Site Report - JPL MkIV Interferometer

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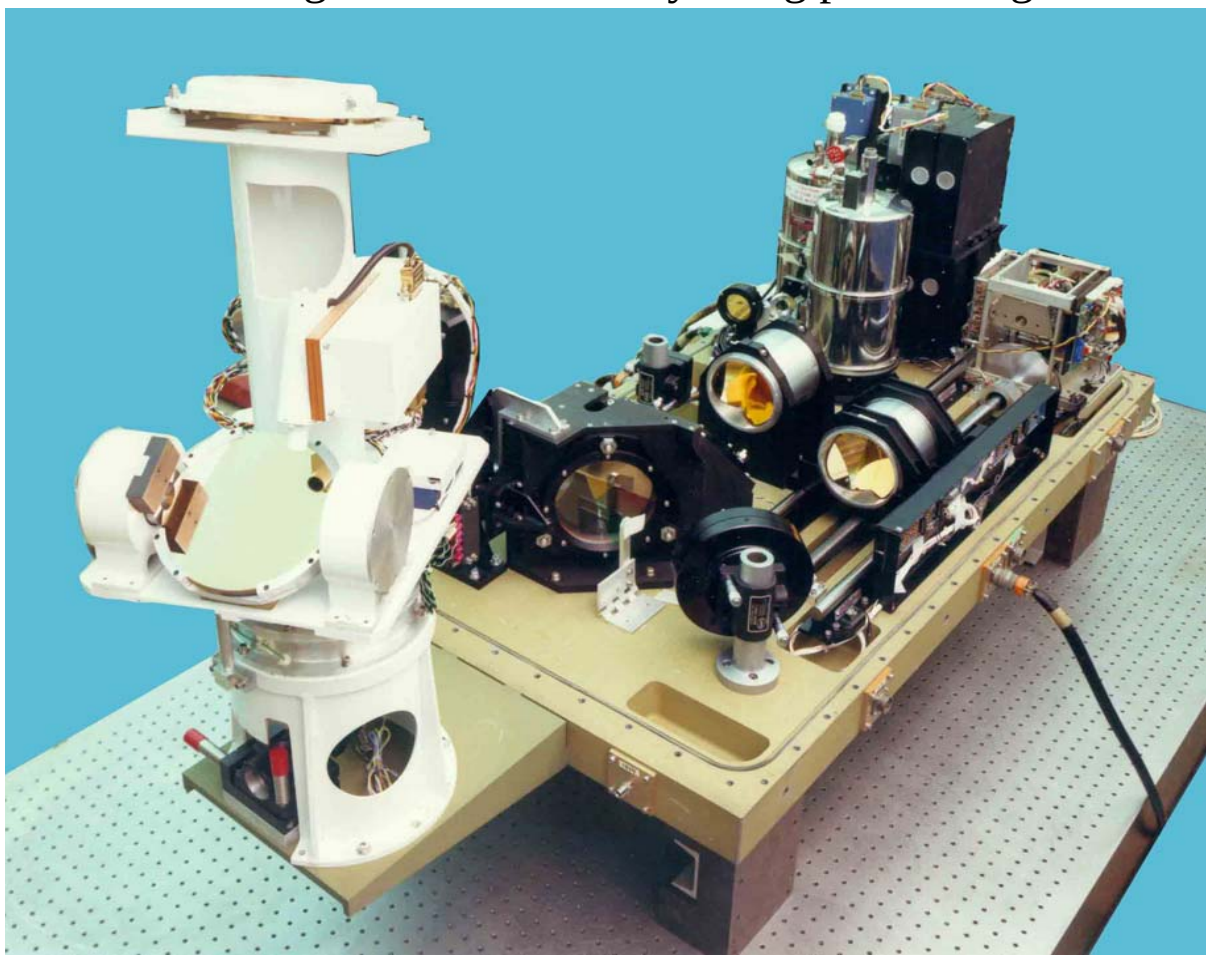
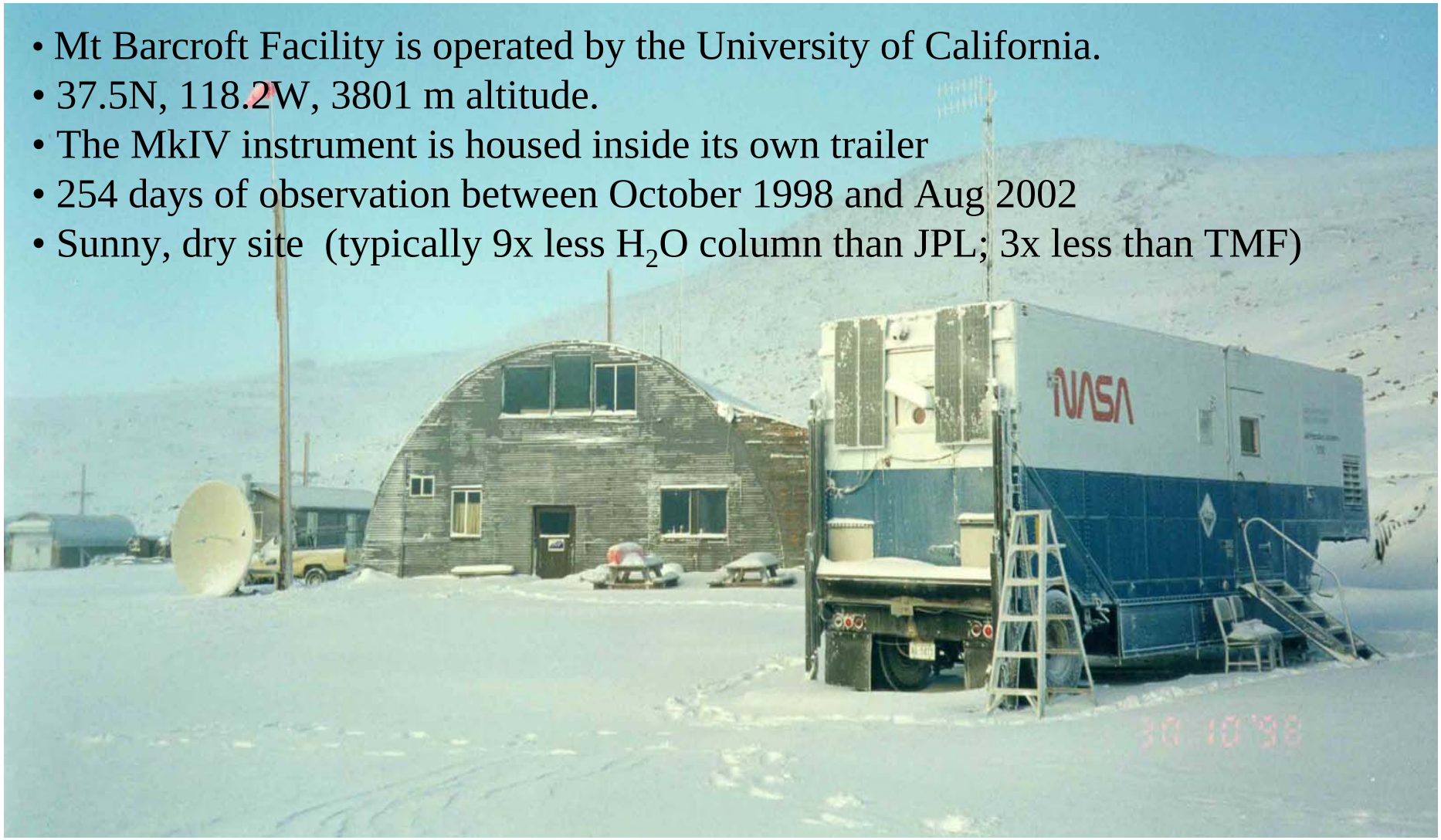
JPL MkIV Interferometer

