

National Aeronautics and
Space Administration



EXPLORE

Protecting our Home Planet with SmallSats

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Chair, Small Spacecraft Coordination Group

NASA Headquarters

AGU 2021

Google Earth Timelapse
Dubai, UAE
1984

Google Earth Timelapse (Google, Landsat, Copernicus)



AMAZON DEFORESTATION

May 2017—Sep 2020



American Football Field



0.5 mi



0.5 km



2017

2018

2019

2020

KEY SCIENCE THEMES

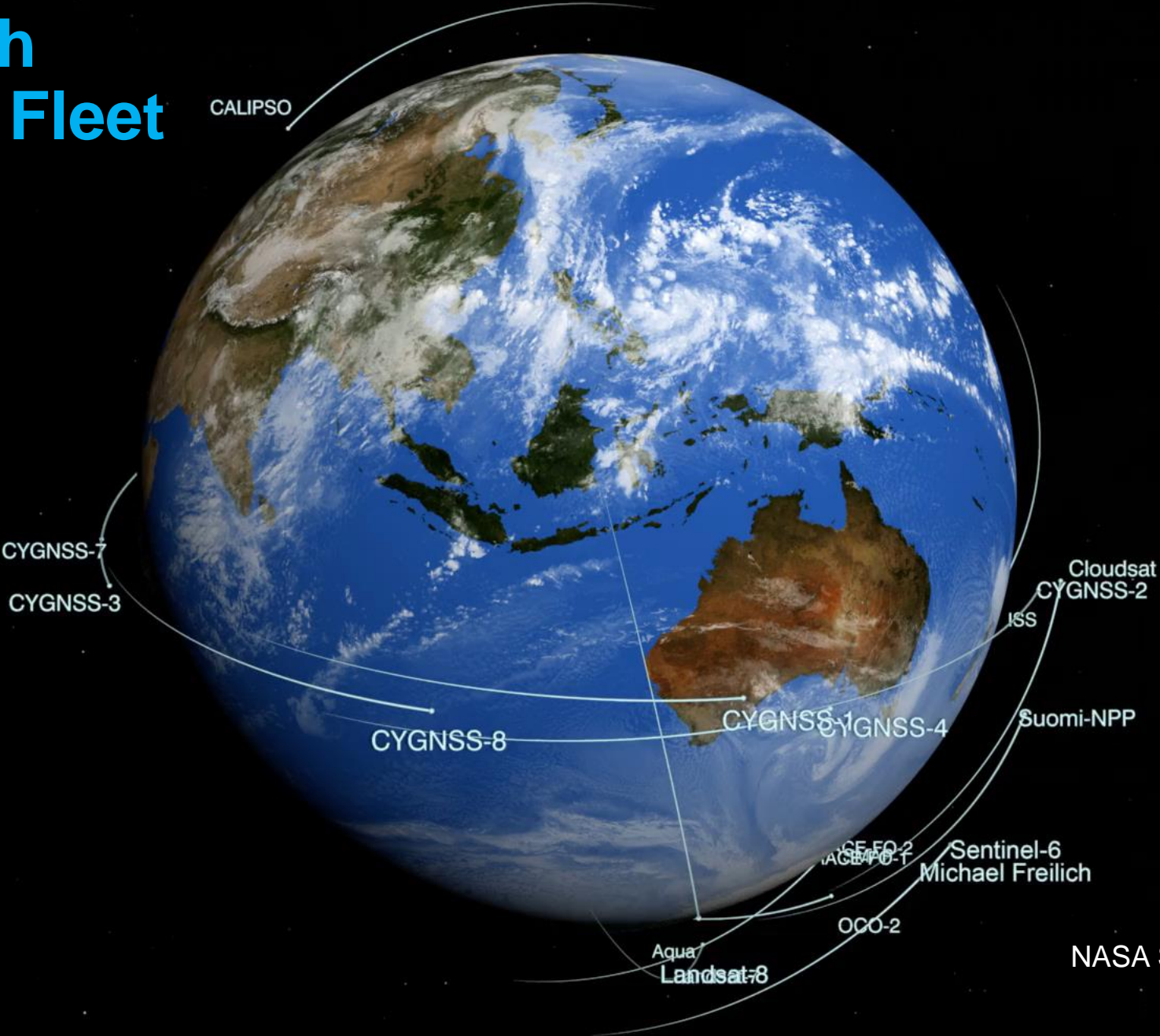
**PROTECT AND
IMPROVE LIFE ON
EARTH AND IN SPACE**

