

UDC: 528

GEODETIC AND HYDROLOGICAL RESEARCH AROUND BULGARIAN ANTARCTIC BASE ON LIVINGSTON ISLAND, ANTARCTICA

Borislav Alexandrov, Yuri Tzanovsky

University of Architecture, Civil Engineering and Geodesy, Sofia, Bulgaria, 1, Hristo Smirnenski Blvd, alekb_fgs@uacg.bg; tzanovski_fgs@uacg.bg

Summary. This report displays the obstacles and specialties in doing geodetic and hydrographic works in the severe polar conditions of Antarctica, near Bulgarian Antarctic base on Livingston Island, South Shetland Islands. Surveying of the ice free rock passages by means of classical geodetic technology was made. The first hydrographical survey of a part of the South bay, near Bulgarian base was made too and displays the specialties in hydrographical works in polar conditions. For the implementation of the set goals, GPS, hydroacoustic and classical geodetic equipment were used. We represent results from a digital modeling of the relief of South Bay (next to BAB) and surveyed territory on Livingston Island. A geographic information system is used.

Key words: Antarctica, Livingston Island, hydrography, GPS, digital modeling of the relief.

Геодезические и гидрографические исследования в районе Болгарской антарктической базы на о-ве Ливингстон, Антарктика. Александров Борислав, Цановски Юри. Университет архитектуры, строительства и геодезии, София, Болгария, 1046, бул. Хр. Смирненски 1, alekb_fgs@uacg.bg; tzanovski_fgs@uacg.bg

Резюме. Материал отражает трудности и особенности выполнения геодезических и гидрографических исследований в полярных условиях Антарктики в районе Болгарской антарктической базы (БАБ) на острове Ливингстон, Южные Шетландские острова. Средствами классической геодезической технологии выполнено картографирование свободных ото льда проходов в скалах. Сделан первый гидрографический снимок части акватории Южного залива в районе Болгарской антарктической базы, где отражены особенности гидрографической деятельности в полярных условиях. Для выполнения различных задач использованы GPS и гидроакустическая техника, а также конвенциональная геодезическая аппаратура. Представлены результаты цифрового моделирования рельефа дна и картографирования территорий в районе БАБ с использованием географической информационной системы.

Ключевые слова: Антарктика, остров Ливингстон, гидрография, GPS, цифровое моделирование рельефа дна.

Геодезичні та гідрографічні дослідження в районі Болгарської антарктичної бази на о-ві Лівінгстон, Антарктика. Александров Борислав, Цановскі Юрі.

Резюме. Матеріал відображає труднощі й особливості виконання геодезичних і гідрографічних досліджень у полярних умовах Антарктики в районі Болгарської антарктичної бази (БАБ) на острові Лівінгстон, Південні Шетландські острови. Засобами класичної геодезичної технології виконано картографування вільних від криги скельних проходів. Зроблено перший гідрографічний знімок частини акваторії Південної затоки в районі Болгарської антарктичної бази, на якому відображені особливості гідрографічної діяльності в полярних умовах. Для виконання різних завдань використано GPS та гідроакустичну техніку, а також конвенціональну геодезичну апаратуру. Представлено результати цифрового моделювання дна і картографування територій у районі БАБ з використанням географічної інформаційної системи.

Ключові слова: Антарктика, острів Лівінгстон, гідрографія, GPS, цифрове моделювання рельєфу дна.

The Bulgarian Antarctic Base "St. Kliment Ohridski" is situated at 62°38'29"S latitude and 60°21'53"W longitude on Hurd Peninsula. In the Bulgarian Antarctic Base (BAB) every year, a lot of researches are conducted. They are in the sphere of geology, seismology, geomorphology, ecology, biology, geodesy, other scientific fields and Bulgarian and foreign scientists take part (The illustrations see the color paste between pages 96 and 97).

BAB consists 4 building adapted for living, generator and store premises, a hangar for boats and an orthodox chapel. It has in possession two boats "ZODIAC" and two motor sledges. During expeditions, the station is inhabited by 20 explorers, part of them foreign experts.

Geodetical works in the polar conditions of Antarctica were experienced by authors, during their expeditions in 1998/99,2000/01 (B. Aleksandrov) and 2009/10 (B. Aleksandrov and Y. Tsanovski), in the Bulgarian Antarctic Base (BAB).

For the implementation of the set goals, distance meter, optical theodolite, GPS and hydroacoustic equipment were used. First of all were made digital surfaces of rock passages with using classical instruments. After calculating the elevations of the points, surface was created with GIS AutoCAD Desktop by 1600 shot points and total area about 350 dka, represented by contours with sections 5 m.

Creation of a digital model of the surface. After calculating the elevations of the points on the surface, a filtration of data for atypical elevations was made. During the filtration of the heights, density of the shot points was not disturbed as the recording interval was chosen with a view of receiving information on every 15m. The digital model was created with GIS AutoCAD Desktop with 1600 shot points and total area about 350 dka. It is represented by contours with sections on every 5 m.

In South Bay the whole aquatory was not explored. There was no map with detailed depths, even with an approximate accuracy. During 18th expedition in season 2009-2010 year, was made first detailed map of a part from South Bay. For a proper data base, whole data from hydrographic survey must be reduced to one surface level. That's why was create a foot rule, which helped us to deduce an average sea level for the period of our experience.

