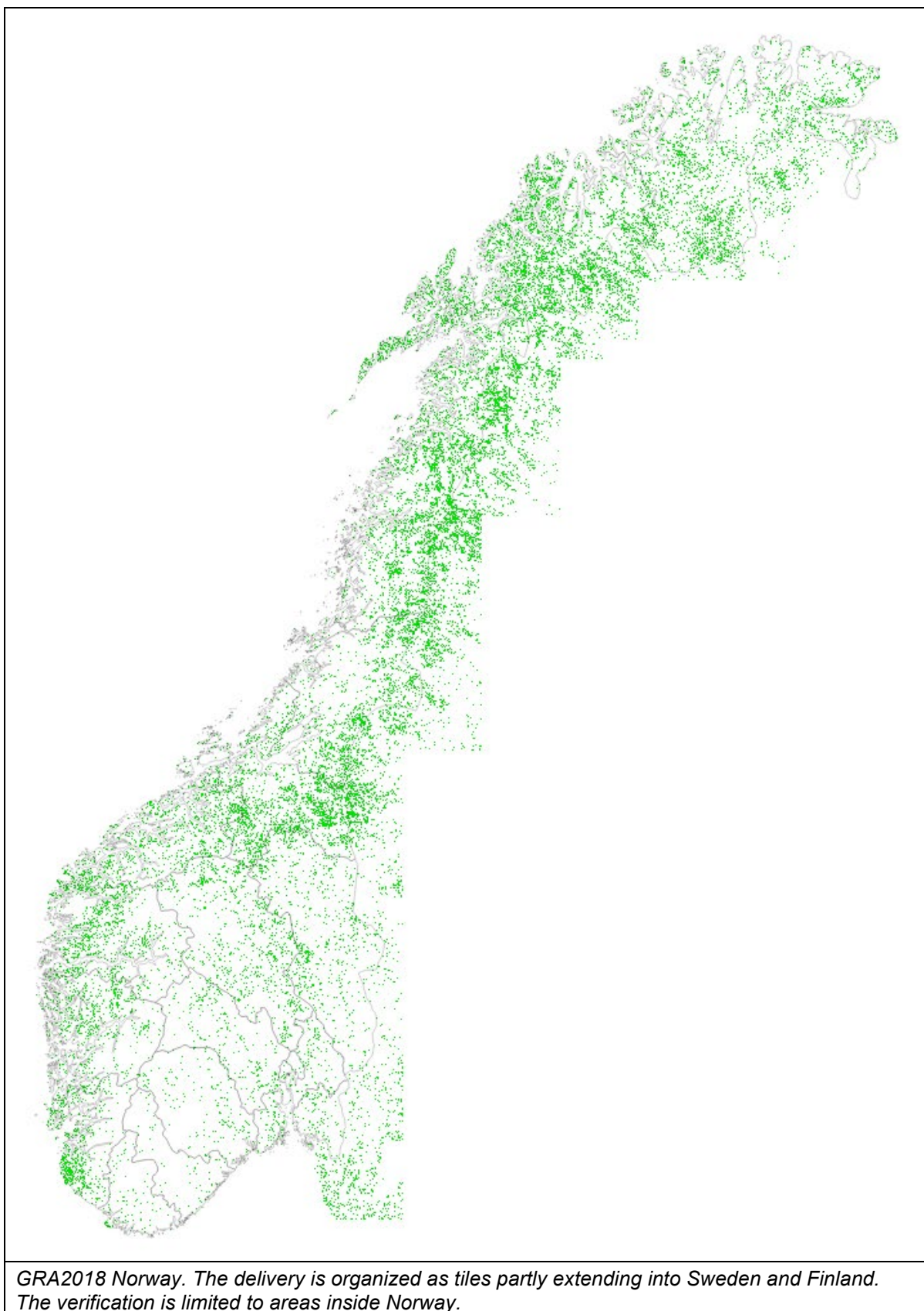


## HRL 2018 look & feel verification report for Grassland (2018) Norway

### I. Administrative part

|  |   |
|--|---|
| HRL  | <i>Grassland 2018</i>   |
| Verified area, region  | <i>Norway</i>   |
| Institution carrying out the work                            | <i>NIBIO Survey and statistics</i>  |
| Overall visual checking done by (name, position and e-mail)  | <i>Hanne-Gro Wallin, Senior Engineer, Head of Department<br/>hgw@nibio.no</i>   |
| Look & feel verification done by (name, position and e-mail) | <i>Hanne-Gro Wallin, Senior Engineer, Head of Department<br/>hgw@nibio.no</i>   |
| In situ data used..  | <i>National ortophoto database Norge-i-bilder<br/>Ref: <a href="http://www.norgeibilder.no">http://www.norgeibilder.no</a></i>  |
|  | <i>National spatial data infrastructure<br/>Ref: <a href="http://kilden.nibio.no">http://kilden.nibio.no</a></i>                |
|  | <i>Area frame survey of land cover and outfield land resources (AR18X18)</i>  |
|  | <i>Ortophoto, topographic and thematic maps available as wms services were integrated with the HRL data using qGIS</i>          |
| Reporting done by (name, position and e-mail)                | <i>Hanne-Gro Wallin, Senior Engineer, Head of Department<br/>hgw@nibio.no<br/>Geir-H Strand, Director R&amp;D, ghs@nibio.no</i> |
| Date and place of writing the report                         | <i>Ås 20.05.2021</i>  |

## II. General overview of the verified data



### Statistical overview

| Class         | Value | Haa        | %       |
|---------------|-------|------------|---------|
| Not grassland | 0     | 28 476 900 | 87,9%   |
| Grassland     | 1     | 3 904 000  | 12,1%   |
| Total         |       | 32 380 900 | 100,00% |

### The grassland in Norway in 2018 (based on the AR18X18 survey and agricultural statistics)

| Class                                   | Haa              | %            |
|---|------------------|--------------|
| Agricultural grassland (not plowed)     | 280 500          | 0,87         |
| Grass snow beds                         | 752 500          | 2,32         |
| Dry grass heath                         | 167 200          | 0,52         |
| Mountain avens heath                    | 277 600          | 0,86         |
| Alpine damp heath                       | 599 000          | 1,85         |
| Low herb meadow                         | 483 700          | 1,49         |
| Damp heath                              | 237 000          | 0,73         |
| <b>Total</b>                            | <b>2 797 500</b> | <b>8,64</b>  |
| Agricultural arable grassland (plowed)  | 476 548          | 1,47         |
| <b>Total including arable grassland</b> | <b>3 274 048</b> | <b>10,11</b> |

The grassland reported by the HRL (12,1 %) is higher than the grassland reported by national statistics (8,6 % without arable grassland, or 10,1% including arable grassland) pointing to probable commission errors. Inclusion of arable grassland (plowed every 3-5 year and harvested annually) is not sufficient to explain the difference.

## III. Overall visual checking

| Positional accuracy          |   |                                    |  |
|------------------------------|---|------------------------------------|--|
