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SOLAR WIND AND TEMPERATURE FIELD OF THE TROPOSPHERE

by

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(USSR)

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SUMMARY

New possibilities are described for tracing solar-terrestrial relationships by way of direct measurements of solar plasma fluxes with the aid of rockets and satellites and comparison of data on solar wind velocities with air temperatures of the near-ground layer is given.

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Comparison of data on solar wind velocities (swv) [1 – 3] with the air temperature of the near-ground layer averaged by seven regions of the Soviet Black sea shore shows that during the operation of Mariner-2** relationship between swv and the temperature of the lower troposphere layer was continuously traced with inversions of the sign of the relationship.

As is shown in Fig.1 (next page) the dates of inversions of 11, 26 September and 8 October 1962 for solar revolutions NN 1767-1768 coincide with the passage of the Earth through the boundaries of the interplanetary field [4], whereupon a tendency is noted for the given regions toward a positive relationship for a mostly negative polarity of the sector, and vice-versa. This tendency is maintained for the revolution No.1770 (the data on rev.No.1769 are incomplete because of the interruption in station's operation), where after the assumed passage of sector boundary on 30 November (according to geomagnetic sequence, swv variation and recurrent si) there is observed a shift of the negative sign of relationship to a positive. The correlation factors by sectors for the revolution No.1767 are respectively equal to –0.768 and 0.681; for the convolution No.1768 they are respectively –0.553 and 0.867. The verification of the reality of connection with the aid of t-distribution shows that the coefficients obtained correspond to levels of significance above 0.05 for the 2nd and 3rd coefficients, and above 0.001 for the 1st and 3rd. The 27-day recurrence of temperature extremes is linked with the recurrence of swv distribution inside the sectors and sector boundaries, as this follows from Fig.1.

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* [SOLNECHNYY VETER I TEMPERATURNOYE POLE TROPOSFERY]

** When utilizing the data of Mariner-2, account has been taken of the lag time variation in the arrival of solar wind to the station relative to the Earth's magnetosphere.

Thus, the temperature minimum corresponding to swv increase and observed on 3 September is consecutively traced on 29 September, 27 October 23 November, with a particularly sharp expression on 21 December. After passage of the boundary of the sector on 11 September and 8 October and also of the assumed 4 November, 30 November and 27 December, development took place in all cases of the temperature minimum, linked in this sector with a drop in swv.

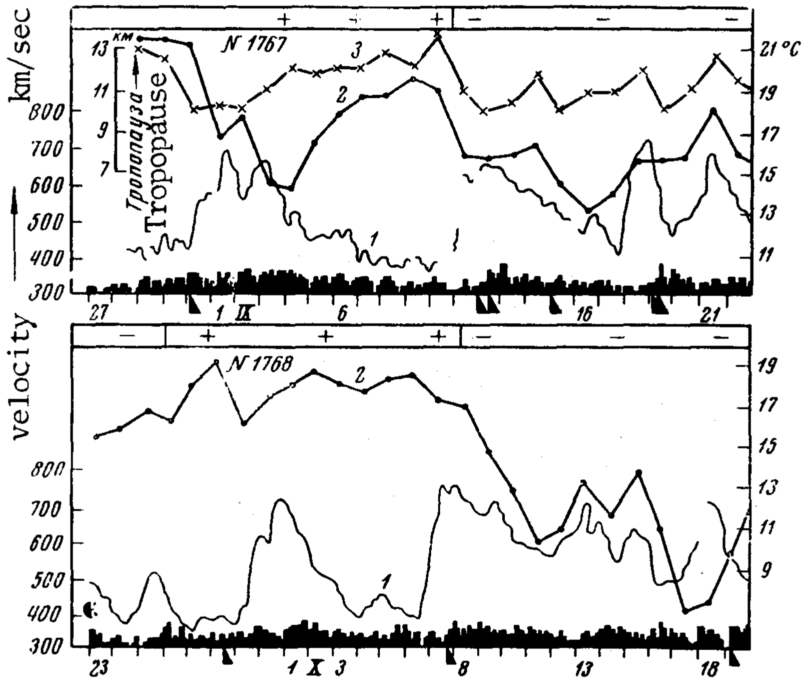

Fig.1. Comparison of the curves of solar wind velocities (swv) (1), of night temperature (2) and of the night tropopause (3). Three-hour K_p-indices are plotted below for each revolution. The blackened triangles indicate the SC of magnetic storms. Shown in the upper part are the boundaries of interplanetary field sectors and its polarity

On the other hand, swv variations, dependent on the development phase of the active region and the possible shifts of sector boundaries, will contribute alongside with proper tropospheric processes to the distortion of the 27-day recurrence in the temperture field. The transfer time into the troposphere of a perturbation from the boundary of the frontal shock wave must be rather small, which is confirmed by the variations (close in time within the limits of a few hours) of swv and temperature values.

