Temperature trends derived from lidar measurements and AMSU: Sesonal and sampling effects

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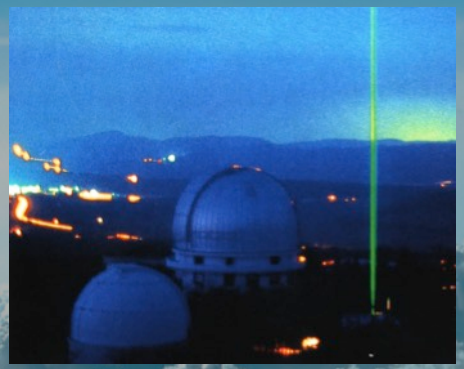
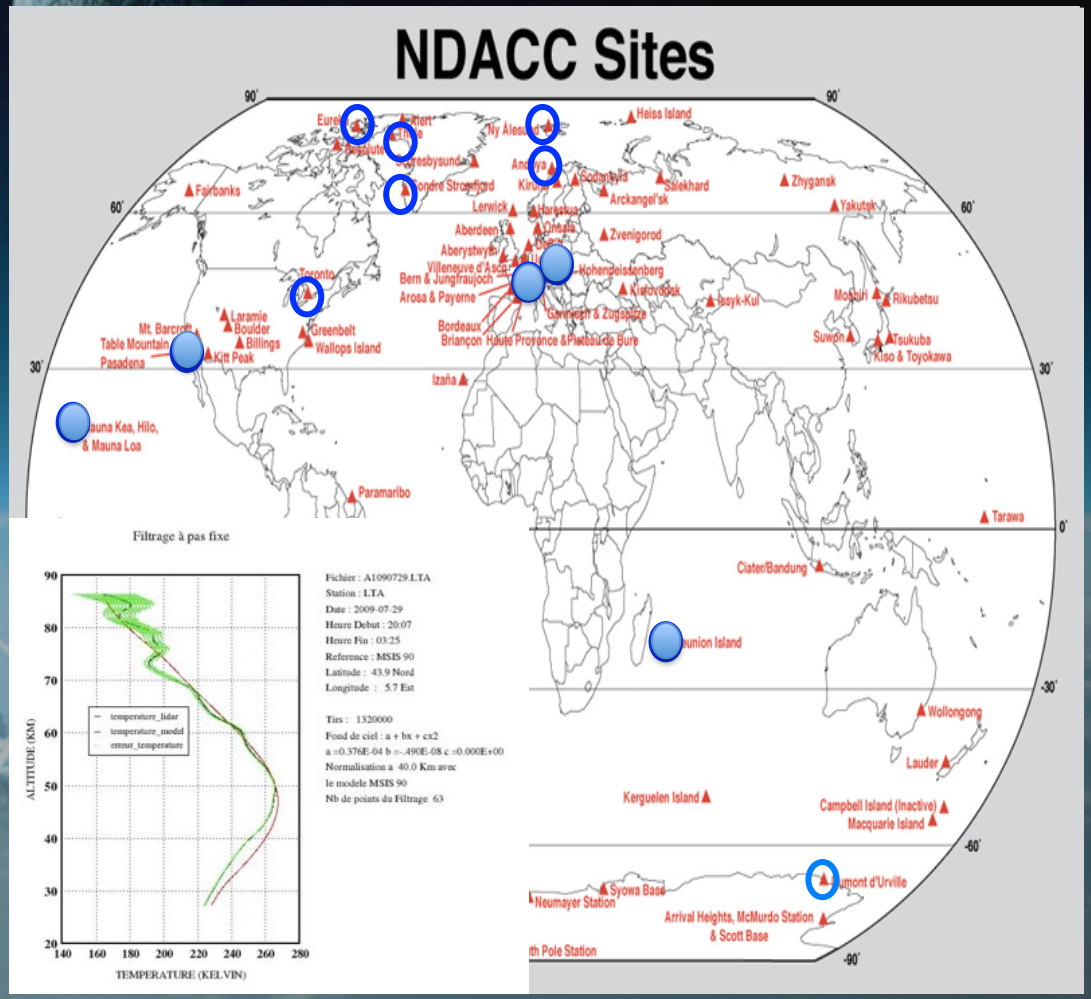
Outline

- Past Works
- Trends derived from AMSU
- Seasonal trends and a new methodology for deriving trends
- Anomalies associated with SSW
- Conclusions

Temperature Lidar series: NDACC network

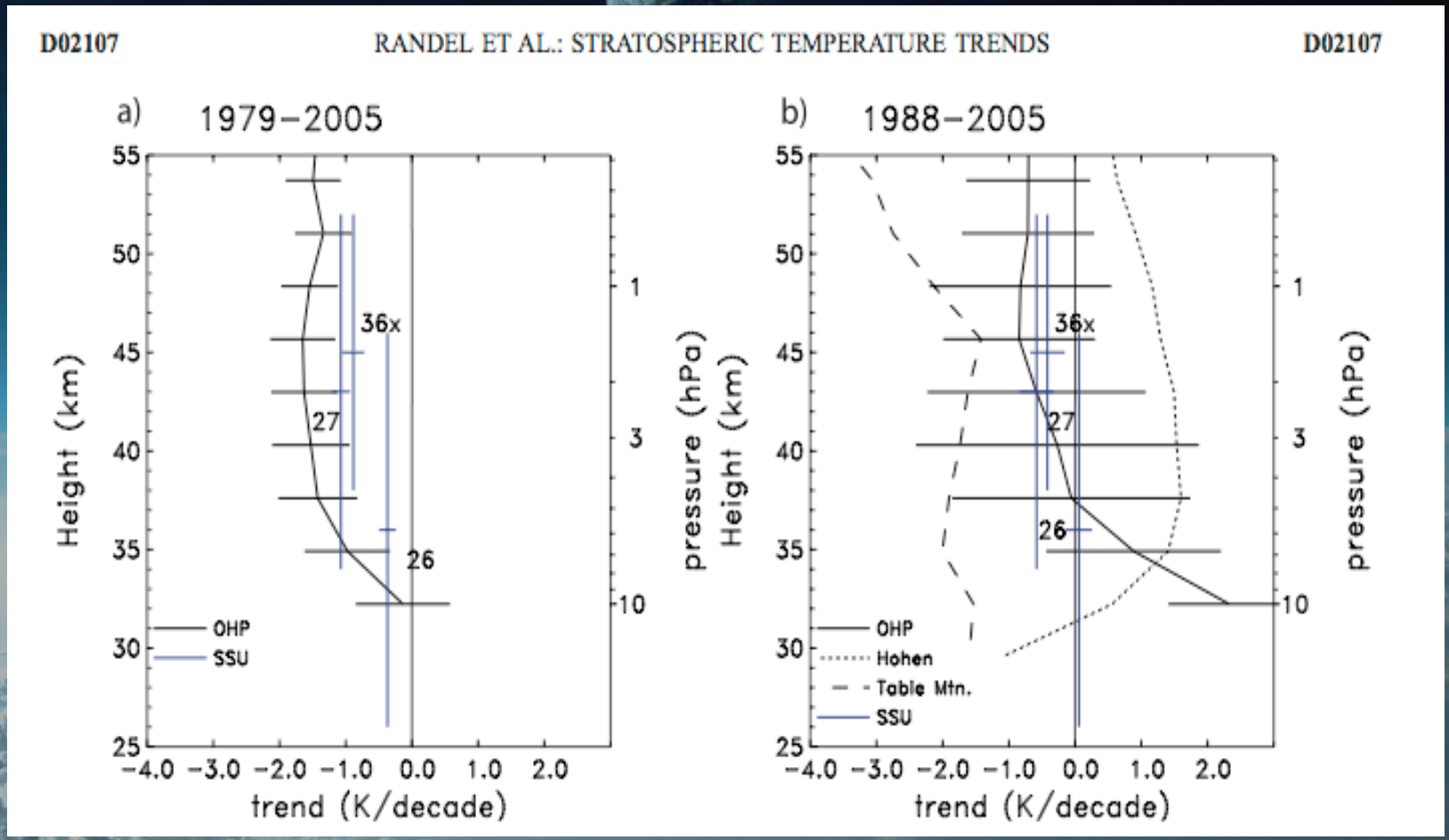
- Hohenpeissenberg 48°N 1987
- Haute-Provence 44°N 1979
- Table Mountain 34°N 1989
- Mauna Loa 20°N 1993
- La Réunion 22°S 1993





