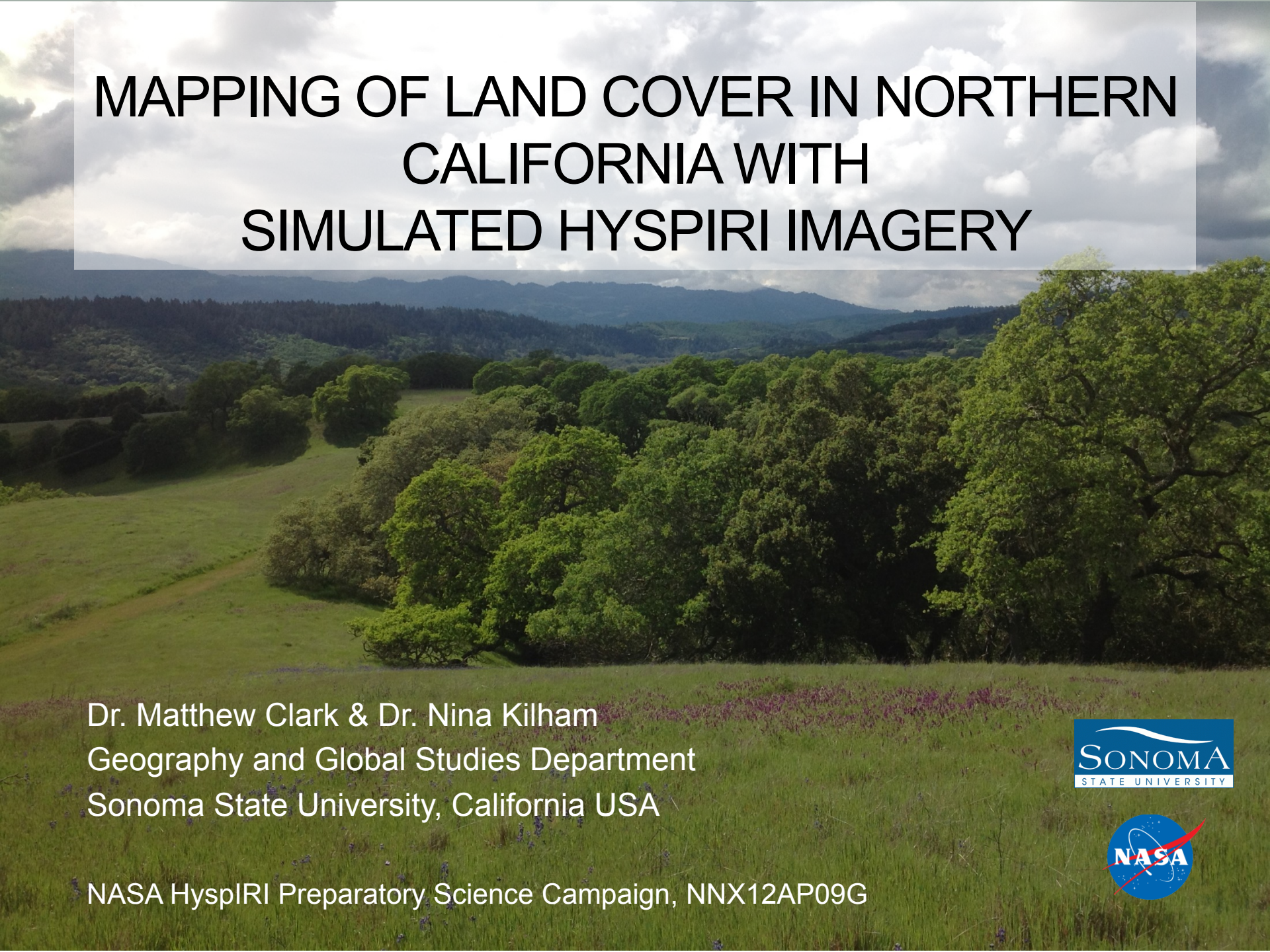
# MAPPING OF LAND COVER IN NORTHERN CALIFORNIA WITH SIMULATED HYSPIRI IMAGERY



Dr. Matthew Clark & Dr. Nina Kilham
Geography and Global Studies Department
Sonoma State University, California USA

NASA HyspIRI Preparatory Science Campaign, NNX12AP09G

# Objective

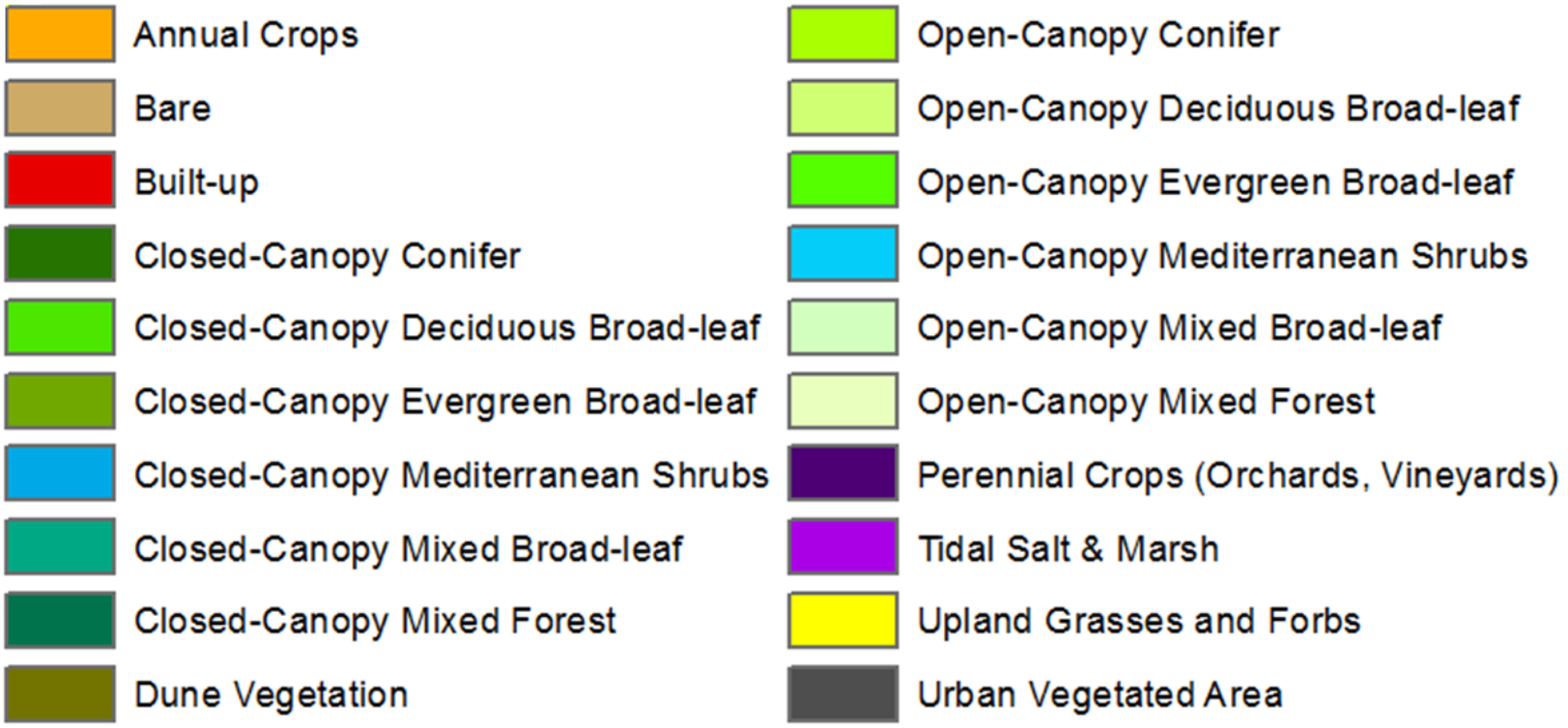
Land-cover and its change are important variables used by the science, policy and conservation communities

Will HyspIRI imagery produce better land-cover maps than possible with conventional satellites?

- More classes and with greater accuracy
- Reliable estimates of change (subtle and drastic)

# Land Cover Classification System (LCCS)

Global, universal system - U.N. FAO




Closed-Canopy: > 65% cover trees or shrubs
Open-Canopy: 15% - 65% cover trees or shrubs

# San Francisco Bay Area Analysis

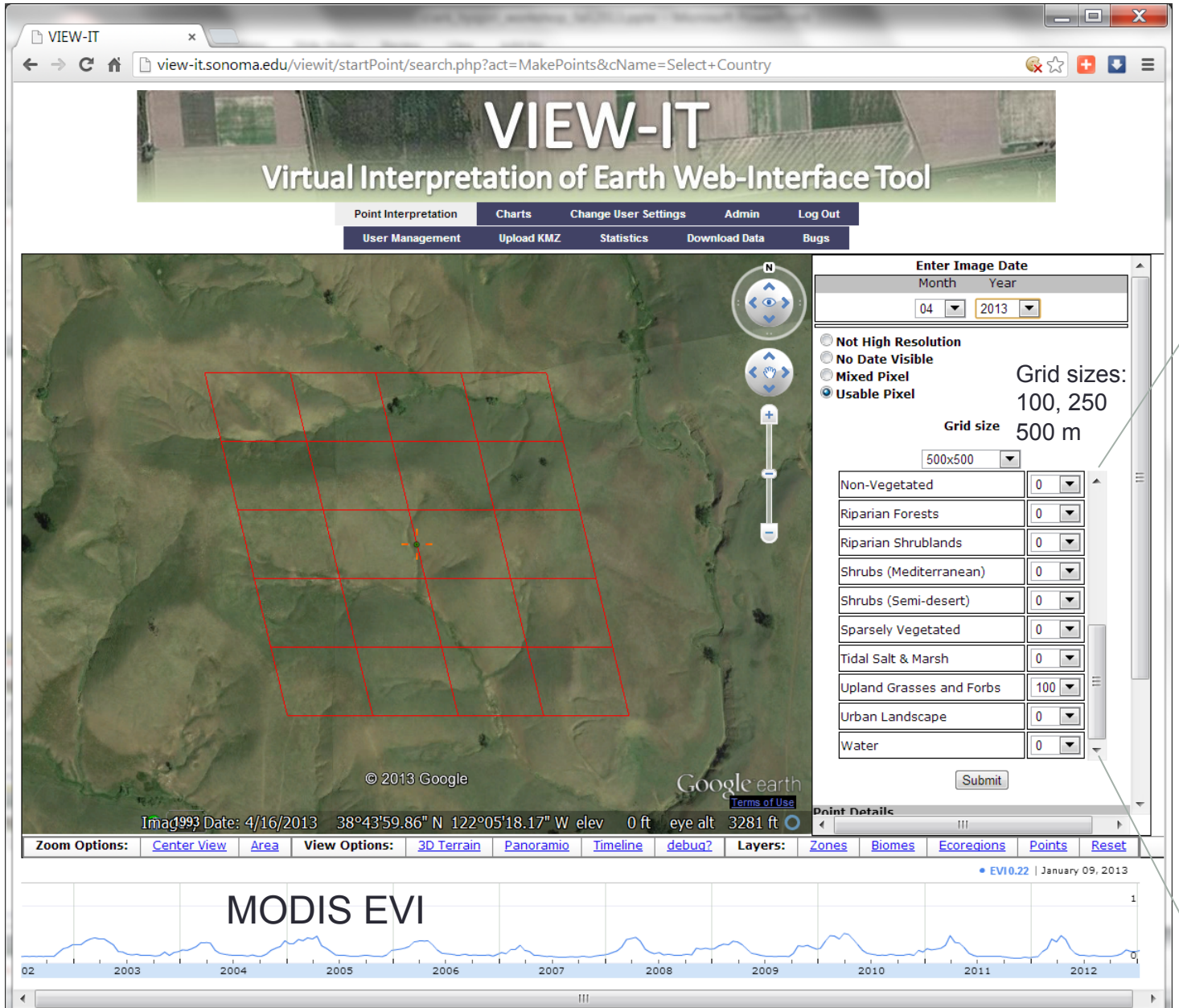
- SF Bay Area box (HyspIRI Prep. Science)
  - 2013 AVIRIS-C, ER2: Spring (April), Summer (June), Fall (Nov-Dec)
- Simulated HyspIRI products, 30 and 60 m
  - Reflectance: 186 “good bands” x 3 seasons = 558 reflectance bands
  - Minimum Noise Fraction (MNF): 100 MNF bands from 558 refl. bands
  - Spectral metrics: 88 metrics x 3 seasons = 264 metrics
- Simulated Landsat OLI, 30 m
  - 7 radiance bands x 3 seasons = 21 bands
- Reference data
  - Google Earth visual interpretation with web tool (VIEW-IT)
  - Percent cover classified to LCCS
- Random Forests classifier
  - 999 decision trees, majority vote


Sonoma
Cownty
CLO LOCAL
SF Bay Area Box
AVIRIS-C Reflectance
Spring: April 10, 2013
NASA JPL & Matthew Clark, Sonoma State, Esri, HERE, DeLorme, TomTom, MapmyIndia, © OpenStreetMap contributors, and the GIS user community


SF Bay Area Box
AVIRIS-C Reflectance
Summer: June 7, 2013
NASA JPL & Matthew Clark, Sonoma State University, Esri, HERE, DeLorme, TomTom, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

