# Near-Earth Asteroid risk mitigation strategy in the next decade: from Earth-based facilities to DART and Hera space missions

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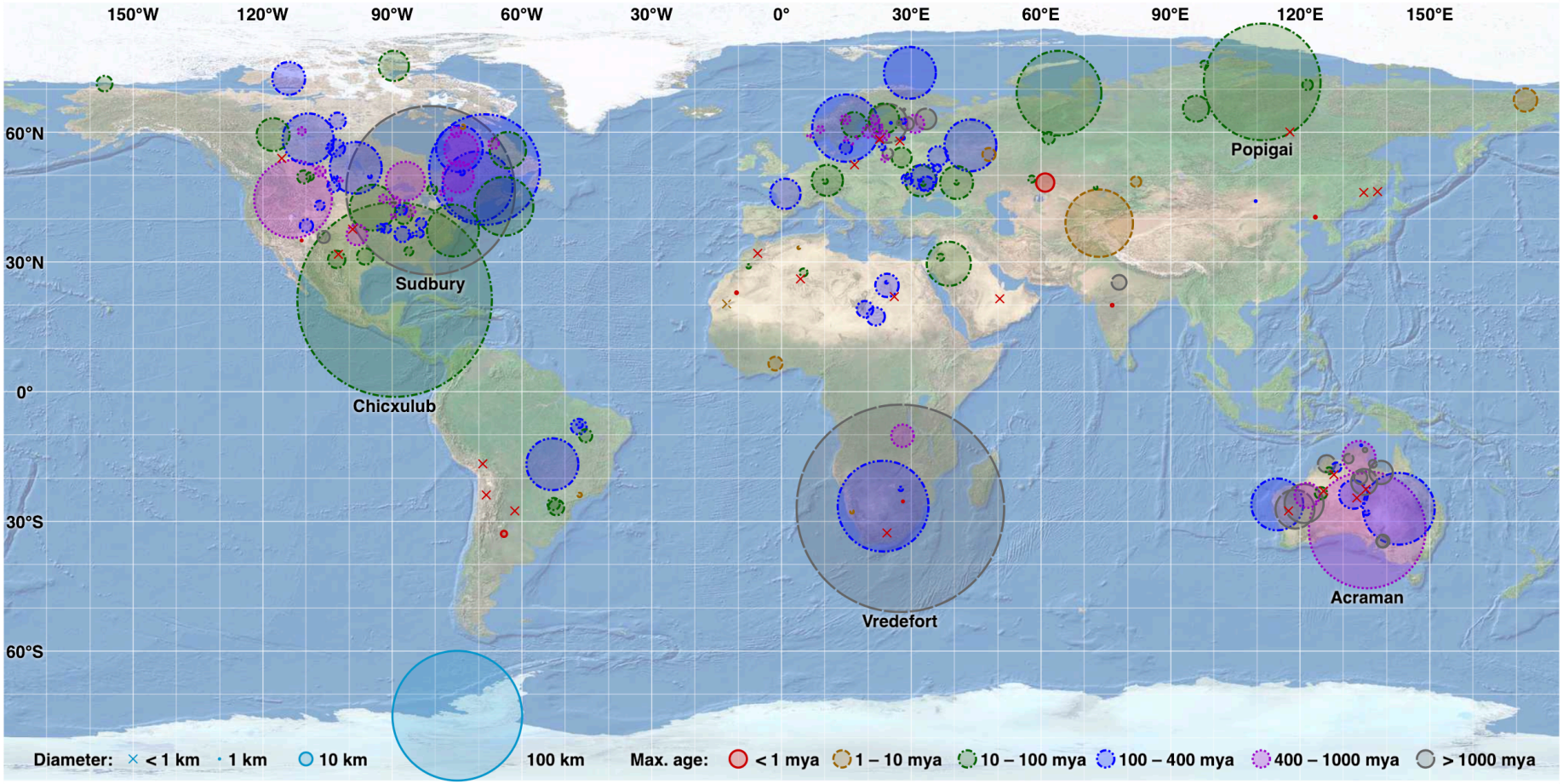
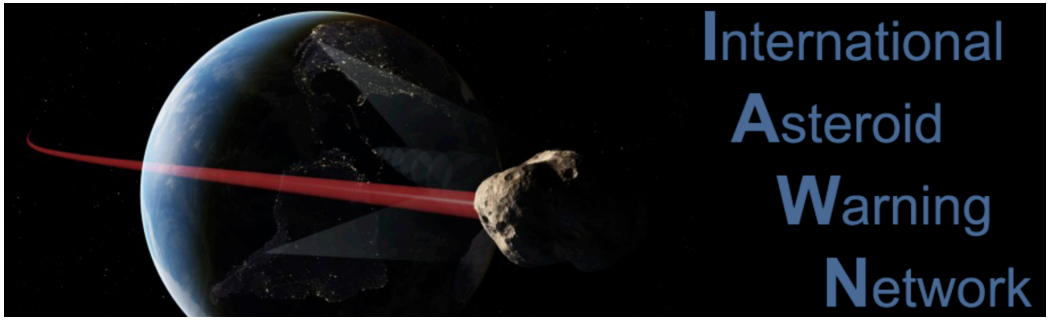
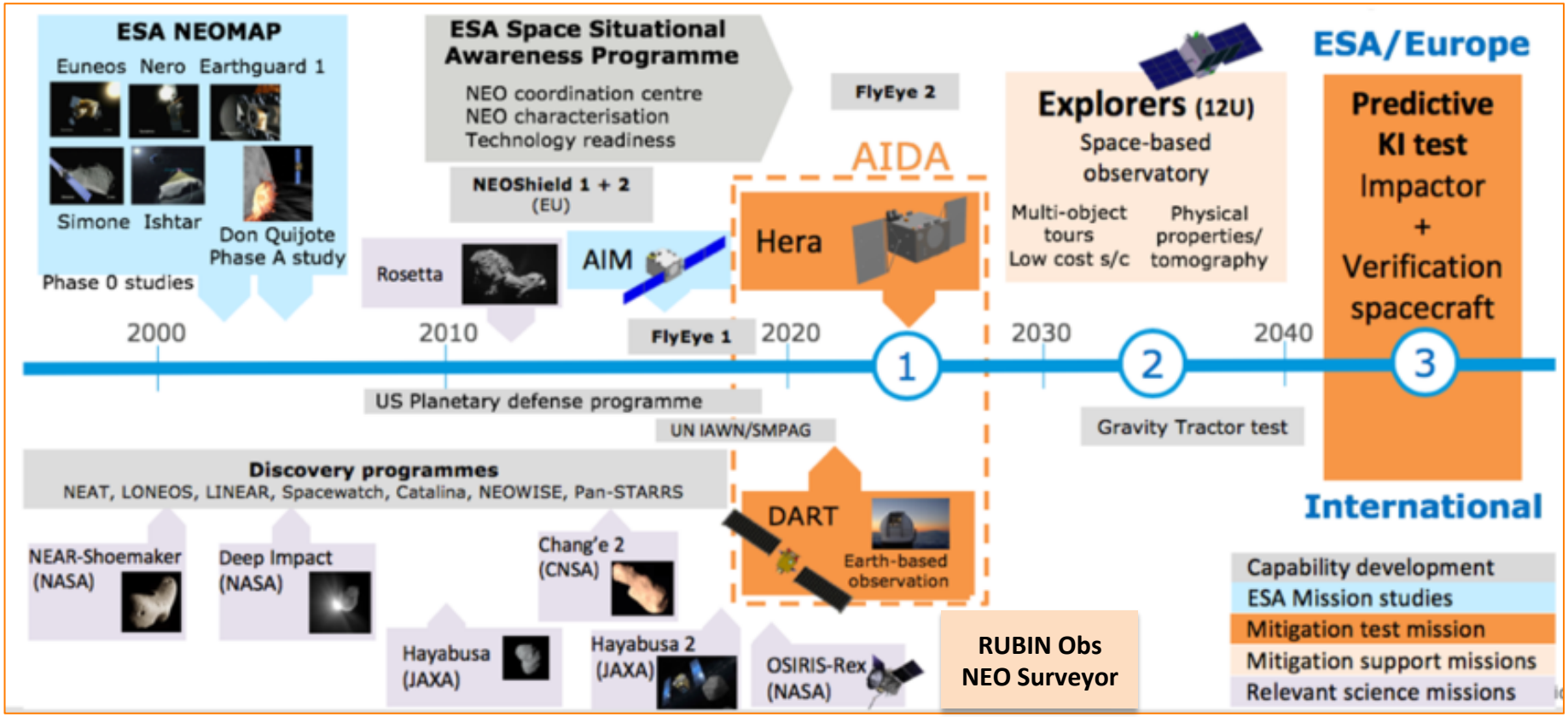


