Natural Disasters' Impact on the Earth

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Introduction

Historically my Earth History unit has been very boring for my students, so I wanted to develop a curriculum unit that would stimulate interest in the subject. The unit is usually taught after the holiday break, so I'm willing to concede that this could be due to the timing of the unit, but the students always seem to bring such enthusiasm into the unit. They genuinely seem excited to learn about Earth History. Then, the unit starts and it's slow, dry, and boring, the students quickly tune it out. This, as we all know, leads to lower grades and classroom management issues due to low student engagement. So I said to myself, "How can I make Earth History sexy?" I know what you're thinking, sexy units? For students? Well sex sells but by no means am I suggesting using sex in the unit of study. I am simply trying to match its interest level in society. So, for this unit to be "sexy" I had to find out how I could fit something with high interest into the standards of the unit. In choosing natural disasters, I have found a "sexy" topic. This is the stuff of movies, high winds, cracking Earth, buildings falling, and huge waves washing on the shore.

Earth History seems sometimes to be the forgotten Science, but that doesn't make it any less important. Earth History helps to explain the planet we live on and how it works. When students arrive in sixth grade, most of them have had little or no Science instruction. The shift in content has put so much stress on teaching and testing Math and English that the other content areas can sometimes be lost. Getting excitement out of the students is the first step in conveying the importance of the unit. As pre-teens, sixth graders are becoming very aware of the world around them, how it works, and why things are this way. That is Earth History. It can capture a student's most prized asset, their imagination. Earth History deals with dinosaurs, comet impacts, and extinctions. How could these things that no one has ever seen before not spark the imagination of a twelve year old? This is how movies are made. On the technical side of Earth History, it introduces the Earth's processes that are still happening today, right before our very eyes. For a student to be able to see the past through rocks and apply it to the present or future involves important scientific skills, inference and extrapolation. These skills are important in all the sciences and are easily demonstrated and learned through the study of Earth History.

How Does It Fit?

Being able to fit new material into curriculum is always challenging. Reading standards developed by administrators are equally as challenging. The Next Generation Science Standards (NGSS) that I will attempt to address is MS-ESS-2. It states: "Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and special scales.[1] That would be the technical part. How I'd like to fit it into my curriculum is a little different. Included in the district curriculum and science kit I am given each year to work from, puts an emphasis on the Grand Canyon. The makers of the kit have undoubtedly done this to convey the awesome power of the Earth, since the Grand Canyon is the world's greatest example of erosion. It shows how a river can carve a mile deep canyon in the middle of the desert in only a few million years.

Embedded in the lessons and the explanation on how the canyon was formed is a mention about a volcanic eruption that helped, among other forces, to shape the canyon. This is the connection I have used to write my unit. A volcanic eruption is a natural disaster so I will use it as a lead in to take a look at other natural disasters such as earthquakes, hurricanes, drought, flood, and tsunamis. Even though global climate change may play a role in their formation, or their impact on some human populations may be dramatic, I have chosen to stay away from natural disasters such as tornadoes because they don't change the physical parameters of their environment enough.

Cross-Cutting Connections

Our school's PLC (Professional Learning Community) vision is for teachers to take this mandatory or contractually obligated time and use it in the fashion they see fit to benefit their students. I am the team leader and thus tasked with creating each and every agenda for our meetings. The major deficit that I have identified is that there is no cohesiveness in the 6th grade curriculum. The students study something different in every single class every day and, of course, this is directly tied to how they are being taught and the activities that are used. I have found that natural disasters are addressed in every discipline except math. All of them. So my question is, why not incorporate this common idea in all of the contents at one time? Students would have a common theme in every class, and hopefully gain a better understanding of the concept because of this. It is inevitable that each content area teacher, in delivering their own content, will reinforce concepts from other disciplines. The big idea for common core is cross-cutting. As the unit is taught now the cross-cutting occurs at different times during the school year. I feel that it would be most effective if the cross-cutting of one main idea happened period by period during one day instead of appearing in different classes at different times on the year.

Increased vocabulary retention will be a major bonus of the unit being cross curricular. Tier I to Tier III words will be used in each class for an extended period of time and in different contexts. This will give students access to different teaching styles

and techniques on the same vocabulary and content. Having the same words taught four different ways is a great example of differentiated instruction.

