



# The SSA-NEO programme within ESA and the NEO Coordination Centre

Detlef Koschny,  
Gerhard Drolshagen (ESA)



# How does ESA work?



Advisory  
Structure

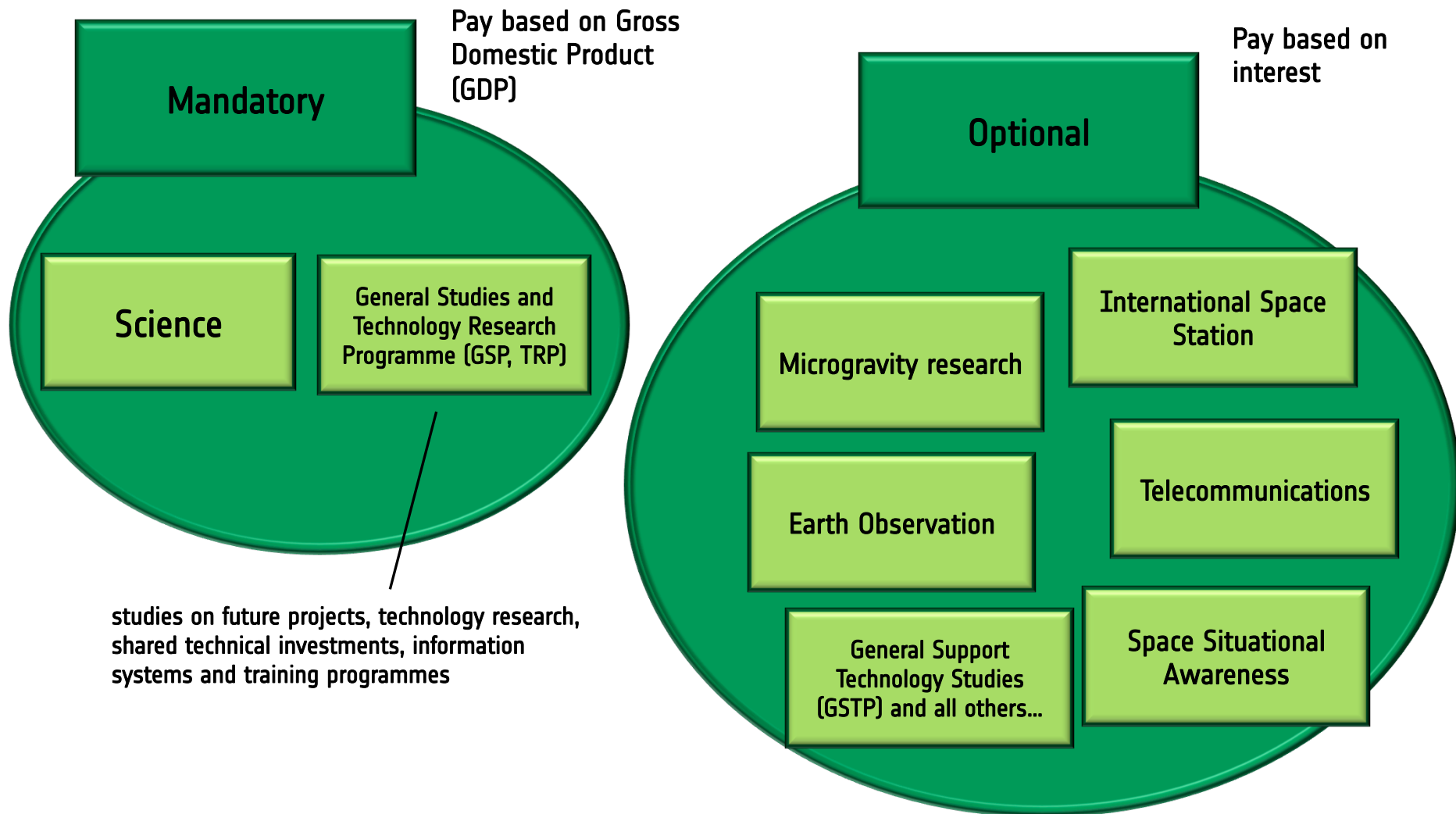


ESA

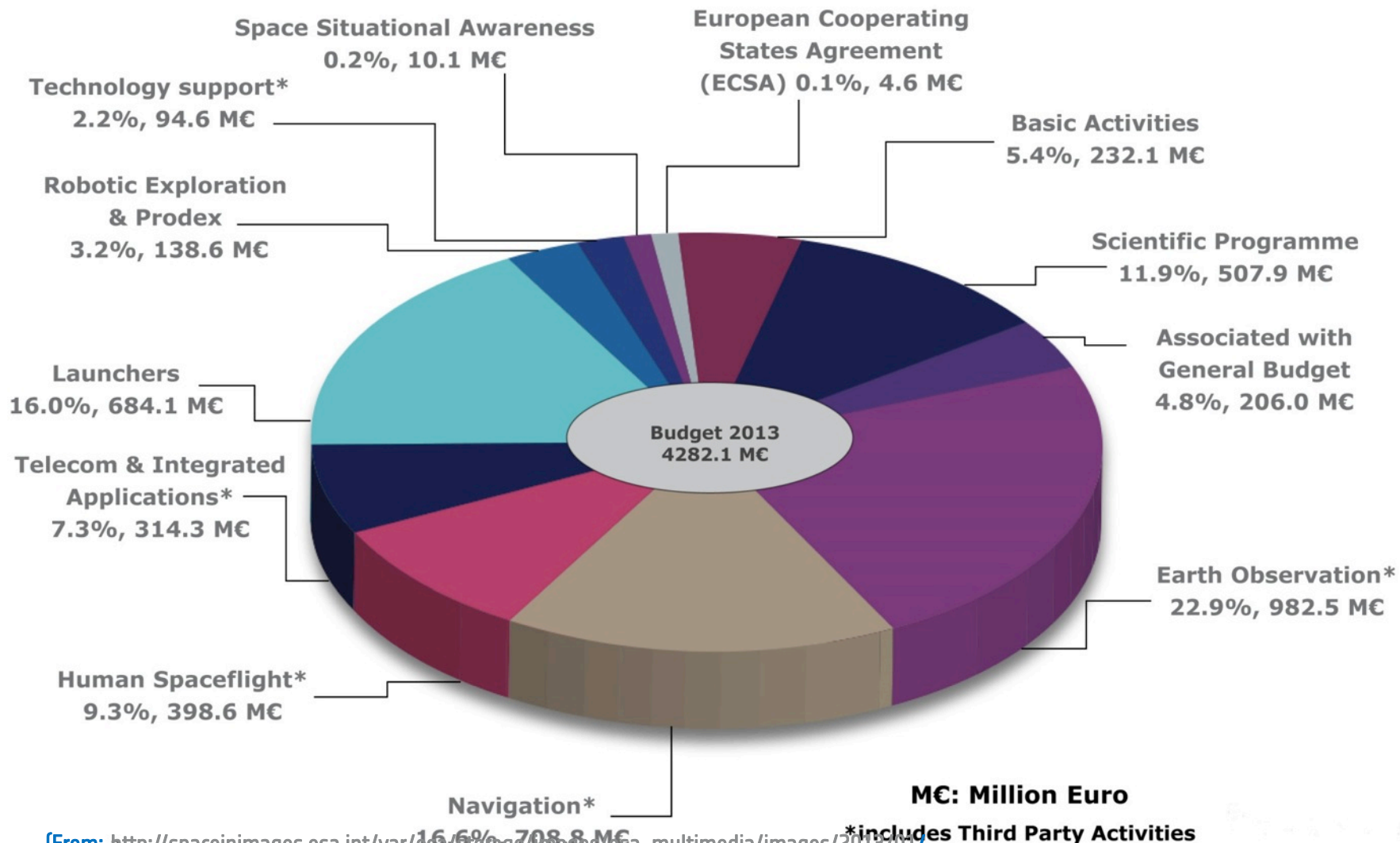
ESA currently has  
20 member states  
+ 1 affiliated member



