Observing Gravity Waves By Analyzing Mean Winds Over Jicamarca, Peru, Found From 50MHZ Radar At JRO

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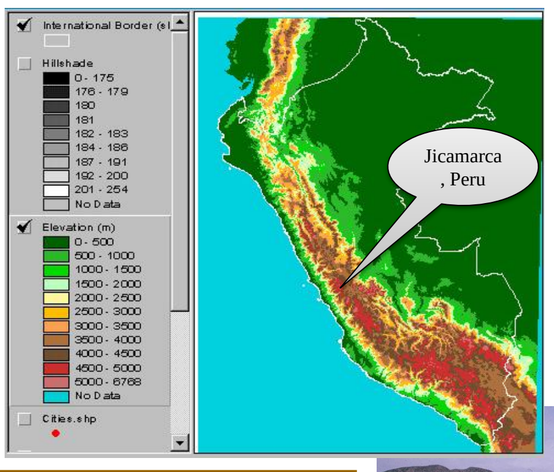
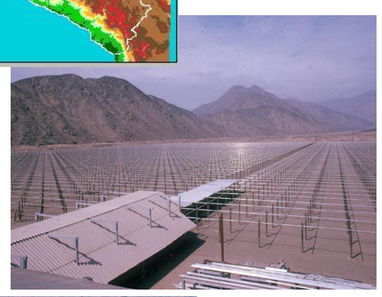
Abstract

The mean wind velocities in the zonal, meridional, and vertical directions have been over Jicamarca using Incoherent and Coherent Scatter Radar Modes of the 50MHz radar at the Jicamarca Radio Observatory (lat. 11.95°S, long. 76.87° W) since 1974 [Woodman & Guillen, 1974] and the first set of mean winds analysis in the tropical stratosphere and mesosphere was published by Hitchman et al., 1997. We use the similar wind data taken during the tropical summer days of February of 1999 and analyze the filtered wind perturbations for monitoring the traveling and stationary gravity waves generated due to Jicamarca topography and due to certain convective cells.



JRO consists of three 1.5 MW transmitters and an antenna array of 18,432 dipole elements, covering an area of approx. 85,000 m²

