

## CNES Earth Observation Activities

Pierre TABARY

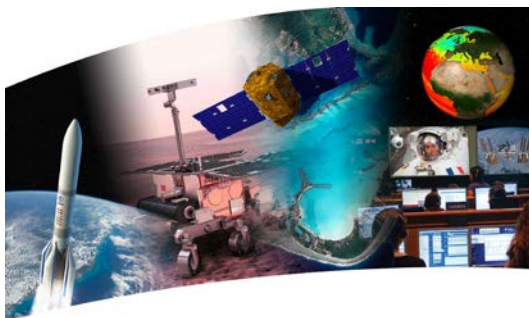
Programme Manager for Atmosphere, Meteorology and Climate  
CNES, Directorate for Innovation, Applications, Science

28th of March, 2017

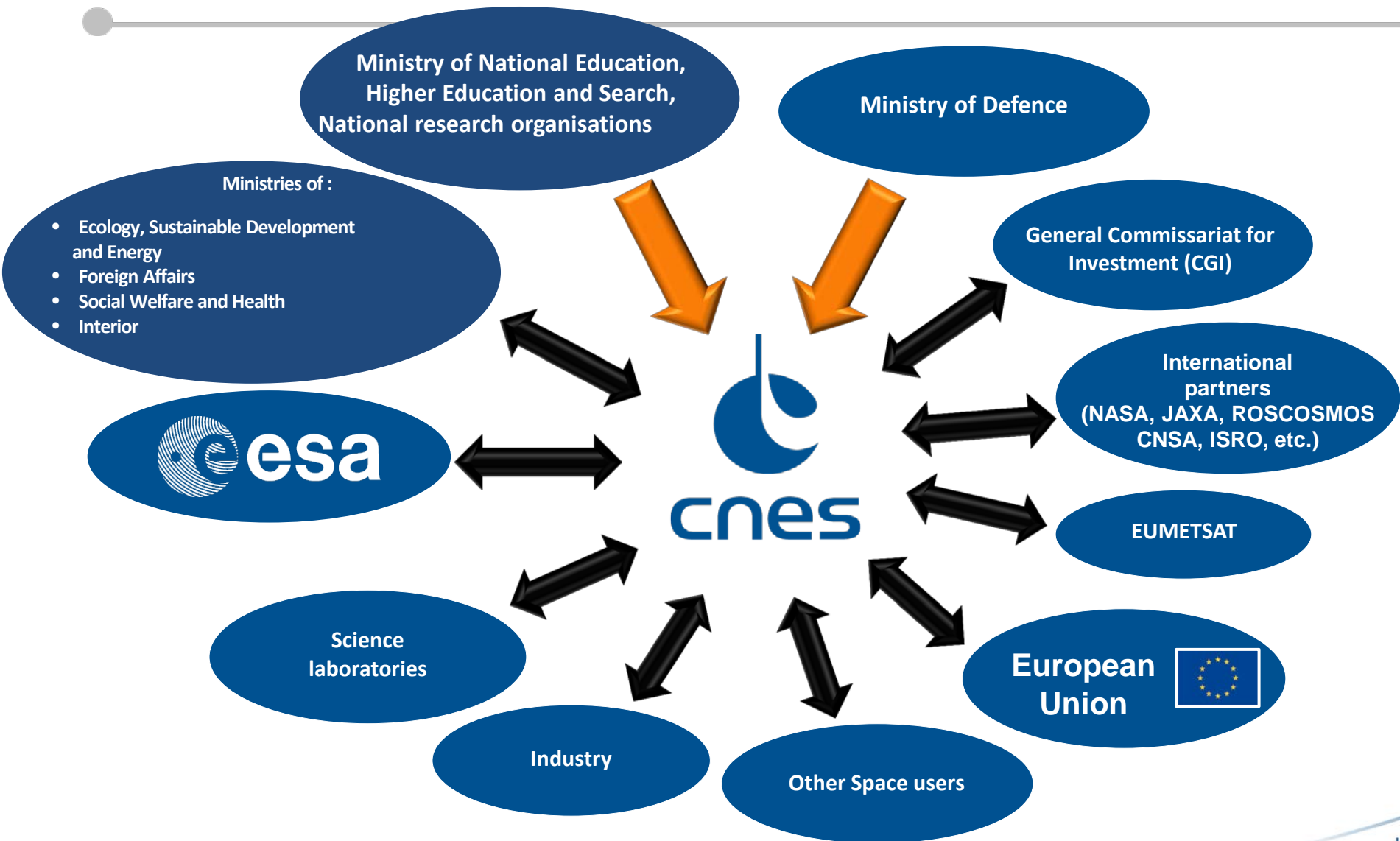
ADM-Aeolus CAL/VAL Rehearsal Workshop Programme  
Toulouse

