**Table 1.** Key Parameters of Geomagnetic Storm Events (2015–2019) and Correlation Analysis between and Indices

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| # | Datea | Dsta | Start (UT)b | End (UT)b | CCc | Delayd | CCe | p-valuef | kg | bg |
| 1  2  3  4  5  6  7  8  9  10  11  12  13  14  15  16  17  18  19  20  21  22  23  24  25  26  27  28  29  30  31  32  33  34  35  36  37  38  39  40  41  42  43  44  45  46  47  48  49  50  51  52  53  54  55  56  57  58  59 | 2015/01/04  2015/01/07  2015/03/01  2015/03/02  2015/03/17  2015/04/10  2015/04/11  2015/05/11  2015/05/13  2015/06/08  2015/06/23  2015/07/05  2015/07/13  2015/07/23  2015/08/15  2015/08/23  2015/09/07  2015/09/09  2015/09/20  2015/10/07  2015/10/18  2015/11/07  2015/12/14  2015/12/20  2016/01/20  2016/02/03  2016/03/06  2016/04/08  2016/04/13  2016/04/14  2016/04/16  2016/05/08  2016/08/03  2016/09/02  2016/09/28  2016/10/13  2016/10/25  2016/10/29  2016/11/10  2017/04/04  2017/04/20  2017/04/22  2017/05/28  2017/06/16  2017/08/31  2017/09/08  2017/09/08  2017/09/28  2017/11/08  2017/11/09  2018/04/20  2018/05/06  2018/08/26  2018/09/11  2018/10/07  2019/05/11  2019/05/14  2019/08/05  2019/09/27 | −78  −107  −56  −64  −234  −60  −85  −57  −82  −67  −198  −74  −68  −72  −71  −57  −75  −105  −81  −130  −56  −87  −55  −166  −101  −57  −99  −62  −56  −61  −58  −95  −51  −59  −51  −110  −65  −70  −60  −50  −50  −51  −125  −72  −51  −122  −109  −56  −73  −63  −66  −57  −175  −60  −53  −51  −65  −51  −50 | 01/03 03:00  01/07 07:00  02/28 15:00  03/02 03:00  03/17 06:00  04/09 23:00  04/10 19:00  05/10 18:00  05/12 22:00  06/08 04:00  06/22/13:00  07/04 16:00  07/13 02:00  07/23 02:00  08/15 09:00  08/23 05:00  09/07 13:00  09/09 01:00  09/20 06:00  10/07 13:00  10/18 03:00  11/07 02:00  12/14 16:00  12/20 04:00  01/20 11:00  02/02 20:00  03/06 15:00  04/07 19:00  04/12 20:00  04/14 07:00  04/16 13:00  05/07 24:00  08/02 20:00  09/01 18:00  09/28 09:00  10/13 06:00  10/25 11:00  10/28 19:00  11/10 08:00  04/04 04:00  04/20 01:00  04/21 18:00  04/27 20:00  06/16 07:00  08/31 07:00  09/07 20:00  09/08 21:00  09/27 06:00  11/07 04:00  11/08 10:00  04/20 24:00  05/05 13:00  08/25 17:00  09/10 21:00  10/07 11:00  05/10 21:00  05/14 03:00  08/05 03:00  09/27 12:00 | 01/05 05:00  01/09 21:00  03/01 14:00  03/05 17:00  03/18 04:00  04/10 17:00  04/11 17:00  05/11 10:00  05/13 16:00  06/08 18:00  06/24 13:00  07/05 08:00  07/13 16:00  07/23 16:00  08/15 23:00  08/23 19:00  09/08 06:00  09/10 01:00  09/20 20:00  10/08 01:00  10/18 20:00  11/07 16:00  12/15 06:00  12/21 12:00  01/21 01:00  02/03 10:00  03/07 06:00  