

Smoke Restrictions to Visibility in Montana – A Brief Climatology

Smoke from wildfires across western North America affected Montana this summer of 2018. Smoke can affect the state at any time of the year, but most often peaks during the warm season, when the vegetation dries out and lightning or other causes spark a fire. Smoke from fires has drifted over Montana from along the west coast, and even Alaska at times.

A climatology of visibility reductions due to smoke was done at the Automated Surface Observation System (ASOS) sites in Montana. Their periods of record are rather short, but this record was used exclusively as the values cannot be easily compared with the pre-ASOS era when visibility was determined by human observers. Visibility markers, such as distant hills or mountains may have been dimly visible by a human observer, while the ASOS observation may likely have differed. The period of record starts in 1994 at several stations, with many more starting around 2000.

This summer, some sites recorded their highest number of hours of visibility reductions due to smoke since the ASOS records began. ASOS regards visibility of 10 miles or greater as “10SM” (statue miles). When smoke or other particulate restricts visibility to 6 miles or less, the sensor will report **haze**. It does not discriminate what is causing the haze, be it volcanic ash, dust, smoke, or some other particulate causing the restriction. If the site is capable of being augmented, the observer may report smoke, but few sites in Montana have this capability.

More on how visibility is determined at an ASOS can be found in the ASOS User’s Guide (ASOS 1998). Horizon distances are computed by a formula $d \approx 3.57\sqrt{h}$, where d is in kilometers and h is height above ground in meters (Young 2003). At a flat location, the horizon is at a distance of about three miles; ASOS can determine a visibility beyond the horizon and 10 miles or more is reported as 10 miles.

On the following pages are the plots of top-of-the-hour visibility, separated by visibility thresholds of up to 1 mile, 2 miles, 3, 4, 5, 6, 7, and 8-9 miles. This was done at 19 sites across Montana, including: Baker (BHK), Billings (BIL), Bozeman (BZN), Butte (BTM) Cut Bank (CTB), Dillon (DLN), Glasgow (GGW), Glendive (GDV), Great Falls (GTF), Havre (HVR), Helena (HLN), Kalispell (GPI), Lewistown (LWT), Livingston (LVM), Miles City (MLS), Missoula (MSO), Sidney (SDY), West Yellowstone (WYS), and Wolf Point (OLF). Each site is shown with the visibility thresholds by year, along with the period of record “climatology” of the cumulative hours of visibility restriction of 9SM or less, 6SM or less, and 3SM or less, including the values for 2018. Each of these “climatology” charts is grouped by each week of the month. Data is through August 29, 2018. Typically, there are smoky days in September as well.

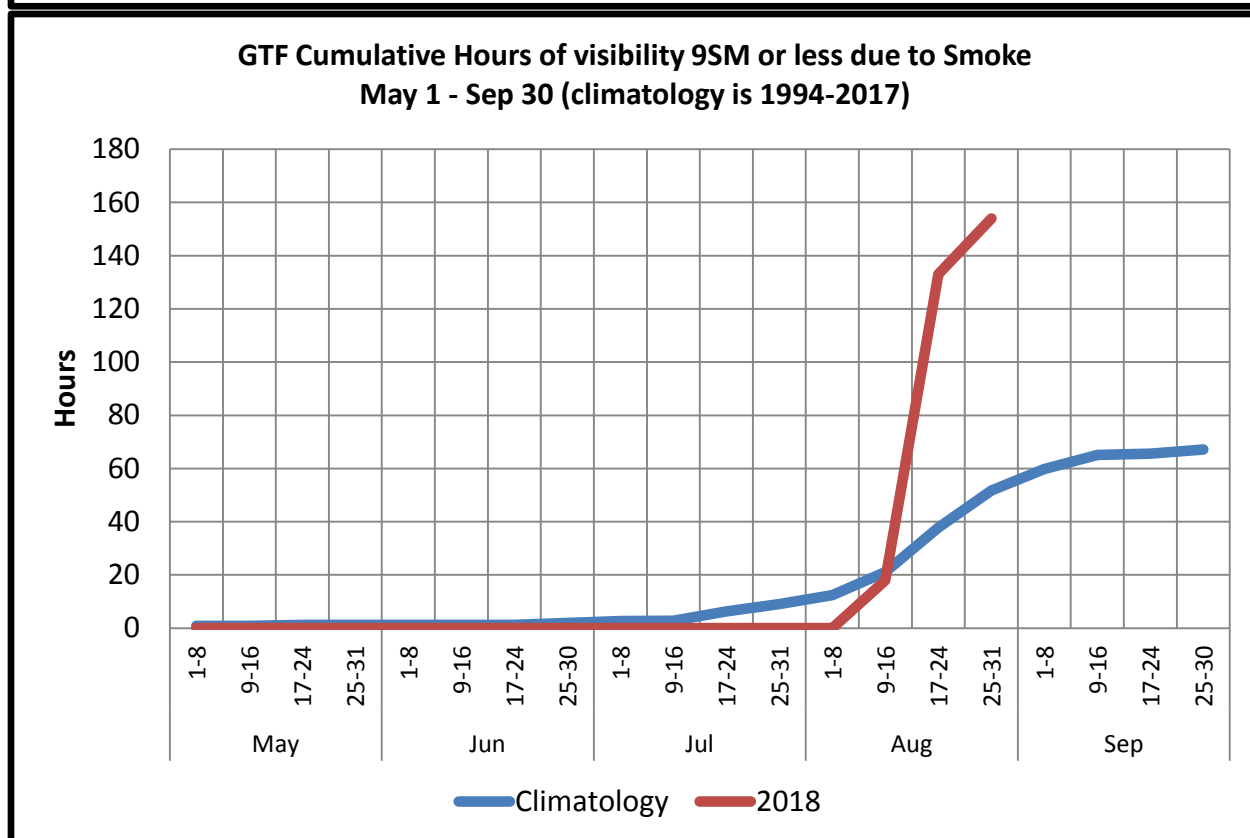
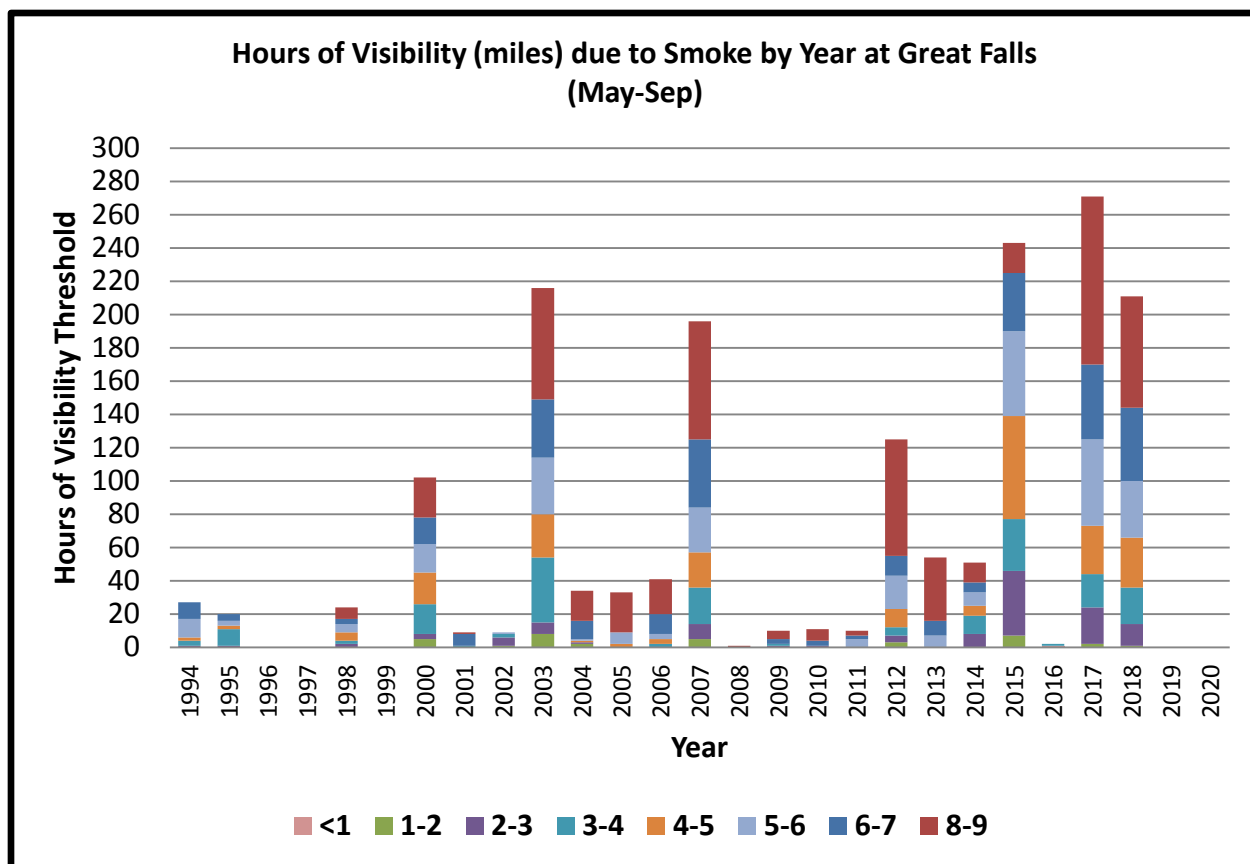
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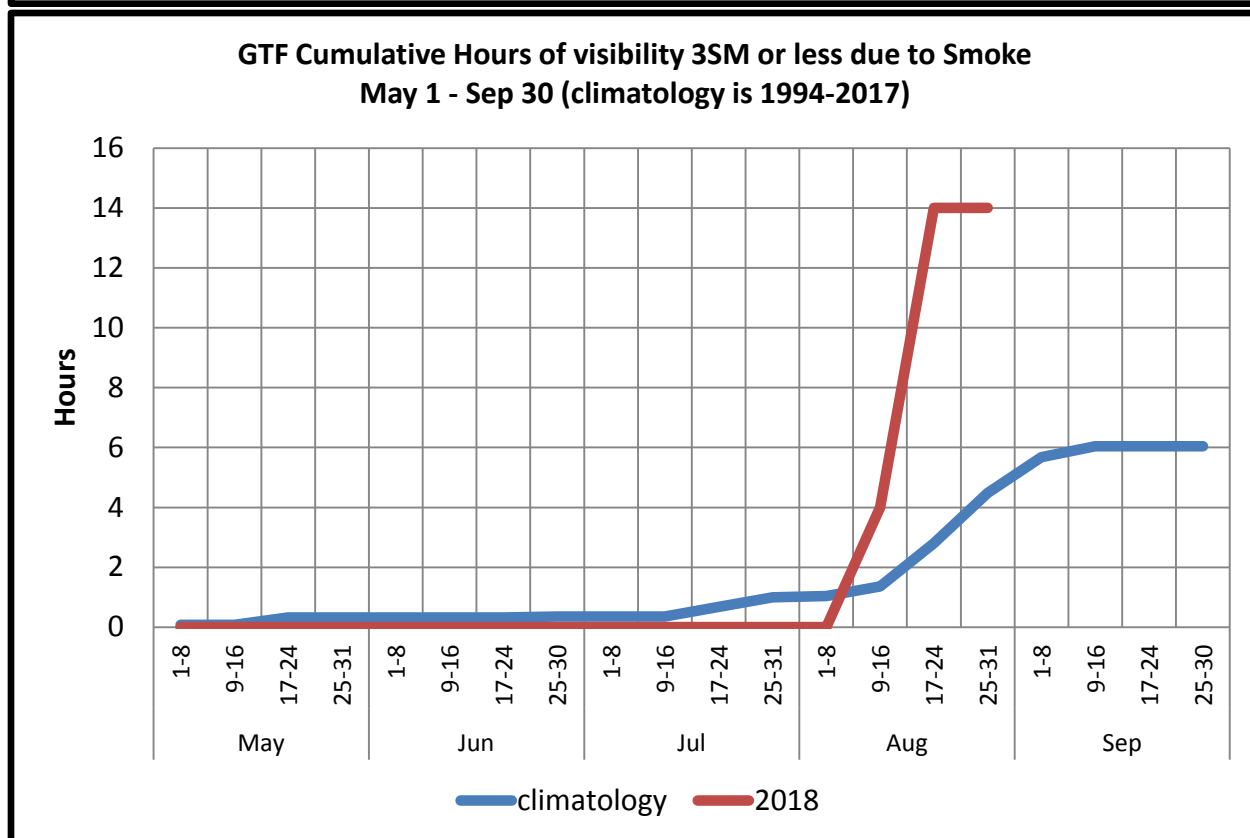
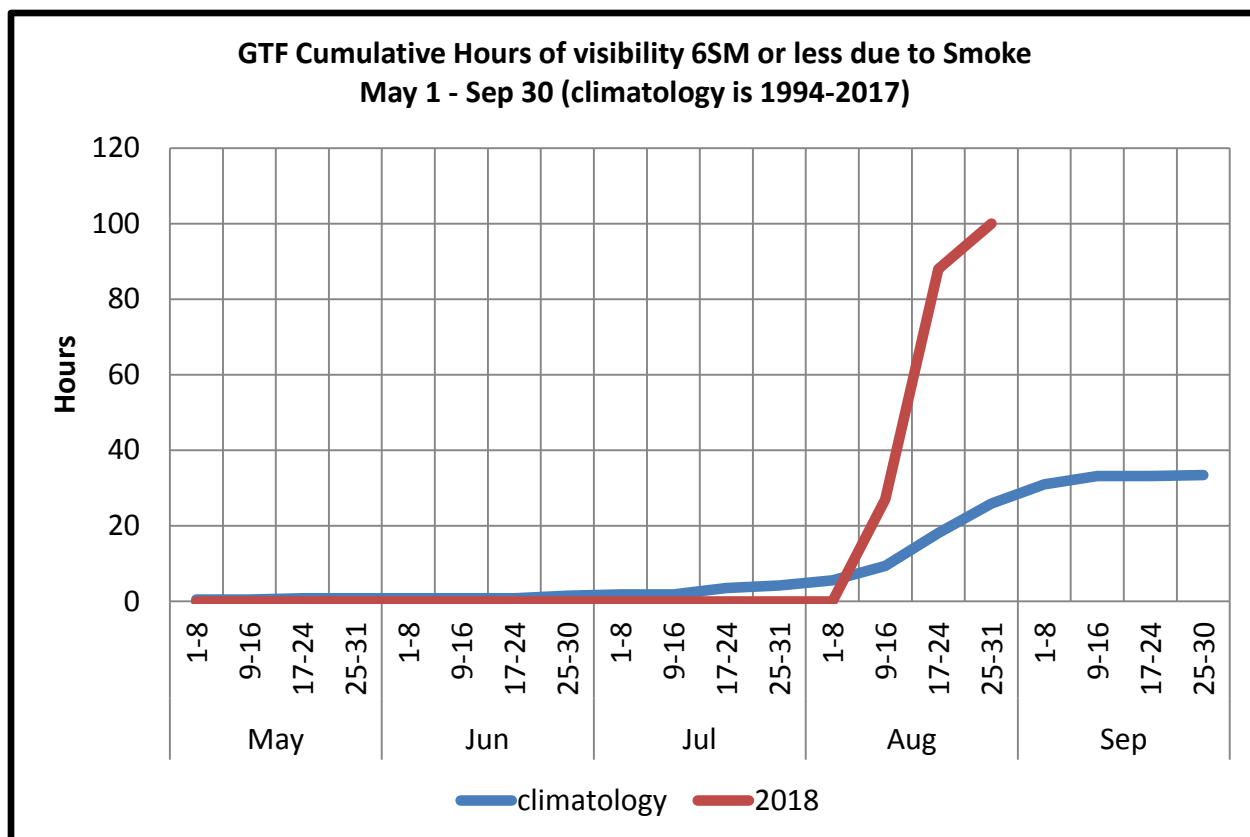
Natl. Oceanic and Atmos. Admin., Dept. of Defense, FAA, U.S. Navy. “ASOS User’s Guide. 1998.

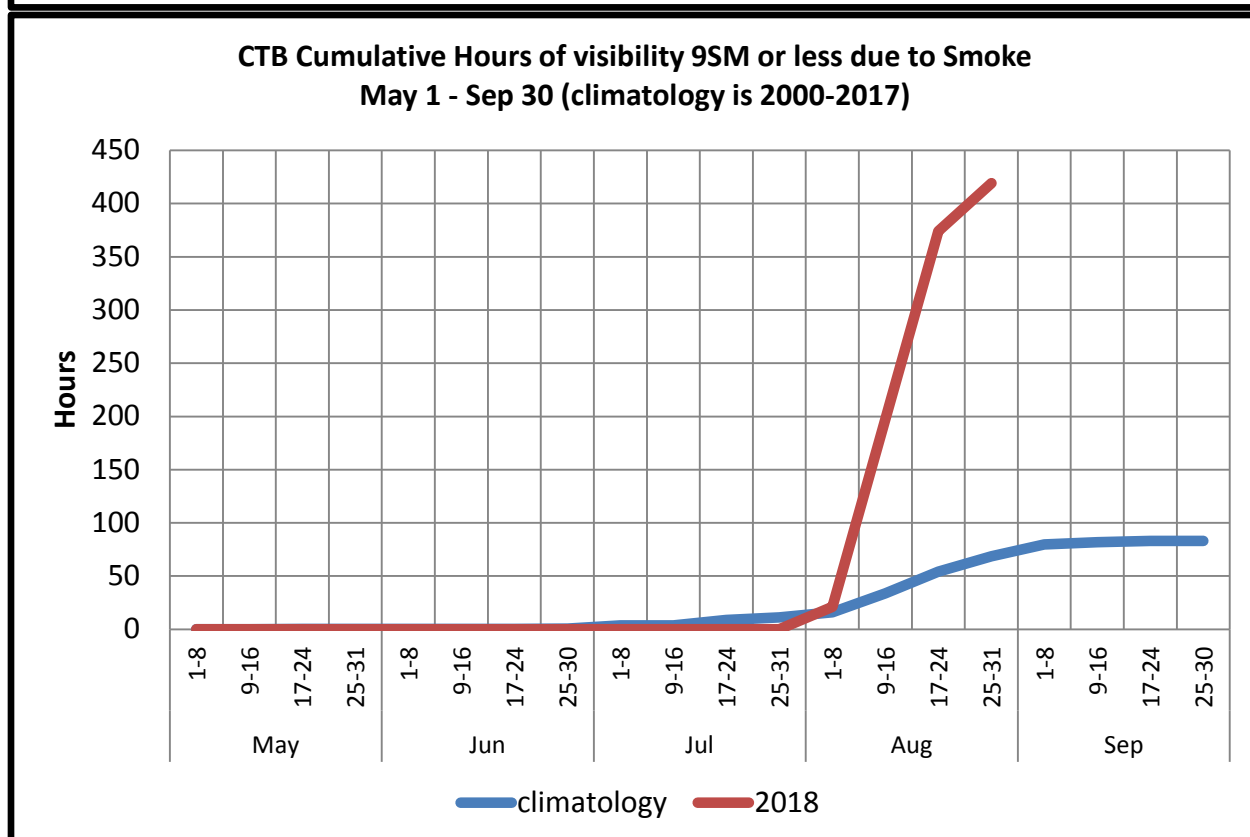
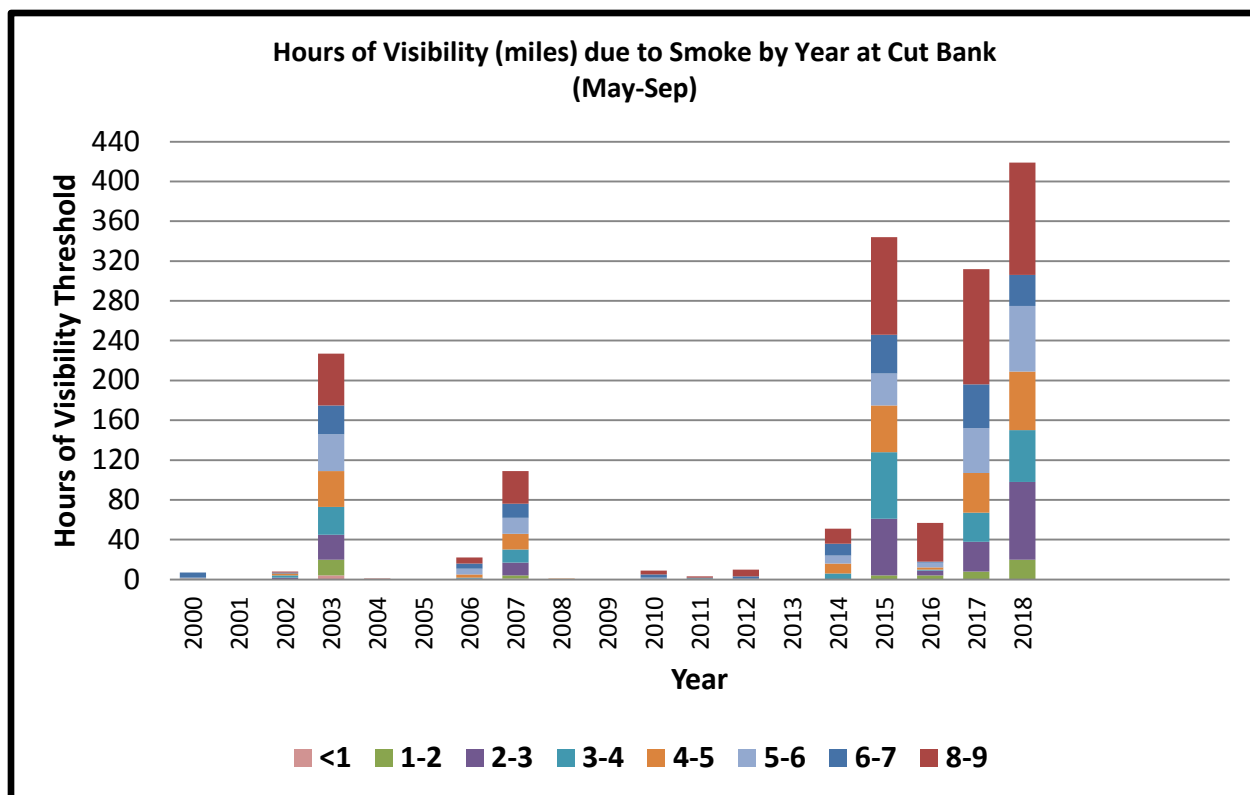
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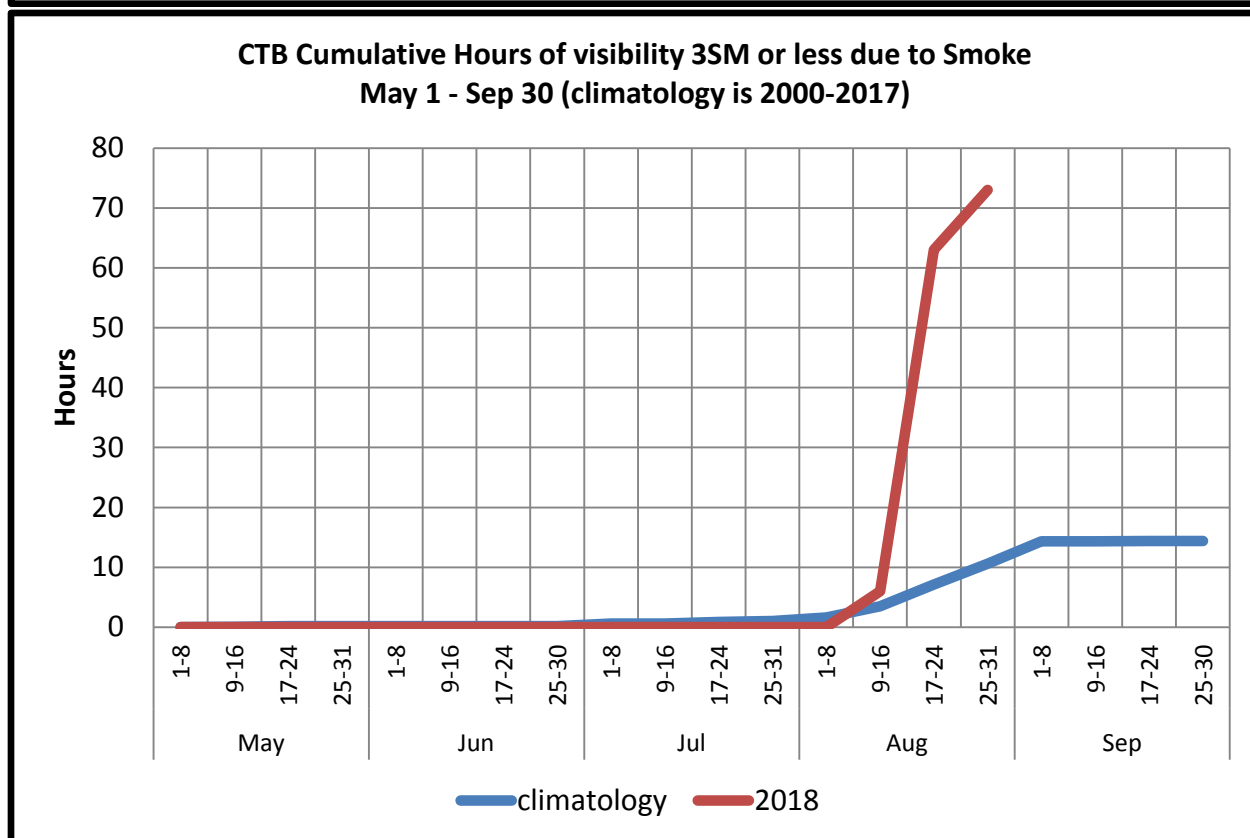
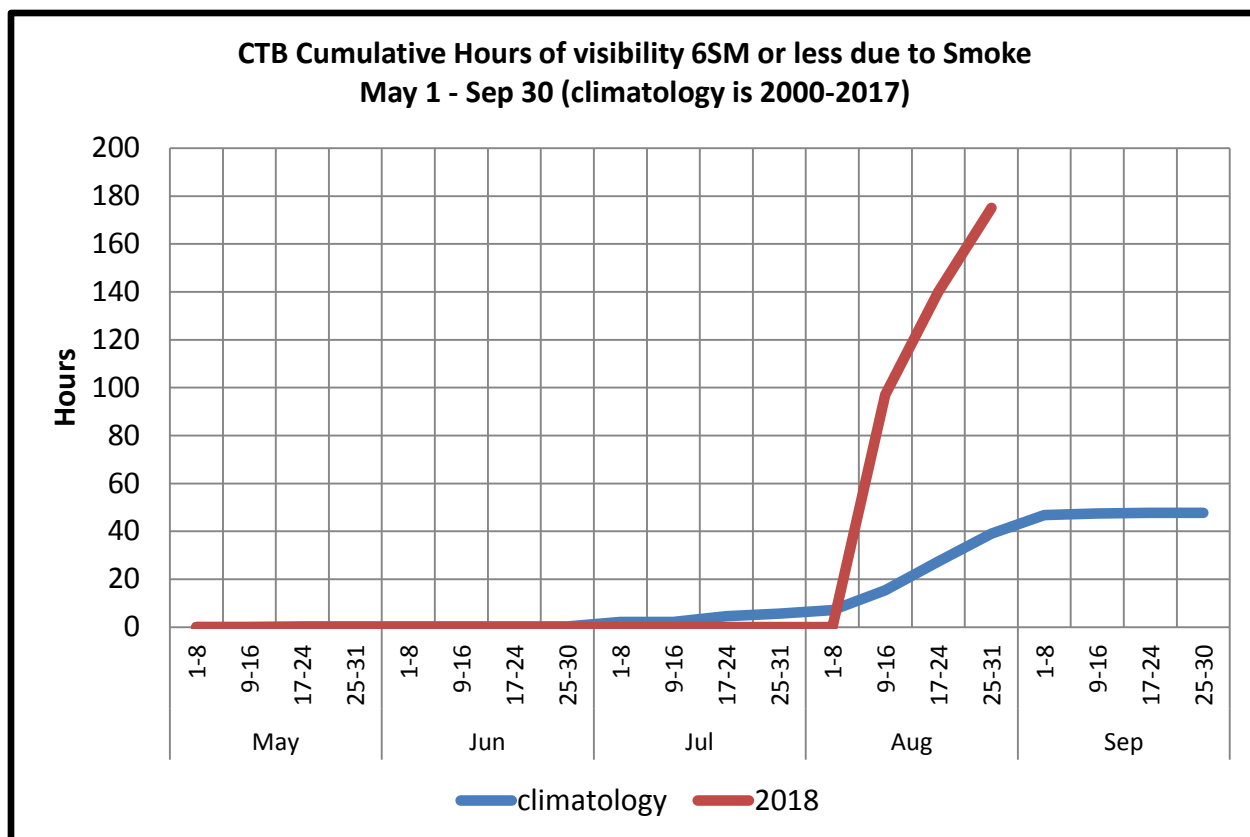
Young, A.T. “Distance to the Horizon”. San Diego State University Department of Astronomy.

