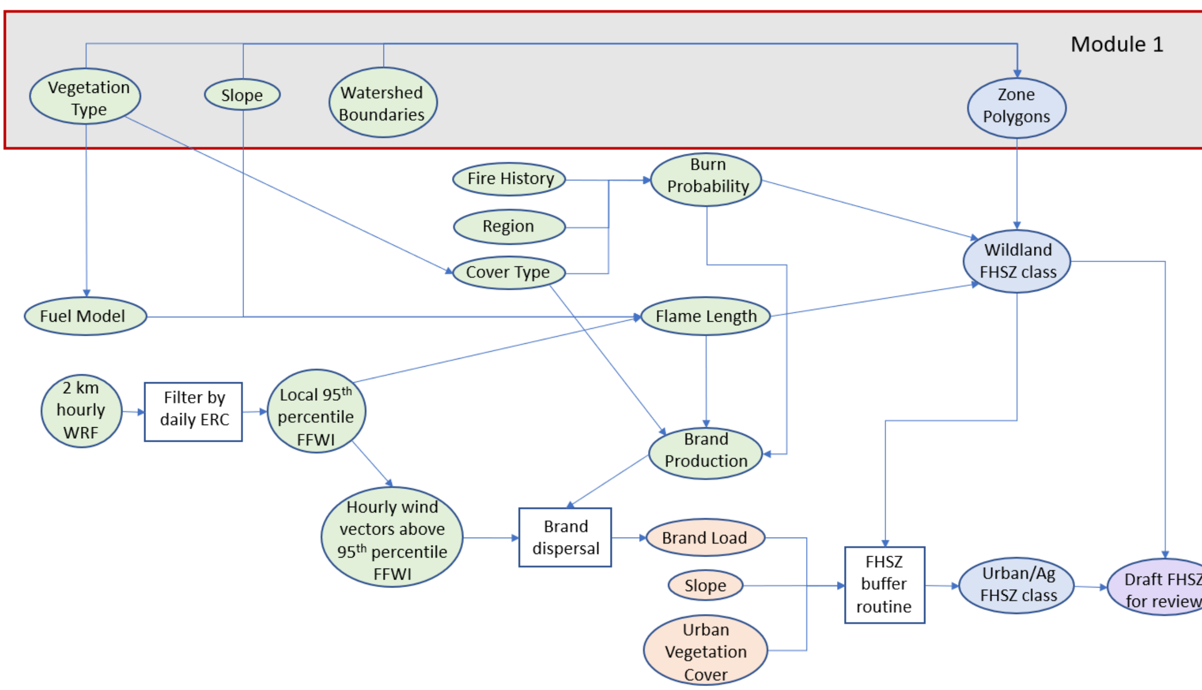
Fire Hazard Severity Zone Methods

Overview

Fire Hazard Severity Zone (FHSZ) maps are developed from a geospatial model that is designed to describe relative wildland and urban-interface fire hazard potential over the long-term for all areas of the state. Different steps were taken for modeling FHSZ in wildland areas, defined as those where a fuel model can be applied, and non-wildland areas. Non-wildland includes urban, agricultural and barren lands, and water or wetlands. Wildland areas were scored directly based on data inputs within the wildland, and non-wildland areas were scored using a buffering routine that builds zones based on proximity to wildland as well as factors that reflect how conducive the non-wildland area is to fire spread. In addition, slightly different rules apply for zoning in State Responsibility Area (SRA) vs Local Responsibility Area (LRA) and Federal Responsibility Area (FRA). The modeling methods for building FHSZ are easiest to explain when divided into five modules.

Module 1 – Delineate wildland zones

Zones aim to capture patches of contiguous "fire environments" within which similar fire behavior potential could be expected. By definition, FHSZ classes are ultimately applied across an entire zone. The zones were built using a simplified vegetation classification that groups vegetation types into 3 classes of relative fire potential and 2 slope classes (< or > 20%). This method aims to reflect similar slope and vegetation fire potential within the zone, although fine grained variability is present. We further divided zones using watershed boundaries, to help break up very large zones. There is no maximum zone size, but there is a minimum size of 200 acres in wildland and 20 acres for isolated islands embedded in non-wildland.



Module 2 – Wildland FHSZ classification

In Module 2 all wildland polygons get assigned to an FHSZ class. Each zone was given a hazard score based on two factors: flame length expected under the worst conditions and burn probability.