# INTERNATIONAL & INTERDISCIPLINARY EFFORT

**IAWN was established (2013) as a result of the UN-endorsed recommendations**




10s of countries
Plus two space agencies




**DISCOVERY – FOLLOW-UP – CHARACTERIZATION - EXPLORATION**

**PROTECTION**

# DISCOVERY: SURVEYS A NASA EFFORT

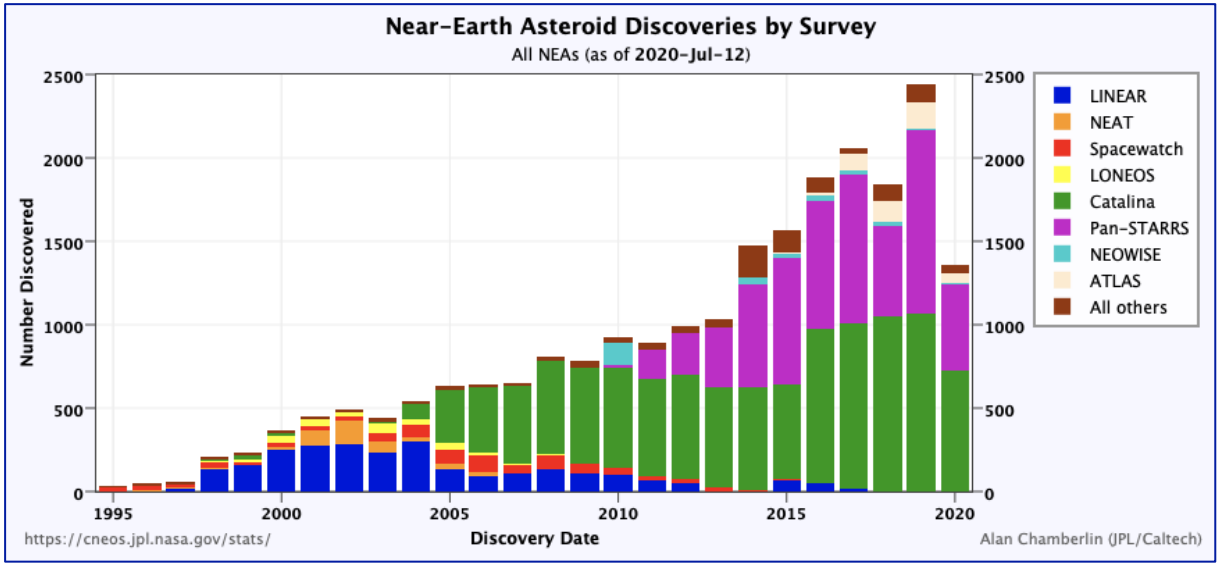
- **1998: NASA started the NEOO Program** following a mandate from congress to detect all the NEOs >1km (potential global devastating effects)

