Subject offered for a contract starting October 2017

SUBJECT TITTLE: Seismo-acoustic signature of the ocean storms at the center of Eurasia

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Financing: Doctoral contract with or without teaching assignment

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Presentation of the subject:

Continuous and global infrasound recordings are provided by the global International Monitoring System (IMS) network in place for the verification of the CTBT (Comprehensive Test Ban Treaty). In the frequency band of interest to monitor atmospheric explosions (0.02-4 Hz), ocean waves – so-called microbaroms – are a constant source of noise which may hide signals of interest. Studies of seismic noise generated by ocean noise suggested similar mechanisms to those of infrasound signals. Microseisms are attributed the same source mechanism as microbaroms, involving the non-linear interaction of standing ocean waves. If the characterization of the ambient coherent infrasound noise is an active research topic, the coupling between the ocean surface and the atmosphere is still little studied. To further evaluate oceanic wave action models and better characterize the source, infrasound analysis can then be supplemented by microseism observations collected seismic arrays. Multi-year comparisons between the observed and modeled directional microbarom amplitude using two-dimensional wave energy spectrum ocean wave products allows building of a reference database of oceanic sources for source and propagation studies.

This thesis proposes to use the Kazakhstani seismic and infrasound arrays which clearly record microseisms and microbaroms from North Atlantic and North Pacific at sites where

the background noise level is very low. Seasonal variations in the spatial distribution of the source will be resolved using accurate processing results of multi-year continuous microbarom and microseism records. The inferred source regions will be compared with the interference of the ocean wave systems travelling in opposite directions. Time- and space-dependent wind profiles derived from operational meteorological atmospheric models will be used for the propagation modeling. Microbarom and microseism source regions will be studied, highlighting spatial and temporal variations (from seasonal to hourly scales) of the frequency and intensity of the source. This research will be conducted using historical datasets for Akbulak, Karatau, Borovoe Makanchy seismic arrays and I31KZ, Kurchatov and Makanchy infrasound arrays operated by the Geophysical Research (IGR) of National Nuclear Center (NNC). Multiyear datasets will be reprocessed using a standardized array processing scheme developed by CEA allowing a fine characterization of interfering signals in the microbarom frequency band.

This thesis thus proposes a systematic and comprehensive analysis of complementary data (ocean wave and atmospheric models, seismic and infrasound observations, middle atmospheric soundings) to finely characterize the source and the coupling mechanisms at ocean / earth / atmosphere interfaces using the dense Kazakhstani seismo-acoustic network. In return, a better knowledge of the source (location, intensity, spectral content) will be used to image the dynamics of the middle atmosphere (30-90 km altitude) and its disturbances yet unresolved by the current models. The expected benefits of this thesis concern the improvement of operational monitoring tools (discrimination and propagation methods) thanks to the contribution of new observational constraints.