

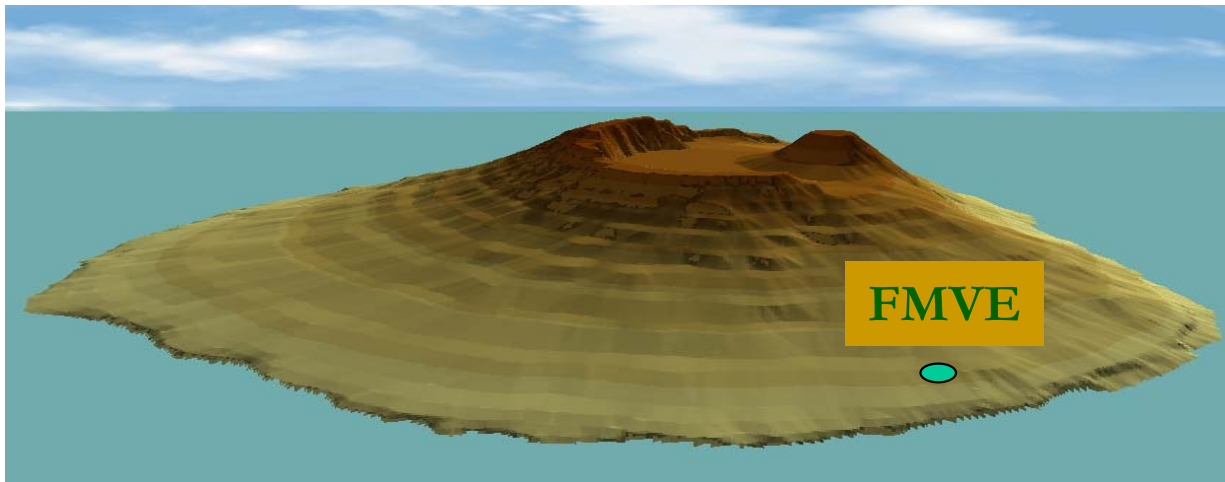


ICIST

Laboratório
de
Engenharia
de Cabo
Verde



Semi-diurnal modulation of the seismic noise in Fogo Island, Cape Verde – possible causes



By **Susana I. S. Custódio⁽¹⁾,**
Zuleyka Bandomo^(1,2),
Nicolas d'Oreye⁽³⁾,
João F. B. D. Fonseca⁽¹⁾

- (1) ICIST, Instituto Superior Técnico
- (2) Laboratório de Engenharia de Cabo Verde
- (3) European Center for Geodynammics and Seismology

Seismic Noise in Monte Vermelho

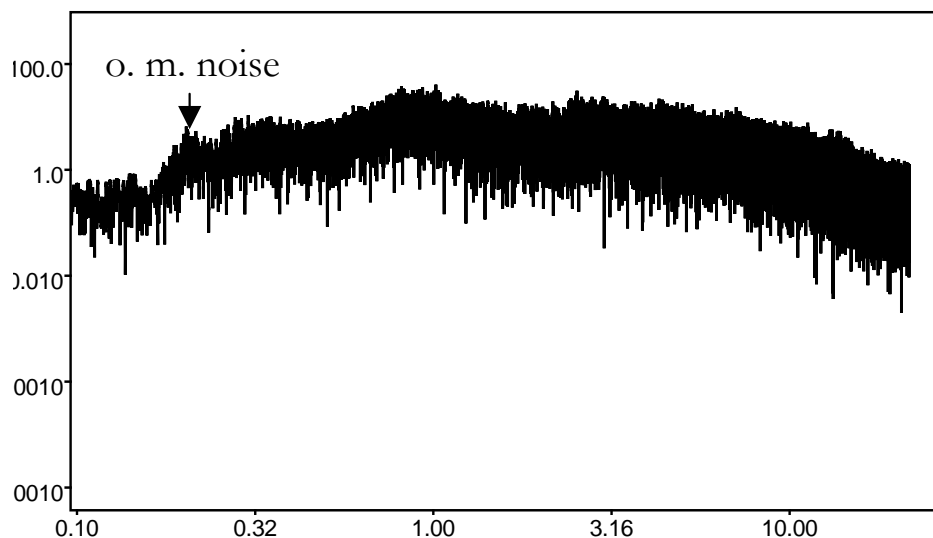
3 day register of the seismic noise in Monte Vermelho, EW



Semi-diurnal modulation of the seismic noise observed in all 3 components EW, NS and Z, both in Monte Vermelho and Monte Losna seismic stations.

