FAST TRACK PAPER

The 10th-Generation International Geomagnetic Reference Field

International Association of Geomagnetism and Aeronomy (IAGA), Division V, Working Group VMOD: Geomagnetic Field Modeling

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SUMMARY

The International Association of Geomagnetism and Aeronomy (IAGA) on 2004 December 12 has released the 10th-Generation International Geomagnetic Reference Field—the latest version of a standard mathematical description of the Earth's main magnetic field used widely in studies of the Earth's deep interior, its crust, ionosphere and magnetosphere. The coefficients were finalized by a task force of IAGA. The IGRF is the product of a large collaborative effort between magnetic field modellers and the institutes involved in collecting and disseminating magnetic field data from satellites and observatories around the world.

Key words: geomagnetic field model, geomagnetic reference field, IGRF, secular variation.

The IGRF is a series of mathematical models of the Earth's main field and its annual rate of change (secular variation). In source-free regions at the Earth's surface and above, the main field, with sources internal to the Earth, can be represented as the negative gradient of a scalar potential V, expanded into spherical harmonics as

$$V(r,\theta,\lambda,t) = R\sum_{n=1}^{n_{\max}}\left(\frac{R}{r}\right)^{n+1}\sum_{m=0}^{n}\left[g_n^m(t)\cos m\lambda + h_n^m(t)\sin m\lambda\right]P_n^m(\theta),$$

where r, θ, λ are geocentric coordinates (r is the distance from the centre of the Earth, θ is the colatitude, i.e. $90^\circ -$ latitude, and λ is the longitude), R is the magnetic reference radius (6371.2 km); g_n^m (t) and h_n^m (t) are the coefficients at time t, and P_n^m (θ) are the Schmidt semi-normalized associated Legendre functions of degree n and order m. The main-field coefficients are functions of time. For the IGRF the change is assumed to be linear over 5-year intervals. For the upcoming 5-year epoch, the rate of change is given by predictive secular variation coefficients $\dot{g}_n^m$ and $\dot{h}_n^m$. For more details on main-field modelling the reader is referred to Chapman & Bartels (1940) and Langel (1987).

The coefficients of the 10th-generation IGRF are listed in Table 1 and are available in digital form from the IAGA web site www.iugg.org/IAGA and the World Data Centers listed at the end of this paper, along with software to compute magnetic field values from them. The new coefficients are the preliminary main-field coefficients for 2005.0 and the predictive secular-variation coefficients for 2005.0–2010.0. The previous (9th) generation IGRF with the definitive coefficients for 1995.0 and 2000.0 (Macmillan *et al.* 2003) was finalized at the XXIII General Assembly of the International Union of Geophysics and Geodesy, held at Sapporo in Japan in 2003 July.

The satellite magnetic missions of the International Decade of Geopotential Research (Ørsted launched 1999, CHAMP launched 2000) are providing an unprecedented wealth of highly accurate magnetic field measurements. In order to ensure that the accuracy of the IGRF reflects the high quality of available data, IAGA decided in 2001 that the main-field coefficients of the IGRF from the year 2000 onwards should extend to degree $n_{\max} = 13$ and be quoted to 0.1 nT precision (to reflect improved spatial resolution and instrument precision). Pre-2000 coefficients extend to degree 10 and are quoted to 1 nT precision. The predictive secular-variation coefficients $\dot{g}_n^m$ and $\dot{h}_n^m$ for the upcoming 5-year epoch are given to degree 8 with a precision of 0.1 nT yr^{-1}.

With the previous 9th-generation IGRF, there was an update in the nomenclature. Table 2 gives the new nomenclature that should be used henceforth, and provides a summary of the history of the IGRF. It is recommended that the term IGRF should always be used with reference to the generation; otherwise, it is difficult to establish which coefficients were actually used. For example, one cannot recover the original full-field data from an aeromagnetic anomaly data set in order to tie it with adjacent surveys if one does not know which generation of the IGRF was used. Finally, it is now recommended that the World Geodetic System 1984 (WGS84, $a = 6378.137$ km, $b = 6356.752$ km) should be used when specifying the IGRF in geodetic coordinates.

