Teaching with Great Lakes Data

Great Lakes Waves and Water Safety Lesson
Activity 1 Worksheet Key: The Path of the Edmund Fitzgerald

On November 10th, 1975, a massive storm struck Lake Superior causing the shipwreck of the *Edmund Fitzgerald*, a 729-foot freighter ship with 29 crewmembers, all of whom perished in the storm. It initially departed from Superior, Wisconsin at the western end of Lake Superior and was traveling towards Whitefish Bay, Michigan when the wreck occurred.

While the exact cause of the accident is unknown, there is little doubt that gale force winds and massive waves contributed to the wreck. The official conclusion was that the combination of a large cargo load (26,000 tons of iron ore pellets) and water damage from the huge waves berating the ship caused the wreck. As arguably Lake Superior's most famous historical shipwreck, the story of the *Edmund Fitzgerald* has spawned controversy and a cultural aura that few wrecks have captured. It even spawned the famous narrative rock song, *The Wreck of the Edmund Fitzgerald*, by Gordon Lightfoot.

YouTube Link: The Wreck of the Edmund Fitzgerald
http://www.youtube.com/watch?v=Q0DqPSF2fyo

Principles:

Wave periodicity: Taller, more frequent waves pose the biggest hazard to large ships particularly when they exceed five meters in height.

Wave height: Is typically determined by **wind speed** and the **fetch** (distance over which the waves are generated)

Season: Autumn has produced some of the largest storms on record in the Great Lakes Region. "**November gale**" has become a common term to refer to late autumn storms.

Route: The *Edmund Fitzgerald* was travelling from Superior, Wisconsin to Detroit, Michigan and loaded with over 26,000 tons of iron ore. The captain tracked a northern route across Lake Superior, a common practice during late autumn storms.

Ship speed: The ship was traveling at approximately 13 mph on its journey across Lake Superior.