| Relative positional accuracy | Quick visual comparison of HRL data with available EO imagery (identifying large positional errors) | OK / correct,                      | The map does not allow assessment of the relative positional accuracy, but there is no obvious positional errors                                 |
| Thematic accuracy            |   |                                    |  |
| Classification correctness   | Simple look & feel thematic check (identifying basic thematic mistakes)                             | OK / correct,<br>NOK / not correct | The classification is good in southern and central parts of Norway but shows considerable commission errors in the outfields in northern Norway. |

#### IV. Look & feel verification results

##### 1. Included elements, possible OMISSIONS

| Stratum                                     | Name of the stratum  | Number of samples verified | Results of the verification by strata (using qualitative evaluation as: Excellent, good, acceptable, insufficient, very poor).  |
|---|--|----------------------------|---|
| 1   | Natural, semi-natural, agricultural / managed grass-covered surfaces.  | 60                         | <i>Variable between Excellent and Very poor. Patches of managed grassland is often partly classified as grassland, partly as non-grassland. Arable land with cereals is occasionally classified as grassland, but this is rare. The situation is consistent in all regions.</i> |
| 2   | Grasslands with scattered trees and shrubs covering a maximum 10 %.  | 55                         | <i>Acceptable but also variable. We often find that only parts of a patch of grassland is classified as grassland. Pasture near farms is more correctly classified than similar grassland further away from the farms (where the grazing may be less intensive?).</i>           |
| 3   | Coastal grasslands, such as grey dunes and salt meadows located in intertidal flat areas with at least 30 % graminoid species of vegetation cover. | 2                          | <i>A rare category in Norway. We found two locations: One was excellent and one was poor..</i>  |
| 4   | Sparsely vegetated grasslands (> 30% vegetation cover).  | 13                         | <i>We checked known grass snowbeds and the classification was Good</i>  |
| 5   | Grasslands in urban areas: parks, urban green spaces in residential and industrial areas.  | 22                         | <i>Good</i>   |
| 7   | Grass cover at airports  | 15                         | <i>Variable results. The mapping at some locations were Excellent, other locations were Poor. We could not find any plausible explanation.</i>  |
| 8   | Grass cover at sport and recreation areas  | 11                         | <i>Good/Excellent</i>   |
| 10  | Wet grasslands along rivers & lakes  | 10                         | <i>Mostly Poor</i>  |
| Overall evaluation (based on look-and-feel) |  |                            | <i>(excellent, good, acceptable, insufficient, very poor)</i><br>Acceptable   |
| Comments                                    |  |                            | The results are Good in Urban and Agricultural areas. The classification of arable grassland vary, This is probably linked to the rotation (plowing every 3-5 years) the time since tilling. The grass on a plowed  |