Details of the geomagnetic modelling methods will be published later this year in a special issue of Earth, Planets and Space. The 10th-generation IGRF coefficients were computed from candidate sets of coefficients produced by the participating members of the IAGA Working Group VMOD, listed at the head of this announcement.

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Table 1. Spherical harmonic coefficients of the 10th-generation IGRF.

g/h	n	m	1900.0	1905.0	1910.0	1915.0	1920.0	1925.0	1930.0	1935.0	1940.0	1945.0	1950.0	1955.0	1960.0	1965.0	1970.0	1975.0	1980.0	1985.0	1990.0	1995.0	2000.0	2005.0	SV
g	1	0	−31543	−31464	−31354	−31212	−31060	−30926	−30805	−30715	−30654	−30594	−30554	−30500	−30421	−30334	−30220	−30100	−29992	−29873	−29775	−29692	−29619.4	−29556.8	8.8
g	1	1	−2298	−2298	−2297	−2306	−2317	−2318	−2316	−2306	−2292	−2285	−2250	−2215	−2169	−2119	−2068	−2013	−1956	−1905	−1848	−1784	−1728.2	−1671.8	10.8
h	1	1	5922	5909	5898	5875	5845	5817	5808	5812	5821	5810	5815	5820	5791	5776	5737	5675	5604	5500	5406	5306	5186.1	5080.0	−21.3
g	2	0	−677	−728	−769	−802	−839	−893	−951	−1018	−1106	−1244	−1341	−1440	−1555	−1662	−1781	−1902	−1997	−2072	−2131	−2200	−2267.7	−2340.5	−15.0
g	2	1	2905	2928	2948	2956	2959	2969	2980	2984	2981	2990	2998	3003	3002	2997	3000	3010	3027	3044	3059	3070	3068.4	3047.0	−6.9
h	2	1	−1061	−1086	−1128	−1191	−1259	−1334	−1424	−1520	−1614	−1702	−1810	−1898	−1967	−2016	−2047	−2067	−2129	−2197	−2279	−2366	−2481.6	−2594.9	−23.3
g	2	2	924	1041	1176	1309	1407	1471	1517	1550	1566	1578	1576	1581	1590	1594	1611	1632	1663	1687	1686	1681	1670.9	1656.9	−1.0
h	2	2	1121	1065	1000	917	823	728	644	586	528	477	381	291	206	114	25	−68	−200	−306	−373	−413	−458.0	−516.7	−14.0
g	3	0	1022	1037	1058	1084	1111	1140	1172	1206	1240	1282	1297	1302	1302	1297	1287	1276	1281	1296	1314	1335	1339.6	1335.7	−0.3
g	3	1	−1469	−1494	−1524	−1559	−1600	−1645	−1692	−1740	−1790	−1834	−1889	−1944	−1992	−2038	−2091	−2144	−2180	−2208	−2239	−2267	−2288.0	−2305.3	−3.1
h	3	1	−330	−357	−389	−421	−445	−462	−480	−494	−499	−499	−476	−462	−414	−404	−366	−333	−336	−310	−284	−262	−227.6	−200.4	5.4
g	3	2	1256	1239	1223	1212	1205	1202	1205	1215	1232	1255	1274	1288	1289	1292	1278	1260	1251	1247	1248	1249	1252.1	1246.8	−0.9
