Weather Research and Forecasting Innovation Act of 2017: Sub-Seasonal and Seasonal (S2S) Forecasting Innovation (Public Law 115-25, Section 201)

David G. DeWitt
Director, Climate Prediction Center (NOAA/NWS)

Outline

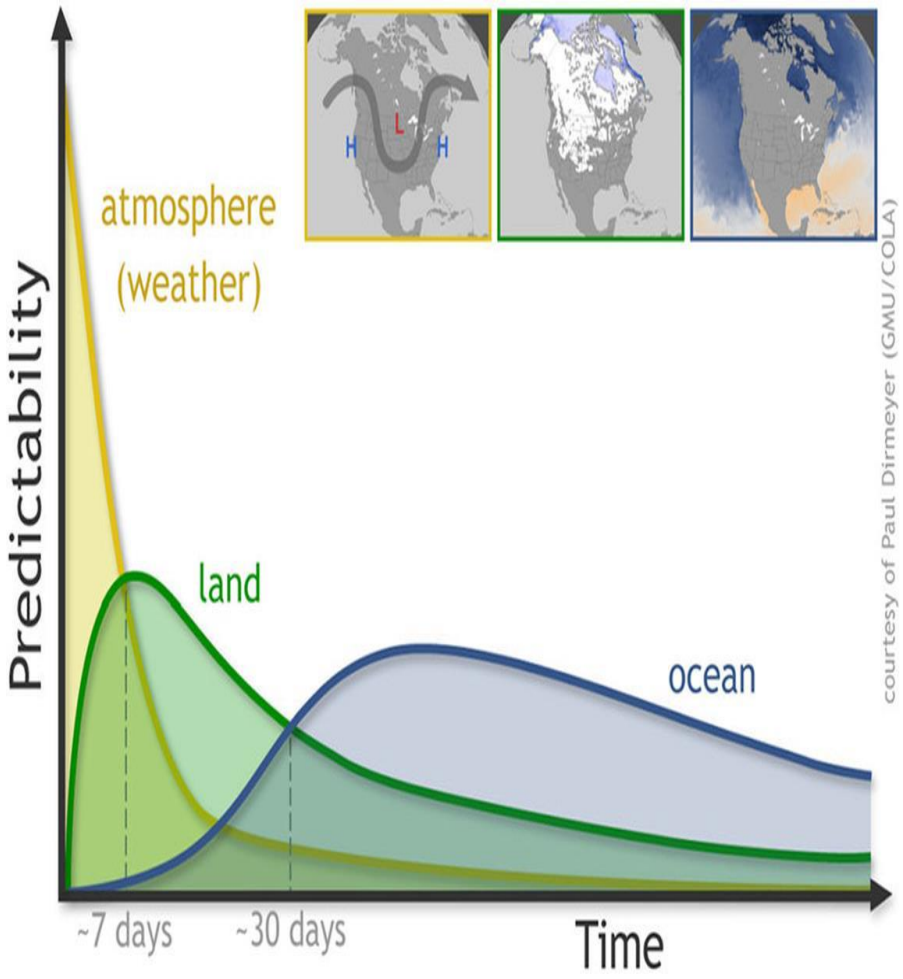
- History of the bill and current status of response
- Report contents
- Pilot project framework
- Science challenges of relevance to WSWC

