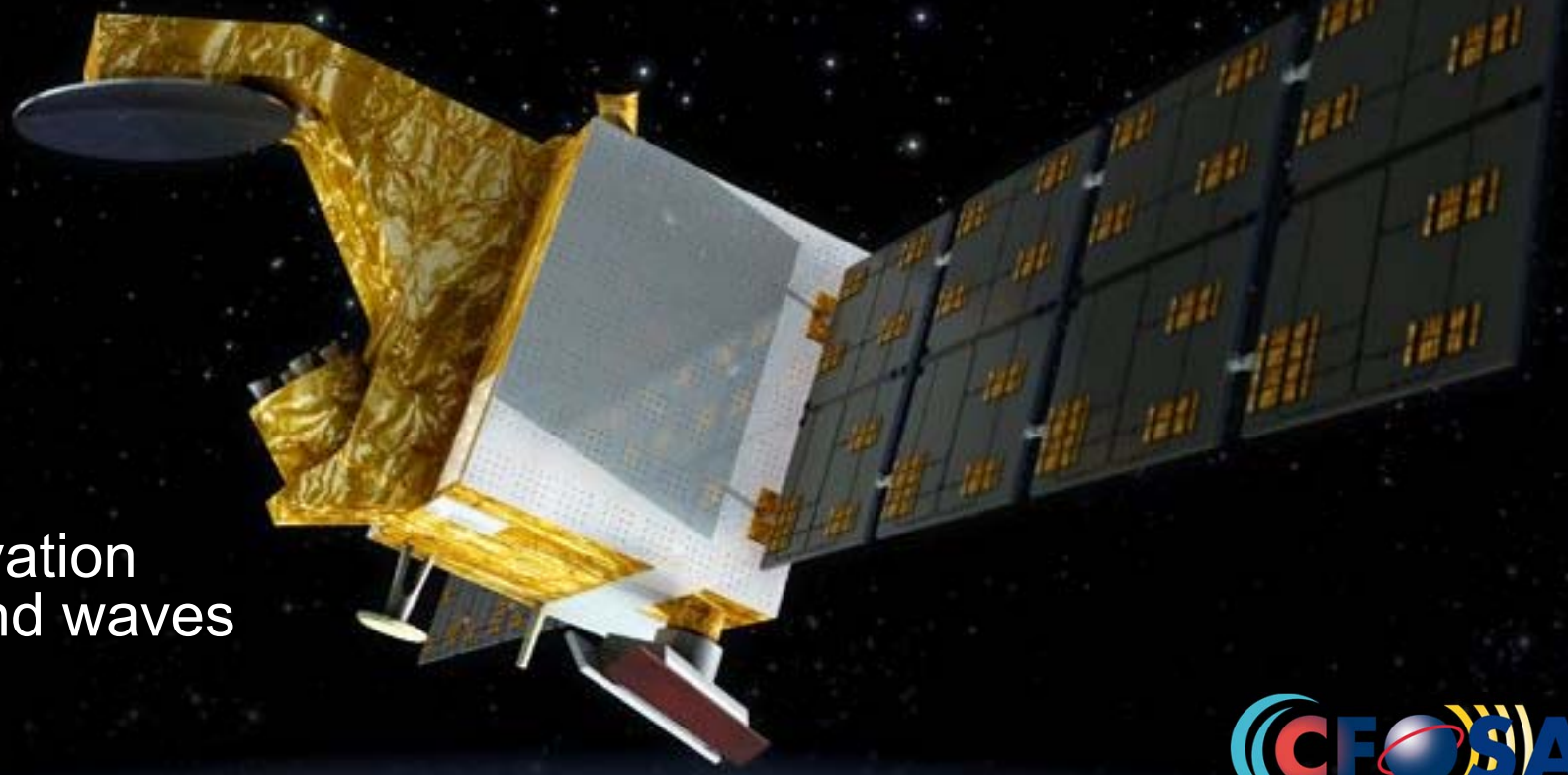
CFOSAT: China France Oceanography SATellite



