

Introductions and preliminary remarks:

1. Opening remarks: Nancy
 - 5.3 Tasks completed
 - Submitted draft prospectus to CCSPO for approval
 - Prospectus subjected to public review
 - Approved prospectus was posted on CCSP web site
 - Charter established at NOAA
 - Next steps: First draft assignments due April 30th
 - NAS completes review Aug 15th
 - Authors revise Sept 15th
 - Public review Sept 16th – Oct 31st
 - Audience: Decision makers interested in learning about the experiences of others who have experimented with the use of forecasts, climatologists, scientists
 - Three sections:
 - Description and evaluation of forecast data products
 - Decision support experiments within the water resource management sector
 - Three topics: 1. The range of water-related decisions needed 2. Forecasts needed, 3. Translating climate forecasts and hydrology information for integrated resource management, 4. Decision support development
 - Analysis of present and past decision support experiments and a look towards the future
 - Created a list of stakeholders and stakeholder questions (these have been sent to the stakeholders)
2. Helen: Speaking on the importance of meeting the deadline, producing a quality product is just as important if not more than meeting the deadline. If we must we could hold up the review process in order to have extended time to produce a quality product.

10:00 Stakeholder presentations:

Jan Dutton, AWS Convergence Technologies: Weatherbug: He discussed some prime examples of commonly available sources of climate and weather forecast information from, CPC, IRI, Universities, and the like

- Jan represents private sector organizations has a PhD in meteorology and studied climate modeling. So he knows the science side and the user side.
- Weather Bug provides climate information to energy traders resulting in multi-month contracts, provided an example of one client who lost money due to drought. Knowledge breeds better predictive capabilities for the energy market.
- For water resources the biggest question is how accurate is the information they will be providing to help them predict and plan.
- So the question is if I am going to create a contract for energy based on hydropower, would I use a temperature forecast versus a point forecast
- At present time I would be very skeptical about using this information for this example based on the skill of this forecast.

- The presentation of information is very critical
- The IRI probability density forecast is very well presented for a climatologist but it would not be helpful for the users who would take this information they need. The information has to be presented in the unit that the decision is on. So what we do is take the graphs and present it to the users with a format of the decision only. They would never present information such as the IRI graph, so it must be customized by sector and by user.
- Can you assign monetary values to forecasts (US Air de-icing budget spent on Denver Airport)
- NYC and Boston snow
- More interpretation is just as better as more data or information.
- Question: How frequently do you talk to the producers of the product and give them feedback on them? Response: Currently I don't yet I used to more often when I worked at Weather Bug. I have had experience in a feedback process where you can be involved in the creation of what you need in order to develop something for the users.
- Andy: There is a whole range of needs your users have and there is a translation model on how to take the information and change it to what users will need, for instance, forecasts of kwh. You say this map is not be usable for decision making if the entire east was dark brown that means more confidence, would it then be used? Response: Really not many people would use the information presented on the map to make decisions. Andy: This can in a way be used on a case-by-case basis. Response: So yes the more confident the data shown on the forecast, then it would be used, but it also depends on the actual factor we are looking at, severe drought might make it more cautious
- Tom: When it comes to users and skill? Response: I don't have much to say about users and skill. What is most important is when they actually use the information, and how helpful it actually is. If it works they believe in it, if it isn't then they will be more questionable.
- Pedro: Customers don't want to know about probability and risk weather they know about it or not. Response: Most people today don't want to know about the probability.
- Analogs are used day in and day out because they are more easily to rely on.
- Question: What else do you need? Response: I need the full set of information from the raw data to each step on the manipulation of it into graphs.
- Question: What about your monitoring equipment? Response: Weather Bug was founded 13 years ago through schools. Our competition uses raw data, we have actual weather stations to collect the raw data. We have cooperative agreement now with NOAA on a test bed for data and this cannot be released to the public. We really are unique in our ability to collect our data. We have about 400 stations in the DC area as an example
- Questions: Ocean data, how sophisticated are your users in upstream ocean information? Response: There are end users who are able and do that, however there are ones they don't know it and therefore don't bother.
- Kelly: On of the problems is the fundamental difference in time of forecasts (season, yearly) and the decisions that are made (energy is on an hourly basis and such). Response: Yes that is correct.

