# The Cape Grim Baseline Air Pollution Station Air Archive

**APGG Meeting, Jeju, Korea**

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# Outline

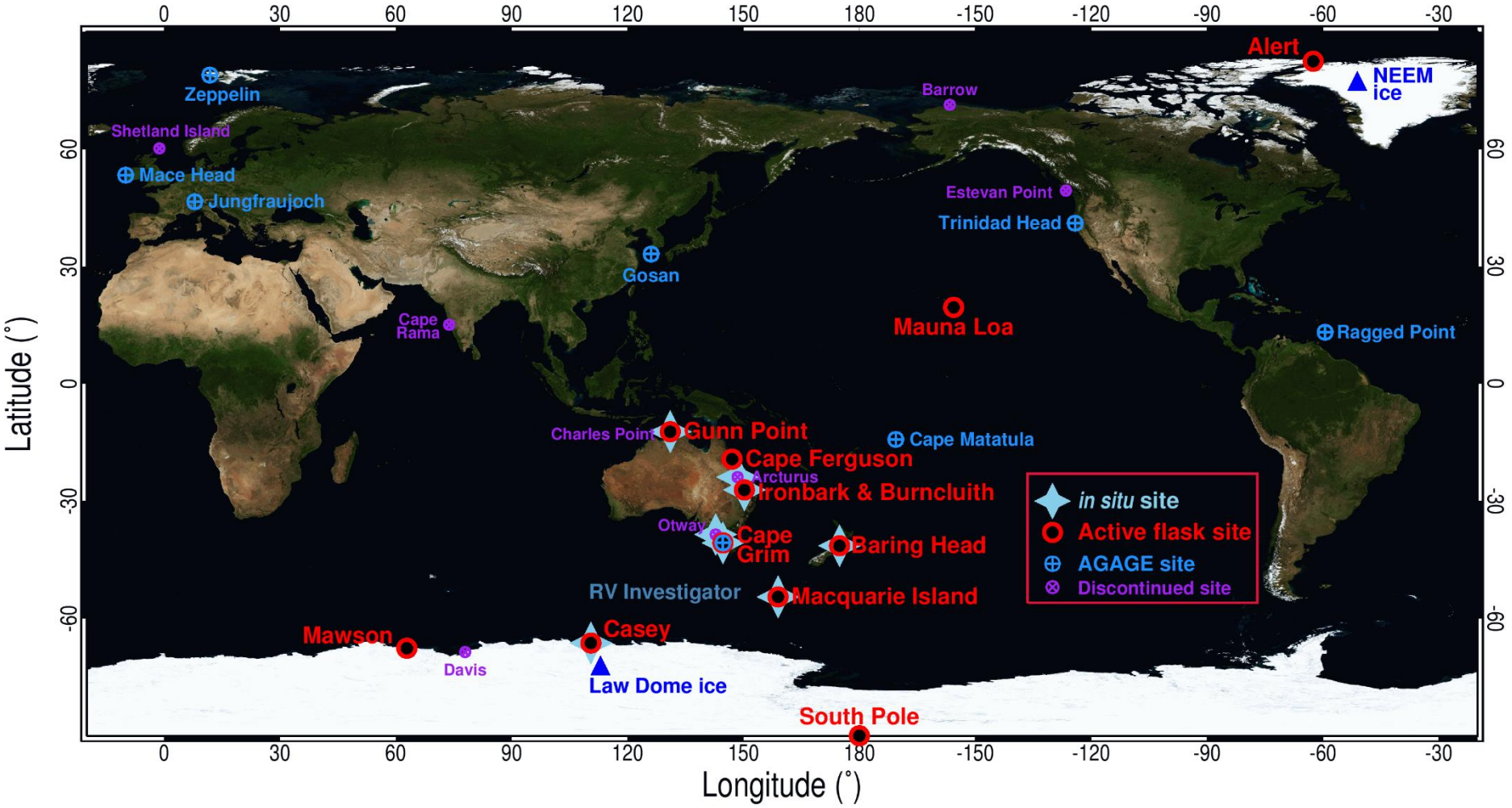
- History of Cape Grim Baseline Air Pollution Station Air Archive
- Air sampling technique
- Air sampling integrity
- Research applications
- Future

***Acknowledgements***:

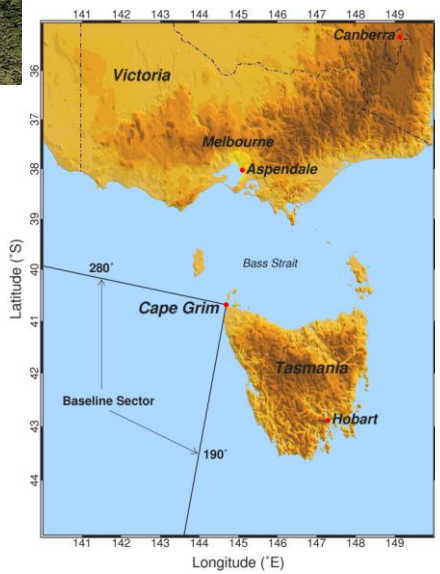
KRISS and KMA!

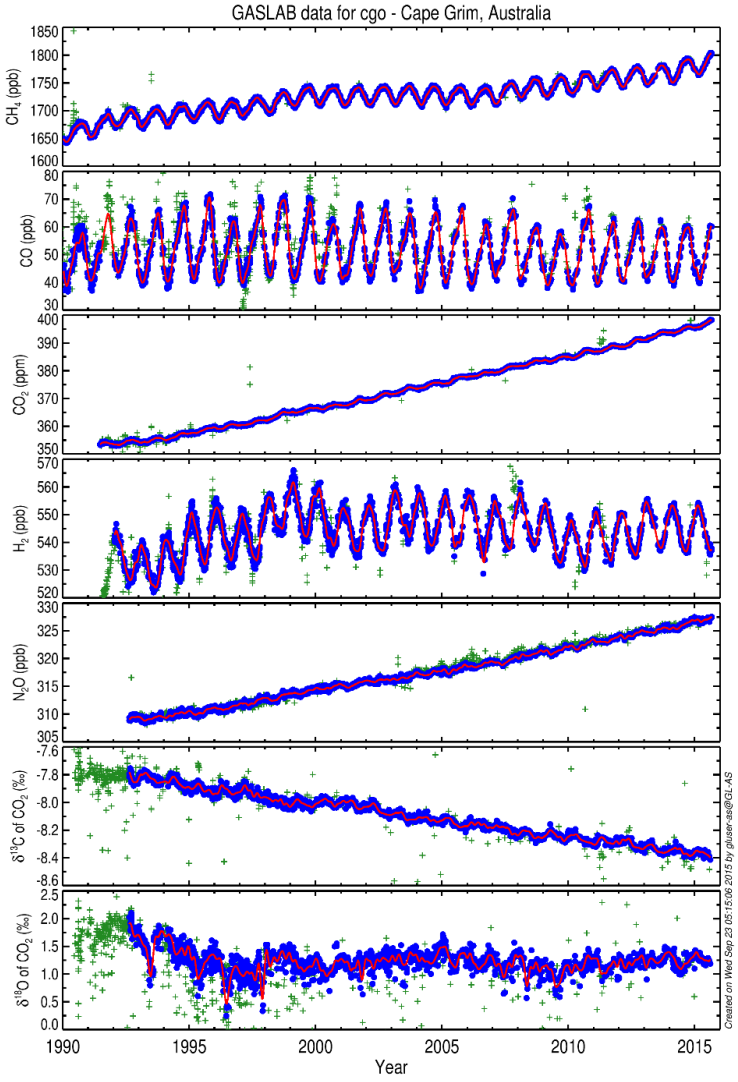
Bureau of Meteorology Cape Grim station staff