# ESA programmes can be...



# ESA budget per programme, 2013



[From: [http://spaceimages.esa.int/var/esa/storage/images/esa\\_multimedia/images/2013/01/esa\\_budget\\_by\\_domain\\_for\\_2013\\_m\\_million\\_euro/12496068-1-eng-GB/ESA\\_budget\\_by\\_domain\\_for\\_2013\\_m\\_million\\_euro.jpg](http://spaceimages.esa.int/var/esa/storage/images/esa_multimedia/images/2013/01/esa_budget_by_domain_for_2013_m_million_euro/12496068-1-eng-GB/ESA_budget_by_domain_for_2013_m_million_euro.jpg)]

esa\_budget\_by\_domain\_for\_2013\_m\_million\_euro/12496068-1-eng-GB/ESA\_budget\_by\_domain\_for\_2013\_m\_million\_euro.jpg

# What's happening within SSA?



## space situational awareness



ESA

OPERATIONS

GROUND SYSTEMS ENGINEERING

SPACE DEBRIS

SSA

ESA > Our Activities > Operations > Space Situational Awareness

Search here

### - SSA

- SSA home

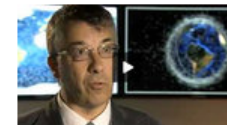
### - SSA Programme

- About SSA
- SSA Programme overview
- SSA team

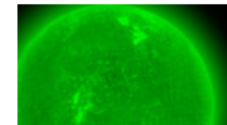
### - SSA activities

- Space Surveillance and Tracking - SST Segment
- Space Weather - SWE Segment
- Near-Earth Objects - NEO Segment

