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An observational study of multiple layers and waves of coastal atmosphere using sodar.

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Abstract: *acoustic sounding is one of the useful techniques to remotely probe the atmospheric boundary layer. The fluctuations in the refractive index are roughly 1000 times stronger for acoustic waves than that for electomagnetic waves. Among the various remote sensing techniques, acoustic sounding is more sensitive to changes in the atmospheric parameters and is simpler both in electronic circuitry and maintenance. When measuring turbulence with sodar, one of the beset by a host of limitations, some basic to remote sensing, but other specific to acoustic propagation.*

A monostatic sodar was set up at Visakhapatnam to study the coastal boundary layer with special reference to sea breeze (Rao et al.,1981). The capability of acoustic sounder in exploring the boundary layer of continental locations as well as marine boundary layer and even the popular environment is well established. About 90% of research work on atmospheric acoustic deals with the studies conducted at the continental locations.

The valuable information on the diurnal pulsation off of boundary layer, acoustic sounder has provided and innovative understanding of subsidence and turbulence inversions ,gravity waves, thunderstorm density currents, synaptic scale fronts,chinooks and lee waves. Do you studies include scattering from low level stratus clouds, fog layer, multiple eco pattern from undulating atmospheric layers and number echoes. Besides meteorological application, the acoustic sounder capability of detecting flocks of birds and insects has been suggested.

The characteristics of the sea breeze are examined, including the onset and cessation of the phenomena. The behavior of wind speed and the depth of the density flow, the time of propagation of the events and the influence of orography. The reported that the behavior of the vertical velocity field associated with the sea breeze is consistent with the model predictions.

Keywords: *acoustic sounding, sodar, sound absorption, sodar parameters, multiple layers, facsimile recorder. Atmosphere boundary layer.*

Introduction: Acoustic sounder data is presented in the form of three dimensional physical recordings of time, height and reflected signal strength for several phenomena like convection to plums ,penetrate to convert to plums ,during sea breeze. Circulation with a capping conversion layer connective plumes during sea breeze circulation without capping inversion layer connective plums during night time ,ground based inversions, elevated inversions ,multiple layers and different wave structures. The data are discussed in terms of the sources of the particular phenomena and the ambient meteorological conditions.

The valuable information on the diurnal pulsation off the boundary layer acoustic sounder is approved to be a

useful tool to help understand the dynamics of turbulence, substance, inversion, gravity, waves, synoptic and meso-scale fronts generally, there is a brief period without any echo between the cessation half convert to activity and the onset of nocturnal radiation inversion. Several investigators described the meteorological processes and their influence on transport and diffusion in coastal zones.Van der Hoven(1967) murder survey of the available information on costal transport and diffusion characteristic and development of predicting the transport. A distance required to complete the transition from our water to our land diffusion as a function of plum height, wind speed and vertical temperature profile.

Besides, the effects of plume trapping fumigation and the recirculation sea breeze is proved to be the factor in the chemistry of air pollution. Stephens (1975)recognised the possibility of formation of photo chemical oxidants with in the moist content of sea breeze.

Experimental technique:

Several scientists experimentally investigated the scattering of sound by atmosphere, wind, and temperature of fluctuations. By using a fog siren on the south coast of England, Tyndall (1975) conducted that the long persisting echo should be attributed to the flocculent nature of the atmosphere.Kelton andBricout(1964) show that the scattered acoustic signals were of section intensity to permit Doppler measurements of wind velocity. The scattering of sound by temperature in homogeneities was explained by Bachelor (1957). The scattering theory was experimentally proved by; Kallistrotova (1959,1959a,1961)and Monin(1962).

The use of parabolic dish as acoustic sounder antenna has become almost a universal. The diameter of the sounder antenna is generally of the order of 1 to 2 m. Baby movie with proportional to the ratio of transmitted wavelength to antenna diameter. The sounder systems where long waves were essentially used the beam, which are typically 10 times greater than those obtained in microwave radars. Not ever being with is possible to sounder systems with an increase in both frequency of operation and antenna diameter. The 16 meter public dish has off power being with of 5 at a frequency of 850h which exceptionally narrow over at this frequency compared to your off power being with off around 10°. At the same frequency for normal diameter of 1.5 m (Fukushima et al.,1975). While the parameters are discuss, the above can obviously affect the acoustic sounder records. Care must be exercised when attempting to optimize the system parameters.

The structure of the atmosphere is such that horizontal stratification and hydrostatic stability seem to prevail. The local static stability is governed by the vertical structure of potential temperature, which, in addition, has the tendency to suppress turbulent motion and the pressure of the horizontal flow field. On the other hand, local vehicle motion and turbulence is induced by the available mechanical energy which is extracted from the mean flow. Does the main source for the turbulent energy production lies in the structure of the vertical wind shear.

Operation of the acoustic sounder:

The acoustic sounder used in the present study is a pulse sounder which sense out a brief burst of acoustic energy. Back scattered energy is then detected by the receiver and is amplified and recorded. The functional operation of the units compares in the acoustic cylinder are not

radically different from those encountered in conventional electromagnetic pulse radars as the basic principles underlying both are the same. However, due to the different types of energy involved, acoustic sounder circuits are much more simpler than those of convectional radar. The black diagram of the acoustic sounder used in the present study is shown in figure 1.

