

## **International River Basins: Mapping Institutional Resilience to Climate Change**

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Introductory Remarks

**Geoffrey Dabelko**

Director, Environmental Change and Security Program

My name is Geoffrey Dabelko. I'll be hosting and chairing today's discussion that we've entitled "International River Basins: Mapping Institutional Resilience to Climate Change." We are very fortunate to have one of our recidivists, one of our returning, prodigal son is too strong, one of our good friends, one of our water gurus, Aaron Wolf, coming back to the Center for I don't know, I've lost track of how many times. As I think many of you know Aaron and his colleagues, and he's very good at working with colleagues and we have two of them here on the podium as well, Matt Zentner and Jim Duncan, in really giving us the baseline foundational hard work that goes into understanding how states interact over water. And I think many of you know that his path-breaking work from their transboundary dispute water database and their basins of risk work really has set the stage for our understanding of how states interact around water from a conflictual and from a cooperative perspective. So it was a terrific opportunity for us to take advantage of him spending some time in Washington this week to have him come talk about, again with his collaborators and coauthors, some research that was originally done for the World Bank and will be forthcoming in the peer review literature that really looks at some of these questions of resilience and vulnerability and variability and connecting water and climate change, something that we hear a lot about, climate change in this town, not always bringing it down to what it means in specific places and how it affects specific resources. Aaron and his colleagues are doing that for us in ways that I think are very productive and so we wanted to have them share their work with all of you so we can have a conversation and go forward.

We have some new faces so just allow me to say for a moment we're sitting at the Wilson Center, the formal memorial to Woodrow Wilson. Founded in Congress in 1968 as a nonpartisan, non-advocacy forum to bring the worlds of research and policy together, what we're clearly trying to do here today.

Our Environmental Change and Security Program is a younger program but we're now in our seventeenth year trying to bridge these worlds of natural resources, environment, development, health, population and understand them in broader foreign and policy contexts. So many of those themes we're touching on very directly today.

Today's session is part of our Resources for Peace Project which is a collaboration and partnership with USAID's Office of Conflict Management and Litigation. It's great to see Neil Levine here. Cynthia Brady is here. It's been wonderful working with them and other colleagues at AID and within USG around town on trying to again be productive in understanding these links, parsing them out and then importantly taking the additional steps of having dialogue with the practitioners and the policymakers so that we can translate some of our understanding into practical responses with different tools. Obviously even just looking around the room we have

very different toolboxes that we bring to the table. So our ability to talk across those communities is exactly what we're trying to do with this forum. So we appreciate very much that we have the opportunity to do this both for those of us in the room and also those who are watching the Webcast live and then the video will be on our Web site so we urge you to point your friends and colleagues in the direction of that if you feel that it will benefit from today's discussion.

I'm going to keep their introductions very short in terms of the bios because those are available for you out front. Aaron is going to kick us off. He's a Professor of Geography at Oregon State University. I've told you a little bit about some of the work that he's done from the research perspective. He's also been very much an in-the-room water negotiator, facilitator so this is somebody who very effectively bridges the worlds of scholarship and the worlds of practice with a variety of consultancies with the U.S. government, with international organizations, communities and states and on a state level we had a very interesting conversation for example about that contentious transboundary basin in the Columbia River \_\_\_\_\_ U.S.- Canada relations and what that means on very local levels. He is someone that brings quite a lot of experience to this discussion. It's terrific to have Aaron back.

Jim Duncan is working now as a consultant for the World Bank where he's developing interactive mapping platform of extractive industries in Ghana. I know we have some Ghana expertise here in the room. Ed Carr it's good to see you. But it's kind of in some ways an extension of some of the work that he's done. This paper as I said today's discussion is based on.

Matt Zentner is a hydrologist at the Department of Defense and has had the good fortune of the U.S. government seeing it is valuable to give time and opportunity to go and interact and do Ph.D. and work closely with leading scholars while still bringing that practical research into a specific policy and security community context. So it's great to have Matt here is well.

So Aaron I think you're kicking us off. We'll turn the floor over to you and look forward to the conversation.

## **Aaron Wolf**

Professor of Geography  
Oregon State University

I really appreciate being here in Washington. Although every time I come I have to relearn how to tie a necktie. There are not allowed in Oregon. Actually it sometimes works to your disadvantage because any facilitators in the room? One of the tricks is when you walk in you want to give everybody a sense that you're just going to relax. One of the tricks of a facilitator is you walk in with a jacket and tie and then you make a big production out of taking off your jacket and tie so everybody else will do the same. So one of the first meetings in the Pacific Northwest I was involved with, I walked in and I went to do this and I looked and there wasn't a tie in the place. It was absolutely ineffective.

It's a real pleasure as always. When Geoff asks the answer the yes regardless of what it is. It's always a joy to be here at the Woodrow Wilson Center. It's a particular joy to be here with two former students. Those of us who are educators or have interns or who have people who work with us, the real joy in this work is to work with them for a while and then watch as they go off and do way cooler stuff than they were doing at OSU and they still have to talk to you because you're their former adviser. You'll get a sense of Jim and Matt's expertise and this is all work that what you're going to see comes out of a larger project that we did from OSU with the World Bank and then from Matt's Ph.D dissertation, then work that we've all been doing subsequent.

