



Automatic mapping of rice growth stages using the integration of SENTINEL-2, MOD13Q1, and SENTINEL-1

Table S1. Comparison between the West Area and East Area.

Study Area	West Area (WA)	East Area (EA)
Topography	broad coastal plain on the north and hills the south	Most of the area is a flat area in the north and hilly on the south.
Height	0 –1500 m, 0 – 2 %.	150 –1500 m, 0 – 2 %.
Climate	Total annual rainfall: 1849 mm with the amount of rainy day: 95 days (2018)	Total annual rainfall: 1,860 mm with the amount of rainy day: 102 days (2018)
Soil type	Alluvial, Lithosol	Alluvial, Grumusol, Regosol
Irrigation	Cimanuk, Cipanduy, Citarum, Ciliwung Irrigations area	Brantas, and Solo irrigations area
Irrigated paddy field	272,633 ha	166,286 ha
Non-irrigated paddy field	37,632 ha	91,349 ha
Total paddy field	310,265 ha	257,635 ha

Type	Cropping pattern	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(a) West Area													
Type 1	R-BL-R	BL		R1			BL		R2		BL		
Type 2	R-BL-R	R1	BL		R2			BL				R1	
Type 3	R-R-BL		R1		R2			BL				R1	
(b) East Area													
Type 1	R-R-R		R1		R2				R3				
Type 2	R-R-R		R1		R2			BL				R1	
Type 3	R-SC-BL		R1		SC			BL				R1	
Type 4	R-BL		R1				BL					R1	

Note: R1: Rice 1st cultivation, R2: Rice 2nd cultivation, R3: Rice 3rd cultivation, SC: Secondary crops, and BL: Bare land.

Figure S1. The simplified cropping pattern of the West Area and East Area.

Table S2. Remote sensing data.

Sentinel-2 L2A (5 Days Revisit Time)			MOD13Q1 (16 Days Composite Period)		Sentinel-1 (12 Days Revisit Time)	
Band	Central Wavelength (nm)	Resolution (m)	Band	Resolution (m)	Band	Resolution (m)
Band 2 - Blue	490	10	NDVI	250	VH	10
Band 3 - Green	560	10	EVI	250		
Band 4 - Red	665	10	Quality indicator	250		
Band 5 - Red edge 1	705	20				
Band 6 - Red edge 2	740	20				
Band 7 - Red edge 3	783	20				
Band 8 - Near-infrared	842	10				
Band 8A - Red edge 4	865	10				
Band 11 - Shortwave infrared 1	1610	20				
Band 12 - Shortwave infrared 2	2190	20				
Scene land classification (SCL) band	-	20				

Table S3. List of the acquisition date of Sentinel-2, MOD13Q1, and Sentinel-1.

Sensor	Acquisition Date (Day of the Year) in 2018	Total
Sentinel-2	T48MZU and T48MZT: 152, 157, 162, 167, 172, 177, 182, 187, 192, 197, 202, 207, 212, 217, 222, 227, 232, 237, 242, 247, 252, 257, 262, 267, and 272 T48MYU and T48MYT: 155, 160, 165, 170, 175, 180, 185, 190, 195, 200, 205, 210, 215, 220, 225, 230, 235, 240, 245, 250, 255, 260, 265, and 270 T49MFM, T49MEM, T49MEM, T49MEN, and T49MFN: 154, 159, 164, 169, 174, 179, 184, 189, 194, 199, 204, 209, 214, 219, 224, 229, 234, 239, 244, 249, 254, 259, 264, and 269	200 scenes
	IW mode, VV-VH band: 159, 161, 171, 173, 183, 185, 195, 197, 200, 207, 209, 219, 221, 231, 233, 236, 243, 245, 248, 257, 267, 269, 279, 281, 291, 293, 296, and 303	
Sentinel-1		28 scenes
MOD13Q1	1, 17, 33, 49, 65, 81, 97, 113, 129, 145, 161, 177, 193, 209, 225, 241, and 257	17 composite scenes

Table S4. Timeline of remote sensing images processed in 2018.