SF Bay Area Box
AVIRIS-C Reflectance
Fall: Nov 22-Dec 5, 2013

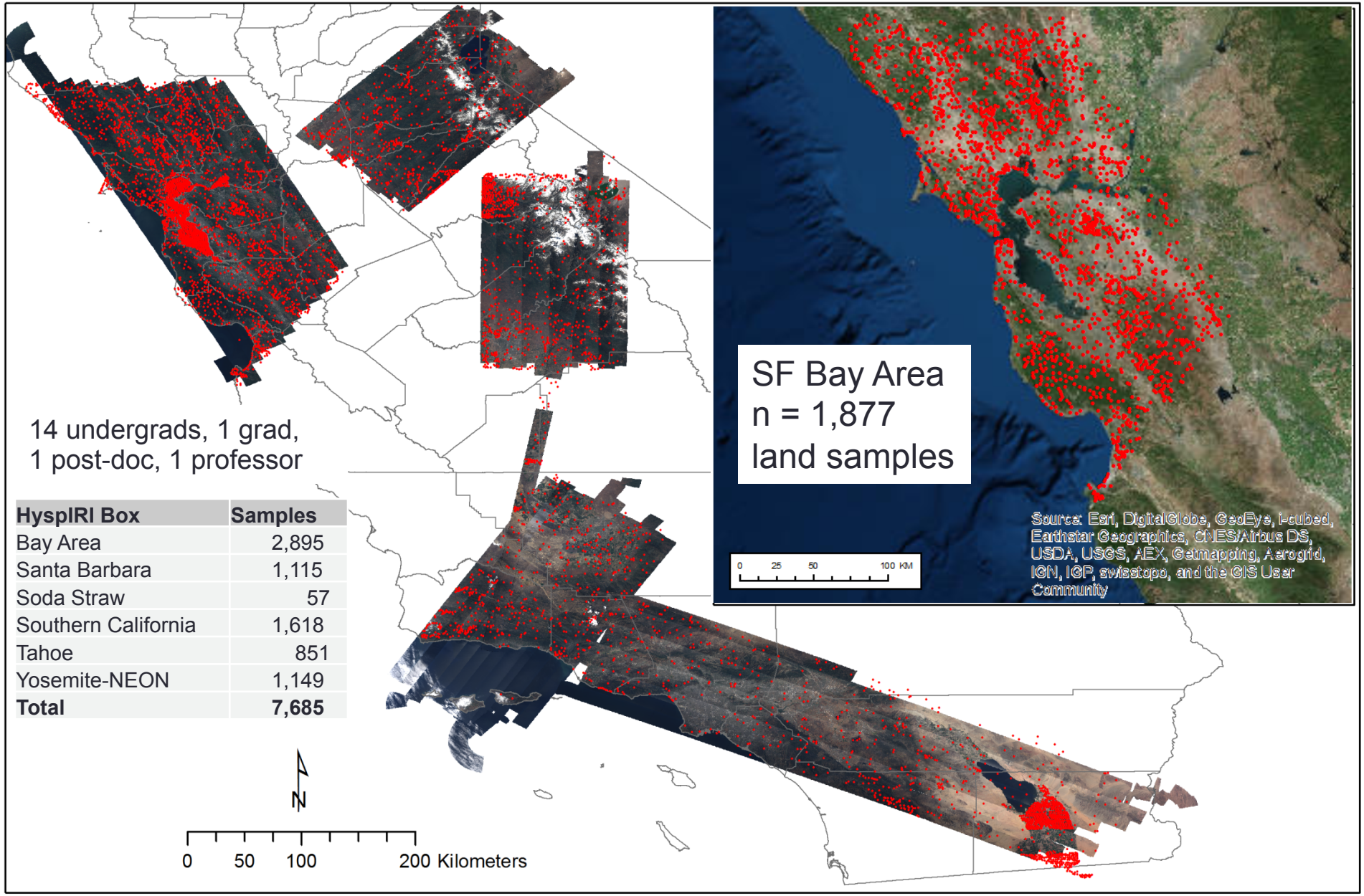
# Land cover reference data



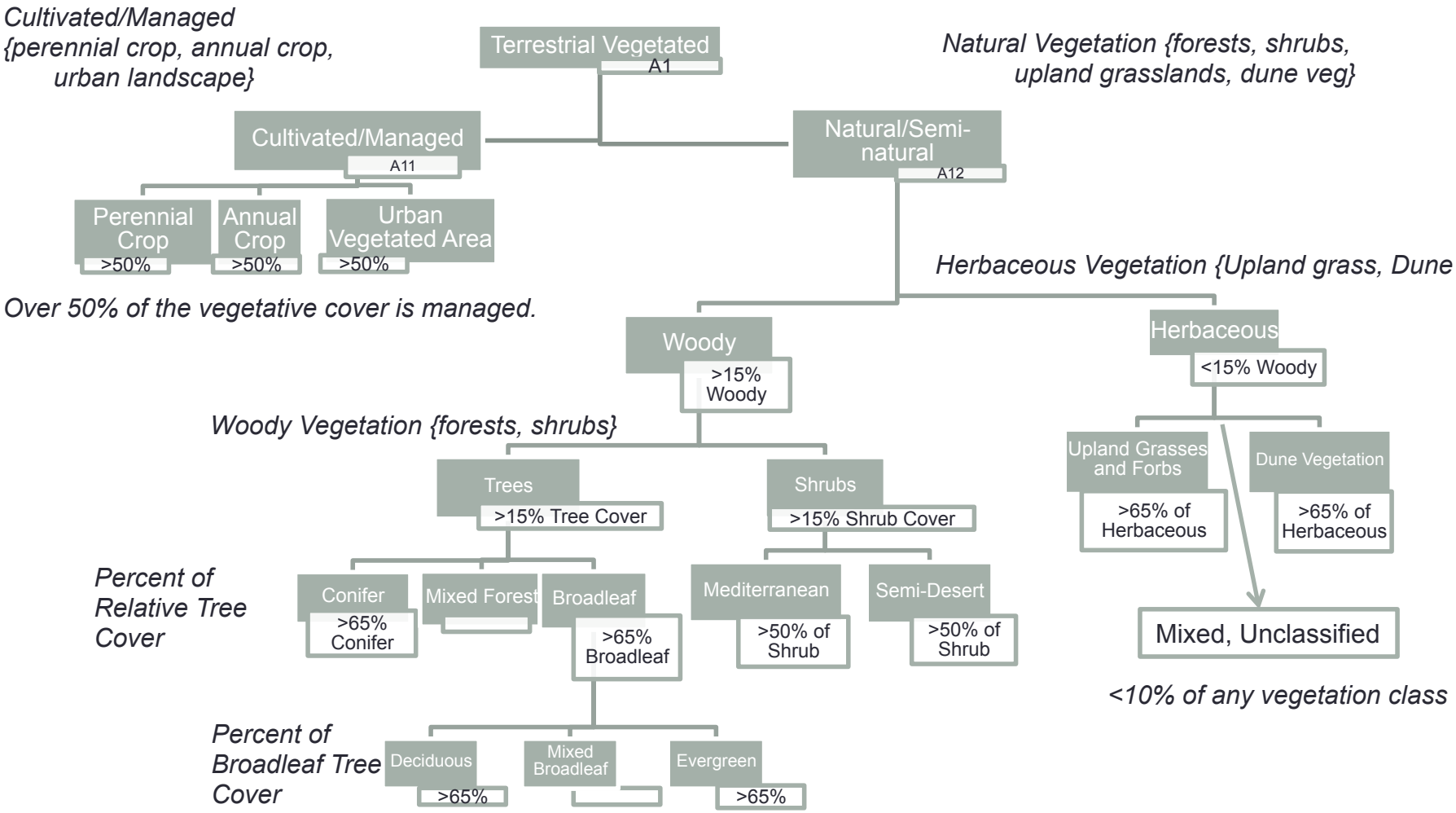

**COVER TYPES (%)**

*Impervious Surface*
*Water*
*Urban Landscape*
*Annual Crops*
*Perrenial Crops*
*Beaches or Dunes*
*Sparsely Vegetated*
*Non-Vegetated*
*Aquatic Vegetation*
*Riparian Shrubs*
*Riparian Trees*
*Freshwater Wetlands*
*Tidal Salt & Marsh*
*Upland Grasses and Forbs*
*Dune Vegetation*
*Semi desert Shrubs*
*Mediterranean Shrubs*
*Conifer Trees*
*Evergreen Broadleaf Trees*
*Deciduous Broadleaf Trees*

# VIEW-IT land-cover reference data



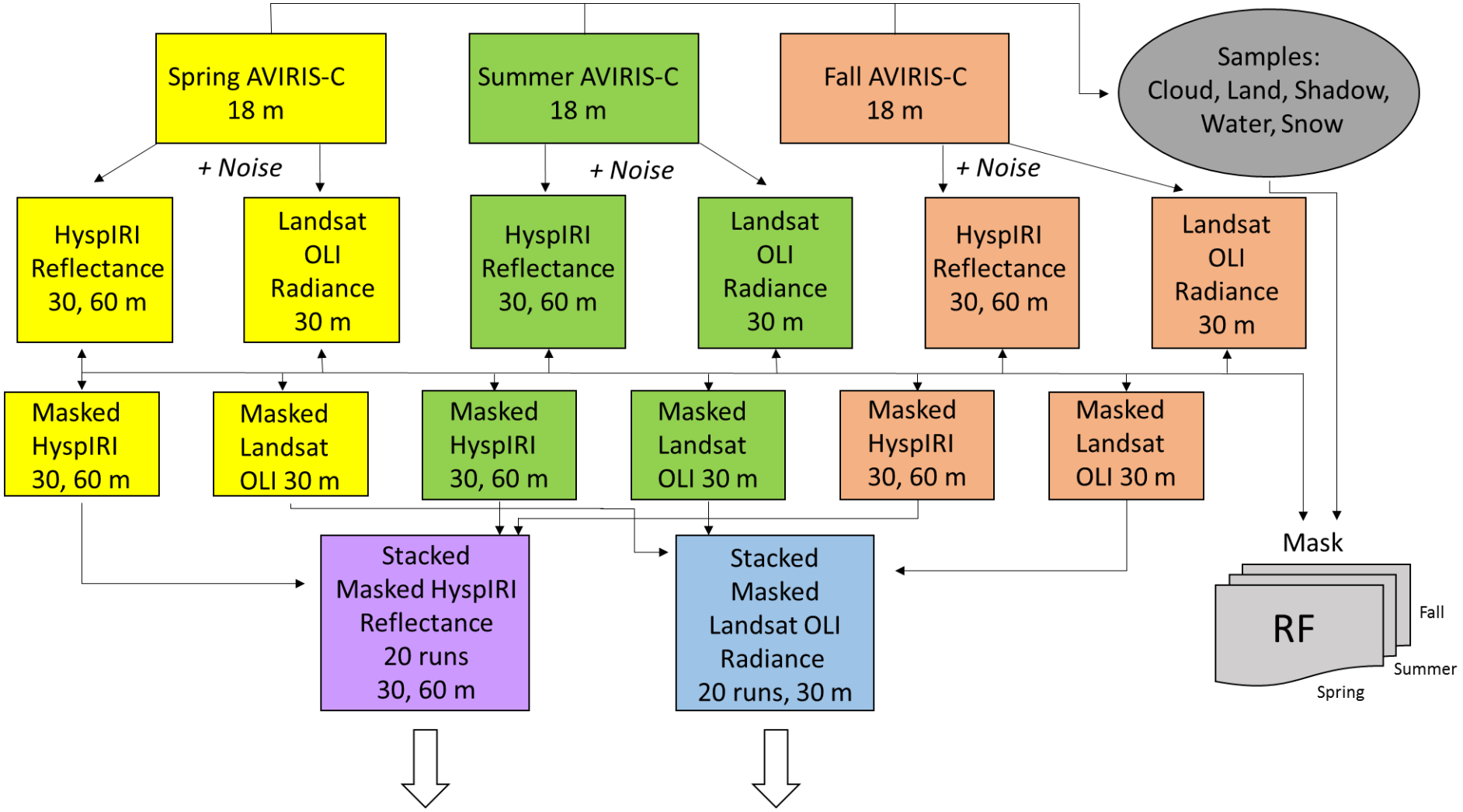

| HyspIRI Box | Samples |
|---|---|
| Bay Area | 2,895 |
| Santa Barbara | 1,115 |
| Soda Straw | 57 |
| Southern California | 1,618 |
| Tahoe | 851 |
| Yosemite-NEON | 1,149 |
| **Total** | **7,685** |



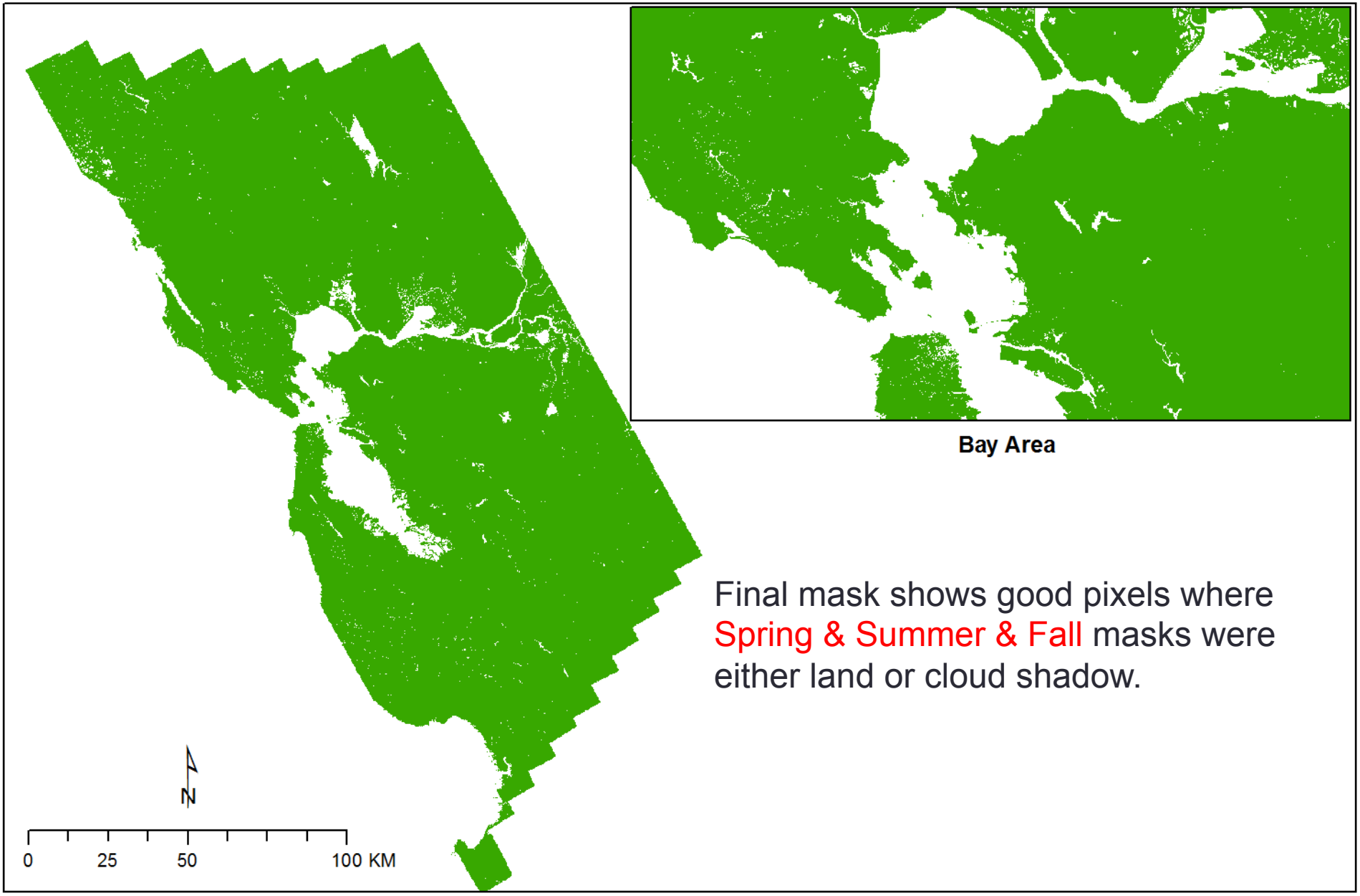

# VIEW-IT % cover to LCCS (hard) class

Closed-Canopy: > 65%
Open-Canopy: 15% - 65%

# Processing flow

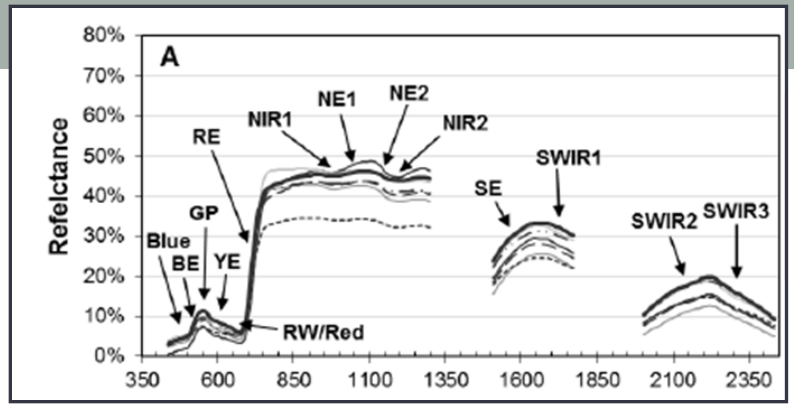


# Multi-temporal mask – 60 m




Final mask shows good pixels where Spring & Summer & Fall masks were either land or cloud shadow.

# Spectral metrics




Summary of hyperspectral metrics organized by methods (in bold) and dominant spectral features and region (in italics).

| **Indices** | **Absorption-Based** | **Derivative** |
|---|---|---|
| *Photosynthetic pigments, LAI, structure, physiology, stress (VIS-NIR)* | | |
| SR, NDVI, EVI, SAVI, ARVI<br>ARI1, ARI2, mARI, CRI1, CRI2<br>PRI, RVSI<br>mSR705, NDVI705, MCARI<br>VOG1, VOG2, VOG3<br>VIgreen, VARIgreen, CIrededge<br>PSRI, NDII | Blue-D,W,A,As<br>Red-D,W,A,As | BE-Wvl,Mag,DArea<br>GP-Wvl,Refl<br>YE-Wvl,Mag,DArea<br>RW-Wvl,Refl<br>RE-Wvl,Mag,DArea |
| *Water and structure (NIR)* | | |
| WBI<br>NDWI<br>MSI | EWT<br>NIR1-D,W,A,As<br>NIR2-D,W,A,As | NE1-Wvl,Mag<br>NE2-Wvl,Mag |
| *Lignin, cellulose, nitrogen (SWIR)* | | |
| CAI<br>NDLI<br>NDNI | SWIR1-D,W,A,As<br>SWIR2-D,W,A,As<br>SWIR3-D,W,A,As | SE-Wvl,Mag |

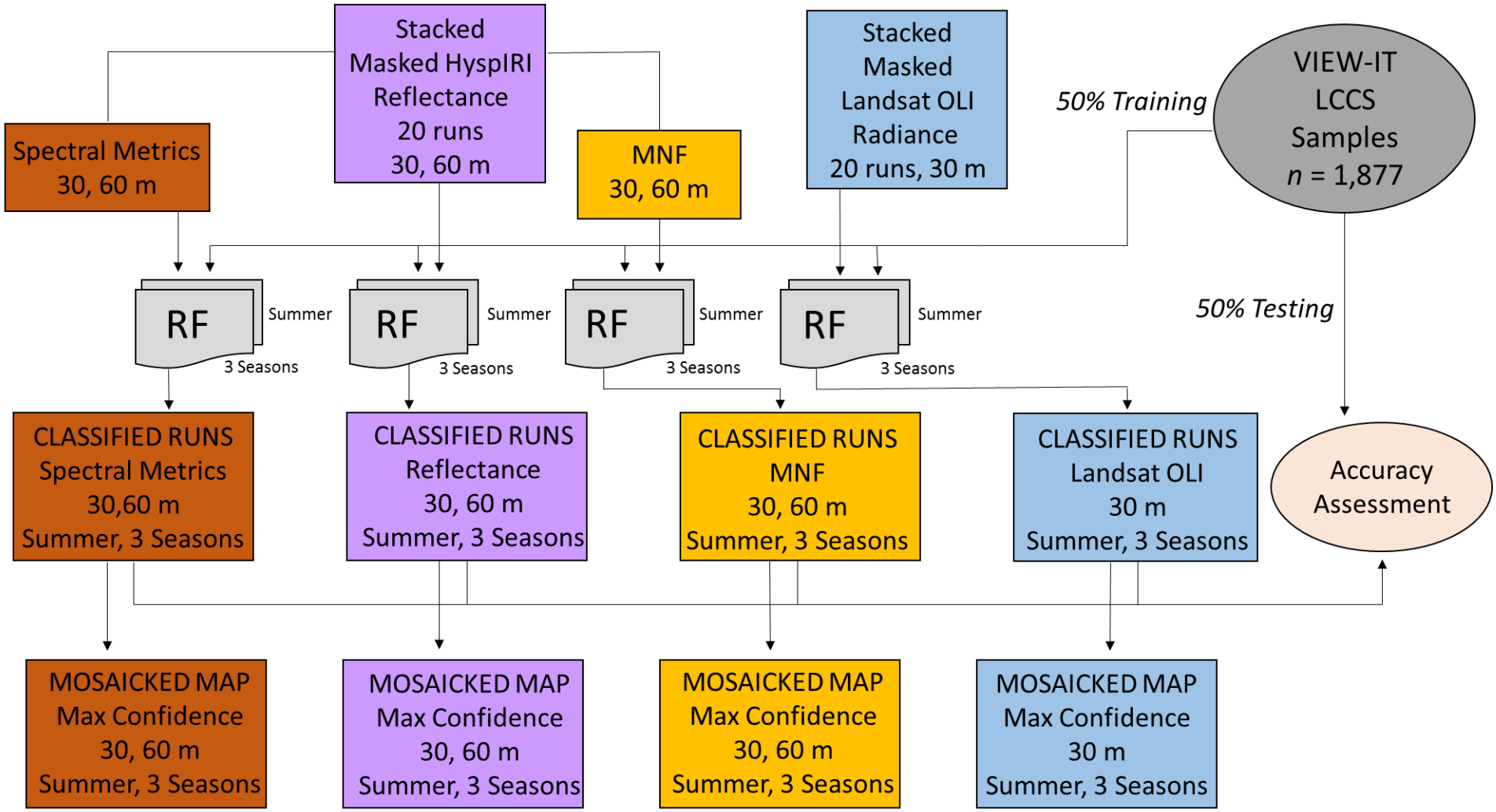
Wvl = wavelength, Mag = derivative magnitude, Refl = percent reflectance, D = depth, W = width, A = area (width x depth), As = Asymmetry.