h	3	2	3	34	62	84	103	119	133	146	163	186	206	216	224	240	251	262	271	284	293	302	293.4	269.3	−6.5
g	3	3	572	635	705	778	839	881	907	918	916	913	896	882	878	856	838	830	833	829	802	759	714.5	674.4	−6.8
h	3	3	523	480	425	360	293	229	166	101	43	−11	−46	−83	−130	−165	−196	−223	−252	−297	−352	−427	−491.1	−524.5	−2.0
g	4	0	876	880	884	887	889	891	896	903	914	944	954	958	957	957	952	946	938	936	939	940	932.3	919.8	−2.5
g	4	1	628	643	660	678	695	711	727	744	762	776	792	796	800	804	800	791	782	780	780	780	786.8	798.2	2.8
h	4	1	195	203	211	218	220	216	205	188	169	144	136	133	135	148	167	191	212	232	247	262	272.6	281.4	2.0
g	4	2	660	653	644	631	616	601	584	565	550	544	528	510	504	479	461	438	398	361	325	290	250.0	211.5	−7.1
h	4	2	−69	−77	−90	−109	−134	−163	−195	−226	−252	−276	−278	−274	−278	−269	−266	−265	−257	−249	−240	−236	−231.9	−225.8	1.8
g	4	3	−361	−380	−400	−416	−424	−426	−422	−415	−405	−421	−408	−397	−394	−390	−395	−405	−419	−424	−423	−418	−403.0	−379.5	5.9
h	4	3	−210	−201	−189	−173	−153	−130	−109	−90	−72	−55	−37	−23	3	13	26	39	53	69	84	97	119.8	145.7	5.6
g	4	4	134	146	160	178	199	217	234	249	265	304	303	290	269	252	234	216	199	170	141	122	111.3	100.2	−3.2
h	4	4	−75	−65	−55	−51	−57	−70	−90	−114	−141	−178	−210	−230	−255	−269	−279	−288	−297	−297	−299	−306	−303.8	−304.7	0.0
g	5	0	−184	−192	−201	−211	−221	−230	−237	−241	−241	−253	−240	−229	−222	−219	−216	−218	−218	−214	−214	−214	−218.8	−227.6	−2.6
g	5	1	328	328	327	327	326	326	327	329	334	346	349	360	362	358	359	356	357	355	353	352	351.4	354.4	0.4
h	5	1	−210	−193	−172	−148	−122	−96	−72	−51	−33	−12	3	15	16	19	26	31	46	47	46	46	43.8	42.7	0.1
g	5	2	264	259	253	245	236	226	218	211	208	194	211	230	242	254	262	264	261	253	245	235	222.3	208.8	−3.0
h	5	2	53	56	57	58	58	58	60	64	71	95	103	110	125	128	139	148	150	150	154	165	171.9	179.8	1.8
g	5	3	5	−1	−9	−16	−23	−28	−32	−33	−33	−20	−20	−23	−26	−31	−42	−59	−74	−93	−109	−118	−130.4	−136.6	−1.2
h	5	3	−33	−32	−33	−34	−38	−44	−53	−64	−75	−67	−87	−98	−117	−126	−139	−152	−151	−154	−153	−143	−133.1	−123.0	2.0
g	5	4	−86	−93	−102	−111	−119	−125	−131	−136	−141	−142	−147	−152	−156	−157	−160	−159	−162	−164	−165	−166	−168.6	−168.3	0.2
h	5	4	−124	−125	−126	−126	−125	−122	−118	−115	−113	−119	−122	−121	−114	−97	−91	−83	−78	−75	−69	−55	−39.3	−19.5	4.5
