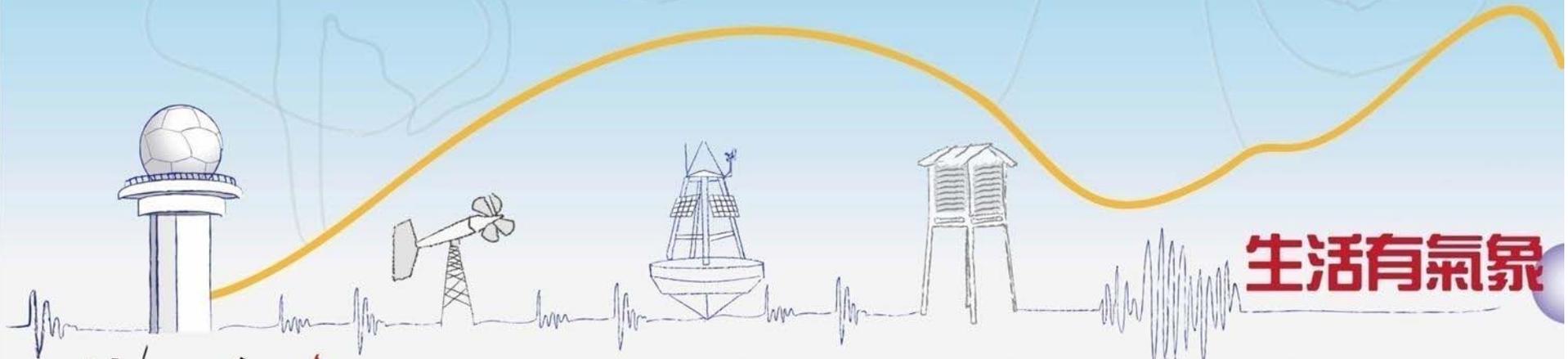




# 雙都卜勒雷達風場分析 在侵台颱風海面風力估計之研究

張保亮 唐玉霜

中央氣象局



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

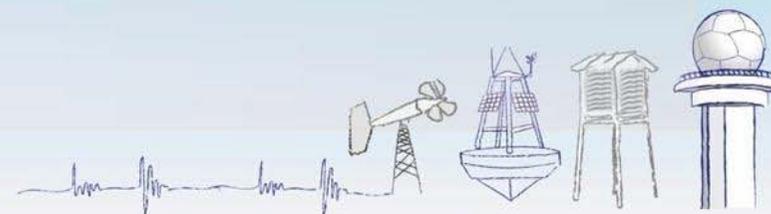
# 報告大綱



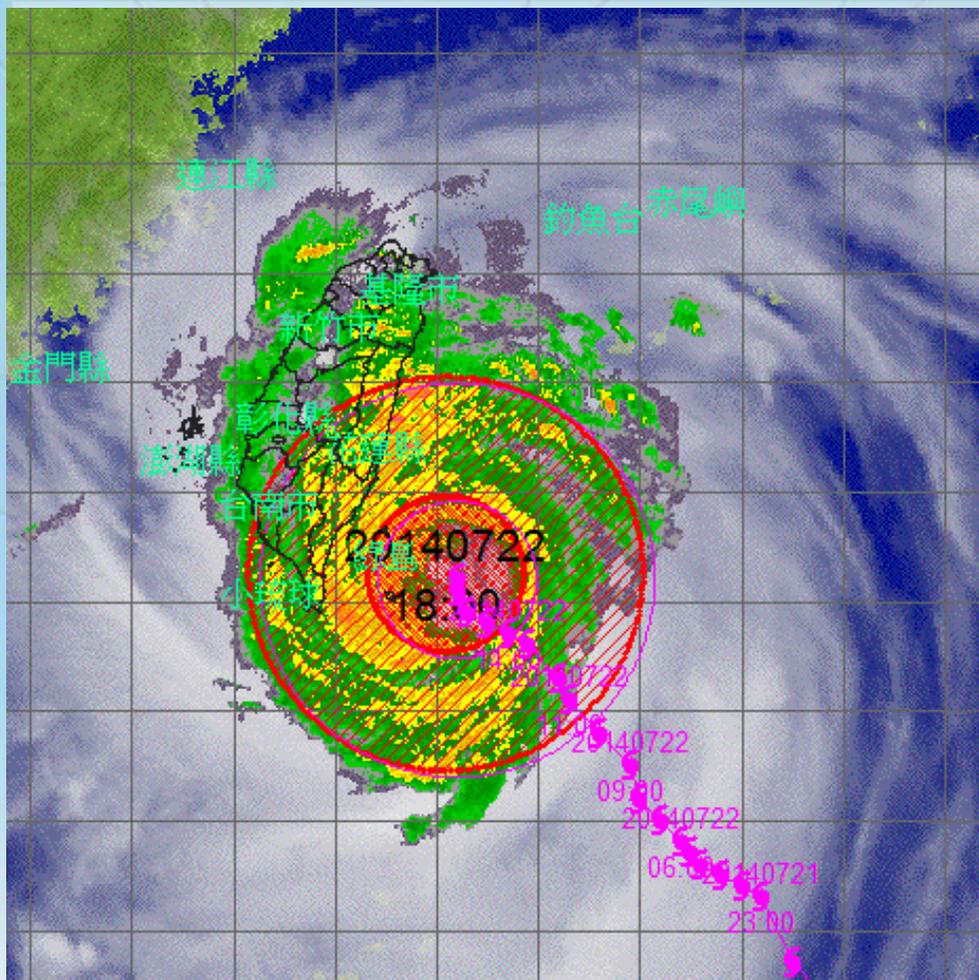
- 🐓 前言
- 🐓 資料來源
- 🐓 研究方法
- 🐓 結論
- 🐓 未來展望

**Weather<sup>+</sup>**

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# 前言



✚ 颱風侵襲期間，  
密集的雷達觀測，提供預報  
作業重要資訊

- ✓ 降水
- ✓ 颱風環流中心
- ✓ 颱風強度
- ✓ 暴風半徑？
- ✓ 海面風力？
- ✓ 地面風力？

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# 前言



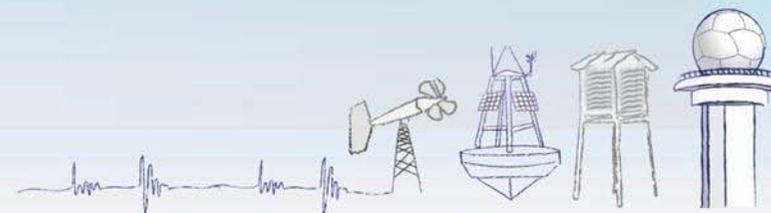
✎ 暴風半徑：地面風速

✎ 如何增加海面風力觀測資訊？

- ✓ 最早始於利用飛機飛行高度資料來進行海面風力的估計，經由飛機飛行高度資料與海面測站之風力觀測的統計分析，即可推導出兩者間之相關，並可進一步應用於實際作業上(Powell et al. 1996)
- ✓ Dropwindsonde (Franklin et al. 2003 與 SFMR (Stepped Frequency Microwave Radiometer) (Powell et al. 2010)也相繼被應用於海面風力的估計。

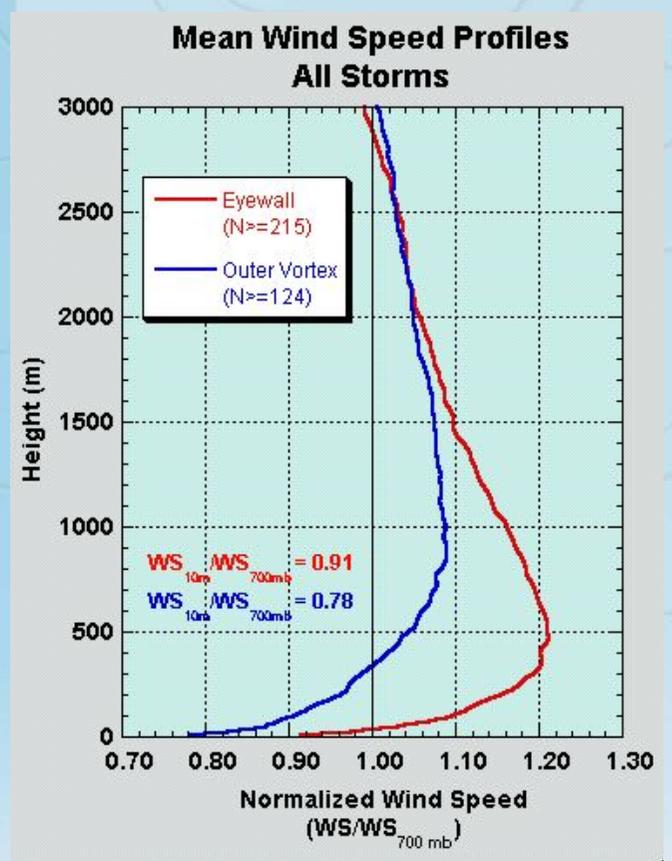
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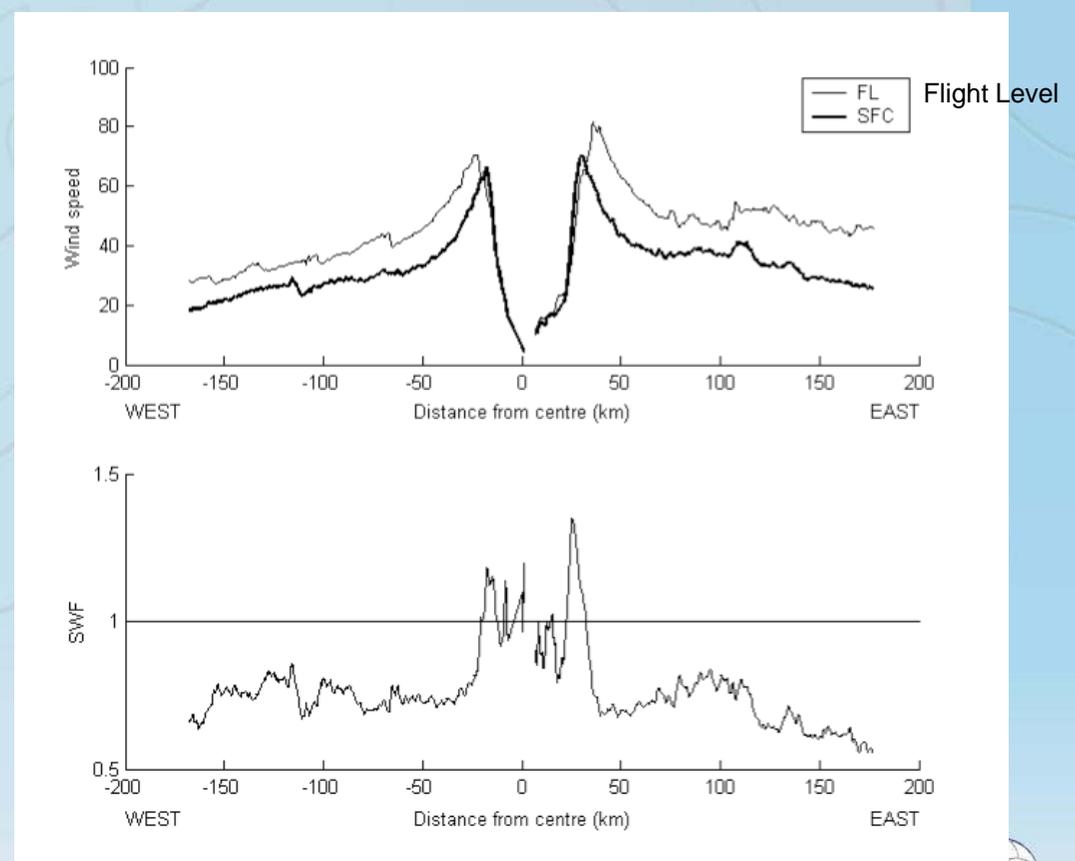
## Dropwindsonde



