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The Sudden Onset of the 2017 Northern High Plains Drought

Muthuvel Chelliah and David Miskus
Climate Prediction Center, NOAA/NWS/NCEP, College Park, MD

1. Introduction

Across the Northern Great Plains (NGP) states of the United States, in large parts of Montana, North Dakota and South Dakota, drought like conditions emerged suddenly in spring 2017, which progressively got worse quickly in late spring and summer lasting throughout the year, and the drought conditions have not eased even in early 2018. This brief note describes the conditions under which the NGP drought emerged, whether its emergence could have been identified a bit earlier, and for how long it is likely to last.

2. Drought fact and 2017 NGP condition

The first and foremost fact about this or any other drought is the very obvious, that, it is the consequence of the lack of, or significant deficit in, the "normal/expected precipitation" in a given region during a "certain time" of the year. The severity, extent and longevity of the resulting drought depend on how much the precipitation deficit is from normal levels, and for how long that deficit lasts. If that "certain time" of the year happens to be among the few months in the main rainy season for that region, then the consequences of the rainfall deficit possibly leading to the local drought is certain, and that drought conditions will probably last until next year when the rainfall season returns. In Fig. 1 is shown the sequence of weekly United States Drought Monitor (USDM) maps beginning with the week of 2nd May 2017 map, until the 18th May 2017 map. From these USDM maps, it appears that drought conditions were declared in very late May in eastern Montana and the Dakotas at the D0 level of drought and quickly spreading and intensifying in the subsequent weeks to the maximum D4 category by August and September (bottom two big panels of Fig.1). At the beginning of this sequence of maps, except for a small patch of drought in the southeast US, drought free conditions prevailed in general over much of the country, and by the end of summer into early fall, the Northern Plains Drought was the dominant meteorological event and newsmaker in the country.

3. Early detection of drought onset

Even though, once the Northern Great Plains (NGP) drought was forecast well, in successive months after the drought got established, the quick emergence and the sudden development of the drought caught many local farmers by surprise, and there was even an inkling if the NGP Drought was not "declared" even earlier, during the onset period. We will address this issue partly by using Figures 2 and 3. In Fig. 2, is shown the1-month (1st column), 2-months (middle column), and 3-months (last column) accumulated precipitation deficit (yellow/red) and surplus (blue/green) in months ending Jan 2017 through May 2017. Medium percent of annual precipitation during the different 3-month calendar seasons for the United States (courtesy of Rich Tinker, CPC/NCEP) are shown in Fig. 3. Here we highlight the main precipitation season May-June-July (MJJ) for the Northern Plain states, the region of drought under study here. Note that in the NGP states, even though over half to two thirds (possibly above) of the annual rain falls during MJJ months, the region begins to get some early rain in late March and April, which is critical to the farmers there, after the rigid winter cold, when much of the surface is frozen. Here, the pre-rainy season Feb-Mar-Apr (FMA) gets about 15-20 percent of the median rainfall. But in 2017, as can be seen in Fig. 2 (middle/last columns across April), as indicated by a red square, there has already been a deficit building up towards end of April, which must have been a warning sign for possible emerging drought. Precipitation deficit/excess maps like Fig. 2 (which can be made at any day of the month) made in the last week of April or first week of May, for the preceding contiguous 30, 60 or 90 days (not shown here) period accumulations, show in fact, that even by late April or early May, the clear warning signs of developing dryness and an emerging drought, are already in place.

Correspondence to: Muthuvel Chelliah, Climate Prediction Center, NOAA/NWS/NCEP, College Park, MD;
E-mail: Muthuvel.Chelliah@noaa.gov

With the established deficit already in place in the region, if the "expected rain" did not arrive in successive week(s), the caution/alarm bells should have triggered to initiate the drought warning there. But it was not done until very late May, when the US drought monitor caught the drought condition.

