Presentation of initial fire models for Sagehen Creek Basin to district team. Two-day meeting to refine understanding of fireshed planning and analysis.

Translating SPLATs from a theoretical to a real world landscape: The implications of fuel management strategies for Sagehen Creek Basin, Tahoe National Forest

David Saah
John J. Battles
Scott L. Stephens
Gary B. Roller

5/24 – 5/25 2006

A) FLAMMAP 3 Approach

Rate of Spread
(m/min)

Flame Length
(m)

Heat/Unit Area
(kJ/m^2)

Fireline Intensity
(kW/m)

Crown Fire Activity
1 (surface)
2 (torching)
3 (active crown)

Landscape File

Custom Fuel Model

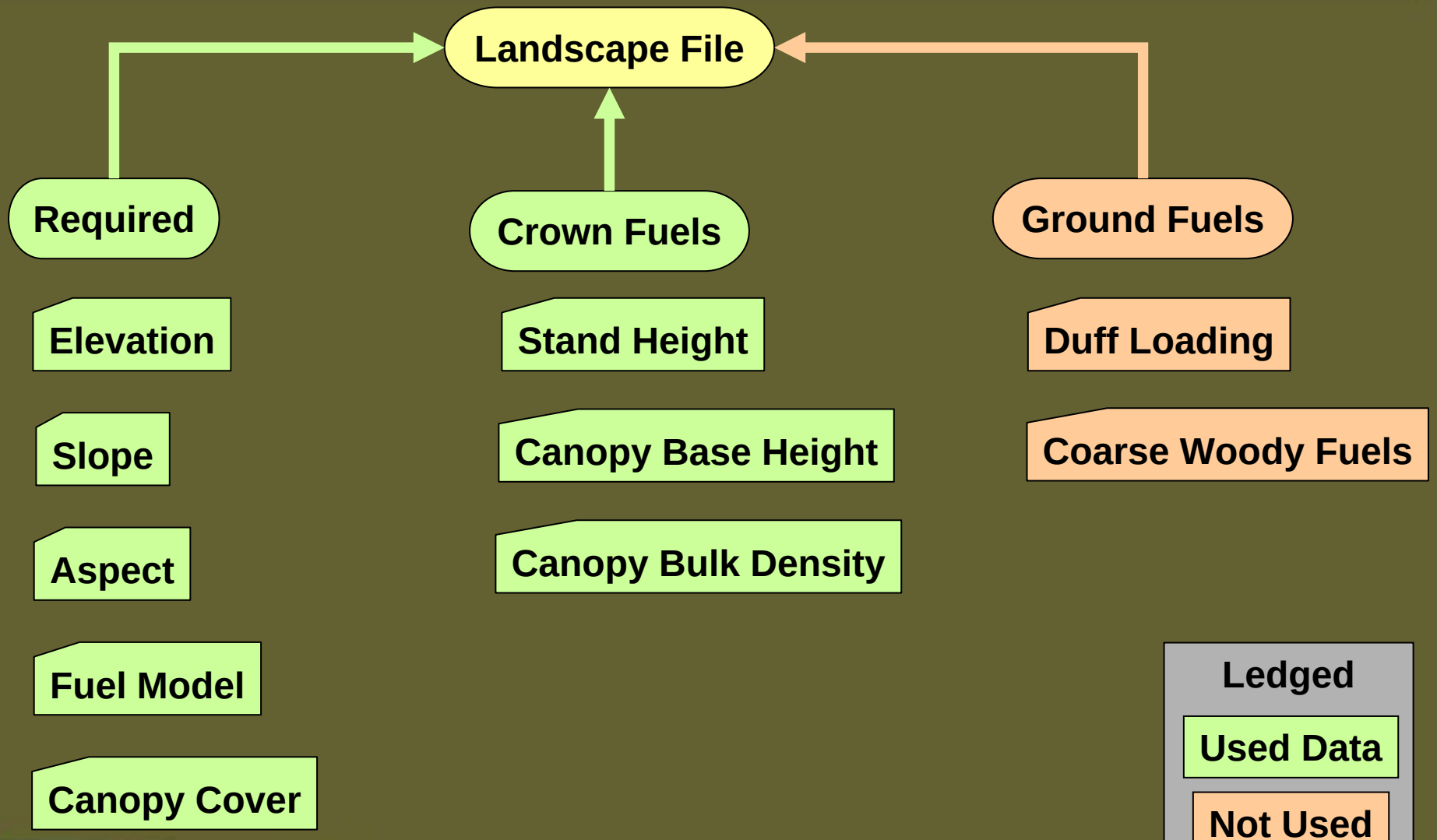
Weather File

Wind File

FIELD DATA

RAWS

FlamMap Input: Landscape File Flowchart



Landscape (LCP) File Generation

Load Source LCP File | C:\SAGEHEN\4_FlamMap...\SAGEHEN_USF.lcp | Clear Fields | Save as LCP | Help

General

Latitude:	40	Grid Distance Units:	Meters		
Rows:	640	Lower Left X:	-27389	CellSize:	10
Columns:	1043	Lower Left Y:	153952		

Required Themes

	Source	Use LCP	Source Units	Constants	
Elevation:	C:\SAGEHEN\4...\ned_elev_ft.asc	☐	Feet	☐ Constant:	0
Slope:	C:\SAGEHEN\...\ned_slope_p.asc	☐	Percent	☐ Constant:	0
Aspect:	C:\SAGEHEN...\ned_aspect_d.asc	☐	Degrees	☐ Constant:	0
Fuel Model:	C:\SAGEHEN\4_Flam...\fmod.asc	☐	Custom	☐ Constant:	1
Canopy Cover:	C:\SAGEHEN\4_Fl...\cc_sda1.asc	☐	Percent	☐ Constant:	50

Crown Fuels

Include Crown Fuels ☑

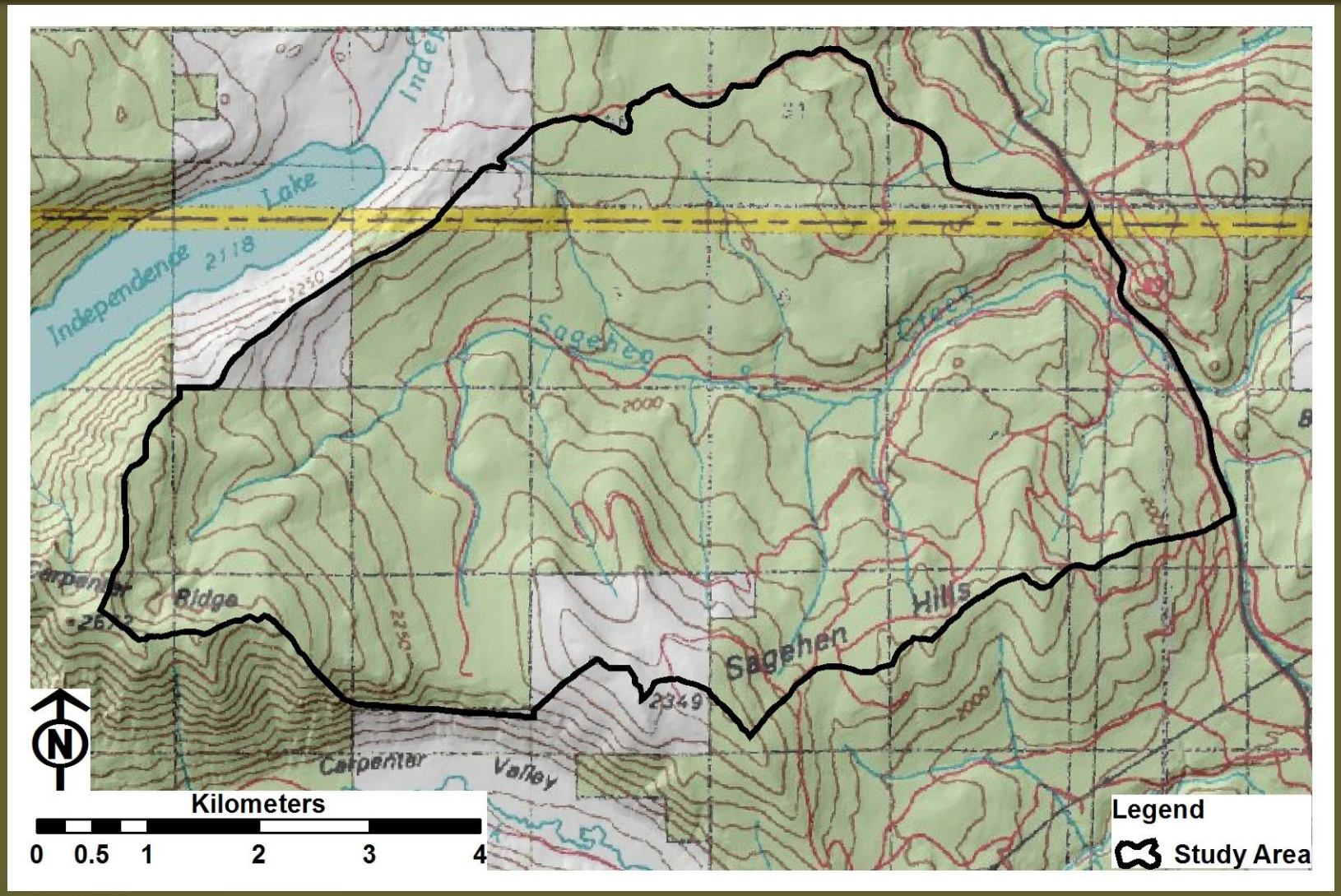
Stand Height:	C:\SAGEHE...\stand_height_m.asc	☐	Meters	☐ Constant:	15
Canopy Base Height:	C:\SAGEHEN\4...\cbh_sda_m.asc	☐	Meters	☐ Constant:	1
Canopy Bulk Density:	C:\SAGEH...\cbd_sda_kg_m3.asc	☐	kg/m3	☐ Constant:	0.2

Ground Fuels

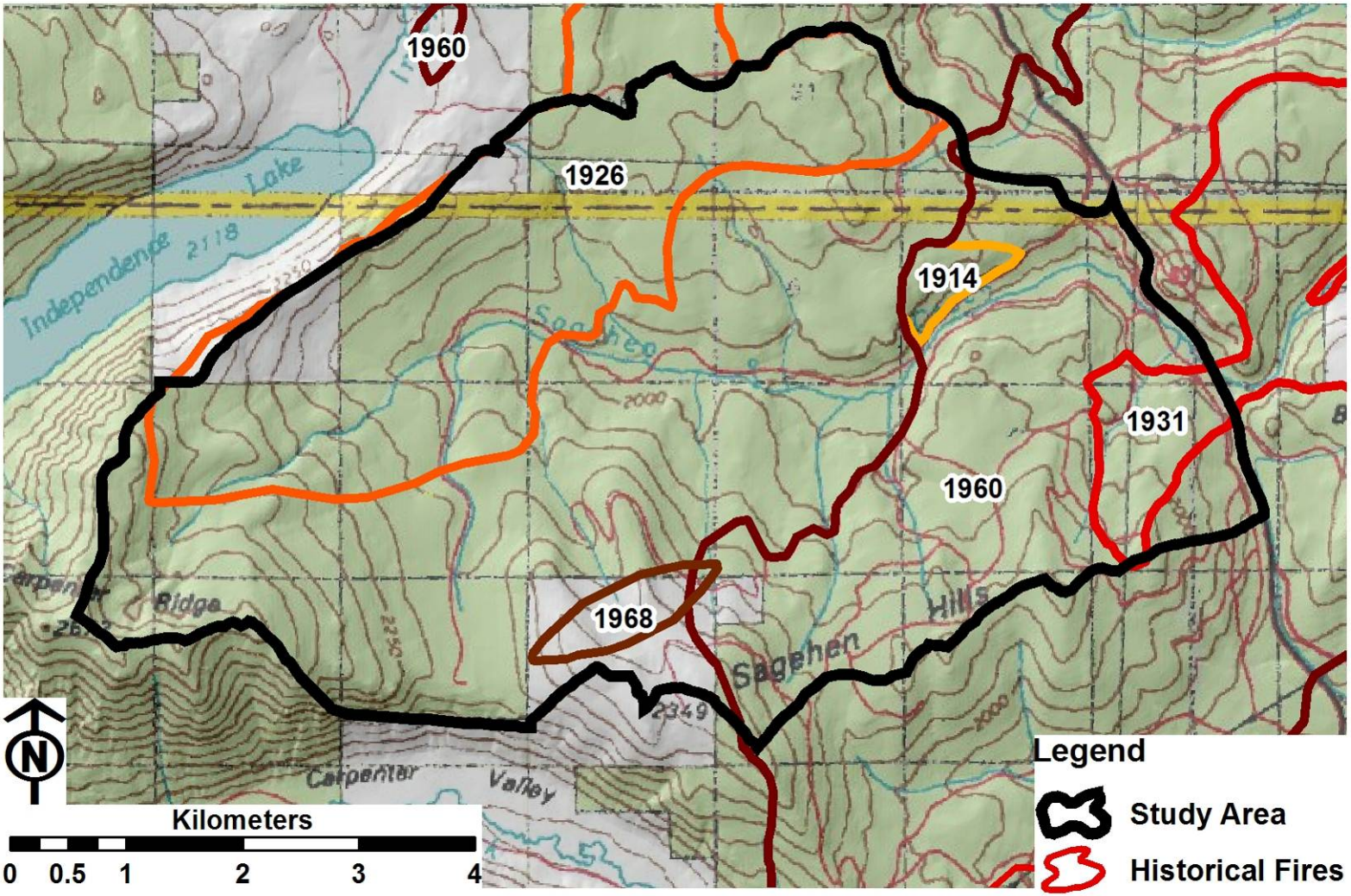
Include Ground Fuels ☐

Duff Loading:	NA	☐	Mg/Ha	☐ Constant:	50
Coarse Woody Fuels:	NA	☐	Class	☐ Constant:	50

B) Study Area


Lake
Independence
2118
Sagehen
Creek
Ridge
Hills
Sagehen
2349
Carpenter
Valley
N
Kilometers
0
0.5
1
2
3
4
Legend
Study Area

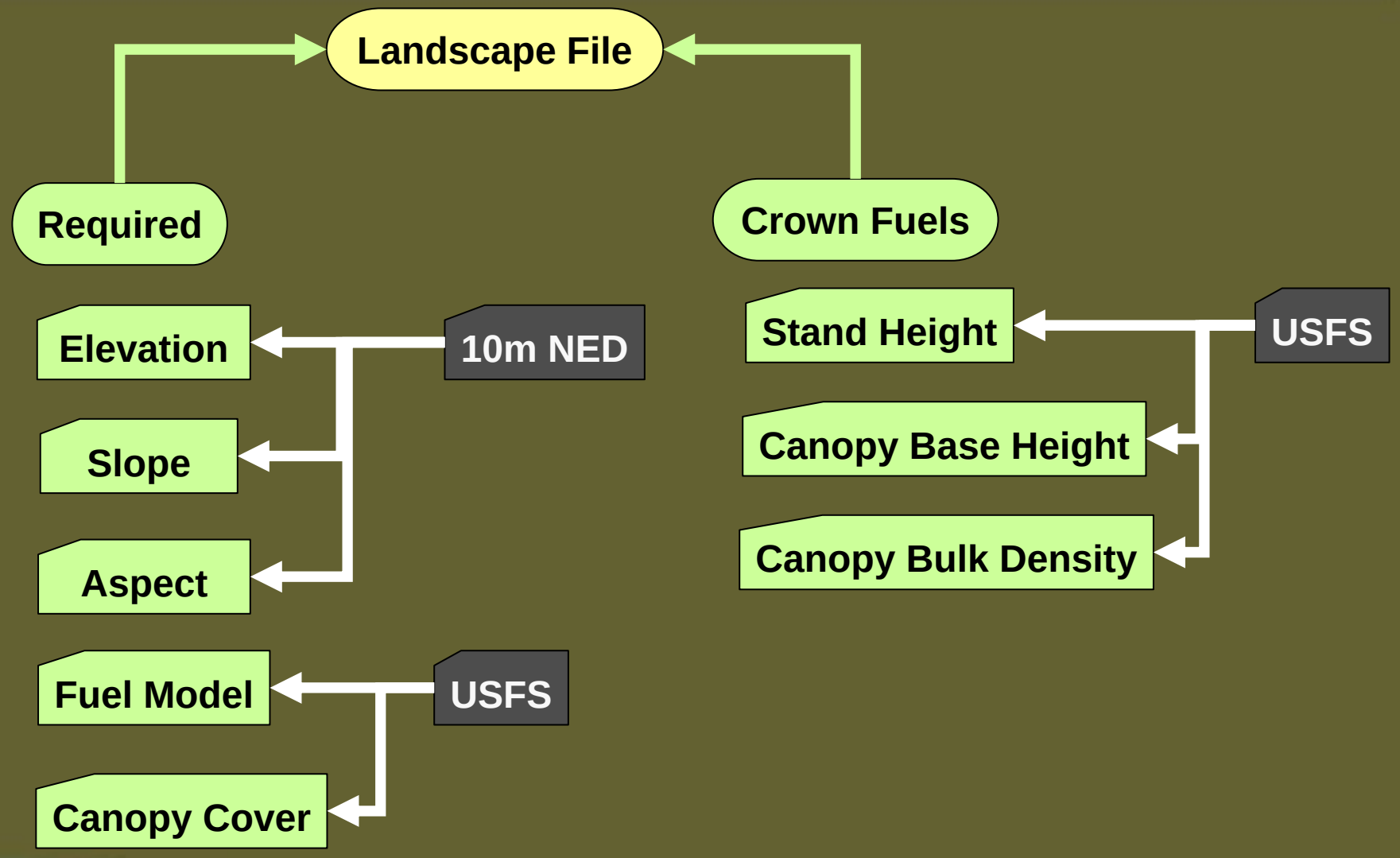
Fire History



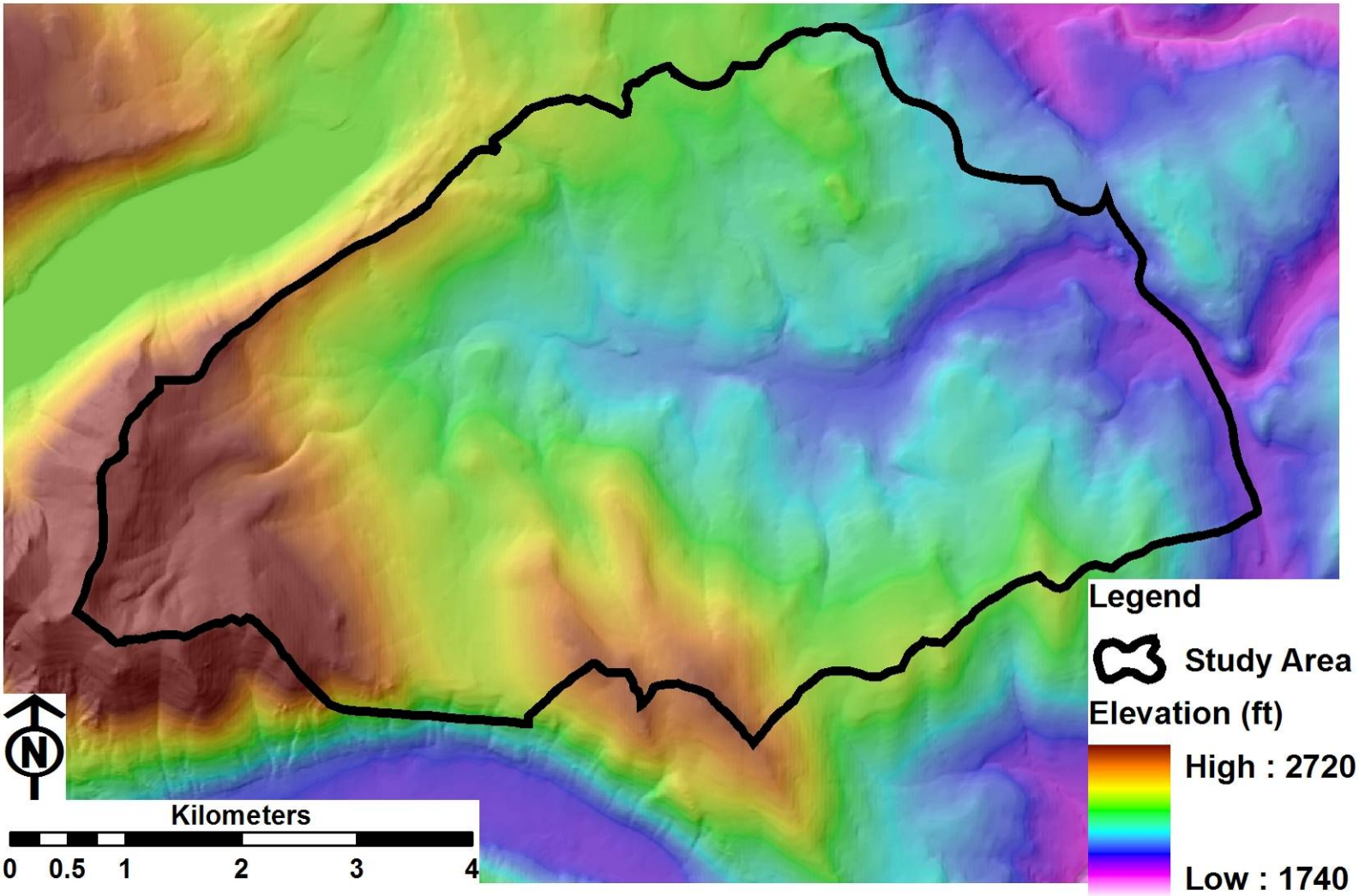
Simulation Project Plan

Model ID	Terrain	Fuel Model
Run1 (Baseline)	10 m NED	USFS
Run2 (Terrain)	LiDAR (5m)	USFS
Run3 (Fuel Model)	10m NED	Berkeley
Run4 (Combo)	LiDAR (5m)	Berkeley

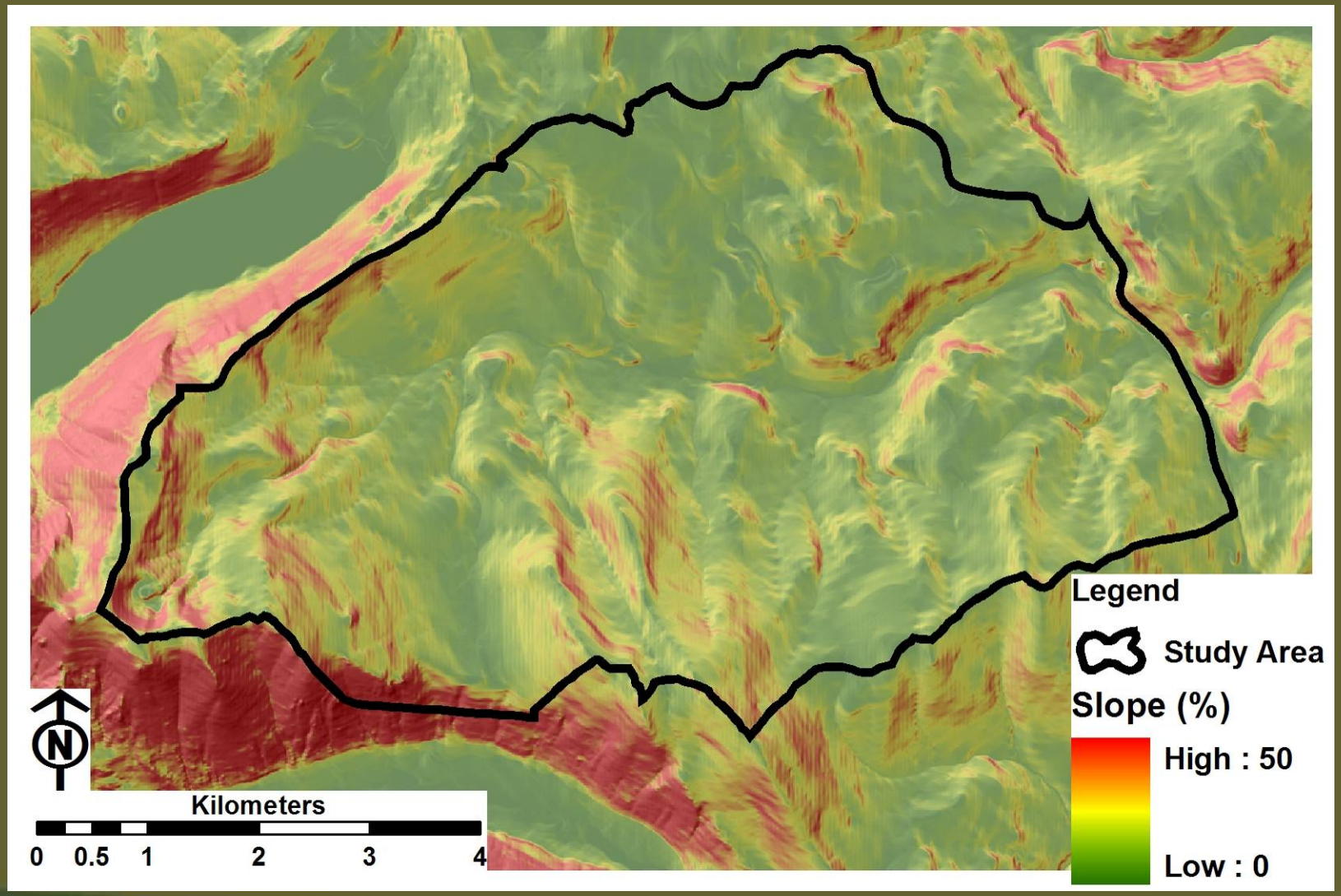
INPUT: Run1 (Baseline)



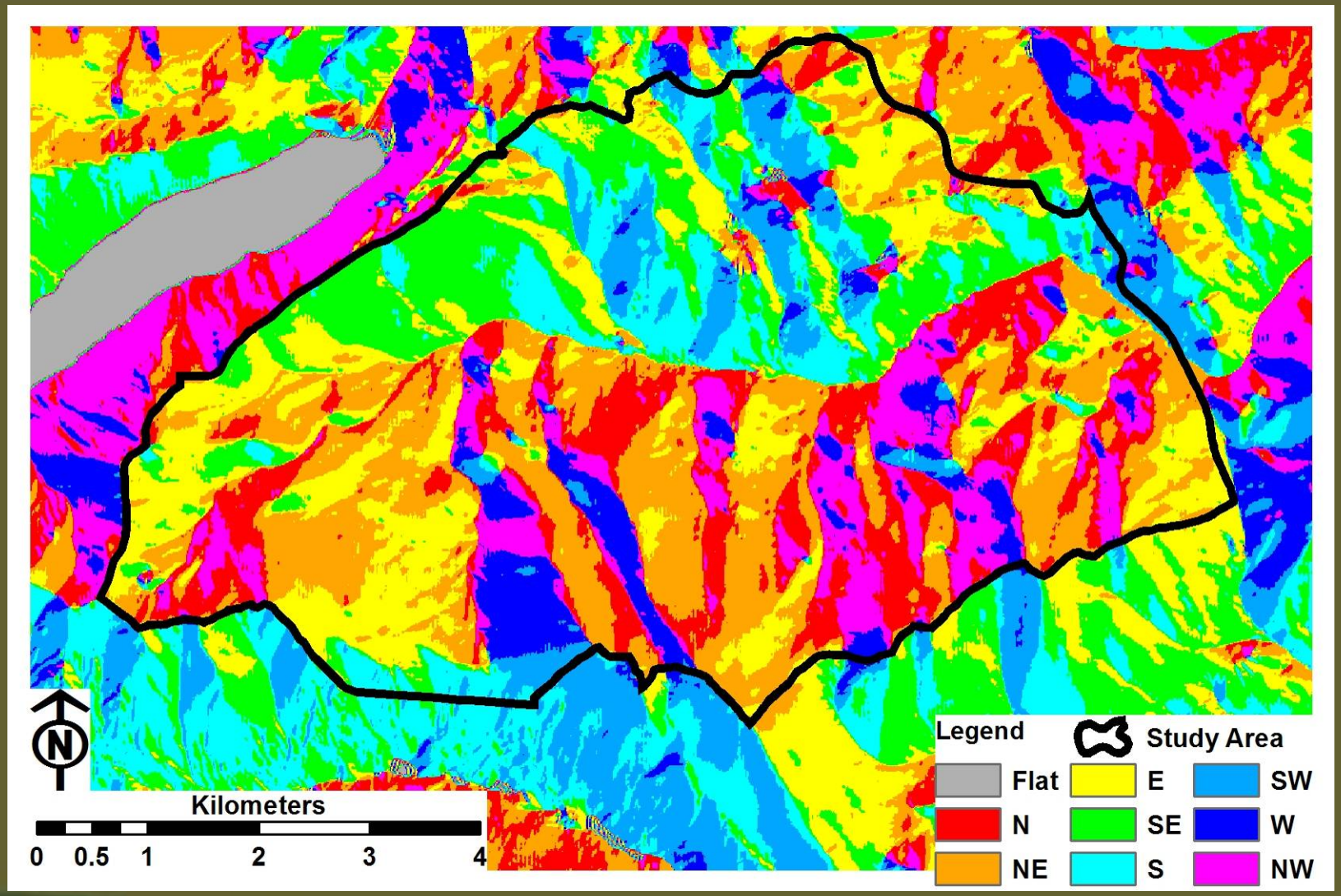
NED 10m: Elevation (ft)