g	5	5	−16	−26	−38	−51	−62	−69	−74	−76	−76	−82	−76	−69	−63	−62	−56	−49	−48	−46	−36	−17	−12.9	−14.1	−0.6
h	5	5	3	11	21	32	43	51	58	64	69	82	80	78	81	81	83	88	92	95	97	107	106.3	103.6	−1.0
g	6	0	63	62	62	61	61	61	60	59	57	59	54	47	46	45	43	45	48	53	61	68	72.3	72.9	−0.8
g	6	1	61	60	58	57	55	54	53	53	54	57	57	57	58	61	64	66	66	65	65	67	68.2	69.6	0.2
h	6	1	−9	−7	−5	−2	0	3	4	4	4	6	−1	−9	−10	−11	−12	−13	−15	−16	−16	−17	−17.4	−20.2	−0.4
g	6	2	−11	−11	−11	−10	−10	−9	−9	−8	−7	6	4	3	1	8	15	28	42	51	59	68	74.2	76.6	−0.2
h	6	2	83	86	89	93	96	99	102	104	105	100	99	96	99	100	100	99	93	88	82	72	63.7	54.7	−1.9
g	6	3	−217	−221	−224	−228	−233	−238	−242	−246	−249	−246	−247	−247	−237	−228	−212	−198	−192	−185	−178	−170	−160.9	−151.1	2.1
h	6	3	2	4	5	8	11	14	19	25	33	16	33	48	60	68	72	75	71	69	69	67	65.1	63.7	−0.4
g	6	4	−58	−57	−54	−51	−46	−40	−32	−25	−18	−25	−16	−8	−1	4	2	1	4	4	3	−1	−5.9	−15.0	−2.1
h	6	4	−35	−32	−29	−26	−22	−18	−16	−15	−15	−9	−12	−16	−20	−32	−37	−41	−43	−48	−52	−58	−61.2	−63.4	−0.4
g	6	5	59	57	54	49	44	39	32	25	18	21	12	7	−2	1	3	6	14	16	18	19	16.9	14.7	−0.4
h	6	5	36	32	28	23	18	13	8	4	0	−16	−12	−12	−11	−8	−6	−4	−2	−1	1	1	0.7	0.0	−0.2
g	6	6	−90	−92	−95	−98	−101	−103	−104	−106	−107	−104	−105	−107	−113	−111	−112	−111	−108	−102	−96	−93	−90.4	−86.4	1.3
h	6	6	−69	−67	−65	−62	−57	−52	−46	−40	−33	−39	−30	−24	−17	−7	1	11	17	21	24	36	43.8	50.3	0.9
g	7	0	70	70	71	72	73	73	74	74	74	70	65	65	67	75	72	71	72	74	77	77	79.0	79.8	−0.4
g	7	1	−55	−54	−54	−54	−54	−54	−54	−53	−53	−40	−55	−56	−56	−57	−57	−56	−59	−62	−64	−72	−74.0	−74.4	0.0
h	7	1	−45	−46	−47	−48	−49	−50	−51	−52	−52	−45	−35	−50	−55	−61	−70	−77	−82	−83	−80	−69	−64.6	−61.4	0.8
g	7	2	0	0	1	2	2	3	4	4	4	0	2	2	5	4	1	1	2	3	2	1	0.0	−1.4	−0.2
h	7	2	−13	−14	−14	−14	−14	−14	−15	−17	−18	−18	−17	−24	−28	−27	−27	−26	−27	−27	−26	−25	−24.2	−22.5	0.4
g	7	3	34	33	32	31	29	27	25	23	20	0	1	10	15	13	14	16	21	24	26	28	33.3	38.6	1.1
h	7	3	−10	−11	−12	−12	−13	−14	−14	−14	−14	2	0	−4	−6	−2	−4	−5	−5	−2	0	4	6.2	6.9	0.1
g	7	4	−41	−41	−40	−38	−37	−35	−34	−33	−31	−29	−40	−32	−32	−26	−22	−14	−12	−6	−1	5	9.1	12.3	0.6
h	7	4	−1	0	1	2	4	5	6	7	7	6	10	8	7	6	8	10	16	20	21	24	24.0	25.4	0.2
g	7	5	−21	−20	−19	−18	−16	−14	−12	−11	−9	−10	−7	−11	−7	−6	−2	0	1	4	5	4	6.9	9.4	0.4
h	7	5	28	28	28	28	28	29	29	29	29	28	36	28	23	26	23	22	18	17	17	17	14.8	10.9	−0.9

