

Product Information of INAGEOID2020 Version 2.0

According to Law No. 4/2011 on Geospatial Information and Law No. 11/2020 on Omnibuslaw, the National Gravity Control Network (JKGN) is a part of Basic Geospatial Information (IGD) that used as a reference in the preparation of the Thematic Geospatial Information (IGT). The Regulation of Head of the Geospatial Information Agency (BIG) No. 13/2021 about Indonesia Geospatial Reference System (SRGI) mentions that Indonesian Geoid is used as a national vertical geospatial reference system. In 2020, INAGEOID2020 was ratified through the Decree of Head of the BIG No. 81/2020 about INAGEOID2020. This standard is important because now all of vertical control network organizer have the same reference. A geoid is an equipotential field of earth gravity field that mathematically coincides with the global mean sea level. A geoid is formed as a result of the earth's gravity variations, so that required adequate gravity data and covers all regions of the world in order to produce the ideal geoid.

INAGEOID2020 which launched in 2020 needs to be updated due to the addition of gravity data in several locations in Indonesia under the name INAGEOID2020 version 2.0. INAGEOID2020 version 2.0 is modeled from several data such as gravity data, global geoid model, and elevation data. The gravity data is a primary data resulted from the gravity survey campaign by various methods like terrestrial and airborne. The Earth Gravity Model 2008 (EGM2008) with 360 degrees is chosen due to its quality more fitted to the Indonesian area. The elevation data is represented by Digital Elevation Model is Shuttle Radar Topographic Mission (SRTM) 30 meters. The Remove-Restore Technique and the Fast Fourier Transformation (FFT) approach is used for modeling. Figure 1 explains the flowchart of Indonesian geoid modeling.

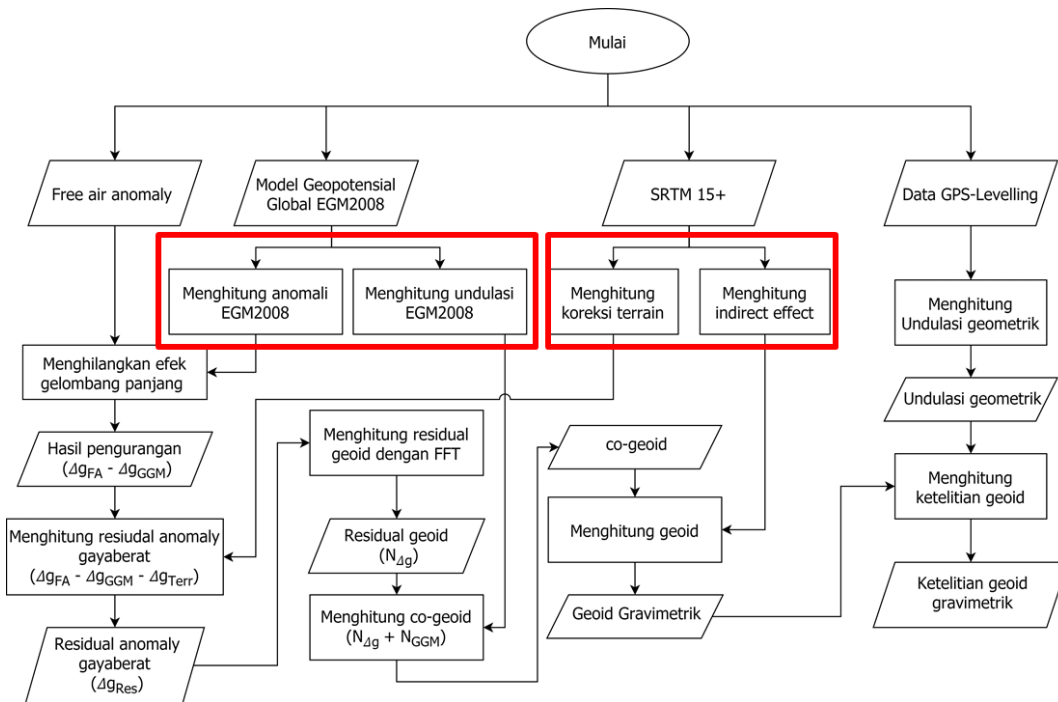


Figure 1. The flowchart of Indonesian geoid modeling

INAGEOID2020 version 2.0 uses gravity data up to 2021. Figure 2. explains the difference data-set between INAGEOID2020 version 1.0 and 2.0. In the other hand, the difference between INAGEOID version 1.0 and 2.0 is in the fitting method. INAGEOID2020 version 1.0 is fitted to several validation control point in Java and Bali. Meanwhile, INAGEOID2020 version 2.0 is fitted to tidal benchmark (BM) spread throughout Indonesia. The reasons are:

1. Geoid is more coincide to the Mean Sea Level (MSL).
2. Maintaining the pattern and trend of geoid.

Figure 3. explains the flowchart of fitting geoid process.

