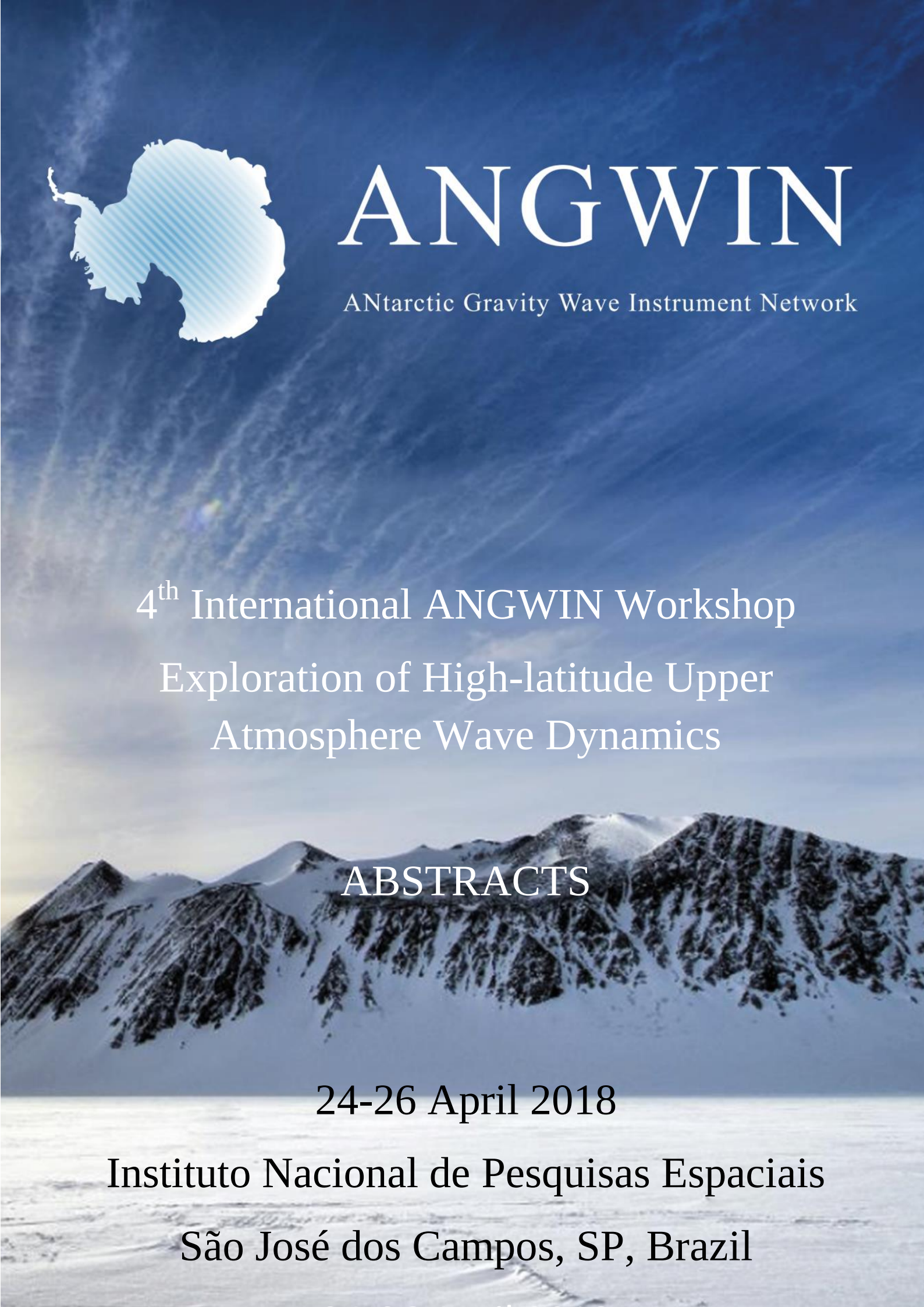

ANGWIN

ANtarctic Gravity Wave Instrument Network

4th International ANGWIN Workshop

Exploration of High-latitude Upper Atmosphere Wave Dynamics

ABSTRACTS

24-26 April 2018

Instituto Nacional de Pesquisas Espaciais

São José dos Campos, SP, Brazil

ANGWIN Organizing Committee:
Mike Taylor (USU)
Takuji Nakamura (NIPR)
Tracy Moffat-Griffin (BAS)
Damian Murphy (AAD)
José Valentin Bageston (INPE)
Jeong-Han Kim (KOPRI)

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PREFACE

New observational and modeling studies of atmospheric gravity waves have significantly improved our understanding of their important role for transporting energy and momentum within the middle atmosphere and the coupled thermosphere/ionosphere system. However, gravity wave fluxes and dynamical contributions at polar latitudes are not well understood, primarily due to a paucity of measurements.

ANGWIN (Antarctic Gravity Wave Instrument Network) is a scientific program initiated in 2011 that utilizes a network of instrumentation operated at several international research stations around Antarctica with the primary research goal of quantifying and understanding the dominant sources, propagation and impact of such dynamical processes on a continental-wide scale.

The goal of this workshop is to combine together new Antarctic and Arctic observations using optical and radio-wave techniques, and results with modeling studies to gain fresh knowledge and insight of their large-scale effects on the general circulation of the polar-regions lower, middle and upper atmosphere and ionosphere. Dynamical coupling processes associated with the gravity wave “hot spot” over the area between the Antarctic Peninsula and South American continent would also be discussed during the workshop.

PROGRAM

April 24 (Tuesday)			
Hour	**Chair**	**Duration (min)**	**Presentation**
08:00			**Registration**
09:00	José V. Bageston	10	Opening words (INPE's Director)
09:10		10	ANGWIN Historical (Michael J. Taylor)
09:20		20	ANGWIN Project (Tracy Moffat-Griffin)
09:40		20	Wrasse, Cristiano Max Thermospheric Nightime MSTIDS observed by an all-sky imager at Comandate Ferraz Antactica Station (62ºS)
10:00		**30**	**Coffee break**
10:30	Cristiano M. Wrasse	**30**	Taylor, Mike **(Invited Talk)** ANGWIN Research Activities at Utah State University: Summary and Future Plans
11:00		20	Corwin Wright (Tracy Moffat-Griffin) Exploring gravity wave characteristics over the Southern Andes and South Georgia Island
11:20		20	Pautet, Pierre-Dominique Investigation of Mesospheric Gravity Waves over South Pole and McMurdo Stations using two Advanced Mesospheric Temperature Mappers
11:40		20	Pautet, Pierre-Dominique Gravity Wave Ducting over Antarctica
12:00		**120**	**Lunch**
14:00	Tracy Moffat-Griffin	**30**	Kim, Jeong-Han **(Invited Talk)** Observations for the polar upper atmosphere research at Korea Polar Research Institute (KOPRI)
14:30		20	Kam, Hosik Propagation analysis of mesospheric gravity waves on OH and OI-557.7nm airglow layers over King Sejong Station, Antarctic Peninsula
14:50		20	Raunheitte, Luís Tiago Medeiros Characterization of the effects of Gravity Waves in the ionosphere using VLF
15:10		20	Figueiredo, Cosme A. O. B. Latitudinal differences of medium-Scale traveling ionospheric Disturbances observed over Andes Mountains
15:30		**30**	**Coffee break**
16:00	Emília Correia	**30**	Reichert, Robert Retrieval of intrinsic gravity wave parameters from lidar and airglow temperature data and radar wind data
16:30		20	Perwitasari, Septi (Masaru Kogure) Development of a Phase Velocity Spectral Analysis Software Package (M-Transform) for Airglow Imaging Data
16:50		20	Zhao, Yucheng First Coordinated AMTM and Fe lidar Measurements at McMurdo, Antarctica
17:10		20	Zhao, Yucheng Investigating Mesospheric Wave Activities at High Latitude Stations and South Pole
17:30			**End of Session**

April 25 (Wednesday)			
Hour	**Chair**	**Duration**	**Presentation**
09:00	Mike J. Taylor	**30**	Moffat-Griffin, Tracy **(Invited Talk)** Gravity waves in the lower atmosphere above South Georgia (54ºS, 36ºW)
09:30		20	Kogure, Masaru Different propagation characteristics of mesospheric gravity waves in Syowa and Davis, the Antarctic, using OH airglow imagers
09:50		20	Nyassor, Prosper K. Determination of gravity waves parameters in the airglow combining photometer and imager data
10:10		20	Rodrigues Gómez, Jenny Marcela Solar Spectral Irradiance (SSI) from CODET model and their relation with Earth's upper atmosphere
10:30		**30**	**Coffee break**
11:00	Lourivaldo M. Lima	**30**	Kherani, Esfhan A. Dynamics of Acoustic Gravity Waves and their role in the generation of Atmospheric Ionospheric Disturbances
11:30		20	Katamzi-Joseph, Zama Multi-instruments observations of atmospheric gravity waves/traveling ionospheric disturbances (AGWs/TIDs) associated with enhanced auroral activity
11:50		20	Rourke, Sharon (Frank Mulligan) A survey of mesospheric frontal events observed at Davis Station Antarctica (68°S, 78°E) during the period 2002-2012
12:10		20	Correia, Emília Ionospheric investigations at Comandante Ferraz Brazilian Antarctic Station
12:30			**Lunch, Workshop Photo**
14:00	Hisao Takahashi	20	Jee, Geonhwa Mesospheric and lower thermospheric neutral winds measured by Fabry-Perot Interferometer and Meteor Radar at King Sejong Station, Antarctica
14:20		20	Bilibio, Anderson V. Medium-scale gravity waves obtained from airglow all-sky observations over Cachoeira Paulista
14:40		20	Egito, Fabio Nonlinear interaction between an ultrafast Kelvin wave and the diurnal tide and their effects on the MLT airglow
15:00		20	Lima, Lourivaldo M. Planetary waves observed in the MLT region with a meteor radar at Ferraz Station, Antarctica
15:20		**30**	**Coffee break**
15:50	Pierre-Dominique Pautet	**30**	Bageston , José V. Historical background of all-sky airglow observations at Comandante Ferraz Antarctic Station and small-scale gravity waves climatology
16:20		20	Essien, Patrick Seasonal characteristics of small- and medium-scale gravity waves in the mesosphere and lower thermosphere over Brazilian equatorial region
16:40		20	Lopes, Bibiana C. Temperature behavior analysis during events of secondary effect of the ozone hole
17:00		20	Bittencourt, Gabriela D. Influence of the Antarctic ozone hole on the southern region of Brazil in the last 11 years
17:20			**End of Session**
			Workshop Dinner

April 26 (Thursday)			
Hour	**Chair**	**Duration (min)**	**Presentation**
09:00	Igo Paulino	**30**	Takahashi, Hisao Ionospheric dynamics over South America observed by TEC mapping
09:30		20	Andrioli, Vânia F. Study of the morphology of Na and K layers on MLT region
09:50		20	D'Amico, Dino E. Ionospheric anomalies associated with earthquakes
10:10		20	Barros, Diego Characteristics of equatorial plasma bubbles observed by TEC map over South America
10:30			**Coffee break**
11:00	José V. Bageston	20	Paulino, Igo Possible influence of lunar semidiurnal tide in equatorial Spread-F
11:20		20	Lomotey, Solomon O. Long-wave propagation in the lower thermosphere and its response to the ionospheric F layer over Brazilian equatorial region
11:40		60	Round Table
12:40		10	Closing Remarks
12:50			**Lunch**
14:00		60	ANGWIN Committee Meeting
14:00		60	Visit to EMBRACE and LIT
15:00			**End of Workshop**

