ANNALS OF GEOPHYSICS, 68, 4, A449, 2025; doi:10.4401/ag-9289
OPEN ACCESS

APPENDIX TO

UNUSUAL VERTICAL OSCILLATIONS IN SODIUM DENSITY AND THE FORMATION OF SPORADIC SODIUM LAYER OVER THE ZHONGSHAN STATION

Alicreance Hiyadutuje[1], Xiangcai Chen[2,3,4], John Bosco Habarulema[1,5,6], Michael J. Kosch[1,7,8], Judy A. E. Stephenson[7], Tshimangadzo Merline Matamba[1,5], Wentao Huang[2,3,4], Chao Ban[9,10]

[1] South African National Space Agency (SANSA), Hermanus, South Africa
[2] MNR Key Laboratory for Polar Science, Polar Research Institute of China (PRIC), Shanghai, China
[3] Antarctic Zhongshan Ice and Space Environment National Observation and Research Station, Polar Research Institute of China (PRIC), Shanghai, China
[4] State Key Laboratory of Lunar and Planetary Sciences, Macau University of Science and Technology (MUST), Macau, China
[5] Department of Physics and Electronics, Rhodes University (RU), Makhanda, South Africa
[6] Centre for Space Research, North-West University (NWU), Potchefstroom , South Africa
[7] Department of Chemistry and Physics, University of KwaZulu Natal (UKZN), Durban, South Africa
[8] Department of Physics, University of Lancaster (UL), UK
[9] State Key Laboratory of Atmospheric Environment and Extreme Meteorology, Institute of Atmospheric Physics, Chinese Academy of Sciences (CAS), Beijing, China
[10] Laboratory of Middle Atmosphere and Global Environment Observation, Institute of Atmospheric Physics, Chinese Academy of Sciences (CAS), Beijing, China

1. Additional available data

The additional Na density data at the altitudes between 80 and 105 km before, during and after the storm are given in this section. Due to the influence of weather conditions, the lidar system is not always operational. The available data are presented in this supporting document.

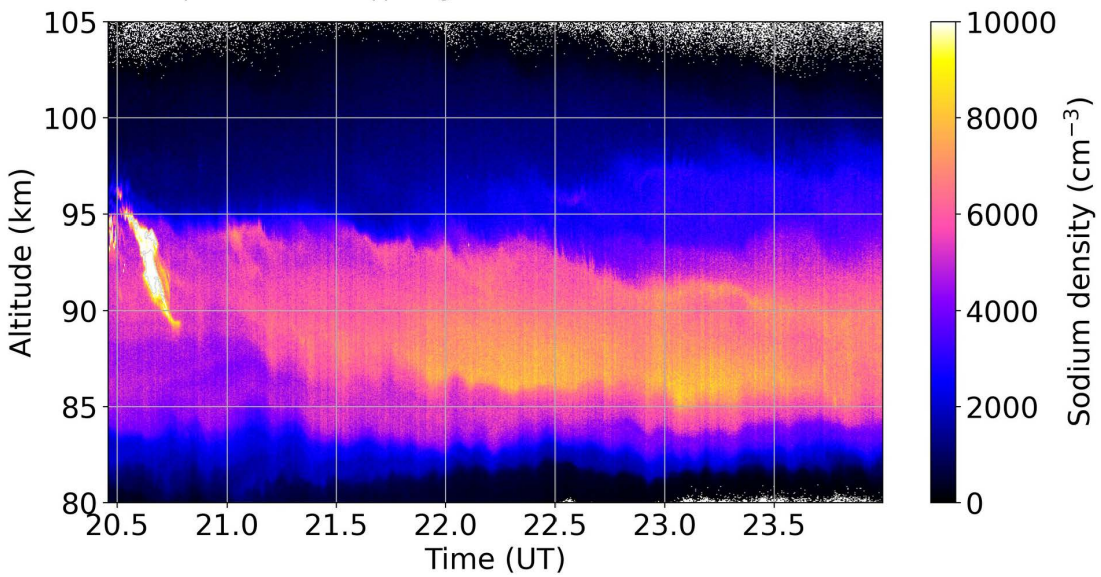

Figure 1. Na number density on 30 August 2019 at around 20:27-24:00 UT. White spaces indicate where there are no data.

