Flash Drought – Priority Research Areas

Summer 2022

NIDIS has identified flash drought as a phenomenon needing further exploration, research, and tool development. The term "flash drought" was coined in the early 2000s to draw attention to the rapid onset or intensification of drought conditions, which can cause large, unexpected environmental and socioeconomic impacts. As a result, flash drought is a target for improved early warning capability.

To advance this process, NIDIS hosted a Flash Drought Workshop in December 2020 for subject matter experts and others—including end users of drought information—to share perspectives on flash drought and to jointly identify a research pathway to address the management and response challenges flash drought poses. The subsequent workshop report documented research and application needs in three key areas of flash drought assessment and response: monitoring, prediction, and planning/response. These priorities are summarized below.

Monitoring:

1. Monitoring Data: Expansion of *in situ* monitoring data (e.g., soil moisture, snowpack, streamflow, evapotranspiration) is needed, along with better application of existing *in situ*, remote sensing, and modeled output data. Research components include:
    - Evaluating areas of the country where **increased *in situ* monitoring would add the most value**
    - Identifying methods to **better harness existing data** to support flash drought assessment

2. Impacts: Documenting the impacts of flash drought is important to fully understand the phenomenon, to find ways to mitigate or adapt to the potential impacts, and to reduce the societal and environmental risks. Research opportunities include:
    - Identifying characteristic flash drought **impacts across different regions and seasons**
    - Assessing and documenting the **compounding and cascading impacts of flash drought**, including better understanding where the impacts of flash drought first manifest in various economic sectors

3. Indicators: A suite of indicators and tools is needed in order to properly monitor the evolution of flash drought from its inception to the end of the rapid intensification period and beyond. Research opportunities include:
    - Assembling **an integrated set of drought indicators that specifically address flash drought** (rapid intensification) conditions (e.g., that include land-atmosphere interactions and other relevant features beyond standard meteorological drivers)
    - Identifying **minimum indicator rates of change during the rapid intensification phase** of flash drought, including key thresholds for flash drought indicators
    - Examining **where and when (region, season, sector) an indicator (or set of indicators) is most relevant for flash drought monitoring**
    - Developing, in conjunction with practitioners, regional and seasonal characterization of **flash drought indicators, thresholds, and appropriate triggers for action**
    - **Benchmarking flash drought events and/or developing a "climatology" of flash drought** to serve as a basis for further exploration of flash drought definitions, indicators, and thresholds

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Prediction:

1. Underlying Physical Processes: To support improvements to flash drought prediction, the research community needs to better understand the physical processes underlying flash drought. Research targets include:
    - Increasing knowledge about the **interactions between precipitation, temperature, wind, evaporative demand, land-atmosphere feedbacks, and/or vegetation/land cover** that create flash drought conditions
    - Exploring how such **interactions vary by region (climatic zone) and season**
    - Better characterizing the **dynamics of vegetative stress**

2. Predictability: There are only a few known sources of predictability for flash drought events (e.g., Rossby waves propagation). Research is needed to identify and evaluate new sources of predictability. Research opportunities include:
    - Exploring **new sources of predictability** (e.g., atmospheric teleconnections) and practical limits to predictability
    - Evaluating **how well any identified new sources of predictability are represented** in current and future forecast models

3. Modeling improvements: A critical part of improving the forecasting of flash drought is to **improve existing operational model capabilities**. Research targets include:
    - Operational adjustments:
        - Using consistent initialization dates
        - Producing at least weekly forecasts with adequate ensemble members
        - Conducting longer hindcasts to test model forecast accuracy
    - Modeling improvements:
        - Improving resolution to 0.5 degree or finer
        - Producing forecasts for variables that are relevant to flash drought detection
        - Improving data assimilation for more accurate forecast initializations
        - Updating models to include processes relevant to flash drought (e.g., dynamic vegetation)

Planning & Response:

1. Characterization: Research is needed to identify if/how flash drought planning and response differs from more conventional drought. Research targets include:
    - Examining **if/how actions taken during a flash drought differ** from conventional drought; do the rapid response requirements impose different constraints?
    - Exploring how **flash drought development in different seasons affects decision making by sector**, particularly those beyond agriculture (e.g., recreation/tourism, ecology, health)
    - Identifying **which indicators and triggers, by time of year and sector,** would best provide decision makers adequate time to respond

2. Effective Communication: There are outstanding questions of how to communicate flash drought effectively to decision makers and the public. Research targets include:
    - Examining **people's perception and understanding of flash drought** and how that might differ from conventional drought
    - Examining whether **where someone lives** (e.g., predominantly wet area versus predominantly dry area) affects how they perceive flash drought
    - Identifying **effective communication strategies** to improve drought response, including better ways to communicate probabilistic risks to non-technical audiences
    - Developing a **graphical communication tool** (e.g., story map, quantitative storyline) to showcase flash drought evolution and impacts

3. Policy and Planning: Both specific planning protocols and broader policy considerations may need to be adjusted to address flash drought. Research targets include:
    - Identifying ways to **integrate appropriate flash drought indicators and triggers into planning**
    - Exploring **effective mitigation and response actions** by sector for flash drought
    - Analyzing whether the **impacts of flash drought are adequately covered by existing relief/planning programs,** or if policy adjustments are necessary to improve responses to flash drought