

**ESA Council at Ministerial level – Space19+
(Seville, 27-28 November 2019)**

**Presentation of the Programmes to
the Belgian actors**

Belgian Science Policy Office

**Royal Library of Belgium, Brussels
30 September 2019**

Introduction

pierre.coquay@belspo.be

WHERE ARE WE

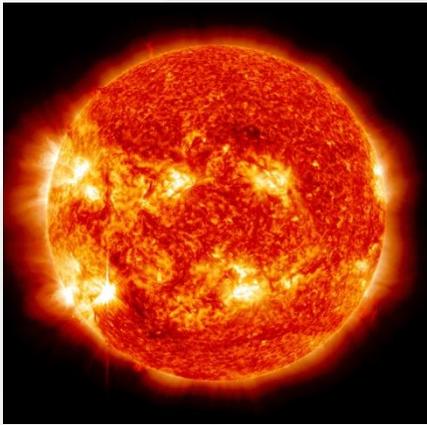
- CM-ESA Luxemburg: Dec. 2014
 - Limited topics: access to space, space exploration and ESA evolution
- CM-ESA Lucerne: Dec. 2016
 - Full ministerial: BE commitment for programmes for the period 2017-2021
- CM-ESA Seville: Nov. 2019
 - Full ministerial: BE commitment for programmes for the period 2020-2024

- CM-ESA in preparation: PB's, 7 CWG....
- Draft Resolutions
 - The five dimensions of Space 4.0
 - inform, innovate, interact, inspire + **infrastructure**
 - Level of resources for the Agency's mandatory activities 2020-2024
 - Science Programme, Basic Activities
 - CSG 2020-2024 + Renewal
 - ESA Optional Programmes
- Belgian level
 - Open and transparent debate with the space associations (VRI, BAG, WE): 3 meetings with 3 representatives of each association + Cabinet Wilmès as observer

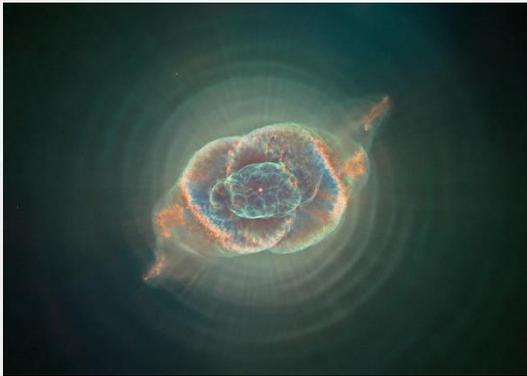
Science and Exploration - The Science Programme

werner.verschueren@belspo.be

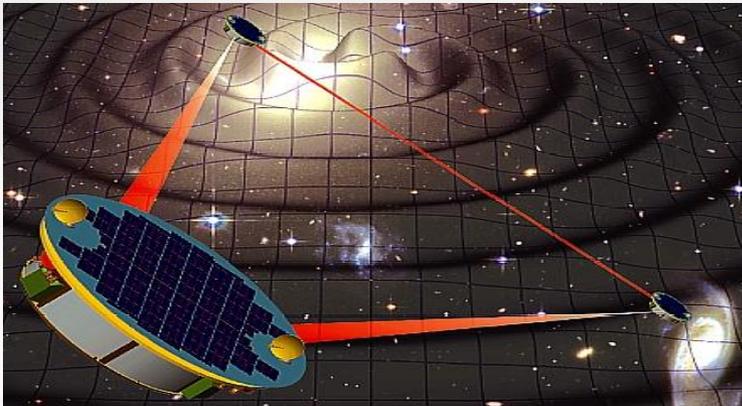
- **Mandatory** Programme
- Contributions according to relative **GDP**
- “**Backbone**” of ESA: provides long-term stability
 - Scientific excellence
 - Cutting-edge technologies and innovation
- Driven bottom-up by the **scientific community**
 - Calls
 - Competition
 - Peer review
- **Payloads** are mostly funded by national programmes
 - For BE: PRODEX
- Shows what Europe can do **together** in science and technology
- Provides a **framework** for additional national programmes



Solar System



Astrophysics



Fundamental physics

Planned activities for 2020-2024

- **Operations in orbit**

XMM, CLUSTER, INTEGRAL, MARS EXPRESS, GAIA, BEPI COLOMBO, SOLAR ORBITER, CHEOPS

EXOMARS/TGO, EXOMARS/2020, PROBA-3

HST, SOHO, HINODE, IRIS, JWST

- **Development**

EUCLID, JUICE, PLATO, ARIEL, ATHENA, LISA

COMET INTERCEPTOR, M5 (ENVISION or SPICA or THESEUS)

JWST, SMILE, EINSTEIN PROBE, XRISM, MMX, WFIRST

- **Future calls**

S, M, L missions

New Missions of Opportunity

- **Basic activities**

Technology development

Science management support

Programme contingency

Budget request

The Science Programme loses buying power continuously since the mid-90ties:

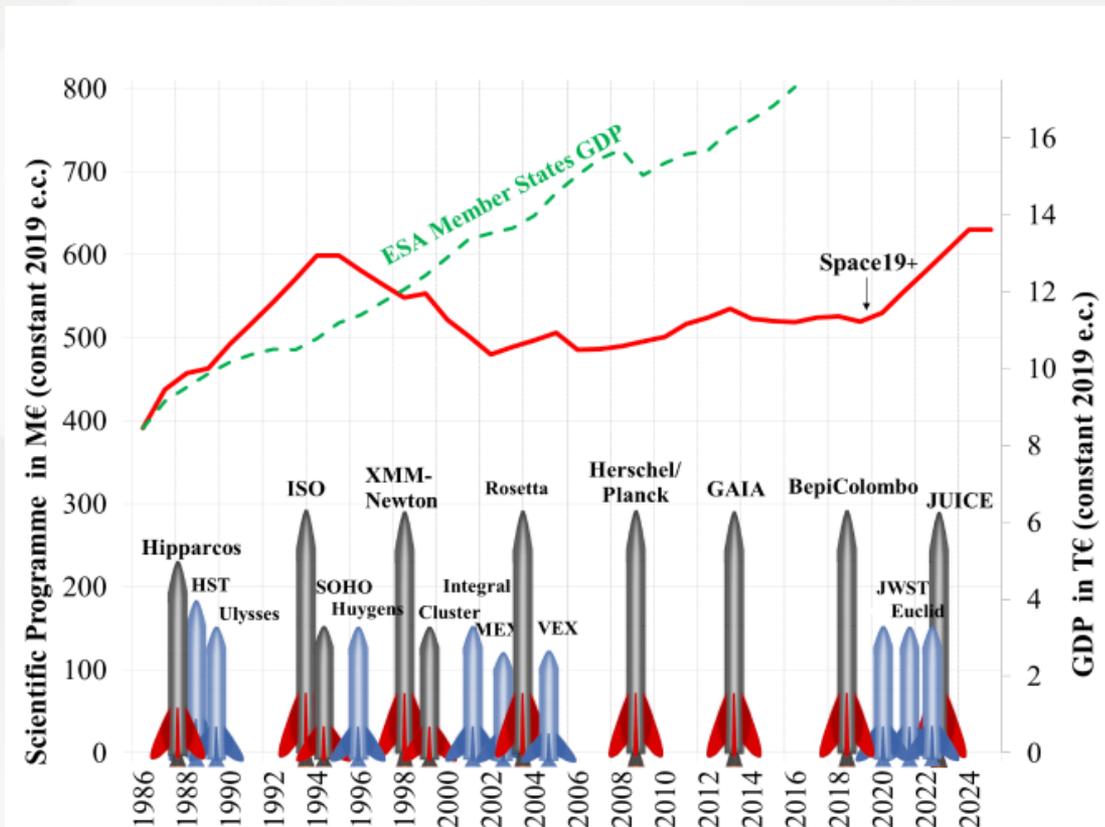


Figure 6. ESA's Scientific Programme in Comparison to Member State's GDP and the Agency's Large (L, red) and Medium Mission (M, blue) Launches

Budget request

- Proposal of ESA for Space19+: **increase of 20% from 2020 onwards in 5 steps, plus inflation compensation**

2020	2021	2022	2023	2024	20-24
538	572	606	633	659	3,008

(MEUR, current e.c.)

- To do what? → **New content** proposed in the Programme:
 - Aligning the development of LISA and ATHENA by clever phasing of the developments and providing payload support to the Member States
 - Developing an additional M mission with NASA to Uranus and Neptune
 - Adding a recurrent F(ast) mission line to the Science Programme
 - Providing payload support to the Member States for all missions during phases A/B

Belgian priorities

- Mandatory Programme → we have very little impact on activities; our georeturn is above 1
- Newly proposed activities: F(ast) missions and payload support during phases A/B
- 10 % increase may be affordable (incl. inflation)
- Unanimity required → Belgium will not block but general support for 20 % is unlikely

Science and Exploration

-

Human Spaceflight, Microgravity and Exploration

tom.verbeke@belspo.be

Main priorities for Space19+

- Maintain recurrent capacities in the production of the ESM for Orion
- Maintain planned production of IBDMs for Gateway
- Support Science In Space (SciSpacE)

Science and Exploration - Scientific Support (PRODEX)