Franklin et al. (2003)

## SFMR

(Stepped Frequency Microwave Radiometer)



Powell et al. (2010)

**Weather**<sup>+</sup>

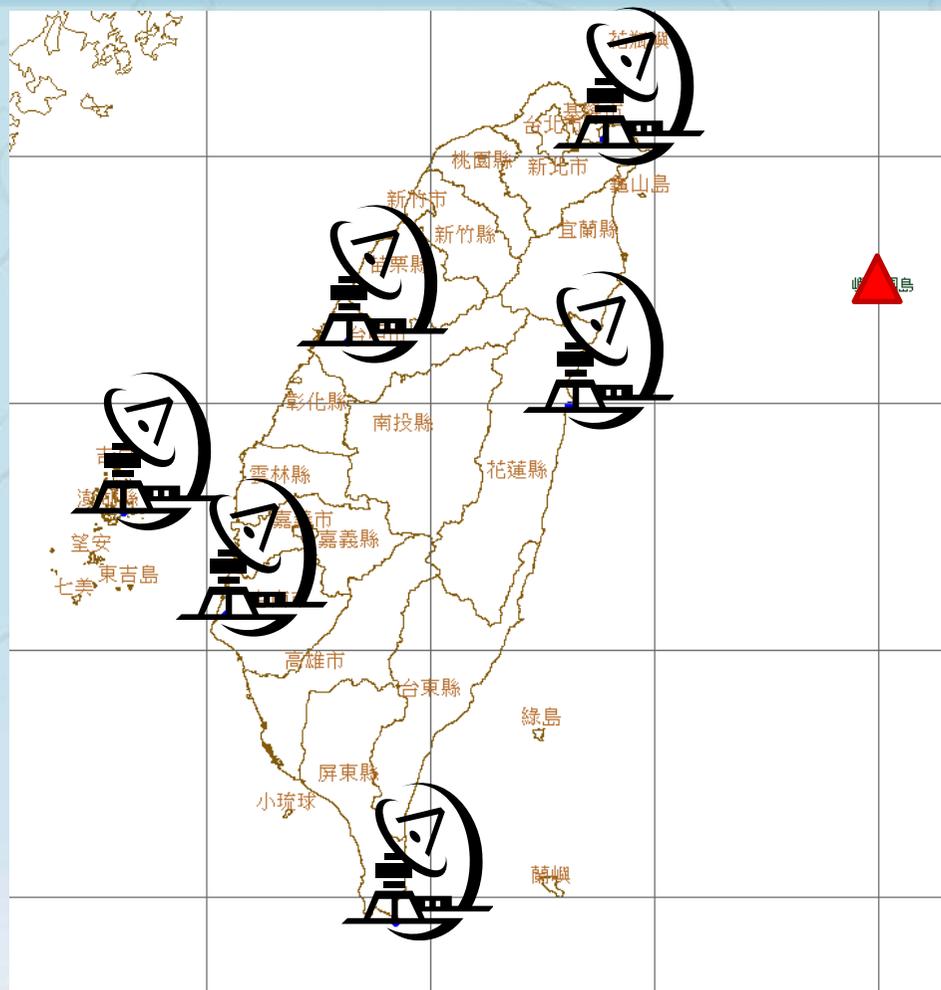
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# 資料來源

 6顆雷達

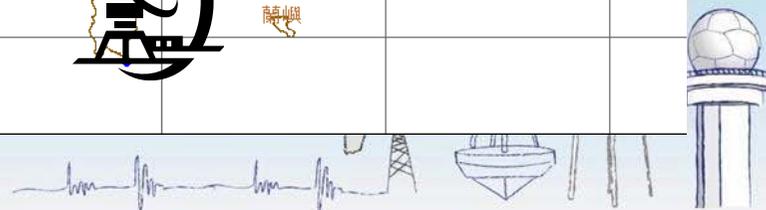
 與那國島剖風儀

 與那國島地面測站



*Weather*<sup>+</sup>

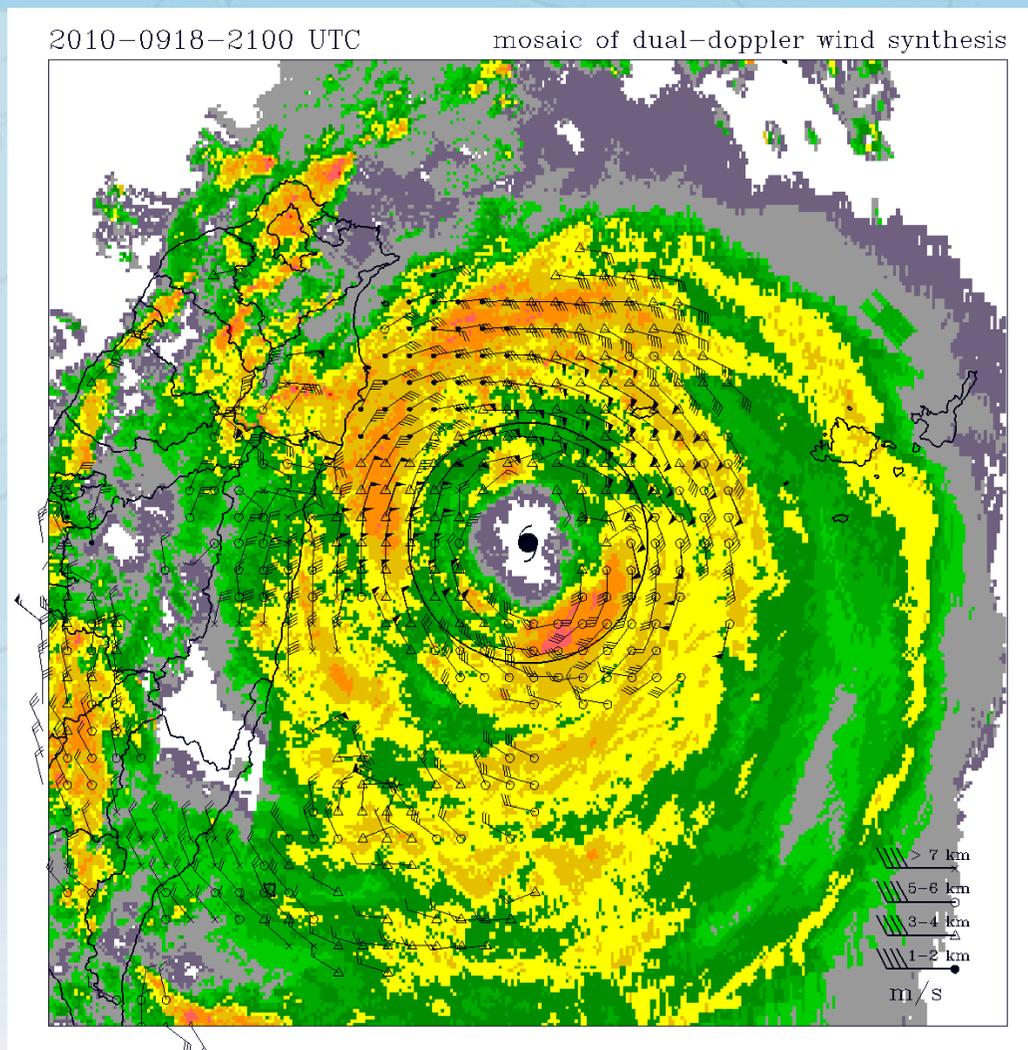
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# 雙雷達合成風場



