EPSC Abstracts
Vol. 11, EPSC2017-324-1, 2017
European Planetary Science Congress 2017
© Author(s) 2017

DynAstVO: a Europlanet database of NEA orbits

J. Desmars (1), W. Thuillot (1), D. Hestroffer (1), P. David (1) and P. Le Sidaner (2)
(1) IMCCE, Observatoire de Paris, PSL Research University, UMR8028 CNRS, UPMC, Université Lille1, France
(2) DIO-PADC, Observatoire de Paris, PSL Research University, UMS2201 CNRS, France

Abstract

DynAstVO is a new orbital database developed within the Europlanet 2020 RI and the Virtual European Solar and Planetary Access (VESPA) frameworks. The database is dedicated to Near-Earth asteroids and provide parameters related to orbits: osculating elements, observational information, ephemeris through SPICE kernel, and in particular, orbit uncertainty and associated covariance matrix. DynAstVO is daily updated on a automatic process of orbit determination on the basis of the Minor Planet Electronic Circulars that reports new observations or the discover of a new asteroid. This database conforms to EPN-TAP environment [3] and is accessible through VO protocols and on the VESPA portal web access (`http://vespa.obspm.fr/`). A comparison with other classical databases such as Astorb, MPCORB, NEODyS and JPL is also presented.

1. Parameters of DynAstVO

For each NEA in the database, DynAstVO provides:

- name, number and designations;
- orbital elements and the state vector at the epoch corresponding approximatively to the middle of the observational period;
- number of observations and radar measurements, dates of first and last observations used for the orbit determination;
- magnitude parameters (H and G slope);
- covariance matrix and Sky-Plane uncertainty (uncertainty in the position at epoch);
- Earth-MOID (minimum orbital intersection distance);
- ephemeris in Spice Kernel format (bsp file) for the 1980-2030 period.

An additional table also provides the orbital elements and the state vector at a current epoch, identical for all asteroids. Dates, minimum distances (and their uncertainties) of close approaches with Mercury, Venus, Earth, Moon and Mars are presented.

2. Processing of DynAstVO

The database is daily updated on the basis of electronic circulars (MPECs) of the Minor Planet Center. The MPECs provide new discovered asteroids and new observations. Orbit determination is proceeded for NEAs in the MPECs according to the following functional scheme:

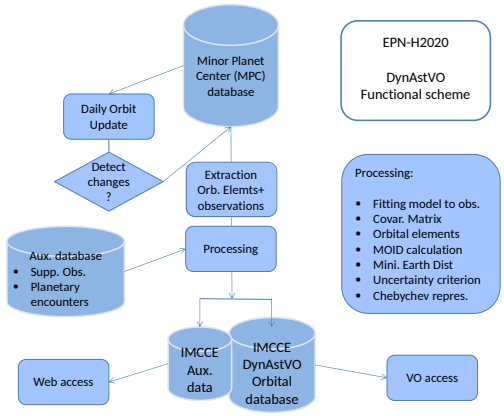

Figure 1: Functional scheme of the processing of DynAstVO.

DynAstVO is built into the EPN-TAP environment [3] and accessible through VO protocols and a web access (`http://vespa.obspm.fr/`).

3. Dynamical model and observations

The orbit determination process comes from [1] and consists in an integration of equations of motion and variational equations. Orbital elements are determined by a Levenberg- Marquadt algorithm. The dynamical model takes into account the gravitational perturbations of the Sun, the eight planets, the Moon and Pluto (positions are from INPOP13c [5], the gravitational perturbations of the four main asteroids (Ceres, Pallas, Vesta and Hygiea), the corrections of relativistic

effects of the Sun, the flatness of Sun $J_{2\odot}$ and the flatness of the Earth $J_{2\oplus}$. Corrections from bias in stellar catalogues are applied and the weighting scheme presented in [4] is used. Observations and radar measurements come from the Minor Planet Center database.

4. Comparison with other databases

We compare DynAstVO with MPCORB, ASTORB, and NEODyS by computing the apparent position from geocentre at reference epoch. Figures 2 show the difference in position for 2238 numbered NEAs in right ascension and declination.

The orbital elements from DynAstVO are in a good agreement with those in ASTORB and MPCORB (about 0.1 arcsec of difference in right ascension and declination). Compared to NEODyS, the differences are even smaller.

Small differences can be explained by different processes of propagation (as epoch is 2016.11.08 for ASTORB and 2016.07.31 for MPCORB and NEODyS).

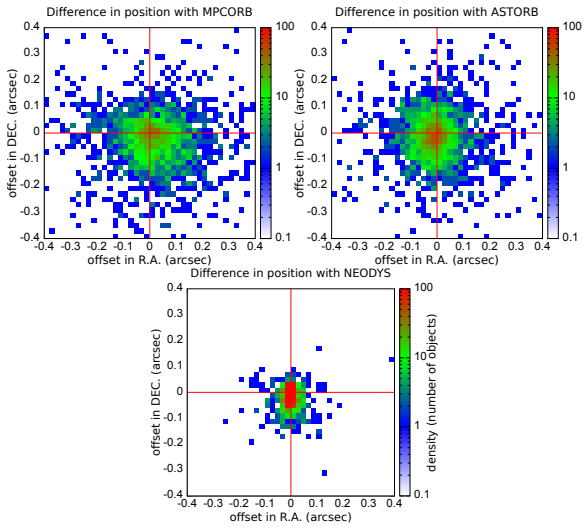

Figure 2: Difference in apparent position for 2238 numbered NEAs in right ascension and declination between Astorb, MPCORB, NEODyS compared to DynAstVO.

5. Conclusion and prospectives

DynAstVO provides the orbits, ephemerides, close approaches of NEAs (15 848 objects on 7 April 2017). In the future, we plan to develop the database by including MOID data, impact probabilities, and post-mitigation tools [2] and to extend the database to all minor planets. Data from Gaia as well as data from NAROO project [6] will be used for the database.

Acknowledgements

This work is done in the framework of Europlanet 2020 RI which has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 654208.

References

[1] Desmars, J. 2015, A&A, 575, A53

[2] Eggl, S., Hestroffer, D., Thuillot, W., et al. 2015, Advances in Space Research, 56, 528

[3] Erard, S., Cecconi, B., Le Sidaner, P., et al. 2014, Astronomy and Computing, 7, 71.

[4] Farnocchia, D., Chesley, S. R., Chamberlin, A. B., & Tholen, D. J. 2015, Icarus, 245, 94

[5] Fienga, A., Manche, H., Laskar, J., Gastineau, M., & Verma, A. 2014, arXiv:1405.0484

[6] Thouvenin, N., Arlot, J.-E., Lainey, V., & Robert, V. 2014, Astroplate 2014, 36