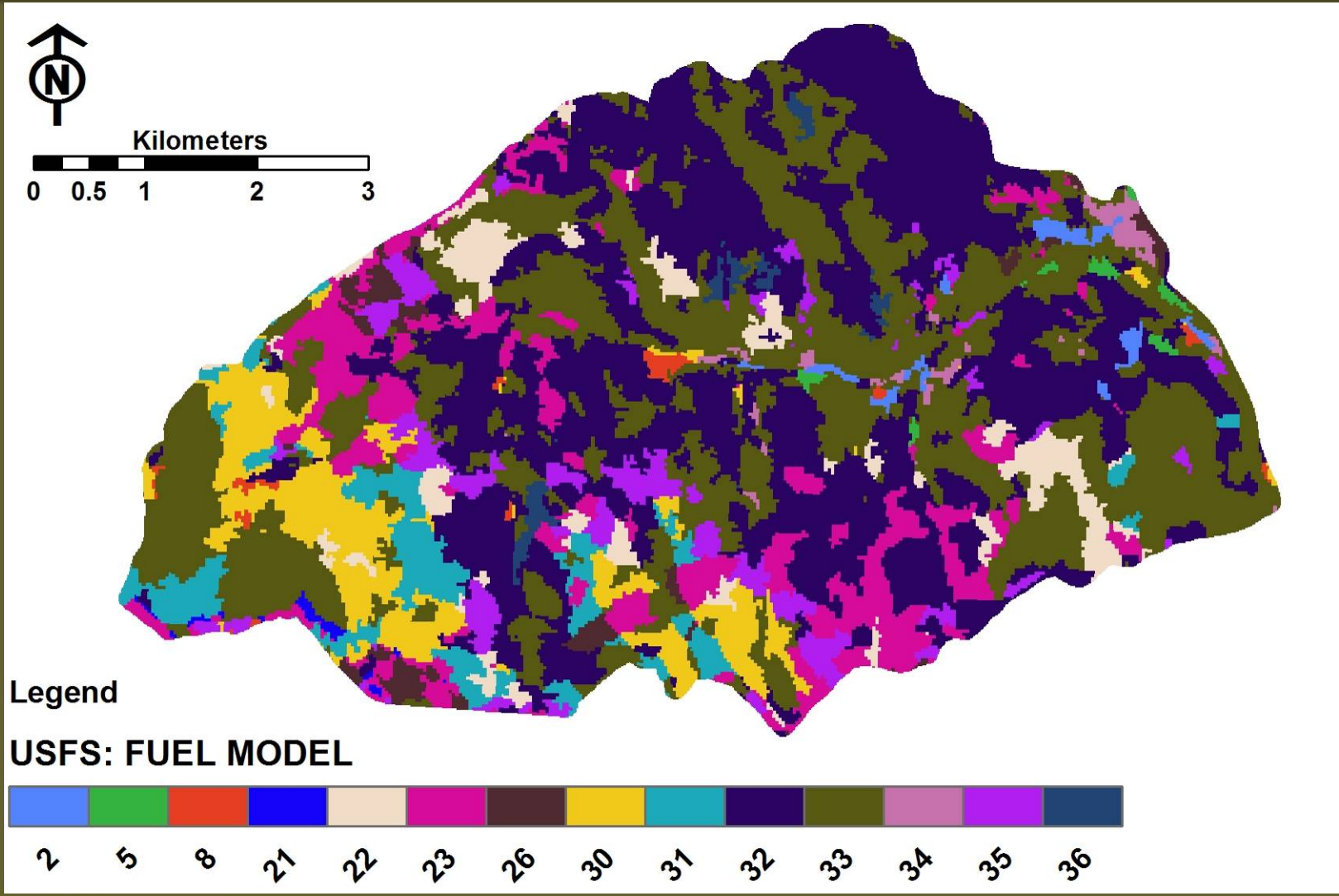
NED 10m: Slope (Percent)



NED 10m: Aspect (degrees)



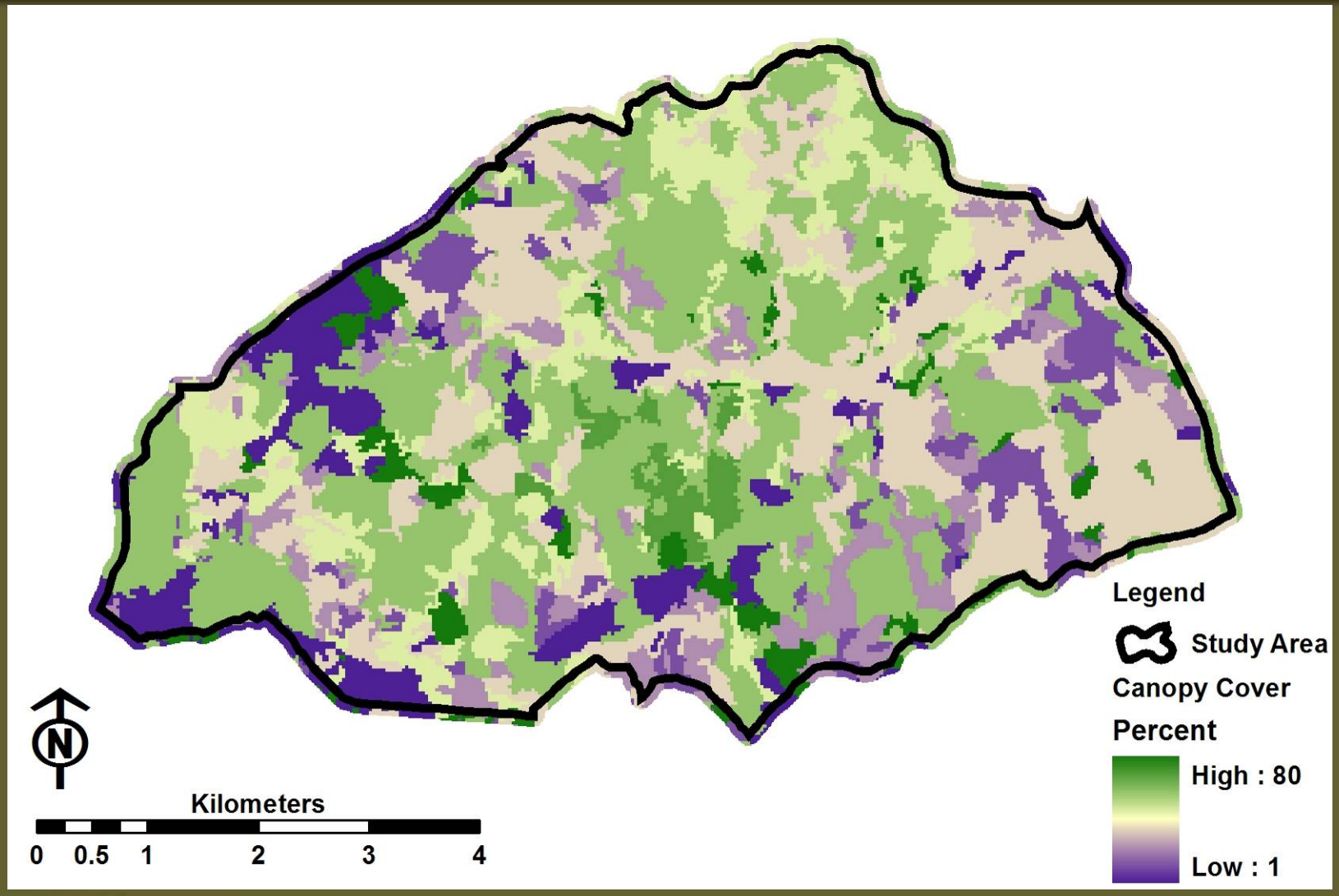
USFS: Fuel Model



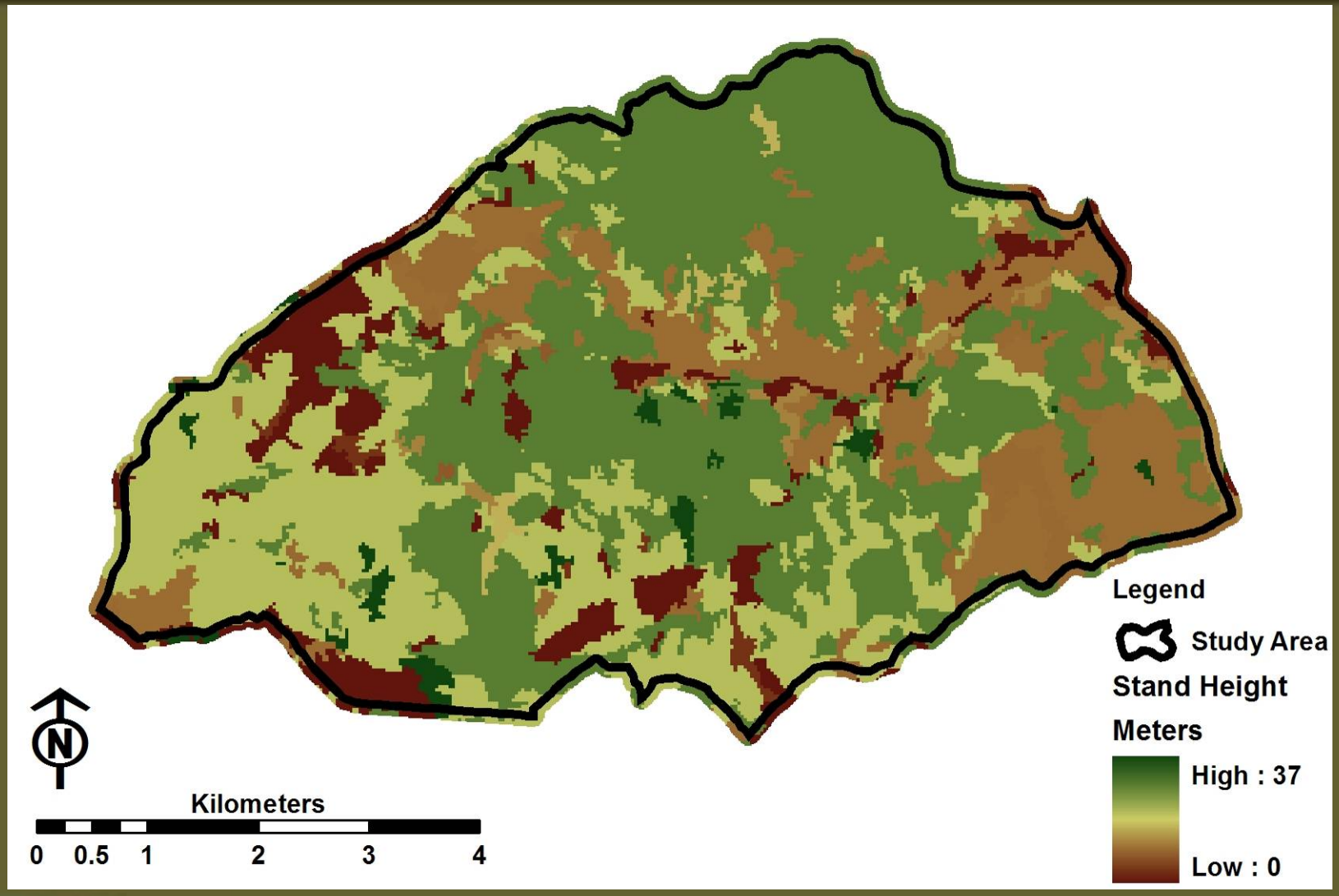
USFS: Fuel Model Data

ID	Fuel Loading						Surface to Volume Ratio			Fuel Bed	XtMoist	Heat Content	
	ton/acre						1/ft			feet	%	BTU/lb	
	1h	10h	100h	LiveH	LiveW	FMTYPE	1HSAV	LiveHSAV	LiveWSAV	Depth	Xmoist	DHt	LHt
2	2	1	0.5	0	0.5	static	3000	1800	1500	1.0000	14	8000	8000
5	1	0.5	0	0	2	static	2000	1800	1500	2.0000	20	8000	8000
8	1.5	1	2.5	0	0	static	2000	1800	1500	0.2000	29	8000	8000
21	2	1.5	3	2	0	static	2000	1500	1500	1.3	25	8000	9000
22	2.7	2.7	1.8	3.6	0	static	2000	1500	1500	3.6	34	8000	9000
23	2	1.5	3	2	0	static	2000	1500	1500	1.3	25	8000	9000
26	3	4.5	1.1	1.5	0	static	2000	1500	1500	3	25	8000	9000
30	2	4.5	3	0	2	static	2000	1500	1500	0.5	25	8000	9000
31	1.5	4.5	5.5	0	0	static	1000	1500	1500	0.5	20	8000	9000
32	3.96	2.64	6.6	0	0	static	2000	1800	1500	0.53	28	8000	9000
33	2	0.4	0.2	0	0	static	2500	1500	1500	0.25	25	8000	9000
34	0.8	0.5	2	0	2	static	2000	1500	1500	1.5	28	8000	9000
35	3.01	2	5.01	0	2	static	2000	1800	1500	1	25	8000	9000
36	3	2	3	2	0	static	2000	1500	1500	1	25	8000	9000

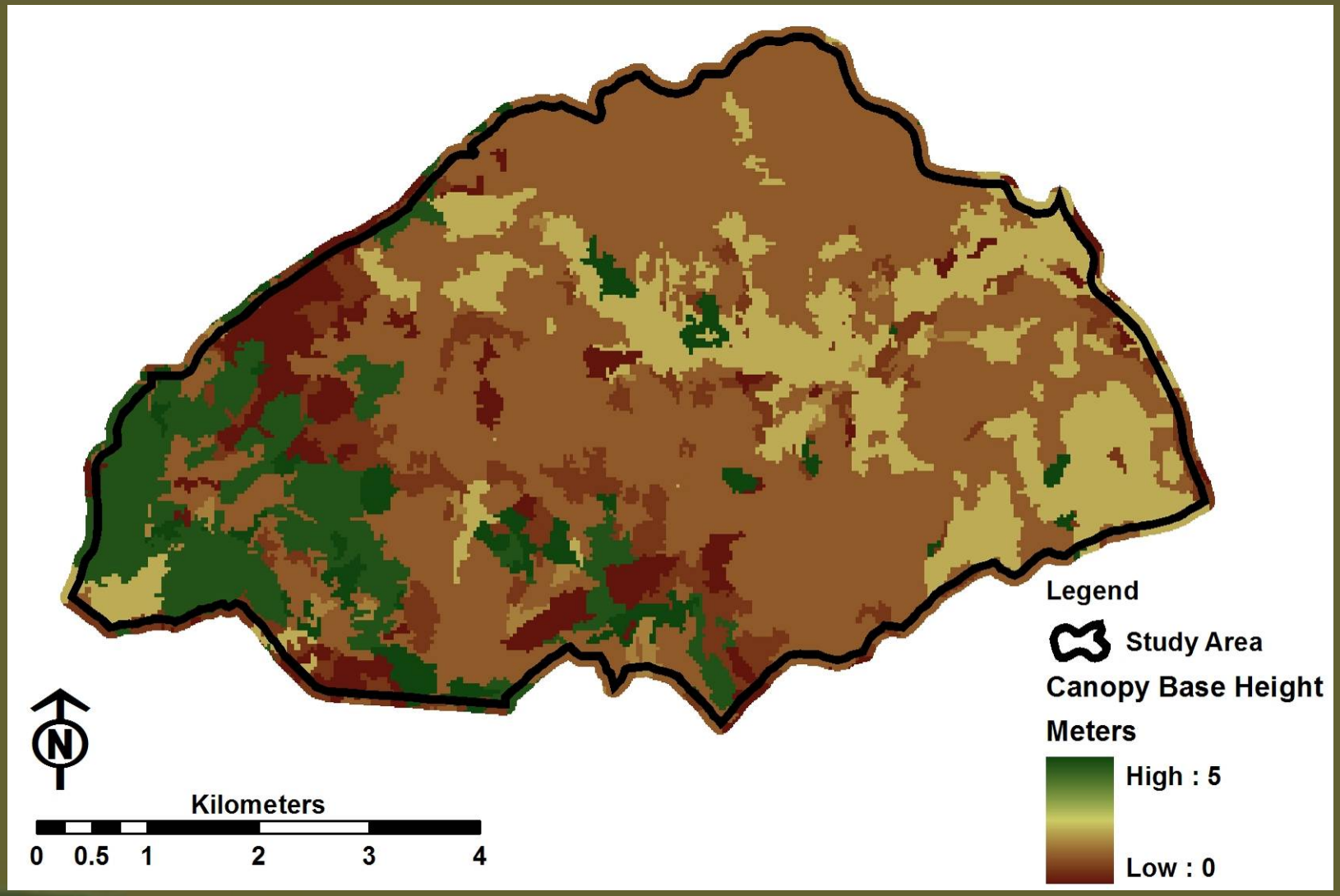
USFS: Canopy Cover (Percent)



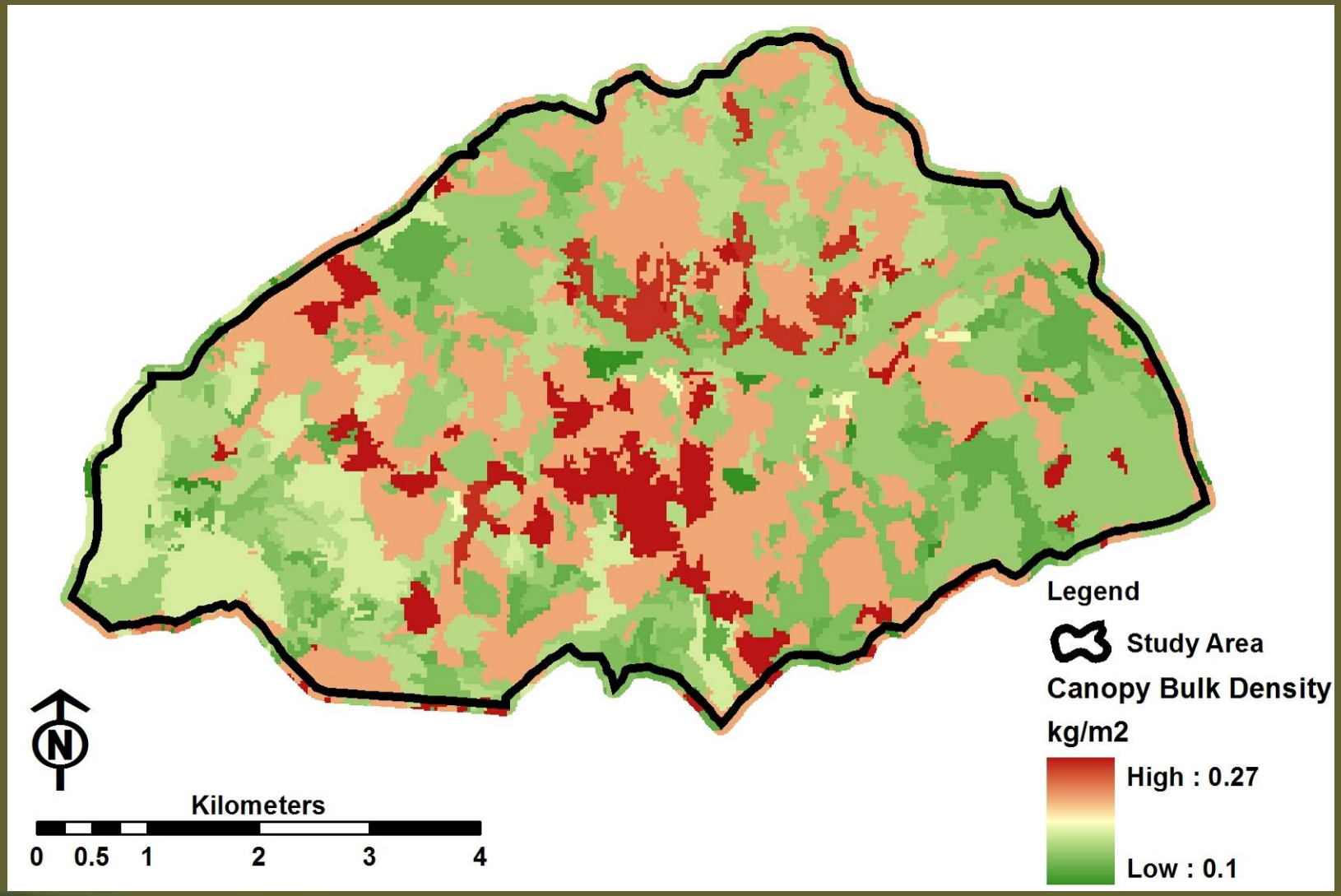
USFS: Stand Height (meters)



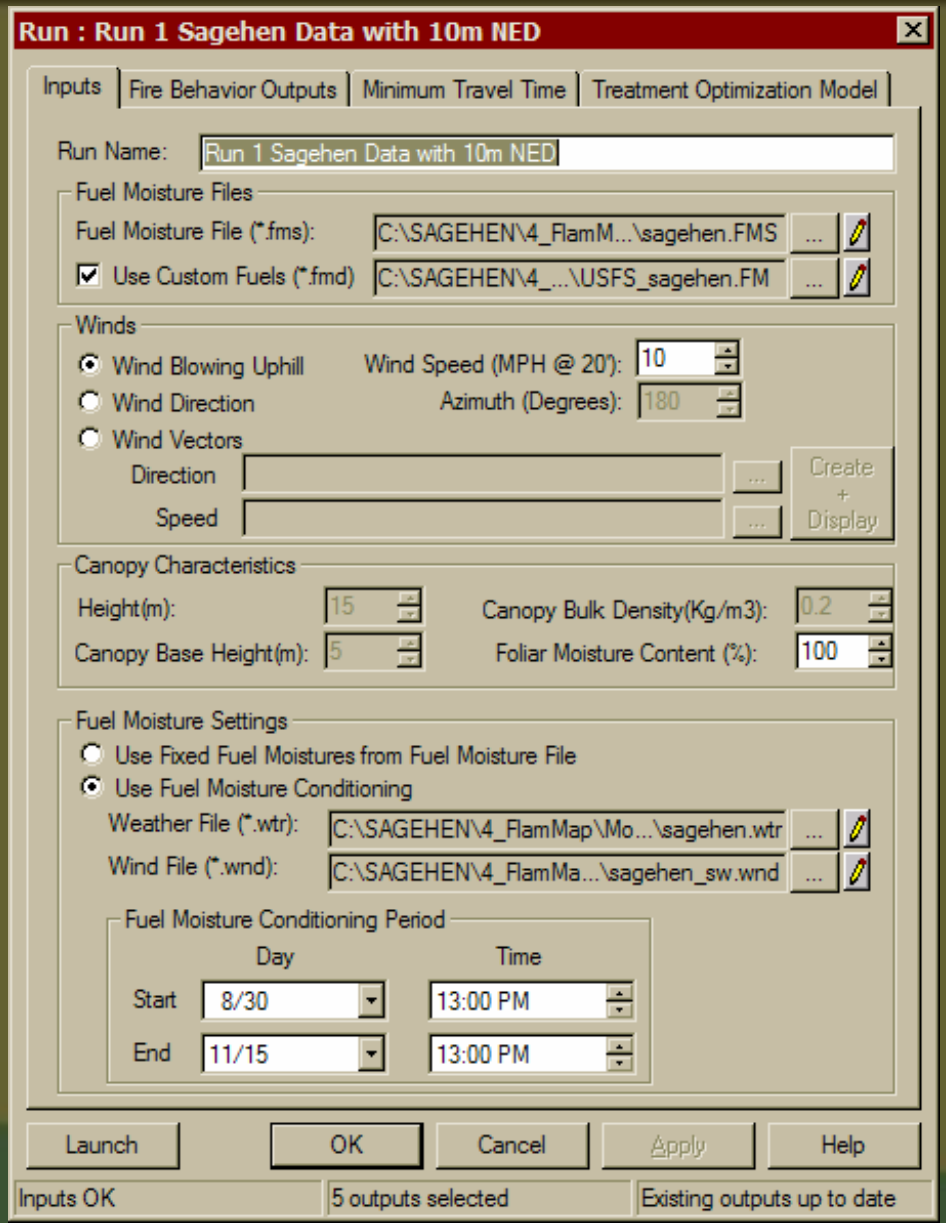
USFS: Canopy Base Height (Percent)



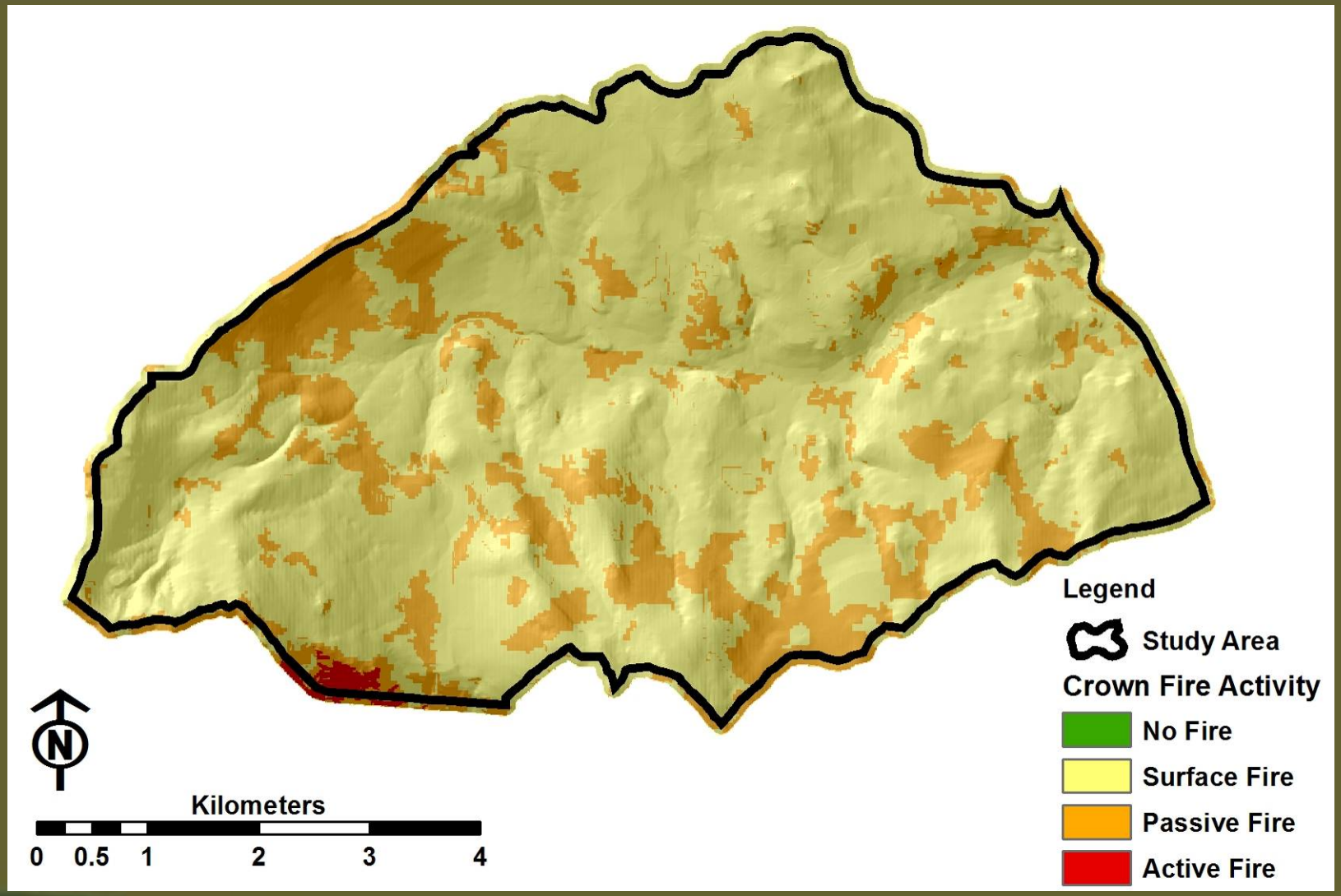
USFS: Canopy Bulk Density (Percent)



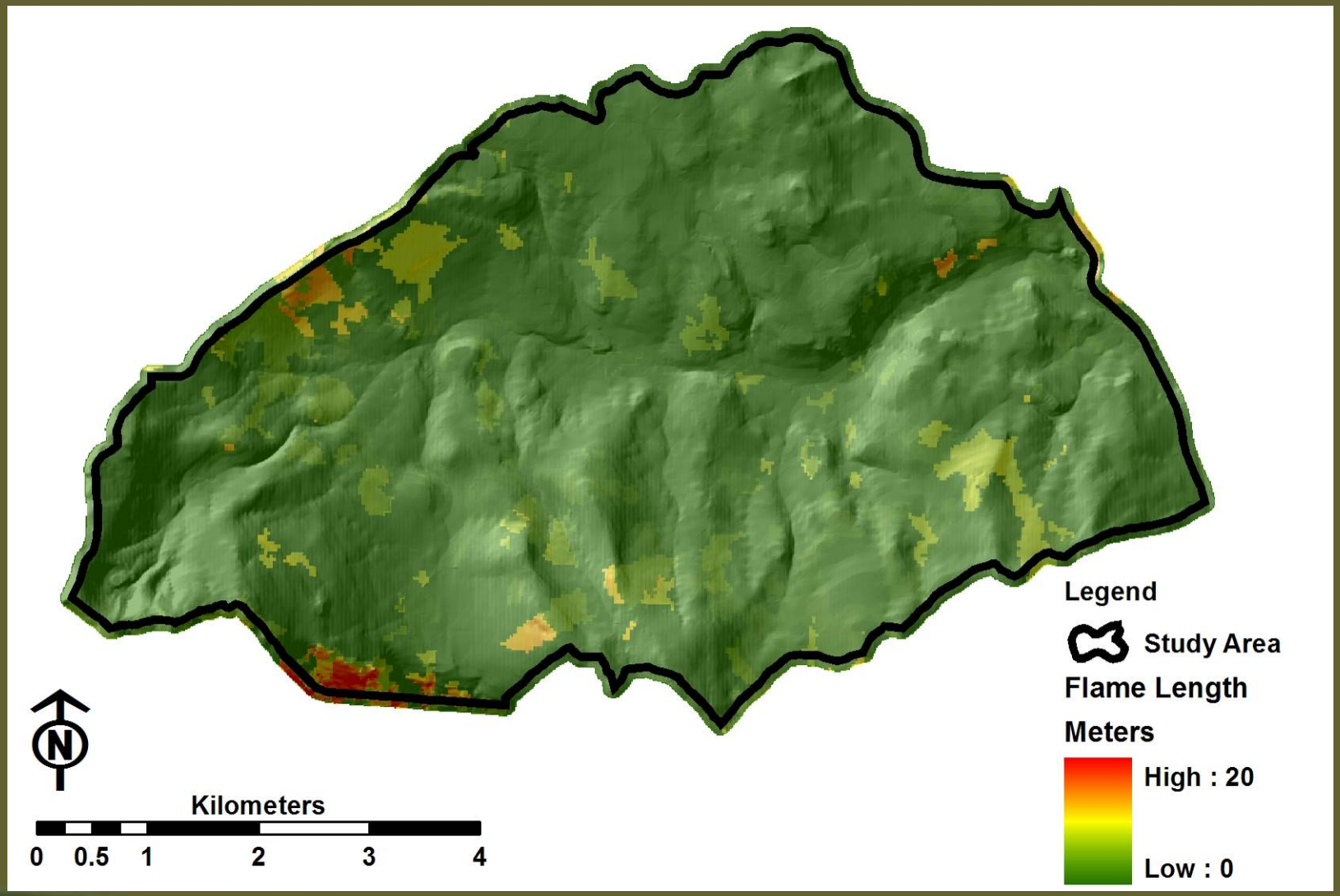
RESULTS: RUN1 (Baseline)



