Crop classification based on temporal signatures of Sentinel-1 observations over Navarra province, Spain

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1. **Ground truth data for the different regions of Navarre.**

In this section, the ground truth data of the different regions is presented. The number of agricultural fields and their area in the declarations and inspections datasets is showed.

**Table S1.** Ground truth data. Number of agricultural fields and their area in the declarations and inspections. a) Region 1

| Crop    | Declarations | Inspections |
|---------|--------------|-------------|
|         | Nº of fields | Area (ha)   | Nº of fields | Area (ha)   | Mean area (ha) |
| Alfalfa | 6            | 8           | 9            | 8           | 1.36          |
| Asparagus | 0           | 0           | 0            | 0           | 0.00          |
| Barley  | 93           | 171         | 3            | 1           | 1.83          |
| Corn    | 313          | 618         | 120          | 216         | 1.98          |
| Fallow  | 27           | 38          | 8            | 14          | 1.42          |
| Grasslands | 8336      | 14263       | 141          | 189         | 1.71          |
| Legumes | 68           | 146         | 2            | 5           | 2.15          |
| Oats    | 89           | 180         | 14           | 15          | 2.02          |
| other crops | 49         | 253         | 19           | 70          | 5.17          |
| Permanent crops | 16      | 16          | 29           | 29          | 1.02          |
| Rapseseed | 16       | 30          | 7            | 4           | 1.85          |
| Rice    | 0            | 0           | 0            | 0           | 0.00          |
| Sunflower | 18        | 23          | 4            | 1           | 1.30          |
| Wheat   | 224          | 526         | 12           | 28          | 2.35          |
| Total   | 9255         | 16274       | 368          | 580         | 1.76          |

**Table S1 (cont.).** Ground truth data. Number of agricultural fields and their area in the declarations and inspections. b) Region 2

| Region 2 |
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Region 2
### Table S1 (cont.). Ground truth data. Number of agricultural fields and their area in the declarations and inspections.

#### Region 3

| Crop          | Declarations | Inspections |
|---------------|--------------|-------------|
|               | Nº of fields | Area (ha)   | Mean area (ha) | Nº of fields | Area (ha) | Mean area (ha) |
| Alfalfa       | 8            | 16          | 2.03           | 8           | 6         | 0.71155        |
| Aasparagus    | 30           | 63          | 2.09           | 4           | 11        | 2.80           |
| Barley        | 2080         | 5583        | 2.68           | 169         | 370       | 2.19           |
| Corn          | 190          | 482         | 2.54           | 20          | 43        | 2.14           |
| Fallow        | 227          | 415         | 1.83           | 28          | 35        | 1.24           |
| Grasslands    | 1333         | 5213        | 3.91           | 9           | 25        | 2.73           |
| Legumes       | 636          | 1822        | 2.86           | 103         | 258       | 2.50           |
| Oats          | 721          | 1874        | 2.60           | 48          | 106       | 2.20           |
| other crops   | 46           | 119         | 2.58           | 11          | 51        | 4.68           |
| Permanent crops | 183       | 562         | 3.07           | 48          | 73        | 1.52           |
| Rapeseed      | 375          | 1018        | 2.72           | 44          | 132       | 3.01           |
| Rice          | 0            | 0           | 0.00           | 0           | 0         | 0.00           |
| Sunflower     | 176          | 562         | 3.19           | 29          | 63        | 2.17           |
| Wheat         | 3279         | 9162        | 2.79           | 203         | 434       | 2.14           |
| Total         | 9284         | 26890       | 2.90           | 724         | 1606      | 2.22           |

#### Table S1 (cont.). Ground truth data. Number of agricultural fields and their area in the declarations and inspections.

