The stratospheric response to a discrepancy of Spectral Solar Irradiance data

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pmod wrc

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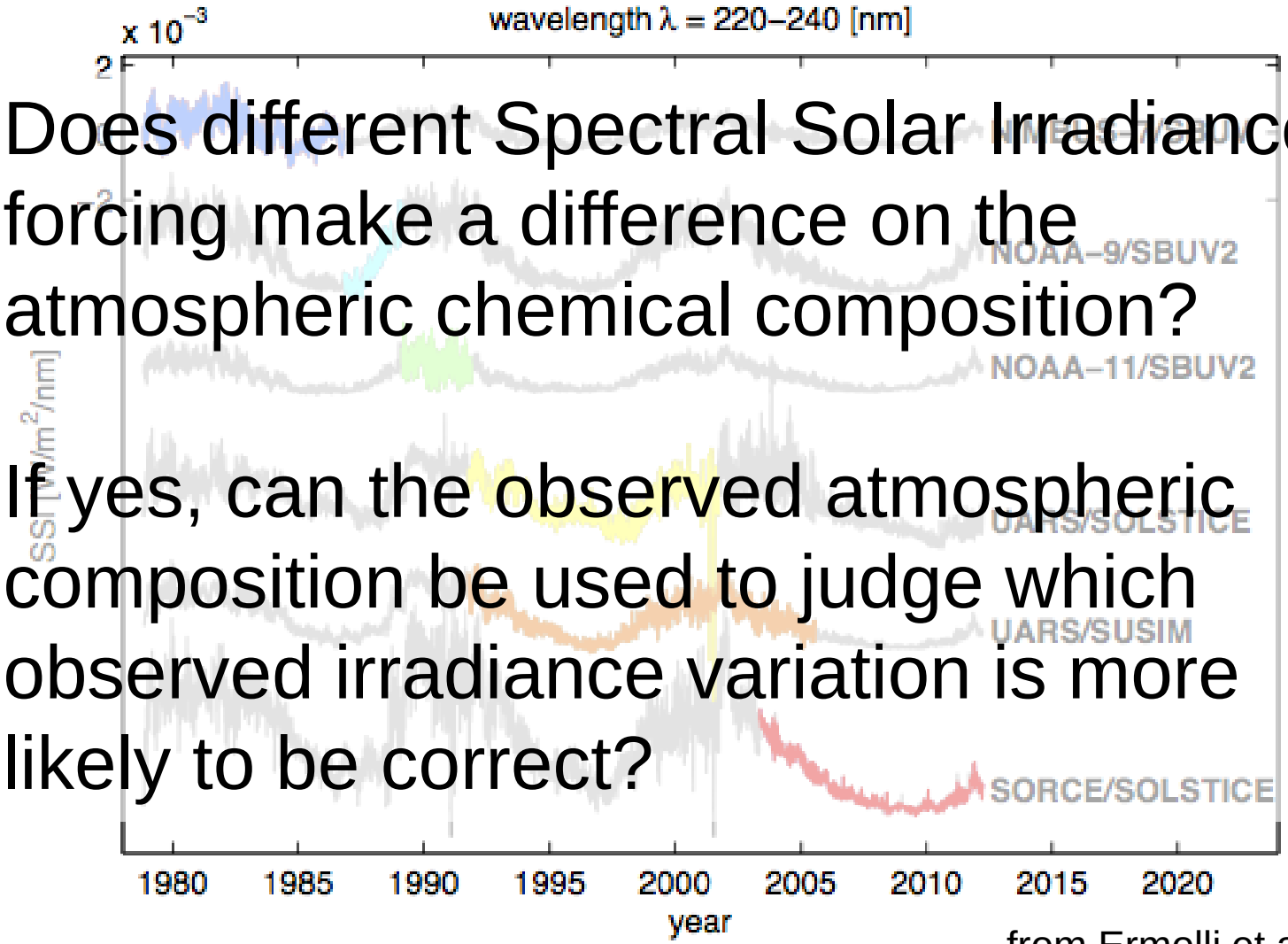
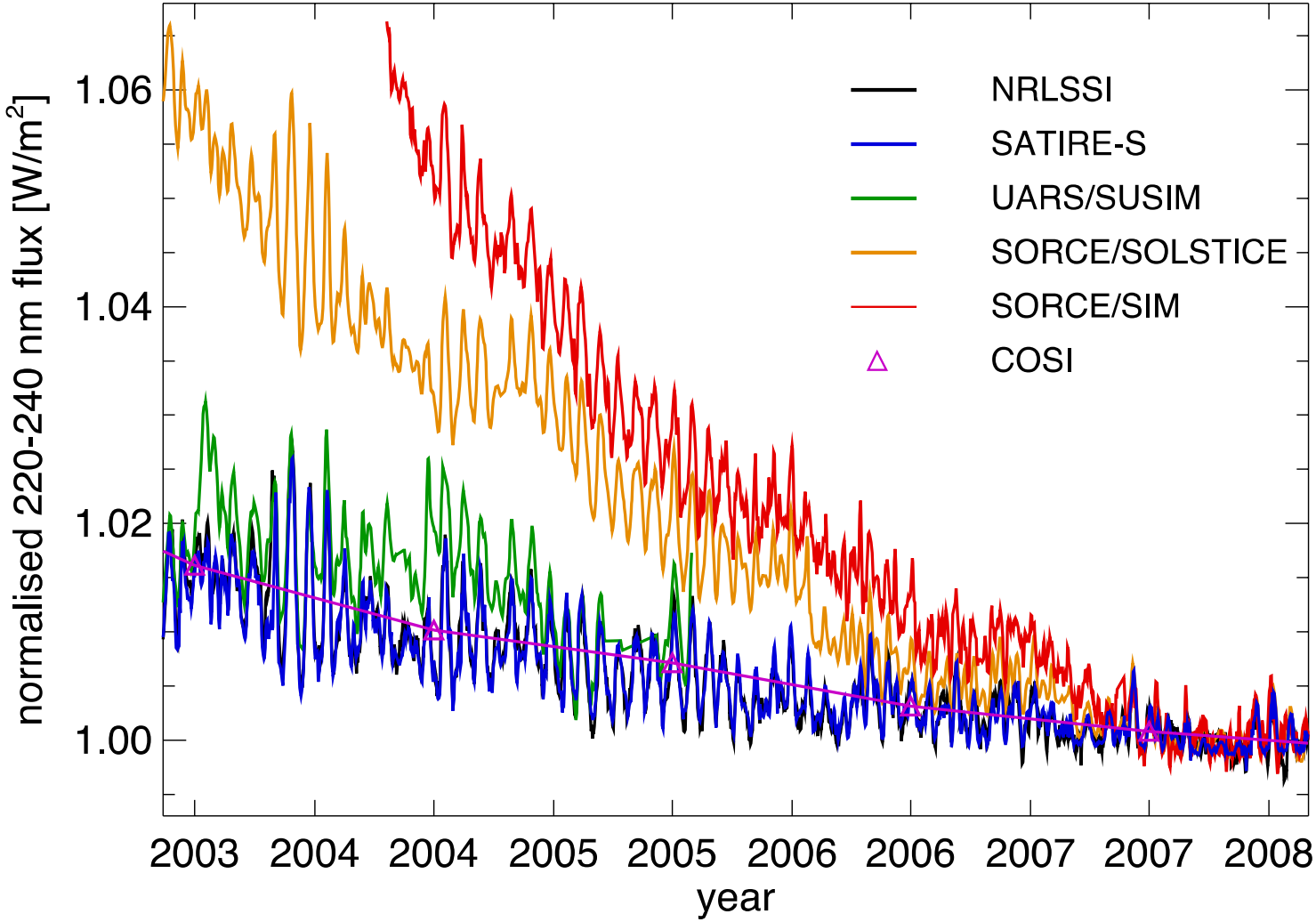
Introduction & Overview



