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Okay, good morning, almost good afternoon. Let's start. So we had a lively presentation before us and the discussion continued. So, but today and this slot, we're going to talk about something completely different, flash flood, early warning.

And I'm glad you're here. I'll give a short introduction. My name is Carol Heineert. I work as a water management consultant for Husqon DHV. That's a consultancy that is based in the Netherlands with the head office, but we work worldwide.

I personally, I'm based in Manila. So a country with lots of flash floods. And while this picture is taken from the country. Previously, I worked on flood forecasting systems, a lot big systems in the US, UK, Netherlands.

Flash flood forecasting actually is not something that's my core expertise, but therefore we have a number of panel members and yourselves probably that, well, that can contribute to the discussion. So in the coming 50 minutes, we'll go through some introductions on the topic, and then we'll have a panel discussion.

Yeah, flash floods, they are, well, they could be devastating. They come quickly, unexpected magnitude often, and they bring quite a lot of sediment, landslides. So these are big events that come unexpectedly, different from river forecast, but you see sometimes the flow building up, coastal forecast the same, flash floods come quickly.

Now how to sort of get a grip on what is coming in the next hours, but also very importantly, how to sort of prepare for that and respond effectively. That's what we want to discuss in this session. Oh, sorry, oh, sorry, sorry, sorry, sorry.

What is going on? Okay, we're back. And for that discussion, we have three panelists that will briefly discuss their line of work, their background and their line of work. So we have Marika Panis, who works for the Red Cross, is leads a data team within the Red Cross, so she's very much in the response, preparation and response side.

We have Musa Sidibe, who works for the World Bank, the GFDRR, as a specialist, he's in the hydromet, operating in the hydromet world, and he will also, with a PhD from Coventry, he will also introduce himself and his work later on.

And we have Josh Terry, who is a colleague of mine from Australia, who is very much in the development of flash flood forecasting systems and also flash flood early warning. And we also, oh, sorry, we have a contribution from Dipo Pawana from the South African Weather Service, and she will explain what is happening in South Africa in this field where flash flood is a big topic.

Okay, so we'll have some introductions now, and after that, we'll discuss between us, but also with you, on a number of topics that are related to flash flood early warning services. So first, I'd like to invite Maraike to introduce herself.

Yes, thank you for the introduction and welcome all of you. And thanks for, yeah, that I can present here during this understanding the risk conference. I will start with a short introduction about myself and start with a bit of a personal note that I grew up with sailing.

So at a young age, I already got interacted with the natural forces that weather can have. So we have been listening to the UK mud offices via the VHF to monitor the current weather, but also layering with the more longer term weather maps to identify

how can we make use of the information in the best way possible to make sure that we enter the harbor of destination, which most often works.

But as we are talking about flash floods today, we also experienced sometimes like sudden weather changes that you have to adapt to. So I'm quite used to preparedness measurements because we had to adapt every time during sailing.

So where I will, before I first start with introducing the topic and the collaboration with Oroya Haskoening about the flash flood modeling, I want to introduce you like what is the position and the role of the Netherlands Red Cross and 510 within the space of anticipatory action.

So we do see ourselves in the intersect between the tech companies, the humanitarian work and the climate forecasting experts. So we work together with a lot of different partners bringing in the expertise and the connection to the communities.

And our mission is to optimize, to speed up the quality and the cost effectiveness of humanitarian aid via data and digital products. And this is one of the products that we have been working on, which is the flash flood model in Malawi.

And I want to bring in today the community side of it as we have like the technical experts here as well to go a bit more into the details there. But I wanted to show you this visual as in Malawi, the impact of floods is quite high.

And what we have been doing is to identify and to layer the data sources of the flood extent map with like the critical infrastructures that might be affected. So here you can see the layer of flood extent with exposed buildings and roads, but also to identify water points, schools and health clinics.

And this is to identify from decision makers where to act and where the impact will be of a disaster that's coming. So with all this information together, what we are aiming to do is to support disaster managers within their decision making and to leverage the data and

technology to mitigate the impact of natural hazards and to monitor what's happening on the ground to inform the national society and the communities.