Flame length

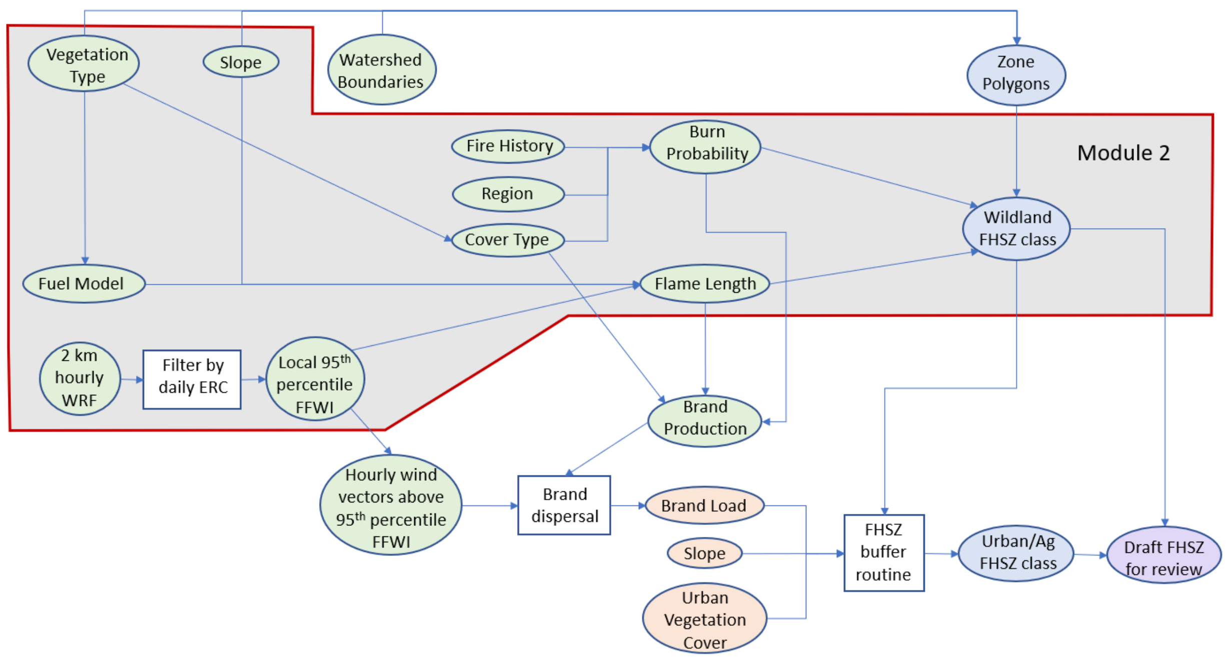
First, a fuel model was assigned to all wildland pixels (30 m scale) using vegetation type (e.g., Coastal Scrub) cross-walked to a surface fuel model from Scott and Burgan 2005 (e.g., Moderate Load, Dry Climate Grass-Shrub; GS2). Forested types also were assigned canopy fuel characteristics to include crown fire estimation. Flame length was then modeled in NEXUS, using fuel model, slope, and the default “High” setting for fuel moisture and weather inputs. We then adjusted the output using local climate data, including observations that occurred when the daily ERC was above the 90th percentile and the Fosberg Fire Weather Index (FFWI) was above the 95th percentile.

Burn probability

We calculated fire rotation using fire history data from FRAP’s fire perimeter database for the years 1991–2020. Fire rotation was calculated within strata defined by vegetation life form (e.g., shrub), climatic region, and urbanized areas from the US census bureau. We then calculated annual burn probability (the inverse of fire rotation). Note that this method gives the same burn probability to all pixels within a given strata (e.g., Southern California Coast shrub outside of urbanized areas) and does not give a higher probability to the actual locations where fires have occurred compared to other areas within the same stratum.

