Atmospheric composition observations during YMC from a new research station on Palau

Chemical troposphere/stratosphere coupling in the Maritime Continent

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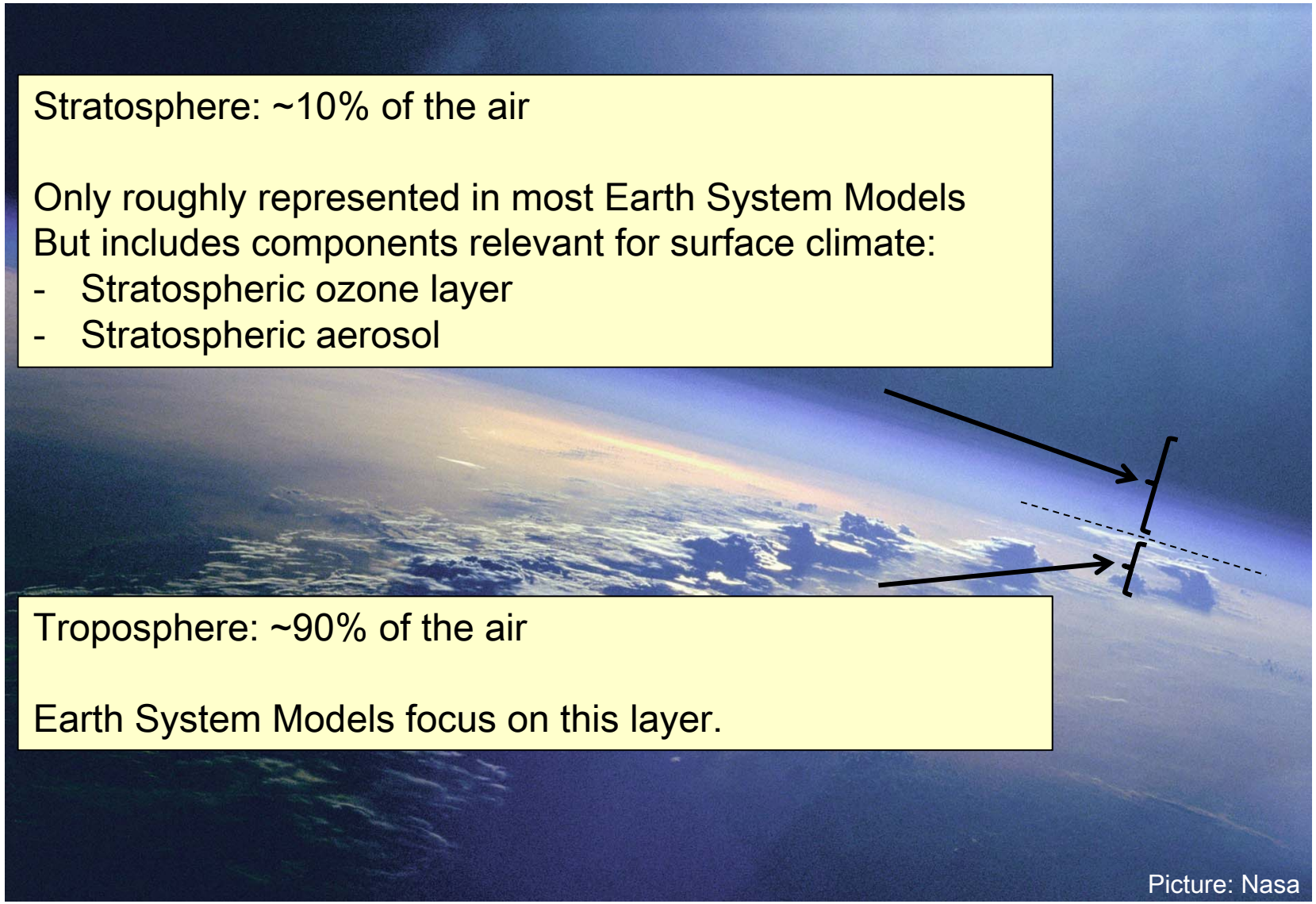
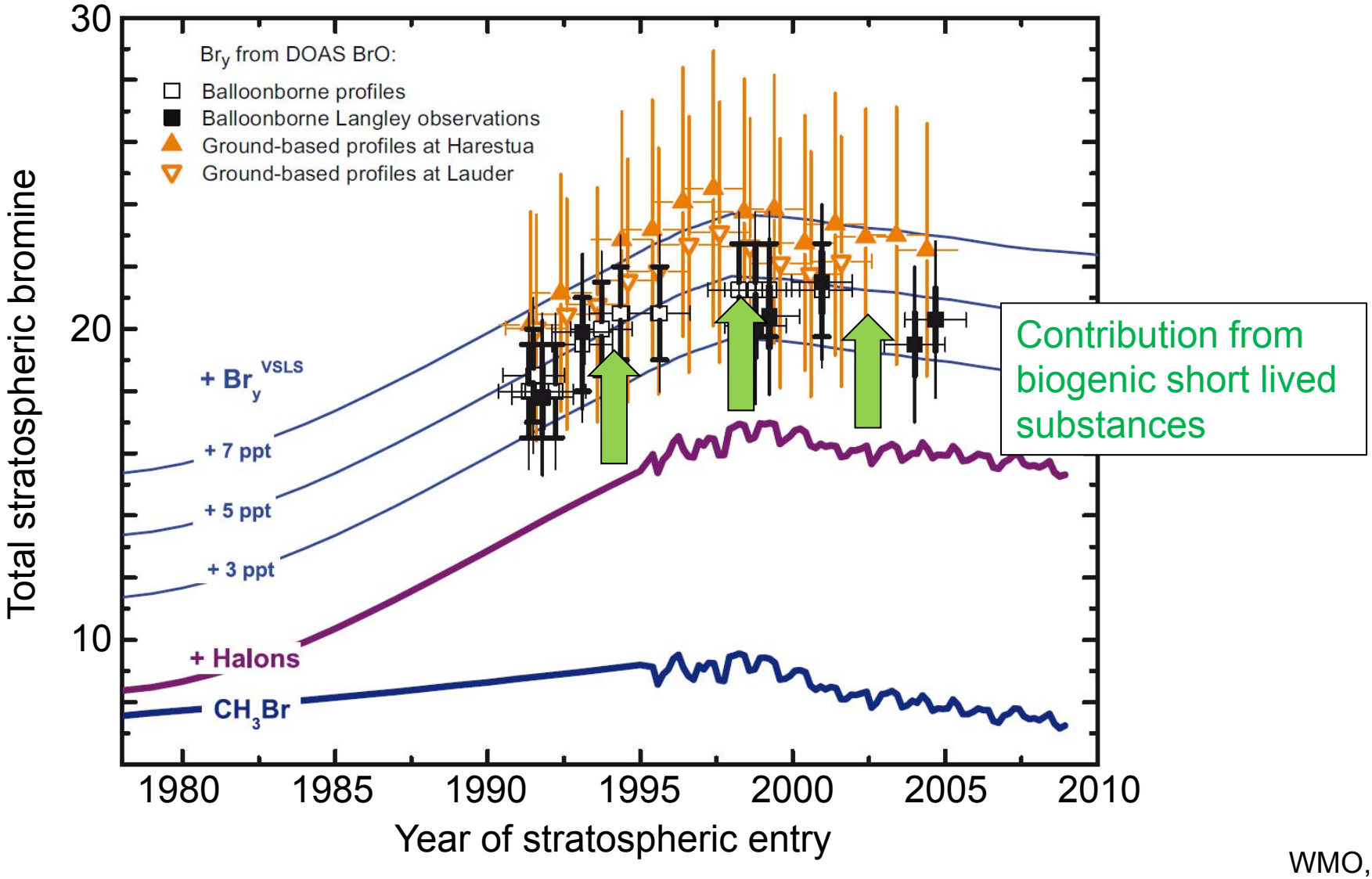
Earth‘s Atmosphere

