NRC Panel on Social Sciences – Decision Support

Andrea J Ray, NOAA/ESRL
Boulder, CO

Committee on Developing a U.S. Research Agenda to Advance Subseasonal to Seasonal Forecasting

15 March 2015

Earth System Research Laboratory
Science, Service & Stewardship

Negotiating the divide between science & users

Examples:

Seasonal Fire Assessments, led by CLIMAS

WWA RISA work with reservoir/water supply managers and the CBRFC

NIDIS regional pilots; Nat'l Drought Mitig. Center

RISAs, DOI CSCs

NOAA/SARP & related grants

- Based on ongoing engagement, iteration, with different user groups
- From these efforts, we know what some of the major classes of users are, and the major needs ("EOFs")
- We know a lot more about user needs than official products able to serve
- Need for ongoing social science work to refine, especially for less studied and under-served

How much forecast skill is needed? Deterministic vs probabilistic How do users deal with uncertainty

Not all users alike, distinction is who's using and what for

- For S2S, major users are intermediaries who do something with the information to manage the risks for the public
  - often with a preparedness or "ready-set-go" mindset, situational awareness, actions/decisions adjustable thru a season
  - skill needed varies, often changes as they understand the products
- Within NWS: Warning Coord. Mets, River Forecast Centers
- Reservoir and water supply managers, Wildfire managers, Public Land managers (grazing, controlling invasive grasses, etc); agriculture
- Many of these *already work with* a variety of uncertain and often probabilistic information
- Different challenges for different users
  -- skill needed varies, often changes as they understand the products

Conveyed effectively? How they deal with uncertainty

- More than just the map, does the product serve the different ways we know S2S knowledge is used?
- Different types of use:
  - **Consult:** the product is looked up on a web page or received from other source
  - **Consider:** after consulting the product, the information is integrated into management deliberations as a factor potentially influencing decisions, but not used in operational models; Hedging
  - **Incorporate:** the forecast is assimilated into an operational model that is utilized in operational decisions; and
  - **Dialogue about risks:** the forecast is used to communicate with other managers and stakeholders about the risk of certain conditions, the need to take actions, or to justify actions

Ray and Webb 2015, chapter in forthcoming RISA book, Wiley and Sons

How S2S/drought information might be used

- "Conversation" within water management groups and with their stakeholders, and with scientists -- dialogue about risks, e.g. drought/ flood
- Mental models of managers for their systems are important as well as hydrologic and management models
- Relationship of climate information to their triggers & thresholds for action
- As interested in the information *behind* the Drought Monitor as the DM itself, in order to make their own assessments
- Major need for synthesis of research into products & analysis that connect climate impacts to water management impacts:
  - Temperature --> evaporation, rain/snow mix, urban demand, length of growing season
  - Timing of spring runoff --> water rights, reservoir reliability

Other ways to frame the discussion

Broaden the research agenda to include an applications agenda

- Need ongoing engagement, iteration, with different user groups
- Need “convenors” for these engagements
  - Many exist: RISA’s, DOI Climate Science Centers, [LCCs], and through some research groups
- Currently underfunded – often difficult to get funding as “research” for these applied activities
- Applications and applied work often difficult under the rewards structure for academic positions
- Structural issues in the NWS:
  - “National product” focus of CPC, regions are on maps, but little time or resources for additional regional
  - No “S2S climate extension” in WFO’s, some in RISAs & among SCO’s, RCCs, many WFO personel not trained in this time scale

What would Success look like 10 years from now?

- Variety of *official* products that meet major classes of user needs
  - Different levels of detail/complexity, more sophisticated users can drill down
  - Serves the different types of use: not just maps and numbers but discussions, knowledge, e.g forecast of opportunity
  - Consulting companies can build business off these products too
- REGIONAL: beyond a national map, where “regional” is determined by user groups (as we now have aviation forecasts), e.g. for water: river basins; for public lands: “ecoregions,” agriculture: growing zones, focused on major crop areas; counties?
  - Climate divisions often not useful for these
- Temporal resolutions beyond 3-mo: monthly; snow accumulation season
- Network of people who can connect products and knowledge to applications
  - within NWS regions, WFOs, RFCs, other organizations, e.g. *S2S climate extension agents*

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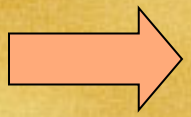
Extras

Who am I now?