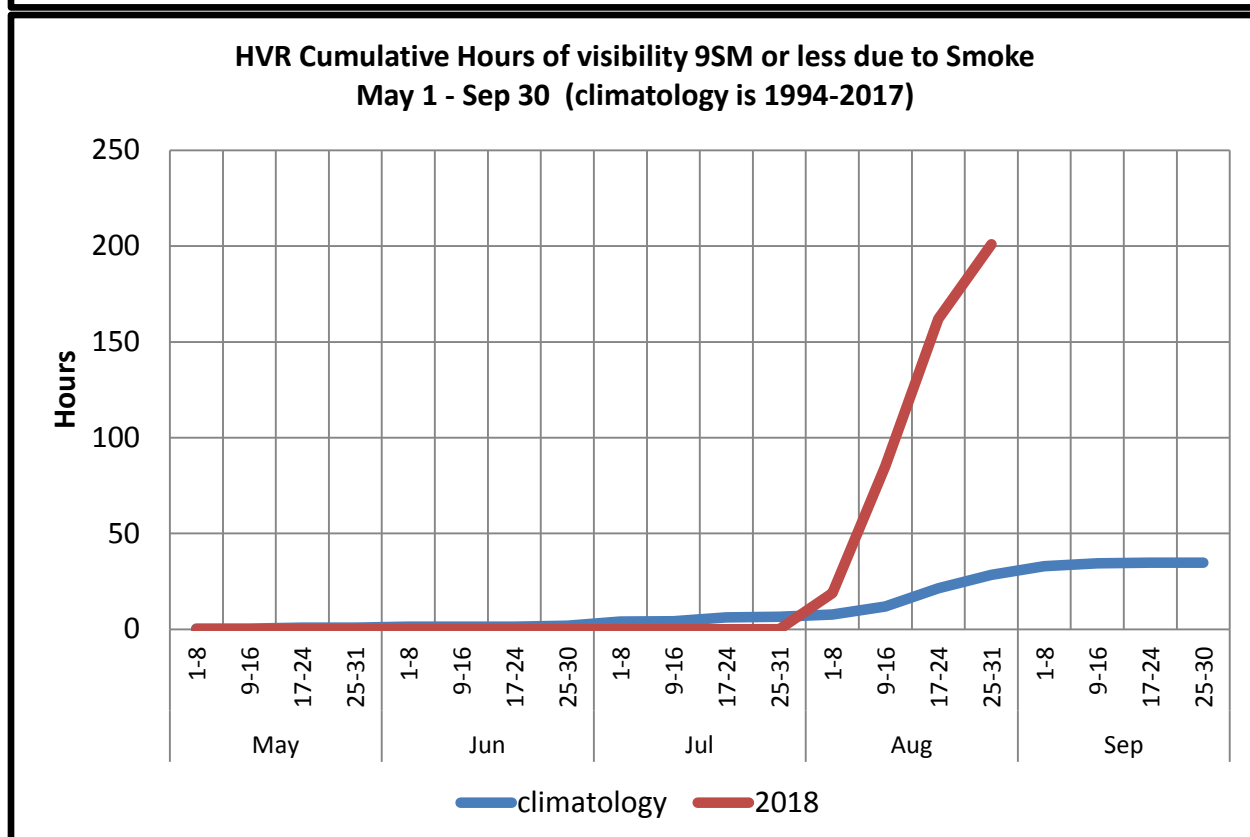
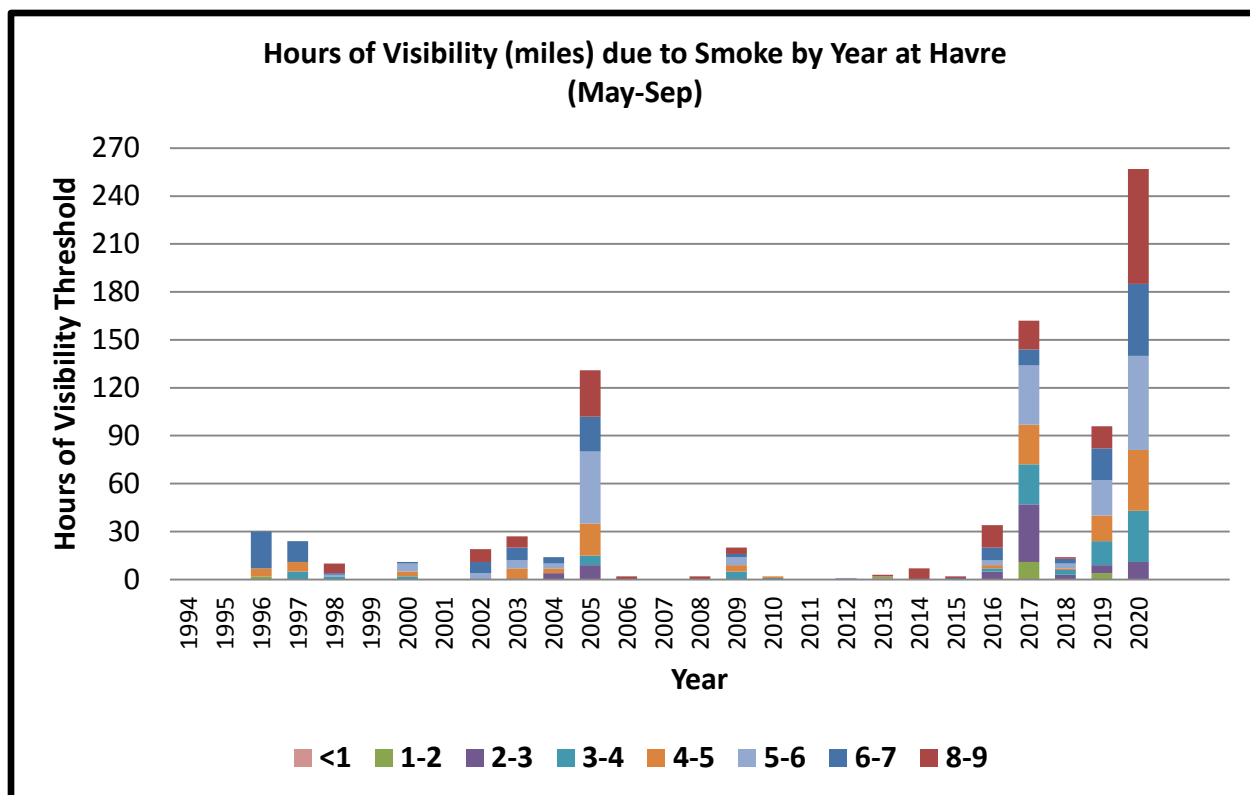
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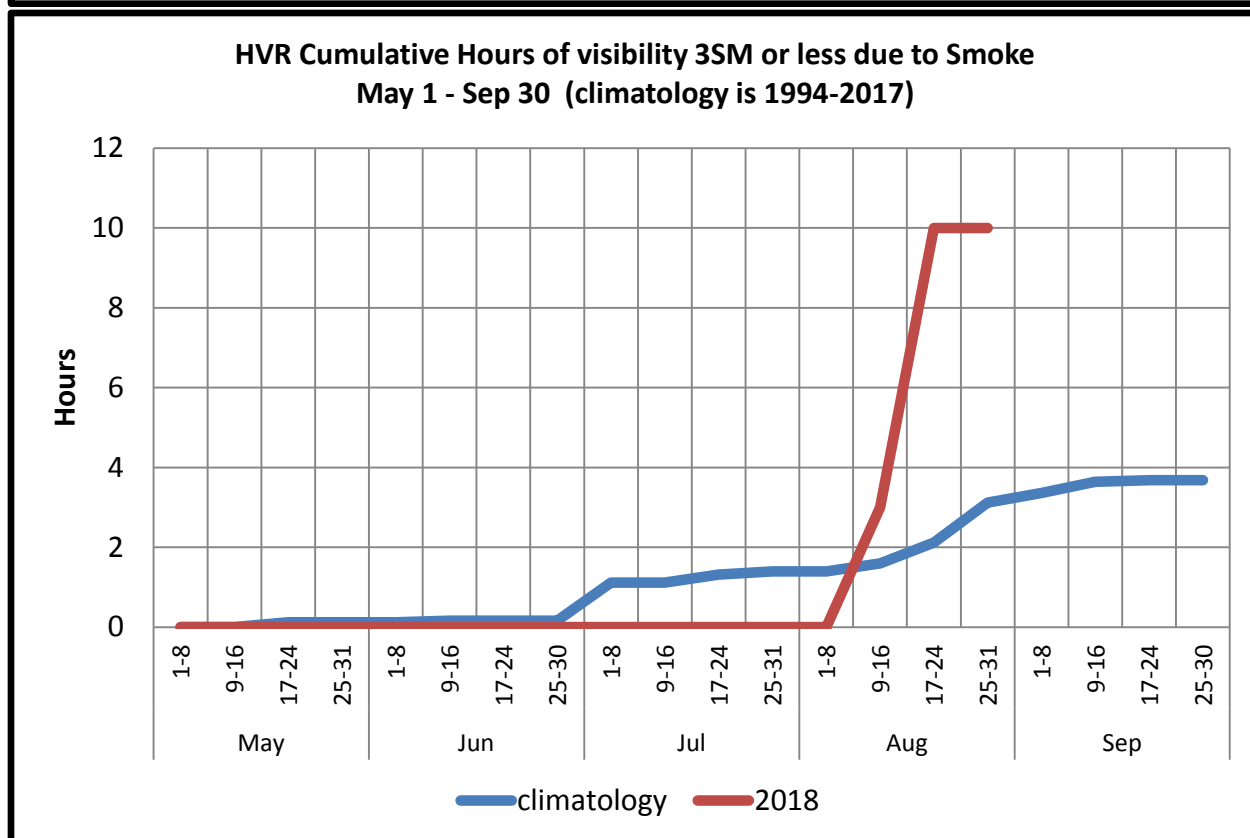
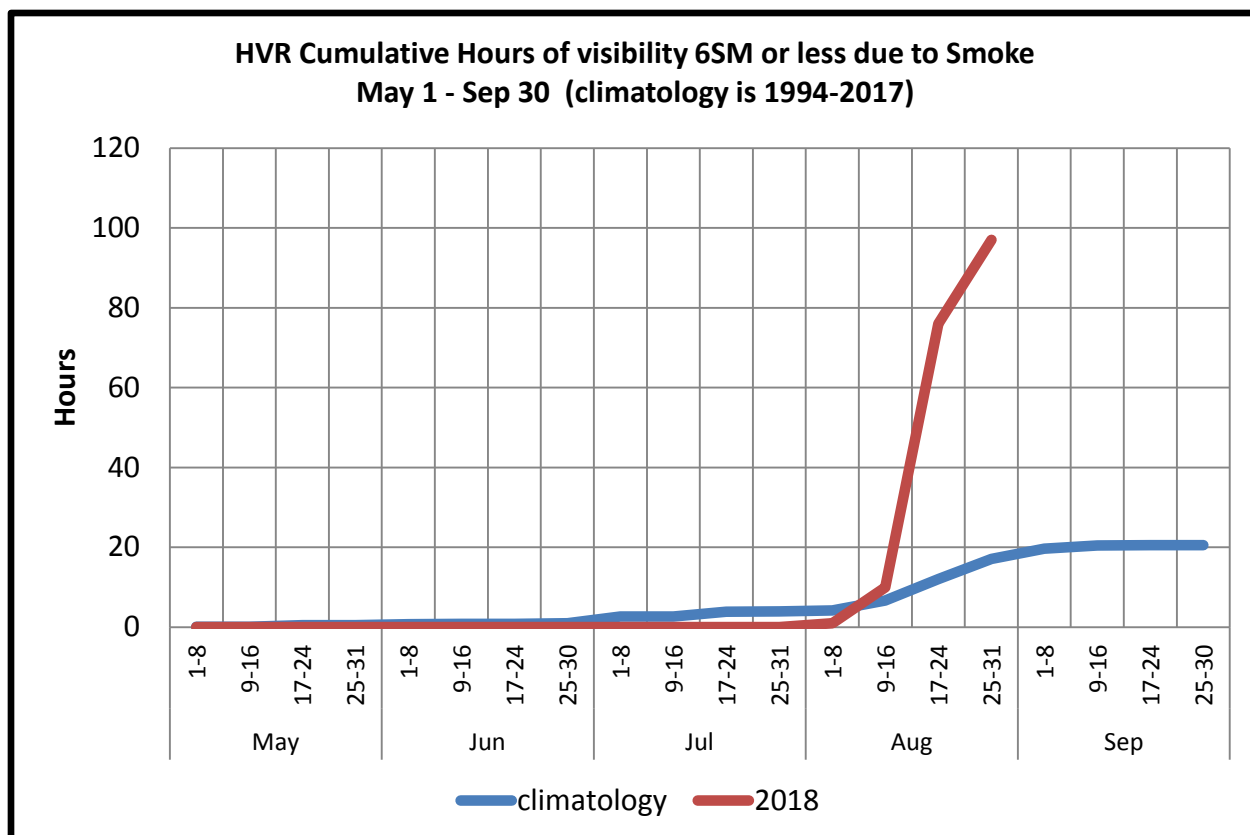


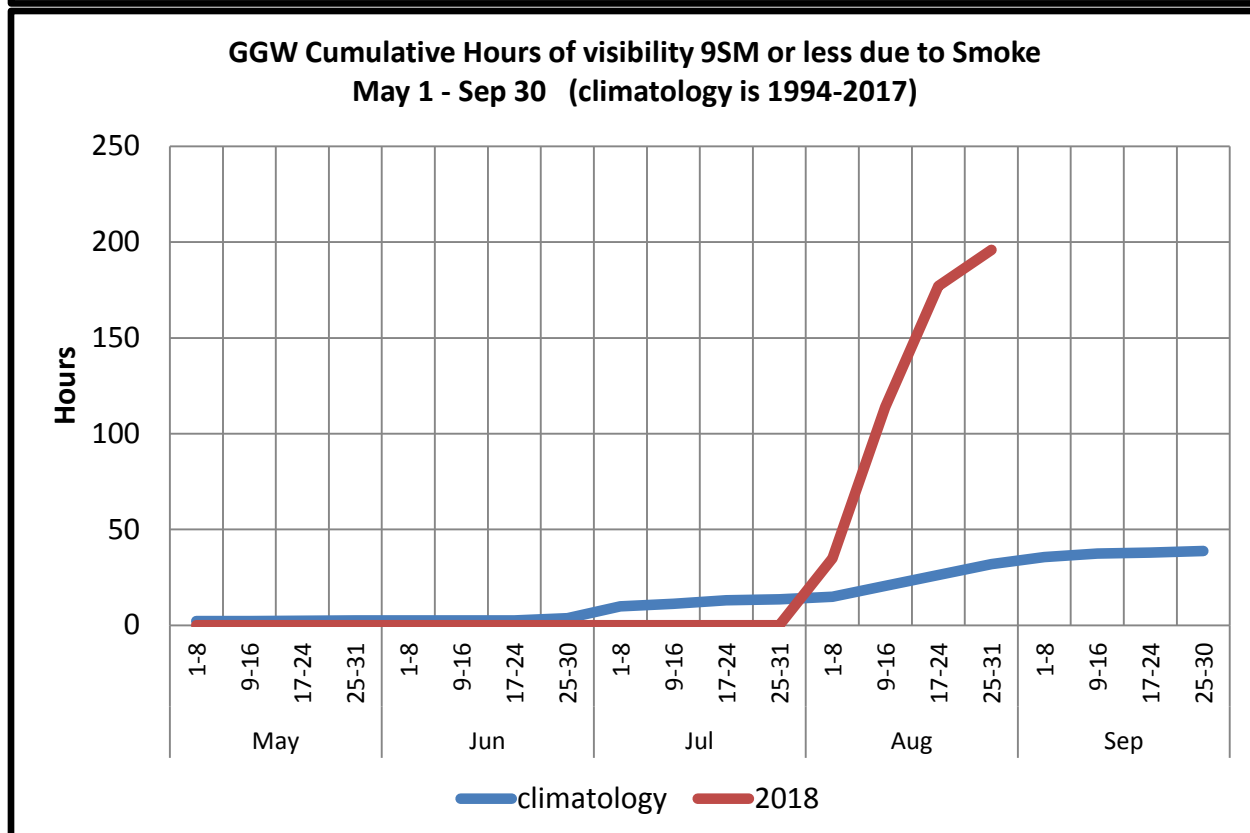
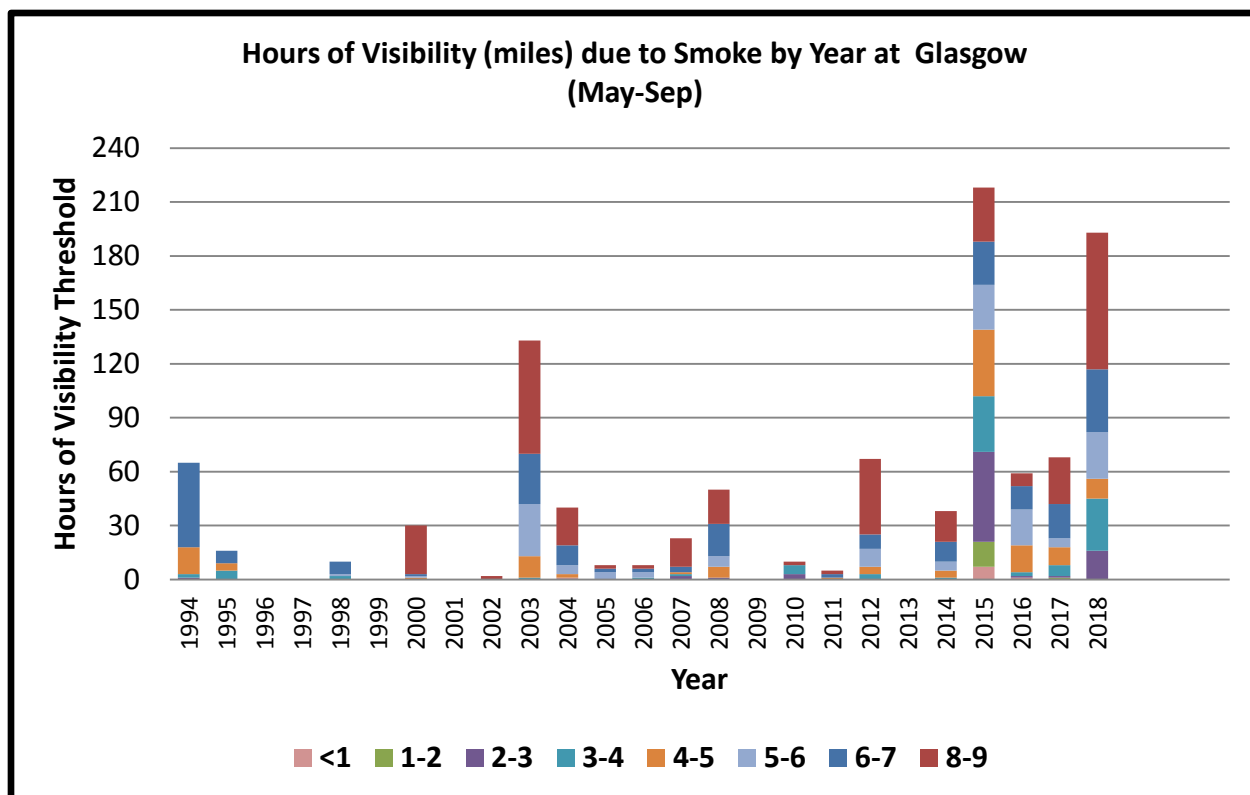


