# Overview of national realizations of the integrated geodetic reference in Europe

**Version 1.0c (2025-06-30)**

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*Attribution*

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*Description*

The information below has been compiled in the course of the EUREF Working Group "European Unified Height Reference". It is based on the contributions submitted by the bodies responsible for the national geodetic reference (e.g. national mapping agencies) since 2022. It contains specifics on the national ETRS89 realizations and their relations to the European realizations (ETRF). This information is relevant at the centimeter level and frequently not included in CRS inventories such as the EPSG. Furthermore, it provides a list of current national height reference surfaces (geoid models) and the corresponding height reference frames in order to provide easier access and use for GNSS-based height determination. For details, please refer to the corresponding EVRS website.

**DISCLAIMER: All information is provided without guarantee and based exclusively on information which was made available to us by the owner. Although it has been checked and compiled with care, no liability is taken that the data are correct and up to date.**

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*Note*

Convention for 7-parameter Helmert transformation (according to EUREF Technical Note Nr. 1): $\boldsymbol{X}_{\mathrm{Target}} = \boldsymbol{X}_{\mathrm{nat}} + T + D \cdot \boldsymbol{X}_{\mathrm{nat}} + \begin{bmatrix} 0 & -R_z & R_y \\ R_z & 0 & -R_x \\ -R_y & R_x & 0 \end{bmatrix} \cdot \boldsymbol{X}_{\mathrm{nat}}$

## List of changes

- Version 1.0 (2024-11-04): Initial version
- Version 1.0a (2024-11-15):
    - Correction for Croatia (HR): HTRS96 refers to ETRF89 in Tables 1 and 2
- Version 1.0b (2025-03-18):
    - DOI link corrected
- Version 1.0c (2025-06-30):
    - Updated for Germany (DE): New realization ETRS89/DREF91 (Realization 2025)
    - Some numbers of cross-references between remarks corrected

**Table 1** Overview of GNSS reference frames (national ETRS89 realizations) in Europe

**Background colors: Grey** No longer in use

**EPSG codes** refer to the according CRS code for 3D geographical coordinates (ellipsoidal longitude, latitude and heights)

| CC | Country | Date of info | Valid from | Valid until | Name of realization | Target frame | Epoch [yr] | Tx [mm] | Ty [mm] | Tz [mm] | D [ppb] | Rx [mas] | Ry [mas] | Rz [mas] | Re-marks | EPSG |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **AL** | Albania | 2024-07-01 | unknown | unknown | KRGJSH/ETRF2000(2008) | ETRF2000 | 2008.0 | | | | | | | | | |
| | Albania | 2024-07-01 | unknown | unknown | | ETRF2000 | 2014.177 | | | | | | | | [1] | |
| **AT** | Austria | 2024-07-01 | unknown | unknown | ETRS89 Austria 2002 | ETRF2000 | 2002.56 | | | | | | | | | |
| **BA** | Entity "Federation of Bosnia and Herzegovina" of Bosnia and Herzegovina | 2024-09-02 | unknown | unknown | BH_ETRS89 | ETRF2000 | 2011.307 | | | | | | | | | 10327 |
| **BE** | Belgium | 2024-07-01 | unknown | unknown | BEREF (Belgian Reference Frame) | ETRF2000 | 2002.73 | | | | | | | | | |
| **BG** | Bulgaria | 2024-07-01 | 2010-07-30 | present | BGS2005 (Bulgarian Geodetic System 2005) | ETRF2000 | 2005.0 | | | | | | | | | 7797 |
| **CH** | Switzerland | 2024-07-01 | unknown | unknown | CHTRF95 | ETRF93<br>ETRF2000 | 1993.0<br>2010.0 | –12.0 | –6.0 | –10.0 | 0.0 | 0.000 | 0.000 | 0.000 | [2] | 4933 |
| **CZ** | Czech Republic | 2022-06-15 | 2011-01-02 | | | ETRF2000 | 2007.0 | | | | | | | | | |
| **DE** | Germany | 2024-07-01 | ca. 2003 | 2016-11-30 | ETRS89/DREF91 Realization 2002 | ETRF2000 | 2002.79 | 63.9 | –93.9 | 53.2 | –10.9 | –2.400 | –0.800 | 2.300 | | |
| | | 2024-07-01 | 2016-01-12 | 2025-06-30 | ETRS89/DREF91 Realization 2016 | ETRF2000 | 2008.46 | 0.0 | 0.0 | 0.0 | 0.0 | 0.658 | –0.208 | 0.755 | | 10283 |
| | | 2025-06-30 | 2025-07-01 | present | ETRS89/DREF91 Realization 2025 | ETRF2020 | 2021.48 | –41.1 | –52.0 | +101.1 | –7.9 | +1.348 | +0.719 | +2.684 | [3] | |
| **DK** | Denmark | 2024-07-01 | unknown | 2019-04-30 | ETRS89/EUREF-DK94 | ETRF92 | 1994.705 | | | | | | | | [12] | |
| | | 2024-07-01 | 2019-05-01 | unknown | ETRS89/EUREF-DK94(2015) | ETRF92<br>ITRF2008 | 1994.705<br>2015.829 | –692.8 | +20.8 | +468.6 | +2.1 | +3.456 | –10.48 | –15.327 | [4]<br>[12] | |
| **EE** | Estonia | 2024-07-01 | unknown | unknown | EUREF-EST97 | ETRF96 | 1997.56 | | | | | | | | [12] | 4935 |
| **ES** | Spain (Iberian Peninsula, Balearic Islands, Alborán Island, Ceuta and Melilla) | 2023-12-23 | 2007-07-28 | unknown | REGENTE | ETRF96 | 1995.4 | | | | | | | | [5] | |
| | Spain (Iberian Peninsula, Balearic Islands, Alborán Island, Ceuta and Melilla) | 2023-12-23 | unknown | unknown | ERGNSS | ETRF2000 | 2017.0 | | | | | | | | [6] | |
| | Spain (Canary Islands) | 2023-05-03 | 2007-07-28 | unknown | REGCAN95 | ITRF93 | 1994.8 | | | | | | | | | 4080 |
| **FI** | Finland | 2024-07-01 | 1999 | unknown | EUREF-FIN | ETRF96 | 1997.0 | | | | | | | | [12] | |
| **FO** | Faroe Islands | 2024-09-05 | 2010 | | ETRS1989 Faroe Islands (FOTM) | ETRF2000 | 2008.75 | | | | | | | | | 5316 |
| **FR** | France | 2024-07-05 | 2010-05-31 | 2020-01-27 | RGF93 v2 | ETRF2000 | 2009.0 | | | | | | | | | 9776 |
| | | 2024-07-05 | 2020-01-28 | unknown | RGF93 v2b | ETRF2000 | 2019.0 | | | | | | | | | 9781 |
| **GB** | Great Britain | 2024-07-01 | 2009-10-04 | present | EUREF IE/UK 2009 (OS Net) | ETRF97 | 2009.756 | | | | | | | | | |