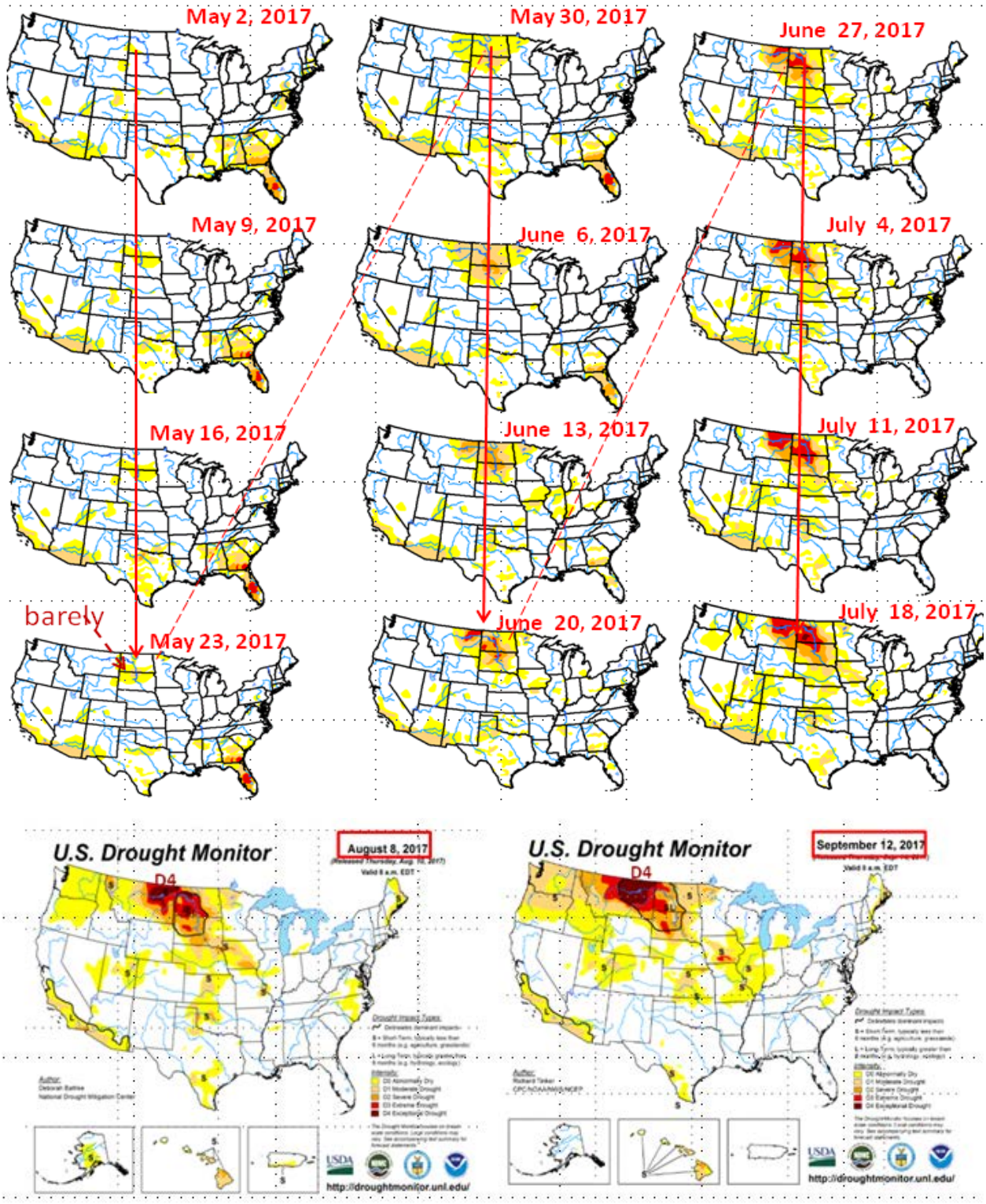

Fig.1 The weekly U.S. Drought Monitor at various stages of the 2017 Great Northern Plains Drought. The top 12 panels are weekly sequential DM maps and the last two are at peak drought stage.

