The FEWS NET Land Data Assimilation System (FLDAS)

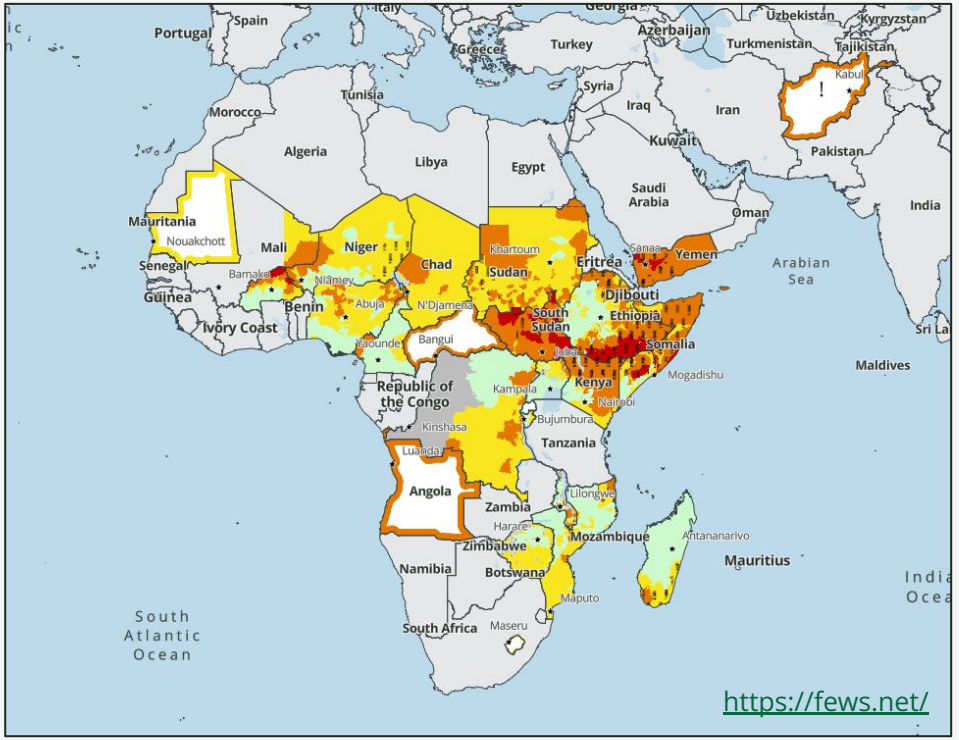
Kimberly Slinski, Abheera Hazra, Daniel Sarmiento, Weston Anderson, Jossy Jacob, Min Huang, Kristi Arsenault, Sujay Kumar, Augusto Getirana, Christa Peters-Lidard, Shrad Shukla, Amy McNally

May 24, 2023

USAID's Famine Early Warning Systems Network (FEWS NET)

Acute Food Insecurity Area Classification

February - May 2023 Near Term Projection



IPC 3.1 ACUTE FOOD INSECURITY CLASSIFICATION

Click on a country for more information

The Integrated Phase Classification (IPC) acute food insecurity scale classifies areas according to a five-phase scale of increasing severity.

Presence Countries

- 1: Minimal
- 2: Stressed
- 3: Crisis
- 4: Emergency
- 5: Famine
- Not mapped
- National Parks/Reserves

Remote Monitoring Countries

Highest IPC classification in areas of concern within the country

- 1: Minimal
- 2: Stressed
- 3+: Crisis or higher

Symbols

! Would likely be at least one phase worse without current or programmed humanitarian assistance

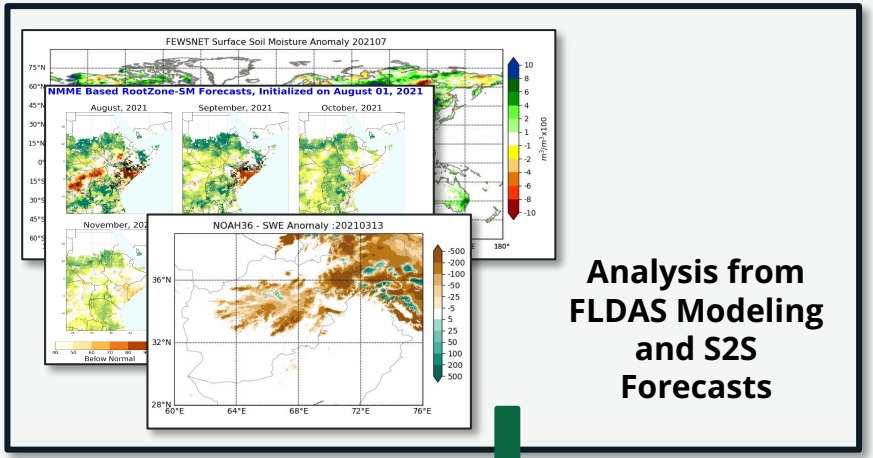
FEWS NET is a leading provider of early warning and analysis on acute food insecurity around the world. FEWS NET relies on a global network of partners to report and provide insightful information on the severity of food insecurity in 30 countries.

