**Appendix A**

Table A1. Spectral bands of the Micasense Altum multispectral camera from Blackswift E2 UAS.

|  |  |  |
| --- | --- | --- |
| Name | Center Wavelength (nm) | Bandwidth (nm) |
| Blue | 475 | 32 |
| Green | 560 | 27 |
| Red | 668 | 14 |
| Near-infrared | 840 | 57 |
| RedEdge | 717 | 12 |

Table A2. Regression relationships between Satellite Indices and GSM data before diagnostic test across time points and depths. Asterisks refer to the level of significance for the coefficient (\* p < 0.05, \*\*, p < 0.01, \*\*\* p < 0.001).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Month | Depth (cm) | Variables | R2 | SE | Pearson Correlation |
| August | 0 – 20 | NSDSI2 | 0.70 | 4.46 | 0.83\*\*\* |
|  |  | NDVI | 0.73 | 4.20 | 0.86\*\*\* |
|  |  | dB | 0.26 | 6.94 | -0.52\*\*\* |
|  | 0 – 10 | NSDSI2 | 0.27 | 17.71 | 0.52\*\*\* |
|  |  | NDVI | 0.24 | 17.99 | 0.49\*\*\* |
|  |  | dB | 0.12 | 19.44 | -0.34\* |
| September | 0 – 10 | NSDSI2 | 0.67 | 7.99 | 0.82\*\*\* |
|  |  | NDVI | 0.60 | 8.78 | 0.77\*\*\* |
|  |  | dB | 0.32 | 11.44 | -0.57\*\* |
|  | 0 – 5 | NSDSI2 | 0.77 | 10.08 | 0.88\*\*\* |
|  |  | NDVI | 0.73 | 10.84 | 0.85\*\*\* |
|  |  | dB | 0.39 | 16.35 | -0.62\*\*\* |

Table A3. Regression relationships between UAS and GSM data before diagnostic test across all depths. Asterisks refer to the level of significance for the coefficient (\* p < 0.05, \*\*, p < 0.01, \*\*\* p < 0.001).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Month | Depth (cm) | Variables | R2 | Std error | Pearson Correlation |
| September | 0 – 10 | NDVI | 0.71 | 7.53 | 0.84\*\*\* |
|  |  | ENDVI | 0.59 | 8.86 | 0.77\*\*\* |
|  |  | NDRE | 0.70 | 7.57 | 0.84\*\*\* |
|  |  | GRVI | 0.68 | 7.88 | 0.82\*\*\* |
|  |  | GLI | 0.69 | 7.73 | 0.83\*\*\* |
|  | 0 – 5 | NDVI | 0.85 | 8.13 | 0.92\*\*\* |
|  |  | ENDVI | 0.73 | 10.88 | 0.85\*\*\* |
|  |  | NDRE | 0.86 | 7.67 | 0.93\*\*\* |
|  |  | GRVI | 0.77 | 10.07 | 0.88\*\*\* |
|  |  | GLI | 0.81 | 9.02 | 0.90\*\*\* |

