# SECTION 27

# ACCURACY OF WGS 84 COORDINATES

Table 27.1

Accuracy ($1\sigma$) of WGS 84 Coordinates
As a Function of Coordinate Determination Technique

| WGS 84 Coordinates of Site Determined Using | Accuracies ($1\sigma$) Geodetic Latitude | Geodetic Longitude | Geodetic Height |
|---|---|---|---|
| Satellite Point Positioning Directly in WGS 84 | ±1 m | ±1 m | ±1-2 m |
| NSWC 9Z-2 to WGS 84 Transformation | 2 | 2 | 2-3 |
| Localized $\Delta X$, $\Delta Y$, $\Delta Z$ Datum Shifts (Tabular or From $\Delta X$, $\Delta Y$, $\Delta Z$ Datum Shift Contour Charts) and Standard Molodensky Datum Transformation Formulas | 2* | 2* | 2-3* |
| Localized $\Delta X$, $\Delta Y$, $\Delta Z$ Datum Shifts and Direct Coordinate Conversion (X, Y, Z to $\phi$, $\lambda$, H) | 2* | 2* | 2-3* |
| $\Delta\phi$, $\Delta\lambda$, $\Delta H$ Datum Shift Contour Charts | 3** | 3** | 2-3** |
| Datum Shift Multiple Regression Equations ( $\Delta\phi$, $\Delta\lambda$, $\Delta H$ ) | 3*** | 3*** | 4*** |
| $\overline{\Delta X}$, $\overline{\Delta Y}$, $\overline{\Delta Z}$ Mean Datum Shifts and Standard Molodensky Datum Transformation Formulas | 5*** | 4*** | 4*** |
| $\overline{\Delta X}$, $\overline{\Delta Y}$, $\overline{\Delta Z}$ Mean Datum Shifts and Direct Coordinate Conversion (X, Y, Z to $\phi$, $\lambda$, H) | 5*** | 4*** | 4*** |

* Pertains only to the use of localized $\Delta X$, $\Delta Y$, $\Delta Z$ datum shifts (tabular or from $\Delta X$, $\Delta Y$, $\Delta Z$ Datum Shift Contour Charts). Applicable only in the vicinity of Doppler stations; the errors are larger elsewhere [and if mean datum shifts ($\overline{\Delta X}$, $\overline{\Delta Y}$, $\overline{\Delta Z}$ ) are used].

** Applicable only in the vicinity of Doppler stations. The errors are larger elsewhere.

*** These are general accuracy values pertaining to NAD 27 (CONUS), and will not necessarily be the same for other local geodetic systems. (See Tables 27.2 and 27.3 for these and other general accuracy values, and then Figures 27.1 - 27.42 for how the accuracy values vary throughout the datum areas.)

Table 27.1 (Cont'd)

Accuracy ($1\sigma$) of WGS 84 Coordinates
As a Function of Coordinate Determination Technique

| WGS 84 Coordinates of Site Determined Using | Accuracies ($1\sigma$) Geodetic Latitude | Geodetic Longitude | Geodetic Height |
|---|---|---|---|
| WGS 72 to WGS 84 Transformation Formulas: | | | |
| - At Doppler Stations (WGS 72 Coordinates from Satellite Point Positioning) | ±2 m | ±2 m | ±2-3 m |
| - At Non-Doppler Geodetic Network Stations: | | | |
| - Near Doppler Stations, WGS 72 Coordinates from Localized Datum Shifts | 3 | 3 | 3-4 |
| - WGS 72 Coordinates from Mean Datum Shifts | [Use Only as a Last Resort; Large Errors. See Sections 11 and 26 of this Report, and Sections 7.2.3 and 9.3 of Reference 2.] | | |

Table 27.2

Accuracy (1σ) of WGS 84 Coordinates at Doppler Sites
- WGS 84 Coordinates Determined Using Molodensky Datum Transformation Formulas and Local Geodetic System-to-WGS 84 Mean Datum Shifts ( $\overline{\Delta X}$, $\overline{\Delta Y}$, $\overline{\Delta Z}$ ) -

| Local Geodetic Systems | Number of Comparison Points | Linear Error Geodetic Latitude ($\sigma_{D_{\ell_\phi}}$) | Linear Error Geodetic Longitude ($\sigma_{D_{\ell_\lambda}}$) | Linear Error Geodetic Height ($\sigma_{D_{\ell_H}}$) | Circular (Horizontal) Error ($\sigma_{D_c}$) | Spherical (Positional) Error ($\sigma_{D_s}$) |
|---|---|---|---|---|---|---|
| Adindan | 25 | ±4.2m | ±4.5m | ±4.1m | 5.1m | 5.1m |
| Arc 1950 | 41 | 13.7 | 26.3 | 5.3 | 29.1 | 29.0 |
| Arc 1960 | 19 | 5.2 | 7.1 | 4.2 | 7.5 | 7.4 |
| Australian Geodetic 1966 | 105 | 3.1 | 2.9 | 3.5 | 3.1 | 3.3 |
| Australian Geodetic 1984 | 90 | 2.8 | 2.9 | 3.5 | 2.9 | 3.1 |
| Bellevue (IGN) | 3 | 2.8 | 2.7 | 3.8 | 2.7 | 3.1 |
| Bermuda 1957 | 3 | 2.8 | 2.9 | 4.2 | 2.9 | 3.3 |
| Bogota Observatory | 7 | 5.2 | 4.8 | 5.1 | 5.8 | 6.0 |
| Campo Inchauspe | 20 | 3.5 | 3.5 | 4.5 | 3.7 | 4.2 |
| Canton Astro 1966 | 4 | 2.6 | 2.5 | 4.3 | 2.5 | 3.1 |
| Cape | 5 | 5.9 | 4.4 | 3.6 | 6.0 | 5.7 |
| Cape Canaveral | 16 | 2.3 | 2.2 | 3.4 | 2.3 | 2.6 |
| Carthage | 5 | 7.3 | 7.5 | 3.8 | 8.8 | 8.3 |
| Chatham 1971 | 4 | 2.4 | 2.4 | 3.7 | 2.4 | 2.8 |
| Chua Astro | 6 | 5.0 | 6.3 | 5.6 | 6.7 | 7.0 |
| Corrego Alegre | 17 | 4.0 | 4.2 | 3.5 | 4.5 | 4.8 |
| Djakarta | 5 | 2.2 | 2.7 | 4.0 | 2.5 | 2.9 |
| European 1950 | | | | | | |
| Western Europe | 85 | 3.2 | 5.7 | 3.6 | 5.5 | 5.4 |
| * UK/Ireland | 47 | 2.2 | 2.3 | 3.4 | 2.2 | 2.6 |
| * UK (Only) | 40 | 2.2 | 2.3 | 3.5 | 2.2 | 2.6 |
| Cyprus | 4 | 2.3 | 2.3 | 3.7 | 2.3 | 2.7 |
| Egypt | 14 | 5.2 | 6.2 | 5.1 | 7.0 | 7.2 |

* ED 50 coordinates developed from OSGB Scientific Network 1980 (SN 80) coordinates.

Table 27.2 (Cont'd)

Accuracy (1σ) of WGS 84 Coordinates at Doppler Sites
- WGS 84 Coordinates Determined Using Molodensky Datum Transformation Formulas and Local Geodetic System-to-WGS 84 Mean Datum Shifts ( $\overline{\Delta X}$, $\overline{\Delta Y}$, $\overline{\Delta Z}$ ) -

| Local Geodetic Systems | Number of Comparison Points | Linear Error Geodetic Latitude ($\sigma_{D_{\ell_\phi}}$) | Longitude ($\sigma_{D_{\ell_\lambda}}$) | Height ($\sigma_{D_{\ell_H}}$) | Circular (Horizontal) Error ($\sigma_{D_c}$) | Spherical (Positional) Error ($\sigma_{D_s}$) |
|---|---|---|---|---|---|---|
| European 1950 (Cont'd) | | | | | | |
| Iran | 27 | ±5.5m | ±8.0m | ±9.6m | 8.4m | 10.8m |
| Geodetic Datum 1949 | 14 | 4.7 | 2.8 | 3.7 | 4.2 | 4.1 |
| Guam 1963 | 5 | 2.6 | 2.4 | 3.9 | 2.5 | 3.0 |
| Hjorsey 1955 | 6 | 2.5 | 2.9 | 5.5 | 2.7 | 3.9 |
| Indian | 14 | 6.3 | 6.8 | 3.4 | 7.9 | 7.5 |
| Ireland 1965 | 7 | 2.3 | 2.4 | 3.3 | 2.4 | 2.6 |
| Kandawala | 3 | 2.9 | 3.3 | 3.8 | 3.1 | 3.3 |
| Kertau 1948 | 6 | 3.1 | 3.0 | 3.6 | 3.2 | 3.3 |
| Liberia 1964 | 4 | 4.4 | 9.4 | 3.8 | 8.9 | 8.3 |
| Luzon | 7 | 10.7 | 7.5 | 5.8 | 11.4 | 11.3 |
| Merchich | 9 | 2.4 | 2.7 | 5.3 | 2.6 | 3.8 |
| Minna | 6 | 4.2 | 4.7 | 3.7 | 4.9 | 4.8 |
| NAD 27 | | | | | | |
| Alaska | 47 | 4.6 | 6.4 | 4.3 | 6.9 | 6.7 |
| Canada | 112 | 8.3 | 10.8 | 4.2 | 12.7 | 11.8 |
| CONUS | 405 | 5.2 | 3.6 | 3.7 | 5.1 | 5.0 |
| Mexico, Central America | 44 | 4.9 | 9.1 | 5.3 | 9.0 | 8.9 |
| Caribbean | 26 | 8.1 | 5.4 | 4.8 | 8.6 | 8.5 |
| NAD 83 | 203 | 2.1 | 2.3 | 3.5 | 2.2 | 2.6 |
| Old Egyptian | 14 | 5.4 | 4.5 | 5.2 | 5.7 | 6.1 |
| Old Hawaiian | 13 | 5.2 | 5.2 | 4.4 | 6.0 | 6.0 |
| Oman | 7 | 6.8 | 2.6 | 3.7 | 5.8 | 5.5 |
| Ordnance Survey of Great Britain 1936 | 38 | 8.8 | 3.9 | 3.4 | 8.2 | 7.7 |

Table 27.2 (Cont'd)

Accuracy ($1\sigma$) of WGS 84 Coordinates at Doppler Sites
- WGS 84 Coordinates Determined Using Molodensky Datum Transformation Formulas and Local Geodetic System-to-WGS 84 Mean Datum Shifts ( $\overline{\Delta X}$, $\overline{\Delta Y}$, $\overline{\Delta Z}$ ) -

| Local Geodetic Systems | Number of Comparison Points | Linear Error Geodetic Latitude ($\sigma_{D_{\ell_\phi}}$) | Longitude ($\sigma_{D_{\ell_\lambda}}$) | Height ($\sigma_{D_{\ell_H}}$) | Circular (Horizontal) Error ($\sigma_{D_c}$) | Spherical (Positional) Error ($\sigma_{D_s}$) |
|---|---|---|---|---|---|---|
| Provisional South American 1956 | 65 | ±23.6 | ±12.9 | ±9.6 | 28.6 | 27.0 |
| Puerto Rico | 11 | 3.0 | 3.0 | 3.7 | 3.1 | 3.3 |
| Qatar National | 3 | 2.5 | 2.7 | 4.0 | 2.6 | 3.0 |
| South American 1969 | 84 | 6.3 | 10.8 | 5.1 | 11.9 | 11.1 |
| Southwest Base | 5 | 2.4 | 3.1 | 3.4 | 2.8 | 3.0 |
| Timbalai 1948 | 8 | 4.5 | 4.3 | 3.4 | 4.9 | 4.6 |
| Tokyo | 11 | 5.5 | 5.3 | 3.8 | 6.3 | 6.1 |
| Wake-Eniwetok 1960 | 7 | 2.3 | 2.8 | 3.6 | 2.6 | 2.9 |
| Zanderij | 5 | 5.8 | 5.0 | 3.5 | 6.1 | 5.7 |

NOTE: The accuracies listed in this table are general accuracy values determined using data developed at Doppler sites. See Figures 27.1 - 27.21 before deciding to use accuracy values from this table.

Table 27.3

Accuracy (1σ) of WGS 84 Coordinates at Doppler Sites
- WGS 84 Coordinates Determined Using Local Geodetic System-to-WGS 84 Datum Transformation Multiple Regression Equations -

| Local Geodetic Systems | Number of Comparison Points | Linear Error Geodetic Latitude ($\sigma_{D_{\ell_\phi}}$) | Longitude ($\sigma_{D_{\ell_\lambda}}$) | Height ($\sigma_{D_{\ell_H}}$) | Circular (Horizontal) Error ($\sigma_{D_c}$) | Spherical (Positional) Error ($\sigma_{D_s}$) |
|---|---|---|---|---|---|---|
| Adindan | 25 | ±5.4m | ±3.6m | ±3.8m | 5.6m | 5.6m |
| Arc 1950 | 41 | 5.3 | 20.4 | 4.7 | 20.5 | 20.5 |
| Arc 1960 | 19 | 3.2 | 2.8 | 3.9 | 3.2 | 3.5 |
| Australian Geodetic 1966 | 105 | 2.4 | 2.4 | 3.4 | 2.4 | 2.8 |
| Australian Geodetic 1984 | 90 | 2.3 | 2.3 | 3.5 | 2.3 | 2.7 |
| Bellevue (IGN) | 3 | 2.4 | 2.5 | 3.7 | 2.5 | 2.8 |
| Bermuda 1957 | 3 | 2.5 | 2.5 | 3.8 | 2.5 | 2.9 |
| Bogota Observatory | 7 | 3.0 | 3.3 | 3.4 | 3.3 | 3.3 |
| Campo Inchauspe | 20 | 2.6 | 2.6 | 3.8 | 2.6 | 3.1 |
| Canton Astro 1966 | 4 | 2.3 | 2.3 | 3.5 | 2.3 | 2.7 |
| Cape | 5 | 2.5 | 2.3 | 3.4 | 2.4 | 2.7 |
| Cape Canaveral | 16 | 2.2 | 2.3 | 3.3 | 2.3 | 2.6 |
| Carthage | 5 | 2.6 | 2.7 | 3.5 | 2.7 | 2.9 |
| Chatham 1971 | 4 | 2.3 | 2.4 | 3.5 | 2.4 | 2.7 |
| Chua Astro | 6 | 3.0 | 2.3 | 3.5 | 2.7 | 3.0 |
| Corrego Alegre | 17 | 3.3 | 3.3 | 3.5 | 3.6 | 3.8 |
| Djakarta | 5 | 2.5 | 2.6 | 3.5 | 2.5 | 2.8 |
| European 1950 | | | | | | |
| Western Europe | 85 | 3.0 | 2.8 | 3.5 | 3.2 | 3.4 |
| * UK/Ireland | 47 | 2.1 | 2.3 | 3.3 | 2.2 | 2.5 |
| * UK (Only) | 40 | 2.1 | 2.3 | 3.4 | 2.2 | 2.6 |
| Cyprus | 4 | 2.3 | 2.3 | 3.5 | 2.3 | 2.7 |
| Egypt | 14 | 2.6 | 2.9 | 3.5 | 2.8 | 3.0 |

* ED 50 coordinates developed from OSGB Scientific Network 1980 (SN 80) coordinates.

Table 27.3 (Cont'd)

Accuracy (1σ) of WGS 84 Coordinates at Doppler Sites
- WGS 84 Coordinates Determined Using Local Geodetic System-to-WGS 84 Datum Transformation Multiple Regression Equations -

| Local Geodetic Systems | Number of Comparison Points | Linear Error Geodetic Latitude ($\sigma_{D_{\ell_\phi}}$) | Longitude ($\sigma_{D_{\ell_\lambda}}$) | Height ($\sigma_{D_{\ell_H}}$) | Circular (Horizontal) Error ($\sigma_{D_c}$) | Spherical (Positional) Error ($\sigma_{D_s}$) |
|---|---|---|---|---|---|---|
| European 1950 (Cont'd) | | | | | | |
| Iran | 27 | ±4.8m | ±4.5m | ±5.6m | 5.7m | 6.6m |
| Geodetic Datum 1949 | 14 | 2.3 | 2.2 | 3.6 | 2.3 | 2.7 |
| Guam 1963 | 5 | 2.5 | 2.3 | 3.8 | 2.4 | 2.8 |
| Hjorsey 1955 | 6 | 2.7 | 2.5 | 3.8 | 2.6 | 3.0 |
| Indian | 14 | 4.9 | 2.9 | 4.1 | 4.6 | 4.7 |
| Ireland 1965 | 7 | 2.3 | 2.4 | 3.3 | 2.4 | 2.7 |
| Kandawala | 3 | 2.5 | 2.6 | 3.7 | 2.5 | 2.9 |
| Kertau 1948 | 6 | 2.6 | 2.6 | 3.6 | 2.6 | 2.9 |
| Liberia 1964 | 4 | 2.3 | 3.0 | 3.5 | 2.6 | 2.9 |
| Luzon | 7 | 2.8 | 3.2 | 4.0 | 3.0 | 3.4 |
| Merchich | 9 | 2.8 | 2.2 | 4.0 | 2.6 | 3.0 |
| Minna | 6 | 2.9 | 2.6 | 3.5 | 2.8 | 3.0 |
| NAD 27 | | | | | | |
| Alaska | 47 | 3.2 | 3.2 | 4.0 | 3.4 | 3.7 |
| Canada | 112 | 3.1 | 3.4 | 3.5 | 3.5 | 3.6 |
| CONUS | 405 | 2.6 | 2.7 | 3.5 | 2.8 | 3.1 |
| Mexico, Central America | 44 | 3.5 | 4.0 | 4.3 | 4.1 | 4.5 |
| Caribbean | 26 | 2.7 | 4.4 | 4.9 | 4.1 | 4.8 |
| Old Egyptian | 14 | 2.5 | 3.7 | 4.7 | 3.4 | 4.3 |
| Old Hawaiian | 13 | 2.7 | 2.2 | 3.6 | 2.5 | 2.9 |
| Oman | 7 | 2.4 | 2.7 | 3.3 | 2.5 | 2.8 |
| Ordnance Survey of Great Britain 1936 | 38 | 2.1 | 2.3 | 3.2 | 2.2 | 2.5 |

Table 27.3 (Cont'd)

Accuracy ($1\sigma$) of WGS 84 Coordinates at Doppler Sites
- WGS 84 Coordinates Determined Using Local Geodetic System-to-WGS 84 Datum Transformation Multiple Regression Equations -

| Local Geodetic Systems | Number of Comparison Points | Linear Error Geodetic Latitude ($\sigma_{D_{\ell_\phi}}$) | Longitude ($\sigma_{D_{\ell_\lambda}}$) | Height ($\sigma_{D_{\ell_H}}$) | Circular (Horizontal) Error ($\sigma_{D_c}$) | Spherical (Positional) Error ($\sigma_{D_s}$) |
|---|---|---|---|---|---|---|
| Provisional South American 1956 | 65 | ±22.2 | ±4.1 | ±8.5 | 25.1m | 23.6m |
| Puerto Rico | 11 | 2.4 | 2.5 | 3.4 | 2.5 | 2.8 |
| Qatar National | 3 | 2.4 | 2.5 | 3.7 | 2.5 | 2.8 |
| South American 1969 | 84 | 3.5 | 3.5 | 4.7 | 3.9 | 4.5 |
| Southwest Base | 5 | 2.4 | 2.4 | 3.4 | 2.4 | 2.7 |
| Timbalai 1948 | 8 | 2.3 | 2.5 | 3.3 | 2.4 | 2.7 |
| Tokyo | 13 ** | 6.1 | 5.0 | 4.2 | 6.8 | 6.7 |
| Wake-Eniwetok 1960 | 7 | 2.2 | 2.2 | 3.3 | 2.2 | 2.6 |
| Zanderij | 5 | 2.7 | 2.9 | 3.6 | 2.8 | 3.0 |

** Number includes two Doppler Stations on Okinawa. Related entry in Table 27.2 does not include these two stations.

NOTE: The accuracies listed in this table are general accuracy values determined using data developed at Doppler sites. See Figures 27.22 - 27.42 before deciding to use accuracy values from this table.

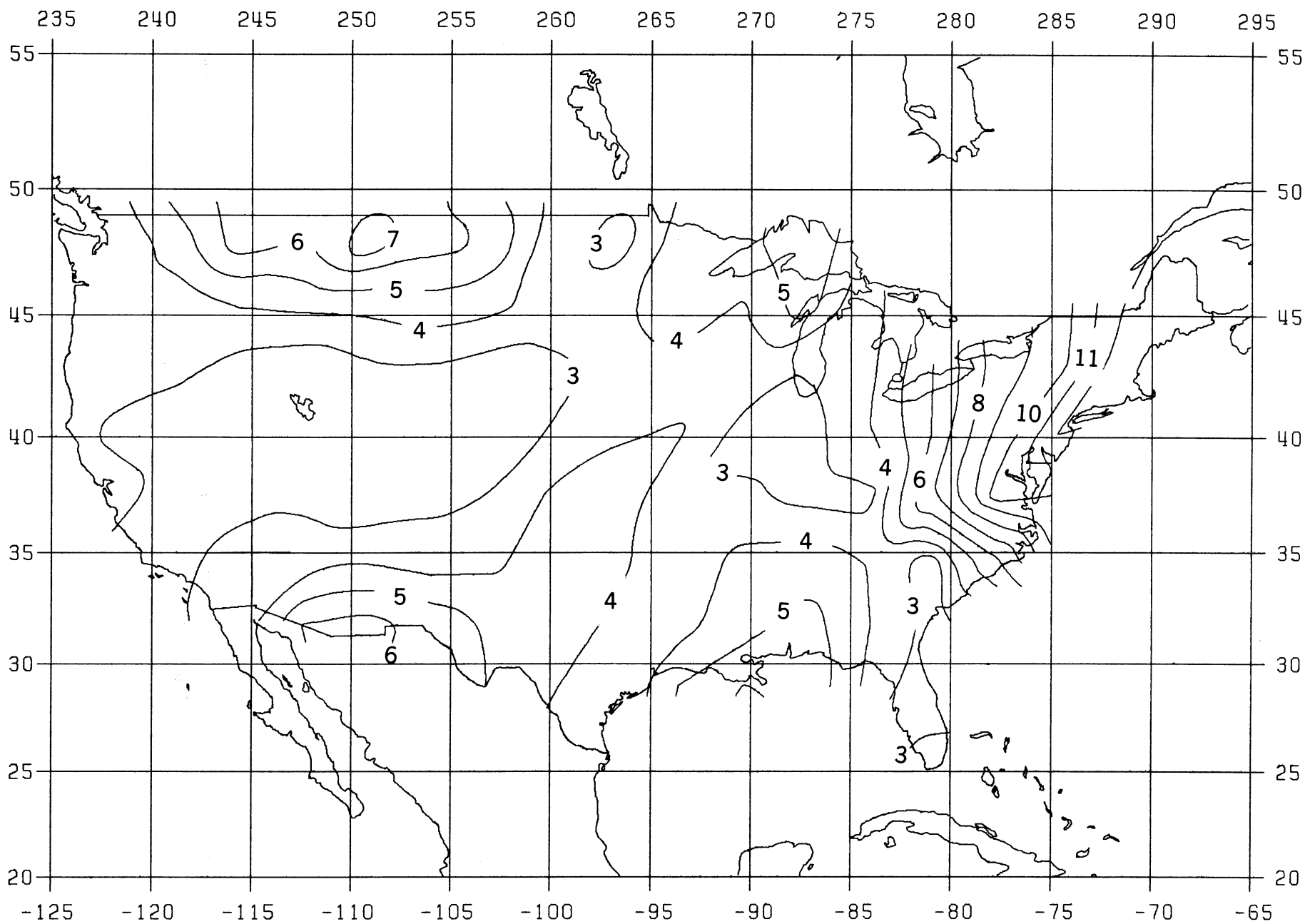


Figure 27.1. Accuracy ($1\sigma$) of WGS 84 Geodetic Latitudes at Doppler Sites (NAD 27 Area, CONUS), Latitude Determined Using Mean Datum Shifts (Contour Interval = 1 Meter)