Figure 1 presents the Na number density on 30 August 2019 at around 20:27-24:00 UT. This figure shows descending SSL from around 96 to 88 km altitude just after 20:30 UT.

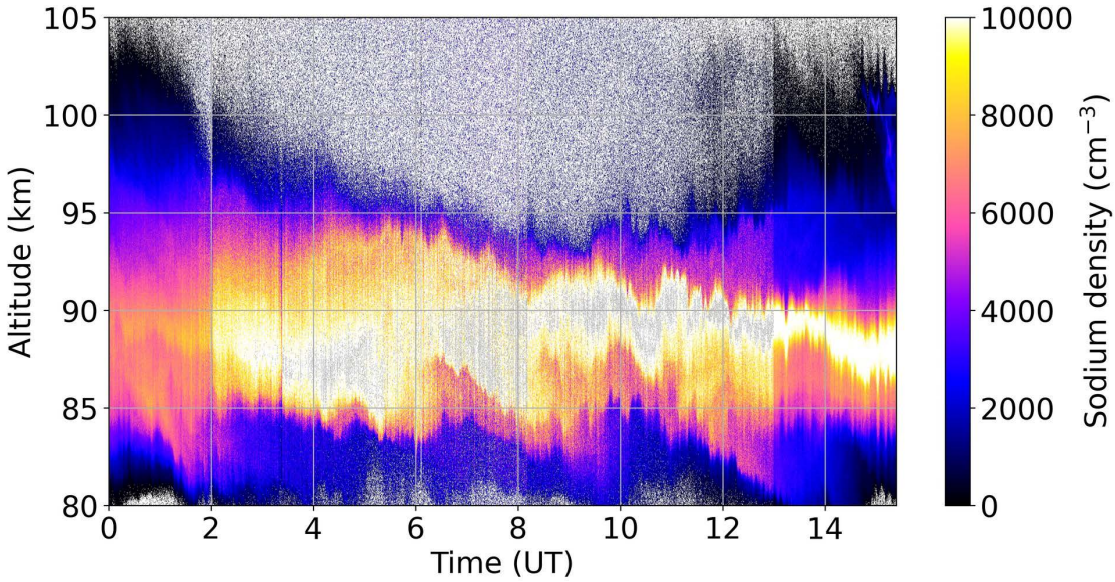

Figure 2. Na number density on 31 August 2019 at around 00:00-15:24 UT. White space indicate where there are no data.

Figure 2 illustrates the Na number density on 31 August 2019 at around 00:00-15:24 UT. Although, the wave activity is present, we can't observe the same structures as those in Fig. 2 of the manuscript.

