Too Much and Too Little Water

Examples of collaborative research between NOAA/OAR/PSD and the Office of Water Prediction to improve understanding of physical processes represented in the National Water Model and to guide future model development.

Improving Flash Flood Forecasts Using the National Water Model

This project evaluates the impact of ensemble high resolution precipitation forecasts to better characterize uncertainty in streamflow predictions.

By Kelly Mahoney

National Water Model Soil Moisture Evaluation

This project evaluates the skill of the NWM's representation of land–surface processes to guide improvements in model forecasts of extreme events.

By Robert Zamora

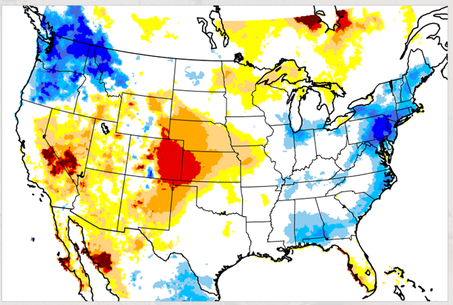
Drought Monitoring Using the National Water Model

This project evaluates the performance of the NWM for drought monitoring and nowcasting in support of the National Integrated Drought Information System (NIDIS) and the U. S. Drought Monitor.

By Mimi Hughes

EDDI – Evaporative Demand Drought Index

This online guidance tool developed at PSD provides early warning of agricultural and hydrologic drought and fire-weather risk by using near-real-time information about the "thirst of the atmosphere."



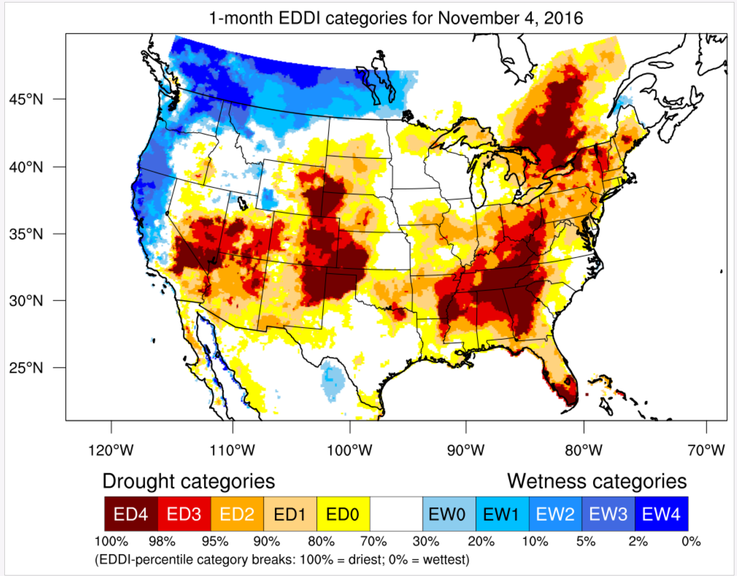
By Mike Hobbins

Meet EDDI - The Evaporative Demand Drought Index

Mike Hobbins

Mapping the Demand Side of Drought

EDDI is the anomaly in **evaporative demand** at a specified timescale, expressed as a percentile.



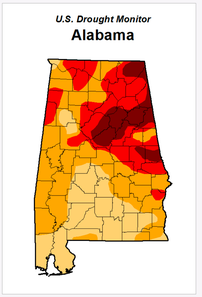
1-month EDDI for the period including both events at right (*NOAA Physical Sciences Division*).

Maps show regions where the near-surface atmosphere is drier than normal (warm colors) or wetter (cool colors). The atmosphere and surface moisture conditions are linked through evaporative demand.

Providing Drought Early Warning

EDDI gives early warning of:

- agricultural drought (low soil moisture, crop stress)
- hydrologic drought (low streamflow)
- "flash drought" (rapid-onset drought)



(Right) Lake Catoma, AL, October 27, at the height of the 2016 drought (*Amanda Shavers-Davis, The Cullman Times*), as depicted by the US Drought Monitor map for Alabama for October 25 (left).