MkIV instrument is JPL-designed FTS built in 1984. 120 cm OPD typically used.
Covers 650–5640 cm^{-1} region simultaneously using parallel HgCdTe & Insb detectors.



Mt. Barcroft ground-based observations



- Mt Barcroft Facility is operated by the University of California.
- 37.5N, 118.2W, 3801 m altitude.
- The MkIV instrument is housed inside its own trailer
- 254 days of observation between October 1998 and Aug 2002
- Sunny, dry site (typically 9x less H_2O column than JPL; 3x less than TMF)

Mt. Barcroft ground-based observations

MkIV has operated at Mt. Barcroft since Oct 1998, except for trips to Sweden during winters of 1999-2000 and 2002-3.

MkIV operates under remote control from JPL via internet or cellular phone.

Can acquire up to 2 hours of data each morning through 6” ZnSe window

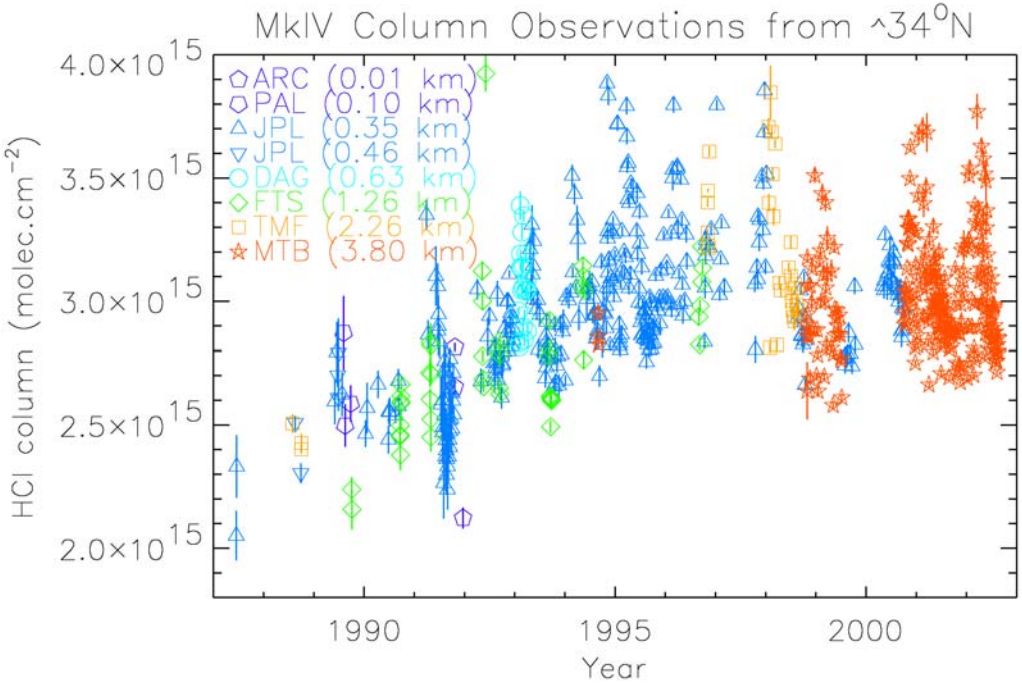
28 Lead-Acid batteries recharged by 18 solar panels (55W each) provide power for data acquisition and maintain MkIV at 25C throughout winter

Detectors are cooled by pressurizing two 35 liter LN_2 storage dewars. These require refilling every 2-3 months

HCl

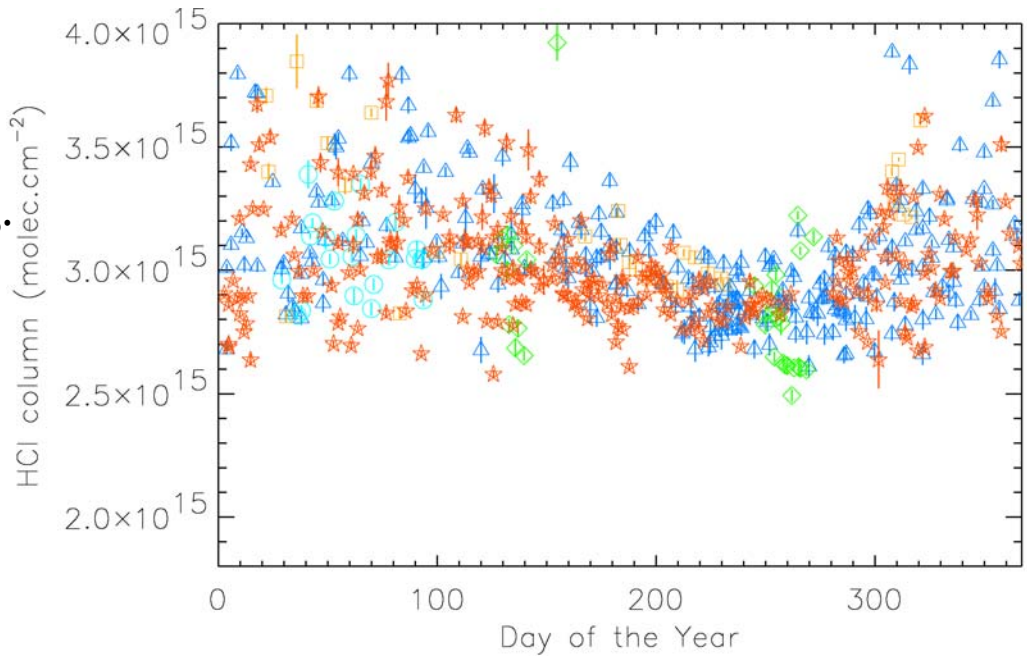
MkIV data from different sites are color-coded by altitude.