Tasked with this idea I have decided to implement this project for my PLC group. We will work on this unit as a grade level and implement it at the same time so that students will go from class to class with the same ideas being expressed in each class. My focus, other than driving the group, will be to develop content to teach about how natural disasters have an impact on Earth.

Demographics

H.B. duPont Middle School is a comprehensive public middle school operating in the Red Clay Consolidated School District. H.B. duPont is located in Hockessin, Delaware. H.B. serves students in the grades sixth, seventh, and eighth grades. These students range in age between ten and fifteen years of age. The schools vision statement is to "have each student college and career ready." H.B. has 68 staff and teachers employed at the school. This number includes support staff as well. H.B. also has three administrators, one principal and two assistant principals. Each grade level has approximately 300 students enrolled for a total school population of around 900. 50% of the student body is being bussed in from the inner city. The other 50% is middle and upper middle class students who reside near the school. The school was opened in 1972. It was built with funds donated by Henry B. duPont, thus the name of the school.

The sixth grade consists of approximately 300 students. There are two Science, two Social Studies, three Math, and three English teachers serving the sixth grade students. In any individual class there is anywhere between 2-10 students identified as special education students out of a class of 20-30 students. In the Science classroom I am the only teacher in the room at any time. The classroom is somewhat cramped due to the large lab tables that reside in room. There are also counters that extend the length of the room in every direction, and on these counters there are about 8 sinks plus one at the front of the room. It is a Science lab in every sense of the word. The students sit in groups at lab tables. Most of the student seats are stools that barely fit underneath the tables; however there are a few odd chairs that are scattered throughout the room. I do not require students to sit in assigned seats. I feel that allowing the students to select their own seats shows me the different dynamics between the students. It also shows me who should not sit together and tends to make it easier for me to construct groups based on achievement. All of these things become evident by the end of the first month of school and will allow me under the guise of misbehavior to strategically change a few seats. It also gives the students an opportunity to feel comfortable right off the bat during a very uncomfortable time in their life, starting middle school.

The curriculum in sixth grade Science at H.B. middle school has three major sections; My Body and Me, Earth History, and Force and Motion. They are taught in that order.

The units cover topics that range from Biology to erosion to Physics. For most of the students, this is their first experience with Science. Due to increased testing in Math and English, Science is pushed to the back burner since it is not a tested subject. Some students come to me with no Science experience at all. The ones that do have some experience only had it for an hour a week. The major challenge is changing students' habits, getting them to begin to think on their own and solve problems instead of regurgitating knowledge from their notebooks to the test paper. The students at H.B. have Science every other day. On the days that they do not have Science they attend Social Studies. Our schedule runs on a rotating schedule ABCD, ABCE, and ABCF. It is difficult to explain so I will not attempt to, but I assure you it is not tough to follow after about a month, especially considering that you have a cheat sheet to let you know what rotation day it is.

Goals

Students will understand that:
1. Earth's processes are dynamic and ever changing.
2. Events that shape the environment are either quick and violent or harsh and prolonged.
3. Man has had a hand in causing disasters by affecting climate.

Students will be able to:
1. Create models expressing landscapes.
2. Understand the effects of different disasters on the environment.
3. Recognize what disaster may have occurred by examining evidence in certain areas.

Types of Natural Disasters to Focus On

In preparing for designing this unit I decided to study a few natural disasters that affect the environment around us the most. These are the disasters that can change the landscape.

Tropical Cyclones

The Atlantic hurricane season runs from June 1st to November 30th, and the Eastern Pacific hurricane season runs from May 15th to November 30th. The Atlantic basin includes the Atlantic Ocean, Caribbean Sea, and Gulf of Mexico.[2] The National Weather service characterizes these storms as Tropical Cyclones. Tropical Cyclones include tropical depressions, tropical storms, hurricanes, and major hurricanes. These storms rotate counter clockwise and are found in the northern hemisphere. The characteristics used by the National Weather service to identify storms are as follows:

1. Tropical Depression: A tropical cyclone with maximum sustained winds of 38 mph (33 knots) or less.

2. Tropical Storm: A tropical cyclone with maximum sustained winds of 39 to 73 mph (34 to 63 knots).
3. Hurricane: A tropical cyclone with maximum sustained winds of 74 mph (64 knots) or higher. In the western North Pacific, hurricanes are called typhoons; similar storms in the Indian Ocean and South Pacific Ocean are called cyclones.
4. Major Hurricane: A tropical cyclone with maximum sustained winds of 111 mph (96 knots) or higher, corresponding to a Category 3, 4 or 5 on the Saffir-Simpson Hurricane Wind Scale.[3]

Tropical Cyclones tend to move to the west and finish by moving north. They are typically formed off the coast of East Africa and begin as a Tropical Depression. The storm gains strength from warm waters as it moves west. Shallow tropical waters fuel hurricane development. Waters of the Caribbean Sea and the Gulf of Mexico are ideal areas for hurricanes to develop due to their warm and shallow waters. Hurricanes lose energy and intensity when they make landfall. This is due to the lack of moisture over the land for the storm to feed on. The warmer the water, the more intense the storm will be. The warm water is the fuel that a hurricane uses just like a car uses gasoline. You can equate the water's warmth with gasoline's octane rating. The higher the rating the bigger bang you get, well the same thing goes for the water temperature, the warmer the water the bigger "bang".

Pacific Cyclones are the same type of storms; they just form in the South Pacific Ocean as opposed to the South Atlantic Ocean. When a cyclone forms in the Pacific or the Indian Ocean it is called a Typhoon.[4] Don't let the names fool you, they are the same type of storm. A Typhoon begins to form in the warm waters of the South Pacific off the coast of Mexico and usually tracks towards the islands of the South Pacific, and Indonesia.[5] These storms can be extra devastating to the tiny island nations in the South Pacific. Islands in this area of the world are separated by vast distances. Unlike in the Atlantic where there are major continental land masses to slow the storm's growth, these tiny islands are surrounded by warm water and many times the storms pass right over and never lose any strength causing immense devastation in their wake.

Rain

Rainfall above normal averages is associated with hurricanes. During the remnants of Hurricane Claudette, Austin Texas saw 43 inches of rain in 24 hours. The heaviest rain tends to fall slightly to the right of the storm due to the way the storm rotates and moves toward the land. Rain of this magnitude will overwhelm rivers and streams and cause severe flooding. [VI] This flooding can change the landscape by cutting new river channels in a short period of time; this is erosion on an exponential scale. The resulting floods from heavy rain such as this can also wash away vegetation, making the landscape much more vulnerable in the future to erosion. The human consequences can range from disease to starvation due to the destruction of food crops.

Storm Surge

A storm surge is a rise in sea level caused by a hurricane. As the hurricane spins and gathers energy from the warm water below, the low pressure will pull up the level of the ocean beneath it. As a hurricane comes ashore this elevated sea level causes extreme beach erosion. It can totally alter the coastline by destroying barrier islands and dunes as well as causing major beach erosion. A resulting storm surge also can cause major coastal flooding, because coastal areas tend to be low lying, at or below sea level. If sea level were to rise in these areas they would be inundated with water. Storm surge tends to be the most costly effect of a hurricane due to the floods it causes in high priced business and coastal areas.

Winds

The Saffir-Simpson Hurricane Wind Scale is a 1 to 5 rating based on a hurricane's sustained wind speed. This scale estimates potential property damage.[7] When a storm reaches a category 3 it is considered major.
Category 1: winds from 74-95mph
Category 2: winds from 96-110mph
Category 3: winds from 111-129mph
Category 4: winds from 130-156mph
Category 5: winds in excess of 157 mph

Damage from the high winds associated with hurricanes is mostly to man-made structures such as homes and power lines. The landscape effect that is most common is trees being uprooted or snapped in half.

