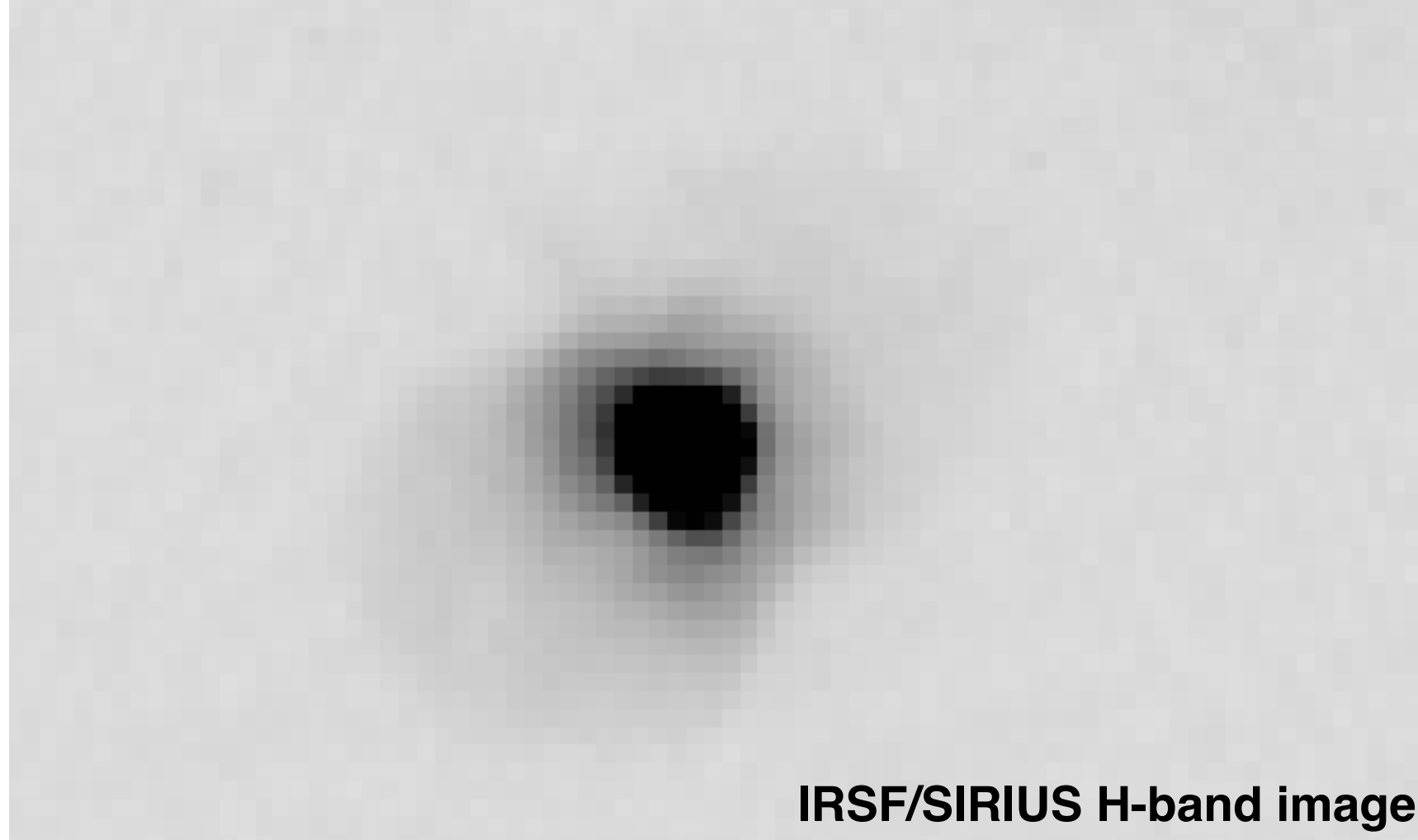


JHK_s PHOTOMETRY OF ETA CARINAE WITH IRSF/SIRIUS ANOTHER EVIDENCE FOR THE DECREASING WIND HYPOTHESIS

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INTRODUCTION

Eta Car is with $M > 100 M_{\odot}$ and $L \sim 10^6 L_{\odot}$ one of the most massive and most luminous stars in our Galaxy. During its *Great Eruption* 170 years ago, its luminous energy output rivaled that of a supernova as it expelled $10\text{-}30 M_{\odot}$. Due to its proximity to us, η Car is one of few supernova impostors whose recovery and continuing instability we can analyze in detail; numerous data sets cover several centuries.

