The special method of satellite data processing and interpretation for this anomaly region was applied. Four relatively large anomalous zones of «oil deposit» type were identified and mapped within the surveyed segment of the Antarctic Peninsula margin. The mapped (during 2006 expedition) geoelectric anomaly of «oil deposit» type completely falls into one of the anomalous zones that were selected by satellite data (Figure, *b*).

The multi-channel seismic data acquired on the South Shetland margin [Jin et al., 2003] show that Bottom Simulating Reflectors (BSRs) are widespread in the area, implying large volumes of gas hydrates. Satellite data over the site of BSR zones extension, identified by seismic studies, have been processed and interpreted. The various processing parameters were analyzed during investigation that allowed revealing and mapping the anomalous zone of «gas hydrates deposit» type within this region. In general, the revealed and mapped anomalous zone of «gas hydrates deposit» type satisfactorily correlate with BSRs zones, defined by seismic data. The anomalous zones of «gas deposit» and «oil deposit» type were not detected there by the satellite data processing and interpretation results.

**Conclusions.** New data about geodynamics and Drake Passage earth's crust structure have demonstrated high efficiency of the VERS method using. New prognosis for local HC accumulations along the Antarctic Peninsula margin confirms the high oil and gas potential perspectives of the Antarctic Peninsula region.

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# Numerical modeling of cloud and precipitation evolution and its connection with entropy

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A recent work devoted to sources of entropy connected with mesoscale frontal cloudiness. Three-dimensional nowacasting and forecasting numerical models developed in UHRI [Pirnach, 1998; 2008; Belyi et al., 2009] for modeling of the winter and summer frontal cloud systems were adapted for theoretical interpretation of the investigated phenomena.

The integration of full thermodynamic equations, which included equations for air motion, water vapor content, temperature transfer, the continuity and thermodynamic state equations are used in these models. Cloud microphysics is considered explicitly by solving the kinetic equations for the droplet and crystal size distribution. The size distribution function of the cloud and precipitation particles is formed due to cloud condensation nucleation, ice nucleation, growth (evaporation) by deposition, and freezing, riming, collection by raindrops of cloud drops. Droplet and ice nucleation is accounted by parameterization in the model. Cartesian coordinates $(x, y, z)$ and terrain-following sigma coordinates $\xi$, $\eta$, $\zeta$ have been used. In second case the system of equation will be described as follows:

$$\frac{dS_i}{dt} = F_i + \Delta S_i , \qquad (1)$$

$$\frac{\partial \rho u}{\partial \xi}+\frac{\partial \rho v}{\partial \eta}+\frac{\partial \rho w}{\partial \zeta}=0\,, \tag{2}$$

$$\rho=\frac{p}{RT}\,, \tag{3}$$

$$S_i=\left(u, v, w, T, q, f_k\right),$$
$$i=1,2,\ldots,8\,;\; k=1,2,3\,, \tag{4}$$

$u$, $v$, $w$ are components of wind velocity across $\zeta$, $\eta$, $\zeta$ axis, which are directed on east, north and perpendicular to the ground surface respectively. $F_i$ are describes separate physical processes: $F_1$—$F_3$ presented right parts of wind velocity projections, which included Carioles parameter, free-fall acceleration, pressure gradients and etc.; $F_4$—$F_5$ describe heat and moisture fluxes; $F_6$—$F_8$ represent processes of droplets and crystal nucleation, cloud and precipitation particles falling velocities, their transfer, condensation and coagulation processes etc; $\Delta S_i$ is turbulent transfer; $p$ and $\rho$ are pressure and density; $T$ is temperature; $q$ is specific humidity; $f_k$ are cloud particle size distribution functions.

A splitting method had been used for sintegration of the system (1). The solution scheme was described as follows:

$$\frac{\partial S_i}{\partial t}=\sum_{n=1}^{6} F_{in}\,,\; n=1,2,\ldots,6\,;\; i=1,2,\ldots,8\,. \tag{5}$$

System (5) to split up on 6 equations as follows:

$$\frac{\partial S_{in}}{\partial t}=F_{in}\,,\; n=1,2,\ldots,6\,. \tag{6}$$

$F_{i1}$ presented the advection, convection and turbulent transfer; $F_{i2}$ included the pressure gradients; $F_{i3}$ included Carioles acceleration; $F_{i4}$ described a vertical motion solution schemes; $F_{i5}$ presented condensation processes; $F_{i6}$ included coagulation solution schemes.

Entropy *S* calculated by relationship [Khrgian, 1969]:

$$S=C_p \ln\theta+\text{const}\,, \tag{9}$$

$\theta$ is potential temperature, $C_p$ is specific heat capacity at the constant pressure.

