Supplementary Material for

**Early-season mapping of winter canola by combining Sentinel-1 and Sentinel-2 data**

Tingting Liu1, Peipei Li 2 , Feng Zhao 3 , Jie Liu1 and Ran Meng1,4\*

1 Artificial Intelligence Research Institute Co., Ltd, School of Computer Science and Technology, Harbin Institute of Technology, Harbin 150000, China; hzauliutingting@gmail.com

2 College of Resources and Environment, Huazhong Agricultural University, Wuhan 430070, China; 18229880838@163.com

3 Key Laboratory of Sustainable Forest Ecosystem Management-Ministry of Education/College of Forestry, Northeast Forestry University, Harbin 150040, China; peakzhao424@hotmail.com

4 National Key Laboratory of Smart Farm Technologies and Systems, Harbin 150000, China;

**\*** Correspondence: mengran@hit.edu.cn;

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**Table S1**. Description of the number of Sentinel-1 satellite images used in the study.

|  |  |  |  |
| --- | --- | --- | --- |
| **Satellite platform** | **Image date** | **Image numbers** | **phenological stage** |
| Sentinel-1 | 2016.12.01-2016.12.09 | 5 | Seeding |
| Sentinel-1 | 2016.12.20-2016.12.31 | 5 | Overwinter |
| Sentinel-1 | 2017.01.20-2017.01.31 | 5 | Early-bolting |
| Sentinel-1 | 2017.02.11-2017.02.20 | 5 | Later-bolting |
| Sentinel-1 | 2017.03.19-2017.03.30 | 6 | Flowering |
| Sentinel-1 | 2017.12.20-2017.12.31 | 6 | Overwinter |
| Sentinel-1 | 2019.1.20-2019.1.31 | 6 | Early-bolting |
| Sentinel-1 | 2019.12.20-2019.12.31 | 6 | Overwinter |
| Sentinel-1 | 2020.12.20-2020.12.31 | 5 | Overwinter |
| Sentinel-1 | 2021.12.20-2021.12.31 | 6 | Overwinter |

**Table S2.** Description of the number of Sentinel-2 satellite images used in the study.

|  |  |  |  |
| --- | --- | --- | --- |
| **Satellite platform** | **Image date** | **Number of images (Before selecting)** | **Number of images**  **(After selecting)** |
| Sentinel-2 | 2016.12.01-2016.12.09 | 28 | 22 |
| Sentinel-2 | 2016.12.20-2016.12.31 | 13 | 11 |
| Sentinel-2 | 2017.02.20-2017.02.28 | 18 | 13 |
| Sentinel-2 | 2017.12.20-2017.12.31 | 31 | 20 |
| Sentinel-2 | 2019.12.04-2019.12.31 | 135 | 42 |
| Sentinel-2 | 2020.12.20-2021.1.12 | 102 | 58 |
| Sentinel-2 | 2021.12.20-2021.12.31 | 60 | 42 |

