How to define Drought Hazard? Which global datasets could be used?

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Source: National Drought Mitigation Center, University of Nebraska-Lincoln, USA
**EM-DAT**  
International Disaster Database - Centre for Research on Epidemiology of Disaster (CRED). Gathering information on natural and technological disasters at **country level** worldwide.  
**1900 to the present.**

**GPCC**  
Global monthly precipitation data based on in-situ rain gauge measurements. Data from 190 national weather services. Observed monthly totals from > 65,000 stations since 1901. Available in near-real time at 2.5° and 1.0° resolutions; non real-time products available at **0.5° resolution.** Operated by German Weather Service under the auspices of WMO.  
**1901 to the present.**

**ERA Interim**  
Global atmospheric reanalysis produced by the European Centre for Medium-Range Weather Forecasts (ECMWF). Available at approx. **1.0° resolution.** Available for the period **1979 to the present.**
**GPCP**
Produced at NASA GSFC the Global Precipitation Climatology Project (GPCP) is a global precipitation product that uses multiple sources of observations. Data from over 6000 rain gauge stations, together with satellite observations, are merged to estimate monthly rainfall on a 2.5° global grid from 1979 to the present.

**CRU**
Climatic Research Unit (CRU). 0.5° (time series) to 5.0° gridded datasets of monthly terrestrial surface climate variables for the period of 1901 to present. The spatial coverage extends over all land areas, including oceanic islands but excluding Antarctica. Based on observations by NMS.

**TRMM**
Tropical Rainfall Measuring Mission (TRMM): joint mission of NASA and the Japan Aerospace Exploration Agency (JAXA) designed to measure rainfall, in particular in the tropical regions. Gridded monthly estimates at 0.25° spatial resolution Global between 50° S to 50° N latitude.

3-hourly high quality/IR estimates are summed for the month; rain gauge data are used to apply a bias adjustment.
**SPEI**

Global monthly information at **0.5° spatial resolution**. **1901 to the present**.

Based on monthly precipitation and potential evapotranspiration from the CRU dataset.

**Soil Moisture**

Estimates available at different spatial and temporal resolutions and from different **distributed hydrological models** and land surface schemes of global climate models.

Estimates available from **microwave satellites** at different and temporal spatial resolutions (ECV soil moisture data set).

Distributed by ESA; Period from **1978 to 2010, 0.25° spatial resolution, layer of top 2 cm**.

**Vegetation**

Global data available at about **1km spatial resolution** from different satellites. **Starting from the late 1990s**.
EM-DAT Database: Drought Events 1951 to 2010 (Global)

<table>
<thead>
<tr>
<th>Continent</th>
<th>Occurrence</th>
<th>Total deaths</th>
<th>Total affected</th>
<th>Total damage ('000 US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>249</td>
<td>697,143</td>
<td>325,150,705</td>
<td>2,920,593</td>
</tr>
<tr>
<td>Americas</td>
<td>120</td>
<td>77</td>
<td>65,108,841</td>
<td>20,811,139</td>
</tr>
<tr>
<td>Asia</td>
<td>142</td>
<td>1,513,389</td>
<td>1,681,286,029</td>
<td>34,109,865</td>
</tr>
<tr>
<td>Europe</td>
<td>37</td>
<td>2</td>
<td>10,482,969</td>
<td>21,461,309</td>
</tr>
<tr>
<td>Oceania</td>
<td>19</td>
<td>660</td>
<td>8,027,635</td>
<td>10,703,000</td>
</tr>
<tr>
<td>Sum</td>
<td>567</td>
<td>2,211,271</td>
<td>2,090,056,179</td>
<td>90,005,906</td>
</tr>
</tbody>
</table>

For Comparison:

estimated economic damage in Europe 1976 to 2005: 100 Billion Euros
Drought Events – the last 20 years 1995 to 2014 (cumulative)

Source: JRC elaborations on EM-DAT data, 2015
How to define a meteorological drought?

**Standardized Precipitation Index (SPI)**

- **Start:** first month with the SPI below the threshold (here -1)
- **End:** last month with the SPI below the mean (= 0)
- **Duration:** number of months of the event
- **Severity:** sum of the absolute differences between indicator and mean
- **Intensity:** severity divided by duration
Drought Hazard

Number of months under meteorological drought conditions during a given period of time (with respect to the long-term climatology)

Indicator: SPI-12

Climatology: 1951 to 2010 (740 months)

Period analyzed: 1991 to 2010 (240 months)

3 classes of drought severity; moderate, severe, extreme

<table>
<thead>
<tr>
<th>SPI Values</th>
<th>Category</th>
<th>Cumulative Probability</th>
<th>Probability of Event [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPI ≥ 2.00</td>
<td>Extreme wet</td>
<td>0.977 – 1.000</td>
<td>2.3%</td>
</tr>
<tr>
<td>1.50 &lt; SPI ≤ 2.00</td>
<td>Severely wet</td>
<td>0.933 – 0.977</td>
<td>4.4%</td>
</tr>
<tr>
<td>1.00 &lt; SPI ≤ 1.50</td>
<td>Moderately wet</td>
<td>0.841 – 0.933</td>
<td>9.2%</td>
</tr>
<tr>
<td>-1.00 &lt; SPI ≤ 1.00</td>
<td>Near normal</td>
<td>0.159 – 0.841</td>
<td>68.2%</td>
</tr>
<tr>
<td>-1.50 &lt; SPI ≤ -1.00</td>
<td>Moderately dry</td>
<td>0.067 – 0.159</td>
<td>9.2%</td>
</tr>
<tr>
<td>-2.00 &lt; SPI ≤ -1.50</td>
<td>Severely dry</td>
<td>0.023 – 0.067</td>
<td>4.4%</td>
</tr>
<tr>
<td>SPI &lt; -2.00</td>
<td>Extremely dry</td>
<td>0.000 – 0.023</td>
<td>2.3%</td>
</tr>
</tbody>
</table>
Total Drought Hazard (TDH) = Moderate*1.0 + Severe*2.0 + Extreme*3.0