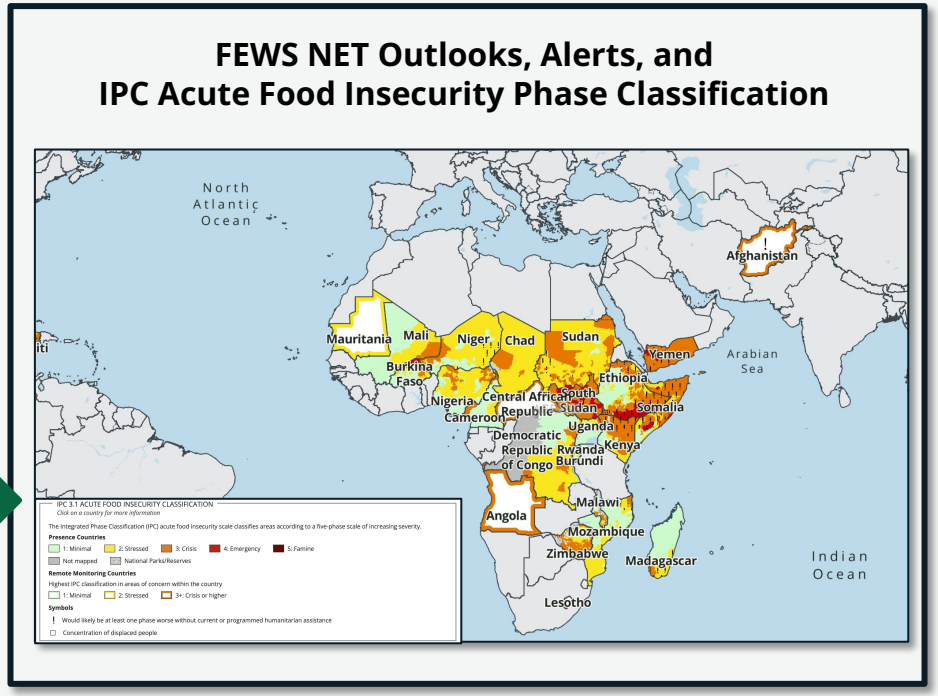
FEWS NET

USAID FROM THE AMERICAN PEOPLE

FEWS NET Land Data Assimilation System

Support of the Famine Early Warning Systems Network



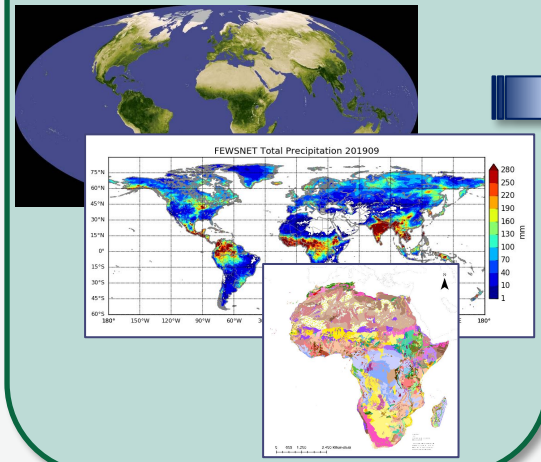


https://fews.net/

Land Information System (LIS)

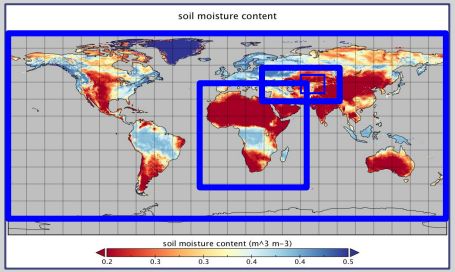
LDT

Land surface parameter processing (topography, soil properties, vegetation properties)
Meteorological forcing processing (precipitation, temperature, wind, …)



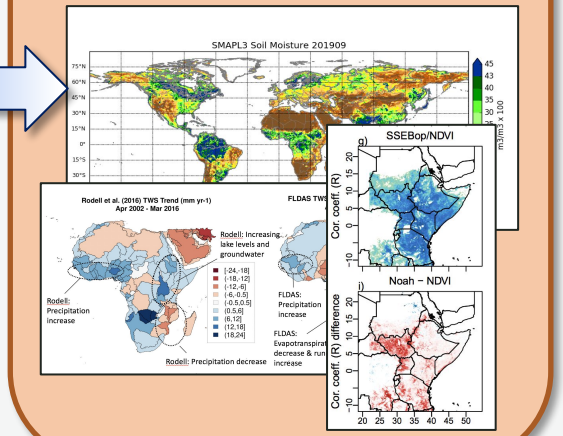
LIS

Land Surface/Hydrological Models/Routing: Noah, Noah-MP, VIC, NASA Catchment, HYMAP2,…



