Australia's National Science Agency

CFOSat SWIM wave measurements against Southern Ocean buoys

3rd CFOSat International Science Meeting, Saint-Malo, Fr

Salman Khan | 12th Sep 2022

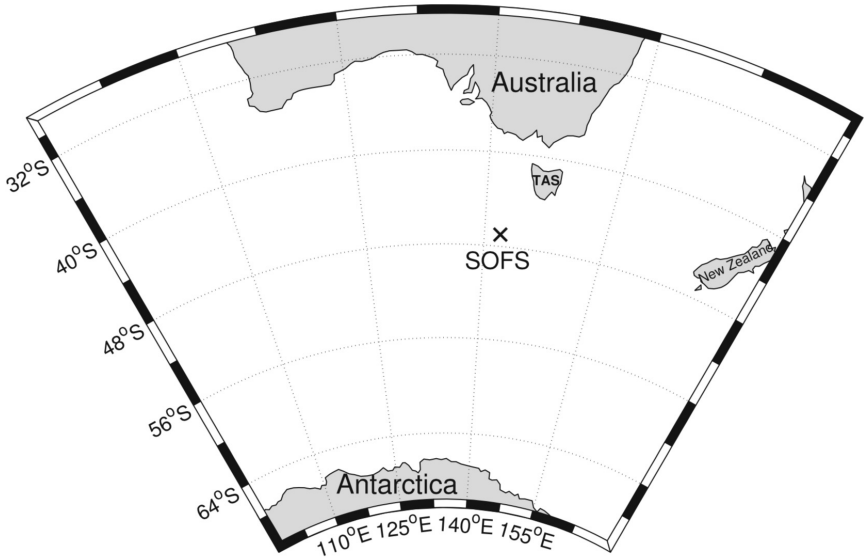
Research Scientist
Oceans & Atmosphere
CSIRO

IMOS
Integrated Marine Observing System

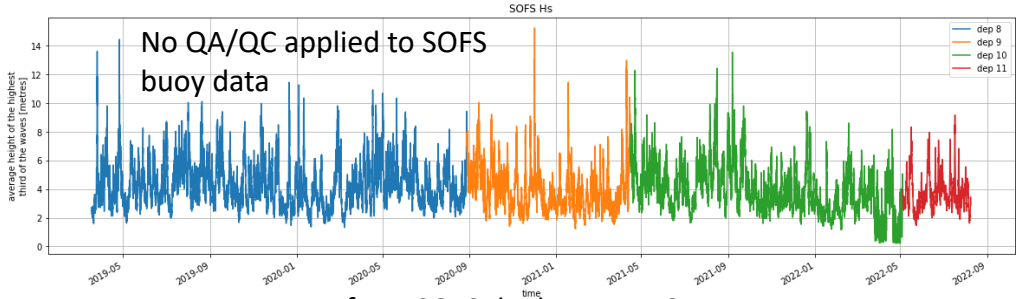
Collaborators/contributors

- CSIRO (Benoit Legresy, Mark Hemer, and Pete Jansen)
- University of Melbourne (Ian Young, Alex Babanin, Agustinus Ribal)
- Australian Bureau of Meteorology (Eric Schulz, Stefan Zieger, Diana Greenslade)
- Oceanum, New Zealand (Tom Durrant)
- University of Western Australia (Jeff Hansen)
- University of Tasmania (Andrea Hay, Chris Watson)

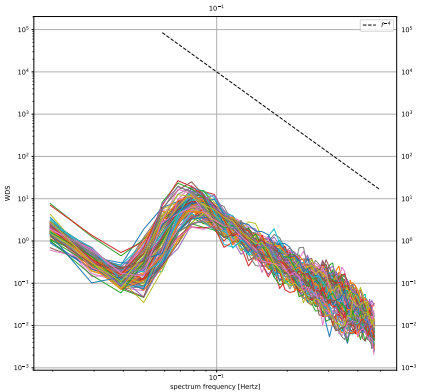
Southern Ocean Flux Station (SOFS) Buoy



- Depth ~4.5 km
- CSIRO's in-house Motion Ref Unit -> samples 10 mins/hour@5Hz
- TriAxys WRB (deployment)
- Data used in this work:
  - 1-D spectra, hourly spectra (deployments 8, 9, 10)
  - TriAxys WRB bulks only (deployment 11)
  - Dep 8-11 span Apr 2019 to present