#### Region 4

| Crop          | Declarations | Inspections |
|---------------|--------------|-------------|
|               | Nº of fields | Area (ha)   | Mean area (ha) | Nº of fields | Area (ha) | Mean area (ha) |
| Alfalfa       | 8            | 16          | 2.03           | 8           | 6         | 0.71155        |
| Aasparagus    | 30           | 63          | 2.09           | 4           | 11        | 2.80           |
| Barley        | 2080         | 5583        | 2.68           | 169         | 370       | 2.19           |
| Corn          | 190          | 482         | 2.54           | 20          | 43        | 2.14           |
| Fallow        | 227          | 415         | 1.83           | 28          | 35        | 1.24           |
| Grasslands    | 1333         | 5213        | 3.91           | 9           | 25        | 2.73           |
| Legumes       | 636          | 1822        | 2.86           | 103         | 258       | 2.50           |
| Oats          | 721          | 1874        | 2.60           | 48          | 106       | 2.20           |
| other crops   | 46           | 119         | 2.58           | 11          | 51        | 4.68           |
| Permanent crops | 183       | 562         | 3.07           | 48          | 73        | 1.52           |
| Rapeseed      | 375          | 1018        | 2.72           | 44          | 132       | 3.01           |
| Rice          | 0            | 0           | 0.00           | 0           | 0         | 0.00           |
| Sunflower     | 176          | 562         | 3.19           | 29          | 63        | 2.17           |
| Wheat         | 3279         | 9162        | 2.79           | 203         | 434       | 2.14           |
| Total         | 9284         | 26890       | 2.90           | 724         | 1606      | 2.22           |
| Crop      | Nº of fields | Area (ha) | Mean area (ha) | Nº of fields | Area (ha) | Mean area (ha) |
|-----------|--------------|-----------|----------------|--------------|-----------|----------------|
| Alfalfa   | 33           | 38        | 1.16           | 9            | 7         | 0.81           |
| Asparagus | 175          | 327       | 1.87           | 18           | 27        | 1.50           |
| Barley    | 6057         | 12391     | 2.05           | 606          | 971       | 1.60           |
| Corn      | 41           | 103       | 2.51           | 1            | 0         | 0.31           |
| Fallow    | 1017         | 1489      | 1.46           | 151          | 136       | 0.90           |
| Grasslands| 3161         | 7397      | 2.34           | 53           | 79        | 1.50           |
| Legumes   | 1220         | 3091      | 2.53           | 195          | 332       | 1.70           |
| Oats      | 793          | 1659      | 2.09           | 99           | 151       | 1.52           |
| other crops | 197        | 403       | 2.05           | 48           | 206       | 4.30           |
| Permanent crops | 1583     | 2343      | 1.48           | 413          | 364       | 0.88           |
| Rapeseed | 365          | 859       | 2.35           | 69           | 149       | 2.16           |
| Rice      | 0            | 0         | 0.00           | 0            | 0         | 0.00           |
| Sunflower | 85           | 229       | 2.70           | 5            | 8         | 1.67           |
| Wheat     | 5792         | 12833     | 2.22           | 641          | 1034      | 1.61           |
| Total     | 20519        | 43163     | 2.10           | 2308         | 3465      | 1.50           |

Table S1 (cont.). Ground truth data. Number of agricultural fields and their area in the declarations and inspections. e) Region 5

| Crop      | Nº of fields | Area (ha) | Mean area (ha) | Nº of fields | Area (ha) | Mean area (ha) |
|-----------|--------------|-----------|----------------|--------------|-----------|----------------|
| Alfalfa   | 158          | 305       | 1.93           | 23           | 47        | 2.03           |
| Asparagus | 39           | 79        | 2.04           | 3            | 5         | 1.64           |
| Barley    | 4272         | 10054     | 2.35           | 697          | 1189      | 1.71           |
| Corn      | 791          | 3204      | 4.05           | 146          | 570       | 3.91           |
| Fallow    | 1078         | 2100      | 1.95           | 323          | 468       | 1.45           |
| Grasslands| 2582         | 11285     | 4.37           | 78           | 73        | 0.94           |
| Legumes   | 701          | 2268      | 3.24           | 219          | 319       | 1.46           |
| Oats      | 385          | 1016      | 2.64           | 40           | 105       | 2.63           |
| other crops | 281        | 815       | 2.90           | 62           | 351       | 5.66           |
| Permanent crops | 1327     | 2194      | 1.65           | 290          | 353       | 1.22           |
| Rapeseed | 331          | 846       | 2.56           | 96           | 233       | 2.42           |
| Rice      | 0            | 0         | 0.00           | 0            | 0         | 0.00           |
| Sunflower | 243          | 859       | 3.53           | 25           | 127       | 5.08           |
| Wheat     | 4310         | 10550     | 2.45           | 709          | 1157      | 1.63           |
| Total     | 16498        | 45578     | 2.76           | 2711         | 4998      | 1.84           |