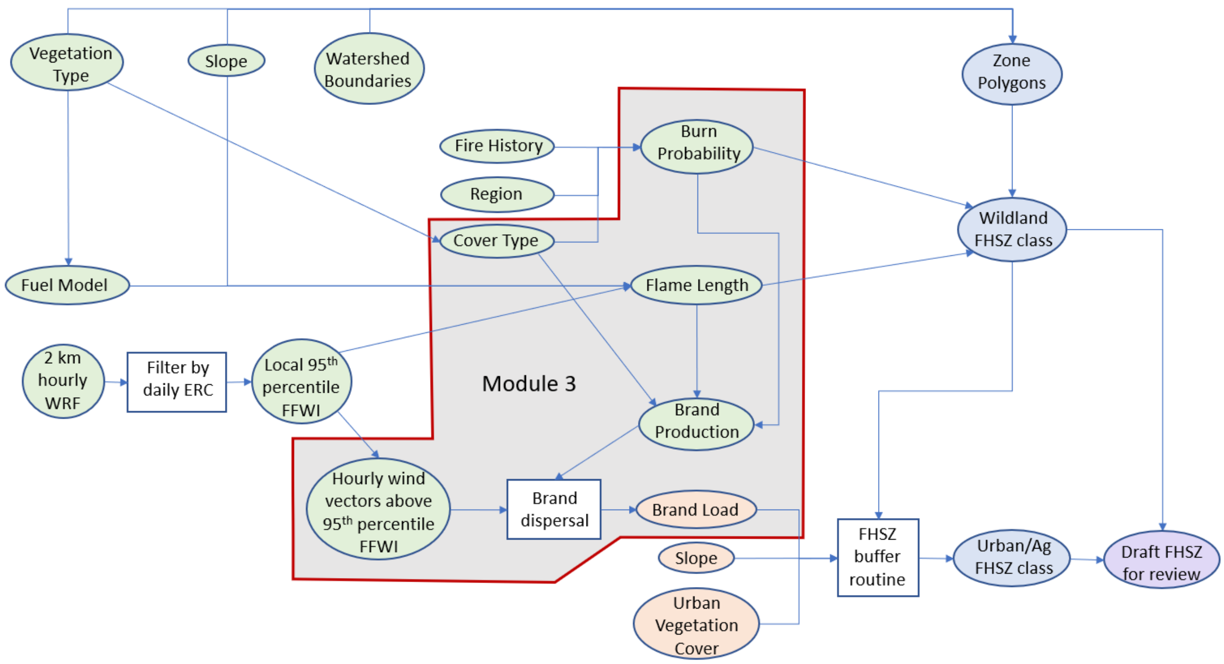
FHSZ designation

Flame length was then multiplied by annual burn probability, giving a pixel level score of fire hazard. All pixels within a zone were averaged to give a hazard score for each FHSZ polygon. The hazard scores were then divided into 3 classes of relative hazard (Moderate, High, and Very High). All wildlands were given one of these three FHSZ designations (i.e., there is no unzoned wildland area and Moderate is the lowest designation).



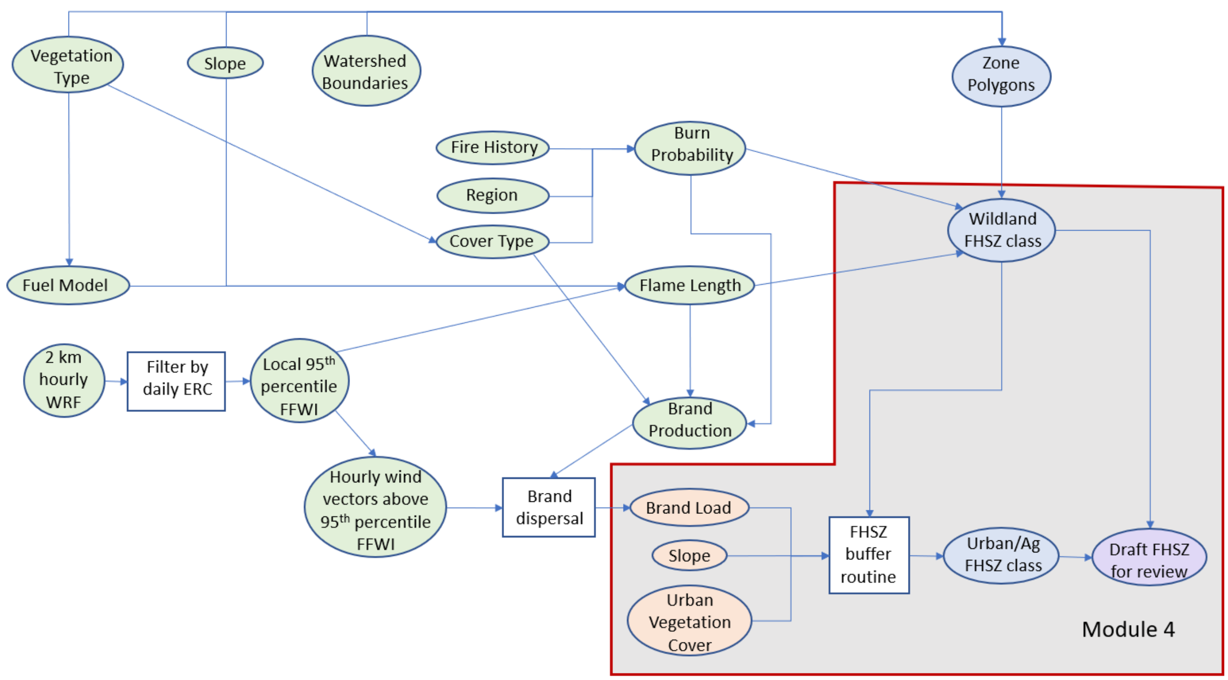
Module 3 – Brand production and dispersal

