Application of a regional wildfire vulnerability index

Presented by Vance Almquist, ORISE Participant

Where this presentation is going….

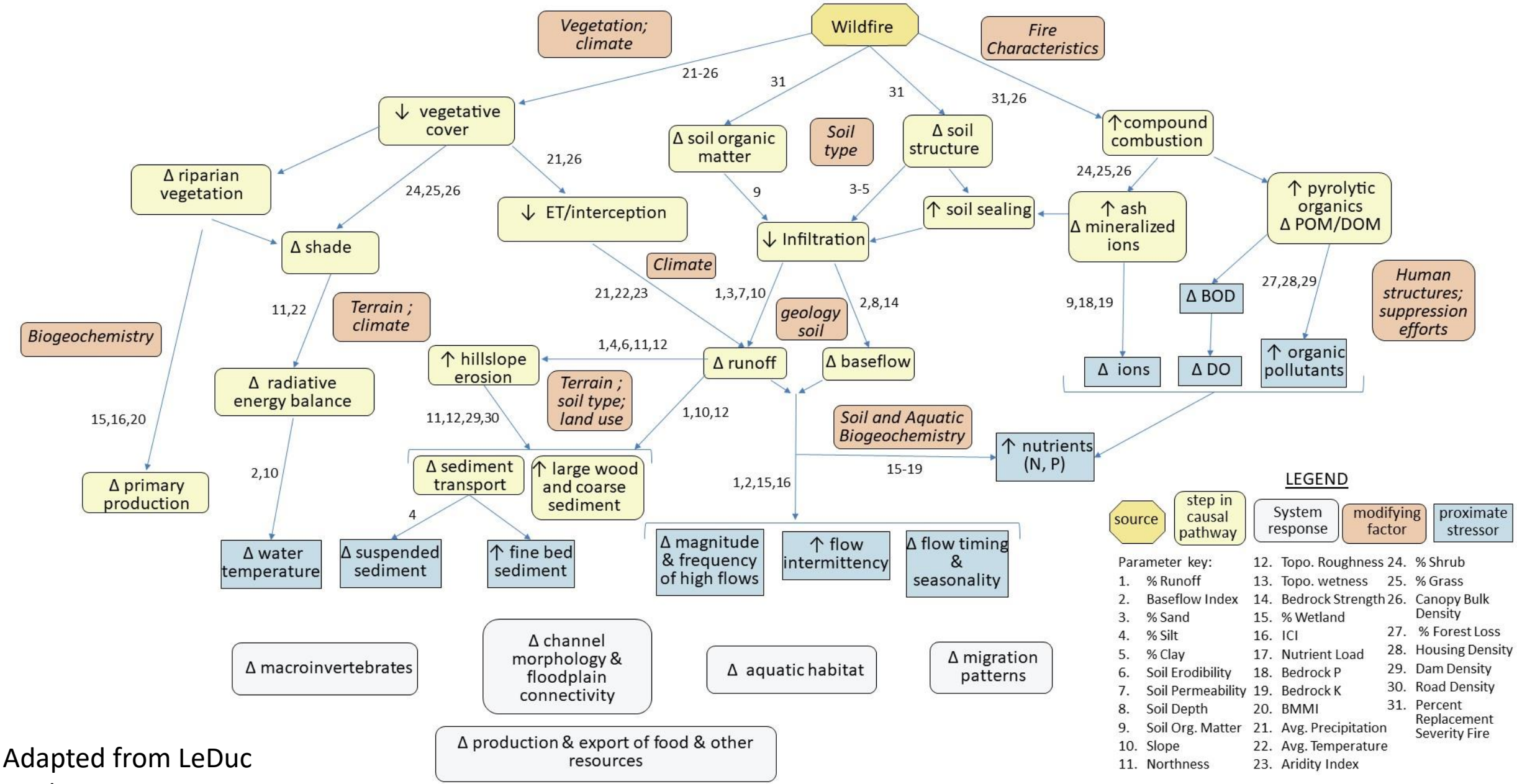
- The background and framework of the regional wildfire vulnerability index
- Presentation of the index, maps, the like
- Two examples of recent proof-of-concept applications
- Time for discussion

Acknowledgements

- Joe Ebersole
- Marcia Snyder
- Ryan Hill
- Mussie Beyene
- Steven LeDuc et al.
- ORISE
- Region 10

The Project : R10 Wildfire Vulnerability

- Estimate of Wildfire Vulnerability
  - Ecologically Focused
  - Concise/parsimonious methods
  - Catchment-based
  - Region-wide
  - accounts for complexity
  - Spatially explicit
    - Estimates of uncertainty
  - Cannot provide specific (i.e. quant.) predictions

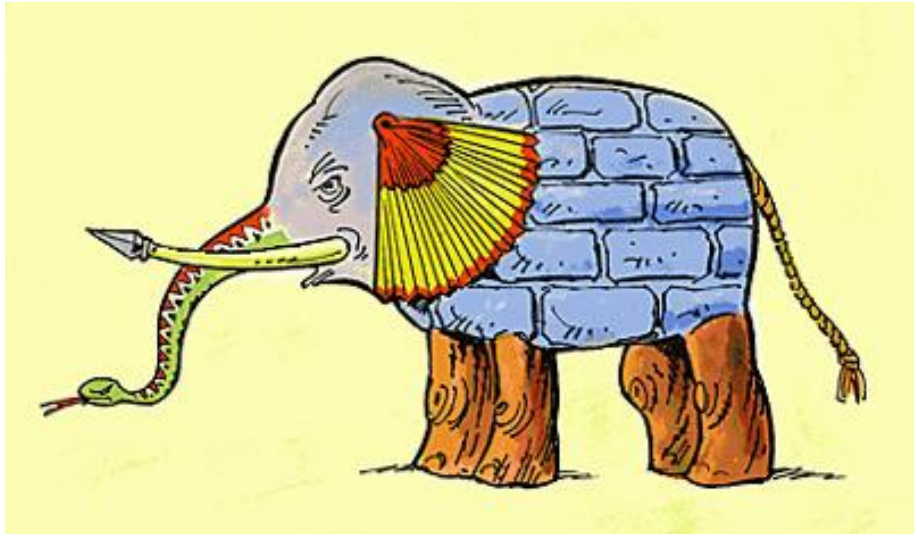


Adapted from LeDuc et al., in-prep

Generalized Methodologic Approach

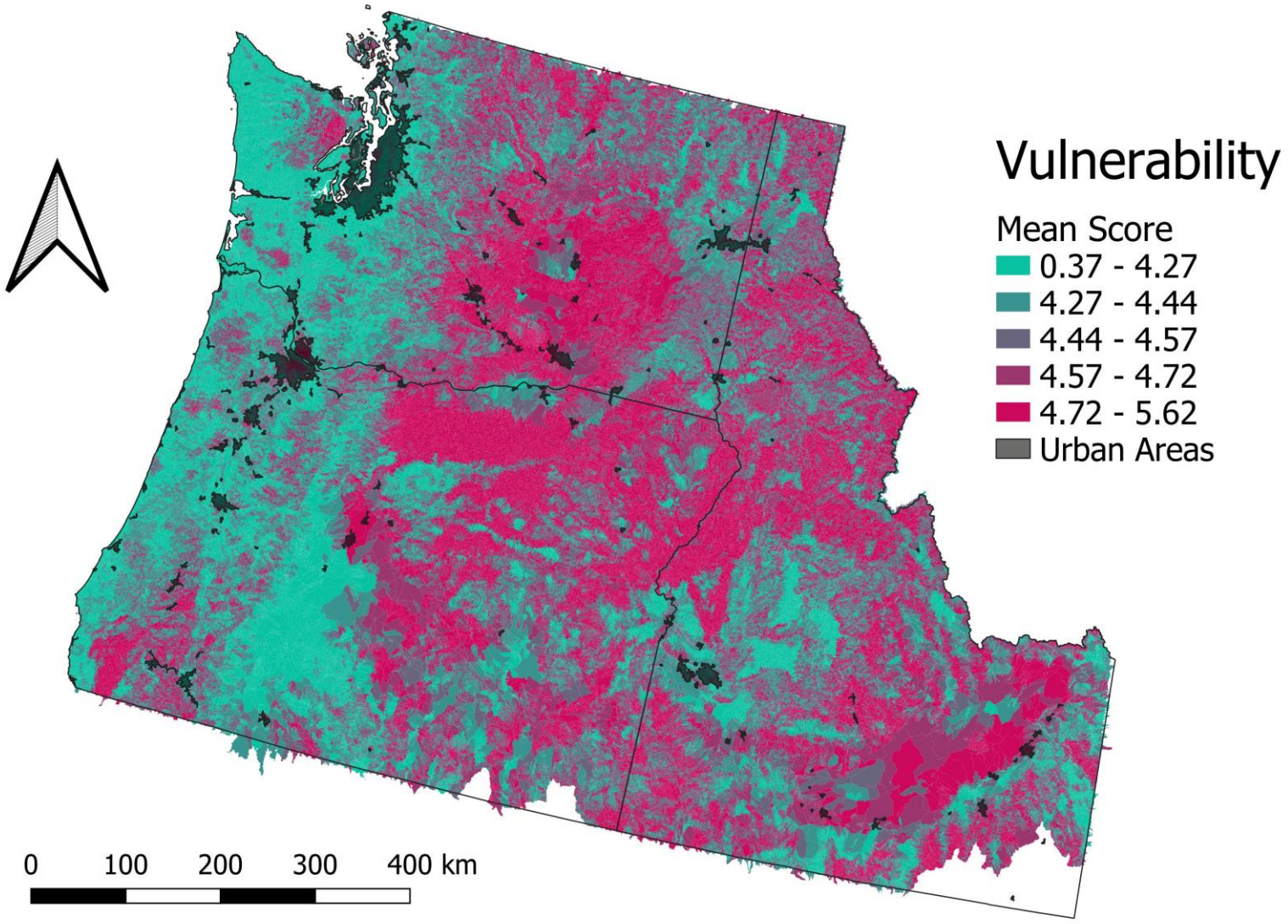
Imperfect Proxies, Imperfect Knowledge

1. Bootstrapping of redundant, rescaled proxies.
2. Multiscale (scale redundancy)
3. Easily updateable, interpretable
4. Spatially explicit estimates of uncertainty
5. Robust



