

Réévaluation de la tendance de la température stratosphérique observée par les sondeurs spatiaux et les lidars au sol

Alain Hauchecorne¹, Chantal Claud², Philippe Keckhut¹,, Beatriz Funatsu^{2 3}, Sergey Khaykin¹,

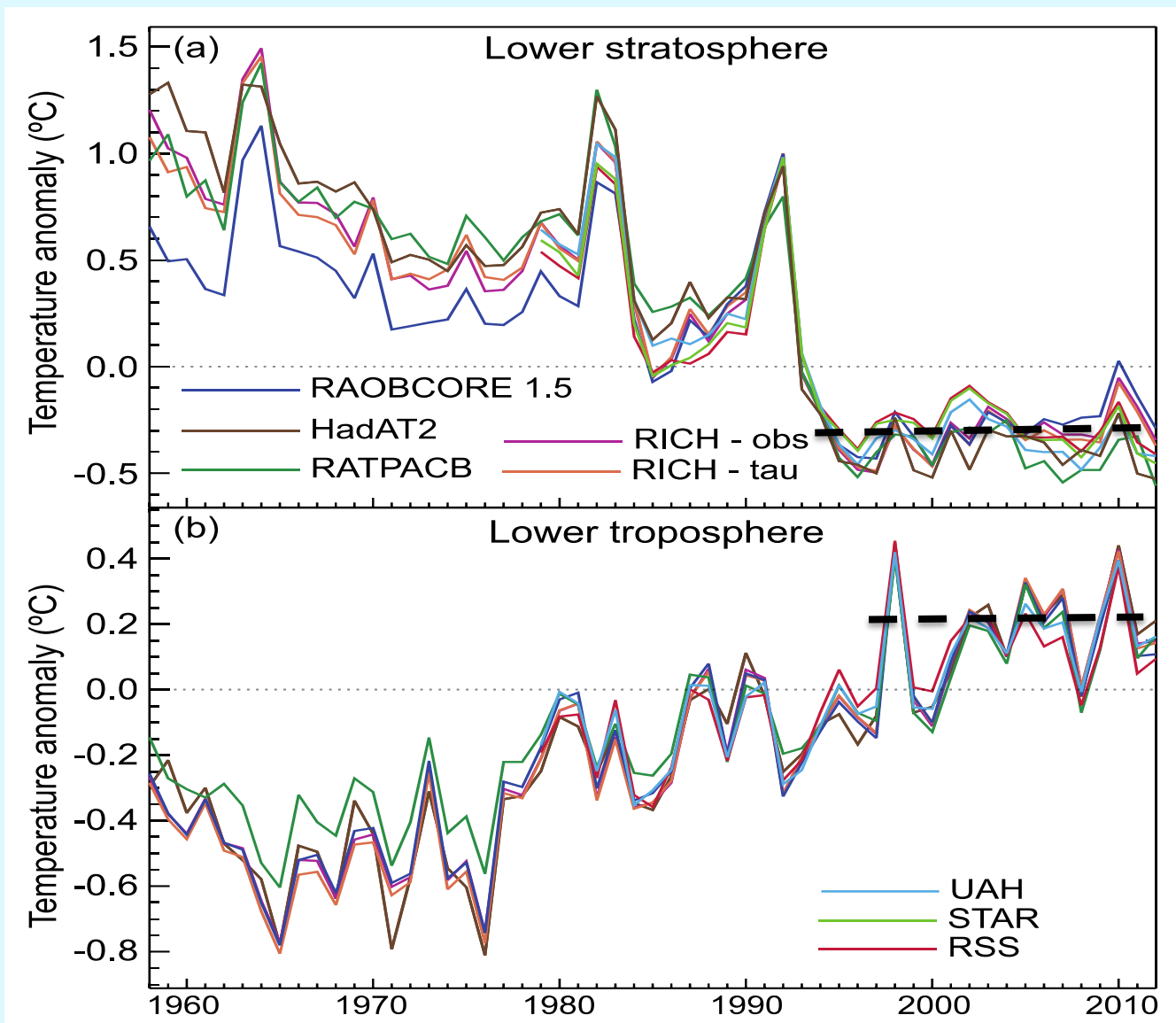
(1) LATMOS/IPSL, UVSQ, PMC, CNRS, Guyancourt, France

(2) LMD/IPSL, Ecole Polytechnique, ENS, UMC, CNRS

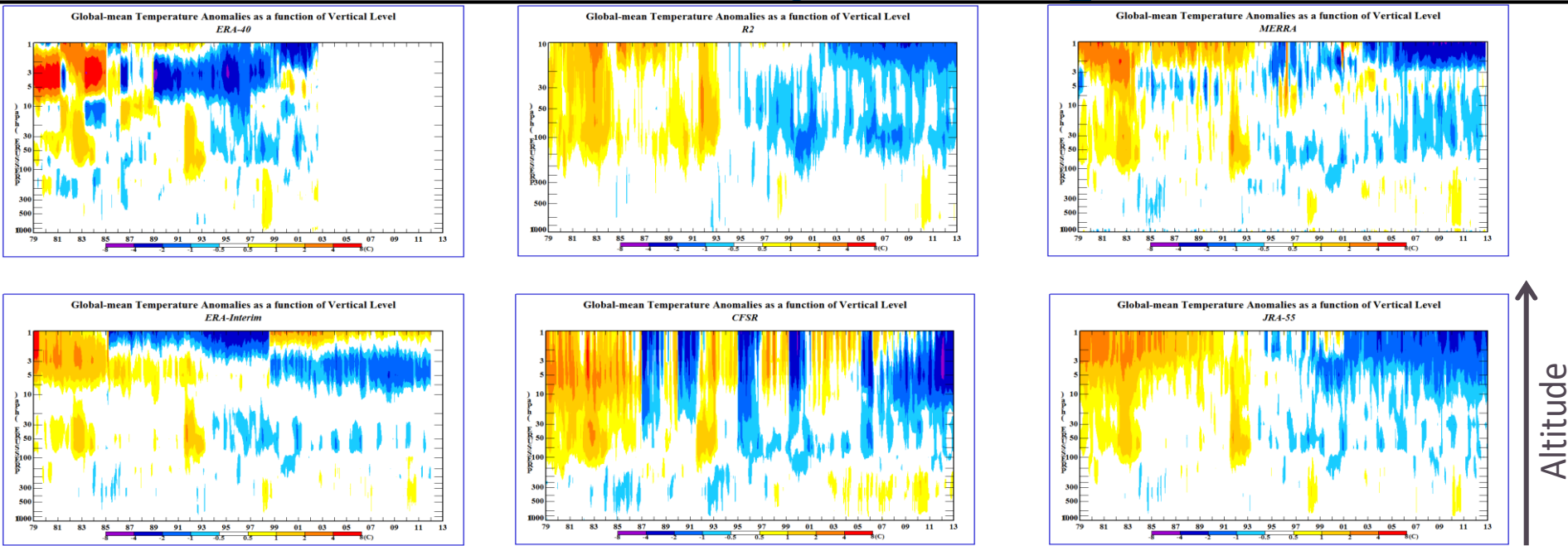
(3) LETG-Rennes-CO TEL, Université de Rennes, CNRS

Evolution de la température dans la basse stratosphère

IPCC-AR5 2014



L'apport des réanalyses ?



T Anomalies in 6 Reanalyses 1979 – 2012

Temperature scale: -8 to +8 K
1000 – top

*Figure courtesy of Craig Long
SPARC Analysis-Reanalysis Intercomparison Project*



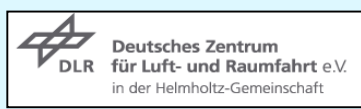
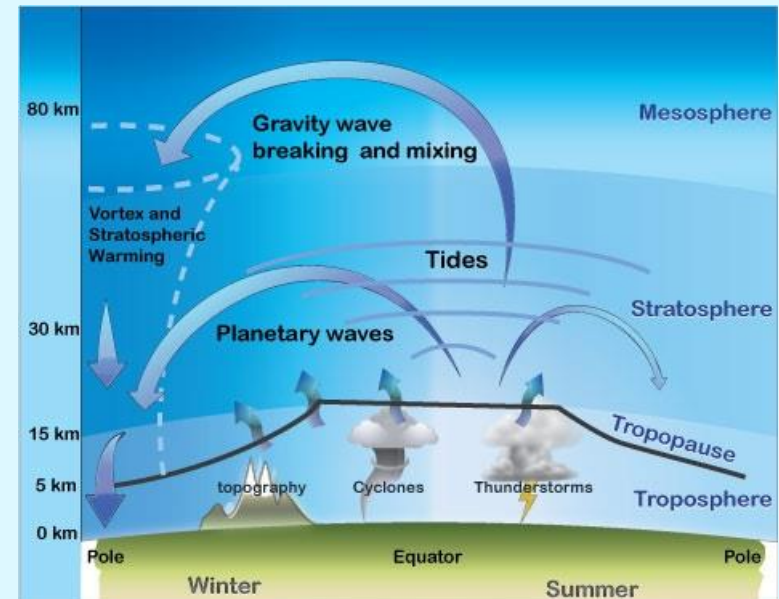
ARISE 1 (2012-2014)
ARISE 2 (2015-2018)



Atmospheric dynamics Research InfraStructure in Europe

Infrastructure Design Study funded by FP7 and H2020 programs, coord. Elisabeth Blanc, CEA

Project objective: Better understanding of the dynamics of the troposphere-stratosphere-mesosphere exchanges including contribution of gravity waves (GW) and planetary waves (PW).

