

# **Microwave Radiometer Retrieval Accuracy**

Rigorous validation of microwave radiometer retrieval accuracy requires statistical comparison with independent observations in peer-reviewed scientific journals by independent experts during representative seasons, weather conditions and locations. Rigorous validation results are summarized and referenced in the following.

#### **Temperature and Humidity Profiles**

Rigorous temperature and humidity profile accuracy validation is based on statistical comparison with radiosondes. The WMO Guide to Meteorological Instruments and Methods of Observation (2010) summarizes rigorous radiometer-radiosonde comparison results as follows:

Profiling radiometer reliability and accuracy have been widely demonstrated during longterm arctic, mid-latitude and tropical operations (Güldner and Spänkuch, 2001; Liljegren and others 2004). The result of the 13-month operation of the Radiometrics MP-3000 (Gaffard and Hewison, 2003) shows that the root mean square value of the difference between the temperature observed by the radiosonde and that retrieved by the microwave radiometer ranges from 0.5 K (near the surface) to 1.8 K (at a height of 5 km). Güldner and Spänkuch (2001), who operated the Radiometrics MP-3000 for 18 months and compared retrievals with four radiosonde soundings daily, also shows a similar root mean square value from 0.6 K (near the surface) to 1.6 K (at a height of 7 km in summer and 4 km in winter). The root mean square value of water vapour profile is not more than 1 gm<sup>-3</sup> in all altitudes (Gaffard and Hewison, 2003; Güldner and Spänkuch, 2001).

A comprehensive radiometer accuracy validation comparing MP-3000 radiometer and four-per-day radiosonde soundings during summer and winter seasons is provided by Güldner and Spänkuch (2001). Their results and the observation error assigned to radiosondes<sup>1</sup> when they are assimilated into models are summarized in Table 1.

	Temperature (C)			Humidity (gm-3)		
Height (km):	0	2.5	5	0	2.5	5
Radiosonde observation error:	1.4	1.1	0.9	2.6	0.9	0.3
Radiometer – radiosonde (rms):	0.6	1.5	1.8	0.3	1.0	0.4

 Table 1. Radiometer and Radiosonde Accuracy

<sup>&</sup>lt;sup>1</sup> Radiometrics TechNote: <u>Radiosonde Observation Error</u>, 2015.



Comparison with tower observations confirms  $\pm 0.1$  C agreement at 50 and 80 m height (Friedrich et al, 2013) and  $\pm 0.5$  C at 100 to 290 m height (Ware et al, 2010).

In general, microwave radiometer and radiosonde humidity soundings show approximately equivalent accuracy to 5 km height. Temperature soundings show radiosonde-equivalent accuracy to 1 km height, and lower temperature accuracy by a factor of two at 5 km height.

### Liquid Water

Liquid water retrieval accuracy is determined by comparison with independent observations. Included are a limited number of special radiosonde (Ware et al, 2003; Serke et al, 2014) and aircraft (Reehorst et al, 2006) observations, and estimation from radar (Campos et al, 2014; Calheiros et al, 2014) and satellite observations (Snider et al, 1980; Hogg et al, 1983). In general, approximately ±15% agreement for liquid profile density as large as 0.5 gm<sup>-3</sup> is reported. Integrated liquid water (ILW) retrieval accuracy is limited by 10–25 gm<sup>-2</sup> microwave absorption model differences, increasing with ILW (Zuidema et al, 2005).

#### **Integrated Water Vapor**

Integrated water vapor (IWV) retrieval accuracy has been validated by comparison with radiosonde and GPS observations (Rocken et al, 1992; Bevis et al, 1992; Liljegren et al, 1999; Ware et al, 1997, 2000; Braun et al, 2003). In general, IWV agreement within ±1 mm is reported between radiometer, radiosonde and GPS. Integrated water vapor and liquid, and liquid profile accuracy are summarized in Table 2.

IWV (mm)	ILW	Liquid Profile
±1	±15%	±15%

## Table 2. IWV, ILW and Liquid Profile Accuracy

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