LVT

Evaluation and benchmarking against remote sensing (SSEBop ET, NDVI, SMAP, GRACE,..) and ground data
Drought Indices: percentiles, SPI, SSWI



https://lis.gsfc.nasa.gov/

FEWS NET USAID FROM THE AMERICAN PEOPLE

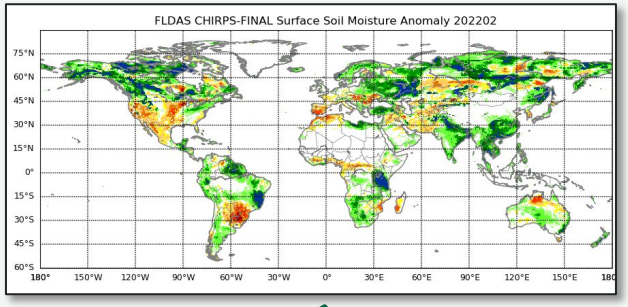
FEWS NET Land Data Assimilation System

Noah-MP in FLDAS

- Advantages:
  - TOPMODEL better simulates runoff processes
  - More sophisticated snowpack development/depletion physics
  - Data assimilation capabilities (within LIS)
- Disadvantages:
  - Longer spin-up
  - Longer runtime, especially when coupled with HyMAP routing

FEWS NET Land Data Assimilation System

FLDAS-Global

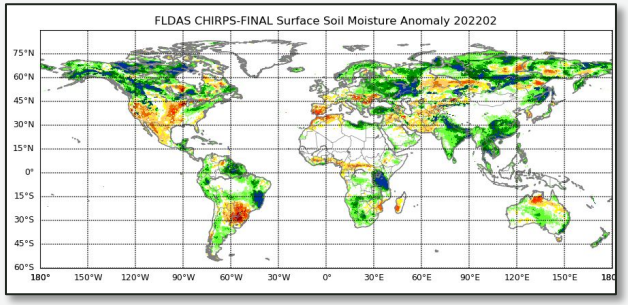


Models: Noah 3.6, HyMAP2 (Africa-only)
Resolution: 0.1 degree (~10 km), monthly
Latency: Prelim: ~5th of next month
Final: ~20th of next month
Forcings: Prelim: CHIRPS-prelim (precipitation); GDAS (non-precipitation)
Final: CHIRPS-final (precipitation); MERRA2 (non-precipitation)

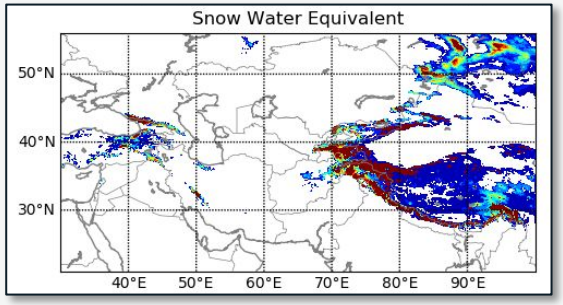
https://ldas.gsfc.nasa.gov/fldas; McNally et al. 2017, Nature

FEWS NET Land Data Assimilation System

FLDAS-Global



FLDAS-Central Asia

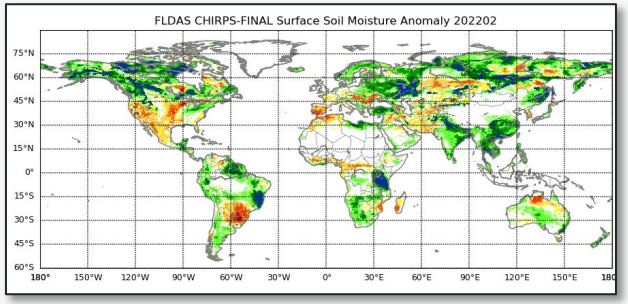


Models: Noah 3.6, Noah-MP 4.0.1
Resolution: 0.01 degree (~1 km), daily
Latency: Near real-time (~ next day)
Forcings: GDAS

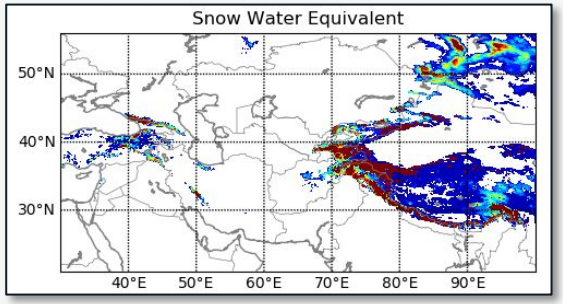
https://ldas.gsfc.nasa.gov/fldas; *McNally et al. 2033, ESSD*