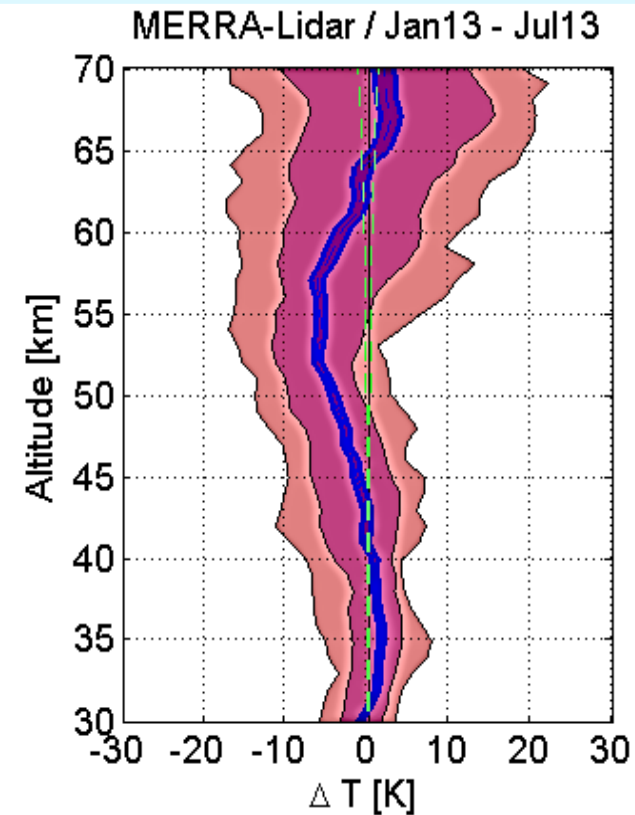
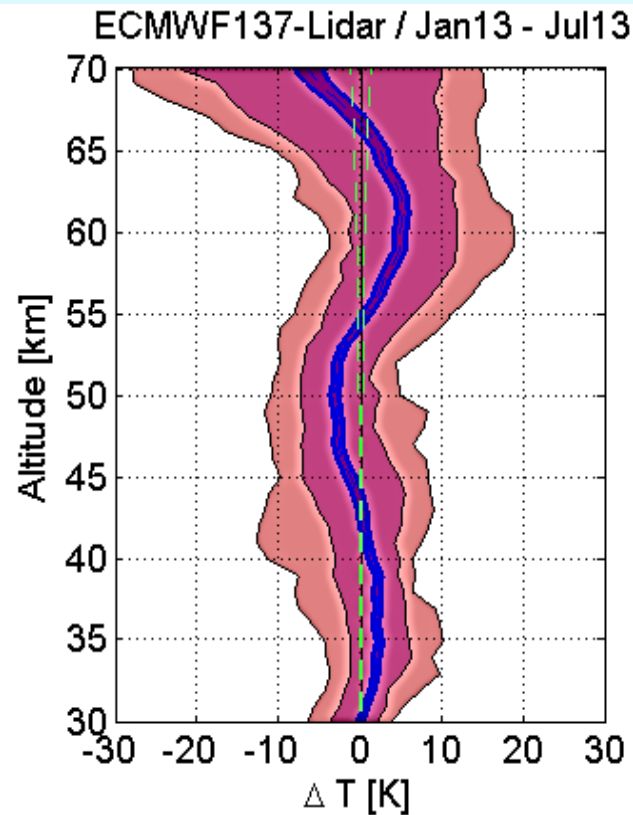
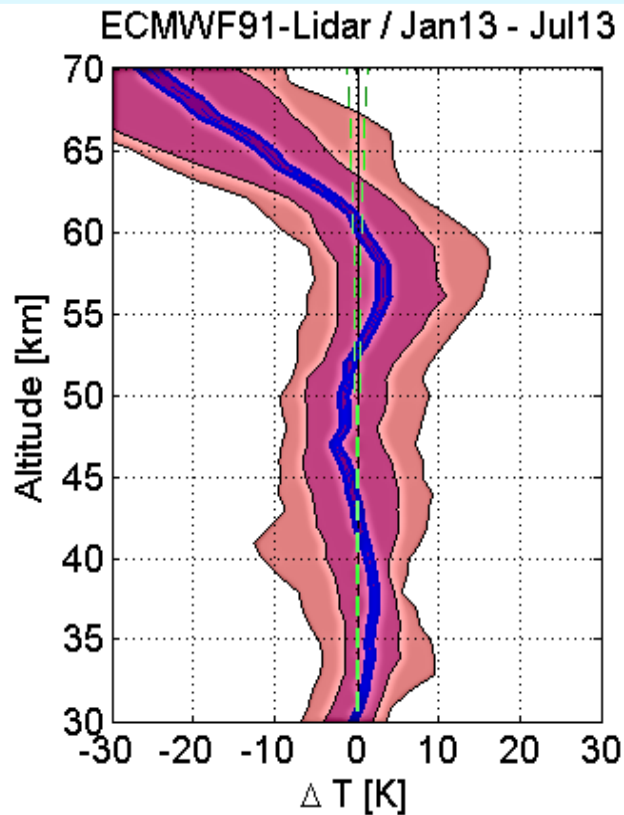


Validation des profils ECMWF opérationnels avec le lidar Rayleigh de l'OHP

91 niveaux

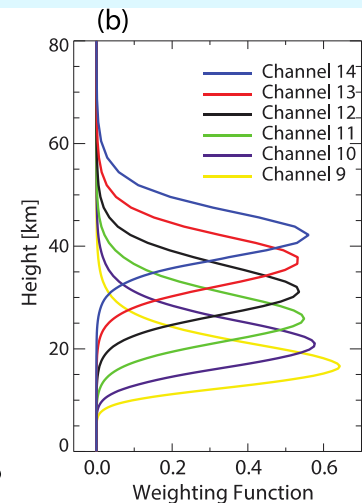
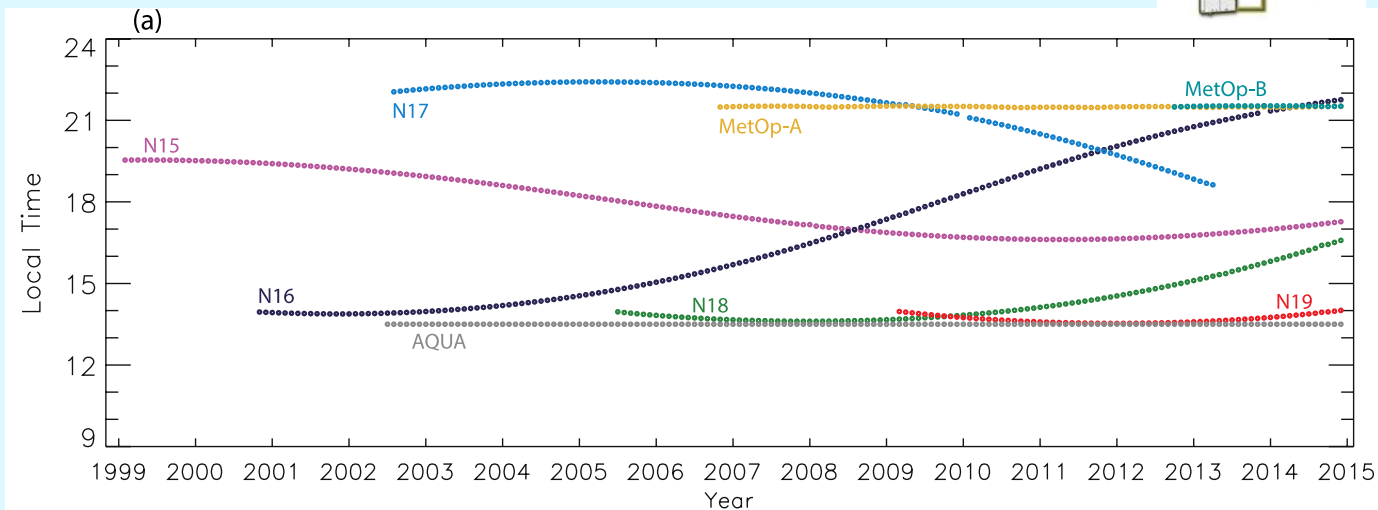
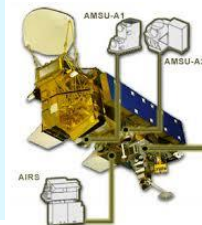
137 niveaux

