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NUMERICAL MODELING OF OROGRAPHICALLY DISTURBED AIR FLOW IN THE TROPOSPHERE IN CONDITIONS OF NONSTATIONARITY OF LARGE –SCALE BACKGROUND PROCESSES

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The formation of weather on the territory of Georgia is the result of joint action of large-scale synoptic and local processes. The classification of basic synoptic processes developed above the territory of Georgia and character of the weather caused by these processes are well investigated by the Georgian meteorologists [1, 2]. Among the local factors the complex relief of Georgia, which essentially deforms air flow of synoptic scales, is very impotent for spatial-temporal distribution of meteorological fields. Clearly, the question arises as to how the meso-scale flow over the complex terrain responds to the variability of large-scale processes. The theoretical investigation of this problem was partially performed in [3, 4] in the framework of the 2-D hydrostatic model. The main goal of this paper is to describe briefly some results of numerical experiments on simulation of meso-scale air flow over the complex terrain (in case of both the model and real relief of Georgia) in conditions of nonstationarity of large-scale background (synoptic) flow on the basis of a 3-D hydrostatic meso-scale numerical model [5].

In case of simulation of air flow over the isolated obstacle with height 1 km and diameter 150 km on a vertical in the troposphere 21 levels were taken with 46 x 66 grid points and grid step 10 km. The time step was $\Delta t = 60$ s. In the numerical experiments with taken into consideration the real relief Caucasus the solution domain with horizontal sizes 830 x 690 km was covered with a grid having 30 levels on a vertical and 84 x 70 points on each horizons. The other parameters were the same as in the previous case.

In the numerical experiments the uniform undisturbed background flow was directed along the axis x. It arose at t = 0 and within two hours reached 12 m/s. After t = 10 h it was transformed during 12 hours and obtained opposite direction with speed U = -12 m/s.

Fig.1, which illustrates transformation of a disturbed air flow in the vertical section zx passing through the centre of the obstacle under the nonstationary background flow, showed that during decreasing of speed of the background flow the meso-scale wave flow over the obstacle loses stability, its amplitudes gradually grow and transform in the vortical movement. Under influence of occurrence and amplification of the background opposite current the disorder meso-scale movement becomes ordered again and current of an opposite direction over the obstacle is gradually formed (Fig1d).

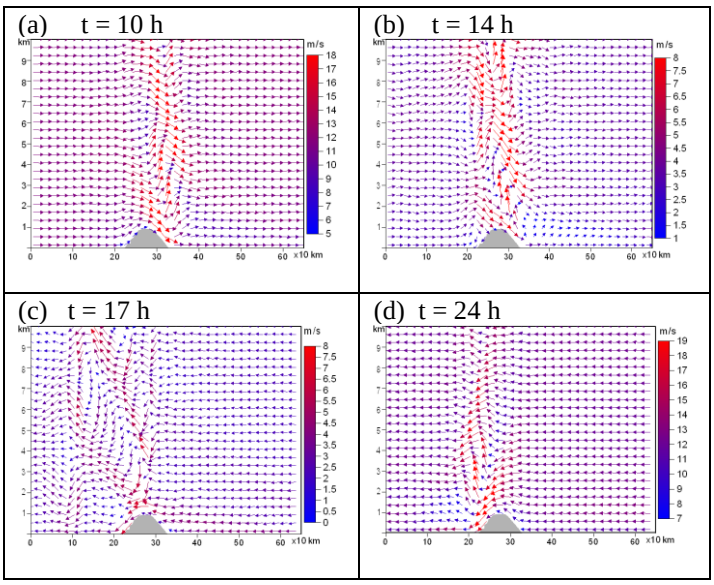

Fig. 1. Transformation of the meso-scale flow in the vertical section. (a)-10 h, (b)- 14 h, (c) – 17 h, (d) – 24 h.

In Fig. 2 the disturbed flows above the Caucasus on height z = 200 m (above the Black Sea level) are shown at t=10h and t=16h, when the western background flow transformed into the eastern flow. Above the Kolchis lowland and the east part of the Black Sea tendency of generation of vortical formation is clearly observed (Fig.2b). Similarly

to the isolated obstacle there is interesting phenomenon, when the disturbed meso-scale current exists in that case, when the background current is absent (Fig. 2b).