- Does different Spectral Solar Irradiance forcing make a difference on the atmospheric chemical composition?
- If yes, can the observed atmospheric composition be used to judge which observed irradiance variation is more likely to be correct?

from Ermolli et al. 2013

SSI variability

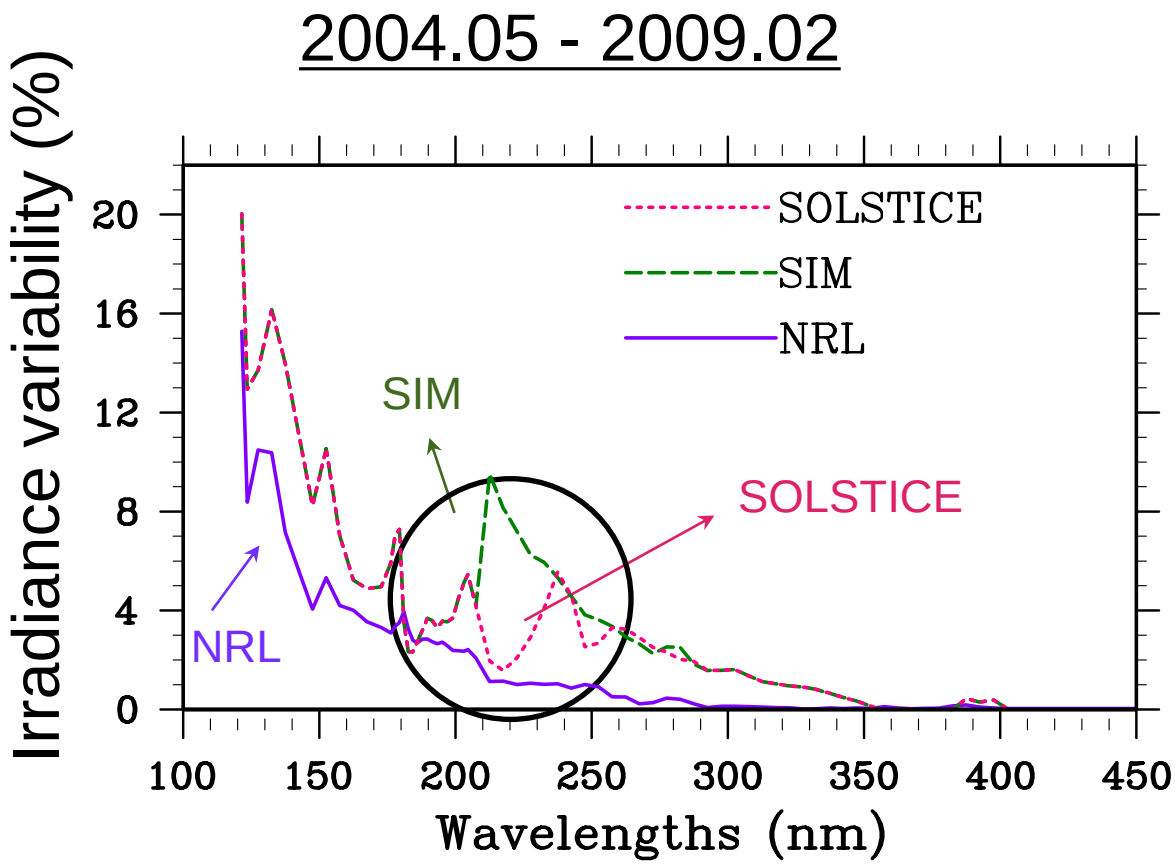


from Ermolli et al. 2013

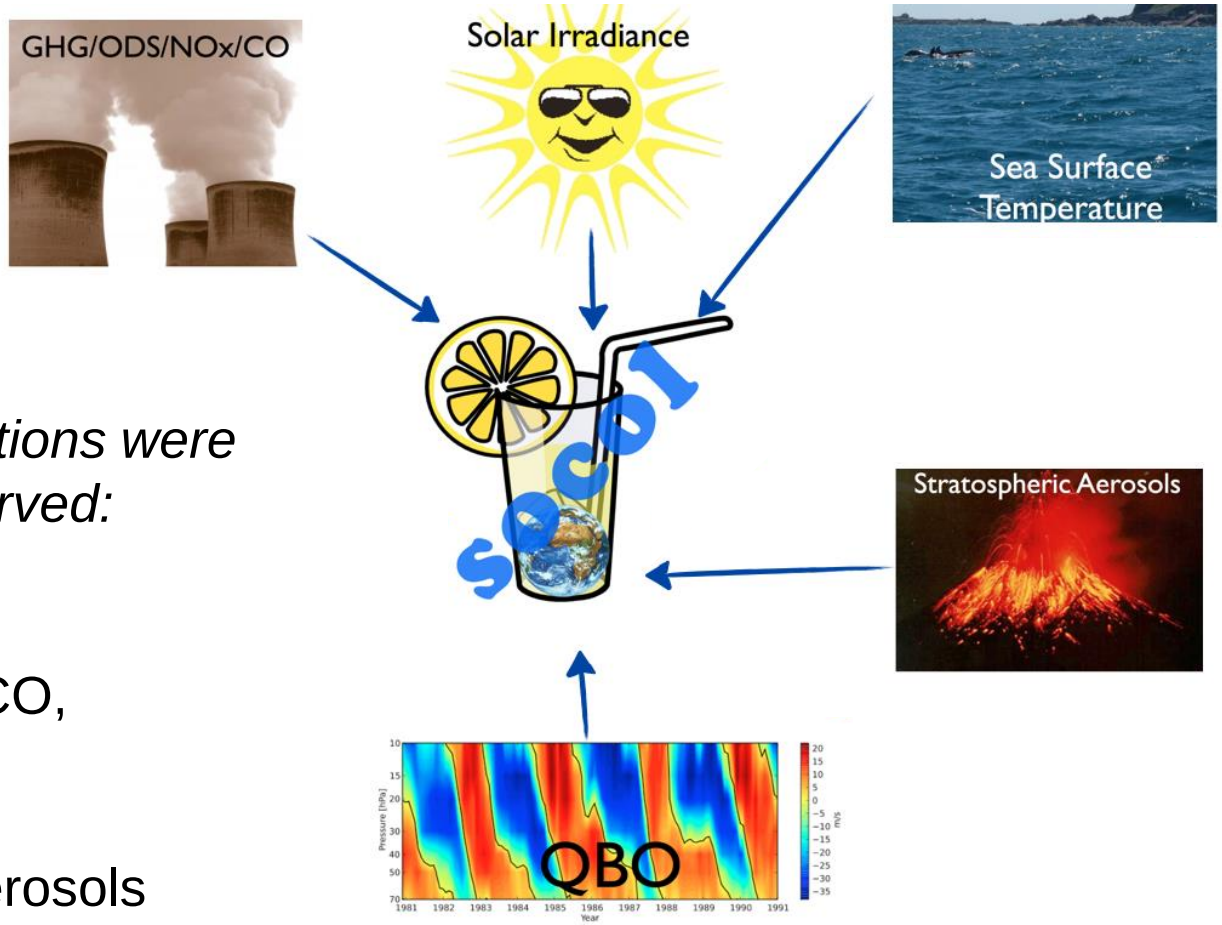
SSI “max-min” variability

SIM
202 - 2400 nm

SOLSTICE
115 - 310 nm



3D Chemistry-Climate-Model SOCOL



The model computations were forced by observed:

SSI,
GHG,
ODS, NOx, CO,
SST,
QBO
Stratospheric Aerosols

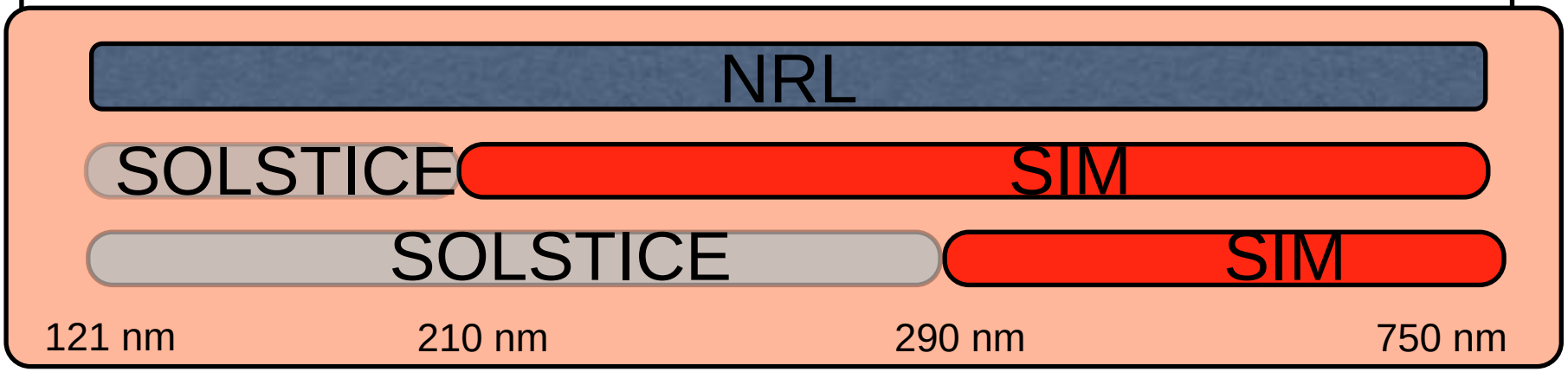
+ no variable Sun or
3 variable SSI

CCM input SSI composites

2004.05 - 2009.02

SOCOL input spectrum: 121-750 nm

NRL	120 - 99925 nm
SIM	202 - 2400 nm
SOLSTICE	115 - 310 nm



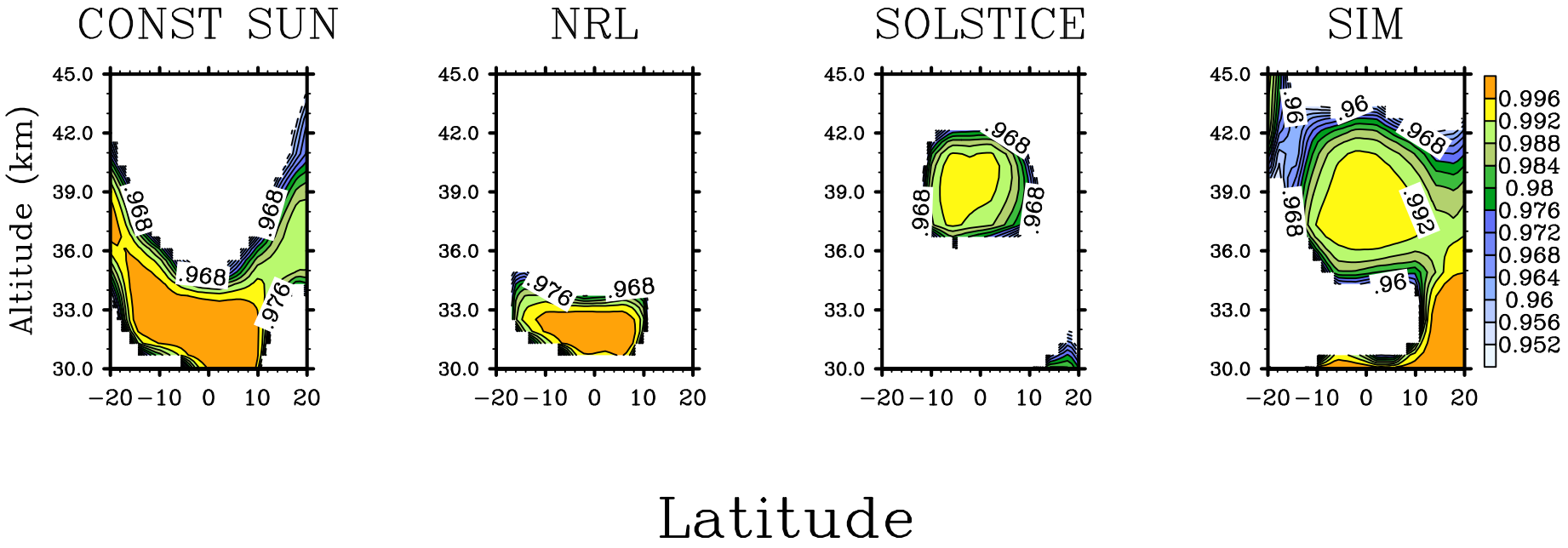
3D model simulations

5 ensemble runs with *each* SSI data set
(SIM or SOLSTICE *dominated* composites, NRL SSI)
+
5 reference ensemble runs (constant SUN)

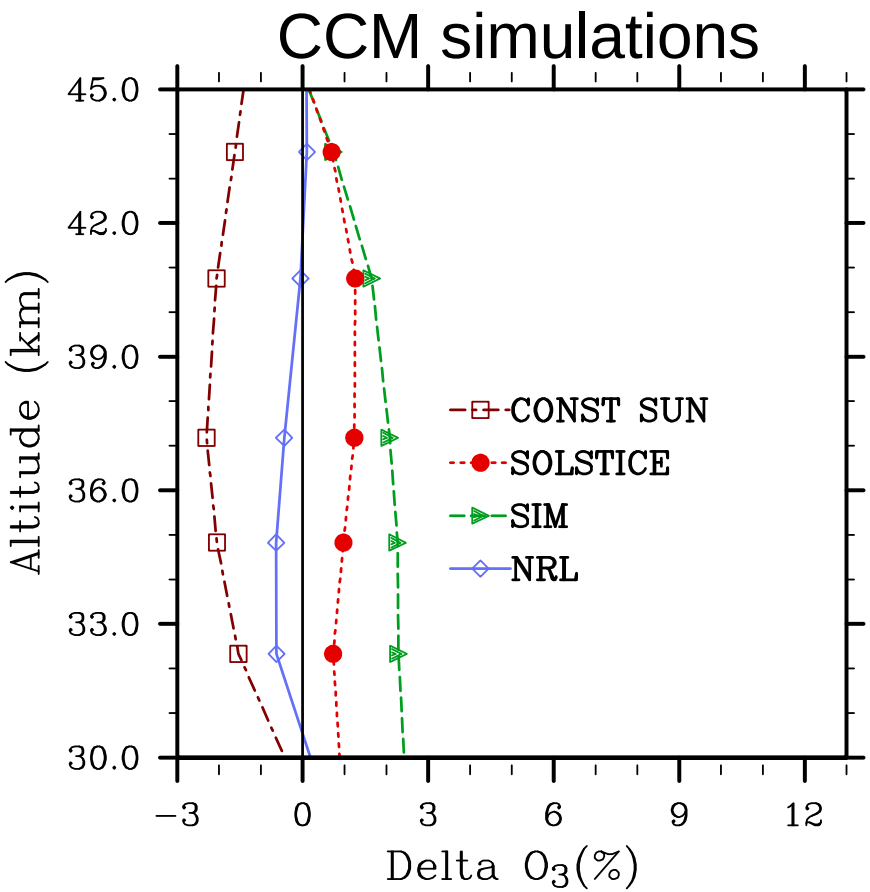
Output:
monthly time series
2004.05 - 2009.02