Table 1. (*Continued.*)

g/h	n	m	1900.0	1905.0	1910.0	1915.0	1920.0	1925.0	1930.0	1935.0	1940.0	1945.0	1950.0	1955.0	1960.0	1965.0	1970.0	1975.0	1980.0	1985.0	1990.0	1995.0	2000.0	2005.0	SV
g	7	6	18	18	18	19	19	19	18	18	17	15	5	9	17	13	13	12	11	10	9	8	7.3	5.5	−0.5
h	7	6	−12	−12	−13	−15	−16	−17	−18	−19	−20	−17	−18	−20	−18	−23	−23	−23	−23	−23	−23	−24	−25.4	−26.4	−0.3
g	7	7	6	6	6	6	6	6	6	6	5	29	19	18	8	1	−2	−5	−2	0	0	−2	−1.2	2.0	0.9
h	7	7	−22	−22	−22	−22	−22	−21	−20	−19	−19	−22	−16	−18	−17	−12	−11	−12	−10	−7	−4	−6	−5.8	−4.8	0.3
g	8	0	11	11	11	11	11	11	11	11	11	13	22	11	15	13	14	14	18	21	23	25	24.4	24.8	−0.2
g	8	1	8	8	8	8	7	7	7	7	7	7	15	9	6	5	6	6	6	6	5	6	6.6	7.7	0.2
h	8	1	8	8	8	8	8	8	8	8	8	12	5	10	11	7	7	6	7	8	10	11	11.9	11.2	−0.2
g	8	2	−4	−4	−4	−4	−3	−3	−3	−3	−3	−8	−4	−6	−4	−4	−2	−1	0	0	−1	−6	−9.2	−11.4	−0.2
h	8	2	−14	−15	−15	−15	−15	−15	−15	−15	−14	−21	−22	−15	−14	−12	−15	−16	−18	−19	−19	−21	−21.5	−21.0	0.2
g	8	3	−9	−9	−9	−9	−9	−9	−9	−9	−10	−5	−1	−14	−11	−14	−13	−12	−11	−11	−10	−9	−7.9	−6.8	0.2
h	8	3	7	7	6	6	6	6	5	5	5	−12	0	5	7	9	6	4	4	5	6	8	8.5	9.7	0.2
g	8	4	1	1	1	2	2	2	2	1	1	9	11	6	2	0	−3	−8	−7	−9	−12	−14	−16.6	−18.0	−0.2
h	8	4	−13	−13	−13	−13	−14	−14	−14	−15	−15	−7	−21	−23	−18	−16	−17	−19	−22	−23	−22	−23	−21.5	−19.8	0.4
g	8	5	2	2	2	3	4	4	5	6	6	7	15	10	10	8	5	4	4	4	3	9	9.1	10.0	0.2
h	8	5	5	5	5	5	5	5	5	5	5	2	−8	3	4	4	6	6	9	11	12	15	15.5	16.1	0.2
g	8	6	−9	−8	−8	−8	−7	−7	−6	−6	−5	−10	−13	−7	−5	−1	0	0	3	4	4	6	7.0	9.4	0.5
h	8	6	16	16	16	16	17	17	18	18	19	18	17	23	23	24	21	18	16	14	12	11	8.9	7.7	−0.3
g	8	7	5	5	5	6	6	7	8	8	9	7	5	6	10	11	11	10	6	4	2	−5	−7.9	−11.4	−0.7
h	8	7	−5	−5	−5	−5	−5	−5	−5	−5	−5	3	−4	−4	1	−3	−6	−10	−13	−15	−16	−16	−14.9	−12.8	0.5
g	8	8	8	8	8	8	8	8	8	7	7	2	−1	9	8	4	3	1	−1	−4	−6	−7	−7.0	−5.0	0.5
h	8	8	−18	−18	−18	−18	−19	−19	−19	−19	−19	−11	−17	−13	−20	−17	−16	−17	−15	−11	−10	−4	−2.1	−0.1	0.4
g	9	0	8	8	8	8	8	8	8	8	8	5	3	4	4	8	8	7	5	5	4	4	5.0	5.6	
g	9	1	10	10	10	10	10	10	10	10	10	−21	−7	9	6	10	10	10	10	10	9	9	9.4	9.8	
h	9	1	−20	−20	−20	−20	−20	−20	−20	−20	−21	−27	−24	−11	−18	−22	−21	−21	−21	−21	−20	−20	−19.7	−20.1	
g	9	2	1	1	1	1	1	1	1	1	1	1	−1	−4	0	2	2	2	1	1	1	3	3.0	3.6	
h	9	2	14	14	14	14	14	14	14	15	15	17	19	12	12	15	16	16	16	15	15	15	13.4	12.9	