Production of entropy calculated by relationship as follows:

$$\frac{dS}{dt}=\frac{d\theta}{dt}\frac{C_p}{\theta}\,. \tag{10}$$

Numerical simulation of atmospheric phenomena connected with atmospheric fronts and their cloud systems that caused the damages events have been fulfilled for several synoptic situations observed in steppe part and mountain regions of Ukraine. Diagnostic and forecast models have been constructed for mesoscale cloud formations followed by high floods in Carpathian region. Numerical experiments are carried out with aim to determine the role of various dynamics and microphisics parameters in formation of strong and catastrophic precipitation. Series of numerical experiments have been carried out with aim to research the key parameters caused features of development of dangerous events and their activity. Special numerical experiments have been carried out with a main goal to research the temporal and spatial distribution of entropy and its production. Numerical study interaction between entropy and cloud and precipitation had been carried out.

It is found, the unlimited growth of water and ice supersaturation is possible if mechanisms of cloud precipitation formation are insufficiently effective for precipitating of whole moisture. In turn, it can cause intensive activation of cloud condensation nuclei and unlimited growth of large drops as well. Therefore the unlimited growth of precipitation intensities may occur.

Some key parameters, meteorological conditions and predictors caused the occurrence of dangerous phenomena were defined. The main features of strong precipitation have been noted as follows: interaction of flows of different physical nature coming from opposite directions; presence of ice supersaturation layers; strong vortical motions in single air mass advanced to mountain ridge; chimney clouds with ice tops and cirrus clouds above; high tropopause achieved 10 km and more, strong ascending and compensative descending motions; the necessary combination of precipitation-forming mechanisms.

Coupling modeling of evolution entropy and precipitation found their perfect agreement. Regions of the low entropy coincided with regions of heavy precipitation. Regions with high entropy located in cloudless space. Regions of the low entropy can to be good predictors of heavy precipitation with a high confidence probability.

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# The effect of variable viscosity in the Earth's mantle on the stress field of the mantle and an overlying continent, moving self-consistently due to mantle flow

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In numerical two-dimensional experiments we investigate the spatial field of stresses in the mantle and continent and its evolution. A continent moves self-consistently with changing mantle flows. Velocity of a continent in the process of movement varies in accordance with time-dependent forces which act from underlying viscous mantle as well as with mantle forces acting on the end faces of continent. This model is described in [Bobrov, Trubitsyn, 2008]. Continent viscosity is equal to 1e5 with respect to average viscosity of the mantle. For convection modeling we used Citcom code with high Rayleigh numbers, strong viscosity variations and active markers for simulating continent [Moresi, Gurnis, 1996]. We consider three model laws for viscosity: isoviscous mantle case; $P,T$-dependent viscosity case and viscosity $= f(P, T$, stress_ invariant). For these three models we analyze how a form of viscosity.

law can change stress fields in the mantle and continent. We research what model law gives the results more close to actual data. The horizontal stress field in moving continent greatly depends on variations of horizontal velocity in the underlying mantle, and also on continent position between the ascending and descending mantle streams. Subcontinental upwelling mantle flows have the extensive effect; sub-continental downwelling ones- the compressive effect. Mantle plumes near continent's borders demonstrate compressive effect on continent, downwelling flows produce its extension. If the horizontal stresses are presented in dimensionless form then our cases show rather big but not principal differences. Thus, the mantle model with constant viscosity can be regarded as qualitatively representative. However, after transition to dimensional parameters it appears, that in isoviscous mantle model stresses values bigger in several times, than in the cases of variable viscosity. In this case isoviscous mantle model leads to strongly overestimated stresses and is not representative in this aspect. Mantle model with variable viscosity has typical horizontal stress values in the major portion of mantle — (2÷6) MPa; in continent at different stages of its movement — (2÷15) MPa.

It should be noted that all examined models should give approximately equal Nusselt number (i. e., should have the same efficiency of bearing-out of heat, as surface heat flow is the observational value). For this reason, the values of the adopted Rayleigh number Ra, in all computations, were different.

Figure presents a comparison of temperature and stress fields for the isoviscous mantle case and for the variable viscosity case. All values are given in dimensionless form. This comparison allows identification of a number of interesting effects.

**Results**. The models in this work are simplified in several aspects. However our purpose was to reveal only the main features and patterns of the process of mantle flow in the presence of floating continental material. From the numerical results, the following conclusions can be derived.

1. The distribution of horizontal stress in a moving continent over a viscous mantle greatly depends