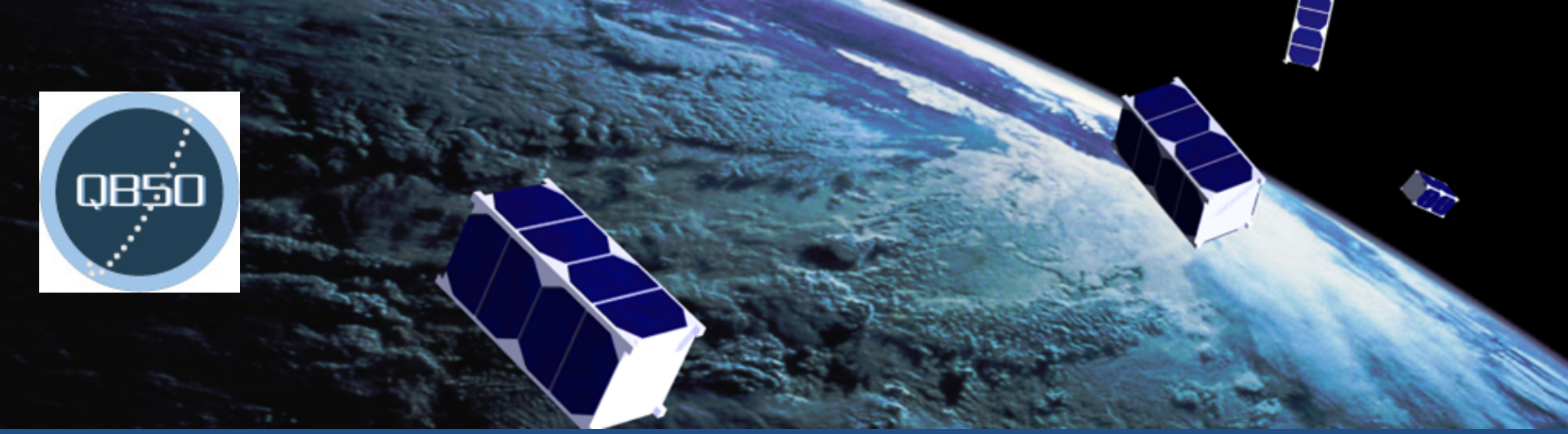


STATUS OF THE QB50

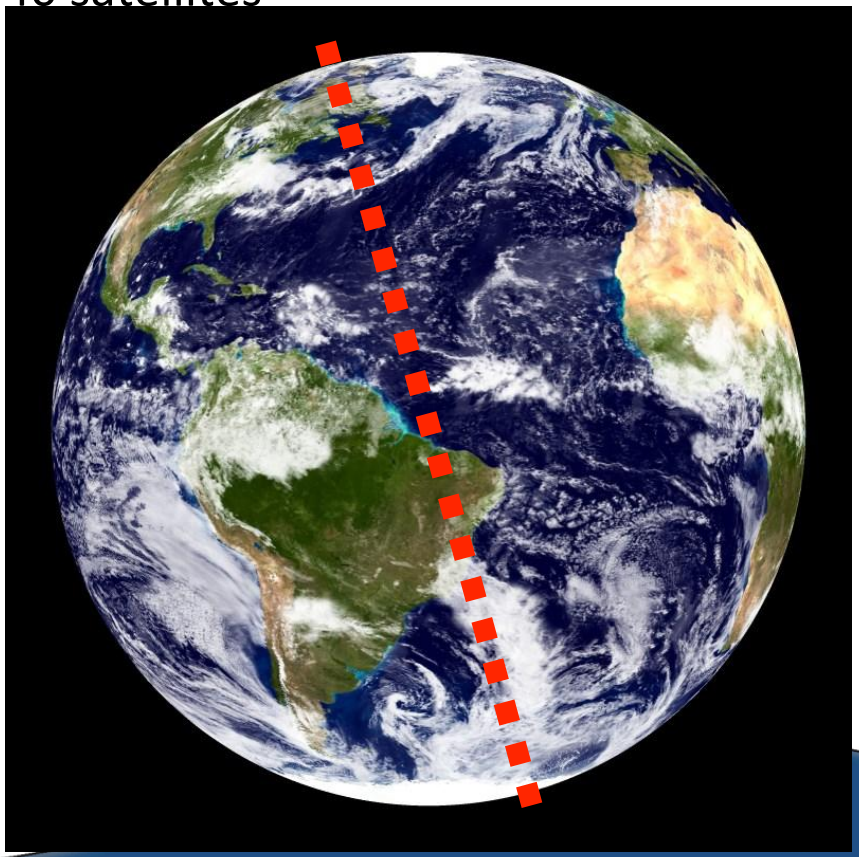
speaker: Jan Thoemel
von Karman Institute, Belgium

Journees ESEP, 12 Decembre 2014, Universite P. & M. Curie

Overview - Project's Main Activities

QB50

- has invited 50+ international universities to join
- will send 50 double CubeSats into LEO in January 2016
- carry-out an unprecedented science campaign to probe the thermosphere with fragmented sensors on ~40 satellites
- demonstrate new technologies
- supports teams with
  - provision of Sensor Units and ADCS
  - guidance on satellite design
- carries out a test flight since June 2014



