**Breakout Group Questions**

1. **The NASA Applied Sciences Program & WWAO support projects that partner with state water management agencies to assimilate remote sensing data into water management decision support tools. A key challenge for many projects is transition to sustained operations. What advice would you give to NASA at the outset of a new project to increase the likelihood of successful transition to operations?**
* Open and accessible data is critical
* The more open source the better; like use of Github as a way to document and share data production and gathering tools
* To answer questions, would need to ask a lot of people in the agency; consider a survey to get answer to questions

a) Are there key data standards, metadata standards or data formats that should be considered by a new project?

* WaterML becoming more prevalanent
* CA Open Water Data Architecture --> currently developing standards
* CA DWR has a set of GIS metadata standards; largely follow FGDC standards
* Use broader standards with wide adoption (use of Federal / international standards preferred)

b) For a new capability that is data intensive but leverages commercial cloud-based resources, how should projects partner with a state agency to plan for long-term financial support?

* Ask the states to create infrastructure to evaluate new capabilities and products (e.g., USGS A16 Circular process); connect review of new capabilities to budget process for states; states typically have at least a 2-year lead time between budget request and availability of resources to support an activity

c) What other best practices should NASA consider in partnering with state agencies to develop new capabilities?

* Anticipate different requirements from different states and from different agencies within state (driven by budgets, organizational structure, etc)
* Plan for flexibility and allow requirements to evolve
* Develop a joint data management plan with partner agency
* Connect planning and use cases to specific laws and regulations within a state / agency (could also assess via surveys)

d) What should be avoided? Are there particular data formats or approaches to data management that would be problematic for your agency?

1. What are currently the most important water-related data gaps that you or your agency routinely encounter?

* + Are there particular requirements that applied research teams should be aware of in working to address these data gaps (e.g., minimum geographic scope, spatial resolution, temporal resolution/frequency, data latency, minimum duration of historic data record, data accuracy)?
* Suborbital UAS systems for western US with robust range of capabilities.
* More Landsats? Interested in information about future of TIR measurements using smallsats/cubesats. What can agencies expect in the future.
* Washington state interested in snow pack monitoring and runoff forecasting.
* Texas – runoff forecasting for both drought and flood applications.
* CA SWRCB interested in new water quality.
* CA interested in hyperspectral data and ML for crop classification and crop pest detection.
* INSAR /subsidence monitoring for groundwater management and assessment of fracking. Important and critical for multiple states (CA, TX, AZ, NM . . . any states with fracking activity).
* ASR (aquifer recharge) – INSAR data also useful for monitoring ASR projects.
* Aerial electromagnetic imaging to map aquifer structure and soil structure
* Vegetation mapping
* Compliance assurance for cannabis mapping and monitoring
* Real-time inundation maps; improve forecasting for flashfloods and extent of flood waters; tools to refine relationships between rainfall, runoff, topography and inundation extent
* Risk indices for flooding, based on soil moisture, precip, veg cover
* SAR maps of inundated area
	+ Are there related ground-based datasets that the applied research teams should be aware of?
* Continuous GPS network
* Weather station networks --> better funding and support
* Ag and reference ET networks --> need better integration and support across states
* See report from CA DWR and Michael Kiparsky on this topic
* USFS stream temperature monitoring network (NOREST); nice example of federal and state collaboration
1. Has your agency recently had to integrate any new data sources, observations, data services or data management tools into your operations? If so, did you utilize a cloud-based resource to implement this new capability? What worked well? What were the challenges? Were there any key lessons learned?
* Texas WDB implementing a new mesonet network for Texas using the cloud
* New Mexico developing new hybrid Google/ESRI geospatial data services (Google for analytics and ESRI for ArcGIS online)
* Common challenge: data literacy, data sources not well structured; it would be valuable to have examples of how to use RS data (and other data) to tell stories and answer question --> interested in learning about how to turn data into interesting and useful products
* WSWC used cloud vendor to set up WADE; can easily set-up empty data node; but for data intensive states (e.g., CO, with hundreds of thousands of records); problems with scaling tables; not cost effective for larger states and WSWC couldn’t sustain capability
1. What tools does your agency currently use to manage its largest geospatial datasets? Is there a specific data volume threshold, above which your agency would consider the data resource to be "big data"? For a new dataset, is there a specific data volume above which special planning would be required to support and maintain the data?
* CA DWR Geotracker data is one of CA’s largest datasets (TB of data)
* NM using custom made widgets and ArcGIS online to help view and manage cloud-based datasets and historic imagery
* Lots of use of ESRI and internal data services
* Main use of big data and high performance computing is for complex hydrologic modeling
1. Does your agency currently utilize remote sensing datasets from NASA or another agency? If so, do you have any recommendations to improve the data services available from NASA (or another agency)? If you do not use NASA data, are there particular barriers to accessing or using the data that you have encountered (e.g., difficulty finding relevant data, lack of metadata, data formats not compatible with our geospatial software tools, lack of documentation and training resources, documentation of data accuracy not sufficient, benefits of using remote sensing data not well documented)?
* During Tubbs fire, really felt the lack of support from NASA after capability was transitioned to USFS – had trouble getting airborne assets deployed to monitor the fire
* CA SWRCB HAB --> have a couple of efforts to explore RS data for water quality monitoring in partnership with NASA
* ET and consumptive use
* NASA – best Federal agency in terms of working with states and reaching out to states to sustain partnership and communication (Gary Darling; CA DWR)
* Subsidence data --> CA SWRCB needs adequate metadata, documentation of accuracy and production methods
* Repository of use of RS data in legal contexts related to water and ag (methods; metadata; documentation)
* Trouble tracking what EOSDIS is doing and who offers what; EOSDIS newsletter from the states (or updates in the WSWC newsletter; RSS feed)

Internet of water? Need to create hubs at state level for larger states; regional hubs for smaller states.