REMOTE-SENSING BASED MODEL FOR DROUGHT IDENTIFICATION

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1. INTRODUCTION

Some quick facts about drought:

1. Drought affects every year an increasing number of people;
2. High economical losses;
3. Lack of data on past drought events;
4. No many tools available to easily and clearly identify drought events;
5. Many drought indices available, each considering a specific aspect of drought (meteorological, hydrological, agricultural).

2. AIM

The aim is the development of a model for drought event identification which is:

- Remote-sensing based;
- Near-real time;
- Trigger based.

The model considers precipitation and vegetation health; only periods in which vegetation stess is due to a lack of precipitation are considered as drought events. The model is useful for:

- Policy and decision makers;
- Governmental agencies;
- NGOs;
- Farmers.

3. DATASETS

Two datasets have been used, one for precipitation, the other for vegetation health:

- Precipitation: CMORPH v. 1.0 from 1998 to the end of 2016, and v. 0.x for the year 2017. The dataset has 25km spatial resolution, 3 hours temporal resolution and a global coverage [1].
- Vegetation Health: VHI Star Global Vegetation Health Products from January 1998 to June 2017. The dataset has 4km spatial resolution, weekly temporal resolution and global coverage [2].

4. METHODOLOGY

VHI data have been aggregated at 25km. Weekly SPI has been computed according to McKee et al [3], starting from [1]. Each grid cell is considered as affected by drought if SPI is lower than S_{inf} and VHI is lower than V. Drought ends when SPI is bigger than S_{sup}.

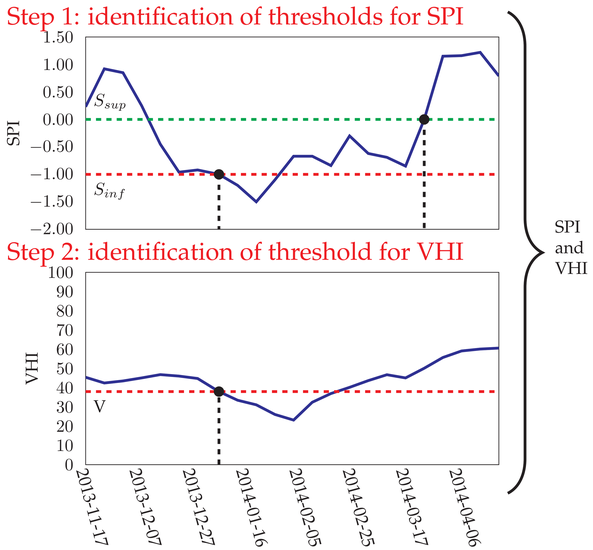

Figure 1: Identification of cells in drought condition using thresholds on SPI and VHI.

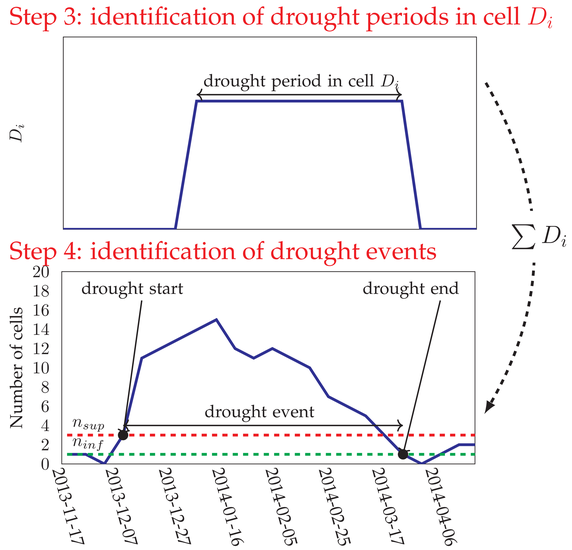

Figure 2: Identification of drought peridos and events

Drought periods in the single cells are determined (Step 3, **Figure 2**). A drought event starts when the numer of cells in drought condition is bigger than n_{sup} and ends when the number of cells in drought condition becomes lower than n_{inf} (Step 4, **Figure 2**). The model is then calibrated.

5. RESULTS

Two case studies have been implemented: Haiti and California. The reported drought events in the case of Haiti have been determined from reports found in ReliefWeb and documents written by NGOs [4]. The registered events in the case of California have been provided by the US Drought Monitor (Severe drought category was considered) [5]. **Figure 1** and **2** show a comparison between modeled and reported drought events for both the case studies.

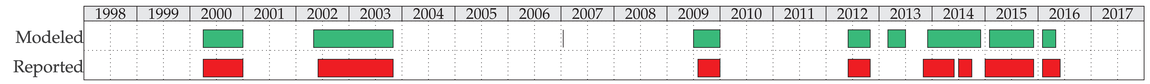

Figure 3: Haiti: Comparison between modeled and reported drought events.

Figure 4: California: Comparison between modeled and reported drought events.

Table 1 shows, on the basis of the 1010 weeks analyzed, how many correct and incorrect events were identified by the model.

	True positive	True negative	False alarm	Missing	POD	PFA	Skill score
Haiti	230	718	50	11	0.95	0.07	0.89
California	421	460	75	54	0.89	0.14	0.75

Table 1: Performance of the model over 1010 weeks for both the case studies.

6. CONCLUSIONS AND FUTURE RESEARCH

Performances are good for both case studies. The model has some advantages:

1. Can be applied also on countries without reliable historical ground-based data since it is based on remote-sensing data;
2. Can be easily implemented over the entire globe at country scale since datasets are global;
3. Can be updated in near-real time because it uses datasets with short latency time.

The same model will be implemented using CMORPH with 8km spatial resolution and 30 minutes temporal resolution.

7. REFERENCES

[1] NOAA, Climate Prediction Center: *CMORPH v.1.0, Raw, 0.25 degrees-3 hourly*, ftp://ftp.cpc.ncep.noaa.gov/precip/CMORPH_V1.0/RAW/0.25deg-3HLY/ (March 2018)
[2] NOAA STAR, Center for Satellite Application and Research: *STAR - Global Vegetation Health Products* ,ftp://ftp.star.nesdis.noaa.gov/pub/corp/scsb/wguo/data/VHP_4km/geo_TIFF/, (March 2018)
[3] T. McKee et al.: *The relationship of drought frequency and duration to time scales*, AMS 8th conference on Applied Climatology, (1993)
[4] ReliefWeb :*ReliefWeb search results for Haiti*, https://reliefweb.int/search/results?search=haiti(January 2018)
[5] US Drought Monitor: *US Drought Monitor Tabular Data Archive*, http://droughtmonitor.unl.edu/Data/DataTables.aspx, (January 2018)