

2017 Lake Mendocino Forecast-Informed Reservoir Operations (FIRO)

Seaside Forum
Scripps Institution of Oceanography
8610 Kennel Way
La Jolla, CA

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SUMMARY NOTES/ACTION ITEMS

Day One – Afternoon of August 1, 2017

Marty Ralph and Jay Jasperse, Co-Chairs of the FIRO Steering Committee, opened the meeting; Marty welcomed everyone to Scripps, and the fourth annual FIRO workshop. He showed a slide highlighting major accomplishments since formation of the FIRO Steering Committee and pointed out several key milestones, thanking everyone for their contribution to this team effort.

UPDATES

Cary Talbot reported on the Orange County/Prado meeting.

Pat Rutten: NOAA leadership on the east coast are starting to understand AR's and acknowledge climate variability but may not fully grasp how significant ARs are to western weather and the challenges of water management.

Mike Dettinger: Challenge is making information flow to the people who need it. PVA is based on what we know now; FVA is opportunity to make the tools better, including monitoring, modeling, etc.

Alan Haynes: Lots of interest in FIRO, and informal efforts with CNRFC and reservoir operators.

Appreciate formal look at FIRO; need to see how it plays out with storms.

Joe Forbis: Folsom WCM changes are slated to be in place later this year. There is a lot of interest.

Discussion:

Need to hit the ground running with tools if we want to implement FIRO – are they going to be ready?

Need to discuss messaging: Corps currently uses forecasts. Not prescriptive, and doesn't fulfill potential of FIRO to optimize water in the basin to reduce flood and drought risk.

Drought precipitated the FIRO project. Went aggressively down this path. Flood risk wasn't pursued.

Now we need to consider flood mitigation aspects of FIRO more aggressively.

Watershed management is big component, too. California Sustainable Groundwater Management Act (SGMA) will require this. Next generation is conjunctive management and storage below ground.

FIRO helps with environmental demands for water, too. **Need to message FIRO as multi-objective.**

At national level, the focus is on snow storms. Discussion of absence of extreme events. NOAA figuring out how to communicate this.

PVA HIGHLIGHTS, MODELING RESULTS– (Rob Hartman)

Rob showed highlights from the PVA, walking through both HEC and SCWA model methodology and results. HEC model showed that average annual damage for watershed from flooding was the same regardless of forecast used. Showed a range of potential storage with high end over 40%. SCWA/HEC analyses show similar results: excellent potential for water supply storage with no /negligible impacts. (Note: Bound PVA was distributed to all participants at the workshop)

Discussion

WS benefits: It was noted that Lake Mendocino (LM) is recovering lost reliability from changes in PVP operations. This is helping benefit RR salmon.

Economic benefits: Is there a monetary cost in doing FIRO? Labor cost for monitoring, forecasting. Also cost of changing WCM. Still, this is cheap water from water supply perspective.

Should we look at what alternate operations will cost? What about the costs of other ways of getting the same amount of water? (Reservoir raising; new reservoirs; desalination)

Flood benefits must be equal on the table and possible to show FIRO works both ways.

Other: Can help alleviate tensions in future as WS becomes more uncertain.

SCIENCE INFORMING PVA (Marty Ralph, CW3E)

Marty highlighted scientific work that went into the PVA including travel time (important for forecast lead time), forecast performance, where improvements are needed most, and contribution of ARs to precipitation in the RR watershed. Slides showed strong evidence that ARs are key drivers of precipitation in RR watershed.

Room for improvement in forecasting skill; need to pursue in FVA.

Science group workshop held in Boulder at the end of May identified several critical needs for the FVA (Marty showed list of needs generated at the workshop)

Announced AR sessions at AGU; public session on Science to Action.

WY 17 Demonstration Recap: Comparing Virtual FIRO Operations with Actual Operations (Chris Delaney, SCWA)

Chris Delaney presented the results of virtual FIRO ops. Used existing data and conditions to simulate FIRO implementation. Challenge was doing this during such a wet year. Didn't expect to show any additional storage possibility at LM. Ended up about 5,500 acft above observed.

Discussion

The model takes the days/hours above rule curve down more quickly. Is this something that can be quantified?

This seemed to work really well; are still questions/concerns?