Last work within SPARC using Lidar

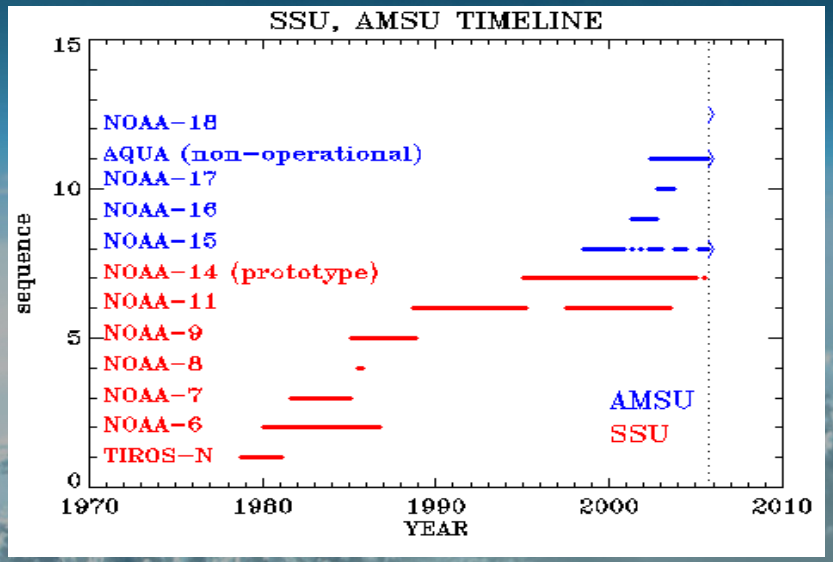
Lidar Trend 1979 et 2005 compared with SSU (a) and 1988-2005 (b)

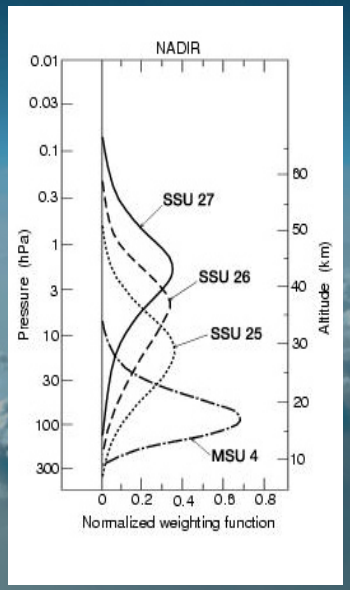


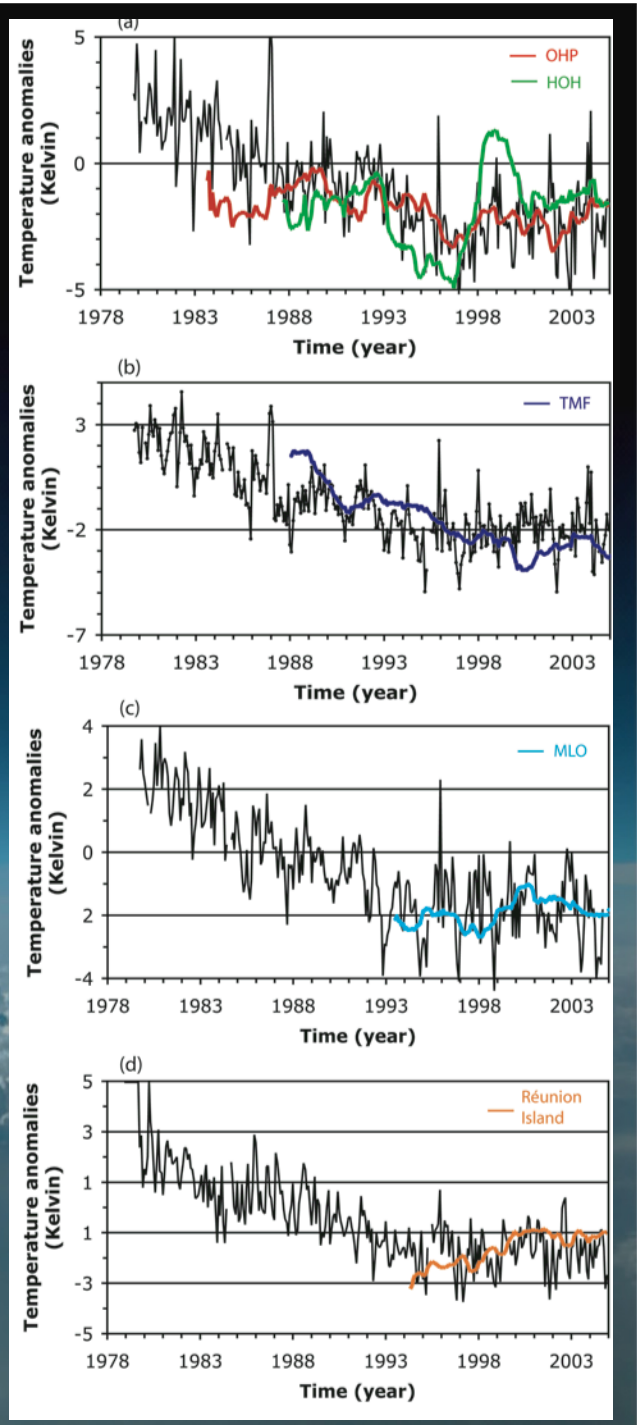
Randel et al, JGR, 2009

Comparisons between SSU-Nash series and lidars

- Comparisons between lidar and SSU present some agreements and disagreement.
- Both SSU and lidar show a cooling up to 1995-1997 and no trend up to 2005.





