Food and Agriculture Organization of the United Nations

DROUGHT MONITORING AND FORECASTING

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DROUGHT MONITORING

- Drought is difficult to measure and define
  - Limits approaches for drought characterization

- The need to monitor drought conditions has encouraged multiple efforts
  - Developing drought indicators
  - Different applications (regions affected and data availability)

- Variety of hydro-meteorological variables
  - Precipitation and soil moisture
  - Streamflow, Groundwater and Snow
  - Evapotranspiration
  - Vegetation.

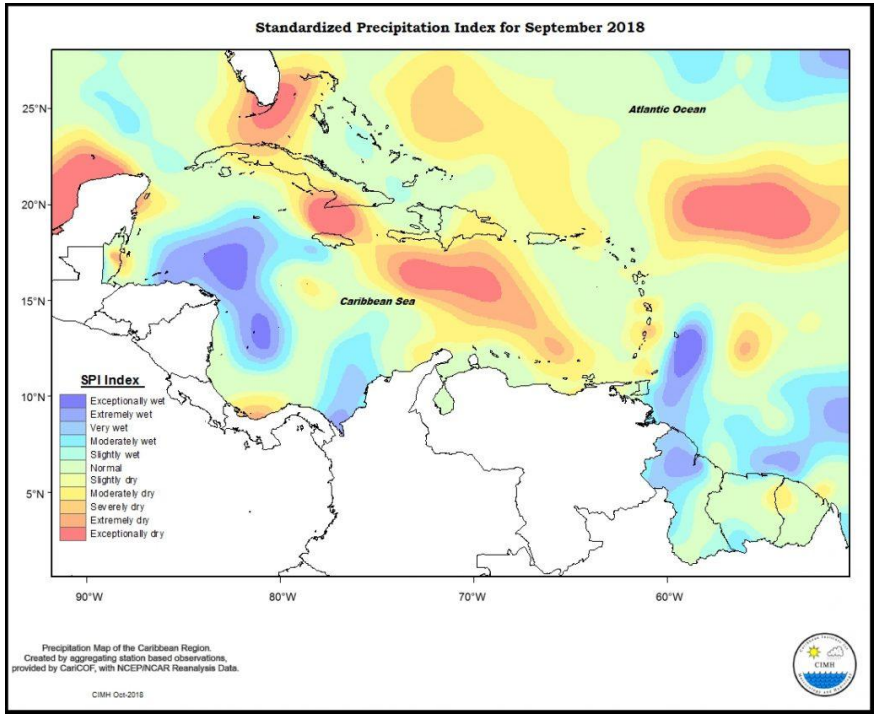
DROUGHT FORECASTING

- **Reliable prediction includes**
  - Drought onset
  - Development/progress
  - Recovery

- **Effective early warnings/prediction can be achieved**
  - through statistical approaches to explore empirical relationships in historical records
  - dynamical approaches based mostly on general circulation models (GCMs).

Drought monitoring

- Traditional drought monitoring
  - Based on in situ observations of hydroclimatic variables
  - Observation networks at local scales
- Drought characterization at regional scales
  - Limited due to sparse observation
  - Networks for some critical variables are missing (e.g. soil moisture)
- Substantial advances have been achieved in the availability of datasets
  - Remote sensing products
  - Land surface model simulations
  - Impact data – including sectoral impacts.



