9.5 Million Variable Star Observations Coming to You by 2005!

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Abstract

The American Association of Variable Star Observers (AAVSO) is in the midst of an exciting two-year project, thanks to a grant from NASA, to validate and make public over 9.5 million mostly visual observations of over 4,900 variable and suspected variable stars. These observations have been contributed to the AAVSO International Database by amateur astronomers around the world since 1911.

The data are being released as the project progresses. **They may be accessed around the clock via the AAVSO webpage www.aavso.org/data/download. Validated data are provided electronically to the researcher automatically; a request for unvalidated data is automatically channeled to AAVSO technical staff for fulfillment on a priority basis set by the requester.**

Why is validation of the data necessary? **The AAVSO is committed to providing to the astronomical community optical variable star data of the highest quality and dependability. To ensure this level of data reliability, incoming observations must be assessed in the context of other observations of the same star made at the same time to be sure they accurately represent both the observers' observations and the optical behavior of the star. When the AAVSO disseminates data on a star, the researcher can rest assured that the AAVSO has performed this assessment. Clearly discrepant observations are not disseminated, but they are kept in the database; no observation is ever discarded except at the express request of the observer.**

Examples are given of the long-term optical datasets – many spanning 90 years or more – that are becoming available to the astronomical community through this project, as well as areas of application for AAVSO data, including multiwavelength data correlation, stellar evolution studies, and theoretical model testing. The services the AAVSO offers to the astronomical and educational communities are also described.

The AAVSO gratefully acknowledges NASA grant NAG5-12602 for providing funding for the AAVSO Data Validation Project.

What is Validation of AAVSO Data?

Validation is a two-part process in which each observation in the AAVSO International Database is:

1) ***Checked for digitization errors*** **in designation, name, date, magnitude, and observer identification code. Errors are resolved by comparison with original reports, and are corrected in the database.**

2) ***Submitted to an intense quality-control check*** **by means of scrutiny by eye in the context of the star's light curve. Observations identified as discrepant are flagged (marked). An observation is usually considered discrepant if it is more than one magnitude outside the mean magnitude for a given interval. If it is not clear that an observation is discrepant, or if there are conflicting observations made by experienced observers, the observation(s) are not flagged. Discrepant observations are not disseminated, but they are retained in the database permanently.**

The scrutiny by eye is actually a two-stage process, in which 1) one technical assistant scrutinizes the file, investigates apparently discrepant observations, makes any necessary corrections to the database, and flags truly discrepant observations; and 2) a second technical assistant reviews the scrutiny performed by the first assistant, makes any necessary revisions, and marks the data as "validated". For some stars, a third person (usually the Director/Interim Director) reviews the dataset after both technical assistants are finished, and then the dataset is marked validated.

The goal of validation is not to produce a "pretty" light curve devoid of scatter, but to remove only those observations that are a) misidentifications of the variable or b) are so far removed from other observers' measurements that they will negatively affect analysis of the data to a statistically significant level. Validation must be done by AAVSO staff at AAVSO Headquarters because the staff have the necessary

-- familiarity with the thousands of observers,

-- access to the original observing reports and to the charts used, and

-- knowledge of how the data were processed.

AAVSO Data Validation Project Status

The AAVSO International Database contains over 11 million mostly visual observations of over 5,000 known and suspected variable stars contributed by over 6,000 observers worldwide since 1911 (the data for some stars go back earlier, even to the late 1800's). Of these 11+ million observations, 9.5 million are being validated by AAVSO Headquarters technical staff and released for downloading from the AAVSO website, thanks to a 2-year grant from NASA. When the project is completed, the data will be placed on Caltech's NASA/IPAC-IRSA site and in other NASA databases so that the data are publicly available and may be used for astronomical research, education, and public outreach.

The AAVSO Data Validation Project, as described above and in the Abstract, is nearly 70% complete as of January 2004 and is on target for completion by the October 2004 deadline. Eight AAVSO Technical staff members at AAVSO Headquarters are working on the project to varying degrees (all eight have additional responsibilities on behalf of the association). The validated datasets are being released daily as the project progresses. They may be accessed around the clock via the AAVSO website and are downloaded electronically to the researcher automatically on request. As the validation project progresses, more and more of these stars become available for automatic download. Keep checking the AAVSO website for "your" stars – stay tuned!

Examples of AAVSO Long-Term Datasets

Figures 1- 6 show examples of validated long-term datasets of eruptive and pulsating stars in the AAVSO International Database [for an example of a Mira long-term dataset, see Figure 1 in *Templeton & Mattei, poster 8.01* (R Aquilae; March 1904 - September 2003; 31,719 observations made by 1,216 observers worldwide)]. These light curves demonstrate the breadth and depth of the database and give a small indication of the treasure-trove it represents, thanks to the extraordinary and untiring efforts of observers over the decades. Not every star in the database has so extensive a dataset, but there are thousands of stars with sufficient long-term data for investigation.

