Session 4b: Observations and Observing Strategies for Tropical Cyclones and their Environment, Part 2:

S4b-03. New eyewall dropsonde observations during rapid intensification events in Super-Typhoons Megi (2010) and Jangmi (2008)

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- **Motivation:**

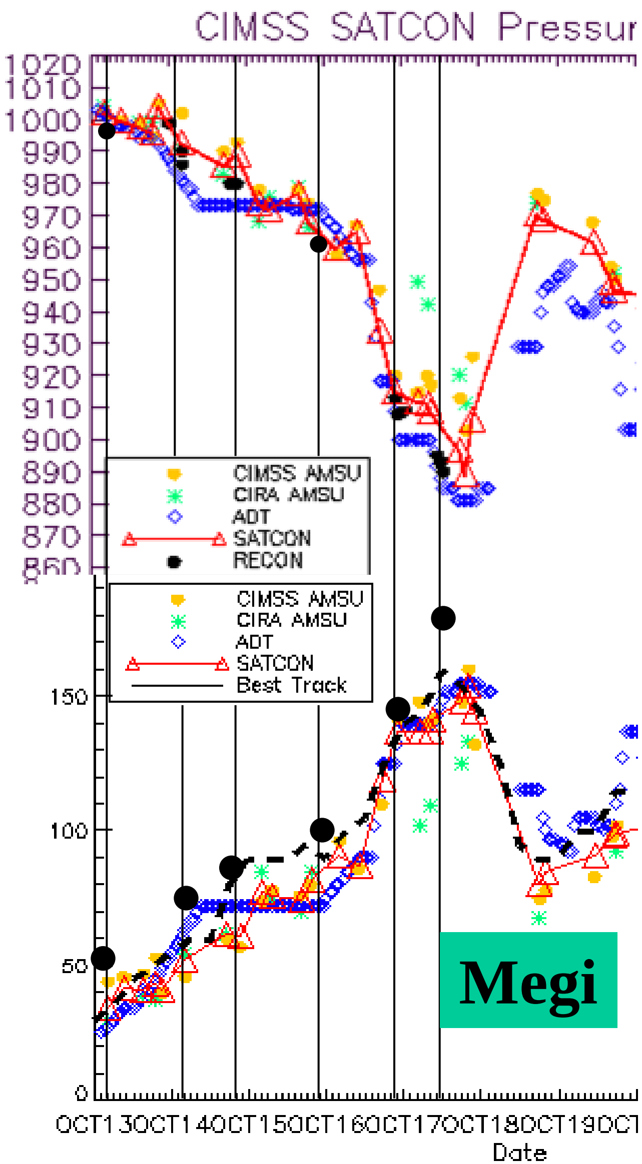
  - ✓ There has been little improvement in TC intensity prediction in the past 20 years in Atlantic and WPAC basins.
  - ✓ There has been little improvement in TC track forecasts in the past 6 years in WPAC: limit of predictability with satellite data inputs reached?
  - ✓ Super-Typhoon boundary layer physics may need to be modified.

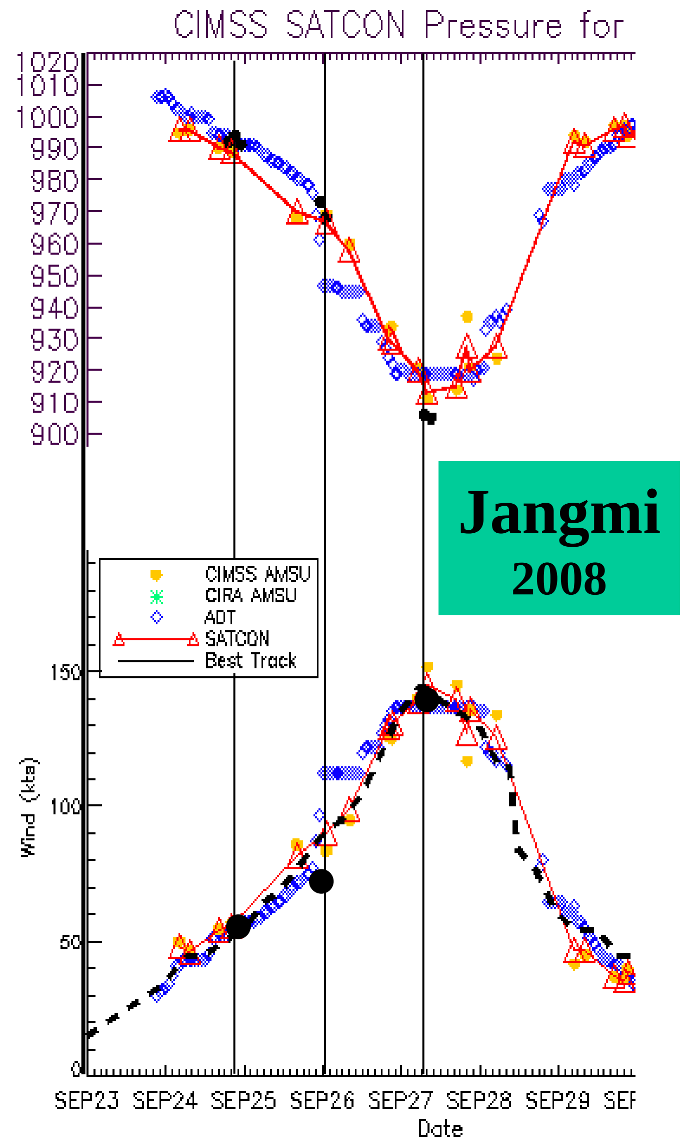
- **Goals and Objectives:**

  - ✓ Utilize dropsonde-pair observing strategy to investigate unusual extreme wind boundary layer features.
  - ✓ Relate extreme wind boundary layer features to microscale eyewall 'vortex filaments' and eye mesovortex features.

