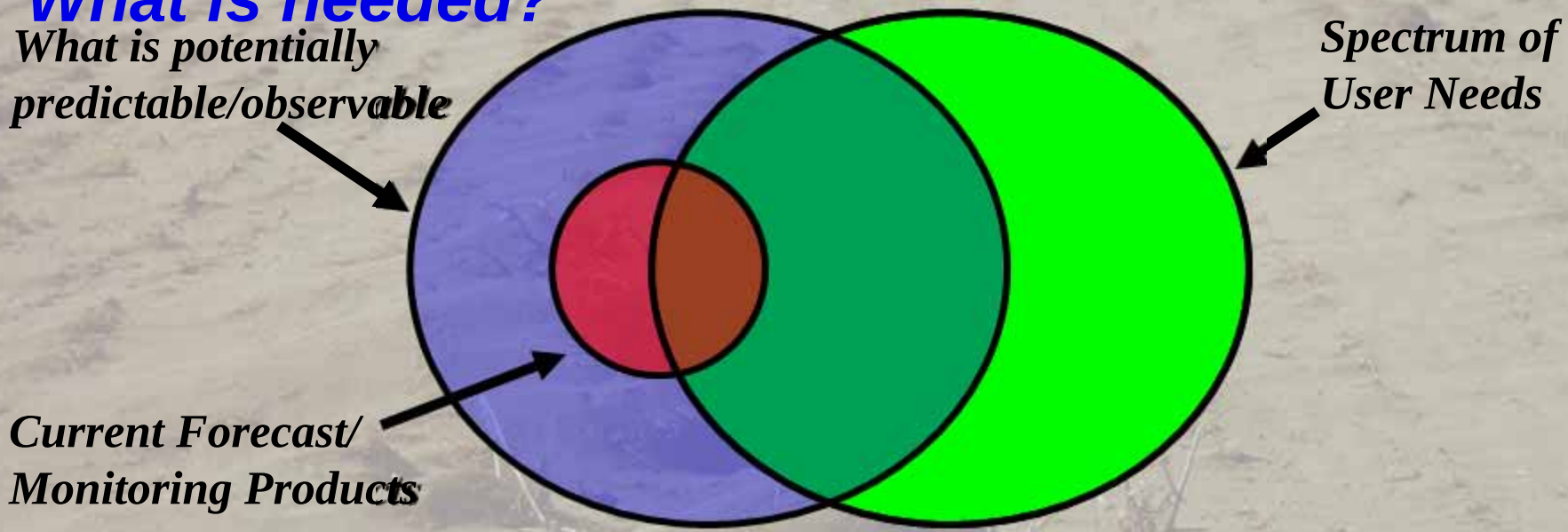
Experiences from the water resources and agricultural sectors during drought: *What do users want? What do researchers want? What is needed?*