Predicting Wildfire Risk

EDDI reflects fuel loads and fire weather.

(Right) The Rough Ridge Fire burning in the Cohutta Wilderness, GA, November 4, 2016 (*National Wildfire Coordinating Group*).

Transitioning to National Water Center

EDDI co-production with stakeholders

Stakeholder engagement is integral to development:

- Outreach to and engagement of potential users
- Feedback from users – social science
- Re-tooling of product, new features – physical science
- Repeat with larger user groups

Transition to operations

EDDI is slated for national operations at the NOAA-Office of Water Prediction's National Water Center.

3-year, JTTI-funded transition to operations.

Operational by May, 2019.

National Water Model Ensemble Prototype for Flash Flood Forecasting

Kelly Mahoney

Overview

Flash flood forecasters increasingly require uncertainty information/probabilistic guidance

National Water Model may provide flash flood forecast guidance via streamflow and hydrologic forecast grids.

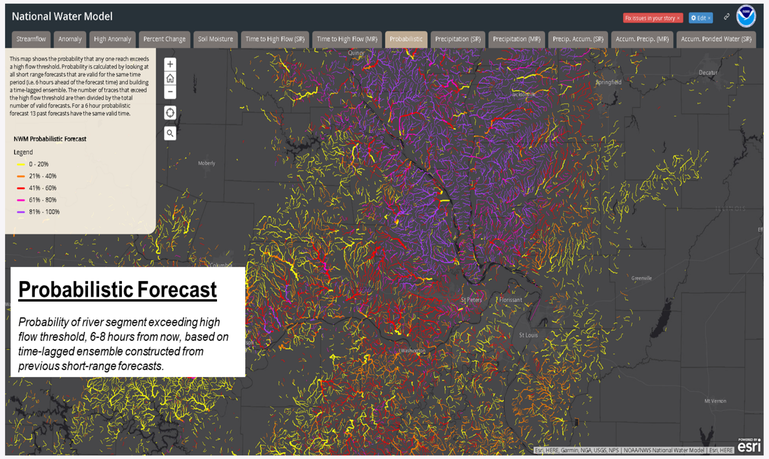
- Current NWM short-term forecast is deterministic
- USWRP/NOAA Hydrometeorology Testbed project developed probabilistic NWM forecast

Tropical Storm Cindy 2017 flooding

Methods

Create probabilistic real-time NWM forecasts

Use time-lagged High Resolution Rapid Refresh (HRRR) model to generate ensemble probabilities



- Real-time products designed in close collaboration with operational forecasters and NOAA testbed coordinators
- National Water Center implemented real-time web-mapping service for dissemination and display of products

Results

Verify and evaluate utility of probabilistic forecasts

- Subjective verification from forecaster surveys, discussion; objective verification metrics developed
- NWC, WPC using 2017 FFaIR feedback to shape future visualization development, 2018 FFaIR

"There is much anticipation from the hydrology community to see more probabilistic guidance emerge from the National Water Model." –2017 FFaIR Final Report

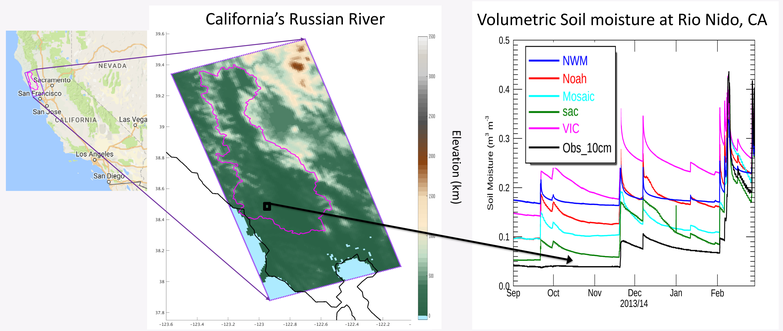
National Water Model Soil Moisture Products for Drought Monitoring

Mimi Hughes

Overview

Applying the National Water Model for Drought Monitoring

NOAA's new National Water Model (NWM) offers fine spatial and temporal analyses and predictions of hydrologic variables of relevance to drought monitoring and forecasts. We present preliminary results exploring the potential for NWM soil moisture nowcasts to inform drought monitoring.