RSS feeds



SSA video report

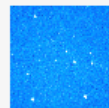


The Sun now

**→ ISON VS THE SUN**  
Watch live updates from the SOHO satellite as comet ISON makes its fiery journey around the Sun

Archive

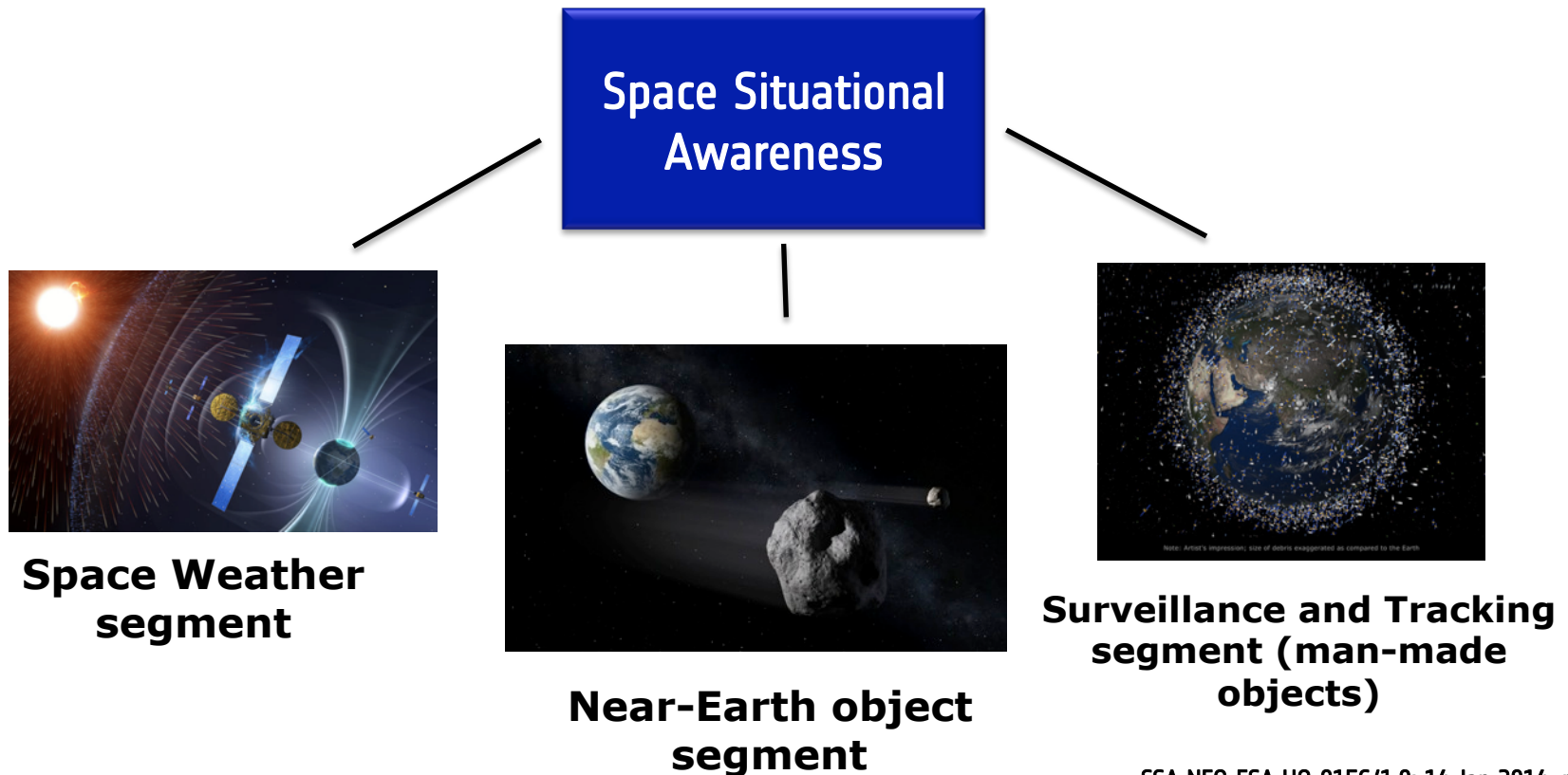
### LATEST NEWS



Space oddity: the mystery of 2013 QW1

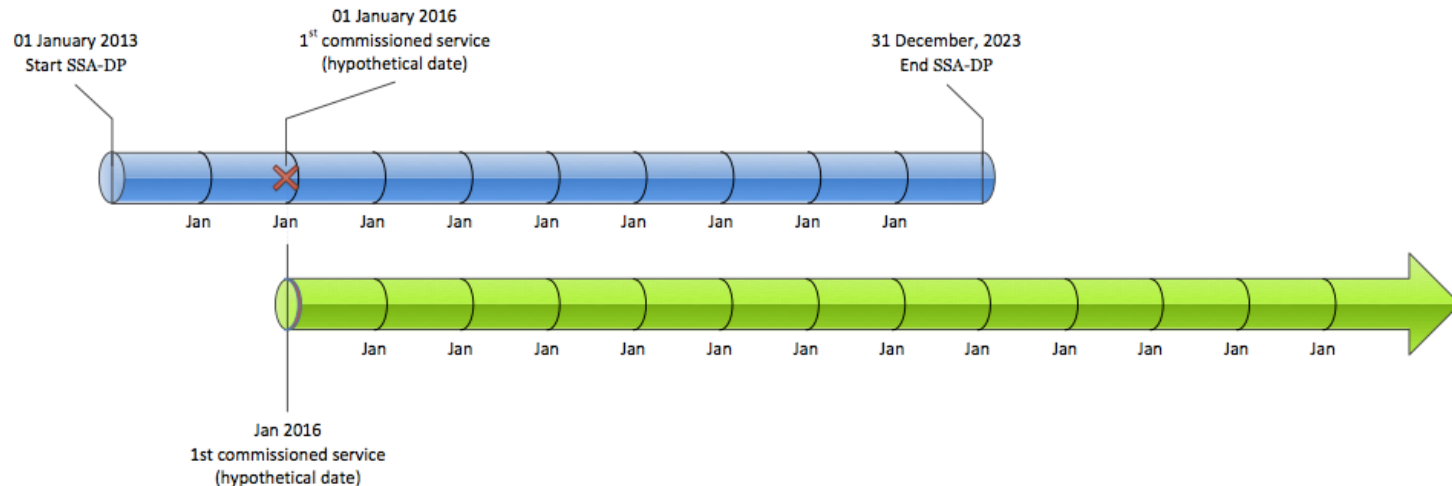
19 September 2013

- Provides a service to customers (governments, disaster management, scientists, the public/press...) about the situation of natural and artificial objects in space. This will allow us to better protect our satellites and our planet.
- Funding 2013-2016: ca. 50 Mio Euro



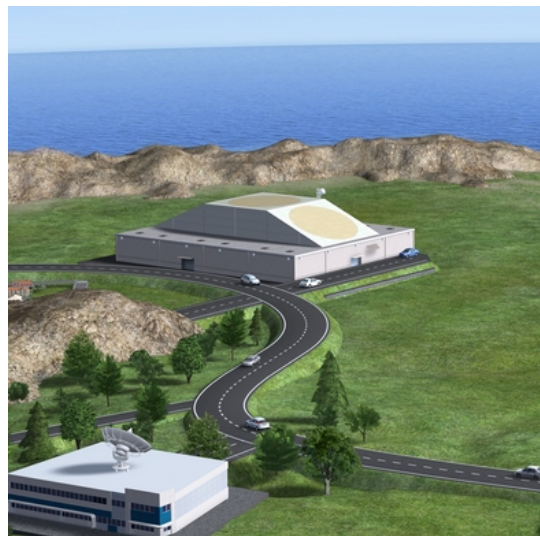
# The European SSA Programme

- Preparatory phase (2009 – 2012) approved at ESA's council meeting on ministerial level in Nov 2008 (50 MEUR) as an optional programme
- After confirmation at ESA's council meeting on ministerial level in Nov 2012: Phase 2 (~48 MEUR)
- Moving over into operations as services are implemented



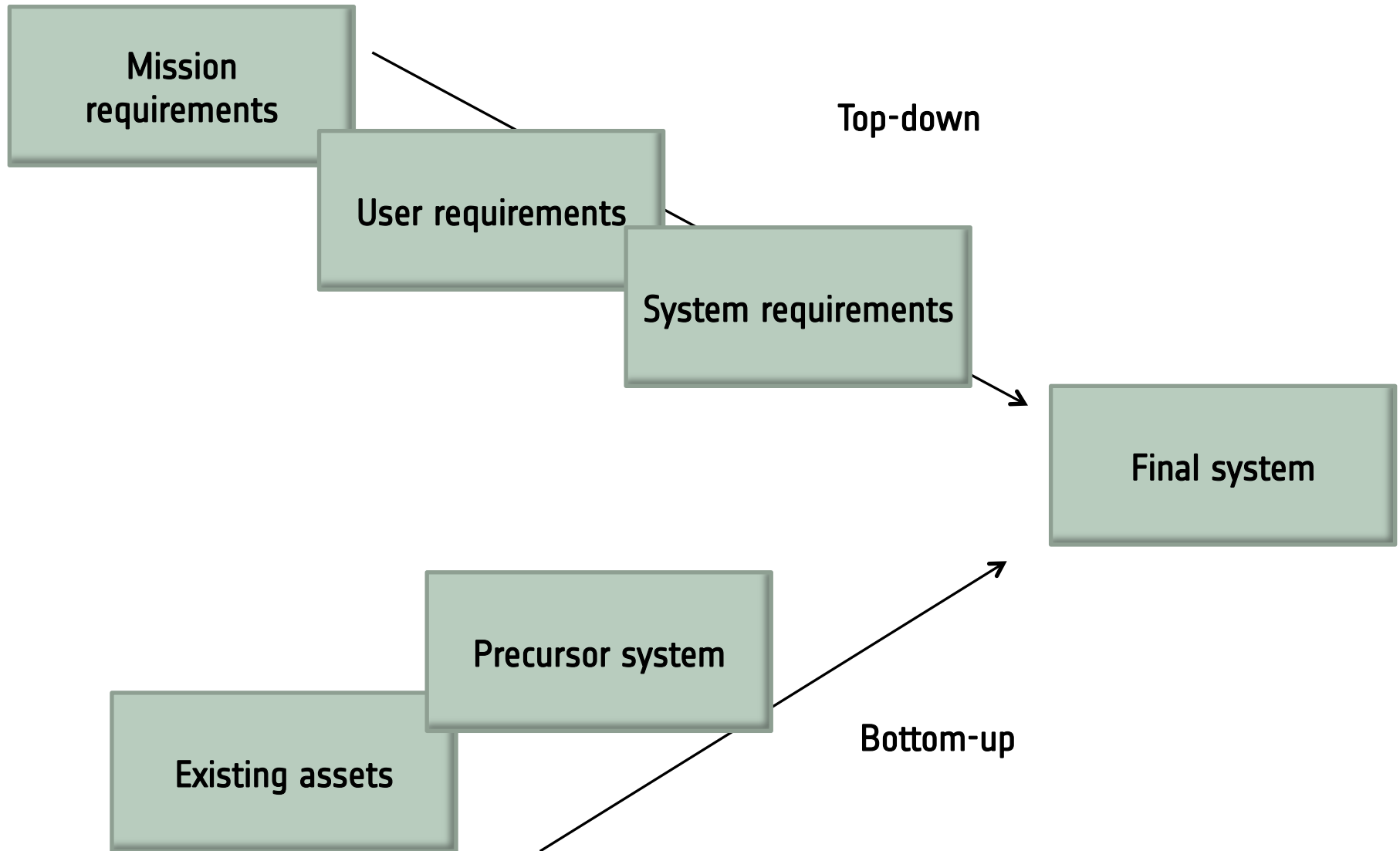
# The European SSA Programme

- Network of sensors (ground- and space-based)
- Data and Coordination centres
- Common data policy and standardization





# A two-tier approach



- **1. Provision of online information on all known NEOs and main belt asteroids, including online search capability**
  - Total numbers of NEOs and objects in risk list
  - Orbital information
  - Impact risk (if applicable)
  - Close approaches (within 0.05 AU to Earth) for the past months and for next 12 months
  - Physical properties (if available)
- **2. Provision of information on other asteroids, including search capability (monthly updates)**
  - total number
  - Orbital information
- **3. Priority list (objects that need follow-up observations)**
  - daily updates
- **4. Observations and special observation campaigns**
  - follow-up observations (4 nights per month with 1-m telescope; support to external observatories)
  - NEO surveys (limited)
  - Coordination of observation campaigns (a few successful tests cases)

## ■ 5. Discovery statistics

- Basic information available right now. Improvements coming soon

## ■ 6. Educational and PR material

- image gallery, basic information
- web stories
- several PR campaigns (Chelyabinsk, NEOCC inauguration)