88 metrics per season

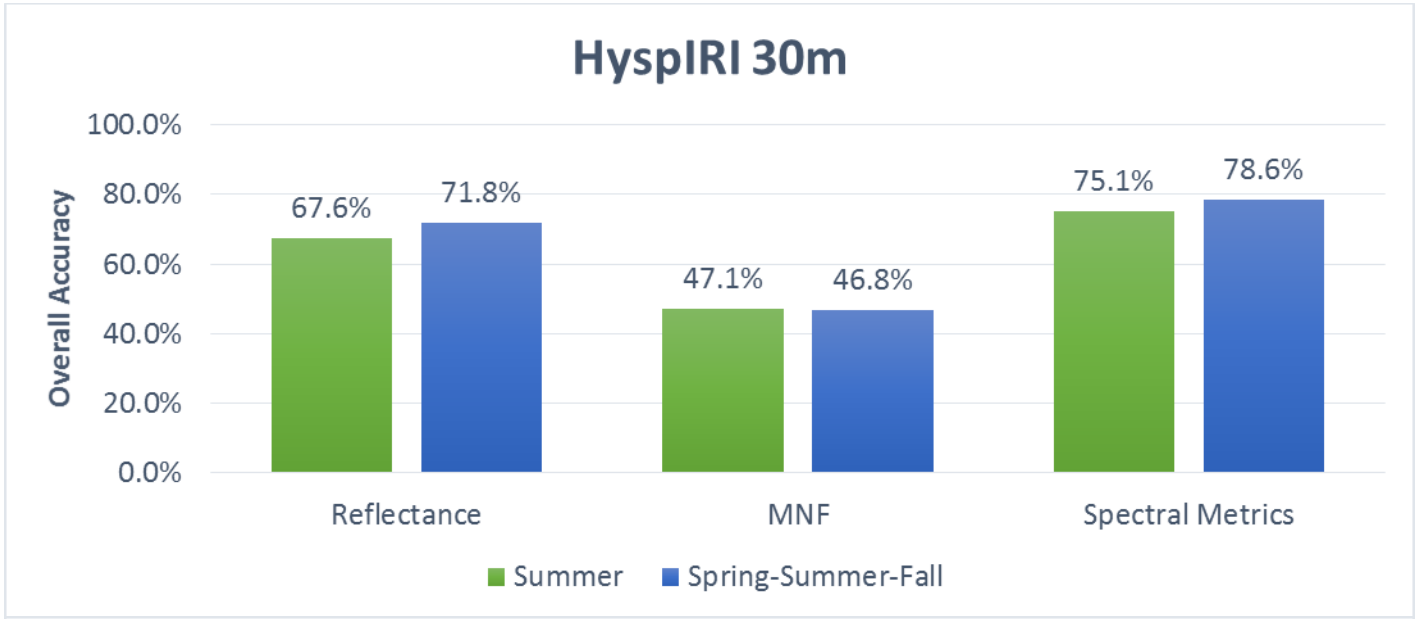
Spring, Summer, & Fall

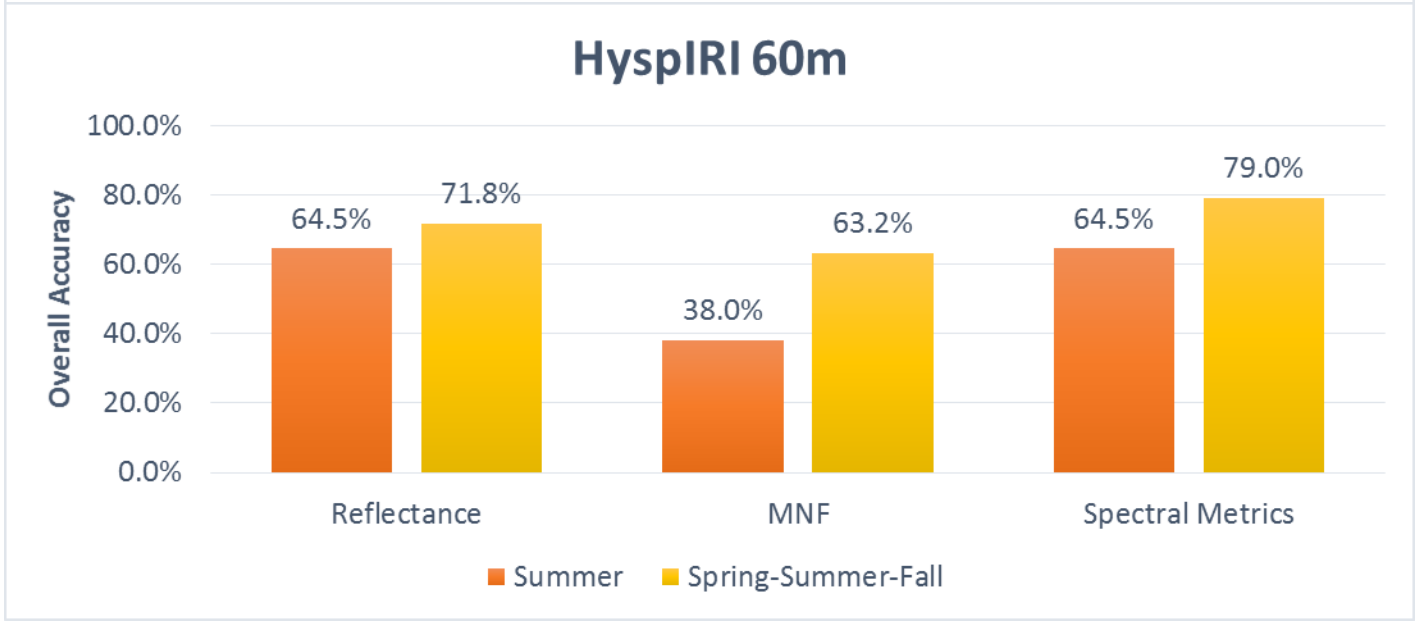
30 m & 60 m

# Processing flow (continued)



# Random Forests Overall Accuracy



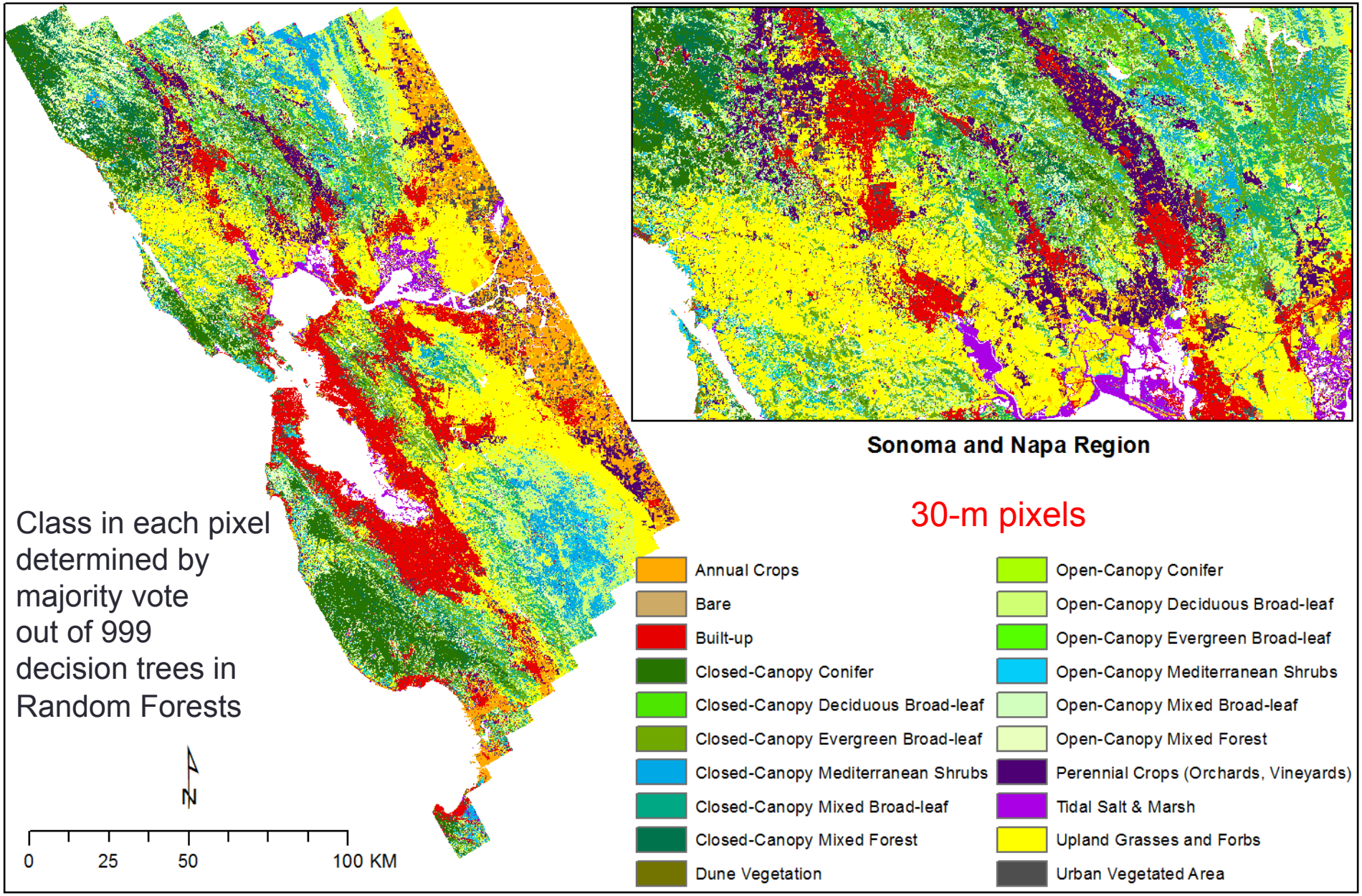

20 classes

Independent test data

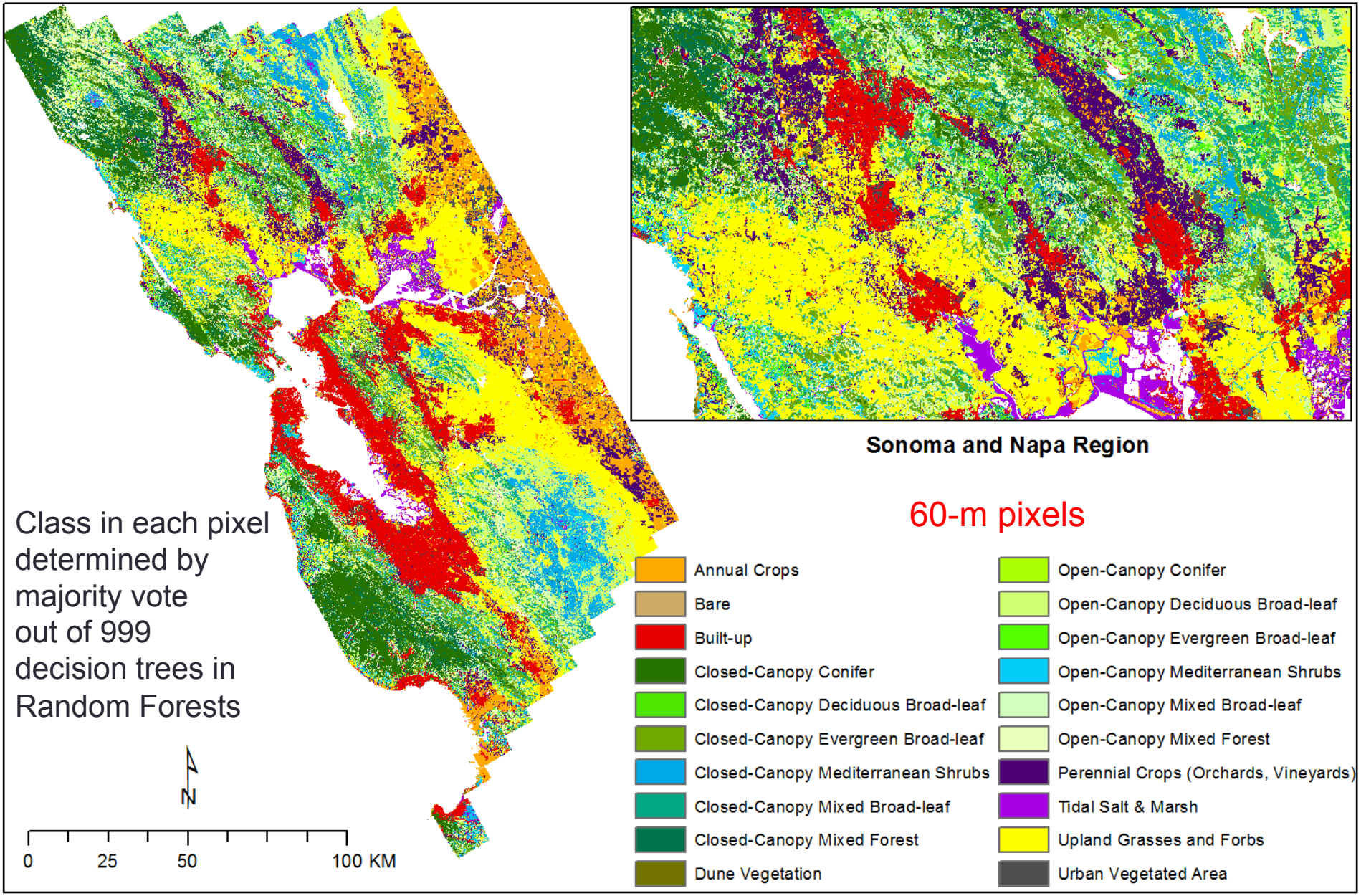
Same VIEW-IT boxes used in all tests

Simulated data have duplicate pixels from scene overlap (↑ sun-view variation than satellite-based HyspIRI image)

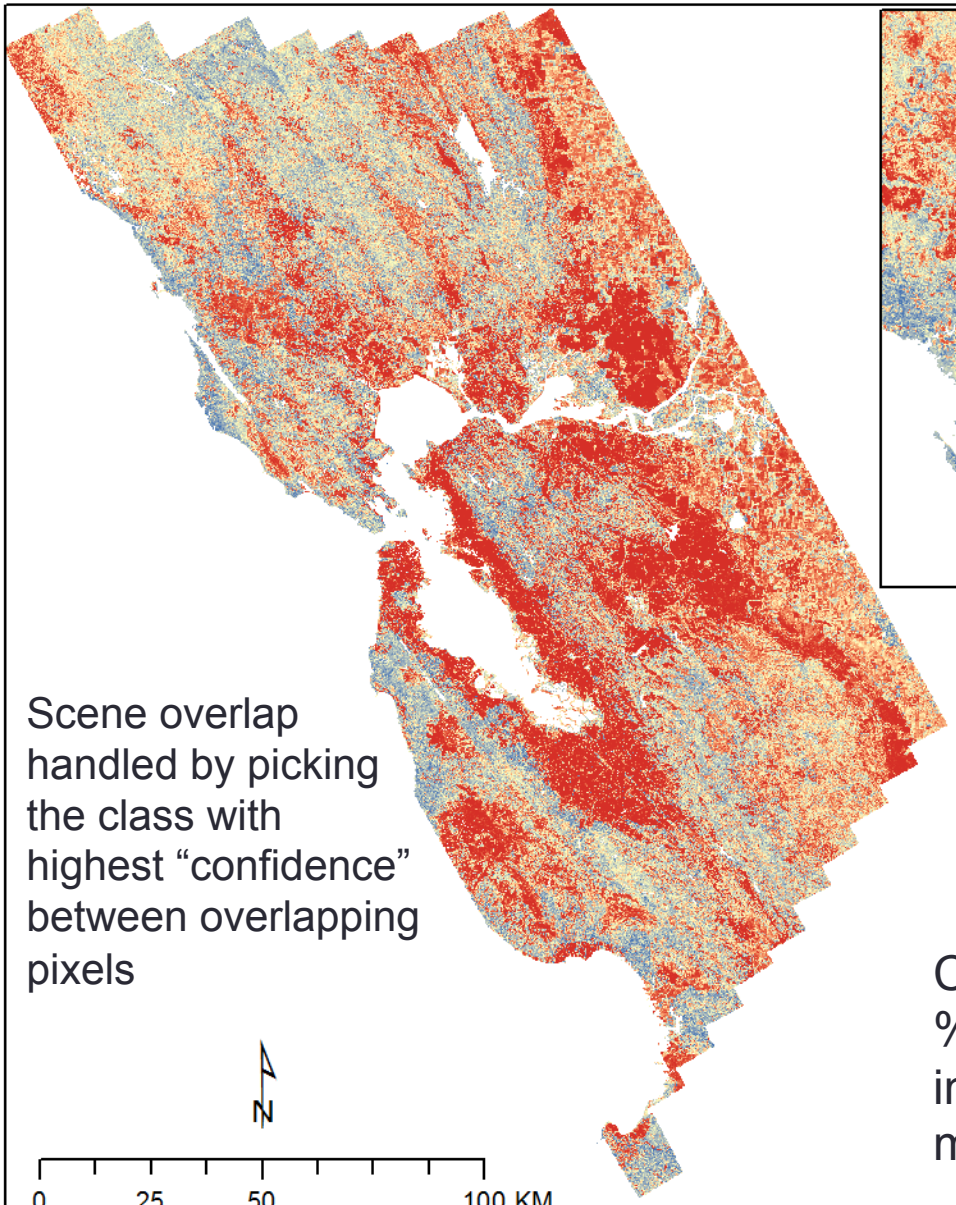
# Multi-temporal HyspIRI spectral metrics – 30 m

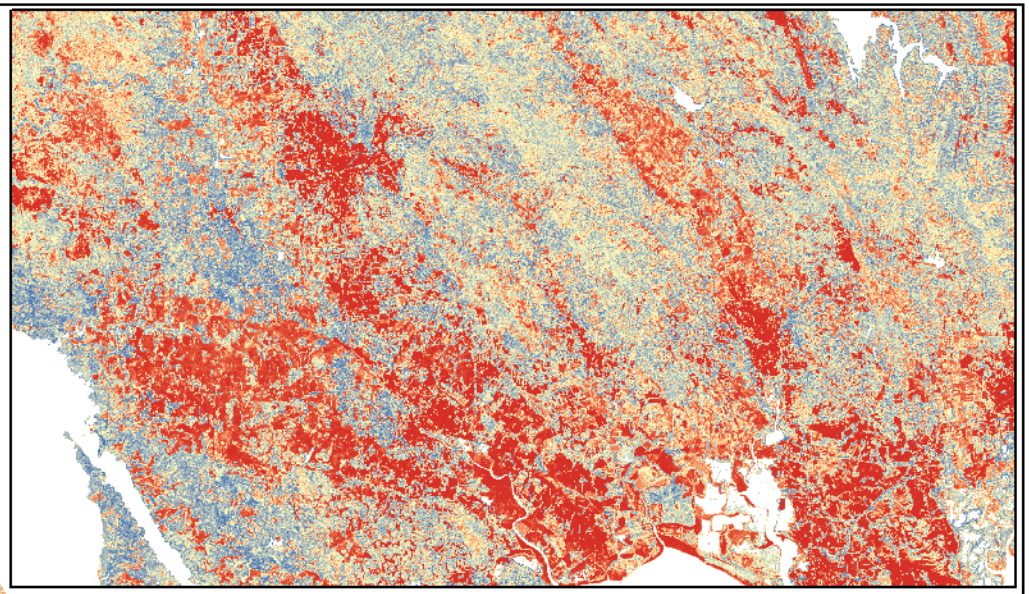


# Multi-temporal HyspIRI spectral metrics – 60 m



# Multi-temporal HyspIRI spectral metrics – 60 m





Sonoma and Napa Region

Scene overlap handled by picking the class with highest "confidence" between overlapping pixels

