SnT 2025 8 SEPTEMBER ONLINE DAY 9 TO 12 SEPTEMBER AT HOFBURG PALACE, VIENNA & ONLINE
CTBT: SCIENCE AND TECHNOLOGY CONFERENCE

Structure of the atmosphere in the form of a “head of cabbage” from acoustic sounding data

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INTRODUCTION AND MAIN RESULTS

This presentation provides the results of theoretical and experimental studies of the fine-scale layered structure (anisotropic turbulence) of the middle atmosphere (20-140 km) using the acoustic method.

The vertical profiles of anisotropic inhomogeneities are reconstructed from the parameters of infrasound waves generated by explosions and volcanic eruptions. A new method of signal decomposition into separate pulses by the pattern recognition method was proposed. The structure in the form of a “head of cabbage” form is characteristic of the whole atmosphere regardless of its spatial distribution and can be stable in general and in details over appreciable time intervals .

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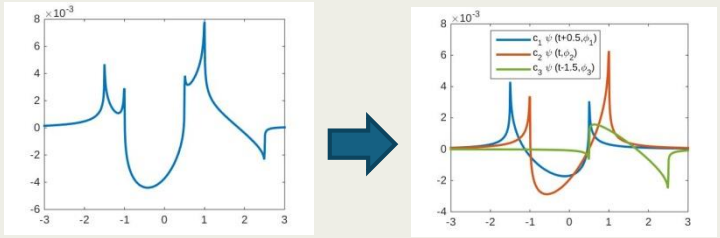
Introduction

The fundamental difference between the acoustic methods proposed by us and the traditional ones is the use of a direct relationship between the characteristics of the recorded signal reflected from thin atmospheric inhomogeneities and the vertical gradients of temperature and wind in these layers. Systematic experiments have been carried out and methods have been developed for determining the parameters of the anisotropic structure of the atmosphere based on data from the registration of acoustic waves from pulsed sources (explosions, volcanic eruptions).

Methods/Data

- The decomposition method of a recorded long-term acoustic signal into its individual components in the form of N and U-wave pulses corresponding to different heights of a partial reflection from inhomogeneities and arriving at the observation point at different time intervals.

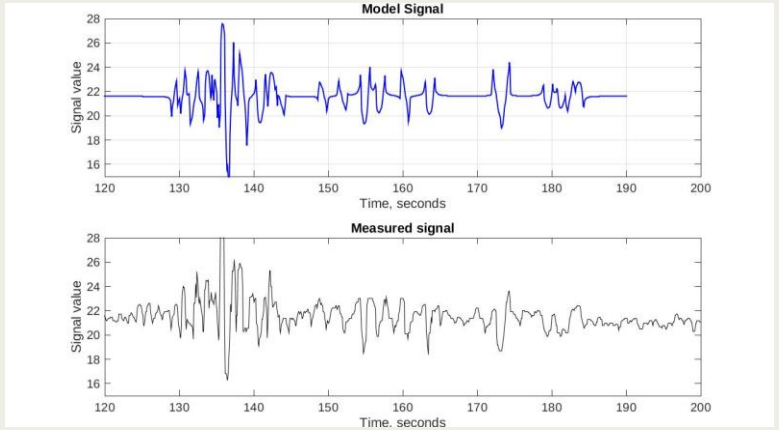


Signal model — Superposion N and U-waves

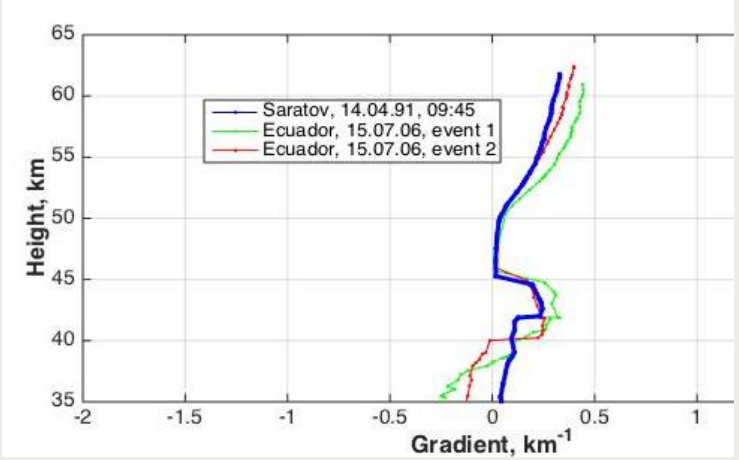
M.N. Zakirov, S.N. Kulichkov, A.I.Chulichkov, I.P. Chunchuzov, O.Ye.Popov, A.A.Mishenin, G.A.Bush, N.D. Tsybulskaya and E.V. Golikova. Acoustic probing of the anisotropic structure of the atmosphere // Doklady Earth Sciences, 2023,Vol.511, Part 1, pp.595-600.

Results

- Comparison of measurement data 14.04.91 and simulation results.

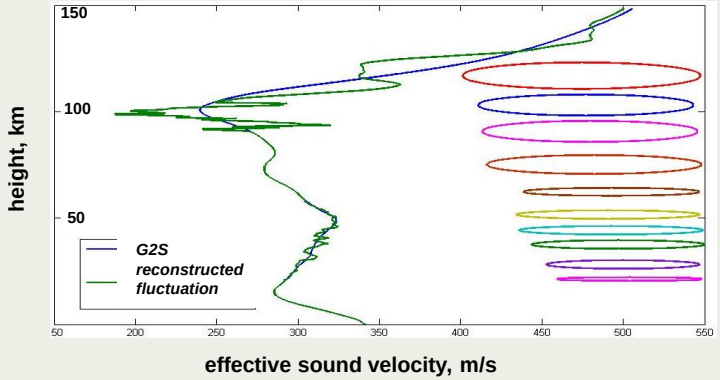


- Vertical gradients determined from infrasound registration data in Russia (explosion) and Ecuador (volcanic eruptions).



- For the first time, it has been established that a thin layered structure fills almost the entire thickness of the atmosphere (at least up to altitudes of 130 km) and is stable over significant time intervals.

Atmosphere model in the form of a “head of cabbage”



Conclusions

We have proposed and tested a new direction for studying the atmosphere – distant acoustic probing of anisotropic inhomogeneities of the lower and upper atmosphere (altitudes 0÷1 km and 20÷130 km). For the first time, an acoustic method has revealed the presence of long-lived thin-structural layered temperature and wind inhomogeneities in the atmosphere characteristic of all seasons and having an order of magnitude higher than average, values of vertical temperature and wind gradients.