Half a century of *UBV* photometry at Hvar: Auxiliary materials ⋆

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ABSTRACT

Key words. stars: early-type – stars: emission-lne(Be) – stars: chemically peculiar (CP) – binaries: eclipsing – binaries: ellipsoidal

1. Accuracy of Hvar observations

As mentioned in the paper, we took care to adapt the integration times of observations in individual passbands to obtain comparable S/N ratio fo all of them. This is important for the non-linear tranformation formulæ, which we used since the resulting accuracy of the standard magnitudes in each passband is affected by the precision of all three passbands. In Figure 1 we show the plots of the rms errors of one observation of unit weight versus each magnitude, for the all-sky archive. Similar plots forthe differential archive are in Fig. 2. Plotted are only objects, for which at least 10 individual observations are available in the respective archive. For a better clarity, we also excluded most of the variable stars, restricting the plots to a maximum rms of $0\overset{m}{.}032$.

2. Monitoring the atmospheric extinction at Hvar

Determination of linear extiction coefficients for every night of observations, in which the observed standard stars span a sufficient range of air masses (at least 0.2), was a natural part of the data reduction.

It was deemed useful to present these data, relevant to air pollution at Hvar. Their value exceeds the astronomical interest and can be valuable for broader community, ecology studies in particular.

The seasonal variations, plotted in Fig 3 and already noted by Koubský & Pavlovski (1982), are clearly seen. During the winter seasons, atmospheric extinction is usually lower as the sea does not evaporate too much. During the summer seasons, the values of the extinction coefficients exhibit a large scatter due to local weather changes but on an average they are much higher then in the winter. Another thing worth noting is that the minimum values of the seasonal changes do not show any annual modulation. Such a behavior has also been found at some other sites, for instance at La Silla (Rufener 1986) or Grosschwabhausen observing station (Reimann et al. 1992)). We note that in Fig 3 there are some values of extiction coefficients lying below the general slope of the minimum extinction, especially for the U band. These extinction coefficients were usually determined on poor photometric nights or the nights where only few extinction standard stars had been measured. Of course, such nights were never used for all-sky photometry.

In Figure 4 we present a time plot of all extinction coefficients in U, B and V passbands, recorded at Hvar Observatory over the past fifty years. The scatter of the values is mainly caused by seasonal changes discussed above. Nevertheless, a mild growth of the extinction can be seen in 1975 and 1982. Such increases are often related to large volcanic eruptions anywhere in the world. The first maximum, seen in 1975 may be due to eruption of the El Fuego volcano in Guatemala (October 1974). We warn, however, that during the first observing seasons at Hvar, only a limited number of nights and standard stars suitable for accurate determination of the extinction were available.

⋆ Based on photometric observations from the Hvar Observatory and ESA Hipparcos Satellite.
⋆⋆ Jiří Horn passed away on Dec. 13, 1994
⋆⋆⋆ Karel Juza passed away on March 13, 1994
⋆⋆⋆⋆ Svatopluk Kříž passed away on Feb. 23, 2018
† Pavel Mayer passed away on Nov. 7, 2018
‡ Stanislav Štefl passed away on June 11, 2014
§ Josef Havelka passed away on June 19, 2009