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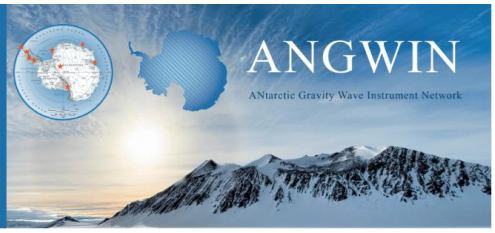

STUDY OF THE MORPHOLOGY OF NA AND K LAYERS ON MLT REGION

[1],[2] Andrioli, Vania F.; [3] Batista, Paulo P.; [3] Pimenta, Alexandre A.; [1],[2] Savio, Siomel; [4] Fagundes, Paulo R.; [1] Xu, Jiyao; [1] Yang, Guotao; [1] Jing, Jiao; [5] Cheng, Xuewu; [1] Wang, Chi; [1] Liu, Shengkuan

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ABSTRACT

In this work, we analyze simultaneous observation of mesopause sodium (Na) and potassium (K) layer by a dual beam LIDAR at São José Dos Campos (23.1°S, 45.9°W). The present study concerns mainly on some specific cases showing distinct morphology of the metal layers. Also, a statistics is presented using all data obtained from November 2016 to December 2017. In addition, we have analyzed the period between 2007-2009 of Na LIDAR temperature and density data from the other LIDAR in the same location. The results show no clear seasonal trend of these different layers, although a large data series should be used for this conclusion. We discuss here the possible wave interaction in the formation of these distinct layers, Ionosonde type CADI data showing the ionospheric E region, and mesospheric winds were also discussed.

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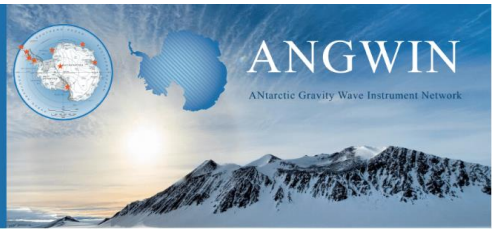

MEDIUM-SCALE GRAVITY WAVES OBTAINED FROM AIRGLOW ALL-SKY OBSERVATOTIO OVER CACHOEIRA PAULISTA

[1] A. V. Bilibio; [1] C. M. Wrasse; [1] C. A. Figueiredo; [2] N. J. Schuch ; [3] I. Paulino; [3] H. K. Takahashi

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ABSTRACT

Images obtained from OH and OI 557.7 nm airglow emissions were used to investigate the characteristics of medium-scale gravity waves observed in the mesosphere and low thermosphere region, between 1998 and 2013 over the Cachoeira Paulista Observatory, SP, Brazil (22.4ºS; 45.0 °O). Using the keogram technique, the results showed that 142 gravity wave events observed in the airglow emission have the following characteristics: horizontal wavelength between 50 and 500 km, observed period between 20 and 80 min, phase velocity between 40 and 100 m/s. The propagation directions of medium-scale gravity waves showed a season variation: in the summer the waves propagate to Northeast and Southeast directions, during autumn the waves propagate mainly to Northwest direction, in winter almost an isotropic propagation were observed, while during spring the waves propagate to Northeast and Southeast. A comparison of propagation directions between small and medium-scale gravity waves was also performed, showing that the main propagation directions of small and medium-scale gravity waves are similar for each season of the year. The results led us to conclude that both small and medium scale gravity waves may be related to the same wave source at the lower atmosphere. The meteorological phenomena that were related to generate small-scale gravity waves over Cachoeira Paulista are the cold frontal and convective systems.

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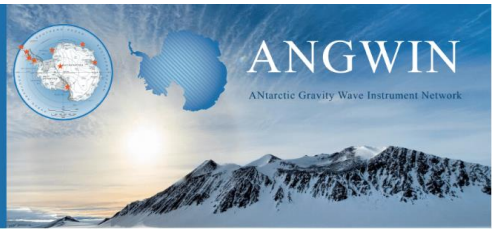

HISTORICAL BACKGROUND OF ALL-SKY AIRGLOW OBSERVATIONS AT COMANDANTE FERRAZ ANTARCTIC STATION AND SMALL-SCALE GRAVITY WAVES CLIMATOLOGY

[1] Bageston, José V.; [2] Giongo, Gabriel A.; [3] Wrasse, Cristiano M.; [3] Batista, Paulo P.; [3] Gobbi, Delano; [3] Takahashi, Hisao

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ABSTRACT

Atmospheric gravity waves are known to play an important role in the atmospheric dynamics and thermal structure. Systematic observations of gravity waves all around the world have been carried out by different research groups. In Antarctica, the gravity waves have been deeply investigated by distinct techniques and modeling in the last years. Since the scientific community knows very little on atmospheric gravity waves over the Antarctic continent as compared to other places in the world. Gravity wave observations at the Comandante Ferraz Antarctic Station - CF (62.1°S, 58.4°W) began in 2007 through a short (6 months) campaign by using a low-cost airglow imager. Later on, in 2010 the same imager system was reinstalled at CF and operated until the beginning of 2012. In 2014, a new airglow experiment returned to operated, but only for a couple of months. The new system installed in 2014 is a more modern airglow imaging system, which contains a filter wheel, with three airglow filters (OH-NIR, OI 557.7nm, and OI 630.0nm). For now, we have been analyzing continually the image data acquired with the OH filter since the gravity waves are commonly seen with a better quality in this emission and also because the previous observations (2007; 2010-2011) were made only in the OH-NIR. In this work, a brief history of the airglow observations at CF and a climatology of all the small-scale gravity waves observed at five distinct years, that is, 2007; 2010-2011; 2014/2015-216, will be presented. We will focus in the presentation of the different types of gravity waves (morphology as seen in the airglow images), their observed parameters and propagation directions, and some examples of case studies on mesospheric fronts.

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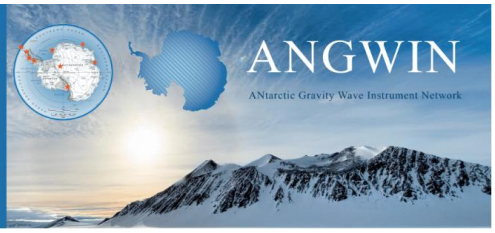

CHARACTERISTICS OF EQUATORIAL PLASMA BUBBLES OBSERVED BY TEC MAP OVER SOUTH AMERICA

[1] Barros, Diego; [2] Takahashi, Hisao; [3] Wrasse, Cristiano M., [4] Figueiredo, Cosme A. O. B.

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ABSTRACT

Equatorial plasma bubbles (EPBs) are large-scale irregularities that occur in the equatorial ionosphere under particular electro dynamical conditions during the sunset to evening period. Ground-based networks of GNSS receivers have been used to monitor EPBs by mapping the total electron content (TEC map). Using TEC map analysis and keogram for the data obtained during the period from November/2012 to January/2016, it was possible to characteristics of the EPBs as: (1) the latitudinal gradient in both zonal drift velocities and inter-bubble distances, (2) extension and apex height, and (3) inclination against the geomagnetic field lines. Comparison of these characteristics with the Fabry-Perot interferometer data and the HWM14 model showed that they are strongly related to thermospheric wind behavior.

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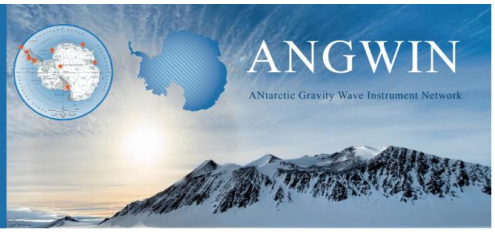

INFLUENCE OF THE ANTARCTIC OZONE HOLE ON THE SOUTHERN REGION OF BRAZIL IN THE LAST 11 YEARS

[1] Bittencourt, Gabriela D.; [1] Pinheiro, Damaris K.; [1] Lopes, Bibiana C.; [2] Bageston, José V.; [3] Peres, Lucas V.; [2] Schuch, Nelson J.

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ABSTRACT

The Antarctic Ozone Hole (AOH) is a cyclical phenomenon occurring during the austral spring, where a temporary reduction in ozone content is observed in the Antarctic region. However, ozone-depleted air masses can break away from the Ozone Hole and reach mid-latitude regions such as the southern region of Brazil, known as the Secondary Effect of the Antarctic Ozone Hole. Thus, the objective of this work is to show the behavior of the stratospheric and tropospheric dynamics during the occurrence of this type of event. The identification of the events of influence the AOH on the southern region of Brazil was done through analysis of 11 years of daily average data, the total ozone column was analyzed through the Brewer Spectrophotometer (MKIII # 167) and also data from the OMI satellite was used. In the analysis of stratospheric and tropospheric fields, reanalysis data available from the ECMWF and stratospheric fields were used at four different isentropic potential temperature levels (475 Kelvin, 530 K, 600 K and 700 K). Besides the preparation of tropospheric fields also using reanalysis data. Thus, it was possible to confirm the occurrence of events influence of the AOH that reached the southern region of Brazil for the period of 11 years of data studied here (2006 to 2016). Most of the AOH side effects events in southern Brazil (~ 38%) were identified in October, followed by September (~ 32.3%). The climatology of the stratospheric fields showed a decrease in the potential vorticity in October and November, whereas the anomaly fields showed a predominance of positive anomalies, mainly in the southern region of Brazil in the months of analysis. In addition, the events showed a predominance of occurrence after the passage of frontal systems (~ 68% of the cases) over the southern region of Brazil, and with the presence of jet stream (polar or subtropical, ~ 91% of cases).

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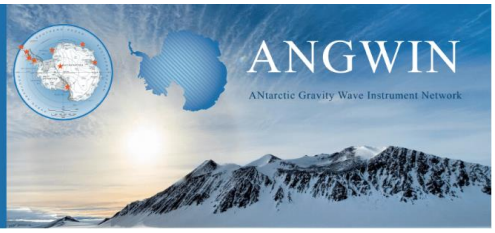

EXPLORING GRAVITY WAVE CHARACTERISTICS OVER THE SOUTHERN ANDES AND SOUTH GEORGIA ISLAND

[1] Corwin, Wright; [1],[2] Neil Hindley; [1] Nick Mitchell; [3] M. Joan Alexander; [4] Dave Fritts; [5] John Gille; [6] Lars Hoffman; [2] John Hughes; [7] Diego Janches; [8] Tracy Moffat-Griffin*; [1] Andrew Moss; [2] Andrew Ross Simon Vosper

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[8] British Antarctic Survey, UK
[9] Met Office, UK

ABSTRACT

Atmospheric gravity waves are one of the most significant dynamical processes in the middle atmosphere. In particular, they are critically involved in polar stratospheric cloud formation, the development of the southern polar vortex, and the 'cold pole problem', a major issue in weather and climate models where the temperature of the polar stratosphere is consistently heavily biased. However, these waves are highly challenging to observe and study. In this talk, I will present observations and model results from this region, using a range of satellite, balloon and ground-based instruments. In particular, I will focus on the Southern Andes and South Georgia Island, two of the largest wave source in the region. Our results highlight the major advantages new observational techniques provide to understanding atmospheric dynamics in this and other regions.

