Impact of surface waves in a Regional Climate Model

A coupled regional atmosphere-wave model system is developed with the purpose of investigating the impact of climate changes on the wave field, as well as feedback effects of the wave field on the atmospheric parameters. This study focuses on the effects of introducing a two-way atmosphere-wave coupling on the atmosphere as well as on wave parameters. The model components are the regional climate model RCA, and the third generation wave model WAM. Two different methods are used for the coupling, using the roughness length and only including the effect of growing sea, and using the wave age and introducing the reduction of roughness due to decaying sea (swell). Introducing a two-way coupling results in an altered frequency distribution of wind speed and wave heights. When only including growing sea the impact of waves on the long term mean atmospheric parameters is limited, inducing a reduction of wind speed and significant wave height. When also the impact of swell is introduced, there is a shift towards higher wind speeds as well as higher significant wave heights in the four investigated areas. There is a reduction of surface heat fluxes and a decrease in near surface temperature as well as a significant increase in near surface humidity. The major conclusion is that when introducing a more realistic surface description over sea, the air-sea interaction represented by waves has a significant impact also on long term averages of parameters in the atmosphere. Waves should thus be introduced in climate models for a realistic description of processes over sea.