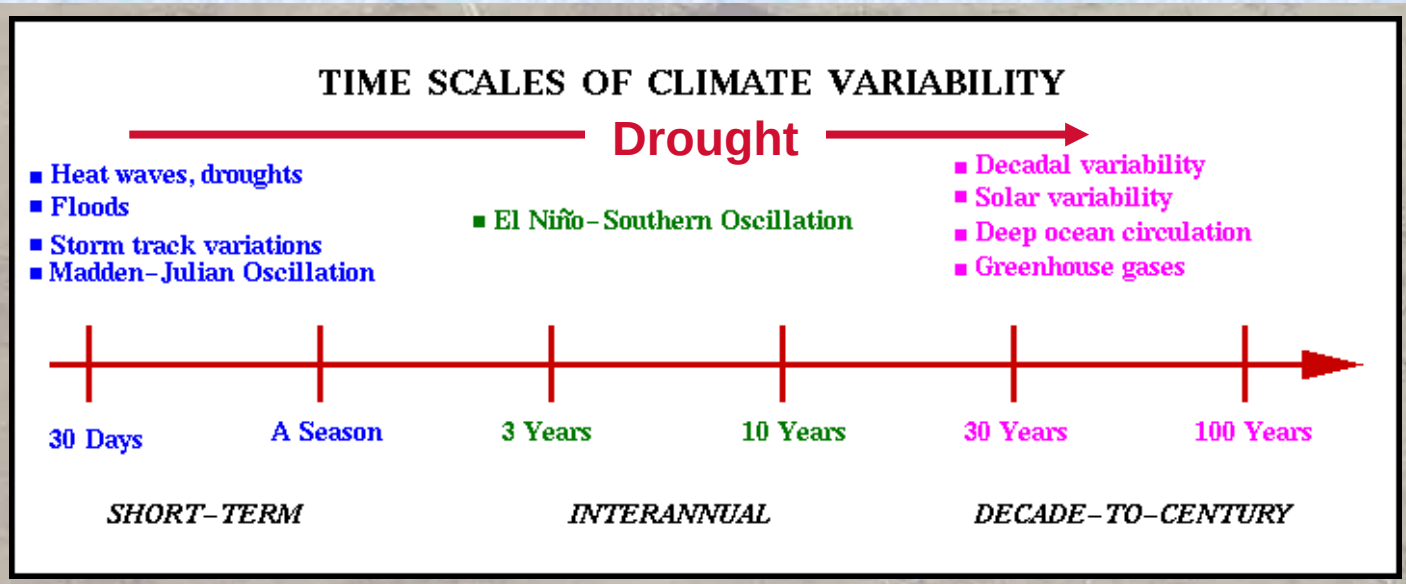


Robert. S. Webb (NOAA OAR Earth System Research Laboratory)

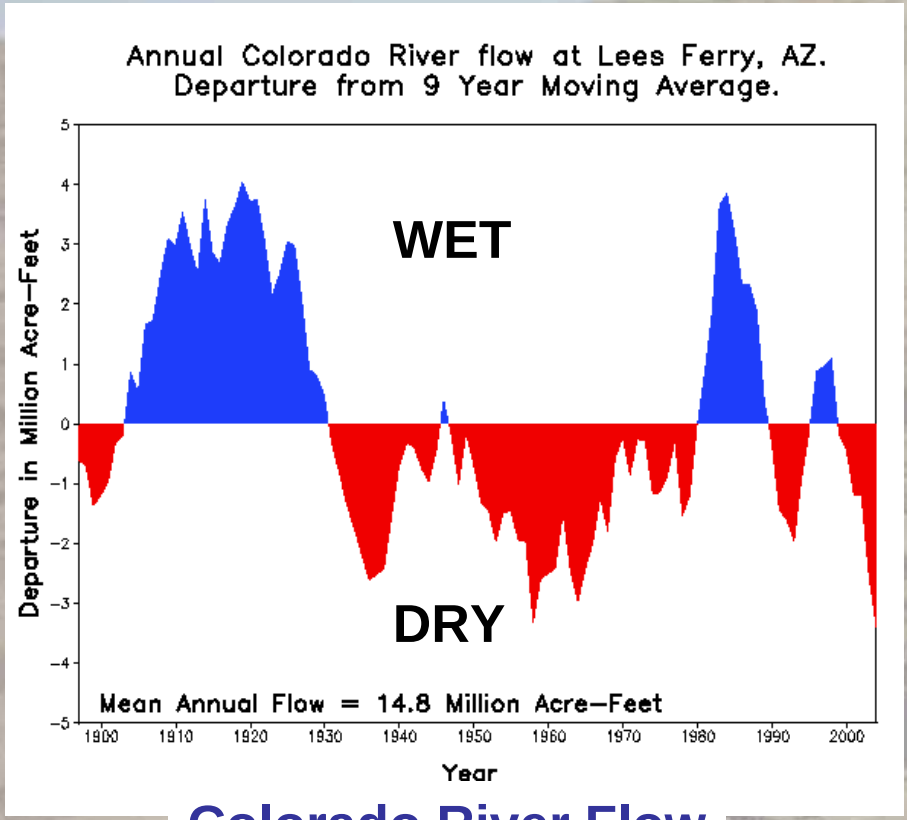
Roger S. Pulwarty (NOAA CIRES Climate Diagnostics Center)

Framing of the Questions:

- Critical Issue Driven
  - Reliability of water supply
  - Yield and profitability of agriculture production
- Overarching temporal and spatial scales of climate impacting these critical issues
- Need to understand information needs, quality and acceptability of information, context of use, accessibility and benefit



