

Interaction of TC with Ocean and its Induced Ocean Cold Wake

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Objectives

- Investigate the TC response to pre-existing cold ocean eddies or the generation of the trailing TC cold wake
 - Kinematic impact on the TC flow structure
 - Modulation of TC symmetry
- Study two-way air-ocean coupling using coupled COAMPS® simulation of super typhoon Jangmi and idealized vortex simulations initialized with a cold wake

Two-Way Coupled COAMPS-TC System

COAMPS-TC, NCOM, NAVDAS, and NCODA



12 hour update
cycle

00 UTC

Analysis System

NAVDAS, 3DVAR

TC relocation, bogus

NCODA, 2D SST &
SICE 3D T,S, SSH
assimilation

gNCOM

Setup IC (cold
start) & BC

NOGAPS

Coupled Forecast
System

COAMPS-TC

Atmos &
Ocean
warm start
first guess

12 UTC

Analysis System

NAVDAS, 3DVAR

TC relocation, bogus

NCODA, 2D SST &
SICE, 3D T,S, SSH
assimilation

gNCOM

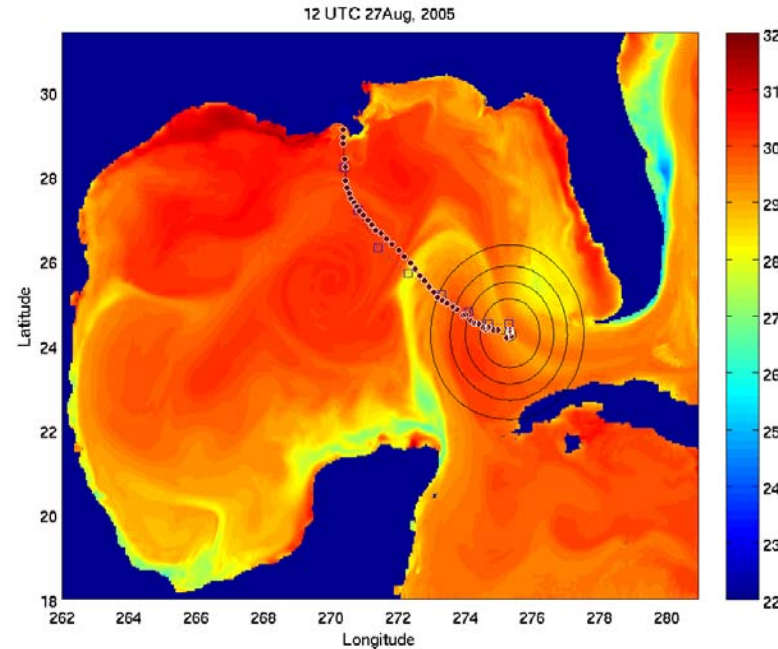
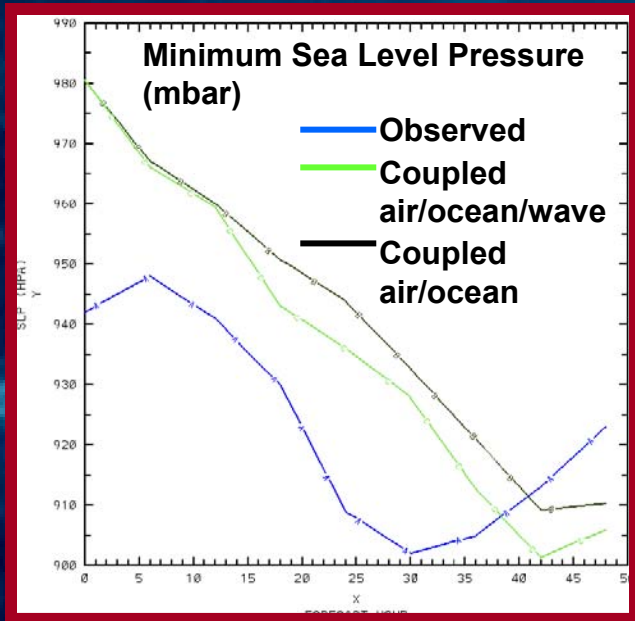
Setup BC