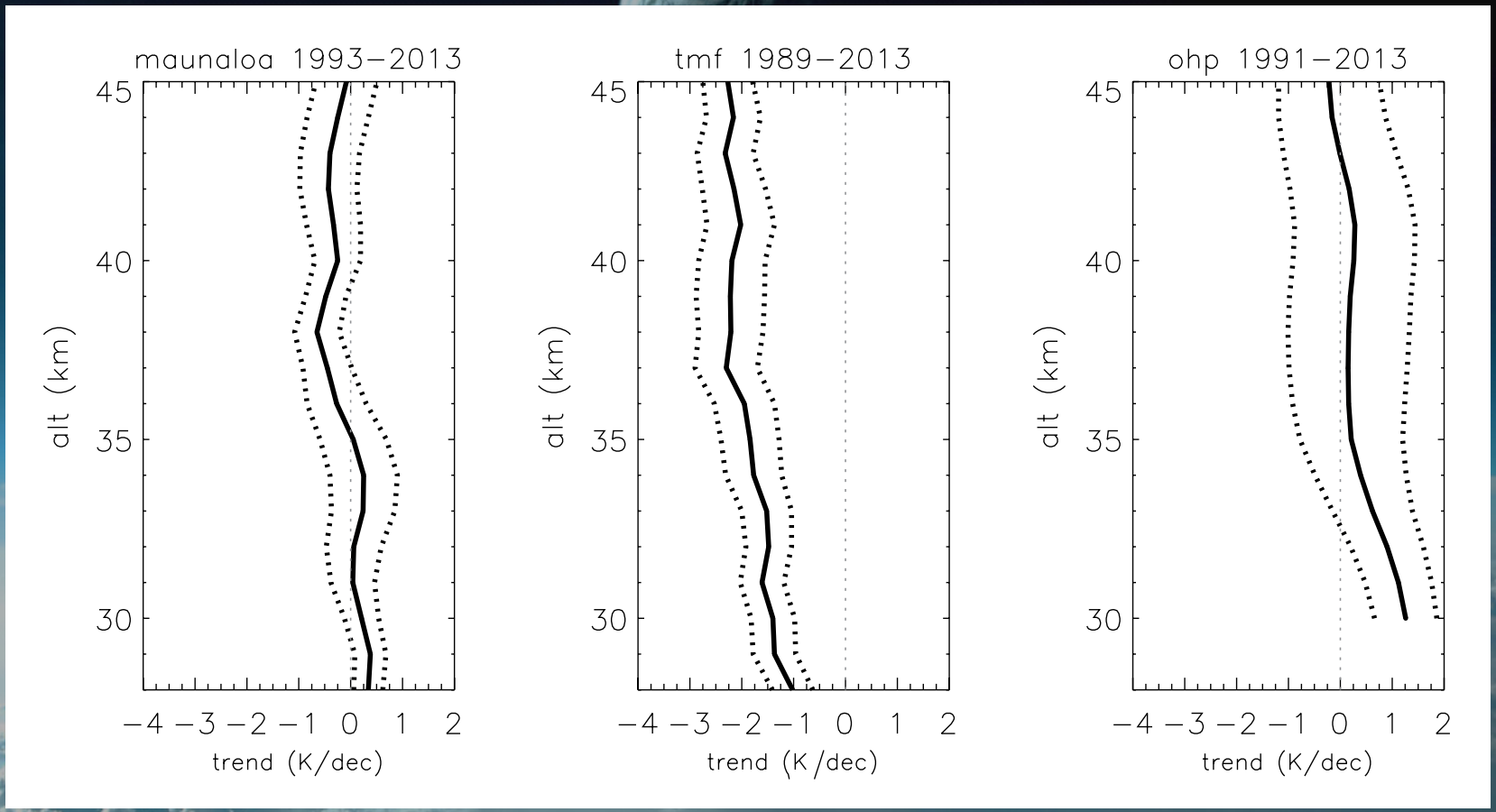


1979 SSU 2004
AMSU 1999 now

Keckhut et al., JASTP, 2011

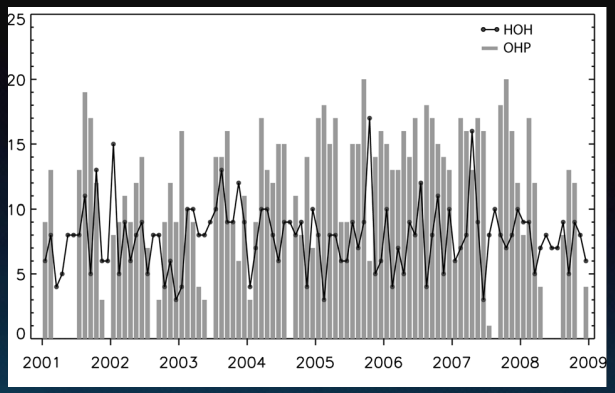
SPARC 2015

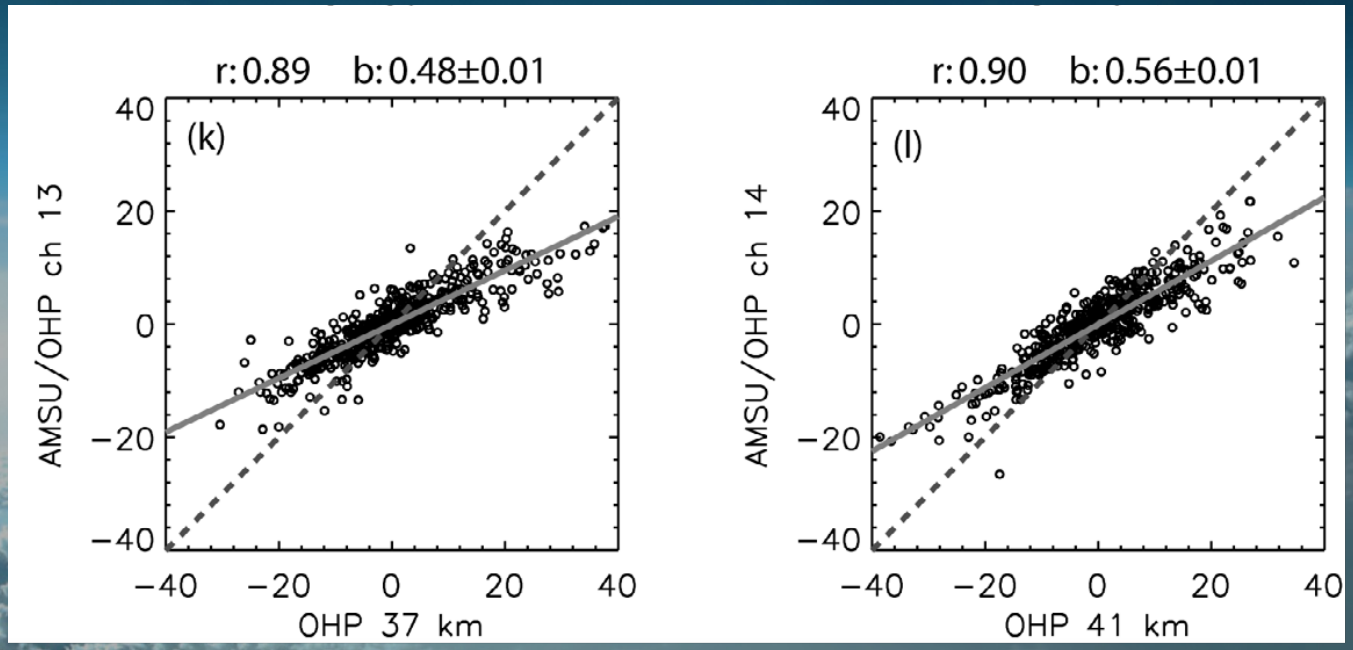
NDACC Lidar trends updated



AMSU-Lidar comparisons

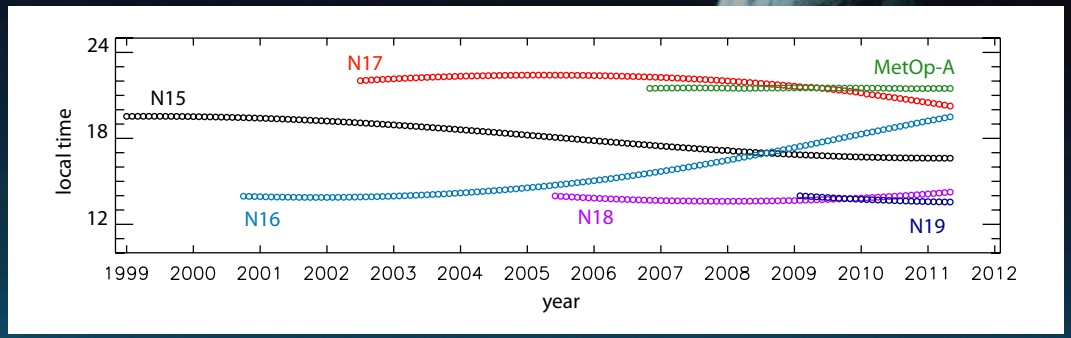
- Good agreement
- Lidar exhibits more variability
- Lidar trends sensitive to sampling effets

