Multi-scale Observational Analyses within the Marsupial Pouch of Pre-depression Tropical Disturbances

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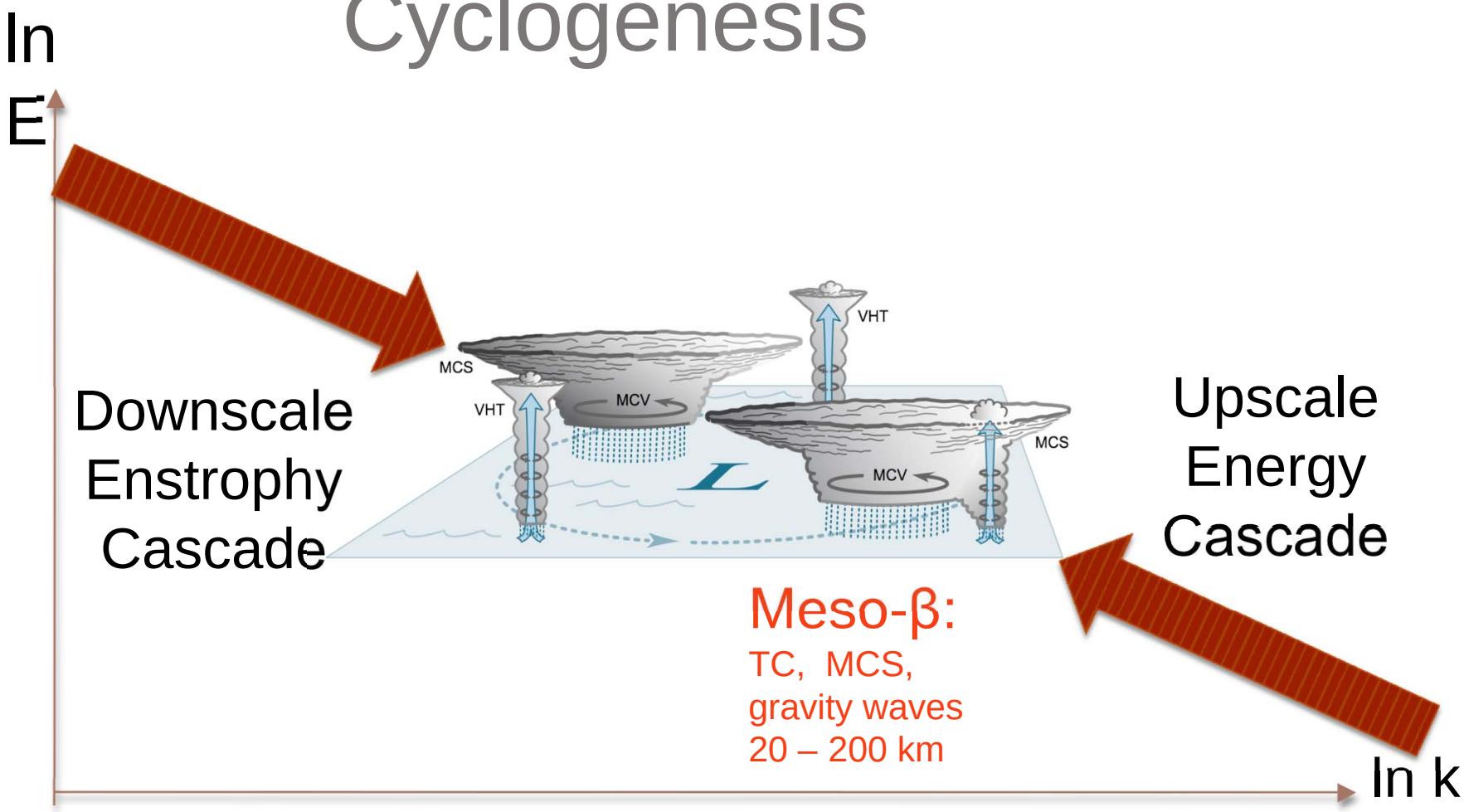
Tropical Cyclogenesis



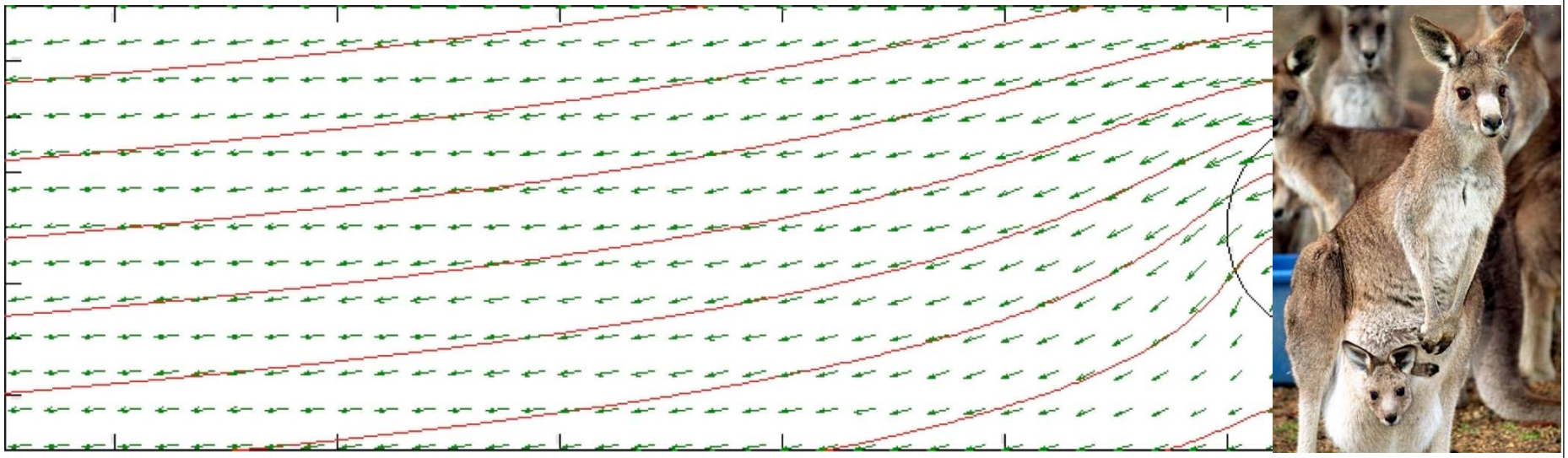
Synoptic
Easterly Waves
Hydro instability of ITCZ
Subtropical intrusions
2,000 – 8,000 km