FEWS NET Land Data Assimilation System

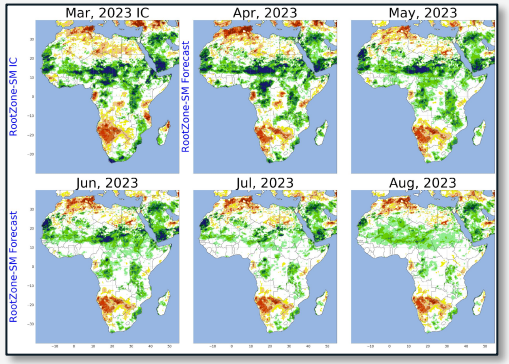
FLDAS-Global



FLDAS-Central Asia



FLDAS-Forecast

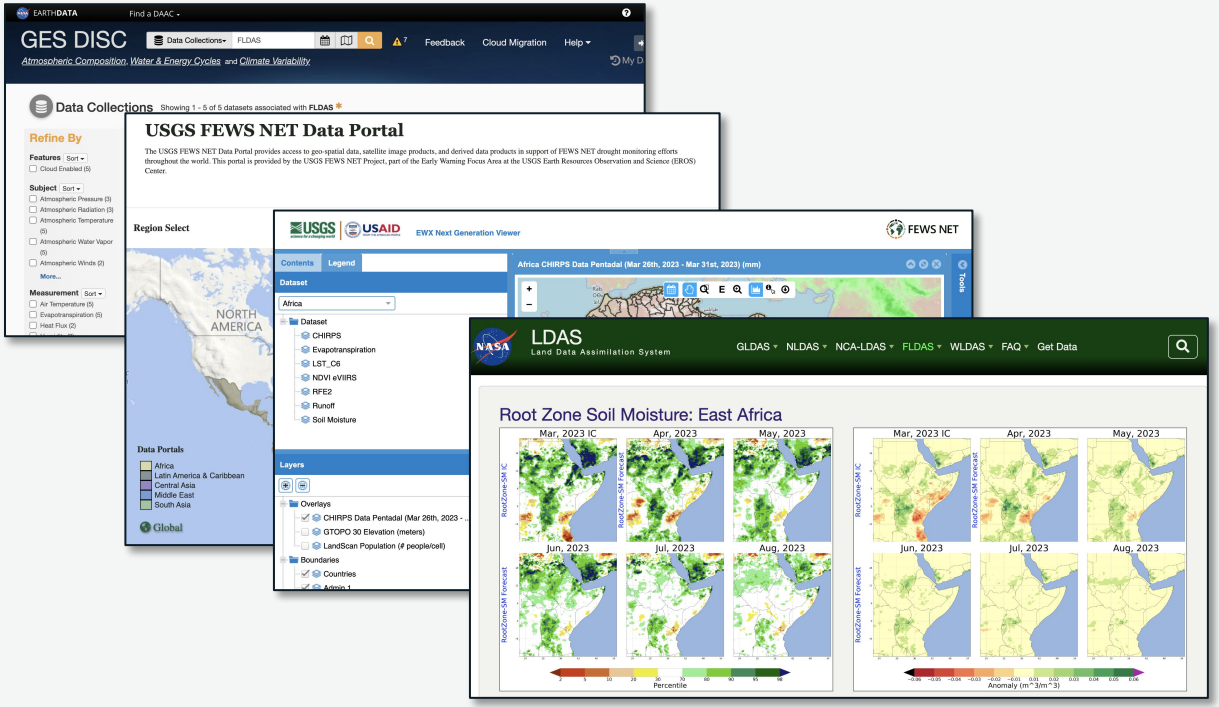


Models: Noah-MP 3.6, NASA Catchment (CLSM)
Resolution: 0.25 degree (~25 km), monthly
Latency: ~15th of first forecast month
Forcings: Initial Conditions: CHIRPS (precip.); MERRA2 (non-precipitation)
Forecasts: North American Multi-Model Ensemble (NMME; precipitation); GEOS (non-precipitation)
Forecasts: Out to 5 months

https://ldas.gsfc.nasa.gov/fldas; Hazra et al, 2023, J. of Hydr.; Arsenault et al. 2020, BAMS

