Idealized Run Results: Observation-Based vs. Nonlinear Vortex under Shear vs. No-Shear Conditions

All Runs Have the Following in Common:

- Environments the same (Dunion moist tropical) except:
    - Initial/environment shear = 8 m/s westerly vs. 0 m/s
- Initial/environment mean-layer flow is set to 5 m/s westward
    - To force storm motion at 5 m/s westward (opposing shear dir)
- Ocean coupling (1-d) is turned on
- Initial SST is set to 29°C
- Initial ocean profiles are the same with a 50-m mixed layer
- All model physics parameters are the same

➔ These simulations are meant to reproduce the observed conditions of the "typical" environment of a steady-state, category-1 hurricane in the Caribbean with the goal of obtaining the simulation of a steady-state, category-1 hurricane as observed

Outline of the Presentation of Results:

1. Time series of scalar metrics:
    - A. Evolution of the environment of the storm
    - B. Basic metrics: intensity and MSLP
    - C. Kinematic structure
    - D. Thermal structure
    - E. Hydrometeors
    - F. Surface and Ocean
2. Radius-height plots of azimuthally averaged fields
    - A. Kinematic structure
    - B. Thermal structure
    - C. Hydrometeors
3. Radius-azimuth plots
    - A. Kinematic structure
    - B. Thermal structure
    - C. Hydrometeors
    - D. PBL, Surface, and Ocean
4. Radius-time Hovmoller diagrams
    - A. Kinematic structure
    - B. Thermal structure
    - C. Hydrometeors
    - D. PBL, Surface, and Ocean

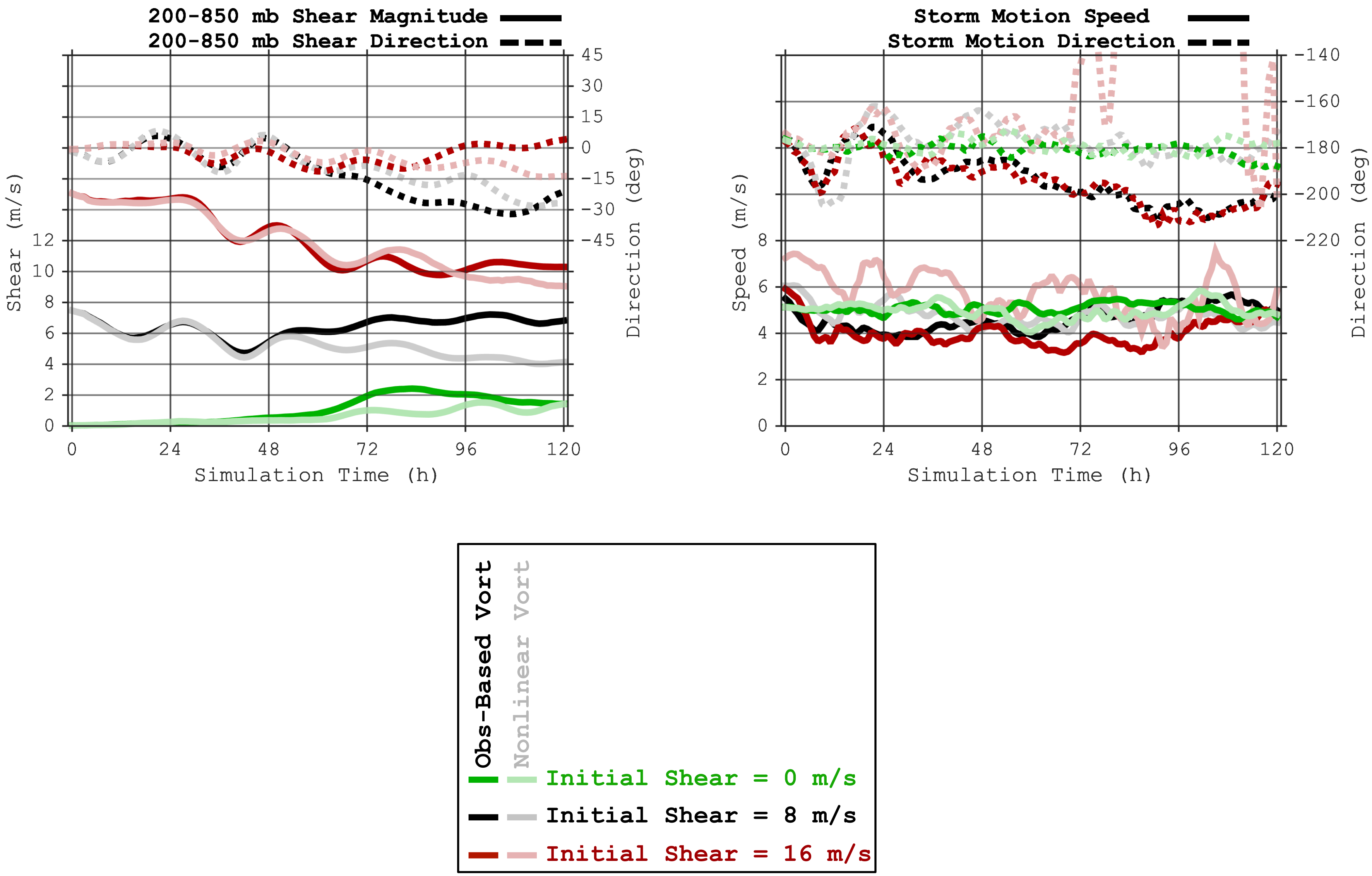
1. Time Series of Scalar Metrics

A. Evolution of the Environment of the Storm: Shear, Storm Speed, and T/RH at Various Heights

➔ How well is the initial environment maintained in the runs? In other words, can we safely attribute the differences in various experiments to the specific parameters that were perturbed.

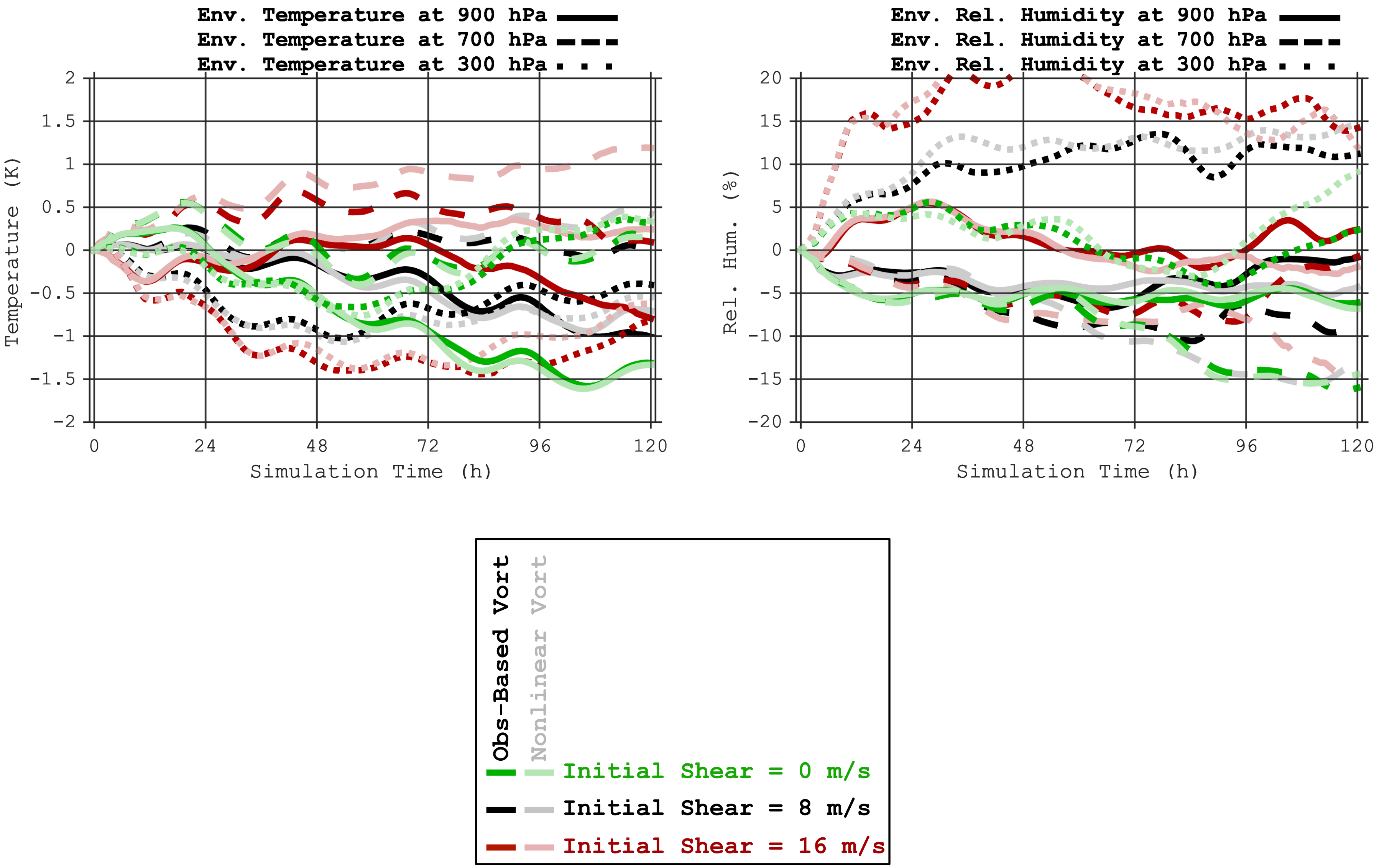
➔ All time series are 6-h (+/- 3 h) moving averages.

Evolution of Shear and Storm Speed



➔ Shear calculated on a circle at 20° from the storm center

Evolution of Env. T and RH (Perturbation from Initial)



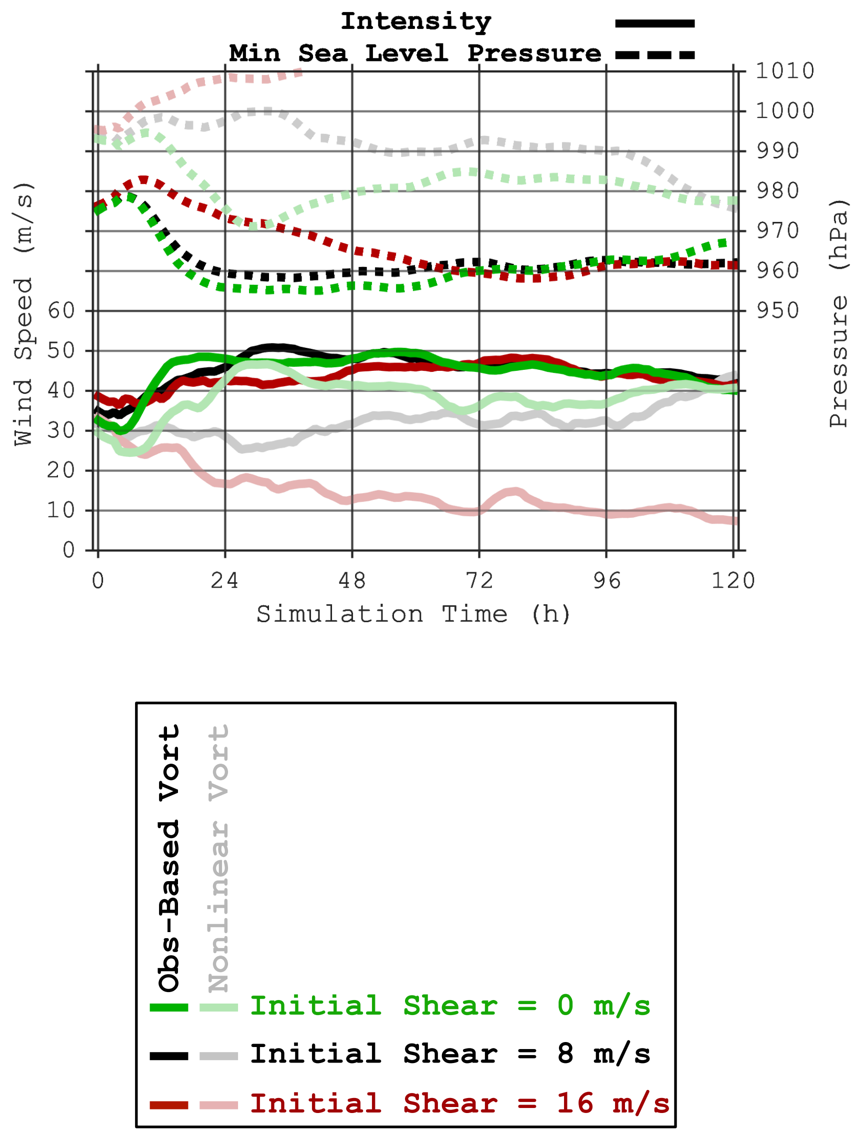
➔ T & RH calculated on a circle at 20° from the storm center

1. Time Series of Scalar Metrics

B. Basic Metrics: Intensity and MSLP

→ Note that Track Here is Irrelevant Because These Are Constant-F & All-Ocean Idealized Runs

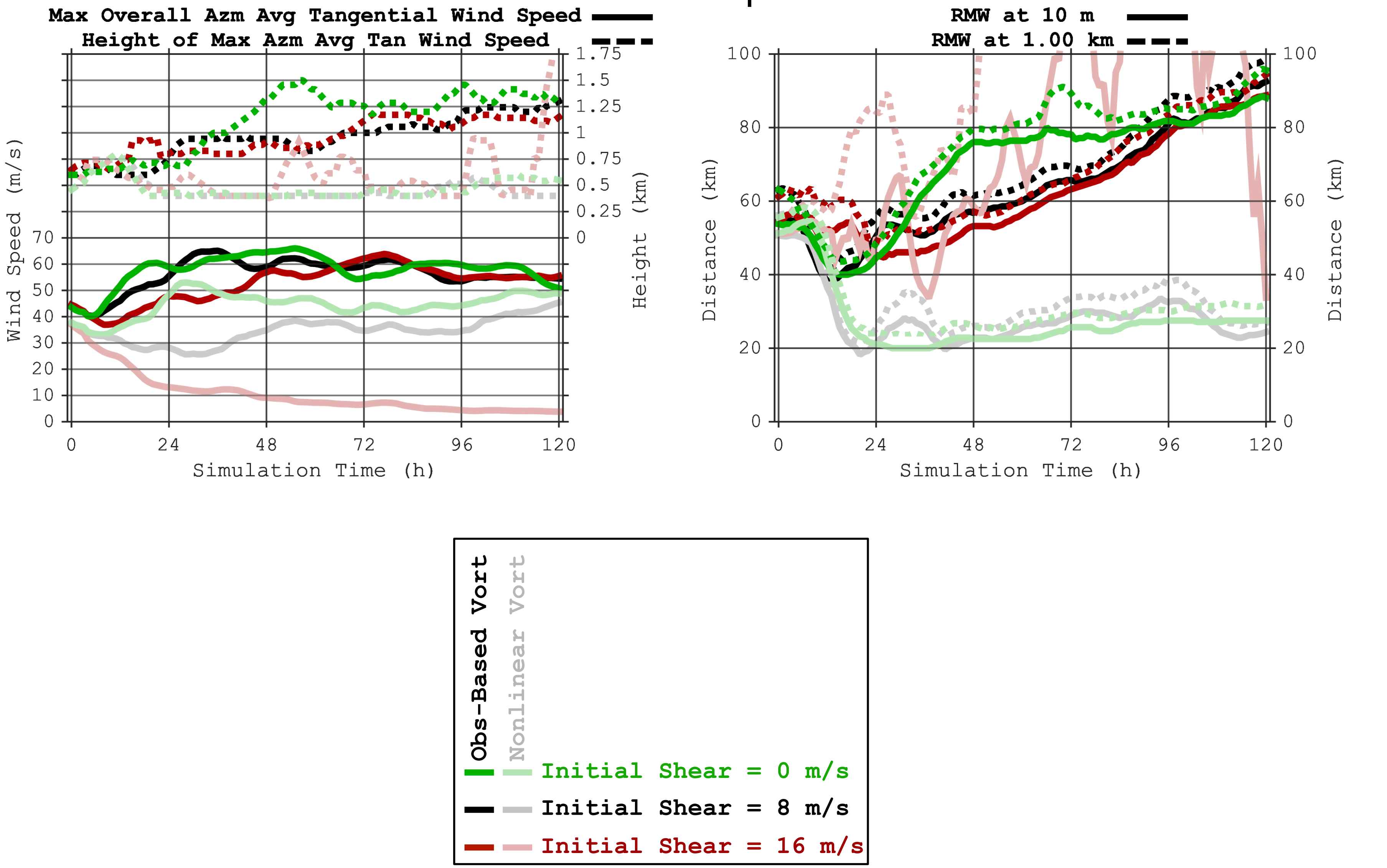
Evolution of Intensity and MSLP



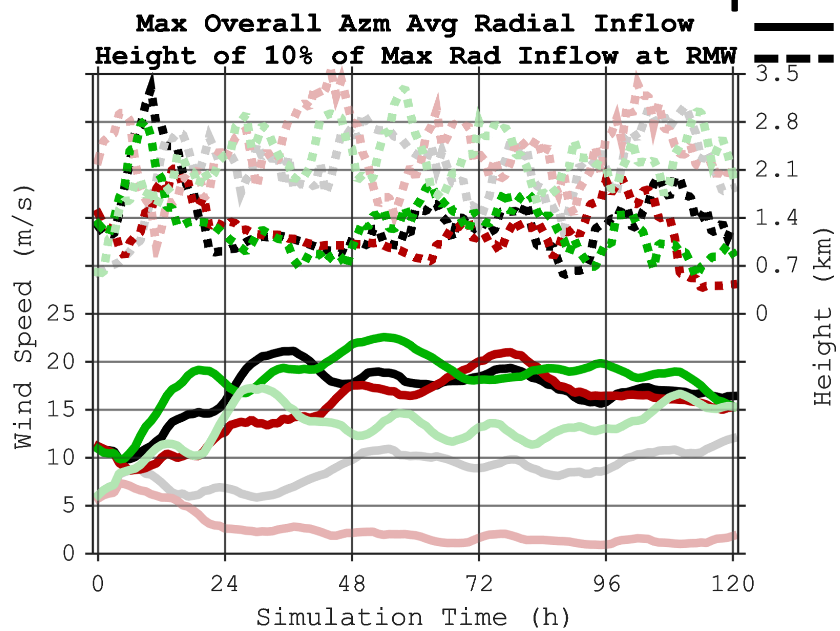
1. Time Series of Scalar Metrics

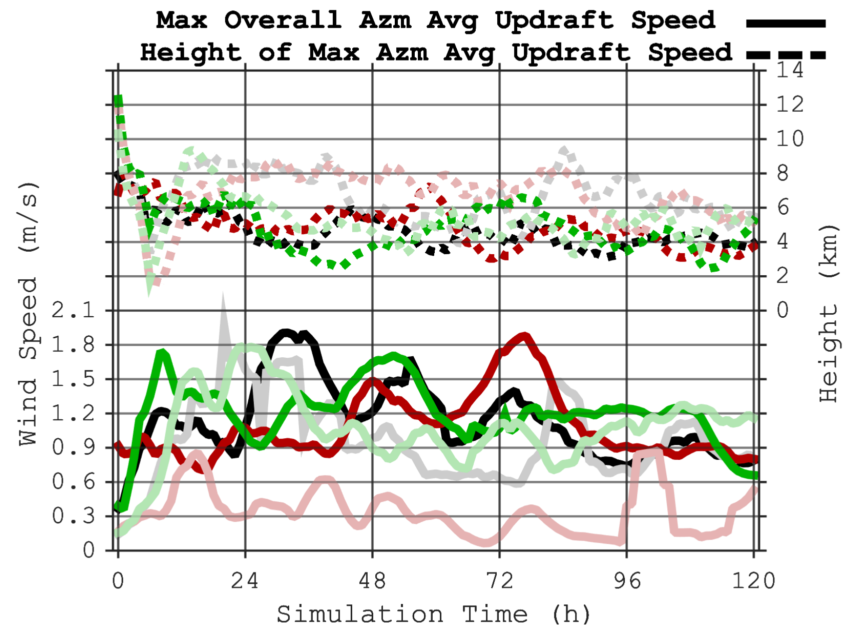
C. Kinematic Structure: Primary & Secondary Circulations, Vorticity

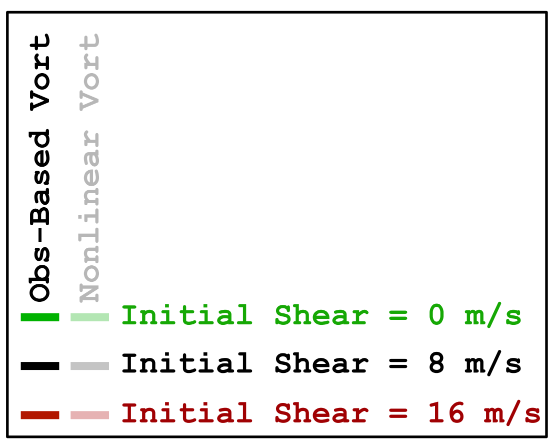
Primary Circulation: V_T Max, Height of V_T Max, & Radius of V_T Max

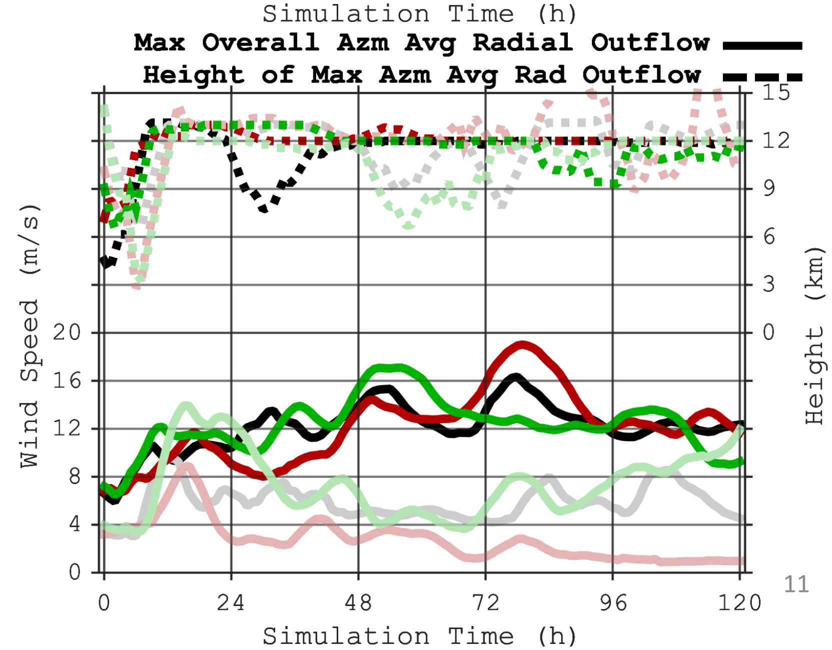


Secondary Circulation: V_R Inflow Max, V_R Outflow Max, & Updraft Max

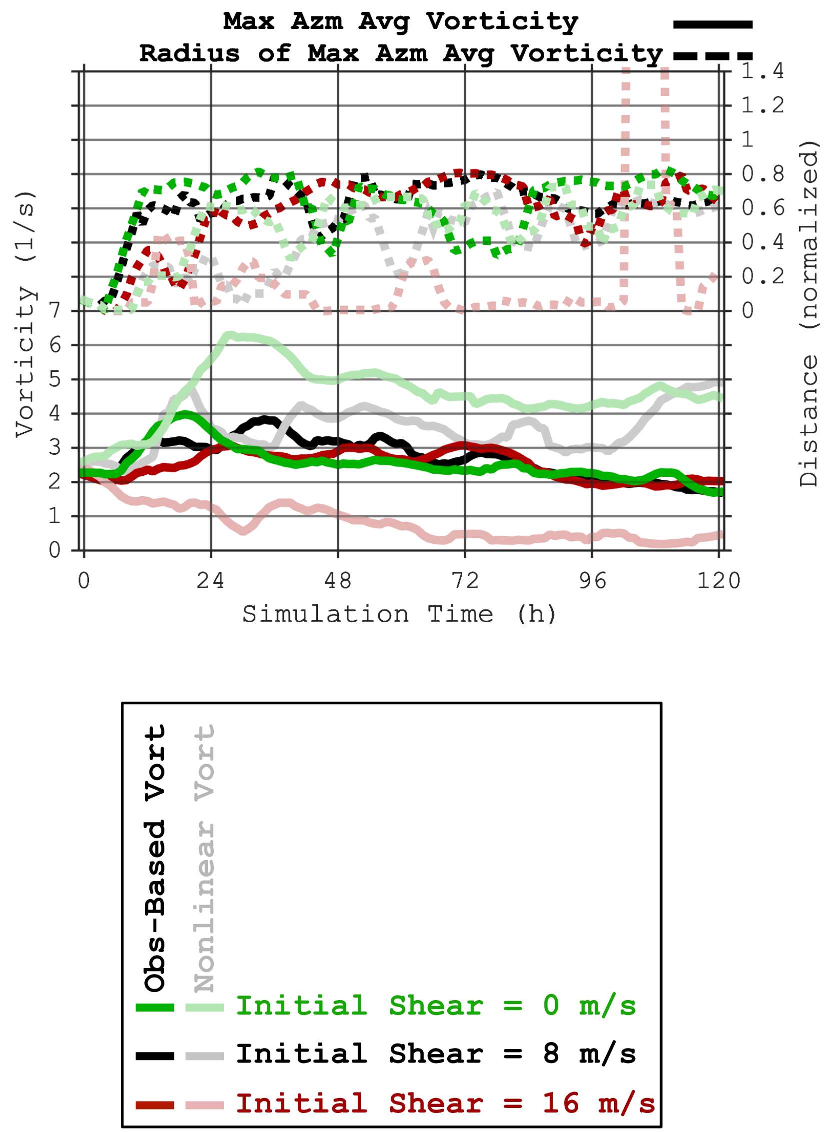








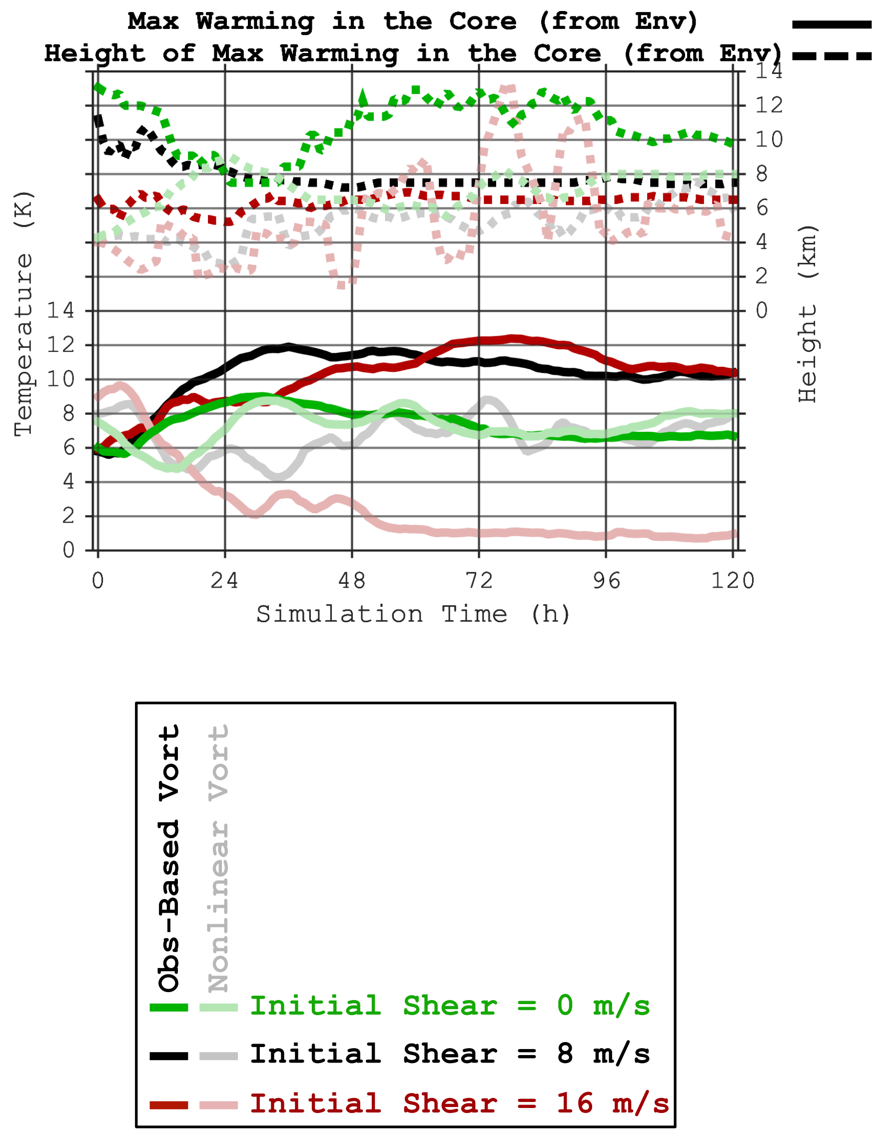
Maximum Vorticity and Its Radius (RMW-Normalized)