Chris: Possible flaws: Releases vary with forecast so there is a lot more variability.
Need to get more robust information into model (only have 25 years, including one large year).
One improvement: This was a daily time-step, when should be done hourly.
The Water Control Manual (WCM) has some wisdom in it; however PVP rules were much different when guide curve was developed.

Day 2 - August 2, 2017

FINAL VIABILITY ASSESSMENT (FVA)

Context Setting

Questions for consideration over the next two days:

How will we know we are done? What are the milestones?

Need to frame the issue for outreach and transferability: Augment and enhance the future of our built infrastructure; not inventing something but bringing information to the table and applying it.

Need to identify a timeframe that we are realistically dealing with. Is it 3-5 days lead-time; 4-6 days? 7-10? It's a risk management question.

FRAMEWORK FOR THE FVA (Jay Jasperse, SCWA)

An outline for the FVA scope includes the following main topics with a workgroup formed on each:

- Decision support tool development (needed to operationalize FIRO)
- Interim operations (Work with Corps to determine how we can use these tools to make interim changes that will help inform long-term changes)
- Modeling/data
- Technical studies (e.g., ramping rates, Hopland flood elevation)
- Science
- Outreach

Discussion

Why are we calling this a viability assessment? Aren't we beyond assessing? When do we implement?

Reply: PVA is a proof of concept. Deviations are pilot studies that we try and tweak. Then make changes to manual; then continue to develop and improve.

Perhaps the FVA needs to be renamed to reflect that the project is being implemented.

Why call it FVA? Sensitivities with Corps on title of PVA/FVA. Need to keep this in mind.

Hopes that by the end of the FVA, we are clear and specific about how we want things to work.

INTERIM OPERATIONS WORKGROUP UPDATE (Joe Forbis, USCACE)

Joe Forbis reviewed WCM policy and deviations, including emergency, unplanned, planned (major or minor). Lake Mendocino is a planned deviation (major). Described the packet of information that is needed for deviation. Internal/external coordination needed. What does this look like? Provided an example: Success Dam (Tule River Association). NEPA documentation can be the hold up in deviations requests. In Success Dam case, it took about three months for request to go through process and approval. From time of official request to approval was about 75 days. This is very quick, and should be our goal. Note that **it's important to include Corps approved models.**

Discussion

NEPA questions: Environmental Assessment versus Environmental Impact Statement is only way to keep it within the timeframe. Maybe the first year you keep the request scaled back so can do EA. Does the drought timing affect the request? Mentioning drought is important part of story.

DECISION SUPPORT SKILLS WORKING GROUP UPDATE (Rob Hartman)

We have a basket to house the ideas/science. What is put in the basket is up to us and we make changes depending on information. Rob provided a list of issues with each model and what needs to be addressed. He noted that DSS interface needs to be created.

Discussion:

What is actually necessary to do for the FVA and what would be nice to have, but not essential. Need to make that cut in the scoping process.

SCIENCE WORKGROUP UPDATE (Marty Ralph and Cary Talbot)

Marty Ralph and Cary Talbot reported on Boulder meeting. The meeting included discussions of observations through AR recon campaigns; AR precipitations impact; streamflow and AR hydrologic response; soil moisture. The question was asked of operations folks “what will contribute to goals of the FIRO project and how can we best coordinate to bring the pieces together for the FVA?”

Discussion:

Need to do outreach: Ensure that potential critics of the project’s recommendation are involved so that their concerns/criticism can be alleviated or managed. Are the critics internal or external? Both.

Transferability: Cary talked about improving modeling; improving critically needed data from monitoring (those with greatest impact) – **modeling group needs to let Science group know what they need (likewise for interim ops and technical studies)**

CHARGE TO BREAK-OUT GROUPS (Arleen O’Donnell and Rob Hartman)