No	Period	Sentinel-2	MOD13Q1	Sentinel-1 (T0)	Sentinel-1 (T-1)	Sentinel-1 (T-2)	Rice Planting Detection
1	10 - 25 June	11 - 14 June	10 - 25 June	10 - 20 June	25 May - 4 June	9 - 19 May	11 February - 11 June
2	26 June - 11 July	26 - 29 June	26 June - 11 July	26 June - 6 July	10 - 20 June	25 May - 4 June	26 February - 25 June
3	12 - 27 July	13 - 16 July	12 - 27 July	12 - 22 July	26 June - 6 July	10 - 20 June	15 March - 12 July
4	28 July - 12 August	28 July - 12 August	28 July - 12 August	28 July - 7 August	12 - 22 July	26 June - 6 July	30 March - 27 July
5	13 - 28 August	13 - 16 August	13 - 28 August	13 - 23 August	28 July - 7 August	12 - 22 July	15 Apr - 12 August
6	29 August - 13 September	30 August - 2 September	29 August - 13 September	29 August - 8 September	13 - 23 August	28 July - 7 August	2 May - 29 August
7	14 - 29 September	14 - 16 September	14 - 29 September	13 - 23 September	29 August - 8 September	13 - 23 August	17 May - 13 September
Total	10 June - 29 September	11 June - 16 September	10 June - 29 September	10 June - 23 September	25 May - 8 September	9 May - 23 August	11 February - 13 September

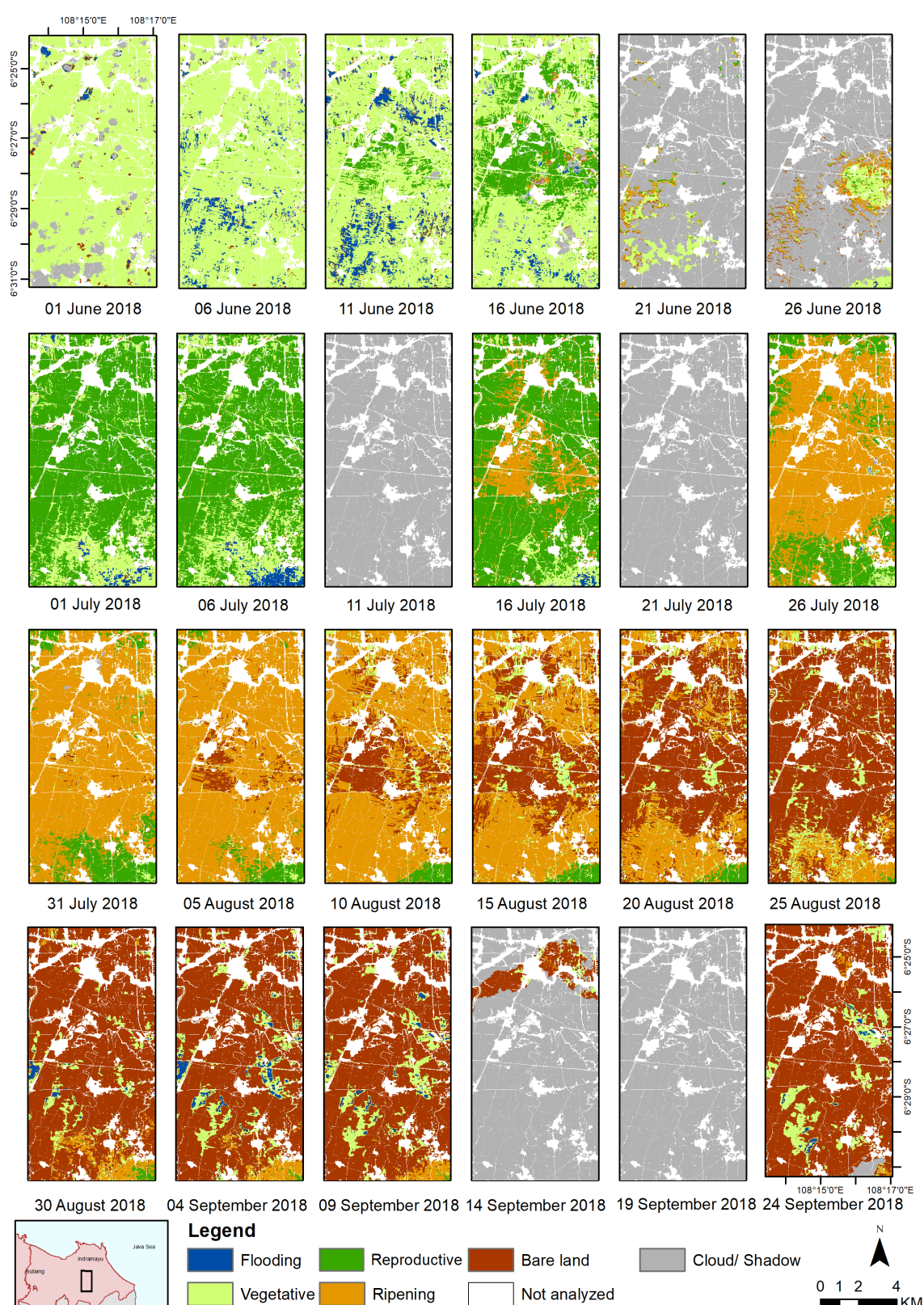


Figure S2. Example of a small area of temporal rice growth stage maps based on the Sentinel-2 model on the West Area between 1 June and 24 September 2018 every five days.