With that, I will stop my introduction and I will go hand over to Musa.

Thank you very much. Good afternoon everybody. My name is Musa Sidibe. I originally come from Bukina Faso, a small landlocked country in West Africa. By training, I'm hydroclimatologist, looking at the impacts of climate change on water resources.

So after the PhDs and all these studies, I've started working now in the global facility for disaster reduction and recovery. So for those who are not really aware of that, so what is the global facility for disaster reduction and recovery?

So it's a multi -dono partnership. It was established in 2006, mostly to help clients and country build resilience against shock. So it does so by providing financial support, technical expertise and knowledge.

Over the past 18 years of existence, there's been a shift in focus. So from GFDRR's perspective, the shift in focus from disaster response and recovery to prevention, preparedness and anticipatory action.

So all this to really make sure to scale up the development, to develop resilience impacts, but most importantly, looking at the climate change impact. So we all know that the hazards, disasters are exacerbated by climate change and that's the endeavor of this facility.

So GFDRR is partnering with the World Bank. So as of now, there's interaction in more than 157 countries. So looking at identifying the emerging early needs and so on. GFDRR is organized around four priority areas.

So we have understanding risk. We have all different areas looking at the risk environment. And also we have two cross cutting areas. So fragility, conflict and violence and also the inclusive aspects.

And GFDRR is built around 13 thematic areas. And one of them being the thematic area I'm working on. So it's really, it's called the hydrometean early warning thematic area. This was created in 2011.

So the idea behind it is really to provide technical support to World Bank teams first and also to the clients in understanding and improving all the value chain along the hydromete value chain. So there are three pillars of activities within this program working in.

So we have the support to the operational teams and we have, okay, analytical support and capacity building and also the partnership coordination. So this team within GFDRR has been central because that's this inception in 2011.

At the World Bank we had a portfolio of around 300 million of projects having hydromete components. But as of a recent portfolio analysis, we have more than 120 projects culminating at 1 .3 billion investments in terms of hydromete.

So the World Bank is really a focal point thanks to the Units Ham working. And it's my pleasure to be here with you today. Thank you very much.

Good afternoon all. I'm Josh Terry. I'm a water resources engineer at Royal Hasconing. I've been working in the field of flood modelling and flood forecasting over the last five years. I've recently taken over our Australian forecasting team at Hasconing and overseen the development of a few systems there.

I've got a few slides to share just to give you an overview of our existing systems and a little bit about flood forecasting approaches as well. So in Australia we currently have four active systems of varying complexity in size.

The first one we developed was the City of Paramata which is a small flashy catchment, probably a lead time of two to three hours and we run a model every 20 minutes to provide updated forecasts. We then developed the Hunter Valley model which isn't particularly flashy catchment.

We've got lead times of several days in some instances so the pressure is not quite so there to have to run models so frequently but we do provide forecasting services for that catchment where we're running models every 12 hours.

The Northern Beaches is another area in Sydney. We aren't running forecasting services there but we are providing a monitoring service that helps the local council to understand where their flood risk is going to occur and how better to prepare their operations during a flood event.

The Townsville system is made up of several smaller coastal catchments with varying lead times and importantly an operational dam which they rely on some of this information to understand how they should operate the dam when there's a flood coming and also to model the impacts of if they deviate from their standard operating rules.

A little overview of the approach that we take with flood forecasting is we develop models which can be run quickly in real time using real time inputs so the first component of that model is establishing some current conditions based on observed rainfall and observed other inputs such as soil moisture and those inputs get fed into a hydrodynamic model which simulates the last 12 hours up until now and then it adopts forecast rainfall data going forward and we apply that rainfall to the model and produce outputs in a dashboard.

All the data stored in a data warehouse on the cloud that's developed by our partner Nelon and Sherman's their product is called Lizard and that system is able to take in other external data that we ingest such as traffic warnings or road closure data from other sources.

That data is output to the dashboard and the dashboard within the dashboard you can control alarms and triggers that are set up by the local councils and our clients and we help them configure the messaging that goes out from there.