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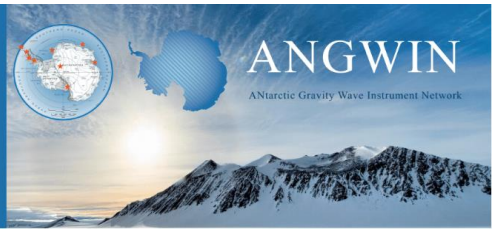

IONOSPHERIC INVESTIGATIONS AT COMANDANTE FERRAZ BRAZILIAN ANTARCTIC STATION

[1] Correia, Emília

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[2] Center of Radio Astronomy and Astrophysics Mackenzie (CRAAM), Mackenzie University, São Paulo, Brazil

ABSTRACT

The long term study of the ionospheric behavior obtained from measurements using radio techniques has been used to characterize the impact of space weather in the atmosphere at Comandante Ferraz Brazilian Antarctic Station (EACF). At EACF, the ionospheric conditions started to be investigated on 1984 using very low radio frequency (VLF) signals, afterwards was improved with the installation of a dual frequency GPS receiver on 2003 and an ionosonde and riometers on 2009. The multi-instrument observations permit characterize the ionospheric electrodynamics from 60 to ~400 km. The long term VLF and GPS data measurements have shown how the ionosphere is driven by the 11-year solar radiation variation and its seasonal variation. Special attention has been given to VLF studies, which have shown that the bottom of ionosphere is strongly affected by atmospheric waves of tropospheric and stratospheric origin, particularly by the planetary waves during the winter. The effect of gravity waves just started to be investigated using the amplitude of VLF signals propagating in two different paths crossing the Drake Passage in the Antarctica Peninsula, which preliminary results are showing a close association with the airglow observations done at EACF. The recent main results of the ionospheric investigation done at EACF will be presented.

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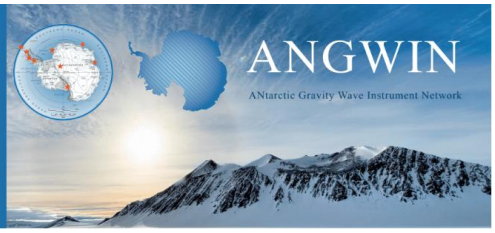

IONOSPHERIC ANOMALIES ASSOCIATED WITH EARTHQUAKES

[1] D´Amico, Dino E.; [2] Correia, Emilia

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ABSTRACT

The objective of this research is to identify the occurrence of ionospheric irregularities before earthquakes occurring using total electron content (TEC) data obtained with global satellite navigation systems (GNSS). Anomalies of TEC have been observed several days before earthquakes, when it can present a value higher or lower than the values obtained under normal conditions. In addition, gravity waves associated with seismic activity have also been observed in TEC measurements. Here we will present the one-month investigations of TEC data and gravity waves prior to the August 24, 2011 earthquake, which was of intensity 6 on the Richter scale, and which occurred in Peru almost on the border with Acre in Brazil. The objective of this study is to identify possible ionospheric precursors of this earthquake. The preliminary analysis of the TEC data suggests positive and negative anomalies occurring 20 to 5 days before the date of the earthquake, which suggest a good correlation with previously reported evidence from ionospheric observations made using VLF technique (propagation of radio waves from low frequency).

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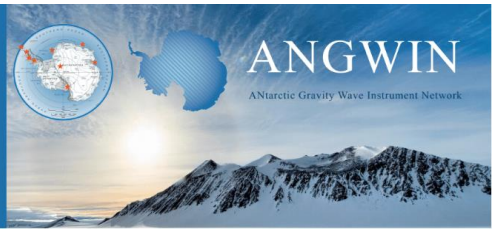

NONLINEAR INTERACTION BETWEEN AN ULTRAFAST KELVIN WAVE AND THE DIURNAL TIDE AND THEIR EFFECTS ON THE MLT AIRGLOW

[1] Egito, Fabio; [2] Buriti, Ricardo Arlen; [3] Medeiros, Amauri Fragoso; [4] Takahashi, Hisao

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[2] Universidade Federal de Campina Grande UFCG), Campina Grande, Brazil
[3] Universidade Federal de Campina Grande UFCG), Campina Grande, Brazil
[4] National Institute for Space Research (INPE), São José dos Campos, Brazil

ABSTRACT

From ground-based airglow and neutral wind measurements we investigated the presence of an ultrafast Kelvin wave (UFKW) and its interaction with the diurnal tide in the MLT. We identified sings of a nonlinear interaction between the ultrafast Kelvin UFKW and the diurnal tide. The amplitude of the diurnal tide was found to be modulated by the 3.5-day UFKW. A 1.33-day secondary wave was observed and found to propagate upward with a vertical wavelength of approximately 44 km, which may allow it to penetrate into the ionosphere. Additionally, the nonlinear interaction, by changing the tidal amplitudes, may have modified the observed airglow variability in the scale of days.

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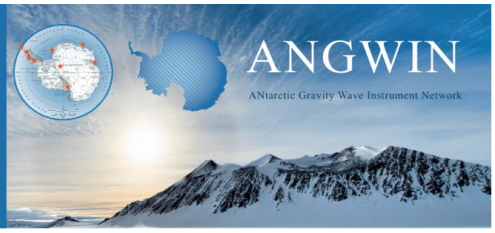

LATITUDINAL DIFFERENCES OF MEDIUM-SCALE TRAVELING IONOSPHERIC DISTURBANCES OBSERVED OVER ANDES MOUNTAINS

[1] Figueiredo, Cosme A. O. B.; [1] Takahashi, Hisao; [1] Wrasse, Cristiano Max; [1] Barros, Diego; 2 Otsuka, Yuichi; [2] Shiokawa, Kazuo.

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ABSTRACT

Traveling Ionospheric Disturbances (TIDs) are fluctuations in the ionospheric plasma, influenced by gravity waves originated from several sources, e.g., convective storms, earthquakes, orography, auroral heating and others. The occurrence of the TIDs was monitored by detrended Total Electron Content (dTEC) maps observed by ground-based GNSS (Global Navigation Satellite System) receiver networks in Andes region. This presentation will address the latitudinal, time occurrence and seasonal differences of TIDs, and compare it with the results already published in South America.

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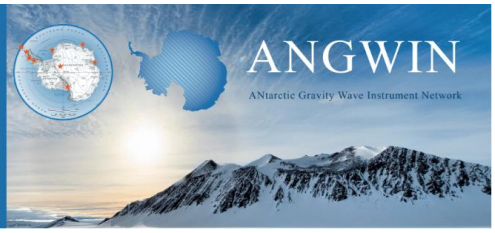

PROPAGATION ANALYSIS OF MESOSPHERIC GRAVITY WAVES ON OH AND OI-557.7NM AIRGLOW LAYERS OVER KING SEJONG STATION, ANTARCTIC PENINSULA.

[1] Hosik Kam, [1] Yong Ha Kim, [2] Takuji Nakamura, [2] Masaki Tsutsumi, [2] Yoshihiro Tomikawa, [2] Masaru Kogure, [3] Jeong-Han Kim

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ABSTRACT

We analyzed mesospheric gravity waves in OH and OI 557.7 nm airglow images which were observed by an All-Sky Camera in 2013 at King Sejong Station (62°S, 58°W), Antarctic Peninsula. Adopting a new method developed by Matsuda et al. (2014) we obtained power spectra in the horizontal phase velocity domain from airglow images sequence in unit of relative emission intensity. Mesospheric gravity wave activities are compared vertically between OH and OI 557.7 nm layers and show seasonal variation from March to October. For selected events that concurrent gravity waves have different behavior between the two layers, we analyzed background conditions such as background winds from a meteor radar and temperatures from satellites. We found events in which filtering of waves by background winds had indeed occurred between the two layers. Furthermore, we compared our results with those of Antarctic Gravity Wave Imaging/Instrument Network (ANGWIN) data (Syowa (69°S, 40°W), Halley (76°S, 69°W), Davis (69°S, 78°W), and McMurdo (78°S, 167°W)) to understand mesospheric gravity wave activity over Antarctica.

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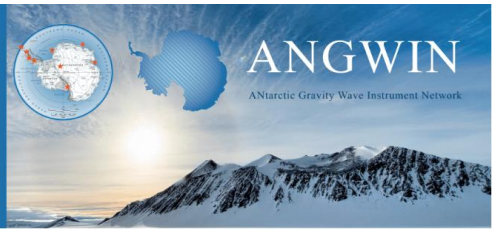

A STUDY ON NON-LINEAR INTERACTION BETWEEN TIDES AND PLANETARY WAVES IN THE MLT REGION FROM 2010 TO 2017 OVER KING SEJONG STATION, ANTARCTICA

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ABSTRACT

King Sejong Station (62.22°S, 58.17°W, KSS) is located near the tip of Antarctic Peninsula, where strong activity of atmospheric waves is known. Atmospheric waves are prominently observed in the mesosphere and lower thermosphere (MLT) region. We have analyzed tidal waves and planetary waves (PWs) using MLT wind data observed by a meteor radar at KSS from 2010 to 2017. We noticed that the semidiurnal tidal wave is more dominant than the diurnal tidal wave, and the semidiurnal tidal wave is stronger in austral summer than that in austral winter. PWs with periods of 8-, 16-, and 27-day were found to be active in austral winter. Through bi-spectral analysis we found evidence that nonlinear interaction occurred between the semidiurnal tidal wave and PWs. The interaction seems to generate a family of secondary waves with periods corresponding to sum and difference of those of the semidiurnal tide and PWs. We also noted amplitude variations of the semidiurnal tide with periods of PWs as consequence of the nonlinear interaction. Such nonlinear wave interaction may contribute significantly to dynamics of the MLT region over Antarctica.

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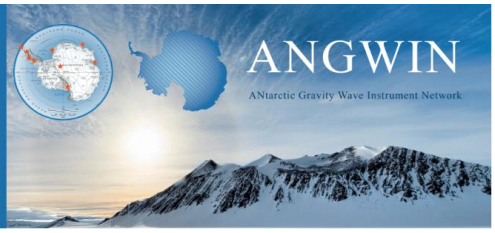

MESOSPHERIC AND LOWER THERMOSPHERIC NEUTRAL WINDS MEASURED BY FABRY-PEROT INTERFEROMETER AND METEOR RADAR AT KING SEJONG STATION, ANTARCTICA

[1] Jee, Geonhwa; [2] Lee, Wonseok; [1] Lee, Changsup; [1] Kim, Jeong-Han; [3] Wu, Qian; [2] Kim, Yong Há

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ABSTRACT

At King Sejong Station (KSS), Antarctica, the mesospheric and lower thermospheric neutral winds have been observed by the meteor radar since 2007 to investigate the characteristics of the neutral atmosphere at the tip of the Antarctic Peninsular where there is known to be a strong gravity wave activity. Recently in 2017, the observations for neutral winds was expanded to thermosphere by a Fabry-Perot interferometer (FPI) in collaboration with National Center for Atmospheric Research (NCAR). With these two observations at KSS, the mesospheric and lower thermospheric winds have been simultaneously measured by the meteor radar and the FPI, which allows us to compare two independent measurements of nighttime neutral winds in the MLT region. In this talk, we will present the preliminary results of the comparative study using a yearlong measurement during March 2017 to March 2018.