Table S1 (cont.). Ground truth data. Number of agricultural fields and their area in the declarations and inspections. f) Region 6
| Crop       | Declarations | Inspections |
|------------|--------------|-------------|
|            | Nº of fields | Area (ha)   | Mean area (ha) | Nº of fields | Area (ha)   | Mean area (ha) |
| Alfalfa    | 562          | 1042        | 1.85           | 41           | 37          | 0.91           |
| Aasparagus | 132          | 310         | 2.35           | 24           | 21          | 0.86           |
| Barley     | 5717         | 15907       | 2.78           | 359          | 1042        | 2.90           |
| Corn       | 1436         | 4038        | 2.81           | 135          | 431         | 3.19           |
| Fallow     | 2161         | 5022        | 2.32           | 259          | 616         | 2.38           |
| Grasslands | 2027         | 8379        | 4.13           | 35           | 69          | 1.98           |
| Legumes    | 553          | 2110        | 3.81           | 40           | 135         | 3.39           |
| Oats       | 417          | 1154        | 2.77           | 26           | 32          | 1.23           |
| other crops| 971          | 2479        | 2.55           | 76           | 323         | 4.25           |
| Permanent crops | 3063   | 4937        | 1.61           | 426          | 588         | 1.38           |
| Rapeseed   | 49           | 213         | 4.35           | 1            | 6           | 6.09           |
| Rice       | 338          | 563         | 1.67           | 27           | 30          | 1.10           |
| Sunflower  | 39           | 226         | 5.80           | 10           | 64          | 6.36           |
| Wheat      | 2471         | 6800        | 2.75           | 279          | 471         | 1.69           |
| Total      | 19936        | 53181       | 2.67           | 1738         | 3866        | 2.22           |

Table S1 (cont.). Ground truth data. Number of agricultural fields and their area in the declarations and inspections. g)

Region 7

2. Temporal signatures of crops in the regions of Navarre

In this section, the median temporal signatures of crops for VH, VV and VH/VV in the different regions are displayed. The three relative orbits are represented in different colors: 103ASC (red), 8DESC (blue) and 81DESC (green). The interquartile range is represented for all the time series as a colored shadow. The horizontal axes represent the period of study, from September 1, 2015 (day 0) to December 30, 2016 (day 487).
Figure S1. Median temporal signatures of crops for VH, VV and VH/VV. a) Region 1.
Figure S1 (cont.). Median temporal signatures of crops for VH, VV and VH/VV. a) Region 1.
Figure S1 (cont.). Median temporal signatures of crops for VH, VV and VH/VV. b) Region 2.
Figure S1 (cont.). Median temporal signatures of crops for VH, VV and VH/VV. b) Region 2.
Figure S1 (cont.). Median temporal signatures of crops for VH, VV and VH/VV. c) Region 3.
Figure S1 (cont.). Median temporal signatures of crops for VH, VV and VH/VV. c) Region 3.
Figure S1 (cont.). Median temporal signatures of crops for VH, VV and VH/VV. d) Region 4.
Figure S1 (cont.). Median temporal signatures of crops for VH, VV and VH/VV. d) Region 4.
Figure S1 (cont.). Median temporal signatures of crops for VH, VV and VH/VV. e) Region 5.
Figure S1 (cont.). Median temporal signatures of crops for VH, VV and VH/VV. e) Region 5.
Figure S1 (cont.). Median temporal signatures of crops for VH, VV and VH/VV. f) Region 6.
**Figure S1 (cont.).** Median temporal signatures of crops for VH, VV and VH/VV. f) Region 6.
Figure S1 (cont.). Median temporal signatures of crops for VH, VV and VH/VV. g) Region 7.
**Figure S1 (cont.).** Median temporal signatures of crops for VH, VV and VH/VV. g) Region 7.
3. Confusion matrix of Ens and R$^2$ for cross-validation in the regions

Table S2. Confusion matrix of Ens and R$^2$ classification for cross-validation. a) Region 1.

