

# **Energy transfer in a bimodal wave spectrum calculated with an exact method (WRT)**

César O. Luna-Miyaki, Paco Ocampo-Torres, Pedro Osuna

Centro de Investigación Científica y de Educación Superior de Ensenada, Baja California  
(CICESE)

Int. Waves Workshop 2025

(Santander) 23 September 2025

# The situation

Estimating energy transfer due to nonlinear interactions between quadruplets ( $S_{nl4}$ ) in wave evolution at the operational level requires the DIA scheme.

However, this approach is known to have limitations in accurately representing these transfers.

Wave spectral models

WaveWatch III (WWIII)

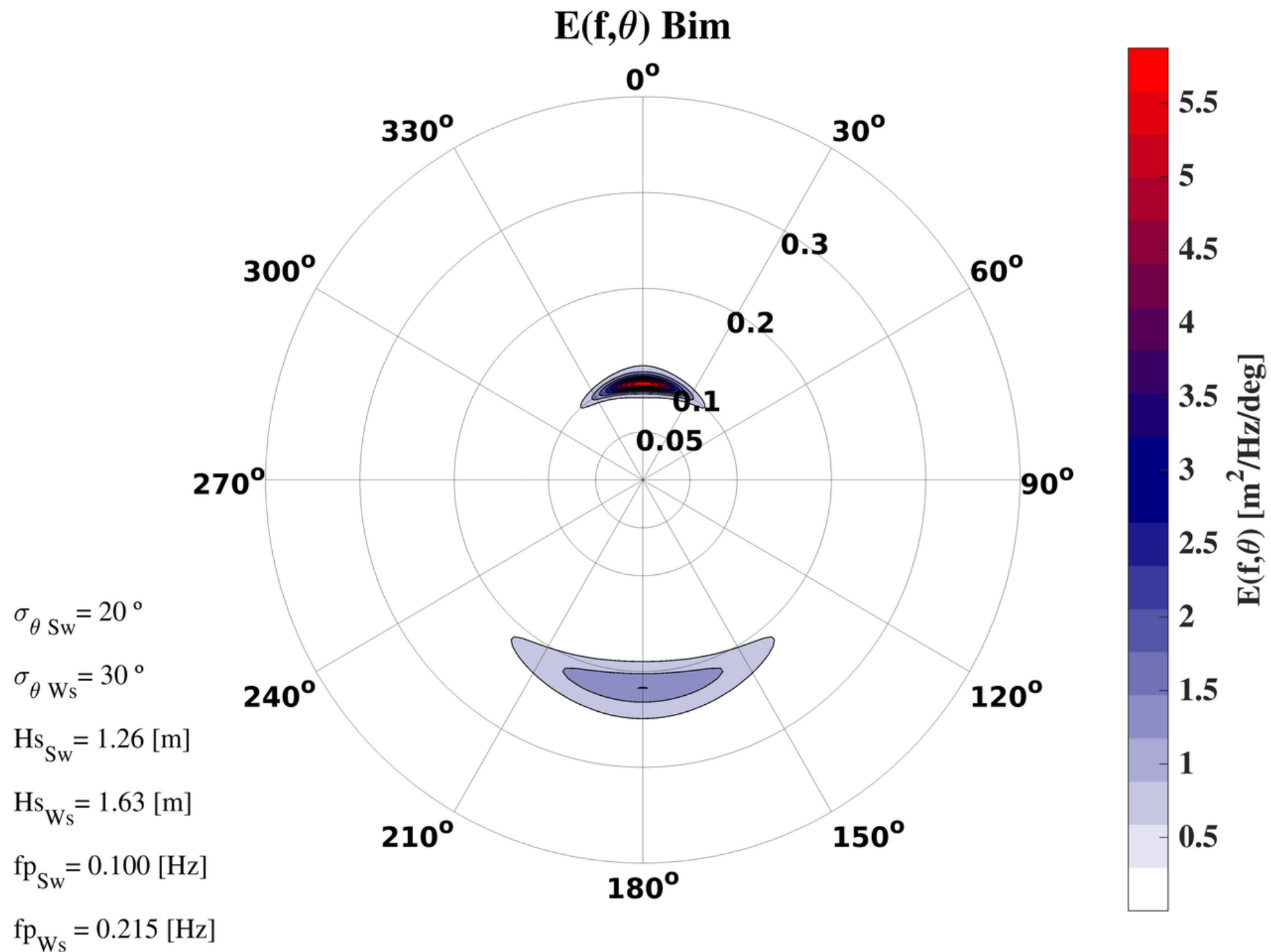
Wave Modelling (WAM)

