FIA and Auxiliary NAIP DSM Pilot Project

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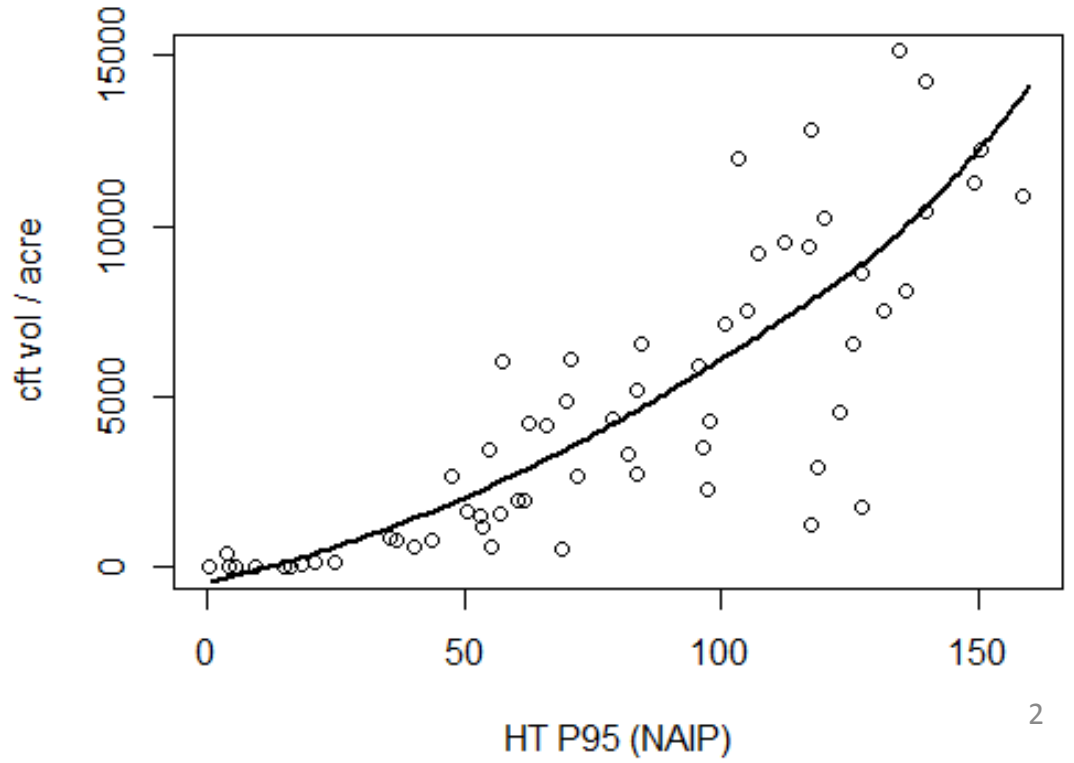
Height Based Remote Sensing

- Remotely sensed height & Field measurements correlated
  - Height, volume, biomass, cover,…
  - (field metrics such as CWD poorly correlated)



Typical Remote Sensing of Height

- lidar
  - Ground & vegetation
  - Works great!