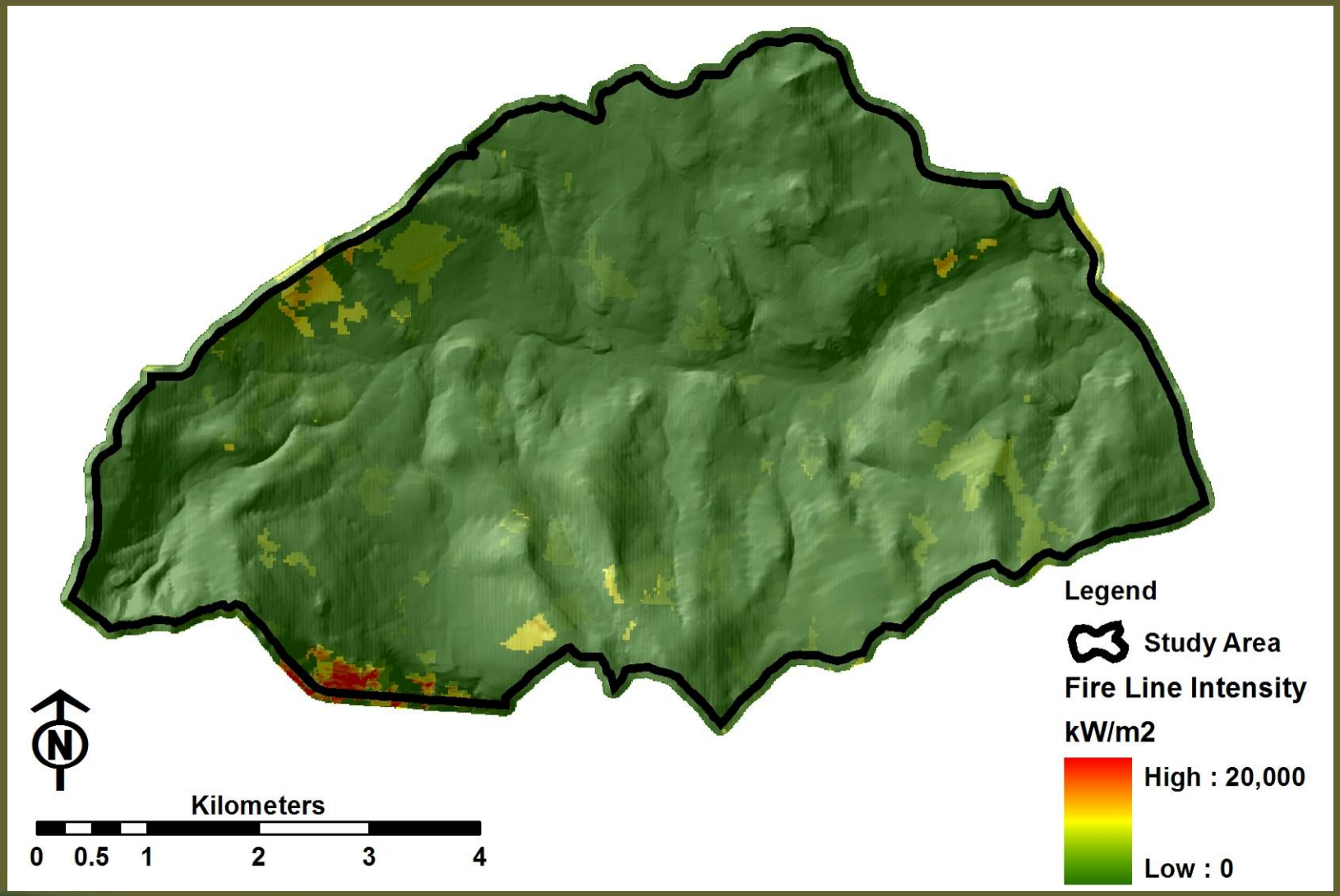
RESULTS: RUN1 (Baseline)
Crown Fire Activity



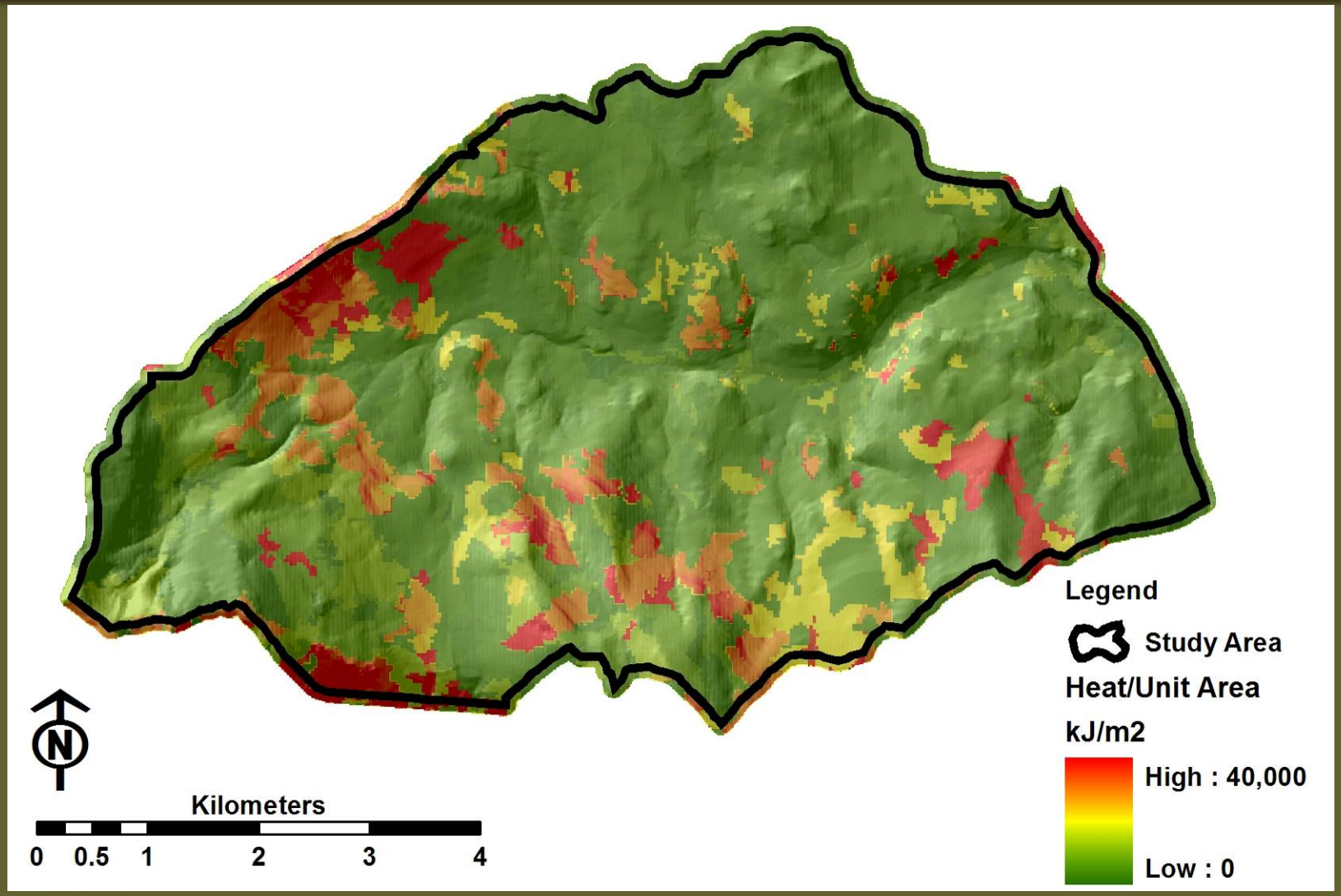
RESULTS: RUN1 (Baseline)
Flame Length



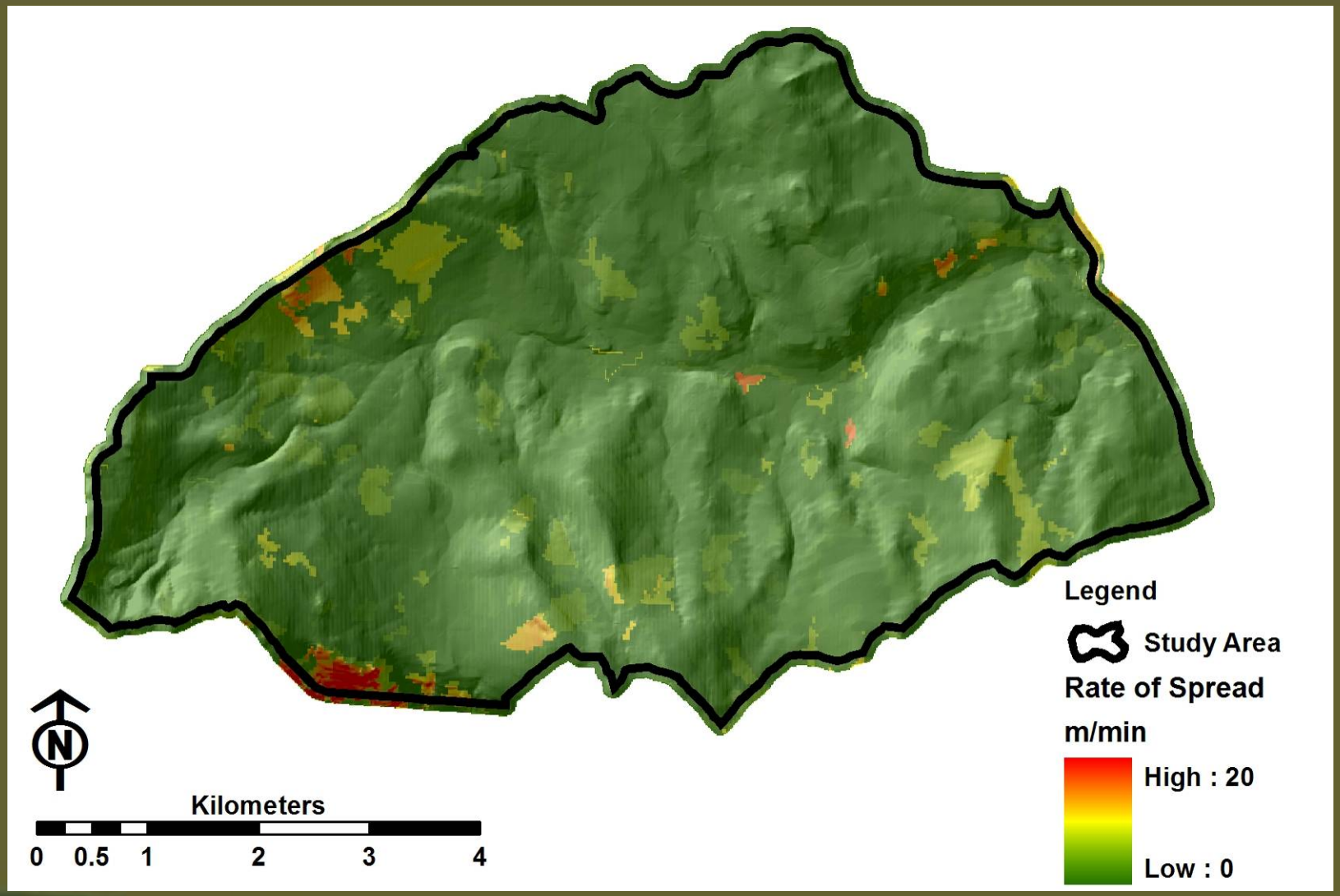
RESULTS: RUN1 (Baseline)
Fire Line Intensity



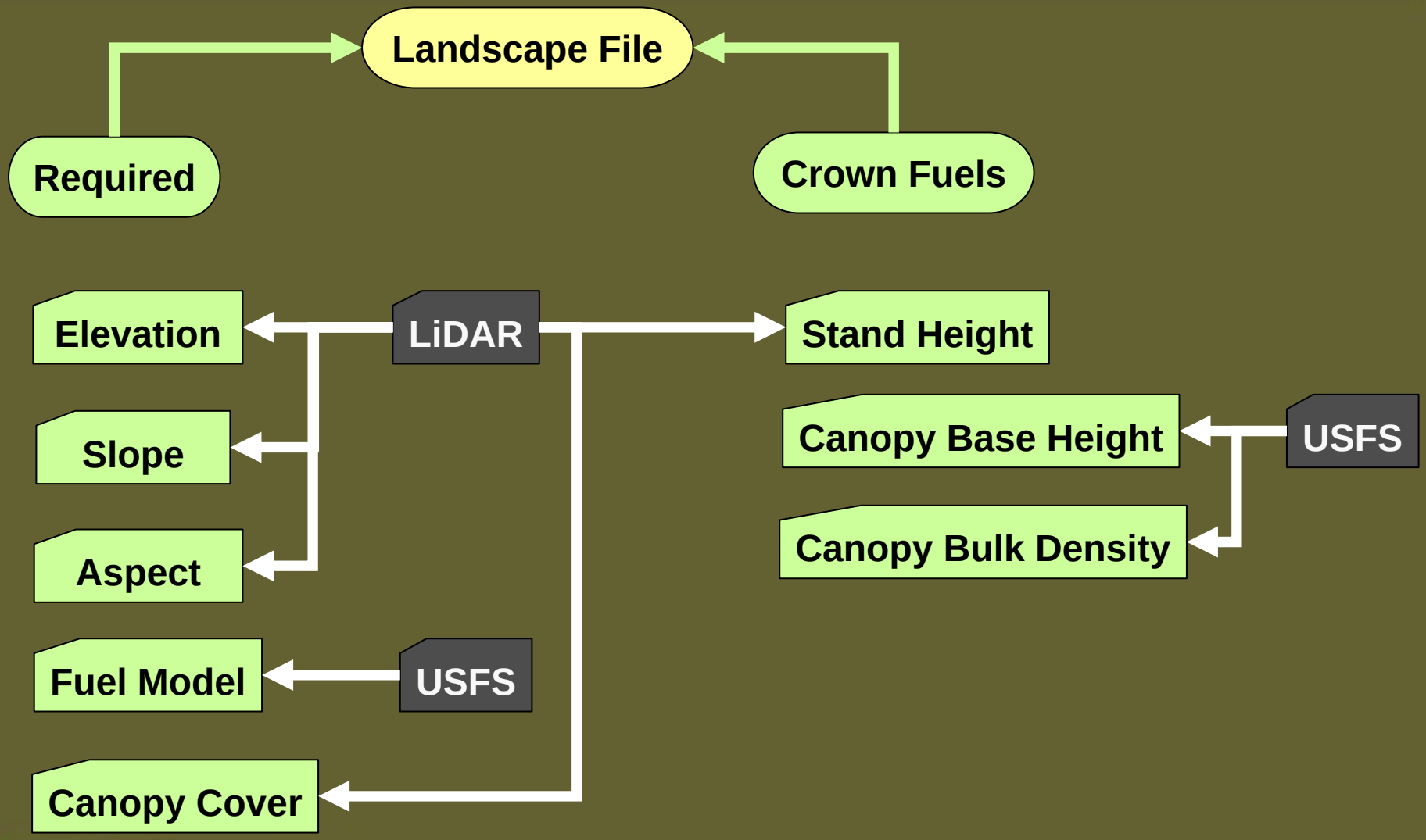
RESULTS: RUN1 (Baseline)
Heat / Unit Area



RESULTS: RUN1 (Baseline)
Rate of Spread



INPUT: Run2 (Terrain)



What is LiDAR?

- LIght Detection And Ranging

- **It is a rapidly emerging technology for determining the shape of the ground surface plus natural and man-made features.**

- **LiDAR is similar to the more familiar radar, and can be thought of as a laser radar.**

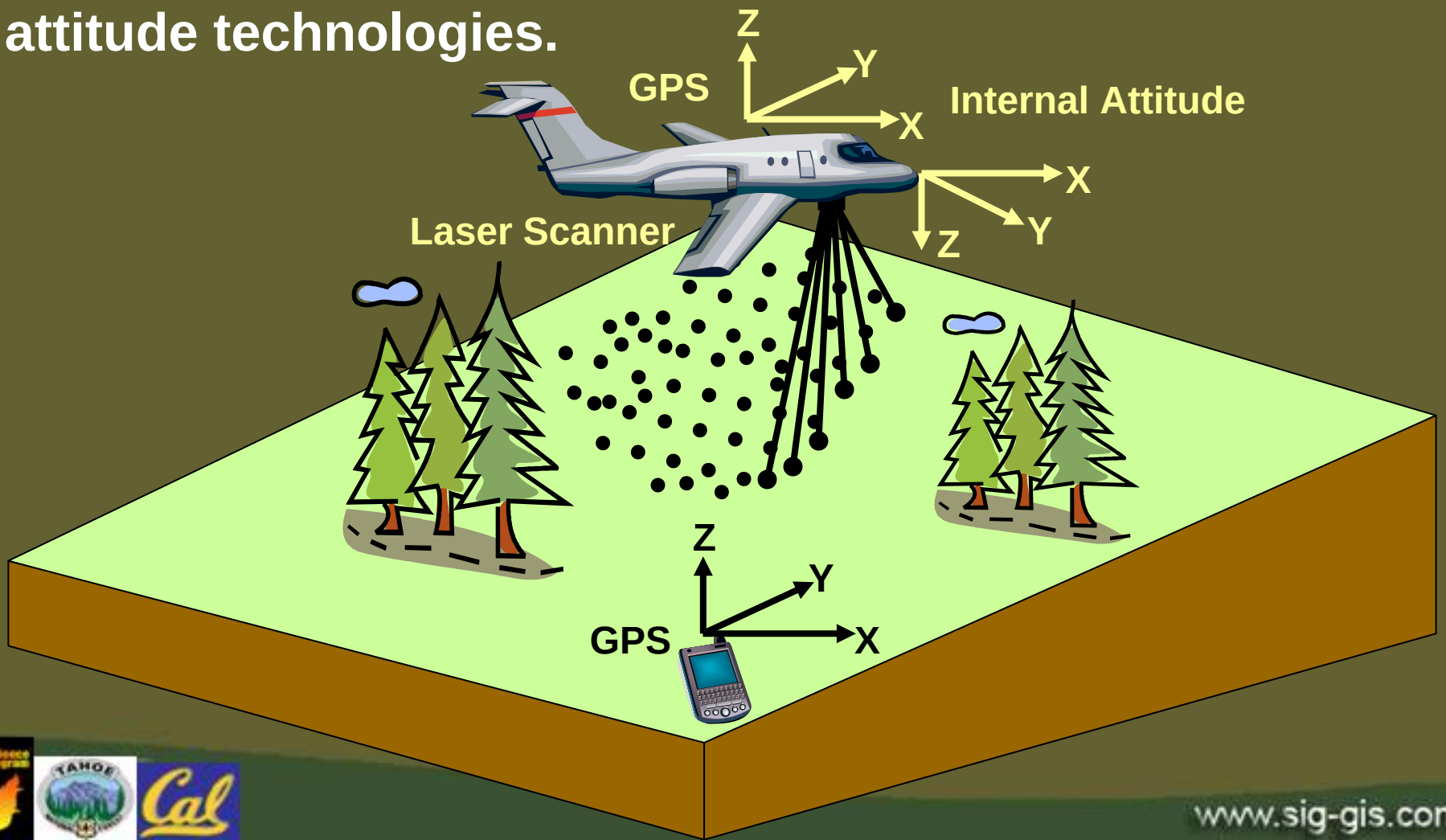
What is LiDAR?

- **RADAR:** radio waves are transmitted into the atmosphere, which scatters some of the power back to the radar's receiver.

- **LIDAR** also transmits and receives electromagnetic radiation, but at a higher frequency. LIDAR operates in the <u>ultraviolet, visible & infrared</u> region of the electromagnetic spectrum.

How does LiDAR work?

- **Collects multiple layer X, Y, Z & Intensity data by merging laser ranging, GPS positioning, and inertial attitude technologies.**



What is LiDAR Intensity?

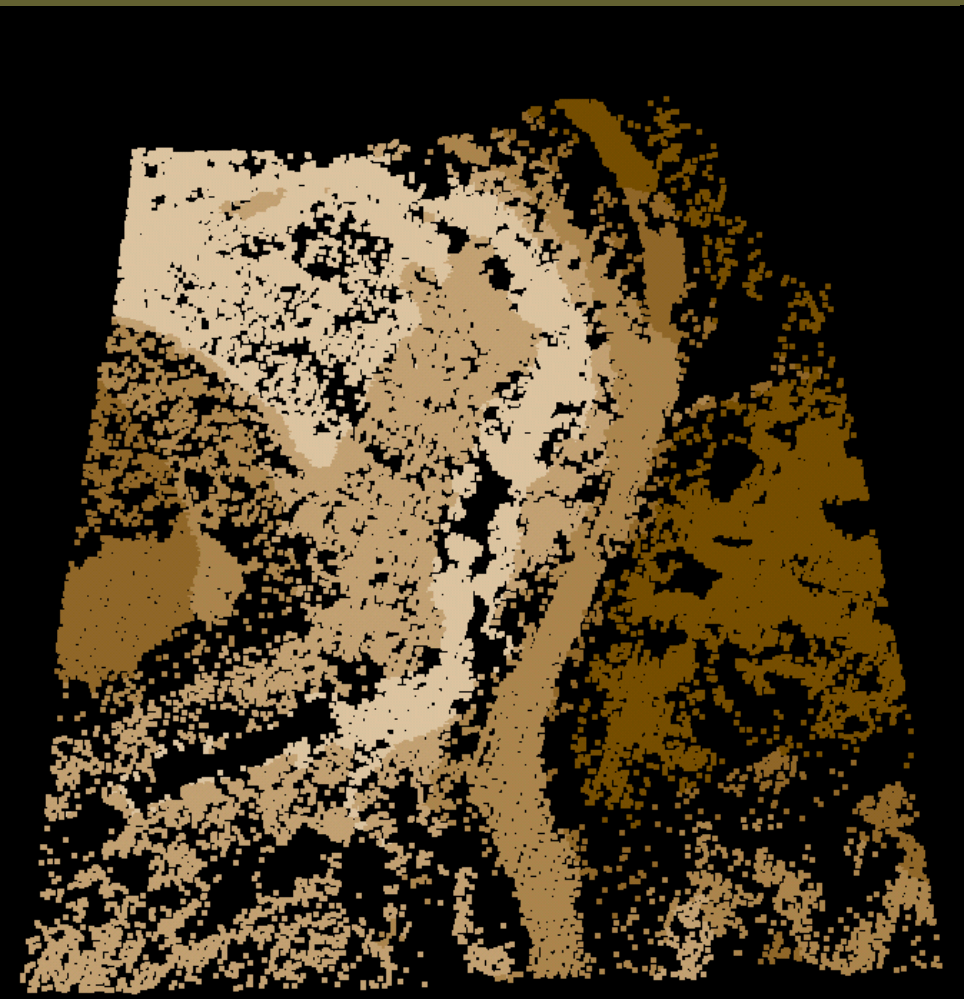
- The Percentage of Infra-Red Reflectance from each Return (Echo)
- Not to be Considered the Same as an Image Flown with IR Film
- Directly Georeferenced and Ortho-metric
- Captured in 3D

LiDAR: NIR Reflectivity Examples

- White Paper up to 100%
- Snow 80-90%
- Beer Foam 88%
- Toilet Paper 60%
- Deciduous Trees~ 60%
- Coniferous Trees ~ 30%
- Dry Sand 57%
- Wet Sand 41%
- Asphalt with Pebbles 17%
- Black Neoprene 5%
- Clear Water< 5%

LiDAR Data: Z Points

Bald Earth: Last Pulse



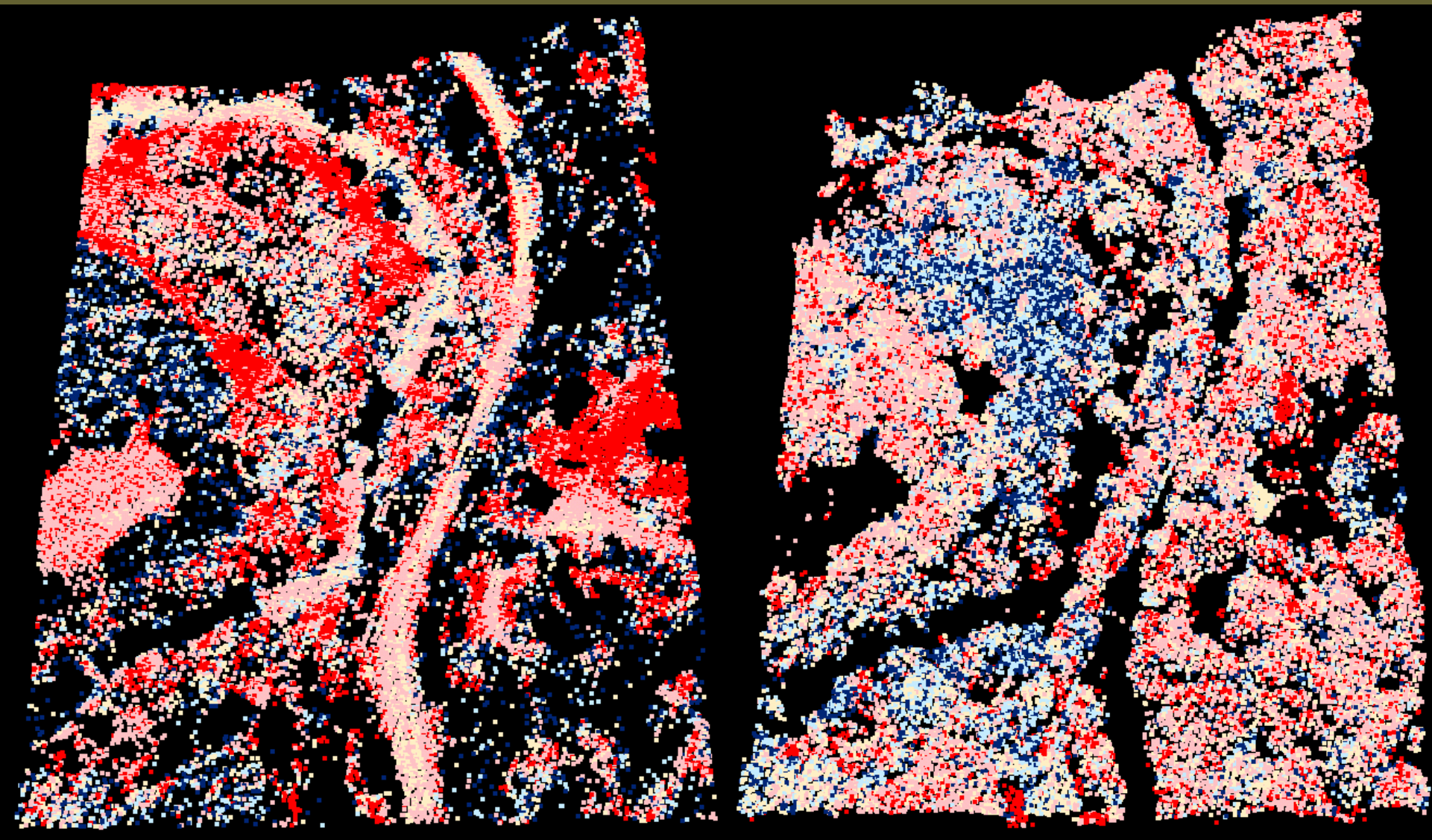
Extracted Feature: First Pulse

LiDAR Data: Intensity Points

Intensity
- 0.100000 - 0.500000
- 0.500001 - 1.000000
- 1.000001 - 2.000000
- 2.000001 - 4.000000
- 4.000001 - 8.000000