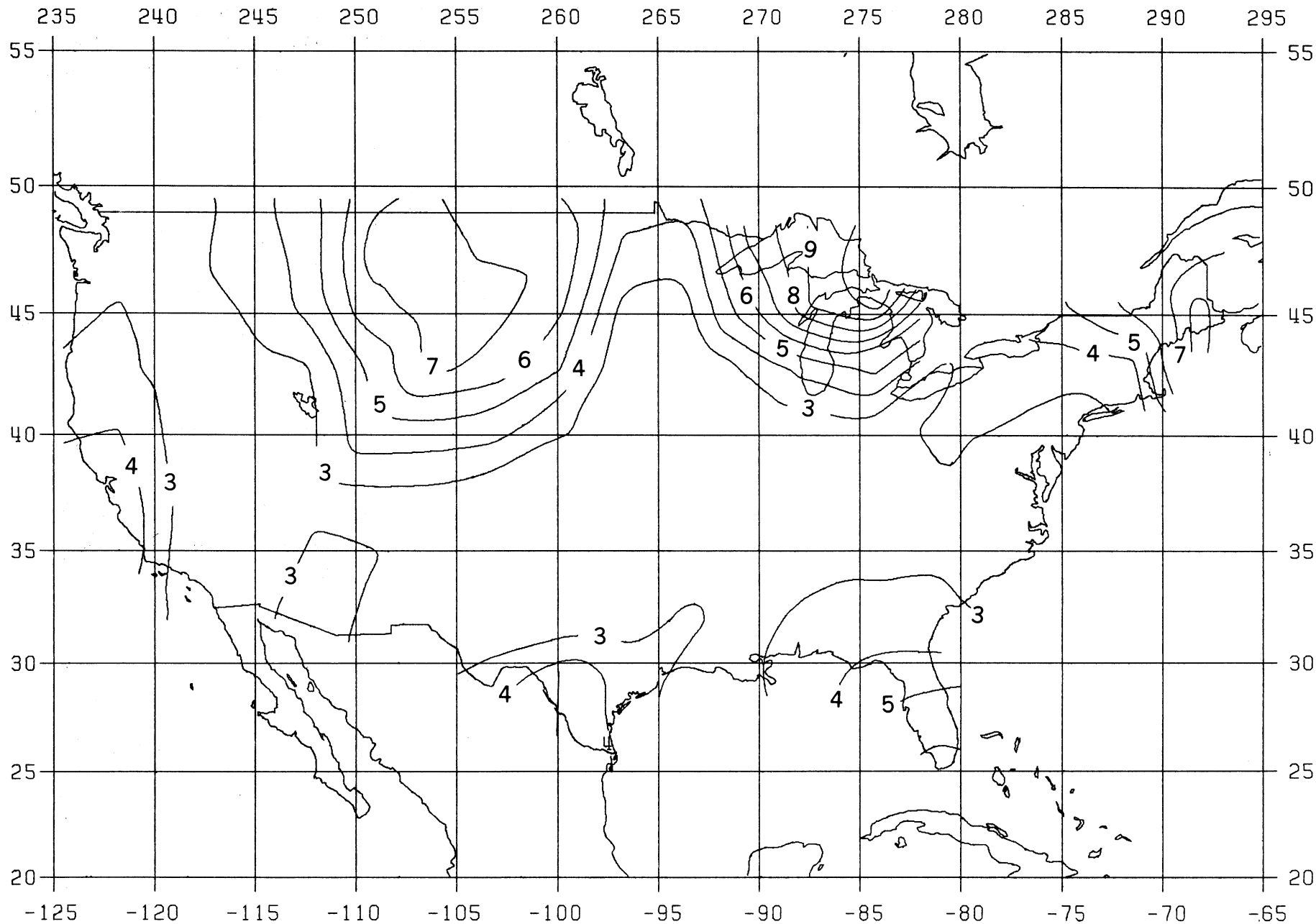


Figure 27.2. Accuracy ($1\sigma$) of WGS 84 Geodetic Longitudes at Doppler Sites (NAD 27 Area, CONUS), Longitude Determined Using Mean Datum Shifts (Contour Interval = 1 Meter)

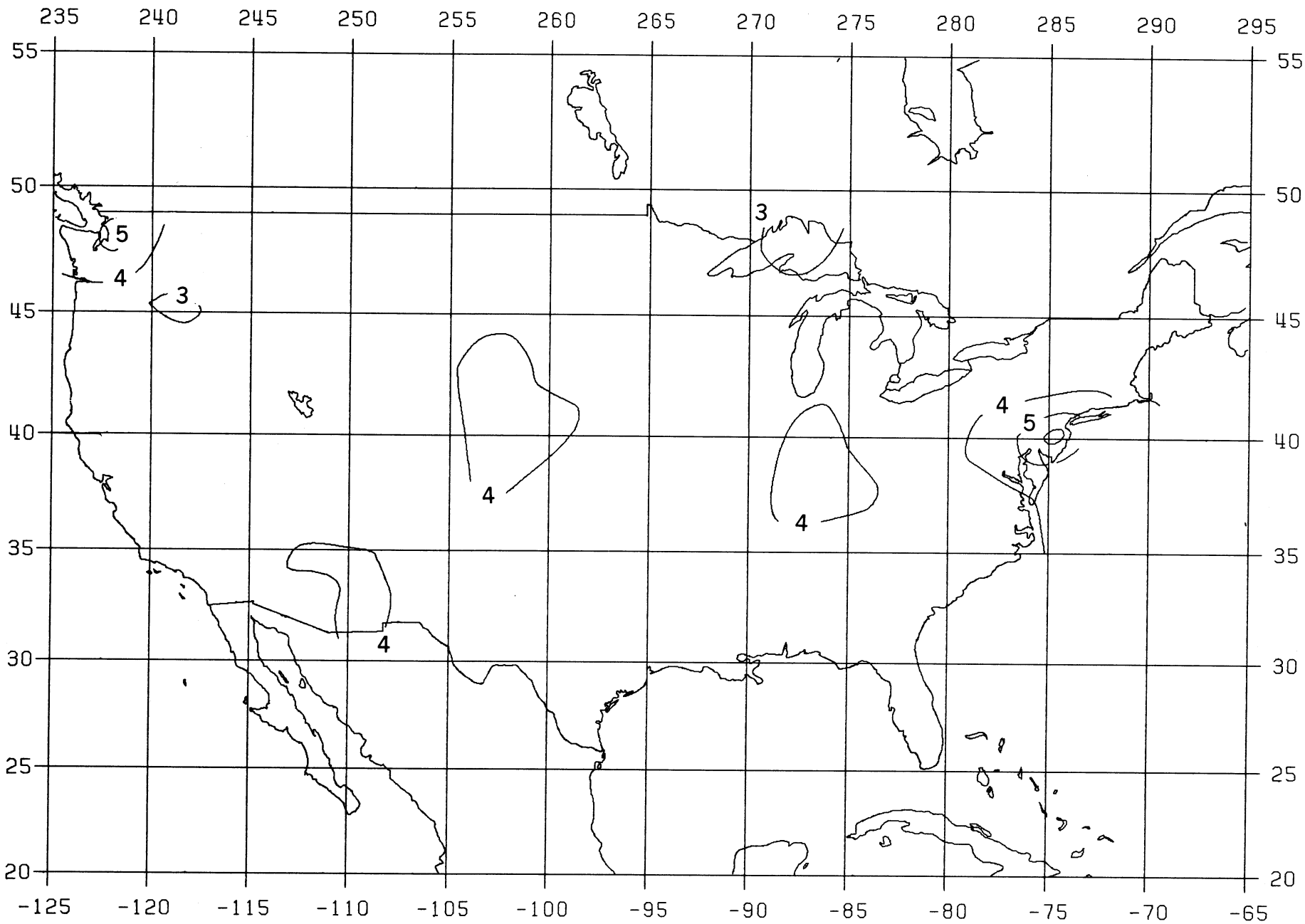


Figure 27.3. Accuracy ($1\sigma$) of WGS 84 Geodetic Heights at Doppler Sites (NAD 27 Area, CONUS), Geodetic Height Determined Using Mean Datum Shifts (Contour Interval = 1 Meter)

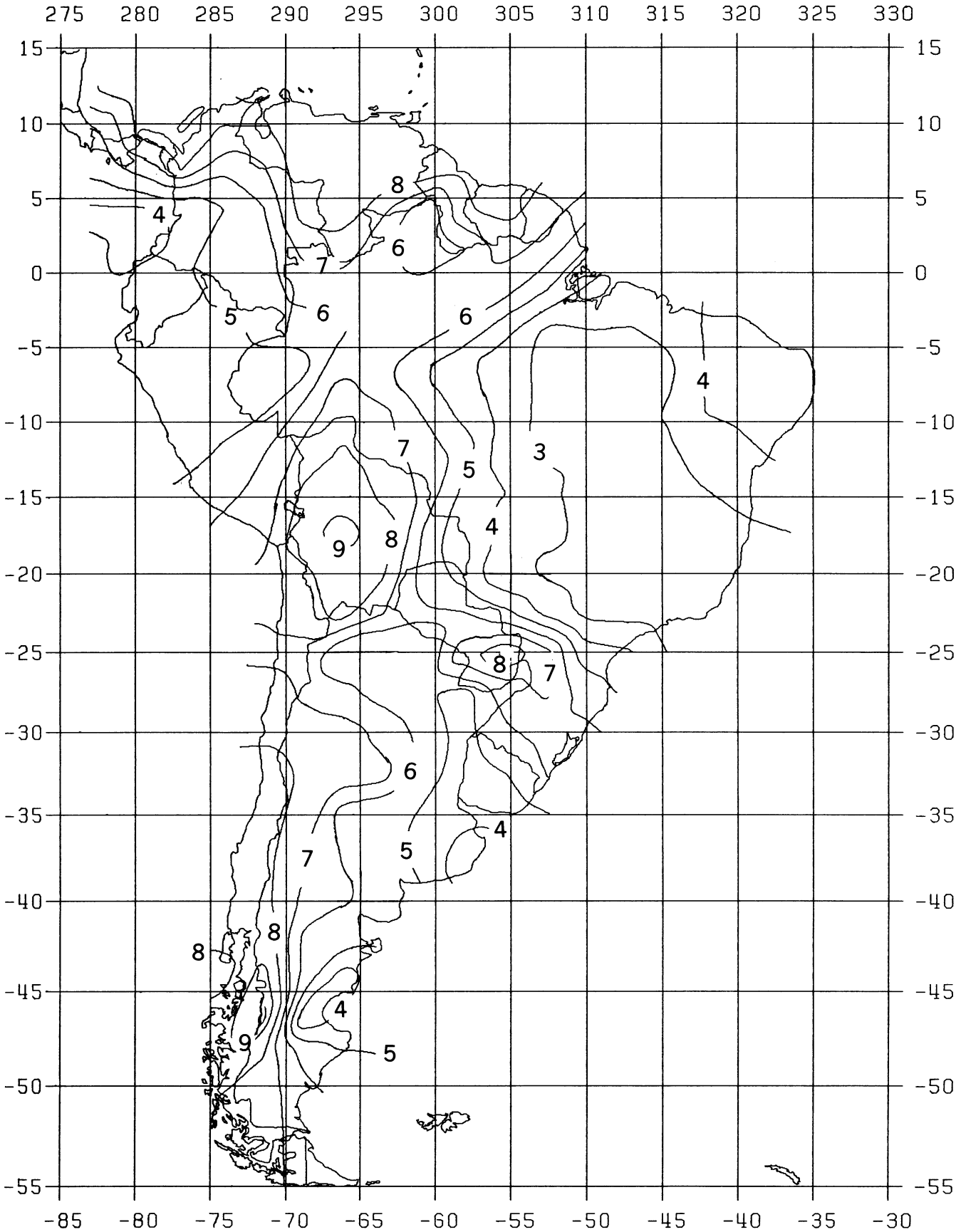


Figure 27.4. Accuracy ($1\sigma$) of WGS 84 Geodetic Latitudes at Doppler Sites (SAD 69 Area), Latitude Determined Using Mean Datum Shifts (Contour Interval = 1 Meter)

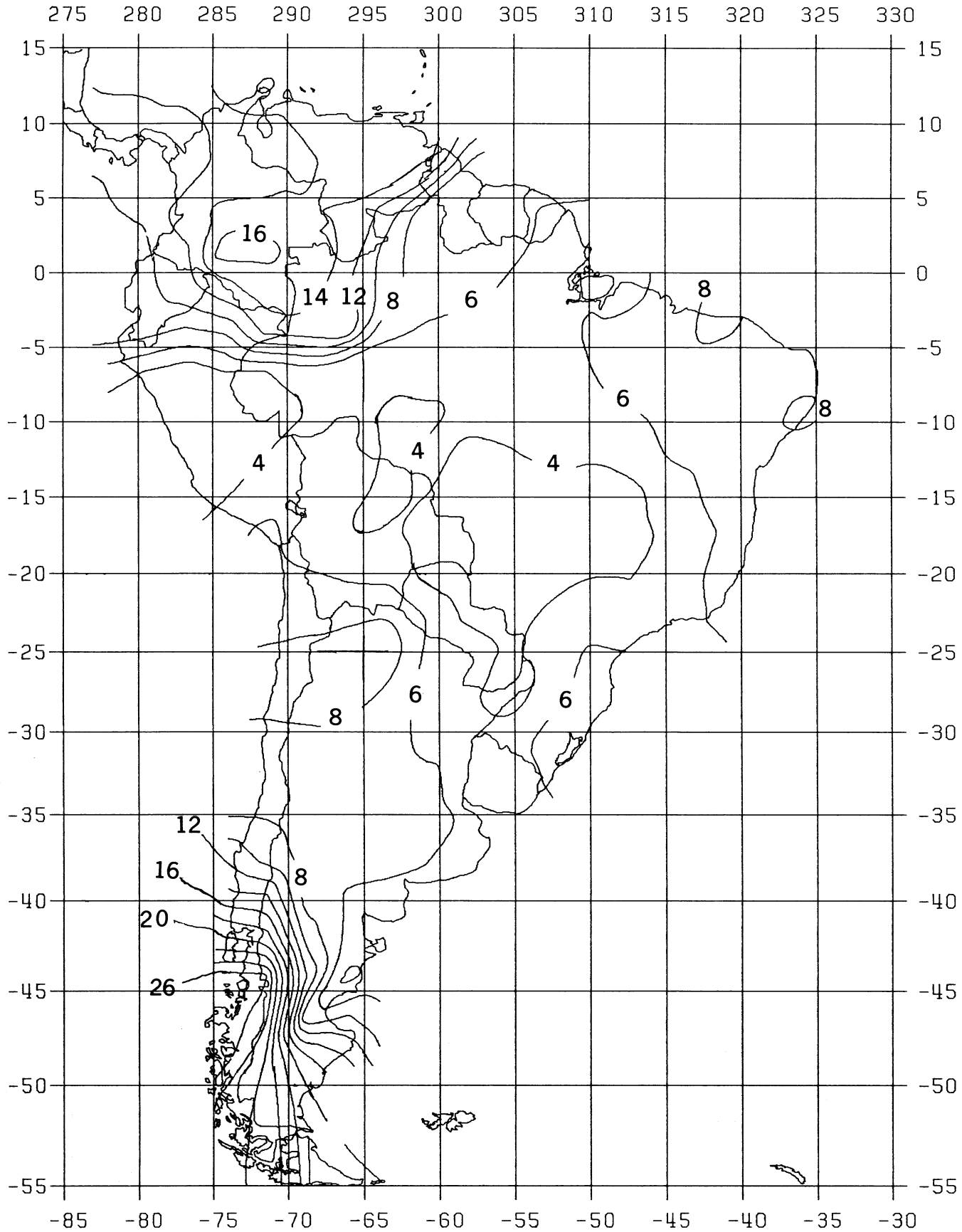


Figure 27.5. Accuracy ($1\sigma$) of WGS 84 Geodetic Longitudes at Doppler Sites (SAD 69 Area), Longitude Determined Using Mean Datum Shifts (Contour Interval = 2 Meters)

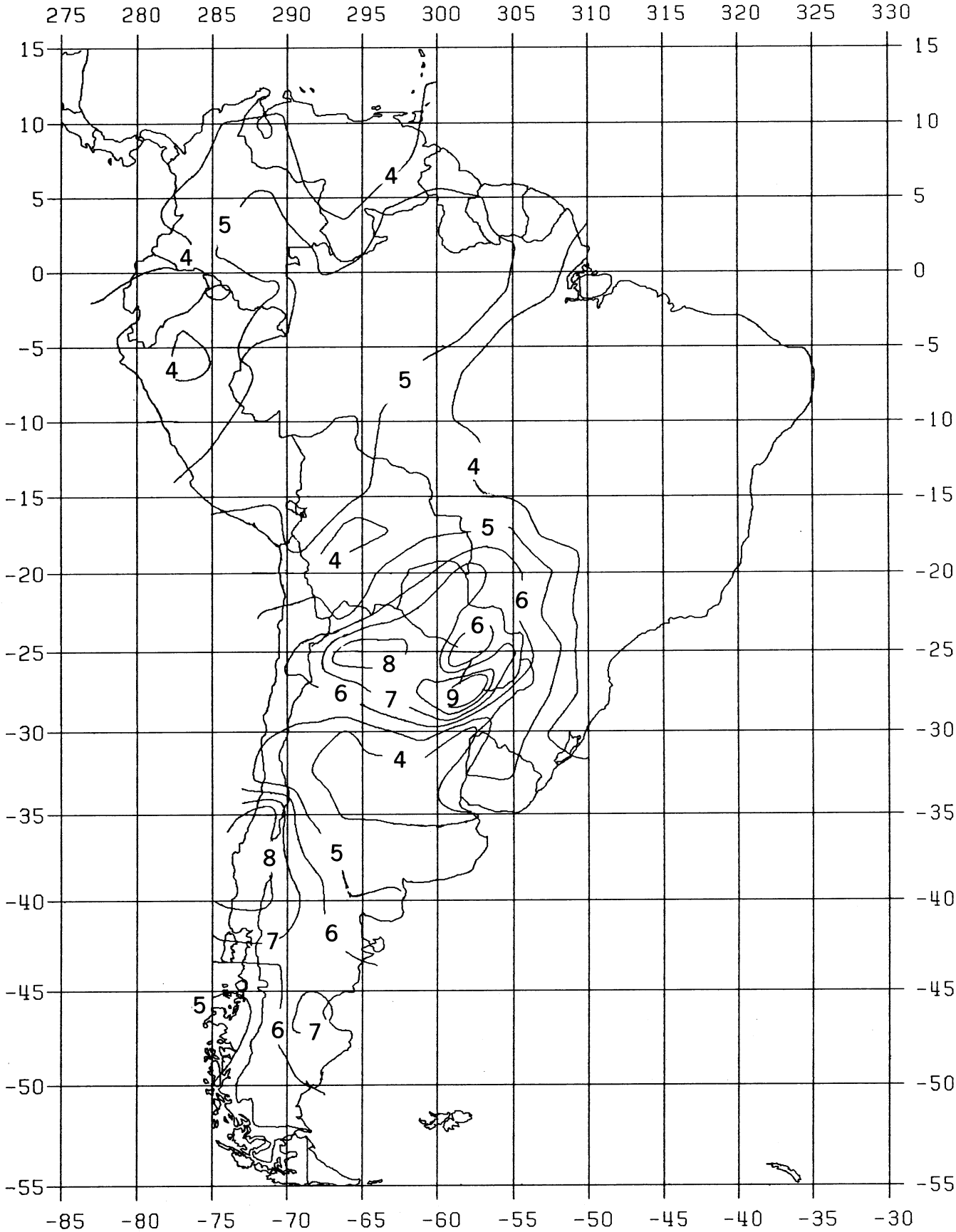


Figure 27.6. Accuracy ($1\sigma$) of WGS 84 Geodetic Heights at Doppler Sites (SAD 69 Area), Geodetic Height Determined Using Mean Datum Shifts (Contour Interval = 1 Meter)

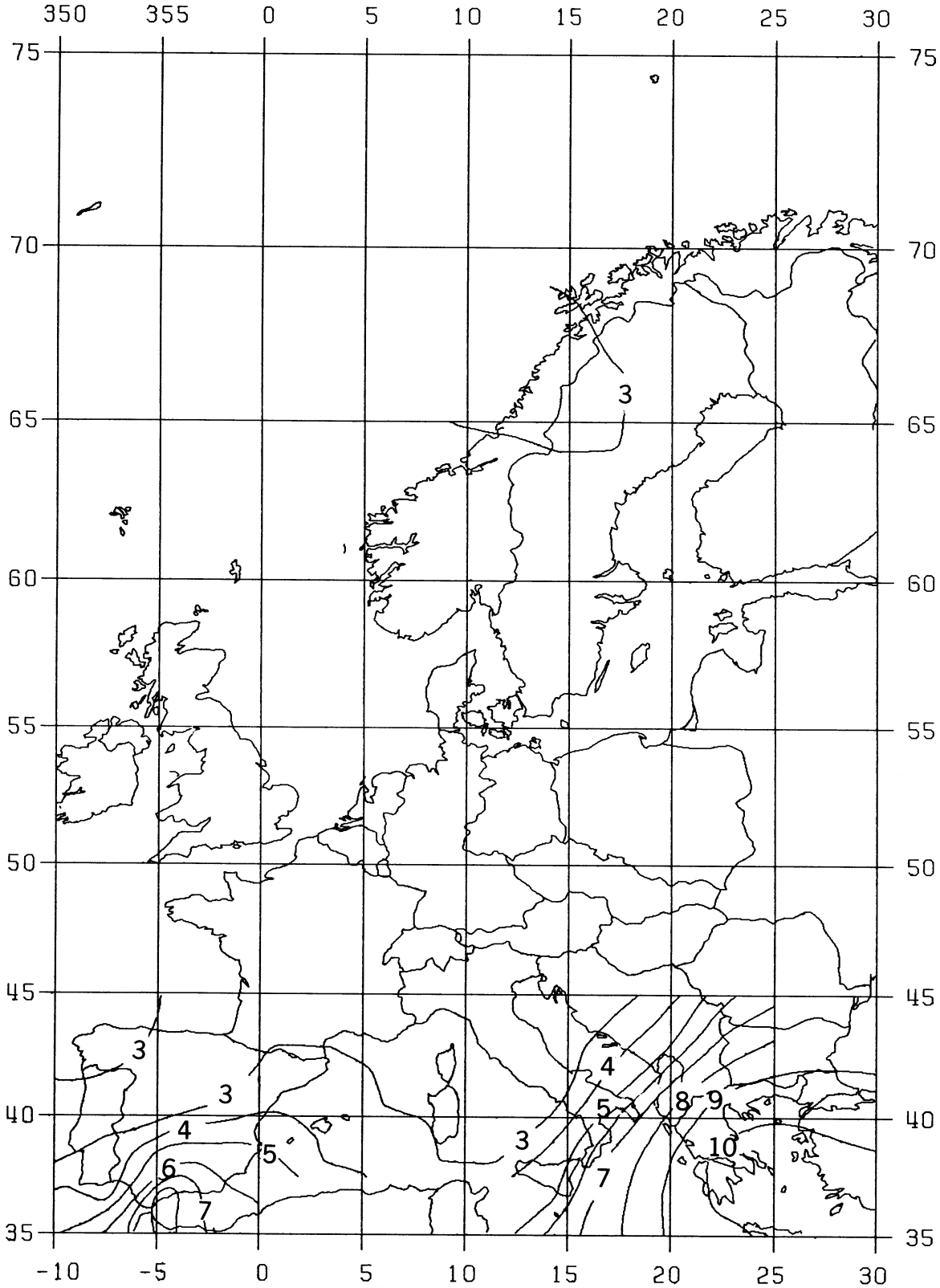


Figure 27.7. Accuracy ($1\sigma$) of WGS 84 Geodetic Latitudes at Doppler Sites (ED 50 Area, Western Europe), Latitude Determined Using Mean Datum Shifts (Contour Interval = 1 Meter)

