Grant applications

Abstracts for critique

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Abstract 1

Biology of the apicomplexan plastid

Apicomplexa are responsible for a number of important human diseases including malaria, toxoplasmosis, cryptosporidiosis and cyclosporidiosis. Management of these diseases rests heavily on chemotherapy but anti-parasitic drug treatment faces multiple challenges. These include poor overall potency, restriction to certain life-cycle stages, unwanted side effects, and rapidly emerging multiple drug resistance. A constant stream of new drugs and potential drug targets is required to stay abreast of the threat posed by these pathogens. One of the most promising sources of such parasite specific targets is the apicomplexan plastid or apicoplast. The apicoplast is unique to the parasite and its function is essential to parasite survival. This organelle is a holdover from a free-living photosynthetic past. The structure and biology of the apicoplast is remarkably complex as it is derived from the endosymbiotic marriage of two eukaryotes: a red alga and an auxotrophic protist. The goal of this application is to unravel the complexity of this biology in mechanistic detail and to identify future targets for intervention. Using Toxoplasma as a model organism we will conduct genetic, cell biological and biochemical approaches to characterize the function of two pathways that unfold in the outer compartments of the organelle and that we hypothesize are essential to the organelle and the parasites. We will complement this focused approach with a broader effort to define a comprehensive set of plastid proteins to continue to feed a pipeline of hypothesis-driven mechanistic experiments with strong candidate genes. Toxoplasma gondii is an important human pathogen that causes disease in the unborn fetus, young children and patients with a weakened immune system. We are a studying a unique cellular structure of the parasite that is related to the chloroplast of plants. A detailed understanding of the biology of this structure will lead us to new parasite specific interventions to treat and prevent disease.

Streipan, B. 2010. Biology of the apicomplexan plastid. Grant application to National Institute of Allergy and Infectious Disease. Grantee Institution: the University of Georgia Research foundation, Inc. Available at: http://www.niaid.nih.gov/researchfunding/grant/Documents/Striepenfull.pdf. [Accessed 27 March 2015]

Abstract 2

Collaborative Research: Impact of Externally and Internally Modulated Convection on Tropical Cyclone Evolution University of North Carolina at Charlotte

The objective of the proposed research is to develop an improved understanding of the convective response of a tropical cyclone's core to external forcing and internal dynamics. The impact of this convective response upon the ensuing evolution of an externally forced tropical cyclone is then examined. In the particular case of a vertically-sheared tropical cyclone, convection has been argued to have both positive and negative influences on vortex structure and intensity. The proposed research will attempt to clearly define the role of convection by examining the impact of vertical shear on a moist-convective vortex within a simplified wave-mean dynamical framework.

The proposed research employs a combined observational and numerical modelling approach. The observations are derived from airborne dual-Doppler radar measurements within a rapidly intensifying, yet vertically-sheared, hurricane. A unique three-dimensional documentation of the hurricane structure and evolution, including the eye-eyewall interface and upper-tropospheric vortex circulation, will be used to examine the nature, timing, and location of convection within the vortex core. These observations, supplemented with additional collected data, will be used to represent convection in a series of idealized numerical simulations. The idealized simulations are designed first to elucidate the role of convection in tropical cyclone resiliency, and then to determine how and when convection begins to impact the tropical cyclone negatively.

Intellectual Merit: The proposed research will provide new insights into i) the observed three-dimensional mixing between eye and eyewall within a rapidly intensifying hurricane, ii) the observed convective asymmetry within a vertically-sheared hurricane, iii) the role of convection in vertically-sheared hurricane resiliency, and iv) the role of deep cumulus convection in the weakening of a vertically-sheared hurricane. The latter two points are approached from a wave-mean perspective which encompasses both the vortex vertical tilt and convective asymmetry evolution.

Broader Impacts: The proposed activities will have several broader impacts. Regarding hurricanes: Presently, there exists a single observational study of the three-dimensional hurricane vorticity dynamics. The proposed case study is an important step towards increasing the statistical database of three-dimensional observations, which is crucial if such data are to be meaningfully assimilated into mesoscale numerical forecast models. Additionally, the proposed mapping of effective stratification based on observed data within the hurricane core may be used by future investigators for idealized numerical modeling. More generally: The convection-vortex interaction is a general atmospheric problem (e.g., mid-latitude MCVs) and has parallels with the convectively-coupled equatorial wave problem. The proposed study draws upon this broader knowledge base, and in return will contribute beyond the scope of hurricanes. Two graduate students and an undergraduate will be trained in the techniques of radar data editing and analysis, atmospheric dynamics, and numerical modeling. These students will also be encouraged to interact with scientists

at NOAA's Hurricane Research Division through their ongoing cooperation with the universities.

Eastin, M.D. and Reasor, P.R. (2005) Collaborative Research: Impact of Externally and Internally Modulated Convection on Tropical Cyclone Evolution University of North Carolina at Charlotte. Funded by: NSF, 2005. Available: http://d32ogoqmya1dw8.cloudfront.net/files/NAGTWorkshops/earlycareer/research/eastin_nsf_proposal.pdf. [Accessed: 05 April 2015). CC BY NC SA Licence at: http://creativecommons.org/licenses/by-nc-sa/3.0/.