Updates on ESA'S Planetary Defence Activities
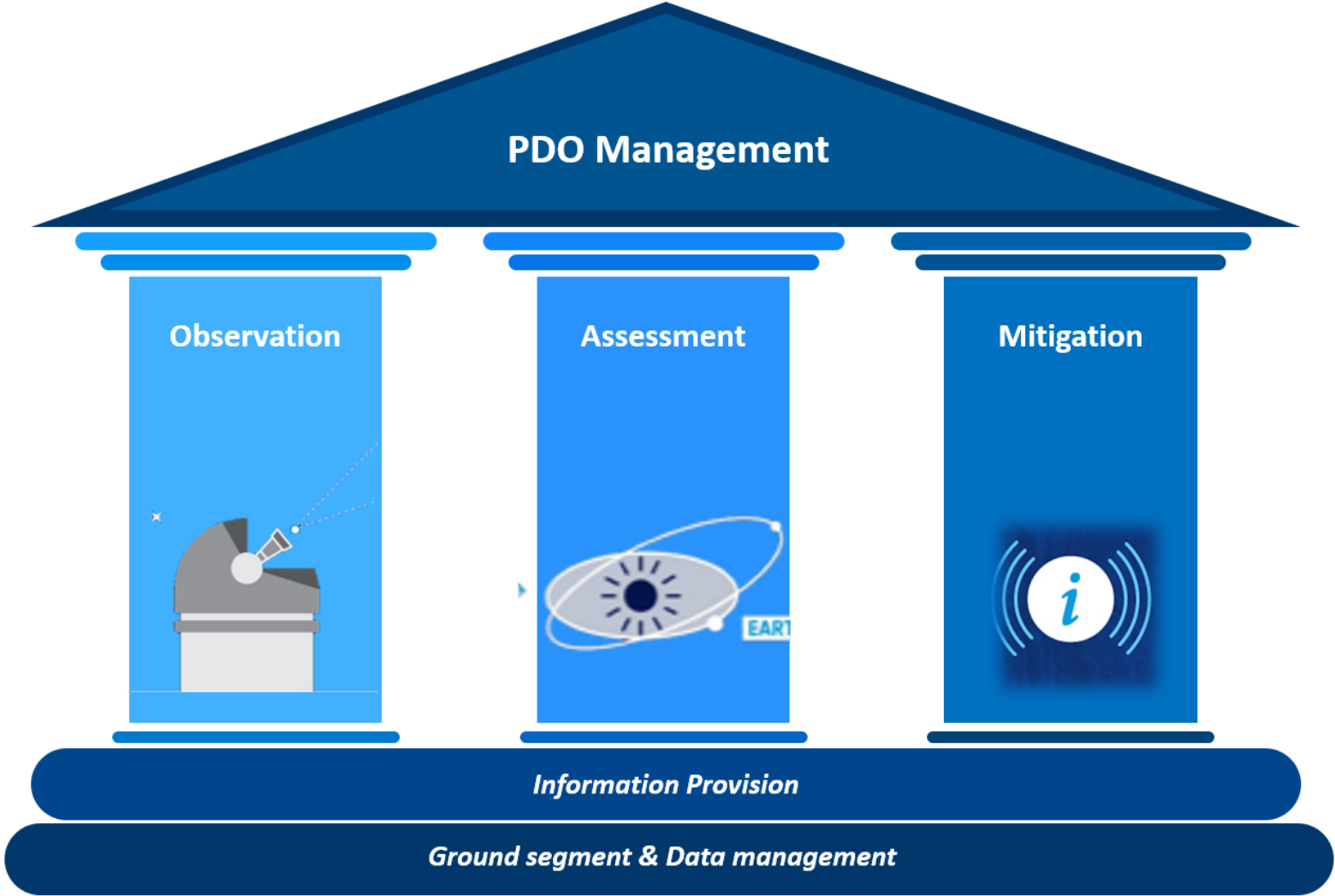
Richard Moissl and the Planetary Defence Office Team
07/02/2023

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Planetary Defence Office Structure

News

- Starting the second Period of S2P

- New Mission studies (Satis/RAMSES, NEOMIR)

- Two conferences:

  - Imminent Impactors (/w EU)

  - NEO and Space Debris

- 10 Years anniversary of the Near Earth Objects Coordination Centre (NEOCC) at Frascati coming up in May

- Detlef's Retirement

Survey
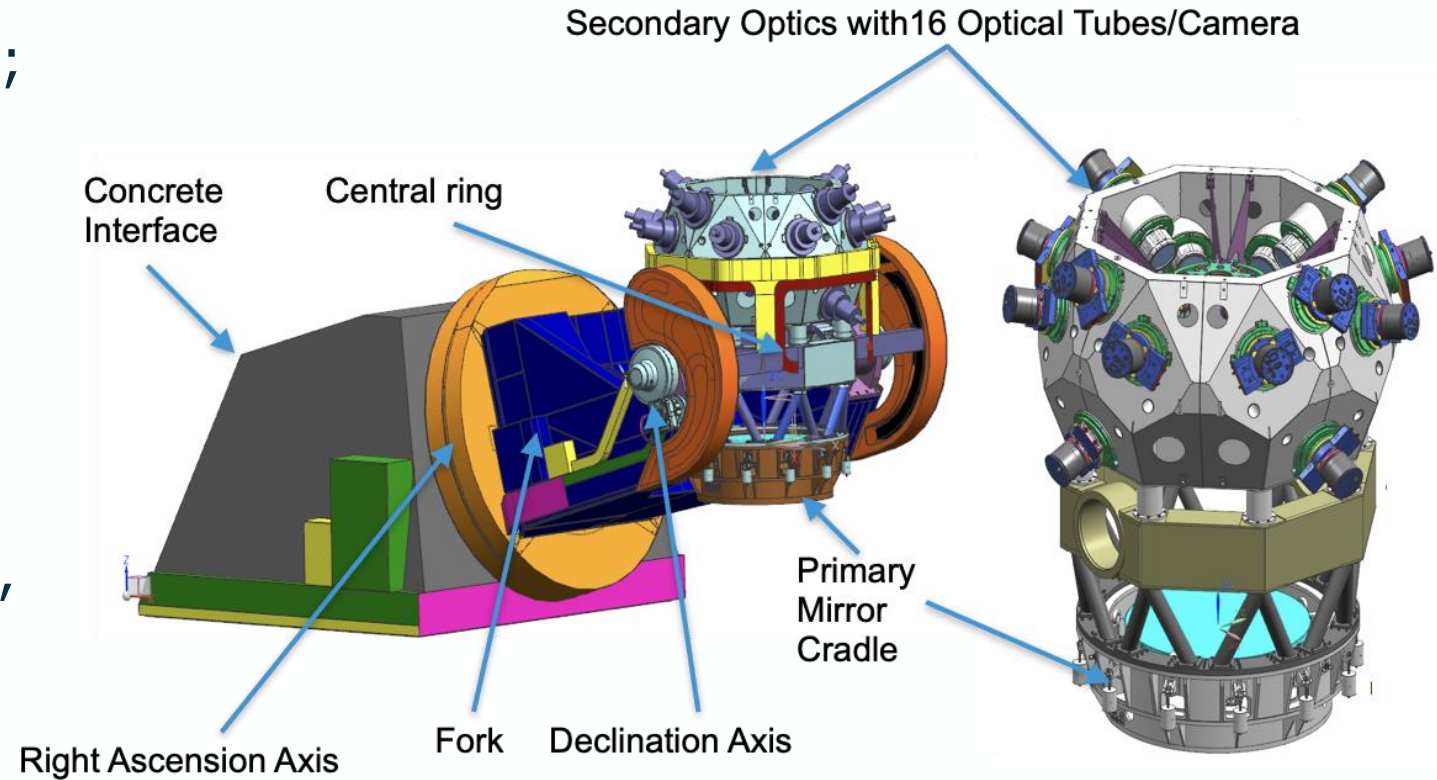
Follow-up

Observations Network

The Flyeye Survey Telescope

1-m class telescope with 6.7º x 6.7º FoV split into 16 different cameras (fly-eye design)
Equatorial mount, telescope structure, primary mirror and beam splitter ready.