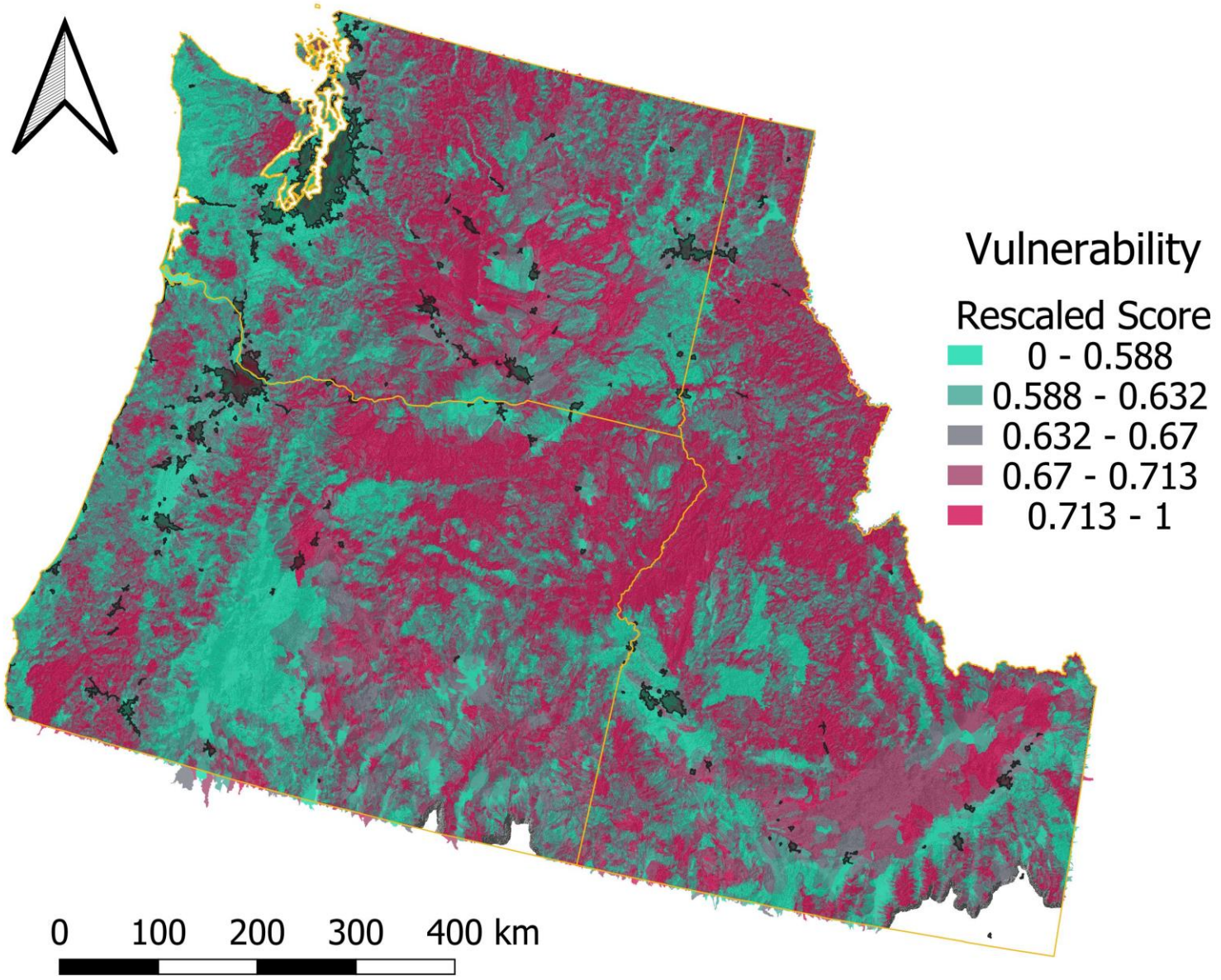
Absolute Vulnerability Score (Mean Score)

- Average of all iterations
- Represents “true value”
- Less sensitive to variation within 1 std. dev.



Relative Vulnerability Score (Rescaled)

- Normalized (rescaled) to 0-1
- Represents region-wide relative hazard
- Particularly useful for large-scale planning

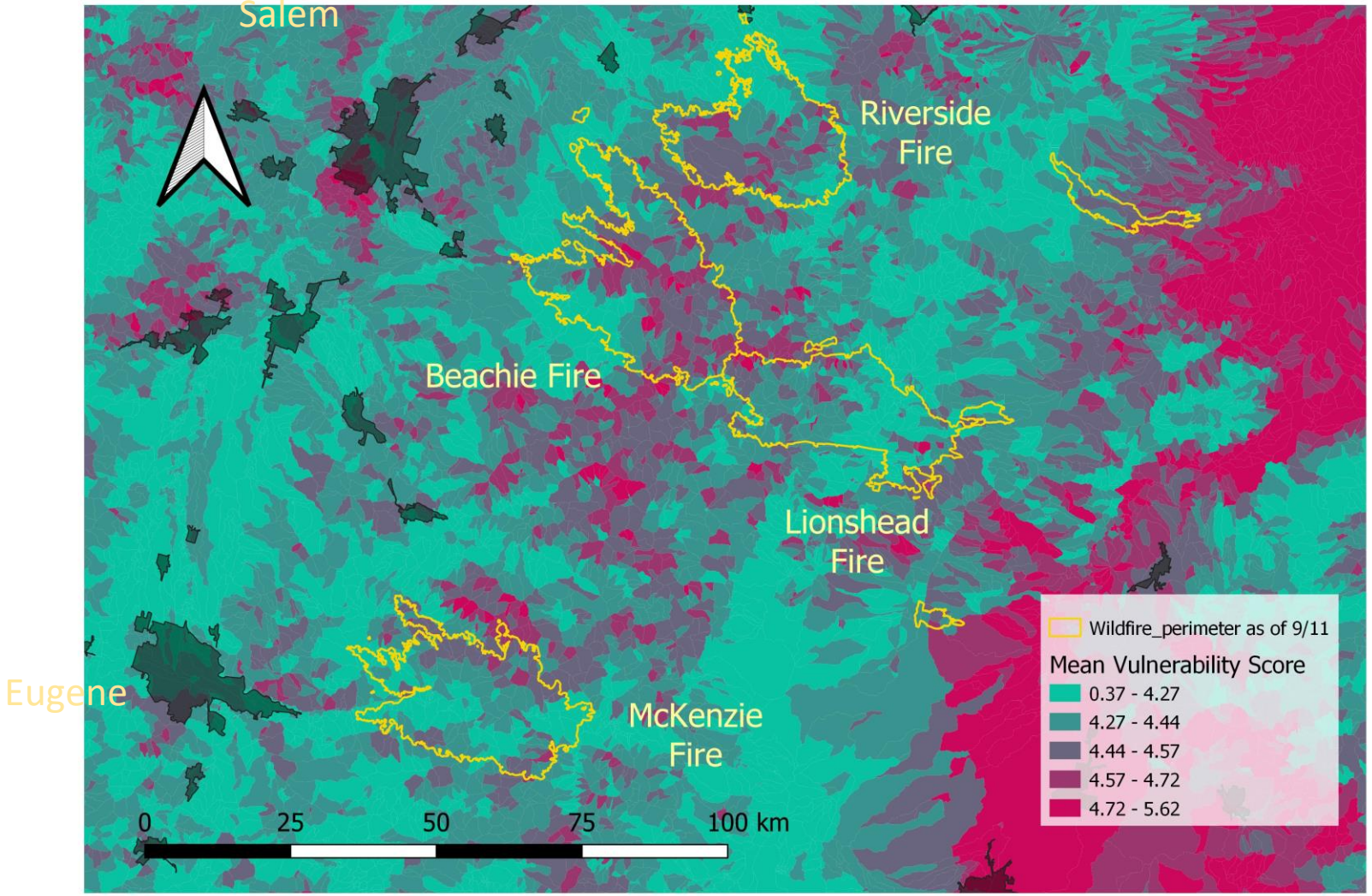


Quick Pause for questions

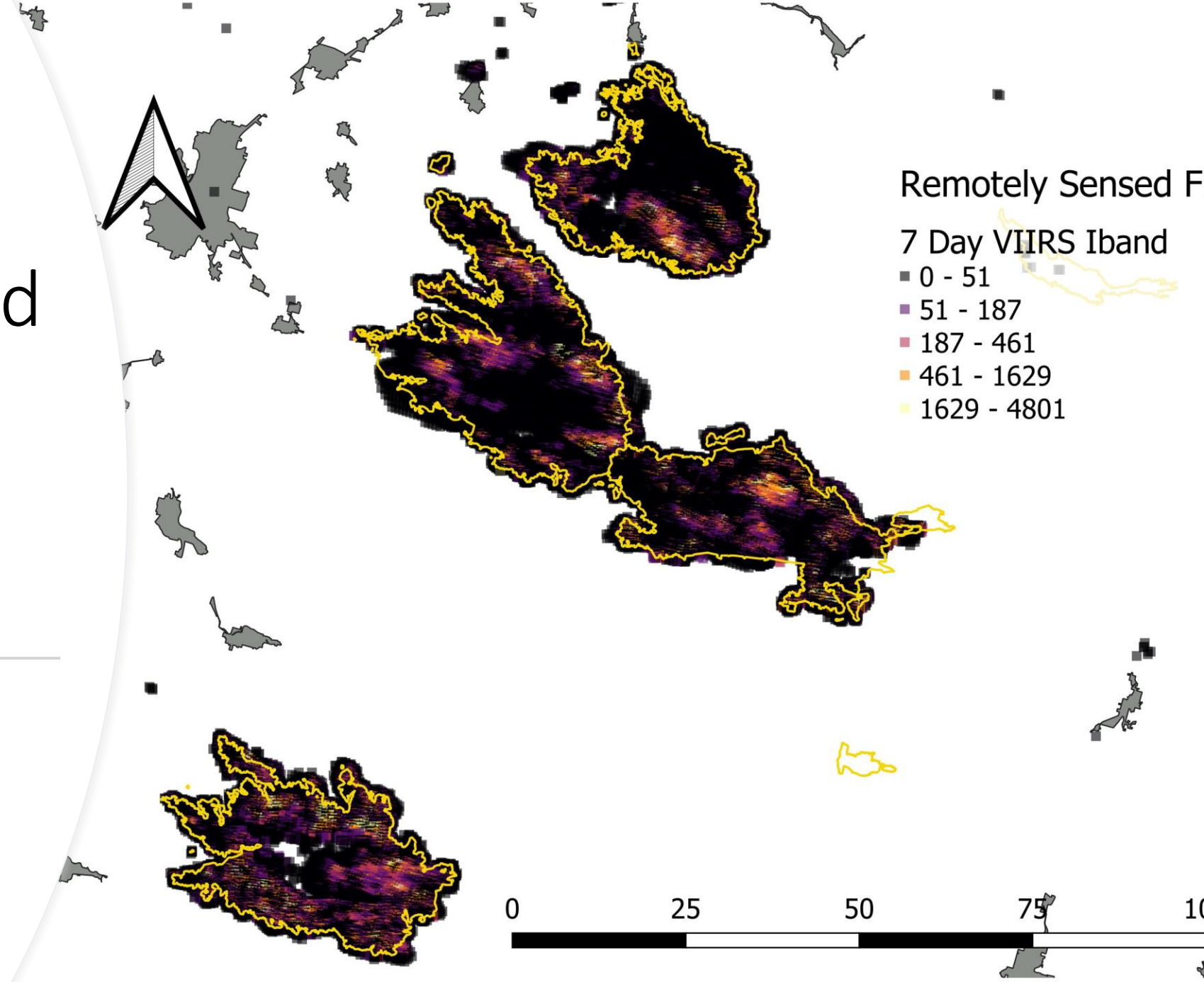
Near-real time assessment : a quick example

