THE PARTICULARITIES OF RADIO HEAT IMAGES OF CLOUDY FIELDS AS A PRIORI INFORMATION FOR REMOTE SENSING ALGORITHMS

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The particularities of earth cover and cloudiness contrasted unhomoginaities at millimetre wave range are shown.

Introduction

Processing of radio thermal and radar images of earth surface and cloudy fields with the purpose of their quality improvementing is one of major procedures at restoring of environmental parameters. As a result of such image processing is decreasing of negative influence of multiplicative (external origin) and additive (apparatus origin) disturbances. Such procedure carrying out provides an improvement of perception of forms and boundaries of earth covers and atmosphere contrasted formations as well as their radio and physical properties retrieving.

However it is necessary to note that in all these cases in different wavelength ranges there are very frequently the situations when the efficiency of evocative methods of processing is reduced (and even in a number of situations its may be reduced to the zero). It is connected with a negative influence of atmospheric discontinuities especially essential in millimetre and sub-millimetre wavelength ranges then earth cover parameters are sounded. On the other hand then atmosphere parameters are sounded we should collide with earth cover destructive influence. We think the discrimination of radiometric contribution between ground surface and atmosphere is one of the most important issues in passive microwave remote sensing from air and space. Especially in millimetre wavelength there is not so much data existed at present. In these situations while as a rule not surmounted to the present time with the help of the conventional approaches (for a case of remote sensing over surface of the Land and sea ice fields) it is necessary to search for the new approaches and ways of mentioned problem overcoming.

Results

This report is dedicated to searching and investigating of above mentioned differences.

The helicopter trace measurements of space changes of earth cover radio brightness temperatures at 3 millimetre-waves /1 –2/, have shown a continuous character of sizes distribution of contrasted formations, and also what absence of preferable direction in azimuth orientation for these formations /1/. In same time, as a result of one-year cycle of observations of atmospheric fronts passing above our terrestrial observatory (49N 37E) we marked some periodic character of space discontinuities of atmospheric attenuation at millimetre wave range /1, 3/.

Such differences (in case their determination) could be useful for secondary processing of radio images by the methods of texture analysis for example. Here we speak about usage of certain guessed statistical differences between discontinuities of earth surface and atmosphere in their form, group orientation and sizes. You see if it would possible to confirm a systematic character of such differences in the form, sizes and orientations, these statistical data could be applied as some a priory information useful for creation of new method of processing. It is

understandable, that for research of such legitimacies the realisation of the analysis of radio heat images for spatially extended areas is necessary. As a source of such data we selected by the radio images over tropics obtained by TRMM satellite (NASA-NASDA). The radiometric instrumentation of the given satellite for today differs by the greatest space resolution of antenna at 3мм and 8мм ranges, and also has the infrared channel. At processing of data presented by Goddard Distributed Active Archive Center we used the radiometer images of areas with a size of 800x2000 km obtained at infra-red, 3мм and 8мм wave ranges. Thus we used the specially designed by us for this purpose a soft-ware - algorithmic support, which allows:

- to conduct a conversion of the satellite maps from a radio brightness sort to a binary pattern (on which selection of contrasting formations of cloudy fields is yielded by a method sliding average – Fig. 1a);
- to calculate sizes of effective lengths and widths for each of the allocated contrasting formations;
- to carry out a calculation and statistical analysis of lengths, widths, ellipticity and orientation for formations contrasted on the radio images.

The Figures 1 and 2 shows the results of such processing for two typical tropical frontal zones at Indian Ocean (14S 60E, the Madagascar's area) and at Pacific Ocean (20,75N 156,6W, the Hawaii's area).

In both figures it is easy to note the availability of some prevailing direction in orientation of cloudy formations (here zero is a direction the North - South). This prevate direction is well allocated not only on a space scale of 700x800 km (fig. 1b) but also on the greater scale 2000x800км (fig. 1c). In this case allocation of directions of orientation practically coincides for IR and for two points of millimetre wave range. Cases however are frequent, when the indicated prevailing directions differ for a little between IR and millimetre ranges, or in IR range they are expressed not so brightly, as in millimetre waves.

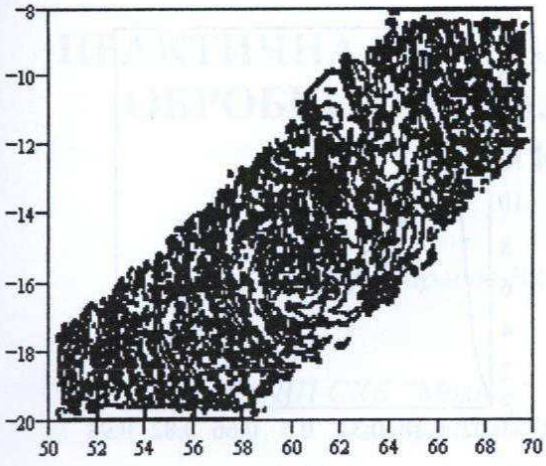
We can also mark availability of certain reference values of relations of lengths and widths (ellipticity) for the allocated formations in cloudiness fields, viewed by us and also availability some reference for each wavelength range of sizes of length of cloudy discontinuities. All this basically is tags (an priori information), which usage can be useful at sharing interaction influence of earth surface and atmosphere radiation at processing of radio heat images.

