Modeling ozone and climate change

Does the answer change with the dataset?

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WHY WORRY ABOUT OZONE?

Several climate model studies have demonstrated that stratospheric ozone depletion is an important driver of stratospheric and tropospheric climate. Climate models that don't include interactive chemistry (most current IPCC models) need to prescribe an ozone dataset to capture these ozone-climate effects. Here we report that different ozone datasets result in significantly different climate impacts.

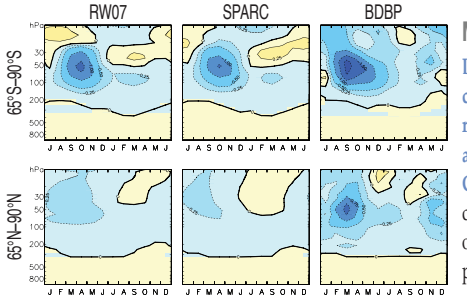
DATASETS: DIFFERENT SOURCES & REGRESSION MODELS

Randel & Wu (RW07) was used for many CMIP3 models; SPARC was built for CMIP5; BDBP is new (Bodeker poster: T180B)

	Regression basis functions						Obs. source
	Trend	EESC	QBO	Solar	ENSO	Volc	
RW07		✔	✔	✔			SAGE I and II, sondes
SPARC		✔					As above
BDBP	✔	✔	✔	✔	✔	✔	Various satellite and sondes

STRONGER POLAR O3 DEPLETION IN BDBP

Plots compare difference between 1995-7 avg and 1979-81 avg ozone (ppmv).



MODELING

Datasets are compared by running the atmospheric model CAM. Compare climate impact of ozone using the periods shown left.

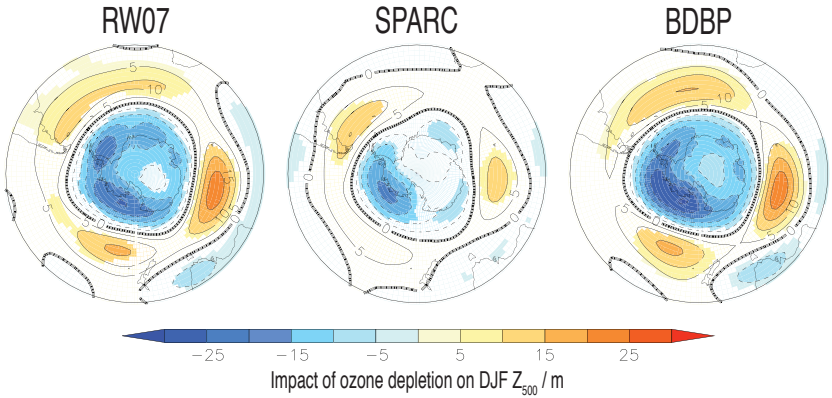
All other conditions (SSTs, GHGs etc) are kept constant in each simulation.

ALL PLOTS HERE SHOW 95-97 MINUS 79-81 AVERAGE OZONE

CLEAR-CUT IMPACTS IN SH FROM DEEPER OZONE HOLE

Comparison of DJF 500 hPa geopotential height highlights well-known impact of ozone depletion on Southern Annular Mode (SAM). This relates to precipitation, surface pressure and surface temperature changes.

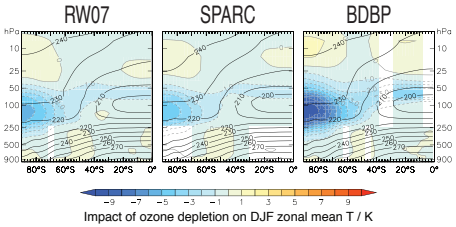
Color-filled contours show signficant changes (based on comparing 80 simulated years).



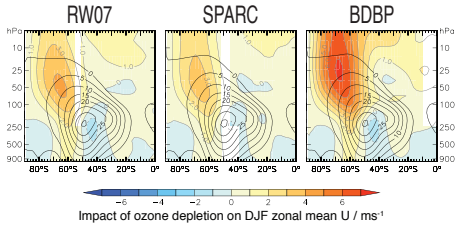
IMPACTS ARE COINCIDENT WITH STRATOSPHERIC CHANGES

(Black contours are the climatological values from the 79-81 simulation)

Stronger ozone depletion gives stronger temperature trends.



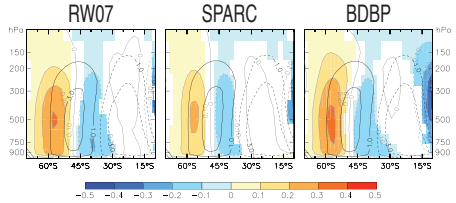
Impact on the jet is also largest using BDBP.

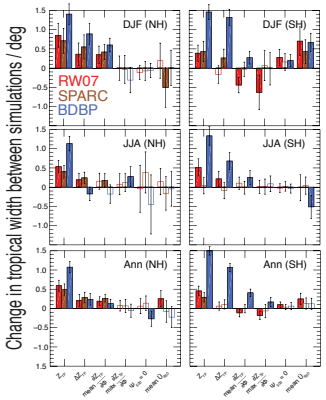


HAS IMPLICATIONS FOR TROPICS

SH impacts caused by ozone extend to lower latitudes. The poleward shift of the Hadley cell is strongest with BDBP ozone.

(Black contours are the climatological values from the 79-81 simulation)



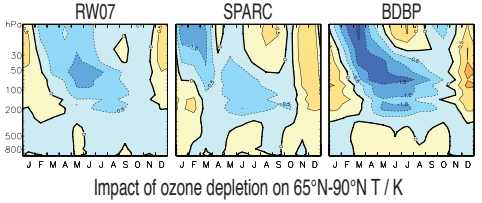


Tropical width changes are not always robust though. The magnitude, significance (filled bar), and direction of change depend on the metric.

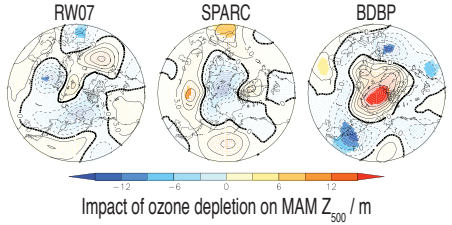
See Davis & Rosenlof, J. Clim., in press, doi: 10.1175/JCLI-D-11-00127.1

NH IMPACTS ARE MORE COMPLEX

Polar temperatures affected by stronger ozone depletion in BDBP.



...but impact on spring 500 hPa geopotential heights less evident.



CONCLUSIONS

Attribution of the climate impacts of 20th century ozone changes will depend on the dataset. Using the more realistic and thoroughly compiled BDBP data gives a stronger climate impact, which extends into the troposphere in the SH. Work is still required to assess if 20th century climate simulations are improved with the BDBP.

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