1. Time Series of Scalar Metrics

D. Thermal Structure

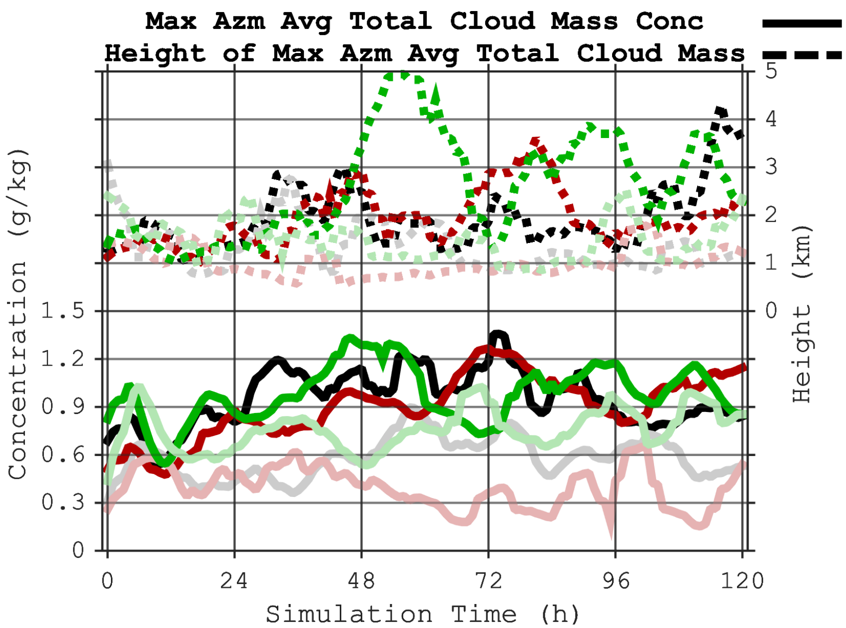
Maximum Warm-Core T Perturbation and Its Height

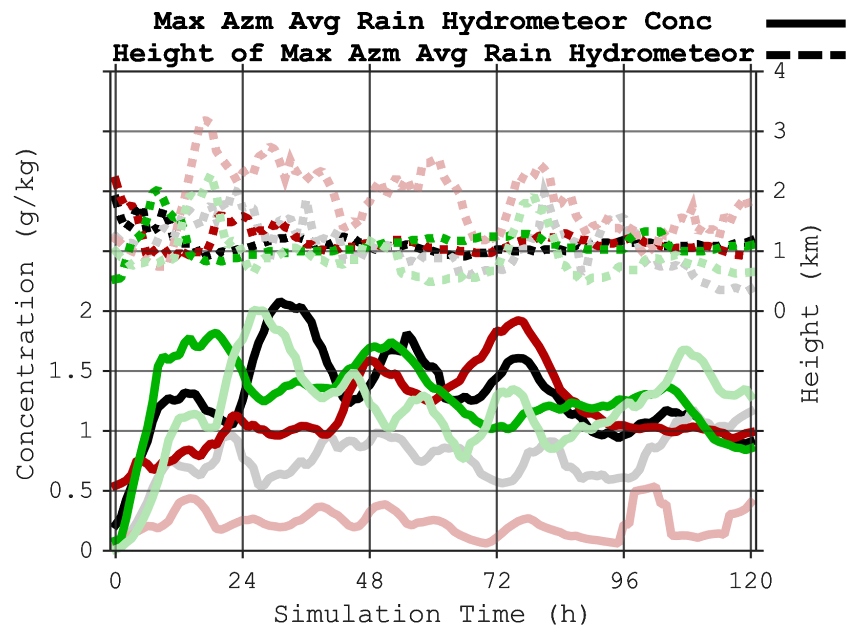


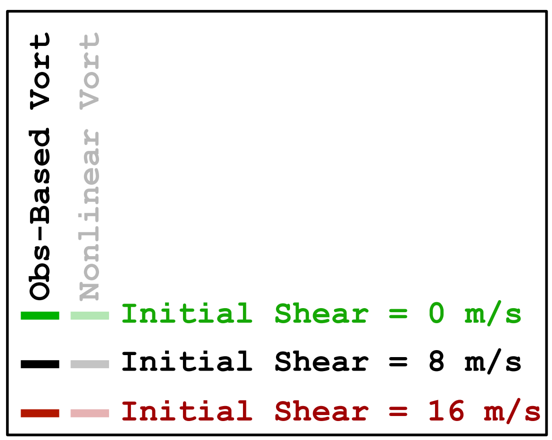
1. Time Series of Scalar Metrics

E. Hydrometeors

Total Cloud Condensate, Rain

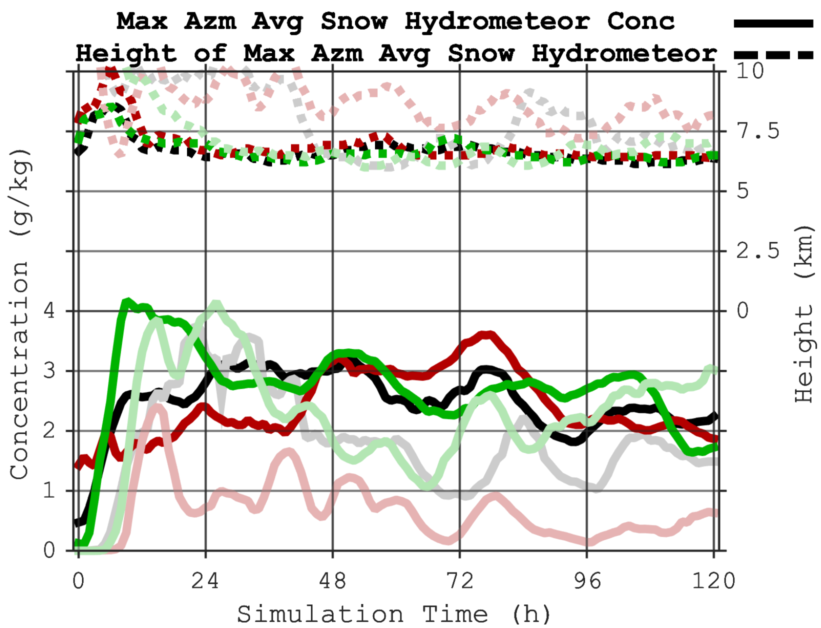


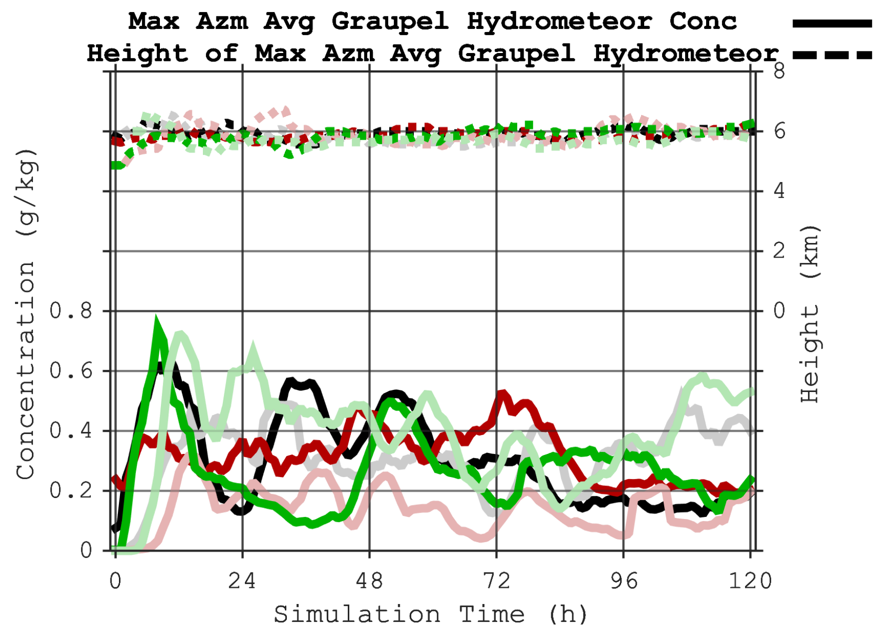


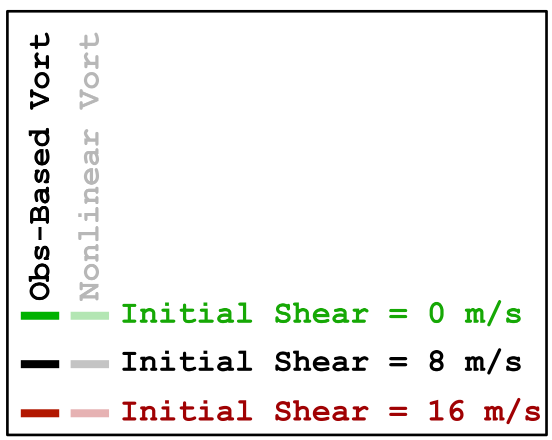


1. Time Series E. Hydrometeors

Snow, Graupel





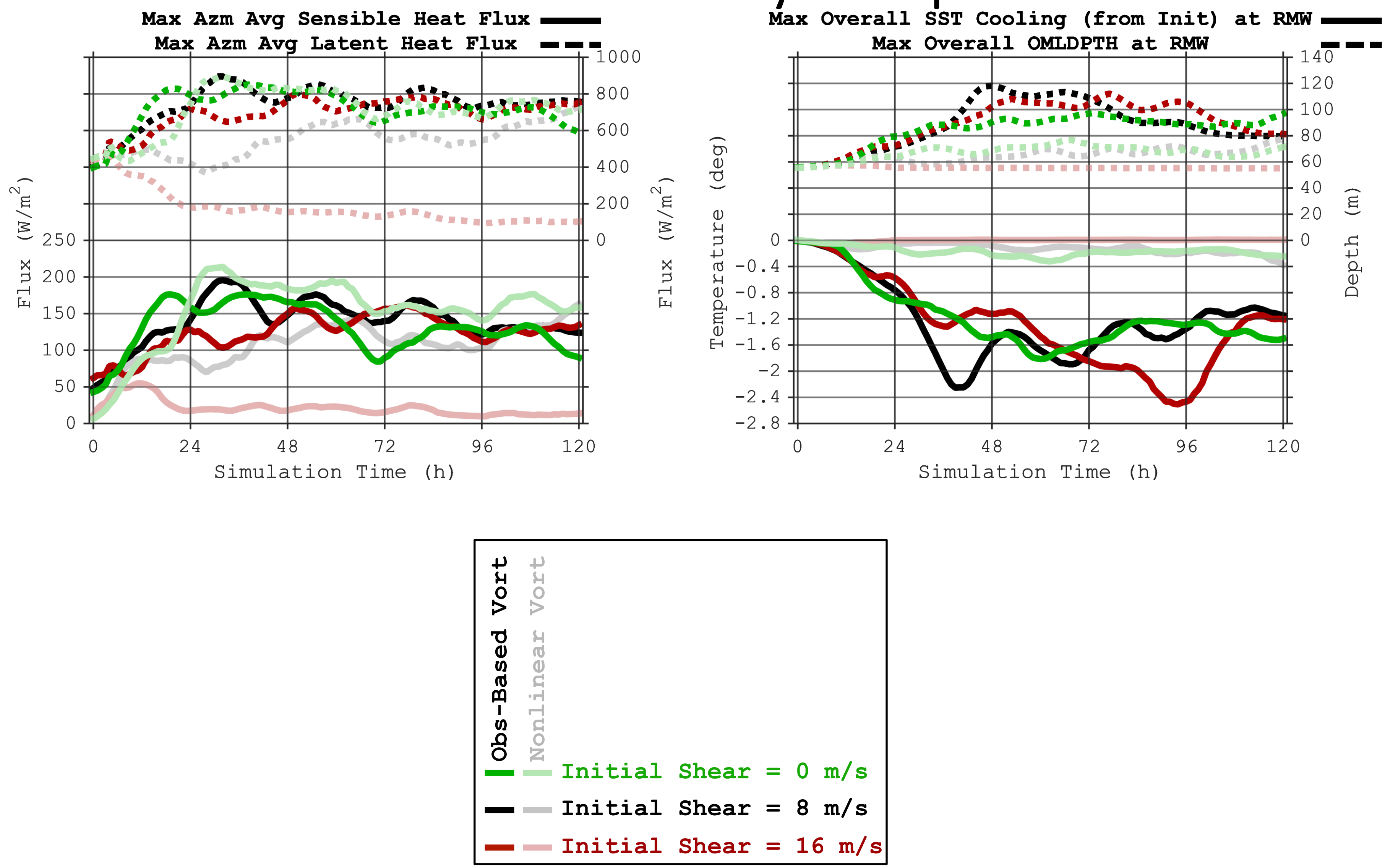


1. Time Series E. Hydrometeors

1. Time Series of Scalar Metrics

F. Surface and Ocean

Surface Latent and Sensible Heat Fluxes, SST Cooling, & Ocean Mixed-Layer Depth



1. Time Series F. Surface & Ocean

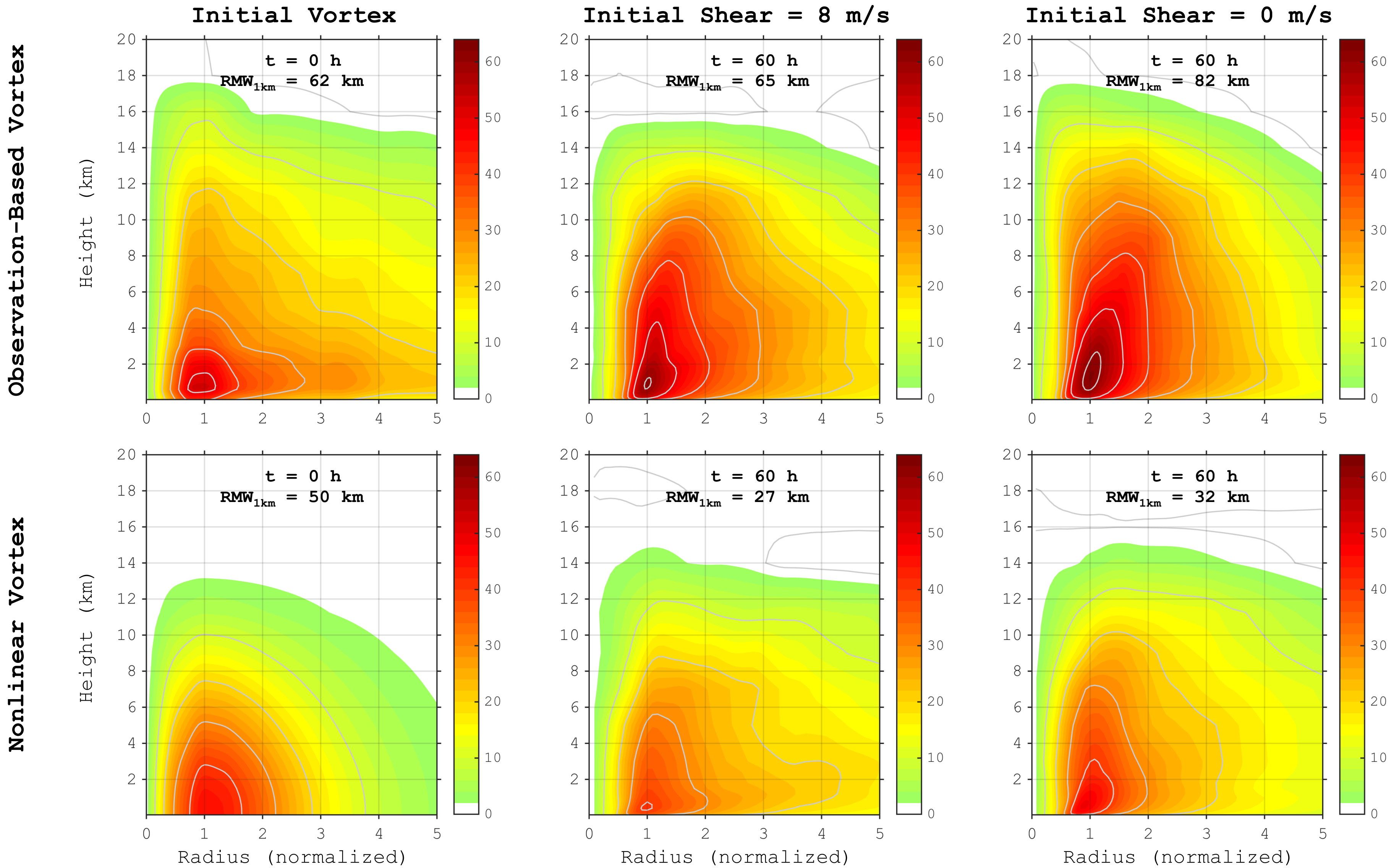
2. Radius-Height (R-Z) Plots of Azimuthally Averaged Fields

➔ To Compare the Vertical Structure of the Steady-State Vortex in Runs Initialized from Observation-Based vs. Nonlinear Vortex for Moderate- (Control) vs. No-Shear Environments

2. R-Z Plots of Azimuthally Averaged Fields

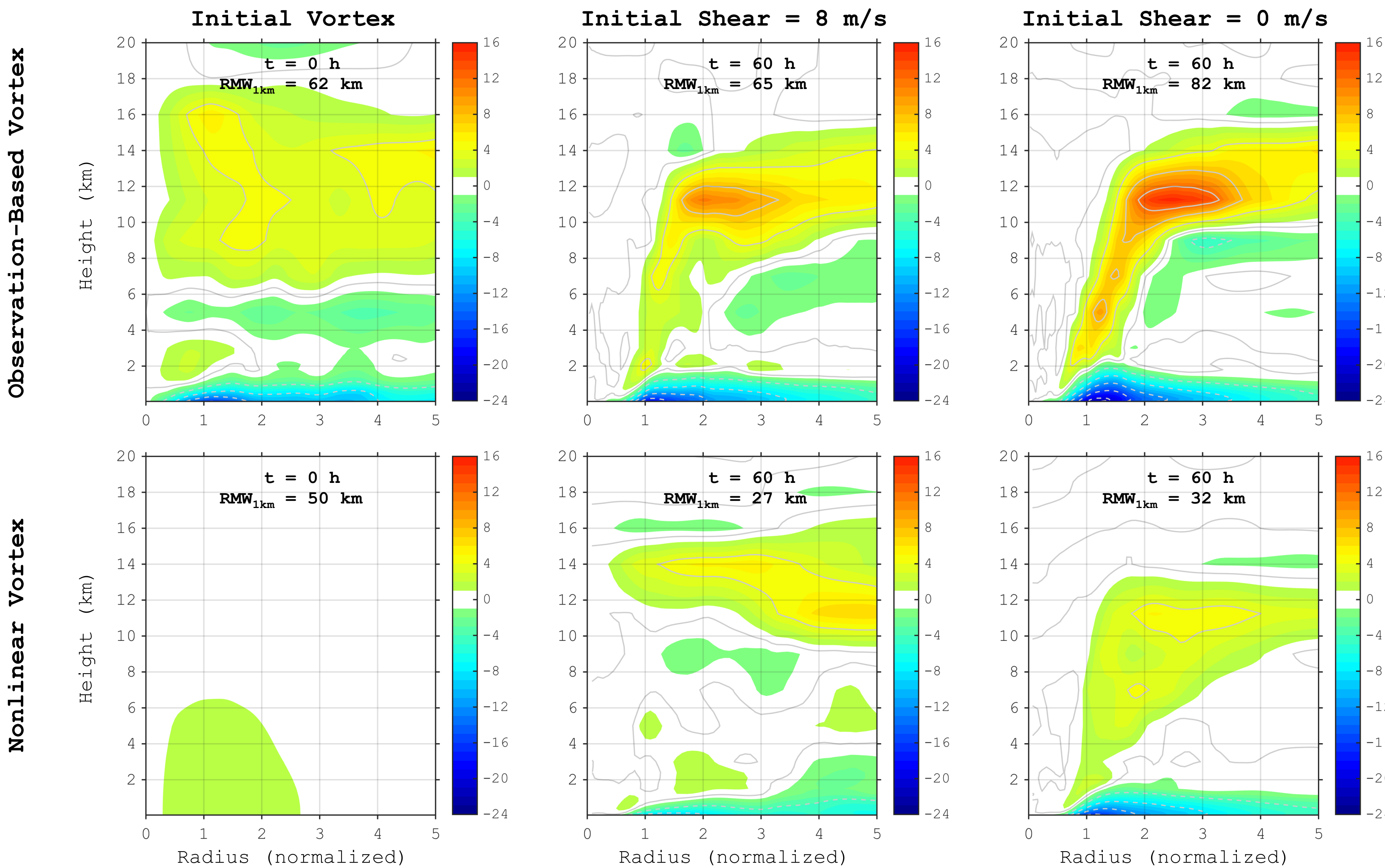
A. Kinematic Structure: Primary & Secondary Circulations, Vorticity

Tangential Wind Speed (m/s)



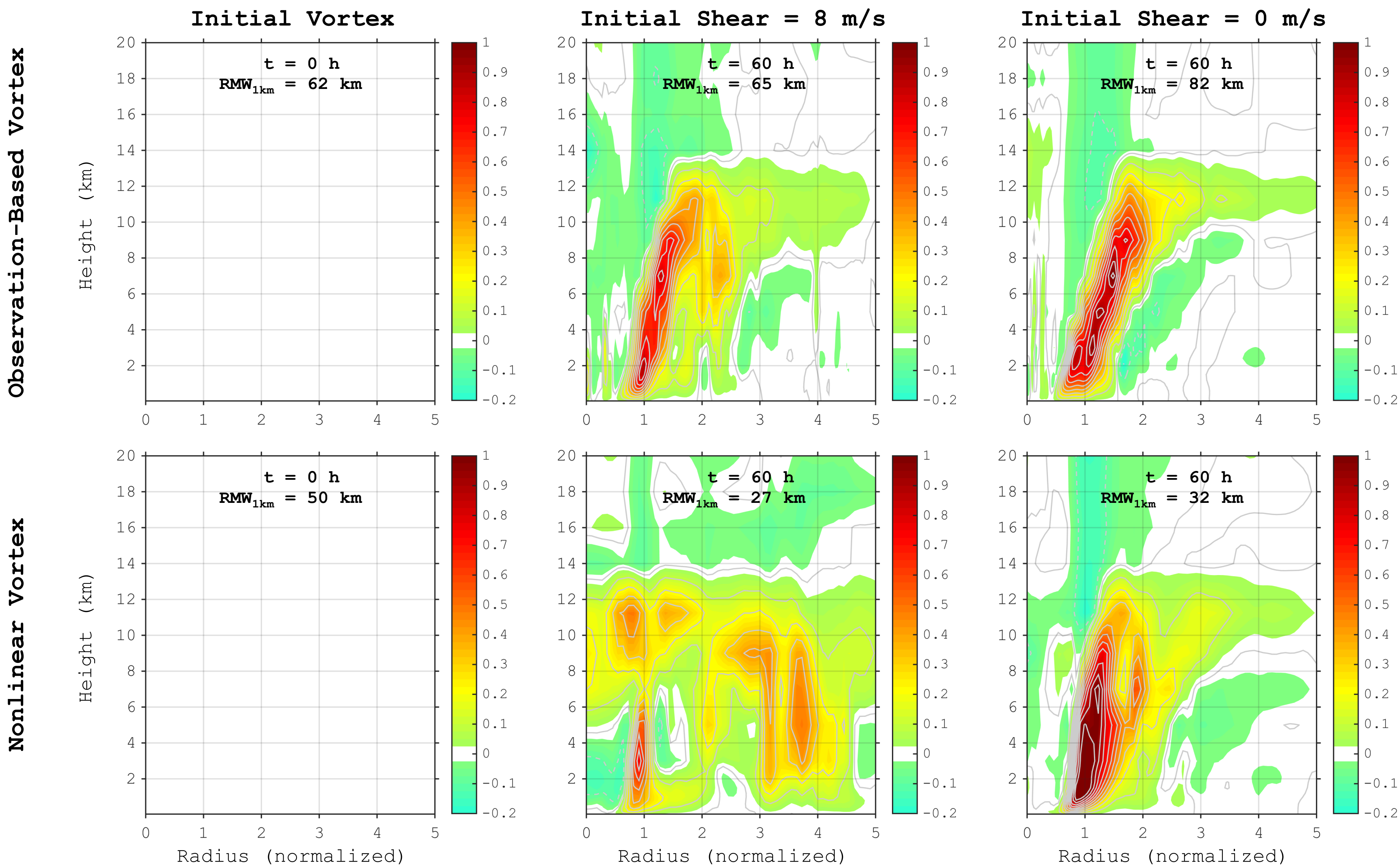
➔ RMW = Max V_T at 1km

Radial Wind Speed (m/s)

