The background of the slide is a deep space scene. On the left, a large, detailed image of Earth is shown, displaying the continents of Africa and Europe. To the right and slightly below the Earth, there is a large, dark, irregularly shaped asteroid with a cratered surface. Further to the right, a smaller, more spherical asteroid is visible. The background is filled with numerous small, distant stars.

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

## Overview

Detlef Koschny, Gerhard Drolshagen  
And >80 % of the European asteroid community

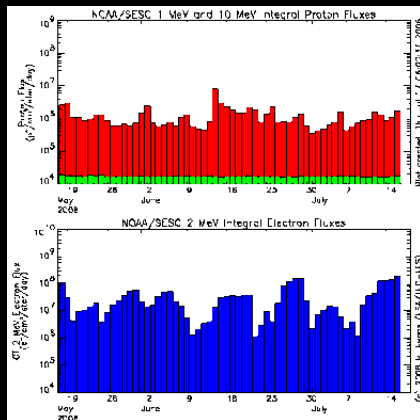
**The SSA-NEO segment shall provide information about the impact threat of near-Earth objects (NEOs). To be able to do this, it shall be aware of the positions and physical properties of NEOs. It shall assess their impact probabilities, effects, and possible mitigation activities.**

*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)

The screenshot shows the NEO Data Centre website. At the top, there is a blue header with the ESA logo and the text "space situational awareness" and "European Space Agency". Below the header, there is a navigation bar with tabs for ESA, SSA, SST, SWE, and NEO. The main content area is titled "NEO Data Centre" and "Precursor services". It displays two statistics: "Current number of known NEOs: 9618" and "Current number of NEOs in risk list: 361". Below these, there is a "Headline News" section with the title "STRANGER IN THE NIGHT: SPACE ROCK TO MAKE CLOSE EARTH FLYBY" and a date "7 February 2013". An image of an asteroid passing Earth is shown, with the caption "Artist's impression of asteroids passing Earth". On the right side, there is a "Sign In" section with fields for "Screen Name" (admin) and "Password" (masked with dots), and a "Sign In" button. Below the sign-in fields, there are links for "Create Account" and "Forgot Password".

ESA SSA SST SWE NEO

17-Feb-2013

**NEO Data Centre**  
Precursor services

Last update: -

Current number of known NEOs: **9618**

Current number of NEOs in risk list: **361**

**Headline News**

**STRANGER IN THE NIGHT: SPACE ROCK TO MAKE CLOSE EARTH FLYBY**

7 February 2013

Artist's impression of asteroids passing Earth

Sign In

Screen Name  
admin

Password  
\*\*\*\*\*

Sign In

Create Account  
Forgot Password

NEO Home

Risk Page

Search for Objects

Priority List

Close Approaches

Orbit Visualizer

Physical Properties

Comets

Discovery Statistics

Image Database

Fireball Database

Additional Information

Service Description

Public Outreach

Gallery

Definitions & Assumptions

FAQ

Links

Contact us

System Status

Services Administration

EARN

Image Upload

Subscribe to Services

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

ESA SSA SST SWE NEO 17-Feb-2013

NEO Home  
**Risk Page**  
 Search for Objects  
 Priority List  
 Close Approaches  
 Orbit Visualizer  
 Physical Properties  
 Comets  
 Discovery Statistics  
 Image Database  
 Fireball Database  
**Additional Information**  
 Service Description  
 Public Outreach  
 Gallery  
 Definitions & Assumptions  
 FAQ  
 Links  
 Contact us  
 System Status  
**Services Administration**  
 EARN  
 Image Upload  
 Subscribe to Services

Last update: 2013-02-17 09:01 UTC

Current number of NEOs in risk list:  
**361**

In the table below for each impact the encounter with the highest impact risk is listed. When better measurements are not available, the size of the objects is estimated from the absolute magnitude. Data are initially sorted by Palermo Scale value but the order can be changed using the table headers.