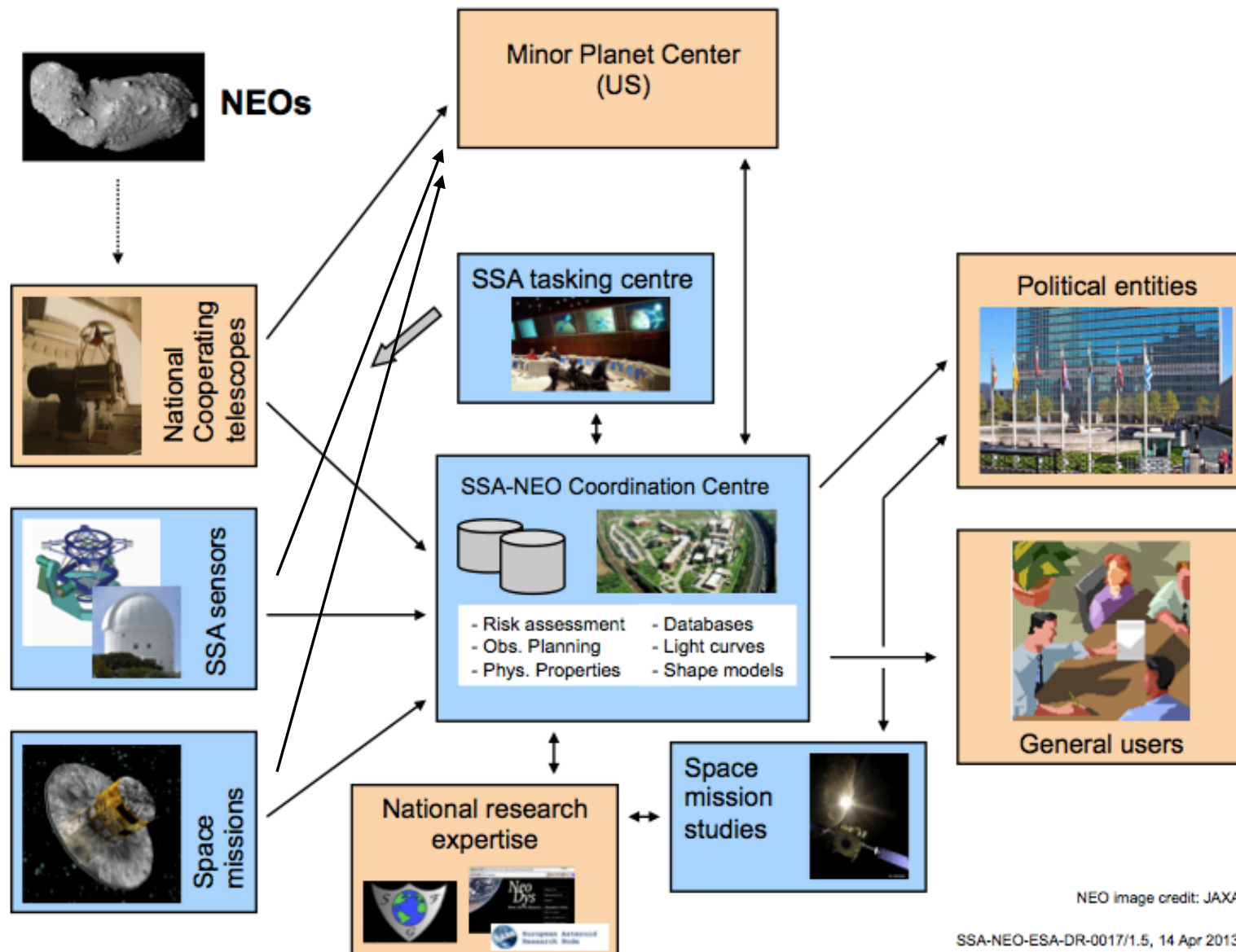
## ■ 7. International coordination and planning

- workshop/roadmaps on NEO impact effects and mitigation measures
- participation in IAWN
- Preparation of SMPAG

## ■ 8. Top-down approach

- Developing a complete system following requirements documentation
- Estimated costs >100 MEUR

# SSA-NEO setup - context



NEO image credit: JAXA

SSA-NEO-ESA-DR-0017/1.5, 14 Apr 2013

# NEO Coordination Centre – ESRIN, Italy



SSA-NEO Coordination  
Centre – Inauguration  
22 May 2013

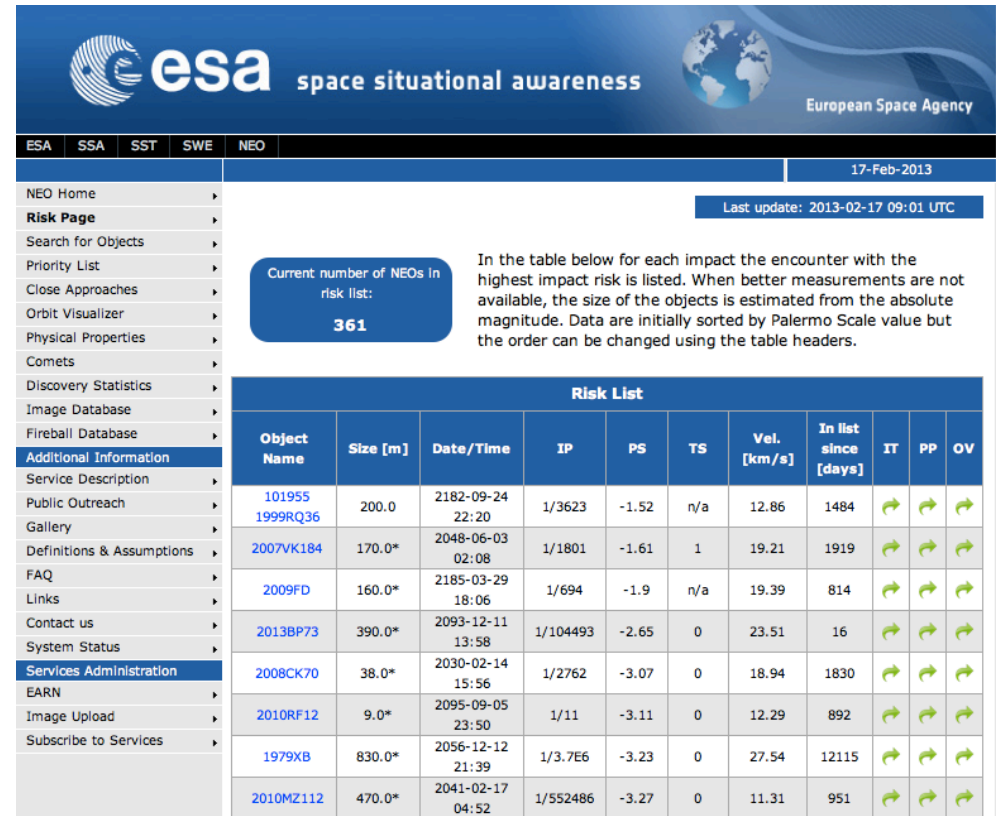
Image © 2011 GeoEye,  
© 2011 Tele Atlas  
Image © 2011 DigitalGlobe  
Data SIO, NOAA, U.S. Navy, NGA, GEBCO  
41°50'27.031"N 12°35'09.14"E elev. 77 m  
Eye alt. 65.98 km

- **Two full-time contractors, IT support, contractor team for s/w**
- **Tasks: Maintain web services; PR; coordination in Europe**



## ■ NEO CC maintains 'risk page'

- NEODyS is one of the 'federated' assets of the NEO CC
- Computes precise orbits including co-variances
- Makes impact prediction
- Details see G. Valsecchi's talk
- Long-term plan: Migrate services to ESRIN, establish with long-term support
- Impact corridor computations will be added



The screenshot shows the ESA Space Situational Awareness (SSA) website's NEO Risk Page. The header includes the ESA logo and the text 'space situational awareness' and 'European Space Agency'. The page is dated 17-Feb-2013 and shows a last update of 2013-02-17 09:01 UTC. A blue box indicates 'Current number of NEOs in risk list: 361'. A table titled 'Risk List' provides details for several NEOs, including their names, sizes, dates, impact probabilities (IP, PS, TS), velocities, and time in the risk list. Each row also includes three green arrows representing IT, PP, and OV risk indicators.