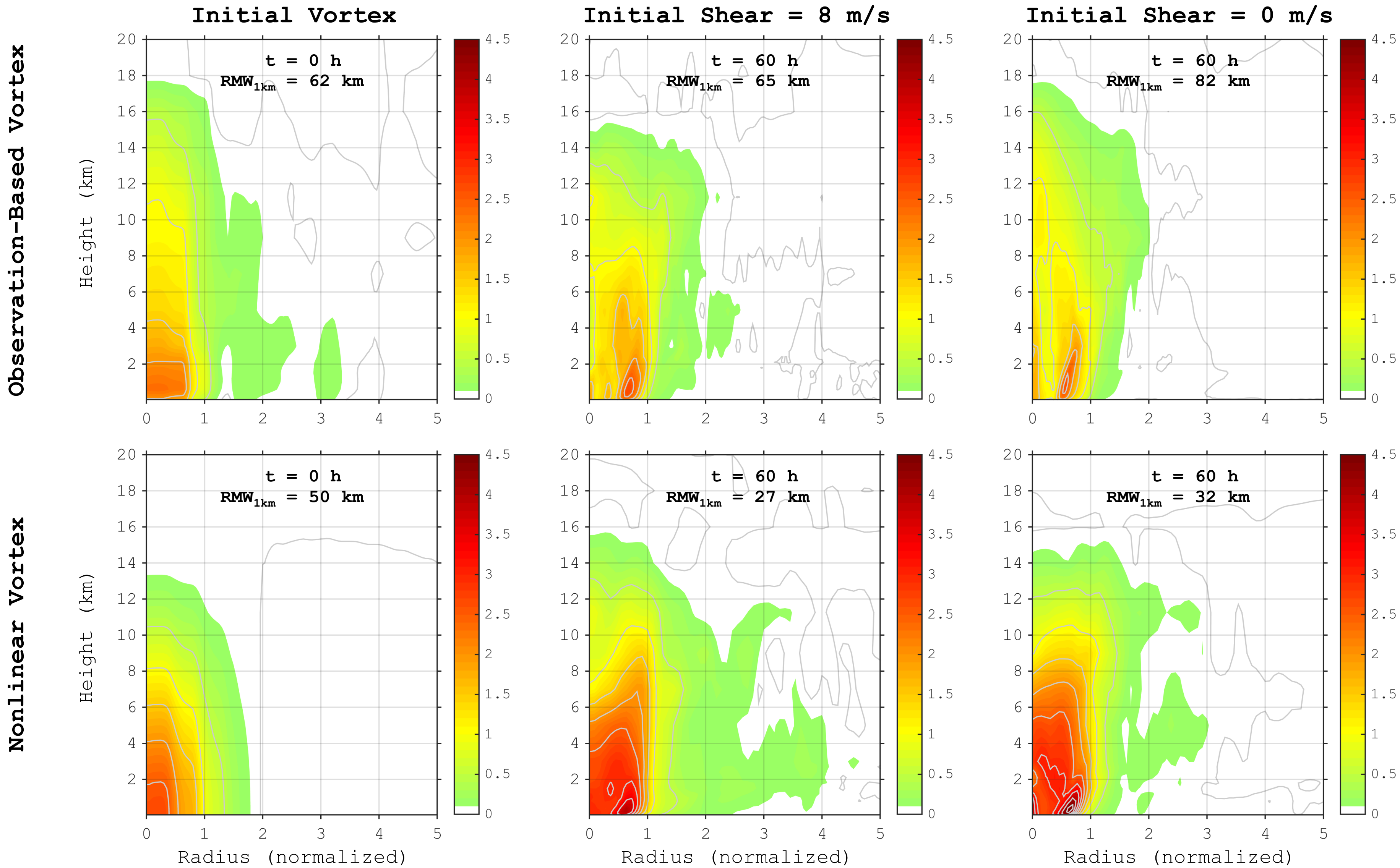


2. R-Height A. Kinematic Structure

Vertical Wind Speed (m/s)



Vorticity (10^5 s^{-1})

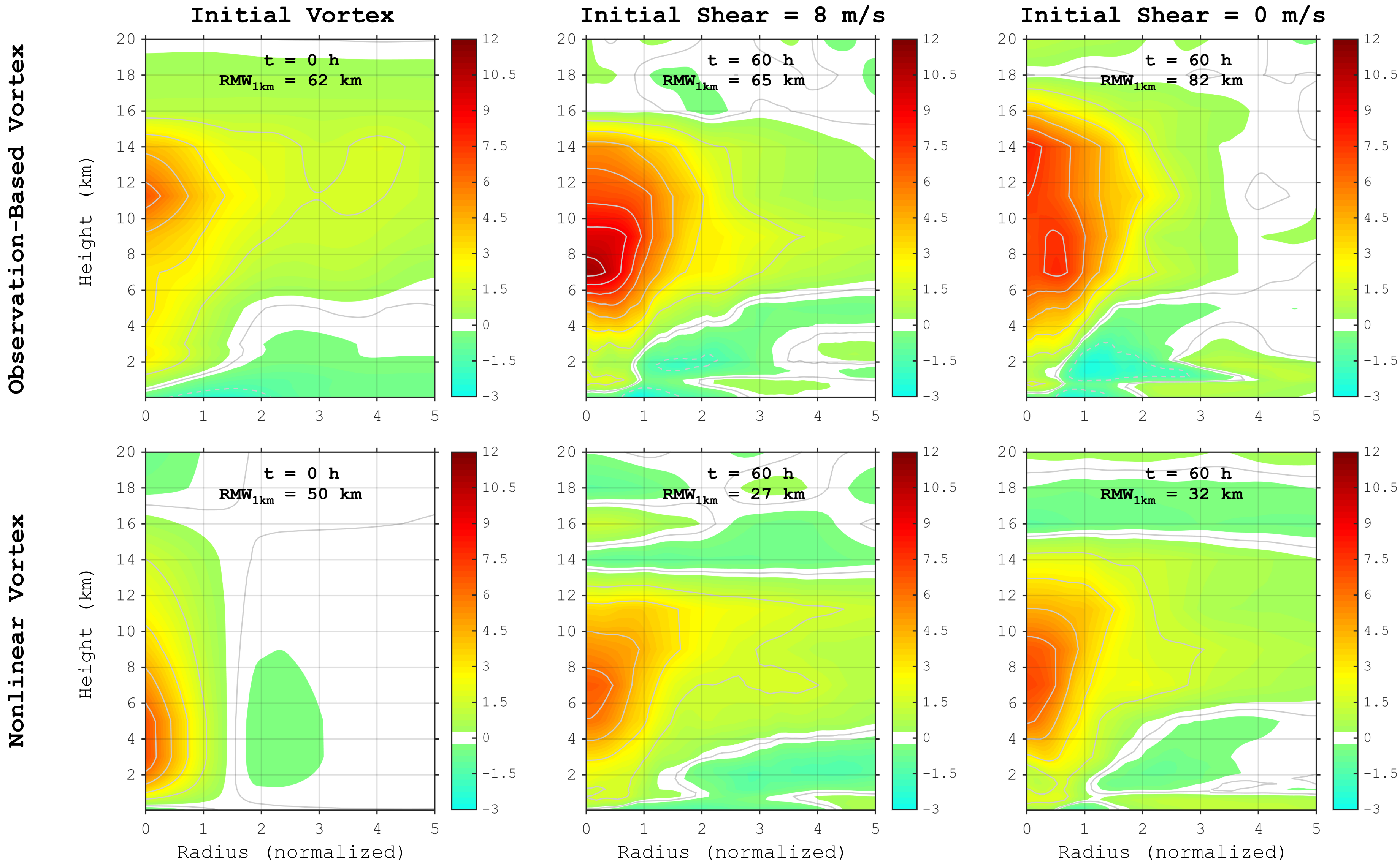


2. R-Height A. Kinematic Structure

2. R-Z Plots of Azimuthally Averaged Fields

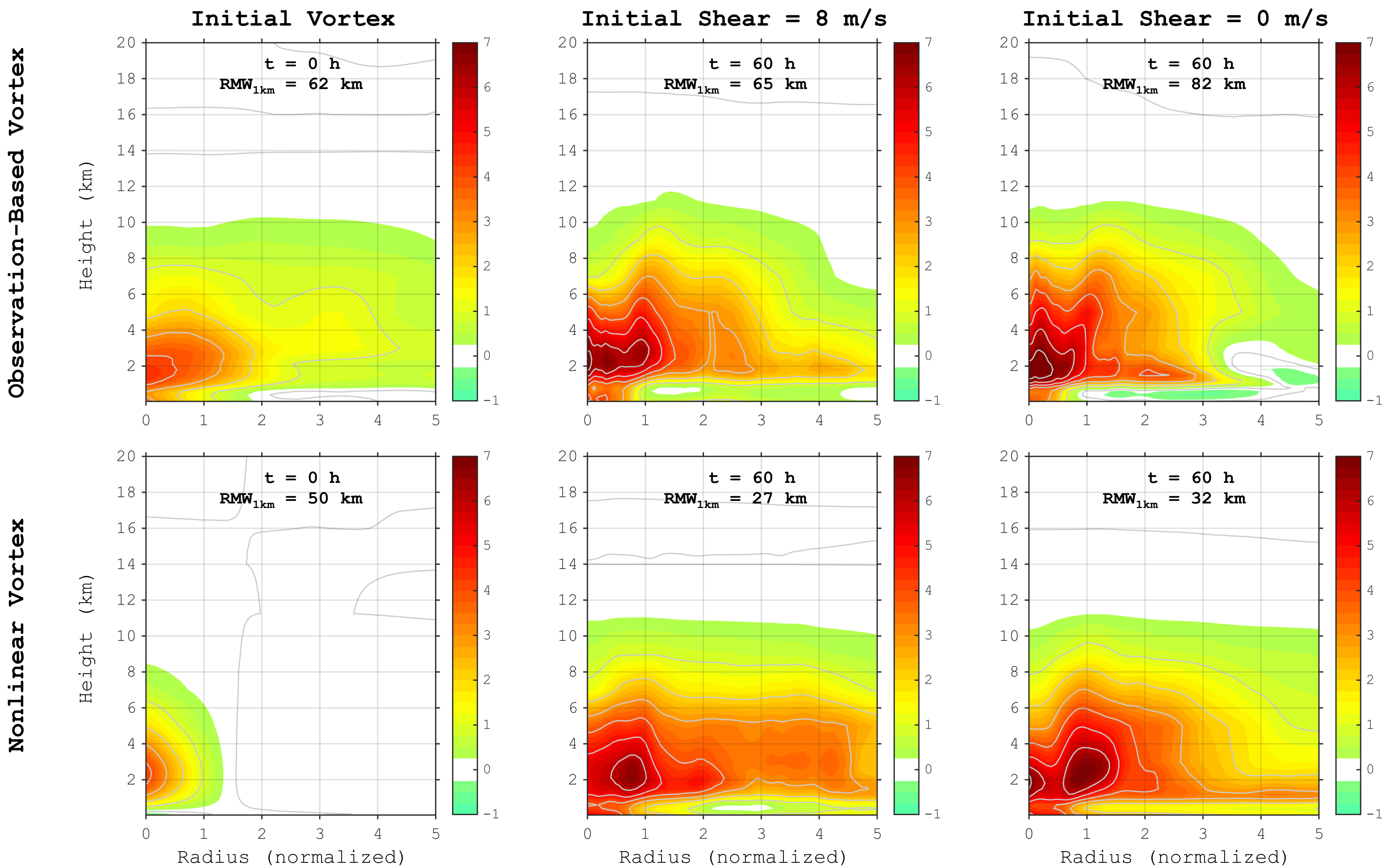
B. Thermal Structure: Temperature and Moisture Perturbations

Temperature Perturbation (K)



2. R-Height B. Thermal Structure

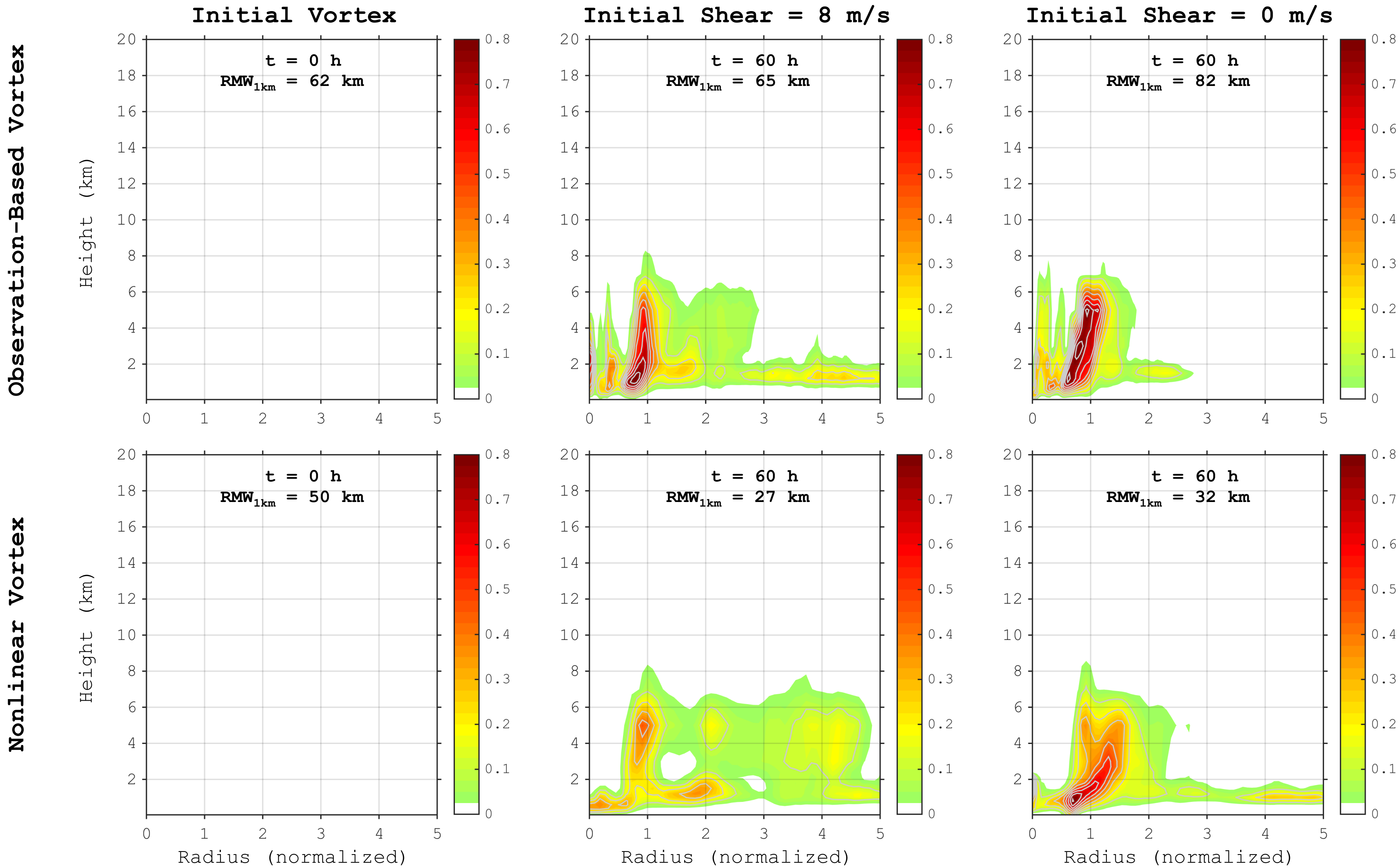
Specific Humidity Perturbation (g/kg)



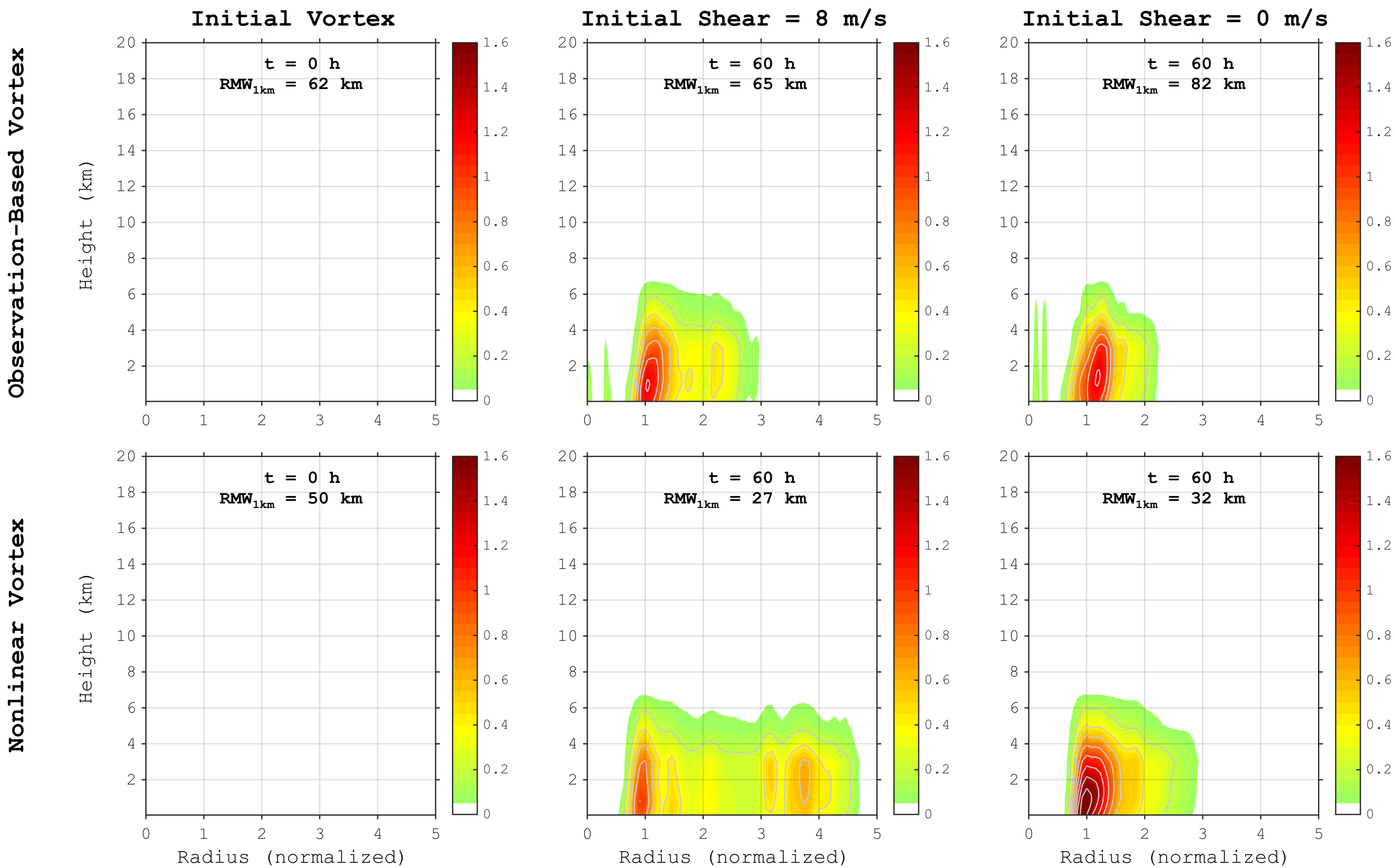
2. R-Z Plots of Azimuthally Averaged Fields

C. Hydrometeors

Total Cloud Condensate (g/kg)

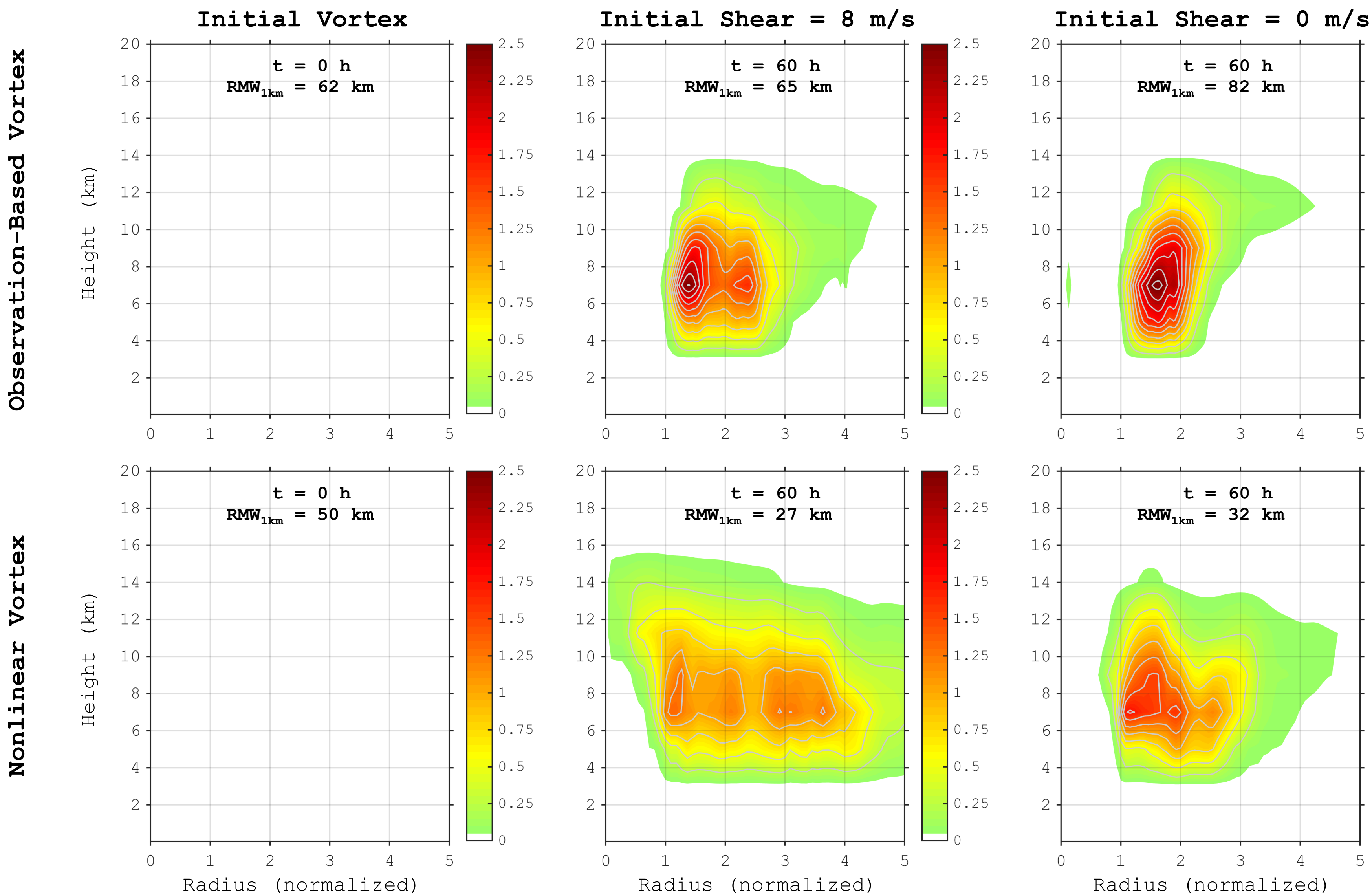


Rain (g/kg)



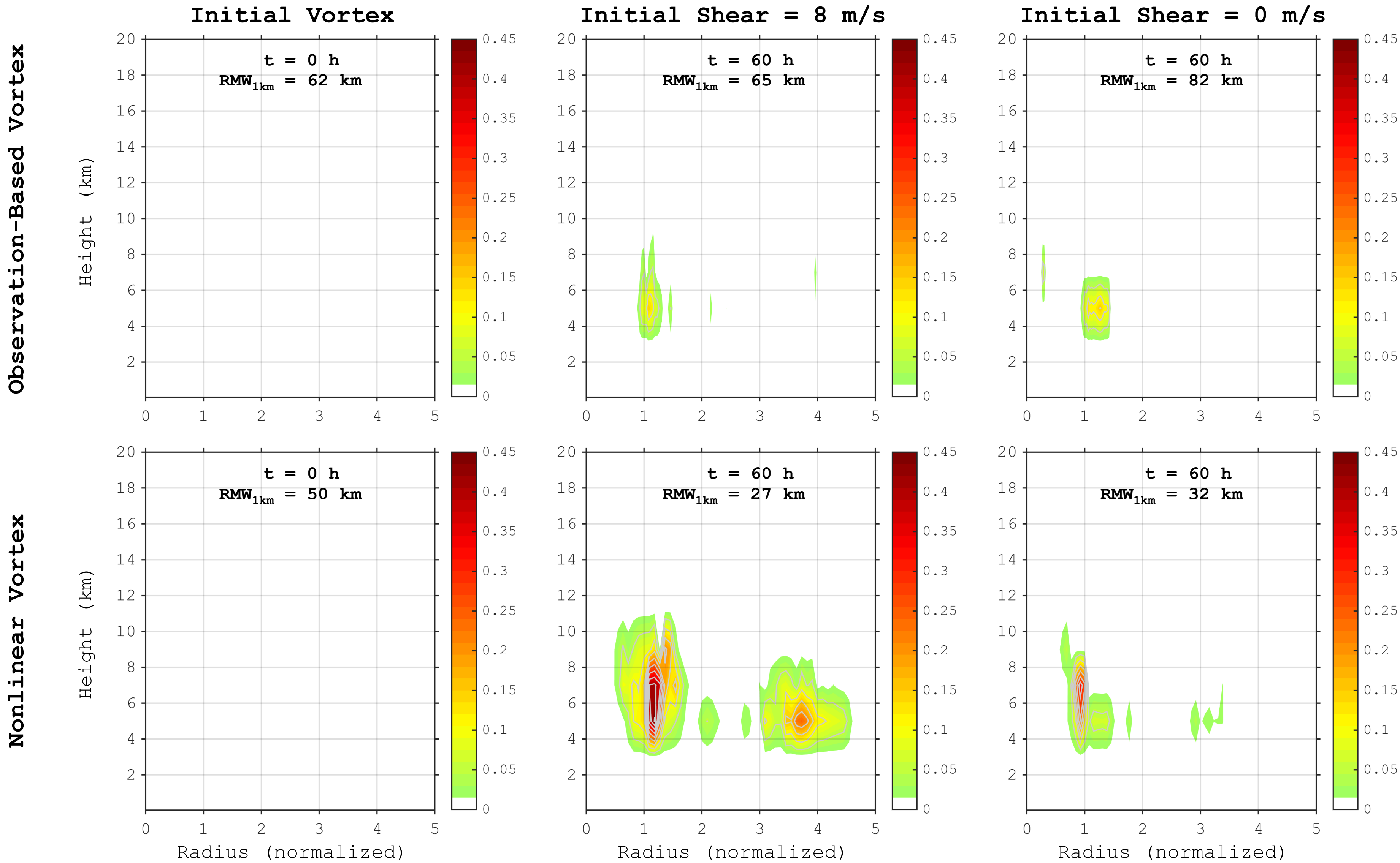
2. R-Height C. Hydrometeors

Snow (g/kg)



2. R-Height C. Hydrometeors

Graupel (g/kg)



