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- Planetary Defense – Recent Progress & Plans**
- NEO Discovery**
- NEO Characterization**
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- Impact Effects that Inform Warning, Mitigation & Costs**
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# THE NEO PRECURSOR SERVICES OF ESA'S SPACE SITUATIONAL AWARENESS PROGRAMME

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## INTRODUCTION

Since January 2008 to December 2012, the European Space Agency has run a Preparatory Phase for a so-called near-Earth object segment within its Space Situational Awareness programme, henceforth called SSA-NEO. The NEO segment is one out of three segments which are being built up in parallel, the other two being a Survey and Tracking segment (focussing on man-made objects in space) and a Space Weather segment.

The phase was operated in two parallel paths - one 'top - down' approach to develop customer requirements, system requirements, and an architectural design for a full-fledged European SSA-NEO system. The second path was 'bottom - up' and resulted in the installation of so-called 'precursor services'. These precursor services have federated European assets like the impact warning system NEODyS of the University of Pisa, the physical properties database of the European Asteroid Research Node (EARN) of DLR Berlin, and the Spaceguard Central Node's priority list of INAF/Rome. We here focus on the capabilities of these precursor services.

## PRECURSOR SERVICES

ESA's NEO precursor services can be accessed via the web address <http://neo.ssa.esa.int>. This web page is the first step to achieving the long-term goal of providing one single access to the main European planetary defense assets. The currently active key pages are:

- Risk page: This takes information from the NEODyS system and provides it in a slightly different way compared to the original pages. In addition to the scientific user they are aimed at the public and at decision makers. E.g. they provides not only Torino scale and Palermo scale values for a possible impact, but also directly the impact probability.
- A functionality to search for NEOs and their physical properties is provided. In the 'advanced search' tab, it is possible to enter different criteria for the search, not only for object types but also for physical properties and ranges thereof. The information from the EARN database has been ingested into an SQL database for this functionality.
- The 'priority list' menu links to a copy of INAF/Rome's Spaceguard Central Nodes priority list (<http://itanet3.iasf-roma.inaf.it/SSystem/NEOCS/NEOCSMain.html>). It provides a list of objects which are in need of observations to better secure their orbit.
- A 'close approaches' page lists all upcoming close approaches up to one year into the future. Information about close approaches are distributed close to the approach date via Twitter and other social media. This page gives a table with information like the date of the approach, the minimum distance, diameter, and flyby velocity.

- A newly developed 'orbit visualizer' allows the 3-D visualisation of the orbit of objects. Currently it is only using a simple orbit propagator; an update to a better orbit propagator allowing precise long-term visualisation of orbits is already scheduled.

Other menu items are available to add functionality to the pages as the programme continues. The work is supported via contracts with the main data providers.

As part of the precursor services ESA has also built up expertise in NEO observations. Using its 1-m telescope on Tenerife, the Optical Ground Station, the NEO team has contributed to the follow-up and discovery of NEOs. In about 250 hours of survey test runs, two NEOs have been discovered in addition to numerous main belt objects. In dedicated search campaigns, three 'lost' NEOs have been recovered. About 1000 astrometric measurements of NEO positions have been provided to the Minor Planet Center during 2010 - 2012. This experience will be incorporated into building up observational capabilities - telescopes, scheduling software, and data processing software.

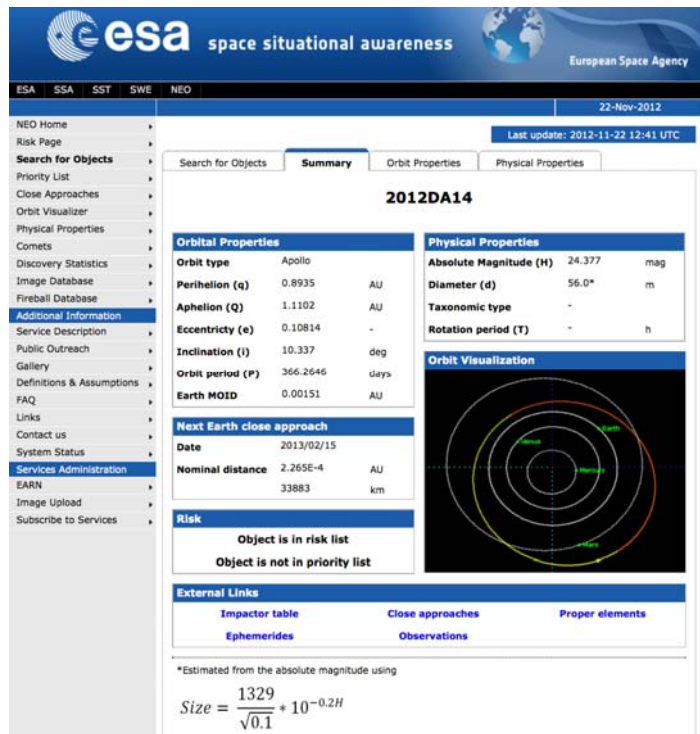


Figure 1: Screenshot of one of the pages of the existing SSA-NEO precursor services.

## PROGRAMME PHASE 2

During the council meeting on ministerial level in Nov 2012, ESA was tasked to continue the SSA programme into a so-called phase 2. With about the same level of funding, all three segments will continue. In the NEO segment, the precursor services will be continued and expanded, e.g. by incorporating a fireball database or further integration of the federated services. Observations will continue and it is foreseen to build up dedicated observational capabilities. Further work will be done on setting up a proper decision strategy on possible mitigation actions in case of an imminent impact. This work will be done in close cooperation with international partners and the United Nations.



Figure 2: An assumed near-Earth asteroid which turned out to be a comet now called C/2012 T5.

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