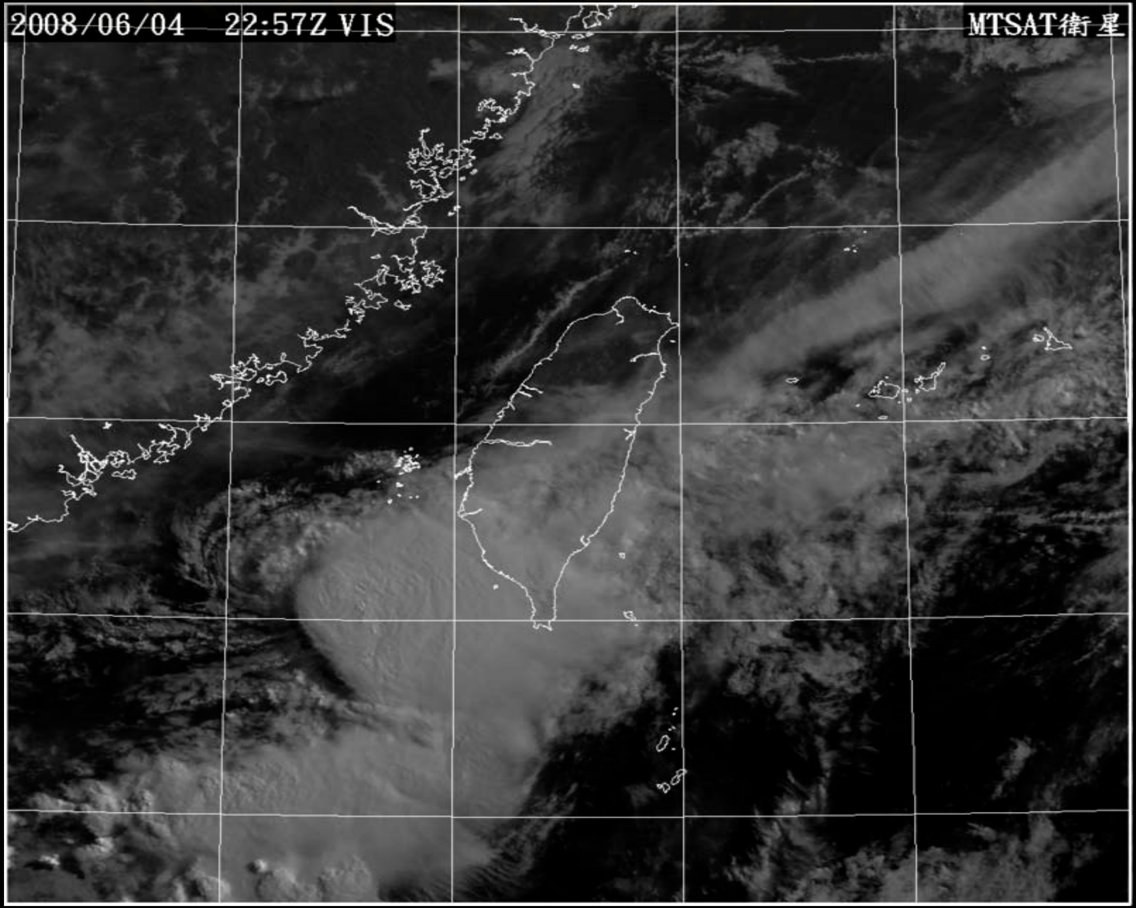
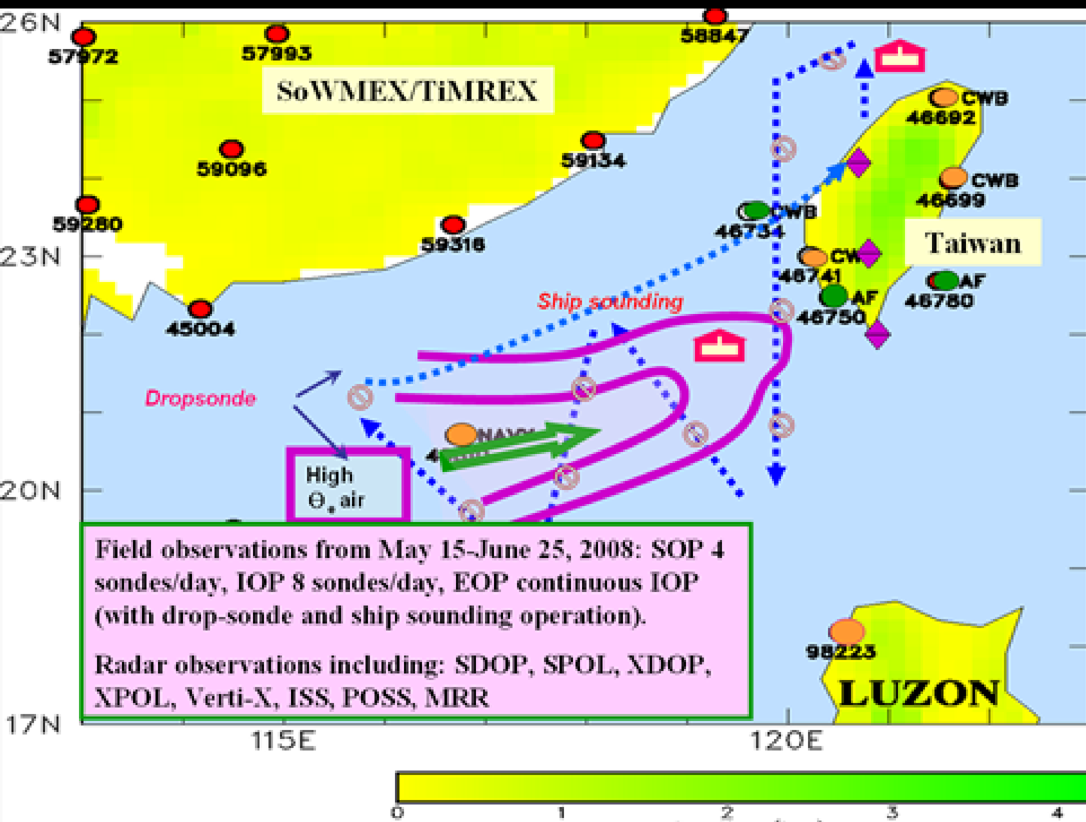
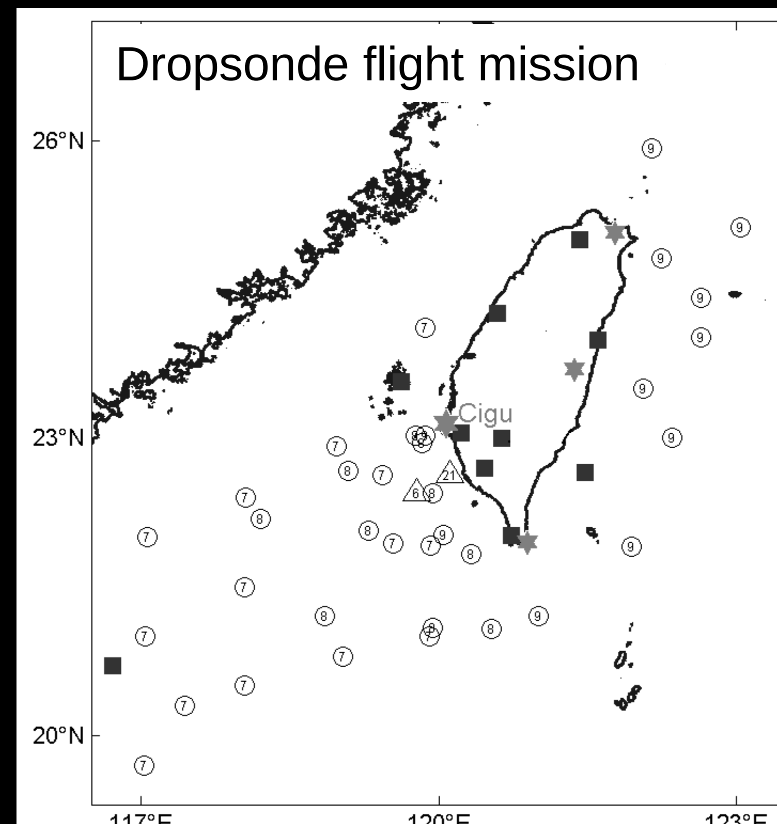
梅雨鋒內海洋性中尺度對流渦旋之分析與模擬



