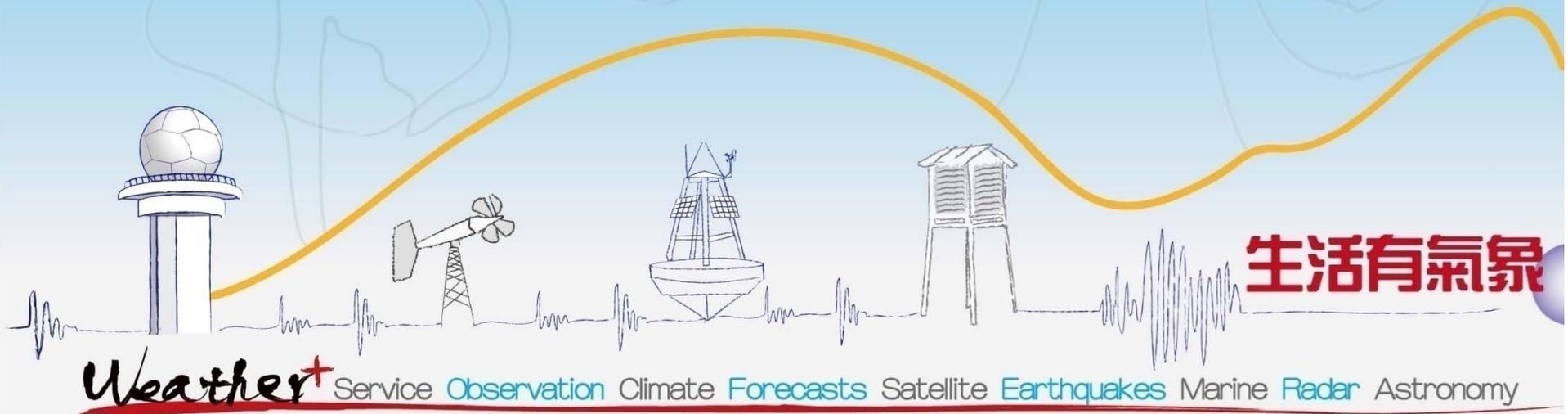




應用回波衰減法進行 雙偏極化雷達定量降水估計評估

唐玉霜、張保亮、黃蕙荳、陳嘉榮
中央氣象局



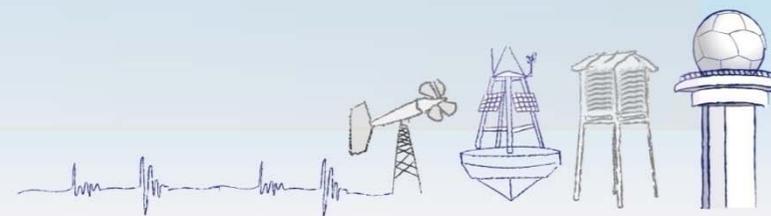
大綱



- 🐓 前言
- 🐓 個案資料說明
- 🐓 研究方法
- 🐓 結果分析
- 🐓 結論與未來展望

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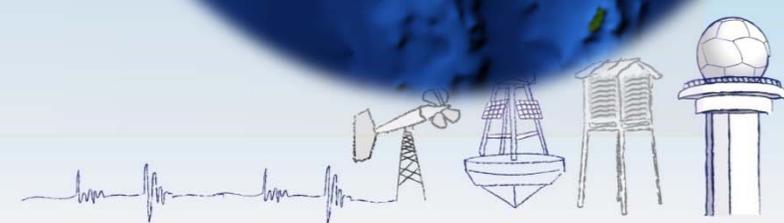
前言

- ✎ 因應不同波段、不同規格雷達使用不同資料品管及處理方法(劇烈天氣監測系統, QPESUMS, 2016)
- ✎ 了解不同定量降雨估計法特性加以應用

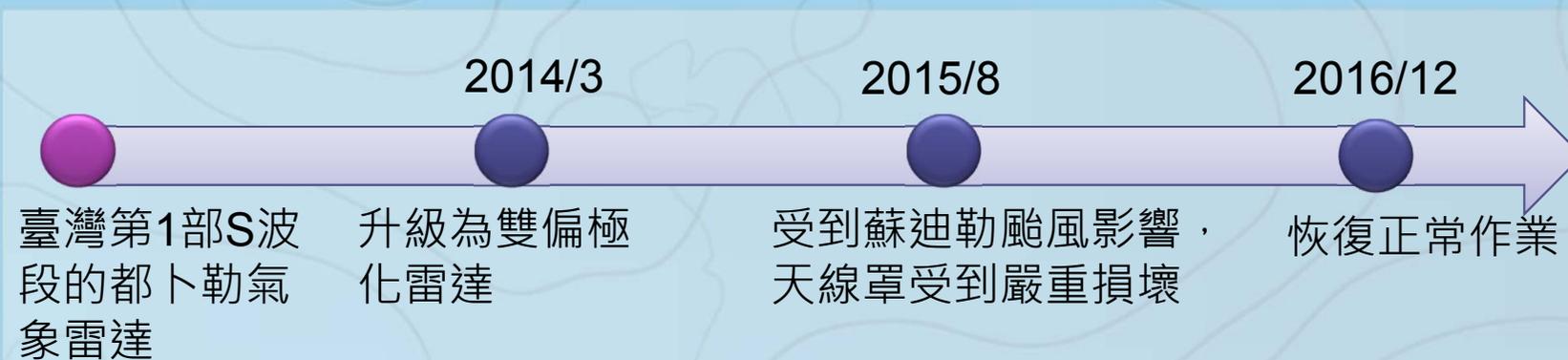


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個案資料說明(五分山雷達)

