Seasonal climatic and phenological peculiarities of the Fall 2016 Southern Appalachian fire season

Asheville Chapter of the American Meteorological Society
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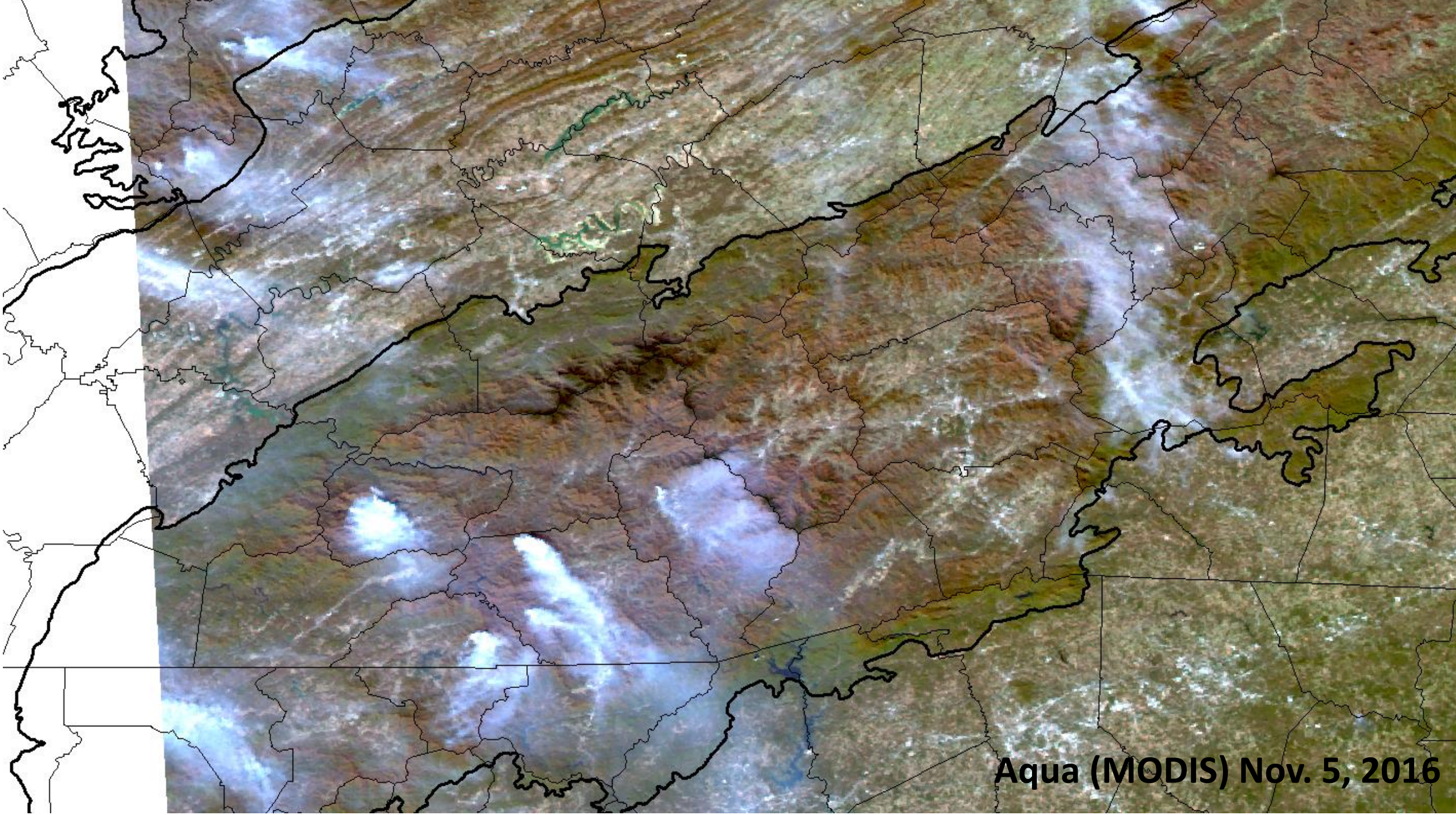
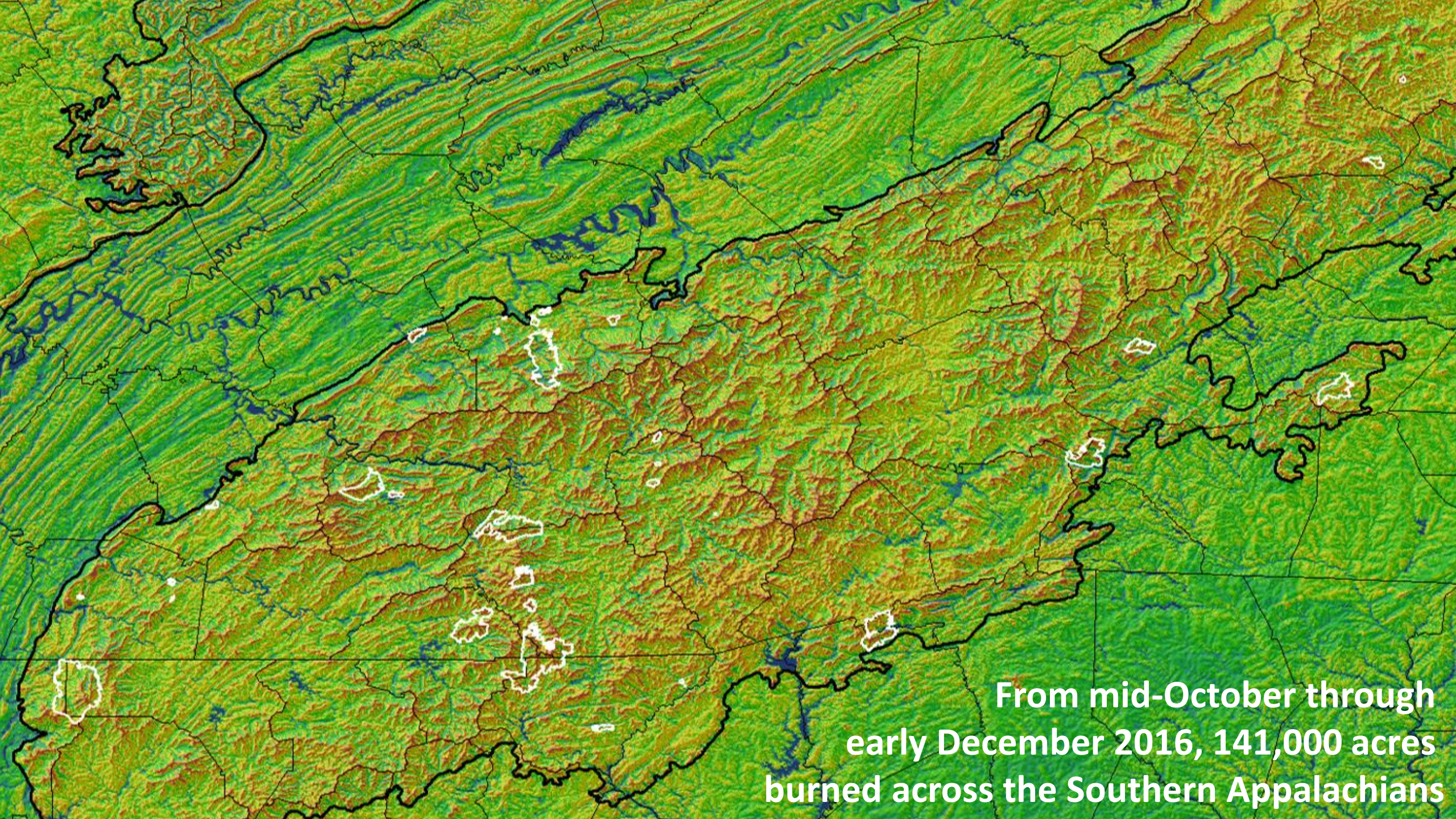
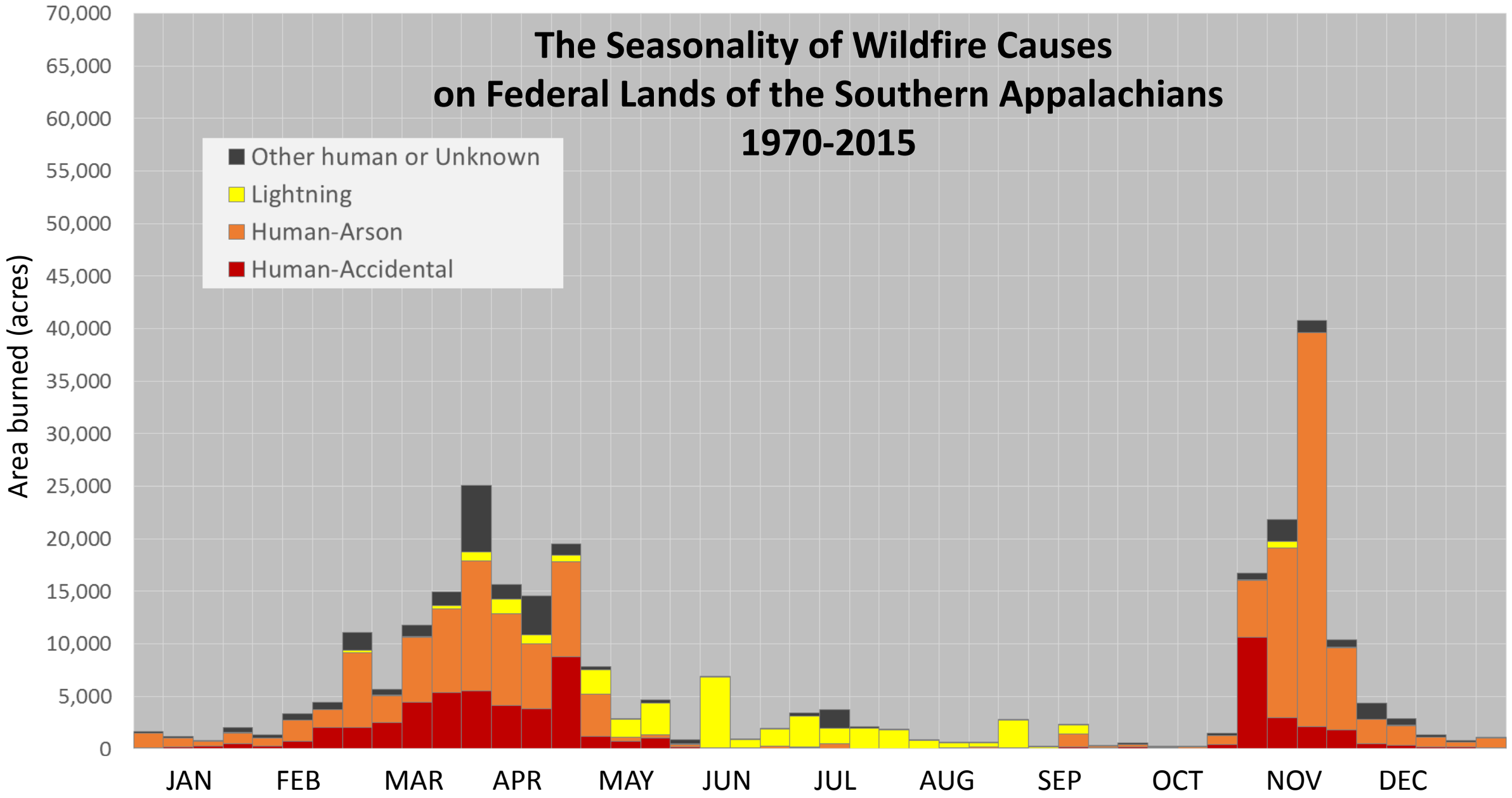
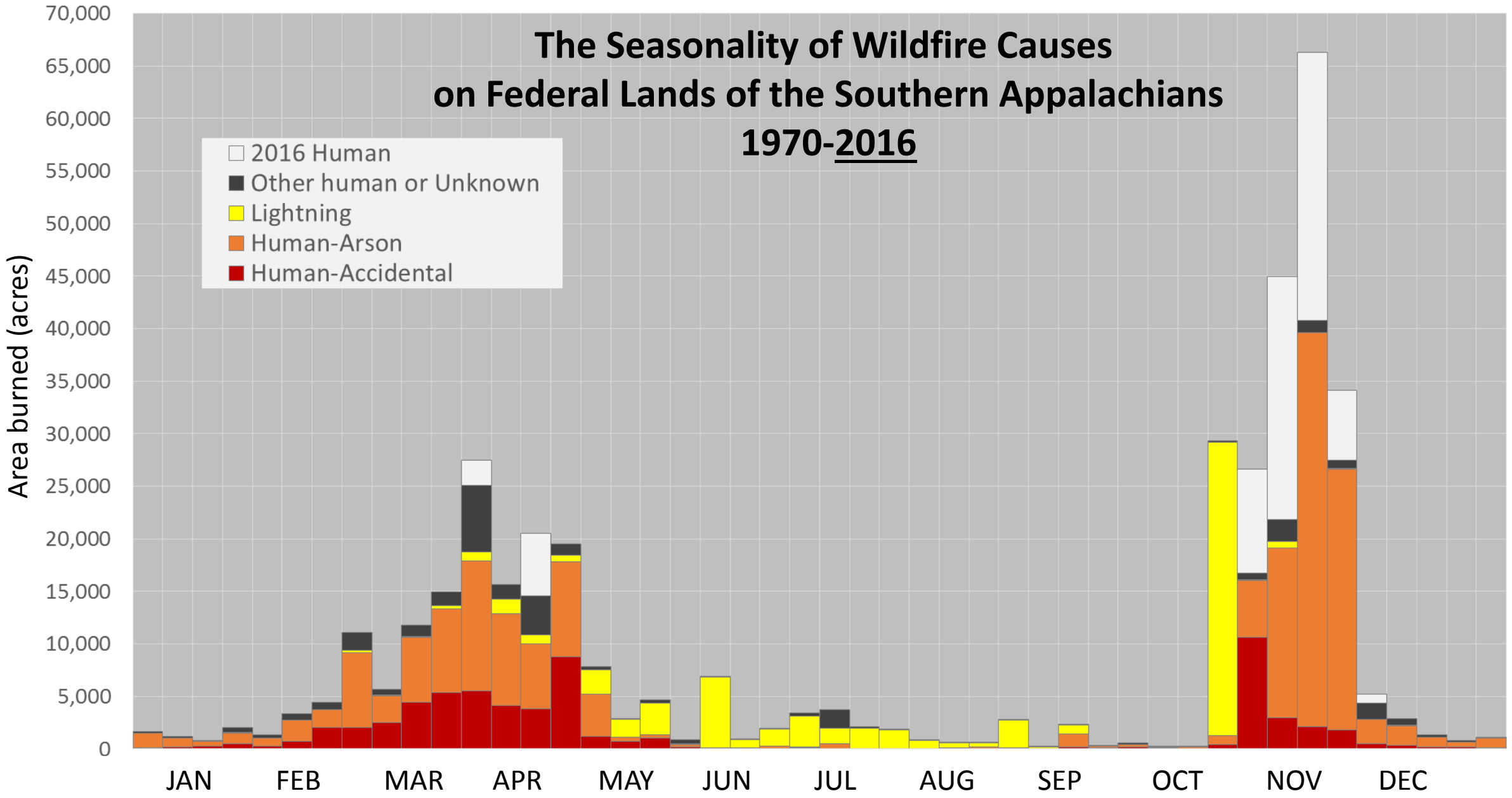