FLDAS Data Access

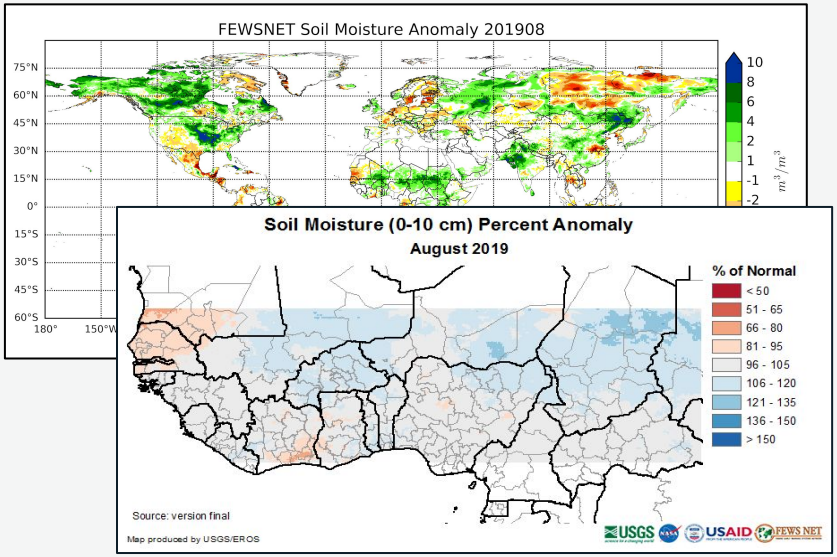
Many Sources



- FLDAS Website (https://ldas.gsfc.nasa.gov/fldas)
- Cloud (Google Earth Engine, Climate Engine)
- Partner Websites (USGS FEWS NET Website,, UCSB EWX)
- GES DISC (https://disc.gsfc.nasa.gov/datasets?keywords=FLDAS)
- NCCS Discover and CSS

