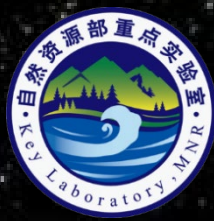
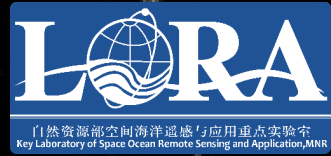




国家卫星海洋应用中心
National Satellite Ocean Application Service



CFOSAT



CFOSAT Wave Spectrum Observations Compared with Numerical Results and Chinese Gaofen-3 SAR

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Key Laboratory of Space Ocean Remote Sensing and Application, Ministry of Natural Resources

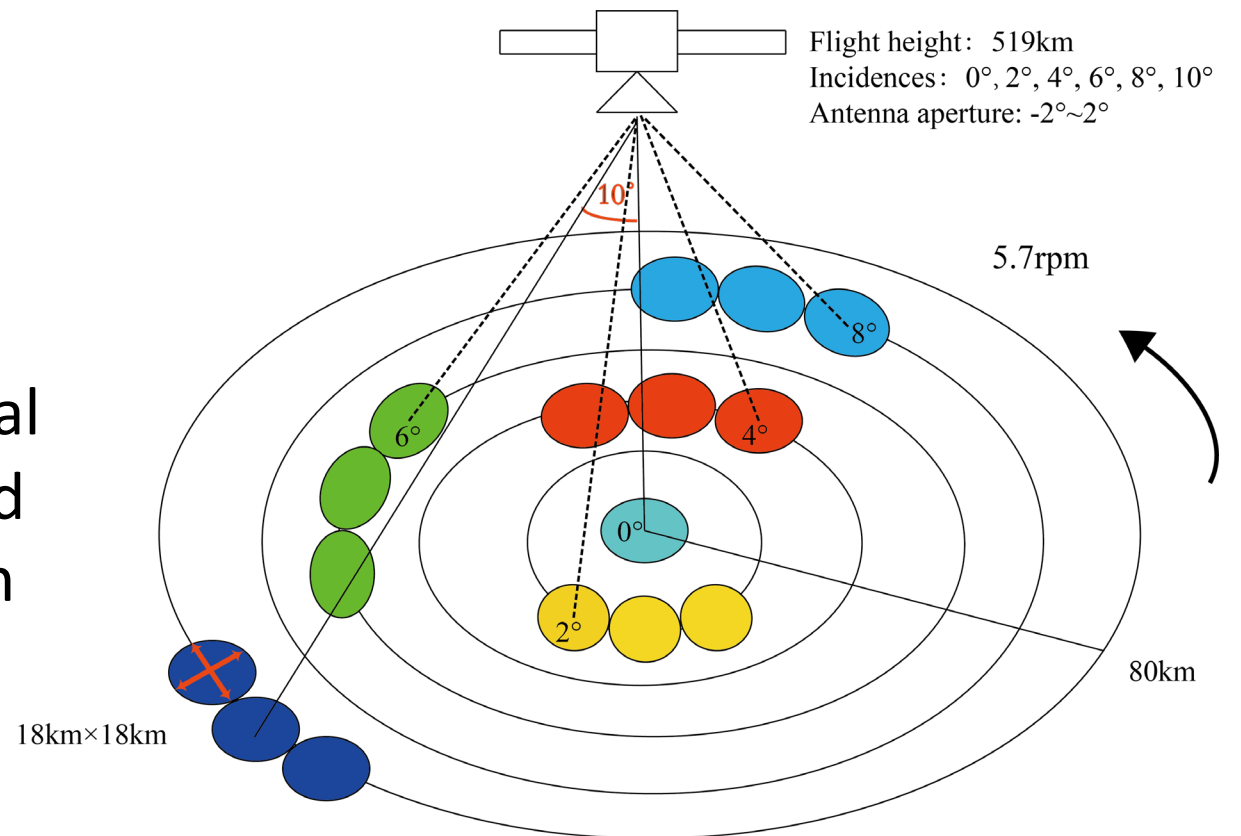
Shanghai Ocean University

China Academy of Space Technology



CFOSAT SWIM

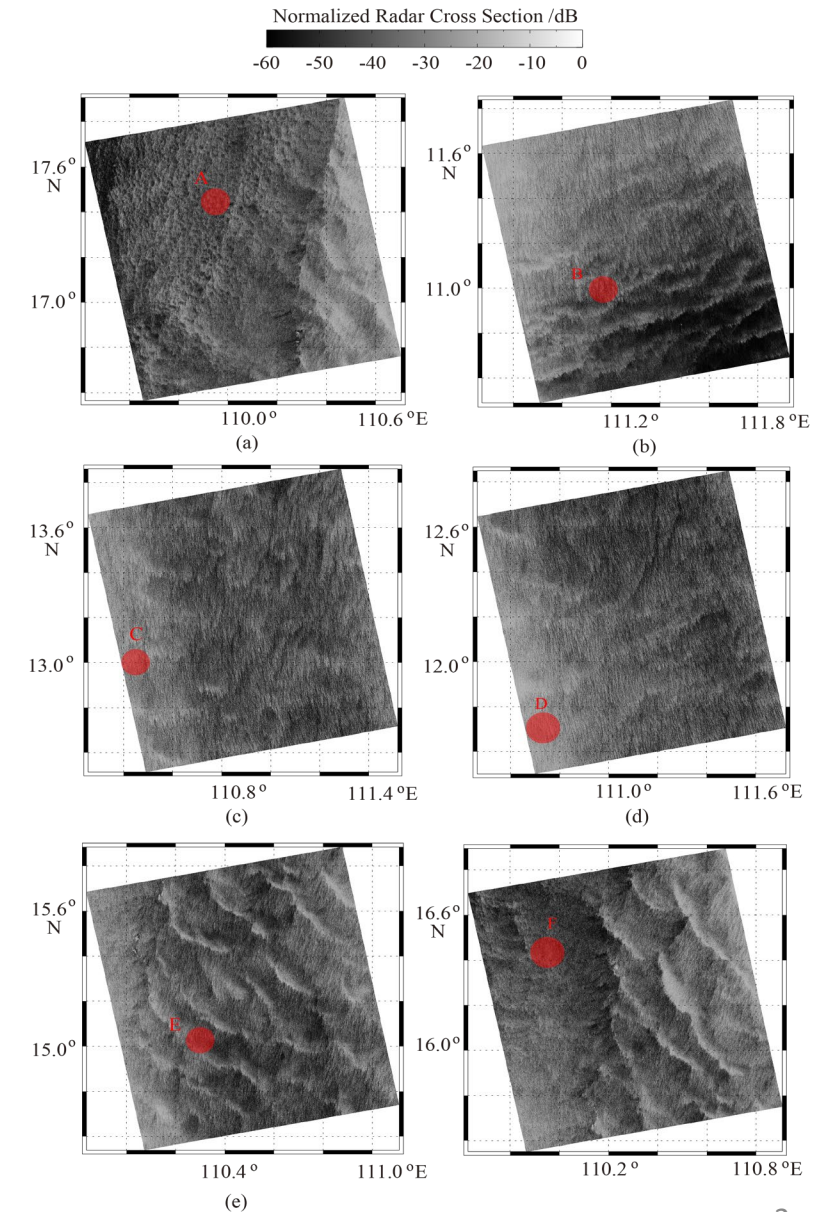
- SWIM works at incidence angles from 0° to 10° in a counterclockwise direction.
- The CFOSAT footprint has a spatial coverage of 18×18 km. It should be noted that the wave spectrum is only provided at incidence angles of 6° , 8° , and 10° .