  *At that monent only about 500 near-Earth asteroids were already known.*

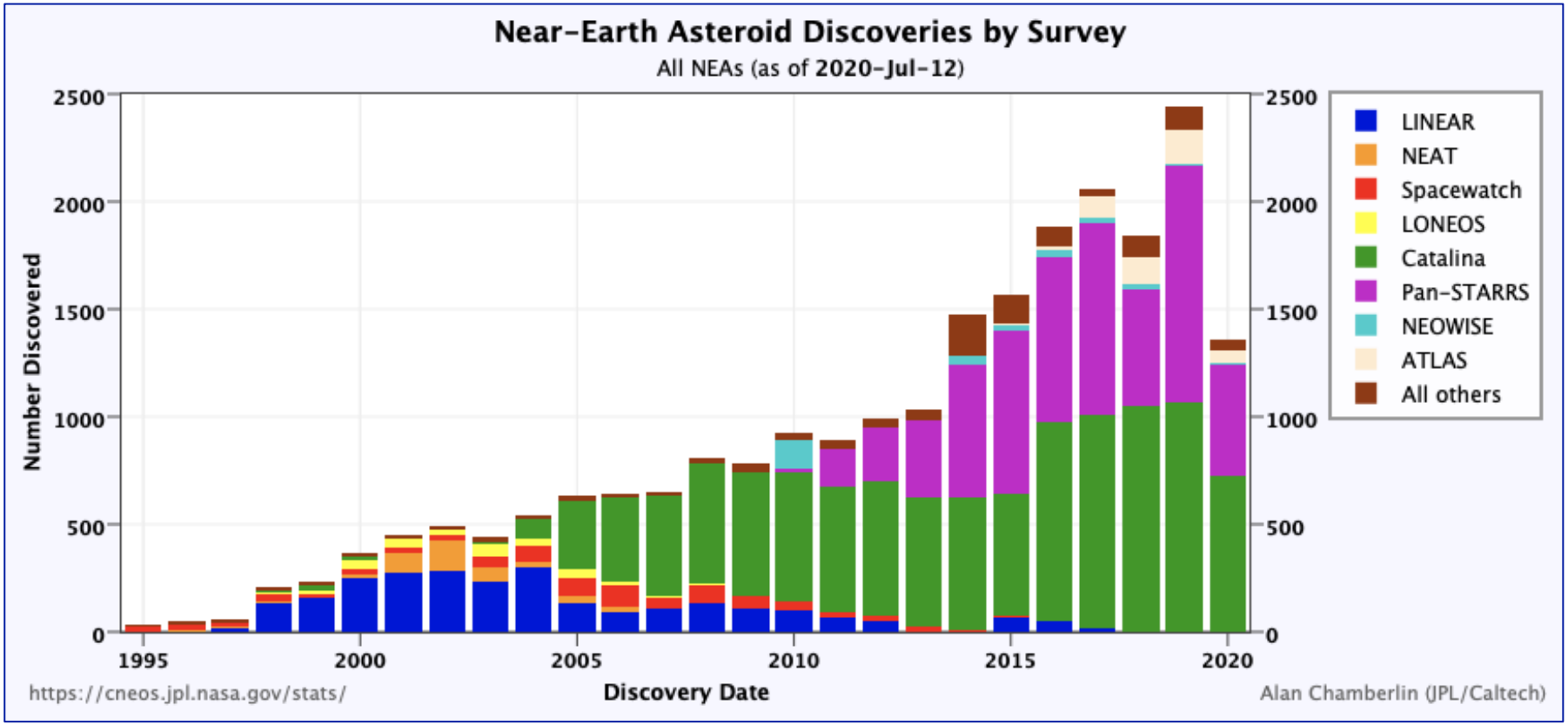
- **By 2010 NASA (and its partners) had identified more than 90% (of 1K estimated)**

**Later on, the eyes turned to objects in 140m < D < 1km**

*Can cause wide regional damage with significant loss of life and complex political, social, and economic problems*