|  |  |
|--|--|
|  | field will also be back as a grass cover only a few weeks after the plowing. |
|--|--|

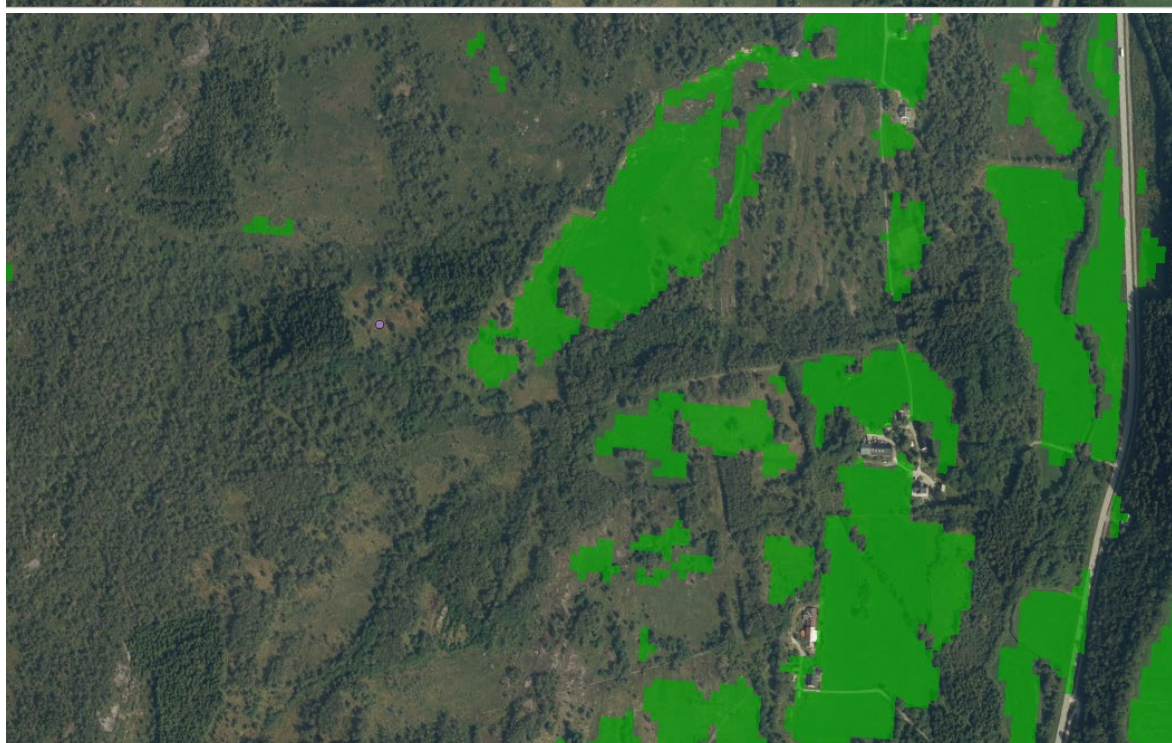
## 2. Excluded elements, possible COMMISSIONS