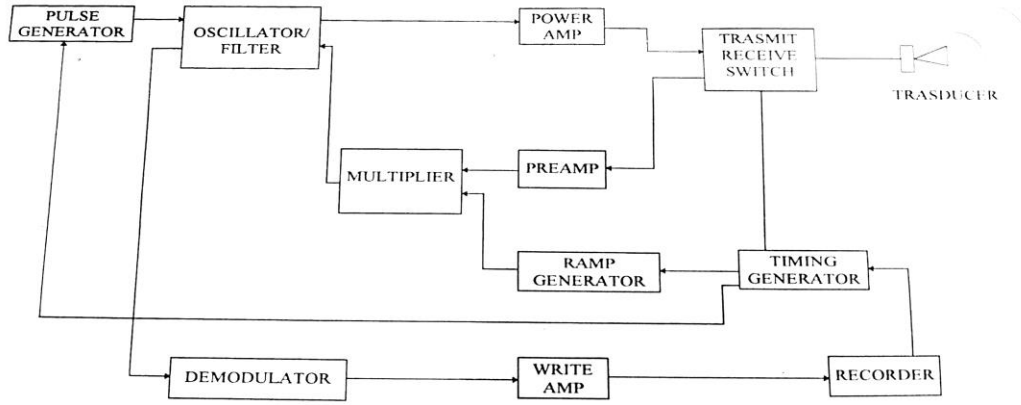

Figure 1. Block Diagram of Acoustic Sounder

Results:

Observation of multiple layers:

The acoustic sound under fecsimile records show multiple layers during night time when wind speeds drop to only a few meters per second. The multiple layers exhibit a little evident temperature structure between individual layers. It is also known that the larger temperature differences and greater wind shears associated with synoptic and meso- scale fronts also lead to the formation of multiple layers.(Ahmet,1978). Cold air sliding under the lifting warmer air masses are warmer air over running low-level colder volumes results in a turbulent interface temperature inversion.Ahmet (1978) show the complex internal structure of a cold air mass.

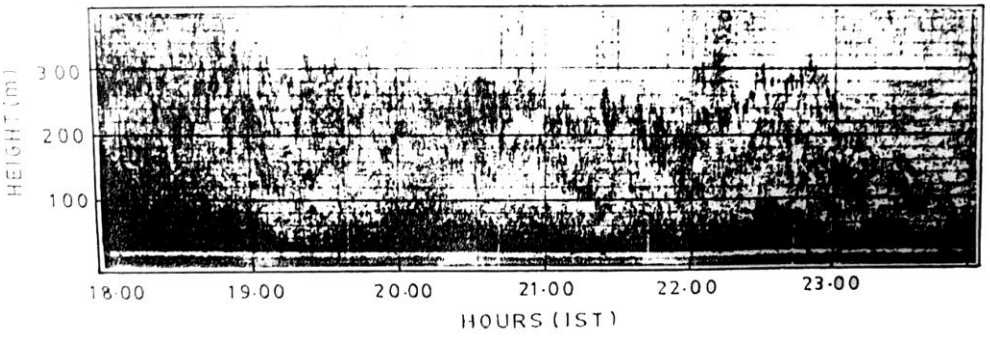

Figure.2: Acoustic sounder facsimile record showing multiple layers

An acoustic sounder facsimile record obtained between 18.00 and 24.00 IST showing multiple layers is presented in figure 2. There was a sea breeze at the side which was set in the forenoon. The elevated layer echo with its base at 150 m height at the beginning of the mile record presented in figure 2 was the interface between the inflowing marine air and land air. As revealed by the facsimile record the depth of a sea breeze circulation started decreasing after about 19.15 IST. Bye about 20.00 IST. The elevated layer came down and the scattering was uniform up to 200 m for about 30 minutes. Between 20.30 to 21.00 IST. Again, after about 22.45 IST, the elevated layer rose to a height 250 m within a span of about an hour. The elevator laser reach 300 m height at about 22.45 IST and a reminder there for the rest of the record. Yes, pointed out earlier. The variations in the height of the elevated layer are directly related to the depth of the sea breeze circulation.

Observation of waves:

In the clear atmosphere and within a hydrostatically stable layer in the presence of strong vertical wind shear, The Kelvin -Helmholtz instability manifests itself has amplifying waves. These waves eventually' roll 'and' break' into turbulent flow on a range of smaller scales.

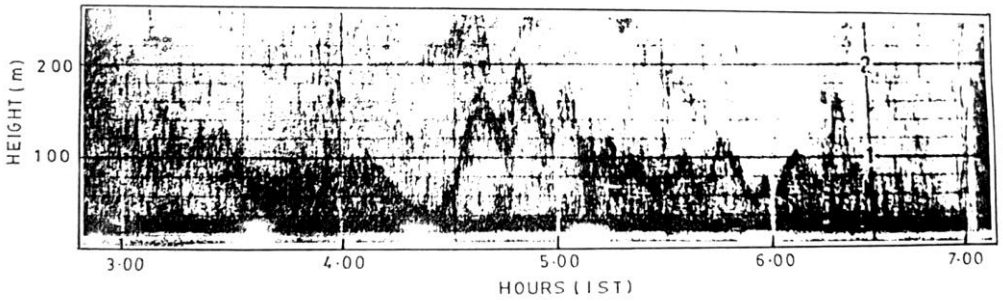

Fig.3: Acoustic sounder facsimile record showing wave structures.

The acoustic sounder facsimile record showing an amplifying way between 04.15 and 6.45 IST is represented in figure 3. Be with decreasing with the increase in the amplitude of the wave. The simple acoustic sounder are used in the present experiment. Give us no quantitative information other than the wave. And a rough estimation of wave magnitude (the vertical displacement). It is important to release the role of the waves in the momentum and energy transports at the atmosphere boundary layer.

Conclusions:

The operation of a monostatic acoustic sounder in a coastal environment resulted in the detection of a variety of meteorological phenomena. The facsimile records presented and discussed in the foregoing sections clearly showed the versatility with which the acoustic cylinder reveals the atmosphere boundary layer process. Observation of convert to plums and various types of atmosphere flows points to the fact that the characteristics of the over lying year mass are important for the growth of the mixed layer.

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