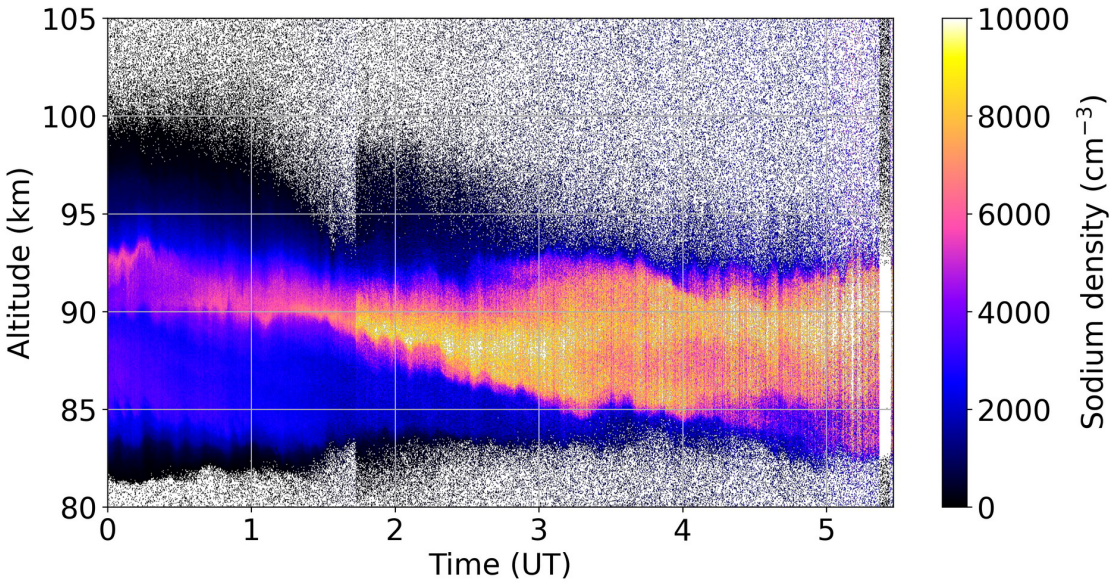

Figure 3. Na number density on 02 September 2019 at around 00:00-05:28 UT. White spaces indicate where there are no data.

Figure 3 shows the Na number density on 02 September 2019 at around 00:00-05:28 UT. Structures in Fig. 2 of the manuscript are not seen in this figure.

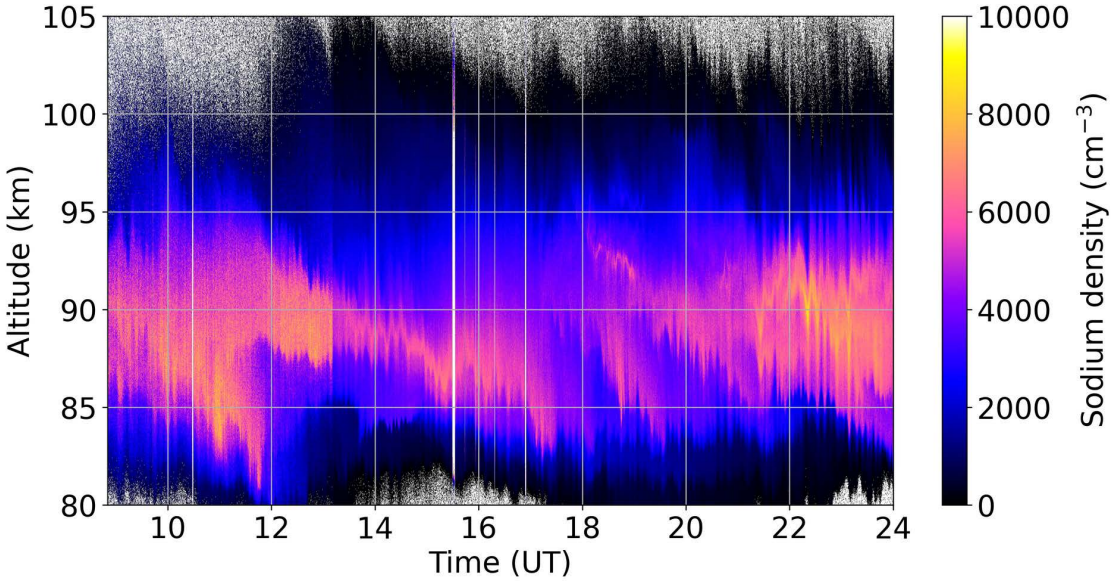

Figure 4. Na number density on 04 September 2019 at around 08:50-24:00 UT. White spaces indicate where there are no data.

Figure 4 shows the Na number density on 04 September 2019 at around 08:50-24:00 UT. The Na number density seems to be unstable, but the SSLs are not present compared to Fig. 2 of the manuscript.

2. Cross correlation between Na density and geomagnetic indices

In this section we will show the cross correlation (CC) between the Na number density and the used geomagnetic indices. In order to check the storm contribution on the Na number density, we estimated the CC when the data is available. The Na number density was processed as described in the manuscript and the mean data between around 85 and 95 km altitude were used.

