GEOLOGICAL SURVEY OF CANADA

OPEN FILE xxxx

FixSEGYRecordLength – A fixed record length SEGY file utility

R. C. Courtney

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Open files are products that have not gone through the GSC formal publication process.

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Abstract

FixSEGYRecordLength is a Windows 7 utility that can be used to resize record lengths in a variable record length input SEGY file to produce an output SEGY file with a fixed record length. The utility also has the option of transforming coordinates stored in the SEGY trace headers to UTM coordinates and changing the earth datum. This utility can be used to precondition seismic data downloaded from NRCan seismic inventory for subsequent use in industry standard seismic mapping packages such as Kingdom Suite (www.ihs.com).

Keywords: seismic data, SEGY,Kingdom Suite, Windows 7, Windows 10

Introduction

The GSC has been collecting digital seismic data since the early 1990's and has used and continues to use SEGY (Norris and Faichney, 2002) as its primary format for storing its digital seismic, sounder and sidescan data.

Most of the positional data stored in the traces headers of these holdings are recorded as latitude and longitude positions. In addition, the trace record lengths may vary within a file as the recording window or sampling rate changes. This effect is most commonly encountered in Knudsen echosounder data that was transcribed from the Knudsen binary format (KEB). Many industry seismic mapping packages accept SEGY only with a fixed SEGY record length and with UTM positional coordinates.

FixSEGYRecordLength was written to address this issue. This routine will scan a sequence of SEG-Y files and create and trace length -zero-padded version of each file with a fixed record length. It can also be used to transform the geographic datum on latitude/longitude pairs in the trace header to WGS84. In addition, the routine can project these positions from to UTM (Universal Transverse Mercator) or UPS (Universal Polar Sterographic) (Snyder, 1987).

Installation

The routine was written with Microsoft Visual Studio 2013 in C#. The code contains calls to the open-source GeographicLib library (http://geographiclib.sourceforge.net) in compliance with the MIT/X11 open-source license. The source code is freely available through contact with the author (email:bob.courtney@canada.ca).

The executable image is packaged in a zip file and distributed with supporting files and documentation , made available through NRCan Open File system via Geoscan (http://geoscan.nrcan.gc.ca/). The excutable image is written for Windows 7 and subsequent operating systems running .Net 4.0 and above.

The zip file retrieved from Geoscsan can be unpacked and the setup.exe file is used to install the program on the host machine.

Use

Launch Program

The program is run via the Windows Start menu:

Start=>All Programs=>NRCan=>FixSEGYRecordLength

The user interface should appear on the desktop:

