Thermodynamic Profiling during Heavy Rain

The Hong Kong Observatory operated a 12-channel Radiometrics thermodynamic profiler at the Hong Kong International Airport during Feb-June 2004. Proprietary Rain Effect Mitigation (REM) methods optimized performance during heavy rain, as validated by radiosonde comparisons. REM methods include a hydrophobic radome, superblower, off-zenith observations and adaptation of atmospheric emission - radiative transfer models for heavy rain conditions.

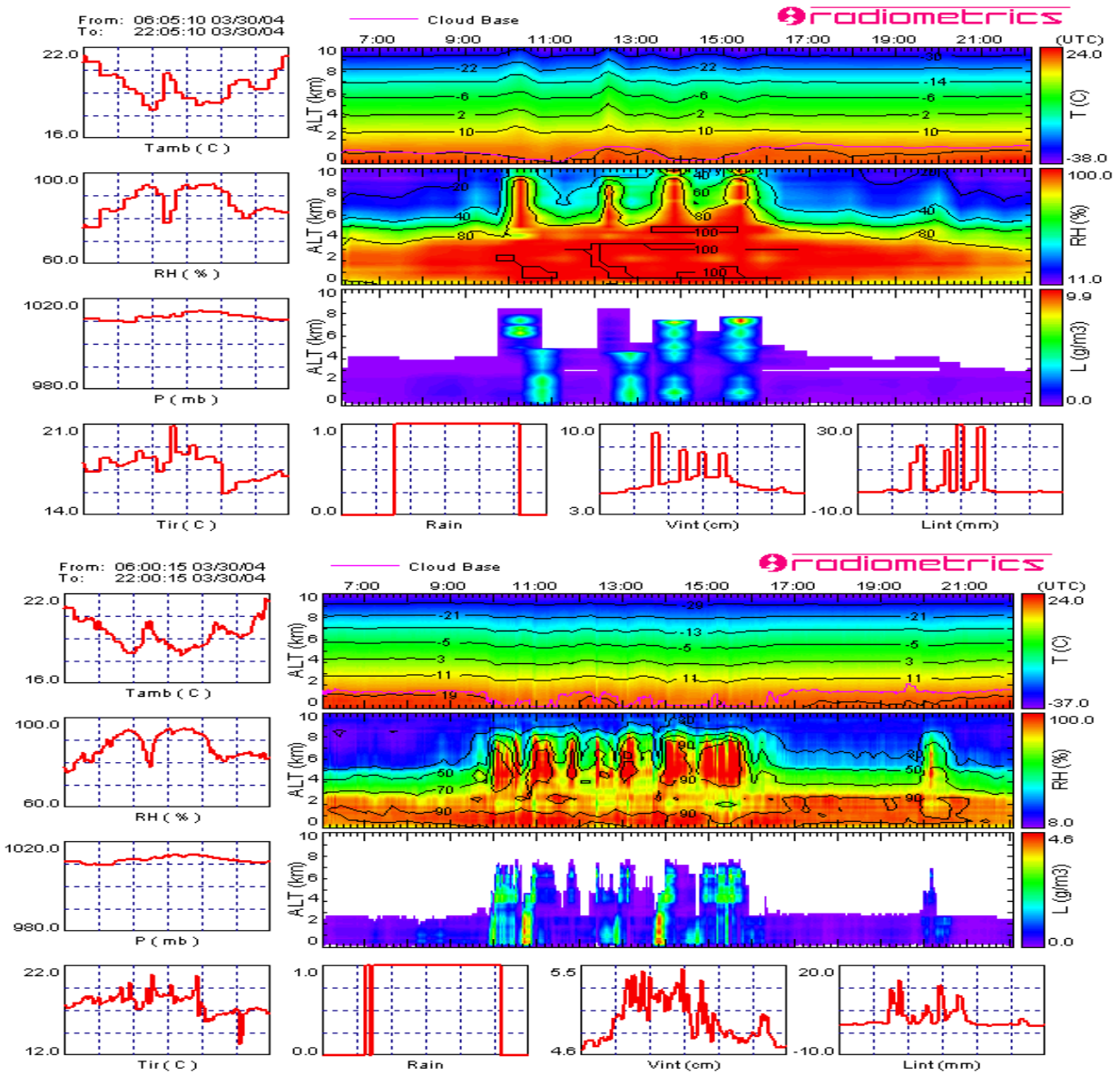

Figure 1. Retrievals without REM (30 min intervals, top) and with REM (1 min intervals, bottom).

Summer monsoon rain fell on 30 March with rates as high as 83 mm/hr recorded by a tipping bucket near the radiometer site. Radiometer retrievals without REM (Figure 1) show unreasonable spikes (>4 cm) in retrieved integrated water vapor (Vint), unreasonably large 9.9 g/m^3 liquid density, and unreasonable temperature increase above 2 km height that correlate in time with liquid density maxima. With REM, Vint, peak liquid density (4.6 g/m^3) and upper air temperatures are reasonable. Comparisons of simultaneous radiometer and radiosonde temperature and humidity profiles in Figure 2 show good agreement during heavy rain. The radiosonde station is 50 km east of the radiometer. Liquid profiles in Figure 3 show descending liquid water physically consistent with heavy rainfall.