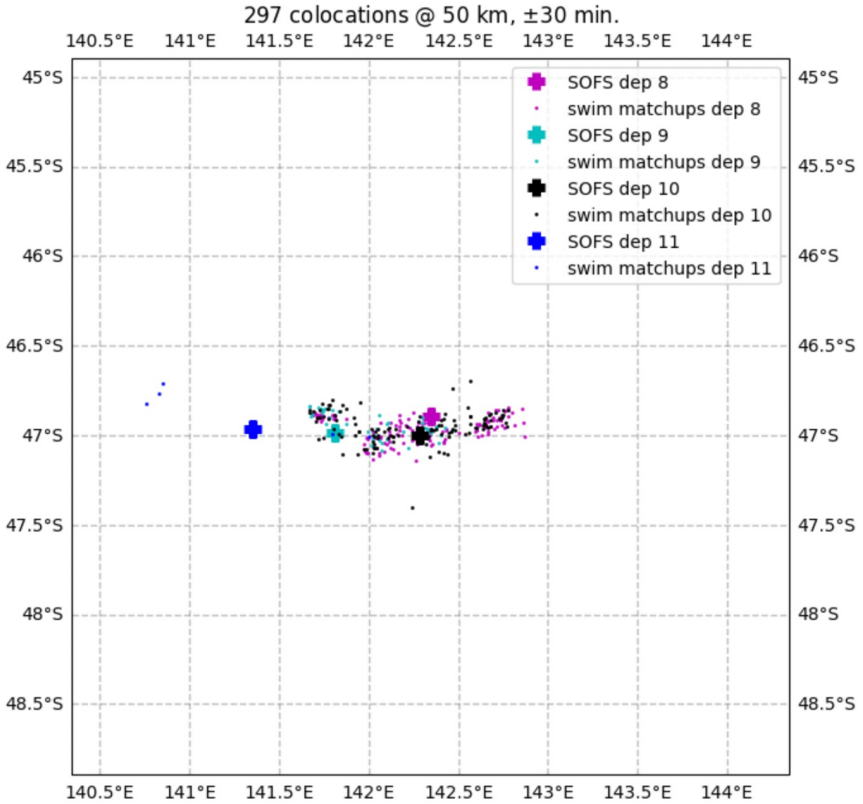
Hs from SOFS deployments 8-11



1-D wave spectra from SOFS

SWIM vs SOFS matchups using SWIM off-nadir spectra (pp_omni_combined)

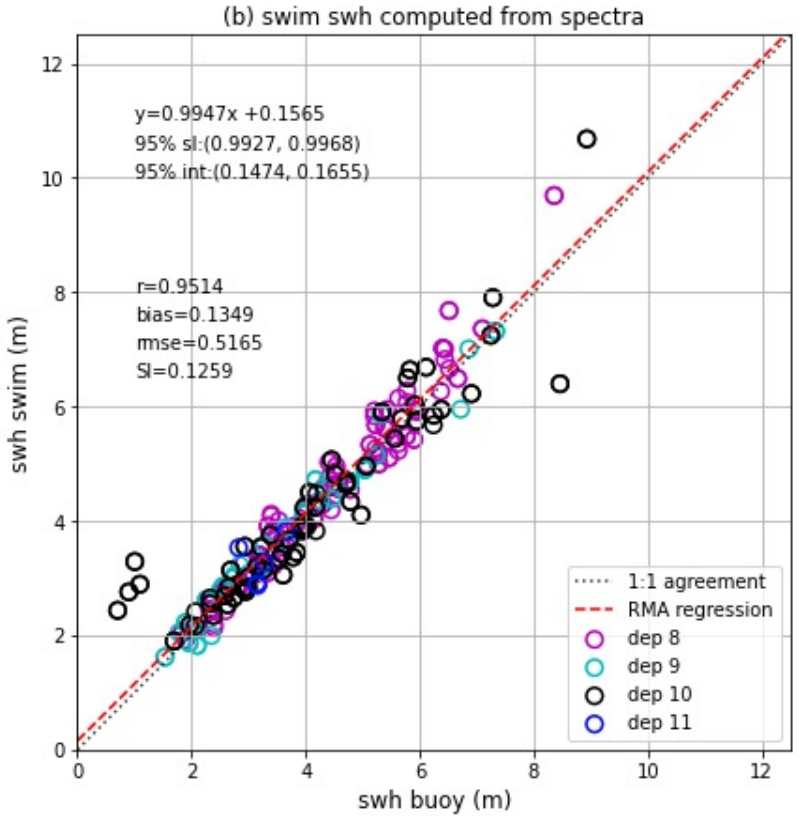
Apr 2019 to Jun 2022



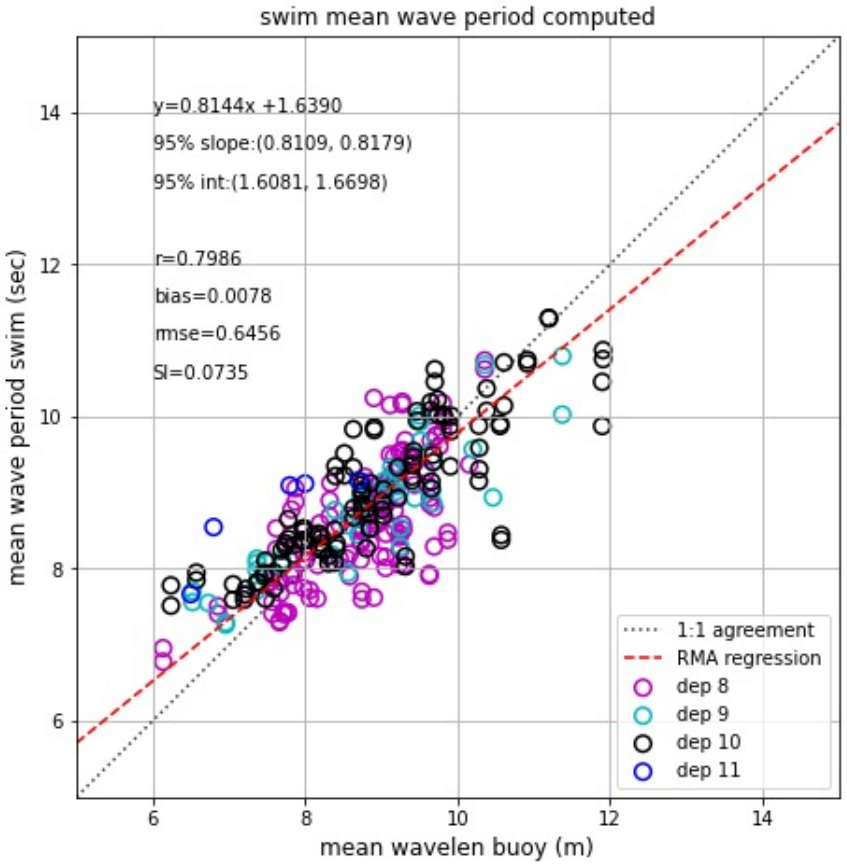
SWIM vs SOFS: Hs comparison

For bulk computations for both buoy and SWIM, the SWIM min and max frequency range i.e., ~0.05 to 0.26 Hz was used.