EXAMPLE OF BREAKOUT GROUP MATRIX USE: TECHNICAL STUDIES

| Issue/Task | Who | Funding | Timing |
|---|--|---|--|
| 8,000 cfs at Hopland What: H&H study | NWS, HEC, SCWA, Mendocino flood district | SCWA has partial funding budgeted, ERDC | Water year 19 |
| Ramping Rate Criteria Need to show dewatering doesn’t have an impact: Stage vs discharge; should be same for rising/falling? Others? | NMFS region (two people); but need some hydro-modeling horsepower (HEC); Corps operations; SCWA (fisheries). Working group chaired by Josh | Internal | Water year 19 (understand ramping rates and where choke points are; if we can ID low-hanging fruits, would be helpful) |
| Resolve CVD Outflow Measurement Issues (when outflow exceeds 1,000 cfs. outflows are underestimated) | Corps (SPK and SPD) | Internal | When have enough water to release to test it (may need some permissions and weather). Have plan in place to mobilize. WY |

| | | | |
|--|--|---|-------------|
| | | | 2019 |
| Enhancing FIRO flood protection. CV flood protection turned up volume on hydrographs. See if current rule curve breaks before FIRO curve breaks. How to create synthetic event that is realistic? | HEC, CW3E, CNRFC, ERDC, DWR (Hartman will lead), USACE, ESRL | Need to have a budget/plan/scoping study so can look for funding, by end of 2017. | End of 2017 |
| | | | |

BREAK-OUT GROUP REPORTS

Each breakout group reported back on the group's FVA scoping exercise.

DISCUSSION

- Science includes lots of information. Are there priorities? Seems like it will be difficult to get all this done.
- **Need a focused outreach program at HQ and division level starting with briefings.** This interaction could help lay out the interim ops approach. Need to relay that this effort is headed towards request for change to WCM (via 3-5 year major deviation requests).
- **Overlap: Needs to be strong relationship between outreach and interim operations so there aren't surprises. Generally we need work groups to coordinate.**
- Discussion about **how science will get into operations. Need two people from science group to participate in interim operations group** in order to bring back what's needed soon.
- How are we going to use advances in science to help operations? There is \$ for transferring science into useable technology.
- **Discussion about the CNRFC forecast that Corps must use. So, how to improve CNRFC if it's the only option? Test bed parallel process. Research will still happen, so need to share with ops folks so it's useful. Sharing what is learned/used. Need to figure out how to operationalize science.** Need research to extend time period.

Day Three - August 3, 2017

Prado Reservoir (Adam Hutchinson, Orange County Water District)

- Aquifer is 75% of water for OC
- 50 TAF/year from storm water
- \$1000 for imported water vs. storm water
- Prado was built after OCWD was formed so water conversation was always part of it
- 1969 – 490 ft (flood and on-flood season)
- 1990 – 494 (flood season Non-flood season)
- 1993 – 494 (flood season)
- 505 ft year around about \$6million per/year 6000AF/year
- Flood season (October-Feb). 505 – only about 10%

Largest Riparian forest in southern CA

Area of shallow ground water

Corps raised the elevation of dam – but not spillway, still need to buy land

Need to get a 5-year deviation – get bridge to get final feasibility study

Feb 17-18 – Corps had to prerelease - ended up 900 acft short – can let it go up above line

OCWD uses forecasts from CNRFC

Only have one event to calibrate a CWMS model

OCPW – during Feb 17-18, had started a project to dredge the channel, equipment in the way – called to ask not to release – airport asking to release

USACE – improving flood capacity of the river channel, improving reach right below Prado, have a release rate 30,000 cfs – max has been 10,000 cfs –too fast causes sediment to change

Currently can only release max 5,000 cfs because of a project downstream

U.S. Bureau of Reclamation FIRO Projects Update (Ethan Rutledge and Ken Nowak, USBR)

Ken Nowak – better forecasts help ramping rate and ability to capture more water and not remove rubber dams

Next Sept 2018 – Reservoir operation guidance and FIRO transferability – Develop an internal request for 5 further studies with FIRO

USBR is opening a funding option to analysis the economic benefits of FIRO

USBR reservoir operation conference in October 24-26 – Denver

Bureau of Reclamation is sponsoring a challenge (see challenge.gov) to look for innovative and accurate forecasting approaches. Teams are scored for each event based on criteria. Cash prize for winner.

Forecasting effort happens every two weeks for S2S – crowd sourcing method to find new approaches.

Past competition

www.usbr.gov/research/challenges/past/index.html

www.usbr.gov/research/challenges/upcoming/index.html

Challenges started 2 years ago – nothing specifically been implemented out of the challenges – trying to figure out how to advance technology and getting insights from sectors that might otherwise be overlooked.