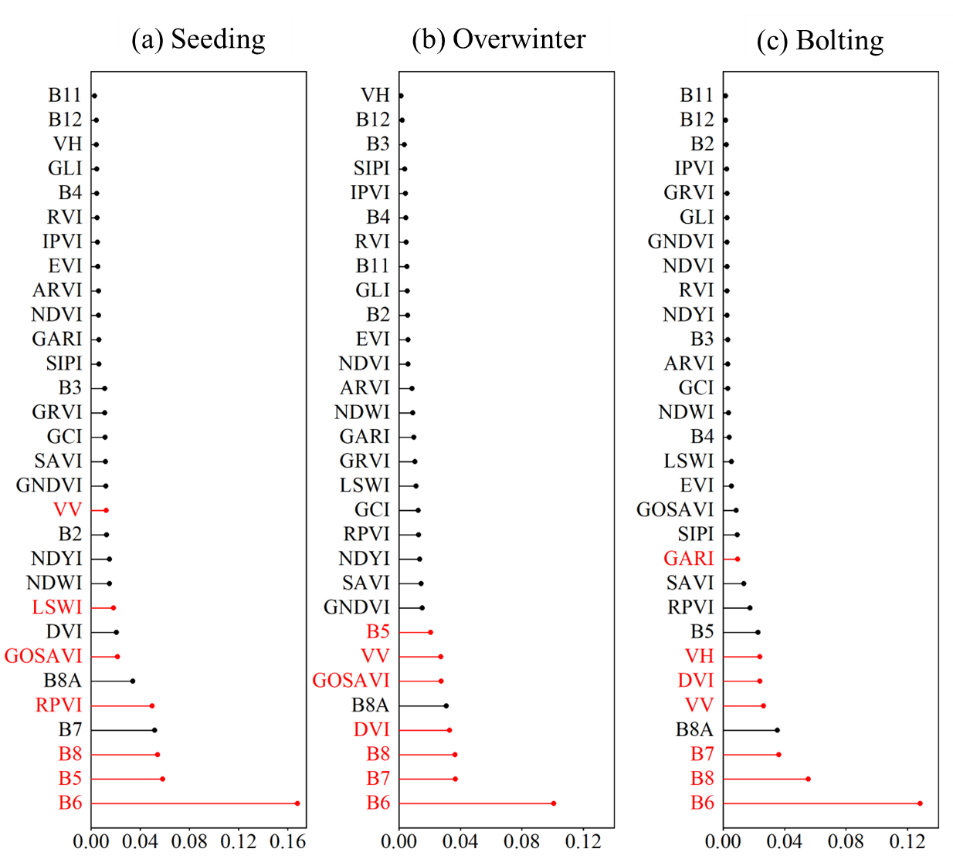
**Table S3** Spectral indexes

|  |  |  |
| --- | --- | --- |
| **Spectral indexes** | **Formula** | **Citation** |
| ARVI | (N-(2\*R)+B)/(N+(2\*R)+B) | (Pen Uelas et al. 1995) |
| DVI | N-R | (Jordan 1969) |
| GARI | (N-(G-1.7\*(B-R)))/(N+(G-1.7\*(B-R))) | (Gitelson et al. 1996) |
| GCI | N/G-1 | (Gitelson et al. 2002) |
| GLI | ((G-R)+(G-B))/((2\*G)+R+B) | (Eng et al. 2019) |
| GNDVI | (N-G)/(N+G) | (Sripada 2005) |
| GOSAVI | (N-G)/(N+G+0.16) | (Tucker 1979) |
| GRVI | N/G | (Pearson and Miller 1972) |
| GSAVI | 1.5\*(N-G)/(N+G+0.5) | (Crippen 1990) |
| IPVI | N/(N+R) | (Ruimy et al. 1994) |
| NDWI | (G-N)/(G+N) | (Broge and Leblanc 2001) |
| NDYI | (G-B)/(G+B) | (Sulik and Long 2015) |
| RVI | N/R | (Gao 1996) |
| SAVI | (1.5\*(N-R))/(N+R+0.5) | (Bannari et al. 2002) |
| SIPI | (N-B)/(N-R) | (Vapnik 1999) |
| Canola Index (CI) | N \* (R + G) | (Ashourloo et al. 2019) |