N

0 25 50 100 KM

**Confidence**

High : 100

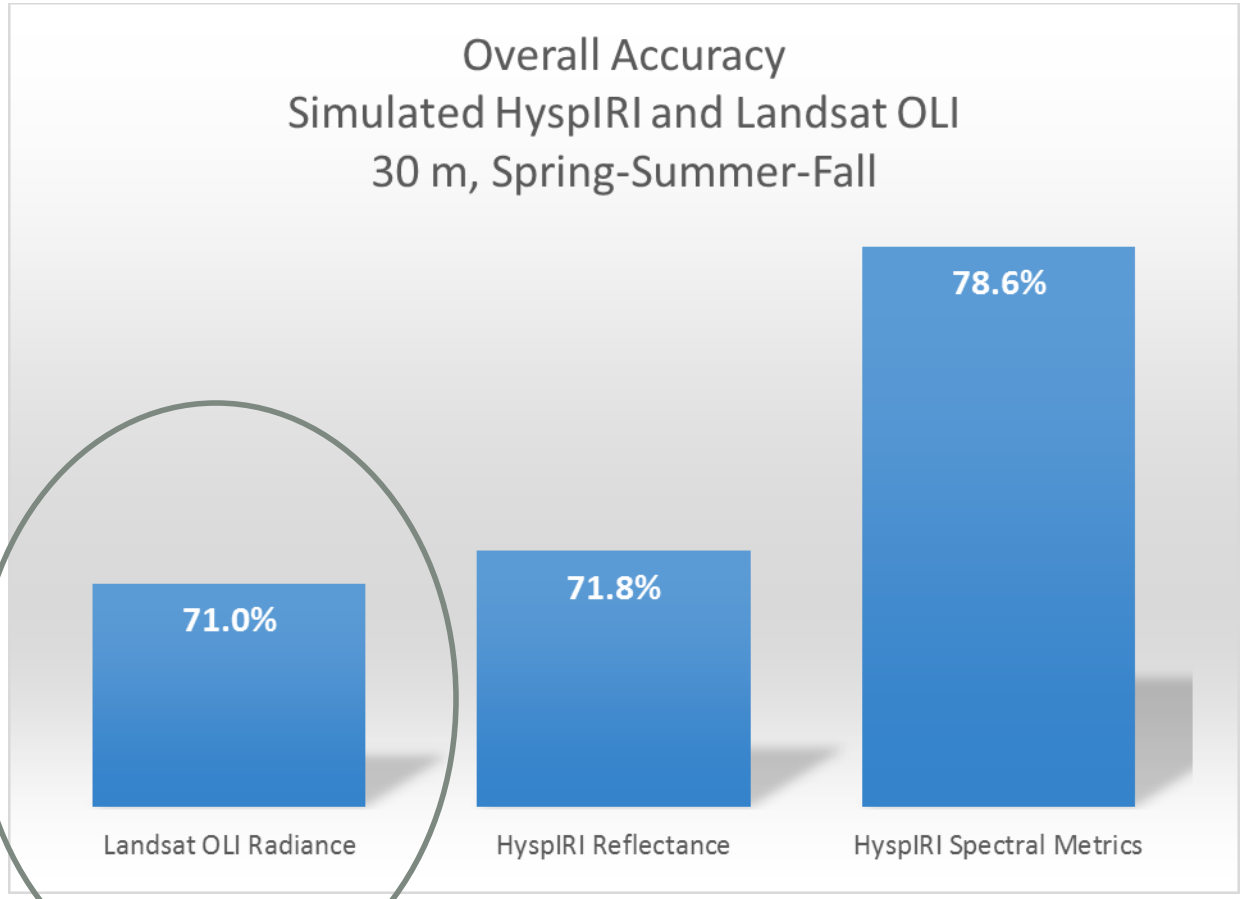
Low : 9

60-m pixels

Mean = 58.8

Confidence =
% of votes from all 999 decision trees in Random Forests that were for the majority class

# Random Forests Classification

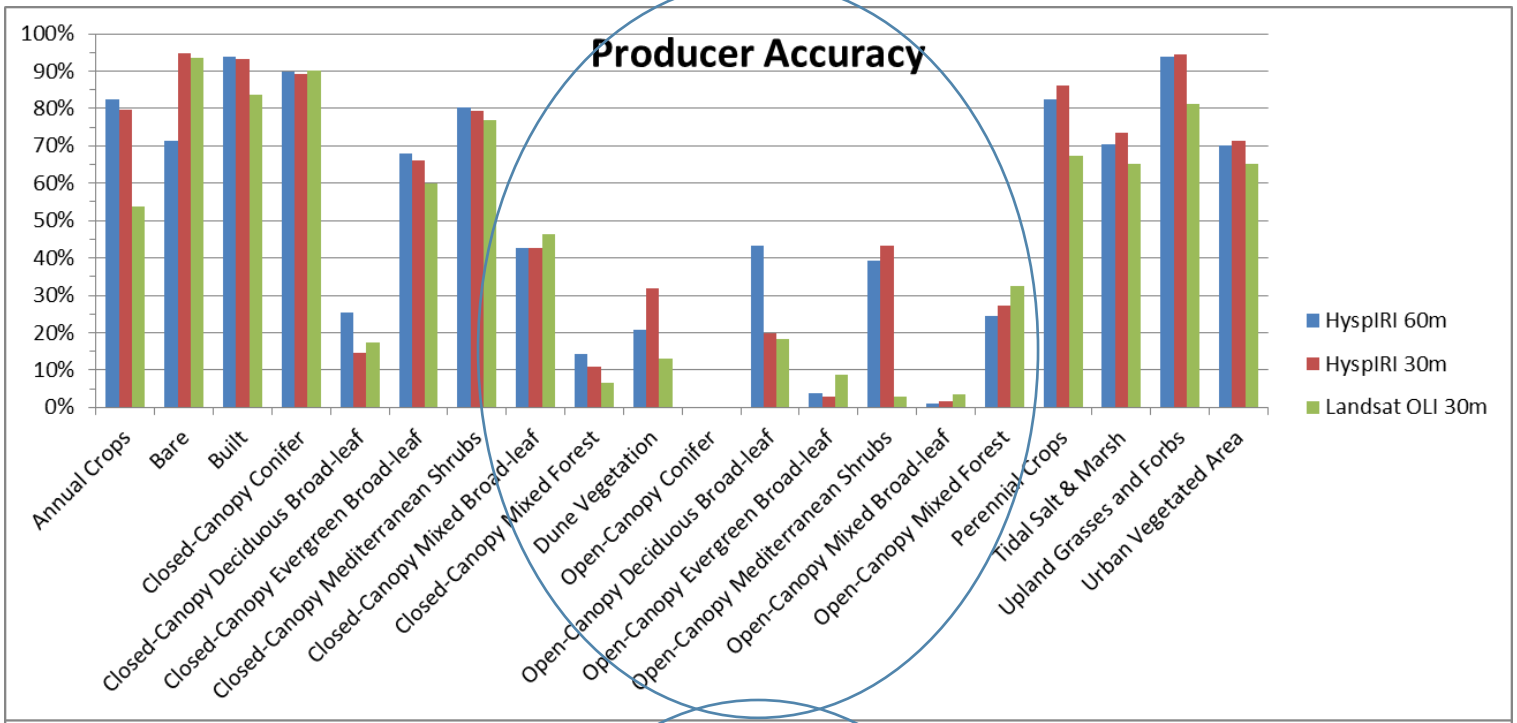


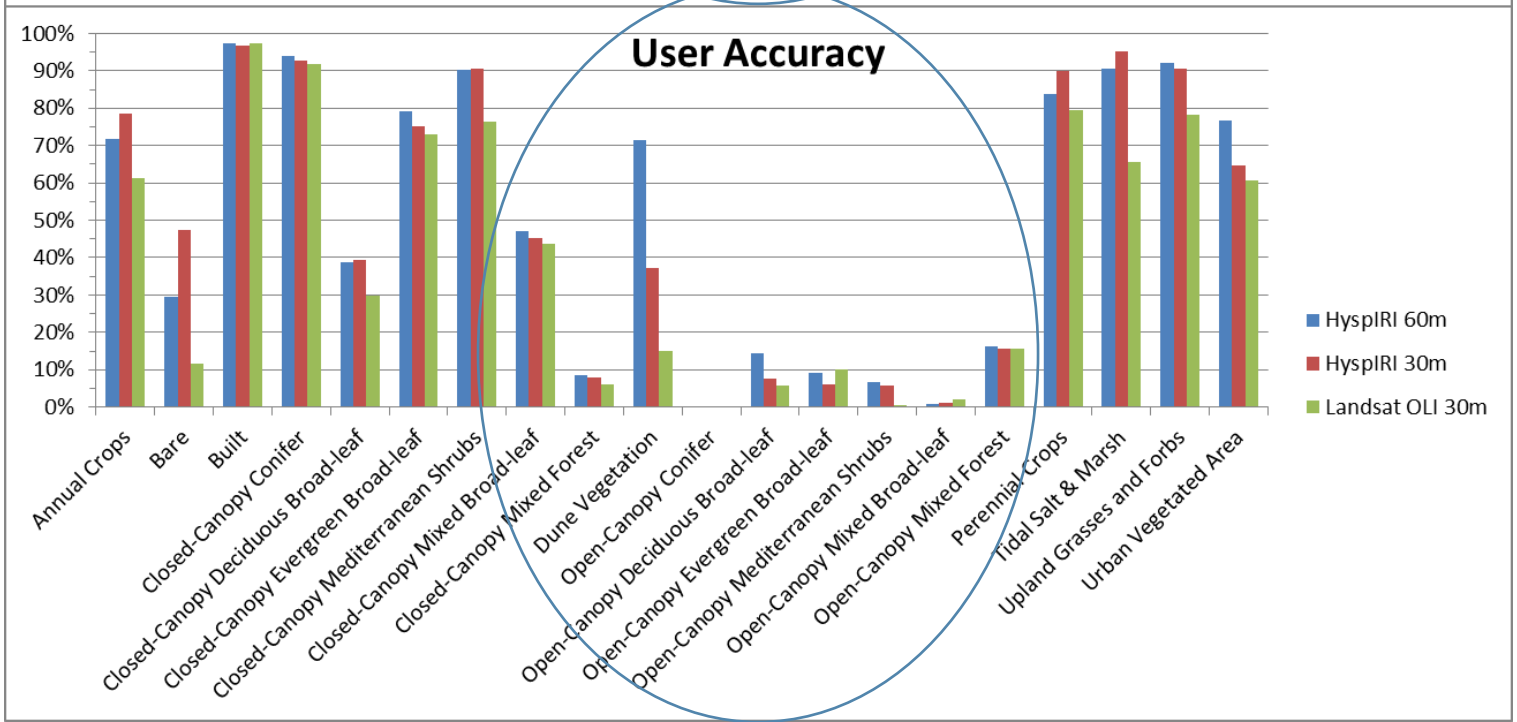

20 classes

Independent test data

Same VIEW-IT boxes used in all tests

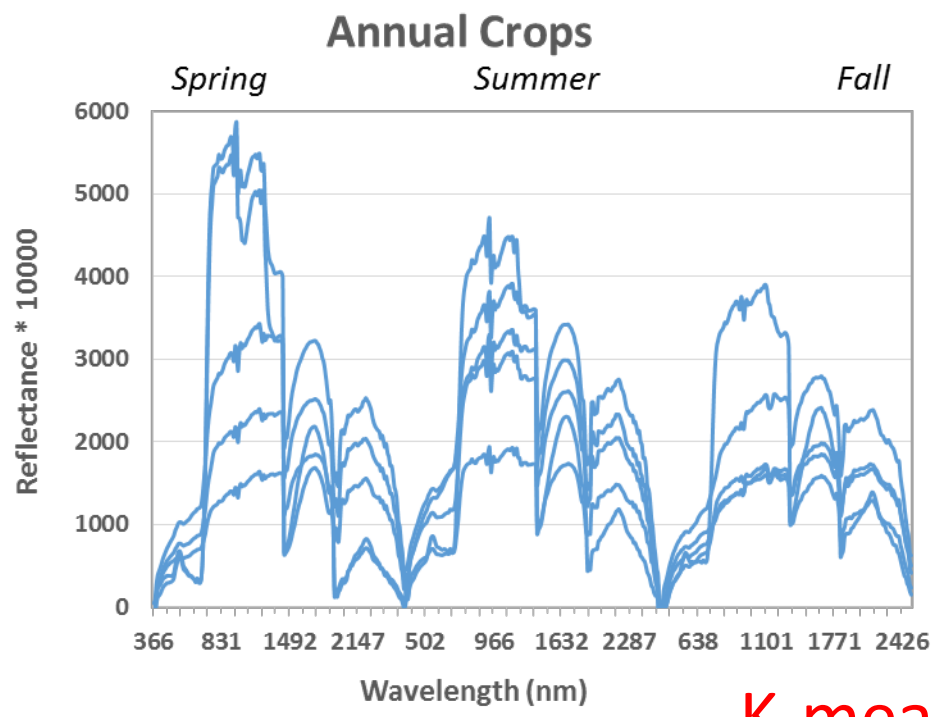
Simulated data have duplicate pixels from scene overlap (↑ sun-view variation than satellite-based HyspIRI image)

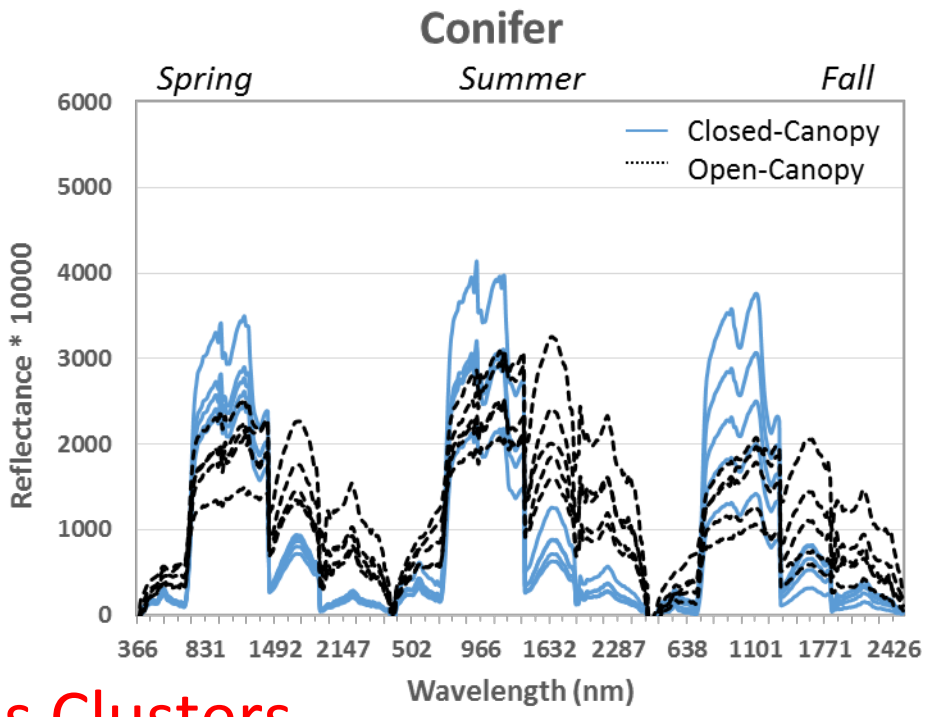

Producer Accuracy
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Annual Crops
Bare
Built
Closed-Canopy Conifer
Closed-Canopy Deciduous Broad-leaf
Closed-Canopy Evergreen Broad-leaf
Closed-Canopy Mediterranean Shrubs
Closed-Canopy Mixed Broad-leaf
Closed-Canopy Mixed Forest
Dune Vegetation
Open-Canopy Conifer
Open-Canopy Deciduous Broad-leaf
Open-Canopy Evergreen Broad-leaf
Open-Canopy Mediterranean Shrubs
Open-Canopy Mixed Broad-leaf
Open-Canopy Mixed Forest
Perennial Crops
Tidal Salt & Marsh
Upland Grasses and Forbs
Urban Vegetated Area
HysplRI 60m
HysplRI 30m
Landsat OLI 30m


User Accuracy
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Annual Crops
Bare
Built
Closed-Canopy Conifer
Closed-Canopy Deciduous Broad-leaf
Closed-Canopy Evergreen Broad-leaf
Closed-Canopy Mediterranean Shrubs
Closed-Canopy Mixed Broad-leaf
Closed-Canopy Mixed Forest
Dune Vegetation
Open-Canopy Conifer
Open-Canopy Deciduous Broad-leaf
Open-Canopy Evergreen Broad-leaf
Open-Canopy Mediterranean Shrubs
Open-Canopy Mixed Broad-leaf
Open-Canopy Mixed Forest
Perennial Crops
Tidal Salt & Marsh
Upland Grasses and Forbs
Urban Vegetated Area
HysplRI 60m
HysplRI 30m
Landsat OLI 30m

