High Resolution Indicators for Local Drought Monitoring

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Monitoring Drought

- Multiple indicators, multiple sources
- Local detail important
Point-Based

Climate-Division Level

http://drought.unl.edu/MonitoringTools/ClimateDivisionSPI/ArchivedSPIMaps.aspx

http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/regional_monitoring/palmer.gif
How do we get Local Detail?

- Utilize Multisensor Precipitation Estimates (MPE)
- Combination of:
  - Radar-derived precipitation
  - Surface gauge observations
  - Satellite-derived precipitation
  - PRISM-precipitation
  - Calculate drought indices

MPE -- Advantages

- High-resolution (4.7625 km)
- Available over contiguous US
- Estimates precipitation where no/few gauges located
- Updated daily (12UTC to 12UTC)
MPE -- Disadvantages

- Limited in areas with:
  - Poor radar coverage
  - Few surface observations

PRISM Grids

- Parameter-elevation Regressions on Independent Slopes Model
- Interpolation of station-based precipitation measurements
- Takes into account:
  - Elevation
  - Topographic facet
  - Proximity to water bodies
- PRISM normals (1981-2010)
- Daily and monthly
- Temperature
- Precipitation (historical)
High Resolution Drought Indicators

- Precipitation
- Percent of Normal
- Standardized Precipitation Index (SPI)
  - SPI Blend
- Keetch-Byram Drought Index (KBDI)
- Palmer Drought Indices (Z-Index, PHDI, PDSI, PMDI)
- Standardized Precipitation Evapotranspiration Index (SPEI)
Standardized Precipitation Index (SPI)

- Proposed by McKee et al., 1993
- Precipitation-based drought index
- Observed precipitation is represented as standard deviations away from mean
- SPI is normally distributed
  - Mean and median equal zero
  - Values typically ±2
- Multiscalar
- Normalized to location’s historical distribution

SPI

- Sum MPE for given time scale
- Sum PRISM normals for same time scale
- Divide MPE by PRISM
- Calculate cumulative probability
  - Use interpolated distribution parameters
- Transform using inverse normal function to SPI
SPI Evaluation

- Comparison against SPI from:
  - WWDT (PRISM-based)
  - NCDC (station-based; climate division)
  - DDIT (station-based; multiple spatial units)

- Strongly correlated at climate division scale
- Pixel-to-station comparisons show strong agreement
- Offers spatial and temporal detail not captured in other products
SPI Blend

• Proposed by McRoberts and Nielsen-Gammon (2011)
• Premise: Current drought severity influenced by recent precipitation
  • Conventional SPI gives equal weight to all precipitation
• SPI Blends give greater weight to more recent precipitation
  • All other aspects of calculation the same
SPI Blend Evaluation

• Comparison to “conventional” SPI and USDM
  • 2012 Central Great Plains Drought
  • 2007-2008 Carolinas Drought

• Results:
  • SPI better matched USDM in Carolinas
  • SPI Blend better matched USDM in Great Plains

• Comparison to in situ soil moisture
  • SPI Blend better match

How can I view these?

www.climate.ncsu.edu/drought
In Progress...

Palmer Drought Indices

- Palmer, 1965
- Simplified climatological balance for each month
  - ET, Runoff, Soil Recharge and Loss, etc.
- Calculate historical “climatologically appropriate” values
  - Use PRISM temp and precip
  - Over 1981-2010 period
- Data:
  - Summed daily MPE
  - Monthly PRISM temperature
Monthly Palmer Drought Indices

- In the process of evaluating
- Will be added to web display
- Next steps: updated daily??

Keetch-Byram Drought Index (KBDI)

- Developed in 1960s by 2 fire scientists at USFS
- Represents depth of dryness in soil
- Varies from 0 (no dryness) to 800
- Don’t need to measure soil moisture
  - Uses daily maximum temperature, daily total precipitation, annual average precipitation
KBDI

• Preliminary evaluation is promising
• Comparison to station-based (and gridded?) KBDI to come

Standardized Precipitation Evapotranspiration Index (SPEI)

• Developed by Vicente-Serrano et al., 2010
• Based on climatological balance:
  • Precipitation – Potential Evapotranspiration
  • Computationally similar to SPI
• Use daily MPE, daily PRISM temperature
• Right now:
  • Historical distribution parameters
  • Preliminary SPEI
  • Evaluation to come next
What’s next?

- Incorporate into active drought (water) monitoring
- Can we establish relationships with drought indicators?
  - Soil moisture
  - Streamflow
  - Groundwater
  - Vegetation (NVDI)

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Partners:
Questions?

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