NOGAPS

Coupled Forecast
System

COAMPS-TC

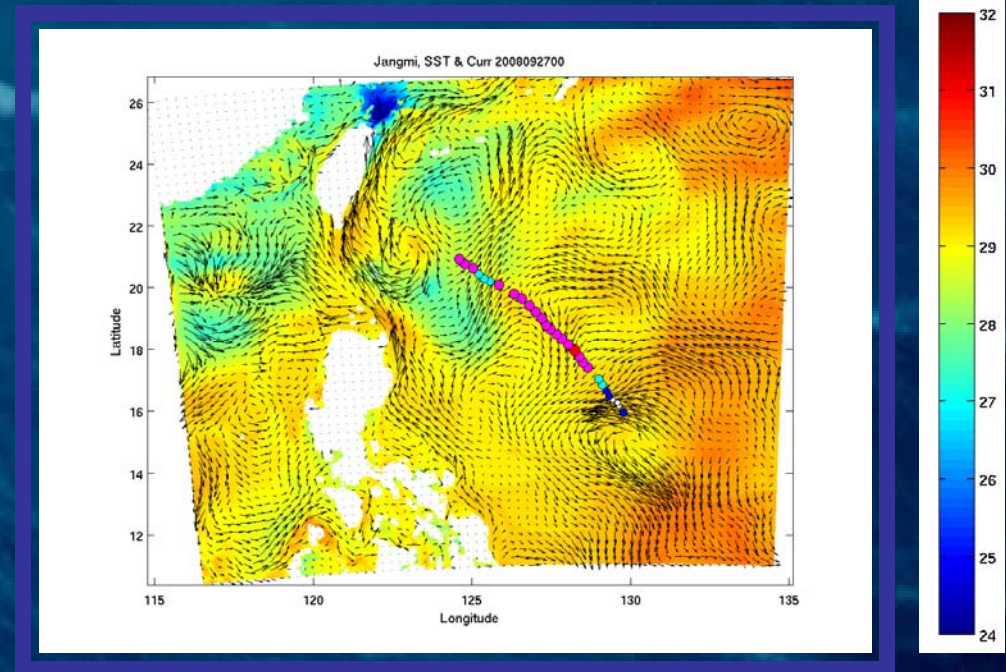
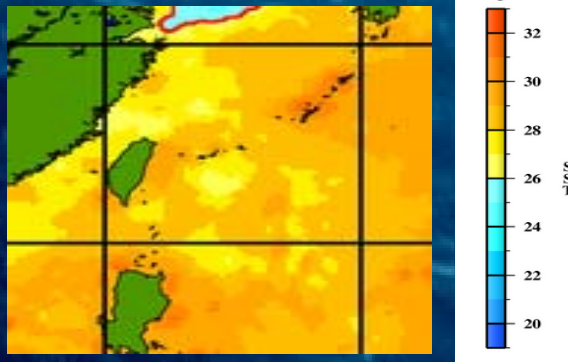
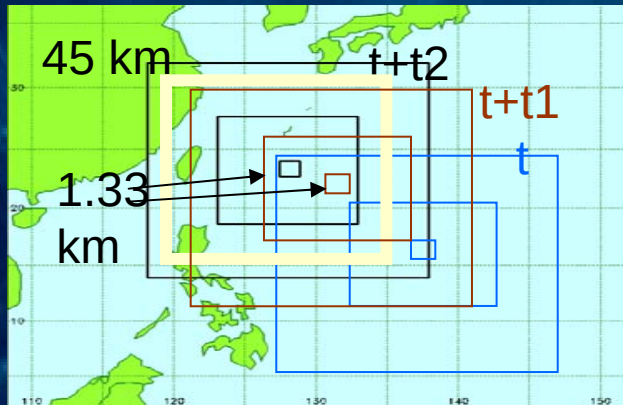
Katrina Simulations