Super-Typhoon Eyewall Boundary Layer Structure

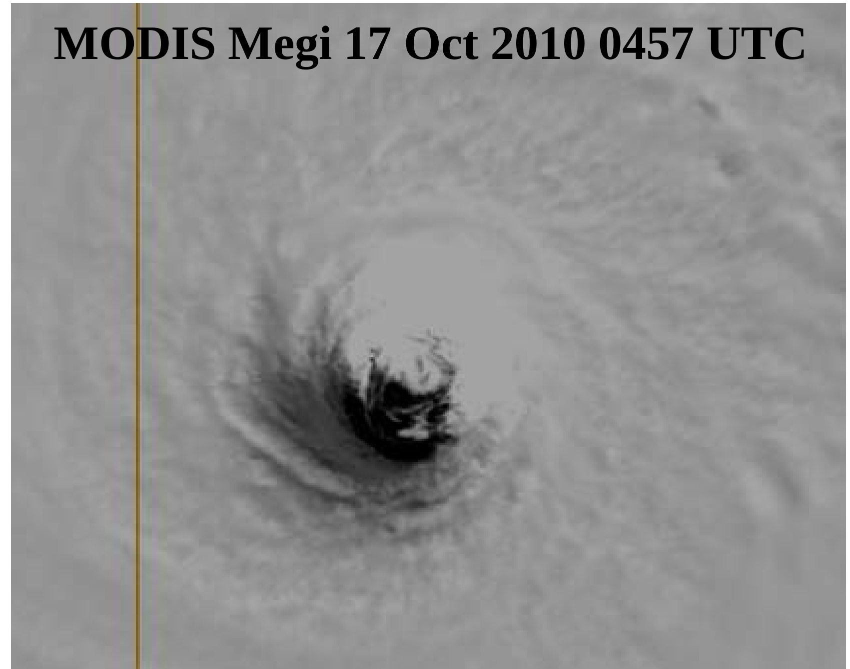
TPARC/TCS08 - ITOP/TCS10

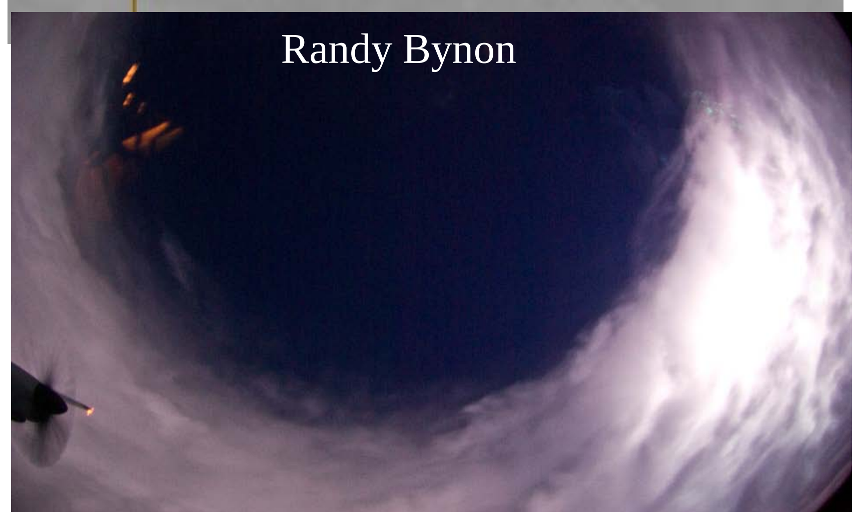


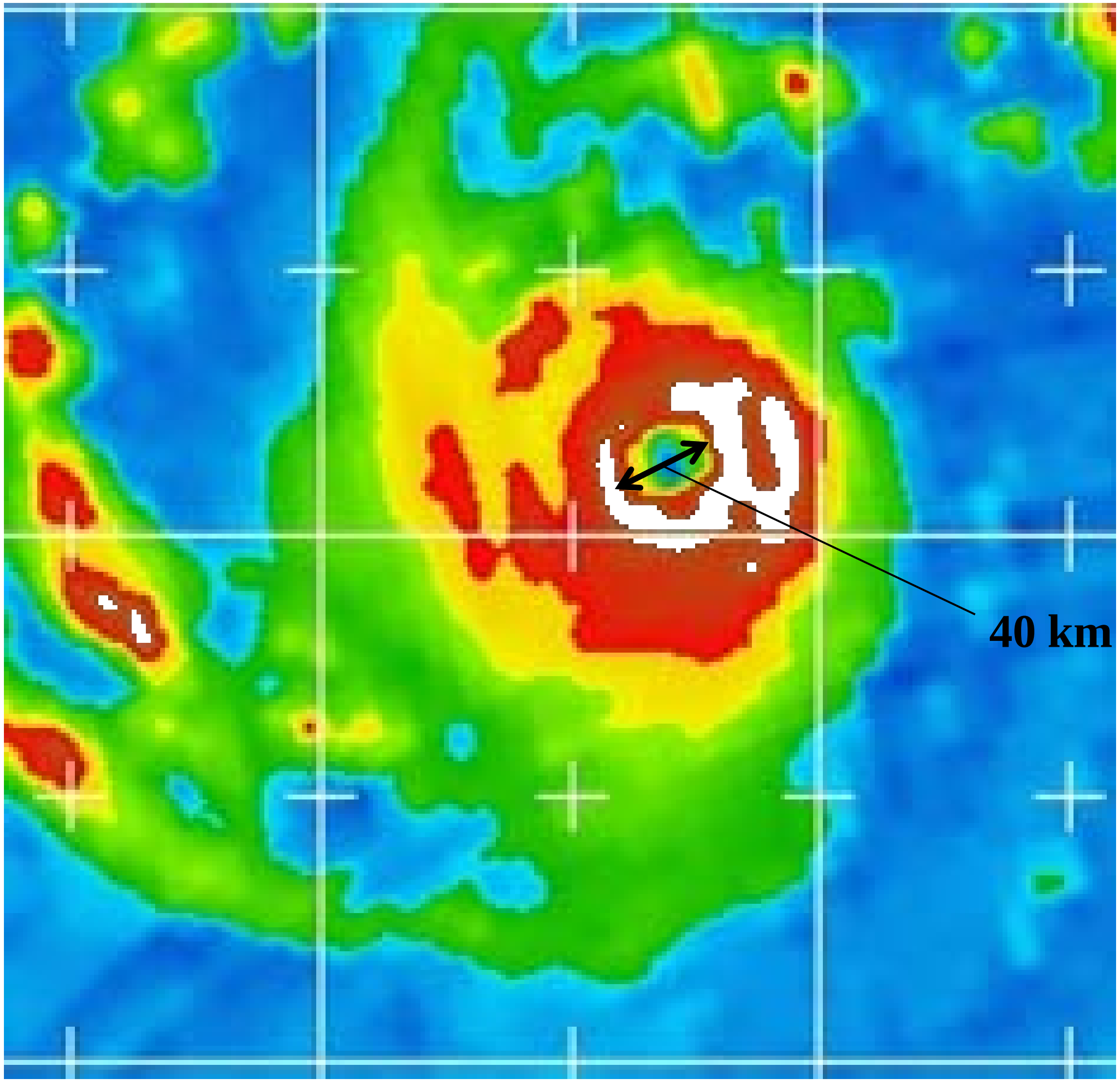


Super-Typhoon Eyewall
