

# Examining tropopause height trends with a high-resolution CCM

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## 1. Motivation:

- We examine the tropopause height ( $p_{tp}$ ) over all the world from 1960 to 2050 as simulated by a high-resolution CCM to determine:
- $\checkmark$  if simulated trends coincide with reanalysis at the end of the 20th century.

1960

- $\checkmark$  the nature of trends projected for the 21st century.
- $\checkmark$  the differences in projections over different latitudinal bands.

### 2. Data used:

· NCEP reanalysis ( $2.5^{\circ} \times 2.5^{\circ}$ , 17 pressure levels)

- · WACCM model (2.5° ×  $\approx$ 2.8°, 66 pressure levels):
- 2 runs (1.1 and 1.2) from 1950 to 2004
- 2 runs (2.1 and 2.3) from 1975 to 2050

3. Does WACCM reproduce mean tropopause height trends obtained from reanalysis? What are the projected changes for the 21st century?

ANOMALIES DEFINED AS THE DEVIATION FROM THE 1975-2004 MEAN

NCEP

2030

WACCM (run 1.1)

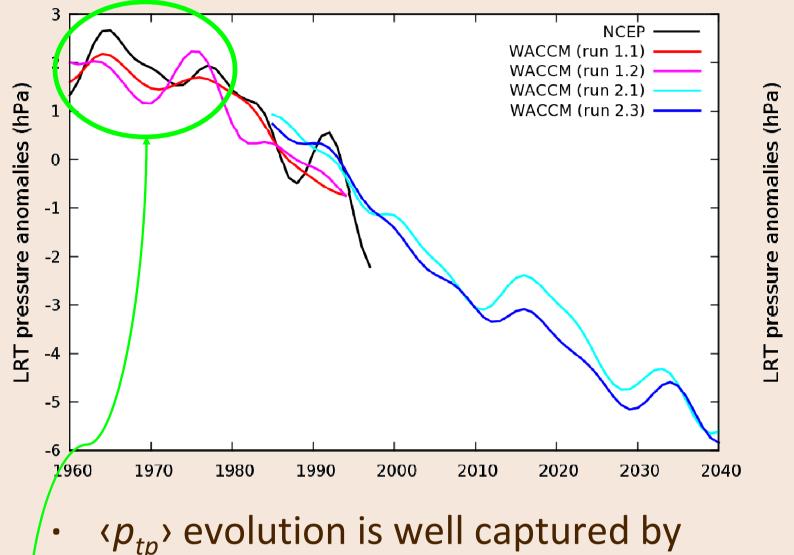
WACCM (run 1.2)

WACCM (run 2.1)

/ACCM (run 2.3) —

Globe (90°S – 90°N) Tropics (20°S – 20°N)

Southern Hemisphere (90°S – 45°S) Northern Hemisphere (45°N – 90°N)

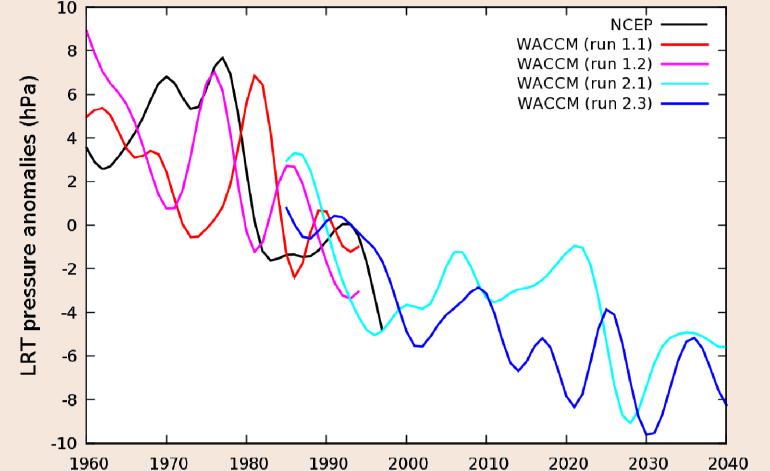


- (p) evolution is well captured by WACCM.
- (p<sub>tp</sub>) decreases continuously from 20th century to 21st century.
- The decrease is slower before 1980 than thereafter.
- There is a disagreement between reanalysis and simulations until 1980.