# CSIRO GASLAB flask, in situ & AGAGE networks



# Cape Grim Baseline Air Pollution Station



# Cape Grim Air Archive

Cape Grim cliff-top
20-May-1981

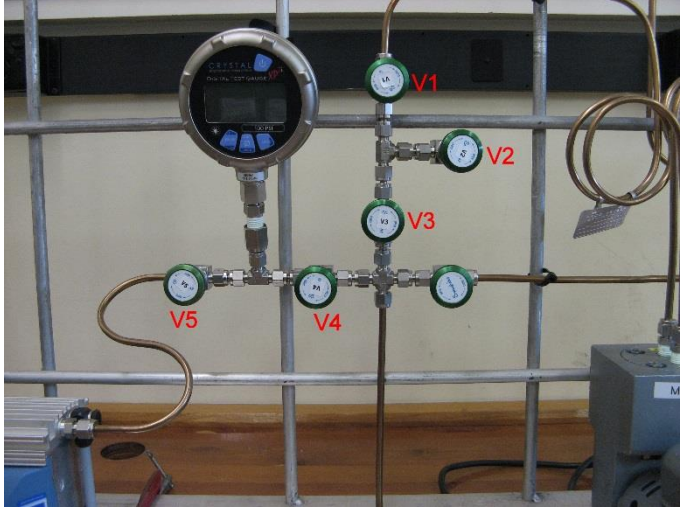
# Air Archive history

**Motivation**:

*To create a store of background air samples over a long period which at some future time could be analysed to recover information on past atmospheric composition*

- Large volume air archive samples collected regularly since April 1978 (P. Fraser)
- Unique resource (continuous air archive) with diverse research applications
- Future studies of new species (synthetic GHG) & new techniques
- Enables reconstruction of atmospheric trends on hemispheric to global scale
- Issues:
  - Sampling artefacts (modification of trace gas composition during sampling)
  - Long-term storage effects