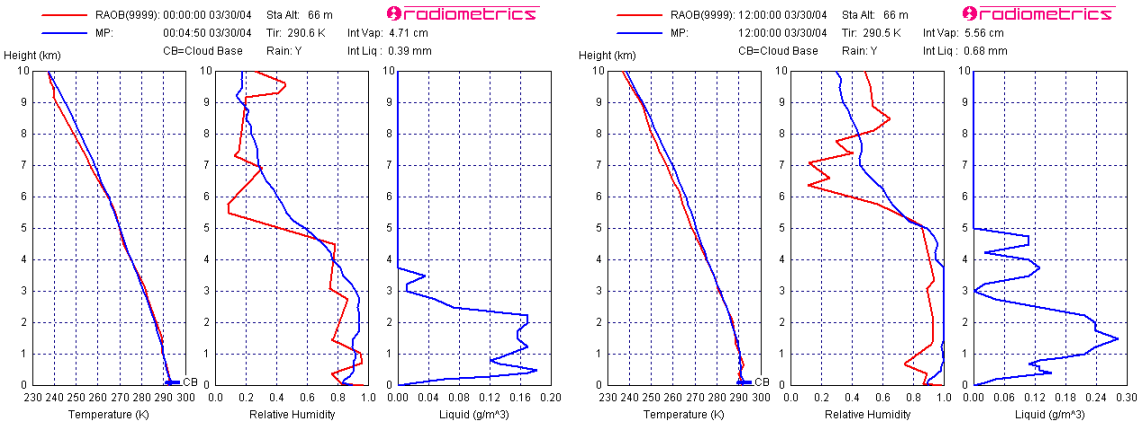

Figure 2. Simultaneous microwave profiler (blue) and radiosonde (red) profiles.

