Wildfire Hazard Potential: Summary of changes between 2014 and 2018 versions

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Introduction

The 2018 Wildfire Hazard Potential (WHP) product is an update to the 2014 WHP dataset and previous versions of the Wildland Fire Potential (WFP) dataset before that. These products represent the same concept from different snapshots in time. Differences between versions reflect a combination of factors, including: 1) changes in landscape conditions on the ground; 2) updates to methods used in mapping vegetation and fuels conditions; 3) updates to methods used in modeling and calibrating wildfire simulations; and 4) updates to the WHP mapping methods. A summary of changes between the 2012 WFP and the 2014 WHP is available online (https://goo.gl/yxU1JD). This summary document briefly describes specific changes between the 2014 and 2018 versions of WHP.

Changes to input data

As with previous WFP/WHP datasets, the year associated with any version indicates the year in which the map was produced, using the most current input data available at the time. The 2018 WHP was produced and released in July of 2018. It was created using LANDFIRE 2012 data (version 1.3.0; https://www.landfire.gov/) for vegetation and fuel conditions, and national wildfire simulation outputs generated from those data and published in 2016 (Short et al. 2016). Thus, the 2018 WHP reflects 2012 landscape conditions. The 2014 WHP reflected landscape conditions as of 2010 (LANDFIRE 2010, version 1.2.0). Therefore, any changes in vegetation and fuel conditions between 2010 and 2012 are captured in the 2018 WHP. No major changes in LANDFIRE mapping methods occurred between the 2010 and 2012 versions (https://www.landfire.gov/version_comparison.php).

Changes to methods

Changes in wildfire simulation modeling methods, and subsequent changes to WHP mapping methods, account for much of the difference between the 2014 and 2018 WHP products. National-scale modeling outputs from the Large Fire Simulator (FSim) have been produced by the U.S. Forest Service, Rocky Mountain Research Station since roughly 2012. These data depict annual burn probability and conditional flame lengths (i.e., potential fire intensity) and have been primary inputs to the WFP/WHP mapping process since the 2012 WFP (Dillon et al. 2015). After the 2014 WHP was released, analysts

working on FSim modeling realized an internal problem in the FSim code that was causing crown fire to model differently than expected. The FSim program was subsequently revised, and at the same time FSim analysts implemented significant improvements to both the modeling methods and the process of calibrating outputs to historical observations. All of these improvements were included in the modeling outputs completed in 2016 and used as input to the 2018 WHP.

Because of the changes to FSim methods, we reevaluated our WHP mapping methods for the 2018 version. Methods we developed for the 2012 and 2014 products (Dillon et al. 2015) accounted for the observation that FSim generally appeared to underpredict crown fire in forests. We had observed that modeled burn probabilities tended to be higher in grass and shrub settings and lower in forested settings, while predicted flame lengths were often lower than expected in forests. For these reasons, we included steps in the 2012 and 2014 mapping process to increase the WHP index values in areas with potential for crown fire (details on pp. 61-65 of Dillon et al. 2015). For 2018, we were able to remove these steps from our WHP mapping methods as a result of improvements to FSim. We compared several test modifications to our WHP methods, and were able to confirm that the revisions to FSim methods addressed the crown fire issue sufficiently that we no longer needed to further emphasize it.

Other aspects of the WHP methods we tested included removing steps that account for the overall fire load, or small fire potential (p. 66 of Dillon et al. 2015), and that adjust the WHP index using resistance to control weights (p. 67 of Dillon et al. 2015). We evaluated tests by looking at the distribution of WHP index values resulting from each (similar to fig. 1), by looking at average WHP values among Forest Service regions, and by looking at spatial patterns in the output. We ultimately decided to keep both the small fire potential and resistance to control adjustment in our methods for 2018. We made this decision based on our test evaluations and because each step appeared to still be serving the intended purpose described in Dillon et al. 2015. We did update the resistance to control weight raster, using LANDFIRE 2012 data. We also updated the small fire potential layer using a newer version of the fire occurrence database (Short 2015).