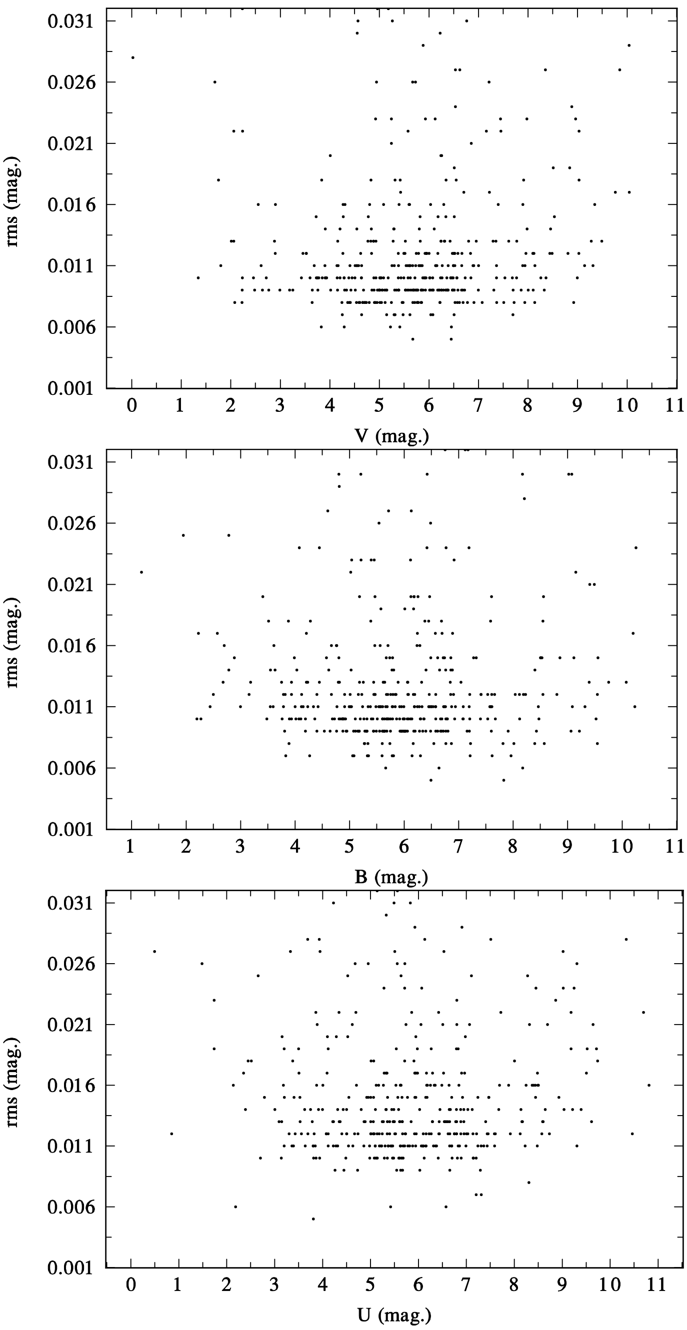

Fig. 1: The rms of one observation of unit weight as a function of a standard magnitude for the stars from the Hvar all-sky archive.

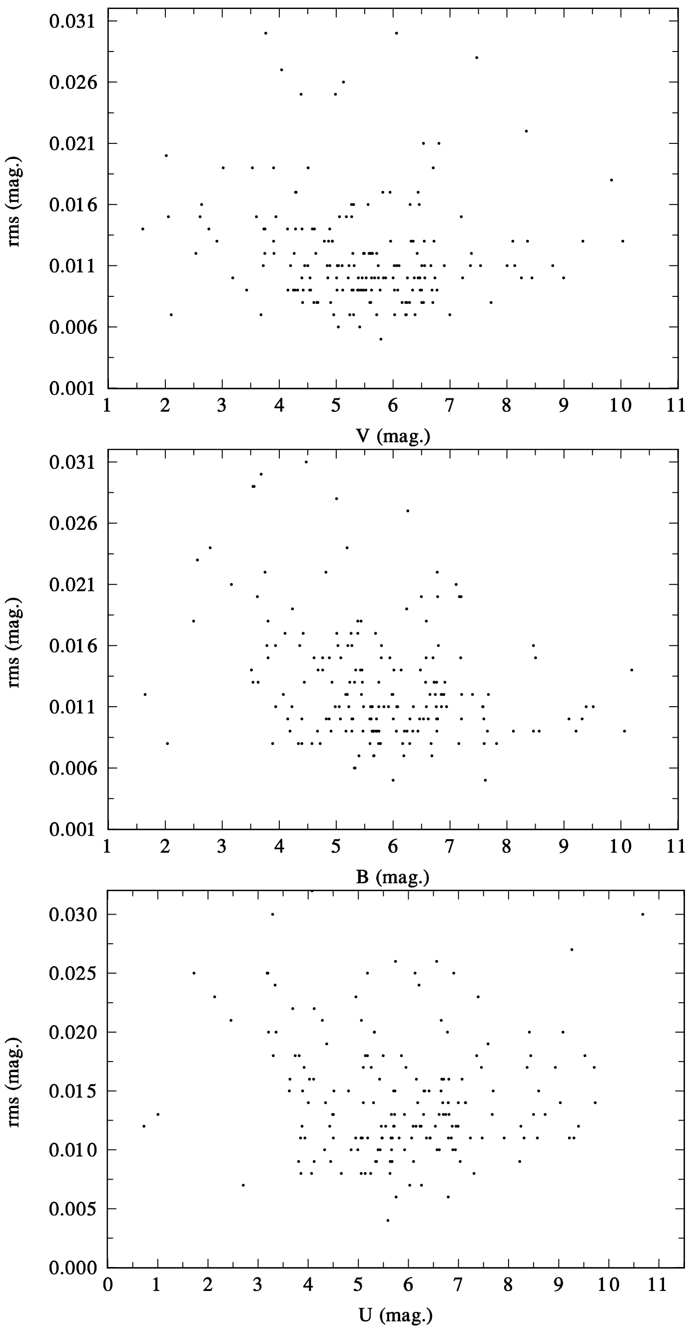

Fig. 2: The rms of one observation of unit weight as a function of a standard magnitude for the stars from the Hvar archive of differential observations.

The next increase of the extinction appeared at the time of eruption of the El Chiichon volcano (March 1982). The growth of extinction coefficients after this eruption was also recorded at other observatories like La Silla (Rufener 1986; Burki et al. 1995), Jena University Observatory (Reimann et al. 1992), or Lowell Observatory (Lockwood & Thompson 1986). However, the effect of the powerful eruption of the St. Helens volcano (March 1980) was not obviously felt at extinction at Hvar. Needless to say, a very small number of observations was made at that time, however. Also the La Silla observations (Rufener 1986) and observations at the Jena University Observatory (Reimann et al. 1992) did not detected this eruption while at the Lowell Observatory (Lockwood & Thompson 1986), the effect was only marginal. The strong Pinatubo eruption (April 1991) was not covered by Hvar observations because of the intermission due to war in Yugoslavia.