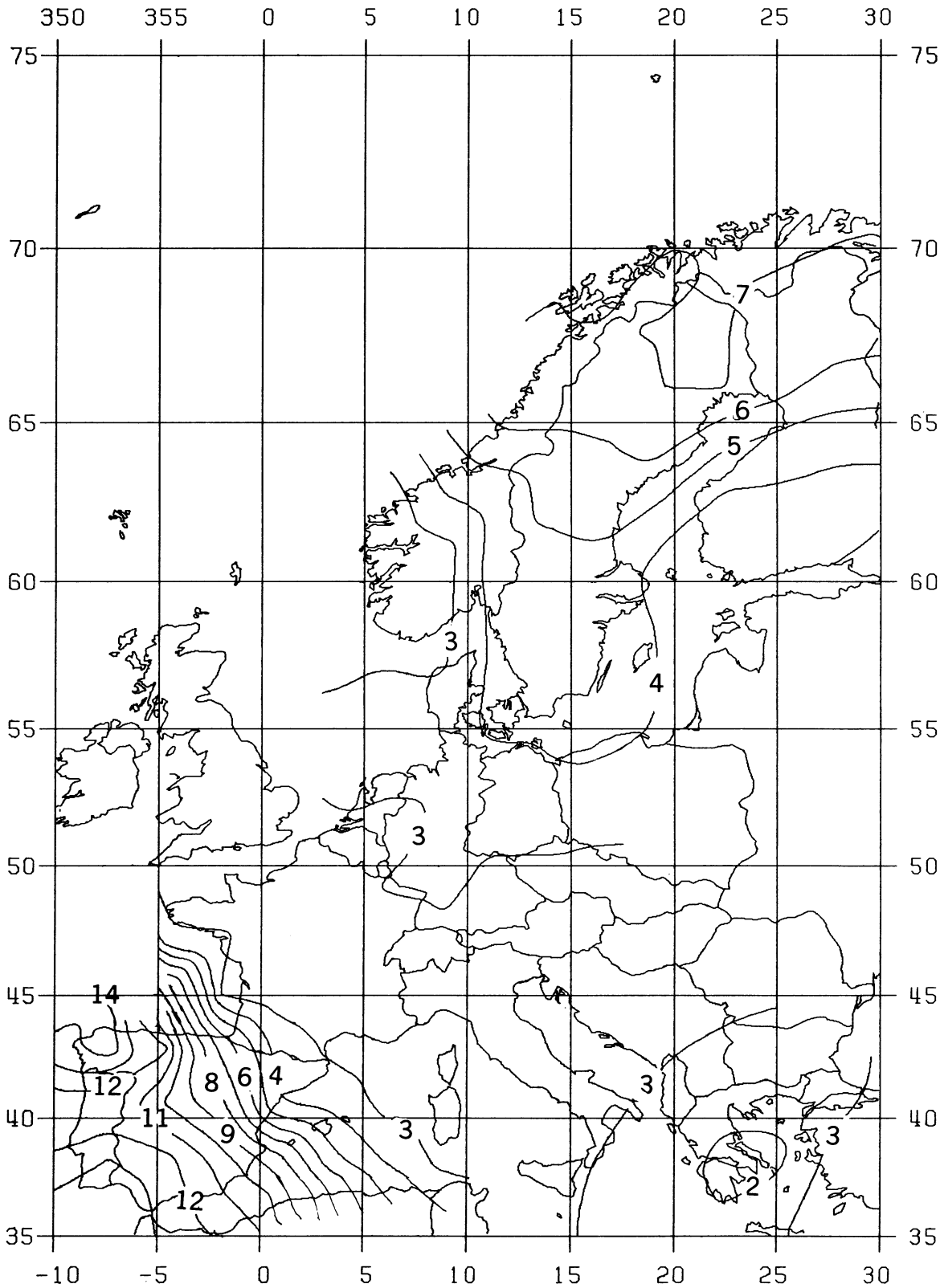


Figure 27.8. Accuracy ($1\sigma$) of WGS 84 Geodetic Longitudes at Doppler Sites (ED 50 Area, Western Europe), Longitude Determined Using Mean Datum Shifts (Contour Interval = 1 Meter)

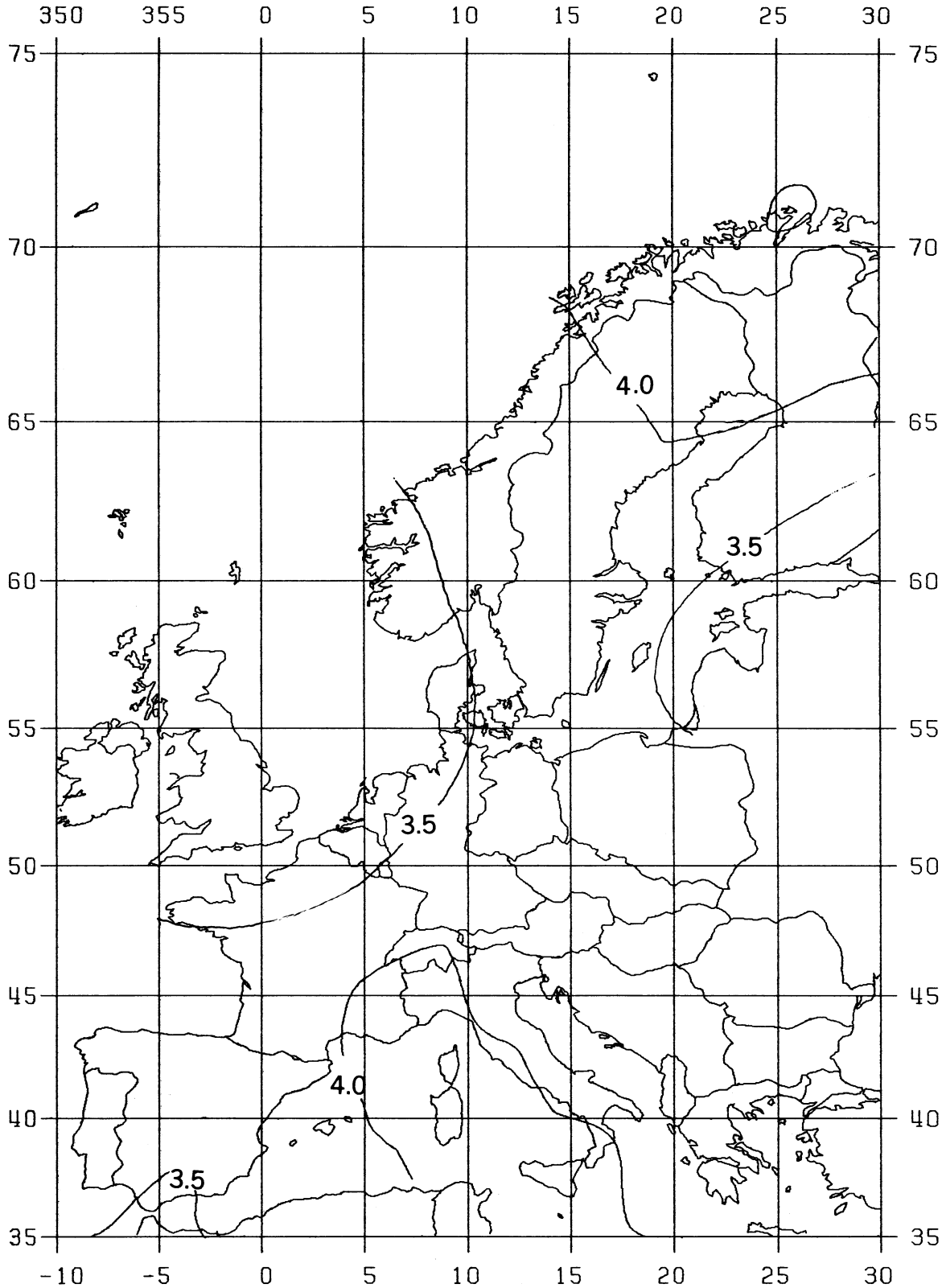


Figure 27.9. Accuracy ($1\sigma$) of WGS 84 Geodetic Heights at Doppler Sites (ED 50 Area, Western Europe), Geodetic Height Determined Using Mean Datum Shifts (Contour Interval = 0.5 Meter)

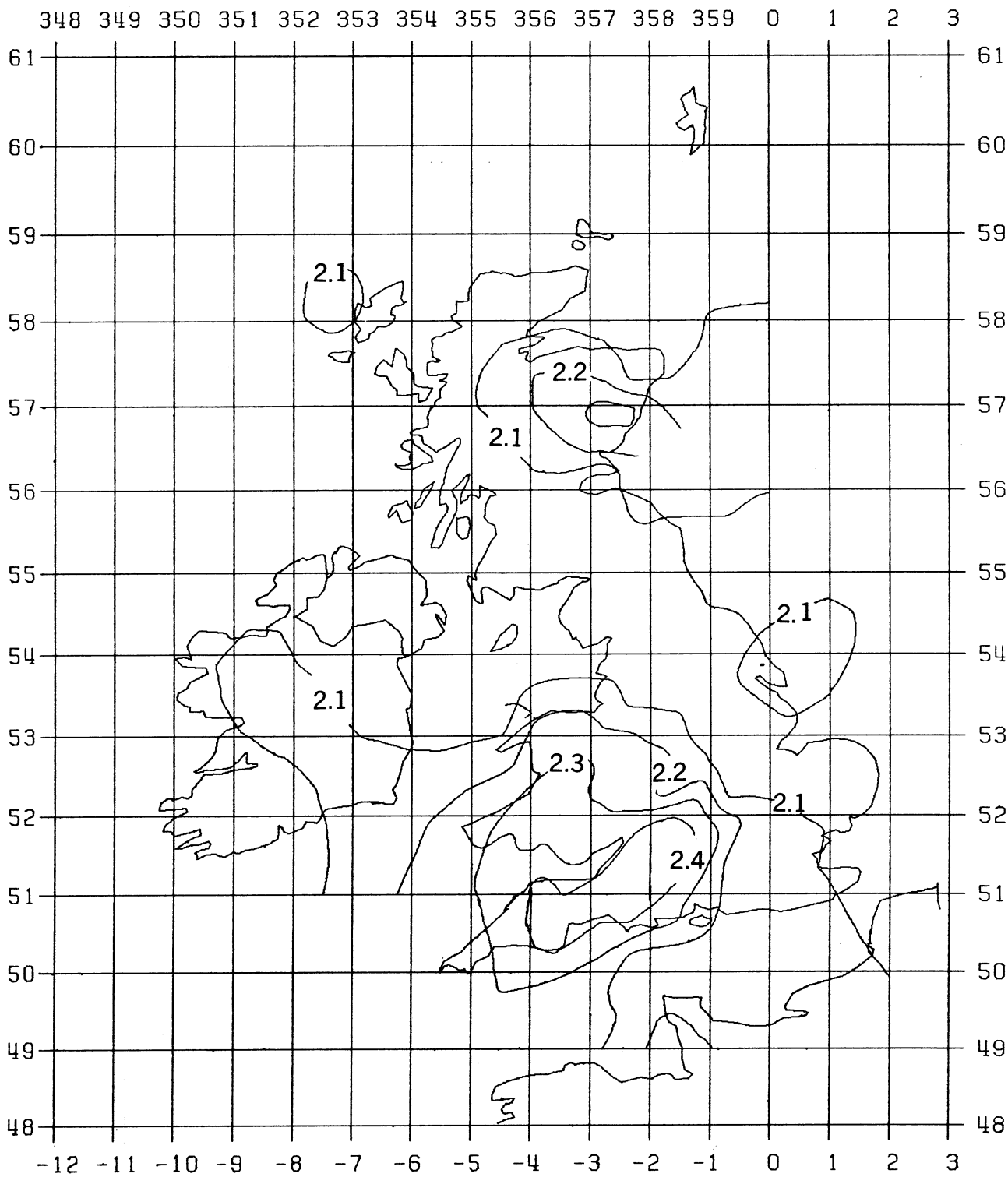


Figure 27.10. Accuracy ($1\sigma$) of WGS 84 Geodetic Latitudes at Doppler Sites (ED 50 Area, UK/Ireland), Latitude Determined Using Mean Datum Shifts (Contour Interval = 0.1 Meter)

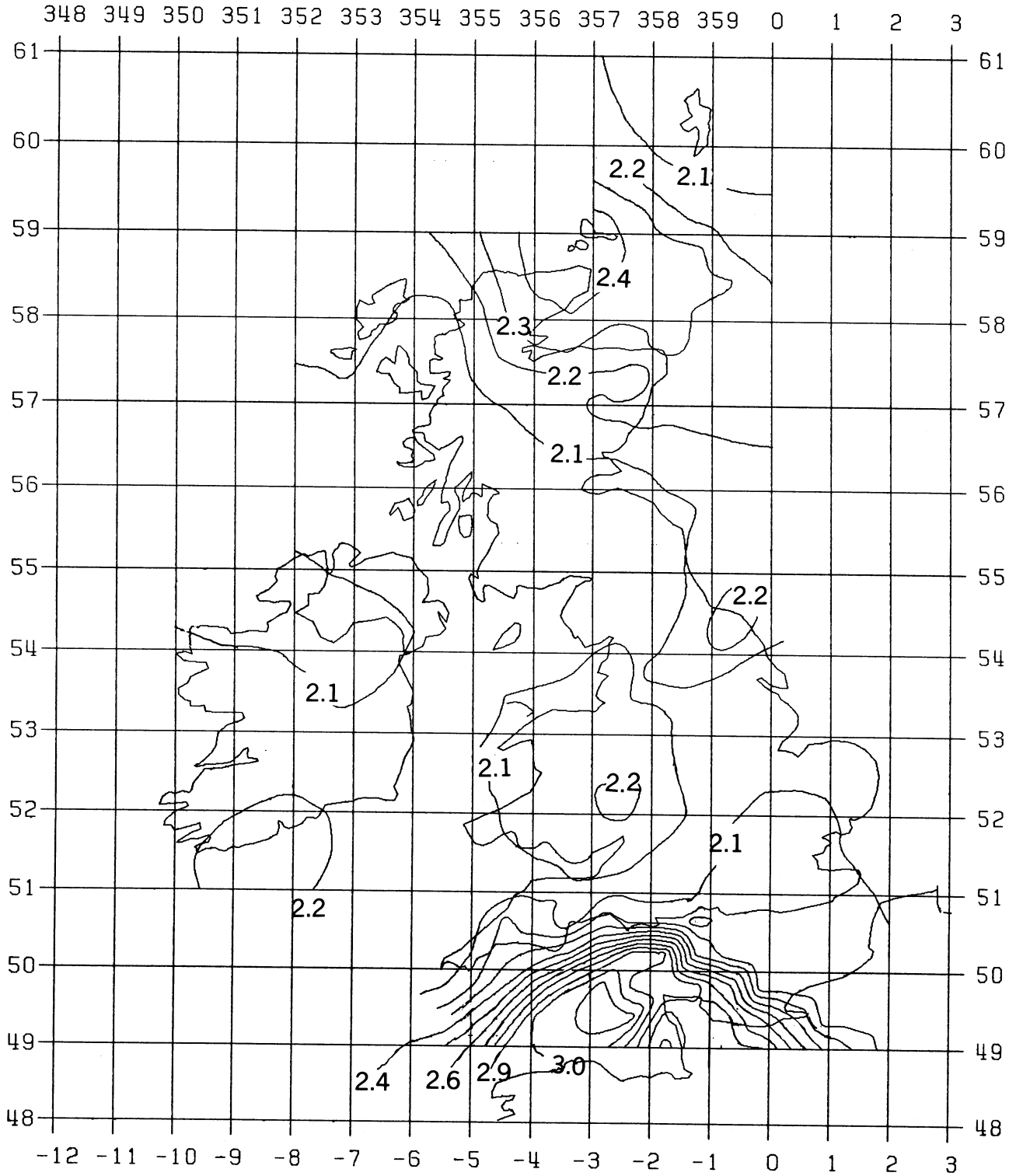


Figure 27.11. Accuracy ($1\sigma$) of WGS 84 Geodetic Longitudes at Doppler Sites (ED 50 Area, UK/Ireland), Longitude Determined Using Mean Datum Shifts (Contour Interval = 0.1 Meter)

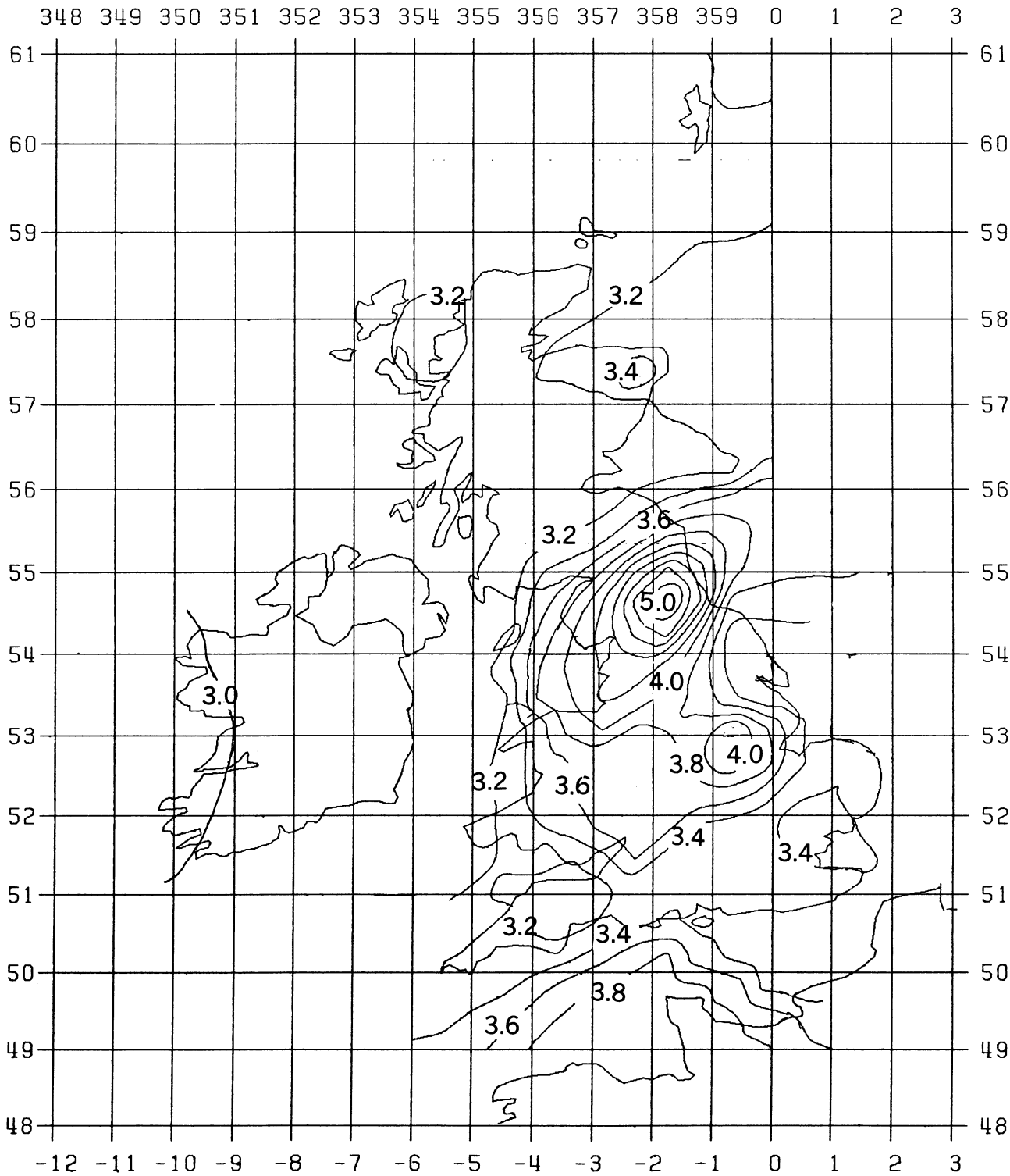


Figure 27.12. Accuracy ($1\sigma$) of WGS 84 Geodetic Heights at Doppler Sites (ED 50 Area, UK/Ireland), Geodetic Height Determined Using Mean Datum Shifts (Contour Interval = 0.2 Meter)

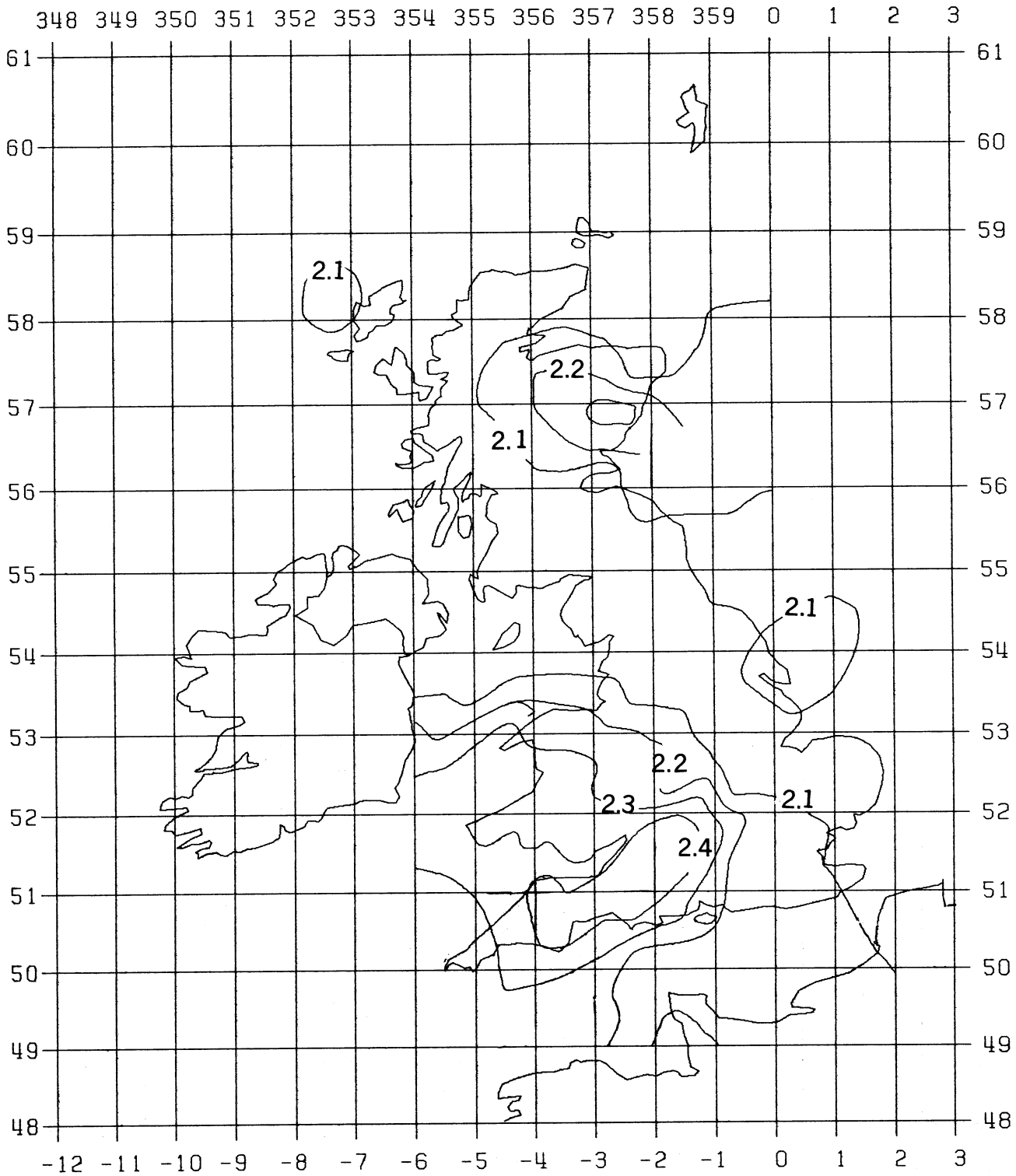


Figure 27.13. Accuracy ($1\sigma$) of WGS 84 Geodetic Latitudes at Doppler Sites (ED 50 Area, UK Only), Latitude Determined Using Mean Datum Shifts (Contour Interval = 0.1 Meter)