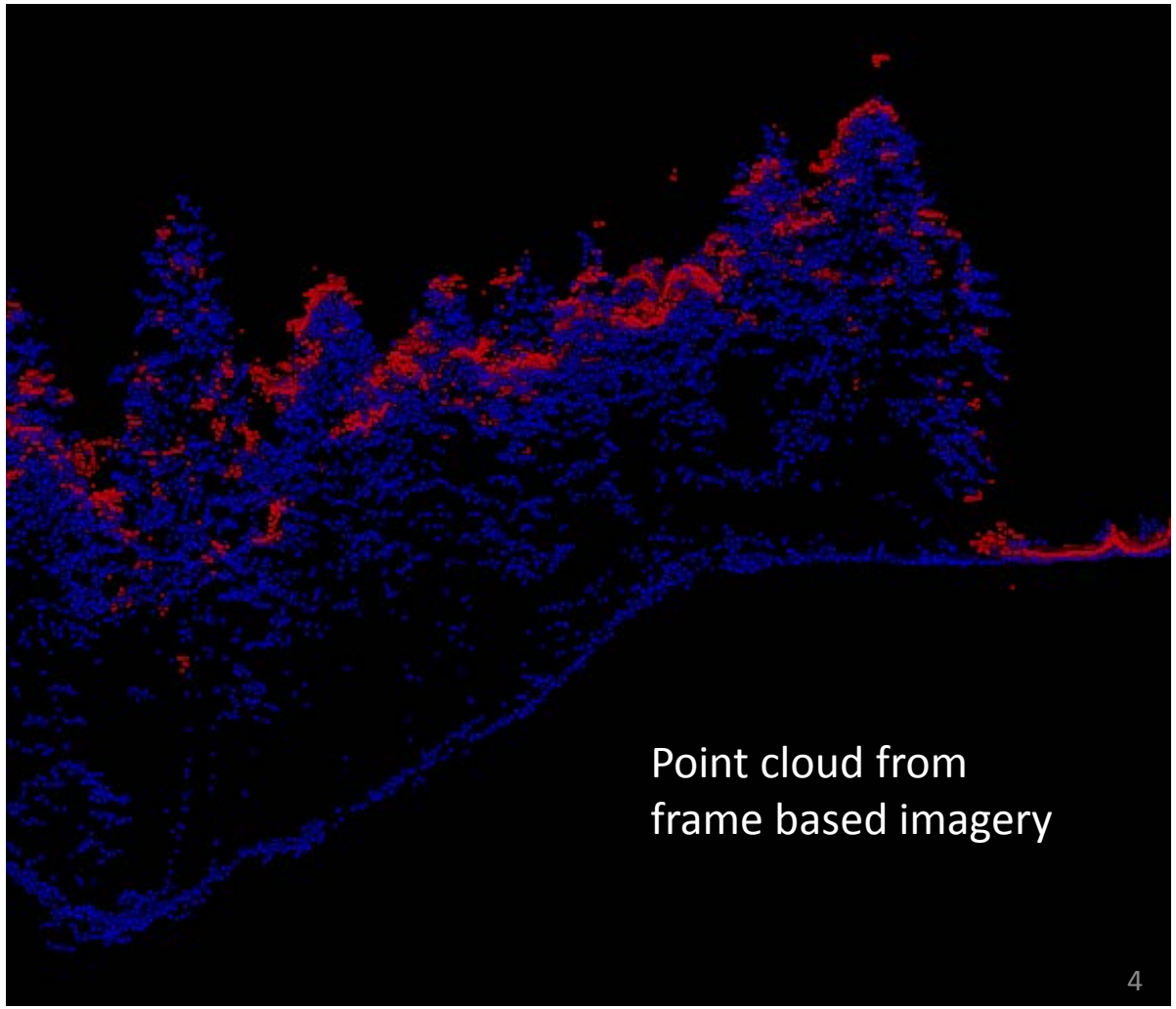
  But

  - Expensive
  - Re-measurement slow
  - Patchwork of projects – an exercise in complexity