**SEARCH FOR LIFE
ELSEWHERE**

**DISCOVER SECRETS
OF THE UNIVERSE**



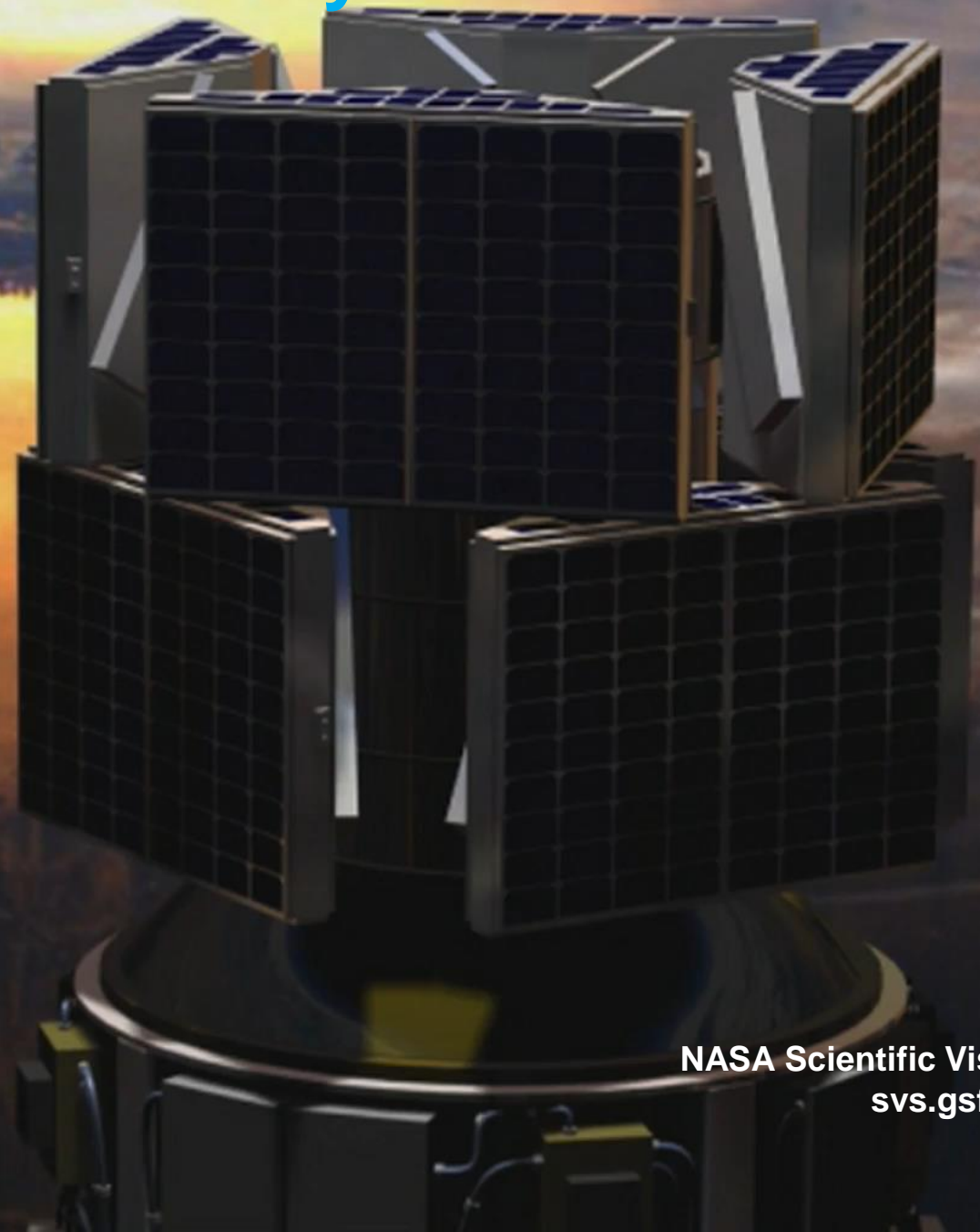
NASA Earth Observing Fleet



August 2021

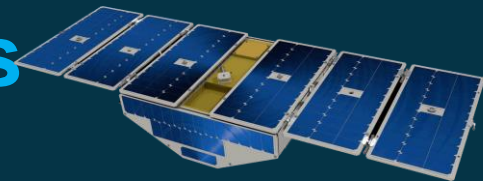
NASA Scientific Visualization Studio
svs.gsfc.nasa.gov/4931

CYGNSS: Eight Eyes in the Sky



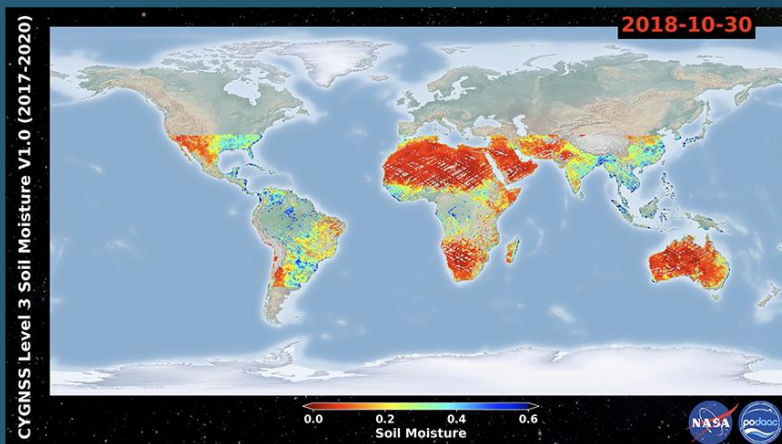
NASA Scientific Visualization Studio
svs.gsfc.nasa.gov/12447

CYGNSS Scientific Results and Applications



Daily soil moisture data product

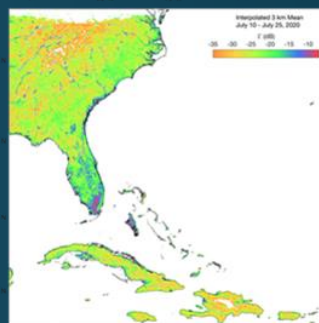
- Oct. 30, 2018



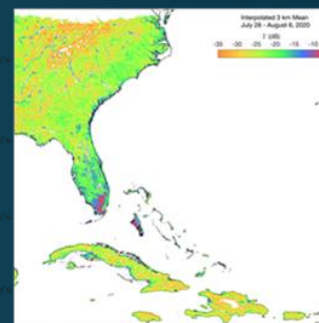
Map flood inundation after hurricane landfall