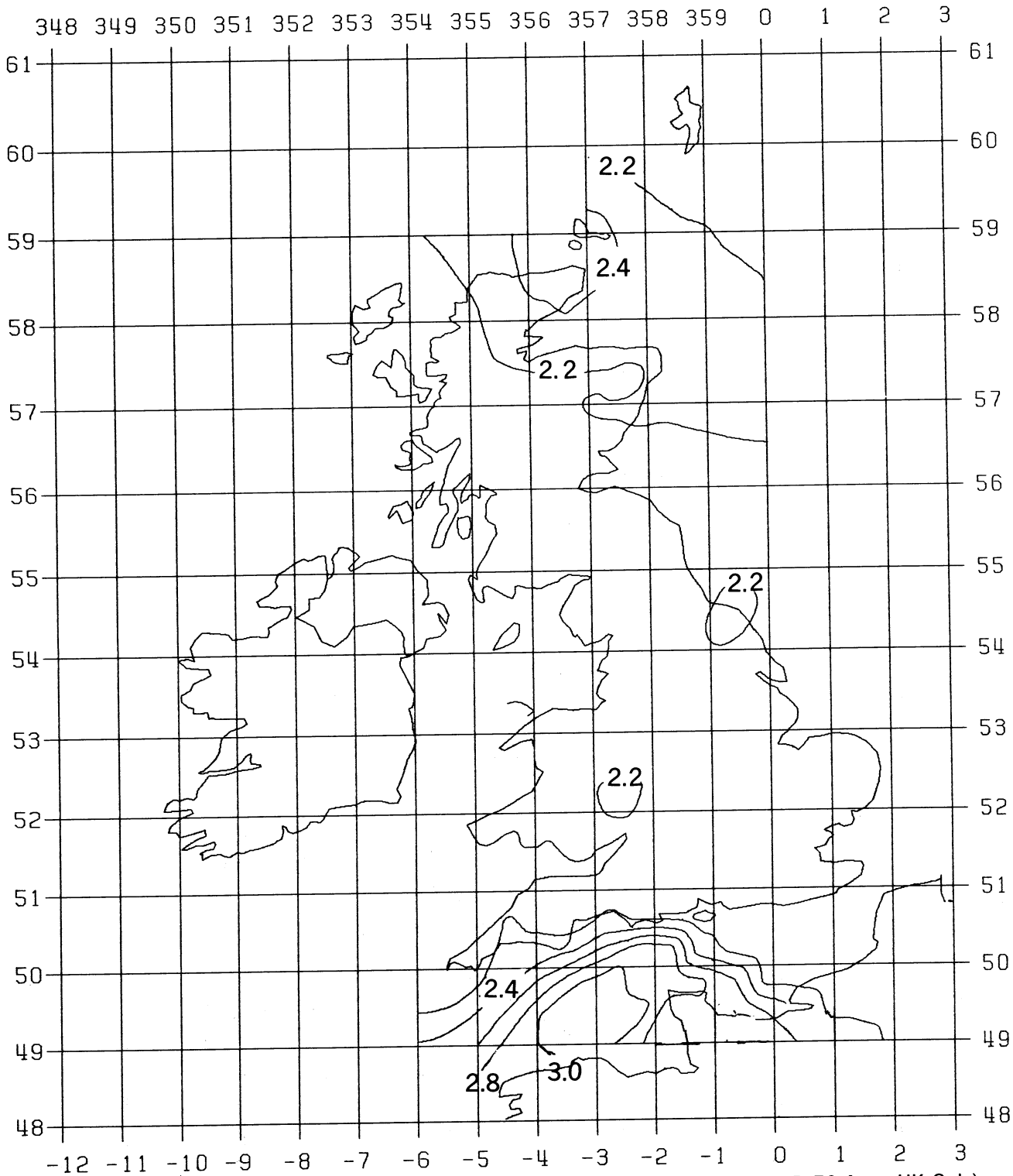


Figure 27.14. Accuracy ($1\sigma$) of WGS 84 Geodetic Longitudes at Doppler Sites (ED 50 Area, UK Only), Longitude Determined Using Mean Datum Shifts (Contour Interval = 0.2 Meter)

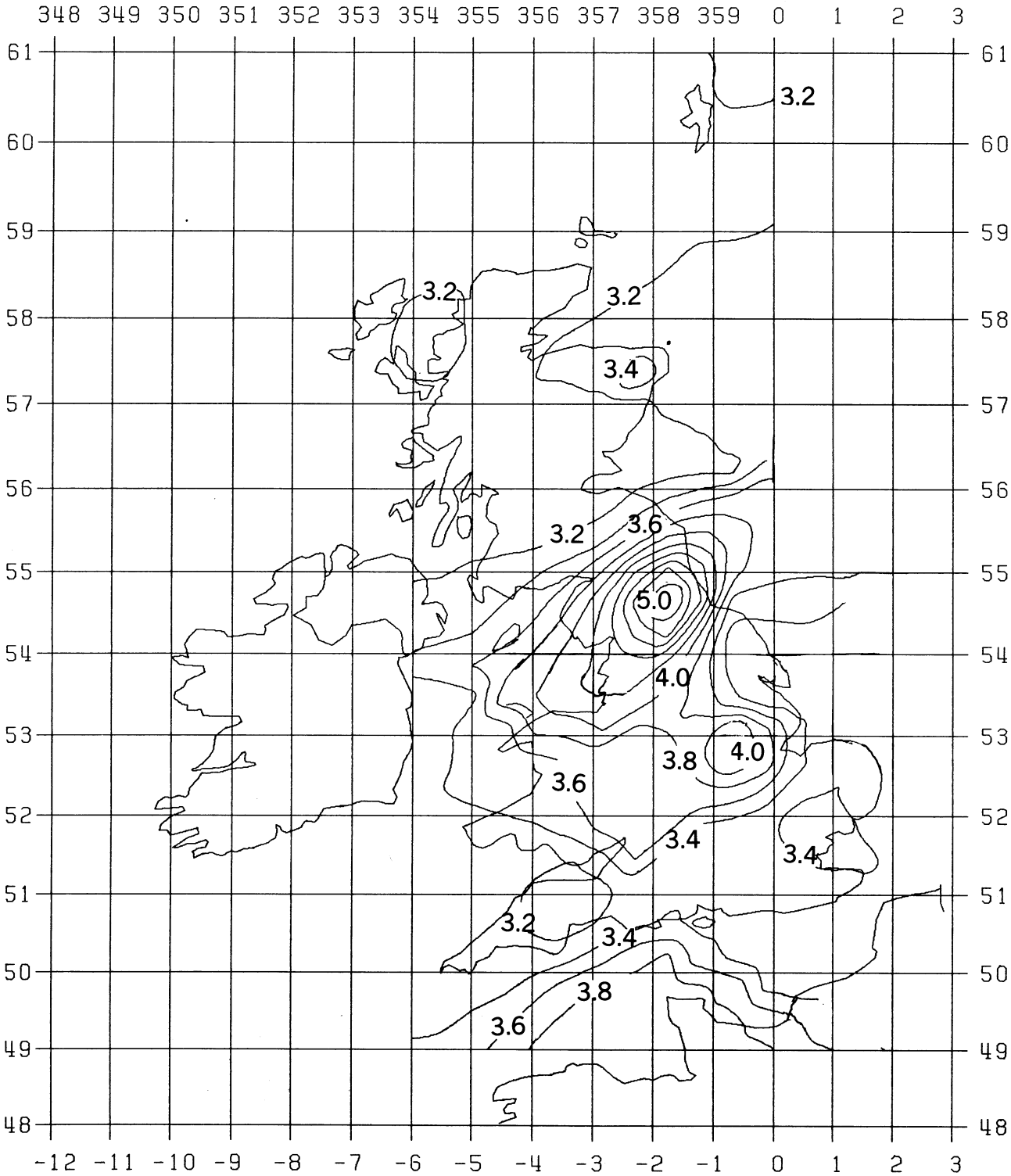


Figure 27.15. Accuracy ($1\sigma$) of WGS 84 Geodetic Heights at Doppler Sites (ED 50 Area, UK Only), Geodetic Height Determined Using Mean Datum Shifts (Contour Interval = 0.2 Meter)

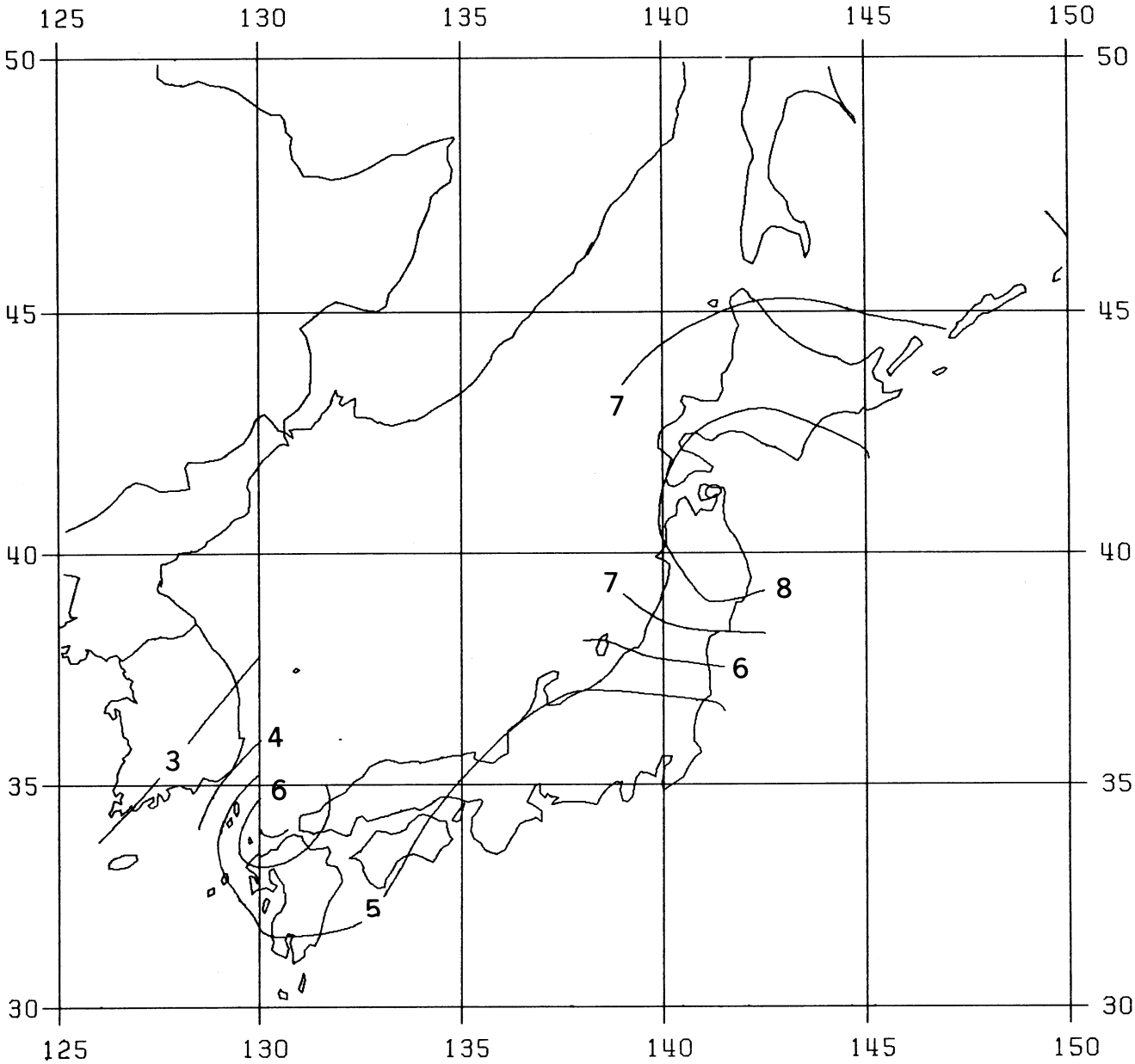


Figure 27.16. Accuracy ($1\sigma$) of WGS 84 Geodetic Latitudes at Doppler Sites (TD Area), Latitude Determined Using Mean Datum Shifts (Contour Interval = 1 Meter)

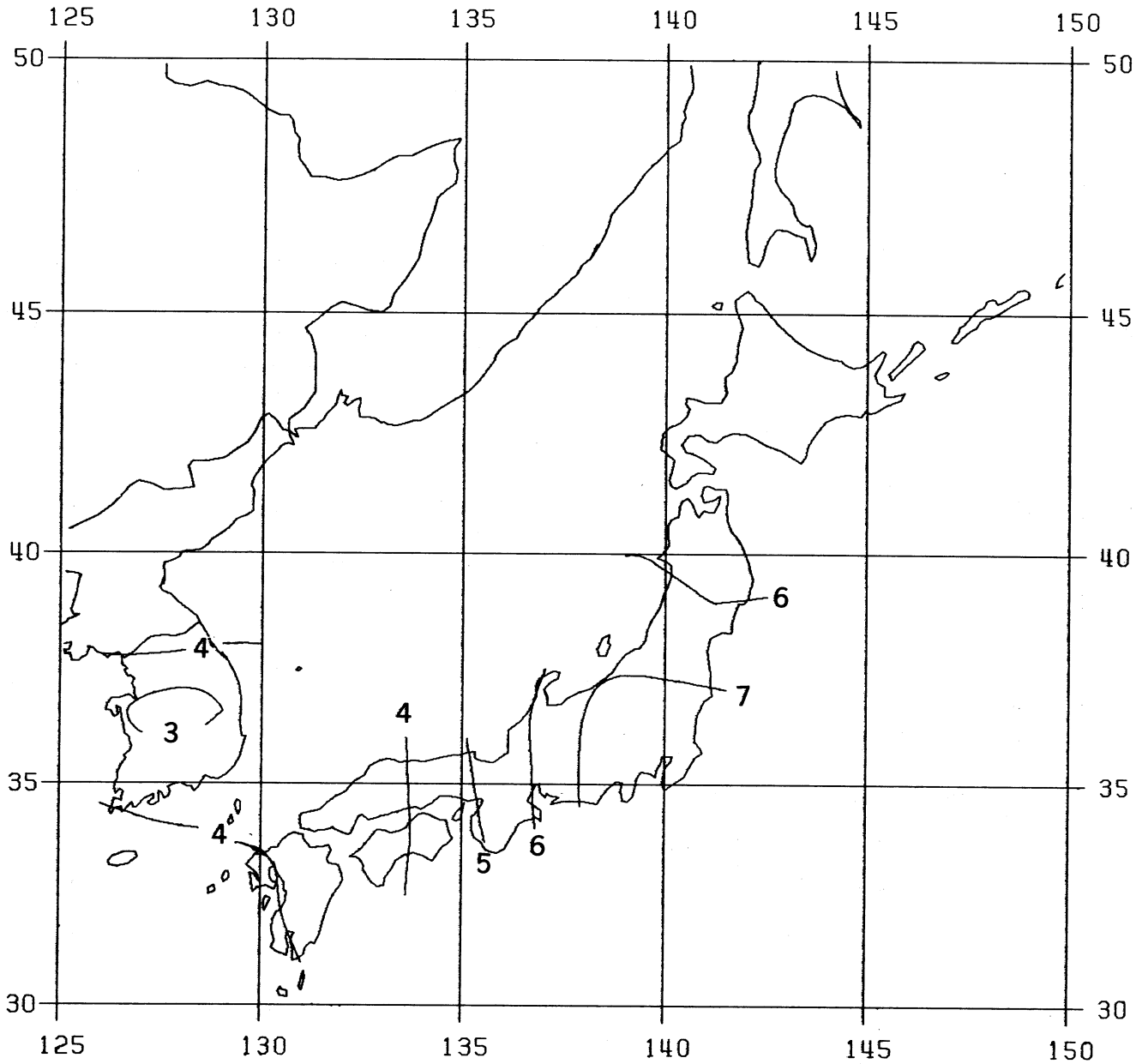


Figure 27.17. Accuracy ($1\sigma$) of WGS 84 Geodetic Longitudes at Doppler Sites (TD Area), Longitude Determined Using Mean Datum Shifts (Contour Interval = 1 Meter)

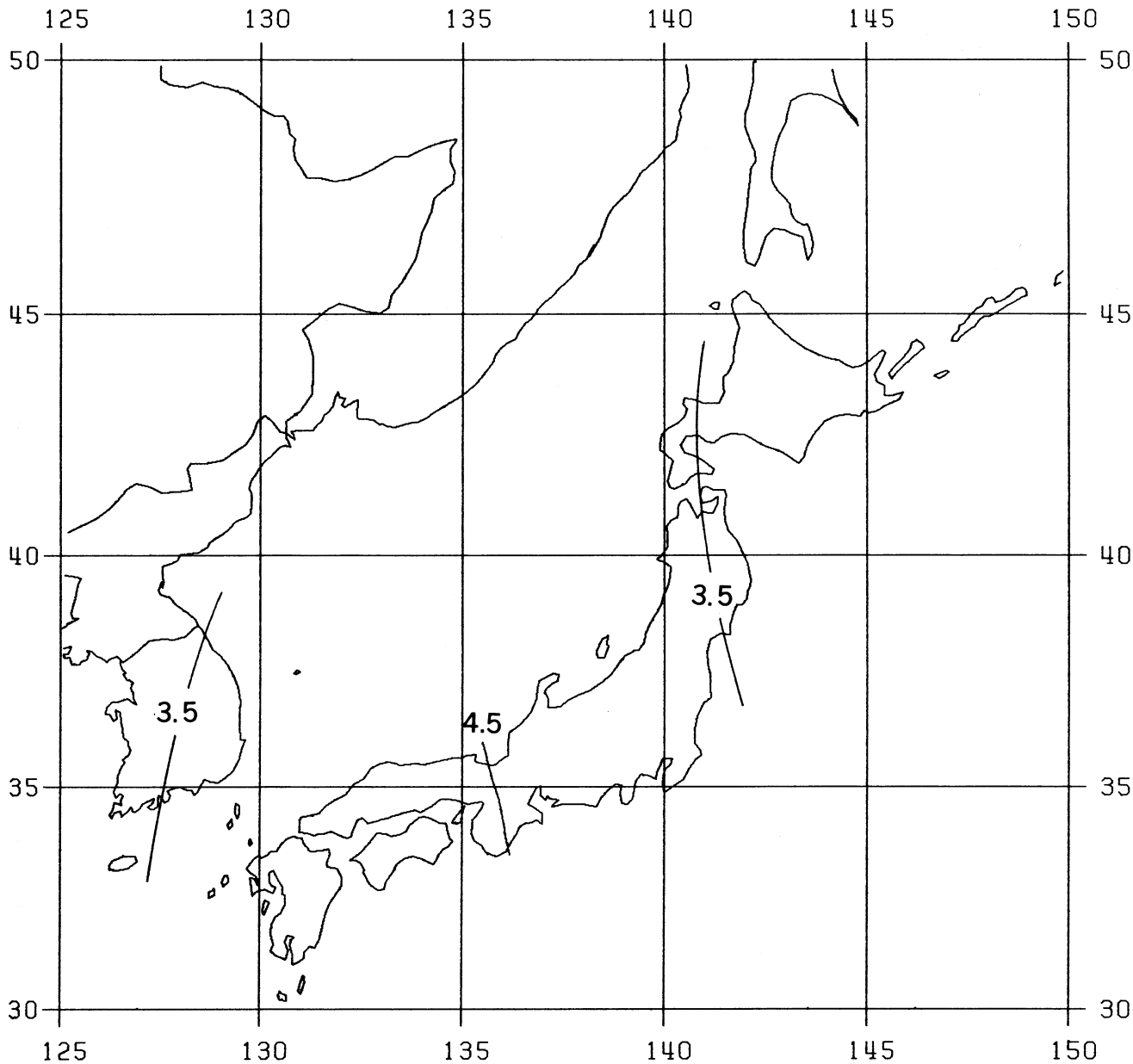


Figure 27.18. Accuracy ($1\sigma$) of WGS 84 Geodetic Heights at Doppler Sites (TD Area), Geodetic Height Determined Using Mean Datum Shifts (Contour Interval = 1 Meter)

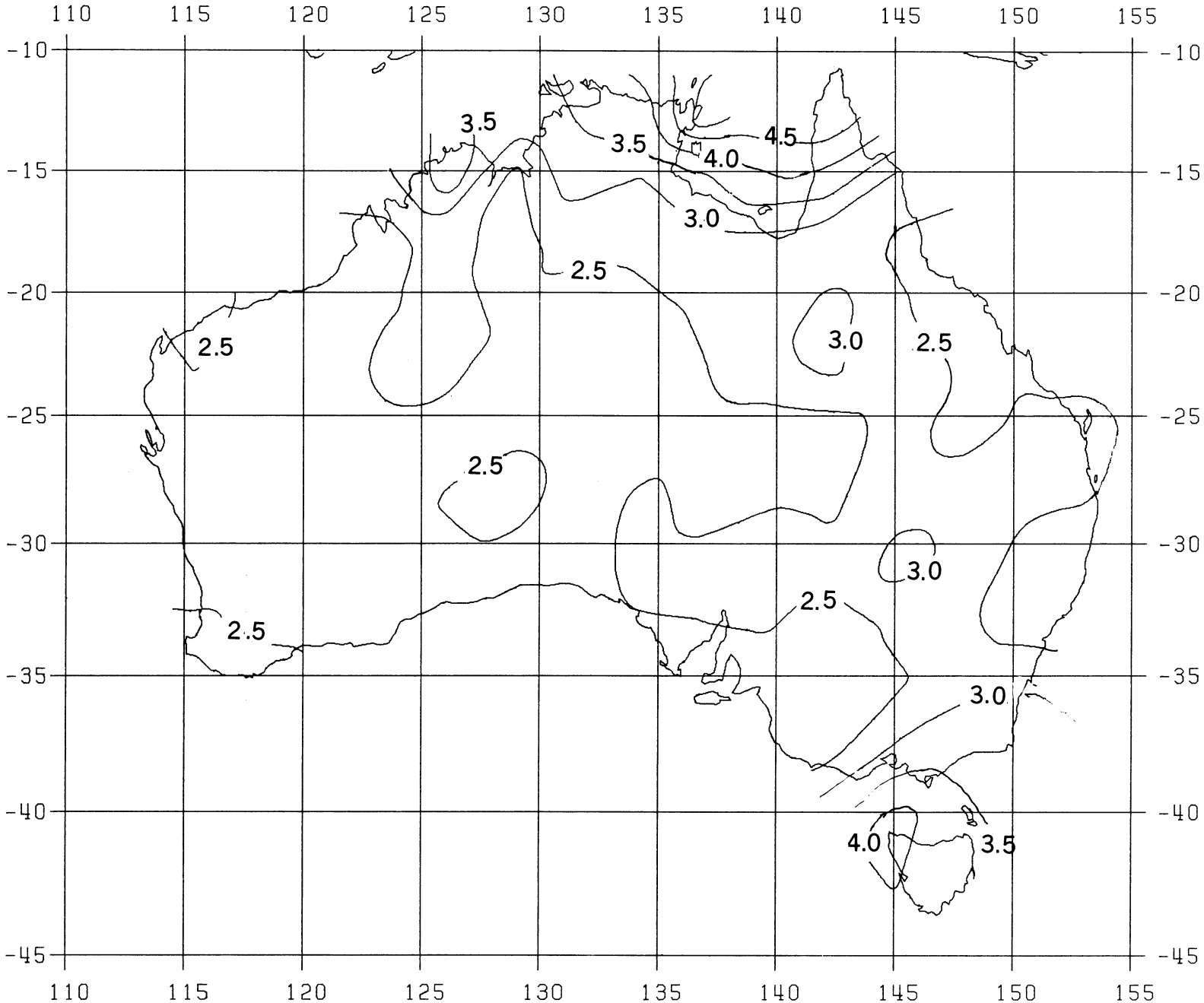


Figure 27.19. . Accuracy ($1\sigma$) of WGS 84 Geodetic Latitudes at Doppler Sites (AGD 84 Area), Latitude Determined Using Mean Datum Shifts (Contour Interval = 0.5 Meter)