Regression with 297 points

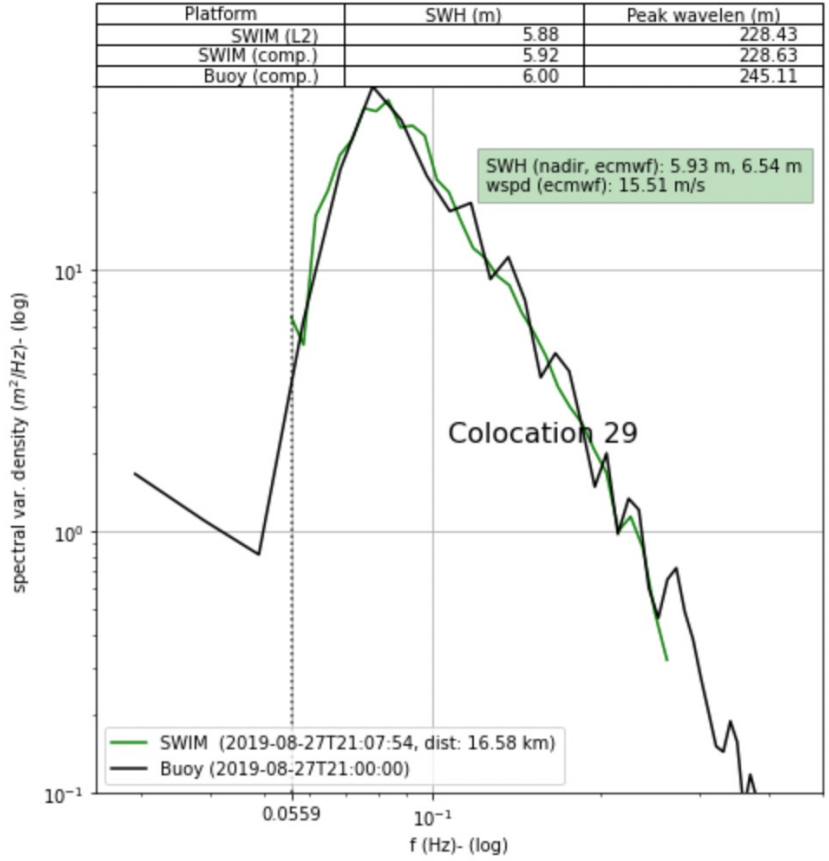


SWIM vs SOFS: zero-crossing period (tm02)

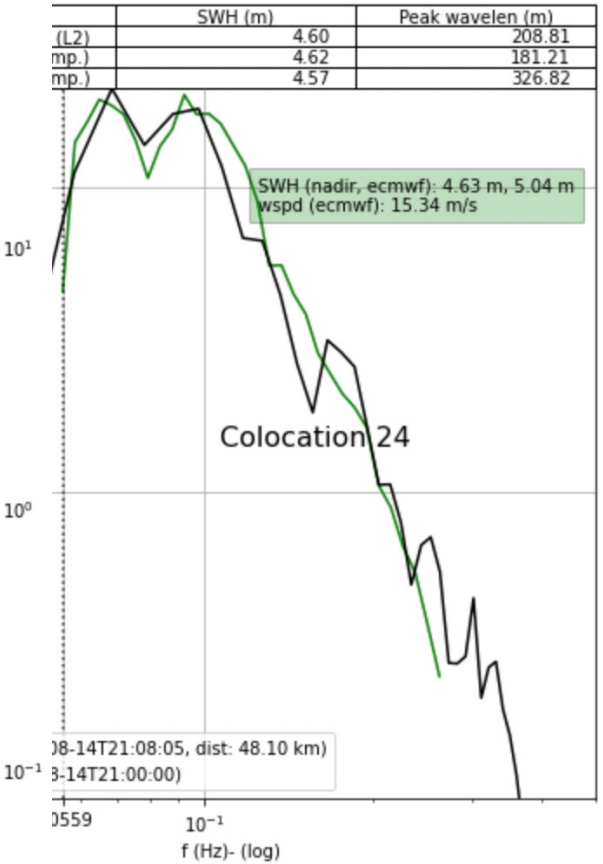


SWIM vs SOFS: sample 1d spectra

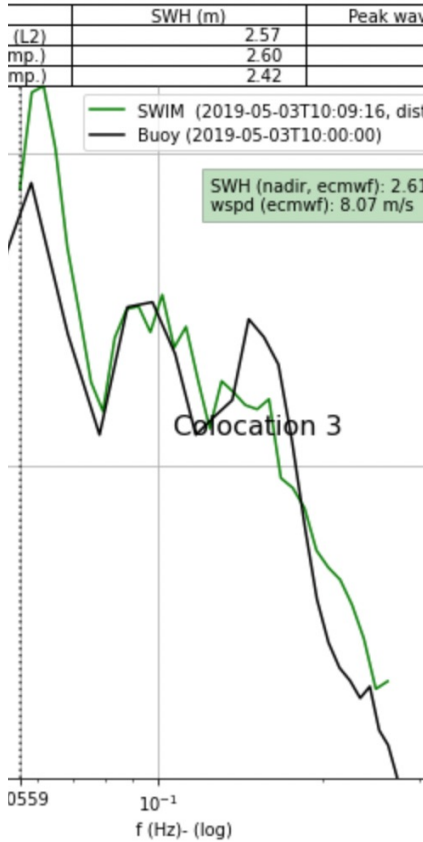
Platform	SWH (m)	Peak wavelen (m)
SWIM (L2)	5.88	228.43
SWIM (comp.)	5.92	228.63
Buoy (comp.)	6.00	245.11



