

## **EAPS 59100**

### **Capstone Project: Derecho or Hurricane Sandy**

**Due May 3rd, 2023 at 11:59pm**

#### **I. Introduction**

Impacts from various historical weather events have shaped society across the world in various ways. From building material modifications to improving the accuracy of forecasts, resilience is essential for humankind to survive natural disasters. Forecasting is an example of the scientific method. Part of the scientific method is to assess our hypothesis based on the outcome of the results. One way we can improve forecasting or improve the response to an anticipated weather event is to evaluate historical events. By doing this, we can learn what went wrong or what can be improved moving forward.

We have spent a good portion of this module introducing numerical weather prediction and the Sustainability Developmental Goals. Now, it is time to choose a historical weather event to simulate with the WRF model and write up your findings.

#### **II. Project Criteria/Content**

##### **a. Introduce the Weather Event**

Choose your historical weather event (Derecho of 2012 or Hurricane Sandy). Once you have selected your topic, provide a thorough introduction of the TYPE of weather event you are going to discuss. For example, if you have selected Hurricane Sandy, introduce with your understanding of the science of hurricanes.

Then in the introduction section, briefly discuss the dates the event occurred, the significant weather impacts (flooding, wind damage, precipitation accumulation, etc.) Note this discussion only needs to be brief since you will have another section dedicated to detailing the impacts and the ensuing responses. This portion of introducing your event should provide the objective as to why researching historical events is important.

#### b. WRF Simulation

Simulate your chosen event with the directory we provide for you. You will run the WRF simulation independently. Discuss your simulation setup by describing the resolution, lateral boundary updates, physics options, data type, etc. You need to explain the physics suites and how they work. Once you have run the simulation, select at least 5 figures from the “pythonprd” directory to demonstrate the formation and progression of the weather event. The big question to answer from your WRF simulation is: what was forecasted/predicted?

#### c. What Was Observed/Happened and Compare With Your WRF Simulation

For this section, explain what happened through the entire duration of the weather event. You can use researched surface maps, radar images, or anything else you can think of to show the weather observations as your event was unfolding. For a hurricane, you can talk about how the hurricane moved toward the coast it hit. Go into as much detail as possible with data. Give dates and time. Explain the weather to the best of your ability. This part is so important because understanding the actual happenings of the event is our best measuring stick for the validity of forecasting. Once you have sufficient information of the observations,

explain how your WRF simulation performed. (Keep in mind that quantitative forecast verification is not covered in this module, so we are relying on visual interpretations for now).

#### d. Societal Impacts

What were the damages of this event? Please discuss impacts in monetary value, fatalities, injuries, property damage, etc. Find data and if there are pictures from the damage feel free to put them in the report.

#### e. Implications and SDGs

Synthesize the information you have collected about the model simulation, the observations of the event, and the impacts of the event. Explain the effects this event had regionally, nationally, or even globally. How well was the event forecasted with WRF? Do you think the physics options were a good pick? How about the domain resolution?

Now, think about the observations and impact. How did the infrastructure hold up during the event? Were there modifications to building materials or changes in location of where they built building after this event? How was the response to the aftermath? What lessons were learned from this event happening?

The Sustainability Development Goals have been a major part of this module. Discuss 2-3 SDGs that could strengthen societal resilience and adaptivity to the case you chose and why. Discuss the significance of NWP to meeting these SDGs.

### III. Grading

This paper is worth 75 points of your grade. Scoring for each section will be broken down:

#### a. Introduction

|   |              |
|---|--------------|
| Clear explanation of weather type. Science well explained. Clear, concise introduction to historical event.         | 10-15 points |
| Weather type explanation somewhat clear. Science is vague. Clear, concise introduction to historical weather event. | 5-9 points   |
| Weather type explained vaguely with little science inclusion. Brief explanation of historical weather event.        | 0-4 points   |

#### b. WRF Simulation

|   |              |
|---|--------------|
| Clear explanation of WRF model parameterization. Physics well explained. 5 figures used from pythonprd directory. | 16-20 points |
| Somewhat clear explanation of WRF parameterization. Physics somewhat explained. 2-4 figures used.                 | 11-15 points |
| Unclear explanation of parameterization. No information about physics. 0-1 figures shown.                         | 0-10 points  |

c. What Happened

|  |              |
|--|--------------|
| Clear explanation of observations.<br>Data used several times and<br>figures/maps shown with captions.<br>Demonstrates understanding of the<br>event's timeline. | 16-20 points |
| Somewhat clear explanation of<br>observations. Data used somewhat<br>and no figures/maps shown.<br>Demonstrates vague understanding<br>of the event's timeline.  | 11-15 points |
| Unclear explanation of observations.<br>Data not used and no figures shown.<br>Reader left uncertain about the<br>event's timeline.                              | 0-10 points  |

d. Societal Impacts

|   |             |
|---|-------------|
| Clear explanation of impacts. Data<br>reported for any fatalities, damages,<br>and monetary values in extensive<br>detail.  | 8-10 points |
| Somewhat clear explanation of<br>impacts. Data reported vaguely for<br>any fatalities, damages, and<br>monetary values.   | 5-7 points  |
| Unclear explanation of impacts. Data<br>not used or used very little for<br>fatalities, damages, and monetary<br>values. Reader left uncertain about<br>the impacts and significance. | 0-4 points  |

e. Implications

|  |             |
|--|-------------|
| Excellent synthesis of WRF, observations, and impacts. Reader feels they understand the significance of the event & how it affected the area. SDGs are appropriately incorporated for the event.     | 8-10 points |
| Good synthesis of WRF, observations, and impacts. Reader feels they somewhat understand the significance of the event & how it affected the area. SDGs are briefly mentioned and not well explained. | 5-7 points  |
| Below average synthesis of WRF, observations, and impacts. Reader feels they do not understand the significance of the event & how it affected the area. SDGs are glossed over or not mentioned.     | 0-4 points  |

IV. Paper Length & Citations

Mark Twain once said, “I didn’t have time to write a short letter, so I wrote a long one instead.” Quantity does not always mean quality. If you can write a paper that contains no redundancy yet meets all the criteria written above, you have written a great case study. No length will be given for this paper. Be organized, be well written, and have all the information asked of you. Make sure everything you write is relevant and not repetitive.

At university level, it is expected to use quality resources and formally cite your sources as you are discussing data and information that you did not collect/write yourself. You are expected to cite your sources throughout your paper and list your resources at the end of the paper. You can use MLA or APA format (<https://owl.purdue.edu/>).

Wikipedia is a great starting point for your research, but do not use Wikipedia as your entire source. For example, you can use the National Weather Service website, climate websites, news articles, research journals, or even books. It is suggested to aim for three different resources for this case study. Sources will vary depending on your event so ask me if you are having issues finding enough resources to write this case study.