

Episode No. 10

Radio Serial on Climate Change and Global Warming

Volcanism, plate tectonics and Climate change Violent Volcanoes and Varying Climate

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One of the factors which affect the global climatic conditions is volcanic eruptions. During volcanic eruptions tonnes of sulphur dioxide gas is injected into the stratosphere.

Sulphur dioxide gas and sulphate aerosols which eject out through volcanic eruptions strongly absorb or scatter solar radiation, creating a global layer of sulphuric acid haze. As a result, there is long-term global warming and short-term global cooling.

This episode depicts how volcanic eruptions affect local and global climatic conditions with some interesting examples in the past.

List of Characters: (In the sequence they appear in the script)

- Rohit :** A school going boy – Age 12 to 13 years
Rakesh : Rohit's father (About 40 - 42 years old)
Revati : Rohit's mother (Age about 38 - 40 years)
Announcer : Female announcer at the airport (25 to 30 years of age)
Teacher : Rohit's teacher (Female character, Age about 40 years)
Benjamin Franklin : A Scientist in the past age about 75 years

(Rakesh and his wife Revati along with their son Rohit are coming back to India from London. They have arrived at the airport for boarding into the flight. It is the scene of airport. Rakesh, his wife Revati and son Rohit got down from the car. Sound of shutting the door of the car is heard followed by the sound of footsteps of these three)

- Rakesh :** So, we reached at the airport after a long two hours of journey!
- Revati :** Hmmmm.
- Rakesh :** Revati, you wait here. I will check about our flight.
- Revati :** Yes!
- Rohit :** Shall I come with you Pappa?
- Rakesh :** (*Annoyingly*) Rohit... what did I say? You have to wait here along with Mamma.

Rohit : Okay Pappa!

Rakesh : Good! I already have received the message that, our flight has been delayed –

Rohit : What?

Revati : By how much time? When is it expected now?

Rakesh : No idea! That's what I will enquire. You wait here with the luggage.... I will come. Wait here only.

Revati : Okay.

(At that time announcement is heard followed by typical initial beep sound)

Announcer : Your attention please... all flights taking off from this airport are cancelled today. No flight will take off from the airport...Inconvenience to all the passengers is deeply regretted.

(Music – A typical beep sound of closing of announcement is heard)

(A scenario at the airport changes all of a sudden due to this announcement. Noises of people all around are heard. There is lot of confusion in the minds of people. The chaotic situation occurred can be presented with lot of noise from the people and relevant music effects. People started asking why this situation has occurred. On this chaotic situation dialogues start....)

Revati : Ohhh my god!

Rohit : (started crying) Now can't we go back to India, Pappa?

Rakesh : Calm down, Rohit!

Revati : (getting panic) But Rakesh, what will we do now? How to go back and now where will we go in this foreign country?

Rakesh : Don't get panic, Revati. We are not alone here. Can't you see all the passengers here waiting for their planes?

Revati : But Rakesh, they are from the same country! What will we do? And do you know why all these flights are cancelled? It may be due to some terrorist attack -

Rakesh : (interrupting Revati) Come on Revati!

Revati : What 'come on'? This is something serious! Try to understand Rakesh.... I am getting frightened....

Rakesh : Revati, we are safe here. Don't worry. Let me enquire about the reason. I will go to the staff in charge and –

(At that time again announcement is heard followed by typical initial beep sound)

Announcer : All the passengers, please pay attention here! (all of a sudden the noise of people stops) We came to know that there is volcanic eruption in Iceland. So for the safety of our passengers, we have completely closed down all the flight services till further notice. Passengers going abroad please contact respective staff in charge before checking in. Inconvenience is deeply regretted. (Music – A typical beep sound of closing of announcement is heard)

Rakesh : Come Revati... Rohit. We will go to the staff in charge and we will inform them. Also, I will call our tour operator here. He will definitely help us in this situation. Don't worry!

Revati : Okay! Let's hope for the best!