# Air Archive sampling setup

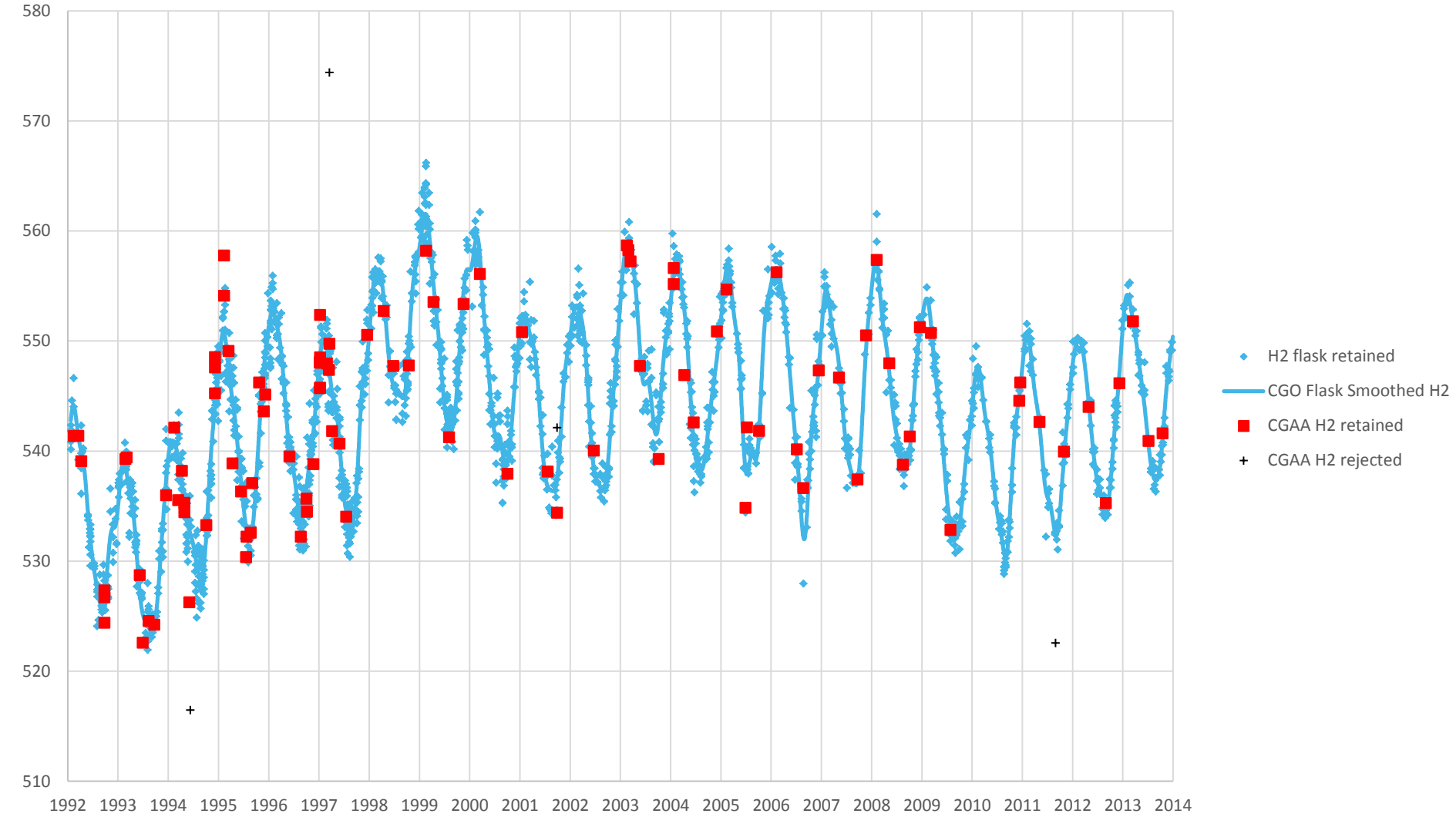



Essex Cryogenics p/n 80C-0008-8

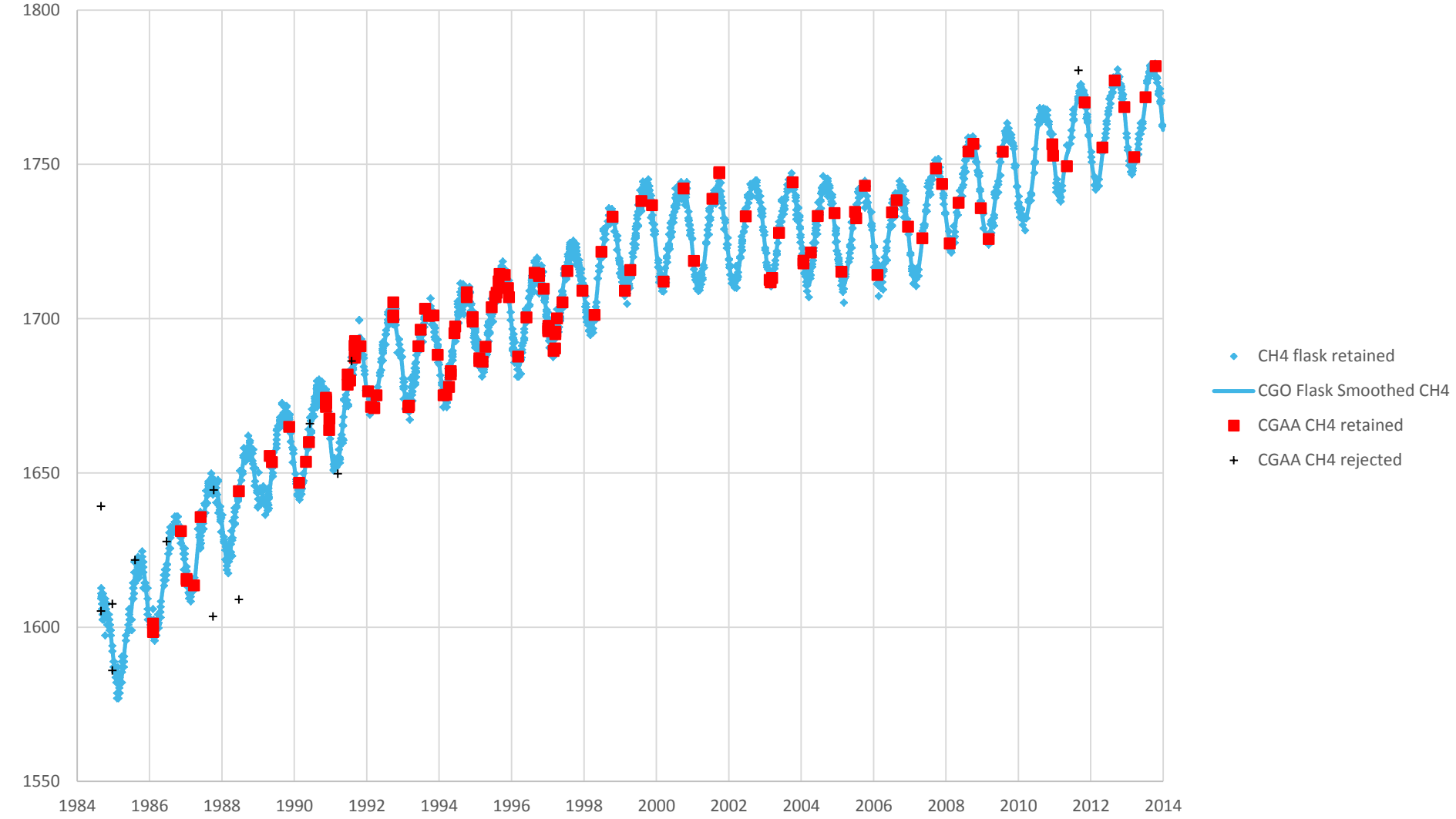
# Air Archive sampling components

- **TUBING:** Restek Corp, Part Number 21517, serial number RSS07-21517
- **VACUUM PUMP:** Vacuubrand, Model MD 1, serial number 29690402
- **VACUUM GAUGE:** Crystal, model XP2
- **PRESSURE PUMP:** Robbins & Myers inc, Model KS-P330-BOWL, metal bellows, part number 1833218011
- **TANKS:** Essex Cryogenics Inc., electropolished stainless 304 steel - part number 80C-0008-8