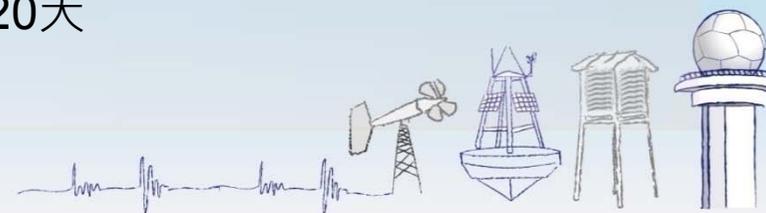


個案期間	個案代號
2017/6/1-2017/6/4	梅雨(06-01)
2017/6/11-2017/6/18	梅雨(06-02)
2014/7/22-2014/7/23	麥德姆颱風(TYMD)
2014/9/20-2014/9/22	鳳凰颱風(TYFH)
2015/8/7-2015/8/8	蘇迪勒颱風(TYSD)
2017/7/29-2017/7/30	海棠颱風(TYHT)

約20天

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研究方法-定量降雨估計法



✂ R(Z): $Z=32.5R^{1.65}$

✂ R(A): $R=\gamma A^\wedge$ (Ryzhkov et al.,2014)

✓ 回波資料品質優化

✂ 充分利用雙偏極化
參數特性

✂ 保留回波解析雨量
強度的能力

✓ 加入雨滴譜資訊

✂ 即時觀測資料調整
(Z、ZDR)

$$R = \gamma A^\wedge$$

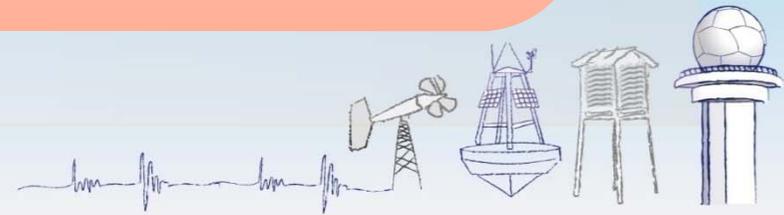
$$A(r) = \frac{[Z_a(r)]^b C(b, PIA)}{I(r_1, r_2) + C(b, PIA)I(r, r_2)}$$

$$I(r_1, r_2) = 0.46b \int_{r_1}^{r_2} [Z_a(s)]^b ds$$

$$I(r_1, r_2) = 0.46b \int_r^{r_2} [Z_a(s)]^b ds$$

$$PIA(r_1, r_2) = \alpha[\Phi_{DP}(r_2) - \Phi_{DP}(r_1)] = \alpha\Delta\Phi_{DP}$$

$$\alpha = -0.75K + 0.04875$$



研究方法-定量降雨估計法



✈️ $R(Z): Z=32.5R^{1.65}$

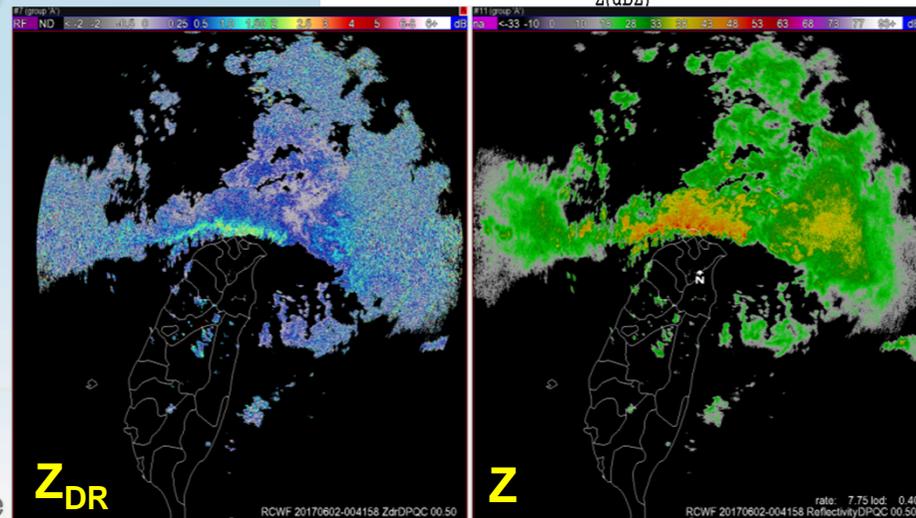
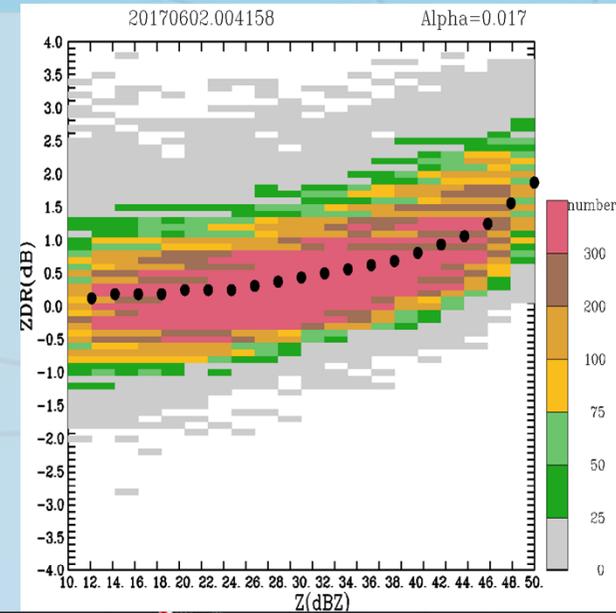
✈️ $R(A): R=\gamma A^\wedge$ (Ryzhkov et al.,2014)