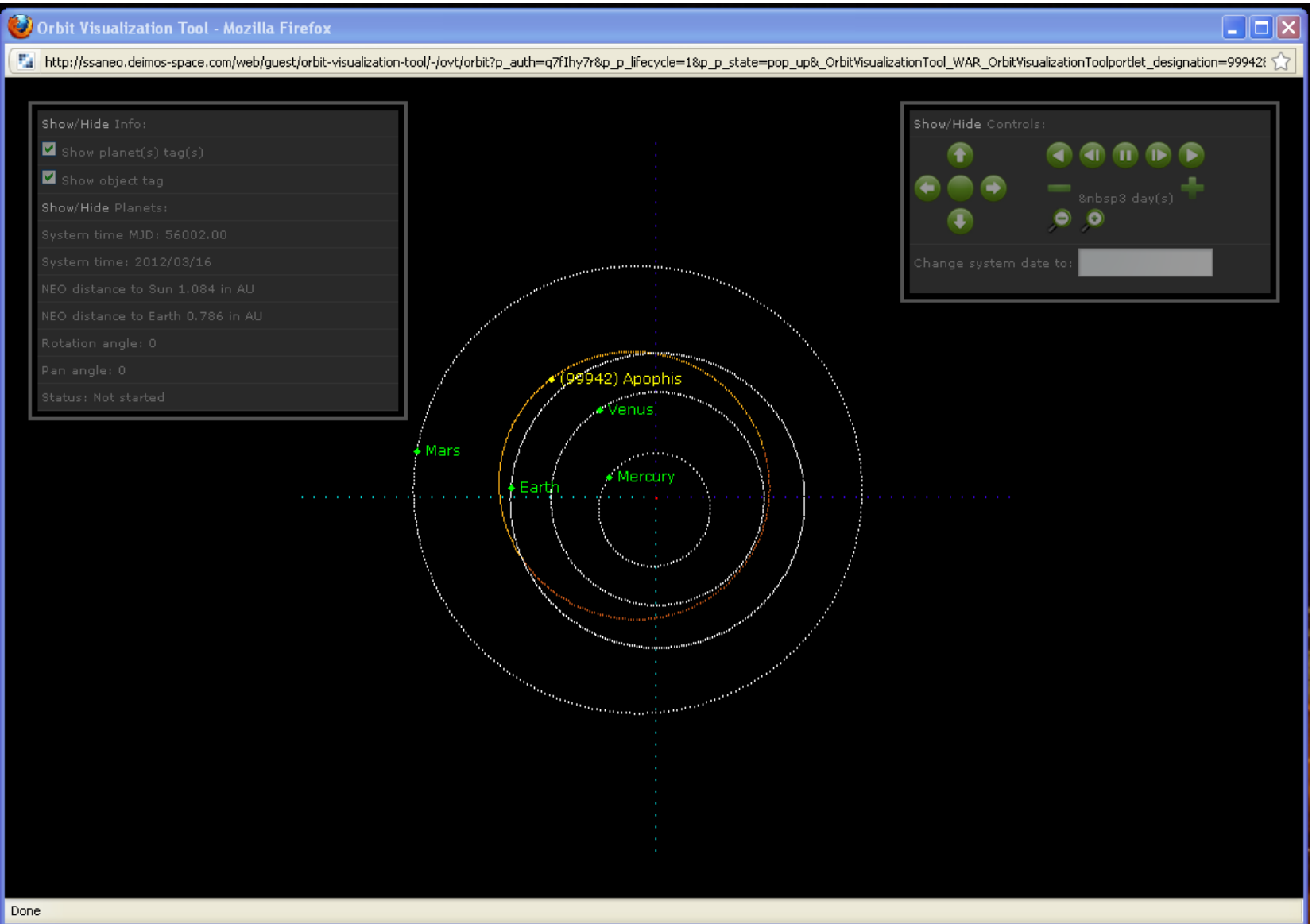
Risk List										
Object Name	Size [m]	Date/Time	IP	PS	TS	Vel. [km/s]	In list since [days]	IT	PP	OV
101955 1999RQ36	200.0	2182-09-24 22:20	1/3623	-1.52	n/a	12.86	1484	→	→	→
2007VK184	170.0*	2048-06-03 02:08	1/1801	-1.61	1	19.21	1919	→	→	→
2009FD	160.0*	2185-03-29 18:06	1/694	-1.9	n/a	19.39	814	→	→	→
2013BP73	390.0*	2093-12-11 13:58	1/104493	-2.65	0	23.51	16	→	→	→
2008CK70	38.0*	2030-02-14 15:56	1/2762	-3.07	0	18.94	1830	→	→	→
2010RF12	9.0*	2095-09-05 23:50	1/11	-3.11	0	12.29	892	→	→	→
1979XB	830.0*	2056-12-12 21:39	1/3.7E6	-3.23	0	27.54	12115	→	→	→
2010MZ112	470.0*	2041-02-17 04:52	1/552486	-3.27	0	11.31	951	→	→	→