Overview II - Mission Architecture

QB50

- consists of:
  - space segment
    - ~40 satellites contributed by a world wide community for an atmospheric science campaign
    - ~10 additional In-Orbit Demonstration satellites
  - ground segment
    - combination of 50 amateur ground stations
    - central functions like Mission Display Centre, Central Node
  - launch segment
    - modular, versatile deployment system
    - launcher
- is realized by:
  - an EC funded consortium of 15 world wide partners
  - 50 CubeSat teams from all over the world
  - many collaborators

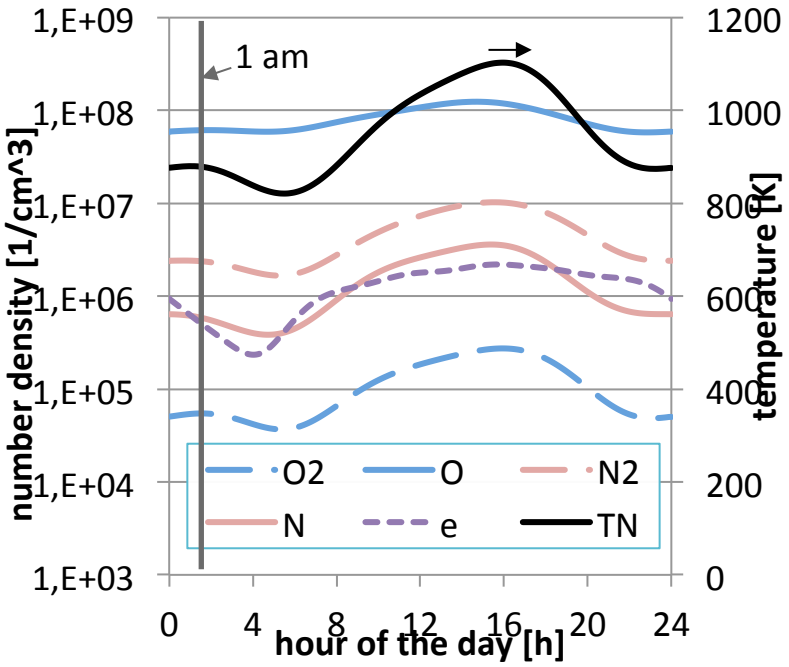
QB50 Science

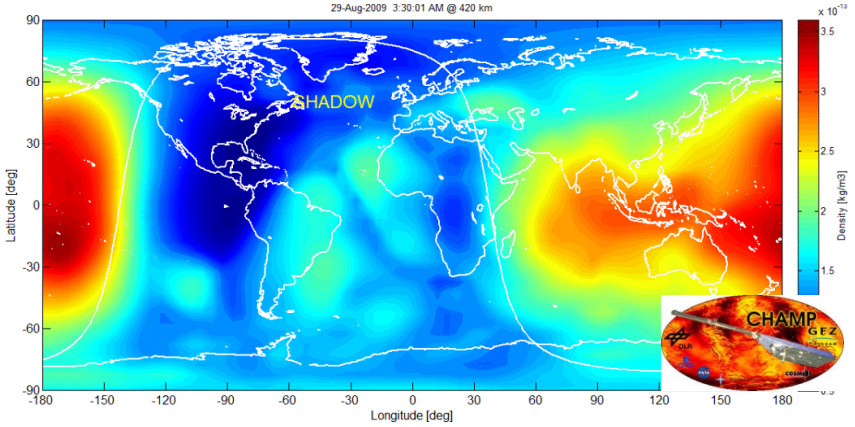
- objectives:
  - technology science:
    - miniaturization of satellite technology
    - facilitating access to space
    - in-orbit demonstration of new space technology
  - fundamental science:
    - understand thermosphere and improve modeling
- dissemination: Annual European Cubesat Symposium
    - 14-16th October, 2014 , Estavayer-le-Lac, Switzerland
    - ~8-11 Sept. 2015, Liege , Belgium

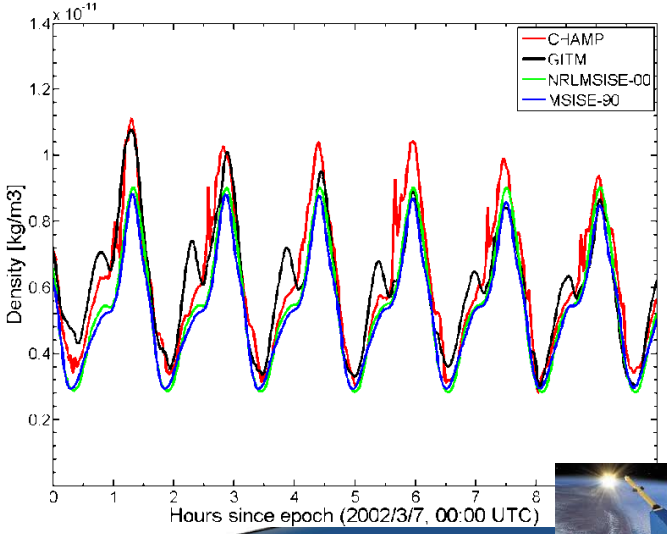
Focus: Thermosphere Science I, Activities

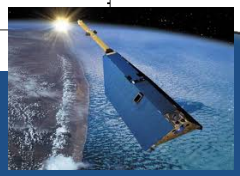
- Predict measurements using:
  - empirical models such as MSISE & IRI
  - first principles models such GITM
- compare predictions with available data:
  - from satellites CHAMP, TIMED
  - from ground based data EISCAT
- coordinate with science community science team:
  - von Karman Institute (VKI, B):
  - Mullard Space Science Laboratory (MSSL, UK):
  - Institute for Atmospheric Physics (IAP, D):
  - interested cubesat teams
- key requirement on science cubesats:
  - acquire and downlink 2Mbit/day during science phase