✍️ 回波資料品質優化

- ✈️ 充分利用雙偏極化參數特性
- ✈️ 保留回波解析雨量強度的能力

✍️ 加入雨滴譜資訊

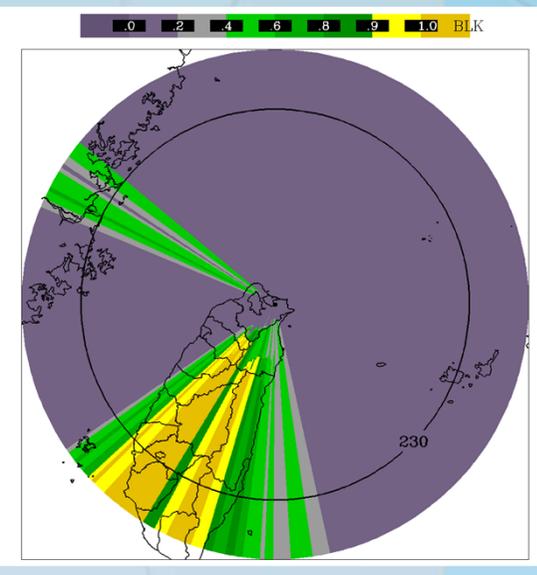
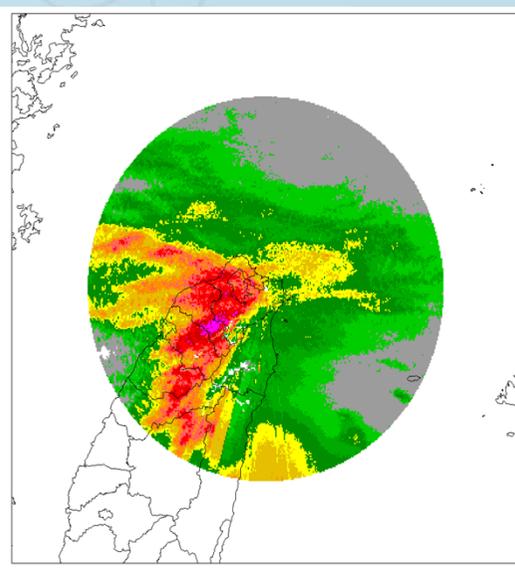
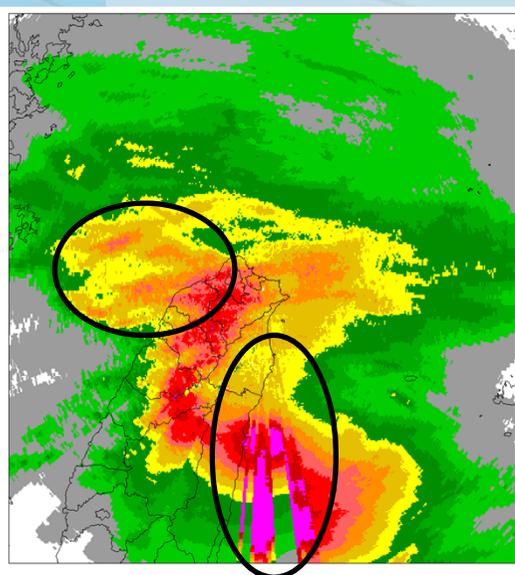
- ✈️ 即時觀測資料調整 (Z、ZDR)





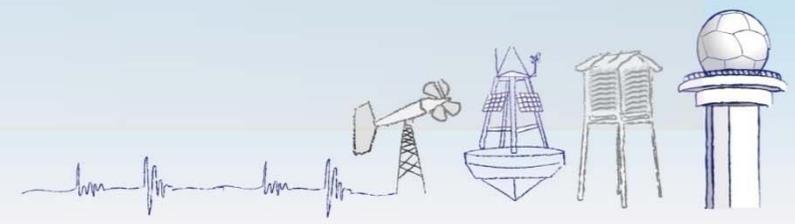
R(Z)

R(A)



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研究方法-校驗得分計算



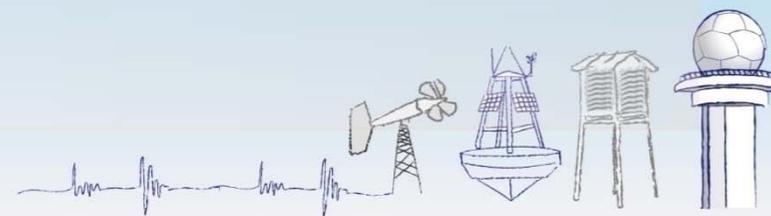
$$\text{RMSE} = \sqrt{\frac{\sum_{i=1}^n (R_{i \text{ gauge}} - R_{i \text{ radar}})^2}{n}}$$

$$\text{CC} = \frac{\sum_{i=1}^n (R_{i \text{ gauge}} - \overline{R_{i \text{ gauge}}})(R_{i \text{ radar}} - \overline{R_{i \text{ radar}}})}{\sqrt{\sum_{i=1}^n (R_{i \text{ gauge}} - \overline{R_{i \text{ gauge}}})^2 \cdot \sum_{i=1}^n (R_{i \text{ radar}} - \overline{R_{i \text{ radar}}})^2}}$$

$$\text{Bias} = \frac{\sum_{i=1}^n R_{i \text{ radar}}}{\sum_{i=1}^n R_{i \text{ gauge}}} \quad \begin{array}{l} >1 \text{ QPE 高估} \\ <1 \text{ QPE 低估} \end{array}$$

