# Effective data for interferometric analysis with PALSAR-2 ScanSAR mode

## 1. Burst mis-synchronization before Feb. 7, 2015

Burst timing of PALSAR-2 ScanSAR mode is synchronized between observations to obtain high burst overlap rate (over 90%, 1σ) and to enable interferometry analysis. However, JAXA found that burst overlap rate was not always high for data acquired before Feb. 7, 2015.

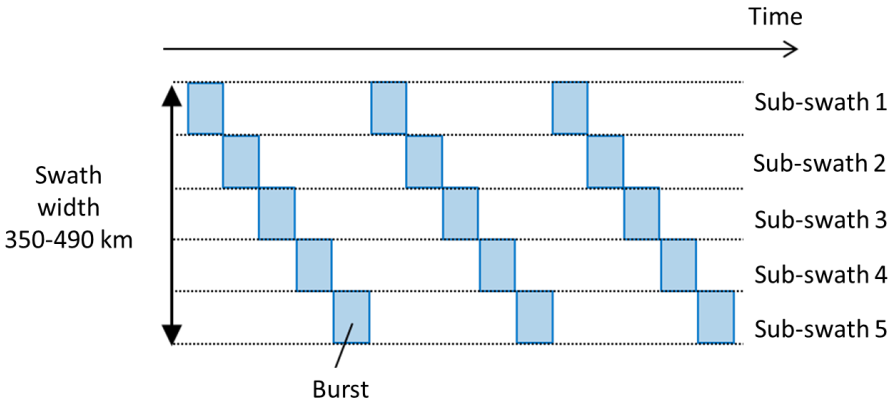


**Figure 1.1** Diagram of ScanSAR observations. Image swath becomes large by transmitting and receiving microwave for several directions intermittently. Each observation footprint is called as "burst". Bursts are required to be highly overlapped between observations to obtain high coherence.

## 2. The cause of the mis-synchronization

Due to an error in the calculation of the argument of latitude for burst synchronization, burst timing was changing periodically. Therefore, ScanSAR-ScanSAR interferometry was not always successful, depending on the acquisition dates of interferometric pairs.

## 3. Measures against the issue

The above error has fixed on Feb. 8, 2015. JAXA confirmed that burst timing has been synchronizing for the data acquired after Feb. 8, 2015. Thus interferometric pairs using the data after Feb. 8, 2015 are always effective for ScanSAR-ScanSAR interferometry. For the data acquired before Feb. 8, 2015, interferometry is available for only several acquisition time windows. The method to search effective data pairs for interferometry is described in the next section.

## 4. How to search effective interferometric pairs with high burst overlap rate

① Interferometry with the data acquired after and before Feb. 8, 2015.

The data with high burst overlap rate were acquired during the time windows shown in the Table 4.1 (burst overlap rate greater than 90%) and Table 4.2 (burst overlap rate greater than 20%). Please select these data for interfereometry with the data acquired after Feb. 8, 2015. Table 4.1 is recommended if the same level coherence as interfereometric results using two data acquired after Feb. 8, 2015 is required.

**Table 4.1** Effective data pairs for ScanSAR-ScanSAR interferometry with the data acquired after Feb. 8, 2015 (burst overlap rate: greater than 90%)

| Mode | Data acquisition period | | Number of scenes |
|---|---|---|---|
| | Start | End | |
| ScanSAR 350km W1 | 2014/11/17 18:00 | 2014/11/19 03:00 | 0 |
| | 2014/12/19 06:00 | 2014/12/20 11:00 | 0 |
| | 2015/01/19 07:00 | 2015/01/20 15:00 | 0 |
| ScanSAR 350km W2 | 2014/11/13 13:00 | 2014/11/15 05:00 | 1 |
| | 2014/12/19 04:00 | 2014/12/20 12:00 | 21 |
| | 2015/01/23 03:00 | 2015/01/24 19:00 | 43 |
| ScanSAR 350km W3 | 2014/08/07 13:00 | 2014/08/10 05:00 | 0 |
| | 2014/10/30 22:00 | 2014/11/02 13:00 | 4 |
| | 2014/12/13 01:00 | 2014/12/26 18:00 | 0 |
| | 2015/01/27 08:00 | 2015/02/07 24:00 | 5 |
| ScanSAR 350km W4 | 2014/09/05 06:00 | 2014/10/04 23:00 | 13 |
| | 2014/12/18 17:00 | 2014/12/21 00:00 | 0 |
| ScanSAR 490km V1 | 2014/12/19 01:00 | 2014/12/20 17:00 | 0 |
| ScanSAR 490km V2 | 2014/12/18 23:00 | 2014/12/20 19:00 | 0 |
| ScanSAR 490km V3 | 2014/12/18 11:00 | 2014/12/21 07:00 | 0 |