|                | Alfalfa | Barley | Corn | Fallow | Grasslands | Legumes | Oats | Other crops | Permanent crops | Rapeseed | Sunflower | Wheat | UA |
|----------------|---------|--------|------|--------|------------|---------|------|-------------|----------------|----------|-----------|-------|----|
| Alfalfa        | 1       | 0      | 0    | 0      | 47         | 0       | 0    | 0           | 0              | 0        | 0         | 0     | 2% |
| Barley         | 0       | 28     | 3    | 0      | 51         | 1       | 0    | 1           | 0              | 0        | 1         | 3     | 32%|
| Corn           | 0       | 0      | 96   | 2      | 38         | 3       | 0    | 1           | 0              | 0        | 1         | 0     | 68%|
| Fallow         | 0       | 0      | 0    | 100    | 1          | 0       | 1    | 0           | 0              | 0        | 1         | 0     | 1% |
| Grasslands     | 0       | 0      | 0    | 4      | 2154       | 2       | 0    | 6           | 1              | 0        | 0         | 0     | 99%|
| Legumes        | 0       | 1      | 1    | 2      | 36         | 11      | 0    | 0           | 0              | 0        | 1         | 2     | 20%|
| Oats           | 0       | 1      | 0    | 0      | 36         | 1       | 27   | 1           | 0              | 0        | 0         | 7     | 37%|
| Other crops    | 0       | 0      | 1    | 0      | 125        | 0       | 0    | 3           | 2              | 0        | 0         | 0     | 2% |
| Permanent crops| 0       | 0      | 0    | 0      | 114        | 0       | 0    | 4           | 2              | 0        | 0         | 0     | 2% |
| Rapeseed       | 0       | 0      | 0    | 0      | 1          | 0       | 0    | 0           | 0              | 5        | 0         | 0     | 83%|
| Sunflower      | 0       | 0      | 1    | 0      | 53         | 0       | 0    | 0           | 0              | 0        | 2         | 0     | 4% |
| Wheat          | 0       | 1      | 1    | 0      | 24         | 3       | 2    | 0           | 0              | 0        | 0         | 63    | 67%|

PA | 100% | 90% | 93% | 11% | 78% | 50% | 93% | 18% | 40% | 100% | 33% | 84% |


Table S2 (cont.). Confusion matrix of Ens and R² classification for cross-validation. b) Region 2.

|       | Barley  | Corn   | Fallow | Grasslands | Legumes | Oats   | Other crops | Permanent crops | Rapeseed | Sunflower | Wheat | UA  |
|-------|---------|--------|--------|------------|---------|--------|-------------|----------------|----------|-----------|-------|-----|
| Barley| 382     | 0      | 2      | 6          | 2       | 0      | 0           | 0              | 0        | 0         | 0     | 9   |
| Corn  | 0       | 7      | 0      | 15         | 0       | 5      | 0           | 0              | 0        | 0         | 0     | 26  |
| Fallow| 0       | 0      | 58     | 4          | 2       | 1      | 1           | 0              | 0        | 0         | 0     | 88  |
| Grasslands| 0  | 0      | 14     | 1781       | 0       | 9      | 0           | 0              | 0        | 0         | 0     | 99  |
| Legumes| 1      | 0      | 12     | 116        | 120     | 1      | 9           | 1              | 0        | 0         | 0     | 13  |
| Oats  | 1       | 0      | 3      | 19         | 5       | 150    | 3           | 0              | 0        | 0         | 0     | 107 |
| Other crops | 0  | 0      | 4      | 43         | 0       | 0      | 1           | 1              | 0        | 0         | 0     | 2   |
| Permanent crops | 0 | 0      | 8      | 112        | 0       | 0      | 310         | 0              | 1        | 0         | 0     | 7   |
| Rapeseed| 0     | 0      | 0      | 3          | 4       | 0      | 0           | 38             | 0        | 0         | 0     | 84  |
| Sunflower| 0    | 1      | 5      | 7          | 0       | 0      | 1           | 0              | 0        | 37        | 0     | 73  |
| Wheat | 5       | 0      | 4      | 12         | 5       | 16     | 5           | 0              | 0        | 0         | 0     | 618 |
| PA    | 98%     | 88%    | 53%    | 84%        | 87%     | 90%    | 3%          | 77%            | 100%     | 97%       | 83%   |     |

