

Research Activities in Japan and other Asian Countries

Hideharu Akiyoshi (NIES)

1. Ground-based observation

- AGAGE monitoring stations: **China, Korea, and Japan**
- Ozone measurements by NDACC stations in **Japan** were stopped

Ozone lidar (October 1990 – March 2011) at Tsukuba

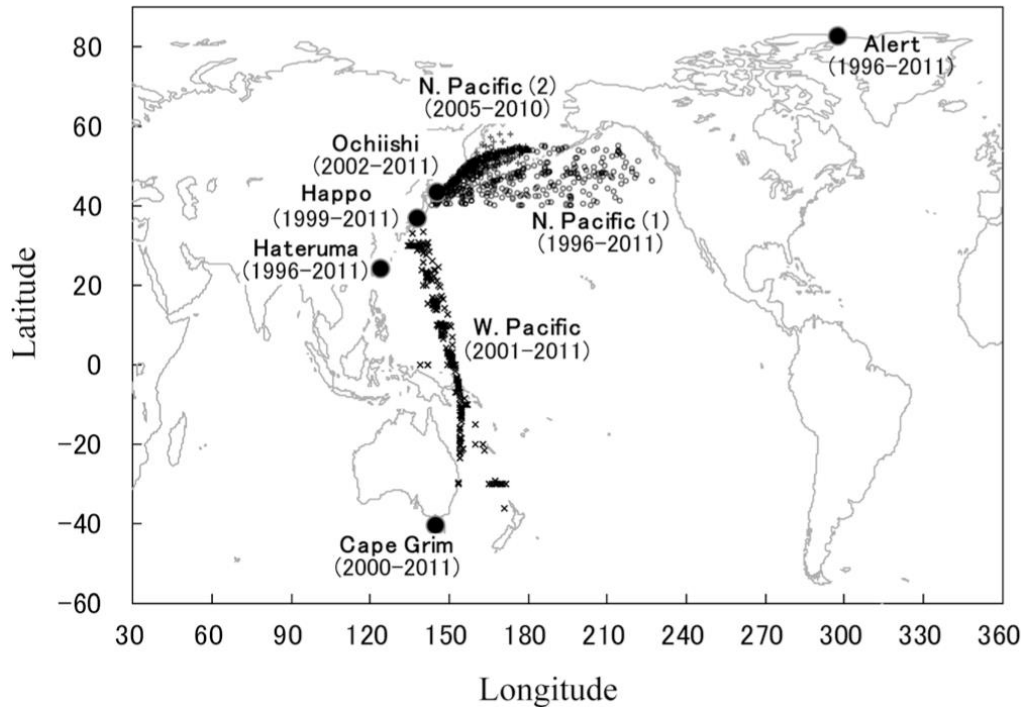
Millimetre-wave radiometers

(September 1995 – March 2011) at Tsukuba

(March 1999 – March 2011) at Rikubetsu

- **China** measures ozone profile in the Antarctic, Arctic, Tibet, and surface ozone in China, and mechanisms associated with the ozone variations are studied.
- **Indonesia** contributes to ozone and water vapor measurements by SOWER
- **Viet Nam** contributes to ozone measurements by SOWER