**Table 4.2** Effective data pairs for ScanSAR-ScanSAR interferometry with the data acquired after Feb. 8, 2015 (burst overlap rate: greater than 20%)

| Mode | Data acquisition period | | Number of scenes |
|---|---|---|---|
| | Start | End | |
| ScanSAR 350km W1 | 2014/09/02 20:00 | 2014/10/07 14:00 | 17 |
| | 2014/11/12 14:00 | 2014/11/23 21:00 | 6 |
| | 2014/12/15 02:00 | 2014/12/24 15:00 | 12 |
| | 2015/01/14 14:00 | 2015/01/25 15:00 | 8 |
| ScanSAR 350km W2 | 2014/11/07 12:00 | 2014/11/20 15:00 | 28 |
| | 2014/12/14 14:00 | 2014/12/25 04:00 | 306 |
| | 2015/01/17 20:00 | 2015/01/30 12:00 | 439 |
| ScanSAR 350km W3 | 2014/07/30 03:00 | 2014/08/20 18:00 | 17 |
| | 2014/10/20 10:00 | 2014/11/10 21:00 | 24 |
| | 2014/12/13 01:00 | 2014/12/26 18:00 | 18 |
| | 2015/01/27 08:00 | 2015/02/07 24:00 | 11 |
| ScanSAR 350km W4 | 2014/08/23 9:00 | 2014/10/24 12:00 | 17 |
| | 2014/12/10 19:00 | 2014/12/28 23:00 | 19 |
| ScanSAR 490km V1 | 2014/08/24 23:00 | 2014/10/16 6:00 | 18 |
| | 2014/12/13 5:00 | 2014/12/26 13:00 | 0 |
| ScanSAR 490km V2 | 2014/12/12 10:00 | 2014/12/27 9:00 | 9 |
| ScanSAR 490km V3 | 2014/12/08 11:00 | 2014/12/31 7:00 | 23 |

② Interfermetry with data pairacquired before Feb. 8, 2015

Figure 4.1 illustrates the time-series in burst timing difference from that of data acquired after Feb. 8, 2015 from Aug. 1, 2014 to Feb. 7, 2015. The dotted lines indicate burst timing difference due to the error (the solid line) plus an integral multiple of first sub-swath observation cycle. Interferometry is effective when burst timing difference becomes the same as shown in the figure. Figure 4.2 shows the burst timing difference for each ScanSAR beam (W1-W4: 350 km swath and V1-V3: 490 km swath) and Table 4.1 and 4.2 show the parameters of the regression equation for the burst timing difference.