Meso-α:
Easterly wave critical layer
Isolated recirculation regions
Inertia gravity waves
200 – 2,000 km

Meso-γ:
VHTs, Congestus,
Precip. Driven
downdrafts, Gust fronts
2 – 20 km

Hypotheses

Animation From Dale



- The cat's eye '**pouch**' is a region of approximately closed circulation, where air is repeatedly moistened by deep moist convection and protected to some degree from dry air intrusion
- The parent wave is maintained and possibly enhanced by diabatically amplified mesoscale vortices within the

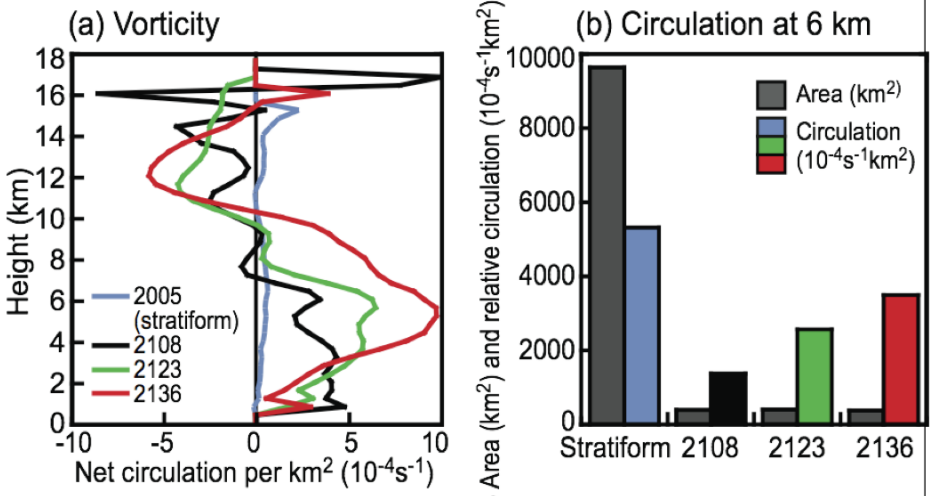
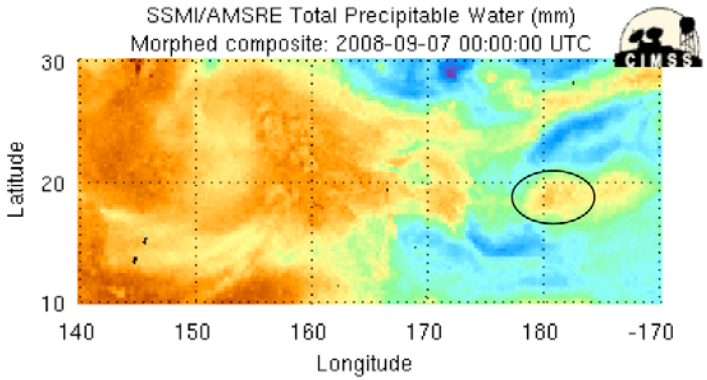