2. R-Height C. Hydrometeors

3. Radius-Azimuth (R-Theta) Plots at Specified Heights

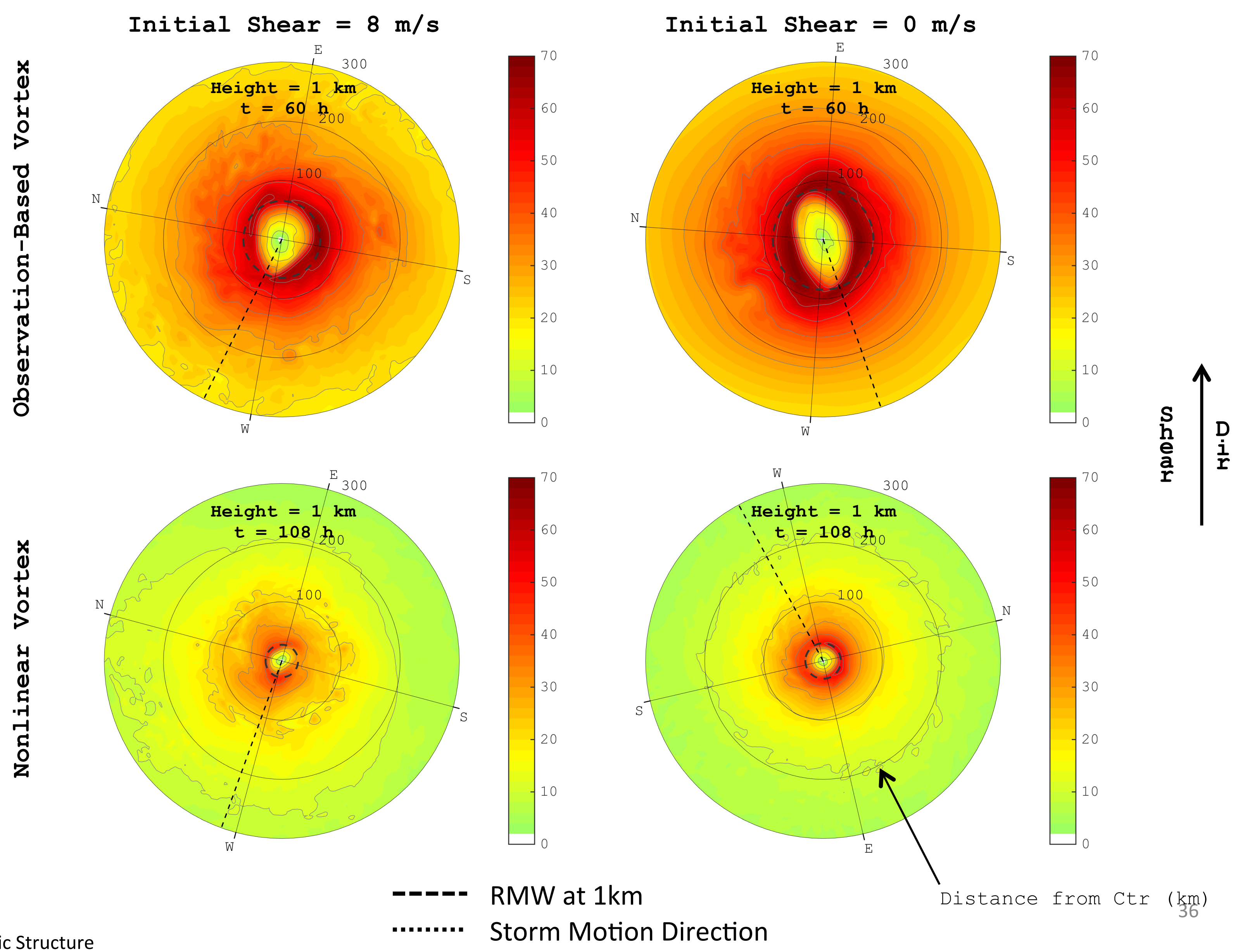
➔ To Compare the Horizontal Structure of the Steady-State Vortex in Runs Initialized from Observation-Based vs. Nonlinear Vortex for Moderate- (Control) vs. No-Shear Environments

3. R-Theta Plots at Specified Heights

A. Kinematic Structure: Primary & Secondary Circulations, Vorticity

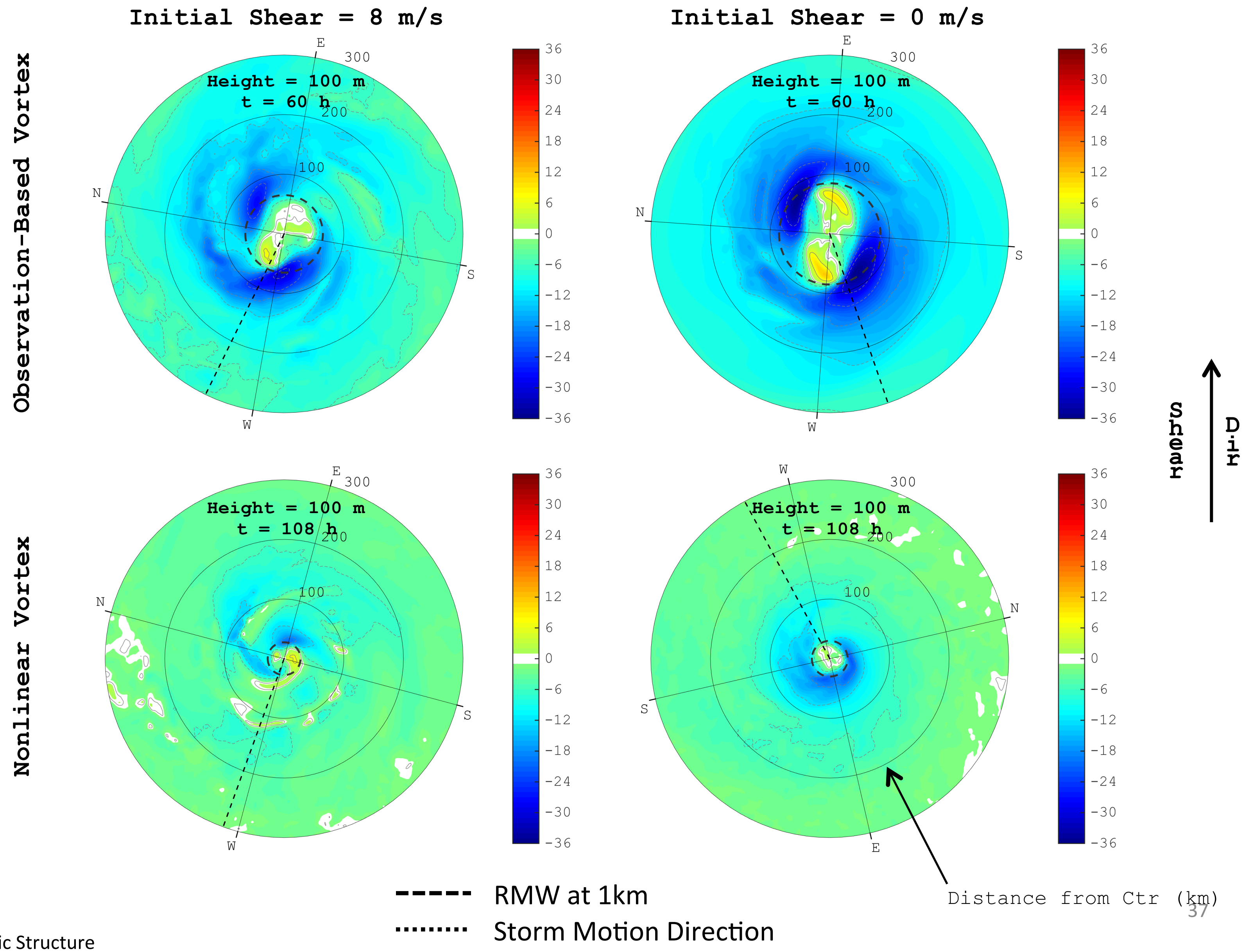
Tangential Wind Speed (m/s)

(Shear Relative)



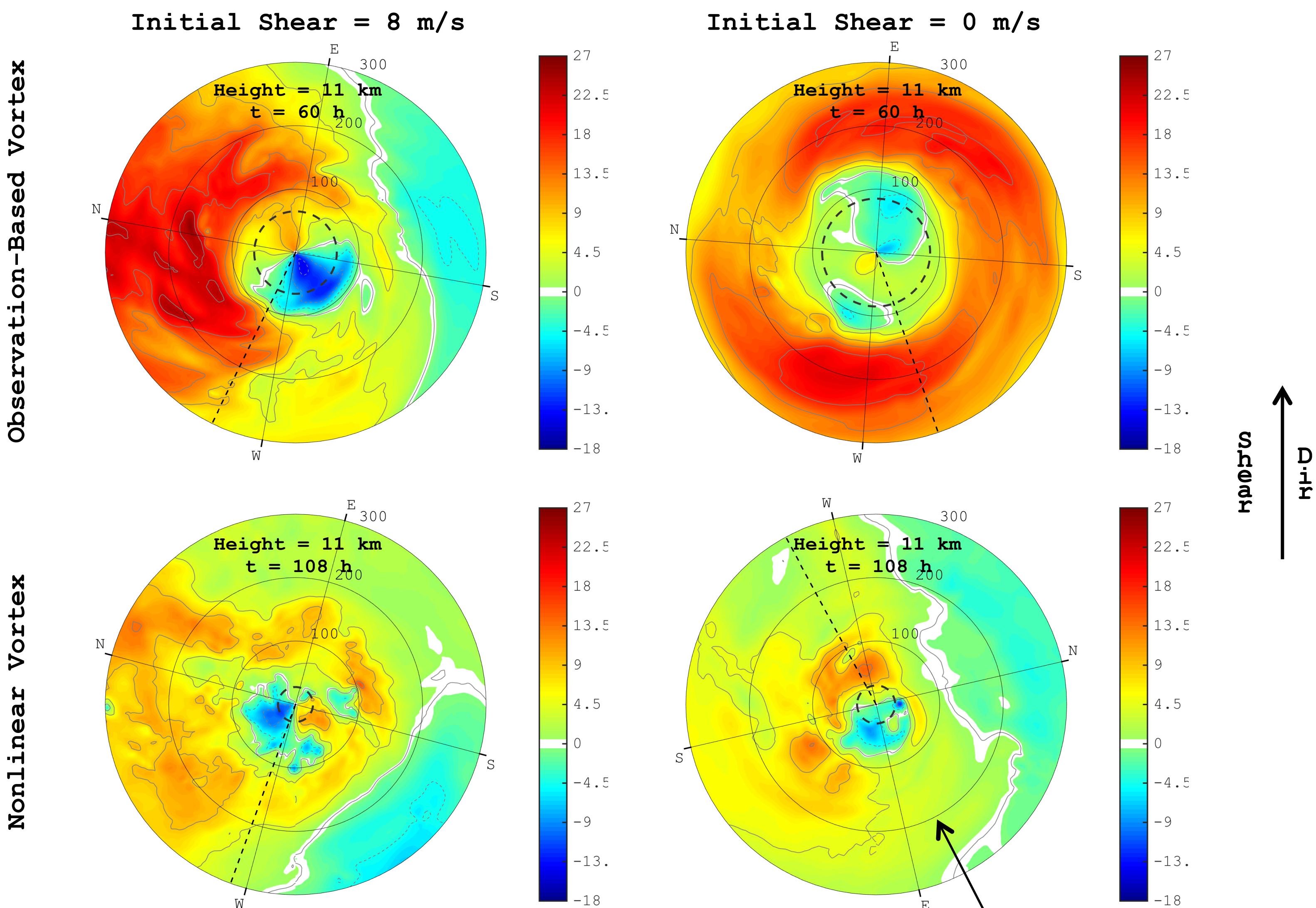
Radial Wind Speed (m/s)

(Shear Relative)



Radial Wind Speed (m/s)

(Shear Relative)

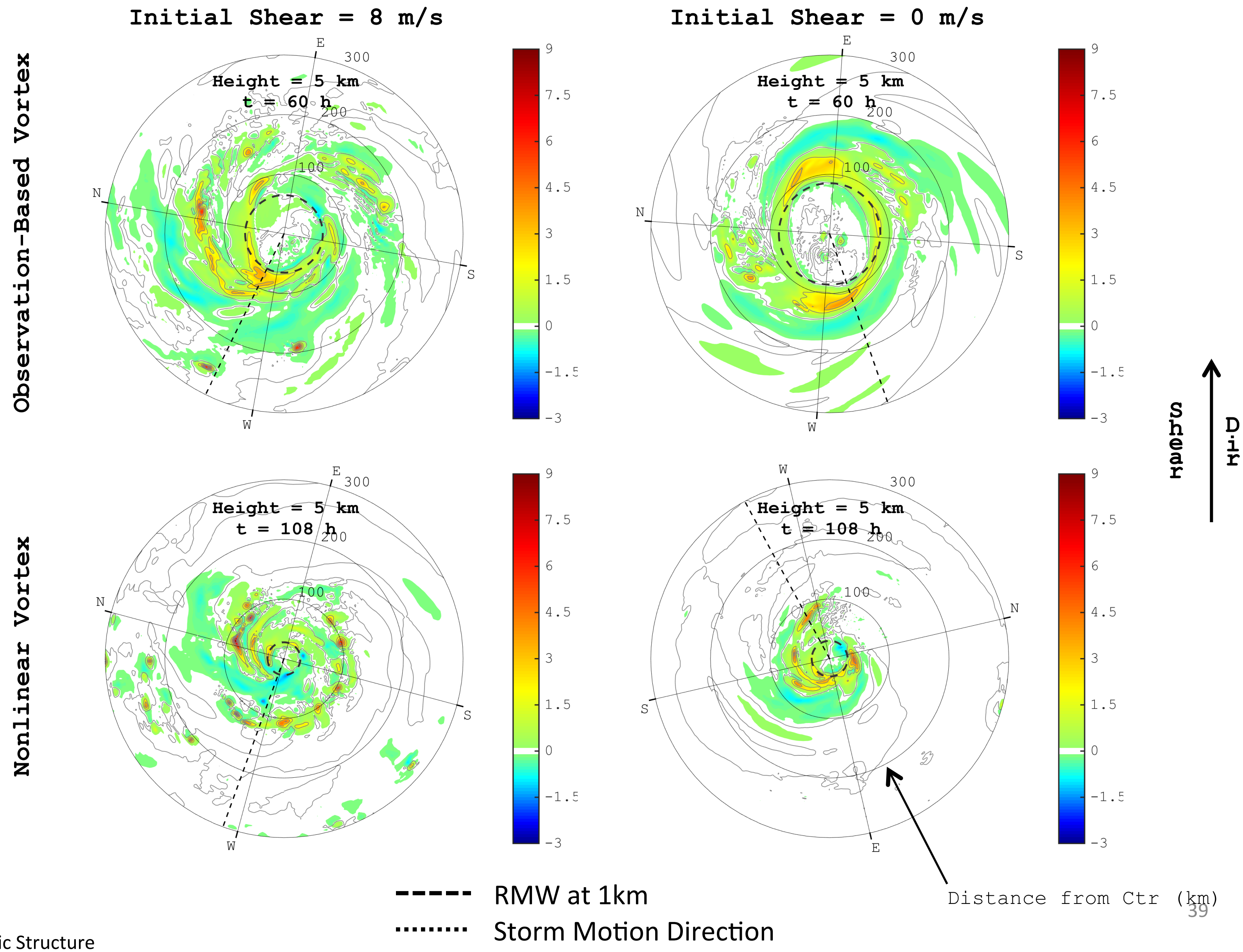


RMW at 1km

Storm Motion Direction

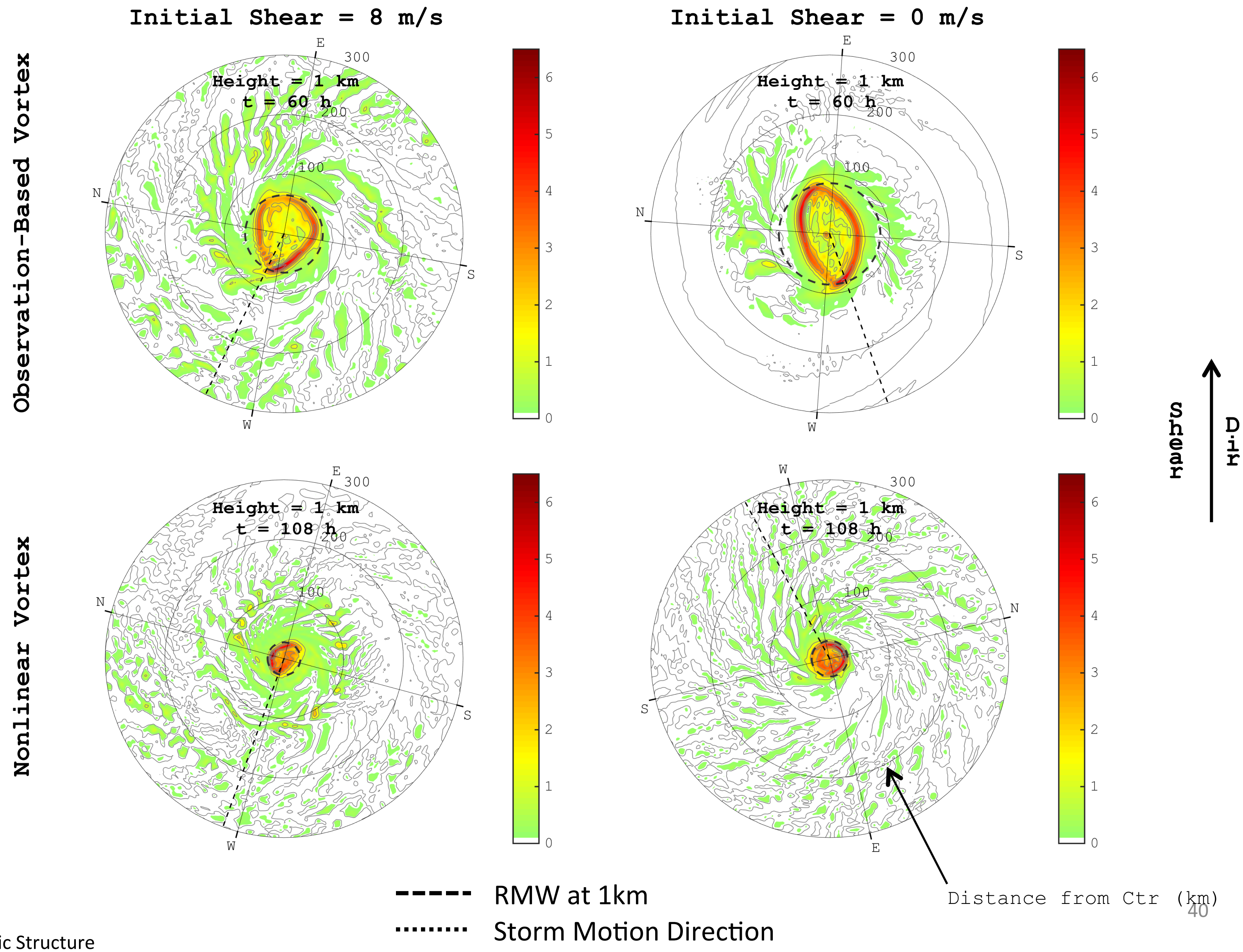
Vertical Wind Speed (m/s)

(Shear Relative)



Vorticity (10^5 s^{-1})

(Shear Relative)

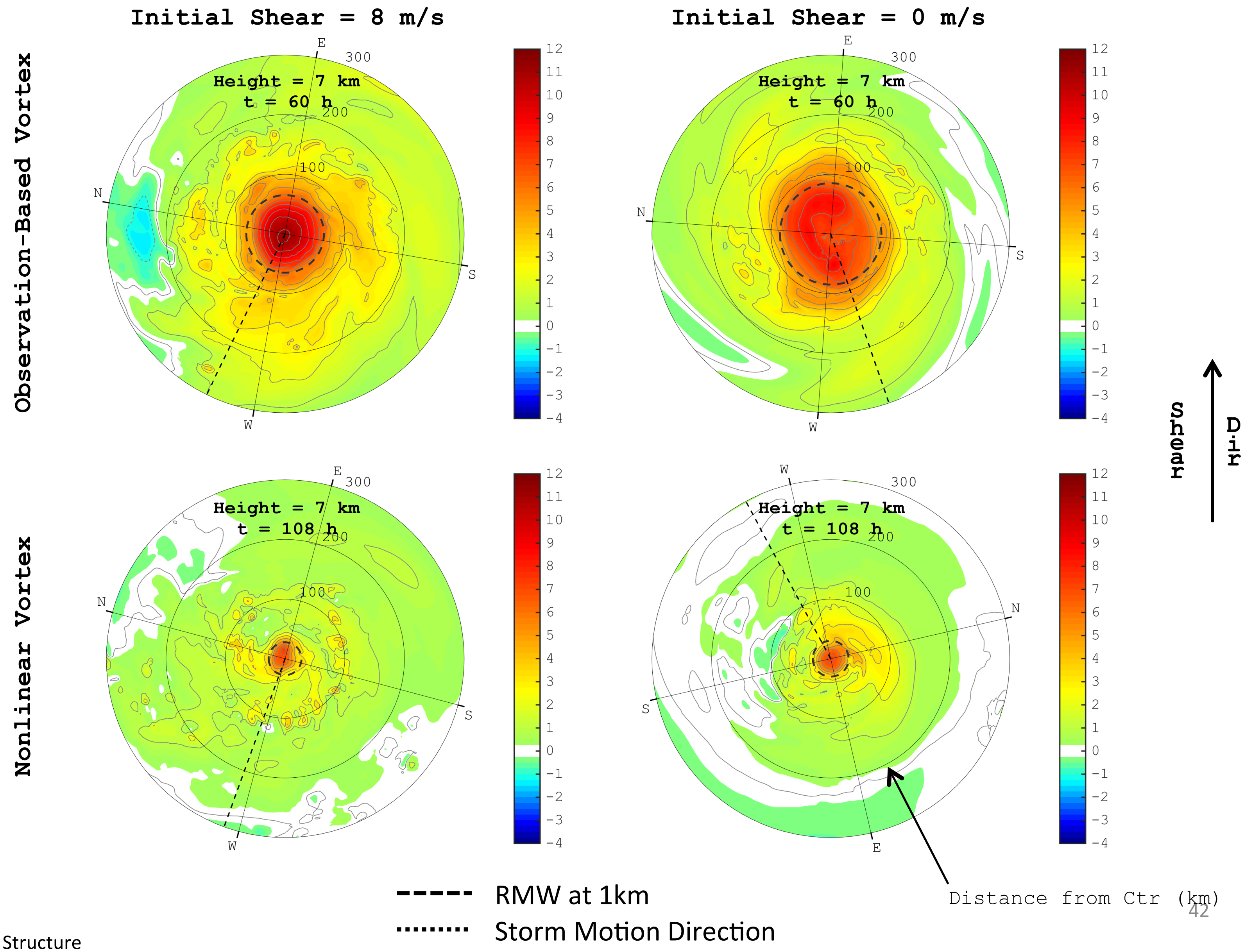


3. R-Theta Plots at Specified Heights

B. Thermal Structure: Temperature and Moisture Perturbations

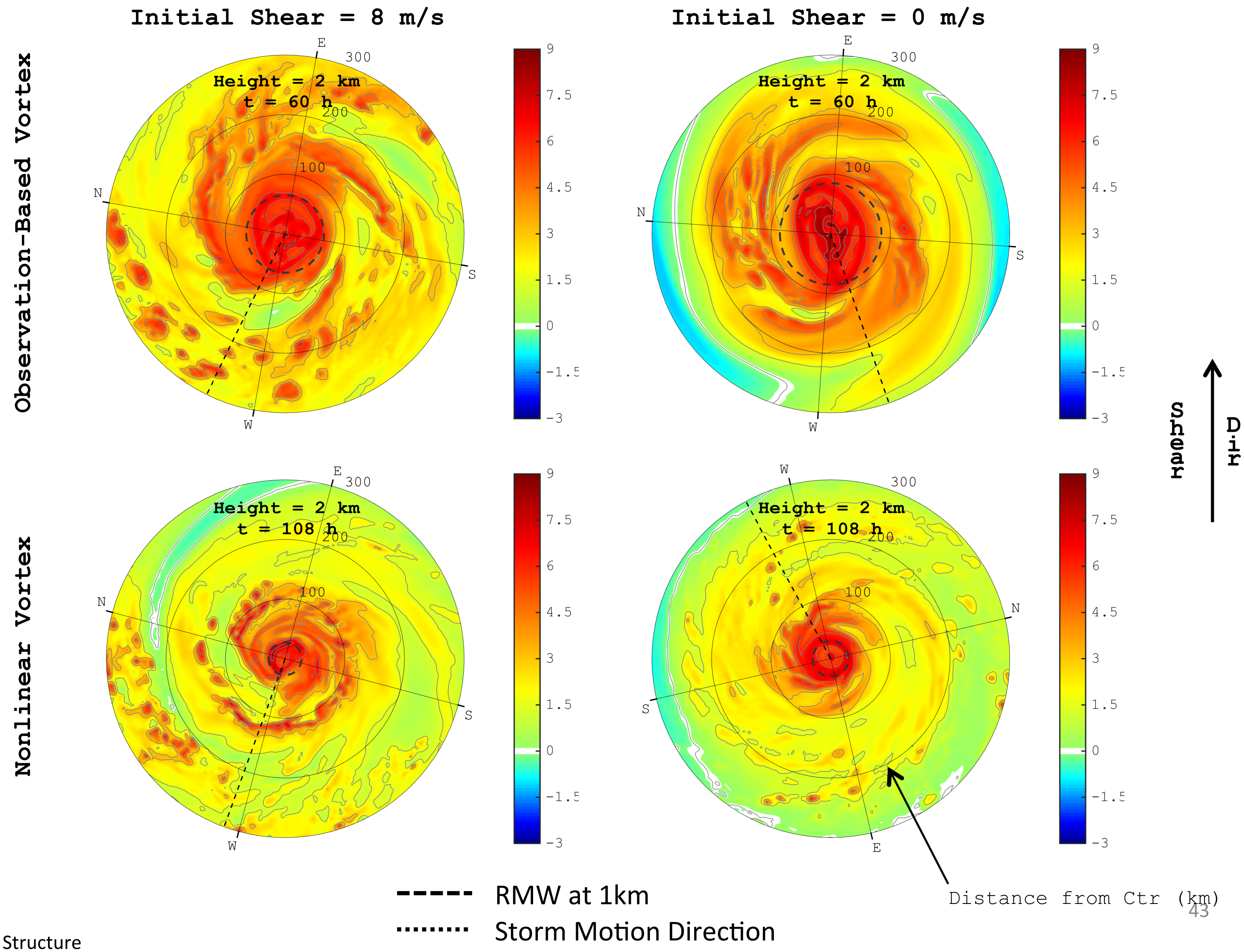
Temperature Perturbation (K)

(Shear Relative)



Specific Humidity Perturbation (g/kg)

(Shear Relative)