MERRA



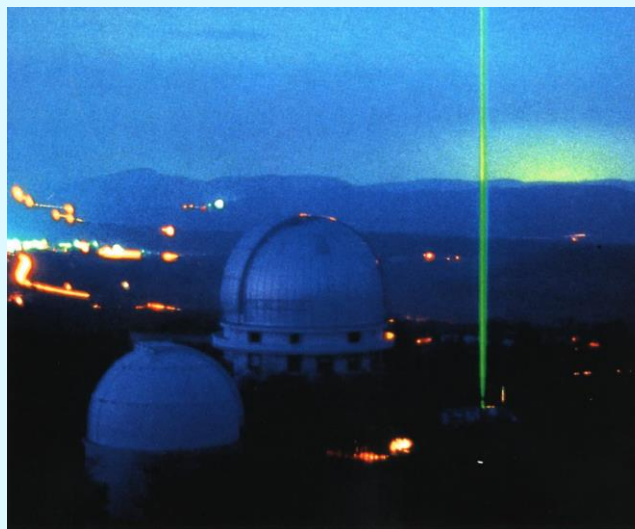
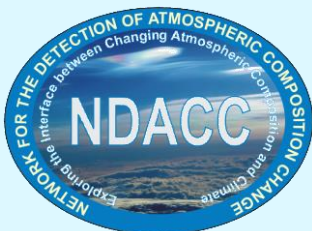
AMSU data Advanced Microwave Sounding Unit

On board NOAA, AQUA and MetOp satellites since 1998

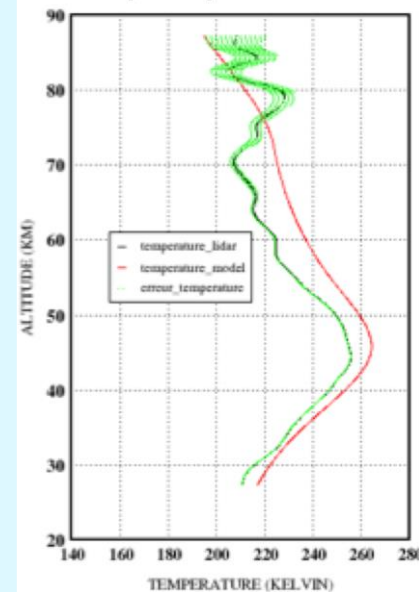


SSU Stratospheric Sounding Unit 1979-2006

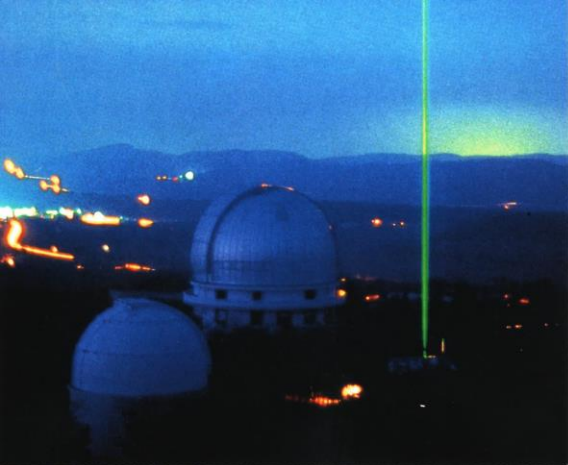
NDACC Rayleigh lidar data



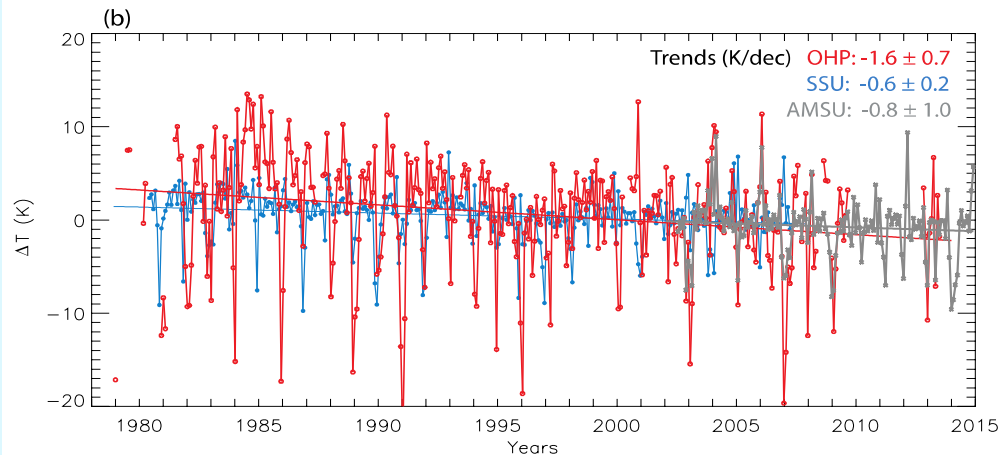
17/01/2013



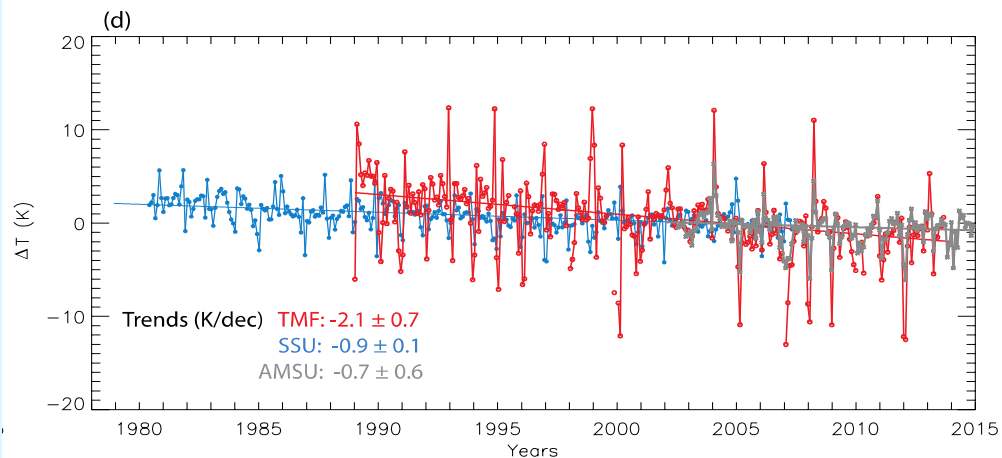
- Observatoire de Haute-Provence, OHP, 44N, 6E
- Table Mountain, TMF, 34N, 118W
- Mauna Loa, MLO, 19N, 156W