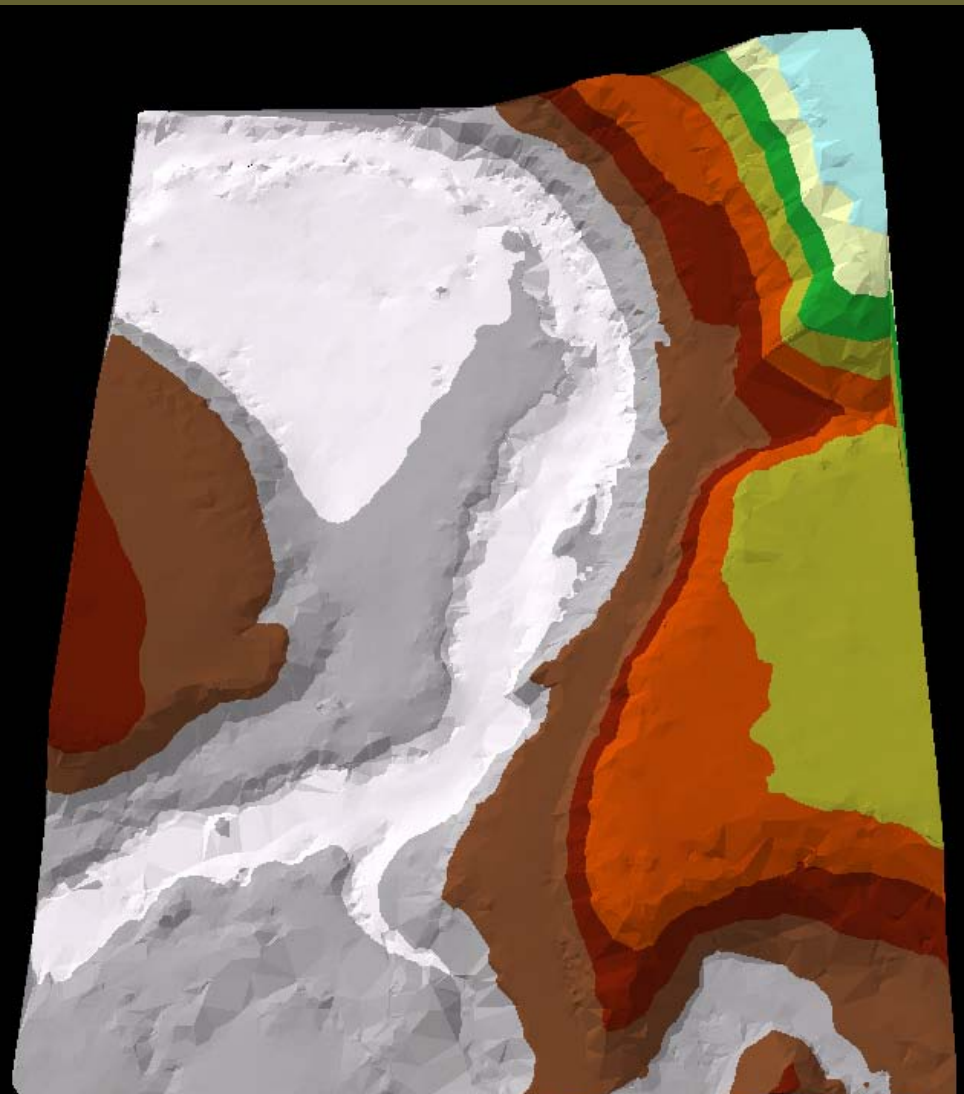
Bald Earth: Last Pulse

Extracted Feature: First Pulse

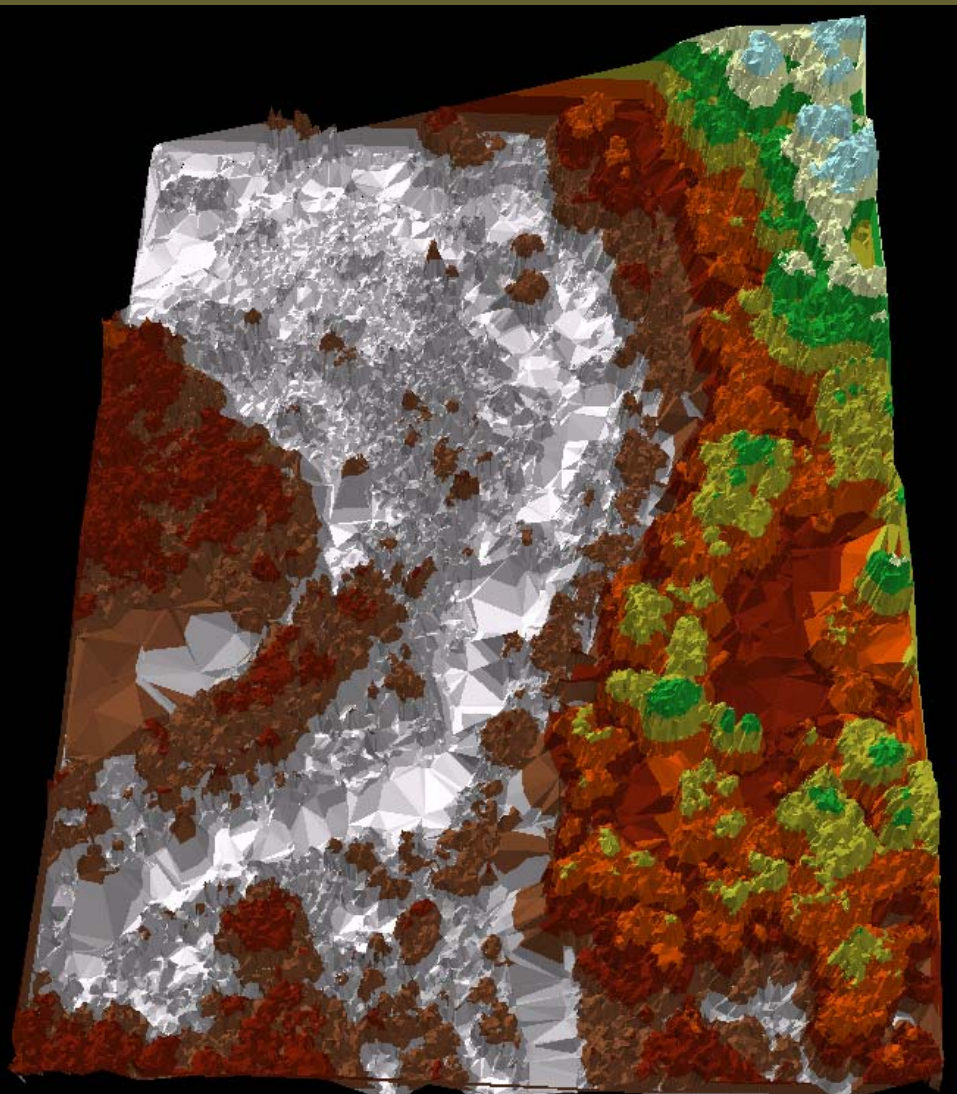


LiDAR Data: Surface

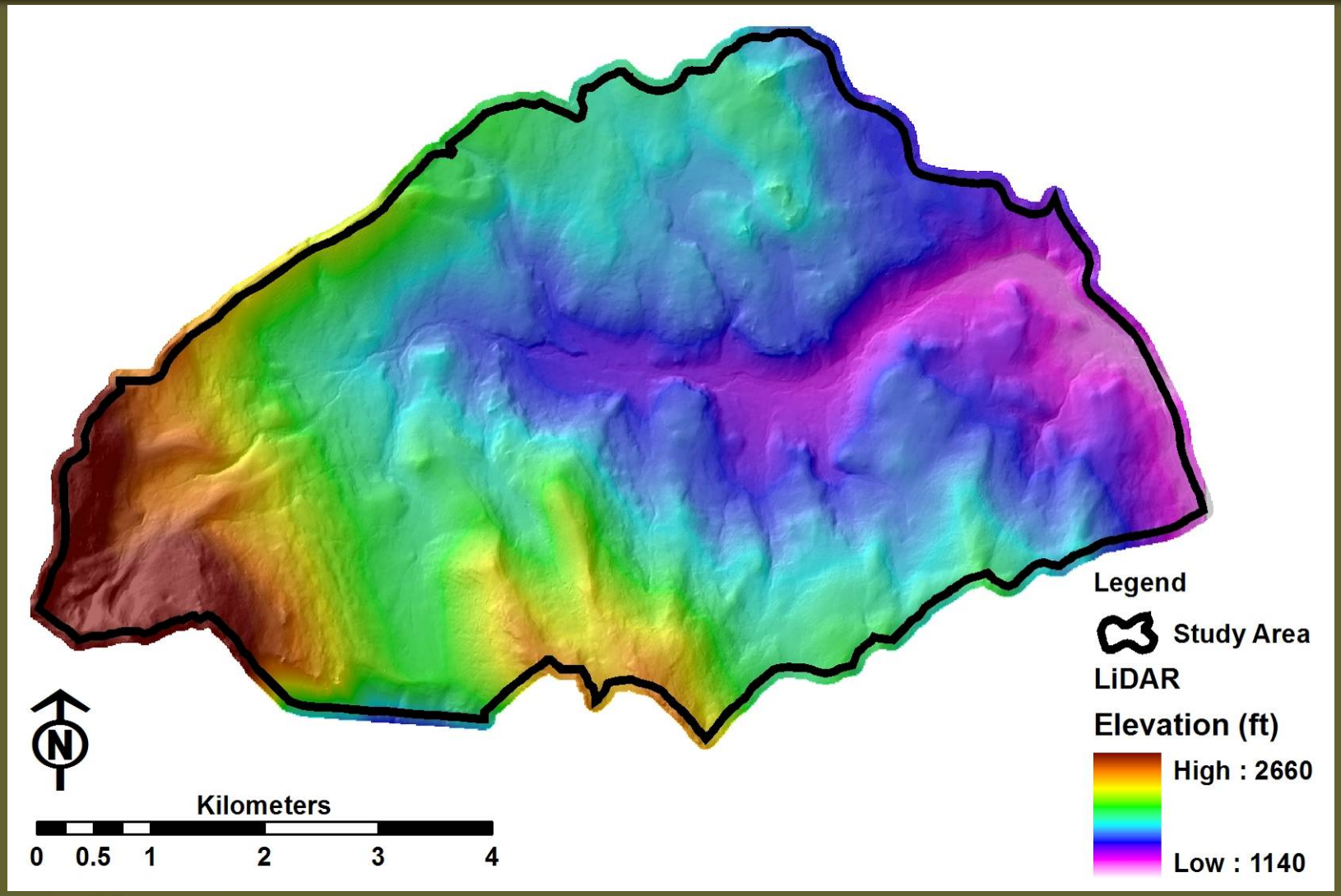
Bald Earth: Last Pulse



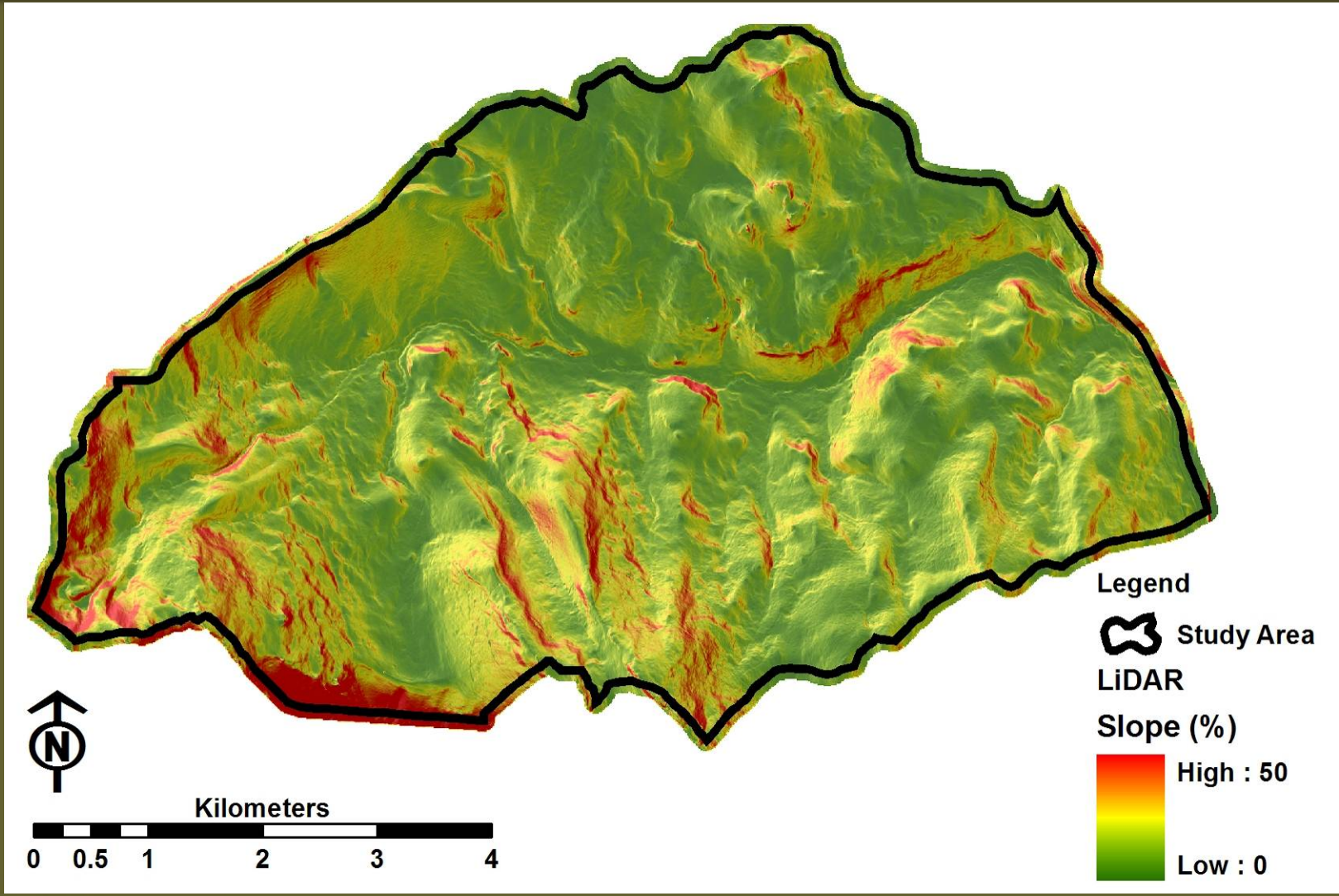
Extracted Feature: First Pulse



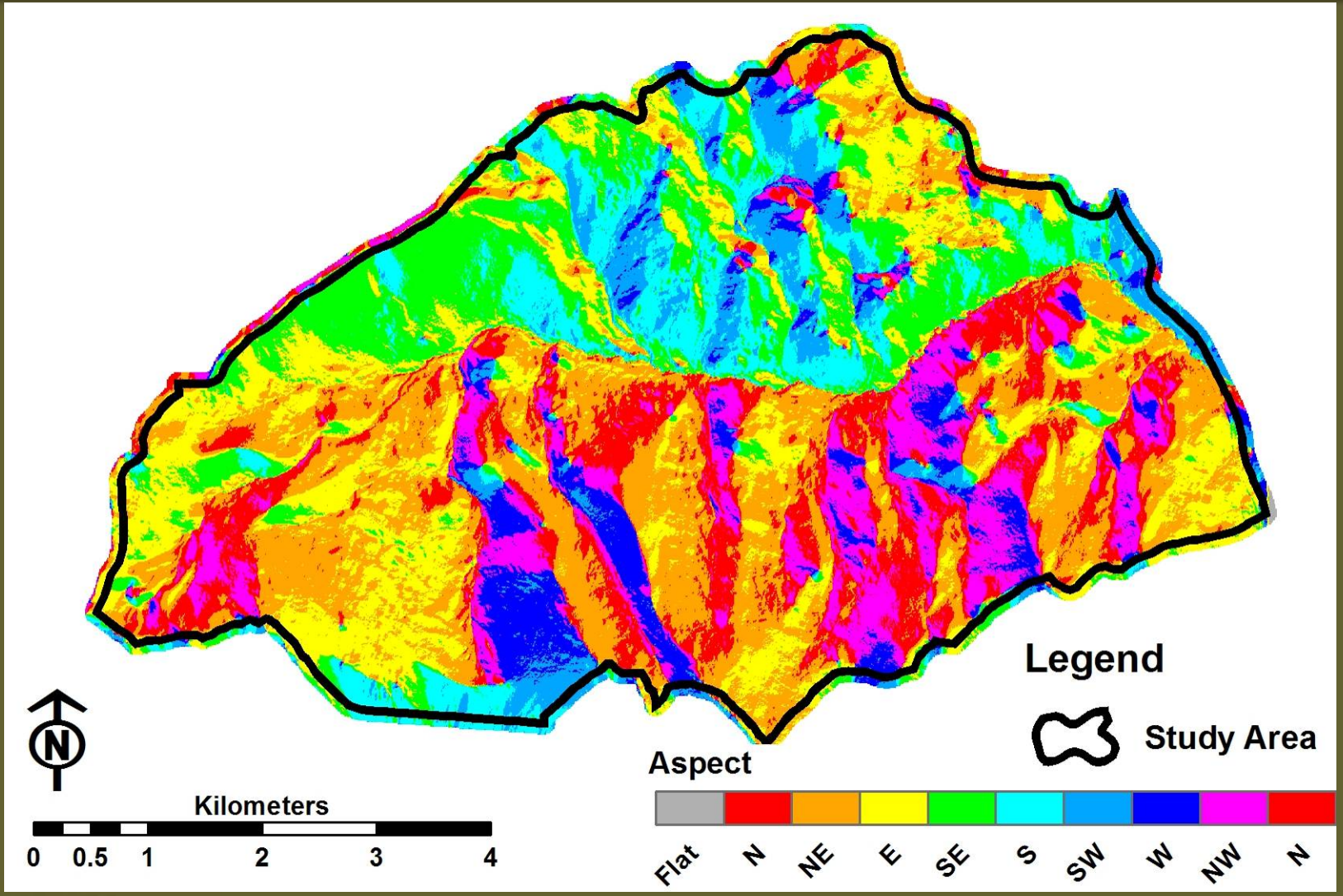
LiDAR 5m: Elevation (ft)



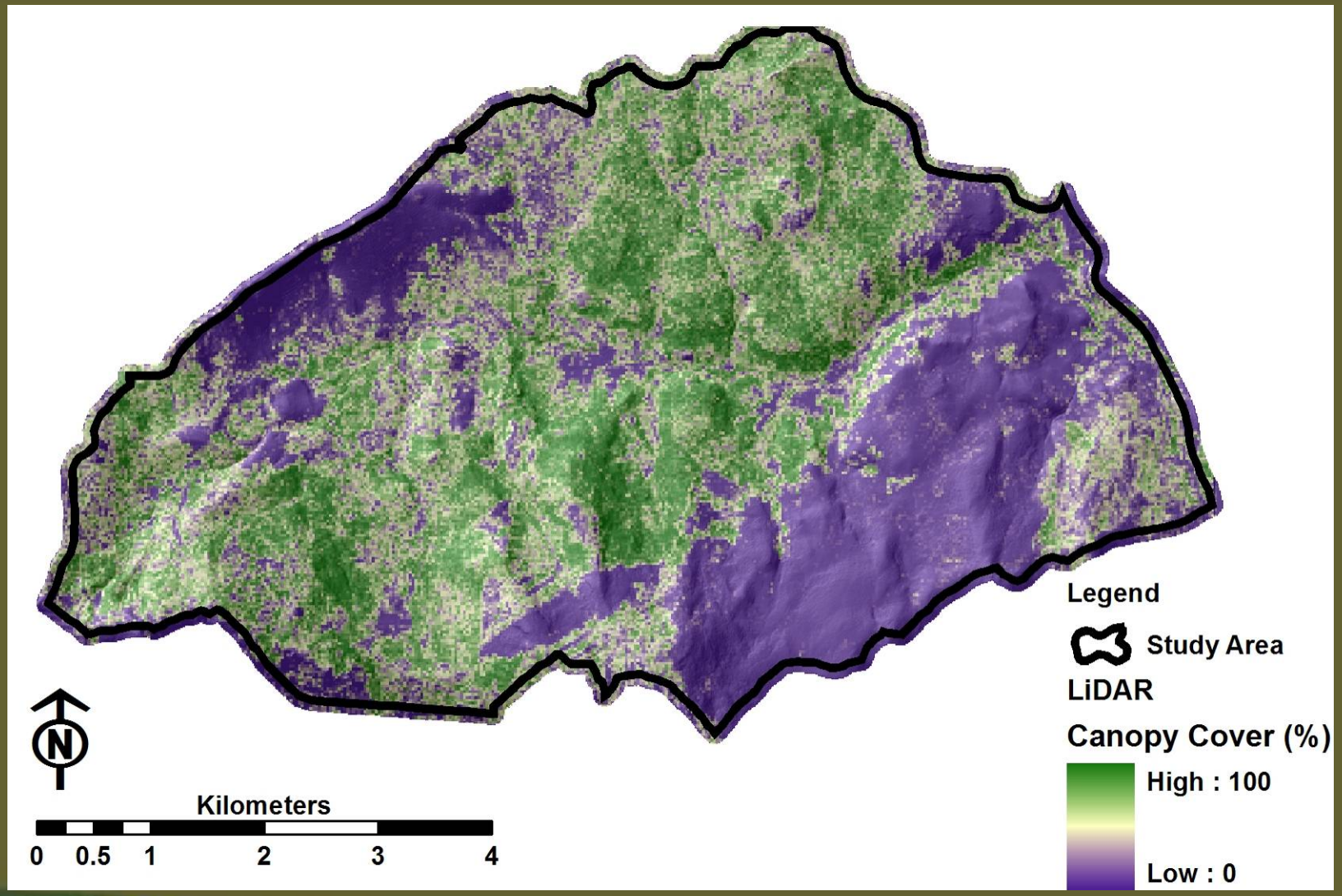
LiDAR 5m: Slope (Percent)



LiDAR 5m: Aspect (degrees)



LiDAR 5m: Canopy Cover (Percent)



Min Stand Height = 15 meters

LiDAR: Fuel Models

(Andersen, et al, 2005)

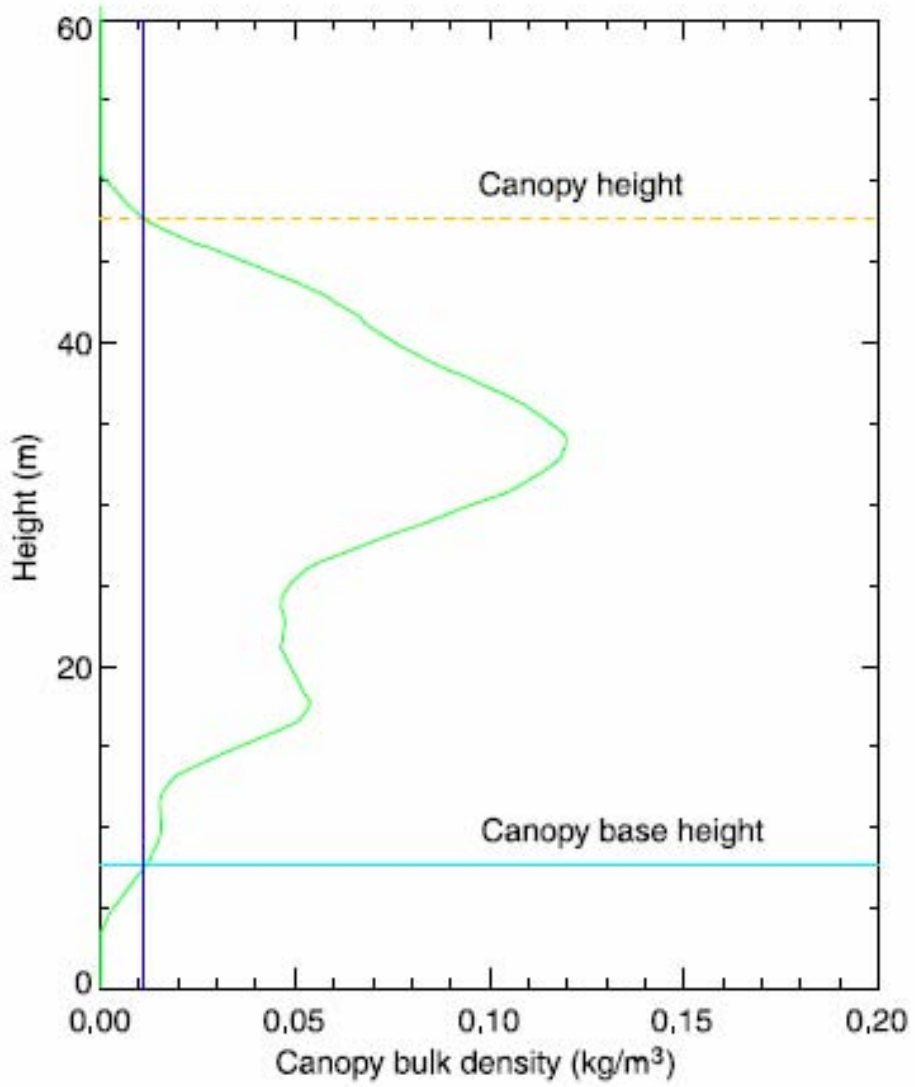
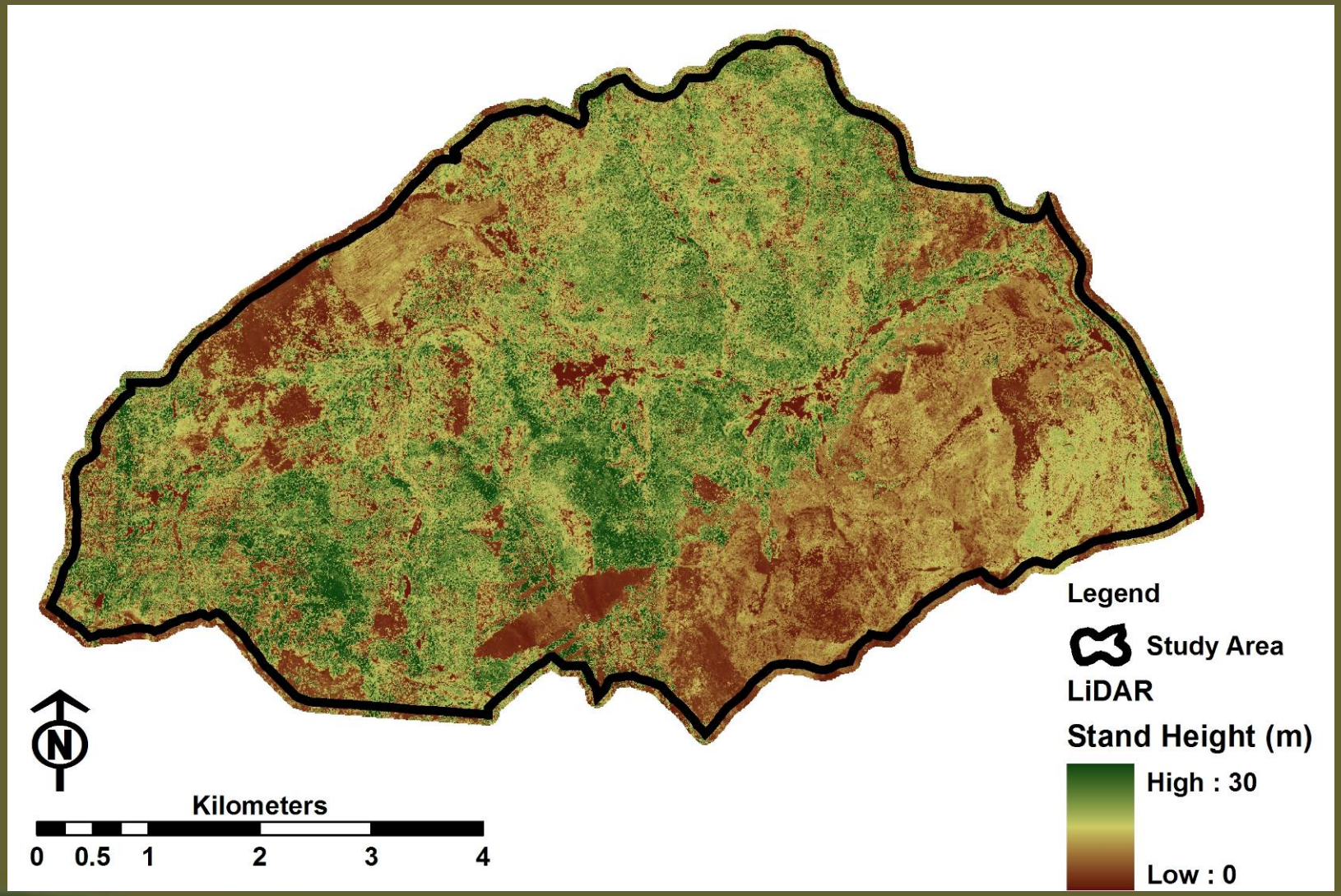
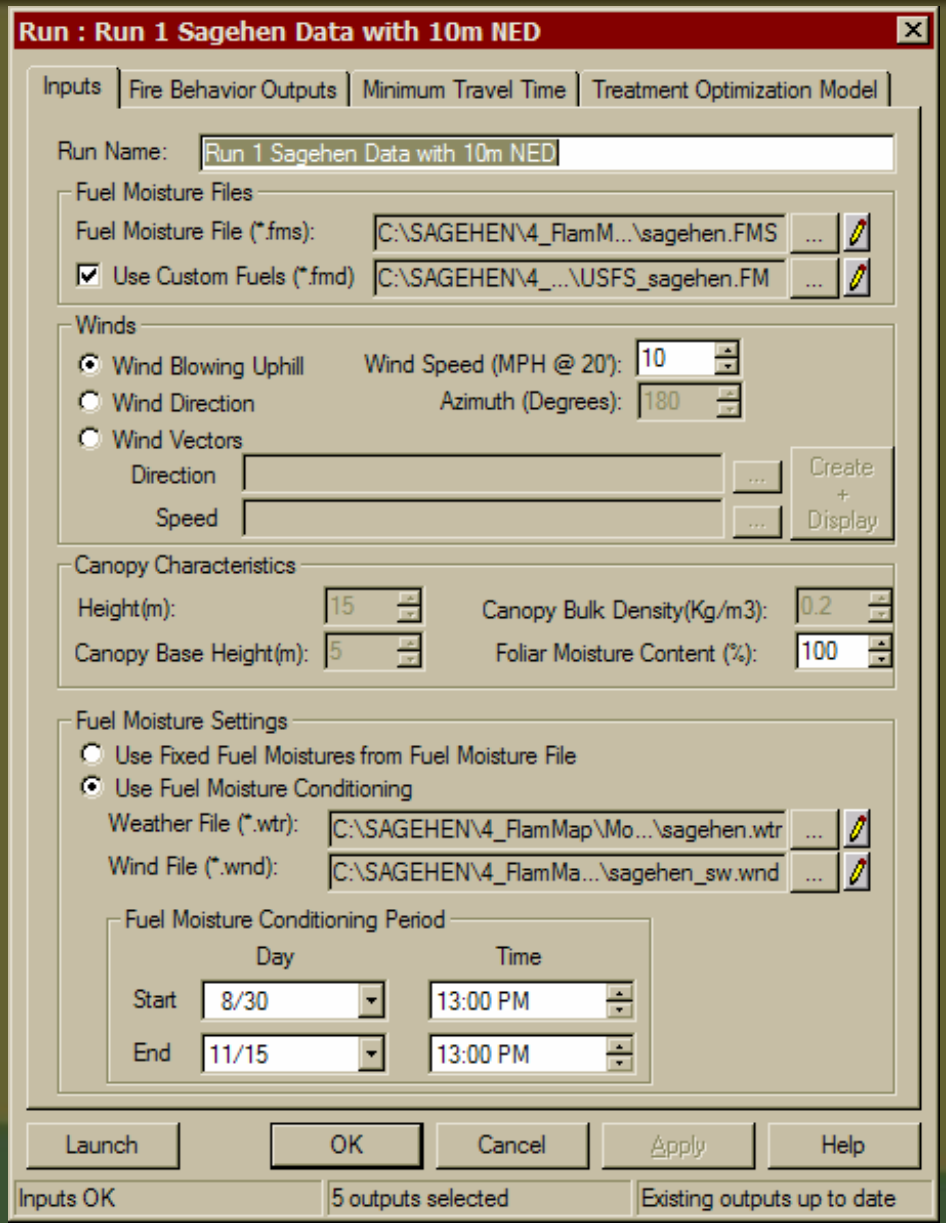


Fig. 2. Estimation of fuel parameters at inventory plot within dense, mature Douglas-fir canopy unit, Capitol Forest study area.