Western Cascade Fires OR, 2020

Enter: Unusual fire event in Region

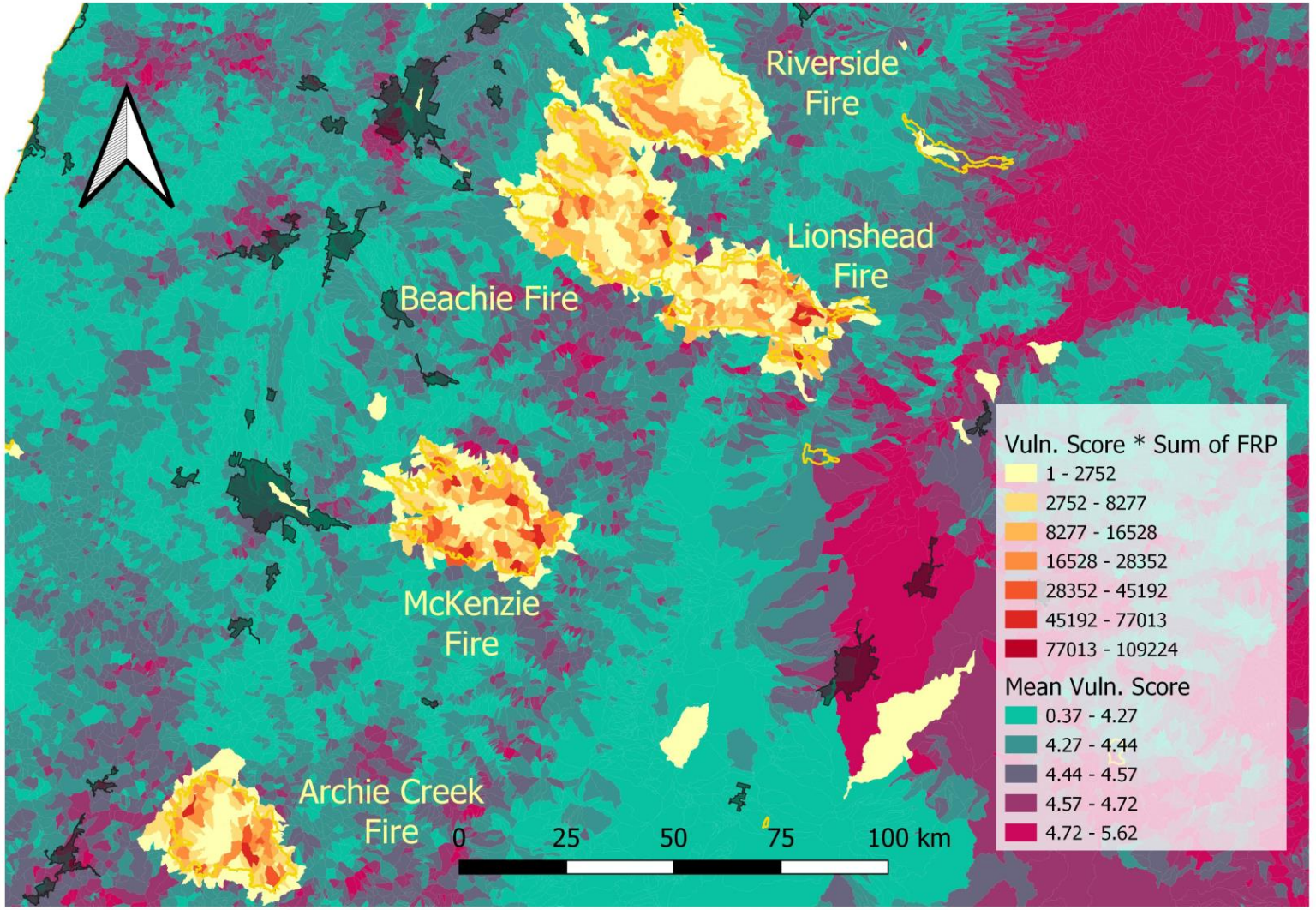


Remotely sensed fire intensity : Proxy for burn severity?



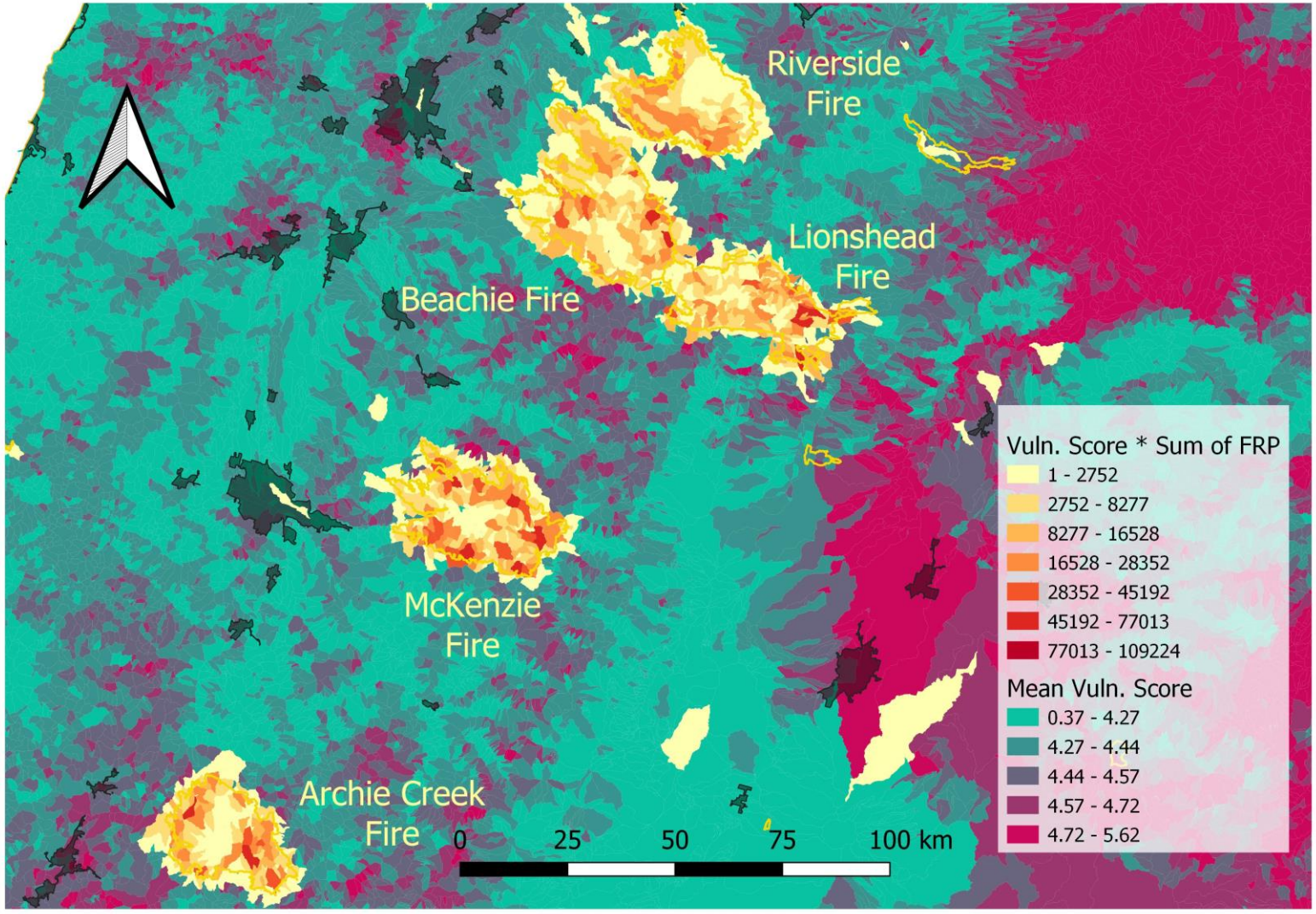
Using thermal returns to identify hazard in real-time

- Thermal dose is proportional to severity (posited)
- Add up thermal returns
- Multiply by vulnerability
- Approximates hazard



Section Wrap-Up

- Rapid Assessment of hazard potential
- Many potential uses
  - BAER Planning
  - Water Utilities
  - Restoration Projects
- Hypothetical
  - Need data
  - 2020 Fires => experimental control

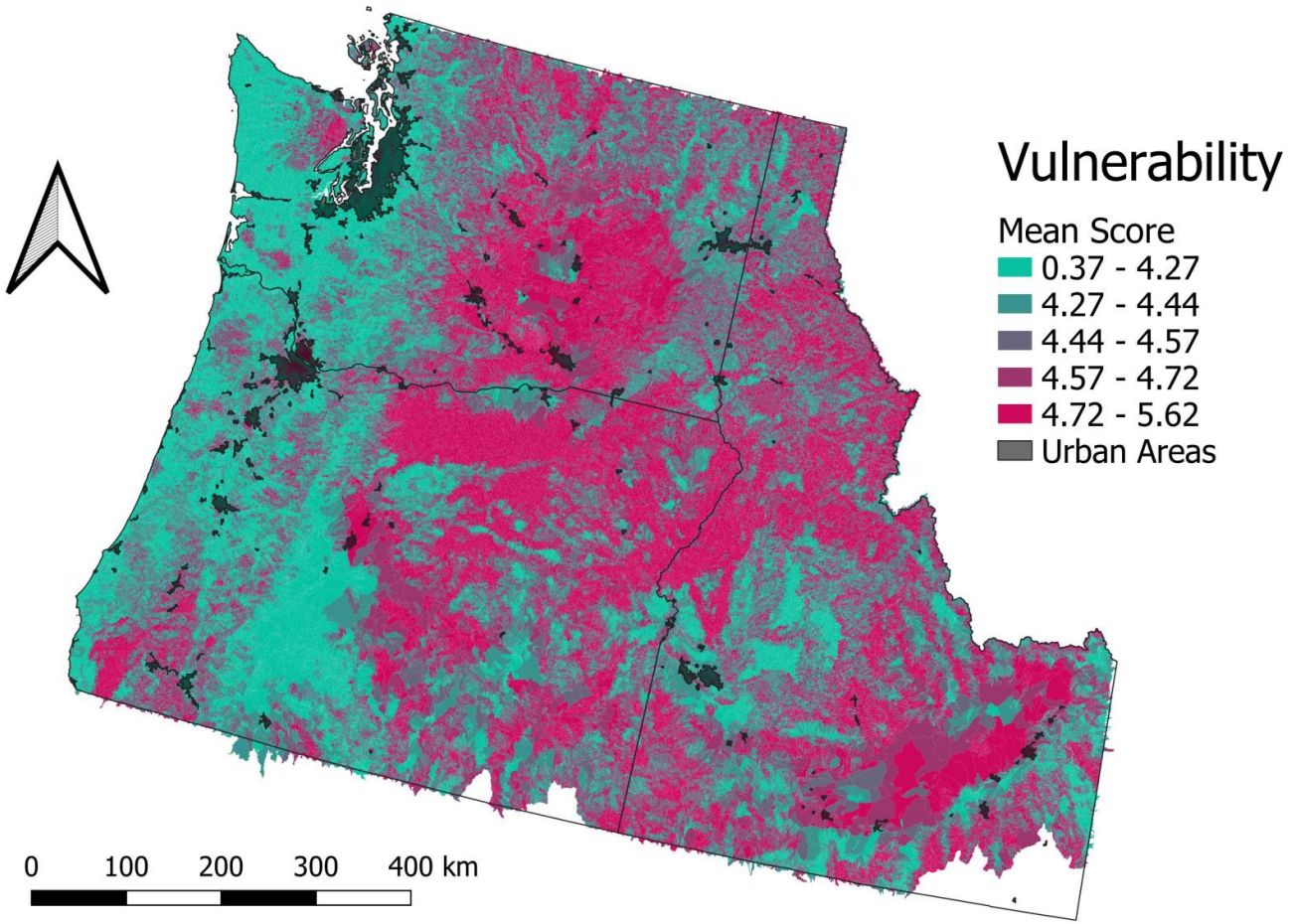


Municipality vulnerability assessment

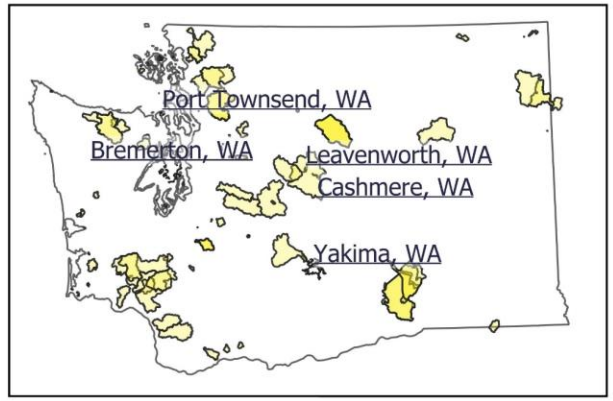
Surface Water Protection Areas, WA state