- ✚ 6顆作業型雷達
- ✚ 7組雙雷達分析
- ✚ 取垂直最低、最大風場整合顯示
- ✚ 每10分鐘一筆



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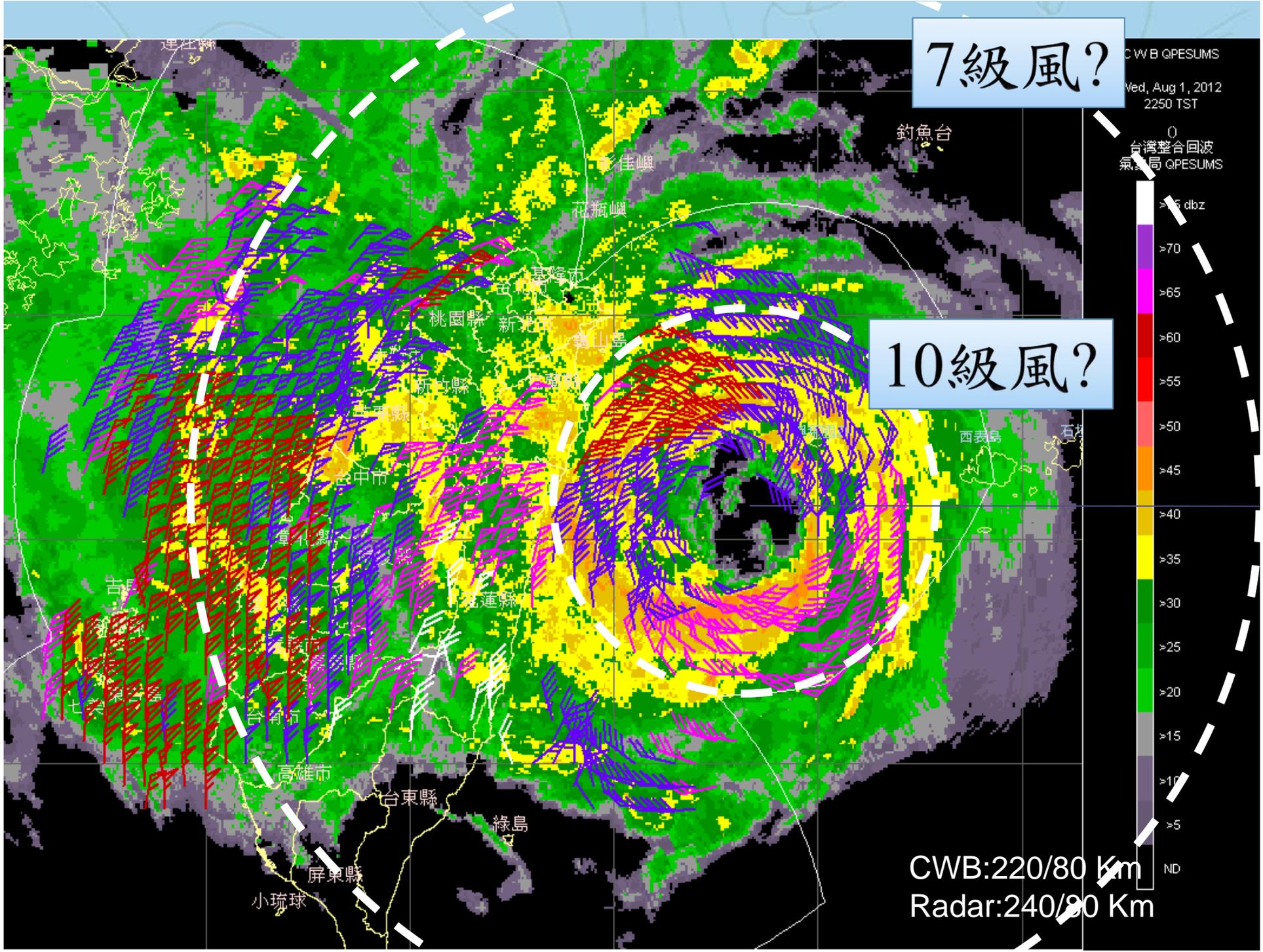
7級風?

10級風?