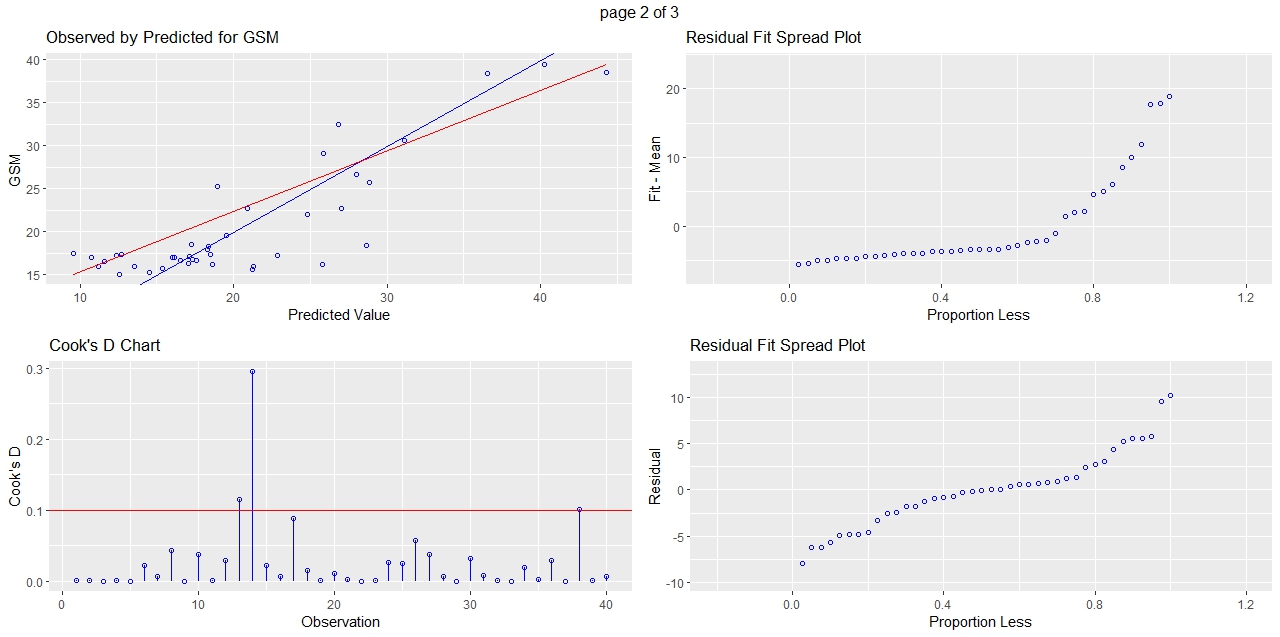
Table A4. Regression relationships between satellite indices and VSM data across time points and depths. Asterisks refer to the level of significance for the coefficient (\* p < 0.05, \*\*, p < 0.01, \*\*\* p < 0.001).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Month | Depth (cm) | Variables | R2 | Standard Error | Pearson Correlation |
| August | 0 – 20 | NSDSI2 | 0.22 | 7.29 | 0.47\*\*\* |
|  |  | NDVI | 0.21 | 7.35 | 0.46\*\* |
|  |  | dB | 0.03 | 8.12 | -0.18 |
|  | 0 – 7.6 | NSDSI2 | 0.21 | 8.03 | 0.46\*\*\* |
|  |  | NDVI | 0.18 | 8.19 | 0.42\*\* |
|  |  | dB | 0.06 | 8.73 | -0.25 |
| September | 0 – 7.6 | NSDSI2 | 0.22 | 3.47 | 0.47\*\* |
|  |  | NDVI | 0.19 | 3.52 | 0.44\* |
|  |  | dB | 0.18 | 3.56 | -0.42\* |

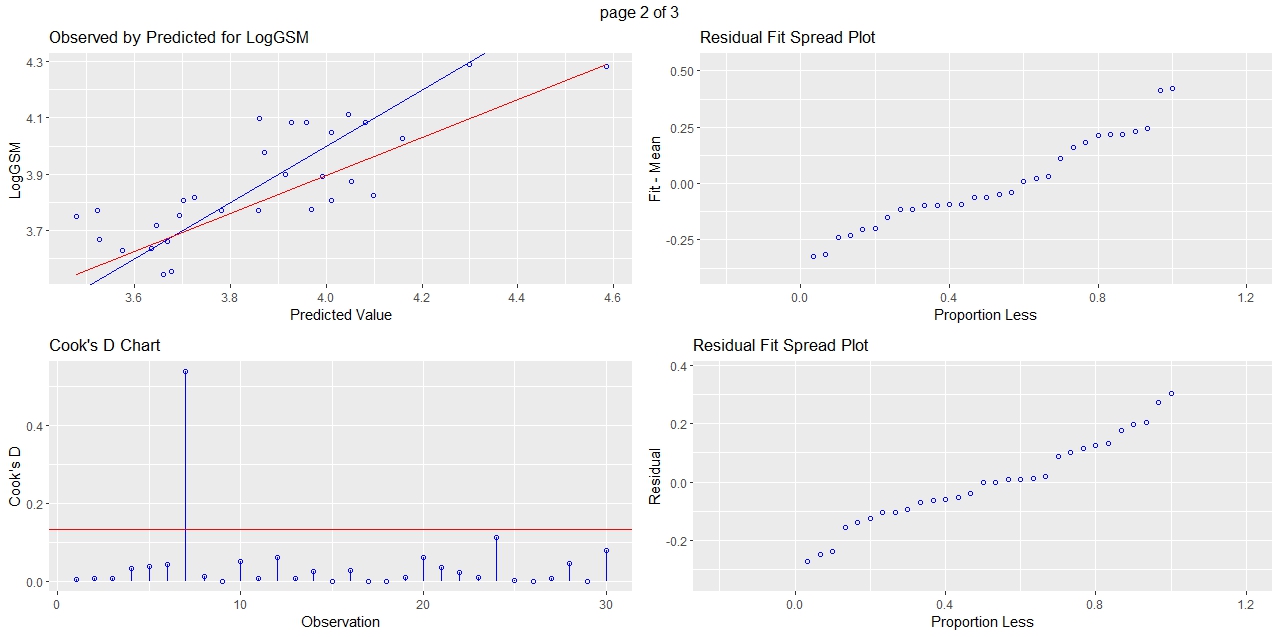
Table A5. Regression relationships between UAS indices and VSM data. Asterisks refer to the level of significance for the coefficient (\* p < 0.05, \*\*, p < 0.01, \*\*\* p < 0.001).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Month | Depth (cm) | Variables | R2 | Std error | Pearson Correlation |
| September | 0 – 7.6 | NDVI | 0.24 | 3.41 | 0.492\*\* |
|  |  | ENDVI | 0.19 | 3.52 | 0.439\* |
|  |  | NDRE | 0.24 | 3.41 | 0.492\*\* |
|  |  | GRVI | 0.31 | 3.26 | 0.554\*\* |
|  |  | GLI | 0.28 | 3.33 | 0.529\*\* |