A new satellite
for the observation
of wind and waves

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The CFOSAT mission

CFOSAT: A China/France world premiere for oceanography

Joint measurements of oceanic wind and waves

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

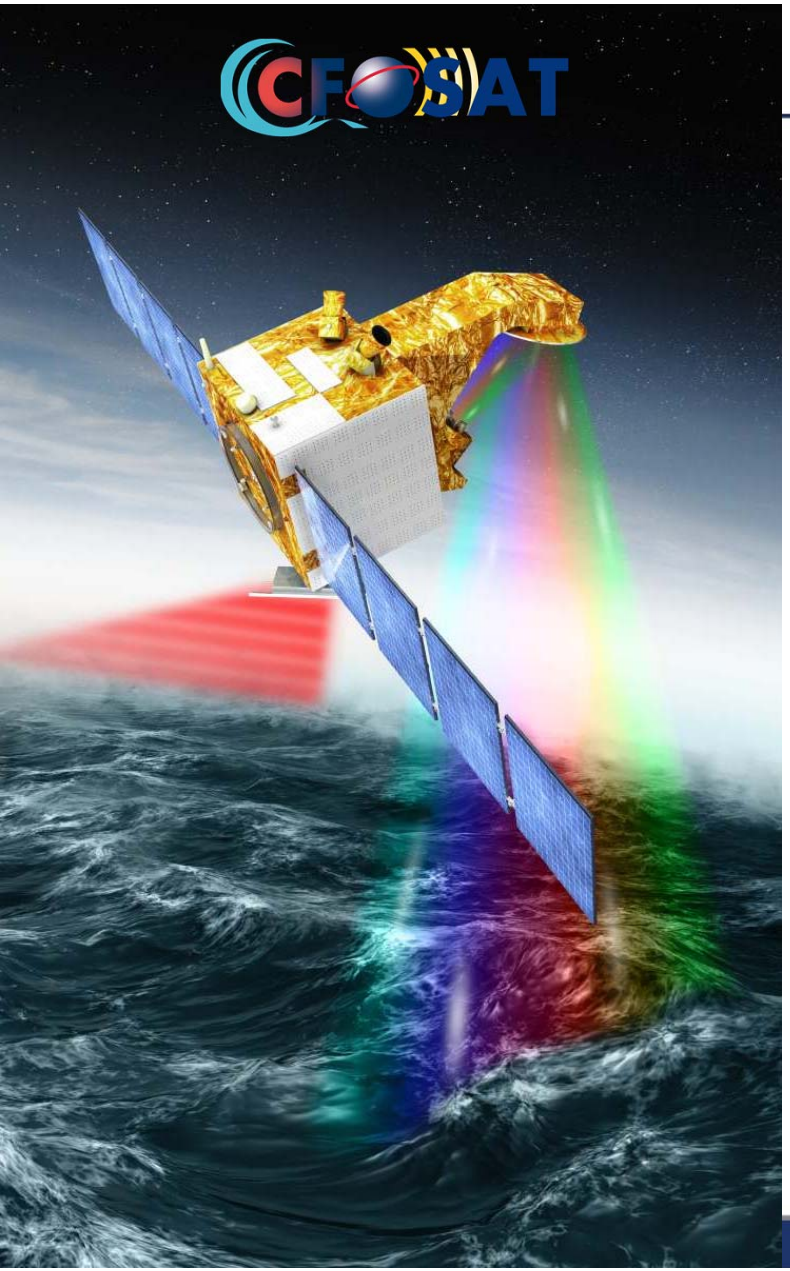
Main Objective : Measure at the global scale ocean surface wind and waves spectral properties

