Changes/updates fall into the following categories:

1. The addition of four routines to the Precession/Nutation/Polar Motion
   section, which deliver long-term (+/-200,000 years) precession using
   the model of Vondrak, Capitaine and Wallace (2011, 2012).

2. Introduction of a new section entitled Ecliptic Coordinates. This
   section consists of six routines dealing with the transformation
   between equatorial and ecliptic coordinates using either the IAU 2006
   precession model or the long-term precession model of Vondrak et al.

3. Separate Earth Attitude Cookbooks for Fortran and C users, replacing
   the existing Fortran-only edition.

4. Some documentation corrections.

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FORTRAN Routines

New routines that implement a long-term precession model:

iau_LTP   Precession matrix, J2000.0 to date using the Vondrak
               et al. long-term model.

iau_LTPB   Precession+bias matrix, J2000.0 to date using the Vondrak
               et al. long-term model.

iau_LTPECL   Precession (Vondrak et al. long-term) of the ecliptic. A
               unit vector representing the direction of the ecliptic
               pole with respect to the J2000.0 mean equator and equinox.

iau_LTPEQU   Precession (Vondrak et al. long-term) of the equator. A
               unit vector representing the direction of the pole of the
               equator with respect to the J2000.0 mean equator and
               equinox.

Routines comprising a new section on ecliptic coordinates:

iau_ECEQ06   Ecliptic coords to equatorial: transformation of
               longitude and latitude (mean equinox and ecliptic of date)
               to mean J2000.0 right ascension and declination, using
               IAU 2006 precession.

iau_ECM06   ICRS (equatorial) to ecliptic rotation matrix using
               IAU 2006 precession.

iau_EQEC06   Equatorial to ecliptic coords: transformation of ICRS
               right ascension and declination to ecliptic longitude and
               latitude (mean equinox and ecliptic of date) using
               IAU 2006 precession.

iau_LTECEQ   Ecliptic coords to equatorial: transformation of
               ecliptic longitude and latitude (mean equinox and
               ecliptic of date) to mean J2000.0 right ascension and
               declination, using the Vondrak et al. long-term
               precession.

iau_LTECM   ICRS (equatorial) to ecliptic rotation matrix using the
               Vondrak et al. long-term precession.

iau_LTEQEC   Equatorial to ecliptic coords: transformation of ICRS
               right ascension and declination to ecliptic longitude and
               latitude (mean equinox and ecliptic of date) using the
               Vondrak et al. long-term precession.

Updated:

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t_sofa_f.for  Test program, incorporating the ten new routines.


Revisions:

iau_ATCO13    List of called routines corrected.

iau_ATIO13    List of called routines corrected.

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ANSI C Routines
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New functions that implement a long-term precession model:

iauLtp        Precession matrix, J2000.0 to date using the Vondrak
              et al. long-term model.  A new routine.

iauLtpb       Precession+bias matrix, J2000.0 to date using the Vondrak
              et al. long-term model.  A new routine.

iauLtpecl     Precession (Vondrak et al. long-term) of the ecliptic.  A
              unit vector representing the direction of the ecliptic
              pole with respect to the J2000.0 mean equator and equinox.
              A new routine.

iauLtpequ     Precession (Vondrak et al. long-term) of the equator.  A
              unit vector representing the direction of the pole of the
              equator with respect to the J2000.0 mean equator and
              equinox.  A new routine.