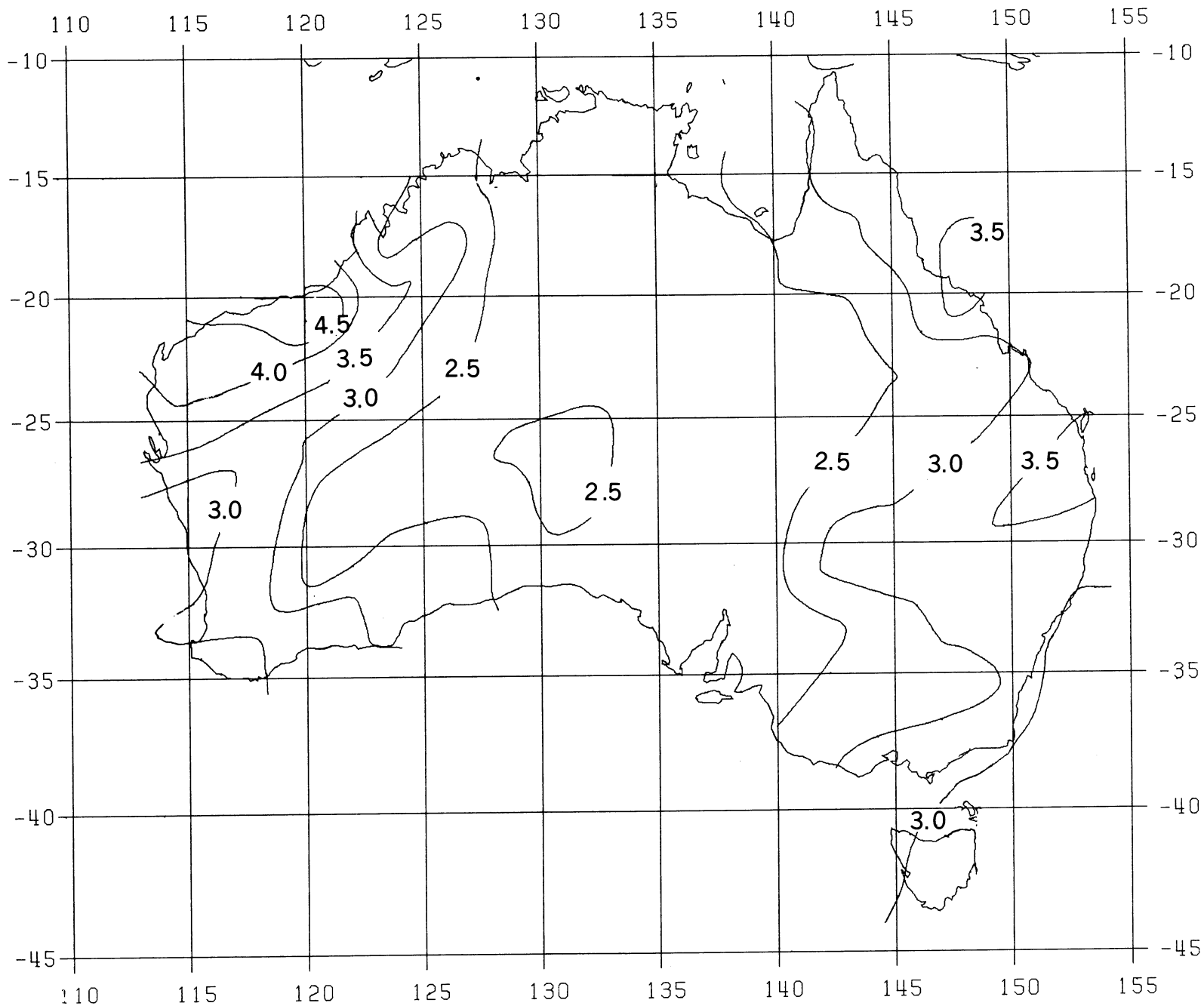


Figure 27.20. Accuracy ($1\sigma$) of WGS 84 Geodetic Longitudes at Doppler Sites (AGD 84 Area), Longitude Determined Using Mean Datum Shifts (Contour Interval = 0.5 Meter)

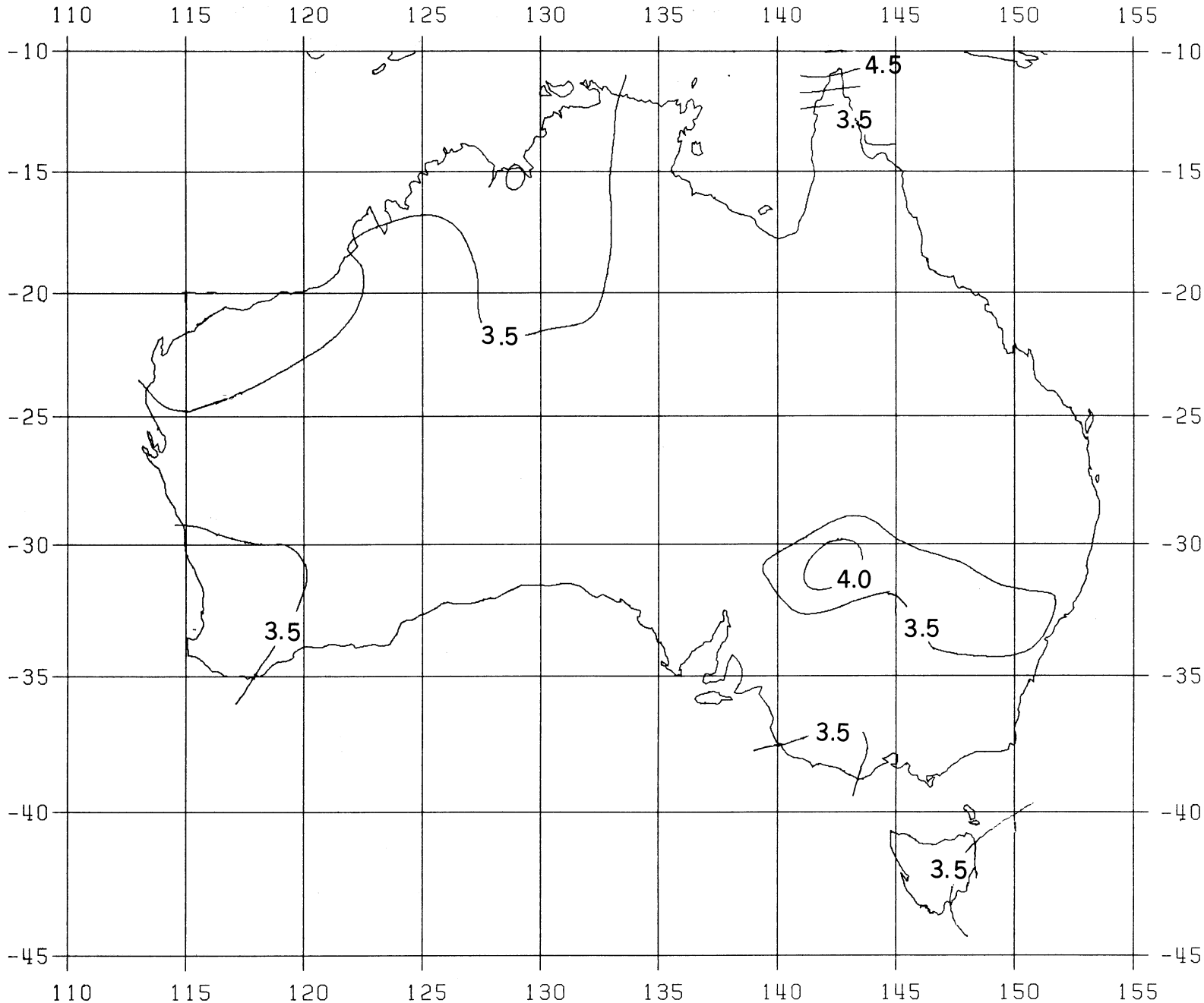


Figure 27.21. Accuracy ($1\sigma$) of WGS 84 Geodetic Heights at Doppler Sites (AGD 84 Area), Geodetic Height Determined Using Mean Datum Shifts (Contour Interval = 0.5 Meter)

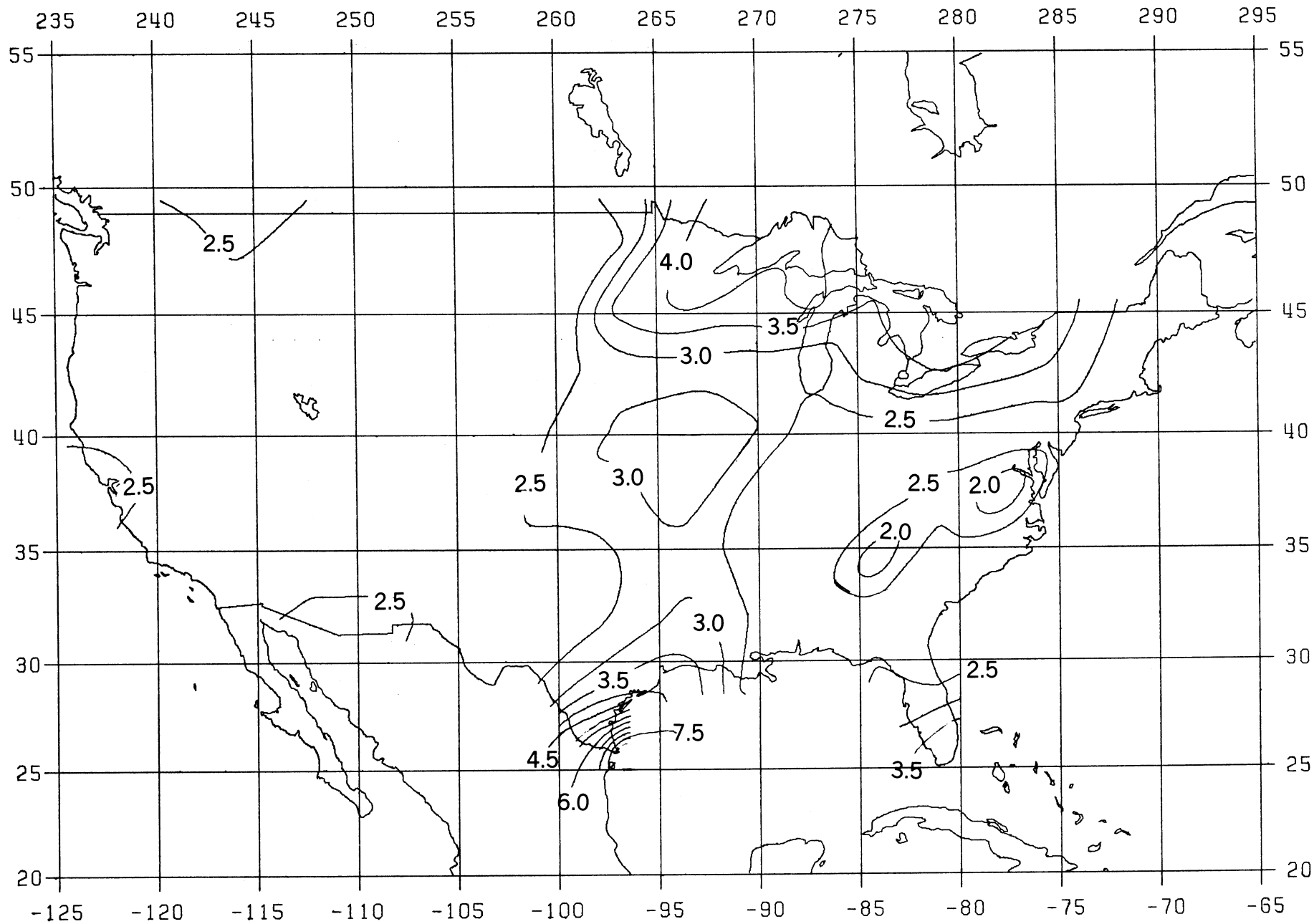


Figure 27.22. Accuracy ($1\sigma$) of WGS 84 Geodetic Latitudes at Doppler Sites (NAD 27 Area, CONUS), Latitude Determined Using Datum Transformation MREs (Contour Interval = 0.5 Meter)

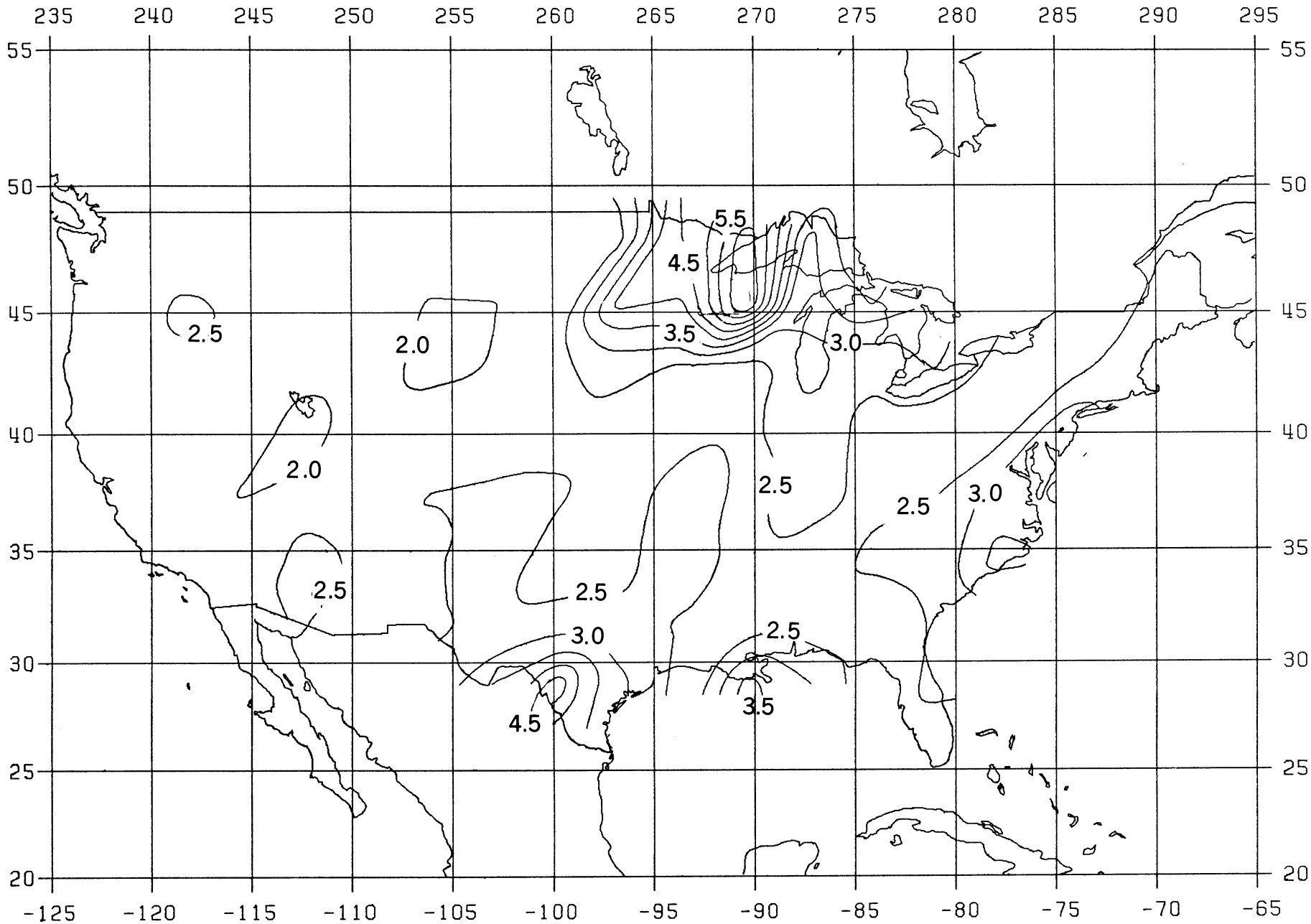


Figure 27.23. Accuracy ($1\sigma$) of WGS 84 Geodetic Longitudes at Doppler Sites (NAD 27 Area, CONUS), Longitude Determined Using Datum Transformation MREs (Contour Interval = 0.5 Meter)

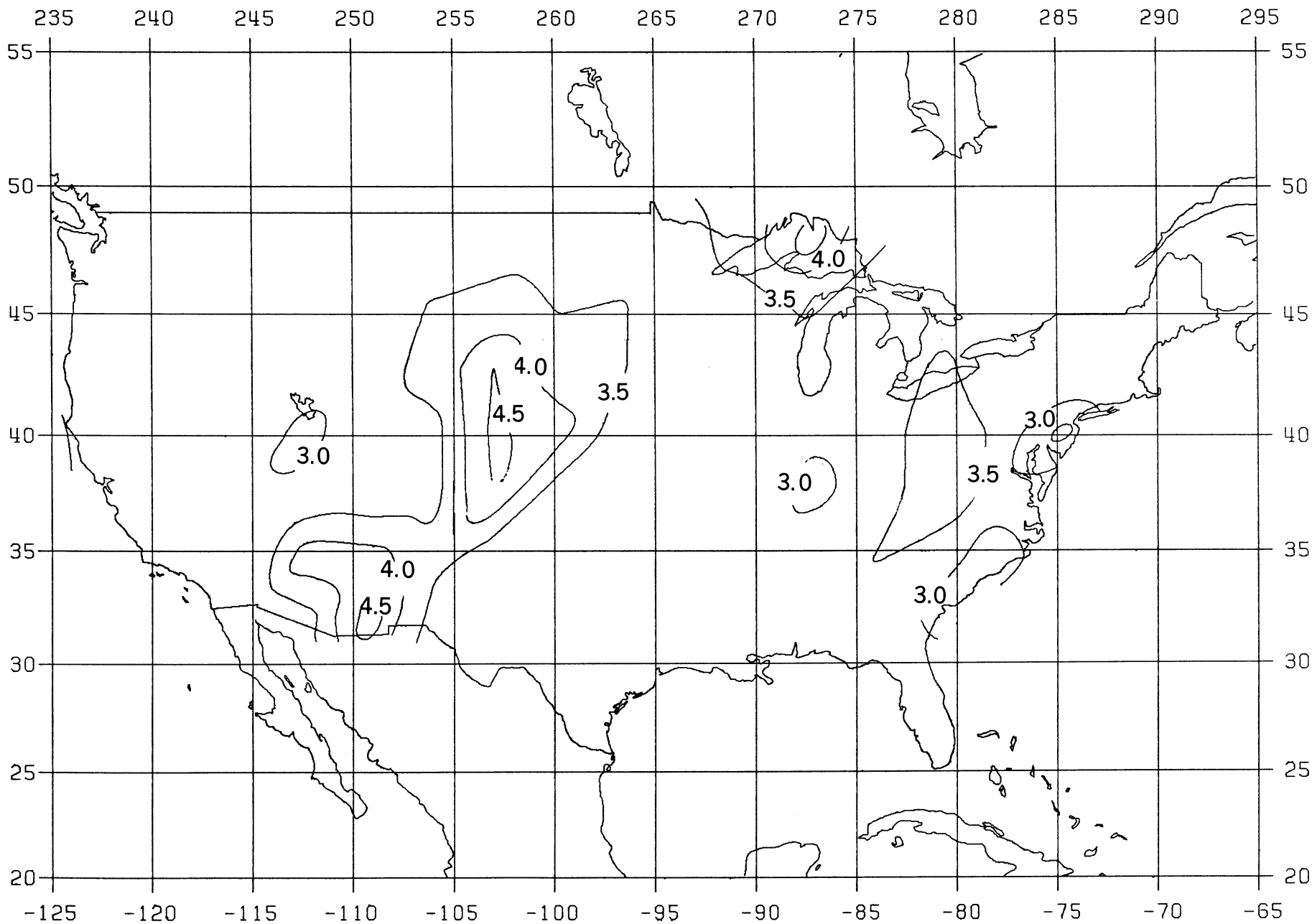


Figure 27.24. Accuracy ($1\sigma$) of WGS 84 Geodetic Heights at Doppler Sites (NAD 27 Area, CONUS), Geodetic Height Determined Using Datum Transformation MREs (Contour Interval = 0.5 Meter)

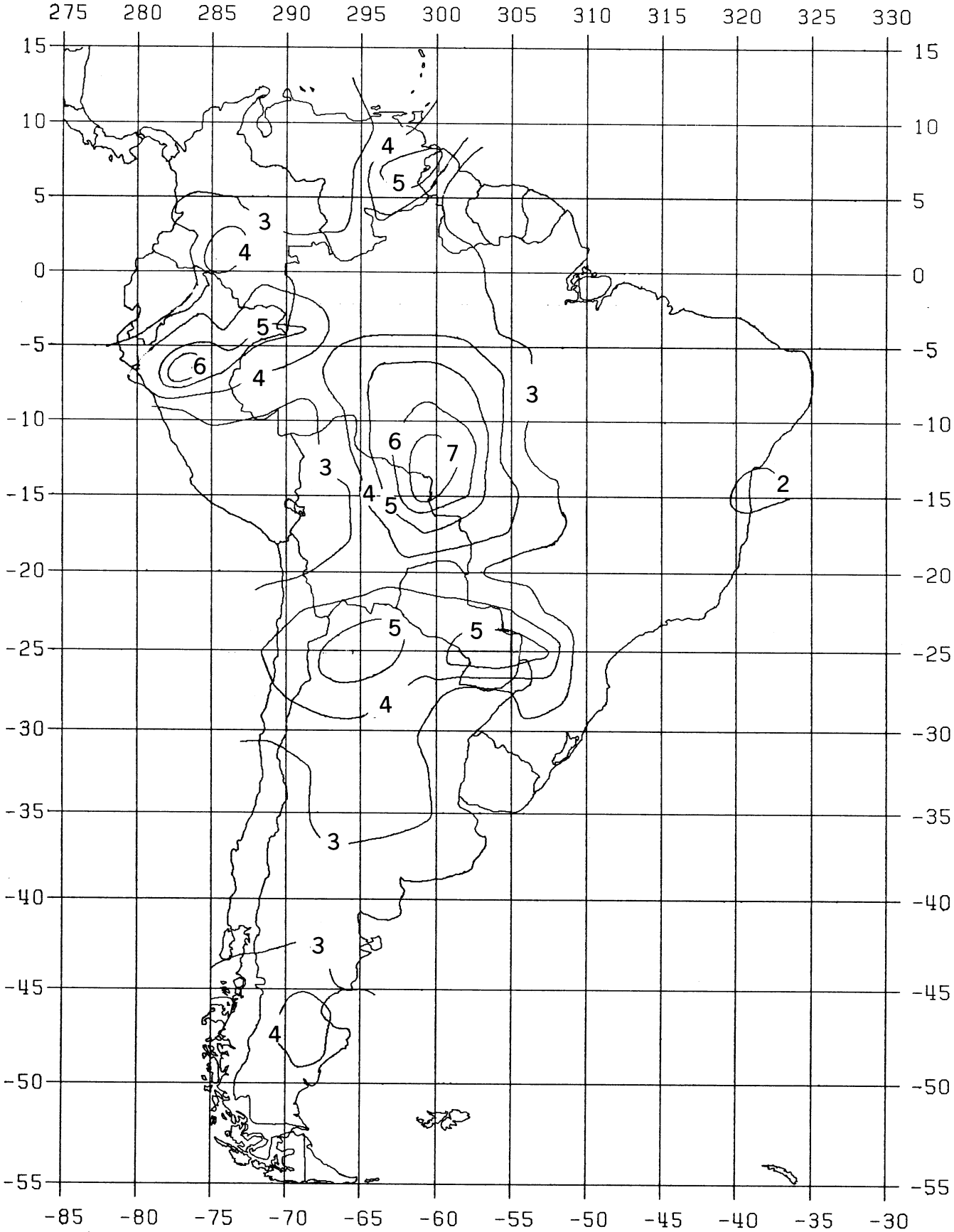


Figure 27.25. Accuracy ($1\sigma$) of WGS 84 Geodetic Latitudes at Doppler Sites (SAD 69 Area), Latitude Determined Using Datum Transformation MREs (Contour Interval = 1 Meter)