# CNES in brief

- CNES = French Space Agency
  - Founded in 1961 under the impulsion of the Général de Gaulle
  - CNES is placed under the authority of two ministries : Defense and Research
  - About 2500 staff located on 4 sites (Paris Les Halles, Paris Daumesnil, Toulouse, Kourou)
  - 5 main fields of activity : Launchers / Observation / Science / Telecoms / Defense
- CNES is responsible for proposing France's space policy to the Government, and, once decided, for implementing it within Europe
- CNES is also a systems architect responsible for innovating and designing new space systems
- CNES's current mottos : “Innovation and Inspiration”, “Connecting space people”

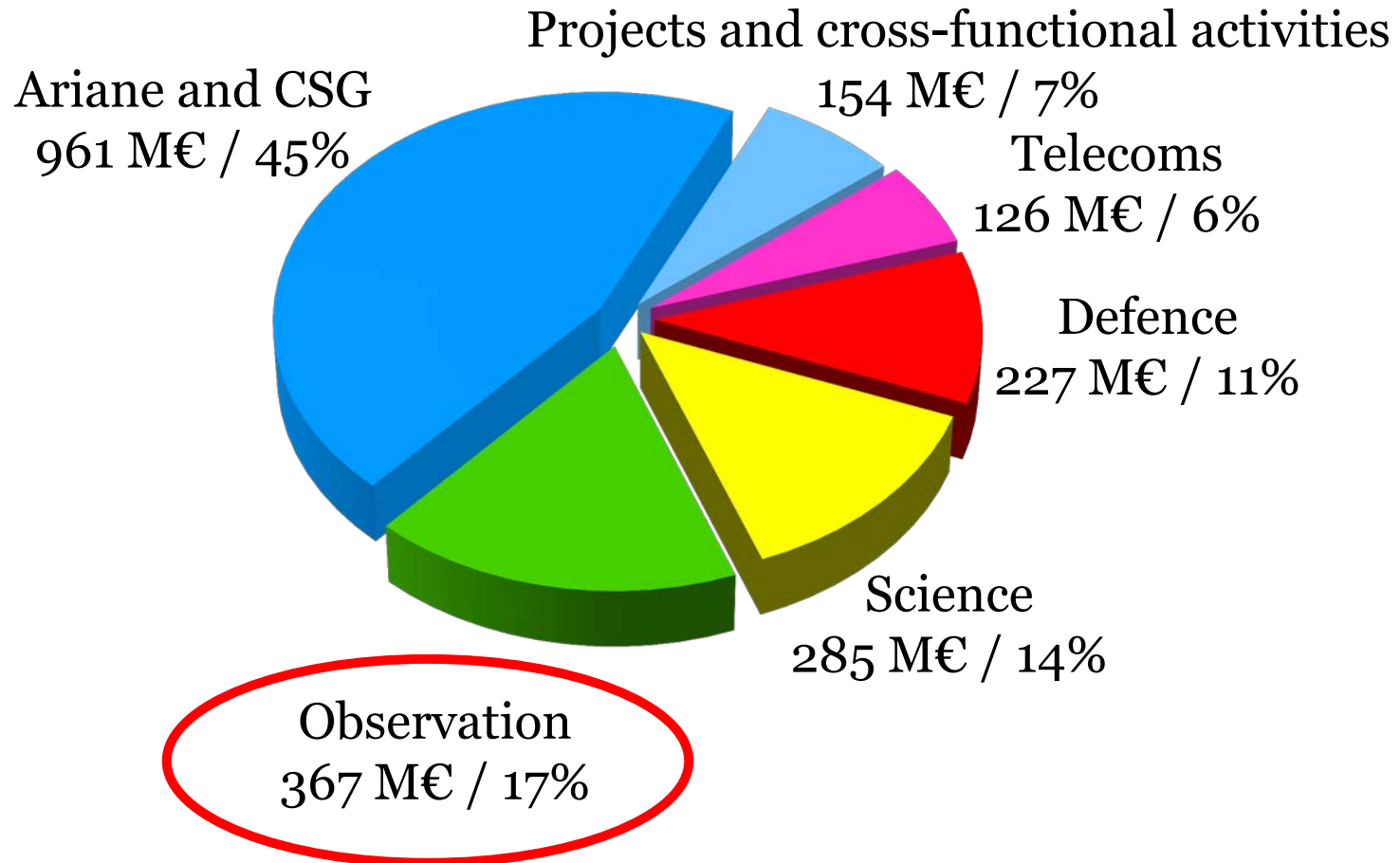


# CNES supervising authorities and partners



# CNES 2016 budget : 2120 M€

## CNES 2016 expenses



# Non exhaustive overview of the CNES missions in Earth Observation in development or operation

Note : Missions with significant contribution from CNES (payload, operation, platform, ...)