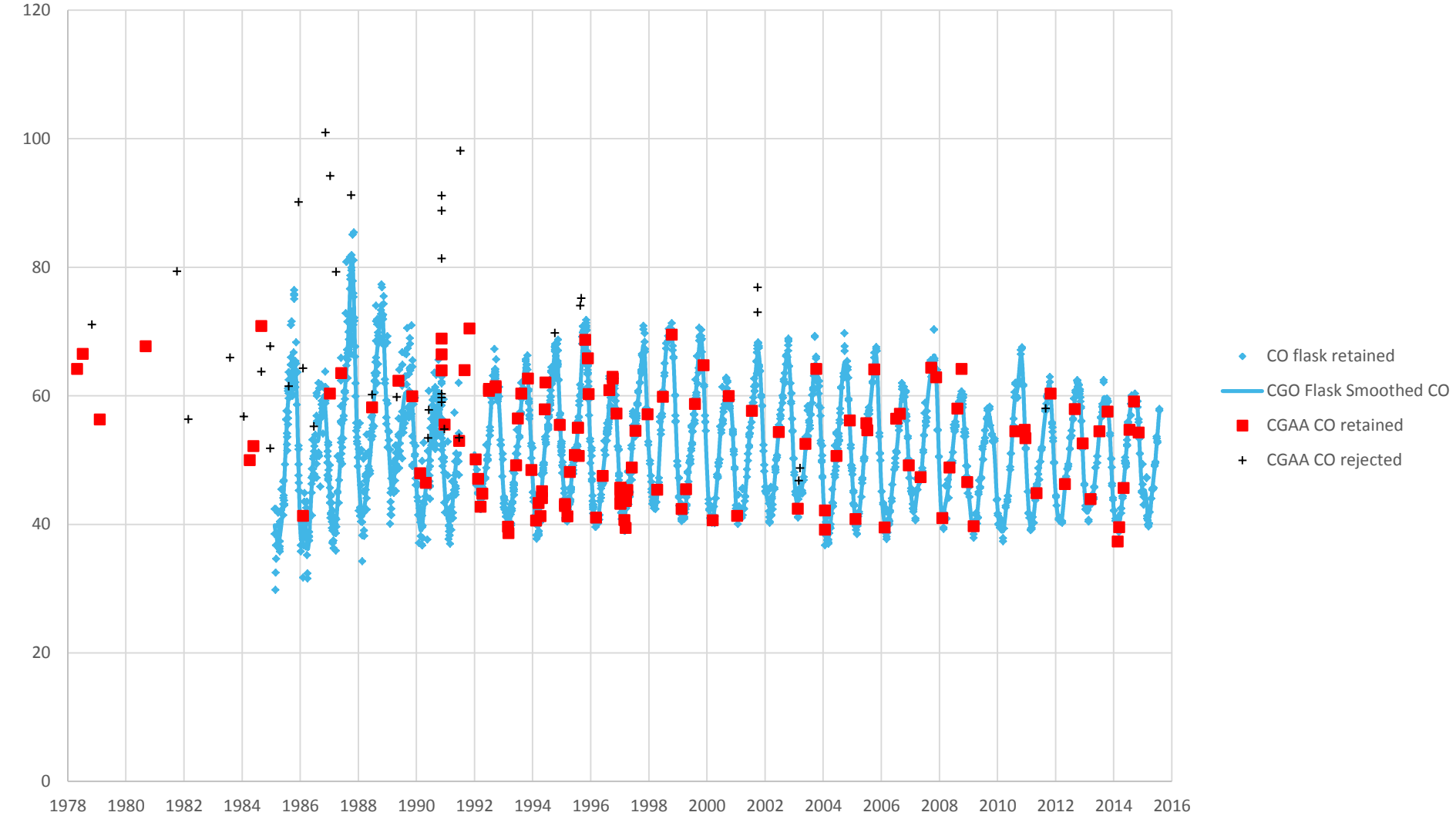
# Air Archive – $H_2$ integrity



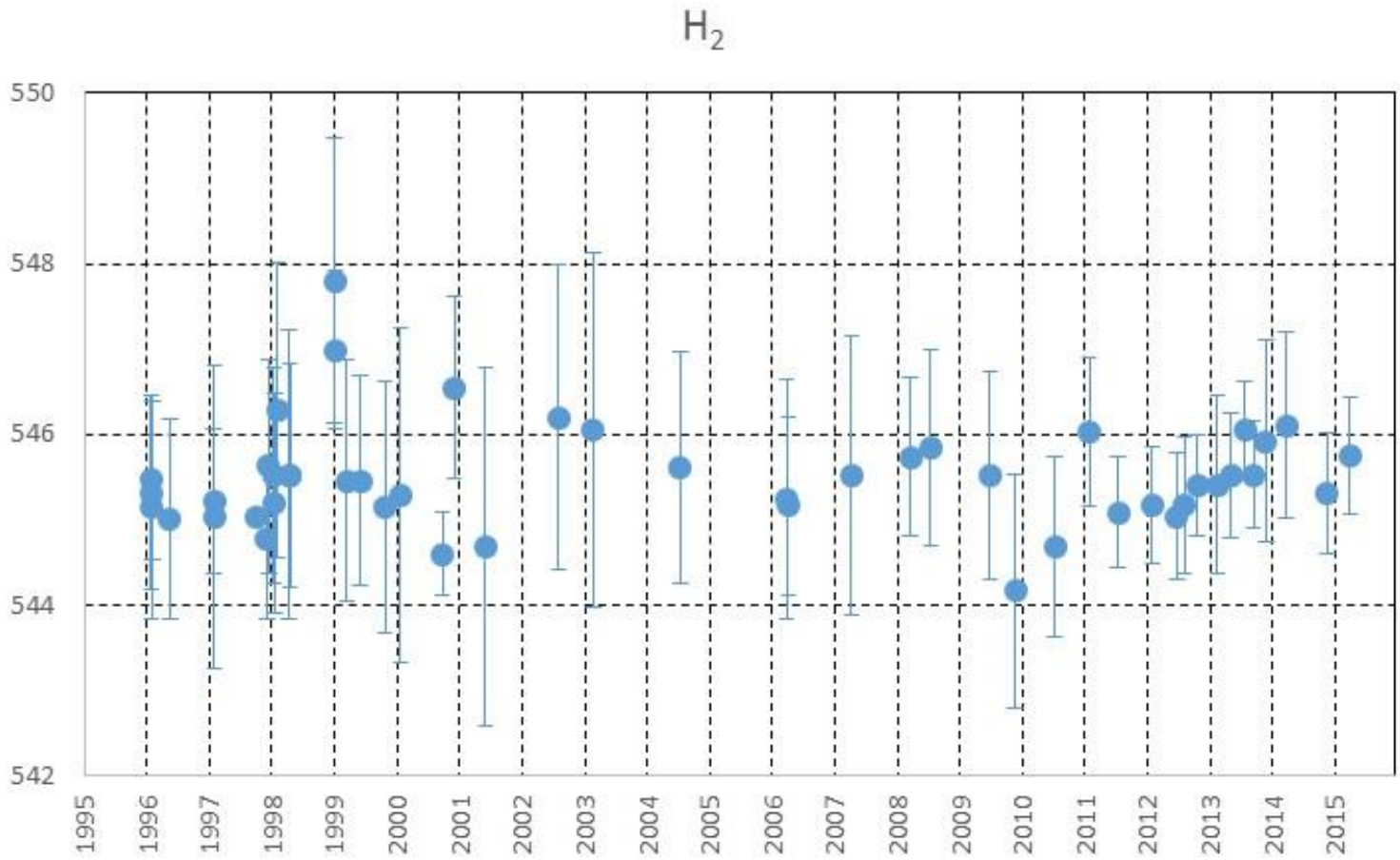
# Air Archive – $CH_4$ integrity



# Air Archive – CO integrity



# Analysis history CGAA sample UAN 960051



# Key metrics

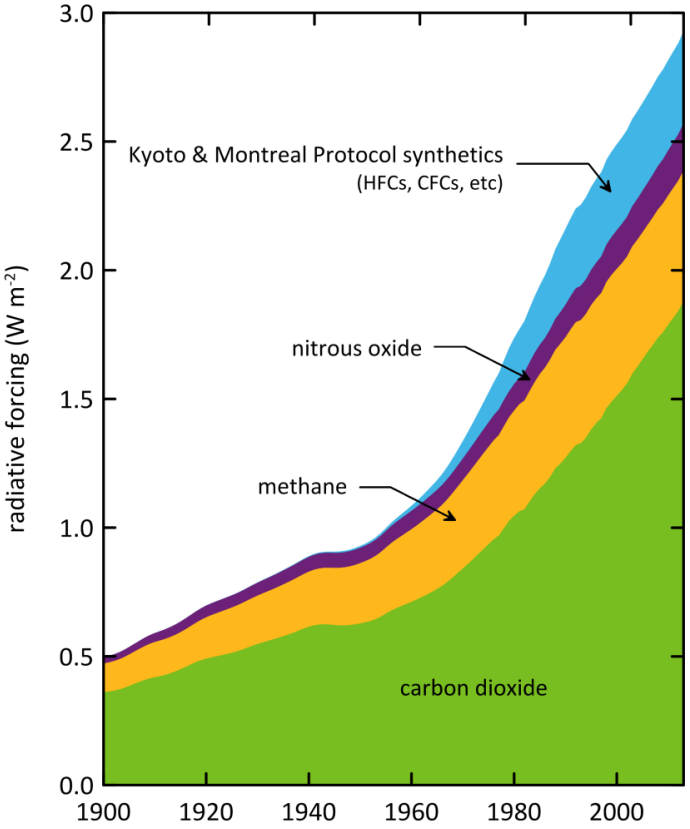
- 37 years of archived air
- ~175 high pressure samples collected
- ~100-150 surviving samples
- >100 publications
- >56 gases
- >12 isotopic species

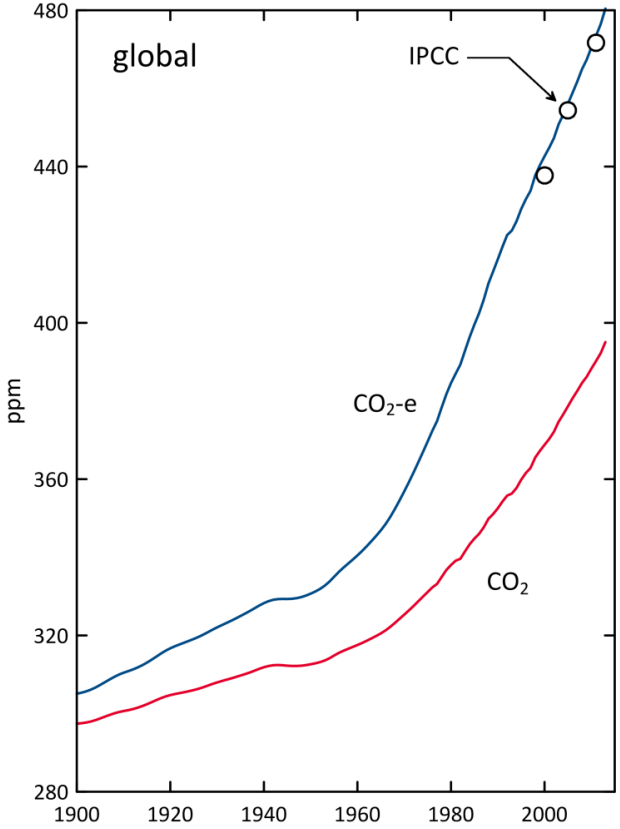
# Air Archive applications

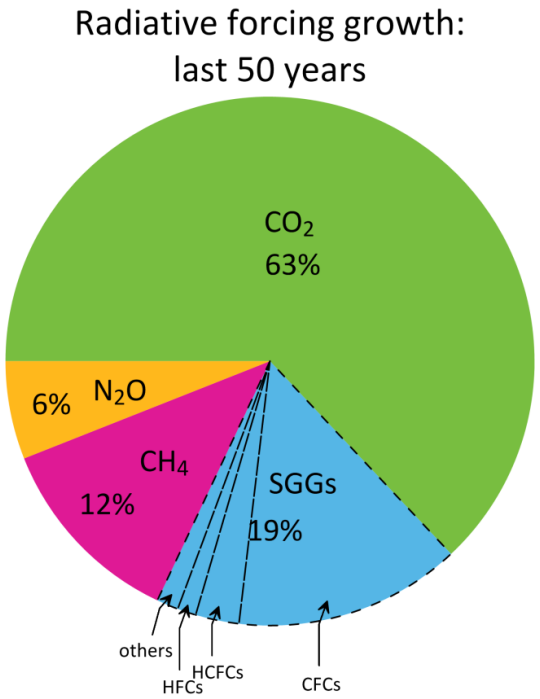
## Recent applications/research

- $N_2O$ sources and sink attribution ($N_2O$ isotope), Park 2012
- $CF_3SF_5$, Sturges 2012
- Octaflurocyclobutane (c-$C_4F_8$ or PFC-318), Oram 2012
- $C_4F_{10}$, $C_5F_{12}$, $C_6F_{14}$, $C_7F_{16}$, $C_8F_{18}$, Ivy 2012
- N-$C_7F_{16}$, Laube 2012
- Stratospheric $O_3$ depletion analysis, Montzka 2011
- HFCs (HFC-365mfc, HFC-245fa, HFC-227ea, HFC-236fa, Vollmer 2011
- Reconstruction of $SF_6$ emissions, Rigby 2010