Changes in the WHP product

Despite changes in modeling and mapping methods, there is not a significant difference in the distribution of continuous WHP index values between 2014 and 2018 versions (fig. 1). While we kept threshold values for WHP class breaks constant between the 2012 and 2014 versions, we chose to reset

the class break values for 2018 due to the changes in mapping methods. We did, however, keep the same percentiles for breakpoints (Very Low to Low = 44th, Low to Moderate = 67th, Moderate to High = 85th, High to Very High = 95th). The newly calculated threshold values were very similar to previous values (fig. 1).

Looking at the classified WHP product, we see that the majority of lands had little to no change in WHP class (Table 1). Across all lands, 70% had no change in WHP class, while an additional 20% only changed by one class. For pixels that did change, the WHP class increased on 12% and decreased on 13%. The amount of increase or decrease was fairly consistent among different regions of the country (fig. 2). Considering just National Forest System (NFS) lands, 57% had no change in WHP class, while 34% changed by just one class. More areas saw an increase in WHP on NFS lands compared to all lands; WHP class increased on 29% of NFS lands and decreased on 14%. By region, the amount of increase or decrease was again fairly consistent, except in the Southwest (Region 3) where WHP increased on 49% of NFS lands and the Northeast (Region 9) where WHP increased on only 12% of NFS lands (fig. 3). Changes in the LANDFIRE fuel layer from burnable to non-burnable fuels or vice versa represented 4% of all lands and were negligible on NFS lands.

The spatial pattern of WHP class changes is fairly subtle in the eastern U.S., and somewhat more pronounced in parts of the western U.S. (figs. 2 and 3). In the East, changes appear mostly due to slight shifts in the density of fire ignition points captured in the small fire potential layer. These changes appear as rings or halos where WHP shifted up or down by one class, and are largely an artifact of spatial processing. In the West, there was a general trend toward higher WHP on forested land and lower WHP on non-forest lands. This change is line with changes in FSim modeling that more accurately capture the potential for crown fire in forests, and we feel provides a more accurate depiction of hazard potential than our previous WHP products.

Conclusion

While there is temptation to compare subsequent versions of the WHP to indicate changes in fuel conditions across the landscape, we must caution against doing this. Older versions of the WFP exist from 2007, 2010, and 2012, and we now have two versions of WHP maps from 2014 and 2018. The 2007 and 2010 WFP versions were created with significantly different input data and mapping methods. The 2012 WFP and both versions of WHP have been based on FSim model outputs and the general

methods described in Dillon et al. (2015). As described here, however, important differences in input data and methodology continue to occur between versions that make direct comparisons to track landscape changes over time inappropriate. Development of wildfire simulation outputs and subsequent products like the WHP map is an evolving science, and will continue to change as our knowledge advances.