| CC | Country | Date of info | Valid from | Valid until | Name of realization | Target frame | Epoch [yr] | Tx [mm] | Ty [mm] | Tz [mm] | D [ppb] | Rx [mas] | Ry [mas] | Rz [mas] | Re-marks | EPSG |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **GL** | Greenland | 2024-07-01 | 2007-08-01 | present | GR96 | ITRF94 | 1996.62 | | | | | | | | | 4909 |
| **GR** | Greece | 2022-03-23 | unknown | unknown | HTRS07 (Hellenic Terrestrial Reference System 2007) | ETRF2000 | 2007.83 | | | | | | | | | |
| **HR** | Croatia | 2024-11-01 | 2004-08-04 | present | HTRS96 (Croatian Terrestrial Reference System 1996) | ETRF89 | 1995.55 | | | | | | | | | 4889 |
| | | 2024-11-01 | 2023-12-09 | present | CROPOS (CORS network) | ETRF2000 (R05) | 2008.83 | | | | | | | | | |
| **IE** | Ireland | 2023-08-03 | unknown | unknown | EUREF IE/UK 2009 | ETRF2000 | 2009.756 | | | | | | | | | |
| **IS** | Iceland | 2024-08-19 | 1997-01-01 | 2007-12-31 | ISN93 | ITRF93 | 1993.6 | | | | | | | | | 4945 |
| | | 2024-08-19 | 2008-01-01 | 2017-08-31 | ISN2004 | ITRF2000 | 2004.6 | | | | | | | | | 5323 |
| | | 2024-08-19 | 2017-09-01 | unknown | ISN2016 | ITRF2014 | 2016.5 | | | | | | | | [7] | 8085 |
| **IT** | Italy | 2024-11-01 | 1996-01-01 | 2011-11-10 | IGM95 | ETRF89 | 1996.0 | | | | | | | | | 4983 |
| | | 2024-11-01 | 2011-11-10 | present | RDN2008 | ETRF2000 | 2008.0 | | | | | | | | | 6705 |
| **LI** | Liechtenstein | See **CH** Switzerland | | | | | | | | | | | | | | |
| **LT** | Lithuania | 2023-03-03 | unknown | unknown | LKS94 | ETRF2000 | 2003.75 | | | | | | | | [8] | 4951 |
| **LU** | Luxembourg | 2024-07-01 | unknown | unknown | | ETRF2000 | 2020.82 | see [6] | | | | | | | [9] | |
| **LV** | Latvia | 2024-07-01 | unknown | 2024-12-31 | LKS-92 (EUREF-BAL92) | N/A | 1992.75 | | | | | | | | [12] | 4949 |
| **MC** | Monaco | See **FR** France | | | | | | | | | | | | | | |
| **MD** | Moldova | 2024-08-21 | unknown | unknown | MOLDREF99 | ETRF97 | 1999.4 | | | | | | | | | 4017 |
| **MK** | North Macedonia | 2022-06-15 | unknown | unknown | EUREF-MAK2010 | ETRF2000 | 2010.631 | | | | | | | | | |
| **NI** | Northern Ireland | 2023-08-03 | unknown | present | EUREF IE/UK 2009 | ETRF2000 | 2009.756 | | | | | | | | | |
| **NL** | The Netherlands | 2022-05-03 | unknown | unknown | AGRS2010 | ETRF2000 | 2010.5 | | | | | | | | | |
| **NO** | Norway | 2024-07-01 | unknown | unknown | EUREF89 | ETRF93 | 1995.0 | | | | | | | | [12] | |
| **PL** | Poland | 2024-07-01 | unknown | unknown | PL-ETRF2000-GRS80h | ETRF2000 | 2011.0 | | | | | | | | | 9701 |
| **PT** | Portugal (Mainland) | 2024-07-01 | 2007-01-01 | 2026-01-01 | ETRS89 (ETRF97) | ETRF97 | 1995.4 | | | | | | | | | |
| | Portugal (Azores, Madeira) | 2024-07-01 | 2007-01-01 | 2026-01-01 | PTRA08 (ITRF93) | ITRF93 | 1994.0 | | | | | | | | [10] | 5012 |
| **RO** | Romania | 2022-05-03 | unknown | unknown | | ETRF2000 | 2000.0 | | | | | | | | | |
| **RS** | Serbia | 2024-07-01 | 2012-03-16 | unknown | EUREF Serbia 2010 (SRB_ETRS89) | ETRF2000 | 2010.63 | | | | | | | | | 8683 |
| **SE** | Sweden | 2024-10-09 | unknown | unknown | SWEREF 99 | ETRF97 | 1999.5 | | | | | | | | | |
| **SI** | Slovenia | 2024-07-01 | unknown | 2019-12-31 | ETRS89/D96 | ETRF96 | 1995.5 | | | | | | | | | 4883 |
| | | 2024-07-01 | 2020-01-01 | unknown | ETRS89/D96-17 | ETRF2000 | 2016.75 | –236.6 | 98.5 | 201.3 | 0.0 | –17.79 | 3.673 | –24.370 | | |
| **SK** | Slovak Republic | 2024-08-23 | 2011-04-01 | 2024-03-31 | SKTRF09 | ETRF2000 | 2008.5 | | | | | | | | | |
| | | 2024-08-23 | 2024-04-01 | present | SKTRF2022 | ETRF2000 | 2008.5 | | | | | | | | | |
| **TR** | Turkey | 2022-05-11 | unknown | unknown | TUREF (Turkish National Reference Frame) | ITRF96 | 2005.0 | | | | | | | | | 5251 |

## Remarks

[1] Used for the coordinates of the 27 reference stations of the active ALBCOR network in Albania. Differences with the official KRGJSH realization are negligible (5-7 mm for all components).

[2] The original definition of CHTRF95 was to be identical to ETRF93(1993.0). Today, this is no longer strictly realized due to equipment changes and modified values in the local ties. The transformation of CHTRF95 to any ETRF frame for a certain epoch is done empirically by a 3D translation. The coordinates of the GNSS station in Zimmerwald (Station name: ZIMM00CHE, domes number: 14001M004) in CHTRF95 (Epoch 1993.0, velocity=0) are X=4331297.348, Y=567555.639, Z=4633133.728. The transformation parameters to ETRF2000 given here were calculated in 2019 and were used in the projects DACH-Geoid, EAlpG and EUHR.

[3] Transformation parameters to ETRF2020 derived from official AdV dataset (link). Additionally, a 2D transformation model (NTv2 grid) between ETRS89/DREF91 (Realization 2016) and ETRS89/DREF91 (Realization 2025) is available at https://www.adv-online.de/AdV-Produkte/Integrierter-geodaetischer-Raumbezug/Transformationsparameter/ETRS89-DREF91-R2016-R2025/.

[4] The original observation epoch of the underlying GNSS campaign and thus the epoch of the dynamic (nation-wide residual) uplift signal is 2015.829. However, the systematic part (nation-wide trend) of the land uplift in the national ETRS89 realization refers to approximately 1994.705 since the coordinates were referenced to the previous realization by Helmert transformation.

[5] Network of passive GNSS benchmarks

[6] Network of active GNSS reference stations (used for RTK etc.)

[7] Semi-dynamic datum (land uplift model ISN_vel_beta)

[8] Land uplift model NKG2016LU at epoch 2008.0

[9] Epoch 2020-10-25. LUREF2020 is a GNSS-based realization of the national LURES datum (based on Hayford ellipsoid). Transformation from LUREF2020 to ETRF2000 according to convention of EUREF Technical Note Nr. 1: Tx –189.2280 m, Ty 12.0035 m, Tz –42.6303 m, D 463.46 ppb, Rx –481.71 mas, Ry –3099.48 mas, Rz 2686.39 mas (source https://act.public.lu/dam-assets/fr/publications/documents-techniques/20210129-DTECH-ETRF2000toLUREF-datum-transition.pdf, note the inverse sign convention for the rotation parameters with w.r.t. EUREF Technical Note Nr. 1).

[10] TANGO 1994 campaign and subsequent measurements between 1995 and 2005

[11] SWEREF 99 was updated in early 2021 (2021-02-07), and the NKG2008 transformation should be used for coordinates that relate prior to that date. After that update, NKG2020 transformation should be applied instead.