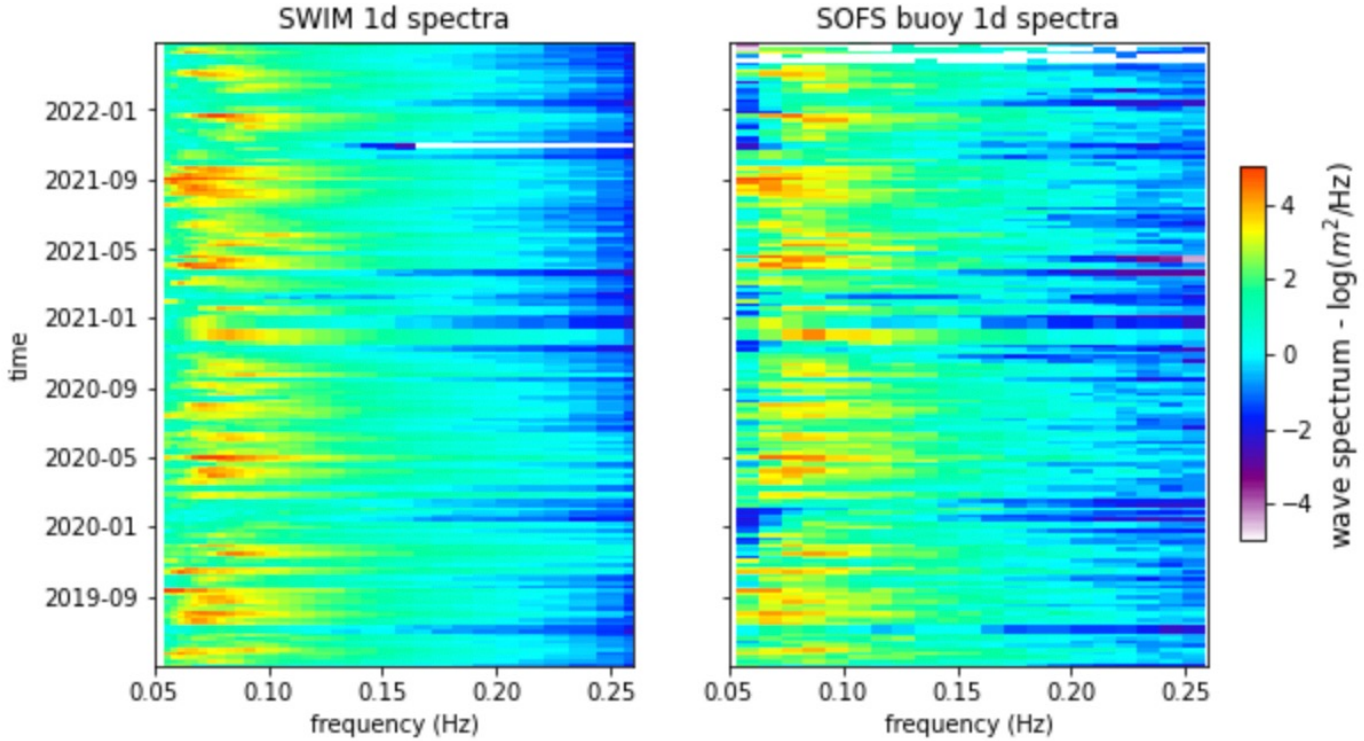
	SWH (m)	Peak wavelen (m)
(L2)	4.60	208.81
mp.)	4.62	181.21
mp.)	4.57	326.82



