SECTION 20

[Revised: 30 September 1988]

LOCAL GEODETIC SYSTEM-TO-WGS 84

DATUM TRANSFORMATION MULTIPLE REGRESSION EQUATIONS ($\Delta\phi$, $\Delta\lambda$, ΔH)

FOR REMAINDER OF 83 LOCAL GEODETIC SYSTEMS*

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* EXCEPT FOR EUROPEAN DATUM 1979 (SINCE IT DOES NOT REPLACE ED 50). CONSTANT OR AVERAGE $\Delta\phi$, $\Delta\lambda$, ΔH VALUES ARE GIVEN IN TABLE 20.46 FOR THOSE LOCAL GEODETIC SYSTEMS HAVING ONLY THE SMALL NUMBER OF COLOCATED DOPPLER AND LOCAL GEODETIC SYSTEM STATIONS INDICATED (1, 2, or 3). ALSO, SEE TABLE 7.1. THE EQUATION PORTION OF THE FOOTNOTE TO PAGE 19-1 ALSO APPLIES HERE (SECTION 20).

Table 20.1

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Adindan Datum* to WGS 84 -

$$\Delta\phi'' = 2.30939 - 2.70532\,U - 0.17616\,U^2 - 0.67784\,UV + 2.14942\,UV^2 - 6.21315\,U^3V + 0.11956\,V^4 - 2.65405\,U^3V^2 + 0.44562\,U^6 + 8.77907\,U^5V + 4.61321\,U^3V^3 + 0.70866\,U^2V^4 + 1.15691\,U^6V^2 + 6.39994\,U^7V^2 + 4.95968\,U^6V^3 - 3.17763\,U^4V^5 + 3.41973\,U^6V^4 + 2.24544\,U^4V^7 - 11.02072\,U^9V^3 - 9.13270\,U^8V^4 - 0.40499\,U^4V^9$$

$$\Delta\lambda'' = 2.46978 + 0.82797\,V + 0.10716\,U^2 - 0.10258\,UV + 0.12861\,V^2 - 0.46939\,U^2V - 0.22576\,U^3V - 0.04250\,V^5 - 0.40529\,U^2V^4 - 0.20142\,U^3V^8 + 0.08317\,U^3V^9$$

$$\Delta H_m = 2.337 + 6.056\,U + 9.628\,V - 7.824\,U^2 + 30.221\,U^3 - 4.046\,U^2V - 5.632\,UV^2 - 25.258\,U^5 - 9.483\,U^2V^3 - 5.105\,U^5V + 21.890\,U^4V^2 - 37.142\,U^5V^2 + 17.646\,U^5V^3 + 27.471\,U^9V^2$$

In the preceding equations:

$U = K\,(\phi - 14)$
$V = K\,(\lambda - 32)$
$K = 0.10471975$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 44, 47, and 50 comparison points to the following root-mean-square (RMS) differences, respectively:

ϕ: ±1.5 m; λ: ±1.3 m; H (geodetic height): ±1.2 m.

Test Case:

Input data for Adindan Datum test point:	ϕ = 9°05'12.250"N	$\Delta\phi$ = 3.860"
	λ = 36°34'48.852"E	$\Delta\lambda$ = 2.899"
		ΔH = -0.90 m

* Ethiopia, Sudan

Table 20.2

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Arc Datum 1950* to WGS 84 -

$$\Delta\phi'' = - 2.90105 - 1.41963\ U - 0.07116\ V + 0.41503\ U^2 - 0.48095\ UV - 0.37682\ V^2 - 0.43296\ U^2V - 0.59626\ UV^2 - 0.41464\ U^4 + 0.06665\ U^2V^2 + 0.86933\ UV^3 + 0.38753\ U^3V^2 + 0.32332\ UV^4 - 0.09534\ V^5 + 0.10867\ U^6 - 0.04367\ U^4V^2 - 0.56953\ UV^5 - 0.16240\ U^3V^4 - 0.00776\ U^8 + 0.00726\ U^7V - 0.00485\ U^8V^2 + 0.04105\ U^4V^6 + 0.05398\ UV^9$$

$$\Delta\lambda'' = - 1.01486 + 0.14107\ U + 0.85408\ V + 0.21169\ U^2 + 0.25056\ UV - 0.10768\ V^2 + 0.46444\ U^3 - 0.31266\ U^2V - 0.20193\ UV^2 + 0.18042\ U^2V^2 + 0.11677\ V^4 - 0.12972\ U^5 + 0.11348\ U^4V - 0.02386\ U^3V^2 - 0.15945\ V^5 - 0.01031\ U^6V + 0.05005\ UV^6 - 0.02366\ U^4V^4 + 0.00192\ U^9$$

$$\Delta H_m = 13.579 - 11.898\ U + 2.606\ U^2 - 4.757\ UV + 6.771\ V^2 - 1.794\ V^3 - 7.273\ U^2V^2 + 4.633\ UV^3 - 5.660\ V^4 + 1.941\ U^3V^2 - 0.944\ U^2V^3 + 4.462\ UV^4 - 0.009\ U^9$$

In the preceding equations:

$U = K\ (\phi + 22)$
$V = K\ (\lambda - 27)$
$K = 0.15707963$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 62, 64, and 66 comparison points to the following root-mean-square (RMS) differences, respectively:

ϕ: ±1.6 m; λ: ±1.3 m; H (geodetic height): ±1.5 m.

Test Case:

Input data for Arc Datum 1950 test point:	ϕ = -21°09'03.500"S	$\Delta\phi$ = -3.097"
	λ = 27°30'38.724"E	$\Delta\lambda$ = -0.921"
		ΔH = 12.03 m

* Botswana, Lesotho, Malawi, Swaziland, Zaire, Zambia, Zimbabwe

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Table 20.3

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Arc Datum 1960* to WGS 84 -

$$\Delta\phi'' = - 8.75971 - 2.42934\ U - 0.47525\ V - 1.70734\ U^2 - 0.21247\ V^2 + 0.94299\ U^3 - 4.82318\ U^4$$
$$- 0.48322\ U^3V + 2.24563\ U^2V^2 + 10.41787\ UV^3 + 19.09009\ U^6 - 11.89529\ U^2V^5 - 14.08796\ U^8$$
$$+ 19.61428\ UV^8 - 55.57920\ UV^9 + 12.62838\ U^9V^2 - 189.54308\ U^7V^4 - 82.59136\ U^9V^3 + 413.75352\ U^9V^4$$

$$\Delta\lambda'' = 2.88994 + 0.23890\ U + 0.74278\ V - 0.59971\ U^2 - 0.59553\ UV + 0.76985\ U^2V + 1.08910\ UV^2$$
$$+ 1.11164\ V^3 - 2.76334\ U^4V - 1.58354\ U^6 + 4.50776\ U^4V^2 - 4.69780\ UV^5 - 0.78364\ V^6$$
$$+ 2.39396\ U^8 - 18.34020\ V^9$$

$$\Delta H_m = - 4.706 - 48.308\ U + 15.189\ V - 41.560\ U^2 + 10.967\ UV - 4.423\ V^2 + 21.834\ U^3 + 140.872\ UV^2$$
$$+ 14.126\ U^5 - 817.014\ U^2V^3 - 263.676\ UV^4 + 41.387\ U^6 + 517.996\ U^4V^2 + 2398.411\ U^2V^5$$
$$+ 271.110\ U^7V^2 - 2705.340\ U^3V^6 - 972.194\ U^7V^3 - 5016.963\ U^8V^4 + 21175.898\ U^8V^7$$

In the preceding equations:

$U = K\ (\phi + 3)$
$V = K\ (\lambda - 36)$
$K = 0.10471975$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 38, 41, and 41 comparison points to the following root-mean-square (RMS) differences, respectively:

ϕ: ±1.4 m; λ: ±1.4 m; H (geodetic height): ±1.0 m.

Test Case:

Input data for Arc Datum 1960 test point:	ϕ = -6°03'32.760"S	$\Delta\phi$ = -8.216"
	λ = 35°55'19.249"E	$\Delta\lambda$ = 2.742"
		ΔH = 5.69 m

* Kenya, Tanzania

Table 20.4

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Bellevue (IGN) Datum* to WGS 84 -

$$\Delta\phi'' = 16.12246 - 0.03550\ V^6$$

$$\Delta\lambda'' = 26.36897 - 26.40849\ U^9V^9$$

$$\Delta H_m = 68.606 - 10.688\ U^5V^3$$

In the preceding equations:

$U = K\ (\phi + 18)$
$V = K\ (\lambda - 169)$
$K = 1.57079631$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 3 comparison points to the following root-mean-square (RMS) differences:

ϕ: ±0.0 m; λ: ±0.2 m; H (geodetic height): ±0.1 m.

Test Case:

Input data for Bellevue (IGN) Datum test point:	ϕ = -17°44'17.400"S	$\Delta\phi$ = 16.079"
	λ = 168°20'33.250"E	$\Delta\lambda$ = 26.381"
		ΔH = 68.74 m

* Efate and Erromango Islands (New Hebrides Islands)

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Table 20.5

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Bermuda Datum 1957* to WGS 84 -

$$\Delta\phi'' = 6.29809 - 2.78250\ U + 1.42629\ U^2 - 0.00394\ U^9$$

$$\Delta\lambda'' = 0.92185 - 0.76776\ V + 1.65926\ V^2 - 0.81073\ V^3 + 0.00367\ V^9$$

$$\Delta H_m = -30.797 - 1.853\ U + 145.113\ V - 336.079\ V^2 + 181.174\ V^3 + 0.012\ U^9 - 1.008\ V^9 + 0.003\ U^8V^9 - 0.002\ U^9V^9$$

In the preceding equations:

$U = K\ (\phi - 32)$
$V = K\ (\lambda - 295)$
$K = 3.66519141$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 11 comparison points to the following root-mean-square (RMS) differences:

ϕ: ±0.4 m; λ: ±0.3 m; H (geodetic height): ±0.3 m.

Test Case:

Input data for Bermuda Datum 1957 test point:	ϕ = 32°21'08.707"N	$\Delta\phi$ = 5.044"
	λ = 295°20'37.053"E	$\Delta\lambda$ = 0.996"
		ΔH = -29.44 m

* Bermuda Islands

Table 20.6

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Bogota Observatory Datum* to WGS 84 -

$$\Delta\phi'' = -10.20547 - 0.04536\,U - 0.32067\,V + 0.28431\,UV + 0.16880\,U^2V + 0.90592\,UV^2 + 0.61577\,V^3 - 2.32975\,UV^3 - 0.25607\,V^4 + 2.13800\,U^2V^4 - 4.60849\,U^2V^5$$

$$\Delta\lambda'' = 12.33779 - 0.10858\,U + 0.54020\,V + 0.15784\,U^2 - 1.29192\,V^2 + 0.21029\,U^3 - 0.53682\,V^3 + 2.18555\,V^4 + 0.46590\,U^2V^3 - 0.75178\,V^5 + 5.08165\,UV^6 + 7.79816\,U^2V^8$$

$$\Delta H_m = 10.043 - 43.824\,U + 19.329\,V + 14.074\,UV + 71.105\,V^2 + 36.197\,U^3 - 48.258\,U^2V + 170.437\,V^3 - 39.291\,U^3V - 525.555\,V^4 - 8.762\,U^5 + 145.878\,U^2V^3 - 503.109\,V^5 + 810.751\,V^6 + 1013.581\,U^3V^8$$

In the preceding equations:

$U = K\,(\phi - 6)$
$V = K\,(\lambda - 286)$
$K = 0.15707963$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 22 comparison points to the following root-mean-square (RMS) differences:

ϕ: ±1.3 m; λ: ±1.4 m; H (geodetic height): ±0.8 m

Test Case:

Input data for Bogota Observatory Datum test point:	ϕ = 2°34'26.221"N	$\Delta\phi$ = -10.276"
	λ = 287°21'36.733"E	$\Delta\lambda$ = 12.466"
		ΔH = 33.29 m

* Colombia

Table 20.7

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Campo Inchauspe Datum* to WGS 84 -

$$\Delta\phi'' = 1.67470 + 0.52924\ U - 0.17100\ V + 0.18962\ U^2 + 0.04216\ UV + 0.19709\ UV^2 - 0.22037\ U^4 - 0.15483\ U^2V^2 - 0.24506\ UV^4 - 0.05675\ V^5 + 0.06674\ U^6 + 0.01701\ UV^5 - 0.00202\ U^7 + 0.08625\ V^7 - 0.00628\ U^8 + 0.00172\ U^8V^4 + 0.00036\ U^9V^6$$

$$\Delta\lambda'' = - 2.93117 + 0.18225\ U + 0.69396\ V - 0.04403\ U^2 + 0.07955\ V^2 + 1.48605\ V^3 - 0.00499\ U^4 - 0.02180\ U^4V - 0.29575\ U^2V^3 + 0.20377\ UV^4 - 2.47151\ V^5 + 0.09073\ U^3V^4 + 1.33556\ V^7 + 0.01575\ U^3V^5 - 0.26842\ V^9$$

$$\Delta H_m = 17.004 + 8.380\ U - 7.968\ V + 1.795\ UV - 2.289\ U^3 + 6.660\ U^2V - 3.283\ UV^2 + 3.235\ V^3 + 0.418\ U^4 - 2.475\ U^3\ V - 4.829\ U^2V^3 + 0.010\ U^7 + 0.011\ U^2V^5 + 0.602\ U^4V^4 + 2.724\ U^2V^7 + 0.215\ U^4V^7 - 1.159\ U^2V^9$$

In the preceding equations:

$U = K\ (\phi + 35)$
$V = K\ (\lambda - 296)$
$K = 0.15707963$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 44 comparison points to the following root-mean-square (RMS) differences:

ϕ: ±1.2 m; λ: ±1.1 m; H (geodetic height): ±0.8 m

Test Case:

Input data for Campo Inchauspe Datum test point:	ϕ =	-29°47'45.682"S	$\Delta\phi$ =	1.953"
	λ =	301°52'21.803"E	$\Delta\lambda$ =	-1.963"
			ΔH =	18.29 m