- Reflectivity before and after Hurricane Isaias landfall, July-August 2020

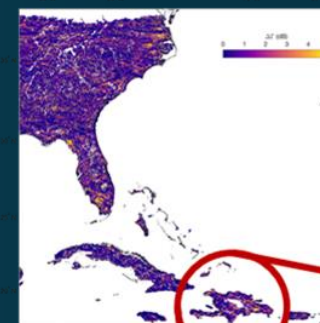
Before landfall



After

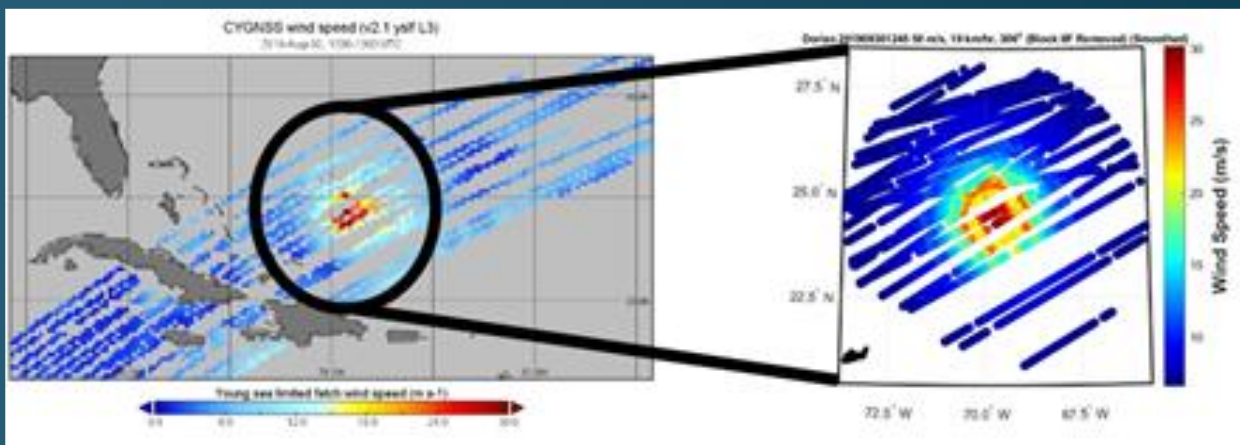


Delta