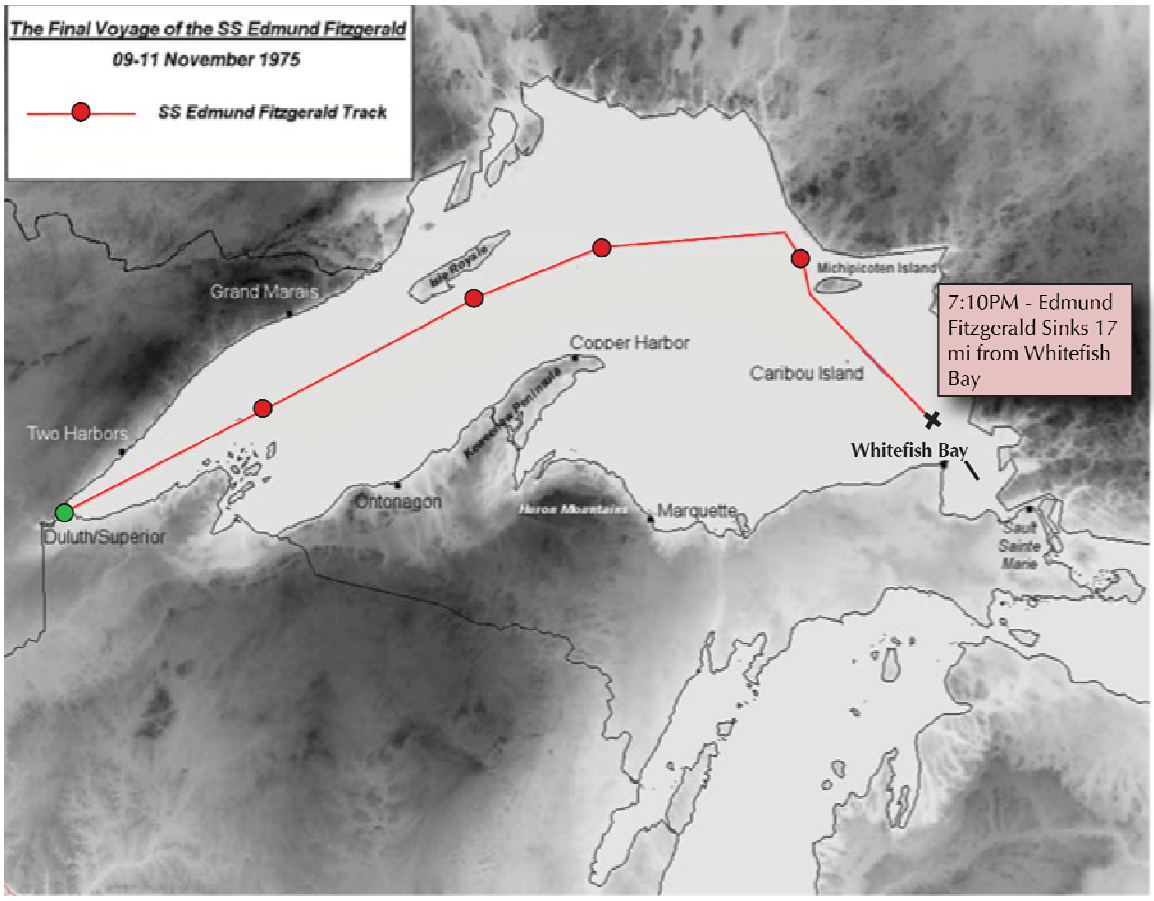


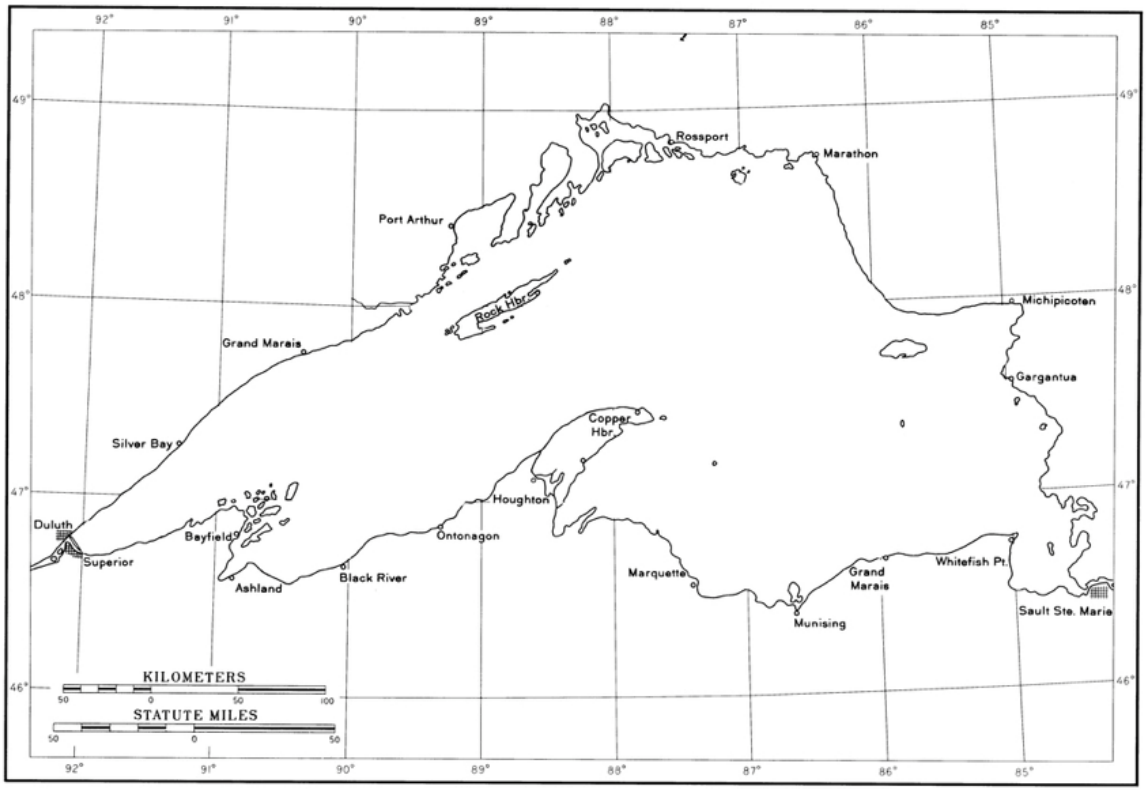
Figure 1: Most probable route of the Emund Fitzgerald from November 9-10, 1975

Procedure:

Each team of three students should have a set of modeled images from the storm that caused the wreck of the Edmund Fitzgerald. Due to incredible advances in time traveling technology – you have the opportunity to travel back to the fateful day in 1975 and stop the shipwreck!

It will take shrewd planning though. Your first task is to work as a team to draw a new route for the Edmund Fitzgerald that will prevent it from encountering the high waves that led to its destruction. Be sure to examine to the forecast images carefully and make note of the times for which each image was generated. Keep in mind that waves over five meters in height have the potential to cause significant damage *so you must avoid these waves at all cost!* You also should try to plot the most fuel-efficient route that avoids these waves. In other words try to draw the shortest possible route that keeps the ship safe.

When you are drawing your route be sure to enter the time that the ship will travel through various points in its route. When you finish – answer the questions below to justify your decisions.