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

- The 'priority list' has been migrated to the NEO CC

| Priority List |                          |            |        |       |        |             |             |                   |
|---------------|--------------------------|------------|--------|-------|--------|-------------|-------------|-------------------|
| Priority      | Object                   | Inserted   | R.A.   | Decl. | Elong. | Magn.       | Sky uncert. | End of Visibility |
| UR            | <a href="#">2013WV45</a> | 2014-01-13 | 13h16m | 49.2  | 110    | <b>21.8</b> | 37          | 2014-01-17        |
| UR            | <a href="#">2013XY9</a>  | 2014-01-13 | 06h11m | 9.3   | 155    | <b>21.9</b> | 3           | 2014-01-20        |
| UR            | <a href="#">2013XV18</a> | 2014-01-13 | 12h50m | 82.6  | 113    | <b>21.8</b> | 35          | 2014-01-16        |
| UR            | <a href="#">2013XA22</a> | 2014-01-13 | 06h29m | 27.7  | 163    | <b>20.8</b> | 7           | 2014-01-31        |
| UR            | <a href="#">2013YB48</a> | 2014-01-13 | 05h24m | 22.7  | 148    | <b>21.5</b> | 12          | 2014-01-28        |
| UR            | <a href="#">2013YD48</a> | 2014-01-13 | 02h36m | -33.1 | 89     | <b>19.3</b> | 0           | 2014-01-17        |
| UR            | <a href="#">2014AB16</a> | 2014-01-13 | 06h53m | 27.3  | 168    | <b>21.7</b> | 7           | 2014-01-17        |
| UR            | <a href="#">2014AB17</a> | 2014-01-13 | 06h33m | -64.1 | 93     | <b>19.3</b> | 4           | 2014-01-17        |
| UR            | <a href="#">2014AM29</a> | 2014-01-13 | 11h56m | -10.1 | 110    | <b>19.7</b> | 1           | 2014-01-17        |
| NE            | <a href="#">2013WB44</a> | 2014-01-13 | 05h54m | 47.0  | 147    | <b>21.7</b> | 6           | 2014-01-23        |
| NE            | <a href="#">2013XG4</a>  | 2014-01-13 | 06h25m | 22.6  | 162    | <b>21.1</b> | 6           | 2014-02-07        |
| NE            | <a href="#">2013XW3</a>  | 2014-01-13 | 05h54m | 29.7  | 154    | <b>21.7</b> | 1           | 2014-01-24        |
| NE            | <a href="#">2013XZ20</a> | 2014-01-13 | 09h47m | 61.6  | 134    | <b>21.8</b> | 1           | 2014-01-14        |
| NE            | <a href="#">2013XE22</a> | 2014-01-13 | 05h44m | 23.6  | 153    | <b>21.9</b> | 1           | 2014-01-23        |
| NE            | <a href="#">2013XG22</a> | 2014-01-13 | 05h21m | 10.3  | 145    | <b>21.1</b> | 2           | 2014-01-26        |



<http://neo.ssa.esa.int/web/guest/image-database>

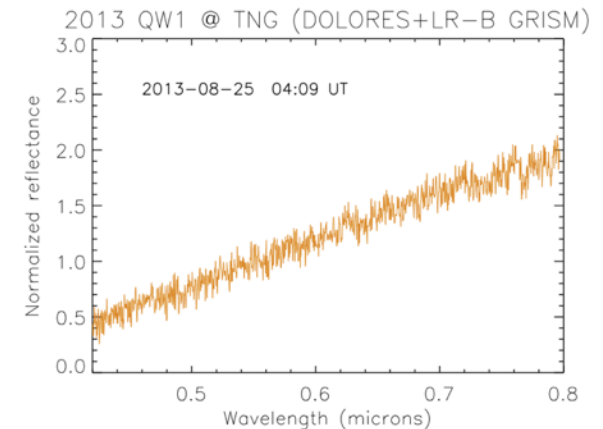
<http://vmo.estec.esa.int/totas/>



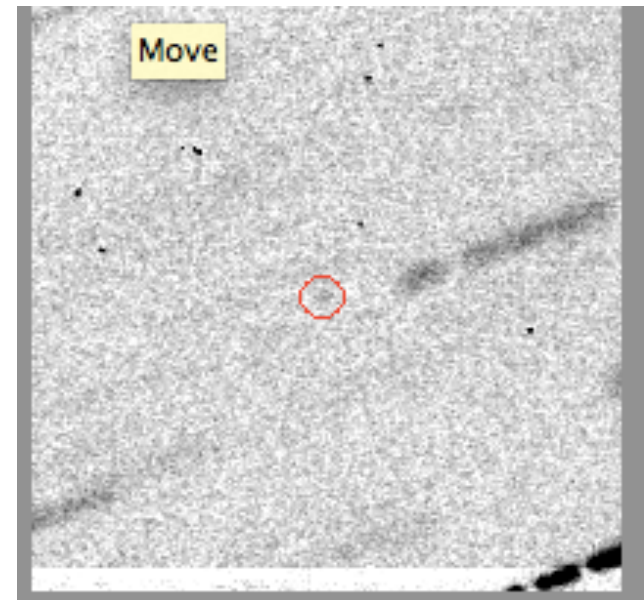
## LA SAGRA SKY SURVEY



<http://www.lasagraskysurvey.es>

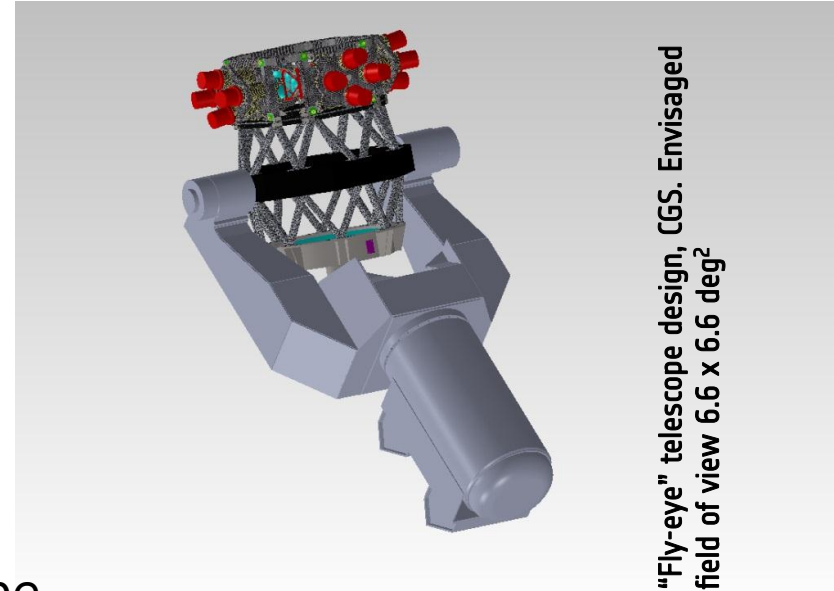


- We have 11 hours per semester on the 8-m VLT
- Short response time being set up
- Observation of 2009 FD at  $\sim 24$  mag – reduced risk by one order of magnitude