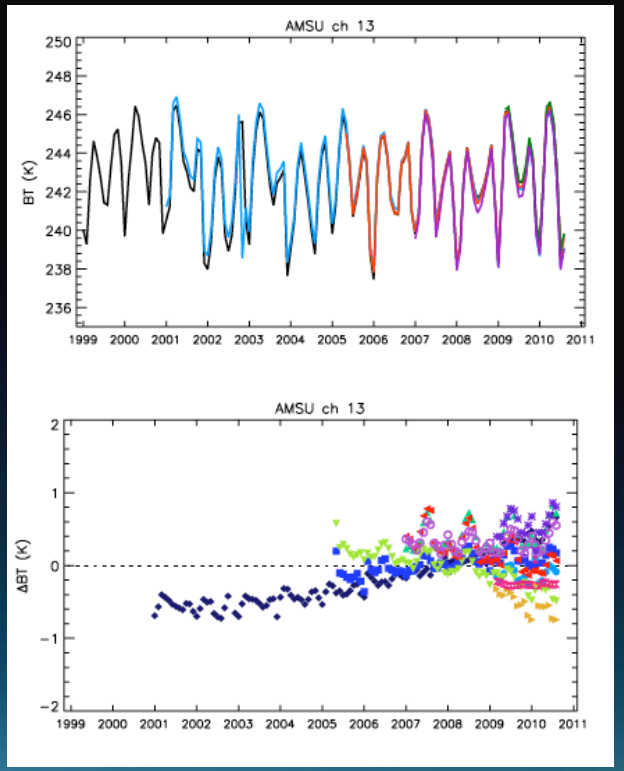




Funatsu et al., JGR, 2008, 2011

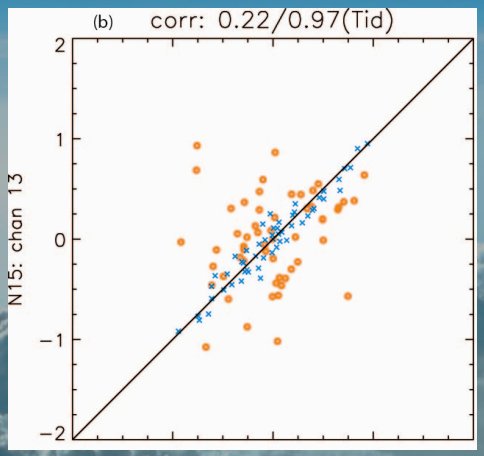
Tidal effects on AMSU 15 and 16





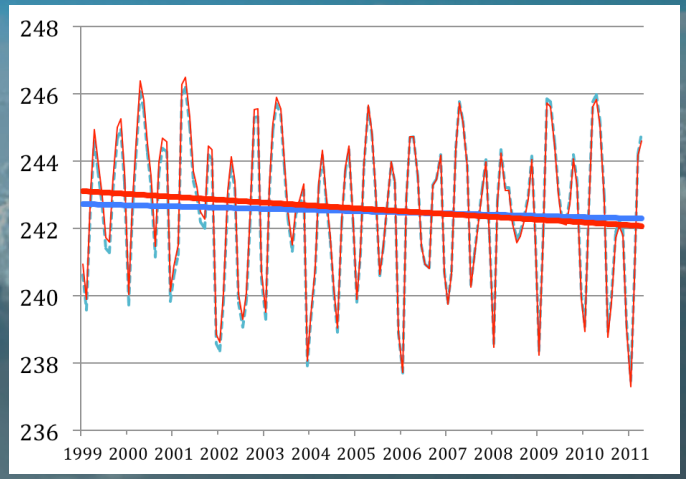
Channel 13, 10°S-10°N