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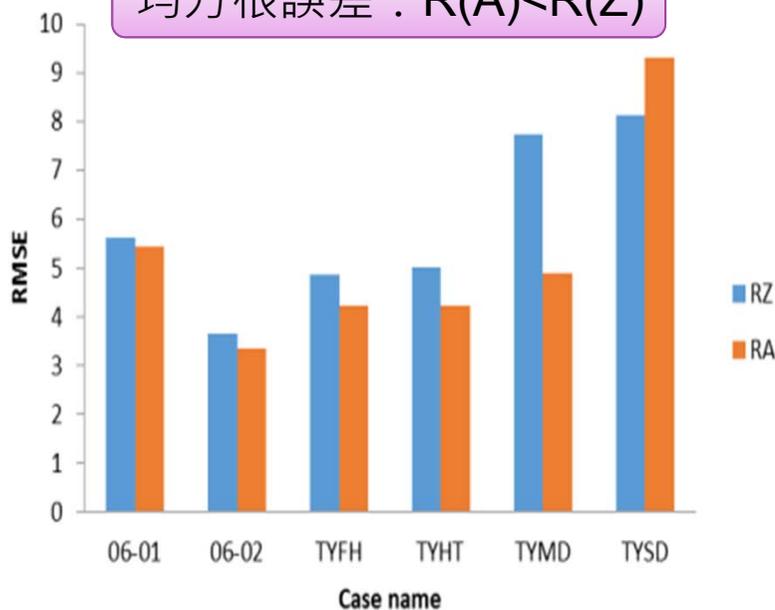
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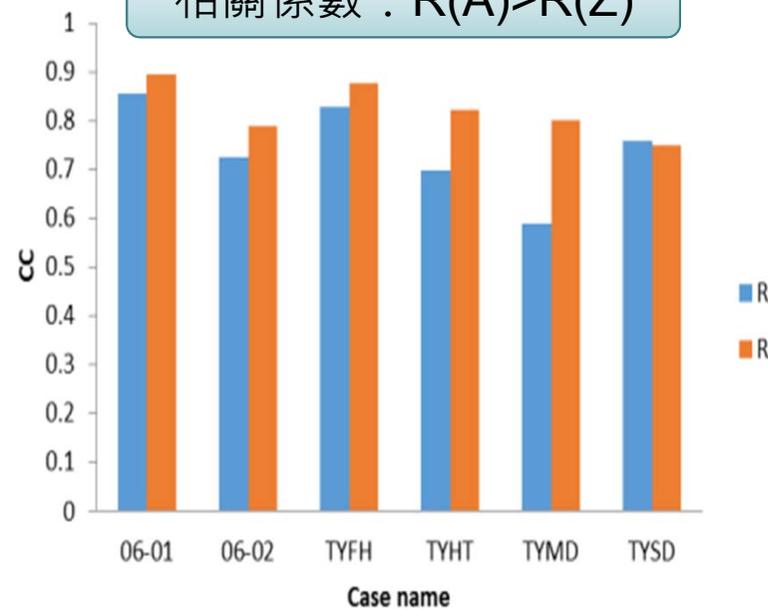
校驗得分



