The Precursor Services of ESA's Space Situational Awareness NEO programme (SSA-NEO)

Overview

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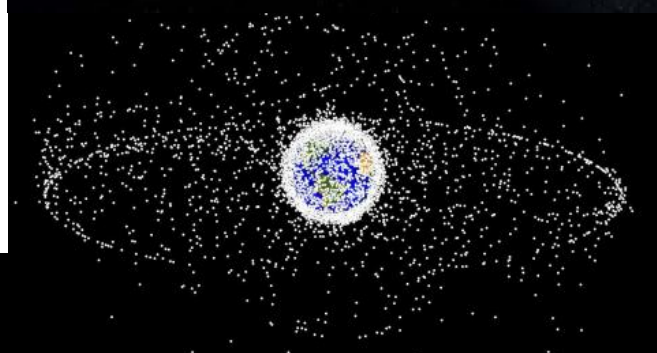
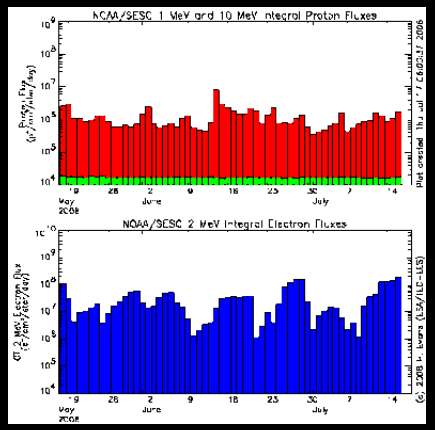
And >80 % of the European asteroid community

The SSA-NEO segment shall provide information about the impact threat of near-Earth objects (NEOs). To be able to do this, it shall be aware of the positions and physical properties of NEOs. It shall assess their impact probabilities, effects, and possible mitigation activities.

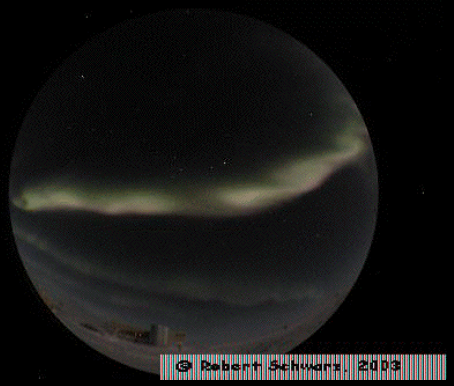
Presented 15 Apr 2013 at the PDC 2013

- **Three ‘segments’:**
  - Space Weather
  - Near-Earth Objects
    = “SSA-NEO”
  - Space Surveillance and Tracking
    (of satellites and space debris)
- **2009 – 2012: Preparatory phase; now in ‘Phase2’, 2013 – 16, a bit under 50 Mio Euro (for all three segments)**





<- Proton and electron fluxes (NOAA)