# CSIRO/AGAGE long-lived GHG radiative forcing

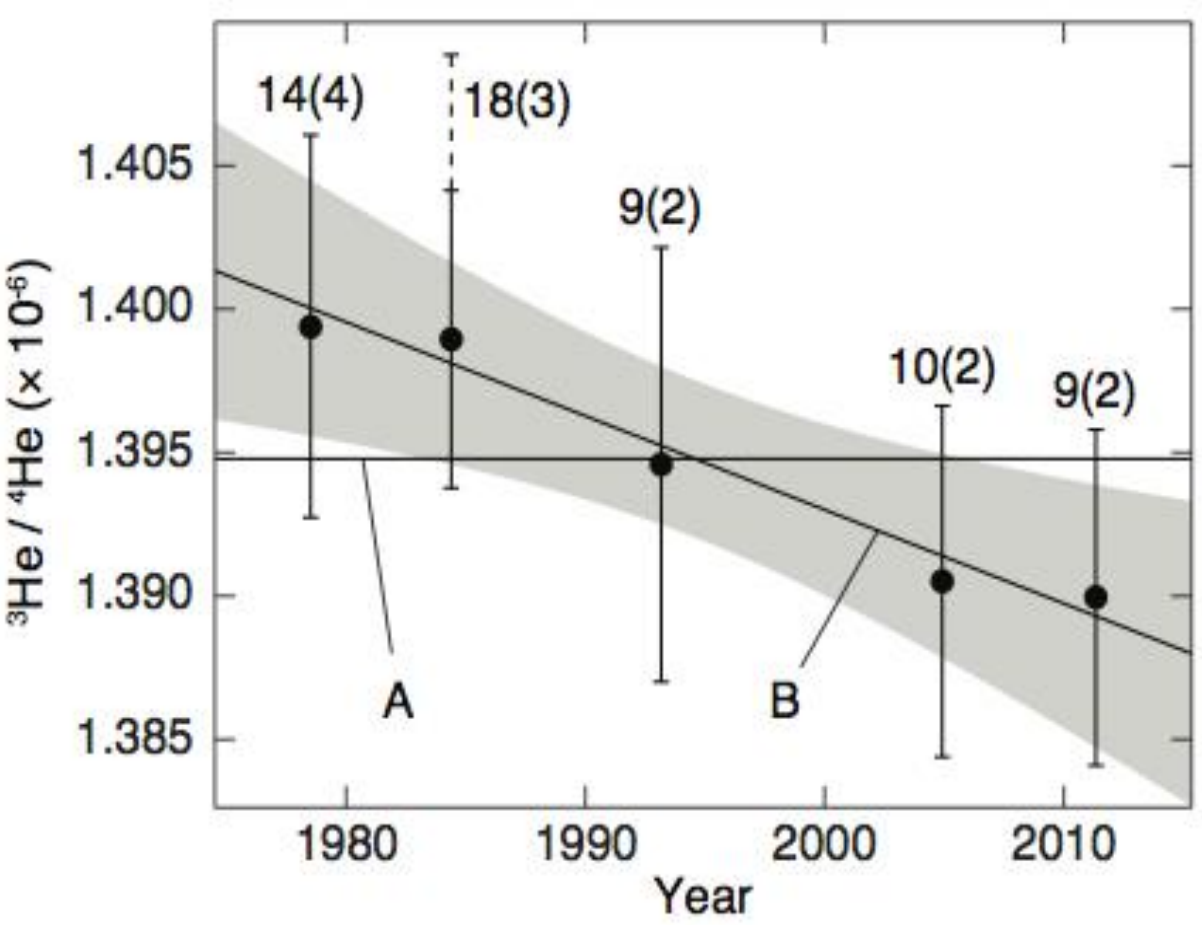



- uses flask/in situ networks, and firn and icecore records.
- global $CO_2$ 2013: 395 ppm, $CO_2$-e 480 ppm ; 2014: 397 ppm
- able to replicate TAR, AR4 and AR5 global radiative forcing
- biennial reporting: BoM/CSIRO *State of the Climate* report

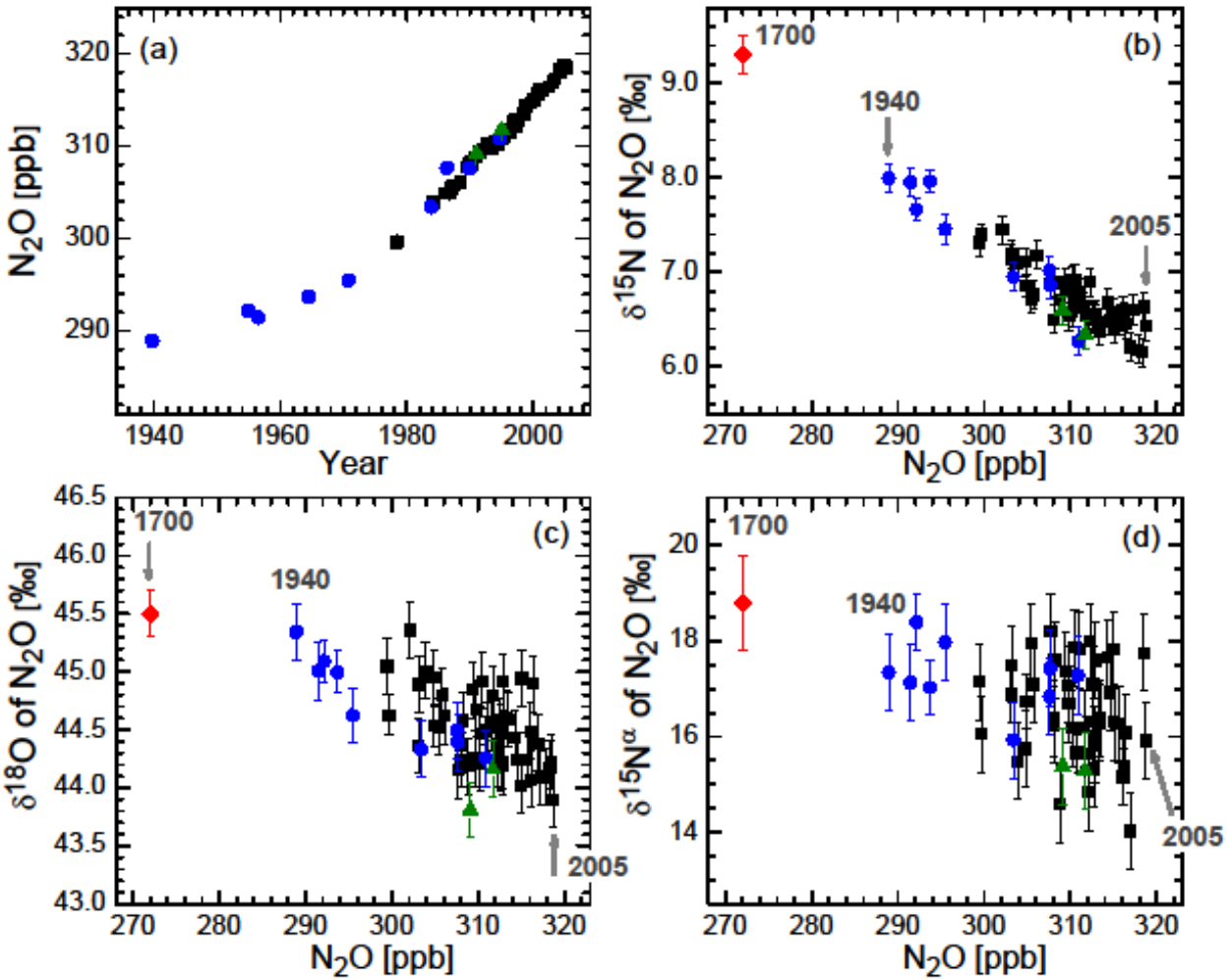
# Helium isotopes (Brennwald *et al*., Earth and Planetary Science Letters, 2013)