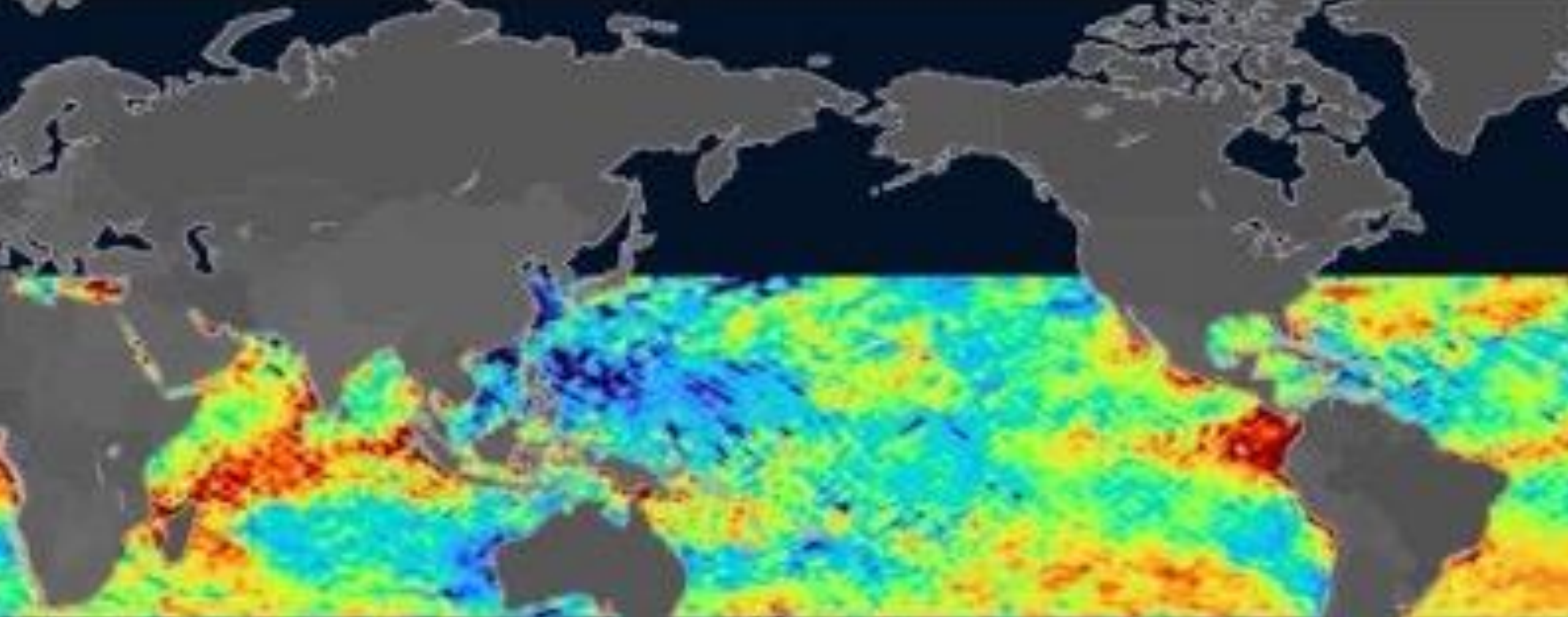


Measure winds in tropical cyclones

- Hurricane Dorian overpass, Aug. 30, 2019 at 02:45 UTC



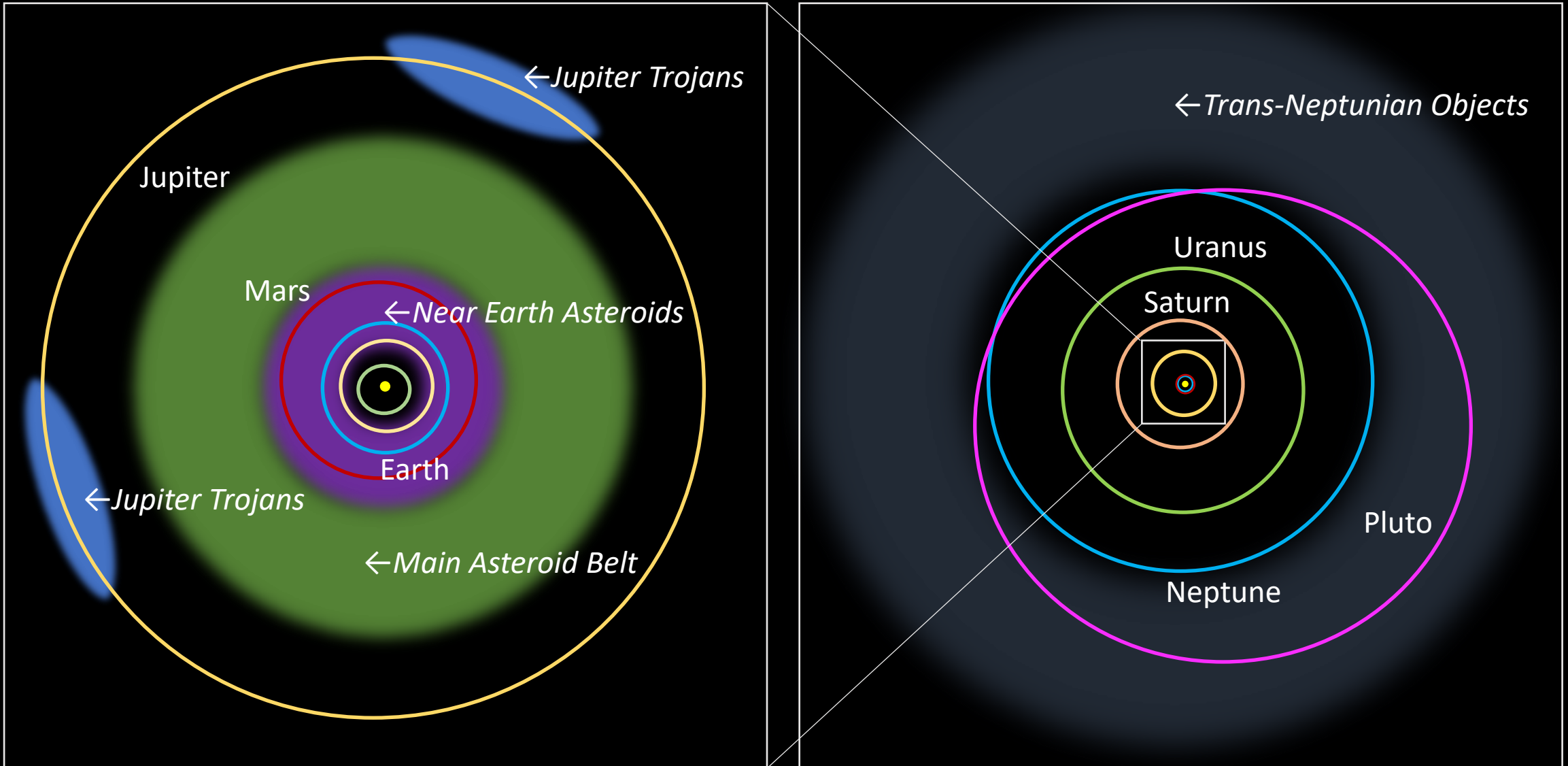
Extensive flooding in the Dominican Republic