Commencing about 15 years ago, η Car showed a dramatic increase in the near-UV, visual, and near-IR [2]. As the most obvious explanation a decrease in η Car's mass loss rate was proposed. The recent X-ray light-curve also indicated a decrease in wind momentum and optical spectra from 1998-2012 revealed major changes in the primary wind. These findings lead to the hypothesis that η Car's wind may have gradually decreased by a factor of 2 over the last decade [5,6,4,1].

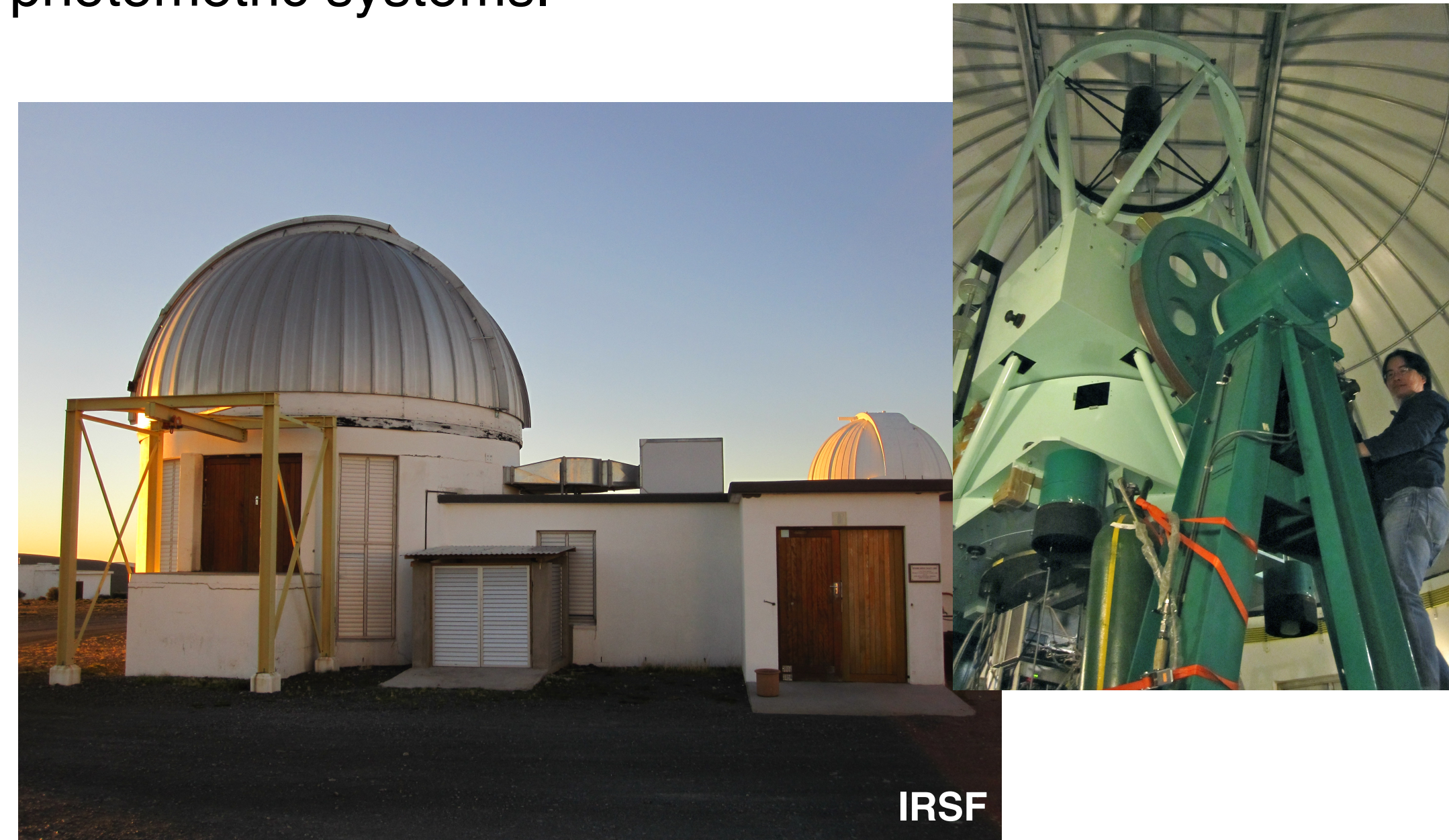
To further investigate the current state of η Car and to complement the recent studies in the visual and X-rays, we obtained JHK_s photometry with IRSF/SIRIUS in 2012 May. We expected to observe long-term changes in the JHK light-curves and color-color diagrams if the wind and/or the central star itself had changed over the last decade.