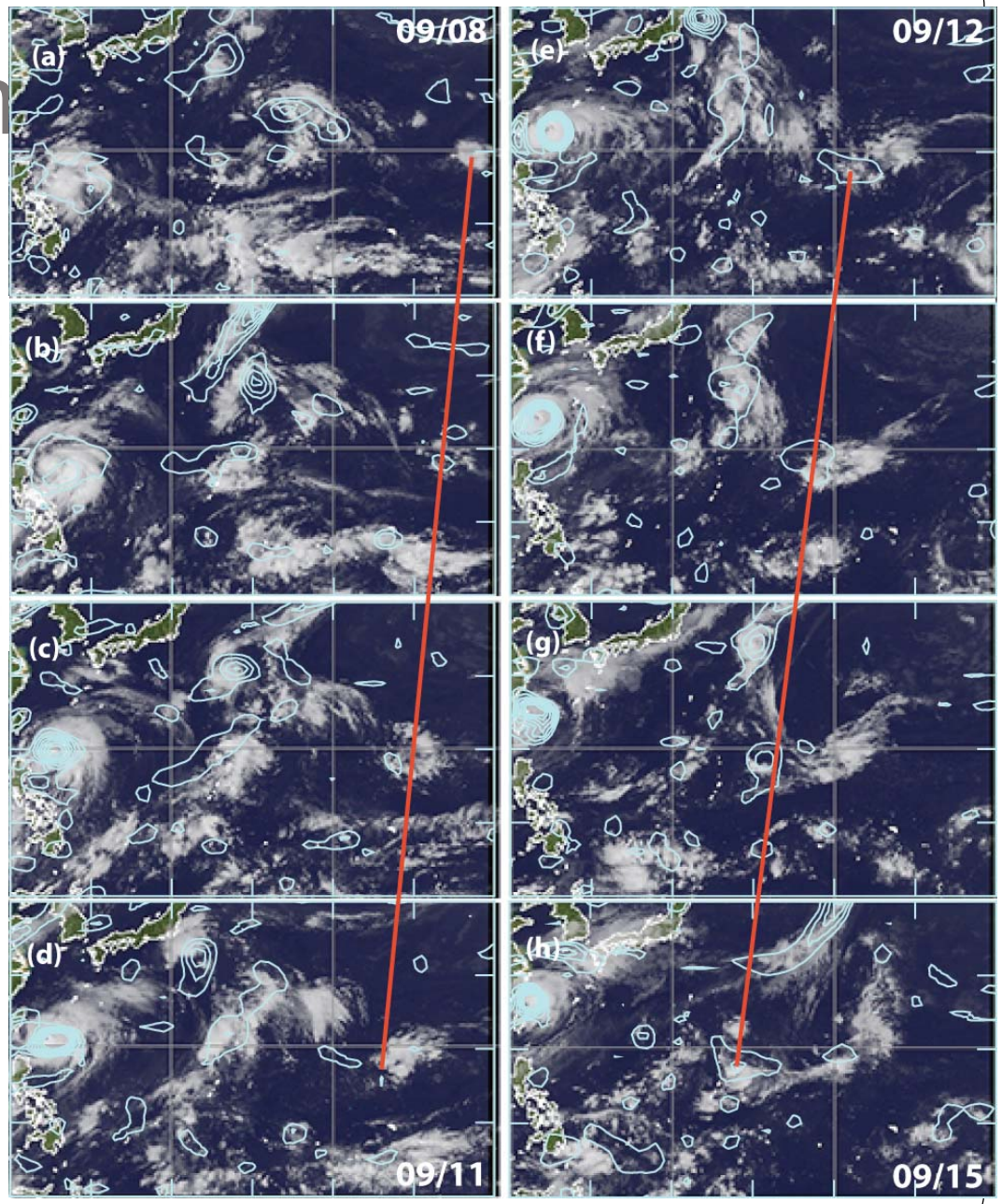
Figure from Houze et al. (2009)

Montgomery et al. (2006, 2009); Bluestein et

Pre-Depression Hagupit

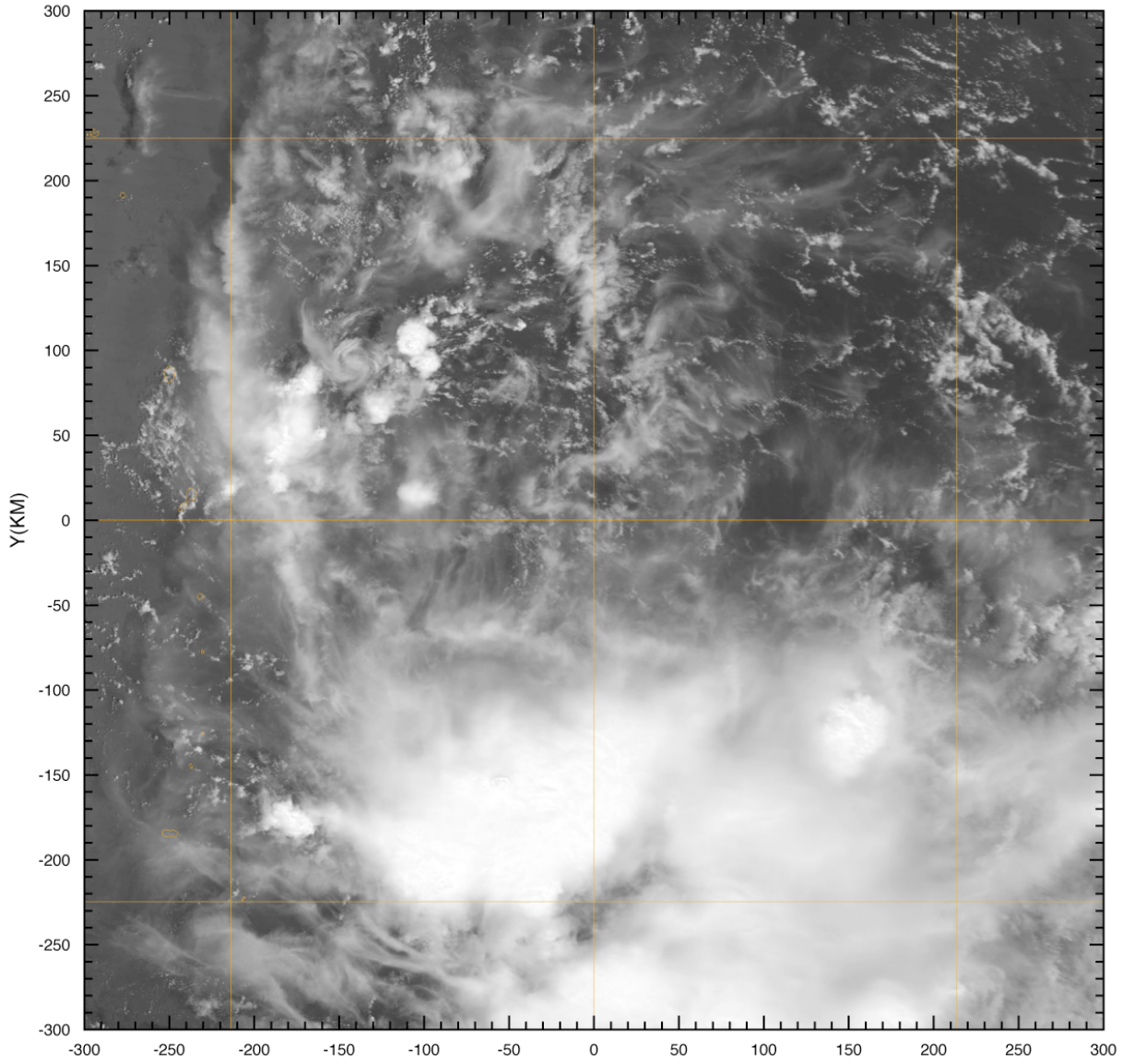


- Two consecutive aircraft missions observed a developing low-level circulation (LLC) four days prior to the JTWC tropical cyclone formation alert