[12] Information about NKG20xx transformations from national ETRS89 realizations to NKG_ETRF2000 resp. NKG_ETRF2014 can be found in:
- NKG2008 transformation to NKG_ETRF2000 at epoch 2000.0: Häkli et al. (2016), https://doi.org/10.1515/jogs-2016-0001
- NKG2020 transformation to NKG_ETRF2014 at epoch 2000.0: Häkli et al. (2023), https://doi.org/10.1515/jogs-2022-0155
Recommended transformation to ETRF2014 at epoch 2000.0 by means of EUREF Transformations 2020 (however, see [11] for exceptions in Sweden).

**Table 2** Overview of national height reference surfaces (geoid models) for transformation between ellipsoidal heights and leveling heights. For more details on the GNSS realizations, please refer to Table 1.

**Height types: NH** Normal heights, **NOH** Normal-orthometric heights, **OH** Orthometric heights (Helmert heights not precluded), **OH(H)** Helmert orthometric heights (confirmed), **U** Uncorrected for gravity

**Background colors:** Yellow CRS of grid is not ETRS89 or WGS84 geographic (longitude, latitude) → projected coordinates and/or other datum, Grey No longer in use

**Standard CRS of interpolation grids:** "ETRS89 geographic" (i.e., any ETRFxxxx) assumed as EPSG:4258, "WGS84 geographic" (i.e., any ITRFxxxx) assumed as EPSG:4326

| CC | Country | Subregion | HRS grid | Valid from | Valid until | CRS of grid | GNSS realization of ellipsoidal height | ETRS89 datum? | Ell. height linked to | Height realization | Height datum | Height type | Re-marks | Link |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **AL** | **Albania** | | **ALBAGEO03 (software only)** | 2008 | | ETRS89 geographic | **KRGJSH** | **yes** | ETRF2000 (2008.00) | **ALB86** | Durrës | OH(H) | | |
| **AT** | **Austria** | | **Austrian Geoid 2008 (GRS80)** (EPSG:9276) | 2008-01-01 | | ETRS89 geographic | **ETRS89 with GRS80 ellipsoid** (EPSG:4937) | **yes** | ETRF2000 (2002.56) | **EVRF2000 Austria** (EPSG:9274) | Amster-dam/NAP | OH | [1] [2] | Info Info ZIP |
| **AT** | **Austria** | | **Austrian Geoid 2008 (Bessel)** (EPSG:9277) | 2008-01-01 | | MGI geogr. with Bessel (EPSG:4312) | **MGI with Bessel ellipsoid** (EPSG:9267) | **no** | ETRF2000 (2002.56) by transf. | **EVRF2000 Austria** (EPSG:9274) | Amsterda m/NAP | OH | [1] [2] | Info Info ZIP |
| **AT** | **Austria** | | **Höhen-Grid plus Geoid** (EPSG:9499) | 2013-11-08 | | MGI geogr. with Bessel (EPSG:4312) | **ETRS89 with GRS80 ellipsoid** (EPSG:4937) | **(yes)** | ETRF2000 (2002.56) | **GHA height** (EPSG:5778) | Trieste (MGI/ Adria) | NOH | [2] | Info Info ZIP |
| **BA** | **Bosnia and Herzegovina** | Federation of Bosnia and Herze-govina | **Not yet available** | | | | **BH_ETRS89** (EPSG:10327) | **yes** | ETRF2000 (2011.31) | **BH_VRS1875** (EPSG:5195) | Trieste 1875 | NOH | | |
| **BE** | **Belgium** | | **hbG18** | 2018-08-01 | | ETRS89 geographic | **BEREF** (EPSG:4937) | **yes** | ETRF2000 (2002.73) | **TAW/DNG height** (EPSG:5710) | Ostende | U | | ISG |
| **BG** | **Bulgaria** | | **BG_VRS_2021** | 2021-01-01 | | ETRS89 UTM35 (EPSG:7800) | **BGS2005** (EPSG:7797) | **yes** | ETRF2000 (2005.00) | **BGS2005 height** (EPSG:9669) | Amster-dam/NAP | NH | [3] | Info Mail |
| **BG** | **Bulgaria** | | **GEOID.BG** | 2018-01-01 | | ETRS89 geographic | **BGS2005** (EPSG:7797) | **yes** | ETRF2000 (2005.00) | **Baltic Height System 1982** (EPSG:5786) | Kronstadt | NH | | Info |
| **CH** | **Switzerland** | | **CHGeo2004_ ETRS89** | 2005-01-01 | | ETRS89 geographic | **CHTRF95** (EPSG:4933) | **yes** | ETRF93 (1993.00) | **LHN95** (EPSG:5729) | Marseille (RPN) | OH | [4] [5] | Info ZIP |
| **CH** | **Switzerland** | | **CHGeo2004_ HTRANS_ETRS89** | 2005-01-01 | | ETRS89 geographic | **CHTRF95** (EPSG:4933) | **yes** | ETRF93 (1993.00) | **LN02** (EPSG:5728) | Marseille (RPN) | U | [4] [6] | Info ZIP |
| **CH** | **Switzerland** | | **CHGeo2004_ LV95** | 2005-01-01 | | CH1903+/ LV95 with Bessel (EPSG:2056) | **CHTRF95** (EPSG:4933) | **(yes)** | ETRF93 (1993.00) | **LHN95** (EPSG:5729) | Marseille (RPN) | OH | [4] [5] | Info ZIP |
| **CH** | **Switzerland** | | **CHGeo2004_ HTRANS_LV95** | 2005-01-01 | | CH1903+/ LV95 with Bessel (EPSG:2056) | **CHTRF95** (EPSG:4933) | **(yes)** | ETRF93 (1993.00) | **LN02** (EPSG:5728) | Marseille (RPN) | U | [4] [6] | Info ZIP |