(Change over music piece. Some time has passed. Rakesh, Revati and Rohit are now relaxed and waiting on the airport)

Rohit : Pappa, how much time we have to wait like this, here on the airport?

Rakesh : What can we do now! We just have to wait.

Revati : What a situation we are experiencing! In normal case, we would have enjoyed the premise of this wonderful airport. But, now –

Rakesh : Don't worry. I have talked with our tour operator. He assured me for the help. He is sending a vehicle for us!

Revati : That's okay, but where shall we stay? For how much time?

Rakesh : The tour operator has said, he will make the arrangements. And we might require to stay for couple of days more here!

Revati : Two more days?

Rakesh : Yes! Enjoy your trip, Revati... for some more days! Bonus! (laughs)

Revati : Are you joking, Rakesh? Don't you understand the seriousness of the situation?

Rakesh : (laughs) I can understand, but what can we do? Flights are cancelled... that's all. We can't go back flying on our own! So just cross your fingers and watch!

Rohit : But Pappa, what is the connection with cancellation of flights and volcanoes?

Rakesh : Yehhh.... That's the good question, Rohit! See....during volcanic eruption, huge amount of lava comes out from the earth's crest.

Rohit : Yes. I know that!

Rakesh : But, lava does not come out alone! Along with lava huge amount of ash comes out vigorously and so also various gases mainly Sulphur dioxide and carbon dioxide!

Rohit : Then?

Rakesh : This ash and the gases comes out with tremendous velocity and they are so huge that, they just occupy the entire sky.

Rohit : So huge?

Rakesh : Yes. Lakhs of tones of ash get ejected during volcanic eruption.

Rohit : And the pilot cannot see through the ash!

Rakesh : Correct!

Rohit : But the flights can be operated on auto pilot mode!

Rakesh : (laughs) Rohit, you are right! But the danger is from ash particles!

Rohit : How?

Rakesh : The ash particles can cause significant damage to the engine, propellers, windows, fuel system of the plane. And not only the ash particles, but the damage can be caused due to pulverized rocks, minerals and pieces of volcanic glass coming out along with the ash.

Rohit : Ohhh my god! Then its always better that we should stay here only!

Rakesh : (laughs) The flights have been cancelled for the safety of passengers only. Otherwise this is the great loss due to flight companies!

Rohit : Pappa, this ash can also cause huge loss to environment, because it is causing air pollution!

Rakesh : Yes, you are right! Even though volcanoes are in specific places on Earth, their effects can be more widely distributed as gases, dust, and ash get into the atmosphere. The ash not only destroys nearly everything! When Mount Pinatubo erupted in the Philippines in June 1991, an estimated 20 million tons of sulfur dioxide and ash particles blasted more than 20 kilometer high into the atmosphere. The eruption caused widespread destruction and loss of human life. Gases and solids injected from this eruption circled the globe for three weeks!

Rohit : My god!

Rakesh : Large-scale volcanic activity like this may last only for a few days, but the massive outpouring of gases and ash can influence the environment for several years!

Rohit : Several years? How?

Rakesh : The ash can influence global climate!

Rohit : Global climate.....

Rakesh : Yes!
(At this time mobile phone of Rakesh rings)

Rakesh : (Talking on phone) Hello,... Hmm... Yes, yes. Just wait for few minutes! We are coming outside!

Rohit : Who is that, Pappa?

Rakesh : Our vehicle has come. Let's move! And yes, wake up your Mamma! (laughs) She had a very good nap due to our discussion!

(Rakesh and Rohit both laughs. Change over music.)

(A scene of Rohit's home. Rohit's tuition teacher has come to his home)

Revati : (Calling Rohit) Rohit..... Come out. Your teacher has come. Come on with the books!

Rohit : (from inside) Yes, Mamma.... I am coming!

(Rohit comes out from his room)

Teacher : Hello, Rohit! How are you? And how is your trip? Enjoyed?