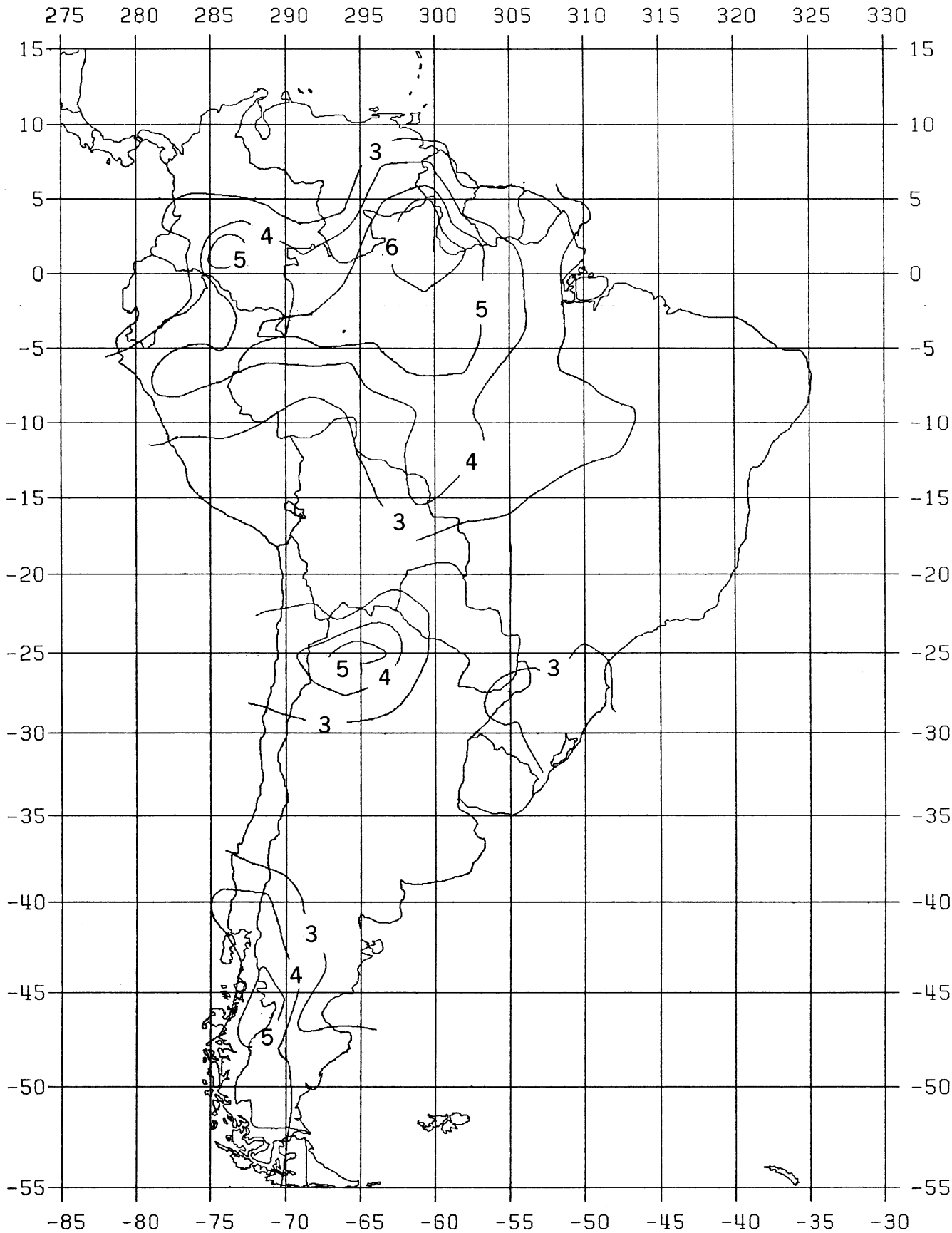


Figure 27.26. Accuracy ($1\sigma$) of WGS 84 Geodetic Longitudes at Doppler Sites (SAD 69 Area), Longitude Determined Using Datum Transformation MREs (Contour Interval = 1 Meter)

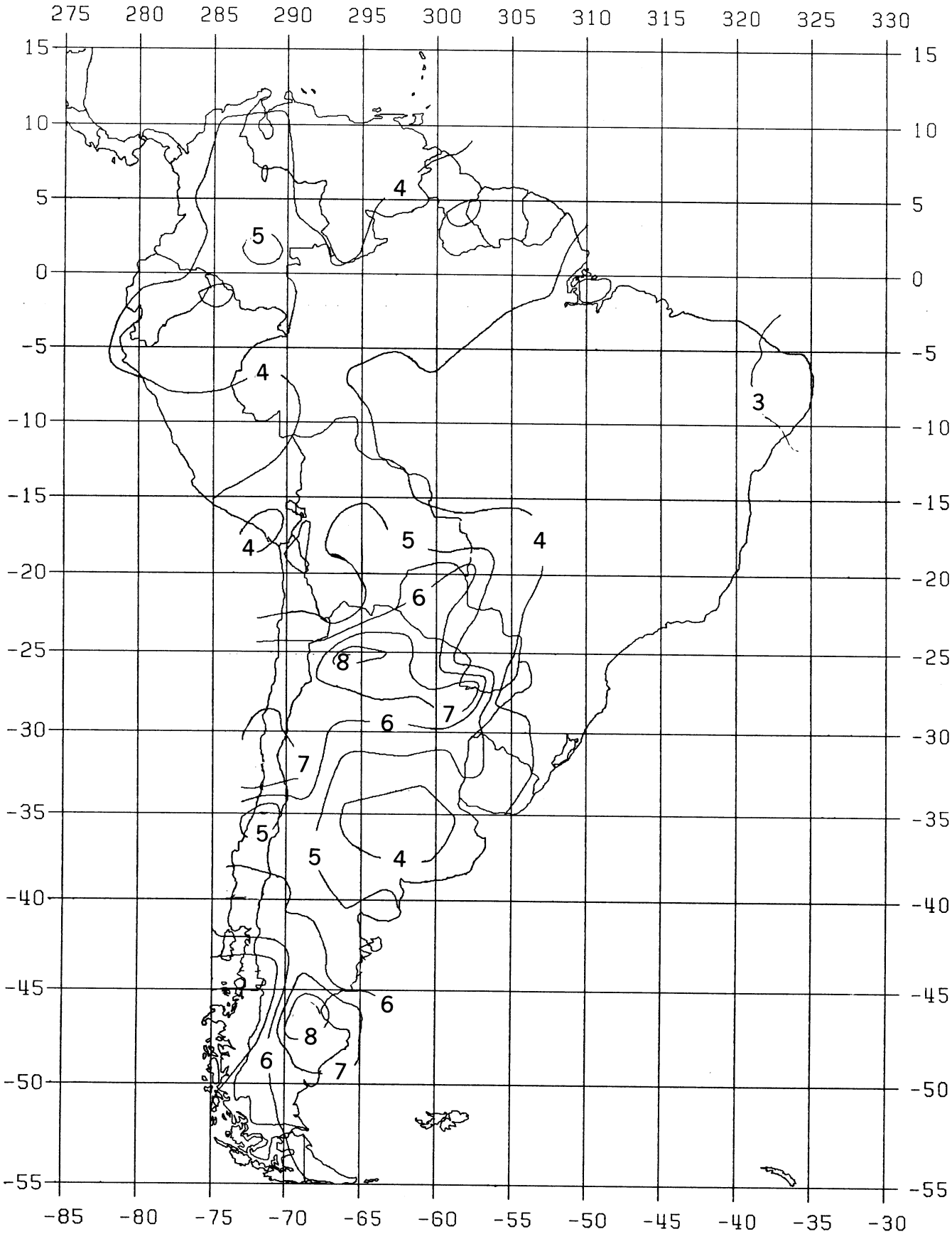


Figure 27.27. Accuracy ($1\sigma$) of WGS 84 Geodetic Heights at Doppler Sites (SAD 69 Area), Geodetic Height Determined Using Datum Transformation MREs (Contour Interval = 1 Meter)

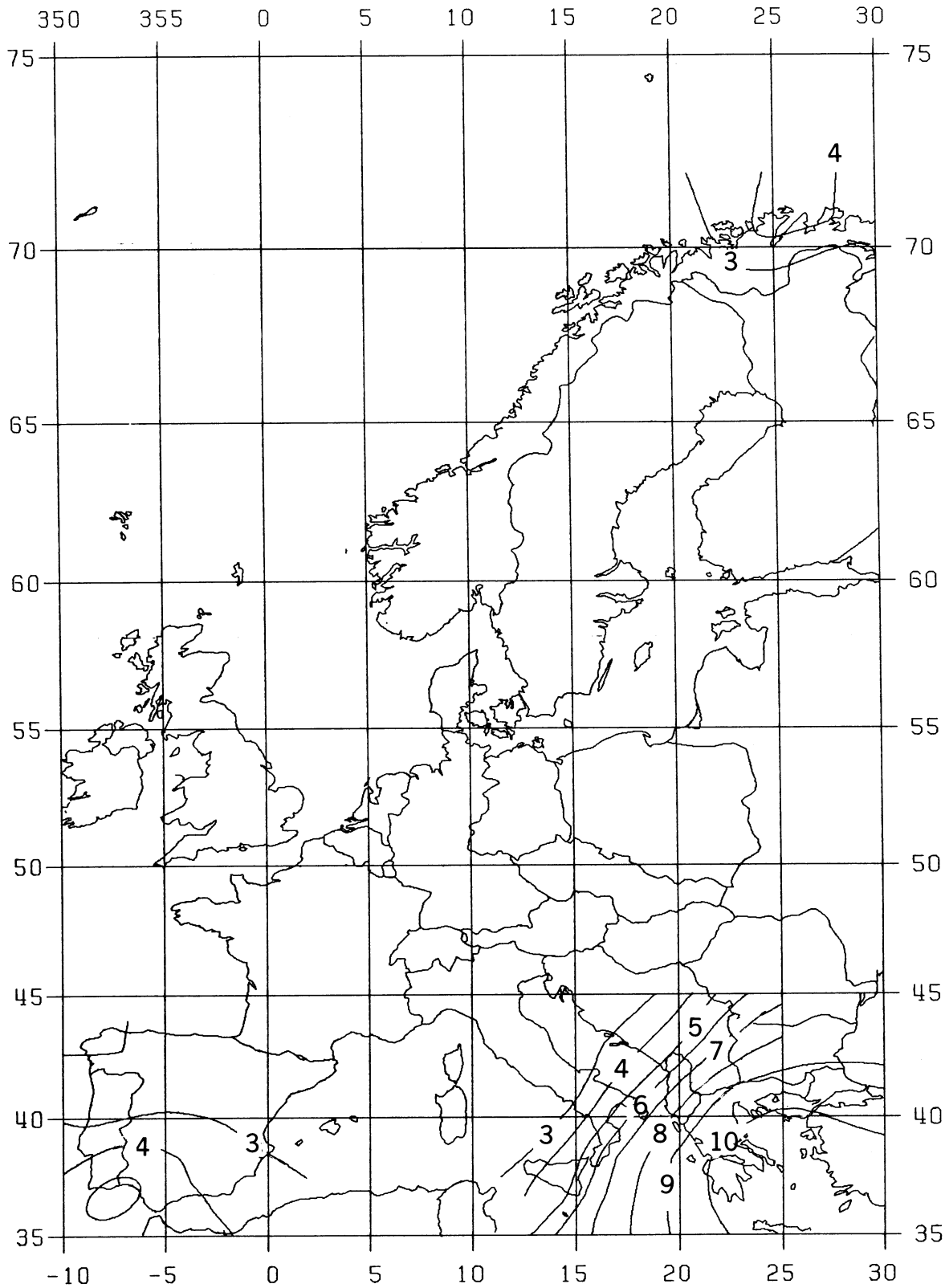


Figure 27.28. Accuracy ($1\sigma$) of WGS 84 Geodetic Latitudes at Doppler Sites (ED 50 Area, Western Europe), Latitude Determined Using Datum Transformation MREs (Contour Interval = 1 Meter)

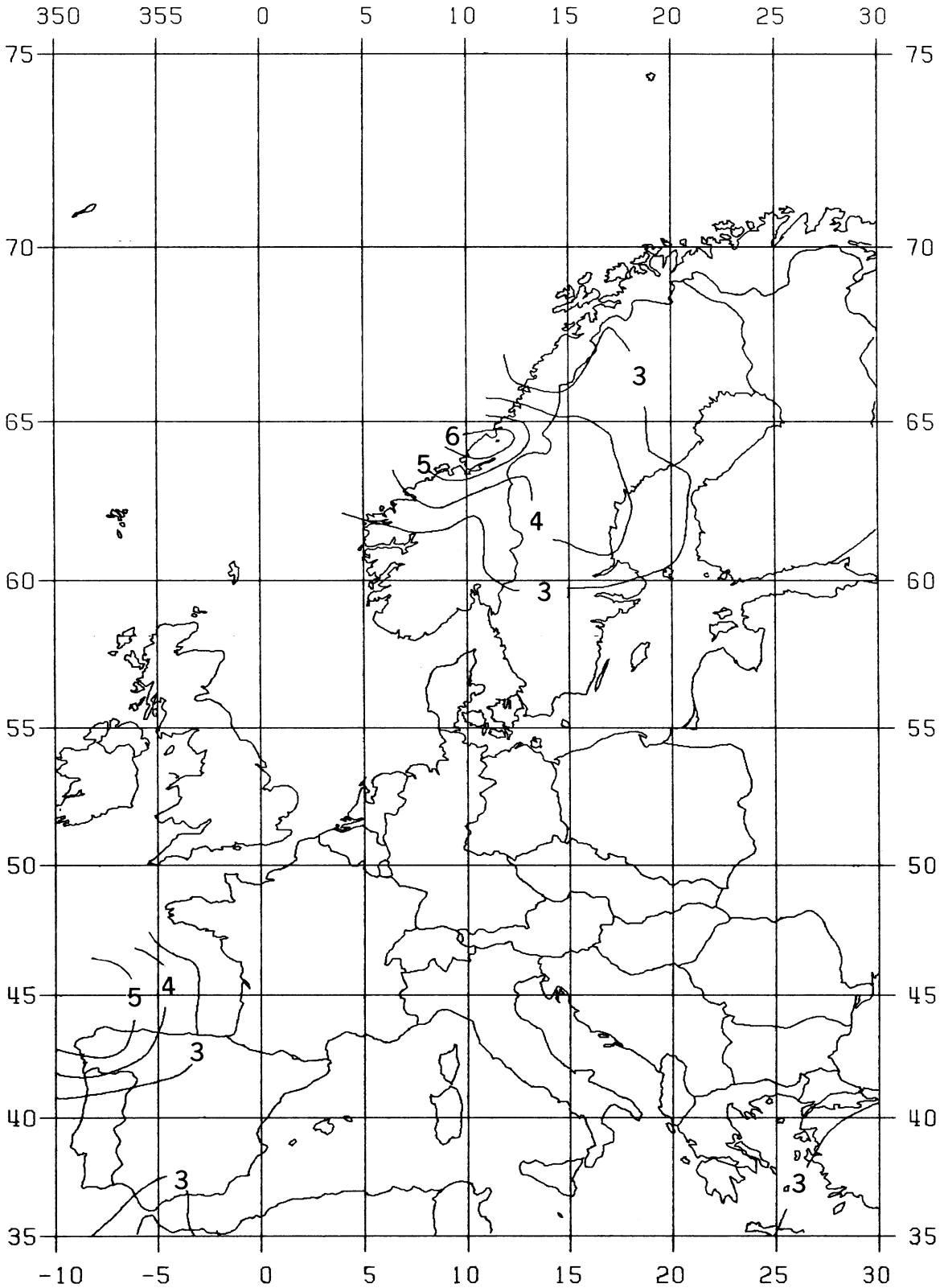


Figure 27.29. Accuracy ($1\sigma$) of WGS 84 Geodetic Longitudes at Doppler Sites (ED 50 Area, Western Europe), Longitude Determined Using Datum Transformation MREs (Contour Interval = 1 Meter)

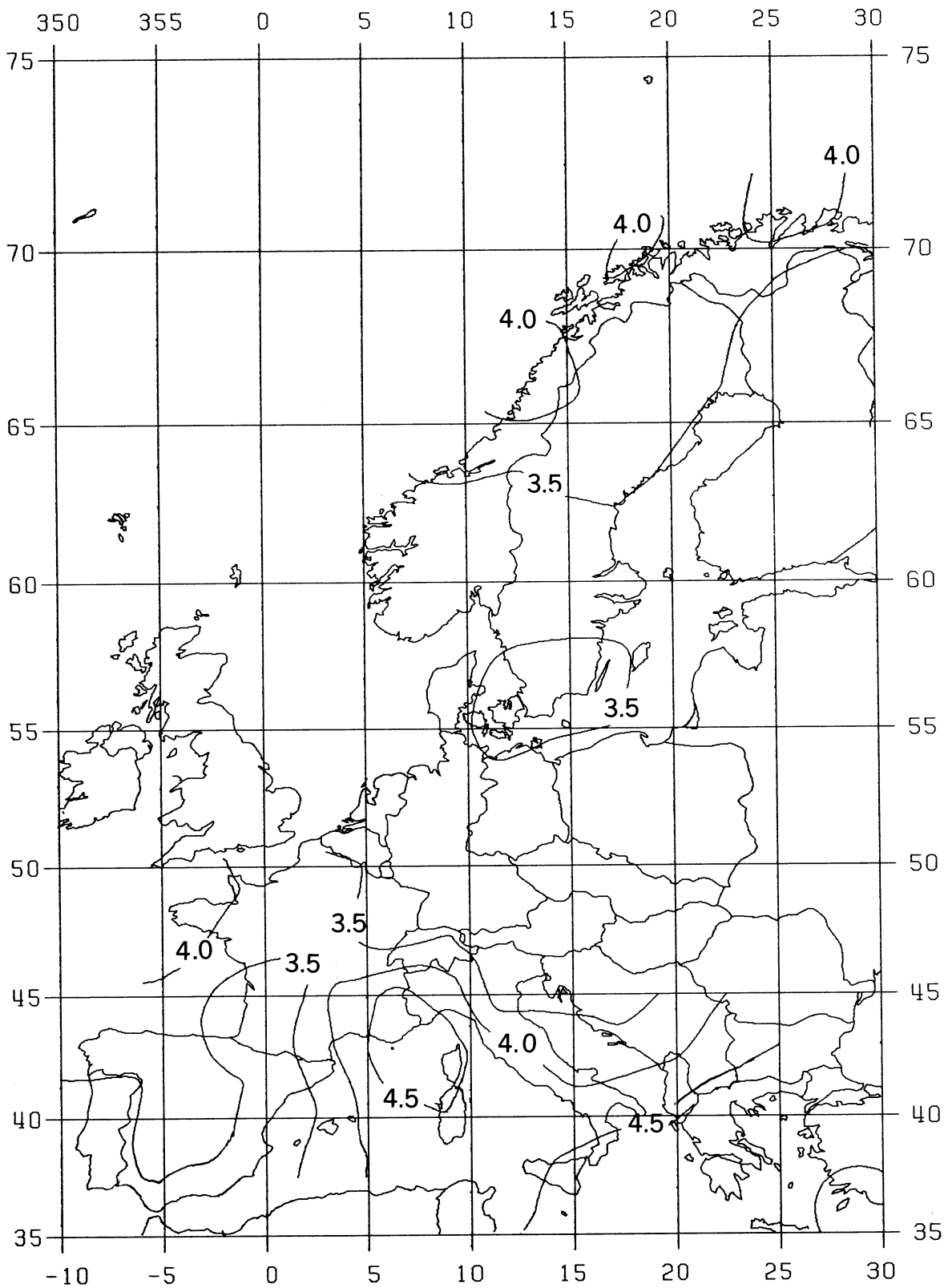


Figure 27.30. Accuracy ($1\sigma$) of WGS 84 Geodetic Heights at Doppler Sites (ED 50 Area, Western Europe), Geodetic Height Determined Using Datum Transformation MREs (Contour Interval = 0.5 Meter)

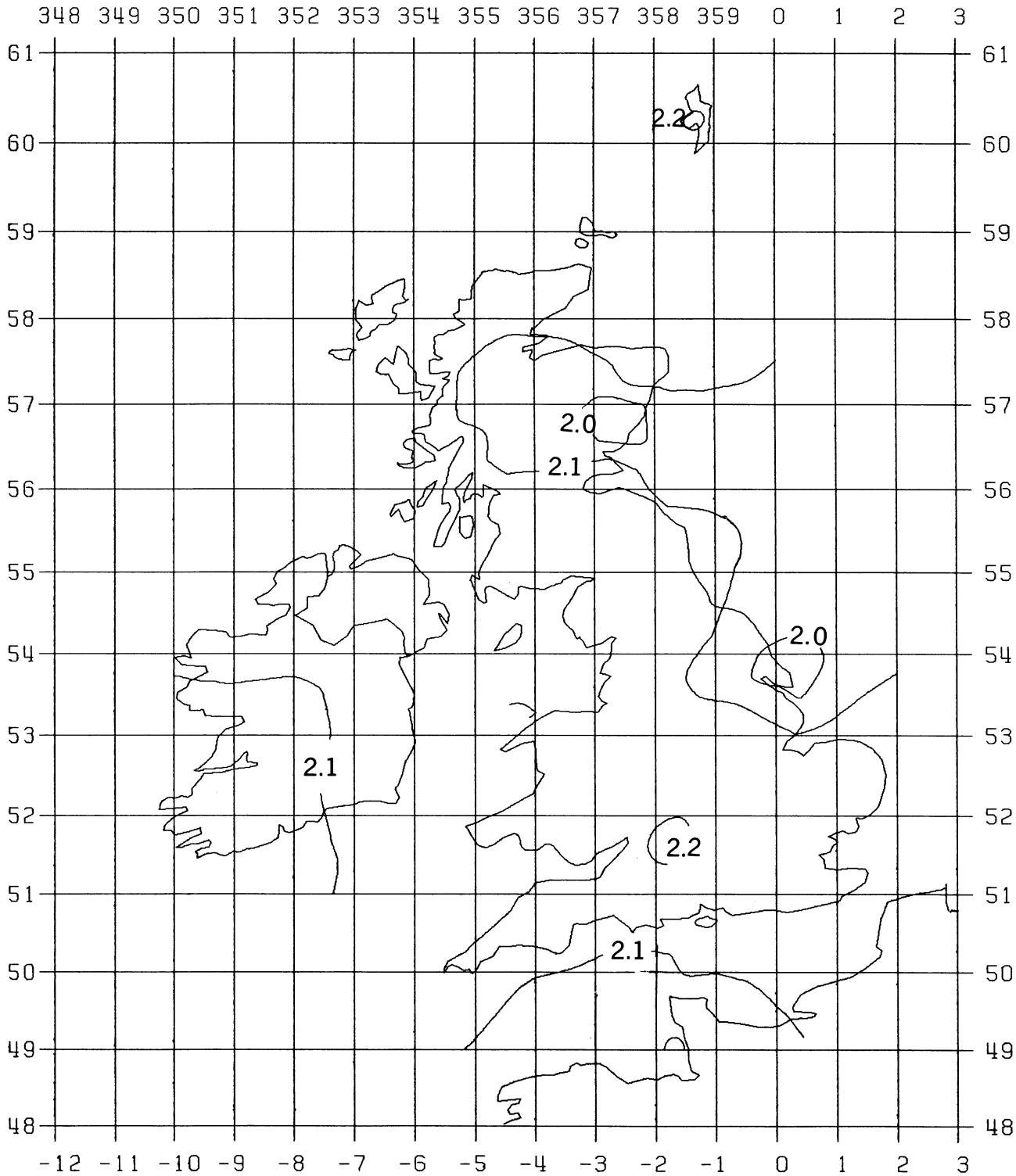


Figure 27.31. Accuracy ($1\sigma$) of WGS 84 Geodetic Latitudes at Doppler Sites (ED 50 Area, UK/Ireland), Latitude Determined Using Datum Transformation MREs (Contour Interval = 0.1 Meter)

