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North Atlantic Weather Regimes:
A Synoptic Study of Phase Space

A thesis submitted in partial satisfaction of the requirements for the degree Master of Science in Atmospheric Sciences

by

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TABLE OF CONTENTS

Acknowledgements .......................................... vi
Abstract .................................................... vii
1. Introduction ................................................ 1
   1.1 Dynamical background ................................... 1
   1.2 Combining statistics and dynamics .................... 5
   1.3 A new approach ........................................ 9
2. Data .................................................... 12
3. The trajectory minimization method .................... 15
   3.1 EOFs and the phase space of weather ................. 15
   3.2 Depicting the trajectory ................................ 18
   3.3 Finding weather regimes ................................ 21
   3.4 The regimes over the North Atlantic and northwestern Europe ................................................. 23
   3.5 The classification of events .......................... 26
4. Persistent events and the behaviour of the trajectory .... 28
   4.1 The path in phase space ................................ 28
   4.2 Duration of the events .................................. 31
   4.3 Regime transitions .................................... 35
4.4 The trajectory within and between events ....................... 39

5. Synoptic study of the regimes .............................................. 42
   5.1 The blocking regime ................................................ 46
      a. Classification of the activities ............................... 50
      b. Actions and reactions .......................................... 53
      c. Action – reaction sequences .................................. 55
      d. The oscillation and balance .................................... 59
      e. Trajectory behaviour ........................................... 60

   5.2 The zonal regime ..................................................... 63
      a. Event activities .................................................. 65
      b. Interactions ....................................................... 67
      c. Trajectory behaviour ........................................... 68

   5.3 The Greenland anticyclone regime ............................... 72
      a. Event activities .................................................. 74
      b. Responses and interactions .................................... 76
      c. Trajectory behaviour ........................................... 79

   5.4 The Atlantic ridge regime .......................................... 80
      a. Important factors in the flow .................................. 81
      b. Interactions in different situations ........................... 83
      c. Trajectory behaviour ........................................... 85

6. Synoptic study of the transitions .................................... 86
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ABSTRACT OF THE THESIS

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In the phase space of weather, low-frequency variability (LFV) of the atmosphere can be captured in a large-scale subspace, where a trajectory connects consecutive large-scale weather maps, thus revealing flow changes and recurrence. Using this approach, Vautard (1989) applied the trajectory-speed minimization method (Vautard and Legras, 1988) to atmospheric data. From 37 winters of 700 mb geopotential height anomalies over the North Atlantic and the adjacent land masses, four persistent and recurrent weather patterns, interpreted as weather regimes, were discernable: a blocking regime, a zonal regime, a Greenland anticyclone regime and an Atlantic ridge regime.

In this study, we investigate these regimes further in terms of
maintenance and transitions. A regime survey unveils preferences regarding event durations and precursors for the onset or break of an event. The transition frequencies between regimes vary, and together with the transition times, suggest the existence of easier transition routes. These matters are more systematically studied using complete synoptic map sequences from a number of events. In the maintenance of an event, oscillations between different balancing forces are observed, in connection with recurring nonlinear interaction sequences. Also the transition routes seem to contain particular evolution sequences leading to the next quasi-stationary flow pattern.