Aqua (MODIS) Nov. 5, 2016


From mid-October through
early December 2016, 141,000 acres
burned across the Southern Appalachians


The Seasonality of Wildfire Causes
on Federal Lands of the Southern Appalachians
1970-2015
Other human or Unknown
Lightning
Human-Arson
Human-Accidental
Area burned (acres)
70,000
65,000
60,000
55,000
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC


The Seasonality of Wildfire Causes
on Federal Lands of the Southern Appalachians
1970-2016
2016 Human
Other human or Unknown
Lightning
Human-Arson
Human-Accidental
Area burned (acres)
70,000
65,000
60,000
55,000
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
JAN
FEB
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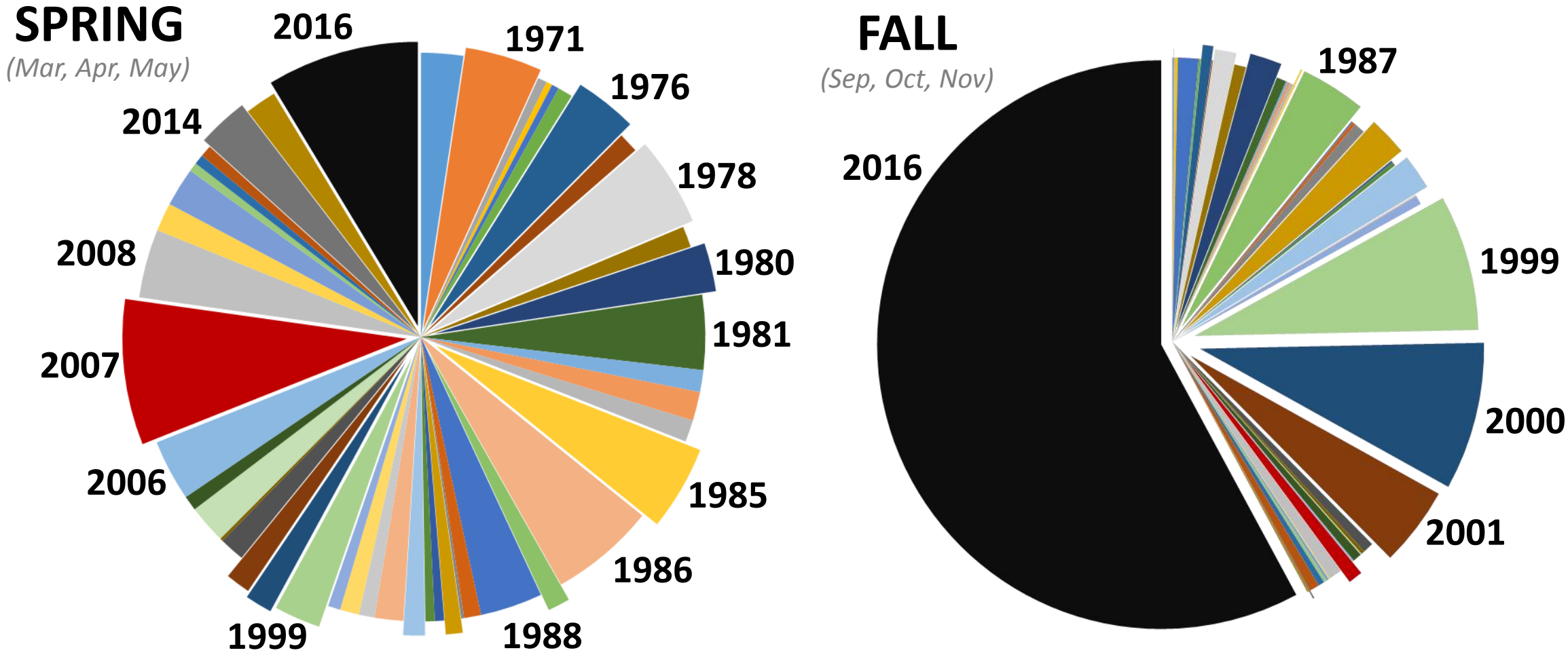
DEC

Relative area burned on National Forest and Park Service lands of the Southern Appalachians 1970-2016



Year is shown only when it exceeds 2.5% of total.

The seasonality of fire regime drivers in the Southern Appalachians

Seasonality of macro-climate

- Daylength (sunlight) affects temperature
- Seasonal winds drive fire spread
- Differences in air mass humidity affect fuel moisture

Seasonality of canopy phenology

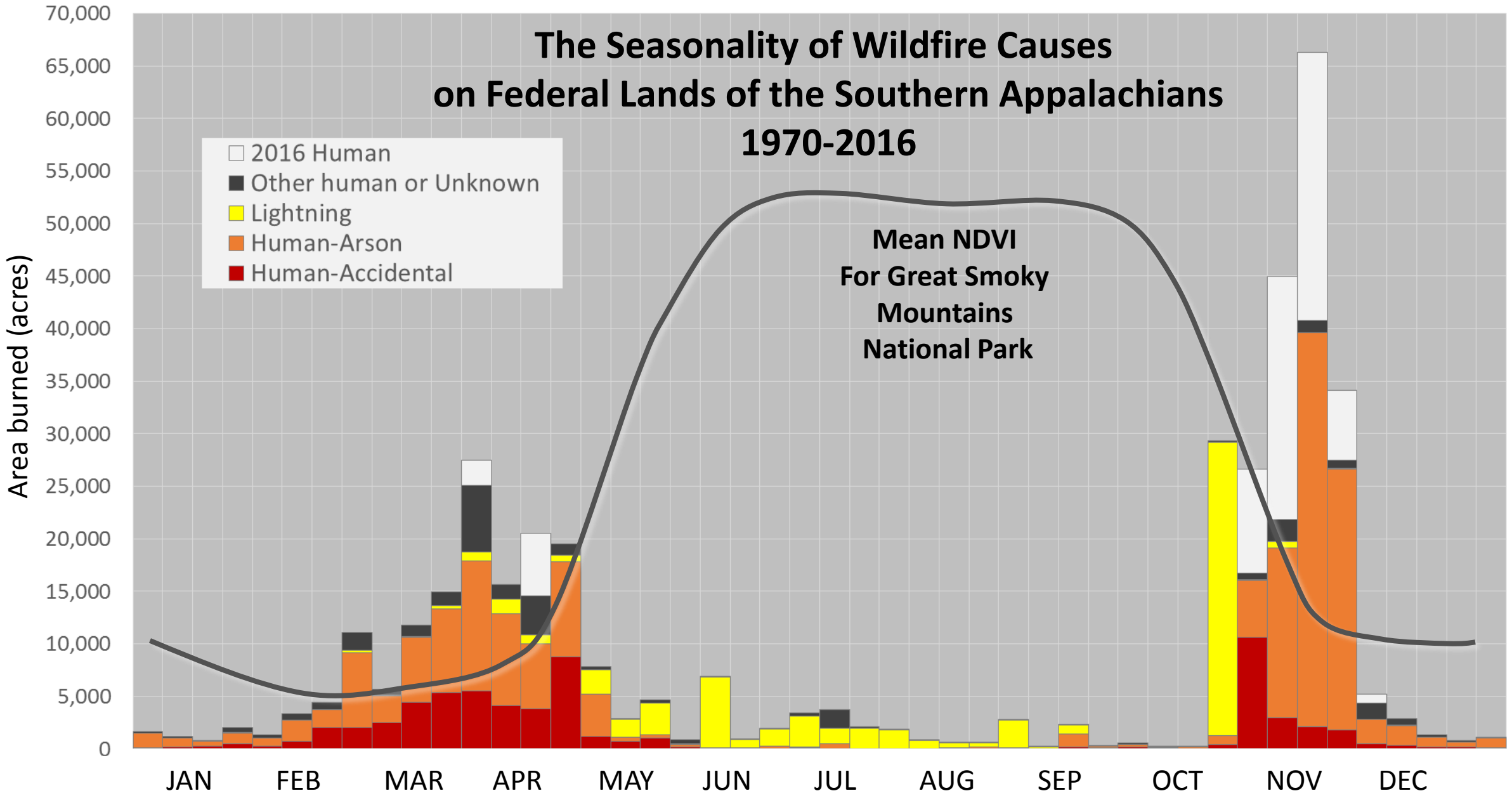
- With leaf emergence, shading cools surface fuels
- Transpiration and interception increase humidity
- Overstory foliage reduces wind and fire behavior