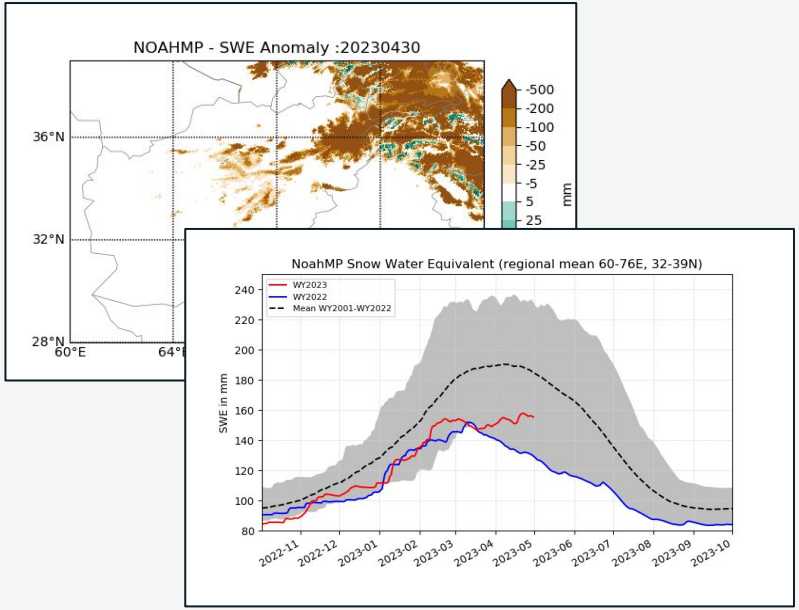
Derived Products: “Quick-Look” Indices

Soil Moisture Anomalies and Percent Anomalies



https://ldas.gsfc.nasa.gov/fldas, https://earlywarning.usgs.gov/fews

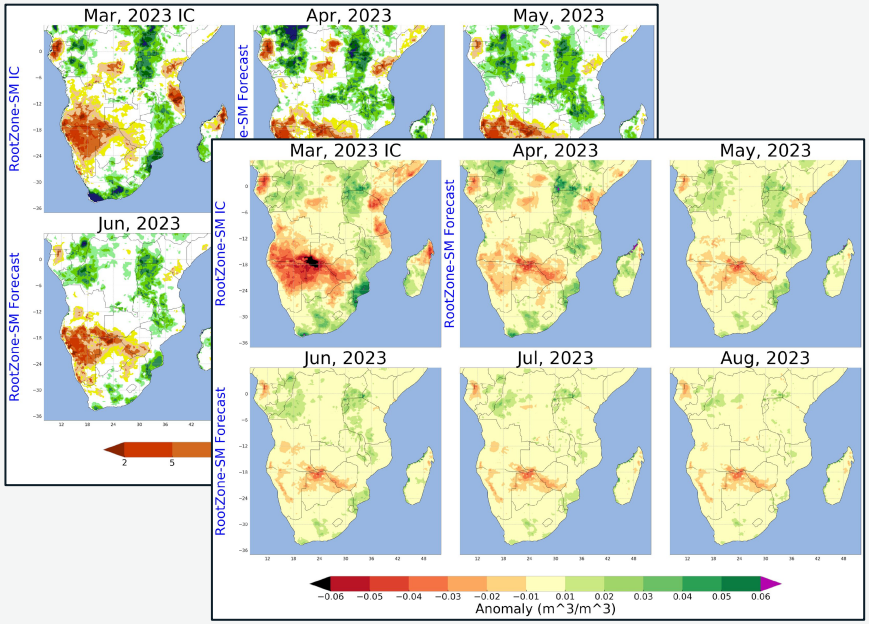
Snowpack Development and Depletion



https://ldas.gsfc.nasa.gov/fldas

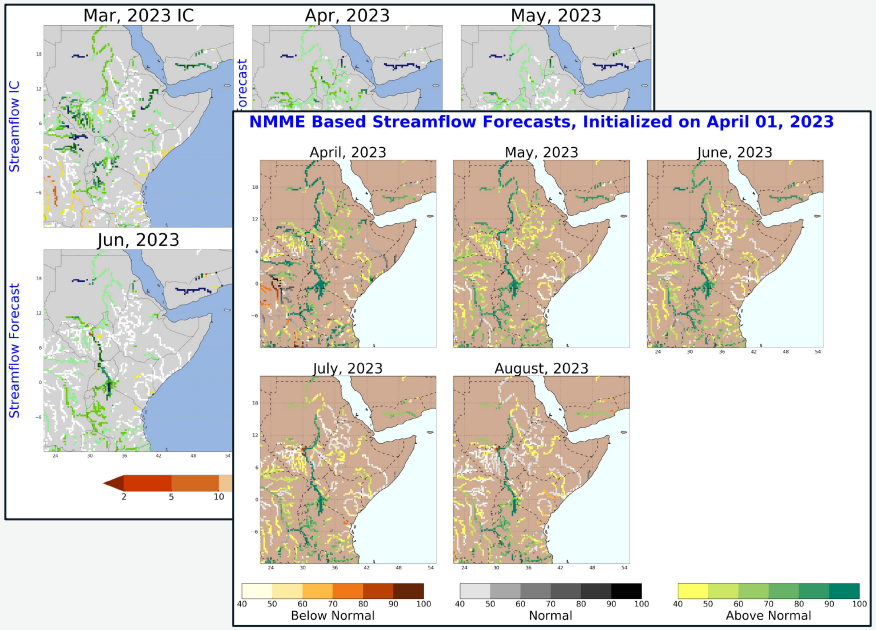
Derived Products: “Quick-Look” Indices

Soil Moisture Forecasts