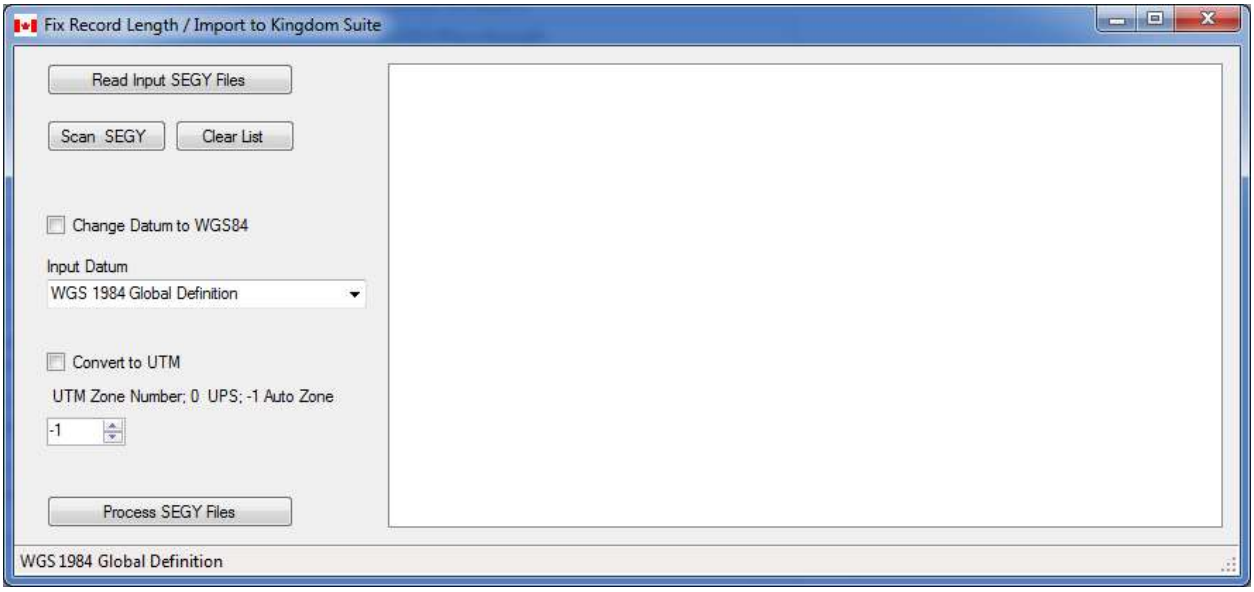
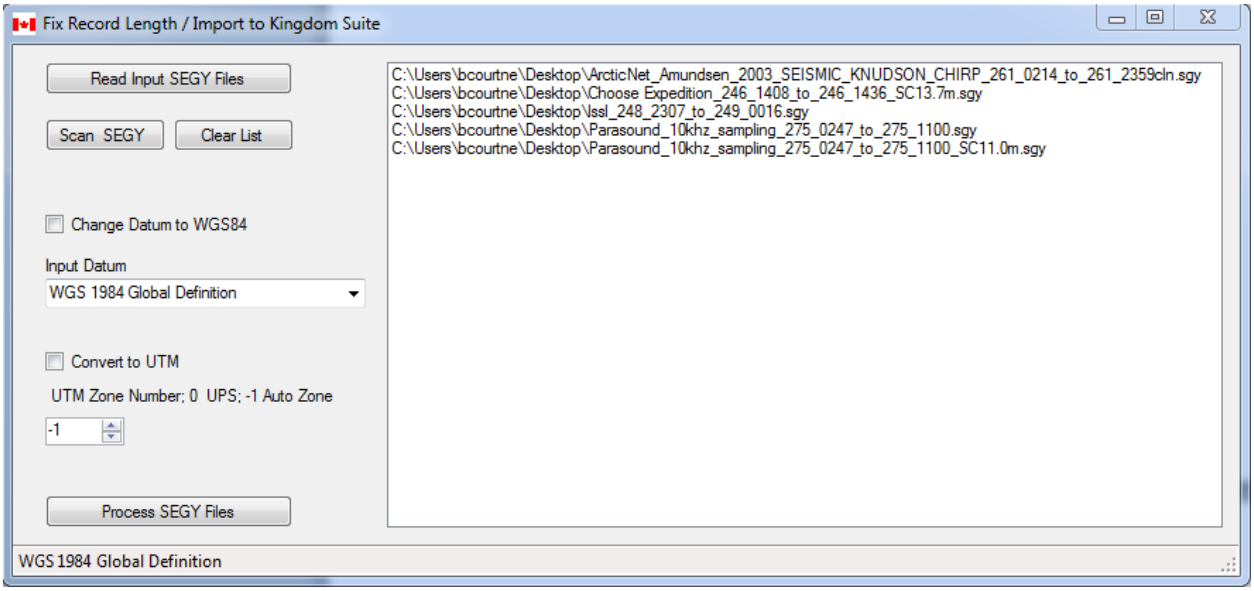


Figure 1 – User interface

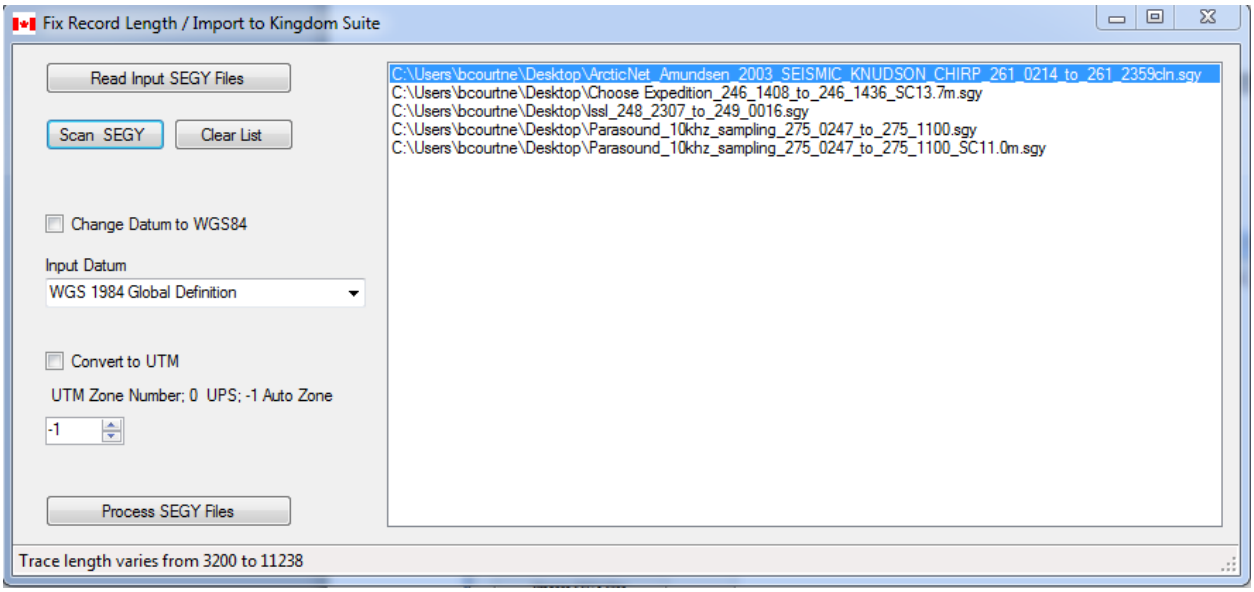
Read SEGY

Press the “Read Input SEGY file” button to read in the SEGY files of interest. Multiple files can be chosen and, to some extent, the program will automatically exclude files not recognized as SEGY.