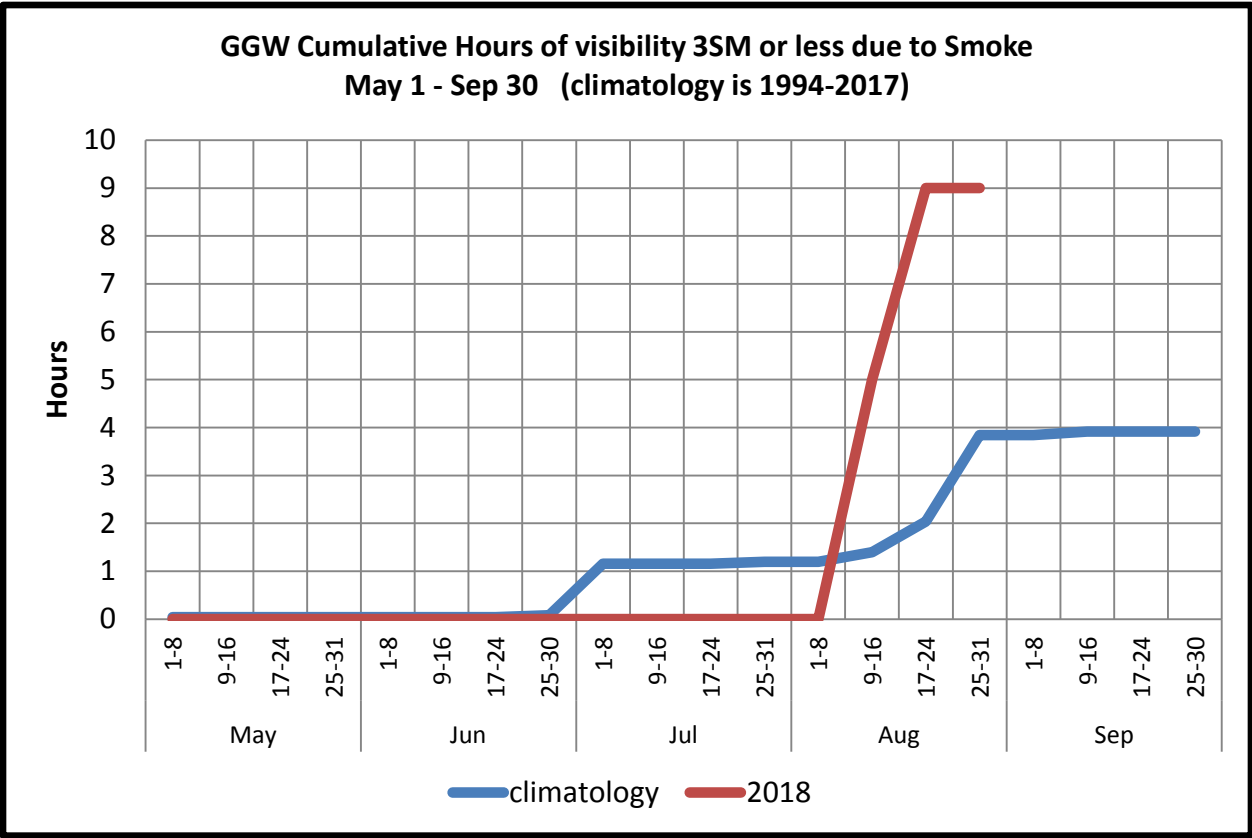
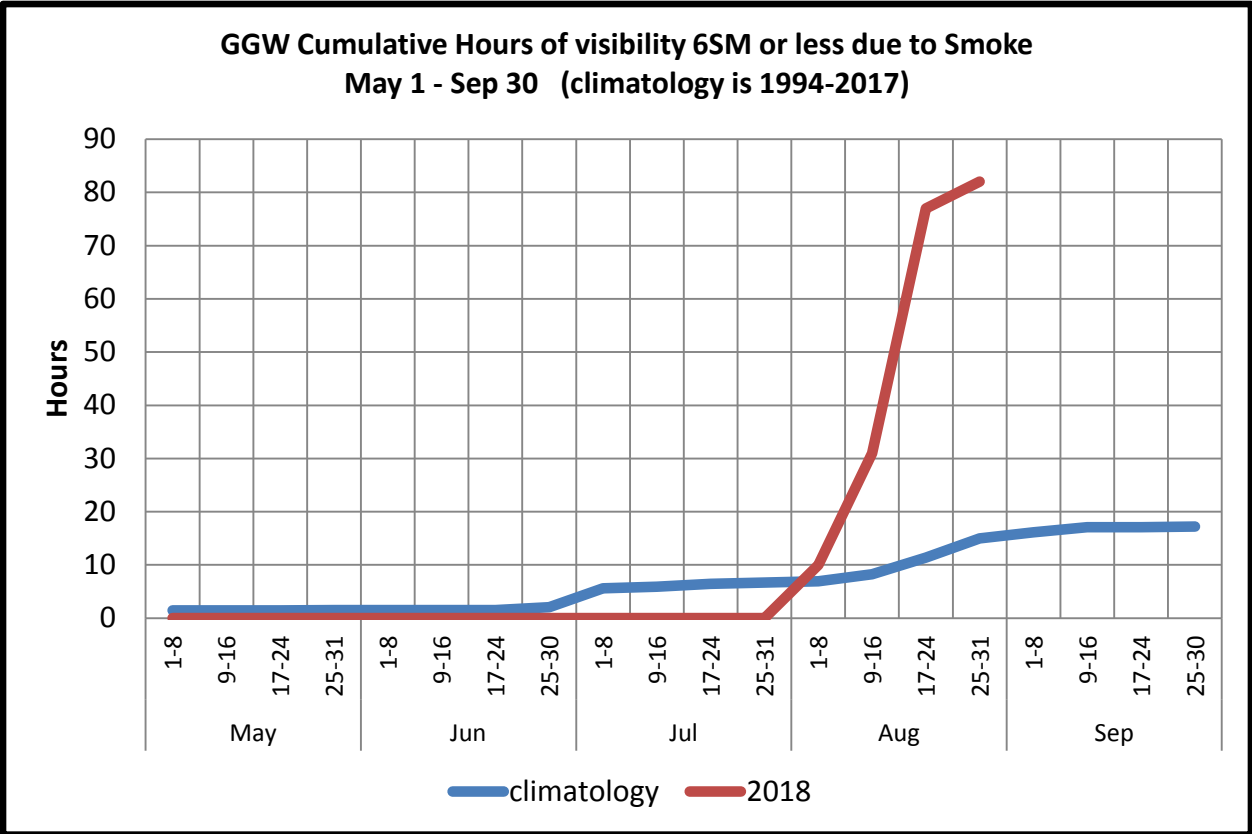


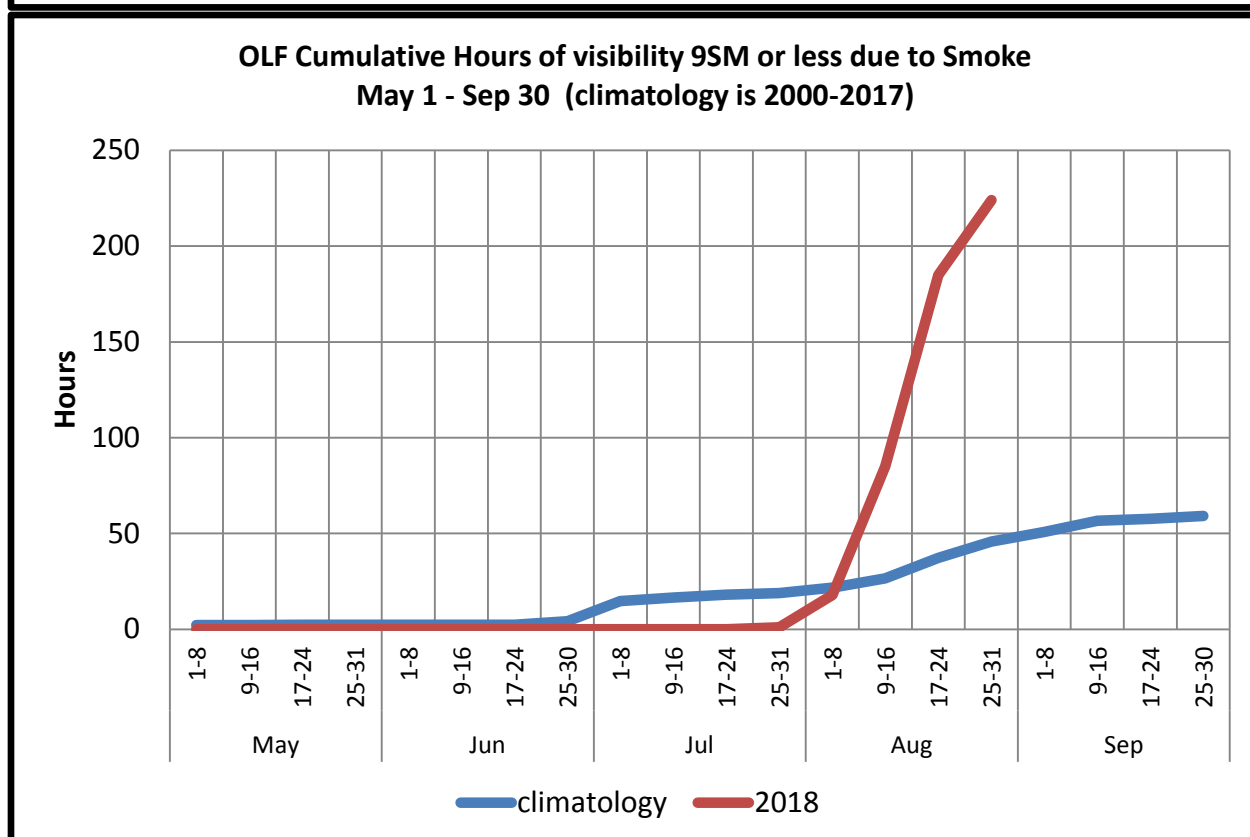
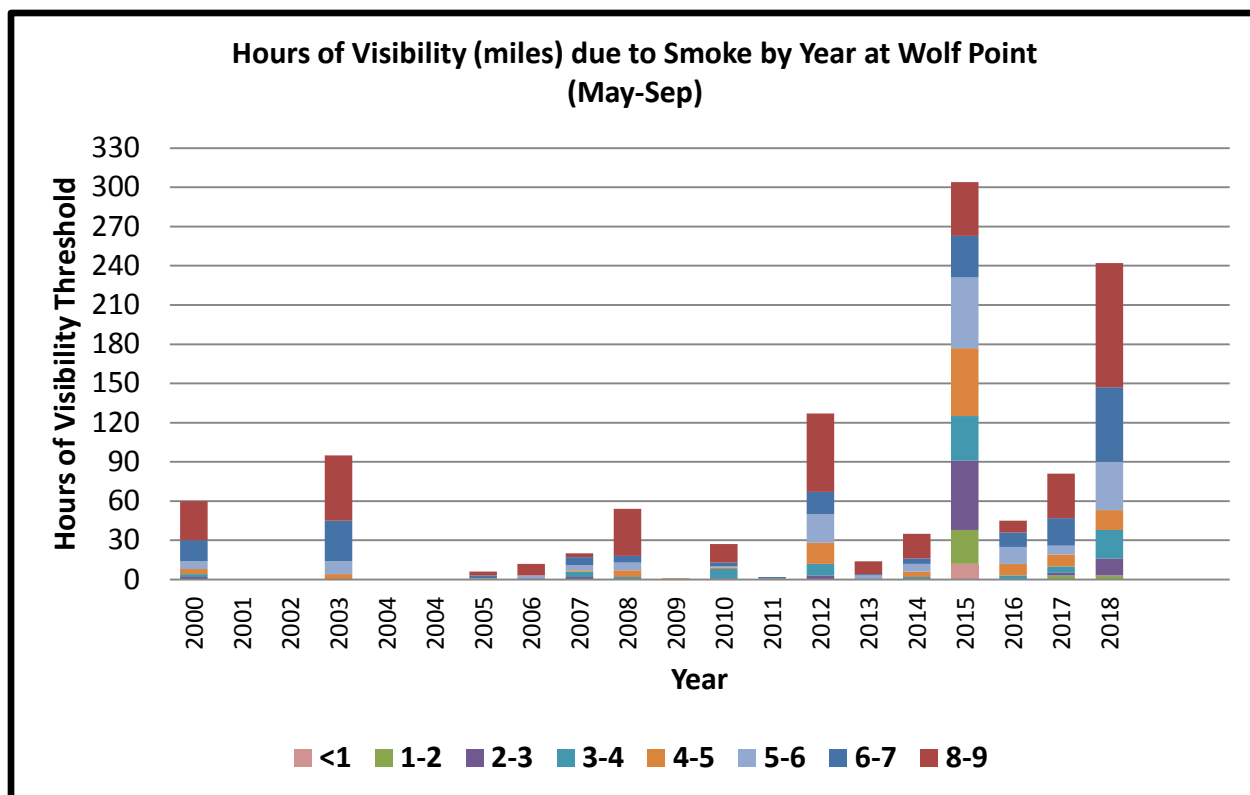


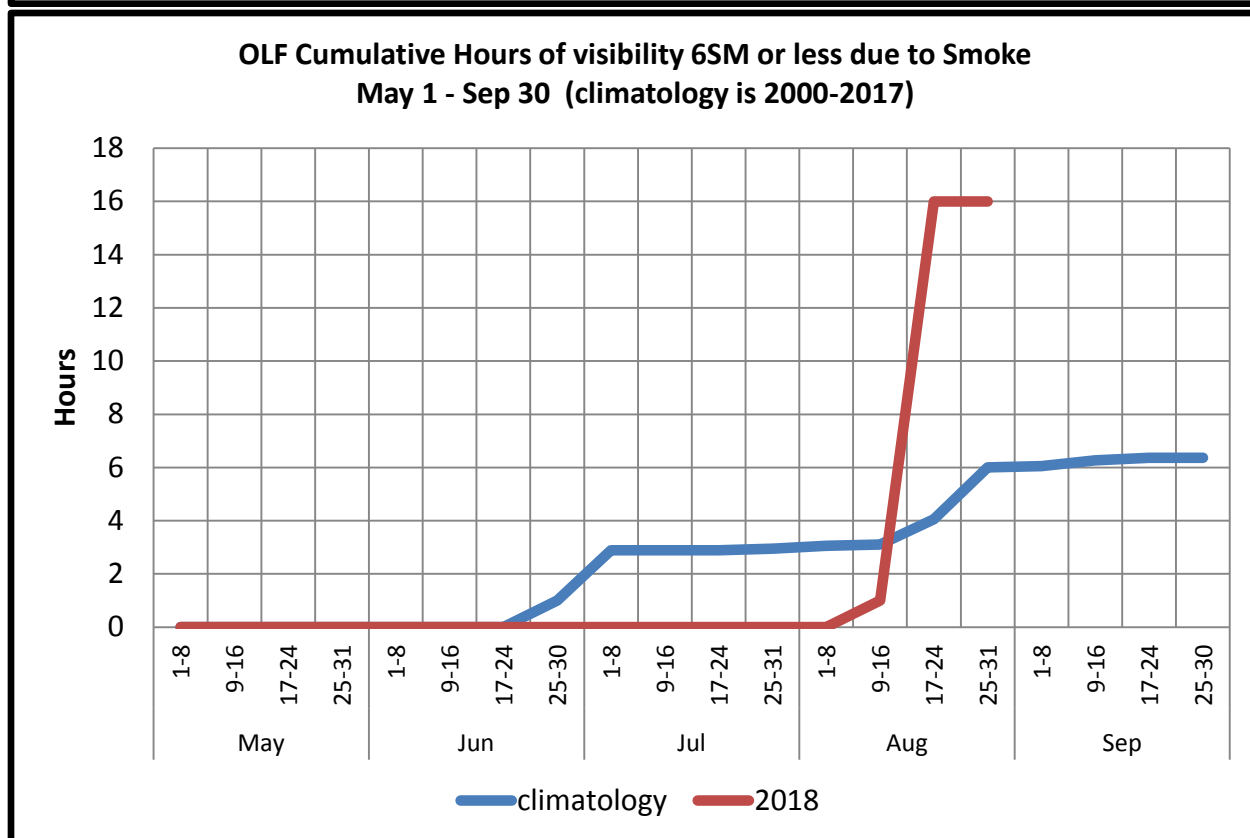
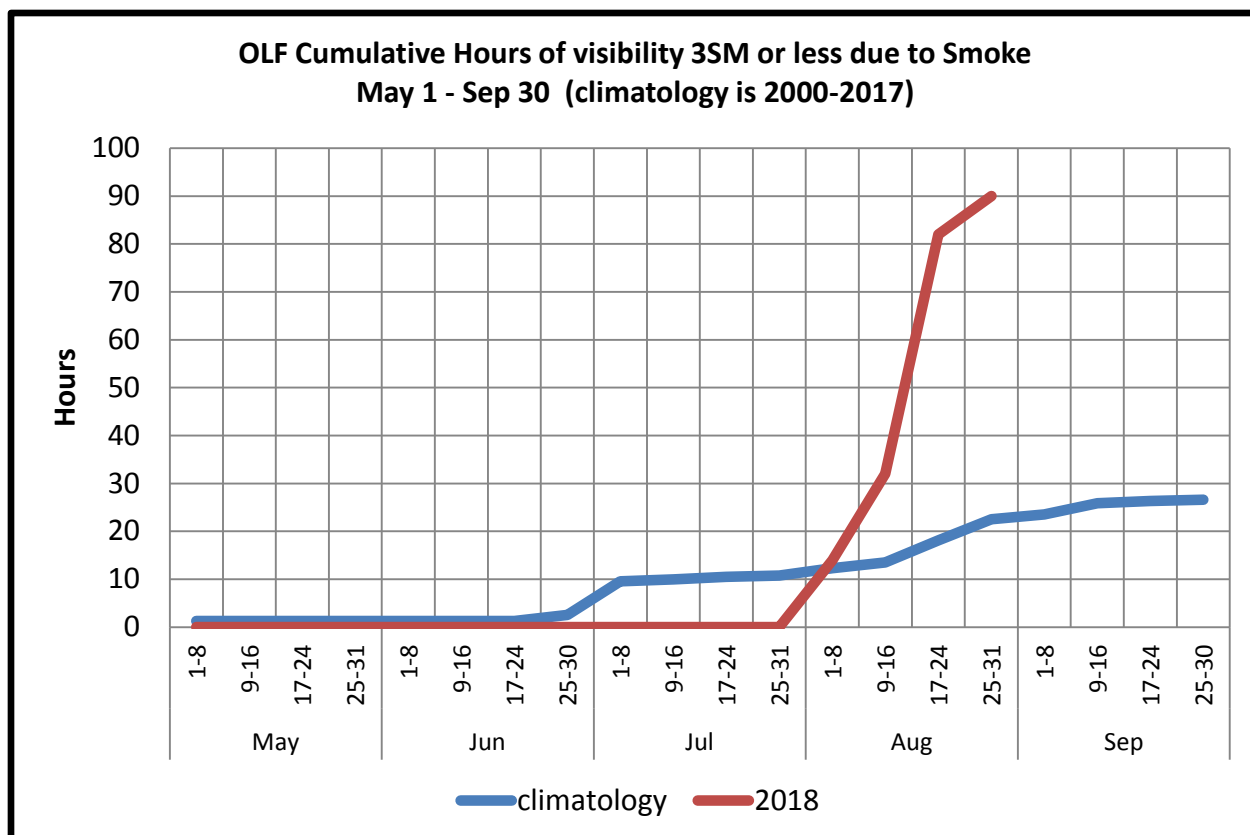


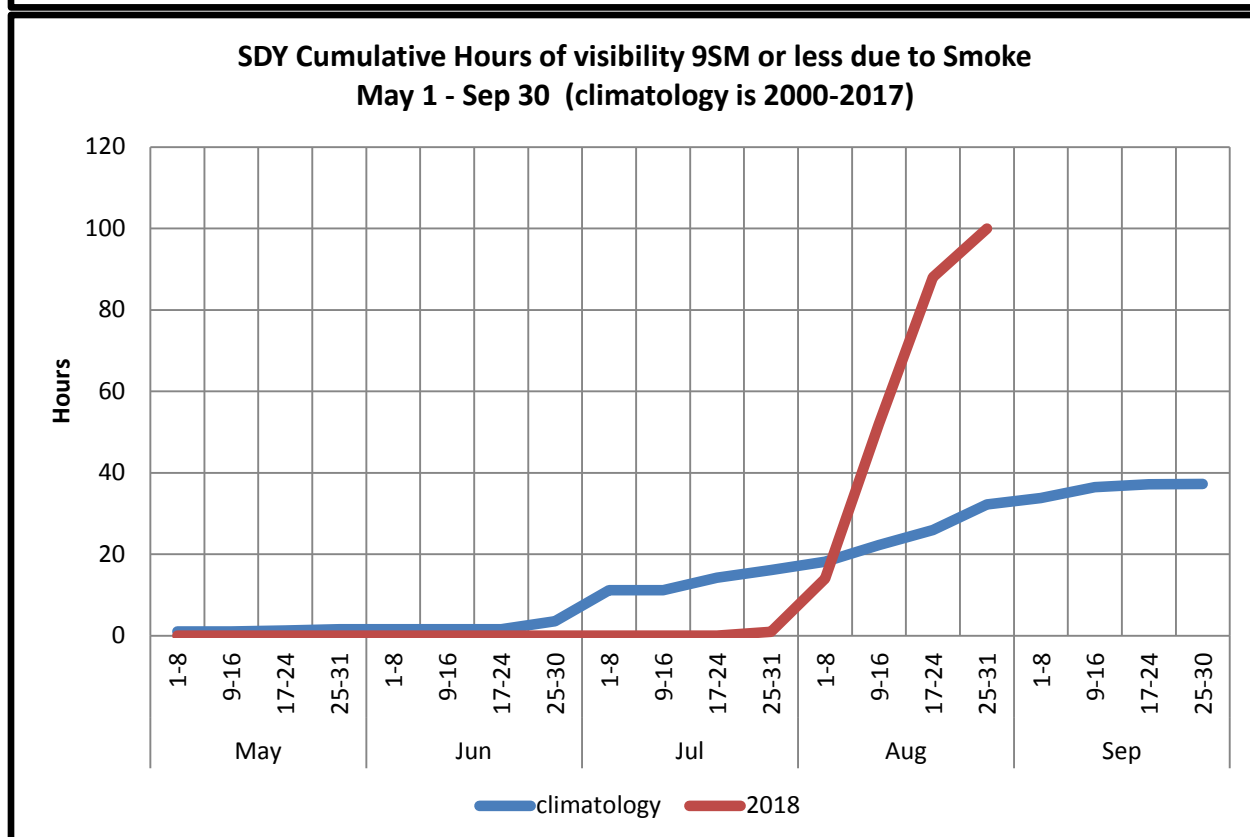
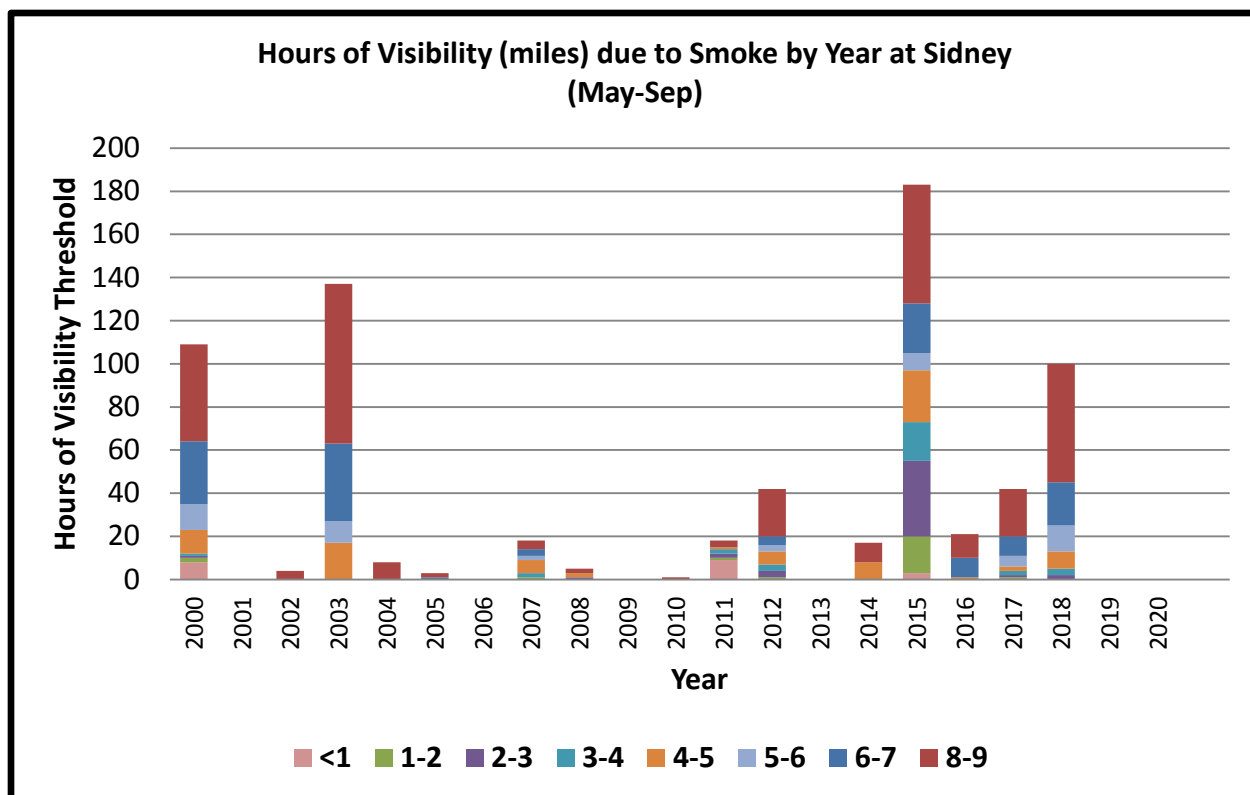