	SWH (m)	Peak wav
(L2)	2.57	
mp.)	2.60	
mp.)	2.42	

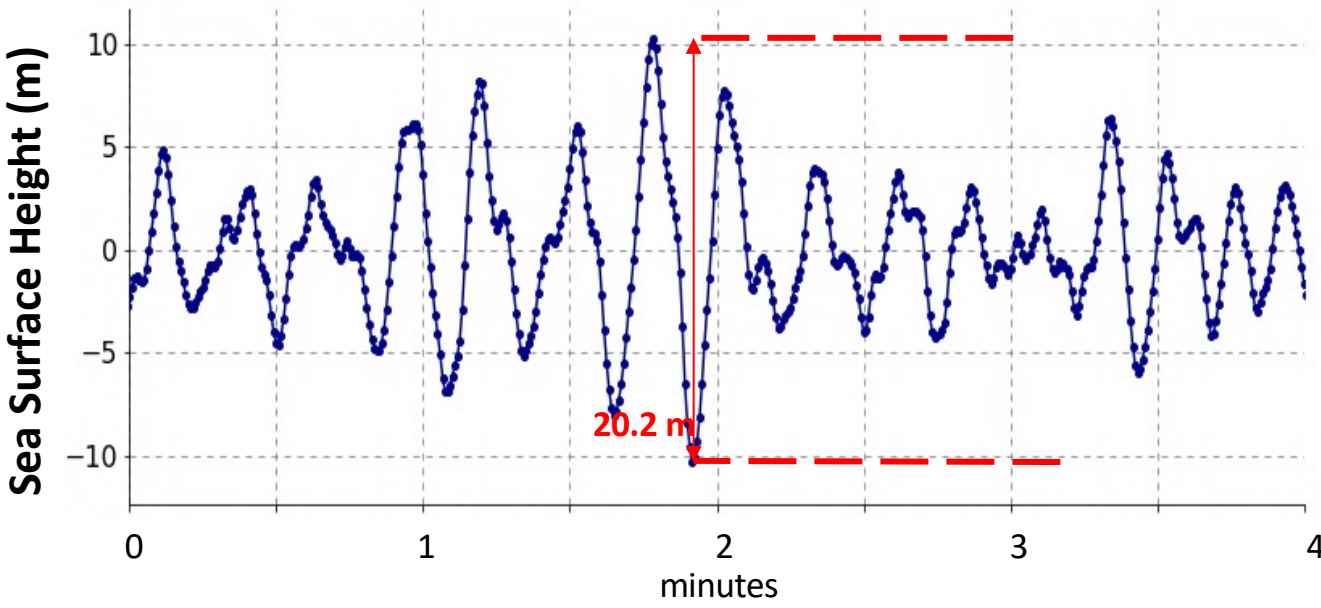


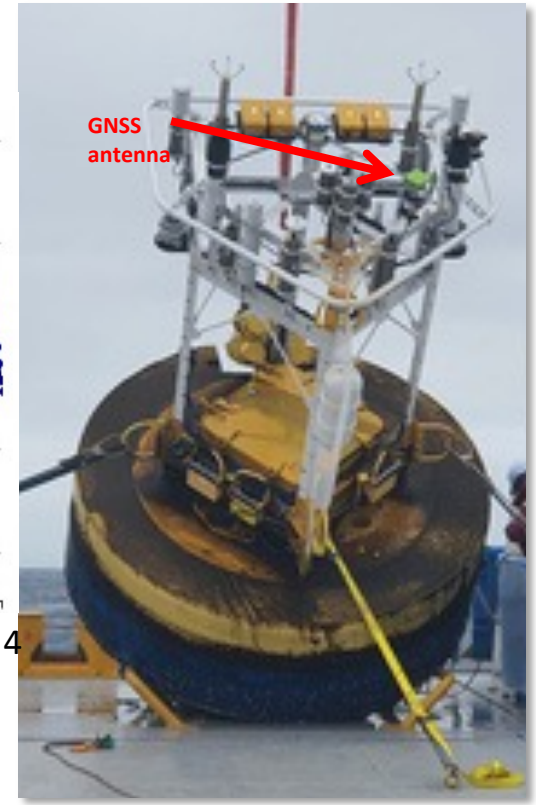
SWIM vs SOFS: 1d spectra summarised (all colocations)



SOFS validation of satellite altimetry relative sea level and wave regime from GNSS on surface buoy

PhD work by Andrea HAY, contributions Chris Watson, slides from B. Legresy





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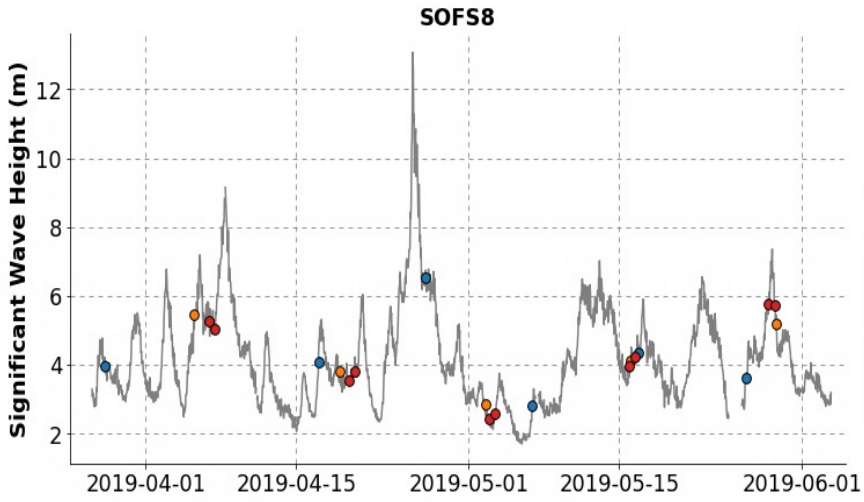

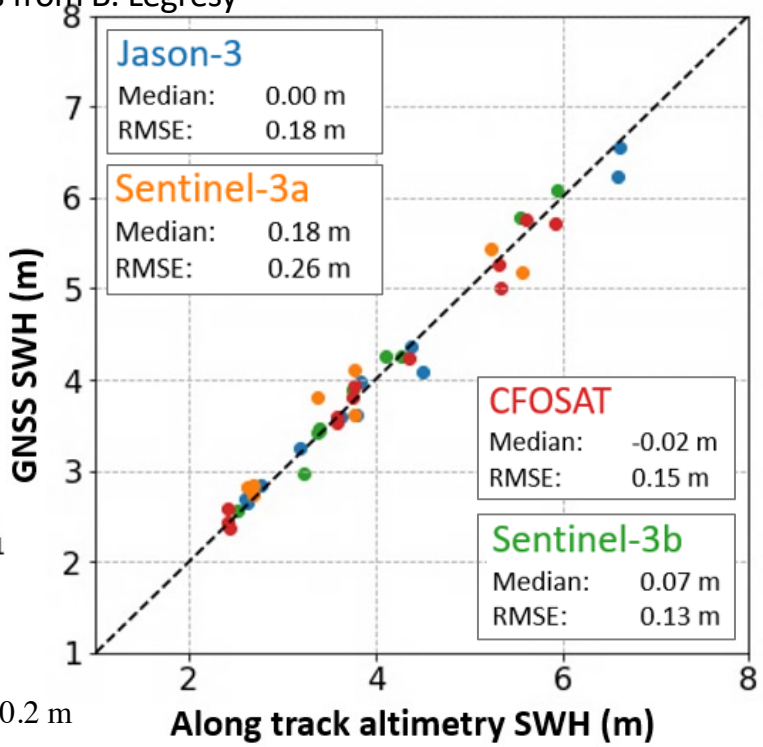

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IMOS Integrated Marine Observing System

SWH: average of highest 1/3 of waves

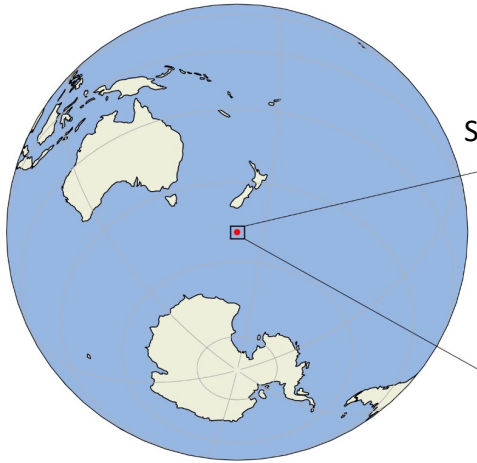
Good comparisons to altimetry – error below 0.2 m