04/08 04:00  04/13 09:00  04/15 03:00  04/17 08:00  05/08 15:00  08/03 18:00  09/02 08:00  09/28 24:00  10/14 05:00  10/26 01:00  10/29 13:00  11/11 03:00  04/04 20:00  04/20 16:00  04/22 20:00  04/28 18:00  06/16 21:00  08/31 19:00  09/08 10:00  09/09 02:00  09/28 14:00  11/08 09:00  11/09 03:00  04/21 02:00  05/06 05:00  08/26 16:00  09/11 19:00  10/08 03:00  05/11 17:00  05/14 16:00  08/05 19:00  09/28 02:00 | −0.70  −0.90  −0.72  −0.85  −0.81  −0.65  −0.56  −0.87  −0.89  −0.69  −0.84  −0.84  −0.59  −0.83  −0.76  −0.64  −0.64  −0.76  −0.69  −0.67  −0.87  −0.75  −0.78  −0.68  −0.93  −0.83  −0.78  −0.69  −0.90  −0.78  −0.97  −0.84  −0.82  −0.89  −0.67  −0.59  −0.71  −0.60  −0.46  −0.51  −0.71  −0.72  −0.86  −0.75  −0.79  −0.81  −0.86  −0.77  −0.85  −0.78  −0.75  −0.64  −0.77  −0.70  −0.67  −0.51  −0.71  −0.88  −0.77 | 2  0  0  0  0  0  −3  1  0  0  0  −1  −1  0  −1  0  1  1  −1  1  0  0  0  −1  0  1  0  1  0  0  0  1  0  −1  1  2  0  1  3  2  0  0  1  0  0  1  0  0  0  0  1  −1  2  0  0  0  1  0  0 | −0.71  −0.90  −0.72  −0.85  −0.81  −0.65  −0.68  −0.97  −0.89  −0.69  −0.84  −0.86  −0.6  −0.83  −0.77  −0.64  −0.85  −0.76  −0.81  −0.68  −0.87  −0.75  −0.78  −0.75  −0.93  −0.87  −0.78  −0.84  −0.90  −0.78  −0.97  −0.91  −0.82  −0.90  −0.82  −0.71  −0.71  −0.66  −0.79  −0.65  −0.71  −0.72  −0.89  −0.75  −0.79  −0.83  −0.86  −0.77  −0.85  −0.78  −0.79  −0.65  −0.89  −0.70  −0.67  −0.51  −0.84  −0.88  −0.77 | 0.000  0.000  0.000  0.000  0.000  0.003  0.000  0.000  0.000  0.004  0.000  0.000  0.019  0.000  0.001  0.01  0.000  0.000  0.000  0.011  0.000  0.001  0.000  0.000  0.000  0.000  0.000  0.003  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.003  0.002  0.000  0.005  0.002  0.000  0.000  0.001  0.001  0.000  0.000  0.000  0.000  0.000  0.000  0.005  0.000  0.000  0.003  0.017  0.000  0.000  0.001 | −1.84  −1.35  −1.09  −2.20  −2.13  −1.48  −1.22  −2.56  −1.91  −0.94  −1.41  −0.91  −0.78  −0.43  −0.48  −0.47  −0.84  −0.62  −0.71  −0.63  −1.25  −0.84  −1.10  −0.83  −1.02  −0.80  −1.12  −0.84  −1.00  −0.75  −0.59  −1.01  −0.55  −0.90  −1.13  −0.98  −1.10  −0.62  −0.66  −0.45  −0.96  −0.57  −0.69  −0.41  −0.28  −0.97  −1.41  −0.68  −0.66  −0.73  −0.48  −0.35  −0.70  −0.34  −0.31  −0.35  −0.47  −0.48  −0.44 | 0.28  1.34  0.65  0.81  2.59  1.07  −0.07  0.56  0.91  1.03  0.17  0.90  0.72  0.07  0.86  0.32  0.35  −0.23  0.63  1.28  0.92  1.02  0.42  0.78  −0.18  −0.02  1.81  0.54  0.40  0.20  0.34  0.48  0.52  0.33  0.03  0.61  0.26  −0.04  0.10  0.51  0.52  0.51  0.45  0.33  0.45  0.33  −0.27  0.63  0.35  0.13  0.18  0.05  0.06  0.13  −0.02  0.05  0.30  −0.01  −0.03 |