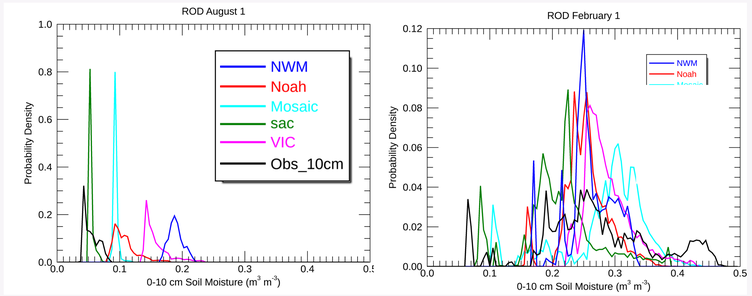
Modeled and Observed Soil Moisture in CA's Russian River

Although the NWM covers the Contiguous U.S., we focus on California's Russian River watershed (a NIDIS Pilot basin) to prototype the NWM drought products because of the NOAA Physical Sciences Division's (PSD's) instrumentation network in that basin. We compare NWM soil moisture to observations and to other gridded datasets currently used to inform the National Drought Monitor.

Methods

Climatological distributions of soil moisture

Because drought monitoring relies on accurate representation of climatological soil moisture values to establish anomalies, we begin our analysis focused on comparisons of this climatology in the NWM with climatologies from in situ soil moisture observations and from the North American Land Data Assimilation System version 2 (NLDAS-2).



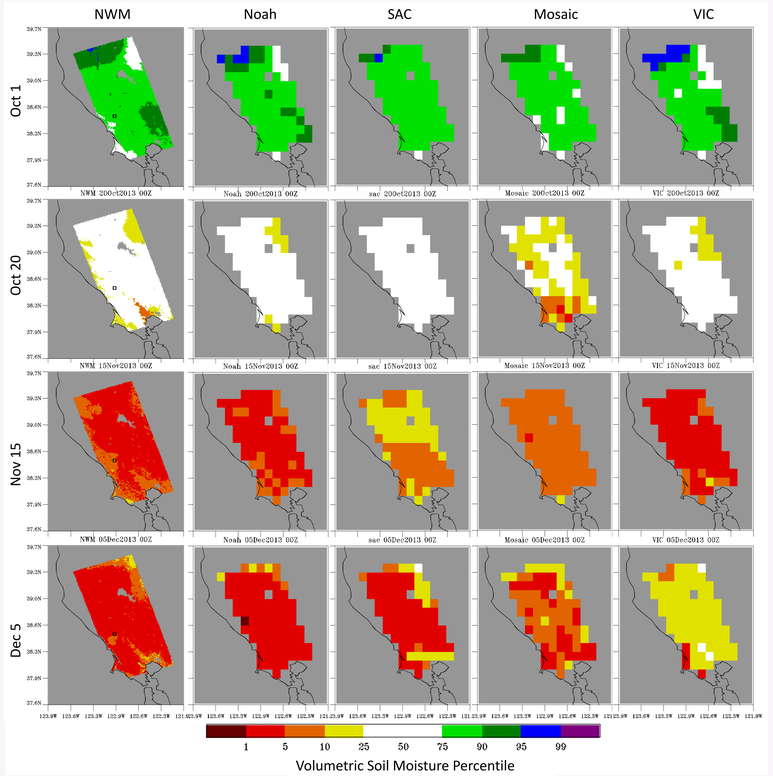
Estimated Probability Density Functions (PDFs)

We created the above PDFs from ~10 years of historical data for the NWM, the 4 NLDAS2 models, and the in situ observations. We then use these PDFs to determine the ranking (i.e., the percentile) of any given day's soil moisture compared to the climatology. We compare the percentile soil moisture values for a case study across models and to the in situ observations.