References

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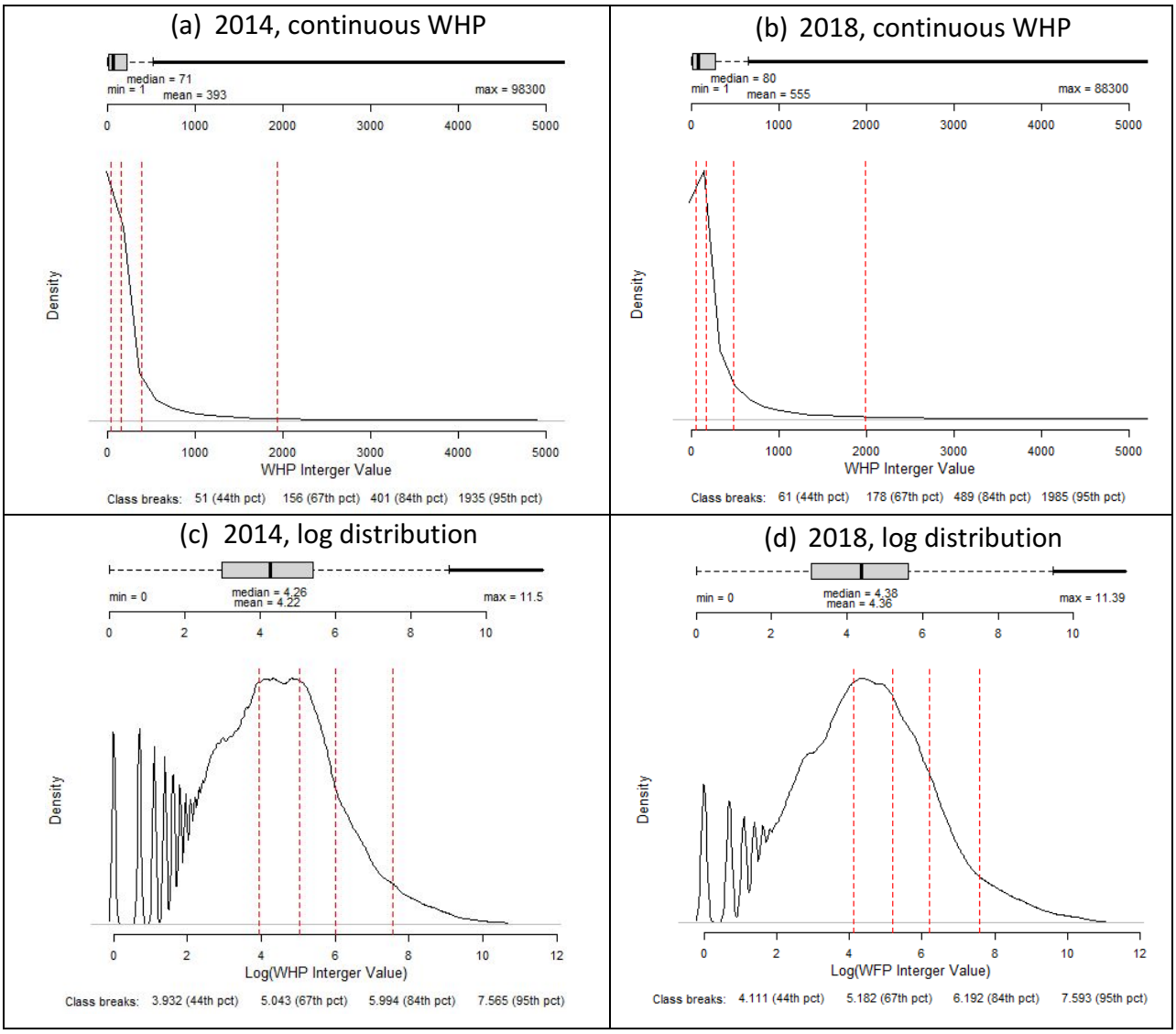

Figure 1. Distributions of continuous WHP values from 2014 (left) and 2018 (right). The original WHP index values are shown on top (a and b), and the log distribution of those values is shown on bottom (c and d). Dashed red lines show breaks between WHP classes. Despite changes to modeling and mapping mehods, the overall distribution of values is very similar. We did set new class threshold values because of the changes in methods, but kept with the same percentiles (44th, 67th, 84th, and 95th). The new threshold values are very close to those used in 2014.

Table 1—Summary of WHP class changes from the 2014 to 2018 versions, by all lands and National Forest System (NFS) lands. Acreage values are based on counts of 270m pixels (each approx. 18 acres) and rounded to the nearest 1,000 acres. WHP class values are: Very Low = 1, Low = 2, Moderate = 3, High = 4, Very High = 5. Areas with a negative difference moved to a lower WHP class in 2018; areas with a positive difference moved to a higher WHP class in 2018.

	WHP Class Difference (WHP 2018 - WHP 2014)	All Lands		NFS Lands	
		Acres	%	Acres	%
Decrease in WHP Class Value	-4	244,000	0%	42,000	0%
	-3	4,834,000	0%	504,000	0%
	-2	34,443,000	2%	3,372,000	2%
	-1	212,837,000	11%	20,130,000	12%
No Change	0	1,348,336,000	70%	97,339,000	57%
Increase in WHP Class Value	1	176,393,000	9%	37,946,000	22%
	2	54,184,000	3%	9,709,000	6%
	3	6,414,000	0%	1,282,000	1%
	4	605,000	0%	51,000	0%
Special Cases	Burnable to non-burnable	46,150,000	2%	160,000	0%
	Burnable to water	4,000	0%	-	0%
	Non-burnable to burnable	36,826,000	2%	146,000	0%
	Water to burnable	1,000	0%	-	0%
	Non-burnable to water	18,000	0%	2,000	0%
	Water to non-burnable	-	0%	-	0%
	Total	1,921,288,000		170,685,000	