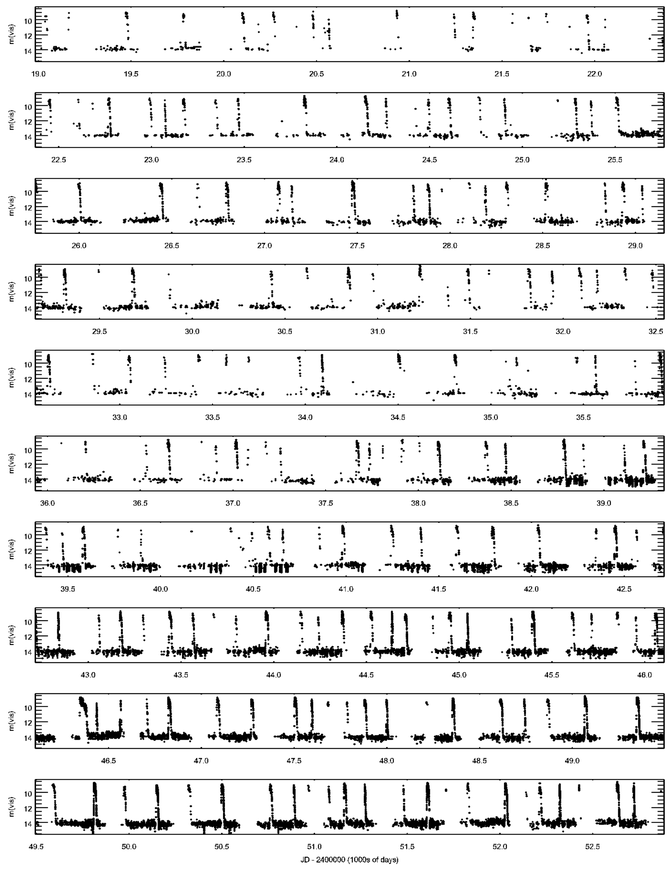

Figure 1. AAVSO optical light curve for the dwarf nova-type (SS Cyg subclass) cataclysmic variable **U Geminorum**; January 1908 - September 2003; 55,371 observations made by 1,027 observers worldwide.

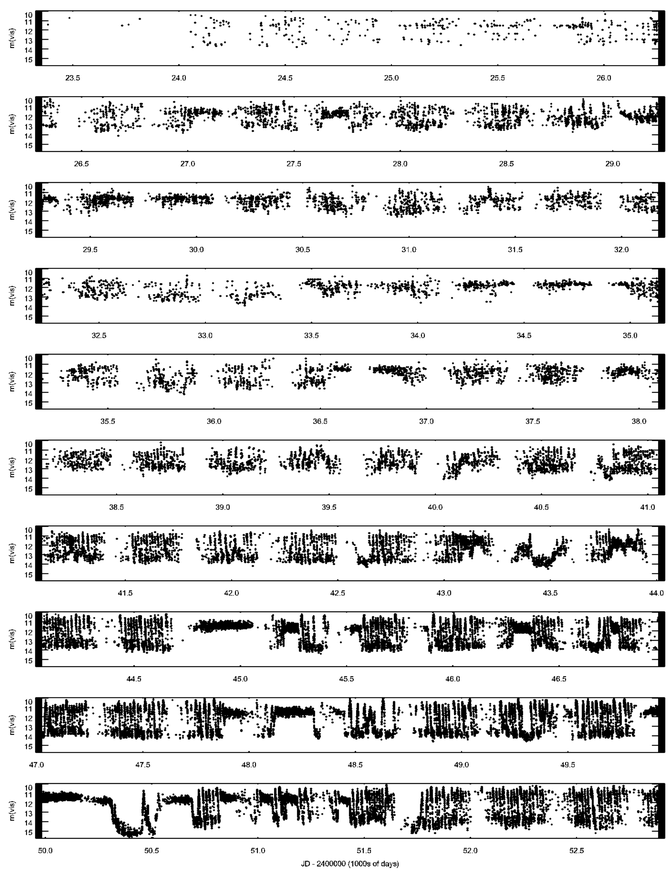

Figure 2. AAVSO optical light curve for the dwarf nova-type (Z Cam subclass) cataclysmic variable prototype **Z Camelopardalis**; May 1923 - September 2003; 71,668 observations made by 632 observers worldwide.

Services to the Astronomical and Educational Communities

AAVSO data, both published and unpublished, are disseminated extensively to astronomers around the world via the AAVSO website or on request of AAVSO Headquarters. AAVSO services are sought by astronomers and educators for the following purposes:

a. **Assistance in scheduling and executing variable star observing programs using earth-based large telescopes and instruments aboard satellites;**
b. **Real-time, up-to-date information on unusual stellar activity;**
c. **Assistance in simultaneous optical observations of program stars and immediate notification of their activity during ground-based or satellite observing programs;**
d. **Correlation of AAVSO optical data with spectroscopic, photometric, and polarimetric multi-wavelength data;**
e. **Collaborative statistical analysis of stellar behavior using long-term AAVSO data.**
f. **Assistance in designing variable star observing program and/or choosing equipment for school observatory;**
g. **Assistance in achieving math/science/computer curriculum goals through variable star observing (e.g., use of AAVSO's *Hands-On Astrophysics* curriculum);**
h. **Assistance in selecting observing targets for projects ranging from science fair presentation to doctoral thesis.**