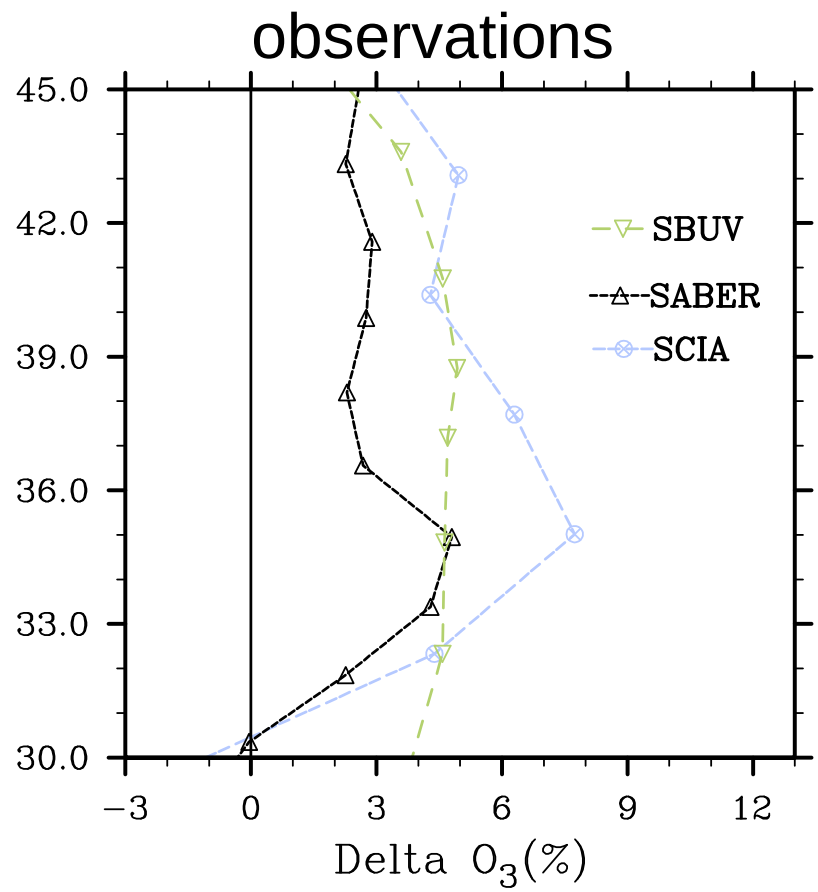
Stratospheric Ozone 30-45 km

July 2004 - July 2008 (same QBO phases)
Statistical significant responses



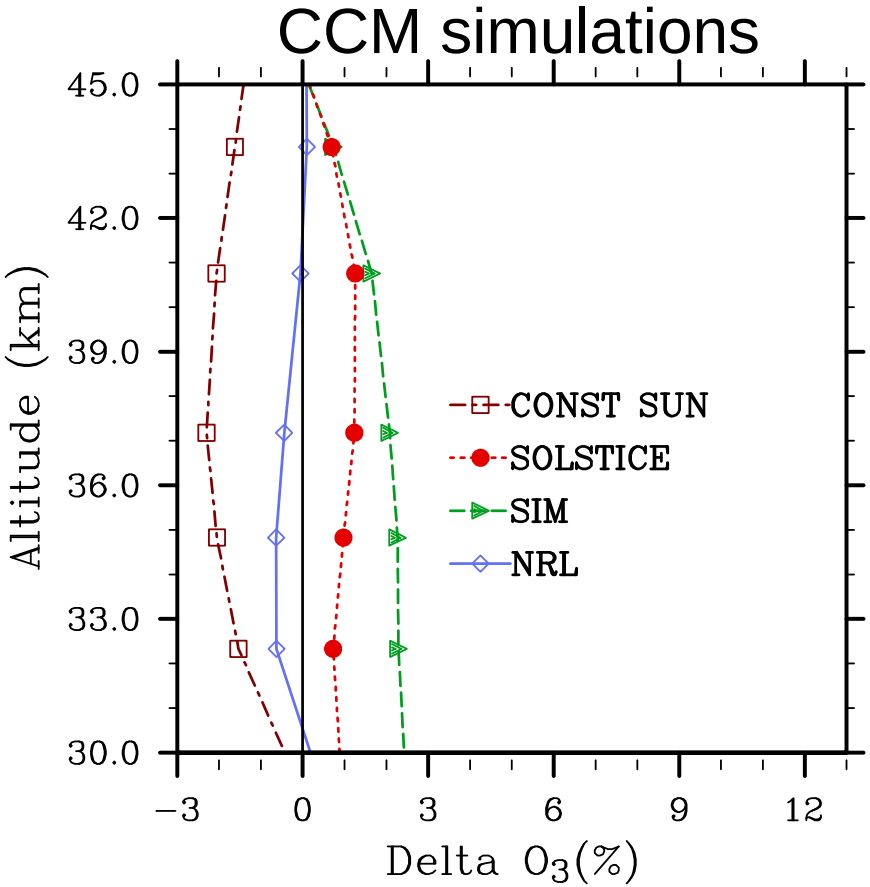
Stratospheric Ozone July 2004 - July 2008

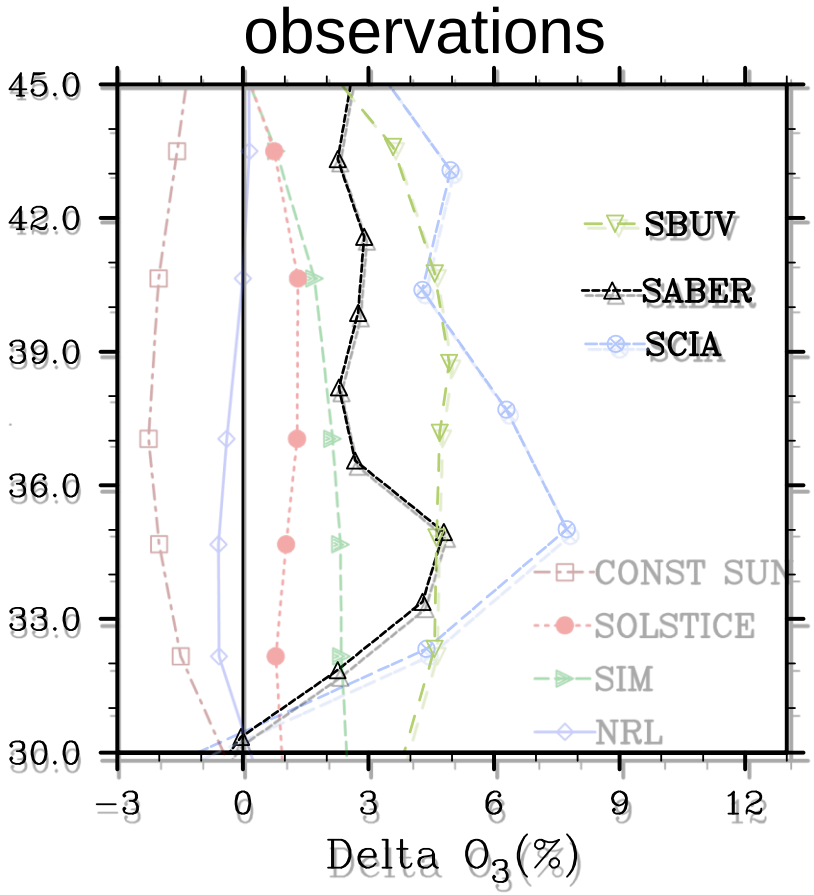




July 2004 - July 2008 (same QBO phases)