A key component of this is understanding where your impacts are throughout your catchment so on the left hand side you can see the paramatter urbanised area that the local government has divided into certain areas that they know different flood impacts occur at.

Local residents can nominate to go on a mailing list to subscribe to alerts that go out when individual subcatchments are at risk. On the right hand side, Texas is probably too small to read from back there but we have worked with the Hunter Valley flood mitigation team extensively they have a really good understanding of their catchment at water level gauges.

When something gets to a certain level what impacts are there to the nearby areas are roads over topped spillways engaged are we having to manually operate flood gates that sort of thing. So they provided us all that data we input it into the system so that they receive email alerts when these triggers are either met or our forecast model says that they're going to be met.

Finally here's an example of our emails that go out these are completely customisable but I just did want to show this because I know we're going to talk about it later but the benefits of sending our emails that relate back to those impacts it's no use for someone who's inexperienced with the catchment to receive an alert saying your water level gauges at two metres if they don't know what that means relative to the catchment so all of our messaging goes out and reinforces the idea that At these gauges, something's happening on the ground.

Maybe it hasn't reached there yet, but be aware because if the water levels are climbing, these are the impacts that you can expect to see.

So De Povo couldn't be here, but she has prepared a clip which I will show you now.

My name is Dipu Wotawwana, I'm a forecaster in South African Weather Service and the use of the Flesh Flat Guidance System. Today I'll be giving the insights of the Flesh Flat Guidance System and the RJ so far using the SSS.

Standing the risk, we all know it is pivotal to understand the hazard. Flesh floods are a significant threat worldwide, causing loss of life, livelihood and damage to property and infrastructure. The Flesh Flood Guidance System was a tool developed to assist focusses with readily inaccessible observed and focused data and numerical weather prediction models as well as the hydrological model to produce timely and accurate flesh flood warnings.

Before the development of the Flesh Flood Guidance System, focusses mainly focus on predicting precipitation and weather conditions, overlooking the critical aspect of what happens to the rainfall when it reaches the ground.

This oversight often relegates the responsibility of understanding the ground wave impacts to the hydrologies. However, Flesh Flood Guidance System bridged this care by integrating meteorological and hydrological concepts.

The FFGS system provides focusses with comprehensive guidance on the anticipated impact of rainfall events on the ground, facilitating timely and issuance of flesh flood alerts. In 2008, WMO initiated a global project to implement Flesh Flood Guidance System in various regions of the world.

In South Africa, with the assistance of our National Disaster Management Centre, which funded our project, the country's national flesh flood guidance system was developed and it mainly covered the economic ups of the country.

Consequently in 2014, the South FFG was implemented in the South Arabian Africa, covering nine countries in Sadek and it was funded by WMO, Cruise and US -8. South Africa is currently using both the SAFFG and the South FFG.

What are the differences between these two models? The SAFFG, the domain focus mainly on the four major economic ups of the country, that is the Eastern Cape, Guazulunatal and Hauden province and the basin sizes are quite small at 50 square kilometres with average of about 5 ,366 basin for the entire system.

And the rainfall input is from the radar and the satellite secondary with the bias correction from the rainfall gauges and it updates soil moisture and FFG values hourly. However, it's a different for the SAFFG, which covers a larger domain with bigger basin sizes.

The rainfall input on the South FFG is mainly satellite -engaged data because most African countries in Sadek do not have radars. It updates soil moisture and FFG values every six hourly, which can pose a problem.

This SAFFG is effectively a high -resolution zoomed -in version of the South FFG and we are mainly focusing on the major urban regions in our country. The pros and cons of the flesh flat -gurling system are focused mainly on the SAFFG system.

On the pros side, it provides unique predictive capability that assists forecasters in forecasting flesh flats accurately. It has high -resolution radar -based output and soil moisture that is available hourly.

It aids in disaster response and decision making as it provides frequently the information that is required to focus for flesh flats. And a focus on duty is able to zoom into the affected areas, allowing them to issue a radar that is more specific in terms of the location and also to focus on the location that will require more resources or that it's more in danger than the others.