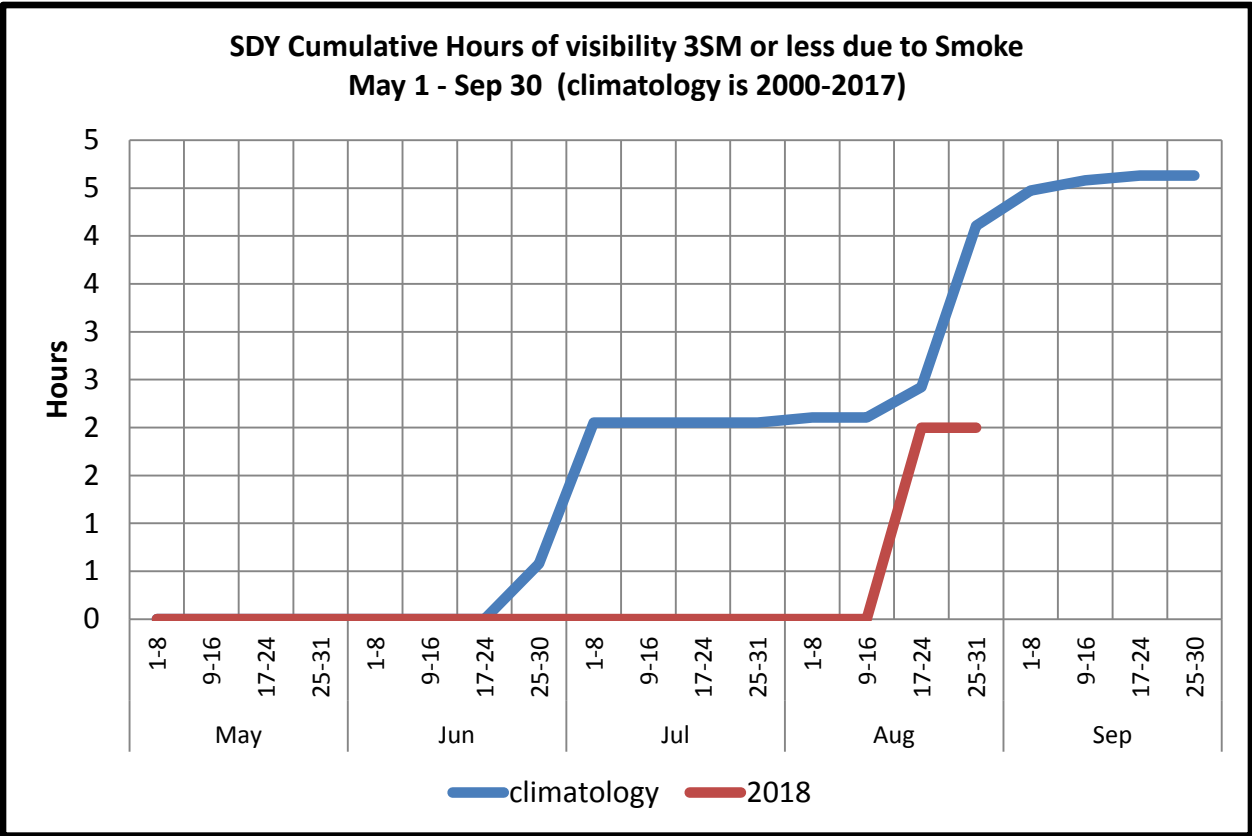
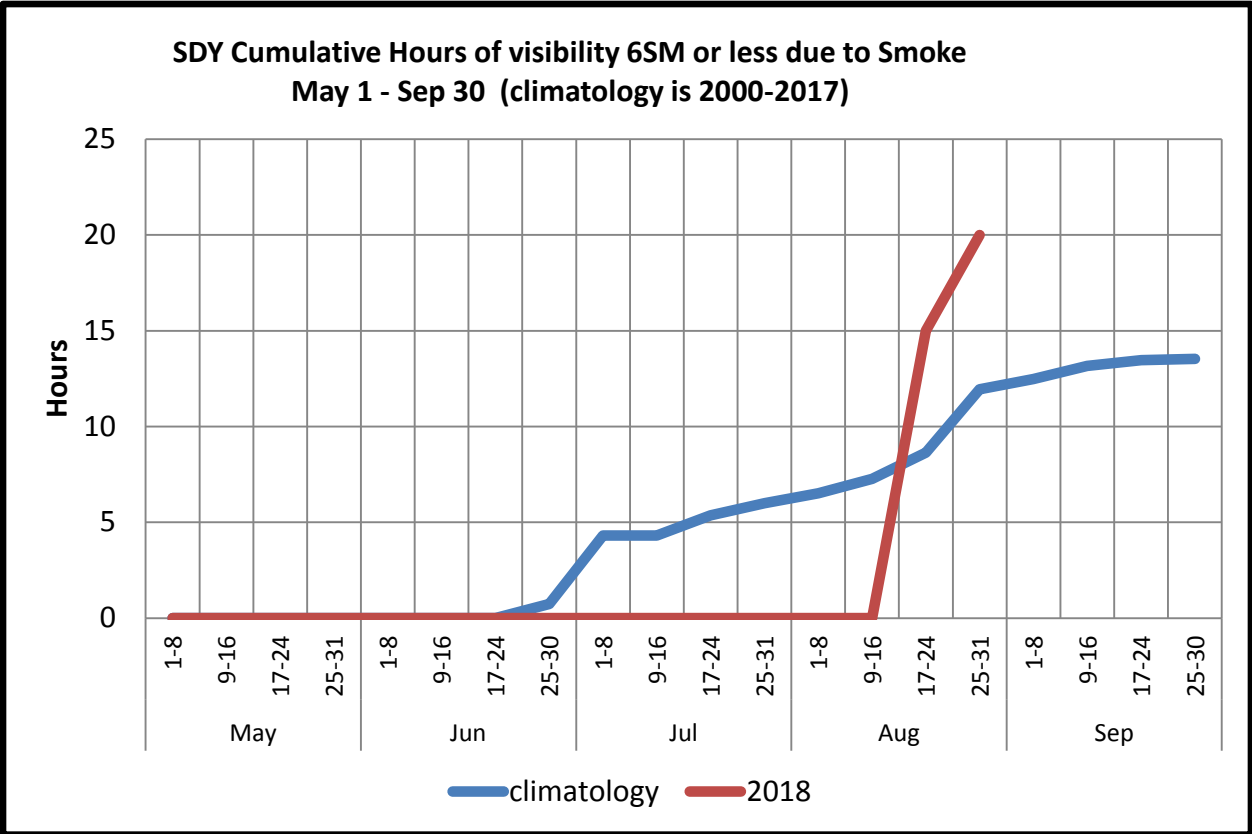


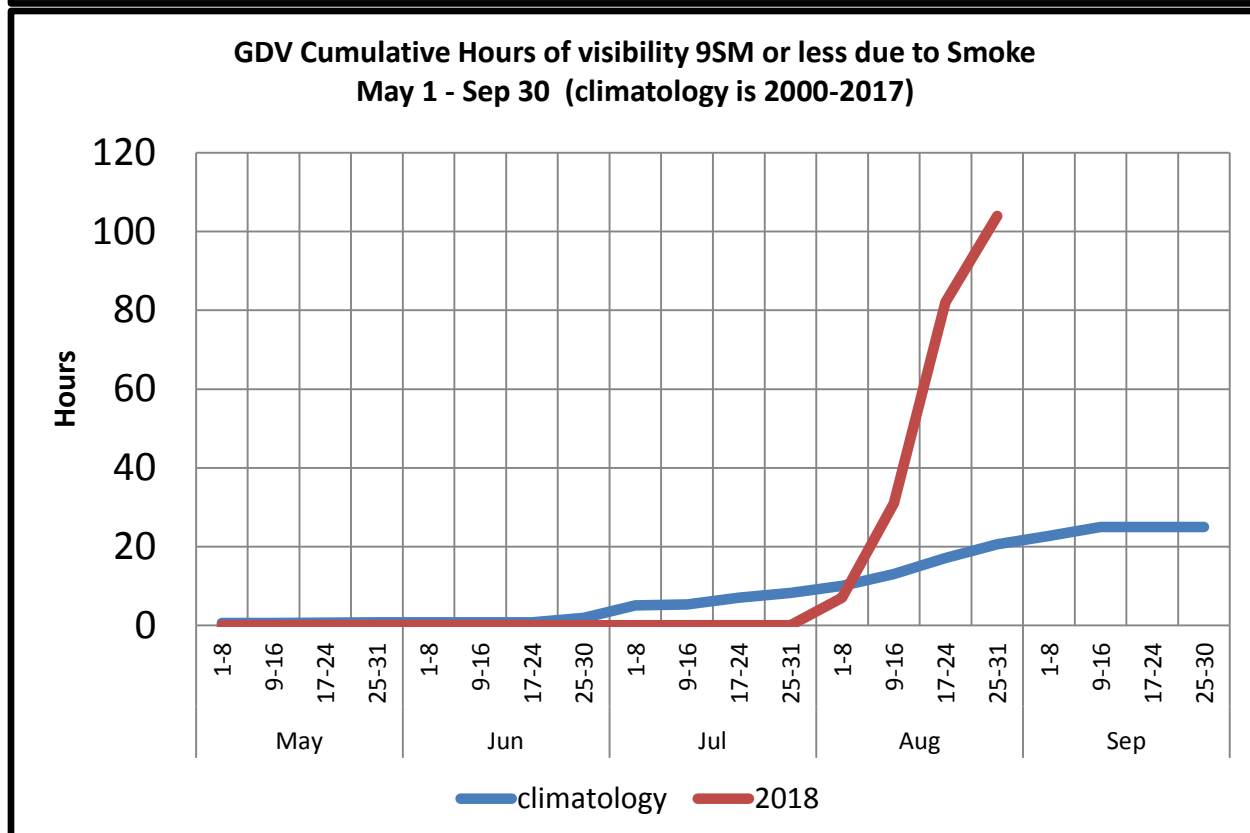
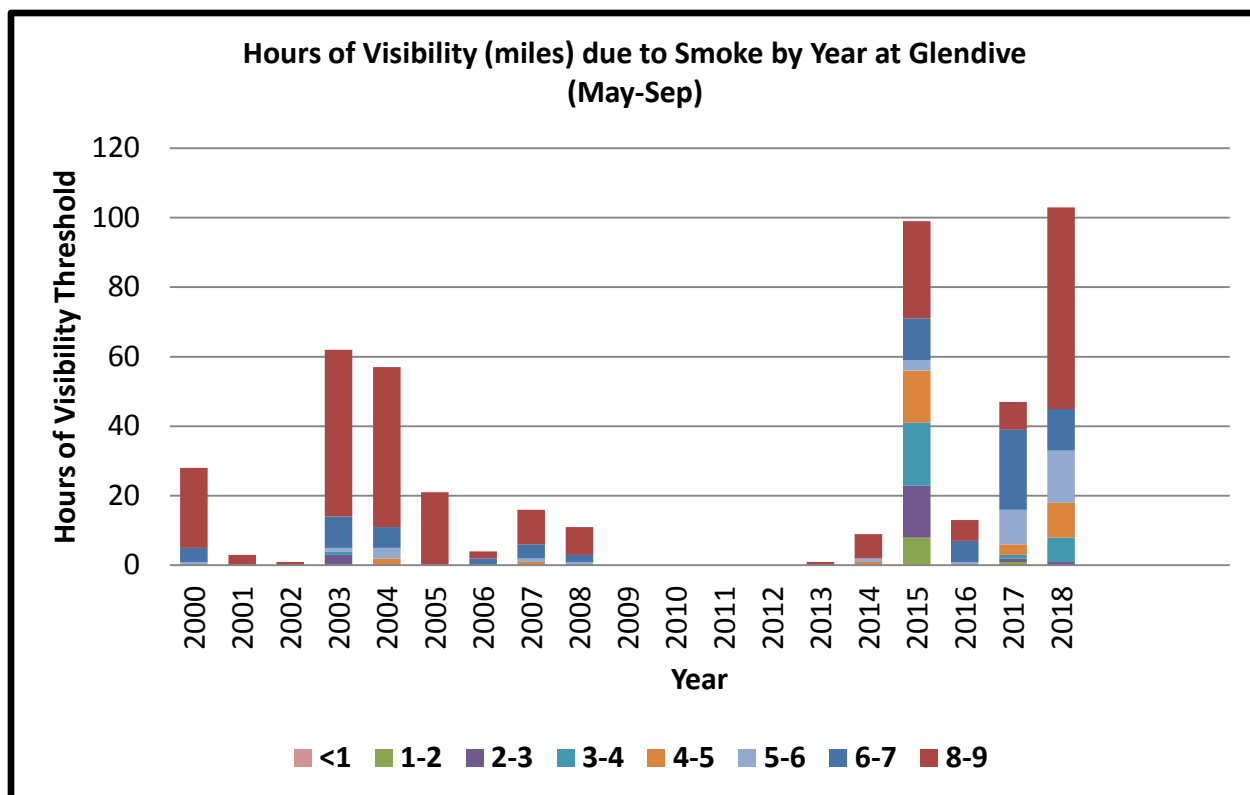


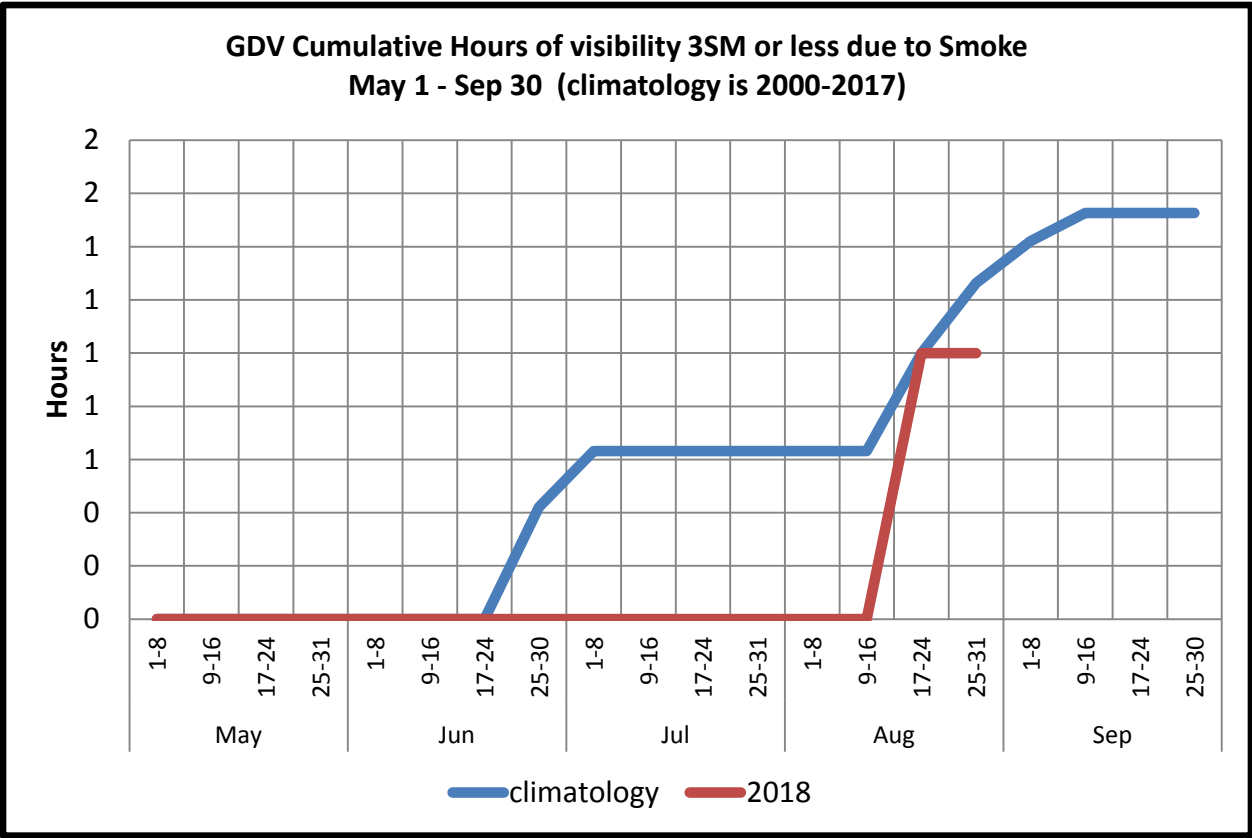
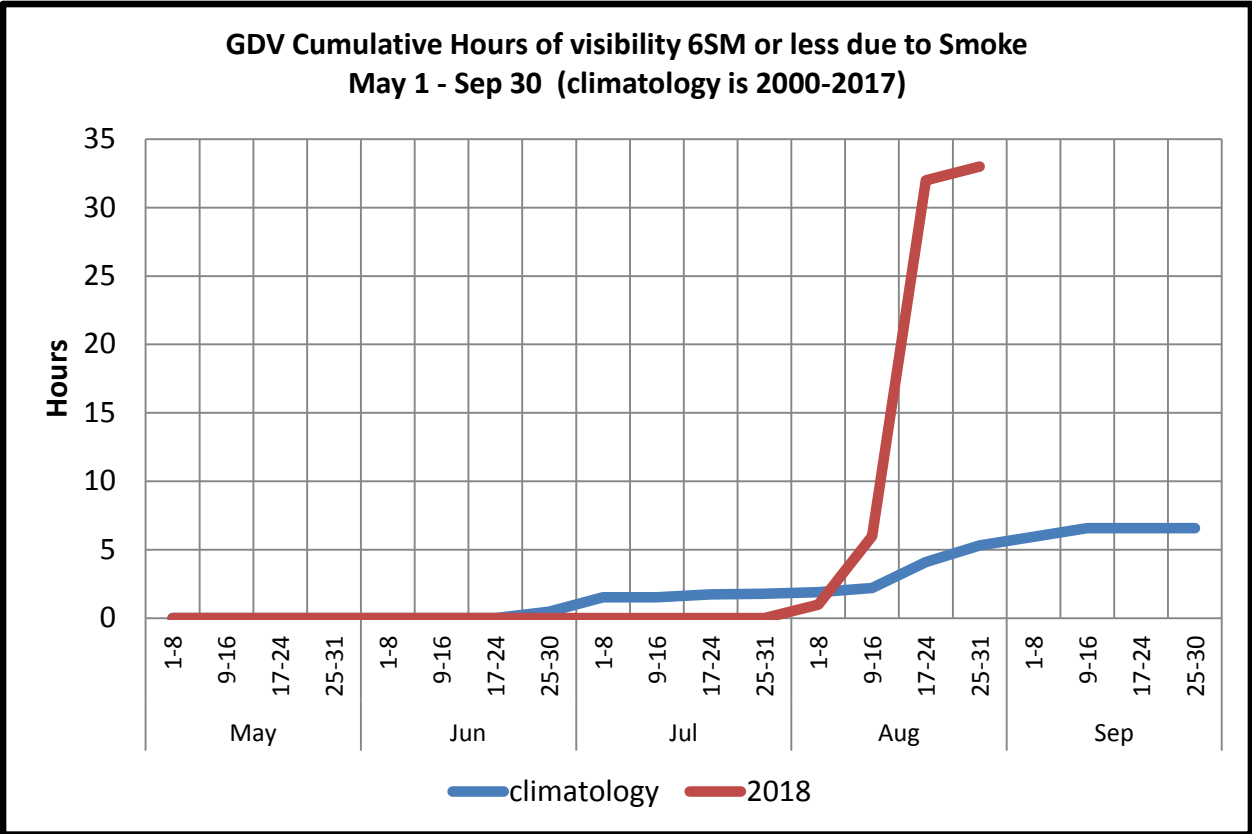


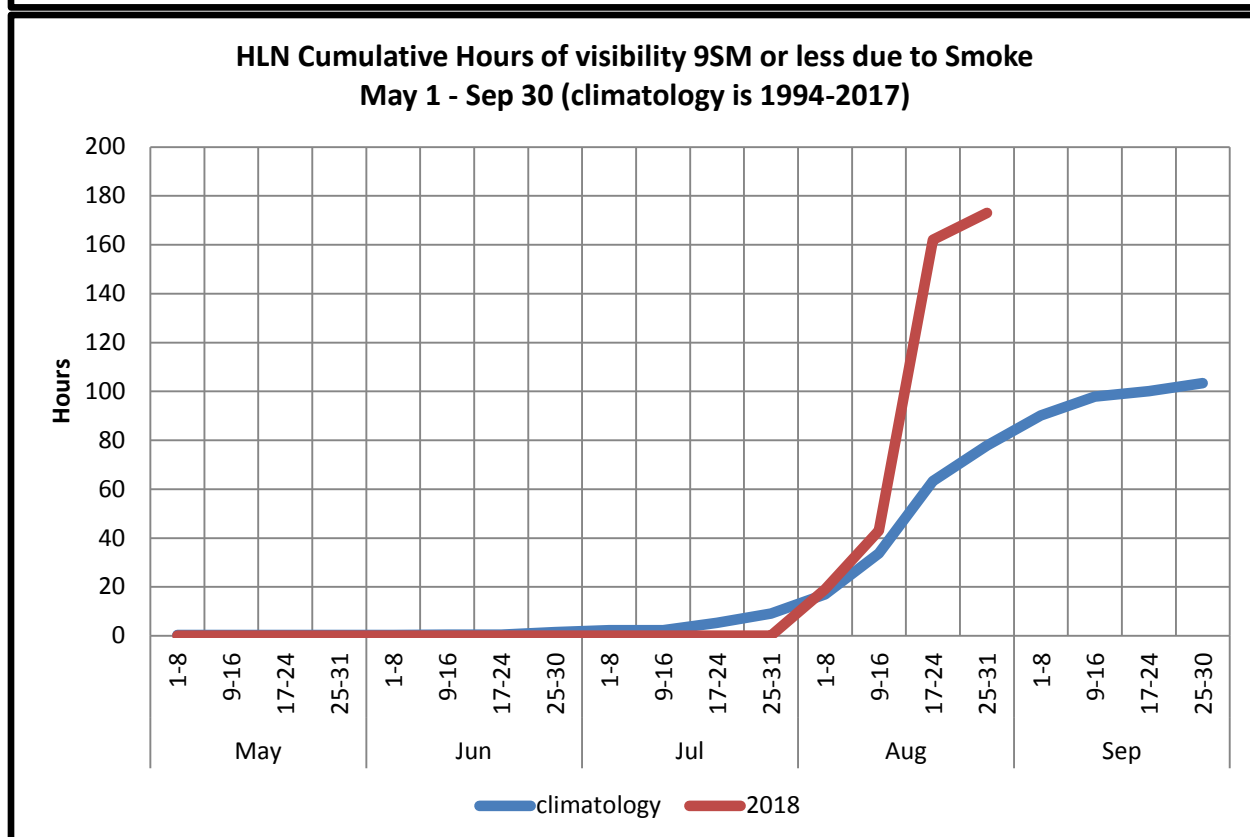
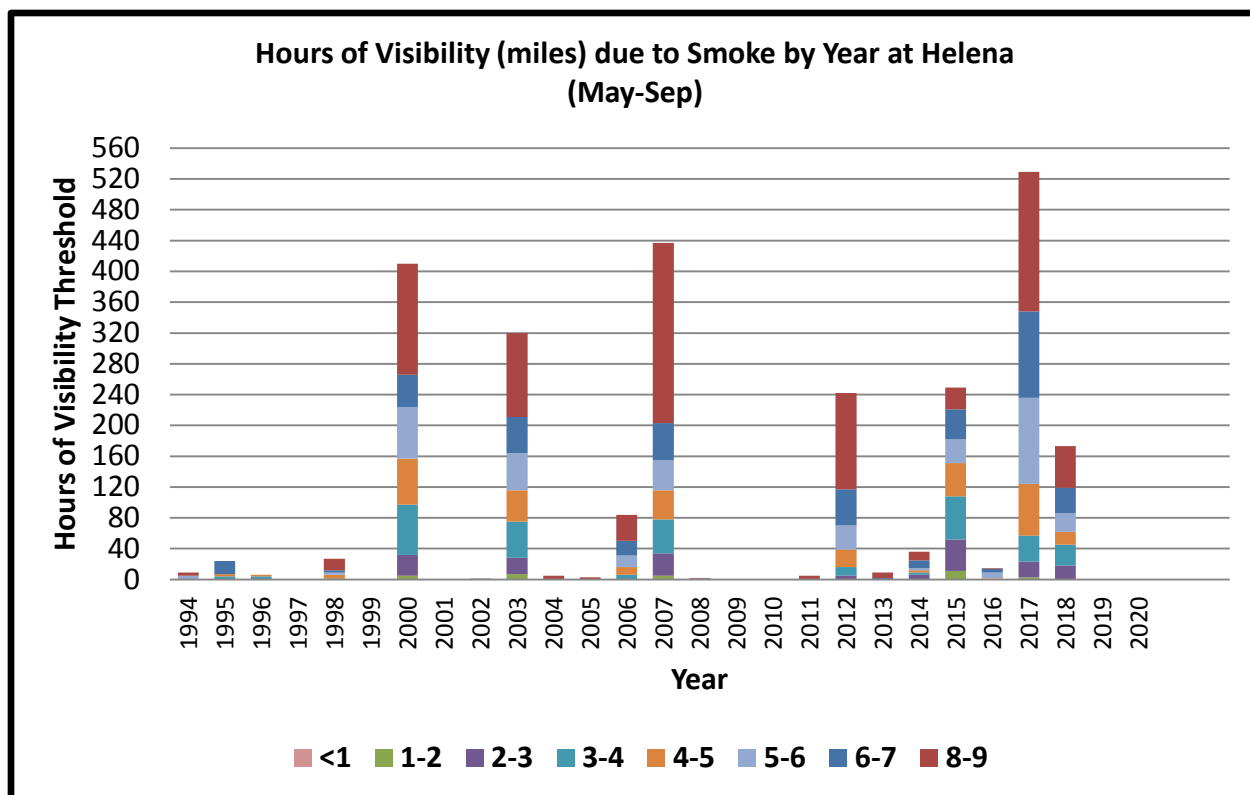