均方根誤差： $R(A) < R(Z)$

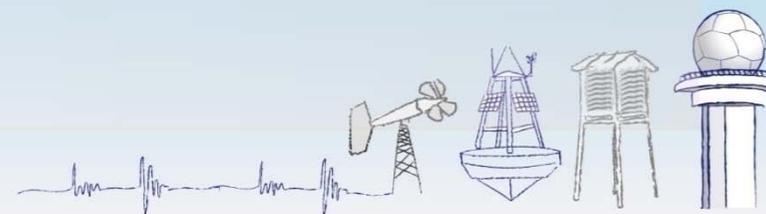


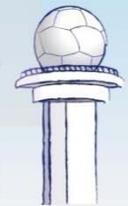
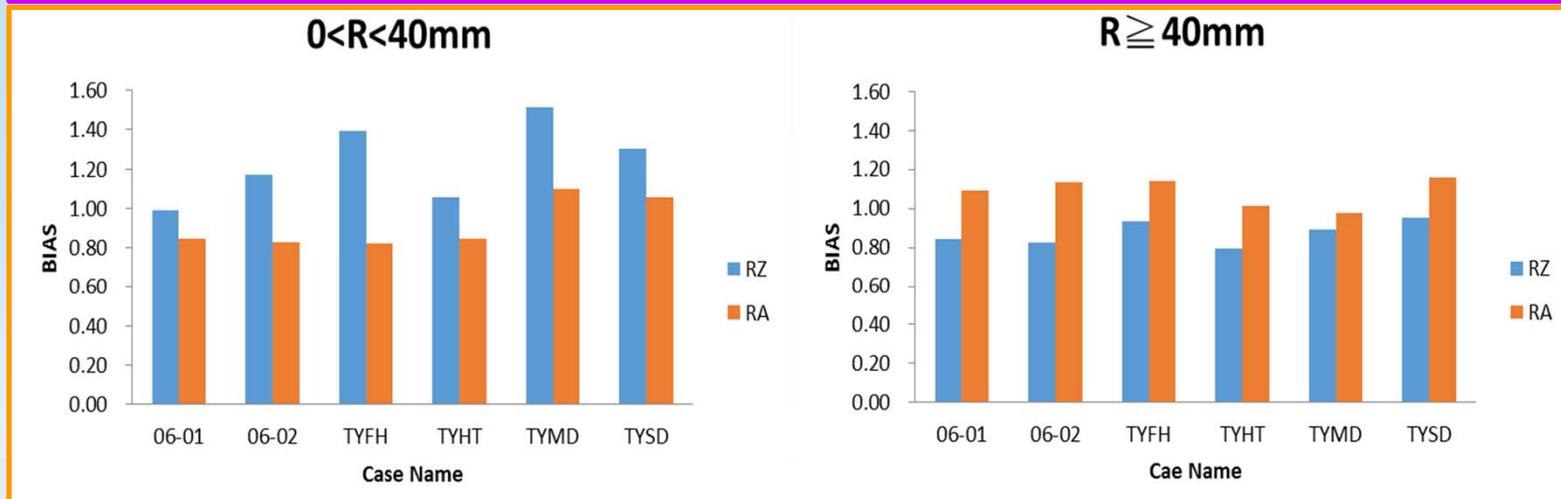
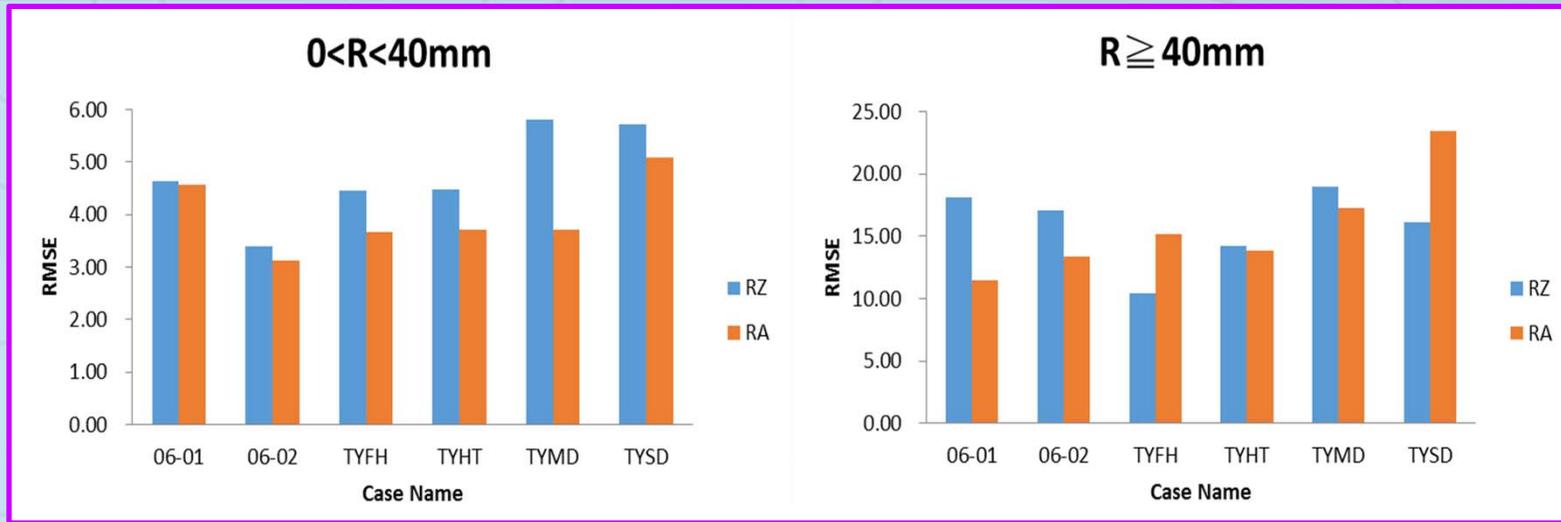
相關係數： $R(A) > R(Z)$