Boundary Layer Structure

TPARC/TCS08 - ITOP/TCS10





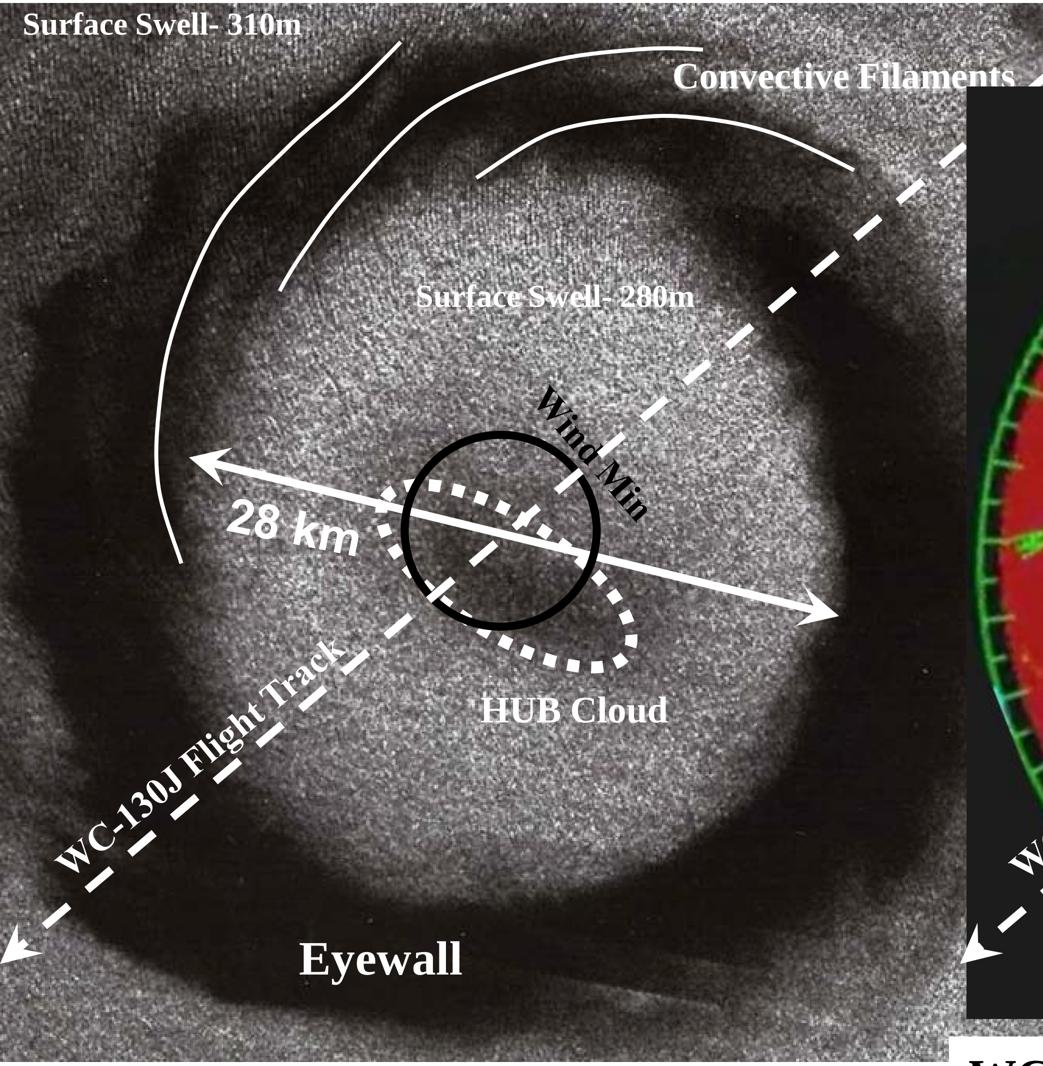


Megi
17 Oct 2010
1008 Z

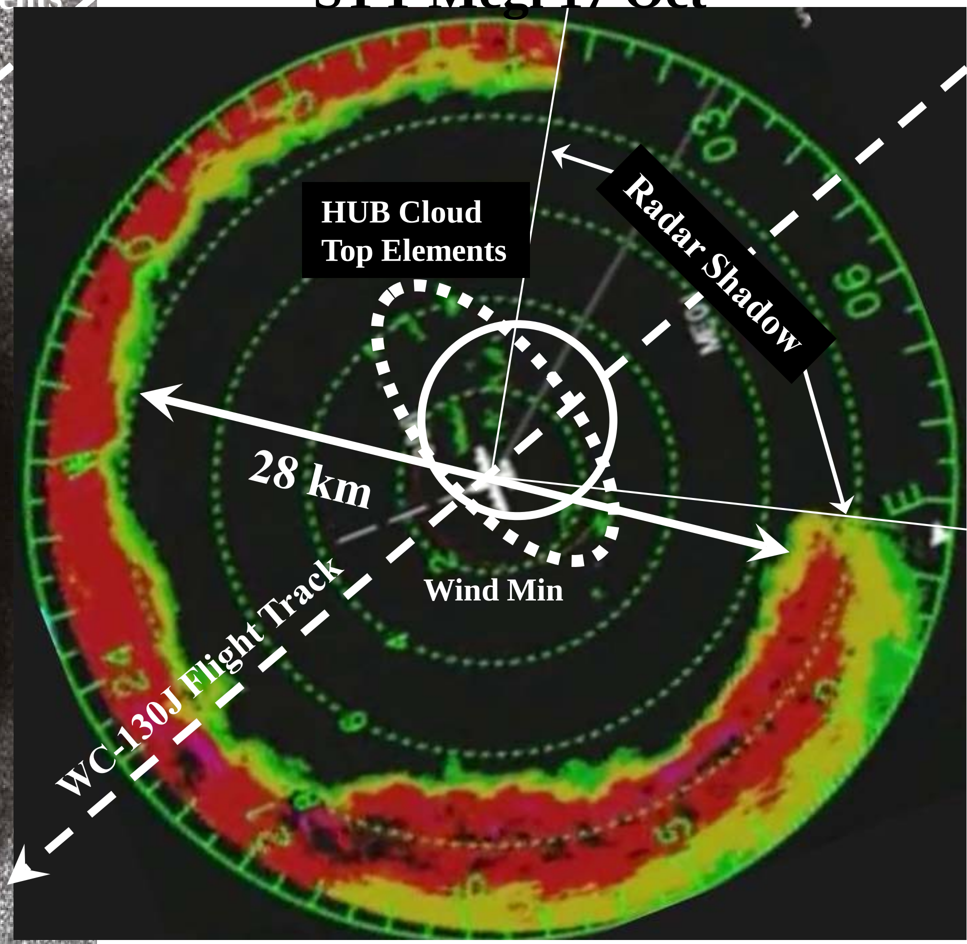
Super-Typhoon Eyewall
Boundary Layer Structure