Scan SEGY

Click of one of the entries in the listbox found to the right-hand side and press “Scan SEGY” to scan the selected file and summarize the trace length changes in the file.



Fix Trace Length

Press “Process SEGY Files” to generate a zero-padded, constant trace version of the input file. The program will prompt for an output folder then generate fixed length records for all the SEGY files with the file suffix “_fixed.sgy”.

Change Datum to WGS84

Often for older SEGY files derived from registered scanned sections, the trace header positions are stored with reference to in an older geodetic datum, usually NAD27. This option can be enacted to apply a geocentric –based datum correction method to apply the appropriate datum shift and ellipsoidal parameters needed to transform positions to the WGS84 datum. (http://earth-info.nga.mil/GandG/publications/tr8350.2/wgs84fin.pdf).

The datum transform parameters are stored in the folder, *C:\Program Files (x86)\NRCan\FixSEGYRecordLength,* in two csv files : *Ellipsoids.csv* and *GeodeticTransformParameters.csv.* *GeodeticTransformParameters.csv* can be manually edited to update existing corrections or add additional corrections.

Choose the source datum from the pull-down combo-box and check the checkbox option. These corrections will be calculated and applied to the output SEGY when the Fix Trace Length button is pushed.

Convert to UTM

For many industry-standard seismic mapping packages, UTM mapping coordinates are used as the survey areas are generally local in natures and the UTM projection offers a convenient equal-area mapping of geographic data.

If the positional information in the source SEGY file is stored in latitude and longitude positions, then the Convert to UTM checkbox can be used to convert the positions stored in the output file to UTM.

By default, the zone number is set to -1. With this choice, the program will project the positional data into their “natural “ zone, one that is defined by the closest UTM zone to a given trace location. A choice of 0 will result in a UPS projection for polar regions. A choice greater than 0 results in a UTM projection.

If the seismic line crosses UTM zone boundaries, the automatic choice of the natural zone will change causing large discontinuities in the apparent survey track. But set the zone number to -1 first and process the seismic file.

The program will produce a file with the extension "_fixed.prj" that lists the source and projected coordinates and the calculated zone number. Open and examine this file with a text editor :

65.6695575 -59.9996461111111 362138.696753519 7286368.05251473 21

65.6697455555556 -59.9997591666667 362134.503884546 7286389.24177669 21

65.6698563888889 -59.9998136111111 362132.592529226 7286401.70325827 21

65.6699919444444 -59.9998919444444 362129.715422386 7286416.97012963 21

65.6701425 -59.9999533333333 362127.696383433 7286433.87019568 21

65.6702475 -60.0000055555556 637873.63351048 7286445.65285542 20

65.6704447222222 -60.0001172222222 637867.455912818 7286467.37002568 20

65.6705427777778 -60.0001719444444 637864.421129602 7286478.16918734 20

65.6706855555556 -60.000245 637860.306523946 7286493.90828034 20

Take note of the zone changes and then choose a best-representative zone , change the input zone value and reprocess the seismic file. Check the resulting .prj file to ensure the process completed as expected. The seismic file may have to be spilt into separate sections if the converted points fall too far away from the prescribed zone meridian (+/- 500 km).

Appendix 1 – Ellipsoid Definitions (*Ellipsoids.csv)*

Ellipsoid	Semi-major axis	1/flattening
Airy 1830,	6377563	299.325
Modified Airy	6377340	299.325
Australian National	6378160	298.25
Bessel 1841 (Namibia)	6377484	299.1528
Bessel 1841	6377397	299.1528
Clarke 1866,	6378206	294.9787
Clarke 1880,	6378249	293.465
Everest (India 1830)"	6377276	300.8017
Everest (Sabah Sarawak)	6377299	300.8017
Everest (India 1956)	6377301	300.8017
Everest (Malaysia 1969)	6377296	300.8017
Everest (Malay. & Sing)	6377304	300.8017
Everest (Pakistan)	6377310	300.8017
Modified Fischer 1960	6378155	298.3
Helmert 1906	6378200	298.3
Hough 1960	6378270	297
Indonesian 1974	6378160	298.247
International 1924	6378388	297
Krassovsky 1940	6378245	298.3
GRS 80	6378137	298.2572
South American 1969	6378160	298.25
WGS 72	6378135	298.26
WGS 84	6378137	298.2572

