Radar Activities

This is a summary on the usage of marine radars (X-band radars). The Bragg wavelength of X-band radars is 3 cm. The ISPAS radar is ku-band with a Bragg wavelength of ku band is a bit lower.

Imaging effect	Details
Tilt modulation	- The radar basically sees the slope of the waves - The main contribution to the modulation transfer function (MTF) is due to the tilt modulation
Hydrodynamic modulation	- Bragg waves on the surface are modulated. The Bragg waves are affected by the underlying waves. The amplitude and frequency changes slightly depending on the position on the gravity waves. - For X-band radars this modulation is typically disregarded. But people mention it all the time - From my understanding the effect should be very similar for the range of gravity waves the radar provides - For ku-band radar, this should have even less to say
Shadowing	- Parts of the waves can have so reduced backscatter that it is considered as no backscatter. These parts are behind (large) wave crests. - The amount of shadowing depends on the sea state, the elevation of the radar antenna over the water level. - Shadowing increases with increasing range. - Different radars have different kind of shadowing. Bill Plant claims that there is no shadowing. His radar gets return (although reduced). - It will be very interesting how the ISPAS ku-band radar behaves. - Shadowing is hopeful to get clear data when the radar is not that good.
Decay of Energy	- Depending on the electromagnetic beam, the intensity of the returned signal decays with the range (e.g. r**-3) - It is nice if ISPAS remove this effect based on theoretical considerations
Effect of Wind	- X-band radars depend heavily on the wind and the intensity is influenced locally by different roughness of the surface - Upwind and downwind, the image is different - Dispersion Filtering is probably removing the effect
Polarization	- The polarization is given for emit and receive. - For both horizontal and vertical are thinkable - HH and VV are most common for waves - For the most common ocean waves applications HH is common - VV are better for wind???

Topic	Success	Challenges	Groups
Wave spectra, directional spectra, Tp	Generally done, directional distribution preferred from radars rather than buoys (e.g. met.no)	MTF required, MTFs are not general. Distribution of energy in frequency can be off due to that	Standard
Hs	Determining from signal to noise ratio or based on machine learning	Not sure	Invented by Jose Carlos (JC)
Wave inversion	A lot of people have tried a comparison. No publication with a proper comparison available; results have been shown in conferences/workshops	MTF is not necessarily correct. Shadowing influences.	By JC, Everyone who does wave prediction, Scripps
Bathymetry	Accurate maps have been provided; change of bathymetry has been documented	Not sure, possibly water depth limitation due to resolution	Paul Bell (David McCann), Rutter, Ron Abileah, HZG, Scripps, Bjørn Lund
Currents	Development of algorithm	Validation is difficult due to different averaging in time and space; Errors mainly expected in lower layers reconstructable by radar, Layer very near to the surface cannot be included	Bjørn Lund, Scripps
Wave Breaking	Dissipation of energy with coherent radar, breaking in surf zone detected with radar	Cumbersome finding of breaking events; resolution averages out in local breaking	HZG (Michael Stresser) Diaz/Haller/ Campana
Rain/Wind	Not sure	Reference measurements	e.g. HZG

What to offer ISPAS and what not	Yes	No
Spectra, Tp	No problem	
Hs	Not done yet, should not be too hard, especially if Jose Carlos is consulted	
Wave inversion		To time intensive, too many questions; best to avoid, optional at the end of the project
Bathymetry	Should not be too hard, A student could be involved to do this	No experience. Not sure if it will be useful to us
Currents	A basic algorithm could be provided. I am about to write a paper on this. After publication…	Not sure they want it /need it; could be misused (measures the effective current, not the current)
Wave breaking		Better to avoid; Not of use for them; to