Aggregated probability to specific concerns

- Vuln. index is a composite (franken-) metric
- Useful as planning tool in *anticipation of fire*
- Individual covariates and factor grouping



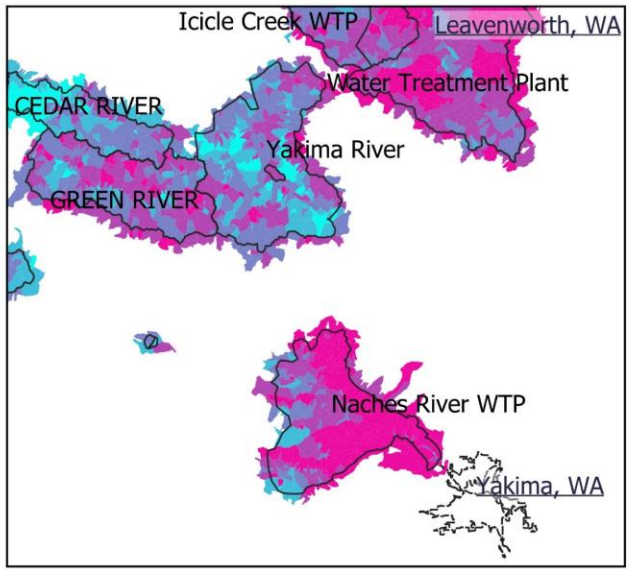
Wildfire Vulnerability of Select SWP Areas in WA

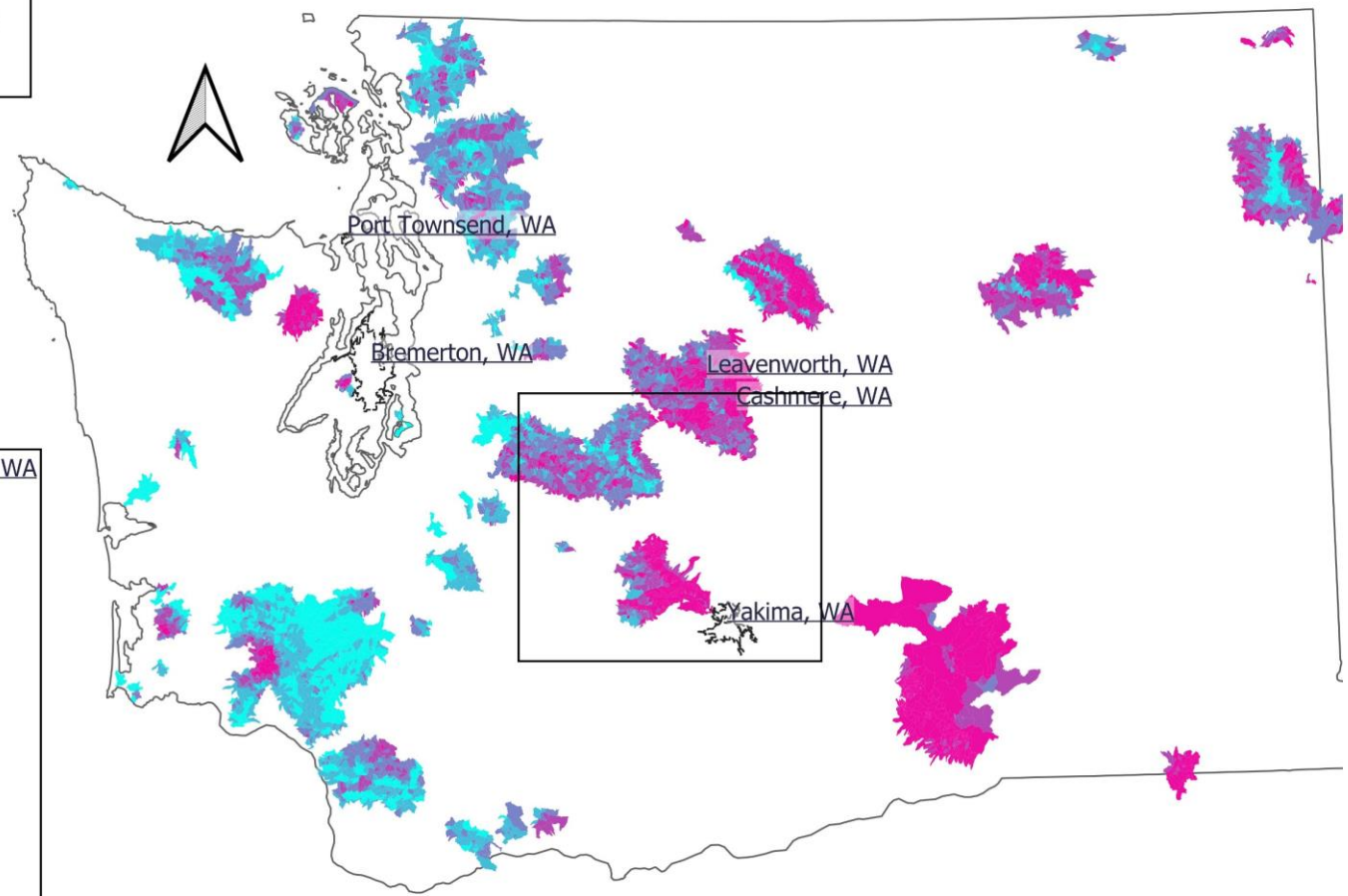


Select SWP Areas

Mean Vulnerability

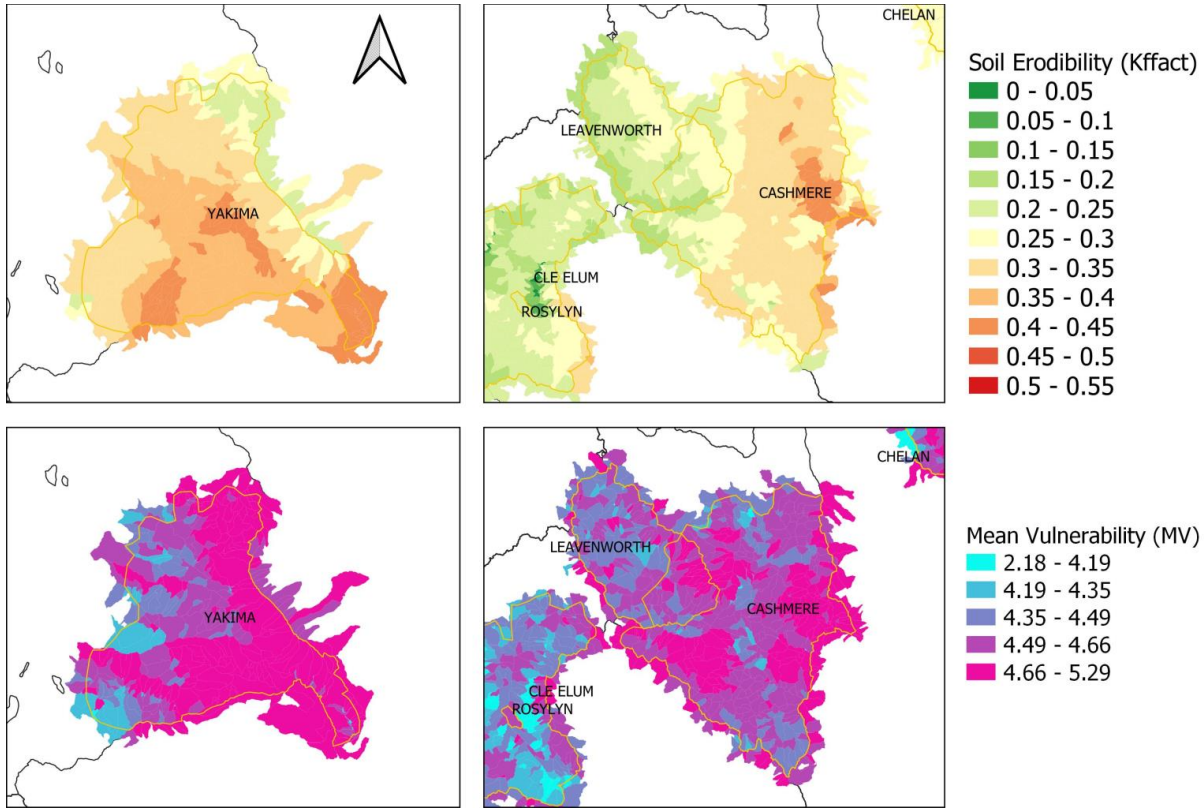
- 2.18 - 4.19
- 4.19 - 4.35
- 4.35 - 4.49
- 4.49 - 4.66
- 4.66 - 5.29