Next steps: wave period, direction

CSIRO

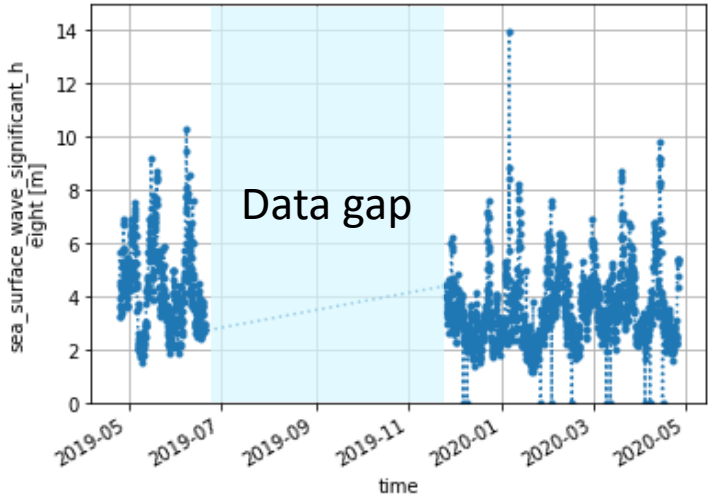
Campbell Island WRB (CIWRB)

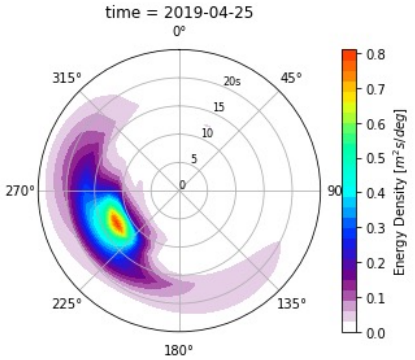
- Type: TriAaxys directional wave buoy
- Available overlap with SWIM data: 26th Apr 2019 till 25thth Apr 2020
- 3-hourly directional wave spectra



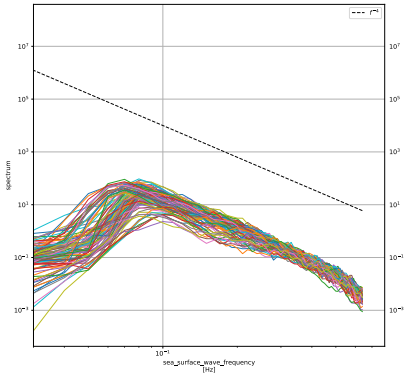
Source: McComb et al., 2021

Hs with some QC





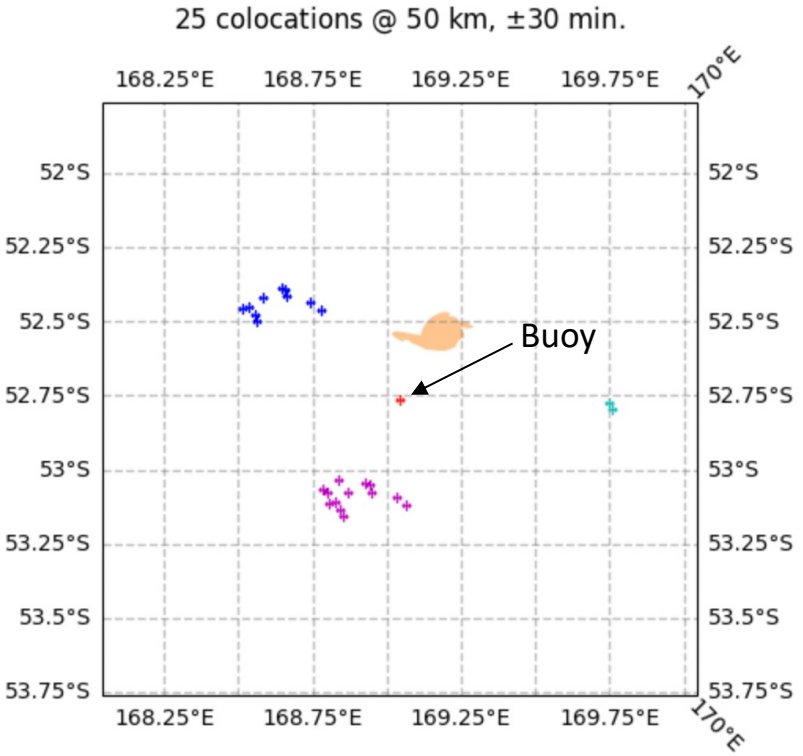
Sample buoy spectra



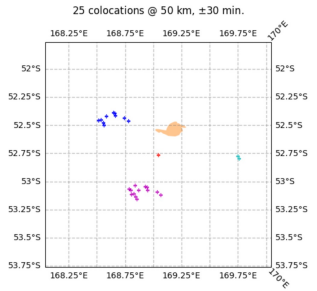
CIWRB vs SWIM matchups using SWIM off-nadir spectra (p_combined)

With SWIM off-nadir beam footprint being ~90 x 70km, all collocations have some land contamination