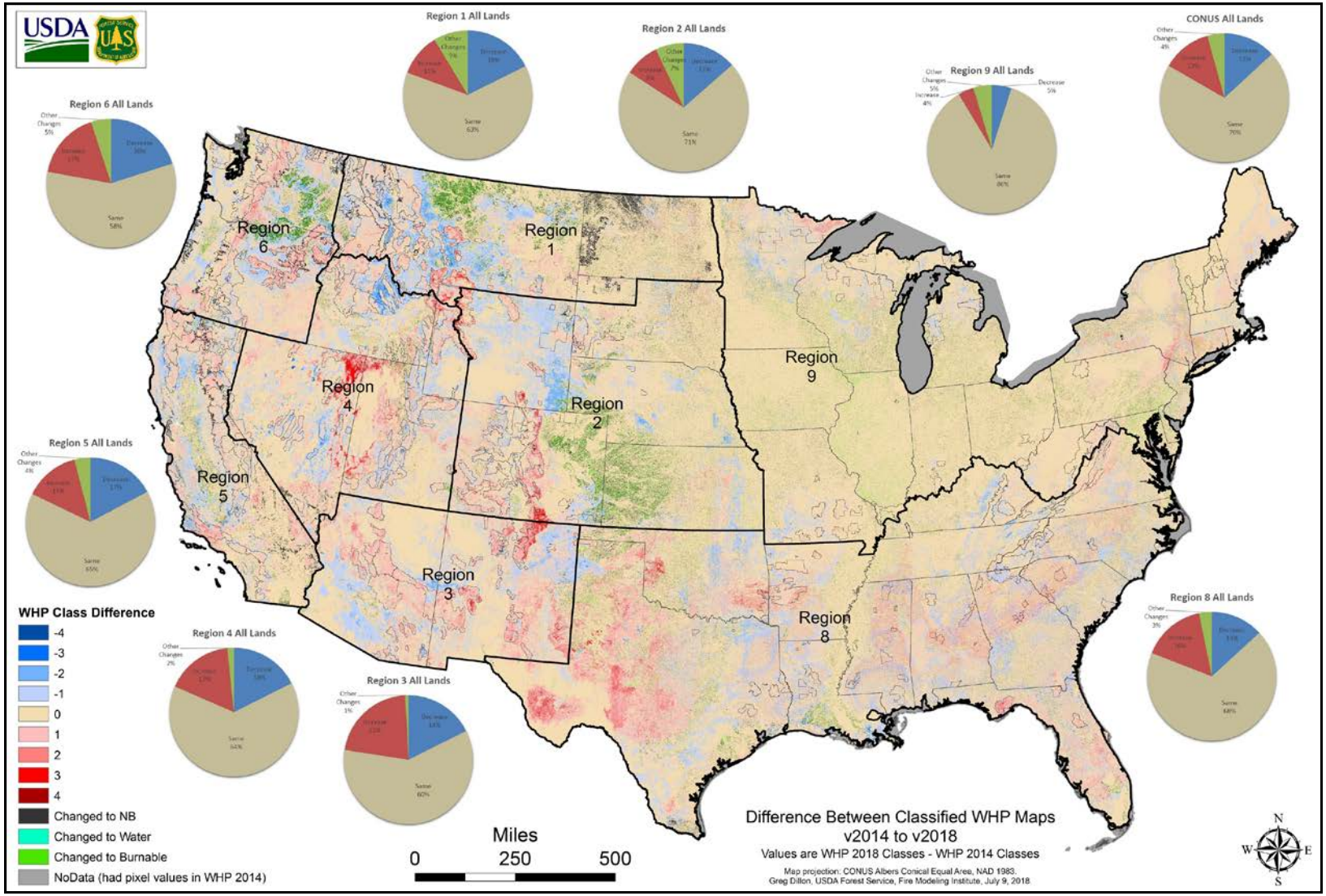

Figure 2. Difference between classified WHP maps from 2014 to 2018 for all lands. Charts summarize changes by Forest Service region. WHP class values are: Very Low = 1, Low = 2, Moderate = 3, High = 4, Very High = 5. Areas with negative values moved to a lower WHP class in 2018; areas with positive values moved to a higher WHP class in 2018. Other changes include pixels that changed from burnable to non-burnable and vice versa in LANDFIRE input data.