Seasonality of fuel availability

- Emergence and senescence of live understory fuel
- The timing of leaf abscission varies among species
- Winter loss from decay
- Winter fuel compaction

Seasonality of ignitions

- Lightning vs. human ignition seasonality
- Seasonal outdoor activity varies


The Seasonality of Wildfire Causes
on Federal Lands of the Southern Appalachians
1970-2016
2016 Human
Other human or Unknown
Lightning
Human-Arson
Human-Accidental
Mean NDVI
For Great Smoky
Mountains
National Park
Area burned (acres)
70,000
65,000
60,000
55,000
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
JAN
FEB
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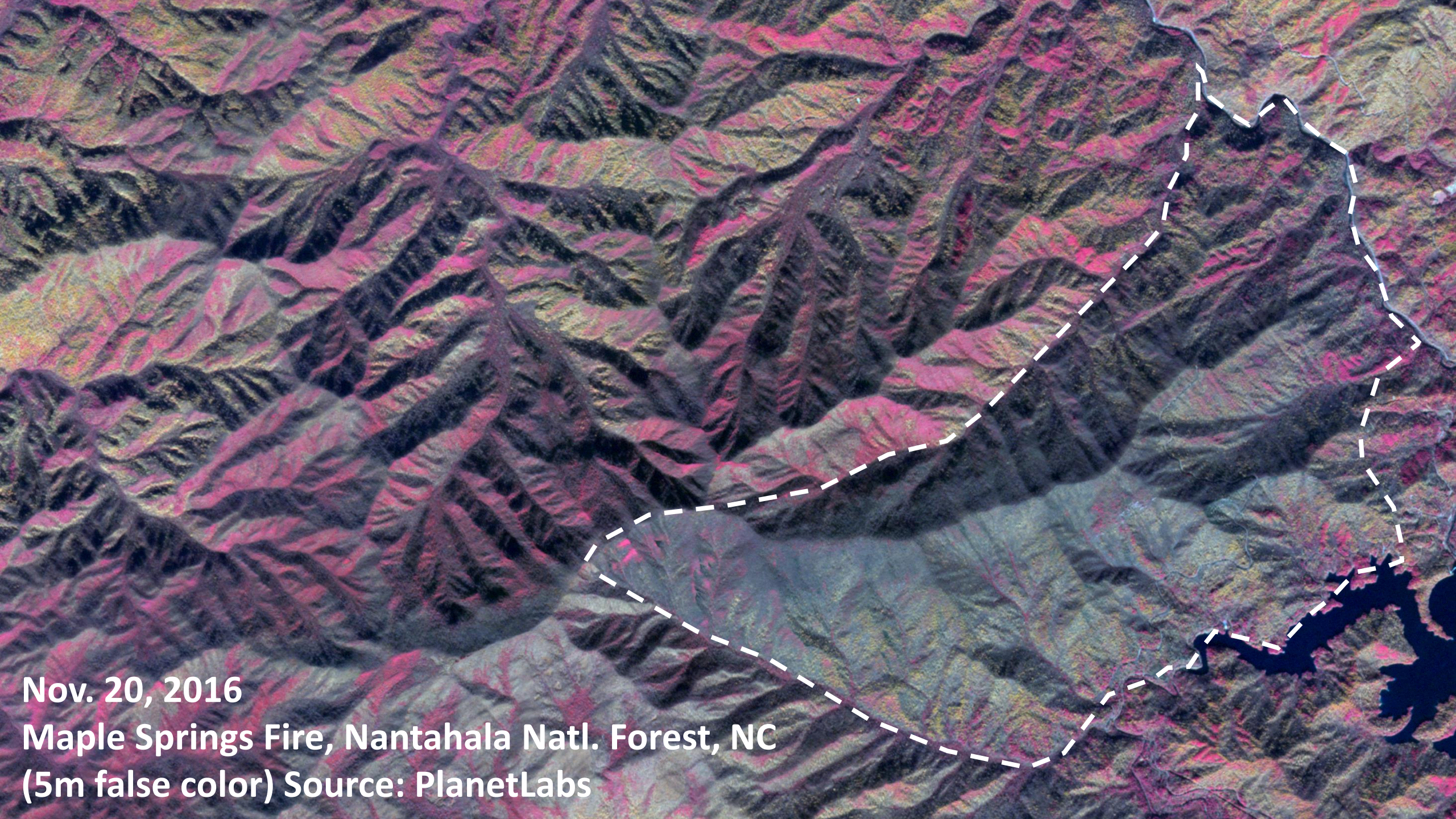
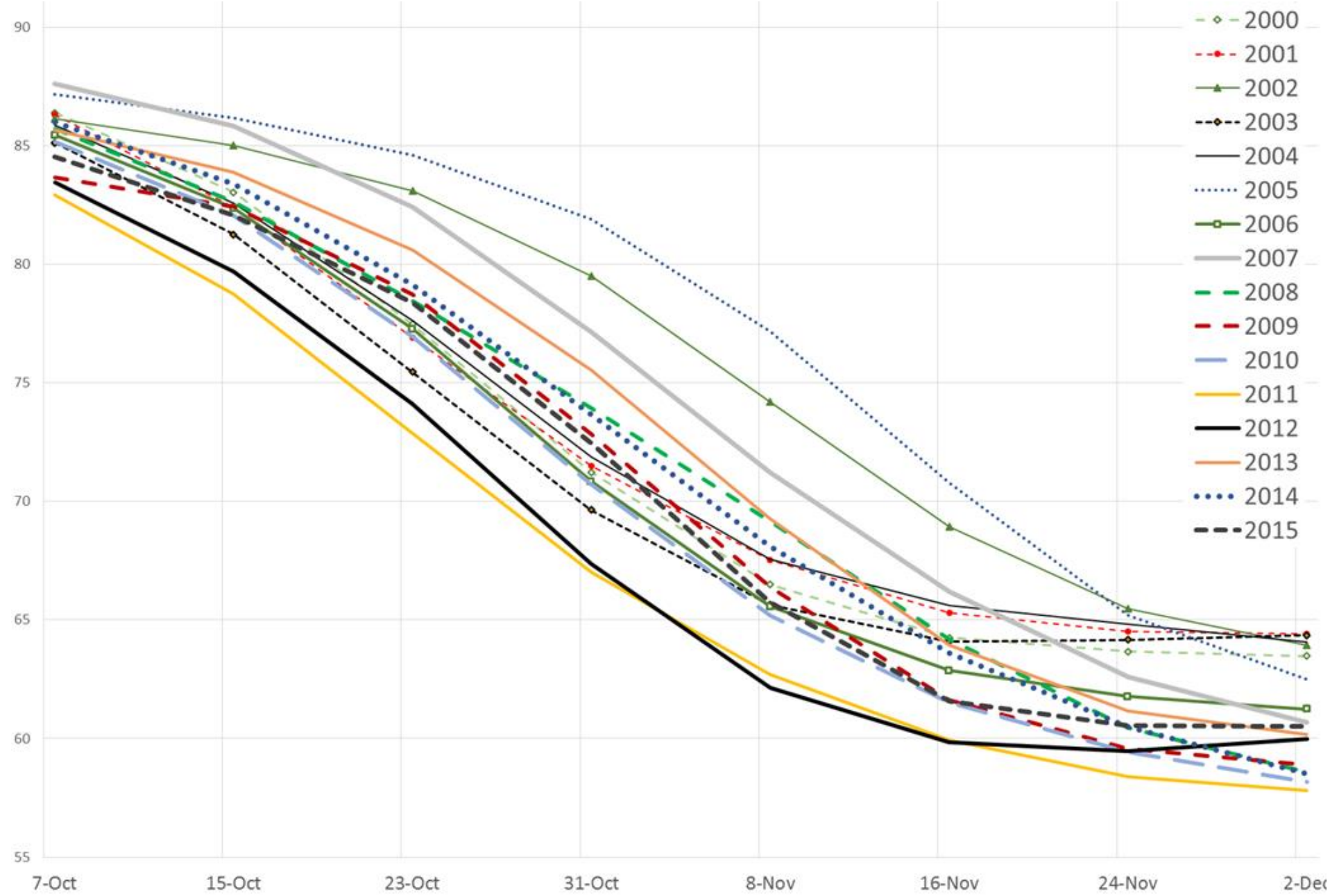
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

