Mapping Landscape Fire Frequency For Fire Regime Condition Class

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Background

Fire Regime Condition Class (FRCC) is an ecological departure index that compares the current amounts of the different vegetation succession classes, fire frequency, and fire severity to historic conditions.

Used for evaluating ecological conditions n reports such as land and fire management plans, National Environmental Policy Documents, project plans, burn plans and agency accomplishments

Utilization of fire history data attributed with spatial fire extent (e.g. fire atlas) is the preferred method for estimating fire frequency.

Interagency FRCC Guidebook, FRCC Map Tool, User Guides, Tutorials and training available from www.frames.gove/partner-sites/frcc/frcc-home.

Purpose

The FRCC Mapping Tool (FRCCmt) spatially models FRCC.

Succession classes are available as a spatial input to the FRCCmt from LANDFIRE.

Fire Severity can be generated by the Wildland Fire Assessment Tool (WFAT) which utilizes spatial inputs from LANDFIRE.

Model fire frequency, departure and condition class at a spatial scale similar to that of succession class, fire severity.

Objective

Develop and evaluate methods and data which would enable users to create spatial fire frequency inputs to the FRCCmt and associated frequency departure and condition outputs with treatment implications.

Fire frequency methods and results are presented for case studies of user specified time periods.

These methods could be implemented to provide a software tool which can produce spatial frequency data which can be utilized as inputs to produce outputs for mapping of FRCC and associated metrics.

Fire History Data Sources – LANDFIRE, MTBS and Local Fire History Atlas

LANDFIRE Disturbance Data

LANDFIRE disturbance layers describe landscape change for determining vegetation transitions over time.

Time Period: 1999 – 2011

Data: One ArcGRID per year showing disturbances occurring during that year including:

- Wildland / Prescribed Fire
- Insect / Disease
- Harvesting / Thinning
- Development

Monitoring Trends in Burn Severity (MTBS)

MTBS assesses the frequency, extent and magnitude of all large wildland fires in the US.

Time Period: 1984– 2011

Data: Shapefile which contains polygons that represent the extent and magnitude (severity) of all large wildland fires. Large wildland fires are considered to be greater than 1000 acres in the western US and 500 acres in the eastern US. Does not include prescribed fires.

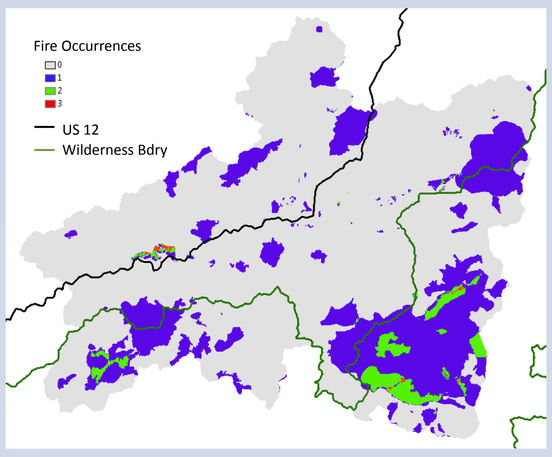
Digitized Local Fire Atlas

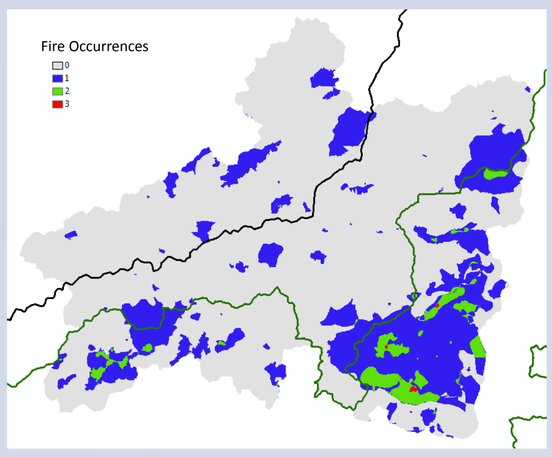
Local fire history data digitized from local fire atlas and other local sources.