賴曉薇　周仲島
台灣大學大氣科學系

2008年西南氣流實驗





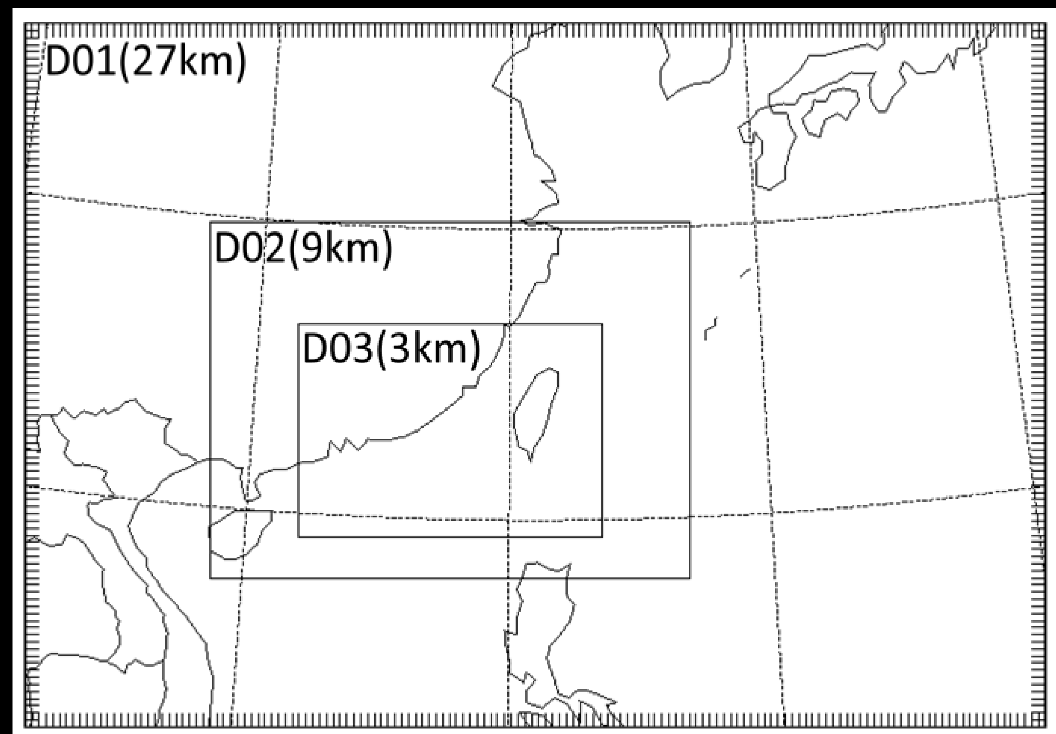
分析方法及模式設定

- Sounding analysis
- Simulation
  - ARW version 3.1
  - 3 nested domain:
    27km 9km 3km
  - Start time:
    00Z 06Z 12Z June 4
  - Initial and boundary field
    NCEP FNL 1x1 degree
  - Cumulus physics: Betts-Miller-Janjic scheme
  - Microphysics: Thompson scheme
  - Grid-FDDA include wind and temperature from global grid analyses between 0-18hrs on the 1st domain.

- Vorticity diagnosis
  - The analyzed box was chosen as 2.5° x 2.5° (270km x 270 km).

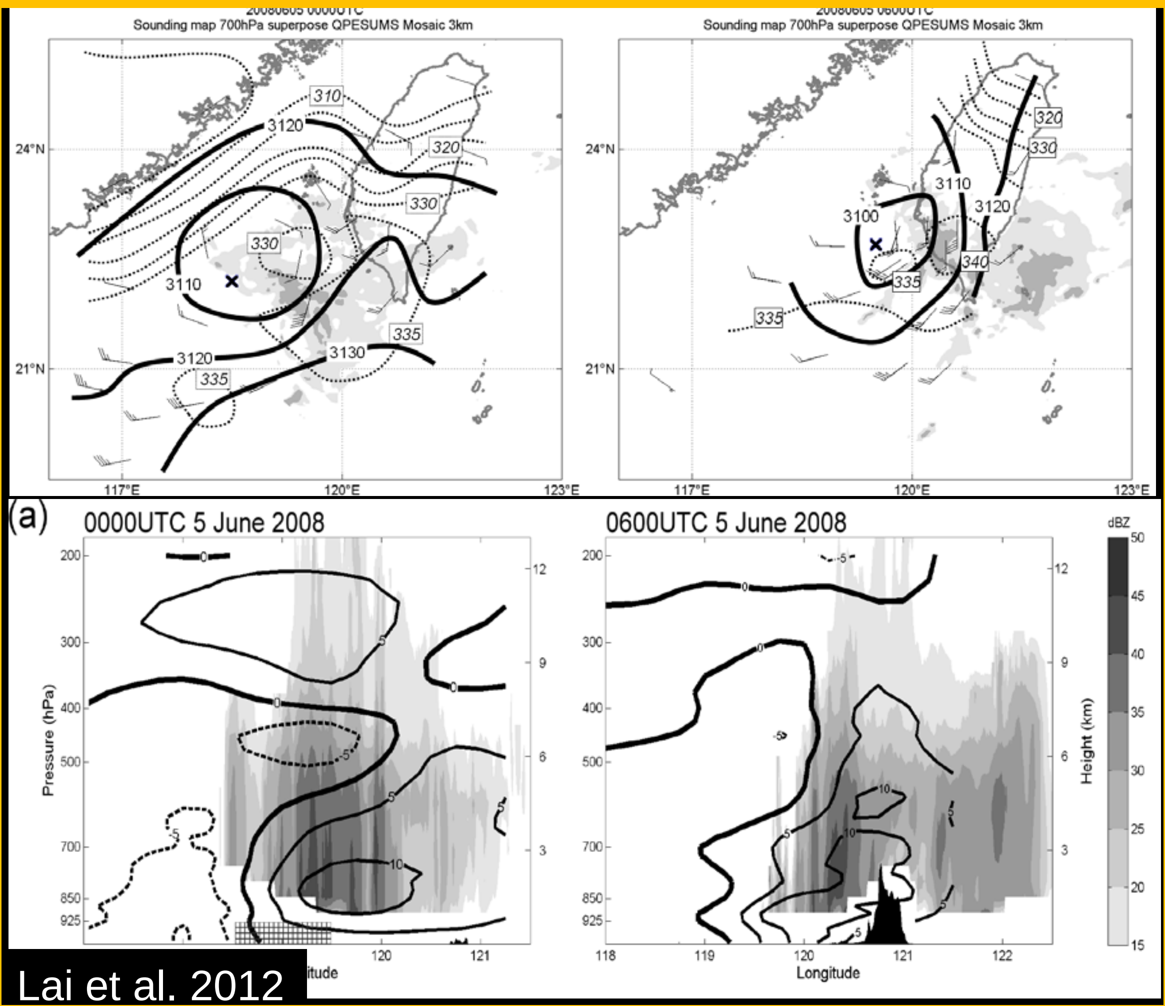
$$\frac{\partial C}{\partial t} = -\eta \tilde{\delta} A - \oint \eta' \mathbf{V}' \cdot \hat{\mathbf{n}} dl + \oint \omega \left(\hat{\mathbf{k}} \times \frac{\partial \mathbf{V}}{\partial p} \right) \cdot \hat{\mathbf{n}} dl + \oint \left(\hat{\mathbf{k}} \times \mathbf{F} \right) \cdot \hat{\mathbf{n}} dl$$