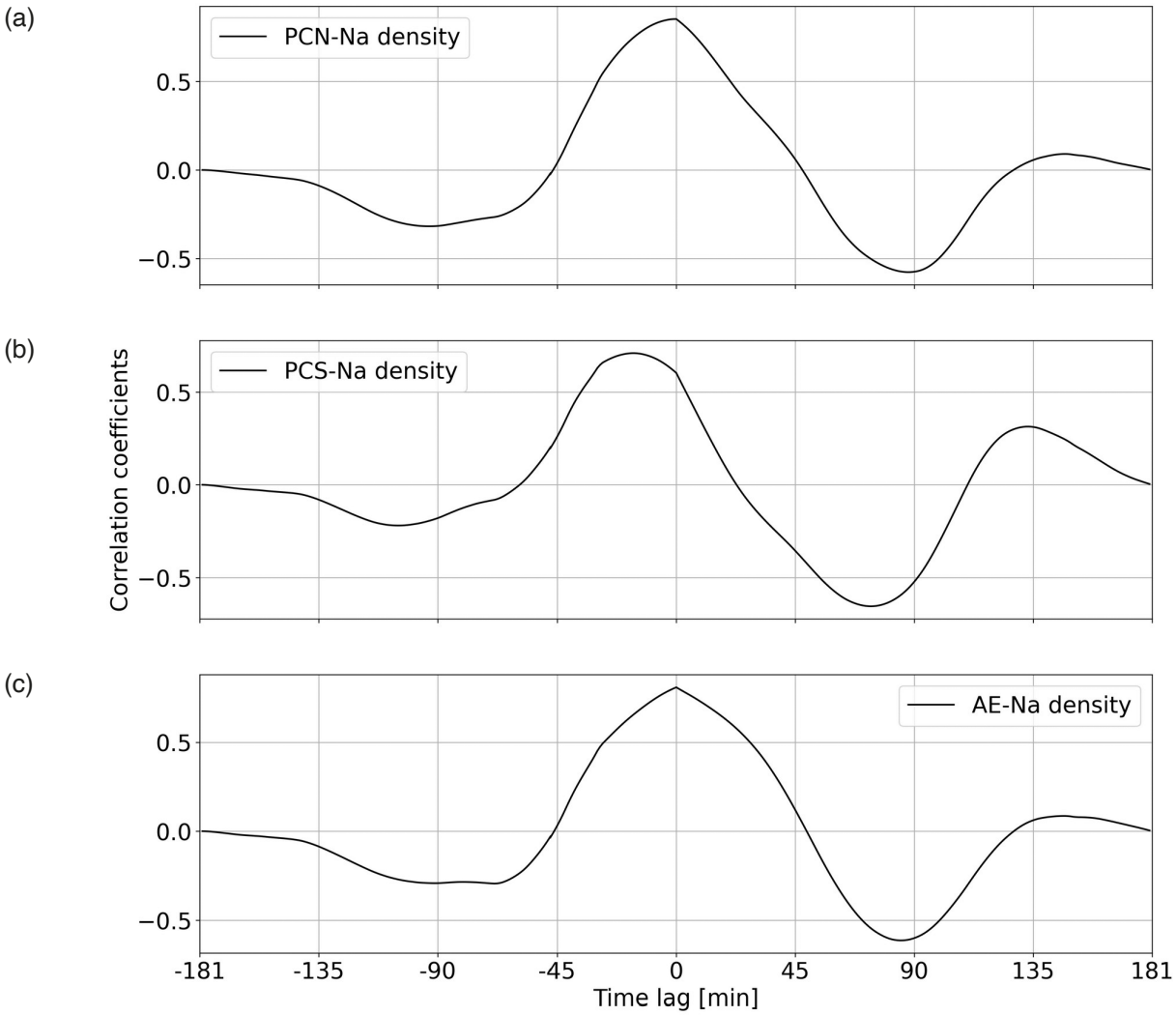

Figure 5. Cross correlation between Na density and PCN (a), PCS (b) and AE index (c) on 30 August 2019 at around 20:27-24:00 UT.

Figure 5 demonstrates the computed CC between the PCN, PCS and AE indices and Na number density on 30 August 2019 at 20:27-24:00 UT. It was 0.85, 0.71 and 0.80 as shown by the top, middle and bottom panel, respectively. This means that there is a strong correlation between the geomagnetic storm and Na number density during the specified period.

