THE UPPER-LEVEL STATIC STABILITY AND TROPOPAUSE STRUCTURE OF TROPICAL CYCLONES

by

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A Dissertation

Submitted to the University at Albany, State University of New York

in Partial Fulfillment of

the Requirements for the Degree of

Doctor of Philosophy

College of Arts and Sciences

Department of Atmospheric and Environmental Sciences

2018

ABSTRACT

We did some research and wrote about the results.

ACKNOWLEDGEMENTS

This dissertation is the fulfillment of a childhood dream that would not have come true without the selfless dedication of countless people.

First I must thank my advisor, John Molinari, for his unswerving kindness, humility, and patience over these past six years. Former students have described him as a "brilliant scientist and an even better man," an assessment with which I wholeheartedly concur. I could not have asked for a better mentor, and am so grateful for the opportunities he has given to me.

I also would like to thank my committee members - Kristen Corbosiero, Robert Fovell, Brian Tang, and Ryan Torn - for their guidance and support over these years. Truly an academic all-star team, I will continue to look up to each of them as models of scientific brilliance.

Thanks to all of the DAES faculty for building and carefully maintaining such a positive and constructive departmental culture. It was always comforting to know that every faculty member truly cared about the students, and always worked to build us up as scientists and professionals. Nowhere was their dedication to students more evident than in their outstanding courses, which I thoroughly enjoyed, and which greatly contributed to my knowledge.

I also owe a tremendous debt to Steven Lazarus and Michael Splitt of the Florida Institute of Technology, whose selfless investment in me as an undergraduate played a critical role in my academic development, and prepared me for PhD-level research and course work.

I am grateful for the support and friendship of all of the DAES graduate students,

particularly Travis Elless, Stephanie Stevenson, Oscar Chimborazo, Sarah Ditchek, Matthew Vaughan, and Steven Fuhrman. Their friendship and encouragement over these years has meant a lot to me. I owe a special thanks to Chip Helms for not only being a fantastic friend, but for innumerable stimulating conversations, and for introducing me to so many people in the tropical meteorology community. Thanks also to research associate Dave Vollaro, whose guidance during my first year of graduate school greatly accelerated my development as a programmer, and whose baseball knowledge far surpassed mine.

Last and most importantly, I thank my fiancée, Erika Navarro, for her constant love and support, and my parents for the innumerable sacrifices that they have made on my behalf. Their gentle encouragement always pushed me to achieve my greatest potential, and their belief in me provided indispensible sustenance during times of hardship. This work is dedicated to them.

CONTENTS

1. Introduction

1.1 Section Heading

I can reference a section using the label, for example: Section 1.

1.1.1 Subsection Heading

2. The tropopause-layer static stability structure of tropical cyclones: Idealized modeling

2.1 Introduction

The preceding two chapters highlighted the effect of tropical cyclones on the tropopause and upper-level static stability structure in dropsonde observations. These observations alone, however, cannot explain the mechanisms that force the observed variability. Numerical simulations of an axisymmetric hurricane conducted in an idealized framework reproduced the observed variability. Using these simulations, some physical insight into these mechanisms is obtained and described in the present chapter.

2.2 Model Setup

The numerical simulations were performed using version 19.1 of Cloud Model 1 (CM1) described in Bryan and Rotunno (2009) and available online at [WEBSITE]. The fully-compressible, axisymmertic equations of motion were integrated on an Arakawa C-Grid with 1-km horizontal and 250-m vertical grid spacing using a 3rd-order Klemp-Wilhelmson time-splitting integration scheme with 5th-order spatial differencing. Sub-grid turbulence was parameterized using the planetary boundary layer scheme described in Bryan and Rotunno (2009), with prescribed horizontal mixing lengths of 100 m at a surface pressure of 1015 hPa and 1000 m at a surface pressure of 900 hPa. The model domain was 3000-km-wide and 35-km-deep with a Rayleigh damping layer applied outside of the 5000-km radius and above the 25-km level to prevent spurious gravity wave reflection at the model boundaries. Microphysical processes were parameterized every advective time step using the Thompson microphysics scheme Thompson et al. (2004) and radiative heating tendencies were computed every two minutes using the RRTMG [CITATION] longwave and shortwave schemes. Temperature and humidity were initialized with a horizontally-homogeneous sounding computed by averaging all dropsondes deployed during the TCI flight conducted on 21 October,

2015 within and around Tropical Storm Patricia (see Doyle et al. (2017) for details.) Since relative humidity measurements were unreliable at temperatures below -40 deg C Bell et al. (2016), the water vapor mixing ratio was assumed to be zero above 16 km.

As in the preceding chapters, static stability is analyzed using N2, which is output directly by the model. Potential temperature tendencies

2.3   Results

The modeled storm's intensity evolution during the first four days of the simulation is depicted in Fig. 1 (blue lines). Following a 24-hour initial spin-up period, the storm rapidly intensifies, and its maximum 10-m wind speed reaches XXX kt at XXX hours and its minimum central pressure reaches XXX hPa at XXX hours. This intensification closely resembles that recorded in the NHC best track for Hurricane Patricia (Fig. 1, red stars), indicating that the CM1 simulation is a good representation of Patricia's evolution. The cold-point tropopause and static stability evolution during this time period is depicted in Fig. 2 for the modeled storm. The mean tropopause height during the first 24 hours (Day 1; Fig. 2a) lies near XXX km and exhibits little radial variability, with a static stability maximum immediately overlying it in the XXX-XXX-km layer. As the storm begins its rapid intensification period (Day 2; Fig. 2b), the mean static stability just above the tropopause decreases. This decrease is particularly pronounced near the storm center, which allows the tropopause to rise at the innermost radii. The static stability continues to weaken at small radii into Days 3 and 4 (Figs. 2c,d), and the tropopause rises dramatically above the storm's eye. Meanwhile, outside of the eye region, static stability just above the tropopause strengthens. This static stability evolution closely follows that observed by the TCI dropsondes deployed in Hurricane Patricia (2015; Duran and Molinari (2018)).

You can use footnotes.[1]

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[1] Here is a footnote.

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