IRSF/SIRIUS OBSERVATIONS

IRSF (InfraRed Survey Facility) is a 1.4 m telescope located at SAAO. It is a joint project of Nagoya University, the National Astronomical Observatory of Japan, and SAAO. SIRIUS (Simultaneous-3color InfraRed Imager for Unbiased Survey) is a simultaneous 3-channel JHK_s camera equipped with three 1024x1024 HAWAII arrays. The field of view is approximately $7.8' \times 7.8'$ and the pixel scale is $0.45''/\text{pixel}$.

On 2012 May 11 and 15 we monitored η Car with 1.6 s and 2 s exposures for more than 12 hours. Because of η Car's brightness a 1% plus a 10% neutral density filter were used. Great care was taken to achieve high-precision photometry of η Car. For example, we monitored the same 2 standard stars throughout the night to determine the zeropoints and extinction curves.

The data were reduced using the SIRIUS pipeline. The resulting SIRIUS JHK_s values were converted to Carter JHK for comparison with published values from 1972-2004 [3,7,8,9]. The relative accuracy of our JHK magnitudes is better than 0.02 mag. The rather large errors of the absolute magnitudes presented here are introduced by the transformations between the photometric systems.



JHK LIGHT-CURVE AND COLOR EVOLUTION

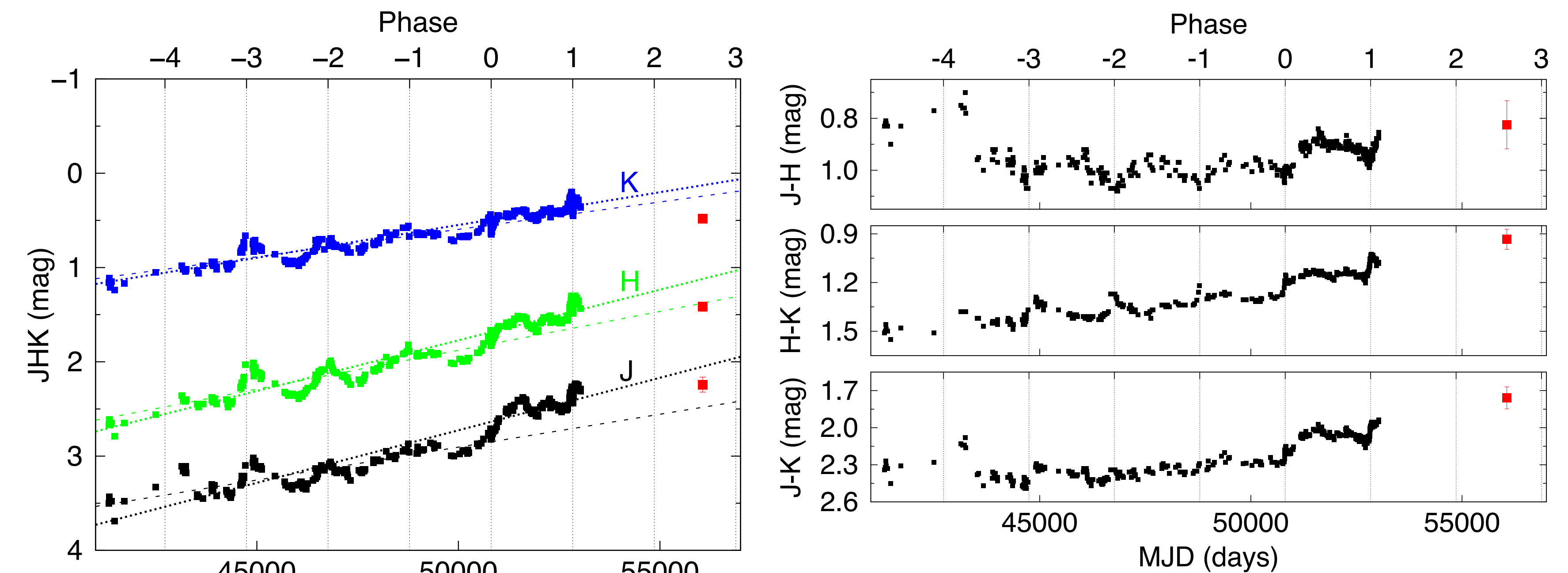


Figure 1: JHK light-curve 1972-2012. SIRIUS values from 2012 May (■) are compared to the historical light-curve from 1972 to 2004 (J=■, H=■, K=■). Linear fits to the historical data are shown to visualize the long-term trend (dotted curve: fit through 1972-2004 values; dashed curve: fit through 1972-1998 values).

Figure 2: Color evolution 1972-2012. SIRIUS values from 2012 May (■) are compared to the historical values from 1972-2004 (■).