Appendix 2 –Geocentric Datum Corrections (*GeodeticTransformParameters.csv)*

Datum	Ellipsoid	dX	dY	dZ	Region of use	eX	eY	eZ	#S
Adindan	Clarke 1880	-118	-14	218	Burkina Faso	25	25	25	1
Adindan	Clarke 1880	-134	-2	210	Cameroon	25	25	25	1
Adindan	Clarke 1880	-165	-11	206	Ethiopia	3	3	3	8
Adindan	Clarke 1880	-123	-20	220	Mali	25	25	25	1
Adindan	Clarke 1880	-166	-15	204	MEAN FOR Ethiopia; Sudan	5	5	3	22
Adindan	Clarke 1880	-128	-18	224	Senegal	25	25	25	2
Adindan	Clarke 1880	-161	-14	205	Sudan	3	5	3	14
Afgooye	Krassovsky 1940	-43	-163	45	Somalia	25	25	25	1
Ain el Abd 1970	International 1924	-150	-250	-1	Bahrain	25	25	25	2
Ain el Abd 1970	International 1924	-143	-236	7	Saudi Arabia	10	10	10	9
American Samoa 1962	Clarke 1866	-115	118	426	American Samoa Islands	25	25	25	2
Anna 1 Astro 1965	Australian National	-491	-22	435	Cocos Islands	25	25	25	1
Antigua Island Astro 1943	Clarke 1880	-270	13	62	Antigua (Leeward Islands)	25	25	25	1
Arc 1950	Clarke 1880	-138	-105	-289	Botswana	3	5	3	9
Arc 1950	Clarke 1880	-153	-5	-292	Burundi	20	20	20	3
Arc 1950	Clarke 1880	-125	-108	-295	Lesotho	3	3	8	5
Arc 1950	Clarke 1880	-161	-73	-317	Malawi	9	24	8	6
Arc 1950	Clarke 1880	-143	-90	-294	MEAN FOR Botswana; Lesotho; Malawi; Swaziland;	20	33	20	41

					Zaire; Zambia; Zimbabwe				
Arc 1950	Clarke 1880	-134	-105	-295	Swaziland	15	15	15	4
Arc 1950	Clarke 1880	-169	-19	-278	Zaire	25	25	25	2
Arc 1950	Clarke 1880	-147	-74	-283	Zambia	21	21	27	5
Arc 1950	Clarke 1880	-142	-96	-293	Zimbabwe	5	8	11	10
Arc 1960	Clarke 1880	-160	-6	-302	MEAN FOR Kenya; Tanzania	20	20	20	25
Arc 1960	Clarke 1880	-157	-2	-299	Kenya	4	3	3	24
Arc 1960	Clarke 1880	-175	-23	-303	Taanzania	6	9	10	12
Ascension Island 1958	International 1924	-205	107	53	Ascension Island	25	25	25	2
Astro Beacon E 1945	International 1924	145	75	-272	Iwo Jima	25	25	25	1
Astro DOS 71/4	International 1924	-320	550	-494	St Helena Island	25	25	25	1
Astro Tern Island (FRIG) 1961	International 1924	114	-116	-333	Tern Island	25	25	25	1
Astronomical Station 1952	International 1924	124	-234	-25	Marcus Island	25	25	25	1
Australian Geodetic 1966	Australian National	-133	-48	148	Australia; Tasmania	3	3	3	105
Australian Geodetic 1984	Australian National	-134	-48	149	Australia; Tasmania	2	2	2	90
Ayabelle Lighthouse	Clarke 1880	-79	-129	145	Djibouti	25	25	25	1
Bellevue (IGN)	International 1924	-127	-769	472	Efate & Erromango Islands	20	20	20	3
Bermuda 1957	Clarke 1866	-73	213	296	Bermuda	20	20	20	3
Bissau	International 1924	-173	253	27	Guinea-Bissau	25	25	25	2
Bogota Observatory	International 1924	307	304	-318	Colombia	6	5	6	7
Bukit Rimpah	Bessel 1841	-384	664	-48	Indonesia (Bangka & Belitung Ids)	-1	-1	-1	0
Camp Area Astro	International 1924	-104	-129	239	Antarctica (McMurdo Camp Area)	-1	-1	-1	0
Campo	Internation	-148	136	90	Argentina	5	5	5	20