TPARC/TCS08 - ITOP/TCS10

Mesoscale eyewall features: Unknown effects on ocean forcing STY Megi 17 Oct

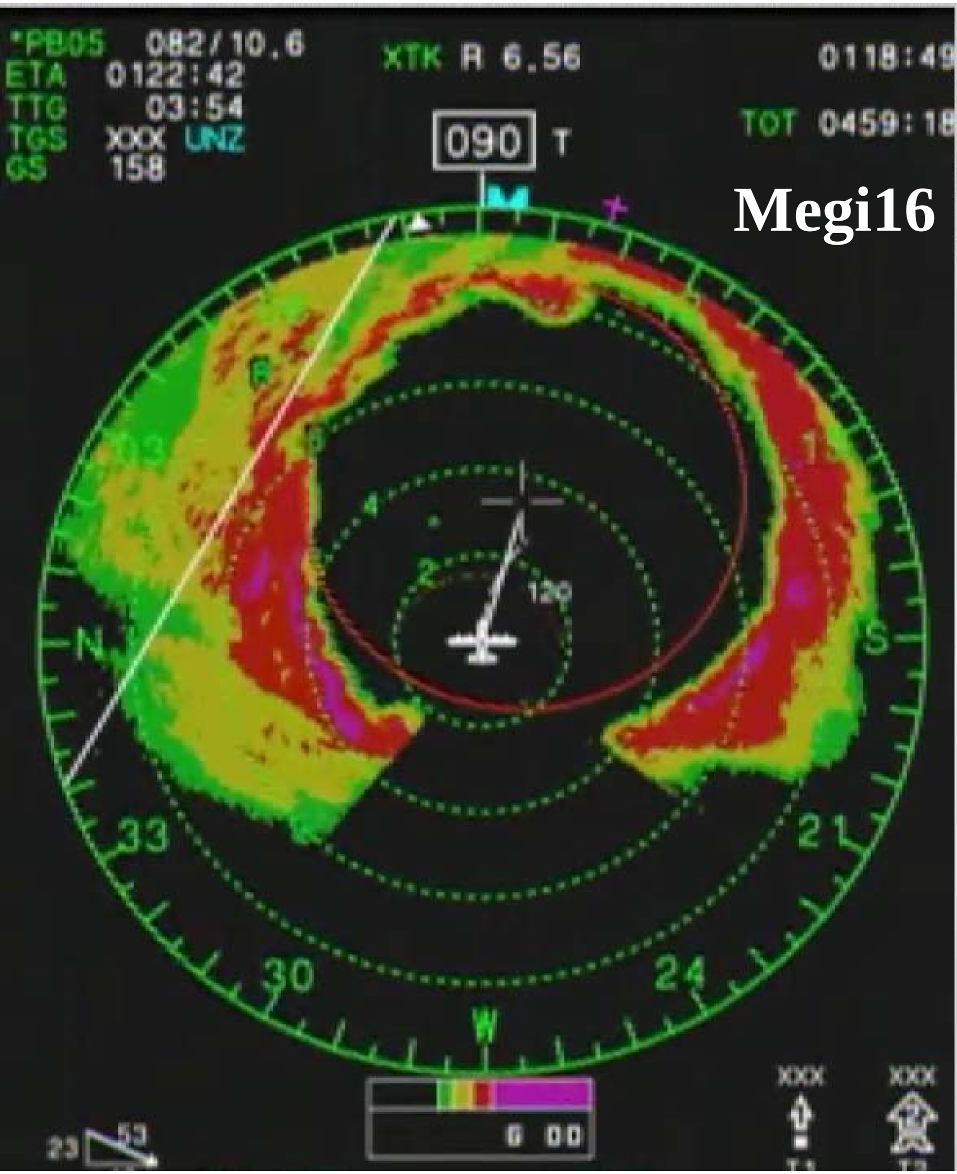


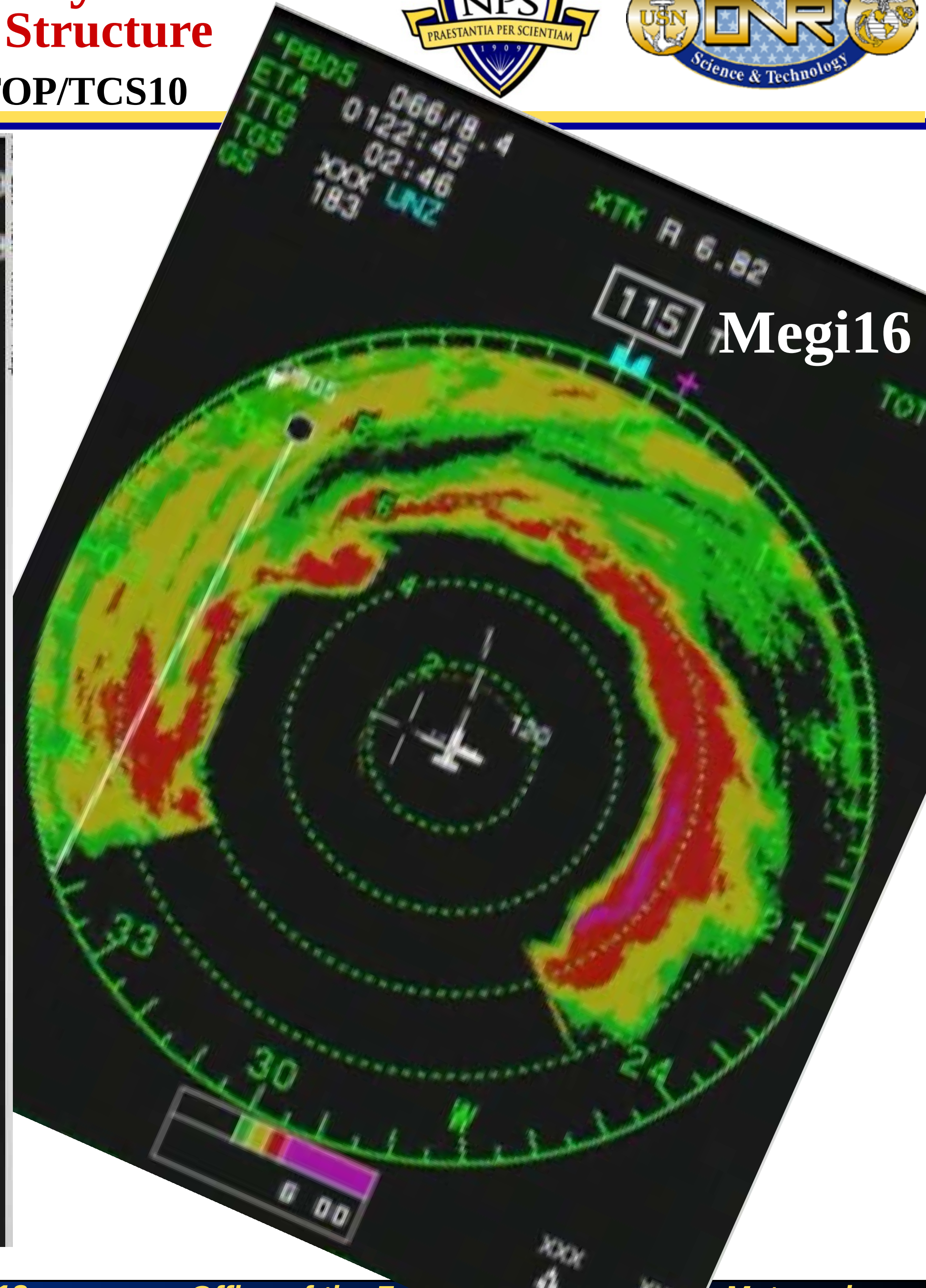
COSMO SKYMED-3 SAR: 0925 UTC



WC-130J C-band Weather Radar: 1115 UTC

Super-Typhoon Eyewall
Boundary Layer Structure
TPARC/TCS08 - ITOP/TCS10



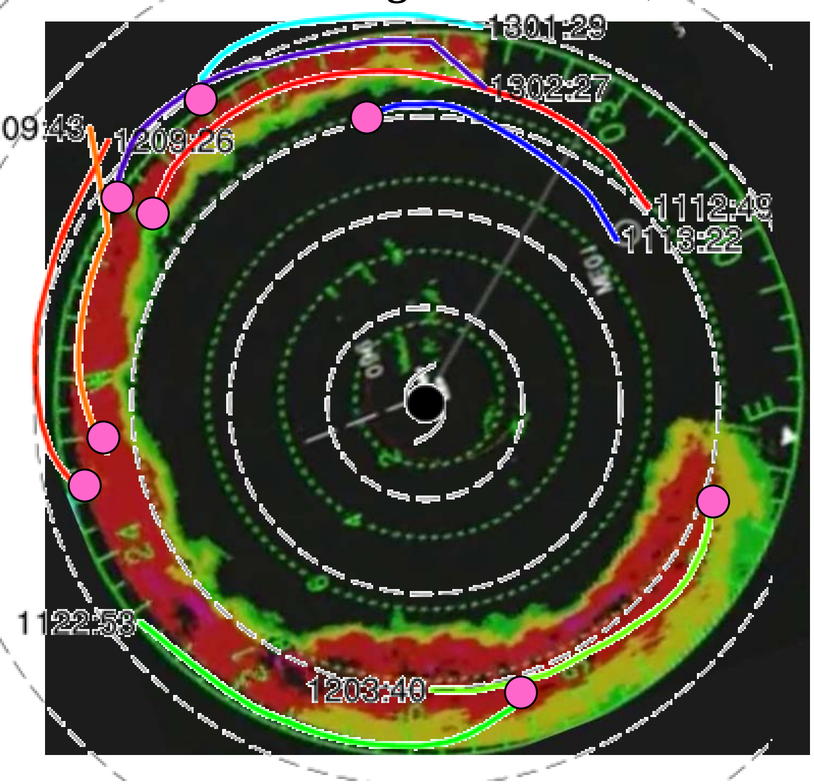