Stratospheric Ozone July 2004 - July 2008

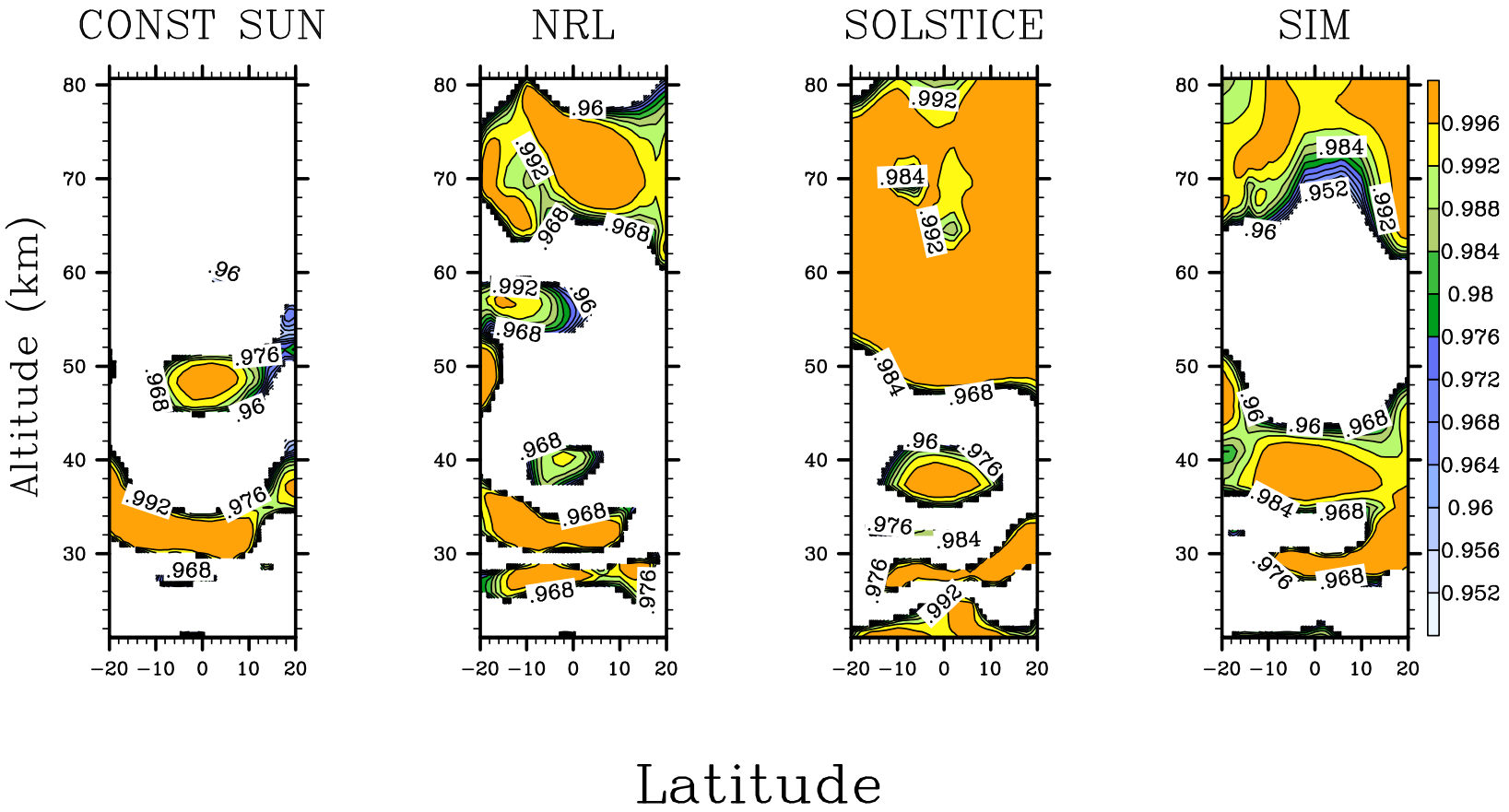




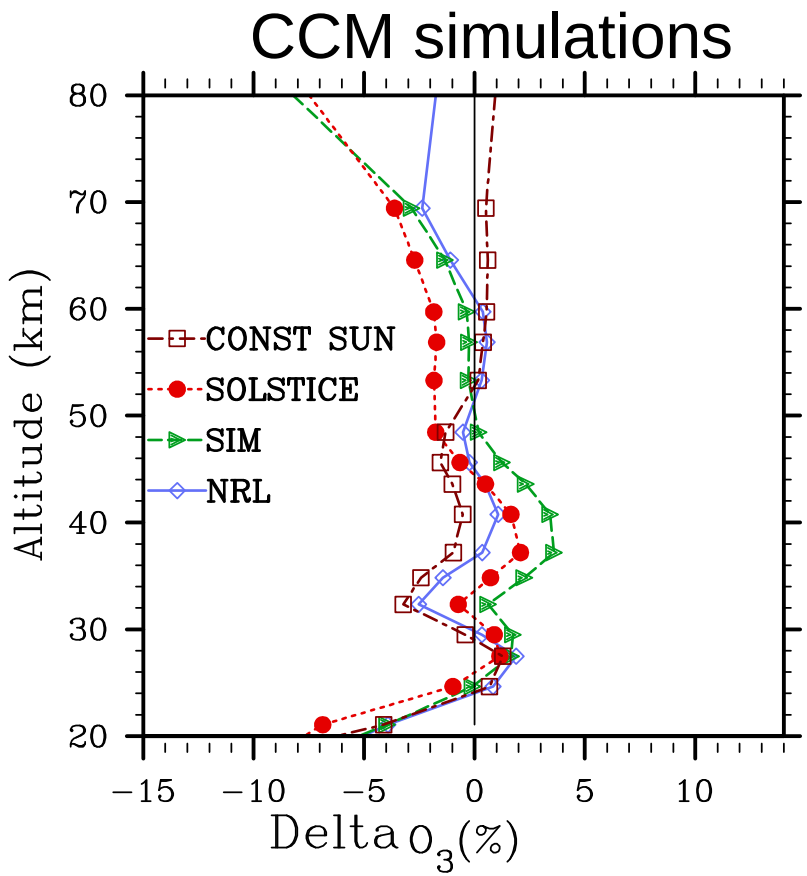
July 2004 - July 2008 (same QBO phases)