So this is our basic. I need to start at kind of international waters 101. Do it really really quickly. But our basic problem is this. Water people see watersheds like this image on the left. We see only the watershed boundaries. We see the things that unite us, the things that bring us together. We know everything is connected to each other—surface water, quality, quantity. Everybody who lives in the basin, all the wildlife that lives in the basis. It's all connected and it's all brought together. So these are the forces that bring us together.

And then people who think about politics see the basin this way on the right. The political boundaries, the economic sectoral boundaries, all the things that divide us and for a long time we try to persuade each other that our view of the world was right until we finally recognize that both views are right. These boundaries are here for very legitimate reasons, protecting the economies and sovereignties and so on. And this is also correct. But we then have to do in international waters or any water that crosses boundaries is figure out how to balance these two sets of interests. Both the things that bring us together and the things that separate us.

Today's focus is on transboundary international waters so these are the basins that cross the boundaries of two or more countries. There's quite a lot. There's 276 international basins. It's half the land surface of the earth. Forty percent of the world's population lives within these basins and interestingly 80% of the world's fresh water originates in basins that are shared by two or more countries. So there's a lot of discussion about how precisely countries go about managing these relations when their water resources cross international boundaries and some of those international boundaries aren't particularly friendly. When we're talking about shared basins we're taking about Israelis and Arabs, Indians and Pakistanis, Izaris and Armenian and

around the world we're faced with this set of questions. To manage the water efficiently we need to do it cooperatively. How does that happen and how does it happen particularly in a tense basin?

One of the things that we tried to do years ago because there was so much anecdotal evidence is just collect stuff. If we have a claim to fame it's that we collect stuff and we count it and that turns out to be useful when a lot of the rhetoric was really anecdotal. There's going to be wars about water, there's going to be violence, there's so much information. The bottom line, there's almost no systematic collection twenty years ago when we first started getting involved in this so we started collecting stuff, started collecting treaties. We have the largest collection, 688 treaties that deal with transboundary waters, all the U.S. contacts negotiating those, annotated bibliography. One of the things that we did, if we're famous for a figure—not famous, water world is about this big, we have to be honest. If there is a figure that's known it's this one because when we counted stuff some interesting things started to come out of it. One of the things we did is look over the last fifty years. Any time two countries did anything over water question is what did they do? And there is whole spectrum, a conflict cooperation spectrum of things they can do. They can cooperate, they can do nothing, they can conflict, they can go to war. And we didn't know because everybody at the time was talking about the tensions and the coming wars and so on.

So when we actually collected, was it 1800 events at the time, it's now, I don't know, 2400 events or something like this, regularly we see that at any scale two-thirds of the time we do anything over water it's cooperate and that's really useful to know. How is it? And these are the same people who don't like each other very much. These are Israelis and Arabs, Indians and Pakistanis, Izaris and Armenians, figuring out ways to cooperate over their shared water and the conflict side is 80% verbal conflict. This is people talking about conflict, journalists writing about conflict, politicians saying there is going to be conflict but actual conflict turns out to be very rare, 37 cases, 27 of these are between Israelis and Arabs and no wars at all. You have to go back 4500 years to find an actual war over water between two countries.

The reason this is important is because we now have something that we can start to test the relationship between conflict, cooperation and the things that create settings for these kinds of things which is where we actually wanted to go today. A number of years ago we were asked what are the indicators of conflict, evidence-based indicators that you can use to suggest places that are going to be conflicted in the next three to five years? We thought about the things that we normally hear that are going to cause conflicts. Number one, scarcity. We assume that when you run out of something you're going to fight to get more of it. The other things we thought, populations growth, water stress, level of development, dependence. These are the things intuitively if you thought what could lead to areas of stress in the future. And then we did a study and this is the one that Geoff alluded to, 2003 this basins is at risk studies was led by Sherry [?Affe?] She's not at state, she's in forestry. A really really smart student, helped us think. And what we did is we did a big GIS, a geographic information system of all the things we think might indicate conflict, tested them against our event datas to see what actually did. And sure enough none of the things that we thought statistically led to conflict. In fact statistically nothing indicates anything anywhere about anything. [laughter] That was basically our finding until we finally realized that we were looking at it, we were trying to look at things at change and conflict by itself. And one of the triggers that really got us thinking in a different way was that the arid

climate which you would assume would be the most conflictive was actually the most cooperative. And all of a sudden a little light bulb goes off and I can see a lot of you are going ah, ah, ah, of course, right? Why? Aridity leads to institutions to help manage aridity. You don't need cooperation in this humid climate. So that was suddenly the point where we started to think wait a second. It's not just about change in a basin, it's about the relationship between change and the institutions that are developed to mitigate the impacts of change. And so the likelihood of conflict, of tension goes up when the rate of change in a basin exceeds the institutional capacity to absorb the change and that's become our working hypothesis ever since.

