Oregon Coordinate Systems

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Coordinates

- The latitude is **45º 48’ 45.20911”**
- The longitude is **118º 28’ 15.16974”**
- The height of the point is **550.25**
- The height above “sea level” is **1871.74**
- The Northing is **240,441.515**
- The Easting is **385,722.685**

Coordinates and Datums

- Latitude: **45º 48’ 45.20911”** **NAD83 (1991)**
- Longitude: **118º 28’ 15.16974”** **NAD83 (1998)**
- Ellipsoid height: **550.25 m** **NAD83 (1991)**
- Orthometric height: **1871.74 ft** **(NAVD88)**
- Northing: **240,441.515 m** **SPC OR N NAD83 (1998)**
- Easting: **385,722.685 m** **UTM 11 NAD83 (1998)**

Metadata Is Data About Data

DATUMS

NAD27, NAD83(1986), NAD83(1991), NAD83(1998), NAD83(CORS), NAD83(NSRS), NGVD29, NAVD88

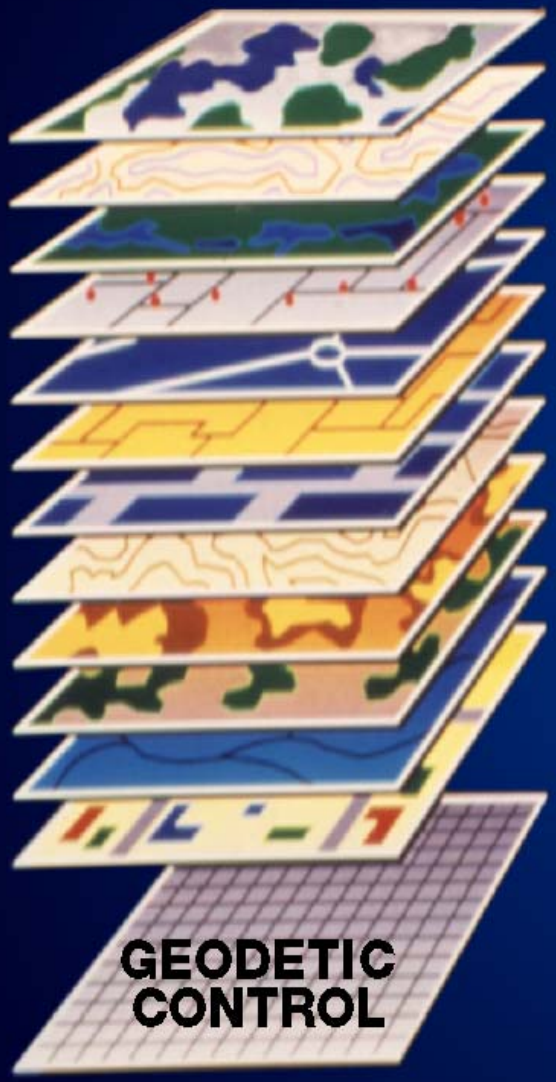
UNITS

Meters, U.S. Survey Feet, International Feet, Chains, Rods, Poles, Cubits

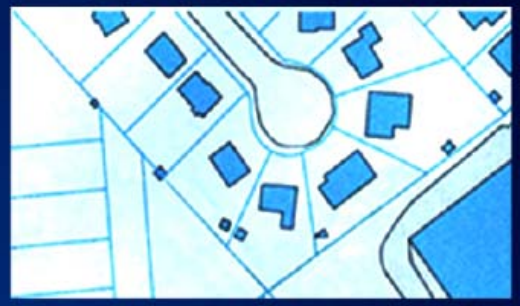
ACCURACY

A-Order, B-Order, 1st-Order, 2nd-Order, 3rd-Order, 3-cm, 5-cm, 1-meter, Scaled

Geographic Information Systems (GIS)