$^3He/^4He$ trend

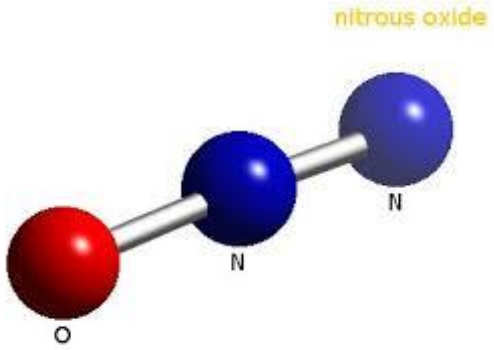
- -0.23 – -0.30 ‰/yr
- Forced by release of terrigenic He from fossil fuel mining and combustion

# Nitrous oxide ($N_2O$; Park *et al.*, Nature Geoscience, 2012)




$N_2O$ isotope trends

- $\delta^{15}N$ consistent with fertilizer emissions
- $\delta^{15}N^{\alpha}$ constrains nitrification component



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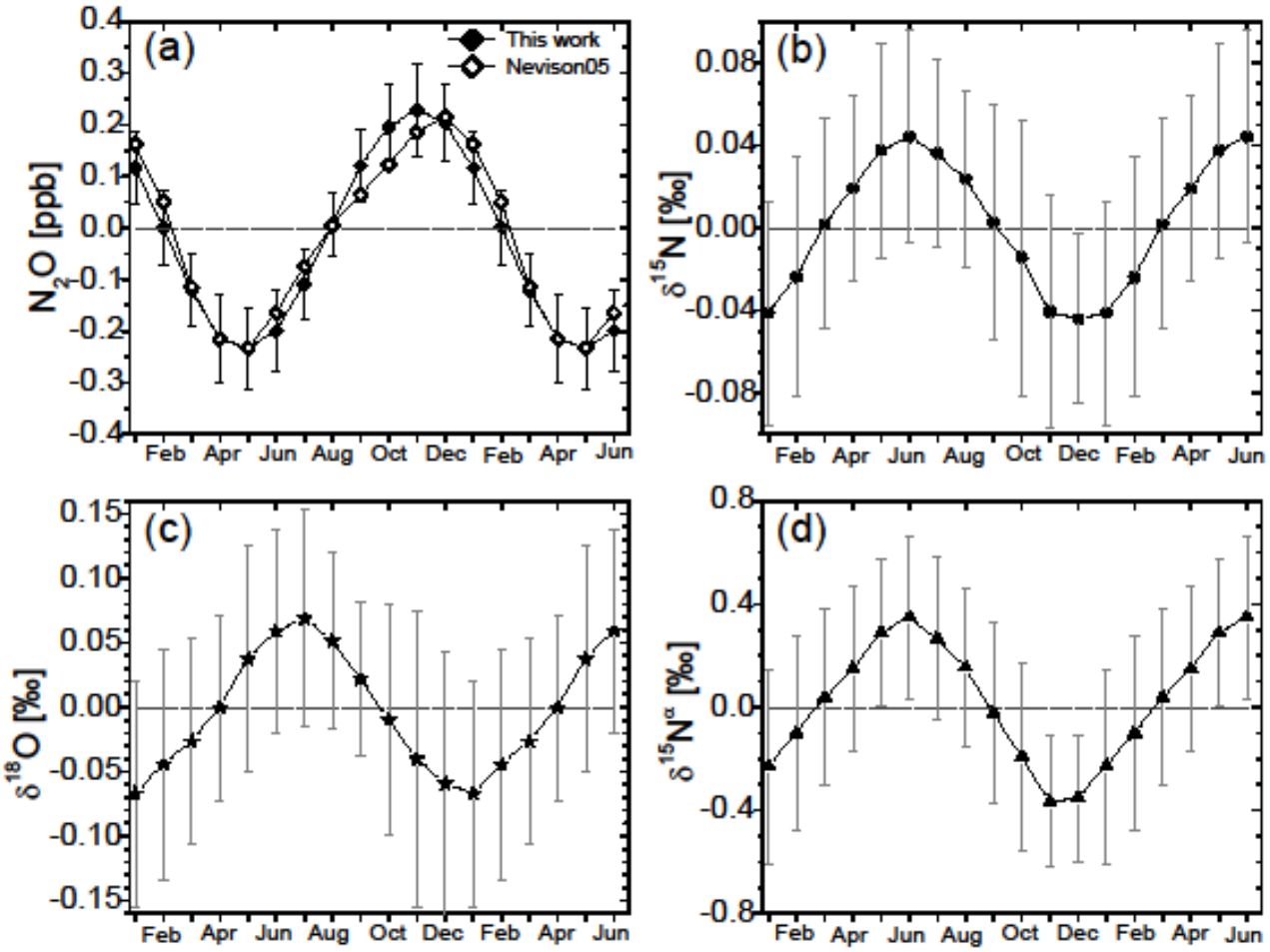
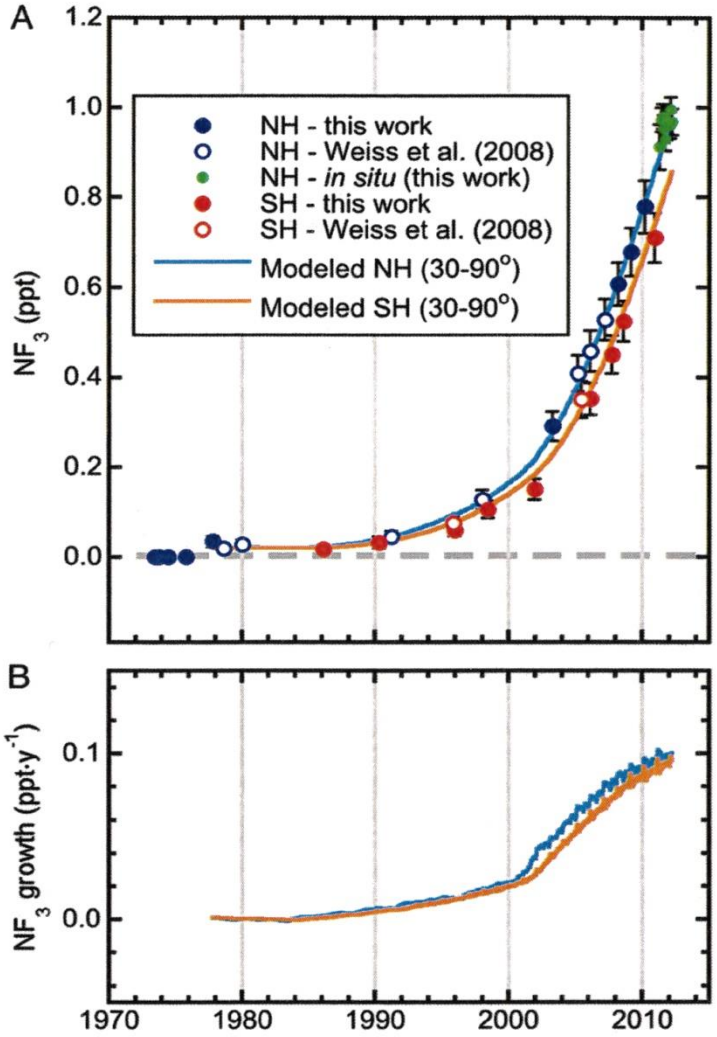
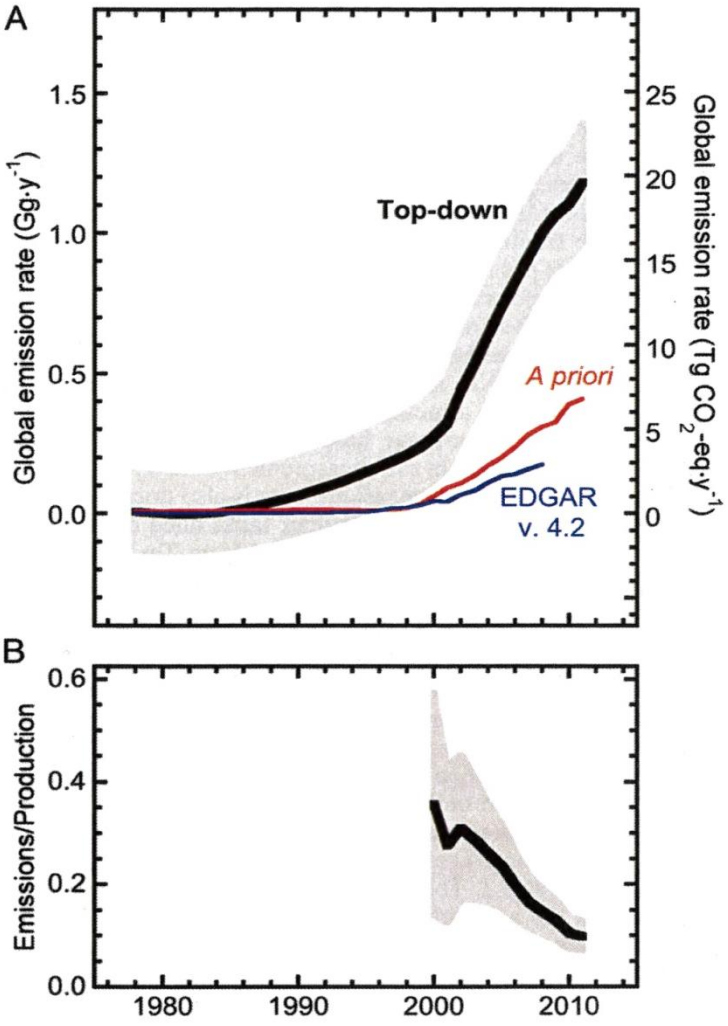