(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

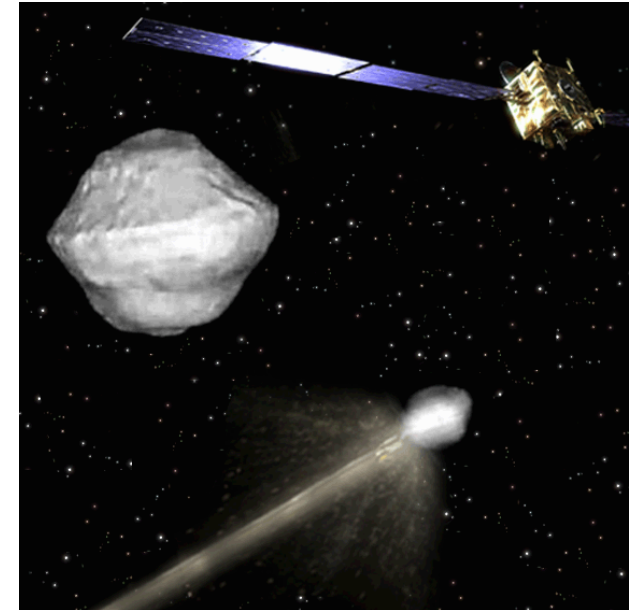




- **Support to existing observatories, e.g. the La Sagra Sky Survey**
- **Use of ESA's 1-m telescope on Tenerife (Optical Ground Station = OGS)**
  - **Used for testing observational strategies**
  - **Provides high-accuracy astrometry of asteroids to Minor Planet Center**
  - **During surveys (ca. 300 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**



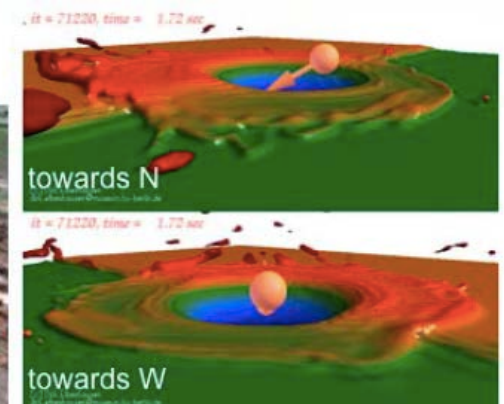
- Close interaction with ESA's General Studies Programme (e.g. the US-European Asteroid Impact and Deflection mission (AIDA) study)
- Close interaction with science programme which studies MarcoPolo-R, an asteroid sample return mission for its Cosmic Vision programme
- Coordination with EU-funded NEOShield 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)

