Geophysical Research Abstracts
Vol. 15, EGU2013-3678, 2013
EGU General Assembly 2013

Validation of coherence model for infrasonic station

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January 8, 2013

Abstract

The infrasound monitoring stations consist generally of 4 to 12 sensors located in an area where the aperture radius is about 2 km. It is well known that for very remote sensors the coherence can be partially lost. It is an important issue because most of the detection and estimation algorithms are based on the assumption that the observed signals are delayed versions of a signal of interest (SOI), therefore the coherence function is 1 over the full frequency band. Following the seminal article of Mark and Flynn we consider that the loss of coherence can be modeled by the randomness of the wavenumber. More specifically we consider that the wavenumber writes $\Theta = \theta + \epsilon$ where θ is a deterministic unknown parameter in R^3, and ϵ is a multivariate gaussian random variable with zero-mean and unknown covariance Γ_ϵ. Then we derive the spectral matrix expression depending on θ and Γ_ϵ. Using the Whittle's formula giving the asymptotic likelihood function in the frequency domain we can estimate the full parameter $(\theta, \Gamma_\epsilon)$. In this study we present, on one hand, numerical results on simulated signals and, on the other hand, a cross-validation conducted on the data of the IMS station IS31 whose the signal of interest is a gas-flare with a well-known location.

Infrasound, coherence, Whittle formula

*This work was financially supported by KIGAM, Korea, the Telecom-ParisTech Institute and the French Commissariat à l'Énergie Atomique (CEA), France.