$N_2O$ isotope seasonality

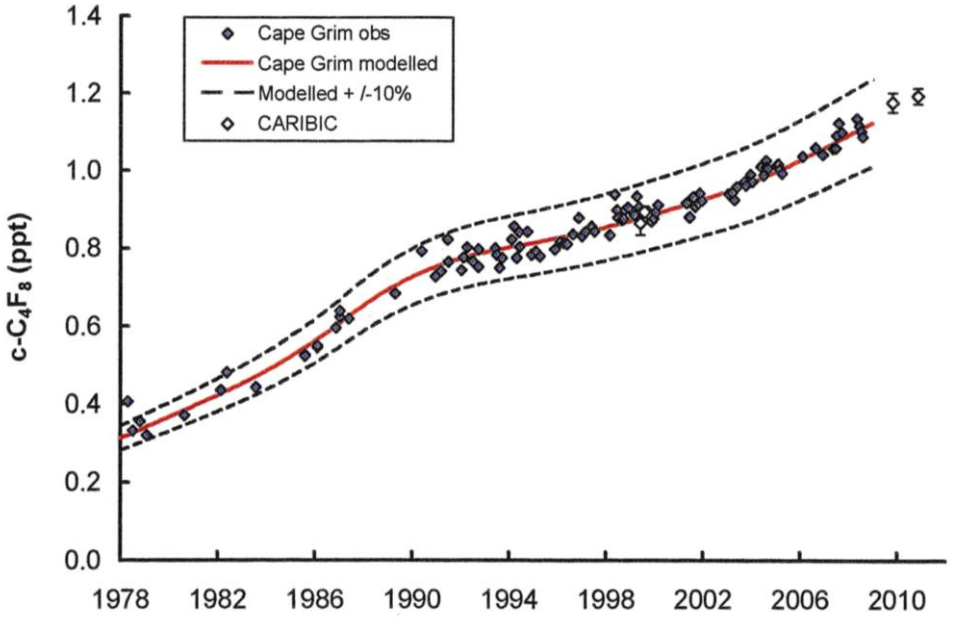
- $\delta^{15}N$ and $\delta^{18}O$ consistent with stratospheric and oceanic forcing
- $\delta^{15}N^{\alpha}$ amplitude larger than expected

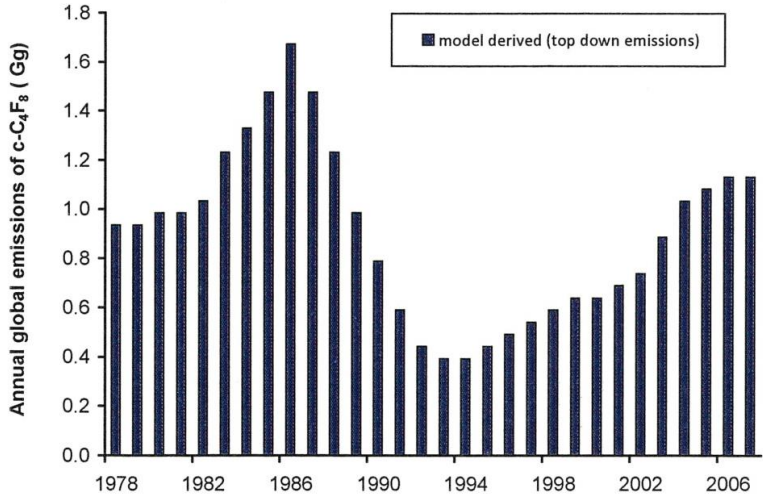
# Nitrogen trifluoride ($NF_3$; Arnold et al., PNAS, 2013)