And that's important to understand as we move into today's talk. What does this mean? There's floods and droughts in a basin, there's population growth, there's economic growth. All this stuff is happening. If it's happening between say the U.S. and Canada where we have tremendous institutional resilience. We have treaties going back to 1909. We love each other, we cooperate over everything. Sometimes we forget there is a border, Canadians never forget there's a border between the two. That's not like we would to lead the tension. If you take that same change and you put in a basin where there's hostility, where there are no treaties, where there is suspicion of the motives of the other, now you're in a more conflictive setting. So understanding that we're able to look and this is the map we developed at the time. These basins, what we call basins at risk, where we saw plans, development plans in these basins that conflicted with the development plans of others and there was no agreement in place to mitigate for those.

So the concept we think holds true. The relationship between change and institutions but the basins of course have changed. There's been a lot of building institutional capacity precisely in these basins which all is preamble to what we want to talk about today. This study that was led by Lucia De Stefano, who was a post doc with us. Jim was on, Shlomi Dinar, Christian Stall, Kenster Strzepek and cooperating also with Matt and others, a huge number. I have to right up front say there's a lot of people who helped on this work and I urge you, there's a Web site that gets you to study. Look at the acknowledgment section to see all the folks who really kicked in.

And what we had to do in order to think about the relationship particularly between hydrologic variability and institutions, we had to step up our game in terms of data. We had done all of our assessments as most of the world had based on river basins. So you talk about the map. How many treaties are there on the Nile? That's important but what's even more important is if you break basins up into the parts of a basin within a different country, now you can get a much finer scale and do some assessments. So we know there's a good treaty, well, an old treaty between Sudan and Egypt on the Nile but not on the other eight, now nine, riparian states. So we had to break up and instead of thinking about basins as a whole, start to think in terms of basin country units. So picture for example the Columbia basin, there's a part of the Colombia in the U.S., there's a part of the Columbia in Canada. These are the things that we're doing. So the first thing we had to do was break up our basin.

Second thing we wanted to think about was variability. The question is the relations between hydrologic variability and institutions. So here working with Ken Strzepek at the University of Colorado, he helped us downscale hydrologic variability to the basin country units that we're looking for. So these reds are basins with a lot of variability. The Jordan, for example, 40% above and below the mean in any given year and a number of these basins less variable. And then

we had to step up our treaty game. We had to go out and collect more treaties which is fun, then we had to read the treaties which is less fun. And what we find right off the bat and Jim's going to go into a little bit more detail, 276 international basins. Of those 86 have more than two countries associated with it. The percent of basins with at least one treaty is about 40%. A percent of bilateral basins, it's only 30%. This is interesting. So here you think oh my gosh we don't have a lot of treaty coverage. The percent of transboundary area that's covered by basins almost 70%. So even though there are very few basins by number actually quite a lot of the world of transboundary waters is covered by treaty and the percent of population covered by treaty is actually almost 80%. So a lot of different ways to look at these questions and we had to go through and code what do each of the treaties deal with. So we're looking for things that help mitigate. For variability we're looking for allocation mechanisms. Only a quarter of the treaties have allocation mechanisms. Only 5% of treaties designate river basin organizations, a third have some kind of joint management, a fifth are for hydro power, only 5% deal with ground water explicitly. This is the source that most of the world relies on for water resources. Only a third have conflict resolution mechanisms. So there's a lot of treaties but they're not very comprehensive and they don't generally do a good job of dealing with the things that we need to deal with if we're thinking about variability.

So then we kind of figured out what are those things that help us deal with variability and it's things like understanding allocation, a variability management mechanism, a conflict resolution mechanism or ideally there's actually a river basin organization that can manage. So think about rivers fluctuating. You need some subset of these and ideally most of these to help deal with variability and we went through. I think Jim will come back and look at this in a little bit more detail. Again, different conflict resolution mechanisms on different continents but here we have now of our basic country units this is now how well or poorly they can deal with variability, at least according to the treaties that they've signed. So you see quite a lot of red where there is no treaty at all, quite a lot of orange where they have only one of the things that we think can help us deal with variability and some green, particularly in Europe and North America but not in a lot of the rest of the world which means there's a lot of variability going out there that doesn't have the capacity or the institutional capacity to deal with it.