The table above shows the confusion matrix for cross-validation in region 2, with rows representing the actual classes and columns representing the predicted classes. The numbers indicate the counts of observations for each class, and the percentages show the accuracy for each class.
Table S2 (cont.). Confusion matrix of Ens and $R^2$ classification for cross-validation. c) Region 3.

|           | Alfalfa | Asparagus | Barley | Corn | Fallow | Grasslands | Legumes | Oats | Other crops | Permanent crops | Rapeseed | Sunflower | Wheat | PA |
|-----------|---------|-----------|--------|------|--------|------------|---------|------|-------------|----------------|----------|-----------|-------|----|
| Alfalfa   | 2       | 0         | 0      | 0    | 2      | 4          | 0       | 0    | 1           | 0              | 0        | 0         | 0     | 100%|
| Asparagus | 0       | 6         | 0      | 0    | 2      | 1          | 0       | 0    | 2           | 3              | 0        | 0         | 0     | 60% |
| Barley    | 0       | 1         | 677    | 0    | 0      | 6          | 5       | 0    | 2           | 0              | 0        | 0         | 25    | 98% |
| Corn      | 0       | 2         | 0      | 0    | 6      | 1          | 0       | 0    | 1           | 0              | 0        | 0         | 0     | 95% |
| Fallow    | 0       | 0         | 0      | 0    | 38     | 9          | 0       | 0    | 2           | 2              | 0        | 0         | 0     | 75% |
| Grasslands| 0       | 0         | 0      | 0    | 13     | 333        | 2       | 0    | 2           | 10             | 0        | 0         | 0     | 93% |
| Legumes   | 0       | 0         | 1      | 0    | 4      | 15         | 191     | 0    | 2           | 1              | 2        | 0         | 0     | 88% |
| Oats      | 0       | 0         | 5      | 0    | 3      | 8          | 4       | 216  | 0           | 1              | 0        | 0         | 126   | 60% |
| Other crops| 0    | 0         | 0      | 0    | 3      | 6          | 2       | 0    | 1           | 0              | 0        | 0         | 1     | 8%  |
| Permanent crops | 0 | 1 | 0 | 0 | 8 | 57 | 0 | 0 | 1 | 43 | 0 | 0 | 0 | 39% |
| Rapeseed | 0       | 0         | 0      | 0    | 4      | 0          | 1       | 0    | 123         | 0              | 0        | 0         | 0     | 96% |
| Sunflower| 0       | 0         | 0      | 2    | 3      | 1          | 0       | 0    | 0           | 0              | 58       | 0         | 0     | 91% |
| Wheat     | 0       | 0         | 10     | 0    | 1      | 5          | 4       | 24   | 0           | 1              | 0        | 0         | 940   | 95% |