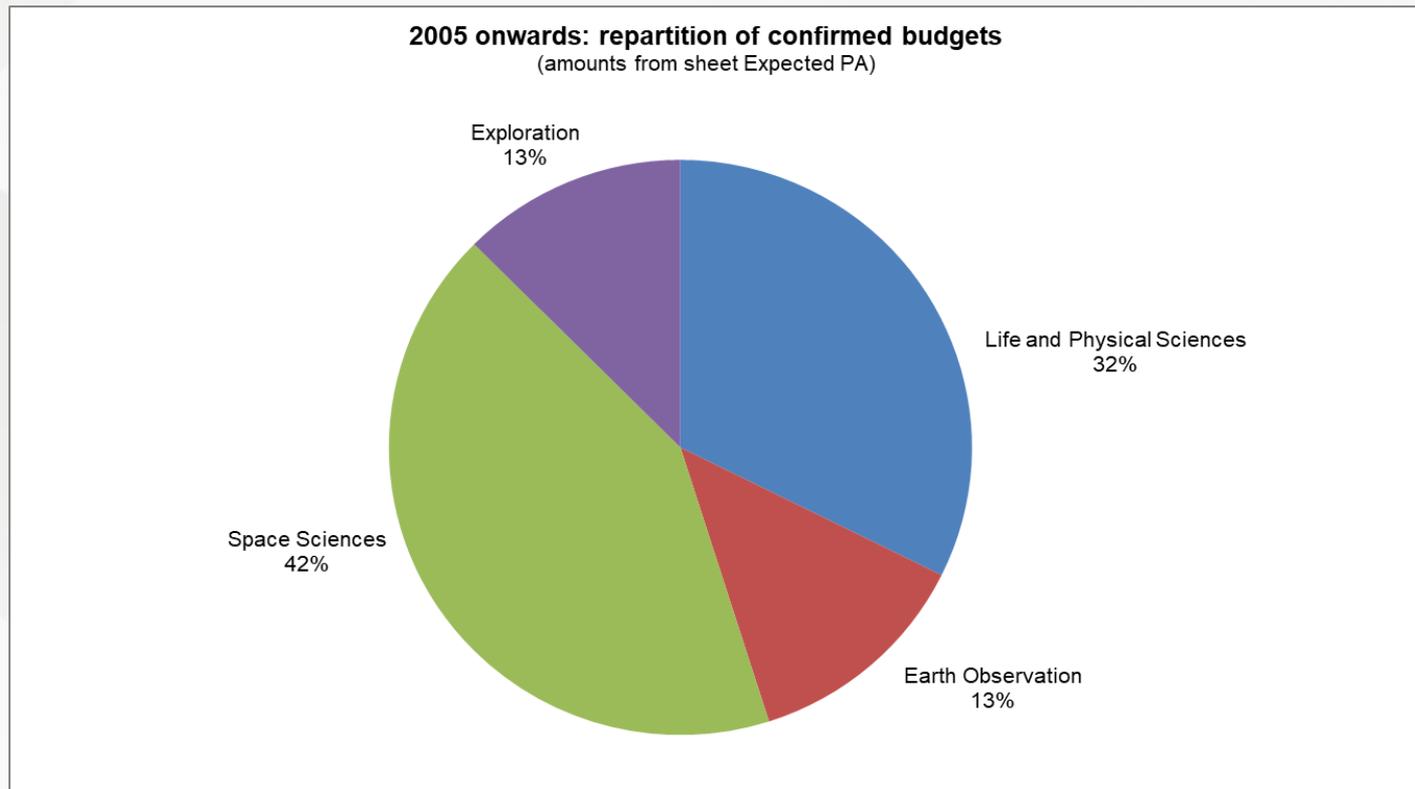
werner.verschueren@belspo.be

PROgramme for the Development of scientific EXperiments

- Provide funds through ESA for **payload**
 - ✓ hardware and software development
 - ✓ operations (incl. cal/val)
 - ✓ data exploitation
- Cooperation among **scientific institutes/universities** and between those (in the driving seat) and **industry**
- **Implementation:**
 - ✓ ESA selects the projects
 - ✓ BELSPO determines the level of financial support
 - ✓ ESA issues the contracts with institutes and industry
 - ✓ Joint follow-up by ESA and BELSPO
- Guaranteed **georeturn** of one

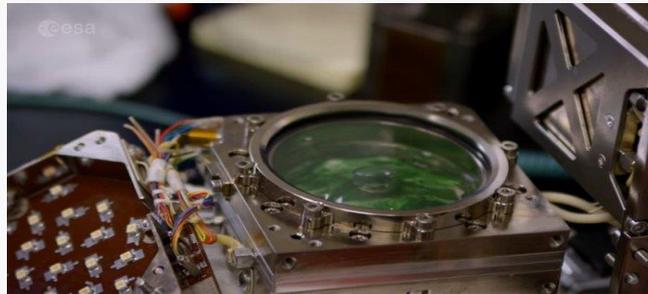
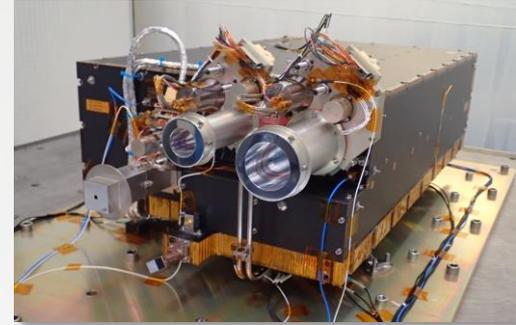
4 main areas:

- ✓ Space Sciences (~ Science Programme)
- ✓ Life and Physical Sciences (~ ISS Programmes)
- ✓ Earth Observation (~ EO Programmes)
- ✓ Space Exploration (~ Robotic Exploration Programmes)



Some successful past and ongoing Belgian PRODEX projects:

- ✓ Extreme Ultraviolet Imager (EUI) on SOLAR ORBITER
- ✓ ArtemISS: study the potential of algae for bioregenerative life support in space: the first photobioreactor in space



- ✓ Development of the APEX hyperspectral imager for EO cal/val activities over Belgium



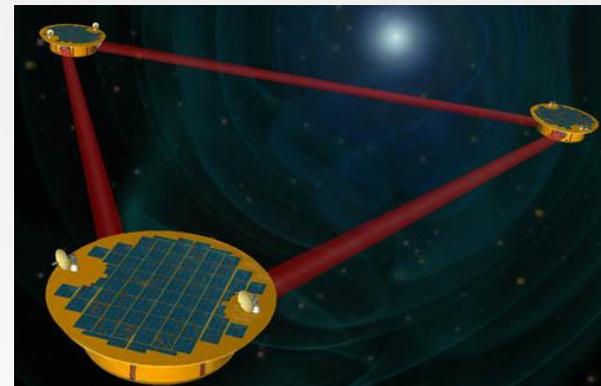
- ✓ NOMAD spectrometer on EXOMARS/TGO
---> *Nature* **568**, 517–520 (2019)

Some planned Belgian PRODEX projects for 2020-2023:

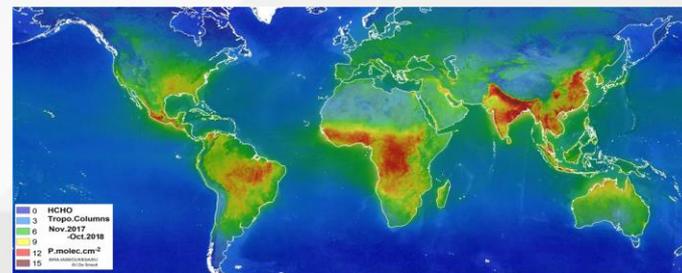
- ✓ ASIC development for the photosensors of the LISA mission, and gravitational wavefront modeling of inspiraling black holes



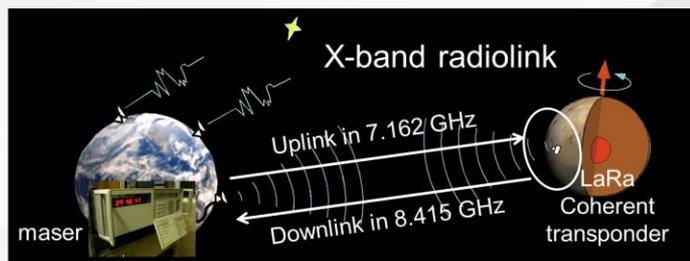
- ✓ Dexterous locomotion in microgravity



- ✓ Retrieval algorithm improvement and data processors update for HCHO and SO₂ on SENTINEL-5P



- ✓ Science Operations Centre for the LaRa instrument on EXOMARS 2020



Budgetary erosion: constant budget (18-19 M/y)
increase of salary costs above inflation
overcosts in hardware dev. projects
more BE payload participations selected
risk for budget decrease in the future

→ Future **evolution:**

- ✓ significant savings needed in the period 2020-2023
- ✓ priority for ESA missions/projects
- ✓ priority for developments (pre-launch)
- ✓ new limitations for data exploitation (post-launch):
number of FTE's and duration

Applications - Telecommunications and Integrated Applications

sophie.pireaux@belspo.be

ARTES evolution for CMIN19:

A matrix with **Generic and Strategic Programmatic Lines (GPL/SPL)**

To Be Allocated €

ARTES 4.0 PROGRAMME

Advanced Research in Telecommunications Systems



Transversal Themes = SPLs

To integrate in BE strategy to generate a BE ecosystem around a given theme?!