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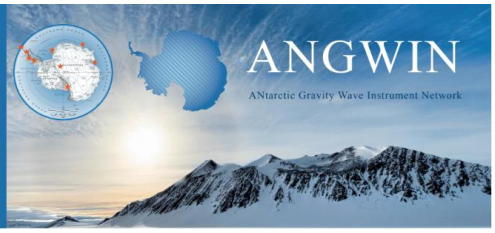

MULTI-INSTRUMENTS OBSERVATIONS OF ATMOSPHERIC GRAVITY WAVES/TRAVELING IONOSPHERIC DISTURBANCES (AGWS/TIDS) ASSOCIATED WITH ENHANCED AURORAL ACTIVITY

[1],[2] Katamzi-Joseph, Zama T.; [3] Aruliah, Anasuya L.; [4],[5] Oksavik, Kjellmar; [1],[2] Habarulema, John Bosco; [1] Kosch, Michael J.

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ABSTRACT

Atmospheric gravity waves have been observed as perturbations in the neutral density and temperatures and hence fluctuations of airglow intensity and electron density. Traveling ionospheric disturbances (TIDs) are signatures of these AGWs in the ionospheric measurements such as total electron content (TEC). In this study, AGWs/TIDs have been observed using Global Positioning System (GPS) TEC measurements and Fabry-Perot Interferometer (FPI) intensity of oxygen red line emission at 630 nm over Svalbard on the night of 6-7 Jan 2014. The TIDs from TEC data have most dominant periods ranging between 14 and 58 minutes and propagate at ~749-761 m/s with azimuth of ~345-347 deg. On the other hand, AGWs from FPI data were found to have much larger periods of ~128-174 minutes (i.e 2.1-2.9 hours). The AGWs/TIDs have been linked to enhanced auroral activity identified using co-located all sky imager and IMAGE magnetometers, which also revealed similar periods and moving at similar velocities; ~41-49 minutes and ~743 m/s from all sky imager, as well as ~31-41 minutes and ~823 m/s from IMAGE magnetometers.

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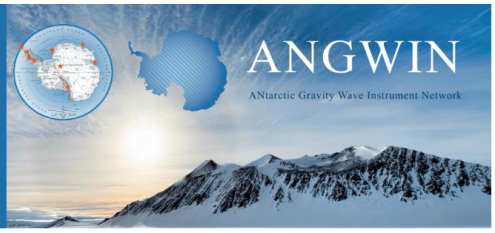

DYNAMICS OF ACOUSTIC GRAVITY WAVES AND THEIR ROLE IN THE GENERATION OF ATMOSPHERIC IONOSPHERIC DISTURBANCES

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ABSTRACT

In this work, genesis of Acoustic Gravity Waves (AGWs) from varieties of sources and their effects on the Atmosphere/Ionosphere, will be discussed. Results from Number of Numerical experiments (NEs) during seismic and convective weathers will be the focus of the presentation. These NEs offer glimpse of Atmospheric Ionospheric Disturbances produced during seismic and Convective activities. These NEs not only interpret observations but also open the possibility for early warning of natural hazards. Moreover, they also fill the gap in space at locations where observations are not available.

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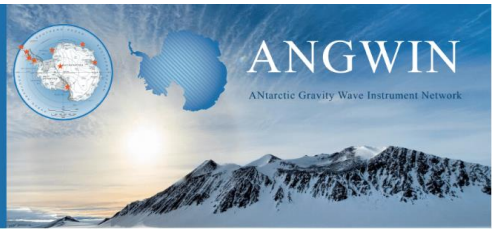

OBSERVATIONS FOR THE POLAR UPPER ATMOSPHERE RESEARCH AT KOREA POLAR RESEARCH INSTITUTE (KOPRI)

[1] Kim, Jeong-Han; [1] Jee, Geonhwa; [1] Lee, Changsup

[1] Korea Polar Research Institute, Incheon, Republic of Korea

ABSTRACT

KOPRI has been conducting a number of ground-based observations for the mesosphere and lower thermosphere (MLT) region for almost a decade at Korean Arctic and Antarctic stations. In addition, we have been expanding the observation area into the ionosphere and thermosphere in southern polar region since the 2nd Korea Antarctic station, Jang Bogo Station (JBS) was established in Terra Nova Bay (74° 37´S, 164° 12´E), which is mostly located in the polar cap region, while the first Antarctic station, King Sejong Station (KSS), is located in the subauroral region. These stations allow us to systematically monitor the upper atmosphere including the mesosphere, the thermosphere, and the ionosphere, by using various optical and radar instruments such as FTS, ASC, FPI, Meteor radar, digisonde, GPS etc.. In this presentation, we will briefly introduce our ground-based observations for the polar upper atmosphere at Korean Arctic and Antarctic stations in collaborations with several international partners as well as some preliminary results from the instruments recently installed in JBS.

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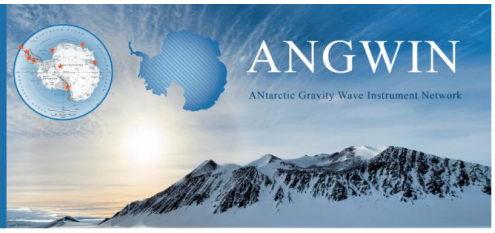

PLANETARY WAVES OBSERVED IN THE MLT REGION WITH A METEOR RADAR AT FERRAZ STATION, ANTARCTICA

[1] Lima, Lourivaldo M.; [1] Araújo, L. R.; [2] Batista, P. P.; [3] Bageston, José V.; [4] Janches, Diego; [5] Hocking, Wayne K.

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[3] National Institute for Space Research (INPE), Southern Regional Center for Space Research (CRS), Santa Maria, Brazil
[4] Space Weather Laboratory, NASA/Goddard Space Flight Center, Greenbelt, MD, USA
[5] Department of Physics and Astronomy, University of Western Ontario, London, Ontario, Canada

ABSTRACT

Wind measurements from meteor radar at Ferraz station (62.1°S, 58.4°W), Antarctica obtained from February 2011 to mid-February 2012, have been used to examine the planetary wave activity in the upper mesosphere and lower thermosphere - MLT region. The hourly mean winds in the altitude range from 82 to 98 km were subjected to spectral and harmonic analysis and from these analyses it was possible to identify the presence of planetary-scale oscillations. The analysis can be used to study the transient character of these planetary waves, once they have been seen to occur in intermittent bursts. The presence of planetary wave oscillations with periods around 2 and 5 days have been observed during summer, whilst in the time interval from late autumn to late spring the characteristic was the presence of waves with periods of around 10 and 16 days. The characteristics of these planetary waves identified over Ferraz station will be discussed and presented in this work.

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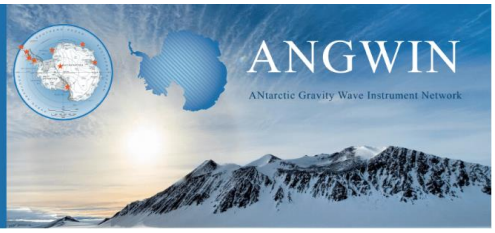

TEMPERATURE BEHAVIOR ANALYSIS DURING EVENTS OF SECONDARY EFFECT OF THE OZONE HOLE

[1] Lopes, Bibiana C.; [1] Bresciani, Caroline; [1] Bittencourt, Gabriela D.; [2] Bageston, José V.; [1] Pinheiro, Damaris K.; [2] Schuch, Nelson J.; [3] Bencherif, Hassan; [4] Leme, Neusa P.; [5] Peres, Lucas V.

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ABSTRACT

Ozone has one of the most relevant roles in the atmosphere when it comes to ultraviolet radiation absorption. Spectral range of ultraviolet radiation is from 100 to 400 nm, ultraviolet radiation type B (UV-B) ranges from 320 and 280 nm and it is known for cause harm to plants, animals and human health. Ozone reaches a high concentration in the stratosphere, between 20 and 35 km, forming a protection layer for ultraviolet radiation absorption, the "ozone layer". Its maximum concentration is located in 28 km approximately. It is evidenced that during the austral spring, between August and November, there is a severe decrease in ozone concentration, resulting in the "Antarctic ozone hole". During this period ozone levels may achieve 250 UD, which has direct consequences in the UV-B radiation levels that intensify, reaching the surface. There is evidence of effects in mid-latitudes regions, including southern Brazil, caused by the reduction in ozone concentration, which is called "Secondary effect of the ozone hole", during the events there is disturbance in the ozone levels in those regions. The main goal of the study presented here was to verify temperature behavior during the event of secondary effect of the ozone hole in the regions of Santa Maria and Uruguaiana, located in the south of Brazil. The instruments used in the analysis were a Brewer Spectrophotometer, located in São Martinho da Serra/RS – Brazil (29.53°S, 53.85°W), data from a sounding balloon, lunched from the same location, data from the satellites TIMED/SABER, AURA/MLS, and OMI-ERS.15 and a GPS-PRO as a forecast model. It was found that on October, 19th, 2016 there was a reduction in ozone concentration over the city of Uruguaiana and two days later there was a greater reduction in ozone levels in the same region. Concomitantly to the event it was registered an oscillation in stratospheric temperature which was expected to increase with height in stratosphere, had the opposite behavior. On October, 23rd the air mass poor in ozone moved from the site and the temperature in the stratosphere as well as ozone levels were normalized.