SS Station from 400 km,
/SW Munich, 80 cm aperture

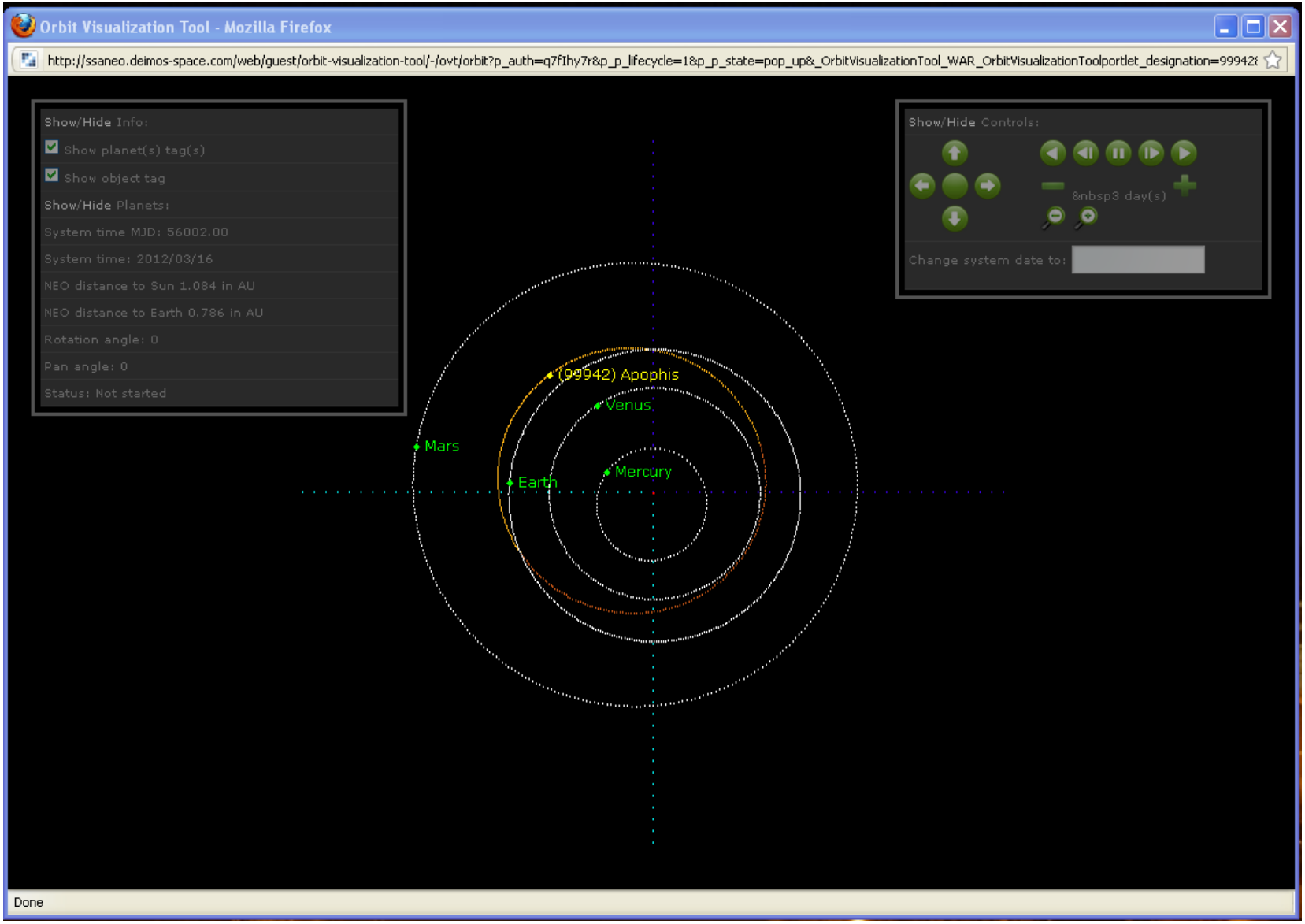
- **Issue NEO impact warnings and information on close approaches and provide news releases**
- **Make information on NEOs available via a searchable database with web access**
- **Perform observations – set up a ‘wide survey’ to detect all objects visible in the night sky down to 40 m (‘Tunguska-sized’) in time to give about three weeks of warning (find ‘threatening objects’)**
- **Education, outreach**
- **Develop relevant tools and make them available**

http://neo.ssa.esa.int

- **Built up by an industrial consortium in Europe**
- **With involvement of**
  - Univ. Pisa + SpaceDys (I)
  - INAF Rome (I)
  - DLR Berlin (D)

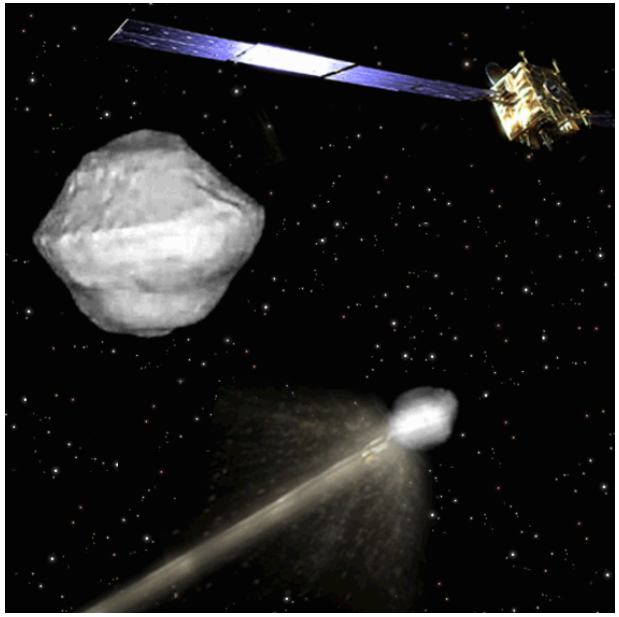
- **Single entry point to key European NEO services**
- **Federating NEODyS(1), EARN (2), SCN(3) priority list**
- **Risk list**
- **Close approaches list**
- **Search capability for physical properties of asteroids**
- **Orbit visualization tool**