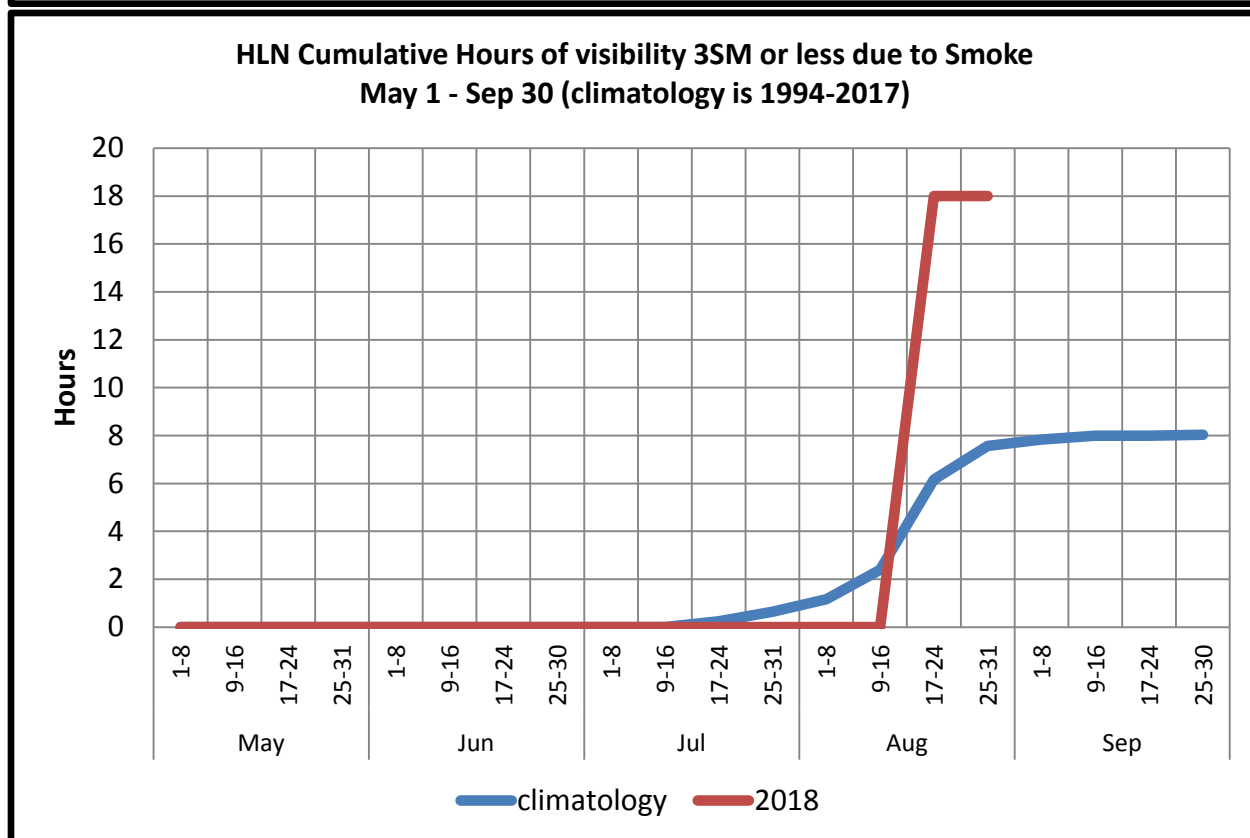
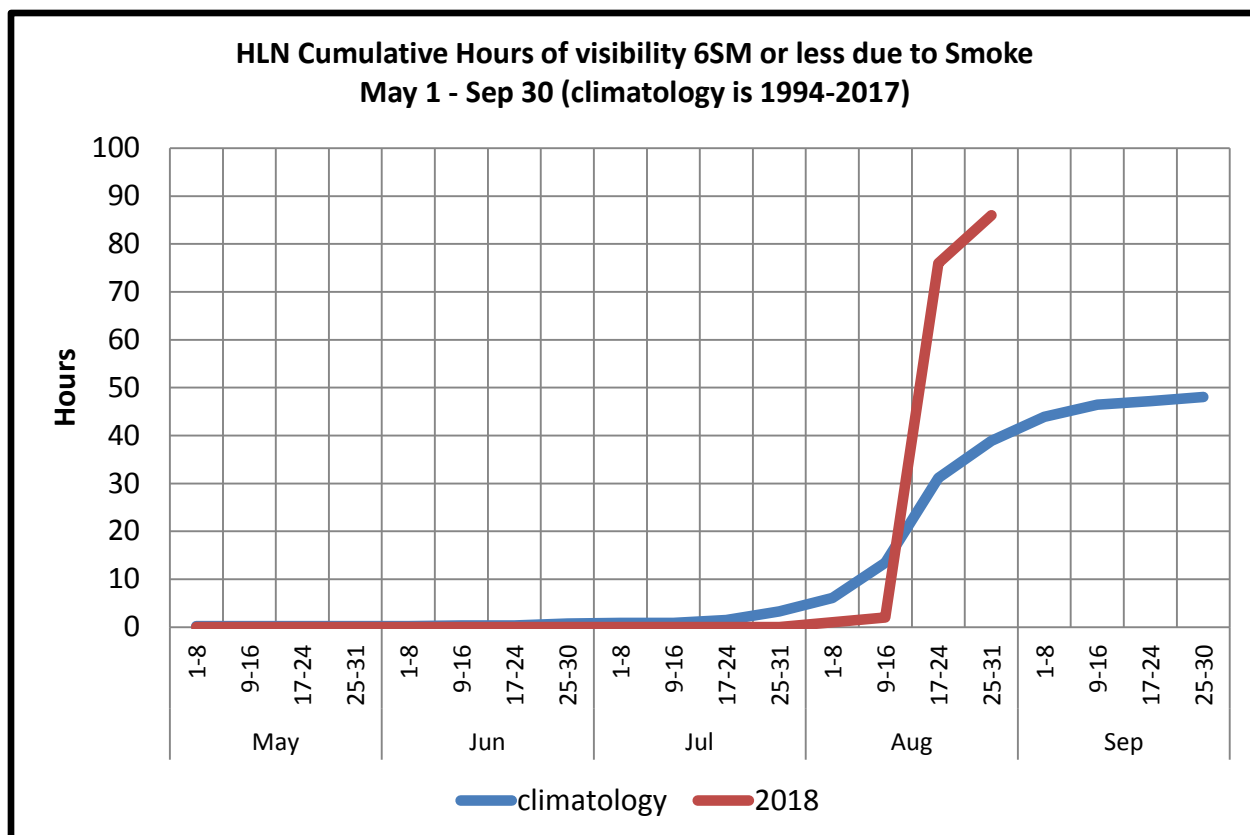


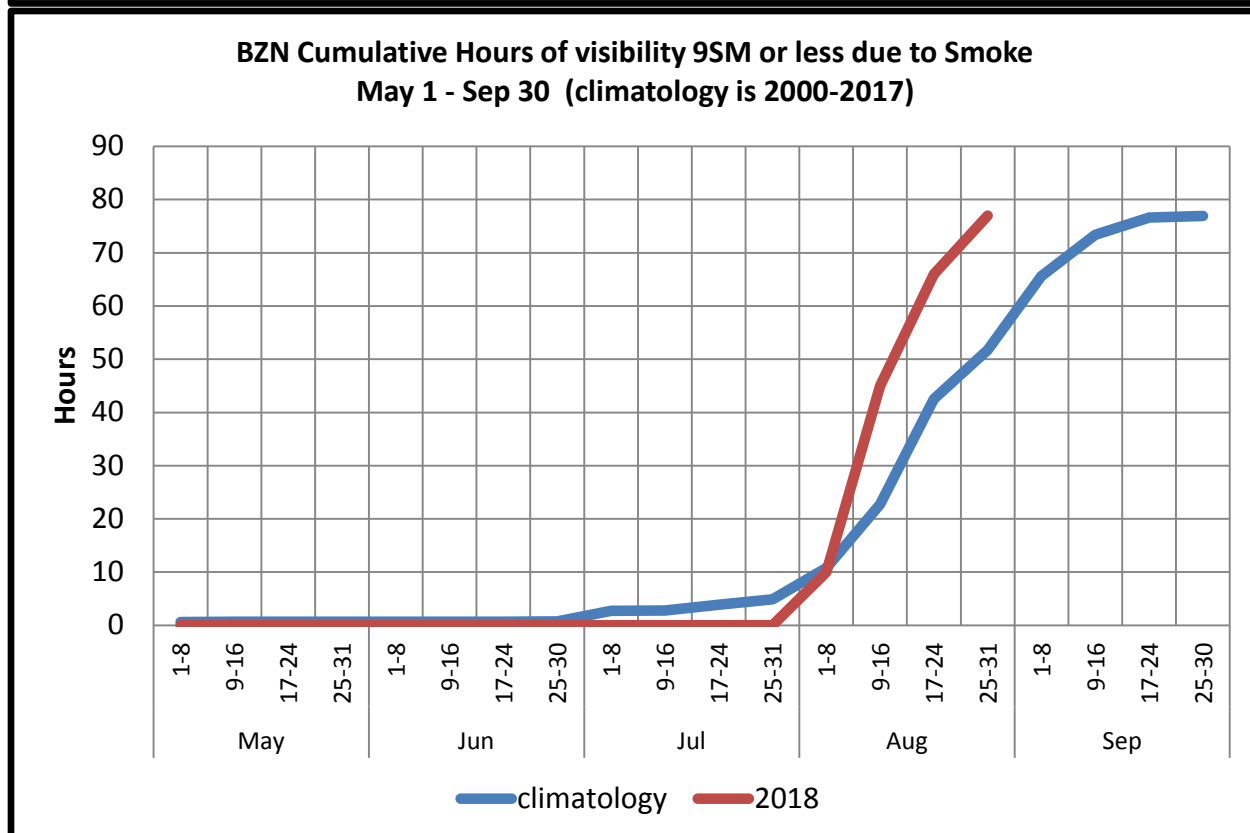
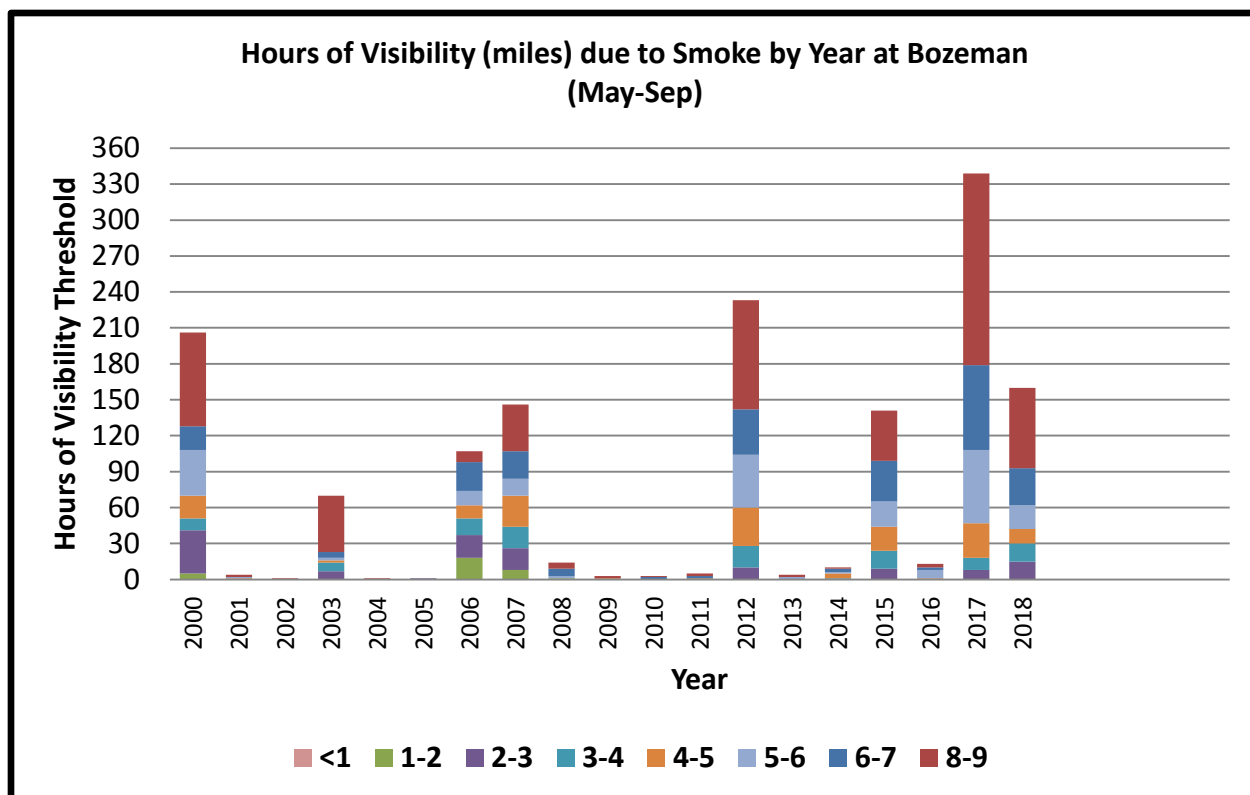


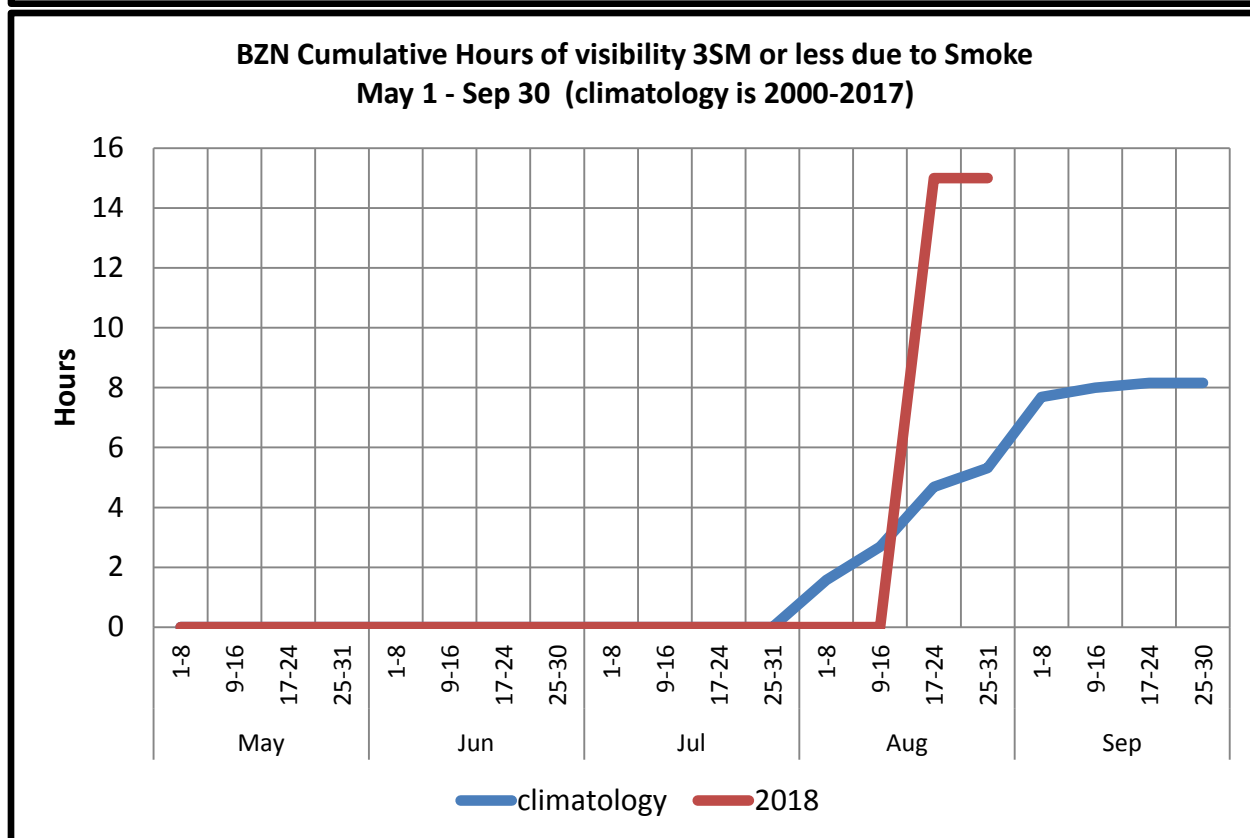
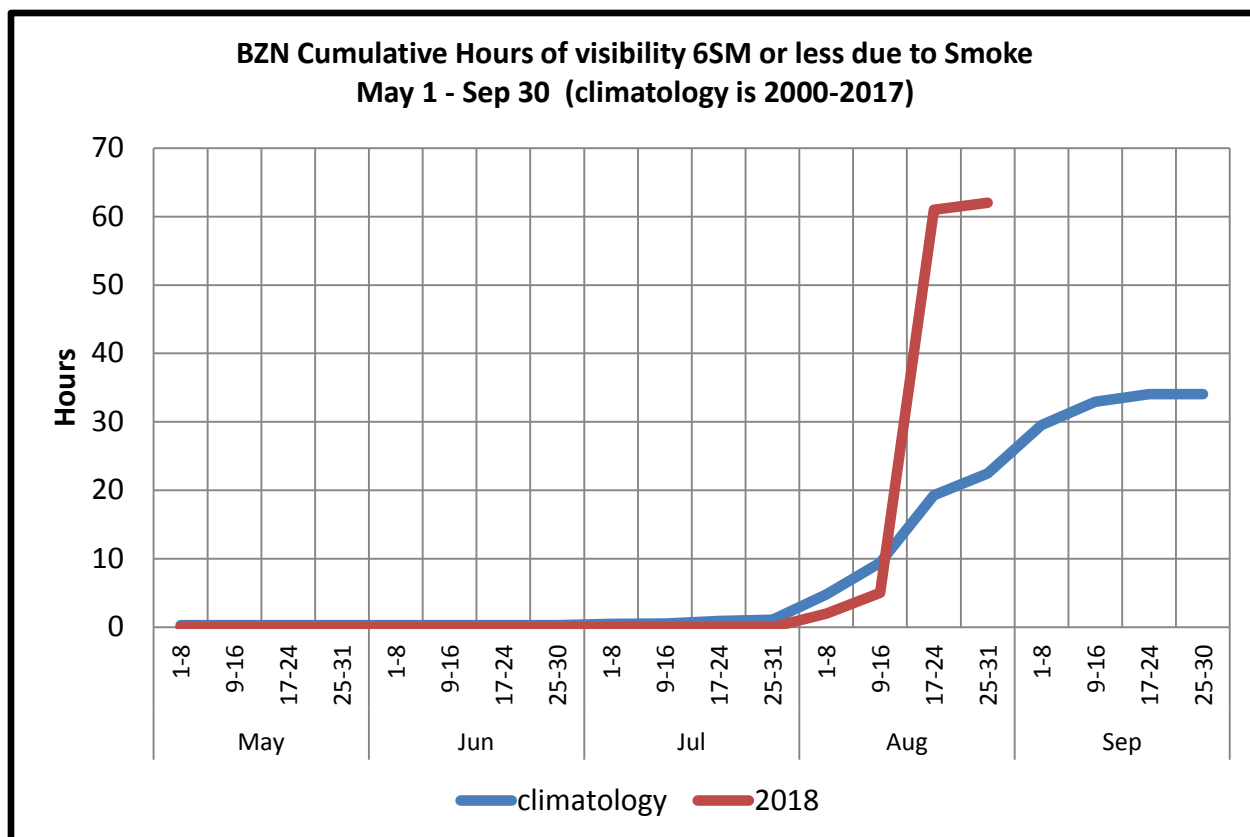