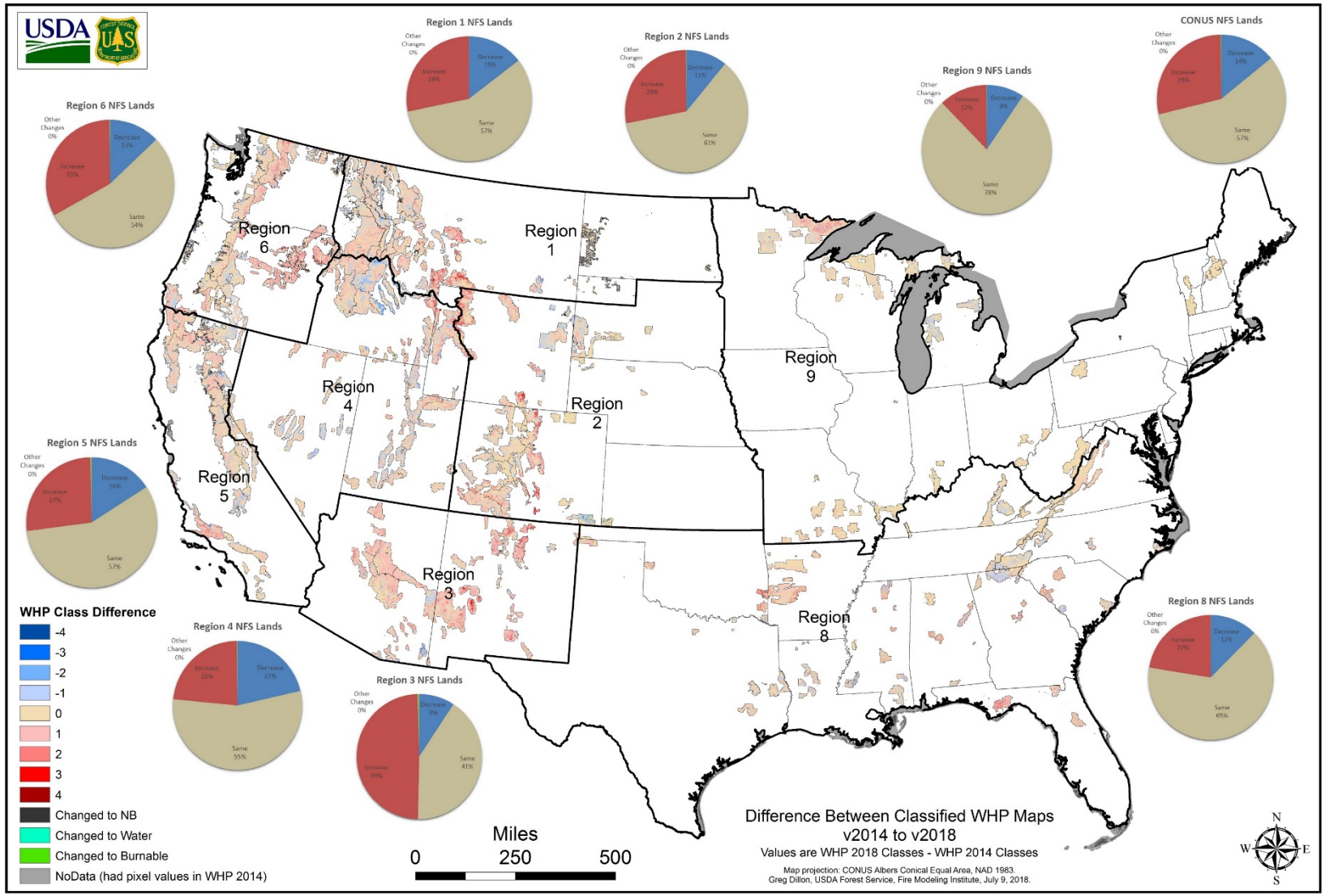

Figure 3. Difference between classified WHP maps from 2014 to 2018 for Forest Service lands. Charts summarize changes by FS region. WHP class values are: Very Low = 1, Low = 2, Moderate = 3, High = 4, Very High = 5. Areas with negative values moved to a lower WHP class in 2018; areas with positive values moved to a higher WHP class in 2018. Other changes include pixels that changed from burnable to non-burnable and vice versa in LANDFIRE input data.