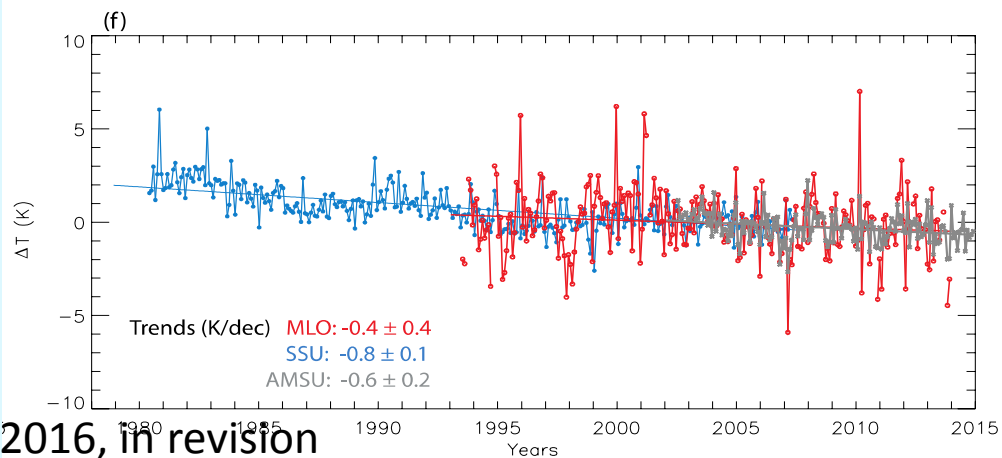
OHP
44°N



TMF
34°N

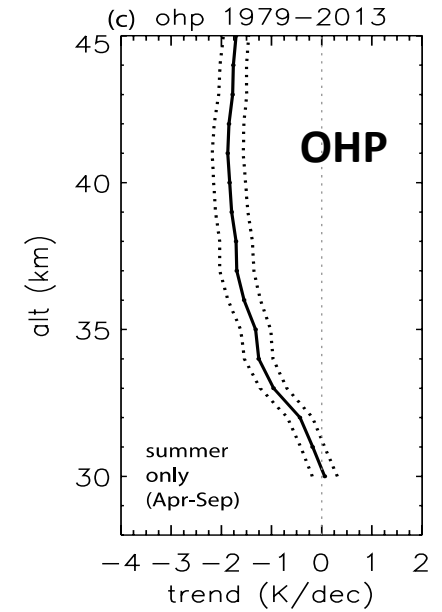
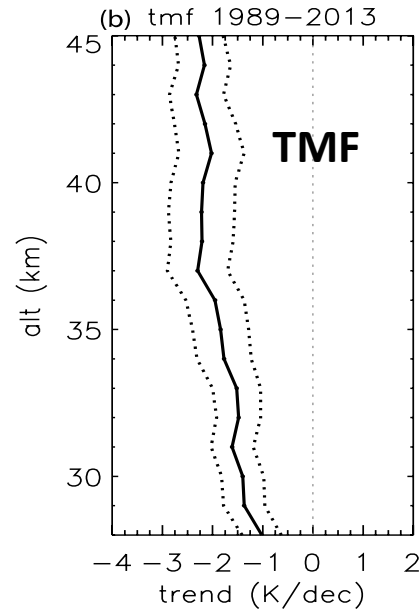
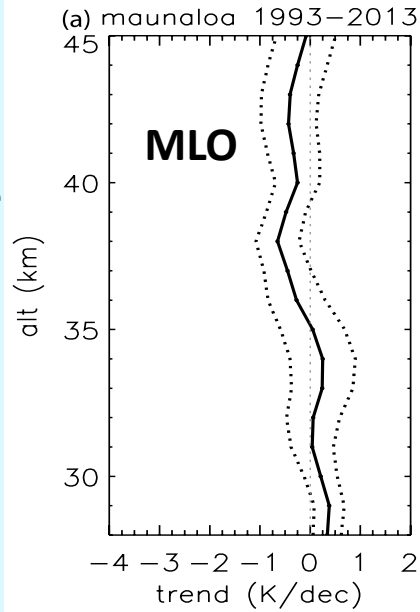


MLO
20°N

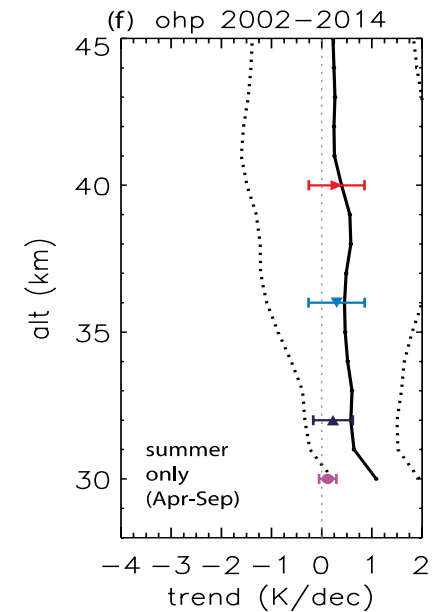
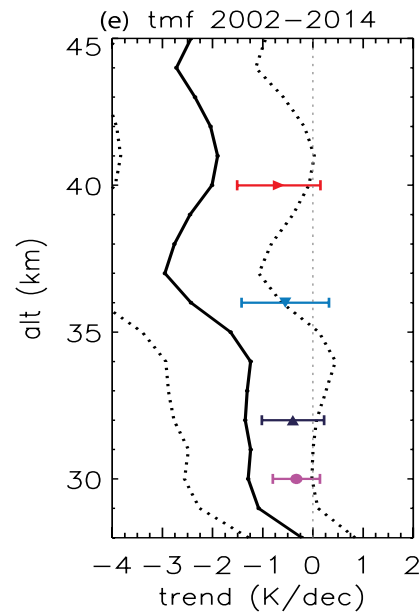
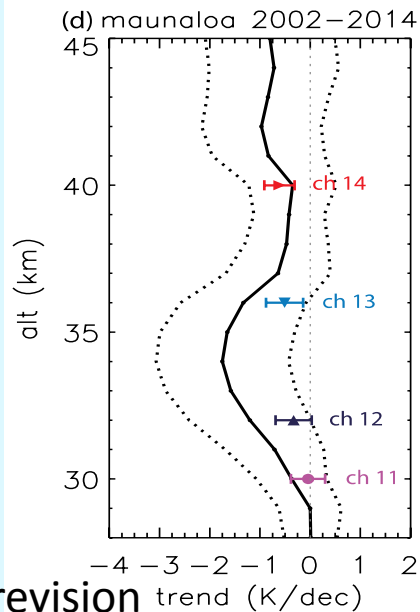