g	9	3	−11	−11	−11	−11	−11	−11	−12	−12	−12	−11	−25	−5	−9	−13	−12	−12	−12	−12	−12	−10	−8.4	−7.0	
h	9	3	5	5	5	5	5	5	5	5	5	29	12	7	2	7	6	7	9	9	11	12	12.5	12.7	
g	9	4	12	12	12	12	12	12	12	11	11	3	10	2	1	10	10	10	9	9	9	8	6.3	5.0	
h	9	4	−3	−3	−3	−3	−3	−3	−3	−3	−3	−9	2	6	0	−4	−4	−4	−5	−6	−7	−6	−6.2	−6.7	
g	9	5	1	1	1	1	1	1	1	1	1	16	5	4	4	−1	−1	−1	−3	−3	−4	−8	−8.9	−10.8	
h	9	5	−2	−2	−2	−2	−2	−2	−2	−3	−3	4	2	−2	−3	−5	−5	−5	−6	−6	−7	−8	−8.4	−8.1	
g	9	6	−2	−2	−2	−2	−2	−2	−2	−2	−2	−3	−5	1	−1	−1	0	−1	−1	−1	−2	−1	−1.5	−1.3	
h	9	6	8	8	8	8	9	9	9	9	9	9	8	10	9	10	10	10	9	9	9	8	8.4	8.1	
g	9	7	2	2	2	2	2	2	3	3	3	−4	−2	2	−2	5	3	4	7	7	7	10	9.3	8.7	
h	9	7	10	10	10	10	10	10	10	11	11	6	8	7	8	10	11	11	10	9	8	5	3.8	2.9	
g	9	8	−1	0	0	0	0	0	0	0	1	−3	3	2	3	1	1	1	2	1	1	−2	−4.3	−6.7	
h	9	8	−2	−2	−2	−2	−2	−2	−2	−2	−2	1	−11	−6	0	−4	−2	−3	−6	−7	−7	−8	−8.2	−7.9	
g	9	9	−1	−1	−1	−1	−1	−1	−2	−2	−2	−4	8	5	−1	−2	−1	−2	−5	−5	−6	−8	−8.2	−9.2	
h	9	9	2	2	2	2	2	2	2	2	2	8	−7	5	5	1	1	1	2	2	2	3	4.8	5.9	
g	10	0	−3	−3	−3	−3	−3	−3	−3	−3	−3	−3	−8	−3	1	−2	−3	−3	−4	−4	−3	−3	−2.6	−2.2	
g	10	1	−4	−4	−4	−4	−4	−4	−4	−4	−4	11	4	−5	−3	−3	−3	−3	−4	−4	−4	−6	−6.0	−6.3	
h	10	1	2	2	2	2	2	2	2	2	2	5	13	−4	4	2	1	1	1	1	2	1	1.7	2.4	
g	10	2	2	2	2	2	2	2	2	2	2	1	−1	−1	4	2	2	2	2	3	2	2	1.7	1.6	
h	10	2	1	1	1	1	1	1	1	1	1	1	−2	0	1	1	1	1	0	0	1	0	0.0	0.2	
g	10	3	−5	−5	−5	−5	−5	−5	−5	−5	−5	2	13	2	0	−5	−5	−5	−5	−5	−5	−4	−3.1	−2.5	
h	10	3	2	2	2	2	2	2	2	2	2	−20	−10	−8	0	2	3	3	3	3	3	4	4.0	4.4	
g	10	4	−2	−2	−2	−2	−2	−2	−2	−2	−2	−5	−4	−3	−1	−2	−1	−2	−2	−2	−2	−1	−0.5	−0.1	
h	10	4	6	6	6	6	6	6	6	6	6	−1	2	−2	2	6	4	4	6	6	6	5	4.9	4.7	
g	10	5	6	6	6	6	6	6	6	6	6	−1	4	7	4	4	6	5	5	5	4	4	3.7	3.0	
h	10	5	−4	−4	−4	−4	−4	−4	−4	−4	−4	−6	−3	−4	−5	−4	−4	−4	−4	−4	−4	−5	−5.9	−6.5	
g	10	6	4	4	4	4	4	4	4	4	4	8	12	4	6	4	4	4	3	3	3	2	1.0	0.3	
h	10	6	0	0	0	0	0	0	0	0	0	6	6	1	1	0	0	−1	0	0	0	−1	−1.2	−1.0	
g	10	7	0	0	0	0	0	0	0	0	0	−1	3	−2	1	0	1	1	1	1	1	2	2.0	2.1	
h	10	7	−2	−2	−2	−2	−2	−2	−2	−1	−1	−4	−3	−3	−1	−2	−1	−1	−1	−1	−2	−2	−2.9	−3.4	
g	10	8	2	2	2	1	1	1	1	2	2	−3	2	6	−1	2	0	0	2	2	3	5	4.2	3.9	
h	10	8	4	4	4	4	4	4	4	4	4	−2	6	7	6	3	3	3	4	4	3	1	0.2	−0.9	
g	10	9	2	2	2	2	3	3	3	3	3	5	10	−2	2	2	3	3	3	3	3	1	0.3	−0.1	
h	10	9	0	0	0	0	0	0	0	0	0	0	11	−1	0	0	1	1	0	0	−1	−2	−2.2	−2.3	