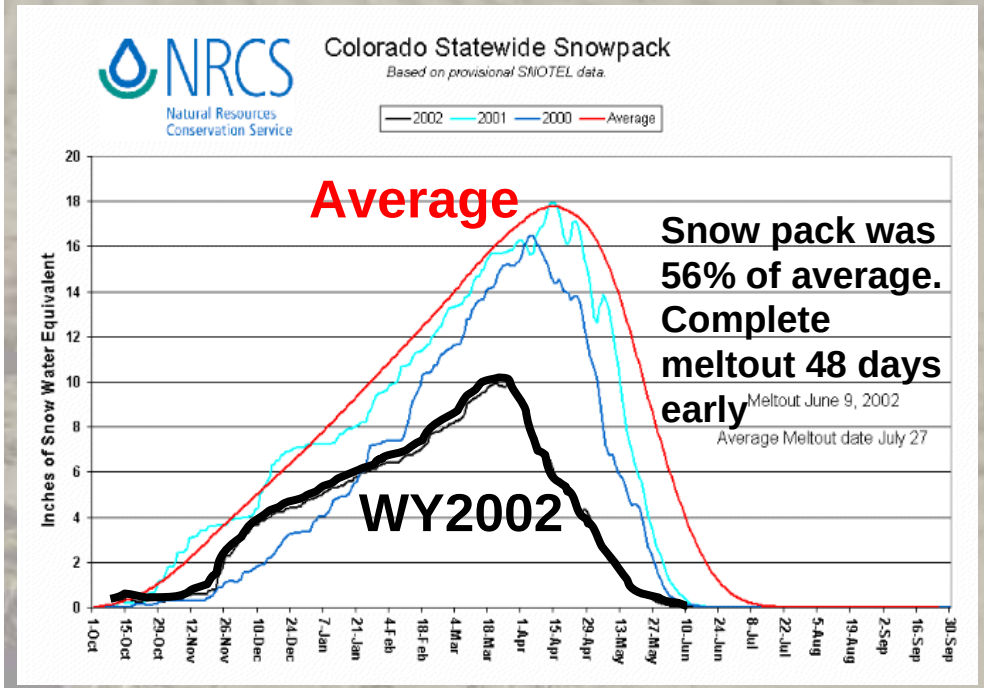
2001-2002 Drought in Colorado



Colorado River Flow

(Average 100 year natural flow ~14.8 maf)

Years	Duration	Average Flow
1931-1935	5 years	11.4 maf
1953-1956	4 years	10.2 maf
1959-1964	6 years	11.4 maf
1988-1992	5 years	10.9 maf
2000-2004	5 years	9.9 maf



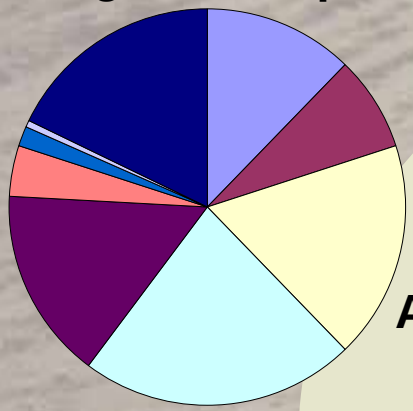
- **Winter wheat production fell by nearly 30 million bushels between 2001 and 2002**
- **Most irrigators received only 50% of their typical supply, 14% received none.**