CYGNSS: Observations of sources of ocean microplastic from space

<https://www.youtube.com/watch?v=sQTGOU9LiJ0&t=5s>

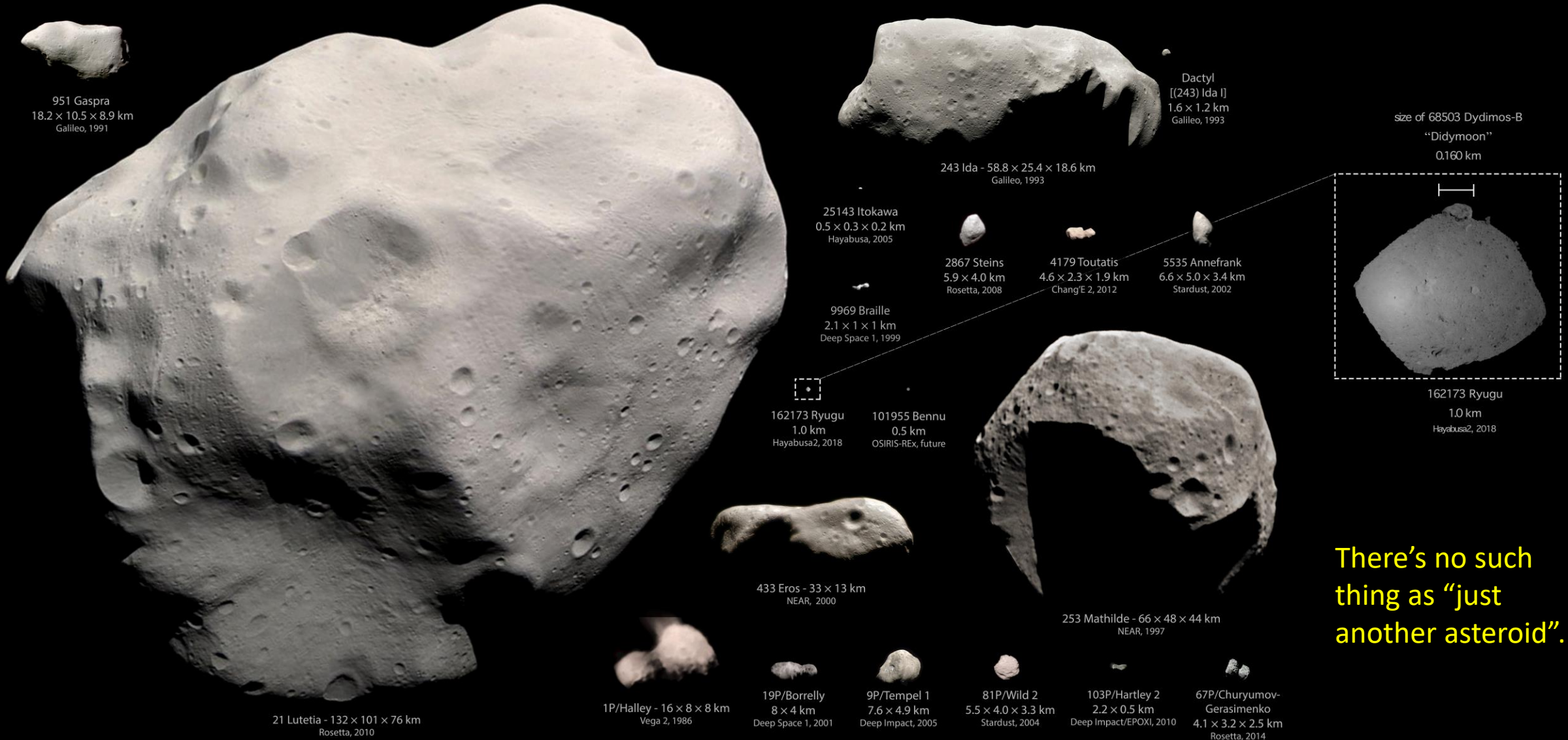
Different Asteroid Populations Tell Distinct Stories About our Solar System's History



Inner Solar System

Outer Solar System

Asteroids and Comets Seen Up Close by Spacecraft



There's no such thing as "just another asteroid".

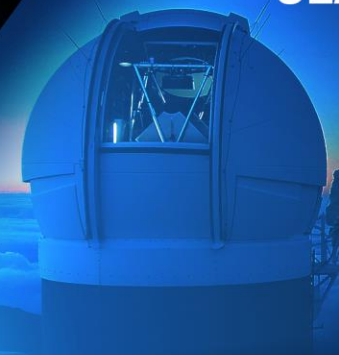
ASSESS

[CENTER FOR NEAR EARTH OBJECT STUDIES]



SEARCH, DETECT & TRACK

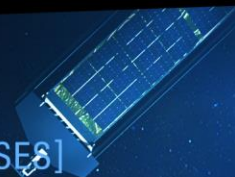
[SPACE-BASED & GROUND-BASED OBSERVATIONS, IAWN]



MITIGATE

[DART, FEMA EXERCISES]

DART is the first full-scale flight demonstration of an asteroid deflection technology: kinetic impact



PLANETARY DEFENSE

PLAN & COORDINATE

[SMPAG, PIERWG, NITEP IWG]

CHARACTERIZE

[NEOWISE, GOLDSTONE, IRTF]