* Argentina

Table 20.8

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Canton Astro Datum 1966* to WGS 84 -

$$\Delta\phi'' = -12.36756 + 0.35103\ U^2V^6$$

$$\Delta\lambda'' = 11.07250 + 0.11654\ V$$

$$\Delta H_m = 17.689 - 4.578\ U - 3.911\ UV^7$$

In the preceding equations:

$U = K\ (\phi + 3)$
$V = K\ (\lambda - 188)$
$K = 1.57079631$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 4 comparison points to the following root-mean-square (RMS) differences:

ϕ: ±0.3 m; λ: ±0.1 m; H (geodetic height): ±0.0 m

Test Case:

Input data for Canton Astro Datum 1966 test point:	ϕ =	-4°29'08.524"S	$\Delta\phi$ =	-12.367"
	λ =	187°49'32.444"E	$\Delta\lambda$ =	11.041"
			ΔH =	28.37 m

* Phoenix Islands

Table 20.9

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Cape Datum* to WGS 84 -

$$\Delta\phi'' = -1.47191 - 0.82976\ U - 0.77153\ V - 1.08380\ U^3 + 0.69870\ UV^2 + 0.85794\ V^3 - 8.05489\ U^5 - 6.08125\ U^6 + 0.44971\ V^6 - 16.35098\ U^5V^2 + 101.23469\ U^8V$$

$$\Delta\lambda'' = -1.41127 + 0.35645\ U + 0.77969\ V + 0.48733\ V^2 - 0.41143\ U^2V - 2.36026\ U^2V^2 + 4.00369\ U^5 - 5.59891\ U^4V + 21.62355\ U^8 - 114.94636\ U^5V^3 + 1521.92420\ U^8V^6$$

$$\Delta H_m = 23.339 - 3.590\ U - 4.129\ V - 10.628\ U^3 - 2.554\ U^2V + 3.724\ V^3 - 21.394\ U^4 + 1.696\ V^6 + 2610.177\ U^9V^5$$

In the preceding equations:

$U = K\ (\phi + 28)$
$V = K\ (\lambda - 26)$
$K = 0.10471975$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 20 comparison points to the following root-mean-square (RMS) differences:

ϕ: ±0.8 m; λ: ±0.7 m; H (geodetic height): ±0.2 m

Test Case:

Input data for Cape Datum test point:	ϕ =	-22°15'13.678"S	$\Delta\phi$ =	-2.874"
	λ =	29°09'47.488"E	$\Delta\lambda$ =	-0.879"
			ΔH =	14.63 m

* South Africa

Table 20.10

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Cape Canaveral Datum* to WGS 84 -

$$\Delta\phi'' = 1.16421 - 1.08512\ U + 0.13663\ V + 4.91857\ UV^2 + 3.12400\ V^3 + 124.43651\ U^5 - 387.46848\ V^9$$

$$\Delta\lambda'' = 0.86515 - 0.20467\ U + 0.40432\ V + 1.21195\ V^2 - 317.68323\ V^9$$

$$\Delta H_m = -29.579 + 3.968\ U - 74.289\ UV^2 + 74.086\ V^4 + 39588.838\ UV^9$$

In the preceding equations:

$U = K\ (\phi - 27)$
$V = K\ (\lambda - 280)$
$K = 0.10471975$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 27 comparison points to the following root-mean-square (RMS) differences:

ϕ: ±0.8 m; λ: ±0.9 m; H (geodetic height): ±0.8 m

Test Case:

Input data for Cape Canaveral Datum test point:	ϕ =	26°03'36.424"N	$\Delta\phi$ =	1.268"
	λ =	279°51'51.267"E	$\Delta\lambda$ =	0.880"
			ΔH =	-29.97 m

* Florida and the Bahama Islands

Table 20.11

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Carthage Datum* to WGS 84 -

$$\Delta\phi'' = 5.62302 + 0.97026\ V - 0.30964\ U^2 - 4.50523\ UV - 0.45229\ U^3 - 1.72821\ U^2V - 8.79206\ V^3 + 11.31713\ U^3V + 7.11384\ U^4V - 19.74569\ UV^4 + 38.84103\ U^2V^4 + 95.47870\ UV^5 + 282.34348\ V^9$$

$$\Delta\lambda'' = 1.75559 + 0.96288\ U + 0.46232\ V + 0.98581\ U^2 + 0.23217\ UV + 1.72414\ V^2 - 2.04345\ U^3 - 2.05410\ U^4 + 18.63465\ U^5V^3 - 122.61534\ V^8$$

$$\Delta H_m = 31.477 + 10.815\ U + 2.921\ V + 12.107\ U^2 + 7.567\ V^2 - 18.692\ U^3 - 20.265\ U^4 + 74.574\ UV^3 - 2077.760\ UV^8$$

In the preceding equations:

$U = K\ (\phi - 35)$
$V = K\ (\lambda - 9)$
$K = 0.20943951$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 21 comparison points to the following root-mean-square (RMS) differences:

ϕ: ±0.9 m; λ: ±1.2 m; H (geodetic height): ±0.6 m

Test Case:

Input data for Carthage Datum test point:	ϕ =	36°49'21.208"N	$\Delta\phi$ =	5.280"
	λ =	10°46'08.814"E	$\Delta\lambda$ =	2.514"
			ΔH =	39.19 m

* Tunisia

Table 20.12

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Chatham Datum 1971* to WGS 84 -

$\Delta\phi'' = 1.70498 + 2115.19930\ V^5$

$\Delta\lambda'' = 2.11344 + 0.92449\ V$

$\Delta H_m = 6.412 - 25.629\ V$

In the preceding equations:

$U = K\ (\phi + 44)$
$V = K\ (\lambda - 183)$
$K = 0.15707963$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 4 comparison points to the following root-mean-square (RMS) differences:

ϕ: ±0.1 m; λ: ±0.6 m; H (geodetic height): ±0.3 m

Test Case:

Input data for Chatham Datum 1971 test point:	ϕ =	-43°47'29.102"S	$\Delta\phi$ =	1.705"
	λ =	183°10'33.902"E	$\Delta\lambda$ =	2.139"
			ΔH =	5.70 m

* Chatham Island

Table 20.13

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Chua Astro Datum* to WGS 84 -

$$\Delta\phi'' = -2.21781 + 0.54448\,U - 0.16463\,V - 0.47450\,U^2 - 0.49228\,UV - 9.12731\,U^3V^6$$

$$\Delta\lambda'' = 0.28682 + 0.70405\,V - 2.88525\,UV - 4.82907\,UV^2 + 39.41621\,UV^3 + 2.93416\,V^4 - 92.33439\,UV^5 - 0.49038\,U^7 + 180.05225\,U^2V^9 - 125.64645\,U^8V^5$$

$$\Delta H_m = 9.322 + 6.031\,U + 0.414\,V - 37.127\,U^2 - 30.453\,UV - 10.042\,V^2 + 76.251\,U^2V + 4.806\,V^3 + 35.515\,U^4 + 89.644\,U^2V^2 + 3.270\,V^5$$

In the preceding equations:

$U = K\,(\phi + 25)$
$V = K\,(\lambda - 302)$
$K = 0.15707963$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 18 comparison points to the following root-mean-square (RMS) differences:

ϕ: ±1.3 m; λ: ±0.5 m; H (geodetic height): ±0.8 m

Test Case:

Input data for Chua Astro Datum test point:	ϕ =	-25°19'23.270"S	$\Delta\phi$ =	-2.322"
	λ =	305°24'47.315"E	$\Delta\lambda$ =	0.957"
			ΔH =	8.14 m

* Paraguay

Table 20.14

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Corrego Alegre Datum* to WGS 84 -

$$\Delta\phi'' = - 0.84315 + 0.74089\ U - 0.21968\ V - 0.98875\ U^2 + 0.89883\ UV + 0.42853\ U^3 + 2.73442\ U^4 - 0.34750\ U^3V + 4.69235\ U^2V^3 - 1.87277\ U^6 + 11.06672\ U^5V - 46.24841\ U^3V^3 - 0.92268\ U^7 - 14.26289\ U^7V + 334.33740\ U^5V^5 - 15.68277\ U^9V^2 - 2428.85860\ U^8V^8$$

$$\Delta\lambda'' = - 1.46053 + 0.63715\ U + 2.24996\ V - 5.66052\ UV + 2.22589\ V^2 - 0.34504\ U^3 - 8.54151\ U^2V + 0.87138\ U^4 + 43.40004\ U^3V + 4.35977\ UV^3 + 8.17101\ U^4V + 16.24298\ U^2V^3 + 19.96900\ UV^4 - 8.75655\ V^5 - 125.35753\ U^5V - 127.41019\ U^3V^4 - 0.61047\ U^8 + 138.76072\ U^7V + 122.04261\ U^5V^4 - 51.86666\ U^9V + 45.67574\ U^9V^3$$

$$\Delta H_m = - 8.765 - 9.454\ U - 7.325\ V + 21.798\ U^2V + 17.921\ UV^2 - 2.168\ U^4 - 34.514\ U^2V^2 + 5.573\ U^5 - 18.770\ U^4V + 90.838\ U^8V^2$$

In the preceding equations:

$U = K\ (\phi + 15)$
$V = K\ (\lambda - 310)$
$K = 0.05235988$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 46, 45, and 47 comparison points to the following root-mean-square (RMS) differences, respectively:

ϕ: ±1.1 m; λ: ±1.2 m; H (geodetic height): ±0.7 m

Test Case:

Input data for Corrego Alegre Datum test point:	ϕ =	-20°29'01.019"S	$\Delta\phi$ =	-1.030"
	λ =	305°12'46.829"E	$\Delta\lambda$ =	-2.101"
			ΔH =	-5.16 m

* Brazil

Table 20.15

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Djakarta Datum* to WGS 84 -

$$\Delta\phi'' = -1.66114 - 2.10884\,U + 0.20931\,V + 0.54056\,UV + 1.43422\,U^3 + 1.35169\,U^2V + 0.47553\,U^4V + 1.89489\,U^2V^4 + 0.41506\,U^9 - 3.02864\,U^4V^9$$

$$\Delta\lambda'' = 8.15798 + 0.52103\,U - 0.20776\,V + 0.49247\,U^2 + 0.31892\,U^3 - 1.26810\,U^2V - 0.74453\,V^3 + 0.94524\,U^5 - 2.42459\,U^6 - 1.51501\,U^7V + 4.34916\,U^6V^9$$

$$\Delta H_m = -5.198 - 12.267\,U + 2.855\,V - 12.562\,U^2 + 18.596\,U^2V + 6.077\,V^3 + 19.700\,U^4 + 9.834\,U^8V - 52.945\,U^6V^8$$

In the preceding equations:

$U = K\,(\phi - 0)$
$V = K\,(\lambda - 100)$
$K = 0.15707963$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 17, 18, and 18 comparison points to the following root-mean-square (RMS) differences, respectively:

ϕ: ±1.1 m; λ: ±1.0 m; H (geodetic height): ±0.6 m

Test Case:

Input data for Djakarta Datum test point:	ϕ =	5°25'51.475"N	$\Delta\phi$ =	-3.409"
	λ =	95°32'32.178"E	$\Delta\lambda$ =	9.980"
			ΔH =	-31.04 m

* Sumatra

Table 20.16

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- ED 50 (Cyprus) to WGS 84 -

$$\Delta\phi'' = -3.84288 + 0.09188\,U + 0.03581\,V - 0.07481\,UV$$

$$\Delta\lambda'' = -1.10294 - 0.04240\,U + 0.12748\,V - 0.32783\,UV^2 + 0.51023\,UV^3 - 0.01600\,V^7 - 0.1718\,U^3V^9$$

$$\Delta H_m = 24.430 - 5.719\,U + 0.0778\,V + 5.631\,U^2 - 23.892\,UV + 18.980\,U^2V - 0.988\,V^3 + 106.027\,U^3V - 42.824\,U^4V - 323.655\,U^9V^2 + 2.261\,U^4V^9$$

In the preceding equations:

$U = K\,(\phi - 35)$
$V = K\,(\lambda - 33)$
$K = 0.78539816$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 16 comparison points to the following root-mean-square (RMS) differences:

ϕ: ±0.5 m; λ: ±0.3 m; H (geodetic height): ±0.2 m

Test Case:

Input data for ED 50 (Cyprus) test point:	ϕ =	34°43'23.316"N	$\Delta\phi$ =	-3.885"
	λ =	32°28'06.026"E	$\Delta\lambda$ =	-1.126"
			ΔH =	23.64 m

Table 20.17

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- ED 50 (Egypt) to WGS 84 -

$$\Delta\phi'' = -4.26321 + 0.53413\,U - 0.25545\,V + 0.22185\,U^2 - 0.94305\,UV + 0.32199\,V^2 + 1.45564\,U^3V - 5.32845\,U^7 - 27.06979\,U^3V^4 - 17.61168\,U^4V^4 + 50.14314\,U^5V^4$$

$$\Delta\lambda'' = -1.43240 + 2.03143\,V + 0.83784\,U^2 - 0.18148\,UV + 2.45164\,V^2 - 2.19685\,U^2V - 17.28492\,V^3 - 18.37881\,U^2V^2 - 4.37317\,V^4 + 58.86054\,V^5 + 37.96406\,U^2V^4 + 16.79416\,U^4V^3 - 64.07183\,V^7 + 67.58848\,U^8V^2$$

$$\Delta H_m = 7.841 - 8.571\,U + 6.308\,V + 9.597\,U^2 - 48.792\,UV + 12.857\,V^2 - 35.858\,U^3 + 19.847\,U^2V - 19.243\,V^3 - 32.325\,V^4 + 132.326\,U^5 + 335.520\,U^5V + 1620.894\,UV^9 - 3902.371\,U^3V^9$$

In the preceding equations:

$U = K\,(\phi - 27)$
$V = K\,(\lambda - 30)$
$K = 0.10471975$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 30 comparison points to the following root-mean-square (RMS) differences:

ϕ: ±1.2 m; λ: ±1.4 m; H (geodetic height): ±1.1 m

Test Case:

Input data for ED 50 (Egypt) test point:	ϕ =	29°50'07.103"N	$\Delta\phi$ =	-4.116"
	λ =	30°36'05.306"E	$\Delta\lambda$ =	-1.247"
			ΔH =	5.20 m

Table 20.18

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- ED 50 (Iran) to WGS 84 -

$$\Delta\phi'' = -4.14386 + 0.35424\,U + 0.09268\,UV + 0.74969\,U^3 - 0.28888\,V^3 + 0.10130\,UV^3 - 0.84113\,U^5 - 0.11329\,U^4V + 0.08632\,V^5 - 0.18535\,U^3V^3 + 0.18609\,U^7 + 0.22312\,U^2V^5 - 0.05310\,UV^7 + 0.05686\,U^3V^8 + 0.02849\,U^3V^9$$

$$\Delta\lambda'' = 0.12417 + 0.43410\,U + 0.65033\,V + 3.66512\,U^2 + 0.26615\,UV + 0.34660\,V^2 - 0.79178\,U^3 - 1.13677\,U^2V - 0.70829\,UV^2 - 7.82858\,U^4 - 0.20007\,UV^3 - 0.12099\,V^4 + 3.67528\,U^4V + 2.06675\,U^3V^2 + 7.24212\,U^6 + 0.61665\,U^5V - 0.75923\,U^3V^3 - 0.75831\,U^2V^4 + 0.19255\,U^7 - 3.20687\,U^6V + 0.08964\,UV^6 - 2.27832\,U^8 - 0.00669\,U^4V^4 - 1.78975\,U^7V^2 - 0.26966\,U^9V^3$$

$$\Delta H_m = -5.287 - 19.726\,U + 3.664\,V + 13.034\,UV + 24.858\,U^3 - 5.856\,U^2V - 12.079\,U^4 - 18.577\,U^2V^2 - 3.275\,UV^3 - 15.804\,U^5 + 8.058\,U^3V^2 - 1.694\,V^5 + 10.972\,U^6 + 10.770\,U^2V^4 - 0.462\,V^8 - 3.976\,U^3V^6 - 0.358\,U^3V^9$$

In the preceding equations:

$U = K\,(\phi - 32)$
$V = K\,(\lambda - 55)$
$K = 0.15707963$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 47 comparison points to the following root-mean-square (RMS) differences:

ϕ: ±1.2 m; λ: ±1.4 m; H (geodetic height): ±1.6 m

Test Case:

Input data for ED 50 (Iran) test point:	ϕ =	29°28'59.127"N	$\Delta\phi$ =	-4.518"
	λ =	60°52'31.547"E	$\Delta\lambda$ =	1.145"
			ΔH =	-3.22 m

Table 20.19

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Geodetic Datum 1949* to WGS 84 -

$$\Delta\phi'' = 6.18012 + 0.18236\ U + 0.10785\ V - 0.15566\ UV + 1.36545\ U^3 - 0.44813\ UV^2 + 0.16518\ V^3 - 1.66408\ U^5 + 0.44854\ U^9$$

$$\Delta\lambda'' = 0.55131 + 0.18193\ U + 0.29501\ V - 0.36522\ UV - 0.12613\ U^3 - 1.13550\ U^2V^2 + 3.31705\ U^3V^3 + 3.40098\ U^9V^6$$

$$\Delta H_m = 8.630 + 13.910\ U + 7.007\ V + 3.463\ V^2 + 20.507\ U^3 - 16.813\ U^2V - 20.530\ U^6V - 11.602\ U^9 - 28.424\ U^9V^3$$

In the preceding equations:

$U = K\ (\phi + 41)$
$V = K\ (\lambda - 173)$
$K = 0.15707963$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 31 comparison points to the following root-mean-square (RMS) differences:

ϕ: ±0.9 m; λ: ±0.7 m; H (geodetic height): ±1.2 m

Test Case:

Input data for Geodetic Datum 1949 test point:	ϕ =	-41°17'32.050"S	$\Delta\phi$ =	6.176"
	λ =	173°15'15.405"E	$\Delta\lambda$ =	0.555"
			ΔH =	8.27 m

* New Zealand

Table 20.20

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Guam Datum 1963* to WGS 84 -

$$\Delta\phi'' = 5.17587 + 0.22868\ UV^4 - 0.47793\ U^4V^5 + 0.00015\ V^9 - 0.07930\ U^5V^7 + 0.38348\ U^8V^8 + 0.14079\ U^9V^9$$

$$\Delta\lambda'' = 8.74222 - 3.34020\ U + 8.74187\ U^2 - 6.34324\ U^3 + 0.85495\ U^5$$

$$\Delta H_m = 52.110 + 5.279\ V - 0.855\ V^3 + 0.114\ UV^7 - 0.023\ U^2V^9$$

In the preceding equations:

$U = K\ (\phi - 13)$
$V = K\ (\lambda - 144)$
$K = 1.57079631$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 11 comparison points to the following root-mean-square (RMS) differences:

ϕ: ±0.8 m; λ: ±0.4 m; H (geodetic height): ±1.2 m

Test Case:

Input data for Guam Datum 1963 test point:	ϕ = 13°36'56.376"N	$\Delta\phi$ = 5.171"
	λ = 144°51'25.420"E	$\Delta\lambda$ = 8.674"
		ΔH = 57.70 m

* Guam Island

Table 20.21

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Hjorsey Datum 1955* to WGS 84 -

$$\Delta\phi'' = -1.10314 + 0.50569\,U + 0.61317\,U^2 - 7.18436\,U^5 - 23.54798\,U^9V - 0.13673\,U^2V^8$$

$$\Delta\lambda'' = 1.41076 + 0.72408\,V + 1.34450\,U^2 - 0.28168\,V^3 - 12.78896\,U^6 - 10.20299\,U^6V^3$$

$$\Delta H_m = 61.924 - 5.697\,U + 63.712\,U^2 - 8.224\,UV - 1.524\,V^2 + 144.810\,U^3 - 420.492\,U^4 + 87.768\,U^4V^5$$

In the preceding equations:

$U = K\,(\phi - 64)$
$V = K\,(\lambda - 341)$
$K = 0.20943951$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 19 comparison points to the following root-mean-square (RMS) differences:

ϕ: ±1.2 m; λ: ±0.9 m; H (geodetic height): ±1.0 m

Test Case:

Input data for Hjorsey Datum 1955 test point:	ϕ = 64°31'29.258"N	$\Delta\phi$ = -1.040"
	λ = 337°37'54.160"E	$\Delta\lambda$ = 1.015"
		ΔH = 62.08 m

* Iceland

Table 20.22

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Indian Datum* to WGS 84 -

$$\Delta\phi'' = 6.30669 - 0.41180\,U + 0.45552\,V - 0.96595\,U^2 + 0.31697\,UV - 0.48167\,V^2 - 0.09791\,U^3 - 6.60932\,V^3 + 0.40350\,U^4 - 0.14233\,U^3V + 0.60845\,U^3V^2 + 19.25057\,V^5 + 0.05826\,U^7 - 0.82453\,U^5V^2 + 1.51908\,U^4V^3 - 19.45903\,V^7 - 0.45581\,U^5V^3 + 2.02975\,U^4V^4 + 6.24026\,V^9 + 0.26237\,U^6V^7$$

$$\Delta\lambda'' = -12.88589 - 0.80318\,U - 1.64008\,V - 0.16164\,U^2 - 1.58754\,UV + 2.00136\,V^2 + 0.57130\,U^3 + 0.62091\,U^3V - 10.96520\,V^4 - 0.13892\,U^5 + 0.09699\,U^4V + 0.25365\,V^5 + 0.24101\,U^5V + 0.57246\,U^4V^2 + 0.54428\,UV^5 + 11.95528\,V^6 + 0.51469\,U^3V^4 - 3.80343\,V^8 + 0.16968\,U^6V^3 + 0.07936\,U^9V^2 + 0.05200\,U^9V^5$$

$$\Delta H_m = -29.391 - 15.922\,V + 14.787\,U^2 - 13.320\,UV + 1.015\,U^3 + 2.266\,UV^2 - 8.544\,V^3 - 13.228\,U^4 - 6.601\,V^4 - 14.879\,U^2V^3 + 4.036\,U^6 + 1.916\,U^5V + 11.199\,U^4V^3 + 6.068\,V^7 + 3.470\,U^4V^4$$

In the preceding equations:

$U = K\,(\phi - 13)$
$V = K\,(\lambda - 103)$
$K = 0.20943951$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 38, 40, and 39 comparison points to the following root-mean-square (RMS) differences, respectively:

ϕ: ±1.6 m; λ: ±1.4 m; H (geodetic height): ±1.3 m

Test Case:

Input data for Indian Datum test point:	ϕ =	16°32'45.140"N	$\Delta\phi$ =	6.209"
	λ =	107°38'49.803"E	$\Delta\lambda$ =	-15.664"
			ΔH =	-59.53 m

* Thailand and Vietnam only. Contact DMA (see PREFACE) if data in this form is needed for Bangladesh, India, and Nepal

Table 20.23

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Ireland Datum 1965* to WGS 84 -

$$\Delta\phi'' = 1.01297 - 1.55326\ U - 0.83565\ U^2 + 3.45237\ UV + 10.42033\ U^3 - 4.52518\ UV^3 + 1260.47570\ U^8V^4$$

$$\Delta\lambda'' = -3.62716 + 1.11402\ V + 1.73255\ U^2 + 32.41814\ V^2 - 9.39322\ U^2V - 0.66537\ UV^2 + 102.63359\ V^3 + 132.39954\ V^4 + 210.32656\ U^4V + 61.75430\ V^5 + 1116.76600\ U^8 + 939.22583\ U^6V^2 + 767.75304\ U^6V^7$$

$$\Delta H_m = 51.881 + 1.772\ U - 2.238\ V + 2.177\ UV + 1.410\ V^5$$

In the preceding equations:

$U = K\ (\phi - 53)$
$V = K\ (\lambda - 354)$
$K = 0.20943951$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 22, 21, and 22 comparison points to the following root-mean-square (RMS) differences, respectively:

ϕ: ±1.4 m; λ: ±0.6 m; H (geodetic height): ±0.3 m

Test Case:

Input data for Ireland Datum 1965 test point:	ϕ = 54°22'26.715"N	$\Delta\phi$ = 0.415"
	λ = 351°37'44.633"E	$\Delta\lambda$ = -2.621"
		ΔH = 53.15 m

* Ireland

Table 20.24

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Kandawala Datum* to WGS 84 -

$$\Delta\phi'' = 1.21983 - 0.45486\ U - 0.07532\ V^2 + 0.05193\ V^6$$

$$\Delta\lambda'' = 7.57891 + 0.07158\ U - 0.84390\ V - 0.03457\ U^2 - 0.09152\ UV^2 + 0.01253\ U^9V$$

$$\Delta H_m = - 94.499 + 1.087\ U + 7.514\ V - 0.094\ U^2 + 0.956\ UV^2 - 0.272\ U^2V^2 - 42.147\ UV^8 - 0.177V^9 + 49.565\ UV^9$$

In the preceding equations:

$U = K\ (\phi - 7)$
$V = K\ (\lambda - 80)$
$K = 0.52359877$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 17 comparison points to the following root-mean-square (RMS) differences:

ϕ: ±0.8 m; λ: ±0.7 m; H (geodetic height): ±0.1 m

Test Case:

Input data for Kandawala Datum test point:	ϕ =	7°37'02.730"N	$\Delta\phi$ =	1.039"
	λ =	81°40'49.750"E	$\Delta\lambda$ =	6.833"
			ΔH =	-87.21 m

* Sri Lanka

Table 20.25

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Kertau Datum 1948* to WGS 84 -

$$\Delta\phi'' = -0.72690 - 0.41117\,U + 0.15112\,V + 0.12332\,V^2 - 0.05560\,U^3 - 0.00966\,U^9V - 0.60881\,U^4V^9 + 0.97603\,U^5V^9$$

$$\Delta\lambda'' = -5.42037 + 0.14298\,U - 1.17613\,V - 0.20661\,U^2 + 1.27718\,V^3 + 0.42230\,U^4V + 0.63147\,U^3V^2 - 0.20582\,U^5V - 0.69876\,U^2V^5 - 0.54175\,V^8 - 0.64231\,UV^9 + 0.82187\,U^4V^9$$

$$\Delta H_m = 1.527 - 3.043\,V - 4.561\,U^2 + 2.444\,U^3 + 1.298\,U^3V^2 + 12.411\,U^6V^8$$

In the preceding equations:

$U = K\,(\phi - 3)$
$V = K\,(\lambda - 102)$
$K = 0.41887902$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 18 comparison points to the following root-mean-square (RMS) differences:

ϕ: ±1.0 m; λ: ±1.0 m; H (geodetic height): ±0.9 m

Test Case:

Input data for Kertau Datum 1948 test point:	ϕ =	3°27'50.710"N	$\Delta\phi$ =	-0.759"
	λ =	102°37'24.550"E	$\Delta\lambda$ =	-5.684"
			ΔH =	0.58 m

* West Malaysia and Singapore

Table 20.26

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Liberia Datum 1964* to WGS 84 -

$$\Delta\phi'' = 0.51236 - 0.50199\ U + 0.19599\ U^2 - 0.78118\ U^4 - 1.40415\ U^5 + 1.14578\ U^7 + 0.48817\ U^8$$

$$\Delta\lambda'' = 0.83381 + 0.12109\ V - 1.15747\ U^2 + 4.17464\ U^4 - 2.87835\ U^6 - 0.00347\ V^6 + 0.75462\ U^7 - 0.66246\ U^9$$

$$\Delta H_m = 22.686 + 1.214\ U^3 + 0.730\ V^3 + 2.651\ U^4 - 2.772\ U^6 - 0.041\ V^8 - 0.497\ U^9$$

In the preceding equations:

$U = K\ (\phi - 7)$
$V = K\ (\lambda - 350)$
$K = 0.52359877$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 20 comparison points to the following root-mean-square (RMS) differences:

ϕ: ±0.5 m; λ: ±1.2 m; H (geodetic height): ±0.4 m

Test Case:

Input data for Liberia Datum 1964 test point:	ϕ =	7°31'11.956"N	$\Delta\phi$ =	0.384"
	λ =	351°28'54.245"E	$\Delta\lambda$ =	0.863"
			ΔH =	23.06 m

* Liberia

Table 20.27

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Luzon Datum* to WGS 84 -

$$\Delta\phi'' = -4.81355 - 0.59913\,U - 0.09937\,V - 0.51911\,U^2 + 0.28771\,V^2 + 0.44253\,U^2V + 0.22569\,U^4 + 0.47409\,UV^4 - 0.89246\,U^5V^2 - 0.70372\,U^6V^2 + 0.00860\,U^9$$

$$\Delta\lambda'' = 5.10770 - 0.29185\,U + 0.04185\,V + 0.48103\,V^2 + 0.23972\,U^3 - 0.12251\,U^3V - 2.57709\,U^2V^2 + 14.91383\,U^4V^4 + 17.78653\,U^3V^5 - 0.00540\,U^9 - 9.52315\,U^3V^7 - 4.72388\,U^6V^5$$

$$\Delta H_m = 51.075 + 6.883\,V - 0.885\,U^2 - 42.832\,UV - 0.681\,V^2 - 15.610\,U^3 + 45.350\,U^3V + 108.705\,UV^3 + 5.666\,U^5 - 4.855\,U^3V^2 - 65.708\,UV^4 - 12.935\,U^5V + 896.300\,U^2V^8 - 836.997\,U^2V^9$$

In the preceding equations:

$U = K\,(\phi - 12)$
$V = K\,(\lambda - 122)$
$K = 0.20943951$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 24, 26, and 26 comparison points to the following root-mean-square (RMS) differences, respectively:

ϕ: ±1.1 m; λ: ±1.3 m; H (geodetic height): ±1.3 m

Test Case:

Input data for Luzon Datum test point:	ϕ =	6°06'29.040"N	$\Delta\phi$ =	-3.973"
	λ =	125°10'44.230"E	$\Delta\lambda$ =	4.986"
			ΔH =	70.55 m

* The Philippines (Except Mindanao Island)

Table 20.28

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Merchich Datum* to WGS 84 -

$$\Delta\phi'' = -9.15842 - 0.69580\,U - 0.45597\,V + 0.26095\,UV + 0.09490\,V^3 - 0.21306\,U^2V^2 + 0.26479\,U^8 + 1.37933\,U^8V - 0.58879\,U^7V^2$$

$$\Delta\lambda'' = 5.70056 + 0.19659\,U + 0.05914\,U^2 - 0.09782\,UV - 0.66866\,UV^3 - 0.42469\,U^4V + 0.38831\,UV^5 + 0.10930\,U^9 + 0.84666\,U^5V^7 + 0.67921\,U^6V^7 + 0.14063\,U^4V^9$$

$$\Delta H_m = 47.063 - 7.758\,U + 5.293\,U^2 + 19.518\,UV + 4.735\,U^3 - 10.062\,U^4 - 29.573\,UV^3 - 7.921\,U^3V^2 + 8.701\,UV^5$$

In the preceding equations:

$U = K\,(\phi - 32)$
$V = K\,(\lambda - 353)$
$K = 0.20943951$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 32 comparison points to the following root-mean-square (RMS) differences:

ϕ: ±1.3 m; λ: ±0.5 m; H (geodetic height): ±1.4 m

Test Case:

Input data for Merchich Datum test point:	ϕ =	35°08'39.942"N	$\Delta\phi$ =	-9.863"
	λ =	357°34'13.307"E	$\Delta\lambda$ =	5.675"
			ΔH =	41.46 m

* Morocco

Table 20.29

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Minna Datum* to WGS 84 -

$$\Delta\phi'' = 0.49461 - 0.69094\ U + 0.39940\ V - 7.44709\ U^3 - 1.82129\ U^2V - 2.92752\ UV^2 + 5.70789\ U^3V - 2.10838\ U^2V^2 - 6.88780\ UV^3 + 14.35602\ U^5 + 5.10389\ UV^4 + 6.18524\ U^6 + 8.62320\ UV^5 + 48.52705\ U^7V^2 - 0.49769\ V^9 - 11.39331\ U^4V^8$$

$$\Delta\lambda'' = -2.624356 - 0.21876\ U + 0.43678\ V + 0.35068\ UV - 1.53864\ U^2V - 0.46268\ UV^3 + 2.20240\ U^4V - 0.11456\ V^5 + 1.59485\ U^3V^4$$

$$\Delta H_m = 20.013 + 2.098\ U - 11.691\ V + 47.983\ U^2V - 60.195\ U^4V - 21.214\ U^2V^3 + 8.642\ V^5 - 12.588\ U^5V - 27.760\ U^2V^8$$

In the preceding equations:

$U = K\ (\phi - 10)$
$V = K\ (\lambda - 8)$
$K = 0.15707963$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 23 comparison points to the following root-mean-square (RMS) differences:

ϕ: ±1.2 m; λ: ±1.0 m; H (geodetic height): ±0.7 m

Test Case:

Input data for Minna Datum test point:	ϕ =	9°19'09.051"N	$\Delta\phi$ =	0.930"
	λ =	12°13'50.125"E	$\Delta\lambda$ =	-2.348"
			ΔH =	13.43m

* Nigeria

Table 20.30

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Nahrwan Datum* to WGS 84 -

$$\Delta\phi'' = 6.38908 - 0.53788\,U + 0.04816\,U^2 - 0.14476\,U^2V - 0.16987\,V^3 + 0.53171\,U^3V^4 - 0.01410\,U^9 + 0.04281\,V^9 + 0.44507\,U^8V^9$$

$$\Delta\lambda'' = 4.40107 + 0.12321\,U + 0.36418\,V + 0.06577\,UV^3 - 0.10987\,U^3V^2 + 0.27991\,U^2V^5 + 0.04889\,UV^8 - 0.04749\,U^9V^2 + 0.25424\,U^9V^8$$

$$\Delta H_m = -36.488 + 6.910\,U + 4.728\,V + 0.264\,V^2 + 10.160\,U^3 + 0.739\,U^2V - 13.461\,U^5 - 0.170\,U^6 + 3.090\,U^9 - 0.774\,U^8V^9 - 0.473\,U^9V^9$$

In the preceding equations:

$U = K\,(\phi - 23)$
$V = K\,(\lambda - 57)$
$K = 0.41887902$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 20 comparison points to the following root-mean-square (RMS) differences:

ϕ: ±0.7 m; λ: ±0.3 m; H (geodetic height): ±0.1 m

Test Case:

Input data for Nahrwan Datum test point:	ϕ =	24°58'07.671"N	$\Delta\phi$ =	6.276"
	λ =	55°00'07.720"E	$\Delta\lambda$ =	4.059"
			ΔH =	-33.88 m

* Masirah Island (Oman) and United Arab Emirates only.

Table 20.31

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- NAD 27 (Alaska) to WGS 84 -

$$\Delta\phi'' = -2.08611 + 0.59833\,U + 0.52967\,V + 0.23473\,U^2 + 0.23563\,UV + 0.28672\,UV^2 + 0.27573\,V^3 + 0.19561\,U^4 - 0.15184\,U^3V - 0.21241\,U^2V^2 + 0.04891\,V^4 - 0.18860\,UV^4 - 17.032\,V^5 - 0.05741\,UV^5 - 0.04292\,U^2V^5 + 0.02097\,V^7 - 0.01487\,U^2V^6 - 0.00384\,V^8 - 0.18402\,U^9 - 0.00188\,U^3V^7$$

$$\Delta\lambda'' = -8.19369 - 1.56665\,U + 0.73861\,V - 3.10809\,U^2 - 0.35323\,UV - 0.06926\,V^2 - 0.68114\,UV^2 - 0.32398\,V^3 + 0.74679\,U^4 + 0.43200\,U^3V + 4.24388\,U^2V^2 + 0.14065\,UV^3 - 0.30990\,U^2V^3 + 0.11365\,V^5 - 1.48566\,U^4V^2 - 1.96501\,U^2V^4 + 2.04229\,U^6V - 0.48255\,U^5V^2 + 0.09847\,UV^6 + 0.49313\,U^2V^6 - 1.00218\,U^8V - 0.02809\,U^2V^8 + 0.00054\,U^5V^9$$

$$\Delta H_m = 8.352 - 13.742\,U - 8.268\,V + 0.900\,V^2 + 5.340\,U^3 + 2.960\,UV^2 - 2.016\,V^3 + 5.087\,U^3V + 1.437\,UV^3 + 0.951\,V^5 - 2.461\,U^3V^4 - 1.560\,U^8 - 1.980\,U^7V - 0.205\,U^5V^3 + 0.094\,UV^8 - 2.885\,U^8V^2 - 0.011\,UV^9$$

In the preceding equations:

$U = K\,(\phi - 62)$
$V = K\,(\lambda - 208)$
$K = 0.10471975$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 85, 86, and 86 comparison points to the following root-mean-square (RMS) differences, respectively:

ϕ: ±1.7 m; λ: ±1.7 m; H (geodetic height): ±1.2 m

Test Case:

Input data for NAD 27 (Alaska) test point:	ϕ =	64°31'09.064"N	$\Delta\phi$ =	-2.648"
	λ =	194°37'28.092"E	$\Delta\lambda$ =	-9.525"
			ΔH =	19.20 m

Table 20.32

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- NAD 27 (Canada) to WGS 84 -

$$\Delta\phi'' = 0.79395 + 2.29199\,U + 0.27589\,V - 1.76644\,U^2 + 0.47743\,UV + 0.08421\,V^2 - 6.03894\,U^3 - 3.55747\,U^2V - 1.81118\,UV^2 - 0.20307\,V^3 + 7.75815\,U^4 - 3.10170\,U^3V + 3.58363\,U^2V^2 - 1.31086\,UV^3 - 0.45916\,V^4 + 14.27239\,U^5 + 3.28815\,U^4V + 1.35742\,U^2V^3 + 1.75323\,UV^4 + 0.44999\,V^5 - 19.02041\,U^4V^2 - 1.01631\,U^2V^4 + 1.47331\,UV^5 + 0.15181\,V^6 + 0.41614\,U^2V^5 - 0.80920\,UV^6 - 0.18177\,V^7 + 5.19854\,U^4V^4 - 0.48837\,UV^7 - 0.01473\,V^8 - 2.26448\,U^9 - 0.46457\,U^2V^7 + 0.11259\,UV^8 + 0.02067\,V^9 + 47.64961\,U^8V^2 + 0.04828\,UV^9 + 36.38963\,U^9V^2 + 0.06991\,U^4V^7 + 0.08456\,U^3V^8 + 0.09113\,U^2V^9 + 5.93797\,U^7V^5 - 2.36261\,U^7V^6 + 0.095775\,U^5V^8$$

$$\Delta\lambda'' = 1.36099 + 3.61796\,V - 3.97703\,U^2 + 3.09705\,UV - 1.15866\,V^2 - 13.28954\,U^3 - 3.15795\,U^2V + 0.68405\,UV^2 - 0.50303\,V^3 - 8.81200\,U^3V - 2.17587\,U^2V^2 - 1.49513\,UV^3 + 0.84700\,V^4 + 31.42448\,U^5 - 14.67474\,U^3V^2 + 0.65640\,UV^4 + 17.55842\,U^6 + 6.87058\,U^4V^2 - 0.21565\,V^6 + 62.18139\,U^5V^2 + 1.78687\,U^3V^4 + 2.74517\,U^2V^5 - 0.30085\,UV^6 + 0.04600\,V^7 + 63.52702\,U^6V^2 + 7.83682\,U^5V^3 + 9.59444\,U^3V^5 + 0.01480\,V^8 + 10.51228\,U^4V^5 - 1.42398\,U^2V^7 - 0.00834\,V^9 + 5.23485\,U^7V^3 - 3.18129\,U^3V^7 + 8.45704\,U^9V^2 - 2.29333\,U^4V^7 + 0.14465\,U^2V^9 + 0.29701\,U^3V^9 + 0.17655\,U^4V^9$$

$$\Delta H_m = - 26.806 + 9.266\,U - 5.857\,V + 14.794\,U^2 + 3.497\,UV + 9.600\,V^2 - 7.664\,UV^2 - 40.040\,U^2V^2 - 3.439\,V^4 + 14.592\,U^2V^3 - 23.902\,U^5V + 15.246\,U^4V^2 + 18.445\,U^2V^4 + 0.770\,V^6 - 130.424\,U^6V - 11.874\,U^2V^5 - 100.769\,U^7V - 3.165\,U^2V^6 - 0.182\,UV^7 - 0.066\,V^8 + 2.404\,U^2V^7 + 0.073\,UV^8 - 0.074\,U^2V^9$$

Table 20.32 (Cont'd)

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- NAD 27 (Canada) to WGS 84 -

In the preceding equations:

$U = K\ (\phi - 60)$
$V = K\ (\lambda - 260)$
$K = 0.05235988$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 145, 144, and 153 comparison points to the following root-mean-square (RMS) differences, respectively:

ϕ: ±1.5 m; λ: ±1.8 m; H (geodetic height): ±1.6 m

Test Case:

Input data for NAD 27 (Canada) test point:	ϕ =	54°26'08.667"N	$\Delta\phi$ =	0.289"
	λ =	249°42'57.590"E	$\Delta\lambda$ =	-3.156"
			ΔH =	-22.36 m