**(a)**



**(b)**



**(c)**

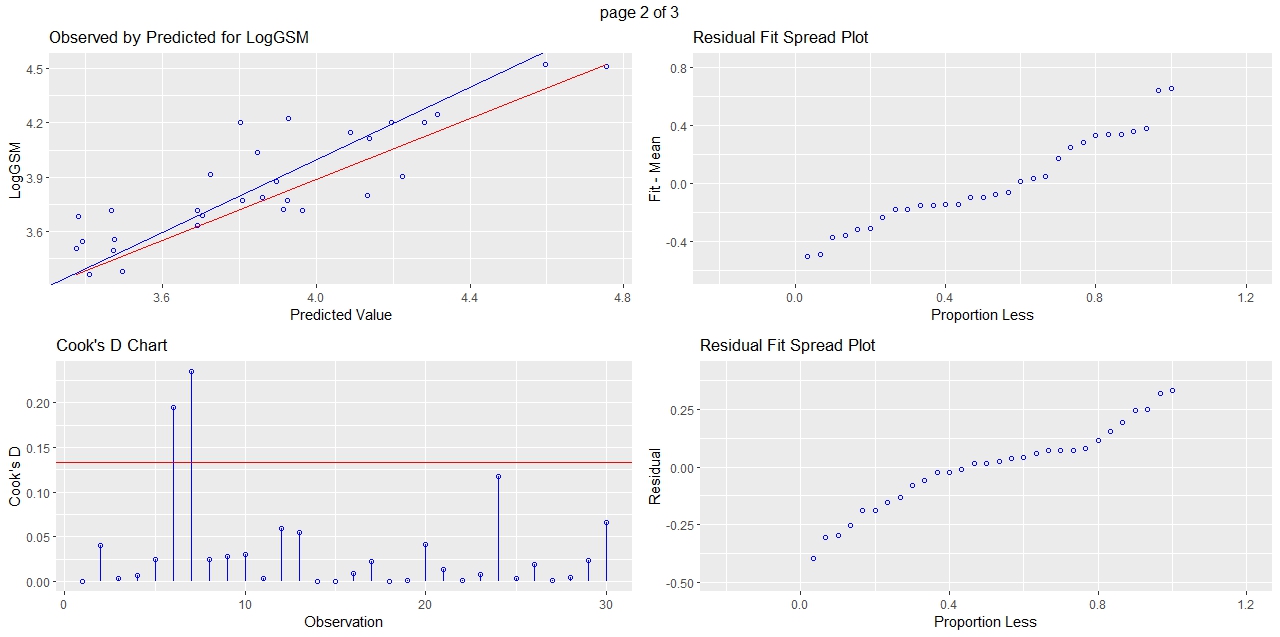
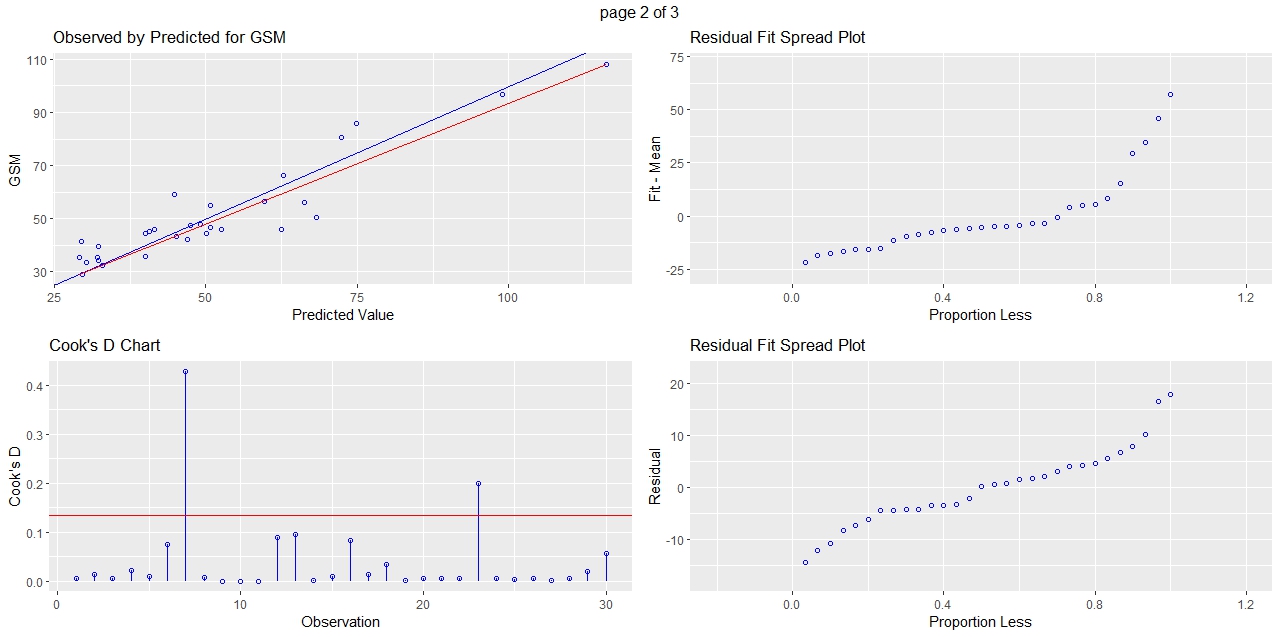


