

ATS/CIRA Colloquium

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Visiting ATS from the Massachusetts Institute of Technology

Dry and Semi-Dry Hurricanes

Hosted by Dave Thompson

Friday, March 29, 2019

ATS room 101

Discussion will begin at 11:15 a.m.

Refreshments will be served at 10:45 a.m. in the weather lab

It is widely believed that tropical cyclones are an intrinsically moist phenomenon – requiring evaporation and latent heat release in cumulus convection. Recent numerical modeling work by Mrowiec et al (2011), however, found formation of axisymmetric dry tropical cyclones in dry radiative-convective equilibrium (RCE) – raising many questions. What can such vortices teach us about intensity, structure, and size of real moist tropical cyclones in nature? Are dry tropical cyclones even stable in 3D? What about nearly-dry surfaces that still have some latent heat flux – can they also support cyclones?

To address these questions, the System for Atmospheric Modeling (SAM) convection-permitting model is used to simulate rotating RCE, using two surface parameters to scale between moist and dry states. One surface parameter is a multiplier on the surface saturation vapor pressure (0-1), and the other is the surface temperature (240K-300K, low surface temperatures decrease the surface latent heat flux to near zero). Tropical cyclones are found to spontaneously form and persist for tens of days in both moist and dry/cold states, as well as part of the relatively moist/warm intermediate parameter space. As the surface is dried or cooled, cyclones weaken, both in absolute terms and relative to their potential intensities, and become more uniform in intensity. Structurally, dry and semi-dry cyclones have larger radii of maximum winds relative to their outer wind field, less variability in size, and prominent eyewall asymmetries. Strikingly, spontaneous cyclogenesis fails to occur at moderately low surface wetness values, and intermediate surface temperatures of 250-270 K. Simulations with time-varying surface moisture and sea-surface temperatures reveal that this range of parameter space is a barrier to spontaneous genesis but not cyclone existence.

Speaker's website: <http://mit.edu/~twcronin/www/>