Imagery (Stereo) as an Alternative to Lidar

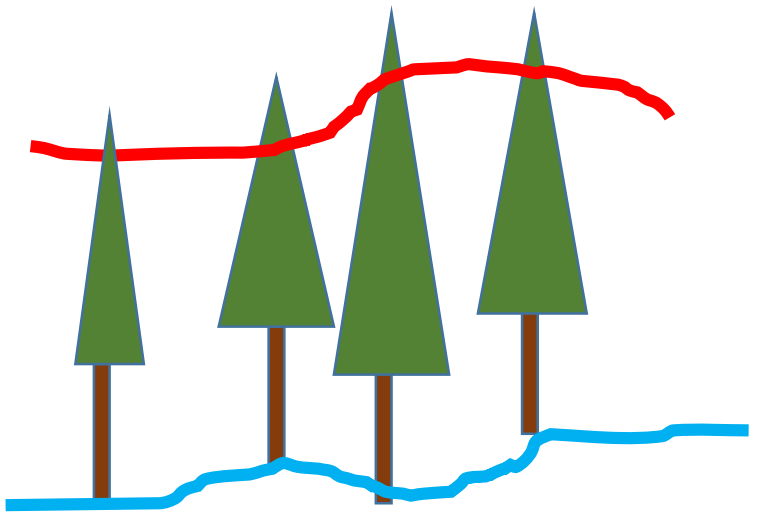
- Lower cost!
- Works well in tests

- No ground



Imagery Approach

- Canopy surface from Stereo Imagery (NAIP)