Volcano

Volcanos usually occur at or near tectonic plate boundaries. These are areas where two of the Earth's plates are making contact with each other. There are different types of plate boundaries; the one most associated with volcanos is a subduction boundary. A subduction boundary is when one plate dives below another plate. The pressure causes material from the mantle of the Earth to be forced to the surface. The place where this material reaches the surface is known as a caldera. The cooled and built up rock and earth around the caldera is the volcano. Volcanos can also occur at hot spots. Hot spots are areas in the middle of a plate where magma from the Earth's mantle has risen up through the crust and is exposed, such as the Hawaiian Islands. There are three different types of volcanos:

1. Composite: These volcanos consist of layers of solid lava flows mixed with layers of sand- or gravel-like volcanic rock called cinders or volcanic ash. Mt. St. Helens is an example of this type.[8]
2. Cinder Cones: These volcanos consist almost entirely of loose, grainy cinders and almost no lava.[9]
3. Shield Volcano: Very large volcanos that tend to consist almost entirely of cooled lava flows. The Hawaiian Islands are a composite of several of these types of volcanos.[10]
4. Super Volcano: Very large caldera of magma under the ground. These volcanos are so large they are difficult to spot. An example of a super volcano would be Yellowstone National Park. Scientists believe there is one below the park.[11]

Volcanos change our landscape in a few different ways. The major way they affect the environment is that they lay down new material covering old material. When we look at layers of rock we can see when volcanic eruptions took place because of a layer of ash or cooled lava. Depending on how this lava spreads out will determine how the landscape is changed. Another way a volcano may change the environment is due to a large explosion. This is rarer and occurs when intense pressure builds up and is released all at once. The resulting explosion can move major sections of earth and knock down trees. The final way a volcano can change the Earth is to change the climate. If the eruption is large enough the resulting ash cloud can reduce the amount of sunlight that reaches the ground. This in turn can change an environment by turning a lush one into a barren desert type environment. These ash clouds can be so thick that they can actually stop photosynthesis; this is the process plants use to convert sunlight into food. Scientists believe that volcanoes are responsible for the mass extinction that made it possible for the dinosaurs to dominate the environment.[12] Scientists found in rock layers, or strata, evidence that this occurred by looking at certain elements found in the strata. Elements like Zircon and Uranium.[13] These mass eruptions occurred over about 600,000 years and coincided with the break-up of the super continent Pangea.[14]

Earthquakes

Earthquakes occur near plate boundaries, the most common being a transverse boundary. A transverse boundary is when two plates slide past each other. Areas where a lot of activity takes place are called faults, the most famous in the United States is the San Andreas Fault near San Francisco. These plates sometimes become locked in place and begin to build up extreme pressure. When the plates finally break free an earthquake is the result. The shaking from an Earthquake only lasts for less than a minute. The intensity of earthquakes are measured by using the Richter Scale. The Richter Scale was developed in 1935 by Charles F. Richter of the California Institute of Technology.[15] The magnitude of the earthquake is determined by the logarithm of the amplitude of waves taken by a seismograph.[16] The earthquake is given a whole number sometimes with a decimal for this calculation. We say this is the earthquake's magnitude. Each time the whole number

increases one, the intensity of the earthquake increases 31 times. In other words, a magnitude 6 is 31 times more powerful than a magnitude 5.

The most powerful earthquake ever recorded was a magnitude 9.5 on May 22, 1960 in Chile.[17] It caused a major tsunami and a volcanic eruption that lasted for weeks.[18] An earthquake causes a tsunami by simply shaking. Imagine taking a bowl of water and taping on the side, you would see ripples. These ripples are caused from the vibration or motion caused by your hand tapping the side of the bowl. This is the same concept that causes tsunamis; the tapping done by the earthquake is a lot stronger than your finger and creates a much larger ripple. The continental shelf, the area where the ocean begins to become shallow near the mainland, can exacerbate the effects of the tsunami by minimizing the area for the ripple to go thus increasing the wave's height. The most powerful earthquake to hit the United States was a magnitude 9.2 in 1964 and located in Prince William Sound, Alaska. This earthquake raised some outlying islands 11 meters, and caused a terrible tsunami. The way these earthquakes changed the environment is astounding. The force that is involved in raising islands is immense. This kind of physical change in the environment could take thousands of years in normal conditions for that area. During this event it took just one minute.