Late October 2016
Rough Ridge Fire, Cohutta Wilderness,
Chattahoochee Natl. Forest, GA (lightning)

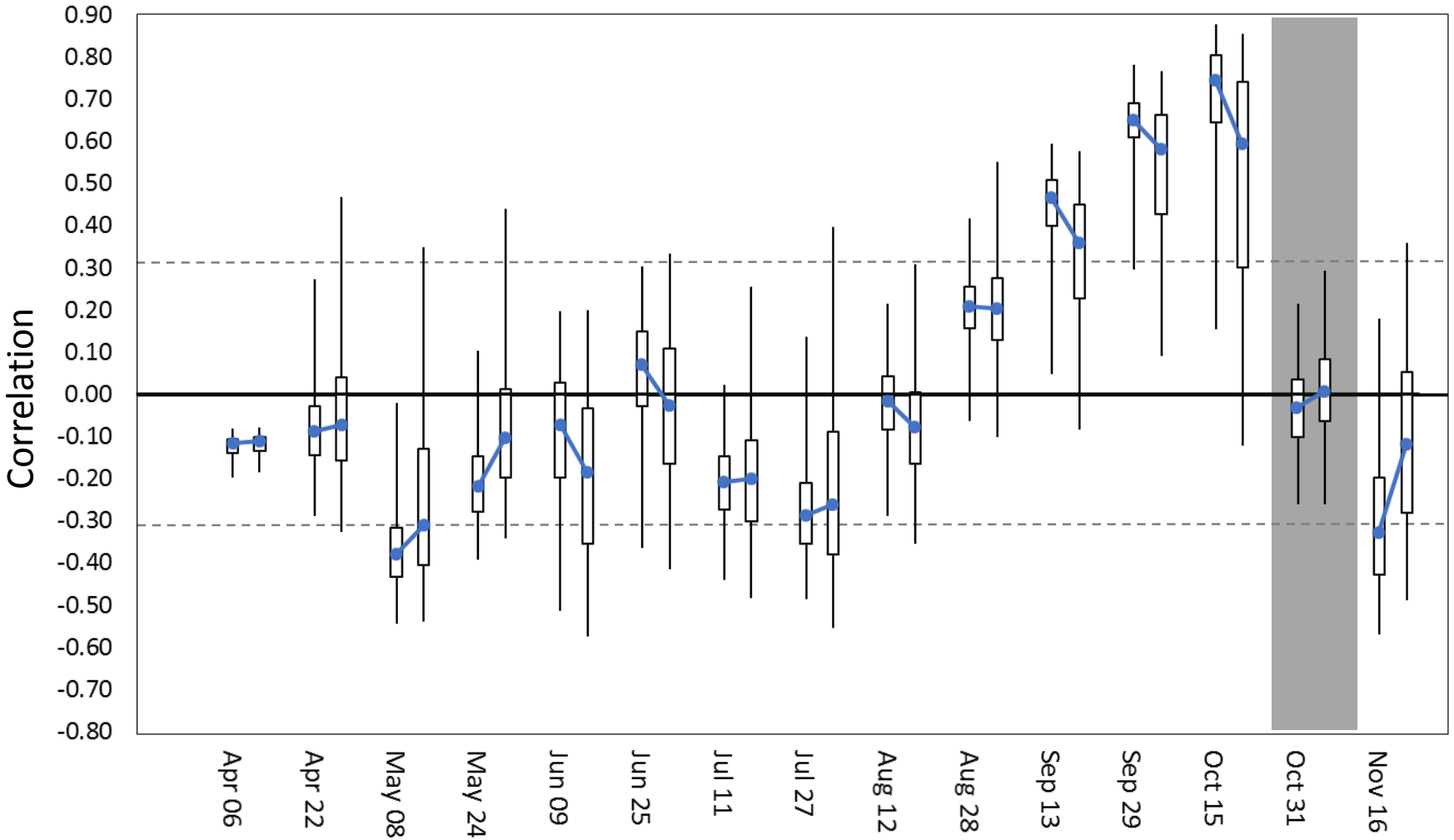

04:27 PM Nov. 4, 2016
Tellico Fire, Nantahala Natl. Forest, NC
(Likely arson)
Photo credit: Kenny Frick
US Forest Service


Nov. 20, 2016
Maple Springs Fire, Nantahala Natl. Forest, NC
(5m false color) Source: PlanetLabs

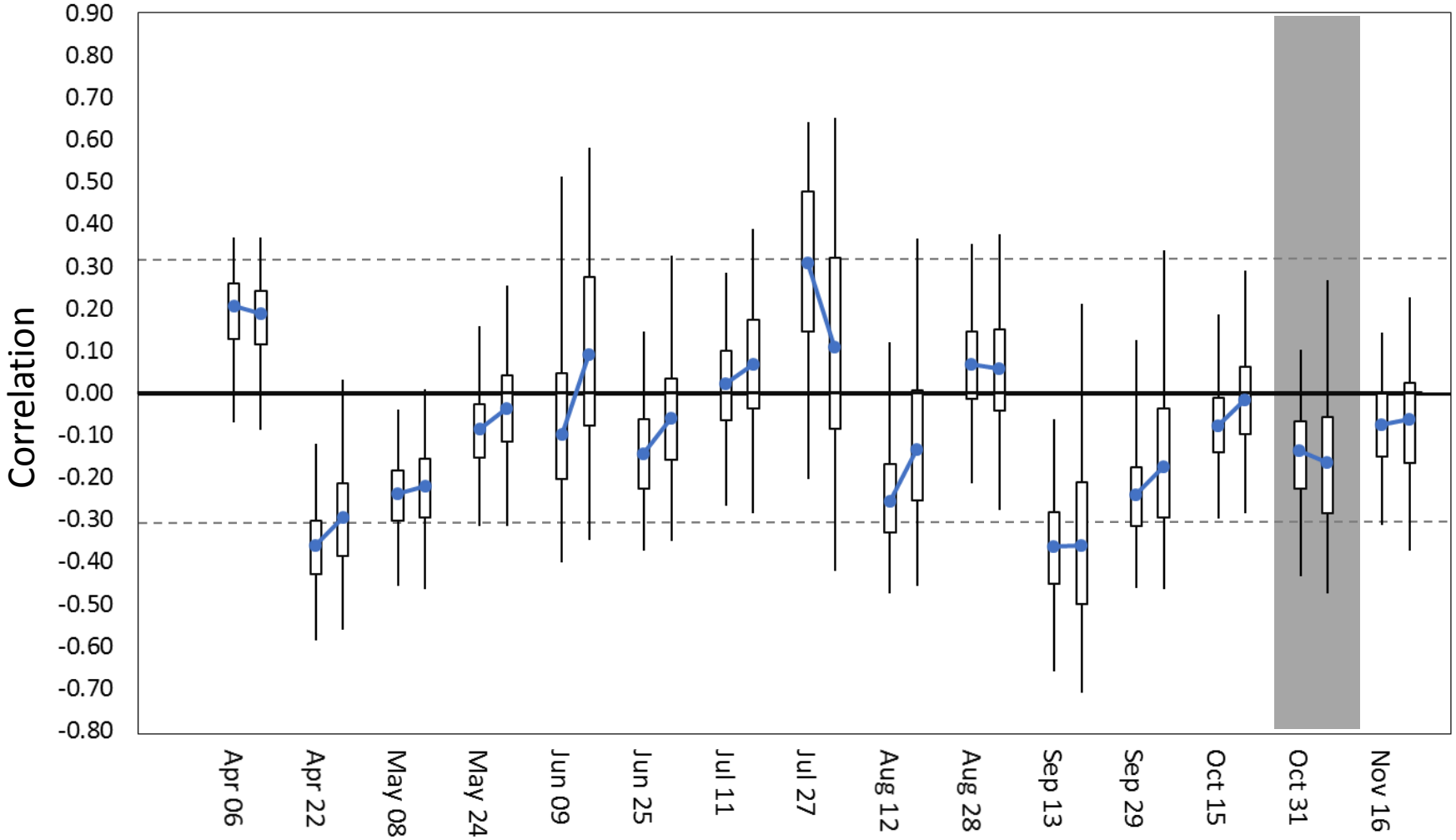
Variation in fall NDVI across Great Smoky Mountains National Park