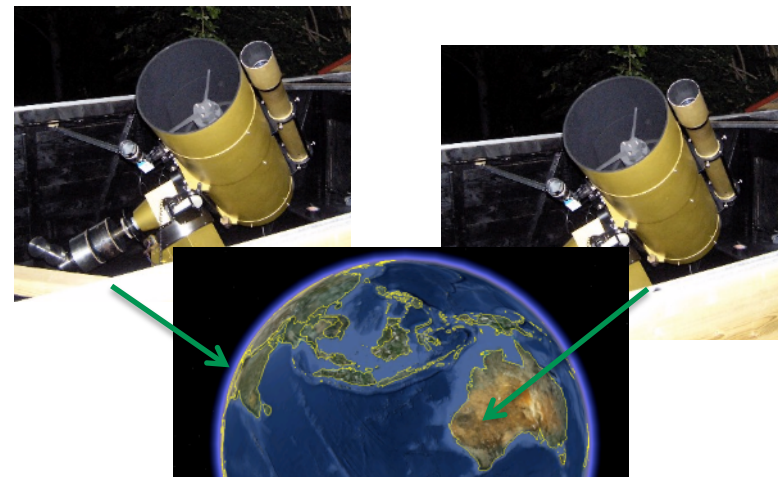
## ■ NEO Survey Telescope

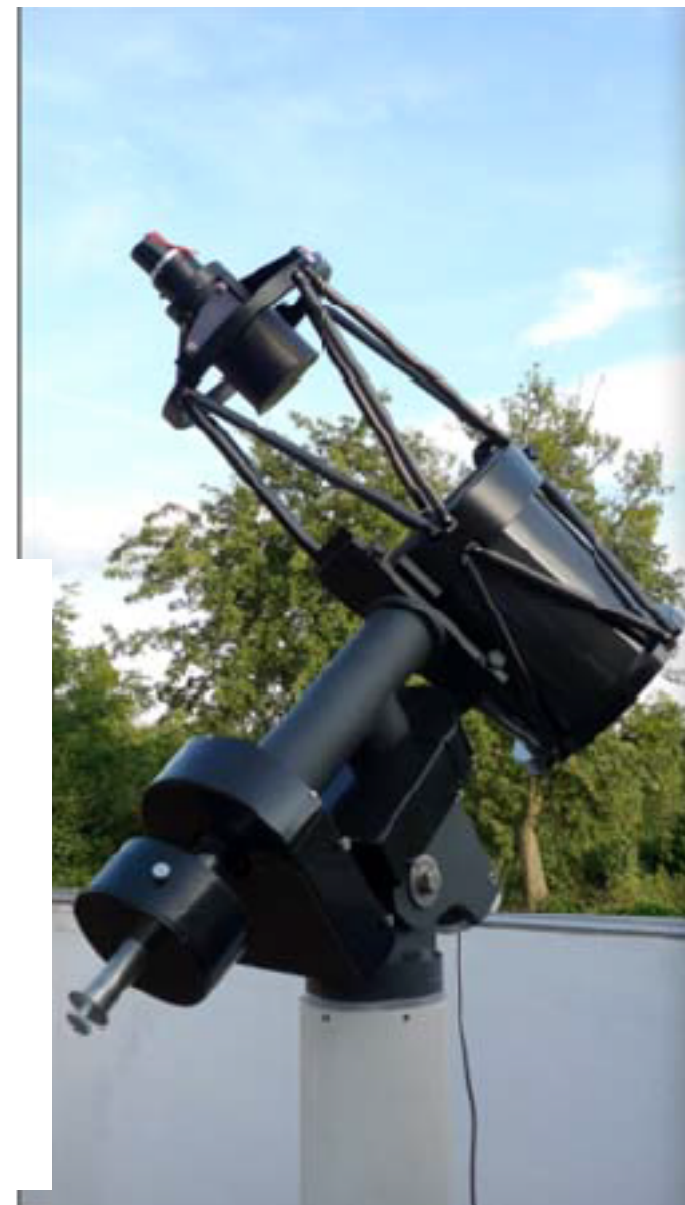
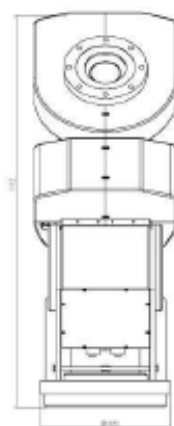
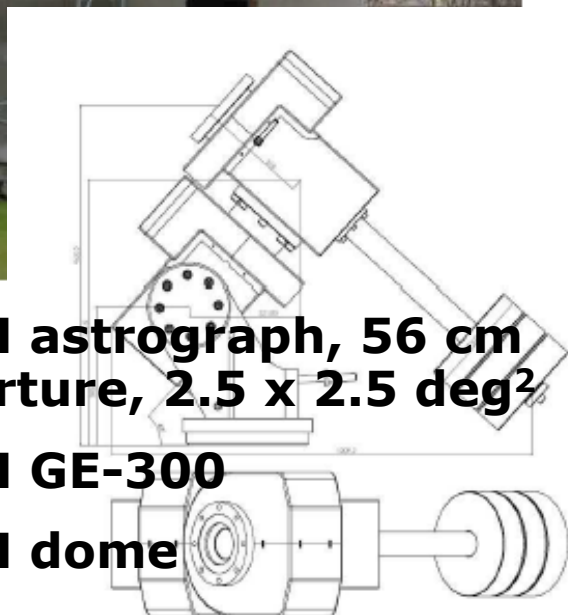
- 1-m effective aperture,  $6.5 \times 6.5$  deg<sup>2</sup> field of view
- 'Fly-eye' concept available on paper
- Needed for a full 'wide survey' covering all sky in one night to 21.5 mag
- Funding foreseen for one prototype



## ■ 'Test-Bed Telescope'

- Demonstrator for scheduling and data processing for space debris and NEOs
- Two 56-cm telescopes will be set up in New Norcia (Australia) and Cebreros (Spain) – 2014/15



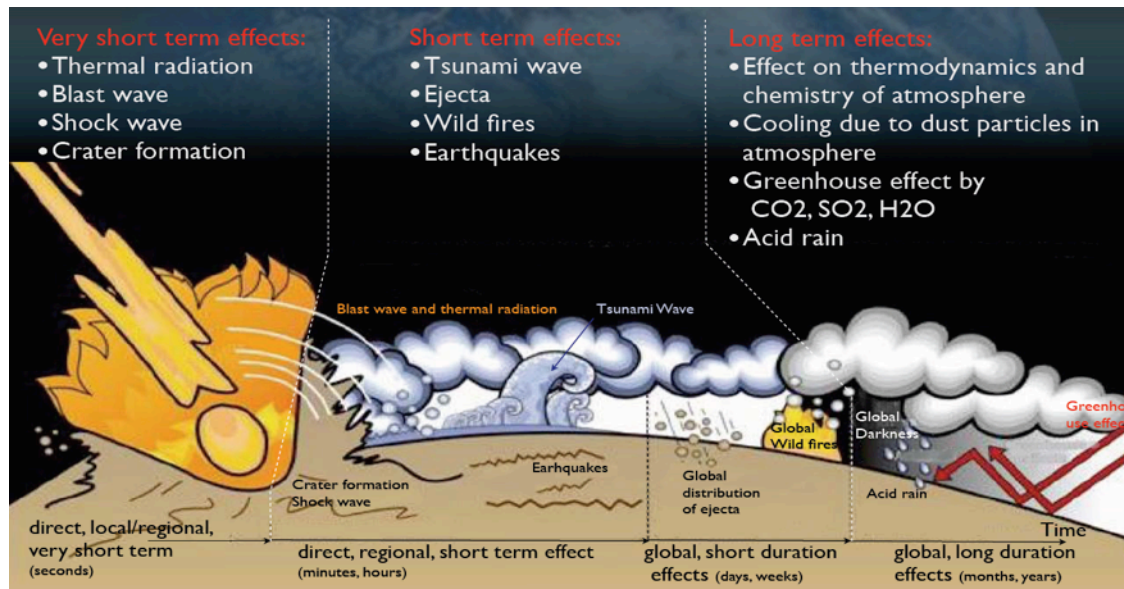


- **APM astrograph, 56 cm aperture,  $2.5 \times 2.5 \text{ deg}^2$**
- **APM GE-300**
- **APM dome**