HCl peak in late 1990's, but little decline observed since



High variability in winter and spring.

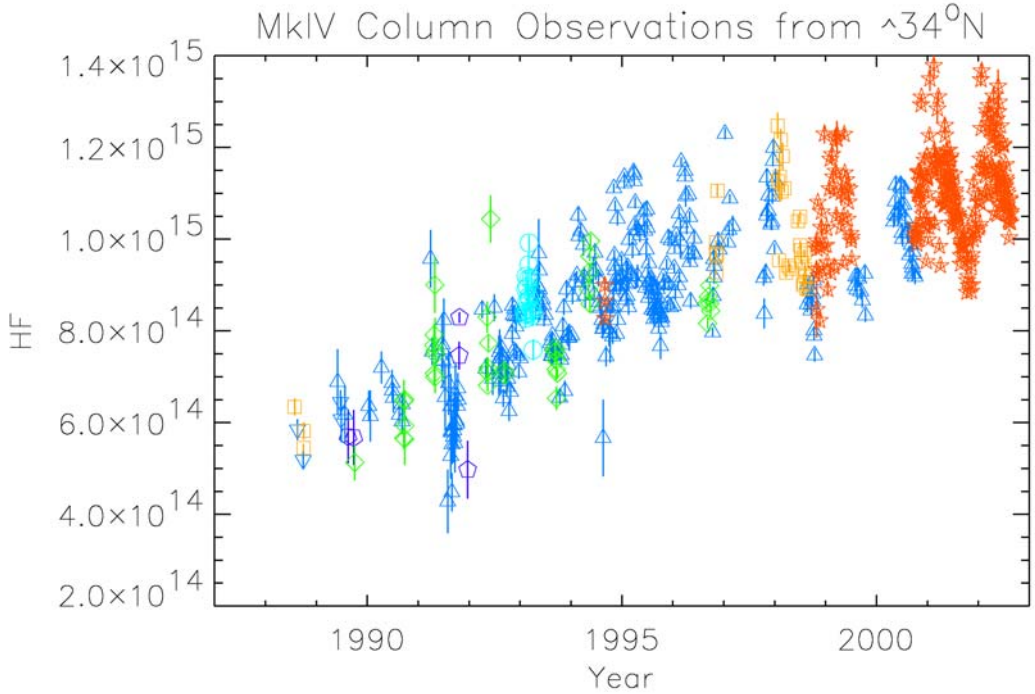
Low variability in late summer



HF

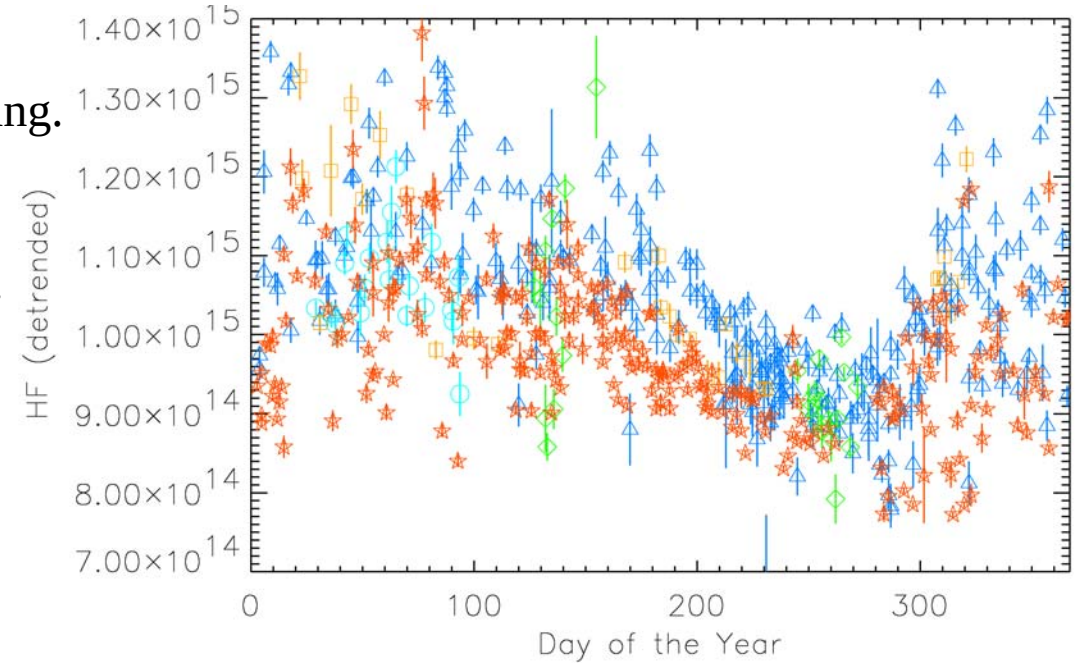
HF still increasing, but has slowed down considerably since 1996.

Same color scheme as previously.