Plotted in Fig.2 is the comparison of swv [2] for the revolutions Nos. 1793 and 1794 with temperature variations for the same regions. The dashes of the curve for swv correspond to the position of the satellite beyond the interpanetary space. Fig.2 shows (next page) that a noticeable connection is observed between the phenomena considered. Thus, from 1 August through 10 August 1964 the relationship has a sharply expressed negative sign. Subsequently, the relationship changes sign and again becomes negative with the beginning of a new swv maximum on 25 August. A tendency toward a positive relationship is again noted after 5 September through the end of revolution

No.1794. It is striking that the inversion dates of relationship sign of 11, 25 August, 6 September and also of 21 September and 3 October have a propensity to be drawn, on the one hand, to periods after which swv increase, and to correspond to commencements of geomagnetic sequences on the other. The period of sign change are not linked with the commencement of every geomagnetic sequence and a corresponding increase of swv, though a substantial variation in the latter is reflected in the temperature field of the troposphere The noted dates of sign inversion have a 27-day recurrence, and the recurrent sc and si also have a propensity to tend to them.

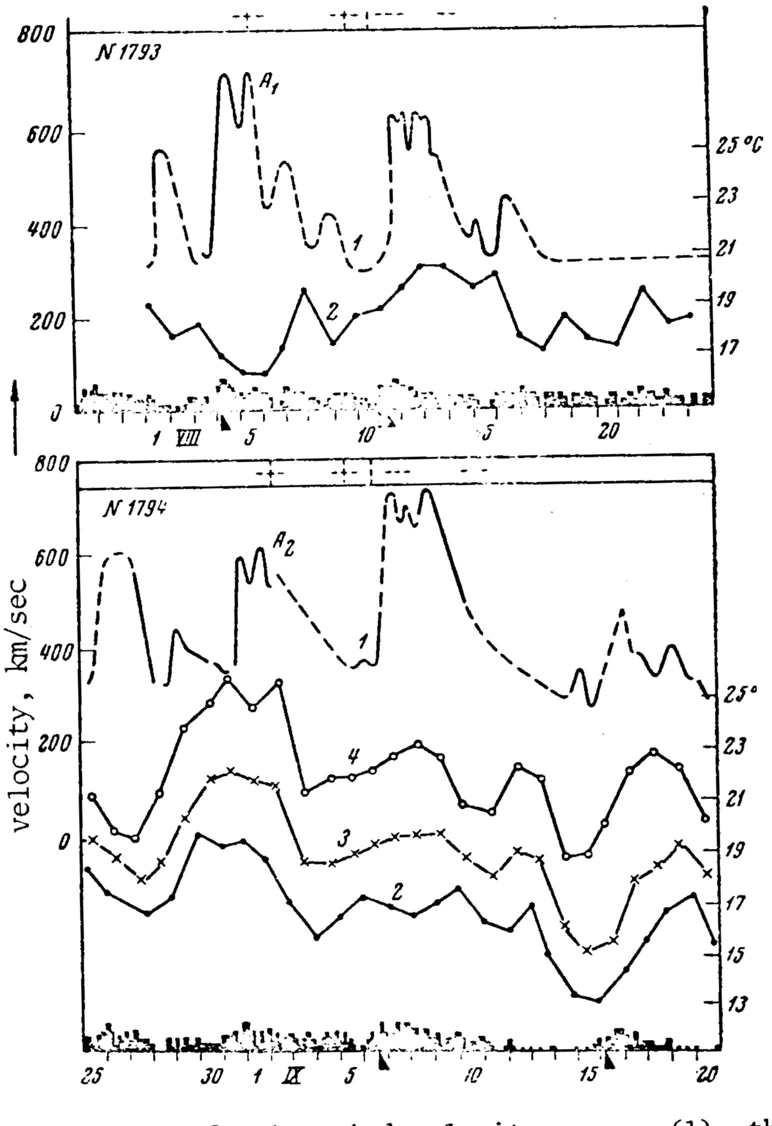

Fig.2. Comparison of solar wind velocity curves (1), the night (2) average-daily (3) and daytime temperature (4). The assumed boundary of sectors and their polarity are denoted by dashes in upper parts

All this compels us to assume that, just as is the case for Fig.1, the the sign inversion of relationship are related to passage of sector boundaries.

