

Report from Atmospheric Science Issues

I. Physical Processes

II.

A. Internal Efforts

The convection distribution is tightly coupled to the atmospheric (and thus the oceanic) boundary layer. The boundary layer fluxes are modulated by convective rolls over ocean and land.

Key role of heating distribution for creating the PV distribution, which is then modified by vorticity mixing processes that create adjustments in the inner-core wind distribution (possibly also leading to formation of an outer rainband) and central pressure (perhaps rapid) changes.

Microphysical effects affect the heating distribution in the upper regions of inner core and rainbands that modifies the structure evolution.

The vortex structure (including inertial stability in the inner region and outflow) determines the modifications of the structures from Vortex Rossby Wave propagation, heating/warming distribution, and external influences on the intensity.

B. Environmental effects

C.

May affect the intensity and the structure (size) via interaction with an external circulation that changes the vertical wind shear, or ingests dry, dusty air (e.g., SAL), or causes an influx of high momentum air.

Interaction with land mass or with an adjacent circulation can also cause formation of an outer concentric (or partial) eyewall that may subsequently contract and affect the structure and intensity.

II. Hypotheses

The intrinsic limit of predictability for intensity change for achievable initial conditions is of the order of 24-36 h and thus a probabilistic approach rather than a deterministic approach is required beyond that time.

Hurricane intensification to Category 2 is fundamentally determined by the inner-core convective processes, but at Category 3-5 the inner-core dynamical processes become the dominant processes determining the intensity change.

Microphysics are the critical process determining the latent heating (and thus the potential vorticity) distribution in the inner core and the rainband structure.

Concentric eyewall formation is caused by inner-core vorticity re-arrangement (as opposed to interaction with land or an approaching upper-tropospheric trough).

Size expansion physics are dominated by external momentum flux dynamics.

III. Strategies

- A. Exploit existing HRD and various experimental data sets to explore relative roles of internal and external effects on intensity and outer structure changes.
- B. Prepare a number of real-data sets that incorporate a range of intensity change scenarios for use as initial conditions in a model intercomparison study to understand sensitivity to physical processes.
- C. Use the time evolution aspect of four-dimensional variational data assimilation to isolate dynamical and thermal processes.
- D. Use a high-resolution, advanced numerical model capable of predicting intensity change in a research ensemble model to understand probabilistic dynamics, predictability aspects, sensitivity to physics, and kinds of observations that are required.
- E. Field experiments are necessary for internal versus external influences, microphysical processes, and response to boundary layer influences.