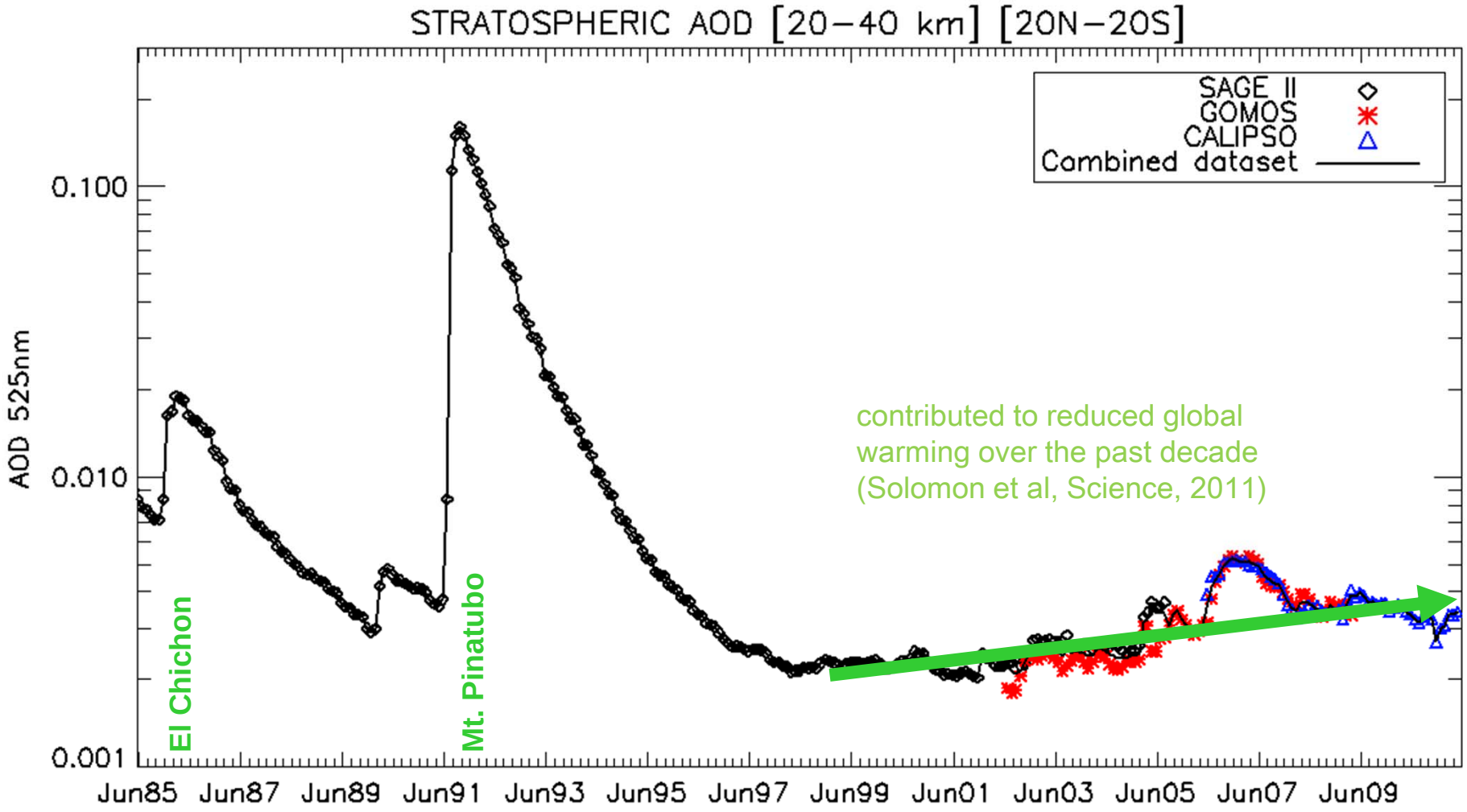


Stratospheric bromine



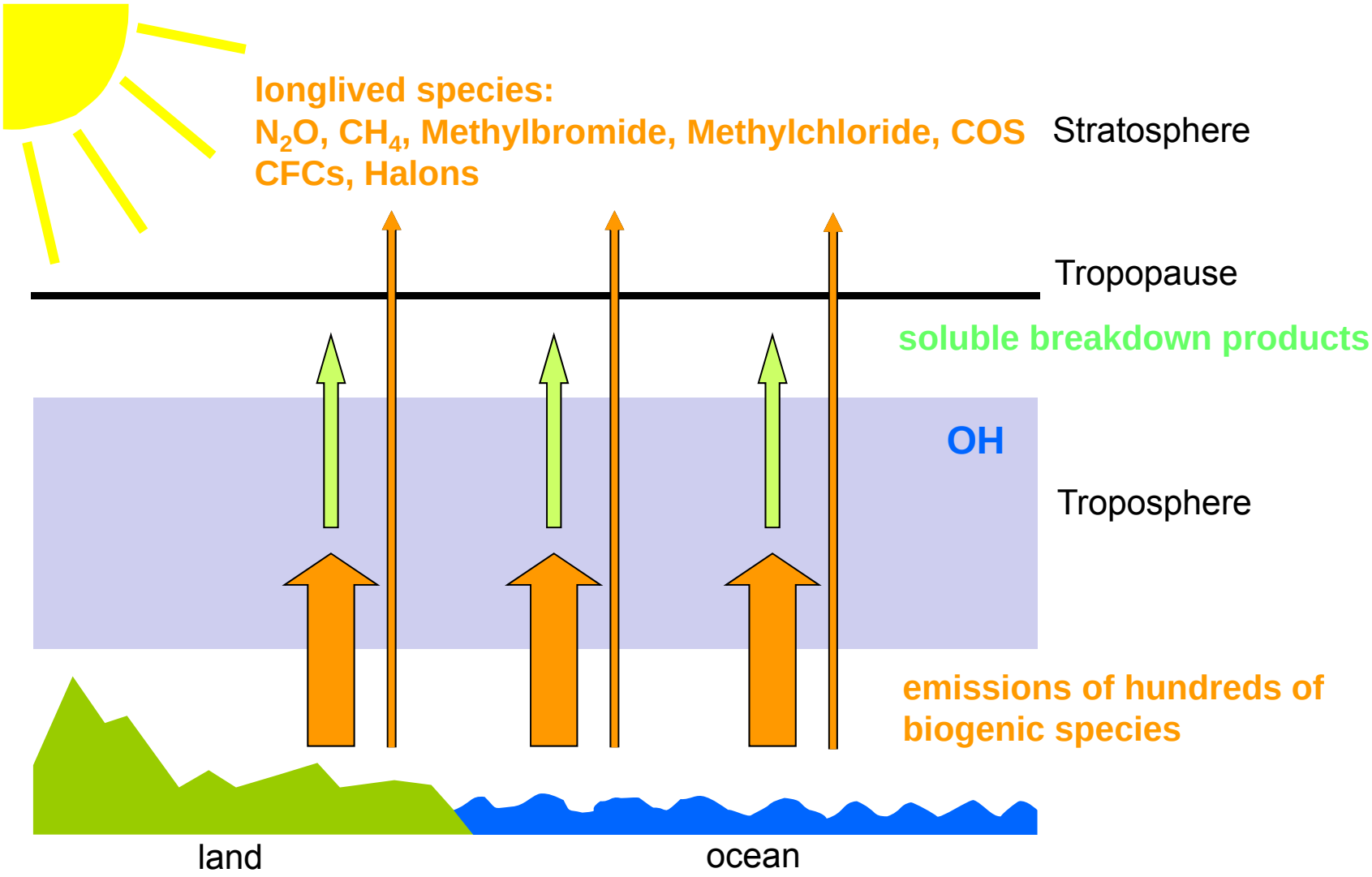
WMO, 2011

Tropical mean stratospheric aerosol

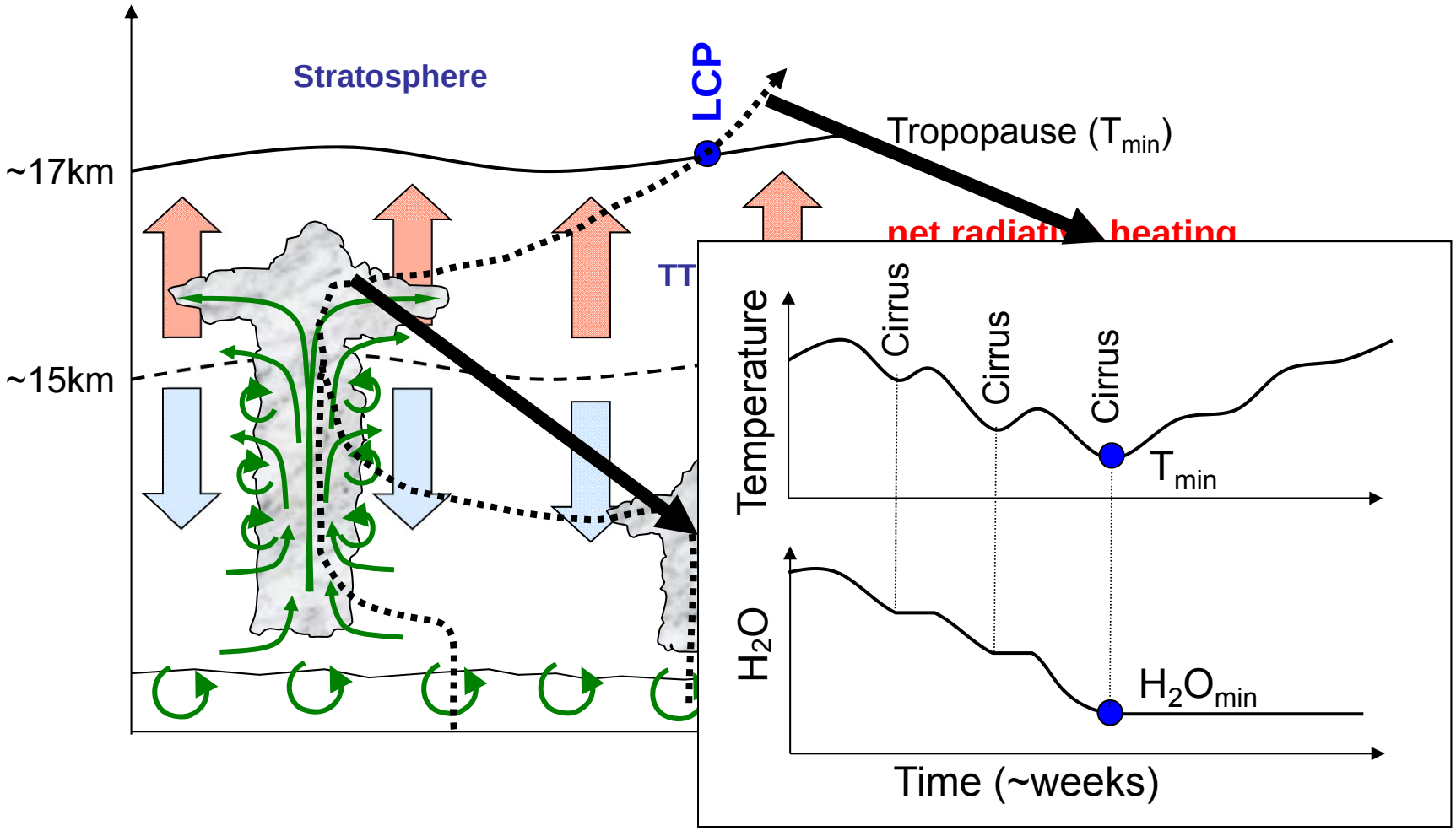


