Natural Hazards
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Lecture – 08
Introduction to Natural Hazards (Flood & Tsunami)

Welcome back.

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So, in previous lectures we discussed more about earthquakes, landslides and all that and as I told in the beginning that some part of this picture is also available in the other course which I gave and as I told that this is a very important part which cannot be removed or isolated from this course because this course is exclusively on the natural hazard part. Anyways let us move ahead and discuss as I left this with this picture in the last lecture.

So, this is a bit this picture is from Gujarat and the city this Surat city which was affected by the flood and that was in August 2006. Now, the question which lies here important one is whether this was because of natural process.

So, when I am saying that natural process means we are talking about the other rainfall or the second point is not whether this was the human induced flood. So, these are two questions which usually we are concerned with. So, it was August definitely we all

understand that this was relate related to the southwest monsoon and of course, during the rainy season we expect rainfall, but in 2006 this area did not experience much of rainfall and for talking about in particularly the Surat city, then the question comes that then why flooding who was experienced in Surat city.

Now, there is a very interesting story behind this. Now, what happened was that there was a heavy rain in the upstream of Tapti river and the Surat city is located on the bank of Tapti river, not very far from the coast. So, you have the Arabian sea not very far from Surat. So, there was a heavy rain in the of the upper reaches of Tapti river.

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Now, the fact that there was a dam almost like 50 to 60 kilometers if I am not wrong in the upstream of Surat are known as Ukai dam. Now, the look the officers or the technical staff knew that there is a heavy rain in the upstream and water is going to come down to their reservoir. They allowed the reservoir to fill up because this is a human tendency and mostly in India where we are having lot of scarcity of drinking water and all that and even the water for irrigation we think that whatever the amount of water has been stored will be helpful for the people or the society for the next spell of or the coming spell of the year. So, with this in mind we usually try to store water and we believe that if we are storing water that is going to help in or overcome the shortage of the water in the major cities as well as in the surrounding areas. So, they allowed the water to accumulate in the reservoir, but finally they realized that they need to release it otherwise the dam will get

damaged and there will be more devastation which was not they were not ready to accept it. So, they started releasing the water.

Now, in this region the Gulf of Khambhat, the tidal range is quite high more than if I am not wrong around 5 meter or. So, high tidal range is very dangerous for the local flooding or the flooding because of the. So, the water was released at the time of high tide. If you are loving the water to be released from the upstream towards the ocean during the high tide, you have a very less chance to flow out the water in ocean and this resulted into the flooding the local flooding in Surat. So, now the question is not should we call this as a natural process hazard related to the natural process or it was human induced. I would say this was a human induced disaster which took place in this region.

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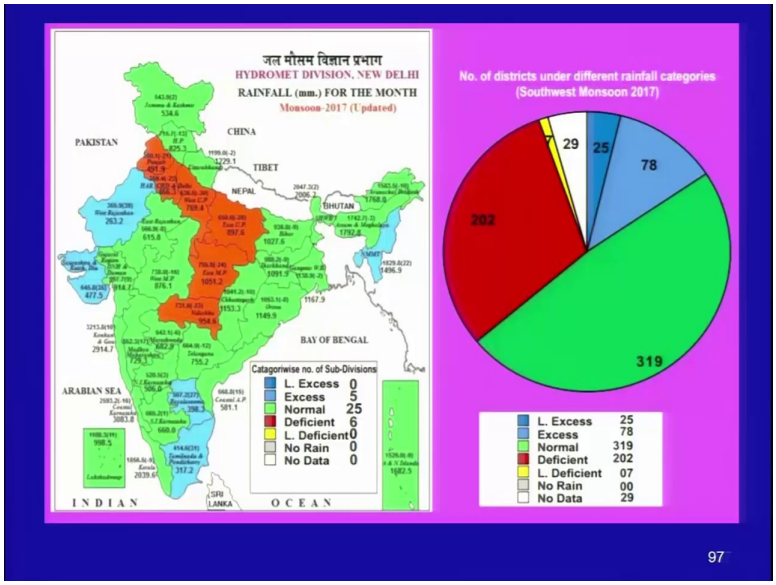

Now, these are some another piece of information which talks about the overall rain distribution in India and if you see that we have the low excess which is been given here 0 which goes and more up to normal rainfall which is been put as a green part of it and red part or the orange part is been given as a deficit rainfall areas.