S2S Weather Bill History, Status, Definitions

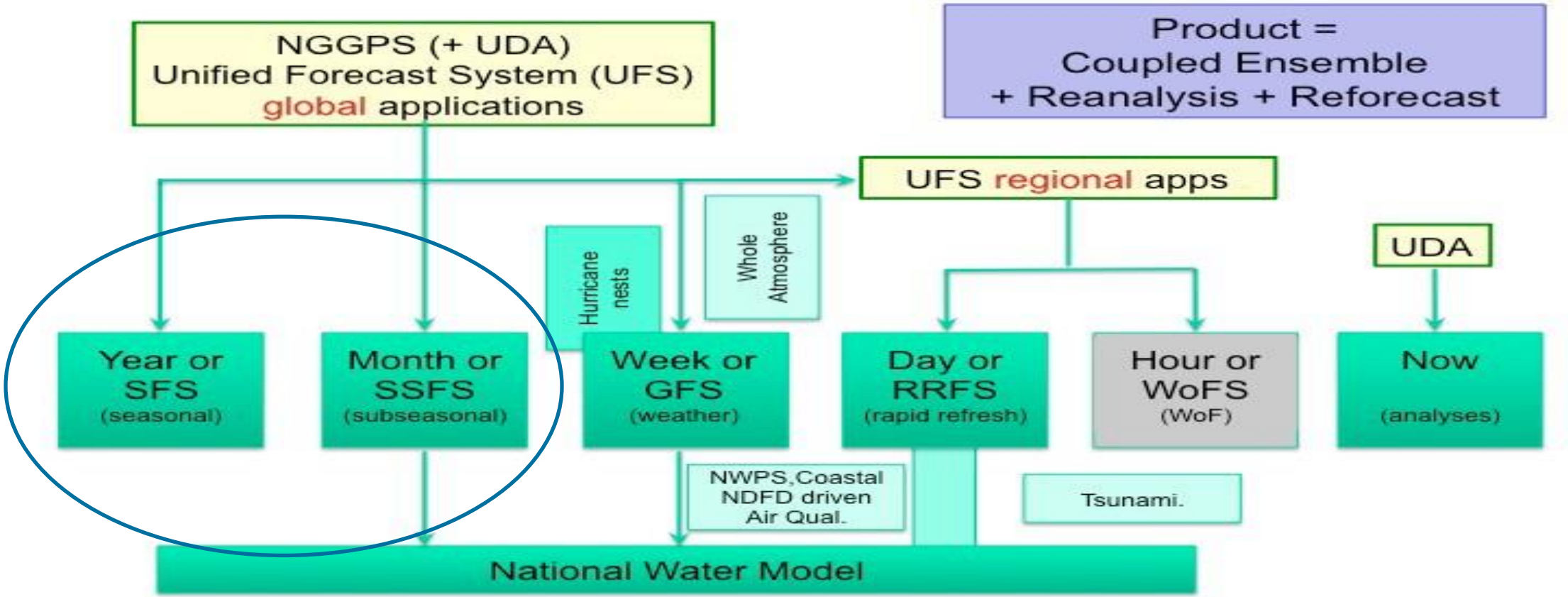
- Bill required a report to Congress by October 2018. Report was sent to Congress in early October 2020. The report is available here: https://repository.library.noaa.gov/view/noaa/27408.
- Bill defines sub-seasonal as week two (day 8) to 3 months (first season), and seasonal as from 3 months to 2 years.
- Bill was an authorization. To date there hasn't been an associated appropriation.
- Report to Congress:
  - Serves as a guidepost for NOAA planning and execution, as well as to inform the public and NOAA's stakeholders on its efforts on sub-seasonal and seasonal forecasting.
  - Two main goals of the report: Improve the skill of the S2S forecasts, and enhance the value of S2S products for stakeholders.
- One of the main themes of the report was need to improve S2S precipitation forecasts. The goals of the report are in strong alignment with and superseded by the proposed Precipitation Prediction Grand Challenge (PPGC) that was discussed earlier.

Key Contents of S2S Report to Congress

- Requirements for Improving S2S Products and Services
  - 4.1 Background
  - 4.2 Forecast Requirements
  - 4.3 Research Requirements
  - 4.4 Observational Requirements
  - 4.5 Monitoring Requirements
  - 4.6 Towards Improving S2S Capabilities, Usage, and Value
    - Unified Forecast System (UFS)
  - 4.7 Pilot Projects



Improving S2S Capabilities: Unified Forecast System (UFS)



UDA: Unified Data assimilation
SFS: Seasonal Forecast System
SSFS: Subseasonal Forecast System

GFS: Weather Forecast System
RRFS: Rapid Refresh Forecast System
WoFS; Warn on Forecast System

Paradigm for S2S Pilot Projects (Strong Alignment with PPGC)

- Recognition of the difficulty of the problem and the fact that there is no single activity that will solve the problem.
  - Rather, compounding incremental improvement will lead to long-term measurable gains in forecast skill.
  - Increased investment addressing key skill and knowledge gaps (science challenges) will accelerate these improvements.

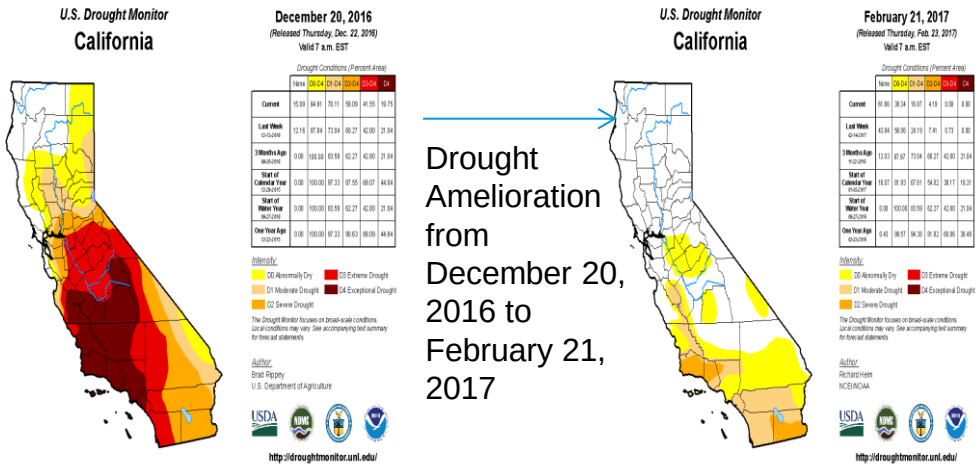
- Four regionally-focused pilot projects:
  - Winter S2S precipitation forecasts for water management in the western United States
  - Spring and summer S2S precipitation forecasts in the central United States
  - S2S forecasts of Arctic Sea Ice
  - S2S forecasts of tropical cyclone activity