update of Vernier et al., 2011

The „OH shield“

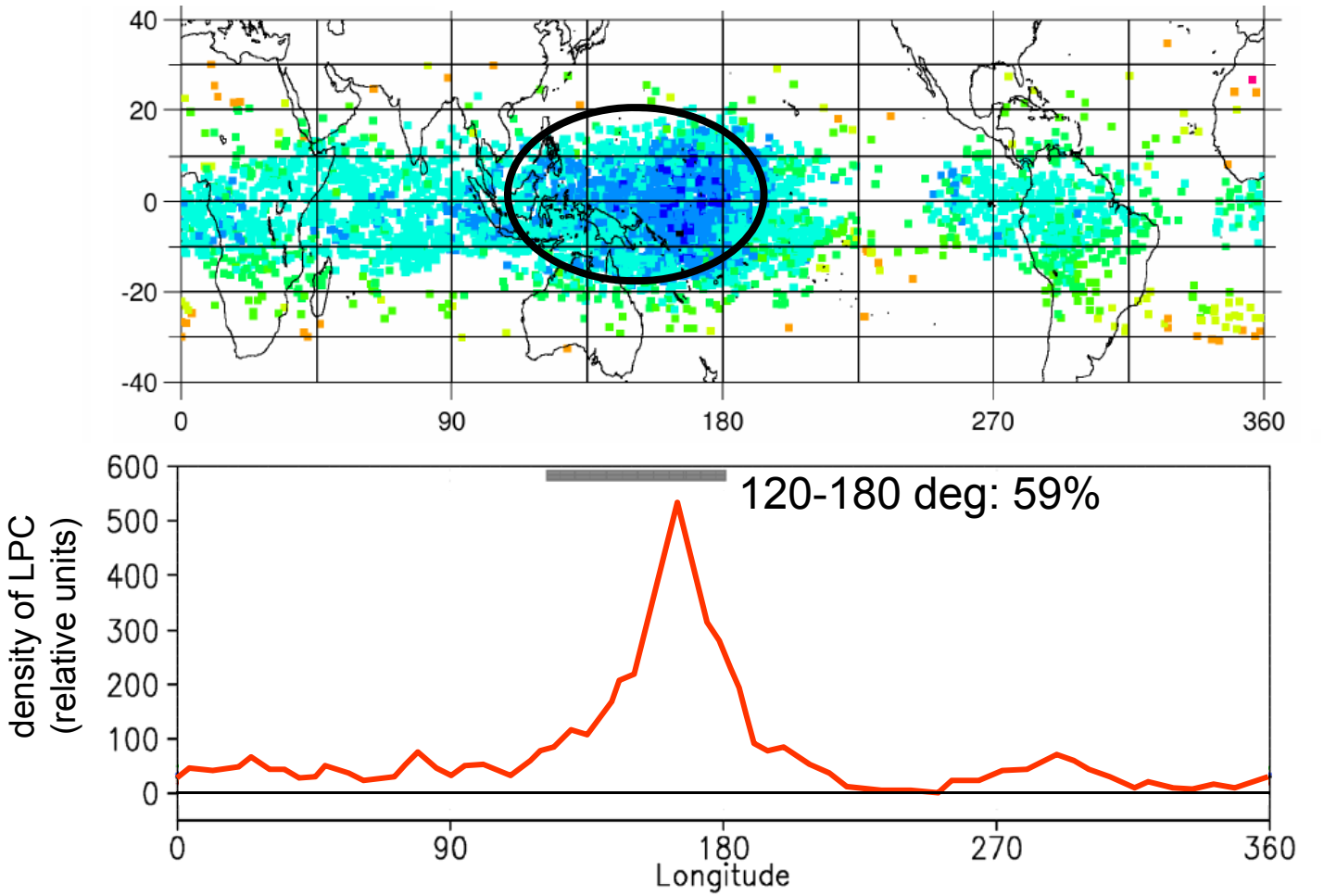


Transport into the Stratosphere



Geographical distribution of LCPs

NH winter 2000/2001