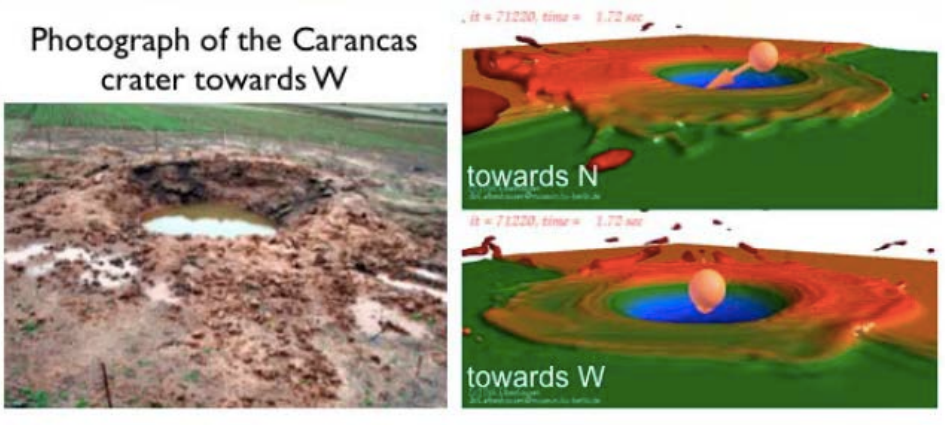
(1) for orbit computation in collaboration with JPL
(2) NEO database of the European Asteroid Research Node at DLR Berlin (D)
(3) Spaceguard Central Node (INAF, I) – providing information on which NEOs are in need of observation


Orbit Visualization Tool - Mozilla Firefox
http://ssaneo.deimos-space.com/web/guest/orbit-visualization-tool/-/ovt/orbit?p_auth=q7fIhy7r&p_p_lifecycle=1&p_p_state=pop_up&_OrbitVisualizationTool_WAR_OrbitVisualizationToolportlet_designation=99942
Show/Hide Info:
Show planet(s) tag(s)
Show object tag
Show/Hide Planets:
System time MJD: 56002.00
System time: 2012/03/16
NEO distance to Sun 1.084 in AU
NEO distance to Earth 0.786 in AU
Rotation angle: 0
Pan angle: 0
Status: Not started
Show/Hide Controls:
 3 day(s)
Change system date to:
(99942) Apophis
Venus
Mars
Earth
Mercury
Done

- **Support to existing observatories, e.g. the La Sagra Sky Survey**
- **Use of ESA's 1-m telescope on Tenerife (Optical Ground Station = OGS)**
  - **Used for testing observational strategies**
  - **Provides high-accuracy astrometry of asteroids to Minor Planet Center**
  - **During surveys (ca. 300 hours): more than 1000 asteroids with new designation, 5 new NEOs**
  - **1318 position measurements of ca. 400 NEOs**
  - **In 2012: 36643 measurements of 9008 asteroids**
- **Amateurs are a key asset**

- Close interaction with ESA's General Studies Programme (e.g. the US-European Asteroid Impact and Deflection mission (AIDA) study)
- Close interaction with science programme which studies MarcoPolo-R, an asteroid sample return mission for its Cosmic Vision programme
- Coordination with EU-funded NEOShield project
- Workshop in May 2013 to develop roadmap for work on both impact mitigation and effects