Production of all 16 cameras finalised;
Cameras mounted and their
pre-alignement is completed.

Testing of telescope control
software under way.

Telescope and mount are ready
to be shipped to their integration site,
ASI's tracking station in Matera (IT)

Preparing for redesign of 2nd Generation

Secondary Optics with16 Optical Tubes/Camera

Concrete Interface

Central ring

Primary Mirror Cradle

Right Ascension Axis

Fork

Declination Axis

Follow up Highlights

- Two Imminent Impactors (2022 EB5 and 2022WJ1) could be followed up within hours of discovery. Frequency will likely increase
    - Organised EC mandated workshop on Imminent impactors in Dec 2022
- Increasing practice with challenging observations
    - Observing at low altitude (i.e. 2020 XL5)
    - Faint targets (i.e. 2021 GN2, 2021 QM1)
    - DART Impact observations
- Close collaboration with international partners
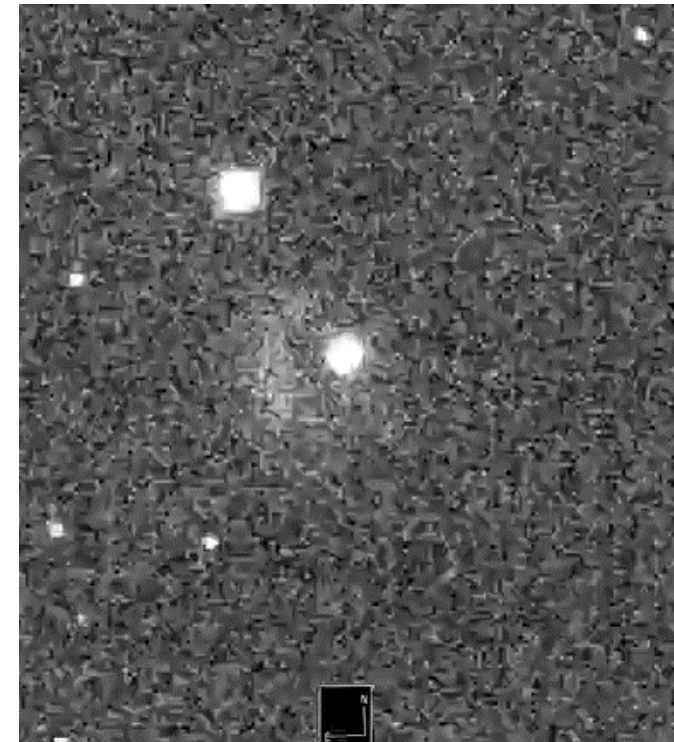
NEOMIR

ESA is currently studying a NEO Mission in the InfraRed (NEOMIR) to focus on detecting impactors coming from the Sun direction, thus not detectable from the ground.
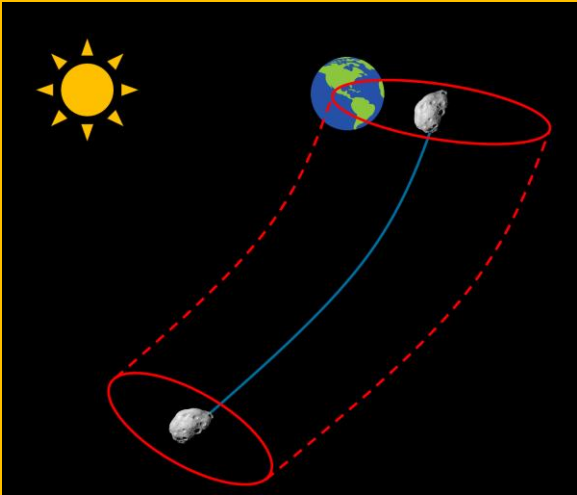
Mission basics:

- orbit around Sun-Earth L1

- able to detect NEOs >20 m typically one month before impact

- fast response: max 24from exposure to data downlinked to Earth

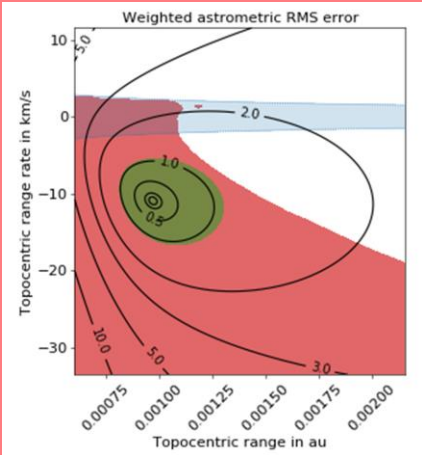- 7 years life-time plus extension

- working in the thermal IR (4-10 μm)

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Assesement
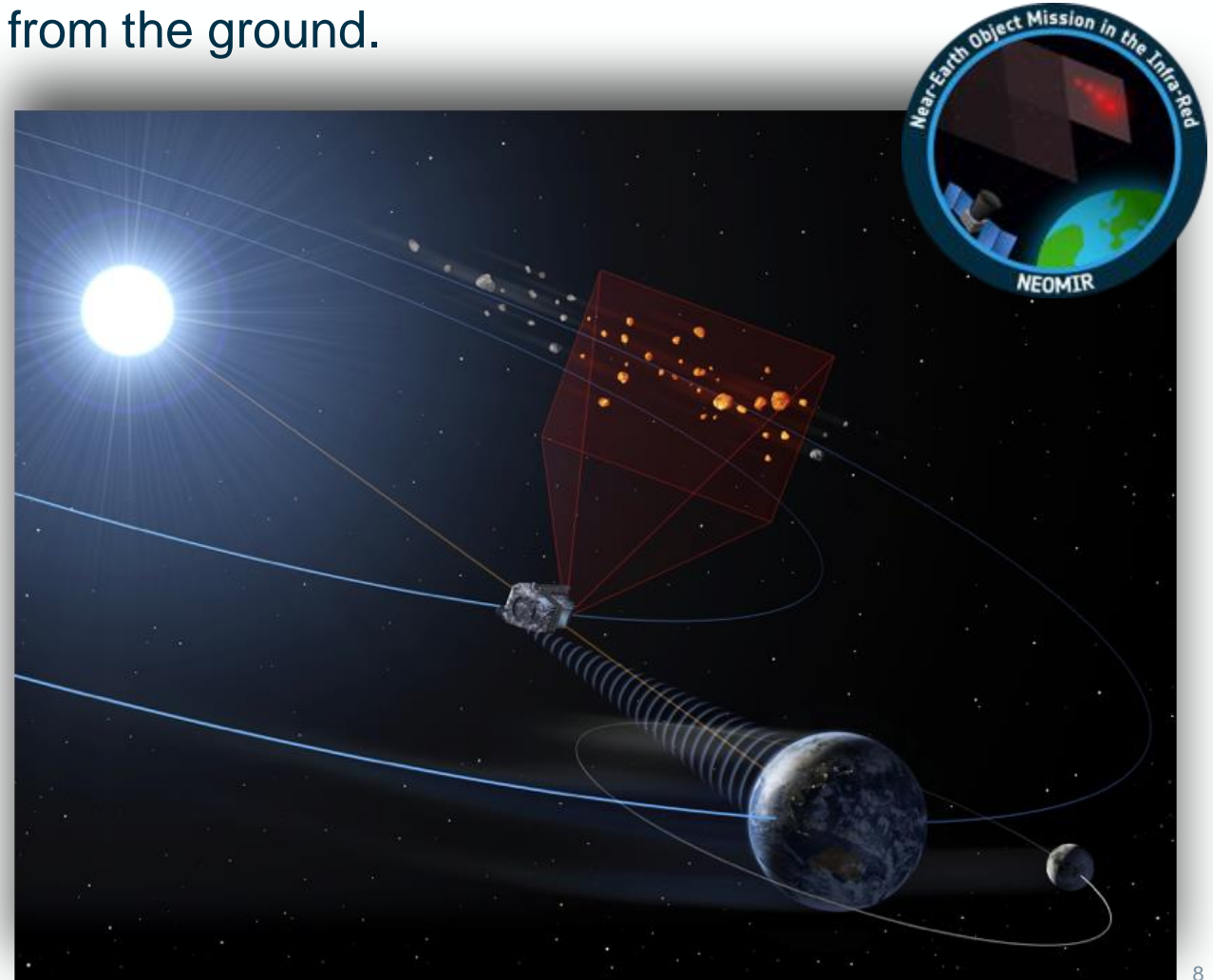
Orbit Determination
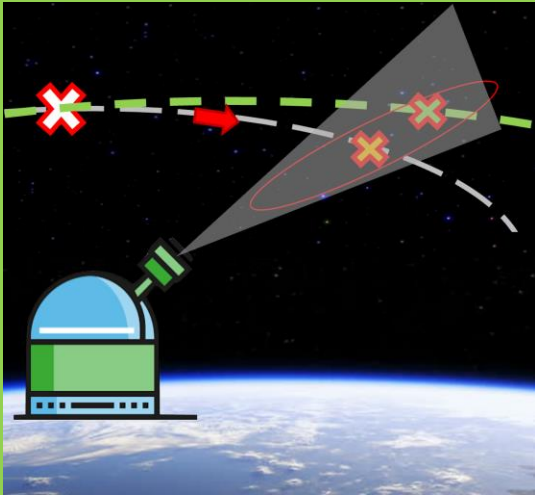
Impact Monitoring

