

# MESOSPHERIC GRAVITY WAVES IDENTIFIED AT FERRAZ ANTARCTIC STATION: GENERAL CHARACTERISTICS AND CASE STUDIES

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## Abstract

Mesospheric gravity waves were observed at Ferraz Antarctic Station (62.1°S, 58.4°W) in two consecutive years (2010-2011), from March to October, through an all-sky airglow imager, which makes use of only one filter for the near infrared OH emission (OH NIR). The airglow camera operated during 81 nights in 2010 and 123 nights in 2011, but it was possible to identify and characterize wave events (due to the cloudy conditions) in 31 nights during 2010 and 46 nights 2011, with 74 mesospheric waves in 2010 and 149 events in 2011. Also, we could identify mesospheric fronts, specifically: one case in 2010 and three cases in 2011.

## 1. INTRODUCTION

The Sub-Antarctic Islands and the Drake Passage are known as a “hotspot” of gravity wave activity, which extends from the troposphere to the mesosphere. An all sky airglow imager and a new-generation meteor radar were installed at the Brazilian Comandante Ferraz Antarctic Station (62°S), known as EACF (acronym in Portuguese), in the beginning of 2010. These instruments were operated during two consecutive years (2010 and 2011), ending the operations with the fire accident occurred at the Brazilian base in February 25 of this year. A full data set of small-scale gravity waves identified during these two years was characterized. The meteor radar data and airglow images obtained at Ferraz Station can be used to conduct a number of studies on gravity waves. Figure 1 shows maps (on the left) indicating a high gravity waves activity at the tip of the South America, in the Drake Passage, in the sub-Antarctic islands and Southern Oceans, while on the right side of Figure 1 are presented two airglow images where are identified gravity waves events (in the red boxes) and their propagation directions (arrows).

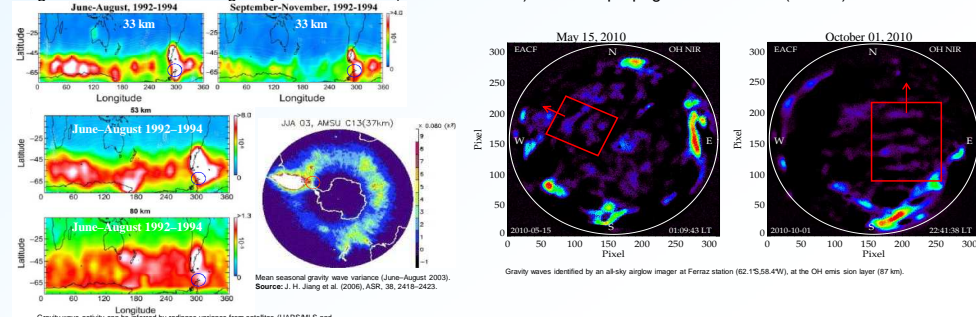


Figure 1: Identification of a high activity of atmospheric gravity wave in the South America, in the southern oceans and near the Antarctica Peninsula, and above Ferraz Station.

## 2. INSTRUMENTATION AND DATA ANALYSIS

For gravity wave studies at Ferraz Station we have used mainly two instruments: an all-sky airglow imager (Figure 2 B) and a new generation meteor radar (Figure 2 A) installed in 2010. An example of gravity wave analysis is presented in Figure 2 C, D and E.

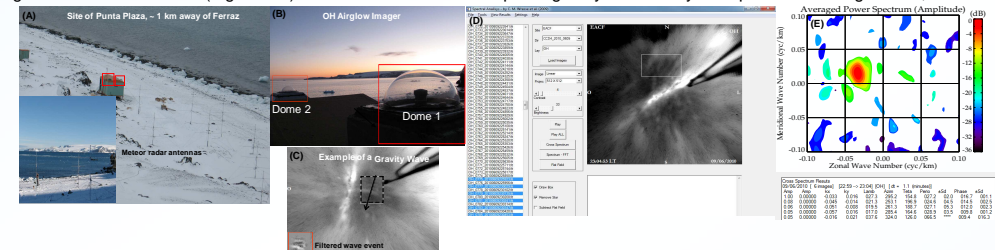


Figure 2: (A) Punta Plaza facilities located near Ferraz Station (62.1°S, 58.4°W), on King George Island, showing the shelter with two domes and the meteor radar antennas on the right side. (B) All-sky airglow imaging system in the Dome 1. (C) Example of a gravity wave event. (D) Selection of a time series of images, linearization, subtraction of the star field and selection of an area where the wave event will be analyzed. (E) Unambiguous FFT cross-spectrum result.