| CC | Country | Subregion | HRS grid | Valid from | Valid until | CRS of grid | GNSS realization of ellipsoidal height | ETRS89 datum? | Ell. height linked to | Height realization | Height datum | Height type | Re-marks | Link |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CZ** | **Czech Republic** | | **CR2005_v1005** | 2011-01-02 | unknown | ETRS89 geographic | **ETRF2000** (EPSG:4937) | **yes** | ETRF2000 (2007.00) | **Baltic System (Bpv)** (EPSG:8357) | Kronstadt | NH | | Info ZIP |
| **CZ** | **Czech Republic** | | **QGZÚ-2013** | 2013-01-02 | unknown | ETRS89 geographic | **ETRF2000** (EPSG:4937) | **yes** | ETRF2000 (2007.00) | **Baltic System (Bpv)** (EPSG:8357) | Kronstadt | NH | [7] | Info ZIP |
| **DE** | **Germany** | | **GCG2011** | 2011 | 2016-11-30 | ETRS89 geographic | **ETRS89/DREF91/ Realization 2002** | **yes** | ETRF2000 (2002.79) by transf. | **DHHN92** (EPSG:5783) | Amster-dam/NAP | NH | | ZIP |
| **DE** | **Germany** | | **GCG2016** (EPSG:10294) | 2016-12-01 | 2023-12-03 | ETRS89 geographic | **ETRS89/DREF91/ Realization 2016** (EPSG:10283) | **yes** | ETRF2000 (2008.46) | **DHHN2016** (EPSG:7837) | Amster-dam/NAP | NH | | |
| **DE** | **Germany** | | **GCG2016/2023** (EPSG:10294) | 2023-12-04 | present | ETRS89 geographic | **ETRS89/DREF91/ Realization 2016** (EPSG:10283) | **yes** | ETRF2000 (2008.46) | **DHHN2016** (EPSG:7837) | Amster-dam/NAP | NH | | Info ZIP |
| **DK** | **Denmark** | | **DKgeoid2013B** (EPSG:10491) | 2013-03-01 | 2023-11-30 | ETRS89 geographic | **ETRS89/EUREF-DK94** | **yes** | ETRF92 (1994.71) | **DVR90(2013)** (EPSG:10484) | 10 tide gauges | OH(H) | [8] [24] | FTP |
| **DK** | **Denmark** | | **DVR90(2023)** (EPSG:10493) | 2023-12-01 | present | ETRS89 geographic | **ETRS89/EUREF-DK94(2015)** | **yes** | ETRF92 (1994.71) | **DVR90(2023)** (EPSG:10485) | 10 tide gauges | OH(H) | [9] [24] | FTP |
| **EE** | **Estonia** | | **EST-GEOID2017** | 2018-01-01 | unknown | ETRS89 geographic | **EUREF-EST97** (EPSG:4935) | **yes** | ETRF96 (1997.56) | **EH2000** (EPSG:9662) | Amster-dam/NAP | NH | [10] [24] | Mail |
| **ES** | **Spain** | Iberian Peninsula | **EGM08_REDNAP** (EPSG:9410) | 2007-07-28 | unknown | ETRS89 geographic | **REGENTE** | **yes** | ETRF96 (1995.40) | **Alicante height** (EPSG:5782) | Alicante | OH(H) | | Info |
| **ES** | **Spain** | Ceuta | **EGM08_REDNAP** (EPSG:9414) | 2007-07-28 | unknown | ETRS89 geographic | **REGENTE** | **yes** | ETRF96 (1995.40) | **Ceuta height** (EPSG:9402) | Ceuta 2 | OH(H) | | Info |
| **ES** | **Spain** | Melilla | **EGM08_REDNAP** (EPSG:10362) | 2007-07-28 | unknown | ETRS89 geographic | **REGENTE** | **yes** | ETRF96 (1995.40) | **Melilla height** (EPSG:10354) | Melilla | OH(H) | | Info |
| **ES** | **Spain** | Alboran | **EGM08_REDNAP** (EPSG:10360) | 2007-07-28 | unknown | ETRS89 geographic | **REGENTE** | **yes** | ETRF96 (1995.40) | **Alboran height** (EPSG:10353) | Alboran | OH(H) | | Info |
| **ES** | **Spain** | Formen-tera | **EGM08_REDNAP** (EPSG:10358) | 2007-07-28 | unknown | ETRS89 geographic | **REGENTE** | **yes** | ETRF96 (1998.30) | **Formentera height** (EPSG:10352) | Formente ra | OH(H) | | Info |
| **ES** | **Spain** | Ibiza | **EGM08_REDNAP** (EPSG:9413) | 2007-07-28 | unknown | ETRS89 geographic | **REGENTE** | **yes** | ETRF96 (1998.30) | **Ibiza height** (EPSG:9394) | Ibiza | OH(H) | | Info |
| **ES** | **Spain** | Mallorca | **EGM08_REDNAP** (EPSG:9411) | 2007-07-28 | unknown | ETRS89 geographic | **REGENTE** | **yes** | ETRF96 (1998.30) | **Mallorca height** (EPSG:9392) | Mallorca | OH(H) | | Info |
| **ES** | **Spain** | Menorca | **EGM08_REDNAP** (EPSG:9412) | 2007-07-28 | unknown | ETRS89 geographic | **REGENTE** | **yes** | ETRF96 (1998.30) | **Menorca height** (EPSG:9393) | Menorca | OH(H) | | Info |
| **ES** | **Spain** | El Hierro | **EGM08_REDNAP Canarias** (EPSG:9421) | 2007-07-28 | unknown | WGS84 geographic | **REGCAN95** (EPSG:4080) | **no** | ITRF93 (1994.80) | **El Hierro height** (EPSG:9401) | El Hierro | OH(H) | | Info |
| **ES** | **Spain** | La Palma | **EGM08_REDNAP Canarias** (EPSG:9420) | 2007-07-28 | unknown | WGS84 geographic | **REGCAN95** (EPSG:4080) | **no** | ITRF93 (1994.80) | **La Palma height** (EPSG:9400) | La Palma | OH(H) | | Info |