## Atmosphere

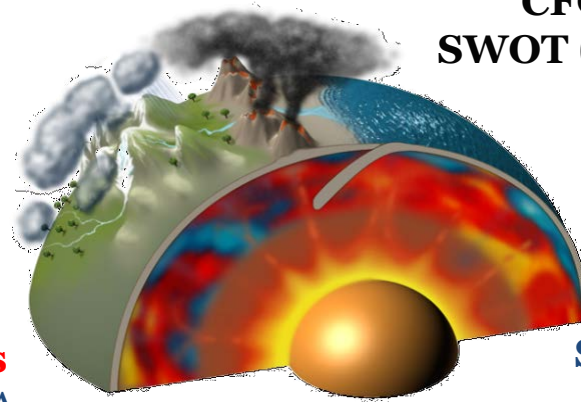
**Calipso** (2006-) with NASA  
**Megha-Tropiques** (2011-) with ISRO  
**IASI-A** (2006-) with EUMETSAT  
**IASI-B** (2012-) with EUMETSAT  
**IASI-C** (2018) with EUMETSAT  
**Strateole2** (2018-2024)  
**Merlin** (2021) with DLR  
**Microcarb** (2020)  
**IASI-NG** (2021) with EUMETSAT

## Continental Surfaces

**SMOS** (2009-) with ESA  
**Pléiades 1A** (2011-) with several european partners  
**Pléiades 1B** (2012-) with several european partners  
**Venus** (2017) with ISA  
**SWOT** (2021) with NASA, CSA, UKSA

## Ocean

**SMOS** (2009-) with ESA  
**Saral-AltiKa** (2013-) with ISRO  
**Jason 3** (2016-) with EUMETSAT NASA NOAA  
**CFOSAT** (2018-) with CNSA  
**SWOT** (2021) with NASA, CSA, UKSA



## Solid Earth

**SWARM** (2013-) with ESA

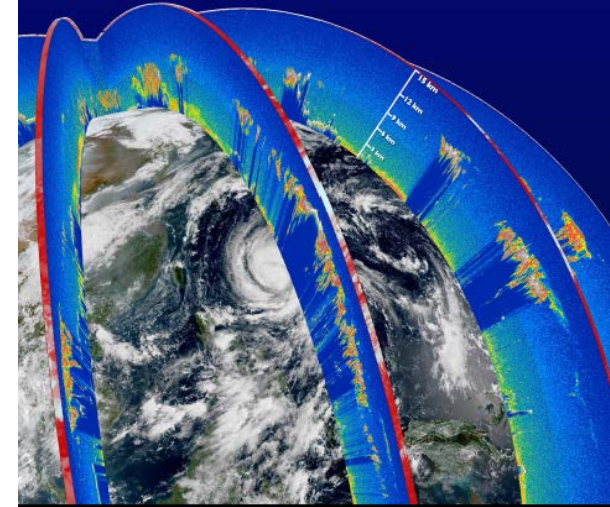
**+ Contribution to Copernicus  
: Sentinel 2, 3 and 6**

- A diversity of partners : NASA, EUMETSAT, DLR, CNSA, ISRO, ISA, ... and ESA of course
- All components of the Earth System are addressed, as well as their interactions : clouds and aerosols, water cycle, carbon cycle, GHG, IR sounding, altimetry, hydrology, HR imagery, ...
- Several multi-thematic missions : SMOS, SWOT, ...

# Calipso

## The success story of a lidar in space

- **CNES – NASA** partnership
  - Study of **clouds and aerosols** at global scale (in the frame of the A-Train)
  - 532/1064 nm (non HSR, non Doppler) nadir-viewing lidar
  - Launched in 2006 – still in operation !
  - A new extension of the mission (covering 2018-2020) will be discussed in the coming weeks
- **Would allow an overlap with ADM-Aeolus and EarthCare (assess impact of switching from 532/1064 to 355)**
- > 1800 publications, many citations in the last IPCC Reports, a bit of serendipity (ocean colour application), ...
  - Joint CNES/NASA Phaseo study underway (**MESCAL**) to design a follow-on lidar mission beyond EarthCare (2025-)
- **Would allow producing consistent, decades-long, multi-mission time series of clouds and aerosols at global scale**