Exploring the Flood Reduction Potential of FIRO (Joseph Forbis, USACE)

Sacramento has 45 reservoirs and 33 water control manuals.

22 WCMs are over 35 years old

Forecasted snowmelt reservoir – 21 use them

Forecasted inflow to determine flood release – 7 reservoirs use them

“Current event” – not clear what is referred to as a current event

Don Pedro – very active, produce forecasting operation – started releasing water prior to February – released an additional 80,000 AF in conservation pool

USACE circulating back with partners to learn how data worked

Don Pedro used 15-day precipitation forecast in Jan and Feb – forecasted to exceed total annual precipitation

There is a new water control manual at Folsom

How does Sacramento determine release schedule?

Folsom has shown flood benefits and water conservation pools – using 1-3-5 day inflow forecasted volume – use most conservative – using 75% non-exceedence volume, not deterministic

Use Folsom for types of things that have been evaluated – what are the efficiencies in using other methods such as structural limitation, downstream flood system limitations, forecast reliability limitations?

Which ones look like the easiest for FIRO application:

- Easy: Black Butte Dam – no significant local flow downstream and can release channel capacity at 8%
- Med: New Bullards Bar: lot of down stream flow, only 2 days to evacuate entire flood space
- Hard: Isabella Dam – structural integrity of the dam needs to be improve and takes 44 days to evacuate

USACE does not necessarily have the staff to look at the information or do deeper analysis of FIRO transferability– need to ask for additional information of partners – but Sacramento District can provide operational context.

Briefing from U.S. Army Corps (Cary Talbot, USACE-ERDC)

1. Two opportunities – core has several different national committees that meet on an annual basis to discuss issues – meeting is in two weeks and are meeting at Ukiah: taking tour of dam – 1 representative from each core divisions – gauge interest
2. Engagement with water operations community on divisional or district level. Interest in PNW for flood risk management – get ahead of large storms and snow melt dominated systems – chance to get to see attitude

FIRO is an operating concept across many different agencies – USBR/USACE etc.

Open Conversation

If enough benefits from collaborators, the federal government will not necessarily be able to fund it. USACE will likely need more collaboration going forward.

Transferability – does the AR forecasting capability identify easier areas to forecast?

Is the skill of the forecast of extreme events better in some area than others?

For FIRO transferability, look at FIRO combined with conjunctive use, possibly with modest infrastructure changes for broader applicability

Jasperse: FIRO is one water management tool – among portfolio of water management strategies – recipe for it is local – provide the tool then need to determine what is needed to make it work. Leverage existing information.

Rutten: Need tangible outcome, need to start to implement with some results to show.

Ralph: **Suggested Informational oriented meeting – share what we've learned with larger water community – share process, what we are doing etc. to socialize FIRO and get input on transferability.**

Meeting: DWR, ACWA

Should present: How to best use the forecast information in particular with transferability, methodologies, and what approaches best work at the operator level

Water operations have not been well served by the scientific community, we can bridge that gap.

Cary: Lesson learned and what has already happen. Plants idea of what different districts can be doing. Better management approach. Best opportunity is that FIRO is about infrastructure and making the infrastructure work better.

Next 2018 FIRO workshop – More on how to operationalize FIRO and how it will be helpful to the operators. Need to address the transferability of science to operations.

How to turn FIRO into a proving ground. How much does FIRO have to be formalized to codify the proving ground point. NOAA has done little to get to the core because it was premature. Where are we are we on that?

CNRFC ensemble path – RFC is a nexus of information. Broader place where there is a direct channel from the RFC – a place where operators can look elsewhere.

Need some pull, not just push for the science. What pops out of the RFC is not necessarily useful for risk management. How does FIRO enable that? Not strictly a question of inflows. Water quality outcomes/fisheries etc. Official channel and other channels and how to work between them so they are better informed and have better outcomes.

Snow melt: Three potential data sets to use (CNRFC, DWR, NASA) – need three different forecasts – or is it easier to just include in the existing forecasts. IS there a way to combine them? Is there a way to make it the best it can be? What is the best way to get it the best information? Where is the liability of the information?

CNRF – are taking the snow survey data (manual obs and pillows) to adjust what that means for the model.

Temperature forecasting for power generators improvement. Using the various different information as an ensemble.