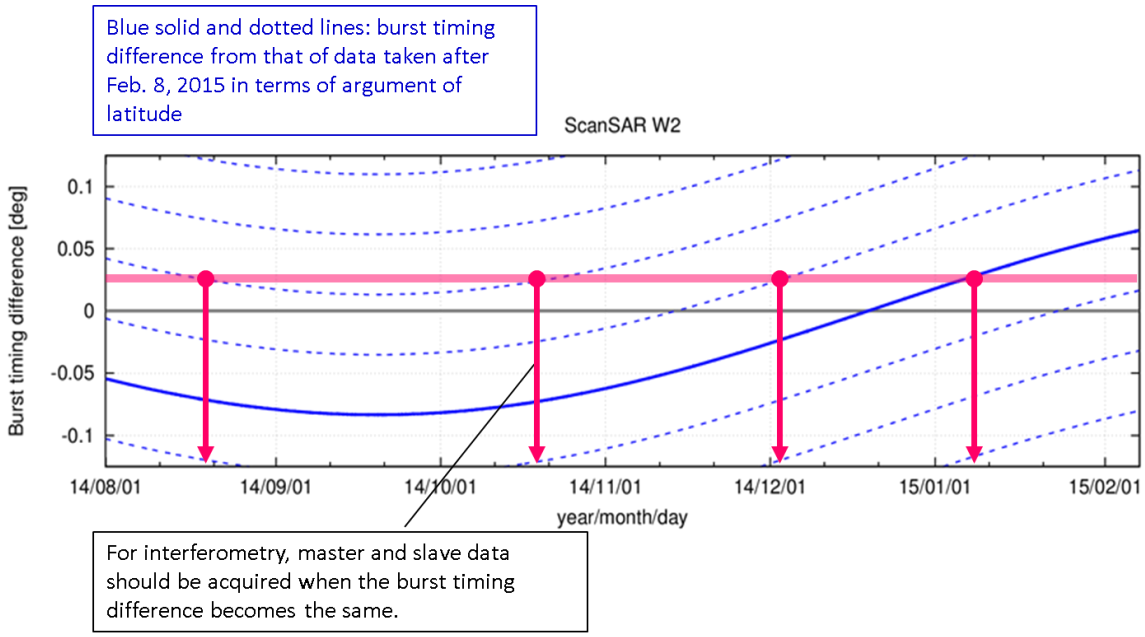


**Figure 4.1** Time-series in burst timing difference from that of data acquired after Feb. 8, 2015 in ScanSAR W2 mode. Red line and arrows illustrate the acquisition dates of data with high burst overlapping rate.

