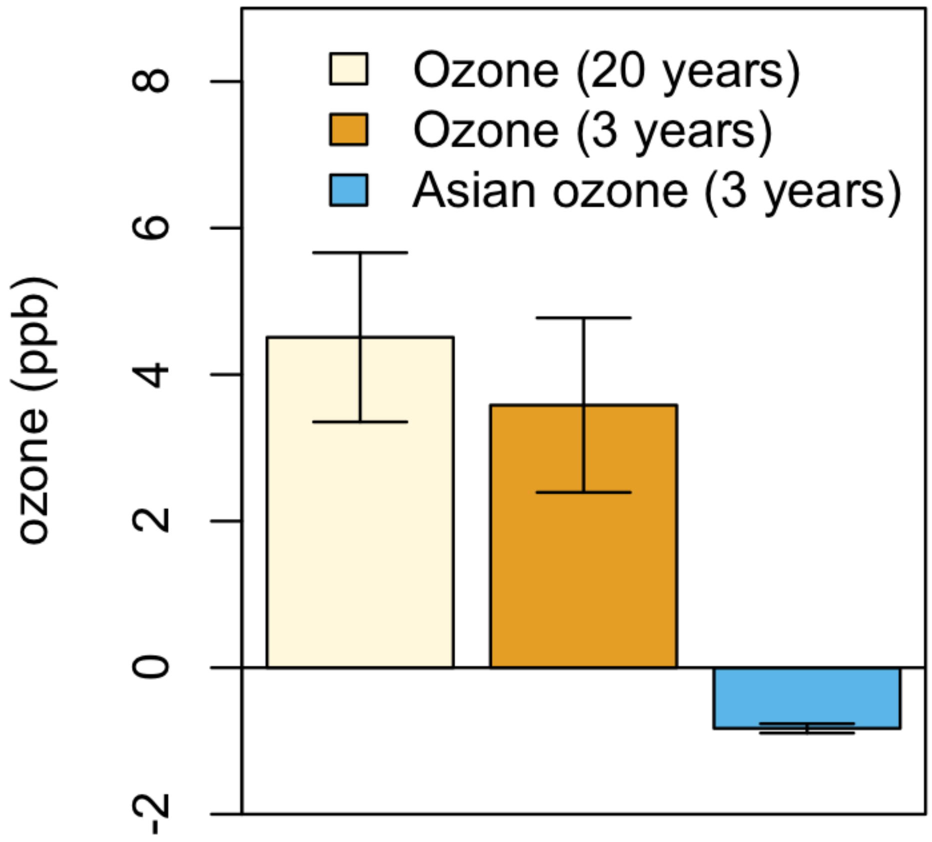


2100 climate change decreases Asian ozone by up to 1ppb over the U.S. due to enhanced PAN decomposition



Reduction in Asian ozone in response to 2100 climate change offsets ~20% of ozone climate penalty in the U.S.

Changes in U.S. average surface ozone due to 2000-2100 climate change



Summary

- 2100 climate change decreases Asian ozone by up to 1ppb over the U.S. due to enhanced PAN decomposition, and this reduction offsets ~20% of ozone climate penalty averaged over the U.S.

Acknowledgements

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