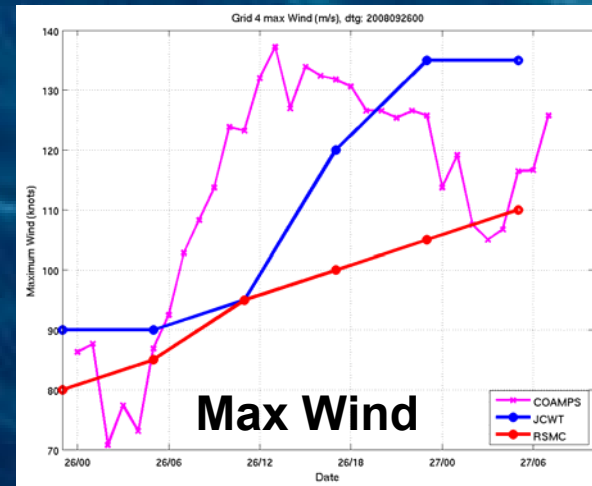
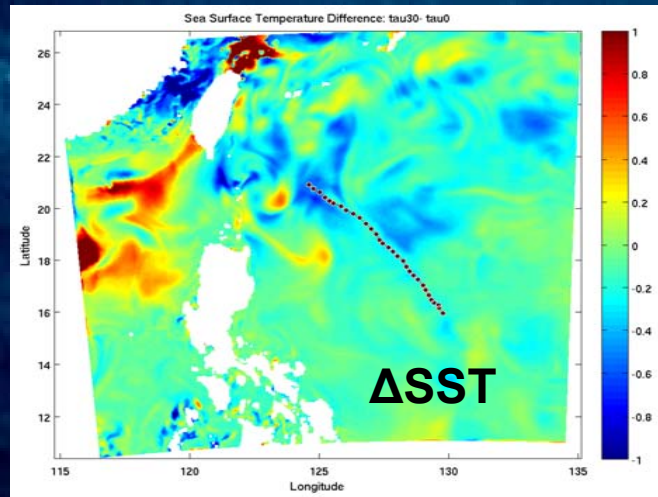
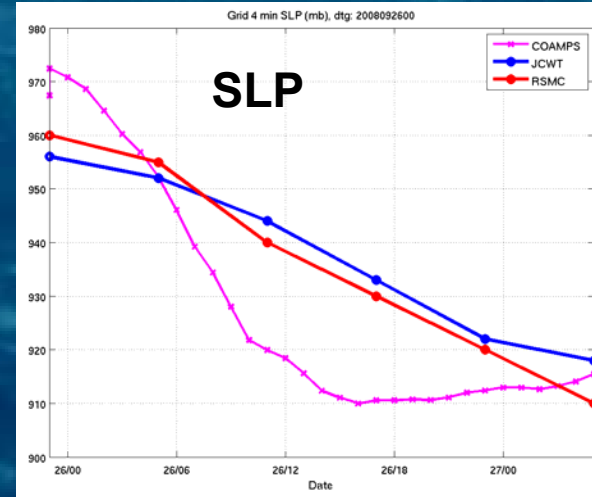
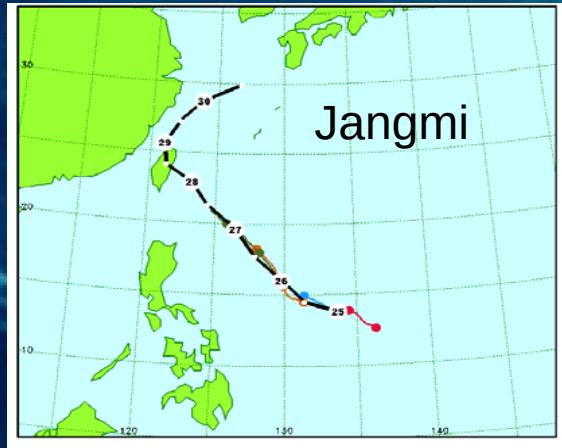
- Significant ($>3^{\circ}\text{C}$ in average) cooling occurs near 13 UTC 28 Aug
- Maximum cooling located about 100 km SE of the storm's landfall location
- Intensity changes arises 8 hr after the generation of the cold wake

S. Chen, Campbell T.J., Jin H., Gaberšek S., Hodur R.M., and Martin P., 2010: Effect of two-way air-sea coupling in high and low wind speed regimes, *Mon. Wea. Rew.*