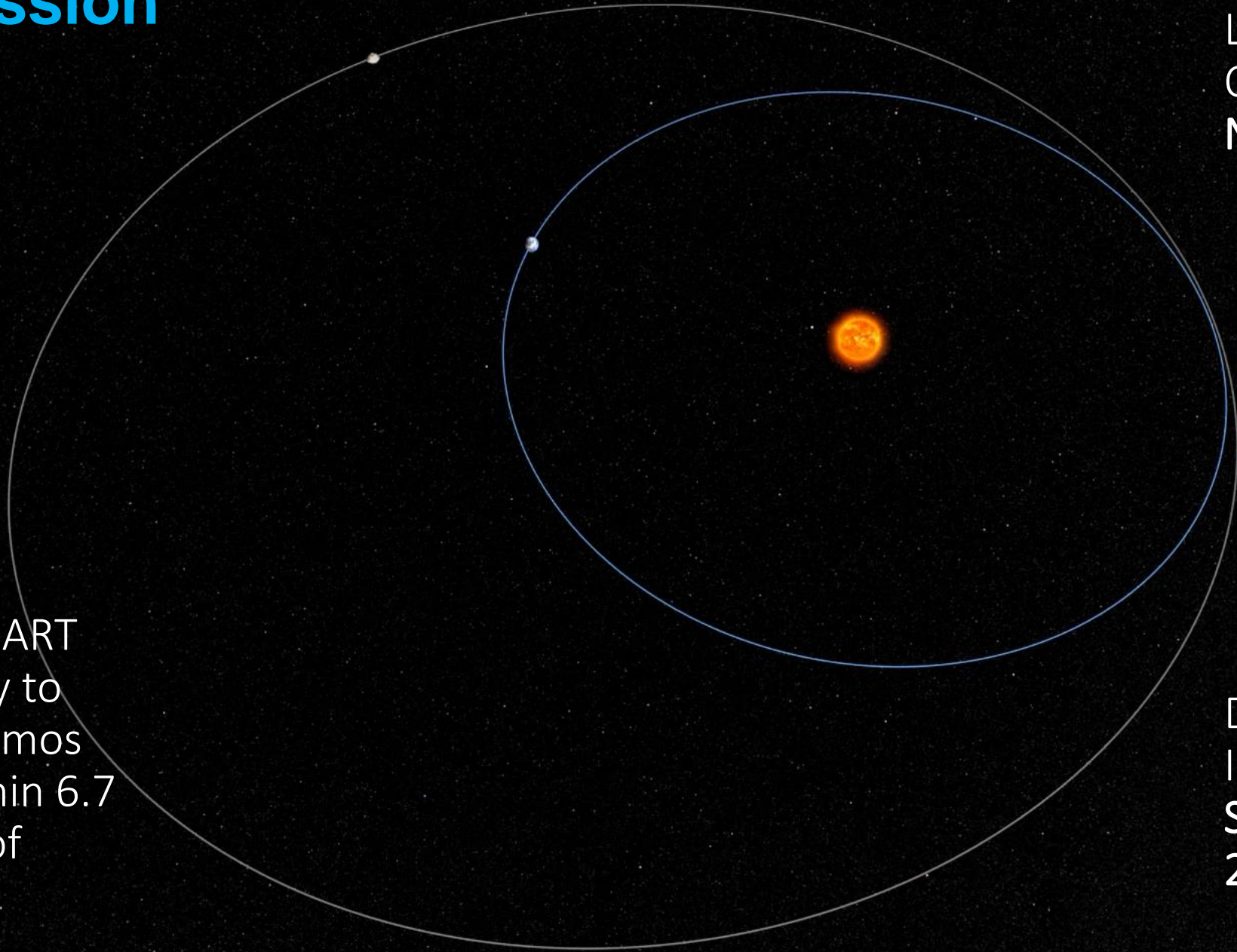
NASA's DART Mission: Learning to Defend Earth from Asteroid Impacts

DART Mission Profile

Launch Window
Opens:
Nov. 23, 2021

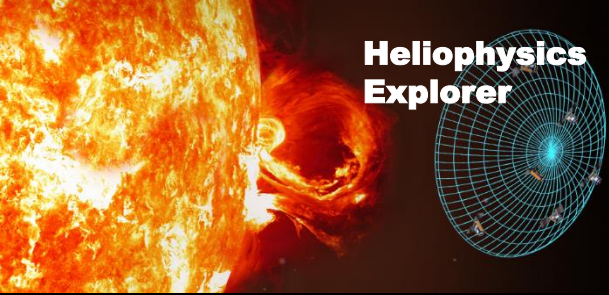
Launch puts DART
on a trajectory to
intercept Didymos
when it is within 6.7
million miles of
Earth

DART Kinetic
Impact:
**Sept. 26 – Oct
2, 2022**



Double Asteroid Redirection Test Mission (DART) / LICIA Cube





Heliophysics
Explorer



Sun Radio Interferometer Space Experiment (SunRISE)

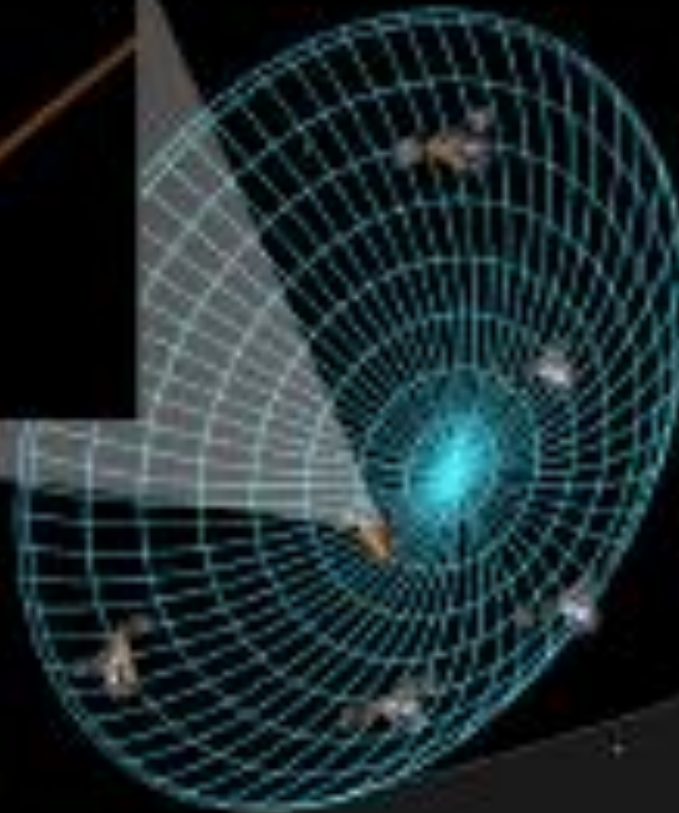
PI: Justin C. Kasper/University of Michigan



