A calibrated radar is one of the best sources of high-resolution spatial-temporal rainfall data and for other hydro-meteorological variables. However, forecasters learn to live with dodgy radar calibration and adjust their decision making with the reflectivity level that they are used to. What if they move to another region?

The accuracy of radar’s rainfall estimation depends on:
- The mean of the returned power and its conversion to reflectivity (seven sources of errors), and
- Transformation of the measured reflectivity to rainfall intensity (two sources of errors).

\[ R = 0.0364 \times \text{dBZ} \]

\[ Z = 35 \text{ dBZ}, R = 6 \text{ mm hr}^{-1} \]

\[ Z = 40 \text{ dBZ}, R = 12 \text{ mm hr}^{-1} \]

**Objective:**

Develop a robust radar calibration and monitoring technique for the Australian Bureau of Meteorology (BoM) radar networks that can address the radar calibration issue in near-real time for a better quality control of radar reflectivity.

**Data:**

- Un-correction (ground clutter) and corrected reflectivities from the ground radar (GR)
- Measured reflectivity (V5) from the space-borne precipitation radar (Ku-band) onboard the Global Precipitation Mission (GPM) satellite (GR)

**Description of RCA Method and Results:**

- Uses the probability distribution of reflectivity in clutter areas near stationary, ground-based radar and provides an automated tool for tracking relative changes in calibration (Rinehart 1978, Silberstein et al. 2008, Wolff et al. 2015).
- Probert-Jones (1962) Radar Equation:
  \[ 10 \log Z = 10 \log P_i + 20 \log r - 10 \log C \]
- Hence, any variation in ground clutter reflectivity is caused by a change in radar calibration provided no changes in surface-based structures responsible for ground clutter and in the radar elevation angle.
- \( \Delta R = \frac{1}{2} (10 \log C) \)
- The RCA technique collects the echoes from ground clutter and then computes the PDF and CDF to calculate the 95th percentile reflectivity for a given lowest beam elevation scan to estimate the RCA as below
- \[ \text{RCA(dB)} = \text{DBZ95_{ref}} - \text{DBZ95} \]

![Fig. 1 Maximum Expected Hail Size (MESH) for 27th Nov 2014 Brisbane Hailstorm using calibrated and uncalibrated reflectivities (Source: Warren et al.)](image_url)

![Fig. 2 Clutter area maps for six BoM Operational Radar Networks](image_url)

![Fig. 3 Visions in the 95th percentile reflectivity of the clutter region for the Melbourne and Namoi radars.](image_url)

![Fig. 4 Left panel: comparison of PDF of reflectivities estimated by the RCA and GPM technique, which identifies stable periods of radar calibration, and right panel: PDF of differences in reflectivities for the same dates](image_url)

![Fig. 5 Time series of mean reflectivity differences of Melbourne radar with the GPM.](image_url)

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**Conclusion:**

The RCA technique provides a way to monitor changes in calibration with high precision (better than 0.3 dB), but does not provide an absolute calibration. In contrast the GPM comparisons provide an absolute calibration, but with uncertainties for each overpass generally exceeding 1.5 dB.

We are working on an operational implementation of a hybrid RCA-GPM technique, which identifies stable periods of calibration using RCA, and averages all individual estimates of absolute calibration from the GPM technique over these stable periods. Our first results indicate that the errors on absolute calibrations are lower than 1 dB.

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**References:**