## ■ Observations

- Optical Ground Station (1-m telescope on Tenerife)
  - 4 nights/month
- Other collaborating observatories
  - La Sagra, others in progress
- Image database
  - Currently being established – to contain all images from OGS, La Sagra...
- NEO Coordination Centre activities
  - E.g. follow-up/spectroscopy of Chang-E'3 booster with TNG 3.5 m scope
  - Pre-discovery searches allowed us to take a few objects off the risk list
- 2014/15: 'Test-Bed Telescope'
- Later: 'Fly-eye telescope'

- A review of available knowledge, tools and technologies in the areas of NEO impact effects and mitigation measures was performed – workshop in May 2013 with international support
- Roadmaps were produced for:
  - Development of NEO Impact Assessment Tools
  - Advance in NEO Mitigation Measures

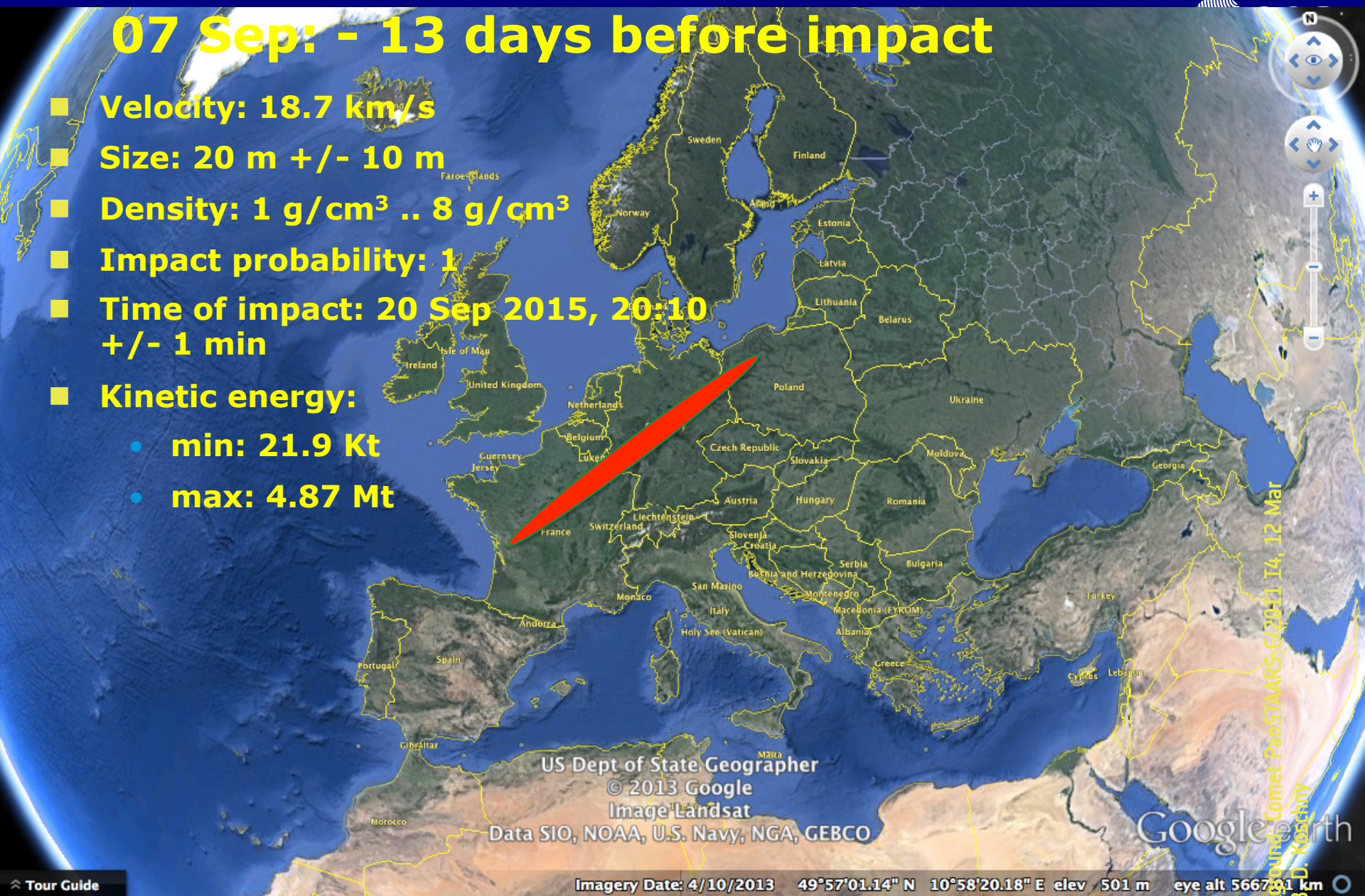


Sketch by  
Laubscher &  
Reimold

# Interface to emergency response agencies

# 07 Sep: - 13 days before impact

- **Velocity: 18.7 km/s**
- **Size: 20 m +/- 10 m**
- **Density: 1 g/cm<sup>3</sup> .. 8 g/cm<sup>3</sup>**
- **Impact probability: 1**
- **Time of impact: 20 Sep 2015, 20:10 +/- 1 min**
- **Kinetic energy:**
  - **min: 21.9 Kt**
  - **max: 4.87 Mt**



US Dept of State Geographer  
© 2013 Google  
Image Landsat  
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Google Earth