Inageoid2020 v1.0	Inageoid2020 v2.0
DTU10 untuk wilayah perairan	DTU17 untuk wilayah perairan
Wilayah daratan yang kosong tidak diisi data	Wilayah daratan yang kosong diisi data FAA EGM2008 degree 2190
-	Ada penambahan data airborne gravity di wilayah Kalimantan Barat dan Tengah
Banten menggunakan data gayaberat airborne + gayaberat terestris	Banten menggunakan data gayaberat terestris + FAA EGM2008 degree 2190
Sebagian wilayah NTT dan Seluruh Pulau Papua menggunakan data gayaberat airborne	Sebagian wilayah NTT dan Seluruh Pulau Papua menggunakan data FAA EGM2008 degree 2190
-	Penambahan data gayaberat terestris di Penajam Paser, Tarakan, Banjarnegara, Cilacap, Banten, dan Majalengka

Figure 2. The difference dataset between INAGEOID2020 version 1.0 and 2.0

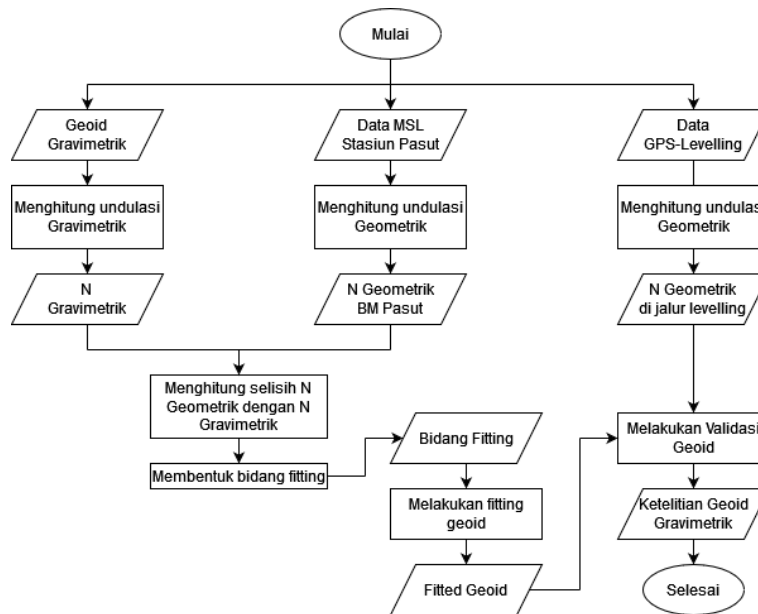


Figure 3. The flowchart of fitting geoid process

The accuracy of the Indonesian geoid model is evaluated by comparing values between the gravimetric and geometric undulation. The geometric undulation is obtained by subtracting the ellipsoidal height resulting from Global Navigation Satellite System (GNSS) observation with the orthometric height resulting from leveling measurements corrected with gravity data. The gravimetric undulation is obtained by interpolating the geoid undulation value generated in each control point based on its coordinates.

The accuracy of the Indonesian geoid model is defined in five island regions. This is due to the limited number of validation control points in Indonesia. The accuracy of the Indonesian Geoid model is shown in Table 1.

Table 1. The accuracy of the Ina-Geoid 2020 Version 2.0

<i>Island</i>	<i>Number of validation points</i>	<i>Std (cm)</i>
Jawa	186	11.81
Bali	184	21.67
Sumatera	21	28.58
Sulawesi	53	25.10
Kalimantan Barat	284	6.43
Kalimantan Timur	264	5.88

Table 1 shows the range of the accuracy starts from 28 cm up to 5 cm. Based on the Master Plan for the Implementation of the National Vertical Reference System 2020 - 2024. Our goals for INAGEOID2020 are the target of accuracy is 5 cm in the entire territory of Indonesia, high resolution and seamless between land and ocean and also can be used as a reference in large-scale mapping < 1:1.000.

In brief, the INAGEOID2020 will be updated annually to achieve a higher accuracy supporting One Map Policy and largescale map project. It is through by periodic observation of the gravity control points, densification of terrestrial gravity data , and the renewal of data acquisition.