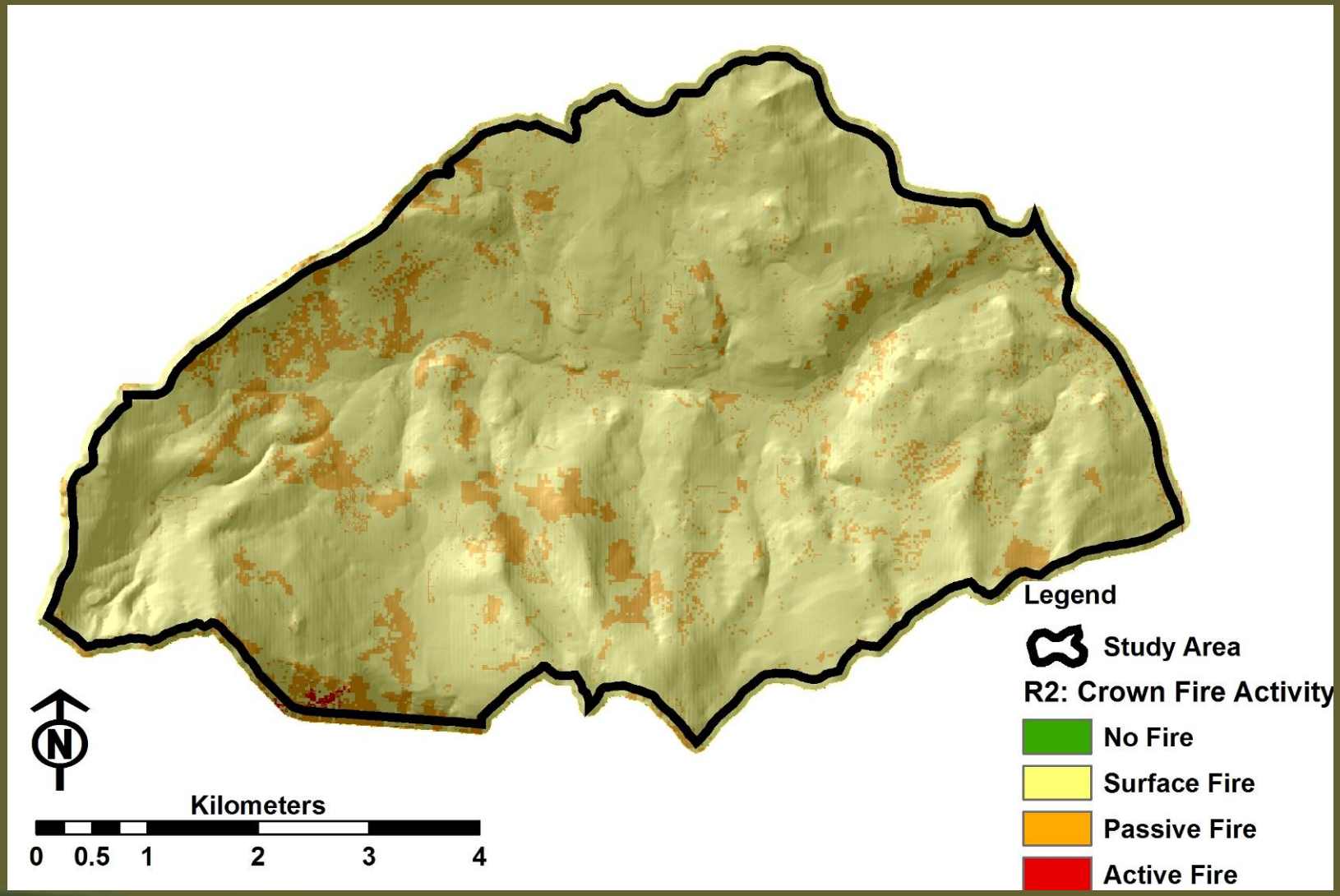
LiDAR 5m: Stand Height (meters)



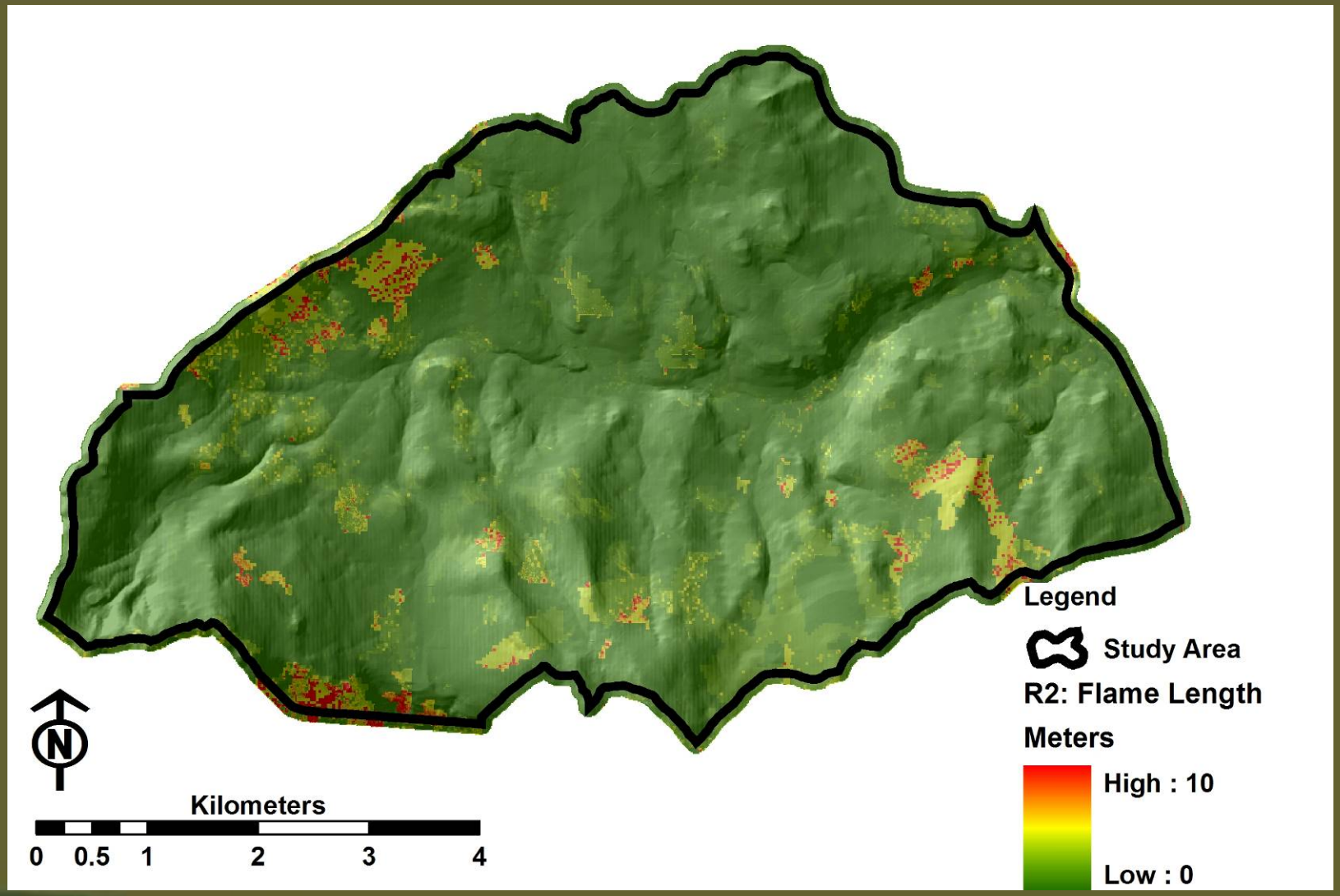
RESULTS: RUN2 (Terrain)



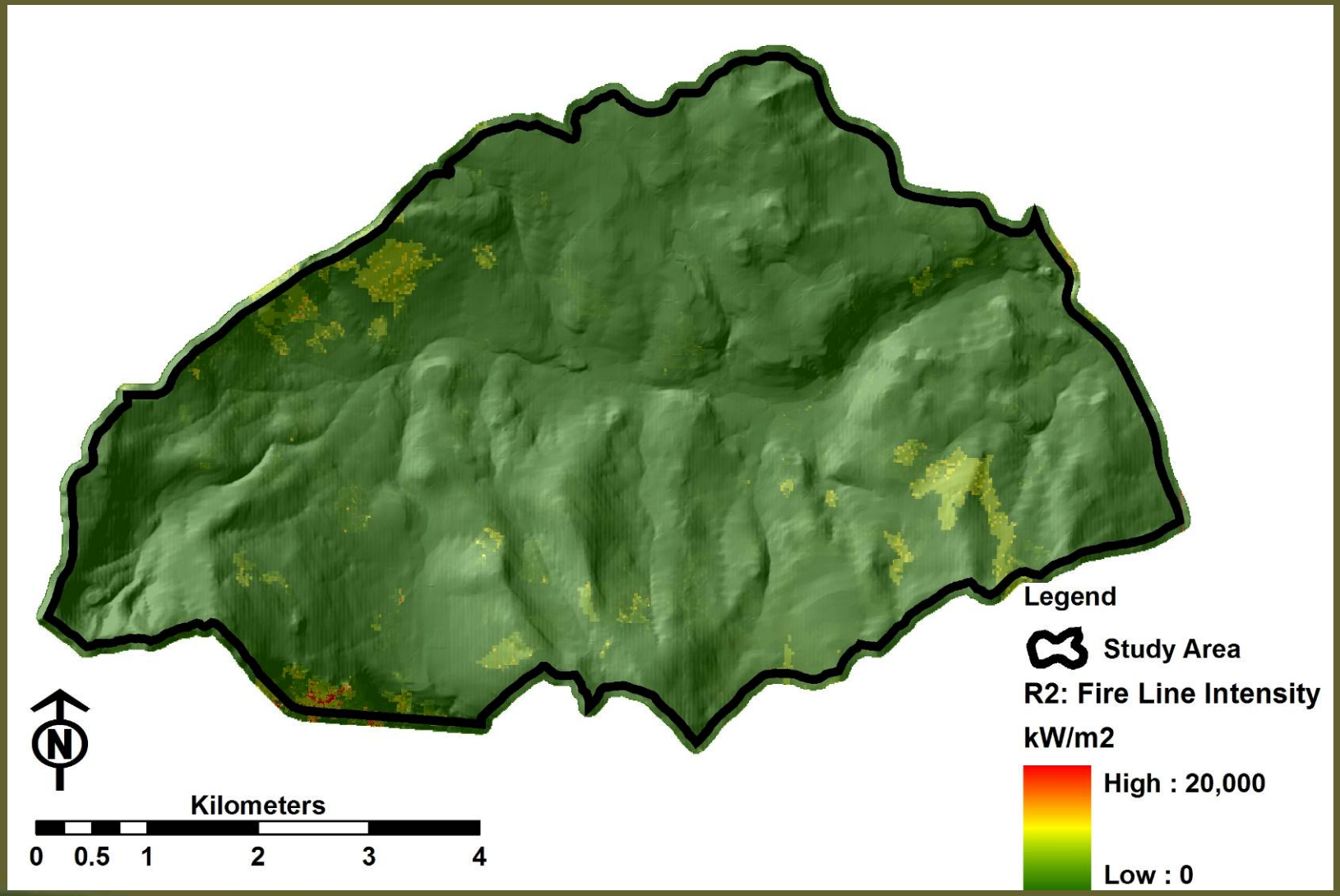
RESULTS: RUN2 (Terrain)
Crown Fire Activity



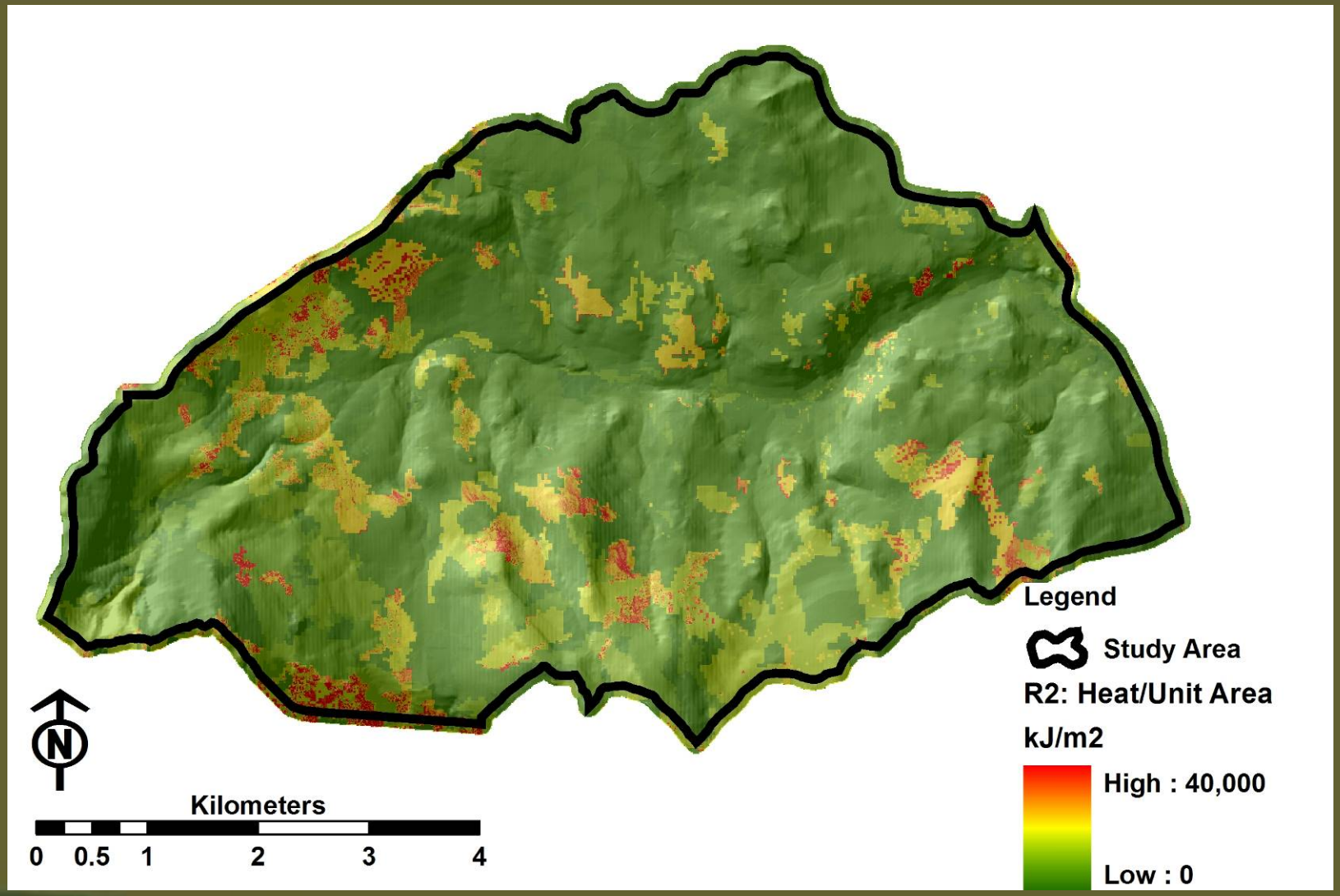
RESULTS: RUN2 (Terrain)
Flame Length



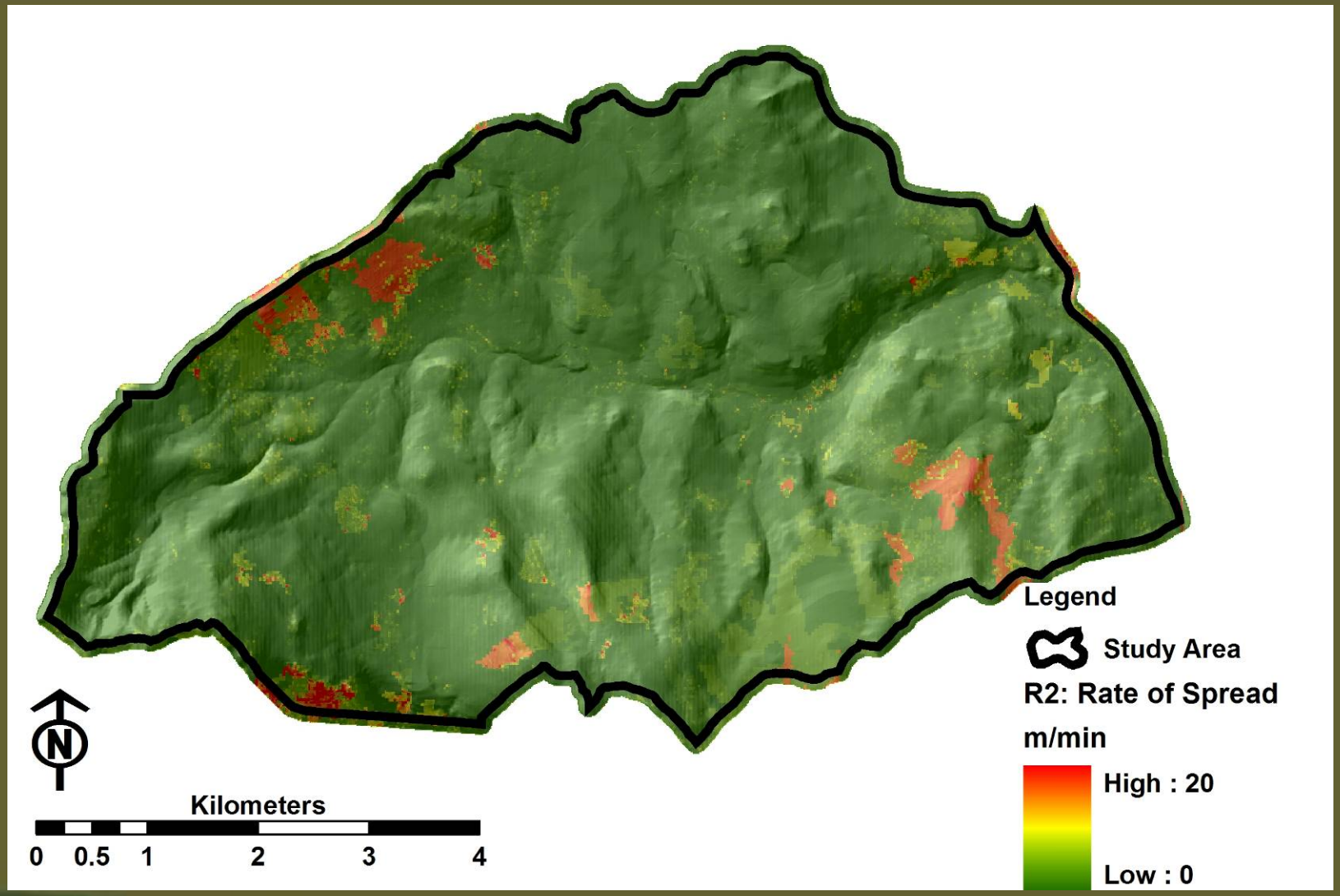
RESULTS: RUN2 (Terrain)
Fire Line Intensity



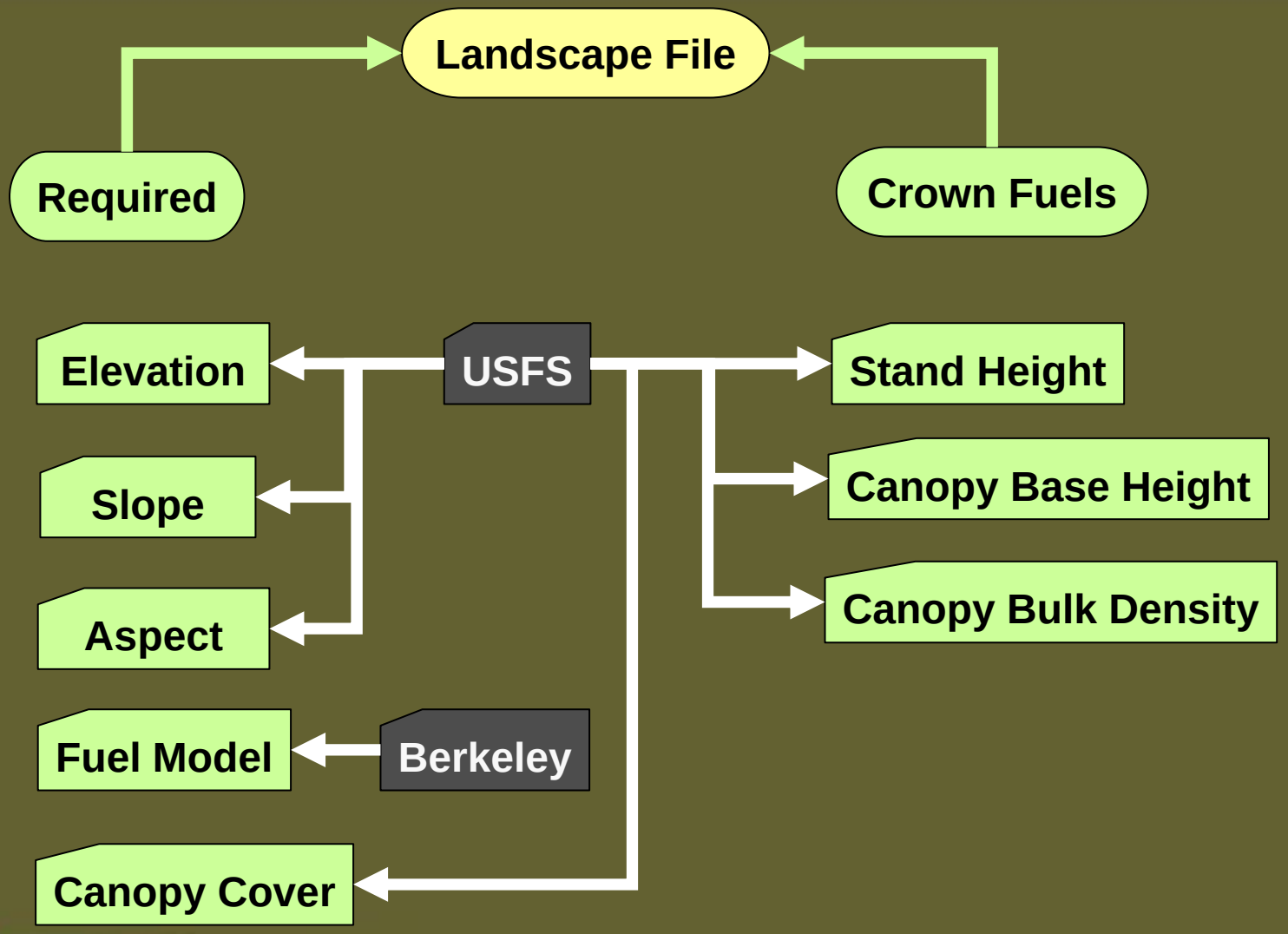
RESULTS: RUN2 (Terrain)
Heat / Unit Area



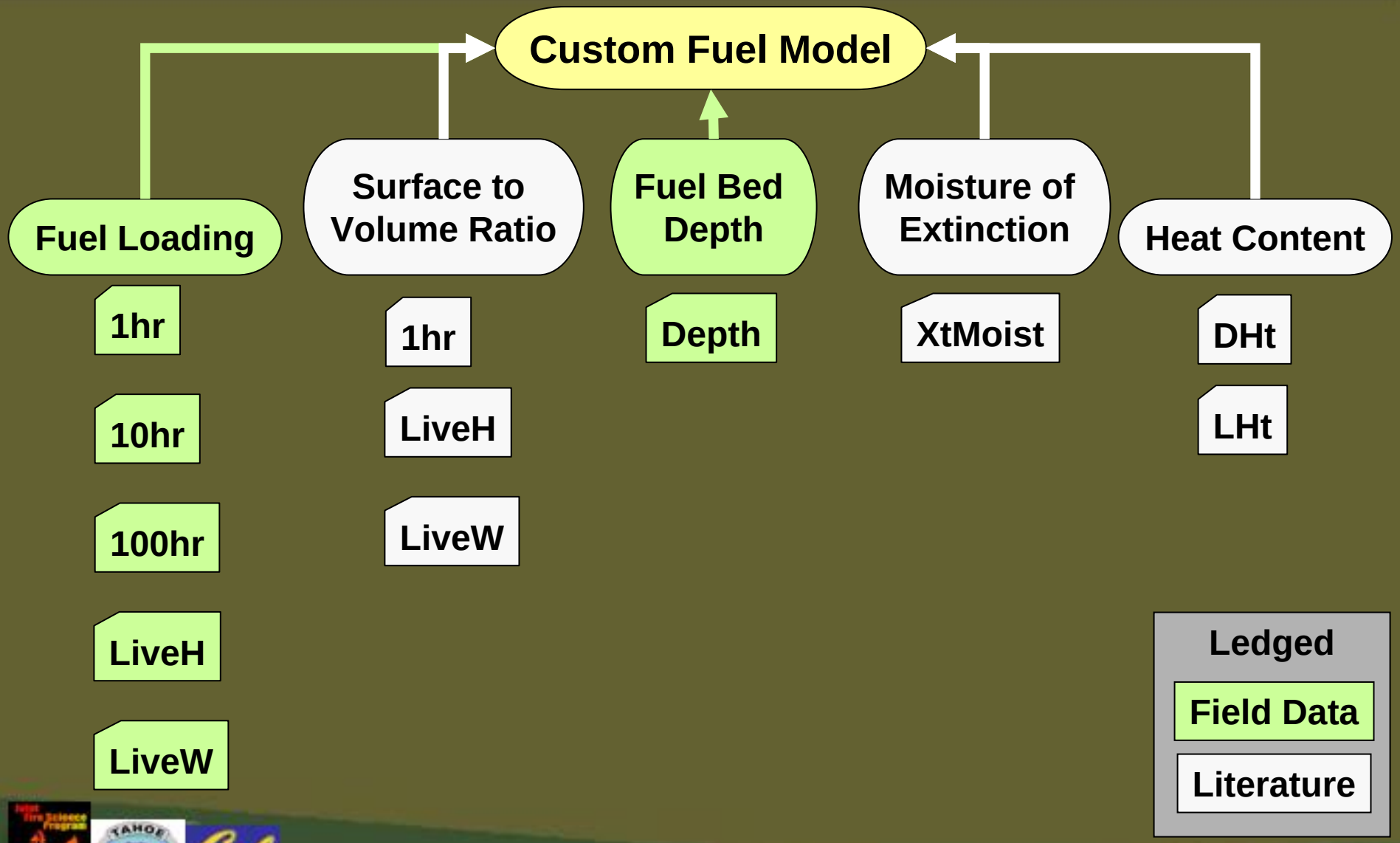
RESULTS: RUN2 (Terrain)
Rate of Spread



INPUT: Run3 (Fuel Model)



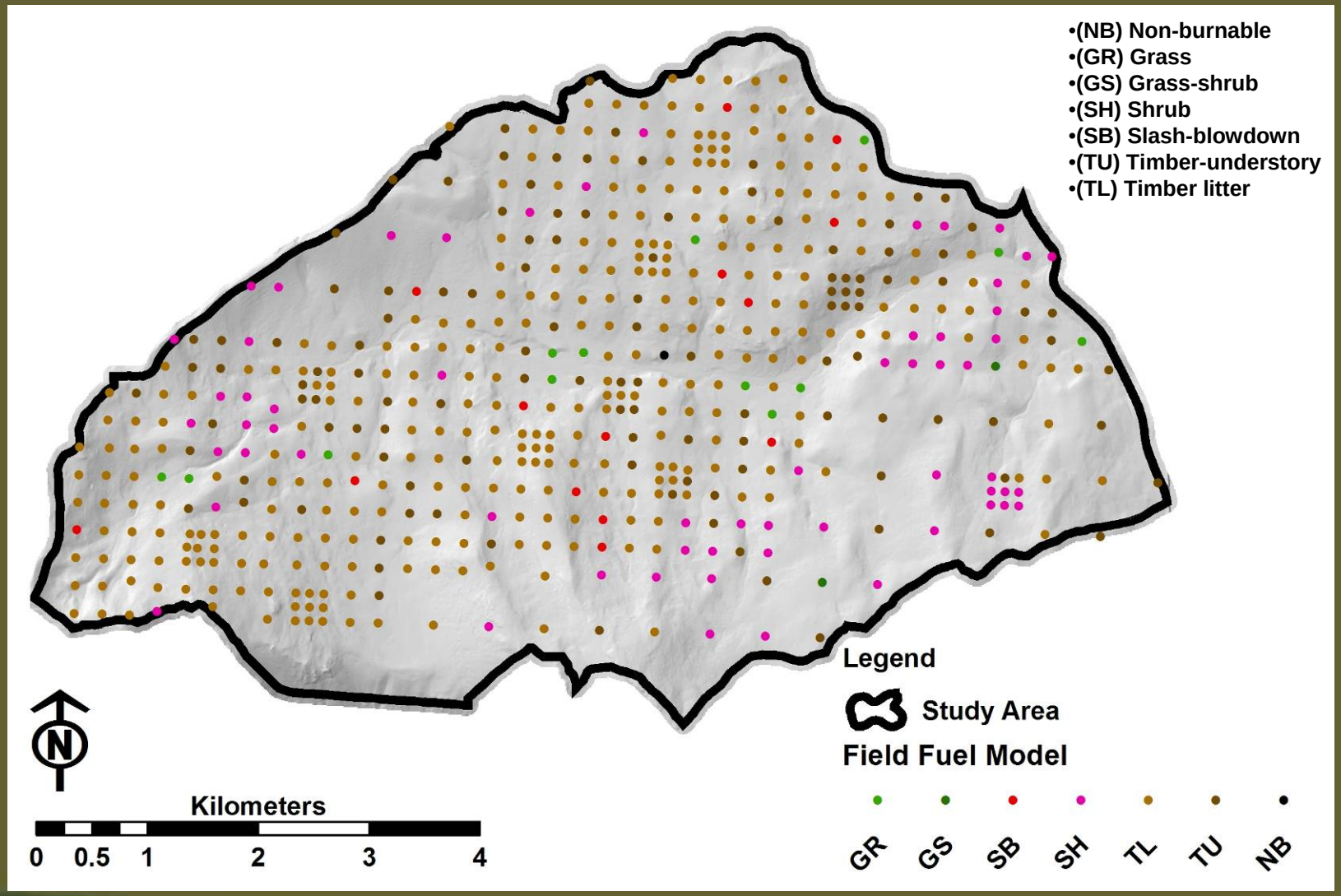
FlamMap Input: Custom Fuel Model Flowchart



