



“Right now I think the wisest strategy is to diversify among your mattresses.”

- Two Very Different Discussions
 - One mostly focused on questions of “what”
 - What can we do to assist decision makers?
 - Answer: need Donald Rumsfeld to rescue us
 - Knowns, Knowable Unknowns, Unknowable Unknowns
 - One mostly focused on the question of “how”
 - How do we do we provide better information?
 - Answer: some kind of ‘connector’ organization
- I’ve combined into one set of slides

Purpose of the Workshop from Website

1. Match questions being asked by decision-makers with answers that can currently be supplied by available modeling tools;
2. Identify/define questions being asked by decision-makers that cannot be answered by currently available modeling tools;
3. Take a first step toward identifying gaps that might be closed by (improvement in/development of additional) high resolution models; and
4. Identify alternative strategies might be needed to supplement decision support needs across different timescales.

First Group added this to the mix:

0. What climate related decisions do decision-makers face? What data drives these decisions?

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- **Long term capital decisions**
 - Conveyance, storage, desal, etc
 - May be tied to changes in extremes
 - When do we cross a threshold that requires structural solution?
- **Changes to Operations**
 - Some effected quickly (e.g. no outdoor watering) , some slowly (reservoir ops with legal impediments)
 - ‘Uncontrolled Spill’ like a crime these days
 - Changes in means may apply to these changes...
- **Changes in User Practices and Behavior**
 - Conservation
 - Also see Feedback Loop in Social Change
- **Changes in Water Portfolio**
 - Conjunctive Use, Institutional Coordination, Banking, Sharing, etc...
- **Possible Feedback Loop: climate caused social change could impact economy, thus impact all of the above.**
 - E.g. Let’s tear down a dam
- **Uncertainty: is it real, or an artifact of models?**
- **Knowns and Unknowns – can we categorize as:**
 - Knowns, Unknowable Unknowns, Knowable Unknowns
- **Timeframe of Decisions**
 - 30 to 40 years but lead time plus life of investments can mean these are 175 Year Decisions
- **Need collaborative process with scientists and water managers**
 - No need for water managers to pursue modeling independently
 - Scientists and water managers are thinking about the same things.
- **Observations are a disaster...**
 - Can’t calibrate or verify models with bad observations

1. Match questions being asked by decision-makers with answers that can currently be supplied by available modeling tools;

- Don't care how much warmer; do care how much a buffer we have...
 - Buffer includes anything and everything we can think of...
- Engineers need temp, precip, runoff, demand response at suitable time/space scales
- Thresholds
 - Should modelers provide probabilities for questions asked by managers, or should modelers provide the best projection,
 - First is easier to do by modelers, second may be more useful
 - Engineers want a clear outcome from models
- Temperatures
 - We know it will be 2C warmer, just don't know exactly when. Is this actionable? Can this help us with snow related questions?
- Sea Level
 - Similarly, sea level rise of 2 feet is a given, just don't know exactly when.
- Intensification
 - All models predict some form of this, but our ability to quantify is limited.

2. Identify/define questions being asked by decision-makers that cannot be answered by currently available modeling tools;

- **Vulnerability**
 - Consequences * Probability is understood
 - We know the consequences, but not the probabilities
 - Engineers design for failure, but DM's won't tell public this
- **Robustness of PDFs**
 - Current EIS questions – people are making answers up in response to a need
 - Fake a PDF for Decision Makers – Don't Ask – Don't Tell
 - Tacit Understanding Between Engineers and Decision Makers
 - Lots of PDFs available, just don't know how much to trust
 - Climate Modeler: "We still don't have robust PDFs. I hope decision makers are not using these PDFS!"
 - DM's don't want Probabilities, they want Possibilities – Mulroy
 - DM's can wilfully ignore lesser probabilities if they imply politically tough decisions
 - DMs need to game out future with possibilities
- **Absence of 'Risk Tolerance' Analysis**
 - What is the risk sensitivity of utilities?
- **Ability of current models to adequately describe new natural variability**
- **Precip Questions**
 - Do difficult science questions get put off in favor of doing new science? e.g. convective precipitation
- **'Upscaling' idea**
 - Could we use general model tendencies (e.g. CA's mediterranean climate changes to arid desert) to our benefit?
- **Floods**
 - No Way to get 3-hour precip from GCMs.
 - Climate Science is a miserable failure on timescale of hours to days. Flood events very much the key to re-operations and yet this is a huge gap.
 - May be helped by increased resolution

3. Take a first step toward identifying gaps that might be closed by (improvement in/development of additional) high resolution models.

- What do higher res models get us?
 - Weather models have always improved with increased resolution
 - High Elevation Areas are a big target with big potential gains
 - Flat areas not as promising
 - We get better depiction of extremes
 - Any chance to mix high/low resolution in models?
 - High Resolution is the easiest thing to fix right now compared to other problems
- Apparent failures from higher resolution efforts
 - Newer high res models are not as well developed as older, lower res
 - Correct parameterizations are difficult, but not best use of scientist time
- What would we do differently with higher resolution?
- Sensitivity Analyses with Historical Data Might be just as useful as higher resolution model output
 - Could be more confident with results

4. Identify alternative strategies might be needed to supplement decision support needs across different timescales.
- Need better connector/boundary organizations
 - Possibly RISA-like, possibly IRI-like
 - No RISA is perfect right now
 - Can't be monolithic
 - 'Nobody wants someone else telling them what their vulnerability is.'
 - Must be intelligent interface
 - How do we help smaller utilities in the West?
 - “The big elephant for water managers is to what degree should water managers be concerned that current science questions are not relevant to water management?”
 - Need to commission water management science?
 - Answer: No need for Water Managers to pursue climate modeling science independently – same questions are being asked by both groups

Closing Thoughts

- Is old model of risk (water provider bears/hides risk from everyone else) too expensive and too stupid for the 21st century?
 - Speaking of False Certainty, we already have it...
 - R. I. P. 'Firm Yield' Concept
- Can 'insurance' (i.e. sharing risk) increase reliability?
- Can we really afford to insure against biggest potential drops?
 - Isn't this a question for society as a whole?
 - Rethink water use?
- Can we deal with -20% through efficiency in many places?
- Can we move to 'adaptive management' and be more intelligent in investments and operations?

‘You go first’...who’s going to be the fall guy or gal?