ARTES 4.0

Generic Programmatic Lines (GPLs)

FP = Future Preparation (ARTES entry ticket)
for knowledge building, preparatory studies, standardisation
according to an ESA workplan



CC = Core Competitiveness

BE usual strong a la carte use

BASS = Space Solution Center (including BICS)
& **Business Applications** (formerly IAP)
& network of Brokers, Ambassadors, Investors

PP = Partner Projects (formerly PPP)

BE occasional use as sub



GPL CC

- **Advanced Technology (AT)** = ESA initiated activities according to an ESA workplan to promote farther away from the market studies and developments

- **Competitiveness & Growth (C&G)** = Industry initiated activities following their own strategic roadmap, must be rather close to market, aiming at a commercial product. Different co-funding levels for Design or Technology Development or Product Phases

BE FOCUS

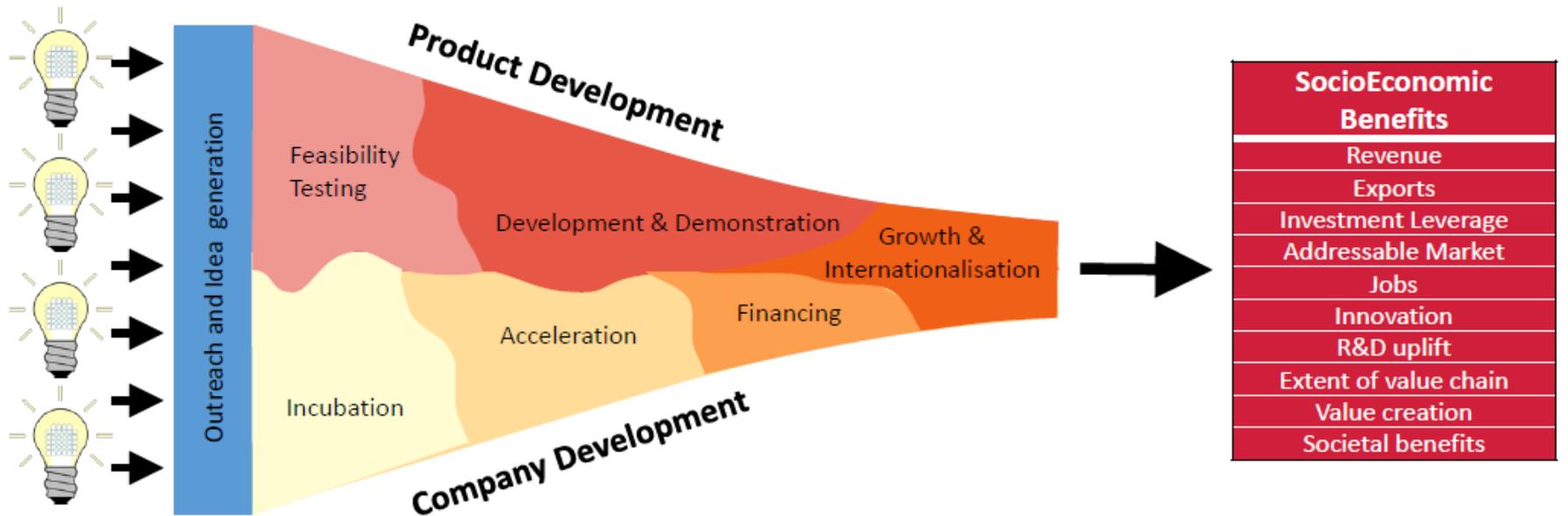
CO-funding





BASS

GPL BASS



Business Applications & Space Solution center:

BE FOCUS

1! future BE

contract

- Product development: **B**usiness **A**pplication of SpaceTechnos (BA) to Non-Space sector
- Company development: current ESA **B**usiness **I**ncubators (BIC) & space techno spin in/off
- Networking: **T**Echnology brokers & **A**mbassadors (**TEAM** network) & private investment funds & financial institutions (Investor Network)

