

# SID



سرویس های ویژه



سرویس ترجمه تخصصی



کارگاه های آموزشی



بلاگ مرکز اطلاعات علمی



عضویت در خبرنامه



فیلم های آموزشی

## کارگاه های آموزشی مرکز اطلاعات علمی جهاد دانشگاهی



PROPOSAL

پروپوزال

مركز آموزش  
پروپوزال نویسی و پایان نامه نویسی

کارگاه آنلاین  
پروپوزال نویسی و پایان نامه نویسی



مركز آموزش  
روش تحقیق و مقاله نویسی علوم انسانی

کارگاه آنلاین  
روش تحقیق و مقاله نویسی علوم انسانی



ISI  
Scopus

مركز آموزش  
آشنایی با پایگاه های اطلاعات علمی بین المللی و ترکیه های جستجو

کارگاه آنلاین آشنایی با پایگاه های اطلاعات علمی بین المللی و ترکیه های جستجو



مرکز ملی پژوهش‌های دریایی

سازمان بنادر و دریانوردی به عنوان تنها مرجع حاکمیتی کشور در امور بندری، دریایی و کشتی‌رانی بازرگانی به منظور ایفای نقش مرجعیت دانشی خود و در راستای تحقق راهبردهای کلان نقشه جامع علمی کشور مبنی بر "حمایت از توسعه شبکه‌های تحقیقاتی و تسهیل انتقال و انتشار دانش و سامان‌دهی علمی" از طریق "استانداردسازی و اصلاح فرایندهای تولید، ثبت، داوری و سنجش و ایجاد بانک‌های اطلاعاتی یکپارچه برای نشریات، اختراعات و اکتشافات پژوهشگران"، اقدام به ارایه این اثر در سایت SID می‌نماید.



سازمان بنادر و دریانوردی



## Field study of the physical regularities of sand suspending under breaking waves

**Ruben KOS'YAN**

Head of Department

SB IO RAS

353467 Gelendzhik - 7, Russia.

E-mail: kosyan@sdios.sea.ru

**Nikolay PYKHOV**

Leading researcher

Nakhimovskiy prospectus 36,

117851 Moscow, Russia.

E-mail: pykhov@geo.sio.rssi.ru

**Igor PODYMOV**

Leading researcher

SB IO RAS

353467 Gelendzhik - 7, Russia.

E-mail: podymov@sdios.sea.ru

**Hans KUNZ**

Director of CRS

An der Muehle 5, D-26548

Norderney, Germany.

E-mail: kunz.crs@t-online.de

**Sergey KUZNETSOV**

Senior researcher

Nakhimovskiy prospectus 36,

117851 Moscow, Russia.

E-mail: kuznets@geo.sio.rssi.ru

The mechanisms and time scales of sand suspension by irregular waves are considered on the basis of field experiment «Norderney'94» performed in the North Sea.

Sand suspension events in the surf zone are caused by macro turbulence under the plunging and spilling breakers (Kos'yan et al., 1997). Plunging breakers are characterized by a jet impinging on the oncoming trough and subsequent violent transition from irrotational to rotational water motion with horizontal axis. During this transition, the vortex with horizontal axis is formed near the water surface of the forward front of the breaking waves, than penetrates to the bottom and suspends the sand into the water. The vortex passing through the measurement point is reflected by the zigzag shape of the forward front of the cross-shore velocity and by the alternating direction changing of the vertical velocity component. This character of the cross-shore and the vertical velocity changing is determined by a vortex rotation in the clockwise direction. The sand suspension event is related to the positive value of the vortex vertical velocity and has some time lag with regard to the maximum of the vertical velocity.

The observed data testify to the fact, that the vertical velocity determines the suspended sand flux from the bottom. The vertical suspended sand fluxes, provided due to wave and turbulent velocity components was determined as the product of the concentration and the corresponding component of the vertical velocity. The vertical sand flux is remarkable at the moments of wave breaking and is insignificant during the other times.

Statistically significant values of the coherence between the concentration and free surface elevations are observed for the same frequencies as for the peak of the wave spectrum ( $f = 0.1$  Hz), and also for the lower frequencies. The sediment concentration insignificantly leads on a phase in the relevant frequency band ( $f < 0.1$  Hz), where the significant values of coherence take place. The contribution to the sand flux by the wave component ( $f < 0.8$  Hz), is in the range of an order larger than the flux provided by the turbulent component ( $f > 0.8$  Hz).