It also assists in informed decision making when providing support. During the response phase of the disaster management, flesh flat guidance data can inform decision such as the safety of opening the dams loose or necessity of evacuating people from vulnerable areas.

The SAFFG has limited accessibility. You cannot access it online like you would SAFFG. It's only accessible through South African Weather Service Service. And hourly updates may pose challenges for intense rainfall events on the MISO scale.

As you all know, it can take a thunderstorm 30 minutes to cause quite significant damages. The effectiveness of the flesh flat guidance system is limited in urbanized areas. It works well in natural basins.

besides the focus that there are other role players in the flesh flat guidance system.

wanted to show. So because we are running a bit out of time, so we got an introduction about response, the work of the DRR Australia, South Africa. Now I think it's good idea to have a discussion around a number of topics.

And what I will do, I will ask the panel some questions, but please feel free any time to chip in and ask a question. So first I wanted to ask Musa. Flash flood forecasting is just one element about flood risk management in flesh flood prone areas.

So what is DRR, what are the thoughts there on projects to improve flood risk safety in those areas and what is the role of flesh flood early warning in that respect, Musa, please.

Thank you very much. So yeah, to put it into perspective, so the World Bank in general supports the client country through different instruments. So we have investment project financing, we have development policy financing, and we have other complex instrument that we use.

And the World Bank also works with GFDR through some global practices. And at the level of the bank, the global practice on urban resilience and land is in charge of all the project, looking at the DRM into the different spaces.

And this practice looks also on the urban areas. So in general, there are a lot of assessment now in terms of what are the flood risk at the country level. This help assess in general the flood risk and the areas which might be evacuated and also prepare some strategic investment plan.

So as part of that, there is a systematic assessment of the flood risk. But then looking at the early warning value chain. So as we all know, there are four main components to the early warning value chain.

So understanding the risk, monitoring, we have the communication and warning, and then the response. So on implementing all of these steps, there are issues, there are bottlenecks, and we all know that these four key components need enablers, such as institutional policies, enough funding, and we also need collaboration between the different institution.

So obviously there is added value of GFDRR there in providing the knowledge to build these kind of flash flood systems in general. And yeah, so this is what I can say in general from the bank perspective, but we have dedicated investment also looking in details at what is the perfect system to put into place.

As we all know, we have different types of flash flood early warning systems, which are obviously very in terms of complexity. So we have the local systems. We also have the flash flood guidance systems which are organized differently.

So yeah, this is a bit the space that I can provide for now. Thank you.

Thank you, Musa. Thank you. So, Fleschfeld early warning system provide information, but of course that's only useful if you can really respond to it effectively. So, I would like to ask Marijke, also related to this point, what kind of challenges do you see in well, protecting people and property in Fleschfeld prone areas?

Thank you very much. Yeah, I think it's a good question to see like yeah and our aim of course to identify and address the most vulnerable and to Protect them from the impact of a hazard with flash floods It is challenging because the lead time of predicting the hazard and the response time is quite limited So the model that that's being used has a time frame of six hours Which gives you?

Yeah, a limited time to respond and you have to adopt your actions to that that is possible for in this case the communities to Yeah to respond at the moment the model and the portal is giving the early warning the early actions are not yet Identified but you can think of a relocation of livestock or evacuation And that is possible within the times time.

Yeah the time period of six hours If you are talking about other type of floods for example, you might have a few days to act which you also will give other type of actions to protect the communities in that regard

Okay, and is your experience that they can react effectively to flush flood early warnings?

The model is operational, we haven't had yet a response. So I cannot answer this case specifically for Malawi. I know that there has been heavy rains and the model did give the warning. And to my knowledge they did not act yet on it.

Okay, good. Moussa was already alluding to some of the aspects of flood early warning systems. Now, what do you need to do actually to develop a flood early warning system? So, George, maybe you can, you already alluded to some points, but maybe you can give us some insights in what comes about to set it up.

So as we know, the requirement for these sort of systems is to have some sort of rainfall prediction in the first place. And that's where a lot of the challenges come in, in areas that are data poor, perhaps.