Stretching Eddy flux Tilting Friction



探空分析

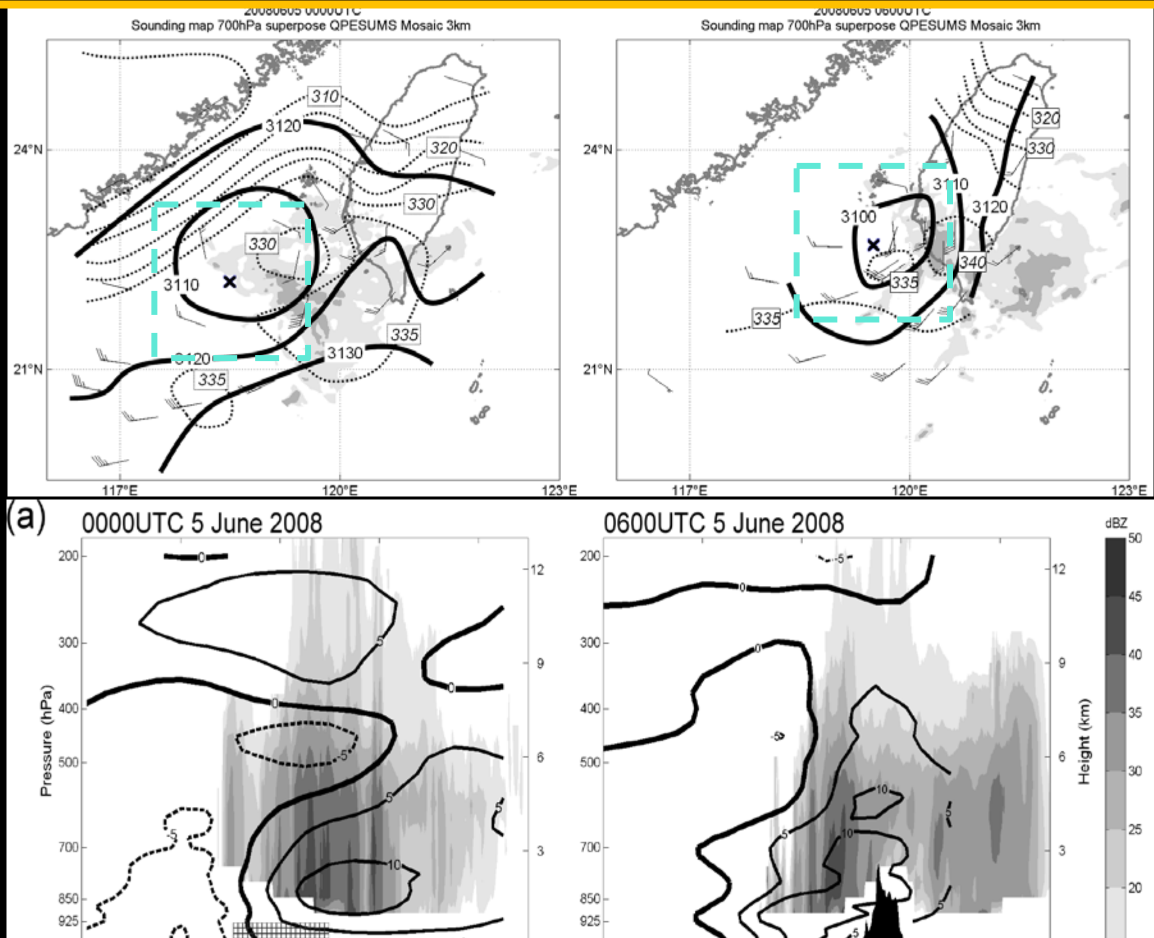
兩次探空觀測之間，中尺度低壓加深，
降雨主要發生在環流的南風區域。



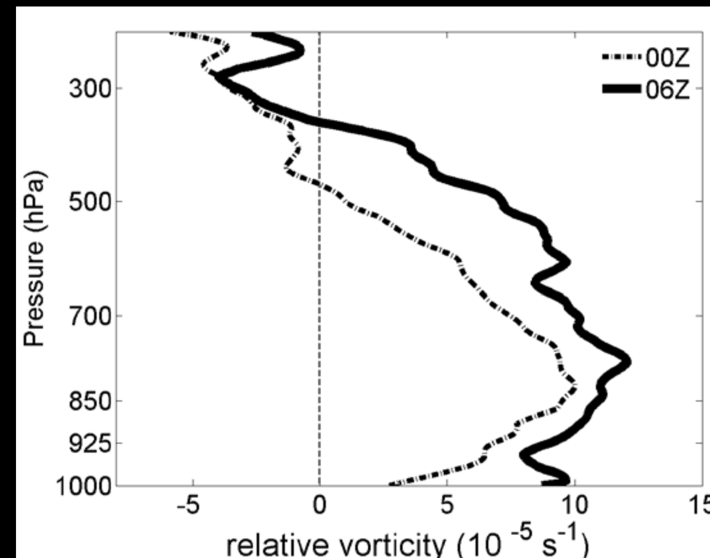
Lai et al. 2012

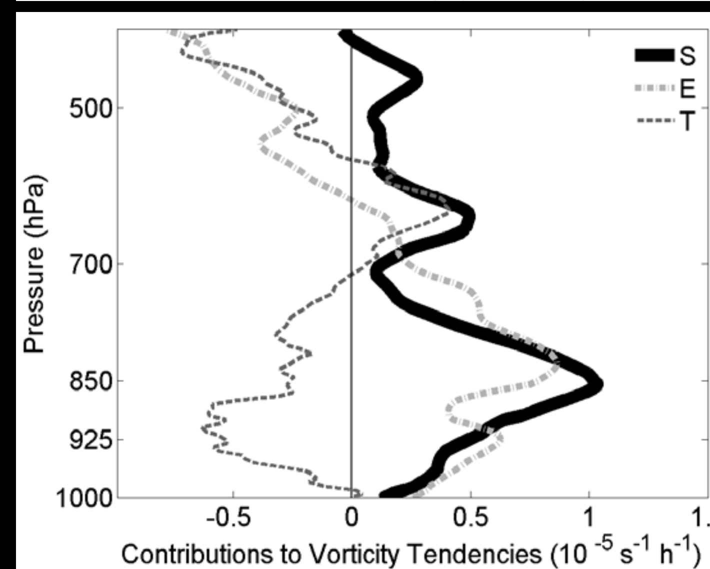
探空分析

兩次探空觀測之間，中尺度低壓加深，中尺度渦旋增強、增厚。主要貢獻同時來自於拉伸項及渦度擾動通量。



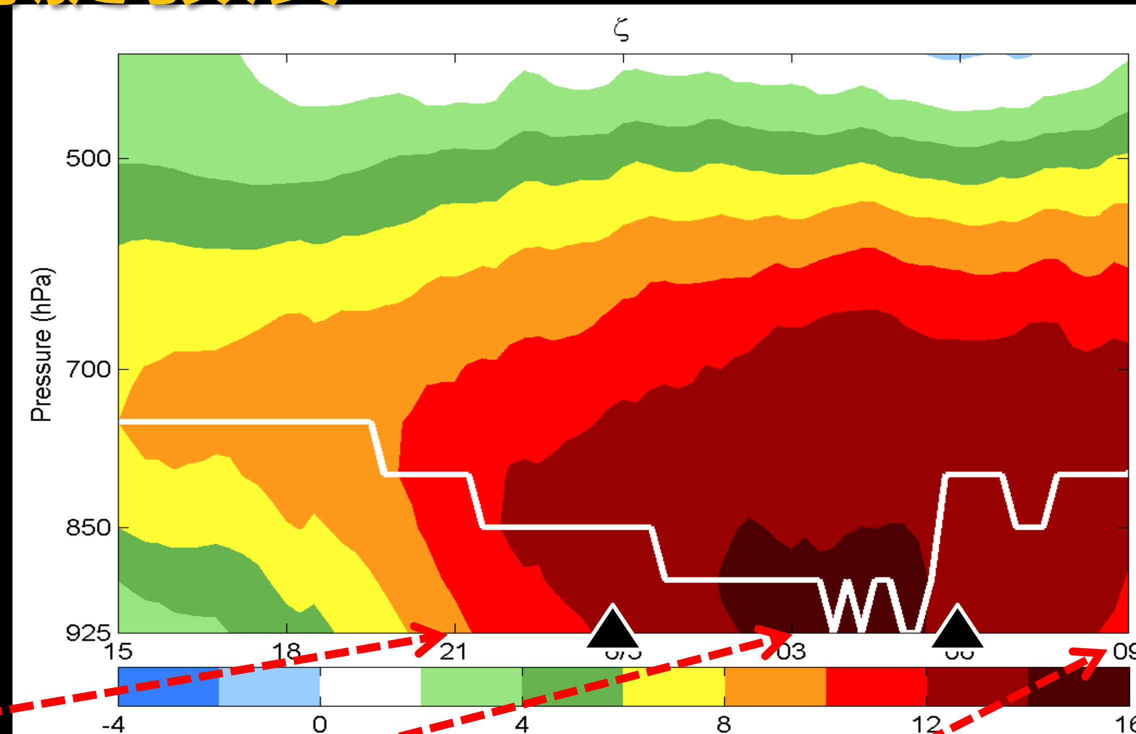
Lai et al. 2012

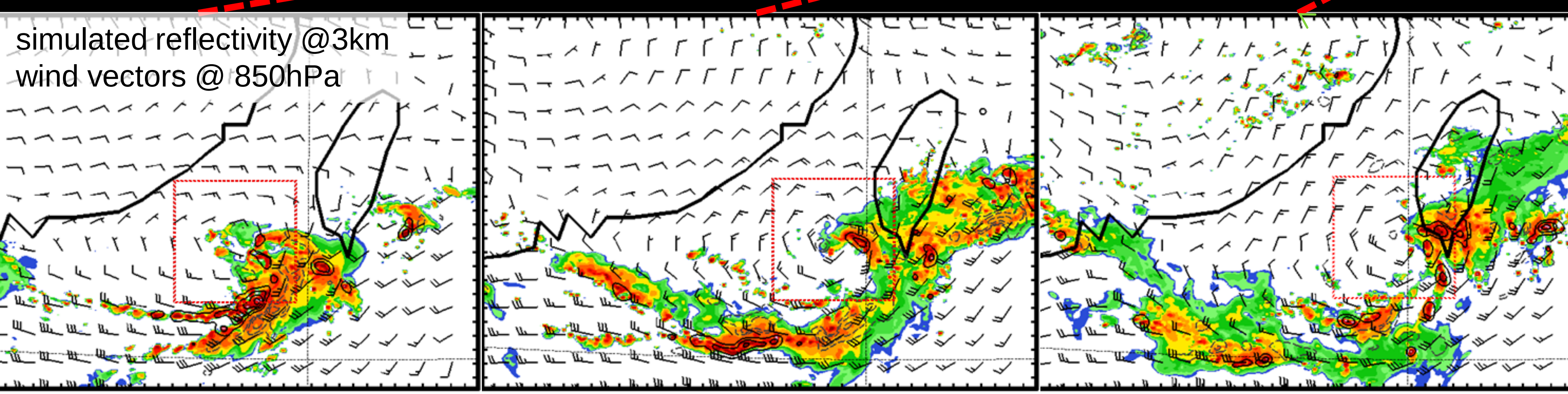




不對稱雨帶及渦旋發展

- 不對稱雨帶與西南氣流有關
- 中尺度渦旋由750hPa開始向上下發展、增強。