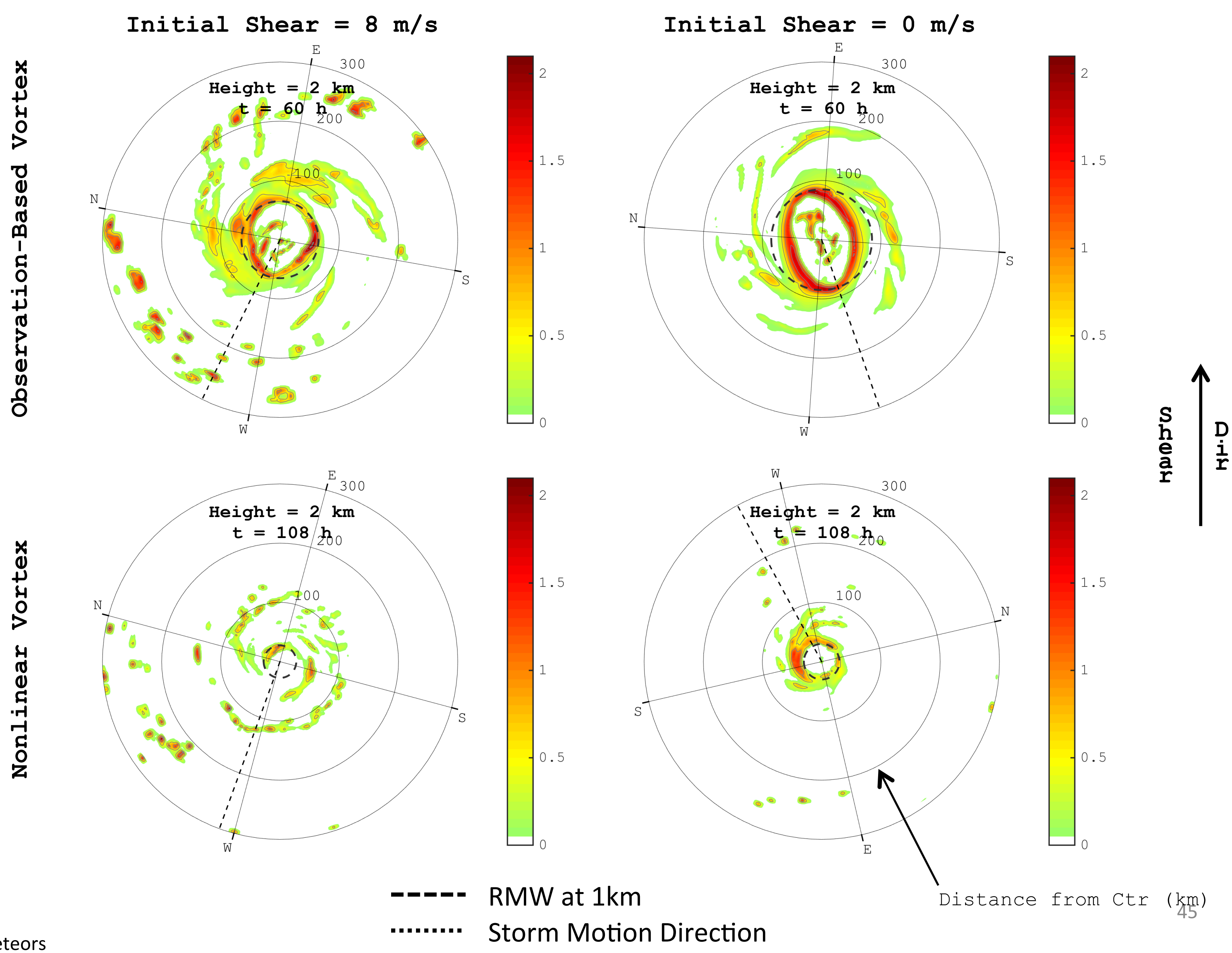


3. R-Theta Plots at Specified Heights

C. Hydrometeors

Total Cloud Condensate (g/kg)

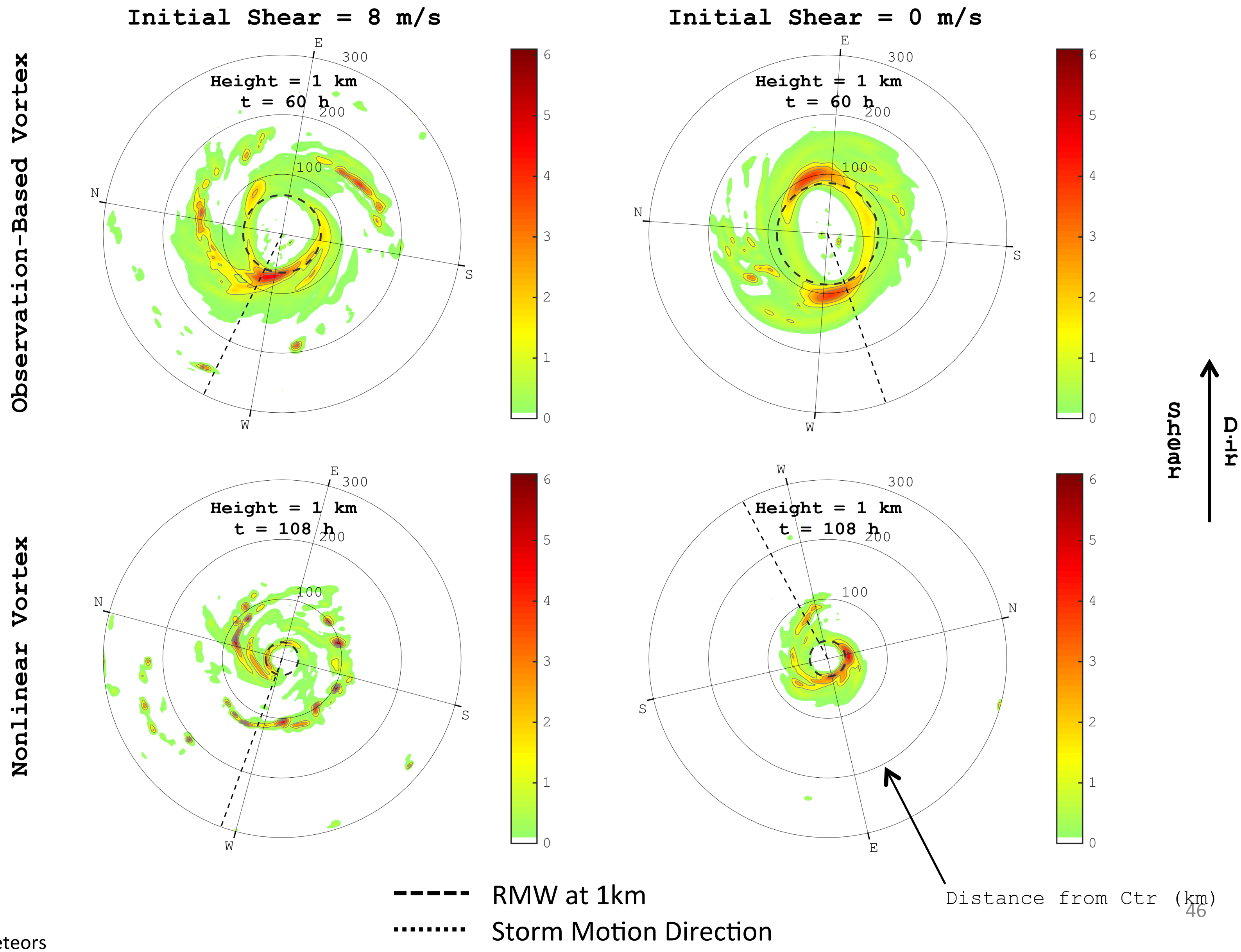
(Shear Relative)



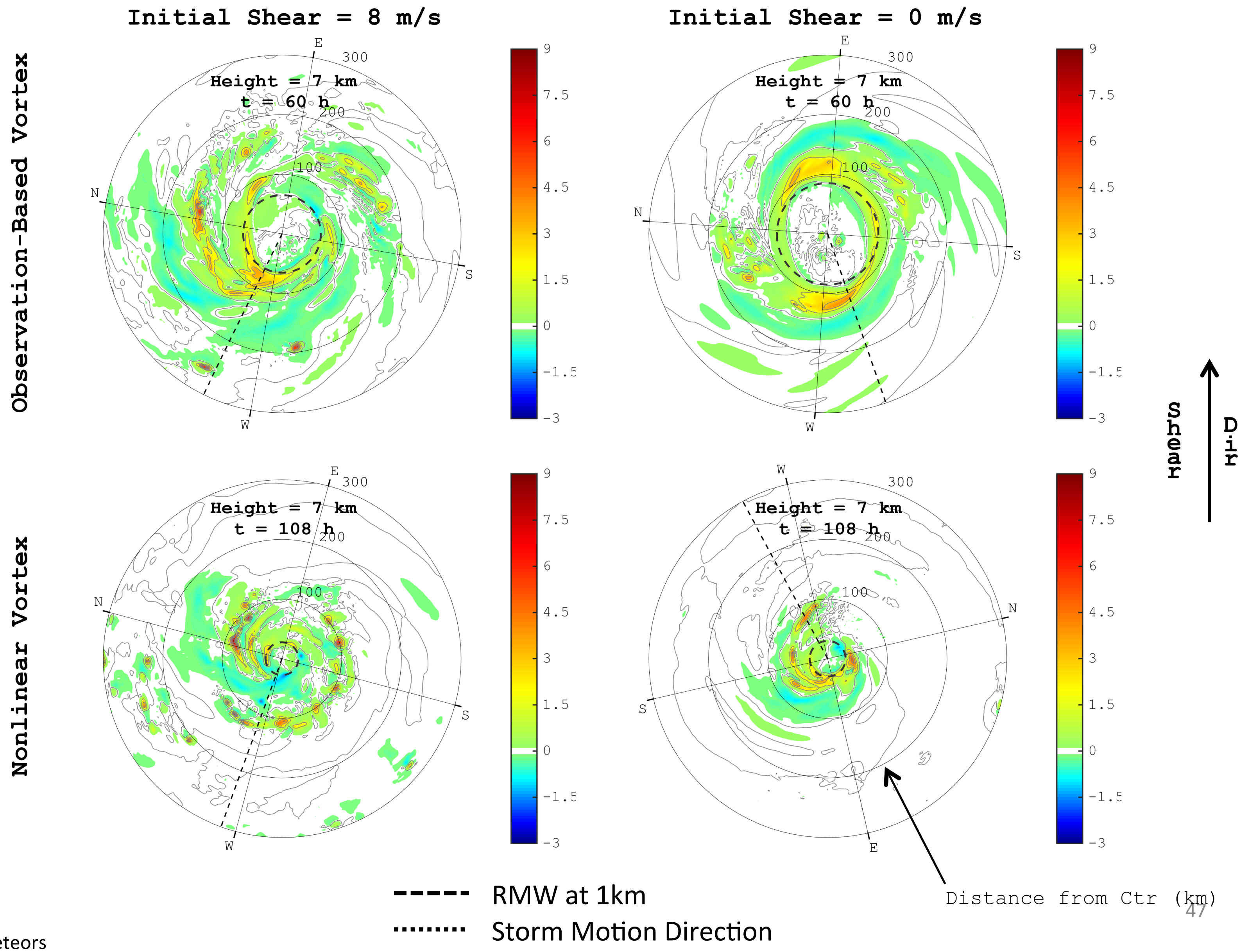
3. R-Theta C. Hydrometeors

Rain (g/kg)

(Shear Relative)

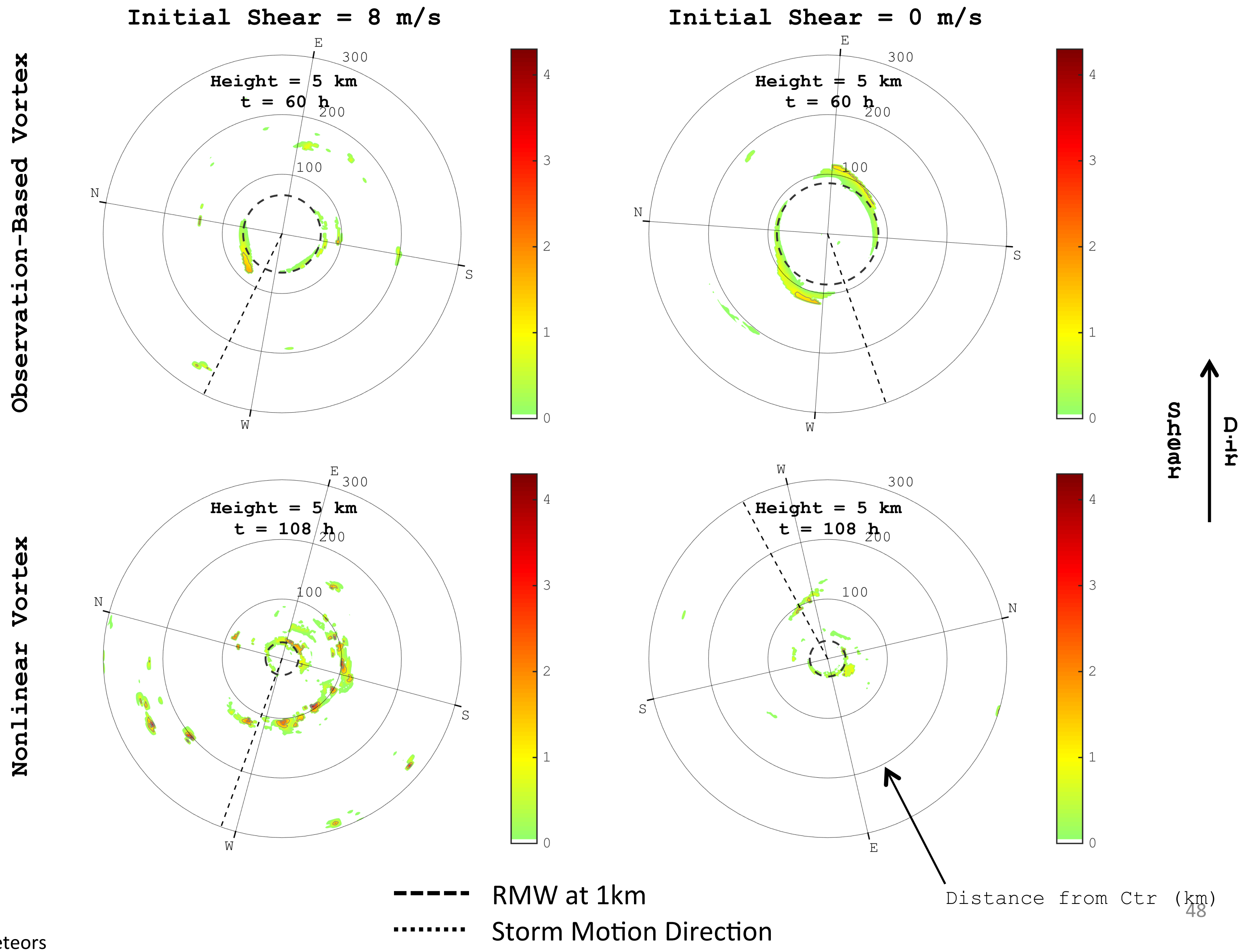


Snow (g/kg)
(Shear Relative)



Graupel (g/kg)

(Shear Relative)

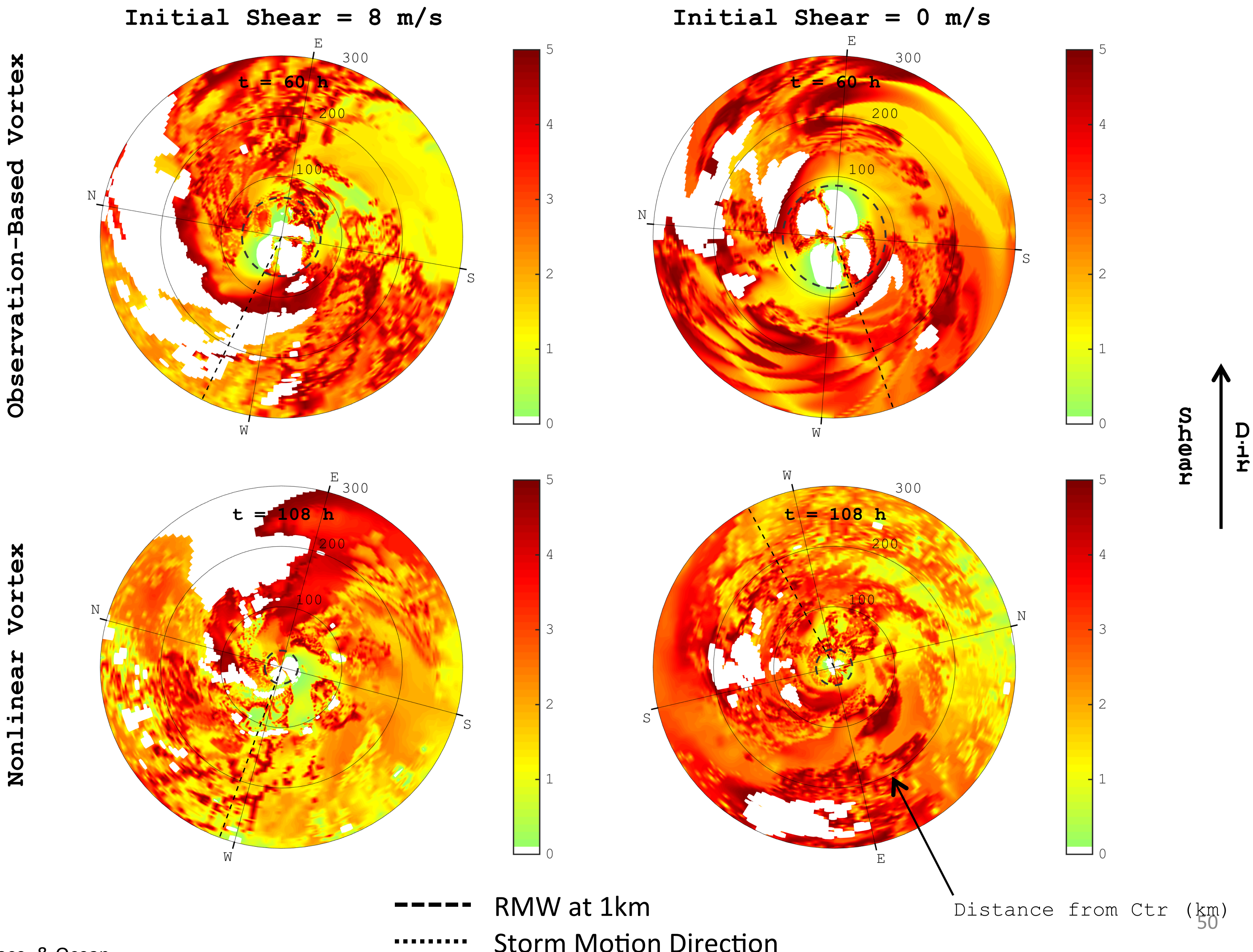


3. R-Theta Plots at Specified Heights

D. Two-Dimensional Features That Relate to The PBL, Surface, and Ocean

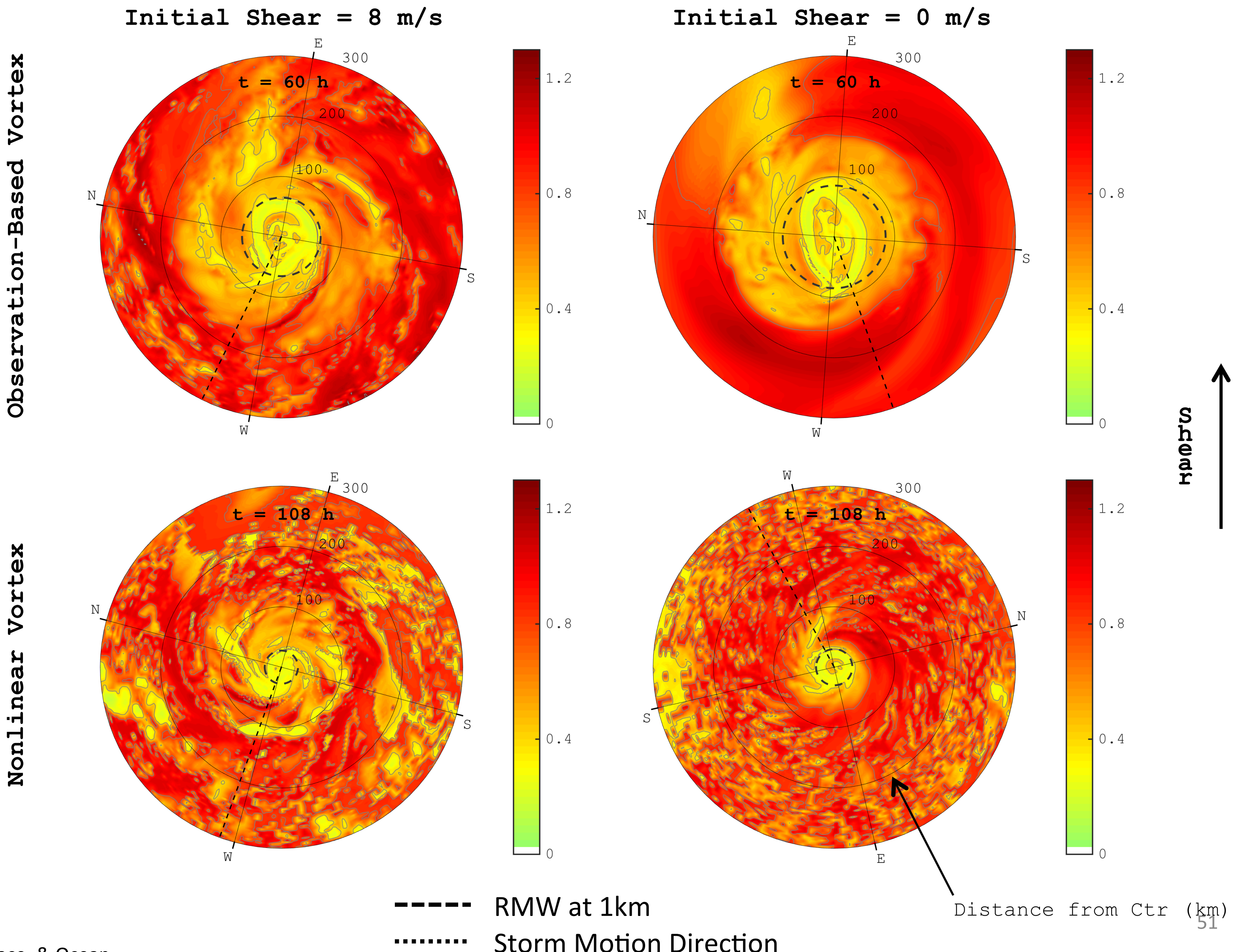
PBL Height Measured as 10% of Radial Inflow (km)

(Shear Relative)



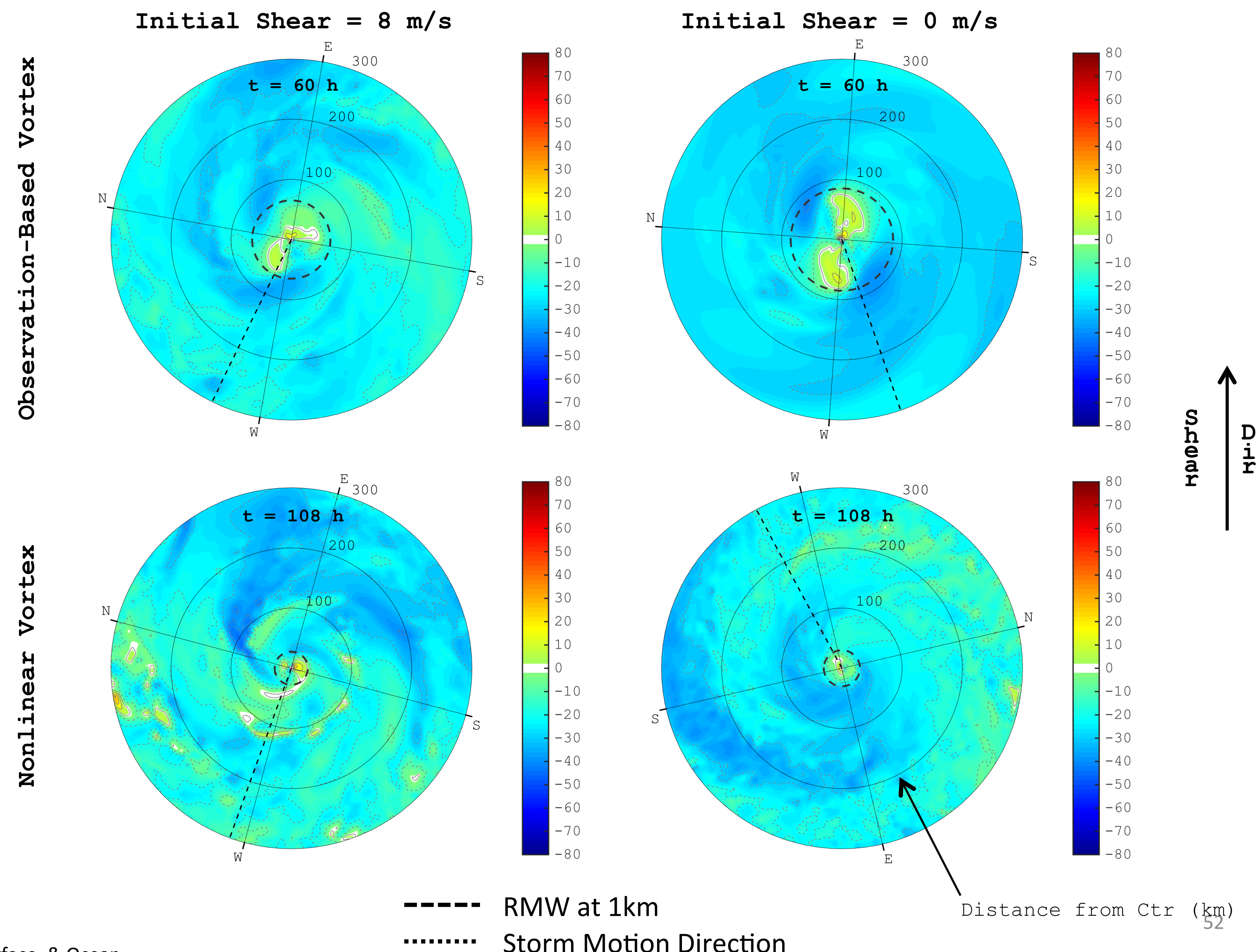
PBL Height Measured as Theta_v Pert = 0.5 K (km)

(Shear Relative)