N15



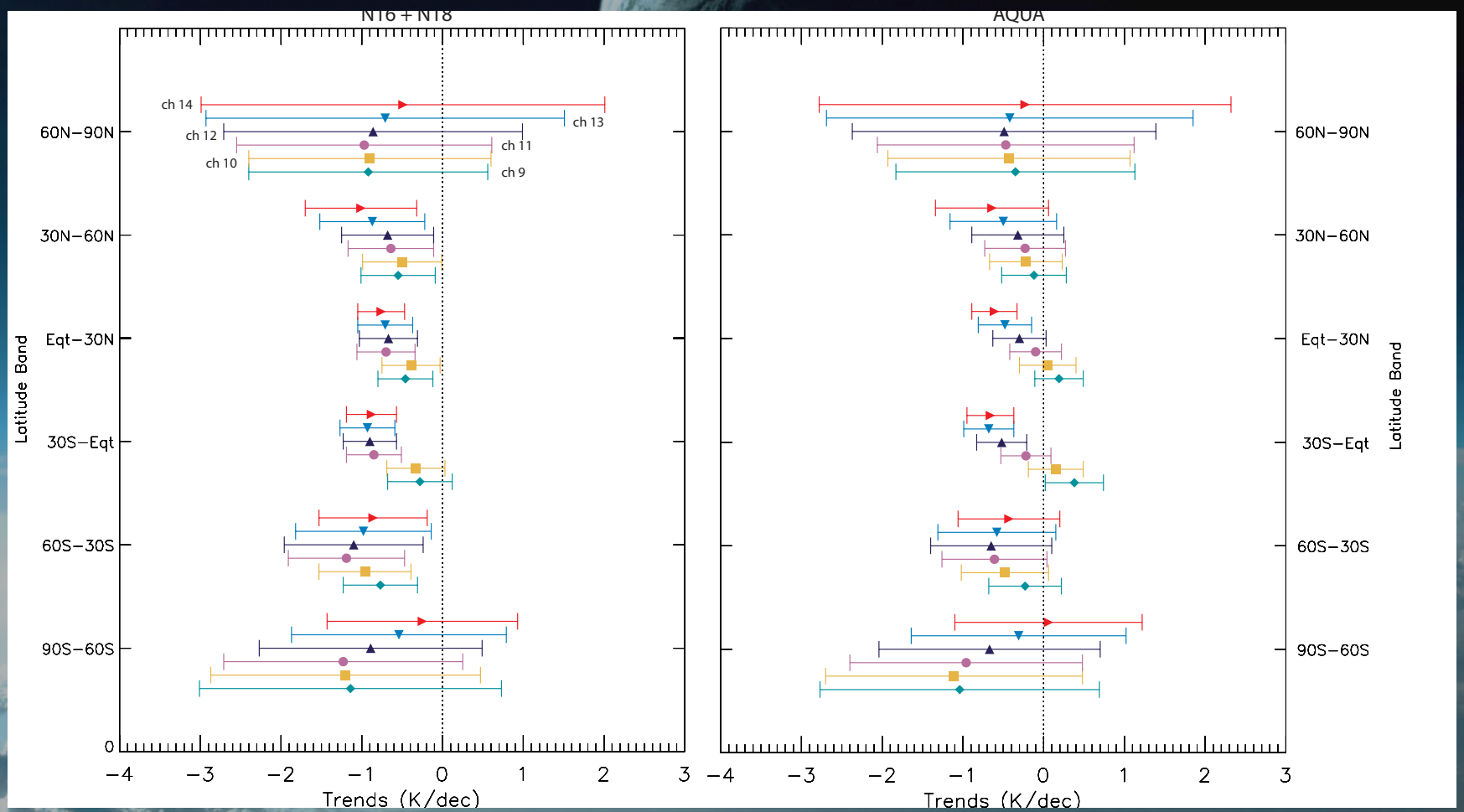
N16

Tidal Corrected →

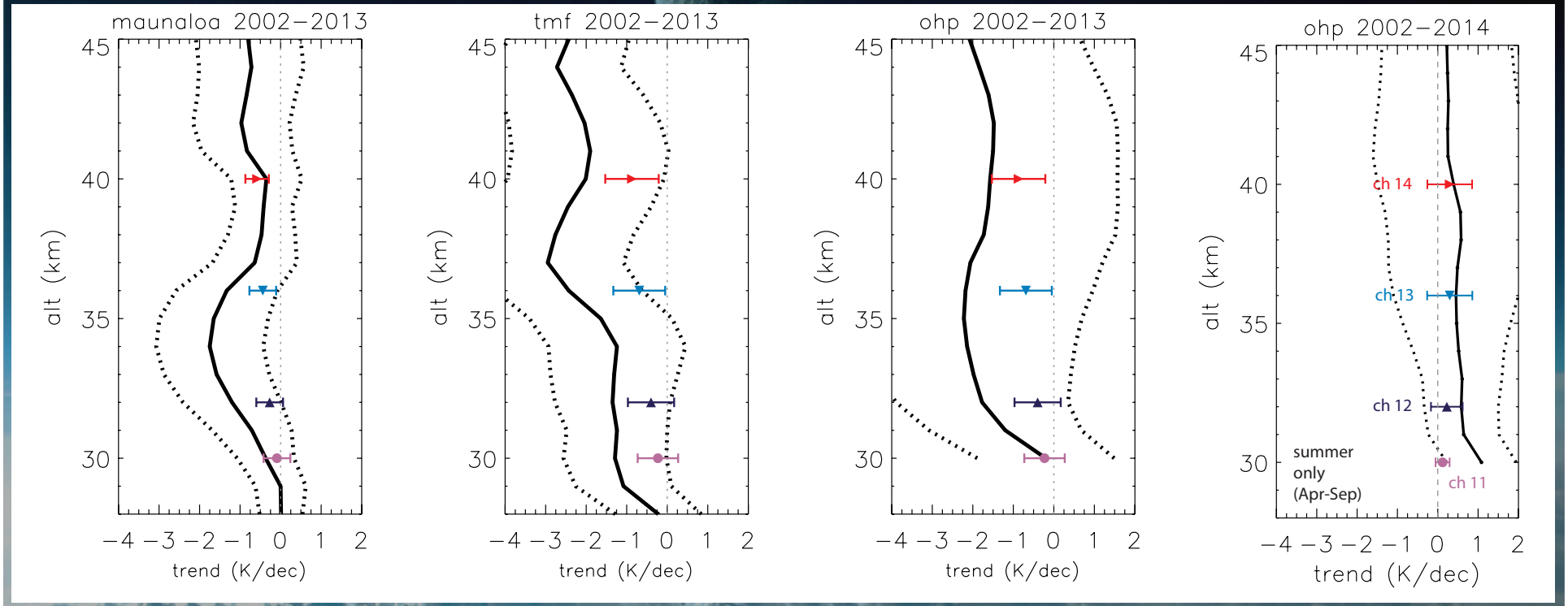


Keckhut et al, QJRMS, 2014

AMSU Trends 2002-2012
NOAA 15-16 and AMSU AQUA

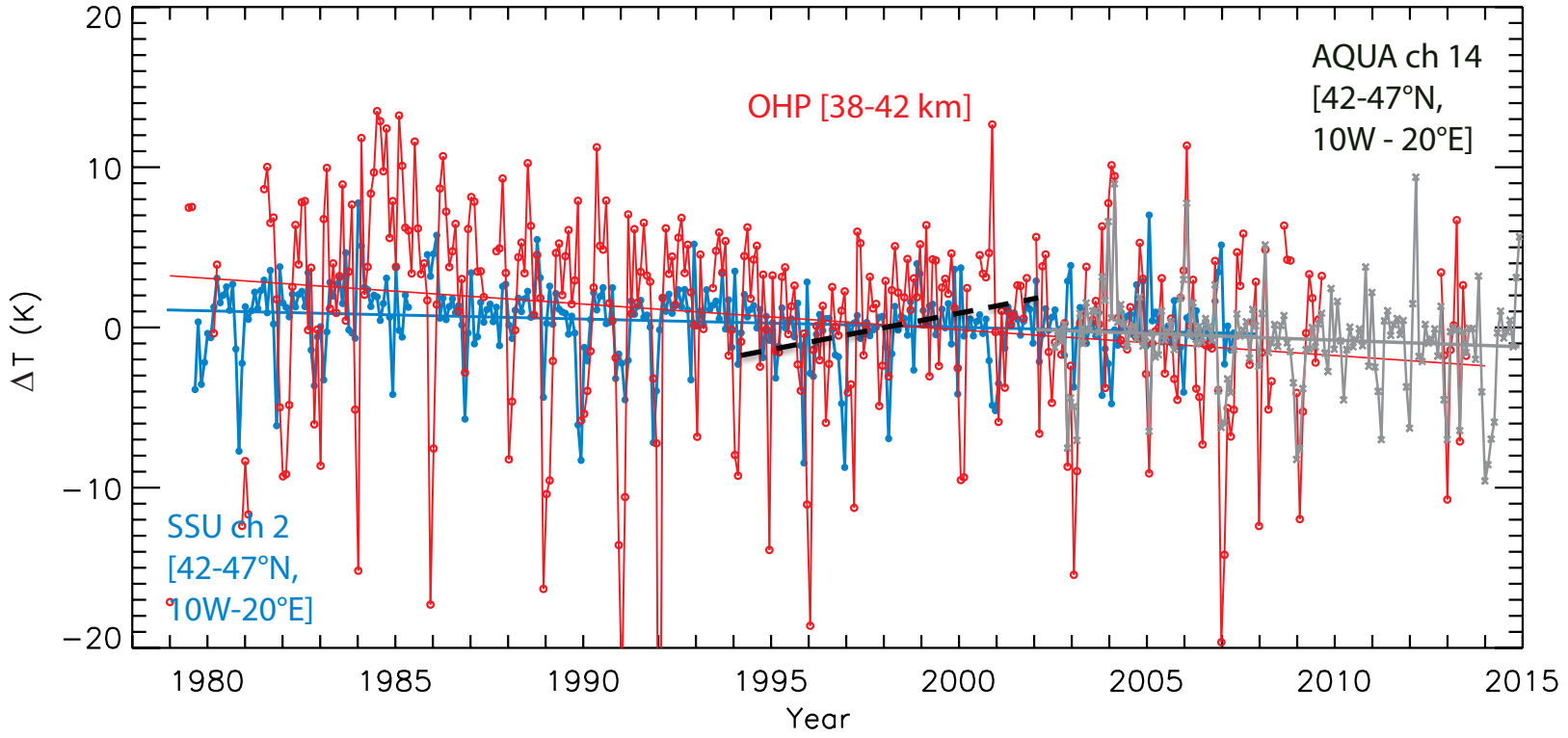