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)



cnes

SCAT: a wind scatterometer

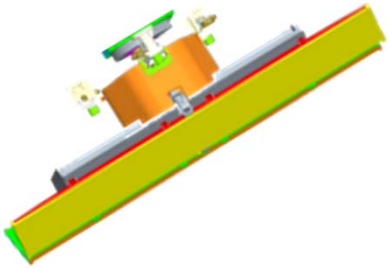
Ku band

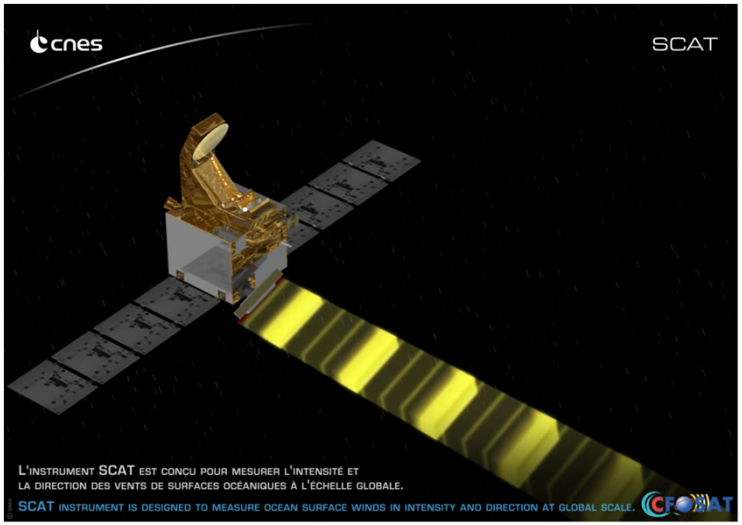
- Fan beam concept

⇒ Combine advantages :