How can we explain it?

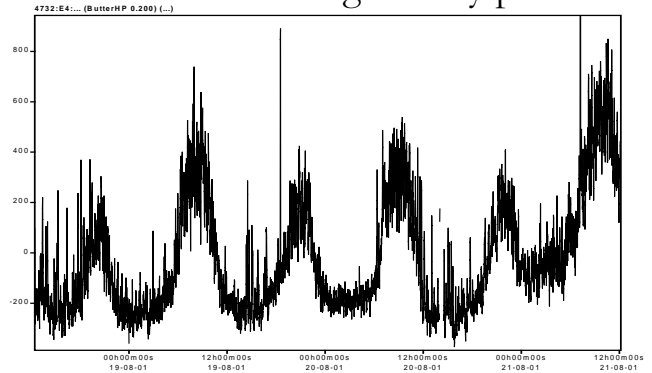
Typical amplitude spectrum for the signal above



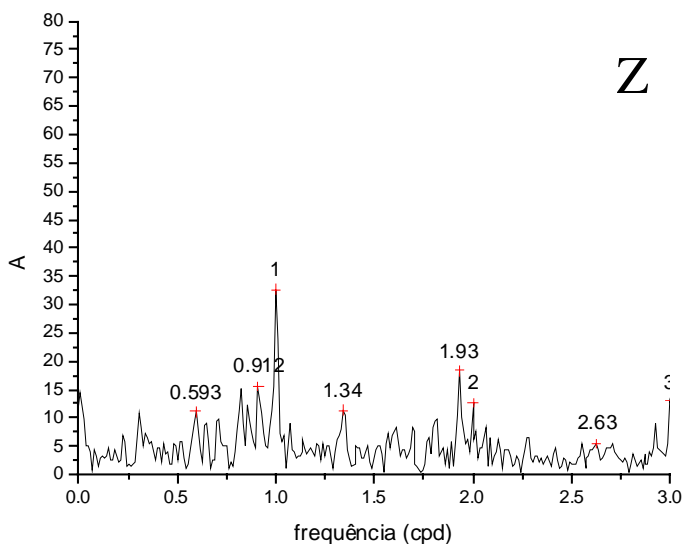
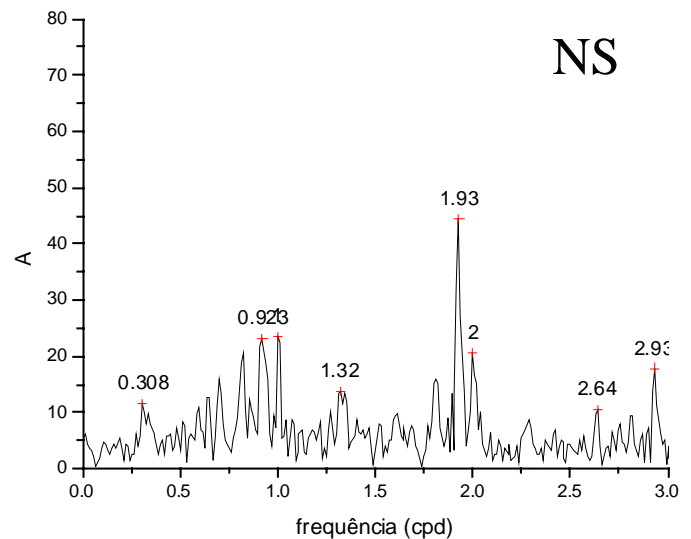
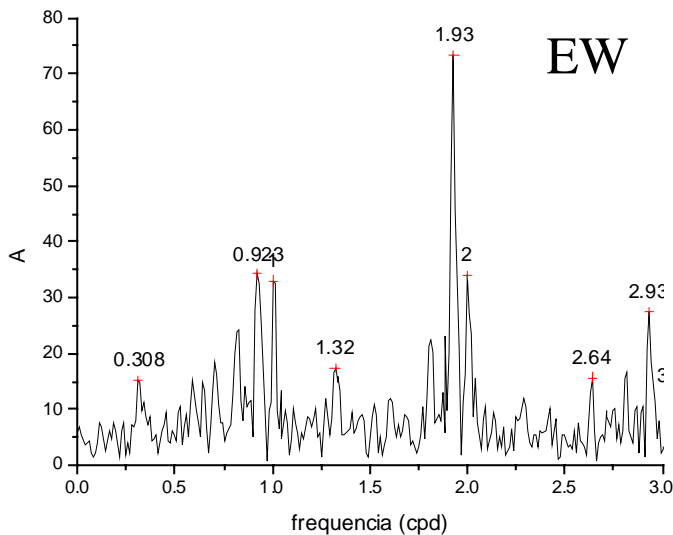
oceanic microseismic noise at **0.125 – 0.250 Hz**
=> **cannot justify the observed modulation**