Inchauspe	al 1924								
Canton Astro 1966	International 1924	298	-304	-375	Phoenix Islands	15	15	15	4
Cape	Clarke 1880	-136	-108	-292	South Africa	3	6	6	5
Cape Canaveral	Clarke 1866	-2	151	181	Bahamas; Florida	3	3	3	19
Carthage	Clarke 1880	-263	6	431	Tunisia	6	9	8	5
Chatham Island Astro 1971	International 1924	175	-38	113	New Zealand (Chatham Island)	15	15	15	4
Chua Astro	International 1924	-134	229	-29	Paraguay	6	9	5	6
Corrego Alegre	International 1924	-206	172	-6	Brazil	5	3	5	17
Dabola	Clarke 1880	-83	37	124	Guinea	15	15	15	4
Deception Island	Clarke 1880	260	12	-147	Deception Island; Antarctia	20	20	20	3
Djakarta (Batavia)	Bessel 1841	-377	681	-50	Indonesia (Sumatra)	3	3	3	5
DOS 1968	International 1924	230	-199	-752	New Georgia Islands (Gizo Island)	25	25	25	1
Easter Island 1967	International 1924	211	147	111	Easter Island	25	25	25	1
Estonia; Coordinate System 1937	Bessel 1841	374	150	588	Estonia	2	3	3	19
European 1950	International 1924	-104	-101	-140	Cyprus	15	15	15	4
European 1950	International 1924	-130	-117	-151	Egypt	6	8	8	14
European 1950	International 1924	-86	-96	-120	England; Channel Islands; Scotland; Shetland Islands	3	3	3	40
European 1950	International 1924	-86	-96	-120	England; Ireland; Scotland; Shetland Islands	3	3	3	47
European 1950	International 1924	-87	-95	-120	Finland; Norway	3	5	3	20
European 1950	International 1924	-84	-95	-130	Greece	25	25	25	2
European 1950	International 1924	-117	-132	-164	Iran	9	12	11	27
European 1950	International 1924	-97	-103	-120	Italy (Sardinia)	25	25	25	2
European 1950	International 1924	-97	-88	-135	Italy (Sicily)	20	20	20	3

European 1950	International 1924	-107	-88	-149	Malta	25	25	25	1
European 1950	International 1924	-87	-98	-121	MEAN FOR Austria; Belgium; Denmark; Finland; France; W Germany; Gibraltar; Greece; Italy; Luxembourg; Netherlands; Norway; Portugal; Spain; Sweden; Switzerland	3	8	5	85
European 1950	International 1924	-87	-96	-120	MEAN FOR Austria; Denmark; France; W Germany; Netherlands; Switzerland	3	3	3	52
European 1950	International 1924	-103	-106	-141	MEAN FOR Iraq; Israel; Jordan; Lebanon; Kuwait; Saudi Arabia; Syria	-1	-1	-1	0
European 1950	International 1924	-84	-107	-120	Portugal; Spain	5	6	3	18
European 1950	International 1924	-112	-77	-145	Tunisia	25	25	25	4
European 1979	International 1924	-86	-98	-119	MEAN FOR Austria; Finland; Netherlands; Norway; Spain; Sweden; Switzerland	3	3	3	22
Fort Thomas 1955	Clarke 1880	-7	215	225	Nevis; St. Kitts (Leeward Islands)	25	25	25	2
Gan 1970	International 1924	-133	-321	50	Republic of Maldives	25	25	25	1
Geodetic Datum 1949	International 1924	84	-22	209	New Zealand	5	3	5	14
Graciosa Base SW 1948	International 1924	-104	167	-38	Azores (Faial; Graciosa; Pico; Sao Jorge; Terceira)	3	3	3	5
Guam 1963	Clarke 1866	-100	-248	259	Guam	3	3	3	5
Gunung Segara	Bessel 1841	-403	684	41	Indonesia (Kalimantan)	-1	-1	-1	0
GUX 1 Astro	International 1924	252	-209	-751	Guadalcanal Island	25	25	25	1
Herat North	International 1924	-333	-222	114	Afghanistan	-1	-1	-1	0
Hermannskogel Datum	Bessel 1841 (Namibia)	653	-212	449	Croatia -Serbia, Bosnia-Herzegovina	-1	-1	-1	0
Hjorsey 1955	International 1924	-73	46	-86	Iceland	3	3	6	6
Hong Kong 1963	International 1924	-156	-271	-189	Hong Kong	25	25	25	2
Hu-Tzu-Shan	Internation	-637	-549	-	Taiwan	15	15	15	4