COAMPS Simulations of Super Typhoon Jangmi

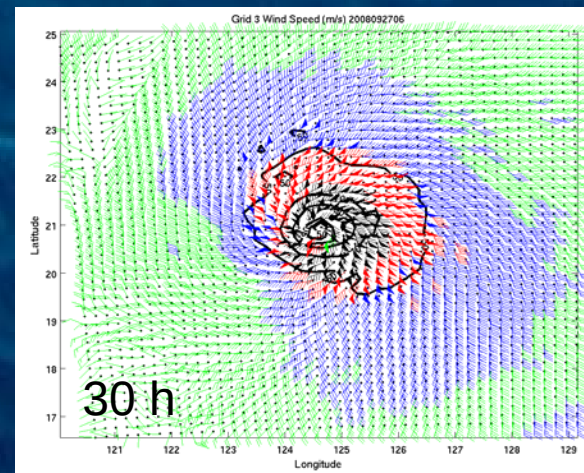
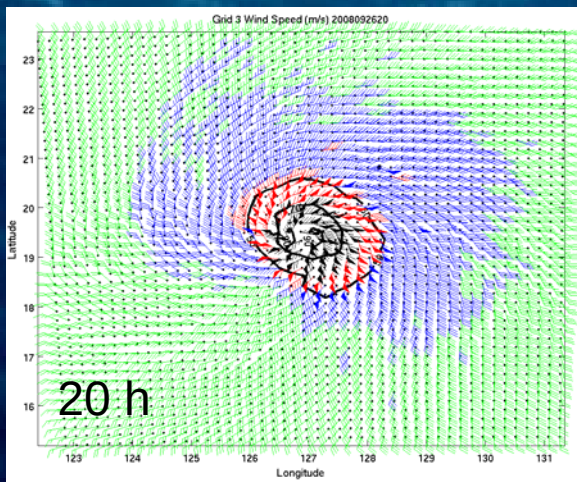
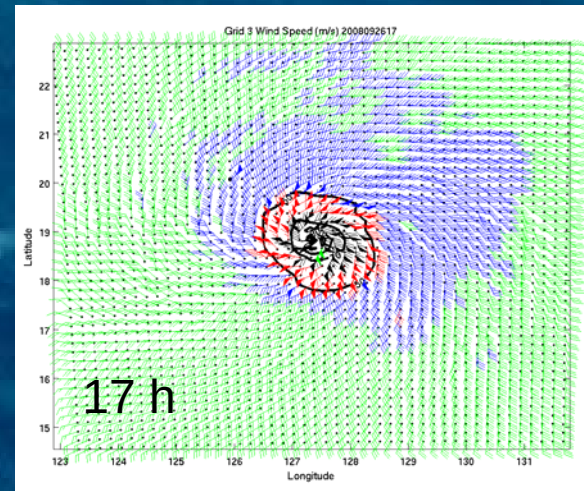
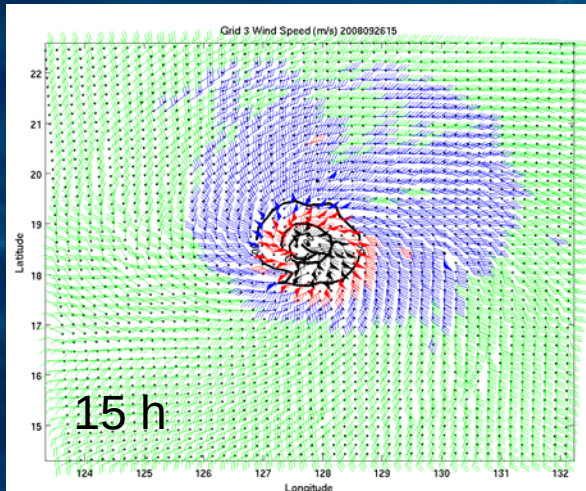


- Weak wake cooling ($< 1^{\circ}\text{C}$)
- More complex cold eddies, cold wake, and TC interaction
- Intensity decreases after encounters with cold eddies left in the wake of two previous typhoons