https://ldas.gsfc.nasa.gov/fldas

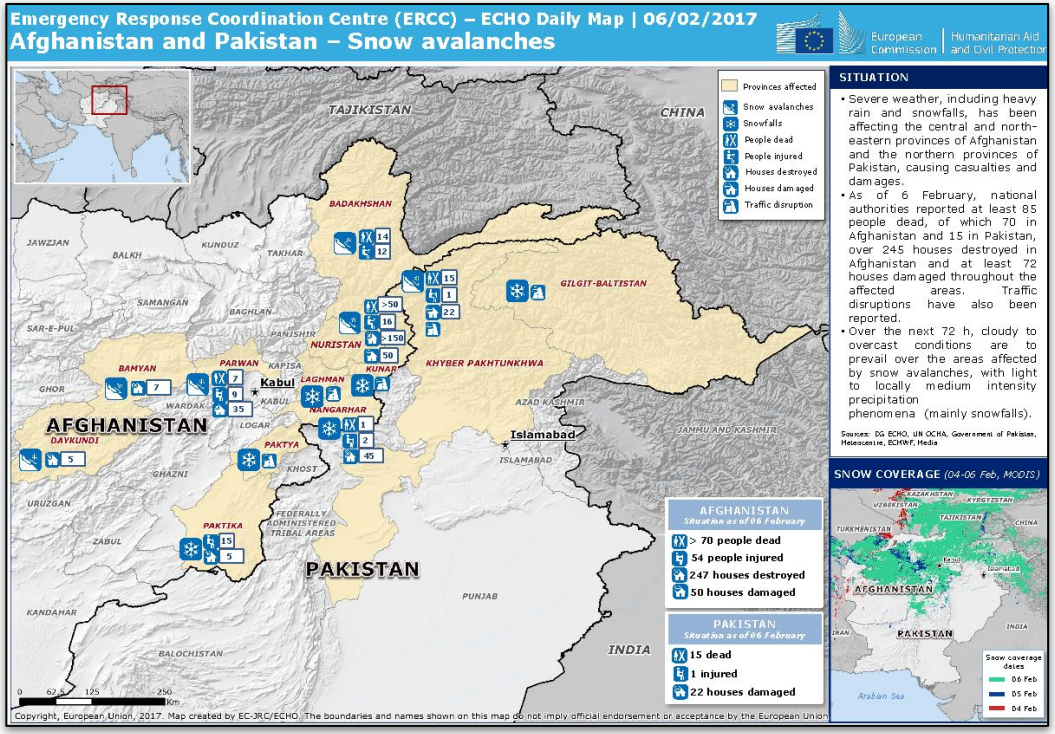
Streamflow Forecasts

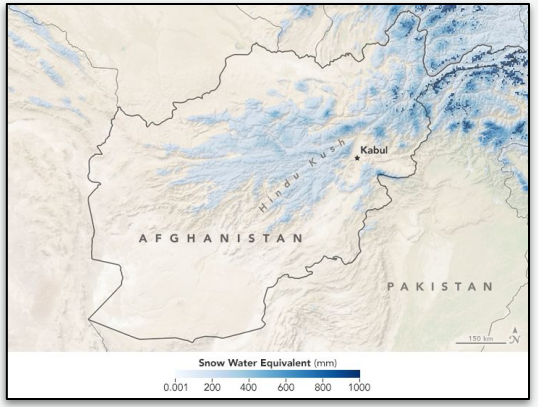


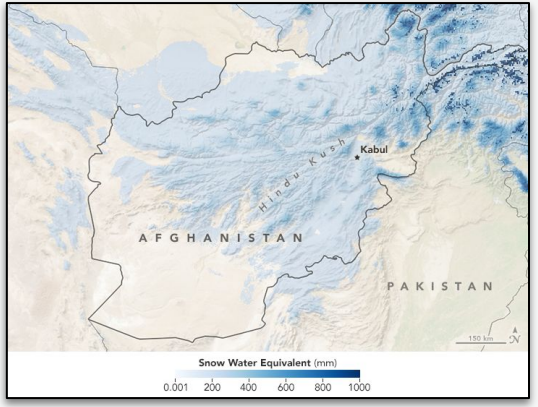
https://ldas.gsfc.nasa.gov/fldas

FLDAS Case Studies: Afghanistan

2017 Heavy Snow + Avalanches



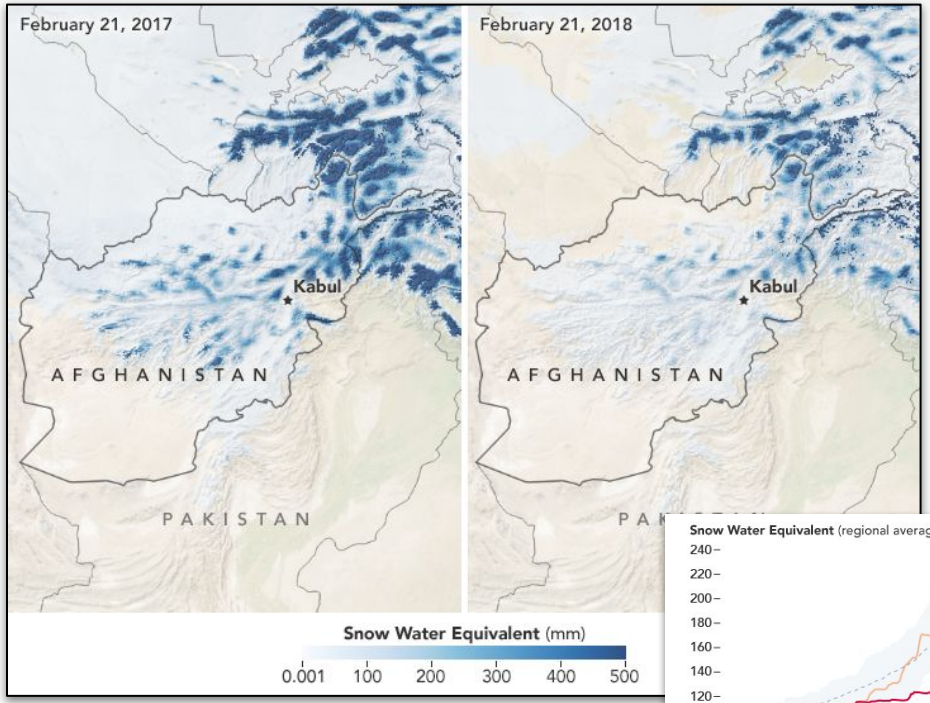


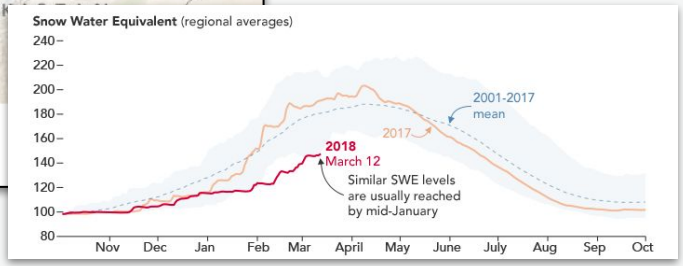


https://earthobservatory.nasa.gov/images/89674/widespread-snowfall-in-afghanistan