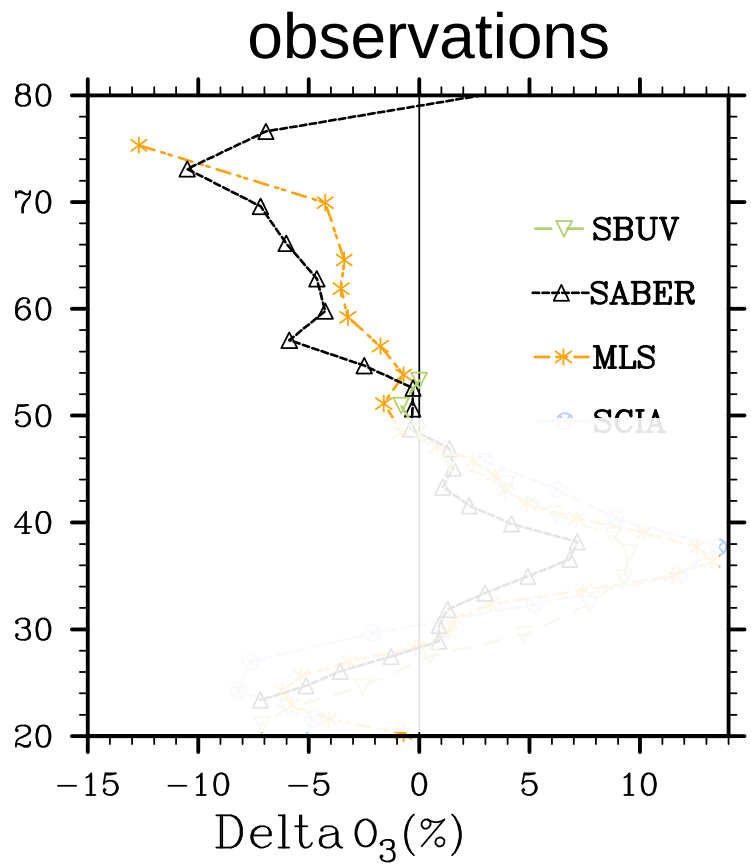
Ozone 20-80 km

August 2004 - August 2008 (same QBO phases)
Statistical significant responses



Ozone
August 2004 - August 2008

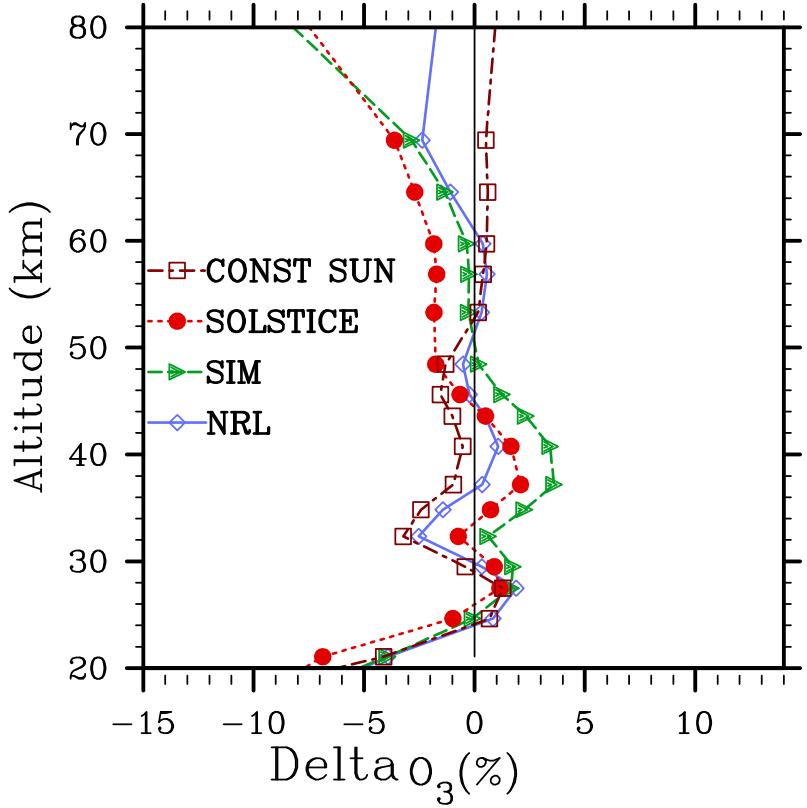




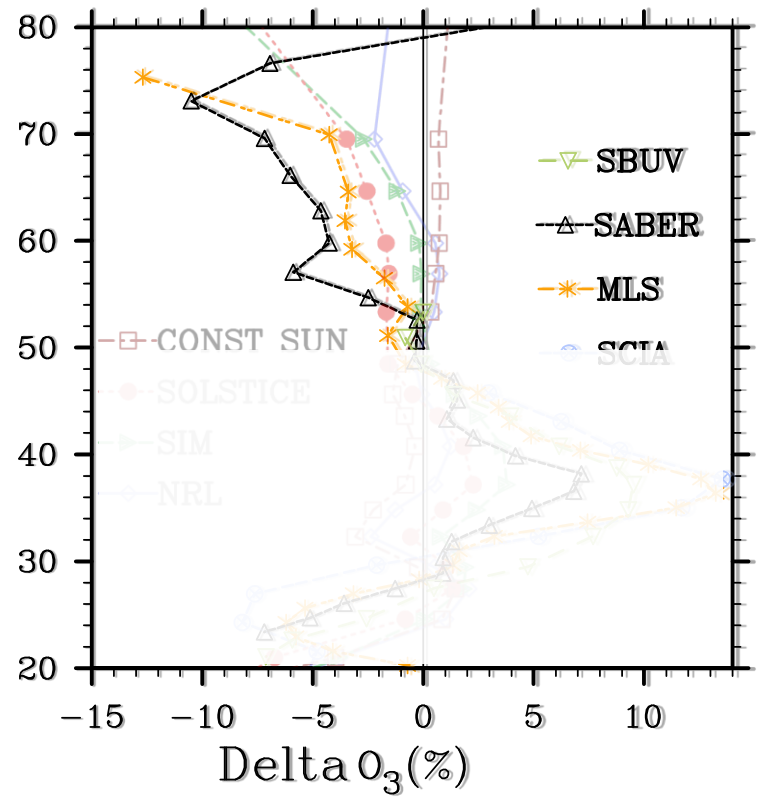
August 2004 - August 2008 (same QBO phases)

