Tropical cyclone fundamentals: The rotating-convection paradigm and a new book

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Abstract. Understanding how tropical cyclones form, intensify, mature and decay requires first and foremost a conceptual model. Without such a model, forecasters and researchers must rely entirely on numerical model predictions from, in essence, a black box. In this talk, I review briefly the conceptual models available, focusing on a new framework that my colleagues and I have developed progressively over the last two decades. This framework, which we refer to as the "Rotating-convection paradigm", emphasizes the intrinsic three-dimensional nature of tropical cyclone evolution, principally as a result of the stochastic and localized nature of deep convection. However, the framework includes a simplified azimuthally-averaged perspective to connect it with previous paradigms, all of which have been based on strictly axisymmetric models. Unlike previous paradigms, the new one recognizes the importance of nonlinear boundary layer dynamics and the mostly overlooked fact that all of the air converging in the boundary layer may not be able to be ventilated to the upper troposphere by deep convection, especially as the storm matures and in the subsequent stages of its life cycle. Decoupling of the boundary-layer inflow from the deep-convective mass flux leads to a richness of storm behavior not described by previous conceptual frameworks.