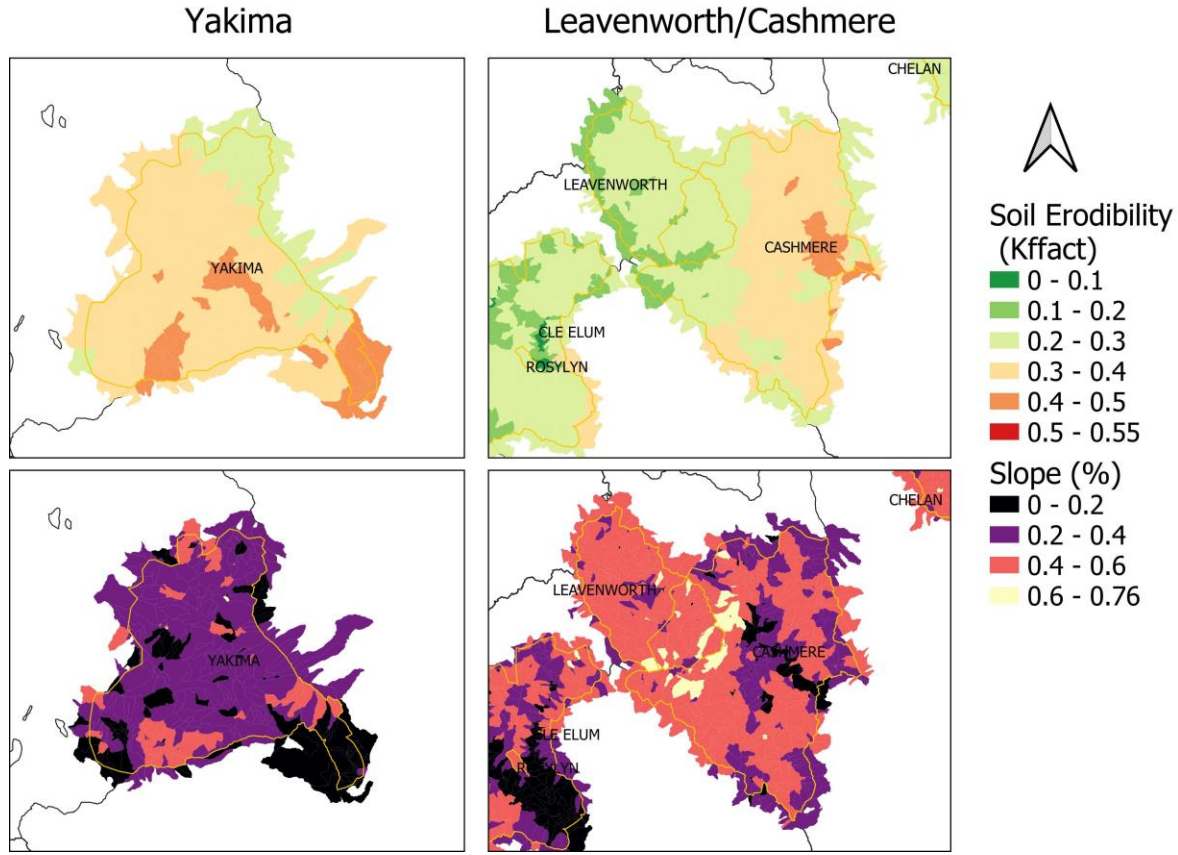


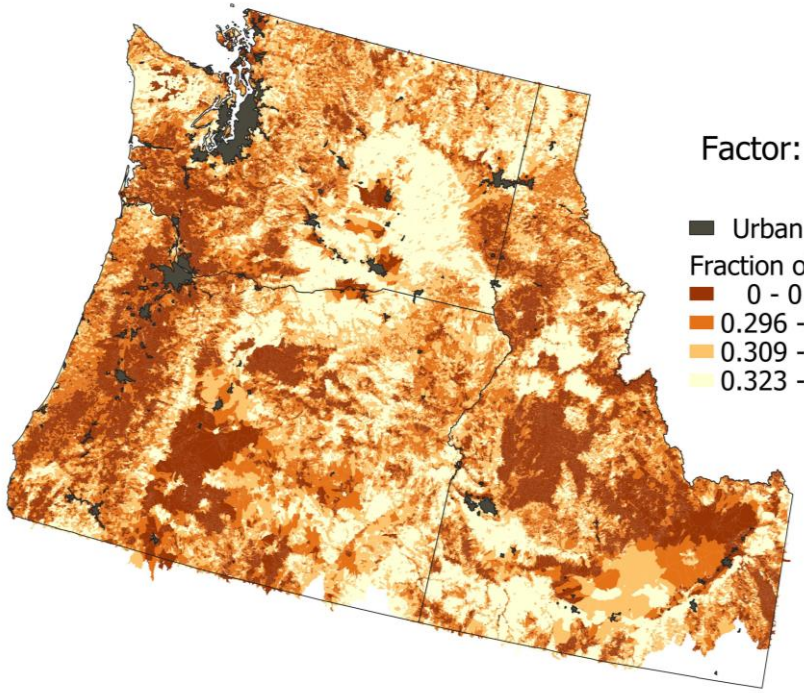
Individual catchment properties yield insights into sources of vulnerability

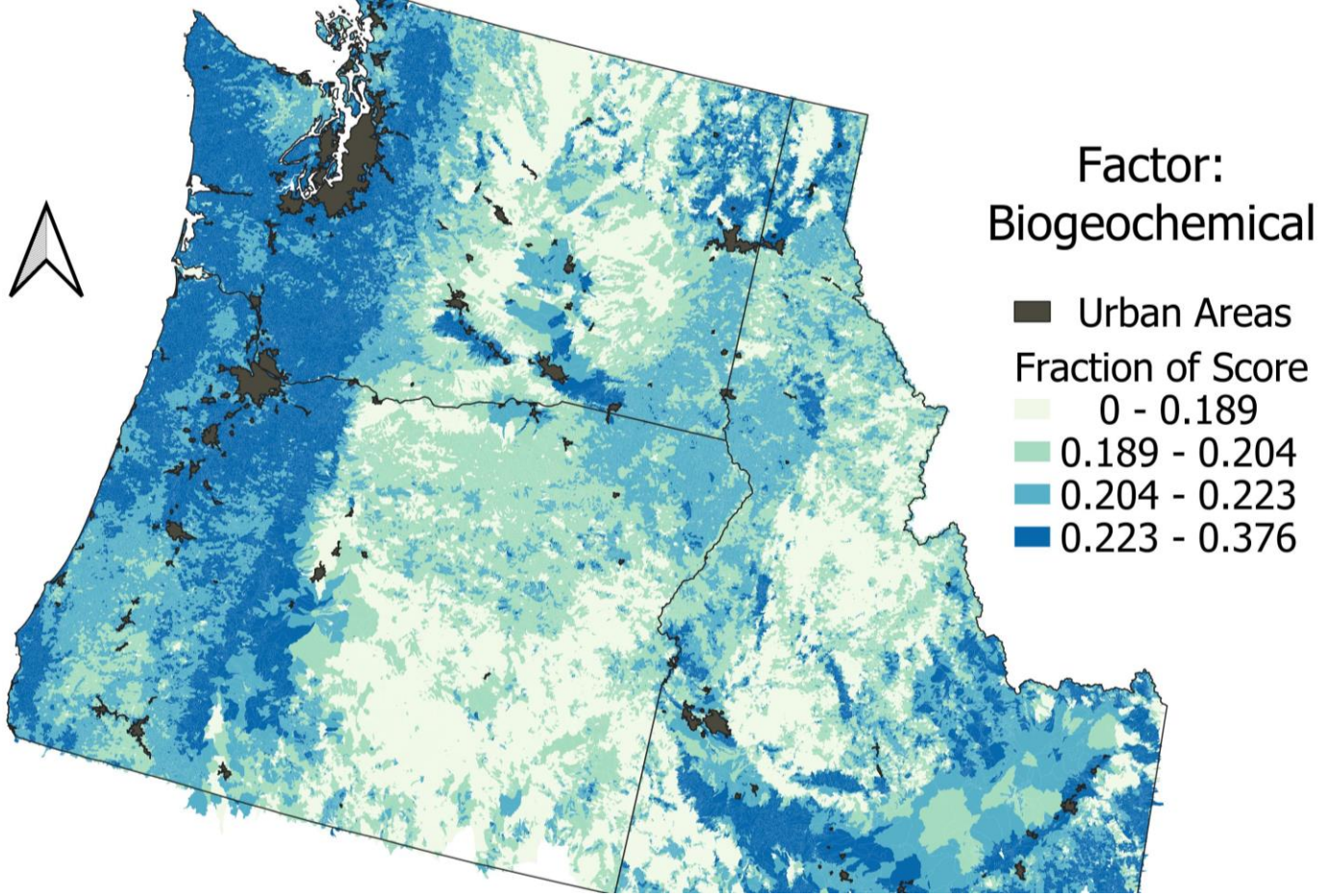
Soil erodibility (textural basis)

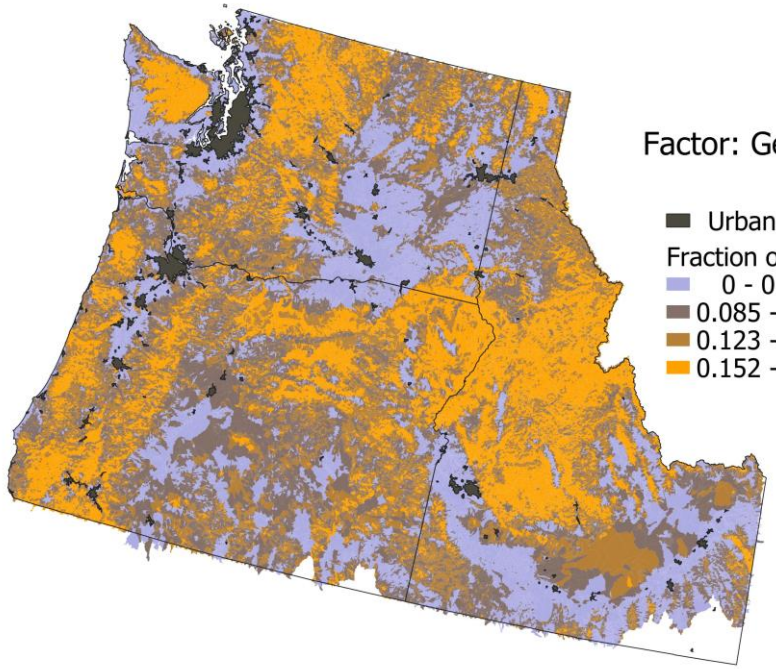


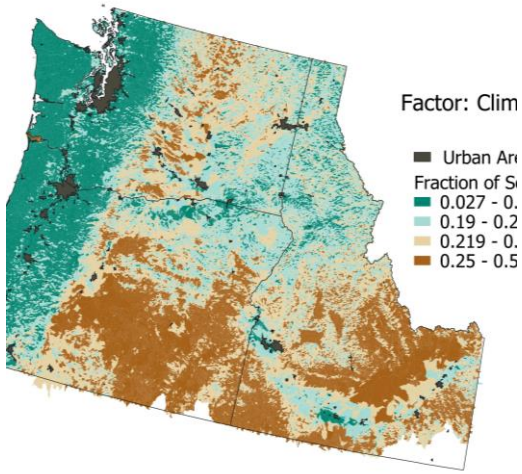
Erosion is also dependent on slope…

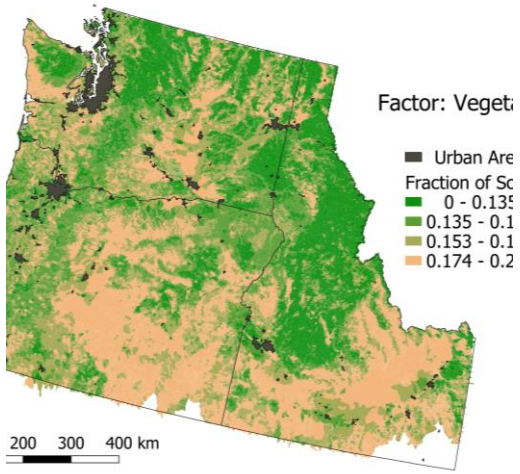


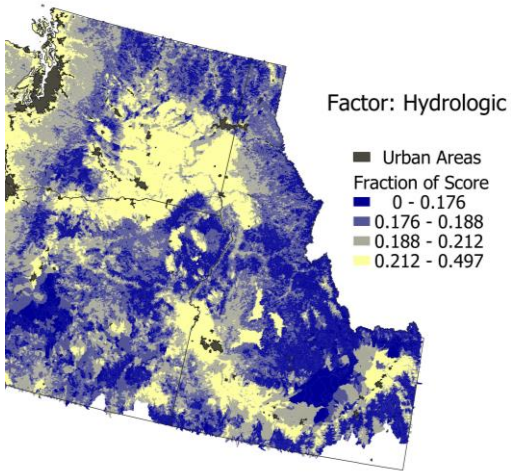

Factor: Soil
Urban Areas
Fraction of Score
0 - 0.296
0.296 - 0.309
0.309 - 0.323
0.323 - 0.458


Factor:
Biogeochemical
Urban Areas
Fraction of Score
0 - 0.189
0.189 - 0.204
0.204 - 0.223
0.223 - 0.376


Factor: Geologic
Urban Areas
Fraction of Score
0 - 0.085
0.085 - 0.123
0.123 - 0.152
0.152 - 0.476

