

ANNOTATION

for a dissertation for a doctoral degree
Philosophy (PhD) 6D071100 – Geodesy
Urazaliyev Aset Seisenbekovich

MODERNIZATION OF LOCAL GEODETIC NETWORK OF ALMATY CITY WITH USE OF SATELLITE AND GRAVITY DATA

Relevance of the topic. Modernization of the local geodetic network of Almaty is an important task for improving the accuracy of spatial positioning and ensuring the sustainability of the city's geodetic infrastructure. The rapid development of urban infrastructure, as well as the seismic and tectonic activity of the region, require regular updating and improvement of the accuracy of geodetic measurements. At present, the solution of modern problems in geodesy is associated with high requirements for the accuracy of the geodetic network. The existing urban geodetic network no longer meets the requirements of regulatory and technical documents, this is closely related to the emergence of high-precision geodetic instruments (satellite receivers, electronic tacheometers, etc.). The contradictions between the accuracy of measurements performed by new instruments and the accuracy of the existing local urban geodetic network are due to the fact that old coordinate systems were created using other equipment that are much inferior in technical characteristics (theodolites, light range finders) and measuring technologies. Given the above factors, the right solution would be to integrate modern satellite technologies and gravimetry data, which will significantly improve the accuracy of altitude and horizontal coordinates, which is necessary for various engineering projects, monitoring deformations of the earth's surface and ensuring the safety of urban structures. Also, the creation of a local geoid model is not only of scientific and practical importance, but is also considered economically feasible, since the construction of a geoid model will replace expensive, labor-intensive geometric leveling with cheaper GNSS methods.

The aim of the study is a comprehensive modernization of the local geodetic network of the city of Almaty by using satellite technologies and gravimetric data to improve the accuracy of spatial coordinates. The complex provides for the transformation of coordinates between the local system and the global WGS 84 system and the development of a local geoid model using modern methods and technologies.

Object and subject of the study. The object of the study is the local geodetic network of the city of Almaty. The subject of the study is modern methods and technologies for the comprehensive modernization of the geodetic network (calculation of transformation parameters between coordinate systems, creation of a local geoid model) using satellite and gravimetric data.

Research objectives. Adjustment of statistical satellite observation data performed at the points of the Almaty geodetic network in the universal software package GAMIT / GLOBK to improve the accuracy of spatial coordinates. Taking into account system errors for ionospheric delays, tide accounting, etc. and joint adjustment with global IGS stations will allow determining the coordinates of the points with high accuracy. Calculation of the parameters of the transition between the local coordinate system and the global WGS 84 system, taking into account the heterogeneity of networks, is achieved by using various transformation methods: the Helmert method, polynomial and conformal transformation, etc. Evaluation of the accuracy of the obtained results, selection of the most suitable method that ensures high accuracy of the transformation.

Development of a local geoid model based on ground-based gravimetric data and gravimetric modeling methods that will take into account regional features of the gravity field. Comparative analysis of the results obtained with existing global geoid models.

Scientific provisions submitted for defense.

Modernized geodetic network of Almaty city using satellite and gravimetric data, providing increased accuracy of spatial positioning.

1) New parameters for the transition between the local coordinate system and the global WGS 84, which ensures high transformation accuracy by eliminating uncertainties in positioning, joint adjustment with global IGS stations of statistical satellite measurement data and selection of the optimal transformation method taking into account the heterogeneity of the two systems .

2) Highly accurate local geoid model for the territory of Almaty, taking into account regional features. The proposed model takes into account the specifics of the gravitational field of the city of Almaty, which significantly increases its practical applicability.

Scientific novelty of the research.

A comprehensive approach to modernizing the geodetic network of Almaty has been developed based on satellite and gravimetric data:

New parameters for the transition from the local coordinate system to WGS84 of the Almaty geodetic network were obtained based on the processing of daily statistical measurements at points by eliminating positioning uncertainties (clock errors, ionospheric delays, taking into account tides), as well as joint adjustment with global IGS stations, which made it possible to determine the coordinates of the points with high accuracy.

A highly accurate local geoid model has been created for the city of Almaty, which meets modern accuracy requirements.

Practical significance. The results of the work can be used in practical activities on the modernization and operation of the geodetic network of the city of Almaty. The created local geoid model and new parameters of the transition between coordinate systems will be useful for increasing the accuracy of spatial measurements in engineering projects, construction, deformation monitoring and other tasks requiring high data accuracy. The results of research work can be used in various fields of activity: RSE on the Right of Economic Management "NCGPI", the Land Relations Department of Almaty , domestic and international research organizations in this area, which contributes to the development of the economy and increasing the safety of national infrastructure.