Table S2 (cont.). Confusion matrix of Ens and $R^2$ classification for cross-validation. d) Region 4.
| Crop Type    | Alfalfa | Asparagus | Barley | Corn | Fallow | Grasslands | Legumes | Oats | Other crops | Permanent crops | Rapeseed | Sunflower | Wheat | UA   |
|--------------|---------|-----------|--------|------|--------|------------|---------|------|-------------|----------------|----------|-----------|-------|------|
| Alfalfa      | 9       | 0         | 0      | 0    | 4      | 26         | 2       | 1    | 3           | 2              | 0        | 0         | 2     | 18%  |
| Asparagus    | 0       | 43        | 0      | 0    | 2      | 6          | 5       | 0    | 0           | 0              | 65       | 0         | 1     | 33%  |
| Barley       | 0       | 2         | 1919   | 6    | 9      | 17         | 11      | 11   | 0           | 0              | 0        | 0         | 70    | 94%  |
| Corn         | 0       | 0         | 10     | 4    | 1      | 0          | 0       | 6    | 0           | 0              | 2        | 0         | 0     | 43%  |
| Fallow       | 0       | 1         | 0      | 10   | 174    | 9          | 1       | 0    | 2           | 14             | 0        | 0         | 0     | 87%  |
| Grasslands   | 1       | 2         | 0      | 0    | 35     | 844        | 3       | 0    | 7           | 71             | 0        | 0         | 1     | 88%  |
| Legumes      | 0       | 0         | 19     | 0    | 23     | 40         | 302     | 4    | 8           | 4              | 2        | 0         | 18    | 72%  |
| Oats         | 0       | 0         | 13     | 0    | 4      | 11         | 12      | 195  | 5           | 1              | 0        | 0         | 257   | 39%  |
| Other crops  | 0       | 2         | 8      | 0    | 21     | 48         | 6       | 2    | 3           | 12             | 0        | 0         | 11    | 3%   |
| Permanent crops | 0     | 8         | 0      | 0    | 32     | 45         | 0       | 0    | 2           | 356            | 0        | 1         | 0     | 80%  |
| Rapeseed     | 0       | 0         | 5      | 0    | 5      | 7          | 49      | 0    | 3           | 0              | 120      | 0         | 0     | 63%  |
| Sunflower    | 0       | 0         | 0      | 1    | 18     | 3          | 0       | 0    | 2           | 1              | 0        | 23        | 0     | 48%  |
| Wheat        | 0       | 0         | 55     | 0    | 6      | 8          | 14      | 51   | 5           | 1              | 0        | 1         | 1571  | 92%  |
| PA           | 90%     | 74%       | 95%    | 71%  | 51%    | 80%        | 74%     | 74%  | 5%          | 68%            | 98%      | 82%       | 81%   |      |
Table S2 (cont.). Confusion matrix of Ens and $R^2$ classification for cross-validation. e) Region 5.

|          | Alfalfa | Asparagus | Barley | Corn | Fallow | Grasslands | Legumes | Oats | Other crops | Permanent crops | Rapeseed | Sunflower | Wheat | UA |
|----------|---------|-----------|--------|------|--------|------------|---------|------|-------------|----------------|----------|-----------|-------|----|
| Alfalfa  | 35      | 0         | 0      | 1    | 4      | 25         | 1       | 1    | 2           | 4              | 0        | 0         | 1     | 47%|
| Asparagus| 0       | 6         | 0      | 1    | 1      | 0          | 0       | 6    | 18          | 18             | 0        | 0         | 0     | 18%|
| Barley   | 1       | 0         | 1353   | 7    | 17     | 7          | 4       | 3    | 1           | 8              | 0        | 0         | 58    | 93%|
| Corn     | 0       | 3         | 0      | 248  | 0      | 1          | 0       | 0    | 11          | 8              | 0        | 0         | 0     | 92%|
| Fallow   | 0       | 0         | 0      | 200  | 7      | 6          | 0       | 3    | 12          | 12             | 0        | 1         | 0     | 87%|
| Grasslands| 2      | 0         | 1      | 0    | 41     | 635        | 3       | 1    | 12          | 50             | 0        | 0         | 1     | 85%|
| Legumes  | 12      | 0         | 17     | 0    | 35     | 83         | 178     | 1    | 10          | 10             | 7        | 0         | 15    | 48%|
| Oats     | 1       | 1         | 13     | 1    | 3      | 14         | 4       | 101  | 5           | 1              | 0        | 0         | 190   | 30%|
| Other crops| 1   | 0         | 0      | 2    | 27     | 18         | 3       | 0    | 16          | 23             | 0        | 1         | 0     | 18%|
| Permanent crops | 0  | 3         | 0      | 1    | 30     | 48         | 1       | 0    | 6           | 308           | 0        | 0         | 0     | 78%|
| Rapeseed | 0       | 0         | 3      | 0    | 2      | 1          | 20      | 0    | 1           | 0              | 104      | 0         | 0     | 79%|
| Sunflower| 0       | 0         | 0      | 8    | 3      | 0          | 0       | 0    | 10          | 4              | 0        | 79        | 0     | 76%|
| Wheat    | 0       | 0         | 37     | 1    | 5      | 11         | 10      | 20   | 8           | 3              | 0        | 0         | 1172  | 93%|
| PA       | 67%     | 46%       | 95%    | 94%  | 56%    | 74%        | 76%     | 79%  | 17%         | 70%           | 94%      | 98%       | 82%   |
Table S2 (cont.). Confusion matrix of Ens and R² classification for cross-validation. f) Region 6.