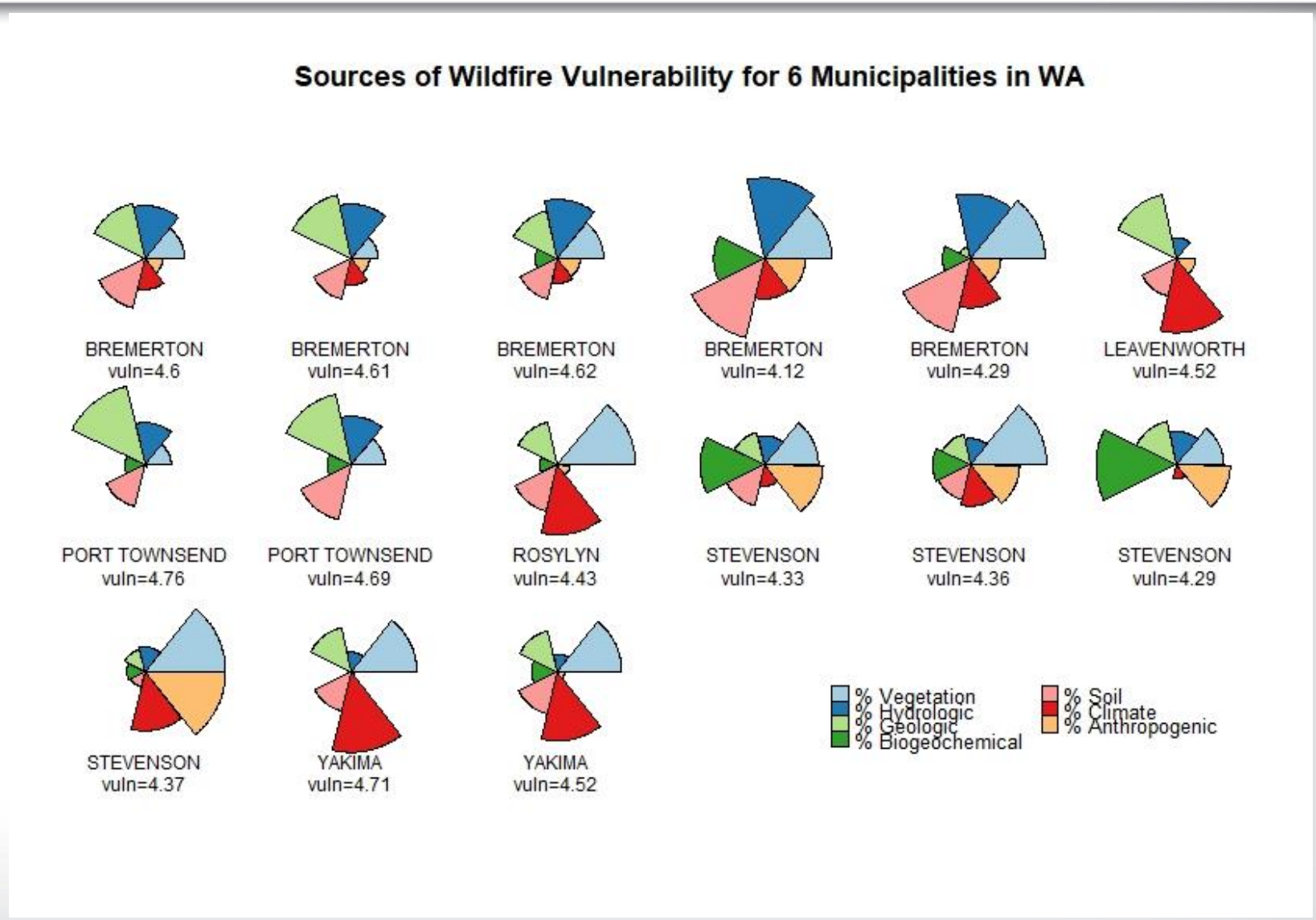

Factor: Clim
Urban Ar
Fraction of S
0.027 - 0.
0.19 - 0.2
0.219 - 0.
0.25 - 0.5


Factor: Vegeta
Urban Are
Fraction of Sc
0 - 0.135
0.135 - 0.1
0.153 - 0.1
0.174 - 0.2
200 300 400 km


Factor: Hydrologic
Urban Areas
Fraction of Score
0 - 0.176
0.176 - 0.188
0.188 - 0.212
0.212 - 0.497

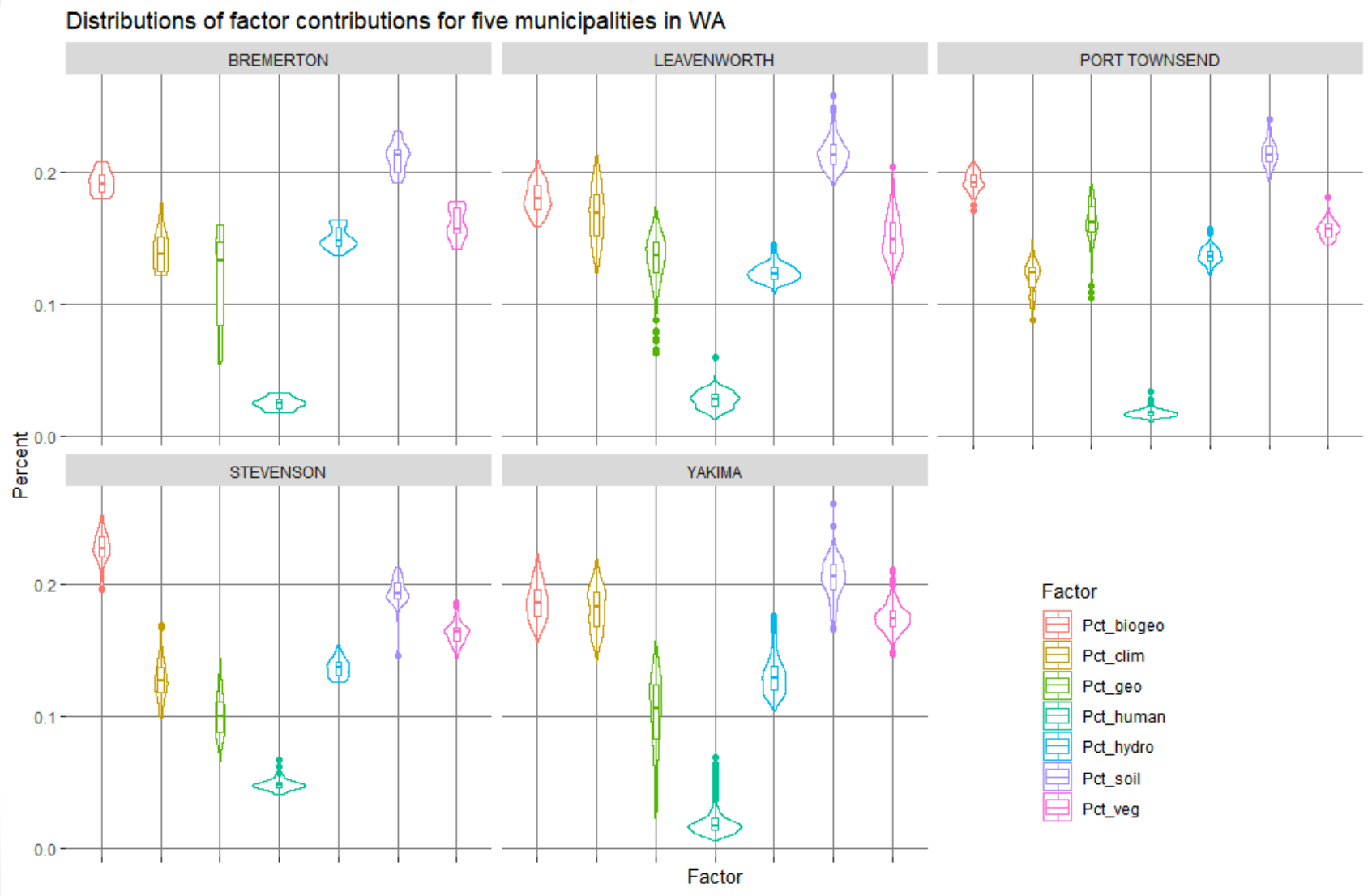
Factor Comparison for Municipalities

- Rapidly assess relative vulnerability
- Factors can be used to identify comparable SWP areas
- Identify likely effects
- However, aggregation prevents fine-level management actions



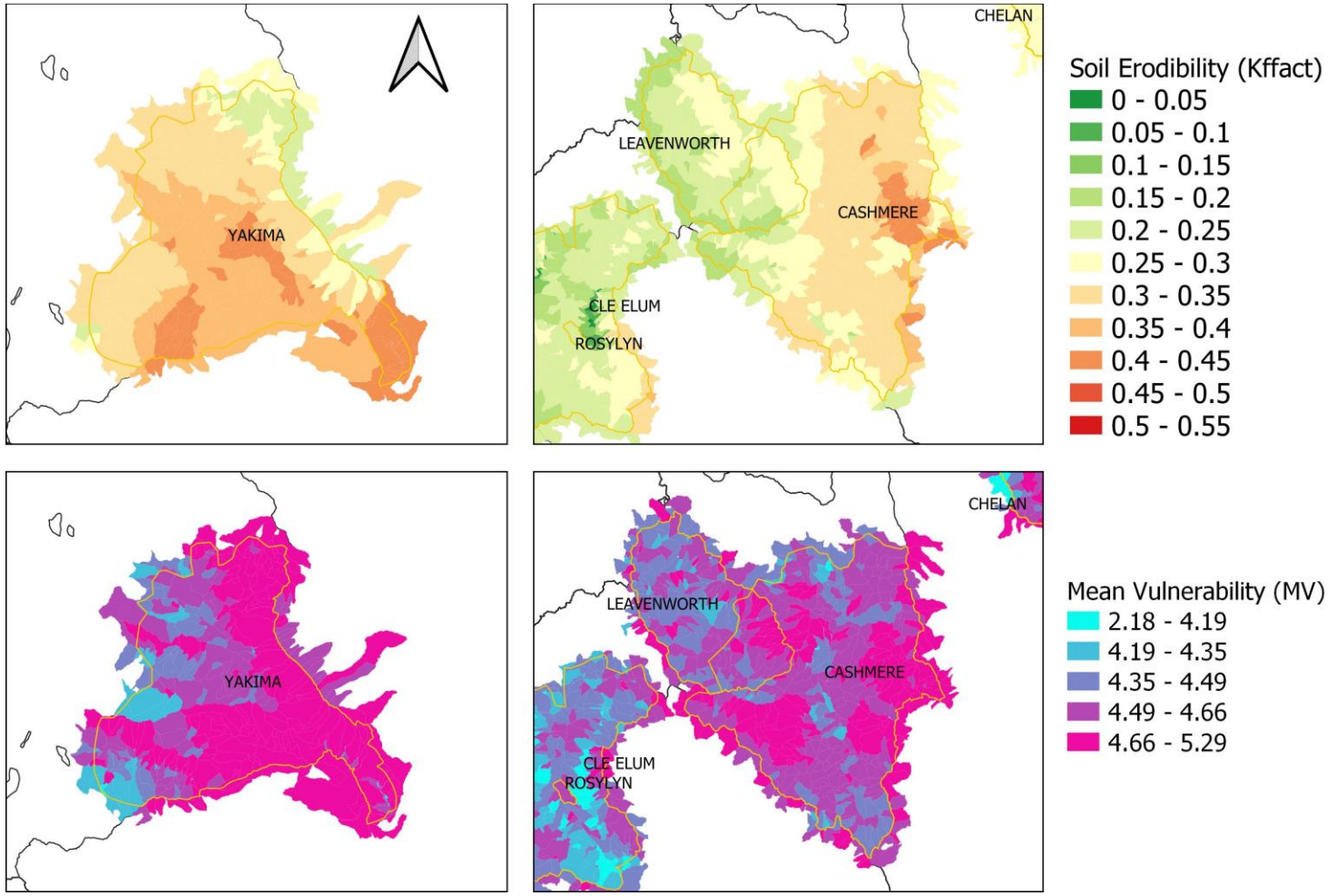
Identifying Variation within SWP Areas

- Finer level sleuthing is needed for context
- Planning around extrema versus the average