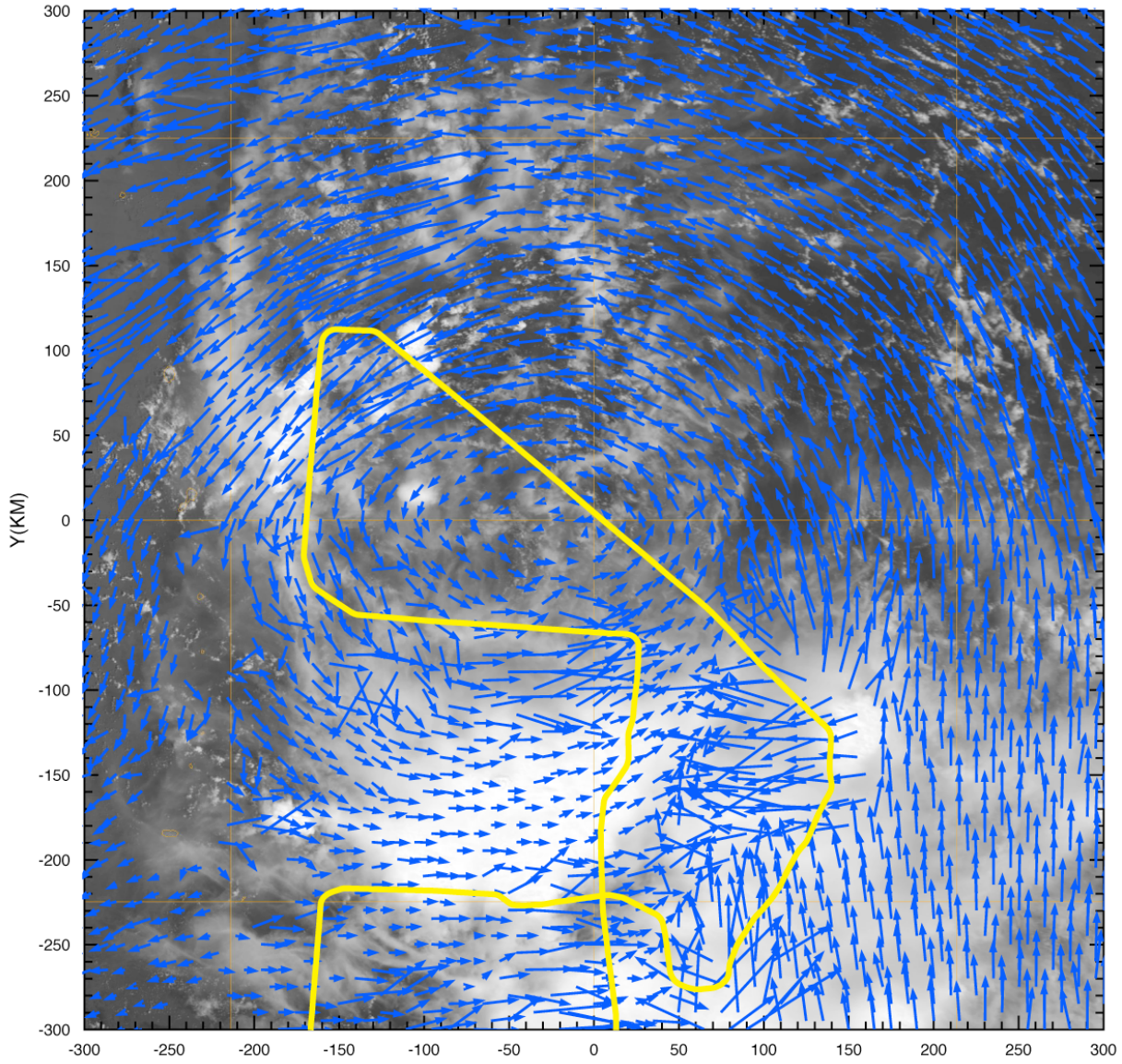


Lau and Lau (1990)