Chinese GF-3 satellite

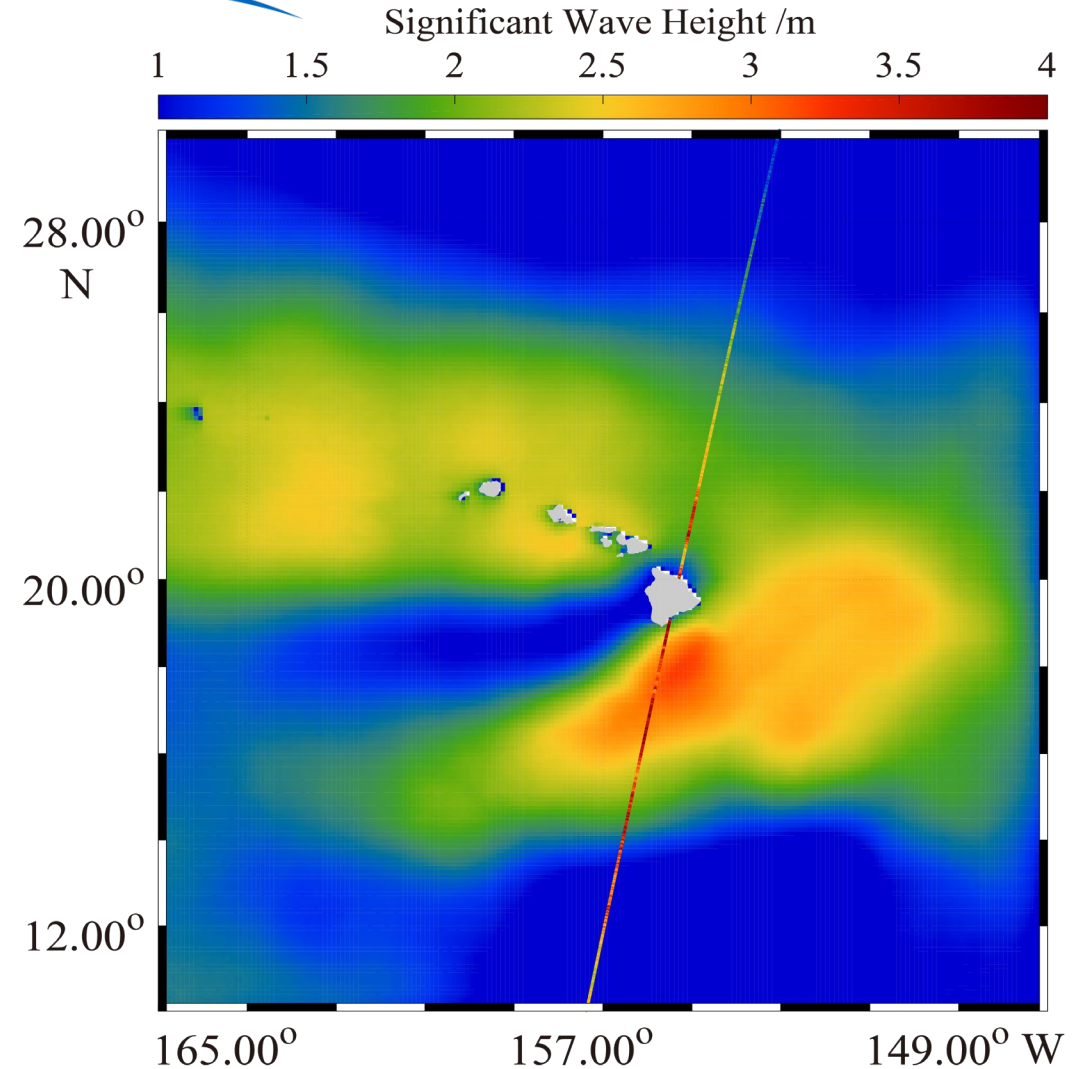
- GF-3 SAR has 12 imaging modes, e.g., Spotlight (SL), fine strip (FS), quad-polarization strip (QPS), and wave mode (WAV).