Rayleigh lidar vs AMSU temperature trend

Période complète

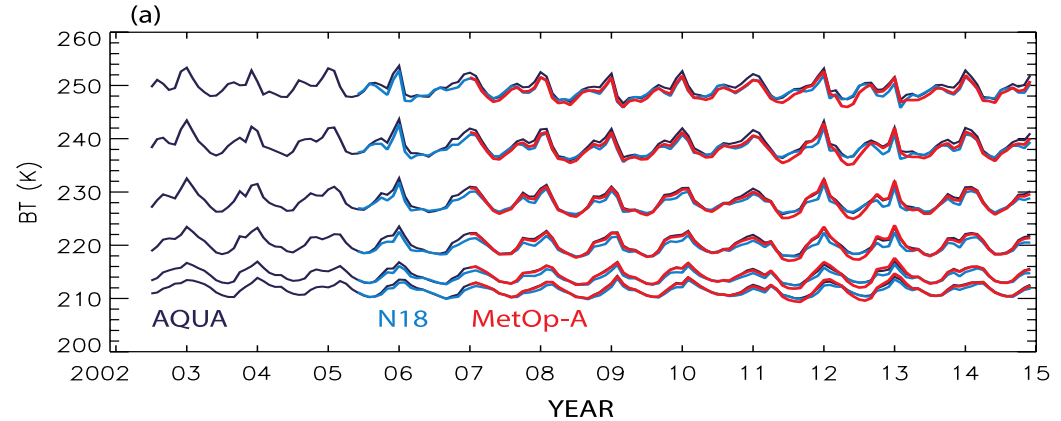


Depuis 2002

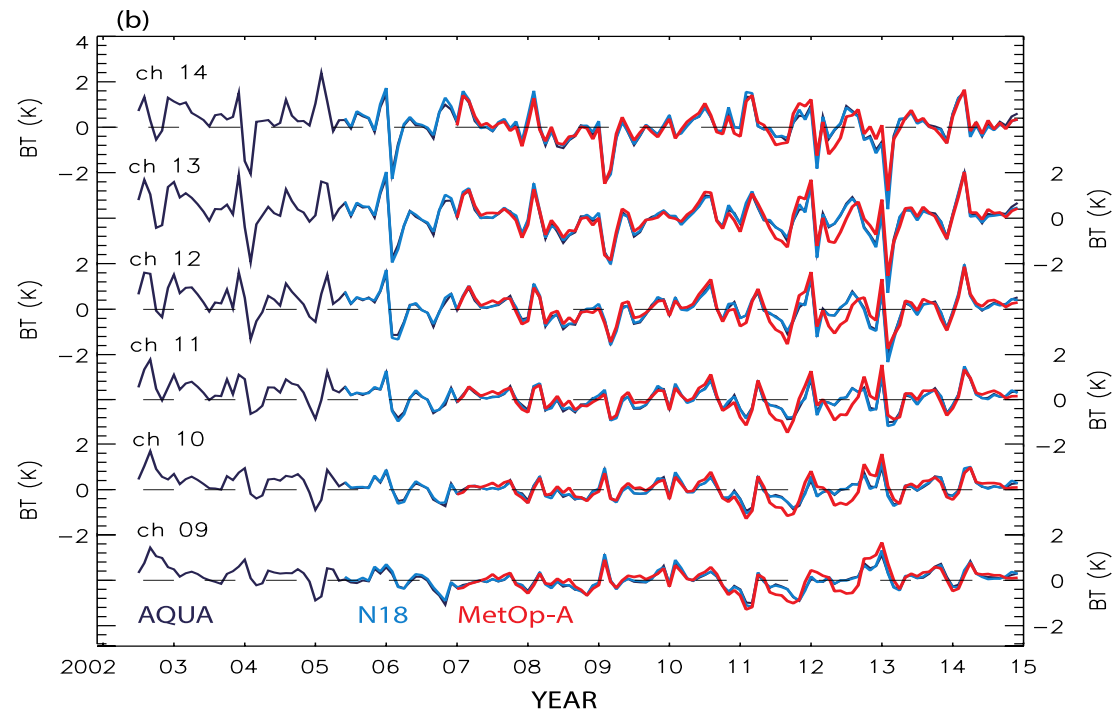


Evolution de la température observée par les différents instruments AMSU

Température de brillance

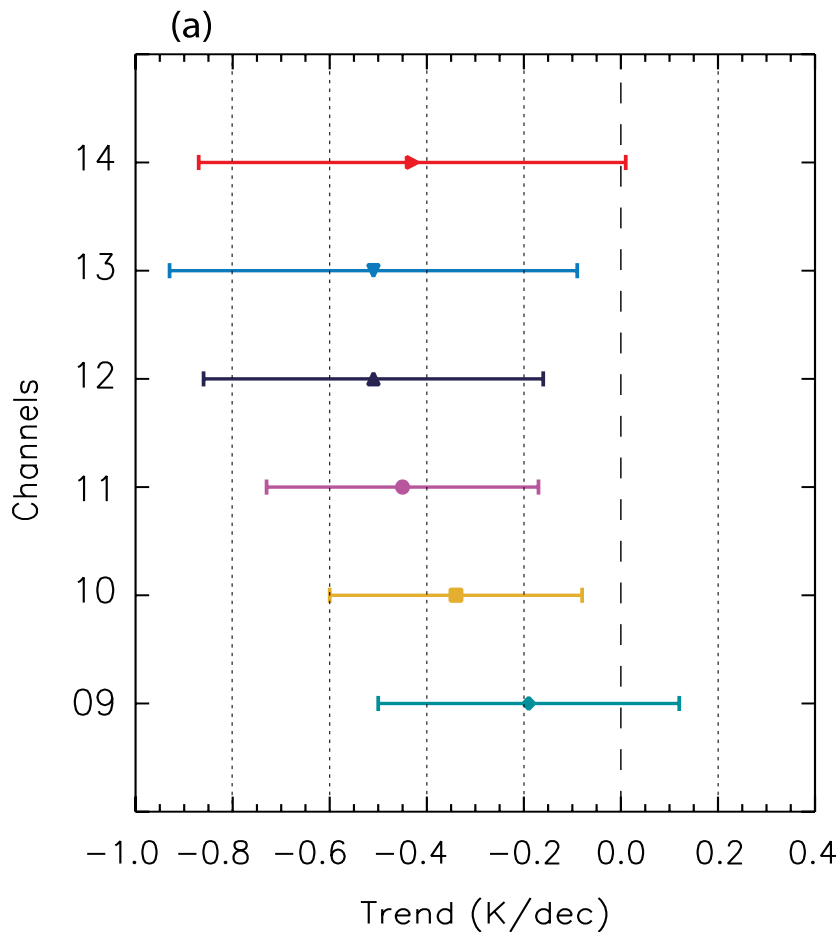


Anomalie de température

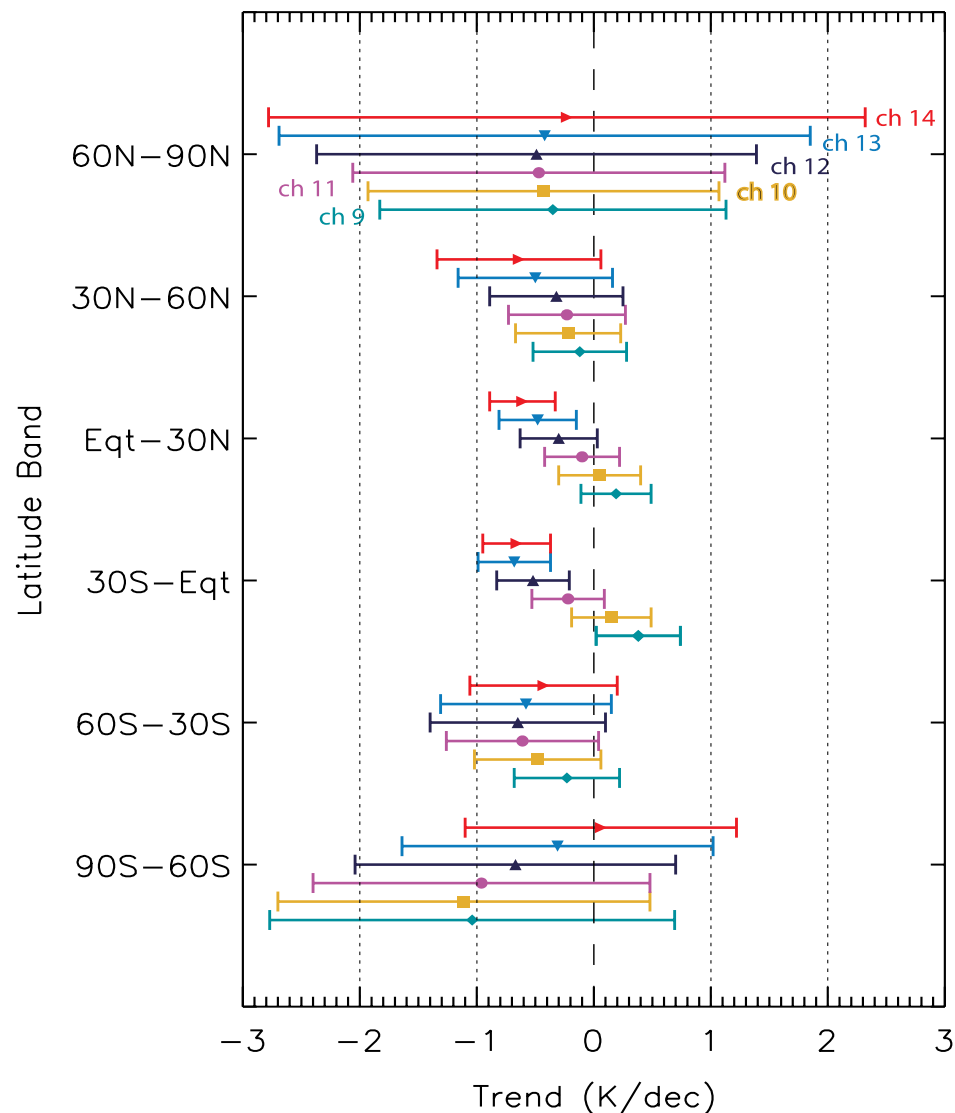


Stratospheric temperature trend AMSU-AQUA 2002-2014

Global



(b) Par bande de latitudes



Tendance par saison et par bande de latitudes AMSU-AQUA 2002-2014

DJF

MAM

JJA

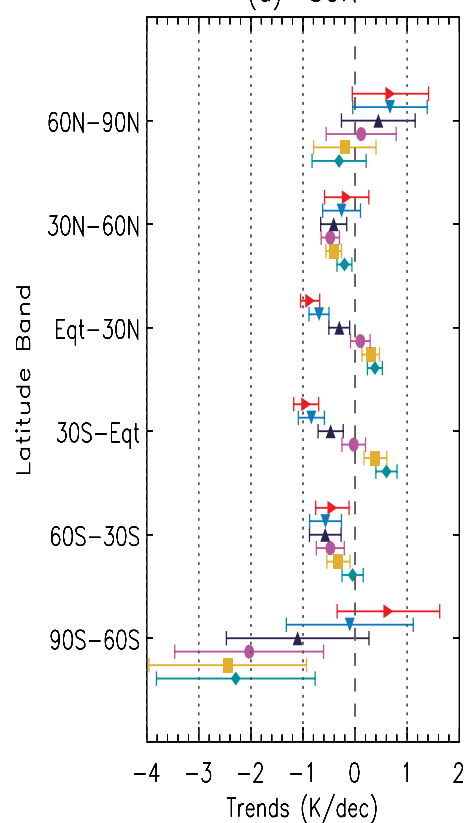
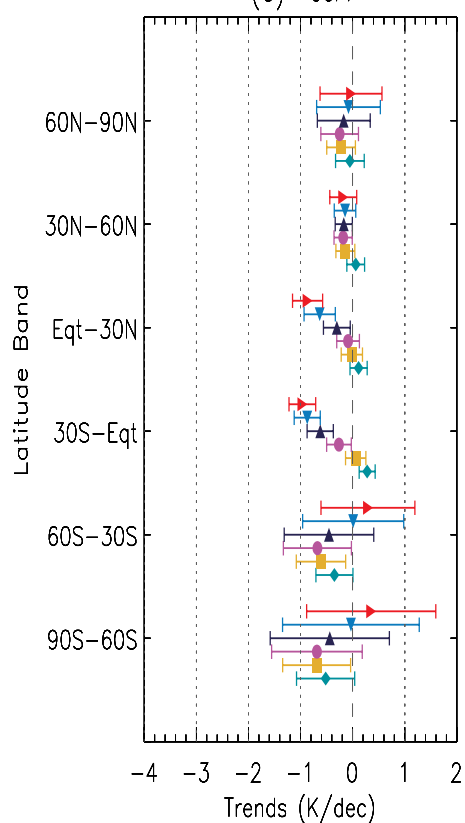
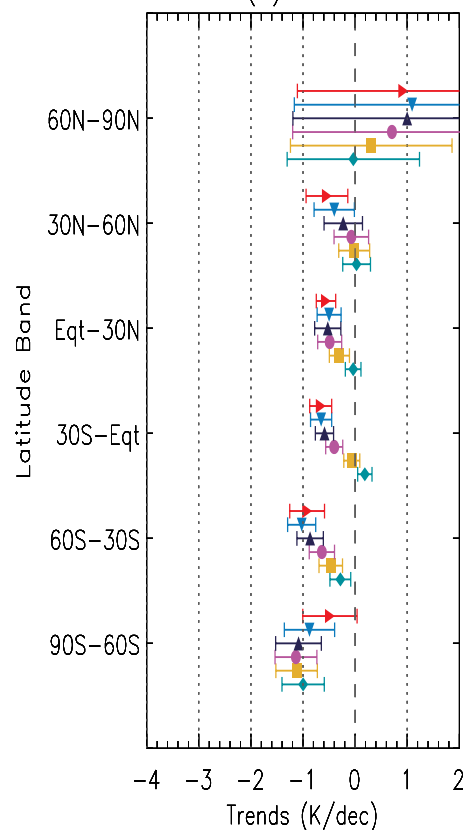
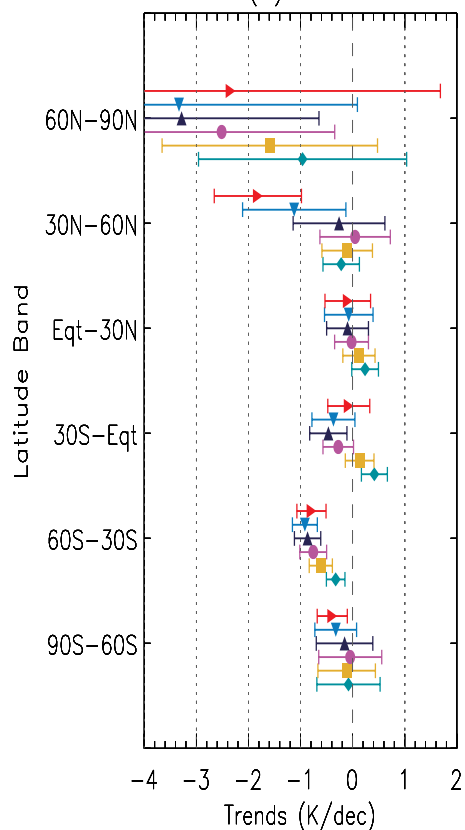
SON