CWB QPESUMS  
Wed, Aug 1, 2012  
2250 TST  
0  
台灣整合回波  
氣象局 QPESUMS



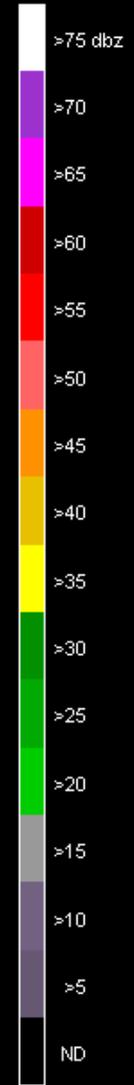
CWB:220/80 Km  
Radar:240/90 Km



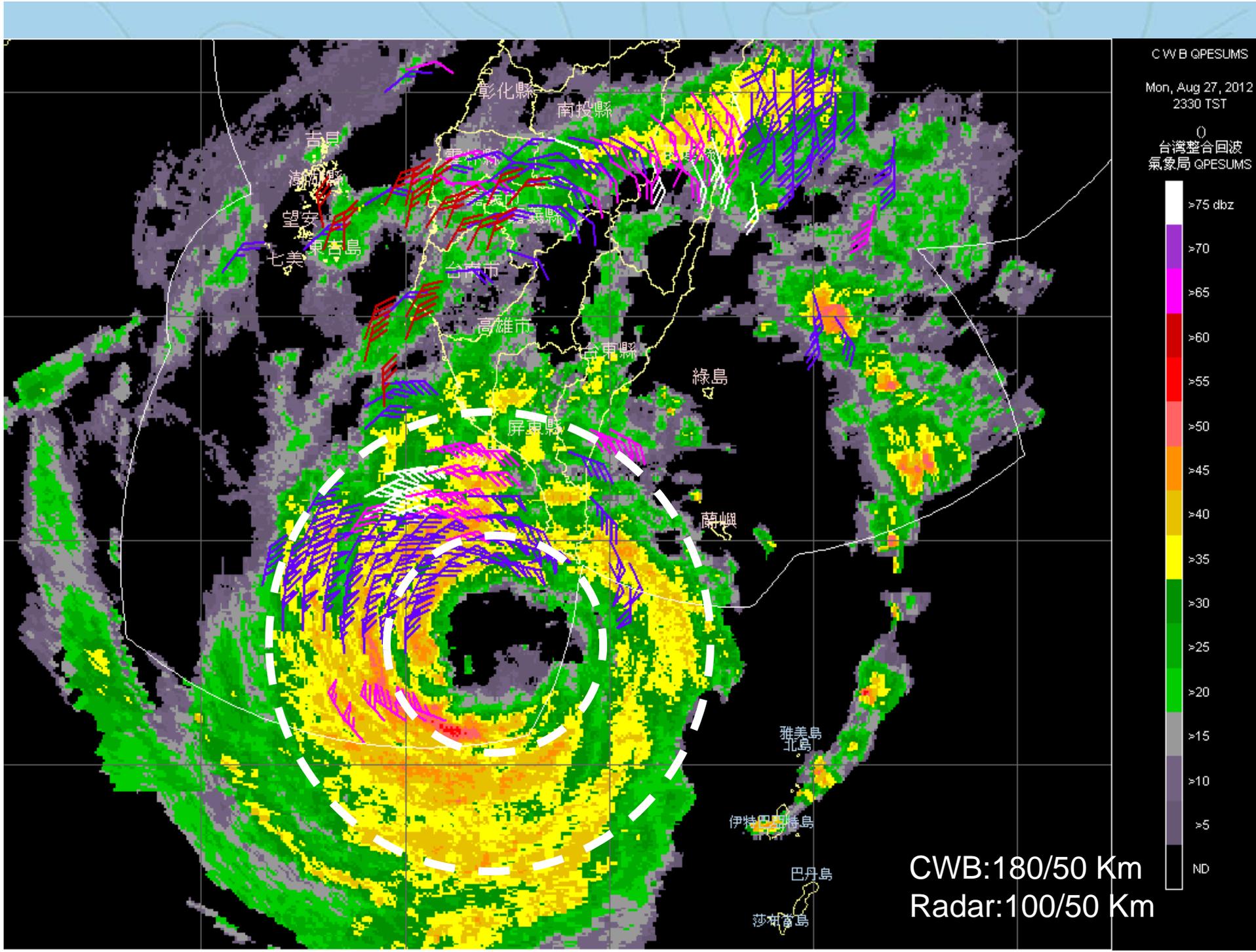
CWB GPESUMS

Mon, Aug 27, 2012  
2330 TST

台灣整合回波  
氣象局 GPESUMS



CWB:180/50 Km  
Radar:100/50 Km

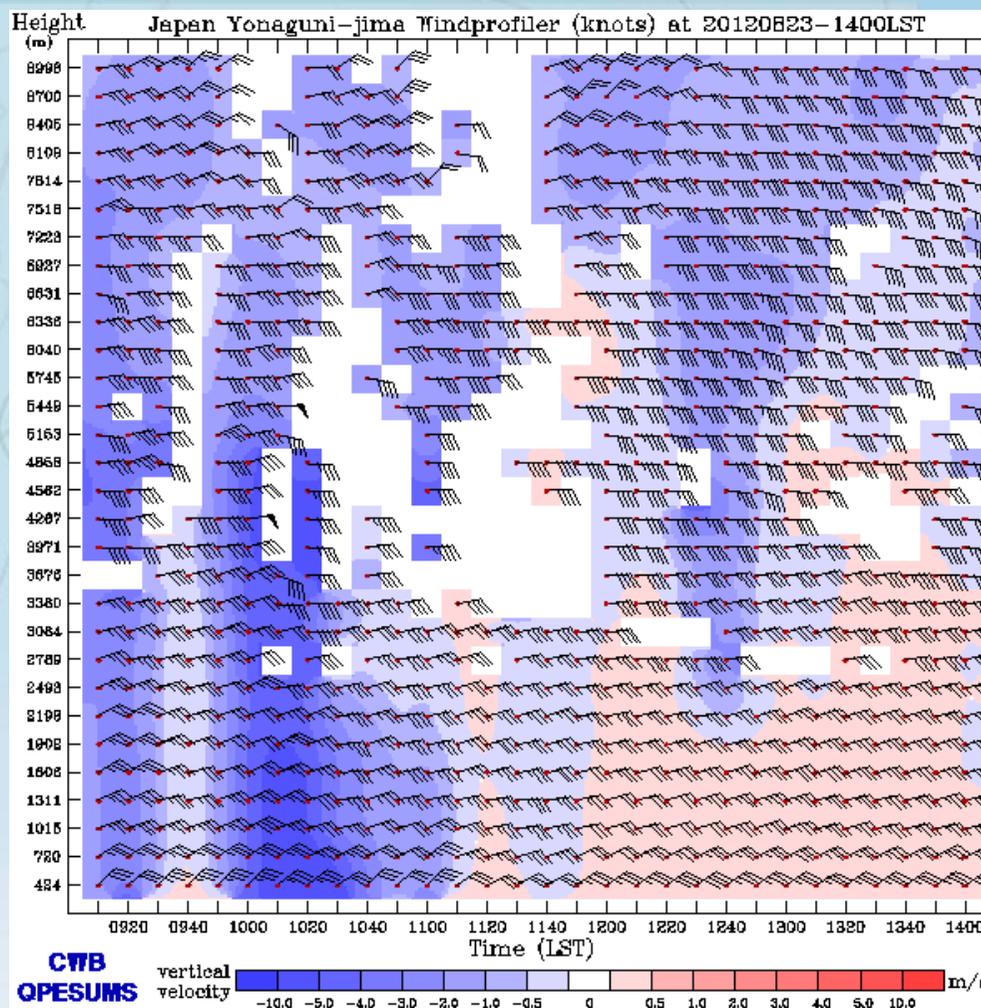


# 與那國島剖風儀



天秤颱風(2012)期間

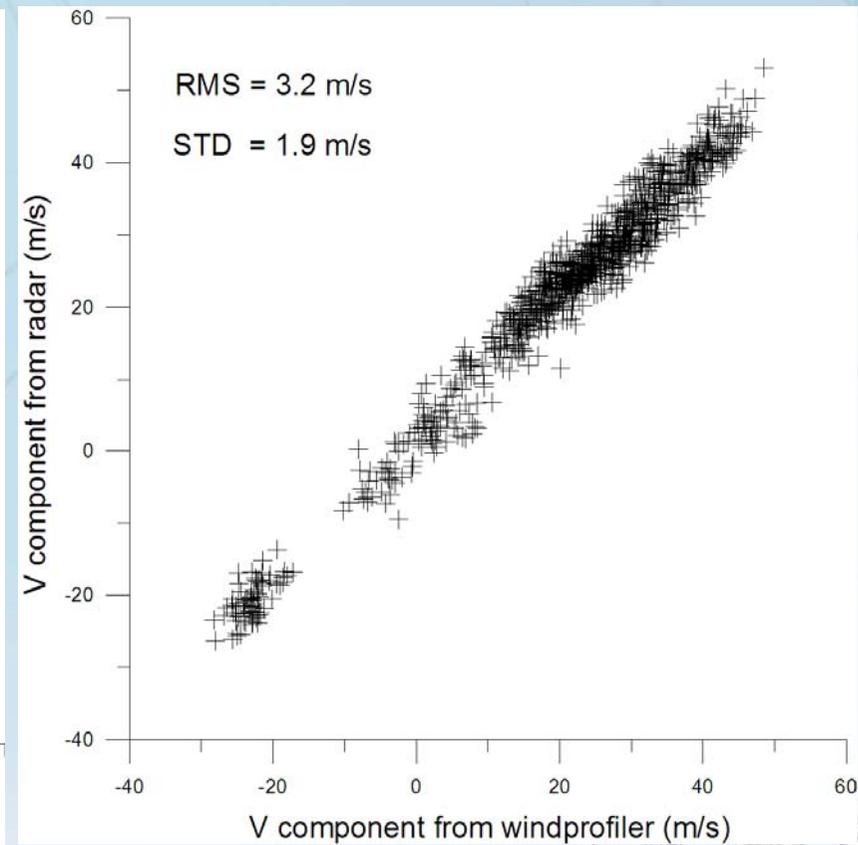
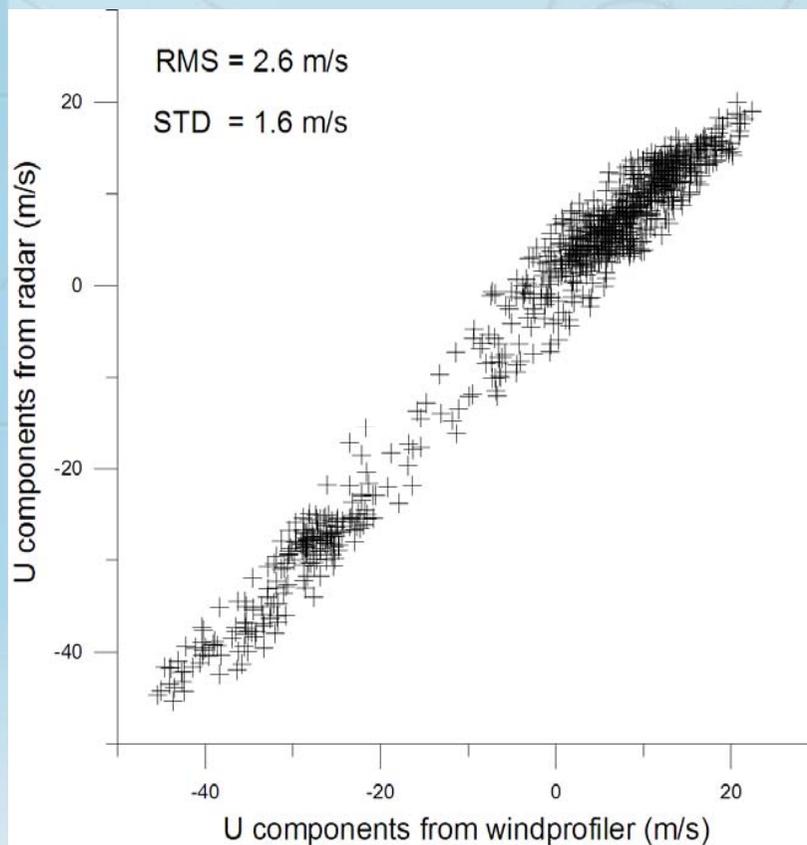
- ✎ 垂直層數30層，解析度為300m
- ✎ 每10分鐘一筆
- ✎ 與地面觀測比較
- ✓ 2008年到2012年11個颱風侵台期間
- ✓ 去除地形影響
- ✓ 有效筆數1989筆



Weather<sup>+</sup>

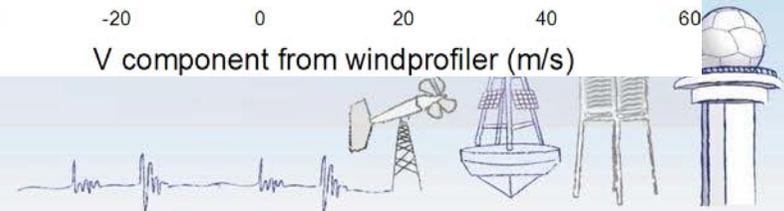
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# 雷達反演風場與剖風儀比對分析