FIRO is a continuum. A lot of the operations are already using FIRO, and how is it being used. An operator did not know what was going into the forecast. Very fundamental transfer of knowledge feeds about the forecasts.

We made a lot of progress because we focused specifically on Mendocino – need to keep the local focus.

NOTES FROM BREAK OUT GROUPS

Interim Ops and Decision Support Tools Breakout Meeting-FIRO Workshop Aug 2, 2017

- Deviation Strategy
 - Rationale for major deviation
 - Parallel minor deviation request
 - This will be as failsafe plan if major isn't feasible or
- Cuong Ly (USACE): SPD restricts that maximum length of deviation is 3 consecutive years
 - If you need a longer deviation you should be working on a long-term change to the WCM
 - For a minor deviation, the engineers (Ly) can approve deviation without higher-ups
 - For a major deviation, approval is needed from many more folks (legal team, etc.); major deviation affects everybody
 - Minor deviations are likely to be approved for more than 3 years running, however major deviations are more likely to be shut down
- Jay Jasperse (SCWA)...can we communicate that our process for deviations are in route to a major change in the WCM?
 - Ly...perhaps, it may take a more direct route of communicating the overall plans
 - Jasperse...perhaps a trip in person to convince them?
- If the Commander is on board, it will likely make things much easier
- Takeaway...we need to review the existing policy and understand it much better
- Recurring deviation-definition...it doesn't say THOU SHALT NOT...it says need to get permission

- Need to check with all different headquarters
- Ly: Prado deviation, they had a minor deviation submitted and saw the forecast was dry ; minor deviations are more durable
- Success asked for a Major deviation, but they only needed a Minor deviation
- Question to Ly...are minors not counted until a major is submitted?
 - They are counted, but it is by folks like Ly who can be more flexible
- **Takeaway: talk to folks at the division level about how certain policies are enforced**
- Question to Ly: need to say, we have a feasibility study in progress, but in the process, we have had a few deviations, which may buy us time to get to project of completion...can the major deviation be for 5 years and count as a single deviation?
- Allow flexibility in the plan, to tweak along the way
- Rob Hartman (RKH): maybe we need to work with Corps Headquarters, explain the path we are on and we need to be on same page to move forward. It is a long process to change the WCM...multiyear deviation sounds like a nightmare. Need to Corps headquarters and division levels with a consistent message.
- WCM and deviations all approved at the Division level (SPD) not back to headquarters, but Division gives background and passes along information on the plan. But HQ doesn't necessary need to approve.
- Jasperse: but HQ will be involved
- HQ, Division, District will all need to be worked with
- Need to consider legal components, environmental components...
- McPherson: for transferability, will it always be this process?
 - Ly: it is very well likely Case by Case...show viability. But likely the same type of iterative process
 - McPherson...is there a way to adapt corps policy to adapt to accommodating these types of Water Management technique projects?
- Jasperse...nuance here, we are using the deviations here as part of the WCM changing process
 - Ly: you will probably get what you want, but it is more complicated than you think. Process will take much longer than 77 days in all likelihood
 - We are in new territory...this isn't really what deviations are meant for
- Hartman...are folks interested in advocating for changing in corps policy for projects like this?
- People understands feasibility study but legal Ops policy review is necessary. Major deviation could be longer and tedious
- Nick Malasavage (USACE)...is it more important to communicate Exit Ramps? Buttons that you push to get you back into safe zone where folks are comfortable. Strategy for the pitch!

