Measurement of Middle Atmospheric Water Vapor in Seoul by SWARA

Dr. Soohyun KA†, Prof. Dr. Niklaus KÄMPFER‡ and Prof. Dr. Jung Jin OH†

Sookmyung Women's University, Korea†
University of Bern, Switzerland‡
jjinoh@sookmyung.ac.kr

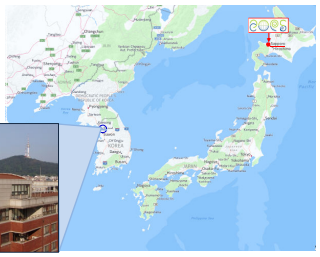
PS15-D3-PM2-P-019
(PS15-A014)

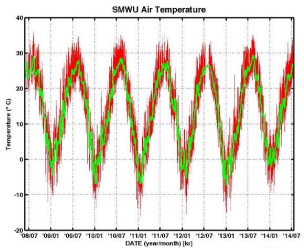
The ground-based microwave radiometer at 22 GHz called SWARA (Seoul Water Vapor Radiometer) has been operated on the roof of the science building at Sookmyung Women's University since October 2006. It is the result of the collaboration between Sookmyung Women's University in Korea and University of Bern in Switzerland supported by Swiss-Korea outstanding research efforts award (SKORE-A). SWARA became an NDACC instrument at September 2012. Water vapor signal at 22 GHz with a beam-size of 6 degrees is down-converted to 0.5 GHz and then measured by Acqiris AC240 FFT spectrometer of 1 GHz band with 61 kHz resolution. With the hot and cold calibration loads, the instrument employs balancing calibration and tipping curve method to detect 0.1 K weak water vapor signal. The weather condition of Seoul is very humid in summer, but quite low in winter. It is shown by the 22 GHz opacity variation between 0.05 and 0.5.

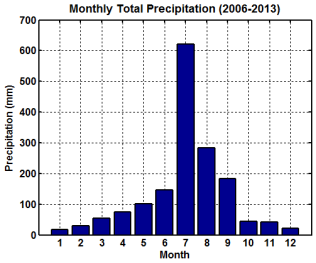
Observatory

Sookmyung women's university in Seoul, Korea

37.32 ˚N, 126.57 ˚E, 52m a.s.l.

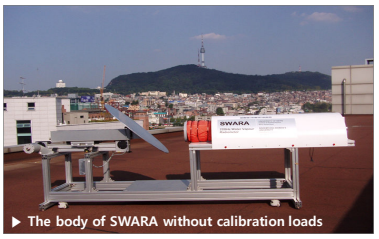


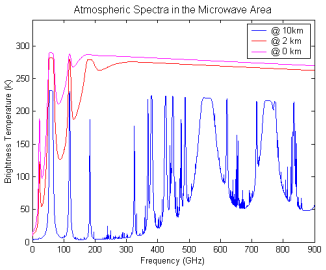




The maximum temperature is normally above 30 ℃ in summer. At summer, the precipitation shows the maximum total amount, but the weather is dry during winter. It means that environment for the ground-based microwave radiometer is very different at each season.

Instrument



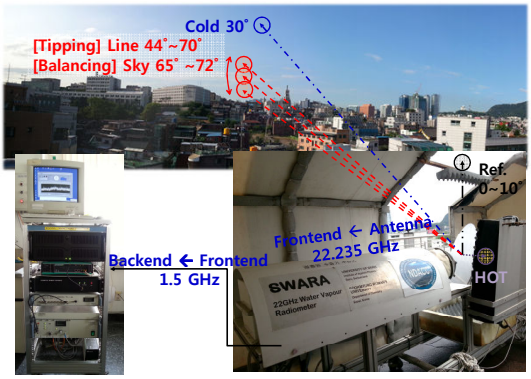


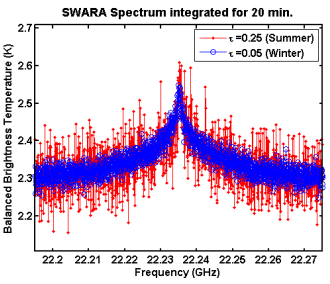
SWARA (Seoul Water Vapor Radiometer)

- 22.235 GHz ground based microwave radiometer
- Located on the roof of Science building in Sookmyung Women's University
- Developed by the joint project with IAP in Univ. of Bern, Switzerland
- Accepted as NDACC Instrument on Sep. 2012

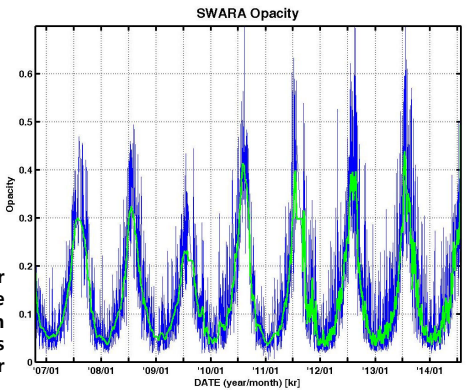
The rotational transition of the atmospheric molecules causes the spontaneous microwave emission. Water vapor in the troposphere makes the continuum absorption which is very broadened lines. The target frequency of the microwave radiometer depends on the platform altitude in order to detect line signal above the continuum. For water vapor microwave line signal, 22.235 GHz detection can be performed at the ground, but 183 GHz measurement is possible on the airborne.

Measurement

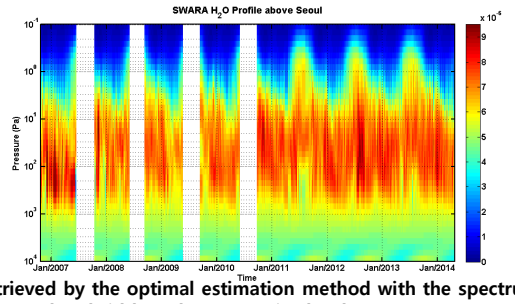




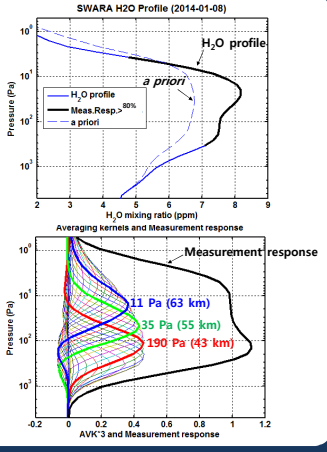
The spectrum noise depends on the water vapor amount in the troposphere. Under the same integration time the noise in summer is much bigger than the noise in winter. It means the loss of the number or lower quality for summer profile.



H_2O Profile



- Retrieved by the optimal estimation method with the spectrum of 80 MHz bandwidth and 0.01 K noise level.
- Four blanks till summer 2010 result from too long integration time due to too high opacity.
- The system upgrade in June 2011 increases in the integration time and improves the summer retrieval.



Conclusion

SWARA is the ground based microwave radiometer installed in Sookmyung Women's Universiy in Seoul, Korea.

The observation is performed by two calibration methods, a balancing and a tipping curve method with various sky signals.

From the SWARA measurement, the various of the opacity caused from the tropospheric water vapor and the water vapor profile in the middle atmosphere has been monitored since October 2006.

The obvious seasonal variation of the opacity at Seoul has been detected by SWARA and it can be dedicated to improve the troposphere-the stratosphere coupling dynamics field with the water vapor variation at middle atmosphere.