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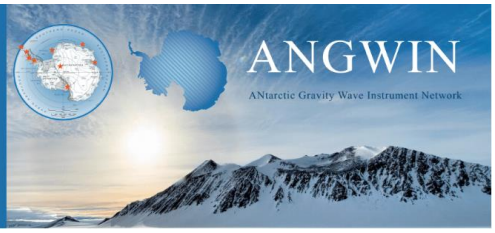

MULTI-INSTRUMENT INVESTIGATION OF TROPOSPHERE-IONOSPHERE COUPLING AND THE ROLE OF GRAVITY WAVES IN THE FORMATION OF EQUATORIAL PLASMA BUBBLE

[1] M. Sivakandan; [2] I. Paulino; [1] T.K. Ramkumar; [3] A. Taori, [1] A.K. Patra, [4] S. Sripathi; [5] K. Niranjan

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ABSTRACT

Equatorial plasma bubble (EPB) occurs in the equatorial ionosphere in pre-mid night (most of the time) as well as post-midnight (rarely) hours. The generation of EPBs by Rayleigh-Taylor Instability (RTI) due to seeding of gravity wave perturbation (polarization electric field) have well been explained theoretically by several authors but experimental evidence supporting this hypothesis is very limited. Using co-located observations from Gadanki (13.5°N, 79.2°E) an all sky airglow imager and Gadanki Ionospheric Radar Interferometer (GIRI) and Ionosonde observations from Tirunelveli (8.7°N, 77.8°E), we investigate the role of gravity waves in the generation EPB during geomagnetic quiet conditions. To avoid any changes occurring in the background ionosphere owing to the large scale features (e.g., seasonal variation), we use four consecutive nights (03-06, February, 2014). Out of these four nights on two nights we have noted very strong plasma depletions in the OI 630 nm airglow emission and radar plumes. We analyse data to identify cases where, 1) EPBs occurred with large amplitudes of mesospheric gravity waves, 2) Occurrence of EPBs without large amplitudes of mesospheric gravity waves, and 3) identifiable mesospheric gravity waves with weak EPBs occurrence. In order to calculate the mesospheric gravity wave parameter we used mesospheric OH airglow emission imager data, to identify their propagation to the E-region, we used E-region observations made using the MST radar which resembled the gravity wave signatures. Together with these, by using ray tracing techniques, we have identified the source region of the noted gravity wave events also. These results are discussed in detail in the present study.

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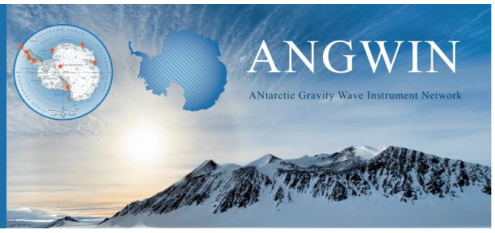

ANGWIN RESEARCH ACTIVITIES AT UTAH STATE UNIVERSITY: SUMMARY AND FUTURE PLANS

[1] M.J. Taylor, [1] P.-D. Pautet, [1] Y. Zhao, [1] V. Chambers, [1] W.R. Pendleton, Jr.

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ABSTRACT

This presentation focuses on recent research activities by Utah State University (USU) and summarizes new data and results obtained over the past 18 months since the 3rd ANGWIN Workshop at Cambridge, UK in April, 2016. As a key part of our ANGWIN contribution USU has continued to operate several high-quality airglow imaging systems at international research stations around Antarctica. These comprise four infrared InGaAs all-sky imagers located at Halley (UK), Davis (Australia), McMurdo (US) and South Pole (US), one infrared Advanced Mesospheric Temperature Mapper (AMTM) at South Pole and one multi-wavelength CCD all-sky imager at Rothera (UK). In 2017 we installed a new AMTM system at McMurdo station. This system operates alongside ongoing Fe lidar measurements (PI: X. Chu) and new meteor radar observations (PI: S. Palo) at Arrival Heights providing complementary measurement with South Pole, deep inside the Polar Vortex. Our extended 5-year gravity wave imaging program (2015-to date) continues to proceed well with new gravity wave measurements at each site (mainly since 2012). However, operations at Halley on the Brunt Ice Shelf were, unfortunately, curtailed in 2017 for safety considerations. This review will provide examples of data obtained to date together with ongoing research activities and new findings. New capabilities for enhanced collaborative research of the gravity wave "hot-spot" over South America and the Antarctic Peninsula using an AMTM recently installed at Rio Grande, Argentina, may also be discussed.

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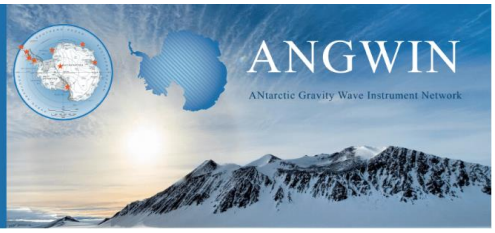

DIFFERENT PROPAGATION CHARACTERISTICS OF MESOSPHERIC GRAVITY WAVES IN SYOWA AND DAVIS, THE ANTARCTIC, USING OH AIRGLOW IMAGERS.

[1],[2] Masaru Kogure; [2],[1] Takuji Nakamura; Yoshihiro Tomikawa; [2],[1] Mitsumu K. Ejiri; [2],[1] Takanori Nishiyama; [2],[1] Masaki Tsutsumi; [3] Michael J. Taylor; [3] [3] Yucheng Zhao; [3] P.-Dominique Pautet; [4] Damian Murphy

[1] Department of Polar Science, Sokendai, Tachikawa, Japan
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ABSTRACT

Gravity waves transport momentum and energy from the lower atmosphere to the upper atmosphere, and drive the general circulation, which significantly changes the temperature in the middle atmosphere [Fritts and Alexander, 2003]. Understanding this role quantitatively will improve the modern general circulation models. The polar night jet is known to contain regions of high gravity wave (GW) activity. However, their source, propagation and intermittency are only poorly understood because of a lack of observations. To understand their source and propagation, our group has observed the gravity waves over Syowa (69°S, 40°E) using some instruments (e.g., lidar, OH imager and MF radar). We also compared the gravity waves over Syowa and Davis (69°S, 79°E), at which terrain and meteorological conditions are similar, to investigate their horizontal variation over the east Antarctic. We found, from the lidar temperature observations, that the vertical profile of gravity wave potential energy is similar between Syowa and Davis, except for a clear enhancement around 30-40 km over Davis [Kogure et al., 2017]. Horizontal propagation characteristics are more clearly observed by airglow imaging measurements of ~90 km altitude. The comparison of four imagers' results between April-May 2013 have indicated that the major propagation directions were westward at three station (Syowa, McMurdo, Halley), but at Davis GWs seems to propagate all the directions, which is totaly different from the other three. [Matsuda et al., 2017]. It seems like the GWs over Davis did not experience the same wind filtering in the middle atmosphere. The goal of this study is to compare the gravity waves over Syowa and Davis in many different ways and with more observational data. In this presentation, we will show the ground-based horizontal phase speed spectrum over the two stations derived from OH imagers in more detail. We analyzed the OH airglow imager data obtained for eight months (from March to October in 2016) over the two stations with M-transform [Matsuda et al., 2014]. We analyzed the data without clouds and aurora contaminations continuously

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for at least one hour. The numbers of nights with such data sets are 40 at Syowa and 55 at Davis. The seasonal variations of the nightly mean variance were very similar with winter maximum, but the variance over Syowa was significantly larger than that over Davis in September. The reason for a larger variance over Syowa in September was the existence of southward propagating gravity waves with the phase speed of ~10 - 80 m/s. In 2016, clear sky and aurora free data were available at both station on ten nights. Comparison of phase velocity spectra obtained on the same night showed similarity on only one night out of ten. On five nights, the spectra were quite different. On the other four nights, the spectral peaks with slow westward phase velocity (> 50 m/s) were commonly observed but additional spectral peaks were found over Davis and not over Syowa. We calculated transmission diagram, which indicates the GW phase speeds for which a GW would encounter turning and critical level [Tomikawa, 2015], and we found that the diagrams over both stations were similar. These results suggest that the difference was not caused by wind filtering or reflection. We will show these spectra and transmission diagrams, and discuss what causes the different spectra. We will, moreover, present paths of gravity waves estimated from the ray-tracing method [Dunkerton, 1984] and discuss where the gravity waves were generated.

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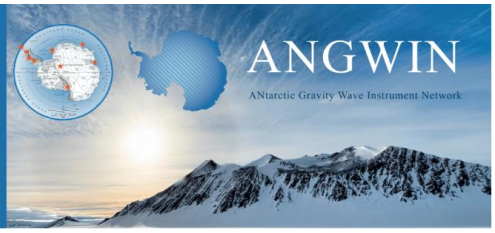

CHARACTERIZATION OF THE EFFECTS OF GRAVITY WAVES IN THE IONOSPHERE USING VLF

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ABSTRACT

Gravity Waves (GW) are mechanisms that affects the transport, circulation and thermal structure at the middle atmosphere. They are mostly investigated using airglow all-sky imagers, which give their characteristics at about 90km of height. Here we will investigate their impact on the base of ionosphere, at D-region, using very low frequency (VLF) radio measurements done at Brazilian Antarctic Station Comandante Ferraz (EACF) on King George Island. The characteristics of GW detected using VLF during 2007 is compared with air-glow observations done at EACF. The preliminary results suggest a close association of the GW properties detected using VLF with the ones observed using airglow.

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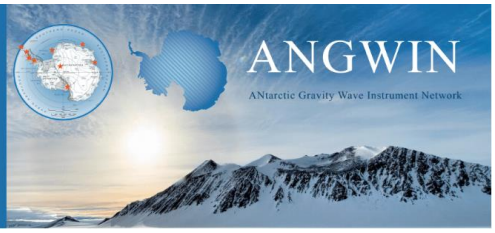

STUDYING TRAVELLING IONOSPHERIC DISTURBANCES USING GNSS OVER EUROPE AND AFRICA

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ABSTRACT

Here we will show results of the Travelling Ionospheric Disturbances(TIDs) over Europe and Africa, which are excited by the generation of gravity waves during strong and severe storms in the current solar cycle. We will trace it from High to Mid-latitudes in both hemispheres. We will show the interhemispheric differences of the ionospheric response during these events.

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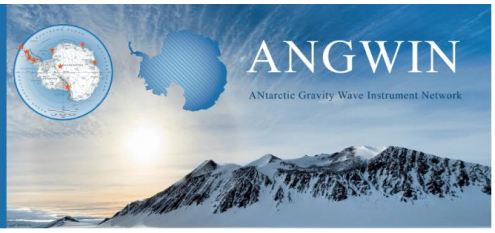

SEASONAL CHARACTERISTICS OF SMALL- AND MEDIUM-SCALE GRAVITY WAVES IN THE MESOSPHERE AND LOWER THERMOSPHERE OVER BRAZILIAN EQUATORIAL REGION

[1] Patrick Essien; [2] I. Paulino;[1] C. M. Wrasse; [2] J. A. V. Campos; [2] A. R. Paulino; [2] A. F. Medeiros; [2] R. A. Buriti; [1] H. Takahashi; [2] E. Agyei-Yeboah; [1] D. Barros; [1] C. A. O. B. Figueiredo; [1] A. N. Lins

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ABSTRACT

Present work reports seasonal characteristics of small- and medium-scale gravity waves in the mesosphere and lower thermosphere (MLT) region. All-sky images obtained from the hydroxyl (NIR-OH) airglow emission layer have been taken over São João do Cariri (7.45ºS, 36.ºW, hereafter Cariri). The observations were made from September 2000 to December 2010, with a total of 1496 nights. For investigation of the characteristics of small-scale gravity waves (SSGWs) and medium-scale gravity waves (MSGWs), we employed the Fourier two dimensional (2D) spectrum and keogram Fast Fourier Transform (FFT) techniques, respectively. From the 11 years of data, we could observe 2343 SSGWs and 537 MSGWs events. The horizontal wavelengths of the SSGWs were concentrated between 10 to 35 km, while that of the MSGWs ranged from 50 to 200 km. The observed periods for SSGWs were concentrated around 5 to 20 min, whereas the MSGWs ranged from 20 to 60 min. The observed horizontal phase speeds of SSGWs were distributed around 10 to 60 m/s, and the corresponding MSGWs were around 20 to 120 m/s. In summer, fall and winter both SSGWs and MSGWs propagated preferentially northeastward and southeastward, while in spring the waves propagated in all directions. The critical level theory of atmospheric gravity waves (AGWs) was applied to study the effects of wind filtering on SSGWs and MSGWs propagation directions. The SSGWs were more susceptible to wind filtering effects than MSGWs. The average of daily mean Outgoing Long-wave Radiation (OLR) was also used to investigate the possible wave source region in the troposphere. The results showed that in summer and fall, deep convective regions were the possible source mechanism of the AGWs. However, in spring and winter the deep convective regions did not play an important role in the waves observed at Cariri, because they were too far away from the observatory. Therefore, we concluded that the horizontal propagation directions of SSGWs and MSGWs show clear seasonal variations based on the influence of the wind filtering process and wave source location.