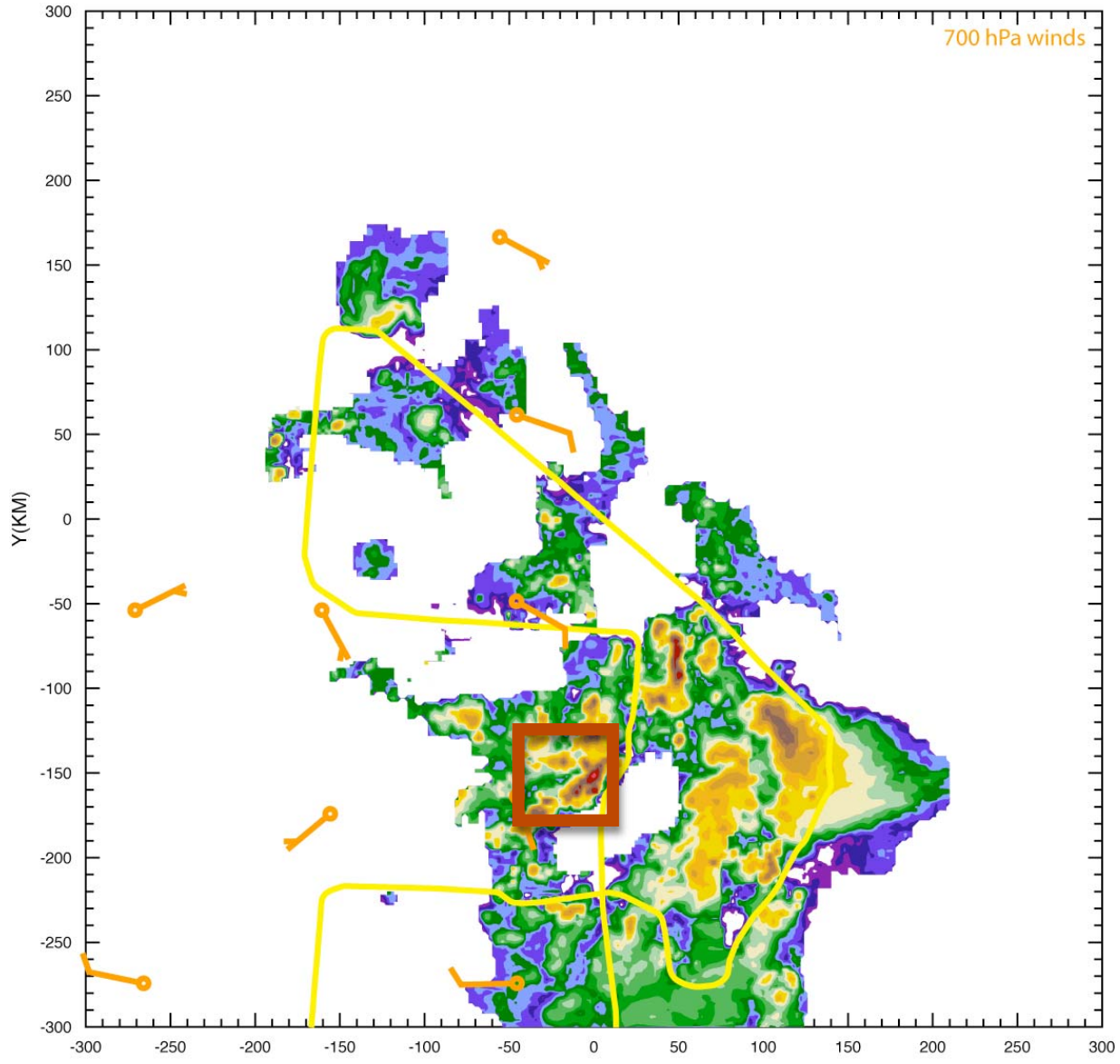
Research Flight 00 UTC 15 Sept.



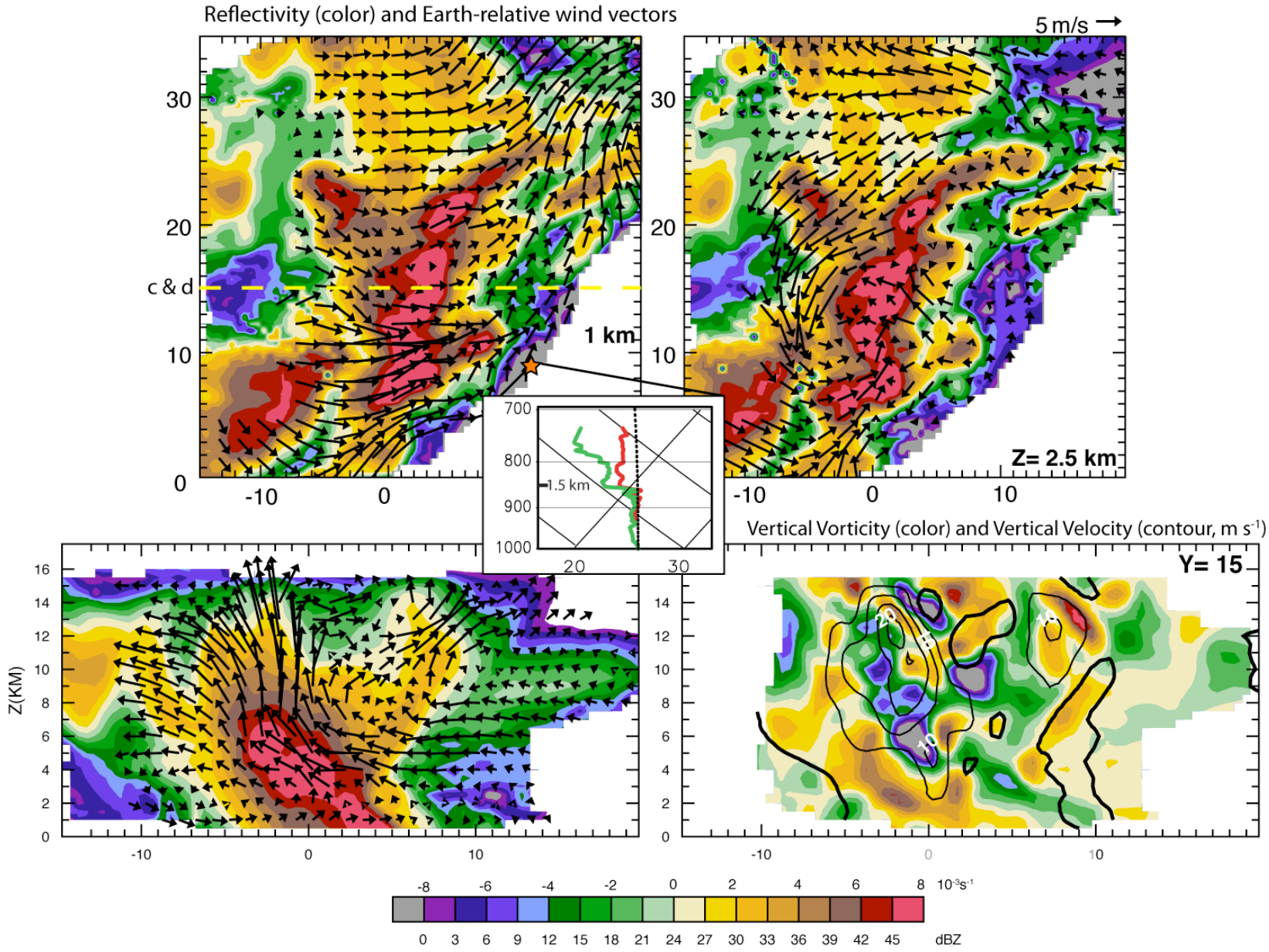
Research Flight 00 UTC 15 Sept.