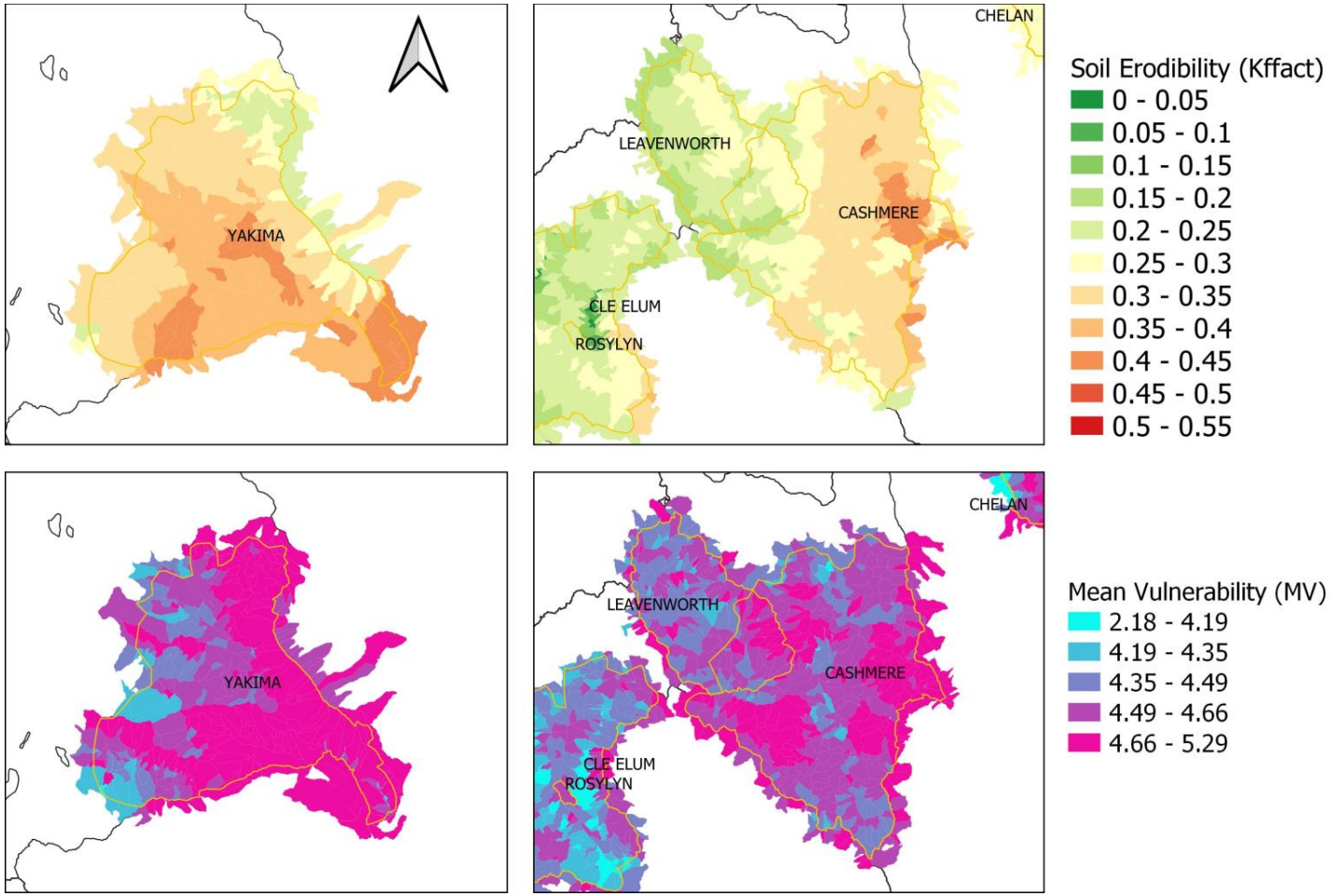
Summary and Takeaways (uses)

- Potential for wildfire hazard
  - Concise, robust, updateable
  - Useful for proactive planning
- Consistent across study area => regional coordination
- Can be used to compare study areas
- source of geospatial information



Summary and Takeaways (caveats)

- Work in progress
  - Awaiting external validation
- Represents a *hypothesis*
- Can not provide specific information
  - Need detailed, process-based models
- Compliments post-fire planning efforts



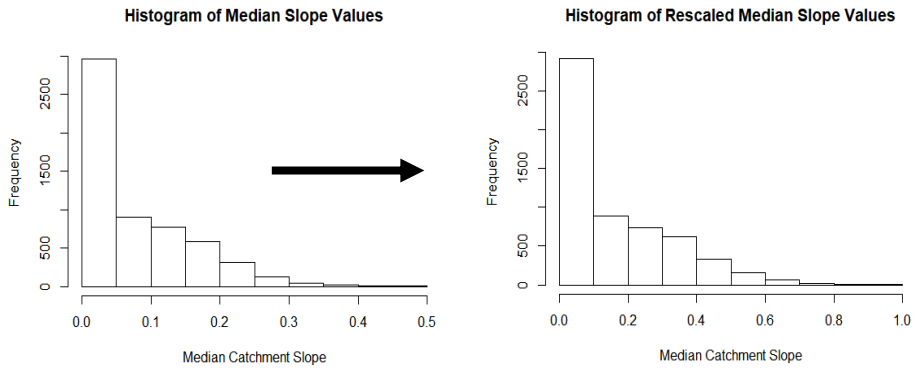
Questions / Comments

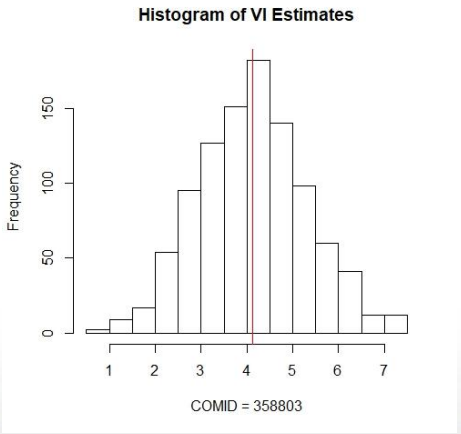
Email : Almquist.vance@epa.gov

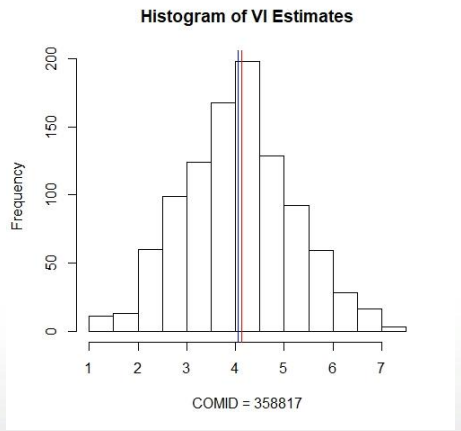
Generalized Methodologic Approach

$$y = \sum (x_1, x_2, \ldots, x_n)$$

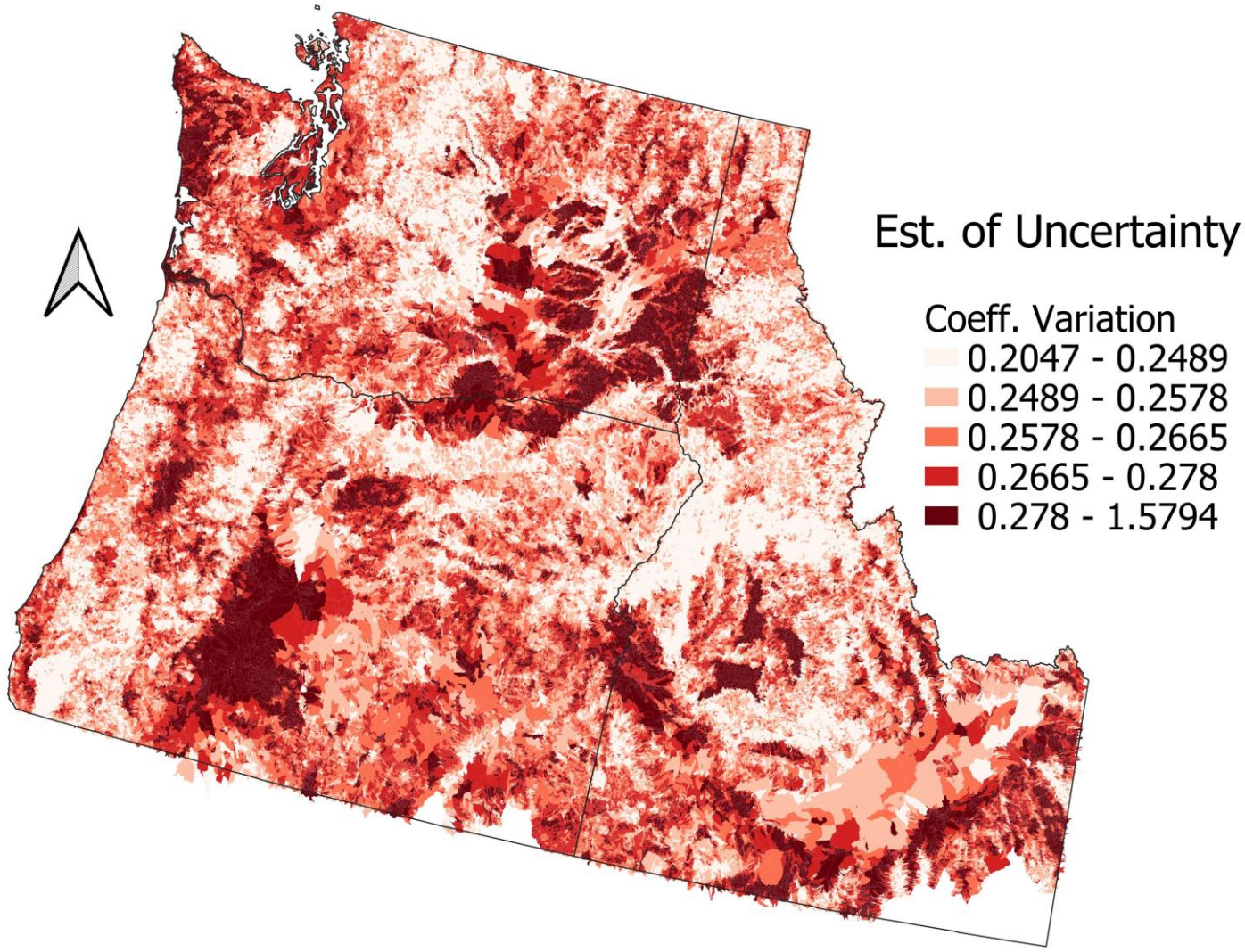
1. Unweighted, rescaled variables (0-1)
2. Randomly sample 30% of variables
3. Sum values to construct index
4. Iterate 1000 times to calculate mean, median, S.D., and Coeff. Variation