| CC | Country | Subregion | HRS grid | Valid from | Valid until | CRS of grid | GNSS realization of ellipsoidal height | ETRS89 datum? | Ell. height linked to | Height realization | Height datum | Height type | Re-marks | Link |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ES** | **Spain** | La Gomera | **EGM08_REDNAP Canarias** (EPSG:9419) | 2007-07-28 | unknown | WGS84 geographic | **REGCAN95** (EPSG:4080) | **no** | ITRF93 (1994.80) | **La Gomera height** (EPSG:9399) | La Gomera | OH(H) | | Info |
| **ES** | **Spain** | Tenerife | **EGM08_REDNAP Canarias** (EPSG:9418) | 2007-07-28 | unknown | WGS84 geographic | **REGCAN95** (EPSG:4080) | **no** | ITRF93 (1994.80) | **Tenerife height** (EPSG:9398) | Tenerife | OH(H) | | Info |
| **ES** | **Spain** | Gran Canaria | **EGM08_REDNAP Canarias** (EPSG:9417) | 2007-07-28 | unknown | WGS84 geographic | **REGCAN95** (EPSG:4080) | **no** | ITRF93 (1994.80) | **Gran Canaria height** (EPSG:9397) | Gran Canaria | OH(H) | | Info |
| **ES** | **Spain** | Fuerte-ventura | **EGM08_REDNAP Canarias** (EPSG:9416) | 2007-07-28 | unknown | WGS84 geographic | **REGCAN95** (EPSG:4080) | **no** | ITRF93 (1994.80) | **Fuerteventura height** (EPSG:9396) | Fuerte-ventura | OH(H) | | Info |
| **ES** | **Spain** | Lanzarote | **EGM08_REDNAP Canarias** (EPSG:9415) | 2007-07-28 | unknown | WGS84 geographic | **REGCAN95** (EPSG:4080) | **no** | ITRF93 (1994.80) | **Lanzarote height** (EPSG:9395) | Lanzarote | OH(H) | | Info |
| **FI** | **Finland** | | **FIN2005N00** | 2009 | present | ETRS89 geographic | **EUREF-FIN** | **yes** | ETRF96 (1997.00) | **N2000** (EPSG:3900) | Amster-dam/NAP | NH | [24] | Info ZIP |
| **FI** | **Finland** | | **FIN2023N00** | 2024-01-15 | present (recomm.) | ETRS89 geographic | **EUREF-FIN** | **yes** | ETRF96 (1997.00) | **N2000** (EPSG:3900) | Amster-dam/NAP | NH | [24] | Info ZIP |
| **FO** | **Faroe Islands** | | **Fogeoid12.02** | 2012-01-01 | unknown | ETRS89 geographic | **ETRS89** (EPSG:4937) | **yes** | ETRF2000 (2008.75) | **FVR09** (EPSG:5317) | 4 tide gauges | OH | | Info TIFF |
| **FR** | **France** | Mainland | **RAF09** (EPSG:8371) | 2010-05-31 | 2018-07-11 | ETRS89 geographic | **RGF93 v2** (EPSG:9776) | **yes** | ETRF2000 (2009.00) | **NGF-IGN69** (EPSG:5720) | Marseille | NH | | Info TXT |
| **FR** | **France** | Mainland | **RAF18** (EPSG:8885) | 2018-07-12 | 2020-01-27 | ETRS89 geographic | **RGF93 v2** (EPSG:9776) | **yes** | ETRF2000 (2009.00) | **NGF-IGN69** (EPSG:5720) | Marseille | NH | | Info TXT |
| **FR** | **France** | Mainland | **RAF18b** (EPSG:9786) | 2020-01-28 | 2021-07-01 | ETRS89 geographic | **RGF93 v2b** (EPSG:9781) | **yes** | ETRF2000 (2019.00) | **NGF-IGN69** (EPSG:5720) | Marseille | NH | | Info TXT |
| **FR** | **France** | Mainland | **RAF20** (EPSG:9876) | 2021-07-02 | unknown | ETRS89 geographic | **RGF93 v2b** (EPSG:9781) | **yes** | ETRF2000 (2019.00) | **NGF-IGN69** (EPSG:5720) | Marseille | NH | | Info TXT |
| **FR** | **France** | Corsica | **RAC09** (EPSG:8372) | 2010-06-15 | 2023-10-27 | ETRS89 geographic | **RGF93 v2** (EPSG:9776) | **yes** | ETRF2000 (2009.00) | **NGF-IGN78** (EPSG:5721) | Ajaccio | NH | | Info TXT |
| **FR** | **France** | Corsica | **RAC23** (EPSG:10506) | 2023-10-23 | unknown | ETRS89 geographic | **RGF93 v2b** (EPSG:9781) | **yes** | ETRF2000 (2019.00) | **NGF-IGN78** (EPSG:5721) | Ajaccio | NH | | Info TXT |
| **GB** | **Great Britain** | Mainland + 2km | **OSGM15_GB** (EPSG:7711) | 2016-08-01 | unknown | ETRS89 TM (EPSG: 19916) | **EUREF IE/UK 2009 / OS Net** | **yes** | ETRF97 (2009.76) | **ODN height** (EPSG:5701) | Newlyn | NOH | | Info ZIP |
| **GB** | **Great Britain** | Offshore | **OSGM15_GB** (EPSG:7713) | 2016-08-01 | unknown | ETRS89 TM (EPSG: 19916) | **EUREF IE/UK 2009 / OS Net** | **yes** | ETRF97 (2009.76) | **ODN (Off-shore) height** (EPSG:7707) | Newlyn | NOH | | Info ZIP |
| **GB** | **Great Britain** | Orkney Islands | **OSGM15_GB** (EPSG:7712) | 2016-08-01 | unknown | ETRS89 TM (EPSG: 19916) | **EUREF IE/UK 2009 / OS Net** | **yes** | ETRF97 (2009.76) | **ODN Orkney height** (EPSG:5740) | Newlyn (Orkney Islands) | NOH | | Info ZIP |
| **GB** | **Great Britain** | Shetland Islands | **OSGM15_GB** (EPSG:7714) | 2016-08-01 | unknown | ETRS89 | **EUREF IE/UK 2009 / OS Net** | **yes** | ETRF97 (2009.76) | **Lerwick height** (EPSG:5742) | Lerwick | NOH | | Info ZIP |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | TM (EPSG: 19916) | | | | | | | | |
| **GB** | **Great Britain** | Outer Hebrides | **OSGM15_GB** (EPSG:7715) | 2016-08-01 | unknown | ETRS89 TM (EPSG: 19916) | **EUREF IE/UK 2009 / OS Net** | **yes** | ETRF97 (2009.76) | **Stornoway height** (EPSG:5746) | Storno-way15 | NOH | | Info ZIP |
| **GB** | **Great Britain** | Scilly Islands | **OSGM15_GB** (EPSG:7716) | 2016-08-01 | unknown | ETRS89 TM (EPSG: 19916) | **EUREF IE/UK 2009 / OS Net** | **yes** | ETRF97 (2009.76) | **St. Marys height** (EPSG:5749) | St. Mary | NOH | | Info ZIP |
| **GB** | **Great Britain** | Isle of Man | **OSGM15_GB** (EPSG:7717) | 2016-08-01 | unknown | ETRS89 TM (EPSG: 19916) | **EUREF IE/UK 2009 / OS Net** | **yes** | ETRF97 (2009.76) | **Douglas height** (EPSG:5750) | Douglas02 | NOH | | Info ZIP |
| **GL** | **Greenland** | | **gvr2016_2016.tif** | 2016-01-01 | unknown | GR96 geographic | **GR96** (EPSG:4909) | **no** | ITRF94 (1996.62) | **GVR2016 (geoid-only)** (EPSG:8267) | Nuuk 1960 | OH | | ZIP FTP |
| **GR** | **Greece** | | **GR_HEPOS2011** | 2011-01-01 | unknown | ETRS89 TM07 | **HTRS07 (EUREF GR 2007)** | **yes** | ETRF2000 (2007.83) | **Hellenic Vertical Datum** | Piraeus | OH | | Info ZIP |
| **HR** | **Croatia** | | **HRG2009 (web application T7D)** | 2010-01-01 | present | ETRS89 geographic | **HTRS96** (EPSG:4889) | **yes** | ETRF89 (1995.55) | **Croatian Vertical Ref. System 1971** (EPSG:5610) | 5 tide gauges | NOH | | Mail |
| **IE** | **Ireland** | | **OSGM15_Malin** (EPSG:7959) | 2023-08-03 | unknown | ETRS89 geographic | **EUREF IE/UK 2009** | **yes** | ETRF2000 (2009.76) | **Malin Head height** (EPSG:5731) | Malin Head MSL 1960-69 | NOH | | Info ZIP |
| **IS** | **Iceland** | | **IceGeoid2011 (IceGeoid_ ISN93)** | 2011-01-01 | unknown | WGS84 geographic | **ISN93** (EPSG:4945) | **no** | ITRF93 (1993.6) | **ISH2004** (EPSG:8089) | Reykjavik 2004.6 | NH | [11] | GTX |
| **IS** | **Iceland** | | **IceGeoid2011 (IceGeoid_ ISN2004)** | 2011-01-01 | unknown | WGS84 geographic | **ISN2004** (EPSG:5323) | **no** | ITRF2000 (2004.6) | **ISH2004** (EPSG:8089) | Reykjavik 2004.6 | NH | [11] | Info ZIP |
| **IS** | **Iceland** | | **IceGeoid2011 (IceGeoid_ ISN2016)** | 2017-09-01 | unknown | WGS84 geographic | **ISN2016** (EPSG:8085) | **no** | ITRF2014 (2016.5) | **ISH2004** (EPSG:8089) | Reykjavik 2004.6 | NH | [11] | GTX |
| **IT** | **Italy** | Mainland | **ITALGEO2005** (EPSG:9727) | 2005-01-01 | unknown | ETRS89 geographic | **RDN2008** (EPSG:6705) | **yes** | ETRF2000 (2008.0) | **GE42 height** (EPSG:5214) | Genova 1942 | U | [12] | Info |
| **IT** | **Italy** | Sicily | **ITALGEO2005** (EPSG:9727) | 2005-01-01 | unknown | ETRS89 geographic | **RDN2008** (EPSG:6705) | yes | ETRF2000 (2008.0) | **Catania 1965 height** (EPSG:9721) | Catania 1965 | U | [12] | Info |
| **IT** | **Italy** | Sardinia | **ITALGEO2005** (EPSG:9728) | 2005-01-01 | unknown | ETRS89 geographic | **RDN2008** (EPSG:6705) | **yes** | ETRF2000 (2008.0) | **Cagliari 1956 height** (EPSG:9722) | Cagliari 1956 | U | [12] | Info |
| **LI** | **Liechten-stein** | | See **CH** Switzerland | | | | | | | | | | | |
| **LT** | **Lithuania** | | **LIT20G** | 2021-01-01 | 2025-12-31 | ETRS89 geographic | **LKS94** (EPSG:4951) | **yes** | ETRF89 (2003.75) | **LAS07** (EPSG:9666) | Amster-dam/NAP | NH | [13] [24] | Info |