Focus: Thermosphere Science II, Results



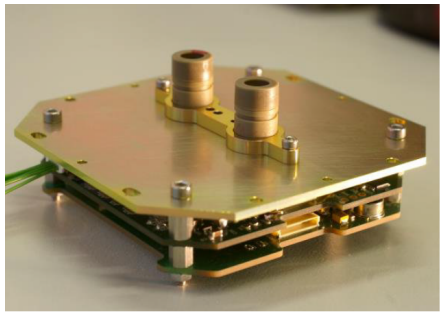




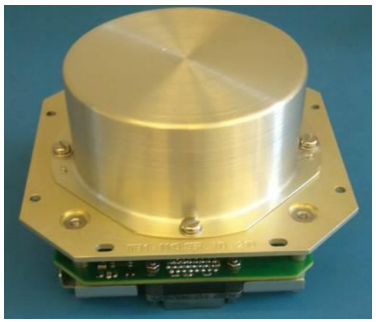


Focus: Thermosphere Science III, Sensors

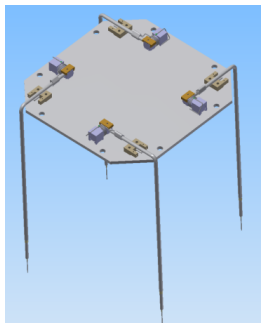
- sensing means: ~ 43 fragmented sensors
  - 19 AO, O2: FIPEX
  - 11 electron density: multi Needle Langmuir probes (MNLP)
  - 13 ion and neutral mass spectrometers (INMS)

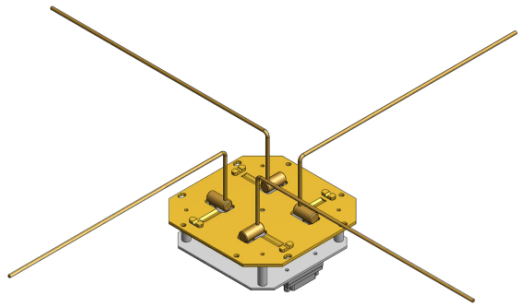


FIPEX (TU-Dresden, D),



INMS (MSSL, UK),

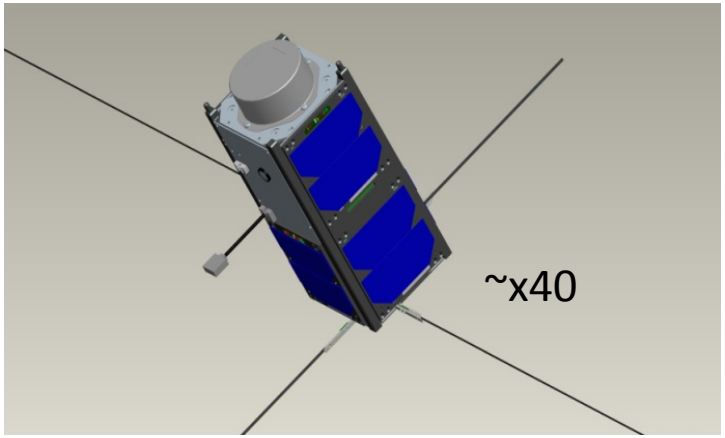


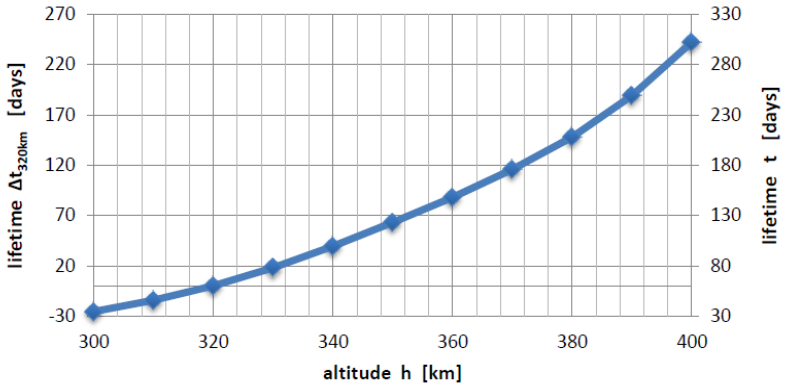


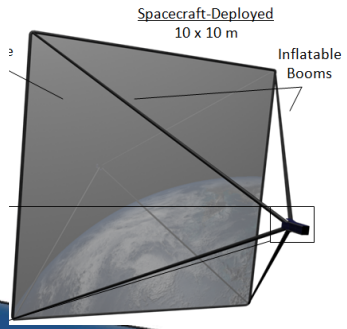
Langmuir Probe, stowed, deployed (UiO, Norway)

