

Planetary World Coordinate System in Astro^opy

Chiara Marmo, oudeis.io, Université Paris Saclay - Stéphane Erard, LESIA, Observatoire de Paris



Planets : somewhere between Earth and Sky

Geologists

- Remote Sensing, in situ observations
- Lon/lat angular, linear coordinates
- Open Geospatial Consortium
- Tiff, BigTiff, HDF5, ...
- Proj4, GDAL, geoJSON, rasterio, leaflet, openLayers, ...



Astronomers

- ☆ Telescope, satellite observations
- ☆ Angular sky, topocentric coordinates
- ☆ International Astronomical Union, International Virtual Observatory Alliance
- ☆ FITS, WCS, ...
- ☆ WCSlib, Astropy, WCSTools, Aladin, ...



From deep sky to planets : spheroidal bodies

Spheroidal coordinate representations:

- **BaseGeodeticRepresentation** provided with the equatorial radius and flattening assigned to `_equatorial_radius` and `_flattening` attributes -> NAIF geodetic coordinates
- **BaseBodycentricRepresentation** -> NAIF Planetocentric coordinates

Any custom spheroid can be described in a planetary body-fixed frame.

We have a tool to convert between different standard spheroids.



From deep sky to planets : spheroidal bodies

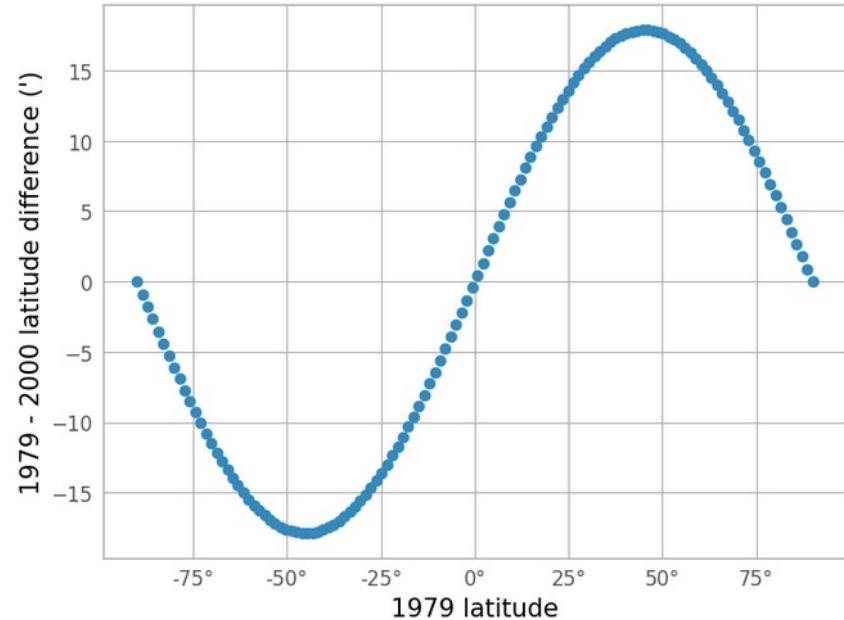
We have a tool to convert between different standard spheroids.

```
class IAUMARS1979GeodeticRepresentation(BaseGeodeticRepresentation):
```

```
    _equatorial_radius = 3393400.0 * u.m  
    _flattening = 0.518650 * u.percent
```

```
class IAUMARS2000BodycentricRepresentation(BaseBodycentricRepresentation):
```

```
    _equatorial_radius = 3396190.0 * u.m  
    _flattening = 0.5886008 * u.percent
```



Vespa tutorial [surfaces astropy-planetary-coordinate-frames/bodyfixed-frame-conversions.ipynb](https://surfaces.astropy.org/planetary-coordinate-frames/bodyfixed-frame-conversions.ipynb)

From deep sky to planets : WCS body-fixed frame

Astropy 6.0 ships WCSlib > 8.0:
extends the auxiliary WCS structure
to new planetary keywords.

- Similar to SunPy approach
- *Marmo et al. (2018)*,
[10.1029/2018EA000388](https://arxiv.org/abs/10.1029/2018EA000388)

WCS to/from body-fixed planetary
reference frame conversion.

We have a tool for image cut-outs or
feature selections by coordinates.

A_RADIUS	Semimajor axis of the ellipsoid.
B_RADIUS	Intermediate axis of the ellipsoid.
C_RADIUS	Semiminor axis of the ellipsoid.
BLON_OBS	Bodycentric longitude of the observer in the body-fixed reference frame of the target body.
BLAT_OBS	Bodycentric latitude of the observer in the body-fixed reference frame of the target body.
BDIS_OBS	Distance between the centre of the celestial body and the observer in meters.

Vespa tutorial surfaces [astropy-planetary-coordinate-frames/planetary-images-wcs.ipynb](https://github.com/astropy/planetary-coordinate-frames/blob/master/planetary-images-wcs.ipynb)



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Thank You for your attention!