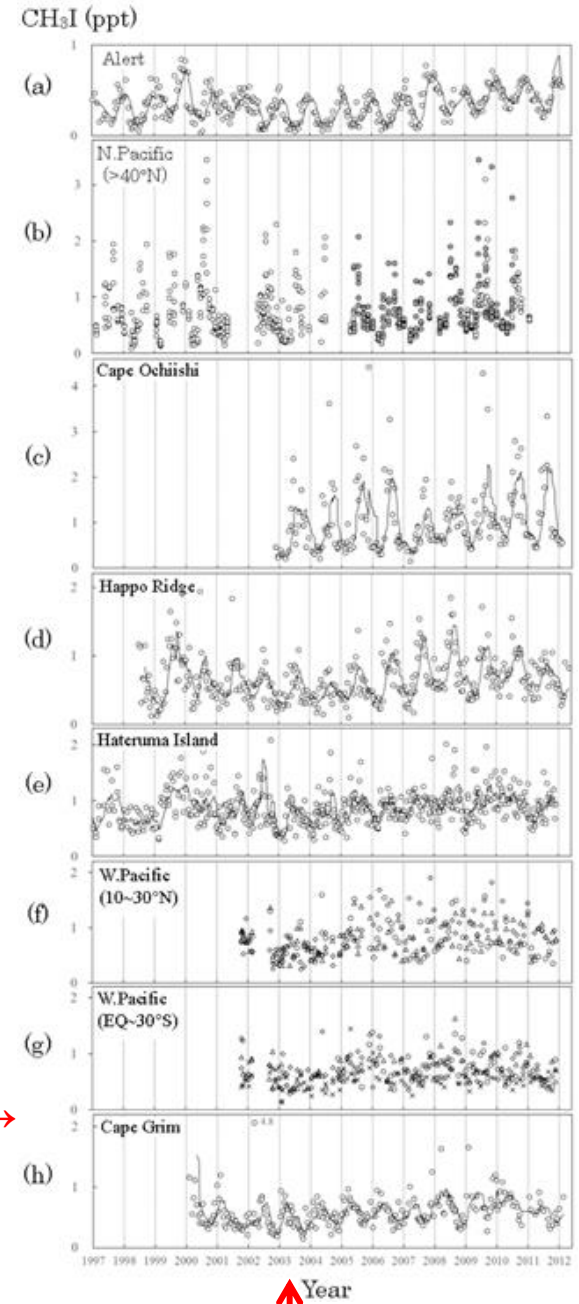
CH₃I observation



Y. Yokouchi et al. (2012): “Long-term variation of atmospheric methyl iodide and its link to global environmental change”, *Geophys. Res. Lett.*, 39, L23805

Minimum CH₃I around 2003-2004 →

suggesting some relation to SST distribution pattern associated with physical and biological processes



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2. Observation from the space

- JEM/SMILES (**Japan**, and 12 October 2009 – 21 April 2010)
- Satellite measurements of ozone by **China**

3. Japanese Research Project on Stratospheric Ozone

Studies on the Variability of Stratospheric Processes and Uncertainties in the Future Projection of Stratospheric Ozone (FY: 2007 – 2009, supported by Ministry of Environment)

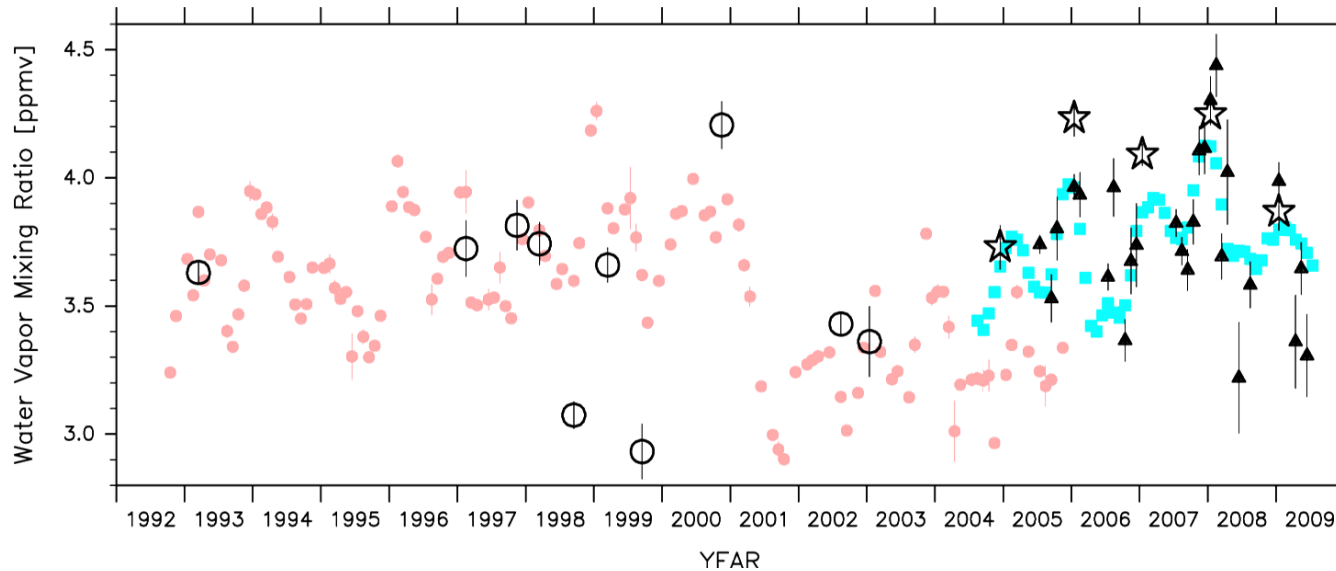


Investigations conducted in this project were:

- (i) detection of the variation of water vapor in the upper troposphere and lower stratosphere in the tropics
- (ii) determination of the mean age of stratospheric air (CO₂, SF₆)
- (iii) evaluation on reproducibility of chemical and meteorological fields in the stratosphere calculated by CCSR/NIES CCM
- (iv) understanding of the impact of solar activity change on ozone distribution using CCSR/NIES CCM and climate models

✓ Soundings of Ozone and Water in the Equatorial Region (SOWER)

Japan, Indonesia, and Viet Nam



68-37 hPa
tropical

Fujiwara et al, 2010, JGR

SOWER CFH(☆), NOAA FPH(O), HALOE(●), MLS(■), Ticozonde CFH(▲)

✓ Dehydration process study in the TTL, supported by The Ministry of Education, Culture, Sports, Science, and Technology (MEXT) (2009-2012, 2014-2016)

Chemistry Climate Model (CCM) and Chemical Transport Model (CTM) studies

Three Japanese CCM (NIES, MRI, and JAMSTEC) join Chemistry Climate Model Initiative (CCMI) activities.