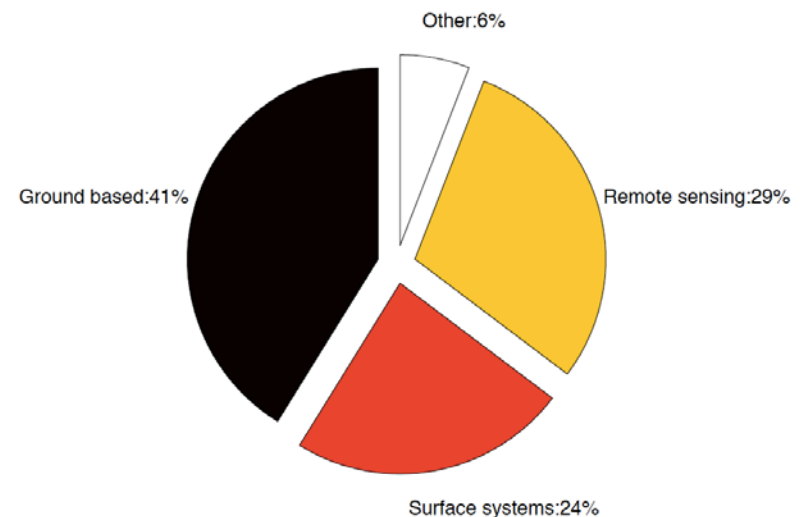
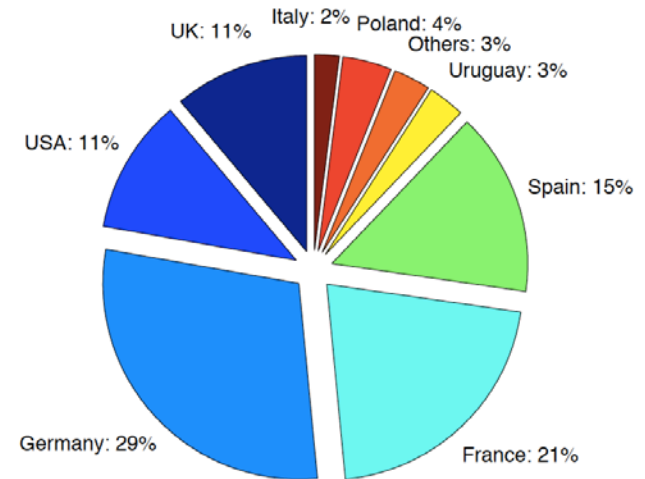
Lower right: iSale model of the Carancas crater, Peru 2007 (Museum fur Naturkunde, Berlin)