**Notes.**

a The date and minimum value of the Dst index for each event.

b The start and end times cover the main phase of the storm.

c The correlation coefficient between and in the above time interval.

d The time delay yielded from a correlation analysis of and .

e The correlation coefficient between the shifted  and the indices.

f The significance level of the correlation coefficient between the shifted and the indices. Note that the p-value for each event is rounded to three decimal places, and a value of 0.000 is not a strict zero value but a value less than 5.0 × 10−4.

g The k and b obtained from a linear fit of the shifted and the indices.

The significance level for these events is less than 0.05.

**Table 2.** Key Parameters of Geomagnetic Storm Events (2015–2019) and Correlation Analysis between and Indices

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| # | Datea | Dsta | Startb | Endb | CCc | Delayd | CCe | p-valuef | kg | bg |
| 1  2  3  4  5  6  7  8  9  10  11  12  13  14  15  16  17  18  19  20  21  22  23  24  25  26  27  28  29  30  31  32  33  34  35  36  37  38  39  40  41  42  43  44  45  46  47  48  49  50  51  52  53  54  55  56  57  58  59 | 2015/01/04  2015/01/07  2015/03/01  2015/03/02  2015/03/17  2015/04/10  2015/04/11  2015/05/11  2015/05/13  2015/06/08  2015/06/23  2015/07/05  2015/07/13  2015/07/23  2015/08/15  2015/08/23  2015/09/07  2015/09/09  2015/09/20  2015/10/07  2015/10/18  2015/11/07  2015/12/14  2015/12/20  2016/01/20  2016/02/03  2016/03/06  2016/04/08  2016/04/13  2016/04/14  2016/04/16  2016/05/08  2016/08/03  2016/09/02  2016/09/28  2016/10/13  2016/10/25  2016/10/29  2016/11/10  2017/04/04  2017/04/20  2017/04/22  2017/05/28  2017/06/16  2017/08/31  2017/09/08  2017/09/08  2017/09/28  2017/11/08  2017/11/09  2018/04/20  2018/05/06  2018/08/26  2018/09/11  2018/10/07  2019/05/11  2019/05/14  2019/08/05  2019/09/27 | −78  −107  −56  −64  −234  −60  −85  −57  −82  −67  −198  −74  −68  −72  −71  −57  −75  −105  −81  −130  −56  −87  −55  −166  −101  −57  −99  −62  −56  −61  −58  −95  −51  −59  −51  −110  −65  −70  −60  −50  −50  −51  −125  −72  −51  −122  −109  −56  −73  −63  −66  −57  −175  −60  −53  −51  −65  −51  −50 | 01/03 03:00  01/07 07:00  02/28 15:00  03/02 03:00  03/17 06:00  04/09 23:00  04/10 19:00  05/10 18:00  05/12 22:00  06/08 04:00  06/22/13:00  07/04 16:00  07/13 02:00  07/23 02:00  08/15 09:00  08/23 05:00  09/07 13:00  09/09 01:00  09/20 06:00  10/07 13:00  10/18 03:00  11/07 02:00  12/14 16:00  12/20 04:00  01/20 11:00  02/02 20:00  03/06 15:00  04/07 19:00  04/12 20:00  04/14 07:00  04/16 13:00  05/07 24:00  08/02 20:00  09/01 18:00  09/28 09:00  10/13 06:00  10/25 11:00  10/28 19:00  11/10 08:00  04/04 04:00  04/20 01:00  04/21 18:00  04/27 20:00  06/16 07:00  08/31 07:00  09/07 20:00  09/08 21:00  09/27 06:00  11/07 04:00  11/08 10:00  04/20 24:00  05/05 13:00  08/25 17:00  09/10 21:00  10/07 11:00  05/10 21:00  05/14 03:00  08/05 03:00  09/27 12:00 | 01/05 05:00  01/09 21:00  03/01 14:00  03/05 17:00  03/18 04:00  04/10 17:00  04/11 17:00  05/11 10:00  05/13 16:00  06/08 18:00  06/24 13:00  07/05 08:00  07/13 16:00  07/23 16:00  08/15 23:00  08/23 19:00  09/08 06:00  09/10 01:00  09/20 20:00  10/08 01:00  10/18 20:00  11/07 16:00  