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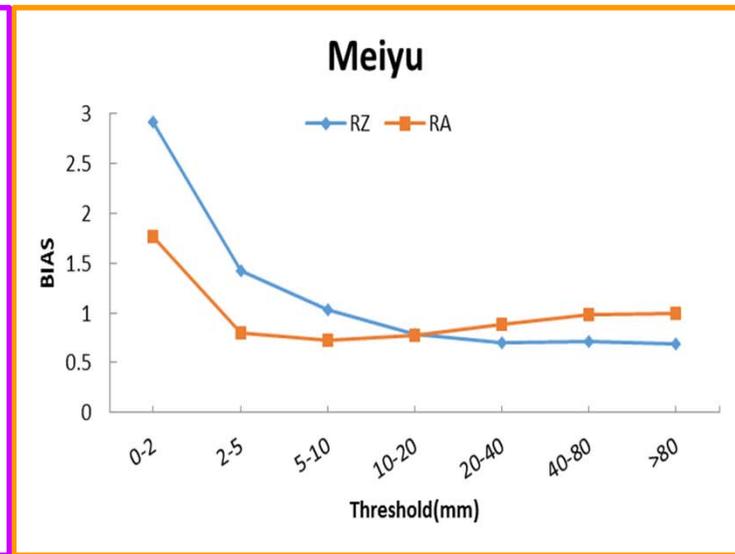
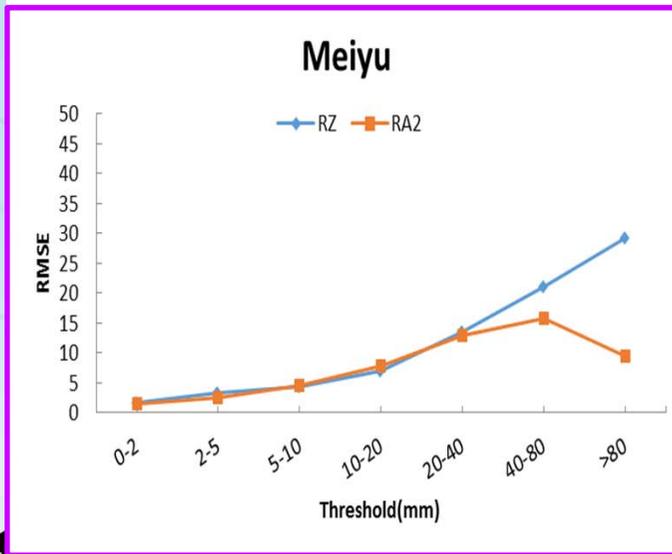
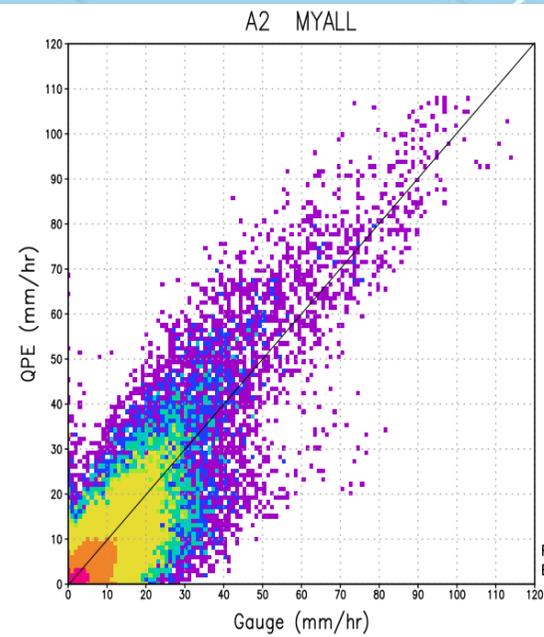
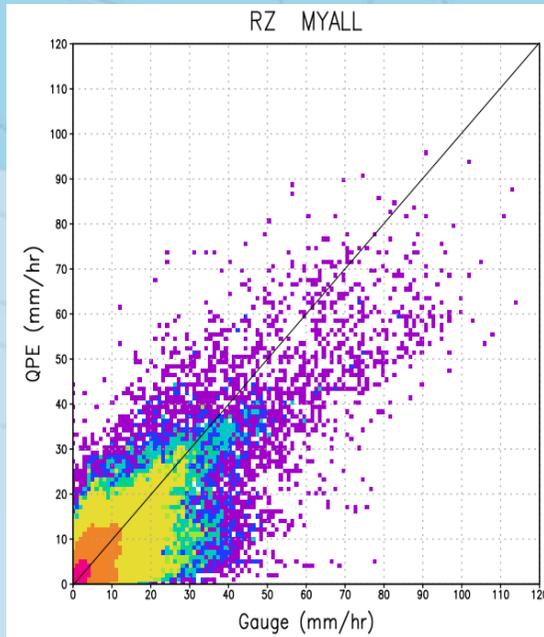