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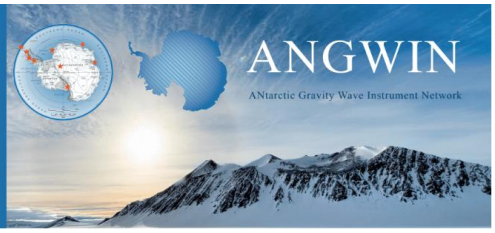

POSSIBLE INFLUENCE OF LUNAR SEMIDIURNAL TIDE IN EQUATORIAL SPREAD-F

[1] Paulino, Igo; [2] Paulino, Ana Roberta; [3] Cueva, Ricardo Yvan; [1] Buriti, Ricardo Arlen; [1] Medeiros, Amauri F.; [4] Wrasse, Cristiano M.; [4] Takahashi, Hisao

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ABSTRACT

An intensive study on the start time of equatorial plasma bubble, observed by an all sky imager deployed at São João do Cariri (7.4ºS, 36.5ºW), and equatorial spread-F, observed by a coherent back scatter deployed at São Luis (2.5ºS, 44.3ºW) was conducted from 2001 to 2009. Oscillation of 14.5 days was clearly observed in three month (September 2003, October 2005 and January 2008) in the airglow images with amplitudes of 45-60 min. Furthermore, using the data from the radar range time integration (RTI) maps, several events were observed with dominant period of 14.5 days in September 2001, November 2002, January-February 2003, October-December 2005 and November 2008. In such case, the amplitude of the oscillation were from 3 min up to 60 min. This oscillation could be related to the semidiurnal lunar tide, which appear as an important contributor to the time of occurrence of equatorial spread-F.

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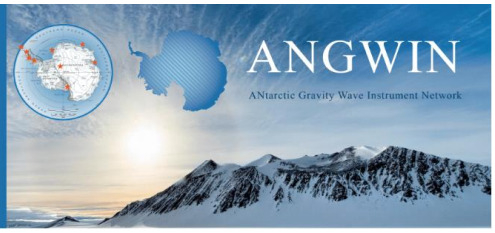

INVESTIGATION OF MESOSPHERIC GRAVITY WAVES OVER SOUTH POLE AND MCMURDO STATIONS USING TWO ADVANCED MESOSPHERIC TEMPERATURE MAPPERS

[1] Pautet, Pierre-Dominique; [1] Taylor, Mike; [1] Zhao, Yucheng

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ABSTRACT

Since 2010, Utah State University (USU) has operated an Advanced Mesospheric Temperature Mapper (AMTM) from the South Pole Station (90°S) to study gravity waves at mesospheric altitude. This instrument measures the OH (3,1) rotational temperature over a large region (~200x160 km) around 87 km altitude. It has performed extremely well each winter season, from mid-April to end of August, and has revealed the existence, even far from their typical sources, of a wealth of gravity waves with periods ranging from ~5 min to several hours. To investigate long range propagation, a second AMTM has been installed at McMurdo Station (78°S) in 2017. It automatically ran from mid-March to end of September alongside the University of Colorado Fe lidar (PI: X. Chu), providing complementary horizontal measurements. A comparison between the South Pole and the McMurdo 2017 data sets will be presented, showing possible long range propagation between the 2 sites separated by ~1300 km.

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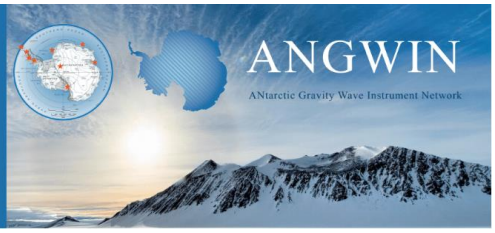

GRAVITY WAVE DUCTING OVER ANTARCTICA

[1] Pautet, Pierre-Dominique; [1] Taylor, Mike; [1] Zhao, Yucheng; [2] Murphy, Damian

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ABSTRACT

During the wintertime, the South Pole is fairly isolated from typical gravity wave sources (orography, convection, jets…), nevertheless, observations made since 2010 with the USU Advanced Mesospheric Mapper (AMTM) show an almost permanent display of short and long period gravity waves at mesospheric altitude. Some of these waves exhibit characteristics similar to bore events, which have been observed at mesopause height since the 1990s, but mostly from low and mid-latitude sites. These are usually associated with wave ducting within stable layers, which allow them to propagate over very large distances. Other frontal-type waves have also been observed over Davis Station (68.5°S) during the last 6 winters, possibly associated with isothermal layers generated by the interaction between a wave 1 structure and the background atmosphere. This presentation will give examples of these events, describe their characteristics and show that they are most likely ducted within horizontally-extensive mesospheric thermal inversion layers. These results provide important new information on the generation and propagation of gravity waves and the structure of the upper atmosphere within the Antarctic polar vortex.

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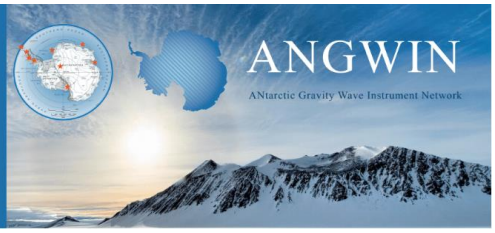

DEVELOPMENT OF A PHASE VELOCITY SPECTRAL ANALYSIS SOFTWARE PACKAGE (M-TRANSFORM) FOR AIRGLOW IMAGING DATA

[1],[3] Perwitasari, Septi; [1],[2] Nakamura, Takuji; [2],[1] Kogure, Masaru; [1],[2] Tsutsumi, Masaki; [1],[2] Tomikawa, Yoshihiro; [1],[2] Ejiri, Mitsumu K.

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ABSTRACT

Airglow imaging observation, among other ground-based techniques, has been proven to be very effective to study energy and propagation characteristics of atmospheric gravity waves (AGWs). However, the lack of sophisticated analysis methods prevented quantitative studies using huge amount data that have been collected over long period of observation. Matsuda et al. [2014] developed a new phase velocity spectrum analysis method based on 3D FFT algorithm (M-transform) to address this issue. This algorithm can efficiently deal with extensive amounts of imaging data obtained on different years and at various observation sites without bias and treat dynamical/physical effect of AGWs by precisely reflecting amplitude, area and lifetime of each AGW event. Based on Matsuda et al. [2014] method, we have developed a simple and user-friendly function to be used in IDL. The input of this program is a three dimensional array of a time series of 2-D image array where the wave parameters (e.g. horizontal wavelength (λh), wave period (τ), phase speed (c), image resolution in space (dx, dy) and time (dt)) can be customized by the user in one-line command to execute the program. Various simulations by using artificial wave images as test data have been done in order to exhibit the new program's performance and the characteristics/interpretation of the spectral analysis. The simulation was done by using test data with different time resolution (dt=1 min, 3 min, 5 min and 7 min), wave packet size (FWHM=50, 100 and 200 km), wave packet duration (30 min, 60 min and 120 min) and by changing the horizontal wavelength and wave periods with a fixed phase speed (40 m/s). In addition, by using observational data from Syowa station we conducted an investigation how waves with different horizontal wavelengths behave independently. We divided the horizontal wavelength into three categories: 5< λh

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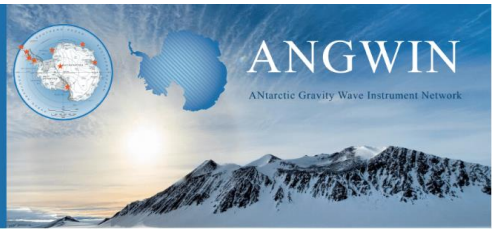

STUDY OF IONOSPHERIC RESPONSE TO ANNULAR AND PARTIAL SOLAR ECLIPSE OF 29 APRIL 2014 IN ANTARCTICA AND AUSTRALIAN REGIONS

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ABSTRACT

An annular and partial solar eclipse was observed on 29 April 2014 over Australian and Antarctic regions. In this study we have analyzed the ionospheric response of this solar eclipse event. We have done a comprehensive study to find out the changes that occurred in various ionospheric parameters during the solar eclipse event over Australia and Antarctic region. We selected four Australian stations Brisbane (27.5°S, 152.9°E), Canberra (35.3°S, 149.1°E), Hobart (42.9°S, 147.3°E) and Perth (31.955°S, 115.859°E) as well as one Antarctic station Mawson (70.6455°S, 131.2573°E). We have studied the changes in the E and F ionospheric layers using the ground based observations at these stations. From our analysis we found that there occurred a decrease in the critical frequencies of sporadic E ($foEs$) and F ($foF2$) layers during the time eclipse was in progress at all the four Australian stations while as at Antarctic the value of $foF2$ recorded an enhancement. At the same time an increase in the corresponding heights of these layers ($h'Es$, $h'F2$) was also observed.

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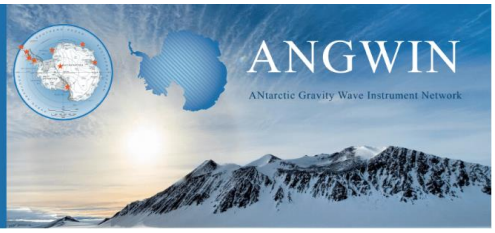

DETERMINATION OF GRAVITY WAVES PARAMETERS IN THE AIRGLOW COMBINING PHOTOMETER AND IMAGER DATA

[1],[2] Prosper K. Nyassor; [1] Ricardo Arlen Buriti; [1] Igo Paulino; [1] Amauri F. Medeiros; [2] Hisao Takahashi; [2] Cristiano M. Wrasse; [2] Delano Gobbi

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ABSTRACT

Mesospheric airglow measurements of two or three layers were used to characterize both vertical and horizontal parameters of gravity waves. The data set was acquired coincidentally from a Multi channel filter (Multi-3) photometer and an all-sky imager located at São João do Cariri (7.4°S, 36.5°W) in the equatorial region from 2001 to 2007. Least Square fitting and wavelet analysis techniques were used to determine the phase and amplitude of each observed wave as well as the amplitude growth. The dispersion relation of gravity waves was used to estimate the vertical and the horizontal wavelength and then compared to the wavelength obtained from the keogram analysis of the images observed by the all-sky imager. Results from the study showed that both the horizontal and vertical wavelengths obtained from the dispersion relation and keogram analysis agree very well for the waves observed on the nights 14th October and 18th December 2006. The determined parameters showed that the observed wave on the night of 18th December 2006, had a period of ~ 43.8 ± 2.19 min with the horizontal wavelength of 235.66 ± 11.78 km having a downward phase propagation, whereas that of 14th October 2006 propagated with a period of ~ 36:00 ± 1:80 min with a horizontal wavelength of ~ 195 ± 9.80 km, and having an upward phase propagation. The observation of a wave taken by a photometer and an all-sky imager, allowed to conclude that the same wave could be observed by both instruments permitting the investigation of the 2-dimensional wave parameter.

