A critical review on the paper "The earliest datable noctilucent cloud observation (Parma, Italy, AD 1840)",
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Abstract

In the present critical review, my aim is to address serious calculation mistakes made by the authors. I do not want to review their interpretation of a given observation on 18 June 1840 made by Antonio Colla, who was a professor of Astronomy and Meteorology at the University of Parma. There is no sense interpreting Colla's observation since the basic astronomical calculations have been made incorrectly by the authors Chiara Bertolin and Fernando Domínguez-Castro. Summarizing, in theory and practice, astronomer Antonio Colla could **not** have observed noctilucent clouds (NLC) at Parma on 18 June 1840. That is why the conclusions of the present paper are not valid.

A critical review
First.
The authors state:

"Therefore, the starting time of the observation 21:00 (LST) corresponds to 20:18:44 (UT) and the end of '*permanent light that lasted for one and a quarter hours*' to 21:33:44 (UT). If we correct this measure for the error as calculated by Dominici and Marcelli for horary measurements in Italy before 1866 (Dominici and Marcelli, 1979), the Colla's observational time becomes 20:03:44 (UT) and 21:18:44 (UT).

The twilight hours for 18 June 1840 were simulated, for the Parma site, using a tool provided by the data service of the Astronomical Applications Department of the U.S. Naval Observatory (https://www.esrl.noaa.gov/gmd/grad/solcalc/azel.html). According with this simulation, Colla's observation was mainly during the civil and nautical twilight when the sun was from 0.5° to 10.1° below the horizon."

This is the key error of the present paper. According to astronomical calculations (by using the given web calculator or another one), the horizontal coordinates of the Sun at the Parma site were as follows:

Elevation angle= **−8.43°** and Azimuth angle=**315.6°** at 20:03:44 UT
Elevation angle= **−16.38°** and Azimuth angle=**331.2°** at 21:18:44 UT

These elevation angles strongly contradict the statement "*the sun was from 0.5° to 10.1° below the horizon*".

Second.
Based on the corrected horizontal coordinates of the Sun, one can compute an area of the sky in which it was potentially possible to observe an NLC for the day and times of Colla's observation, following the methodology of Gadsden and Schröder (1989). The result is shown in Figure 1.
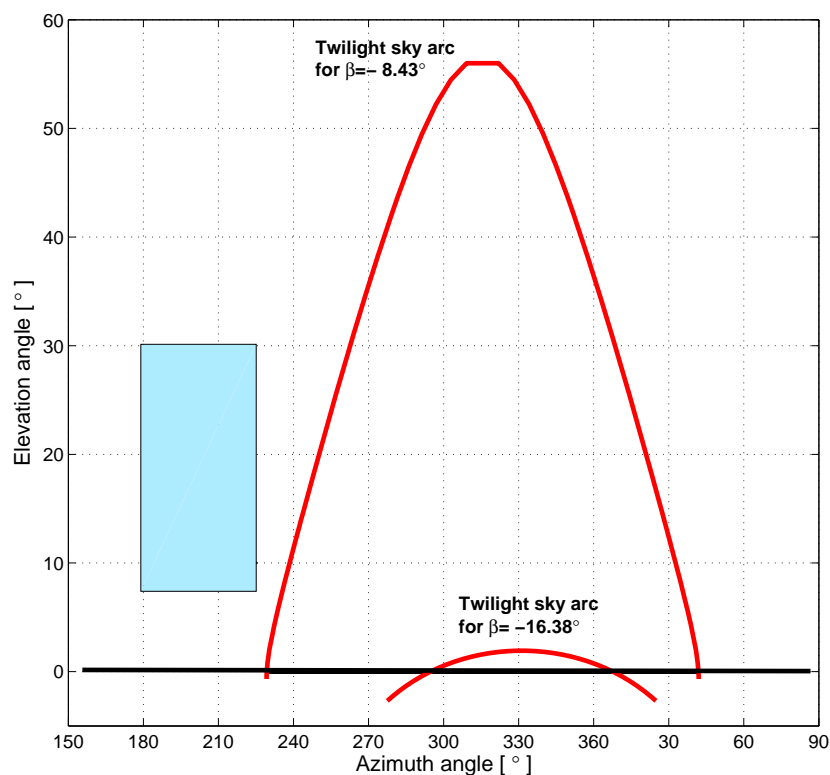
Figure 1. The upper edge of the twilight sky arc determining the illuminated area of an NLC for two extreme cases with solar depression angles of **-8.43° (azimuth angle of the Sun is 315.6°**) and **-16.38° (azimuth angle of the Sun is 331.2°**), corresponding to the start (**20:03:44 UT**) and end (**21:18:44 UT**) of the observation made by Antonio Colla on 18 June 1840. The blue rectangle on the left represents the area of the sky in which Colla saw his atmospheric phenomenon. In these calculations, the Earth's radius is equal to 6373 km, the screening height is 5 km, the NLC height is 83 km (for details, see Gadsden and Schröder, 1989, pages 23-25).

One can clearly see that the area of the sky in which Colla saw his atmospheric phenomenon is outside the illuminated twilight sky arc, i.e., the Sun could **not** illuminate the atmospheric phenomenon seen by Colla. This strongly contradicts the result shown in Figure 3 of the present paper.

Summary
In theory and practice, astronomer Antonio Colla could **not** observe noctilucent clouds at Parma in the southern part of the sky on 18 June 1840. That is why the conclusions of the present paper are not valid.

References
Gadsden, M., and W. Schröder. Noctilucent Clouds. Springer, New York, 1989.

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