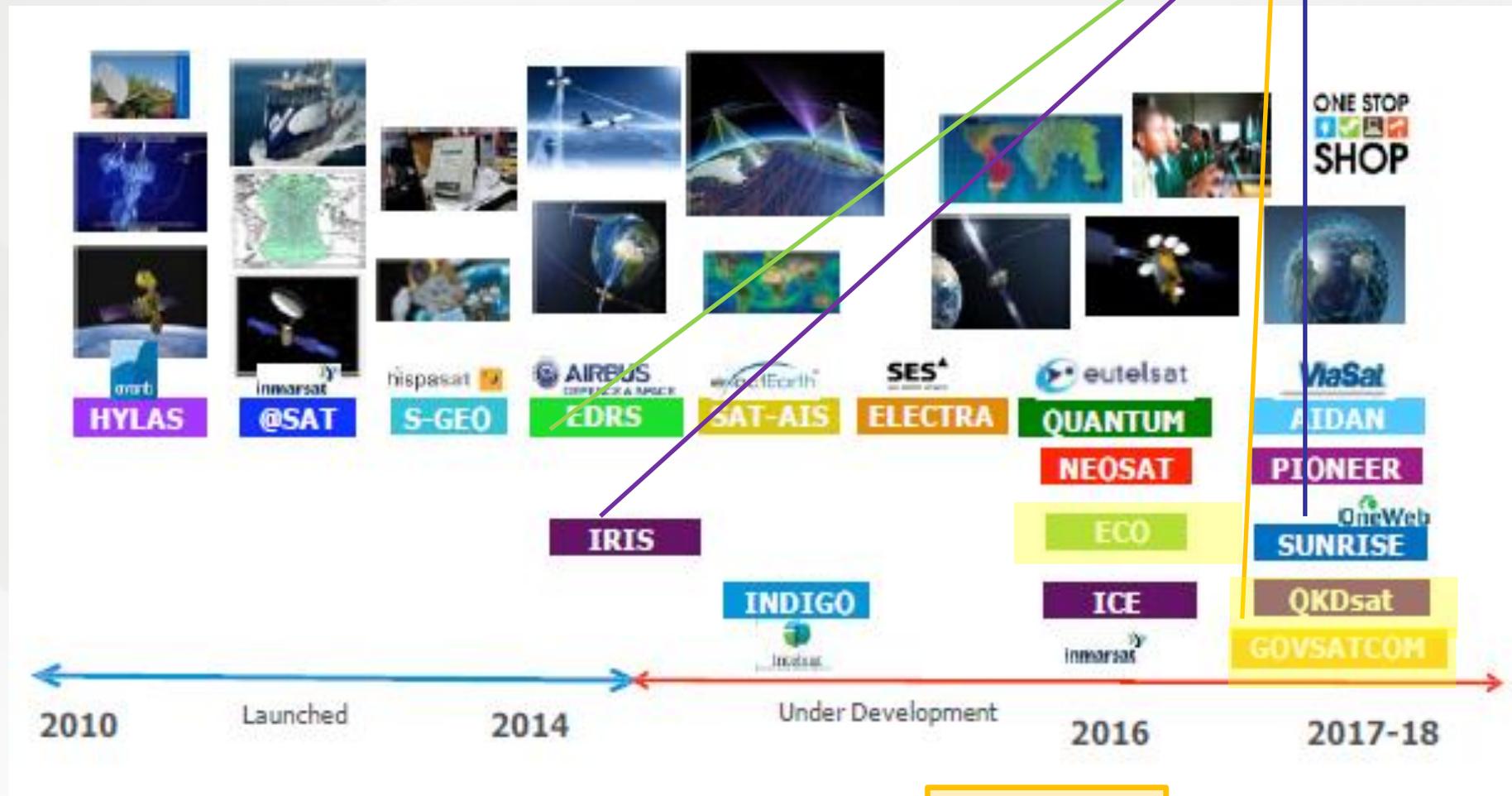




PP

GPL PP

- New dev & funding request for existing PPs at CMIN19



BE FOCUS



PP

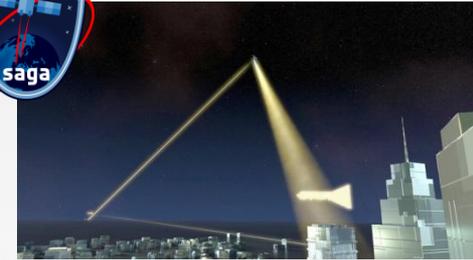
GPL PP

• New proposed PPPs at CMIN19

➤ SAGA (SPL 4S)

BE interest???

See industry workshop 30/09



➤ Iris satcom Global Solution (SPL 4S)

BE interest on BASS side???

See industry workshop 02/10

Potential BE interest

➤ HYDRON (SPL Scylight)



Potential BE interest

➤ NOVACOM 1 (GPL PP)



➤ SUNRISE Phase 2 (SPL 5G)



ARTES 4.0

Strategic Programmatic Lines (SPLs)

Transversal Themes



- **4S (Secure Systems for Safety and Security):** Secure Satcom for key infrastructures or in support to crisis management, maritime safety, border control and other security domains; in agreement with policies/regulations/specifications under authority of institutional/public bodies

BE FOCUS



- **Scylight – Optical Comms:** optical communication technologies in space are expected to achieve major impacts on the satcom sector in the next decade (high levels of transmission rates, data security and resilience)



- **Space for 5G:** new generation of communications is key to support the Digital Transformation with integration of satellite with terrestrial telecom networks

Transversal synergies for 4S SPL

4S ESA/ARTES Programme : Sophie.Pireaux@belspo.be

Other related activities outside ARTES followed by BELSPO Dir Space

➤ ESA ITTs via GSTP programme for C-SOC & SCCoE:
Hendrik.Verbeelen@belspo.be



➤ ESA ESEC infrastructure: Agnes.Grandjean@belspo.be

➤ Transversal (cyber)security matters: David.Cox@belspo.be



➤ EU H2020, EU Parliament Preparatory Action:
Danielle.Coosemans@belspo.be

➤ EU Space Regulation Drafting, including new Govsatcom Programme:
Julien.Beclard@belspo.be

Applications - Earth Observation

steven.bogaerts@belspo.be

Future-EO

- Backbone programme of ESA EO
- Width variety of activities:
 - Different kind of opportunities for BE players
 - In the past a distribution of BE players in the different blocks
- Previous envelopes: BE over returned
 - Continuation of BE support to the programme

Earth Watch (1/2)

- ALTIUS: BE priority
 - BE PI
 - BE Industrial Prime
 - International collaborations
- PROBA-VE extension
 - Maximise the potential of the mission
 - Extend the operations (till the technical limits)
 - Experimental: expand the mission with additional sensors and demonstrate new space technology

Earth Watch (2/2)

- **InCubed+**
 - Strong resemblance with other ESA programmes (GSTP, ARTES,...)
 - But BE participation in InCubed+ enables the engagement of ESA EO team
- **Global Development Assistance (GDA):**
 - Return on investment (contributions to the joint initiative of ESA and Investment Banks via Trust Funds)
- **TRUTHS:** UK interest
- **ARTIC:** Swedish interest

Copernicus Space Component-4 (CSC-4)

- 6 HPCM

CO2M CO2 Monitoring Mission	CHIME Hyperspectral Mission
LSTM Land Surface Temperature Mission	ROSE-L L-Band Radar Mission
CIMR Copernicus Imaging Microwave Radiometer	PICE Altimetry Mission

- BE potential
- Strong international collaborations
- Return on investment (potential EU contribution)

Applications - Navigation

agnes.grandjean@belspo.be

European Global Navigation Satellite System

- Composed of:
 - EGNOS (European Geostationary Navigation Overlay Service) is already operational
 - GALILEO is still being deployed:
 - 26 satellites already in orbit (4 IOV and 22 FOC)
 - 4 more satellites will be launched between end 2020 and mid-2021
 - The full system (30 satellites and ground segment) should be fully operational in 2021 but Galileo Initial Services are provided since December 2016

