

## **NOAA Lyman- $\alpha$ Total Water Hygrometer**

Total water is measured *in situ* as vapor with a Lyman- $\alpha$  hygrometer (Kelly *et al.* [1989]). High ambient sample flows through a closed cell minimize the effect of trapped water. Lyman- $\alpha$  light (121.6 nm) photodissociates water to produce an excited OH radical. The fluorescence from this radical at 309 nm is detected with a phototube and counting system. At aircraft pressures the fluorescence signal is quenched by air which gives a signal that is proportional to mixing ratio. The Lyman- $\alpha$  radiation produced with a DC-discharge lamp is monitored with an iodine ionization cell that is sensitive from 115 nm to 135 nm. Calibration occurs in flight by injecting water vapor directly into the ambient sample flow. This instrument has operated onboard the NASA ER-2 high-altitude research aircraft on numerous flights beginning in the mid-1980's (see Table A2). More recently, the instrument has been integrated and flown successfully on the NASA WB-57F. The instrument has most recently flown on the Atmospheric Chemistry of Combustion Emissions Near the Tropopause (ACCENT I & II) and the fourth Convection and Moisture Experiment (CAMEX-4) missions.

Accuracy:	10%
Precision:	5%
Data rate:	1 second
Weight:	29 kg
Power:	250 W max.(28 VDC), 600 W max (110 VAC 400 Hz 1-phase)

**Table A2: Missions and latitude coverage for NOAA-AL Lyman- $\alpha$  hygrometer**

<u>Mission</u>	<u>Base</u>	<u>Location</u>	<u>Lat range</u>	<u>Time Span</u>	<u>Platform</u>	<u>Hours</u>
STEP		Panama	9N - 3N	1980	U-2	56
ACE		California	49N - 31N	1980 - 1982	U-2	105
Bal. Intercomp.		CA/WY/TX	39N - 32N	1981 - 1983	U-2	90
STEP		California	43N - 37N	1984	U-2	28
STEP		Darwin, Australia	37N - 30S	1987	ER-2	121
AAOE		Punta Arenas, Chile	37N - 72S	1987	ER-2	120
AAOE		Punta Arenas	53S - 90S	1987	DC-8	104
AASE		Stavanger, Norway	82N - 37N	1988 - 1989	ER-2	123
AASE		Stavanger	90N - 59N	1989	DC-8	112
SAGE Validation		California	37N - 34N	1991	ER-2	11
PEM WEST		Pacific Rim, Equator	60N - 0N	1991	DC-8	190
AASEII	Bangor&Fairbanks		90N - 22N	1991 - 1992	ER-2	202
SPADE		California	60N - 14N	1992 - 1993	ER-2	86
ASHOE/MAESA		New Zealand	61N - 70S	1994	ER-2	274
WAM		Houston	45N - 10N	1998	WB-57	30
ACCENT		Houston	45N - 9N	1999	WB-57	44
CAMEX-4		Jacksonville	16N-39N	2001	ER-2	83

### **Selected References:**

- Kelly, K. K., et al., Dehydration in the lower Antarctic stratosphere during late winter and early spring, 1987, *J. Geophys. Res.*, 94, 11317, 1989.
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- Knollenberg, R. G., et al., "Measurements of high number densities of ice crystals in the tops of tropical cumulonimbus", *J. Geophys. Res.*, 98, 8639, 1993.