| Stratum                                     | Name of the stratum                          | Number of samples verified | Results of the verification by strata (using qualitative evaluation as: Excellent, good, acceptable, insufficient, very poor).   |
|---|--|----------------------------|--|
| 12  | Peat forming ecosystems dominated by sedges  | 19                         | Excellent.<br>Fen is correctly excluded  |
| 13  | Reed beds and helophytes dominated systems   | 4                          | <i>Excellent.</i><br><i>Small areas in Norway but the controlled locations were correctly excluded</i>   |
| 14  | Tall forbs, fern, shrub dominated vegetation | 18                         | <i>Good.</i><br><i>Only a small portion of the tall forbs meadows were classified as grassland</i>   |
| 15  | Grasslands that have been observed as tilled |                            | <i>We did not check this stratum. Arable grassland is plowed every 3-5 years and plowing can only be observed for a few weeks.</i>   |
| 18  | Tundras dominated by shrubs and lichens      |                            | <i>Poor. Tundra is limited to the Varanger peninsula in northern Norway. We scanned this area and found that large areas with open broadleaf forest and shrub heath was classified as grassland</i>  |
| 19  | Clearecut areas in woods                     | 20                         | <i>Good.</i>   |
| 20  | Cropland                                     |                            | <i>Cropland is mostly excluded. Arable grassland is mostly or partly mapped as grassland.</i>  |
| Overall evaluation (based on look-and-feel) |  |                            | <i>Acceptable.</i>   |
| Comments                                    |  |                            | <i>The variable mapping of arable grassland probably linked to the plowing taking place every 3-5 years and only visible (as plowing) for a few weeks. This land is probably mapped as non-grassland when plowing is observed, and as grassland when no plowing is observed. This is inconsistent from a national point of view.</i> |

## V. Documentation of errors and critical findings

Please include detailed descriptions, meaningful examples and screenshots of errors, critical findings. Please make sure the nature, location and frequency of the issue is described in some detail. Screenshots should contain ETRS1989 LAEA coordinates.





Stratum 1: Summer farms with grassland [-18609, 6641856]. The arable grassland (in the eastern part of the image) is classified as grassland, while many of the pastures (in the central part of the image) are omitted.



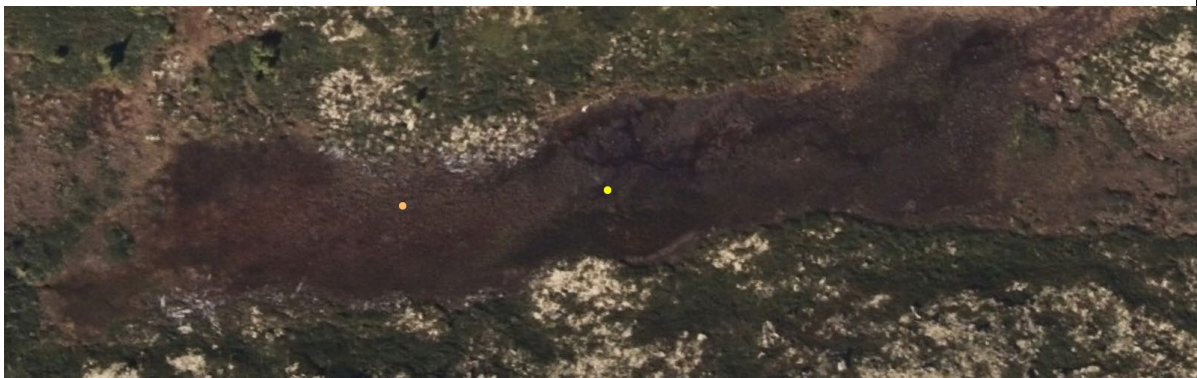


Strata 1: Arable grassland classified as grassland [UTM 143089, 6804001]. A couple of patches in the middle of the fields are omitted





Wetland (and an arable grassland) along a river system [LAEA 4385596, 4087772]



Reed bed, correctly mapped as non-grassland [LAEA 4246000, 4308160]