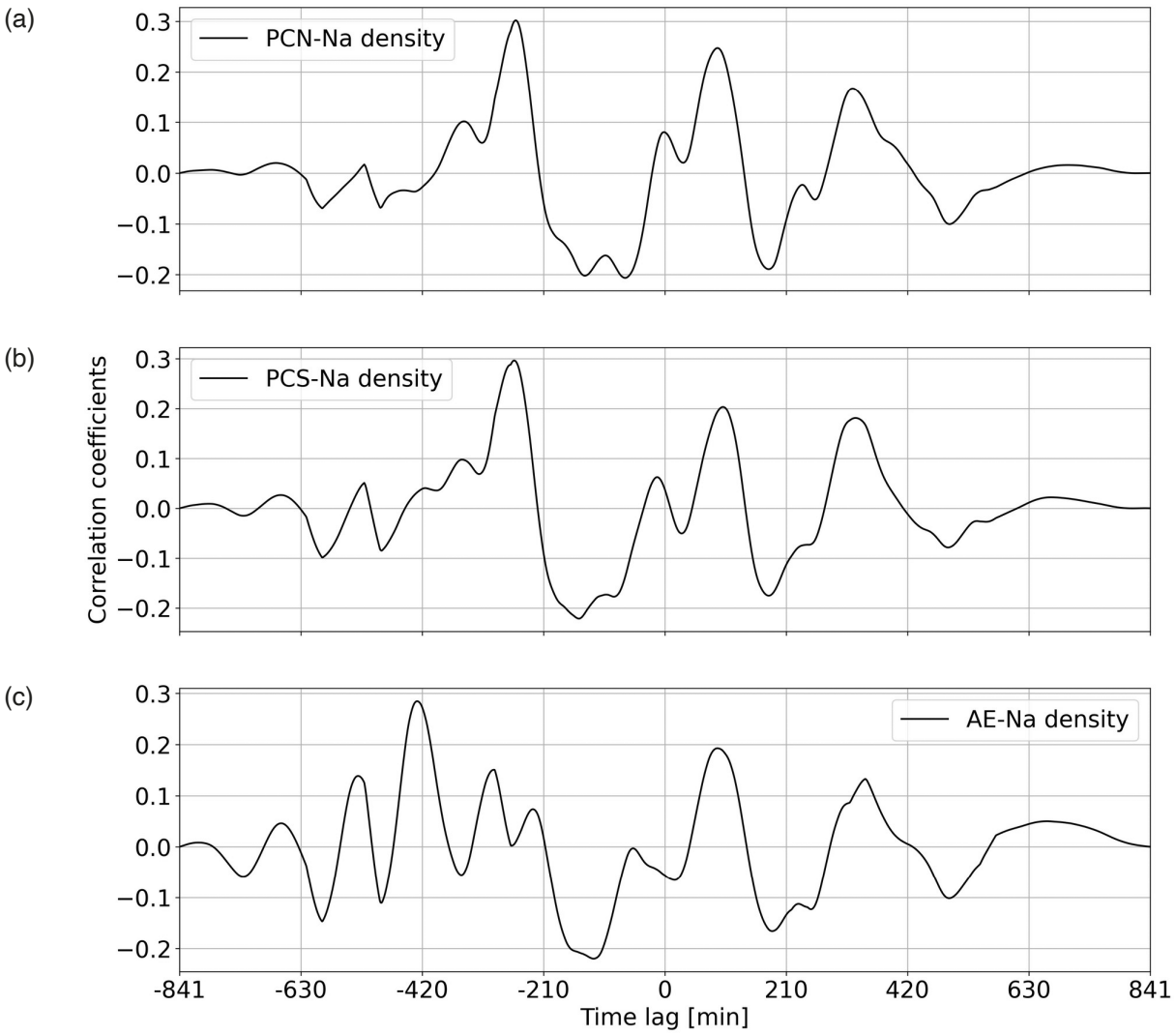

Figure 6. Cross correlation between Na density and PCN (a), PCS (b) and AE index (c) on 01 September 2019 at around 09:00-24:00 UT.

The computed CC between the PCN, PCS and AE indices and Na number density on 01 September 2019 at 09:00-24:00 UT was 0.30, 0.29 and 0.28 as shown by the top, middle and bottom panel, respectively of Fig. 6. This means that there is a very small chance that the geomagnetic storm contributed to the Na number density during the specified period.

The computed CC between the PCN, PCS and AE indices and Na number density on 04 September 2019 08:50-24:00 UT was 0.44, 0.43 and 0.41 as shown by the top, middle and bottom panel, respectively of Fig. 7. This means that there is a small chance that the geomagnetic storm contributed to the Na number density during the current period.