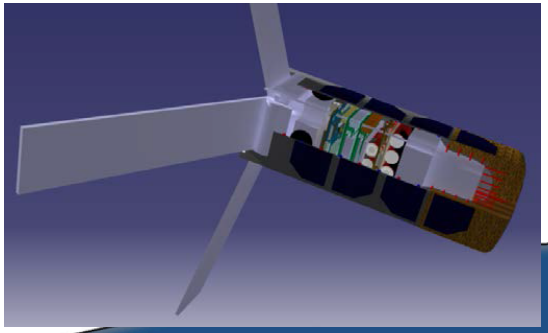
Space Segment

- ~40 science satellites
  - QB50 Sensor Unit
  - CubeSat Payload
- ~10 In Orbit Demonstration satellites
  - InflateSail (Surrey Space Centre, UK)
  - Delta, Phi (TU-Delft, NL)
  - Qarman (VKI)









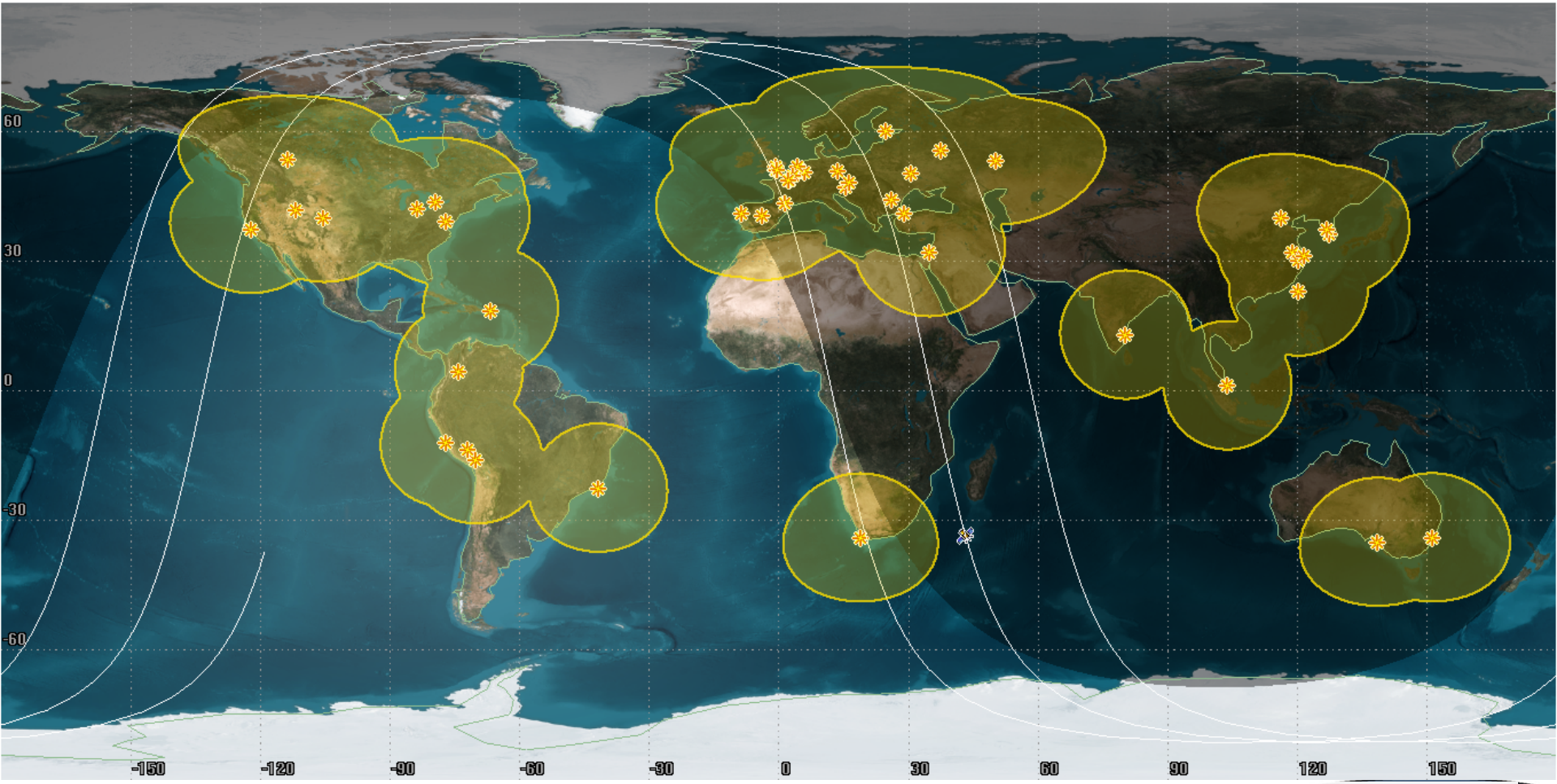
Ground Segment

QB50 Ground Segment

- consists of
  - 50 amateur ground stations
  - central functions such a Central server for TLE, Science Data, WOD storage; coordination with USSTRATCOM/NORAD etc
  - Radio Amateurs coordination
  - Mission Display Centre
- frequency coordination of
  - 50 UHF downlink and
  - 10 shared VHF uplink frequency