- On 5 December 2019, The footprints of CFOSAT passed the 6 GF-3 SAR images acquired in FS mode imaged at 10:48–10:53 UTC





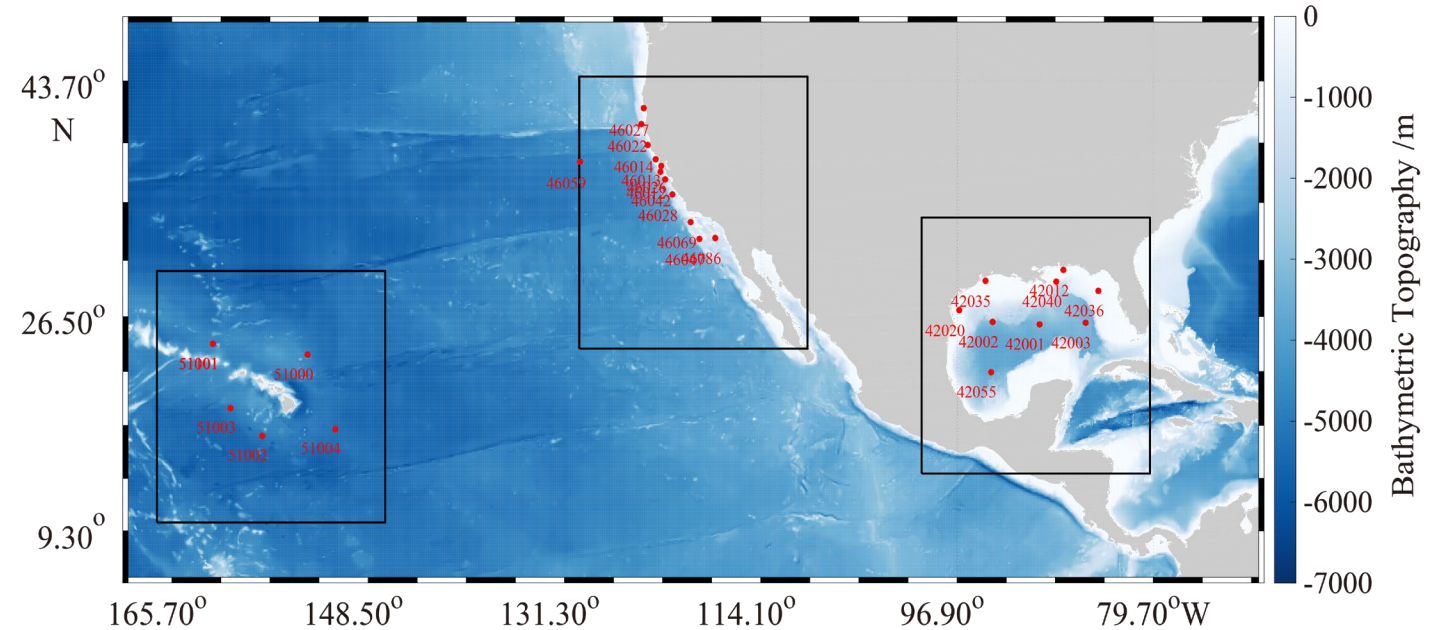
SWAN numerical wave model (version 4.12)

