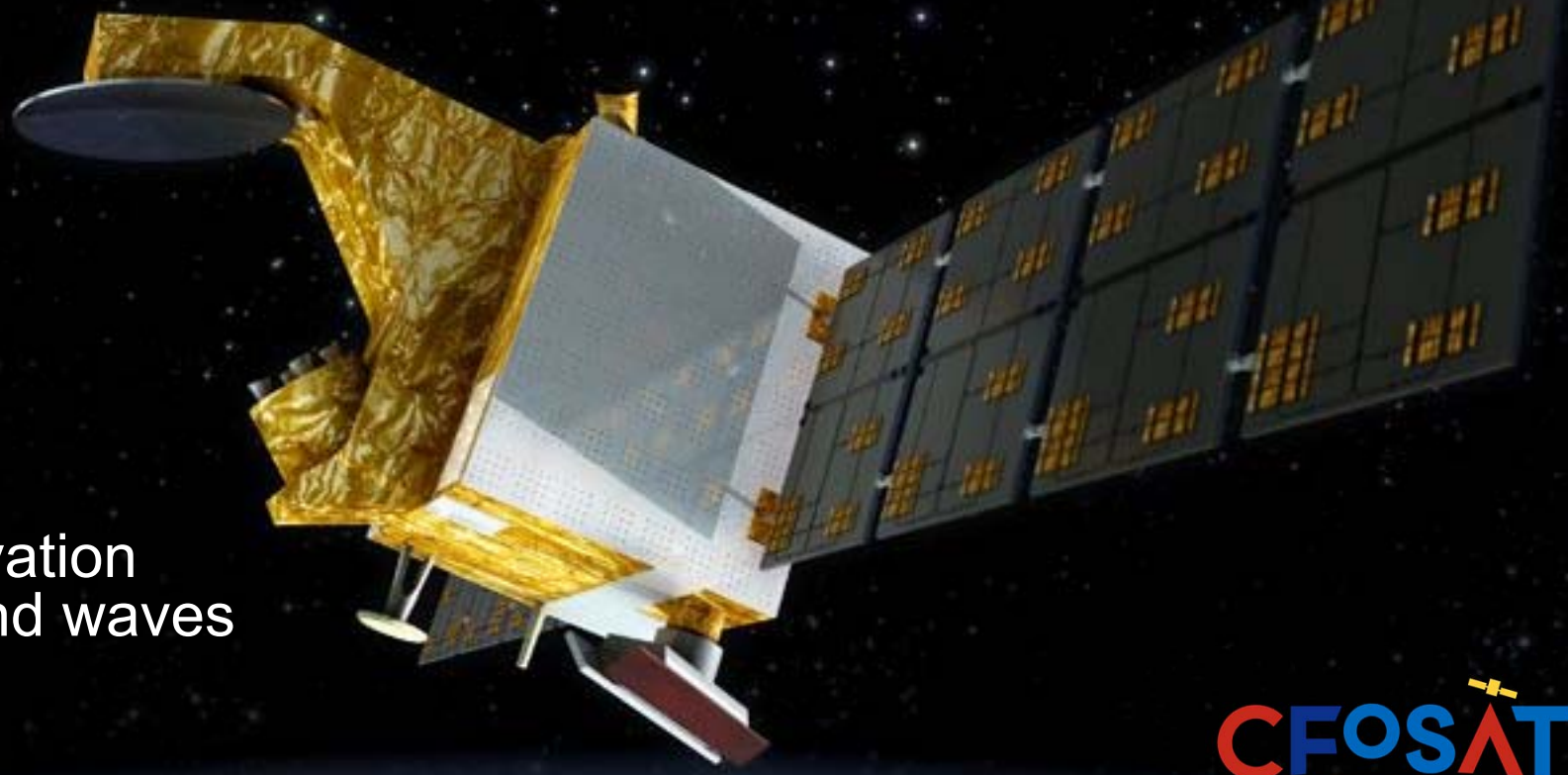
CFOSAT: China France Oceanography SATellite



A new satellite
for the observation
of wind and waves

C. Tourain[(1)], C. Tison[(1)], P. Castillan[(1)], D. Hauser[(2)]

(1) CNES, Toulouse, France

(2) LATMOS, CNRS, UVSQ, UPMC, Guyancourt, France

The CFOSAT mission

CFOSAT: A China/France world premiere for oceanography

Launch date:
2018, October 29th
Jiuquan (China)
Long March 2

Joint measurements of oceanic wind and waves

- **SWIM**: a wave scatterometer (new instrument)
- **SCAT**: a wind scatterometer (fan beam concept)

Main Objective : Measure at the global scale ocean surface wind and waves spectral properties