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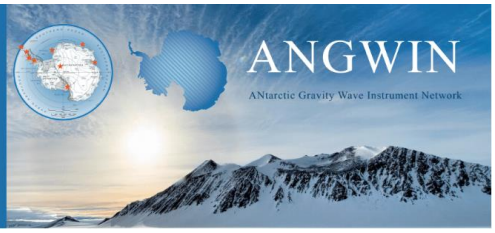

RETRIEVAL OF INTRINSIC GRAVITY WAVE PARAMETERS FROM LIDAR AND AIRGLOW TEMPERATURE DATA AND RADAR WIND DATA

[1] Reichert, Robert; [1] Kaifler, Bernd; [1] Rapp, Markus; [2] Pautet, Dominique; [2] Taylor, Mike; [3] Kolovsky, Alexandre; [4] Lester, Mark

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[2] Utah State University, Logan
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[4] University Leicester, United Kingdom

ABSTRACT

Momentum transport by atmospheric gravity waves represents an important coupling mechanism in the middle atmosphere with strong effects on the energy budget and circulation. Till now the behavior of discrete GWs has been investigated by applying bandpass filters to temperature time series of lidar and airglow temperature data and extracting observed periods. The resulting temperature perturbations have been interpreted as wave packets, where changes in amplitude were considered as a sign of either gravity wave breaking or the wave packet moving out of the observation volume. This interpretation is certainly valid in some cases, but not necessarily true in general. We show that Doppler shifting of intrinsic wave periods caused by variations in the background wind (e.g. tides) can result in disappearance of large scale wave packets in bandpass filtered time series. We use co-located lidar temperature, airglow imager and meteor radar observations acquired from Sodankylä, Finland, during the winter 2015/16, as a part of the GW-LCYCLE2 campaign and derive intrinsic gravity wave parameters as well as propagation directions. Assuming that retrieved intrinsic parameters change slowly with height, time and geographic location, we calculate the Doppler shift as a function of space and time. Using this information, we adapt the passband of our spectral filter to follow the Doppler shift at each point in space and time. This new analysis method allows us to identify single wave packets in lidar and airglow data which undergo strong Doppler shifting and therefore show up as multiple wave packets using traditional filtering methods. Using our new analysis method we see fewer wave packets which however persist over longer times. Our conclusion is that wave packets in the upper mesosphere are more coherent in space and time than previously thought. This may have an impact on the expectable intermittency of gravity waves and their parameterizations in circulation models.

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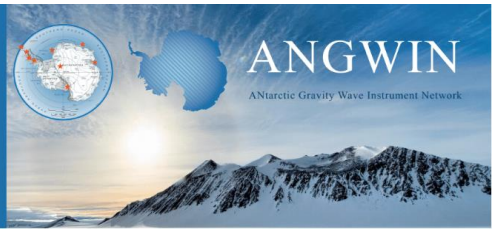

SOLAR SPECTRAL IRRADIANCE (SSI) FROM CODET MODEL AND THEIR RELATION WITH EARTH'S UPPER ATMOSPHERE

[1] Rodrígue Góme, Jenny Marcela; [1] Vieira, Luis Eduardo; [1] Dal Lago, Alissson

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ABSTRACT

The Solar Spectral Irradiance (SSI) influences the Earth's atmosphere for each wavelength in different altitudes. The EUV emission has a considerable impact on the Earth's upper atmosphere, i.e., on the density, temperature, and total electron content (Haberreiter et al. 2014; Schmidtke 2015). Recently was developed a model called CODET (Rodríguez Gómez et al. 2018). This model uses a flux transport model. It employed line-of-sight magnetic field data from SOHO/MDI and SDO/HMI full-disk magnetograms. The data are assimilated into the flux transport model to describe the dynamics of the solar photosphere. These data are then used as boundary conditions for a series of potential-field source-surface (PFSS) extrapolations to obtain the structure of the coronal magnetic field. Additionally, we use an emission model based on the CHIANTI atomic database 8.0. The CODET model has, as an output, the SSI in the EUV band (19.3 and 21.1 nm) from the photospheric magnetic field evolution over solar cycles 23 and 24. These SSI series can be used as an input parameter in ionospheric models.

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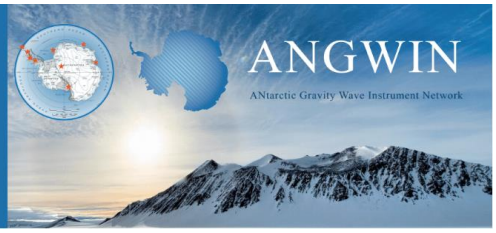

STUDY OF IONOSPHERIC TEC VARIABILITY OVER LOW, MID AND HIGH LATITUDES AND ITS COMPARISON WITH IRI-2012 AND IRI-2016 MODEL

[1] Roshni Atulkar; [1] P.K. Purohit

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ABSTRACT

Total electron content (TEC) is a key of ionospheric parameters which is defined as the total number of electrons present within a cross-section 1 m2 along the integrated path from the satellite to the receiver. TEC describes the major impact of the ionosphere on the propagation of radio waves which is crucial for terrestrial and Earth space communication including Global Positioning System (GPS). For this analysis we used dual frequency GPS observations at low, mid and high latitude stations IISC, Bangalore,India (13.02°N, 77.57°E), GUAO, Urumqi, China (43.82°N, 87.60°E) and NYAL, NY-Alesund, Norway (78.92°N, 11.86°E) respectively; we used one year of data for a high solar activity period of 24th solar cycle, i.e. during January 2012 to December 2012. From our analysis we observed that GPS-TEC achieves its highest values during the months of October and March at low latitude, during the months of April and May at mid latitude and during September and March at high latitude while the lowest values of TEC were recorded at all the stations in December. Almost a linear relationship between ionospheric GPS-TEC with IRI-2012 and IRI-2016 was observed at low and mid latitude stations; however, high latitude TEC does not show any signi_cant relation to IRI 2012 and IRI 2016 TEC. This research obtains a practical approach to study the ionospheric variability at low, mid, and high latitude and compares with the latest IRI-2012 and IRI-2016 models during the high solar activity period 2012.

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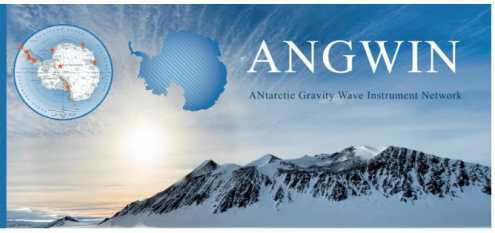

A SURVEY OF MESOSPHERIC FRONTAL EVENTS OBSERVED AT DAVIS STATION ANTARCTICA (68 °S, 78 °E) DURING THE PERIOD 2002-2012

[1] Rourke, Sharon; [1] Mulligan, Frank J.; [2] Pautet, Dominique; [2] Taylor, Michael J.; [3] French W.J.R; [3] Murphy, Damian

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ABSTRACT

Mesospheric bores or wall events have been observed frequently at low- and mid-latitudes, but high-latitude events are not nearly as well documented. An 11-year (2002-2012) database of infrared (1.0 - 1.6 um) images of the night sky recorded by a scanning radiometer deployed at Davis Station, Antarctica (68°S, 78°E) has been surveyed as a contribution towards filling this gap. The images are limited to a very small region (24 km x 24 km) in the zenith with a 1-minute cadence. Verifying the passage of a mesospheric front with this limited field-of-view presents a particular challenge. Images from a second instrument (from Utah State University) observing within the same wavelength region since 2012, but with an all-sky field-of-view, have been used to study a small number (5) of individual bore events in detail. Wind data from the MF radar on site at Davis and temperature profiles from the SABER instrument have been used to characterise the atmosphere at the times of the frontal events. The results of these case studies have enabled us to develop an approach to search the very large number of images available from the radiometer for other potential mesospheric frontal events.The search technique has identified up to 278 potential frontal events in the period 2002-2012. In addition to the five case studies mentioned above, the results of five of these potential events were also examined in detail. Thermal inversions appear to be the primary ducting mechanism for all ten case studies, with just two out of the ten events having a partial Doppler duct. Phase speeds, wavelengths, periods and persistence of the potential mesospheric fronts show similar distributions to the entire database of band-type gravity waves, and these characteristics do not appear to vary substantially with season. Propagation directions tend to be either eastward or westward, which differs from the pattern found in the entire dataset. The frequency of occurrence of potential mesospheric frontal events seems to have a maximum in July/August in agreement with other high-latitude reports. One interpretation is that this is related to the coincident maximum in planetary wave activity on the Eastern Antarctic continent.

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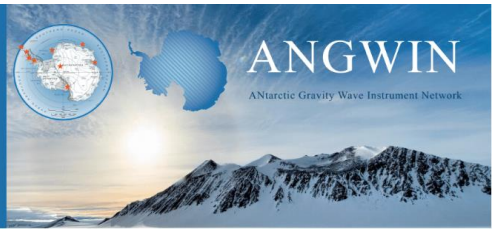

LONG-WAVE PROPAGATION IN THE LOWER THERMOSPHERE AND ITS RESPONSE TO THE IONOSPHERIC F LAYER OVER BRAZILIAN EQUATORIAL REGION

[1] S.O. Lomotey; [2] R. A. Buriti; [2] I. Paulino[1]; [2] A. F. Medeiros; [3] J. J. Makela; [4] J. W. Meriwhether; [1] D. Barros

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ABSTRACT

This research is focused on the study on planetary wave oscillations (PW) observed in the lower thermosphere. The Fabry-Perot Interferometer (FPI) is a passive optical sensing instrument used to estimate thermospheric winds and temperature. The data used in this paper were captured by the FPIs which are located at São João do Cariri (7.4°S, 36,5°W) and Cajazeiras (6,9°S, 38,6 ° W) . A comparison to the ionospheric F-layer virtual height (h'F) located at Fortaleza (3.8°S, 38.6°W) was done. This research aims at looking for periodicities in the wind measurements with periods longer than few days in both components of wind. This was done by using airglow emission of Atomic Oxygen OI 630.0 nm the red line during the nighttime, i.e., from 20:00 to 03:00 local time (LT). Lomb-Scargle analysis was used to process the thermospheric winds and temperature. Phases and amplitudes of these oscillations were estimated by using Least Square fitting method (LSF). Almost all of periodicities of propagation of planetary waves were above 2 days. Strong oscillations of 6 days were observed from September to December 2013.