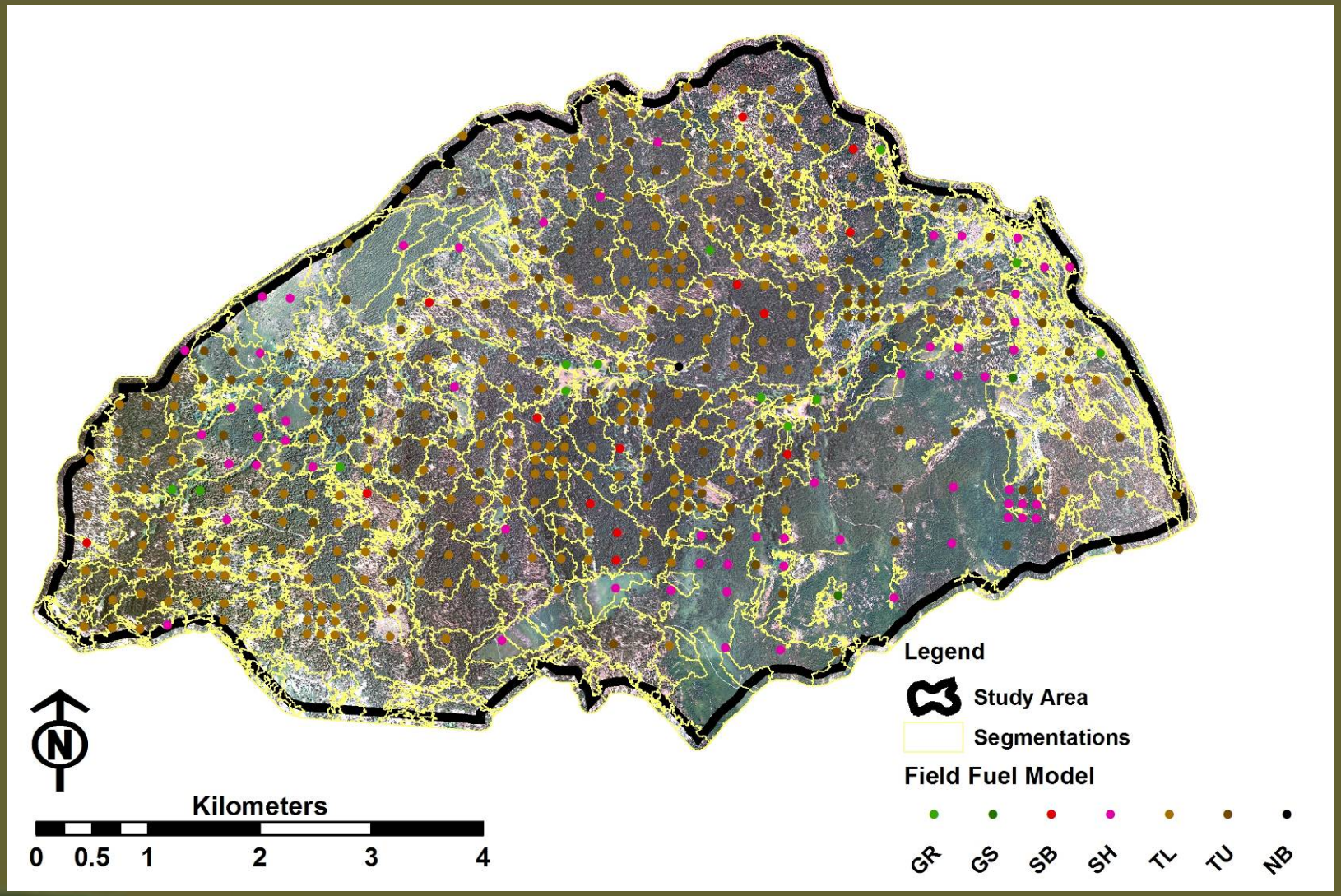
Custom Fuel Model

Field	Name	Data Type	English Units	Metric Units
FMod	Fuel Model	integer	number 14-50	number 14-50
1H, 10H, 100H, LiveH, LiveW	Fuel Loading	decimal	tons/acre	Metric tonnes / hectare
1HSAV, LiveHSAV, LiveWSAV	Surface to Volume Ratio	integer	1/ft	1/cm
Depth	Fuel Bed Depth	decimal	ft	cm
XtMoist	Moisture of Extinction	integer	percent	percent
DHt, LHt	Heat Content live & dead fuels	integer	BTU/lb	J/Kg

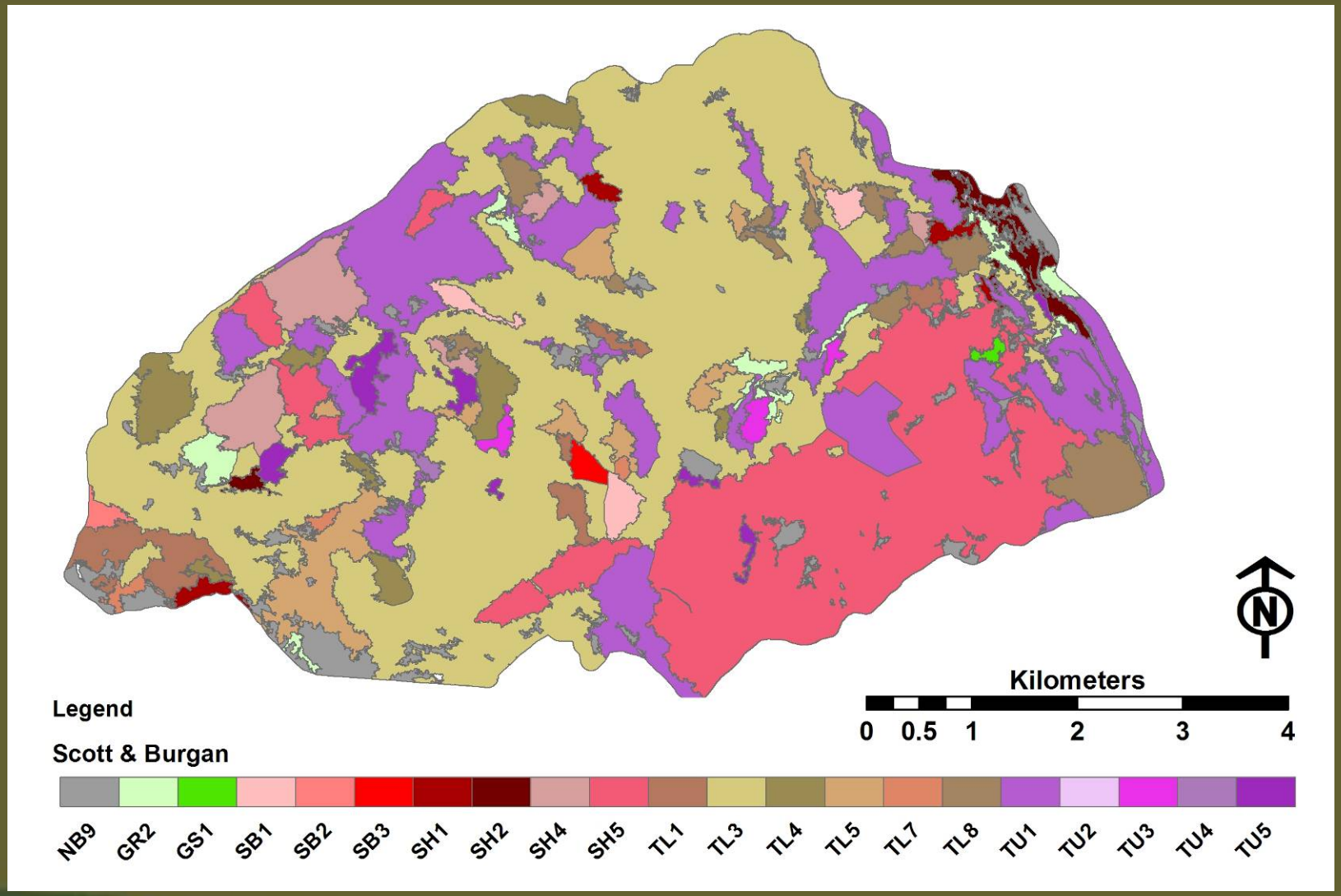
Berkeley: Fuel Field Data



Berkeley: Vegetation Segmentation



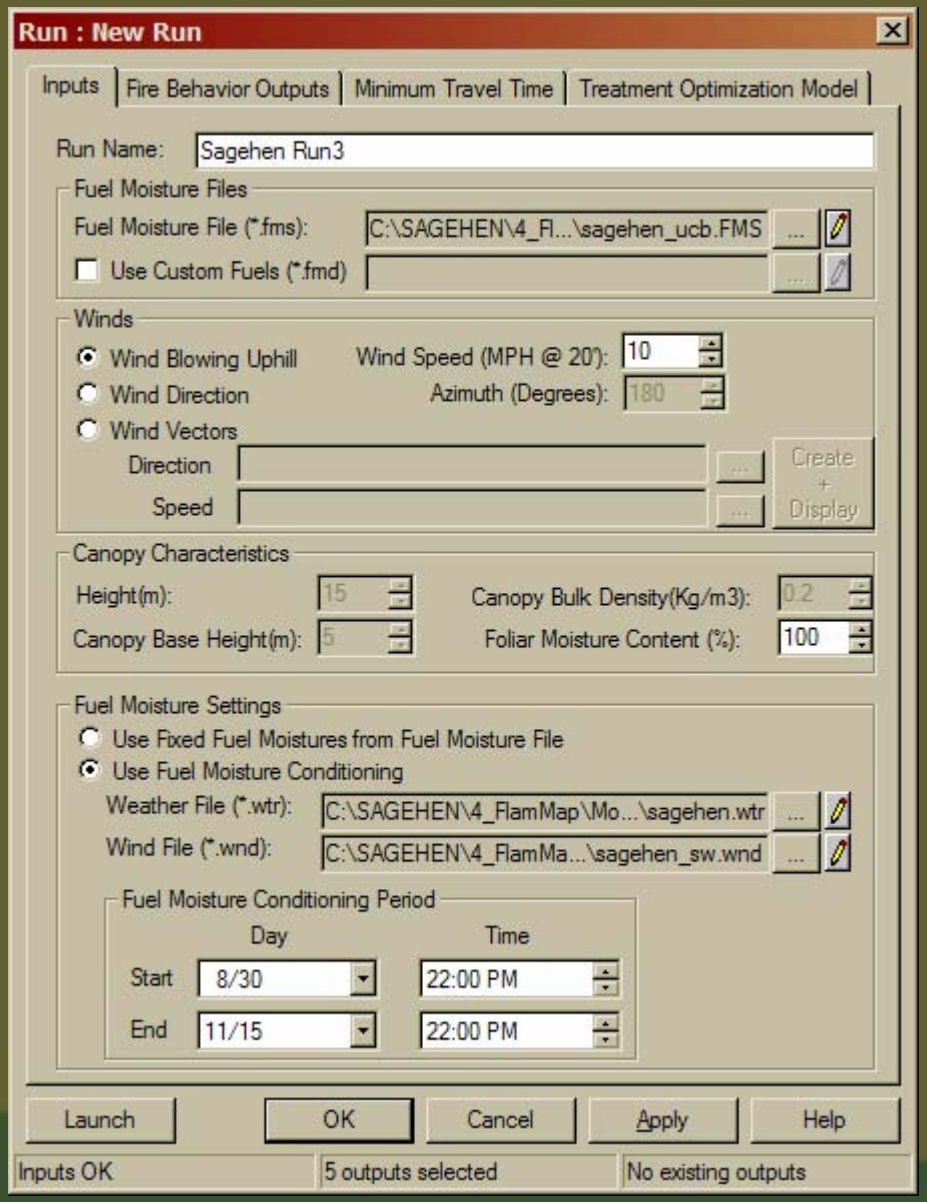
Berkeley: Fuel Model



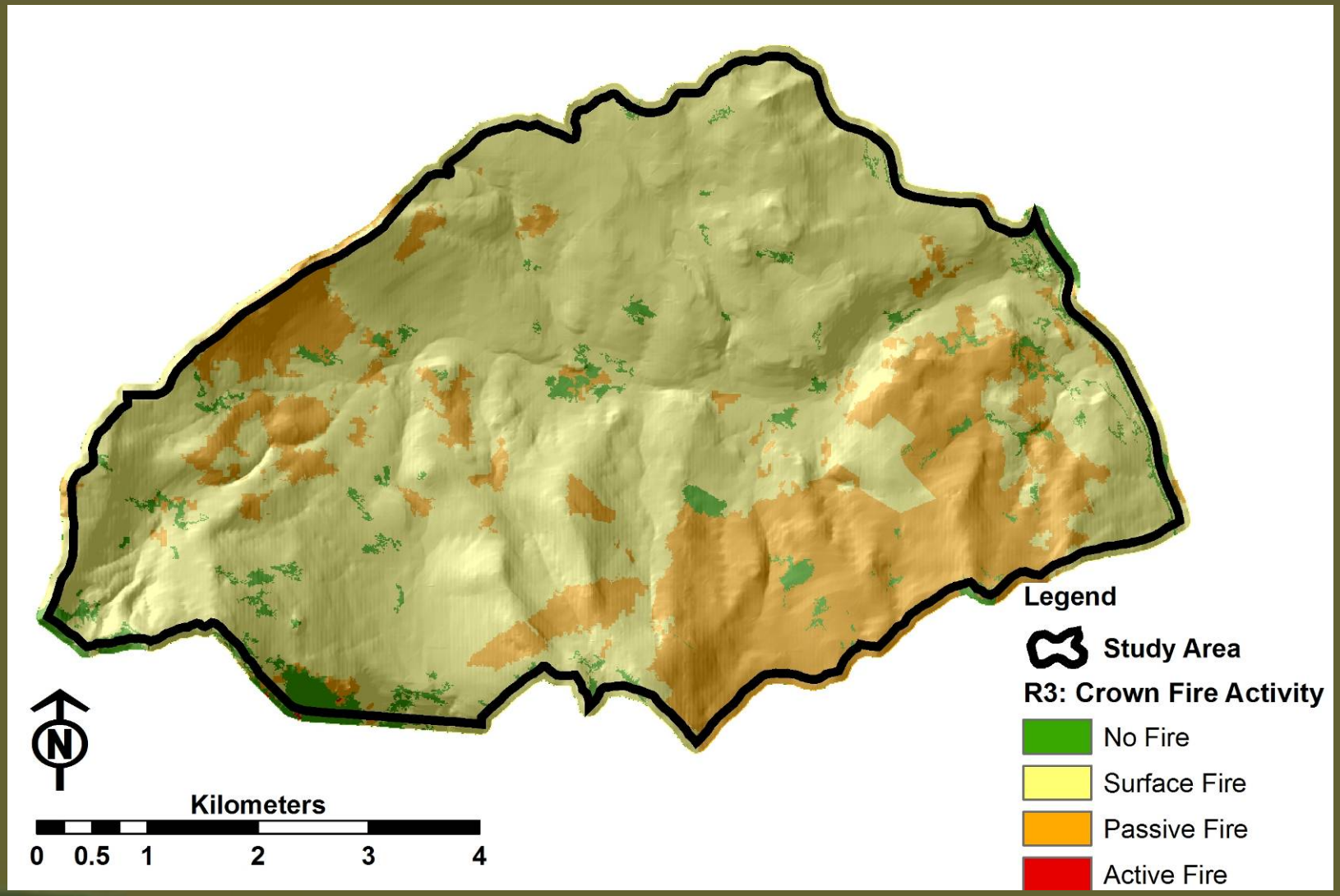
Berkeley: Fuel Model Data

ID	Fuel Loading						Surface to Volume Ratio			Fuel Bed	XtMoist	Heat Content	
FMCODE	ton/acre						1/ft			feet	%	BTU/lb	
FMCODE	1h	10h	100h	LiveH	LiveW	FMTYPE	1HSAV	LiveHSAV	LiveWSAV	Depth	Xmoist	DHt	LHt
101 GR1	0.1	0	0	0.3	0	dynamic	2200	2000	9999	0.4	15	8000	8000
102 GR2	0.1	0	0	1	0	dynamic	2000	1800	9999	1.0	15	8000	8000
121 GS1	0.2	0	0	0.5	0.65	dynamic	2000	1800	1800	0.9	15	8000	8000
141 SH1	0.25	0.25	0	0.15	1.3	dynamic	2000	1800	1600	1.0	15	8000	8000
142 SH2	1.35	2.4	0.75	0	3.85	N/A	2000	9999	1600	1.0	15	8000	8000
144 SH4	0.85	1.15	0.2	0	2.55	N/A	2000	1800	1600	3.0	30	8000	8000
145 SH5	3.6	2.1	0	0	2.9	N/A	750	9999	1600	6.0	15	8000	8000
161 TU1	0.2	0.9	1.5	0.2	0.9	dynamic	2000	1800	1600	0.6	20	8000	8000
162 TU2	0.95	1.8	1.25	0	0.2	N/A	2000	9999	1600	1.0	30	8000	8000
163 TU3	1.1	0.15	0.25	0.65	1.1	dynamic	1800	1600	1400	1.3	30	8000	8000
164 TU4	4.5	0	0	0	2	N/A	2300	9999	2000	0.5	12	8000	8000
165 TU5	4	4	3	0	3	N/A	1500	9999	750	1.0	25	8000	8000
181 TL1	1	2.2	3.6	0	0	N/A	2000	9999	9999	0.2	30	8000	8000
183 TL3	0.5	2.2	2.8	0	0	N/A	2000	9999	9999	0.3	20	8000	8000
184 TL4	0.5	1.5	4.2	0	0	N/A	2000	9999	9999	0.4	25	8000	8000
185 TL5	1.15	2.5	4.4	0	0	N/A	2000	9999	1600	0.6	25	8000	8000
187 TL7	0.3	1.4	8.1	0	0	N/A	2000	9999	9999	0.4	25	8000	8000
188 TL8	5.8	1.4	1.1	0	0	N/A	1800	9999	9999	0.3	35	8000	8000
201 SB1	1.5	3	11	0	0	N/A	2000	9999	9999	1.0	25	8000	8000
202 SB2	4.5	4.25	4	0	0	N/A	2000	9999	9999	1.0	25	8000	8000
203 SB3	5.5	2.75	3	0	0	N/A	2000	9999	9999	1.2	25	8000	8000
99 NB9													

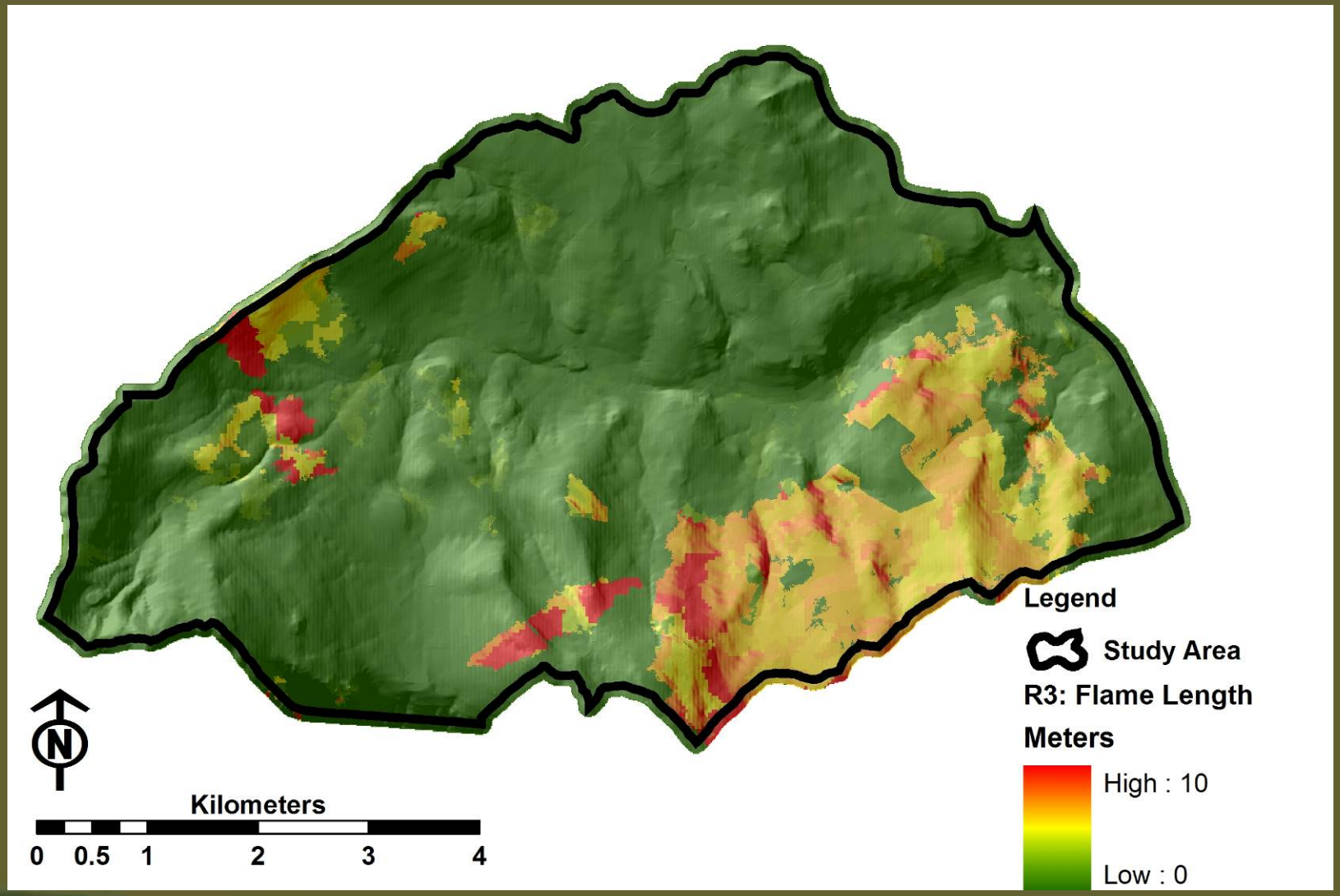
RESULTS: Run3 (Fuel Model)



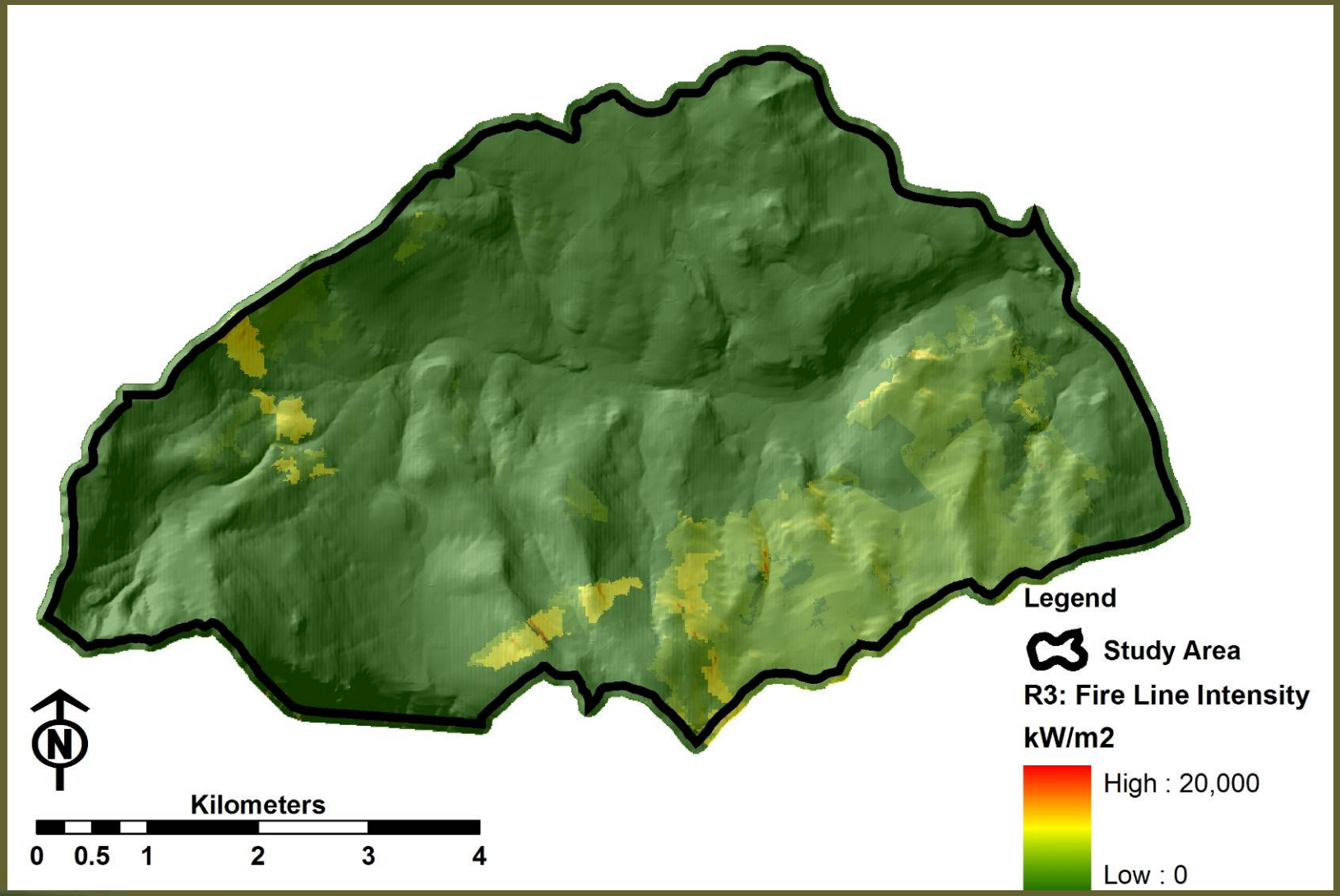
RESULTS: Run3 (Fuel Model)
Crown Fire Activity