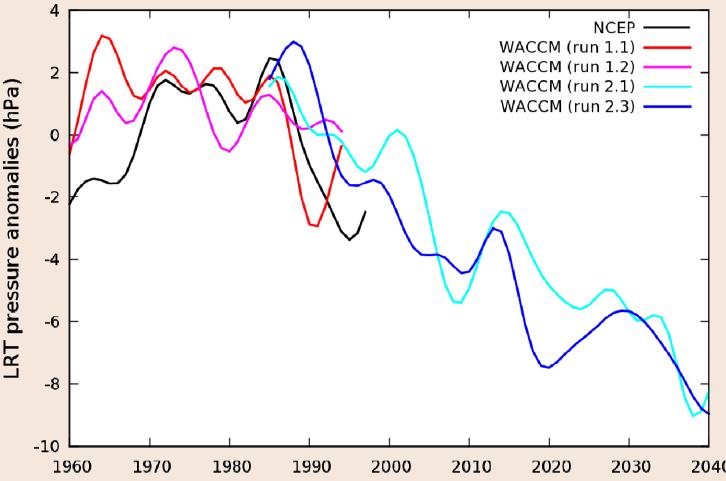
2010

2020

(p) decreases continuously from
 20th century to 21st century.



- (p) evolution is well captured by WACCM only after 1970s.
- (p<sub>tp</sub>) decrease during the last
   decades of the 20th century is
   bigger than in any other band.
- There is an abrupt change of slope in (p<sub>tp</sub>) evolution at the beginning of the 21st century.

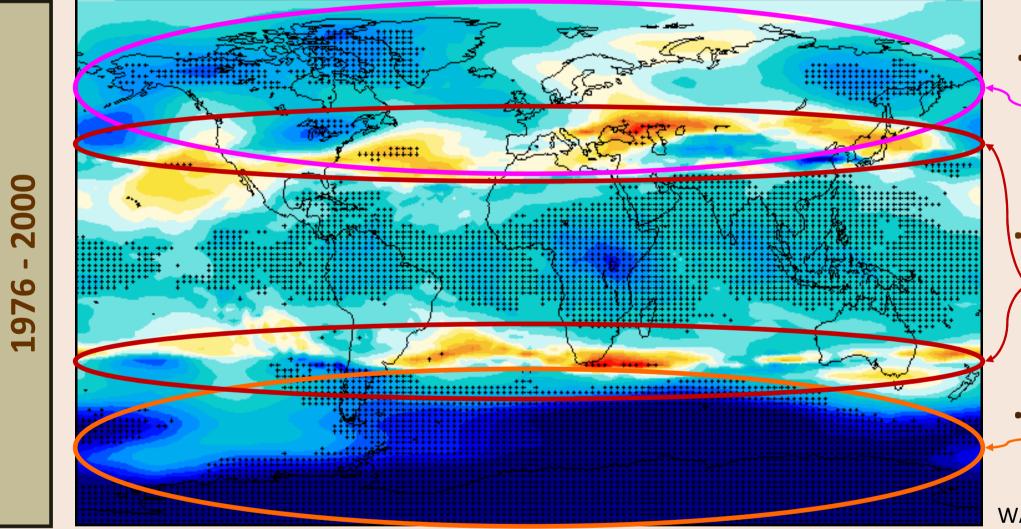


- $\langle p_{tp} \rangle$  evolution is well captured by WACCM after 1970.
- (p) decreases continuously from
   20th century to 21st century.
- The decrease is faster after 1980s than before then.

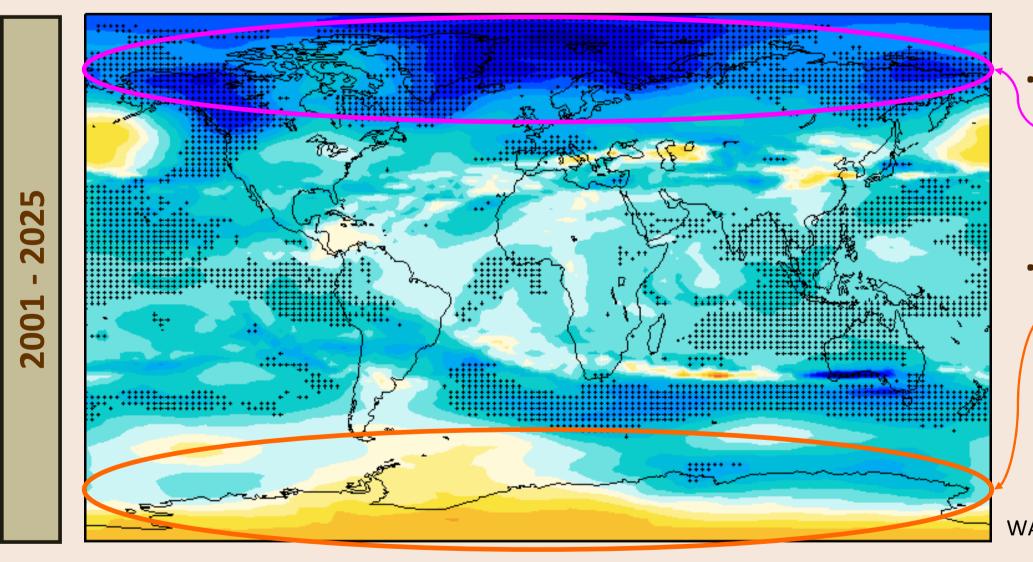
#### 4. Which is the spatial pattern of the simulated trends?

