



System of Geodetic Parameters “Parametry Zemli 1990” PZ-90.11

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The PZ-90.11 is the national Coordinate System

- introduced by the Russian Federation Government Decree 1463 of December 28, 2012, and
- used for geodetic support of orbital missions and navigation from January 15, 2014.
- The PZ-90 Coordinate System is a basis for geodetic support of the GLObal NAVigation Satellite System (GLONASS).



System of Geodetic Parameters “Parametry Zemli 1990” * PZ-90.11

Responsible Organization: Ministry of Defense of the Russian Federation

Abbreviated Frame Name: PZ-90

Associated TRS: PZ-90

Coverage of Frame: Global

Type of Frame: 3-Dimensional orthogonal

Last Version: PZ-90.11

Reference Epoch: 2010.0

* In Russian “Earth Parameters 1990”



Brief Description

“Parametry Zemli 1990” is a system of geodetic parameters including:

- fundamental geodetic constants,
- Earth ellipsoid parameters,
- Earth gravity field parameters,
- geocentric coordinate system, and
- transformation parameters to other reference systems.



Definition of Frame

- **Origin:** Earth's center of mass being defined for the whole Earth including oceans and atmosphere.
- **Axes:**

Z-axis is directed to the Conventional Reference Pole that was defined by the International Earth Rotation and Reference Systems Service (IERS) and Bureau International de l'Heure (BIH);

X-axis is directed to the intersection point of the equatorial plane and the Zero Meridian defined by BIH;

Y-axis completes a right-handed system.
- **Scale:** Conforms to the current state of knowledge of the speed of light, the geocentric gravitational constant as well as to the precision of the satellite laser ranging instruments.
- **Orientation:** Conforms to the Recommendations of BIH.
- **Evolution:** Zero rotation rate with respect to the ITRF2008.

PZ-90.11 is agreed with ITRF2008.



Coordinate System: Orthogonal Cartesian Coordinates (X, Y, Z). The PZ-90 Coordinate System origin also serves as the geometric center of the PZ-90 ellipsoid and the Z -axis is its minor axis. The geodetic coordinates (latitude, longitude, height) are computed using this PZ-90 reference ellipsoid.

Defining Parameters: PZ-90 is defined by four fundamental parameters:

Parameter	Notation	Unit	Value
Semi-major Axis	a	m	6 378 136.0
Flattening Factor of the Earth Ellipsoid	α	–	1/298.25784
Gravitational Constant (Mass of Earth's Atmosphere Included)	fM	m^3/s^2	$398\,600.4418 \times 10^9$
Angular Velocity of the Earth	ω	rad/s	$7.292\,115 \times 10^{-5}$