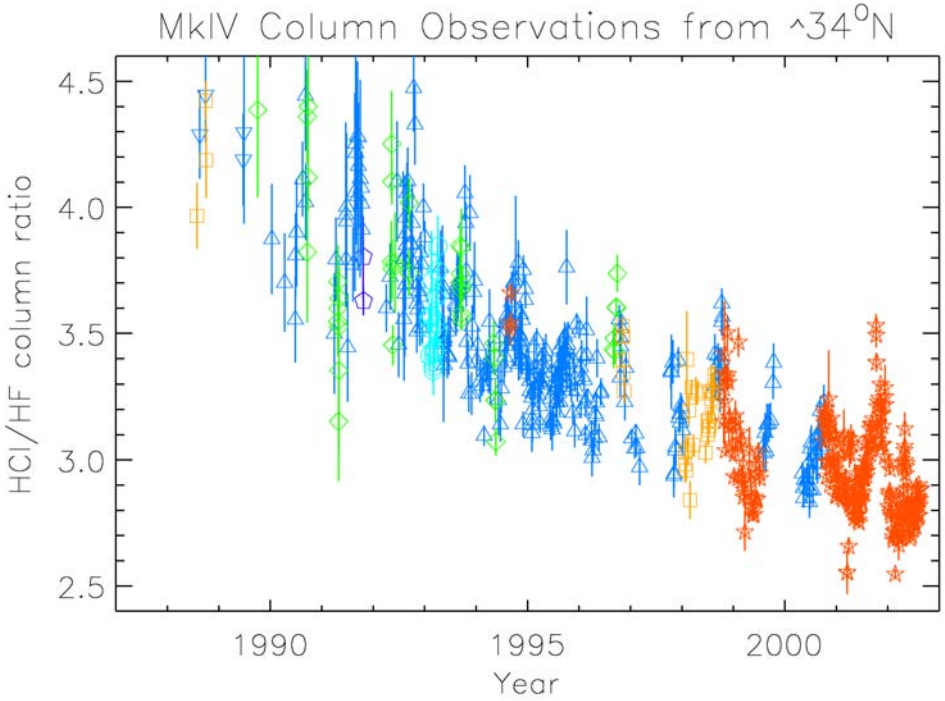
High variability in winter and spring.
Low variability in late summer.

HF columns have been detrended.

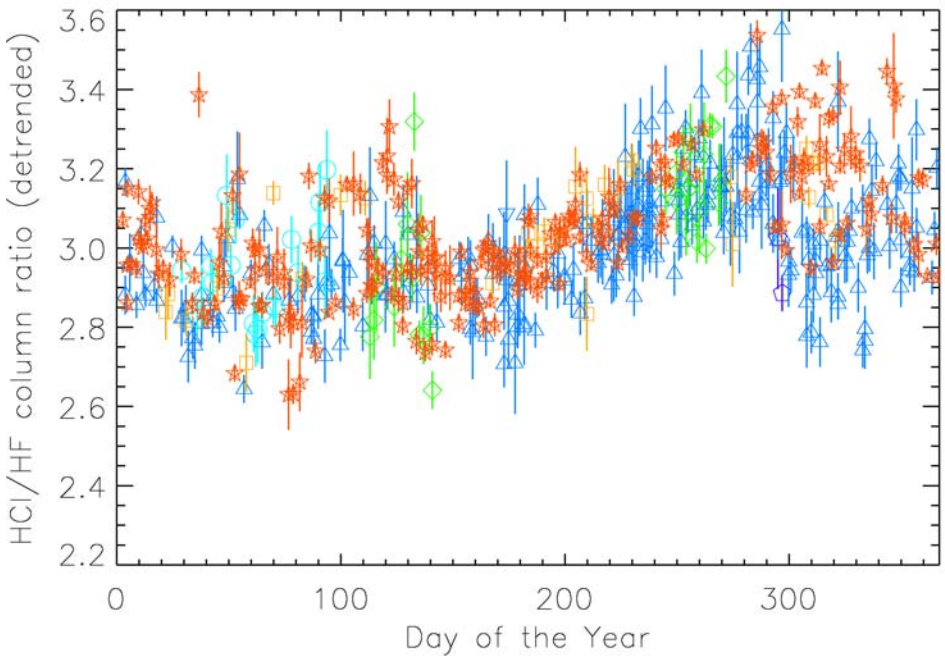


HCl/HF ratio

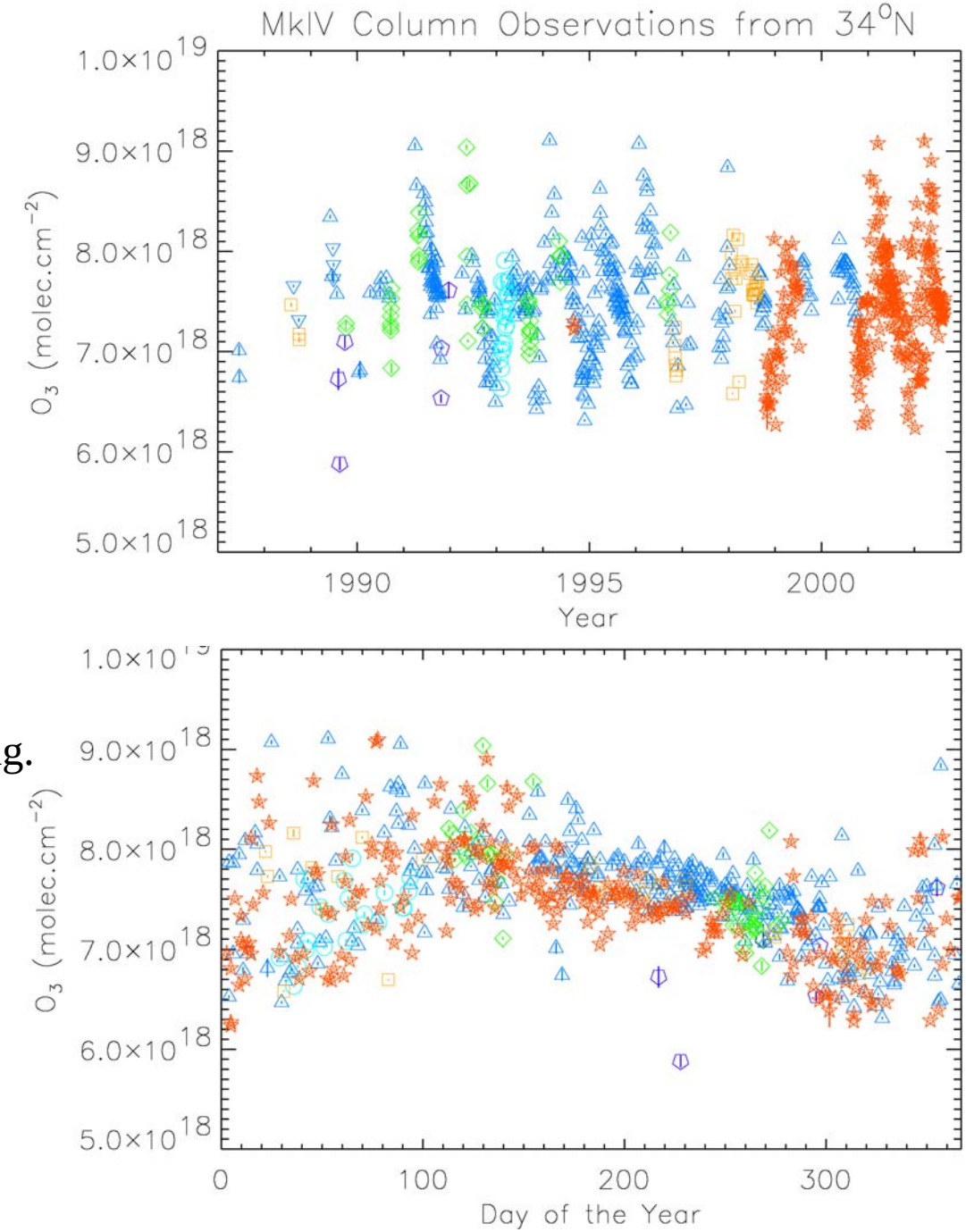
Ratio continues to decrease.



