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of the International Union
of Geodesy and Geophysics**

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РОССИЙСКАЯ АКАДЕМИЯ НАУК

Национальный геофизический комитет

НАЦИОНАЛЬНЫЙ ОТЧЕТ

**Международной ассоциации геодезии
Международного
геодезического и геофизического союза**

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В предлагаемом вниманию читателей Отчете о научных работах по геодезии отражены результаты исследований по тематике секций Международной ассоциации геодезии, проводившихся в Российской Федерации и отраженные в публикациях за период с начала 1990 по конец 1994 г. Несмотря на значительное снижение ассигнований в отчетный период, научные исследования в области геодезии проводились практически по всем направлениям. В особенности значительными результатами явились: завершение построения государственной геодезической сети и ее строгое уравнивание; изучение гравитационного поля и геоида по спутниковой альтиметрии; дальнейшее повышение точности абсолютных гравиметров и приливной аппаратуры; значительный прогресс в области как собственно изучения приливов и нутации Земли, так и использования приливных наблюдений с целью изучения локальных неоднородностей упругих модулей земной коры. Значительно продвинуты работы в области изучения современных движений земной коры как в совершенствовании методов математической обработки результатов полевых измерений, так и в обобщенной интерпретации с использованием геодезических, геофизических и геоморфологических данных. Статьи Отчета написаны членами секции геодезии Национального геофизического комитета.

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Ответственный редактор

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М.Т.Прилепин

The National Report to the International Association of Geodesy, IUGG, contains a brief description of results of research, carried out on the topics of the Sections of the Association by the geodesists of the Russian Federation, and a list of References for the period of 1990-1994. Despite considerable reduction in the financing of observations, the scientific studies were carried out practically in all branches of geodesy. Of particular importance are the following achievements:

- the accomplishment of the State Geodetic Network and its precise adjustment;
 - the study of the gravity field and of the geoid by satellite altimetry;
 - higher precision of absolute gravimeters and of tide instruments; significant progress in the study of the Earth's tides and the Earth's nutation and in the application of tidal observations for the study of local inhomogeneities of elastic modules of the Earth's crust;
 - considerable progress was attained in the study of recent crustal movements both in mathematical processing methods of field measurements and in generalized interpretation by application of geodetic, geophysical and geomorphological data.
- Individual parts of the Report were prepared by the members of the Section of Geodesy of the National Geophysical Committee of the Russian Federation. Prof. M.T.Prilepin, Chairman of the Section of geodesy, is the Editor of the Report.

Editor:

Professor M.T.Prilepin

1. The Basic Geodetic Networks

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The review contains the classification and estimation of the accuracy of the updated State Geodetic Network of Russia, describes the prospects of its further development and improvement, and indicates the stages and methods of adjustment of the State geodetic Network. The review also presents the results of scientific research and experiments with the new instruments and technology in geodetic science and practice; i.e., the establishment of a metrological site or attestation of satellite receiving-computational units, the elaboration of geoinformation systems, participation in solution of ecological problems of the country, description of research in classical geodetic methods.

2. Space Geodesy

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Russian Academy of Sciences
S.K.Tatevyan. Moscow. Astronomical Institute,
Russian Academy of Sciences

The space geodesy studies in Russian were mainly aimed at exploitation of space geodetic satellites GEO-IK equipped with radioaltimeters, laser reflectors, and range-rate tracking systems. The GEO-IK2 satellite with a radioaltimeter of decimeter accuracy is now being elaborated. Thirty million satellite measurements were used to obtain the parameters of the Earth's ellipsoid and the transformation parameters of the geodetic system of coordinates, and also the parameters of the Earth's gravity field, gravity anomalies and undulations of the geoid on the oceans. At the Astronomical Institute, RAS, the data base of laser observations is being augmented for determination of parameters of the Earth's rotation and for the studies on the Wegener Project.