Super-Typhoon Eyewall Boundary Layer Structure

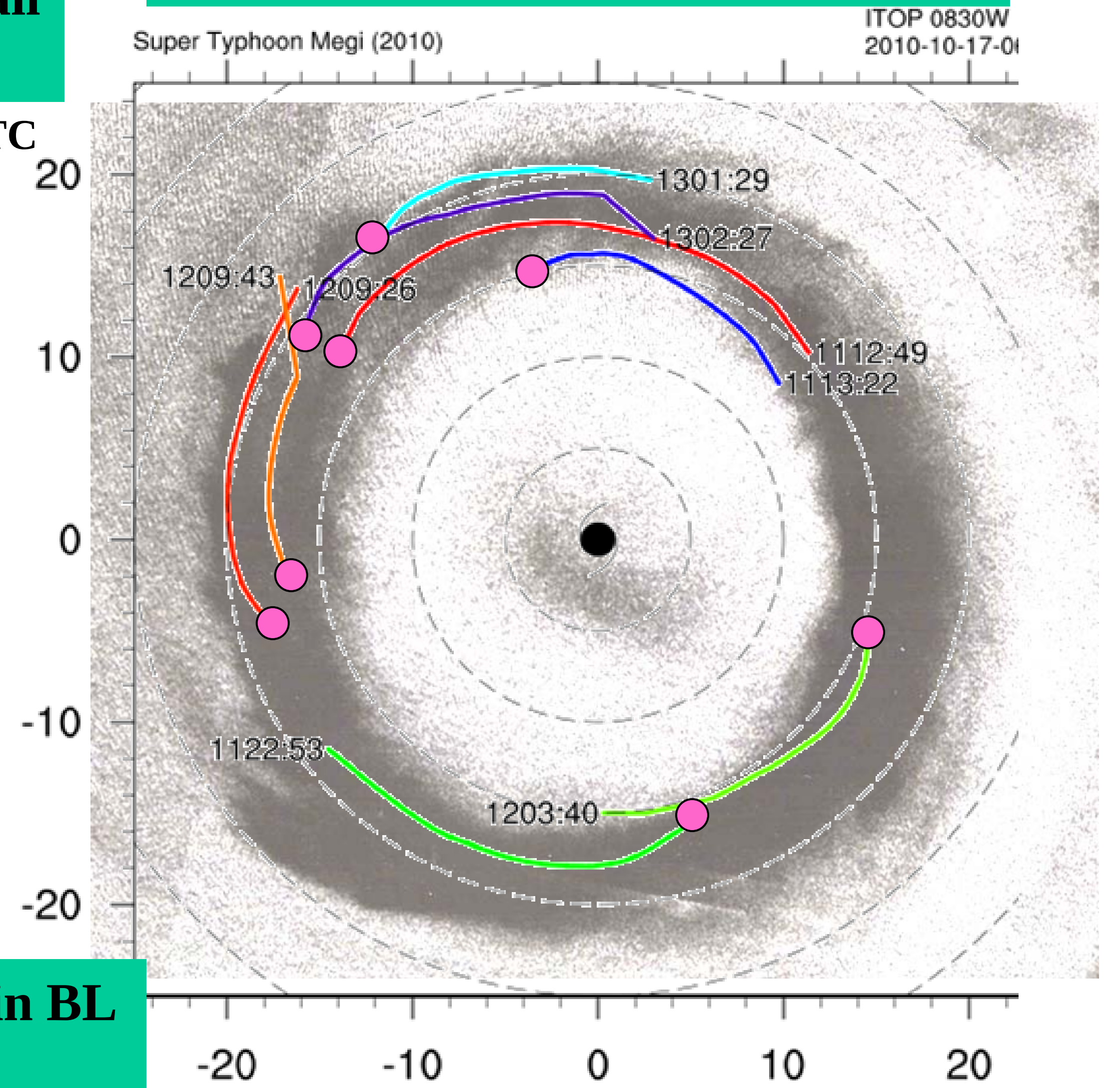
TPARC/TCS08 - ITOP/TCS10

Dropsonde Pairs reveal new eyewall Boundary Layer structure

WC-130J radar Megi 17 Oct 2010, 1115 UTC

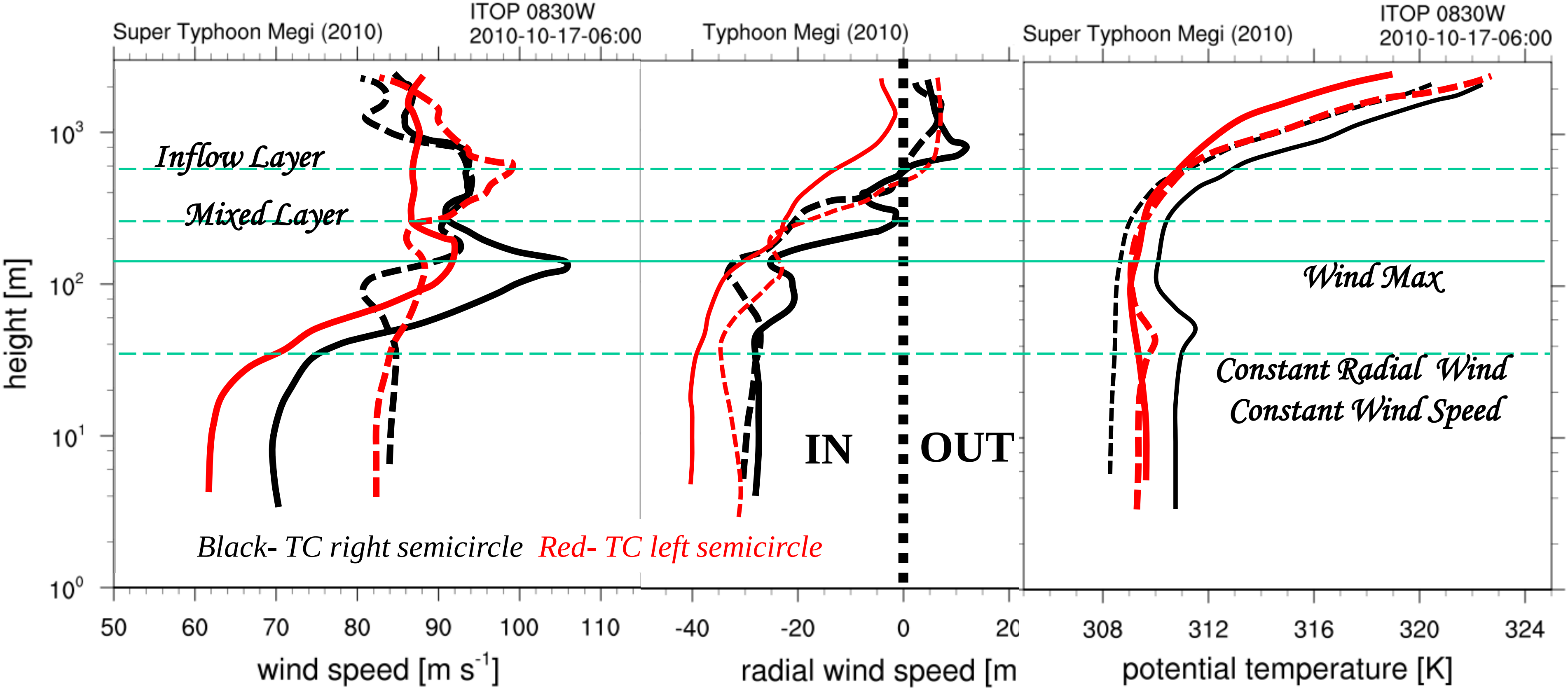


COSMO SKYMED-3 SAR 17 Oct 0925 UTC



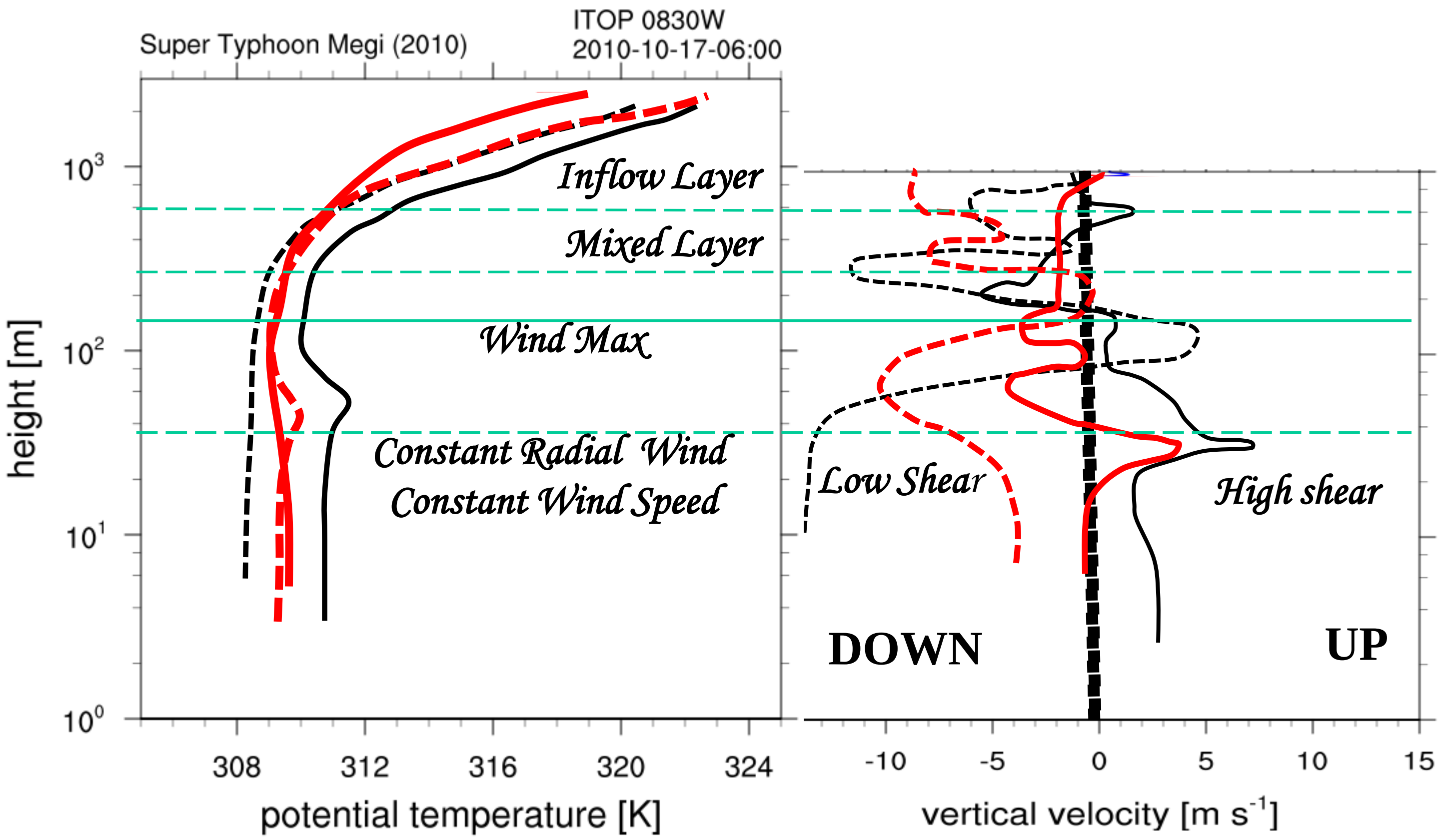
- Sonde Pairs curve inward within BL
- Splash at eyewall edge