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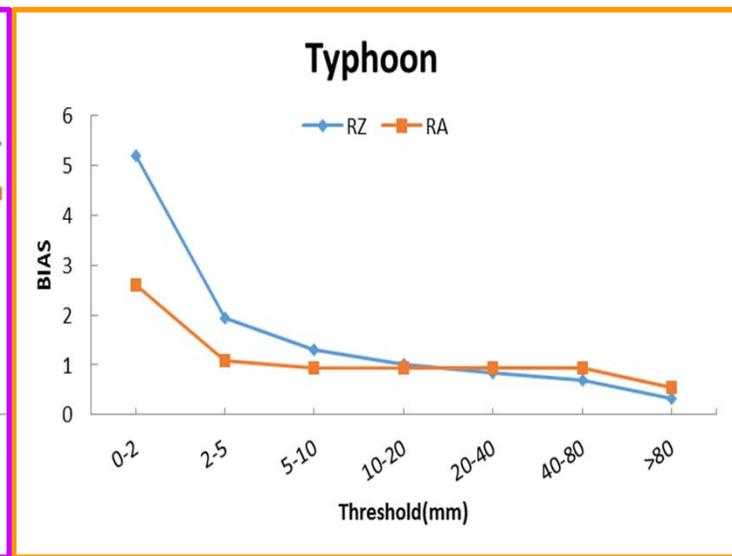
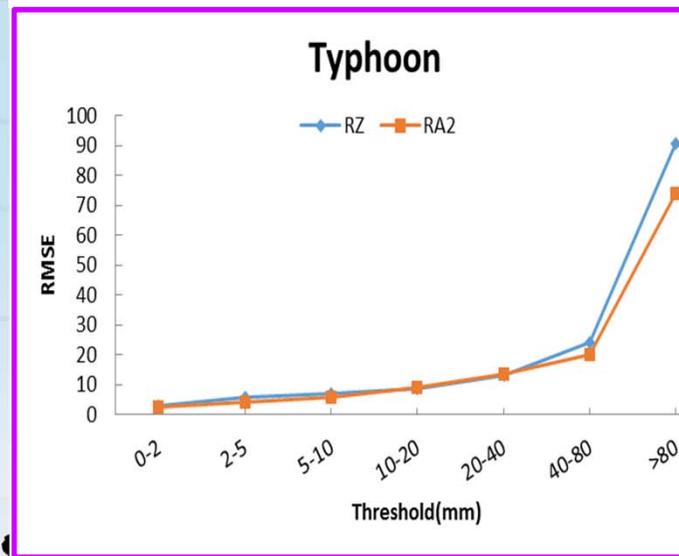
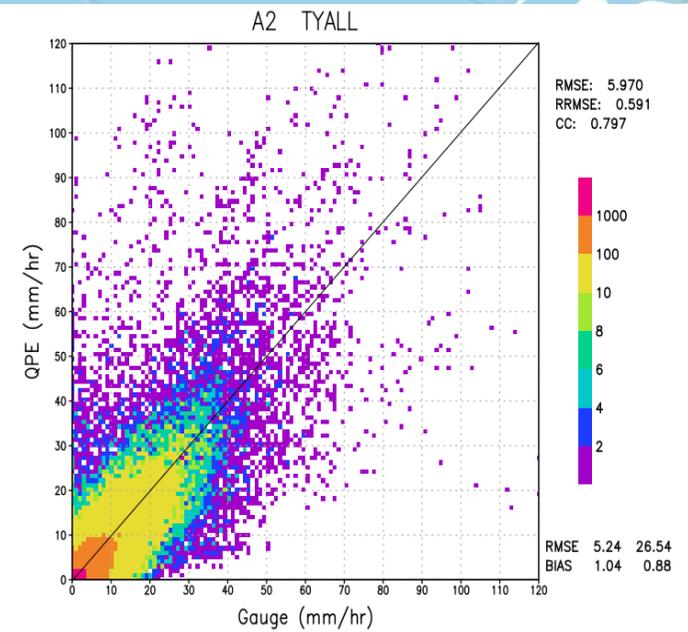
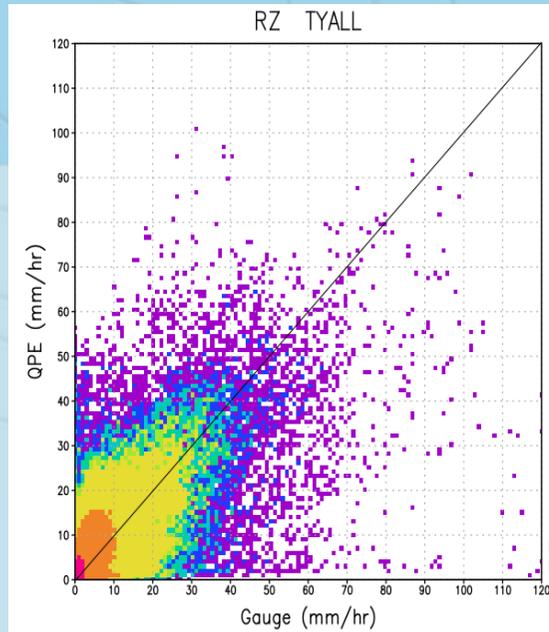
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梅雨



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颱風



Weather

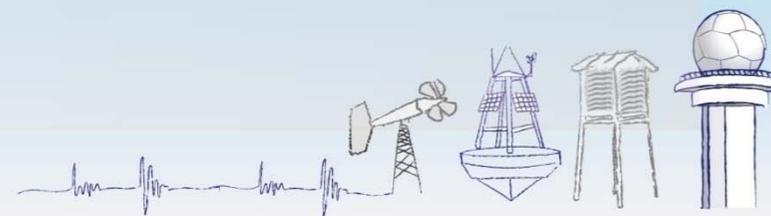
結論與未來展望



- ✦ R(Z)的部分，當小時降雨強度越大時，其均方根誤差越大，且偏差值也顯示其雨量低估情形會越嚴重。
- ✦ 不論颱風或梅雨個案，綜合各項校驗分數，R(A)均較R(Z)結果佳。特別在強降雨部份
- ✦ R(A)在研究上目前仍只適用於融化層以下，故覆蓋範圍受限，未來亦可考慮將較高仰角的R(A)資料進行垂直上的修正，或將R(Z)與R(A)結果相結合，有助於得到更全面的格點定量降雨估計，提供更好的防災應用產品。