Table 1. (*Continued.*)

g/h	*n*	*m*	1900.0	1905.0	1910.0	1915.0	1920.0	1925.0	1930.0	1935.0	1940.0	1945.0	1950.0	1955.0	1960.0	1965.0	1970.0	1975.0	1980.0	1985.0	1990.0	1995.0	2000.0	2005.0	SV
g	10	10	0	0	0	0	0	0	0	0	0	−2	3	0	0	0	−1	−1	0	0	0	0	−1.1	−2.2	
h	10	10	−6	−6	−6	−6	−6	−6	−6	−6	−6	−2	8	−3	−7	−6	−4	−5	−6	−6	−6	−7	−7.4	−8.0	
g	11	0																					2.7	2.9	
g	11	1																					−1.7	−1.6	
h	11	1																					0.1	0.3	
g	11	2																					−1.9	−1.7	
h	11	2																					1.3	1.4	
g	11	3																					1.5	1.5	
h	11	3																					−0.9	−0.7	
g	11	4																					−0.1	−0.2	
h	11	4																					−2.6	−2.4	
g	11	5																					0.1	0.2	
h	11	5																					0.9	0.9	
g	11	6																					−0.7	−0.7	
h	11	6																					−0.7	−0.6	
g	11	7																					0.7	0.5	
h	11	7																					−2.8	−2.7	
g	11	8																					1.7	1.8	
h	11	8																					−0.9	−1.0	
g	11	9																					0.1	0.1	
h	11	9																					−1.2	−1.5	
g	11	10																					1.2	1.0	
h	11	10																					−1.9	−2.0	
g	11	11																					4.0	4.1	
h	11	11																					−0.9	−1.4	
g	12	0																					−2.2	−2.2	
g	12	1																					−0.3	−0.3	
h	12	1																					−0.4	−0.5	
g	12	2																					0.2	0.3	
h	12	2																					0.3	0.3	
g	12	3																					0.9	0.9	
h	12	3																					2.5	2.3	
g	12	4																					−0.2	−0.4	
h	12	4																					−2.6	−2.7	
g	12	5																					0.9	1.0	
h	12	5																					0.7	0.6	
g	12	6																					−0.5	−0.4	
h	12	6																					0.3	0.4	
g	12	7																					0.3	0.5	
h	12	7																					0.0	0.0	
g	12	8																					−0.3	−0.3	
h	12	8																					0.0	0.0	
g	12	9																					−0.4	−0.4	
h	12	9																					0.3	0.3	
g	12	10																					−0.1	0.0	
h	12	10																					−0.9	−0.8	
g	12	11																					−0.2	−0.4	
h	12	11																					−0.4	−0.4	
g	12	12																					−0.4	0.0	
h	12	12																					0.8	1.0	
g	13	0																					−0.2	−0.2	
g	13	1																					−0.9	−0.9	
h	13	1																					−0.9	−0.7	
g	13	2																					0.3	0.3	
h	13	2																					0.2	0.3	
g	13	3																					0.1	0.3	
h	13	3																					1.8	1.7	
g	13	4																					−0.4	−0.4	
h	13	4																					−0.4	−0.5	
g	13	5																					1.3	1.2	