Table 20.33

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- NAD 27 (Caribbean*) to WGS 84 -

$$\Delta\phi'' = 2.18504 - 2.43432\ U - 0.43566\ V - 5.51944\ U^2 - 0.27046\ UV + 12.61954\ U^3 - 2.88156\ U^2V + 1.67846\ UV^2 + 0.95009\ V^3 + 31.98970\ U^4 - 13.72449\ U^3V - 6.90489\ U^2V^2 - 0.41847\ V^4 - 47.35821\ U^5 + 6.14556\ U^2V^3 - 43.90069\ U^6 + 74.23430\ U^5V + 7.40175\ U^2V^4 + 0.00881\ V^6 + 42.60766\ U^7 - 4.43185\ U^2V^5 + 18.21904\ U^8 - 77.96877\ U^7V - 0.05853\ UV^7 + 9.22708\ U^8V^2 + 0.09311\ U^3V^7 + 20.04825\ U^9V^2 + 0.06618\ U^4V^9$$

$$\Delta\lambda'' = 0.94649 + 0.14781\ U + 0.62356\ V + 0.07604\ U^2 - 0.64115\ UV - 0.67051\ U^2V + 0.86816\ V^3 + 0.46311\ U^3V + 0.59579\ U^4V - 2.03251\ V^5 + 1.69755\ V^6 - 0.41475\ V^8 + 0.10863\ V^9$$

$$\Delta H_m = -39.801 + 6.864\ U + 2.477\ V + 43.076\ U^2 + 2.867\ V^2 - 171.105\ U^4 + 230.032\ U^6 - 0.058\ V^7 - 95.522\ U^8$$

In the preceding equations:

$U = K\ (\phi - 20)$
$V = K\ (\lambda - 283)$
$K = 0.10471975$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 57 comparison points to the following root-mean-square (RMS) differences:

ϕ: ±1.8 m; λ: ±2.7 m; H (geodetic height): ±2.6 m

Test Case:

Input data for NAD 27 (Caribbean) test point	ϕ =	21°25'58.442"N	$\Delta\phi$ =	1.637"
	λ =	288°51'14.645"E	$\Delta\lambda$ =	1.393"
			ΔH =	-35.29 m

* Bahama Islands (includes San Salvador Island), Barbados Island, Cuba, Dominican Republic, Grand Cayman Island, Jamaica, Leeward Islands, and Turks and Caicos Islands

[Revised: 30 September 1988]

Table 20.34

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- NAD 27 (Mexico, Central America) to WGS 84 -

$$\Delta\phi'' = 0.67775 + 10.02259\,U - 18.72391\,V + 12.66341\,U^2 - 32.47686\,V^2 - 52.70768\,U^3 - 13.86527\,UV^2 - 16.82734\,V^3 - 59.54646\,U^3V + 120.64887\,U^5 + 7.23362\,U^2V^3 + 95.89131\,U^5V - 2.89651\,UV^5 - 1.23778\,V^6 + 70.19213\,U^8 + 0.84596\,U^2V^6 + 0.14848\,V^8 - 3.83786\,U^3V^6 + 0.10405\,UV^9 + 30.09795\,U^8V^3 + 12.93585\,U^6V^6 - 0.58747\,U^3V^9 + 0.74850\,U^4V^9 + 6.32462\,U^8V^7 - 0.12736\,U^6V^9 - 0.59993\,U^9V^9$$

$$\Delta\lambda'' = -0.33643 - 3.11777\,V - 5.16881\,U^2 - 3.17318\,V^2 - 34.59331\,U^3 + 0.97215\,UV^2 - 0.58180\,V^3 + 223.78114\,U^5 + 358.07266\,U^6 + 270.68064\,U^7 - 87.99549\,U^6V - 0.09789\,UV^6 + 636.41982\,U^7V - 729.91514\,U^6V^2 - 0.60122\,U^3V^5 - 375.38863\,U^6V^3 - 6.97538\,U^4V^5 - 0.00138\,V^9 - 363.45977\,U^9V + 50.19955\,U^8V^2 - 12.01575\,U^5V^6 - 0.43140\,U^6V^9 + 0.43907\,U^9V^9$$

$$\Delta H_m = -20.013 + 12.815\,U - 8.084\,V + 74.122\,U^2V + 39.523\,U^2V^2 - 23.158\,U^4V + 194.444\,U^6 + 36.797\,U^5V + 0.181\,UV^5 - 292.155\,U^8 + 3.749\,U^5V^5 + 2.537\,U^8V^6$$

In the preceding equations:

$U = K\,(\phi - 20)$
$V = K\,(\lambda - 290)$
$K = 0.05235988$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 77, 78, and 82 comparison points to the following root-mean-square (RMS) differences, respectively:

ϕ: ±1.8 m; λ: ±1.9 m; H (geodetic height): ±1.5 m

Test Case:

Input data for NAD 27 (Mexico, Central America) test point:	ϕ =	8°56'12.719"N	$\Delta\phi$ = 4.681"
	λ =	280°25'46.382"E	$\Delta\lambda$ = 0.722"
			ΔH = -26.36 m

Table 20.35

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Old Egyptian Datum* to WGS 84 -

$$\Delta\phi'' = 0.47505 + 0.40361\ U - 0.33767\ V - 0.47316\ UV + 0.14675\ V^2 + 0.53103\ U^3 - 0.91154\ U^5 - 1.80678\ U^3V^4 - 0.93280\ U^2V^8 + 3.45171\ U^9V^6 + 2.48260\ U^7V^9$$

$$\Delta\lambda'' = 5.81106 + 0.30856\ U + 0.30619\ V - 0.09563\ UV + 0.33431\ V^2 - 0.37812\ V^3 - 0.11075\ U^2V^2 - 0.19767\ U^5 - 0.87801\ U^3V^2 - 0.40334\ V^6 + 1.50782\ U^7V^4$$

$$\Delta H_m = 6.689 + 14.900\ V + 5.562\ U^2 - 7.102\ UV - 7.972\ UV^2 + 3.923\ U^5 - 15.171\ U^8V - 12.559\ V^9 - 24.444\ U^6V^8$$

In the preceding equations:

$U = K\ (\phi - 27)$
$V = K\ (\lambda - 30)$
$K = 0.15707963$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 30, 29, and 29 comparison points to the following root-mean-square (RMS) differences, respectively:

ϕ: ±1.3 m; λ: ±1.2 m; H (geodetic height): ±1.1 m

Test Case:

Input data for Old Egyptian Datum test point:	ϕ = 29°50°02.352"N	$\Delta\phi$ = 0.635"
	λ = 30°35°58.098"E	$\Delta\lambda$ = 5.972"
		ΔH = 8.93 m

* Egypt

Table 20.36

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Old Hawaiian Datum* to WGS 84 -

$$\Delta\phi'' = -11.37720 - 0.14634\ V - 0.12247\ V^2 - 0.73184\ UV^2 + 1.11437\ U^2V^2 - 1.01133\ UV^3 + 4.16524\ U^3V^5 - 3.15868\ U^5V^7 - 0.93803\ U^8V^9$$

$$\Delta\lambda'' = 9.86069 - 0.06272\ V - 0.19525\ UV + 0.68017\ V^2 + 0.00368\ U^3 - 0.26472\ U^2V - 0.90367\ V^4 + 0.43038\ V^5 - 0.05705\ U^9V^6$$

$$\Delta H_m = 19.743 - 6.792\ U + 14.315\ V - 2.336\ V^2 - 10.929\ UV^3 + 8.248\ UV^4 + 2.176\ U^9V^6$$

In the preceding equations:

$U = K\ (\phi - 21)$
$V = K\ (\lambda - 202)$
$K = 0.41887902$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 27 comparison points to the following root-mean-square (RMS) differences:

ϕ: ±1.2 m; λ: ±0.8 m; H (geodetic height): ±1.4 m

Test Case:

Input data for Old Hawaiian Datum test point:	ϕ = 21°34'22.580"N	$\Delta\phi$ = -11.364"
	λ = 201°44'13.631"E	$\Delta\lambda$ = 9.883"
		ΔH = 16.51 m

* Hawaii, Kauai, Maui, and Oahu Islands

Table 20.37

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Oman Datum* to WGS 84 -

$$\Delta\phi'' = 1.40340 - 0.52482\ U - 0.39298\ V + 0.06350\ U^2 + 0.43668\ V^3 - 0.24373\ V^4 + 0.02444\ U^5 + 0.25173\ U^4V^2 + 0.02988\ U^8V - 0.12828\ U^3V^6 + 0.17909\ U^4V^7$$

$$\Delta\lambda'' = 9.99946 + 0.23141\ U + 0.27637\ V - 0.15426\ U^2 + 0.05592\ UV - 0.06719\ U^2V + 0.17487\ UV^2 - 0.10007\ V^3 + 0.03666\ U^4 - 0.10515\ U^4V^9$$

$$\Delta H_m = - 29.424 + 4.112\ U + 11.687\ V - 9.535\ U^2 + 7.644\ UV^2 - 11.213\ V^3 + 2.756\ U^4 + 3.699\ V^4 - 13.803\ U^3V^2 + 37.182\ U^3V^4 - 22.258\ U^4V^7$$

In the preceding equations:

$U = K\ (\phi - 21)$
$V = K\ (\lambda - 56)$
$K = 0.31415926$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 21 comparison points to the following root-mean-square (RMS) differences:

ϕ: ±0.7 m; λ: ±0.9 m; H (geodetic height): ±0.5 m

Test Case:

Input data for Oman Datum test point:	ϕ =	24°17'39.334"N	$\Delta\phi$ =	0.908"
	λ =	56°31'43.374"E	$\Delta\lambda$ =	10.164"
			ΔH =	-30.50 m

* Oman

Table 20.38

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Ordnance Survey of Great Britain 1936 Datum* to WGS 84 -

$$\Delta\phi'' = 0.86569 - 2.84325\,U + 0.42841\,V - 0.38129\,U^2 + 0.10976\,V^2 + 0.94422\,U^3 + 0.48727\,U^2V + 2.60383\,U^3V + 0.45210\,U^2V^2 - 4.67120\,U^5V + 5.92805\,U^8V - 1.57065\,U^4V^5 + 9.93871\,U^9V^2 + 4.46776\,U^7V^9$$

$$\Delta\lambda'' = -6.33331 - 1.37857\,U - 3.08334\,V - 2.36779\,UV - 0.31544\,V^2 + 0.16916\,U^2V - 3.30597\,UV^2 - 0.89564\,U^2V^2 - 2.20892\,UV^3 + 10.50912\,U^8V^2 - 14.75340\,U^9V^2$$

$$\Delta H_m = 48.125 + 6.154\,U - 3.952\,V - 13.733\,U^2 + 7.185\,UV + 18.661\,U^4 - 12.149\,U^5 - 25.508\,U^3V^3 - 60.708\,U^7V^6$$

In the preceding equations:

$U = K\,(\phi - 54)$
$V = K\,(\lambda - 0)$
$K = 0.15707963$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 180° and negative west from 0° to -180°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 48, 50, and 50 comparison points to the following root-mean-square (RMS) differences, respectively:

ϕ: ±0.8 m; λ: ±1.2 m; H (geodetic height): ±0.9 m

Test Case:

Input data for Ordnance Survey of Great Britain 1936 test point:	ϕ =	52°08'34.745"N	$\Delta\phi$ =	1.525"
	λ =	358°02'00.119"E	$\Delta\lambda$ =	-5.161"
			ΔH =	47.17 m

* United Kingdom (UK)

[Revised: 30 September 1988]

Table 20.39

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Provisional South American Datum 1956* to WGS 84 -

$$\Delta\phi'' = - 12.04886 + 0.53593\ U - 0.77151\ U^2 + 0.22777\ UV + 0.80832\ V^2 + 0.22515\ V^3 + 0.60656\ U^4 - 1.45756\ V^4 - 0.04241\ U^4V - 0.19135\ U^6 + 0.05461\ U^4V^2 + 0.14627\ U^3V^3 + 0.73219\ V^6 - 0.01691\ U^7 - 1.42463\ U^2V^5 + 0.02264\ U^8 + 0.00447\ U^9 + 1.84039\ U^4V^5 - 0.00913\ U^8V^2 + 0.05740\ U^8V^3 - 1.03610\ U^6V^5 - 0.10195\ U^2V^9 + 0.10483\ U^4V^9 - 0.04520\ U^7V^7 + 0.19591\ U^8V^7 + 0.01040\ U^9V^8 - 0.06467\ U^8V^9$$

$$\Delta\lambda'' = - 7.21832 + 0.45226\ U + 0.86445\ V + 0.71206\ U^2 + 0.25898\ V^2 - 0.74778\ U^3 + 0.78582\ U^2V - 0.19004\ UV^2 - 0.34575\ U^4 - 0.49115\ UV^3 + 0.28299\ U^5 - 0.38667\ U^4V + 0.05364\ U^6 - 0.07100\ V^6 - 0.03680\ U^7 + 0.04457\ U^6V + 0.50006\ UV^7 + 0.02585\ U^7V^2 + 0.04348\ U^6V^3 - 0.44328\ U^2V^7 - 0.09531\ UV^8 + 0.17935\ U^4V^8 - 0.17785\ U^5V^9 + 0.08942\ U^6V^9 + 0.13445\ U^7V^9 - 0.05018\ U^8V^9 - 0.03301\ U^9V^9$$

$$\Delta H_m = 39.322 - 192.920\ U - 26.628\ V - 151.702\ UV + 245.467\ U^3 + 158.056\ UV^2 - 3.514\ U^4 + 330.660\ U^3V + 56.517\ UV^3 - 46.597\ V^4 - 149.686\ U^5 - 72.168\ U^3V^2 - 195.728\ UV^4 - 315.032\ U^5V - 122.158\ U^4V^2 + 105.550\ U^2V^4 - 31.836\ UV^5 + 29.180\ V^6 + 32.957\ U^7 - 28.622\ U^4V^3 + 73.984\ UV^6 + 0.118\ U^8 + 128.458\ U^7V + 78.361\ U^6V^2 + 45.311\ U^4V^4 + 5.057\ UV^7 - 1.737\ U^9 + 1.030\ U^8V - 19.173\ U^9V - 15.269\ U^8V^2 + 4.161\ U^7V^3 - 23.813\ U^2V^8 + 1.458\ U^9V^2 - 2.959\ U^4V^9 - 2.432\ U^8V^6 - 3.089\ U^9V^8 + 2.797\ U^9V^9$$

*Bolivia, Chile, Colombia, Ecuador, Guyana, Peru, Venezuela

Table 20.39 (Cont'd)

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Provisional South American Datum 1956* to WGS 84 -

In the preceding equations:

$U = K\ (\phi + 5)$
$V = K\ (\lambda - 290)$
$K = 0.10471975$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 74, 78, and 78 comparison points to the following root-mean-square (RMS) differences, respectively:

ϕ: ±1.5 m; λ: ±1.8 m; H (geodetic height): ±2.9 m

Test Case:

Input data for Provisional South American Datum 1956 test point:	ϕ =	-16°31'33.903"S	$\Delta\phi$ =	-13.021"
	λ =	291°50'01.014"E	$\Delta\lambda$ =	-6.293"
			ΔH =	99.51 m

* Bolivia, Chile, Colombia, Ecuador, Guyana, Peru, Venezuela

Table 20.40

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Puerto Rico Datum* to WGS 84 -

$$\Delta\phi'' = -7.07242 - 0.35983\ U + 0.09560\ V + 1.16795\ U^3$$

$$\Delta\lambda'' = 1.40909 - 0.07164\ V - 0.07947\ UV - 0.10747\ V^2$$

$$\Delta H_m = -42.510 - 2.649\ V^2$$

In the preceding equations:

$U = K\ (\phi - 18)$
$V = K\ (\lambda - 295)$
$K = 0.52359877$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 19 comparison points to the following root-mean-square (RMS) differences:

ϕ: ±1.0 m; λ: ±0.9 m; H (geodetic height): ±1.0 m

Test Case:

Input data for Puerto Rico Datum test point:	ϕ =	18°22'01.523"N	$\Delta\phi$ = -7.247"
	λ =	292°44'02.548"E	$\Delta\lambda$ = 1.361"
			ΔH = -46.24 m

* Puerto Rico and the Virgin Islands

Table 20.41

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Qatar National Datum* to WGS 84 -

$$\Delta\phi'' = 2.487363 + 0.08786\ U + 0.14283\ U^2 + 0.04380\ UV + 0.07142\ V^2 - 0.08879\ UV^2 - 0.11089\ U^5 - 0.06321\ U^3V^4 + 0.01669\ U^9$$

$$\Delta\lambda'' = -2.80439 + 0.10489\ V + 0.02697\ V^2 - 1.10721\ U^2V^2 + 2.88786\ U^2V^3 - 0.06281\ U^5V - 2.59921\ U^3V^6$$

$$\Delta H_m = -28.376 + 2.381\ U - 1.126\ U^2 + 3.095\ V^2 - 4.112\ U^3V^3 - 13.156\ V^7 - 2.048\ U^8 + 1.618\ U^9 + 18.689\ UV^8$$

In the preceding equations:

$U = K\ (\phi - 25)$
$V = K\ (\lambda - 51)$
$K = 1.04719754$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 15 comparison points to the following root-mean-square (RMS) differences:

ϕ: ±0.3 m; λ: ±0.2 m; H (geodetic height): ±0.2 m

Test Case:

Input data for Qatar National Datum test point:	ϕ =	24°34'55.061"N	$\Delta\phi$ =	2.465"
	λ =	50°59'06.940"E	$\Delta\lambda$ =	-2.806"
			ΔH =	-29.64 m

* Qatar

[Revised: 30 September 1988]

Table 20.42

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Southwest Base Datum* to WGS 84 -

$$\Delta\phi'' = -0.40996 + 0.09162\ U^3$$

$$\Delta\lambda'' = 4.06520 + 0.10550\ V + 0.99687\ UV - 44.30616\ U^4V^2 - 15.85175\ U^3V^3 + 3905.50820\ U^7V^4$$

$$\Delta H_m = 58.268 + 1.325\ V$$

In the preceding equations:

$U = K\ (\phi - 38)$
$V = K\ (\lambda - 332)$
$K = 0.52359877$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 11 comparison points to the following root-mean-square (RMS) differences:

ϕ: ±0.5 m; λ: ±0.6 m; H (geodetic height): ±0.3 m

Test Case:

Input data for Southwest Base Datum test point:	ϕ =	38°46'51.568"N	$\Delta\phi$ =	-0.404"
	λ =	332°53'52.593"E	$\Delta\lambda$ =	4.285"
			ΔH =	58.89 m

* Azores (Faial, Graciosa, Pico, São Jorge, and Terceira Islands)

Table 20.43

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Timbalai Datum 1948* to WGS 84 -

$$\Delta\phi'' = -2.82946 - 0.82553\,U - 0.48000\,V + 0.85905\,UV + 0.29818\,V^3 - 0.89297\,U^2V^2 - 1.23097\,V^4 + 4.44707\,V^6 - 59.09713\,U^7V - 3.02239\,V^8 + 7.38294\,U^9 + 123.99897\,U^9V$$

$$\Delta\lambda'' = 11.11187 - 0.82451\,U - 0.67430\,V - 5.29900\,U^2V + 4.63827\,UV^2 - 2.73892\,V^3 + 7.29643\,U^4V - 2.74536\,UV^4 + 4.19205\,U^4V^4 + 1.54402\,V^9 + 1.74379\,U^2V^9 + 64.65940\,U^9V^4$$

$$\Delta H_m = 48.403 + 4.382\,U + 8.894\,V - 5.748\,UV + 1.434\,V^2 + 13.311\,U^3 + 23.561\,V^3 - 13.367\,U^2V^2 - 289.515\,U^8V - 57.320\,U^4V^5 - 14.505\,V^9$$

In the preceding equations:

$U = K\,(\phi - 4)$
$V = K\,(\lambda - 114)$
$K = 0.20943951$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 25 comparison points to the following root-mean-square (RMS) differences:

ϕ: ±1.0 m; λ: ±1.2 m; H (geodetic height): ±0.7 m

Test Case:

Input data for Timbalai Datum 1948 test point:	ϕ =	5°00'39.333"N	$\Delta\phi$ =	-3.071"
	λ =	115°02'46.480"E	$\Delta\lambda$ =	10.758"
			ΔH =	51.43 m

* Brunei and East Malaysia (Sarawak and Sabah)

[Revised: 30 September 1988]

Table 20.44

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Wake-Eniwetok Datum 1960* to WGS 84 -

$$\Delta\phi'' = -1.71428 - 0.01849\,U - 0.32131\,U^6 + 0.30272\,U^8$$

$$\Delta\lambda'' = -2.40312 + 0.06671\,U + 0.03496\,V + 0.17594\,U^2 - 0.02463\,UV - 0.05576\,V^2 + 0.01897\,V^3 - 0.00955\,U^2V^2 - 0.10109\,U^8$$

$$\Delta H_m = 39.951 + 0.350\,U - 5.739\,U^2 - 0.100\,V^4 + 3.308\,U^6 + 0.002\,U^2V^9$$

In the preceding equations:

$U = K\,(\phi - 9)$
$V = K\,(\lambda - 167)$
$K = 2.09439507$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 14 comparison points to the following root-mean-square (RMS) differences:

ϕ: ±0.5 m; λ: ±0.4 m; H (geodetic height): ±0.5 m

Test Case:

Input data for Wake-Eniwetok Datum 1960 test point:	ϕ =	8°43'12.587"N	$\Delta\phi$ =	-1.712"
	λ =	167°44'13.400"E	$\Delta\lambda$ =	-2.378"
			ΔH =	37.37 m

* Kwajalein Atoll Area Only

Table 20.45

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Zanderij Datum* to WGS 84 -

$$\Delta\phi'' = -11.40903 + 0.18148\ V + 0.11629\ UV + 0.06522\ V^2 + 0.00987\ U^3V^6$$

$$\Delta\lambda'' = -4.80576 - 0.24217\ U + 0.20528\ V + 0.13820\ UV + 0.24352\ U^3 + 0.09556\ U^4 - 0.00241\ V^9 - 0.00355\ UV^9$$

$$\Delta H_m = -31.821 - 5.132\ U - 2.917\ V + 9.090\ U^2 - 1.381\ V^2 - 7.953\ U^3 + 2.007\ UV^2 - 32.124\ U^8 - 19.573\ U^9$$

In the preceding equations:

$U = K\ (\phi - 5)$
$V = K\ (\lambda - 305)$
$K = 0.52359877$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 21 comparison points to the following root-mean-square (RMS) differences:

ϕ: ±0.9 m; λ: ±0.9 m; H (geodetic height): ±0.8 m

Test Case:

Input data for Zanderij Datum test point:	ϕ =	5°27'09.451"N	$\Delta\phi$ =	-11.431"
	λ =	304°47'47.486"E	$\Delta\lambda$ =	-4.885"
			ΔH =	-32.33 m

* Surinam

[Revised: 30 September 1988]

Table 20.46
Local Geodetic System to WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
for Remaining Local Geodetic Systems*

Local Geodetic System	Transformation Parameters			Number of Doppler Stations Used to Determine Transformation Parameters	Reference Ellipsoid
	$\Delta\phi$	$\Delta\lambda$	ΔH		
ADINDAN					
Mali	2.375"	-1.487"	33 m	1	Clarke 1880
Senegal	2.453	-1.838	33	2	Clarke 1880
AFGOOYE					
Somalia	1.644	-2.733	-36	1	Krassovsky
AIN EL ABD 1970					
Bahrain Island	1.743	-1.587	-27	1	International
ANNA 1 ASTRO 1965					
Cocos Islands	14.106	15.201	-33	1	Australian National
ASCENSION ISLAND 1958					
Ascension Island	1.482	1.693	18	1	International
ASTRO BEACON "E"					
Iwo Jima Island	-9.383	-5.309	61	1	International
ASTRO B4 SOROL ATOLL					
Tern Island	-10.981	4.930	25	1	International
ASTRO DOS 71/4					
St. Helena Island	-17.216	17.325	20	1	International

* Supplements the Local Geodetic System-to-WGS 84 Datum Transformation Multiple Regression Equations in Tables 20.1 through 20.45.

Table 20.46 (Cont'd)
Local Geodetic System to WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
for Remaining Local Geodetic Systems*

Local Geodetic System	Transformation Parameters			Number of Doppler Stations Used to Determine Transformation Parameters	Reference Ellipsoid
	$\Delta\phi$	$\Delta\lambda$	ΔH		
ASTRONOMIC STATION 1952					
Marcus Island	-0.105"	5.540"	31 m	1	International
DOS 1968					
Gizo Island (New Georgia Islands)	-24.742	3.002	68	1	International
EASTER ISLAND 1967					
Easter Island	2.517	5.448	-5	1	International
EUROPEAN DATUM 1950					
Sardinia	-3.630	-3.580	52	2	International
Sicily	-4.046	-2.433	42	3	International
GANDAJIKA BASE					
Republic of Maldives	1.547	1.109	-95	1	International
GUX 1 ASTRO					
Guadalcanal Island	-24.812	3.626	67	1	International
HONG KONG 1963					
Hong Kong	-5.496	8.858	-4	2	International
INDIAN					
Bangladesh, India, and Nepal	**	**	**	**	Everest

* Supplements the Local Geodetic System-to-WGS 84 Datum Transformation Multiple Regression Equations in Tables 20.1 through 20.45.

** Contact DMA (see PREFACE) if data in this form is needed for this datum or area.

Table 20.46 (Cont'd)
Local Geodetic System to WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
for Remaining Local Geodetic Systems*

Local Geodetic System	Transformation Parameters			Number of Doppler Stations Used to Determine Transformation Parameters	Reference Ellipsoid
	$\Delta\phi$	$\Delta\lambda$	ΔH		
ISTS 073 ASTRO 1969 Diego Garcia	-8.121"	-10.732"	-71 m	2	International
JOHNSTON ISLAND 1961 Johnston Island	-6.369	3.746	18	1	International
KERGUELEN ISLAND Kerguelen Island	1.974	-9.875	38	1	International
L.C.5 ASTRO Cayman Brac Island	0.848	2.159	-16	1	Clarke 1866
LUZON Mindanao Island	-3.998	5.014	71	1	Clarke 1866
MAHE 1971 Mahe Island	-2.942	-5.146	-37	1	Clarke 1880
MARCO ASTRO Salvage Islands	3.099	-7.425	47	1	International
MASSAWA Eritrea (Ethiopia)	-3.469	-2.878	6	1	Bessel 1841

* Supplements the Local Geodetic System-to-WGS 84 Datum Transformation Multiple Regression Equations in Tables 20.1 through 20.45.

Table 20.46 (Cont'd)
Local Geodetic System to WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
for Remaining Local Geodetic Systems*

Local Geodetic System	Transformation Parameters			Number of Doppler Stations Used to Determine Transformation Parameters	Reference Ellipsoid
	$\Delta\phi$	$\Delta\lambda$	ΔH		
MIDWAY ASTRO 1961 Midway Island	46.597"	3.663"	10 m	1	International
NAHRWAN Saudi Arabia	9.260	1.722	-18	1	Clarke 1880
NAPARIMA, BWI Trinidad and Tobago	6.363	5.754	-47	1	International
NAD 27 Greenland (Hayes Peninsula)	1.190	7.182	11	2	Clarke 1866
OBSERVATORIO 1966 Corvo and Flores Islands (Azores)	4.812	-15.256	57	3	International
PICO DE LAS NIEVES Canary Islands	5.317	-6.247	50	1	International
PITCAIRN ASTRO 1967 Pitcairn Island	0.131	1.250	-6	1	International
PROVISIONAL SOUTH CHILEAN 1963 South Chile (Near 53°S)	0.039	4.385	11	2	International
QORNOQ South Greenland	-5.335	16.027	14	2	International

* Supplements the Local Geodetic System-to-WGS 84 Datum Transformation Multiple Regression Equations in Tables 20.1 through 20.45.