Joe Grindstaff, CalFed Director

- Most critical need is better information as we do flood preparedness. We spent over \$5 million on flood management. Doing a lot of work on the rivers.

- As a state project we look at dealing with management on a long term not just short-term flood issues.
- We made our policy on flood management more aggressive, because we are willing to take the risk that one year out of ten we will be able to make better decisions
- The largest user and producer of power in California is the water utility. They use more power than they use.
- They have about \$1 million/year in natural gas contracts and climate is a driving factor in the price of natural gas, and when we haven't caught it appropriately it costs the people a lot of money.
- The fish in the water system is a major issue as well; they recently did an analysis on what will happen to the fish in 15 years due to different climate scenarios. The temperature increases will severely affect the fish populations there that need the water to be cold.
- They are in the process of doing studies on 5 surface reservoirs
- The key factor for the water utility is now climate; it is the basis of whether or not they will do anything especially building surface storage of water units. This even involves sea-level rise because rising sea level even a foot dramatically changes the characteristics of the delta that they rely on. They are really worried about the long term and they have limited knowledge to make decisions now. The Colorado River is a big factor as well what happens to it affects us. 2/3 of the precipitation is north and the receiving population (2/3) is south. The agriculture economy is still the largest in the nation and it is really important and reliant on the river.
- How does climate modeling affect our decisions? We have about 700,000 acres in the delta and about 400,000 acres is sinking and under supported. So the main questions is what do we do for protection. Sea level rise and climate change are the main two issues that CALFED is really concerned with. There are 5 counties that take care of the area. Right now we are really close to losing islands if we have a ten-year event. They are wondering it we should invest in trying to build up leveys or should we just give up and wait for it to be flooded. How much is sea level rise actually going to be? If it is going to more the 1 foot over the next 50-100 years that will be dramatic for CALFED. If it will be less we will have more options. So it would be wonderful if we had better information on how much sea level rise will be and what kind of events we will be experiencing. How strong will the storms be and what kind of storms is what we want to know. Especially, will the 30-40year events become more frequent and how will that have an effect on what we are doing. We have a year to do a strategic plan on what to do with the delta and will use climate information to make these decisions, especially the 5million we have on the leveys.
- Question: Where should we invest our money in terms of environmental restoration?
Response: We wont do restoration in areas where the sea level rise or changes in climate will affect the area anyways.
- Question: Are there tools or sources of information for shorter-term decisions? Response: We are currently looking at the risks in the delta (Delta risk management study). But our major concern is what to do now in terms of what will happen in the future, how to be proactive. For instance building dams and levees and such that will be able to withstand frequent hundred year storms. But we also have to consider what we want the delta to be in the future.

- Question: How do you decide what is an acceptable level of risk, in that case I just mentioned is was a group of water manages who decided. Does this increase the risk to fish as well? Response: I don't think so. No we have not experienced it yet.
- Question: IPCC will be coming out this month saying that it will most likely be 4-80cm of sea level rise. How does that affect your decisions? Response: That would make it difficult. Knowing if the number is slight (4cm) or more like the larger the number (80cm) makes it easier to make a drastic decision on what to do.

Eric Kuhn, General Manager Colorado River Water Conservation District: Works for the Colorado River district on the west (where there are less people)