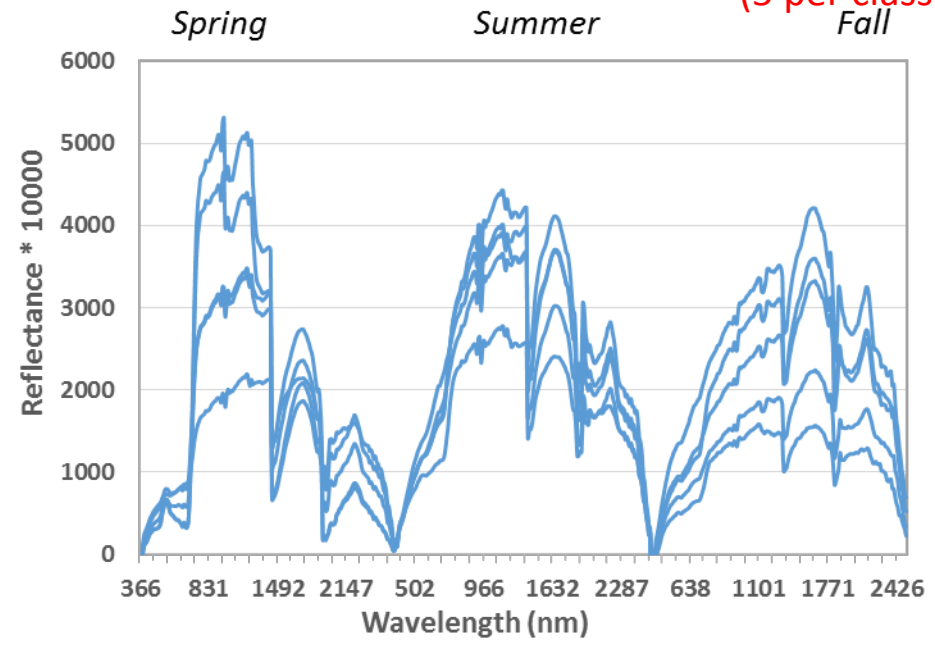
# RF Summary

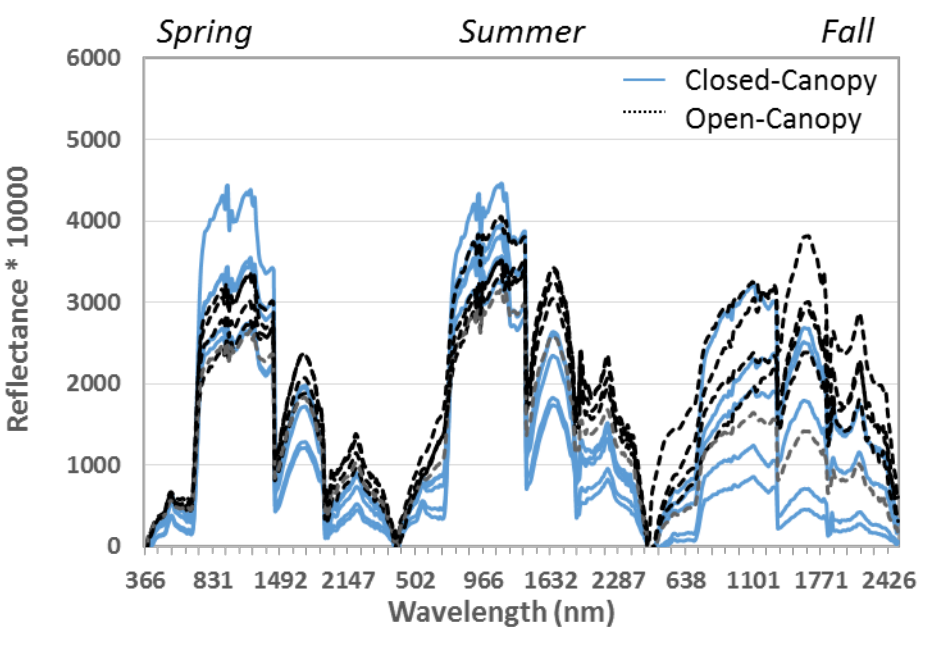
- Random Forests LCCS classification
  - 20 classes focused on natural vegetation
  - HyspIRI multi-temporal spectral metrics best predictors
  - Overall accuracy 78.6% (30 m) and 79.0% (60 m)
  - Multi-temporal HyspIRI 7.6% greater accuracy than Landsat OLI
- Anthropogenic classes and homogeneous vegetation had best accuracy
- Several forest classes with < 20% accuracy
  - Fine-scale mosaic of forest types – gradients, not hard classes
  - Confusion in forests
    - Conifer ↔ Mixed forest ↔ Broadleaf (BL) forests
    - Evergreen BL ↔ Mixed BL forest ↔ Deciduous BL forests
    - Open-canopy ↔ Closed-canopy

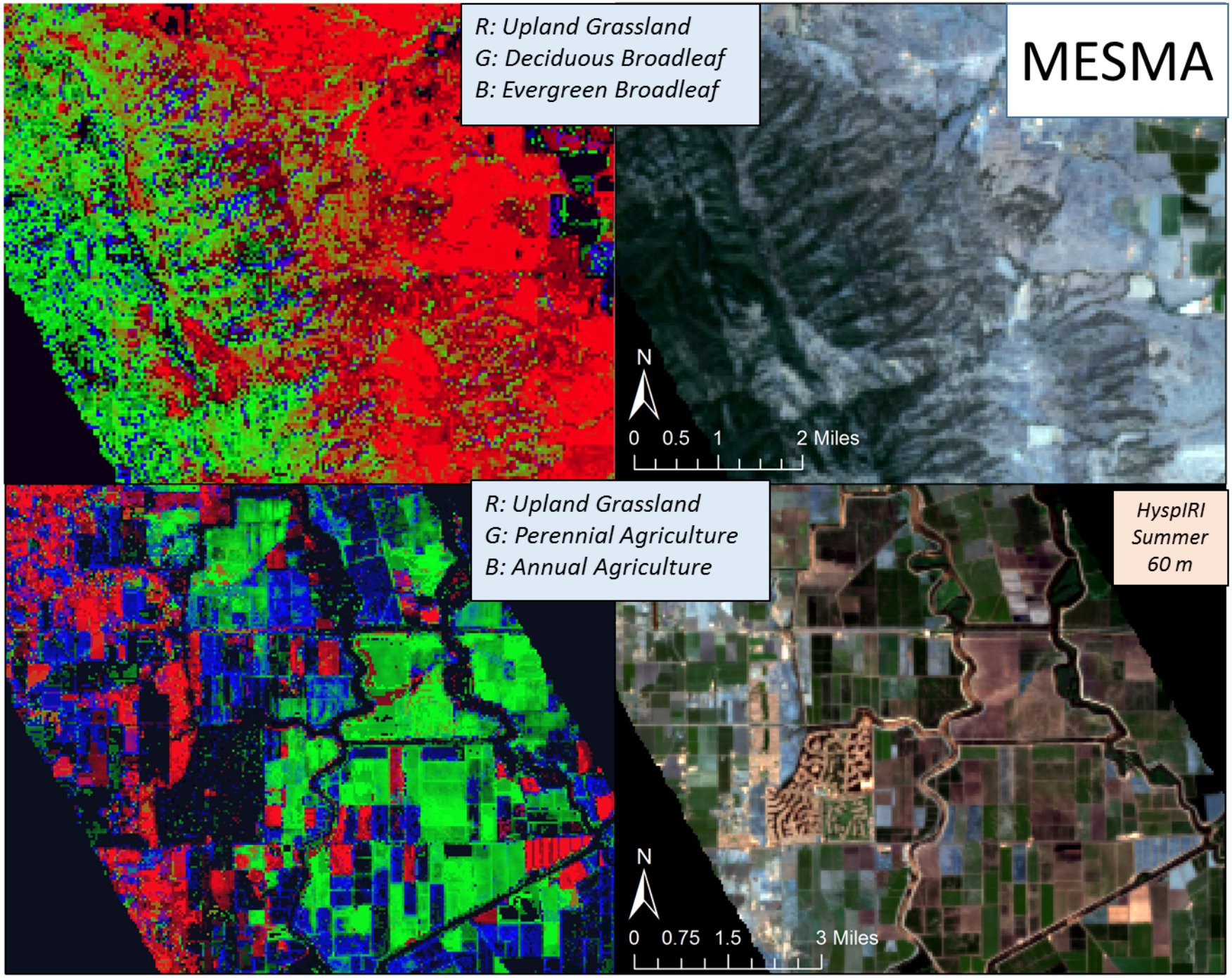



K-means Clusters
(5 per class)




R: Upland Grassland
G: Deciduous Broadleaf
B: Evergreen Broadleaf
MESMA
N
0 0.5 1 2 Miles
R: Upland Grassland
G: Perennial Agriculture
B: Annual Agriculture
HyspIRI
Summer
60 m
N
0 0.75 1.5 3 Miles

# Next steps for Bay Area analysis

- Multi-temporal MESMA – fractions mapped to LCCS classes
- Two-phase classification – RF, then MESMA on forests
- Alliance (species dominant) mapping of forests in Napa, Marin, & Sonoma Counties

# EXTRA SLIDES

# HyspIRI 30-m Error Matrix

| | Annual Crops | Bare | Built | Closed-Canopy Conifer | Closed-Canopy Deciduous Broad-leaf | Closed-Canopy Evergreen Broad-leaf | Closed-Canopy Mediterranean Shrubs | Closed-Canopy Mixed Broad-leaf | Closed-Canopy Mixed Forest | Dune Vegetation | Open-Canopy Conifer | Open-Canopy Deciduous Broad-leaf | Open-Canopy Evergreen Broad-leaf | Open-Canopy Mediterranean Shrubs | Open-Canopy Mixed Broad-leaf | Open-Canopy Mixed Forest | Perennial Crops | Tidal Salt & Marsh | Upland Grasses and Forbs | Urban Vegetated Area | **Total** | **User** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Annual Crops | 7608 | 189 | 488 | 152 | 0 | 0 | 52 | 0 | 0 | 771 | 0 | 0 | 0 | 0 | 0 | 0 | 1501 | 1206 | 773 | 191 | **12931** | **78%** |
| Bare | 417 | 118 | 289 | 1 | 0 | 0 | 0 | 0 | 0 | 112 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 40 | 0 | 0 | **977** | **47%** |
| Built | 42 | 97 | 28975 | 60 | 0 | 0 | 49 | 0 | 0 | 98 | 0 | 0 | 0 | 0 | 0 | 0 | 209 | 732 | 0 | 260 | **30522** | **97%** |
| Closed-Canopy Conifer | 0 | 0 | 0 | 27302 | 0 | 496 | 92 | 12 | 698 | 0 | 0 | 0 | 0 | 1 | 0 | 82 | 0 | 6 | 102 | 23 | **28814** | **93%** |
| Closed-Canopy Deciduous Broad-leaf | 0 | 0 | 0 | 0 | 296 | 249 | 40 | 516 | 0 | 0 | 0 | 17 | 4 | 0 | 26 | 73 | 15 | 0 | 11 | 3 | **1250** | **39%** |
| Closed-Canopy Evergreen Broad-leaf | 2 | 0 | 17 | 820 | 697 | 12098 | 800 | 4761 | 318 | 0 | 23 | 12 | 105 | 11 | 0 | 465 | 23 | 0 | 14 | 277 | **20443** | **75%** |
| Closed-Canopy Mediterranean Shrubs | 0 | 0 | 12 | 0 | 0 | 73 | 24488 | 18 | 12 | 0 | 252 | 21 | 365 | 67 | 20 | 40 | 0 | 24 | 13 | 0 | **25405** | **91%** |
| Closed-Canopy Mixed Broad-leaf | 3 | 0 | 35 | 4 | 1147 | 2813 | 414 | 4036 | 95 | 0 | 6 | 29 | 40 | 12 | 4 | 225 | 4 | 0 | 12 | 53 | **8932** | **45%** |
| Closed-Canopy Mixed Forest | 0 | 0 | 87 | 3580 | 143 | 1430 | 437 | 103 | 372 | 0 | 0 | 152 | 53 | 6 | 1 | 2603 | 3 | 4 | 14 | 139 | **9127** | **8%** |
| Dune Vegetation | 352 | 158 | 8 | 3 | 0 | 0 | 28 | 0 | 0 | 874 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 213 | 87 | 0 | **1723** | **37%** |
| Open-Canopy Conifer | 0 | 0 | 8 | 1 | 19 | 68 | 1545 | 187 | 7 | 0 | 85 | 468 | 20 | 0 | 2 | 412 | 0 | 2 | 102 | 32 | **2958** | **0%** |
| Open-Canopy Deciduous Broad-leaf | 224 | 0 | 101 | 10 | 294 | 295 | 358 | 109 | 12 | 0 | 122 | 2987 | 34 | 42 | 215 | 110 | 427 | 56 | 1183 | 20 | **6599** | **7%** |
| Open-Canopy Evergreen Broad-leaf | 12 | 0 | 16 | 441 | 29 | 134 | 84 | 49 | 11 | 0 | 0 | 106 | 92 | 1 | 16 | 623 | 93 | 0 | 68 | 16 | **1791** | **6%** |
| Open-Canopy Mediterranean Shrubs | 9 | 0 | 120 | 0 | 0 | 32 | 2413 | 0 | 0 | 0 | 12 | 0 | 37 | 249 | 15 | 0 | 27 | 33 | 459 | 23 | **3429** | **6%** |
| Open-Canopy Mixed Broad-leaf | 11 | 0 | 18 | 0 | 192 | 146 | 52 | 188 | 14 | 0 | 0 | 27 | 11 | 0 | 30 | 275 | 38 | 8 | 83 | 3 | **1096** | **1%** |
| Open-Canopy Mixed Forest | 10 | 0 | 28 | 480 | 210 | 804 | 423 | 106 | 50 | 0 | 9 | 134 | 107 | 5 | 53 | 560 | 134 | 116 | 247 | 53 | **3529** | **16%** |
| Perennial Crops | 1637 | 0 | 349 | 0 | 14 | 74 | 50 | 16 | 0 | 0 | 0 | 84 | 10 | 3 | 0 | 2 | 7554 | 741 | 93 | 118 | **10745** | **90%** |
| Tidal Salt & Marsh | 37 | 0 | 98 | 19 | 1 | 0 | 17 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 0 | 5883 | 36 | 19 | **6122** | **95%** |
| Upland Grasses and Forbs | 1270 | 0 | 73 | 0 | 0 | 0 | 18 | 0 | 0 | 0 | 0 | 337 | 0 | 6 | 19 | 20 | 25 | 0 | 27880 | 0 | **29648** | **91%** |
| Urban Vegetated Area | 447 | 0 | 2543 | 99 | 19 | 65 | 268 | 6 | 0 | 0 | 2 | 0 | 0 | 11 | 0 | 10 | 493 | 529 | 441 | 4034 | **8967** | **65%** |
| **Total** | **12081** | **562** | **33265** | **32972** | **3061** | **18777** | **31628** | **10107** | **1589** | **1855** | **511** | **4374** | **878** | **414** | **401** | **5512** | **10546** | **9593** | **31618** | **5264** | **215008** | |
| **Producer** | **80%** | **95%** | **93%** | **89%** | **15%** | **66%** | **79%** | **43%** | **11%** | **32%** | **0%** | **20%** | **3%** | **43%** | **2%** | **27%** | **86%** | **74%** | **94%** | **71%** | | **78.6%** |