Imminent Impactors Warning

Orbit Determination and …

- Available at the NEOCC from 2012 as provided by NEODyS

- Incorporated in 2017 after **migration and improvement** from NEODyS

- Processes MPC's MPECs and JPL radar data to perform **accurate OD** for NEOs and non-NEOs

- Hourly, daily, weekly and monthly MPC releases are processed

- OD is based on a standard dynamical model, weighted non-linear least squares method and a differential corrections algorithm

- **Weighting** and **debiasing** is applied to the processed observables

- Automatic iterative outlier rejection algorithm

- Rank deficiency properly detected and treated

- Resulting information is provided in the **NEOCC web portal**

…Impact Monitoring: "Aegis"

- Available at the NEOCC from 2012 as provided by NEODyS

- The **Impact Monitoring System (IM)** was delivered to NEOCC as migrated from NEODyS in mid-2019 by SpaceDyS

- **Virtual impactors** are checked in the **next 100 years**

- IM **algorithm based on the LOV**

- **Long validation campaign** carried out

- The **full risk list was recomputed** after the validation

- The software, formerly known as "ODIM" has been renamed to "**Aegis" in Version 4**

- Lately used to:

  - Compute the effects of the Yarkovsky acceleration in the trajectory of Apophis

  - Compute the non-gravitational accelerations over more than 100 NEAs

  - Remove Apophis from the risk list after the radar obs in March

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Meerkat

- **Imminent impactor** warning system at ESA
- Based on the immediate processing of **NEOCP data**
- Detection of imminent impactors and very close approachers
- Based on a **systematic ranging** algorithm
- It provides:
  - Impact probability
  - Impact zone
  - Conditioned impact statistics
  - Object observability
- Previously available only **internally**