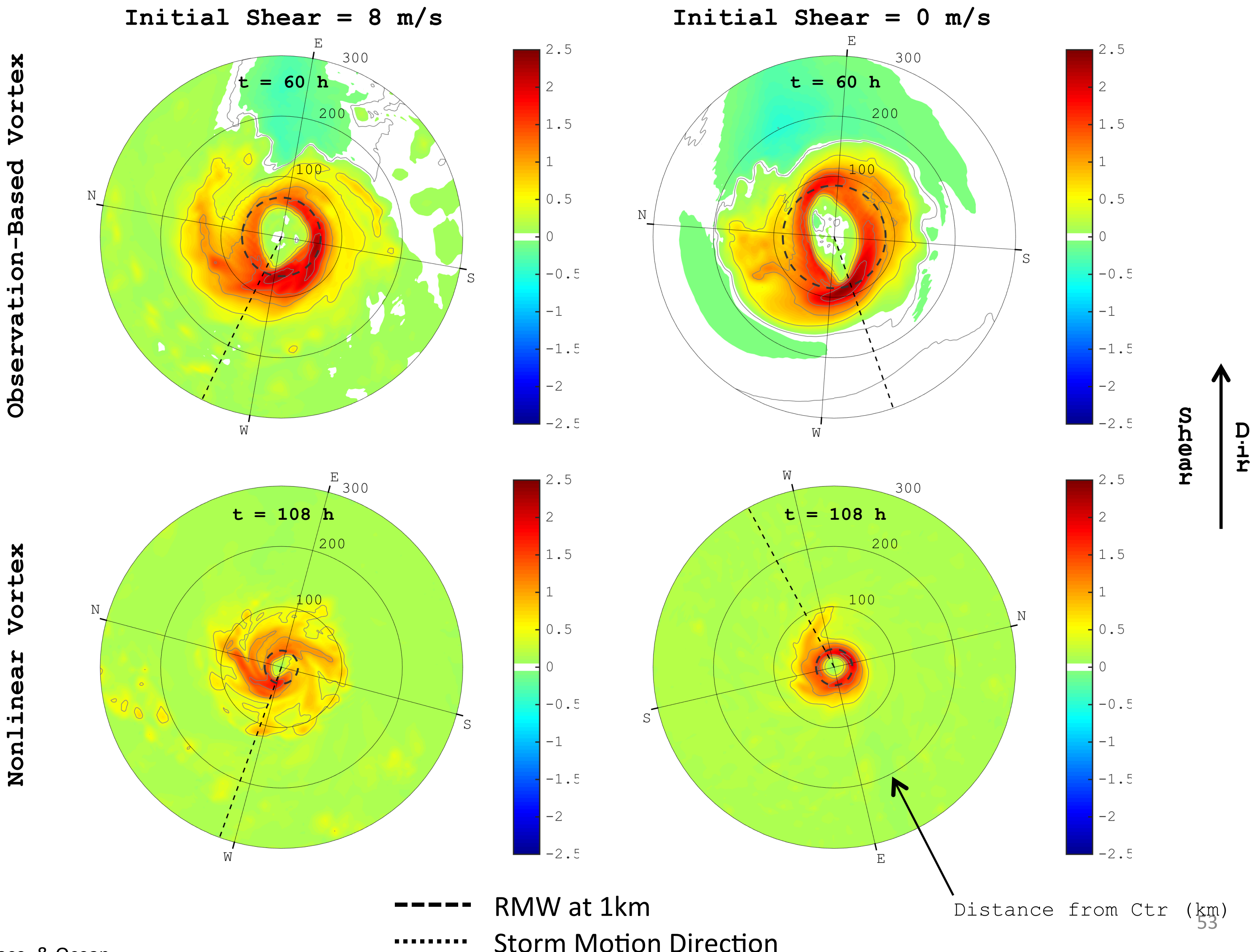
Inflow Angle (degrees)

(Shear Relative)



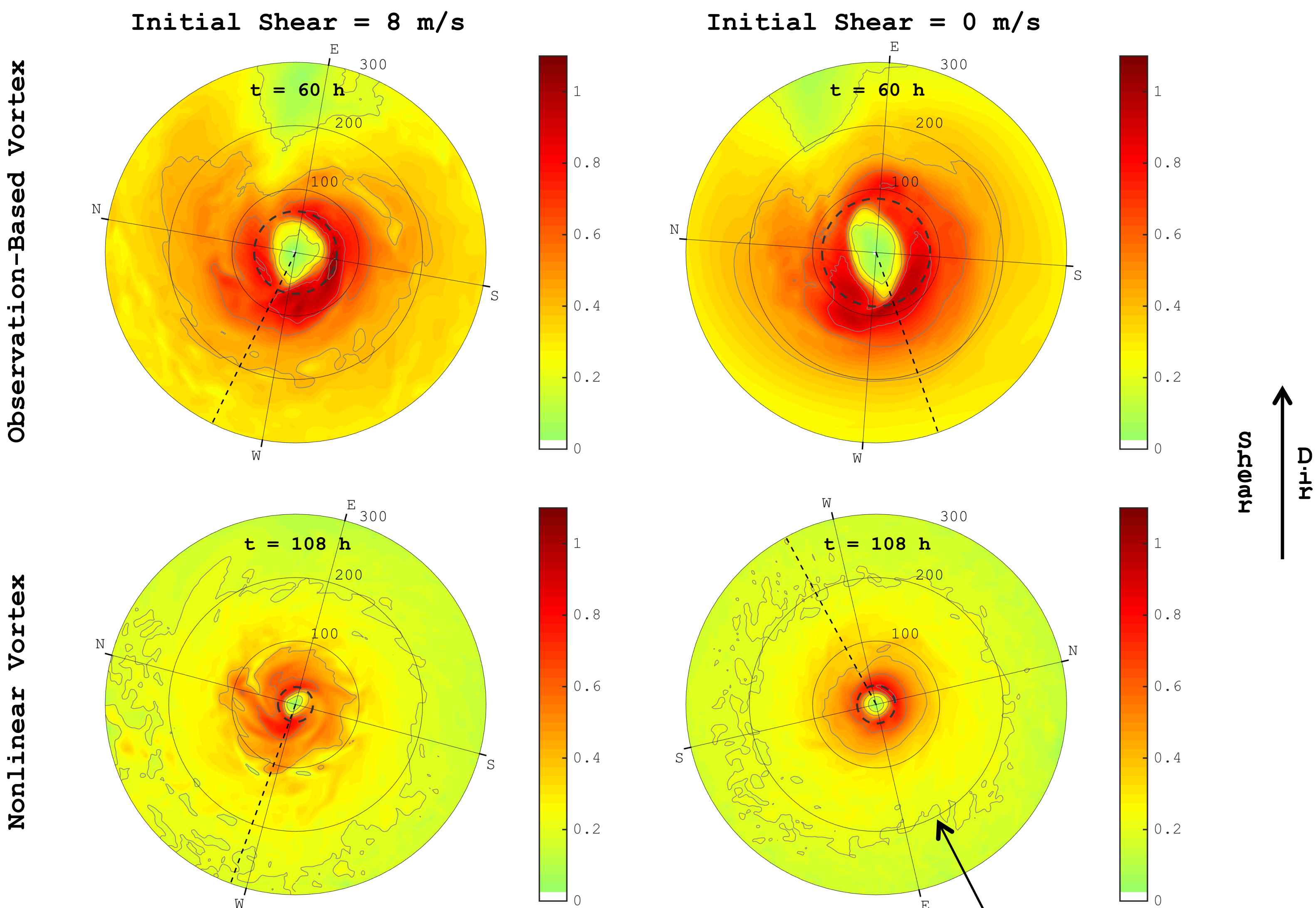
Sensible Heat Flux (10^2 Wm^{-2})

(Shear Relative)



Latent Heat Flux (10^3 Wm^{-2})

(Shear Relative)

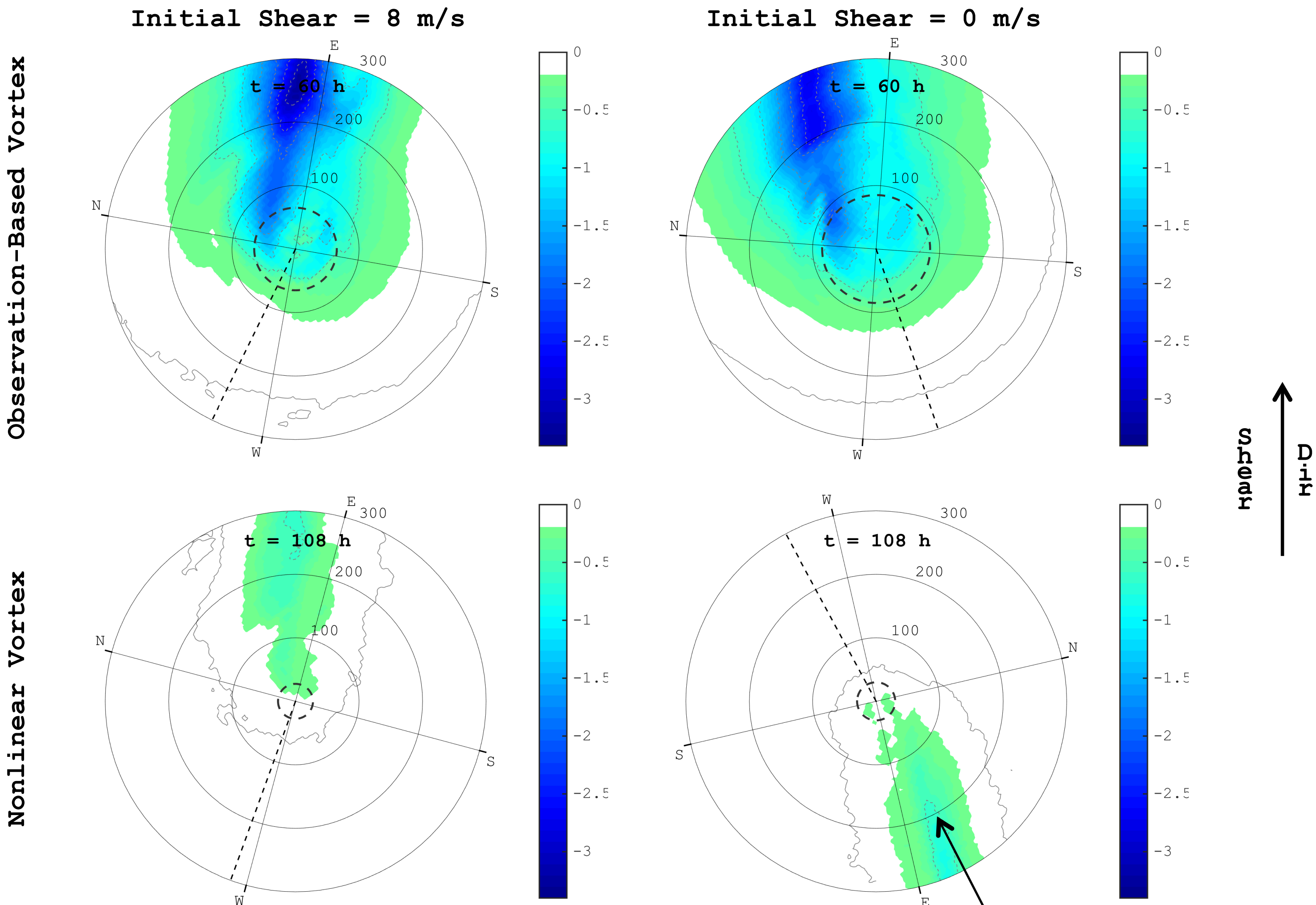


- - - - RMW at 1km

.... Storm Motion Direction

SST Perturbation from Initial (K)

(Shear Relative)

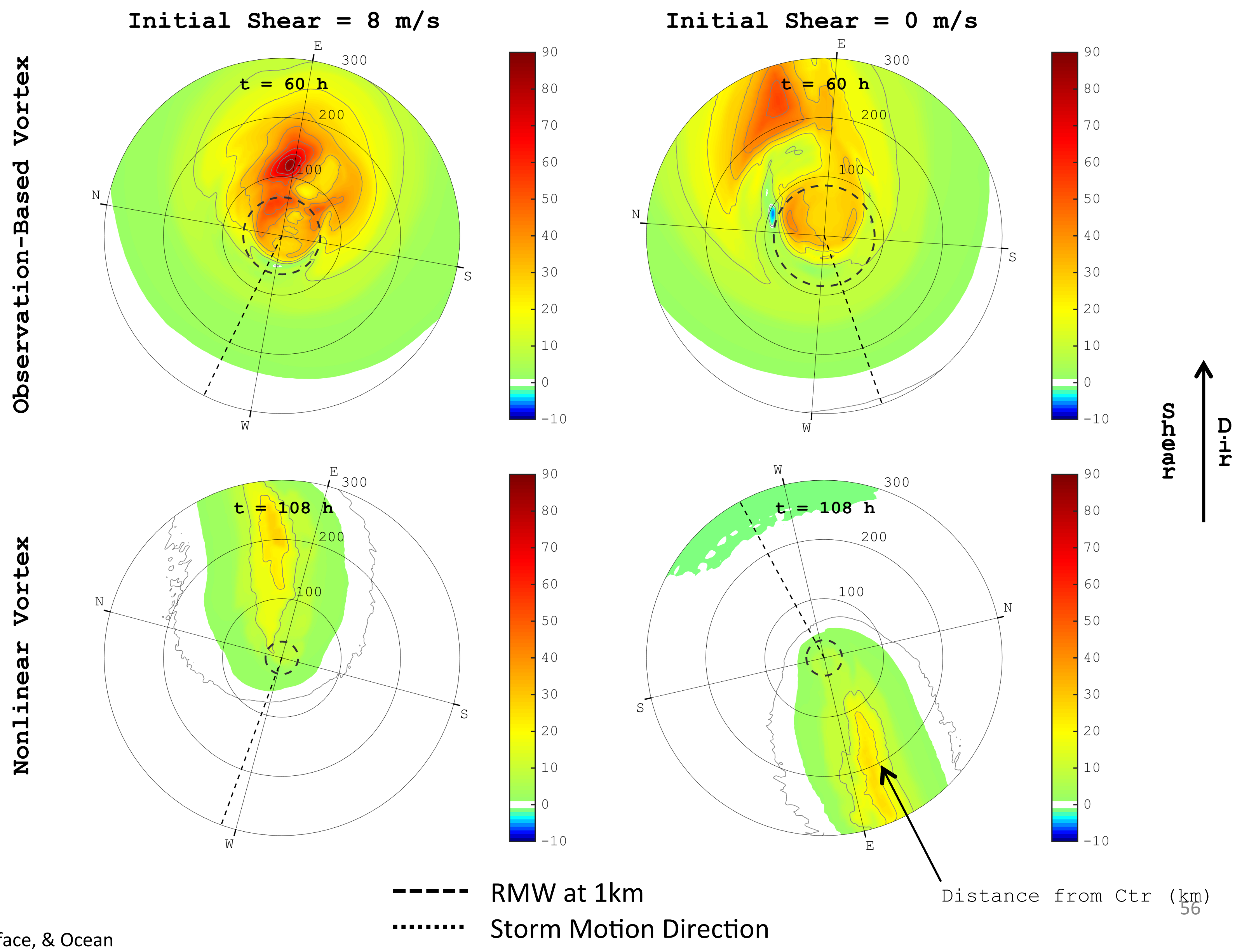


RMW at 1km

Storm Motion Direction

Ocean Mixed Layer Depth Perturbation from Initial (m)

(Shear Relative)



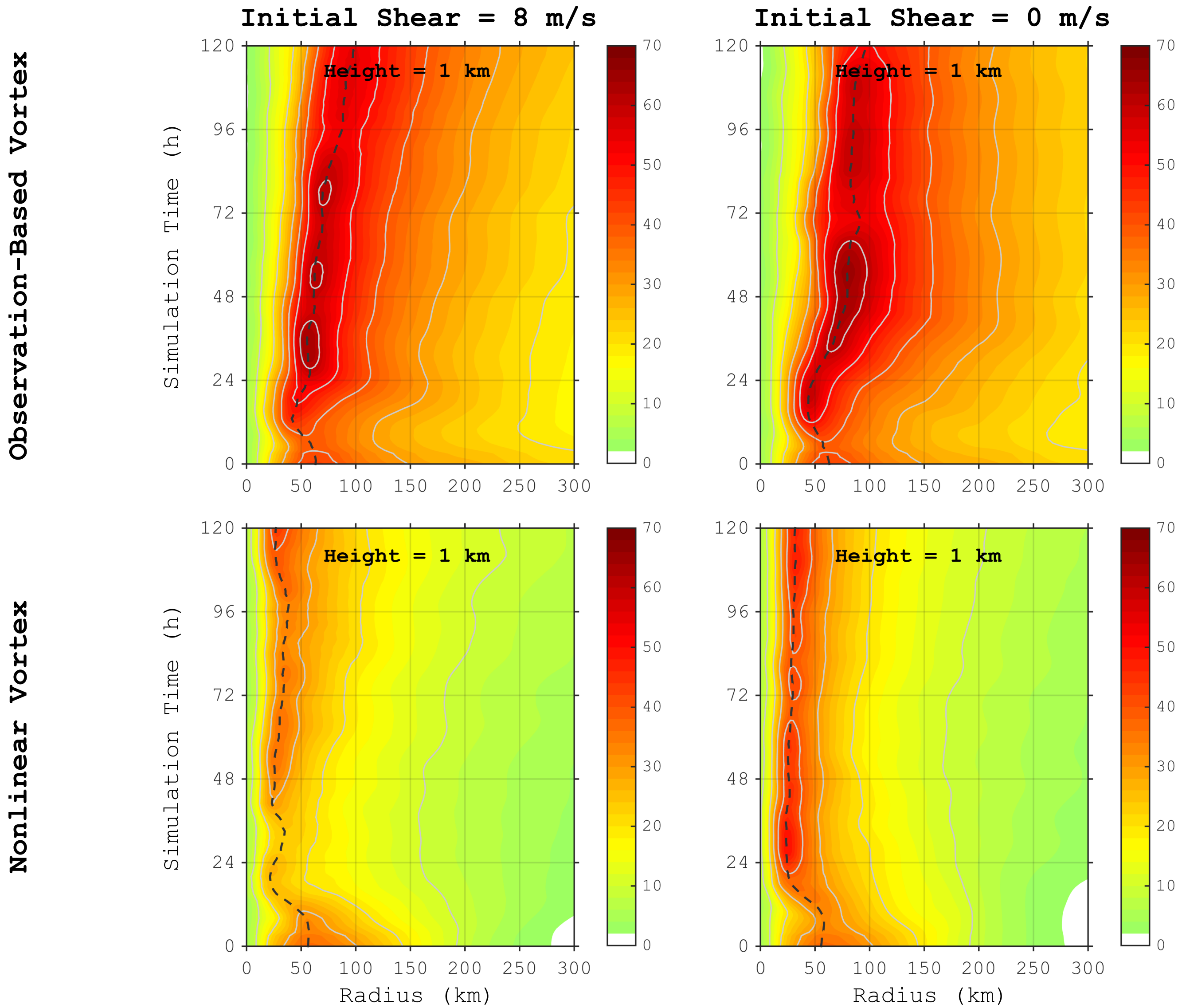
4. Hovmoller Diagrams (R-t Plots) of Azimuthally Averaged Fields

➔ To Compare the Evolution of the Axisymmetric Radial Structure in Runs Initialized from Observation-Based vs. Nonlinear Vortex for Moderate- (Control) vs. No-Shear Environments

4. R-t Plots of Azimuthally Averaged Fields

A. Kinematic Structure: Primary & Secondary Circulations, Vorticity

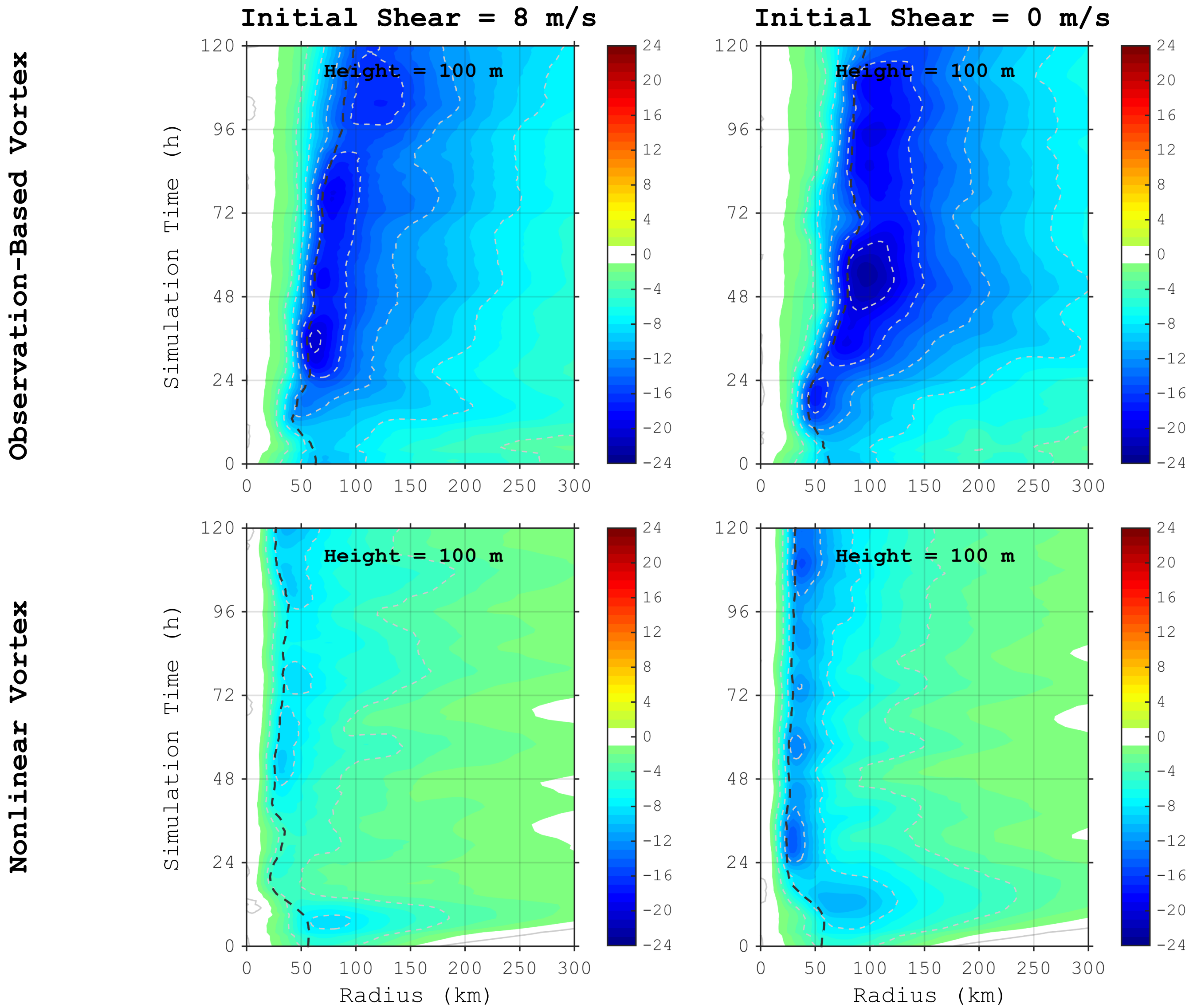
Tangential Wind Speed (m/s)



----- RMW at 1km

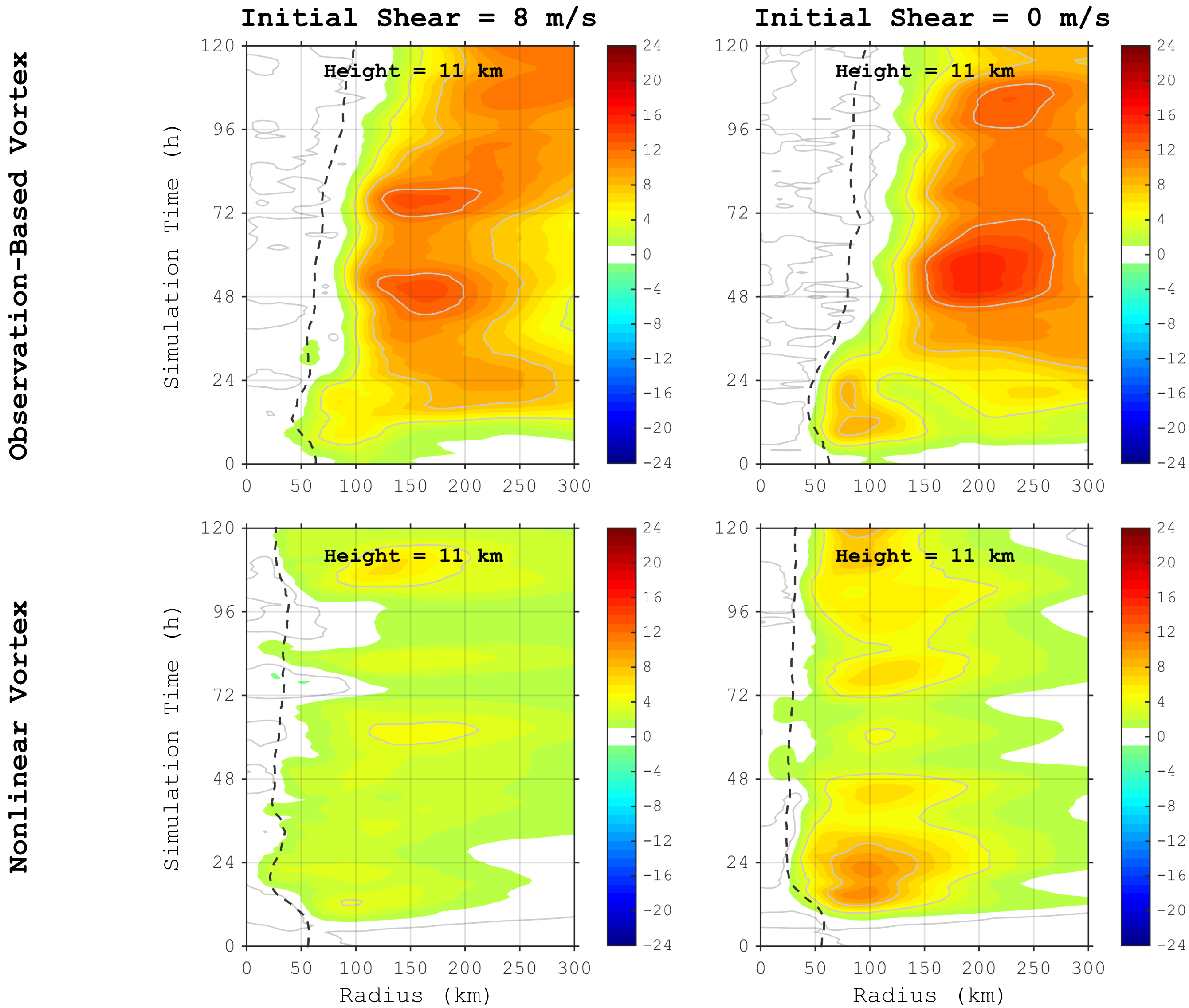
4. Hovmoller A. Kinematic Structure

Radial Wind Speed (m/s)