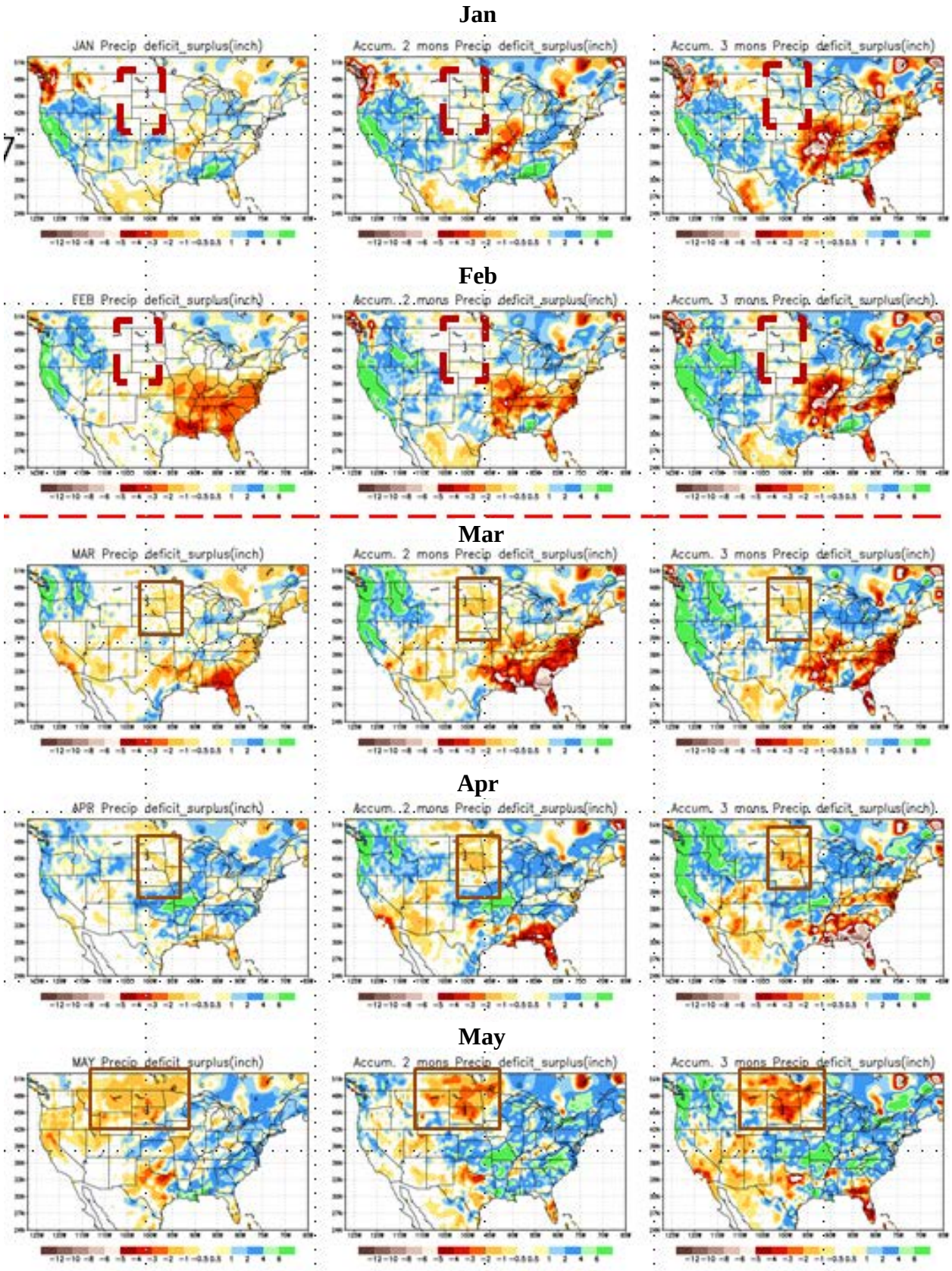

Fig. 2 1-mon (1st column), 2-months (middle column), and 3-months (last column) accumulated precipitation Deficit (yellow/red) Surplus (blue/green) in months ending Jan through May 2017.