Sar2593 Dashboard: 14 obs, 0.65 h arc length

Mitigation and Information Provision
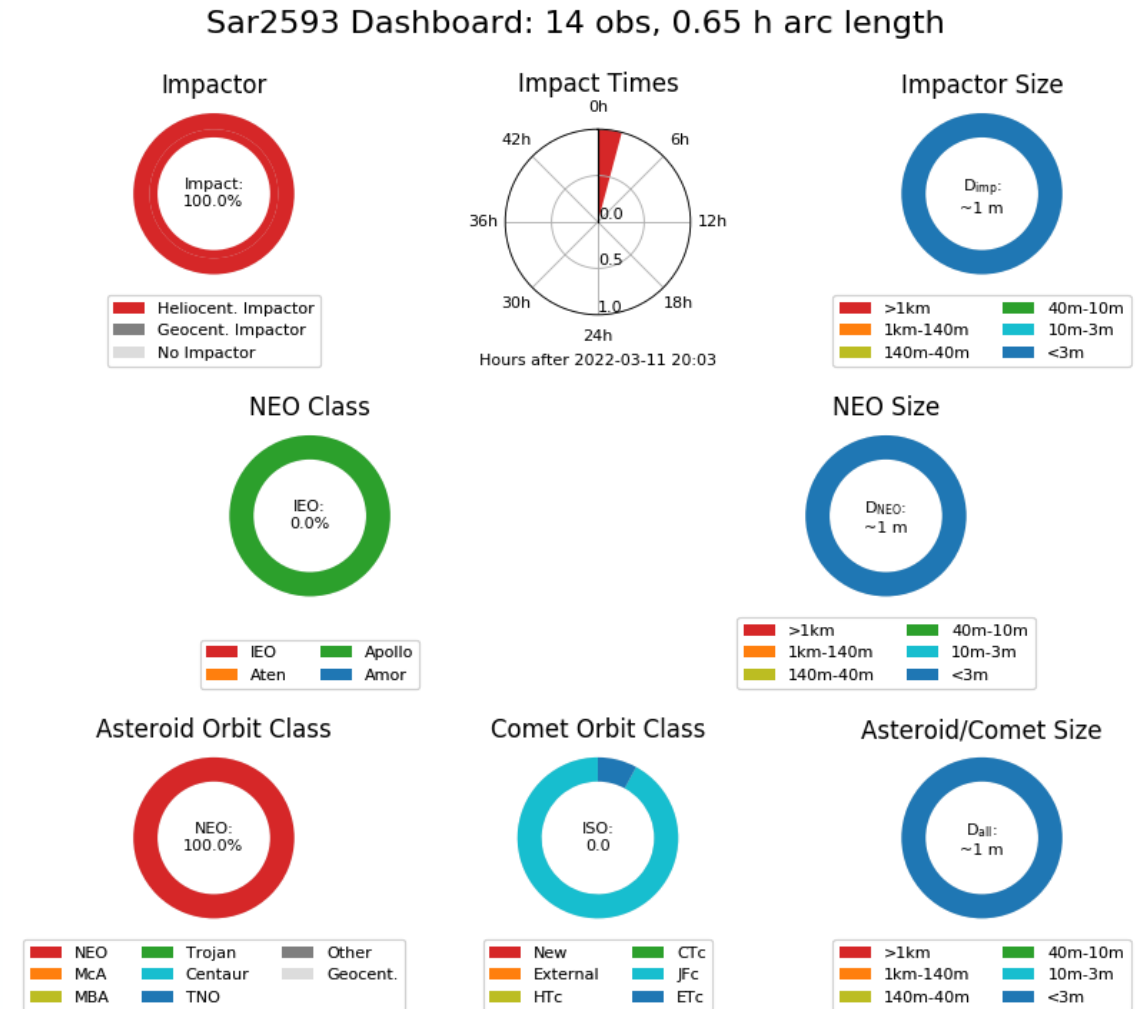
- Participation to **IAWN** and **SMPAG**

- Production of **Close Approach Fact Sheets** (CAFS)

- Development of an **Impact Effects Tool**

- Fostering increase in the level of NEO **threat awareness** among national **civil protection** agencies

- Mitigation related **missions**:

  - Support to **Hera**

  - **Satis** mission to Apophis
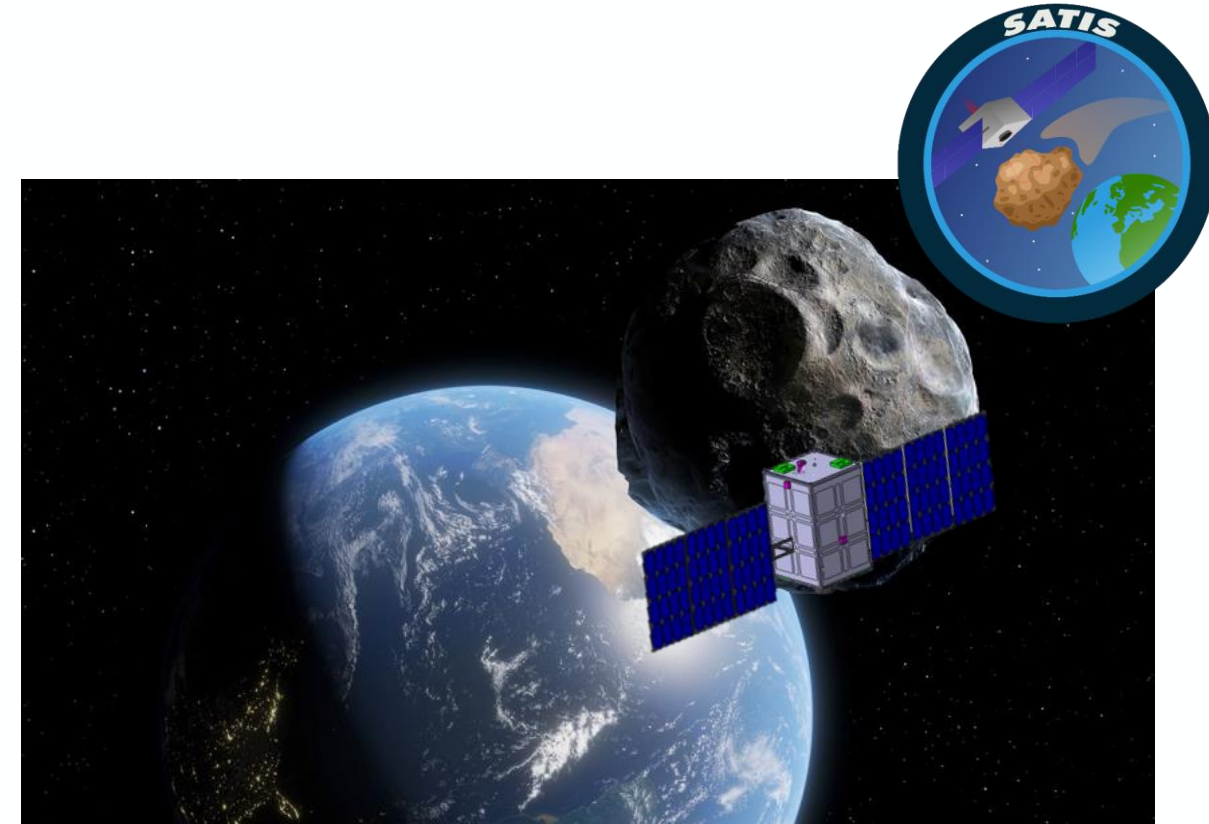
  - Support to other concepts: **M-ARGO**, **LUMIO**

Thermal radiation map

Hazard map
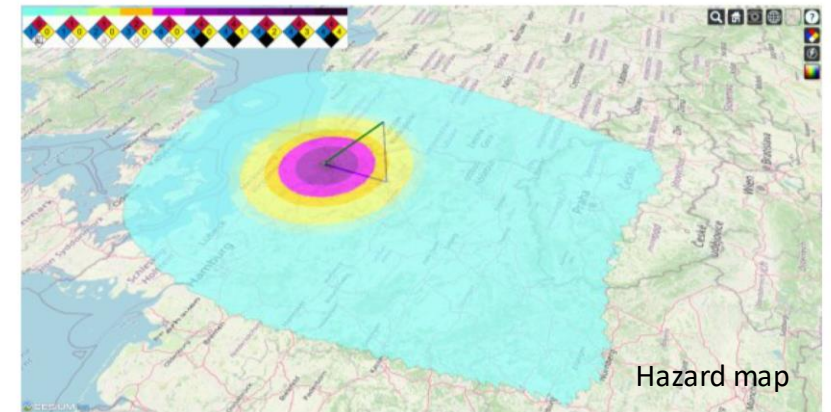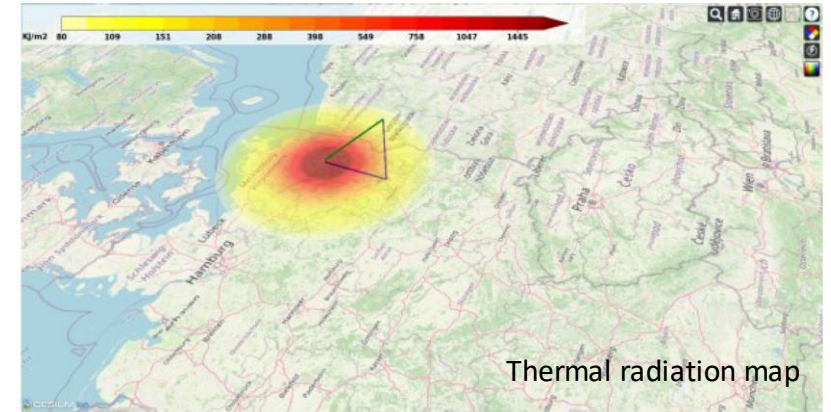
IAC-22-E10.1,x69147