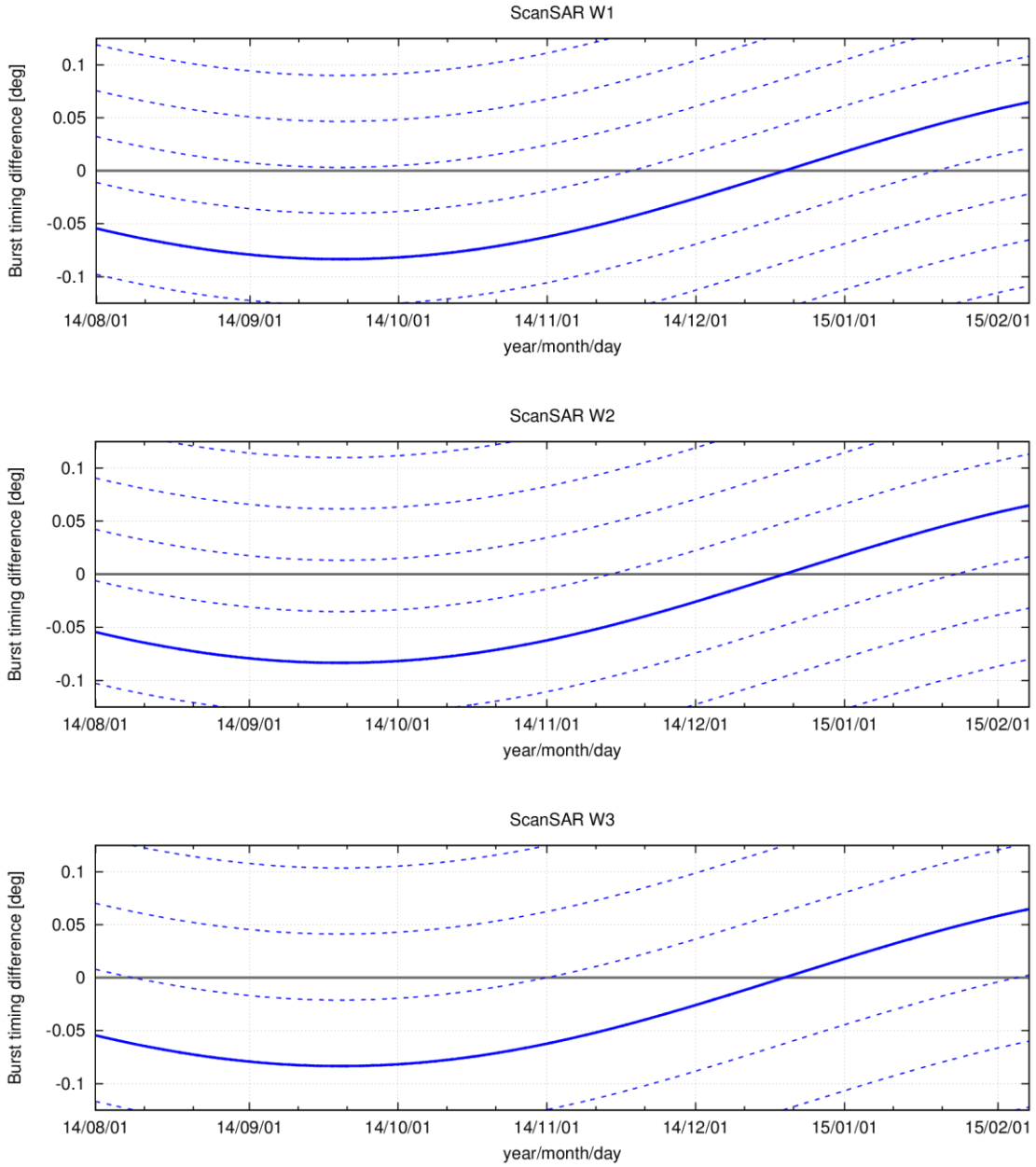


**Figure 4.2** Time-series in burst timing difference from that of data acquired after Feb. 8, 2015 in ScanSAR W1, W2, and W3 mode.