It is necessary also to note a frequent availability of some harmonically (multiplicity to two or three) in distribution of lengths of clouds formations /Fig. 1e). The same features were marked earlier by us at a data analysis of terrestrial observations of passing of atmospheric fronts in middle latitudes /1/. It is easy to see the maximums at distributions of "ellipticity" values for both different cyclones (Fig. 1d and 2b). At that these characteristic maximums have values near 0,2 for both different atmosphere events observed for different areas of world.

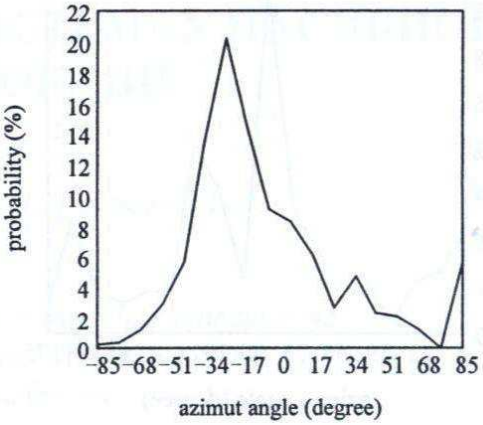
Conclusions

Thus as a result of this work, the availability chain expressed features in a morphological structure of cloudy fields is confirmed. These features can be used as the a priori information at build-up of new algorithms of retrieving of cloudy coverage parameters observed on the phone of earth surface, and also at retrieving of earth surface parameters apparent through a cloudy cover in a millimetre waves.

At realisation of further operations in this direction we plan to receive more complete statistical grounding of the quantitative evaluations for above mentioned features in different seasonal and synoptic situations. After that it will be possible to initiate directly with development of algorithms of secondary processing of air-space radio heat images.



a)



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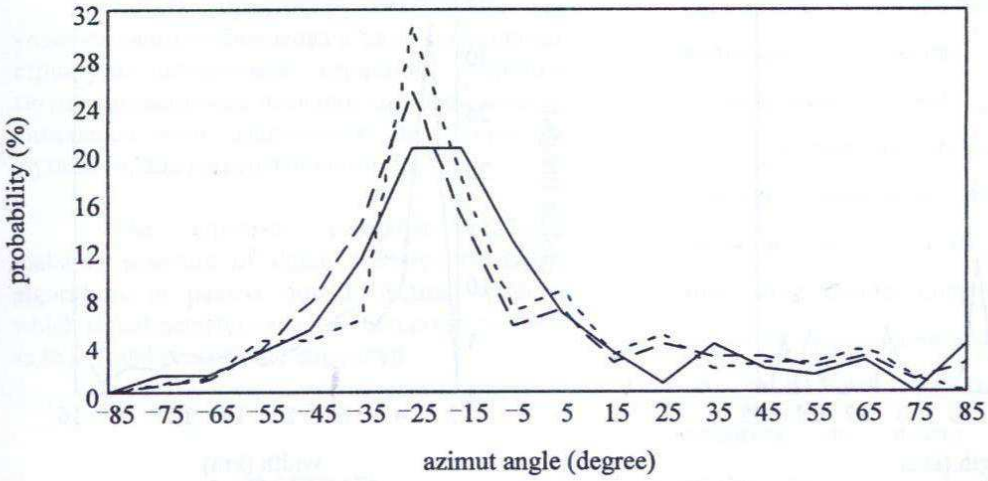

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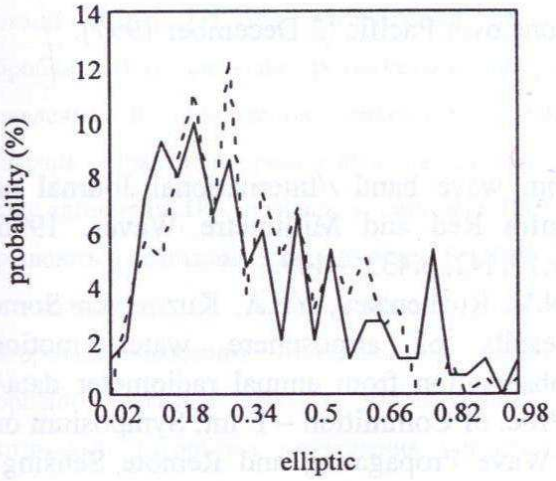
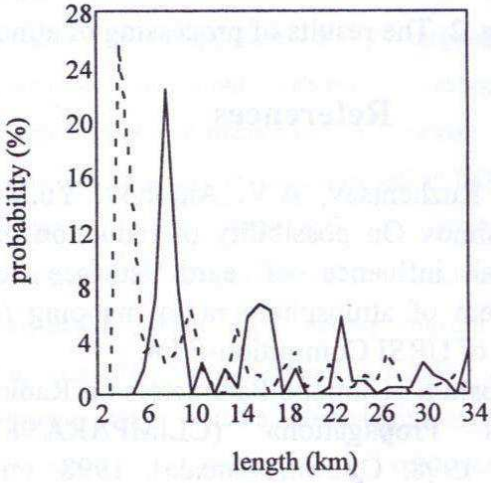