Detrended HCl/HF ratio has maximum in Sep/Oct.



O_3

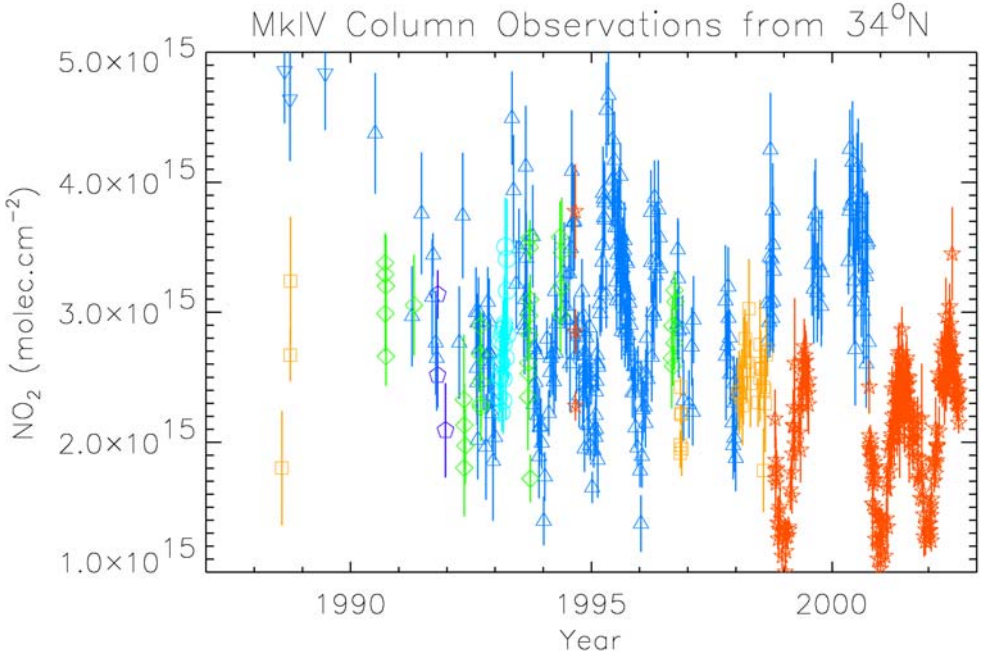


High variability in winter and spring.
Low variability in late summer.