- Ly...deviation is just an APPROVAL for a deviation. But the actual operators are going to be in charge of operating according to deviation or the old WCM.
- Process of getting the WCM changed? What happens in the interim of getting WCM changed?
 - Ly...deviation seems okay here, it shows you are operating on 'Good Faith' to do the right thing and change it permanently.
- Interim WCM is a USACE thing. Could be the right tool for time period in between FIRO and final WCM
 - Can be approved in a year timeframe
- Prado had Interim WCM while dam was under construction and shortly after, but it doesn't need
 - WCM and WCP (water control plan) are different. Plan is articulated in the WCM. But NEPA, description are included in the WCM. Changing WCP has been done without changing entire WCM
- Greg Kukas (USACE)...5-10 years sounds like too long in-between FIRO and WCM change. Unless we do something wrong, external problem.
- During the waiting process: set up plan/interim/structure in place; do necessary activities on updating the WCM.
- Ly...deviations do not go through the entire review process, Interim WCM has a lengthier more intense review process
- Hartman...should we be targeting Interim WCM?
 - Ly advises against...this is a more intense effort
 - Deviation process is time-limited, but it doesn't go through the same review process
- Ly...during the 2nd year or so of the deviation, you should start building the structure to have in place for the WCM change
- Hartman...team needs to be focused on changes to WCM right away
- Jasperse...we need to be looking at this multiyear deviation
 - Should we be requesting something bigger than we had in mind for this year? With all exit ramps etc included, where the ops scheme is still within the operation comfort zone of the Corps
 - Still trying to find out what the comfort level ceiling is...not convinced it isn't 15,000AF, not just 10,000AF.
 - Malasavage...it is the change in storage available vs the likelihood of event that freaks people out...maybe different ceilings for different months, 5,000AF JAN 10,000AF FEB, 15,000AF MAR?
 - Jasperse...having some capacity in earlier year is important for the DRY SPRING years. It is a delicate balance
- Ly...something about Chapter 24 Exemption?

- Goal is to avoid that
- Strategy for when to contact Dam Safety...maybe once there is a larger consensus and buy in Ops and Managers first
- No current way around to exemption Ch24
- Changes in 8,000cfs Hopland and 100cfs CVD thresholds will allow more rapid changes to be made in Mendocino reservoir.
- What are the implications of needing more dump time to account for increased storage capacity?
 - Potential flood impacts
- Sam Sandoval...how many hours are we gaining ahead of time using forecast?
 - Malasavage...the pitch is what gets people on board or uncomfortable
 - Sandoval...different exit ramps for different storage levels
- Delaney...when do you anticipate needing exit ramps?
 - Not going to be a clear cut answer, probably in flood watch conditions
 - If we get a scare 48hrs out, we are only 24hrs away from old rule curve, so we are good!
 - What to do in different situations to show that we understand how all the pieces fit together in terms of how operations change risk, and which protocols are in place to mitigate those risks→net effect is zero
- Do we want to delegate?
 - Jasperse...subcommittees need to be formed, what do we want to ask for, how are we going to relay our rationale for what and how we want to do, exit ramps...
- Deviation is an operational accommodation, not a R&D tool

Decisions Support!

- Janice...our CWMS model already does this (figure 6 layout)
 - But it doesn't have SCWA model
 - From the approval folks comfort level, they don't want outside agencies model to be used to make flood control decisions when it is their responsibility to do so
 - Ford Question...who runs this on a day to day basis?
 - Answer...Patrick Sing (USACE)
 - Ultimate responsibility is with SPN, this system needs to be a tool for operators, but it can't just be SCWA model out, for perception issues
- Hybrid was going to be the proposed model, and how you operate in the space is determined by how ensemble performs using SCWA model

- Let's lean on the comforts of the USACE systems (CWMS), but add in the SCWA model to the picture...recall that this isn't some drastic new change to the system, the hybrid operation is drastically similar to operations at this time.
- What does the DST look like?
 - It needs to objectively inform Patrick on how to make the informed decision...
 - What does the interface look like? What does the web interface look like? What is the workflow for coordinating?
 - Delaney: our work is done once we develop the DST, SCWA isn't the authority nor has the liability to be in charge of flood releases
 - David Ford: SCWA never makes decision to release water...only help develop tools
- Hartman...Is it acceptable if SCWA model is adapted to CWMS and incorporated, would Corp be OK?
 - McPherson...the people doing the job have the largest voice in what tools they use
 - Patrick will need to be fully aware of what the model informs him of, and why...needs to see risks, ensembles, cross-test?
 - Who will be in charge of creating interfaces etc that Patrick will need to operate
- The model scripts can be distributed on webpage.
- Can output get posted on website and someone can get it and input into CWMS? Ly...concern I have is that Patrick gets all information and has to make the decision on operations...who is he working with, confirming with, checking with to finalize decision
 - Hartman...do we need to open up pathway/context to have a common set of information for multiple people to look at
- Part of the task is to initiate the work to make all of this happen (create interface etc. (deliver the right information to the operator)
- If there is not a good DSS, need a lot of information to make judgement.
- Jasperse closing notes...
 - DSS modeling group meeting Aug 14
 - What specifics need to be done to create a decision making environment in CWMS for the operator, e.g., 3-yr vs. hybrid PVA now
 - Ops water agency group meeting Aug 17
 - Bring NEPA in, and articulate what we need to do, are we providing enough information for what they need to do? How to create the information?
 - Good time to discuss exit ramps