This module is focused on modeling potential fire brand dispersal from wildlands into non-wildland areas (e.g., urban areas). First, we modeled the amount of fire brands produced by each wildland pixel that is within transport distance of a non-wildland boundary. Brand production is a function of vegetation cover type, modeled flame length, and burn probability. Next, we modeled the dispersal of fire brands based on an area's wind speed and direction patterns, using the same selection criteria as the weather inputs for flame length (when the daily ERC was above the 90^{th} percentile and the FFWI was above the 95^{th} percentile). For example, if the fire weather at a given location tended to have winds predominantly out of the NE at 40 mph, modeled brands go predominantly to the SW and go a greater maximum distance than they would at a site with predominantly 20 mph winds. The dispersed brands coming from all wildland pixels are then summed to generate an estimate of brand load within non-wildland areas.



Module 4 – Non-wildland FHSZ classification

In Module 4 we assign an FHSZ class to non-wildland areas, which are areas that lack a fuel model and include urban, agriculture, barren areas, and water bodies/wetlands. This is done by generating buffers into non-wildland areas that are adjacent to wildlands. The initial zone classification is the same as the adjacent wildland, with buffers of lower FHSZ classes modeled at further distances from the wildland boundary. The width of the FHSZ buffer is a function of brand load, slope, and the amount of tree cover within the non-wildland area. The FHSZ buffer into non-wildland is wider in areas that have higher brand load, steeper slope, and greater tree cover. Note that non-wildland areas that are sufficiently far from wildland remain unzoned, in contrast to wildland, which always receives a zone designation.



Module 5 – Jurisdictional overlay and cleanup

Module 5 consists of final zone processing and overlay with SRA. FHSZs were intersected with SRA and all unzoned areas within SRA, including water bodies, were reclassified as Moderate. This is to account for statute that requires all SRA to be assigned an FHSZ designation.

Summary of data inputs

Text in italics indicates the dataset is used as an indirect input in a given module.

Input dataset (source)	Module 1	Module 2	Module 3	Module 4	Module 5
Vegetation type (FRAP's fveg layer)	Grouped into 3 classes based on expected fire behavior potential and used to delineate zone boundaries	Assign a fuel model that is used to derive expected flame length in wildlands 4 cover types used to define burn probability strata	*Cover type and expected flame length used to model brand production*	*Brand production used as an input to the cost surface used in determining the buffer width of FHSZ in non-wildland*	
Slope	Classified as < or >20% and used to delineate zone boundaries	Used to derive expected flame length in wildlands (6 classes)		Input for determining the buffer width of FHSZ in non-wildland	
Watershed boundaries (HUC 12)	Used in conjunction with vegetation and slope to define zone boundaries				
Hourly climate data on a 2 km grid for the years 2003–2018, filtered to select just days where ERC exceeds the local daily 80th percentile		The local 95th percentile Fosberg Fire Weather Index (FFWI) is used to adjust expected fireline intensity and flame length	The distribution of wind speed and direction for the hours exceeding the 95th percentile FFWI are used to model transport of fire brands into non-wildland areas		
Fire history from 1991–2020 (FRAP's fire perimeter database)		Used to calculate annual burn probability	*Burn probability used to model brand production*	*Brand production is an input for determining the buffer width of*	

Input dataset (source)	Module 1	Module 2	Module 3	Module 4	Module 5
				FHSZ in non-wildland	
Climatic regions (from the 2017 FRAP Assessment)		Used to define burn probability strata	*Burn probability used to model brand production*	*Brand production is an input for determining the buffer width of FHSZ in non-wildland*	
Urbanized areas (from the US 2010 census)		Used to define burn probability strata	*Burn probability used to model brand production*	*Brand production is an input for determining the buffer width of FHSZ in non-wildland*	
Percent vegetation cover (from Earth Define within Urbanized census areas; from Salo Sciences to cover other non-wildland areas)				Input for determining the buffer width of FHSZ in non-wildland	
SRA boundaries					Overlay with FHSZ; all SRA must be zoned (minimum class of Moderate, including water)