CNES Earth Observation Activities

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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

Ministry of National Education, Higher Education and Search, National research organisations

Ministry of Defence

General Commissariat for Investment (CGI)

International partners (NASA, JAXA, ROSCOSMOS CNSA, ISRO, etc.)

EUMETSAT

European Union

Science laboratories

Industry

Other Space users

Ministries of:
- Ecology, Sustainable Development and Energy
- Foreign Affairs
- Social Welfare and Health
- Interior

European Union

International partners (NASA, JAXA, ROSCOSMOS CNSA, ISRO, etc.)
CNES 2016 budget: 2120 M€

CNES 2016 expenses

- **Ariane and CSG**: 961 M€ / 45%
- **Observation**: 367 M€ / 17%
- **Defence**: 227 M€ / 11%
- **Science**: 285 M€ / 14%
- **Telecoms**: 126 M€ / 6%
- **Projects and cross-functional activities**: 154 M€ / 7%
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

**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

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

→ 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, ...

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

→ See Alain Dabas (CNRM) presentation on Wednesday morning (09.00 – 09.10)
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, CO2, cirrus (with a lidar), upgoing radiative fluxes, ozone

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

Exploitation (to be developed in the future):

- Radial winds assimilation experiments in the Météo France NWP models
  → Assessment 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 »