ESA's Impact Effects Tool - Quantitative Predictions of NEO Impact Effects in Atmosphere and at the Surface
Anca Radulescu[a]*, Ionut Grozea[a], Marius Marinescu[a], Mihai Gherasim[a], Beniamin Teodorescu[a], Kai Wünnemann[b]*, Robert Luther[b], Natalia Artemieva[b], Detlef Koschny[c*, d], Richard Moissl[c]

Apophis Reconnaissance Mission: Satis

- CDF Study in 2022, evaluating a fast flyby and a rendezvous option

- Rendezvous Scenario chosen for further studies:

  - Heliocentric orbit with rendezvous 1-2 months in advance of close approach to earth.

  - 12UXL Cubesat (baselined to follow closely the M-ARGO design)

  - Baseline Payload:

    - Hyperspectral Imager

    - IR imager

- Launch window ends on 13th May 2027

- Received sufficient subscription for Phase A/B (Programme Board to confirm Workplan)

- Upgrade option to larger S/C being evaluated via GSTP

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NEO Tools Update

Hera

- ✓ All subsystem CDRs closed
- ✓ Propulsion module delivered to AVIO for integration
- ✓ Avionic Test Bench integrated
- ✓ All EM units delivered
- ✓ Core Module integration started
- ✓ All FM units delivered or in delivery
- ✓ Ground Segment Design Review succesful
- ✓ CMOC kicked-off, TM/TC I/F workshop held
- ✓ System CDR successful
- ✓ Successful Ministerial covering Period 2
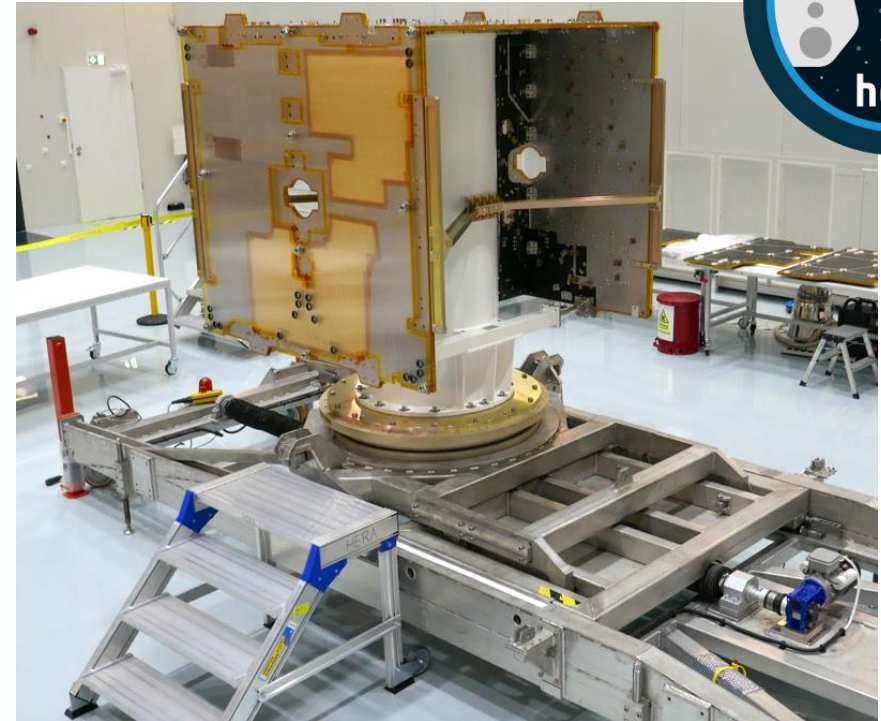
=> Hera is on track for launch in October 24 (on Falcon-9)

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