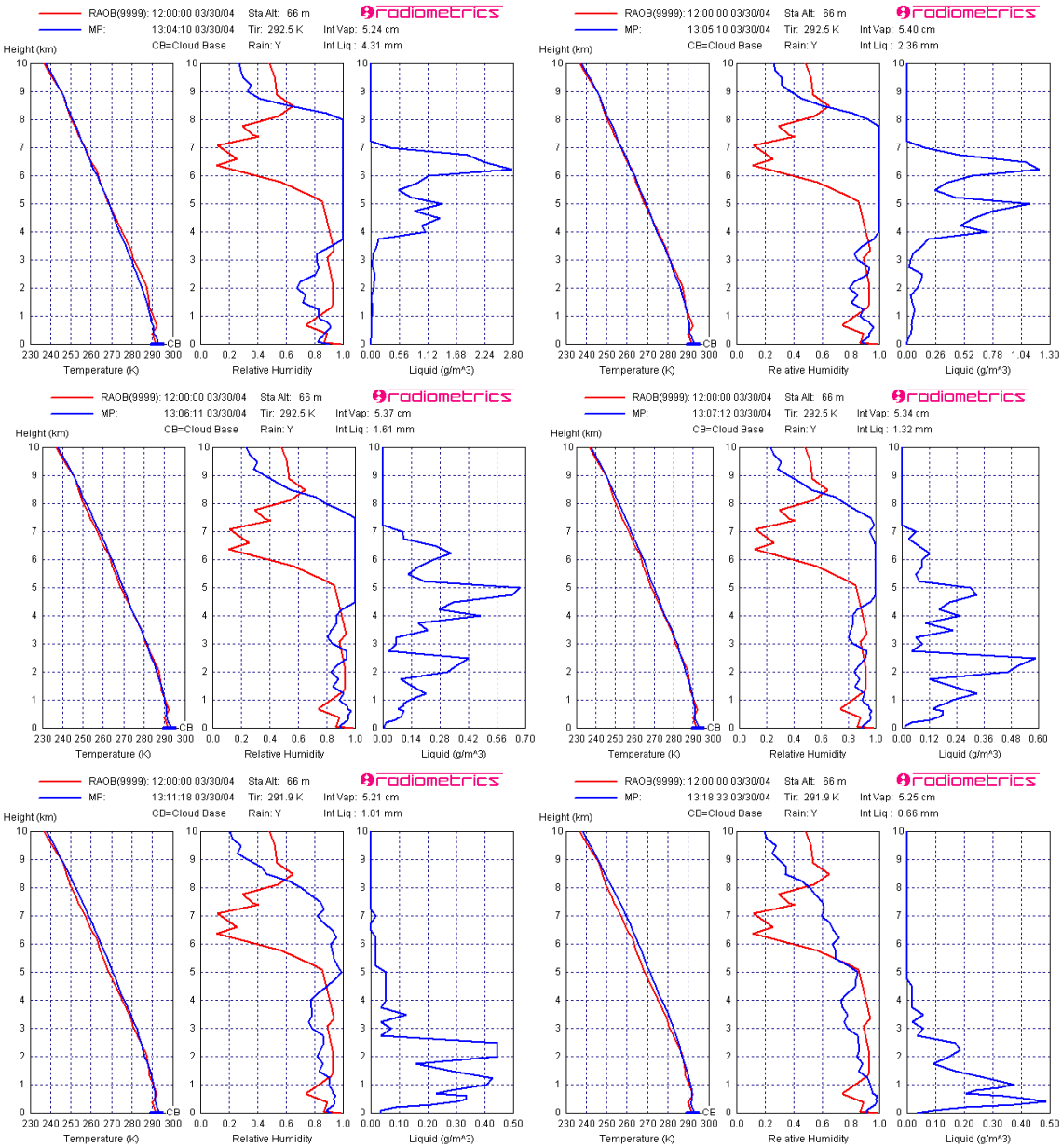

Figure 3. Descending liquid (right hand panels) is seen in sequential radiometer retrievals 13:04-13:18 UT (5:04-5:18 local time).

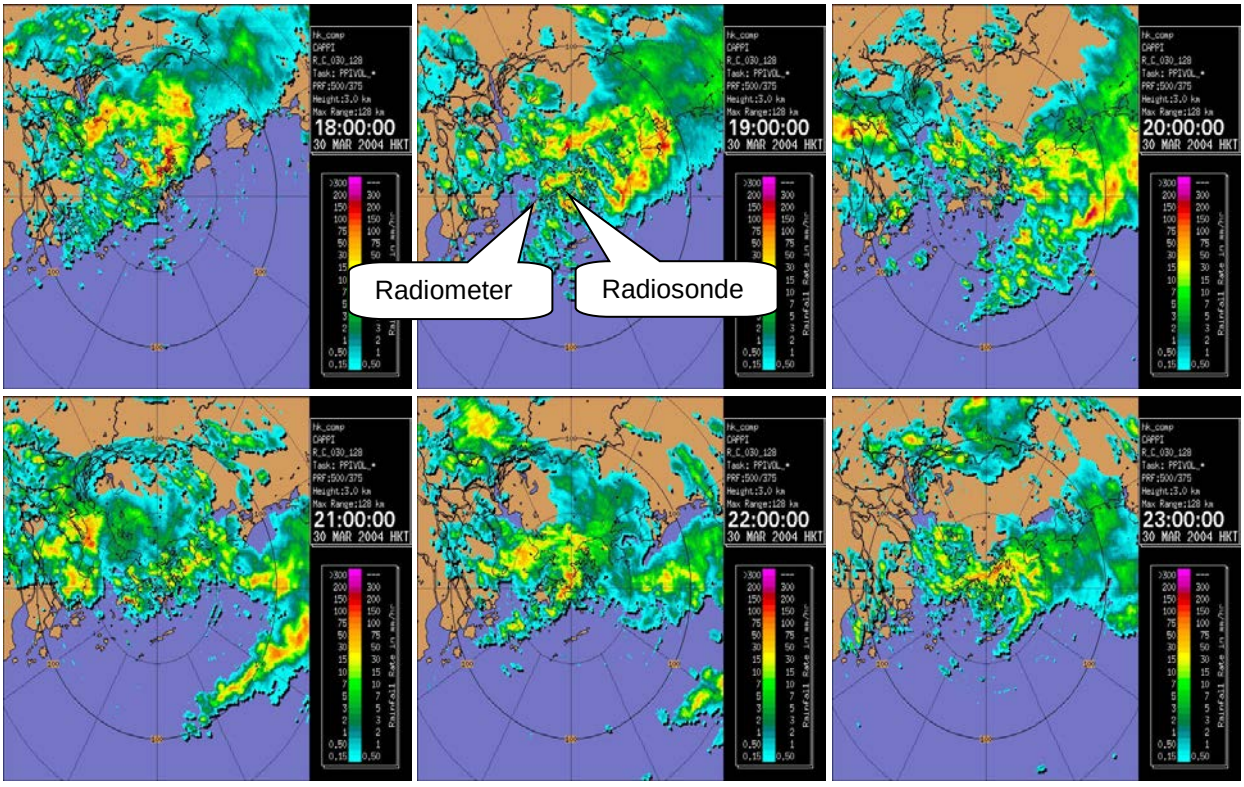

Figure 4. Hong Kong radar images 18-23 local time (10-15 UT) 30 Mar 2004. The radiometer is located 50-km east of the radiosonde launch site.

Radar images in Figure 4 show movement of the rainstorm over the radiometer and radiosonde sites during a 5 hour interval.

Additional examples of radiometer measurements during heavy precipitation are provided by Chan and Tam (2005) and by Ishihara et al. (2006). Radiometer measurements can also be used to make direct measurements of rain rate within the field of view (Marzano et al., 2006).

In summary, a Radiometrics thermodynamic profiler with Rain Effect Mitigation hardware and software demonstrates reliable performance during rain rates as high as 83 mm/hr.

Acknowledgements

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References

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