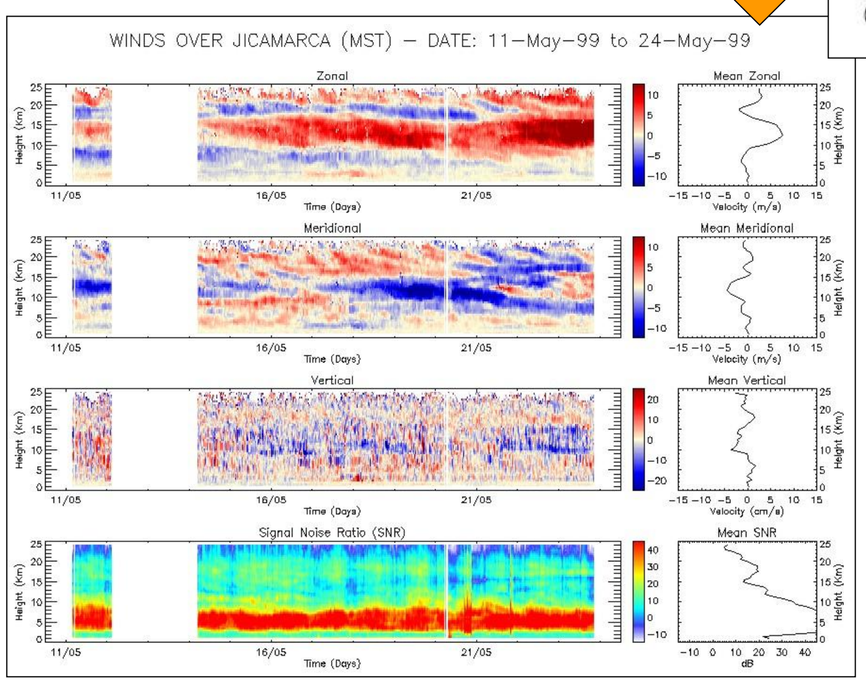


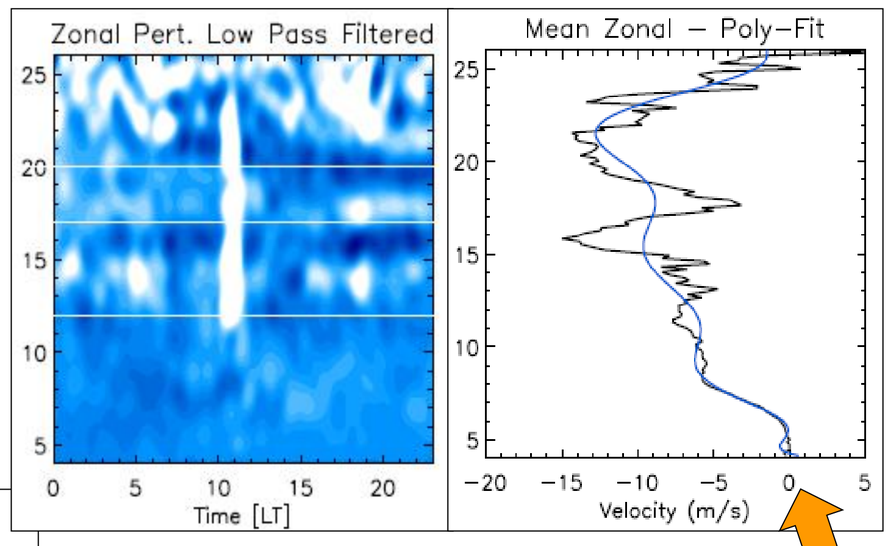
Winds Over Jicamarca

Below are the mean zonal, meridional and vertical winds over Jicamarca, Peru during May of 1999. The data is taken in the MST Mode of 50MHz Radar to get intended height and atmospheric turbulence information above Jicamarca.

These standard plots are available at:

http://jro.igp.gob.pe/database/winds/html/winds.htm





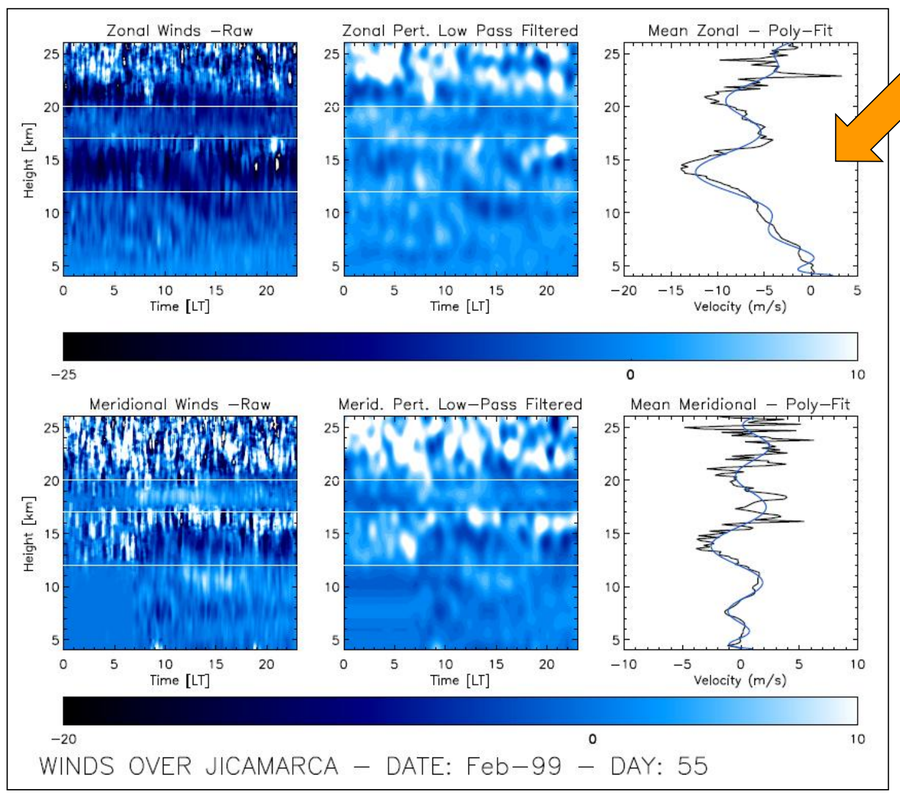
Plotting Methodology

The .ncdf format raw wind data files were read in IDL. Wind velocity data were sine corrected and mean wind profiles were obtained by averaging across time.

The wind velocity data were median filtered, and were used to find wind perturbation.