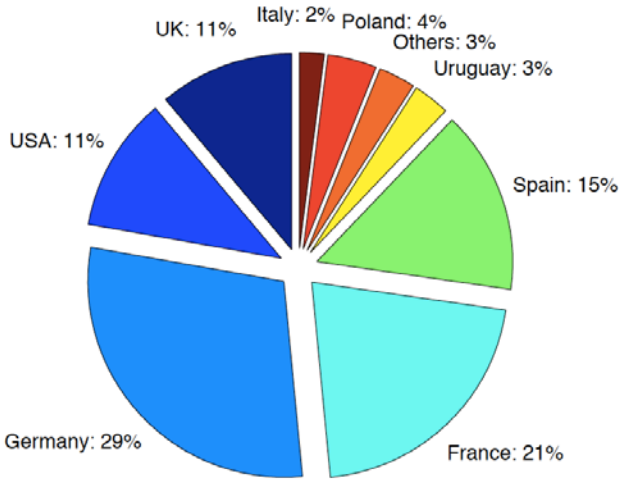


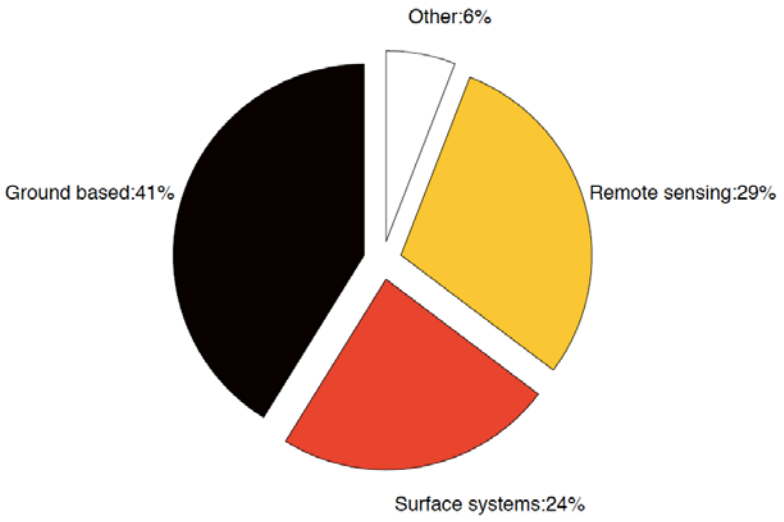


Upper right: Artist impression of the AIDA mission (ESA)

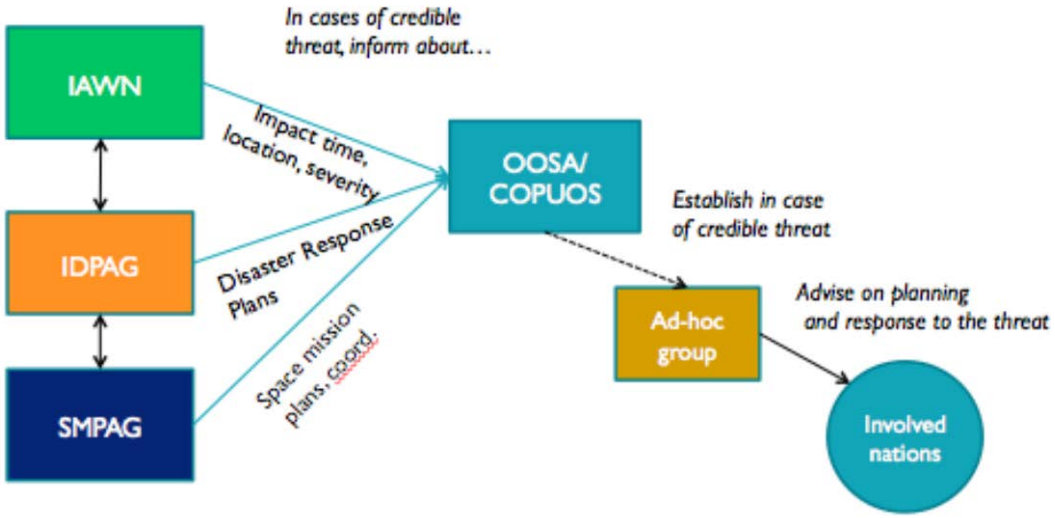
Lower right: iSale model of the Carancas crater, Peru 2007 (Museum fur Naturkunde, Berlin)

- **We have had a ‘call for ideas’ for work to be done related to AIDA**
- **Proposals came in for observations, instrumentation, experimental work**
  - Impact, cratering and seismology-related experiments,
  - related ground testing and numerical simulation,
  - Spacecraft instruments (TIR camera, LIDAR, surface elements) that could contribute to analysing the impact dynamics
- **AIDA would hence be a true impact assessment mission**
- **We need to find a compromise for the system complexity and mass to remain low.**