- 最大渦度高度往下降至近地層

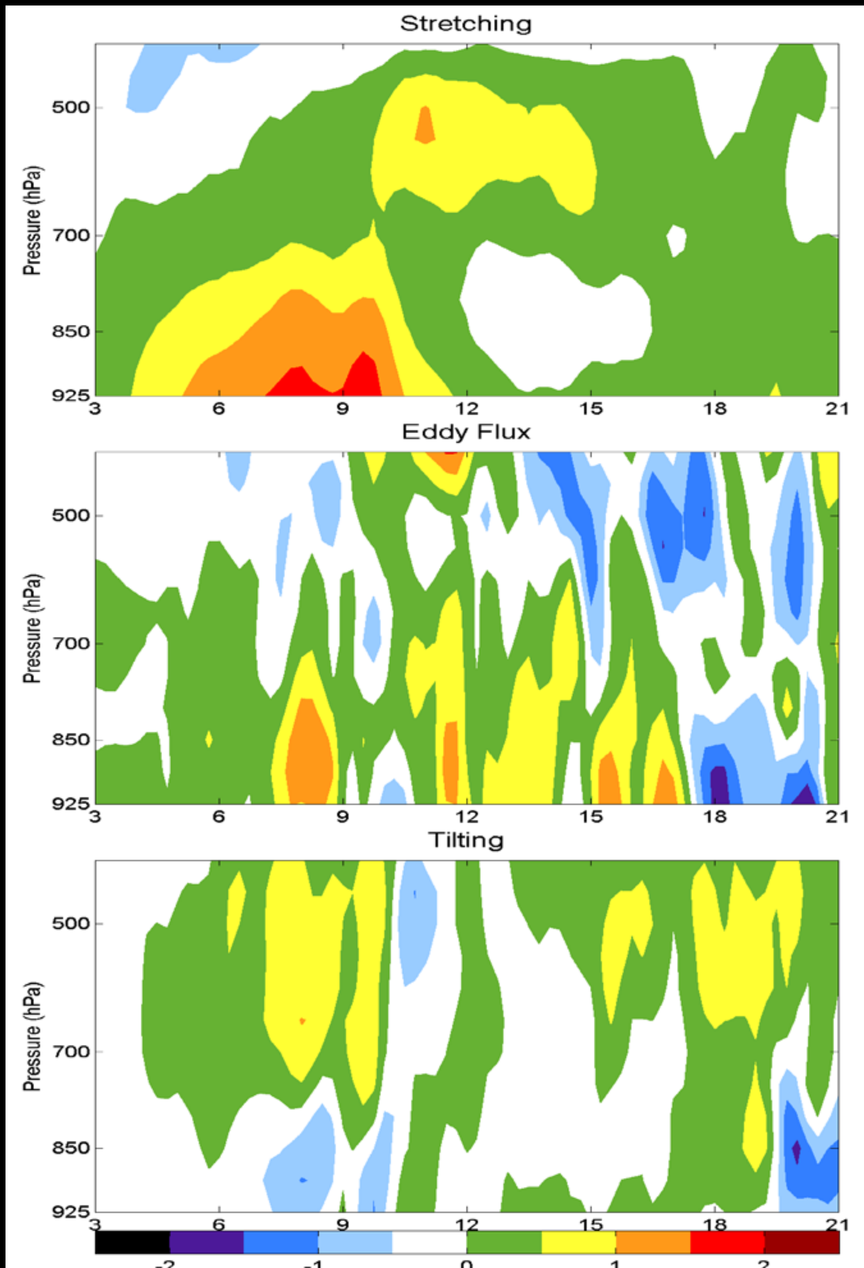


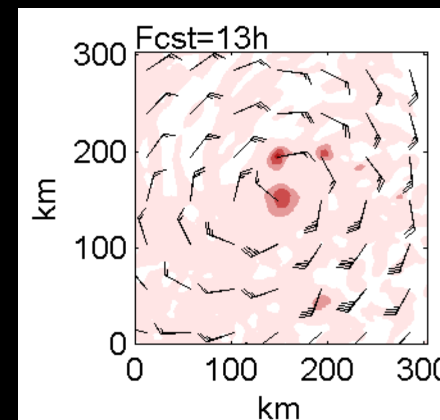


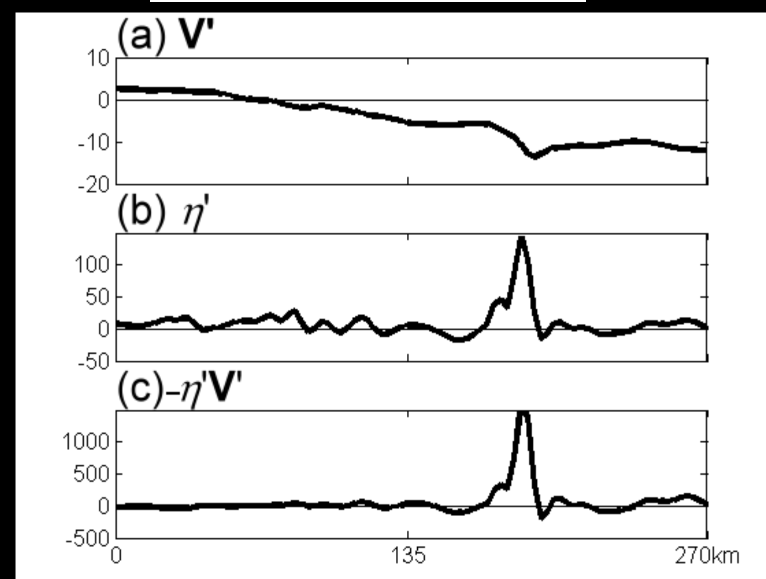
渦度收支分析

$$\frac{\partial C}{\partial t} = -\eta\tilde{\delta}A - \oint \eta'\mathbf{V}'\cdot\hat{\mathbf{n}}dl + \oint \omega\left(\hat{\mathbf{k}}\times\frac{\partial \mathbf{V}}{\partial p}\right)\cdot\hat{\mathbf{n}}dl + \oint\left(\hat{\mathbf{k}}\times\mathbf{F}\right)\cdot\hat{\mathbf{n}}dl$$