The southern collocation points have relatively low contamination approx. < 10%

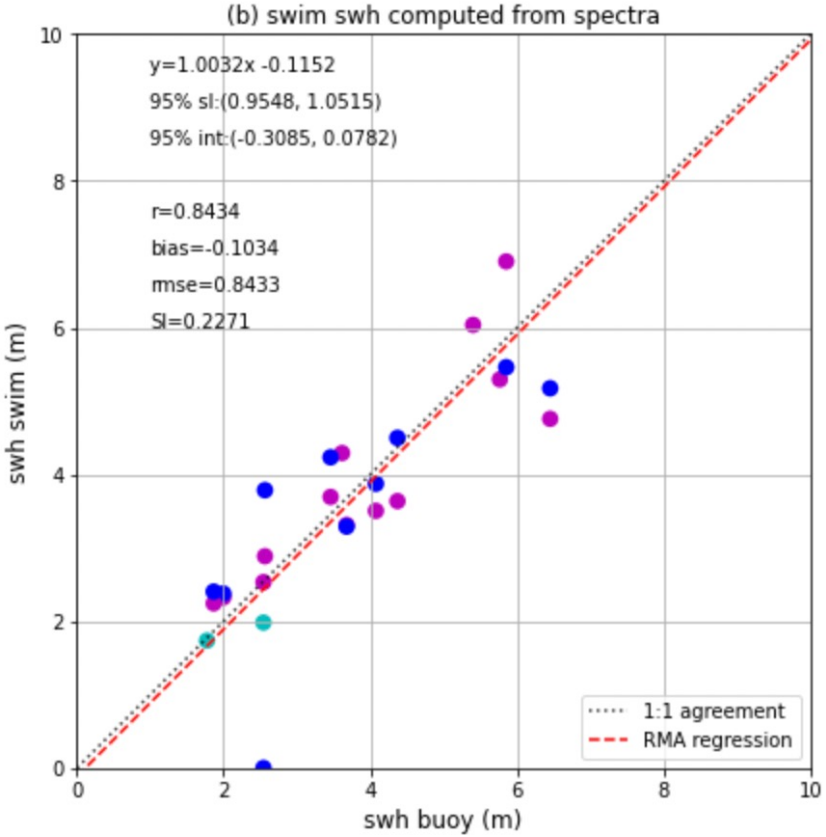


CIWRB vs SWIM: Hs comparison

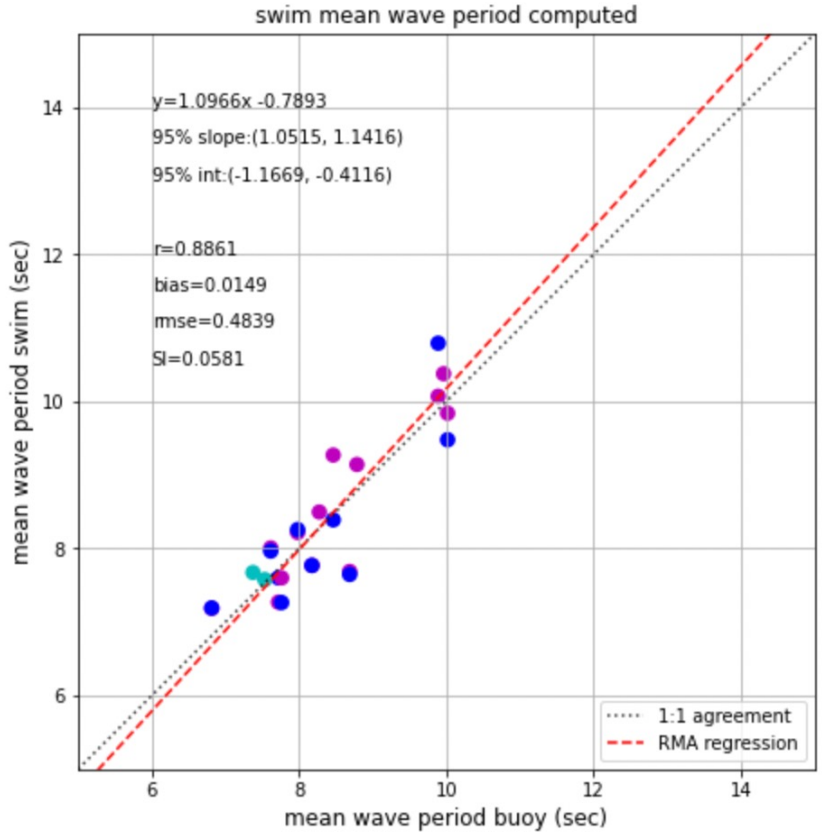


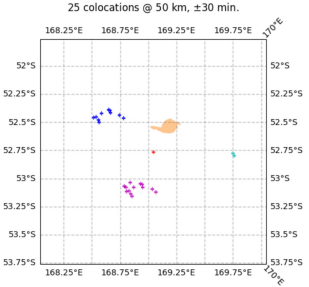
Matchup color scheme

For bulk computations for both buoy and SWIM, the SWIM min and max frequency range i.e., ~0.05 to 0.26 Hz was used.