- The river has many mandates that regulate the use of the river. The organizations and groups involved are really involved and proactive about working on this issue. Everyone understands that the forecasts are probabilistic and do take that into consideration.
- Water managers are very conservative. They are reluctant to draw from reserves unless necessary. They the forecasting products and understand that just because they say something it might not actually be the case.
- The longer-term decisions are much more liberal. All the water agencies maker very conservative short run decisions and very risky long run decisions, and I am not sure that they are understanding the consequences of those decisions.
- The remaining useful water is the water in the basin. There is a forum being developed on how to use this remaining water. The BLM is doing an environmental impact statement on the oil shale in the area. The DOI secretary said they must have a shortage criteria developed. Both of these decisions have billion dollar implications. Colorado has senior water rights, while Arizona and New Mexico have less rights, yet are two of the fastest growing areas in the west.
- The decisions will be based on historic hydrology from 1900-2000 however; this data set doesn't include the most recent drought issues that are plaguing the area.
- The question is will present hydrology be at all similar to past?
- No real sources of alternative hydrology other than paleo so it does tell them some things about the differences in the infrastructure and how this affects what happened. Same precipitation and different run off patterns will lead to different availability of use.
- Some cases people really just don't want to use the information, the excuse is always lets wait for better science but when do we stop waiting and use the information we have now.
- The spring forecast is now getting a lot more attention than it used to
 - There was a 101% snowpack above Lake Powell forecast
 - The actual was 72% normal
 - Runoff is a huge factor!!!!
- The 20-year smooth flow is the most important to the CO River. It showed the variability within the 20-year periods. One dry year followed by wetter will not make much difference
- The tension we see is toward more efficient and more adaptive management vs. emphasizing on long-term drought and extremes.
 - In some ways we are talking to two different audiences making two very different decisions
 - One is the water managers while the other is the agencies and the public

- In the last year is when we have started to talk about risk not just in amount but quality as well
- One of the main questions is not when to put the decisions in place but when to stop those restrictions
- The real thing that's driving the decisions is the political opinion on what's considered acceptable
- California is really on the climate change bandwagon unfortunately despite what is going on in CO they have yet to really join the group.
 - It's the leadership. CA has the political leadership that is really invested in climate change state wise. CA is not at risk of a shortage so they can think about the climate change issue. While CO has to deal with the shortage issue as well as the climate change issues, and we have not had the same political leadership that CA has to take climate change into effect.
 - Joe: I think part of it is that the governor does care, and the other part is that the science has caught up with it and we are now interested in the science community and what they have to say, we didn't really care about the science beforehand. Even the conservatives are interested.
 - So Yes the science members of the CA board has directly influence the increase in the use of science and their opinions in the decision making process and the drive to pay more attention to climate change.
- 3 environmental contributions
 - CA has not been facing the drought that the CO basin has, and if they had they wouldn't have been able to take on future projections as they currently are
 - Issue of geography. CO doesn't grasp the concept of how warm their mountains could get and therefore don't worry about floods as much as CA does. Sacramento is much lower and less protected they New Orleans and they are well aware of it they have not forgotten about Katrina.
 - Question: For institutional change to happen there must be some major events like the drought problem. Are these comments you have laid our really widely accepted? Response: We are going through a process of change and this really needs to happen in the bureau of reclamation. It is happening because people are looking at the paleo-hydrology now but that isn't the only thing that should be studied.

Jayantha Obeysekera – Director Hydrologic Systems Modeling Division, South Florida Water Management District

- Water Resources Planning: Changes to the complex water management system
 - Water supply planning, flood control
- Operations: actually implemented the climate information
 - We used seasonal and multi seasonal climate information
 - Implementation of climate based rules
 - Emergency management (hurricanes)
- Lake Okeechobee: the key is the tradeoff between the ecosystem, flood protections, supply and the everglades.
- Take the CPC information and translate that into a rule book that the operators can follow