|                | Alfalfa | Asparagus | Barley | Corn | Fallow | Grasslands | Legumes | Oats | Other crops | Permanent crops | Rapeseed | Rice | Sunflower | Wheat | UA  |
|----------------|---------|-----------|--------|------|--------|------------|---------|------|-------------|----------------|----------|------|-----------|-------|-----|
| Alfalfa        | 129     | 0         | 0      | 0    | 26     | 99         | 3       | 1    | 6           | 17             | 0        | 0    | 0         | 1     | 46% |
| Asparagus      | 0       | 31        | 0      | 27   | 8      | 1          | 0       | 0    | 18          | 35             | 0        | 0    | 1         | 0     | 26% |
| Barley         | 1       | 0         | 1708   | 0    | 19     | 13         | 6       | 6    | 14          | 1              | 0        | 0    | 0         | 59    | 93% |
| Corn           | 0       | 3         | 0      | 383  | 1      | 0          | 2       | 0    | 31          | 8              | 0        | 1    | 0         | 0     | 89% |
| Fallow         | 6       | 0         | 0      | 0    | 361    | 10         | 8       | 0    | 2           | 13             | 0        | 0    | 0         | 0     | 90% |
| Grasslands     | 6       | 0         | 3      | 0    | 118    | 448        | 2       | 5    | 11          | 76             | 0        | 0    | 0         | 4     | 67% |
| Legumes        | 28      | 0         | 21     | 3    | 68     | 31         | 106     | 6    | 16          | 6              | 0        | 0    | 1         | 11    | 36% |
| Oats           | 3       | 1         | 32     | 2    | 19     | 8          | 16      | 107  | 19          | 23             | 0        | 0    | 0         | 119   | 31% |
| Other crops    | 1       | 4         | 0      | 32   | 16     | 10         | 2       | 77   | 0           | 49             | 0        | 0    | 0         | 0     | 40% |
| Permanent crops| 0       | 4         | 0      | 14   | 38     | 21         | 3       | 0    | 29          | 777            | 0        | 0    | 0         | 0     | 88% |
| Rapeseed       | 1       | 0         | 21     | 0    | 13     | 3          | 19      | 0    | 6           | 1              | 16       | 0    | 0         | 0     | 20% |
| Rice           | 0       | 0         | 0      | 4    | 0      | 1          | 3       | 0    | 14          | 1              | 0        | 111  | 0         | 0     | 83% |
| Sunflower      | 0       | 0         | 0      | 7    | 14     | 2          | 3       | 0    | 55          | 5              | 0        | 0    | 9         | 0     | 9%  |
| Wheat          | 11      | 1         | 120    | 6    | 19     | 28         | 11      | 15   | 27          | 10             | 0        | 0    | 1         | 627   | 72% |

PA 69% 70% 90% 80% 50% 66% 58% 76% 24% 76% 100% 99% 75% 76%
Table S2 (cont.). Confusion matrix of Ens and R² classification for cross-validation. g) Region 7.

| Alfalfa | Asparagus | Barley | Corn | Fallow | Grasslands | Legumes | Oats | Other crops | Permanent crops | Rice | Sunflower | Wheat | UA  |
|---------|-----------|--------|------|--------|------------|---------|------|-------------|-----------------|------|-----------|-------|-----|
| Alfalfa | 265       | 0      | 1    | 15     | 30         | 51      | 3    | 0           | 60              | 0    | 0         | 3     | 61% |
| Asparagus | 2       | 15     | 0    | 18     | 12         | 0       | 0    | 0           | 23              | 42   | 0         | 1     | 0   |
| Barley   | 2        | 0      | 523  | 2      | 265        | 1       | 2    | 0           | 46              | 0    | 0         | 3     | 110 |
| Corn     | 0        | 0      | 0    | 262    | 3          | 0       | 0    | 0           | 31              | 2    | 1         | 1     | 1   |
| Fallow   | 5        | 0      | 2    | 1      | 1419       | 12      | 3    | 0           | 4               | 13   | 0         | 1     | 1   |
| Grasslands | 3       | 0      | 9    | 4      | 194        | 460     | 1    | 0           | 17              | 42   | 0         | 1     | 12  |
| Legumes  | 7        | 0      | 50   | 1      | 159        | 4       | 38   | 2           | 55              | 6    | 0         | 2     | 21  |
| Oats     | 13       | 0      | 46   | 2      | 69         | 20      | 5    | 12          | 32              | 15   | 0         | 3     | 116 |
| Other crops | 2       | 0      | 16   | 2      | 34         | 2       | 1    | 87          | 14              | 0    | 2         | 13    | 50% |
| Permanent crops | 4   | 2      | 1    | 3      | 108        | 37      | 1    | 1           | 8               | 505  | 0         | 0     | 0   |
| Rice     | 0        | 0      | 0    | 5      | 0          | 0       | 0    | 0           | 10              | 0    | 99        | 0     | 0   |
| Sunflower | 1       | 0      | 0    | 5      | 7          | 0       | 0    | 38          | 4               | 0    | 26        | 0     | 32% |
| Wheat    | 22       | 0      | 126  | 17     | 50         | 15      | 7    | 4           | 100             | 4    | 0         | 1     | 525 |
| UA       | 81%      | 88%    | 68%  | 78%    | 60%        | 76%     | 62%  | 63%         | 19%             | 71%  | 99%       | 63%   | 65% |
4. Producer’s Accuracy (PA), User’s Accuracy (UA) and F1-score for the different classification schemes in Navarre and regions.