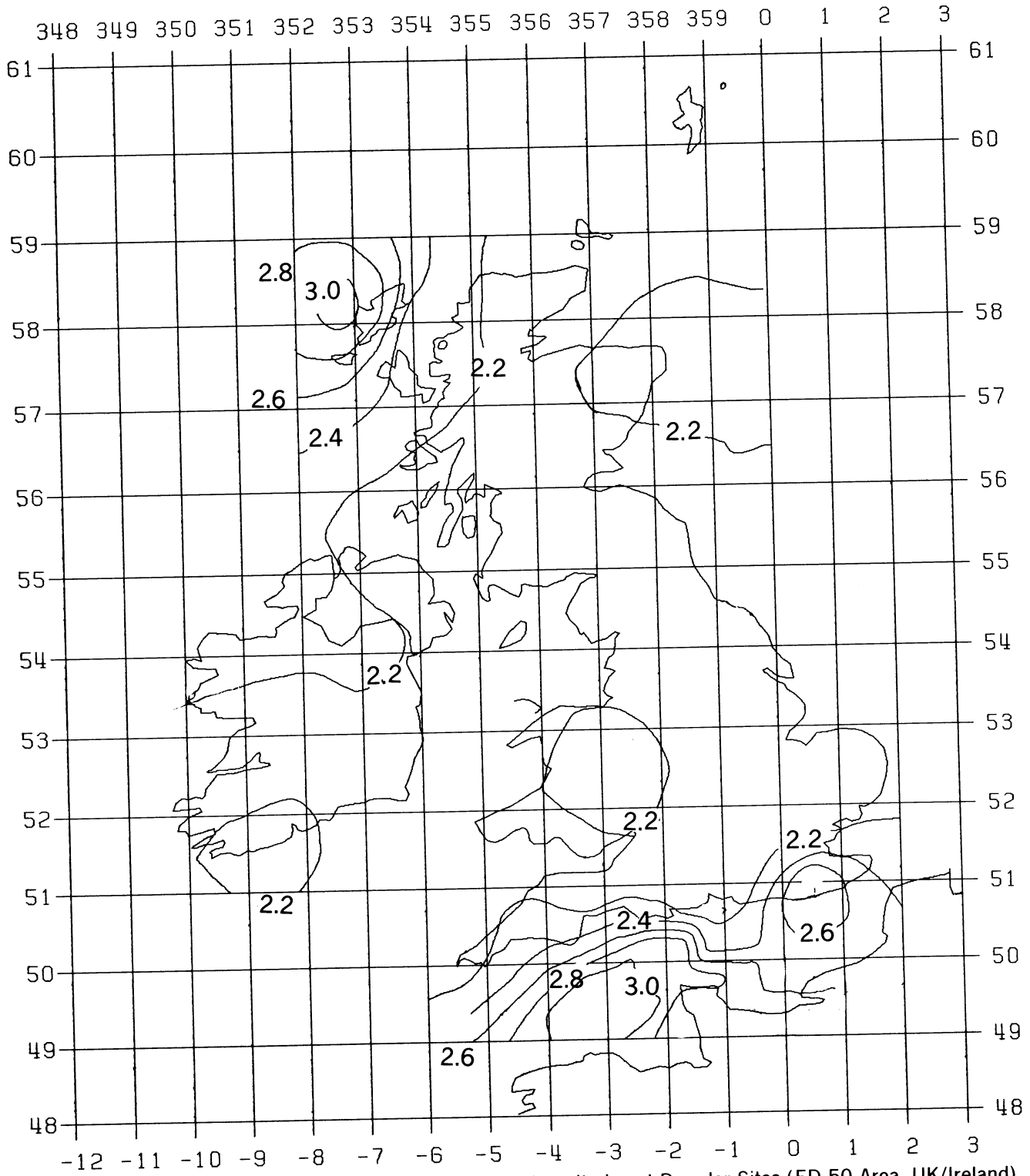


Figure 27.32. Accuracy ($1\sigma$) of WGS 84 Geodetic Longitudes at Doppler Sites (ED 50 Area, UK/Ireland), Longitude Determined Using Datum Transformation MREs (Contour Interval = 0.2 Meter)

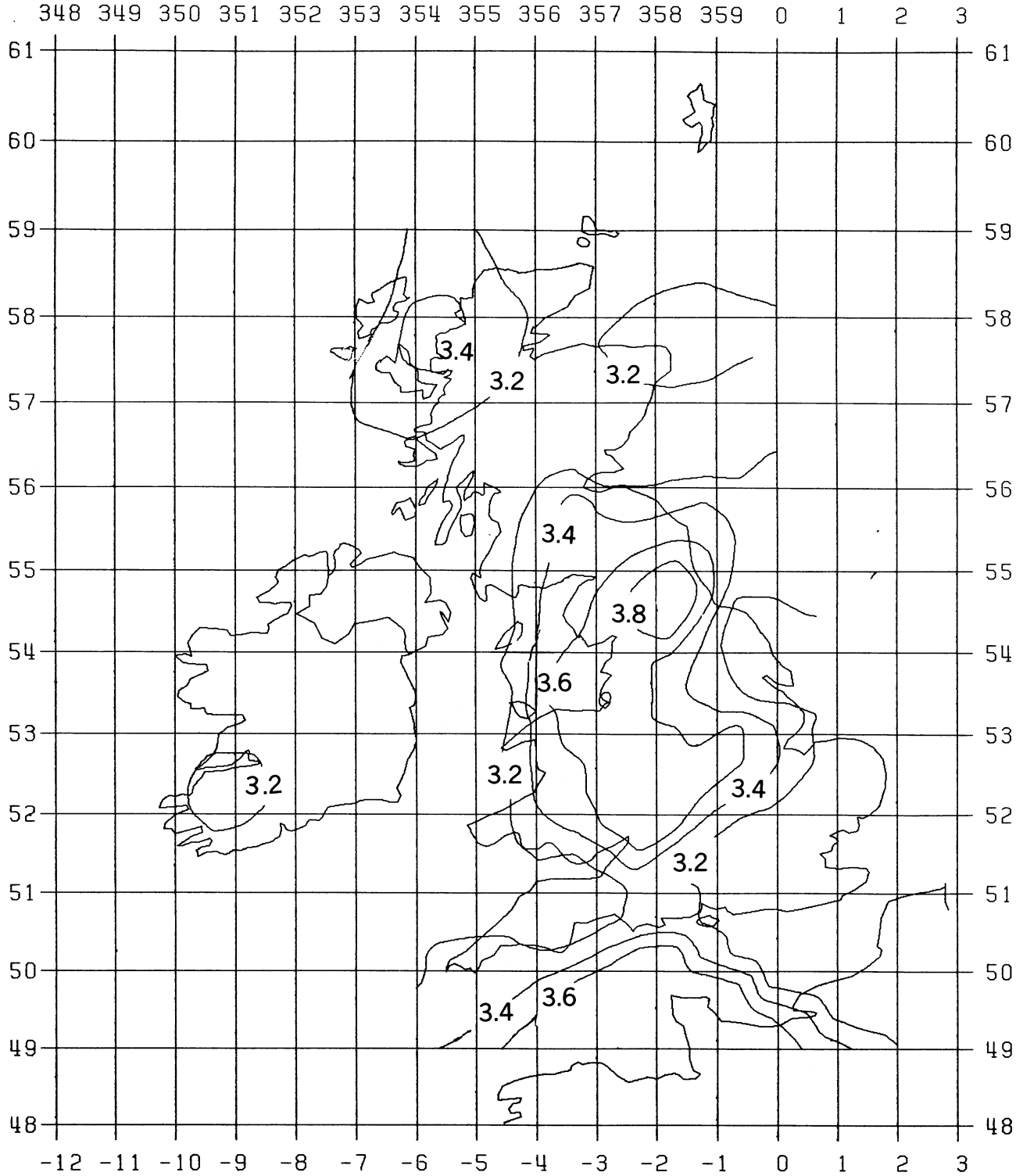


Figure 27.33. Accuracy ($1\sigma$) of WGS 84 Geodetic Heights at Doppler Sites (ED 50 Area, UK/Ireland), Geodetic Height Determined Using Datum Transformation MREs (Contour Interval = 0.2 Meter)

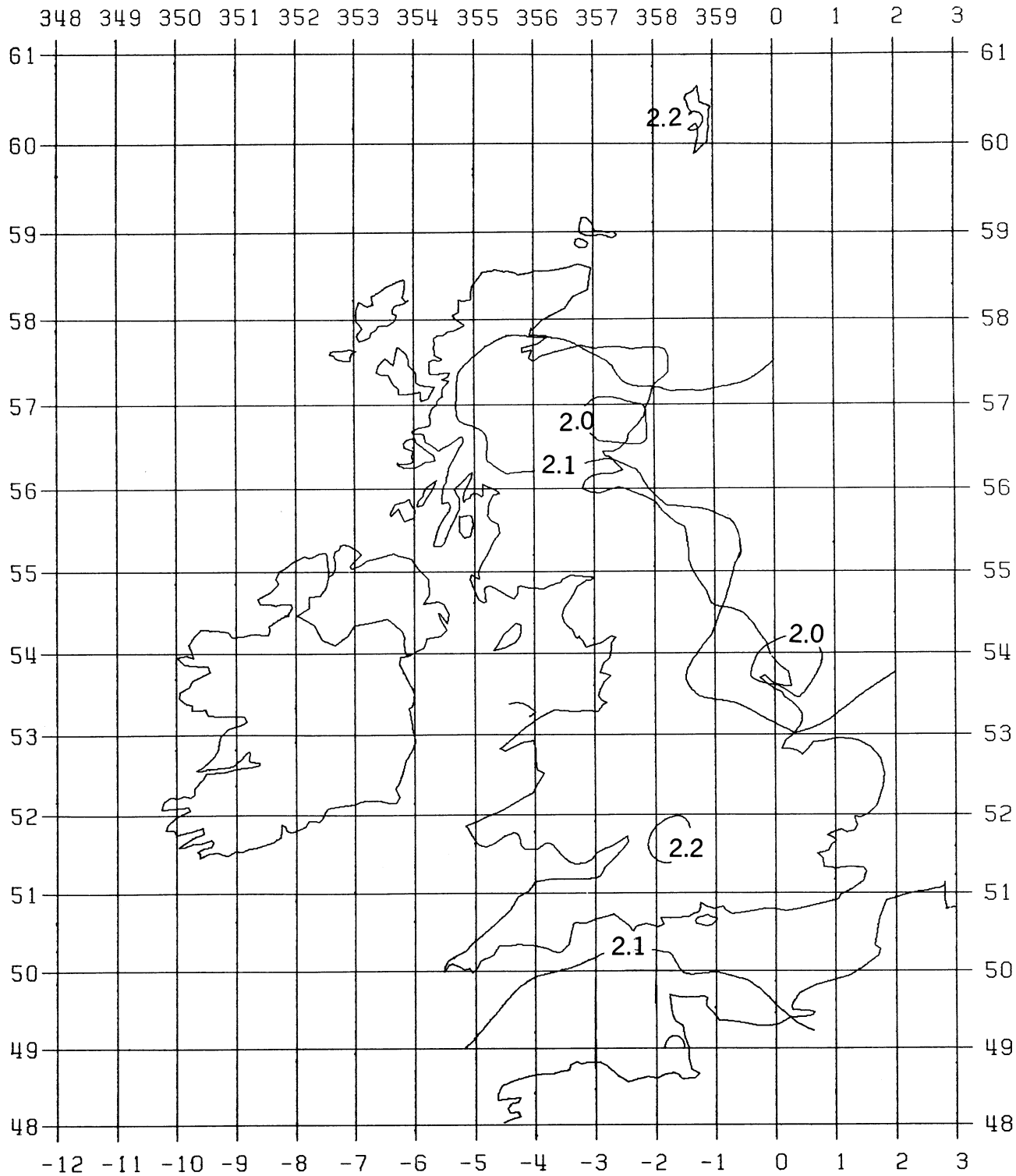


Figure 27.34. Accuracy ($1\sigma$) of WGS 84 Geodetic Latitudes at Doppler Sites (ED 50 Area, UK Only), Latitude Determined Using Datum Transformation MREs (Contour Interval = 0.1 Meter)

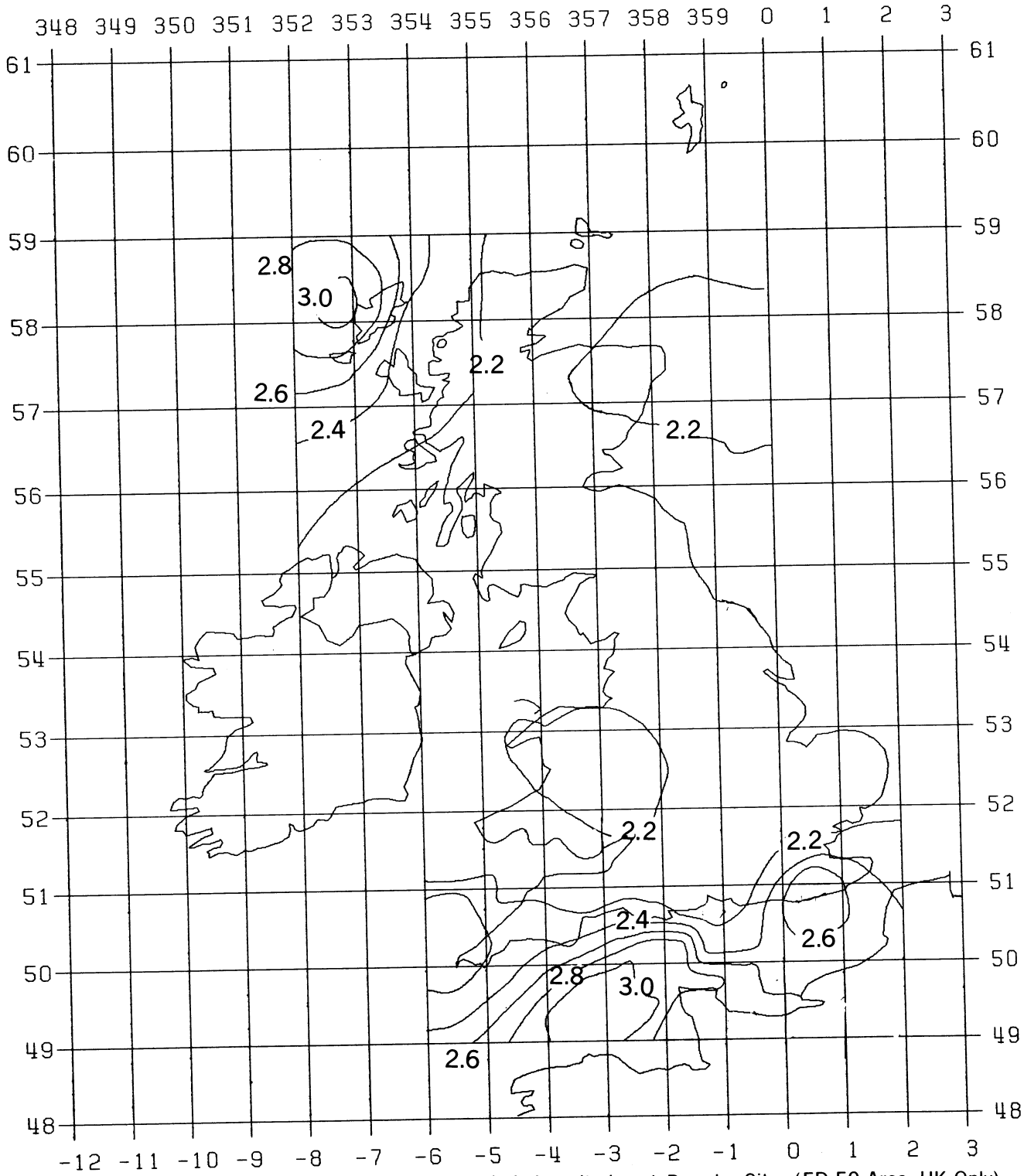


Figure 27.35. Accuracy ($1\sigma$) of WGS 84 Geodetic Longitudes at Doppler Sites (ED 50 Area, UK Only), Longitude Determined Using Datum Transformation MREs (Contour Interval = 0.2 Meter)

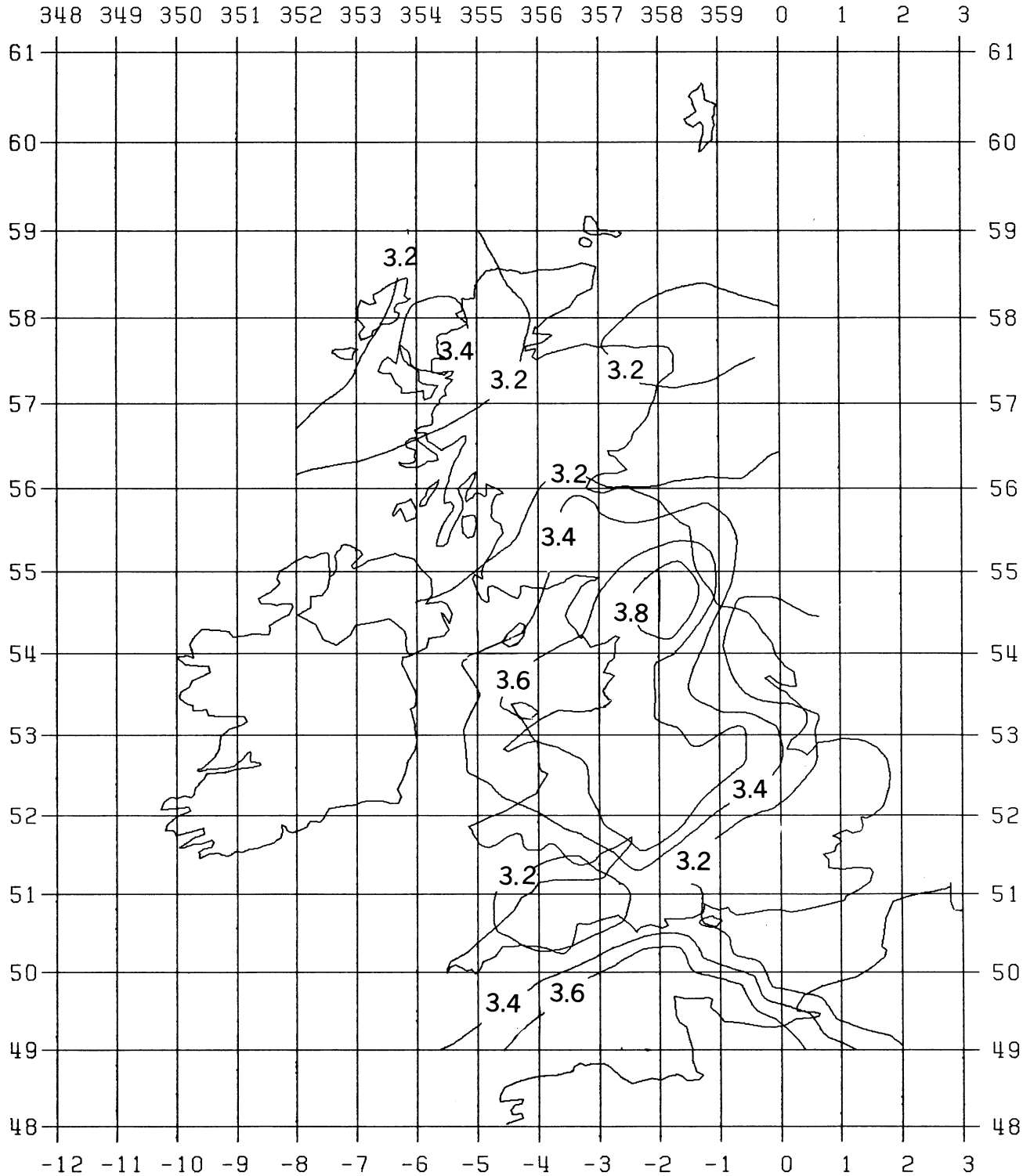


Figure 27.36. Accuracy ($1\sigma$) of WGS 84 Geodetic Heights at Doppler Sites (ED 50 Area, UK Only), Geodetic Height Determined Using Datum Transformation MREs (Contour Interval = 0.2 Meter)

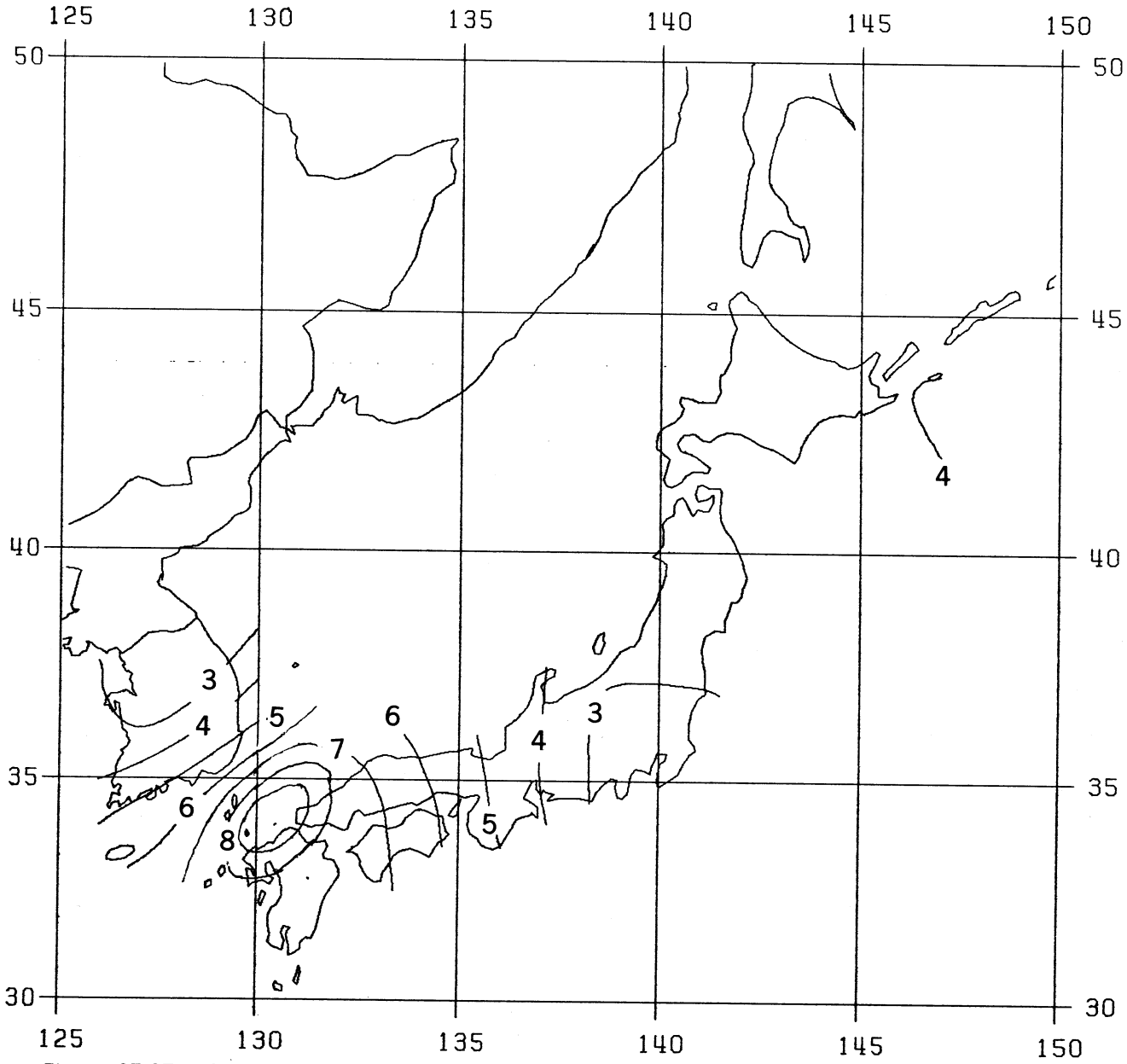


Figure 27.37. Accuracy ($1\sigma$) of WGS 84 Geodetic Latitudes at Doppler Sites (TD Area), Latitude Determined Using Datum Transformation MREs (Contour Interval = 1 Meter)