- Planning for infrastructure changes, evaluation of ENSO and tropical outlook, status AMO, PDO, NAP
 - El Nino is really a factor because Florida gets such a strong signal
- They use climate information from CPC and IRI
 - CPC is very conservative in their forecasts which isn't really helpful for us
 - ENSO, seasonal probabilistic, analog years, and tropical outlook
 - Weekly ENSO updates, status of AMO, PDO, PNA, NAO
- Barriers in using the climate of information (from a workshop)
 - Net benefits of using the seasonal climate forecasts have not been demonstrated
 - Users require objective user friendly products
 - Socio-economic forecasts are very important
 - Stakeholder buy-in is a challenge (stakeholders will use forecasts to their advantage)
 - Updating forecasting methods is difficult
 - Operators do not like flexibility
 - Decisions makers do not like uncertainty
 - Public loses confidence quickly after a single incorrect forecast
- Things we need: Climate change vs. climate variability
- Greatest concerns about vulnerability
 - Uncertainties in current El Nino effects on the dry season
 - Increased frequency of hurricanes affecting Florida (increased insurance rates)
 - Increased severity of extreme rainfall
 - Sea level rise and its effects on coastal erosion, flood protection, and environment
 - Over-design or under design of infrastructure facilitates.
- We developed a better emergency management system and response system for hurricanes but we also know that increased hurricanes is not necessarily going to be the norm now
- How does the staff produce the information you speak of? We actually do a lot of research in the first 3-5 years, we came up with an operating rule that must include climate forecasts and now we talk regularly with CPC and IRI about the updates of the forecasts and not just to take them for granted
- We have been sued by everybody
 - Example: The Lake has a lot of objectives; too much intake makes the upstream suffer and so the river management will sue us because we have made a bad decision, this is why they want a cookbook so that we can always be clear in our intentions.
- Question: How much flexibility do you have in changing the cookbook? Response: We have to send up the information to the head office for approval,
- Question: How do you deal with the uncertainty? Response: yes that is something that we are still dealing with and the community has pointed that out to us numerous times and we have to figure out how to deal with that issue
- The ENSO projections have been very useful for us, those shorter-term projections have been useful and the AMO projections have been useful for us as well

Brett Rosenberg, US Council of Mayors.

It is made up of a number of committees that work on supporting information and make policies that the US conference of Mayors subscribe to. Brett is on the Mayors water council task force, which ensures fiscally and environmentally responsible water services and management. Also to help mayors understand how climate change may affect their water supply and ecosystem

- Mayors are more concerned with the economics behind the water utility especially infrastructure upgrades.
- Major mayoral priorities in regards to water. Among the top 10 that are relevant here:
 - Aging water infrastructure (pipes, plants, etc) this update will cost billions to trillions of dollars, Mayors are now having to look at how much the true cost of water purification will cost.
 - About 40% of the cities that responded, don't have any certainty as to where their water supply will come from 20 years from now. It remains to be seen as to how climate change and forecasting will be helpful or even involved in the decisions surrounding this issue. The federal government has not really provided the federal dollars to the communities to meet the rules and regulations.
- In terms of forecasts, they want a yes or no answer not a probability, however the utilities do use the meteorological information
- The water council meet 3-4 times a year, whether the mayors use the tools we come up with remains to be seen. (USGS and other agencies will come and present information to the mayors)
- For Mayors day-to-day issues take precedence over long-term issues such as climate change so it's important that these task forces must help remind them of these issues.
 - Plus because mayors that aren't there forever it is hard to get them to be proactive now about future possibilities, especially when it involves them being the ones who must increase rates and such
 - The reliability of the models still make a lot of these politicians skeptical
- They want credible reliable information for prediction of extreme weather events
- Greatest concern: A lack of a reliable supply of water, increased storm events and how it will effect the infrastructure, how to plan for these type of these events so that no money is wasted on some massive capital campaign
- Recently established the Mayors Climate Protection Committee. This committee commits their operations to meeting the Kyoto protocols
 - Seattle was the first city to commit to this and most of their power is hydro
- If the private sector can help the city in a just as effective manner but more economically then they are all for it. But there are lots of cases where it doesn't work out so well. (American Water has been able to help water infrastructure be set up in New Orleans)
- Don't want situations where resources are set aside for future major events that do not occur that is a waste of taxpayer dollars.
- Addressing these questions on a general mayoral level is difficult because the cities each have their own unique way of dealing with water resources. Some cities don't have direct control over their own water utility while others are regional some are private, etc.
- Political cover comes better when we have readdressed and refocused the issues
- Much smaller timescale water agencies in Orange country that reported that they were clearing out channels and such in preparation of the ENSO event in 1998