Results from the fully Lagrangian ATLAS model, Wohltman&Rex, 2009; Wohltmann et al. 2010
Krüger et al., ACP, 2008

What determines OH?

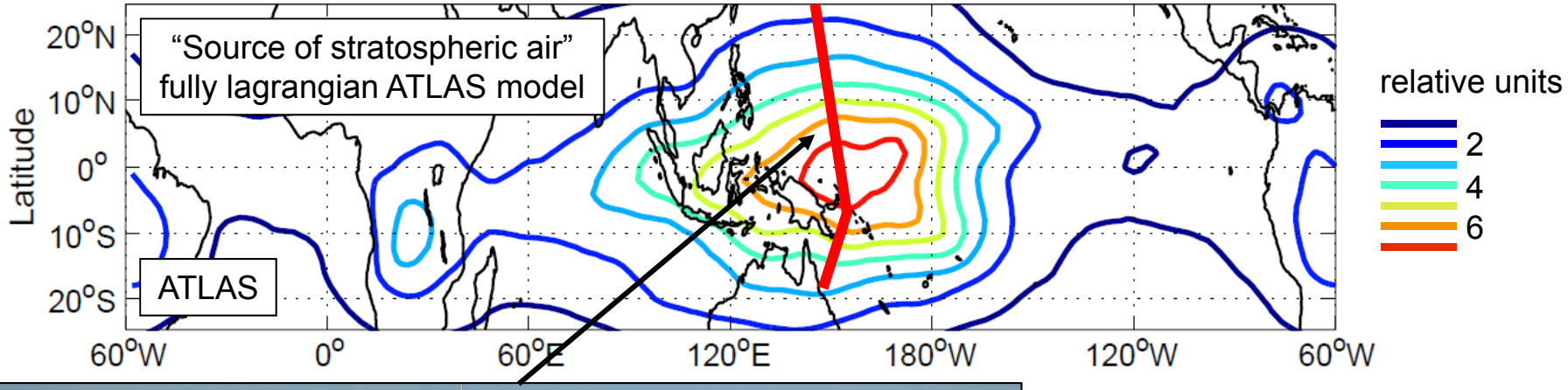
Major source of HO_x in "clean" (hydrocarbon poor) air:

$O_3 + h\nu\ (\lambda<340nm) \rightarrow O_2 + O(^1D)$

$O(^1D) + H_2O \rightarrow OH + OH$

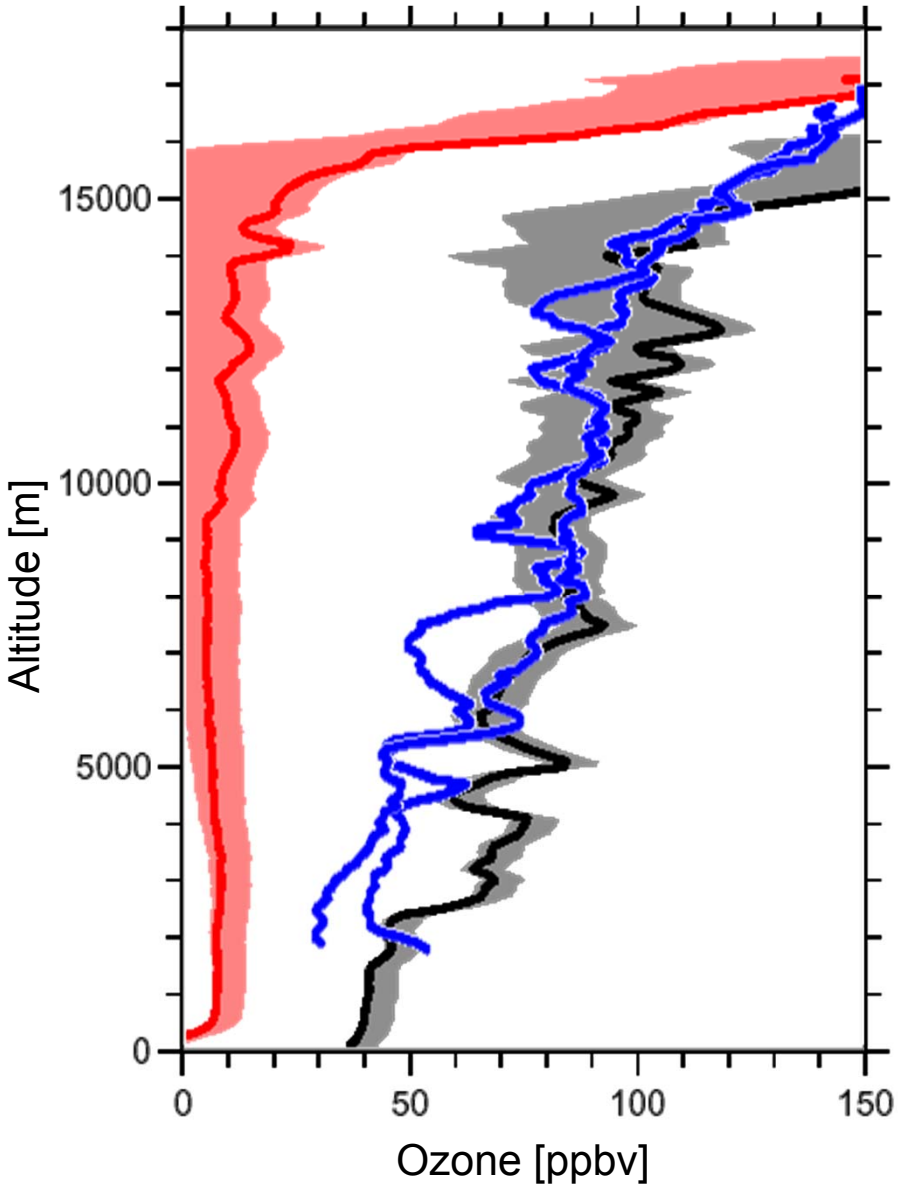
=> In clean air OH depends mainly on ozone (and NO_x)