Figure A1. Satellite/GSM models diagnostic plots. A: NDVI at the depth of 0 – 20 cm; B: NSDSI2 at the depth of 0 – 10 cm; C: NSDSI2 at the depth of 0 – 5 cm

**(a)**



**(b)**

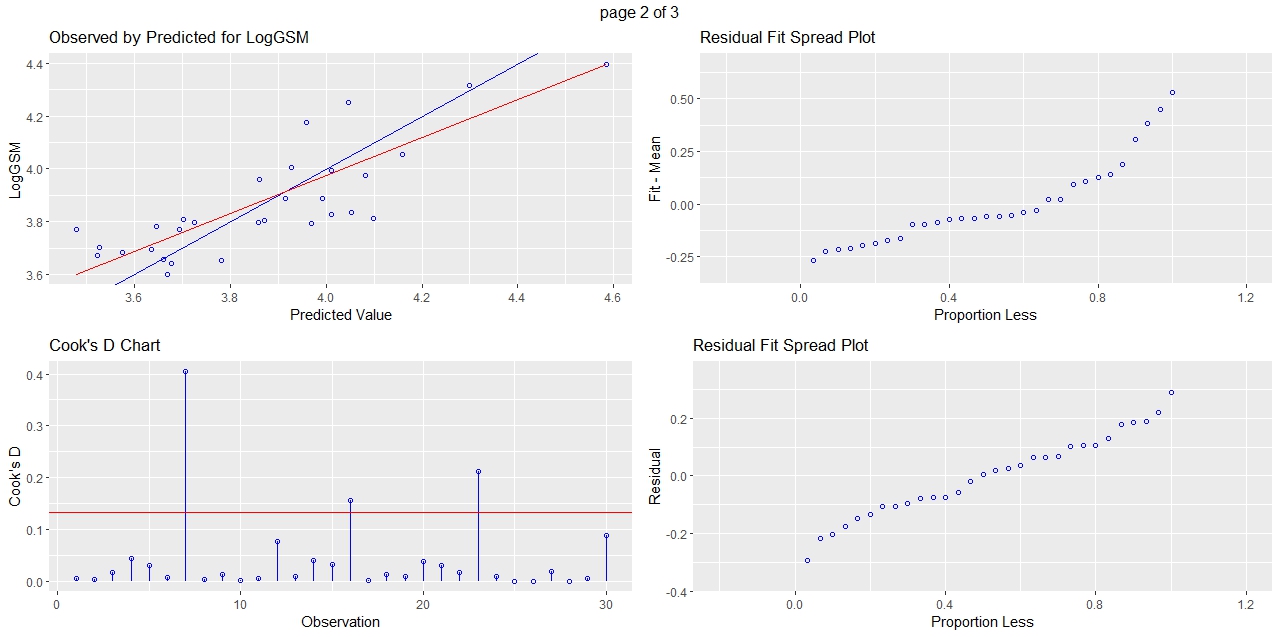


Figure A2. UAS/GSM models Diagnostic plots. A: NDRE at the depth of 0 – 5 cm; B: NDVI at the depth of 0 – 10 cm