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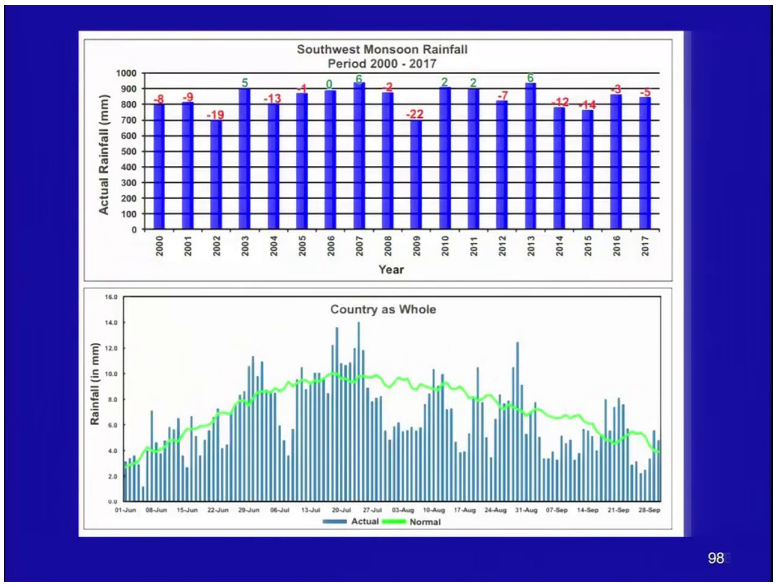

Again mostly we are concerned with the southwest monsoon rainfall over the years and this the this shows the annual actual rainfall in millimetre and what was the fluctuation which was experienced over the time between the period 2000 and 2017 and this figure shows again the rainfall from June until September and this was for 2017 where we see that this was the normal rainfall. Some places we see deficit here, but in some locations, we seed. So, spikes coming up with suggest that it was above normal. So, during this month we experience some excess rainfalls and probably that will be one of the reasons that we experienced the floods also in some part of parts of India.

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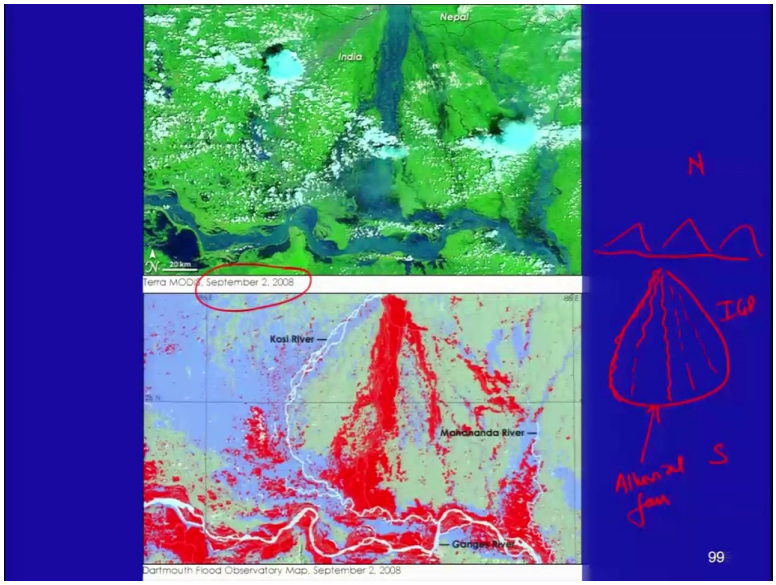

Another very good example which I always discuss in my lectures is from Bihar and this is and like the example if you see the signatures of the flood events goes back into a couple of decades. Now, this happened on September 2008, September 2nd and the story is again from the Kosi river which took different path during the due to the heavy rain. Now, if you carefully look at there is a very conspicuous feature which we can put here something like that. So, if you if you see this what it shows feature like that. So, this is the Himalayan front which has not been seen here. Maybe in the next slide I will be able to show you. So, this we have hilly track here or the folded mountain chain of Himalaya and this is the base of that and from that if you move towards south. So, this is your North, this is your South, we move towards South in the Indo Gangetic plain and this is your Indo Gangetic plain.