New Features in Extreme Wind Boundary Layer- Megi



- Simultaneous sonde pair launches reveal strong/weak shear couplets: mesoscale influence
- Constant Wind Layer (30 m) violates 'log' law: air/water (spray) slurry may act as no-slip layer
- Wind max (210 m) below top of mixed layer (250 m) in contrast to reverse at larger radii
- Shallow inflow layer (600 m)

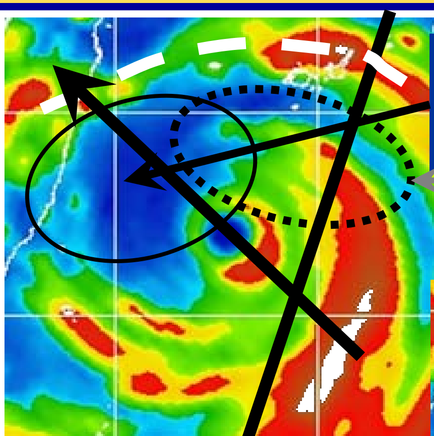
New Features in Extreme Wind Boundary Layer- Megi



Black- TC right semicircle *Red- TC left semicircle*

Super-Typhoon Eyewall
Boundary Layer Structure
TPARC/TCS08 - ITOP/TCS10

Rapid Structure Change
STY Jangmi

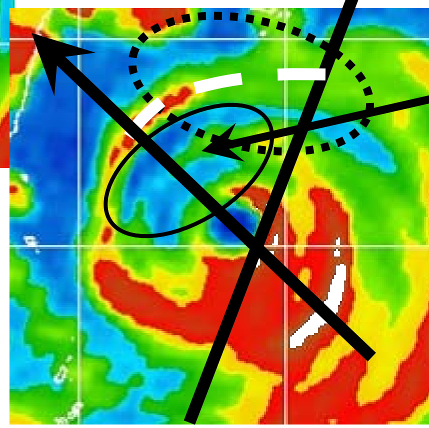


DRY Slot expands downstream from band & SSTA

SSTA

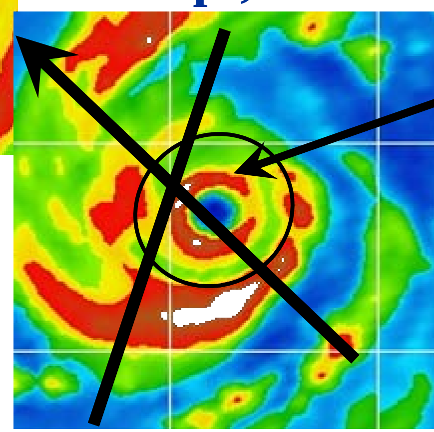
28 Sept, 0006

27 Sept, 2132



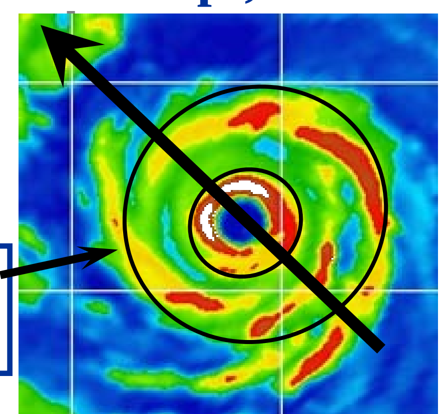
Inner Bands Decay: Outer Band Forms

27 Sept, 1134



Eyewall shrinks, asymmetric band structure forms

27 Sept, 0445

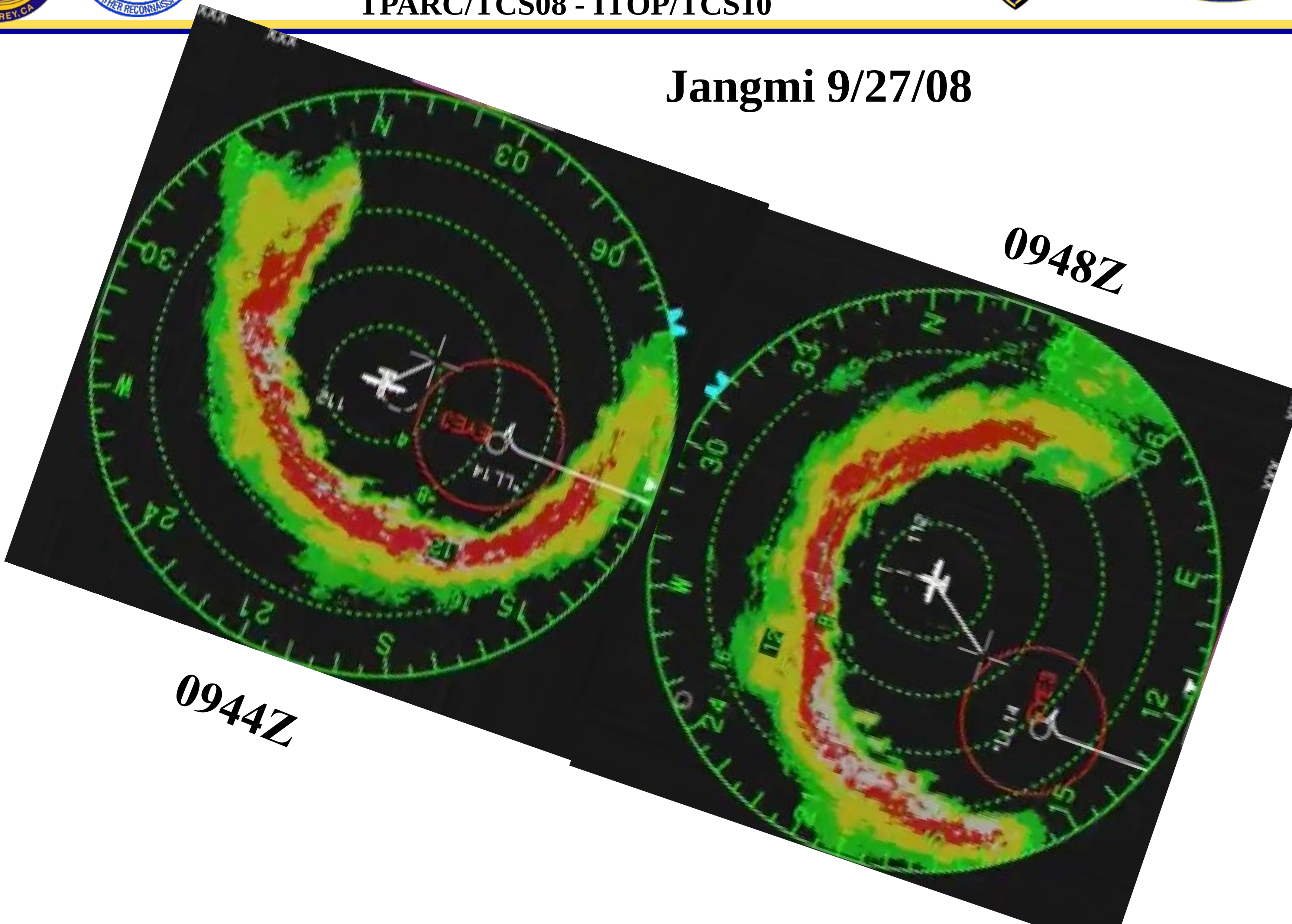


Concentric Eyewalls: Peak Intensity

Result:

Ocean eddy pair interacts with storm dynamics to produce immediate rapid decay and structure change prior to landfall.