  - Large swath
  - Rotating antenna: 3 rpm

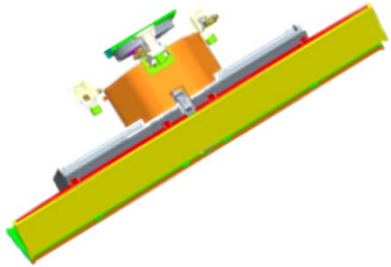
- Incidences between 26° and ~50°



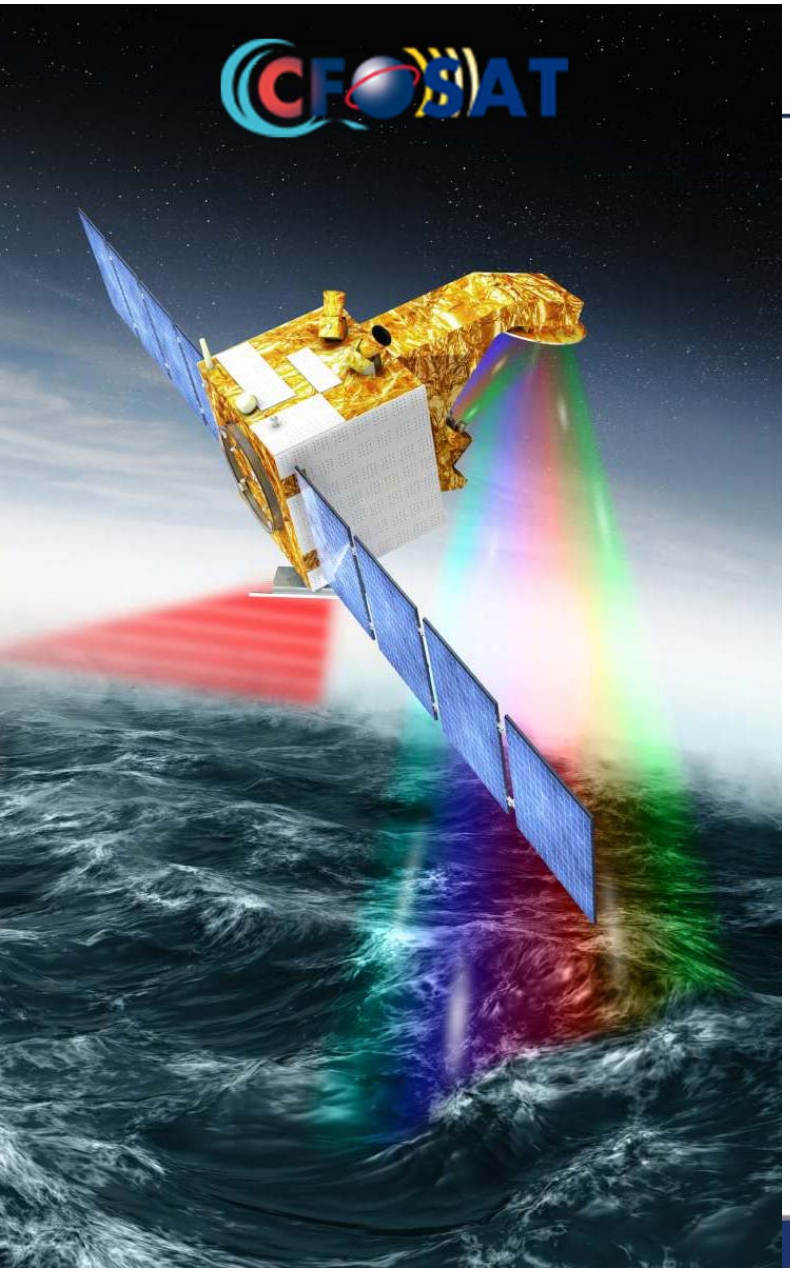


SCAT– expected performances

- Mission requirements :
  - Global coverage within 3 days
  - Near Real Time access to the data
  - Data geolocalization better than 5km

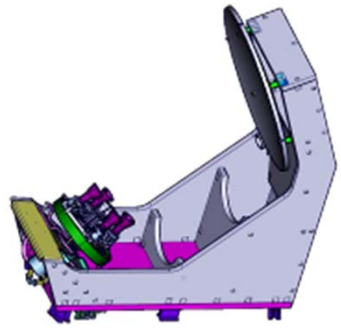


- Parameters to be measured:
  - **σ_0**
    - ± 1.0 dB for Wind Speed ∈ [4-6 m/s]
    - ± 0.5 dB for Wind Speed ∈ [6-24 m/s]
  - **Ocean wind vector**
    - Wind speed: 2 m/s or 10% (the largest) for Wind speed ∈ [4-24 m/s]
    - Wind direction: ± 20°



SWIM

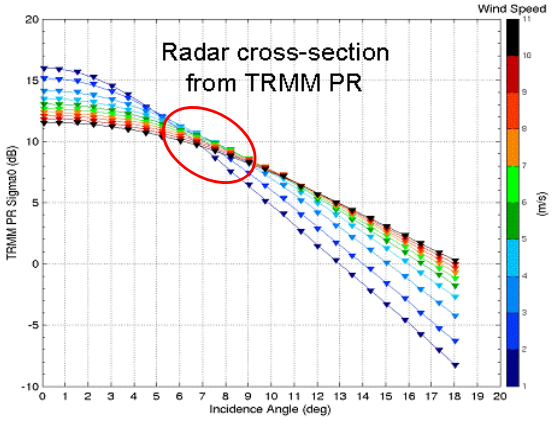
Concept :

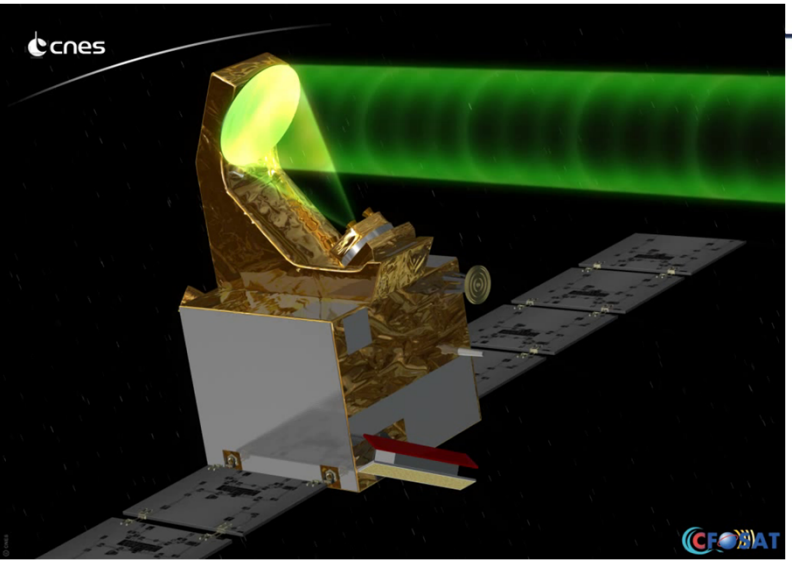


- Wave scatterometer:
- measures sea surface backscattering coefficient modulation