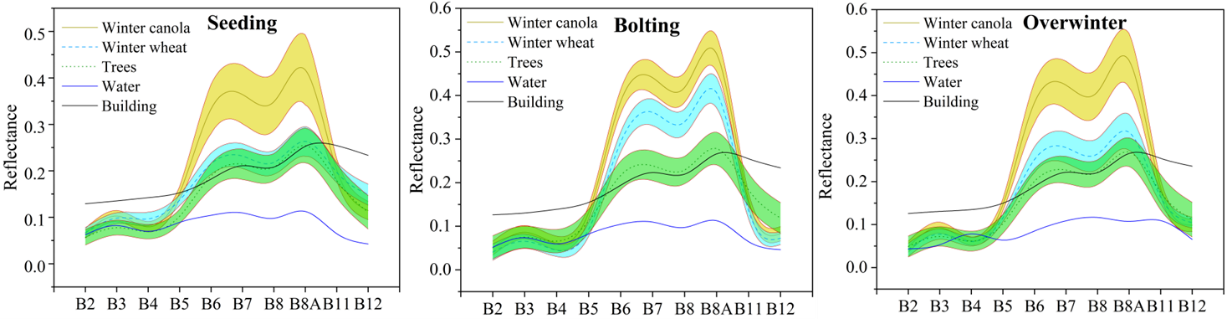
图形用户界面, 应用程序

描述已自动生成

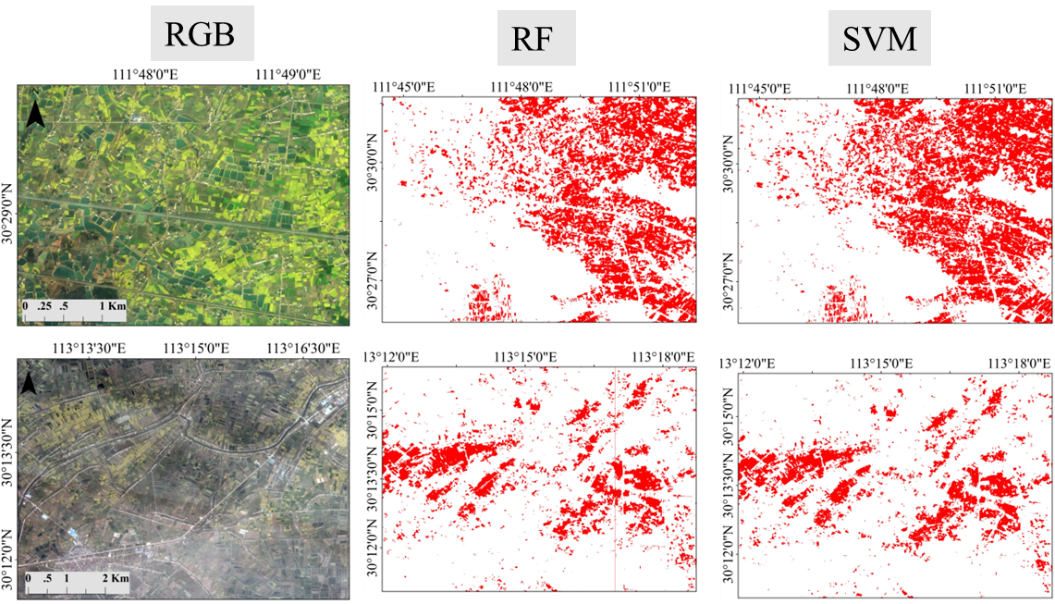
**Figure S1**. Five sample images from Planet and Google Earth



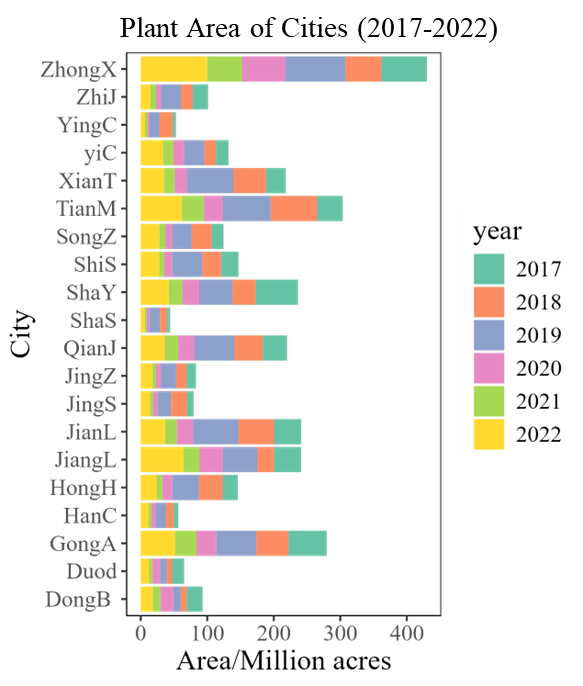
**Figure S2**. Importance of features at different winter canola phenological stages based on Sentinel-2 and Sentinel-1.



**Figure S3.** Spectral curves of different land types at different phenological stages.



**Figure S4**. The spatial details of the winter canola map at the overwinter stage in 2017



**Figure S5.** Winter canola area in each city of Jianghan Plain in 2017–2022.

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