In order to analyze better the modulation, the signal variance was calculated over a 2-minute window, thus obtaining the noise's envelope with a sampling frequency of 1 min^{-1}

noise variance during a 3-day period



And then we obtained the spectra of the seismic signal variance...
(for a 2 month period)



➤ **most important** frequencies (1.93 and 2.00 cpd) correspond to **semi-diurnal modulation**

➤ **diurnal variation** (0.92 and 1.00 cpd) also present

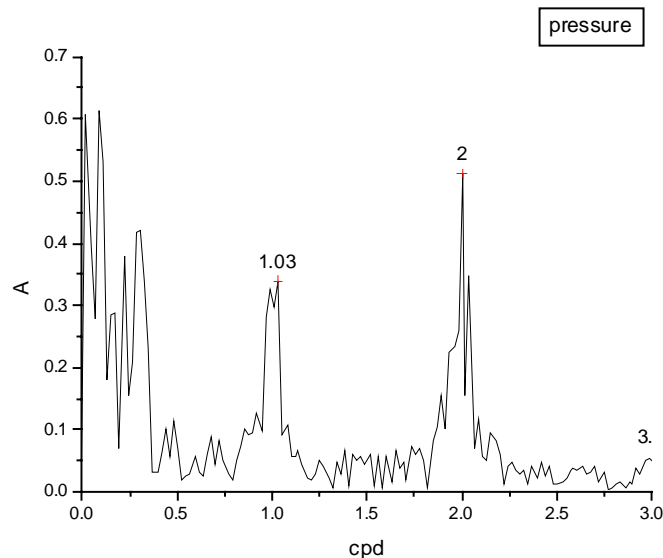
➤ **EW** component with most evident modulation

Environmental Parameters

Pressure

(15 day records)

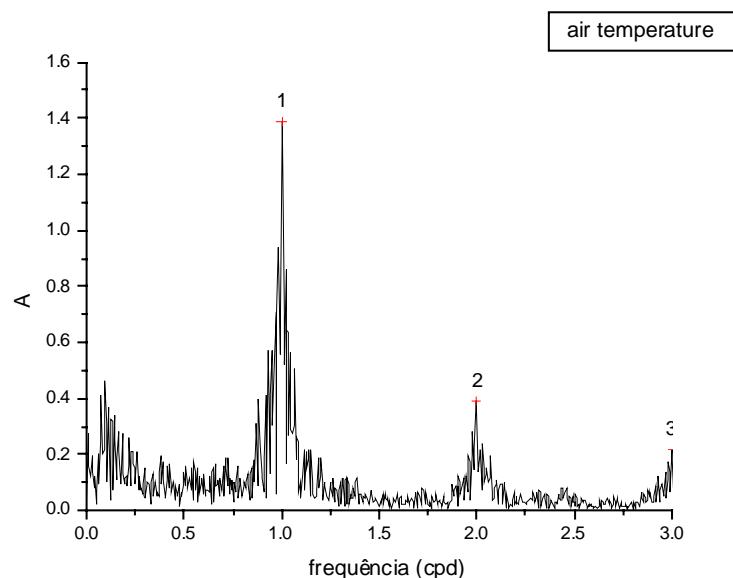
- **mainly semi-diurnally modulated (2 cpd)**
- **diurnal modulation (1 cpd) also present**



Temperature

(2 month records)

- **mainly diurnally modulated (1 cpd)**
- **semi-diurnal modulation (2 cpd) also present**