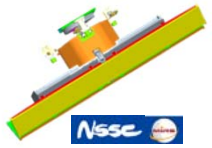
Applications :

- atmospheric, oceanic and wave forecast systems
- wind and wave climatology
- characterization of processes affecting surface waves
- characterization and modeling of ocean/atmosphere coupling

Secondary objective : Land and sea ice characterization (Sun synchronous polar orbit)

- Sea ice and ice cover
- Land surface (variations of humidity and roughness)

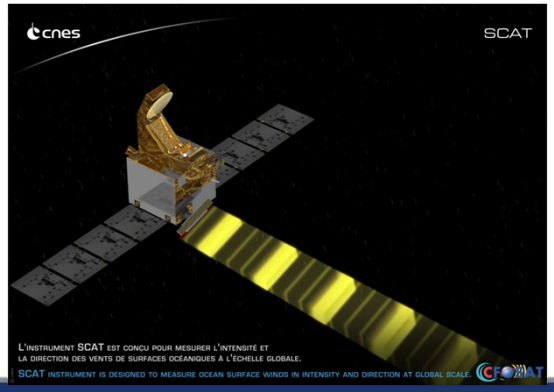
CFOSAT instruments

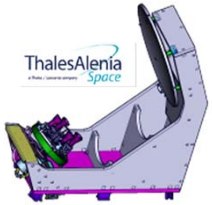


SCAT

Wind scatterometer

- Ku Band
- Fan beam concept
- ⇒ Combine advantages :
  - Large swath
  - Rotating antenna: 3 rpm
- Incidences between 26° and ~50°
- Provides
  - Sigma0
  - Ocean wind vector

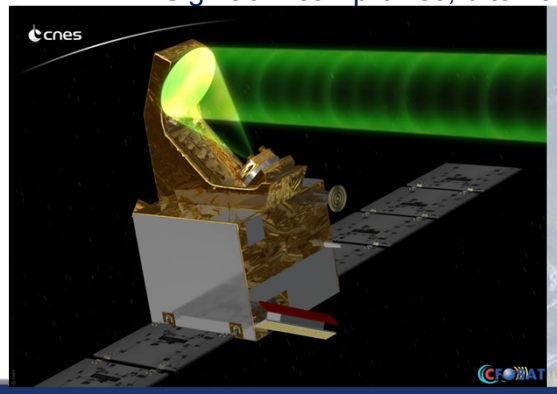




SWIM

Wave scatterometer

- Ku band real aperture radar,
- Sequential illumination with 6 incidence angles :
  - Beams 0°, 2°, 4°, 6°, 8°, 10°
- Rotating antenna (all azimuth direction acquisition): 5,6 rpm
- Provides :
  - Directional wave spectra
  - Significant wave height and wind speed
  - Sigma0 mean profiles, 0 to 10°



DFH Satellite Co., Ltd

Mission status

CFOSAT satellite ready for launch :

- Assembly and integration phase completed
- Satellite at the launch site
  - Last health tests and ground operations ongoing.

Ground segment :

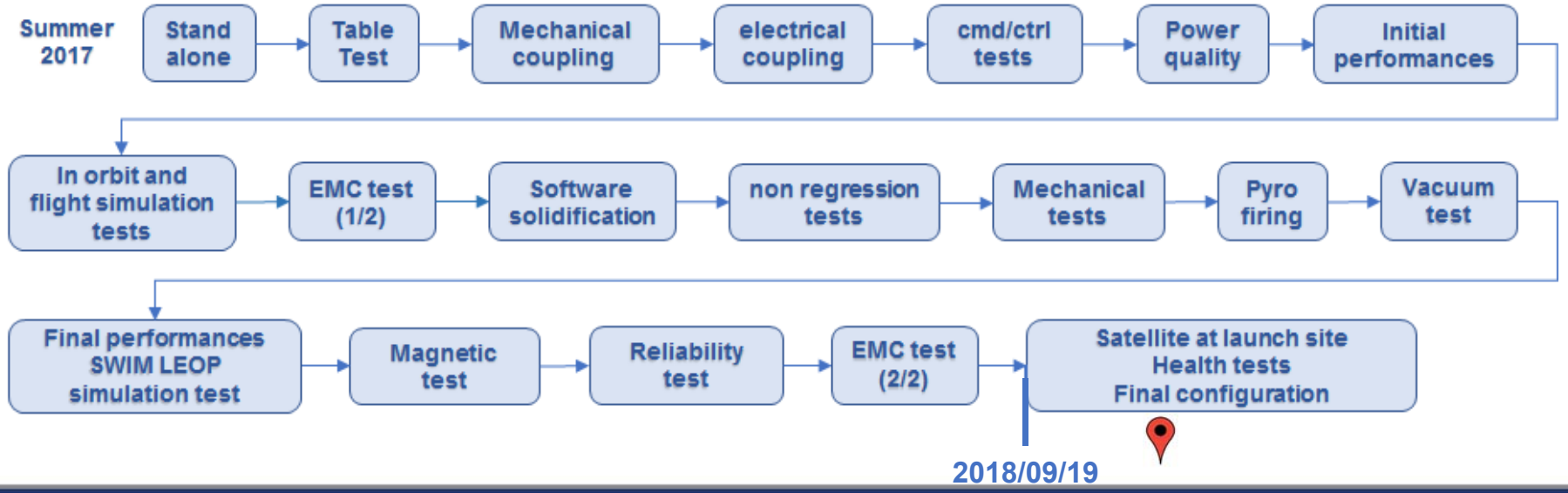
- **Processing chains – ready**
- Final operational qualifications – on-going