So, if you move to the Indo Gangetic plain, then this river at present you see here the channel is been shown here, but the red part which you see is the channel which was occupied in 2008. So, the present stream is somewhere over here, but in 2008 it followed this path. So, if you go back into the history it has an very typical pattern, but I would say that it does not follow that typical pattern, but yes of course we see some paleo channels in this area and that feature which I was talking about this one is termed as alluvial fan. So, Kosi fan has many dry streams and this is what we are called as we call as an paleo channels, and over the time it has shown the tendency to reoccupy its own channels. So, reoccupy its own streams, paleo streams.

Now, if again it is human tendency that if there is nothing is happening over 5-6 years, in particular year we will try to occupy that and that has happened and this should have been taken care by the local administration, but then with an understanding of that what hazard is associated with this type of events that in the past we have experienced that Kosi has reoccupied its own paleo channel. So, we should not allow the people to occupy that area otherwise they will face problem and this happened in 2008.

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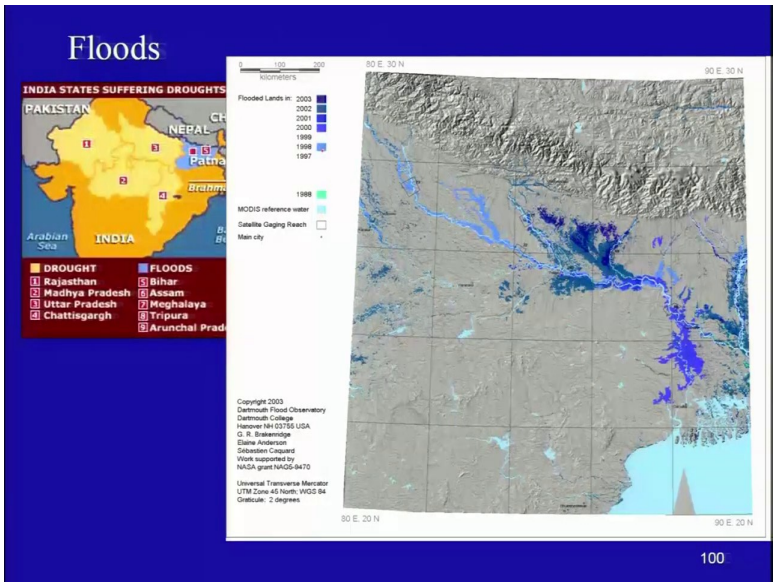

So, we will talk maybe later about in greater detail about this. So, these are further the floods in Odissa and all that. Now, as the as we keep developing the science also develops and this is an example from digital gauging station or satellite daging gauging stations which gives us the complete information about nothing in the floods. So, if you see this information comes from that mouth flood observatory from USA and here what you see is the flooded land which have been marked by different colours which you can see here.

So, backdrop what you see the map is the elevation data and here you see the blue 2003. So, you can make out there in 2003 what was the scenario, how much area was affected by flood, then comes to 2002 and so on. So, in some years there is no data. That means, that area did not experience flood, but most of the time if you see that these areas are flooded, now this the this is not the stream is not so wide, but the area which has been shown here that the width here is the its clearly suggest that the surrounding area is close to the channel where affected by flood.

So, this area we know that we this region is most of the time is getting affected which were from which you can you can make out that it was flooded in 2003 and up to 2002 and then further also in 1998 and as I told that it was also affected in 2008.

