SSA–NEO Segment

Overview and approach for Phase 2

Detlef Koschny, Gerhard Drolshagen
Detlef.Koschny@esa.int

SSA-NEO-ESA-HO-0140/1.0, Industry Day ESOC

Image credit: ESA

ESA Unclassified – Releasable to the Public
Tasks of the NEO segment

- NEO = near-Earth object = asteroid or comet which comes closer than 0.3 Astronomical Units to our planet
- Be aware of positions of NEOs in space, in particular those which may threaten our assets
- Produce warnings in case of a close approach of an NEO
- Make databases related to NEOs available
- Understand the effects of an impact
- Prepare possible mitigation strategies

System overview

NEOs
- National Cooperating telescopes
- SSA sensors
- Space missions

Minor Planet Center (US)

SSA tasking centre
- Databases
- Risk assessment
- Phys. Properties
- Light curves
- Shape models

SSA-NEO Coordination Centre

Political entities

General users

National research expertise

Space mission studies

NEO image credit: JAXA
Achievements in precursor phase – where do we stand now?
SSA-NEO achievements during the Preparatory Phase

- NEO precursor system has been developed, based on existing assets
  - NEODyS (Univ. Pisa, SpaceDyS) – computation and prediction of NEO orbits
  - EARN (DLR) – database with physical properties of NEOs
  - Priority List (INAF) – list with objects in need of follow-up observations

- An SSA-NEO web portal was developed

- A NEO Coordination Centre was established at ESRIN
  - Inauguration 22 May 2013
NEO Precursor Services Web Portal
http://neo.ssa.esa.int

NEO Coordination Centre

Precursor services

Please note that all SSA-NEO Services are under development

Current number of known NEOs: 9884
Current number of NEOs in risk list: 411

Headline News

WATCHING FOR HAZARDS: ESA OPENS ASTEROID CENTRE

22 May 2013
SSA-NEO achievements during the Preparatory Phase, cont.

■ Top-Down activities:
  • Production of Requirements documents
  • The Architectural Design for a complete SSA-NEO system was started

■ Preparatory activities in the area of NEO impact effects and mitigation (SN-VII)

■ International coordination (Action Team 14 of UN COPUOS)

■ GSTP activities:
  • ‘Test-bed telescope’
  • Orbit propagator
  • NEO model population

■ Observations
  • 5 NEOs were discovered with the OGS telescope

■ Public Relations activities
Approach for Phase 2 – 2013 - 2016
Following the Declaration of the SSA Programme for Period 2 the NEO activities will focus on 3 main areas:

- NEO Coordination Centre, web portal
- Observations and Telescope Development
- Technology Development and Mitigation
SSA-NEO approach for phase 2
Main points

NEO Coordination Centre and web portal at ESRIN

- **Continue precursor operations**
  - Train new personnel

- **Enhance NEO Coordination Centre**
  - Assure availability
  - New capabilities (storage, search, back-up, foreign data ingestion, fireball database)
  - Establish redundancy

- **Migrate capabilities to SSA-NEO Coordination Centre**
  - Mainly from NEODyS
Observations

- Continue observations with OGS
- Use/test automatic robotic telescope from GSTP contract ‘Test Bed Telescope’
- Establish automatic tasking function
- Establish automatic image processing and data handling
- Develop new 1-m fly-eye NEO survey telescope
- Deploy, test and operate NEO survey telescope
- Establish agreements with cooperating telescopes and make use of them
Technology, mitigation

**Technology**
- Develop missing technologies
  - Impact effect tools
  - Improved orbit propagator
  - Ground corridor of impact locations
  - Space-based IR camera for fireball observation

**Mitigation strategies, mission design**
- Workshop on impact effects and mitigation on 7/8 May 2013 (development of roadmap)

**Use of space mission data (Gaia, star trackers, and more)**

**International coordination of mitigation issues**
- Participate in work of Action Team 14 of UN-COPUOS
Planned procurements in detail as structured in Work Plan
SSA-NEO approach for phase 2
Planned procurements to start 2013