CAL/VAL phase organization defined

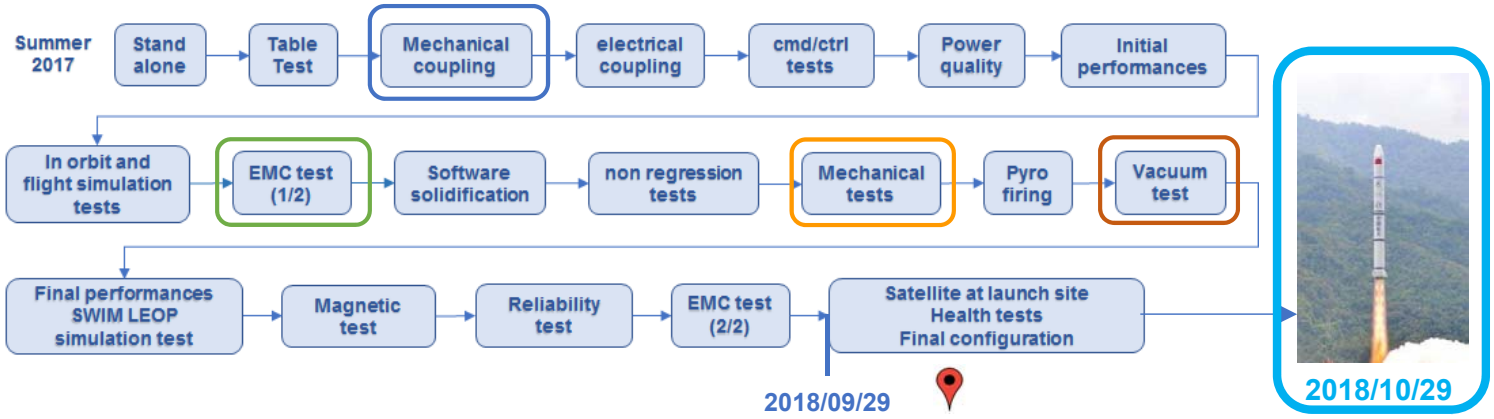
- Verification objectives and planning defined

CFOSAT AIT main steps

- AIT campaign over one year in China,
- Long test sequence, on different sites,
- Closed collaboration between French and Chinese teams to make it work.