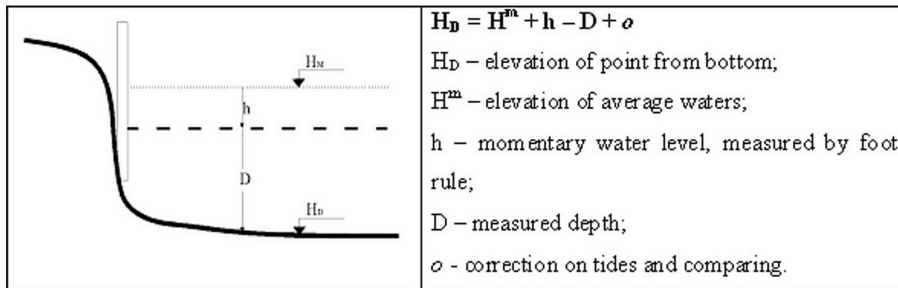
The elevation of the zero level of the mounted foot rule was fixed through a total station and an existing geodesic net, created in 1998/99. It was used in the same period for making of a digital model of the region around the Bulgarian Antartvic Base (BAB). Thus, it was made a unity between the ashore geodesic and cartographic operations that were already done and hydrographic measurements.

In Antarctic conditions, the attention in the preparation for a hydrographic photo is essential - the boat and working team. As a priority is people safety, their equipment, their own motivation and training level. To lead the boat in projected profiles was not an easy task, because of constant ice-moving and sudden changes in the atmospheric conditions.

Binding the measured depths to an united elevation system with the one of the shore was accomplished through water level indications on the foot rule for the duration of the hydrographic survey. In the beginning and in the end of the survey, reports from the water meter gauge were made. Measured depths are corrected in order to remove tides fluctuations.

After calculating elevations of measured points, a filtration of data for atypical elevations was made. These calculations are as a result from acoustic "sounds" or "participations" of local inhabitants - whales and seals. During this filtration, density of the shot points was not disturbed as the recording interval was chosen with a view of receiving information on every 15 m. The digital model was created with 1815 points and total area about 1.5 km². It is represented by isobaths with sections on every 2 m.

Using measurements done in the researches of the authors, we represent a geodetic map of region nearby Bulgarian Antarctic Base "St. Kliment Ohridski". The tradition is everything what was made in Antarctica to be turned back there as a basic knowledge for future works.

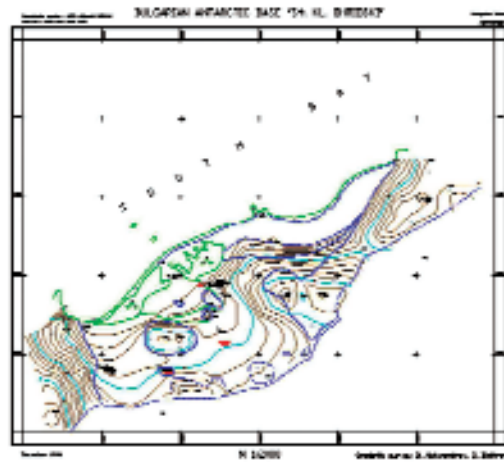


CALCULATION OF ELEVATIONS OF MEASURED POINTS

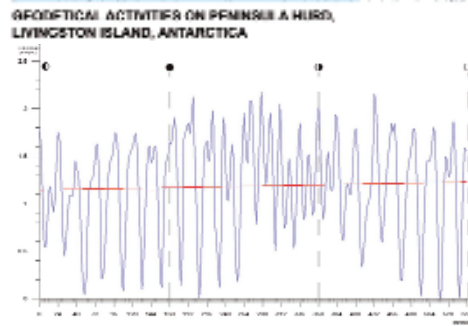
Geodetical activities on Livingston Island:

- Geodetical survey on rock passages;
- GPS measurements for geological goals;
- GPS measurements for geomorphological and glacier goals;
- Geodetical research for vertical refraction;
- Measurements for glacier deformation;
- Hydrological survey in part of South Bay;
- Creation of a foot rule for researching the sea level;
- Digital modelling of shore and seabed around Bulgarian base.

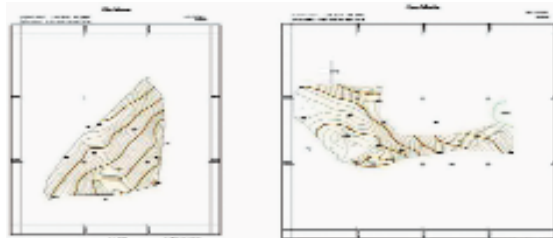
Borislav Alexandrov, Yuri Tzanovsky
 GEODETIC AND HYDROLOGICAL RESEARCH AROUND BULGARIAN ANTARCTIC
 BASE ON LIVINGSTON ISLAND, ANTARCTICA



**Topographical plane nearby Bulgarian Antarctic base
 "St. KLIMENT OHRIDSKI"**



AVERAGE SEA WATER LEVEL FOR THE PERIOD OF MEASUREMENTS



**Topographical planes of Sero Mirrador
 and Pico Moores mountain**



3D model of the region of Bulgarian Antarctic base