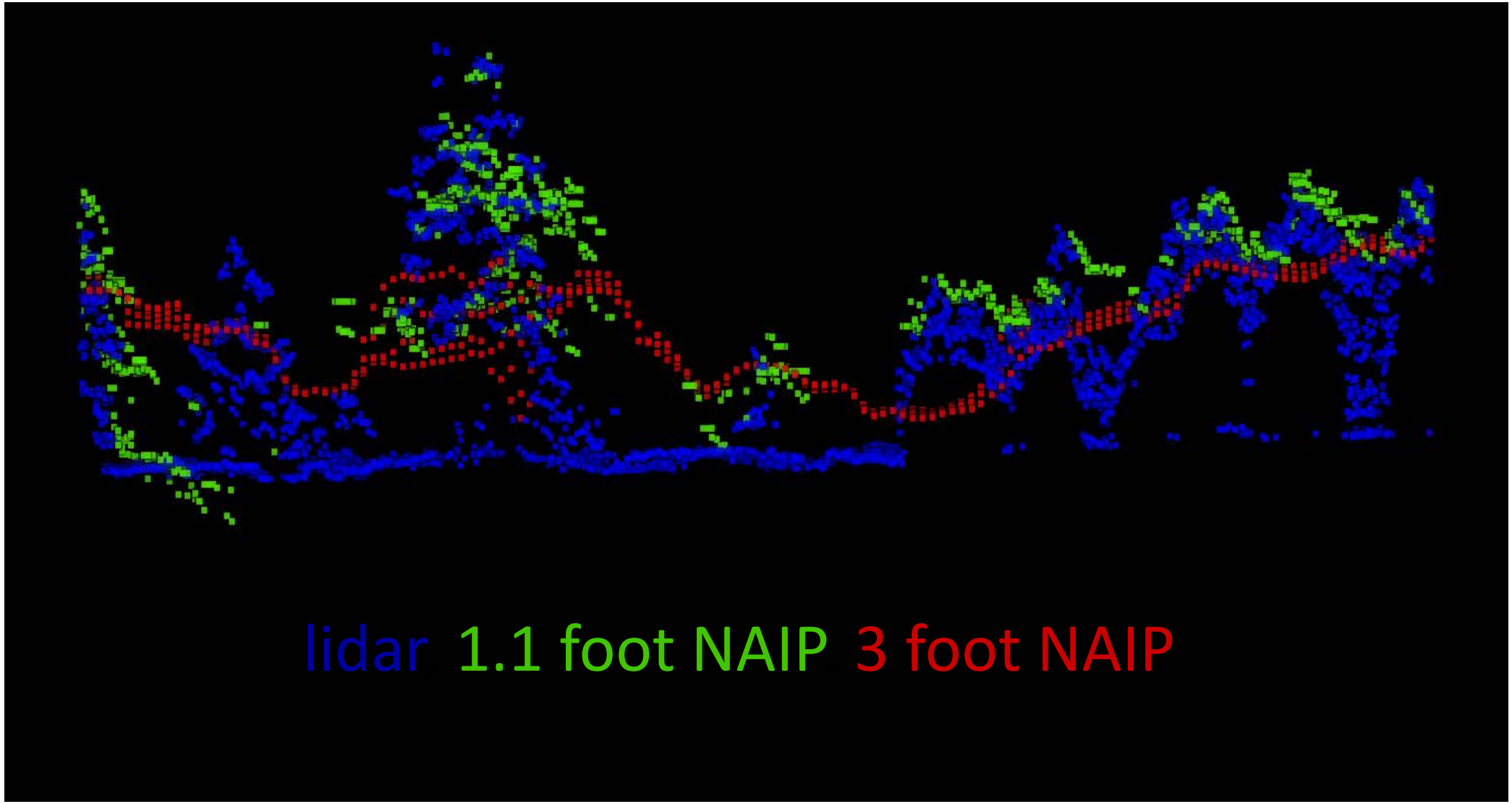


- Ground from lidar (0-18 yrs old)*
  - Old lidar OK for ground
  - Forest may have changed drastically
  - Ground typically does not