	al 1924			203					
Indian	Everest (India 1830)	282	726	254	Bangladesh	10	8	12	6
Indian	Everest (India 1956)	295	736	257	India; Nepal	12	10	15	7
Indian	Everest (Pakistan)	283	682	231	Pakistan	-1	-1	-1	0
Indian 1954	Everest (India 1830)	217	823	299	Thailand	15	6	12	11
Indian 1960	Everest (India 1830)	182	915	344	Vietnam (Con Son Island)	25	25	25	1
Indian 1960	Everest (India 1830)	198	881	317	Vietnam (Near 16øN)	25	25	25	2
Indian 1975	Everest (India 1830)	210	814	289	Thailand	3	2	3	62
Indonesian 1974	Indonesian 1974	-24	-15	5	Indonesia	25	25	25	1
Ireland 1965	Modified Airy	506	-122	611	Ireland	3	3	3	7
ISTS 061 Astro 1968	International 1924	-794	119	-298	South Georgia Islands	25	25	25	1
ISTS 073 Astro 1969	International 1924	208	-435	-229	Diego Garcia	25	25	25	2
Johnston Island 1961	International 1924	189	-79	-202	Johnston Island	25	25	25	1
Kandawala	Everest (India 1830)	-97	787	86	Sri Lanka	20	20	20	3
Kerguelen Island 1949	International 1924	145	-187	103	Kerguelen Island	25	25	25	1
Kertau 1948	Everest (Malay. & Sing)	-11	851	5	West Malaysia & Singapore	10	8	6	6
Kusaie Astro 1951	International 1924	647	1777	-1124	Caroline Islands	25	25	25	1
Korean Geodetic System	GRS 80	0	0	0	South Korea	2	2	2	12
L. C. 5 Astro 1961	Clarke 1866	42	124	147	Cayman Brac Island	25	25	25	1

Leigon	Clarke 1880	-130	29	364	Ghana	2	3	2	8
Liberia 1964	Clarke 1880	-90	40	88	Liberia	15	15	15	4
Luzon	Clarke 1866	-133	-77	-51	Philippines (Excluding Mindanao)	8	11	9	6
Luzon	Clarke 1866	-133	-79	-72	Philippines (Mindanao)	25	25	25	1
M'Poraloko	Clarke 1880	-74	-130	42	Gabon	25	25	25	1
Mahe 1971	Clarke 1880	41	-220	-134	Mahe Island	25	25	25	1
Massawa	Bessel 1841	639	405	60	Ethiopia (Eritrea)	25	25	25	1
Merchich	Clarke 1880	31	146	47	Morocco	5	3	3	9
Midway Astro 1961	International 1924	912	-58	1227	Midway Islands	25	25	25	1
Minna	Clarke 1880	-81	-84	115	Cameroon	25	25	25	2
Minna	Clarke 1880	-92	-93	122	Nigeria	3	6	5	6
Montserrat Island Astro 1958	Clarke 1880	174	359	365	Montserrat (Leeward Islands)	25	25	25	1
Nahrwan	Clarke 1880	-247	-148	369	Oman (Masirah Island)	25	25	25	2
Nahrwan	Clarke 1880	-243	-192	477	Saudi Arabia	20	20	20	3
Nahrwan	Clarke 1880	-249	-156	381	United Arab Emirates	25	25	25	2
Naparima BWI	International 1924	-10	375	165	Trinidad & Tobago	15	15	15	4
North American 1927	Clarke 1866	-5	135	172	Alaska (Excluding Aleutian Ids)	5	9	5	47
North American 1927	Clarke 1866	-2	152	149	Alaska (Aleutian Ids East of 180øW)	6	8	10	6
North American 1927	Clarke 1866	2	204	105	Alaska (Aleutian Ids West of 180øW)	10	10	10	5
North American 1927	Clarke 1866	-4	154	178	Bahamas (Except San Salvador Id)	5	3	5	11
North American	Clarke 1866	1	140	165	Bahamas (San Salvador Island)	25	25	25	1

1927									
North American 1927	Clarke 1866	-7	162	188	Canada (Alberta; British Columbia)	8	8	6	25
North American 1927	Clarke 1866	-9	157	184	Canada (Manitoba; Ontario)	9	5	5	25
North American 1927	Clarke 1866	-22	160	190	Canada (New Brunswick; Newfoundland; Nova Scotia; Quebec)	6	6	3	37
North American 1927	Clarke 1866	4	159	188	Canada (Northwest Territories; Saskatchewan)	5	5	3	17
North American 1927	Clarke 1866	-7	139	181	Canada (Yukon)	5	8	3	8
North American 1927	Clarke 1866	0	125	201	Canal Zone	20	20	20	3
North American 1927	Clarke 1866	-9	152	178	Cuba	25	25	25	1
North American 1927	Clarke 1866	11	114	195	Greenland (Hayes Peninsula)	25	25	25	2
North American 1927	Clarke 1866	-3	142	183	MEAN FOR Antigua; Barbados; Barbuda; Caicos Islands; Cuba; Dominican Republic; Grand Cayman; Jamaica; Turks Islands	3	9	12	15
North American 1927	Clarke 1866	0	125	194	MEAN FOR Belize; Costa Rica; El Salvador; Guatemala; Honduras; Nicaragua	8	3	5	19
North American 1927	Clarke 1866	-10	158	187	MEAN FOR Canada	15	11	6	112
North American 1927	Clarke 1866	-8	160	176	MEAN FOR CONUS	5	5	6	405
North American 1927	Clarke 1866	-9	161	179	MEAN FOR CONUS (East of Mississippi; River Including Louisiana; Missouri; Minnesota)	5	5	8	129
North American 1927	Clarke 1866	-8	159	175	MEAN FOR CONUS (West of Mississippi; River Excluding Louisiana; Minnesota;	5	3	3	276