Lidar AMSU trends comparisons 2002-2013

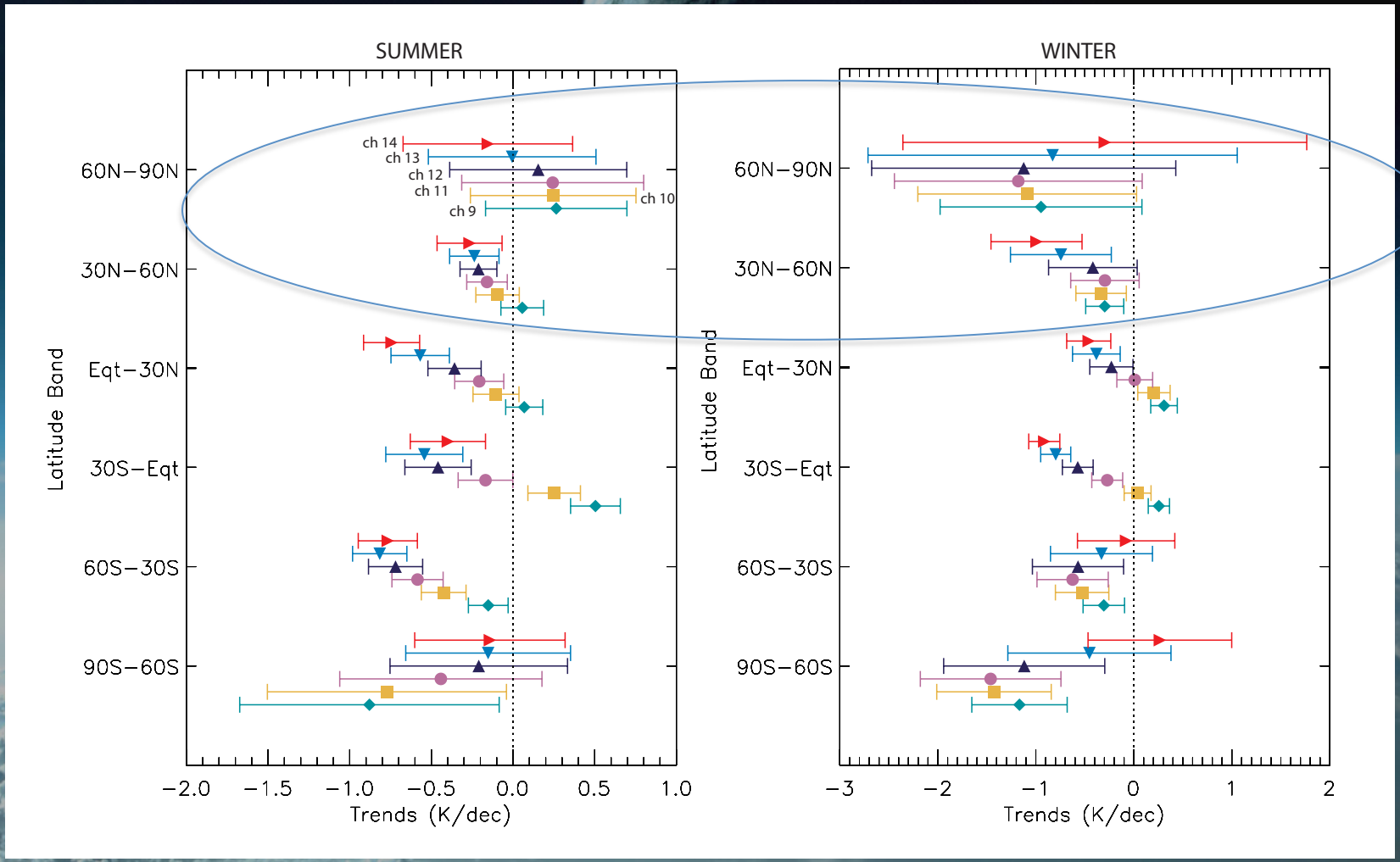


SSU-AMSU-Lidar

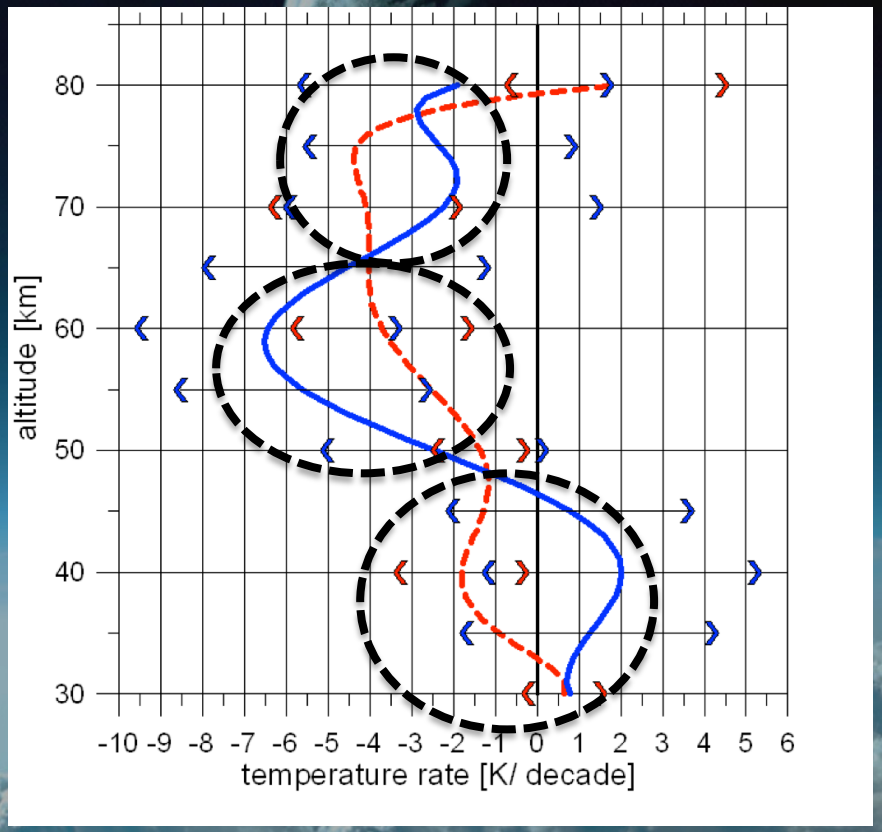
Trends – Lidar: -1.56±0.72 – SSU: -0.51±0.2 – AMSU:-0.83±1.01 K/decade