Water Agriculture Production: Yield and profitability

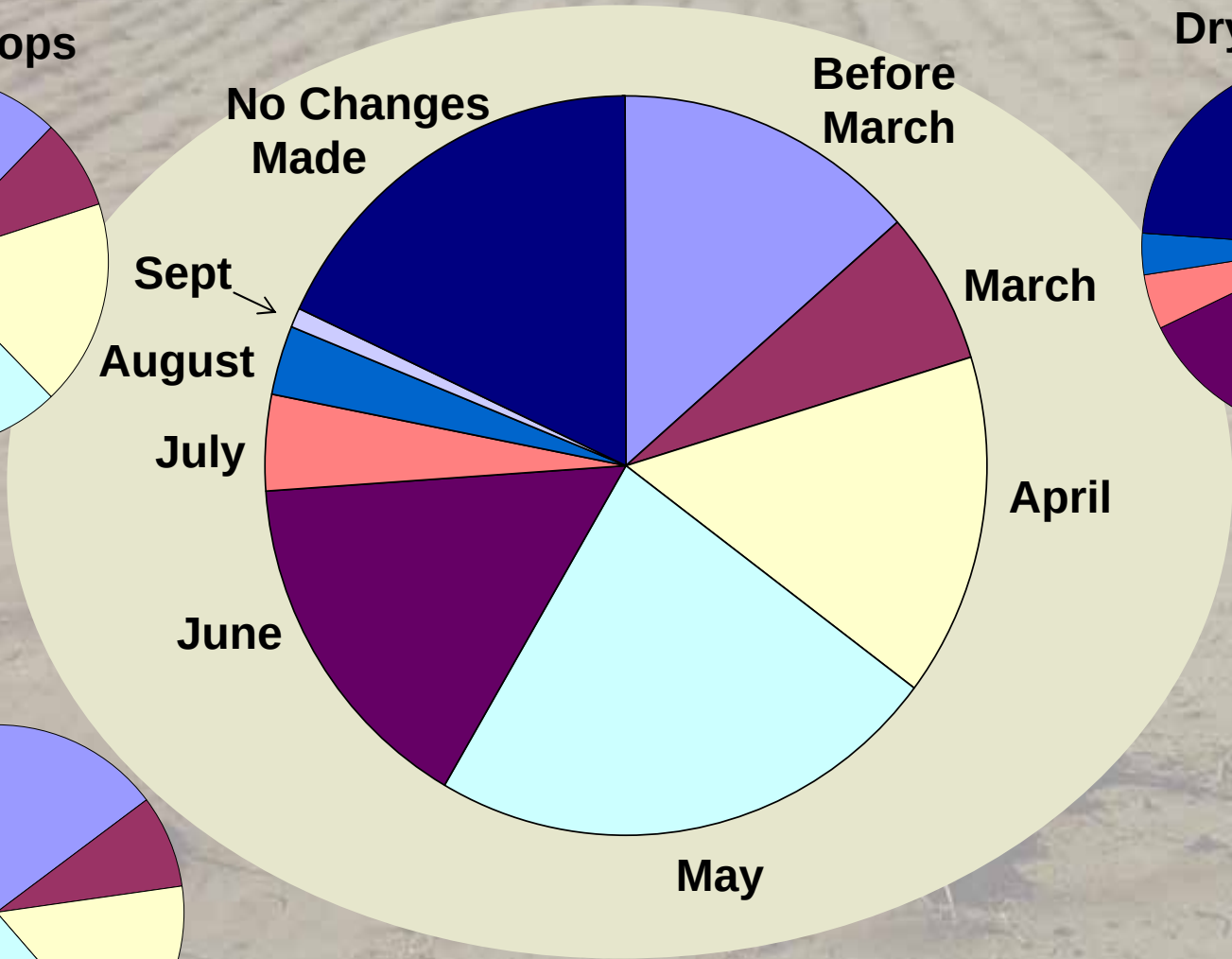
(*collaborative project with CSU*)

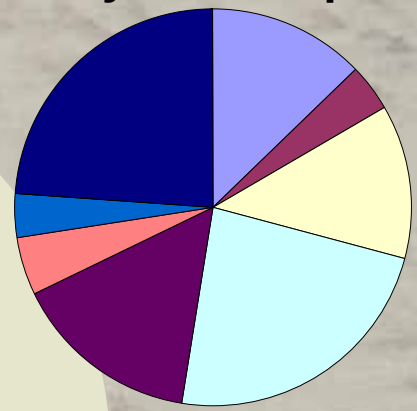
- **Sector Dependent Requirements**
- **What is going on over a year**
  - **What seed to buy and how much**
  - **When/if to plant or abandon crop**
  - **Irrigate or lease out water rights**
  - **Buy feed or cull herd**
- **Information needs (monitored and/or forecasted)**
  - ✓ What types of climate monitoring and climate forecast products could help mitigate the impacts of drought on agriculture?
  - ✓ When in the agriculture management decision process is this information needed for making strategic decisions and for making tactical decisions.
  - ✓ Where and how do you get climate and weather information

When did you first make changes in your production practices because of the 2002 drought?

