"When Nature Strikes: Hurricanes"

Activity: How Difficult Is It to Predict Hurricane Path and Intensity Forecasts?

In the "When Nature Strikes: Hurricanes" video, Jenni Evans of the Pennsylvania State University describes her investigations into what factors influence where and when storms make landfall in an effort to save lives. The following activity may give you a better understanding of how hard it is to predict what a storm will do, even with the most advanced technologies and computer modelling.

This example uses the famous 2012 "Hurricane Sandy" which severely impacted New York City, the Jersey Shore, and many other locations along the East Coast. The images you will use come from archived real-time tropical storm forecast charts. They are used with permission from Prof. Clark Evans of the University of Wisconsin-Milwaukee. Sandy began in the eastern tropical Atlantic in mid-October and made landfall at the end of the month. Some locations in NJ and NY have still not fully recovered from damage inflicted by this storm.

Examine the images in the accompanying slideshow to answer the questions below. The images show the forecast storm tracks and intensities as "Sandy" moved northward toward landfall. Use the images provided, your knowledge of tropical cyclones, and other resources to respond to the questions.

1. 1200 UTC (7 am EST) 22 Oct — Images 1A and 1B
   By Oct 22, what was to become "Sandy" was still only identified as "Tropical Depression 18" south of Cuba in the Caribbean Sea. But computer models began to indicate it would become stronger.
   Examine Image 1A
   Q1: Where do most models predict the storm will go over its lifetime?
   Q2: How many predict landfall somewhere in the US?
   Examine Image 1B
   Q3: How many models predict this storm will develop into a hurricane?
   Q4: What are the maximum wind speeds predicted?

2. 1800 UTC (1 pm EST) 22 Oct — Images 2A and 2B
   Examine Image 2A
   Q5: Six hours later, what is the classification of the storm now?
   Q6: How many models predict landfall in the US?
   Q7: In what states is this landfall predicted to occur?
   Q8: Where do most models predict the storm will go?
   Examine Image 2B
   Q9: How many models now predict the storm will become a hurricane?
   Q10: How many predict it might develop into a category 2 storm?
   Q11: What ocean conditions may have provided the increased energy to the storm?

3. 0000 UTC (7 pm EST) 23 Oct — Image 3 [The following images are all for the same time.]
   Q12: 6 hours later, what is the strength of the storm?
   Q13: How many models think there will be landfall?
   Q14: In which States/Provinces do these models predict landfall will occur?

4. 0000 UTC 24 Oct — Image 4
   Q15: 24 hours later, where do most models predict the storm will go?
   Q16: Describe the range of potential landfall locations by State and Province
   Q17: What factors might create such a wide spread between the models?

5. 0000 UTC 25 Oct – Image 5A and 5B
   Examine Image 5A
   Q18: What is the category of the storm now?
   Q19: Looking at the locations of possible landfalls, in which State would <u>you</u> predict it to come ashore?

   Examine Image 5B
   Q20: How fast are the maximum winds?
   Q21: How many models predict it will develop into a Category 3 storm?
   Q22: How many models predict it will diminish back to a tropical storm?

6. 0000 UTC 26 Oct – Images 6A and 6B
   Examine Image 6A
   Q23: What is an important difference now from the models 24 hours earlier?
   Q24: Based on these, where would you predict landfall will occur?
   Examine Image 6B
   Q25: What is the storm's strength now?
   Q26: Why might most models predict the storm will begin to weaken 96 hours later?

7. 0000 UTC 27 Oct – Image 7
   Q27: Where do most models now predict the storm will come ashore?
   Q28: How does this compare with the predictions you first made (Q19)?

8. 0000 UTC 28 Oct – Image 8
   Q29: Off which State is the center of the storm at this time?
   Q30: Where do most models predict landfall?
   Q31: Is there still a wide difference among the predicted paths?

9. 0000 UTC 29 Oct – Images 9A and 9B
   Examine Image 9A
   Q32: Off which State is the center of the storm now?
   Q33: What might you guess is different about the sea surface temperatures here from those

feeding the storm energy when it was farther south?
Examine Image 9B
Q34: What do these models predict will happen to the storm in the next 48 hours?
Q35: Why might the winds become so much weaker in this time period?

10. 0000 UTC 30 Oct – Image 10
    Q36: What does it mean that the storm is now described as a "Post-Tropical Cyclone"?
    Q37: Why might there be so much variation in where the storm will eventually end?

11. 0000 UTC 31 Oct – Images 11A and 11B
    Examine Image 11A
    Q38: Where is the center of the storm now?
    Q39: What factors that affect its path and strength are different from when it was over the ocean?
    Examine Image 11 B
    Q40: Examine these final intensity predictions, and then compare their range with the differences shown at the beginning of the storm on 22 Oct (slide 4).

12. 0000 UTC 31 Oct – Image 12
    Here is the actual path of "Sandy" during its lifetime. Based on looking again at the predicted paths, did any of the models prove to be significantly better than the others?
    Explain your answer.

Wrap-Up

What could be three areas of research or technology developments which would enable Dr. Jenni Evans and others to improve the ability to predict future storm paths and intensities?

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