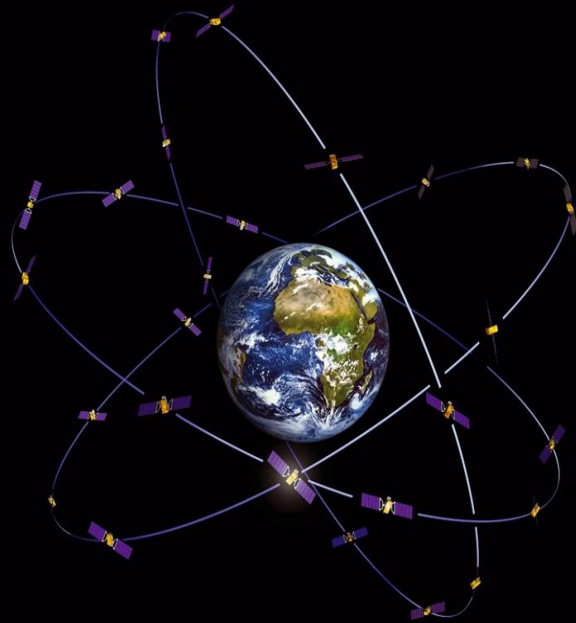


## Extending GNSS services to Cis-lunar Study

- 1) Earth-Moon and Moon-Earth transfer orbits
- 2) Lunar Orbit
- 3) Descent/Landing and Moon Surface Operations



### Some of the key challenges

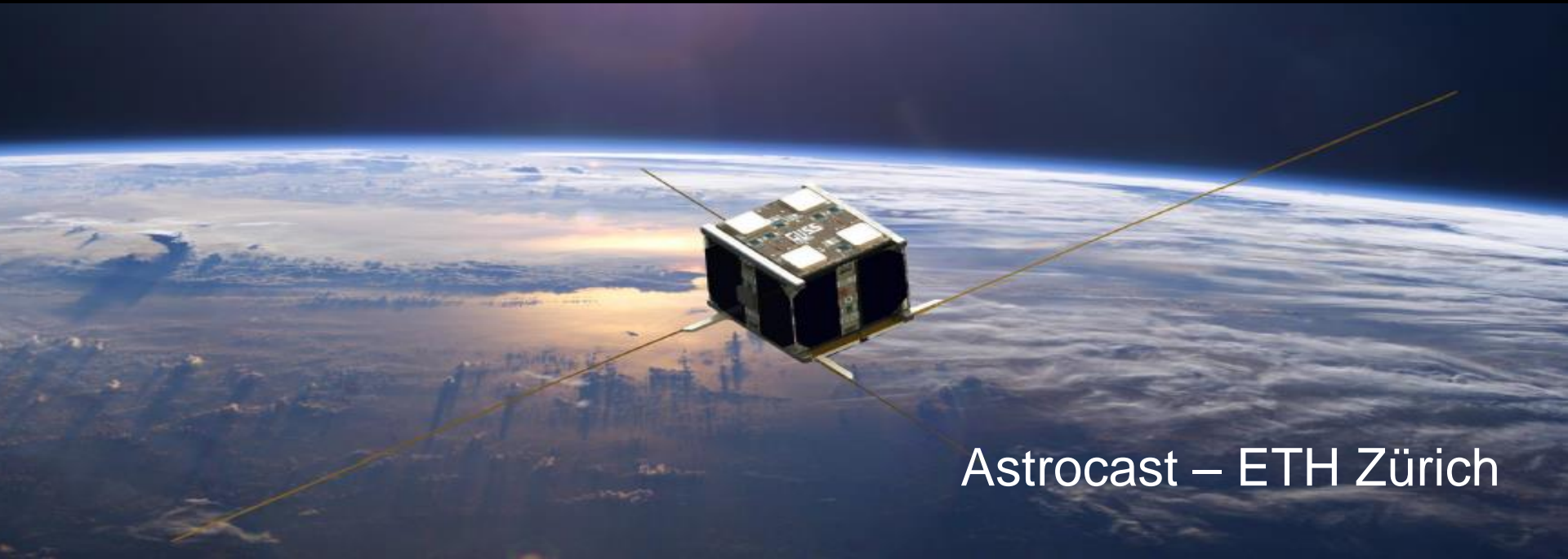
- very low signal levels of GNSS signals;
- kinematics of the receiver (e.g. high Doppler rates and Doppler shifts);
- reduced visibility of satellites;
- no access to navigation data
- need of augmentations

1. to perform a **dedicated System study** on the use of multi-constellation GNSS for Earth-Moon missions: a) **consolidating the necessary PNT User Requirements**; b) **assessing in detail all previous studies**; and c) **identifying a preliminary architecture with possible enhancements/augmentation to existing GNSS constellations, assessing its feasibility and associated performances (9 months study)**
2. to **develop and test a high-sensitivity GNSS space-borne receiver** (target TRL5) that might be used in future demonstrations missions to gather data and support further system activities. The unit develop in this activity **might be considered for a short In-Orbit Demonstration (IOD) mission (18 months development)**.