- Committed to connecting science to applications to benefit society
  - Dynamical ENSO forecasts to seasonal-interannual in water & natural resources management; hazards/extremes
  - Climate information, climate projections, changes in extremes -> adaptation to climate change
- "Physical Scientist," NOAA Earth Systems Research Lab, Physical Sciences Division, Climate Analysis Branch
  - Environment and society interactions, policy sciences, social science methodologies
  - Uses of climate information in natural resource management, especially public land management
  - Connecting specific research to applications (climate projections, attribution, monsoon)
- Ph.D. Geography, environment & society interactions

Our perspectives as natural scientists vs those informed by social science speaking across the divide

- Information as a commodity
- Externally generated, research-based information [legitimacy]
- Decisions based on efficiency, optimization
- Methodologies for providing model output as the end product to operational management



- Information as a process of negotiation, i.e., what information is needed in a given context, i.e. drought, and for a given sector)
- Information produced within management organizations or agencies or by accustomed source
- Decisions based on acknowledgement of interdependence of organizations & missions
- Dialogue about risks vs. constructing and delivering a risk message; climate- related decision support systems

Reservoir Management Decision Calendar

Water Year Planning → Next Water Year Planning

Provide for late Summer/early Fall irrigation while maintaining target flows

Next water year runoff unknown, reserve water until February snowpack observations

Winter season precipitation forecast for Fall release decisions

Winter releases based on January/February snowpack observations

Winter/Spring forecast for Winter release decisions

Peak Flow Augmentation - fill curve

Summer season forecast for Peak Augmentation planning

Week 2 forecasts for Peak Augmentation

Peak Flow Augmentation releases

Plan releases for Summer irrigation & hydropower

Week 2 forecasts for Summer irrigation & hydropower release decisions

Provide for Summer irrigation & hydropower needs while maintaining target flows

Legend:

- Planning Process
- Operational issues
- Potential use of forecasts

Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun July Aug Sep Oct

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Sectoral context

"Extremes" plays out in many sectors, need context for each

- Water*: reservoir management, flood forecasting, longer term: urban planning/infrastructure, drought
- Agriculture: crop outlooks, planting decisions, crop disease, frost, hail, early/late season events
- Coastal*: storminess, flooding, sea level, wind, trends
- Ecosystems*: marine (NOAA)* & terrestrial (DOI, states)
  - probabilities associated with changes in wet/dry precipitation extremes
  - cascading impacts of changes on marine ecosystems
- Energy, Energy-Water nexus:
  - water demand for urban residences, agricultural and industrial use
- Human Health: heat waves, sequences & disease
- Urban/building infrastructure: heat waves, snow loads,
  - changes in extremes for adaptation planning processes

Regional phenomena

- RISAs point out that there are some key climate features of interest to different regions, include:
  - Southeast and great plains: convective precipitation is a big issue.
  - Southwest, the monsoon leads to extremes, but isn't well represented in the outlooks; infrequent but severe dust storms.
  - Northwest and pacific coast: Pineapple Express/Atmospheric rivers drive flooding.
  - In the mountainous west, early springs or late falls affect snowpack.
  - Southeast and Atlantic coast: Ice storms, heavy winter storms in the east coast
  - Central/SE: tornado outbreaks

Interesting points

"Extremes are of course important, as they link to large impacts, but they fit within the broader operational communication about all magnitudes of climate variability."

"Our biggest unmet requirement is an assessment of skill focused on extremes. Especially useful would be an assessment of CFSv2 skill in forecasting extremes in comparison with other seasonal forecast systems."

"Customers have a strong interest in extremes on the scales of two to four weeks…interested in extremes month by month in the seasonal forecast if they had any confidence of reliability of such forecasts, even in the form of regional probabilities by month"

"Whether climate change will exacerbate these critical effects" including drought, flooding, effects of glacier melt, wildfire-inducing events, [long list from many users]

"Regionally specific features are rarely called out in the seasonal forecast discussion – but people often wonder if shifts in the risk of the terciles indicates something about these features"

Continue CFSv1 long enough to evaluate/intercompare w/v2, modify software [CBRFC], and finish/adapt research and operational projects

Need to develop "ways to analyze, evaluate and effectively communicate information on changing extremes" to users and stakeholders