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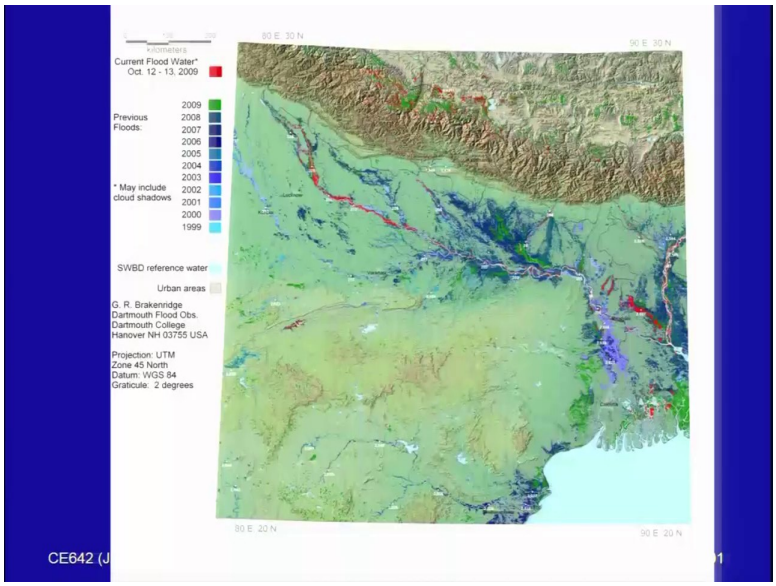

So, this was the condition in 2008. Now, you just recall what I was talking about that this is Himalayan front here. So, as soon as this Kosi river flows down into the Indo Gangetic plain, it forms a alluvial. The result into the formation of alluvial fan as well as the present stream is here which goes and meet Ganga, but in 2008 this was the portion which is occupied. Now, we keep on claiming that and blaming the in at Nepal area or the Nepalese are in responsible for this area whoever is staying there either the they are they are involved in deforestation and because of the deforestation, lot of erosion is taking place, but the other reason which I feel is that not only the deforestation is allowing these the more amount of sediment erosion. But at the same time the ongoing deformation between these two plates that is this side is the Indian plate and this side is the Eurasian plate and ongoing deformation of Himalaya can also trigger more of erosion.

So, more of erosion, more amount of sediment load is been supplied in the channel and that will result into the reduction of your channel width and channel depth. So, if you reduce the cross sectional area and not allow the water to flow easily, it will spill over the banks and result into the floods.

So, again the red marks which have been shown the current flood that was in 2009, this data is from 2009 and then we have darker green colour which have been shown here in 2009-2008 which I was talking in the previous is this area. So, when we understand that

this portion of our Indo Gangeti plain is going to be affected in future also because we see the history and the floods are such an climatic hazard which will reoccur again and again during in particular season or a particular period of the year. So, we have lot of data which will be available and we know with the experience not what has happened in the past. So, based on that one can easily make out the hazard map and then, you can you can save more and more life loss as well as the property loss.

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Again flood in 2013 in Uttarkashi. Now, if you see this picture probably we can spend some time on this and then, understand that because of in appropriate practice of land use, we our self are putting like us to risk more and more risk and as I told that river will not stop saying that fine you people are staying here and leaving and occupying my area. So, I will flow some for somewhere else and not come across crossing your region, but it can flow anywhere and it has tendency to reoccupying its own floodplains in own paleo channels and all that.

Now, there was lot of my issues which were been experienced at the time of 2013 Uttrakhand flood.

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And the erosion of the banks were one of the major cause of collapsing of the houses which we are sitting close to the river banks now rode this house houses you see here the lower portion is been slided down. So, this is one of the process which we can put it in landslip or the landslide, but this was caused because of the erosion of the banks at the base. So, you erode the bank at the base and this portion hanging in the air will collapse and some places what you see are the terraces. So, terraces we will learn when we are talking about the in the floods and all that, but this is one of the important land form which will be always associated with the river system. So, these are the terraces and these are all I will just catch it here.

So, if you if you put the boundary here, this is the boundary one, there is another boundary over here which goes and then you have 3rd boundary which is coming here and these are all the river cliffs or the banks and these are one and this is another one. So, if you ask to how to classify it, it is just the elevation. The higher terrace may come somewhere over here.

So, this will be your youngest T0 terrace. This is T1 and this is your T3. T3 is the highest and the older one and this is younger one. So, in any case we are occupying these terraces and in this case in particular the water did not reach right up to this, but because of the erosion which took place underneath close to the time because the water was very

turbulent. So, this court eroded and because of the erosion and the experience the collapse.