In this section, Producer’s Accuracy (PA), User’s Accuracy (UA) and F1-score for Navarre and regions are presented. In each figure, results for $R^2$ metric are shown on left side and results for RMSE metric are shown on right side.

**Figure S2.** F1-score, PA and UA for the different polarization channels. a) Cross-Validation in Navarre
Figure S2 (cont.). F1-score, PA and UA for the different polarization channels. b) External-validation in Navarre
Figure S2 (cont.). F1-score, PA and UA for the different polarization channels. c) Cross-validation in Region 1
Figure S2 (cont.). F1-score, PA and UA for the different polarization channels. d) External-validation in Region 1.
Figure S2 (cont.). F1-score, PA and UA for the different polarization channels. e) Cross-validation in Region 2
Figure S2 (cont.). F1-score, PA and UA for the different polarization channels. f) External-validation in Region 2.
Figure S2 (cont.). F1-score, PA and UA for the different polarization channels. g) Cross-validation in Region 3
Figure S2 (cont.). F1-score, PA and UA for the different polarization channels. h) External-validation in Region 3.
Figure S2 (cont.). F1-score, PA and UA for the different polarization channels. i) Cross-validation in Region 4
Figure S2 (cont.). F1-score, PA and UA for the different polarization channels. j) External-validation in Region 4
Figure S2 (cont.). F1-score, PA and UA for the different polarization channels. k) Cross-validation in Region 5
**Figure S2 (cont.)**. F1-score, PA and UA for the different polarization channels. 1) External-validation in Region 5
Figure S2 (cont.). F1-score, PA and UA for the different polarization channels. m) Cross-validation in Region 6
Figure S2 (cont.). F1-score, PA and UA for the different polarization channels. n) External-validation in Region 6.
Figure S2 (cont.). F1-score, PA and UA for the different polarization channels. o) Cross-validation in Region 6
Figure S2 (cont.). F1-score, PA and UA for the different polarization channels. p) External-validation in Region 7
5. Influence of field size on classification results

Figure S3. Overall Accuracy of External validation based on field size: <0.5 ha (left), 0.5-1ha (middle) and >1ha (right).
Figure S4. F1-score, PA and UA of Ens and R2 classification based on field size for external validation. a) Region 1
Figure S4 (cont.). F1-score, PA and UA of Ens and R2 classification based on field size for external validation. b) Region 2
Figure S4 (cont.). F1-score, PA and UA of Ens and R2 classification based on field size for external validation. c) Region 3
Figure S4 (cont.). F1-score, PA and UA of Ens and R2 classification based on field size for external validation. d) Region 4
Figure S4 (cont.). F1-score, PA and UA of Ens and R2 classification based on field size for external validation. 
e) Region 5
Figure S4 (cont.). F1-score, PA and UA of Ens and R2 classification based on field size for external validation.

f) Region 6
Figure S4 (cont.). F1-score, PA and UA of Ens and R2 classification based on field size for external validation.

g) Region 7