Processes at stratospheric entry point in NH winter



Rex et al., ACP, 2014

Ozone profile measurements in the West Pacific

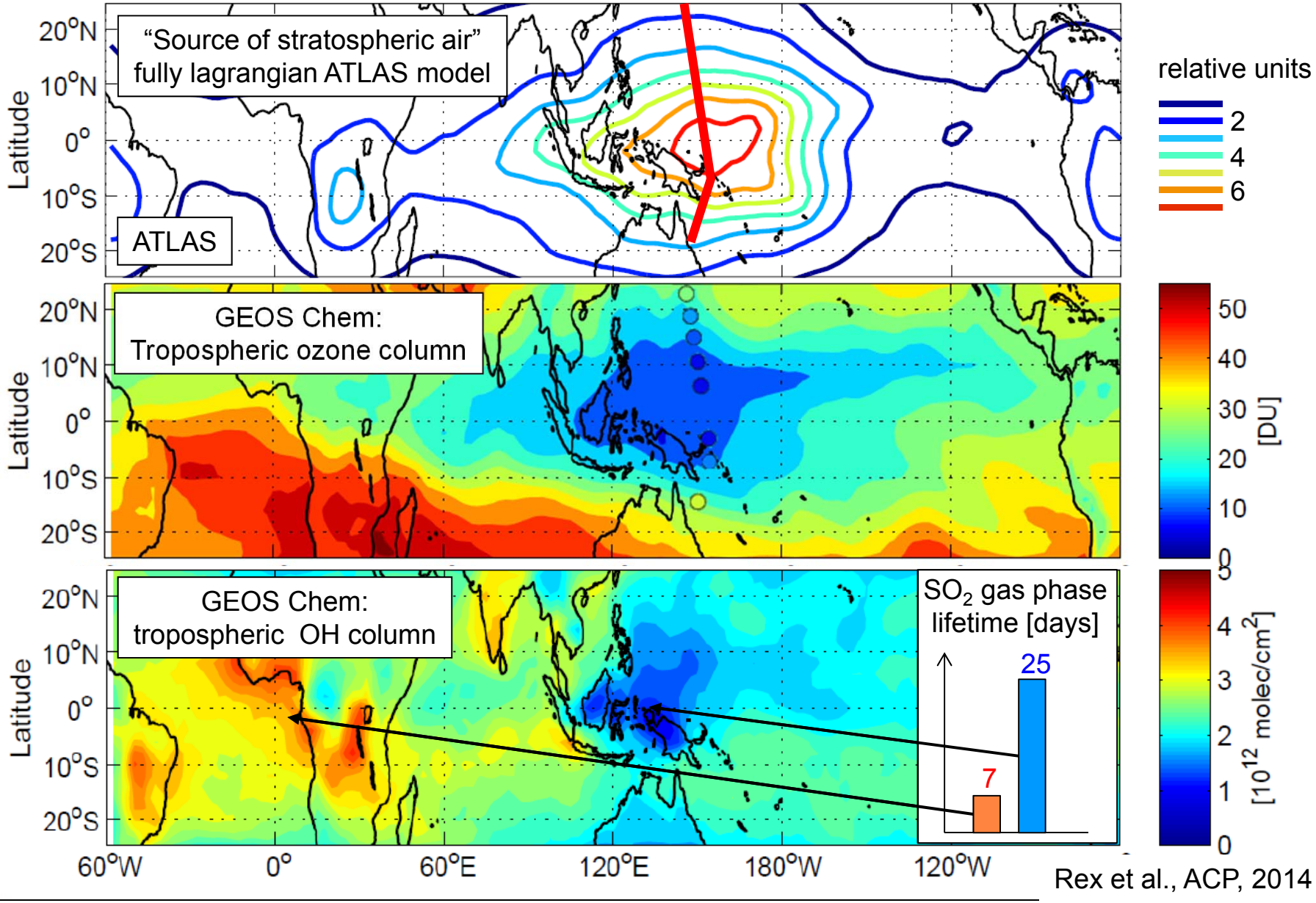


Extratropical West Pacific ~30°

Tropical Atlantic

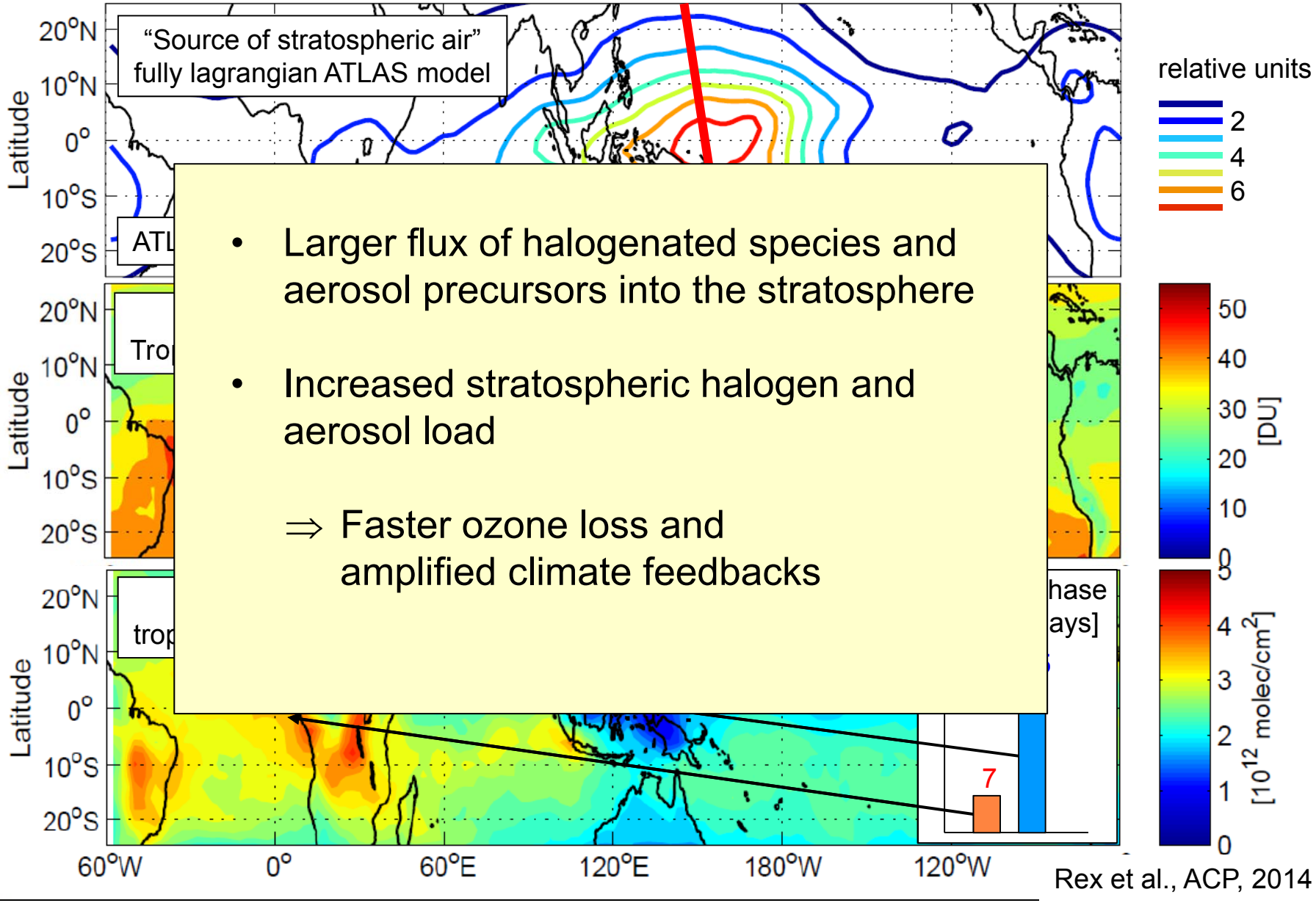
Tropical West Pacific

Processes at stratospheric entry point in NH winter



Rex et al., ACP, 2014

Processes at stratospheric entry point in NH winter



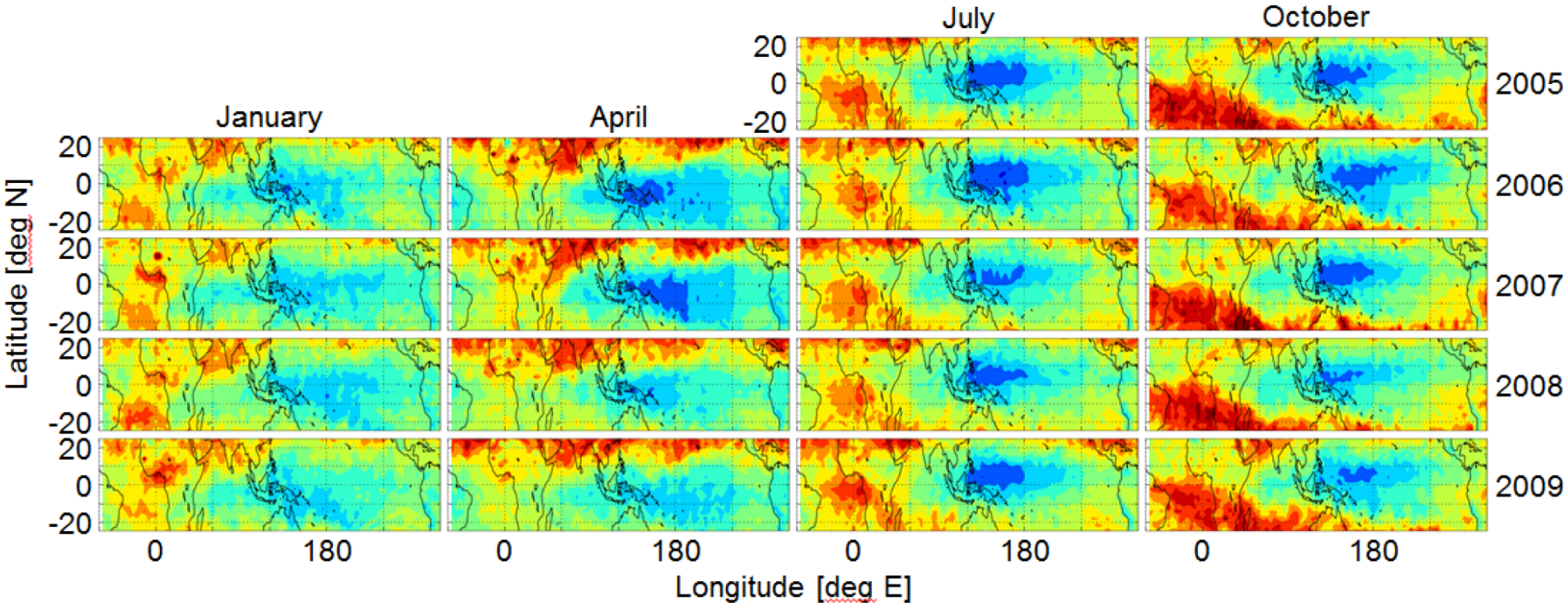
- Larger flux of halogenated species and aerosol precursors into the stratosphere
- Increased stratospheric halogen and aerosol load

⇒ Faster ozone loss and amplified climate feedbacks

Rex et al., ACP, 2014

Longer term picture

TES tropospheric ozone column



StratoClim
Planned field activities

Geophysica aircraft campaign
+ COBALD & CFH soundings

Palau station 2016-2018

StratoClim : Ground stations

Tropical ground station:

- Location: Palau (close to center of warm pool)
- ~2 years of initial operation during 2016 – 2018
- Instrumentation
  starting Jan 2016:
  - Fourier Transform Infrared Spectrometer