NIES activities:

✓ CCM studies

CCM simulation for the past and future projection of ozone layer (CCMI REF-C1, REF-C2 and sensitivity studies)

“Effects of Additional CFC Regulation on Fragility of Ozone Layer under Future Global Warming” supported by Ministry of the Environment (2014-2016)

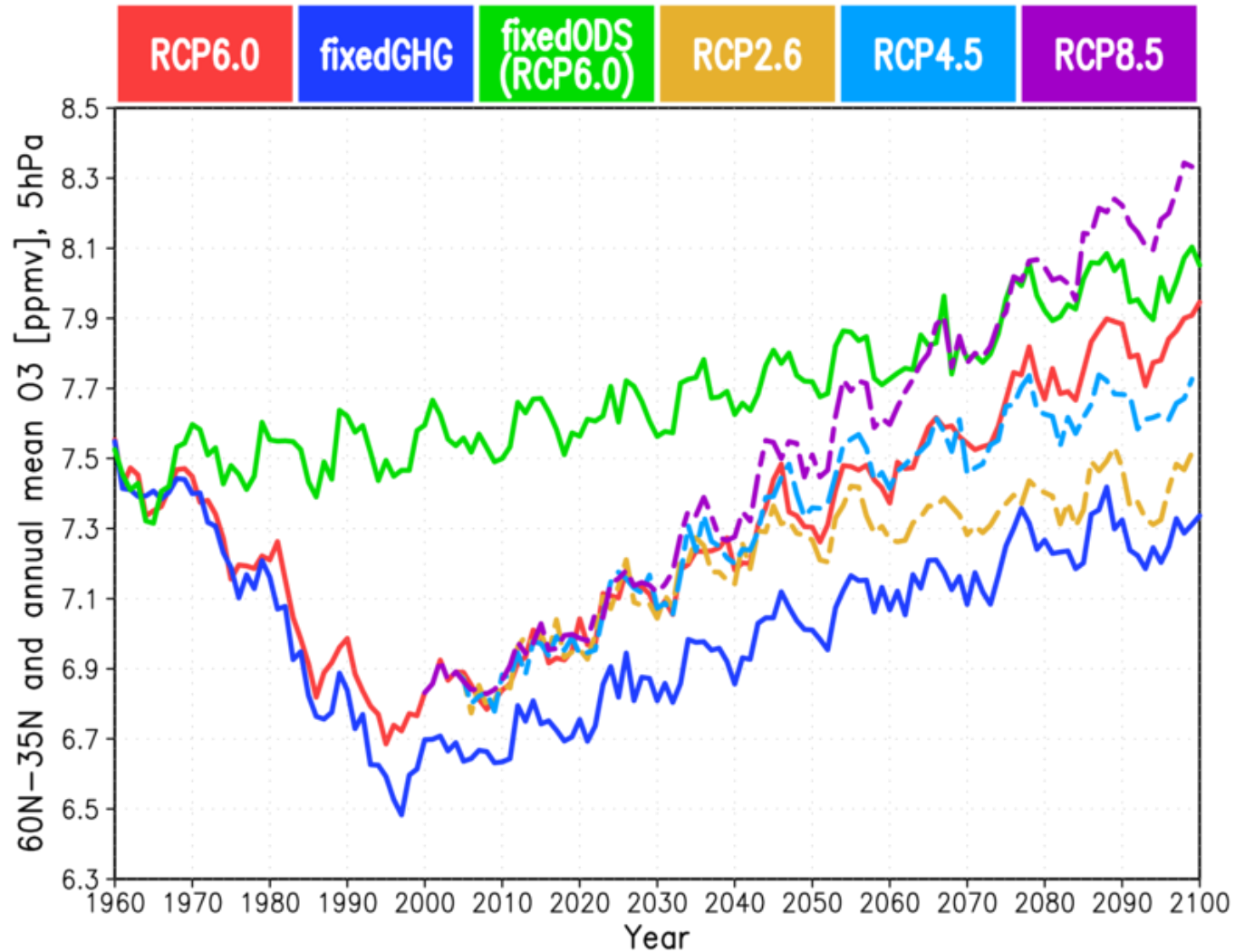
-100-year CCM simulations with different combinations of ODS and GHG concentrations

✓ Nudged CCM (CTM) studies

- Compared with SMILES observation at stratospheric sudden warming
- low ozone event in southern South America

Future ozone projection by CCSR/NIES-MIROC3.2 CCM

~ 37km



4. Future plans, needs and recommendations

For understanding chemistry-climate interaction,

- ✓ Observation of ODS from natural source
- ✓ Observation of ozone at tropical and subtropical regions
- ✓ Observation of water vapor.
- ✓ A high accuracy satellite observation of ozone and associated chemical species (SMILES II ?)
- ✓ NO_x and HO_x changes in the stratosphere and lower mesosphere
- ✓ Regular update of CCM based on the newest GCM

CCSR/NIES-CCM → MIROC3.2-CCM → MIROC5-CCM

(IPCC – AR4)

(IPCC – AR5)

A CCM coupled to ocean is needed.

- ✓ Chemistry-climate interaction through stratospheric ozone column, UV, and tropospheric aerosols (air quality)