Results

An example of NWM soil moisture during drought

Percentiles of soil moisture in the NWM and the 4 NLDAS2 models all show increasing dryness during the fall-winter of 2013, when California was in severe and worsening drought.



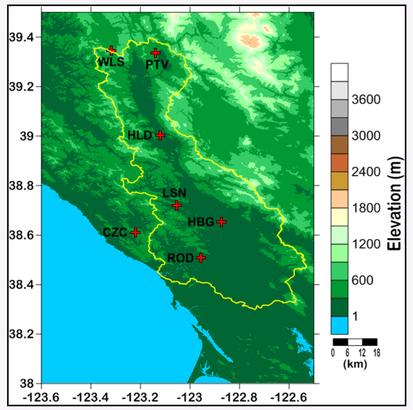
National Water Model Soil Moisture Evaluation

Robert Zamora

Overview

This project evaluates the skill of the NWM's representation of land–surface processes to guide improvements in model forecasts of extreme events.

- Compare the PSD Russian River soil moisture observations with NWS/OWP National Water Model soil moisture simulations
- Assess the representation of soil physical processes in the NWM



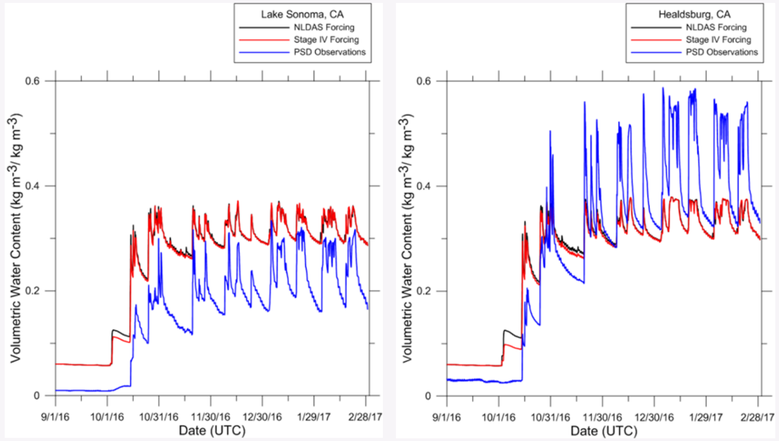
Red crosses show the locations of the Russian River soil moisture observing stations at Cazadero, (CZC) Rio Nido (ROD), Lake Sonoma (LSN), Healdsburg (HBG), Hopland (HLD), Potter Valley (PTV), and Willits (WLS).

Method

NWM Configuration

- NWM version 1.1.2
- Noah MP LSM 1-km grid, 250 m routing
- NLDAS-2 and Stage IV precipitation forcing
- 1-h LSM time step
- Simulation period: 1 September 2016 – 1 March 2017
- 10 cm soil moisture observations compared with 0-10 cm NWM model layer

Intercomparison



Results

Site	R^2 NLDAS	R^2 Stage IV	NSE NLDAS	NSE Stage IV
CZC	0.82	0.80	0.24	0.27
HBG	0.86	0.87	0.76	0.77
LSN	0.88	0.90	-0.17	-0.12
PTV	0.93	0.94	0.68	0.67
ROD	0.76	0.75	0.31	0.34
WLS	0.91	0.90	0.06	-0.04

NSE = Nash Sutcliffe Efficiency

- The NWS/OWP National Water Model can reproduce the observed soil volumetric water content in the Russian River Basin with skill
- The NWM simulated soil moisture responds faster to the initial wet season precipitation than indicated by the observations.
- Calibration parameters and the model soil hydraulic properties could be responsible for the differences shown here
- Future research will focus on using the SSURGO soil data sets in the NWM cutout. The county soil surveys are complete for the basin and could enhance the performance of the NWM.