Modeling DSS group, what can we get done for the first DSS request...doesn't need to be final product

Opening remarks:

Mike Dettinger: Helping to describe/detail simulate forecast skills in a more scientifically informed way than we have done to date. Can we take the things we've learned about forecast skills and modify the ensemble outcomes to see what we learn? We need to describe how the forecast for a big event looks— More than just forecast skill metrics; it's evaluating and replicating the methods. They need a mechanism for evaluating reliability of the forecast. We also need to figure out how these improvements in forecast impact reservoir operation. Other comments on this topic:

-May not be good enough to provide five days with an error bar; we need to provide ensembles with a range of options. The error bars are in essence “misleading” for someone that doesn't know the range of possibilities within those error bars. We do know some synoptic characteristics that we can communicate to the engineers better.

-We should leverage the large-scale synoptic characteristics more than we have. Our synoptic characteristics are more reliable both in forecasts and initial conditions.

- The challenge is “will it hit this basin at this magnitude?” We need to do “an event will hit this basin, above this threshold”; we need a cost function that defines this metric. We need a probability of exceedance method.

-Being able to say “here is the official ensemble, but maybe this ensemble more accurately expresses the probability” – conditional ensembles could be a good idea. Can we pull out certain cases based on the current storm system, then rerun our models?

-We need to make it easier to play some of these ensemble games in which we have conditions that we can explore the space of possible water outcomes.

OVERALL POINT: How do we take forecasts and implement them in decision making? What can we provide the operational folks?

CHALLENGES: uncertainty of forecast, reliability of forecast, and lead-time of forecast required for operators.

RE: Lead-time, in the hybrid model, there is currently zero tolerance up to day six, and this is why the uncertainty in the forecast model is very high. How do we communicate the importance of 1 ensemble member being above the threshold to the water managers? We need to show them the historical information based on these ensembles, i.e., hindcast these events and show the reliability of each ensemble model.

Major focus areas for FVA:

Improve AR forecast skill-

Aneesh: How much will the hydro model use actual AR forecasts vs. precipitation?

- It's all precipitation. All of this atmospheric modeling is just the boundary conditions.

- The ARs are important because it tells us which events to simulate.
- The key meteorological features that ARs have are the important parts to understand. Mesoscale frontal waves (MFWs) for example, might be critical features that we need to better understand and represent. Andy Martin is currently looking into this, specifically using the GFS comparisons to pinpoint where the issues are with MFWs in the models. What physics have to be added to fully represent these problems? Does a new model construct need to be invented in order to more accurately represent this phenomenon? Both ESRL and Scripps will do the analysis of representation of MFWs in the model.

Additionally, models have trouble with orographic precipitation. How can we address this issue?

2nd topic in this category:

We need to develop AR centric forecast skill metrics. This is just a good idea to communicate the science across communities, and to characterize events.

- Tracking landfall position error.
- Orientation, duration, intensity, precipitation efficiency errors, and vertical structure.

Improve observation-monitoring capacity-

Is there effort to use models to assess locations for data gathering devices? How do we maximize our information in terms of driving the model and can we put instrumentation in “optimal” locations as determined from the model?

What observations are needed right now depend on what hydrological model is being assessed. Which is sort of a problem that we can explore. Part of the reason for running multiple resolutions can help inform this problem. These are important questions to know in terms of pushing the needle with FIRO.

Marty: The model utilized matters in terms of what observations are needed. We need to explore this space, maybe we can inform NOAA or the national water model in this realm through FIRO.

Soil moisture assimilation testing. We can learn by an inter-comparison of models.