After low pass filtering with 3km and 2hr frequency bound across time and height, regions of high SNR, 0-12km and 17-21km, were signified using white boundaries

Graph on left shows u & v raw, filtered perturbation and mean winds for Day 55



Ongoing Work

We will carry on the same analysis for an extended period over the summer days and in winter days

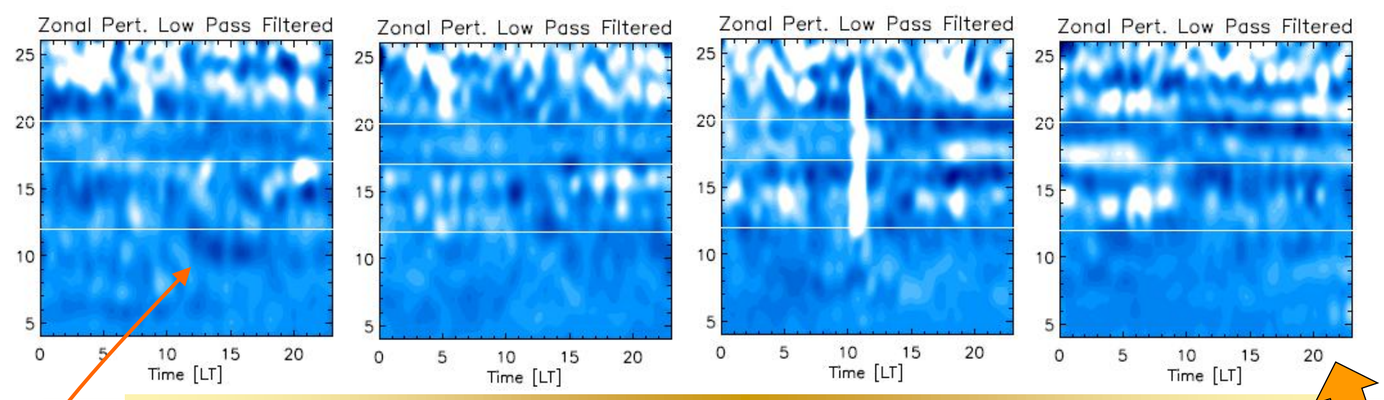
We will be analyzing Jicamarca's topographic maps to model the stationary waves generation and to filter those components from our perturbation plots

Source of certain noise factors would be examined as clearly seen on Day 58

Travelling waves would be back-traced to their source after observation & parameterization

Instrumentation & Data Acquisition

- The main parts of the 50-MHz Jicamarca radars are: antennas, transmitters, receivers, radar controllers and acquisition systems
- The technique we used is called "MST technique" (Mesosphere, stratosphere, troposphere). It uses VHF (30-300MHz) to study weak backscattering arising from refractive index fluctuations in neutral atmosphere.
- The echoes are from coherent scatter from the dynamic atmospheric irregularities (i.e., changes in humidity, temperature, pressure).
- The main antenna is divided in four sections, allowing four simultaneous beams to be used at the same time, pointing in the four cardinal directions ~2.5 degrees from vertical.
- The raw data is coherently integrated and then spectra are obtained every xx points using FFT. yy spectra are incoherently integrated. Radial velocities of each beam are obtained from the first moment of the integrated spectra. 4 equations are solved to get u, v & w every zz seconds.

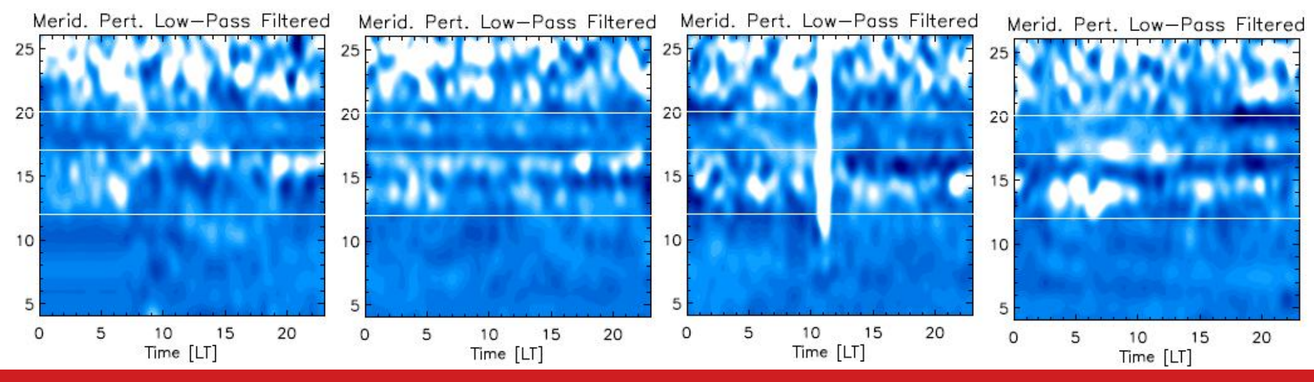


Graphical Analysis

The above series of zonal graphs show some occurrence of travelling gravity waves propagation in time. The upward curved shows a possible gravity wave that travels and dissipates in time. (the figures represent days 55, 57, 58 & 59 resp.)

Below series of meridional plots also show lesser apparent pattern seen in zonal plots

A shift in wind velocities' directions is seen from alternating light and dark patches (also visible in mean wind profile), which could be due to stationary waves



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