Mike Sale – Oak Ridge National Labs

- They are involved in a lot of FERC
- Energy Water nexus to increase awareness on the importance of water for energy
- The environment is one of the most important component of water supply needs
- Climate impacts both sides of the energy water nexus (as does population and economic growth)
- Ecosystems are also climate driven, affects hydrology, sediments, habitat structure, species assemblages and biodiversity, etc
- FERC are conditioned on an index of unregulated streams. (PG&E Potter Valley Project in California)
- Quantify multi-use performance and find the best alternative
- Scale matters: a set of conclusions is established for a big system and but that doesn't necessarily apply to a smaller system. There is a need to figure out some other way of getting formation into small systems
- Storage matters and figuring out a way to provide adequate storage is necessary. Climate will take a way large chunk of natural storage (snow pack) and the environment and people will have to figure out a way to deal with that.
- Need to have multi-variate forecasts not just precipitation but temperature regimes.
- It takes quite a while to get agencies to adapt to new information and ways of studying a problem
- The council on environmental quality has looked at how NEPA documents have or should use climate information and could be one way to help implement a way to demonstrate the uses of climate information
- Education, especially of mayors and other political entities. This can in turn encourage pressure on organization and agencies. Education of stakeholders as well.
- Report to congress on the energy water nexus
- The FERC process is not really relying on the accurate information that we have but relaying on the old information (old historical data) claiming the new information is still uncertain, while it is clearly inaccurate.
- Issue is differences between observation and predication. If we don't see it we don't truly believe in it occurring
- It's general thought that climate is not being seen in the Southeast, but it is temperature wise causing cooling issues in nuclear plants on the Tennessee river (sometimes the intake water temperature is higher than the water leaving the plant to be cooled)
- New England ISO experienced a maximum load this summer that they thought they wouldn't reach until 2011.
- National Energy Modeling System which is used to forecast energy trends is used to track energy use across the US
- Design criteria for watershed projects which involves state engineers
 - Dam safety issues are a huge concern
- Change in water availability is a huge concern and are we approaching a place where we need to understand the demands we have or will we be still studying this for years to come

Remaining stakeholder session questions:

1. Robin: using the past information is not the best, but nor is using analogous, how do we reconcile that and how do we move forward?
 - Joe: We do have analogous that work well for what we are doing. So it's not an insurmountable variable as long as it is explained well to those who need explaining
 - Jan: The question is will we get to a point where there are no analogous because things will be so drastically different
 - Jayantha: In the planning scenario they might not be willing to use it because of the uncertainty but in operational standpoint then they would be more likely to use these forecasts
2. Helen: Do we see this in the RISAs?
 - Nate: It has taken a long time to have people accept the long term decadal information, which I think is a result of political leadership turnover and ideals. It is also slow to develop; it wasn't until the 1997 El Nino where the work really developed.
 - Gregg: Hartmann and Pagano worked on projects about the use of the forecasts. Events can galvanize consciousness and makes people more interested in looking at the past present and future forecasts
 - Holly: There is a tension between providing a yes or no answer as apposed to educating people on the use of this difficult information
 - The problem is the upper management and policy level where there isn't an understanding of the probabilistic nature and the operational folks need to help them understand that.
 - Climate information is definitely being used better and more often in the US where there are RISAs as opposed to other places and you can actually see the link between the work the RISAs do and how it works up the chain to the decision makers
 - Barbara: it will take a lot of time to build the trust in believing the information that you want people to be using
3. Robin: you have to be there not just when they are making decisions but also when they are not making their decisions and show how you can be helpful at all times and you are able to build a rapport with them so they are more willing to rely on you when it comes time to.
4. Helen: Science is thought to answer questions not to raise questions or problems and people are used to using science to solve a problem or create a way out. Now a day we are having this issue where policy makers are frustrated when the scientists provide options or suggestions with probability attached to it to, instead of actual results or answers that are definite enough to use without any consequences.
5. Pedro: Has California considered the flood management strategy of flooding certain areas upstream to protect downstream?
 - Joe: Yes we have considered that and have talked to upstream people about letting us flood their lands in the event of a flood so that we can protect downstream people. Katrina has really made the city of Sacramento much more aware and afraid of what could happen to them, causing on going discussions on what to do.
6. Helen: What about water allocation similar to the fallow land concept?