Develop distributed watershed hydrological model for potential long-term implementation of decision support tool:

What is the history/background? – FIRO is providing us an opportunity to test this distributed system. How much of an advantage does a distributed model bring from a FIRO advantage? We can test this. GSSHA links this availability. GSSHA also adds water quality information through linking with a nutrient sub-model. RFC forecast don't provide water quality and also don't provide whether the uncertainty is from initial soil moisture levels or from magnitude of precipitation. In the next version of GSSHA they will include reservoir operation rules.

The purpose of the different models in the Russian river watershed is to decide what sort of resolution/etc. need to be considered within the models. Can we be more spatially course? That would be the first step. Right now we are calibrating the models (done by end of September). We will be expanding this to the entire valley. We have several calibration periods from 1988-now, also new great

data is coming in from CW3E; this data needs to be included. MAIN POINT: The empirical models have a good track record, but how much more accurate could a distributed model be?

We touched on the importance of the natural geochemistry of the area. CW3E will be gathering data from for the watershed and streams. CW3E will be checking the chemistry of surface vs. groundwater vs. precipitation to understand contribution of groundwater vs. surface runoff. Potter valley watershed has shallow groundwater, leading to a potential run off efficiency of up to 70%.

We should be communicating with Flints about the groundwater in Lake Mendocino area.

Is NOAA going to be running West-WRF operationally? If not, then are we going down a path in which NOAA can't run and we can't make happen operationally?

-We can't just "use whatever model we want", either we have to approach NOAA's weather service and tell them this is where we are headed, and make sure that we can eventually integrate with them.

- There is a difference between moving forward with science and moving forward with the operations. The point is stressed that the sciences needs to be compatible with operation.

- Marty: the FIRO effort has a dual effort, implementation and assessment. We have until now been only assessment, we are doing well so now we can implement maybe. We need to be able to push the science regardless of how we can implement. This is a major issue though. We can't shut down other avenues of effort; we need to find the breakthroughs. Tools emerge from the breakthroughs; we have headspace to work on the science. We are focusing on the western USA; NOAA's models are nationwide. We might lose some regional skill if we adapt to that system.

-What are the additional things that are good contexts for the model?

- If we want to do this well, we will need these supporting tools.

Brian Henn: distinguishing differences in stream-flow forecast error sources e.g. land surface vs. atmosphere. Can we put "deep ground water's" role as an important aspect?

Flood potential of FIRO (also listed under technical studies)

Watershed characterization leads to flood response. Can we identify when the basin is primed? Are there model states that lead us into a flood prone condition, or a different decision space? We would like to build a conditional risk structure, and work with operators.

Formalizing the storm flow vs. efficiency effort. How well do models represent the run off efficiency in ARs? E.G. moderate strength AR with wet soil vs. strong AR with dry soil.

How good are we are forecasting sequences of ARs & inter event timing?

Travel time between stations and the uncertainty with that. It is important to get phase speed of flood wave, not the water travel time that we need. We need use of realistic scenarios and understand slow flow river moments, and how that affects our total understanding of release control.

ASIDE FROM THE SCIENCE GROUP MEETING:

Let's figure out a link between the science team and the applications team

Marty- we have these meetings once a year, and we talk about a range of topics. We pulled off a science workshop, for cross coordinate, we need more people time together. We need a 4-5 day meeting where we have a day to dig in deep on particular topics. Look at AR orientation in terms of forecast errors. We can't think of a study, which looks at this on a S2S timescale. People currently looking at this: Sasha Gershunov, Alan White, and Gary.

Outreach and Communication Breakout Meeting-FIRO Workshop Aug 2, 2017

PVA needs to go up on the FIRO website; need to be able to have 'cite-able' reference document – Sam Sandoval

How to share PVA – internally - Steering committee tells us who should receive it and who should send it
 Shirley send to legislative leaders and officials

Press release that goes out to politicos

Press Democrat – general, water blog (Lund)

Deviation – piloting it, experimenting, caution with using deviation

| Task | Role(s) | Funding | Timing | Notes | |
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| Slides | Who: Ann DuBay What: Incorporate findings (from Chris and Rob's slide deck) | | September | | |
| FAQ | Who: Arleen and circulate to SC | | September | | |
| Logo | Who: Mike D., Cary, SC | | October | | |
| One pager | Who: Ann Reviewed by SC | SCWA | September (DONE) | | |
| Identify outreach opportunities to leverage work efforts for a larger audience | "Study Sessions for the board" | | | | |