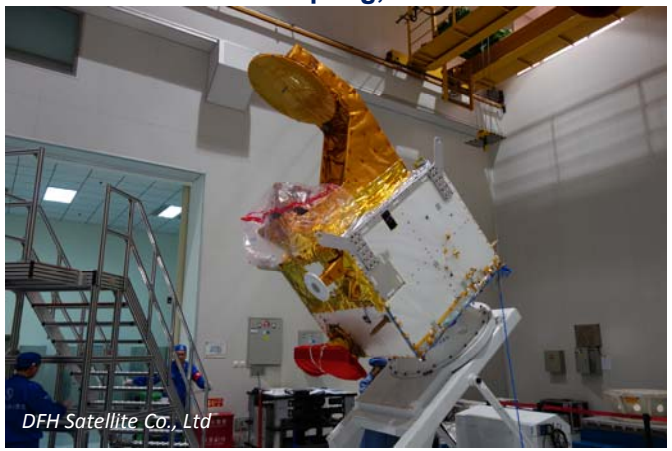


CFOSAT AIT main steps

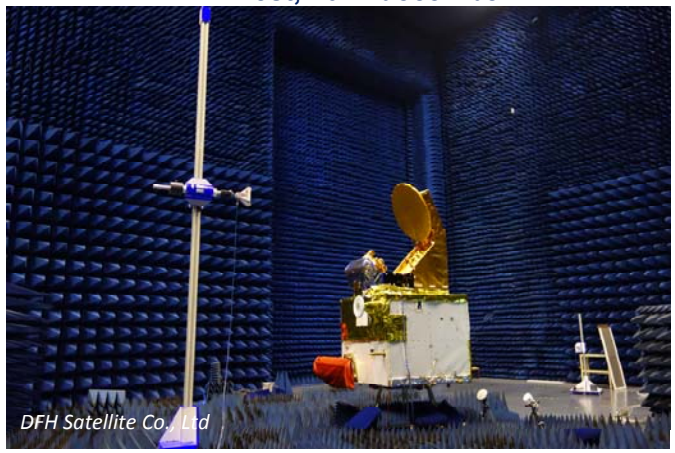


Vacuum test, 2018 July

Mechanical coupling, 2017 October

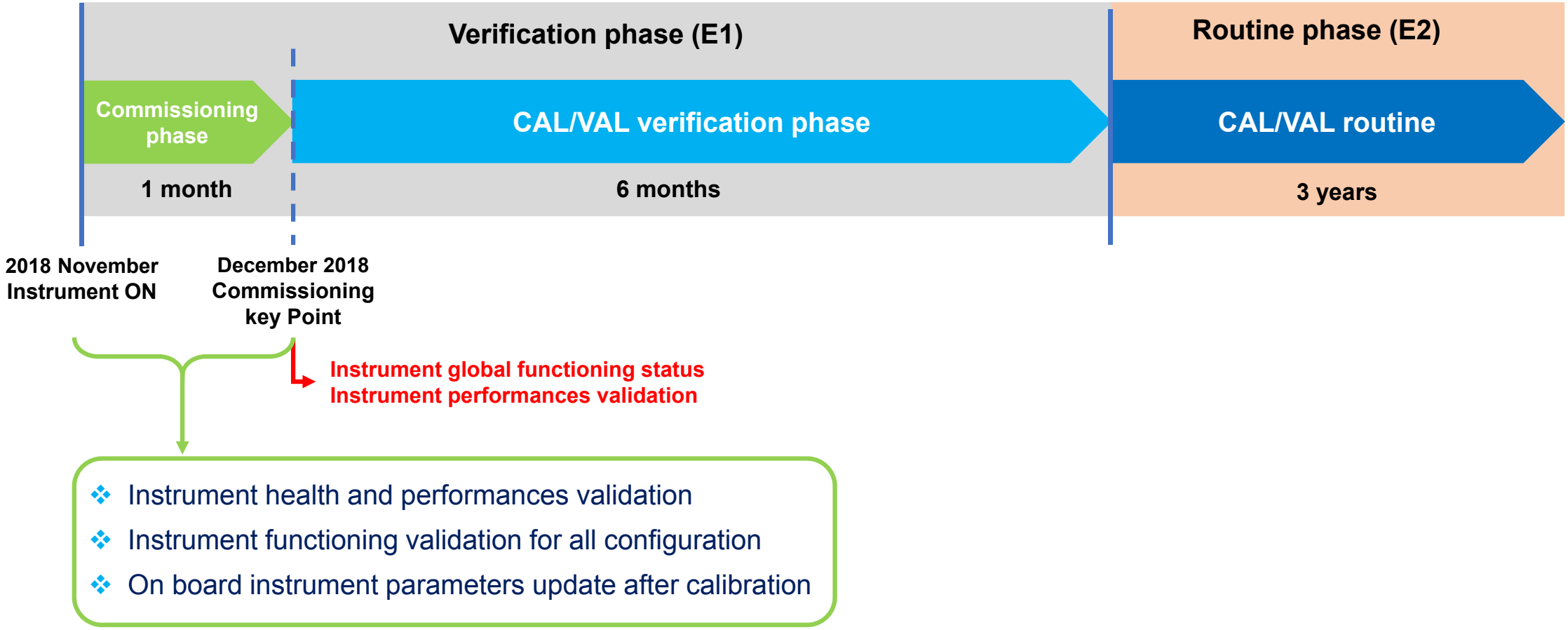


EMC Test, 2017 december



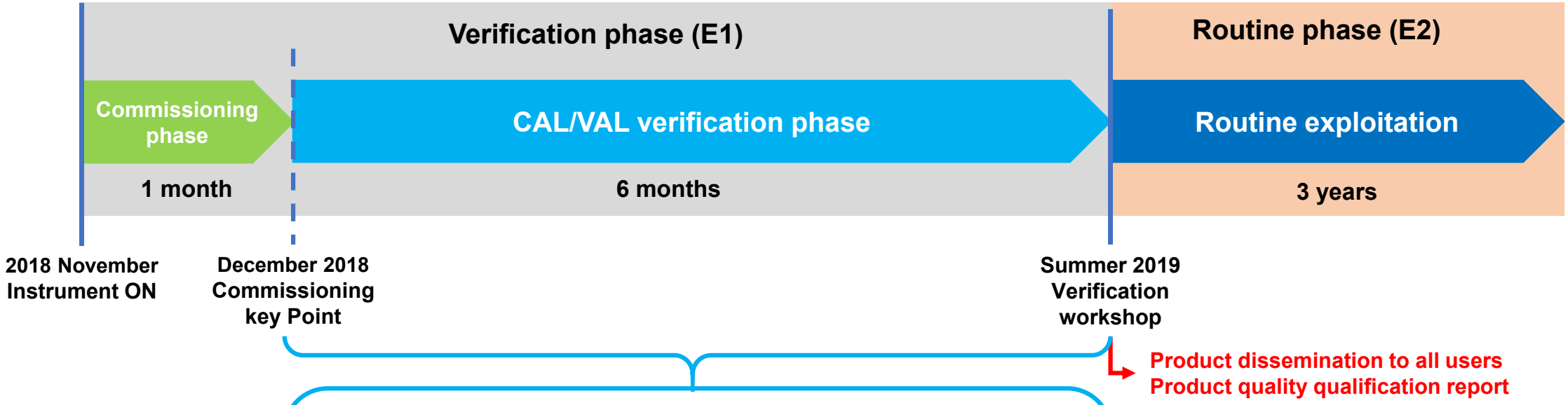
Mechanical test, 2018 april

Coming steps after launch (SWIM)



- Instrument health and performances validation
- Instrument functioning validation for all configuration
- On board instrument parameters update after calibration

Coming steps after launch (SWIM)