  done with help of AMSAT UK/FR/NL/BE

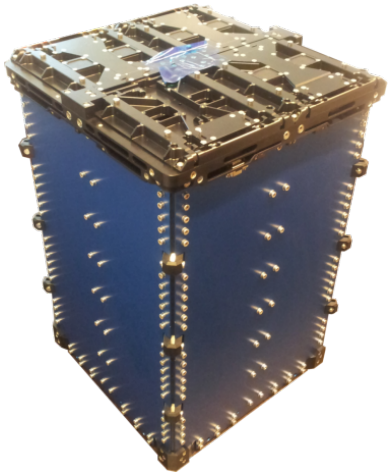
Ground Segment

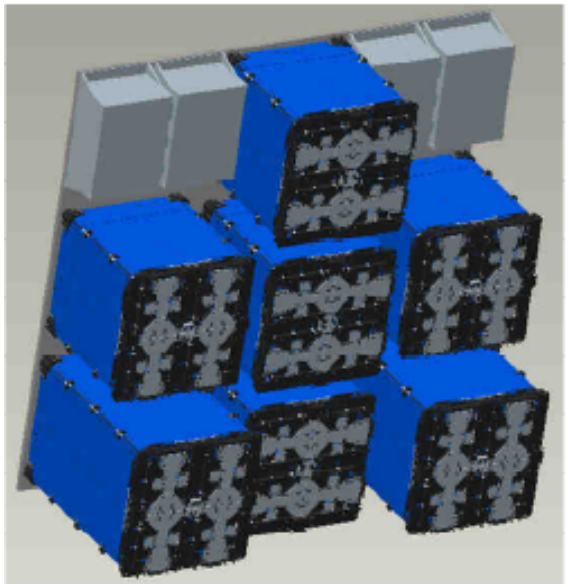


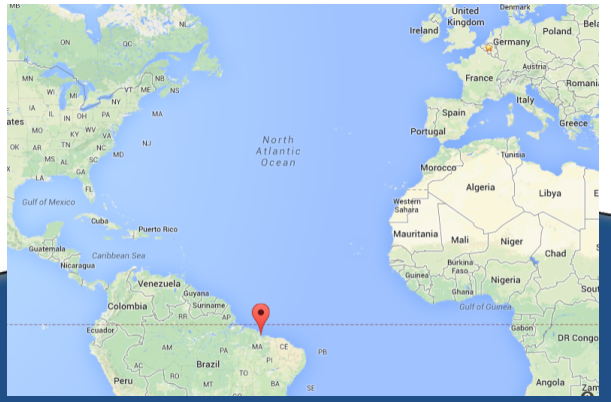
Distribution of baseline ground station and coverage for 380 altitude

Launch Segment

- deployment system made of versatile QuadPack modules, designed and manufactured by ISIS B.V., NL
- launch will take place January 2016
- orbit:
  - ~380 km altitude
  - 98 deg inclination