Table 1. (*Continued.*)

g/h	n	m	1900.0	1905.0	1910.0	1915.0	1920.0	1925.0	1930.0	1935.0	1940.0	1945.0	1950.0	1955.0	1960.0	1965.0	1970.0	1975.0	1980.0	1985.0	1990.0	1995.0	2000.0	2005.0	SV
h	13	5																					−1.0	−1.0	
g	13	6																					−0.4	−0.4	
h	13	6																					−0.1	0.0	
g	13	7																					0.7	0.7	
h	13	7																					0.7	0.7	
g	13	8																					−0.4	−0.3	
h	13	8																					0.3	0.2	
g	13	9																					0.3	0.4	
h	13	9																					0.6	0.6	
g	13	10																					−0.1	−0.1	
h	13	10																					0.3	0.4	
g	13	11																					0.4	0.4	
h	13	11																					−0.2	−0.2	
g	13	12																					0.0	−0.1	
h	13	12																					−0.5	−0.5	
g	13	13																					0.1	−0.3	
h	13	13																					−0.9	−1.0	

Table 2. Summary of nomenclature and IGRF history.

Full name	Short name	Valid for	Definitive for
IGRF 10th generation (revised 2004)	IGRF-10	1900.0–2010.0	1945.0–2000.0
IGRF 9th generation (revised 2003)	IGRF-9	1900.0–2005.0	1945.0–2000.0
IGRF 8th generation (revised 1999)	IGRF-8	1900.0–2005.0	1945.0–1990.0
IGRF 7th generation (revised 1995)	IGRF-7	1900.0–2000.0	1945.0–1990.0
IGRF 6th generation (revised 1991)	IGRF-6	1945.0–1995.0	1945.0–1985.0
IGRF 5th generation (revised 1987)	IGRF-5	1945.0–1990.0	1945.0–1980.0
IGRF 4th generation (revised 1985)	IGRF-4	1945.0–1990.0	1965.0–1980.0
IGRF 3rd generation (revised 1981)	IGRF-3	1965.0–1985.0	1965.0–1975.0
IGRF 2nd generation (revised 1975)	IGRF-2	1955.0–1980.0	—
IGRF 1st generation (revised 1969)	IGRF-1	1955.0–1975.0	—

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