Classroom Strategies

The classroom environment is different for every teacher. In my classroom, my students thrive on the autonomy that I give them to complete their activities. This does not mean it is a free for all or that there is no structure, there definitely is, but students need to feel independent and that they are in-charge of their learning. Everyday students are required to arrive in class and retrieve their science notebook from a folder that I provide in the classroom. From there they should take their seat and begin work on their "Do Now". This allows me to get their brains thinking about science or our activity. It also allows me to take attendance or do any final set-ups of the activity. Teaching back-to-back classes doesn't always give you enough time to reset. The students should always receive clear instructions in at least two forms, usually I give written and verbal. When they start the activity is where I tend to stay hands off. I like to hover around in case I am needed and also to assess progress and knowledge and of course to make sure the class is on task. Frequent time checks are also beneficial. It gives the students incentive to move forward on their classwork. Finally giving ample time to clean up is crucial to the cleanliness and organization of your classroom.

Classroom Activities

Lesson #1

The NGSS' that will be targeted are as follows:

MS-ESS3-2 Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.[19]
MS-ETS1-4 Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.[20]

As the students walk into class on the first day, I will have a "Do Now" posted for them to complete. A "Do Now" is a quick activity each student will complete on their own and usually in their science notebook. It is usually an assessment on students' knowledge of an upcoming lesson or an activating strategy designed to get the student's brains working in the right direction. In this instance the do now is for the students to recall a natural disaster that affected them in their lifetime and to describe how or what caused the disaster.

As a classroom teacher with knowledge my students, the time given for the "Do Now" is at my discretion and may differ from class to class. When the students have finished with the activity, I will lead them into a discussion about the topic. Eliciting responses from the students and informally assessing knowledge of the content as we progress. This discussion is a great transition into the direct instruction on the processes of earthquakes, why they occur and how they occur.

Hands on Activity

The materials needed for this activity are as follows:
1. Two small (2'x1') pieces of luan plywood per group.
2. Glue
3. One box of tooth picks or popsicle sticks.
4. A 1'x2' sheet of aluminum foil.

The students will be directed to construct a building using the materials provided. Half of their buildings foundation must be on different sheets of luan. Each building should be constructed at least three stories tall with the aluminum foil used as outer walls. The designs should be left to dry overnight.

The next day students will complete a "Do Now" that asks them to attempt to identify what type of fault their building is sitting upon. Again I will give each class the needed amount of time to complete this question. I will lead the students into a discussion of their answers and transition into magnitudes of earthquakes. We will use magnitude 5 as our first example. I will tell the students that in the case of a magnitude 5 earthquake our model's two pieces of wood will slide one millimeter in different directions, and that this movement will model a magnitude 5 earthquake on our buildings. You can begin at any magnitude; just remember that each whole number increase multiplies the original distance by 31. I will then show the students how with each increased whole number in magnitude how many more times the original magnitude 5 it is. Using the math formula that states each step up in magnitude the force is multiplied 31 times. I have the students

do their calculations to find out how far the boards should slide for each magnitude increase. They are then allowed to model the effects of an earthquake on their structure.

When the students are done modeling the destructive force of an earthquake, they will begin to write a conclusion paper. This paper should be at least one page hand written and explain all of their findings from the activity. The students should cite information gained from instruction and back up their findings with evidence.

Lesson # 2

The NGSS' that will be targeted are as follows:
MS-ESS3-2 Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.[21]
MS-ETS1-4 Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.[22]

As the students arrive to class the "Do Now" posted will be for the students to make an acrostic of the word hurricane. An acrostic is using the root word's letters to fit into new words that describe the root word, in this case hurricane. I will have the word hurricane on the board written as a column. The discussion I will lead is to have the students give me examples of the words they chose and fill in the acrostic for the class together making sure to elaborate on each word added in an attempt to fit it into the instruction and help into the transition to direct instruction that follows the "Do Now".

During the direct instruction, I will show a short clip on Hurricane Katrina found on NBC Learn.[23] Similar clips can also be found on YouTube.[24] While discussing the effects and devastation caused by Hurricane Katrina I will transition into the directions for the hands on activity.

Hands on Activity

The materials needed for this activity are as follows:
1. A multi speed fan.
2. Two pieces of wood, books, or cardboard to create a wind tunnel.
3. One spring scale per group.
4. One piece of string about two feet long.
5. One small plastic sandwich bag that can be fashioned into a sail.
6. If possible a wind meter so that the wind speed can be accurately calculated.