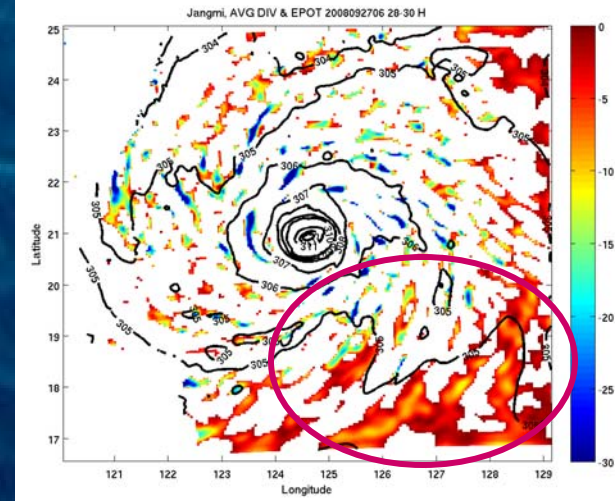
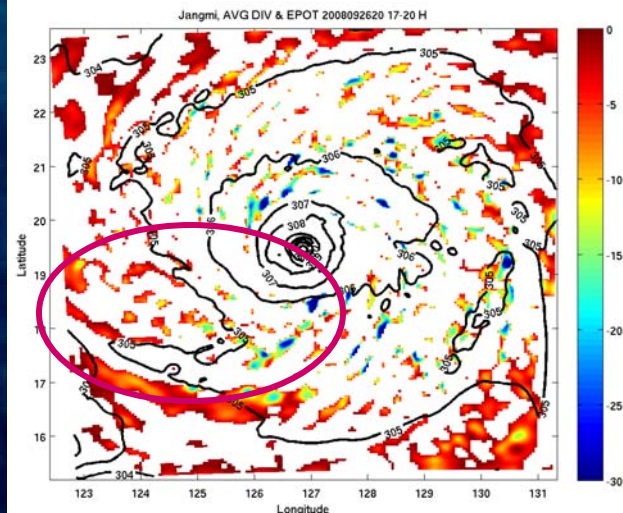
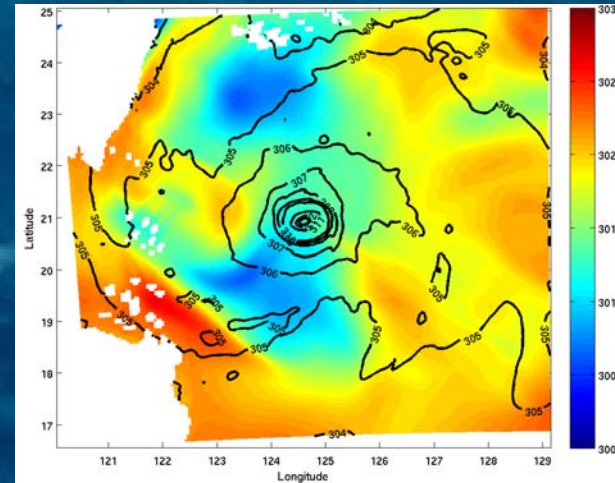
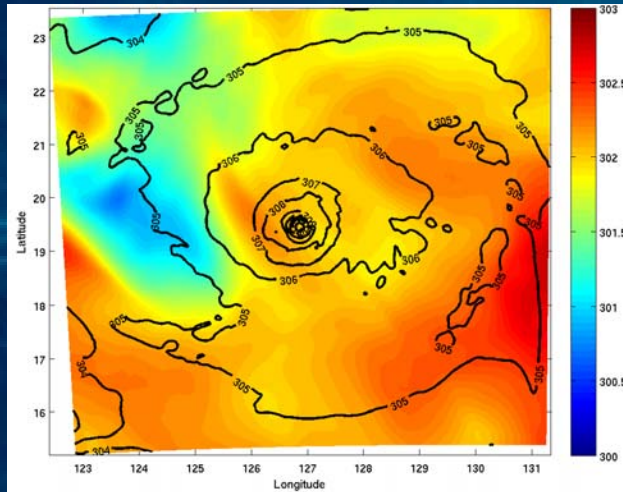
- Small track error
- Averaged observed and forecast TC translation speeds are 6.4 & 7.3 m/s

Grid 3 10-M Wind: Jangmi



Expansion of the eye and radius of maximum winds occurs when the typhoon passed over the pre-existing cold eddies