Sun Radio Interferometer
Space Experiment



Coronal Mass Ejection
Coronagraph Image

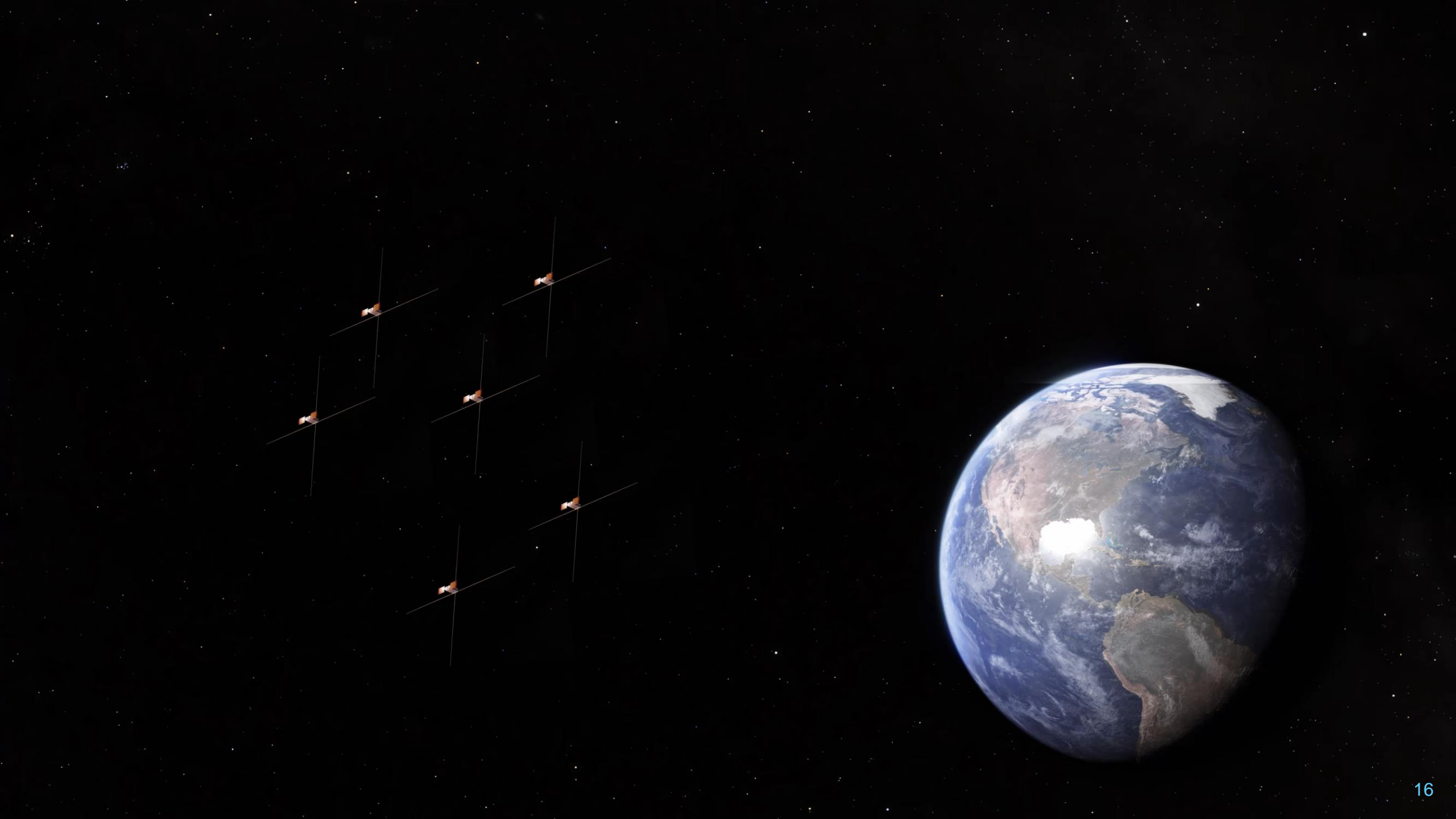


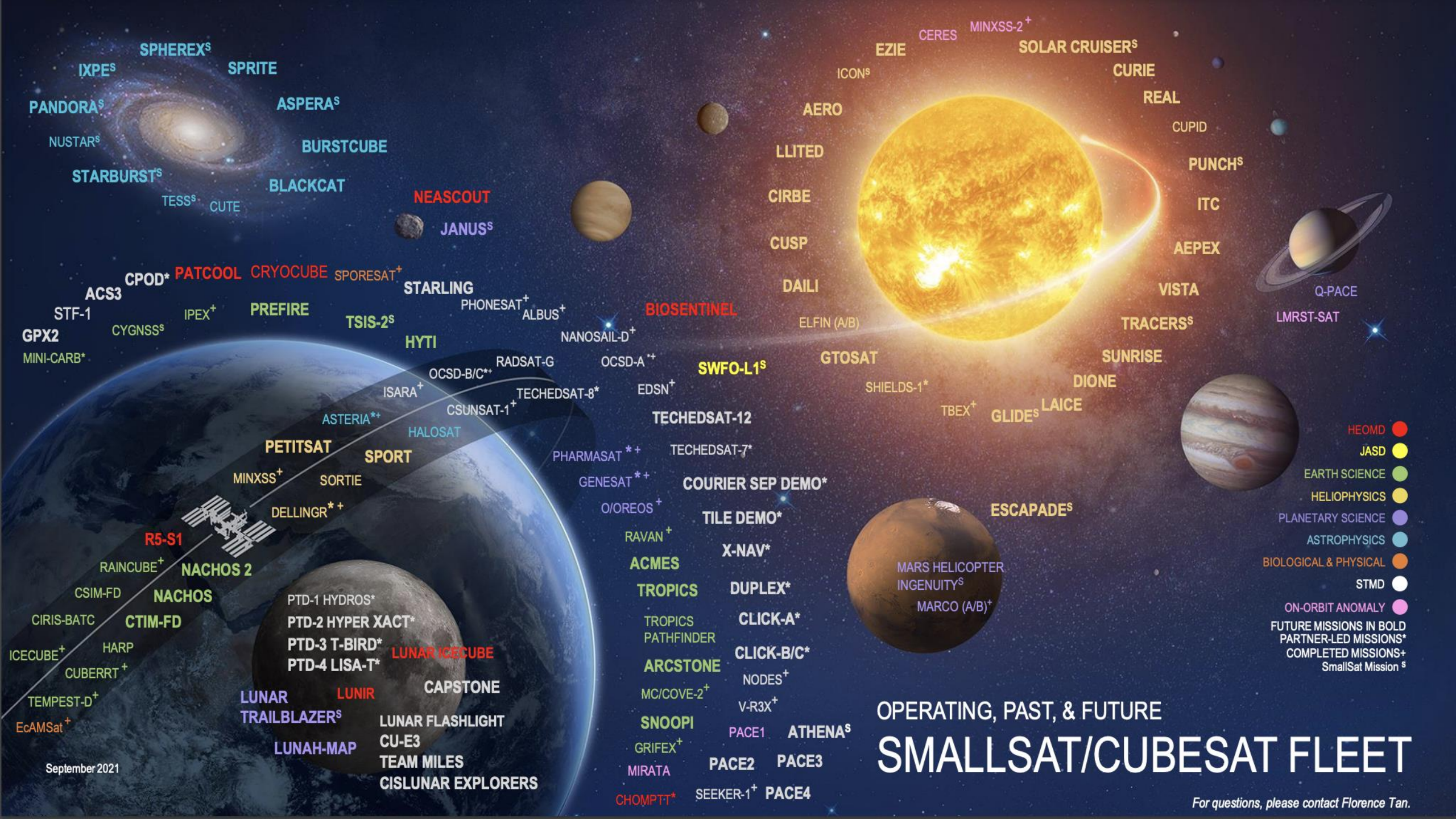
SunRISE Observatory



Global Navigation
Satellite System







IXPE^S SPHEREX^S SPRITE
 PANDORA^S ASPERA^S
 NUSTAR^S BURSTCUBE
 STARBURST^S BLACKCAT
 TESS^S CUTE

ACS3 CPOD* PATCOOL CRYOCUBE SPORESAT⁺
 STARLING
 STF-1 PHONESAT⁺ ALBUS⁺
 GPX2 CYGNSS^S IPEX⁺ PREFIRE
 TSIS-2^S HYTI
 MINI-CARB* RADSAT-G

OCSD-B/C**
 ISARA⁺ RAVAN⁺
 ASTERIA**
 CSUNSAT-1⁺ TECHEDSAT-8*
 HALOSAT
 PETITSAT
 SPORT
 MINXSS⁺ SORTIE
 DELLINGR**⁺

R5-S1
 RAINCUBE⁺ NACHOS 2
 CSIM-FD NACHOS
 CIRIS-BATC CTIM-FD
 ICECUBE⁺ HARP
 CUBERRT⁺
 TEMPEST-D⁺
 EcAMSat⁺

PTD-1 HYDROS*
 PTD-2 HYPER XACT*
 PTD-3 T-BIRD*
 PTD-4 LISA-T*
 LUNAR ICECUBE
 LUNAR LUNIR
 CAPSTONE
 LUNAR FLASHLIGHT
 CU-E3
 TEAM MILES
 CISLUNAR EXPLORERS
 LUNAH-MAP

NEASCOUT
 JANUS^S