I will set up the wind tunnel in my desired or central location. In their groups, students will begin to make their sails out of the plastic bags and attach them to the piece of string. When they have completed their sail, they will attach them to their spring scale in preparation to drag them into the wind created by the fan. Allow the groups one by one to

measure the wind speed and then drag their sail up wind recording the force needed to do so into their notebooks; this will be the reading on the spring scale. Each group should do this as many times as the fan has speeds.

As the students return to their tables they will begin to calculate the differences in the force needed to move their sail as the wind speeds increased. They should calculate their recorded wind speeds with the Saffir-Simpson Hurricane Scale. The finished product is a one page hand written conclusion presenting all of their data backed up with evidence collected through experimentation or instruction.

Lesson # 3

The NGSS' that will be targeted are as follows:
MS-ESS3-2 Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.[25]
MS-ETS1-4 Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.[26]

As the students enter the classroom the "Do Now" posted will ask them to draw a picture of a volcano in their notebook. The students should be allowed and encouraged to use color in their drawing. The students should also label their drawing to the best of their ability.

I will begin the direct instruction portion of the lesson by projecting pictures of some volcanoes. Ask the students if their drawings resemble any of the real life pictures you have shown. I will then discuss the processes that cause a volcano to erupt. I will use a diagram of the inside of a volcano that shows the processes, paying close attention to the specific plate boundary that causes volcanoes, subduction.

Hands on Activity

The materials needed for this activity are as follows:
1. Recipe for play-doh found on cooks.com[27]
2. Vegetable oil.
3. Flour.
4. Water.
5. Salt.
6. One large shoe box lid
7. Dirt, sticks, grass, and anything else desired to decorate the finished product.
8. Baking soda.
9. Food coloring.
10. Vinegar.
11. Small plastic cup to act as the caldera.

Follow the recipe for each group of students. Depending on the class I or the students dispense the ingredients into the large mixing bowl. The students are instructed to knead the ingredients into dough, and when it is pliable enough, mold it into the shape of a volcano with the small cup hidden at the top. The finished molds can now be decorated with dirt, grass, or any desired medium. I allow the students to be a creative as possible in designing their volcano and setting the scene in their box. The final activity involves erupting the volcanoes. I instruct all the students to put on safety goggles for this part of the activity. I will then allow each group to choose the color of their lava, and using the reaction of vinegar and baking soda I will erupt each volcano. The assessment for this activity is the finished volcano. I assess it on creativity, the group's ability to follow a procedure, and the final look of the volcano, is it realistic?

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Notes

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Curriculum Unit Title	Natural Disasters' Impact on Earth	**Author**	Matthew Robinson

KEY LEARNING, ENDURING UNDERSTANDING, ETC.

1. The Earth is an ever changing planet. 2. Natural disasters affect populations all over the globe. 3. Natural Disasters are caused by the Earth continually changing. 4. Plate movements cause volcanoes to erupt. 5. Plate movements cause earthquakes to occur. 6. Hurricanes are products of wind and moisture.

ESSENTIAL QUESTION(S) for the UNIT

1. What causes an earthquake? 2. What causes a volcano to erupt? 3. What fuels a hurricane?

CONCEPT A	CONCEPT B	CONCEPT C
Volcanoes erupt due to the movement of Earth's plates.	Earthquakes are a release of energy due to the movement of the	Hurricanes gain energy from moisture.
ESSENTIAL QUESTIONS A	**ESSENTIAL QUESTIONS B**	**ESSENTIAL QUESTIONS C**
What forces act on magma to create a volcano?	What tectonic plate boundary is most responsible for earthquakes, and how do they occur?	What causes hurricanes to form and move across the globe?
VOCABULARY A	**VOCABULARY A**	**VOCABULARY A**
1. Caldera 2. Magma 3. Lava 4. Erupt	1. Magnitude 2. Richter 3.Boundary	1. Saffir-Simpson 2. Moisture

ADDITIONAL INFORMATION/MATERIAL/TEXT/FILM/RESOURCES

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