Correct student answers should favor a southern route. Initially, the wind is coming from the east, making it safer for the ship to head towards the northeast Canadian shoreline where wave heights would theoretically be the lowest. However when the wind switches so that it is coming from the northwest, the wave heights rapidly increase to the dangerous heights that contributed to the shipwreck. Based on the ship's travel speed it could have traversed a southern route to reach the protection of Whitefish Bay.

Now that you have plotted a route for the *Edmund Fitzgerald*, it's time to think about the tools that were used to make decisions.

Question 1:

What change in the weather occurs at 1800 hours UTC on November 10th that makes the Fitzgerald's route so much riskier? Why?

The wind shifts so that is coming from the northwest. This means that the waves grew largest in the southeastern part of Lake Superior, the location where the Edmund Fitzgerald happened to be tracking at the time of the wind shift. The large waves were the result of the constant high wind speed and the extensive fetch of wind traveling across hundreds of miles of open water.

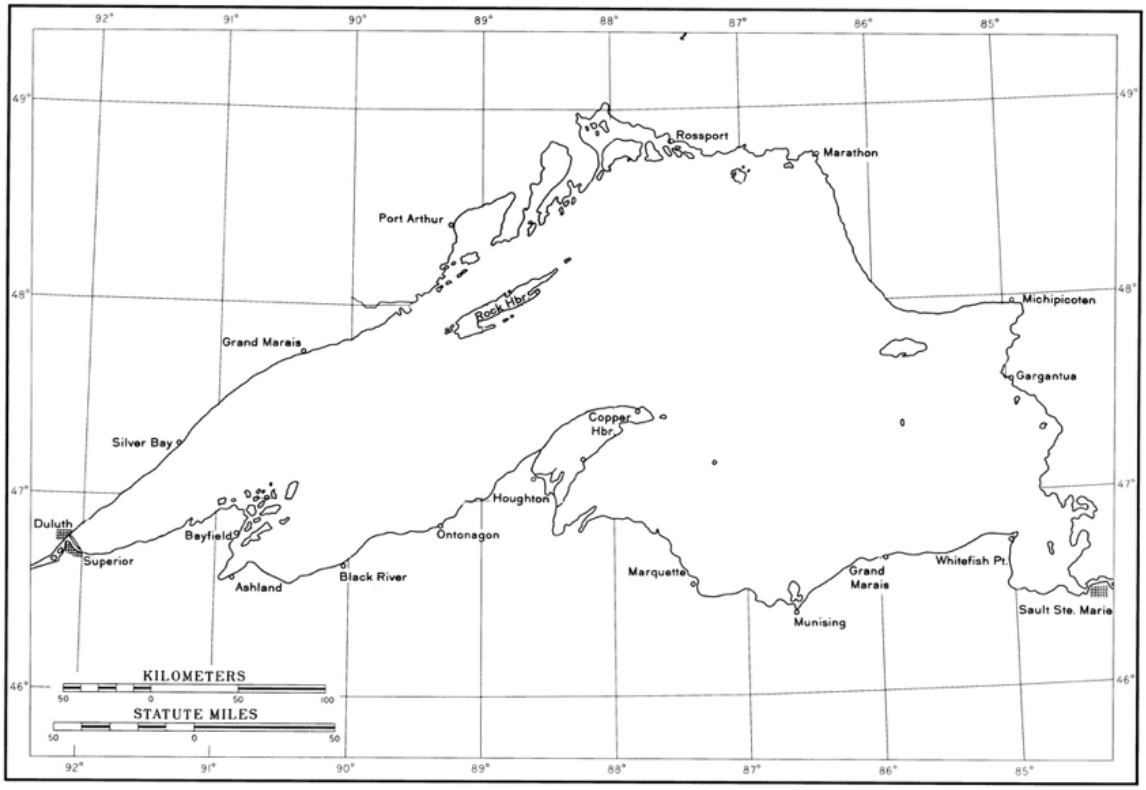
Question 2:

What invention has allowed us to create the strong predictive models that were used in this historical study? What about the modeling of weather and wave conditions makes this necessary?

Meteorological modeling requires extensive computing power, something that did not exist at the time the Edmund Fitzgerald sunk. The huge number of contributing variables and complexity of weather systems makes large-scale computing a requirement.

Question 3:

Today you learned that wave heights are determined by the wind speed and fetch (distance traveled over water). With this in mind, where on Lake Superior would you expect waves to be the most dangerous if the wind is coming from the northwest? Highlight these areas on this map of Lake Superior.



Southeastern regions of the lake are most susceptible to large waves.