Observational Campaign of the FluTuES project - Torre Meaípe

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RESUMO
O principal objetivo do projeto FluTuES (Fluxos Turbulentos no Espírito Santo) é investigar a interação da atmosfera com a superfície através da determinação observacional das principais componentes do balanço de energia sobre superfície oceânicas e costeiras no estado do Espírito Santo. A primeira região de estudo está sendo em Meaípe, Guarapari, onde há a presença de areia monazítica. Neste trabalho será brevemente descrito a instalação, equipamentos e a publicação automatizada dos dados obtidos no projeto no site do Laboratório de Interação ar-mar (LIAM).

ABSTRACT
The main objective of the FluTuES (Turbulent Flows in Espírito Santo) project is to investigate the interaction of the atmosphere with the surface through the observational determination of the main components of the energy balance on oceanic and coastal surfaces in the state of Espírito Santo. The first region of study is being in Meaípe, Guarapari, where there is the presence of monazite sand. This work will briefly describe the installation, equipment and automated publication of the data obtained in the project on the site of the Air-Sea Interaction Laboratory (LIAM).

1. Introduction

This work describes the tower installed in Meaípe (20°39′13″ S, 40°30′07″ W), Guarapari, ES. The beach of Meaípe was chosen because of its monazite sand - type of sand with high natural concentration of heavy minerals. The thorium (232Th) is found in these sands and decays in several child nuclei, one of which is radioactive, colourless, odourless and inert natural gas called radon (220Rn). Studies carried out under controlled laboratory conditions show that radon therapy can inhibit oxidative damage and enhance antioxidant functions in humans, and it is used in the treatment of inflammatory pain such as rheumatoid arthritis or osteoarthritis. However, in natural environments, studies on the inhalation of radon gas point to both benefits and harm to humans due to, perhaps, the lack of knowledge of the dosage of existing natural radiation at a given location and time.

The focus of this project will be to investigate the possible relationship between the atmosphere and the variation of the ionizing radiation present in the beach of Meaípe.

2. Site and equipment

An instrumented tower was installed in November of 2018 at Meaípe beach in the "Restaurante Cantinho do Curuca". Table 1 describe the sensors used to get the meteorological data. The low frequency equipment collects (i) air temperature and (iii) relative humidity, (iv) radiation components (incoming and outcoming longwave and shortwave radiations) [1], (v) atmospheric pressure, (vi) soil temperature and (vi) soil heat flux. Figure 2 illustrate the atmospheric and soil measurements.

Table 1: Equipment installed at Meaipe tower of FluTuES project.

Sensor	Model	Height (m)	Serial number	Calib. constant (µV/W/m2)	Variable
Net radiometer	CNR4	3.9	17 350	13.52	Incident solar radiation
				12.43	Reflected solar radiation
				11.41	Incident longwave radiation
				13.01	Outgoing longwave radiation

Thermistor and capacitive transducer	HC2S3	3.7	61247977	-	Air temperature and air relative humidity
Barometric pressure	CS106	0.55	K3230009	-	Atmospheric pressure
Soil heat flux	HFP01	-0.05	4484	62.3	Soil heat flux
Thermistor	109	-0.05	-	-	Soil temperature
3-D sonic anemometer	CSAT3	4.1	2072	-	Three orthogonal wind components.
Gas analyser	LI-7500	4.1	1987	-	Absolute CO2 and water vapor, barometric pressure
Datalogger	CR3000	0.40	9812	-	Data acquisition system

The low frequency data has been collected using a sampling rate of 0.05 Hz and storage in the datalogger every 30 min [2].

Figure 1: Meaipe tower and soil measurements.

The high frequency data (CO2 and H2O fluxes; wind ant temperature fluctuations) have been collected with 3 three orthogonal wind components using a sampling rate of 10 Hz and then transmitted to USP automatically (Figure 3).

Figure 3: High frequency equipment. 3D anemometer with sonic temperature, speed of sound and U, V and W vector outputs. LI-COR CO2/H2O differential gas analyzer designed for field uses.