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And there is another picture from that area again. You can easily make out what I was talking about. This is hanging, this is the hanging part and of course, this whole housing are sitting in your its whole plain which has been occupied and now got getting affected because of the and heavy flood in this region and this house is hanging in air. The lower part portion of this is been eroded by water action

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Now, this is the statue of Shiv which is 10 feet above the river bed. This is from Rishikesh and 10 feet above the riverbed and the statue is around 15 feet, 10 from the bed and 15, almost 25 feet above the river bed. So, what happened at the time of the flood, the peak flood the water reach right up to its neck. So, his neck was pain and finally which I what I learned was that the statue was been driven away in waters ok, but in the previous slide if you see remember this house I will just put it back. So, over here this is the house which has been shown in the next one and the temple is over here this one. So, you can make out that whole this area is been occupied by water and it is going right up to this green part over somewhere over here. So, the water flow depth were very high and which was experienced in the Uttrakhand flood.

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There is again a very important one. So for me if you see almost of all the hazards are very important for us to understand. When we talk about Tsunami immediately you will find in most of the sites or the websites as well as the textbooks this beautiful picture. Now, this picture was like printed at the Metropolitan Museum of Arts. It was by Katsushika Hokusai, the person who was the artist who painted this picture and he wanted to show that Tsunami could be so high and devastating if you compare this to the Mount Fuji, but this what we kept on understanding that this was the story behind this picture. Although this was not ok although it was it is often used in Tsunami literature, this picture you will find everywhere.

So, the story which I was the part which I was talking about that Hokusai part he was an artist and he painted this to show this was our understanding and we he kept on studying and we still study the Tsunami wanted to show that how high Tsunami could be as compared to the Fuji, Mount Fuji.

So, in literature this was been used most of the time, but there is no reason to suspect that Hokusai intended to be interpreted in that way. It was not the not for the Tsunami. The wave in this picture works picture work are something mistakenly referred to as Tsunami. So, this was not exactly, but they were they are more accurately called Okinami, a great offshore waves. So, he just wanted to project the great offshore waves and he wanted to compare it with the Mount Fuji, but not exactly the Tsunami, but in most of the literature you will find this when we are talking about the Tsunami. So, Tsunami waves or the tsunami word itself it came from the Japanese literature and talking about the harbour waves and you can you can just make out this or the clove. So, these are what this the Tsunamis can eat away the whole region. It was being shown like that.

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Now, Tsunami is very well known in other countries like mostly in Japan and the world. It was being coined in Japan as a great offshore wave or harbour wave, but this was shocking for us in 2004 given of Sumatra Andaman Tsunami. This picture is from Mariana beach at Chennai which shows the devastation and then local flooding which

was caused by 2004 Tsunami. I am not going to get into the detail right now, but I have couple of pictures which we collected and took from Andaman after immediately after the event in 2005 January. So, anyways this was quite shocking. Lot of people who got killed not only in Andaman, but along the in the East and West coast line of Indian Mainland and also it affected the neighbouring countries like Thailand and other regions at joining in ocean it was one of the devastating event. The magnitude of the earthquake which triggered the Tsunami was 9.2 and 9. 3.

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Now, this picture was taken at Carnicobar and the what you see here is only the water tank which standing and rest of the whole occupation which was the housing society or the houses or the colony of occupied by the Indian army and Air Force at Malacca bay was completely wiped off. The reason for this was that because it has in circular structure the energy got dissipated and nothing happened to this even this structure even though it was quite tall, but other areas they in or the houses which were being constructed were completely destroyed. I will talk in detail when I am talking about in particular about this event the lectures which I will be giving later on.

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But here there are a couple of pictures which you see that it has it had a twofold effect. One was because of strong ground shaking and the area in this area this region got subsided or because during in the major earthquake subduction zone earthquake some areas will get uplifted and some areas will get subsided and this area of Carnicobar was subsided almost by 1.5 to 2 meters.

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This was from port blare the area known as c p card which also subsided by one meter and the picture which quite amazing because you see most of the features here these are

all paddy farms. So, the paddy people he told us the survivors told us here that this area was extremely expensive because of its like very fertile land very good for paddy cultivation. So, more and more people wanted to buy this land and this hands it became very expensive, but in two thousand four this area got subsided and now even during the low tide this area remain submerged under the tidal waters and high tide of course, more area get affected. So, even you can easily make out some locations over here there are plantation which are sitting right into the waters and even few houses which you see they are sitting in waters. So, this is this was one of the one of the affect which was been experienced during and after two thousand four tsunami

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This was at great Nicobar at the southernmost tip of India in Andaman islands where most of the houses now sits and water they say this point subsided almost by 3 meters.