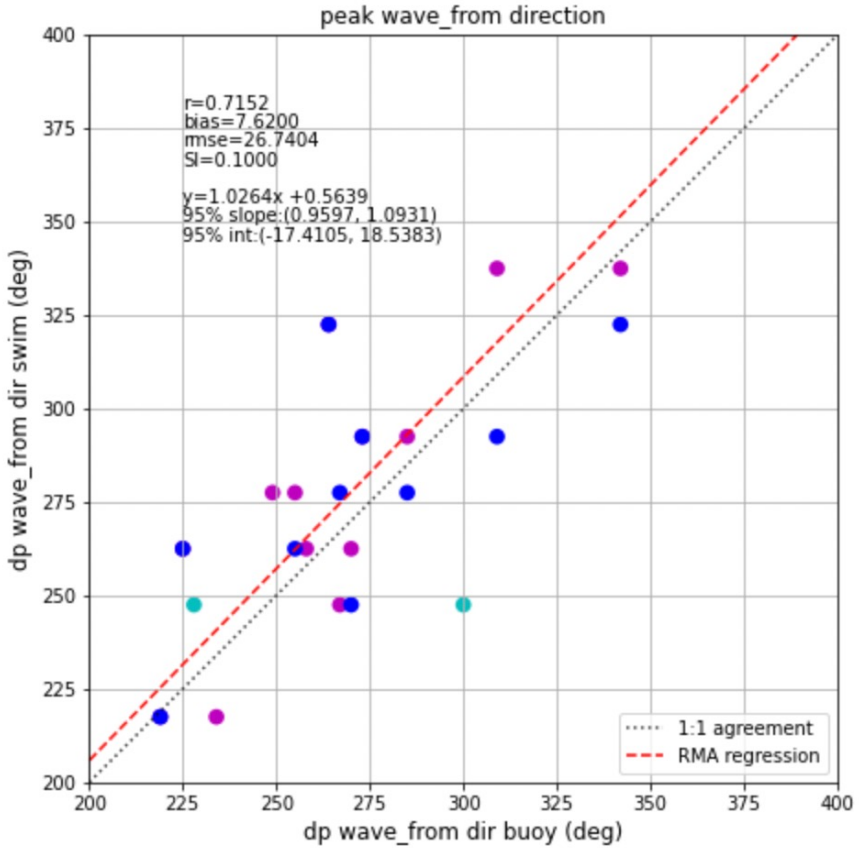
CIWRB vs SWIM: tm02

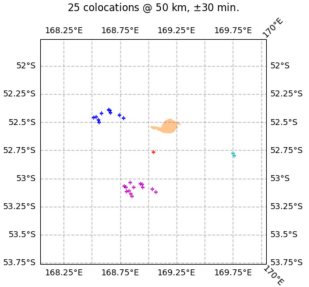




Matchup color scheme

CIWRB vs SWIM: peak direction

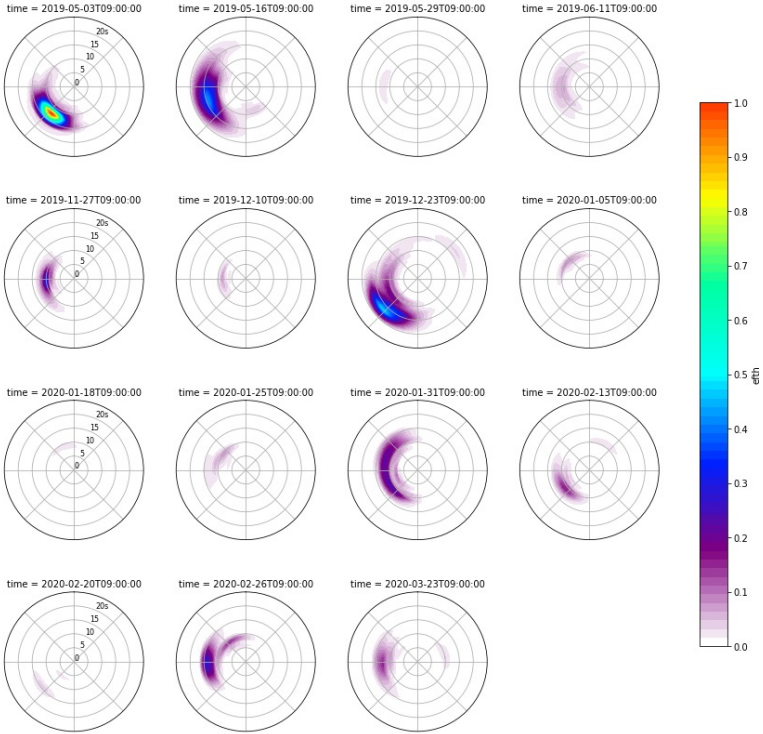




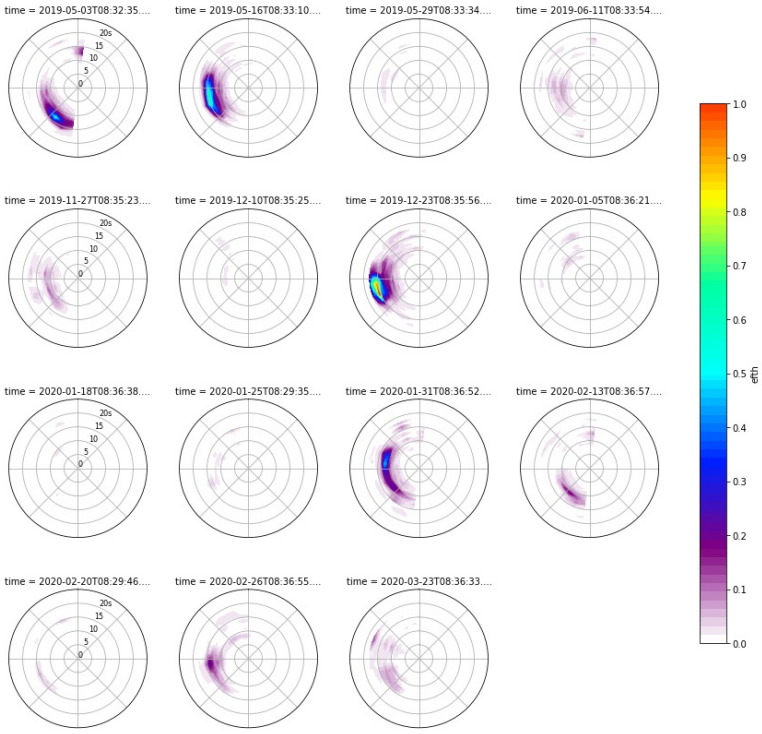
Matchup color scheme

CIWRB vs SWIM: directional spectra

15 matchups remaining after removing duplicates: several SWIM obs matching the same buoy measurement



CIWRB buoy spectra: ~33.2 deg magnetic variation correction applied to CIWRB buoy data



Matching SWIM spectra (plotted without directional 180^{o} ambiguity)

Summary of COFSAT SO buoy comparisons

Conclusion

Encouraging initial results have been obtained, which need some further refinement and extension in time/addition of buoys

Future

SWIM comparisons against *directional* SOFS wave measurements (both TriAxys WRB and GNSS on surface buoy):

- Directional spectra comparisons
- Directional statistics comparisons

SWIM comparisons against CIWRB to be extended subject to future deployments

SWIM comparisons against other SO moored and/or drifting spotter buoys

Thank you

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