| CC | Country | Subregion | HRS grid | Valid from | Valid until | CRS of grid | GNSS realization of ellipsoidal height | ETRS89 datum? | Ell. height linked to | Height realization | Height datum | Height type | Re-marks | Link |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **LU** | **Luxem-bourg** | | **N/A (NULL transformation)** | unknown | unknown | N/A | **LUREF2020 with Hayford 1924 ellipsoid** (EPSG:9893) | **no** | ETRF2000 (2020.82) by transf. | **NG95** (EPSG:5774) | Amster-dam/NAP | NOH | [14] | Info |
| **LV** | **Latvia** | | **LV'14** | 2014-12-01 | 2024-12-31 | ETRS89 geographic | **LKS-92 (EUREF BAL-92)** (EPSG:4949) | **yes** | ETRF2014 (2000.0) by transf. | **LAS2000,5 (Latvian Height System 2000)** (EPSG:1162) | Amster-dam/NAP | NH | [15] [24] | Info ZIP |
| **LV** | **Latvia** | | **N.N. (not yet published)** | 2025-01-01 | unknown | ETRS89 geographic | **LKS-2020** (EPSG:10304) | **yes** | ETRF2020 (2020.29) | **LAS2000,5 (Latvian Height System 2000)** (EPSG:1162) | Amster-dam/NAP | NH | [15] | |
| **MC** | **Monaco** | See **FR** France | | | | | | | | | | | | |
| **MD** | **Moldova** | | **EGM2008 geoid** | 2015-07-04 | unknown | WGS84 geographic | **MOLDREF99** (EPSG:4017) | **no** | ETRF97 (1999.4) | **Baltic 1977 height** (EPSG:5705) | Kronstadt 1974-1978 | NH | [16] | |
| **MK** | **North Macedonia** | | **N.N. (not yet published)** | unknown | unknown | | **EUREF-MAK2010** | | ETRF2000 (2010.631) | **NVT1** | Trieste 1875 | NOH | | |
| **NI** | **Northern Ireland** | | **OSGM15_Belfast** (EPSG:7958) | 2023-08-03 | unknown | ETRS89 geographic | **EUREF IE/UK 2009** | **yes** | ETRF2000 (2009.76) | **Belfast height** (EPSG:5732) | Belfast Lough | NOH | | |
| **NL** | **The Netherlands** | | **NLGEO2018** (EPSG:9283) | 2019-08-01 | unknown | ETRS89 geographic | **AGRS2010** (EPSG:7931) | **yes** | ETRF2000 (2010.50) | **NAP** (EPSG:5709) | Amster-dam/NAP | U | | TXT |
| **NO** | **Norway** | | **Href2018B** (EPSG:9485) | 2018 | unknown | ETRS89 geographic | **EUREF89** | **yes** | ETRF93 (1995.00) | **NN2000** (EPSG:5941) | Amster-dam/NAP | NH | [17] [24] | Info ZIP |
| **PL** | **Poland** | | **PL-geoid2021** | 2022-04-05 | unknown | ETRS89 geographic | **PL-ETRF2000** (EPSG:9701) | **yes** | ETRF2000 (2011.00) | **PL-EVRF2007-NH** | Amster-dam/NAP | NH | [18] | Info TXT |
| **PT** | **Portugal** | Mainland | **GeodPT08** (EPSG:10544) | 2009-01-01 | 2026-01-01 | ETRS89 geographic | **ETRS89/Portugal (ETRF97)** | **yes** | ETRF97 (1995.4) | **Cascais Helmert 1938** (EPSG:5780) | Cascais | OH(H) | | Info TXT |
| **PT** | **Portugal/ Azores** | São Jorge | **GeodAz2014** | 2014-01-01 | 2026-01-01 | WGS84 geographic | **PTRA08 (ITRF93)** (EPSG:5012) | **no** | ITRF93 (94-05) | **Cais das Velas height** (EPSG:6180) | Cais das Velas | OH | | Info TXT |
| **PT** | **Portugal/ Azores** | Faial | **GeodAz2014** | 2014-01-01 | 2026-01-01 | WGS84 geographic | **PTRA08 (ITRF93)** (EPSG:5012) | **no** | ITRF93 (94-05) | **Horta height** (EPSG:6181) | Horta | OH | | Info TXT |
| **PT** | **Portugal/ Azores** | Pico | **GeodAz2014** | 2014-01-01 | 2026-01-01 | WGS84 geographic | **PTRA08 (ITRF93)** (EPSG:5012) | **no** | ITRF93 (94-05) | **Cais da Mada-lena height** (EPSG:6182) | Cais da Madalena | OH | | Info TXT |
| **PT** | **Portugal/ Azores** | Graciosa | **GeodAz2014** | 2014-01-01 | 2026-01-01 | WGS84 geographic | **PTRA08 (ITRF93)** (EPSG:5012) | **no** | ITRF93 (94-05) | **Santa Cruz da Graciosa hgt.** (EPSG:6183) | Santa Cruz da Graciosa | OH | | Info TXT |
| **PT** | **Portugal/ Azores** | Terceira | **GeodAz2014** | 2014-01-01 | 2026-01-01 | WGS84 geographic | **PTRA08 (ITRF93)** (EPSG:5012) | **no** | ITRF93 (94-05) | **Cais da Figuerinha hgt.** (EPSG:6184) | Cais da Figuerinha | OH | | Info TXT |