All this is really important for today and I really want to stress this. Climate change is in the title. Climate change we see as an exacerbator to an already bad situation. A lot of the world currently can't deal with the variability that they have today. We're seeing the results of this in a lot of different ways. Certainly Eastern Africa right now. The floods along the Indus last year. This is really important. It's happening now. It's a major set of issues now. We want to look into the future but we want to remind people let's also come back to today and step back and say if we know this is a problem let's try and deal with the issues of the day. Why is it useful to look into the future? Take the rivers that come out of the Himalayas, a huge number of, not just number of rivers, but a billion and a half people, a billion and a half people rely on the water that come out of the Himalayas. And we're talking about all south, southeast Asia, all the way up into the Caucasuses and most of the population of course is south of the Himalayas and naturally most of the treaties are south of the Himalayas but there are big blocks if we break down by country unit, there are big blocks that don't have any treaties now to deal with current variability. If we look into the future this is current variability, so most of these rivers aren't wildly variable. Monsoons fairly stable. The combination of the monsoon and the snow melt helps balance out a certain

amount of variability. But if we look at what the climate models are saying in the future, there's going to be increasing variability in precisely the parts of the Himalayas where there is no treaty coverage. So this is why it's useful to think let's start with today, let's look at the variability today, let's look at the vulnerability today and see how we can't help enhance resilience so that as we come to the problems of tomorrow we'll be able to deal with them better. Thanks very much.

[applause]

### **Jim Duncan**

Consultant for the World Bank

I want to thank you all for being here and I thank you Aaron for a great introduction to this topic. I'm going to kind of take two approaches here. We're going to be diving a little bit into the methodology but I want to talk some about the climate piece and then give you some of the most recent findings we've actually gotten from some of this deeper treater analysis that we're doing that can start to answer some of these now questions, what is the state of the transboundary water line now? So I'll talk a little bit about what we did to refine and expand at CFTD, some of the preliminary findings that we got from that database as we're starting to look more deeply into what these data tell us and then come back to the idea of what these institutional arrangements mean for climate change risks.

First thing we were able to do again is map treaty coverage. This is a slightly different map that the one you saw before because this shows kind of the density of treaty coverage so patched areas are no treaties. You can see some really dense areas in South America, around the Himalaya but all in all there's very variability not only across the world but within basins. And I think that's one very powerful tool that we've gotten out of this analysis is we can look at what are the disparities within a basin. Under our climate modeling we actually some places that are pretty well know, the Ryan, the Alb, the Indus have really large disparities and treaty coverage for climate change mechanisms—five. Some parts have zero, some parts have five and that kind of disparity is something that we weren't able to see before. So I wanted to point that out.

Also we tend to see that the types of mechanisms that are being incorporated vary around the world. We saw a lot less coverage in South America of a wide range of mechanisms. So you might have a lot of treaties but they all deal maybe with one or two types of mechanisms such as joint management or allocation. Whereas in places like Africa we are seeing a more wide distribution of that.

Another thing that we did is we introduced a lineage concept and as far as we can tell this is a first time that's been there. We combined say a primary agreement that establishes a certain treaty in a basin and that might have an amendment, it might have a protocol and these things might have different components. The amendment might add joint management to a treaty. We can combine that into one instrument and then analyze that group together. And I think this is interesting because it actually changes the distribution a lot. As Dr. Wolf was showing we see maybe only a third of the treaties have joint management as documents signed. We look at them as groups, it's almost 60%. So there's this real transition when you start to group things in together and I think generally everything goes up. But we also see some things that aren't still

very prevalent like ground water, still only 6% at documents, 14% when you do instruments. So we're still not seeing much coverage in the treaties for

What this has allowed us to do is look at some of the temporal evolutions, some of the spacial evolutions so we can see there's a lot of treaty formation happening as we enter the 19th century and there are definite peaks of formation and large areas that all of a sudden come in to being covered by treaties. So we've started to look into that and we also started to look into some of the stuff the content. We saw this conflict resolution data. You can see that there are some that are more common in treaties than others. We can also break it down by geographic distribution and start to see where there are patterns. For example, a real difference in third part involvement, \_\_\_\_\_ and traditional organizations aren't as common and also show up in different continents relative to other types of conflict resolution.

So all of this is a great way to say that we have a lot more information. We're starting to work on it now and we see overall treaty distributions by continent and in total. You do see a lot more multilateral formation and I think one thing that's interesting about looking into the multilateral situation is you have all these basins as was mentioned that are multilateral, have multiple red pairings but they don't include treaties that include all red pairings. So while we look at it at first pass you see, okay looks like multilateral coverage is good. When you actually look at the completeness of that coverage it drops pretty low. Only 13% of the world's transboundary basins that are multilateral have a complete multilateral treaty and that's something that might be a challenge going forward. Similarly looking at basin scale managements, this idea that we think basin scale should be the way to go it's definitely increasing but overall coverage is pretty low. But suffice it to say that we're seeing about 25% of the world having a basin scale management scheme in place to their treaties. We might see some that are focusing on specific sub basin or saying all of our shared waters are going to be covered in a certain way but that specific basin scale management piece is still in process.

So coming back to the treaties and climate change. We have all this information. We have an idea of where there might be climate risk coming so what is this distribution and we saw the map before that shows us how these mechanisms for climate change are distributed and then what basins may merit further study based on when we match those together with this climate information. So to get into the methodology a little bit we use the vulnerability hazard risk framework. So vulnerability was institutional factors. Hazard has hydrologic factors and you can combine them in a rating model to rate risk from highest down to lowest and start to look at what basins start to pop out, what BCUs, what \_\_\_\_\_ and country units start to pop out after that.