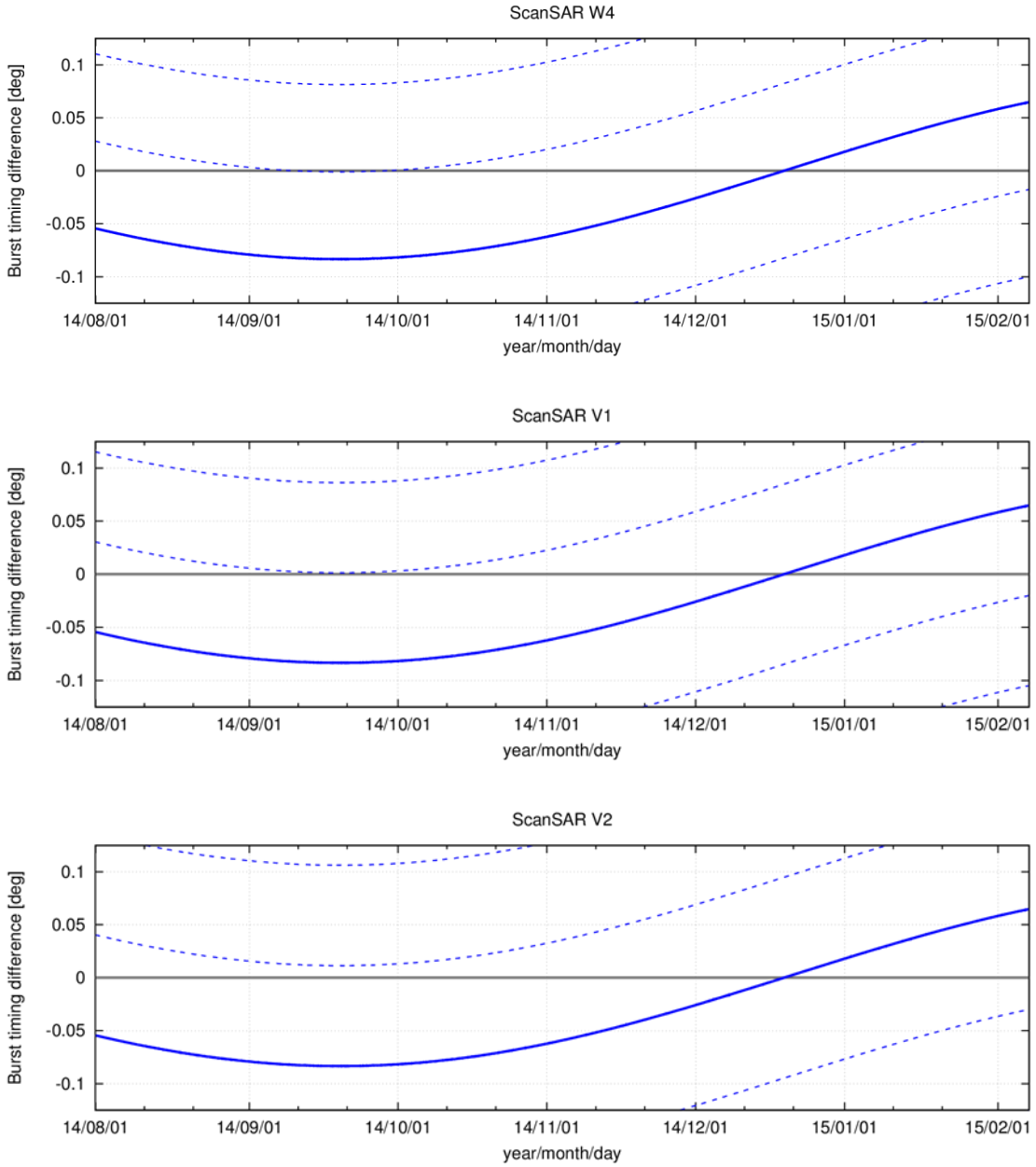


**Figure 4.2 (cont.)** Time-series in burst timing difference from that of data acquired after Feb. 8, 2015 in ScanSAR W4, V1, and V2 mode.

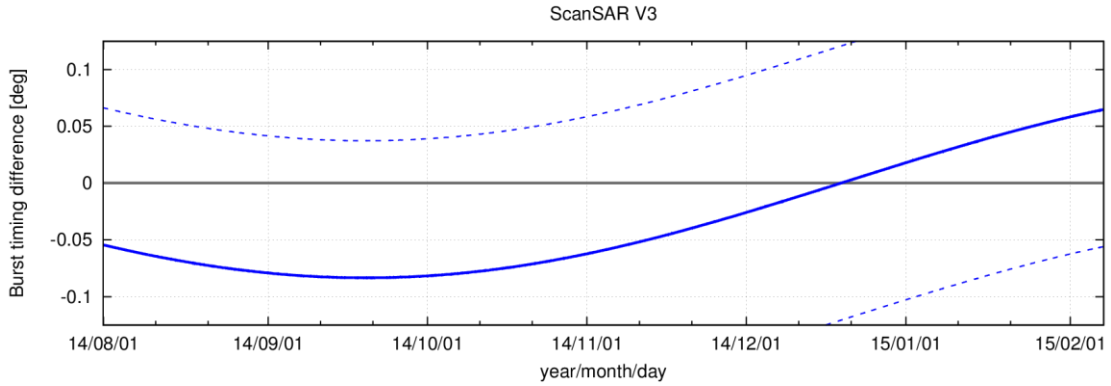


**Figure 4.2 (cont.)** Time-series in burst timing difference from that of data acquired after Feb. 8, 2015 in ScanSAR V3 mode.

**Table 4.1** Parameters of polynomial regression for burst timing difference (the above graphs) based on the data acquired after Feb. 8, 2015. The regression equation is described as $\Delta Burst = a_4 t^4 + a_3 t^3 + a_2 t^2 + a_3 t + a_0 + nC$, where *t* is number of days from Aug. 4, 2014 (12:00 a.m), *C* is the cycle of first sub-swath observation, and *n* is an integer (..., -2, -1, 0, 1, 2, ...).

| | |
|---|---|
| $a_4$ | -0.000000000194 |
| $a_3$ | 0.000000029289 |
| $a_2$ | 0.000010685720 |
| $a_1$ | -0.001106963087 |
| $a_0$ | -0.057085827546 |

**Table 4.2** The cycle of first sub-swath observation ("*C*" in the above regression equation) for each ScanSAR beam.

| Swath width/Beam | Number of scans | *C* |
|---|---|---|
| 350km/W1 | 5 | 0.043368 |
| 350km/W2 | 5 | 0.048348 |
| 350km/W3 | 5 | 0.062359 |
| 350km/W4 | 5 | 0.082436 |
| 490km/V1 | 7 | 0.084866 |
| 490km/V2 | 7 | 0.094837 |
| 490km/V3 | 7 | 0.145103 |