*Also looking at lidar-free approaches

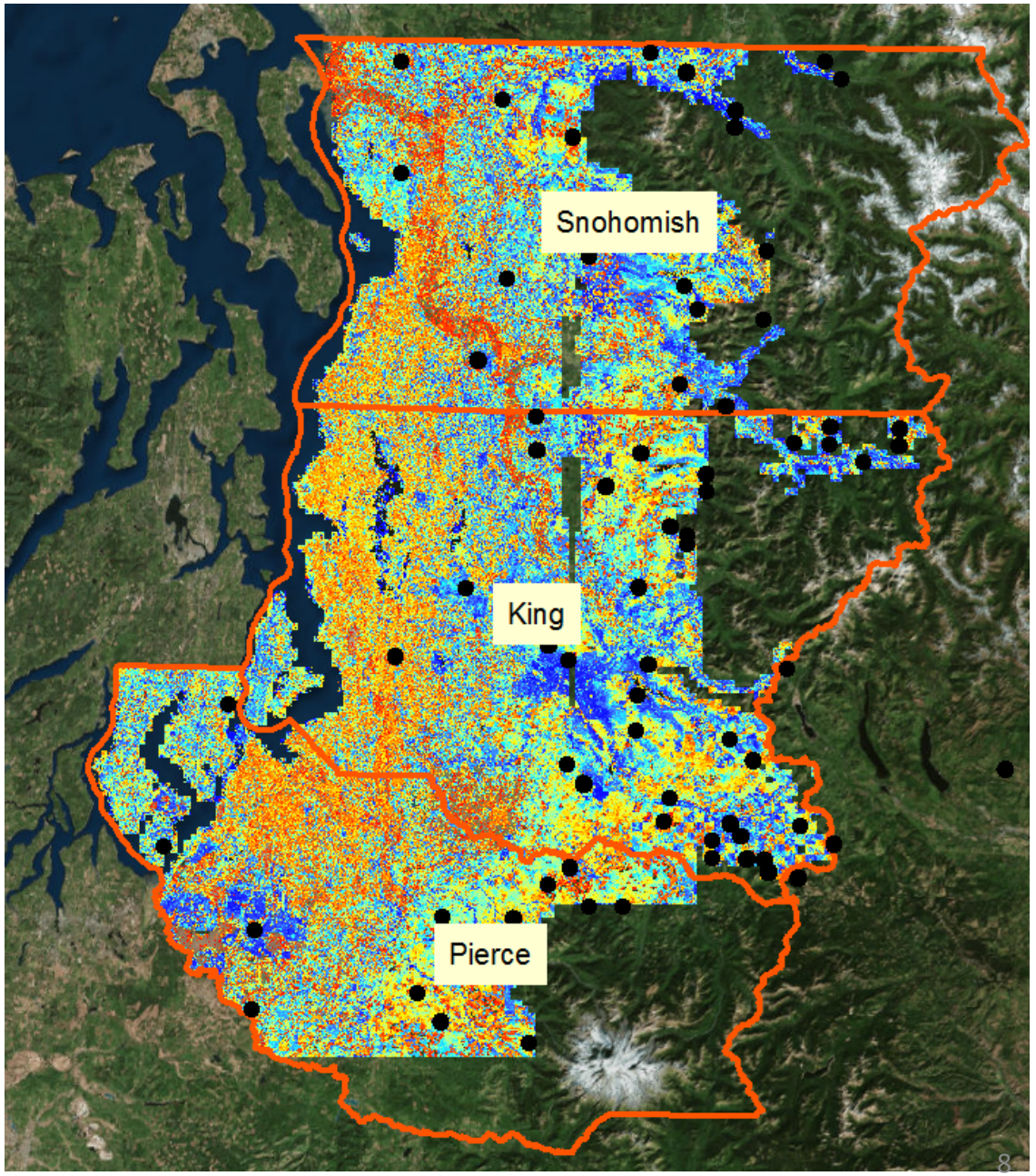
NAIP Imagery

- Wall to wall imagery over contiguous USA
- Frequent (2-3 years)
- 1.1 foot resolution (Stereo)
- $2.50 / Square kilometer (Hexagon / NW Group)


lidar 1.1 foot NAIP 3 foot NAIP

Initial Investigation

- Snohomish, King, Pierce counties
- Estimators
  - SRS
  - Post-stratification
  - Regression est.



Inference: Design Effect (inverse)

$\frac{\mathbf{1}}{\boldsymbol{DE}}$ = number of plots necessary with an simple random sample / HT estimator to achieve the precision of other design / estimator combinations.

$\frac{\mathbf{1}}{\boldsymbol{DE}}$ is a measure of *relative* efficiency with SRS / HT as baseline

Greater values of $\frac{\mathbf{1}}{\boldsymbol{DE}}$ indicated more efficient design / estimator

Volume Performance

Design	n	SE	$\frac{1}{DE}$
SRS	64	4734	1
PSTRS	64	2613	3.28
REG	64	1936	5.98

Simple Random Sample (SRS)
Post-Stratified Random Sample (PSTRS)
Regression Estimator (REG)

$\frac{1}{DE}$ represents the number of plots necessary with an SRS design to achieve the precision of the other designs.

Volume:

FIA plot density (SRS) ≈ 1 plot / 6000 acres

PSTRS (NAIP) ≈ 1 plot / 1830 acres

REG (NAIP) ≈ 1 plot / 1000 acres

Components (briefly)