# Support from CNES to French EO research activities

- CNES supports the French user communities in the preparation and exploitation of EO missions through:
  - ◆ **Post-doctoral grants** (typically 12 / year)
  - ◆ **PhD grants** (typically 12 / year) – Co-funding required
  - ◆ **Support to R&T :**
    - » PhD grants
    - » Funding of R&T specific actions (partnership between CNES, the industry and French labs)
  - ◆ **Funding of research proposals** submitted every year in the frame of a dedicated Call for Proposal
    - » > 300 proposals coming from > 50 Labs are received and funded each year
  - ◆ **Support to strategic in-situ networks:**
    - » **Balloons** : CNES balloon infrastructure
    - » **Aircrafts** : French research aircraft fleet **Safire**
    - » **Ground-based networks** : Aéronet (aerosols), NDACC (ozone), instrumented super-sites (SIRTA, CO-PDD, OPAR, ...)
  - ◆ Support to national data and services centres (**AERIS, THEIA, FORMATER, ODATIS**)

Support allocated and directed according to the recommendations of a committee of recognized, high-level experts of the various fields (TOSCA)

# CNES support to ADM-Aeolus (1)

- From the beginning, France has been a strong supporter of the ADM-Aeolus mission, as it will be a « world première » (first Doppler lidar in space) highlighting the excellence of european industry
- French ADM-Aeolus activities coordinated by Alain Dabas (CNRM)
- French laboratories involved : CNRM, LMD, LATMOS, LSCE, OPAR, ...
- Over the last decade :
  - ◆ >2 FTE (permanent staff) working on the preparation of ADM-Aeolus in French labs
  - ◆ Constant support from CNES to French labs



## CNES support to ADM-Aeolus (2)

### Supported activities

#### ● **Cal/Val :**

- ◆ Preparing / upgrading fixed instrumented supersites : Doppler lidars at OHP and OPAR (La Réunion)
- ◆ Preparing / upgrading mobile validation station : mobile lidars (LSCE)
- ◆ Preparing / upgrading airborne instrumentation
  - » Doppler HSR lidar LNG
  - » 94 GHz Cloud radar, ...
- ◆ Stratéole2 : balloon campaigns in 2018, 2020 and 2023

# Airborne Doppler HSR lidar LNG

Doppler airborne lidar **LNG** onboard  
the French Safire Falcon20  
**355 (HSR) / 532 / 1064 nm**  
Coupled with a 94GHz cloud  
Doppler radar



Photo taken last fall during the **NAWDEX-EPATAN** field campaign in Iceland  
**From left to right** : DLR's Falcon, DLR's HALO and Safire's Falcon  
A remarkable illustration of a fruitful international partnership (ESA + DLR + CNES + ...)  
→ **Something to reproduce in the future (for ADM-Aeolus and EarthCare) !**

→ See Jacques Pelon (LATMOS) presentation on Wednesday morning (09.10 – 09.20)

## Stratéole 2



- Stratospheric pressurized balloon campaigns
  - ◆ 2018 : 5 flights
  - ◆ 2020 : 20 flights
  - ◆ 2023 : 20 flights
- Each flight = 3 months duration
- Flight altitude = 18 - 20 km
- Study of the troposphere – stratosphere interface in the tropics
- 5 to 10 instruments onboard : temperature (profile down to 2 km below the balloon), humidity, pressure, aerosols, winds, CO<sub>2</sub>, cirrus (with a lidar), upgoing radiative fluxes, ozone

→ See Albert Hertzog (LMD) presentation on Wednesday afternoon (15.30 – 15.55)

# CNES support to ADM-Aeolus (3)

## Supported activities

- **Exploitation (to be developed in the future):**
  - ◆ Radial winds assimilation experiments in the Météo France NWP models
    - **Assesment of the specific added value given the overall current and future global observation system network : ground-based Doppler radars, AMDAR, Radio-soundings, Scatterometers, Atmospheric Motion Vectors (incl. from LEO/GEO IR sounders)**
    - **Important work for the forthcoming discussions on some follow-on mission**
  - ◆ Comparison / combination with Calipso (and EarthCARE)
    - **Towards decades-long, multi-mission time series of clouds and aerosols at global scale**

## In conclusion

- Looking forward to the launch !
- CNES has always been a strong supporter of the mission
- French contribution to Cal/Val is well coordinated and multi-components : balloons, aircrafts, ground-based instruments, ...
- Multi-agency coordination (e.g. CNES+ ESA + ...) is needed to achieve the right level of support for Cal/Val activities (cf NAWDEX/EPATAN successful partnership)
- Looking forward to discussing potential follow-on missions, cf :
  - ◆ GCOS Implementation Plan 2016 – Action #A21 : « *Assuming the success of ADM-Aeolus, implement an operational space-based wind profiling system with global coverage* »