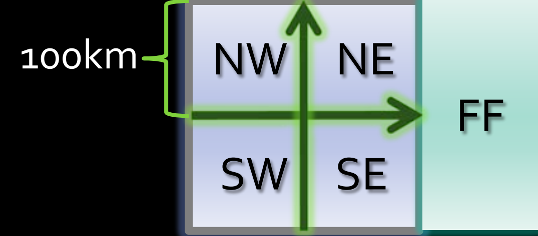
Stretching Eddy flux Tilting Friction

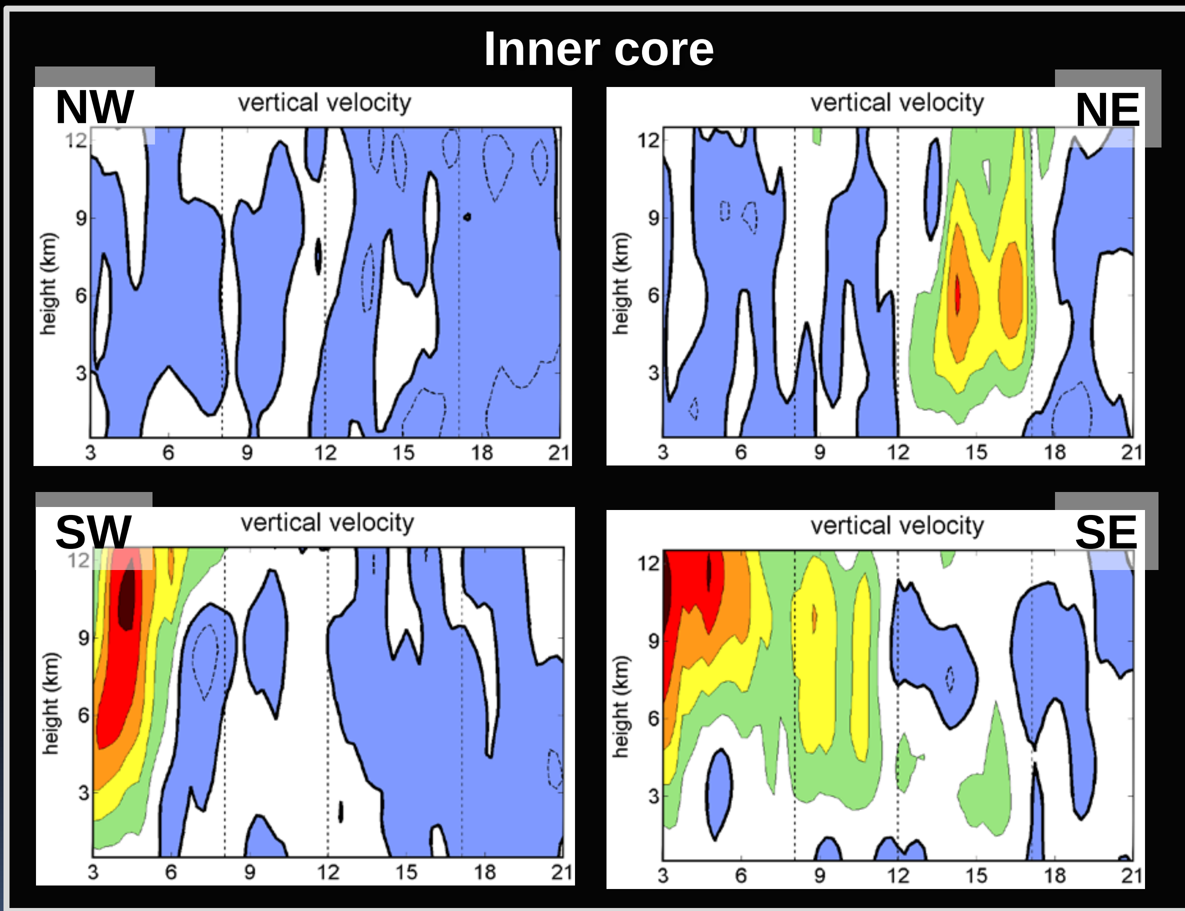


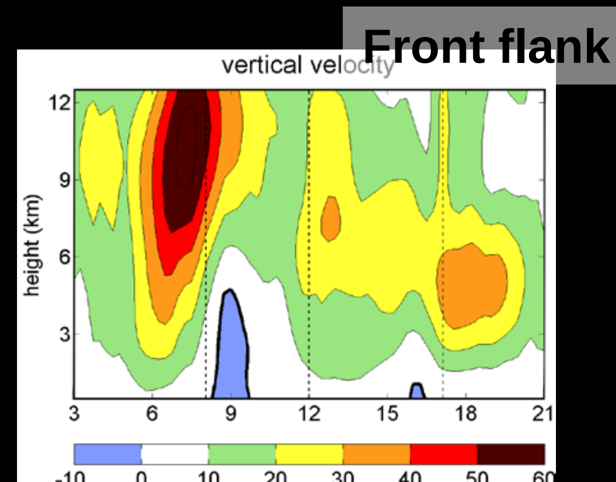




不對稱的對流活動



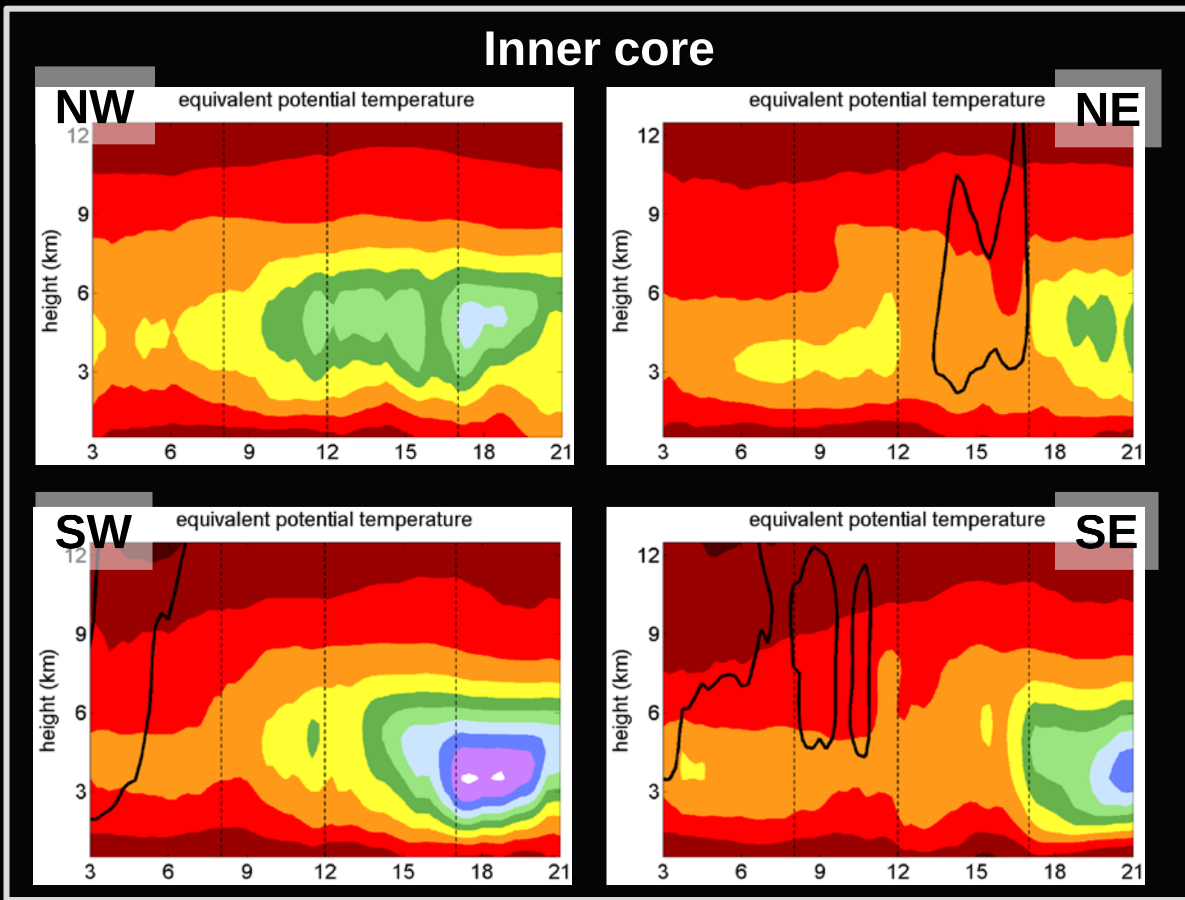


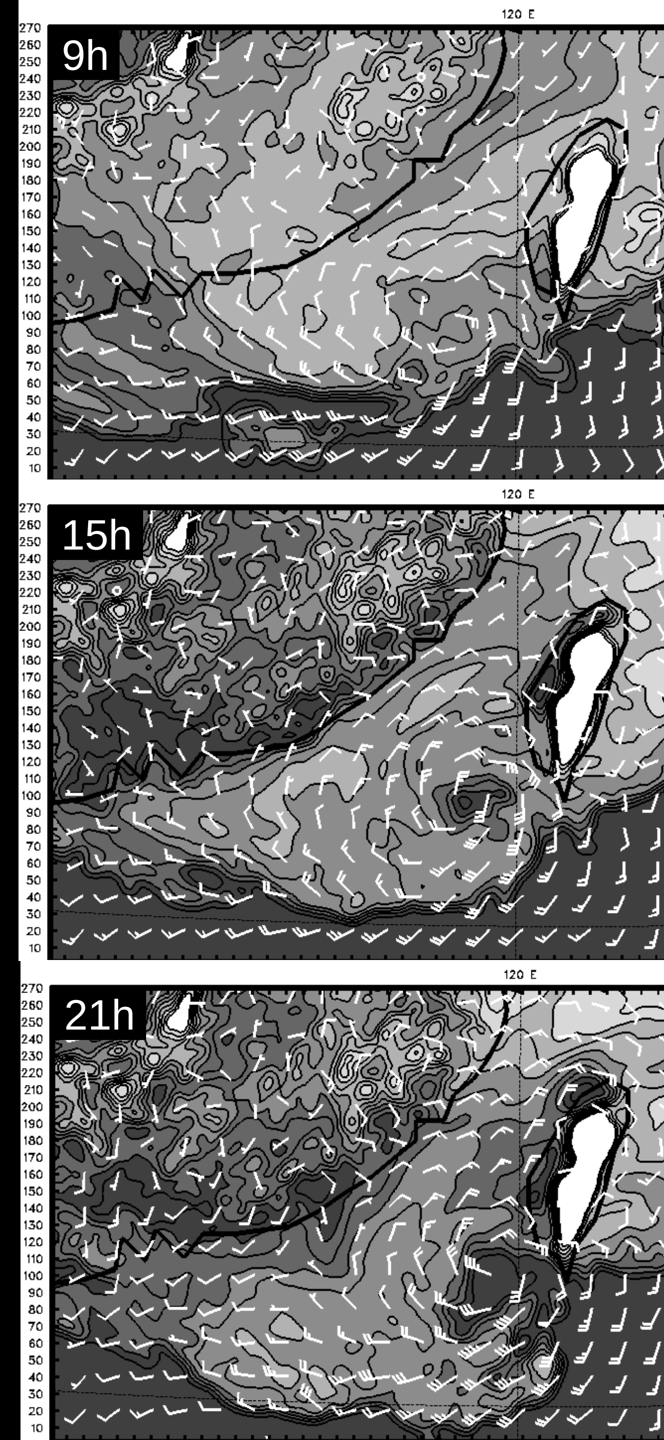


Area-average vertical velocity (cm s^{-1}) time-height series for four quadrants of the MCV and its front flank.

- (I) Developing stage: convective burst (SW, SE)
- (II) Mature stage: updraft + down draft (SW, SE)
- (III) Re-intensifying stage: re-trigger by cold pool (SE, NE)
- (IV) Decaying stage: convection propagate away from inner core