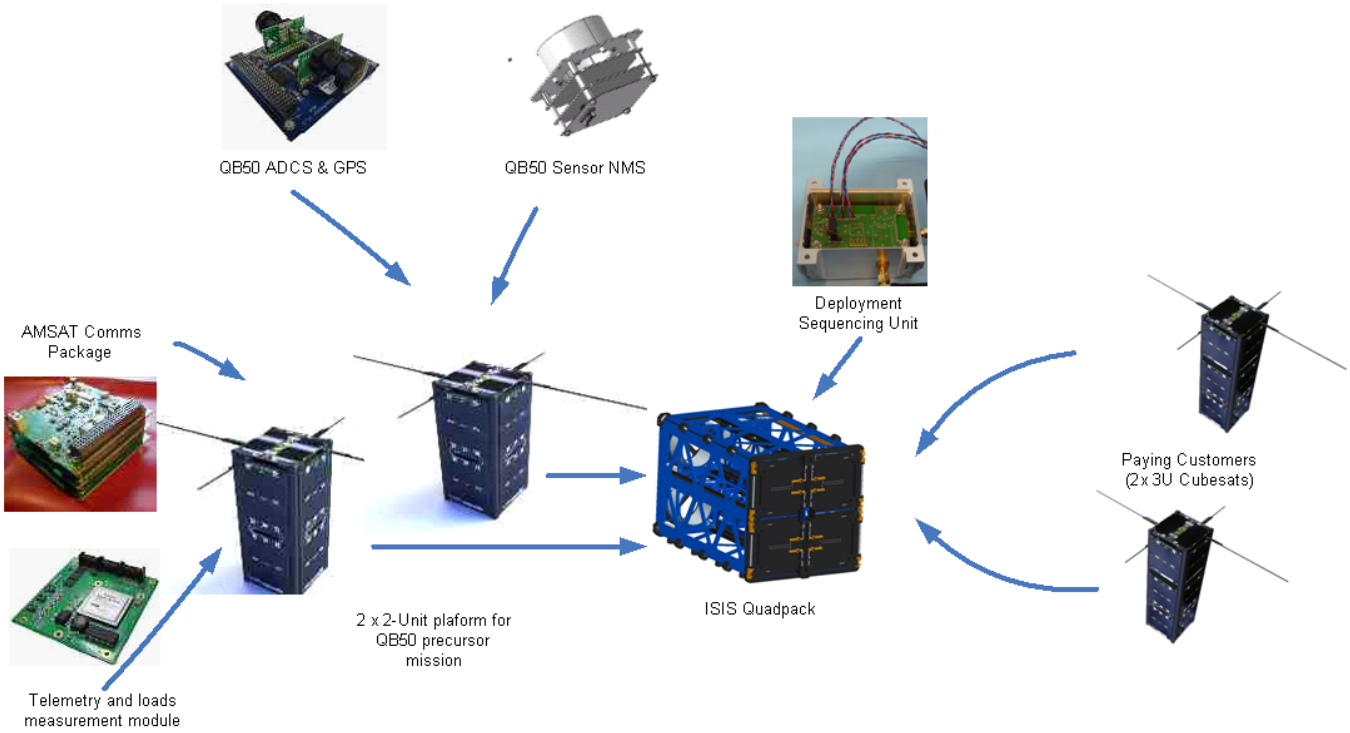






Precursor De-risking Campaign - Rationale

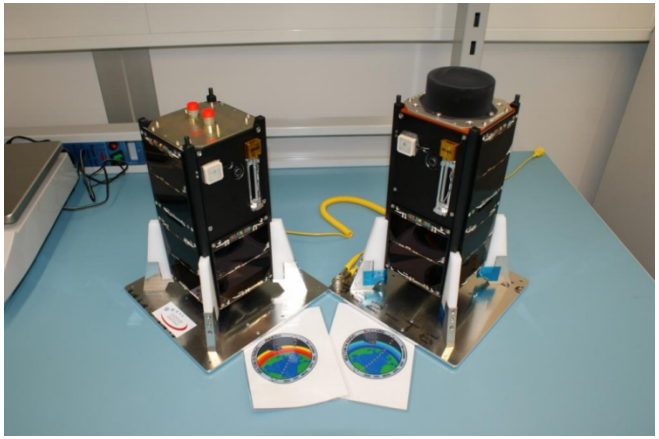
- CubeSat missions are inherently more risky
- Is this acceptable for constellations like QB50?