(a) DJF

(b) MAM

(c) JJA

(d) SON

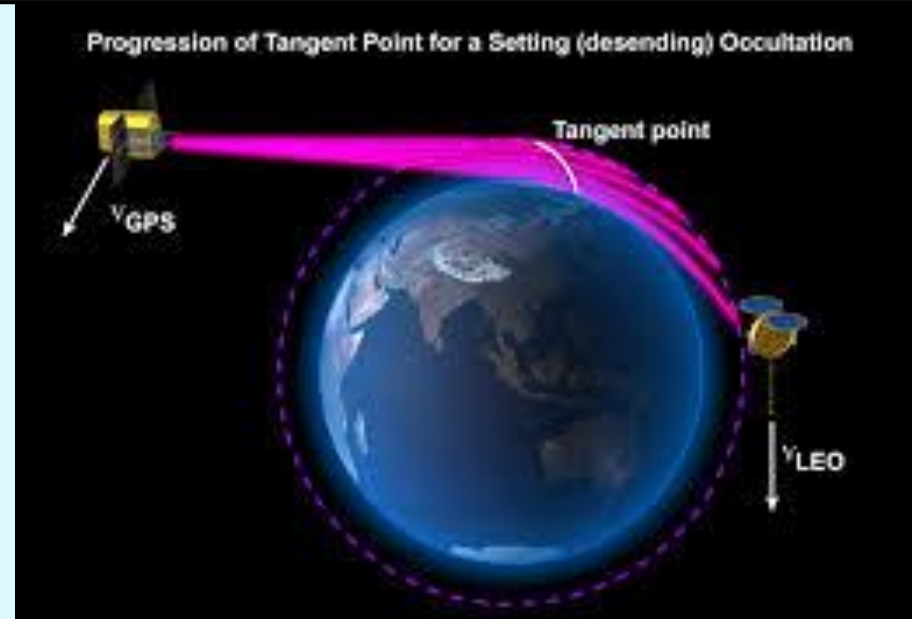




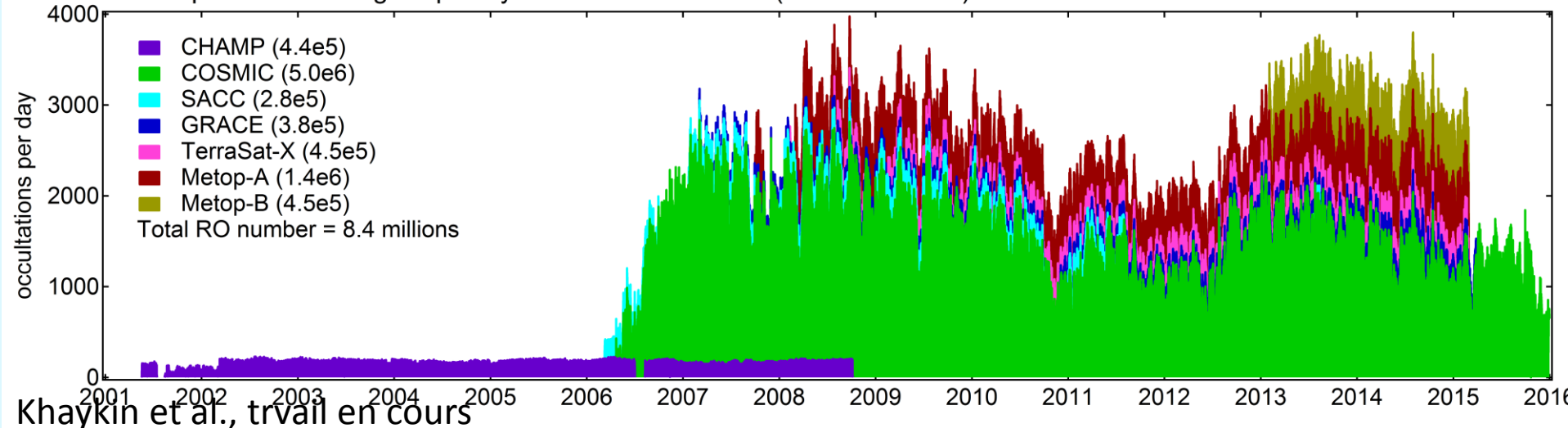
Stratospheric temperature Radio-occultation GNSS

Mesure angle de courbure

- Profil d'indice de réfraction
- Profil de température haute troposphère, stratosphère
- Profil de H₂O basse troposphère



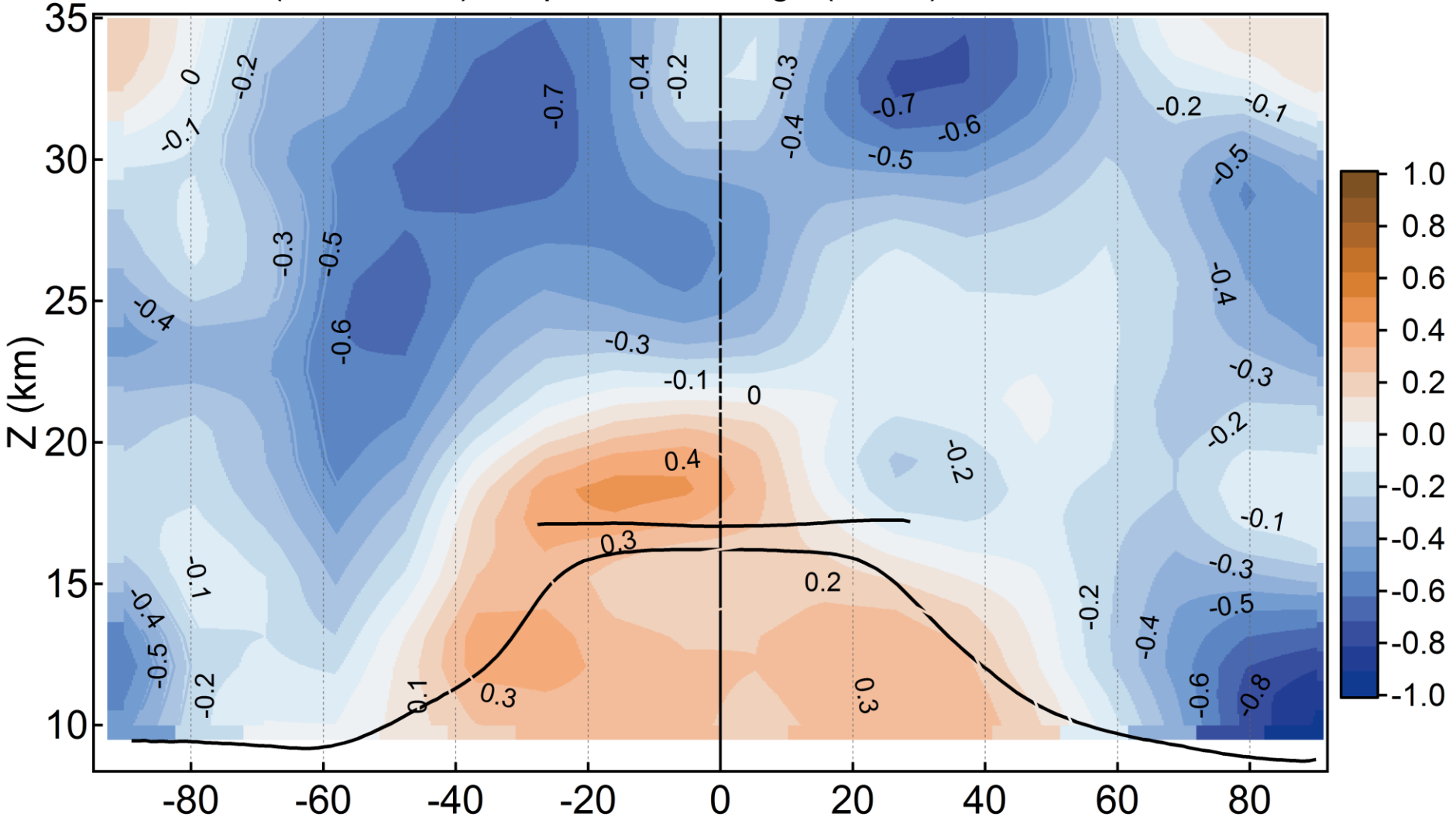
Time span and sampling frequency of GPS RO missions (UCAR CDACC)