### Magnitude of the trends

#### TRENDS DEFINED AS LINEAR REGRESSIONS



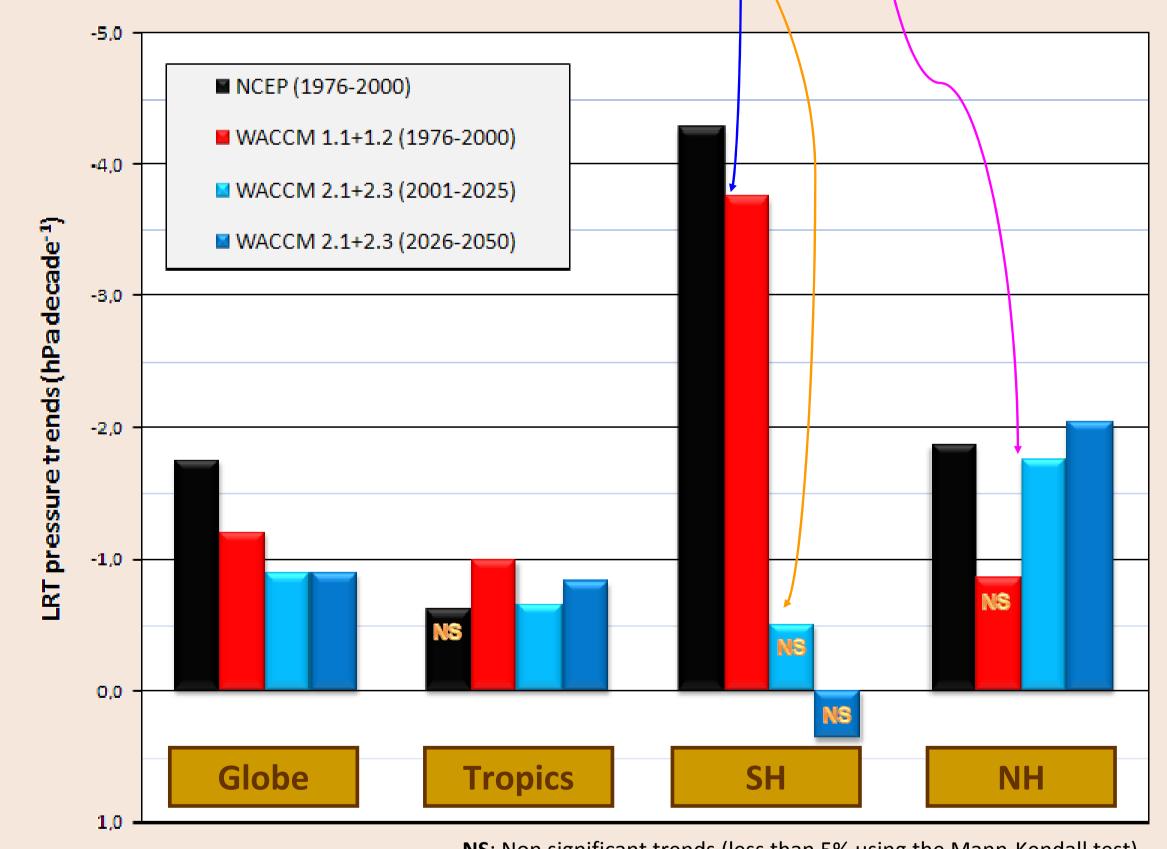
- Few significant trends over the northern mid and high latitudes.
- Positive trends over mid latitudes in both hemispheres.
- High negative trends over the high latitudes of SH.
   WACCM 1.1 + 1.2



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- Intense and significant trends
   appear over high latitudes of NH.
- High negative trends over SH become positive non significant trends.