Functions comprising a new section on ecliptic coordinates:

iauEceq06     Ecliptic coords to equatorial:  transformation of
              longitude and latitude (mean equinox and ecliptic of date)
              to mean J2000.0 right ascension and declination, using
              IAU 2006 precession.

iauEcm06      ICRS (equatorial) to ecliptic rotation matrix using
              IAU 2006 precession.

iauEqec06     Equatorial to ecliptic coords:  transformation of ICRS
              right ascension and declination to ecliptic longitude and
              latitude (mean equinox and ecliptic of date) using
              IAU 2006 precession.

iauLteceq     Ecliptic coords to equatorial:  transformation of
              ecliptic longitude and latitude (mean equinox and
              ecliptic of date) to mean J2000.0 right ascension and
              declination, using the Vondrak et al. long-term
              precession.

iauLtecm      ICRS (equatorial) to ecliptic rotation matrix using the
              Vondrak et al. long-term precession.

iauLteqec     Equatorial to ecliptic coords:  transformation of ICRS
              right  ascension and declination to ecliptic longitude and
              latitude (mean equinox and ecliptic of date) using the
              Vondrak et al. long-term precession.

Updated:

sofa.h        Addition of prototypes for the ten new functions listed
              above.

t_sofa_c      Updated test program incorporating the ten new routines,
              plus a handful of constants extended to more decimal
              places.


Revisions:
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iauAtco13      List of called functions corrected.

iauAtio13      List of called functions corrected.

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Documentation:

board.lis      Inclusion of the new board members.

title.lis      Release number and date updated.

intro.lis      Updated to reflect the updates and additions of this 12th
               release.

sofa_lib.lis   New routines added.

sofa_pn_f.pdf  SOFA Earth Attitude Cookbook for those using Fortran.  The
               former Fortran-only version was called sofa_pn.pdf.  A few
               typographic corrections have been made.

sofa_pn_c.pdf  SOFA Earth Attitude Cookbook for those using ANSI C.  Like
               the former Fortran-only version but with function names
               and argument lists appropriate for the C case.

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End of Updates
2016 April 8
CYH/SAB
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             Updates for SOFA Release 12a : 2016 July
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Summary of Changes
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Changes/updates for this minor release (12a) fall into the following
categories:

1. A leap second at the end of December 2016, requires updates to the
   iau_DAT (dat.for) and iauDat (Dat.c) routines.  The test-bed
   programs t_sofa_f.for and t_sofa_c.c are also updated to test this
   change.

2. The routines iau_LDSUN and iauLdsun, that calculate the deflection
   of starlight by the Sun, have changed, though without affecting
   the results for normal use.  As a defensive measure, an internal
   threshold value tapers off the returned value for cases close to
   the center of the solar disk so that it becomes zero rather than
   infinity at the center.  By making the formerly fixed threshold
   value depend on observer location, it has been possible to make
   the onset of the defensive measure less abrupt, which has greatly
   improved round-trip closure even for impossible (i.e. occulted)
   cases.  For a terrestrial observer, the new threshold corresponds
   to a distance of about 5 arcminutes (formerly 9 arcseconds) from
   the center of the disk.

3. Documentation updates and corrections.

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FORTRAN Routines
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iau_DAT        a leap second is now required in UTC for 2016 December 31.

iau_LDSUN      internal threshold value changed from 1D-9 to DLIM, where
               DLIM = 1D-6 / MAX(EM*EM,1D0) and EM is the dstance in au
               from the Sun to the observer.
```

```
t_sofa_f      this test program has been modified to test the updated
              leap second routine.

Documentation
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sofa_ast_f    Astrometry cookbook has been modified to take account of
              the updated LDSUN routine.

sofa_ts_f     Version number of this cookbook corrected.


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ANSI C:
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iauDat        a leap second is now required in UTC for 2016 December 31.

iauLdsun      internal threshold value changed from 1e-9 to dlim, where
              dlim = 1e-6 / (em*em > 1.0 ? em*em : 1.0) and em is the
              dstance in au from the Sun to the observer.

Cr            In the list of "Returned:" arguments listed in the
              documentation the one argument was listed as "char[]"
              rather than just "c".

t_sofa_c      this test program has been modified to test the updated
              leap second routine.

Documentation
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sofa_ast_c    Astrometry cookbook has been modified to take account of
              the updated Ldsun routine.

sofa_ts_c     Version number of this cookbook corrected.

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End of Updates
2016 July 18
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