My experiences in Australia have been very fortunate. Our Bureau of Meteorology provides some really good data products. But some of the systems we've developed overseas, like Malawi, Mozambique, Oman, we're lower resolution, spatially and temporally, and less accuracy than, for example, radar -based predictions.

But you have to work within those constraints and optimize your model to be able to work with those sort of data inputs. So that's probably the biggest challenge in developing a forecast system like this.

But then on the other side, you've got to work with the people on the ground and understand what sort of triggers need to be set up. Where can we set up the alarms? Do we need to install more gauges to provide better monitoring and overview of the system that you can compare, for example, your flood model results to?

And that can help you respond, but also just oversee the system better.

Okay.

So rainfall forecasting actually is important because it gives you some more lead time and how to deal with the inaccuracy in it. We'll come to that in a minute. Maybe I want to ask you, is there any question from your side?

I'm not an engineer, so I don't really, not following. But then, are you talking about the, what's the foundation to have early warning? That are you talking about internet should be there, Wi -Fi should be available, so then you can do the, you know, access to or share the information.

That if there's not, there's no foundation for that, then it's very limited.

Yeah, it's a very good question. But maybe Josh, because Australia is very well equipped with internet and stuff, maybe Musa can answer this one.

I'm happy to take this question. I think it falls under the technology in general. So if there is a technology gap, obviously, it becomes more difficult to build an early warning system. But in our work, we need to adapt to the realities.

And as I said earlier, there are different types of early warning systems, even for flash floods. So there are the local flash floods warning systems, for instance, where we can only use some cheap hydrometrological recording instruments, where the community is measuring the rainfall, and we have a flash flood coordinator who works with this community and issue the warning.

It can be through sirens and all these things. So it's not, of course, internet is used for the very advanced system, but it really depends on the community where you are, and you need to be, to adapt to the realities.

So this is what I can say. But technology, obviously, is a big divide, and it's an enabler of the system. Because first, you need to understand the risk. How do you understand the risk with our technology?

So you need satellite imageries. You need all these hazard maps. And in terms of technology, again, how do you monitor? So you need observation networks, radars for the richer, and these kind of things, but also in the communication part, where more and more with the technology, with phones, we can disseminate the alert.

But then before, there is indigenous knowledge. So in some villages, in case that I've seen in West Africa, there is someone shouting with an instrument saying, beware, there is a flood. So we really need to have to adapt and not work too fast for the least able.

That's what I wanted to add. Thank you.

Yeah, that, okay, go ahead, please. Oh, sorry.

Thank you. My name is Abdul -Ai. I'm a mayor of Baydor Somalia. So my city is hosting Somalia. There are over 4 million displaced people in the country. So my city is hosting almost 700 ,000 IDPs. So we are dealing with the last year faced with the flash floods in my city, in October, November last year.

So the World Bank, Somalia and the Zillions, is now supporting on the early warning system and also mitigating the mischief at the city level. So we are realizing that during the rain season, there is a lot of water going on the dry river in the citywide.

And during the dry season, there is no water in the city. People are claiming without water. So we are looking for solutions that how we can benefit on the rainwater by harvesting in the positive way.

And how also we can benefit, we can also mitigate the flash floods by using like drainage systems or city planning issues or city development issues. And also the community have no idea about how this is very serious.

And Somalia is one of the areas that have been affected by the climate change for the last 10 years. If the early warning system is the most valuable send this, it seems that people, it seems like it's fun.

So they want to see how the water flood is going on. And many people also see that they try to swim it in the dry river. So we should think a lot of ways that we can mitigate on this experience in Somalia or in African context.

And how also we can also building a very strong system that people can build the capacity of the communities. And also it's very important that was the rule of the communities when the government send this to the alarm in the areas.

Thank you.

Thank you very much. Maybe Maraike, you want to give a short reaction to this?

Yeah, I can give a short reaction. It is good to hear the case in Sumalia, and I think it is indeed like the, how the balance is of like dry season and the rainy season and how that links to each other.

And you do see that there, yeah, you have the single hazards and how, and the next step is also to look into the multi -hazards and the compounding hazards. And I think that is a good example that you are giving there.