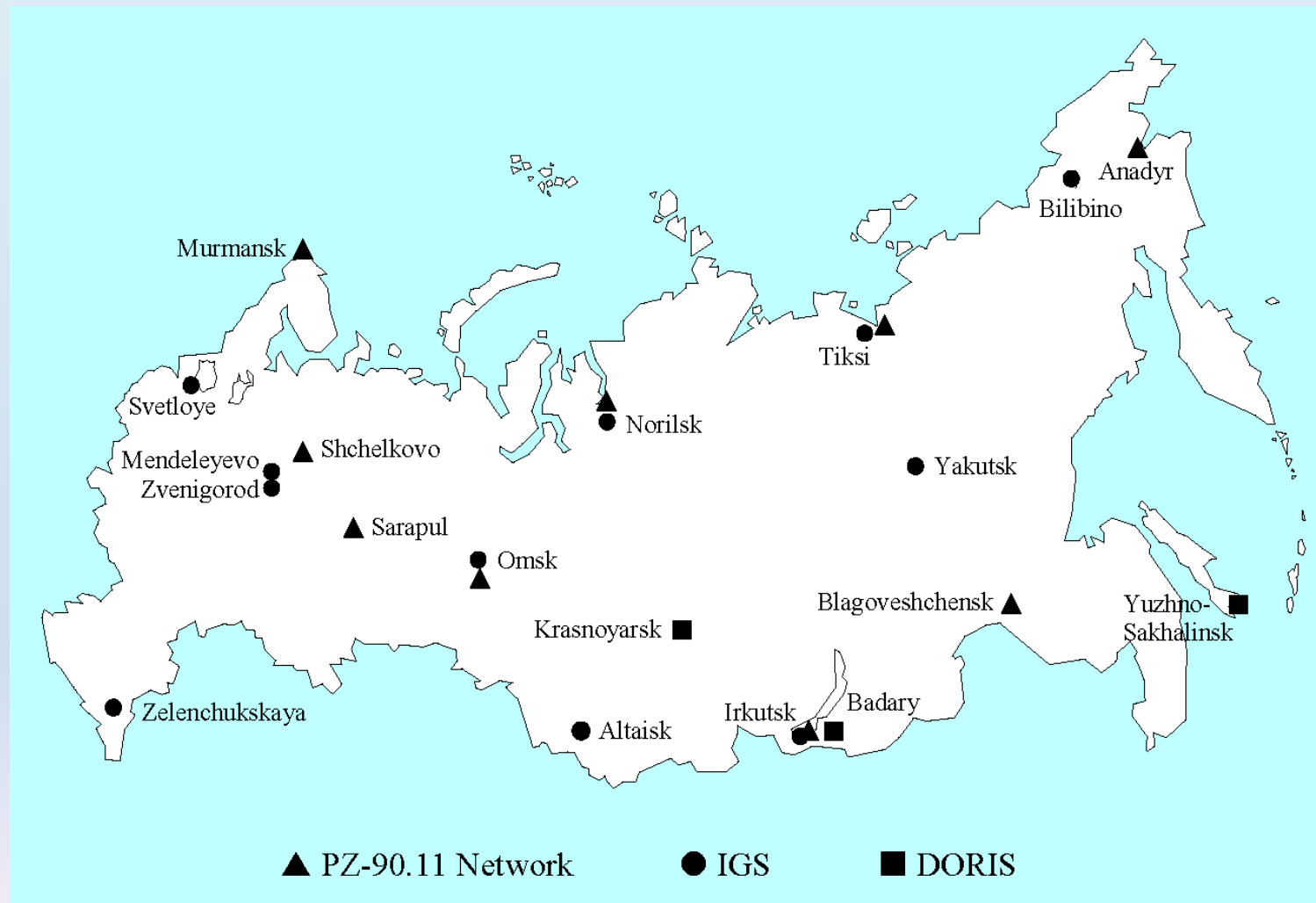
Relationship with other reference systems: Transformation parameters of reference systems are obtained based on the differences between the coordinates of the same sites defined in both systems.

Transformation Parameters: Transformation parameters and their root-mean-square errors for PZ-90, PZ-90.02, PZ-90.11, WGS 84 (G1150) and ITRF2008.

#	From	To	ΔX (m)	ΔY (m)	ΔZ (m)	ω_x (mas)	ω_y (mas)	ω_z (mas)	m (10^{-6})	Epoch
1	PZ-90	PZ-90.02	-1.07 ± 0.10	-0.03 ± 0.10	+0.02 ± 0.10	0	0	-130 ± 10	-0.220 ± 0.020	2002.0
2	WGS 84 (G1150)	PZ-90.02	+0.36 ± 0.10	-0.08 ± 0.10	-0.18 ± 0.10	0	0	0	0	2002.0
3	PZ-90.11	ITRF2008	-0.003 ± 0.002	-0.001 ± 0.002	+0.000 ± 0.002	+0.019 ± 0.072	-0.042 ± 0.073	+0.002 ± 0.090	-0.000 ± 0.0003	2010.0