So we took two different approaches. If you looked at the World Bank report we have one where we looked at just the present variability, if one looked at only the change in variability in the future, then we have a forthcoming in the peer review version, a combination of the two. So where it's variable already or kind of variable and it's going to see an increase. So we wanted to kind of separate out those two.

This just shows you in a map form how we did it. You have your vulnerability combined with a hazard level, gives you a risk map. When you see the maps that's kind of the result you've seen.

Future variability was defined with a speed of climate models. I'm going to skip that little bit of specifics because you either already know or you don't really care. So we can talk about that later. If you want, I'm happy to talk climate models. But this just shows you what we had as projected conditions in 2030 and projected conditions in the 2050 range. It tells us a little bit about what's the year-to-year variability and what's the change. You may have not had much variability but you might see a high degree of change so this targets us to look at basins. So it's not the actual variability but it's a magnitude of departure from what they're experiencing now that's going to be really critical.

This just filters out, it looks only at the high present variability and what the different risk classes are based on the vulnerability. So we can see there's a concentration in Africa and you can see within those BCUs there's a real difference in whether they have good treaty coverage, moderate or low.

When we switch to 2050 and looking just at the future change, the second definition of hazard, you can see a much wider spread and also the spread of vulnerability levels changes quite significantly too so we have some areas in Southeast Asia, we have Central Europe, we have other places that are starting to pop out as potentially interesting. It doesn't mean that there's going to be conflict here, there's going to be problems but these are places we might want to think about.

And looking at this kind of combined mixed method where we look at are you moderately variable now and see some change? We can see different basins popping out. You see a lot of these ones on the fringes. This just gives us a different picture. And all of this is to say, none of this is definitive, but this is the way that we can start using the state of the look for some of these hazards. So what we did then is filtered our results and this just gives you kind of a table version of what we found.

This looks for pieces of basins that are contributing equally because some might be a little sliver with two people living there, one raindrop falls a year and it's five square miles. We don't really care about that. We want to know which ones are actually contributing substantially to the basins. So we ran a filter that kind of identified these more equal distribution ones and these are the ones that popped out. Full face on their present and future variability. Some we can see that we might already be a little concerned about. The Niger, Congo, Lake Chad. But then we have a number of other ones that aren't. In Africa I never heard of until we did this analysis. So I think it's an interesting start. And you can see there are some where you have disparities in treaty RBO scores. Some where nobody has a treaty so it's zero zero. So this is kind of a first pass. It encompasses about 11,000,000 people and that's not a lot in global terms but some of these are really high density areas like this basin piece in Turkey has a density of about 100 people per square kilometer so the actual potential of human impacts in climate change even in these small places could be pretty significant.

This just shows you in map form what we were able to do in terms of identifying these basins. Kind of to what this means from going forward. You can kind of take a step back. Variability management. That was one of our key pieces that we were interested in using to rate institutional capacity. We're seeing that we can now start to break that down further because variability

management can be flood control, it can be dry season control, it can be both. What we're seeing is over half of the treaties that have ever been signed to deal with variability only in terms of flood control and we're only seeing about 15% that deal with dry season control. We know that climate change tends to favor that side of impact. So we can start to look at that. We can also look at types of allocation mechanisms. The treaty database actually breaks down into different types of allocation. Everyone gets 500 cubic feet, everyone gets 50% of the river. You do it by consultation every year. So these kinds of direct and indirect mechanisms for allocating water. We see the direct mechanisms are three times as common as indirect mechanisms. So we can start to look more into what, okay we have, is it there or isn't it, this institution. Now we can look at what does that institution look like.

Another key finding of this is that these disparities could play a real role. We mentioned the Indus before in terms of flood. You have two basin country units within that basin that have a different treaty coverage than the other three and so that might be an area that we need to focus on as better basin-wide coverage. And then also these new distributions of risk. We're seeing risk spread into areas that we hadn't always thought that they would be before.

With that I'm going to turn it over to Matt. [applause]

**Matt Zentner**

Hydrologist

Department of Defense

I work for the Department of Defense right now but what I'm going to talk about are water issues according to Matt and now according to water issues according to the Department of Defense or the U.S. government. I talked to the folks before I came out here and they said that I had to make that announcement.

So we talked about treaties and why they're important and the risk of conflict and why people might in the future rely on these treaties perhaps more than they already do. I think it's important though to talk about a little bit and think about why do governments care? What is it about the water that people care about? Generally speaking it's not really the water so much that people are willing to fight over but it's the issues that are associated with that that cause people to have disagreements. So if we look at water and what it's for and where it comes from—for example this right here is just an example of India. This is their total amount of water. Up at the top is drinking and sanitation water and then underneath that is everything else, industry, agriculture and everything else that goes along with it.