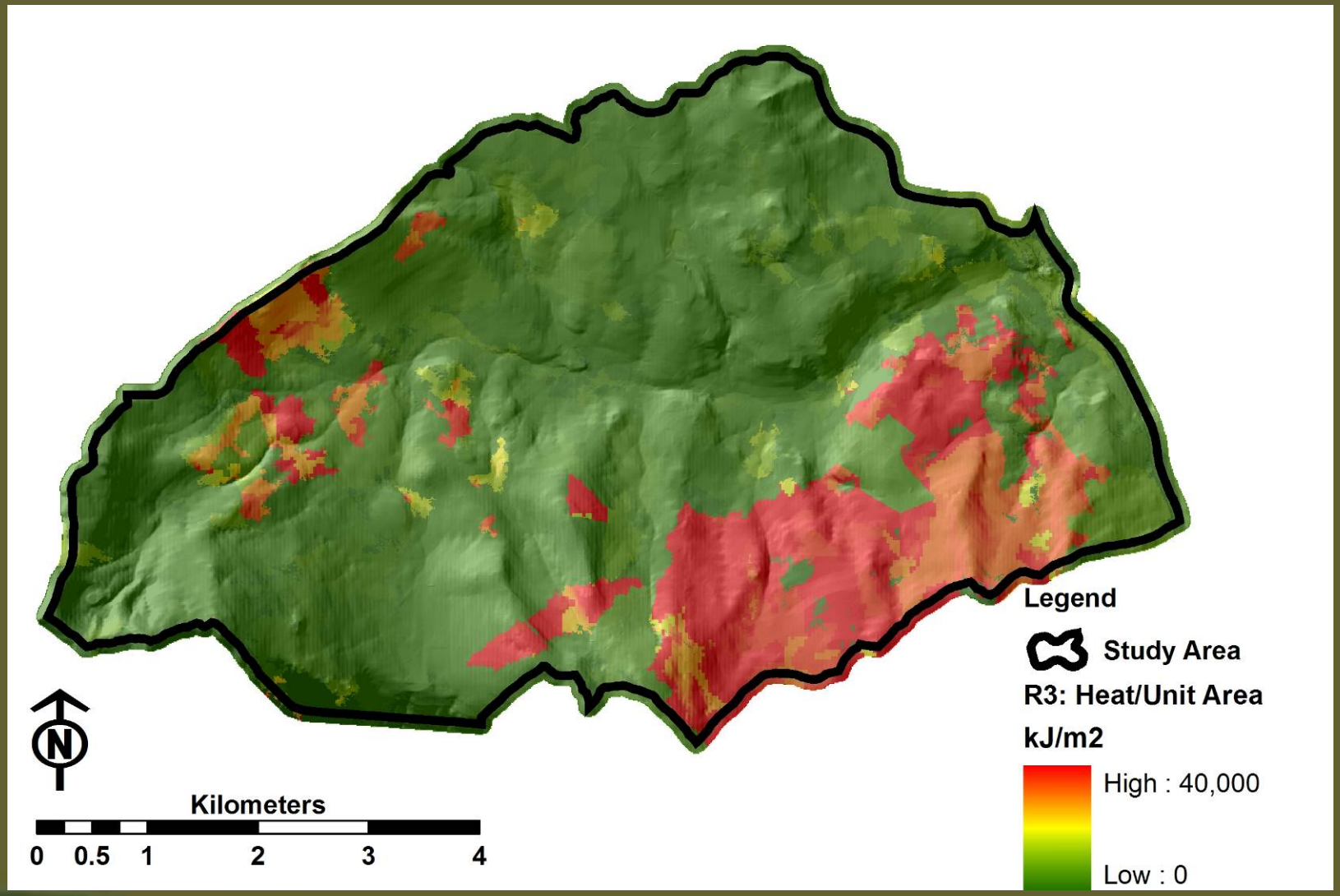
RESULTS: Run3 (Fuel Model)
Flame Length



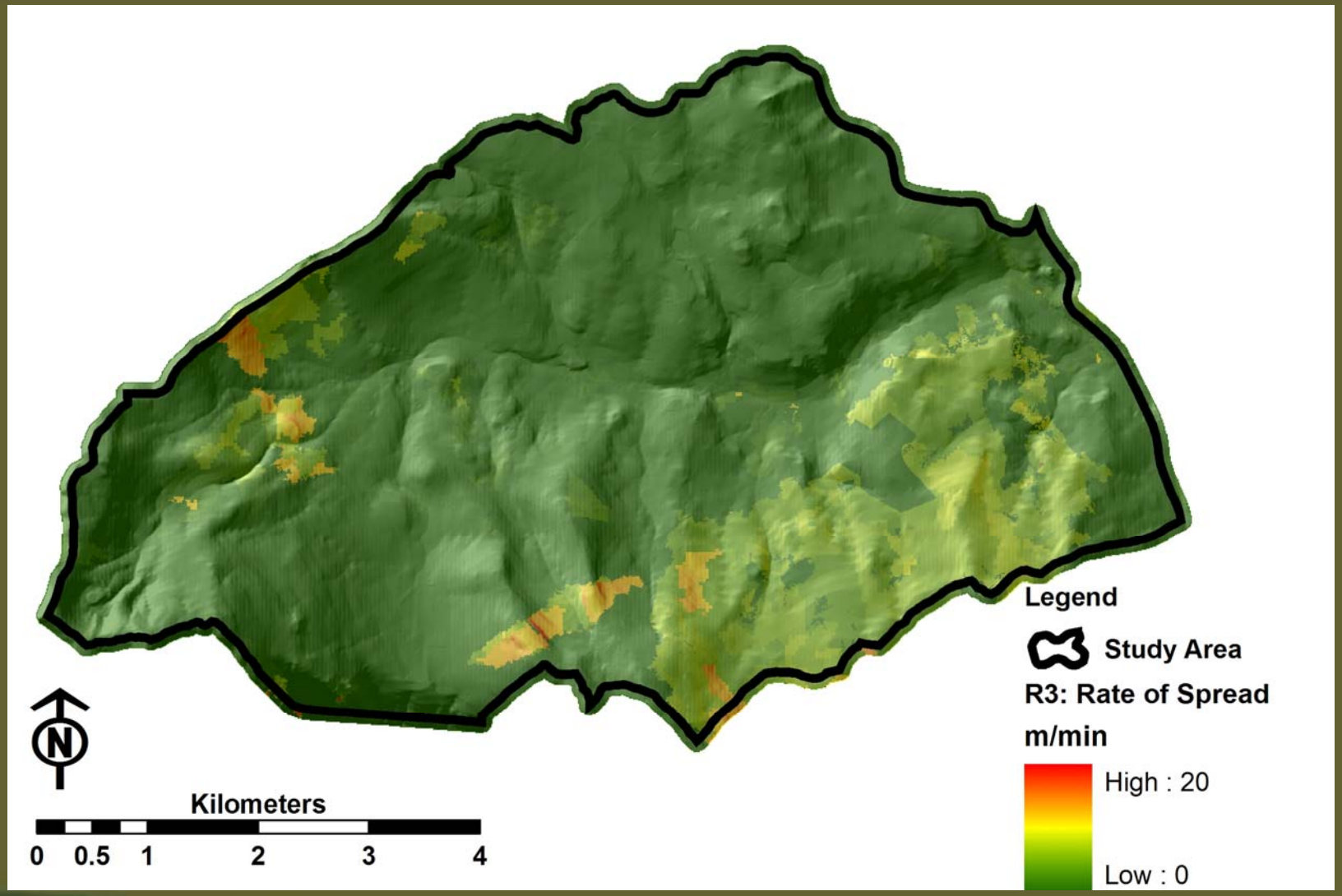
RESULTS: Run3 (Fuel Model)
Fire Line Intensity



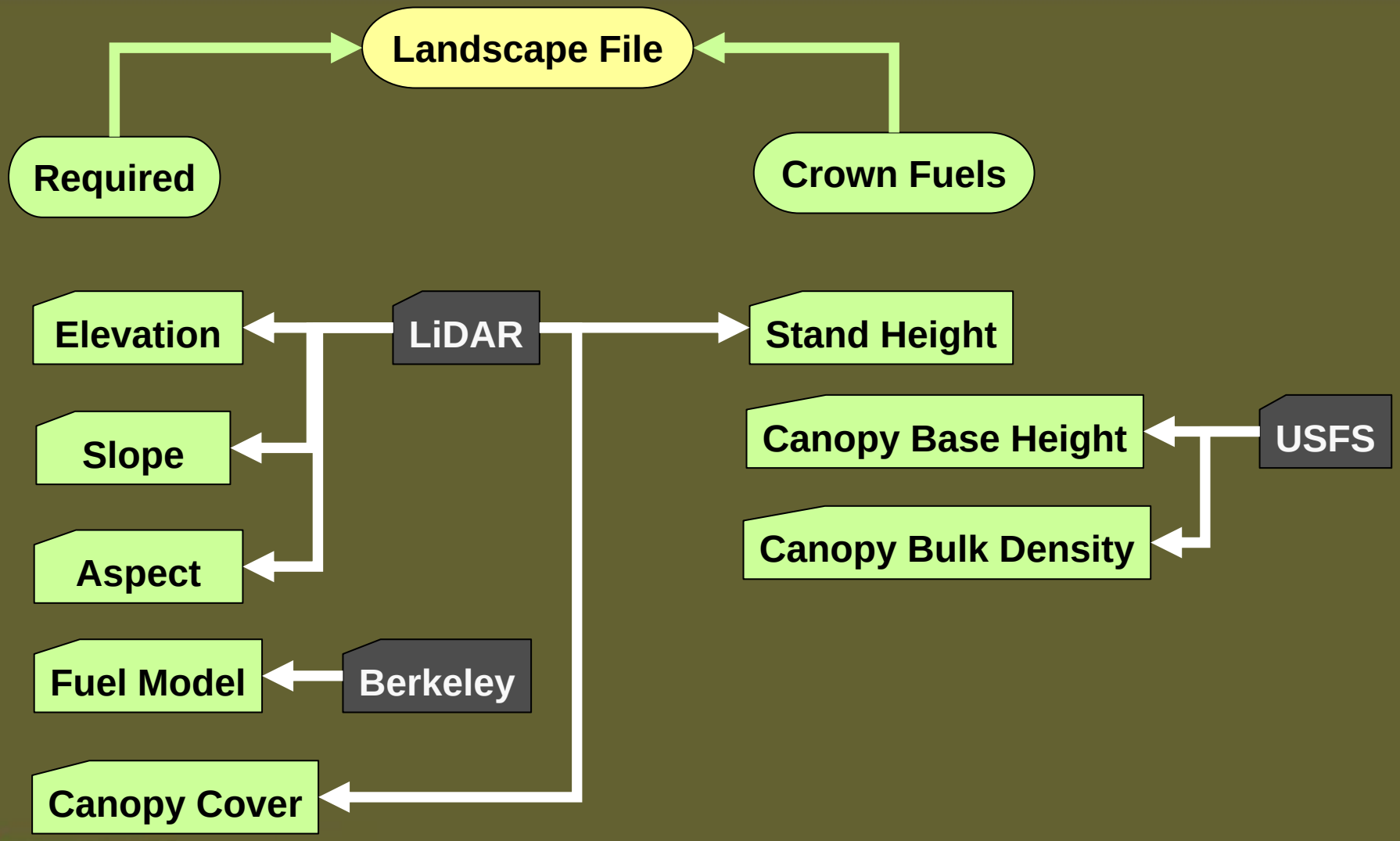
RESULTS: Run3 (Fuel Model)
Heat / Unit Area



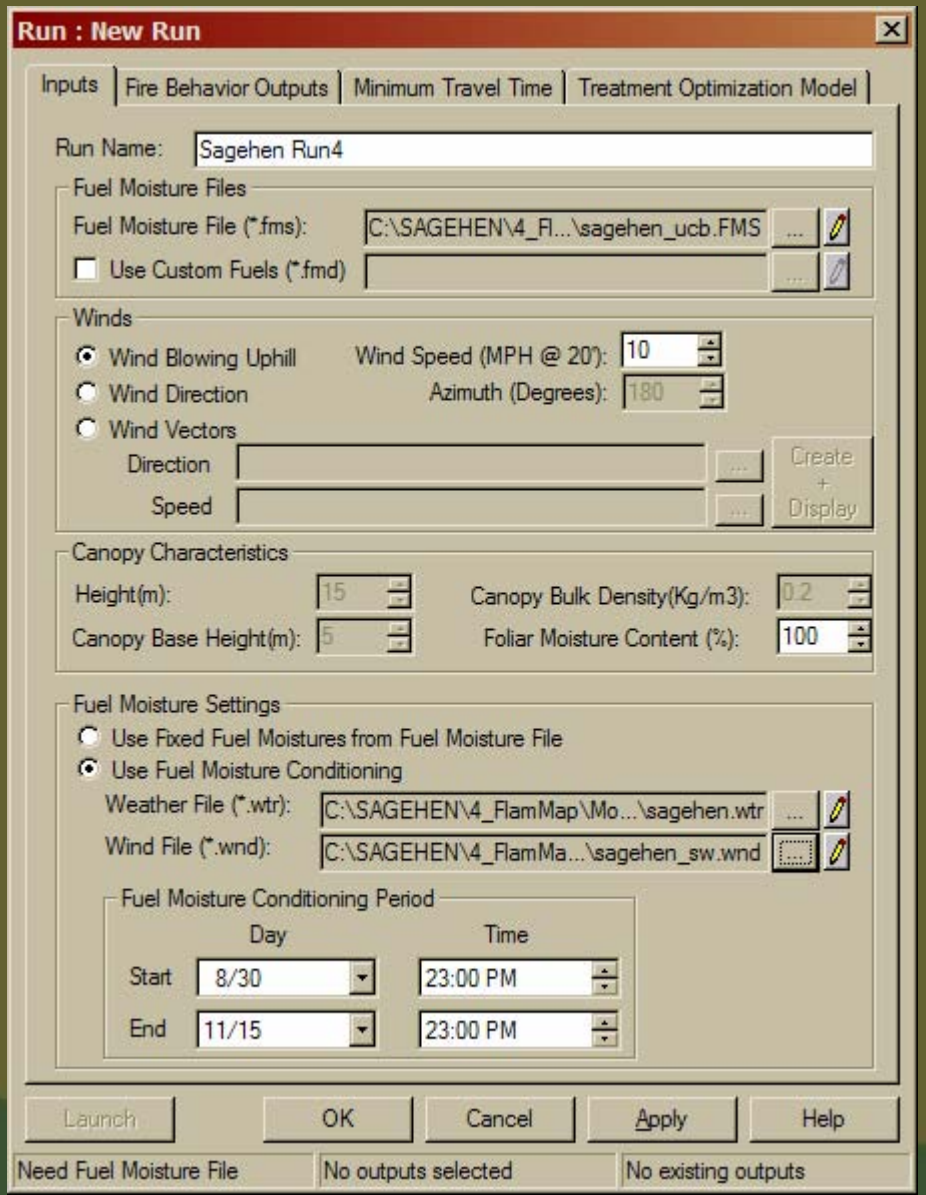
RESULTS: Run3 (Fuel Model)
Rate of Spread



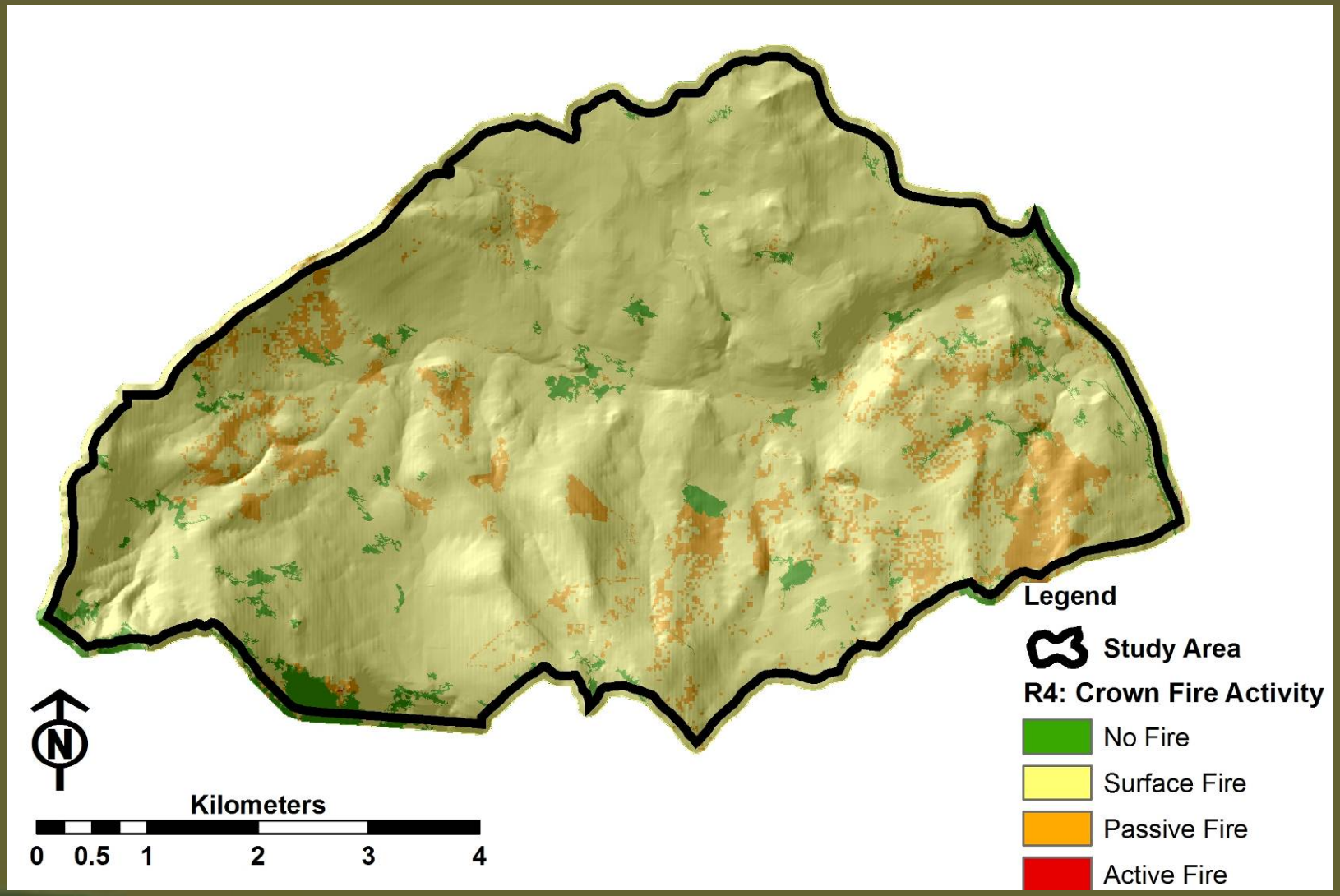
INPUT: Run4 (Combo)



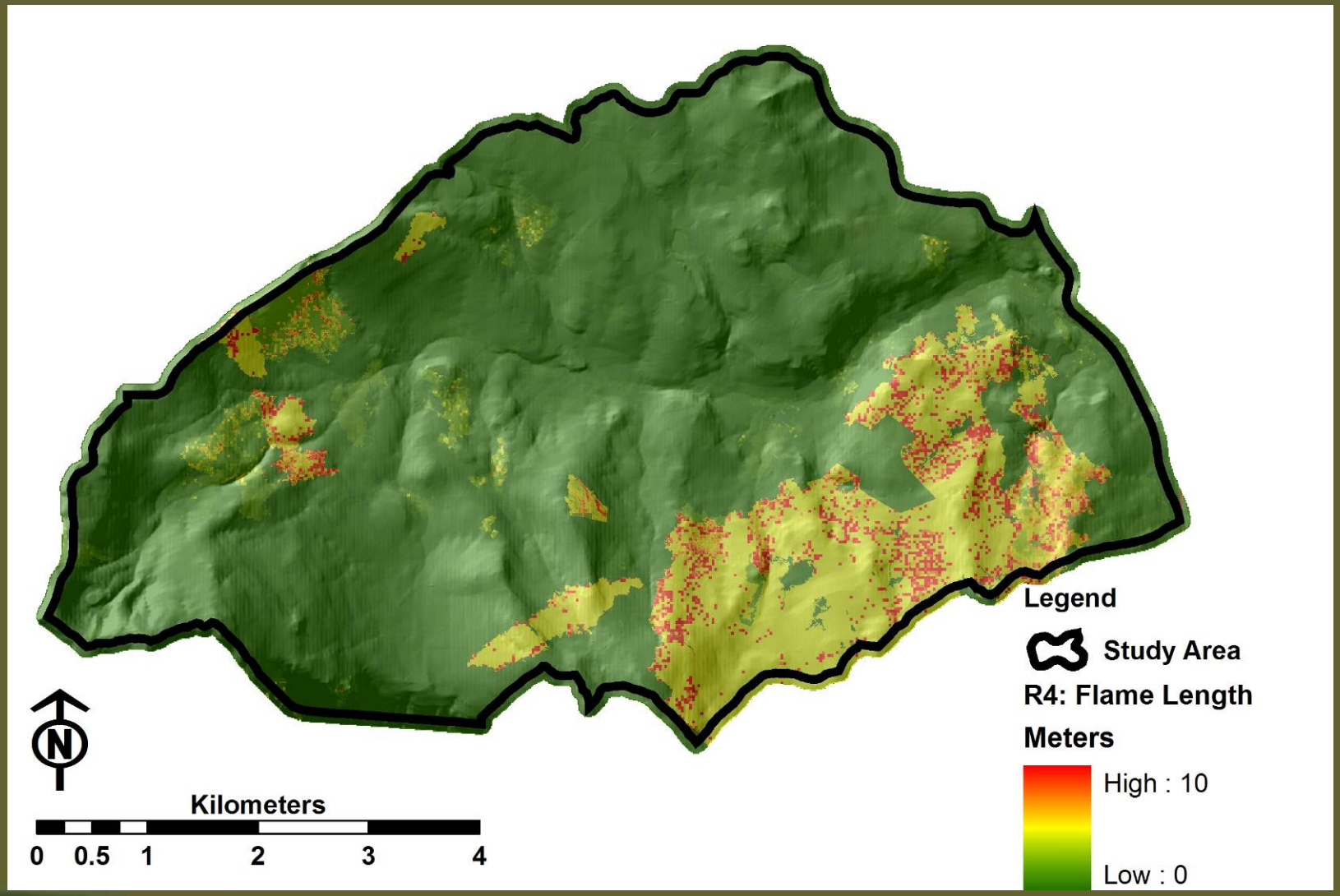
RESULTS: Run4 (Combo)



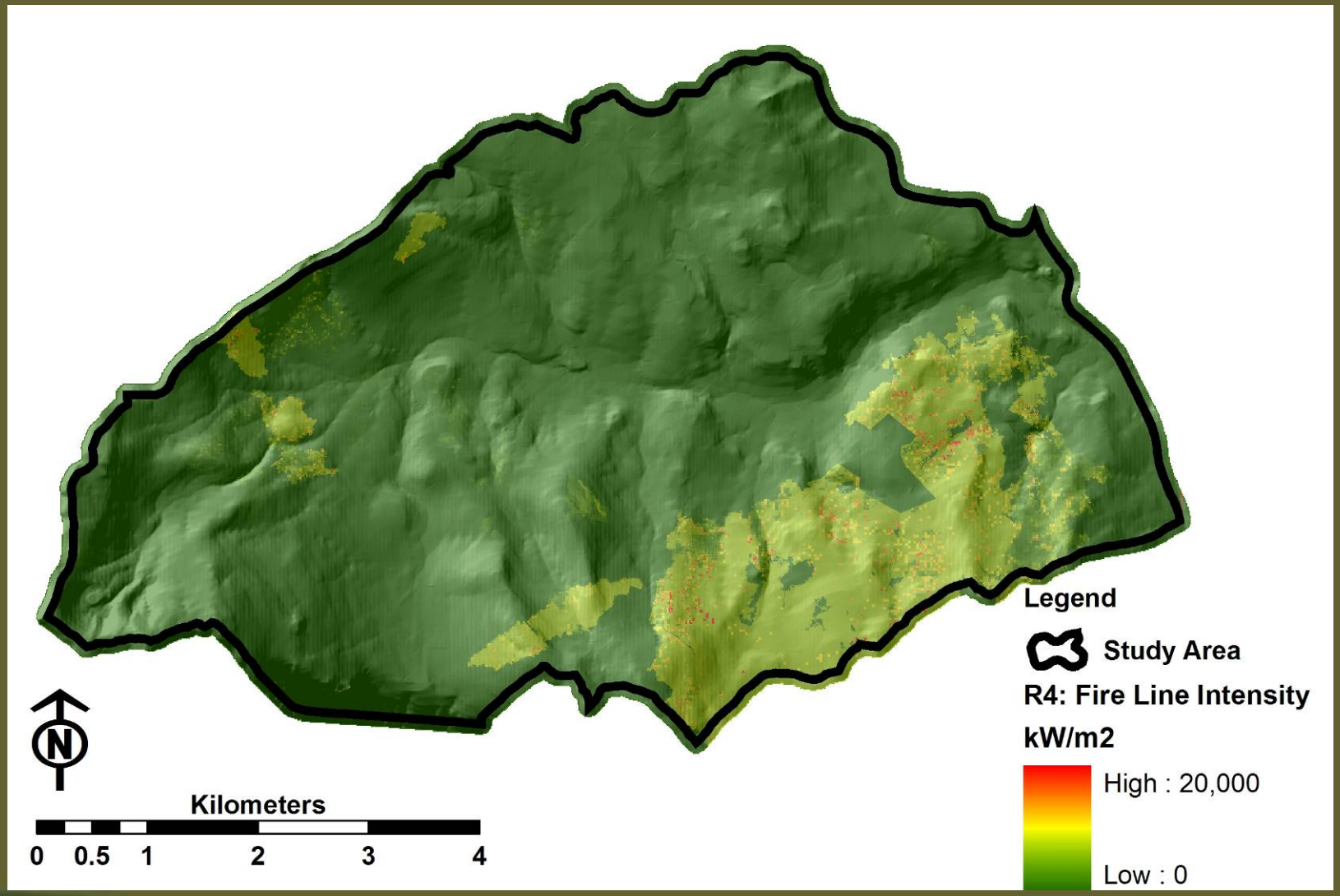
RESULTS: Run4 (Combo)
Crown Fire Activity



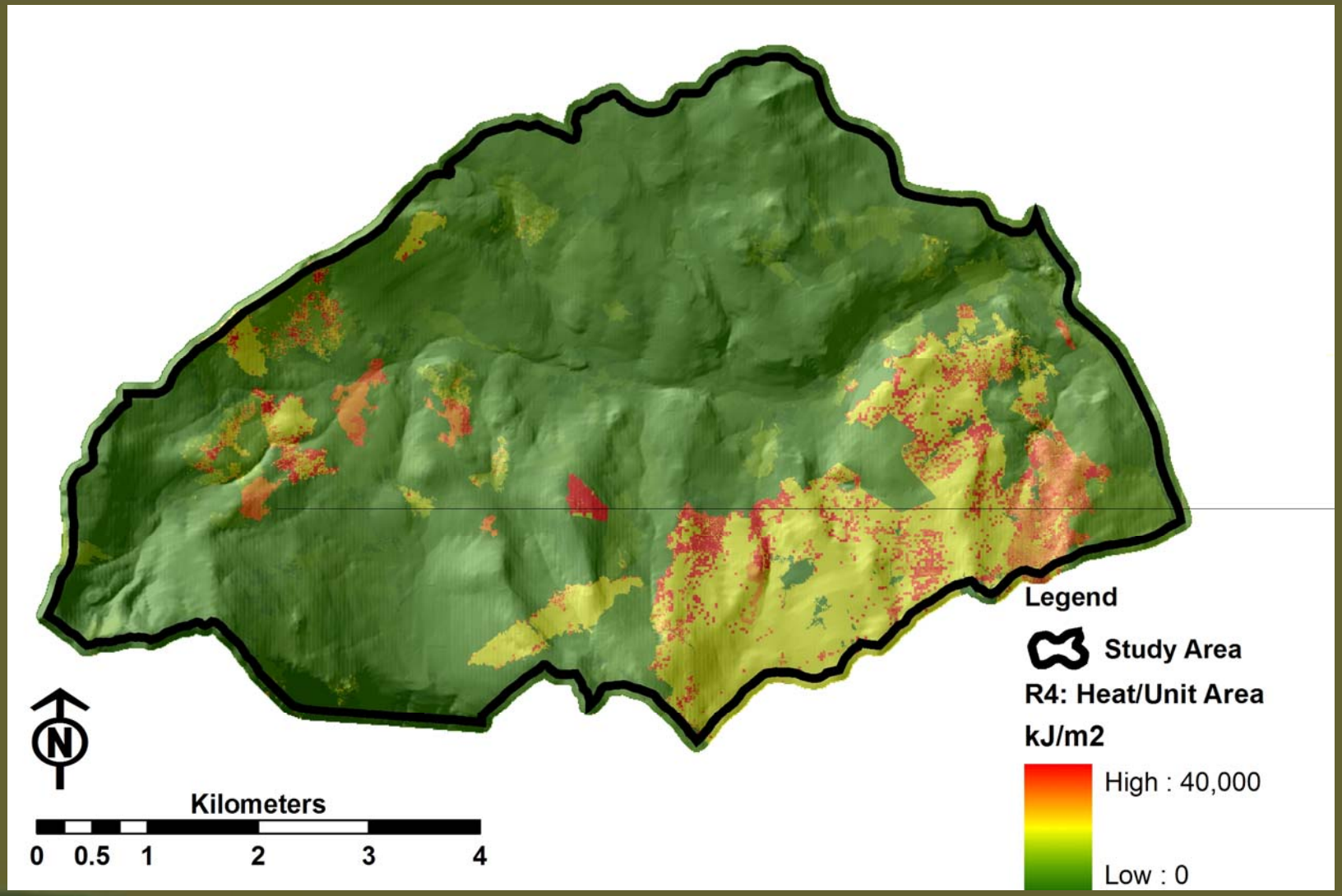
RESULTS: Run4 (Combo)
Flame Length



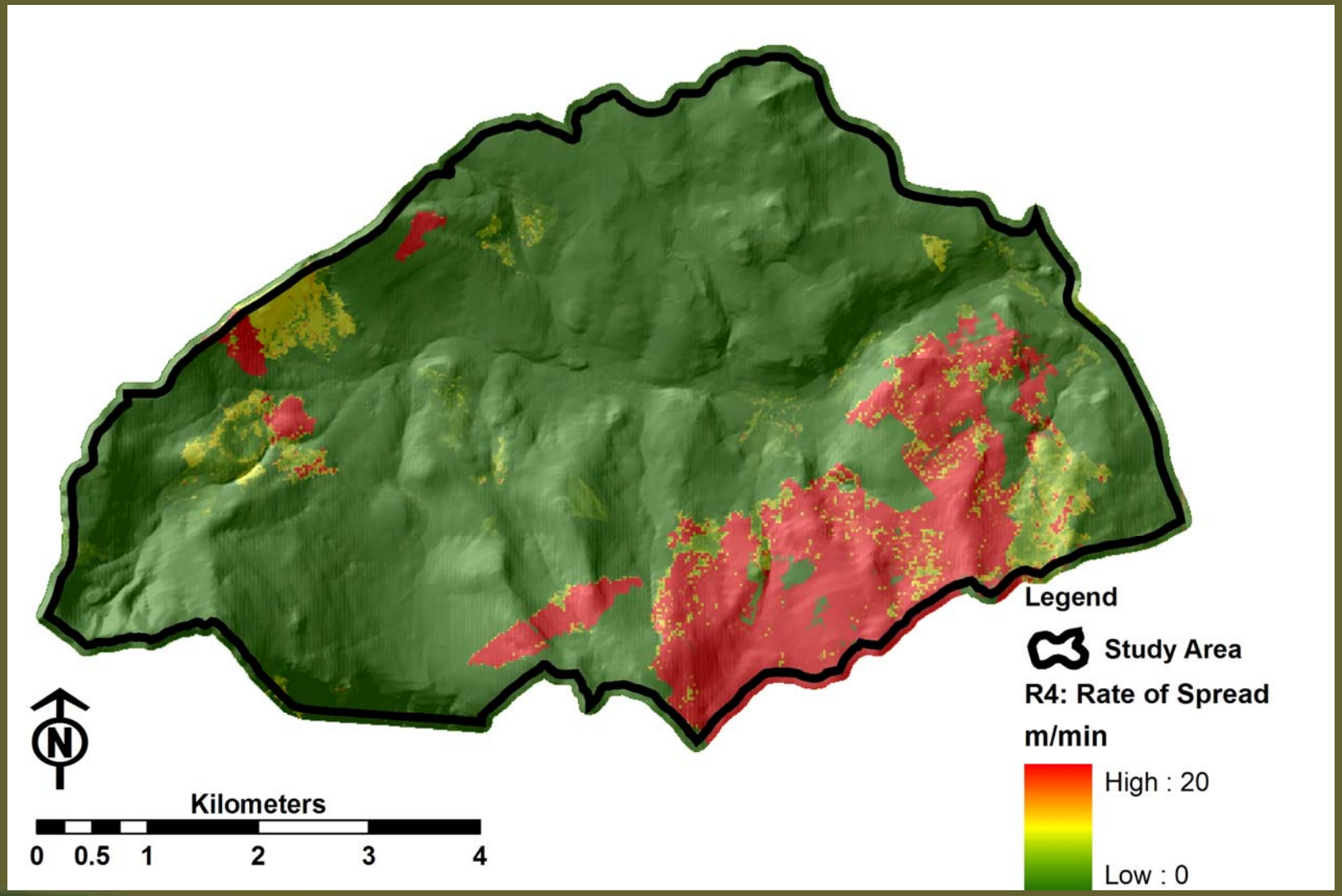
RESULTS: Run4 (Combo)
Fire Line Intensity