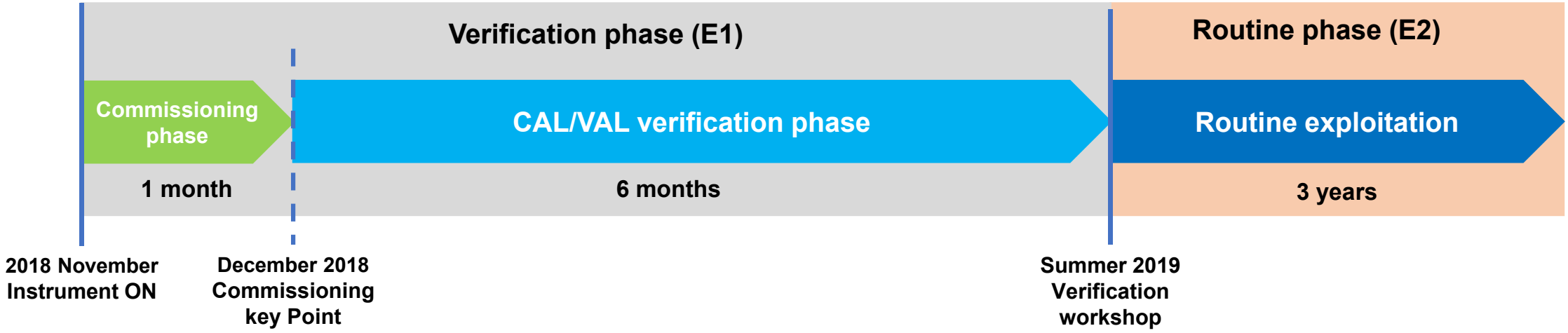


Instrumental systematic monitoring (every CFOSAT cycle – 13 days)

Geophysical products content validation

- Nadir data : usual diagnosis (only SWH and sigma0)
- Six beams data (Sigma0 profiles and modulation, wave parameters ..)
  - Specific instrument configurations planned
  - Validation through expertise centers work

Coming steps after launch (SWIM)



CAL/VAL activities :

Instrumental systematic monitoring (every CFOSAT cycle)

Geophysical products quality systematic information (frequency TBD)