Around 8° incidence, for Ku-band :

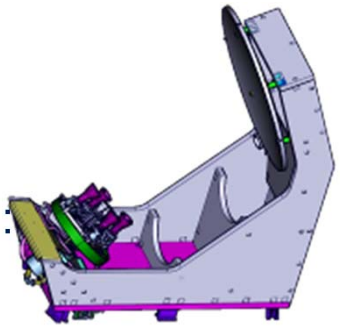
- radar cross-section insensitive to wind speed
- radar cross-section modulation spectrum proportional to wave slope spectrum





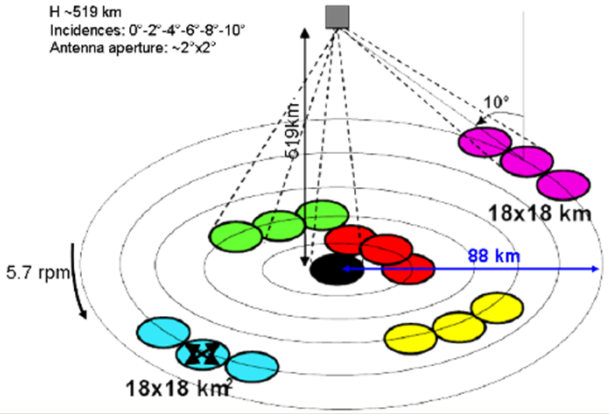
SWIM

Instrument :



- Ku band real aperture radar,
- Sequential illumination with 6 incidence angles :

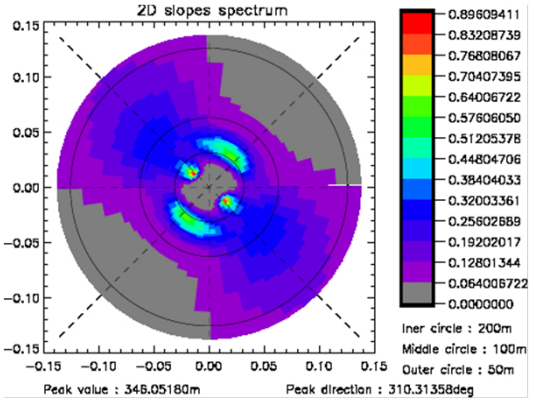
  beams 0°, 2°, 4°, 6°, 8°, 10°
- Rotating antenna: 5,6 rpm
  - all azimuth direction acquisition



SWIM - expected performances

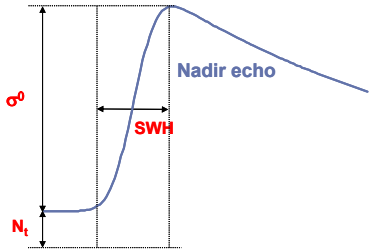
Directional wave spectra, 6º / 8º / 10º beams

λ	$\frac{\delta\lambda}{\lambda}$	ϕ	*Spectral peak power*	*Resolution cell*
70 – 500 m	10%	15°	15% TBC (with real data) (SWH>2m)	70x90 km^2



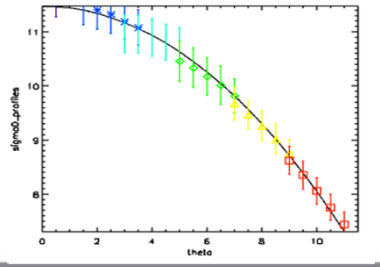
Significant wave height and wind speed, nadir beam

SWH	*WS*
< 10% or 50 cm	2 m/s (TBC)