濕化 vs. 乾化

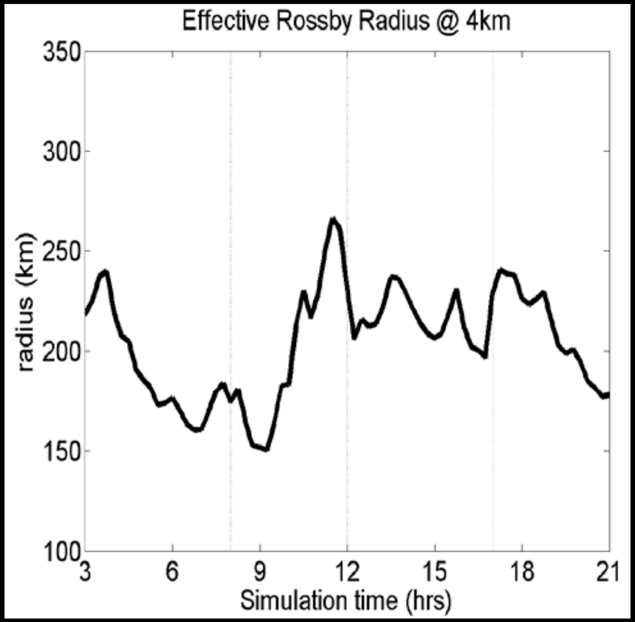


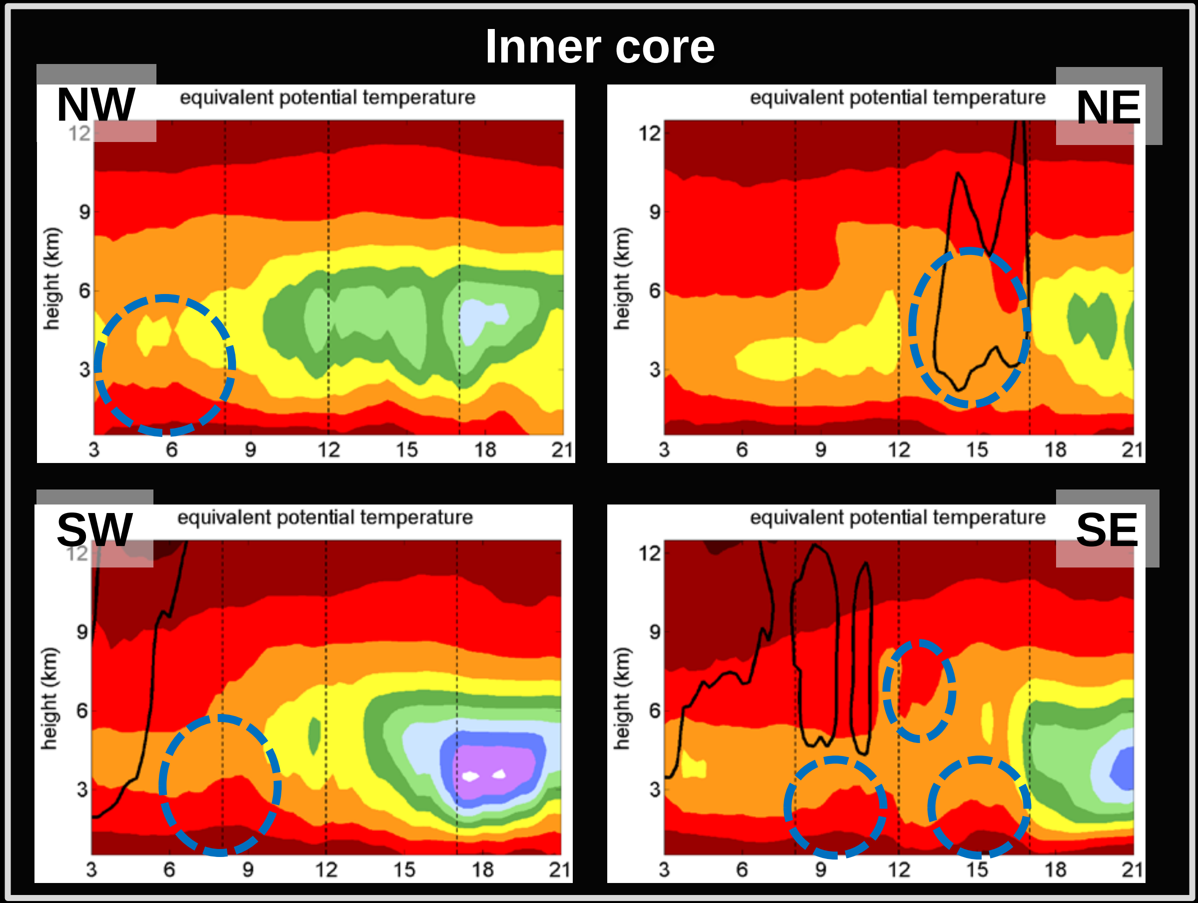


Area-averaged θ_e time-height series for four quadrants of the MCV (Black lines indicate vertical velocity greater than 20 cm s^{-1}).

濕化 vs. 乾化

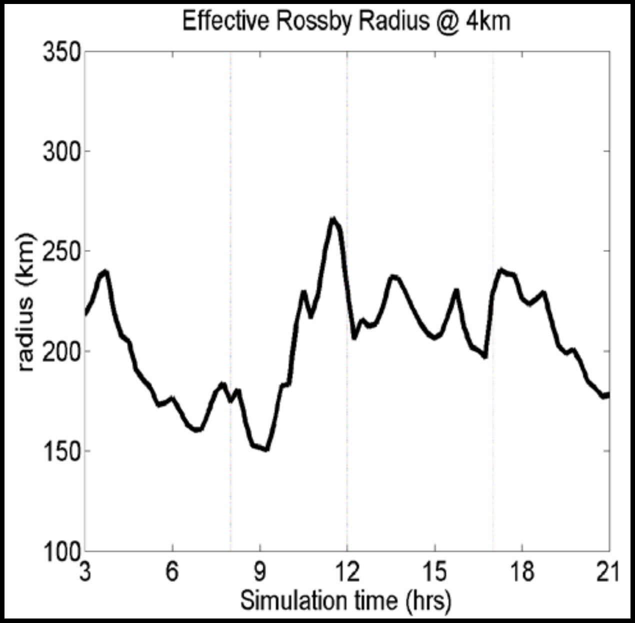
有效羅士比變形半徑

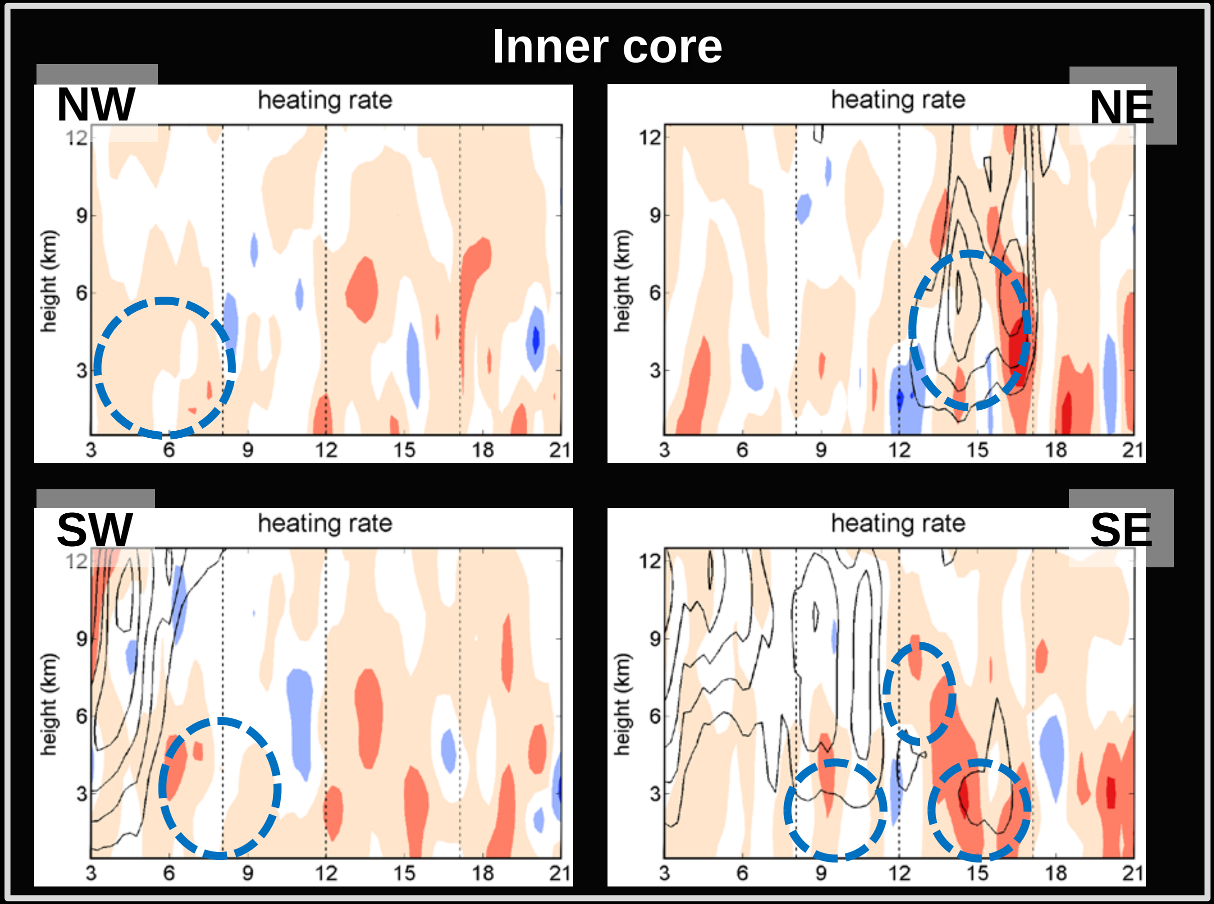




Area-averaged θ_e time-height series for four quadrants of the MCV (Black lines indicate vertical velocity greater than 20 cm s^{-1}).

有效羅士比變形半徑及增溫率





Area-averaged warming rate (℃／hr, Black lines indicate vertical velocity greater than 10 cm s^{-1})

Summary

- **MCV evolution**
- **Vorticity budget**
  - mainly contributed by <u>stretching</u> and also by <u>eddy flux</u>.
- **Asymmetric heating**
  - Moisten vs. dry out → Effective Rossby Radius deformation and efficiency of heating
  - Diabatic heating (deep convection with vorticity core) vs. Adiabatic heating (descending rear-inflow)
    → mesolow
    → cyclonic circulation