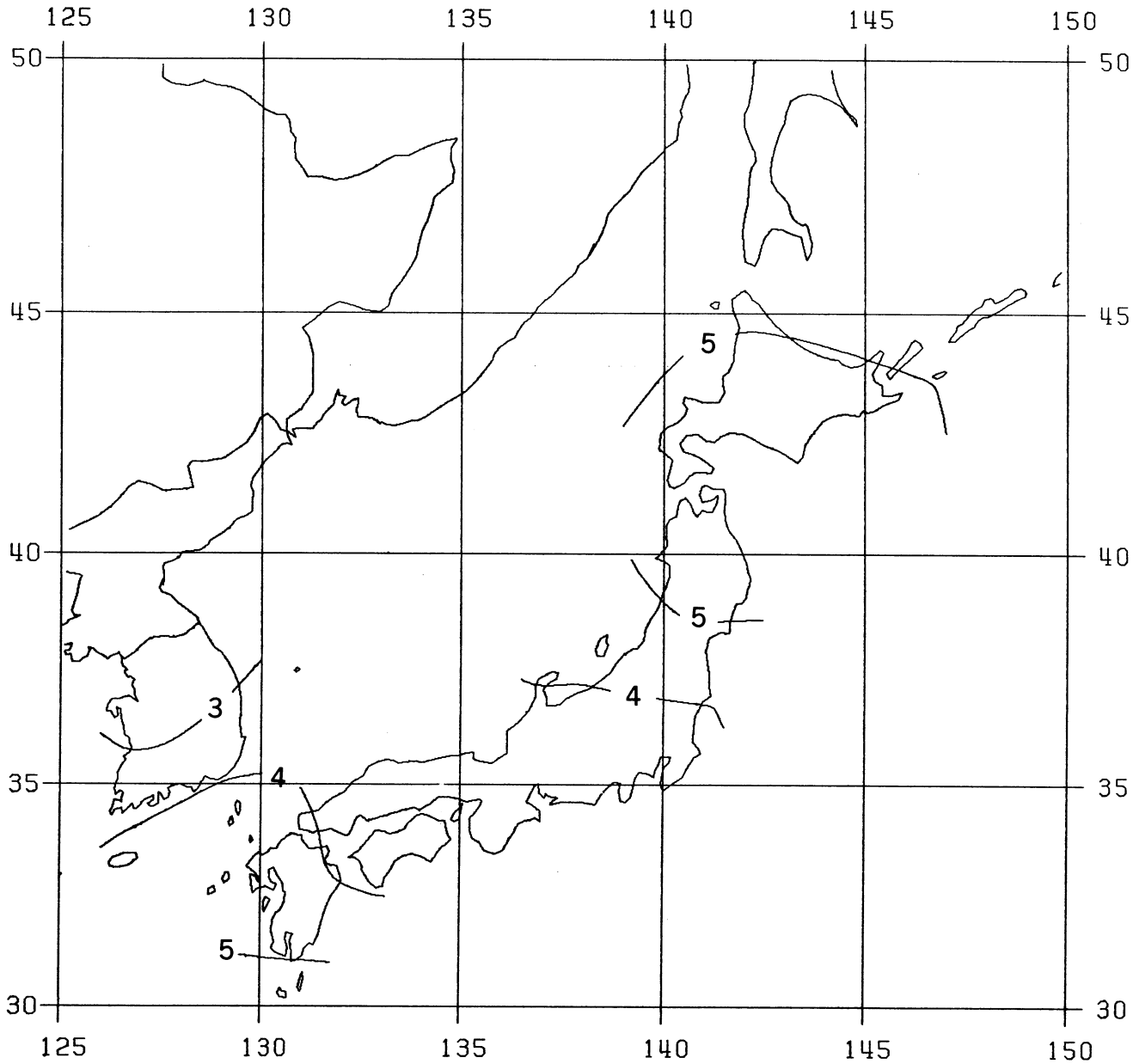


Figure 27.38. Accuracy ($1\sigma$) of WGS 84 Geodetic Longitudes at Doppler Sites (TD Area), Longitude Determined Using Datum Transformation MREs (Contour Interval = 1 Meter)

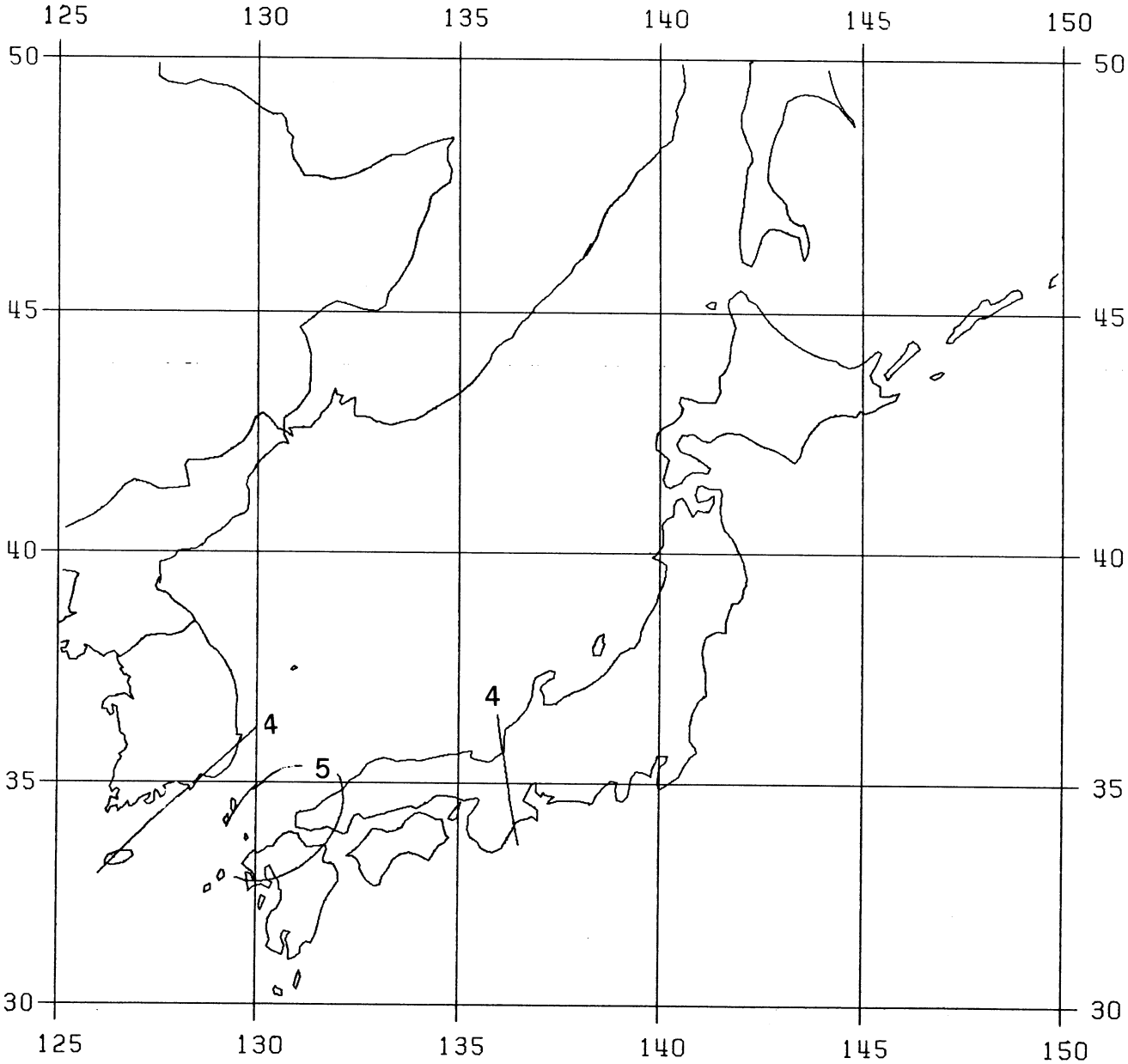


Figure 27.39. Accuracy ($1\sigma$) of WGS 84 Geodetic Heights at Doppler Sites (TD Area), Geodetic Height Determined Using Datum Transformation MREs (Contour Interval = 1 Meter)

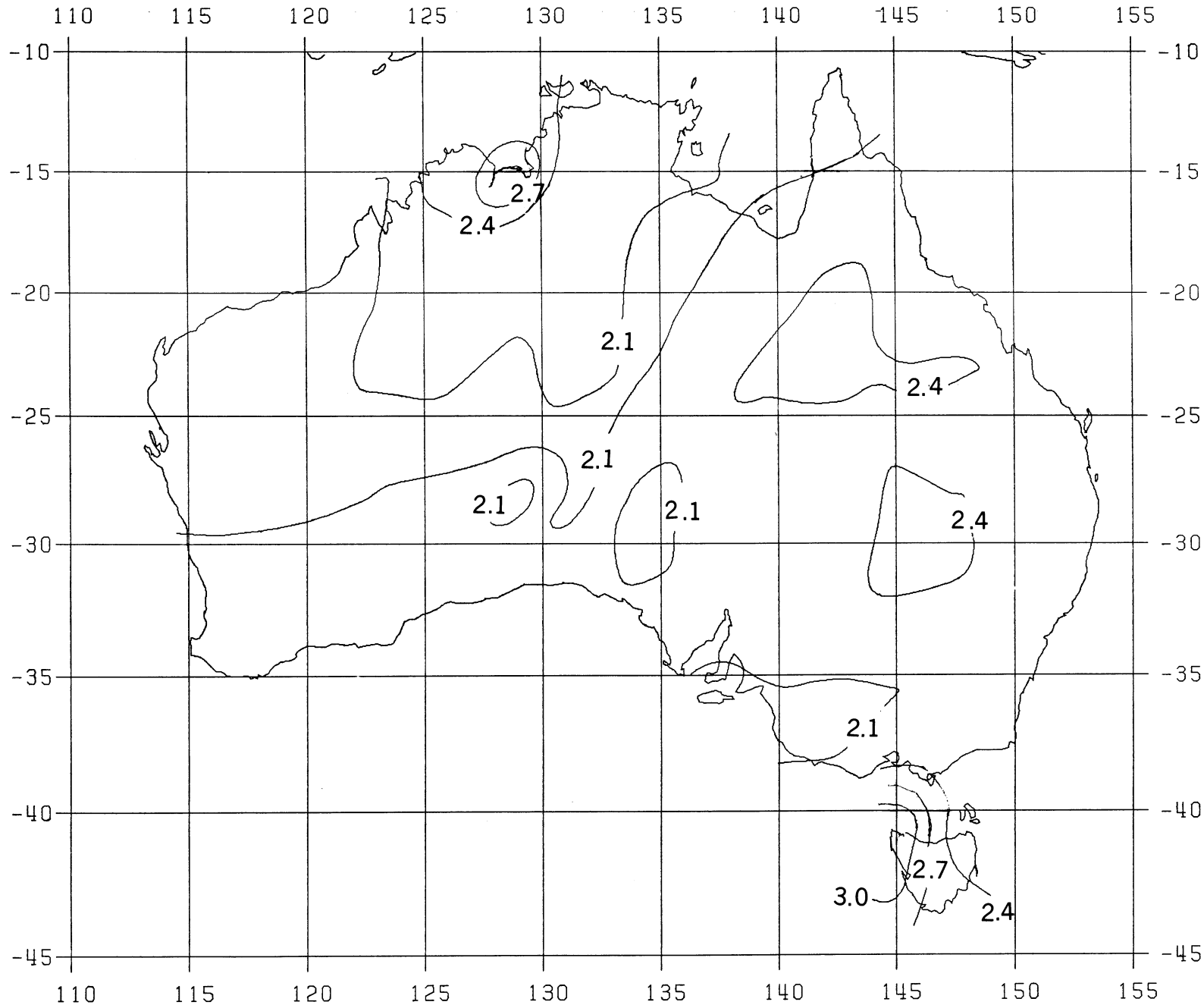


Figure 27.40. Accuracy ($1\sigma$) of WGS 84 Geodetic Latitudes at Doppler Sites (AGD 84 Area), Latitude Determined Using Datum Transformation MREs (Contour Interval = 0.3 Meter)

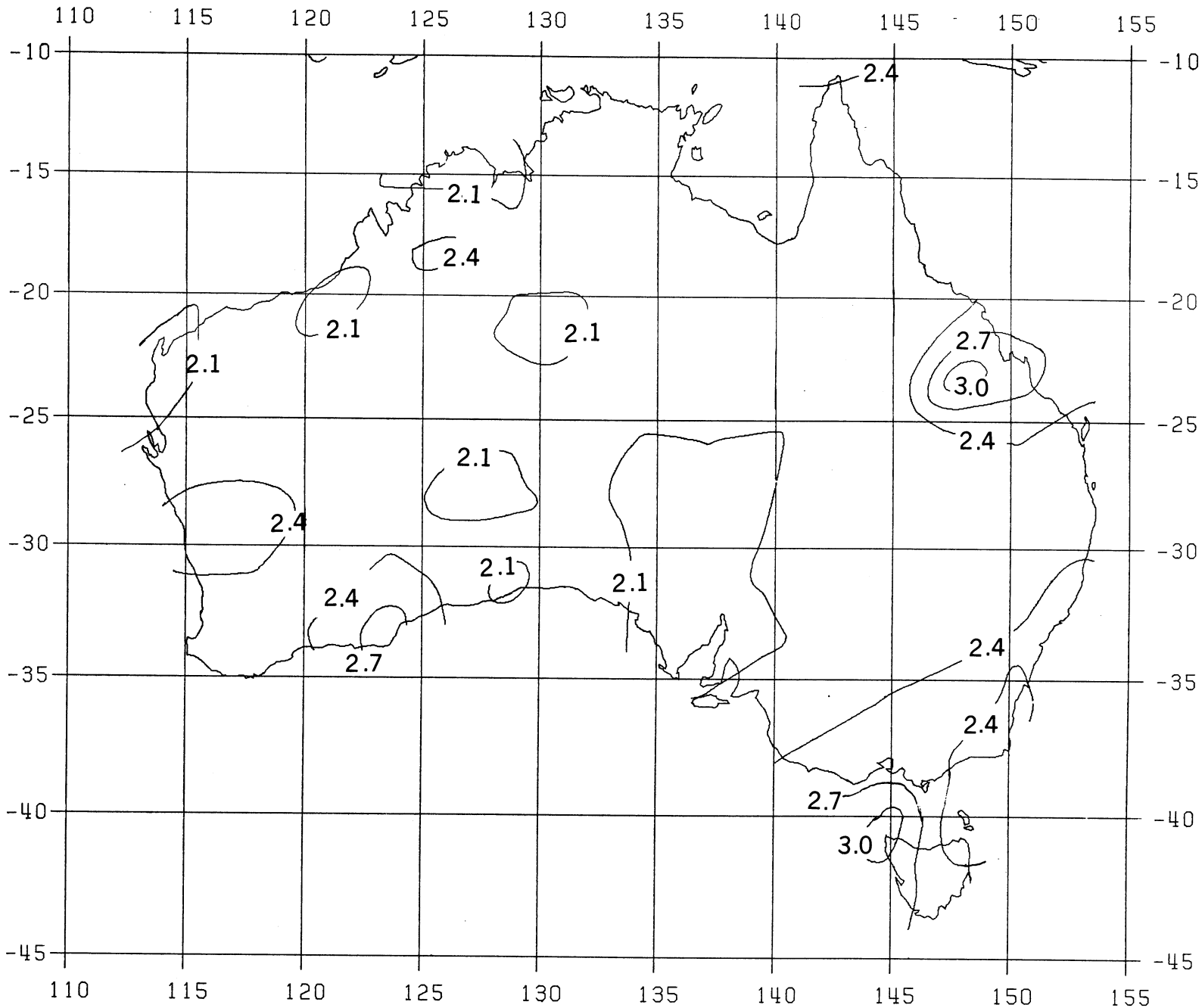


Figure 27.41. Accuracy ($1\sigma$) of WGS 84 Geodetic Longitudes at Doppler Sites (AGD 84 Area), Longitude Determined Using Datum Transformation MREs (Contour Interval = 0.3 Meter)

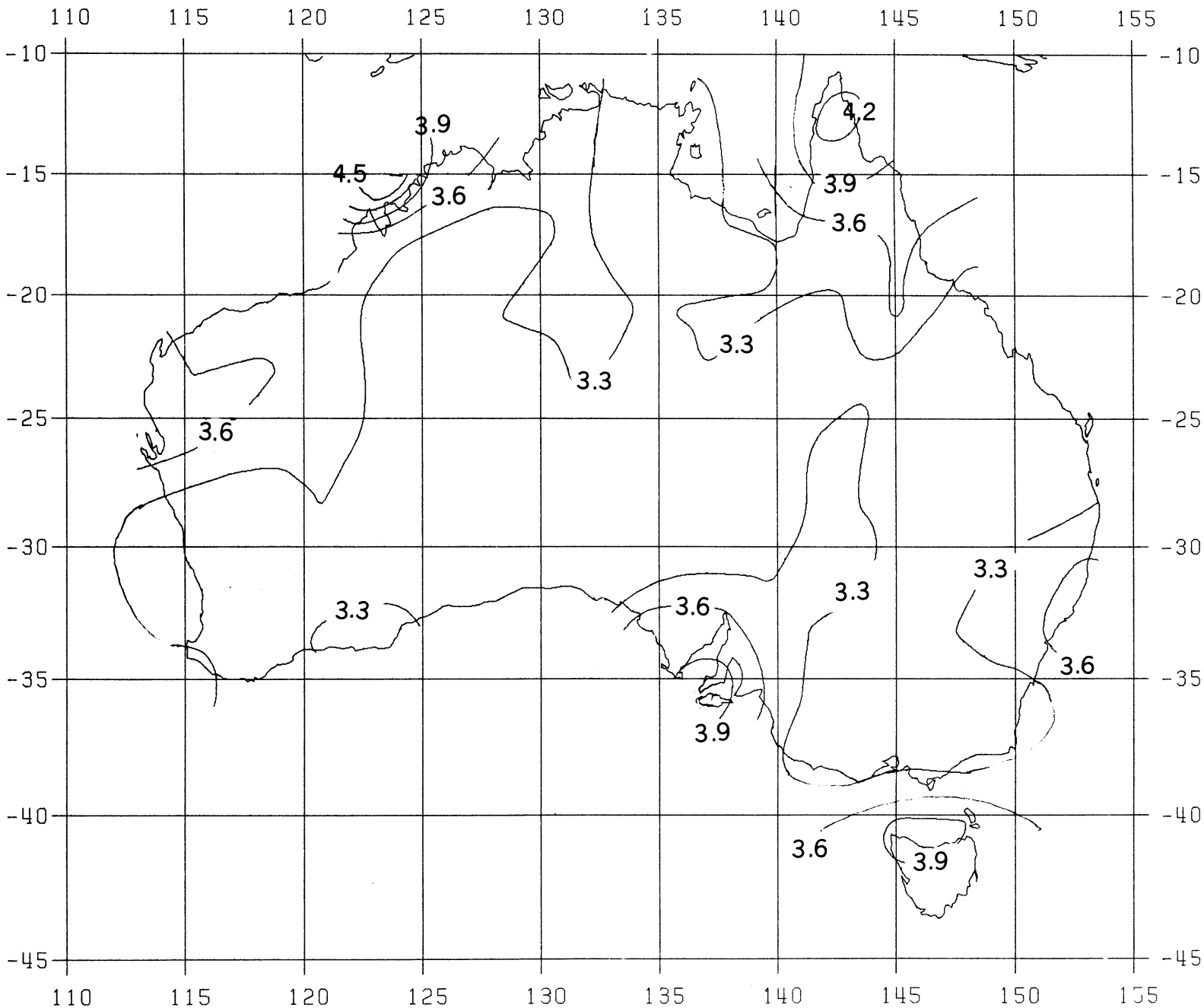


Figure 27.42. Accuracy ($1\sigma$) of WGS 84 Geodetic Heights at Doppler Sites (AGD 84 Area), Geodetic Height Determined Using Datum Transformation MREs (Contour Interval = 0.3 Meter)

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SECTION 28

# ERROR CONVERSION FACTORS

Table 28.1

Error Conversion Factors* [5]

| Notation | | | | |
|---|---|---|---|---|
| **Error Form** | **Standard Error (One Sigma)** | **Probable Error** | **Map Accuracy Standard** | **Near Certainty Error** |
| Linear | $\sigma$ (68.27%) | PE (50%) | MAS (90%) | $3\sigma$ (99.73%) |
| Circular | $\sigma_c$ (39.35%) | CEP (50%) | CMAS (90%) | $3.5\sigma_c$ (99.78%) |
| Spherical | $\sigma_s$ (19.9%) | SEP (50%) | **SAS (90%) | $4\sigma_s$ (99.89%) |

**SAS = Spherical Accuracy Standard

**Linear Error**

| From \ To | 50% | 68.27% | 90% | 99.73% |
|---|---|---|---|---|
| 50% | 1.0000 | 1.4826 | 2.4387 | 4.4475 |
| 68.27 | 0.6745 | 1.0000 | 1.6449 | 3.0000 |
| 90 | 0.4101 | 0.6080 | 1.0000 | 1.8239 |
| 99.73 | 0.2248 | 0.3333 | 0.5483 | 1.0000 |

**Circular Error**

| From \ To | 39.35% | 50% | 90% | 99.78% |
|---|---|---|---|---|
| 39.35% | 1.0000 | 1.1774 | 2.1460 | 3.5000 |
| 50 | 0.8493 | 1.0000 | 1.8227 | 2.9726 |
| 90 | 0.4660 | 0.5486 | 1.0000 | 1.6309 |
| 99.78 | 0.2857 | 0.3364 | 0.6131 | 1.0000 |

**Spherical Error**

| From \ To | 19.9% | 50% | 90% | 99.89% |
|---|---|---|---|---|
| 19.9% | 1.000 | 1.538 | 2.500 | 4.000 |
| 50 | 0.650 | 1.000 | 1.625 | 2.600 |
| 90 | 0.400 | 0.615 | 1.000 | 1.600 |
| 99.89 | 0.250 | 0.385 | 0.625 | 1.000 |

*Errors are assumed to be random and uncorrelated.

SECTION 29

# REFERENCES

## REFERENCES


1. Department of Defense World Geodetic System 1984 - Its Definition and Relationships With Local Geodetic Systems; DMA TR 8350.2; Headquarters, Defense Mapping Agency; Washington, DC; 30 September 1987.

2. Supplement to Department of Defense World Geodetic System 1984 Technical Report: Part I - Methods, Techniques, and Data Used in WGS 84 Development; DMA TR 8350.2-A; Headquarters, Defense Mapping Agency; Washington, DC; 1 December 1987.

3. Supplement to Department of Defense World Geodetic System 1984 Technical Report: Part III - Non-Releasable WGS 84 Geoid, Earth Gravitational Model, and Datum Shift Information and/or Graphics (U) ; DMA TR 8350.2-C; Headquarters, Defense Mapping Agency; Washington, DC; 1 December 1987; classified CONFIDENTIAL.

4. Sepplin, T. O.; The Department of Defense World Geodetic System 1972; Technical Paper; Headquarters, Defense Mapping Agency; Washington, DC; May 1974.

5. Greenwalt, C.R. and M. E. Shultz; Principles of Error Theory and Cartographic Applications; ACIC Technical Report No. 96; Defense Mapping Agency Aerospace Center [Formerly Aeronautical Chart and Information Center (ACIC)]; February 1962 (Reprinted June 1968).

# SECTION 30

## ACRONYMS

| | |
|---|---|
| AGD 66 | = Australian Geodetic Datum 1966 |
| AGD 84 | = Australian Geodetic Datum 1984 |
| BIH | = Bureau International de l'Heure |
| BTS | = BIH Terrestrial System |
| CEP | = Celestial Ephemeris Pole |
| CEP | = Circular Error Probable |
| CIS | = Conventional Inertial System |
| CMAS | = Circular Map Accuracy Standard |
| CONUS | = Contiguous United States |
| CTP | = Conventional Terrestrial Pole |
| CTS | = Conventional Terrestrial System |
| DMA | = Defense Mapping Agency |
| DMAAC | = Defense Mapping Agency Aerospace Center |
| DMAHTC | = Defense Mapping Agency Hydrographic/Topographic Center |
| DMASC | = Defense Mapping Agency Systems Center |
| DoD | = Department of Defense |
| ECEF | = Earth-Centered, Earth-Fixed |
| ECI | = Earth-Centered Inertial |
| ECM | = Earth's Center of Mass |
| ED 50 | = European Datum 1950 |
| ED 79 | = European Datum 1979 |
| EGM | = Earth Gravitational Model |
| FRG | = Federal Republic of Germany |
| GRS 80 | = Geodetic Reference System 1980 |
| ITS | = Instantaneous Terrestrial System |
| MAS | = Map Accuracy Standard |
| MC&G | = Mapping, Charting, and Geodetic |
| MREs | = Multiple Regression Equations |
| NAD 27 | = North American Datum 1927 |
| NAD 83 | = North American Datum 1983 |
| NNSS | = Navy Navigation Satellite System |

## ACRONYMS (Cont'd)

| | |
|---|---|
| NSWC | = Naval Surface Warfare Center (formerly Naval Surface Weapons Center) |
| OSGB 36 | = Ordnance Survey of Great Britain 1936 |
| OSGB SN 80 | = Ordnance Survey of Great Britain Scientific Network 1980 |
| PE | = Probable Error |
| PSAD 56 | = Provisional South American Datum 1956 |
| RMS | = Root-Mean-Square |
| SAD 69 | = South American Datum 1969 |
| SAS | = Spherical Accuracy Standard |
| SEP | = Spherical Error Probable |
| TD | = Tokyo Datum |
| TR | = Technical Report |
| UK | = United Kingdom |
| US | = United States |
| USNO | = United States Naval Observatory |
| WGS | = World Geodetic System |
| WGS 72 | = World Geodetic System 1972 |
| WGS 84 | = World Geodetic System 1984 |