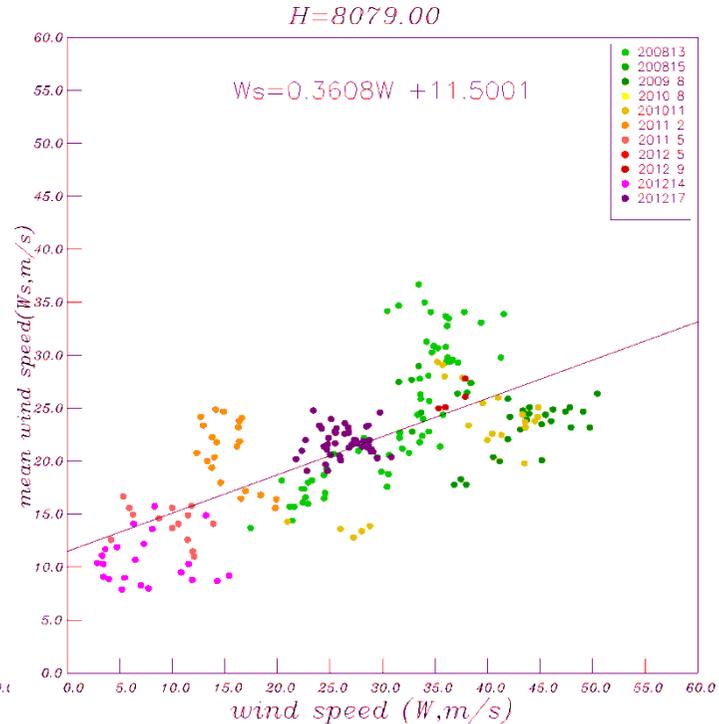
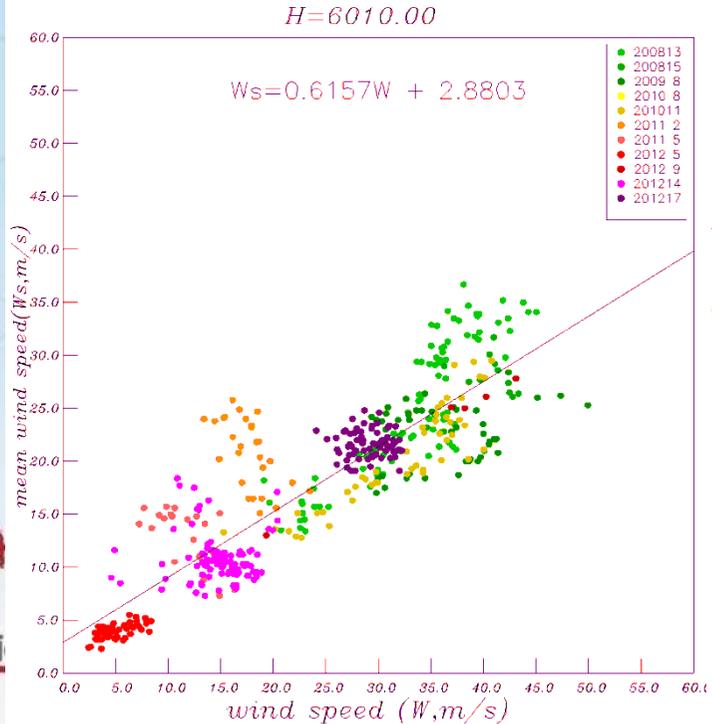
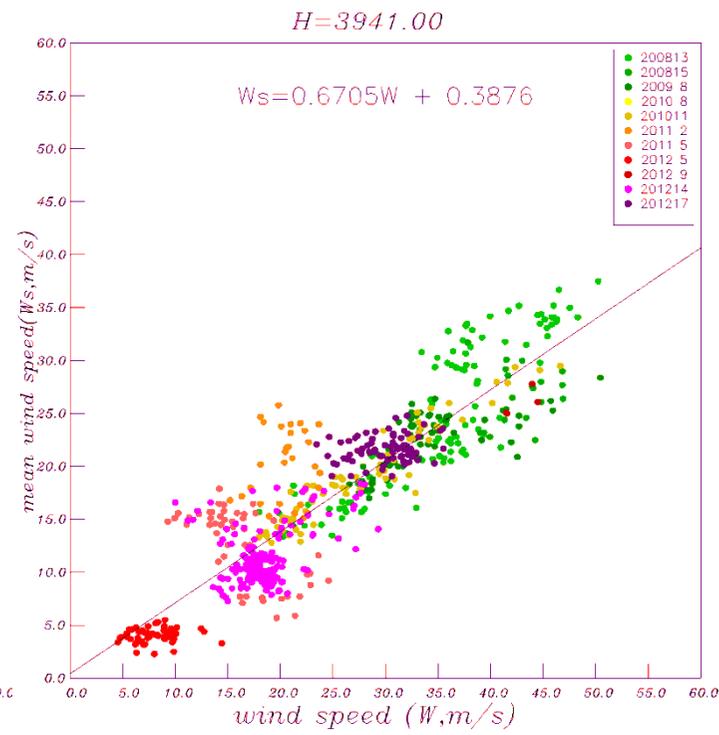
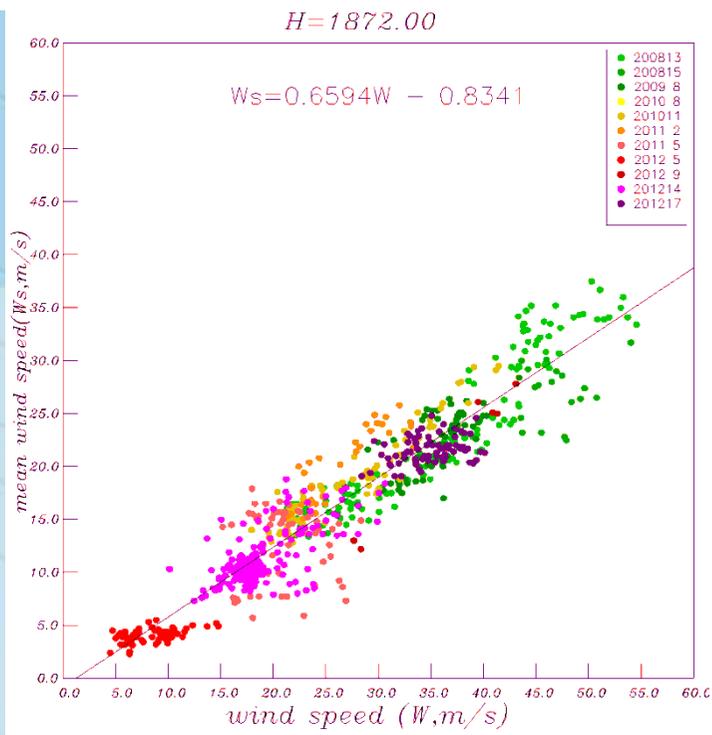


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# 颱風風力垂直剖面分析 1



# 颱風風力垂直剖面分析 2



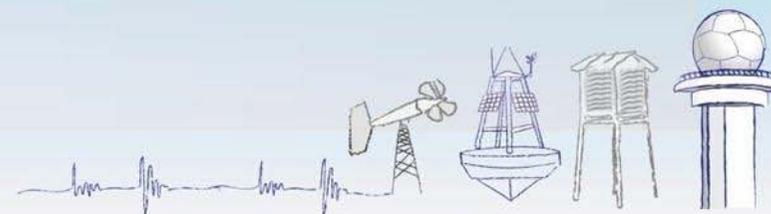
- ✚ 地面風速與高度層風速大小、高度層風速所在高度相關
- ✚ 複迴歸分析嘗試建立多變數之經驗公式

✓ 地面平均風速( $W_S$ )

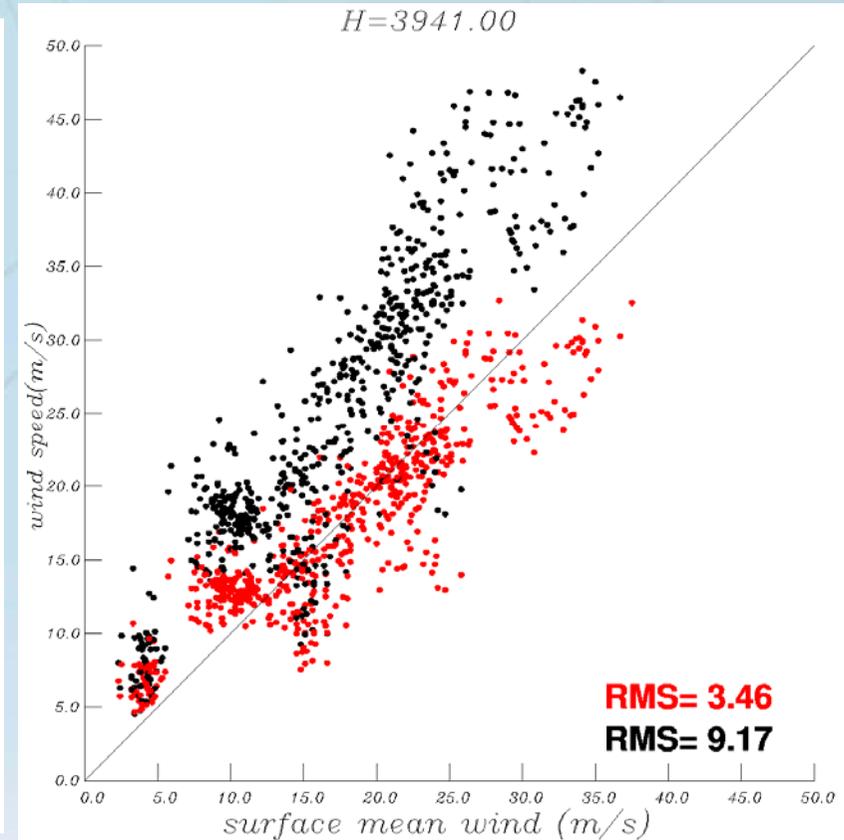
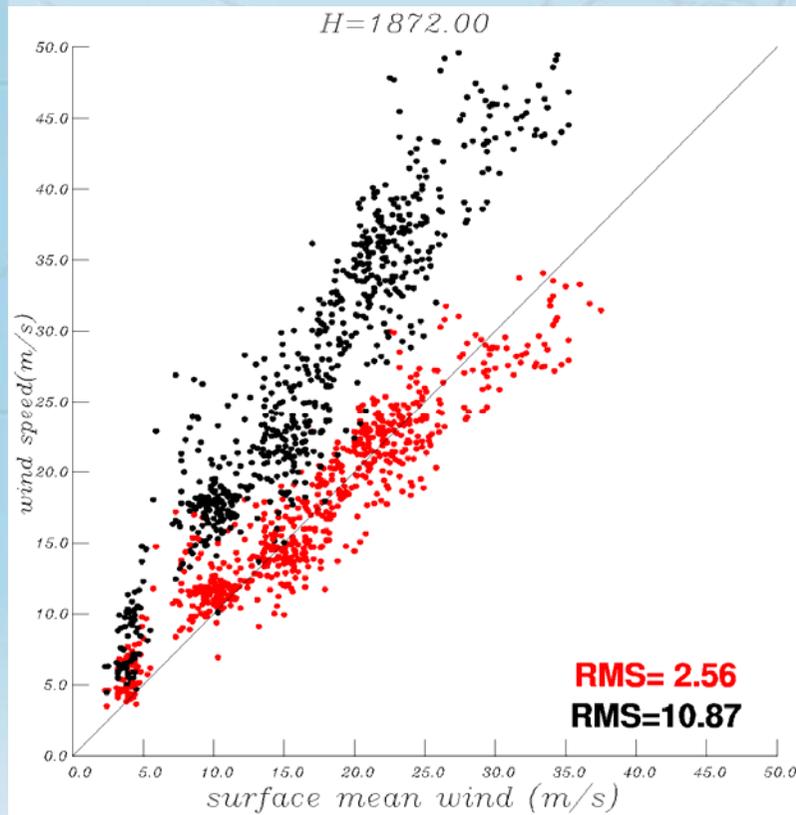
$$W_S = -0.2333 + 0.5407H + 0.6102W_H$$