Fall NDVI and Growing Degree Days in Great Smoky Mountains National Park



Fall NDVI and Precipitation in Great Smoky Mountains National Park



Rank of Fall (Sep-Oct-Nov) Southern Appalachian Climate Division Means since 1895 (122 years)

Rank	T max	T min	Cooling DD	Heating DD*	PCP*	PDSI* (Sep.)	PDSI* (Oct.)	PDSI* (Nov.)
1	**2016**	1985	1925	1985	1939	1925	2007	2007
2	1931	1900	1911	**2016**	**2016**	2007	1954	1931
3	1941	1919	1921	1931	1904	1986	2008	**2016**
4	1998	1986	**2016**	1919	1931	2008	**2016**	2008
5	1919	2004	1926	2004	1922	1954	1931	1954
6	1927	2002	1941	1900	1933	1930	1930	1941
7	2007	2015	1900	1998	1895	1931	1986	1904
8	1897	1911	1931	1927	1978	1914	1925	1987
9	1921	1971	1919	1986	1941	**2016**	1904	1930
10	2010	1947	1933	2015	1954	1941	2000	1939
11	2005	**2016**	1998	1973	1940	1988	1941	1899

*Heating Degree Days (HDD), Precipitation (PCP) and PSDI are shown in reversed order for comparability (showing least)

Rank of Fall (Sep-Oct-Nov) Southern Appalachian Climate Division Means since 1895 (122 years)