- Forcing winds
0.25° grid
intervals of 6 h per day
- Simulation regions
longitude 165° W to 79° W
latitude 9° N to 44° N



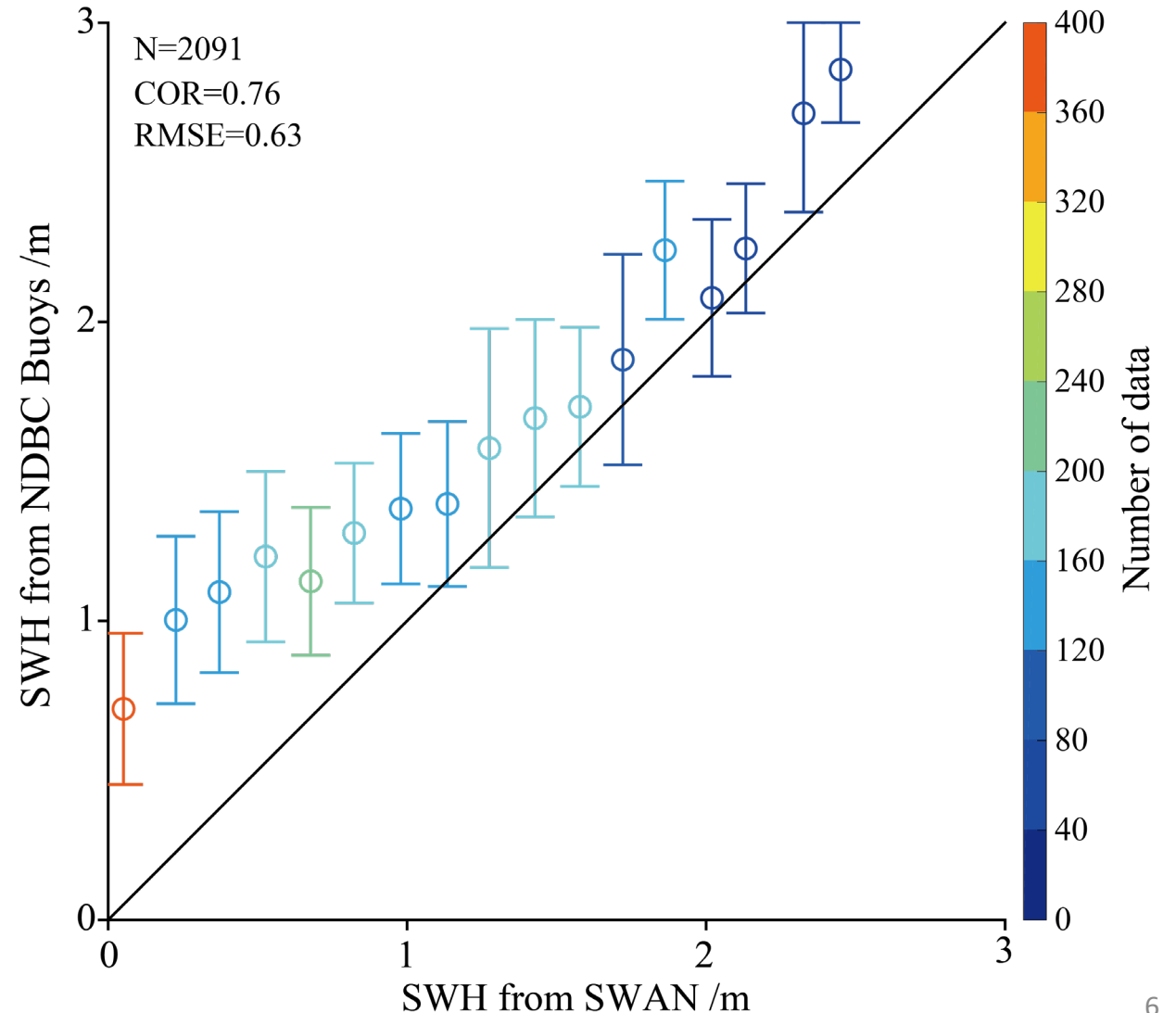
NDBC buoys

- Locations of the National Data Buoy Center (NDBC) buoys selected for validating the simulations



NDBC buoys

- Simulated SWHs from the SWAN model versus the co-located measurements from NDBC buoys for a 0.2 bin of SWH.



SAR PFSM algorithm

- SAR intensity spectrum is decomposed into:
a nonlinearly-mapped portion
a linear portion .

- The separation wave number

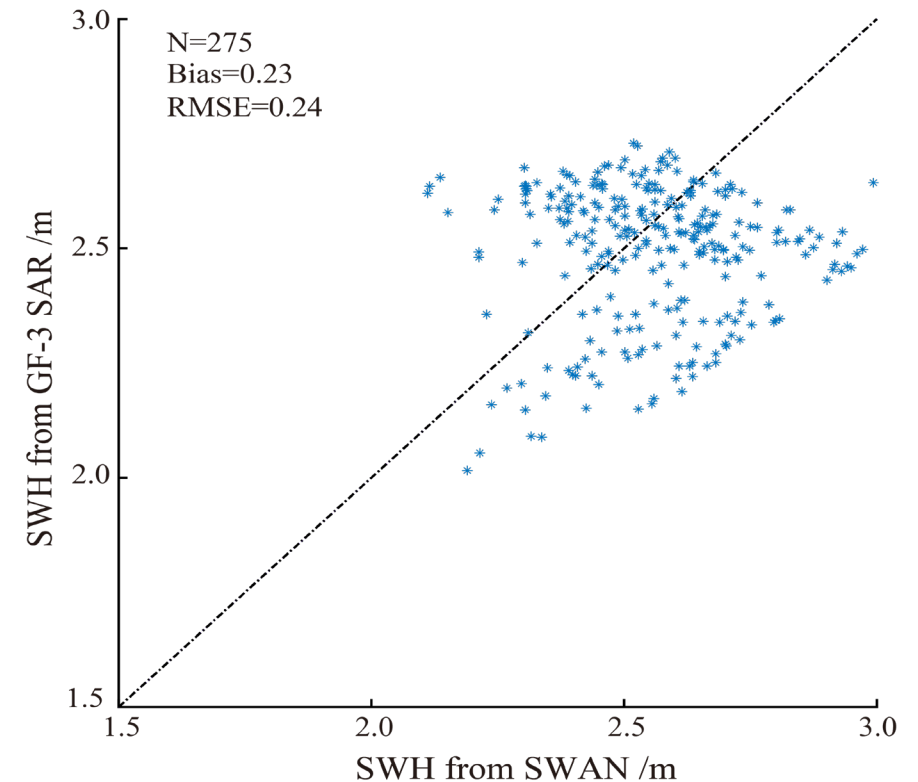
$$k_s = \left(\frac{2.87gV^2}{R^2U_{10}^4 \cos^2 \varphi (\sin^2 \varphi \sin^2 \theta + \cos^2 \varphi)} \right)^{0.33}$$

- the SWH H_s is calculated from an inverted one-dimensional wave spectrum S_k at wave number k :