✓ 地面陣風風速( $W_G$ )

$$W_G = -0.327 + 0.7377H + 0.8279W_H$$



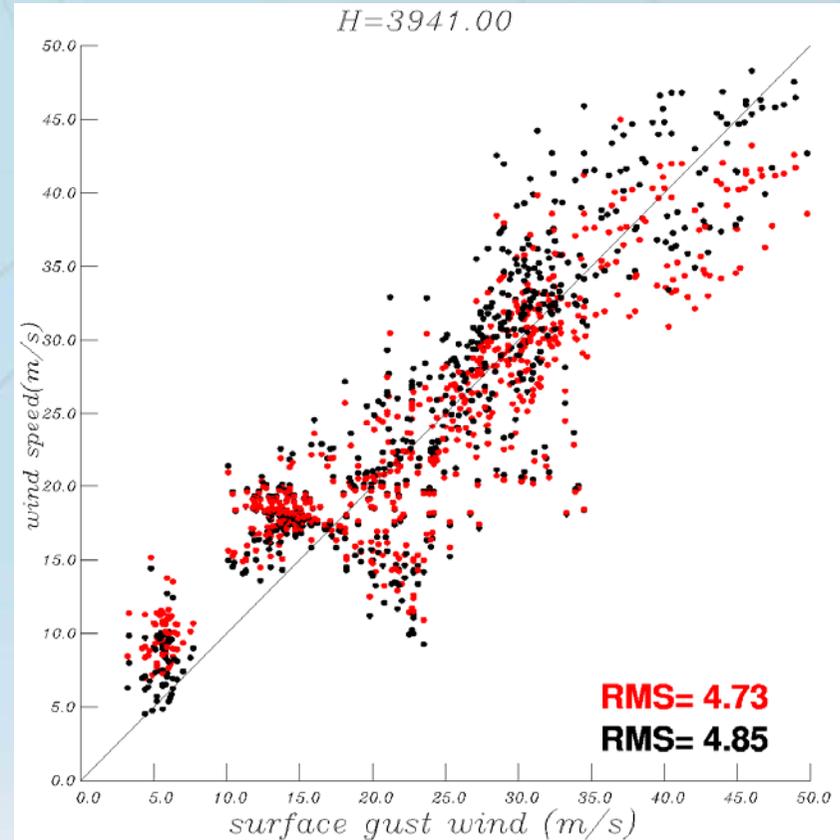
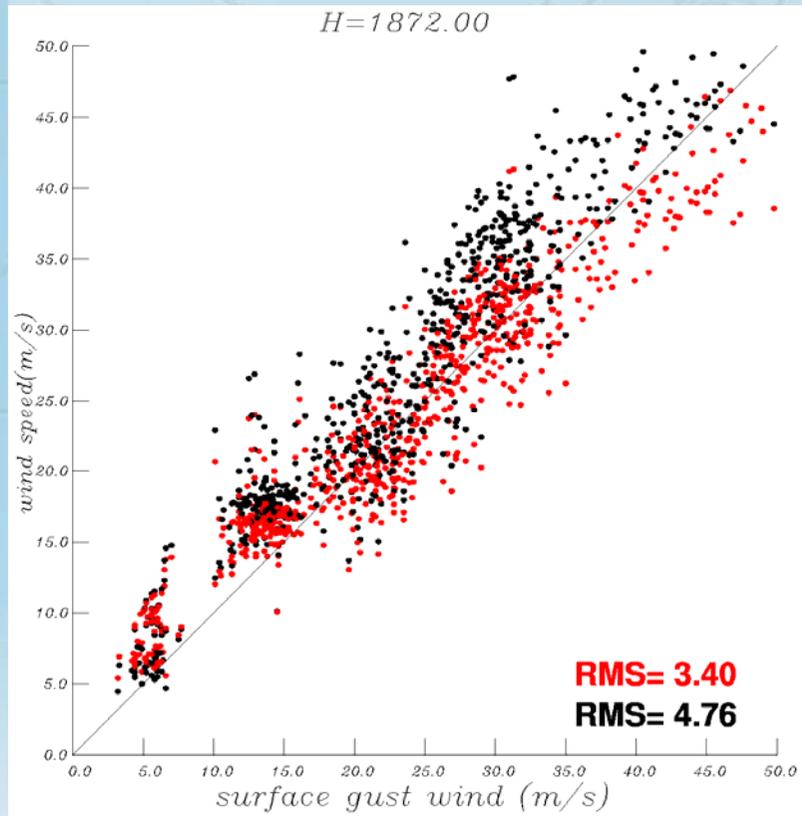
# 不同高度層之平均風與地面風速



Weather<sup>+</sup>

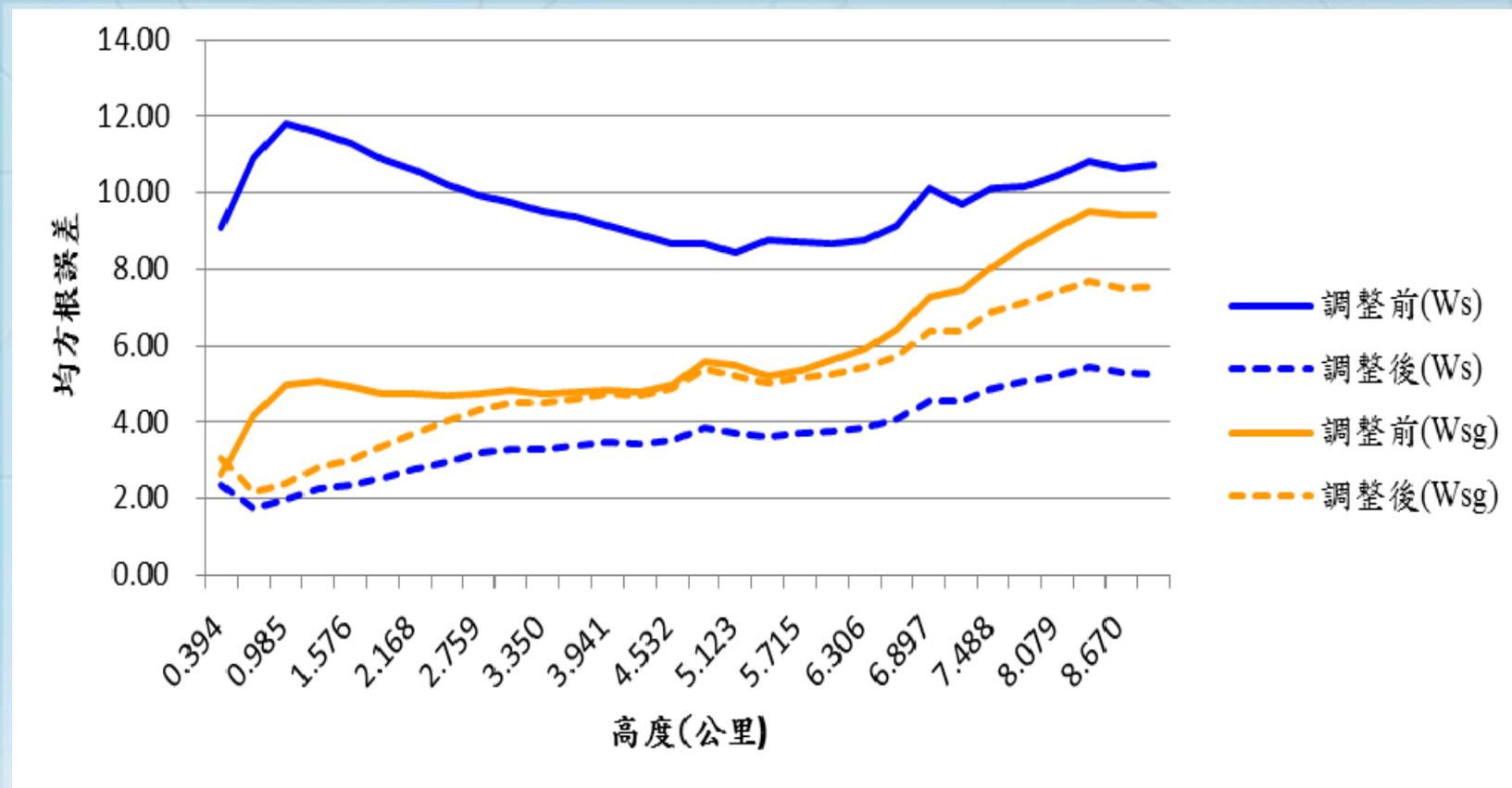
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# 不同高度層之陣風與地面風速



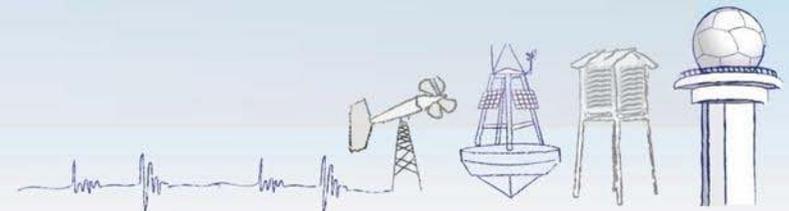
Weather<sup>+</sup>

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**Weather<sup>+</sup>**

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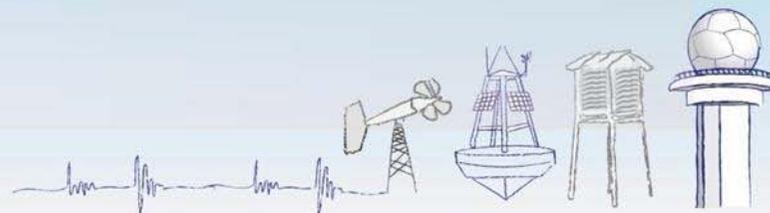
# 結論



- ✚ 雙都卜勒合成風場對於颱風環流中心位置、颱風近中心強度與外圍雨帶區域的環流強度之變化趨勢等，均能提供預報作業值得參考的資訊。
- ✚ 不同高度觀測的風速與地面平均風與陣風風速有明顯的相關性
- ✚ 利用複迴歸統計分析得到的關係式，可有效、快速推算出地面風速

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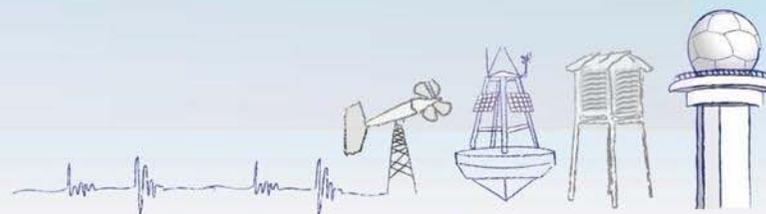
# 未來展望



