CONNECTION BETWEEN VARIATIONS OF THE ATMOSPHERE TEMPERATURE PROFILE AND VARIATIONS OF THE MESON COMPONENT INTENSITY

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The influence of temperature effects on intensity variations of the cosmic ray meson component are now studied in detail. The intensity variations caused by temperature variations are known to have the form /I/

$$\frac{\Delta I^{i}(t)}{I} = \int_{0}^{\infty} W^{i}(h)\,\Delta T(h,t)\,dh \qquad (I)$$

where $W^{i}(h)$ are densities of temperature coefficients. These coefficients were calculated by Dorman /I/ for a wide energy spectrum. Miyazaki and Wada /2/ were the first to consider the possibility to solve the problem inverse to (I) - to predict variations of the atmosphere temperature from intensity variations of the meson component measured on the Earth. With this purpose they proposed a model simple at first glance, in which the temperature variations for each isobaric level were determined linearly from the intensity variations of the meson component registered by several ground-base devices

$$\Delta T_j = \sum_i A_{ij}\,\Delta I_i \qquad (2)$$

Here ΔT is temperature variation of j-th isobaric level. ΔI is intensity variation of the i-th device. The coefficients A_{ij} were found by the method of least squares. The number of divices is as a rule limited to $i \leq 3$.

The present paper is aimed at establishing connection between the temperature variation ΔT and the intensity variation ΔI by using the temperature coefficient density technique developed by Dorman. To this end we divide the atmosphere into some number of isobaric levels n ; let inside each level the temperature variations be constant in magnitude, although vary in time. Then the relation (I) can

be reduced to the form

$$\Delta I^{i}(t) = \sum_{j=1}^{h} A_{ij} \Delta T_j , \qquad (3)$$

where

$$A_{ij} = \int_{h_j}^{h_{j+1}} W^{i}(h)\, dh \qquad (4)$$

Since the temperature coefficient densities are known for a large number of devices, the coefficients A_{ij} can be obtained in any set. And if we choose the number of devices equal to the number of isobaric levels, the system of equations (3)-(4) can be solved exactly relative to the temperature variations

$$\Delta T_j = \sum_{i} B_{ij} \Delta I^{i} \qquad (5)$$

The relation (5) resembles by its form the model (2) used by Japaneese authors, but the coefficients B_{ij} are easily expressed through the temperature coefficient densities

$$B_{ij} = A_{ij}^{-1} \qquad (6)$$

To realize how much devices are actually needed on the Earth for predicting the temperature variation of the atmosphere profile with a reasonable accuracy, we have carried out concrete calculations for IO isobaric levels and IO devices. As the components we have taken: I_I - mesona registered by a cubical telescope with a IO-cm leed absorber. I_2 - mesons observed by ionization chamber at the see level. I_3 - mesons underground at a depth of 25 mwe. I_4 - slow mesons of energy 200-350 MeV. I_5-I_{IO} are mesons observed, respectively, underground at a depth of 55 nwe, at the see level with $\mathrm{Cos}\theta = 0.2$, at the see level with $\mathrm{Cos}\theta = 0.6$, underground at a depth of 55 mwe with $\mathrm{Cos}\,\theta = 0.4$, at a depth of 25 mwe with $\mathrm{Cos}\,\theta = 0.8$, at a depth of 55 mwe with $\mathrm{Cos}\,\theta = 0.6$. Table I presents the values of the coefficients B_{ij} calculated for IO isobaric levels in atmosphere from O to IOOO mb.

Table I

Values of the coefficients B_{ij}

0.872	0.577	-0.I63	0.789	0.058	-0.026	-0.345	0.596	-I.096
-4.742	-2.376	0.68	-2.I74	-9.I9I	0.075	0.834	0.295	4.33
-64.2I	-43.40	II.2I	-45.08	6.453	I.365	I8.60	I.207	72.59
60.I8	74.74	25.20	I53.3	2.2II	-3.665	-68.83	-3.998	-I69.3
-I2.2I	I5.37	-6.088	46.2I	-I.584	-0.599	-20.06	-0.435	3.55
I7.8I	4I.97	4.689	88.88	7.456	-2.I98	-42.69	-I.44	-37.69
-35.02	-85.67	I3.07	-254.9	-6.845	5.377	I28.I	3.809	II8.7
56.95	36.82	-8.23	40.74	-I.642	-I.237	-I8.02	-I.26I	-57.75
-0.553	-0.55I	0.I97	-I.767	-0.023	I.555	-0.399	I.026	I.I69
-24.86	-I3.I6	3.0I3	I3.56	I.298	-I.I05	-I5.28	0.353	20.44

We have varied the set of initial elements of the cosmic ray meson component. The calculation has shown that the matrix of the coefficients B_{ij} is rather sensitive to their choice. Moreover, the analysis of the results shows that if for the calculations of the atmospheric temperature variations the model (2) is used, the number of meson components, essentially exceeding 3, should be taken into account.

REFERENCES

I. Dorman L.I. Cosmic Ray Variations. M. Gostekhizdat, I957, 492 p.

2. Miyazaki Y., Wada M. Proc. II-th ICRC, Budapest, I969, v.2, p. 592.