STRATOSPHERIC AND TROPOSPHERIC OZONE IN ACCMIP

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INTRODUCTION

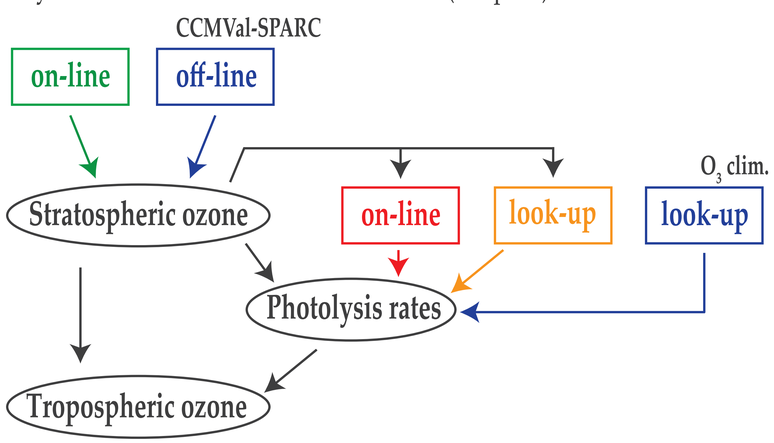
Stratospheric ozone levels are important for the tropospheric ozone budget, both through stratosphere-troposphere exchange and their impact on photoysis rates. Here **we analyse stratospheric ozone and its links to tropospheric ozone** using models from the Atmospheric Chemistry and Climate Model Intercomparison Project (ACCMIP), focussing on Antarctica in austral spring. This was **the first "MIP" to have some models that focussed on both tropospheric and stratospheric chemistry**.

ACCMIP MODELS

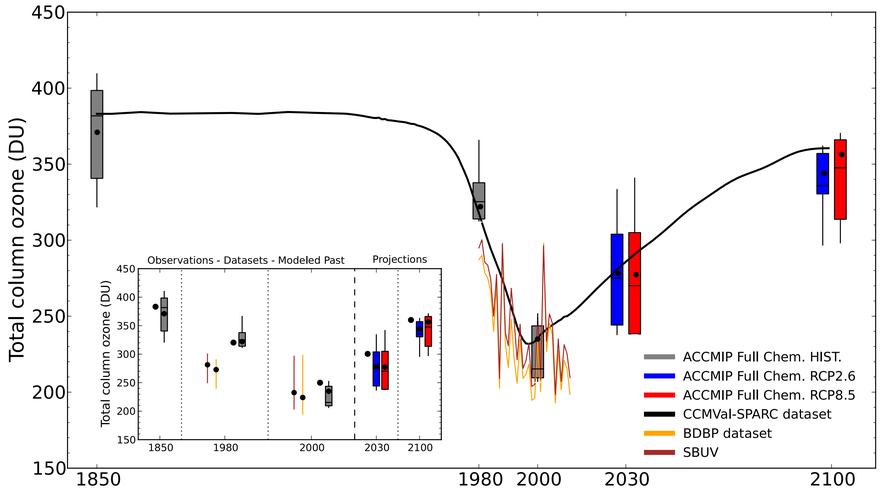
The participating models differed in their treatment of stratospheric ozone.

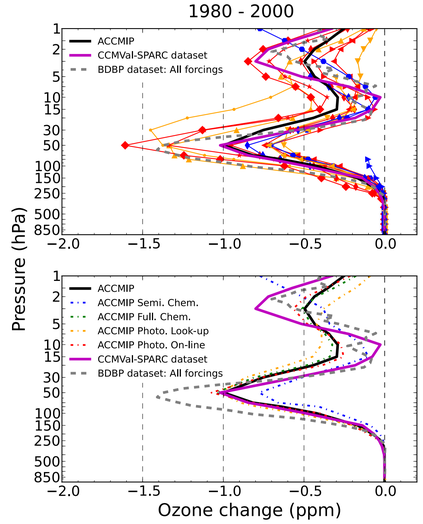
Model	Online strat. chemistry?	O_3-photolysis link?
CESM-CAM-superfast	○	●
CMAM	○	●
EMAC	○	●
GEOSCCM	○	●
GFDL-AM3	○	●
GISS-E2-R	○	●
GISS-E2-TOMAS	○	●
HadGEM2	○	●
MIROC-CHEM	○	●
NCAR-CAM3.5	○	●
STOC-HadAM3	○	●
UM-CAM	○	●