Location of the sites in the Russian Federation used in PZ-90.11



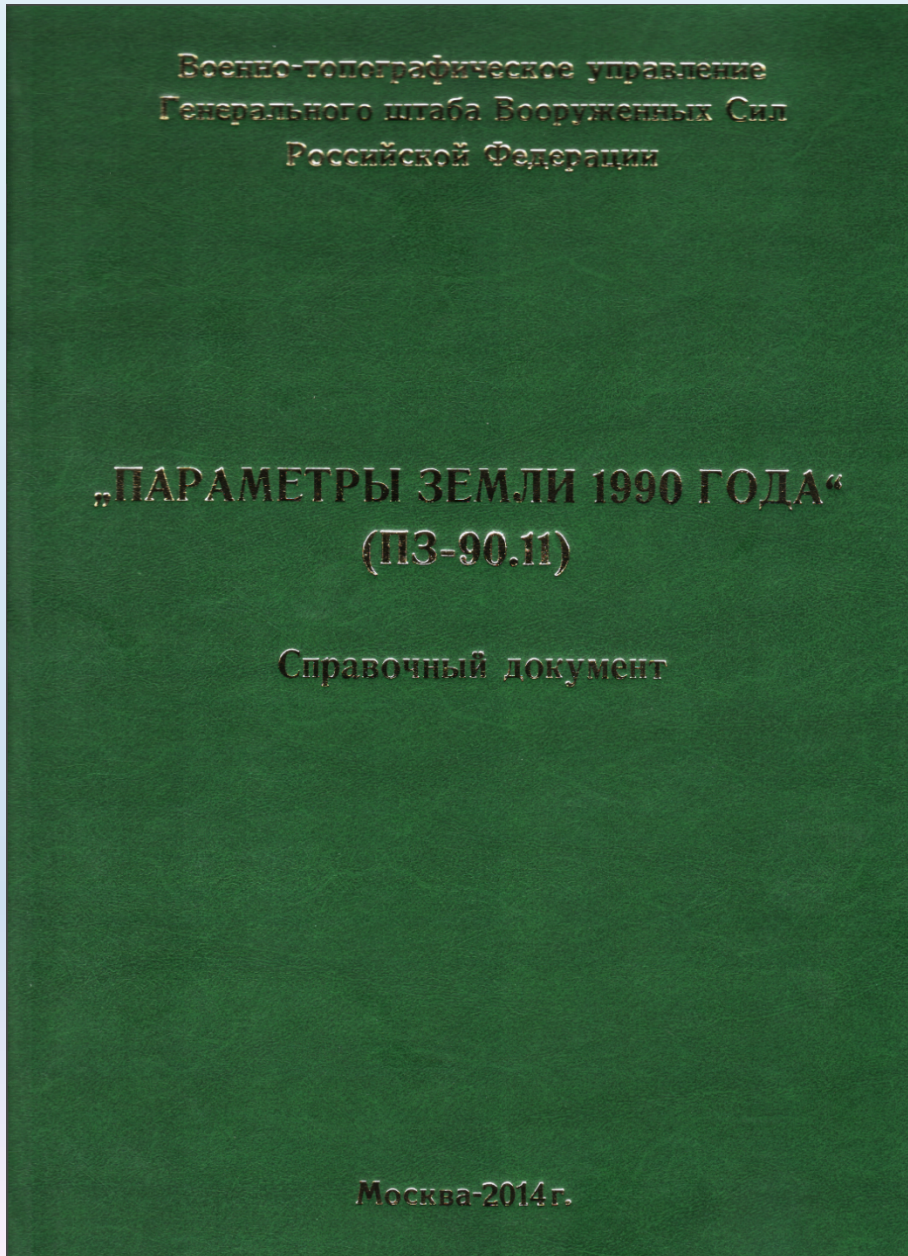


PZ-90.11 Details:

- fundamental geodetic constants – no changes,
- Earth ellipsoid parameters – no changes,
- Earth gravity field parameters – no changes,
- geocentric coordinate system – **updated**, and as a consequence
- transformation parameters to other reference systems – **changes**.

PZ-90.11 accuracy parameters:

#	Parameter	Accuracy
1	Earth's Center of Mass	0.050 m
2	Alignment of the Axes	0.001"
3	Relative Position of the Sites	0.005-0.010 m



References:

“Parametry Zemli 1990” (PZ-90.11): Reference document. – Moscow: Military Topographic Department of the General Staff of the Armed Forces of the Russian Federation, 2014, 52 p.

<p>ОБЩИЕ СВЕДЕНИЯ</p> <p>Цели, задачи, назначение документа.</p> <p>Содержание документа.</p> <p>Ссылки на другие документы.</p>	<p>Содержание документа.</p> <p>Ссылки на другие документы.</p>	<p>Содержание документа.</p> <p>Ссылки на другие документы.</p>	<p>Содержание документа.</p> <p>Ссылки на другие документы.</p>	<p>Содержание документа.</p> <p>Ссылки на другие документы.</p>
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Conclusions:

- The new version of “Parametry Zemli 1990” Coordinate System (PZ-90.11) is adopted in the Russian Federation.
- The PZ-90 Coordinate System is also used for orbital mission support and navigation.
- It has been implemented into GLONASS geodetic support. The PZ-90 is the GLONASS geodetic basis. From the GLONASS satellites, users directly receive coordinates in PZ-90 and time in the GLONASS time scale.
- The PZ-90.11 Reference document was issued.
- And the template described The Global Geocentric Coordinate System of the Russian Federation has been prepared and could be placed on ICG website.



Future Plans:

- The PZ-90.11 monitoring is to be provided and user access is to be granted to the coordinates of a number of the PZ-90.11 sites based on the monitoring results.
- The English version of the Reference document “Parametry Zemli 1990” (PZ-90.11) is to follow and to be published on the websites of the Ministry of Defense of the Russian Federation and the Federal Space Agency.



ЦНИИМАШ
TSNIIMASH

Thank you!

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