Data are available for the beginning and the end of 1964 (IMP-1, Mariner-4) on the sectorial structure and polarity of the field [4]. Having traced the possible positions of the sectors for the considered interval, we reach the conclusion that the periods of positive relationship between the fluctuations of swv and the temperature field probably belong to sectors with negative polarity. It follows from the comparison of the three temperature curves in Fig.2, that is, nighttime, average-daily and daytime, that the process of solar agent action is manifest in the illuminated hemisphere at the outset and then in the night hemisphere. A more substantial phase shift of temperature minimum on 4 September relative to swv maximum, denoted by A_2, must apparently be explained by comparison with the preceding one not by a drop in the absolute values of swv in A_2 relative to A_1, but by the influence of troposphere's proper thermobaric fluctuations.

Comparison is given in Fig.3, where preliminary data on swv, measured by Pioneer-6, are utilized.[3, 5]. Here too a mutual relationship is observed between the events considered, of which the details may subsequently be refined by involving additional material. But a similar agreement is revealed in the variations of temperature values and solar plasma fluxes measured by Soviet space probes and satellites. Authors of [6 - 9] have proved the correlation between the values of solar plasma fluxes and the K_p-indices. According to data of Mars-1 [8 - 9], plasma fluxes $\sim 10^9$ cm^{-2} sec^{-1} were observed on 30 November 1962. This date is linked with the presumed passage of sector boundary and the subsequent development of temperature minimum, when the temperature dropped by 12° in two days. On 5 December 1964 ZOND-2 [9] measured minor ion fluxes $(3 \div 7) \cdot 10^7$ cm^{-2} sec^{-1} for comparatively small swv components (300 – 415)km sec^{-1}. As also 4 December, this day is characterized by one of the highest temperature maxima in November December 1964 for the regions considered. The transfer of solar-conditioned perturbation from exosphere to troposphere must be manifest in all structural "floors" of the atmosphere [10 – 12]. Plotted in Fig.1 is the curve of tropopause altitude variation (Crimea), which "reacts", similarly to the temperature curve, on solar wind velocity variation and the passage of sector boundary.

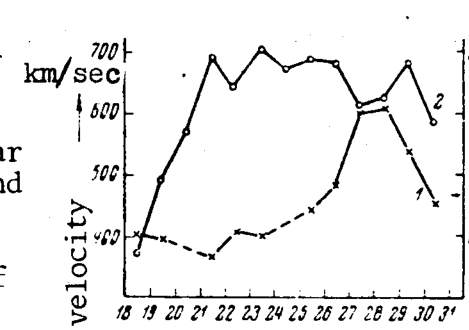

Fig.3. Comparison of the curves for the average-daily swv (1) with the daytime temperature (2). The dashes of (1) denote the absence of data. This refers to December 1965

The centers of zones of solar-conditioned cyclo- and anticyclogenesis are plotted in the chart, established by the authors of [13] for the Northern hemisphere. Referred to the first ones are the Denisov straits and the Southern tip of Kamchatka peninsula, and to the second ones – the region of Baltic sea between Southern Sweden and North Germany, and also the northwestern tip of Alaska. Preliminary comparison of meteoparameter variations over different isobaric surfaces in these and certain other regions with swv, reveal in a series of cases analogous relationships, whereupon the fluctuations of temperature values and surface altitudes are in phse in some regions, and in antiphase in others. Sign inversions take place periodically, possibly encompassing some of the regions, with little effect on others. This increases the complexity of interaction between them.

It is possible that what influences the tropospheric processes is not so much the magnitude of swv as its derivative in time. In this context particular attention should be given the study of influence on the synoptic process of recurrent and sporadic magnetic storms with sudden commencement (sc) linked with the passage of the Earth through the front of the collisionless shock wave [14].

It is striking that the centers of action on the chart of [13] are located either in coastal zones of continents (Alaska, Kamchatka), or have a propensity to be drawn to narrow sea passages and straits, Such a disposition is possibly linked with the properties of the underlying surface and the electromagnetic activity of the coastal zones, and also with the existence in these regions of quasisteady circulation in the lower ionosphere on account of the difference in the fluxes of effective radiation above land and seas [15].

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*** T H E   E N D ***

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