Research Flight 00 UTC 15 Sept.



ELDORA Observations (2341 UTC 14 Sep)



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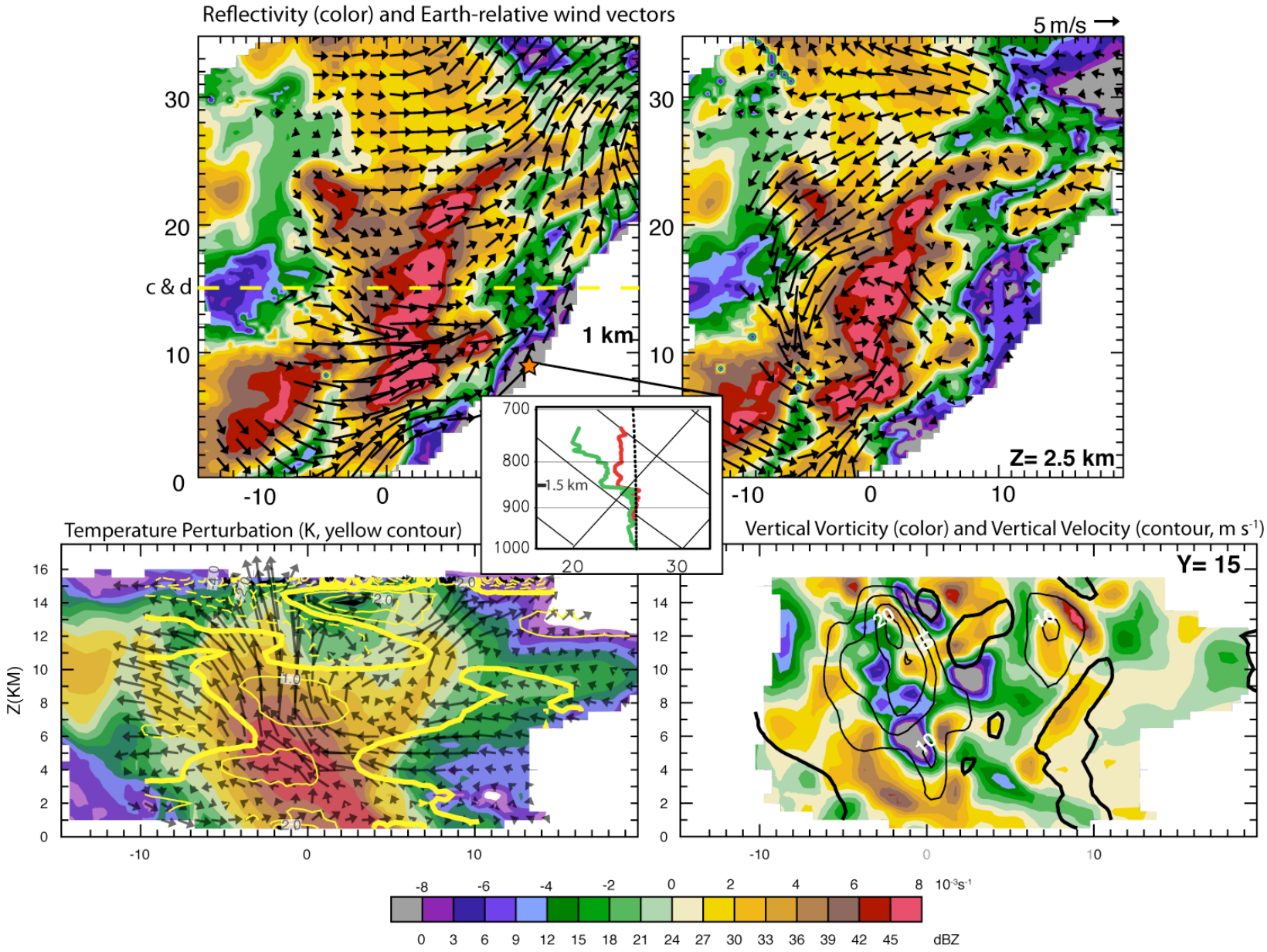