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Another example from Tohoku earthquake in two thousand eleven it was again and devastating even nine point one magnitude.

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This was the situation in some locations at the Japan a lot of houses were been completely wiped off and the energy conditions of the waves were too high.

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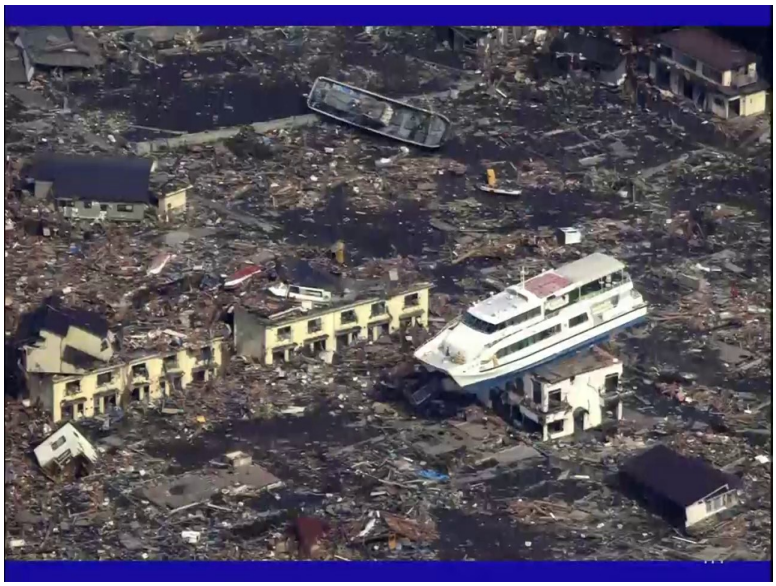

That it moved already the vessels are right on the top of the houses this picture you can see which has been which is close to the coast, but yes it was quite devastating compared to your 2004 also in some locations.

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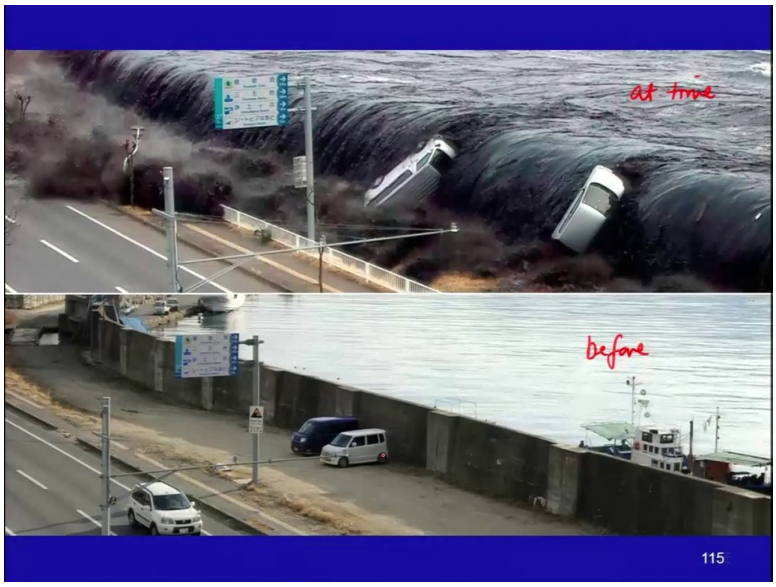

Now, the picture which has been shown here others the above and below this is before, and this is at the time of Tsunami wave arrived.

So, what do you see the common portion they make out, you can make out is this one here. Now, they usually in most of the places in Japan you will find that they have

constructed the walls and these are the walls which are constructed to protect the tidal water coming into the coming into the city and with some understanding we reconstructed the wall couple of meter high knowing that no Tsunami more than will bring the water more than about this level, but that was not true. 90 in 2011 was much damaging which flowed over the walls and destroyed the area. This was quite shocking for them also, but with a proper understanding that what should be done at the time of Tsunami and not many people got killed during even though the event was quite devastating.

I will stop here.

Thank you so much.