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An Observational study of ground based and elevated inversions during sea breeze at Visakhapatnam.

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Abstract: *For tracing out the air pollution, diffusion and environmental problem, acoustic sounders are used to estimate the inversion depth and density. This sensitivity of the interaction may be expressed in terms of the magnitude of the fluctuations in refractive index of the medium.*

Acoustic sounder, FM-CW radar and lider (laser radar) using acoustic, radio and optical waves, respectively are the three remote sensing techniques that are being used for lower atmosphoric research.

Among 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 is the beset by a host of limitations, some basic to remote sensing, but other specific to acoustic propagation.

The first NOAA(National oceanic and atmospheric administration, USA) acoustic sounder was designed and put into operation by westcott et al.(1970). Yeah, monostatic sodar was set up at Visakhapatnam to study the coastal boundary layer with the special reference to seabreeze (Rao et al,1981).

The acoustic sounder used in the present study is a pulsed sounder which sense out a brief burst of a acoustic energy. Back scattered energy is then detected by the receiver and is amplified and recorded. We used it sodar to observe the various Meso-Metrological phenomena. The acoustic sounder data is presented in the form of three dimensional phenomena, recordings of time height and reflected signal strength for several phenomena like ground- based inversions and elevated inversions.

Keywords: *Doppler sodar- acoustic back scattering- sound absorption -sodar parameters- FM-CW radar.*

After sunrise, the convective boundary layer typically develops quickly to a depth of few hundred metres. When the capping inversion is strong and subsidence is large, the convective boundary layer grows so slowly that the capping inversion remains below the maximum height range of the sodar .One such case is presented in fig 2.

The sodar facsimile record presented in figure 2 provides valid and useful information on atmosphoric mixing processes.

This information is of the following types:

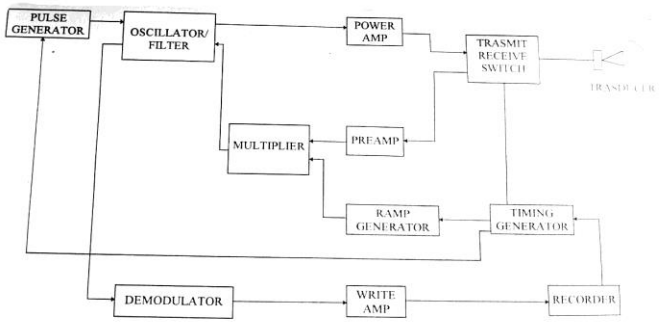
* Information on the height of the inversion base, frequently called the depth of the mixer layer, and
* Information on the bigger of mixing within the mixer layer indicated by the presence of convective plume echoes at the surface.

Introduction: The pattern of the sounder records obtained at the continental locations on days of fair weather conditions, compresses of surface based layer related to nocturnal radiation inversion which disappears in the following morning with the onset of convective plums.

Relatively, very little amount of data is available on coastal boundary layers using acoustic sounders. One of the most important and characteristic features of the atmospheric environment in coastal regions is the formation of internal boundary layer when air flows across the surface discontinuity between land and sea. Internal boundary layers may be primarily caused by differences in surface temperature or by difference in surface roughness but are typically caused by difference in both properties. Over most continental areas, The atmosphere is mostly unstable in summer and stable conditions prevail in winter. Air pollution levels will be lower in summer and higher in winter. But the coastal area differ in several ways which affect the dispersive capability of the atmosphere in the first few hundred meters.

Operation of the acoustic sounder:

The acoustic sounder used in the present study is a pulsed sounder which sends out a brief burst of acoustic energy. Backscattered energy is then detected by the receiver and is amplified and recorded. The functional operation of the units comprising the acoustic sounder are not radically different from those encountered in convectional electromagnetic radars, as the basic principles underlaying 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 block diagram of the acoustic sounder used in the present study is shown in figure 1.