Simulating WAves Nearshore (SWAN)



# The situation

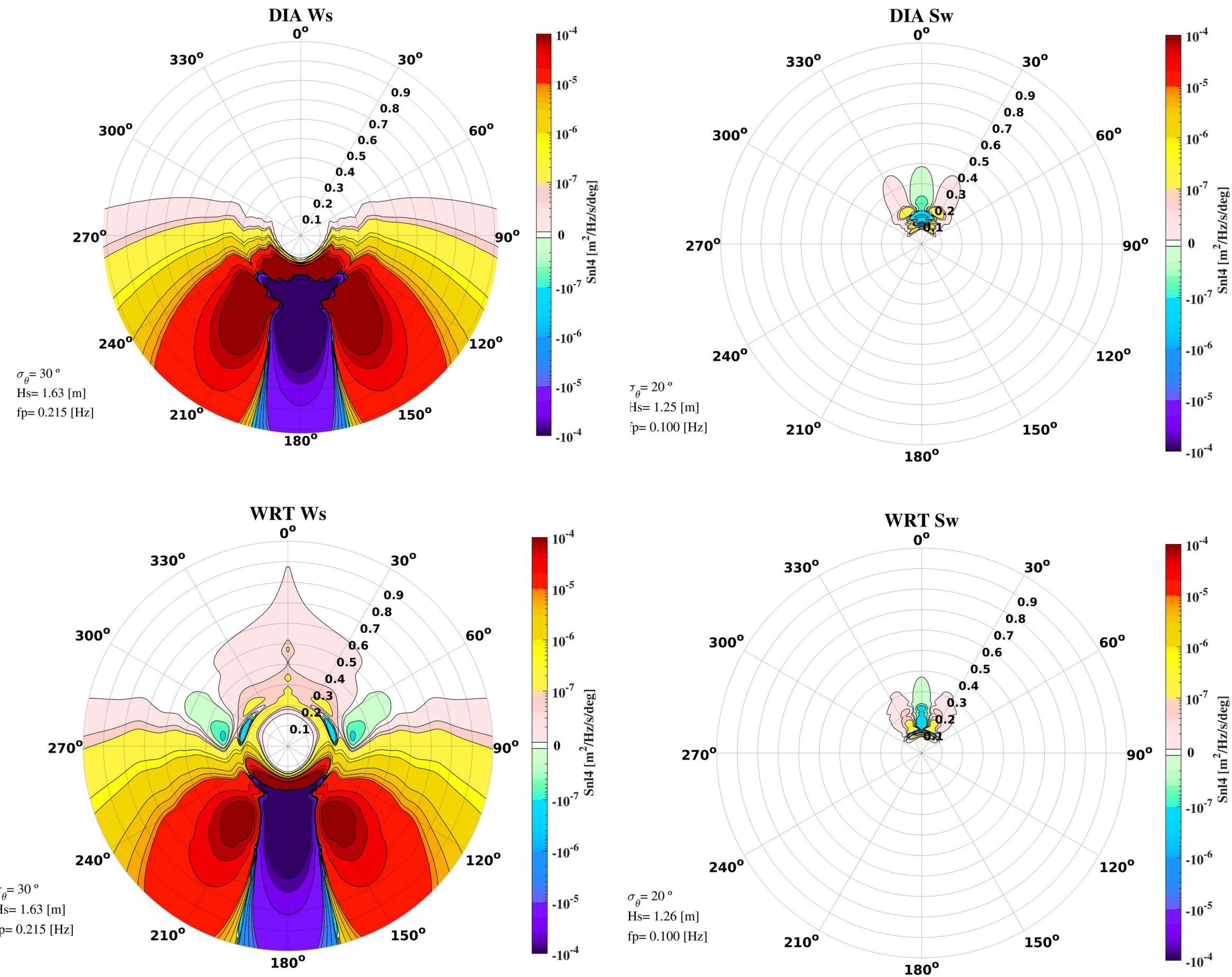
In this work, we assess how the evolution of the directional wave spectrum may differ when comparing  $S_{nl4}$  for a bimodal spectrum consisting of oppositely propagating wave systems, as estimated by DIA, with that obtained using the WRT scheme.





# Results

## $S_{nl4}$ structure in the frequency-direction domain





# Results

## $S_{nl4}$ structure in the frequency-direction domain