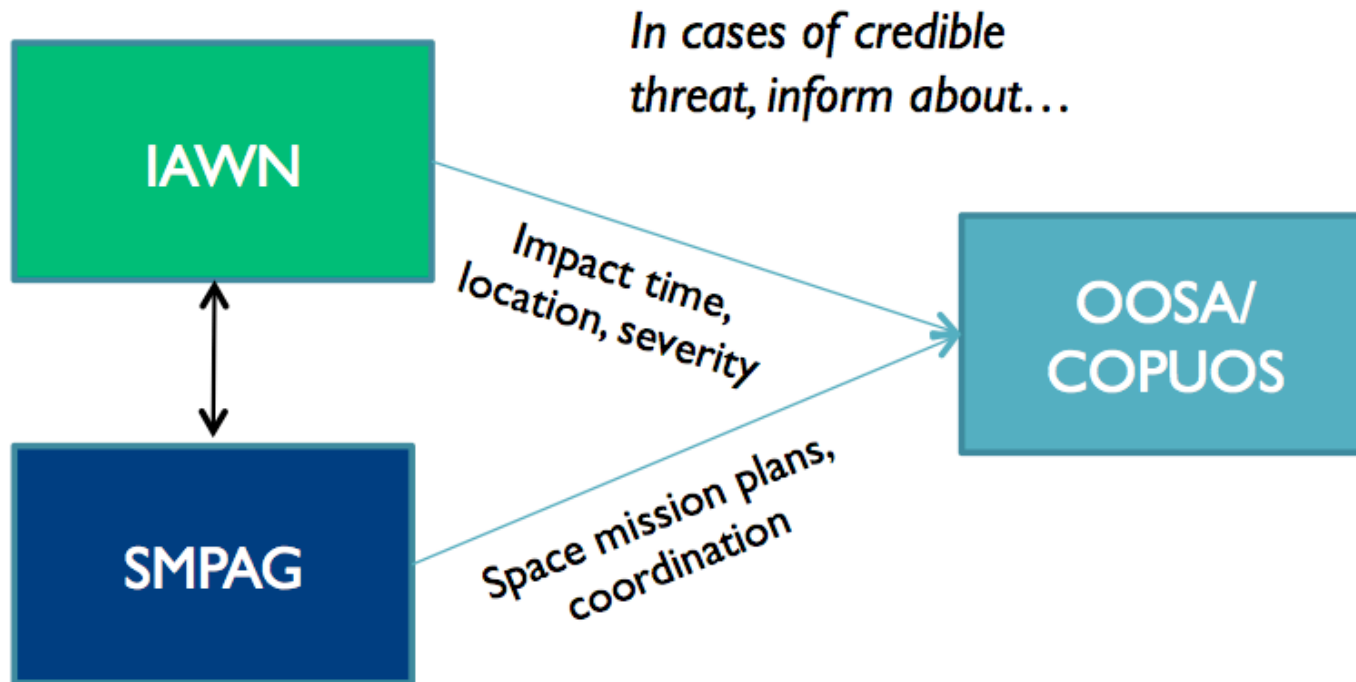
Backburn: Comet PanSTARRS-C/2011 IA4, 12 Mar 2013 D. Koschiny



## ■ SSA and emergency response

- A first workshop took place at ESOC/Darmstadt, Germany in Sep 2013 to start interaction
- Seven European countries sent representatives of their emergency response agencies
- We presented them with a simulated impact scenario – positive response
- Switzerland has started a simulation of an NEO explosion over their country
- ESA has been asked to perform a simulation in 2014
- An 'information plan' is finalized, to be agreed in 2014

# In addition: preparing the SMPAG



## ■ First formal meeting of the SMPAG: ESOC, 06-07 Feb 2014 (for delegates of space agencies/offices)



Reference: OOSA/2013/12  
CU 2013/261/OOSA/CPLA

The Secretary-General of the United Nations presents his compliments to Permanent Representative of Albania to the United Nations (Vienna) and has the honour to transmit, to the Permanent Mission, as the Mission of a member State of the Committee on the Peaceful Uses of Outer Space, and in accordance with paragraph 151 of the report of the Committee (A/68/20), an invitation by the European Space Agency (ESA), in collaboration with the Action Team on Near-Earth objects of the Committee, to the establishment and first official meeting of the space mission planning advisory group (SMPAG) in accordance with the recommendations of the Working Group on Near-Earth Objects of the Scientific and Technical Subcommittee (A/AC.105/1038, para. 198, and annex III) for an international response to the near-Earth object impact threat. The meeting will take place at Darmstadt, Germany from 6 to 7 February 2014. Registration shall be made directly to ESA in accordance with the attached invitation.

23 December 2013



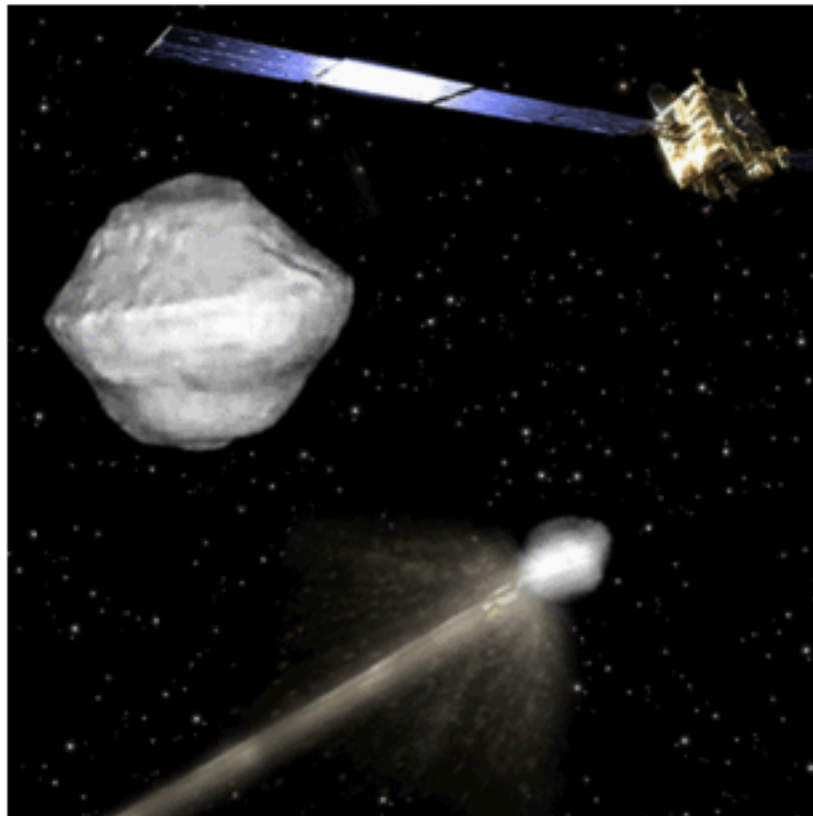
Referencia: OOSA/2013/12  
CU 2013/261/OOSA/CPLA

El Secretario General de las Naciones Unidas saluda atentamente al Representante Permanente de la República Bolivariana de Venezuela ante las Naciones Unidas (Viena) y tiene el honor de transmitir a la Misión Permanente, en su calidad de Misión de un Estado miembro de la Comisión sobre la Utilización del Espacio Ultraterrestre con Fines Pacíficos y de conformidad con el párrafo 151 del informe de la Comisión (A/68/20), una invitación enviada por la Agencia Espacial Europea (ESA), en colaboración con el Equipo de Acción sobre objetos cercanos a la Tierra de la Comisión, al establecimiento y la primera reunión oficial del grupo asesor para la planificación de misiones espaciales, conforme a las recomendaciones del Grupo de Trabajo sobre los objetos cercanos a la Tierra de la Subcomisión de Asuntos Científicos y Técnicos (A/AC.105/1038, párr. 198, y anexo III) para una respuesta internacional a la amenaza de impacto que plantean los objetos cercanos a la Tierra. La reunión se celebrará en Darmstadt (Alemania) los días 6 y 7 de febrero de 2014. La inscripción se formalizará directamente con la ESA en virtud de la invitación que se adjunta.

23 de diciembre de 2013



## ASTEROID IMPACT & DEFLECTION ASSESSMENT (AIDA) STUDY



AIDA mission concept

The Asteroid Impact & Deflection Assessment (AIDA) mission is a joint effort of ESA, JHU/APL, NASA, OCA and DLR. The mission design foresees two independent spacecraft, one *impactor* (DART) and one *rendezvous probe* (AIM). As in the separate DART and AIM studies, the target of this mission is the binary asteroid system Didymos. For a successful joint mission, one spacecraft, DART, would impact the secondary of the Didymos binary system while AIM would observe and measure any the change in the relative orbit.

- A study within ESA's Science programme ('Cosmic Vision')
- Asteroid sample return mission, target 2008 EV5
- Possible selection (one out of four competitive studies) in Feb 2014; launch 2022-24



- **Observations**
- **Orbit computations and impact risk predictions**
- **Priority list**
- **Studies related to impact effects**
- **Support NEO population model update**

**And there are other activities related to the SMPAG going on!**