SAMURAI

$$J(q) = \tfrac{1}{2} q^T q + \tfrac{1}{2} (\mathbf{HC}q - d)^T \mathbf{R}^{-1} (\mathbf{HC}q - d)$$

$$\nabla J(q) = (\mathbf{I} + \mathbf{C}^T \mathbf{H}^T \mathbf{R}^{-1} \mathbf{HC}) q - \mathbf{C}^T \mathbf{H}^T \mathbf{R}^{-1} d$$

$$\mathbf{B} = \sqrt{\mathbf{B}}^T \sqrt{\mathbf{B}} = \mathbf{C}^T \mathbf{C}$$

$$q = \mathbf{C}^{-1} \delta x = \mathbf{C}^{-1} (x - x_b)$$

$$\mathbf{C} = \mathbf{PSDF}$$

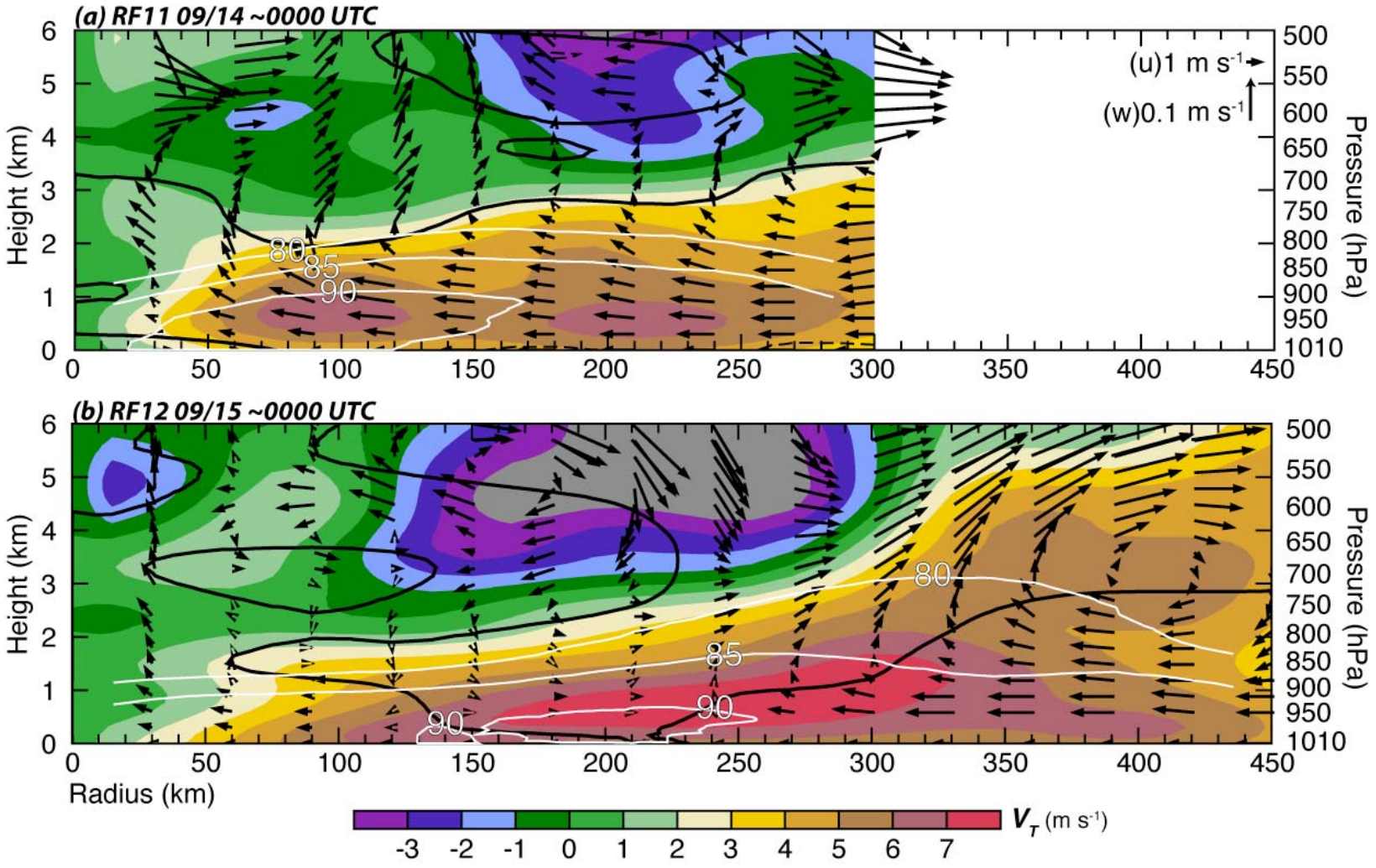
P = Physical Coordinate Transform
S = Cubic Spline Transform
D = Diagonalized Background Error
F = Recursive Gaussian Filter

- Spline Analysis at Mesoscale Utilizing Radar and Aircraft Instrumentation
- Can combine radar, dropsonde, flight level, and some satellite data
- Low noise via cubic interpolations and spectral derivatives (Ooyama 2002)
- Tunable error specifications and filtering (Ooyama 1987, 2001; Purser et al. 1995)