| CC | Country | Subregion | HRS grid | Valid from | Valid until | CRS of grid | GNSS realization of ellipsoidal height | ETRS89 datum? | Ell. height linked to | Height realization | Height datum | Height type | Re-marks | Link |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PT** | **Portugal/ Azores** | Corvo, Flores | **N/A** | unknown | unknown | WGS84 geographic | **PTRA08 (ITRF93)** (EPSG:5012) | **no** | ITRF93 (94-05) | **Santa Cruz das Flores height** (EPSG:6185) | Santa Cruz das Flores | OH | [19] | |
| **PT** | **Portugal/ Azores** | Santa Maria | **GeodAz2014** | 2014-01-01 | 2026-01-01 | WGS84 geographic | **PTRA08 (ITRF93)** (EPSG:5012) | **no** | ITRF93 (94-05) | **Cais da Vila do Porto height** (EPSG:6186) | Cais da Vila | OH | | Info TXT |
| **PT** | **Portugal/ Azores** | São Miguel | **GeodAz2014** | 2014-01-01 | 2026-01-01 | WGS84 geographic | **PTRA08 (ITRF93)** (EPSG:5012) | **no** | ITRF93 (94-05) | **Ponta Delgada height** (EPSG:6187) | Ponta Delgada | OH | | Info TXT |
| **RO** | **Romania** | | **EGG97_QGRJ** | 2017-01-01 | unknown | ETRS89 geographic | **ETRF2000** (EPSG:7931) | **yes** | ETRF2000 (2000.00) | **Black Sea 1975** (EPSG:5179) | Constanta | NH | | ZIP |
| **RS** | **Serbia** | | **SQM2011 (paid web application)** | 2012-01-01 | unknown | SRB_ETRS89 geographic (EPSG:8685) | **SRB_ETRS89 / EUREF Serbia 2010** (EPSG:8683) | **yes** | ETRF2000 (2010.63) | **Serbian Vert. Ref. S. 2012** (EPSG:1216) | Adriatic Sea | NH | [20] | Info |
| **RS** | **Serbia** | | **SQM2011 (paid web application)** | 2012-01-01 | unknown | SRB_ETRS89 UTM34 (EPSG:8682) | **SRB_ETRS89 / EUREF Serbia 2010** (EPSG:8683) | **yes** | ETRF2000 (2010.63) | **Serbian Vert. Ref. S. 2012** (EPSG:1216) | Adriatic Sea | NH | [20] | Info |
| **SE** | **Sweden** | | **SWEN17_RH2000** | 2017-10-25 | unknown | ETRS89 geographic | **SWEREF 99** (EPSG:4977) | **yes** | ETRF97 (1999.50) | **RH2000** (EPSG:5613) | Amster-dam/NAP | NH | [21] [24] | Info ZIP |
| **SI** | **Slovenia** | | **SLO_AMG2000/ Trst** | 2000 | 2018-12-21 | ETRS89 geographic | **ETRS89/D96** (EPSG:4883) | **yes** | ETRF96 (1995.55) | **SVS2000/Trst** (EPSG:5779) | Trieste | NOH | | ZIP |
| **SI** | **Slovenia** | | **SLO_VRP2016/ Koper** (EPSG:10247) | 2018-12-22 | unknown | ETRS89 geographic | **ETRS89/D96** (EPSG:4883) | **yes** | ETRF96 (1995.55) | **SVS2010/Koper** (EPSG:8690) | Koper | NH | | ZIP |
| **SK** | **Slovak Rep.** | | **DVRM05** (EPSG:8361) | 2005-01-01 | unknown | ETRS89 geographic | **ETRF2000** | **yes** | ETRF2000 (2008.50) | **Baltic 1957** (EPSG:8357) | Kronstadt | NH | | ZIP |
| **SK** | **Slovak Rep.** | | **DMQSK2014-E** | 2014-07-01 | unknown | ETRS89 geographic | **ETRF2000** | **yes** | ETRF2000 (2008.50) | **EVRF2007** (EPSG:5621) | Amster-dam/NAP | NH | | ZIP |
| **SK** | **Slovak Rep.** | | **DMQSK2022-A** | 2022-07-01 | unknown | ETRS89 geographic | **ETRF2000** | **yes** | ETRF2000 (2008.50) | **ČSJNS/J – ZNB Lišov** | Trieste (Molo Sartorio) | NOH | [22] | ZIP |
| **TR** | **Turkey** | | **TG-20** | 2020-01-01 | unknown | WGS84 geographic | **TUREF** (EPSG:5251) | **no** | ITRF96 (2005.00) | **TUDKA-99** (EPSG:5775) | Antalya | OH(H) | [23] | Info ZIP |

## Remarks

[1] EVRF2000 Austria is the inofficial scientific height reference frame in Austria. To convert to “Höhe ü. Adria” (“Adria heights”) alias “MGI-Höhen” (“GHA heights”) with datum Trieste separately, see height transformation grid “Höhen-Grid” (“Height grid”) in Table 3.

[2] A detailed description of the datums and transformations used in Austria with EPSG codes can be found in https://www.bev.gv.at/dam/bevgvat/PDF-Dateien/Vermessungswesen/Formatbeschreibungen-und-sonstige-Info/EPSG_Austria_BEV.pdf. Transformation between ETRS89 (EPSG:4937) and MGI datum (EPSG:9267) is described in (ibid, Section 3.1). Helmert-based transformation parameters (EPSG:1619) are described in https://data.bev.gv.at/download/Transformationsparameter/Globale_Transformationsparameter.zip (Note the inverse sign convention for the rotation parameters with w.r.t. EUREF Technical Note Nr. 1). An online transformation service is available at https://transformator.bev.gv.at/at.gv.bev.transformator/.

[3] BGS2005 height is based on EVRF2007 (zero-tide). The geoid grid is embedded in the BGSTrans software, it can be requested by formal letter or email from GCCA (Geodesy, Cartography and Cadastre Agency, acad@cadastre.bg).

[4] Land uplift model for CHTRF95 is CH-VKM95 at epoch 1993.

[5] LHN95 is the scientific height reference frame in Switzerland. Land uplift model for LHN95 is CH-VKM95 at epoch 1993.

[6] LN02 is the height reference frame for practical use in surveying in Switzerland. There is no land uplift model for LN02. The HTRANS model is a simplified method for the conversion between uncorrected LN02 heights and orthometric LHN95 heights.

[7] Inofficial model. Quasigeoid QGZU-2013 is especially aimed at the performing local transformations of heights in the given locality, for the expression of heights measured with GNSS technology or in other geometric methods in Baltic system (Bpv), for the mutual transformation of terrain heights between ETRS89 and Bpv in the given locality, etc. For cadastral purposes, only transformation service/software that includes quasigeoid CR2005 is allowed (resp. recommended for public service). Also within the official transformation published by Czech Office for Surveying, Mapping and Cadastre (CUZK), quasigeoid CR-2005 is included (see http://geoportal.cuzk.cz/Default.aspx?lng=EN&mode=TextMeta&text=wcts&menu=19).

[8] Geoid model now referred to as DVR90(2013) geoid.

[9] The original observation epoch of the underlying GNSS campaign is 2015.829. However, the land uplift epoch of the national ETRS89 realization after datum transformation is approximately 1994.705. See Table 1, remark [4].

[10] Land uplift model for EH2000 is NKG2005LU at epoch 2000.

[11] Land uplift model for ISH2004 is ISN_vel_beta at epoch 2004.6.

[12] A detailed description of the datums and transformations used in Italy with EPSG codes can be found in https://www.igmi.org/++theme++igm/pdf/nuova_nota_EPSG.pdf.
The ITALGEO2005 geoid model was originally computed for IGM95, but later updated for RDN2008. Within the overall accuracy it is valid for both RDN2008 and IGM95.
For Sicily island, height offset between Genoa 1942 height and Catania 1965 height is 0.141 m (to be added to Genoa 1942 height, EPSG:9726).

[13] LAS07 is based on EVRF2007 (zero-tide). Land uplift model for LAS07 and LKS94 is NKG2016LU at epoch 2008. Download requires registration at https://www.geoportal.lt.

[14] No geoid model available. NG95 heights are approximated by LUREF2020 coordinates (best-fitting Hayford 1924 ellipsoid) in the sense of a NULL transformation with accuracy of 5 – 15 cm countrywide. Transformation parameters from ETRF2000 at epoch 2020-10-25 (2020.82) to LUREF2020 are described in https://act.public.lu/dam-assets/fr/publications/documents-techniques/20210129-DTECH-ETRF2000toLUREF-datum-transition.pdf (see Table 1, remark [9]).

[15] Latvijas normālo augstumu sistēma epohā 2000,5 (LAS2000,5) height is based on EVRF2007 (zero-tide) and uses an empirical land uplift model for Latvia at epoch 2000.5. Transformation of LKS-92 ellipsoidal coordinates to ETRF2014 recommended using NKG2020 transformation (see [24]).

[16] The zero level of the global EGM2008 geoid grid approximately coincides with the zero level of the Baltic 1977 heights in Moldova (within the overall level of uncertainty of about 5 cm). In the municipality of Chişinău, a different realization of the Baltic height system is in use (MSL Kronstadt 1957-1977, not EPSG 8357) which deviates from the Baltic 1977 height system by 10 to 30 cm in the area.