Tendance température 2002-2015

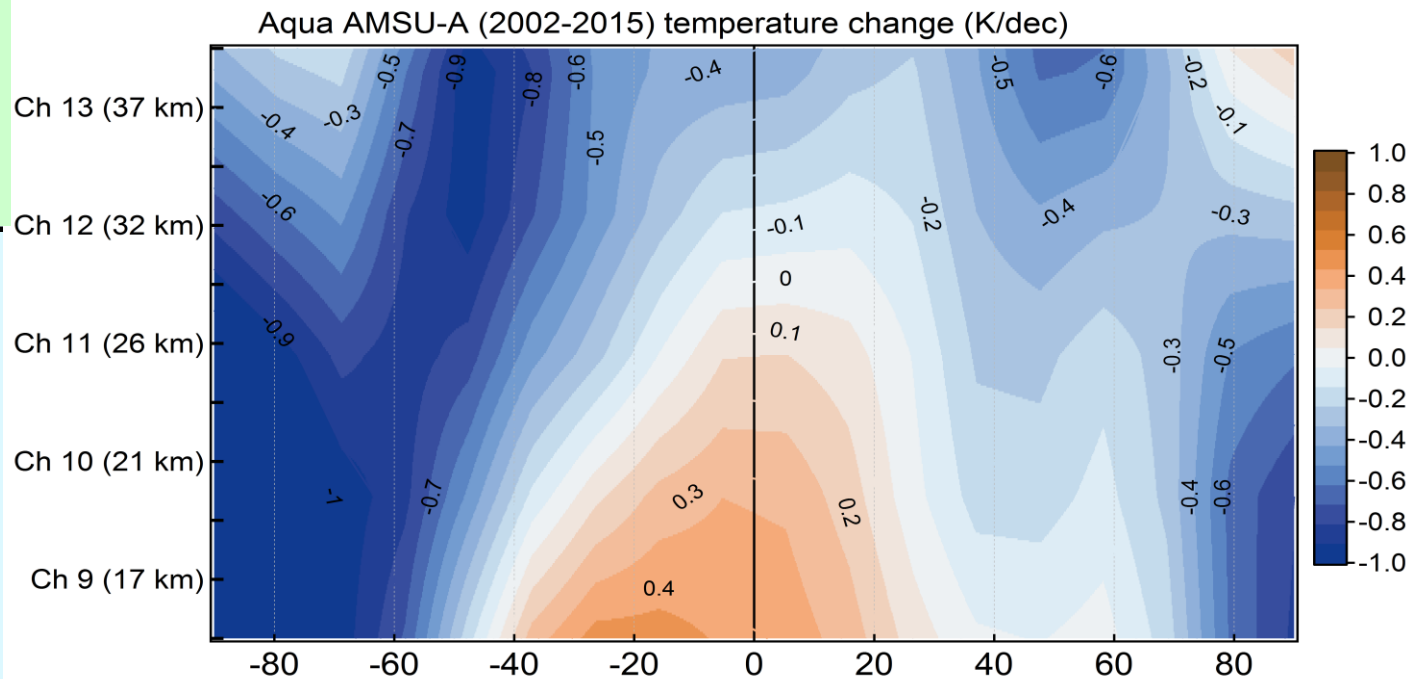
GPS-RO

GPS RO (2002-2015) temperature change (K/dec)