Stratospheric ozone is prescribed **off-line** (time-varying ozone as used in CMIP5, semi chemistry) or calculated **on-line** (full chemistry). Photolysis rates are either sensitive to ozone (coupled) or not.



TOTAL COLUMN OZONE TIME SERIES AND VERTICAL PROFILE OF OZONE CHANGE



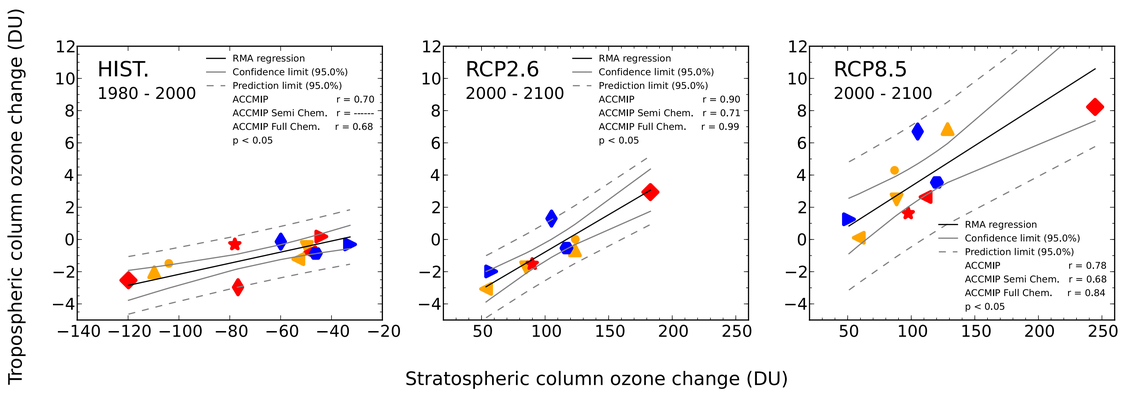


Models tend to underestimate ozone depletion in the lower and upper stratosphere compared to the regression model based Bodeker Scientific (**BDBP**), particularly, those with off-line stratospheric chemistry.

ACCMIP future projections follow the Representative Concentration Pathways (RCP2.6 and RCP8.5) covering the 21st century. The **total column ozone in 1850 is 50% higher than 2000** values. With decreasing ozone depleting substances concentrations into the future, the ozone **recovery is projected in the range of 44.8-48.2% by 2100**, although most models recover to 1980 levels.

Within uncertainty, the ozone depletion between 1980 and 2000 for the **multi-model mean agrees with** observational estimates from the Solar Backscatter Ultraviolet (**SBUV**), as well as with the **BDBP** and the **CCMVal-SPARC** datasets.

STRATOSPHERIC AND TROPOSPHERIC OZONE RELATIONSHIP



Although, the **ACCMIP ensemble indicates significant relationship** ($r = 0.70$-0.90, $p < 0.05$) **between the stratospheric and tropospheric ozone columns**, often the full chemistry multi-model ensemble shows stronger correlation ($r = 0.68$-0.99, $p < 0.05$).

Figures suggest that stratosphere ozone changes cause troposphere ozone changes. Hence, **overestimating changes in the stratosphere may result in an overestimation in the troposphere**.

CONCLUSIONS

Antarctic ozone recovers to 1980 levels by 2100 for most models (in agreement with CCMVal2), and two models recover to 1850 levels (additional 16.6% over 1980).

There is a **significant relationship between stratospheric and tropospheric ozone changes** (>65°S, austral spring), and for the 21st century projections this is strongest for models with online stratospheric chemistry and photolysis.