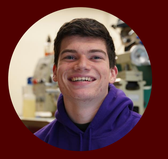
High-Resolution Global Flash Drought Monitoring in Near-Real-Time

Aidan Brown[1] , Sara Antonijevic[2] , Vinit Sehgal[3] , Binayak P. Mohanty[4]

[1]Department of Electrical & Computer Engineering, [2]Department of Statistics, [3]Water Management and Hydrological Science, [4]Department of Biological and Agricultural Engineering, Texas A&M University

Presenter
Aidan
Brown



❑ WHAT ARE FLASH DROUGHTS?

Rapid intensification of drought conditions to **severe** levels over **large areas**, caused by atypically stressful temperatures, winds, lack of precipitation, or both.

❑ Effects of Flash Droughts

Rapid death of crops and soil degradation

Notable Flash Droughts:
Fall 2019: Southeastern USA
Summer 2017: Northern Plains ($2.6 billion loss[1])
2012 Central USA ($34.5 billion loss[1])

[1] NIDIS-Flash-Drought-Workshop-Report-2021

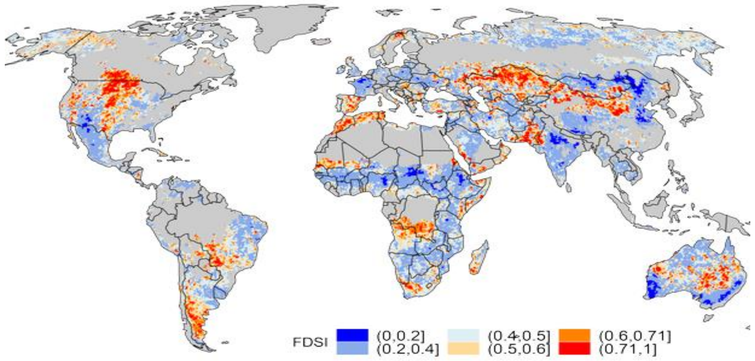
What FLASH provides

- ❑ FDSI estimates (NetCDF)
- ❑ Latest map
- ❑ 14-day drought outlook
- ❑ Parameters for FDSI

Notable features

- ❑ Updated Daily
- ❑ Low latency of 2 days
- ❑ Free & open-source tools

❑ GLOBAL FLASH DROUGHT OUTLOOK



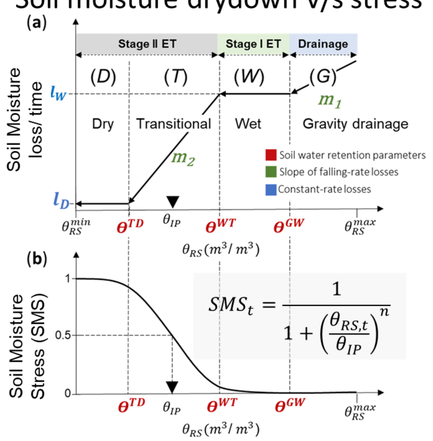
F.L.A.S.H.

FLash Drought Assessment using SMAP Hydrology

An **operational** platform for **global near-real-time** flash drought monitoring

❑ METHODOLOGY

Soil moisture drydown v/s stress

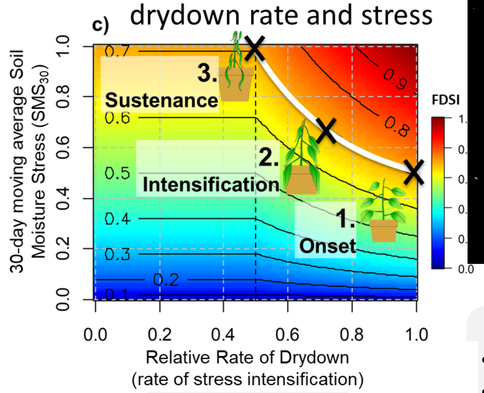


$$SMS_t = \frac{1}{1+\left(\frac{\theta_{RS,t}}{\theta_{IP}}\right)^n}$$

θ_{IP} = Inflection point = $\left(\frac{\theta^{TD}+\theta^{WT}}{2}\right)$

n = Shape factor = $16 . \sqrt{m_2}$

Evolution of FDSI with SM drydown rate and stress



$$RRD_t = \frac{1}{1+\left(\frac{m_2}{RD_t}\right)^6}$$

$$FDSI_t = \begin{cases} \sqrt{SMS_{30,t} \cdot RRD_t} & if\ RRD_t > 0.5 \\ \sqrt{SMS_{30,t} \cdot 0.5} & if\ RRD_t \le 0.5 \end{cases}$$