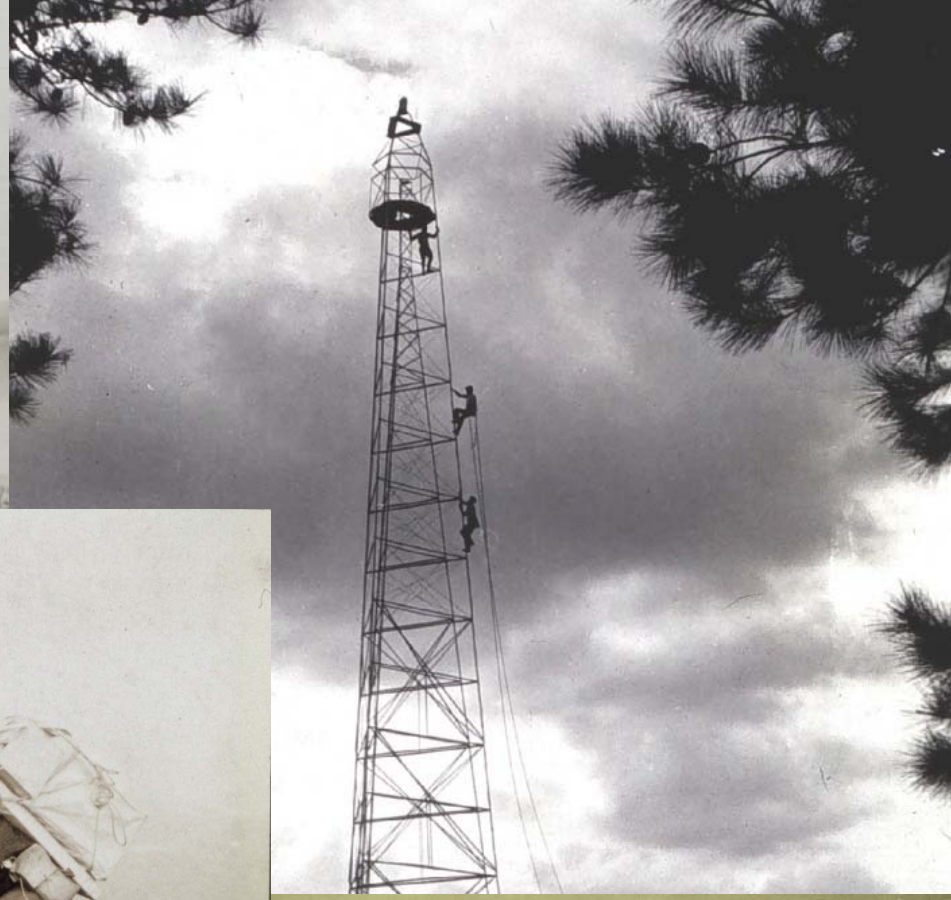
Wards and Precincts
Demographics
Structures
Water Utilities
Sewerage
Electrical Utilities
Roads
Boundaries
Land Use
Hydrology
Soils
Topography

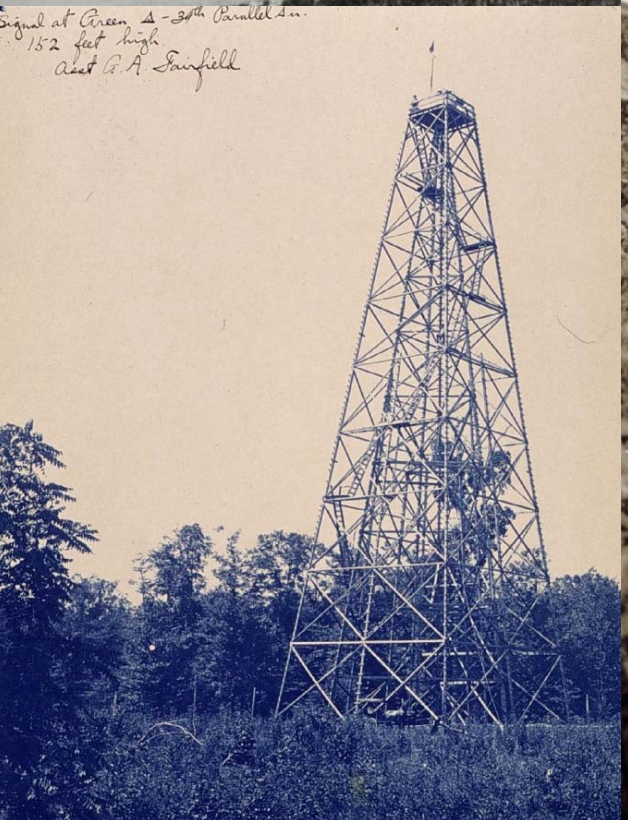


Oregon Datums

- **North American Datum 1927**
  - **NAD 27**
- **National Geodetic Vertical Datum 1929**
  - **NGVD 29**
    - **Supplemental Adjustment of 1933**
    - **Supplemental Adjustment of 1947**
    - **Supplemental Adjustment of 1956**

