THE NEO SYSTEM OF THE ESA SPACE SITUATIONAL AWARENESS PROGRAMME

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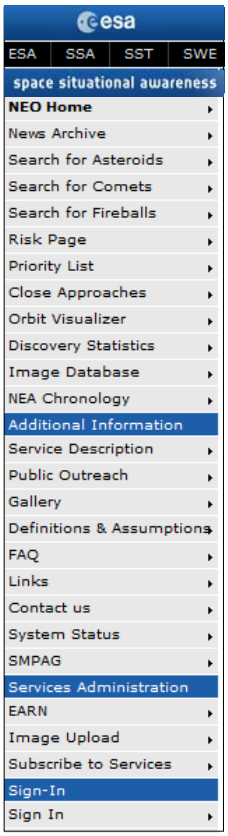
INTRODUCTION

The NEO System, running at the ESA NEO Coordination Centre (ESRIN, Frascati, Italy), collects information on NEOs and other celestial bodies and makes them available to a variety of users, with a particular focus on objects with possible collision solutions with the Earth. It is organized as a dynamic three-layer structure, a database, the related services and an interface (Web Portal) allowing enquiries to the database and acting as a placeholder for additional services. The NEO System is an evolving environment: precursor services have been started in 2012 as part of the deployment of the NEO Segment of the ESA Space Situational Awareness Programme and are continuously improved in order to support at best the observation of risky objects and to evaluate the associated hazards. The services and functions provided are designed to ensure complementarity with respect to other NEO systems (e.g. Minor Planet Centre, NASA Near-Earth Object Program) while keeping a high degree of completeness.

THE WEB PORTAL

The SSA-NEO Web Portal is publicly available at http://neo.ssa.esa.int/ . It provides the user community with a user friendly interface to access the system services, including dynamic tables and the graphical visualization of NEO orbits. A regular maintenance/update activity is performed in order to guarantee the quality of the data displayed.

The web portal has been designed to be ready to further expand both the functionalities and the services. The selection menu of the forthcoming new release, which is described in the following sections, is shown on the right.



IMPACT MONITORING

NEODyS (newton.dm.unipi.it/neodys/) is the fundamental service which provides updated orbital information about NEOs and the associated hazard. NEO catalogue, orbit determination, differential correction, orbit and covariance propagation, observables prediction and risk assessment are computed and provided on-the-fly to the NEO System. The migration of all NEODyS functions inside the NEO System is envisaged in the near future.

The most important outputs on display are are the Risk Page (a table of all known NEOs with impact solutions), a summary of recent and upcoming close approaches, a database of physical properties of NEOs and the so-called Priority List, which allows observers to identify NEOs in most urgent need of observations, and prioritize their observational activities accordingly.

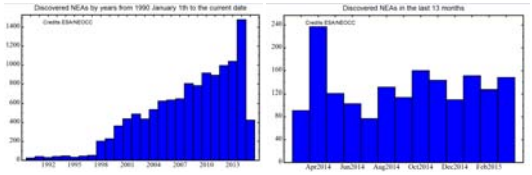
Note that the close approaches page has been improved by evaluating for each object also the "maximum brightness", i.e. the visibility in a best-case encounter geometry.

DATABASES AND CATALOGUES

The NEO System is designed to host a large collection of Small Bodies data. The orbital elements of all asteroids (NEOs, Main Belt, TNOs etc) for which good quality observations are available are regularly provided by NEODyS and ASTDYS (hamilton.dm.unipi.it/astdys/) and stored in the NEO system. As far as NEO physical properties are concerned, EARN data (earn.dlr.de/nea/) have been integrated as a fully searchable database. Thus a single query interface allows to display both the dynamical and the physical properties of any given asteroid or to search for objects within certain parameters range for further investigation.

In order to extend the NEO Segment services, the availability of other solar system objects relevant to NEO hazard is being implemented. Due to the low collision risk, no impact monitoring is foreseen for comets but an updated catalogue (as provided by JPL: ssd.jpl.nasa.gov/dat/ELEMENTS.COMET) is made available.

ESA has also developed an independent Fireball Information System ready for integration into the NEO System .



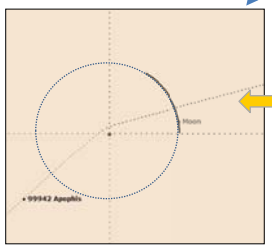
VISUALIZATION TOOLS

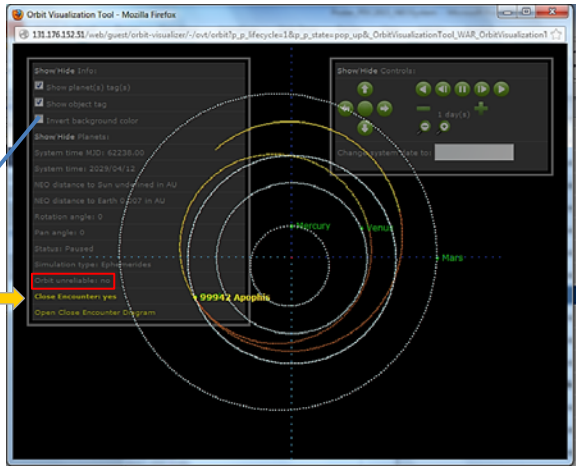
Providing clear and informative material is a key issue in properly disseminating information on the asteroid hazard in order to avoid potentially dangerous misinterpretations of scientifically correct facts and figures. Therefore the NEO system is equipped with several visualization tools and graphical aids in order to ease the comprehension of the NEO risk problem to the wide variety of users the ESA SSA Programme is addressed to.

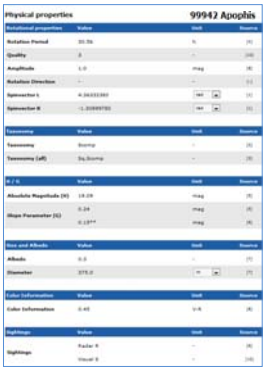
Asteroidal orbits are drawn as a first approximation using the Keplerian elements and the position along the orbit of any given object is computed at regular time intervals. A three-dimensional animated plot of the asteroid trajectory in space is therefore obtained, including the possibility of changing in real-time the viewpoint, the zoom factor, the timescale and the direction of motion. In order to provide orbital plots more closely reflecting the actual dynamical evolution of a NEO, a refined modelling of the trajectory which includes planetary perturbations has been developed. The enhanced functionalities make use of high accuracy ephemeris which allow to correctly display the orbital changes due to Earth close encounters . Switching to a geocentric reference frame where the orbit of the Moon is displayed, is also foreseen in order to better appreciate the geometry of an encounter and the underlying dynamics (see figures below).

Moreover when the orbital evolution becomes unreliable due to error propagation, a red flag appears warning not to use the trajectory displayed for accurate predictions.

Following the advances of our knowledge on the NEO population is also well suited to graphical display: by using simple statistical representations it is possible to monitor NEO discoveries on a daily basis.







OTHER SERVICES

The NEO System is ready to receive data from collaborating observatories, to archive them and to provide users with the necessary tools to retrieve them for dedicated processing (e.g. data reduction, search for precoveries, etc.) .

A NEA chronology page listing significant past and forthcoming events - previously hosted by the International Astronomical Union - has been migrated into the NEO System and regularly updated.

News are published on the NEO web portal when appropriate; public outreach material is also provided as collection of images, diagrams and articles.

ACKNOWLEDGMENTS

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