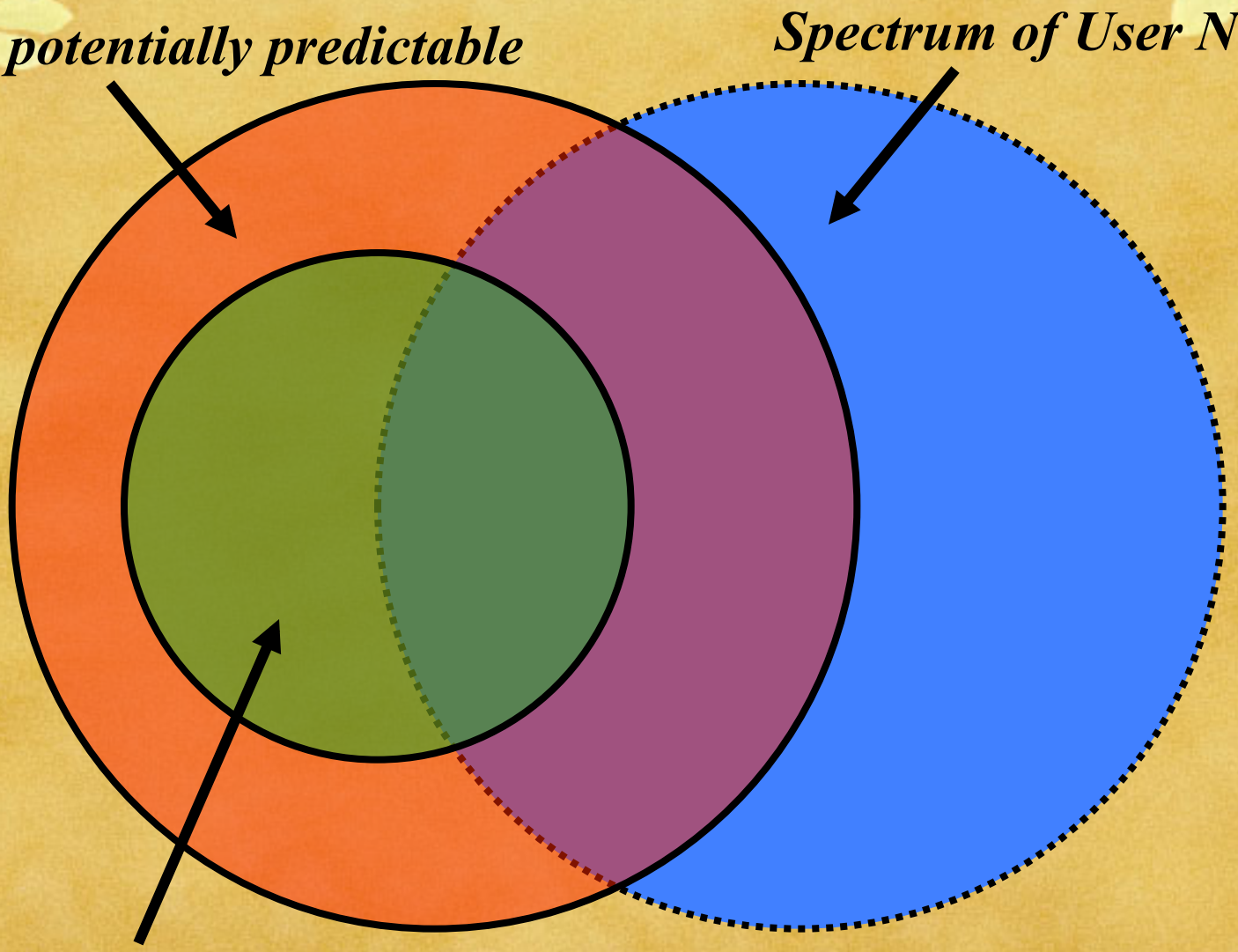
Didn't hear: decadal, 2-5 year -- but know its out there from other sources, important for water and ecosystems

Next steps:
CFSv2 user needs assessment

Near-term:

- Fill out "key informant" representation [next slide, who responded]
  - Other RFCs, OHD, RCCs, NIDIS, other NCEP & NOAA
  - How well-represented are:
    - different types of the private sector
    - university/research community
    - Applied research community - e.g see their role as feeding back to CFS
  - Target questionnaires and phone calls/conversations
- Consult some key references/literature:
  - RISA case studies & ongoing user needs assessments, published and grey lit
  - USGCRP decision report; SREX report, in review
- Upcoming meetings of user communities, WSWC, NIDIS, AMS Summer mtg
  - Participate-observe, collect more questionnaires, focus groups
- Triangulate!

Relationships among current products, potentially predictable, and needed climate information



Regional Climate Services Discussion

Some questions to guide (but not limit) this discussion:

- What key themes or topics have you seen across the meeting?

- What observations do you have to guide development of regional climate services might develop in your region

- How you've heard in this meeting relates to your organization's plans, or the user needs you're identifying. Anything eye-opening? Surprising? Confirming what you're already seeing?

- How do we convert "wants" for information into needs? E.g connecting to uses of information, time-scales of planning/decisions

- What science have you heard about at this meeting that's knowledge you can put to use or that you'd like to see as a product or ongoing service?