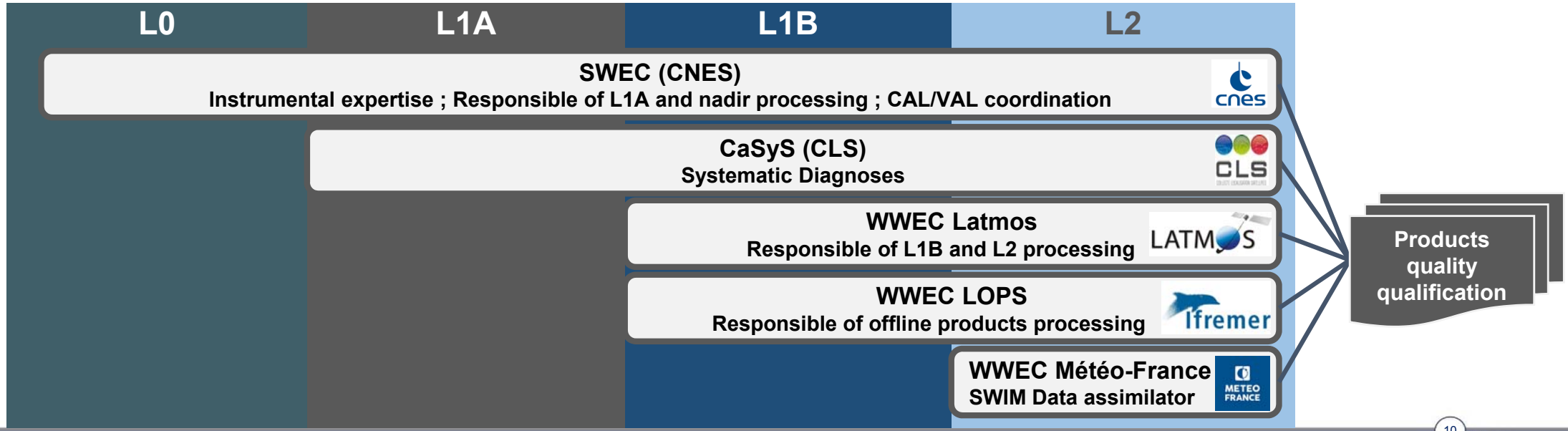
Geophysical products performances qualification

- Expertise centers work
- Users (operational, scientific) feedbacks
- Specific studies

Cal/Val participants (1/2)

CFOSAT SWIM CALVAL group :

- 5 entities with complementary skills, from instrument expertise to data assimilation
  - **SWEC** : **SW**IM **E**xpertise **C**ell
  - **CaSyS :** (**Ca**l/Val **Sy**stématique **S**WIM)
  - **WWEC** : **W**ind and **W**ave **E**xpertise **C**enters



Cal/Val participants (2/2)

Science team

- CNES Research Announcement of Opportunity
  - Emitted on June 4th
  - Deadline for response : September 14th

➔ **In case of late proposal: please contact C. Tourain : cedric.tourain@cnes.fr**

or send proposal to oceano@cnes.fr

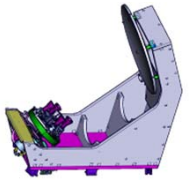
- Proposal selection expected on November 12th
- Scientists will contribute to CAL/VAL
  - During the verification phase : CAL/VAL contributors
  - During the routine phase : all scientists

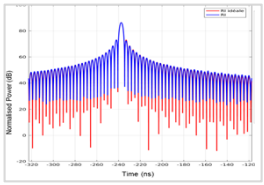
Conclusion

CFOSAT is ready for launch

- On October 29th:

  A new spaceborne wave scatterometer SWIM and a new wind scatterometer SCAT will be in orbit





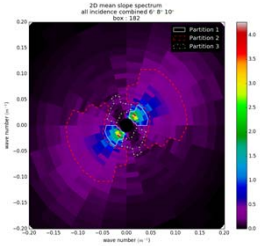
- By the end of the year 2018:

  A first status on SWIM instrument performances will be available

- Summer 2019:

  Product dissemination expected

  Teams are ready and organized to analyze data and provide to users a detailed quality information at that time



Thank you for your attention!