Photograph of the Carancas crater towards W

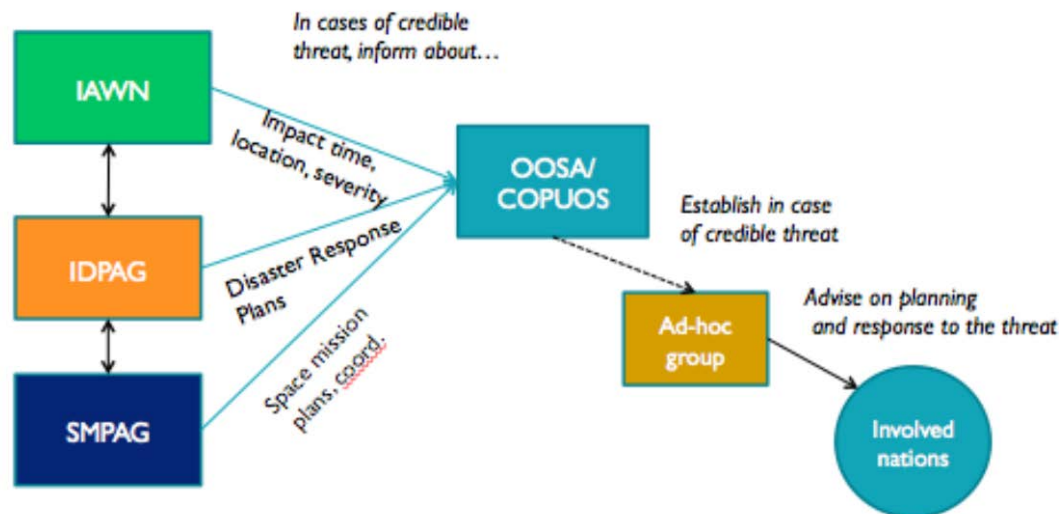




- We have had a 'call for ideas' for work to be done related to AIDA
- Proposals came in for observations, instrumentation, experimental work
  - Impact, cratering and seismology-related experiments,
  - related ground testing and numerical simulation,
  - Spacecraft instruments (TIR camera, LIDAR, surface 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

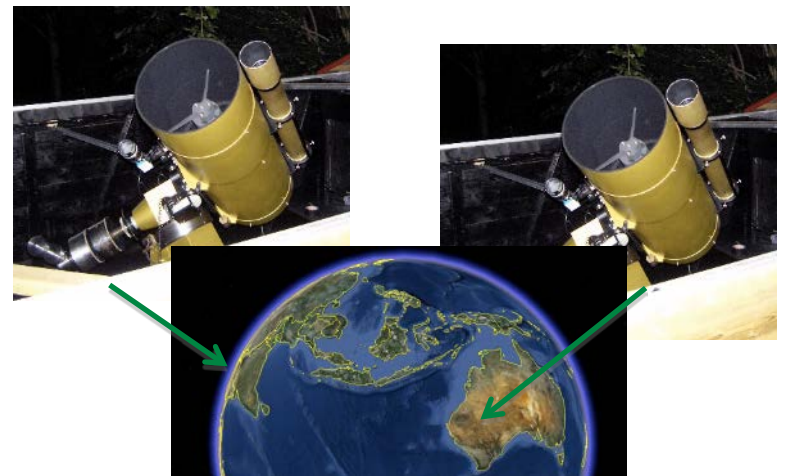
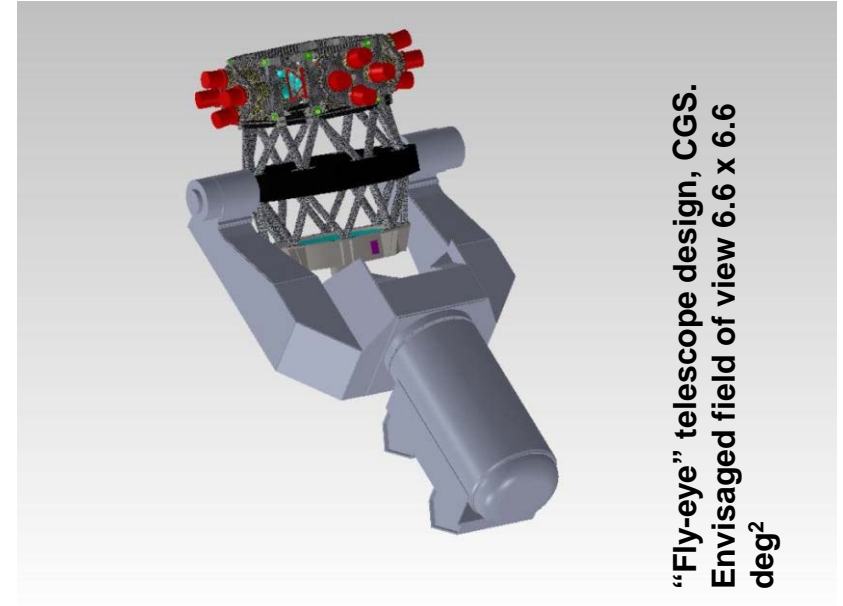


## ■ NEO Survey Telescope

- 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  $\approx 16"$  telescopes in New Norcia (Australia) and Cebreros (Spain)





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 observations)
  - See <http://neo.ssa.esa.int>
- **NEO coordination centre at ESRIIN, 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')**