When I imagine water I tend to think along these lines and I think that's what most people think about is sanitation, water. We need to get water to the people, we need to give them sanitation. In reality that's not really necessarily what governments care about. Water is really a junior ministry. It's not really one that people tend to think of as one of the core places that power resides within a country. You really probably should think about that 20 gallons or 40 gallons differently than the rest of the water. That can pretty much be separated and fall under the human security realm of things.

I like this quote down here is that “when you tug at something in nature you find it attached to the rest of the world,” and I think what happens when people really start caring about water is when it starts impacting these other ministries, these other areas of importance that really start impacting what we would consider national security. So when it starts impacting economic growth people pay attention. When it starts impacting food availability, electric power, your relations, land rights, those kinds of things are what really drive people to pay attention to treaties and can potentially cause them to have disagreements.

So what is water security? Well, it really depends on why you ask. If you ask a farmer he definitely has a definition of water security. I have a different definition, a politician has a different definition. It just depends of what their interests are. So not all of those human security concerns rise to the national security level just because everybody has a different definition of national security. When we talk about human security I’m going to really define that as a small “s” security and when you’re talking about larger national security issues we call that the big “S” security. That will be throughout the presentation. I wanted to make that clear.

When we’re talking about countries and what do they care about water and why would they care about treaties generally speaking water resides at that small “s” security for most countries. There are some exceptions. If you look at these graphs of GDP and rainfall you can see that there’s definitely a correlation for some countries between their overall economic strength and rainfall. So it’s very important to those countries. So generally speaking it’s countries that have agricultural-based economies and are generally developing countries. If you look at precipitation in the United States for example, GDP, you’re going to see a very different correlation. GDP is not going to have any correlation at all with rainfall.

When I think of national security we’ve talked about water wars and I think that’s what generally people say is water security or national security wars. But in reality with water there is a strong element to national security. It’s just more subtle than water wars as you would put it. I kind of tend to think of it as more like cold water wars. You think about some of the relations that aren’t exactly classified as war but they are disagreements. And sure countries definitely recognize the inherent power that they might have within water and definitely they utilize it. Anything that impacts that geopolitical, military, economic or social cohesion can be considered part of national security and water can definitely cause chips in relative wealth or power, can definitely exert influence, could be used as a tool, can definitely be used to impact state civility and can be used as an implicit threat.

Dr.[? Perscoli?] actually gave—I can’t take credit for this over here on this side. If you look at this Chinese character down here and in Japanese I’m not sure exactly how you say it in Chinese but in Japanese it’s “G,” it’s government. If you take river and dike you get political order or government. There’s another interpretation of this. This can be—also again, I’m not sure exactly what the Chinese version but in Japanese this can be water and this is personal so your personal water and this is your mouth, it’s more of like a passivity, it’s just being at peace with things. So if you have water for your mouth you’re at peace with things. There’s definitely a relationship between national security and what people care about with water.

Frankly I've been extremely happy recently. This is a newer phenomenon but people are starting to make this connection between water and not necessarily thinking just human security which sometimes that big/small "s" which sometimes does reach up to that larger "S" level but people are making that connection to all the other issues that water impacts. One of the champions and people who are thinking along those lines is Secretary of State Clinton who has requested a national intelligence estimate to look at those relationships and also is increasingly using it not just in the overall intelligence but also in our foreign policy. So it's really refreshing that we're actually starting to see these relationships and understanding the importance of water.

I wanted to talk a little bit about current stresses and where we are and where we might be going into the future as well. If you look at water availability there's these references that—they have their place but they can also be a little misleading as well. If you look at the Democratic Republic of Congo over here as far as water availability, here's your stress and scarcity levels right here. It looks like hey De Rock is doing great. Everybody is happy in De Rock with their water. They've got lots of water, they really do. And then you look over at UAE and oh my goodness people are dying of thirst over there. We better do something right away. So it's not just the water availability. There's other things that go into that—economic scarcity, being able to develop your water resources, being able to distribute your water resources. All of that goes into play. So it's not a simple oh my goodness we're at this level, we cross over that and we want to watch out, things are going to happen in that country. It's a lot more complicated because you have all of those other factors that go into it.

In the past there really haven't been major conflicts but there are reasons for being concerned. The future might not exactly look like the past and especially just from a purely water availability standpoint. One of the major stresses, world population, up by a billion or so by 2025. The requirements for a broad range of reasons that we'll talk about here for a second up by 40% and then we do talk about the climate change issues and the overall water availability there. But just as important as these water stresses is as far as the overall amounts is getting the water at the right time at the right places. A lot of the changes that we're going to see are changes in timing and being able to get the water to particular locations.

One of the major stresses is going to be food availability. It's our largest consumer of water. Demands are increasing for a broad range of reasons. Higher standards of living, people's more consumption of water usually in a personal sense. And then also our land availability for growing food is decreasing as well. This also has implications as far as having food also equals stability and those countries that have that water invested available to them are going to have increased food and also which equates to increased economic strength and stability as well. And the countries vice versa, countries that don't have that water will have an increased risk of instability from a food angle as well. The food crisis of two years ago didn't really impact us per se. We didn't really notice, we paid maybe a few more dollars but it definitely impacted Africa and several countries had severe impacts.