BE position navigation

- The deployment, operation and evolution of the EGNSS programmes are now funded from EU budget but it is important to secure R&D activities in Navigation to foster Belgian industry in succeeding in the highly competitive and rapidly-evolving global market for Satellite Navigation, and more broadly Positioning Navigation Timing (PNT) technologies and services.
- Two programmatic lines are targeted: Navisp and GSTP

Enabling and Support - Technology

hendrik.verbeelen@belspo.be
peter.vangeloven@belspo.be
matthias.piens@belspo.be

Technology Programmes

- The technology programmes at ESA remain at the core of BE priorities
- GSP & TRP -> DPTD
- GSTP -> GSTP
 - 3 “framework activities”
 - Element 1: prepare and de-risk & Building Blocks
 - Element 3: Technology Flight Opportunities Studies
 - Element 2 “MAKE” (see AO9834)
 - 3 segments (Market, Company Strategy, National)
 - Different entry points (Pre-outline, Outline, Full)

Enabling and Support - Space Transportation

agnes.grandjean@belspo.be

Space Transportation

- Today's priority is to secure the end of Ariane-5 and Vega exploitation and to prepare the transitions to the new family of European launchers with Ariane-6 and Vega-C, and their common motor P120C, in a highly competitive global market situation.

Space Transportation

- Space 19+ focus on:
 - Mandatory programme:
 - CSG Launch Range Continuation Period 2020-2024 and Renewal
 - Exploitation programme:
 - Ariane-6 Transition Programme Step-2
 - LEAP:
 - Ariane-5 Supplementary 2020 to completion
 - Ariane-6 2020-2022
 - Vega / Vega-C Transition Accompaniment 2020-2022

Space Transportation

- Development programmes:
 - Ariane-6, Vega-C and P120C competitiveness improvements
 - Ariane-6 Competitiveness Improvements
 - Ariane-6 Future Upper Stage System Preparation
 - Vega Competitiveness Improvements
 - Vega Evolution Preparation
 - Future Launchers Preparatory Programme (FLPP)
 - Studies, Demonstrators and Advanced technology core Element
 - Prometheus Element
 - Themis / Reusability Element
 - Space Rider
 - Commercial Space Transportation Services and Support

Space Transportation

- In addition to the Space19+ programme proposal, Participating States subscriptions to cover the non-covered parts of the following on-going programmes will be open for subscription:
 - Ariane-6 and P120C Elements of the Ariane and Vega development programme
 - LEAP Ariane-5 Classical and MCO
 - Ariane-6 Transition Programme Step-1

Space Transportation

- BE position:
 - Large investments at CM-ESA 2014
 - Limited budget at Space19+
- Exploitation Programmes
 - Commitments for Ariane-5 Supplementary and Ariane-6 Transition
- Development Programmes
 - New technologies to maintain the skills acquired by Belgian industry in strategic areas such as propulsion, avionic,...

Space Safety and Security

-

Space Safety

werner.verschueren@belspo.be

Belgian priorities

First priority: the **Core Programme**: maintaining and expanding our past investments in **Space Weather**:

- Space Weather Services Coordination Centre (SSCC)
- Expert Service Centres on Solar Monitoring and Space Radiation
- Space Weather Data Centre
- PROBA-2 operations
- Development of new applications and services (future EU funding!)
- Physics-based model development of the Sun-Earth connection
- Small hosted payload developments

Second priority: contribution to the **EUVI instrument** on the L5 mission and TBD contribution to the HERA mission