## 3. RESULTS

### • Examples of Gravity Waves (band events) Observed in 2010 and 2011

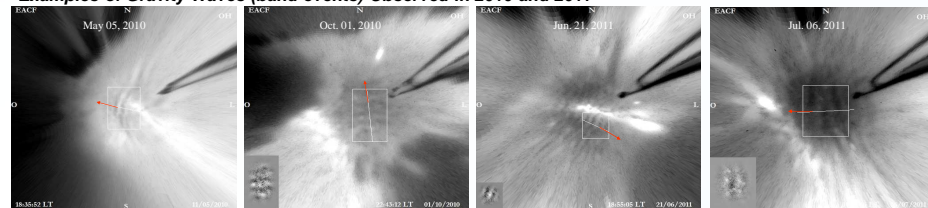


Figure 3: Airglow images showing gravity wave events (band type) identified above Ferraz Station.

## 3. RESULTS

### • General Characteristics: Distribution of the observed and intrinsic wave parameters and propagation directions

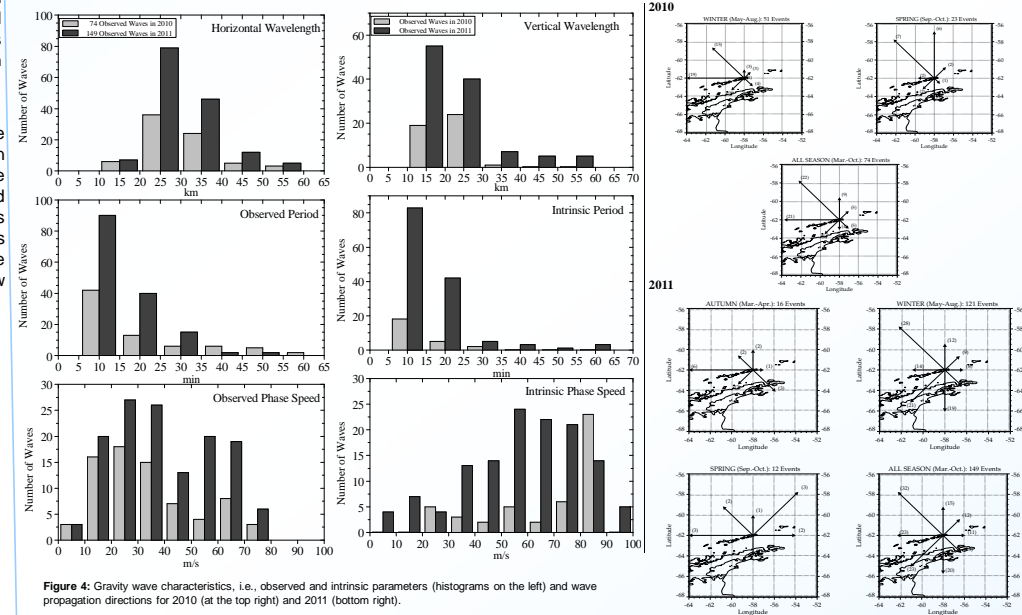


Figure 4: Gravity wave characteristics, i.e., observed and intrinsic parameters (histograms on the left) and wave propagation directions for 2010 (at the top right) and 2011 (bottom right).

### • Case Studies: Mesospheric Fronts and Bore Candidates

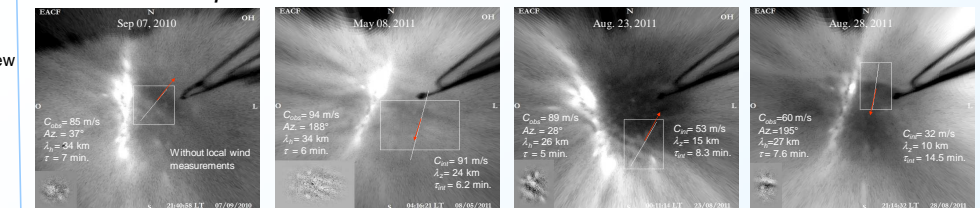


Figure 5: Mesospheric fronts observed at Ferraz Station in 2010 and 2011. Bore candidates are the first and third images, and wall events are the second and fourth images.

### • Potential wave sources (future investigation through ray tracing technique)

- Cold fronts, cyclones, jet stream;
- Winds blowing over mountains peaks and Katabatic Winds (pressure gradient);
- Wave-wave interaction / Wave breaking and strong temperature inversions;

## 4. SUMMARY

We observed gravity waves at the Brazilian Antarctic Station “Comandante Ferraz” during two consecutive years, 2010 and 2011. Here it was presented the main results of the waves identified from May to October 2010, totaling 74 wave events, and from March to October 2011 with 149 characterized waves. The observed parameters and propagation directions were similar to that observed in 2007. We observed clearer anisotropy in 2010 than during 2011. This difference can be attributed to the location of the gravity wave sources or to the background winds. We used local mesospheric winds to infer the intrinsic wave parameters. Also, it was presented four case studies of mesospheric fronts, where two of these cases are bore candidates. These distinct events require to be investigated in details.

## 5. Acknowledgments

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