RESULTS: Run4 (Combo)
Heat / Unit Area

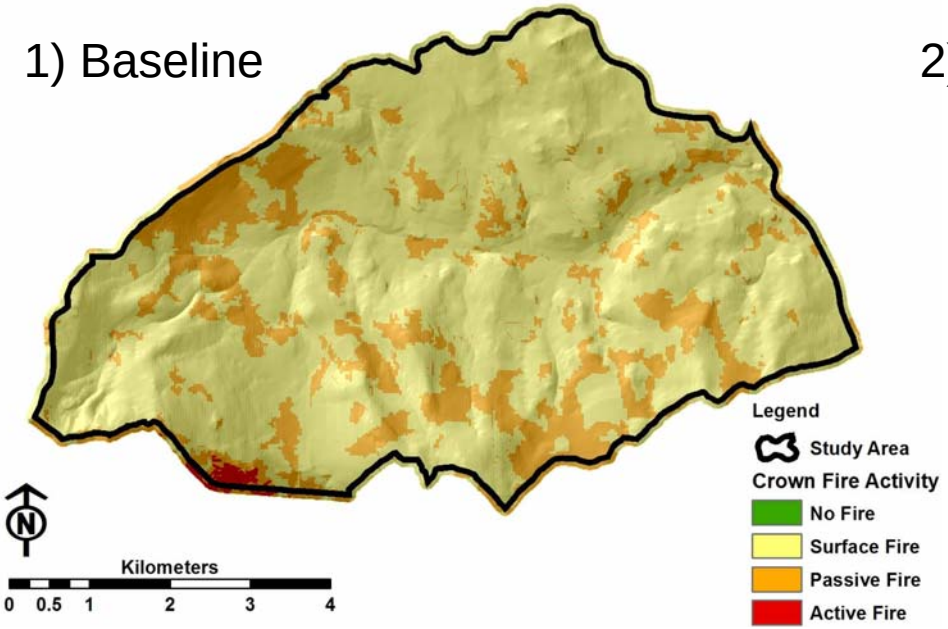


RESULTS: Run4 (Combo)
Rate of Spread

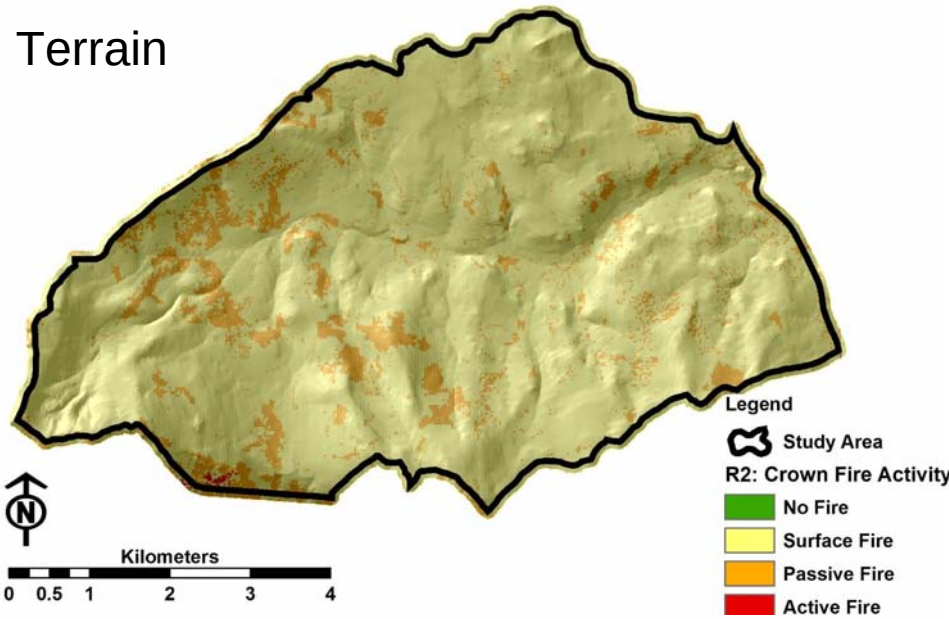


Crown Fire Activity

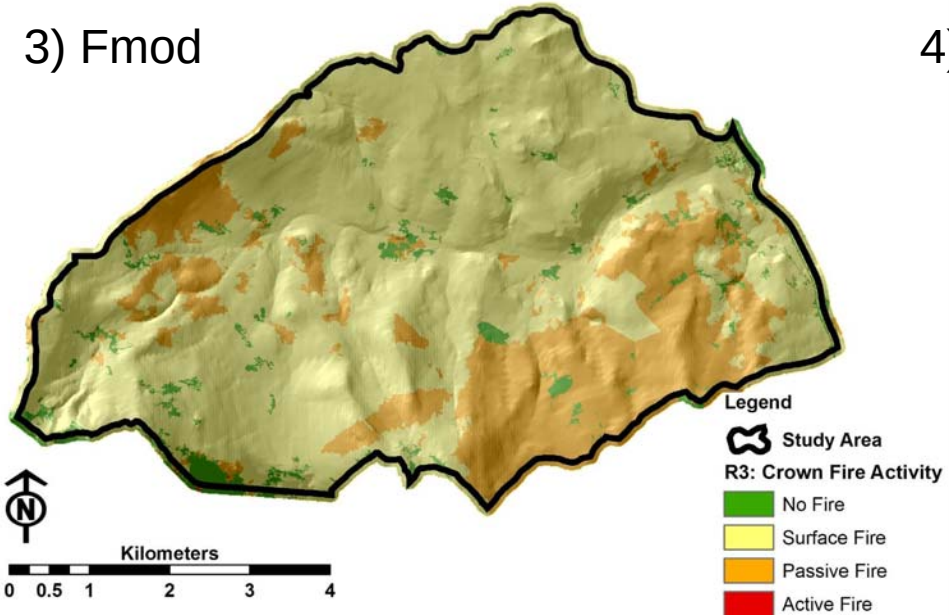
1) Baseline



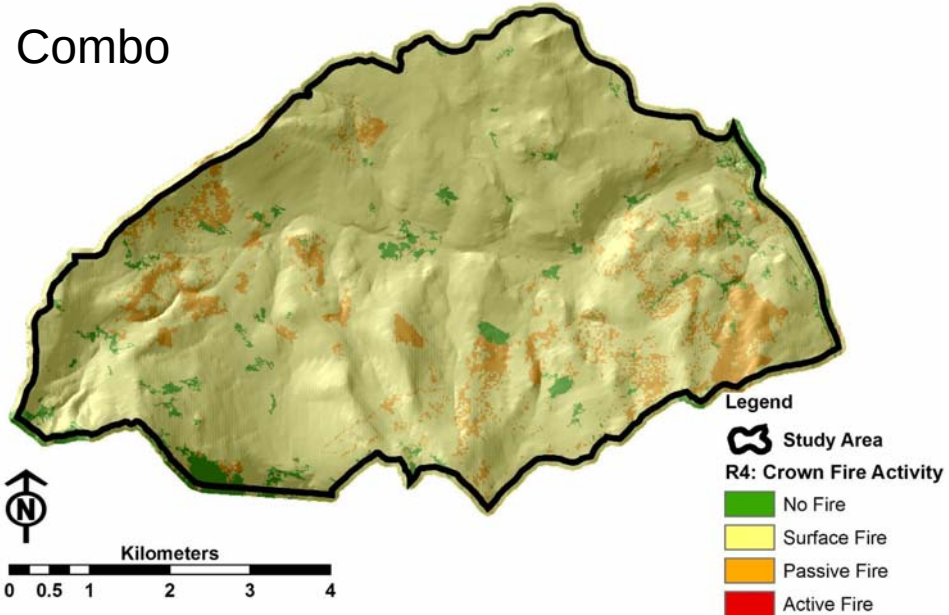
2) Terrain



3) Fmod

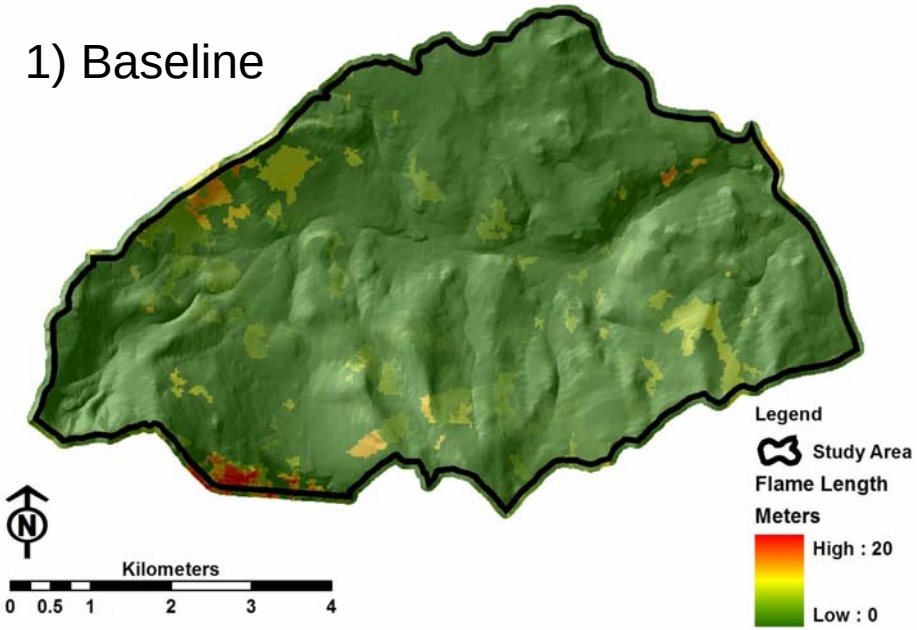


4) Combo

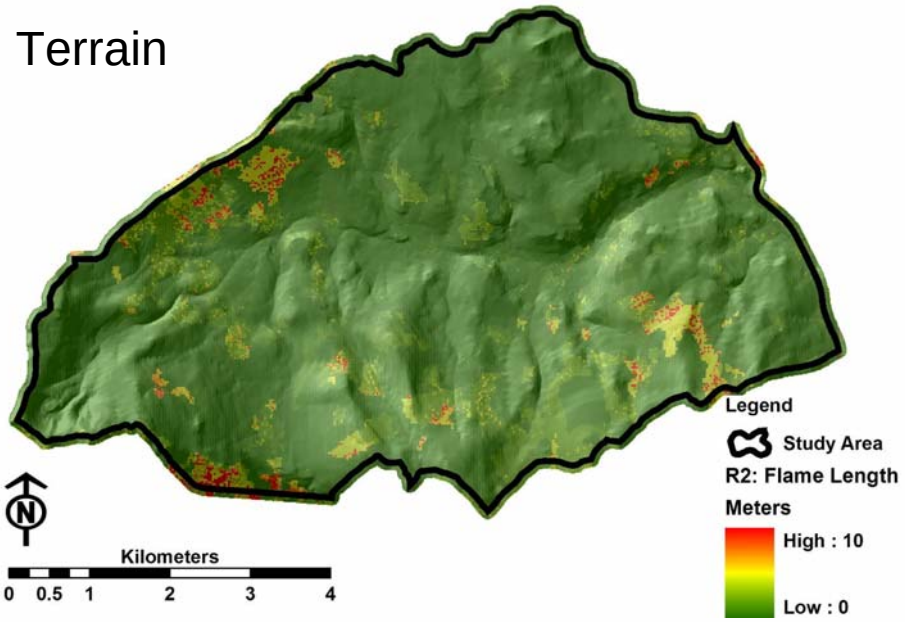


Flame Length

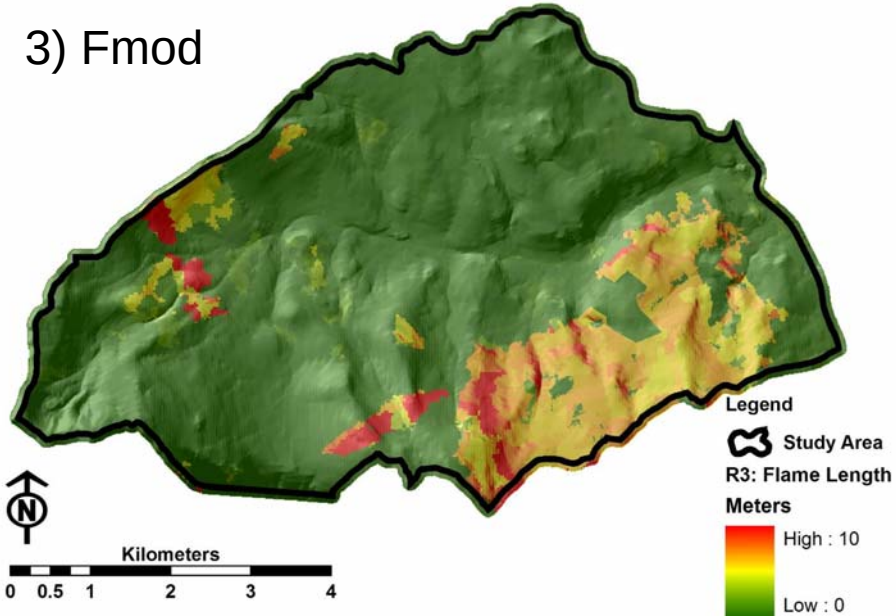
1) Baseline



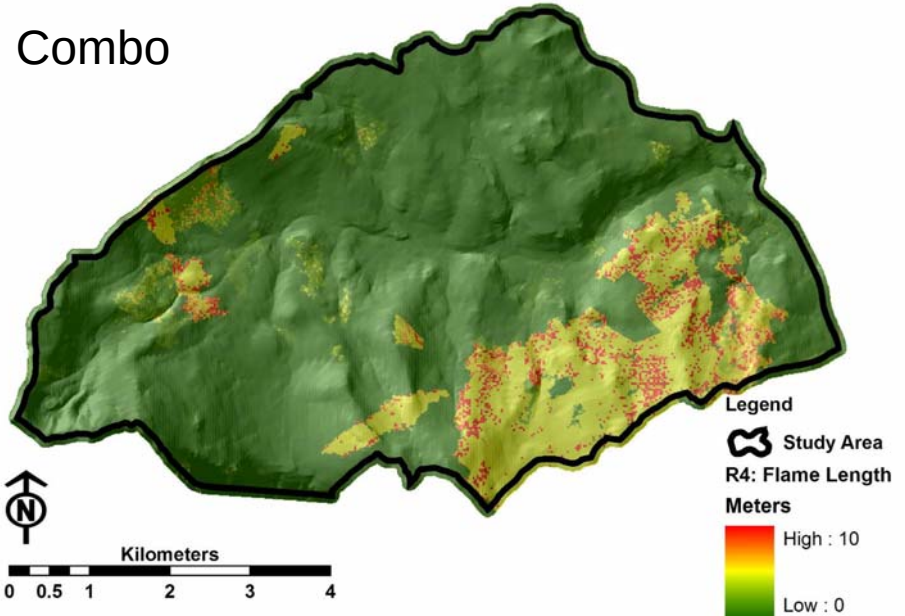
2) Terrain



3) Fmod

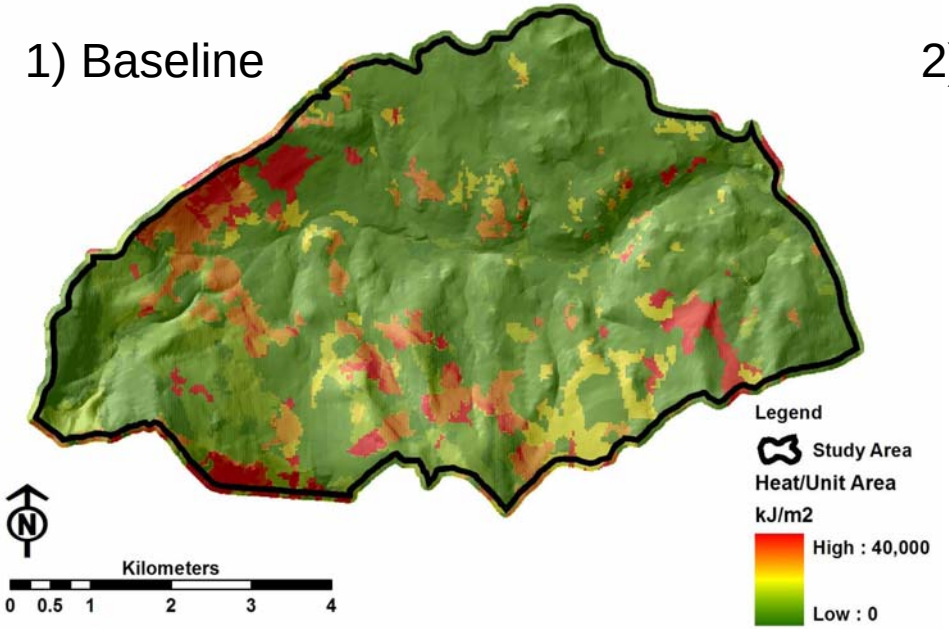


4) Combo

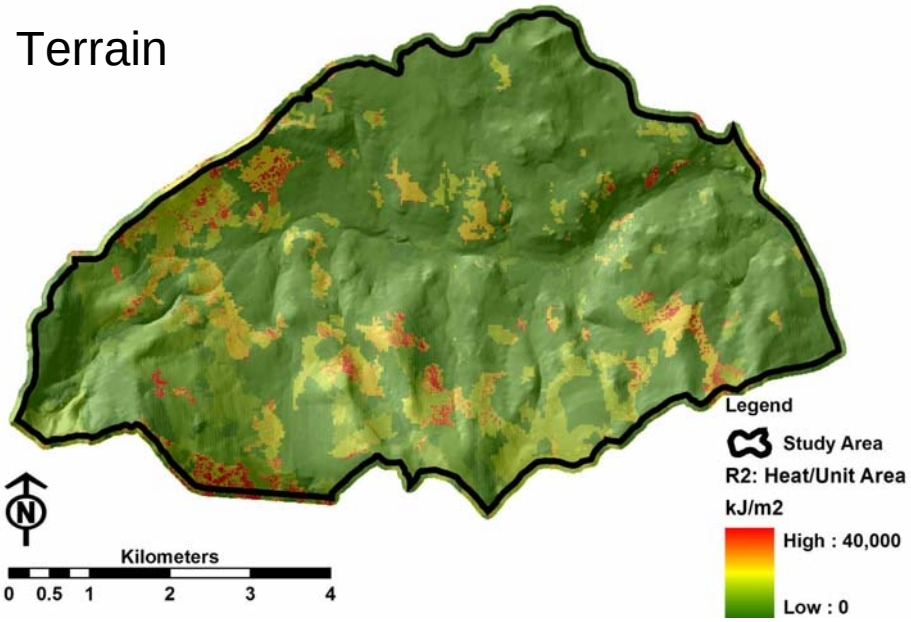


Heat / Unit Area

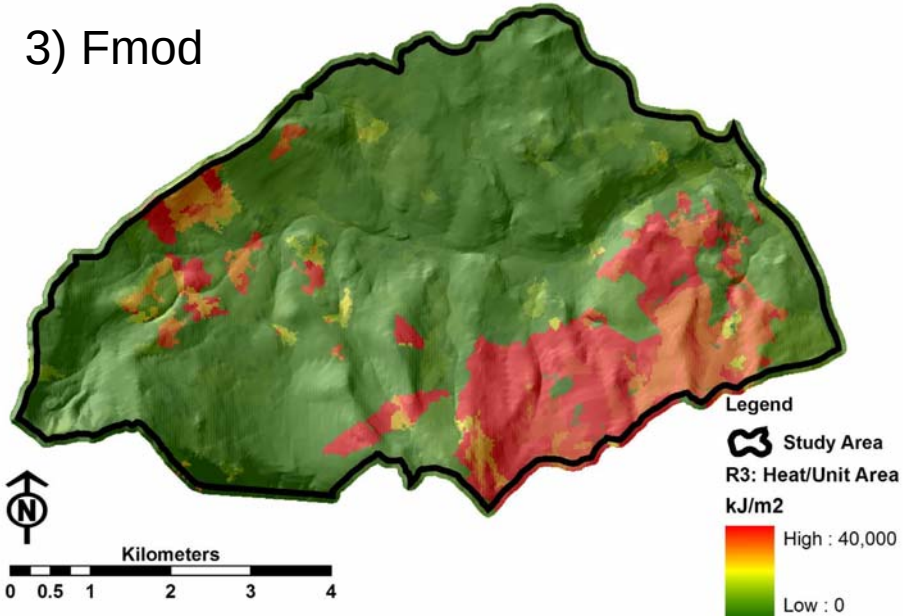
1) Baseline



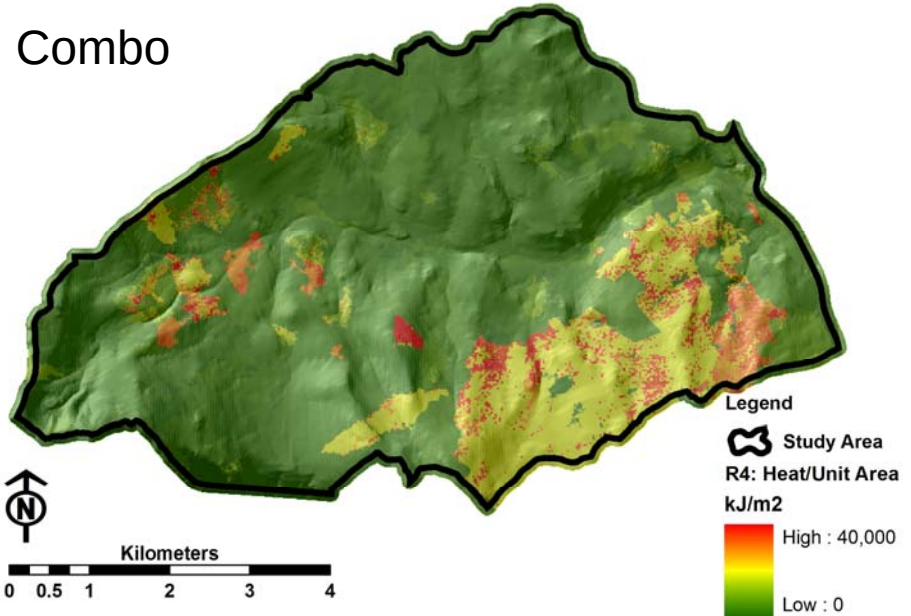
2) Terrain



3) Fmod

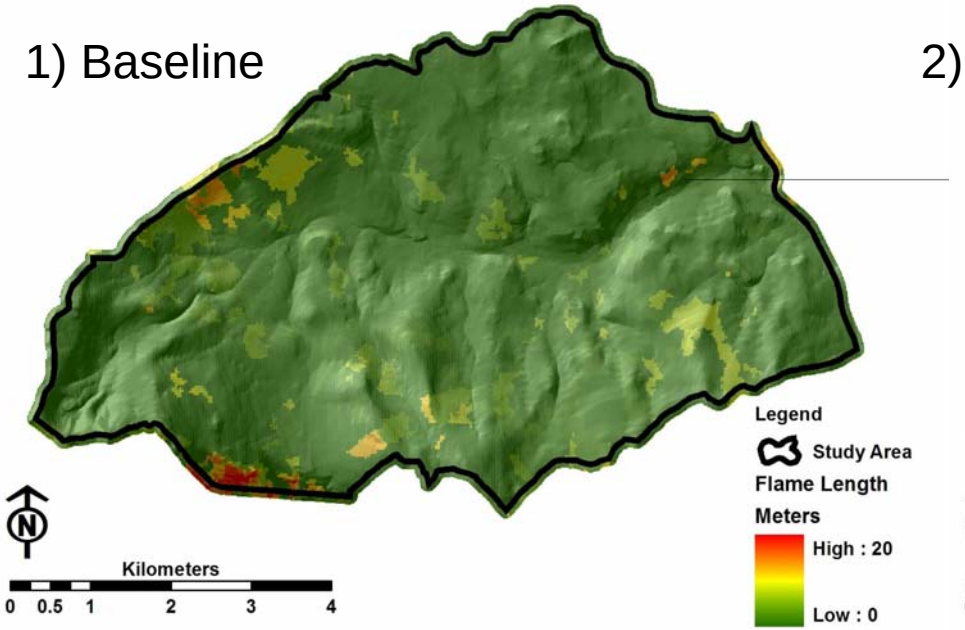


4) Combo

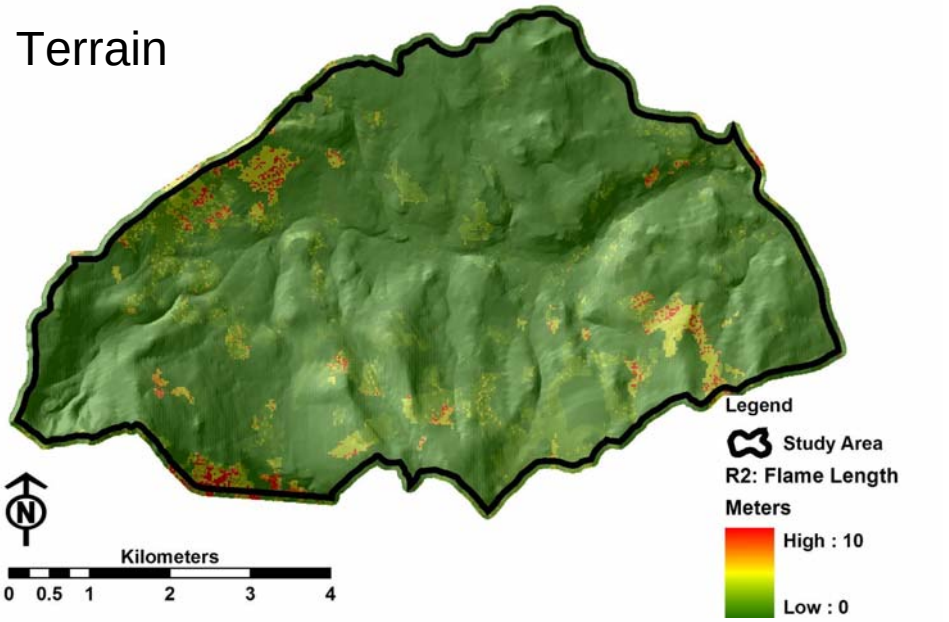


Rate of Spread

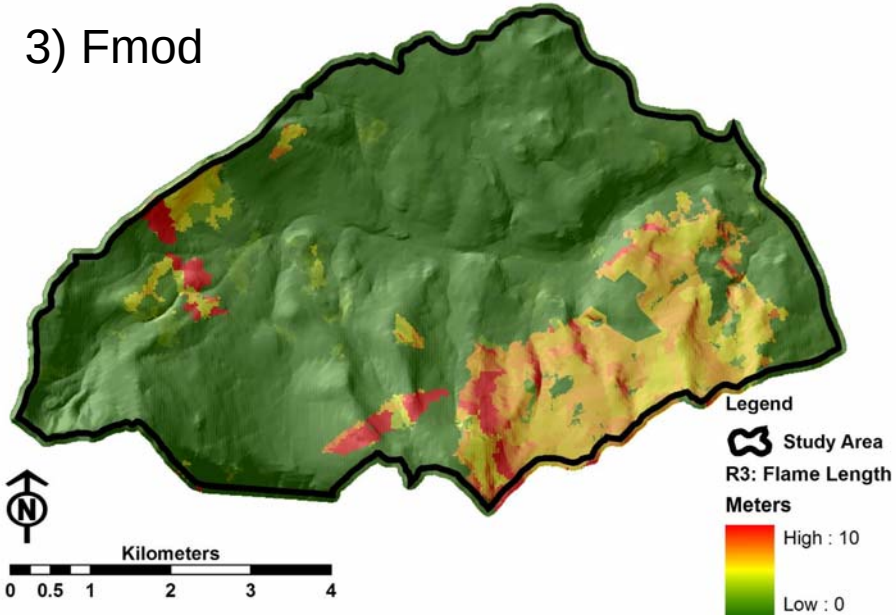
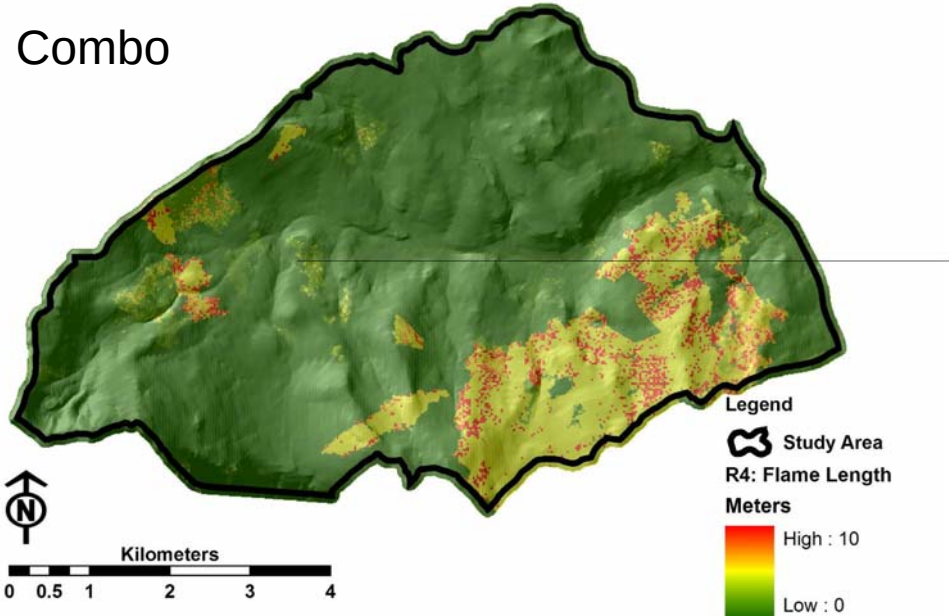
1) Baseline



2) Terrain



3) Fmod



4) Combo