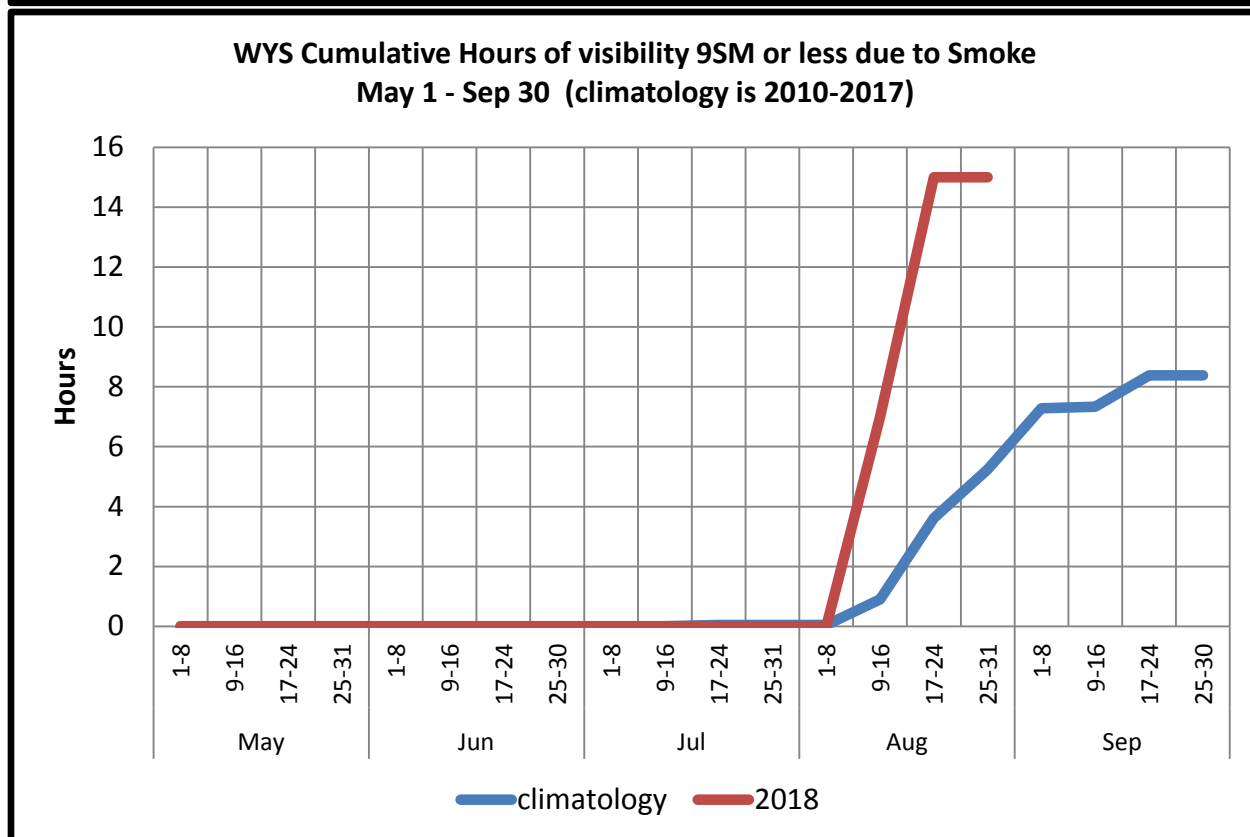
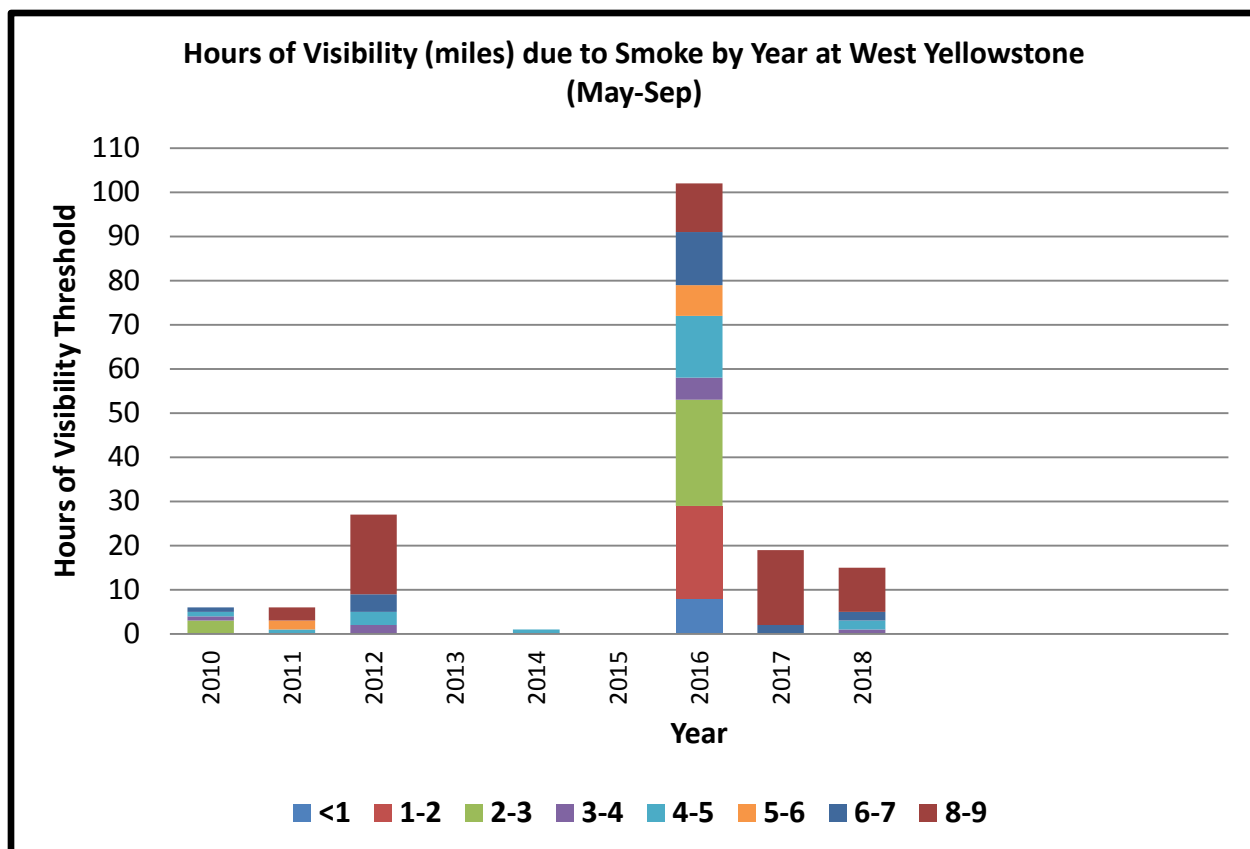


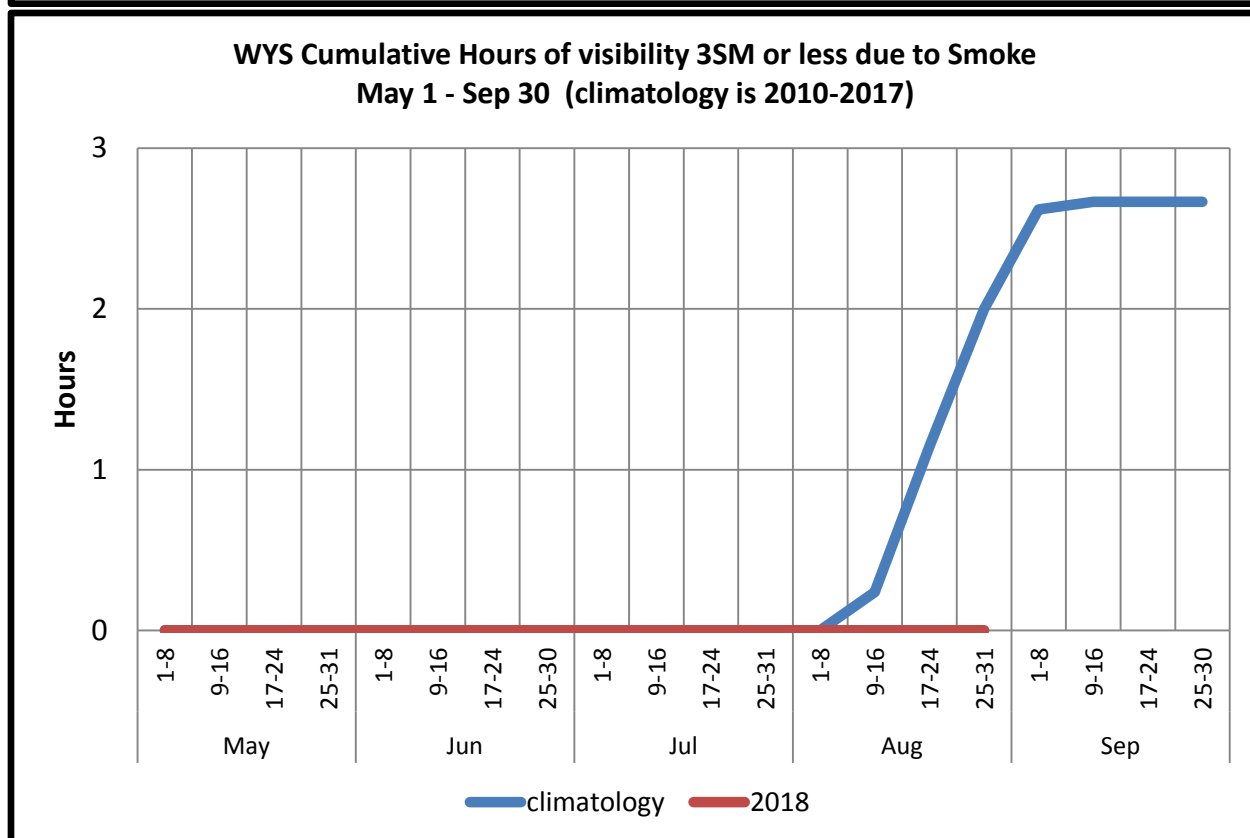
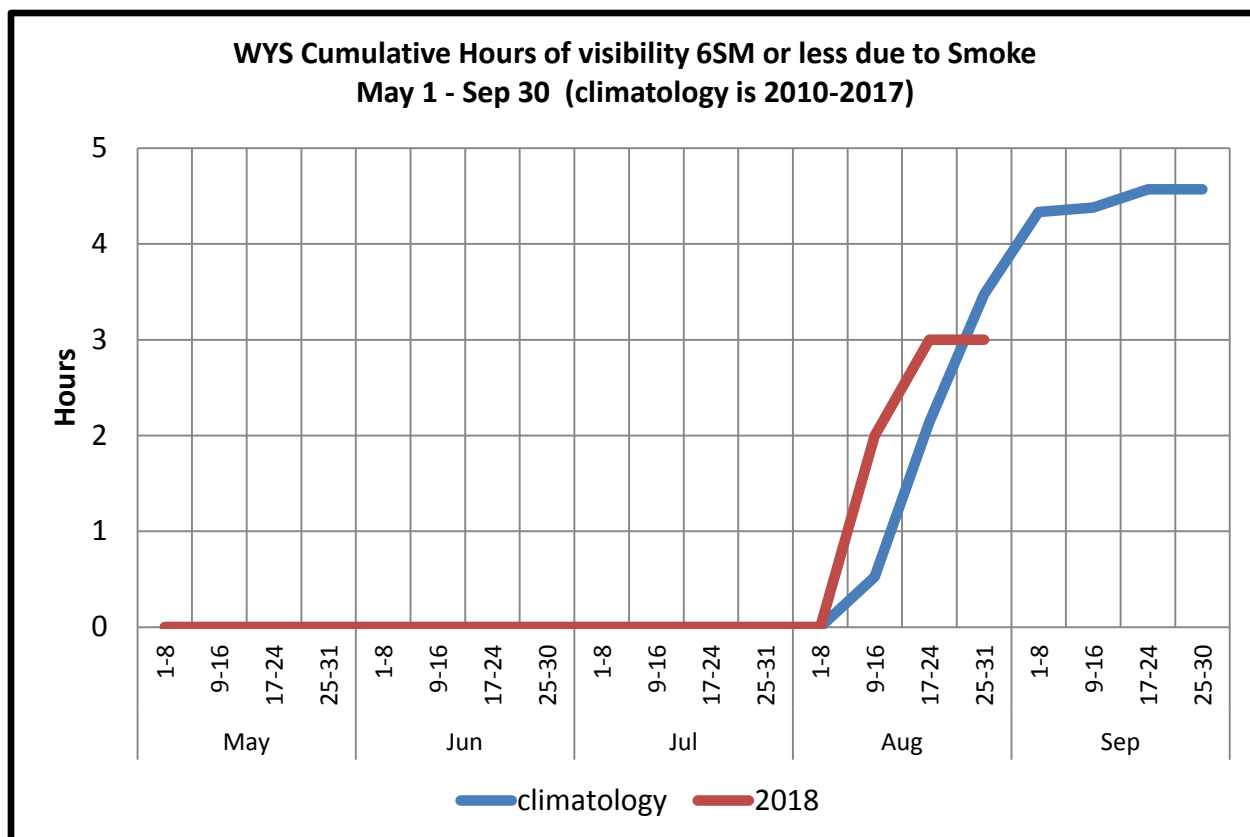


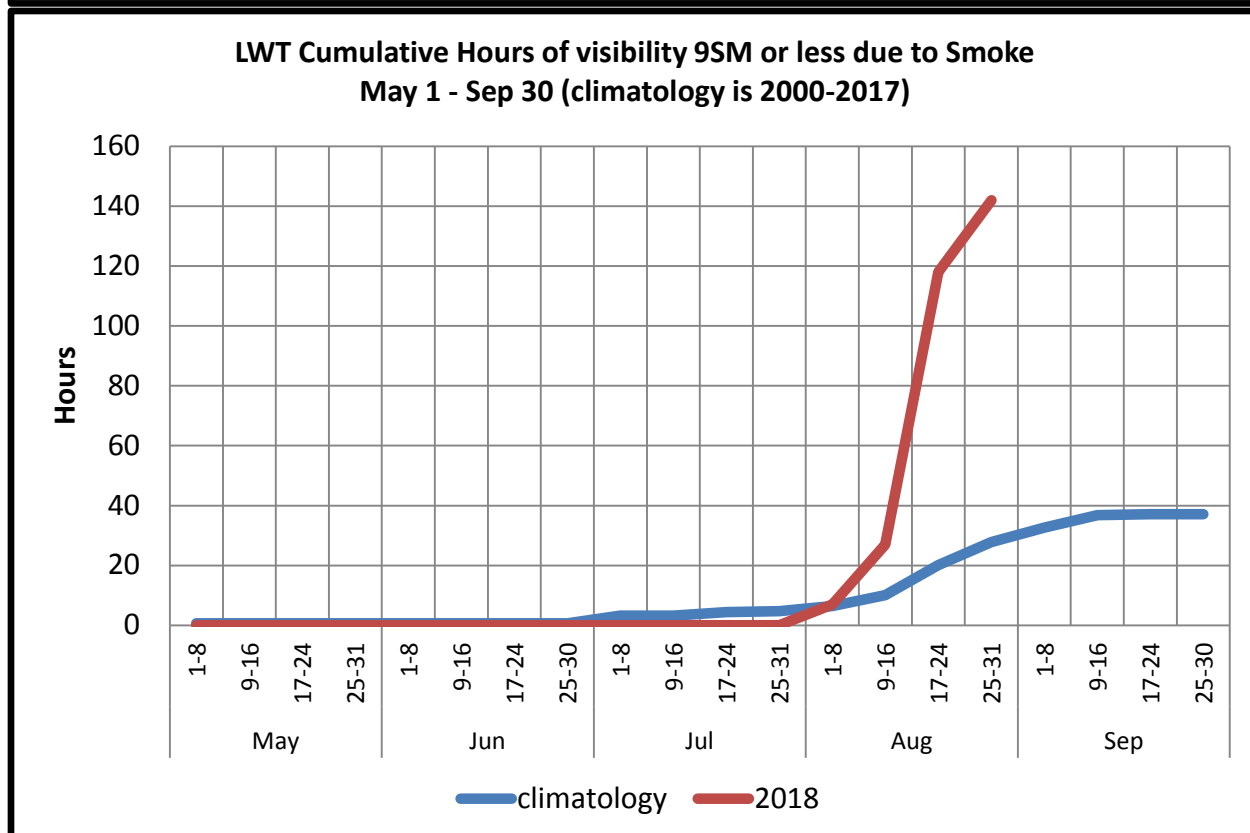
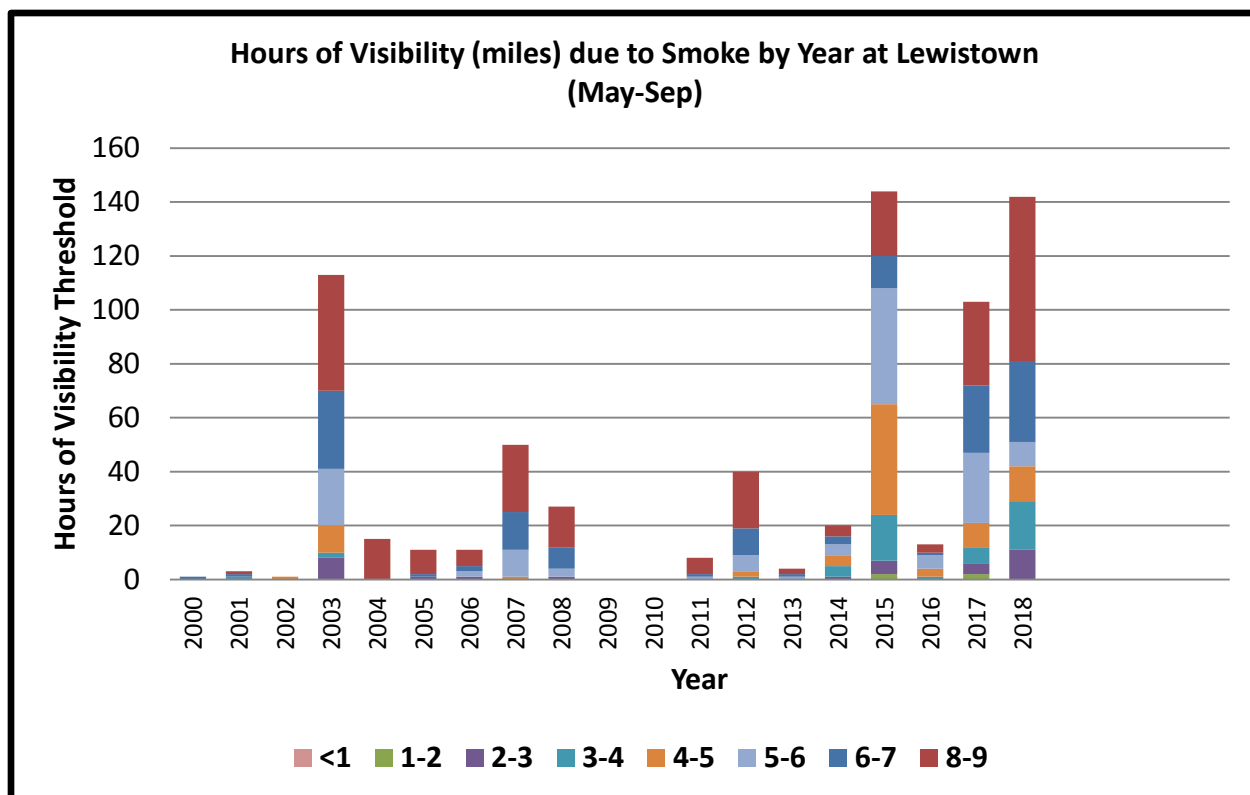


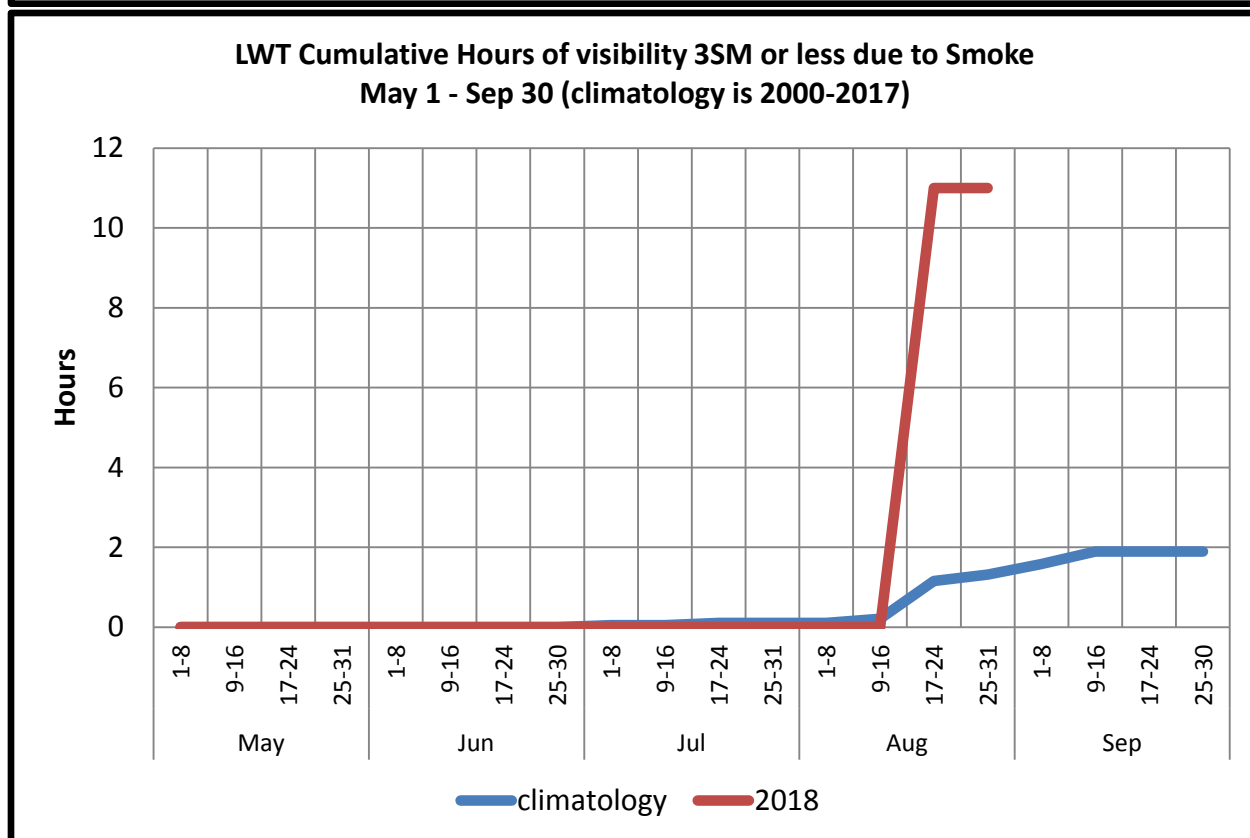
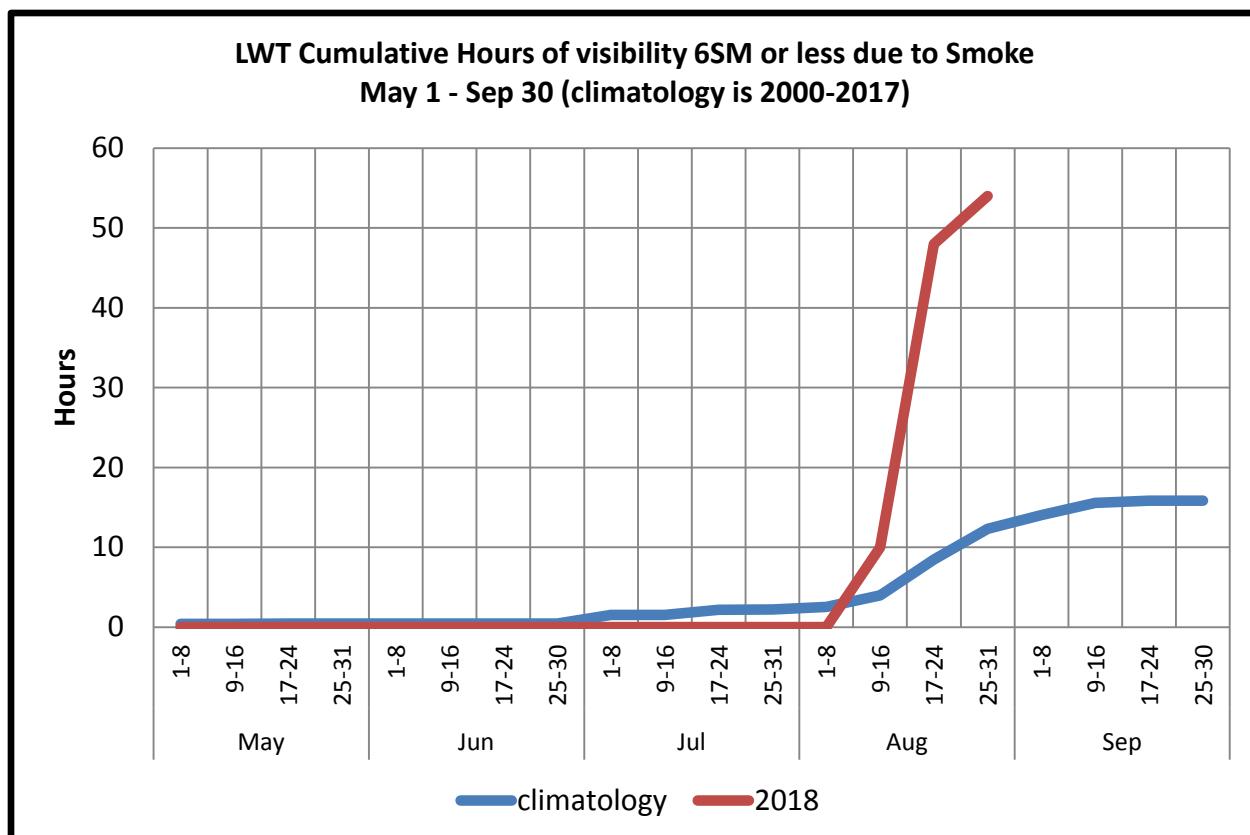