NO_2

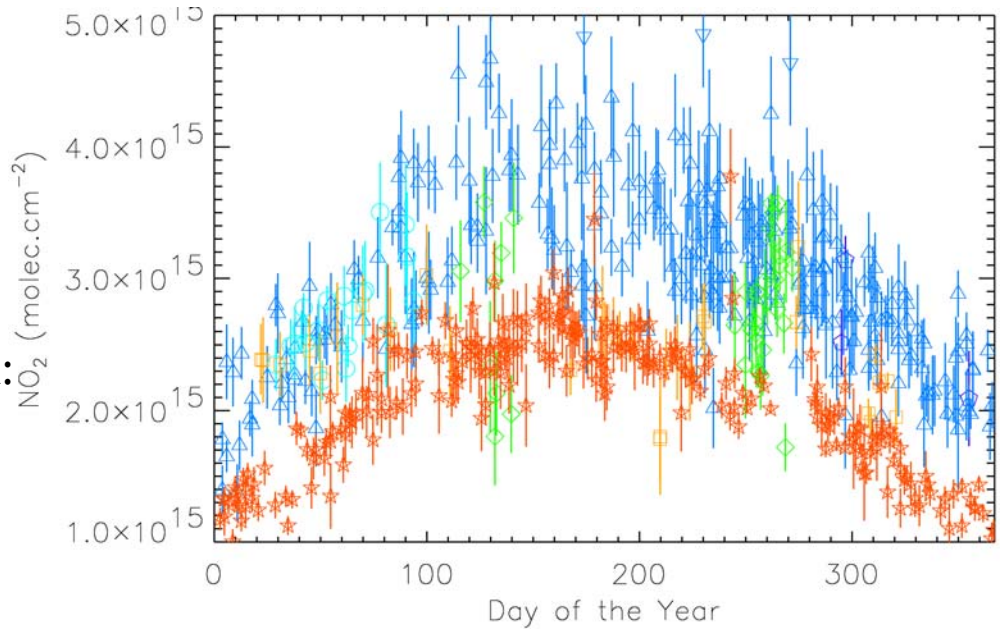
NO_2 measured at 2914.65 cm^{-1}

Strong seasonal cycle driven by photolysis of HNO_3, N_2O_5

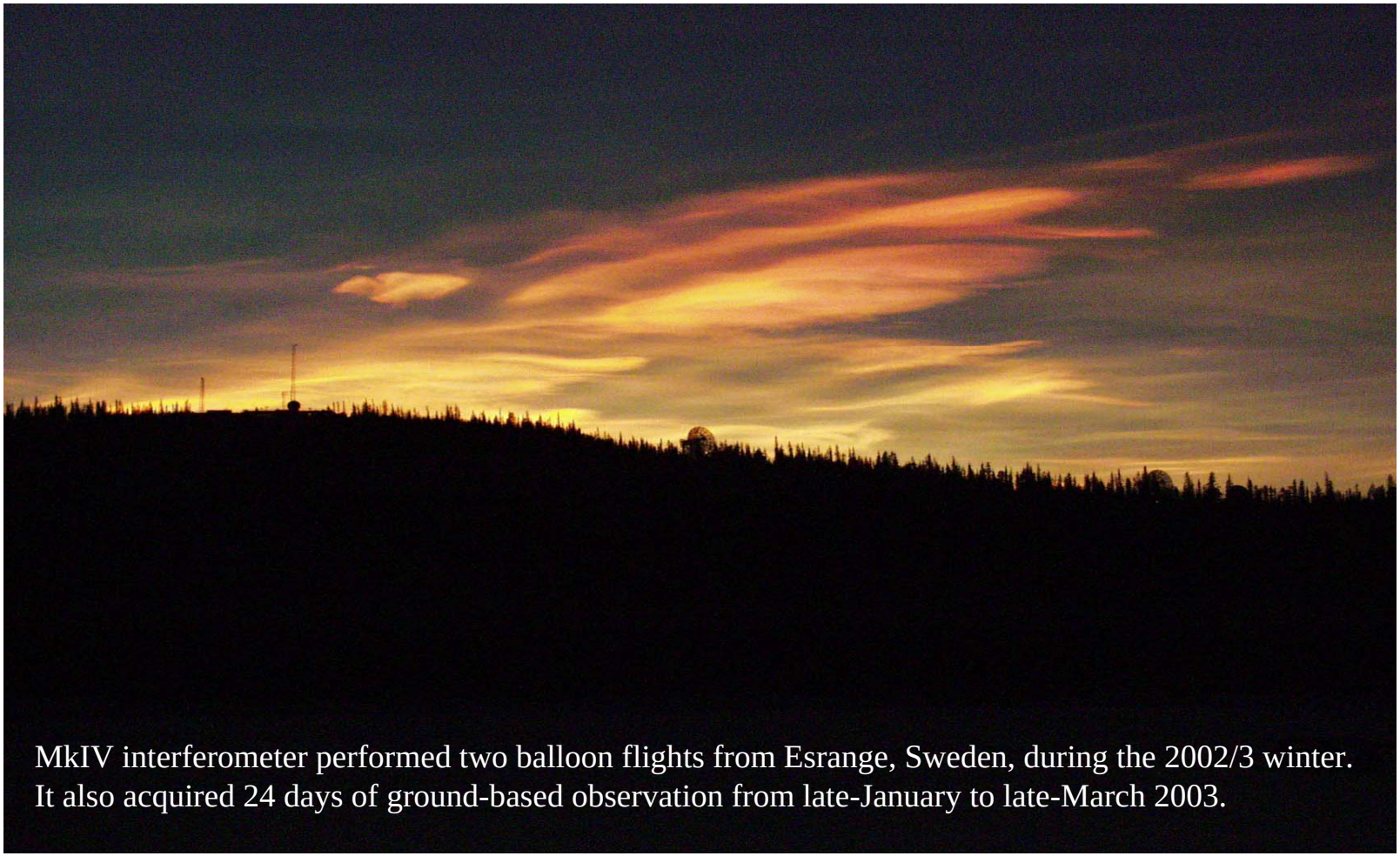


Apparent bias between early, low-altitude measurements and Barcroft measurements is NOT due to tropospheric NO_2

More likely it is the diurnal variation:
- JPL data acquired near noon
- Barcroft data soon after sunrise