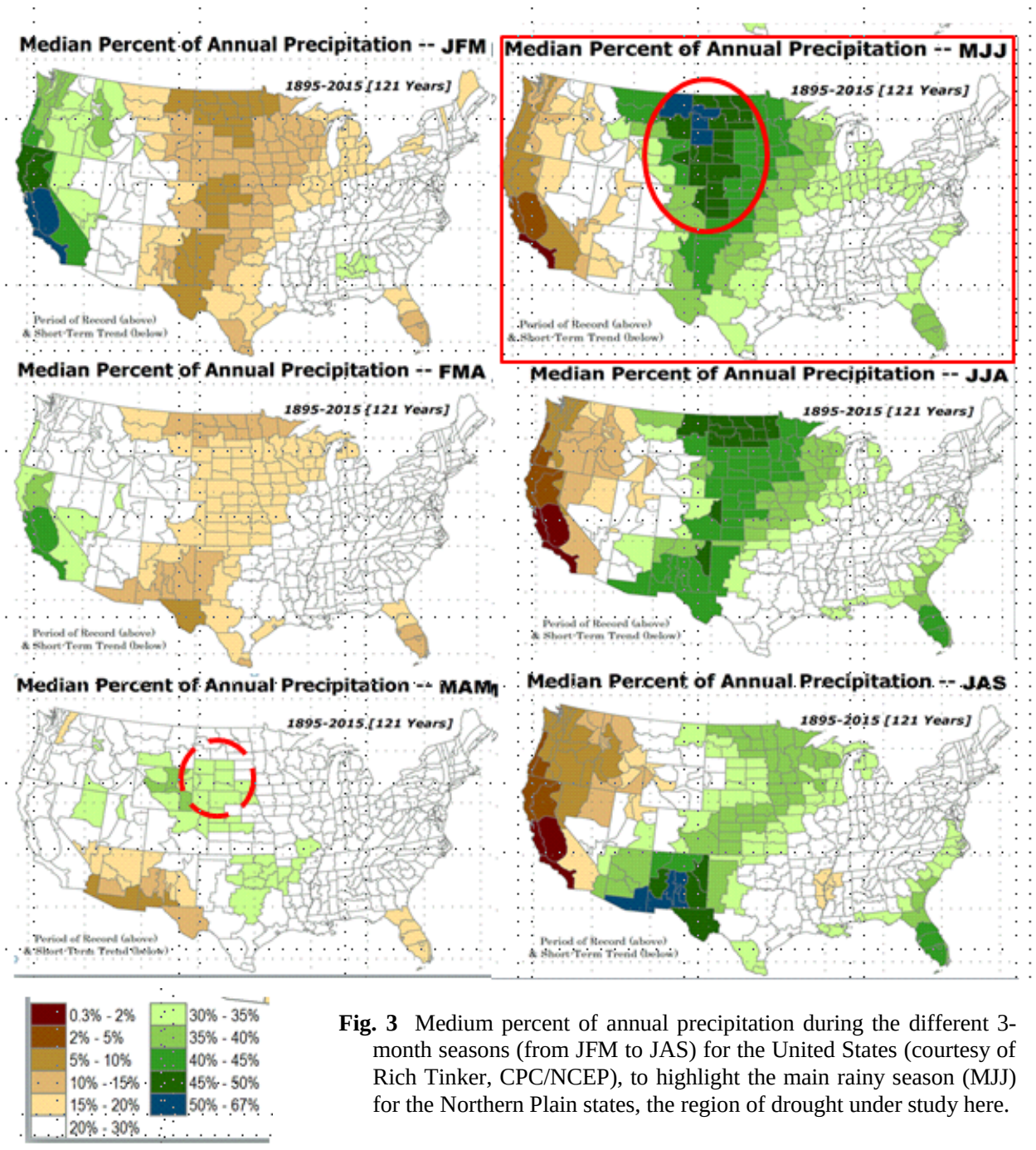

Fig. 3 Medium percent of annual precipitation during the different 3-month seasons (from JFM to JAS) for the United States (courtesy of Rich Tinker, CPC/NCEP), to highlight the main rainy season (MJJ) for the Northern Plain states, the region of drought under study here.

The monthly drought outlook (MDO) issued on April 30, 2017 (Fig. 4) or the seasonal drought outlook (SDO) issued on both 20 April or 18 May did not indicate any drought in the NGP. Only the MDO issued on 31 May pointed to a drought in the region and that it was likely to persist.

4. Remarks

In closing, why was such a delay? In retrospect, a few reasons come to mind. First, this NGP states is not the typical region that drought usually occurs, so overall possibly less attention was given to the region (rarity, low population density (?), *etc.*). Second, until just a few months earlier (late 2016/early 2017) the major focus and more attention had been on the other two major drought areas in more “important” drought prone regions namely California and the southeast US. Also the focus was centered on the totally unexpected rains