Drought monitoring

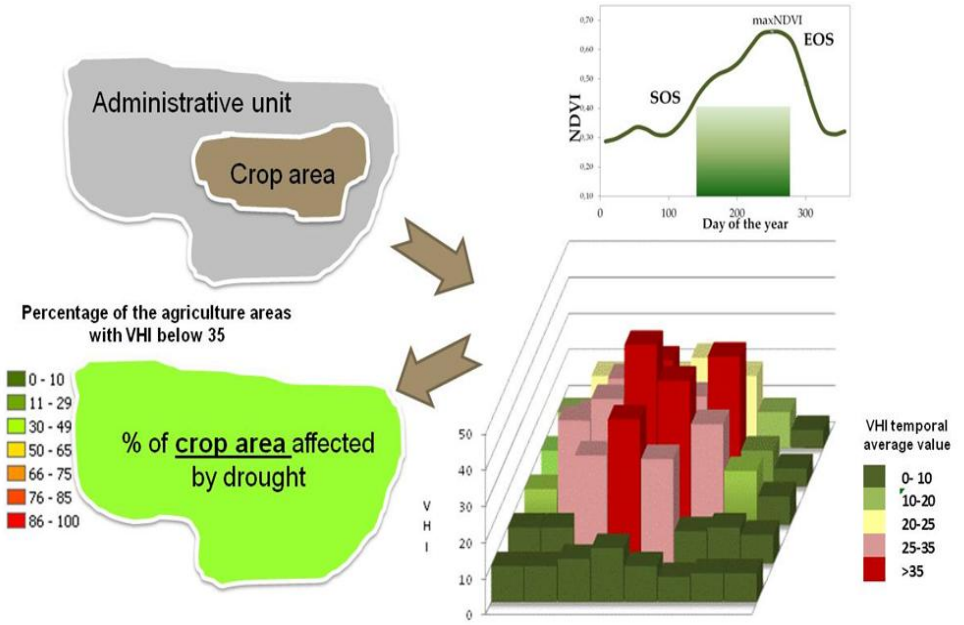
- Remote sensing provides continuous and consistent observations
  - Drought characterizations at regional and global scales
  - Led to new developments in drought monitoring
    - normalized difference vegetation index (NDVI)
    - evaporative stress index (ESI)
- Accurate drought monitoring - track the propagation of drought
  - Land surface model (LSM) simulations provide opportunities
- Monitoring drought impacts on the environment and society
  - crop yield failure, vegetation stress, and water quality degradation

Drought Monitoring

- Integrated drought monitoring based on the composite or multivariate drought indicators
  - Characterize complicated processes and impacts of drought
    - E.g. U.S. Drought Monitor (USDM), developed in 1999
  - Blending of multiple drought indicators and impacts with experts' inputs to characterize drought
- Integration of various data sources without losing the advantages of existing systems is desirable.
- Regression approach has been proposed to model drought categories
- Estimating probabilities of drought categories falling in various categories of drought
- Integrated drought monitoring
  - multivariate standardized drought index (MSDI)
  - standardized precipitation evapotranspiration index (SPEI).
- Percentile-based approach allows for comparing and consolidating different drought indicators

Agricultural Stress Index System

- Based on 10-day (dekadal) satellite data of vegetation and land surface temperature from the METOP-AVHRR sensor at 1 km resolution
- ASIS is based on the Vegetation Health Index (VHI), derived from NDVI
- VHI can detect drought conditions at any time of the year.
- At the country level, ASIS could be used in developing a remote sensing-based index for crop insurance.
- This index was successfully applied in many different environmental conditions around the globe.
- For agriculture, the period most sensitive for crop growth - so the analysis is performed only between the start (SOS) and end (EOS) of the crop season and restricted to crop areas.
- ASIS assess the severity (intensity, duration and spatial extent) of the agricultural drought and express the final results at administrative level.



DROUGHT PREDICTION

- The drought prediction - forecast of several crucial meteorological variables
  - Precipitation, soil moisture and temperature
- Statistical approaches - based on empirical relationships in historical records
  - NOT consider underlying physical mechanisms
  - regression model
  - useful due to their ease of implementation
- Drought forecasts from these approaches are generally used as a baseline/benchmark for dynamical forecasts
- Provide complementary forecast information in certain seasons and/or regions.

Drought prediction

- Dynamical approaches rely on GCMs (extended weather forecast models or seasonal climate models)
  - generally based on physical processes of atmosphere, ocean, cryosphere, and land surface - meteorological drought forecast.
- The seasonal climate predictability
  - The memory in tropical oceans via ocean–atmosphere teleconnections
  - The regional precursors such as stratospheric condition and soil moisture anomaly
- Limitation of coarse resolution - downscaling
  - Coupling with the hydrologic model and matching the performance of statistical approaches.
- Characterizing uncertainties associated with hydroclimatic predictions from various sources is important
  - The Hydrological Ensemble Prediction Experiment includes important initiatives
  - Uncertainty quantification with various post processing procedures for hydrologic forecast of rare events, including droughts and floods.
- Statistical and dynamical approaches come with specific strengths and limitations
  - Integration of both methods (or the hybrid statistical–dynamical method).

Thank you !