Seasonal AMSU Trends 2002-2012



Trends above OHP (44°N) 1979-2009

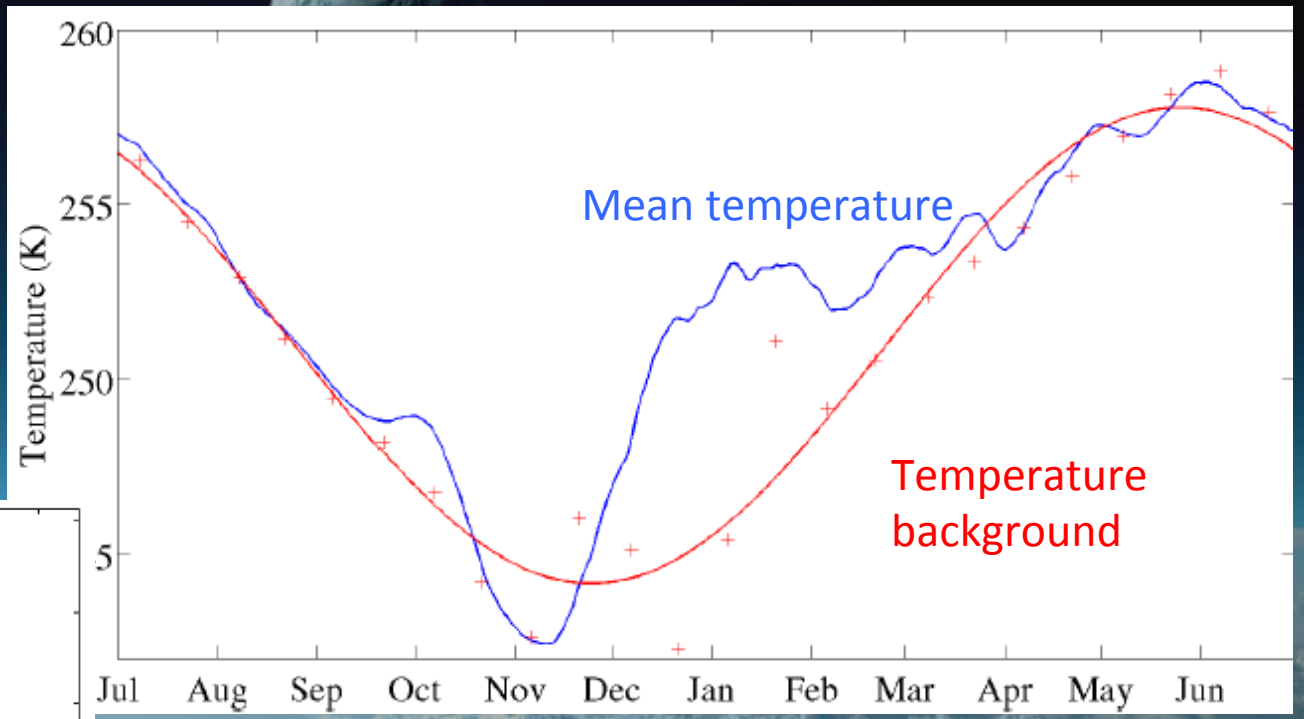


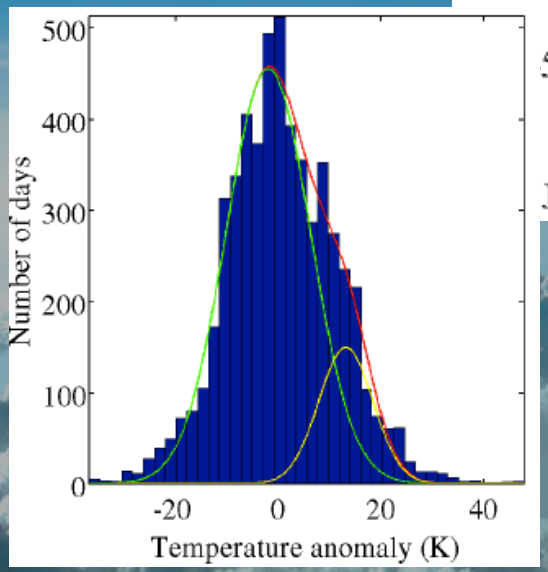
- Summer trends (Oct-Mar)
- Winter trends (Apr-Sept)

Revisiting mean temperatures

Background temperature ≠ Mean temperature

Seasonal change exhibits warming in winter

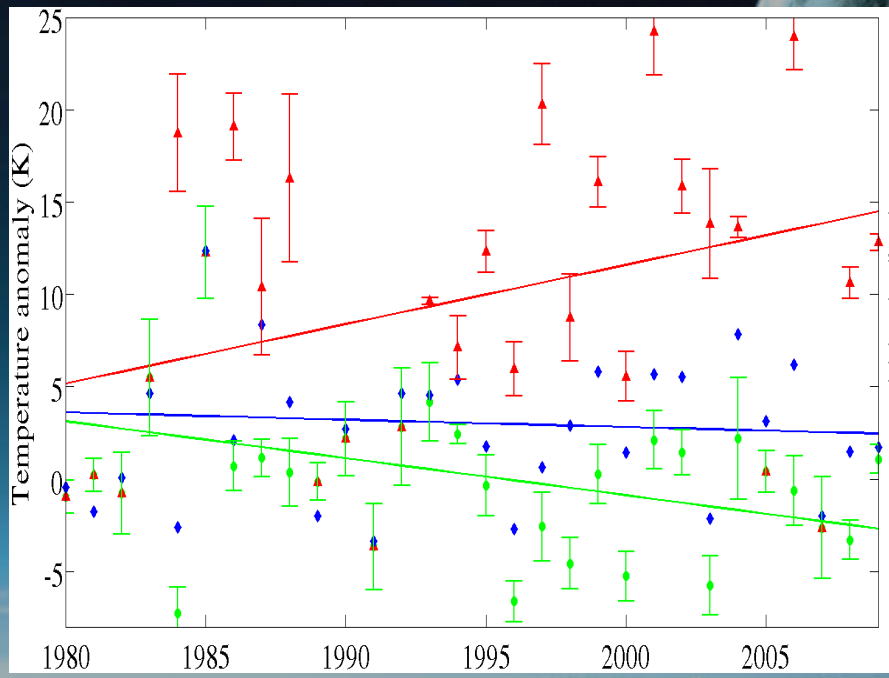


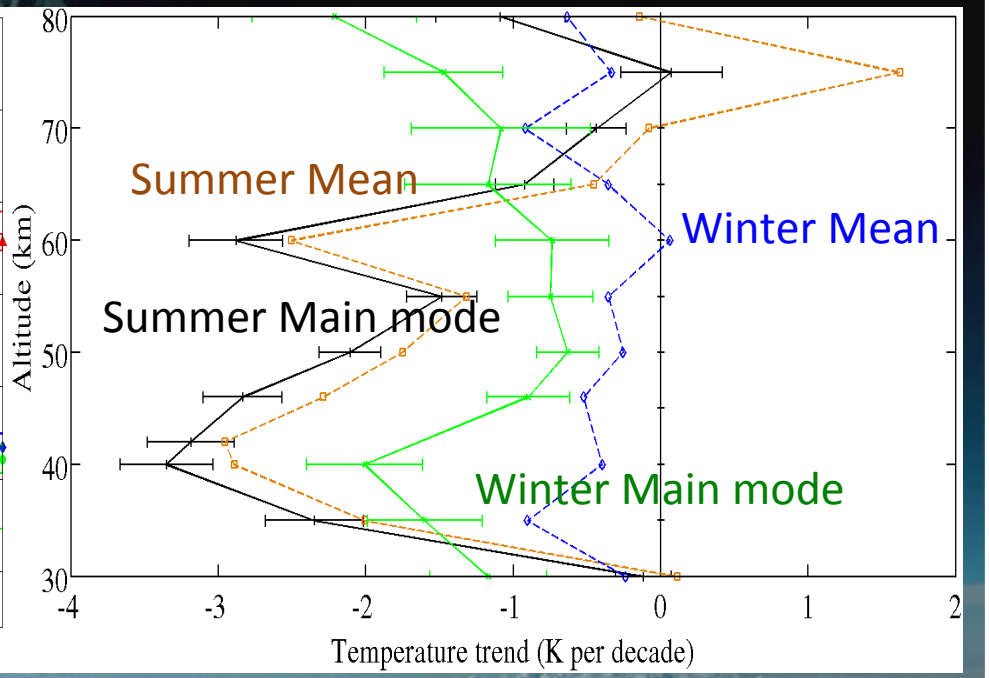


Temperatureanomalies in winter shows multimodel distributions:

- Temperature background (radiative + mean dynamic effects)
- Temperature anomalies associated with SSW

New trend analyses





Background trends are more negative that trend estimates using mean temperature

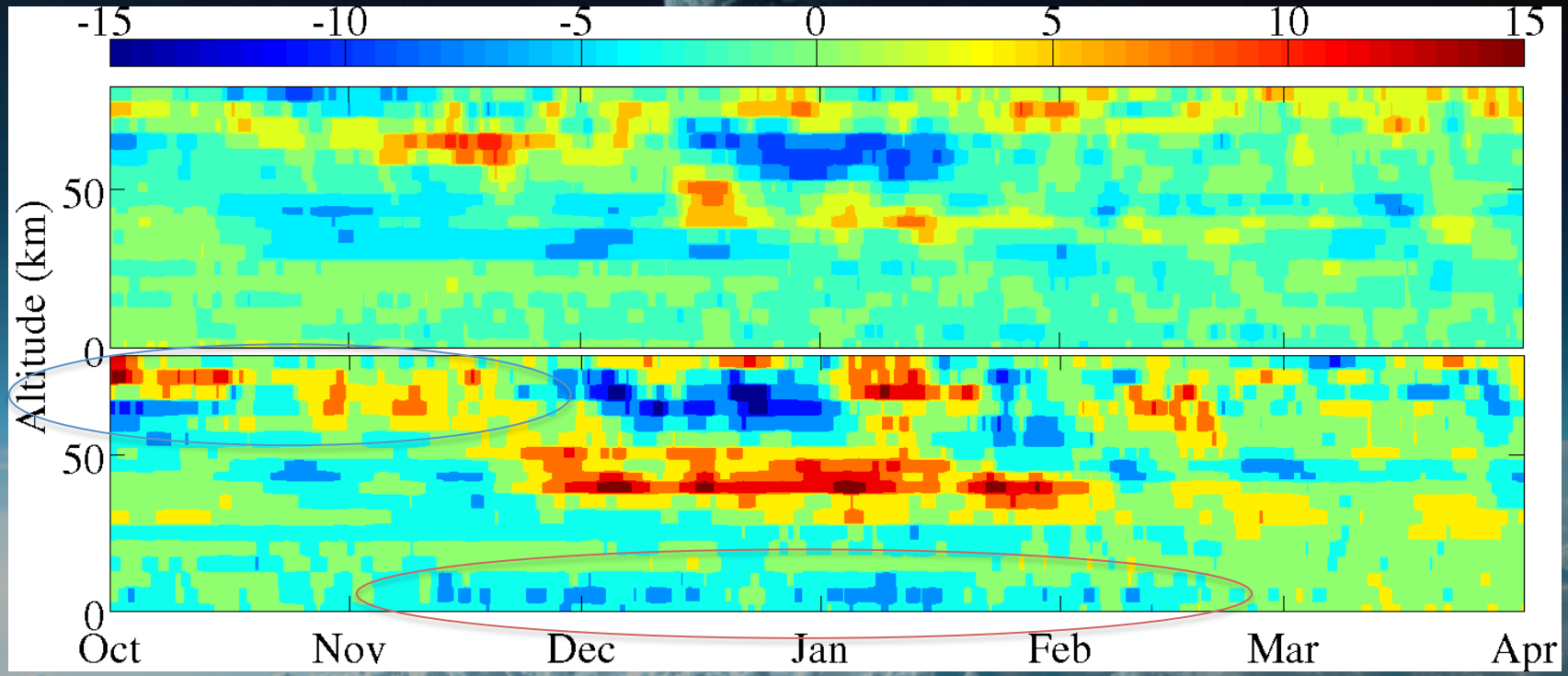
New trend winter estimates closer to summer trend estimates