Table 20.46 (Cont'd)
Local Geodetic System to WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
for Remaining Local Geodetic Systems*

Local Geodetic System	Transformation Parameters			Number of Doppler Stations Used to Determine Transformation Parameters	Reference Ellipsoid
	$\Delta\phi$	$\Delta\lambda$	ΔH		
REUNION Mascarene Island	-44.792"	-21.237"	9 m	1	International
ROME 1940 Sardinia Island	2.222	-1.345	42	1	International
SANTO (DOS) Espirito Santo Island	2.805	-2.630	72	1	International
SÃO BRAZ São Miguel, Santa Maria Islands (Azores)	3.312	1.644	56	2	International
SAPPER HILL 1943 East Falkland Island	-0.763	-15.209	11	1	International
SCHWARZECK Namibia	-2.336	-2.953	19	3	Bessel 1841
SOUTH ASIA Singapore	-0.837	-0.153	6	1	Modified Fischer 1960
SOUTHEAST BASE Porto Santo and Madeira Islands	13.033	-14.685	52	2	International
TRISTAN ASTRO 1968 Tristan da Cunha	-26.823	11.877	17	1	International
VITI LEVU 1916 Viti Levu Island (Fiji Islands)	5.141	-13.327	59	1	Clarke 1880

* Supplements the Local Geodetic System-to-WGS 84 Datum Transformation Multiple Regression Equations in Tables 20.1 through 20.45.

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SECTION 21

HISTOGRAMS

- WGS 84 COORDINATE DIFFERENCES* (MAJOR DATUMS) -

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* WGS 84 COORDINATES OBTAINED FROM DOPPLER-DERIVED NSWC 9Z-2 COORDINATES USING NSWC 9Z-2 TO WGS 84 TRANSFORMATION MINUS WGS 84 COORDINATES COMPUTED USING LOCAL GEODETIC SYSTEM-TO-WGS 84 DATUM TRANSFORMATION MULTIPLE REGRESSION EQUATIONS (SECTION 19); UNITS = METERS

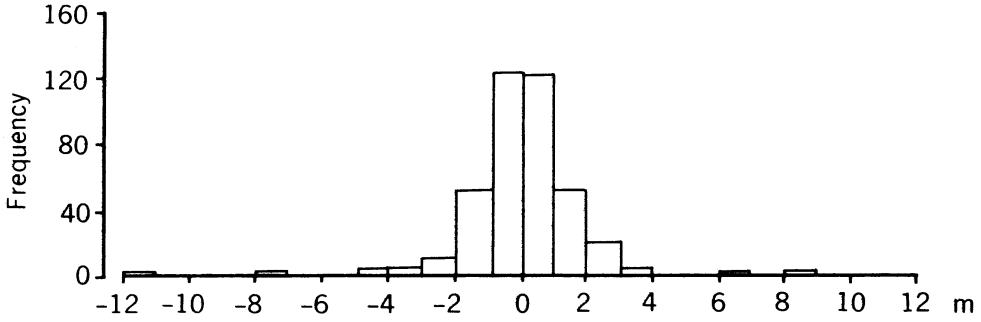

Figure 21.1a. NAD 27 (CONUS)-Geodetic Latitude Differences*

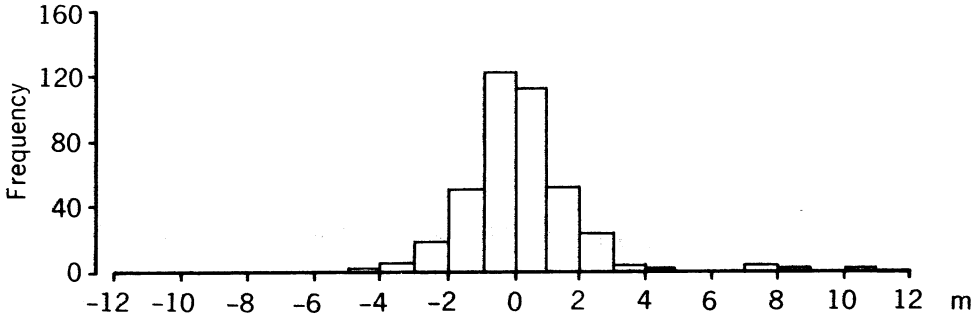

Figure 21.1b. NAD 27 (CONUS)-Geodetic Longitude Differences*

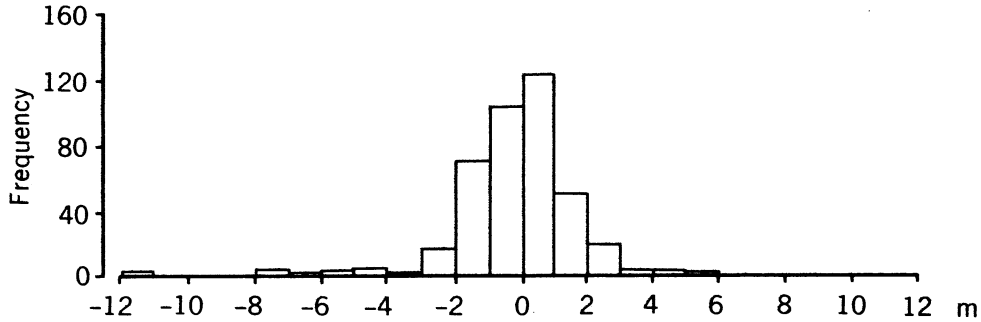

Figure 21.1c. NAD 27 (CONUS)-Geodetic Height Differences*

*Differences = WGS 84 Coordinates Obtained From Doppler-Derived NSWC 9Z-2 Coordinates Minus WGS 84 Coordinates Computed Using NAD 27 (CONUS)-to-WGS 84 Datum Transformation Multiple Regression Equations.

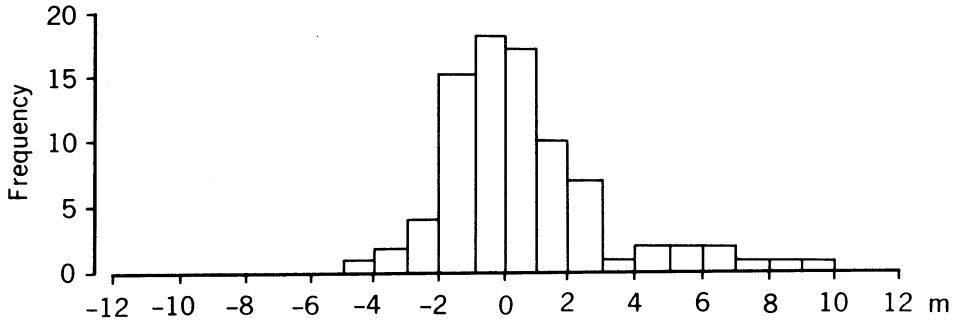

Figure 21.2a. SAD 69-Geodetic Latitude Differences*

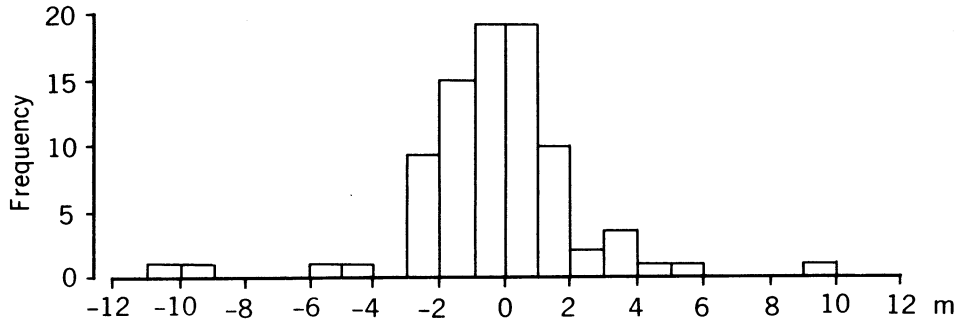

Figure 21.2b. SAD 69-Geodetic Longitude Differences*

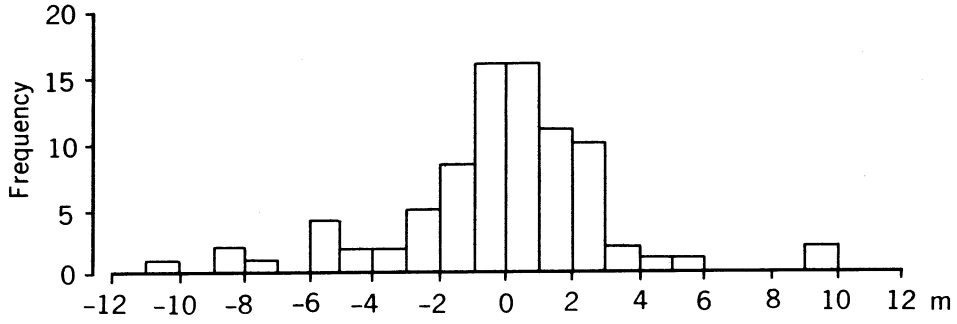

Figure 21.2c. SAD 69-Geodetic Height Differences*

*Differences = WGS 84 Coordinates Obtained From Doppler-Derived NSWC 9Z-2 Coordinates Minus WGS 84 Coordinates Computed Using SAD 69-to-WGS 84 Datum Transformation Multiple Regression Equations.

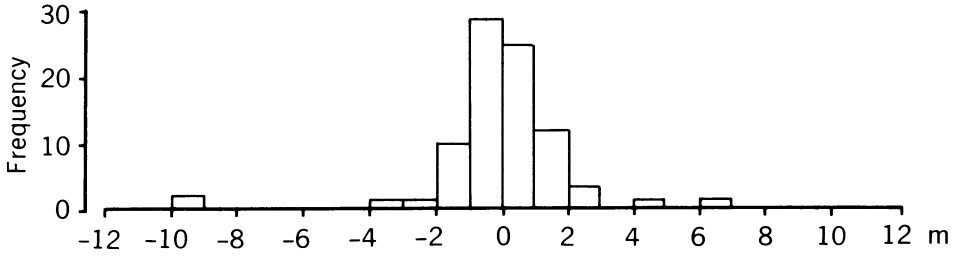

Figure 21.3a. ED 50 (Western Europe)-Geodetic Latitude Differences*

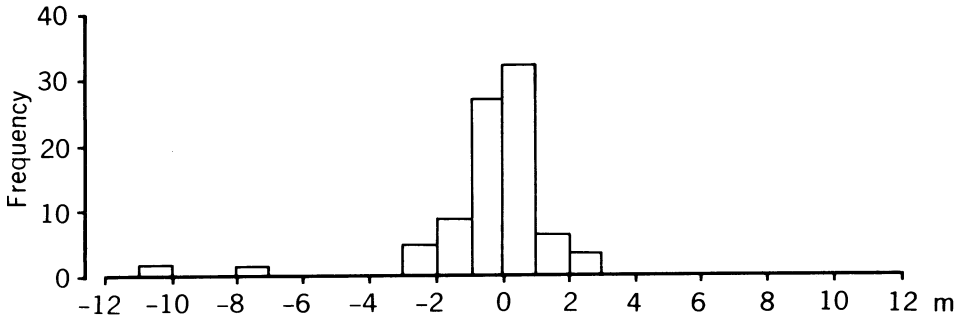

Figure 21.3b. ED 50 (Western Europe)-Geodetic Longitude Differences*

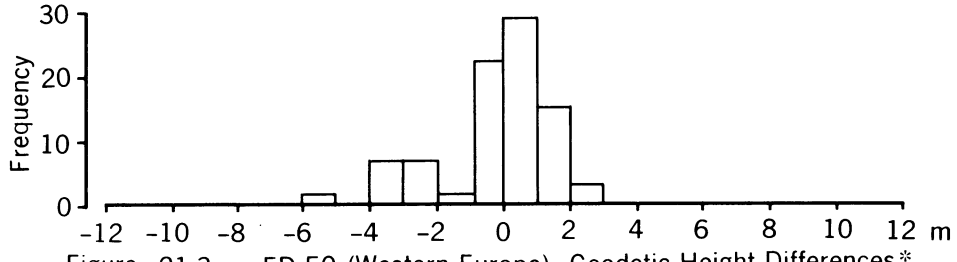

Figure 21.3c. ED 50 (Western Europe)-Geodetic Height Differences*

*Differences = WGS 84 Coordinates Obtained From Doppler-Derived NSWC 9Z-2 Coordinates Minus WGS 84 Coordinates Computed Using ED 50 (Western Europe)-to-WGS 84 Datum Transformation Multiple Regression Equations.

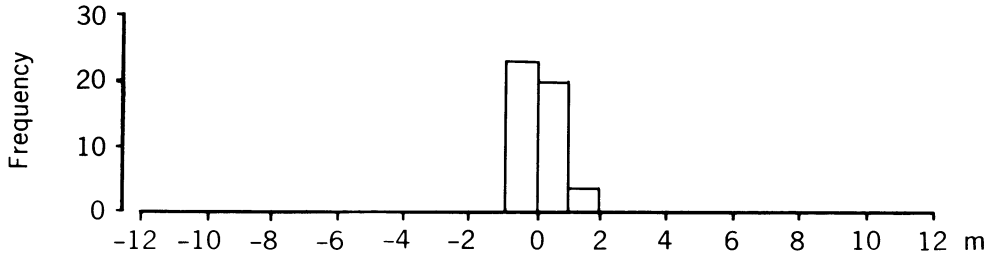

Figure 21.4a. ED 50 (UK/Ireland) - Geodetic Latitude Differences*

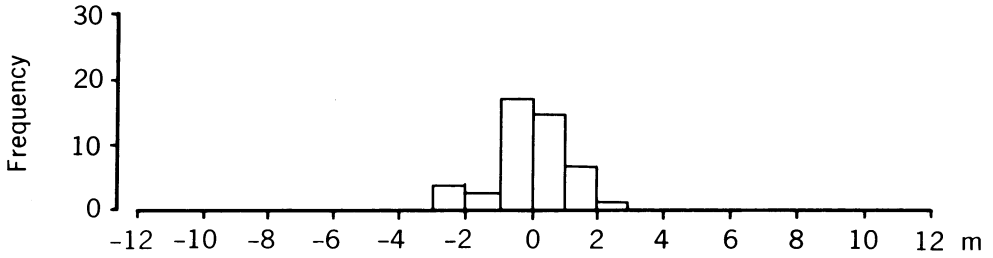

Figure 21.4b. ED 50 (UK/Ireland) - Geodetic Longitude Differences*

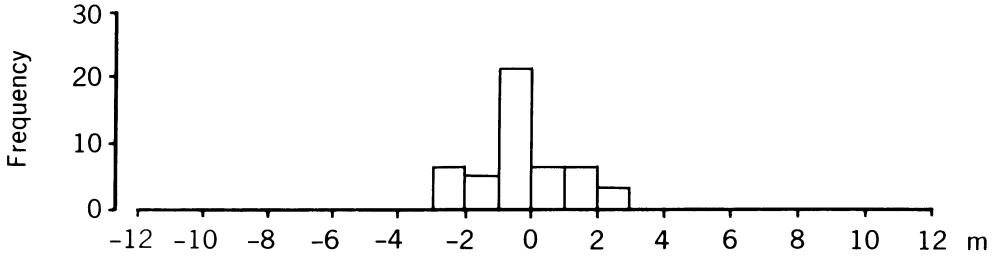

Figure 21.4c. ED 50 (UK/Ireland) - Geodetic Height Differences*

*Differences = WGS 84 Coordinates Obtained From Doppler - Derived NSWC 9Z-2 Coordinates Minus WGS 84 Coordinates Computed Using ED 50 (UK/Ireland)-to-WGS 84 Datum Transformation Multiple Regression Equations.