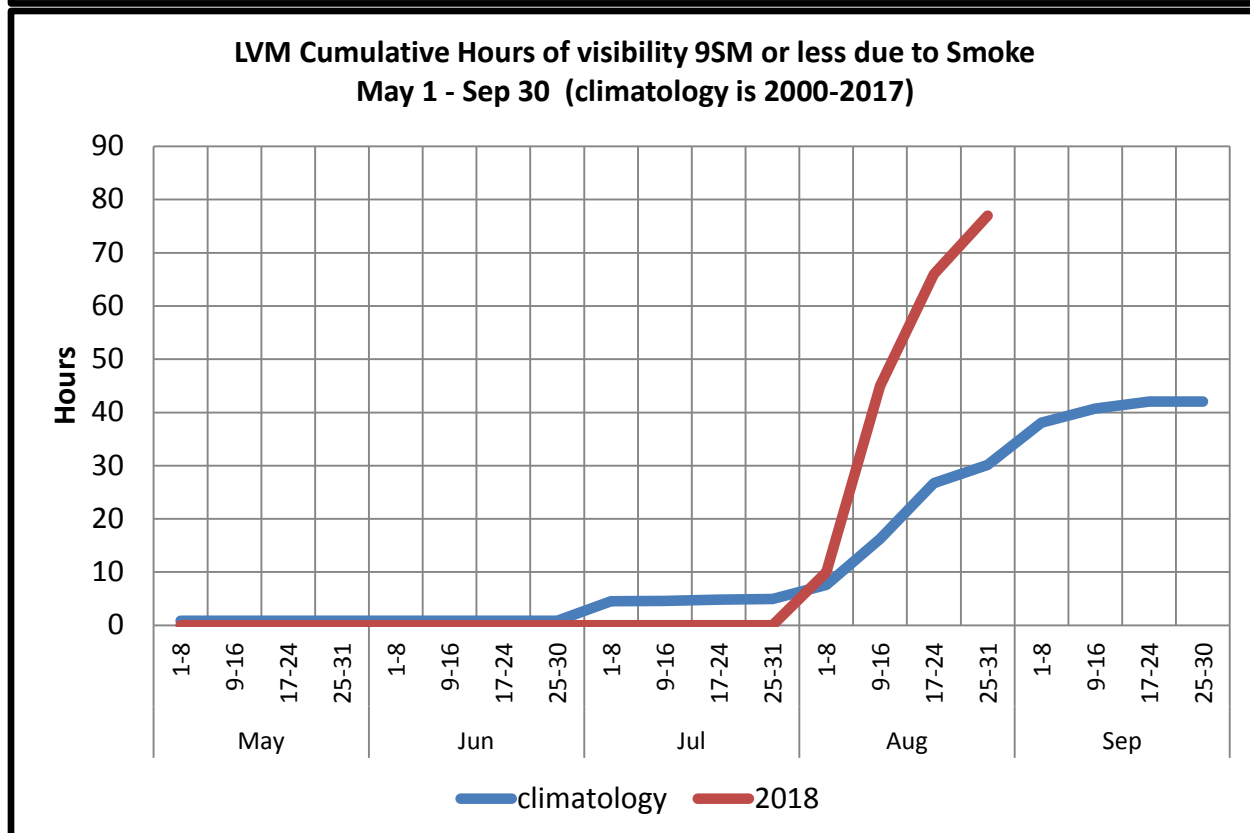
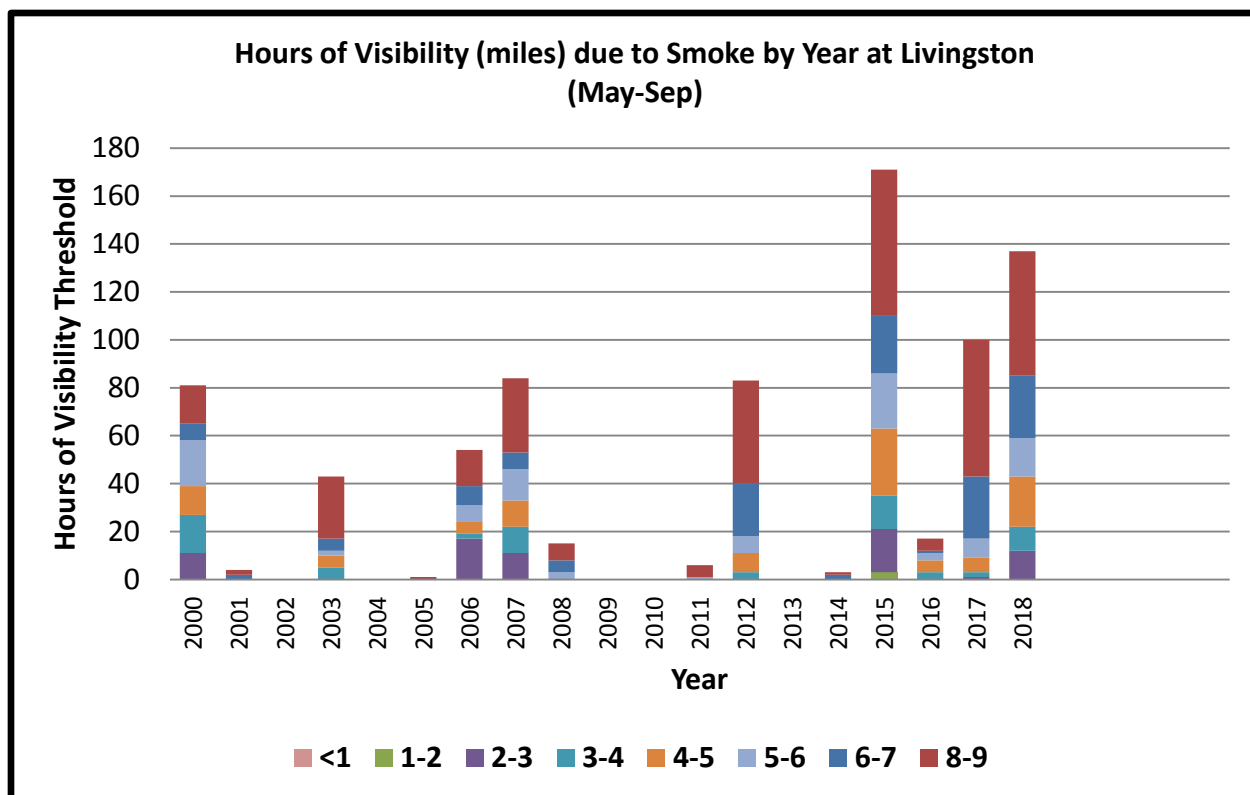


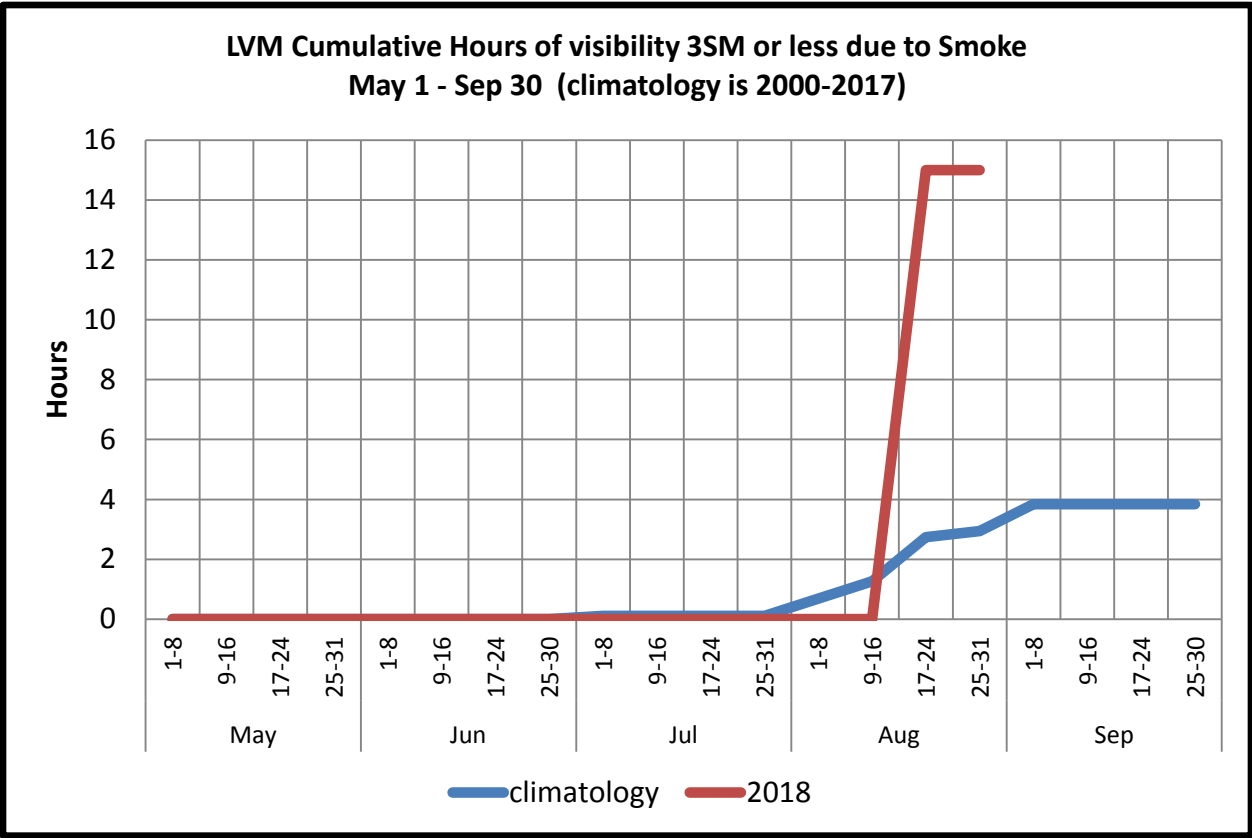
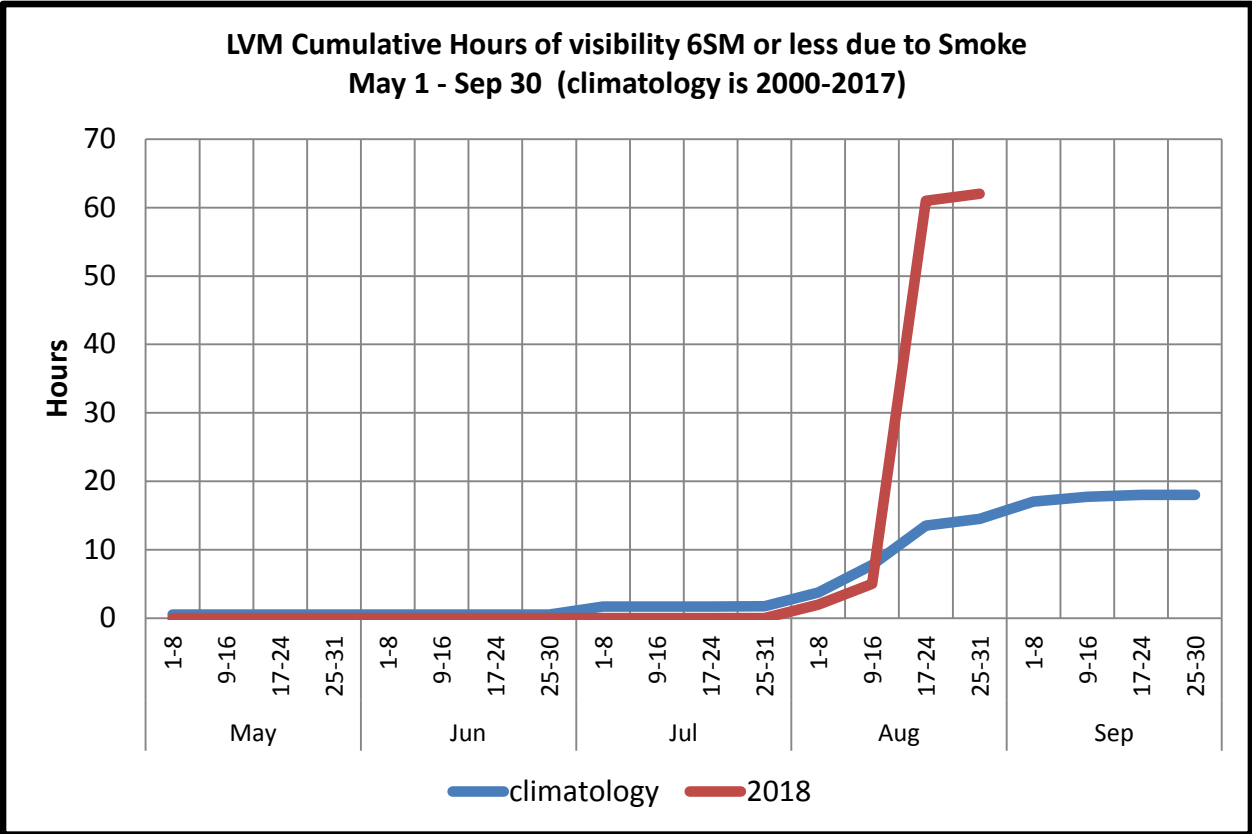


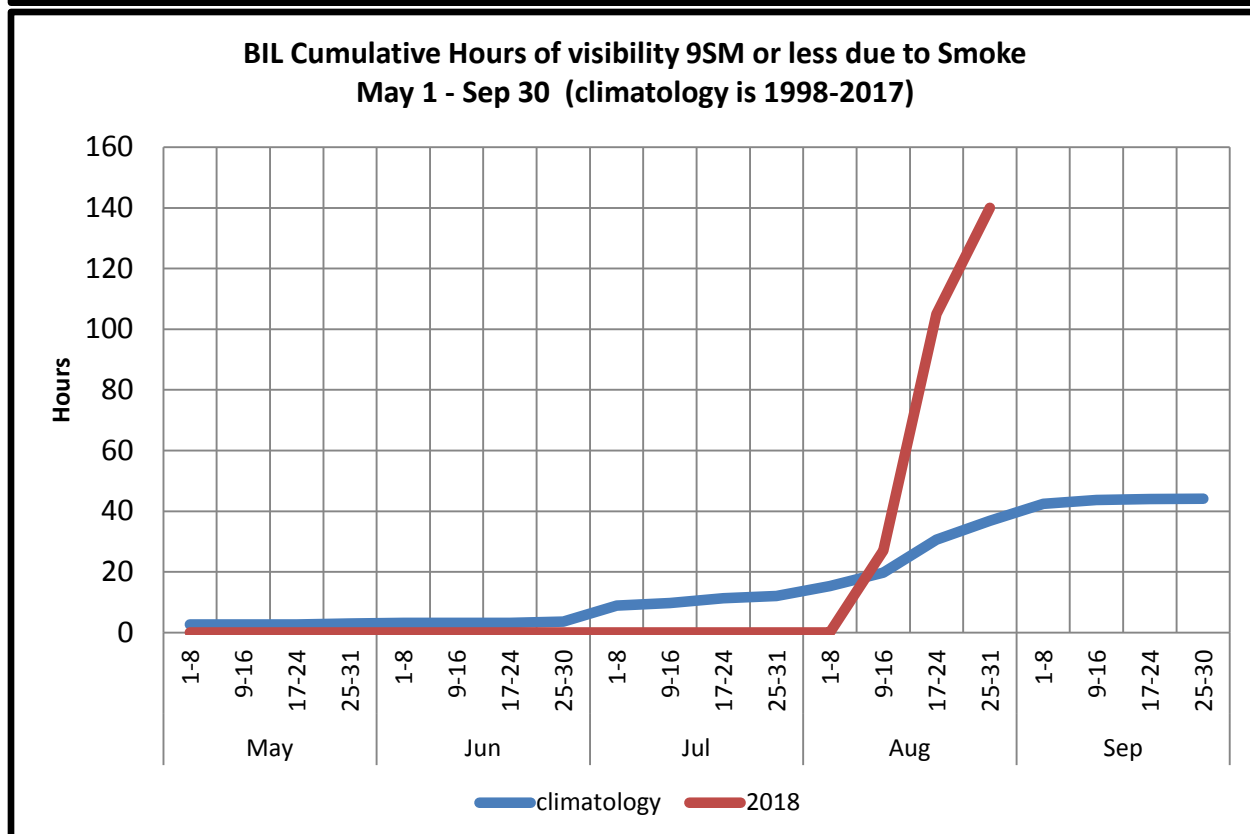
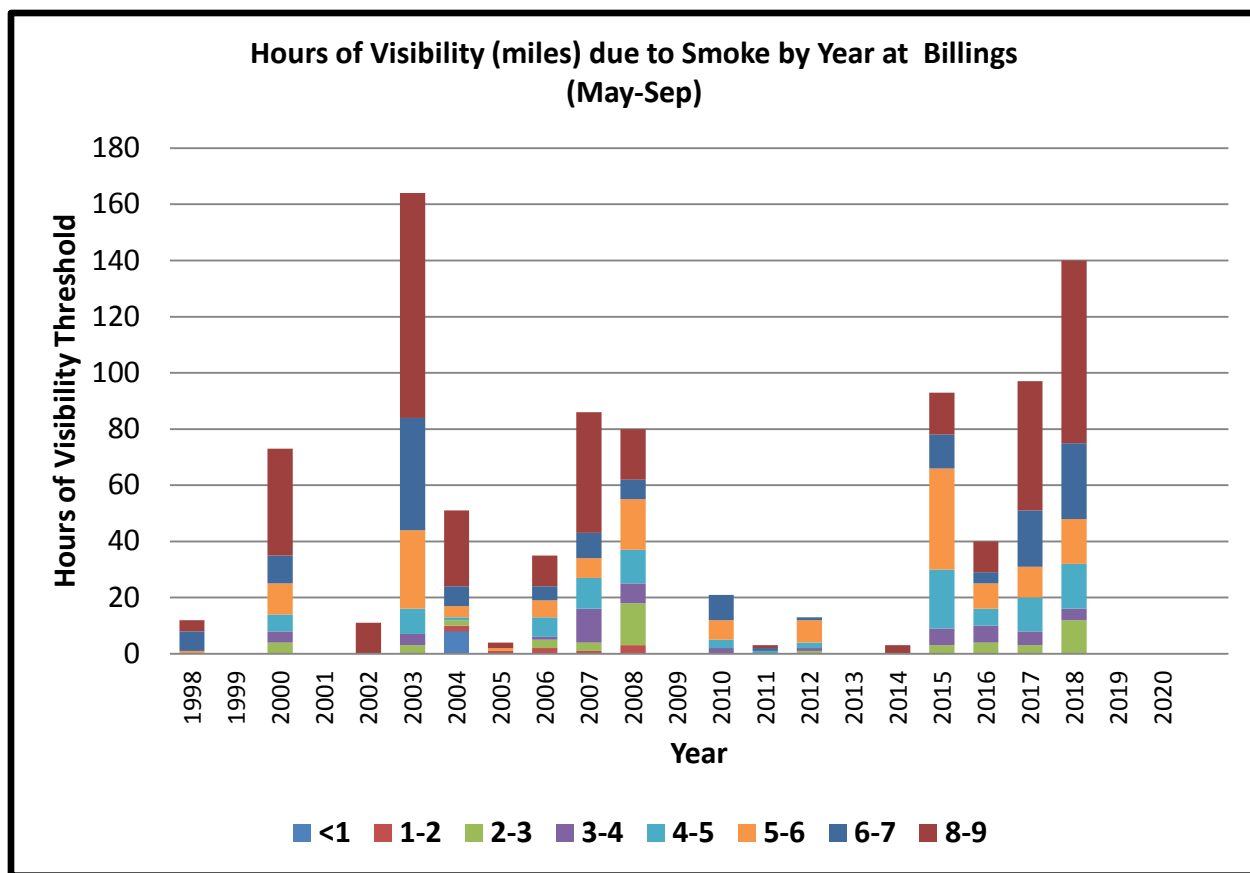


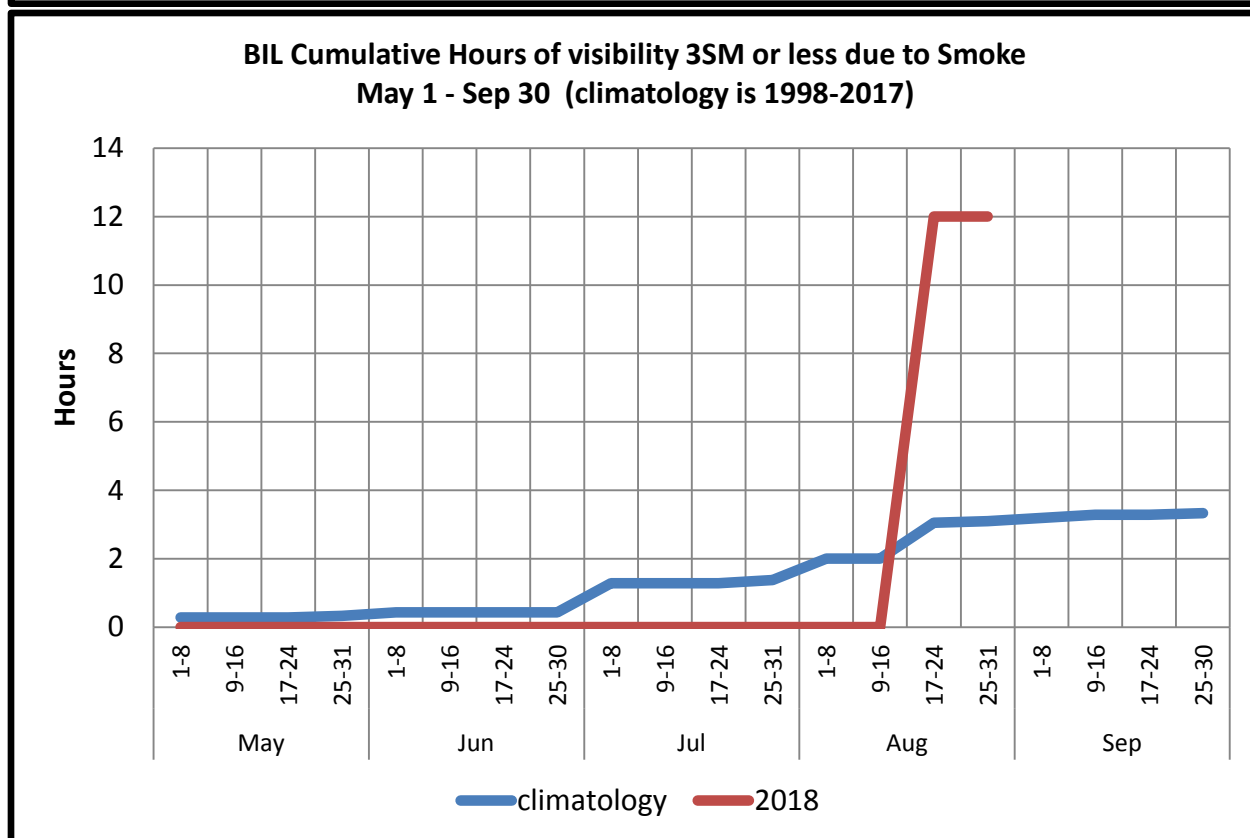
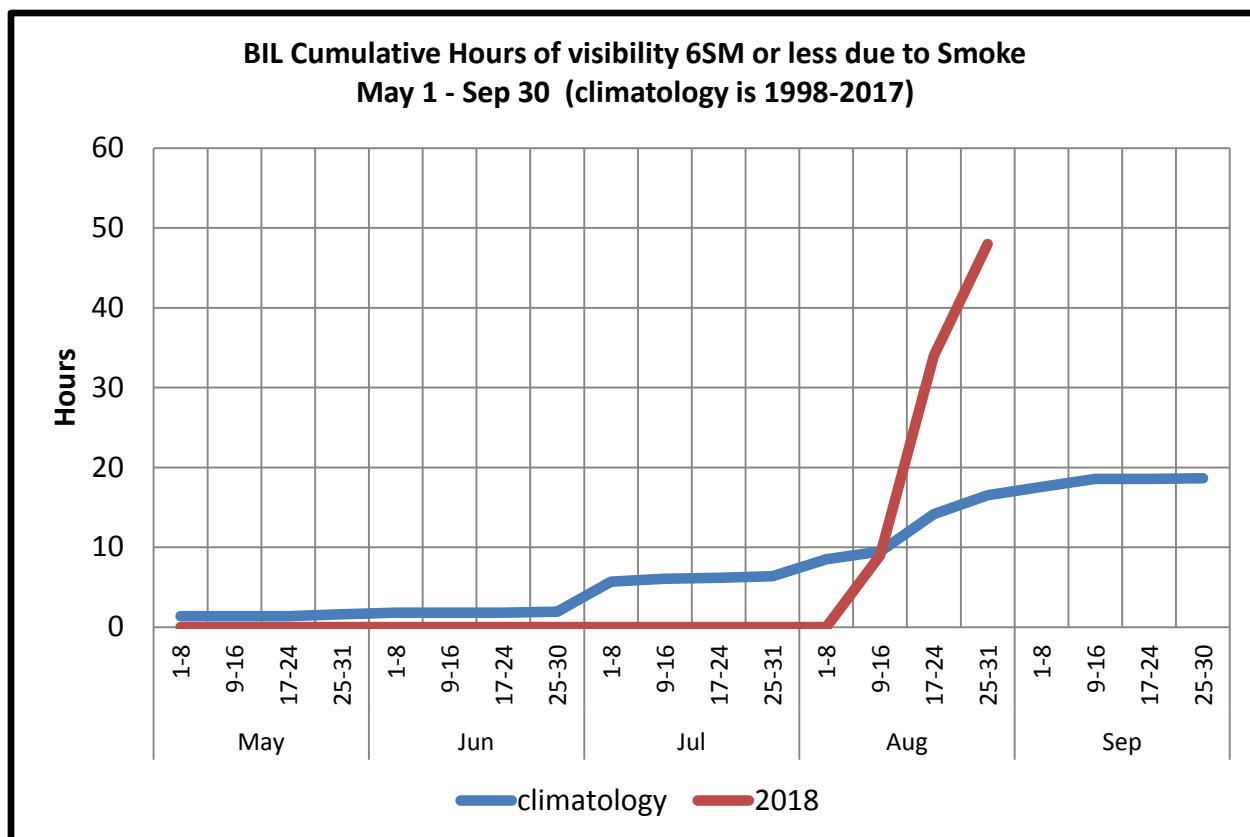