[17] NN2000 is based on EVRF2000. Land uplift model for NN2000 is NKG2005LU_lev at epoch 2000. Land uplift model for EUREF89 is NKG2005LU_abs at epoch 1995.

[18] Land uplift model for PL-EVRF2007-NH is NKG2005LU at epoch 2000.

[19] The islands of Flores and Corvo are not in the geoid model GeodAz2014 due to lack of data.

[20] The geoid model is not available for purchase but as web application for height transformation, with input coordinates in SRB_ETRS89/UTM34N (EPSG:8662), to which only registered users who pay for its usage can have access.

[21] RH2000 is based on EVRF2000. Land uplift model for RH2000 is NKG2005LU at epoch 2000.

[22] ČSJNS/J – ZNB Lišov – Czechoslovak unified leveling network relating to the height of the basic leveling point of Lišov and the Adriatic height system, adjusted after 1945. The system has not been binding since 1957. Transformation is available through the transformation service https://zbgis.skgeodesy.sk/rts/en/Transform.

[23] Geoid model available free of charge at 5' resolution, 1' resolution for purchase at https://www.harita.gov.tr/urun/jeoid-yukseklig-kestirimi-1x-1-cozunurlugunde/490.

[24] Information about NKG20xx transformations from national ETRS89 realizations to NKG_ETRF2000 resp. NKG_ETRF2014 can be found in:
- NKG2008 transformation to NKG_ETRF2000 at epoch 2000.0: Häkli et al. (2016), https://doi.org/10.1515/jogs-2016-0001
- NKG2020 transformation to NKG_ETRF2014 at epoch 2000.0: Häkli et al. (2023), https://doi.org/10.1515/jogs-2022-0155
Recommended transformation to ETRF2014 at epoch 2000.0 by means of EUREF Transformations 2020 (however, see remark [11] to Table 1 for exceptions in Sweden).

**Table 3** Overview of national height transformation grids between different realizations of leveling heights.

Convention: $H_{VRF2} = H_{VRF1} + \Delta H_{Grid}$

**Height types: NH** Normal heights, **NOH** Normal-orthometric heights, **OH** Orthometric heights, **OH(H)** Helmert orthometric heights, **U** Uncorrected (closest to normal heights)

**Background colors: Yellow** CRS of grid is not ETRS89 or WGS84 geographic (longitude, latitude) → projected coordinates and/or other datum, **Grey** No longer in use

**Standard CRS of interpolation grids:** "ETRS89 geographic" (i.e., any ETRFxxxx) assumed as EPSG:4258, "WGS84 geographic" (i.e., any ITRFxxxx) assumed as EPSG:4326

| CC | Country | Transformation grid | Valid from | Valid until | CRS of grid | VRF1 Name | VRF1 Height datum | VRF1 Type | VRF2 Name | VRF2 Height datum | VRF2 Type | Re-marks | Link |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **AT** | **Austria** | **Höhen-Grid** (EPSG:9275) | 2013-11-08 | unknown | MGI geogr. with Bessel (EPSG:4312) | **GHA height** (EPSG:5778) | Trieste (MGI/Adria) | NOH | **EVRF2000 Austria** (EPSG:9274) | Amsterdam/NAP | OH | [1] | Info Info ZIP |
| **CH** | **Switzerland** | **HTRANS** | 2006 | unknown | CH1903+/LV95 with Bessel (EPSG:2056) | **LN02** | Marseille (RPN) | U | **LHN95** | Marseille (RPN) | OH | [2] | Mail |
| **CH** | **Switzerland** | **EVRF19MT-LN02** | 2019 | unknown | CH1903+/LV95 with Bessel (EPSG:2056) | **LN02** | Marseille (RPN) | U | **EVRF2019 mean-tide** | Amsterdam/NAP | NH | [2] | Mail |
| **CZ** | **Czech Republic** | **Evrf1301** | 2013-01-01 | unknown | S-JTSK/ Krovak with Bessel ell. (EPSG:2065) | **Baltic System (Bpv)** (EPSG:8357) | Kronstadt | NH | **EVRF2007 zero-tide** (EPSG:5621) | Amsterdam/NAP | NH | [3] | |
| **BG** | **Bulgaria** | **BG07-19z** | 2022-01-01 | unknown | ETRS89 geographic | **BGS2005 height** (EPSG:9669) | Amsterdam/NAP | NH | **EVRF2019 zero-tide** (EPSG:9389) | Amsterdam/NAP | NH | [4] | Mail |
| **BG** | **Bulgaria** | **BG07-19m** | 2022-01-01 | unknown | ETRS89 geographic | **BGS2005 height** (EPSG:9669) | Amsterdam/NAP | NH | **EVRF2019 mean-tide** (EPSG:9390) | Amsterdam/NAP | NH | [4] | Mail |
| **BG** | **Bulgaria** | **BGBalt-19z** | 2022-01-01 | unknown | ETRS89 geographic | **Baltic height system 1982** (EPSG:5786) | Kronstadt | NH | **EVRF2019 zero-tide** (EPSG:9389) | Amsterdam/NAP | NH | | Mail |
| **BG** | **Bulgaria** | **BGBalt-19z** | 2022-01-01 | unknown | ETRS89 geographic | **Baltic height system 1982** (EPSG:5786) | Kronstadt | NH | **EVRF2019 mean-tide** (EPSG:9390) | Amsterdam/NAP | NH | | Mail |
| **DE** | **Germany** | **HOETRA2016** | 2016-12-01 | unknown | ETRS89 geographic | **DHHN92** (EPSG:5783) | Amsterdam/NAP | NH | **DHHN2016** (EPSG:7837) | Amsterdam/NAP | NH | | Info ZIP |
| **HR** | **Croatia** | **HTMv08 (web application T7D)** | 2010-01-01 | present | ETRS89 geographic | **Croatian Vertical Ref. System 1875** (EPSG:5195) | Trieste | NOH | **Croatian Vertical Ref. System 1971** (EPSG:5610) | 5 tide gauges | NOH | | Mail |
| **SI** | **Slovenia** | **SLO-VTP2024** | 2018-12-22 | unknown | ETRS89 geographic | **SVS2000/Trst** (EPSG:5779) | Trieste | NOH | **SVS2010/Koper** (EPSG:8690) | Koper | NH | | ZIP |

## Remarks

[1] A detailed description of the datums and transformations used in Austria with EPSG codes can be found in https://www.bev.gv.at/dam/bevgvat/PDF-Dateien/Vermessungswesen/Formatbeschreibungen-und-sonstige-Info/EPSG_Austria_BEV.pdf. Transformation between ETRS89 (EPSG:4937) and MGI datum (EPSG:9267) is described in (ibid, Section 3.1). Helmert-based transformation parameters (EPSG:1619) are described in https://data.bev.gv.at/download/Transformationsparameter/Globale_Transformationsparameter.zip (Note the inverse sign convention for the rotation parameters with w.r.t. EUREF Technical Note Nr. 1). An online transformation service is available at https://transformator.bev.gv.at/at.gv.bev.transformator/.

[2] There exist some other height transformation grids involving the following height systems: LN02, LHN95 (OH), LHN95 (NH), LHN95 (Potentials), EVRF2007(ZT), EVRF2019(ZT), EVRF2019(MT), EVRF2019 (Potentials). But these grids are not officially published. They are available on request from swisstopo. Grids in ETRS89 (geographic) are under preparation.

[3] This grid is included within the official transformation service published by Czech Office for Surveying, Mapping and Cadastre (see http://geoportal.cuzk.cz/Default.aspx?lng=EN&mode=TextMeta&text=wcts&menu=19)

[4] BGS2005 height is based on EVRF2007 (zero-tide).