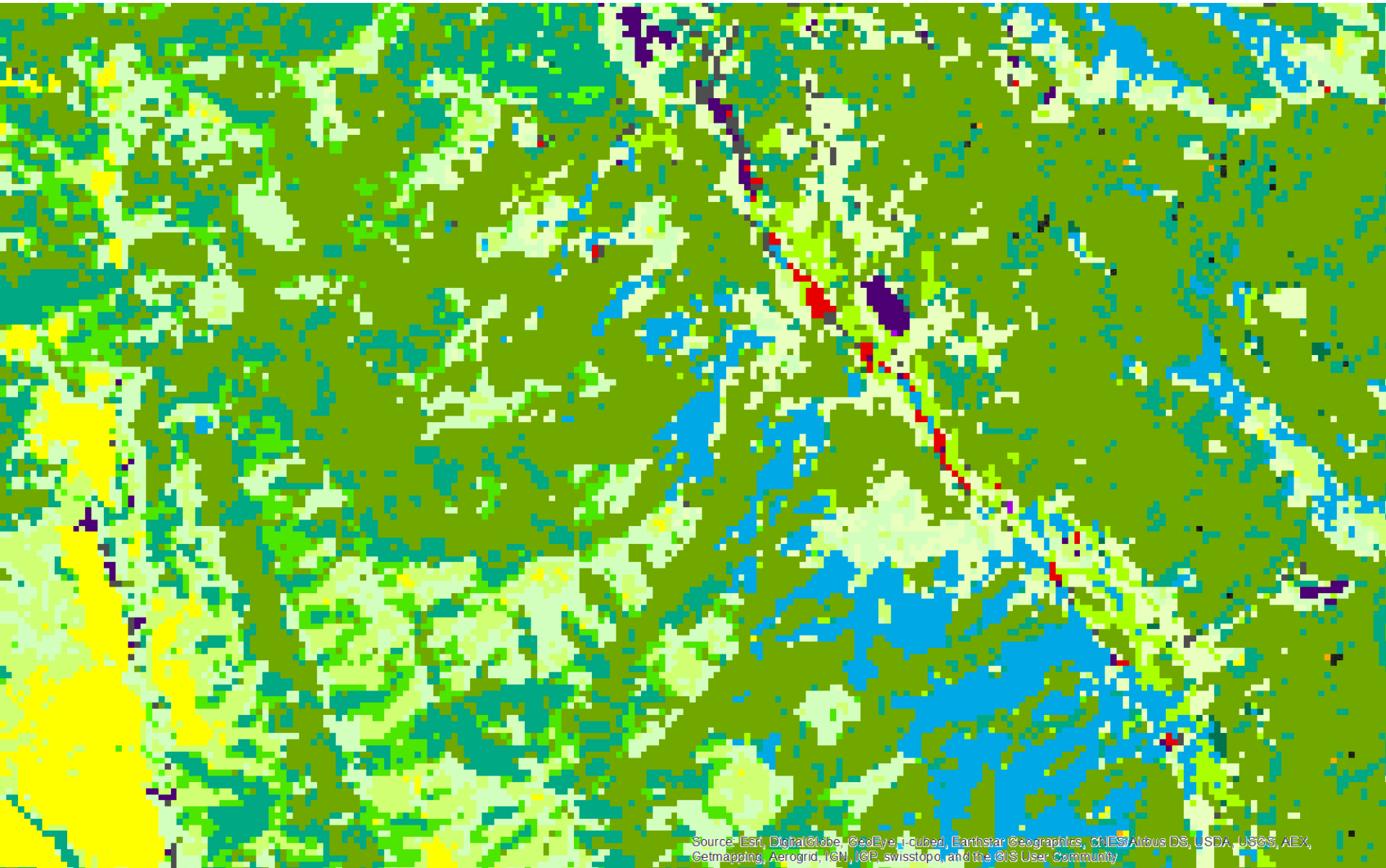
# HyspIRI 60-m Error Matrix

| | Annual Crops | Bare | Built | Closed-Canopy Conifer | Closed-Canopy Deciduous Broad-leaf | Closed-Canopy Evergreen Broad-leaf | Closed-Canopy Mediterranean Shrubs | Closed-Canopy Mixed Broad-leaf | Closed-Canopy Mixed Forest | Dune Vegetation | Open-Canopy Conifer | Open-Canopy Deciduous Broad-leaf | Open-Canopy Evergreen Broad-leaf | Open-Canopy Mediterranean Shrubs | Open-Canopy Mixed Broad-leaf | Open-Canopy Mixed Forest | Perennial Crops | Tidal Salt & Marsh | Upland Grasses and Forbs | Urban Vegetated Area | **Total** | **User** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Annual Crops | 480 | 2 | 9 | 0 | 0 | 0 | 0 | 1 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 125 | 27 | 12 | 2 | **668** | **54%** |
| Bare | 0 | 10 | 23 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **34** | **25%** |
| Built | 0 | 2 | 2203 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 16 | 0 | 40 | **2262** | **97%** |
| Closed-Canopy Conifer | 0 | 0 | 0 | 1517 | 0 | 21 | 1 | 0 | 76 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | **1616** | **96%** |
| Closed-Canopy Deciduous Broad-leaf | 0 | 0 | 0 | 0 | 43 | 11 | 25 | 26 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 3 | 0 | **111** | **24%** |
| Closed-Canopy Evergreen Broad-leaf | 0 | 0 | 0 | 11 | 9 | 697 | 10 | 130 | 18 | 0 | 0 | 0 | 4 | 0 | 0 | 2 | 0 | 0 | 0 | 1 | **882** | **57%** |
| Closed-Canopy Mediterranean Shrubs | 0 | 0 | 1 | 0 | 0 | 6 | 1073 | 3 | 0 | 1 | 12 | 13 | 29 | 3 | 1 | 42 | 0 | 2 | 0 | 2 | **1188** | **96%** |
| Closed-Canopy Mixed Broad-leaf | 0 | 0 | 0 | 2 | 56 | 185 | 39 | 269 | 10 | 0 | 0 | 0 | 1 | 0 | 1 | 4 | 0 | 0 | 5 | 1 | **573** | **39%** |
| Closed-Canopy Mixed Forest | 0 | 0 | 0 | 153 | 1 | 43 | 8 | 15 | 21 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | **242** | **3%** |
| Dune Vegetation | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | **7** | **48%** |
| Open-Canopy Conifer | 0 | 0 | 1 | 0 | 0 | 1 | 4 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 13 | 0 | 0 | 0 | 1 | **23** | **2%** |
| Open-Canopy Deciduous Broad-leaf | 1 | 0 | 2 | 0 | 35 | 7 | 4 | 89 | 5 | 0 | 9 | 57 | 2 | 1 | 78 | 39 | 19 | 10 | 37 | 1 | **396** | **39%** |
| Open-Canopy Evergreen Broad-leaf | 0 | 0 | 0 | 0 | 0 | 1 | 4 | 1 | 0 | 0 | 0 | 4 | 2 | 0 | 1 | 5 | 1 | 1 | 1 | 1 | **22** | **0%** |
| Open-Canopy Mediterranean Shrubs | 0 | 0 | 0 | 0 | 0 | 0 | 116 | 0 | 0 | 0 | 0 | 3 | 1 | 11 | 0 | 0 | 0 | 9 | 21 | 0 | **161** | **8%** |
| Open-Canopy Mixed Broad-leaf | 0 | 0 | 0 | 0 | 17 | 19 | 3 | 66 | 1 | 0 | 0 | 12 | 3 | 2 | 1 | 1 | 1 | 0 | 6 | 4 | **136** | **3%** |
| Open-Canopy Mixed Forest | 0 | 0 | 13 | 4 | 9 | 34 | 24 | 28 | 13 | 0 | 2 | 16 | 11 | 3 | 0 | 36 | 4 | 2 | 3 | 20 | **222** | **16%** |
| Perennial Crops | 15 | 0 | 34 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 13 | 3 | 761 | 30 | 20 | 24 | **909** | **73%** |
| Tidal Salt & Marsh | 0 | 0 | 0 | 0 | 0 | 0 | 16 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 249 | 3 | 0 | **275** | **86%** |
| Upland Grasses and Forbs | 82 | 0 | 1 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 26 | 1 | 4 | 13 | 0 | 14 | 4 | 1770 | 5 | **1922** | **90%** |
| Urban Vegetated Area | 4 | 0 | 62 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 4 | 238 | **310** | **48%** |
| **Total** | **582** | **14** | **2349** | **1687** | **170** | **1025** | **1336** | **629** | **146** | **24** | **23** | **132** | **55** | **28** | **108** | **147** | **925** | **353** | **1886** | **340** | **11959** | |
| **Producer** | **82%** | **71%** | **94%** | **90%** | **25%** | **68%** | **80%** | **43%** | **14%** | **21%** | **0%** | **43%** | **4%** | **39%** | **1%** | **24%** | **82%** | **71%** | **94%** | **70%** | | **79.0%** |

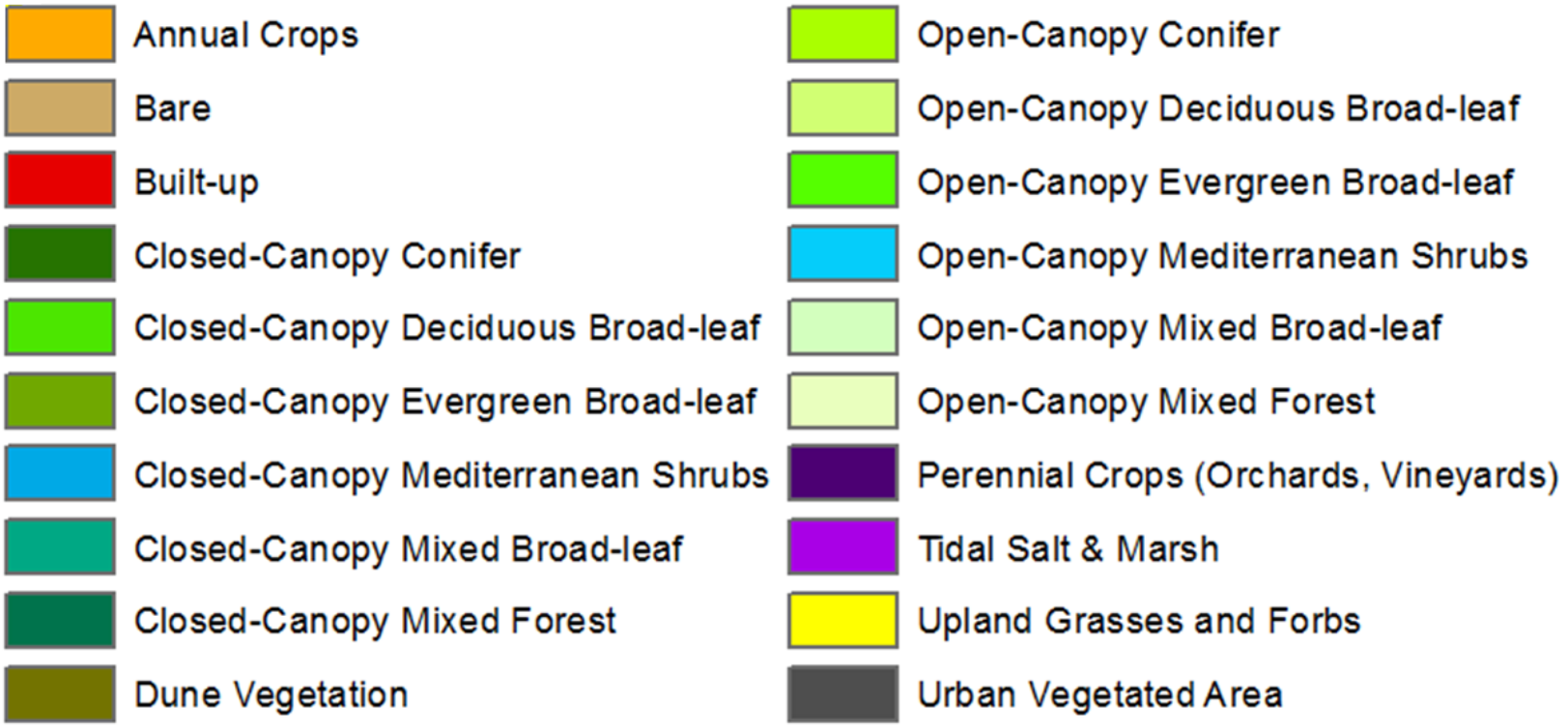
# Napa area


Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

# HyspIRI Spectral Metrics – 30 m



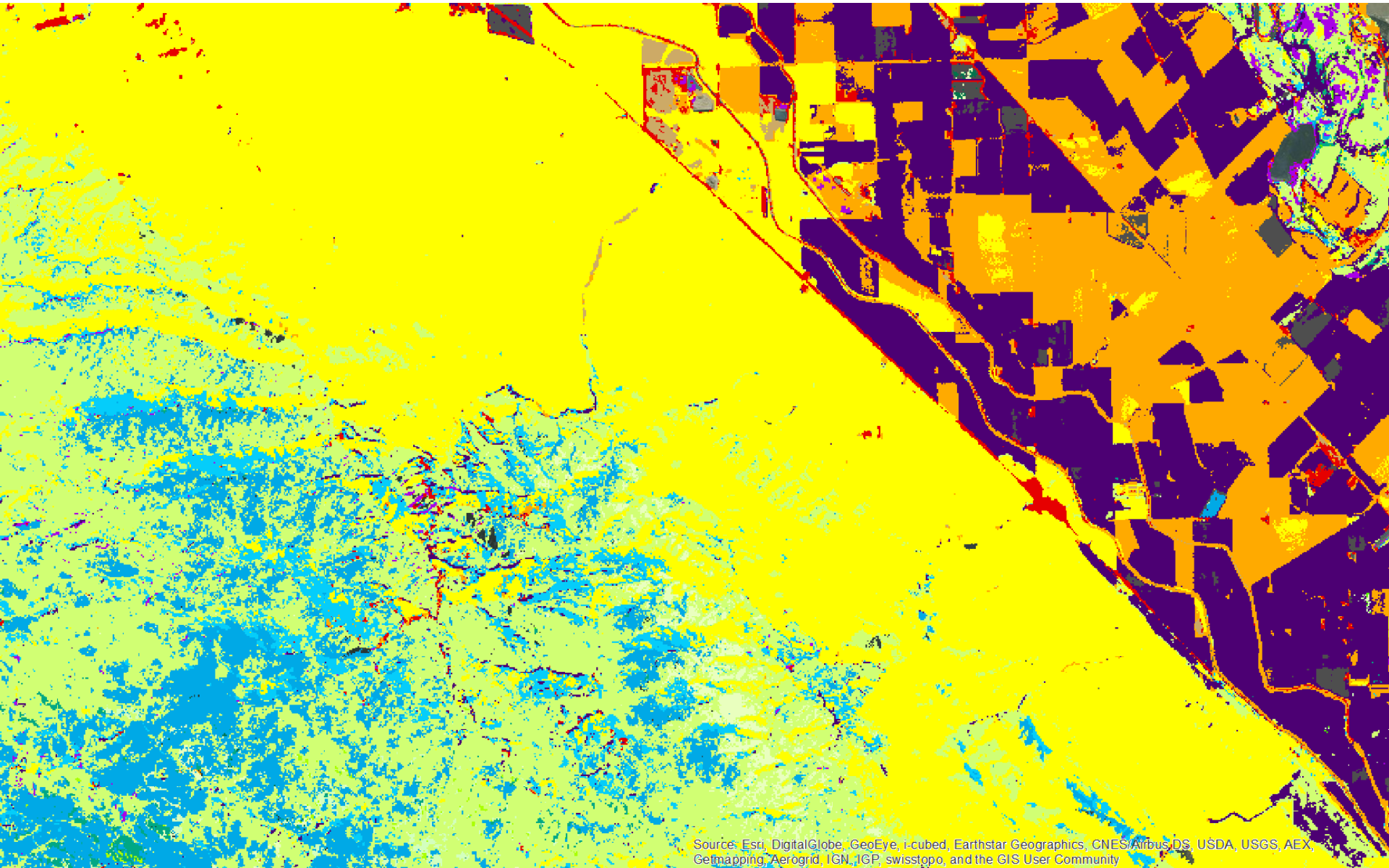
# Land Cover Classification System (LCCS)



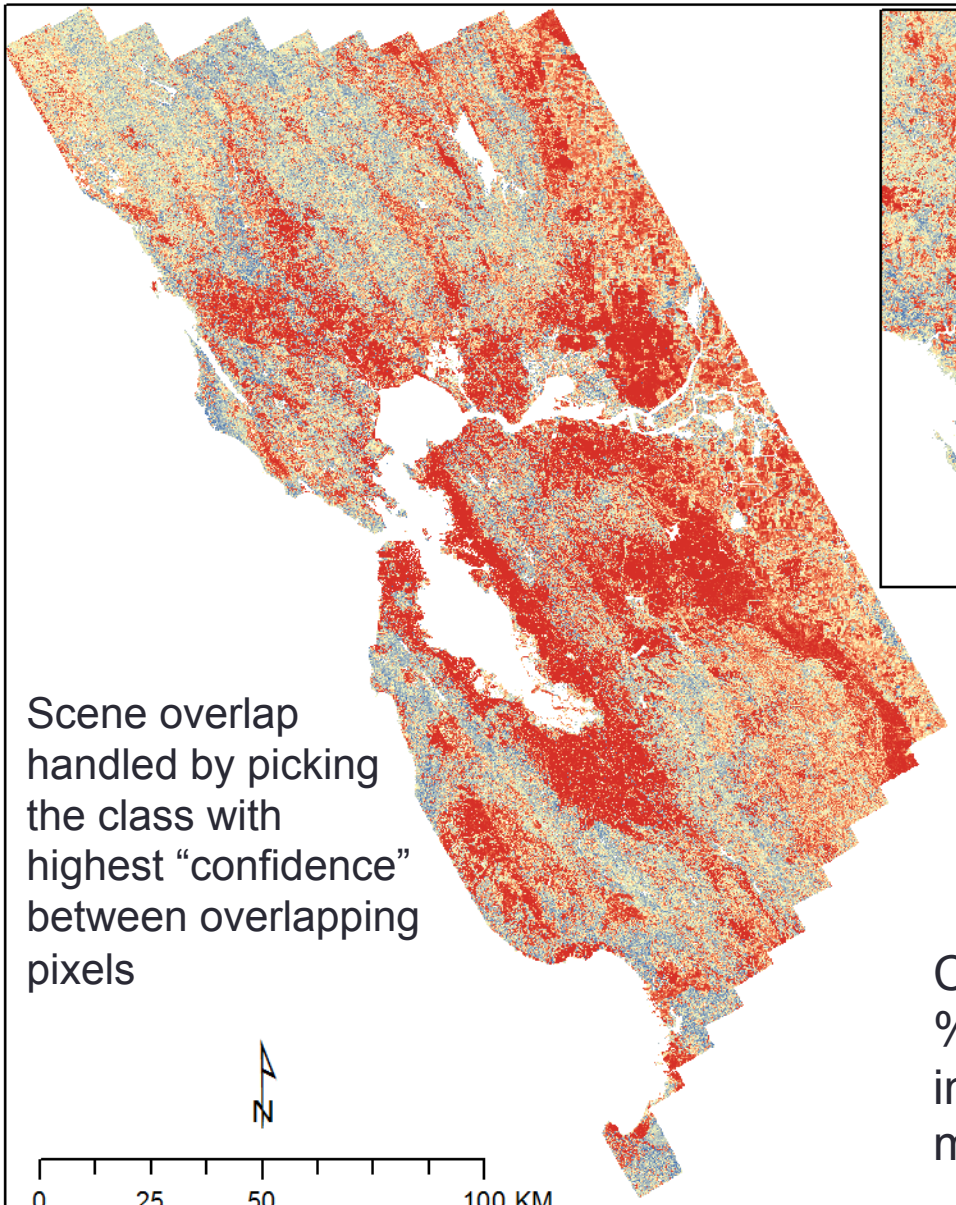

Closed-Canopy: > 65% cover trees or shrubs
Open-Canopy: 15% - 65% cover trees or shrubs

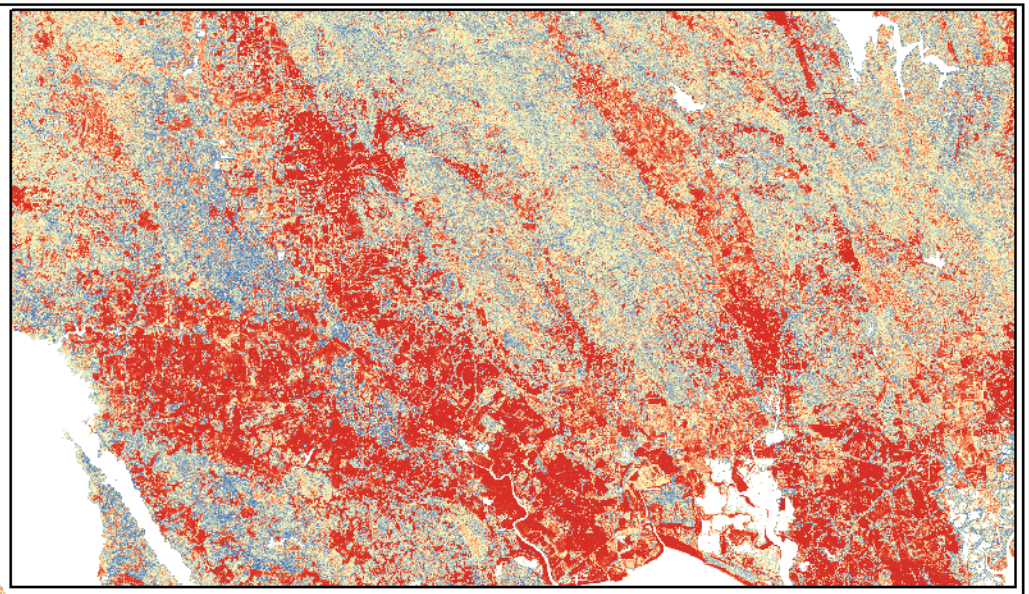
# Western Central Valley/Diablo Range

# HyspIRI Spectral Metrics – 30 m



# Multi-temporal HyspIRI spectral metrics – 30 m

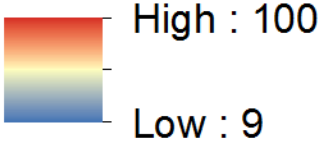




Sonoma and Napa Region

Scene overlap handled by picking the class with highest "confidence" between overlapping pixels