Observation of Ground- based inversions:

Another class of acoustic sounder echo pattern was observed under stable conditions during nocturnal radiation temperature inversions. The acoustic sounder facsimile records showed changes in the character of the echo patterns after sunset when there were no synoptic scale disturbances are meso-scale phenomenal like sea breeze etc. when the diurnal pulsation of the coastal atmospheric boundary layer was controlled solely by the solar heating of the ground during daytime and radiational cooling of the ground during night time. The acoustic sounder echo patterns on facsimile records during

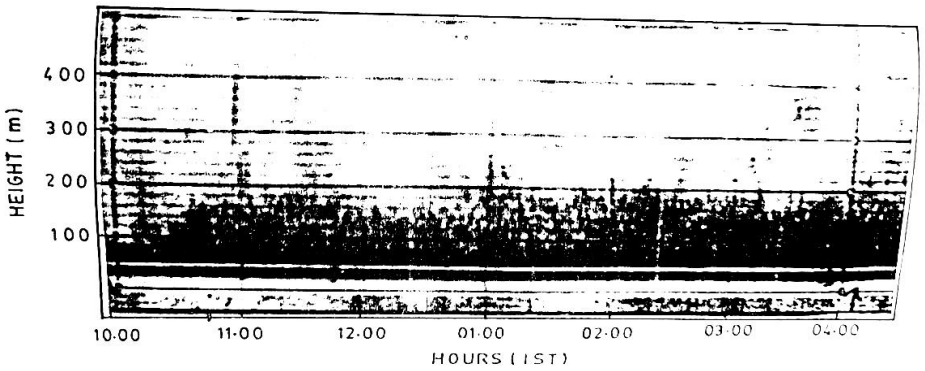
night time showed evidence of ground - based inversions.

Under the light wind clear sky conditions, typical of winter nights in the coastal area of Visakhapatnam, the incidence of surface based inversions frequency. The acoustic sounder facsimile record obtained between 22.00 and 04.00 IST is shown in figure 2. The depth of the anniversary layer showed some variations but the growth of the layer 01.00 IST was study. The height of the stable layer remained below 300 m throughout length of the record.

The facsimile record presented in figure 2 reveals a filamentary from of turbulence fluctuations between 200 and 250 m from 01.00 to 03.00 IST.

Crease et.al.,(1977) attributed such type of echo pattern to temperature fluctuations generated by mechanical turbulence acting on the steep temperature. Gradient the filaments of activity show the presence of region of stronger mixing.

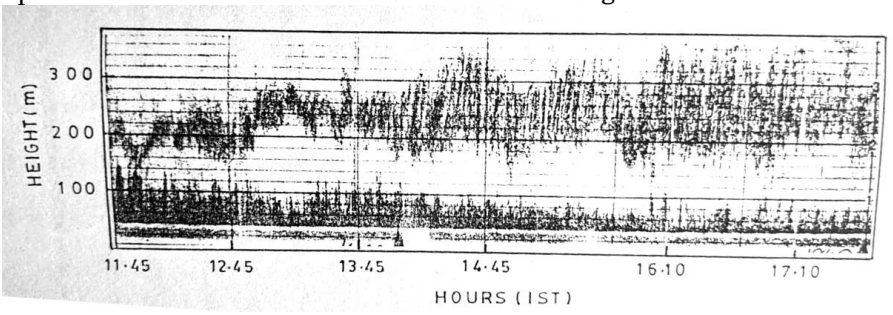
Figure 2. Acoustic sounder facsimile record showing ground based nocturnal inversion.



Observation of elevated inversions:

The elevated inversions were observed on acoustic sounder facsimile records during a variety of occasions such as cyclones and anticyclones, sea breeze, circulation, etc. Most of the elevated inversions observed during the investigating. At Visakhapatnam were formed due to sea breeze circulations when the sea breeze circulation was well developed and elevated, inversion was created following the moment of cool moist marine air overland.

An Acoustic sounder facsimile record obtained between 11:45 and 17.40 IST is shown in figure 3.



As mentioned earlier the inflow of cool marine sea breeze circulation often produces an elevated inversion. The thickness of the elevated layers was almost uniform throughout the period of the record. The elevated layer depicts the mixing zone of the cool moist dry land air. The thickness of the elevated layer was 50 m around noon and 150 m at around 16.00 IST.

Conclusions:

The operation of a monostatic acoustic sounder in a coastal environment resulted in the detection of variety of mateorological phenomena. The ficsmile records presented and discussed in the foregoing sections clearly showed the versatility with which the acoustic sounder reveals the atmospheric boundary layer process. Observation of ground- best, inversions and elevated inversions under various types of atmospheric flows points to the fact that the characteristics of the water laying air mass are important for the growth of the mixed layer.

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