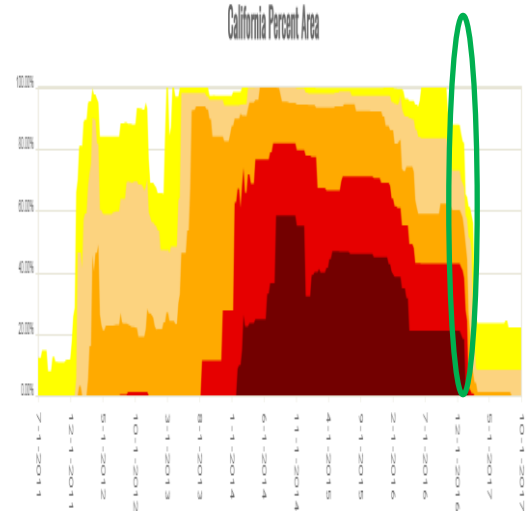
Paradigm for Pilot Projects (continued)

- Well-defined metrics and timelines for evaluating success that are co-developed with the relevant stakeholder communities.
- Recognition of the need to focus on operational outcomes, i.e. not research for research's sake.
- **Sufficient sustained investment in all required aspects of the problem, including human resources, high-performance computing, observing systems, and transition of research innovations to operations.**
- Leveraging the talents of all parts of the weather enterprise, including NOAA labs, other federal agencies, the research community, and relevant NWS operational centers.
- **Recognition that making progress on this problem will require allowing some higher-risk, higher-reward research, i.e. allowing scientists to be more creative but still focused on operational outcomes. "Managing the tension between research push and operational pull."**

Tying science priorities to key decision points for the relevant stakeholder communities.

Pilot Project: Winter S2S Precipitation Forecasts for the Western US
Science Challenge (Regime Transition): Predicting Termination of the California Drought 2011-2017





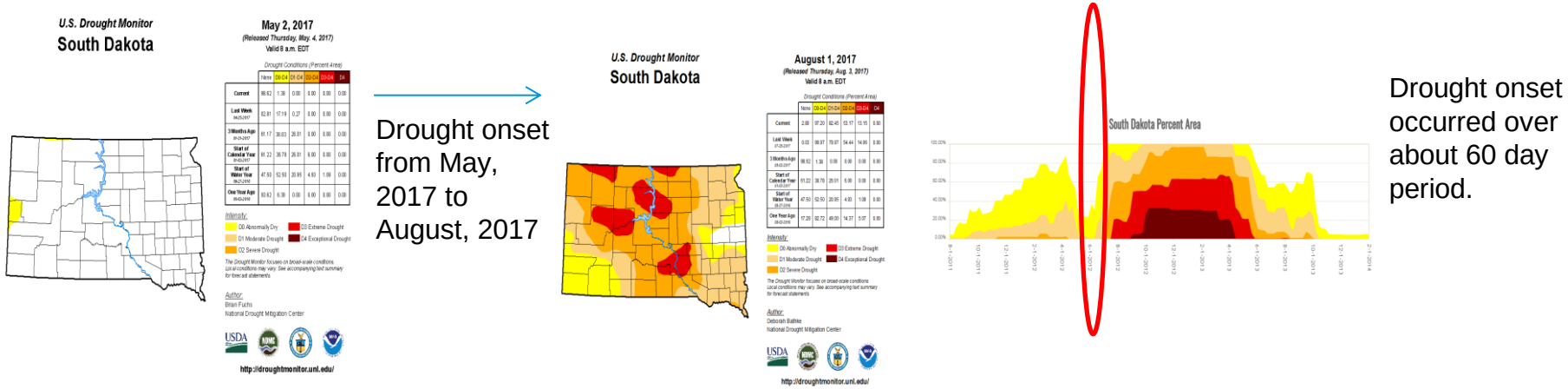
Drought Amelioration occurred over about 60 day period.

Rapid amelioration of the 2011-2017 drought was due to a large number of atmospheric river events. These atmospheric rivers formed and penetrated to California because the large-scaling ridging over the eastern Pacific that had been persistent for six years broke down. This occurred despite La Nina forcing which tends to support ridging in this region. All models failed to predict this transition of the large scale atmospheric state and subsequent heavy rains beyond about two weeks lead. This extended drought and its sudden amelioration highlights several science challenges for improved winter precipitation for the southwest US including:

- What caused the extended persistence and then rapid removal of the eastern Pacific ridge, i.e. regime transition? Was it predictable?
- Are there other predictable modes of monthly to seasonal variability besides ENSO?

Pilot Project: Spring and summer S2S precipitation forecasts in the central US

Science Challenge (Regime Transition): Predicting Onset of the 2017 Northern Plains Flash Drought



Drought onset occurred over about 60 day period.

Rapid onset of the 2017 Northern Plains occurred over a 2 to 3 month period. All models failed to predict the onset of this drought beyond about two weeks lead. The inability to predict the onset of this drought highlights several science challenges for improving spring and summer drought prediction skill:

- Is there predictability for precipitation beyond week two for the Spring and Summer seasons when variability is controlled by convective as opposed to advective processes?
- Can land surface models accurately simulate the onset of flash drought conditions, which are at least partly due to enhanced evaporation?