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Exploring the effect of opposing swell on the wave growth through numerical simulation of the wave directional spectrum

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The possible influence of swell on wind-sea development and on air-sea momentum fluxes have motivated us to further analyse the measurements obtained during the intOA Experiment, a Gulf of Tehuantepec field campaign in early 2005. Hindcasting of directional wave spectrum is performed in order to elucidate on the relative importance of the source functions on the evolution of combined conditions of wind-sea and swell spectra. ECMWF wind and wave analysis results, probably the best data basis for regular maps of the relevant variables, is being used as forcing wind fields for directional wave spectrum hindcast and for reference since they represent results mainly from a global perspective. Integral wave parameters such as significant wave height from ECMWF analysis compare very well with the results from the in-situ measurements, both with ADCPs and an ASIS buoy, however, we are rather interested in the detailed structure and evolution of the full directional wave spectrum. The SWAN model has been run under the typical 3G non-stationary mode for specific cases of moderate to strong offshore winds in the study area. Distinct feature of this study is the presence of swell for opposing offshore winds (Tehuano events), conditions encountered more frequently during the winter season in the Gulf of Tehuantepec. Directional wave spectrum hindcast is performed for the several Tehuano events recorded, where combined conditions varied from moderate to strong wind (9m/s to 19m/s), and from low to moderate wind sea and swell (Hs from 0.5m to 2.5m). In general terms, analysis from ECMWF provides a very representative picture of the wave field in the area, depicting even cases where 3 or 4 spectral peaks are present. Locally generated wind-sea is rather more complicated to reproduce. Nevertheless, ECMWF analysis provides very reasonable results, specially for high intensity Tehuano events. Hindcast with the SWAN model is performed with rather fine spatial resolution (about 1000m) for an area of 500km by 300km. For specific SWAN runs to simulate waves under Tehuano events, locally generated wind-sea is reproduced with lower energy when swell is imposed through boundary conditions. Influence of source functions is addressed. While this is somehow expected for the resolution of a global model, shape and structure of wind sea spectral region is to be considered as a result of the inter-play of energy input and dissipation source functions.