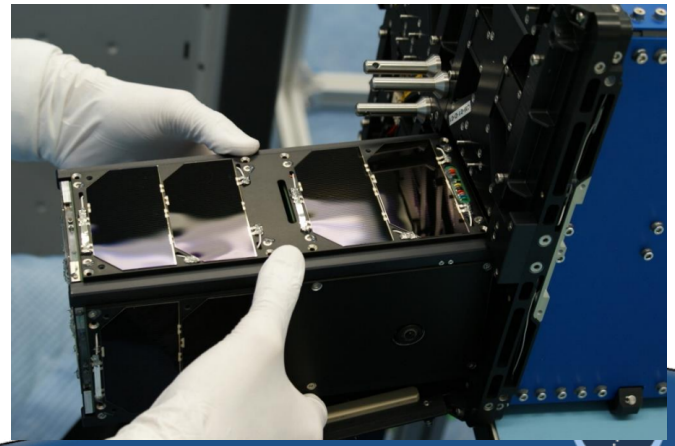


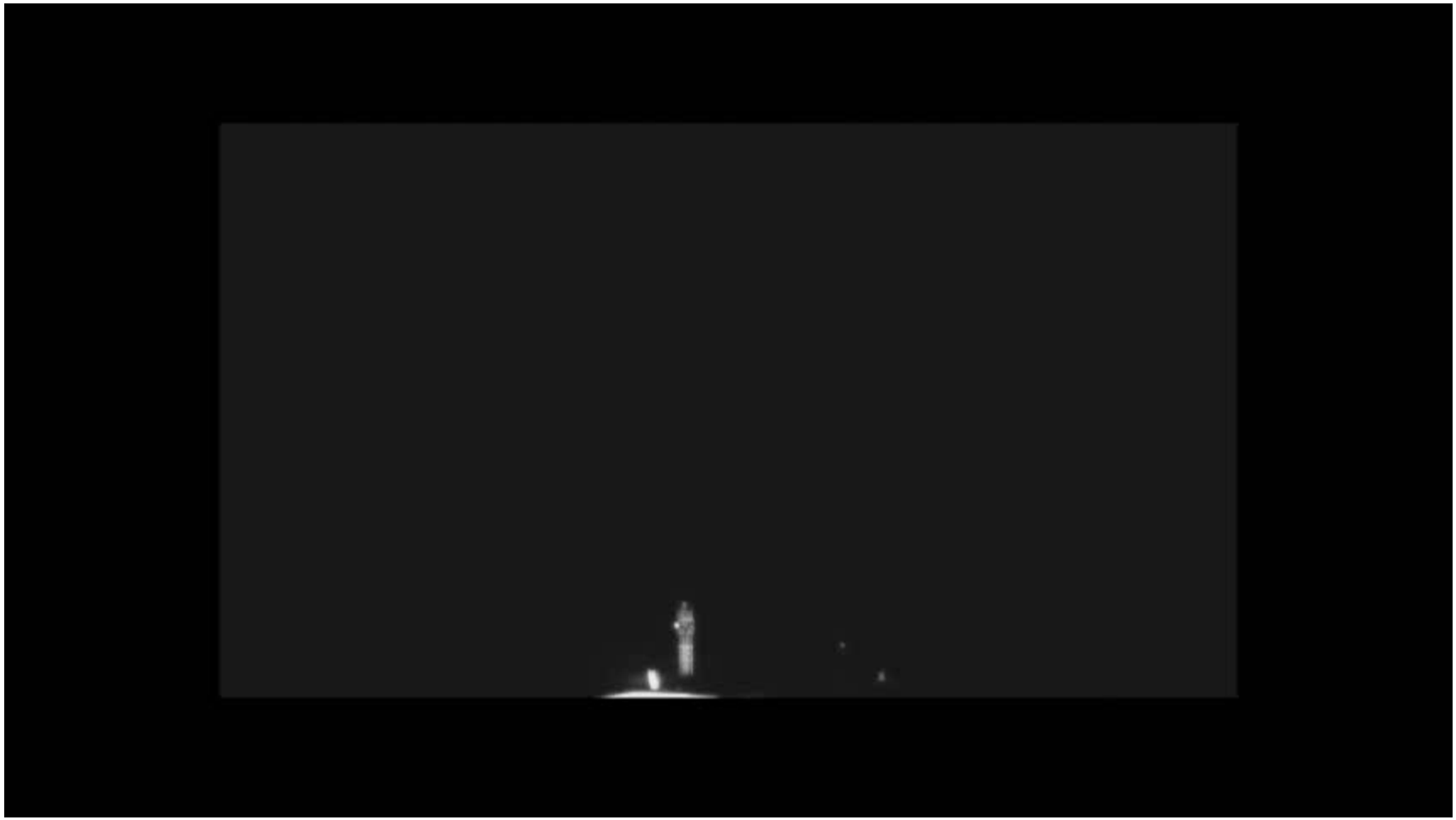
Precursor Derisking Campaign

in less than 12 months:

- consortium and collaborators management
- subsystems definition, design, manufacturing:
  - INMS, FIPEX (MSSL, TU-Dresden)
  - ADCS (SSC)
  - thermal payload and cutting edge thermal analysis (VKI)
  - coms payloads (AMSAT)
- satellite design, assembly and management (ISIS)
- frequency allocation and space object registration