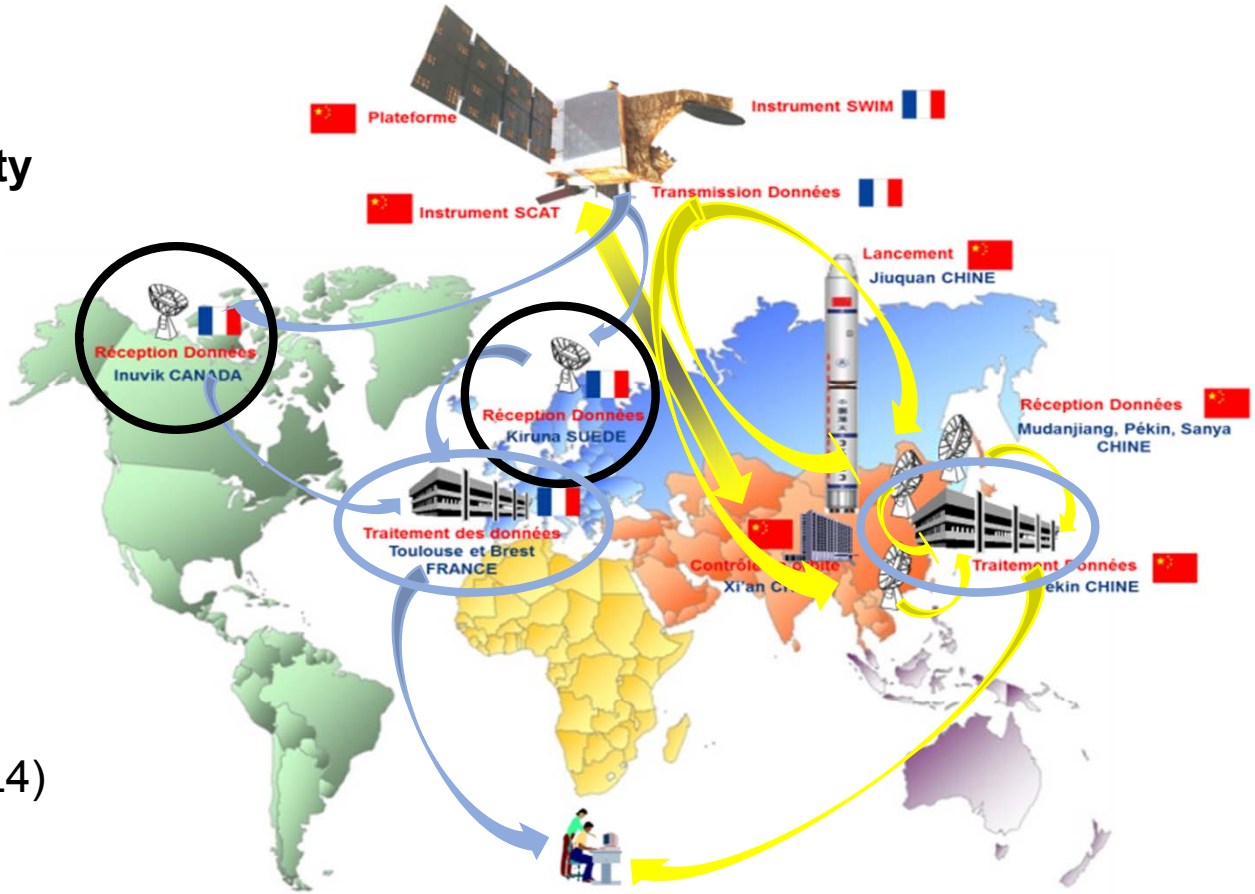
BACKUP

Overview of the ground segment

Polar X-band stations for NRT capability

Two mission centers (China & France):
- Processing of both instrument
- Same L1 products
- Possible different L2 products

French ground segment :
- NRT at CNES (L1, L2)
- Differed time at IFREMER (L2S, L3, L4)



SCAT NRT products

L1a
Backscattered power (about 1 km range resolution)

L1b
Time-Ordered Earth-Located Sigma0s
(~8 km ground resolution)

L2a
Surface Flagged Sigma0s and Attenuations in 25 and 50 km Swath Grid

L2B
Ocean Wind Vectors in 25 and 50 km Swath Grid

SWIM NRTProducts

L1a
Calibrated waveform, geocoded @ 0, 2, 4, 6, 8, 10°
+ nadir waveform non calibrated, compensated for Instrument automatic gain

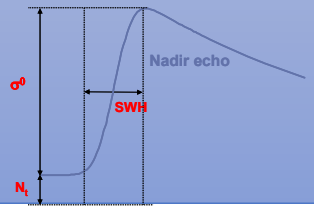
Nadir products (0°)

Wave products (6°, 8°, 10°)

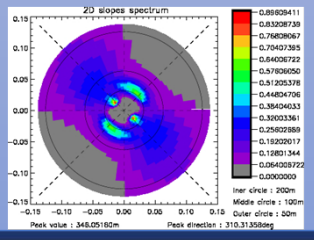
σ^0 products (0°, 2°, 4°, 6°, 8°, 10°)

L1b
- Modulation spectrum

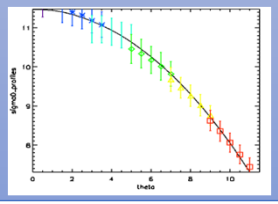
L2
- SWH, wind speed
- Ice and land properties



L2
- Omnidirectional and 2-D wave spectra
- Partitioning and associated parameters (Hs, peak wave number and peak direction)