3. Precise Gravimetry

A.V.Kopaev. Moscow. Astronomical Institute of the Moscow University

The Russian Fundamental Absolute Base Station Network includes stations observed from 2 to 5 times during 1983-1994 with a set of 4 absolute gravimeters exhibiting a precision of about 5-10 vGal. Nontidal gravity variations with the same device can be monitored with an uncertainty of about 2-4 mGal reaching 24 mGal for Petropavlovsk-Kamchatskii (observed twice with GABL).

Vertical gravity gradients at the Lomonosov Fundamental Gravity Base Station have been observed four times in 1991-1992 with two Sodin gravimeters.

The micronetwork at BIPM, Sevres, was observed with two Sodin gravimeters in February and June, 1994.

New instruments for tide gravity recording were developed at the Astronomical

Institute of Moscow University on the base of Sodin quartz gravimeters equipped with CCD-scales and a small portable tilting installation for absolute calibration with precision of about 0.3 %. First tests demonstrate the drift of 3-5 mGal/day and accuracy of hourly values of about 1 mGal.

4. Marine Gravimetry

P.A.Stroeve. Moscow. Shteinberg Astronomical Institute,
Moscow State University

The 1990-1994 period was a time of significant activation of marine gravimetry in Russia, in particular with regard to the elaboration and construction of new instruments, of new methodological and technological approaches to gravity measurements and their processing and application. The role of satellite measurements of gravity field parameters and the importance of the altimeter method of study of the surface of the World Ocean and of the geoid have greatly increased during the last four years.

This activation of marine gravimetry was due to the process of conversion of defence industry which made available theoretical and instrumental results of many defense institutions for application in science and economics, for example, the practical achievements of the Central Research Institute "Elektropribor", of the Central Research Institute "Del'fin", of the State Institutes for Navigation and Hydrography, of the Institute of Automatics and Electronics, and others.

A great impetus to gravity field research and its interpretation was conveyed by the availability of the previously "secret" gravimetric materials. The same is true of regional data on land and in the ocean and of detailed measurements. Naturally, this is primarily applicable to the territory of the Former Soviet Union. The Ministry of Defence of Russia made accessible the detailed gravimetric data of measurements, with 10 km resolution (5' x 7'.5 areas) and with accuracy higher than 0.5 mGal, which cover the entire territory of the USSR from 1950 to 1985 and makes up more than 10 million points.

Finally, the results of study of the gravity field and of the geoid from satellite altimetric data, accomplished by Russian scientists on the basis of their own observations, were published for the first time.

The civil industrial and scientific organisations became increasingly active as well. The studies are carried out in a wide range of problems of gravity observations in motion, including theoretical achievements, elaboration and construction of equipment, preparation and metrological attestation of research on sea, accomplishment of experimental and industrial measurements.

5. Earth's Tides and Nutation

S.M.Molodenskiy. Moscow. Institute of Physics of the Earth

The main aim of our investigations includes the theory of the Earth's tides and nutation, as well as the construction of the models of the internal structure of the Earth, which are based on the results of astrometric and tidal measurements.

The main results are:

1. More rigorous theory of the Earth's forced nutation is constructed, which includes effects of the mantle's unelasticity, effects of the liquid core compressibility and heterogeneity, effects of the core-mantle topography and effects of dissipative core-mantle coupling.

2. Based on new VLBI data some new estimations of unelastic properties of the mantle are obtained.

3. The estimations of the real accuracy of some modern expansions of tide-generating forces are obtained.

4. Some problems of interpretation of tidal data on tilts and strains in the vicinities of cavities are considered.

6. Recent Crustal Movements

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D.A. Lilienberg. Moscow. Institute of Geography, Russian Academy of Sciences