					Missouri)				
North American 1927	Clarke 1866	-12	130	190	Mexico	8	6	6	22
North American 1983	GRS 80	0	0	0	Alaska (Excluding Aleutian Ids)	2	2	2	42
North American 1983	GRS 80	-2	0	4	Aleutian Ids	5	2	5	4
North American 1983	GRS 80	0	0	0	Canada	2	2	2	96
North American 1983	GRS 80	0	0	0	CONUS	2	2	2	216
North American 1983	GRS 80	1	1	-1	Hawaii	2	2	2	6
North American 1983	GRS 80	0	0	0	Mexico; Central America	2	2	2	25
North Sahara 1959	Clarke 1880	-186	-93	310	Algeria	25	25	25	3
Observatorio Meteorologico 1939	International 1924	-425	-169	81	Azores (Corvo & Flores Islands)	20	20	20	3
Old Egyptian 1907	Helmert 1906	-130	110	-13	Egypt	3	6	8	14
Old Hawaiian	Clarke 1866	89	-279	-183	Hawaii	25	25	25	2
Old Hawaiian	Clarke 1866	45	-290	-172	Kauai	20	20	20	3
Old Hawaiian	Clarke 1866	65	-290	-190	Maui	25	25	25	2
Old Hawaiian	Clarke 1866	61	-285	-181	MEAN FOR Hawaii; Kauai; Maui; Oahu	25	20	20	15
Old Hawaiian	Clarke 1866	58	-283	-182	Oahu	10	6	6	8
Oman	Clarke 1880	-346	-1	224	Oman	3	3	9	7
Ordnance Survey Great Britain 1936	Airy 1830	371	-112	434	England	5	5	6	21
Ordnance Survey Great Britain 1936	Airy 1830	371	-111	434	England; Isle of Man; Wales	10	10	15	25

Ordnance Survey Great Britain 1936	Airy 1830	375	-111	431	MEAN FOR England; Isle of Man; Scotland; Shetland Islands; Wales	10	10	15	38
Ordnance Survey Great Britain 1936	Airy 1830	384	-111	425	Scotland; Shetland Islands	10	10	10	13
Ordnance Survey Great Britain 1936	Airy 1830	370	-108	434	Wales	20	20	20	3
Pico de las Nieves	International 1924	-307	-92	127	Canary Islands	25	25	25	1
Pitcairn Astro 1967	International 1924	185	165	42	Pitcairn Island	25	25	25	1
Point 58	Clarke 1880	-106	-129	165	MEAN FOR Burkina Faso & Niger	25	25	25	1
Pointe Noire 1948	Clarke 1880	-148	51	-291	Congo	25	25	25	1
Porto Santo 1936	International 1924	-499	-249	314	Porto Santo; Madeira Islands	25	25	25	2
Provisional South American 1956	International 1924	-270	188	-388	Bolivia	5	11	14	5
Provisional South American 1956	International 1924	-270	183	-390	Chile (Northern; Near 19øS)	25	25	25	1
Provisional South American 1956	International 1924	-305	243	-442	Chile (Southern; Near 43øS)	20	20	20	3
Provisional South American 1956	International 1924	-282	169	-371	Colombia	15	15	15	4
Provisional South American 1956	International 1924	-278	171	-367	Ecuador	3	5	3	11
Provisional South American 1956	International 1924	-298	159	-369	Guyana	6	14	5	9
Provisional South American 1956	International 1924	-288	175	-376	MEAN FOR Bolivia; Chile; Colombia; Ecuador; Guyana; Peru; Venezuela	17	27	27	63

