CFOSAT: China France Oceanography Satellite

New products for the observation of wind and waves

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CFOSAT: A China/France world premiere for oceanography

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

**SCAT**
- Wind scatterometer
  - Fan beam concept
    - Large swath
    - Rotating antenna: 3 rpm
  - Incidences between 26° and ~50°
  - Provides
    - $\sigma_0$
    - Ocean wind vectors

**SWIM**
- Wave scatterometer
  - Ku band real aperture radar,
  - Sequential illumination with 6 incidence angles: 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
    - $\sigma_0$ mean profiles, 0 to 10°
Mission status

2018 October 29th Successful launch:

- Very precise injection with the Long March 2 launcher
- Instruments switched ON
  - SCAT: October 31st
  - SWIM: November 1st
- Both ground segments functional less than one week after launch
  - First SWIM wave spectra and SCAT wind map produced on November 4th

2018 December 17th SWIM commissioning keypoint:

- Functional behavior validated
- Very good instrument performances observed
Mission status

2019 July 1-3: CAL/VAL workshop

- CAL/VAL analyses of verification phase presentations
  - Report on “the SWIM CAL/VAL at the end of the verification phase”: available

2019 September 23rd – 26th: 1st international Science Team Meeting in Nanjing (China)

- 80 international attendees
- CAL/VAL synthesis for both instruments
- First feedbacks from scientific teams
- Agreement on data quality
- Data release recommendation
Mission status

CFOSAT Science Team established

- More than 50 scientific teams leaded by:
  - France
    - PI: Danièle Hauser (LATMOS)
    - Co-PI: Lotfi Aouf (Météo-France)
  - China
    - PI: LIU Jianqiang (NSOAS)

2019 November: data release to all scientific users

- Data already available to science team
- CNES/CNSA Joint Steering Committee expected for formal open worldwide
- CFOSAT enters in routine exploitation
CFOSAT SCAT: firsts results

Wind products

- Wind vectors globally consistent with ECMWF model data
  - Wind speed: 1.3 – 1.4 m/s RMS discrepancies
  - Wind direction: 15 – 17° RMS discrepancies

- Good wind fields consistency with NDBC buoy
  - Wind speed about 1.0 m/s,
  - Wind direction about 16°.
CFOSAT SWIM: firsts results (1/3)

Nadir products

- Operational implementation of the Adaptive retracking Algorithm
- Despite SWIM low measurement rate (5Hz vs 20Hz), remarkable results:
  - Very good consistency with model and altimetry missions
  - Improved performances w.r.t. current operational altimetry retracking
    - SWH and Sigma0 restitution noise reduction

See A. Ollivier specific presentation in CFOSAT Splinter (Thursday 11:20)
CFOSAT SWIM: firsts results (2/3)

Off-nadir sigma0 product: sigma0 profiles

- Ocean surface:
  - Trends consistent with TRMM/GPM

- Sea ice and land surface
  - good sensitivity and consistent with literature

Wave spectra

- 1D spectra
  - Shape consistent with model and buoy data
  - Good wavelength estimation
  - Some parasite peaks to be filtered out
CFOSAT SWIM: first results (3/3)

Wave spectra

- 2D spectra:
  - Overall good correlation with model spectra,
  - Waves detected for wavelengths from \(\approx 60\) m to \(\approx 600\) m,
  - Overall good agreements for wavelength and directions,
  - Some bias in wave height, ongoing work.

See D. Hauser presentation in CFOSAT Splinter (Thursday 11:00)
Conclusion

CFOSAT data will be available very soon (November)

- SWIM data

- SCAT Data
  - On NSOAS website: https://osdds.nsoas.org.cn
  - And on AVISO website

CFOSAT data are ready to use for science

- All SWIM performances and limitations described in the document
  REPORT ON THE SWIM CAL/VAL AT THE END OF THE VERIFICATION PHASE (AVISO website)

SWIM: a very innovative instrument

- Strong potential for many applications
- Processing and products will keep improving
- Feedbacks from users welcomed

CFOSAT data are here.
Make the most of them!
Thank you for your attention!
BACKUP
SWIM NRT Products

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°)

σ0 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
• σ0 mean profiles versus incidence and azimuth
SWIM NRT Wave products

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

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

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

\[ P_{\sigma_0} = P_{\text{IR}} \cdot P_m + P_{\text{sp}} \]

\[ P_w = \frac{P_m}{MTF} \]

SWH = 2.2 m  
\[ \lambda_p = 83 \text{ m} \]
\[ \phi_p = 12^\circ \]

SWH = 2.5 m  
\[ \lambda_p = 288 \text{ m} \]
\[ \phi_p = 103^\circ \]

SWH = 2.7 m  
\[ \lambda_p = 129 \text{ m} \]
\[ \phi_p = 130^\circ \]

- Mean trend suppression
- Ground projection
- Spectral density

- Speckle + IR correction

- Transfer function estimation and wave slope spectrum computation
- 15°-azimuth averaging
- Partitioning and physical parameter computation
SWIM NRT $\sigma^0$ profile

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

- $\sigma^0$ 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