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結論與未來展望



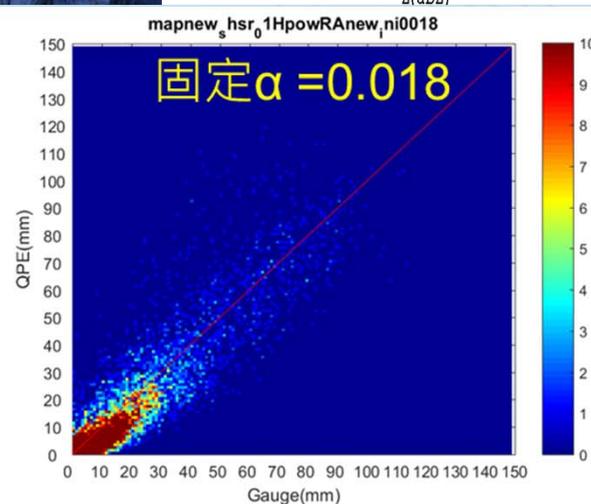
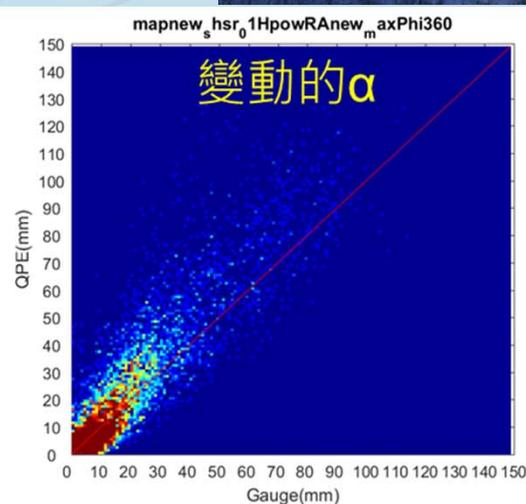
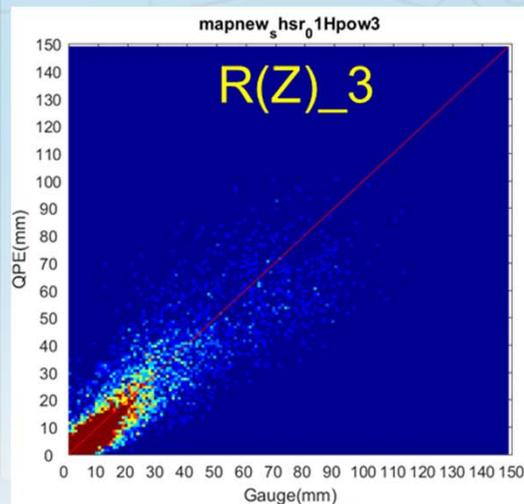
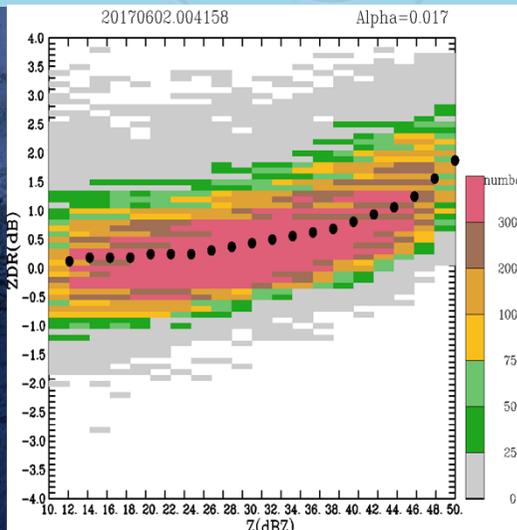
✦ R(A)法的在地化精進

✦ 不同降雨型態改變係數

✦ 長期個案係數統計分析

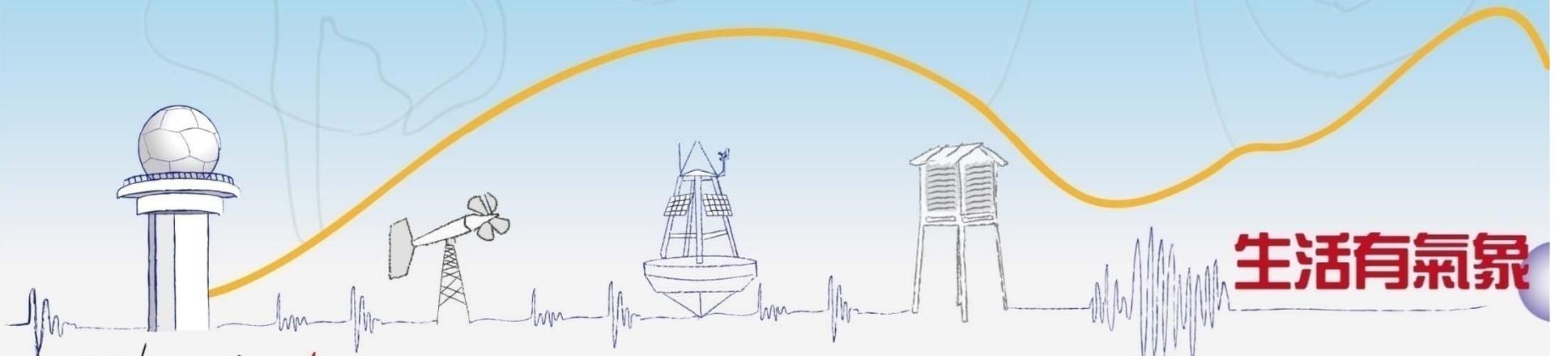
✦ 利用雨滴譜儀觀測比對

✦ C波段定量降雨估計法



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生活有氣象

Weather⁺ Service **Observation** **Climate** **Forecasts** **Satellite** **Earthquakes** **Marine** **Radar** **Astronomy**