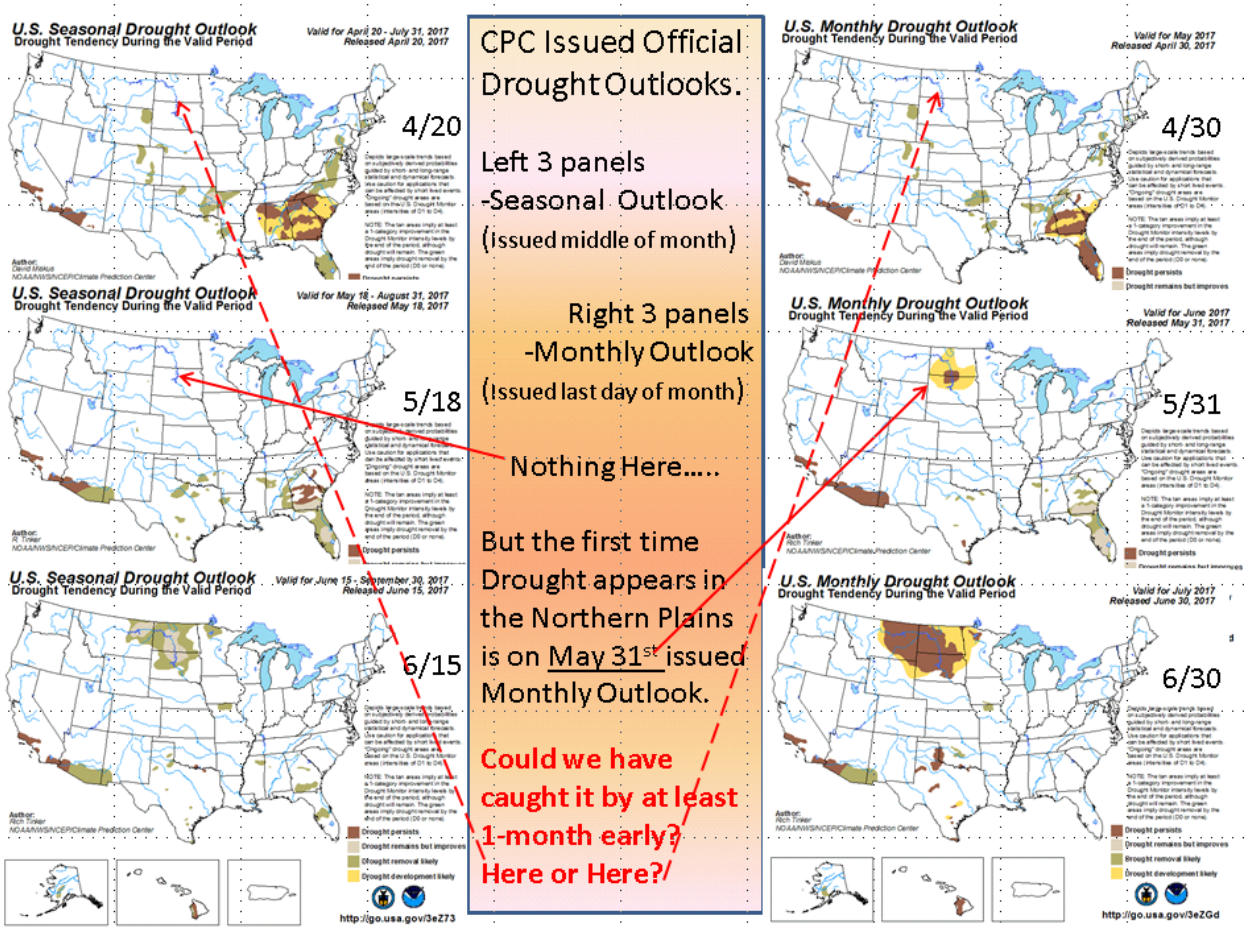

Fig. 4 Monthly Drought Outlooks issued in April, May and June 2017 on the right panels, and the Seasonal drought outlooks issued in the middle of the same months on the left.

in California during 2016/2017 La Nina winter which abruptly ended the long lasted drought in that region and the gradual improvement in the drought in the southeast US. Thirdly, and more importantly, the NMME models and the official forecasts (not shown here) called for above normal MJJ seasonal rain in the region (which of course did not happen!), and consequently the NLDAS models followed suit to return the dryness towards normal (did not verify!). These are valuable lessons learned from this NGP drought, and it is hoped that the onset of the 2018 rainy season (possibly a good one!) will probably end the drought in the region which started in spring 2017.