Rohit : Yes... but –

Teacher : I know you had to stay back due to volcanic eruption!

Rohit : Yes. But, teacher I enjoyed the trip! And a different experience also.

Teacher : Great!

Rohit : Fortunately the sky became clear after two days and we got a chance to get back!

Teacher : So you got two more days to enjoy! (laughs)

Rohit : Yes, but this experience raised several questions in my mind.

Teacher : Which questions?

Rohit: In fact, I had already decided to ask you about those!

Teacher : Fine. Go ahead!

Rohit : Actually, teacher... my Pappa gave me some information about volcanic eruption and so on, but he said the ash and other gases which come out from the volcanic eruption can affect even global climate!

Teacher : Yes....absolutely true!

Rohit : How? Will you please explain?

Teacher : Yes, surely. Rohit, do you know Benjamin Franklin? And his famous kite and key experiment?

Rohit : Kite and key experiment? What's that?

Teacher : Benjamin Franklin was the scientist in 18th century. He was trying to prove that the electric spark occurring during thundering of clouds can be brought to earth and this electricity can be used in home. Though it's fatal, Franklin took the risk and flew kite with wet thread when thundering was going on.

Rohit : Then what happened, teacher?

Teacher : Rohit, actually, that's not the point. We were talking about volcanos.

Rohit : Yes, teacher!

Teacher : I will tell you about the Franklin's kite experiment later, but the important point is Franklin was equally interested in other phenomena which occur in nature.

Rohit : Which phenomena, teacher?

Teacher : In later years of his life, Franklin studied the effects of volcanic eruptions on climate.

Rohit : Teacher, I know volcanoes are destructive. Violent volcanoes can destroy land, farms, biodiversity and so on. I had also experienced, due to volcanoes how air traffic is badly affected.

Teacher : Yes!

Rohit : Also teacher, at the same time when lava gets cooled down, huge rocks are formed. Somewhere new islands have also formed due to huge amount of cooled lava.

Teacher : Yes, absolutely correct, Rohit!

Rohit : But teacher, I did not understand the connection between volcanoes and climate. Volcanoes are occurring due to vigorous movements of plates under the Earth's crust; and climate is something which is related to atmosphere.... that is related to something which is above the Earth's surface!

Teacher : (Laughs) Yes, you are asking me the correct question, Rohit! This correlation of volcanic eruption and climate was first studied by Benjamin Franklin. Do you know, what exactly Benjamin Franklin did?

Rohit : What?

Teacher : Listen....

(Change over music. The voice of old Benjamin Franklin is heard)

Benjamin Franklin : *(In slow and deep voice)*

It was 1763. I took part in the discussions with colonial scholars about the effects of deforestation on local climate. As forests were cleared for farming in the early American colonies, I thought that "cleared land absorbs more heat and melts snow quicker." However, I also think that many years of observations are necessary before any conclusive evidence could be gathered on the effects of deforestation on the local climate.

But now I am doing very interesting study... the effects that volcanic eruptions on weather patterns, cloud formation, and cloud electrification. To my opinion, summer of 1783 was different than any other summer. In fact, the summer of 1783 was not actually summer. The ice cover still remained intact without melting. To my opinion, severe winter of 1783–84 in the northern hemisphere is linked to the volcanic eruption occurring in Iceland in the summer of 1783.

(Silent background music starts.....)

I still remember, on 8 June 1783, a fifteen mile long fissure with 130 craters in Laki mountain range in the south of Iceland opened with phreatomagmatic explosions because of the groundwater interacting with the rising basalt magma.

The eruption continued until 7th February 1784, but most of the lava was ejected in the first five months. Lava fountains are estimated to have reached heights of 2,600 to 4,600 feet. The gases were carried by the convective eruption column to altitudes of about 10 miles.

Due to the ash and other particles inserted into the atmosphere, there was a great amount of reduction in the solar energy received at the Earth's surface after the volcanic eruption. There was ash all around...