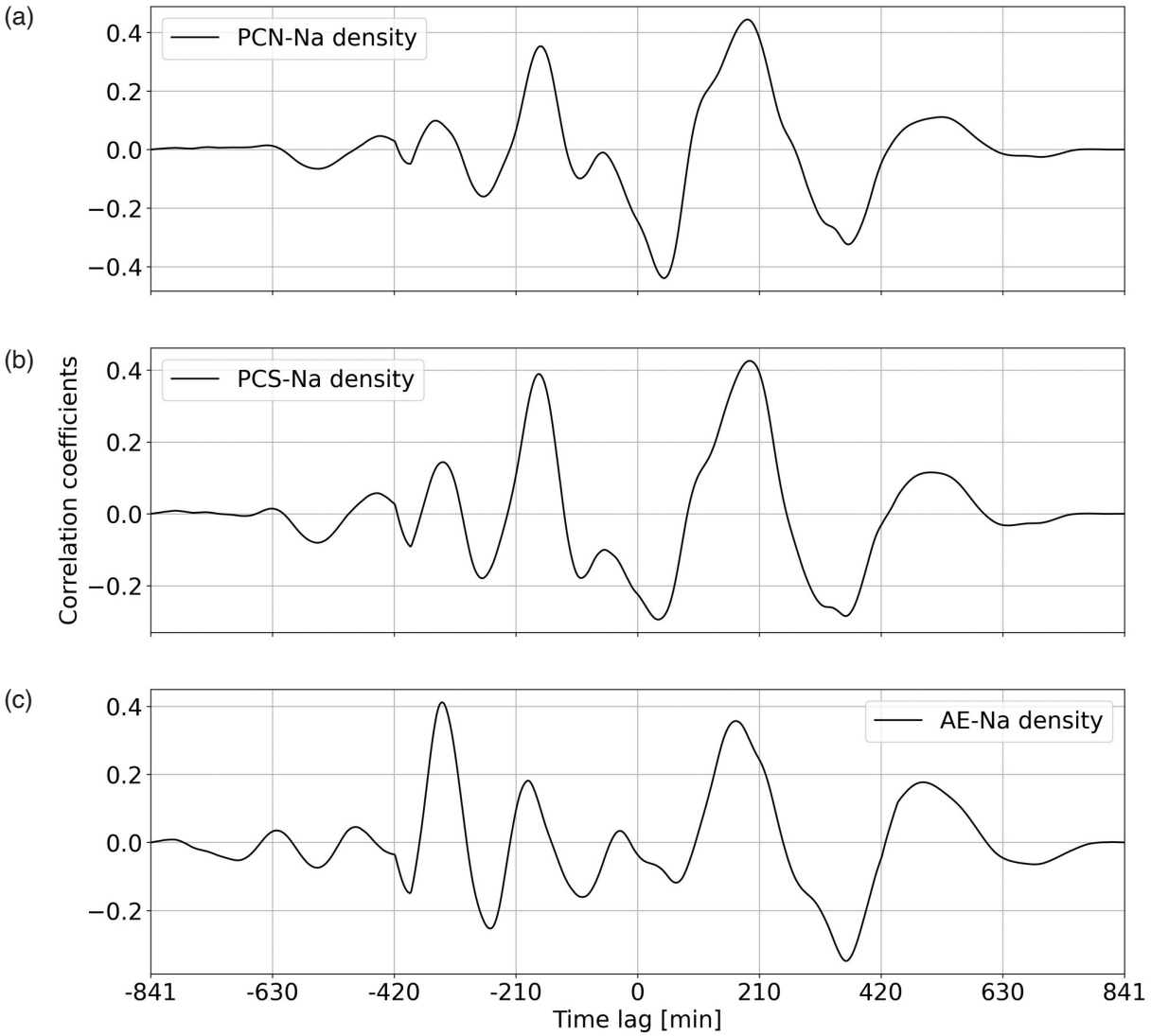

Figure 7. Cross correlation between Na number density and PCN (a), PCS (b) and AE index (c) on 04 September 2019 at around 08:50-24:00 UT.