And I do see that also from experience in South Sudan, where we have been in contact with the communities where they mentioned that they are affected by both rainfall, like the heavy rains and riverine flooding, where they said like we can respond with the youth to dig like drainage channels to protect ourselves for the rainfall, but for the riverine floods, it's way more difficult because the volume of water is so high in that area, which is quite flat, so it doesn't run off.

So I think it's a really good case that you're saying about Sumalia, like how, yeah, how are the different natures of different hazards and how are they interconnected with each other?

Okay, thank you. You had a burning question.

Yeah, just a quick question on your reflections of global flood forecasting models, like the work that JRC is doing on the GLOFAS, and how does it interact with those lower level models? Have you kind of in your experiences used like those levels of information and cross -reference it with yours, and how those kind of levels of data interacted?

I think this was referred to Moussa.

Yeah, any either Josh or so.

Yeah, happy to take it. So yeah, you bring in very interesting point here about the global tools that are available. So yeah, before talking about that, we need to really know what are the capacities of these models globally.

So there is evaluation at our level. At the World Bank level, we use a lot of global products for flood risk assessment, mostly the return periods, the depth, but also in the hydromer space, there are some cases where the countries have been using the glow fuzz, for instance, because there is nothing else to use.

So what we learn from that is that at least within the tropics or in the equatorial region, there are a lot of bias, and it's almost impossible to use the model as it is. So more and more there are incentives for to use local stations to bias correct this global models before using it.

Otherwise, there is an issue of the accuracy of the forecast, which is not really usable on the ground level. So all these are undergoing, but we try to be to balance. When do we need to use these global products?

So obviously in data scans area, we have to use that. We had cases, for instance, in India where we downscaled the, I mean, geoglows. It's almost the same, but it's for rivers. We bias corrected it to have the levels in the rivers.

So there is all these initiatives going, but from the global hydrometrogram, we're trying to look into that because there is a need for more station on the ground to bias correct it. It's very critical not to overlook this and say, go ahead and use this product.

We have to be very careful. So that's what I can react on it. Thank you.

Okay. Can I make a couple? I know that there is.

Can I maybe respond to that as well? Oh, go ahead. Thank you. Yeah, I just wanted to just have a short contact to that as well, unlike the Malawi model where we have been using the Glova's model first.

And we've seen that the resolution was not good enough to do a good prediction. So that's also where we collaborated with, for example, Roya Haskoning, where they had access to higher resolution data and where we have been flying with drones to map out the area and with local river gout, just to complement the global data sources.

So that is also something that we look into, like how can we increase the resolution by using high resolution data, although those are quite often not open source. So it's like balancing, like what is the granularity that you have?

What are the global data source? What's the resolution? And can you have the complementarity of using drone data, for example, which is also limited in the catchment that you can cover?

Okay, I know there is more questions. I will come to you in a minute. I want to introduce, because typical for flesh -flat forecasting is that it's pretty uncertain. So it's shortly times, and it's quite uncertain.

And I like to know also from Josh, so how can you sort of deal with that uncertainty? How can you come out with useful information that you can act on, and from Marijke? So if uncertain information is distributed, or do you process it in a way to distribute it to communities to allow them to know what to do?

Because I think this is a typical thing of flesh -flat forecasting, is that it's uncertain. It's uncertain information shortly times. So I want to address the topic before we run out of time. And then I'll come to you.

I'll start this off. There was a really good session this morning. I'm not sure how many people in here were in it as well, sort of discussing dealing with messiness in forecasting. And that comes back to this answer.

And in the forecast data, I think you have to treat it as a tool as opposed to a definitive answer to how much flooding there's going to be. For example, with Australian systems, the Bureau releases rainfall prediction data with also percentage, percentiles attached to it, saying there's a 50% chance you can have this much rainfall, 25% you'll have this, 10% you'll have this.

And when we develop these systems, when we're running models, we have to pick one of them to run through the model as a starting point. And then you can also opt to make it a more complex system that runs all three of those scenarios, for example.