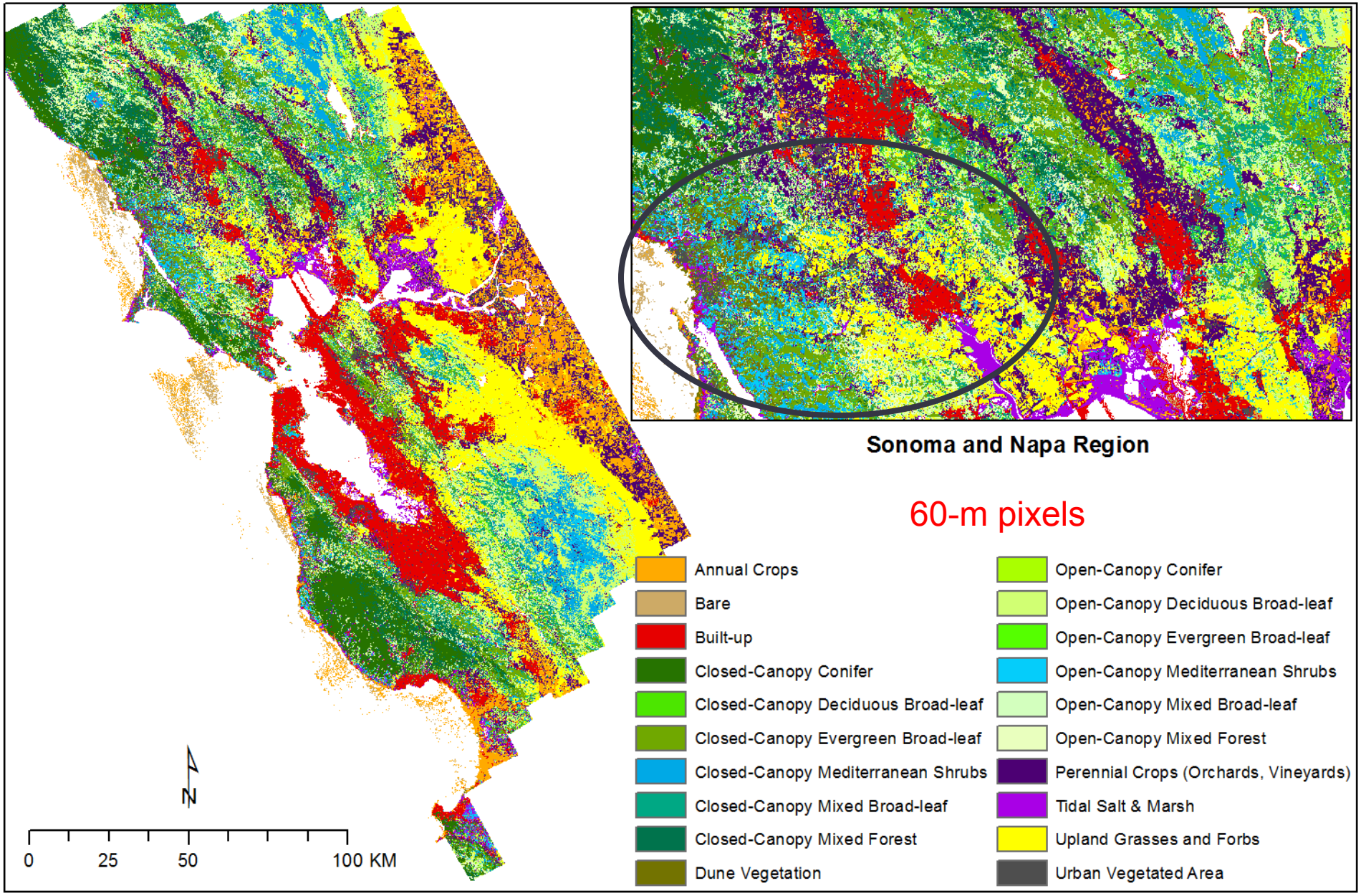




30-m pixels

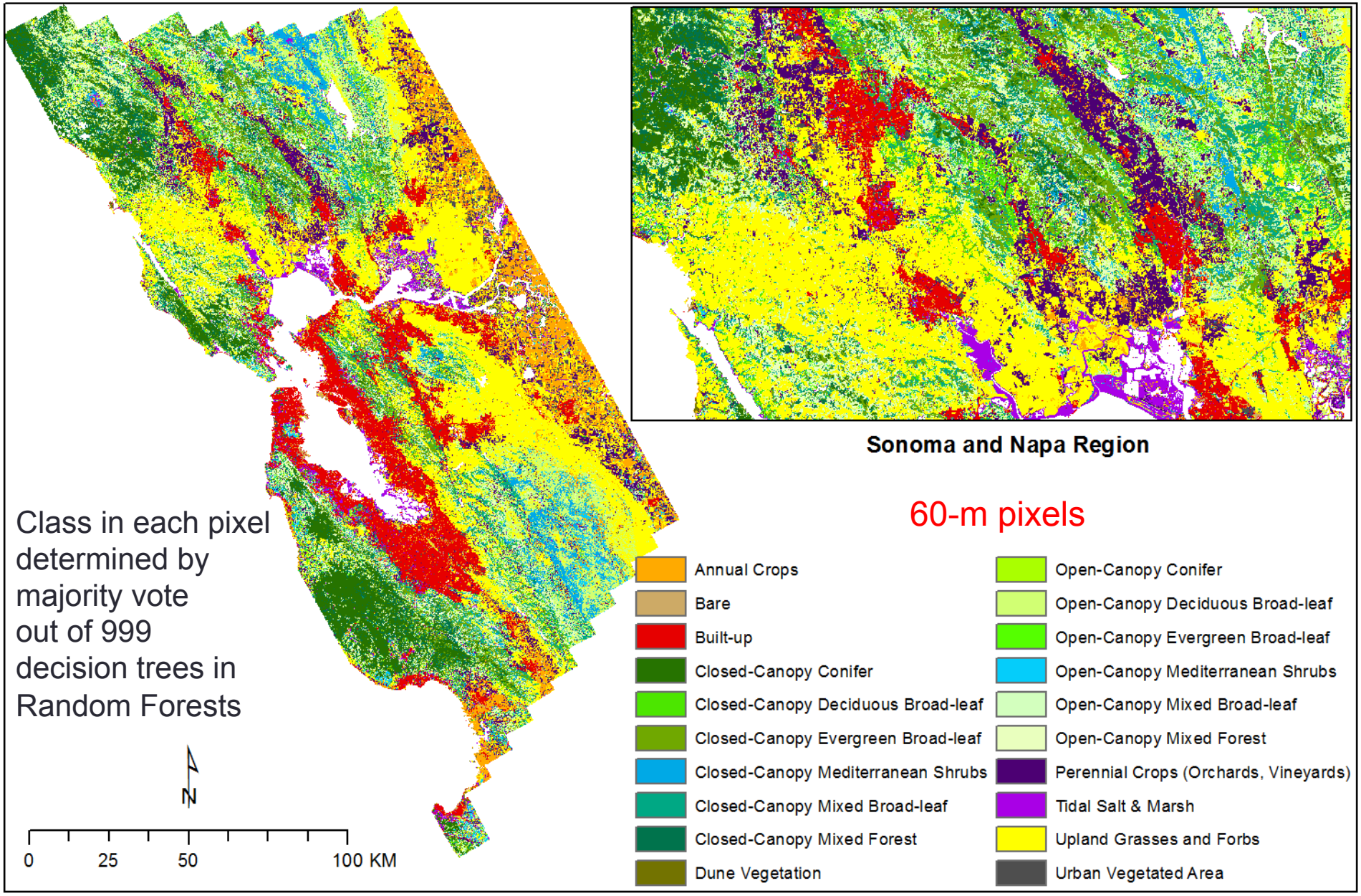
Mean = 60.3

Confidence =
% of votes from all 999 decision trees in Random Forests that were for the majority class

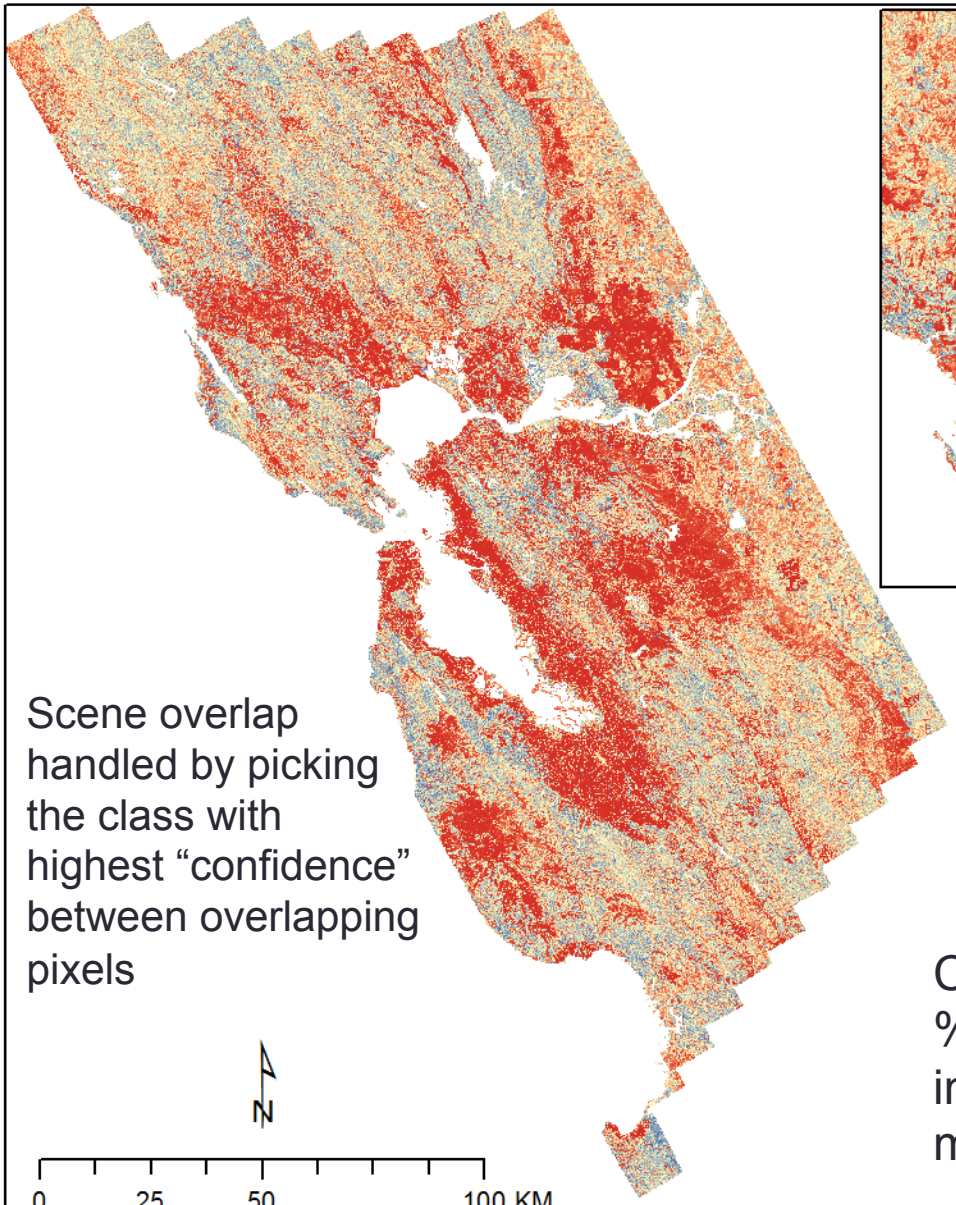
# Summer HyspIRI spectral metrics – 60 m

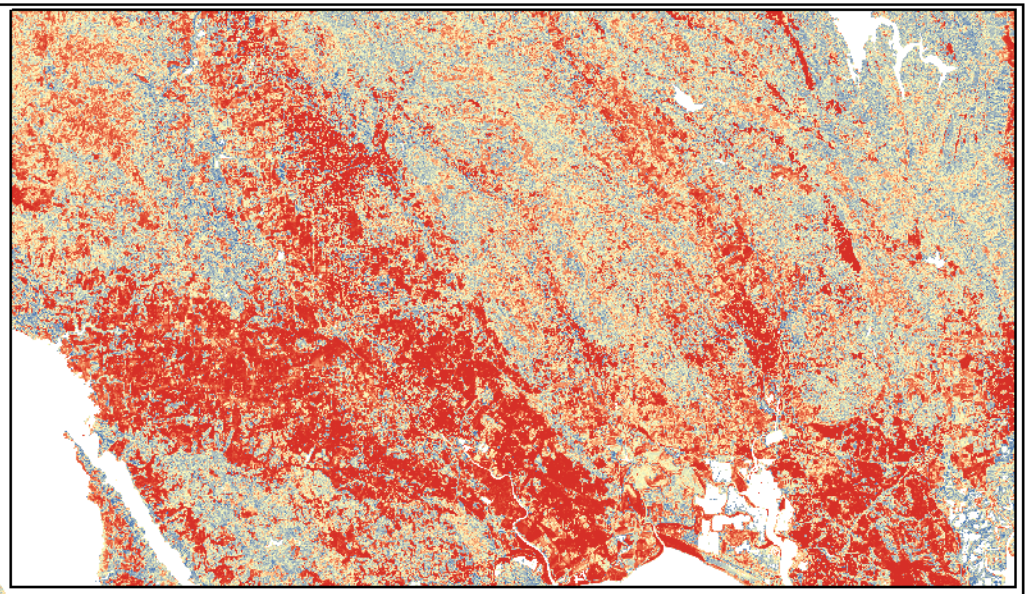


# Multi-temporal HyspIRI reflectance – 60 m



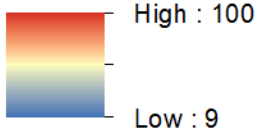
# Multi-temporal HyspIRI reflectance – 60 m





Sonoma and Napa Region

Scene overlap handled by picking the class with highest "confidence" between overlapping pixels