During our measurements spilling breaking of the waves took place, generally inside the surf zone. A suspension event with a nearly vertical forward front coincides well with strong fluctuations of the cross-shore and the long-shore velocity components. Such very intensive turbulent fluctuations of the horizontal velocity component and the suspending events are caused by vortexes that pass through the measuring point. The vortex-type diagram for the surf zone (Zang et al., 1994) confirms

this. Our data are situated in this diagram in a region, which is characterized by situations, when not less than three vortexes with a vertical inclined axis are produced by breaking wave.

The results of our observations testify that in the surf zone the intensive suspending of sediment from the bottom is determined by the macro-scale turbulence which are generated by breaking waves. In those cases, the time scales of the turbulent kinetic energy and of the shear stress near the bottom will define the time scales of the suspended sediment concentration fluctuations.

The temporal variability of the suspended sand concentration coincides well with the turbulent kinetic energy and the absolute value of the shear stress. The broad peaks of the concentration and the turbulent kinetic energy follow with periodicity of 100 to 150 s. Inside such peaks the fluctuations of these parameters on time scales of about the period of the waves were observed.

The spectrum of the cross-shore velocity is characterized by a well-expressed local maximum on the frequency of 0.1 Hz. In a spectrum of the concentration we can practically not detect such a local peak, the spectral density increases quazimonotonously with a decreasing of the frequency. In the range of the gravity the infragravity frequencies ( $f < 0.8$  Hz), the fluctuations of the concentration are low coherent to the fluctuations of the cross-shore velocity, as the values of the quadrate of coherence do not exceed 0.2. This implies for the wave breaking zone that, based on measured or analytically created time-series of the cross-shore velocity, a reliable determination of the temporal variability of the suspended sand concentration is impossible. In this zone, the concentration fluctuations are coherent to the fluctuations of the turbulent kinetic energy in the low-frequency range ( $< 0.08$  Hz) of waves.

The coefficient of the cross-correlation between the low-frequency time series of the suspended sand concentration and the turbulent kinetic energy reaches with approximately 0.7 the greatest value. Thus the fluctuations of concentration delay concerning the fluctuations of the turbulent kinetic energy for approximately 6 seconds, that makes  $0.6 T_p$  ( $T_p$  is a period, which corresponds to the wave spectrum peak). The value of the correlation coefficient for the whole range of wave- and low- frequencies, with approximately the same lag time, does not exceed 0.4. The high values of the correlation coefficient and the coherence for the low frequencies testify that an intensive sand suspending happens at group series of the breaking waves.

From the physical point of view, the most effective way to understand the sand suspending process and to predict the suspension sand concentration fluctuation is the determination of relationships between concentration and macro turbulence parameters as well as between the macroturbulent parameters and the dissipation of wave energy by breaking. To obtain such relations, the investigation of the spatial -temporal variability of macro turbulence and sand suspension under breaking irregular waves is necessary.

This investigation appears under the financial support of the NATO Science Program "Partnership for the peace" Linkage Grant No 974562: "Cross-shore sediment transport: physical regularities and modeling".

The fulfillment of the field experiments was supported by the German Federal Ministry for Science, Education, Research and Technology (BMBF).

# SID



سرویس های ویژه



سرویس ترجمه تخصصی



کارگاه های آموزشی



بلاگ مرکز اطلاعات علمی



عضویت در خبرنامه



فیلم های آموزشی

## کارگاه های آموزشی مرکز اطلاعات علمی جهاد دانشگاهی



PROPOSAL  
پروپوزال

پروپوزال نویسی و پایان نامه نویسی

دکتره تهرانی

کارگاه آنلاین  
پروپوزال نویسی و پایان نامه نویسی



روش تحقیق و مقاله نویسی علوم انسانی

دکتره تهرانی

کارگاه آنلاین  
روش تحقیق و مقاله نویسی علوم انسانی



ISI  
Scopus

آشنایی با پایگاه های اطلاعات علمی بین المللی و ترند های جستجو

دکتره تهرانی

کارگاه آنلاین آشنایی با پایگاه های اطلاعات علمی بین المللی و ترند های جستجو