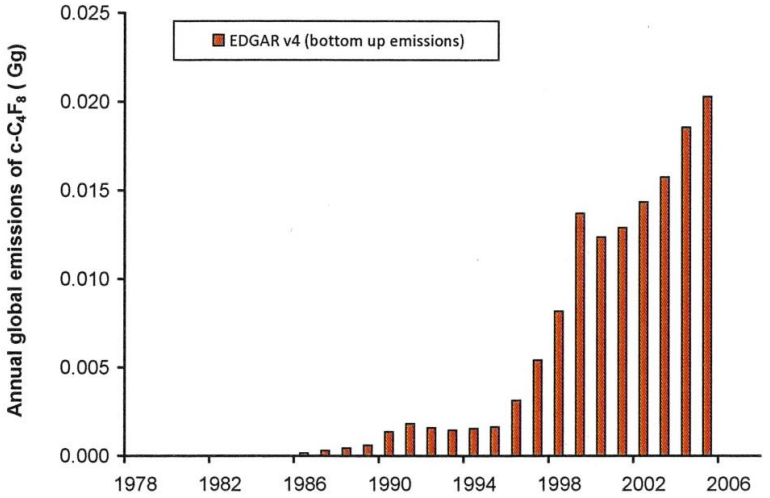


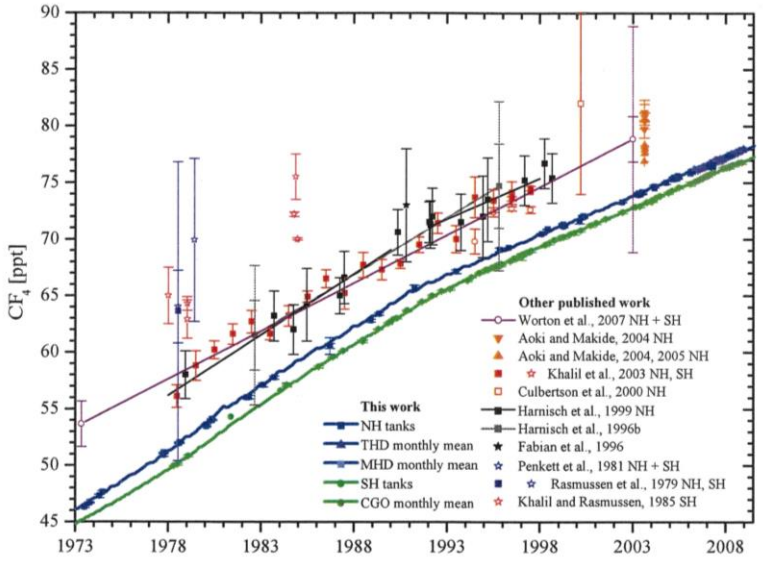
# Octafluorocyclobutane (C-$C_4F_8$ or PFC-118; Oram *et al*., Atmos. Chem. Phys., 2012)

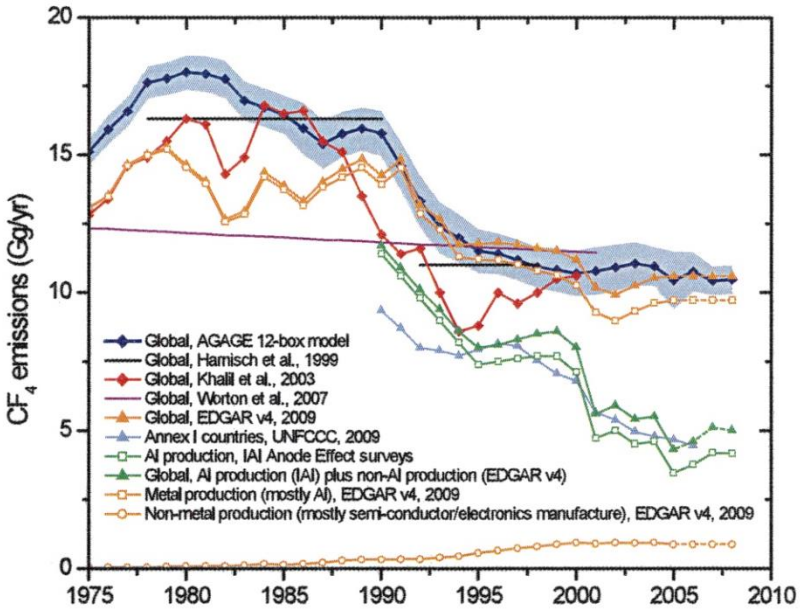


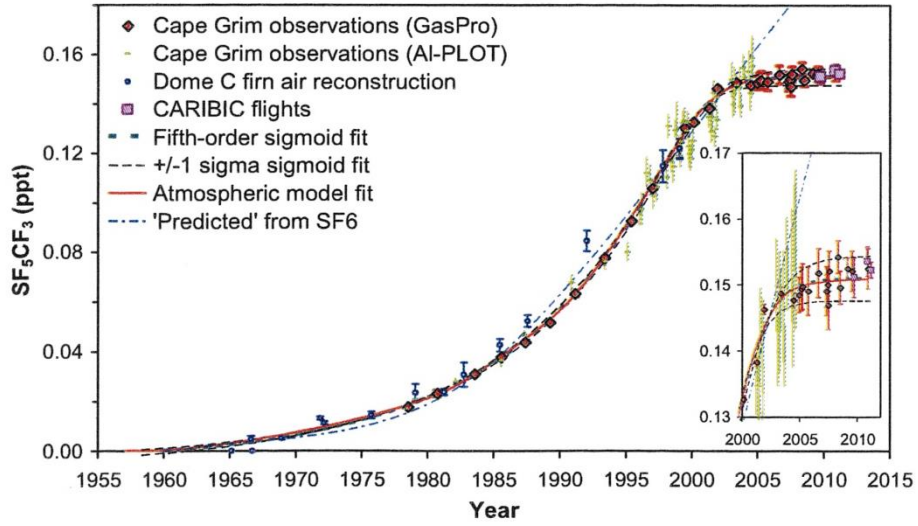



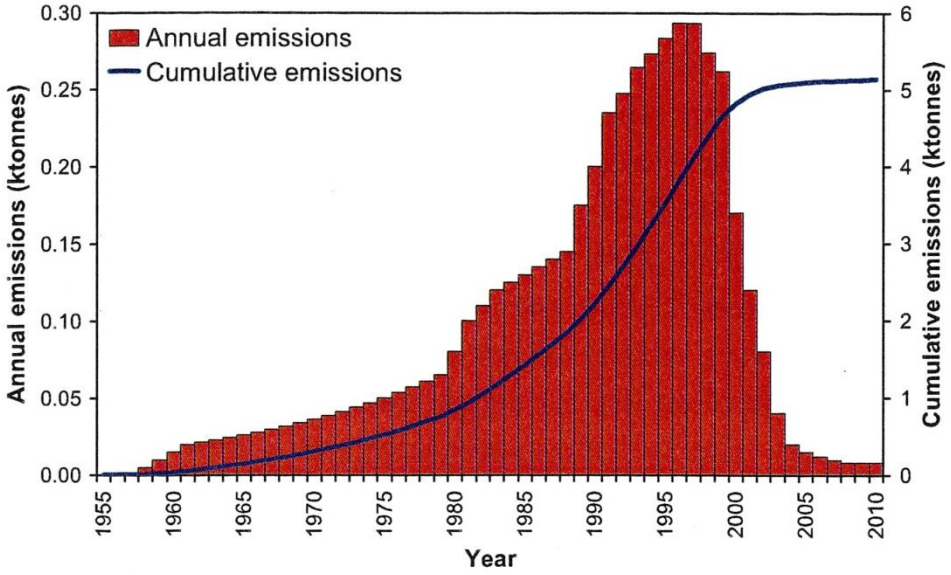



# Tetrafluoromethane ($CF_4$or PFC-14; Mühle *et al*., ACP, 2010)






# $SF_5CF_3$ (Sturges *et al.*, ACP, 2012)

# The future

- Continued prominence in atmospheric composition studies
  - New synthetic gases
  - Higher measurement precision with new technologies
  - Growing emphasis on isotopic measurements
- Transfer of air from leaking tanks
- Increase to 6 AA samples per year

# Thank you

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