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Fixing images observation dates thanks to asteroids

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Abstract

An important piece of metadata for any astronomical image is the date and time at which it was observed (and the exposure time). Unfortunately, the values of the observation epoch found in the FITS headers of digitized photographic plates, for example, are not always accurate.
There can be many different sources of error : mistakes in the original observation log, errors when converting between different dates and time format (calendar date, Julian days, decimal years...).
We present in this poster an analysis of the different values that can be found for the observation epoch of several image sets in various metadata sources.
We show how the presence of known asteroids in the field of view can be used to recover the correct time values with a good accuracy.

Datasets

We studied several photographic plates archives, such as POSS I and II, SERC, ESO... and tried to retrieve the date and time of observation for each image according to different sources:
- Metadata in the image headers
- Observation logs from USNO
- Catalogues of plates from VizieR

Identical images were identified by matching surveys and plate numbers

Epoch metadata

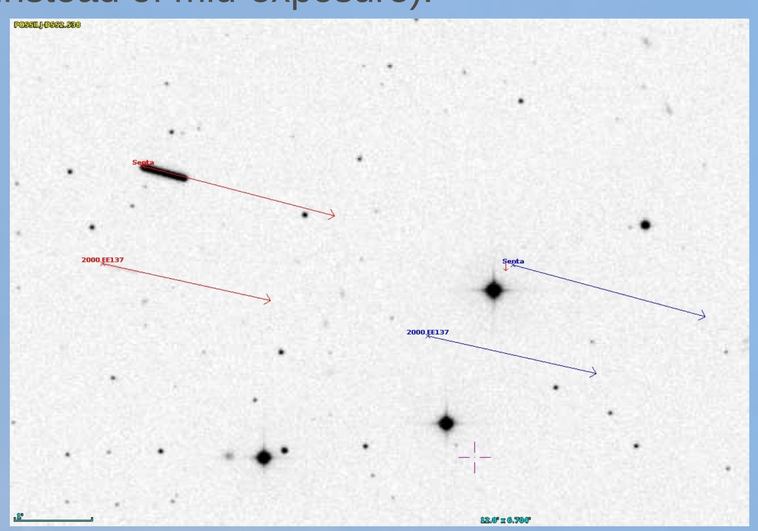
The observation date and time can be stored in many different time formats in the observation log or headers:
- (modified) Julian day
- ISO 8601 or calendar date
- Decimal year
- Decimal hours

Or combinations of the previous, e.g. decimal year for the calendar day and decimal hours for time...

We first converted all original values to Julian days.

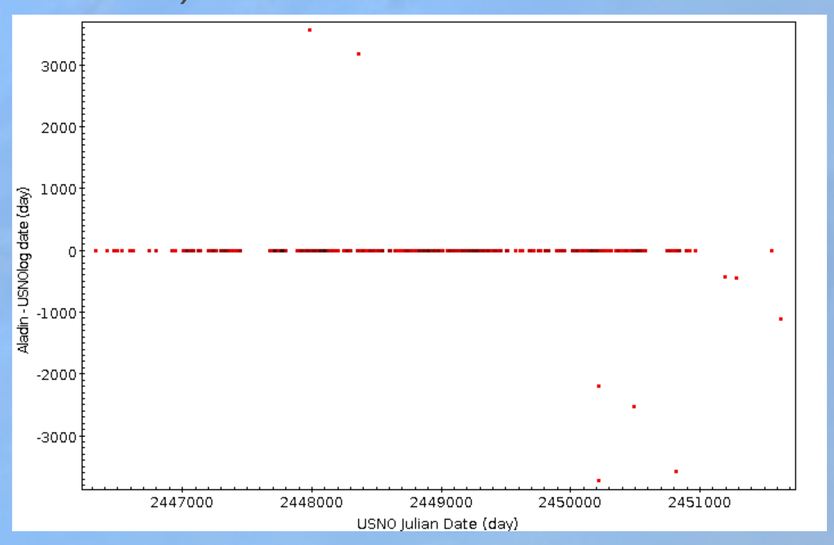
Asteroids bring the truth

Asteroids can help fixing image metadata !
As shown below, querying SkyBot[1] can help determine which of the epochs is correct when discrepancies arise, provided there is at least one observed asteroid in the field of view. The time accuracy is a few minutes, less than the typical exposure time (and can sometimes fix an erroneous metadata description, indicating exposure start instead of mid-exposure).

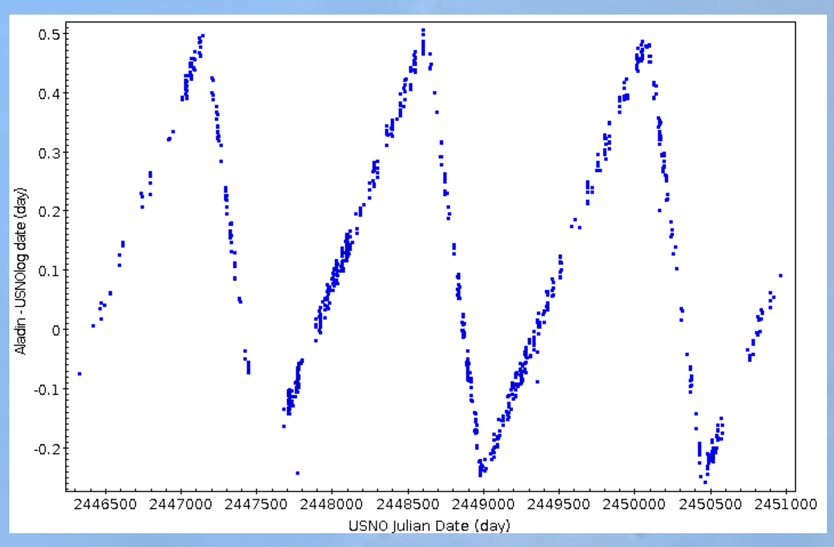


Discrepancies

Comparison of Julian dates from different sources (example for USNO logs and Aladin images metadata for POSS J plates below) show various differences :



Large discrepancies For a small number of plates



Systematic patterns (here variations from -0.25 o +0.5 day due to improper conversion with bissextile years).

Other sources of error that were found include: decimal hours interpreted as minutes, systematic shift in plate numbering, wrong date (+/-1day), ...

Perspectives

- The presence of asteroids in photographic plates can help checking the accuracy and fixing the epoch metadata that are often inaccurate in present image headers, after several conversion between date and time formats have been performed.
- We will provide validated image epochs for plate images available in the Aladin image server, and make these updated metadata available to other servers distributing mirror copies of these surveys

[1] SkyBoT, a new VO service to identify Solar System objects, Berthier, J et al., 2006, ADASS XV p367