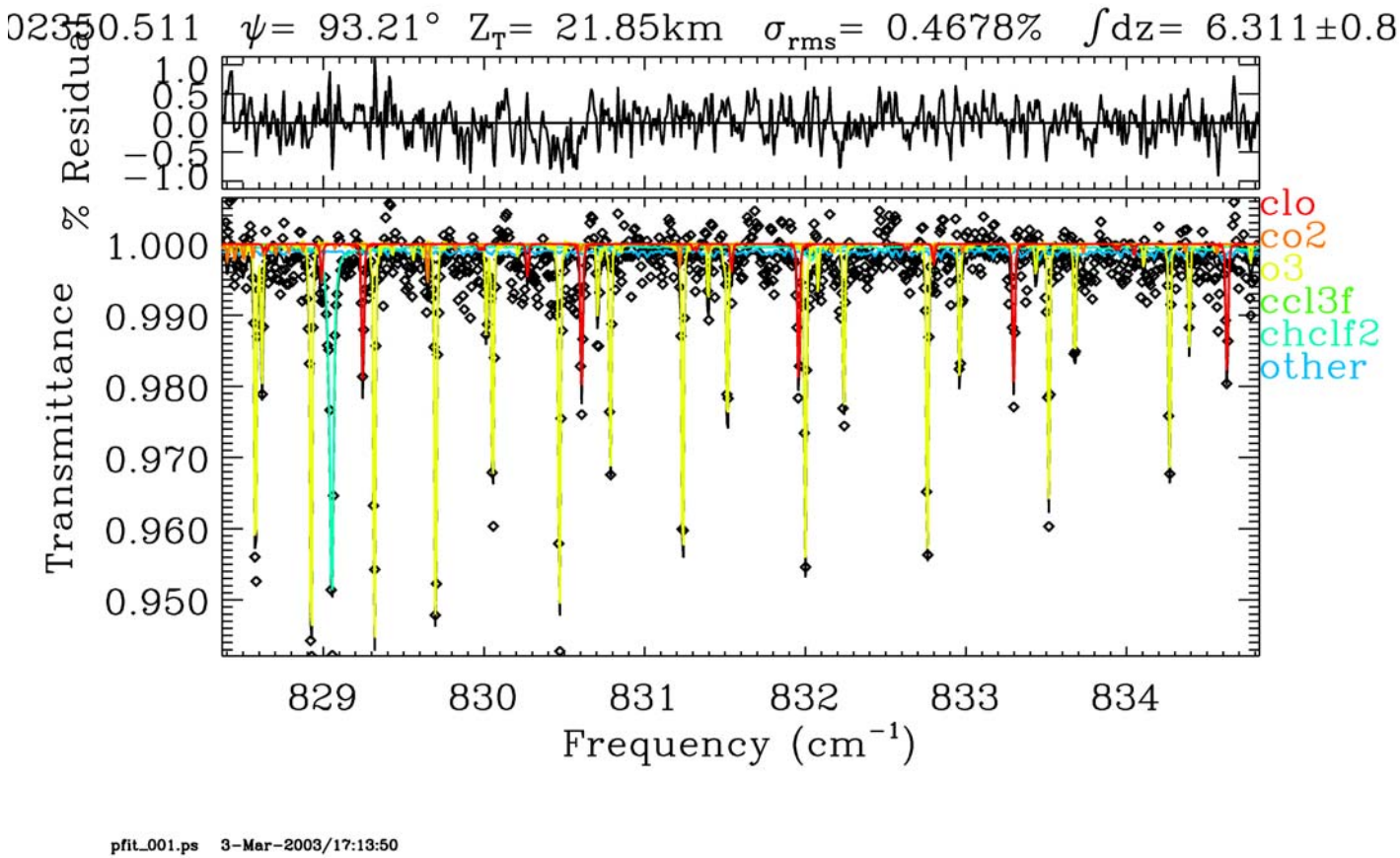
SOLVE2 Campaign, Esrange, Sweden



MkIV interferometer performed two balloon flights from Esrange, Sweden, during the 2002/3 winter. It also acquired 24 days of ground-based observation from late-January to late-March 2003.

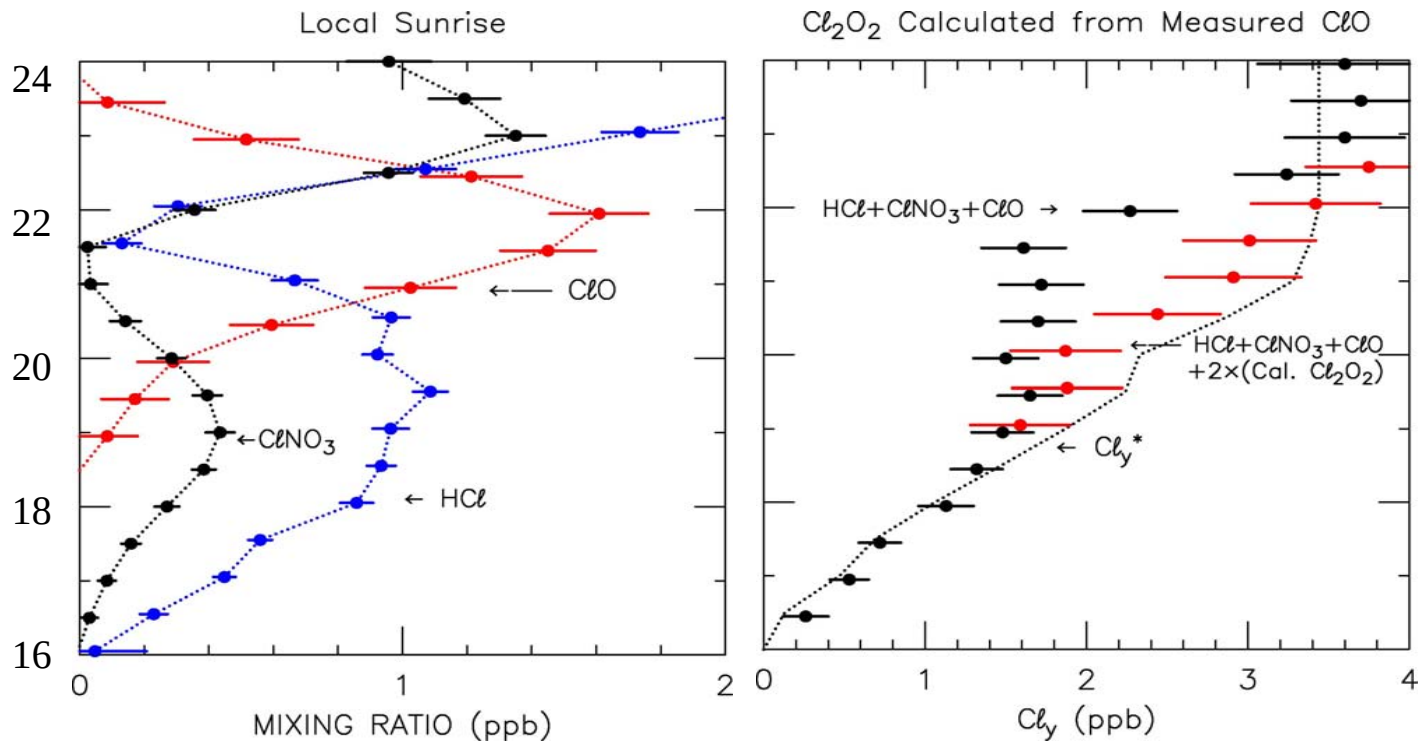
Balloon Flights from Esrange, Sweden

Balloon occultation spectra measured 16’th December 2002 showed 1.6 ppb of ClO at 22 km altitude.



JPL MkIV balloon profiles of ClO and $ClNO_3$

Left panel shows the ClO, $ClNO_3$, and HCl volume mixing ratio profiles between 12 and 28 km altitude measured by MkIV deep inside the winter Arctic vortex on December 16, 2002. Right panel shows the measured Cl_y (HCl + $ClNO_3$ + ClO), Cl_y + 2×(calculated Cl_2O_2), and inferred Cl_y^* using the Cl_y-N_2O correlations measured during SOLVE and MkIV N_2O in December 2002. The dimer is calculated using a photochemical steady state model initialized with MkIV measurements of T_{air}, O_3, H_2O, CH_4, NO_y, Cl_y, etc.



MkIV Site Report - Summary & Conclusions

254 days of ground-based observation from Mt. Barcroft Oct 1998 - Jul-2002, nearly all by remote control from JPL.