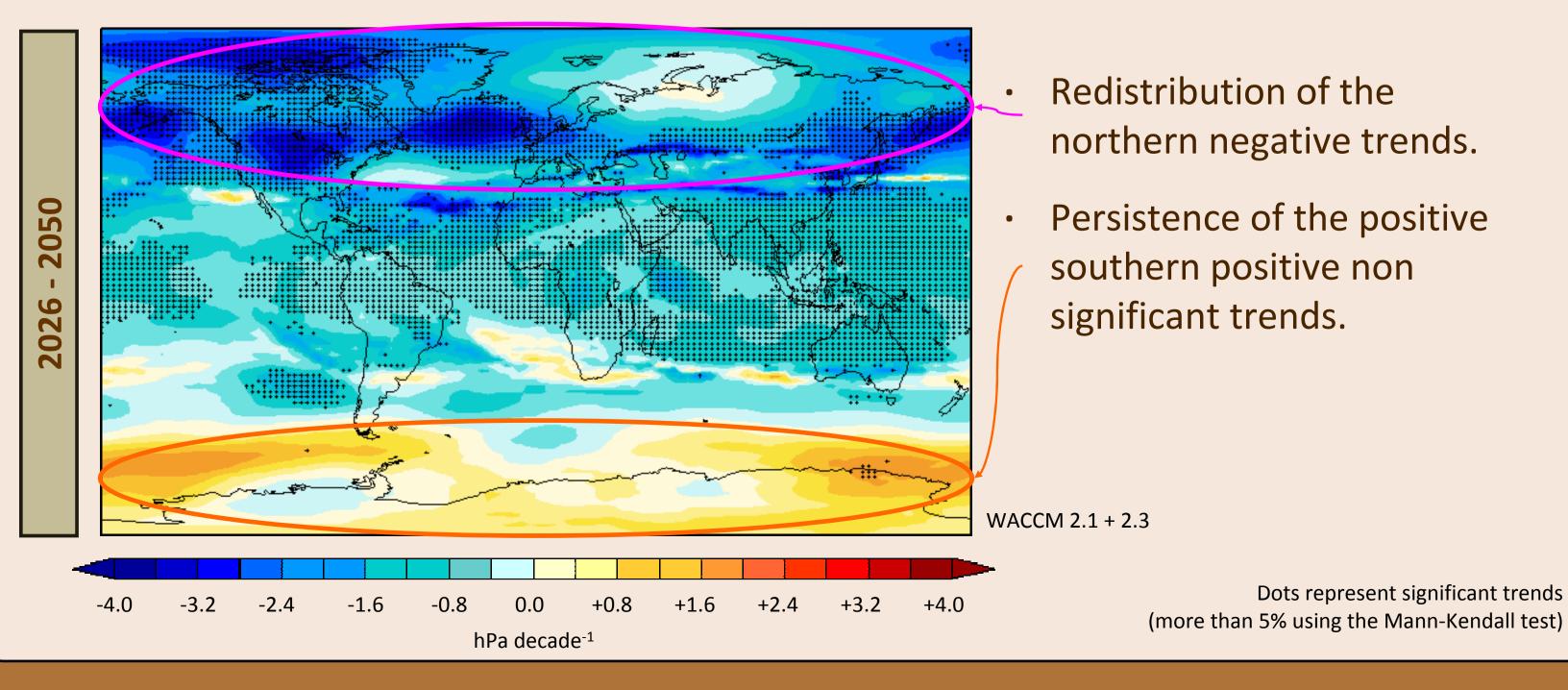
WACCM 2.1 + 2.3



**NS**: Non significant trends (less than 5% using the Mann-Kendall test)

#### 5. Conclusions:

✓ WACCM reproduces correctly the behavior of the global mean tropopause height computed from NCEP reanalysis in the last



four decades of the 20th century. However, the mean values over individual latitudinal bands are not so well simulated.
WACCM projects a continuous decrease of global mean tropopause height during the first half of the 21st century.
WACCM also projects a decrease of tropopause height over all the world except over Antarctica and surroundings.
WACCM projections for the 21st century include changes in tropopause height trends. The most important changes are:
A disappearance of high negative trends in high latitudes over SH.

 An increase of the magnitude of the negative trends over NH.

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