The basic results of study of recent crustal movements during the period of 1991-1994 are discussed. The field measurements were carried out on a limited scale and mainly within international cooperation projects. The specialists concentrated their efforts on theoretical aspects and on generalization and interpretation of available observation materials. A Service for control of deformations of the Earth's surface is being organized in the frame of the Federal Service of Seismological Observations and Earthquake Prediction. The methods and software for mathematical processing and analysis of results of repeated geodetic measurements are being improved, as also the methods of joint interpretation of geodetic, geophysical, geomorphological and other types of observations. The methods and technology of observations are elaborated to obtain seismoprogностic information. The results of study of geodeformations in tectonically active areas of Russia are generalized. The territory of the Caucasus and of the Caspian and Aral seas is thoroughly studied, because the state of high seismic activity is expected there for the next few years. The observation series of many years of the level of the Caspian Sea indicate a possible cessation of its rising. Justification is presented of the hypothesis of the wave character of regional geodynamic processes. The peculiar features of deformation of the active geological structures of the Baikal rift zone and of the Olekmo-Stanovoi seismic zone were investigated. In Yakutia, a deformation precursor of a strong earthquake is recorded. Studies are carried out of the regularities in the seismic and volcanic-tectonic deformations in Kamchatka. The data of global observation with space geodesy technique are analysed to evaluate the planetary kinematic characteristics. The space-time regularities are revealed in the variations of horizontal deformations in geological structures of different ranks and in the lengths of the measured lines. The theory of the autowave origin of geodynamic activity is developed. More than 200 scientific papers were published; the contents of 150 of them are briefly described in the Report.

1. ОПОРНЫЕ ГЕОДЕЗИЧЕСКИЕ СЕТИ

З.С. Хаимов. Москва. Московский государственный университет геодезии и картографии

Приведена классификация и оценка точности построения современной государственной геодезической сети России и перспективы ее дальнейшего развития и совершенствования. Описываются этапы и методы уравнивания государственной геодезической сети.

Приведены результаты научно-исследовательских и экспериментальных работ по использованию новой техники и технологии в геодезической науке и практике: по созданию метрологического полигона для аттестации спутниковых приемо-вычислительных комплексов; по разработке геоинформационных систем; участию в решении экологических проблем страны, а также описаны исследования, относящиеся к классическим геодезическим методам.

Построение современной государственной геодезической сети России и других стран СНГ завершено в 1990 г. Сеть состоит из космической геодезической сети (КГС), доплеровской геодезической сети (ДГС), астрономо-геодезической сети 1-го и 2-го классов (АГС), геодезических сетей сгущения 3-го и 4-го классов (ГСС).

КГС состоит из 20 стационарных постоянно действующих астрономо-геодезических пунктов, геоцентрические координаты которых определены по доплеровским, дальномерным и фотографическим наблюдениям ИСЗ и системы ГЕО-ИК [13] при среднем расстоянии между пунктами около 1 тыс. км.

ДГС состоит из 110 пунктов при среднем расстоянии между ними в 500 км, взаимное положение которых и геоцентрические координаты определены по доплеровским наблюдениям ИСЗ системы "Транзит".

АГС состоит из 164306 пунктов 1-го и 2-го классов, из которых 5% относится к пунктам 1-го класса, а остальные - ко 2-му классу. При этом сеть 1-го класса представляет систему полигонов, периметром в 800-1000 км, состоящих из цепочек треугольников, четырехугольников и центральных систем, проложенных вдоль меридианов и параллелей со средней длиной стороны в 25-30 км и лишь на северо-востоке страны - сплошную сеть треугольников с длиной стороны в 50-70 км. Сеть 2-го класса - это сплошная сеть треугольников с длиной стороны от 7 до 20 км, заполняющая полигоны 1-го класса.

Сеть АГС в основном построена методом триангуляции (более 95% пунктов) и в незначительной своей части - полигонометрии. В ней измерено 7872 базисных линий и определено 3584 астрономических пунктов [32]. Среднеквадратическая ошибка измерения углов, подсчитанная по формуле Ферреро, составила в триангуляции 1-го класса 0,65", а во 2-м классе - 0,9". Невязки треугольников не превышали соответственно 3 и 4". Относительная ошибка базисных сторон и астрономических определений на пунктах Лапласа составили 1:370000, широт 0,36", долгот 0,04" и азимутов 1,2".

ГСС состоит из 170 тысяч пунктов 3-го и 4-го классов, построенных в виде вставок в сети старших классов при длине стороны в 5-8 км - в 3-м классе и 2-5 км - в 4-м классе. Она построена как методом триангуляции, так и методами полигонометрии и трилатерации. Среднеквадратические

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