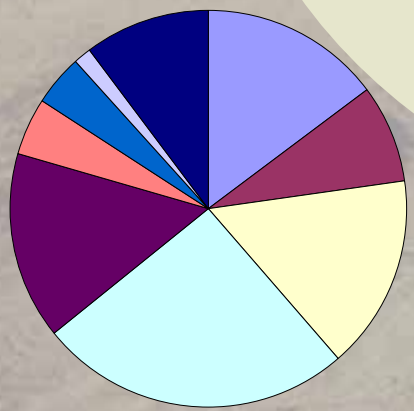


Irrigated Crops



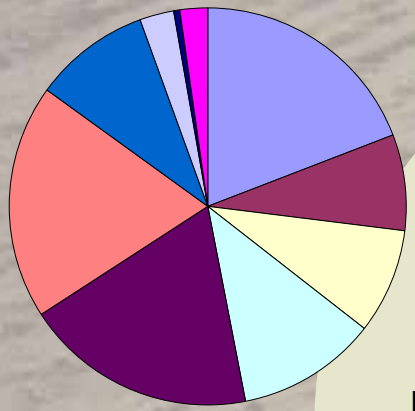


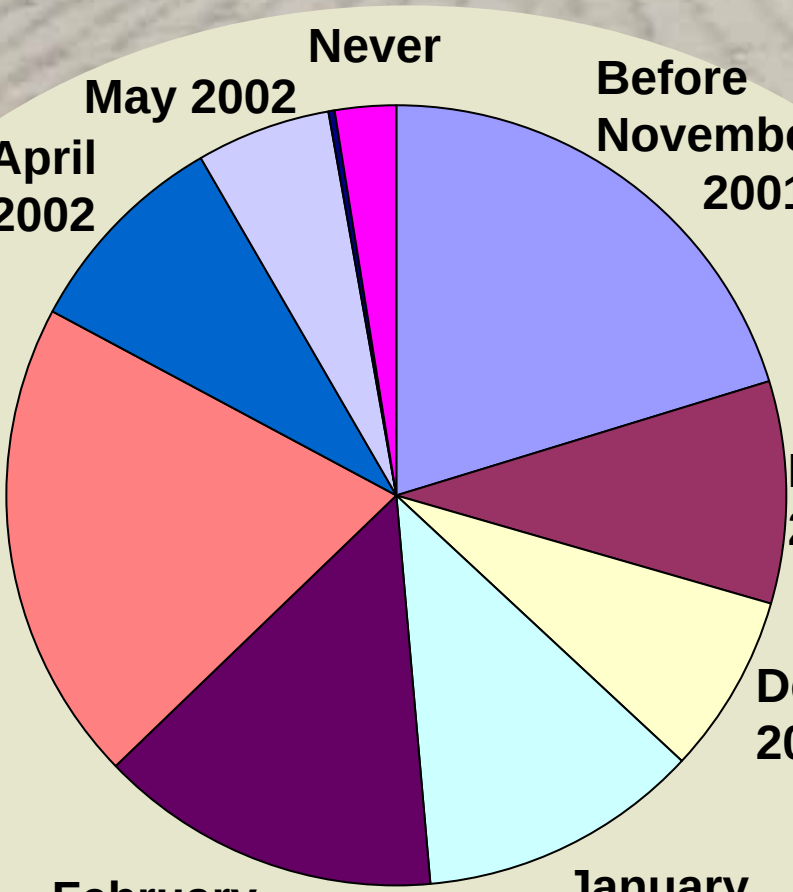
Dryland Crops

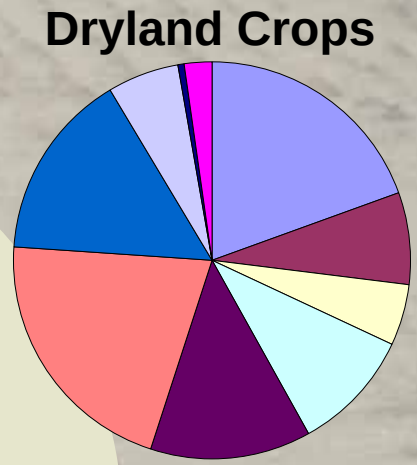


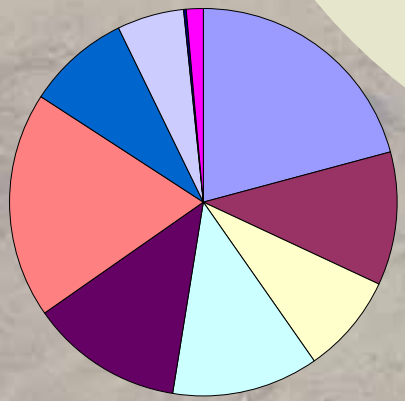
Livestock

What is the latest date an accurate drought forecast for Colorado would have been useful to you for making different production decisions than those actually made?