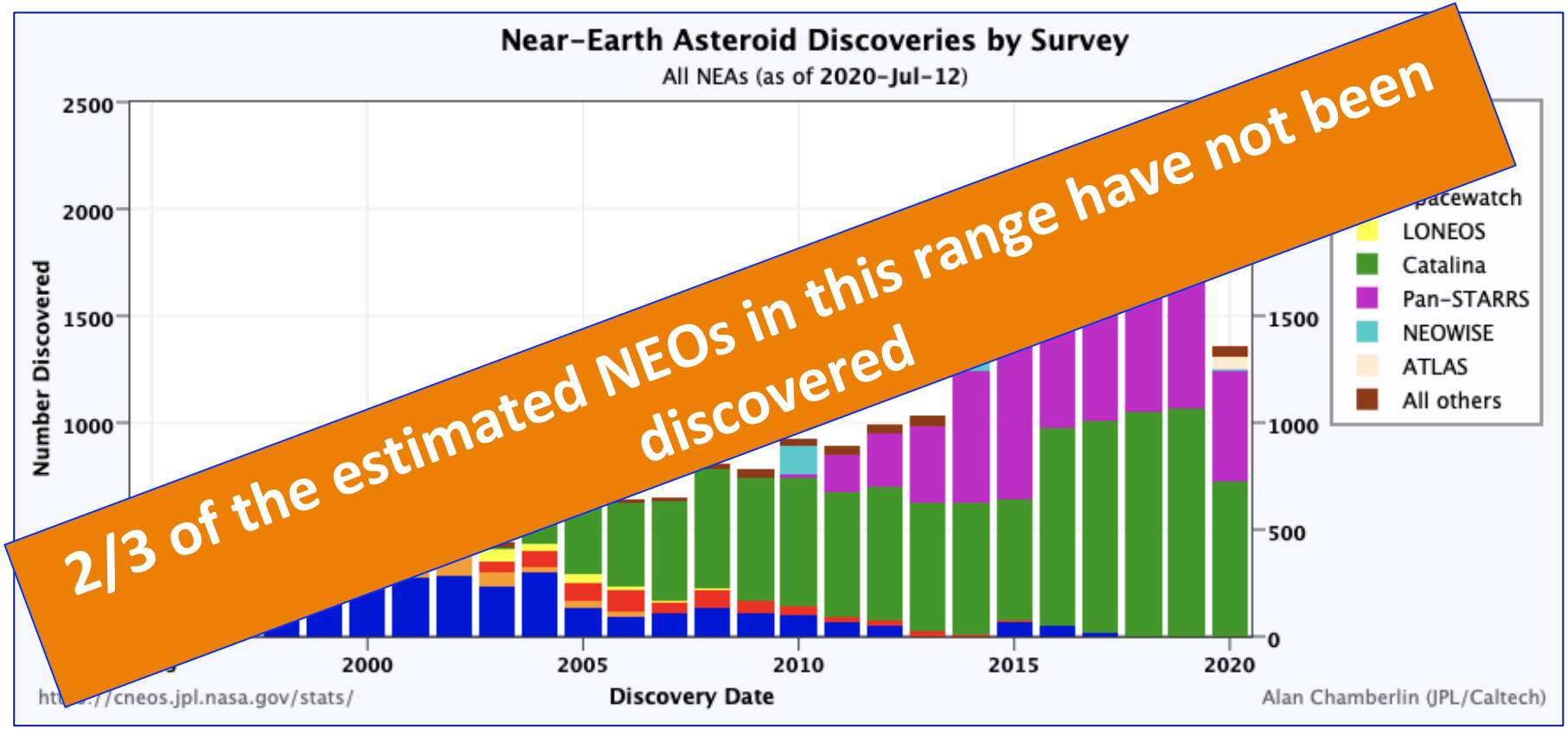

- **By 2020 Catalogue all the NEOs > 140m**




**Catalina Sky Survey (CSS)**: In 20 years has discovered About 10K NEOs . 150 larger than 1 km ((Larson et al. 1998)

**PANoramic Survey Telescope And Rapid Response System** (PANSTARS) (Kaiser et al. 2002) : 10 years now and more than 5k NEOS