Ozone
August 2004 - August 2008

CCM simulations

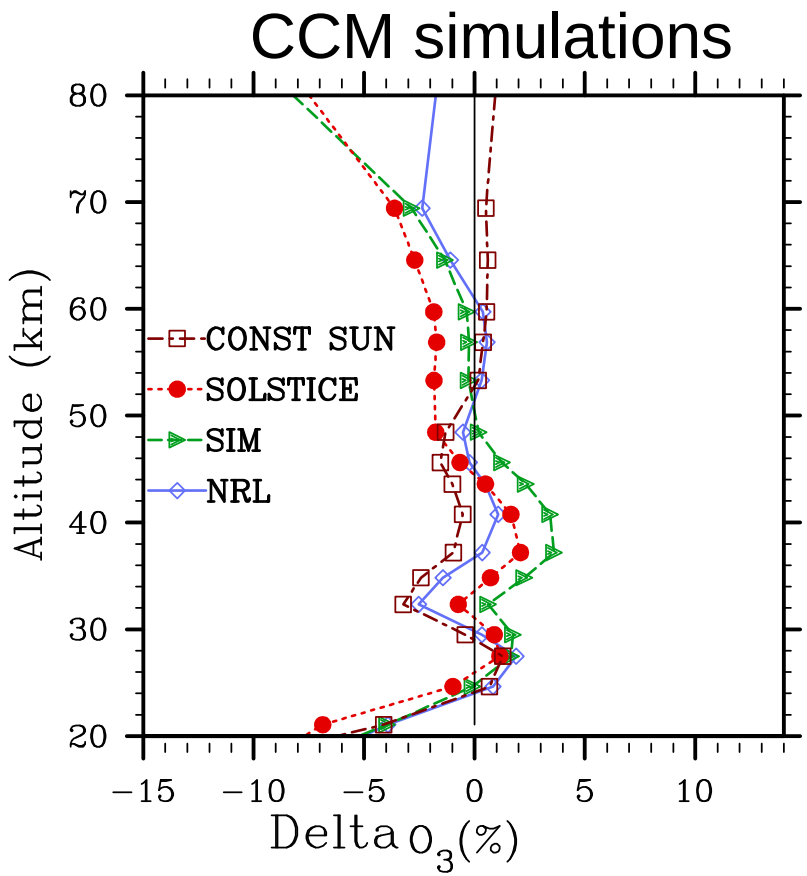


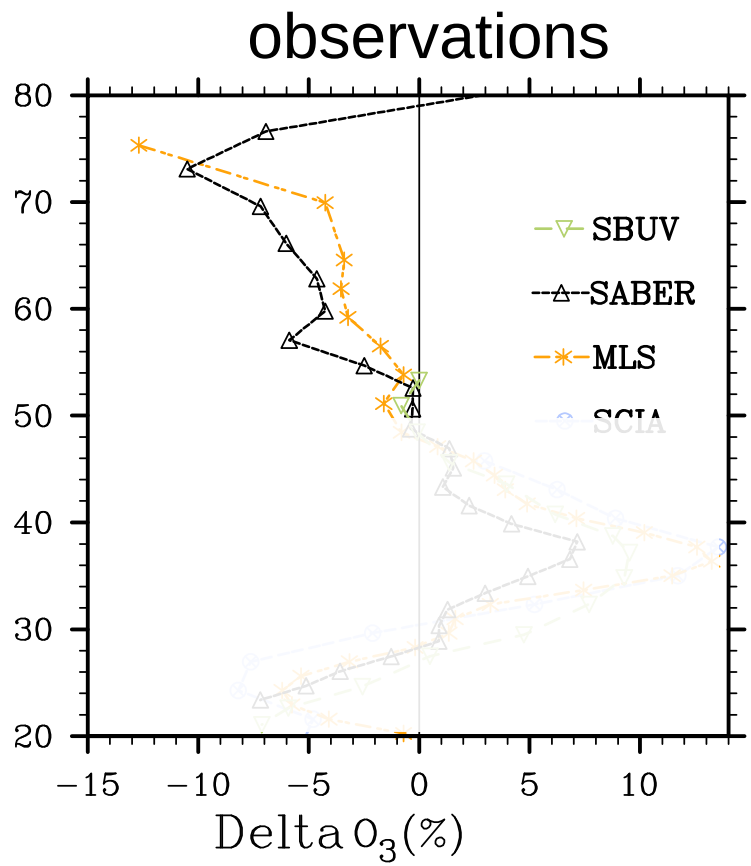
observations



August 2004 - August 2008 (same QBO phases)

Ozone
August 2004 - August 2008





August 2004 - August 2008 (same QBO phases)

Conclusions

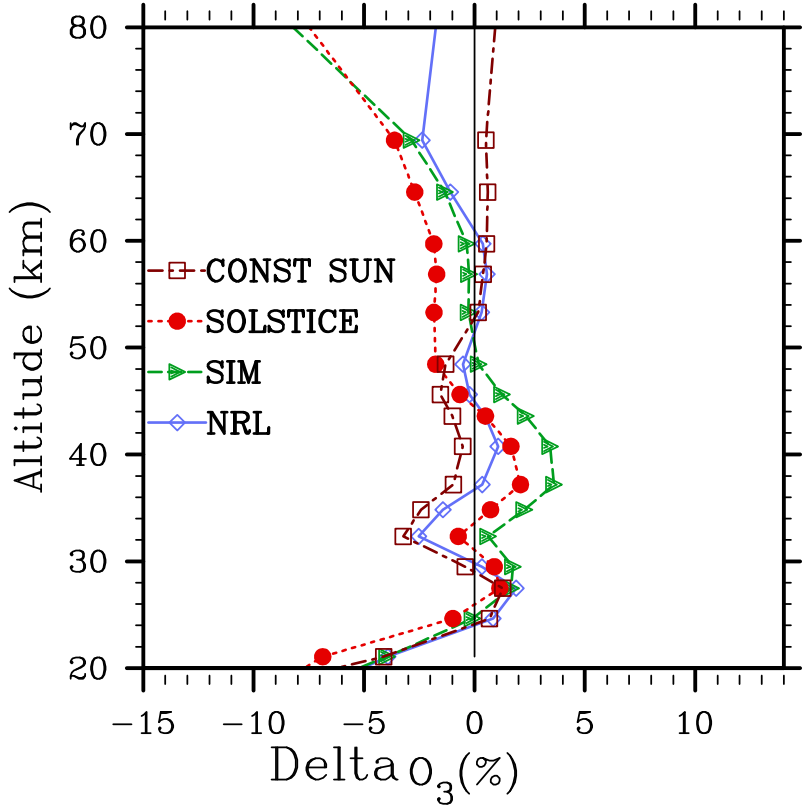
- ✓ The CCM SOCOL responses differently to forcing with different (observed!) SSI variabilities
  - → It *matters* to know what is the correct UV amplitude!

- ✓ Overall, the model-observation comparisons show a better agreement with the
  - → SIM / SOLSTICE data sets

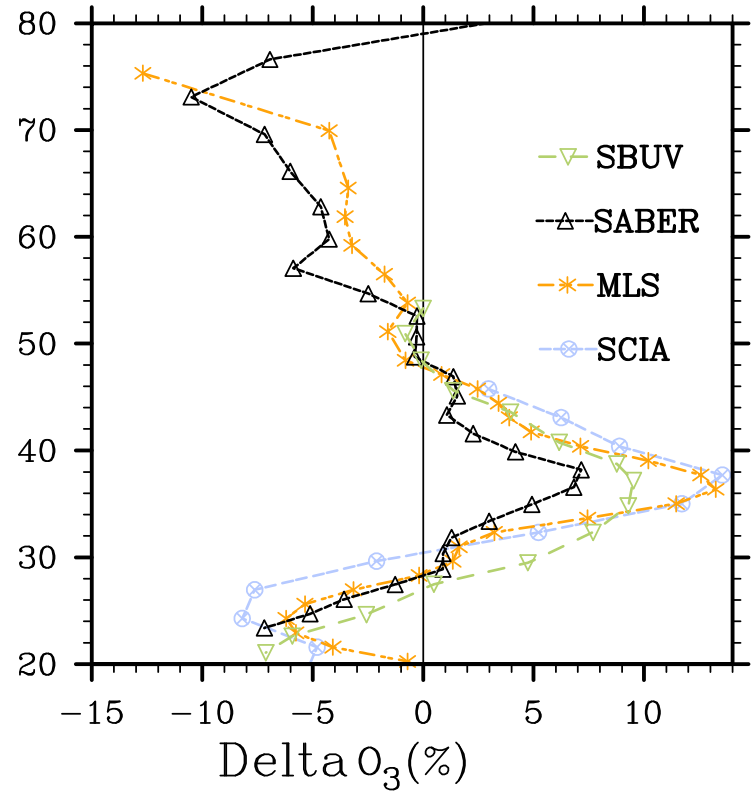
Published: Shapiro et al. (2013), J. Geophys. Res. Atmosph. 118, 3781