A more detailed analysis of the extinction variations at Hvar and their nature will be published elsewhere. Here we only note that already Pavlovski et al. (1979) pointed out that the influence of the molecular absorption (mainly by O_3) is of little effect in the *UBV* region. The Rayleigh scattering on air molecules that depends on wavelength and the air pressure shows a small range of variability. The most variable component of the extinction is scattering by aerosols. The Hvar Observatory is a low-altitude station and in the vicinity of the sea and is a subject to significant weather changes even within one night. Obviously the sea spray plays a major role in the large variations of extinction dur-

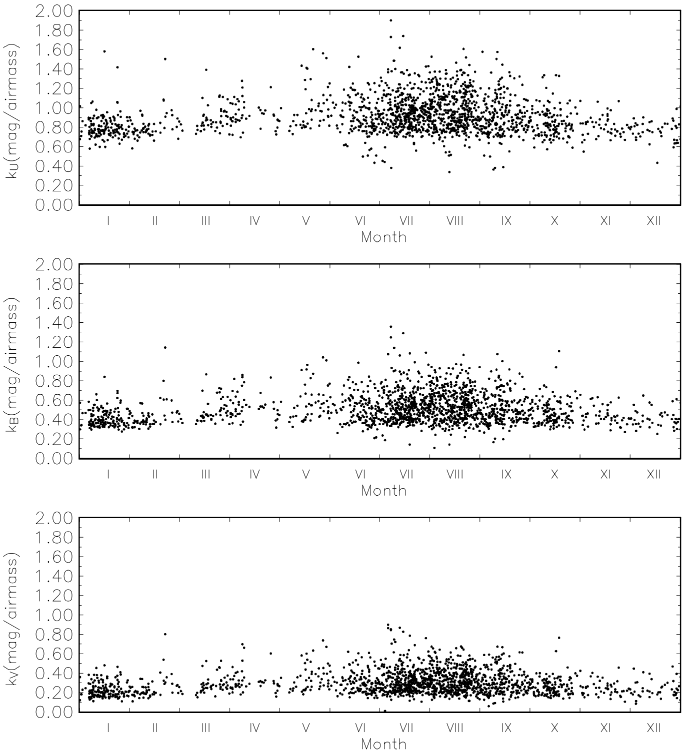

Fig. 3: The seasonal variations of the extinction coefficients at Hvar Observatory.

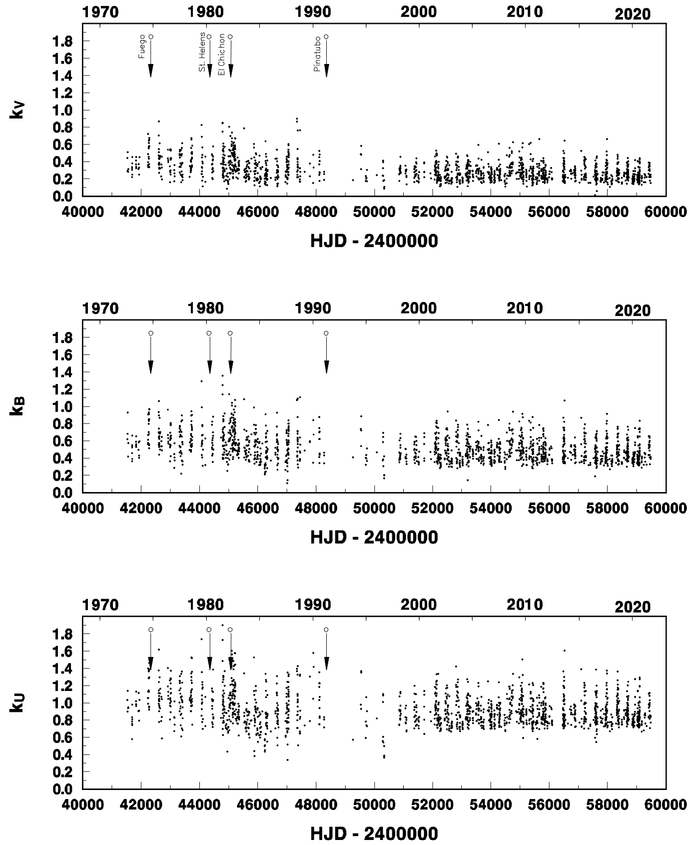

Fig. 4: The long-time behaviour of the extinction coefficients at Hvar Observatory over the past fifty years.

ing the summer seasons. Also occasional forest fires, quite frequent on the Adriatic coast, may have significant influence on the measured extinction.

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