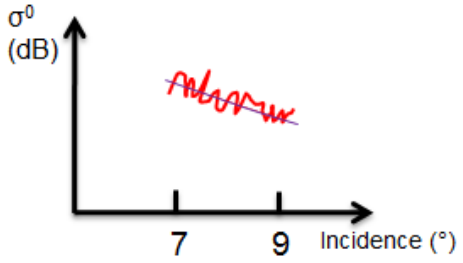


L2
- σ^0 mean profiles versus incidence and azimuth

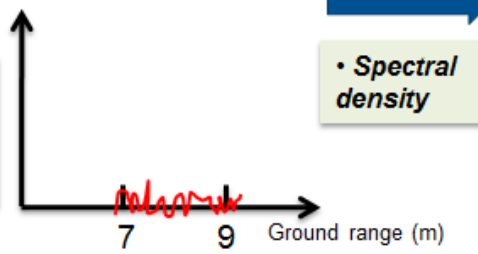


SWIM NRT Wave products

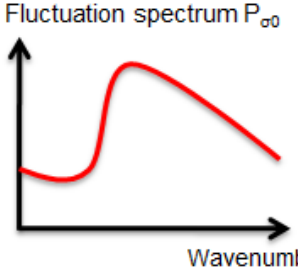
L1a: Calibrated wave form, geocoded
(per cycle, per azimuth, incidence = 6, 8 or 10°)



- ***Mean trend suppression***
- ***Ground projection***



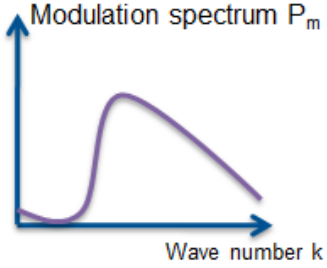
- ***Spectral density***



$P_{\sigma 0} = P_{IR}.P_m + P_{sp}$

- ***Speckle + IR correction***

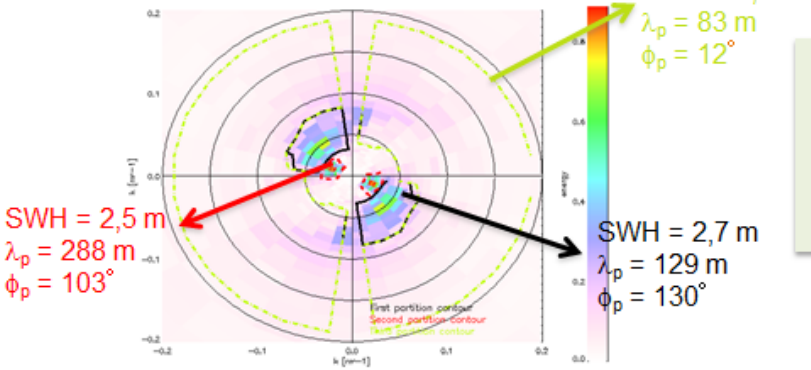
L1b: modulation spectrum
(per cycle, per azimuth, incidence=6, 8 or 10°)



$P_w = P_m/MTF$

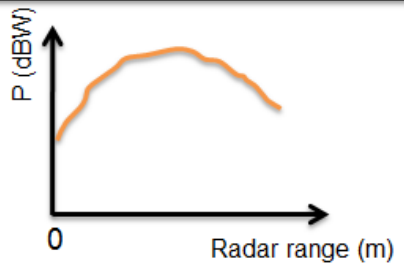
- ***Transfer function estimation and wave slope spectrum computation***
- ***15°-azimuth averaging***
- ***Partitioning and physical parameter computation***

L2: wave slope spectrum and partitions
(per box, per beam or merged)

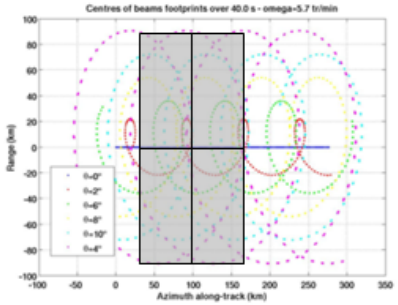


SWIM NRT σ^0 profile

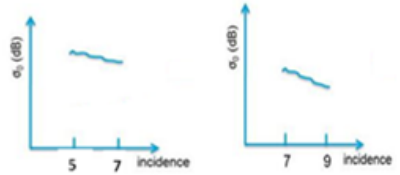
L0: non calibrated wave form (per cycle, incidence, azimuth)



- ***σ^0 estimate from radar equation***
- ***Geocoding***



L1a: Calibrated wave form, geocoded (per cycle, incidence, azimuth)



- ***Combining incidences within boxes***

L2: Normalized radar cross-section profiles
From 0° to 11° (per 15°-azimuth range) at a scale of 70 x 90 km and associated radiometric accuracy