$$H_s = 4 \times \sqrt{\int S_k dk}$$

Comparison of GF-3 SAR-derived waves with SWAN-simulated results

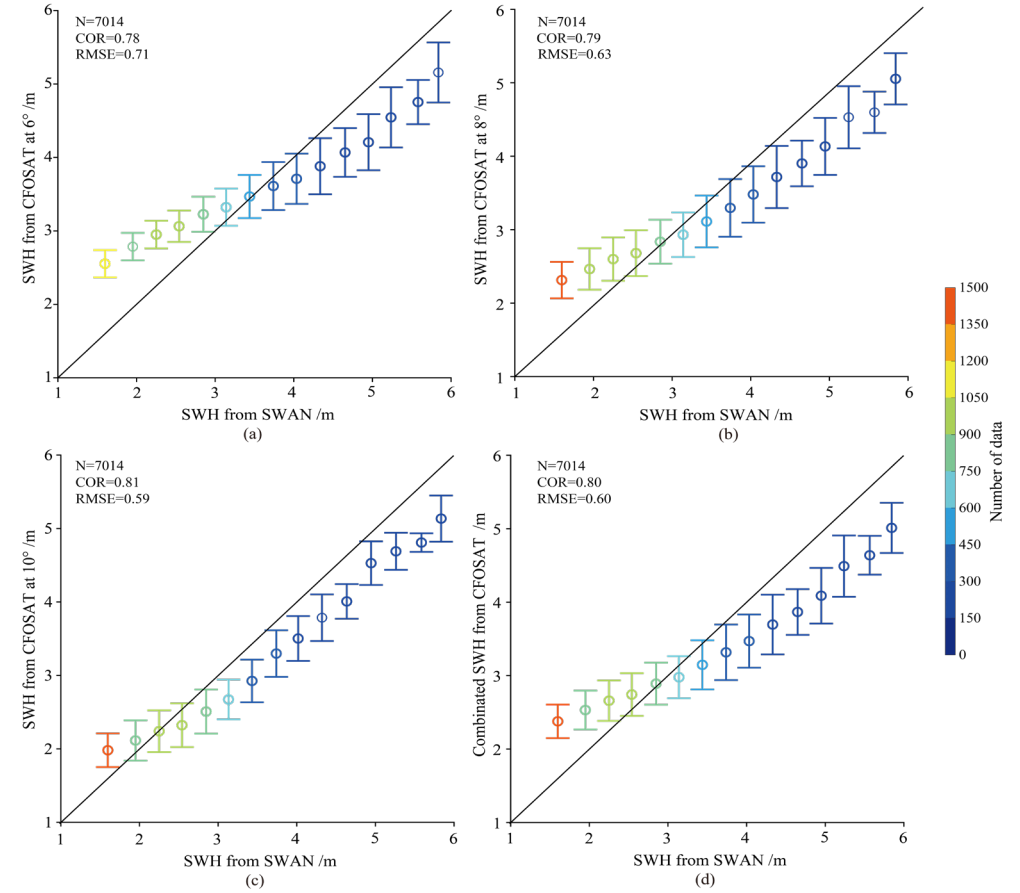
- Using the PFSM algorithm to derive SWHs
- >200 match-ups with the SWAN-simulated results
- a 0.24-m RMSE for the SWH with a 0.23-m bias



Comparison of CFOSAT waves with SWAN-simulated results

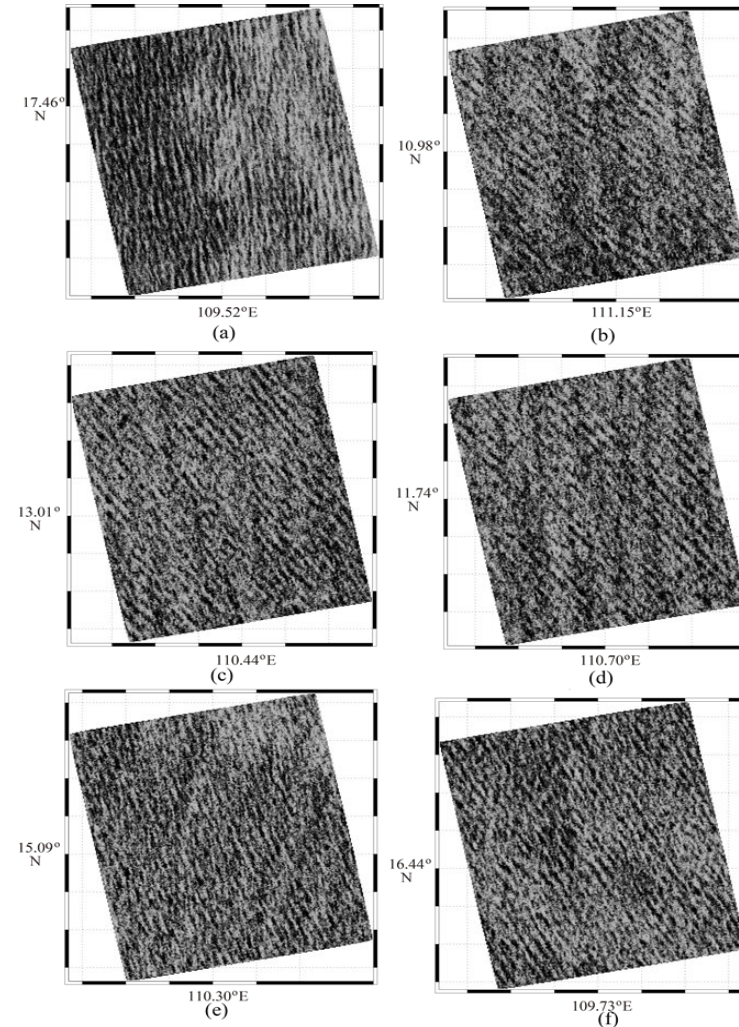
- SWIM waves at incidence angles of 6° , 8° , 10° , and the average of the 3 incidence .
- comparison was processed at a 0.2-m bin
- incidence angle of 10° performed well, exceeded the results at other incidence