<table>
<thead>
<tr>
<th>Procurement ID</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>P2-NEO-I</td>
<td>NEO Precursor Services Operation, Maintenance and Enhancement (500 kEuro)</td>
</tr>
<tr>
<td>P2-NEO-II</td>
<td>Improved Data Processing Capabilities (250 kEuro)</td>
</tr>
<tr>
<td>P2-NEO-III</td>
<td>NEO Service Level Agreements (200 kEuro)</td>
</tr>
<tr>
<td>P2-NEO-IV</td>
<td>NEO Observations with Cooperating Sensors (100 kEuro)</td>
</tr>
<tr>
<td>P2-NEO-V</td>
<td>NEO Survey Telescope detailed design (800 kEuro)</td>
</tr>
</tbody>
</table>

Additional common activities: ICT and Technical Support, architecture consolidation

(‘grey’ means: covered elsewhere in today’s presentations)
P2-NEO-I – Precursor services operation, maintenance, and enhancement

- **P2-NEO-101 – Precursor services operations and maintenance (350 kEuro)**
  - Continued operations of precursor services at NEO Coordination Centre – two people
  - Creation of priority list
  - Maintenance of web portal, news releases, help functions

- **P2-NEO-201 – Precursor services enhancements (150 kEuro)**
  - Enhancement of web portal
  - Enhancement of search capabilities
  - Add functionality to issue news releases and warnings to registered users
  - Educational tools
**P2-NEO-II – Improved data processing capabilities**

- **P2-NEO-401 (250 kEuro)**
  
  Initial developments in the data processing chain, as a minimum:
  - Inclusion of non-gravitational perturbing forces for orbital evolution
  - Determination of impact corridor on ground
P2-NEO-III – Service-Level Agreements

- **P2-NEO-501 (25 kEuro)**
  - Provision of data from the physical properties database (EARN = European Asteroid Research Node)

- **P2-NEO-502 (125 kEuro)**
  - Provision of data from NEODyS2

- **P2-NEO-503 (50 kEuro)**
  - Continuation of observations with the Optical Ground Station on Tenerife
P2-NEO-IV – Observations w/ cooperating sensors

- **P2-NEO-504 (100 kEuro)**
  - NEO observations with external sensors
  - Test the use of large telescopes for follow-up observations and physical characterisation
  - Support the demonstration of NEO observation capabilities of new participating member states
See presentation of Ground Segment Manager
Part of common procurements

- **P2-NEO-102 – ICT support**
  - Procure the necessary support to administration and operations of ICT infrastructure at the NEO Coordination Centre

- **P2-NEO-601 – Technical support**
  - Technical support to prepare and monitor the NEO segment industrial activities
SSA-NEO will focus in Phase 2 on the operations and enhancement of the precursor services; support observational activities; and start the development of a new ‘fly-eye’ telescope.
<table>
<thead>
<tr>
<th>Procurement ID</th>
<th>Title Included Activities</th>
<th>Budget (K€)</th>
<th>ITT issue date/Duration (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P2-NEO-I</td>
<td>SSA NEO Precursor Services Operation, Maintenance and Enhancement P2-NEO-101, P2-NEO-201</td>
<td>500</td>
<td>Q4/15</td>
</tr>
<tr>
<td>P2-NEO-II</td>
<td>Improved Data Processing Capabilities P2-NEO-401</td>
<td>250</td>
<td>Q3/18</td>
</tr>
<tr>
<td>P2-NEO-III</td>
<td>NEO Service Level Agreements P2-NEO-501, P2-NEO-502, P2-NEO-503</td>
<td>200</td>
<td>Q2/12</td>
</tr>
<tr>
<td>P2-NEO-IV</td>
<td>NEO Observations with Cooperating Sensors</td>
<td>100</td>
<td>Q4/18</td>
</tr>
</tbody>
</table>
Estimated Number of Asteroids and NEOs
(Data from NEODyS or JPL NEO site, March 2013)

- > 600,000 known Asteroids
- Almost 10000 known NEOs
- > 400 NEOs in risk list (NEOs with small but non-zero impact probability within next 100 years)

Estimated number of known NEOs:
- 90 % of NEOs with diameter larger than 1 km (861 NEAs + 93 near-Earth comets of a total of ≈ 1050)
- 15-25 % of NEOs larger than 140 m (total ≈ 20000 - 30000)
- < 2.0 % of NEOs larger than 30 m (total ≈ 500000 - 1000000)

Most NEOs are still unknown!