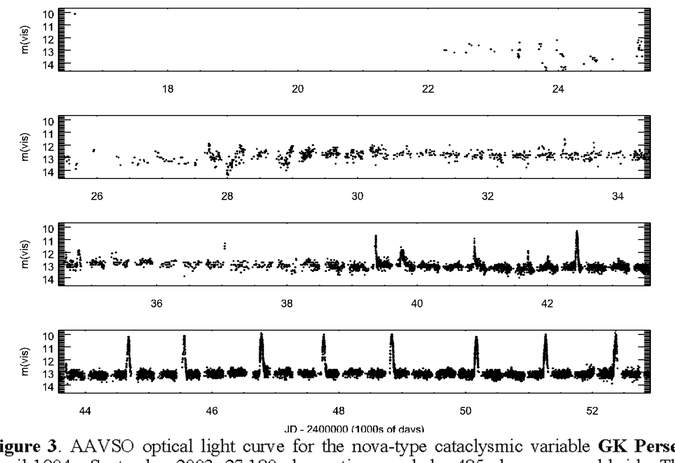

Figure 3. AAVSO optical light curve for the nova-type cataclysmic variable **GK Persei**; April 1904 - September 2003; 27,180 observations made by 485 observers worldwide. The single point from 1904 is part of the decline from the nova outburst of 1901; the subsequent observations show the evolution of the optical behavior to dwarf-nova-like outbursts.

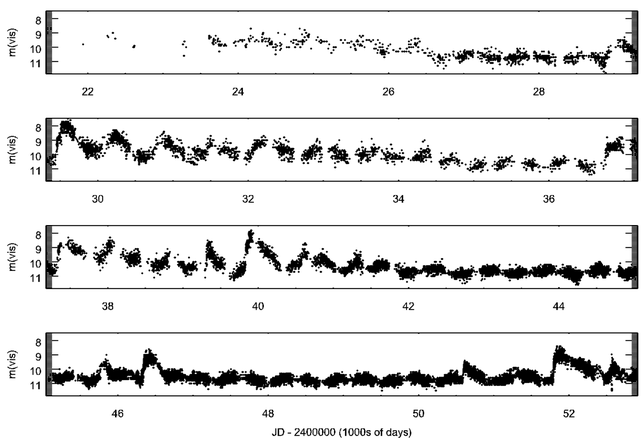

Figure 4. AAVSO optical light curve for the symbiotic-type cataclysmic variable prototype **Z Andromedae**; February 1913 - September 2003; 31,710 observations made by 781 observers worldwide. Note the dramatically different behavior after each major outburst.

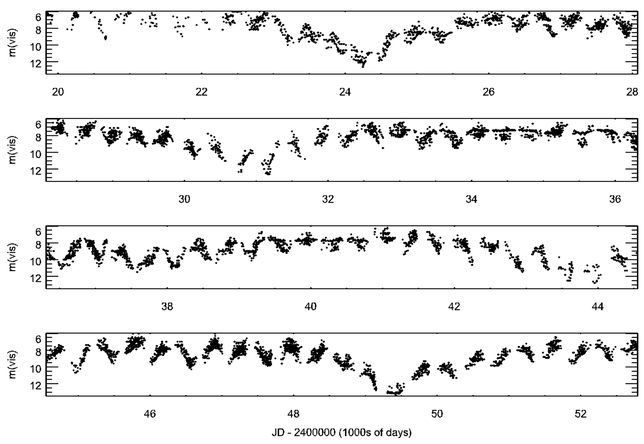

Figure 5. AAVSO optical light curve for the semiregular-type long-period pulsating variable **V Hydrae**; March 1913 - June 2003; 7,727 observations made by 347 observers worldwide.

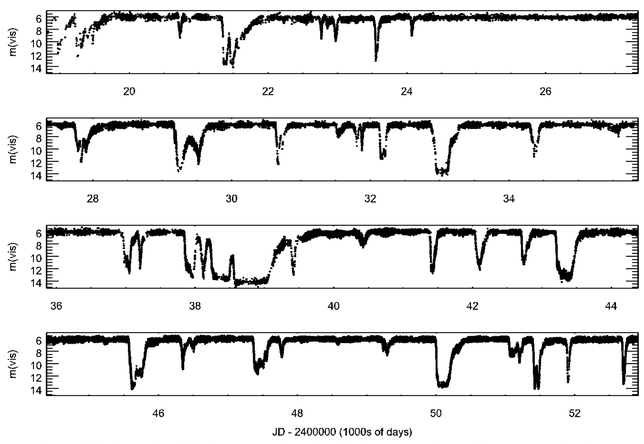

Figure 6. AAVSO optical light curve for the R Coronae Borealis-type pulsating variable prototype **R Coronae Borealis**; May 1905 - September 2003; 197,158 observations made by 2,415 observers worldwide.

Julian Date (JD) & Gregorian Equivalent

JD 2410000 – 3 April 1886
2420000 – 20 August 1913
2430000 – 5 January 1941
2440000 – 23 May 1968
2450000 – 9 October 1995