- Joe: I think that may be part of it but I think it is still a situation of old school thought of not removing farm land for other uses.
 - Mike: There are a lot of issues that you don't want to deal with at the time of the disaster and bringing up those points is good because it will encourage action.
 - In the SE they actually do this where they compensate the farmers to not use land in case we need to flood it or whether they should not plant because of the drought. They also have done this in China for a number of years so as to protect downstream communities
 - Mike: Is compensation based on the forecast or other methods?
 - Yes it is based on the forecast, but in the past few years the forecast has not been so good which has caused the state to pay a lot of money for something they didn't really need. (This is a way to determine the value of the forecast)
 - Mike Sale: This is why spring forecasts are very critical because they have to make their forecasts before the planting season.
7. Robin: how do we prepare decision makers for a forecast of opportunity? How do we capitalize on knowing which forecasts are better than others?
 8. Joe: We are trying to communicate these risks effectively so that we are not crying wolf but also if we are right that people know and make the right decisions because it will be a huge problem

General Discussion Take Home Messages from the Group

1. Josh: Working to reap the value of the climate information, those mechanisms increase the use of the information
2. Gregg: There are really 2 sets of decision makers long-term (agencies and boards) and shorter (water managers)
3. Joe: What do you do when you get to events that are off the charts
4. Mike: Need to change rules to make re-operation more efficient and speedy.
5. Denise: Professor who works in water resources. 1. Listen to recommendations to legal reform. 2. Isolating policy decisions as compared to management decisions, reservoir storage is that management decision or a policy decision? 3. Protection of biodiversity has always been at odds with water protection and aquatic ecosystems with respect to climate change
6. Kathy: No real reference to the rate of changes and the change of thresholds events.
7. Pedro: Why so many water users don't use weather and climate information. It should not just be about temperature and precipitation but what happens to the people and the environment surrounding the temperature and precipitation and changes to the downstream events
8. Tom: How do agencies decide what products and what format to produce? Forecasting organizations need to think about how to innovate within themselves.
9. Holly: Really interesting to see how far we have come within the past five years. How do we get to the great majority, what can we do to get at those that aren't the innovator or adopters. What are the tools and mechanisms? Is there a model or approach to spread the word?
10. Andy: What is the institutional risk in different areas and addressing this risk within the other institutions and if we are going to work on this issue we will need to make sure that we are ready to go along with the institutional risk.

11. Brent: People were either talking about large urban systems or agriculture, but no one was talking about small municipalities, and in my area most of the areas are run by small municipalities and these communities don't have the expertise or the ability to use the information
12. Barbara: Surprises (such as Katrina) can change the way we think and deal with situations.
13. Nate: Diversity of potential stakeholders and users of information and how different their needs are for different applications and how this deals with the charge by group one to deal with writing about the products. One thing we don't want to do is have the federal government come out with all of this information and products which will stifle the ability of the private sector to profit
14. Mika Sale: private sector vs. Federal better understanding the tradeoffs
15. Eric: The report that come out need to be understood by policy makers. How do we do that because they are the ones who really set the water policy
16. Kelly: Infrastructure aging. How do we deal with that and we spend an awful amount of time on the inflow side and not on the outflow side. What level of risk are we willing to take and we have not really had the situation where we have had any classic affects of the ENSO events and if we don't have any effects of the ENSO effects and its not following the script so far and because of this we are not able to show how climate information can be used.
17. Jayantha: The lack of interest among the decision makers. In this situation you have to use what they are comfortable in using. We need to find a way to document how good and how beneficial the products are and how it has helped and been used in real life settings.
18. Rebecca: how do we scale projects down and the difference between the Colorado and the California cases

General Issue of overlap

1. Maybe do some case studies for the section II so that we don't overlap with section I and look at it more holistically and in an integrative manner
2. Section II is going to need more together time to sort things out so they will need to have another physical meeting to create a timeline and therefore section III can grasp when it will be able to start working
3. Section I has an outline and a list of questions
 - a. Data, observations and forecast products
 - i. Discussion of data and observations networks (includes climate and hydrologic information)
 - ii. Forecast products (survey of existing climate and hydrologic forecast information)
 - iii. Institutional frameworks
 - iv. Observation and forecast accuracy
4. Water 2025
5. Make sure we make our important points in a professional manner