**Proposals expected end of this year 2018. Activity planned to Be kicked-off in Feb 2019. First results available for ICG-14 in 2019.**

Fostering Science with GNSS

# Supporting GNSS Scientific Cubesats with Universities



Astrocast – ETH Zürich

Launch planned 19<sup>th</sup> Nov 2018. It includes several GNSS scientific tests (e.g. POD, air density estimation, radio occultation, etc). First GNSS receiver in space tracking 5 GNSS Systems (GPS, Galileo, Glonass, Beidou and QZSS)



# Towards the provision of a GNSS-SSV data repository: proposal for discussion

Dr Javier Ventura-Traveset

06 Nov 2018, ICG-13 meeting, Xi'An, China



# Galileo Science Support Centre (GSSC) portal opens this week



The GNSS Science Support Centre (GSSC) is an initiative of ESA to foster GNSS scientific research and cooperation. It aims at integrating information and processing assets from all different GNSS scientific domains into a single virtual archive.

# ESA GSSC Facilities at ESAC, Madrid (Spain)



Located at European Space Astronomy Center - ESAC

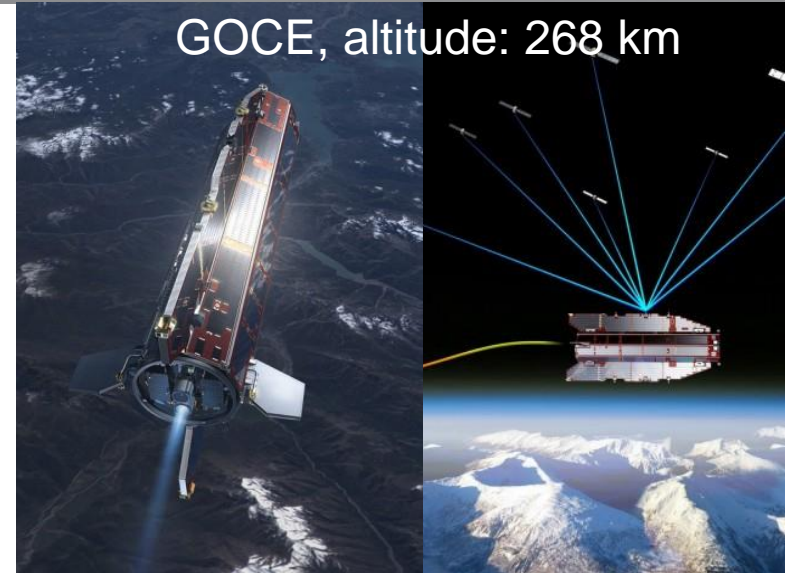
Towards a worldwide reference GNSS Science Exploitation  
and Preservation Platform



# Towards the provision of a GNSS-SSV data repository



- ESA intends to provide via the ESA's GSSC portal all **publically GNSS data observables from ESA/EU Earth Observation satellite missions.**
- First natural candidates **ESA Earth Explorers (GOCE and SWARM data already included)** and then EU Copernicus ESA Sentinel satellites and METOP.
- Interest for scientific purposes and in support to future GNSS SSV activities.
- **Interest for international cooperation.**





# SENTINEL SATELLITES



sentinel-1



sentinel-6



sentinel-2



sentinel-5



sentinel-3



sentinel-sp



sentinel-4



ESA/EUTMETSAT MetOp – C launch on Nov 7, 2018  
with GNSS Radio oculation (GRAS instrument)

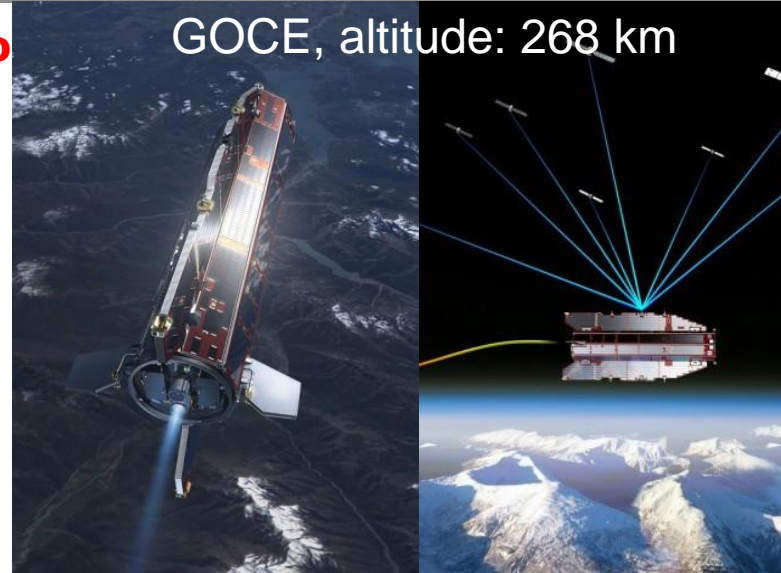


# Towards the provision of a GNSS-SSV data repository: PROPOSAL



- ESA would like to propose a Recommendation **to establish cooperation among all ICG members for the set-up of a GNSS-SSV join data repository to promote Scientific research activities and SSV performance analysis and to ensure long-term data preservation (precise Recommendation to be discussed/formulated in the context of WG-B, Space Applications Subgroup)**
- ESA offers the GNSS Science Support Centre (GSSC) to store and preserve (long-term) this data. If desired, other Agencies could propose back-up centres.
- In medium term, cooperation / integration with IGS could also be conceived.

GOCE, altitude: 268 km



SWARM, altitude: 450-530 km