2012 May:
 $J_{\eta\text{Car}} = 2.242 \pm 0.080 \text{ mag}$
 $H_{\eta\text{Car}} = 1.417 \pm 0.048 \text{ mag}$
 $K_{\eta\text{Car}} = 0.483 \pm 0.039 \text{ mag}$

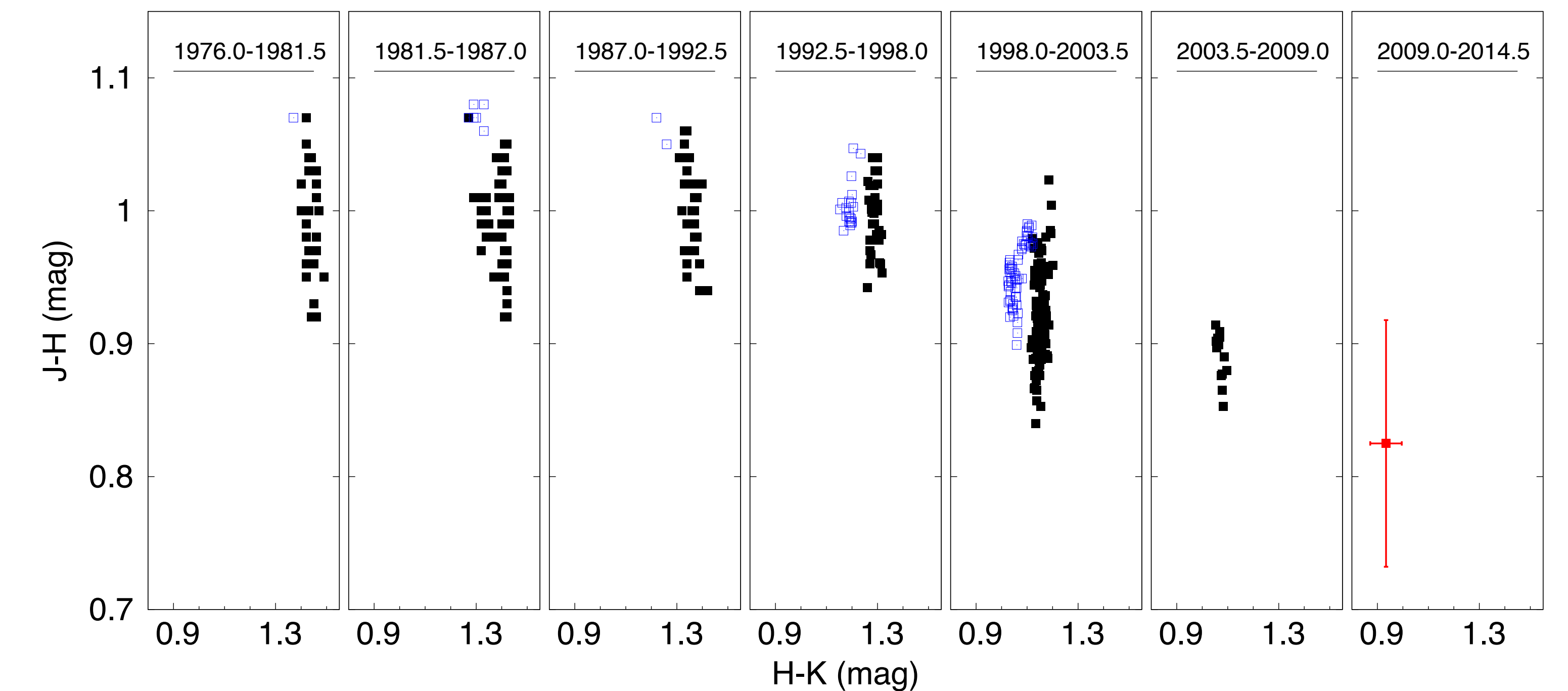


Figure 2: Color-color diagram 1978-2012. SIRIUS data point from 2012 May (■) is compared to the historical values (■ + ■). Blue squares are values close to periastron passage.

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CONCLUSIONS

1. Eta Car's 1972-2004 JHK light-curve showed increasing brightness in all three bands with time. 2012 May SIRIUS data indicate that η Car followed this trend only in J, while H and K band magnitudes are similar or even fainter than in 2004; η Car became bluer in the near-IR since the early 1990s.
2. This is consistent with the hypothesis that η Car's wind may have gradually decreased over the last two decades. The recent JHK magnitudes can be explained with a combination of an expanding Homunculus nebula and increased heating by the central source.
3. We do not detect significant sub-daily variations.