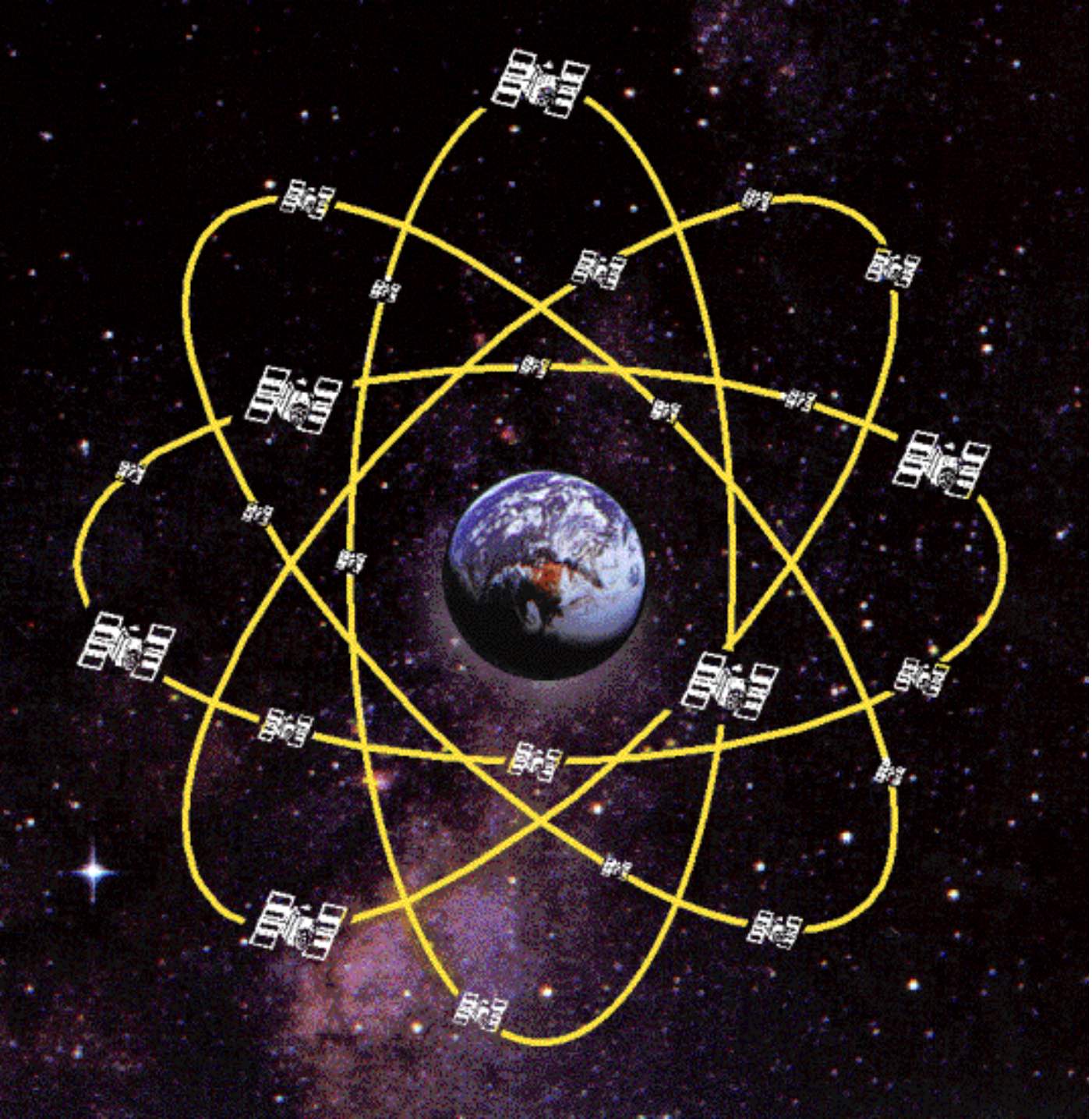
U. COAST AND GEODETIC SURVEY
LABOR




Signal at Green Δ - 34th Parallel Sn.
152 feet high
Asst G. A. Fairfield

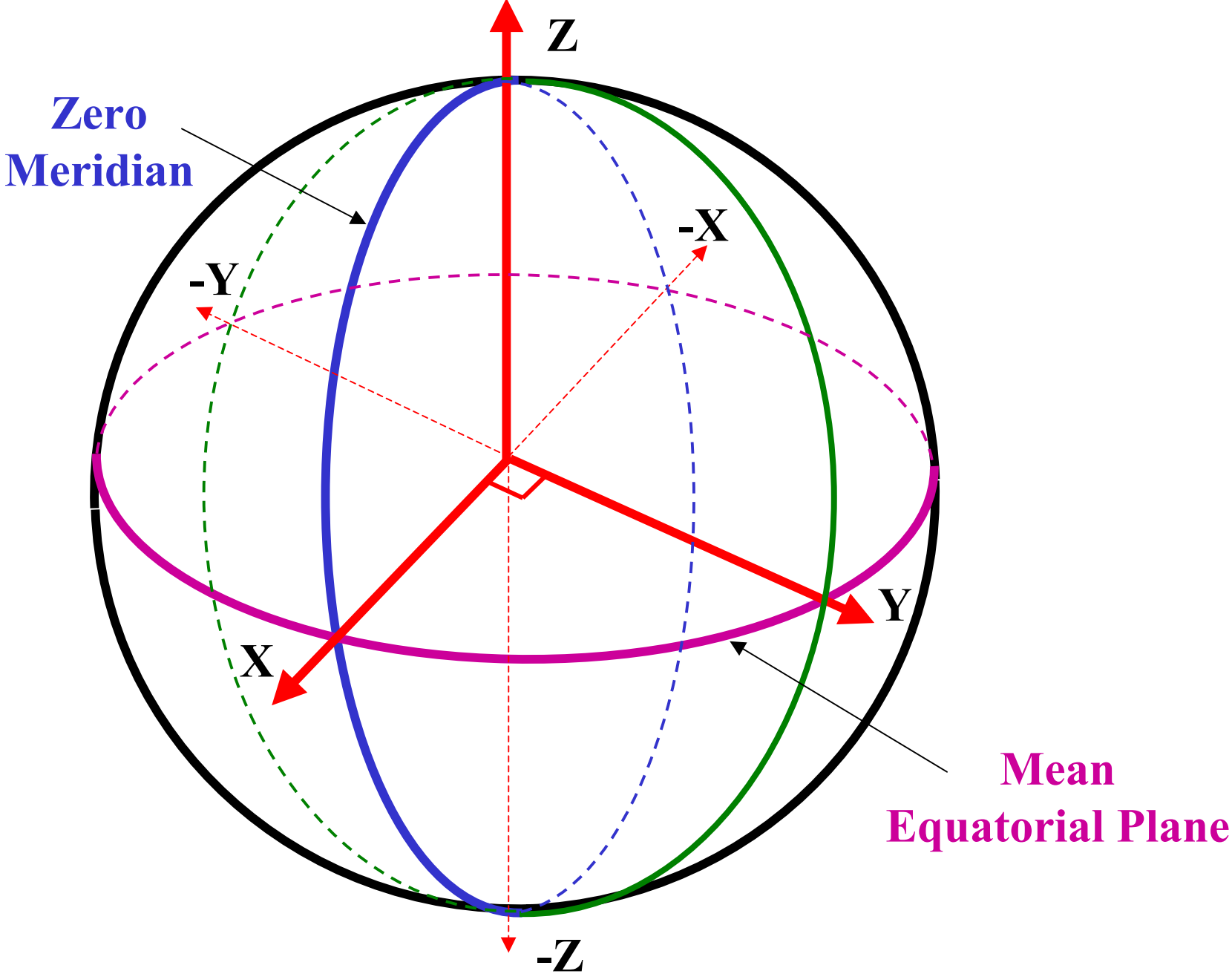
Oregon Datums

- North American Datum 1983
  - NAD 83
    - (1986) Original adjustment
    - (1991) HPGN / HARN
    - (CORS) CORS
    - (1998) HARN
    - (NSRS) Re-adjustment of entire United States
- North American Vertical Datum 1988
  - NAVD 88