But it's critical for us to inform our clients, this is what the model is using, these are what the probabilities are associated with these rainfall events. And even then, it can still be not accurate.

So it is a tool. You've got to communicate really effectively how accurate that tool is. And then let those people that are looking at your system, in our case, it's mostly internal users, council users, local government users, make sure that they understand when they're communicating to the community what the level of confidence in these predictions are.

There's no silver bullet to making these rainfall predictions perfect. For those of you that were in the session this morning, there was a graph shown of the errors made in cyclone tracking. And over the last 50 years, it's decreased a lot, but it's not decreasing to zero.

We're never going to get that level of certainty with our predictions.

Okay. Marika, you want to say something about how to deal with uncertain information and communicate to communities to know what to do?

Yeah, I can comment on that. And I think it also links a little bit to other discussions that have been there in other sessions yesterday and also during the opening speech or one of the ignites about trust.

Like models are, yeah, not often 100% right, I think never. So how do you communicate that and how do you make sure that there is trust in the model? And you also see that trust is quite easy being broken if the model doesn't trigger.

Well, actually there is a response. So it's very important to explain like what are the assumptions, what does the model do? What doesn't the model doesn't do? Like not only saying, okay, this is what it can but this is also what it doesn't do and when can you not rely on a model?

And then also what Musa was earlier saying about like local knowledge, like the communities have local knowledge. So often if there's a warning like local partners look into the warning, having like layering the different data of the warning system but also like the local knowledge and then to make sure that the communities are informed.

Yeah, there will be remain uncertainty in the model. So I think it's important for us in our role to make sure that we provide as much as like the detail of the information that we have like what it does and what it doesn't do.

In the end it has to be do A or B. We can't communicate uncertainty. I think, I think. Can I come in here? Oh, yeah? Yeah, sorry.

Just to clarify, come in these parts, of course, managing uncertainty is one of the key areas in the bank when we implement the project. So basically, how do we do it? So the first approach to it is using ensemble multimodal.

So because for flash flood forecasting, we have the forecast, of course, but then we have the interaction with the ground. So using this ensemble multimodal, it enables you to understand what is the uncertainty associated to the model, and also the uncertainty associated to the boundary conditions.

So this is something that we try to push in our project. There is also another component which is more systematic observations. So we have to collect more data, and this data will be used to fit in to the model and reduce to some extent the uncertainty.

So after the collection, I mean, this data is also a real -time data which can help the forecasters improve their projection. So there are watches initially on a longer time, and then this can be improved based on the real -time data which comes into the system.

And more systematically, there is also a post -event assessment. So after the event, there needs to be an assessment to see there was a flash flood, what was the extent of the damage. So having this loop into the model going back and forth and having a continuous improvement of the model, we've learned that this helped reduce the uncertainty.

But most importantly, the flash flood is not only a scientific and technological aspect, it's also society which has been mentioned here. And we found that this is really critical. We need to communicate the uncertainty.

And one way of communicating the uncertainty is having the communities work in this through tagging the areas where which are flooded, so they get more trust into the systems. And in some communities, for instance, where there is a little maturity or let's say, we can work again with them to develop impact -based forecasts.

So rather than giving the probabilistic, so we can just say, this will be the impact, and you have to act. So these are kind of the, to sum up what we've tried to push from the bank's perspective. Thank you.

Okay, I think you chipped in an important aspect is that the post -event analysis, because the system is not perfect in the beginning, certainly not. And then improvement and systematic improvement is really important, the easiest set and done, because it's often you don't see it happening systematically, only for big events.

But you had a question. I thought...

I am Sana Siddique from Pakistan. Recently we have faced a devastated flood 2022, especially the flood hit, the Blochistan and Sindh area, and I'm basically from the Sindh. So though I have got partial response of my answer, but I want to raise my questions, this is a very insightful session for me to learn about the early warning system.

But I want to ask, what is the actual, actually, as per my understanding, early warning system is dependent on the behavior of the community and the line department, though we are doing a lot for the early warning system, but it depends on the line department, how they react, how they address, and what is the prevention measures.