The **most relevant frequencies** in the seismic noise (1.93 cpd for the semi-diurnal, and 0.92 for the diurnal modulation) **don't appear** in these spectra

=> environmental parameters cannot explain the seismic modulation

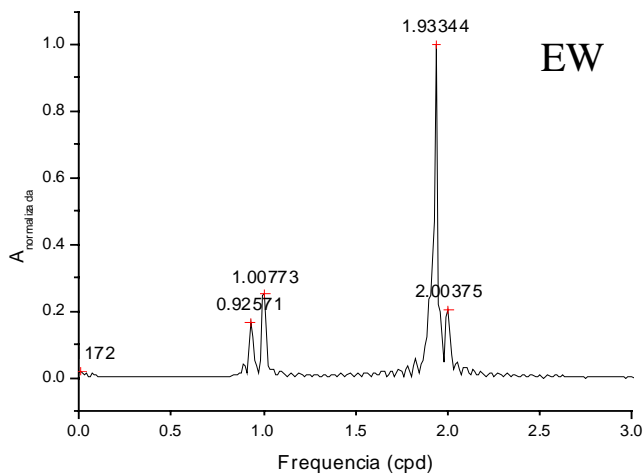
Tides

Their effect can be felt through:

- **earth tides** (the amplitude of earth tides is **quite small**)
- **atmospheric tides** (also with a **too small** effect on Earth)
- **ocean tides** (they cause the **ocean loading** effect and may have an effect on **degassing**)

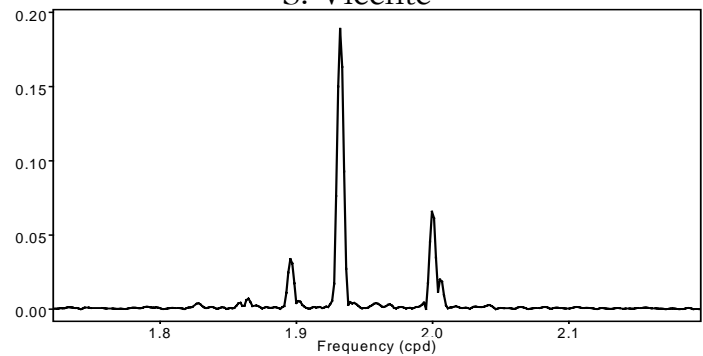
Ocean Loading

Mt Vermelho



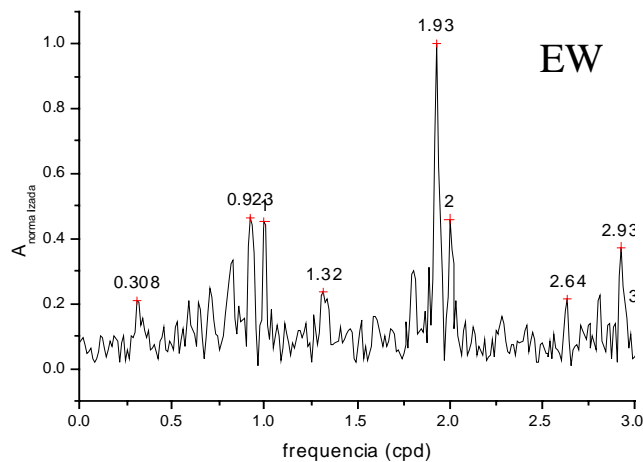
Ocean Tides

S. Vicente



Seismic Noise

Mt Vermelho



Main frequencies on both spectra **match** (on all the 3 components EW, NS and Z):

- 1.93 cpd and 0.92 cpd are caused by the Moon
- 1.00 cpd and 2.00 cpd are caused by the Sun

=> tides seem to be at the origin of the observed seismic modulation in the noise level!

Exactly how do tides originate this modulation?

- **Ocean Loading**

Problem: EW is the direction where the ocean loading effect is less obvious, whereas it is the direction where the seismic noise modulation is most felt.

- **Earth Tides**

Even though the effect of earth tides has a smaller amplitude than the ocean loading, it is stronger in the EW component (just like in the observed seismic noise).

- **Degassing**

Through which process exactly?

Still going on...

- Study of **other stations seismic noise**
- Study of the noise variance **phase spectra**