Radiative winter trends in the stratosphere are partly compensated by dynamical feedbacks

Angot et al., JGR, 2012

Mean temperature evolution during major stratospheric warmings

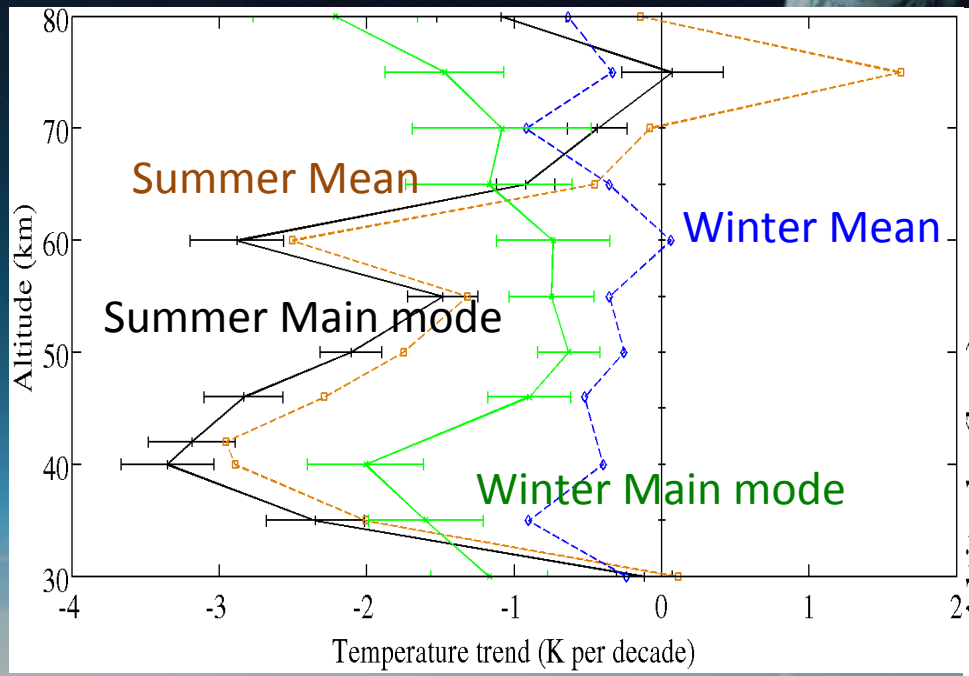
Means of years without major Stratospheric Warmings (11)

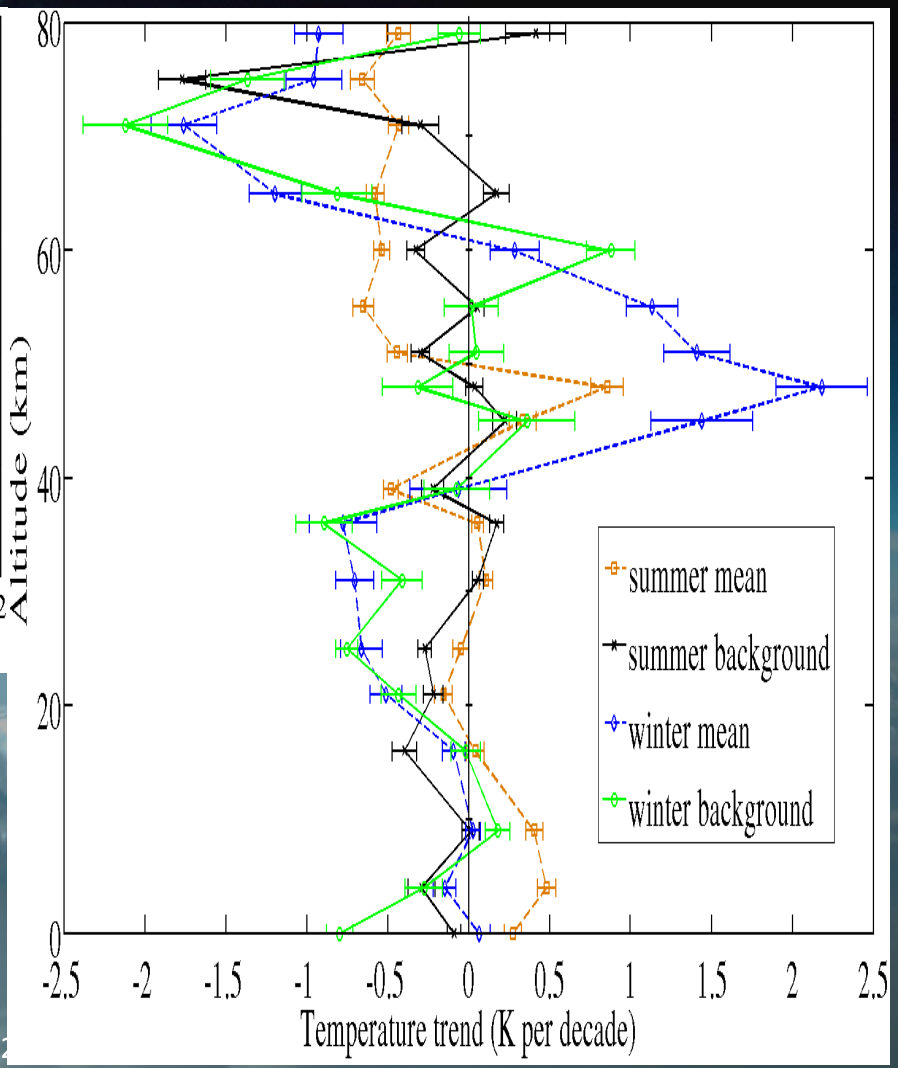


Means of years with Major Stratospheric Warmings (13)

Angot et al., JGR, 2012

Comparisons with a similar analysis of the CMAM-20 (1990-2010)





Conclusions

- OHP Lidar has been compared with SSU and now AMSU.
- Agreements and differences are reported when looking different sites, probably due to sampling effects.
- Combining different AMSU allows to derive trends with better confidence.
- Lidar analyses reveal the contribution of SSW on trends and may explain sampling effects and geographical trend differences.