So I want to, I'm curious to hear about your actual experience, not use word can be, and depending on the community awareness, we are, since long time in many countries, there is the development projects is implementing, but still lack of awareness of the community, we have the excuse, but what is the actual barrier of the awareness, still community facing the lack of awareness, and we all have to, being a professional, we all have to address this barrier.

So as per your actual experience, what you understand, the early warning system is effectiveness, and how do you, what is the system in place to measure the effectiveness of the early warning system?

And the last one question is, sometime in some countries, there is the small dams or the large dams, and it breaks sometime, so it's become a flesh flood also. So for this type of the floods, what is the system in place in your area?

So I want to take a ways to incorporate or integrate the system in our PDMA or NDMA level. Thank you.

Okay, this is a complicated question and an important one. And we have very little time. So because the lunch is starting, but Musa and Mareike, I think you are best place to answer this. But it's an important but difficult question.

happy to get us started because I feel this is really why we are here and trying to find the solution. So we, from what we try to do basically, it's not, it's useless to see an early warning systems as just a system.

It has to be as part of a systems of system perspective and it has to be built into a multi - hazard early warning system. And you mentioned these barriers. So yeah, of course, these barriers are there, the silos are there, but what we need really is the leadership at the higher level to bring these people together.

But there are new technologies that I use to put all the data in the same areas through decision support systems for instance, which can help the decision maker to this decision. But at the end, we still need to work together on this, bringing the community at the front of the measure.

So yeah, there's a lot of barriers and we have to continue the thinking on that. But the decision support system, the knowledge sharing, the regional partnerships, at least in South Asia, there is this South Asia hydromet forum which really works on data integration, data sharing, new modeling practices, which are really helpful in overcoming these barriers.

But it really needs to be a collective endeavor, working from the municipalities, working from the districts, but having them engage into the process. So this is the few points that I can throw there because this is iterative process.

We have to keep working on that. And you mentioned the dam break. Yeah, of course, this is also a part of Flash Flood. And there are systems really which monitor the dams through water levels. So it's possible to have real -time things, but it has to go through the disaster management agencies.

It's not really part of the hydromet system per se because this is a disaster and it has to be managed on that. And from that, there are, I mean, collective endeavors between water agencies and the DRM agencies which has to work together.

So this is the few points I can put in there. Thank you very much for these comments and that's what we are working to understand every day and shift the understanding. Thank you. Marike.

Yeah, thanks, Musa, and thank you for the question. And I think it's a very relevant one and not easy to answer. So, yeah, I also don't have the answer. And I think it is important that it's embedded within the government, that it's really like that if a system is designed or that there's alignment, that it's adopted throughout the different ministries, that if an early warning is that there can be acted on.

So there should be alignment across different levels. And in some countries, it's easier than others. And also from the models and the early warning systems that we have been developing in the last few years, we have seen as well that some models did not active, did not trigger at the right time, or that the effectiveness of the early warning at that time was not accurate or did not predict on time.

So it's still development and also what Musa says, like iterative process, sharing knowledge, integrating data, sharing data. I think it's very important to make sure that there is the integration at the government level as well.

So I hope it answers a little bit the question, but I don't have concrete numbers or anything on the effectiveness of the system itself for now.

I'm going to wrap it up. So you didn't hear a practical example. This is happening in this location. That's what we do. But maybe that can be discussed later. So I want to wrap up the session. So flash flood forecasting is technically complicated.

But in order to make the service work, it's really important that's what we heard to prepare to actually understand what the information needs to take action and talk to communities and first responders, what is needed, and how to react of the information that is sent by the forecasters.

And also the point about communication was mentioned earlier. Because it all goes so fast, it's difficult to move around, to actually use other means than modern communication techniques to actually transfer the message.

So beside the sort of office work on forecasting, also having a communication system in place is really important. And the technology is there, not always the money. But it's something that needs to receive a lot of attention.

You see, actually, this is the weakest link, generally. So thank you very much for being here. Sorry it took a little bit longer. But I'm glad you were here. And I wish you a very nice lunch. Thank you.

Thank you.