❑ DATA COLLECTION

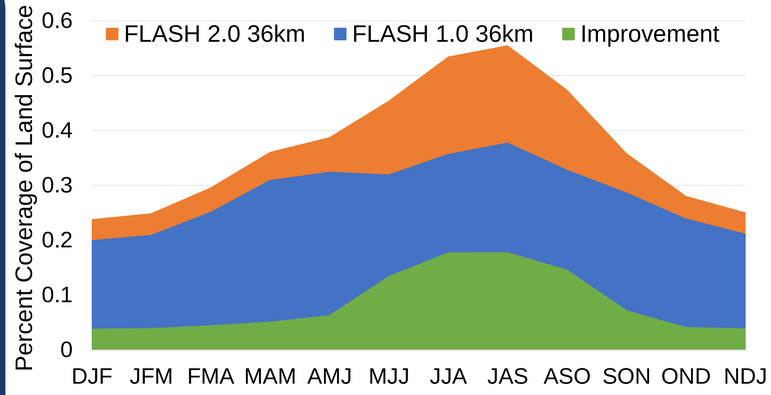
- All data is observed by NASA's SMAP satellite
- Complete global data typically takes 2-3 days to collect

Typical data collection from 1 day

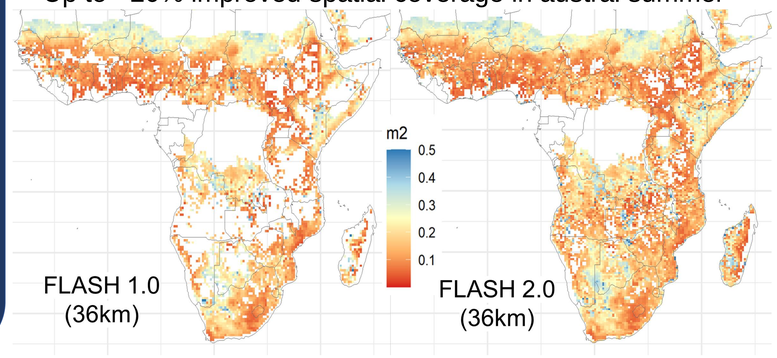
❑ HIGH PERFORMANCE COMPUTING

- Extensive use of TAMU' s High Performance Research Computing
- Global dataset is divided into 41 regions and 12 seasons for parallel computation
- Observations are merged and interpolated to create data on a 2-day interval
- 9km parameters and FDSI estimates are computed
- Data is uploaded to cloud storage and made freely available

❑ IMPROVED COVERAGE IN FLASH 2.0

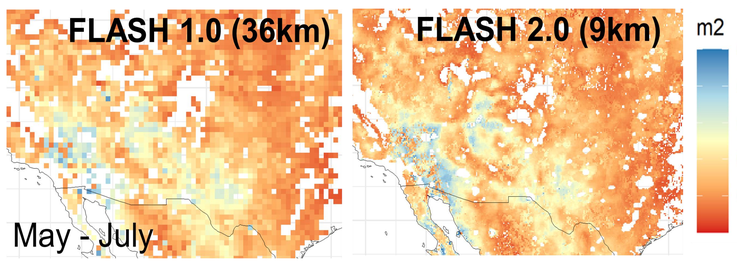


- Relaxed data filtering from 5kg/m^2 to 7kg/m^2 vegetative water content
- Up to ~20% improved spatial coverage in austral summer



- Improved coverage in mildly vegetated and coastal regions

❑ IMPROVED RESOLUTION IN FLASH 2.0



- 16x improvement from 36km to 9km footprint
- Improved representation of sub-grid land-surface heterogeneity

❑ Additional Applications

- Water resource management
- Flood forecasting
- Estimation of "on ground" precipitation
- Soil upscaling parameters estimation

❑ REFERENCE

Sehgal, V., Gaur, N. and Mohanty, B.P., 2021. Global Flash Drought Monitoring using Surface Soil Moisture. *Water Resources Research*