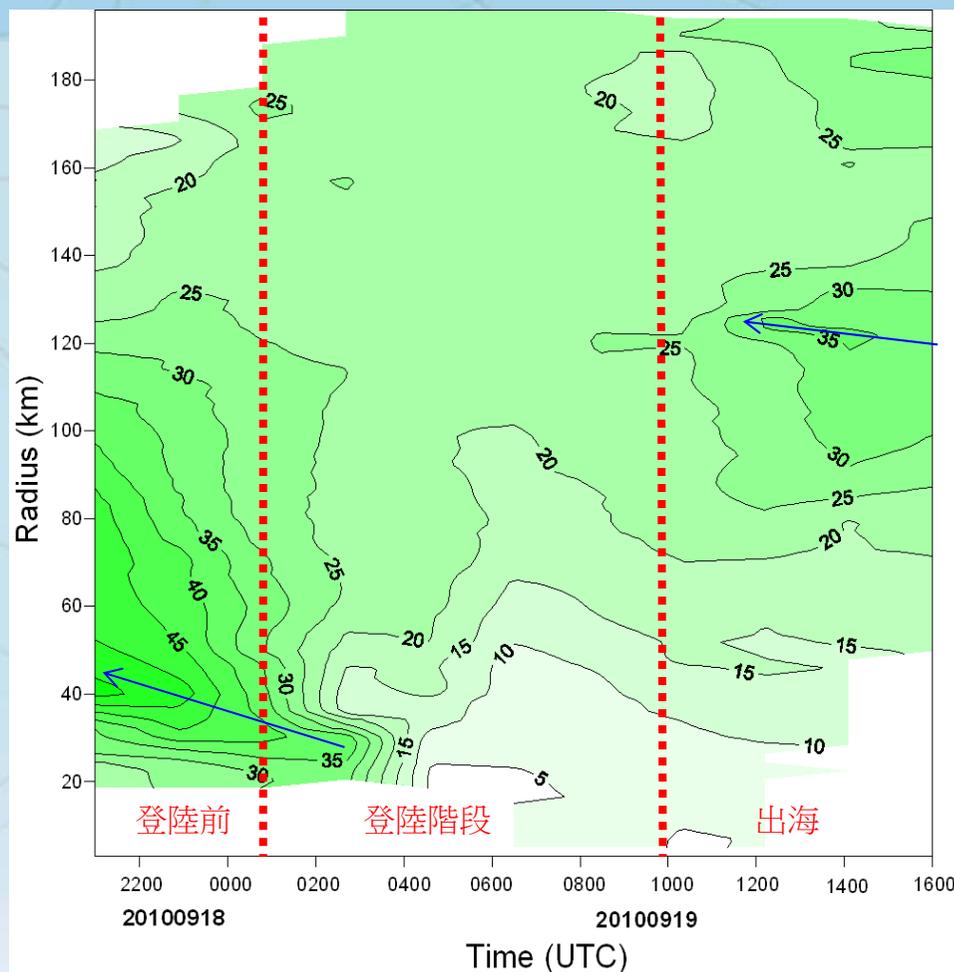
- ✚ 持續進行颱風個案之垂直風力剖面統計分析。
- ✚ 進行雙都反演風力與地面風力之時、空分析。
- ✚ 發展颱風環流中心之輔助定位技術，以及7與10級風暴風半徑估計作業產品。
- ✚ 開發環流中心與徑向、風速剖面產品，提升對於侵臺颱風風雨分布的即時監測與預報。
- ✚ 導入鄰近國家雷達資料，擴大風場分析範圍(如日本、菲律賓)。

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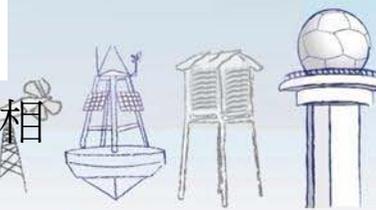
# 未來展望



凡那比(2010)颱風登陸前至出海階段高度4公里相對於颱風中心之風速(m/s)隨時間分布圖

Weather+

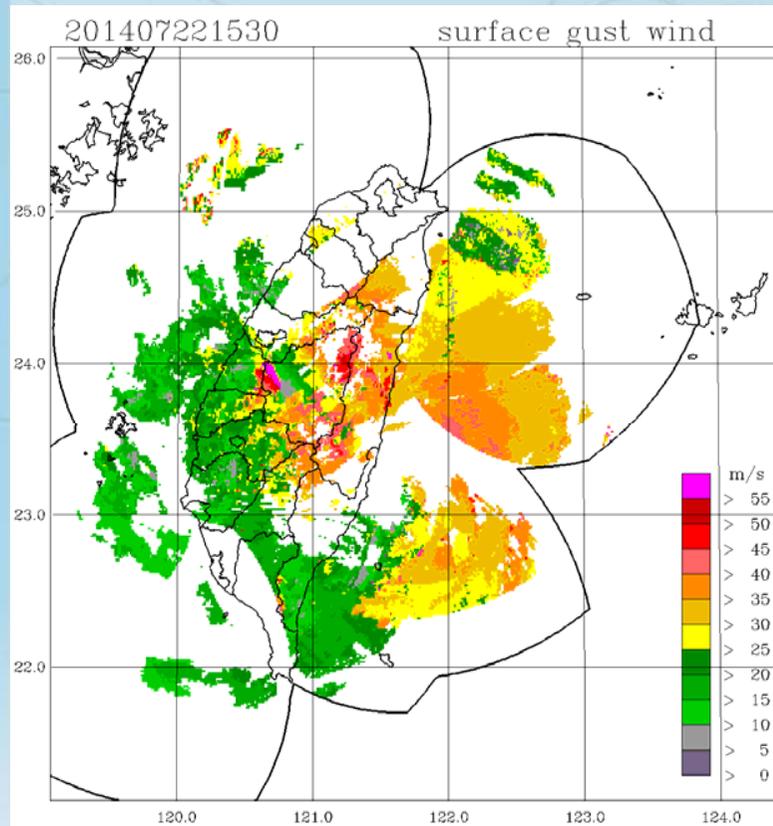
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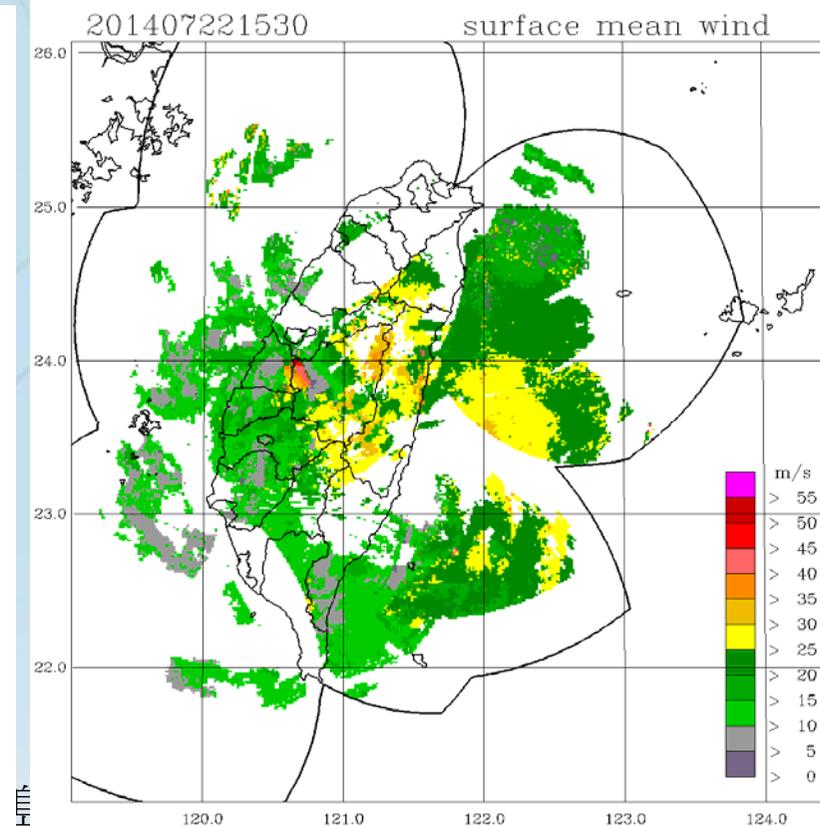
# 未來展望