BIOSENTINEL
 NANOSAIL-D⁺
 OCSD-A**

TECHEDSAT-12
 PHARMASAT*⁺
 GENESAT*⁺
 O/OREOS⁺

TECHEDSAT-7*
 COURIER SEP DEMO*
 TILE DEMO*
 X-NAV*
 RAVAN⁺

ACMES
 TROPICS
 TROPICS PATHFINDER
 ARCSTONE
 MC/COVE-2⁺

SNOOPI
 GRIFEX⁺
 MIRATA

CHOMPTT*
 SEEKER-1⁺
 PACE1 ATHENA^S
 PACE2 PACE3
 PACE4

SWFO-L1^S
 GOTOSAT
 SHIELDS-1*
 TBEX⁺
 GLIDE^S
 LAICE

ESCAPADE^S
 MARS HELICOPTER
 INGENUITY^S
 MARCO (A/B)*

OPERATING, PAST, & FUTURE
SMALLSAT/CUBESAT FLEET

MINXSS-2⁺
 CERES
 EZIE
 ICONS^S
 AERO
 LLITED
 CIRBE
 CUSP
 DAILI
 ELFIN (A/B)
 AEROSOL
 SOLAR CRUISER^S
 CURIE
 REAL
 CUPID
 PUNCH^S
 ITC
 AEPEX
 VISTA
 TRACERS^S
 SUNRISE
 DIONE

- HEOMD ●
- JASD ●
- EARTH SCIENCE ●
- HELIOPHYSICS ●
- PLANETARY SCIENCE ●
- ASTROPHYSICS ●
- BIOLOGICAL & PHYSICAL ●
- STMD ●
- ON-ORBIT ANOMALY ●
- FUTURE MISSIONS IN BOLD
- PARTNER-LED MISSIONS*
- COMPLETED MISSIONS+
- SmallSat Mission ^S

NASA



EXPLORE
with us