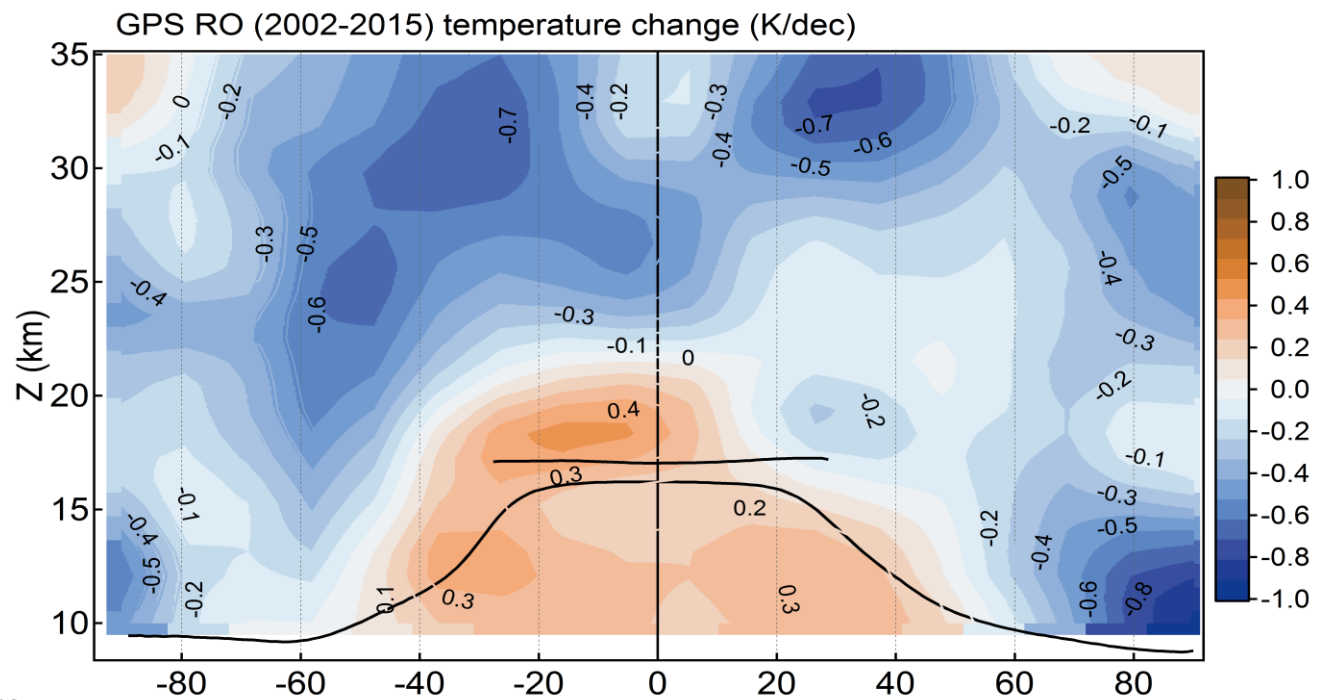


Tendance température

AMSU

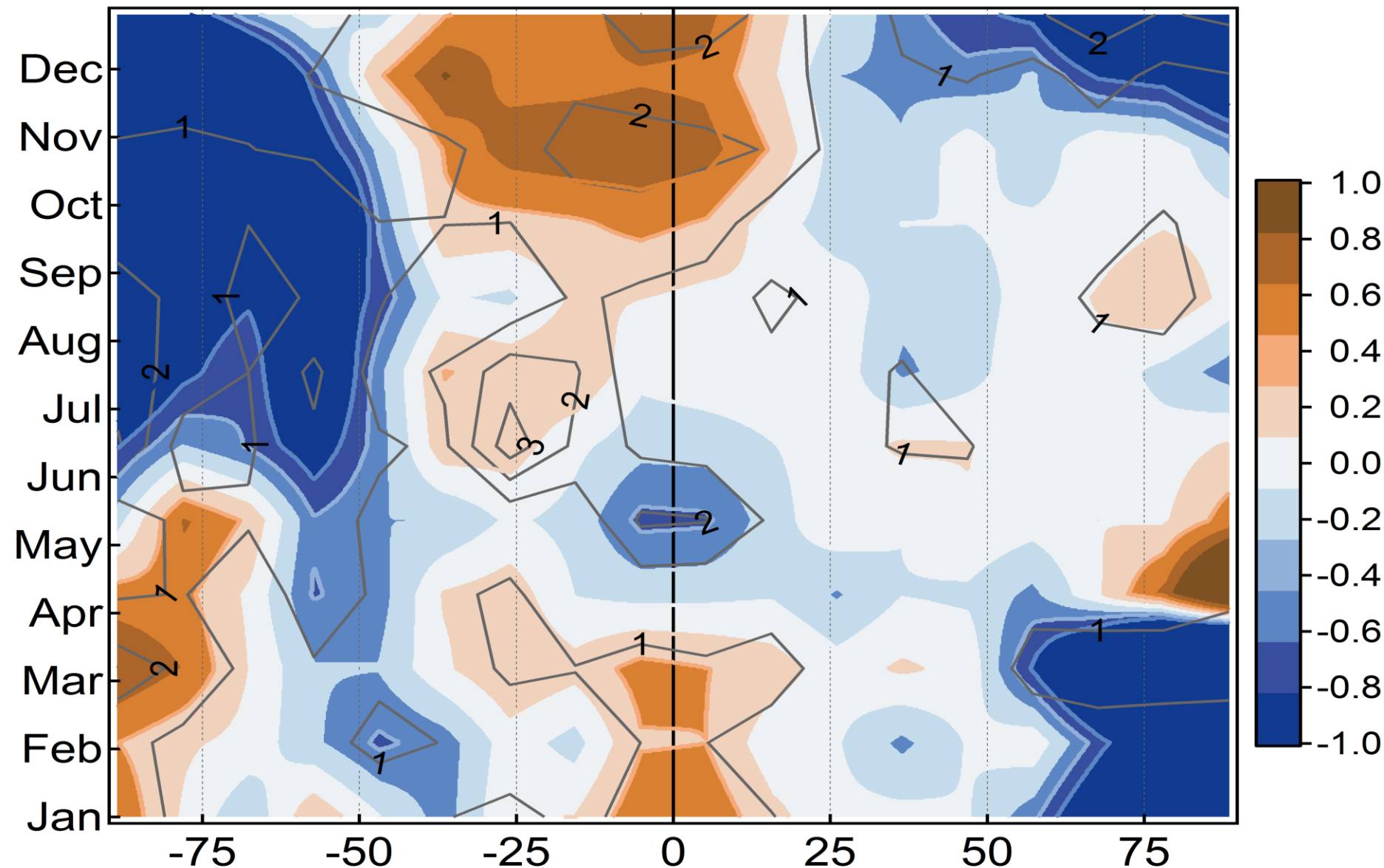


GPS-RO



Evolution saisonnière de la tendance – GPS-RO

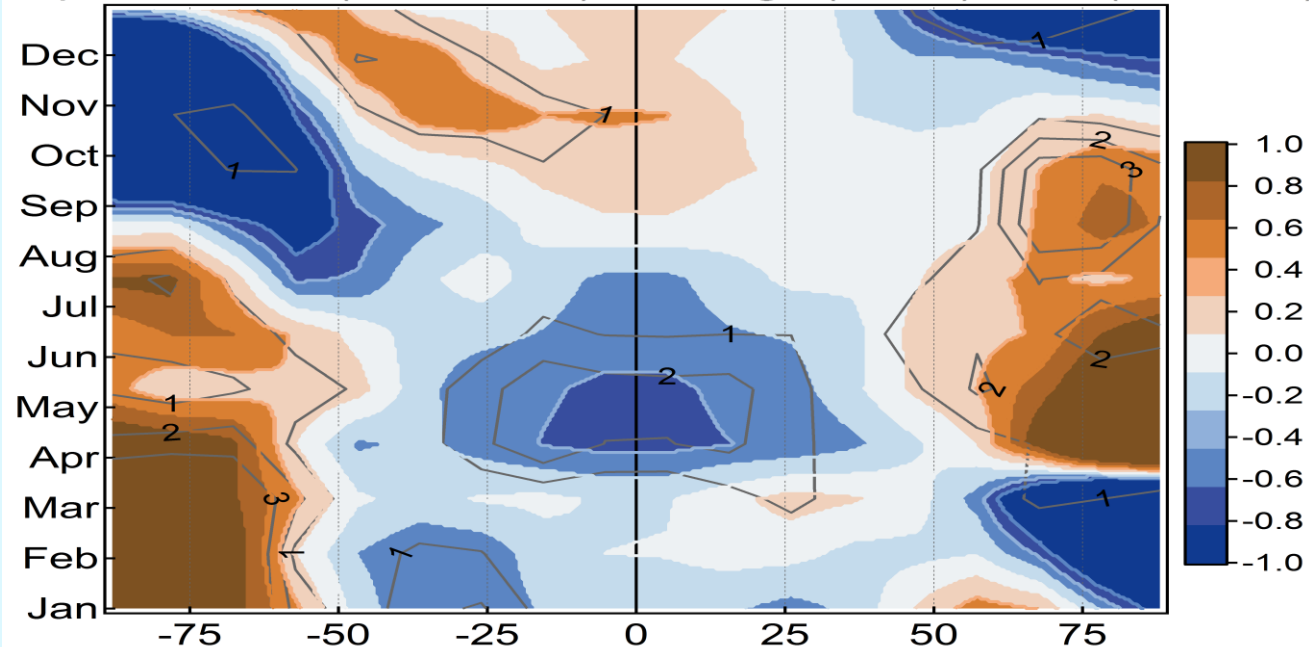
GPS RO (2002-2015) T change (K/dec) 15-19 km



Tendance température

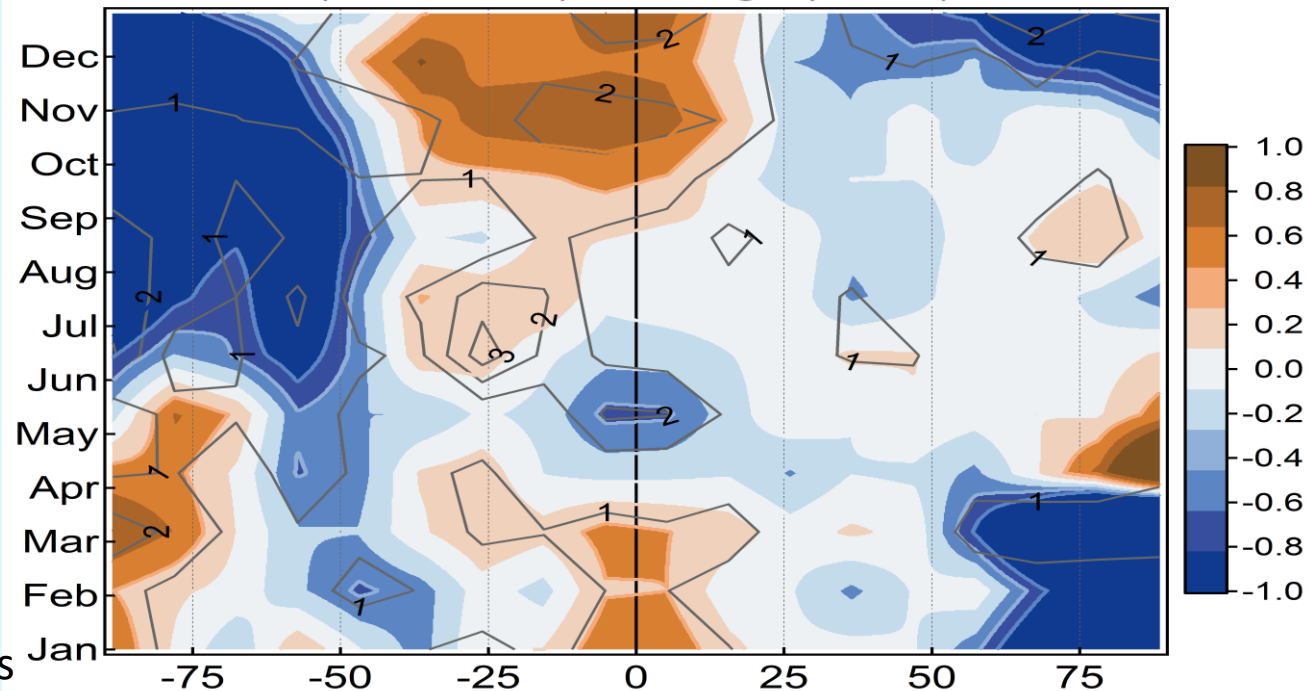
AMSU

Aqua AMSU-A (2002-2015) T change (K/dec) Ch9 (17±5 km)



GPS-RO

GPS RO (2002-2015) T change (K/dec) 15-19 km



Conclusion

- Les analyses des données AMSU depuis 2002 indiquent que **le refroidissement de la stratosphère continue**
- Ces résultats sont confirmés par l'analyse des données des **lidars Rayleigh du NDACC** et les analyses préliminaires des données de **radio-occultation GPS**
- **Les réanalyses météorologiques ne suffisent pas à étudier les tendances de température dans la stratosphère** parce qu'elles sont affectées par des sauts au moment des changements dans les données assimilées