Time Period: Beginning of local fire history records varies by local unit. Clearwater National Forest fire atlas has data from 1907 through 2013.

Data: Shapefile which contains polygons that represent the extent of wildland fires. Tendency to under report small fires.

Convert Spatial Fire History to a Fire Occurrence Raster





Upper Lochsa River Sub-Basin Fire Occurrence Rasters

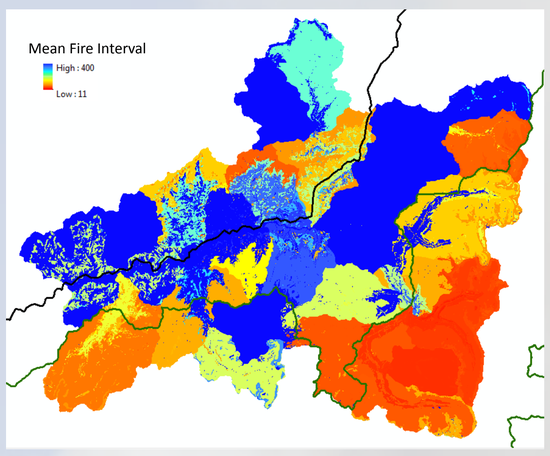
LANDFIRE/MTBS Fire Occurrence

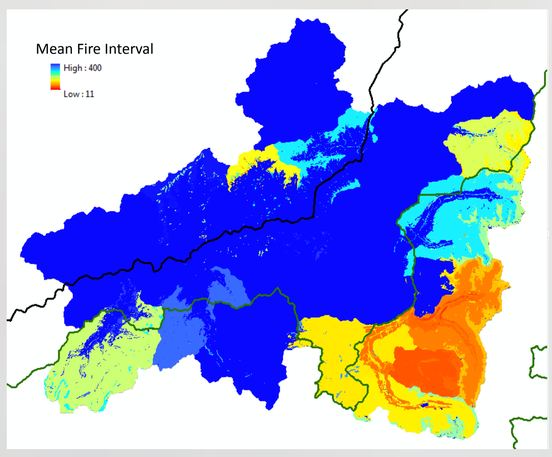
LANDFIRE Disturbance and MTBS layers were converted into a fire occurrence raster. This raster shows how many times fire has occurred in each pixel during the LANDFIRE (1999-2011) and MTBS (1984-1998) periods.

Fire Atlas Fire Occurrence

The Clearwater National Forest's digitized fire atlas was converted into a single raster showing how many times fire has occurred in each pixel during the same time period as the LANDFIRE/MTBS Fire Occurrence raster (1984-2011.)