Gust wind estimation



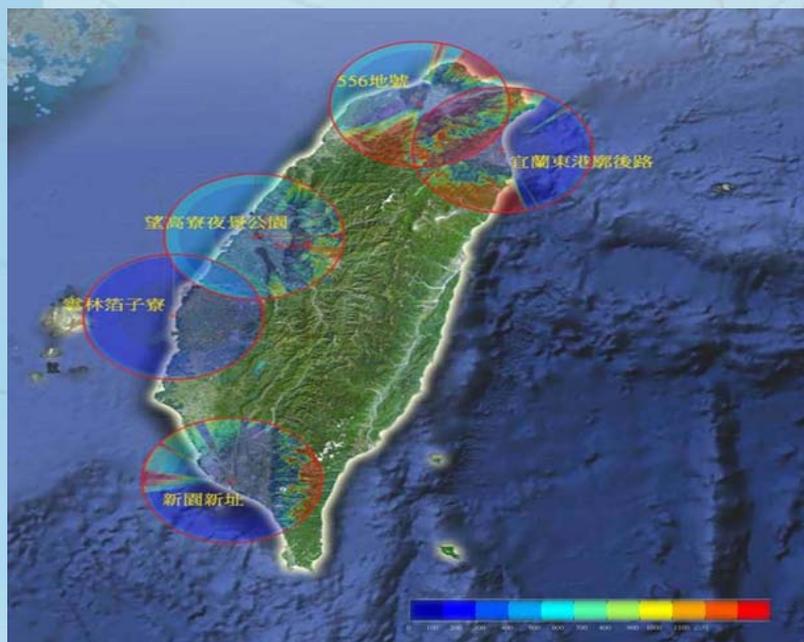
Sustain wind estimation



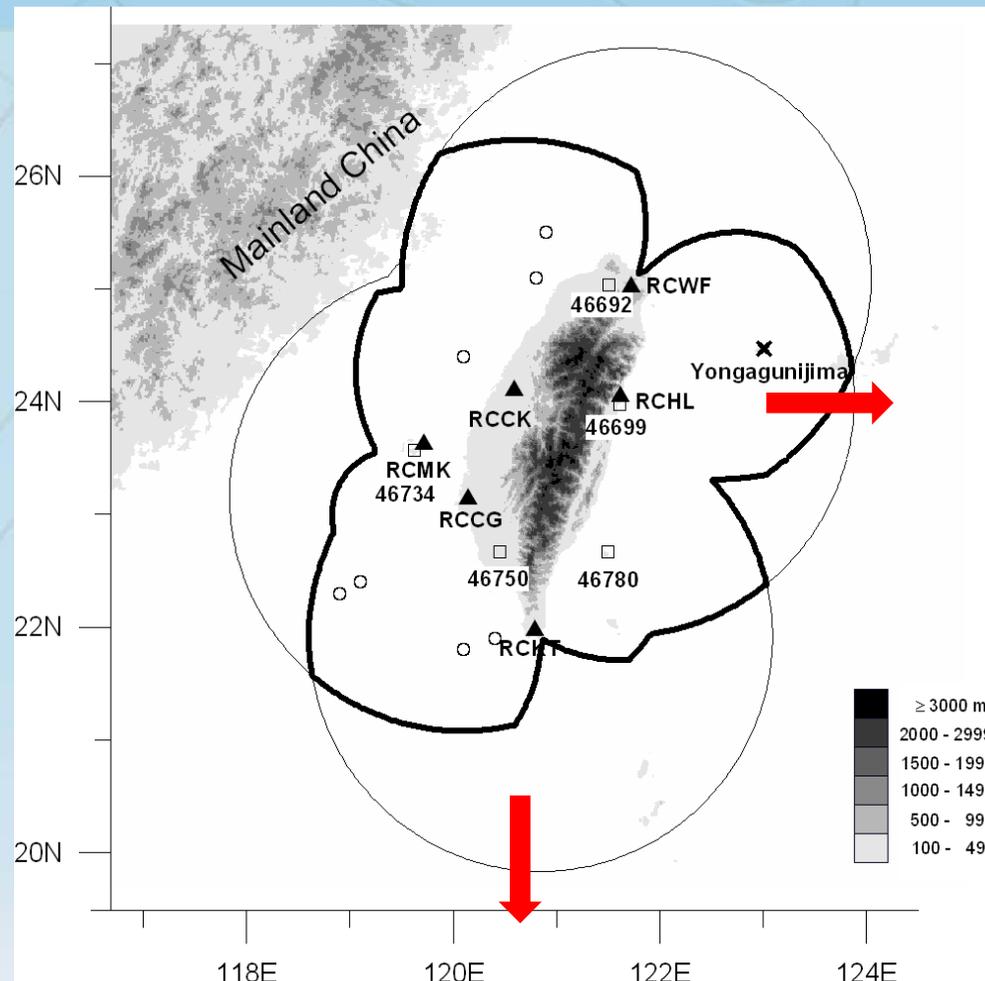
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# 未來展望



北中南、雲嘉南與宜蘭降雨雷達建置

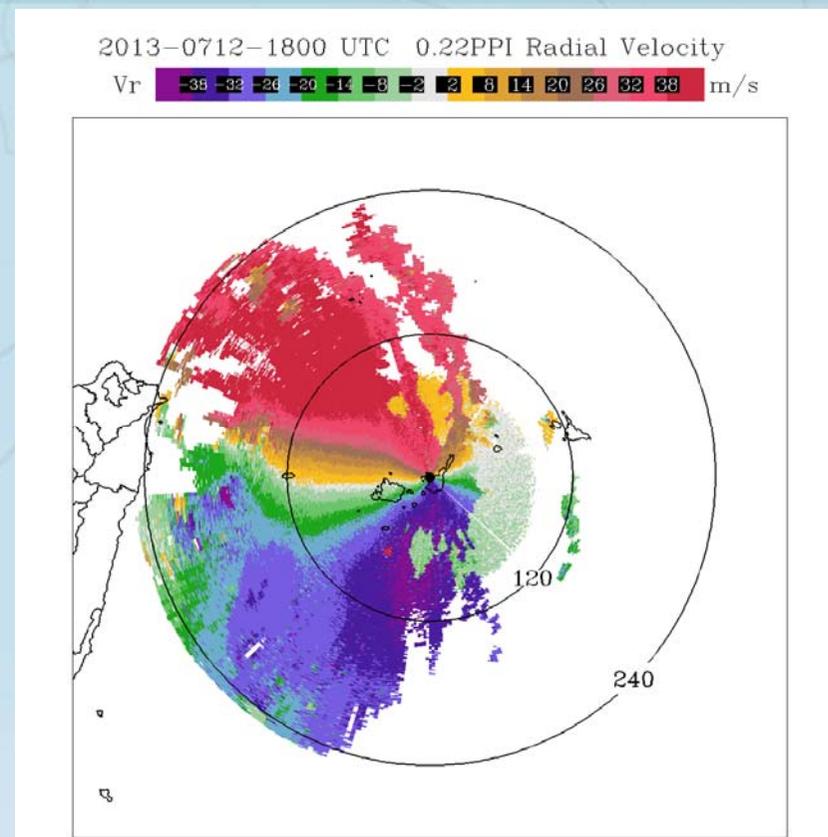
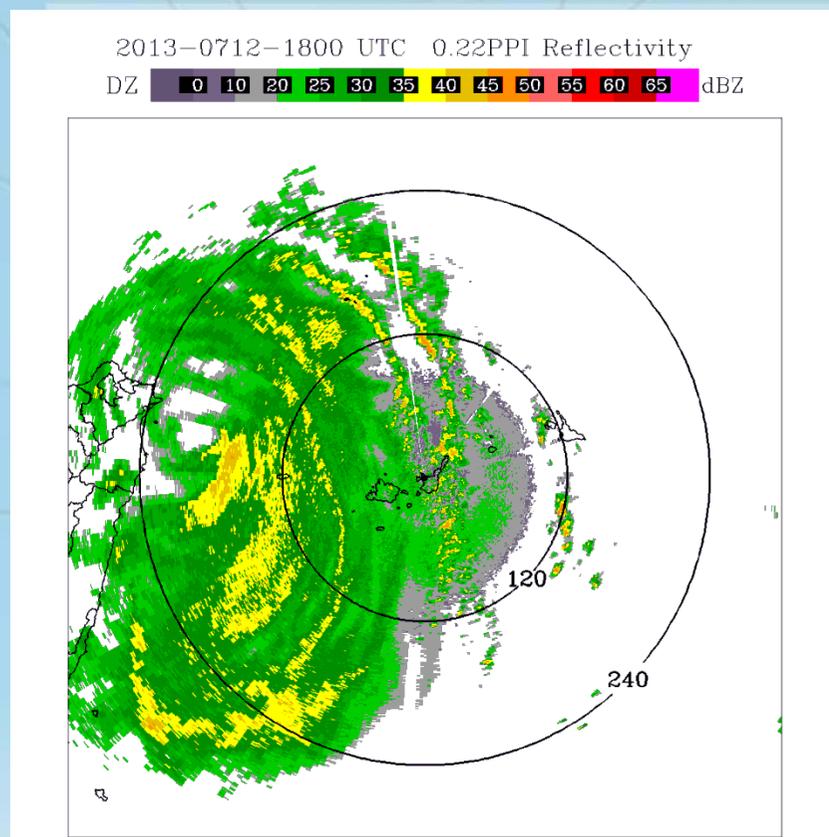


整合鄰近國家雷達

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# 未來展望



2013年7月12日1800UTC日本石垣島雷達站觀測之回波及都卜勒速度場。



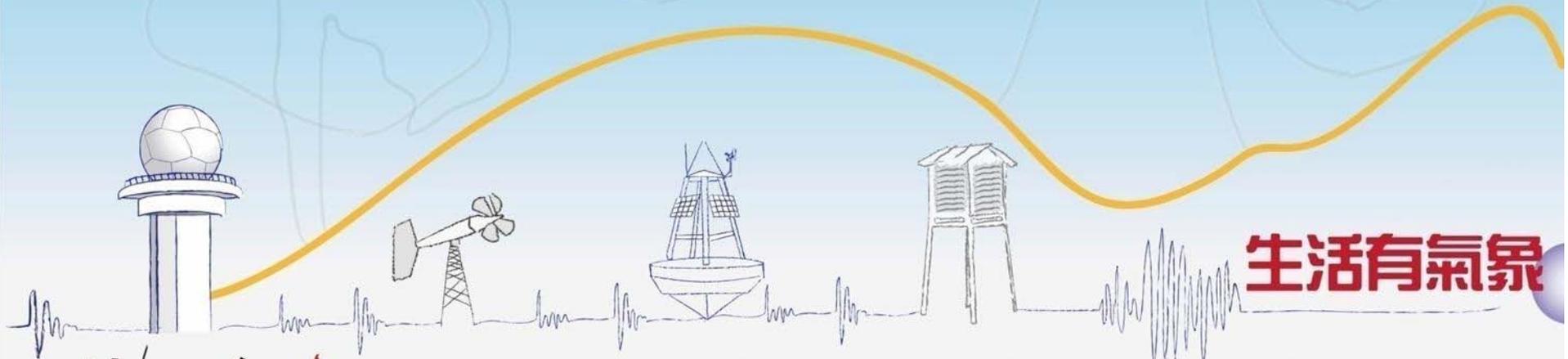
Weather<sup>+</sup>

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# 謝謝聆聽！



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