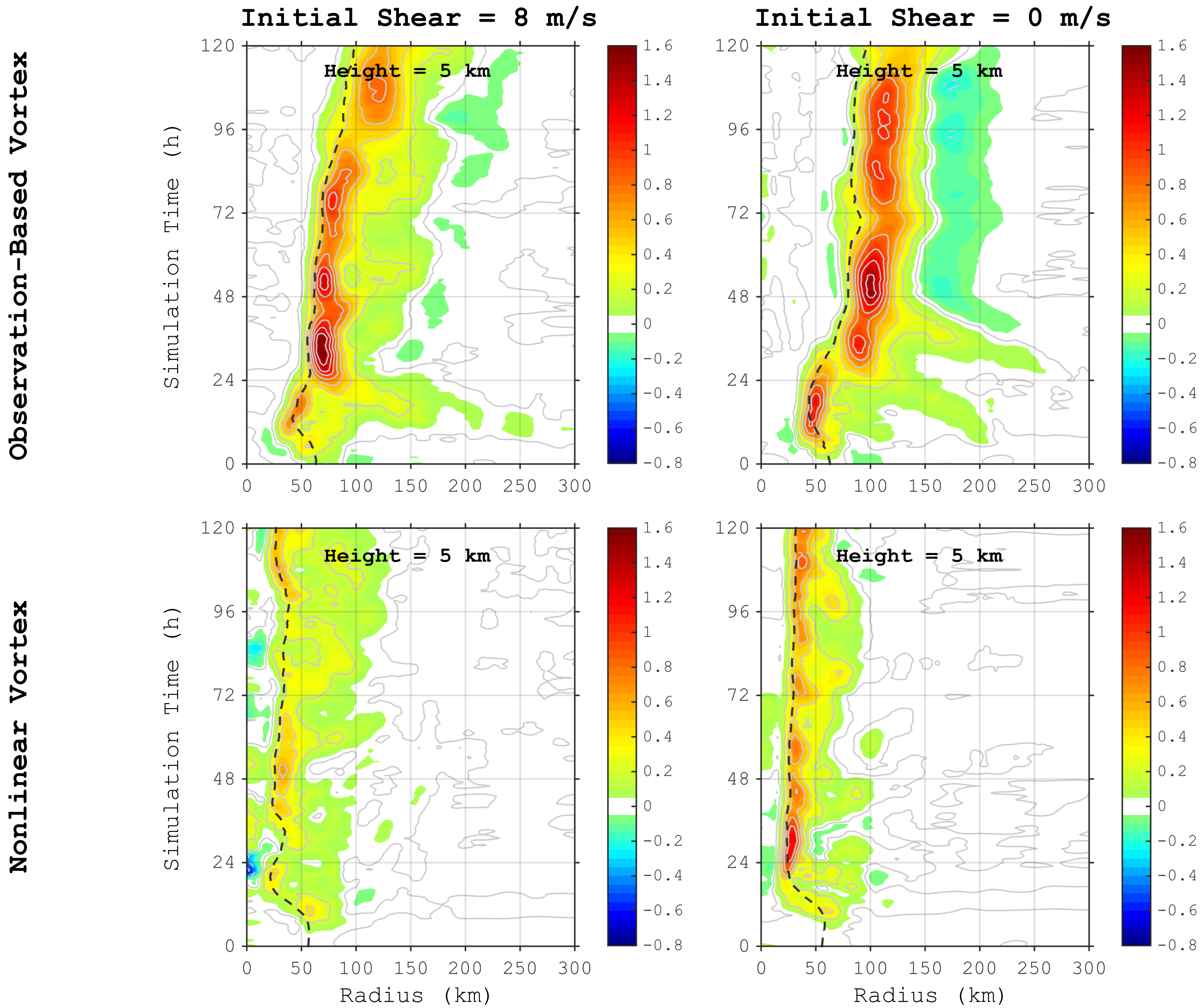
----- RMW at 1km

Radial Wind Speed (m/s)



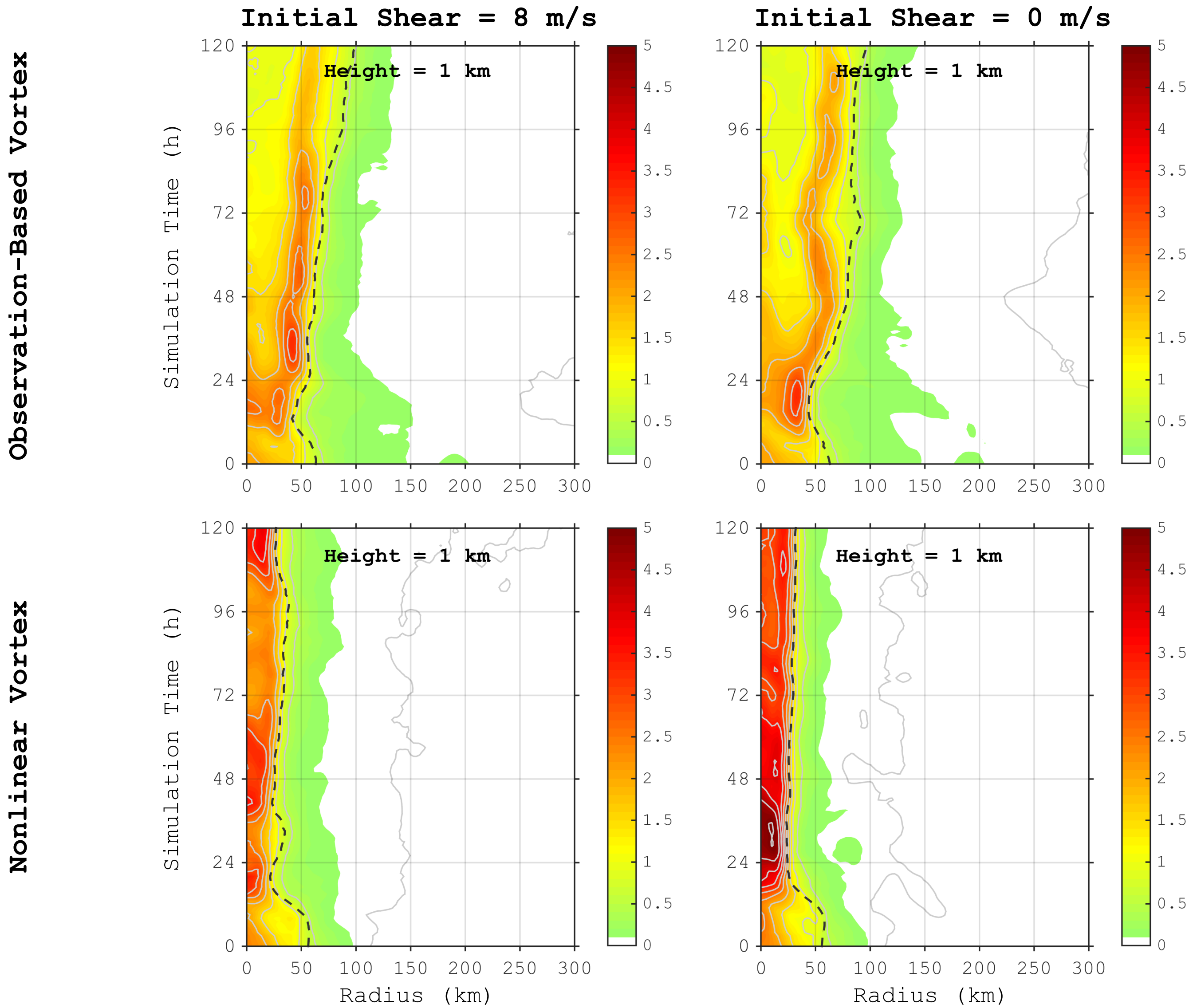
----- RMW at 1km

Vertical Wind Speed (m/s)



----- RMW at 1km

Vorticity (10^5 s^{-1})

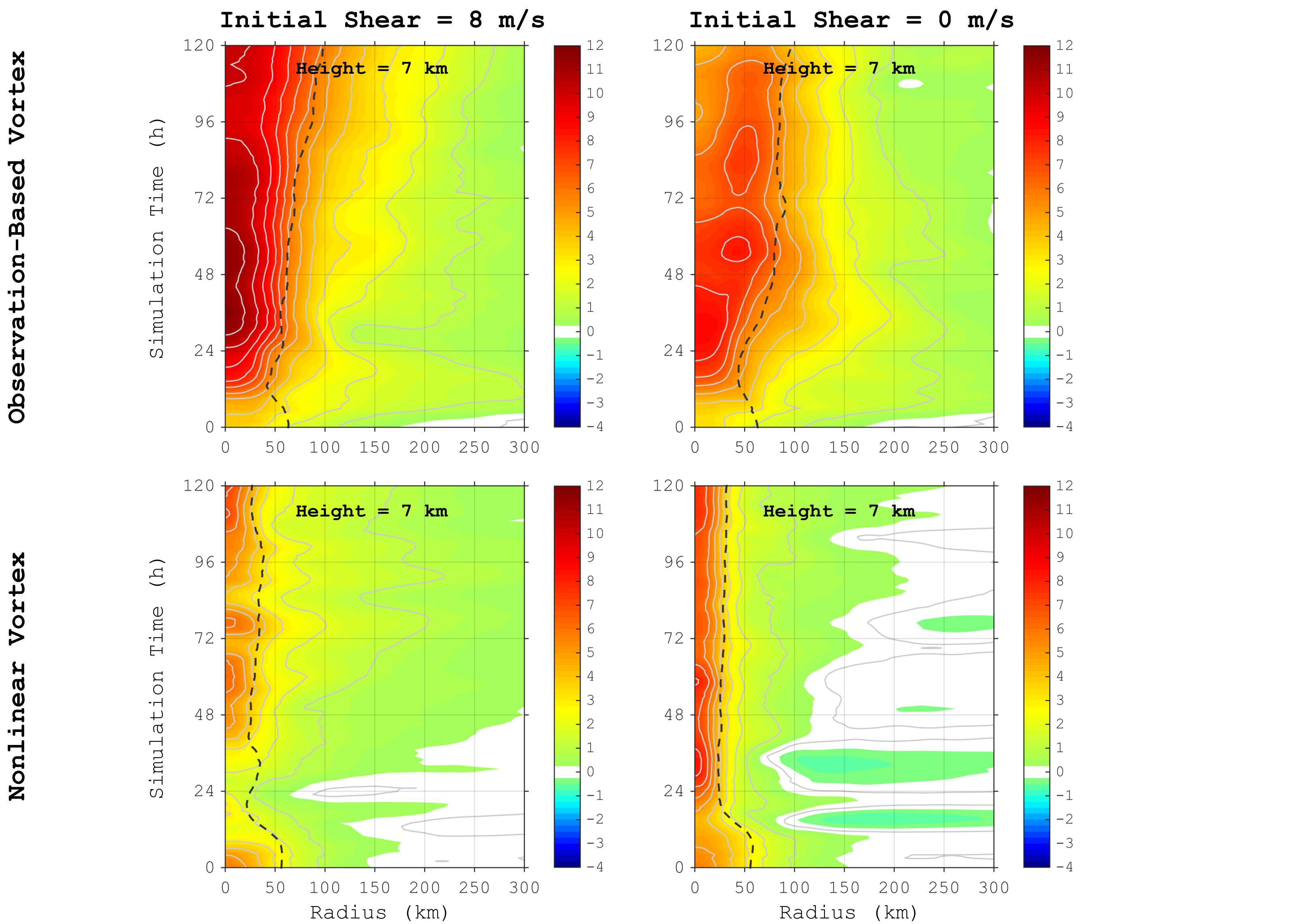


----- RMW at 1km

4. R-t Plots of Azimuthally Averaged Fields

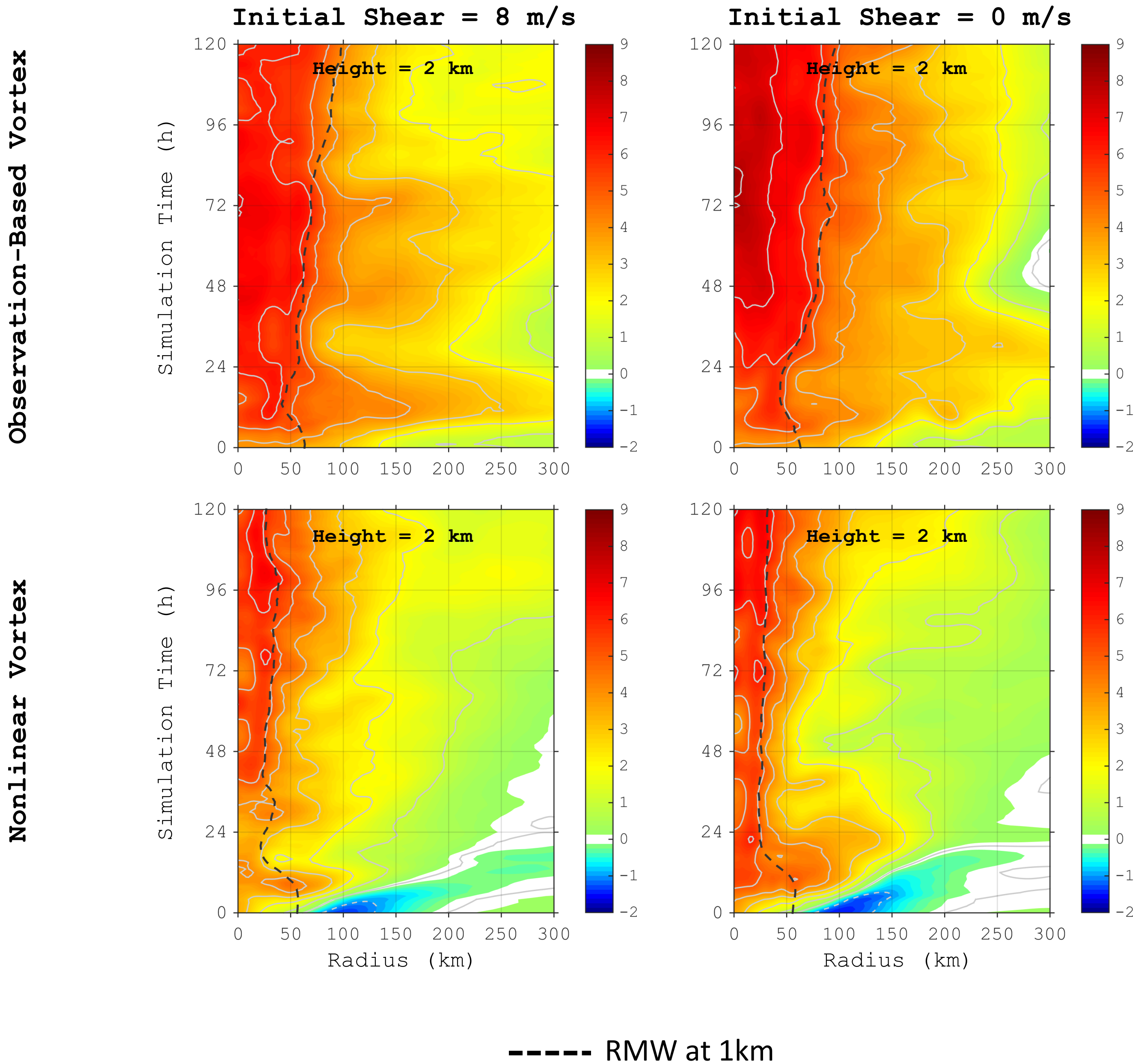
B. Thermal Structure: Temperature and Moisture Perturbations

Temperature Perturbation (K)



----- RMW at 1km

Specific Humidity Perturbation (g/kg)

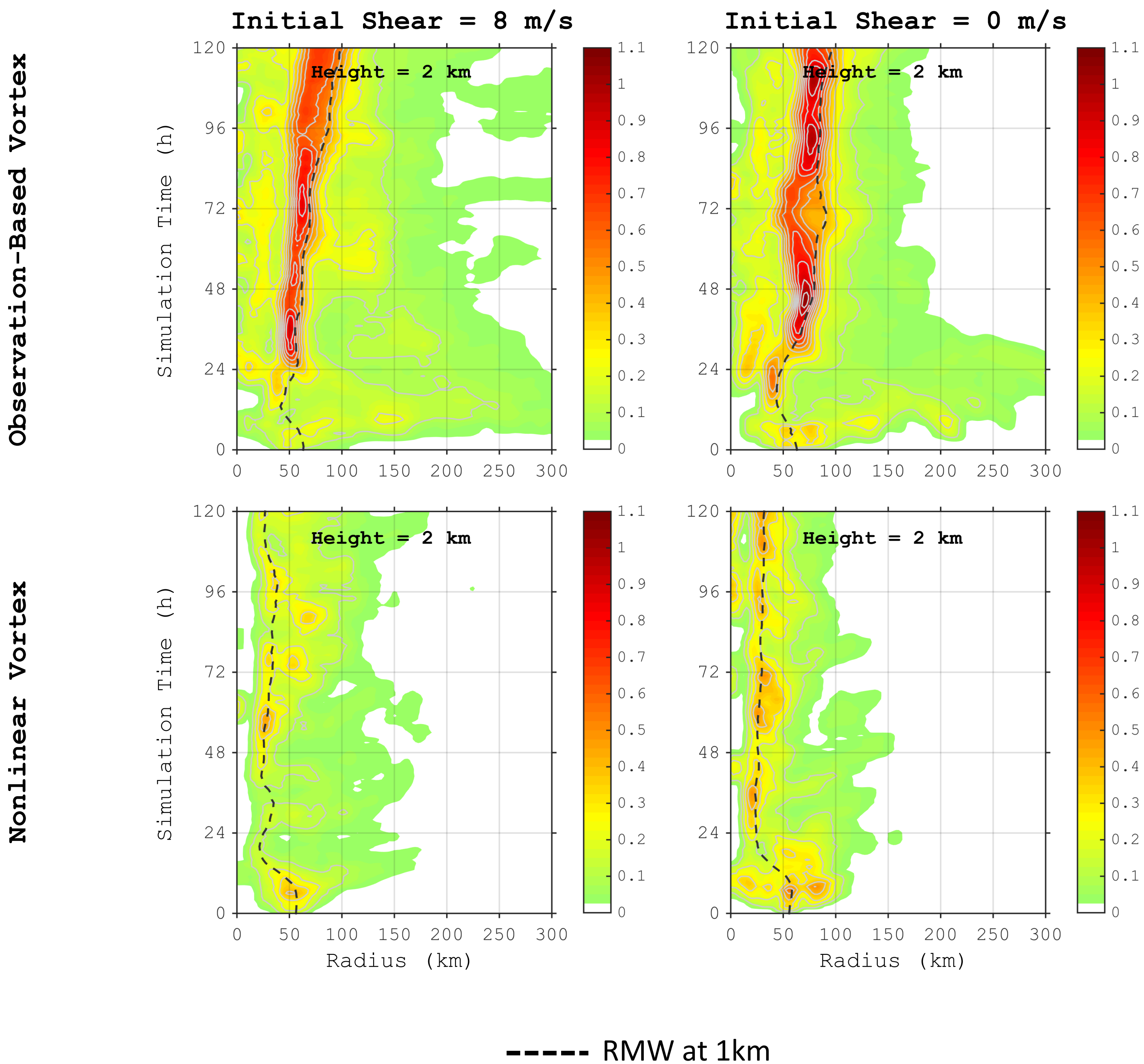


4. Hovmoller B. Thermal Structure

4. R-t Plots of Azimuthally Averaged Fields

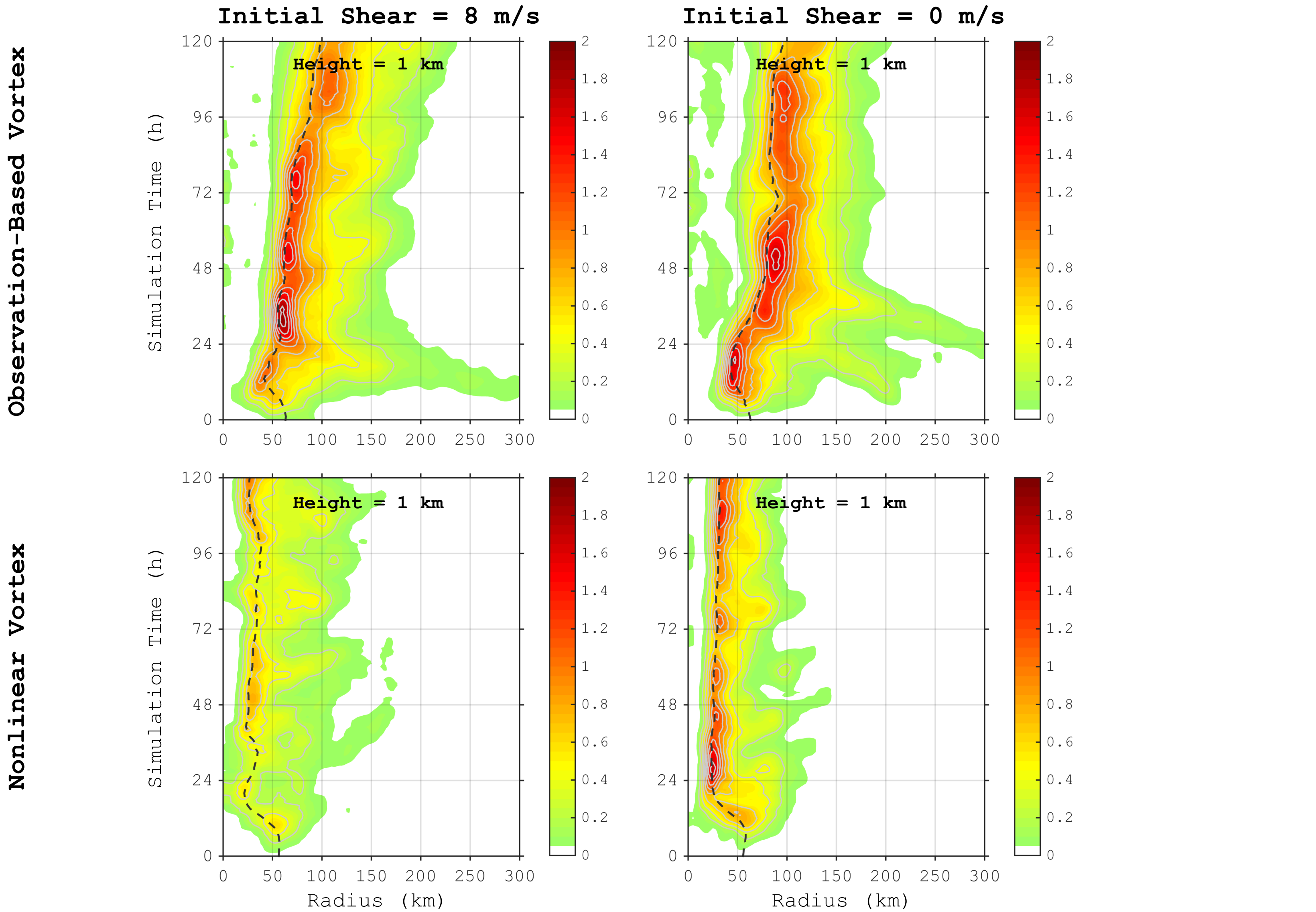
C. Hydrometeors

Total Cloud Condensate (g/kg)



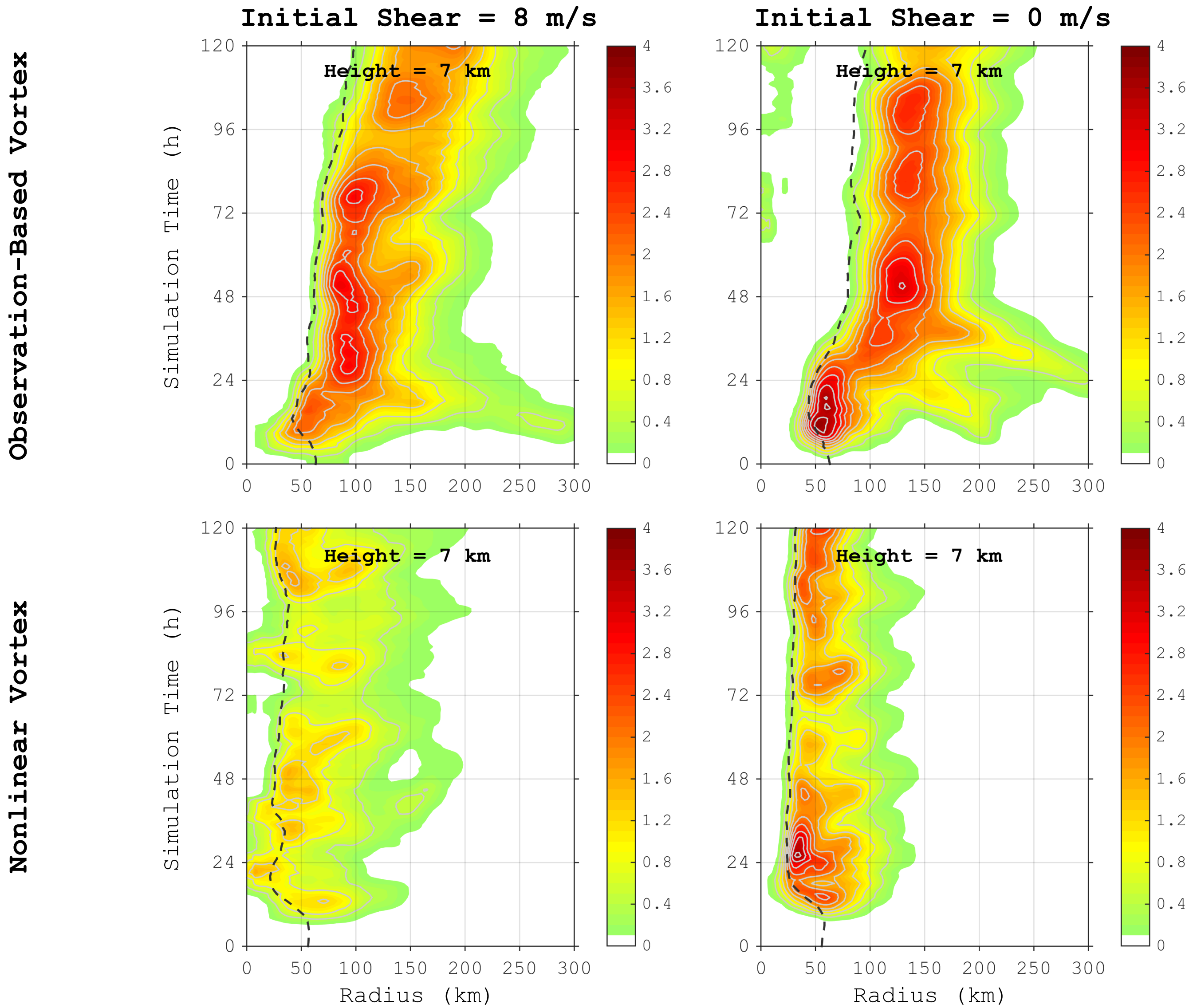
4. Hovmoller C. Hydrometeors

Rain (g/kg)