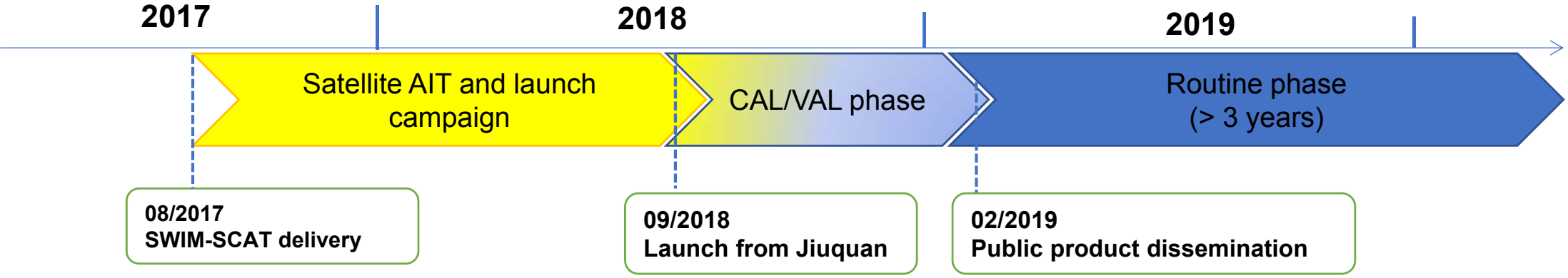


σ_0 mean profiles, 0 to 10º beams

σ_0	$\Delta\sigma_0^{i,j}$
<1 dB	<0.2 dB

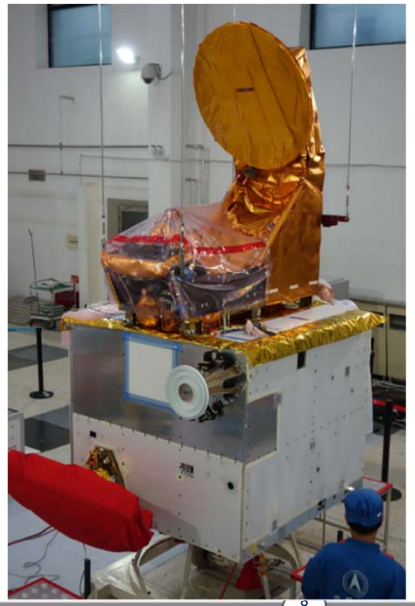


Mission Status



AIT status:

- SWIM and SCAT instruments integrated on the platform
- Mechanical coupling performed
- Electrical coupling tests between platform and payloads on going



Conclusion

Next year, CFOSAT will provide data from two innovative payloads

- A new spaceborne wave scatterometer SWIM
  - Accurate directional wave spectrum characterization.
  - Great source of information for understanding of interaction of sea states in altimeter measurements.
- A new wind scatterometer SCAT
  - Strong potential for wind calculation algorithms validation
- Nadir processing :
  - New generation algorithms (adaptive retracking, P. Thibaut, IP splinter) implemented in ground segment, operational assessment

SWIM simulation data open to scientists on AVISO+ :

- **full CFOSAT cycle available (23/08/2016 -> 05/09/2016)**
- **L1a to L2 products**

http://www.aviso.altimetry.fr/fr/missions/missions-futures/cfosat.html

(please contact cedric.tourain@cnes.fr for more information)

Thank you for your attention!