3. Data acquisition and transmission systems

The management of data acquisition and transmission systems are illustrated in figure 4. The datalogger is connected to the laptop via serial cable by direct connection. The data is collected every 30 min by the software developed by Campbell, called Loggernet. Because the distance between the datalogger is small, there is no need to use any other communication interface. This

data is stored on the laptop and also in the datalogger using a high-speed CompactFlash (CF) type memory card and transferred to a cloud (Dropbox) by a batch script that is scheduled to operate every 30min through the System Scheduler. Using three storage locations ensures that no data is lost during the transfer.

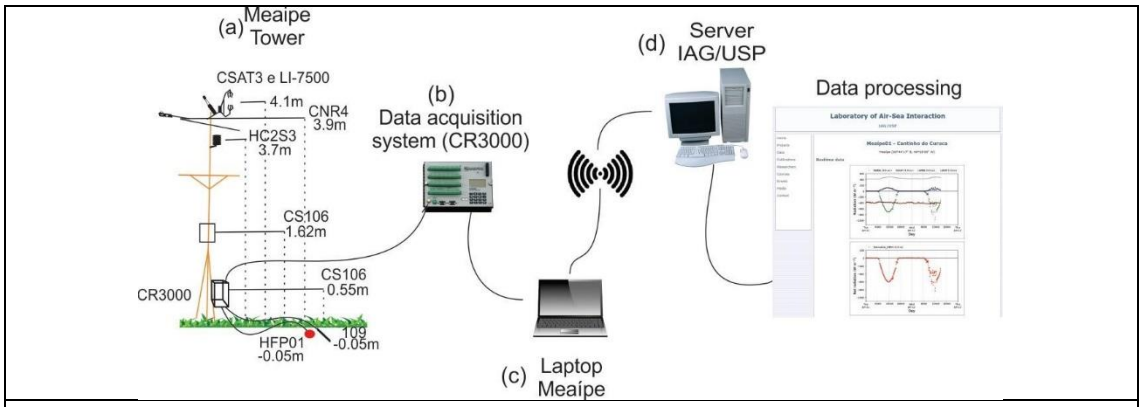

Figure 4: Data acquisition and transmission systems. (a) Meaipe tower scheme; the specifications of the equipment can be found in Table 1, (b) data acquisition system (datalogger CR3000) installed in the tower, (c) laptop receiving information from the datalogger and (d) data reception at IAG / USP.

A modem with a 4G chip is used to access the internet and transfer the data via Dropbox. Another important control program is the "TeamViewer", which provides unrestricted remote access, whenever necessary, to the laptop.

The data is received on a server at USP where a program developed in FORTRAN, by the laboratory technicians, exclusively for this application, reads, interprets and handles the data. Another program developed in PYTHON manages the graphics that are automatically sent to the LIAM website. These programs are executed through the instructions of a batch script that are scheduled to run every 30 minutes by the System Scheduler. With this, the system is automated from the data collection to the graphics published on the LIAM site. These graphs are useful for tracking data behavior and for identifying any data problem or inconsistency more quickly.

4. Discussion

This text describes the atmospheric equipment and its installation, as well as the automatic collection and transmission of data observed in Meaipe.

The atmospheric data are automatically collected at Meaípe beach and sent to LIAM at USP, São Paulo. The data are then processed by a FORTRAN program developed by LIAM technicians. The graphs are made in PYTHON and placed on the laboratory site to facilitate the monitoring and dissemination of the data to any interested research groups. This process occurs every 30 minutes and can be tracked on the LIAM website (http://www.liam.iag.usp.br/data/MEA01.html). All dataset is available to the scientific community on request.

References:

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[2] Soares, J., Alves, M., Ribeiro, F.N.D., Codato, G., Surface radiation balance and weather conditions on a non-glaciated coastal area in the Antarctic region, Polar Science, 2019, https://doi.org/10.1016/j.polar.2019.04.001.

Acknowledgments: We would like to thank CNPq and FAPES. We also thank the whole community of Meaípe for the reception and dissemination of our work, especially the Rest. Cantinho do Curuca, Restaurante Saborear, Hotel da Léa and Restaurante Gaeta.