Wind and Wave Dependent Sea Spray Generation Functions - From the Laboratory to the Field
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To cite this version:
William Bruch, Jacques Piazzola, Hubert Branger, A M J van Eijk, Christopher Luneau, et al.. Wind and Wave Dependent Sea Spray Generation Functions - From the Laboratory to the Field. Workshop Air/sea Interactions, Summer School Oxy-Jeunes, Ecole de Physique des Houches, Jul 2021, Les Houches, France. hal-03348157

HAL Id: hal-03348157
https://hal.science/hal-03348157
Submitted on 5 May 2022
The sea spray generation flux was found to scale best with $S^2$ and $\mu^3$. From the combination of $\mu^3$, $S^2$, and $\mu$, $P_S$ was derived.

Numbers, such as the windsea Reynolds number $R_B$ (denoted $\mu^3$), the wave age $\theta$ (with $\mu$ the phase speed), whitecap coverage were found to be near-logarithmic, allowing to calculate the friction velocity $u^*$, and the sea spray generation flux using a flux-profile approach. Wave breaking processes are essential for the production of sea spray, and the whitecap coverage obtained in the tunnel from colour images was found to have very similar behaviour to the field.

The laboratory wind and wave states were characterized using measured quantities and the calculation of known dimensionless modal medians defined at 2.5, 7 and 25 µm radius,

$$P_S = \frac{\mu^3}{v_{10}g} \langle S^2 \rangle$$


References:


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The deployment of wind, wave and sea spray instrumentation in the field is complicated by the often rough environmental conditions. Wind-wave laboratories are an interesting tool for the study of air-sea interactions, including sea spray aerosols as done in a number of recent studies (Fairall et al. 2009; Mehta et al. 2019). An important challenge is the upscaling of the results obtained in the laboratory to the field.

The presented modelling results indicate that the SSGFs obtained in the laboratory can successfully reproduce the jet and spume droplet production. The combination of the source functions proposed in Bruch et al. (2021) with that proposed in Ovadnevaite et al. (2014) allow to cover a large marine aerosol size range. Further study is required to ensure that the physical characteristics of the air-sea interface are correctly upscaled from the laboratory to the field.

Two New Source Functions

The laboratory wind & wave states were characterized using measured quantities and the calculation of known dimensionless numbers, such as the windsea Reynolds number $R_B$, the wave age $\theta$, the wind speed (m/s) and wind friction velocity cubed $\mu^3$. Wave measurements allowed to estimate the wave slope variance ($S^2$). From the combination of $\mu^3$, $S^2$ and $R_B$, $P_S$ was derived.

The sea spray generation flux was found to scale best with $\langle S^2 \rangle$ and $P_S = \frac{\mu^3}{v_{10}g} \langle S^2 \rangle$.