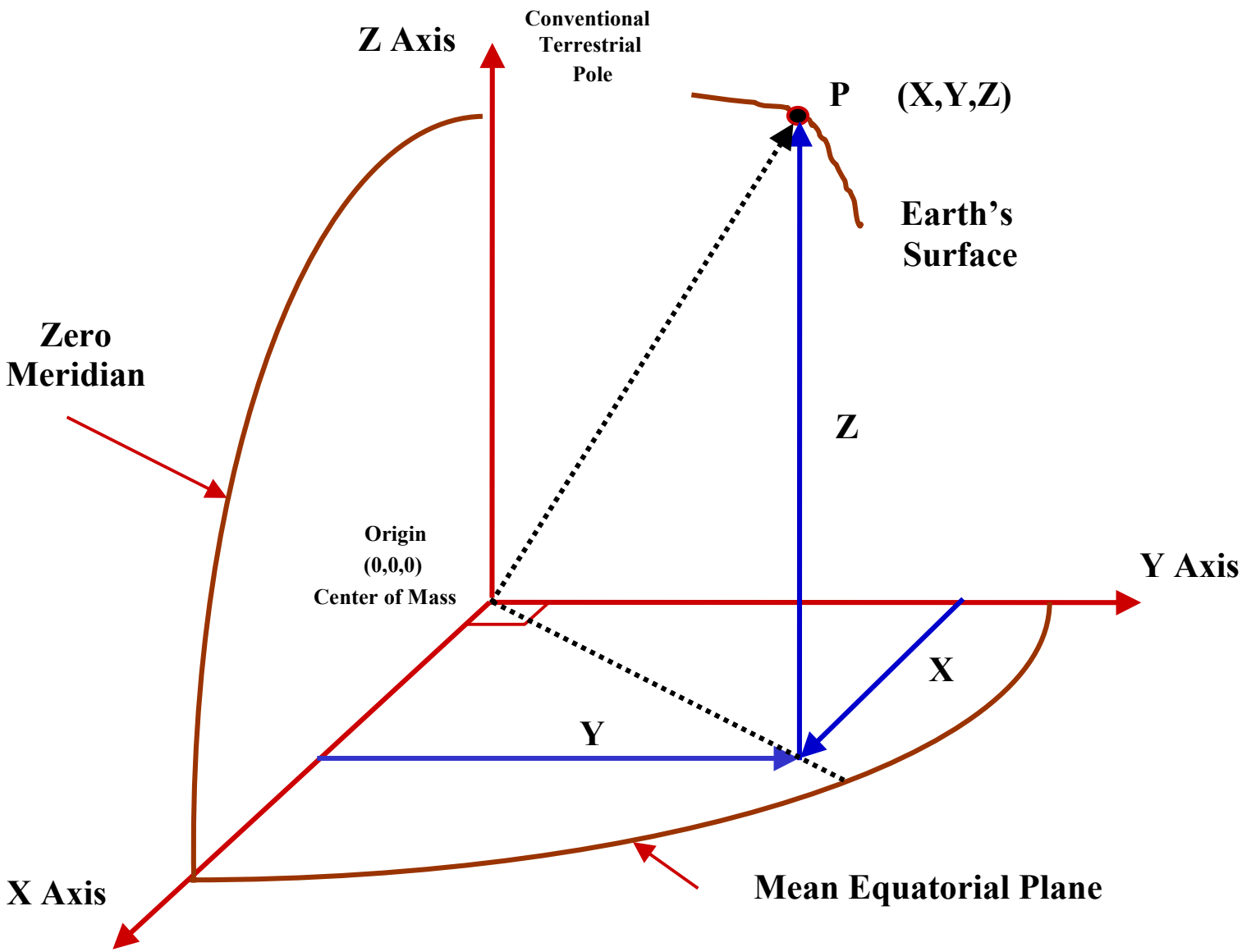


Global Positioning System

27 Satellites
6 Planes, 55° Rotation
4/5 Satellites /Plane
20,183 km Orbit
1 Revolution /12 Hrs


Z
Zero
Meridian
-X
-Y
Y
X
Mean
Equatorial Plane
-Z

Earth-Centered-Earth-Fixed Coordinates



X, Y, and Z Coordinates

- Pros
  - Already using (background in software)
  - Available on NGS Data Sheets
  - True 3-dimensional coordinates
  - “Universal” format for exchanging spatial information

- Cons
  - Large unwieldy numbers