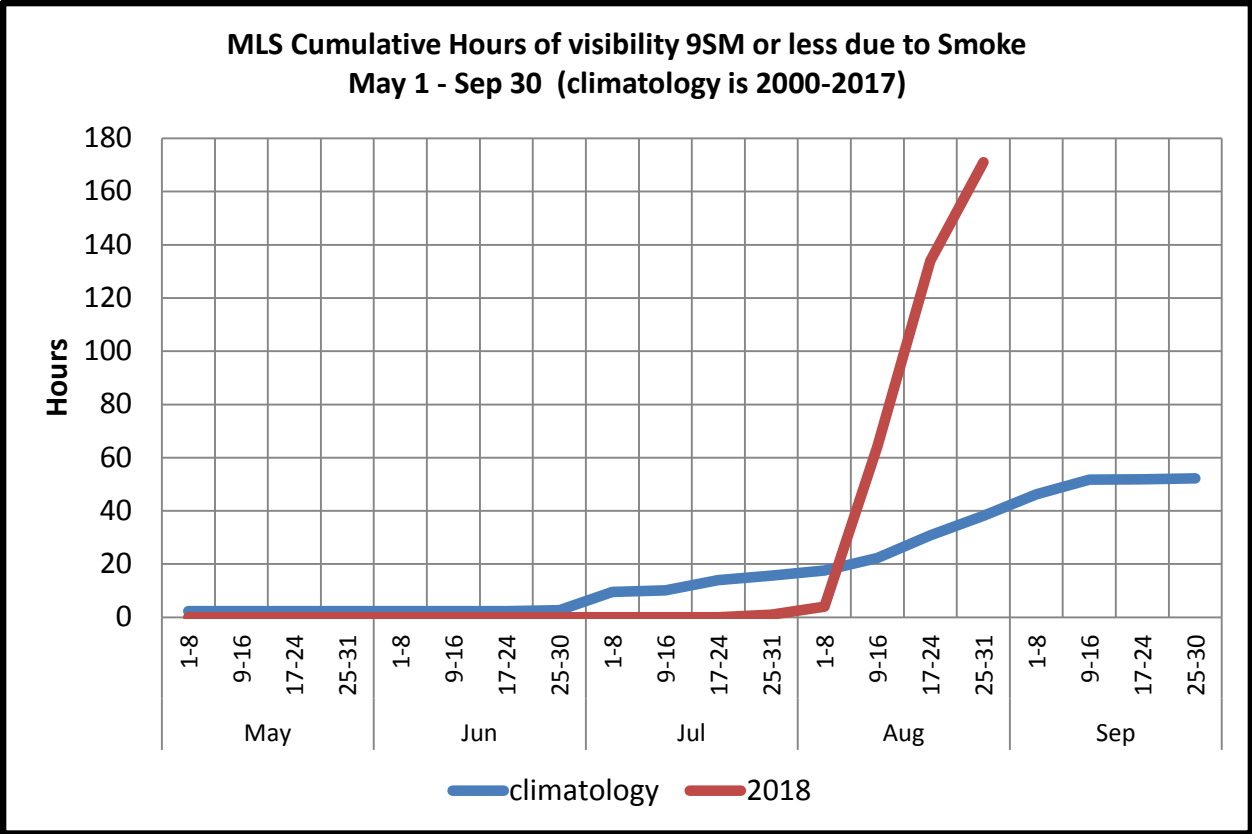
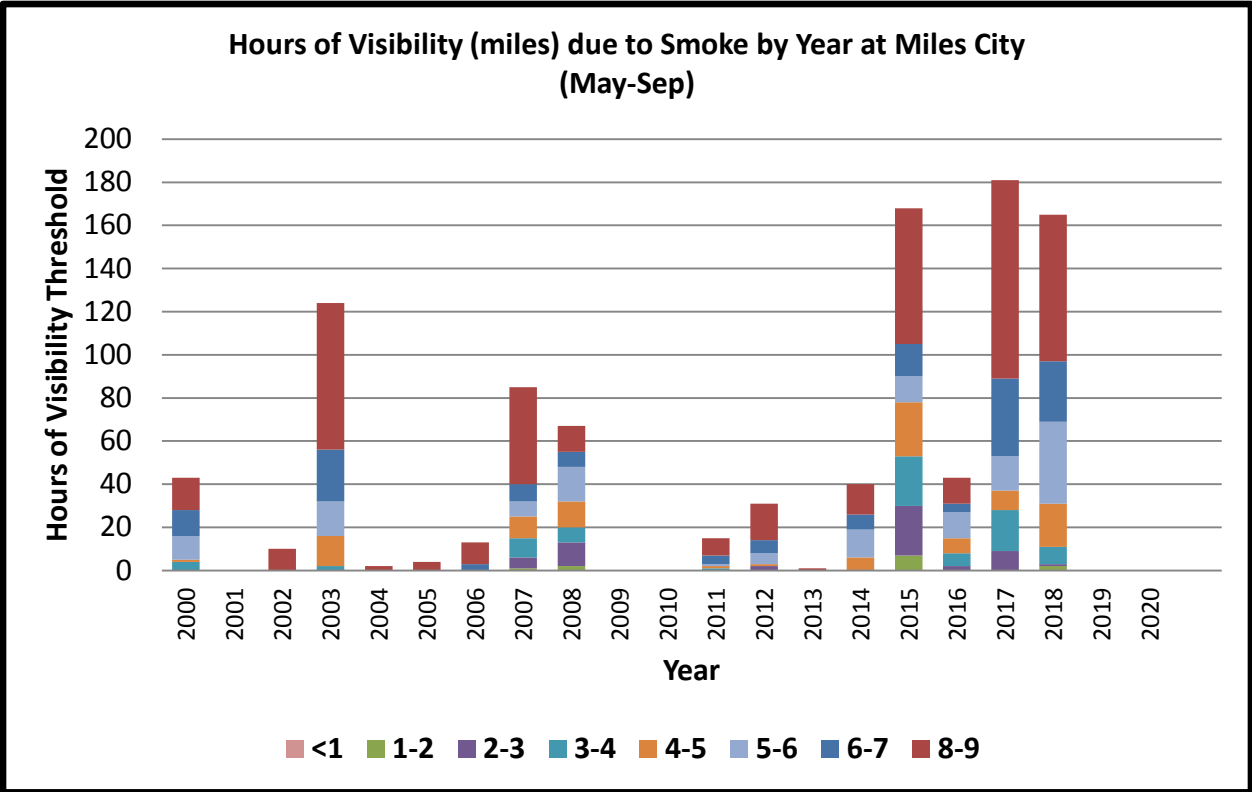


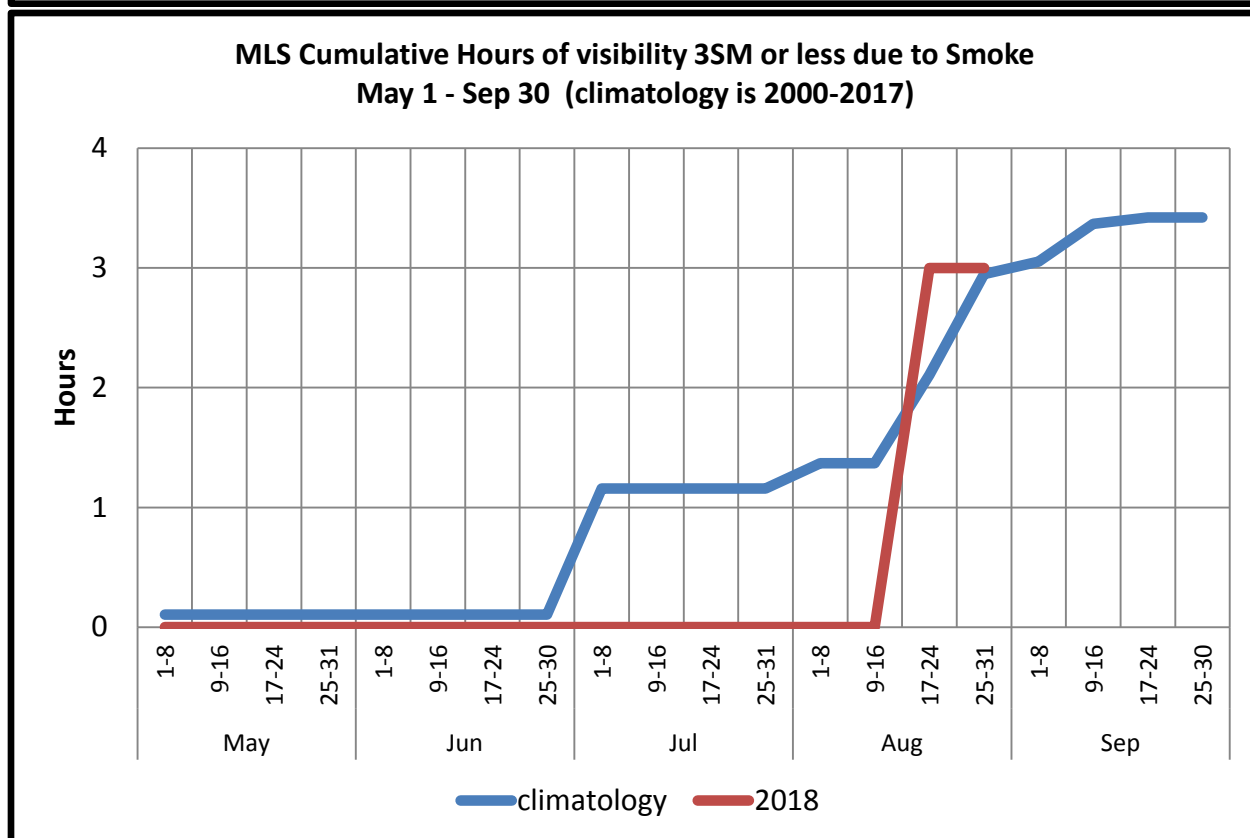
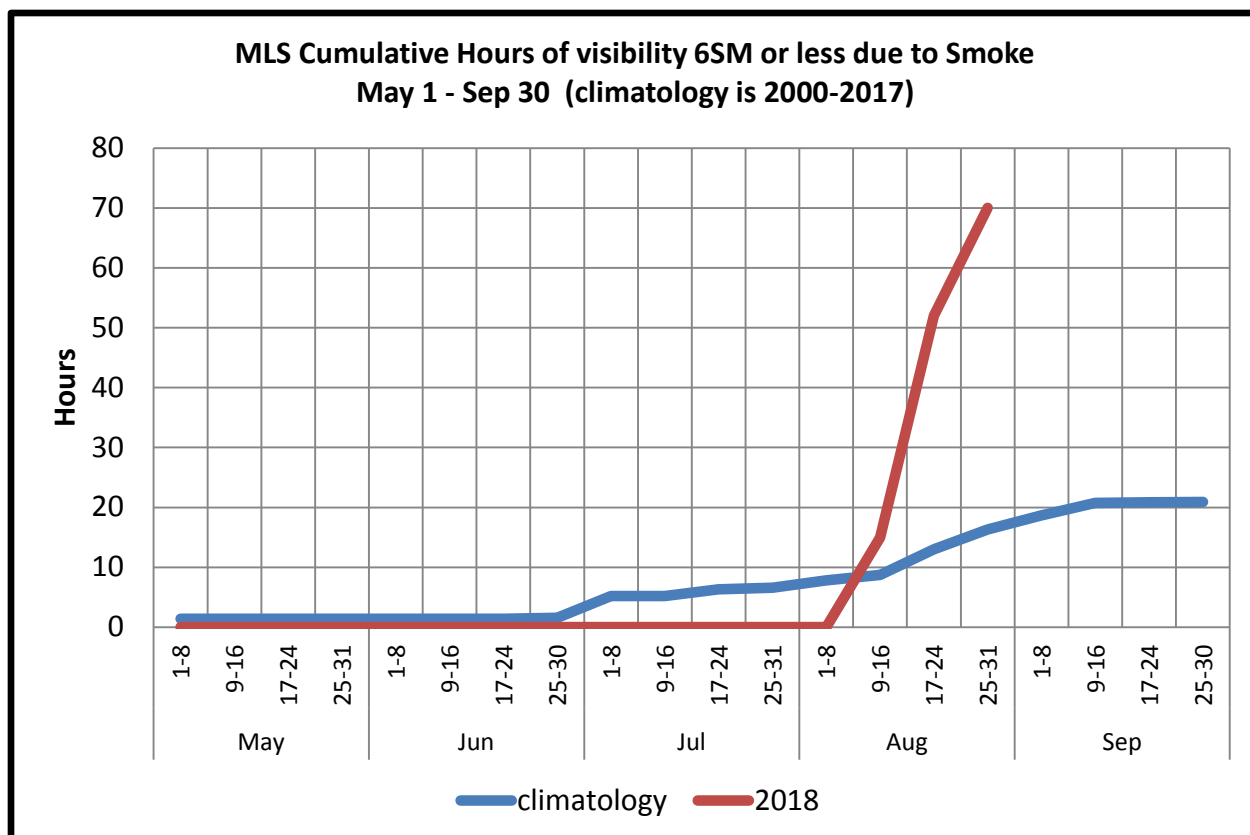


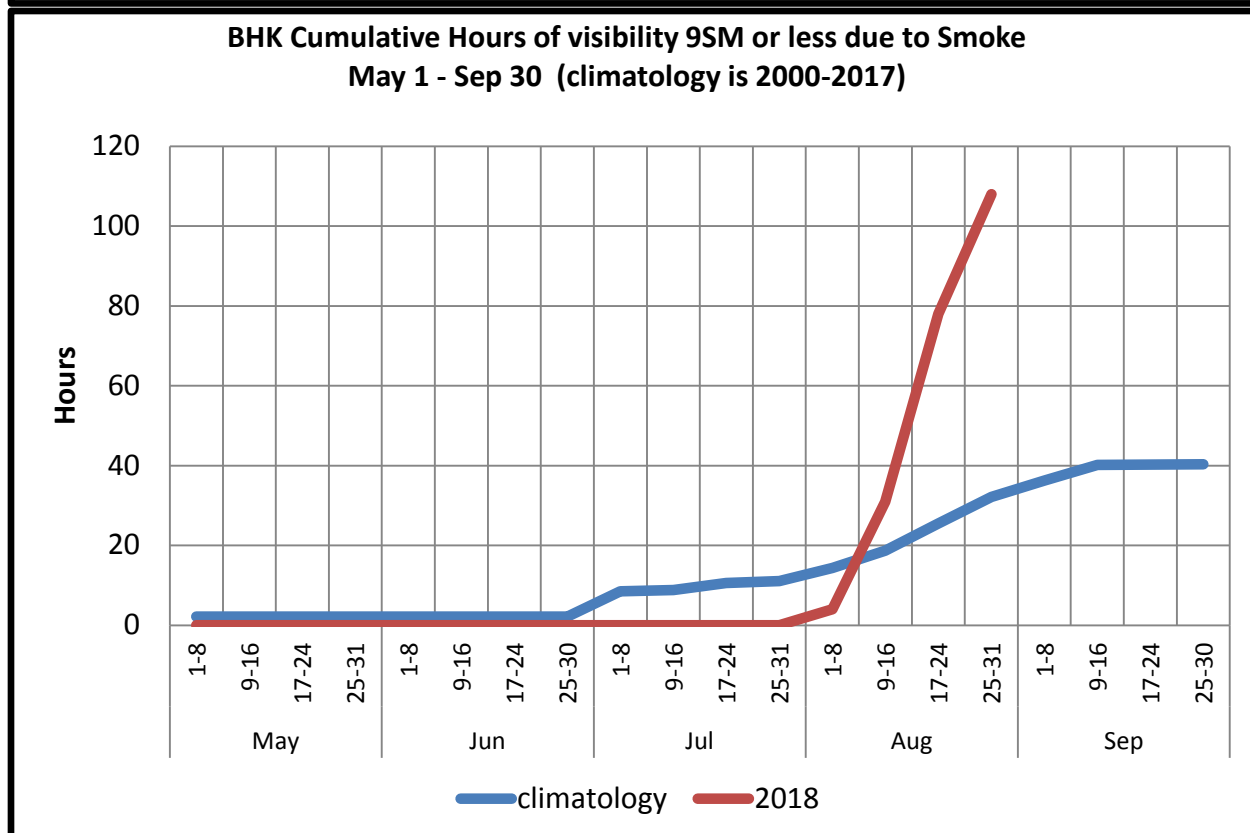
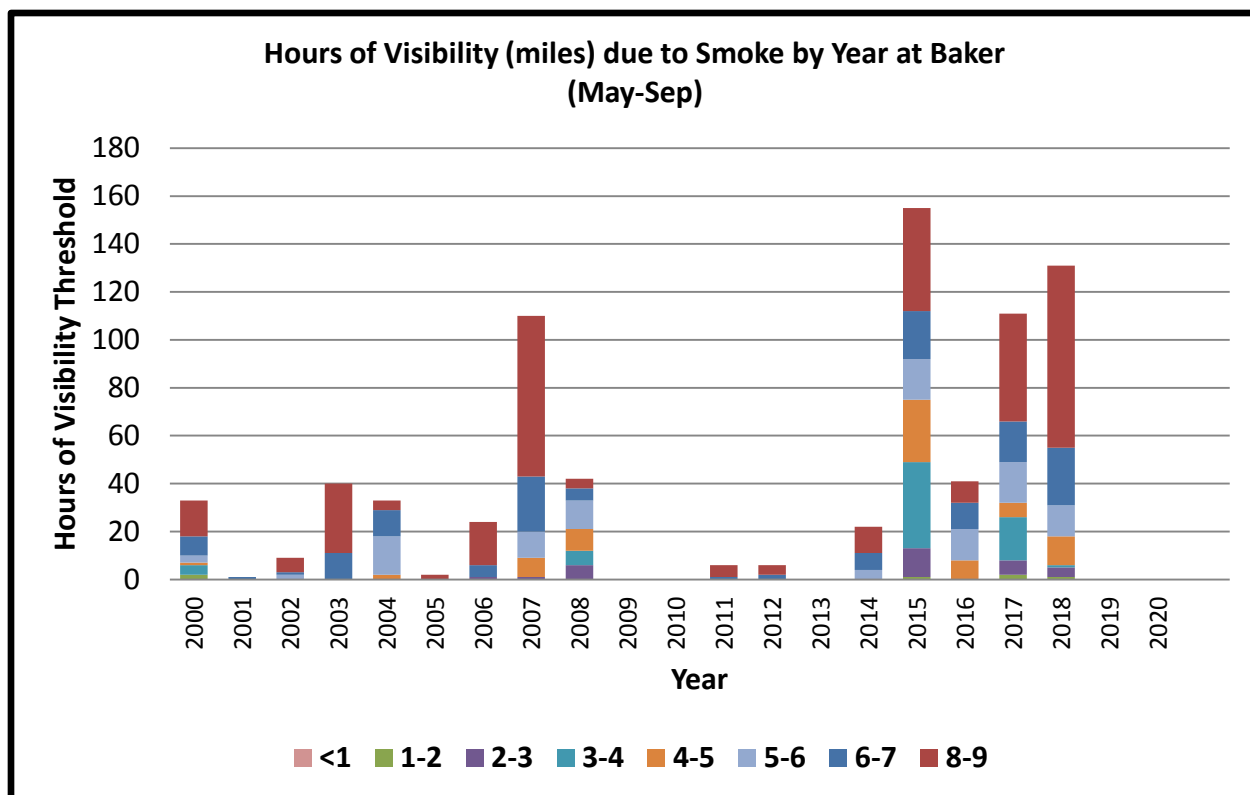




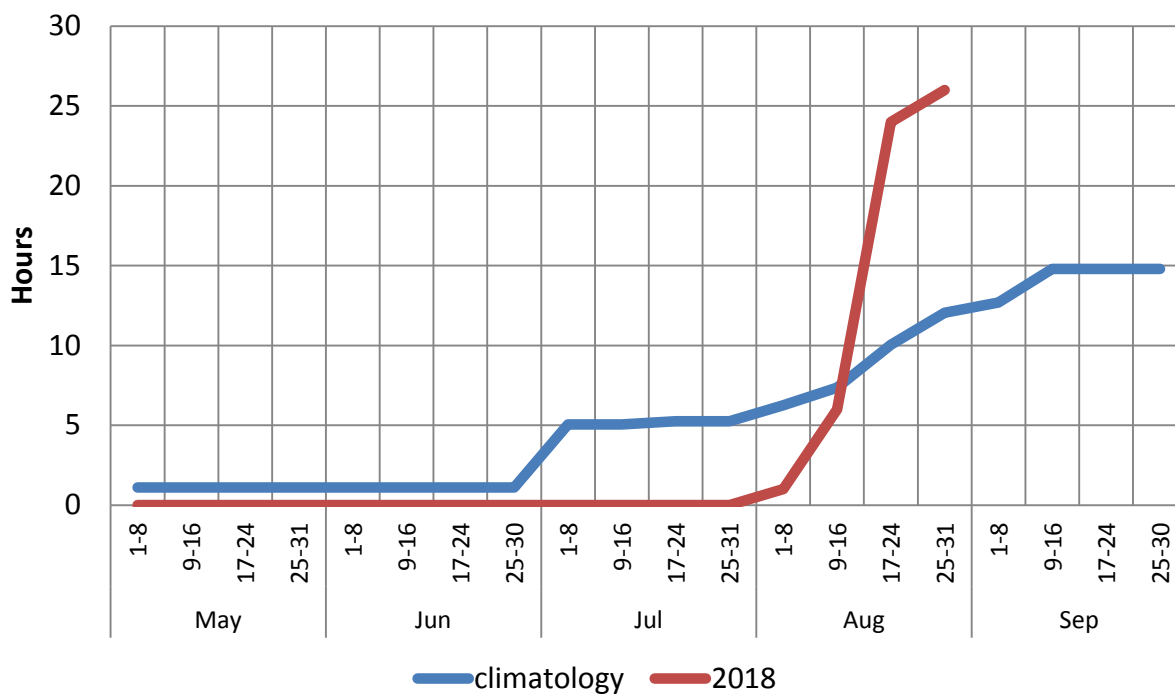








**BHK Cumulative Hours of visibility 6SM or less due to Smoke
May 1 - Sep 30 (climatology is 2000-2017)**



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