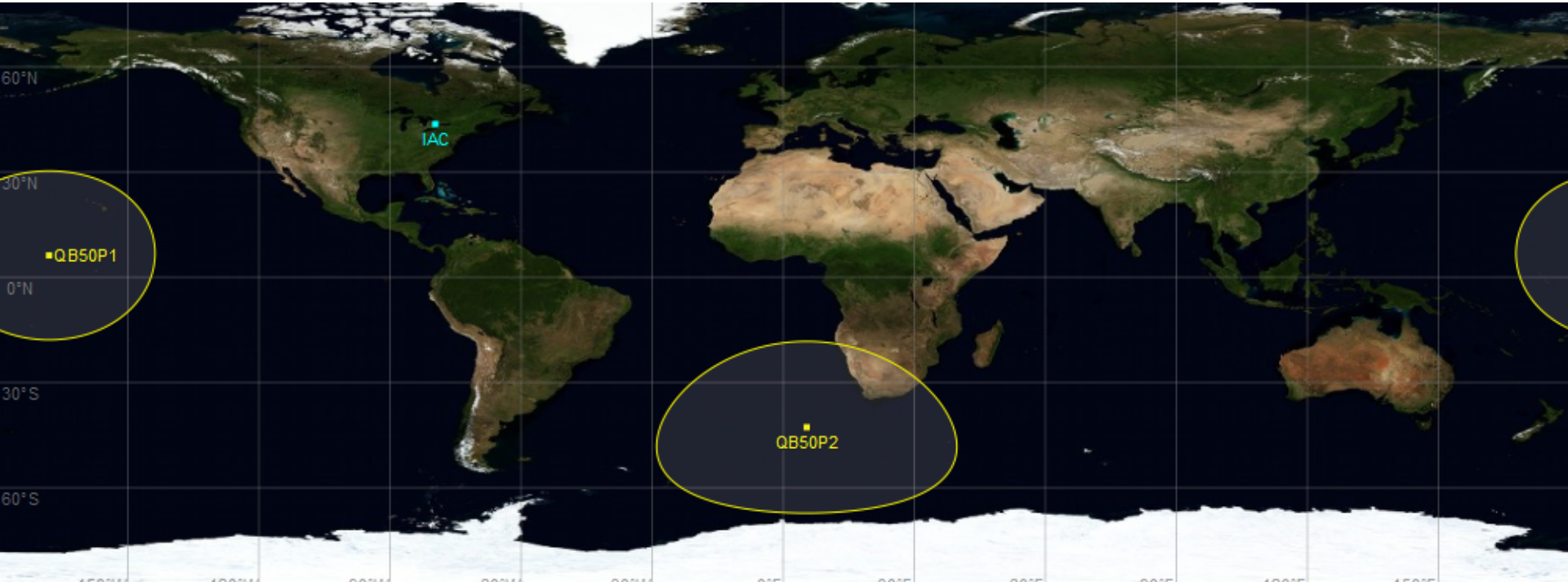




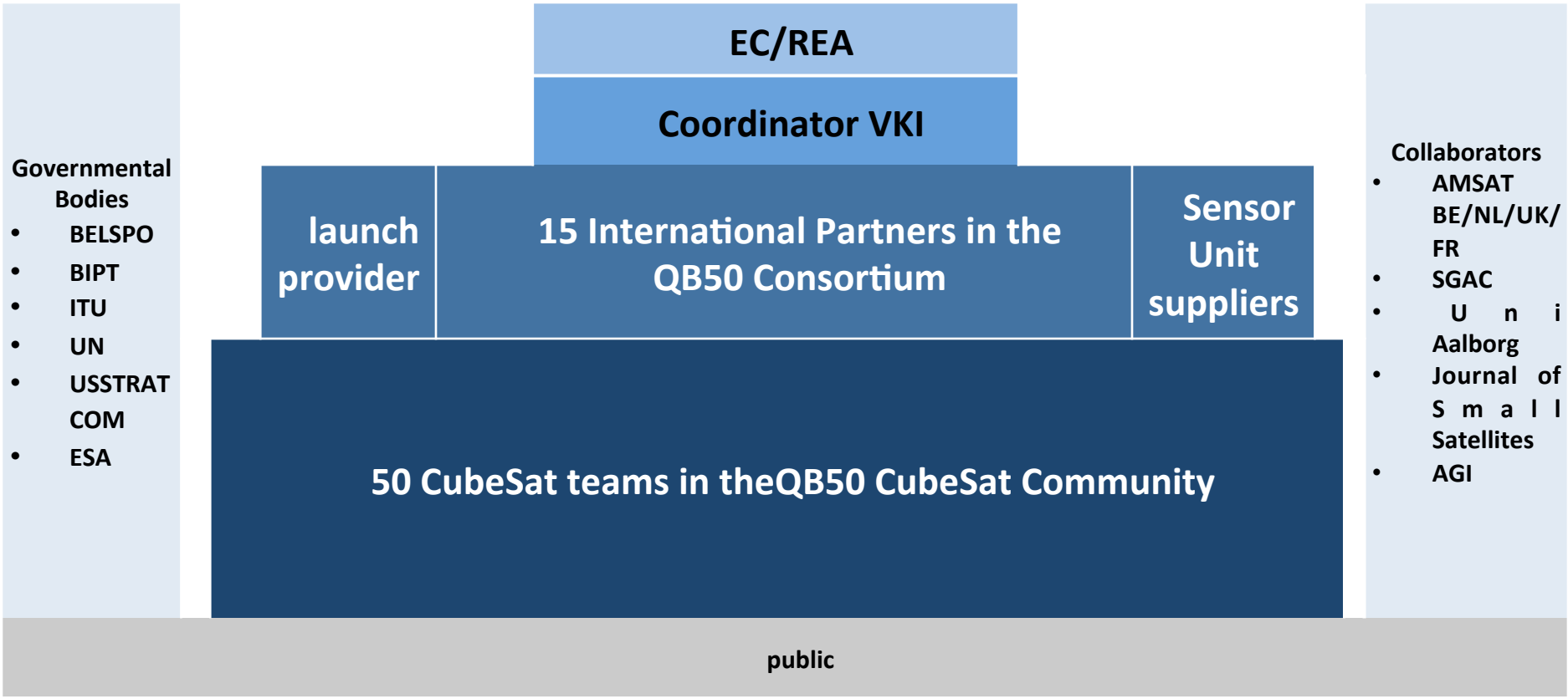


Precursor Derisking Campaign

- status december 2014:
  - satellites healthy
  - commissioning & trouble shooting ongoing
  - lessons learned: improvement of technology and documentation
  - achievement of
    - campaign objective “derisking”
    - project objective “deployment system design” – already commercialized
  - data acquisition expected to start in January 2014



Acknowledgments

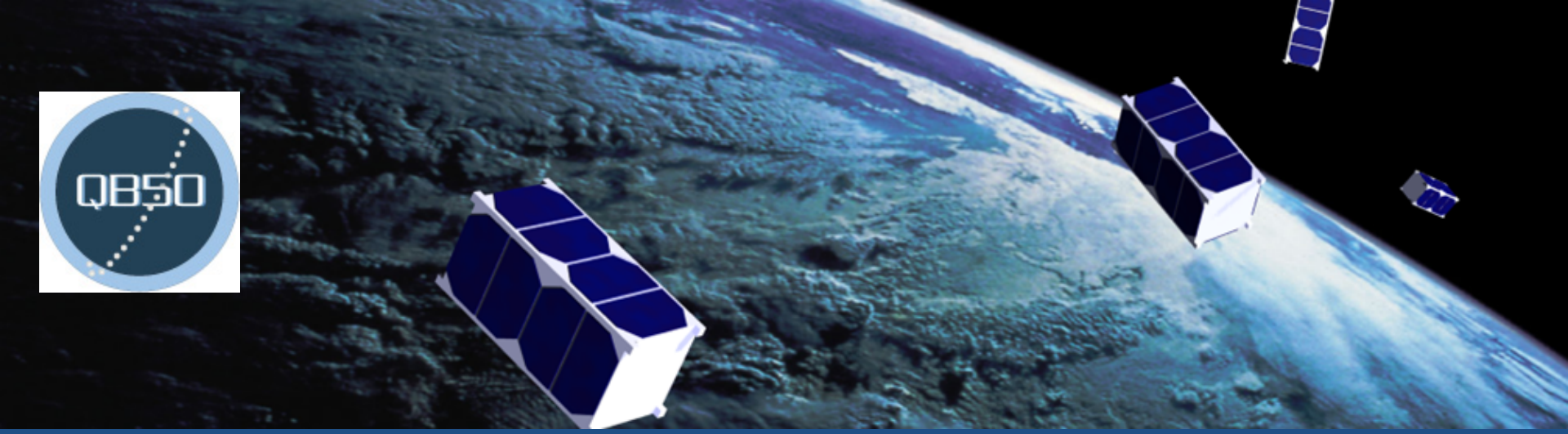


We are grateful for the motivation and support of many individuals from about 90 organizations!

Conferences

- 6th European CubeSat Symposium
  - Estavayer-le-Lac, Switzerland, 14-16th October
  - https://cubesatsymposium.eu/
  - in collaboration with Journal of Small Spacecraft (JOSS)
  - participation fee: 250 Eur
- 7th European Cube Symposium
  - 8-11 Sept. 2015, Liege, Belgium

meet cubesat enthusiasts and friends!



Thank you for your interest.
Do you have any questions?

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jan.thoemel@vki.ac.be