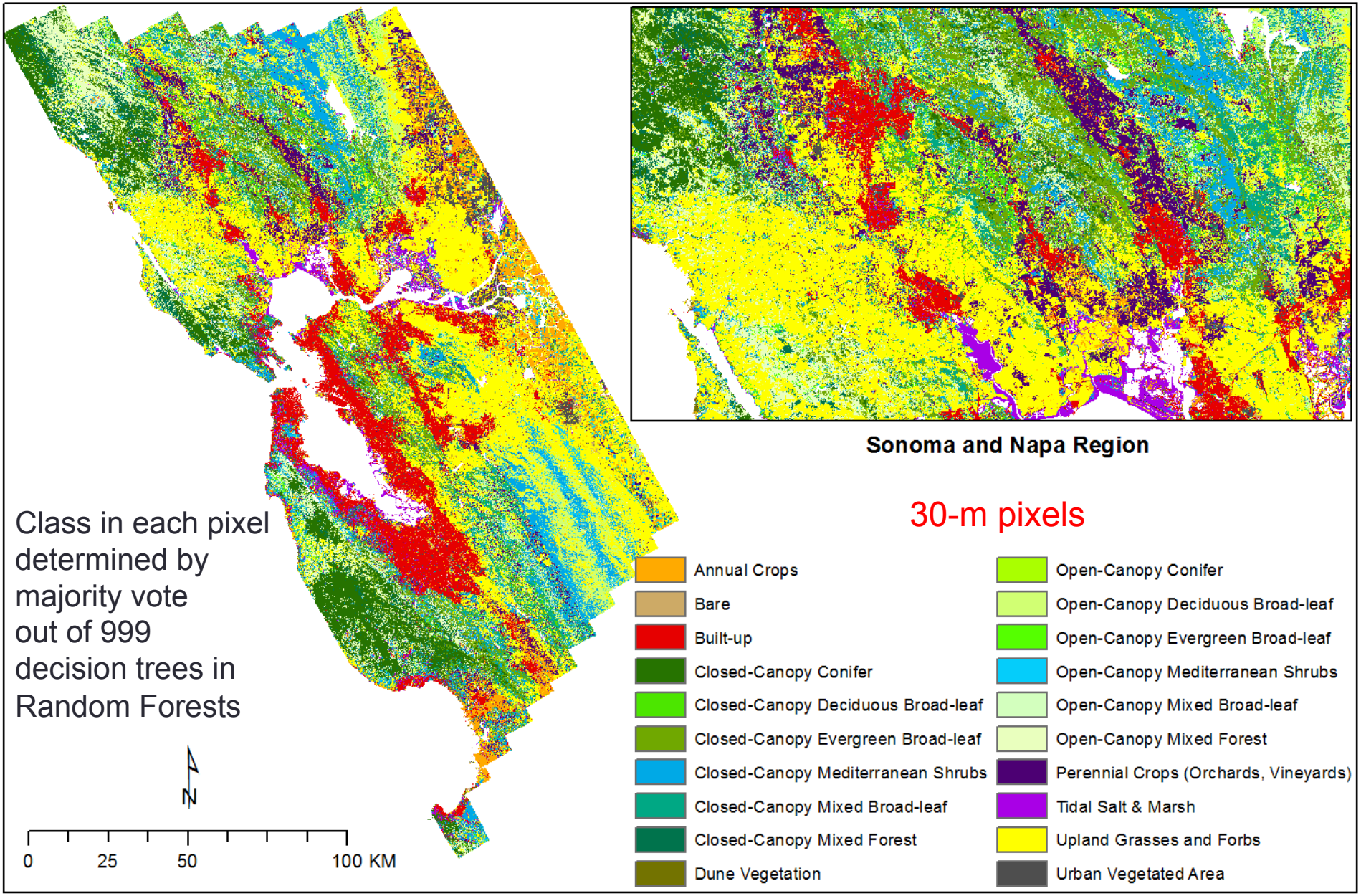



60-m pixels

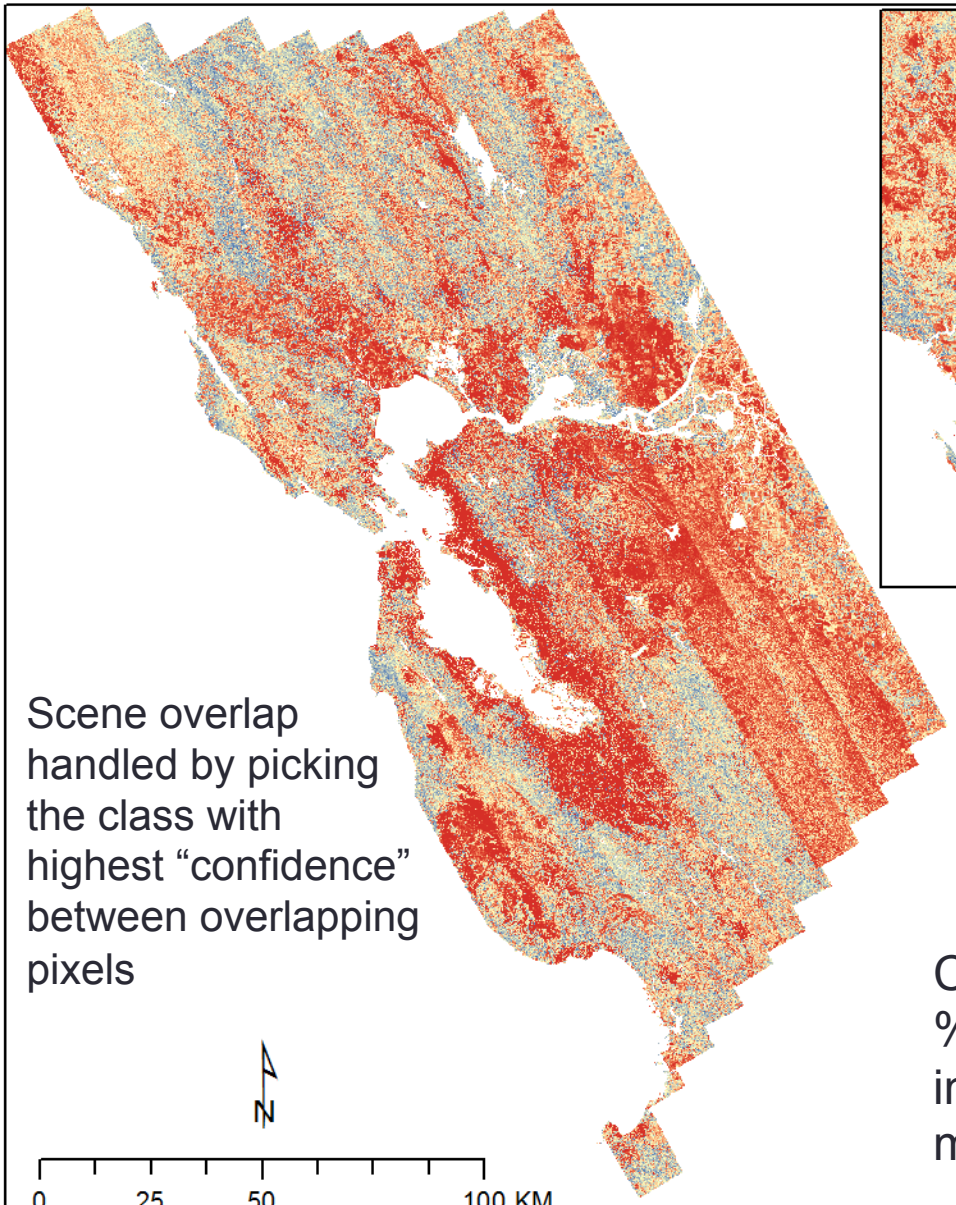
Mean = 59.6

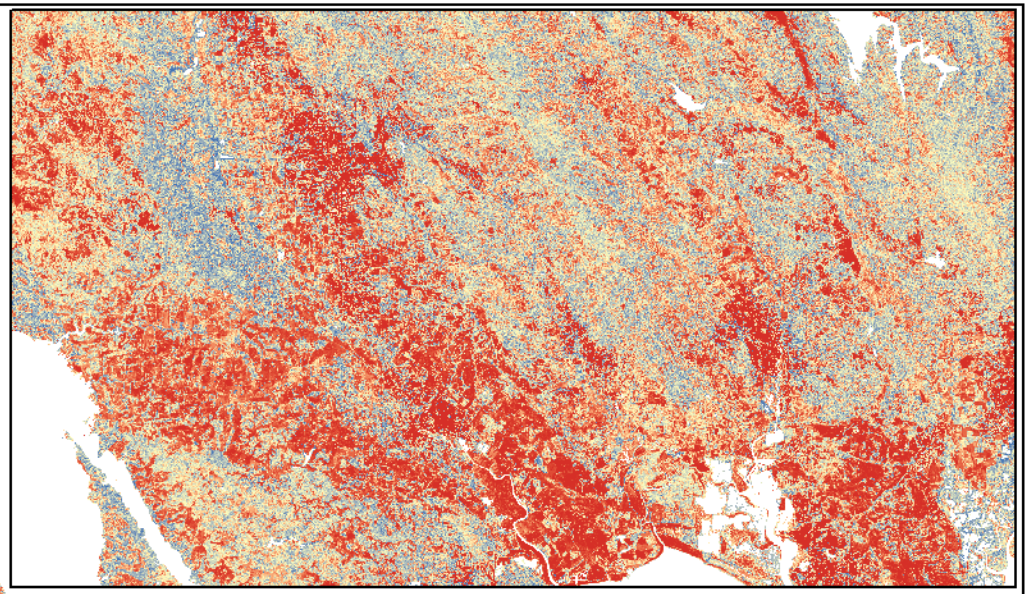
Confidence =
% of votes from all 999 decision trees in Random Forests that were for the majority class

# Multi-temporal Landsat OLI Radiance – 30 m



# Multi-temporal Landsat OLI Radiance – 30 m





Sonoma and Napa Region

Scene overlap handled by picking the class with highest "confidence" between overlapping pixels

N

0 25 50 100 KM

**Confidence**

High : 100

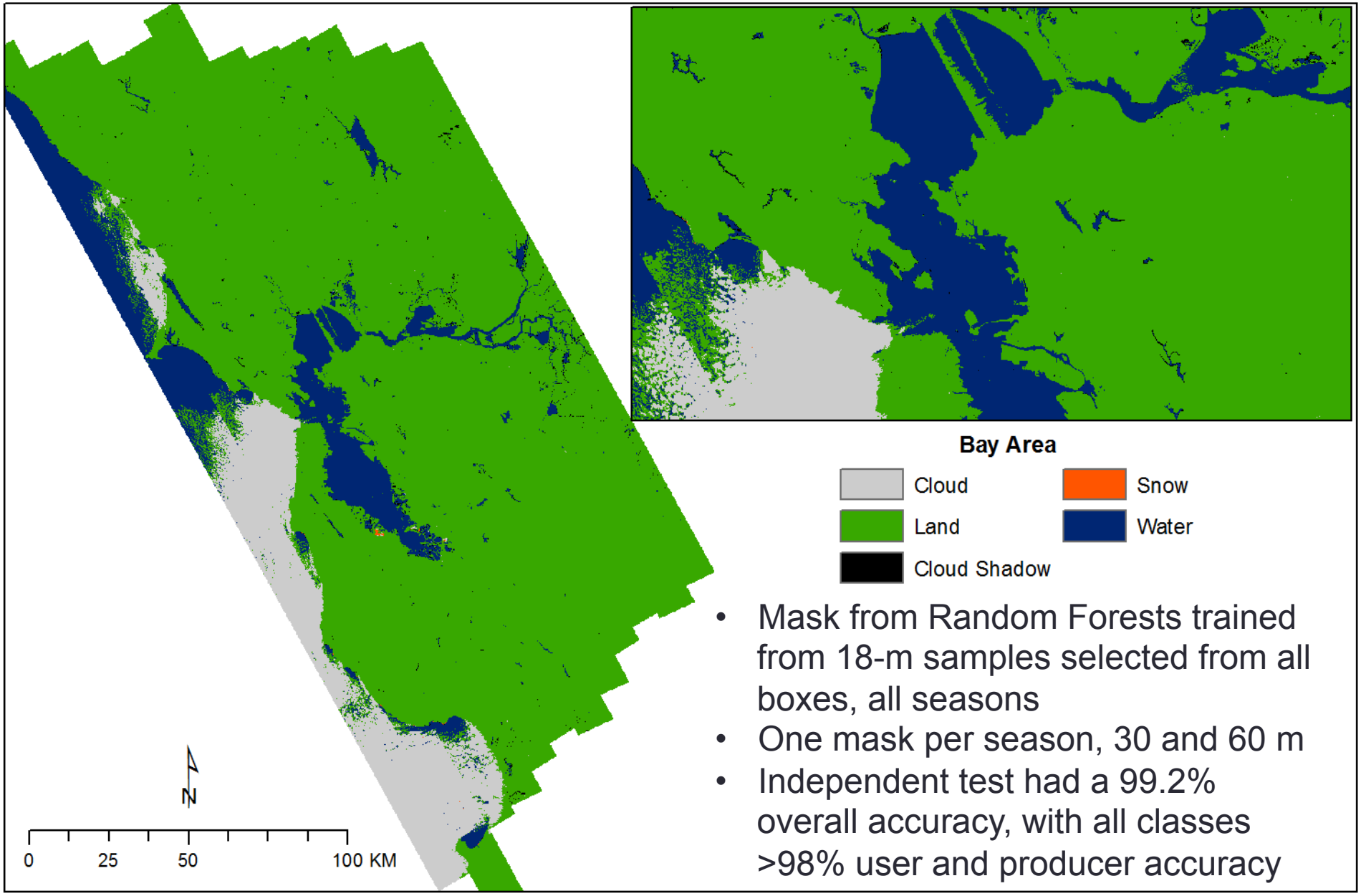
Low : 9

30-m pixels

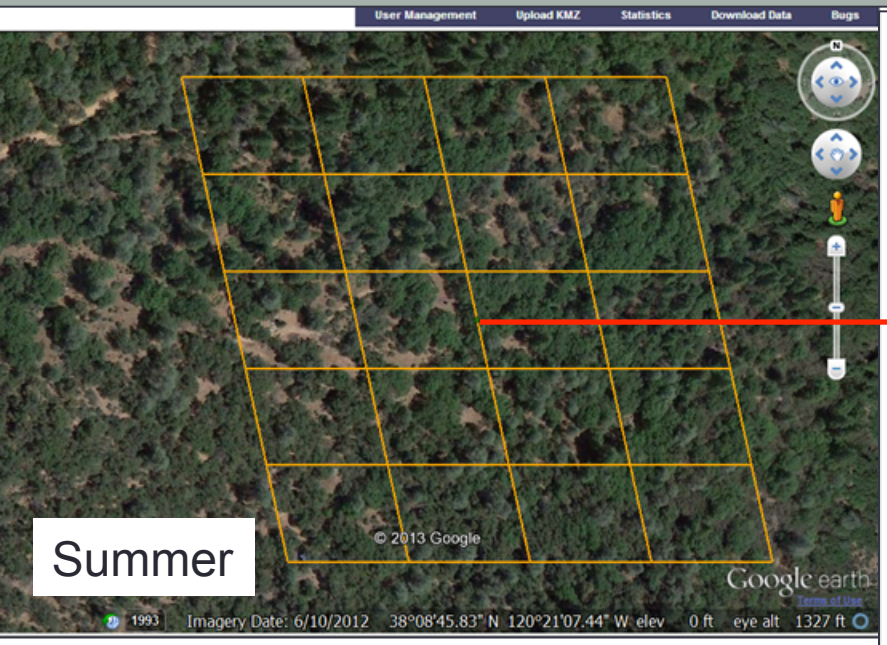
Mean = 60.8

Confidence =
% of votes from all 999 decision trees in Random Forests that were for the majority class

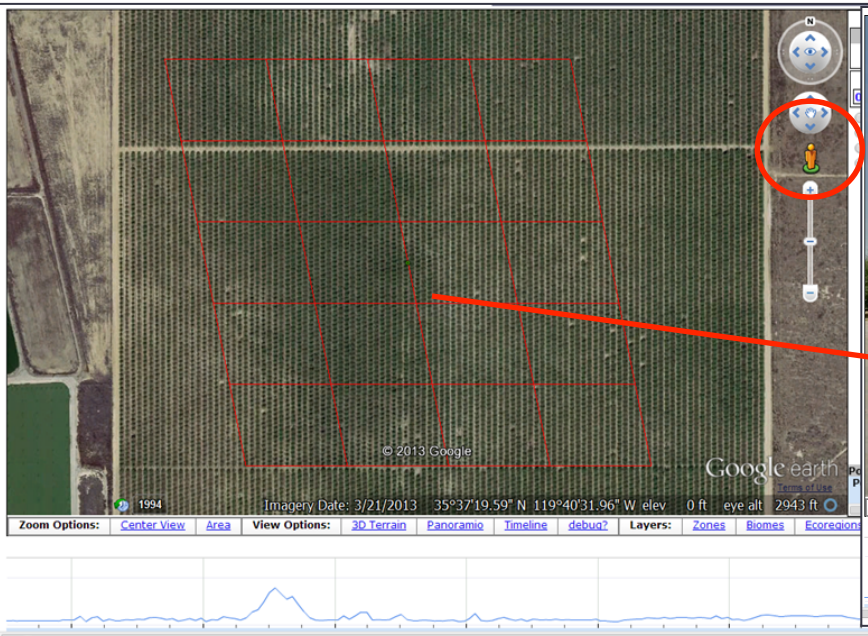
# Summer mask – 60 m

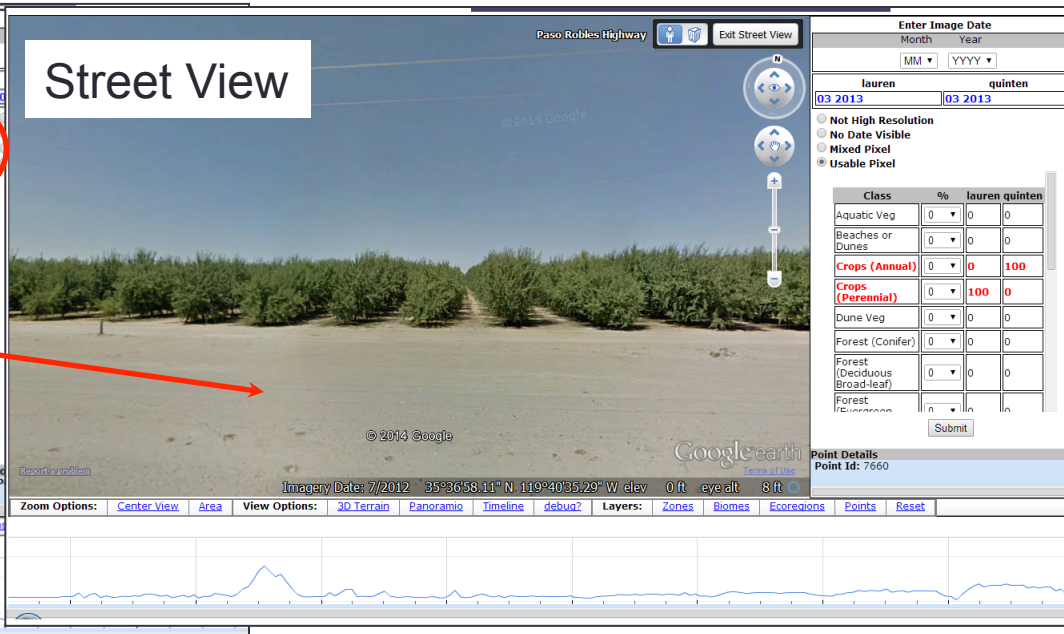



- Mask from Random Forests trained from 18-m samples selected from all boxes, all seasons
- One mask per season, 30 and 60 m
- Independent test had a 99.2% overall accuracy, with all classes >98% user and producer accuracy


User Management
Upload KMZ
Statistics
Download Data
Bugs
Summer
© 2013 Google
Google earth
1993 Imagery Date: 6/10/2012 38°08'45.83" N 120°21'07.44" W elev 0 ft eye alt 1327 ft


11/25/2005
Winter
Image © 2014 DigitalGlobe
Google earth
1993 Imagery Date: 11/25/2005 38°08'39.80" N 120°21'12.97" W elev 0 ft eye alt 1327 ft
Zoom Options: Center View Area View Options: 3D Terrain Panoramio Timeline debug? Layers: Zones Biomes Ecoregions
syd
06 2012
Not High Resolu
No Date Visible
Mixed Pixel
Usable Pixel
Crops (Perennial)
Dune Veg
Forest (Conifer)
Forest (Deciduous Broad-leaf)
Forest (Evergreen Broad-leaf)
Freshwater Wetlands
Impervious Surface
Non-Vegetated
Point Details
Point Id: 7107


© 2013 Google
Google earth
1994 Imagery Date: 3/21/2013 35°37'19.59" N 119°40'31.96" W elev 0 ft eye alt 2943 ft
Zoom Options: Center View Area View Options: 3D Terrain Panoramio Timeline debug? Layers: Zones Biomes Ecoregions


Street View
Paso Robles Highway
Exit Street View
© 2014 Google
Google earth
Imagery Date: 7/2012 35°36'58.11" N 119°40'35.29" W elev 0 ft eye alt 8 ft
Zoom Options: Center View Area View Options: 3D Terrain Panoramio Timeline debug? Layers: Zones Biomes Ecoregions Points Reset
Enter Image Date
Month Year
MM YYYY
lauren quinten
03 2013 03 2013
Not High Resolution
No Date Visible
Mixed Pixel
Usable Pixel
Class % lauren quinten
Aquatic Veg 0 0 0
Beaches or Dunes 0 0 0
Crops (Annual) 0 0 100
Crops (Perennial) 0 100 0
Dune Veg 0 0 0
Forest (Conifer) 0 0 0
Forest (Deciduous Broad-leaf) 0 0 0
Submit
Point Details
Point Id: 7660