24 days of ground-based observation from Esrange Sweden, Jan-Mar 2003

Two balloon flights performed from Esrange, Sweden (Dec 2002, Apr 2003)

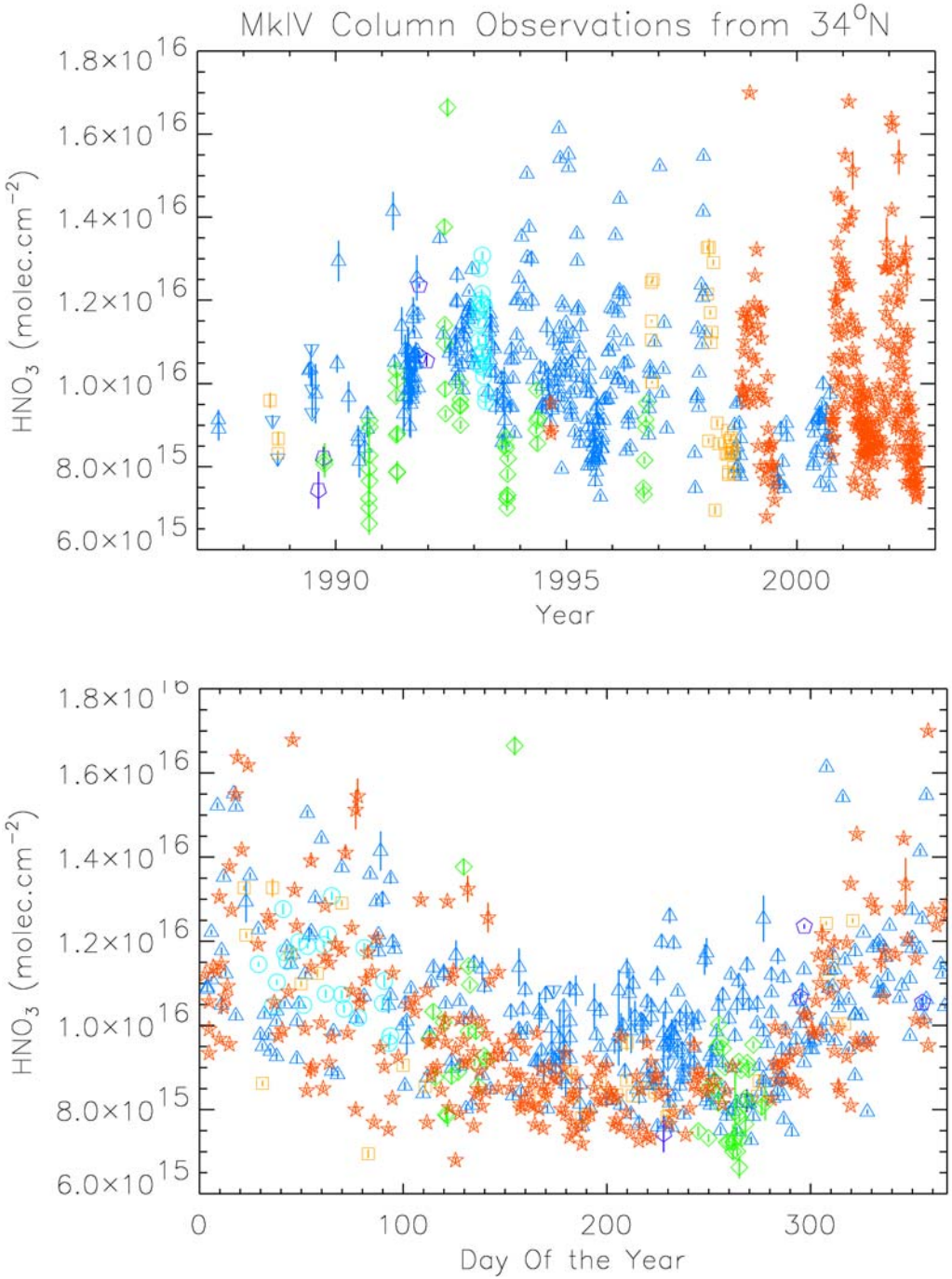
MkIV instrument produces high-quality ground-based data from Mt. Barcroft but data set is spoiled by lengthy interruptions for balloon campaigns

Need new balloon instrument so that MkIV can be “retired” to Mt. Barcroft for uninterrupted ground-based observations.

MkIV Ground-based Observations from various sites

Site Year	ESN 68N	FAI 65N	LYL 57N	MTB 38N	ARC 37N	DAG 35N	FTS 34N	TMF 34N	JPL 34N	PAL 32N	$M^{C}M$ 78S	(DC8) range	Total
1985	0	0	0	0	0	0	0	0	5	0	0	0	5
1986	0	0	0	0	0	0	0	1	3	0	20	0	24
1987	0	0	0	0	0	0	0	0	4	0	0	10	14
1988	0	0	0	0	0	0	0	2	5	0	0	2	9
1989	0	0	0	0	0	0	7	0	10	3	0	10	30
1990	0	0	0	0	0	0	7	0	13	0	0	0	20
1991	0	0	0	0	3	0	7	0	40	0	0	0	50
1992	0	0	0	0	0	0	11	0	32	0	0	18	61
1993	0	0	0	0	0	21	10	0	33	0	0	0	64
1994	0	0	0	3	0	0	5	0	47	0	0	0	55
1995	0	0	0	0	0	0	0	0	72	0	0	0	72
1996	0	0	11	0	0	0	6	6	30	0	0	0	53
1997	0	47	0	0	0	0	0	0	18	0	0	0	65
1998	0	0	0	14	0	0	0	24	8	0	0	0	45
1999	1	0	0	33	0	0	0	0	16	0	0	0	50
2000	21	0	0	29	0	0	0	0	26	0	0	0	76
2001	0	0	0	101	0	0	0	0	0	0	0	0	101
2002	0	0	0	78	0	0	0	0	6	0	0	0	84
2003	24	0	0	0	0	0	0	0	0	0	0	0	24
Total	46	47	11	257	3	21	53	33	368	3	20	40	902

HNO_3


MkIV Column Observations from 34°N
HNO3 (molec.cm-2)
1.8×10^16
1.6×10^16
1.4×10^16
1.2×10^16
1.0×10^16
8.0×10^15
6.0×10^15
1990
1995
2000
Year
0
100
200
300
Day Of the Year