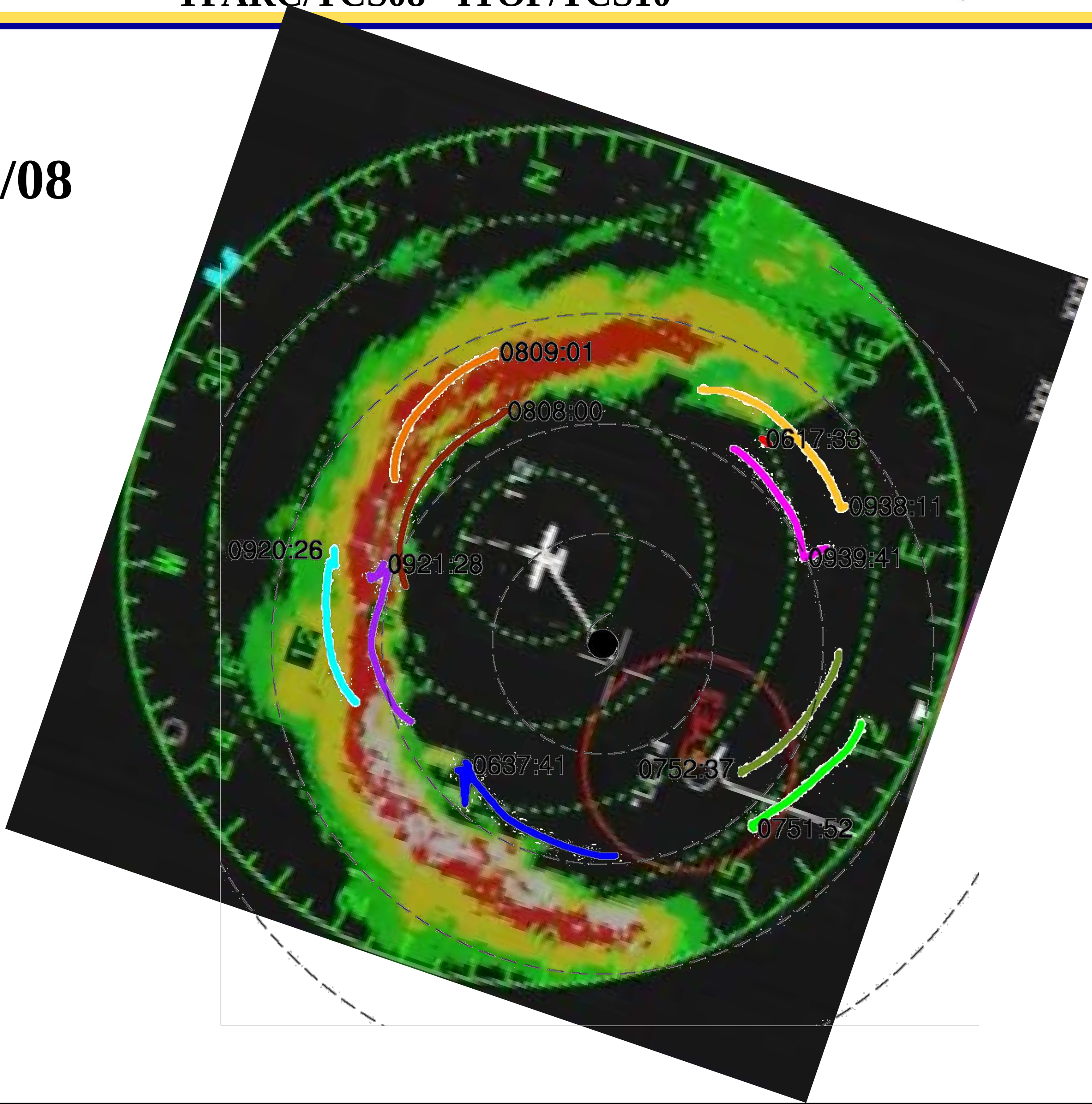
Jangmi 9/27/08

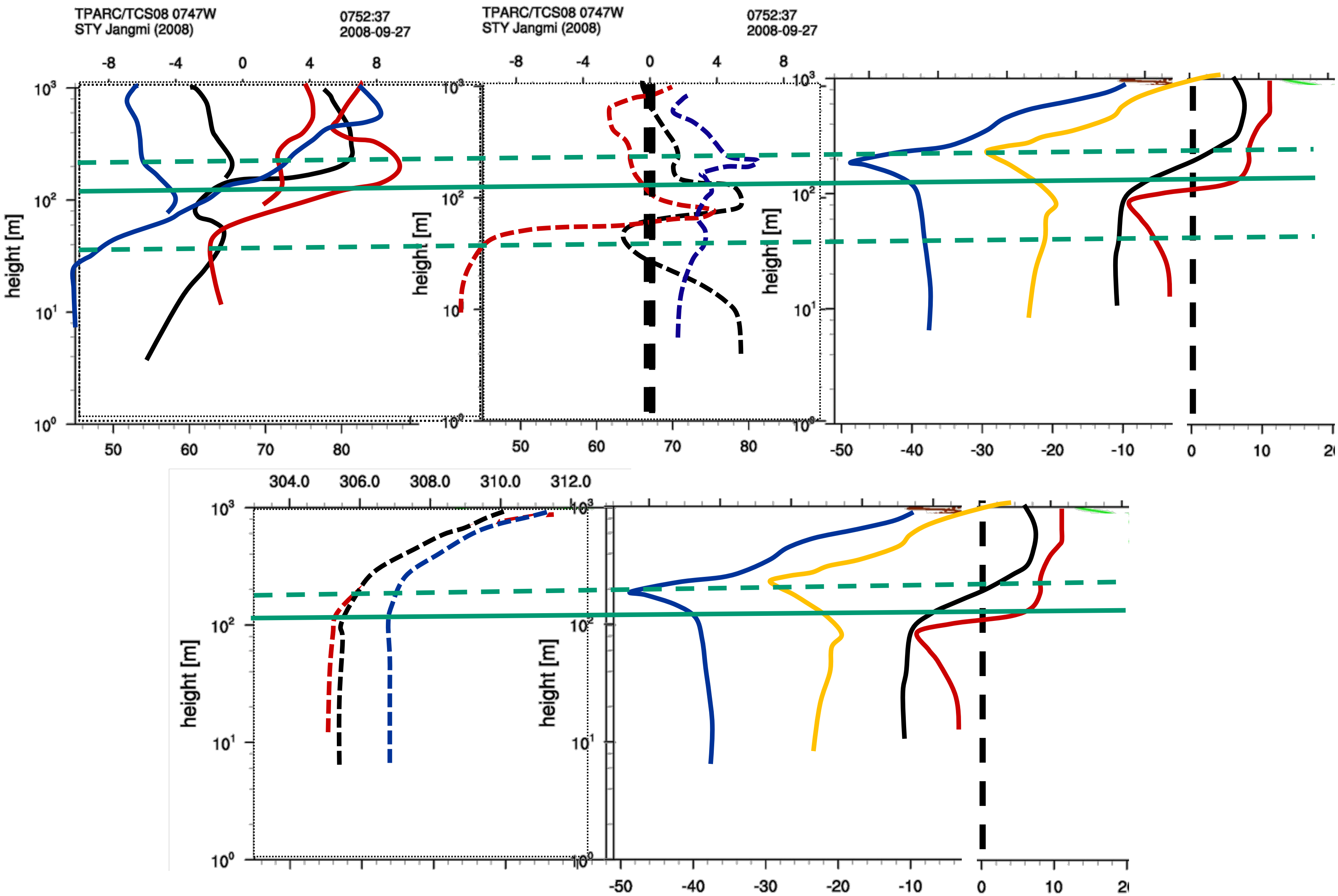


Super-Typhoon Eyewall
Boundary Layer Structure

TPARC/TCS08 - ITOP/TCS10

Jangmi 9/27/08
0948Z




TPARC/TCS08 0747W
STY Jangmi (2008)
0752:37
2008-09-27
TPARC/TCS08 0747W
STY Jangmi (2008)
0752:37
2008-09-27
height [m]
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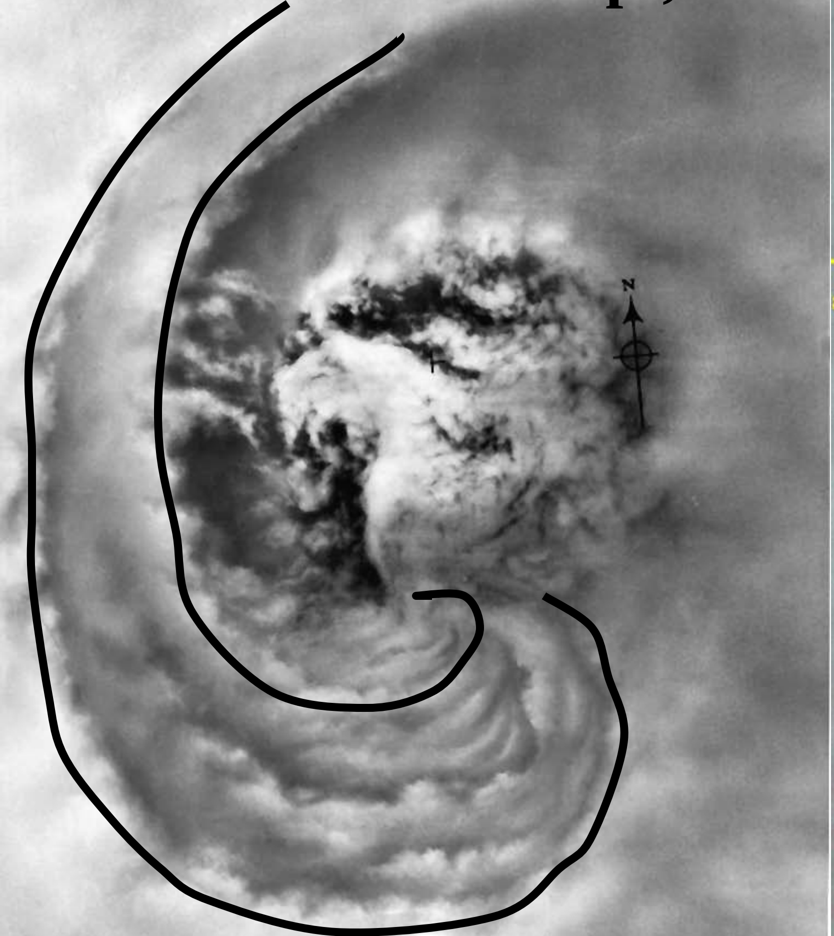
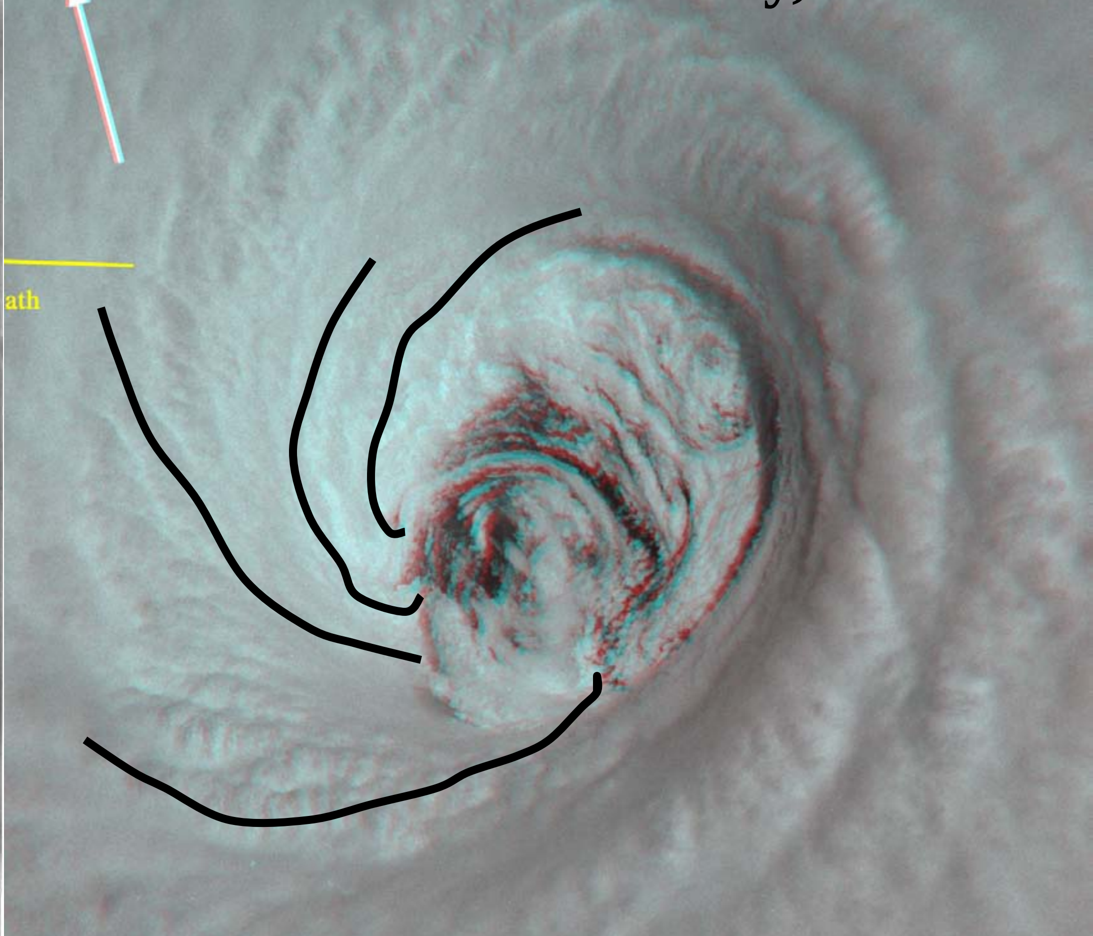
304.0 306.0 308.0 310.0 312.0

Features seen before, but impact not understood!

U2: STY Ida 28 Sept, 1958



STS65: H. Emilia 19 July, 1994



Key Results

- **TC Rapid Intensification cycle associated with unusual boundary layer structures**

- **Eyewall microscale/ mesoscale features modulate high-wind boundary layer structure**

- **High-wind eyewall surface layer observed for the first time by new dropsondes differs from prior observational extrapolation.**

- **Apparent mesoscale modulation of super-typhoon eyewall air-sea transfer processes induces episodic weak-shear and strong-shear eyewall couplets which violate standard boundary layer 'log law' and differs from prior observational extrapolation and existing model parameterizations.**

Future Dreams

- **Continue development of rapid deployment sonde with IR SST sensor**
  - ✓ **Improved eyewall structure understanding from WC-130J**
  - ✓ **Rapid inner core deployment from Global Hawk for improved storm scale and environmental monitoring**

- **Re-institute WPAC recco with WC-130J for inner core monitoring and DoD Global Hawk for environmental monitoring: a pathway to renewed track prediction improvement and initiation of intensity prediction improvement**

- **Continue development of 'Combo' dropsonde/AXBT deployments in anticipated RI situations.**