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Contribution of VHF ST radar to humidity and temperature observations

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As already demonstrated with the MU radar in Japan (Furumoto et al., 2001), temperature (T) and humidity (q) can be accurately measured in the upper atmosphere using a powerful strato-tropospheric (ST) VHF radar equipped with a multiple beam ray tracing and the Radio Acoustic Sounding System (RASS). The object of this presentation is to show that even a very conventional VHF + RASS instrument, as implemented for example at CNRM/Toulouse, is able to provide, in spite of its limitations, the same capabilities under certain conditions. Already operating as an efficient wind profiler, it can therefore play an important role in an integrated sounding system from the ground.

The CNRM radar coverage is 1.5 to 15 km. The associated RASS provides virtual temperature profiles (*Tv*) up to 4 to 6 km height. The main task is to get both q and T over the whole height coverage (15 km) using in an optimal way all the informations available through this system completed with a minimum of external data. To this purpose, three independant data sets from the instrument will be exploited.

1) the *Tv* profile from the RASS in the lower troposphere

2) the refractive index gradient M up to 15 km calculated from the power and width of the signal on the spectra (Tsuda et al., 2001). M is directly related to q and T:

$$M = -77.6 \times 10^{-6} \frac{P}{T} \left[\frac{N^2}{g} . \left(1 + 15600 \frac{q}{T} \right) - \frac{7800}{T} \frac{dq}{dz} \right] \qquad (1)$$

Where P is the pressure, N the Brunt-Väisälä frequency and g the acceleration of gravity. As already illustrated by Hooper et al. (2004), this equation can be reduced to a function depending mainly on T in the upper atmosphere where humidity is negli-

gible:

$$M = -77,6 \times 10^{-6} \frac{P}{T} \frac{N^2}{g} \tag{2}$$

3) The tropopause height, deduced from the difference of the echo power between the vertical and the oblique beams as reported by Sweezy. and. Westwater (1986). This information is very useful to crosscheck the validity of the temperature profile.

The complementary data, necessary to solve the problem, are at least one accurate T measurement at a higher altitude provided for example by regular aircrafts or the approximate T profile given by a radiometer.

After a brief description of the methodology, experimental results from recent measurements at CNRM/Toulouse will be shown and discussed. On-site radio soundings have been used to simulate various complementary data for accurate estimations of q and T.