Space Safety and Security

-

Cyber Resilience

david.cox@belspo.be

Varia - STEREO

jean-christophe.schyns@belspo.be



STEREO

National programme supporting
scientific research in
Earth Observation

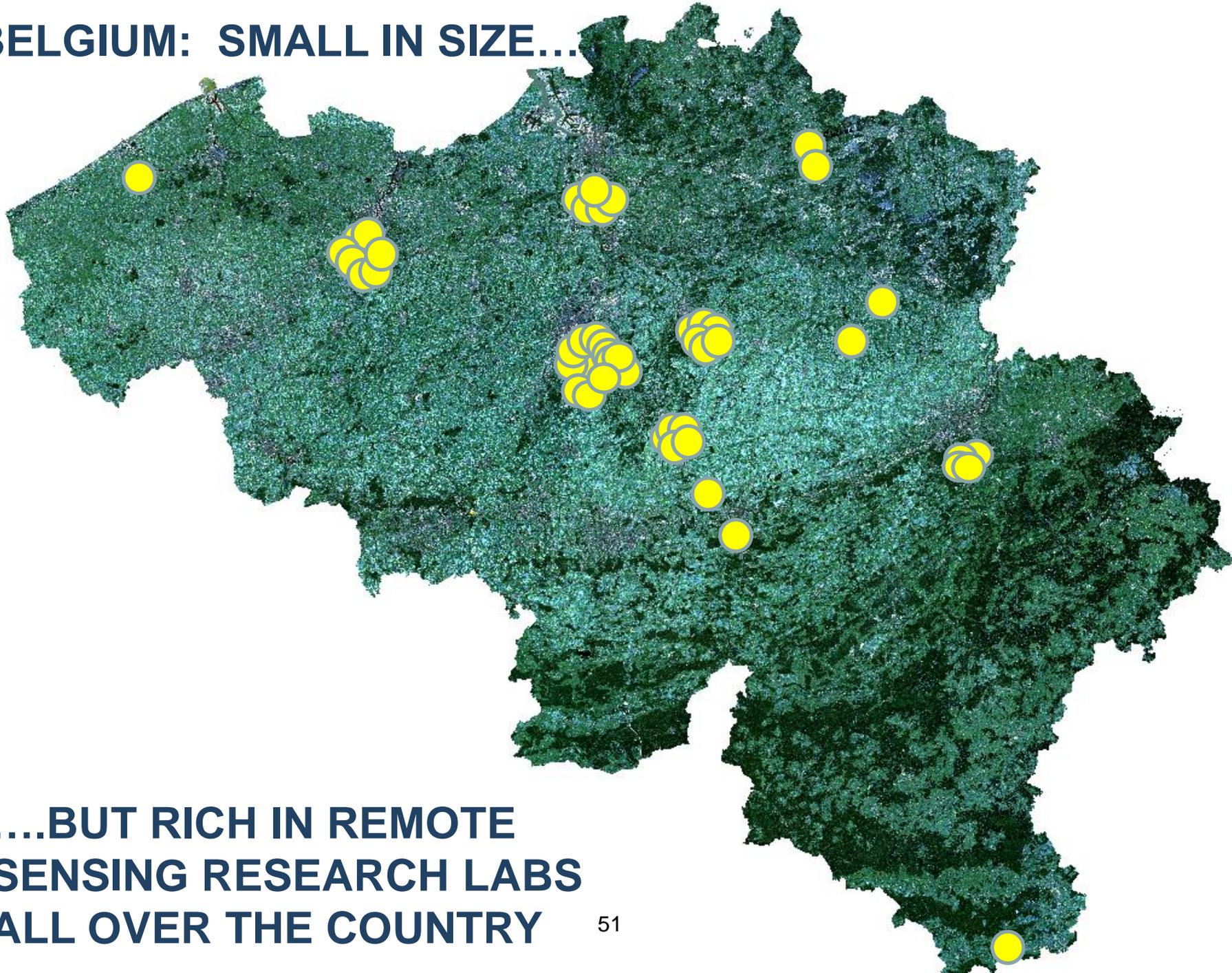
KEY ASPECTS

- 34 years of continuous RS programmes by the Belgian Science Policy Office in // with technology developments.
- Current programme: **STEREO III** (*Support to the Exploitation and Research in Earth Observation*)

Quality – innovation - visibility of research - international collaboration – Introduction of RS in new areas

- 2014-2021
- A yearly call for proposals
- **55** ongoing research projects
- **49** Belgian research groups
- **33** International partners (on the basis of fund matching)

BELGIUM: SMALL IN SIZE...



**....BUT RICH IN REMOTE
SENSING RESEARCH LABS
ALL OVER THE COUNTRY**

THE 3 PILLARS OF STEREO

RESEARCHER SUPPORT

- Financing of various types of research projects with room for PhDs
- Project Steering Committees

RESEARCH COMMUNITY SUPPORT

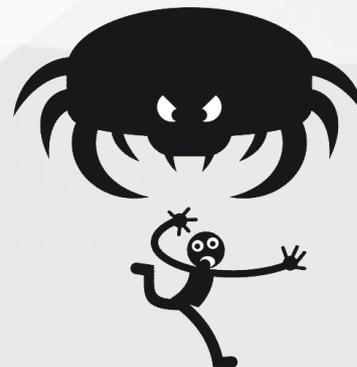
- Support of cal/val sites
- Data purchase
- RS Community days
- Website eo.belspo.be

RESEARCH OUTREACH SUPPORT

- Newsletter
- Support/organisation of events (visibility)
- Education

THEMATIC PRIORITIES

- *Both global and local*
 - Terrestrial and aquatic environments
 - Interaction between land cover and climate change
 - Epidemiology
 - Security and risk management



RESEARCH SUPPORT: FINANCING OF RESEARCH PROJECTS

- Based on call for proposals (fixed date and open)
- Project types:
 - *Application projects*
 - Exploration projects (focus on innovation)
 - Thematic network projects (multidisciplinary)
 - Shared cost projects

DEVELOPMENT OF APPLICATIONS

- Collaborations (knowledge transfer) between research institutions, public administrations (Wallonia and Flanders)
- And with **private companies**
- Non-scientific organisations in the driver's seat
- Private companies cannot obtain funding by the STEREO III programme

IPOT



Request from BELGAPOM

Industrial Potato monitoring for the Belgian potato sector.

Potato prices are estimated early in the growing season and yield prediction are therefore crucial