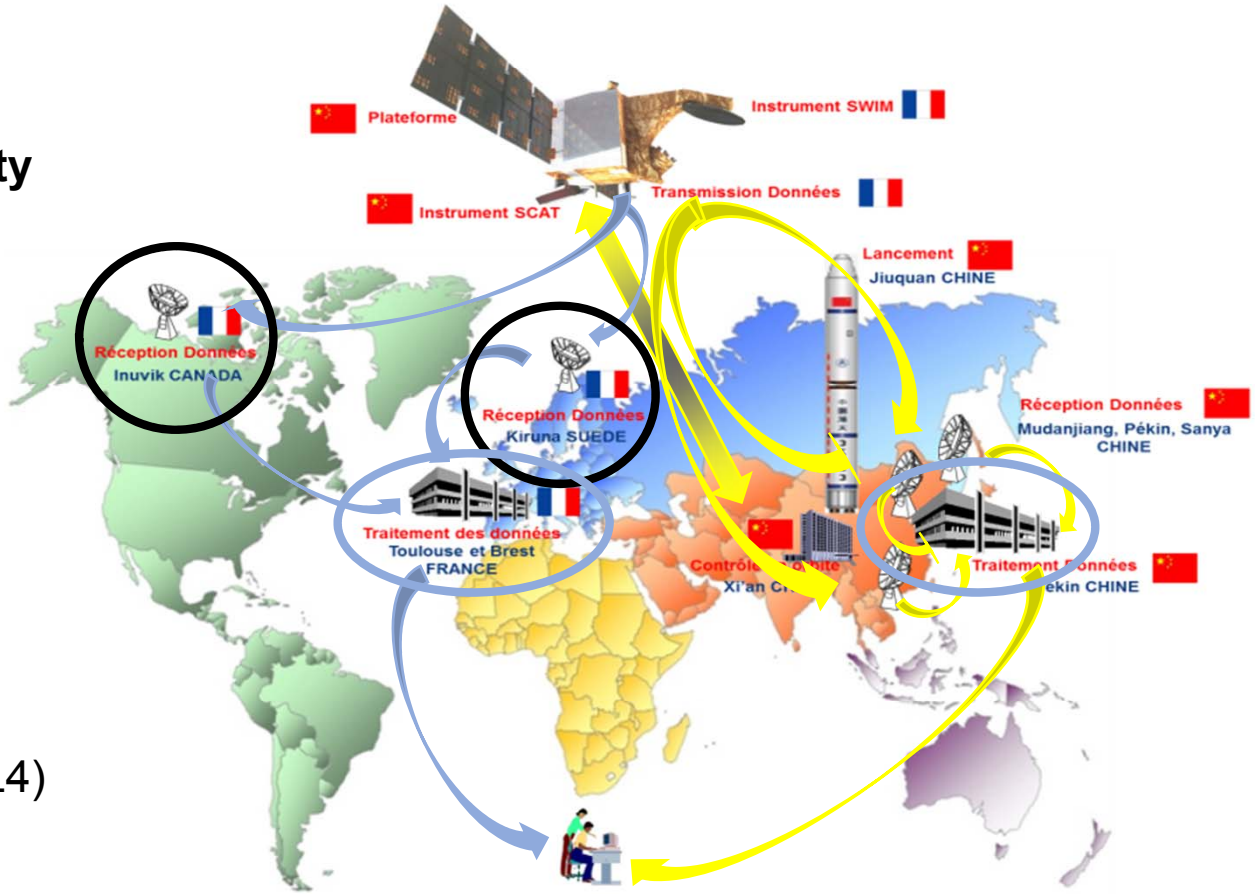
BACKUP

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

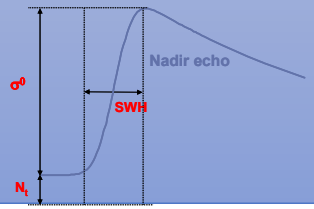
Nadir products (0°)

Wave products (6°, 8°, 10°)

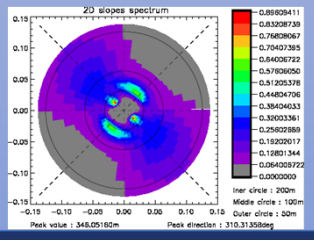
σ^0 products (0°, 2°, 4°, 6°, 8°, 10°)

L1b
- Modulation spectrum

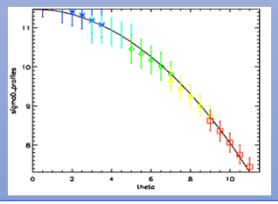
L2
- SWH, wind speed
- Ice and land properties