Provisional South American 1956	International 1924	-279	175	-379	Peru	6	8	12	6
Provisional South American 1956	International 1924	-295	173	-371	Venezuela	9	14	15	24
Provisional South Chilean 1963	International 1924	16	196	93	Chile (Near 53øS) (Hito XVIII)	25	25	25	2
Puerto Rico	Clarke 1866	11	72	-101	Puerto Rico; Virgin Islands	3	3	3	11
Pulkovo 1942	Krassovsky 1940	28	-130	-95	Russia	-1	-1	-1	0
Qatar National	International 1924	-128	-283	22	Qatar	20	20	20	3
Qornoq	International 1924	164	138	-189	Greenland (South)	25	25	32	2
Reunion	International 1924	94	-948	-1262	Mascarene Islands	25	25	25	1
Rome 1940	International 1924	-225	-65	9	Italy (Sardinia)	25	25	25	1
S-42 (Pulkovo 1942)	Krassovsky 1940	28	-121	-77	Hungary	2	2	2	5
S-42 (Pulkovo 1942)	Krassovsky 1940	23	-124	-82	Poland	4	2	4	11
S-42 (Pulkovo 1942)	Krassovsky 1940	26	-121	-78	Czechoslavakia	3	3	2	6
S-42 (Pulkovo 1942)	Krassovsky 1940	24	-124	-82	Latvia	2	2	2	5
S-42 (Pulkovo 1942)	Krassovsky 1940	15	-130	-84	Kazakhstan	25	25	25	2
S-42 (Pulkovo 1942)	Krassovsky 1940	24	-130	-92	Albania	3	3	3	7
S-42 (Pulkovo 1942)	Krassovsky 1940	28	-121	-77	Romania	3	5	3	4
S-JTSK	Bessel 1841	589	76	480	Czechoslavakia (Prior 1 JAN 1993)	4	2	3	6
Santo (DOS) 1965	International 1924	170	42	84	Espirito Santo Island	25	25	25	1
Sao Braz	International 1924	-203	141	53	Azores (Sao Miguel; Santa Maria Ids)	25	25	25	2
Sapper Hill 1943	International 1924	-355	21	72	East Falkland Island	1	1	1	5
Schwarzeck	Bessel	616	97	-	Namibia	20	20	20	3

	1841 (Namibia)			251					
Selvagem Grande 1938	International 1924	-289	-124	60	Salvage Islands	25	25	25	1
Sierra Leone 1960	Clarke 1880	-88	4	101	Sierra Leone	15	15	15	8
South American 1969	South American 1969	-62	-1	-37	Argentina	5	5	5	10
South American 1969	South American 1969	-61	2	-48	Bolivia	15	15	15	4
South American 1969	South American 1969	-60	-2	-41	Brazil	3	5	5	22
South American 1969	South American 1969	-75	-1	-44	Chile	15	8	11	9
South American 1969	South American 1969	-44	6	-36	Colombia	6	6	5	7
South American 1969	South American 1969	-48	3	-44	Ecuador	3	3	3	11
South American 1969	South American 1969	-47	26	-42	Ecuador (Baltra; Galapagos)	25	25	25	1
South American 1969	South American 1969	-53	3	-47	Guyana	9	5	5	5
South American 1969	South American 1969	-57	1	-41	MEAN FOR Argentina; Bolivia; Brazil; Chile; Colombia; Ecuador; Guyana; Paraguay; Peru; Trinidad & Tobago; Venezuela	15	6	9	84
South American 1969	South American 1969	-61	2	-33	Paraguay	15	15	15	4
South American 1969	South American 1969	-58	0	-44	Peru	5	5	5	6
South American 1969	South American 1969	-45	12	-33	Trinidad & Tobago	25	25	25	1
South American 1969	South American 1969	-45	8	-33	Venezuela	3	6	3	5

South Asia	Modified Fischer 1960	7	-10	-26	Singapore	25	25	25	1
Tananarive Observatory 1925	International 1924	-189	-242	-91	Madagascar	-1	-1	-1	0
Timbalai 1948	Everest (Sabah Sarawak)	-679	669	-48	Brunei; E. Malaysia (Sabah Sarawak)	10	10	12	8
Tokyo	Bessel 1841	-148	507	685	Japan	8	5	8	16
Tokyo	Bessel 1841	-148	507	685	MEAN FOR Japan; South Korea; Okinawa	20	5	20	31
Tokyo	Bessel 1841	-158	507	676	Okinawa	20	5	20	3
Tokyo	Bessel 1841	-147	506	687	South Korea	2	2	2	29
Tristan Astro 1968	International 1924	-632	438	-609	Tristan da Cunha	25	25	25	1
Viti Levu 1916	Clarke 1880	51	391	-36	Fiji (Viti Levu Island)	25	25	25	1
Voirol 1960	Clarke 1880	-123	-206	219	Algeria	25	25	25	2
Wake Island Astro 1952	International 1924	276	-57	149	Wake Atoll	25	25	25	2
Wake-Eniwetok 1960	Hough 1960	102	52	-38	Marshall Islands	3	3	3	10
WGS 1972	WGS 72	0	0	0	Global Definition	-1	-1	-1	0
WGS 1984	WGS 84	0	0	0	Global Definition	-1	-1	-1	0
Yacare	International 1924	-155	171	37	Uruguay	-1	-1	-1	0
Zanderij	International 1924	-265	120	-358	Suriname	5	5	8	5