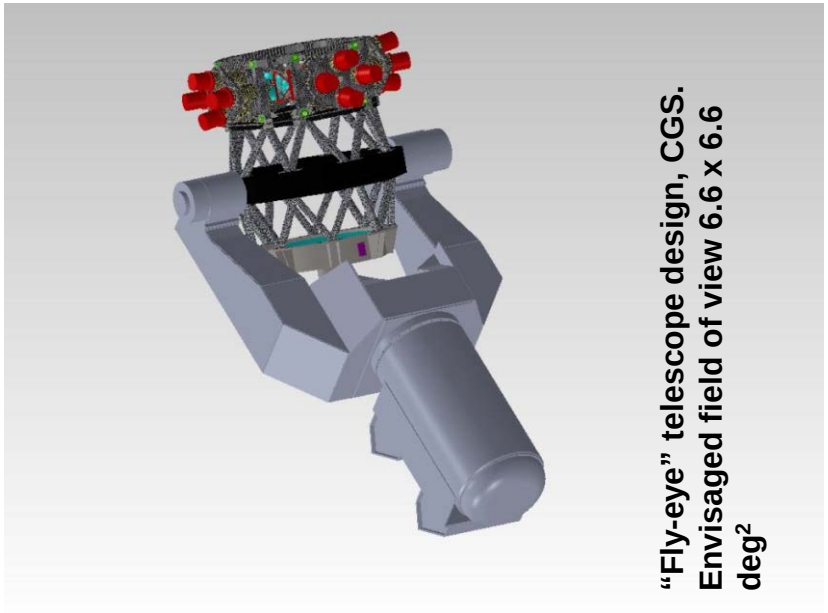




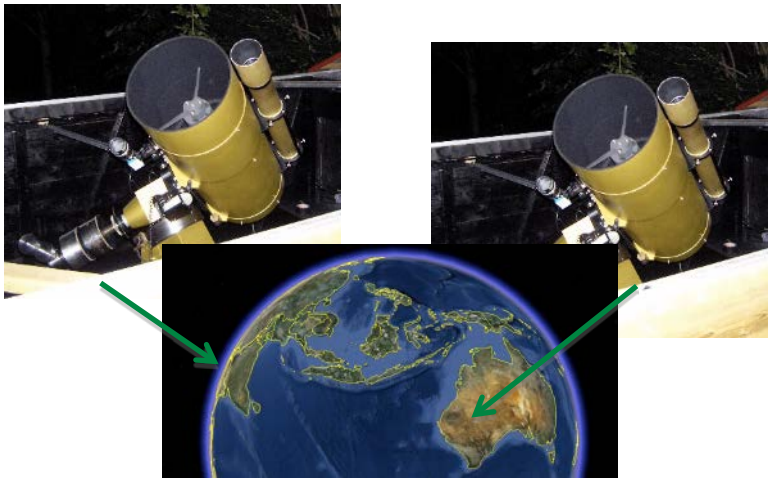
- ESA funds an update of the NEO population model (Bottke, Morbidelli, et al., 2000, 2002) – ongoing, close collaboration with US
- Development of a flexible orbit propagator tool finished
- System engineering studies on future system ongoing
- Work of Action Team 14 is supported, focus on Space Missions Planning and Advisory Group

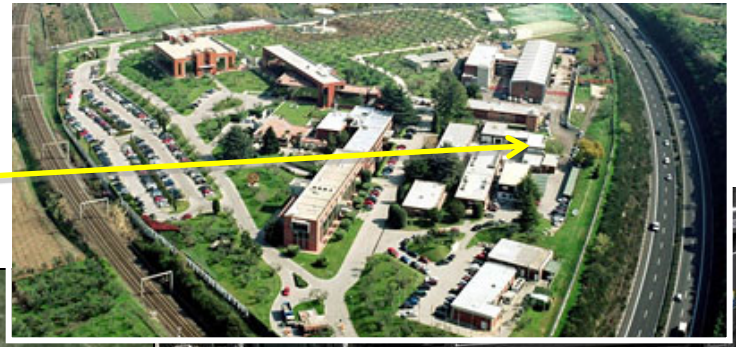


- **NEO Survey Telescope**
  - Fly-eye telescope concept
  - Funding for prototype telescope is available
  - For the ‘wide survey’, 4-6 such telescopes are needed
- **‘Robotic telescope demonstrator’ development ongoing**
  - Focus on software development (schedule and control of multiple telescopes; use for NEOs and Space Debris)
  - Part of baseline: Deploy two ≈16” telescopes in New Norcia (Australia) and Cebreros (Spain)



“Fly-eye” telescope design, CGS. Envisaged field of view 6.6 x 6.6 deg^2





SSA-NEO data centre – inauguration 22 May 2013

- **ESA is successfully contributing to the global effort of coping with the NEO impact threat**
- **Federation of existing assets in precursor system**
  - NEODyS (orbit computation, working in close collaboration with JPL)
  - EARN (database for physical properties)
  - SCN priority list (list of NEOs in need of obervations)
  - See http://neo.ssa.esa.int
- **NEO coordination centre at ESRIN, Italy, hosts the precursor system**
- **Funding available for further expanding the system**
- **Observations will continue - Development of a 1-m effective aperture NEO Survey Telescope has started; funding for prototype is available (see poster by Drolshagen et. al 'Optimizing a wide survey for NEOs')**