FLDAS Case Studies: Afghanistan

2018 Poor Rangeland Conditions + Below-Average Water Availability





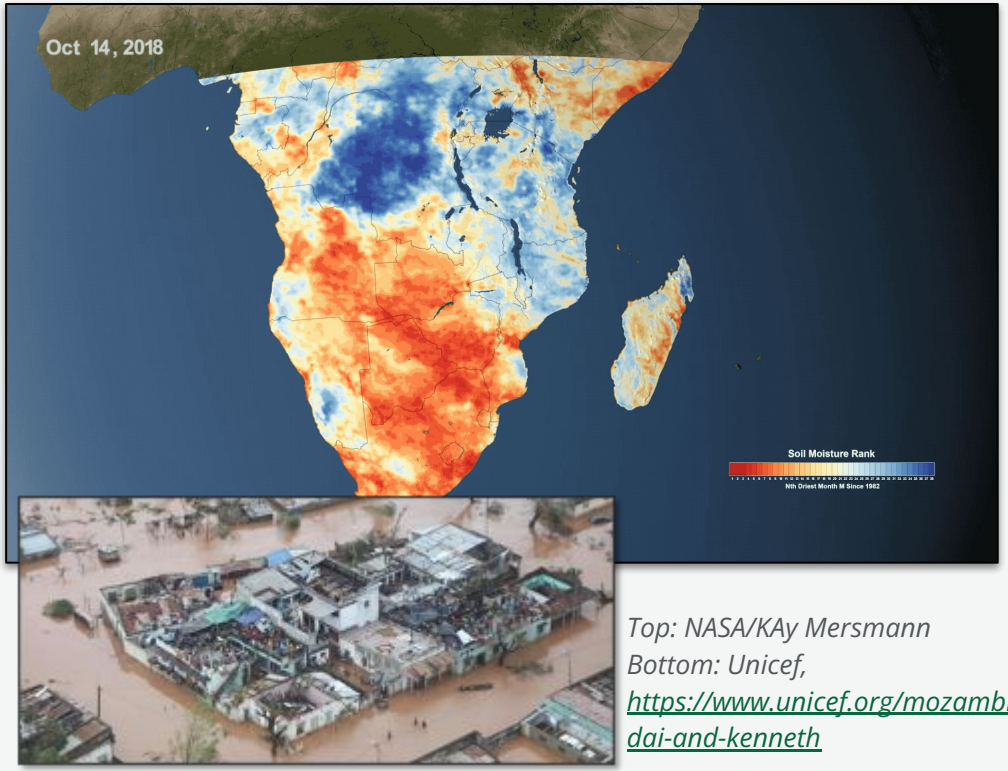
https://earthobservatory.nasa.gov/images/91851/record-low-snowpack-in-afghanistan

FEWS NET Afghanistan Food Security Outlook, April, 2018

*"**Below-average precipitation throughout most of the country during the October 2017 – May 2018 wet season has led to very low snowpack** in most hydrological basins. Low irrigation water availability is likely to have an adverse impact on yields for winter wheat and other main season and second season staples (barley, maize, and others), particularly in downstream areas in regions with limited rainfall"*

FLDAS Case Studies: Southern Africa

2019 Poor Rains + Cyclones Idai and Kenneth



Top: NASA/KAy Mersmann
Bottom: Unicef,
https://www.unicef.org/mozambique/en/cyclone-idai-and-kenneth

FEWS NET Southern Africa Food Security Outlook, February-September, 2019

*"**Southern Africa experienced a very poor rainy season**, with the greatest deficits in the western half of the region. The eastern half, however, has seen **heavy precipitation and flooding most notably from recent cyclonic activity**. Widespread drought and flooding have together driven extensive crop losses in many areas and below-average production is anticipated in most countries."*

FLDAS Case Studies: East Africa

2021-2022 Horn of Africa Experiences Five Consecutive Seasons of Drought for First Time in History

Data from: https://ldas.gsfc.nasa.gov/fldas

FEWS NET Horn of Africa Reporting

*"In the eastern Horn of Africa… **drought has persisted through five consecutive rainfall seasons, resulting in multiple failed harvests, the loss of millions of livestock, and widespread water scarcity.** These impacts have devastated local livelihoods and driven a sharp decrease in access to food and water, leading to a subsequent severe deterioration in nutritional status and excess hunger-related deaths."*

https://fews.net/topics/special/horn-africa, accessed May 22, 2023

FEWS NET Land Data Assimilation System

Links and Contact Information

- FEWS NET Land Data Assimilation System: https://ldas.gsfc.nasa.gov/fldas
- Latest model products:
  - FLDAS-Global: https://ldas.gsfc.nasa.gov/fldas/models/global
  - FLDAS-Central Asia: https://ldas.gsfc.nasa.gov/fldas/models/central-asia
  - FLDAS-Forecast: https://ldas.gsfc.nasa.gov/fldas/models/forecast
  - FLDAS on GES DISC: https://disc.gsfc.nasa.gov/datasets?keywords=FLDAS
- Famine Early Warning Systems Network: https://fews.net/
- NASA Land Information System Software Suite: https://lis.gsfc.nasa.gov/
- NASA Center for Climate Simulation High Performance Computing Resources: https://www.nccs.nasa.gov/

For more information: kimberly.slinski@nasa.gov