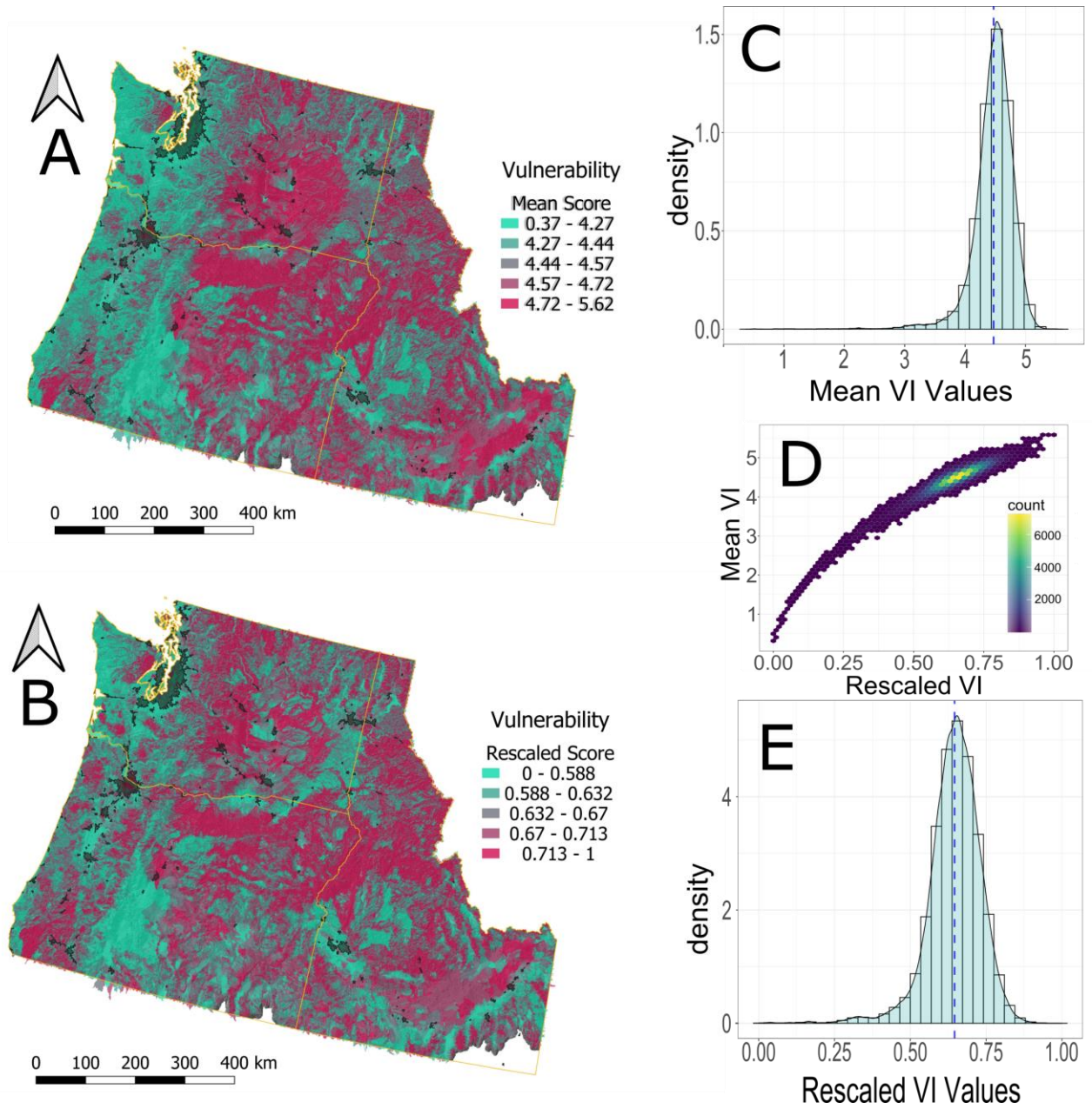


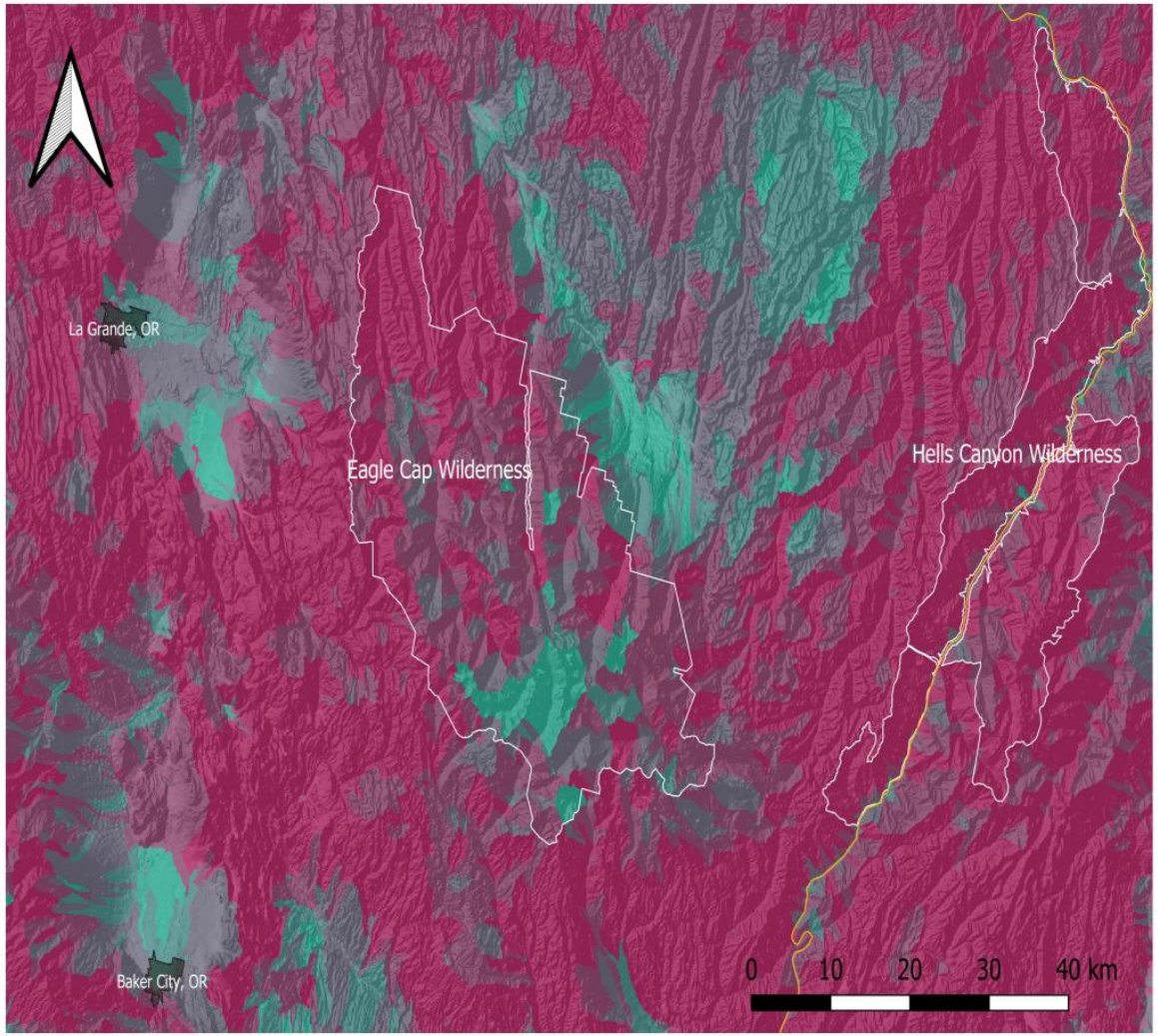




Model Derived Uncertainty




A
Vulnerability
Mean Score
0.37 - 4.27
4.27 - 4.44
4.44 - 4.57
4.57 - 4.72
4.72 - 5.62
0 100 200 300 400 km
B
Vulnerability
Rescaled Score
0 - 0.588
0.588 - 0.632
0.632 - 0.67
0.67 - 0.713
0.713 - 1
0 100 200 300 400 km
C
density
Mean VI Values
D
Mean VI
count
6000
4000
2000
Rescaled VI
E
density
Rescaled VI Values


La Grande, OR
Eagle Cap Wilderness
Hells Canyon Wilderness
Baker City, OR
0 10 20 30 40 km

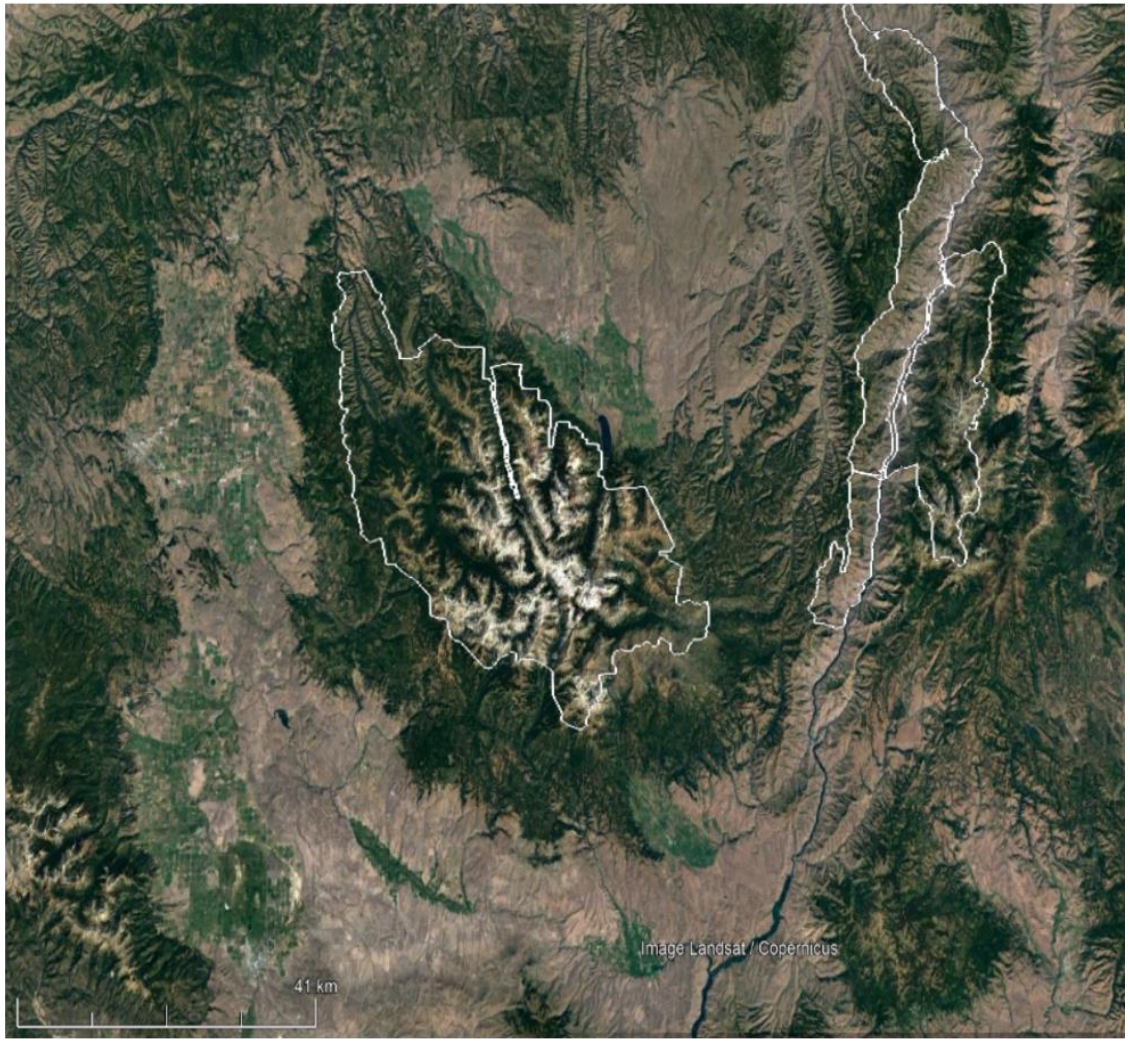


Image Landsat / Copernicus
41 km

- MODIS correlation to rdBNR: Heward et al., 2013
  - International Journal of Wildland Fire 2013, 22, 910–918http://dx.doi.org/10.1071/WF12087
- Data source for VIIRS & Fire Perimeters : https://fsapps.nwcg.gov/afm/