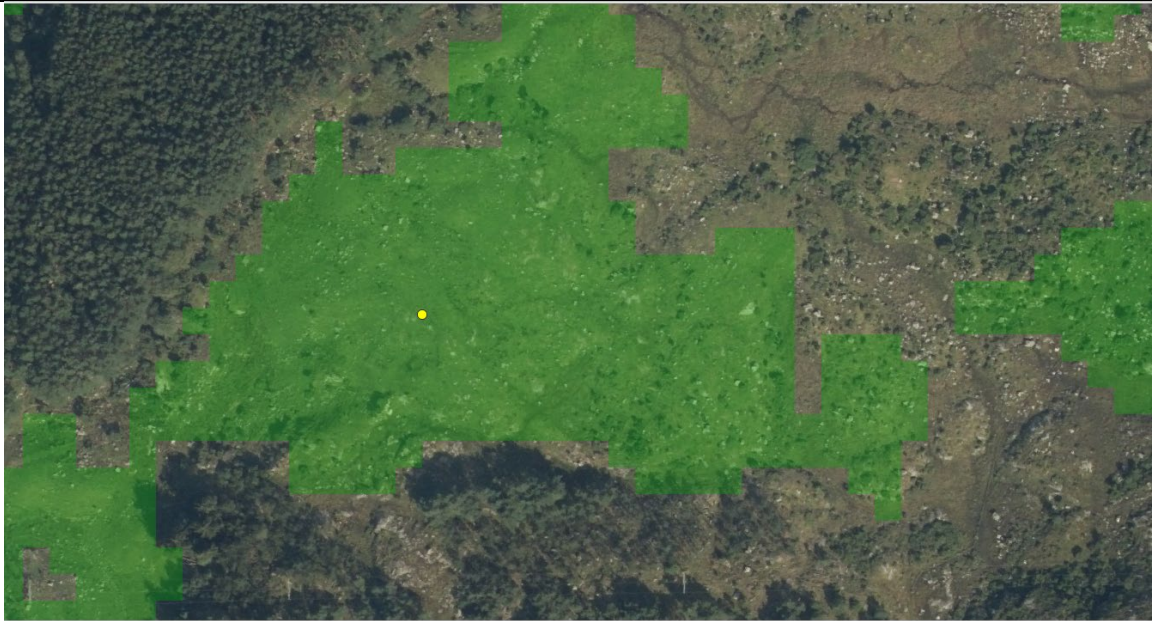


Tall forbs meadow, correctly mapped as non-grassland [LAEA 4316500, 4331636]



Logged land (clear-cut) partly mapped as grassland [LAEA 4188865, 4237675]





Pasture, partly (mostly) mapped as grassland [LAEA 4059000, 4045100]



## VI. Statistical verification (optional)

|   |   |
|---|---|
| Description of methodology and software |   |
| Stratification                          | 0: Not grassland<br>1: Grassland  |
| Comments                                | The interpretation of ground truth was conservative. The HRL was accepted as correct when the analyst was in doubt. Misclassification was only recorded when the analyst was confident that an error was present. |

Please copy here the (weighted) confusion matrix and main accuracy parameters and provide the corresponding Excel file in attachment.

| GRA2018 Verification raw data confusion matrix |       |              |     |       |
|--|-------|--------------|-----|-------|
|  |       | Ground truth |     |       |
|  |       | 0            | 1   | Total |
| HRL  | 0     | 2 640        | 23  | 2 663 |
|  | 1     | 128          | 209 | 337   |
|  | Total | 2 768        | 232 | 3 000 |

| GRA2018 Verification weighted confusion matrix |       |              |      |       |
|--|-------|--------------|------|-------|
|  |       | Ground truth |      |       |
|  |       | 0            | 1    | Total |
| HRL  | 0     | 0,87         | 0,01 | 0,88  |
|  | 1     | 0,05         | 0,07 | 0,12  |
|  | Total | 0,92         | 0,08 | 1,00  |

| GRA2018 Verification Overall accuracy |  |          |        |        |        |
|---------------------------------------|--|----------|--------|--------|--------|
|                                       |  | Accuracy | 95% CI | Lower  | Upper  |
|                                       |  | 94,7 %   | 0,7 %  | 94,0 % | 95,4 % |
|                                       |  |          |        |        |        |
|                                       |  |          |        |        |        |

| GRA2018 Verification User's accuracy |   |          |        |        |        |
|--------------------------------------|---|----------|--------|--------|--------|
|                                      |   | Accuracy | 95% CI | Lower  | Upper  |
| HRL                                  | 0 | 99,1 %   | 0,4 %  | 98,8 % | 99,5 % |
|                                      | 1 | 62,0 %   | 5,2 %  | 56,8 % | 67,2 % |
|                                      |   |          |        |        |        |
|                                      |   |          |        |        |        |

| GRA2018 Verification Producer's accuracy |   |          |        |        |        |
|--|---|----------|--------|--------|--------|
|  |   | Accuracy | 95% CI | Lower  | Upper  |
| HRL                                      | 0 | 95,0 %   | 0,7 %  | 94,4 % | 95,7 % |
|  | 1 | 90,8 %   | 3,5 %  | 87,3 % | 94,3 % |