Generate Mean Fire Interval Raster from Fire Occurrence Raster





Upper Lochsa River Sub-Basin Mean Fire Interval

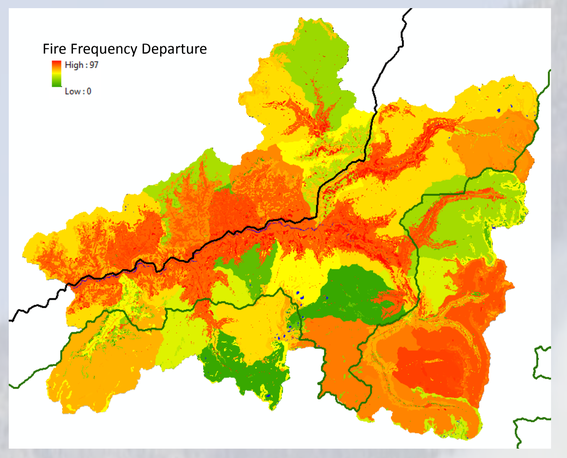
LANDFIRE/MTBS Mean Fire Interval

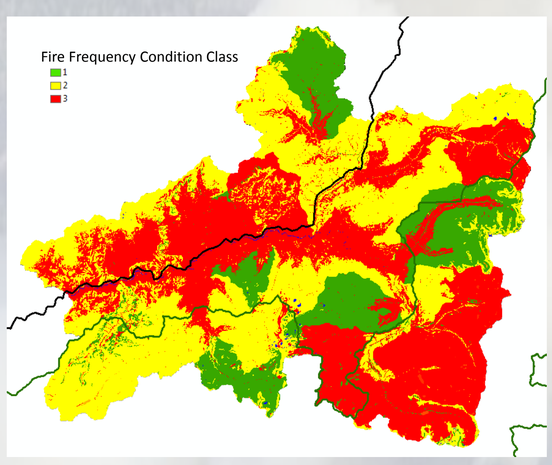
The LANDFIRE/MTBS Mean Fire Interval (MFI) was calculated by Biophysical Setting (BpS) within each Subwatershed (HUC) from the LANDFIRE/MTBS Fire Occurrence raster. The resulting MFI raster can be utilized as an input to the Fire Regime Condition Class Mapping Tool (FRCCmt).

Fire Atlas Mean Fire Interval

The Fire Atlas Mean Fire Interval (MFI) was calculated by Bps within each HUC from the Fire Occurrence raster which was derived from the Clearwater National Forest's digitized fire history atlas. This raster shows MFI for the same time period as the LANDFIRE/MTBS MFI raster (1984-2011.)

Calculate Frequency Departure and Condition Class





Fire Frequency Departure

A Fire Frequency Departure raster is generated by calculating the departure of Mean Fire Interval from the LANDFIRE/MTBS MFI raster. Stratified by each Bps within each HUC from the reference frequency. Departure Equation from the FRCC Guidebook:

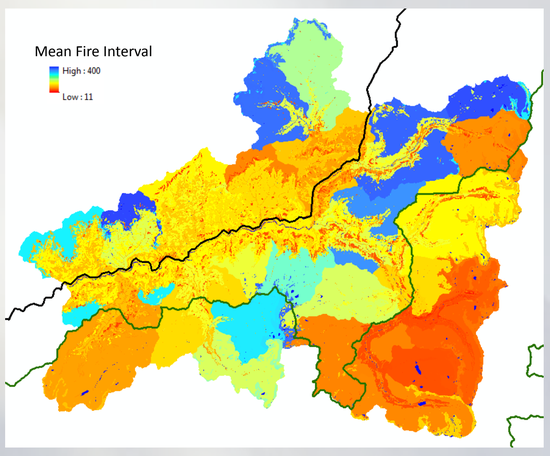
(1-[min(MFI,RefFreq)/max(MFI,RefFreq)])*100

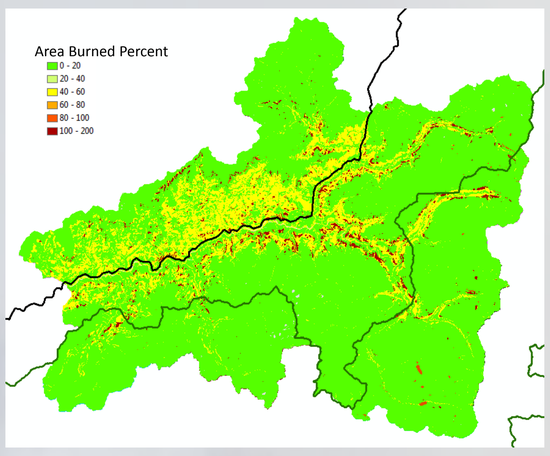
Fire Frequency Condition Class

The Fire Frequency Departure grid is classified into a Fire Frequency Condition Class grid utilizing the classification thresholds from the FRCC Guidebook:

1 - less than or equal to 33%
2 – greater than 33% and less than 66%
3 – greater than 66%

How much do we need to burn in the next 10 years to get back on track?





Mean Fire Interval Catch-up

What would the MFI raster look like in 10 years if we burn enough in each HUC/BpS to bring the MFI since 1984 back to within 33% (Condition Class 1) of what MFI would have been under reference conditions?