(Change over music.)

Teacher : So that was the opinion of Benjamin Franklin... about 235 years back from now! In 1815, the Indonesian volcano Tambora propelled more ash and volcanic gases into the atmosphere than any other eruption in history. This resulted in significant atmospheric cooling on a global scale, much like Krakatau a few decades later. New England and Europe were particularly hard hit, with snowfalls as late as August and massive crop failures. The cold, wet, and unpleasant climatic effects due to the volcanic eruption led 1816 to be known as "the year without a summer"!

Rohit : Such a drastic effect?

Teacher : Yes. It was said that, there was no sun shine due to ash and haze in the sky. British poet Lord Byron made a poem on this occasion.

Rohit : Which poem, teacher?

Teacher : Lord Byron wrote,

"The bright Sun was extinguished, and the stars
Did wander darkling in the eternal space
Rayless and pathless, and the icy earth
Swung blind and blackening in the moonless air;
Morn came and went and came,
And brought no day"

Rohit : So perfectly described! Great!

Teacher : Tambora volcano also affected climatic conditions in our country also.

Rohit : Teacher, the volcanic eruption took place in Indonesia and still it has affected climatic conditions in our country? How is it so?

Teacher : Rohit, boundaries of the nations are for us... for human beings. Nature does not follow such boundaries. One event occurred in nature can affect other natural phenomenon at thousands of kilometres. According to the scientists, Tambora volcano delayed the summer monsoon in India, where unseasonal and torrential rain helped cause flooding, crop failures, famine, and ultimately a cholera epidemic.

Rohit : Hmmmm.

Teacher : Can volcanic eruption causes drop in temperature? This is still a debatable question But, this is for sure that, volcanic ash and gases can drop local temperature significantly. In fact, scientists say that, there is long-term global warming and short-term global cooling due to volcanic eruption.

Rohit : Long-term global warming and short-term global cooling? I don't understand, Teacher.

Teacher : I will explain. As long as there is ash and other gases close to the region of eruption, the small ash particles form a dark cloud in the troposphere. This dark cloud blocks the solar radiation reaching on the Earth's surface. As a result, Earth also radiates less amount of heat and it results in drop in atmospheric temperature that is the cooling effect.

Rohit : Okay.

Teacher : Sulphur dioxide gas which comes out from the eruption also contribute in cooling.

Rohit : How?

Teacher : Sulphur dioxide ejected through volcanic eruption gets converted into sulphuric acid, which condenses rapidly in the stratosphere to form fine sulphate aerosols. The aerosols increase the reflection of radiation from the Sun back into space, cooling the Earth's lower atmosphere or troposphere. But, there is long term effect also.

Rohit : Long term effect?

Teacher : Yes. During volcanic eruptions large amount of carbon dioxide gas also comes out. This is a gas known to contribute to the greenhouse effect. Such greenhouse gases trap heat radiated off of the surface of the earth forming a type of insulation around the planet. Thus, it leads to global warming.

Rohit : Ohhh.

Teacher : And more importantly, the effect of carbon dioxide emission persists for many years. But, Rohit do you know one interesting fact about this carbon dioxide emission?

Rohit : Which fact, Teacher?

Teacher : Volcanoes release less than a percent of the carbon dioxide released currently by human activities.

Rohit : So excess interventions of human in nature are more dangerous for climatic conditions than volcanoes, right?

Teacher : Yes, at least for the long term effects on climate are concerned. By understanding the impact of large volcanic eruptions on Earth's climate system in more detail, perhaps scientists will be in a better position to suggest measures to lessen their effects on people and natural resources.

Rohit : Teacher, I have also learned a lot about volcano and how its affects the climate. Though I haven't seen the eruption, I have experienced its effect at least on air travel.

Teacher : Yes! Rohit, it is rightly said that, 'experience' is the better teacher! Even better than me!

(Both laughs)

(Music piece. Episode ends.)

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