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

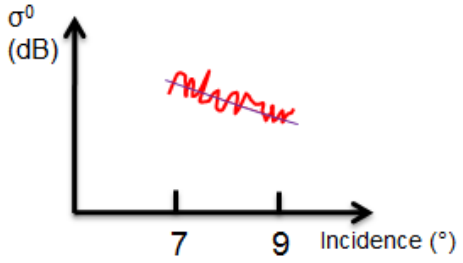


L2
- σ^0 mean profiles versus incidence and azimuth

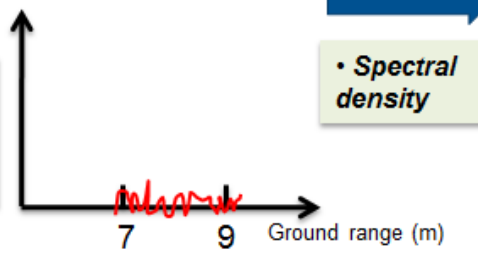


SWIM NRT Wave products

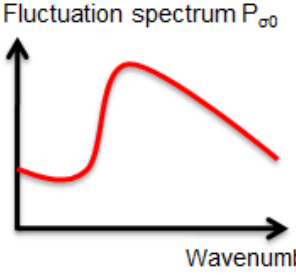
L1a: Calibrated wave form, geocoded
(per cycle, per azimuth, incidence = 6, 8 or 10°)



• ***Mean trend suppression***
• ***Ground projection***



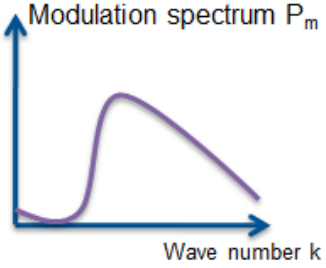
• ***Spectral density***



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

• ***Speckle + IR correction***

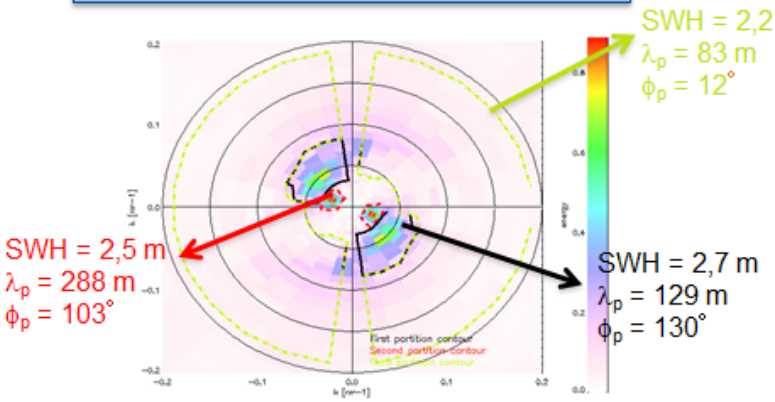
L1b: modulation spectrum
(per cycle, per azimuth, incidence=6, 8 or 10°)



$P_w = P_m/MTF$

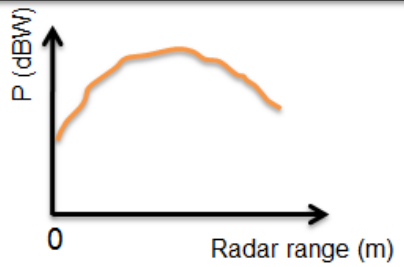
- ***Transfer function estimation and wave slope spectrum computation***
- ***15°-azimuth averaging***
- ***Partitioning and physical parameter computation***

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



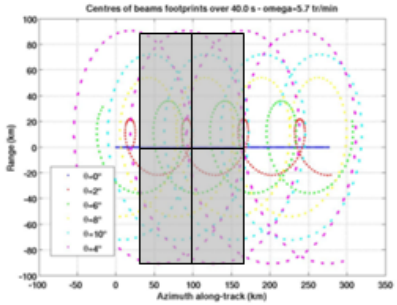
SWIM NRT σ^0 profile

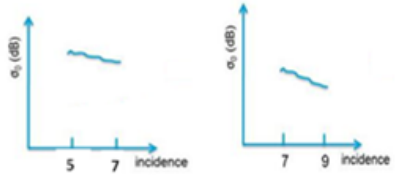
L0: non calibrated wave form (per cycle, incidence, azimuth)



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

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





- ***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