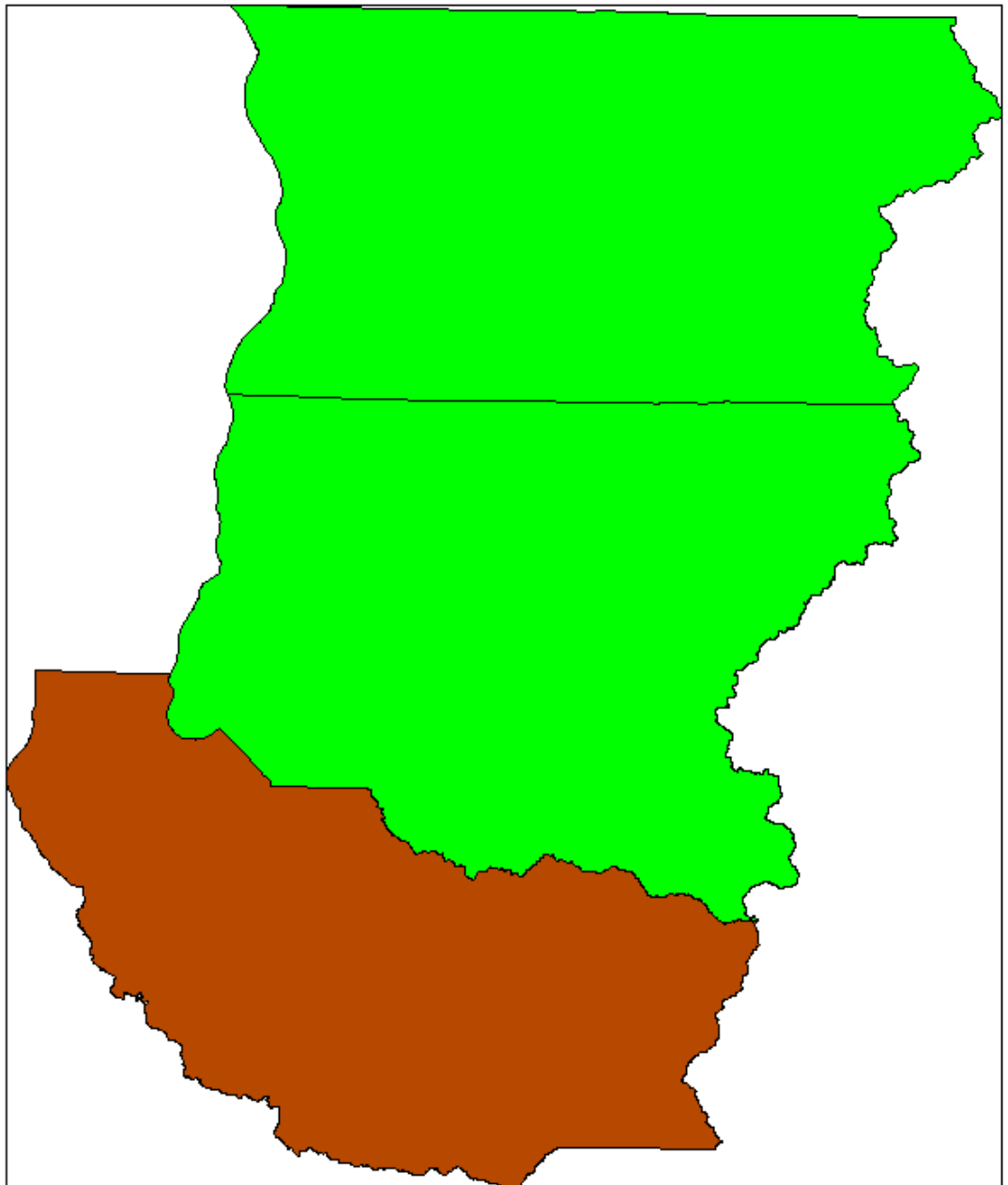
- Post-Stratification
- Volume BY Species BY Diameter class