NOTE: SWIM product version 4.3.2



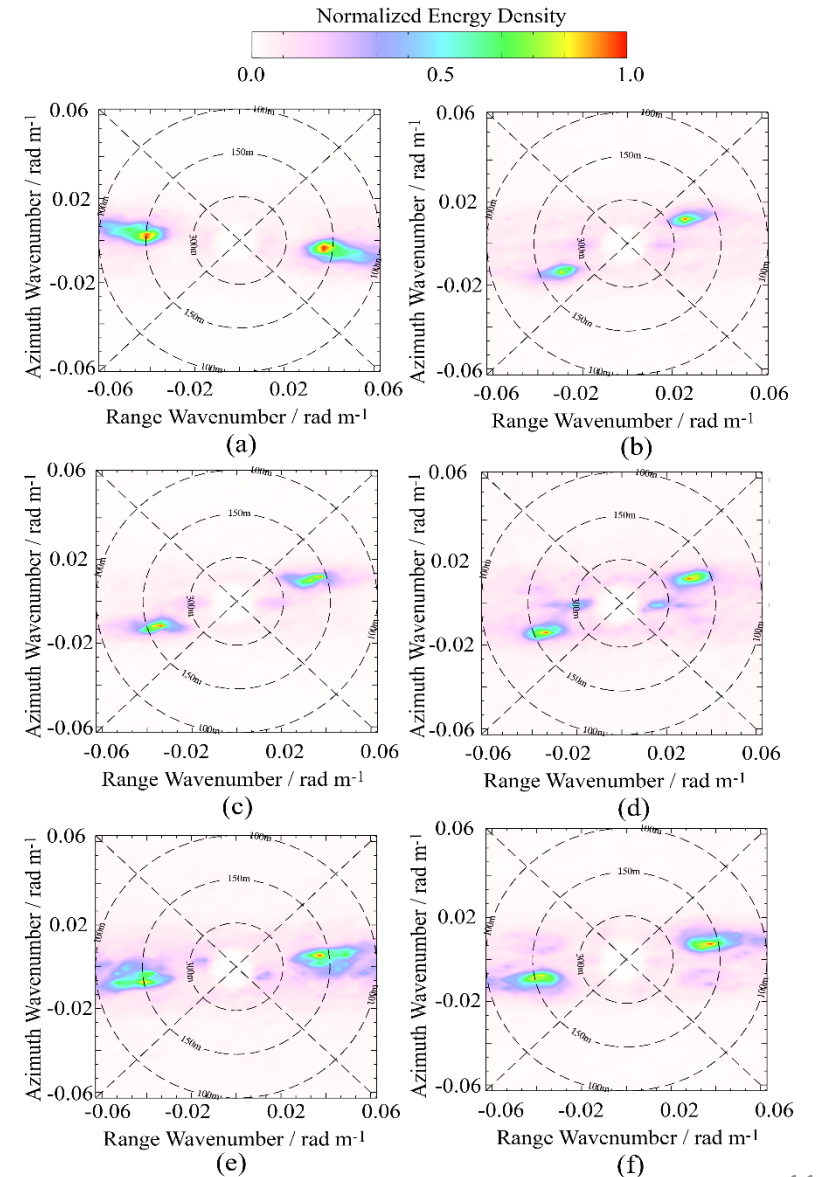
Sub-scenes extracted from the GF-3 SAR images

- Sub-scenes corresponding to different areas extracted from the images acquired at different times on 5 December 2019
- 1024×1024 pixel box, in which wave streaks were apparently observed



