

## IAU WG - Standards of Fundamental Astronomy (SOFA)

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### Annual Report 2016

SOFA is a Functional Working Group of Division A. The IAU SOFA service continues its task of establishing and maintaining an accessible and authoritative set of algorithms and procedures that implement standard models used in fundamental astronomy. This is achieved via the expertise of Board members and the SOFA website ([www.iausofa.org](http://www.iausofa.org)).

During 2016, there has been one major release (number 12) in May, and minor releases in July (12a) and December (12b & c).

SOFA release 12 added ten new routines, making a total of 231 astronomy routines. Thus, there are now four more routines in the Precession / Nutation / Polar Motion section, which deliver long-term (+/-200,000 years) precession using the model of Vondrák, Capitaine and Wallace (2011, 2012). A new section was added, entitled Ecliptic Coordinates, consisting of six routines dealing with the transformation between equatorial and ecliptic coordinates using either the IAU 2006 or the long-term precession model. Also, the Earth Attitude Cookbook was separated for Fortran and C users. It should be noted that this was the first of the three cookbooks, and at that time there were no ANSI C routines.

Release 12a in July took account of the leap second due at the end of December 2016. The routine that calculates the deflection of starlight by the Sun was modified, without affecting the results for normal use. The formally fixed threshold value was changed to a value that depends on the observer location, which means the change is less abrupt and it improved the round-trip closure even for impossible (i.e. occulted) cases.

It was demonstrated that when using a particular combination of processor, compiler and other conditions, the ANSI C routines for Julian to calendar date conversion were giving incorrect results, and thus it was necessary to promptly issue another minor release. At the same time, we took the opportunity to update the STARPV routine to improve numerical efficiency. In all releases, there were various minor corrections to the documentation.

It is impossible to say how many users actually use SOFA. However, there are now some 793 registered users. Each month during 2016, there were between 1 806 and 3 028 unique visitors to the website. For release 11a (April 2015 to May 2016) there were 4 567 downloads of the ANSI C library, while there were 11 055 for the Fortran library. There are also many other users of the SOFA software via other implementations; Java from Jodrell Bank Centre for Astrophysics and C# available from the World-Wide Astronomy library. There are also the thousands of users via the Essential Routines for Fundamental Astronomy (ERFA) version that is bundled with Astropy for Python. We encourage all our users to acknowledge their use of SOFA.

Posters promoting SOFA have been displayed at the Science of Time symposium held at Harvard in June and as well as a joint poster with working groups Numerical Standards for Fundamental Astronomy (NSFA), Cartographic Coordinates and Rotational Elements (CCRE), and Commission A3, Fundamental Standards at Understanding the Earth core and nutation at the Royal Observatory of Belgium in September. At the latter meeting I also gave a review talk about SOFA over the last 20 years.

Finally, we acknowledge and thank the members of the Board and their institutes. The Board thanks the United Kingdom Hydrographic Office for hosting the SOFA website. We also thank our users, and in particular for pointing out various issues and making suggestions.