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THE NIMBUS 7 LIMS WATER VAPOR MEASUREMENTS; Ellis E. Remsberg and James M. Russell III, Atmospheric Sciences Division, NASA Langley Research Center, Hampton, Virginia 23665-5225

The Limb Infrared Monitor of the Stratosphere (LIMS) experiment on Nimbus 7 used the technique of thermal infrared limb scanning to sound the composition and thermal structure of the Earth's stratosphere (1). One of the LIMS channels was spectrally centered at 6.9 micrometers to measure the vertical profile of water vapor radiance from about 15 to 55 km. Data were obtained from late October 1978 until May 1979 over a latitudinal extent of 64 S. to 84 N. providing near global coverage.

The water vapor radiances were registered against pressure-altitude using temperature versus pressure profiles retrieved concurrently from radiances measured in the 15 micrometer CO_2 band. Water vapor mixing ratio profiles were then retrieved using a fully iterative, nonlinear technique that is independent of the first-guess climatological water vapor profile shape (2). Details of the measurements and their validation are given in (3) along with determinations of their uncertainty. Mixing ratios are in the parts per million by volume (ppmv) range throughout the Earth's stratosphere. Data precision was estimated to be 0.2 to 0.3 ppmv, and the accuracy, based on computer simulations, is 20 to 30 percent. Comparisons with several co-located balloon measurements of water vapor during the LIMS measurement period indicated agreement that was consistent with accuracy estimates. The high precision (5 to 10 percent) of the data yields excellent information on the relative variations of the water vapor fields with time and latitude.

Radiance profiles were obtained every 12 seconds along the orbital tangent path, both day and night, and approximately every fifth profile (spaced about 4° apart in latitude) was retrieved. The vertical resolution of each individual profile is about 5 km, while the horizontal resolution set by the LIMS field-of-view and limb viewing geometry is about 18 km by 300 km. The profile tapes were placed in the archive at the National Space Science Data Center (NSSDC) in 1984.

The asynoptic profile data were processed into a zonal mean and six sine and six cosine Fourier coefficients for the synoptic time of 12 GMT by using a Kalman filter algorithm at each 4° of latitude and for 12 pressure levels from 100 mb to 1 mb. These Fourier coefficients were then used to create hemispheric maps of water vapor and to investigate its transport (4). Examples of the fields and their variability will be shown. This coefficient form of the data was archived at NSSDC in the spring of 1985.

The distribution of LIMS water vapor was initially discussed in (3), (5), and (6). The data show that (a) there is a poleward latitudinal gradient with mixing ratios that increase by a factor of 2 from Equator to ±60° at 50 mb; (b) that most of the time there is a fairly uniform mixing ratio of 5 ppmv at high latitudes, but more variation exists during winter; (c) a well-developed hygropause or minimum in mixing ratio exists several kilometers above the tropopause at low to mid latitudes; (d) a source region of water vapor exists in the upper stratosphere to lower mesosphere that is consistent with methane oxidation chemistry, at least within the uncertainties of the data [see also reference (7)]; (e) an apparent zonal mean water vapor distribution prevails that is consistent with the circulation proposed by Brewer in 1949; and (f) a zonal mean distribution exists in the lower stratosphere that is consistent with the idea of quasi-isentropic transport transport by eddies in the meridional direction.

REFERENCES

1. Gille, J. C. and Russell, J. M. III, 1984, J. Geophys. Res., 89, 5125-5140.

2. Gordley, L. L. and Russell, J. M. III, 1981, Appl. Opt., 20, 807-813.

3. Russell, J. M. III; Gille, J. C.; Remsberg, E. E.; Gordley, L. L.; Bailey, P. L.; Fischer, H.; Girard, A.; Drayson, S. R.; Evans, W. F. J.; and Harries, J. E., 1984, J. Geophys. Res., 89, 5115-5124.

4. Haggard, K. V.; Marshall, B. T.; Kurzeja, R. J.; Remsberg, E. E.; and Russell, J. M. III, 1986, NASA Technical Report, in preparation.

5. Remsberg, E. E.; Russell, J. M. III; Gordley, L. L.; Gille, J. C.; and Bailey, P. L., 1984, J. Atmos. Sci., 41, 2934-2945.

6. WMO Global Ozone Research and Monitoring Project Report, No. 16, 1986.

7. Jones, R. L.; Pyle, J. A.; Harries, J. A.; Zavody, A. M.; Russell, J. M. III; and Gille, J. C., 1986, Quart. J. Roy. Met. Soc., in press.