Period when fire records are generally available

1970+

Rank	T max	T min	Cooling DD	Heating DD*	PCP*	PDSI* (Sep.)	PDSI* (Oct.)	PDSI* (Nov.)
1	**2016**	1985	1925	1985	1939	1925	2007	2007
2	1931	1900	1911	**2016**	**2016**	2007	1954	1931
3	1941	1919	1921	1931	1904	1986	2008	**2016**
4	1998	1986	**2016**	1919	1931	2008	**2016**	2008
5	1919	2004	1926	2004	1922	1954	1931	1954
6	1927	2002	1941	1900	1933	1930	1930	1941
7	2007	2015	1900	1998	1895	1931	1986	1904
8	1897	1911	1931	1927	1978	1914	1925	1987
9	1921	1971	1919	1986	1941	**2016**	1904	1930
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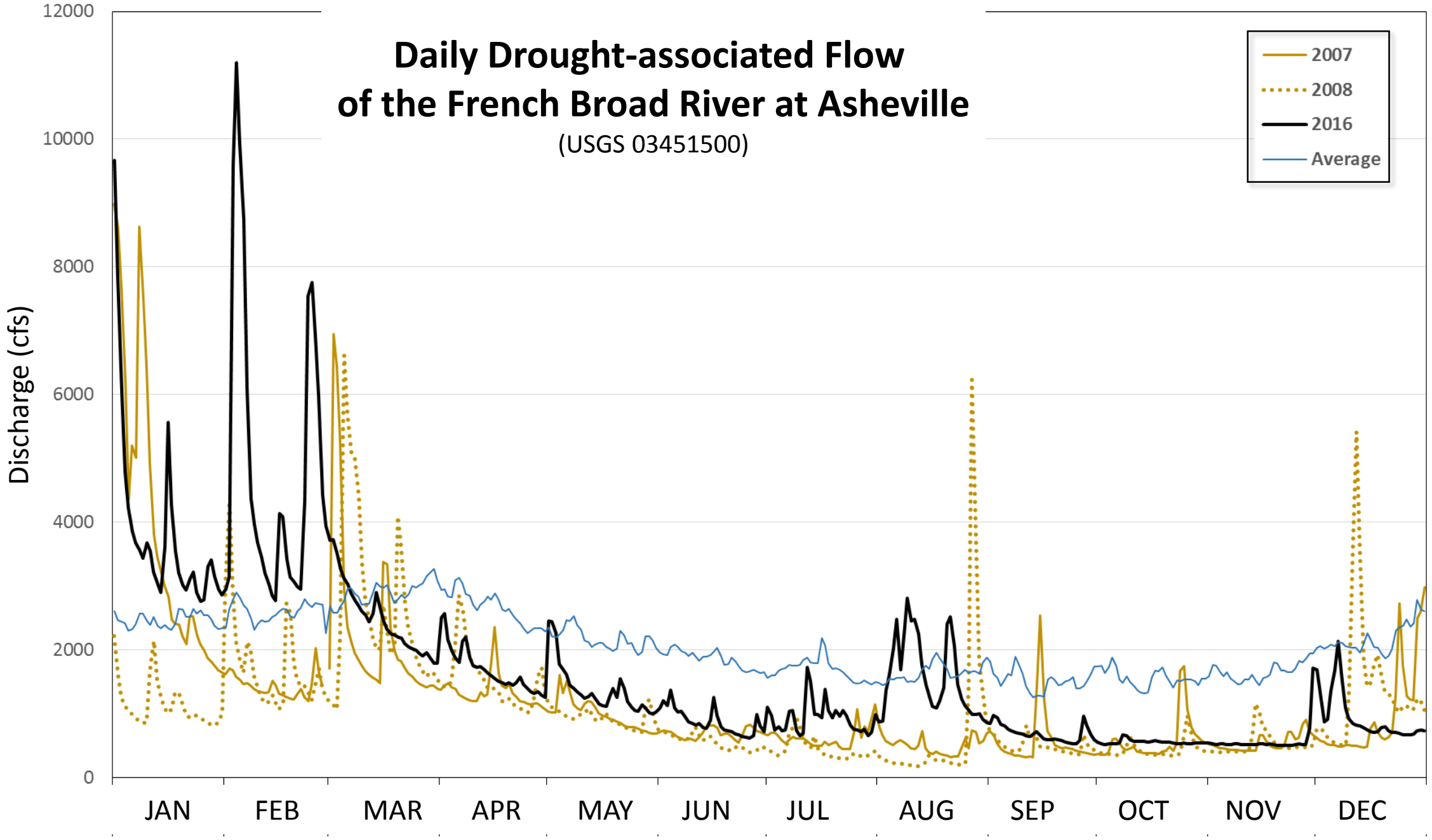
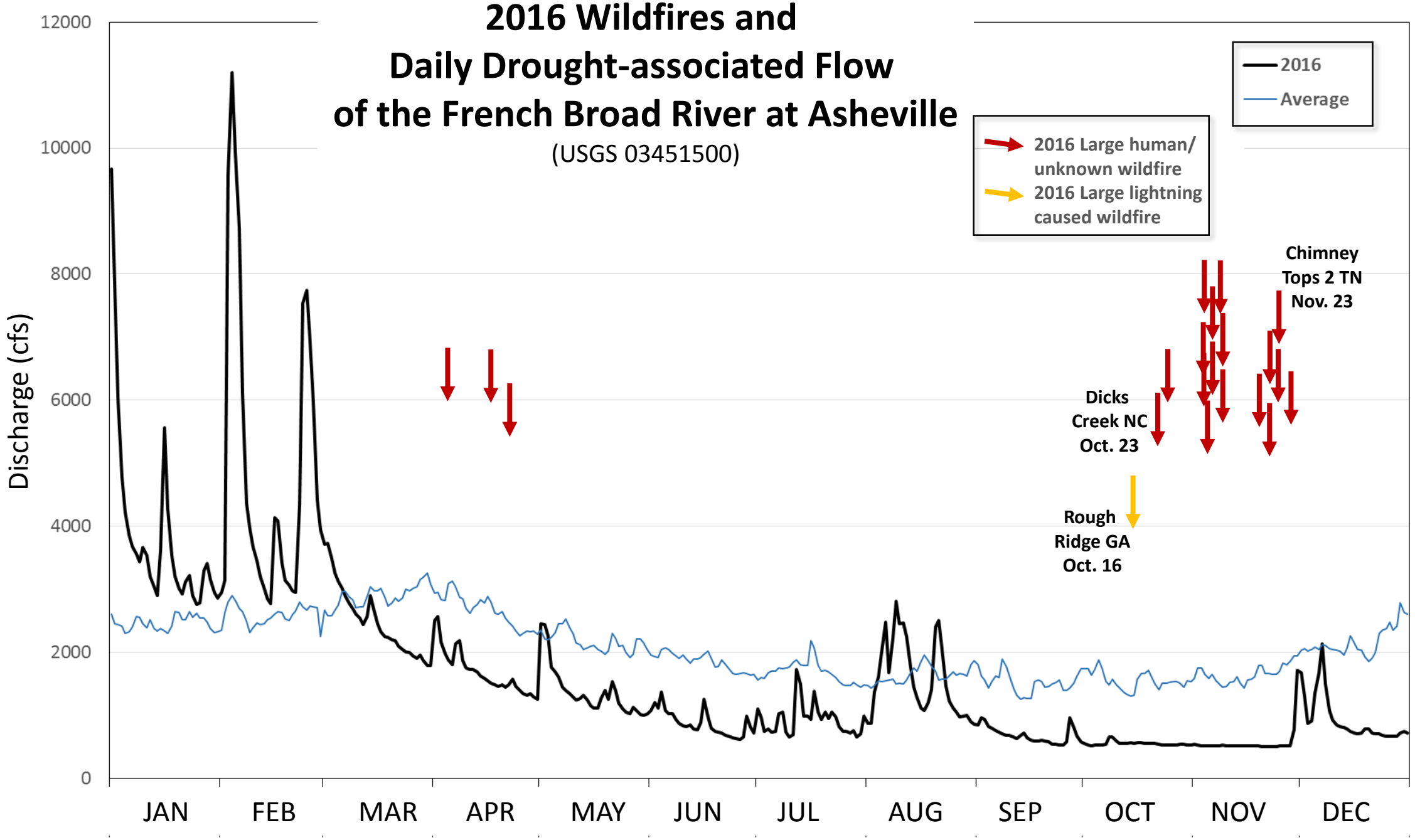
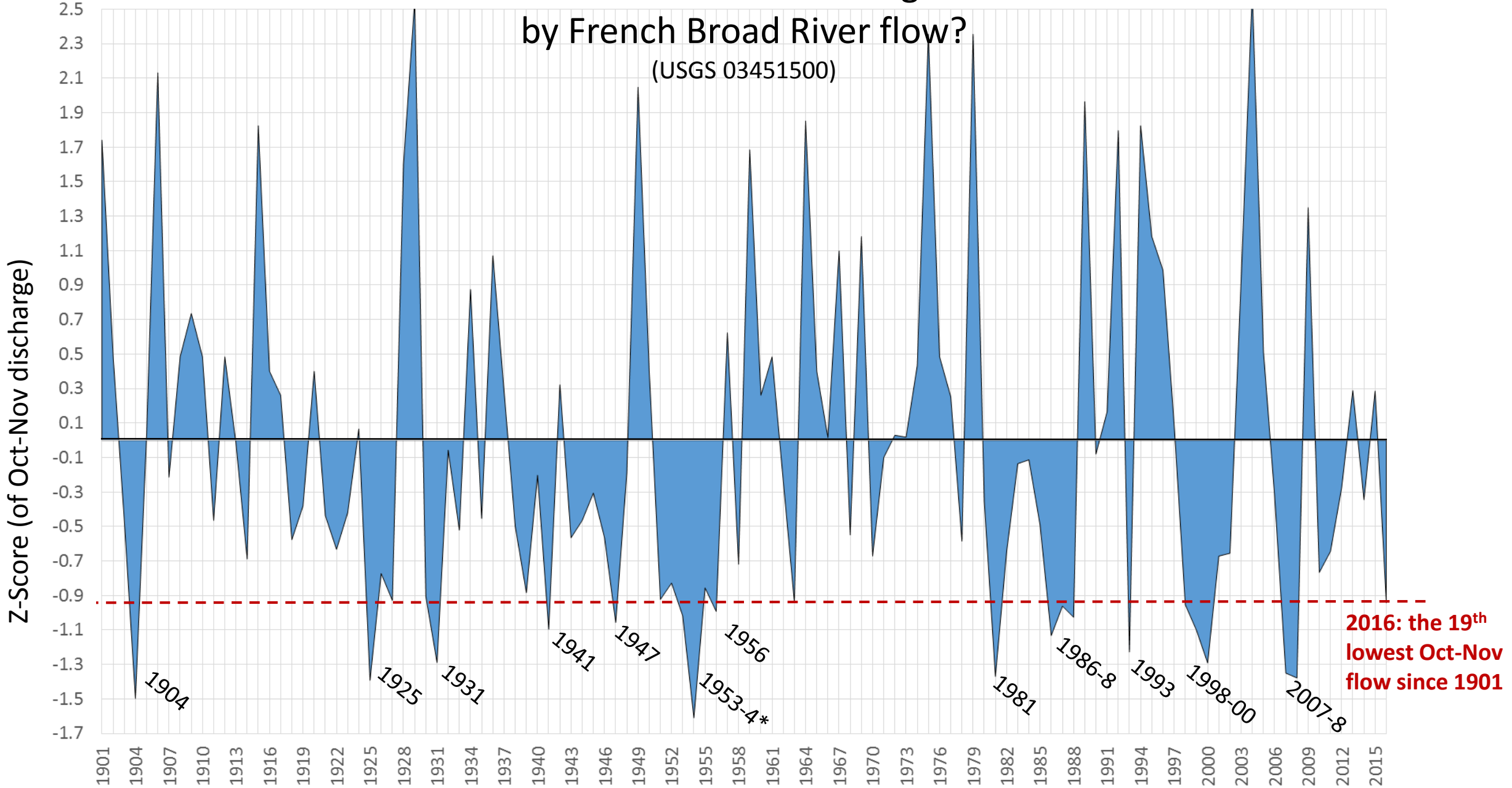
*Heating Degree Days (HDD), Precipitation (PCP) and PSDI are shown in reversed order for comparability (showing least)


Daily Drought-associated Flow
of the French Broad River at Asheville
(USGS 03451500)
2007
2008
2016
Average
Discharge (cfs)
12000
10000
8000
6000
4000
2000
0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC


2016 Wildfires and
Daily Drought-associated Flow
of the French Broad River at Asheville
(USGS 03451500)
2016
Average
2016 Large human/
unknown wildfire
2016 Large lightning
caused wildfire
Chimney
Tops 2 TN
Nov. 23
Dicks
Creek NC
Oct. 23
Rough
Ridge GA
Oct. 16
Discharge (cfs)
12000
10000
8000
6000
4000
2000
0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