Atmospheric Response to Cold Water

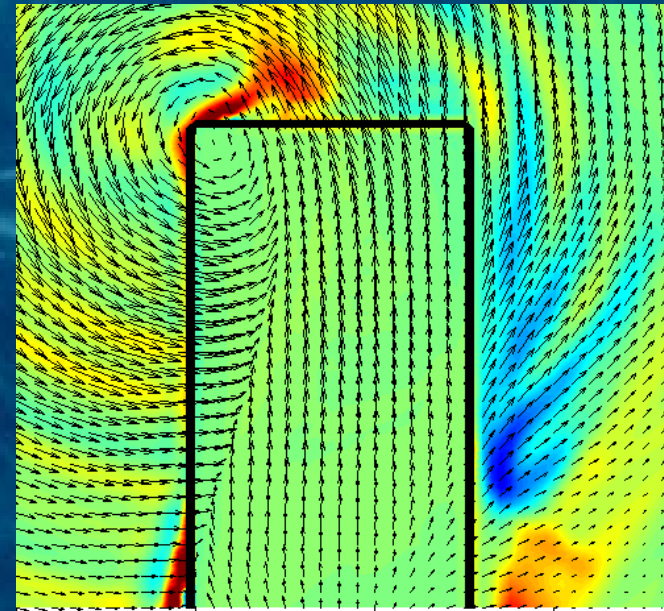
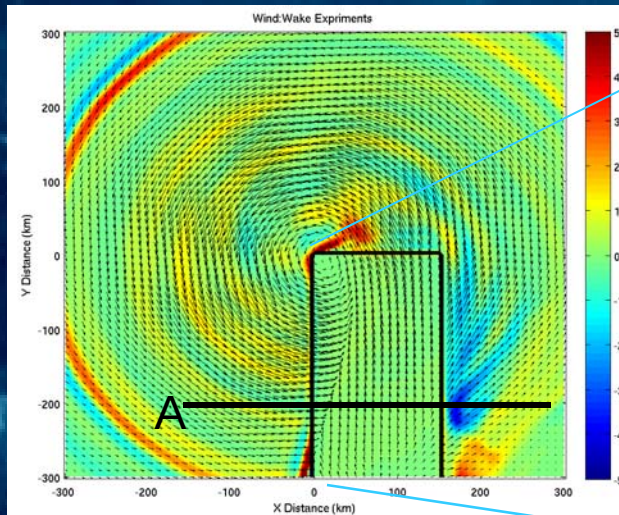


- The cold eddy forced regions of enhanced low-level convergence downwind from the cold eddy

Atmospheric Response to the Wake

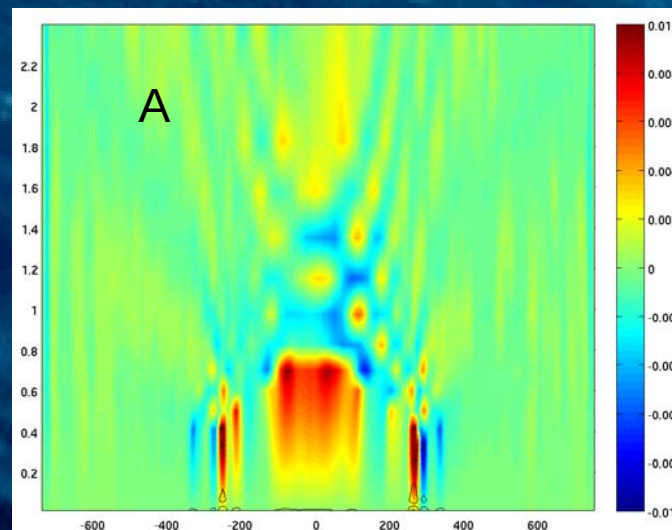
Idealized axis-symmetric dry simulations