d)



e)

Fig. 1. The results of processing of the Hurricanece over Indian Ocean (2 October, 1998)

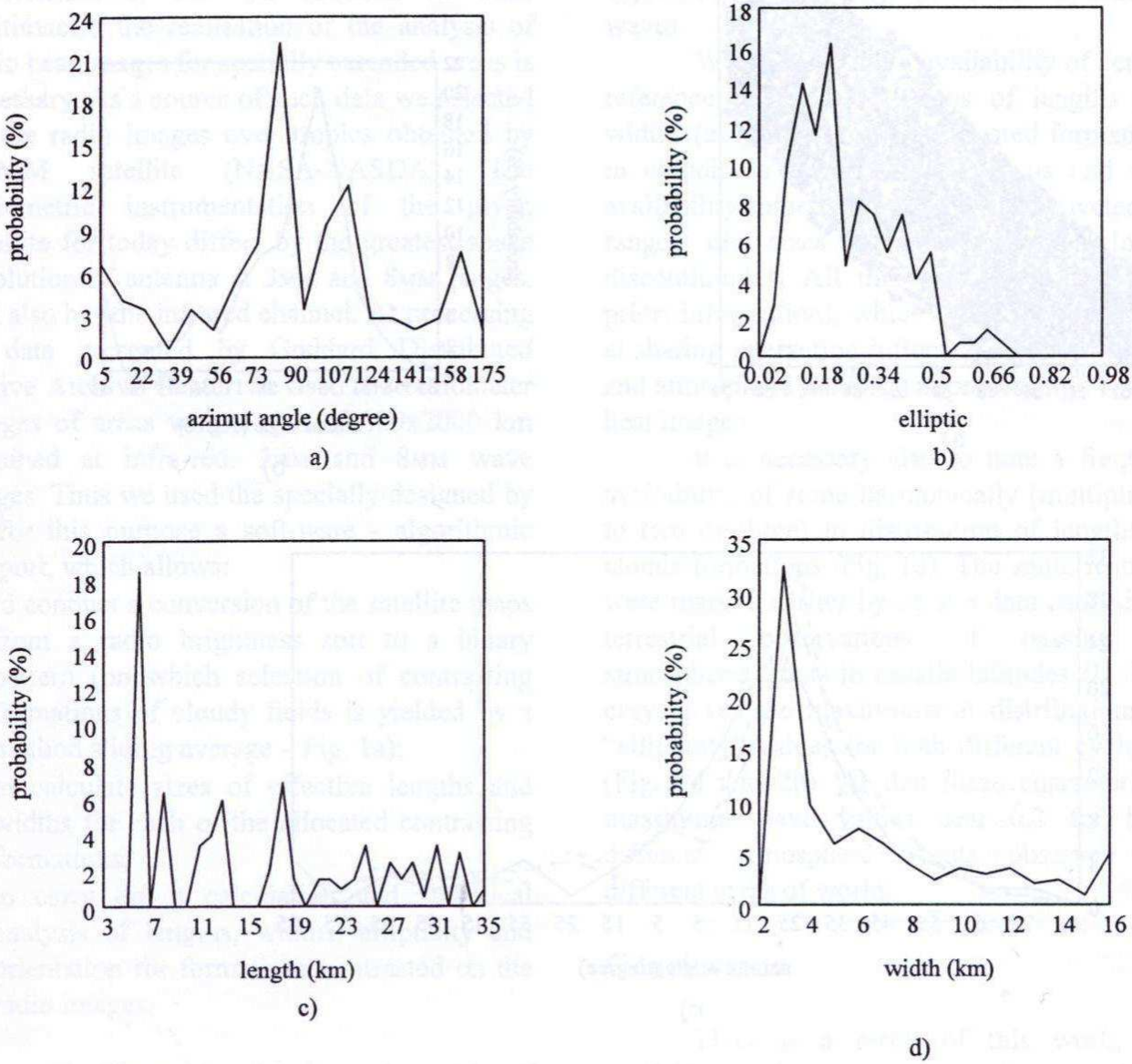


Fig. 2. The results of processing of atmosphere cyclone over Pacific (2 December 1997).

References

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