Relationship with research and development and government programs. The defense of a doctoral dissertation is the expected result of the project for grant funding of fundamental and applied scientific research of young scientists - postdoctoral students under the project " Zhas " galym » for 2023-2025, scientific director - Urazaliyev A.S. Also, the studies carried out on the development of the geoid model were carried out within the framework of State procurement contract for the implementation of a scientific and (or) scientific and technical project under budget program 217 "Development of Science" under the priority "Information, Communication and Space Technologies IRN No. BR 21882366 - OT -23 "Development of a geoid model of the Republic of Kazakhstan as the basis for a unified state system of coordinates and heights", 2023-2025, scientific supervisor - Kasymkanova H.M.

The author's personal contribution consists of setting the goal and objectives of the research, preparing the information base, the calculation part, analysis and interpretation of the results obtained, primary processing of satellite observations and their adjustment, recalculation of the parameters of the transition between the local coordinate system and WGS 84, creation of a geoid model, writing articles and a doctoral dissertation.

Publications. 9 scientific works have been published on the topic of the dissertation, including: 1 article in a journal, which is included in the Scopus database (Percentile - 36), 1 article was published in an international conference, which is included in the WoS and Scopus databases , 6 articles in journals recommended by the Committee for Quality Assurance in Science and Higher Education of the Ministry of Science and Higher Education of the Republic of Kazakhstan.

1. A. S. Urazaliyev , D. A. Shoganbekova , R. Shults , M. S. Kozhakhmetov , G. M. Iskaliyeva . Investigation of LSMSA approach in local geoid modeling//News of the National Academy of Sciences of the Republic of Kazakhstan, Series of Geology and Technical Sciences. – 2024. – T. 4. – P. 261-273. (Percentile - 36)

2. Shults , R., Urazaliyev , A., Annenkov , A., Nesterenko , O., Kucherenko , O., Kim, K. Different Approaches to Coordinate Transformation Parameters Determination of Nonhomogeneous Coordinate Systems//Environmental Engineering. Proceedings of the International Conference on Environmental Engineering. ICEE. – Vilnius Gediminas Technical University, Department of Construction Economics & Property, 2020. – Vol. 11. – pp. 1-7.

3. Urazaliyev AS, Kyrgyzbayeva GM, Nurakynov SN TRANSFORMATION OF COORDINATES OF GEODETIC NETWORK WITH USE OF SATELLITE TECHNOLOGIES ON THE EXAMPLE THE TERRITORY ATTACHED TO THE CITY OF ALMATY // News of the NAS RK. Series physical and mathematical . – 2020. – No. 3. – P. 160-168.

4. Zhanbayev , ZS, Kaldybayev , AA, Nurakynov , SM, Urazaliyev , AS, & Kairanbayeva , AB SCIENTIFIC AND METHODOLOGICAL BASES OF GPS MONITORING OF INTENSIVE MOVEMENTS OF THE EARTH'S CRUST IN THE EARTHQUAKE-PRONE REGIONS OF KAZAKHSTAN// Bulletin of the NAS RK. Physical-mathematical series. – 2020. – No. 3. – P. 177-182.

5. A.S. Urazaliyev , G.M. Kyrgyzbaeva . METHOD OF DETERMINING THE PARAMETERS OF THE TRANSITION TO THE LOCAL COORDINATE SYSTEM OF THE CITY OF ALMATY BY SATELLITE TECHNOLOGIES // BULLETIN " KazNITU ", No. 2 (138), 2020, 274-278 pp., ISSN 2709-4758

6. Shoganbekova D. A., Urazaliyev , A. S., Kasymkanova , Kh. K., Kozhakhmetov , M. S. ASSESSMENT OF THE EFFECTIVENESS OF GLOBAL GEOPOTENTIAL MODELS FOR THE TURKESTAN REGION// Aues Bulletin . – 2024. – Vol. 2. – No. 65.

7. Shoganbekova , DA, Urazaliyev , AS, Kassymkanova , K., Kozhakhmetov , MS , Kydyrkozhaqyzy , S. EVALUATION OF GLOBAL GEOPOTENTIAL MODELS IN KAZAKHSTAN BASED ON GEOID HEIGHTS AND GRAVITY ANOMALIES // Bulletin KazGASA . – 2024. – T. 2. – No. 92. – pp. 194-209.

8. Zemtsova A.V., Urazaliyev A.S. COORDINATE SYSTEMS IN MODERN GEODESY//Bulletin of KazGASU . – 2017. – V. 4. – No. 66. – P. 133-138.

Structure and volume of the dissertation. The dissertation work consists of an introduction, literature review, description of the object and methods of research, results and their discussion, conclusion and a list of references from 75 sources.