**Other:** NEOWISE (Mainzer et al. 2011), ZTF (Bellm et al. 2019), and ATLAS (Tonry et al. 2018)




**2/3 of the estimated NEOs in this range have not been discovered**

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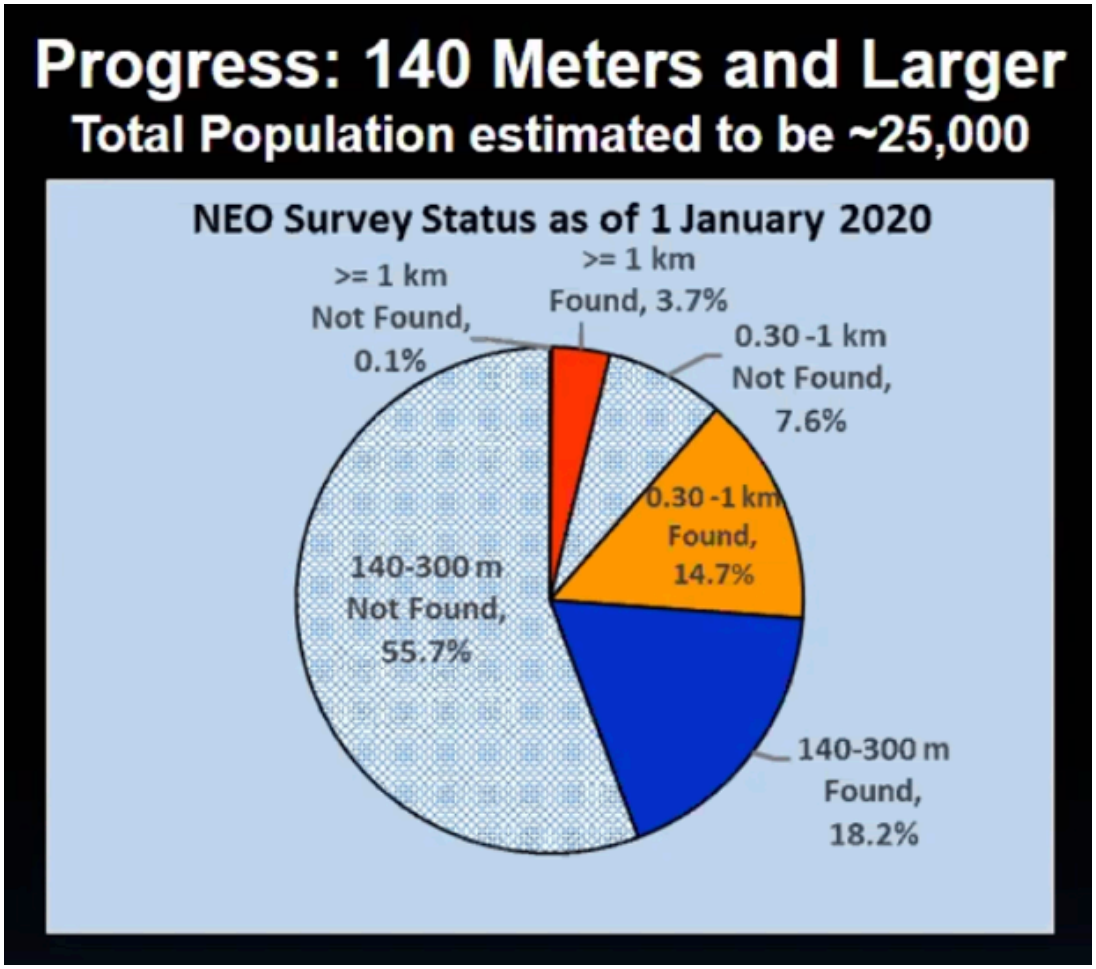
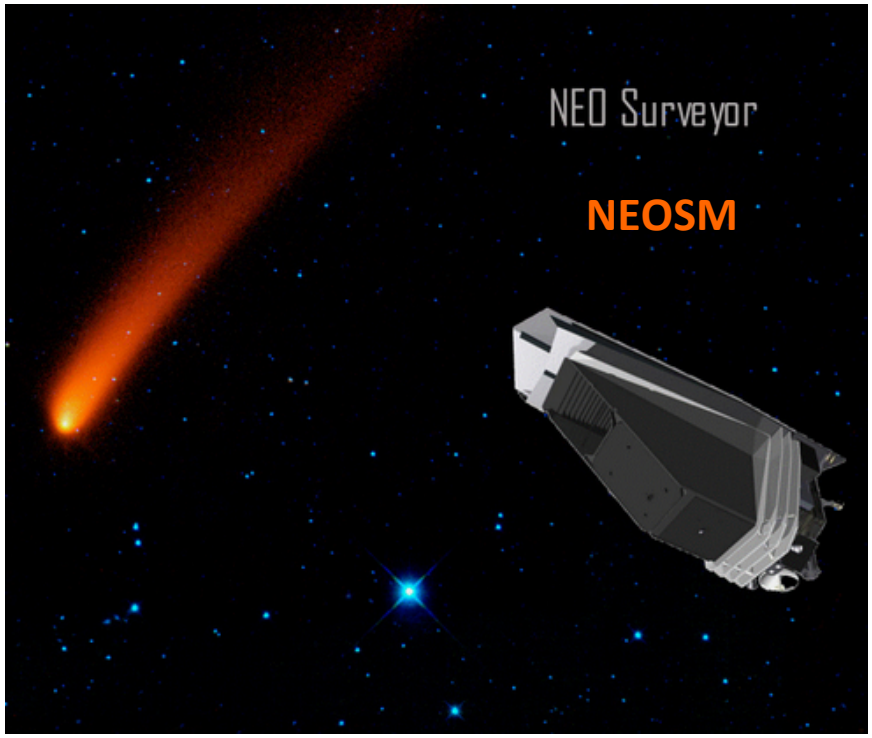