Water and energy. We don't think necessarily about water or energy being a consumptive use of water but it is. There's a certain amount of water that's lost from evaporation when we build dams and use it for hydro power. Biofuels require power. And frankly a lot of countries haven't begun to tap into those energy resources.

And then municipal demands. And that gets more into getting the water to the right locations because 60% of the population will be in urban type setting. We're going to have to get the water to fewer locations and more of it.

So resiliency of water treaties are certainly going to be tested. And some people have predicted that they're not strong enough and that they will fail. Here's a quote by Peter Gleick, "Existing agreements and international principles for sharing water will not adequately handle the strain of future pressures, particularly those caused by climate change." So whether or not they fail or not it's not as simple as saying they are going to have less water therefore these treaties are a fail. We've already talked about there's all kinds of factors that go into that determination. They certainly will be stressful.

As part of my dissertation I actually looked at some of these treaties and looked at the number of conflict, I'm calling them complaints, that happened within these basins and then I also took those complaints and then determined if they were climate-related complaints or any other kind of complaint that went along. There were 85 events of the 400 that I looked at that were actually climate-related complaints. So I'm going to talk a little bit about a couple of basins that actually did have climate-related complaints and talk about how that related to the strength of that treaty in particular. I wanted to point out also that perceptions are sometimes more important than the actual water itself. How people view that and whether they think that water is going to be less can cause people to spur them to action and cause people to care more about water than they might have otherwise.

I want to talk a little bit about the Indus Water Treaty and after this I'm going to talk about the Nile. I'm going to talk about those two treaties. Rapid environmental change, check. Rapid population growth, asymmetric economic growth, yep, got that too. Unilateral development projects, ahem. Internationalization of a basin, certainly within the Nile. And I guess you could also say with Afghanistan and the developments that are going there it's almost that.

So Indus Water Treaty. The Indus Water Treaty is really a unique treaty just because it separates the six major tributaries for the Indus (this is a quick background) and I think it's the only treaty that I can think of where those tributaries full allocation pretty much is given to another country. Can you think of another treaty where there is? I think that's the only treaty that I can think of. So the western tributaries are given to Pakistan and the eastern ones are given to India. The environmental stresses are significant and these are across the basin but the real party that's worried about these stresses is Pakistan. Pakistan relies on the Indus much more heavily than India does. India uses it primarily for hydro power but Pakistan uses it for a broad range of things. Also one other thing about the Indus Water Treaty is just generally considered as the strongest and most successful and probably the most important water treaty out there and it has been successful. It's been through I don't know how many different wars. People have still connected and worked their way through it but there are some new stresses that are coming along those lines.

I looked at complaints that have been filed there. There were 110 complaints but only four were related to climate. So climate issues per se haven't really been as much of a factor there. Much

more importance within the Indus, just the overall political situation and how people utilize the water that definitely has a visceral and sometimes a spiritual aspect to it. Use that for the political environment.

I also thought what was really interesting about the Indus was, sure it's a transnational, transboundary treaty but it also certainly impacts sub national issues as well. Some treaties when they consider scale they consider all the way up from sometimes the individual all the way up to the nations that are party to that treaty. So key international drivers right now are pretty much Afghanistan coming into play as far as developing the Kabul River. They're not a party to the treaty. And also Indian development projects especially kind of kicked off. There were some issues before but pretty much kicked up at the Baglihar Dam. I'm pretty sure everybody has had some exposure to the Baglihar. So the Baglihar ruling caused Pakistan to be a little bit more worried about the Indus Water Treaty than perhaps it had been in the past. It gave India a little bit more leeway, it's not just black and white with the development of those tributaries. Right now the Baglihar went up to one level of arbitration within the treaty and now with another dam, the Kishanganga Dam, that is going up actually to the highest level of arbitration that is available within the treaty. So things have been escalating within the Indus.

The Baglihar Dam. Basically came down to whether or not you can impound water behind the dam. India says no, no no, it's not big enough. There's not going to be any impounding behind it. Pakistan disagreed and so they had a neutral expert that decided on this and the expert said well you pretty much, with minor modifications you need to decrease the spillway levels and a couple of other things. He said India you can go ahead and build that dam. India then says yes we can build the dam, we succeeded. And what does Pakistan say, yes, they had—he sad that India was in the wrong and they had to decrease. So they both claimed that they were successful. The embassy here said cleared by neutral experts stating that the overall design, that being built by India as a run of river plant has been upheld by the expert. And then Pakistan said he made it clear that the verdict that India has been found guilty of breaching the Indus Water Treaty of 1960.

In reality my opinion is that Pakistan is much less sure of that than they state there and actually they're worried about it. They're really worried about it because what does it do? It allows India to take this template now that does indeed have a small amount of reservoir behind it and they can start cranking these out. They can have ten, twelve dams. Its already been decided that this is an acceptable design and India is probably going to take advantage of it.

