USNO Almanac Products

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What is an Almanac?

• A publication containing astronomical data arranged according to date, usually for a given year.

• Provides observable characteristics of bodies
  – Position, brightness, phenomena, etc.

• Based on fundamental reference data
  – Star catalogs
  – Solar system ephemerides
  – Adopted constants
What is an Almanac? (con’t.)

• Traditionally, a paper publication

• Today, almanac data is available from USNO via...
  – Paper publications*
  – Executable software
  – Source code software
  – Web-based services

• Data, precision, and format tailored for specific applications

* co-published with H.M. Nautical Almanac Office, United Kingdom
Applications

• Celestial navigation

• “High precision”
  – Telescope / sensor pointing
  – Scientific research

• Special purposes
  – Ground illumination
    • Mission planning & scheduling
    • NVG use

• General use
  – Litigation, accident reconstruction, photography, architecture, etc.
Almanac Products for Celestial Navigation

• *The Nautical Almanac*
  – For marine navigation
  – Required by Navy policy and U.S. law

• STELLA
  – For marine navigation
  – Includes full sight planning and reduction tools
  – U.S. DoD only

• *The Air Almanac (U.S. version)*
  – For air navigation

• Web services
The Air & Nautical Almanacs
STELLA Overview

- PC-based application
  - Version 2.0 (1970-2010)

- Response to formal U.S. Navy requirement

- Provides standard means for performing celestial navigation computations
  - Almanac
  - Position update
  - Rise/set/transit/twilight (fixed site and moving platform)
  - Gyro/compass error (planning and computation)
  - Sight planning (table and graphic)
  - Sight reduction (with sight recorder)
  - Log
STELLA User Interface
STELLA (Sight Planning)
STELLA (Sight Reduction)
Impact of STELLA

12. Overall, how much help has STELLA been to the Navigation Department?

Source: 1997 Survey of STELLA 1.0 Users
Almanac Products for High-Precision Applications

- **The Astronomical Almanac**
- **MICA**
  - Computer-based counterpart of *Astron. Alm.*
  - PC and Macintosh editions
- **NOVAS**
  - Source code (Fortran and C)
  - Common astrometric quantities & transformations
- **Web services**
  - WebMICA
The Astronomical Almanac & MICA
MICA Overview

- USNO’s second-generation computer almanac
- Complements the *Astronomical Almanac*
  - Geocentric *and* topocentric data
  - TT *and* UT
  - Long interval: 1990-2005 (Version 1.5)
- Provides
  - Nine positions types
  - Sidereal time, nutation & obliquity, calendar
  - Rise/set/transit/twilight
  - Physical ephemerides
  - Configuration
MICA (DOS User Interface)

![Image of MICA interface with Moon data]

<table>
<thead>
<tr>
<th>Date (Zone)</th>
<th>Rise</th>
<th>Az.</th>
<th>Transit</th>
<th>Alt.</th>
<th>Set</th>
<th>Az.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996 Jul 26 (Fri)</td>
<td>26 15:42 113°</td>
<td>26 20:53 32S°</td>
<td>27 02:02 246°</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1996 Jul 27 (Sat)</td>
<td>27 16:44 114°</td>
<td>27 21:53 32S°</td>
<td>28 03:03 246°</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1996 Jul 28 (Sun)</td>
<td>28 17:43 113°</td>
<td>28 22:55 33S°</td>
<td>29 04:10 248°</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1996 Jul 29 (Mon)</td>
<td>29 18:36 110°</td>
<td>29 23:56 36S°</td>
<td>30 05:22 252°</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Location: W 77°04'00", N38°55'20"
(Longitude referred to Greenwich meridian)
Sea level; level horizon

Time Zone: 5h 00m west of Greenwich
NOVAS

- Source code library
  - C & Fortran

- Common astrometric quantities and transformations
  - Precession, nutation, sidereal time, etc.
  - PNSW transformation
  - Apparent, topocentric, astrometric places

- Rigorous and precise
  - Consistent with IAU resolutions

- Current version: 2.0
  - ICRS-compatible
Almanac Products for Special Purposes

• **Solar Lunar Almanac Core (SLAC)**
  – Specialized almanac “engine”
  – C source code
  – Sun/Moon phenomena + illumination
  – U.S. DoD-only

• **Custom solutions**
  – Mainly for U.S. DoD
  – Software
  – Data

• **Web services**
  – Example: illumination data based on SLAC
Products for General Use

• *Astronomical Phenomena*
  – Preprint of selected data from the *Astron. Alm.*

• **Web Site**
  – Wide variety of information
    • Product information
    • Interactive data services
    • Answers to FAQ
  – 7000-10000 user sessions per day
  – DoD-only services
AA Web Site

Data Services
Sun and Moon rise and set times, Moon phases, eclipses, seasons, positions of solar system objects, and other data

Frequently Asked Questions
background information on common astronomical phenomena, calendars and time, and related topics

Publications
astronomical and navigational almanacs, special publications, research reports

Software Products
computer almanac for PCs and Macs, and more

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http://aa.usno.navy.mil/AA/
Plans

- **Major revision of the *Astronomical Almanac***
  - Content and format
  - Incorporate ICRS and new ephemeris (DE405)
  - Web component
  - In progress

- **Determine future of *Air Almanac***
  - Assess true requirements

- **STELLA**
  - Version 2.0 done
  - Continue to maintain and improve
Plans (con’t.)

• **MICA**
  – Version 2.0 in development
    • Improved user interface
    • More calculations
    • Longer interval (~200 years)

• **SLAC**
  – Version 2.0 in development
  – Phenomena at heights above sea level
  – Better refraction model

• **Web site**
  – Ongoing improvements
USNO…

- Provides a wide range of almanac products and astronomical data services
  - Printed almanacs
  - Computer-based almanacs
  - Source-code software and data
  - World Wide Web site

that are benchmark standards used worldwide.

- Will continue to update and improve these products
  - To satisfy user requirements
  - To incorporate the best fundamental reference data