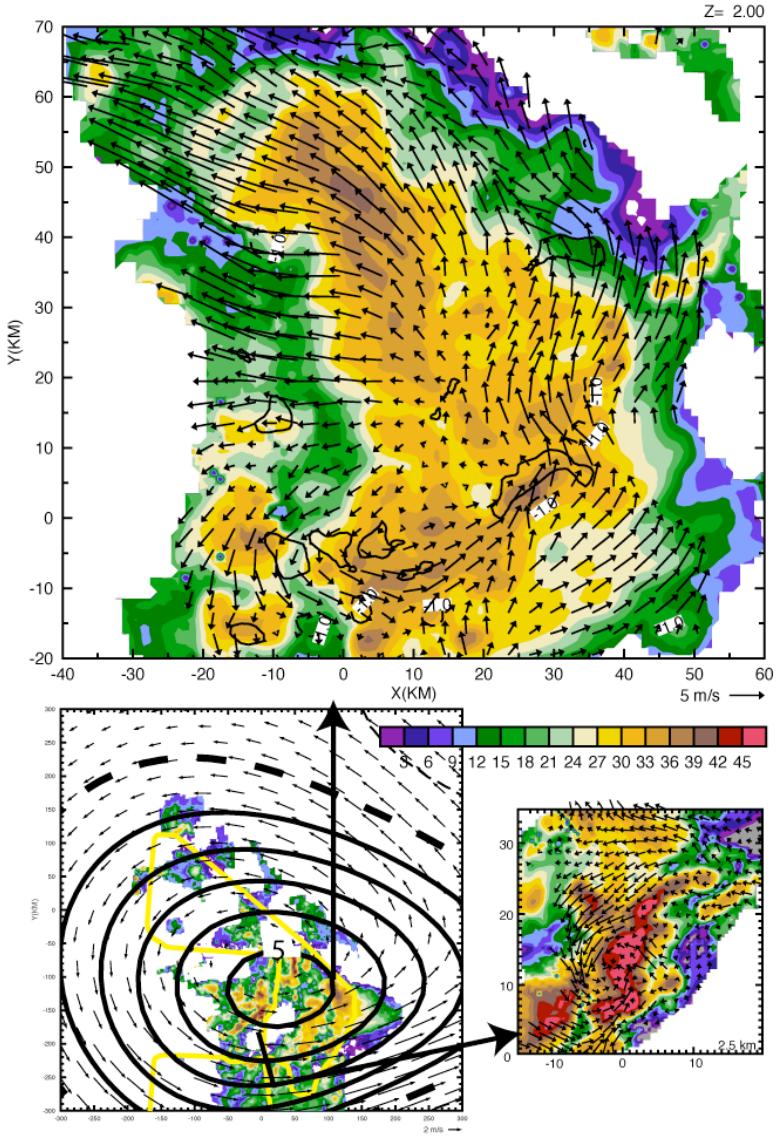
$$q(r,z) = \{\rho rv, \psi, h, q_v', \rho_a'\}$$

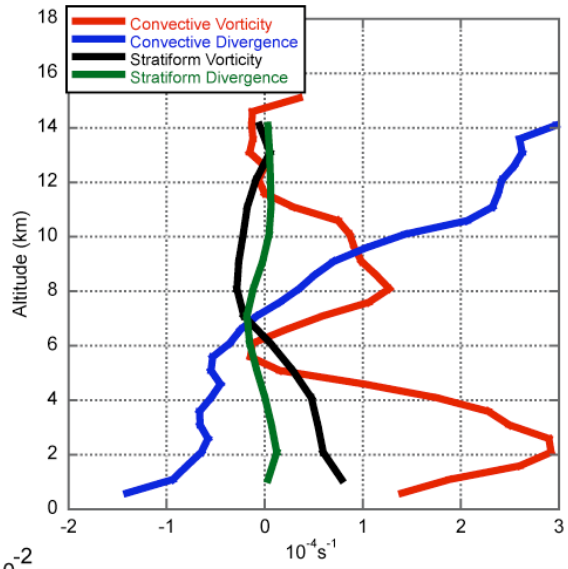
SAMURAI Axisymmetric V_T , V_R & RH

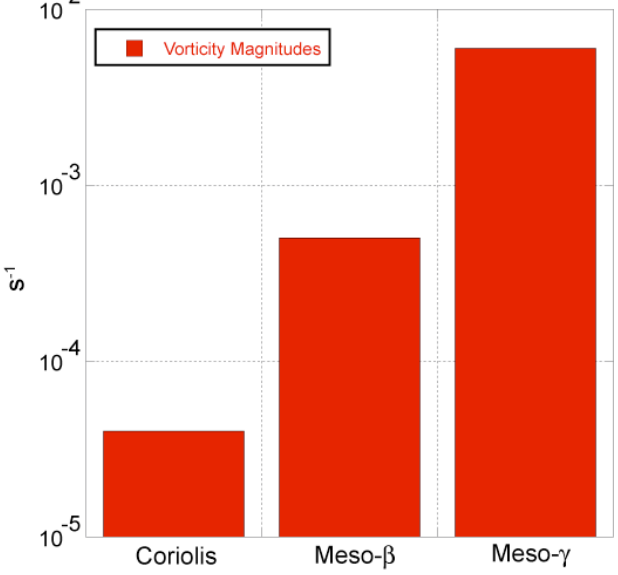
Spline Analysis at Mesoscale utilizing Radar and Aircraft Instrumentation



Multi-scale Contributions to Spin-up







Summary and Goals

- Build upon and compare with results from T-PARC/TCS-08 to test hypotheses of multi-scale interactions leading to tropical cyclogenesis – but increase the range, temporal sampling, and depth of dropsonde measurements using in the ATL
- Analyze G-V observations – especially flight-level, dropsonde, MTP, and HCR (if available) -- in conjunction with NOAA P-3 and G-IV obs -- especially dropsonde and Doppler radar -- and NASA DC-8 and GH data
- Use SAMURAI and other software tools to construct analysis composites from aircraft and satellite data sources