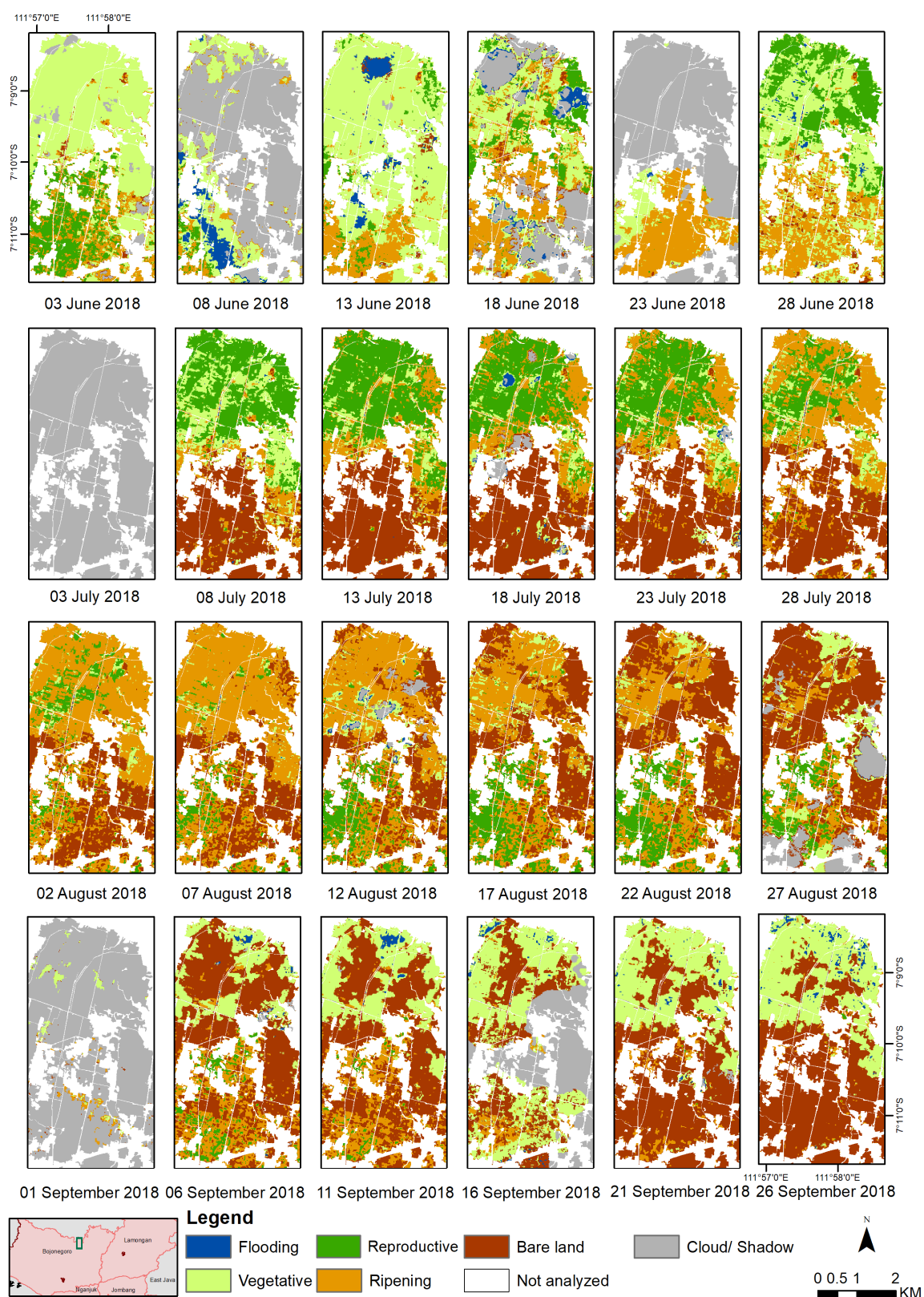


Figure S3. Example of a small area of temporal rice growth stages maps based on the Sentinel-2 model on the East Area between 3 June and 26 September 2018 every five days.