Kelly Fast: SBAG January, 2020

# WIDE FIELDS SURVEYS TO DISCOVER HUNDREDS OF THOUSANDS OF NEW NEOS




- IR telescope in the L1 Earths point
- 5 years to reach the 2/3rds > 140m
- 10 years to reach the 90%
- In phase III – technology development
- Launch: 2025???

- 8-m class optical telescope
- 10-year survey of the sky
- Survey of the southern sky
- ~15k NEOS >140m in 10 years (2/3rds)
- 2020 first-light??

# 2023 – 2032 Decadal Survey: What remains to be known?

**Future Survey and Warning Strategies:** the slope of the size-frequency distribution down to tens of meters Should small NEAs turn out to be more numerous than expected, surveys focused on providing short-term warning on timescales of hours or days

**Observational Follow-Up** Orbit determinations and characterization or refinement of impact corridors.

- Large-aperture ground-based telescopes for optical or radar observations.
- Smaller follow-up assets such as Spacewatch (McMillan 2007)

**Characterization**

- Remote Sensing
- Research Program
- In Situ Missions
- Characterization and Follow-up with Radar Assets
- Infrastructure and International Collaboration
- What Would We Do If a High-Probability Potential Impactor Was Discovered

# What Remains to know?

## *FOLLOW-UP*

**Radar astrometry prevents newly discovered objects from being lost while routinely reducing uncertainties on orbital elements by five orders of magnitude impact warning time an average of 4 years compared to optical-only datasets**

## *CHARACTERIZATION*

***2018 – 23 NASA-NEOO - Arecibo award, including IAC and IAA collaborators***

- ***IAC -*** *"The NEO Rapid Observation, Charecterization and Key Simulations –* ***NEOROCKS"***
  *H2020-SPACE-2019*
  *WP: J de León, J. Licandro, N. Pinilla-Alonso - 2.5 years starting 2020*

- **IAC - ESA-P3NEOI**: Observational Support from collaborating observatories – 2.5y
  2 WP: J. Licandro, De Leon, Serra-Ricart