12/15 06:00  12/21 12:00  01/21 01:00  02/03 10:00  03/07 06:00  04/08 04:00  04/13 09:00  04/15 03:00  04/17 08:00  05/08 15:00  08/03 18:00  09/02 08:00  09/28 24:00  10/14 05:00  10/26 01:00  10/29 13:00  11/11 03:00  04/04 20:00  04/20 16:00  04/22 20:00  04/28 18:00  06/16 21:00  08/31 19:00  09/08 10:00  09/09 02:00  09/28 14:00  11/08 09:00  11/09 03:00  04/21 02:00  05/06 05:00  08/26 16:00  09/11 19:00  10/08 03:00  05/11 17:00  05/14 16:00  08/05 19:00  09/28 02:00 | 0.8  0.8  0.48  0.60  0.48  0.62  0.82  0.89  0.71  0.48  0.66  0.73  0.90  0.82  0.83  0.84  0.47  0.54  0.46  0.72  0.68  0.15  0.92  0.70  0.73  0.78  0.84  0.83  0.72  0.64  0.93  0.65  0.54  0.37  0.85  0.43  0.72  0.44  0.69  0.60  0.76  0.03  0.48  0.24  0.54  0.86  0.78  0.39  0.07  0.77  0.67  0.73  0.50  −0.16  0.53  0.53  0.90  0.91  0.39 | 2  1  1  0  4  2  0  −1  1  −2  0  0  0  0  1  1  1  3  −1  1  −1  4  0  0  −1  0  1  0  −1  1  0  2  0  1  0  3  −1  3  2  2  1  3  4  3  2  1  1  −1  8  0  1  −1  4  5  1  0  0  0  −2 | 0.95  0.87  0.52  0.60  0.61  0.84  0.82  0.91  0.79  0.72  0.66  0.73  0.90  0.82  0.84  0.90  0.62  0.70  0.58  0.81  0.70  0.72  0.92  0.70  0.74  0.78  0.88  0.83  0.76  0.72  0.93  0.83  0.54  0.64  0.85  0.74  0.76  0.89  0.78  0.87  0.79  0.44  0.88  0.90  0.83  0.93  0.81  0.41  0.59  0.77  0.73  0.74  0.70  0.32  0.60  0.53  0.90  0.91  0.76 | 0.000  0.000  0.009  0.020  0.002  0.000  0.000  0.000  0.001  0.002  0.000  0.001  0.000  0.000  0.000  0.000  0.006  0.000  0.020  0.001  0.001  0.003  0.000  0.000  0.000  0.001  0.000  0.003  0.002  0.000  0.000  0.000  0.008  0.011  0.000  0.000  0.001  0.000  0.000  0.000  0.000  0.022  0000  0.000  0.000  0.000  0.000  0.017  0.001  0.000  0.000  0.001  0.000  0.137  0.011  0.014  0.000  0.000  0.001 | 4.11  3.88  2.19  4.05  7.36  4.94  4.50  4.73  6.39  5.98  5.40  3.94  3.93  2.13  2.62  3.31  2.55  4.13  1.81  5.24  4.61  2.89  3.76  3.85  3.81  2.96  3.86  2.22  2.80  2.59  3.46  3.47  2.26  6.77  5.05  4.33  3.40  4.01  2.25  4.06  5.11  2.96  3.99  4.28  2.36  3.93  9.34  1.58  1.27  1.22  2.02  2.14  5.39  1.13  2.33  2.75  3.15  1.84 | −5.93  −6.54  −2.75  −4.55  −12.5  −7.09  −5.78  −5.38  −8.29  −6.52  −6.58  −4.27  −325  −1.75  −2.03  −2.66  −2.08  −3.92  −0.98  −4.52  −4.15  −2.64  −4.36  −4.39  −4.19  −2.97  −4.73  −1.76  −2.29  −2.01  −2.79  −3.31  −1.30  −5.48  −3.91  −4.83  −2.75  −348  −1.90  −2.73  −3.69  −1.94  −2.90  −3.35  −1.60  −4.48  −10.17  −0.88  −1.35  −1.15  −1.49  −1.64  −3.83  −0.97  −1.46  −1.69  −1.99  −1.44 |

**Notes.**

a The date and minimum value of the Dst index for each event.

b The start and end times cover the main phase of the storm.

c The correlation coefficient between and in the above time interval.

d The time delay yielded from a correlation analysis of and .

e The correlation coefficient between the shifted and the indices.

f The significance level of the correlation coefficient between the shifted and the indices. Note that the p-value for each event is rounded to three decimal places, and a value of 0.000 is not a strict zero value but a value less than 5.0 × 10−4.

g The k and b obtained from a linear fit of the shifted and the indices.

The significance level for these events is less than 0.05.