Potato crop monitoring with the use of RS data

<https://watchitgrow.be/en>

BEETPHEN

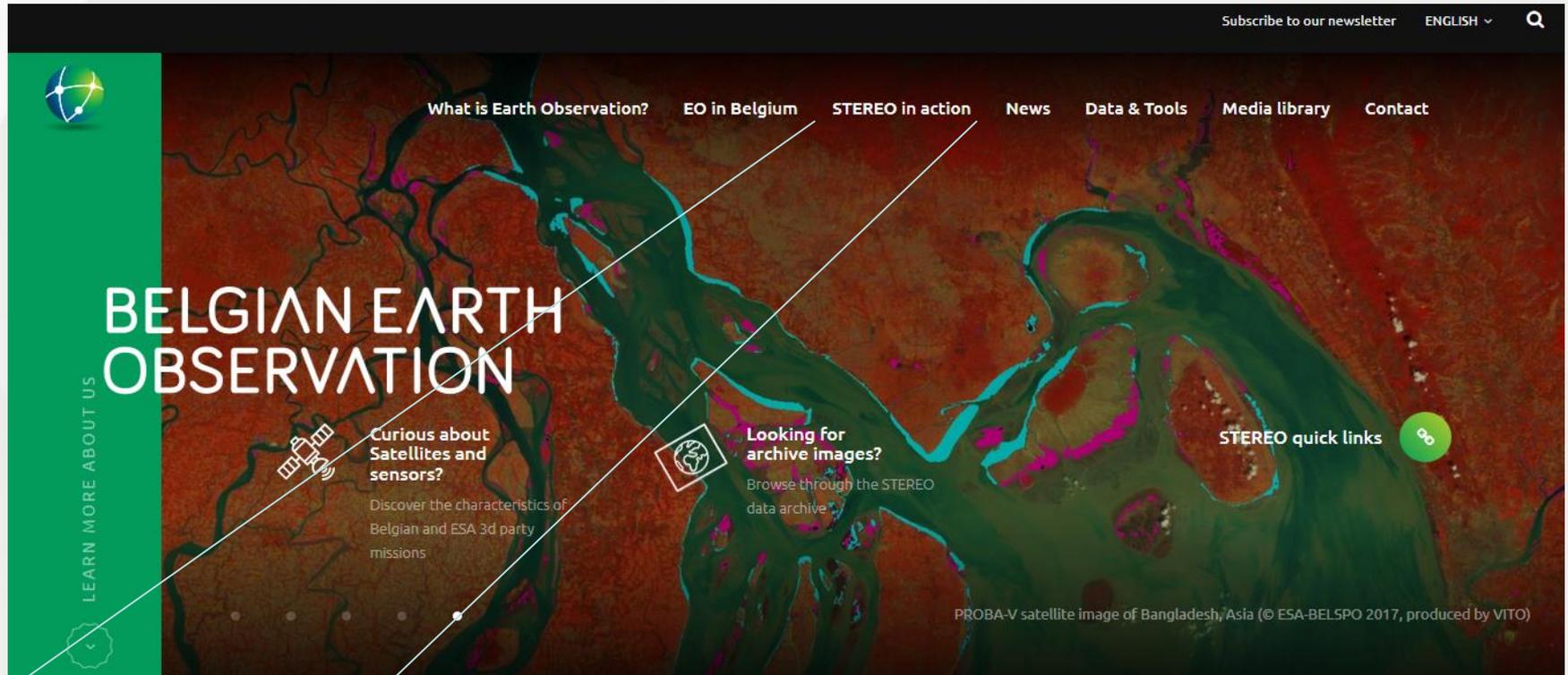
Request from SES VANDERHAVE

This project aims at applying the UAVs potential for the quantitative assessment of a specific plant trait (disease resistance against Powdery Mildew 'PM') within breeding trial plots.



Figure 2: Spectral (left) and geometrical (right) GCP's

SUPPORTING SCIENTIFIC OUTREACH



STEREO in action

eo.belspo.be

- *Newsletter with jobs, events, webstories, ...*
- *Subscribe via eo.belspo.be*

SUPPORTING SCIENTIFIC OUTREACH



Bid book BRUSSELS



International Geoscience & Remote Sensing Symposium - IGARSS 2021
12 - 16 July 2021



NEXT STEPS

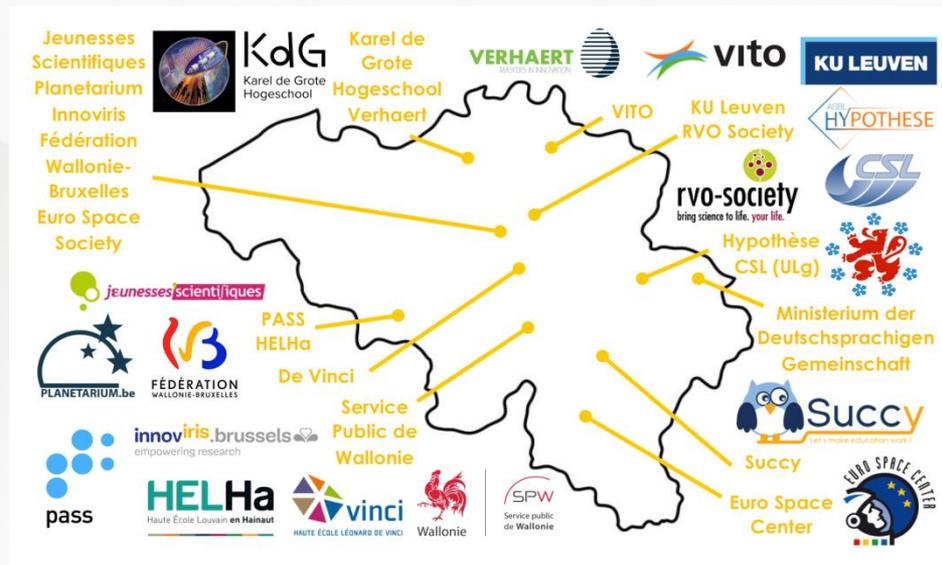
- Evaluation of the STEREO III programme by an external company (already done for STEREO II) with recommendations on how to improve the programme.
- Implementation of a new programme ideally without gap.
- STEREO IV will more focus on link between research and industry
- Use of Copernicus and Sentinel data
- STEREO IV budget is part of the financial envelope to be defined in the framework of the Space19+ preparation

Varia - Education

tom.verbeke@belspo.be
julien.beclard@belspo.be

Education 6-18 years

- European Space Education Resource Office (ESERO)
 - www.eserobelgium.be
 - Inform the teachers in your environment!



Education >18 years

- ESA Academy (https://www.esa.int/Education/ESA_Academy)
 - Hands on space projects:
 - CubeSats - Fly Your Satellite!
 - European Student Earth Orbiter
 - Drop Your Thesis!
 - Fly A Rocket!
 - Fly Your Thesis!
 - Orbit Your Thesis!
 - Spin Your Thesis!
 - Spin Your Thesis! Human Edition
 - REXUS/BEXUS rocket & balloon experiments

Education: >18 years

- ESA Academy (https://www.esa.int/Education/ESA_Academy)
 - Training and learning programme
 - Four-five day training sessions in:
 - Space engineering
 - Space sciences
 - Space medicine
 - Space law
 - Spacecraft operations and communication
 - Project and risk management
 - Product & quality insurance
 - Space debris
 - Technology transfer and innovation
 - Mission planning
 - ...

Education: >18 years

- Traineeships at ESA:
 - ESA YGT programme
 - https://www.esa.int/About_Us/Careers_at_ESA/Graduates_Young_Graduate_Trainees
 - National Trainee Programme
 - https://www.belspo.be/belspo/space/Training_ESA_nl.stm

Education: >18 years

- Summer internships in BE companies?
 - 1 or 2 months
 - 60-40 % funding industry-Belspo
 - Dedicated delivery

Wrap up

pierre.coquay@belspo.be

THANK YOU

The Space Department of BELSPO

Julien BECLARD
Steven BOGAERTS
Danielle COOSEMANS
Pierre COQUAY
David COX
Pascal DERMINE
Agnès GRANDJEAN
Nicolas HELSSEN
Isabelle MEREAU
Matthias PIENS

Sophie PIREAUX
Pieter ROTTIERS
Jean-Christophe SCHYNS
Martine STELANDRE
Peter VAN GELOVEN
Joost VANDENABEELE
Hendrik VERBEELEN
Tom VERBEKE
Werner VERSCHUEREN

+ Frank MONTENY, Alain HEYNEN and Jean-François MAYENCE