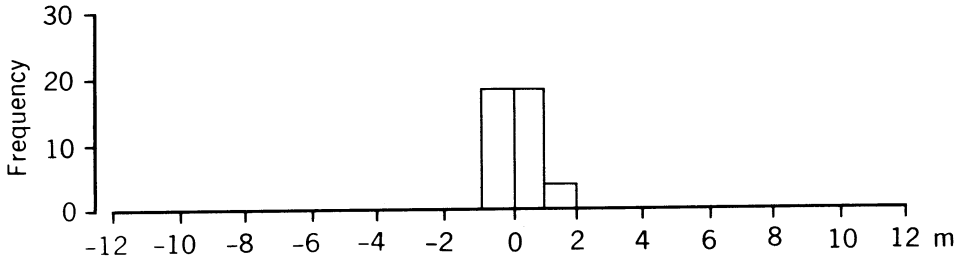

Figure 21.5a. ED 50 (UK Only)-Geodetic Latitude Differences*

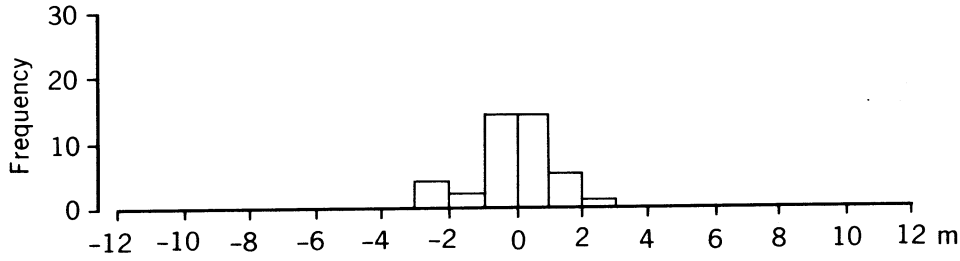

Figure 21.5b. ED 50 (UK Only)-Geodetic Longitude Differences*

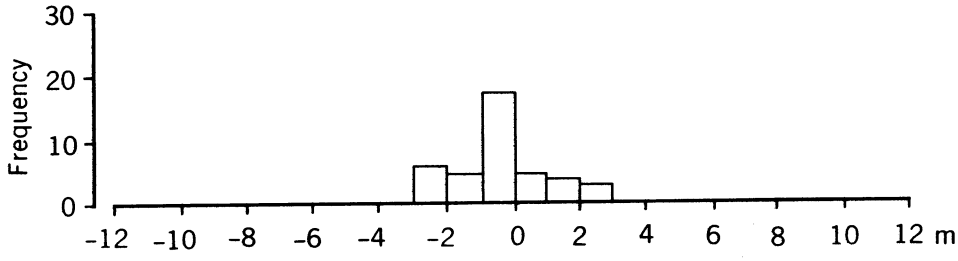

Figure 21.5c. ED 50 (UK Only)-Geodetic Height Differences*

*Differences = WGS 84 Coordinates Obtained From Doppler-Derived NSWC 9Z-2 Coordinates Minus WGS 84 Coordinates Computed Using ED 50 (UK Only)-to-WGS 84 Datum Transformation Multiple Regression Equations.

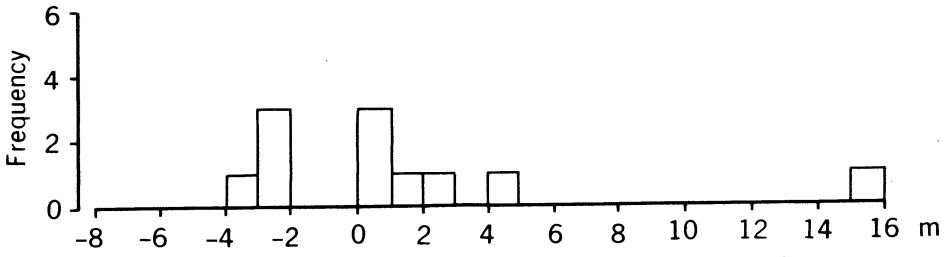

Figure 21.6a. TD-Geodetic Latitude Differences*

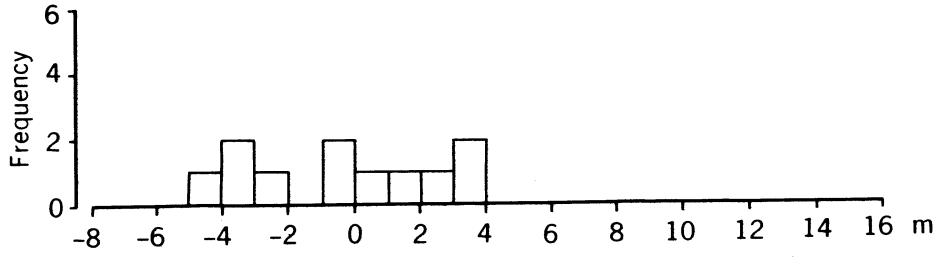

Figure 21.6b. TD-Geodetic Longitude Differences*

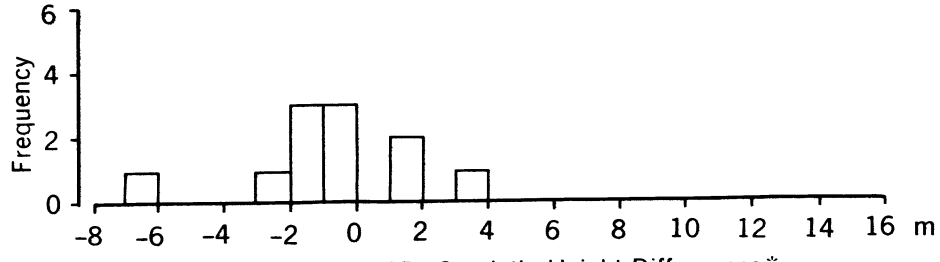

Figure 21.6c. TD-Geodetic Height Differences*

*Differences = WGS 84 Coordinates Obtained From Doppler-Derived NSWC 9Z-2 Coordinates Minus WGS 84 Coordinates Computed Using TD-to-WGS 84 Datum Transformation Multiple Regression Equations.

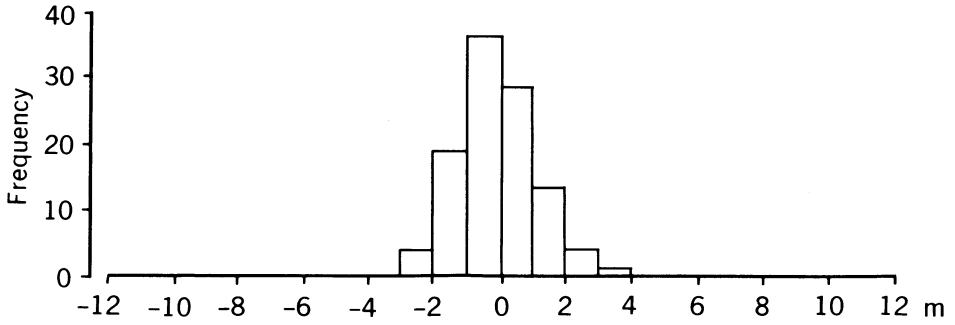

Figure 21.7a. AGD 66-Geodetic Latitude Differences*

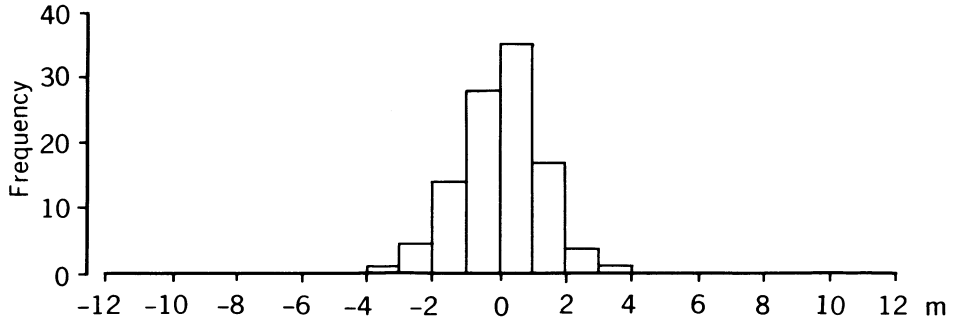

Figure 21.7b. AGD 66-Geodetic Longitude Differences*

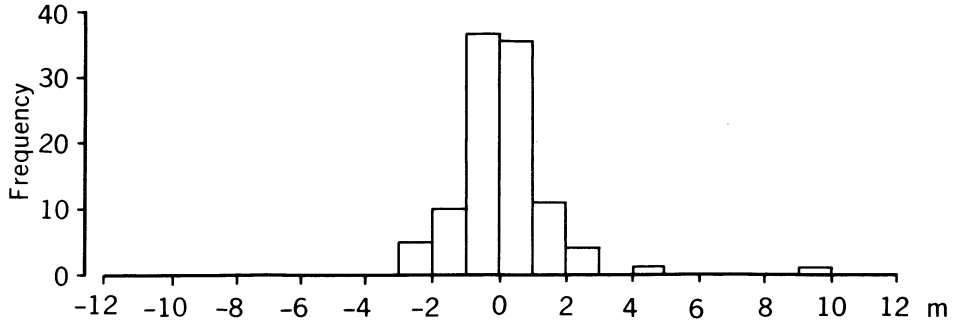

Figure 21.7c. AGD 66-Geodetic Height Differences*

*Differences = WGS 84 Coordinates Obtained From Doppler-Derived NSWC 9Z-2 Coordinates Minus WGS 84 Coordinates Computed Using AGD 66-to-WGS 84 Datum Transformation Multiple Regression Equations.

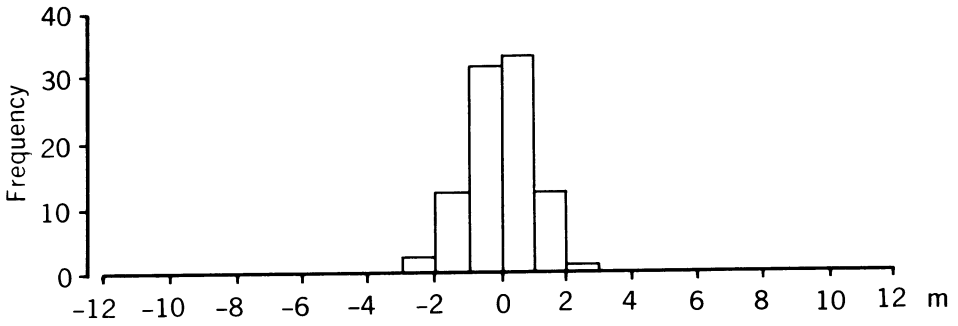

Figure 21.8a. AGD 84-Geodetic Latitude Differences*

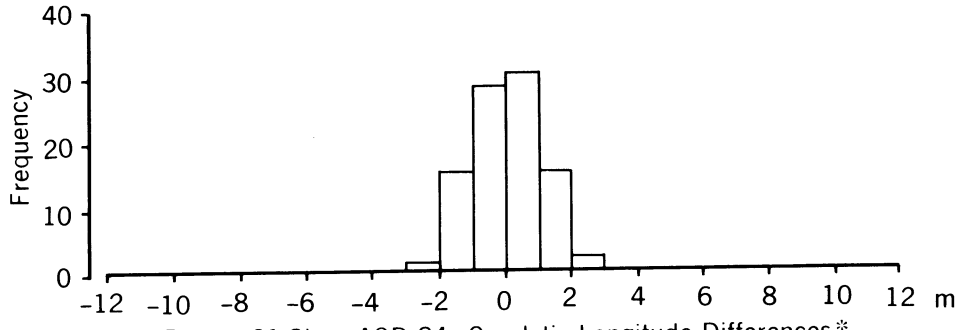

Figure 21.8b. AGD 84-Geodetic Longitude Differences*

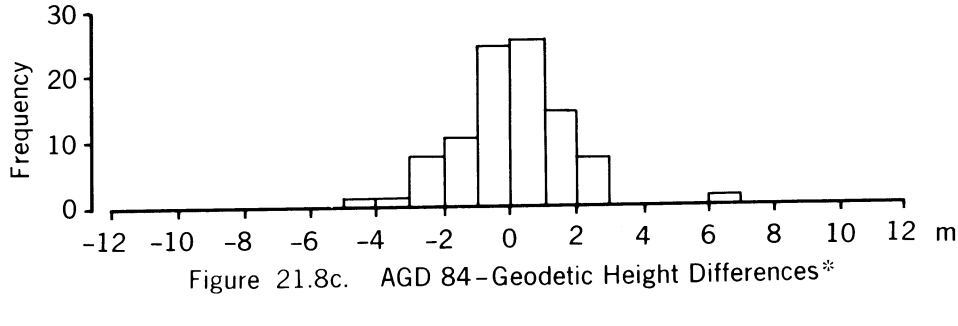

Figure 21.8c. AGD 84-Geodetic Height Differences*

*Differences = WGS 84 Coordinates Obtained From Doppler-Derived NSWC 9Z-2 Coordinates Minus WGS 84 Coordinates Computed Using AGD 84-to-WGS 84 Datum Transformation Multiple Regression Equations.

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