Meteorological Project Work - 1ME426

PROJECT PLAN

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August 23, 2024

1 Introduction

Numerical models have become important tools in fields such as atmospheric science. They are indispensable in forecasting and simulating complex atmospheric phenomena. An example of these models is the Weather Research and Forecast Model (WRF), which integrates a wide variety of physical processes.
Whereas they are excellent tools for operational and research meteorology, their complexity presents challenges in deeply understanding how these models work.

This project aims to understand the fundamental numerical methods that hold these complex models by implementing a numerical model from the ground up, using spectral methods and parallelization techniques.

Objectives

- To understand and be able to apply spectral methods in numerical models.
- To understand the utility of parallelization with approaches such as MPI
- To exploit simpler equations to describe atmospheric phenomena.
- To implement a spectral model for the Eady problem.

2 Tasks

1.- Introduction to Spectral Methods and MPI Parallelization

- **Task 1.1**: Review and study of spectral method literature for numerical modeling of the atmosphere.
- **Task 1.2**: Learn the basics of MPI and how to use it for parallelization.
- **Deliverale 1**: A report summarizing what learned about spectral methods and MPI approach with some example codes.

2.- Practice with simple equations

- **Task 2.1**: Implementation of spectral methods for solving simple equations such as the wave equation or the heat equation.
- **Deliverale 2**: A set of codes solving these simple equations and comparing the results with the analytic solutions.

3.- Implementation of the Eady problem

- **Task 3.1**: Implementation of the Eady problem using spectral methods in a rectangular domain.

4.- Advance scenarios

(Optional in case of finishing the other tasks before the deadline)

- **Task 4.1**: Extend the model to simulate frontogenesis.
- **Task 4.2**: Extend the model to simulate cut-off lows.

5.- Written report on the full project and oral presentation

3 Gantt chart