  - Ozonesondes (ECC)

  starting mid-2016:
  - Improved ECC sondes for better detection limit
  - Water vapour sondes (CFH)
  - Backscatter sondes (COBALD)
  - Microlidar
  - Multi-wavelength aerosol & cloud lidar (ComCAL)

Fourier Transform Infrared Spectrometer (FTIR)

Container:
length: 20 feet
weight: 6-7 tons

Instrument:
Bruker IFS 120/5-M)

Bruker solartracker

Measurements:
spectral coverage: 2000 – 10000 cm^{-1} (5 – 2 μm)
resolution: 0.02-0.005 cm^{-1}

Trace gases:
OCS, CO_2, CH_4, N_2O, HCN, CO, C_2H_6, C_2H_2, CH_2O, H_2O, O_3, HCl, NO_2, HF
black: total columns
red: profiles (~2-4 independent layers)

Compact Cloud Aerosol Lidar (ComCAL)

Laser:
- Nd:YAG 1064nm, 532nm, 355nm
- Power: with 65mJ, 180mJ, 120mJ respectively
- Pulse rate: 20Hz

Telescope:
- Newton, diameter: 40cm
- Focal length=1.2m
- Field of view 0.83mrad

Wavelengths:
- 1064nm, 532p, 532s, 355p, 355s (p and s: polarization parallel and perpendicular)
- Spectrum from 370nm - 430nm in 32 channels
- (including Raman scattering from N2 at 487nm and water vapor at 407nm)

Vertical range:
- 0.7 - 20km

=> Detection (and discrimination) of cirrus, subvisible clouds and aerosol

Status of Palau station

- Visit to Palau in 2014:
  - Permissions from Palau government obtained
  - Memorandum of understanding with Palau Community College (PCC) signed, agreed on location of the station on the PCC campus

- Container with instruments will arrive in Palau on Nov. 30
  Technicians on Palau to set up station: Now to mid-December

- Opening of station January 2016

Conclusions

- Ozone below the detection limit of ECC ozonesondes suggest a pronounced minimum of OH throughout the troposphere over the tropical West Pacific.
- Such an “hole” in tropospheric OH levels cause lifetimes of key tropospheric species to be substantially longer over the tropical West Pacific than in other parts of the tropics.
- This region of the globe may therefore provide a more efficient pathway for shorter lived biogenic species and for SO_2 to reach the stratosphere than currently thought.
- Longer term measurements of atmospheric composition are needed in this region.