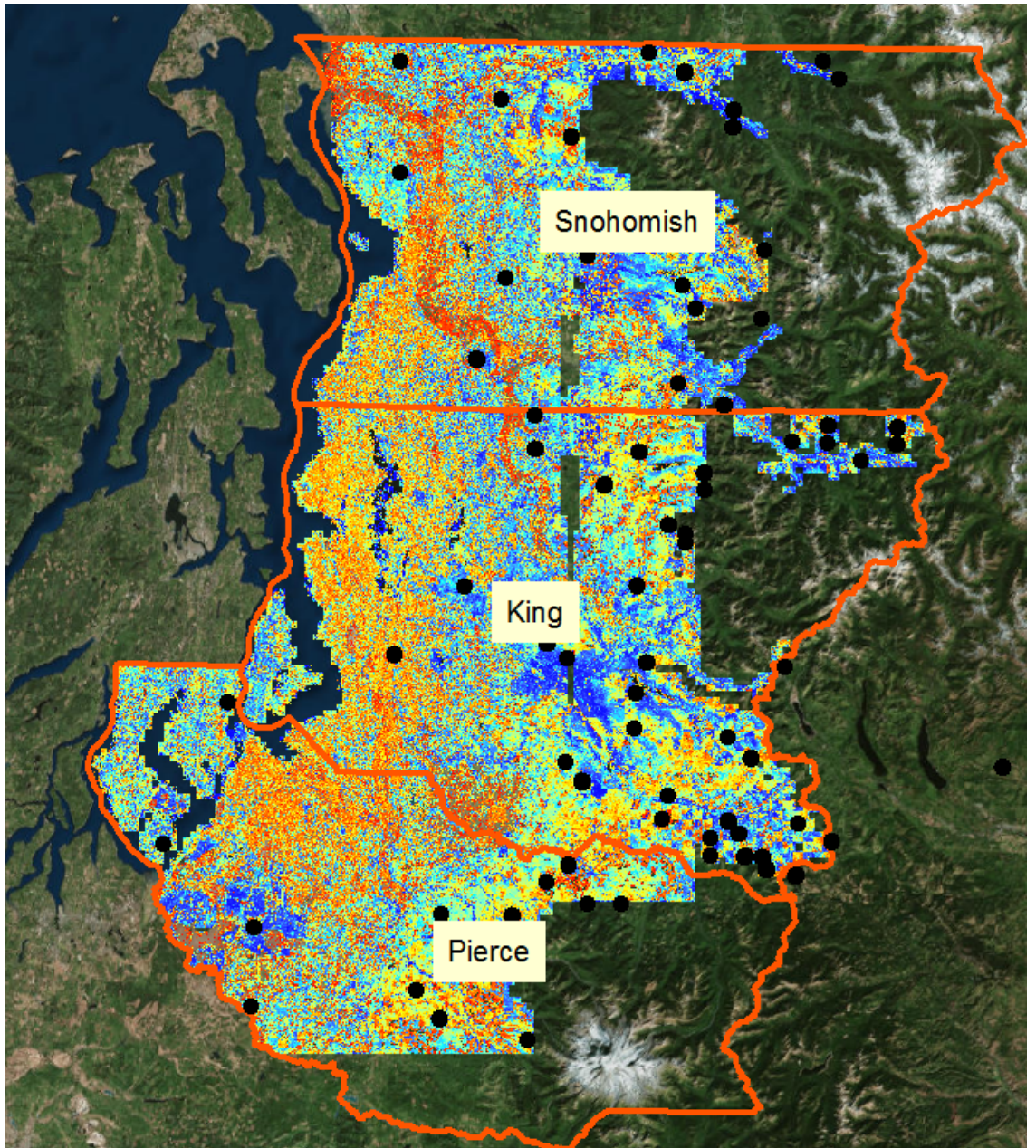
SPCD	Common Name
11	Pacific silver fir
202	Douglas-fir
242	western redcedar
263	western hemlock
264	mountain hemlock
312	bigleaf maple
351	red alder

	SPECIES CODE						
DBCL	**11**	**202**	**242**	**263**	**264**	**312**	**351**
8	1	0.2	2.6	2.1	0.8		
12	11.1	0.9	2	2.2		5.9	1.1
16	1.8	1.1	1.1	2	0.8	1.6	1.4
20	2	1.7	2.8	2.9	0.8	3.4	0.9
24	2.9	1.7	1.6	1.4	1.1	1.5	
28	1.7	2.8	1.3	6.3	1.2		0.8
32	1.1	1.8	0.9	4.3	0.9	1	
36	0.3	1.4	0.9	3.6	1.4	1.7	
40	1.4	1.9	1.3	5.9	1.4	1	0.8

DE^{-1} represents the proportion plots necessary with SRS design to achieve the precision of another design.

Differences in Spatial Resolution





Effect of Precise coordinates:

coordinates	n	SE	$\frac{1}{DE}$
precise	182	2580	4.1
coarse	182	3258	2.6

Equivalent (for volume) to increase in sampling intensity:

1 plot per 1300 acres (precise)

Or

1 plot per 2000 acres (coarse)