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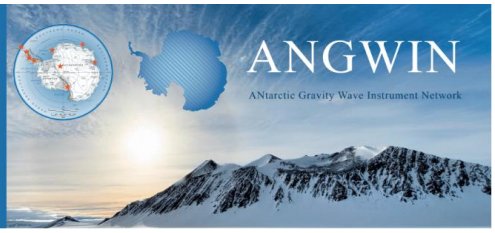

CUBESAT WITH CYLINDRICAL LANGMUIR PROBES TO CHARACTERIZE IONOSPHERE AND THERMOSPHERE PLASMA

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ABSTRACT

CubeSat specifications to indorse and develop the services necessary for the design, manufacture, and testing of small satellites intended for low Earth orbit (LEO) that perform a number of scientific research purposes and explore new space technologies. Nobel Laureate Irving Langmuir pioneered the use of electrostatic probes to measure the electron temperature, number density, floating potential, and plasma potential in ionized gases (in the 1920's). Langmuir probe is comprised of an exposed conductor (e.g., wire) immersed within a plasma. The theory of interpreting the data acquired (namely the current drawn from the plasma at a sequence of different bias voltages) from Langmuir probes is well established. Druyvesteyn noted that the second derivative of the probe current with respect to the bias voltage is proportional to the electron energy distribution function. The analysis by Laframboise enabled accurate evaluation of experimental data for cylindrical and spherical probes regardless of sheath size. PEPL makes extensive use of planar and cylindrical Langmuir (single, double, and triple) probes for evaluating plasma properties in the plumes of thrusters and in near electrode regions. The small size of typical Langmuir probes coupled with their relatively simple theory of operation make them an indispensable and widely used plasma diagnostic. We can constructs custom probes sized to each experiment, commercially available systems do exist. This research paper explore the reliability, validity and susceptibility of small dimensional Langmuir Probe in CubeSat and Pico-Satellite for Ionosphere Characterizations. There is no general theory of Langmuir probes which is applicable to all measurement conditions, because it depends on the probe size and geometry, plasma density and temperature, platform velocity, and other factors. The actual design of the probe is usually determined by considering the relationship between the probe dimensions and the Debye length of the plasma.

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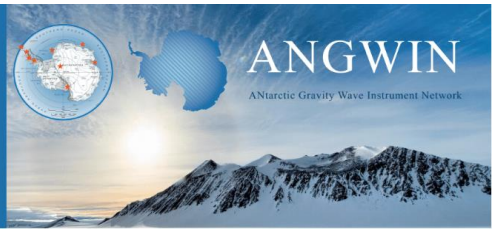

IONOSPHERIC UPFLOW AROUND THE POLAR REGION DURING A SOLAR MINIMUM

[1] T.W. David, D.M. Wright and S.E. Milan, S.W.H. Cowley, J. A. Davies and I. McCrea

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ABSTRACT

EISCAT Svalbard Radar data, obtained during the International Polar Year 2007 campaign, has been used to study ionospheric upflow events with a threshold of ⟦10⟧^13 m^(-2) s^(-1). This study reports the incidence and seasonal variability of ion upflow events classified into low, medium, and high-flux upflows. It is observed that high upflow fluxes are comparatively rare and low flux upflow events are a frequent phenomenon. These classes of ion upflows from the high latitude of Svalbard (78°N) show that occurrence peaks around local noon at 31%, 16%, and 2% for low, medium, and high-flux upflow, respectively, during geomagnetically disturbed periods. Analysis shows that in agreement with previous studies on upflow fluxes, ion upflow occurs over a wide range of geomagnetic conditions, with upflow flux occurrence being greater than downflow occurrence. In contrast to previous observations, however, the upflow occurrence is greater around noon during highly disturbed geomagnetic conditions than for moderate geomagnetic conditions. Moreover, the seasonal distribution shows a high-flux upflow that is peaked around local noon in the summer, a low-flux upflow that is broadly distributed across all seasons at any geomagnetic activity conditions, and a medium-flux upflow showing occurrence peak driven by high Kp across all seasons.

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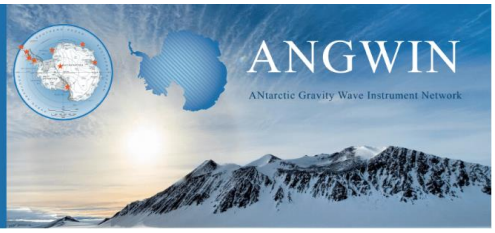

IONOSPHERIC DYNAMICS OVER SOUTH AMERICA OBSERVED BY TEC MAPPING

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ABSTRACT

Equatorial Plasma Bubbles (EPBs) and Medium Scale Travelling Ionospheric Disturbances (MSTIDs) have been monitored by Total Electron Content Map (TECMAP) observed by ground based GNSS (Global Navigation satellite System) receiver networks in South America. We observed that daytime MSTIDs are frequent during the period from March to September while EPBs are frequent during the period of September to March, just in an opposite phase in each other. Investigating the same day occurrence of MSTID and EPBs, however, we found that there is a close relation between the inter-bubble distance and horizontal wavelength of MSTID, suggesting contribution of MSTID in generating the EPBs. TECMAPs during intense geomagnetic storms revealed latitudinal propagation modes of Large Scale Travelling Ionospheric Disturbance (LSTID) and non-symmetric propagation feature between the Northern and southern hemispheres.

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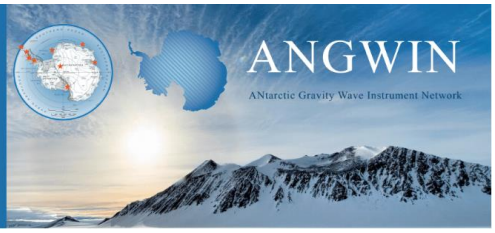

GRAVITY WAVES IN THE LOWER ATMOSPHERE ABOVE SOUTH GEORGIA (54S, 36W)

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ABSTRACT

Recent studies have shown that isolated mountainous islands in regions of strong winds can be intense sources of gravity waves that can have climatologically-significant effects on atmospheric circulation. However, most climate and numerical weather prediction models cannot accurately model waves from such small, intense island sources because the islands are too small compared to the resolution of the models - this is the "small island problem". The South Georgia Gravity Wave Experiment (SG-WEX) is a NERC funded observational and modelling experiment to determine the nature and impacts of gravity waves generated by South Georgia (a small mountainous island in the Southern Ocean). It is a collaboration between Bath University, BAS, Leeds University and the Met Office.
This talk will use primarily radiosonde data to examine the properties and sources of gravity waves observed in the lower atmosphere.

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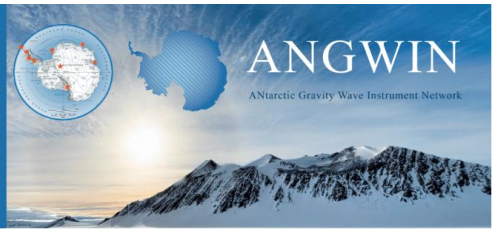

THERMOSPHERIC NIGHTIME MSTIDS OBSERVED BY AN ALL-SKY IMAGER AT COMANDATE FERRAZ ANTACTICA STATION (62 S)

[1] Wrasse, Cristiano Max; [1] Figueiredo, Cosme Alexandre Barros; [1] Takahashi, Hisao; [1] Bajeston, José Valentin; [1] Barros, Diego; [1] Gobbi, Delano; [2] Paulino, Igo

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ABSTRACT

Periodic MSTIDs have been observed at Comandate Ferraz Antactica Station (n (62.1°S, 58.4°W) during the winter time of 2015 and 2016, using OI 630.0 nm airglow images. MSTIDs presented a horizontal wavelength between 100 and 200 km, a period ranging between 15 and 45 minutes, the phase velocity of 30 to 180 m/s, and propagation directions mainly to West-Northeastward. The results were compared to previous ones obtained by Paulino et al (2016) and Figueiredo et al (2018) for low latitudinal stations The anisotropy observed in the periodic MSTID propagation direction will be discussed in term of the wind filtering mechanism and location of the source.

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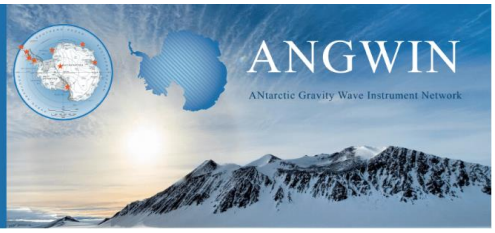

FIRST COORDINATED AMTM AND FE LIDAR MEASUREMENTS AT MCMURDO, ANTARCTICA

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[2] Cooperative Institute for Research in Environmental Sciences, Colorado University, Boulder, USA

ABSTRACT

Early last year, as part of the Antarctica Gravity Wave Instrument Network (ANGWIN) program, a Utah State University (USU) Advanced Mesospheric Temperature Mapper (AMTM) was installed at the McMurdo station (78°S), co-located with the Colorado University's Boltzmann Fe lidar system which was deployed in 2011. During the first winter season, the AMTM has been collecting high quality nighttime OH (3,1) band intensity and rotational temperature from March to September. The Fe lidar system was operating on campaign bases throughout the year. In this study, we compare the limited coincident Fe lidar temperature and AMTM zenith temperature measurements from last southern hemisphere winter season by height weighting the Fe lidar temperature profiles. As a case study, we are trying to use these two temperature measurements to derive the possible OH layer peak altitudes for this high latitude site during the winter season.

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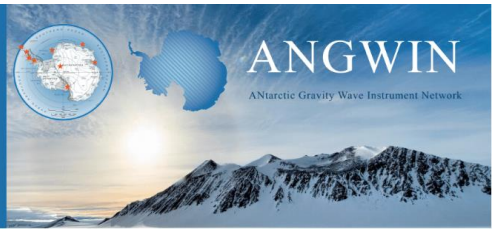

INVESTIGATING MESOSPHERIC WAVE ACTIVITIES AT HIGH LATITUDE STATIONS AND SOUTH POLE

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ABSTRACT

The Utah State University (USU) Advanced Mesospheric Temperature Mapper (AMTM) is a novel instrument designed for high latitude mesospheric IR (1.5 micron) OH (3,1) rotational temperature and band intensity measurements with the present of aurora. As part of the Antarctica Gravity Wave Instrument Network (ANGWIN) program, two AMTMs were deployed at South Pole station (90°S, since 2011) and McMurdo station (78°S, since 2017). Another AMTM was located at the ALOMAR Arctic Observatory (69°N), Norway (2011-2017) which was moved to Fairbank, Alaska (65°N) last fall. The locations of these high-latitude sites relative to the winter polar vortex are unique with the South Pole Station located deep inside the polar vortex. Spectral analysis of the zenith temperature and intensity data from these polar sites have revealed a rich spectrum of gravity waves and planetary waves, with minimal tidal activity at the pole. In this paper, we compare the winter-time wave activities from these sites using the temperature and OH band intensity measurements. In particular, we focus on the similarities and differences in the intra-seasonal variations of the gravity waves and planetary waves, and their year-to-year variability as measured at these geophysically distinct sites. Our goal is to gain new knowledge on the impact of the vortex on waves in the upper mesosphere.

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