This is just a Google earth shot here. This is Baglihar. It's all done now, it's fully operational.

This is a Google air shot though that shows exactly the ravine that we're talking about. I think this is about 500 meters. It's really a narrow ravine. It's like about 700 meters all the way up here. There's really no place for a huge reservoir to exist. However, during the Indus flooding that certainly didn't stop the Pakistani press from saying "Baglihar Dam is releasing water. That's why we're getting the flooding down here." It just didn't have the capacity. The perception was there. It had already been made an iconic figure for people to refer to it.

So this is the Kishanganga. This is the one that's going before the court of arbitration right now. The basic idea is so you have the Kishanganga River, when it crosses over to Pakistan becomes a Nelan River. So what they want to do here is they want to divert water from the Kishanganga River down to the Rular barrage right here, where the Rular Lake and then come back where they have a hydro power plant here and eventually goes back into the Gelan River.

If you look at this, this is where the plant will be. It will go through the mountains here, hydro plant right about here, then comes back down into the Gelan. I think they're about 50% done. It's supposed to be completed in 2014.

So the Nelan-Gelan Dam wouldn't be a problem normally but we have—here's the Kishanganga. India wants to divert water down here so then it comes down and hits the Gelan right here. Well, right there is where this Nelan-Gelan Dam is and so the water will not actually be available for that particular dam at that particular location. What we have is we have a \$4 billion project, \$2 or \$4 billion project being built by Pakistan which if India's gets into place then the water won't be available for both of them. It's really interesting because there's a prior appropriation. It's pretty much going to be a race to decide who finishes first and they'll have the higher standing within the court of arbitration.

So this is what the Nelan-Gelan is going to look like. They're a little bit less further along. They're predicted to be done about 2016. Good thing about water projects is it's a turtle race. It's not like necessarily oh my goodness where did that dam come from? It takes a while, it gives people some time to figure things out.

So the Indus Water Treaty, very strong treaty. We looked at all the different parameters. Very strong treaty. More than capable of handling most stresses. Actually what was interesting from a climate change perspective is that it's actually very weak, it doesn't have very many flood management capabilities built into it. We saw some of those issues during flooding last year. So what does climate change say? The models say generally that overall they're going to have plenty of water but your variability is going to change. You need some flood management capabilities in there, at least until all of the glaciers finish melting, then you might have some variability issues there as well.

I'm just going to zip through the Nile because there's not a lot going on there. I think we're all familiar with the Nile Treaty itself. I'm just going to get into the current stresses right now. The CFA has been signed and is being put forth for ratification by the countries which actually is going to threaten the 1959 treaty if signed. Threatened meaning that there will be more people involved with the treaty rather than just Egypt and Sudan. The problem with the CFA from an Egypt perspective is they want those allocations built into that treaty that preserve their rights to what they get now and the countries are not necessarily willing to do that.

Another stress that's going on with the basin in South Sudan. You just internationalized the basin, you just got another riparian, how is that going to impact things?

Food to security. A lot of countries are starting to buy up land within the basin and utilize it for their own food production purposes. A lot of these are theoretical and actually haven't been applied yet but possibly.

Development. I think with some of these other stresses that are going on with the Arab Spring up in Egypt, some of these upstream countries and with the CFA are thinking hey, it's time for us to start plowing ahead so the Millennium Dam is one that's being put forward in Ethiopia. I'll talk about that in just one second. And also population.

It started off being called the Border Dam, then it started being called Project X, went to Millennium Dam and now I think it's at the Renaissance Dam. If nothing else this is not only going to be the biggest dam in Africa, it's also going to be the most named name and the longest named dam in Africa. But it's a huge project, \$4.8 billion. It's going to be twice the size of Lake Tana right here as far as from a volume perspective. It's going to send Ethiopia's power production through the roof. Whether or not they can pull it off, that's a lot of money for Ethiopia but again it goes into the whole political side of things. What are they using this for? Are they really going to build it or does it tie into the overall water picture?

So my conclusion as I've looked at some of these case studies and applied is that water is definitely part of the larger security picture. Is it just about the water? No. It ties into a lot of different things. The treaty itself and what it ties itself into actually impacts how important that treaty is. Does the treaty tie itself to agriculture, hydro power, industry, potable water, political relations? If it does that increases the importance of that particular treaty. If it doesn't it's not applied as much and people are probably less likely to actually complain about it.

Not all conflict is bad. Not all cooperation is necessarily good. I don't know how many of you are married but there's conflict and there's cooperation and it's part of a healthy relationship. So sometimes you have what we would call complaints and failed treaties but in reality that's success, that's what it's supposed to do, it's supposed to solve those complaints. As long as it doesn't go beyond that level.

The last point I wanted to make was that the solutions that we're taking about here are often static within the treaty. We have some shifting problems. So when we have that flexibility built within these treaties it allows it to be a living breathing important part of solving those problems. Thanks. [applause]