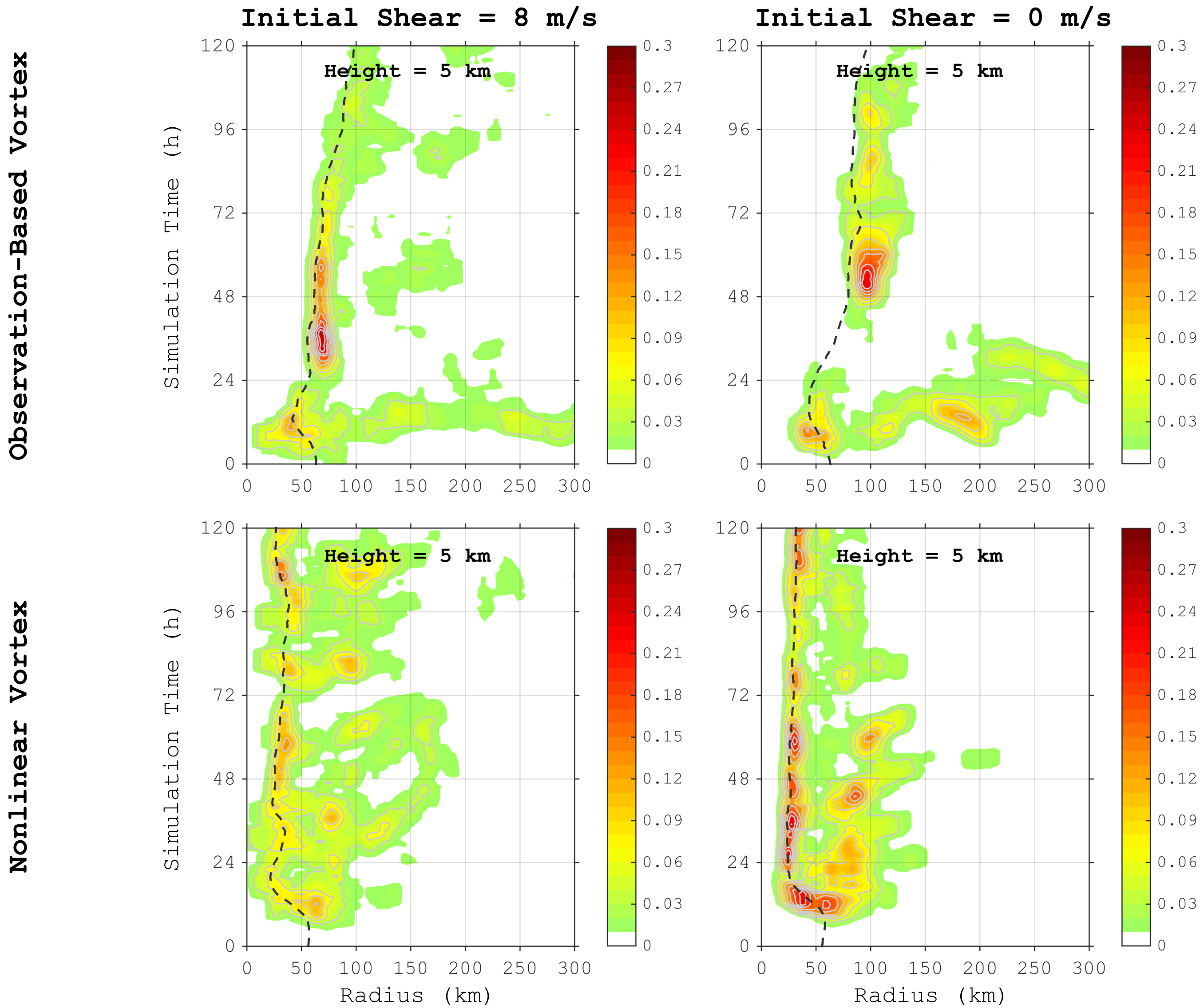
----- RMW at 1km

Snow (g/kg)



----- RMW at 1km

Graupel (g/kg)

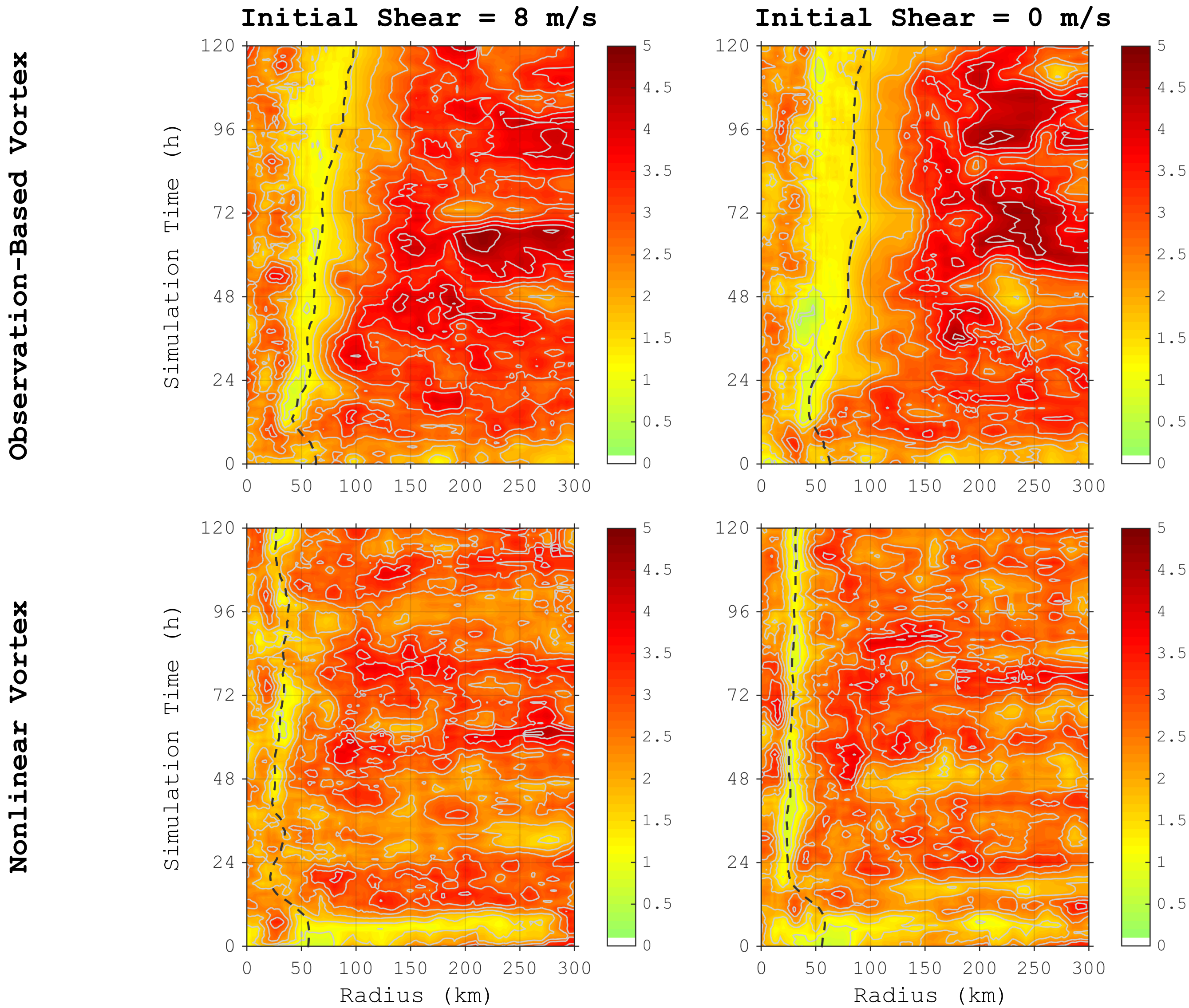


----- RMW at 1km

4. R-t Plots of Azimuthally Averaged Fields

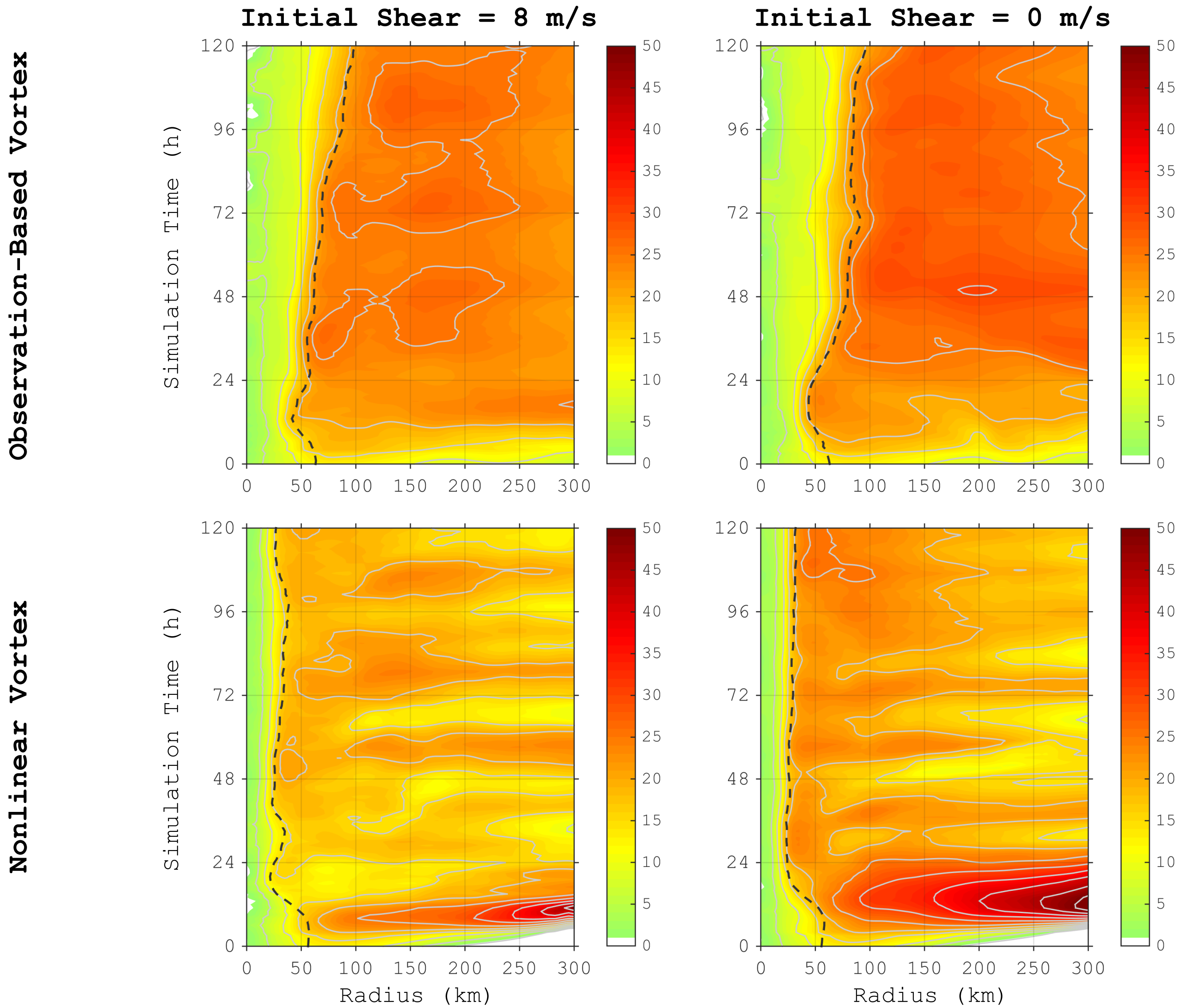
D. Two-Dimensional Features That Relate to The PBL, Surface, and Ocean

PBL Height Measured as 10% of Radial Inflow (km)



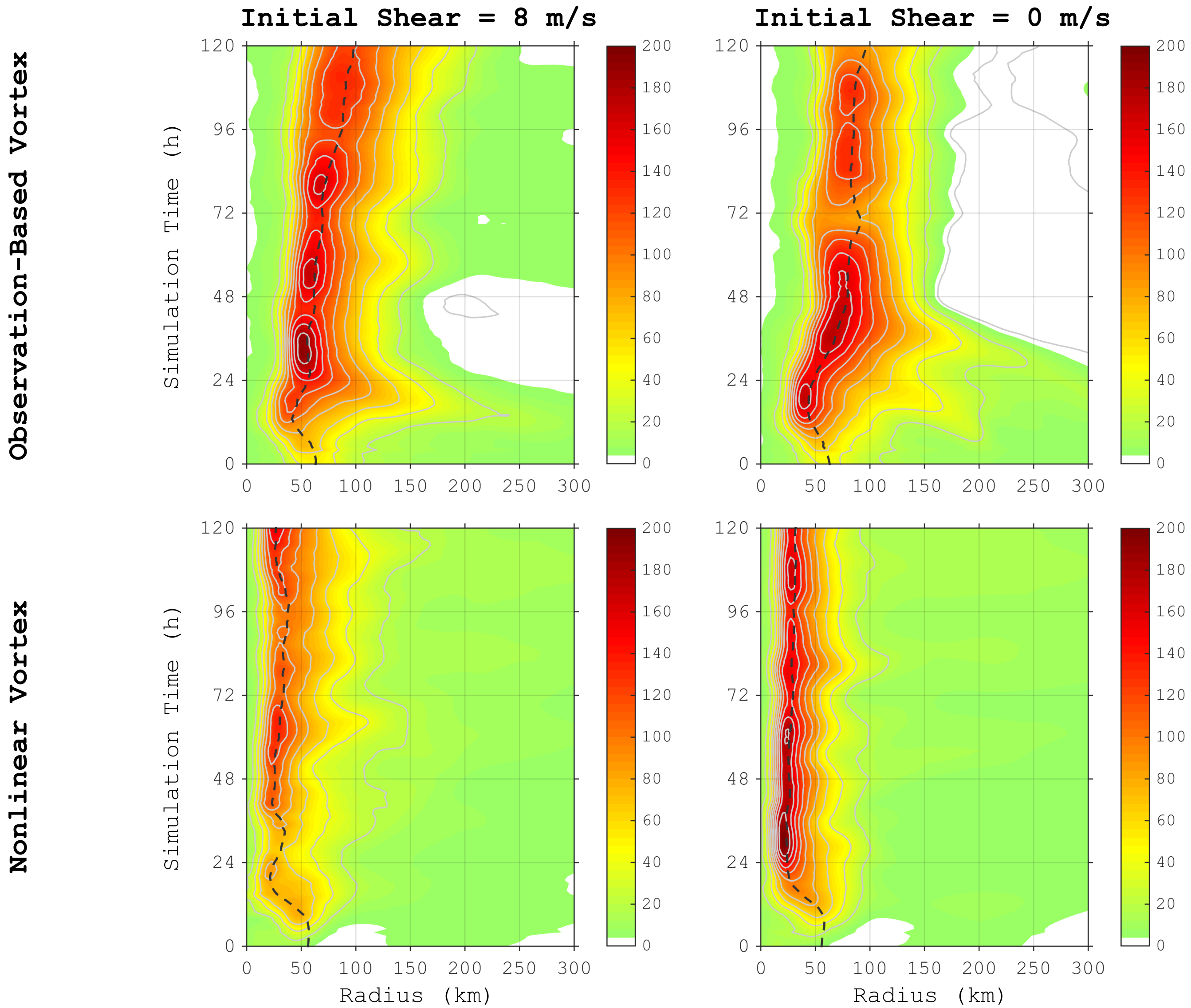
----- RMW at 1km

Inflow Angle (degrees)



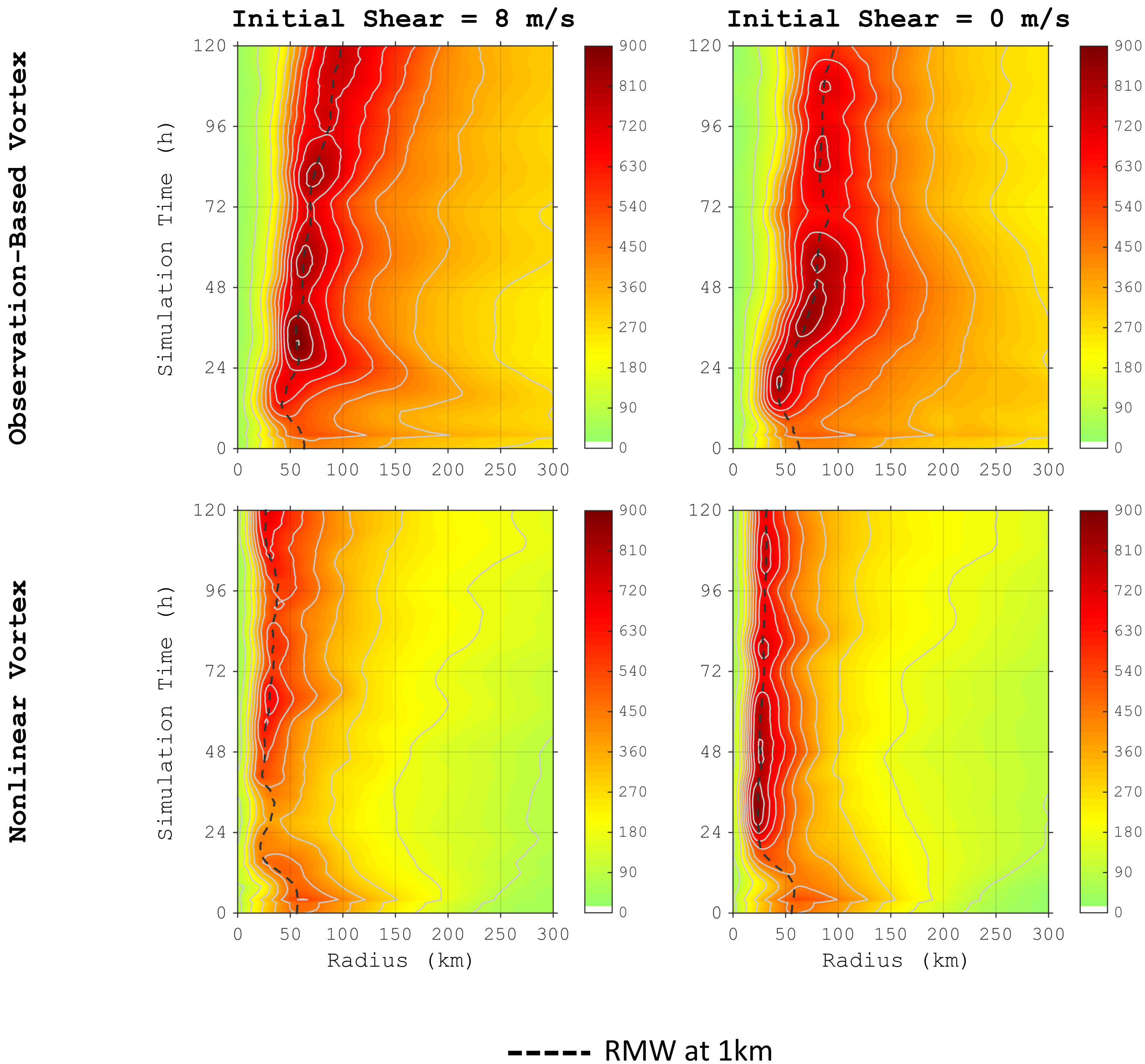
----- RMW at 1km

Sensible Heat Flux (Wm^{-2})

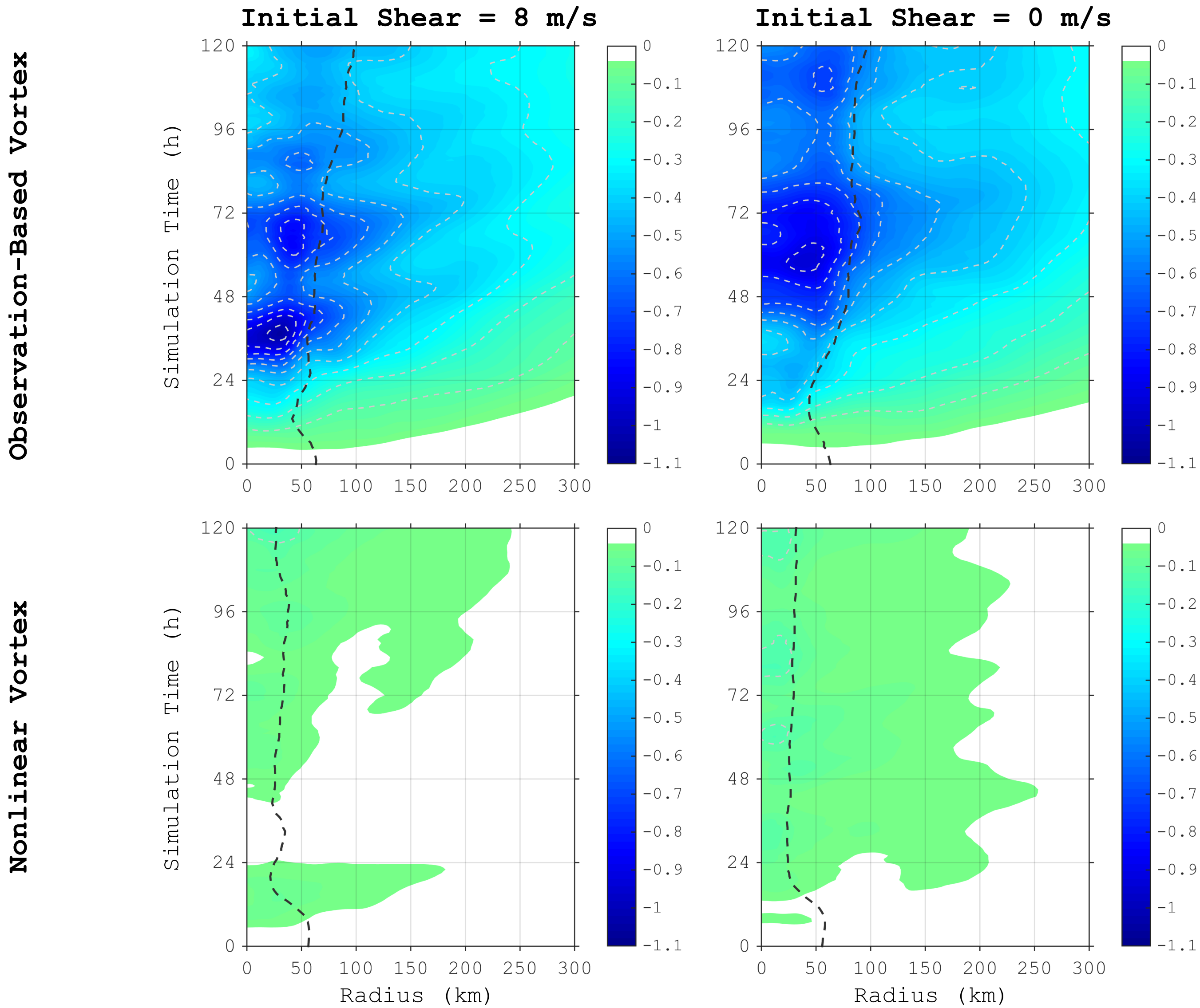


----- RMW at 1km

Latent Heat Flux (Wm^{-2})

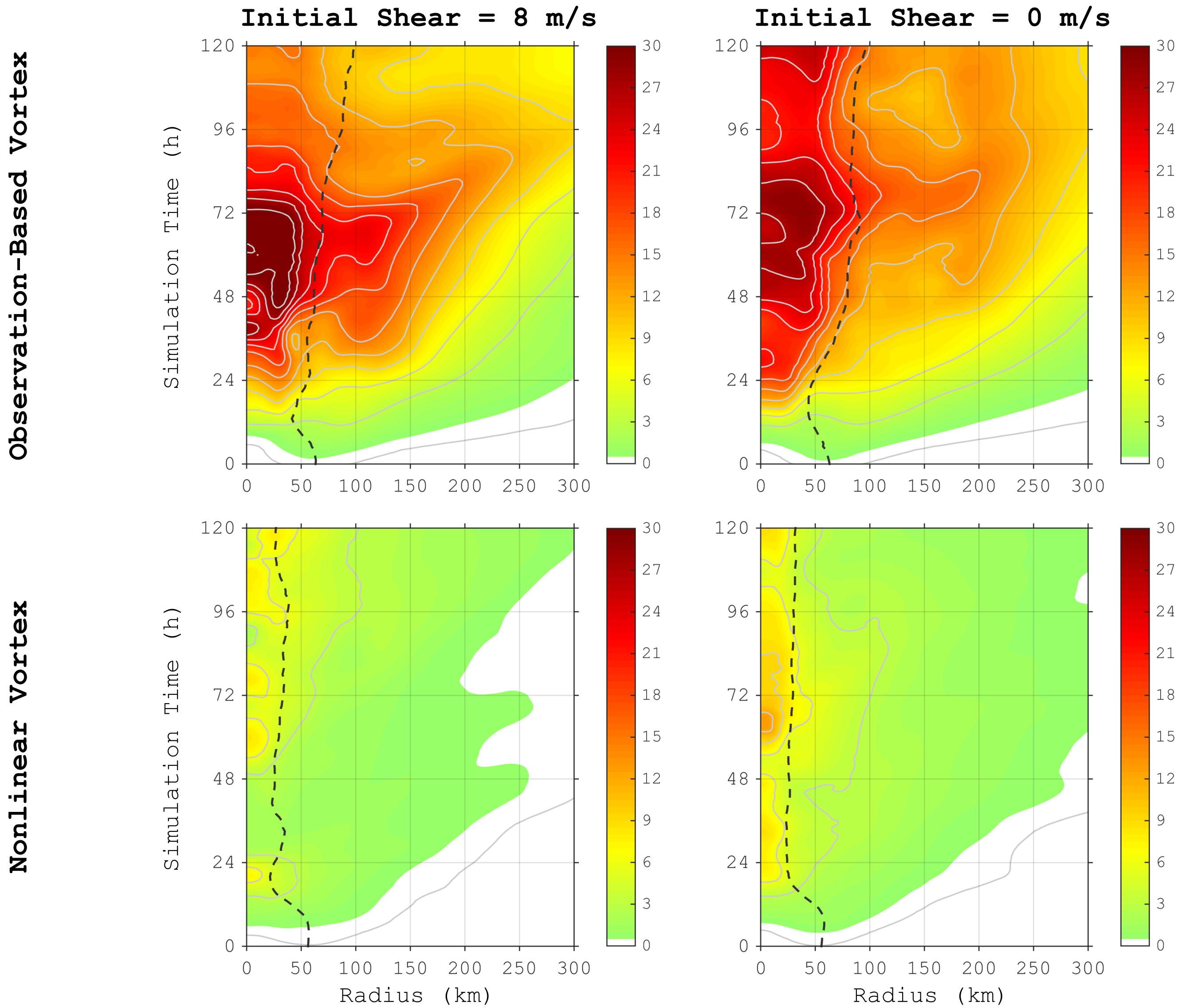


SST Perturbation from Initial (K)



----- RMW at 1km

Ocean Mixed Layer Depth Perturbation from Initial (m)



----- RMW at 1km

4. Hovmoller D. PBL, Surface, & Ocean