Ozone
August 2004 - August 2008

CCM simulations

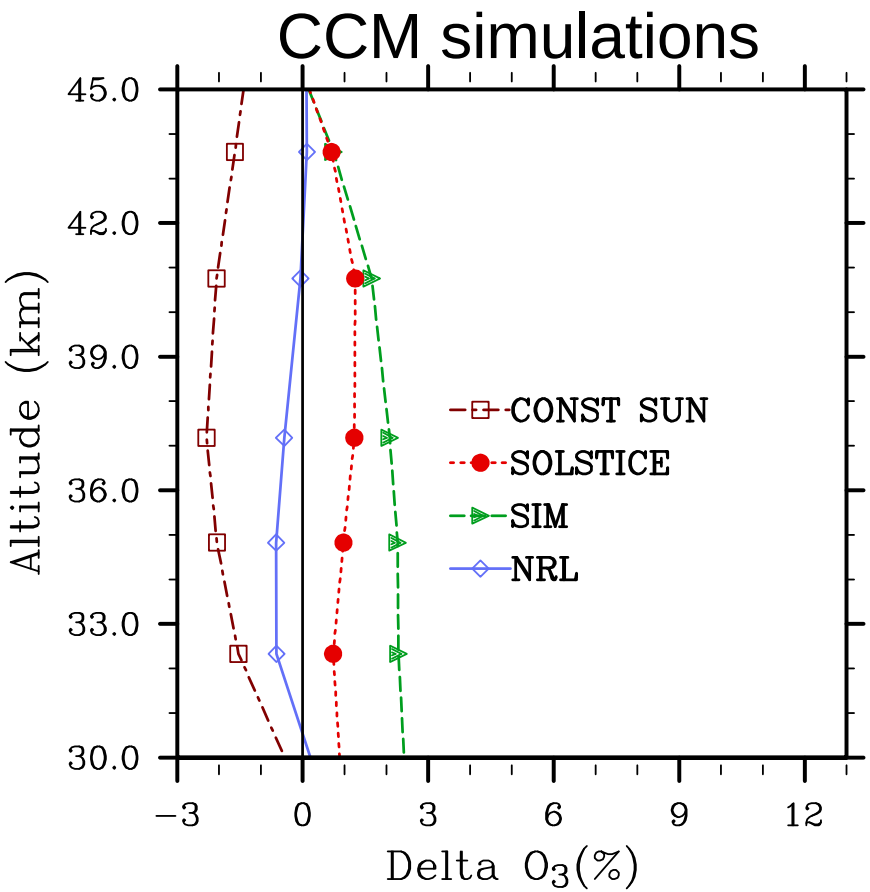


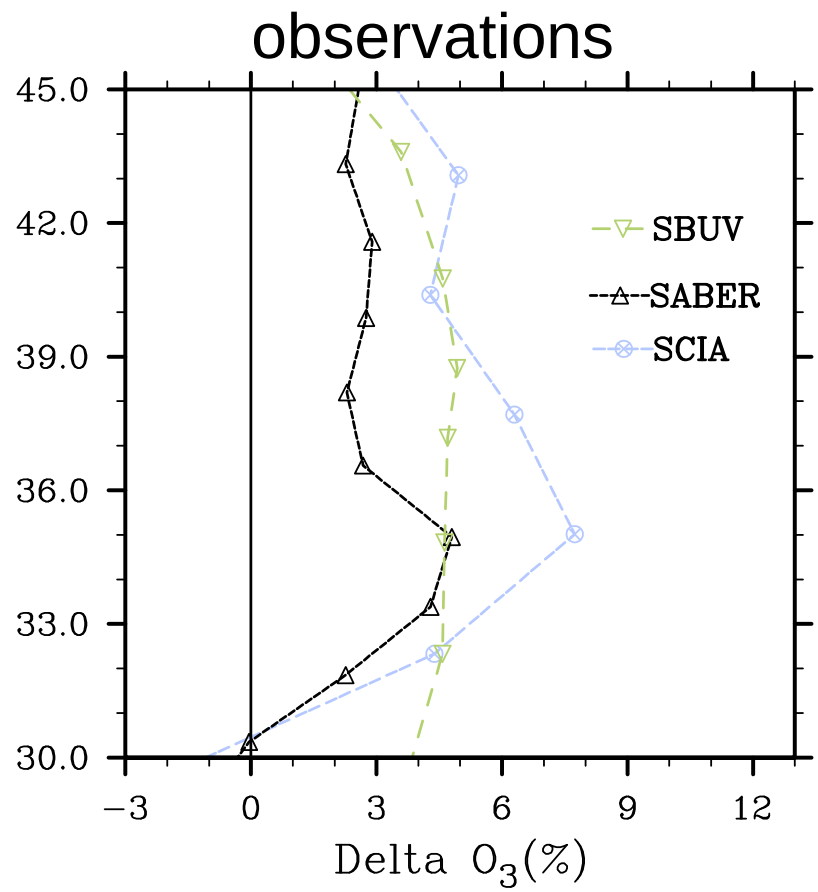
observations



August 2004 - August 2008 (same QBO phases)

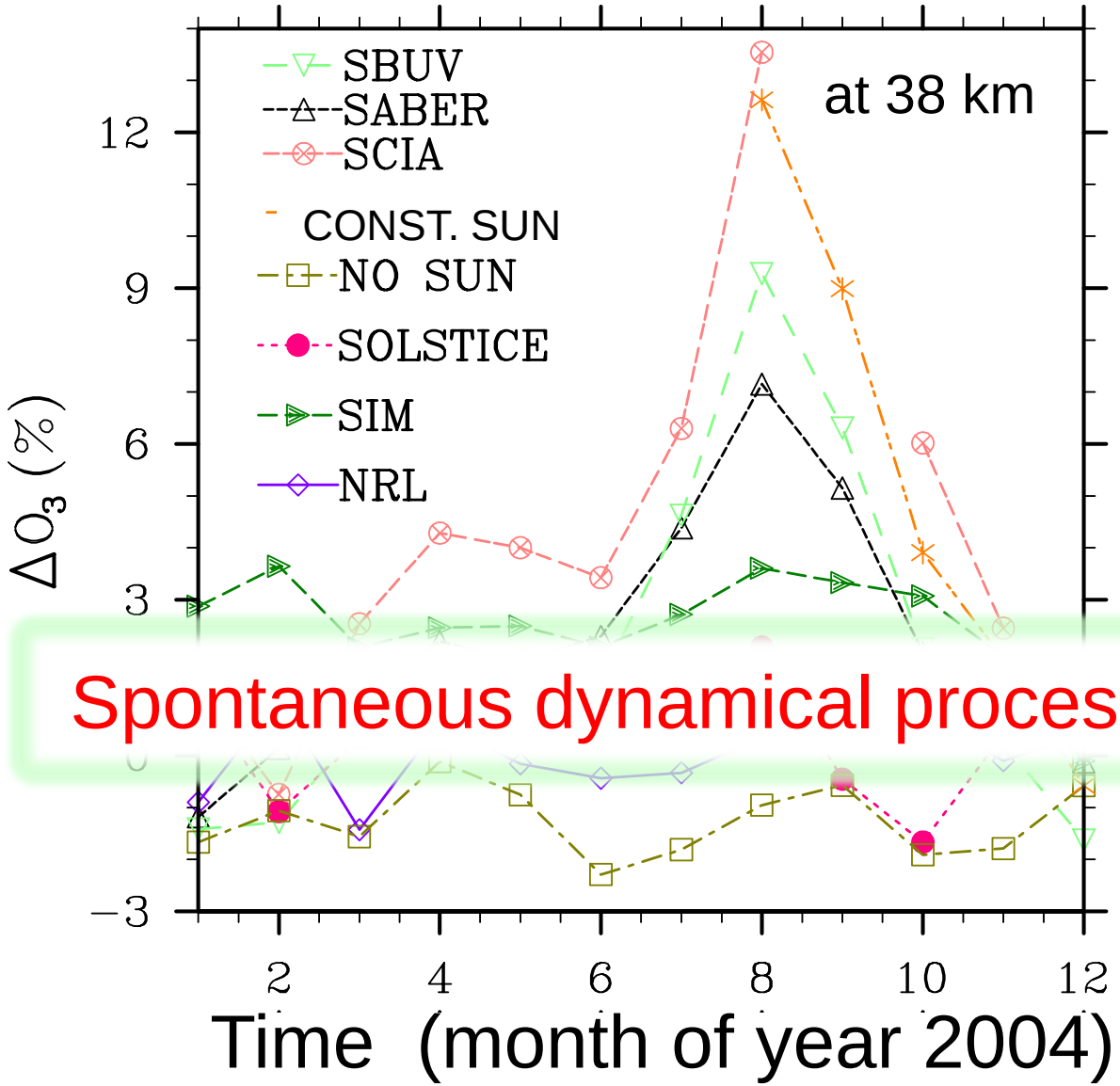
Stratospheric Ozone
July 2004 - July 2008 30-45 km





July 2004 - July 2008 (same QBO phases)

August 2004 ozone event



Spontaneous dynamical process?

Outlook

To understand the nature of the August 2004 ozone event
we are running CCM SOCOL in the mode
in which the dynamics is specified:

Measured meteorological data are nudged
(i.e. prescribed at some chosen altitudes).


Thank you!