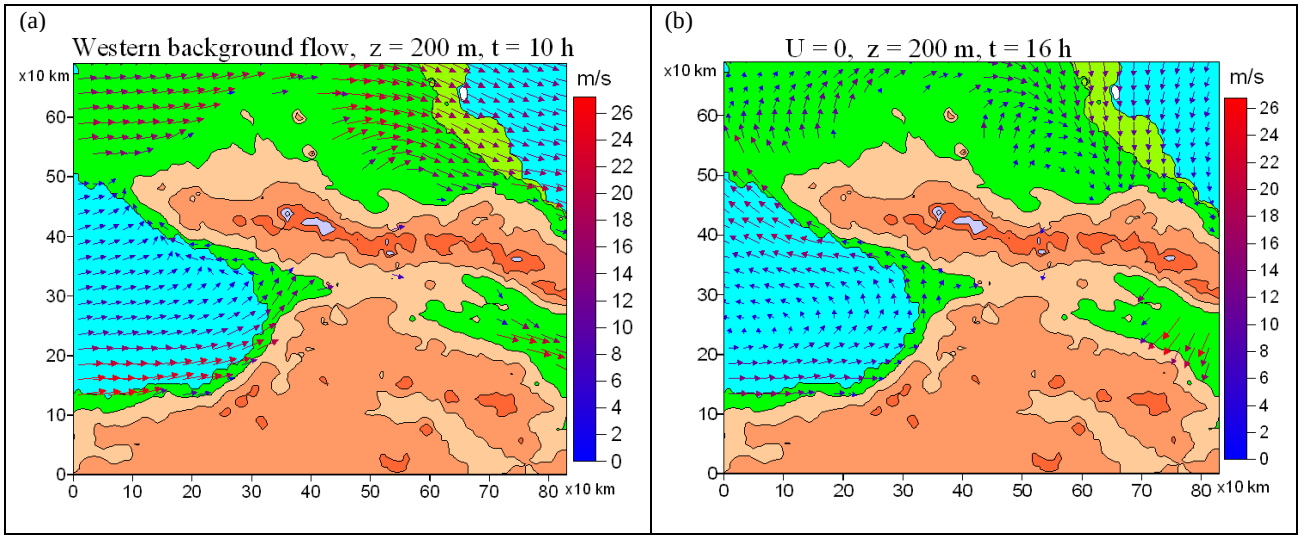

Fig.2. Simulated current field above the Caucasus relief on z = 200 m at following time moments: (a) – 10 h, (b) – 16 h

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ორობრაფიულად შეშფოთებული ჰაერის დინების რიცხვითი მოდელირება ტროპოსფეროში ფონური დიდმასშტაბიანი პროცესების არასტაციონარულობის პირობებში/Dდ.დემეტრაშვილი, თ.დავითაშვილი/ საქართველოს ტექნიკური უნივერსიტეტის ჰიდრომეტეოროლოგიის ინსტიტუტის შრომათა კრებული-2013.-ტ.119.-გვ.14-16-ინგლ., რეზ. ქართ., ინგლ., რუს.

3-განზომილებიანი ჰიდროსტატიკური რიცხვითი მოდელის საფუძველზე გამოკვლეულია ჰაერის მეზომასშტაბური დინების სტრუქტურა ტროპოსფეროში ფონური შეუშფოთებელი დინების არასტაციონარულობის პირობებში მოდელური განმხოლოებული მთისა და კავკასიის რეალური რელიეფის შემთხვევაში. გამოთვლებმა აჩვენა, რომ შეუშფოთებელი დინების არასტაციონარულობას შეუძლია მნიშვნელოვნად შეცვალოს ჰაერის დინების სტრუქტურა მთიანი რელიეფის ზემოთ.

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The structure of meso-scale air flow in the troposphere over the isolated model obstacle and real relief of Caucasus is investigated in conditions of nonstationarity of background undisturbed flow on the base of the 3-D hydrostatic numerical model. Calculations have shown that the non-stationary character of the undisturbed air flow can considerably change the structure of air flow above the mountain relief.

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ЧИСЛЕННОЕ МОДЕЛИРОВАНИЕ ОРОГРАФИЧЕСКИ ВОЗМУЩЕННОГО ВОЗДУШНОГО ПОТОКА В ТРОПОСФЕРЕ В УСЛОВИЯХ НЕСТАЦИОНАРНОСТИ КРУПНОМАСШТАБНЫХ ФОНОВЫХ ПРОЦЕССОВ/ Д. Деметрашвили, Т.Давиташвили/ Сб. Трудов Института Гидрометеорологии Грузинского Технического Университета. - 2013.-т.119.-с.14-16 - Англ., Рез. Груз., Англ., Рус.

На основе 3-х мерной гидростатической численной модели исследуется структура мезомасштабного воздушного течения в тропосфере в условиях нестационарности фонового невозмущенного потока в случае изолированного модельного препятствия и реального рельефа Кавказа. Расчеты показали, что нестационарность невозмущенного воздушного потока может значительно изменить структуру воздушного потока над горным рельефом.