			Current (2011)				Ref	Extrapolated (2021)			
HUC_12	BpS	Acres	Burned	MFI	Depart	CC	Freq	Burned	MFI	Depart	CC
170603030208	1010560	10295	211	400	57	2	172	1500	229	25	1
170603030503	1010560	9359	473	400	57	2	172	1362	194	11	1
170603030301	1010560	9073	704	361	52	2	172	1319	170	1	1
170603030101	1010560	8596	29	400	57	2	172	1253	255	33	1
170603030202	1010560	8150	9255	25	85	3	172	1135	30	83	3
170603030503	1010453	8139	1163	196	65	2	69	2942	75	8	1
170603030304	1010453	6985	434	400	83	3	69	2533	89	22	1
170603030106	1010560	6927	2357	82	52	2	172	996	78	55	2
170603030106	1010453	6569	1666	110	37	2	69	2364	62	10	1
170603030206	1010560	6405	1886	95	45	2	172	923	87	49	2
170603030303	1010560	6320	1547	114	34	2	172	913	98	43	2
170603030304	1010471	5776	347	400	80	3	80	1806	102	22	1
170603030303	1010453	5491	621	247	72	3	69	1987	80	14	1
170603030304	1010560	5456	1069	143	17	1	172	789	112	35	2
170603030302	1010453	5036	402	351	80	3	69	1825	86	20	1
170603030208	1010471	4971	41	400	80	3	80	1558	118	32	1
170603030103	1010471	4825	61	400	80	3	80	1512	117	32	1
170603030106	1010471	4820	664	203	61	2	80	1503	85	6	1

Summary Report Showing 10 Year Extrapolation

Bringing some BpS's in some of the HUCs to within 33% of Reference MFI over the next 10 years will positively reduce Fire Frequency Departure and Condition Class

Percent Area Burned Catch-up

What would the Area Burned Percentage raster look like in 10 years if we burn enough in each HUC/BpS to bring the MFI since 1984 back to within 33% (Condition Class 1) of what MFI would have been under reference conditions?

Conclusions

- Fire frequency, departure and condition are very useful measures for evaluation of the fire regime.
- Data can be coalesced from multiple sources with different formats covering different time periods to calculate Mean Fire Interval for a user specified period.
- Small fires can impact the Mean Fire Interval of a BpS within a sub-watershed.
- One large wildland use fire can enable managers to approach reference Mean Fire Interval for a BpS/HUC.
- Additional fire activity over the next 10 years could have a positive impact on Fire Frequency Departure and Fire Regime Condition Class.
- The methodology employed can be automated for use with a Geographic Information System.

References

Barrett, S.; Havlina, D.; Jones, J.; Hann, W.; Frame, C.; Hamilton, D.; Schon, K.; Demeo, T.; Hutter, L.; and Menakis, J. 2010. [Homepage of the Interagency Fire Regime Condition Class website, USDA Forest Service, US Department of the Interior, and The Nature Conservancy]. [Online]. Available: www.frcc.gov

Jones, Jeff and Colleen Ryan. 2012. Fire Regime Condition Class Mapping Tool (FRCCMT) User's Guide. National Interagency Fuels, Fire, & Vegetation Technology Transfer. Available: www.niftt.gov.

LANDFIRE: LANDFIRE Disturbance layer. (2013, June). U.S. Department of Interior, Geological Survey. [Online]. Available: landfire.cr.usgs.gov/viewer/ [2014,April].

Monitoring Trends in Burn Severity. (2009, November - 2014, April). [MTBS Project Homepage, USDA Forest Service/U.S. Geological Survey]. Available online: www.mtbs.gov [2014, April].

Morgan, P; Heyerdahl, E; Miller, C; Wilson, A; Gibson, C; "Northern Rockies Pyrogeography: An Example of Fire Atlas Utility." *Fire Ecology Volume 10, Issue 1* (2014): 14-30. [Online] www.fireecology.org/docs/Journal/pdf/Volume10/Issue01/014.pdf

Nez Perce – Clearwater National Forests: Fire History Polygon Layer. (2013, November). USDA Forest Service. [Online]. Available online: www.fs.usda.gov/main/nezperceclearwater/landmanagement/gis [2014,April].

Background photo courtesy of the USDA Forest Service

Integrating science, technology and fire management.
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