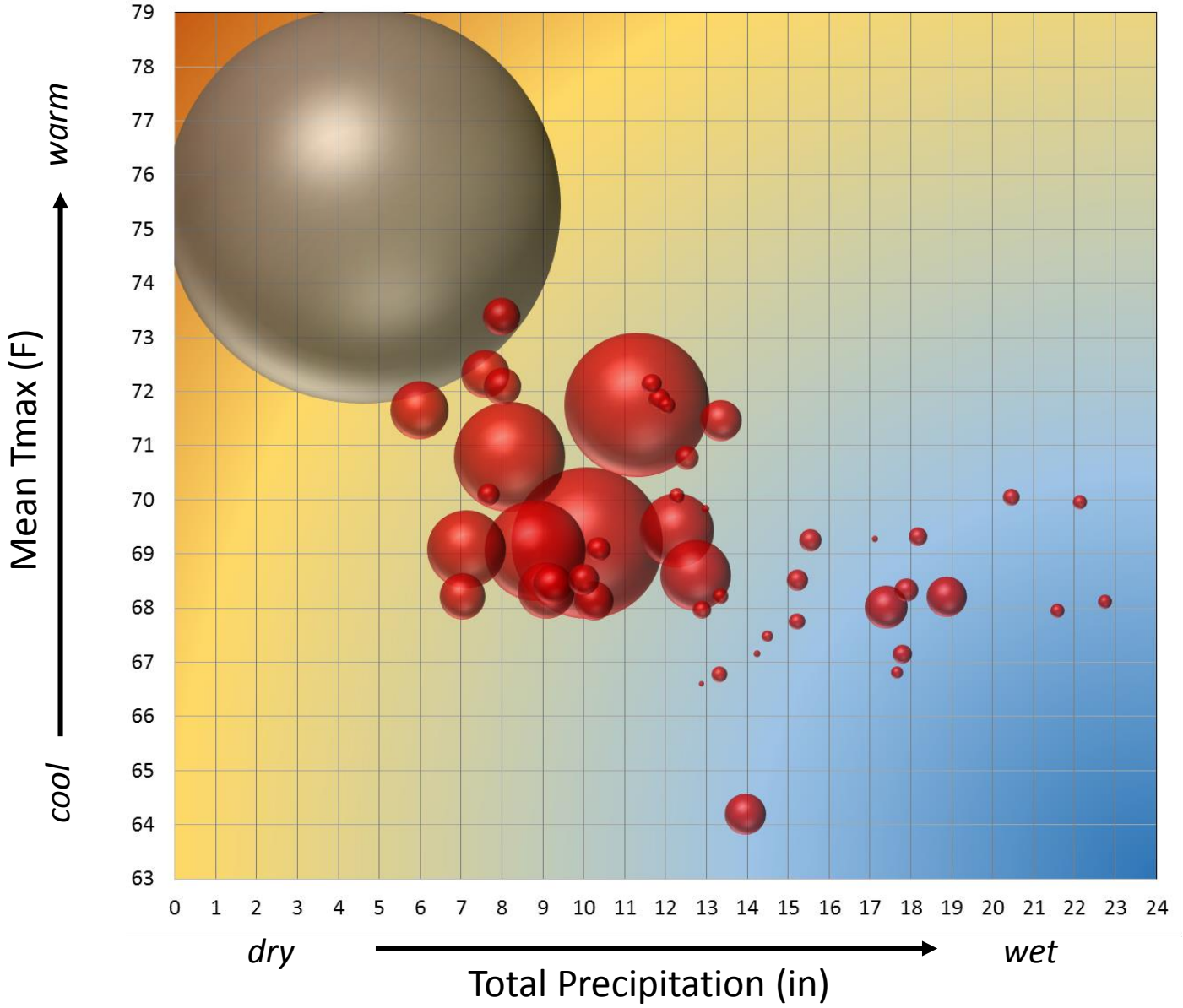
How unusual was the Fall 2016 drought as measured by French Broad River flow?

(USGS 03451500)

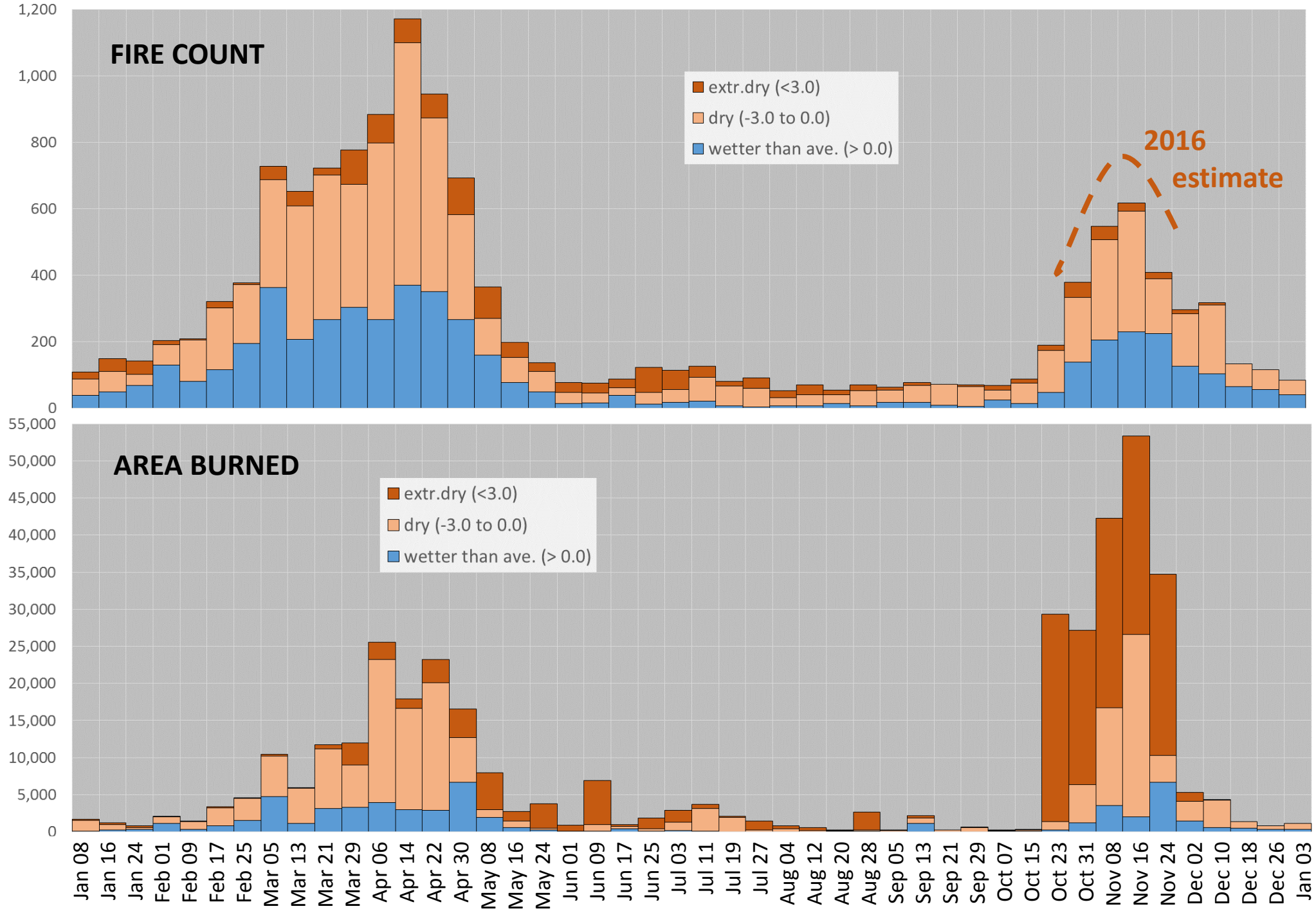


*Record low Oct-Nov flow: 1954

Relative area burned on Southern Appalachian federal lands with respect to Sep.-Nov. climate conditions, 1970-2016



Monthly drought (PDSI) conditions at the time of fire ignition across Southern Appalachian federal lands, 1970-2016



Summary

- The Fall of 2016 experienced extreme drought across the Southern Appalachians, though it was not without precedent.
- It was also extreme phenologically, and this may have contributed to surprising fire behavior.
- As most wildfires were of human origin, better prevention could have lessened impacts.
- This critical human role has implications for the vulnerability of Appalachian forests and communities to increased drought with climate change.