Divergence



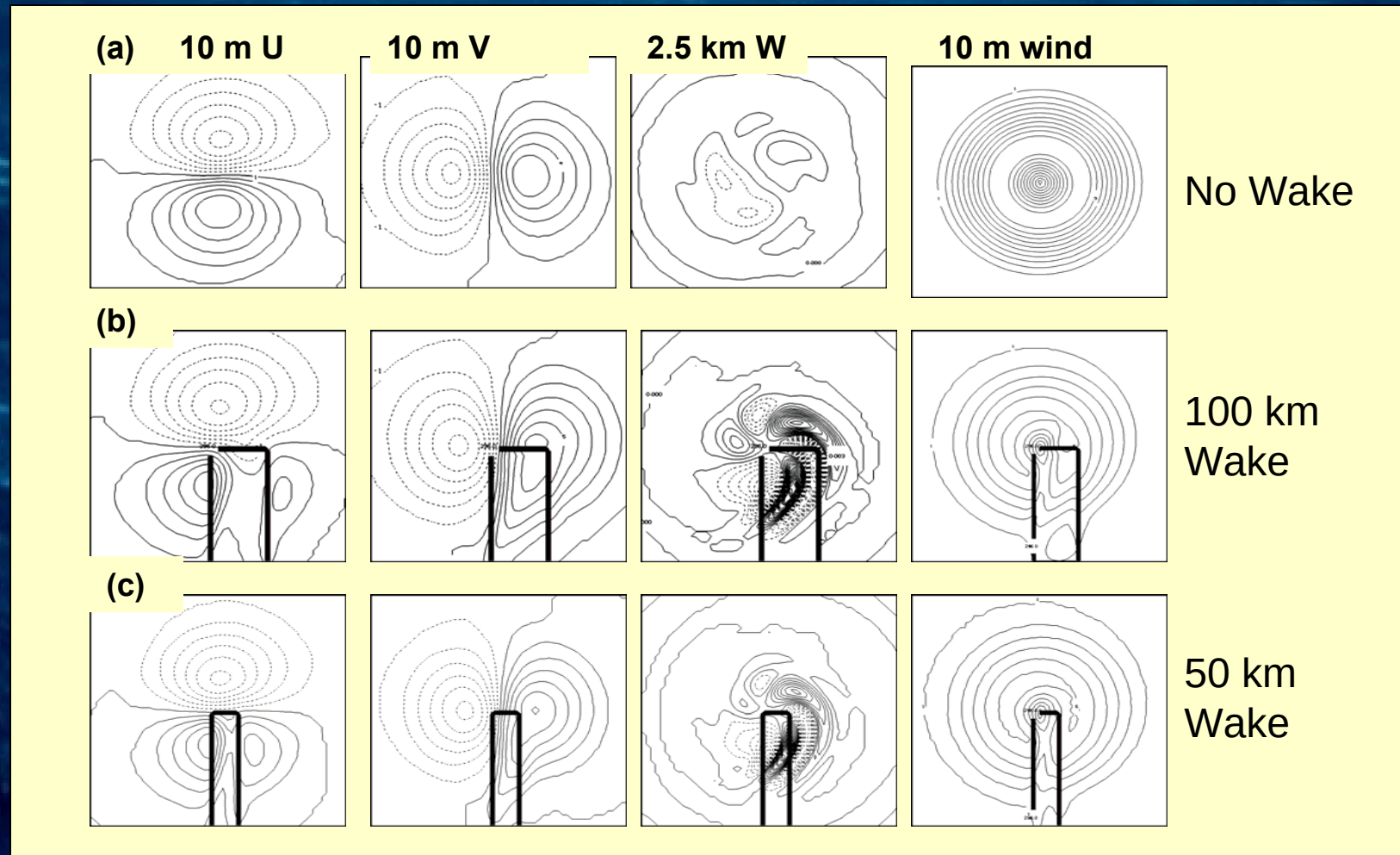
A

W



Atmospheric Response to the Wake

Idealized axis-symmetric dry vortex simulations



The size of the wake affects the horizontal scale and magnitude of the forced circulation

Summary

- The Jangmi simulation had a weaker wake compared to the Katrina case
- The previous cold wakes from typhoon Sinlaku and Hagupit impacted intensity and structural changes
- The adjustment time of TC intensity change is closely related to the horizontal scale of pre-existing cold eddies and/or storm-induced wakes

Future Work

- We plan to use both the idealized and real-data coupled model simulations to continue investigating the:
 - dynamic and thermodynamic processes that lead to the decrease of TC intensity due to the cold wake or eddies
 - wind-current interaction that drives the development of the cold wake
- Compare the coupled model results with available observations from TCS08