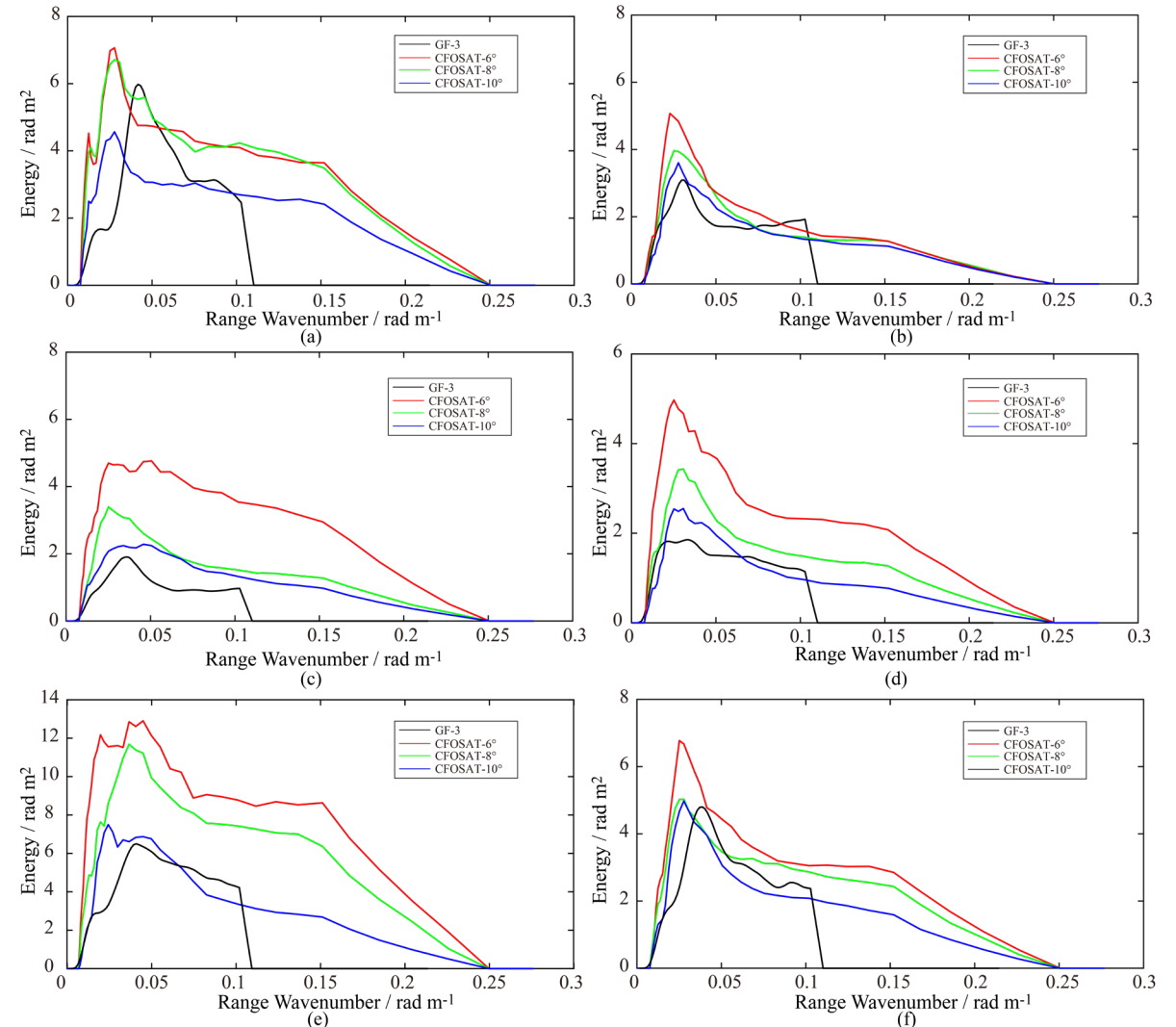
Two-dimensional SAR spectra of the extracted sub-scenes

- Symmetric structures of the SAR spectra are well illustrated due to the good quality of the sub-scenes



One-dimensional CFOSAT-spectrum and the GF-3 SAR spectrum

- GF-3 SAR spectra were most consistent with the CFOSAT-spectra at incidence 10°
- Short waves with wave numbers > 0.1 rad/m were undetectable in the SAR spectra
- CFOSAT spectra, however, were up to 0.25 rad/m wave number.





- CFOSAT SWIM wave data are a valuable source, especially for global wave analysis and small-scale air-sea interactions.
- More data are expected to be used to study the accuracy of CFOSAT-measured waves, especially its performance at various incidence angles.



谢谢！

Merci!