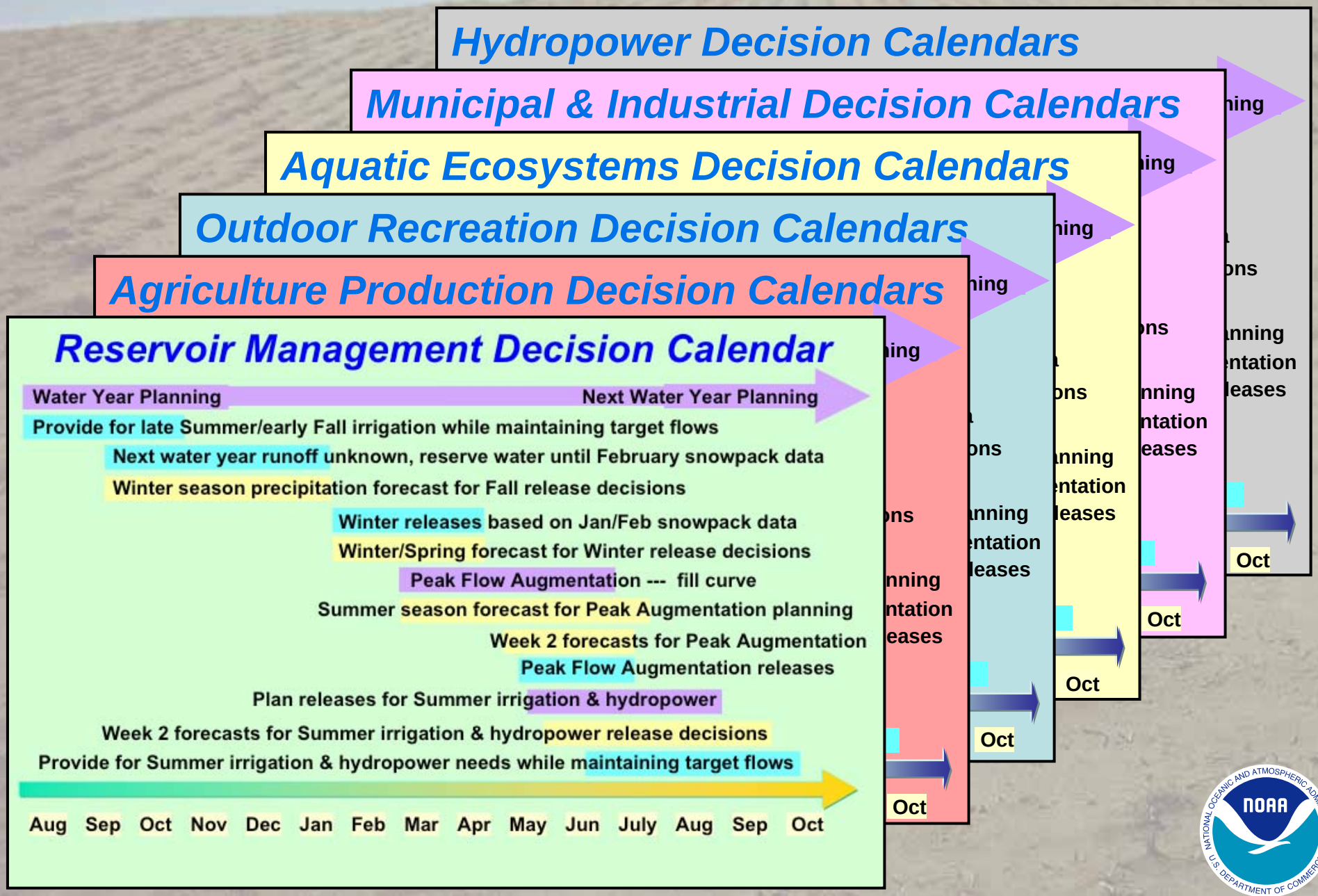


Water Resource Management: reliability of supply

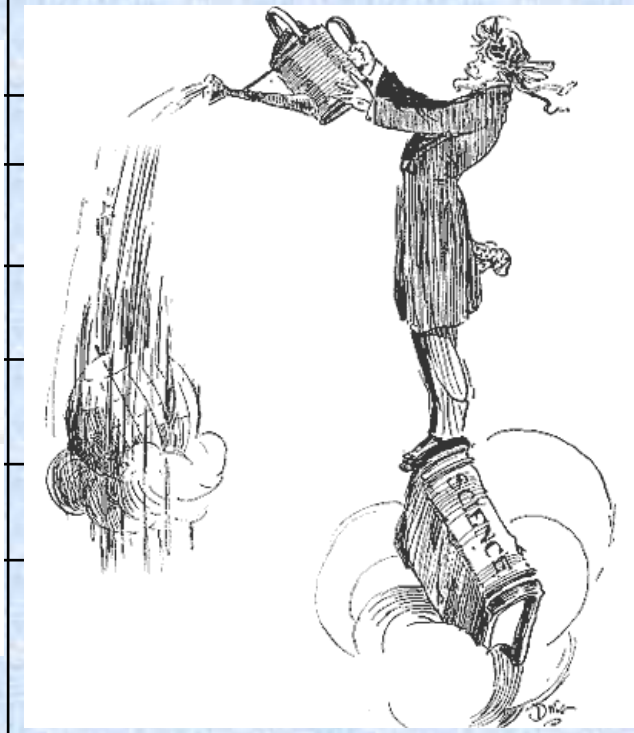
- **Sector Dependent Requirements**
- **What is going on over a year**
  - **Seasonally dependent deliveries**
  - **Peak and minimum flow**
  - **Optimize reservoir water levels**
  - **Hydropower production**
- **Information needs (monitored and/or forecasted)**

✓ Snowpack/SWE
✓ Soil moisture
✓ Streamflow
✓ Timing of spring peak and late season low flows
✓ Reservoir levels
✓ Ground water
✓ Surface water supply index (SWSI)
✓ Temperature & Precipitation
✓ Evapotranspiration, evaporative losses
✓ Demand metrics, water and hydropower
✓ Outlooks of these, and how precipitation and temperature outlooks relate to long term average or other thresholds☐

Water Resource Management: optimizing risk reduction



Water Resource Management: barriers to use

Factor	Water Manager's Perspective	Researcher's Perspective
Identifying critical issue		
Time frame		
Spatial resolution		
Goals		
Basis for Decisions		
Expectation		
Product Characteristics		
Frame		
Nature of Use		

Water Resource Management: communication challenge

Factor	Water Manager's Perspective	Researcher's Perspective
Identifying critical issue	Based on experience	External assessment
Time frame	Immediate (operations) Long-term (infrastructure)	Scientifically defensible Fundable project
Spatial resolution	Institutional boundaries or authorities	Scientifically defensible/funding
Goals	Optimization of multiple conditions and minimize adverse impacts	Enhanced understanding, prediction, explanation
Basis for Decisions	Procedure, judgment, training, Economics, Politics, risk reduction	Scientific methods, funding availability, disciplinary training
Expectation	Save money and time Protect the life and property	Understanding, prediction, continued improvement
Product Characteristics	Simple but accurate Context is important	Peer-review publication and recognition
Frame	Safety and well being, Profit Consistency with institutional culture, policy, etc.	Physical (atmospheric, hydrologic, etc.) conditions as drivers Dependent on scientific discipline
Nature of Use	Applied	Conceptual

What do users want? What do researchers want? What is needed?: *Conclusions and Insights*

- **An outcome of the drought has been the development of regional partnerships between users of climate information and researchers.**
- **These partnerships make it possible to develop a mutual understanding of how problems are framed including drought information needs and usability of various climate products.**
- **These partnerships provide alternatives to external research-based optimization and simulations to identify opportunities to improve operational efficiency.**
- **Interests now extend beyond current drought conditions to assessments of recent droughts in the context of longer-term climate variability and change (e.g., how much more extreme or changes in expected occurrence interval).**

What do users want? What do researchers want? What is needed?: *Future Directions*

- Users and researchers need to partner in a dialog about managing risks and hedging strategies.
- How such partnerships are supported and sustained remains an open question.