  - Negative numbers (quadrants)
  - No visual association
  - Z is not height value

First station : 4S9 B (AA7997)

X = -2424190.8349 m
Y = -3791941.3772 m
Z = 4504340.1907 m

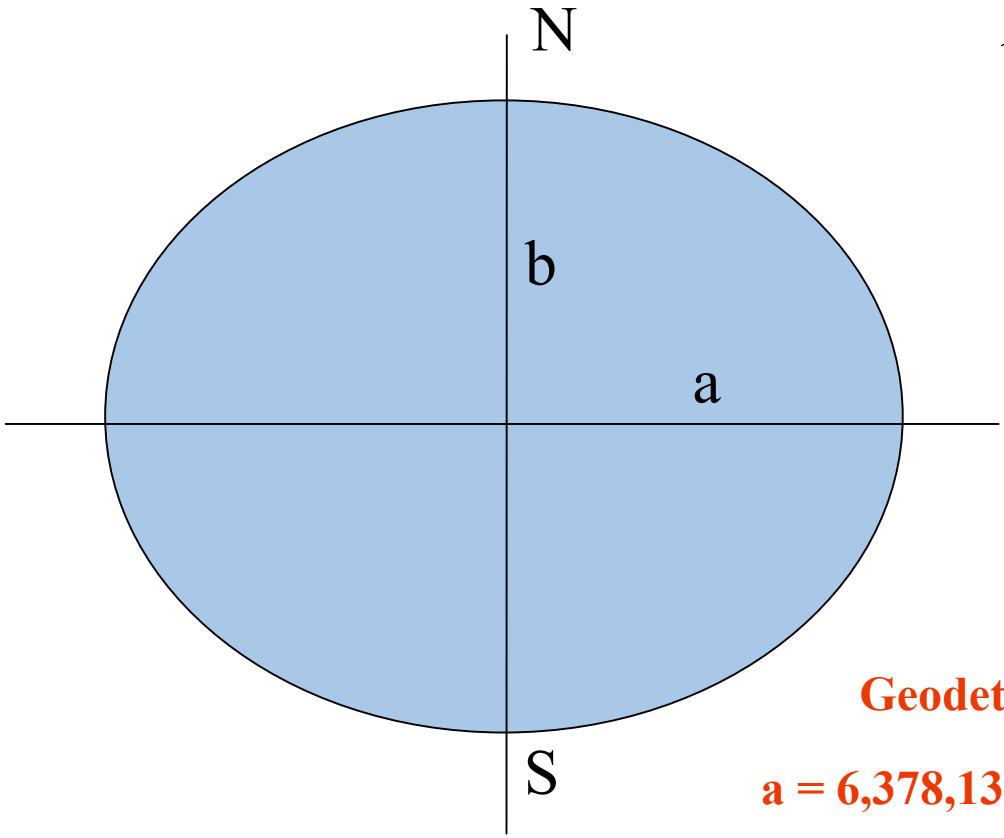
Second station : 4S9 D (AA7999)

X = -2423846.1436 m
Y = -3791974.1790 m
Z = 4504497.0132 m

$$
\begin{array}{rr}
 & 4504340.1907 \text{ m} \\
- & \underline{4504497.0132 \text{ m}} \\
\Delta Z = & -156.8225 \text{ m}
\end{array}
$$

```
First station : 4S9 B (AA7997)
  X =    -2424190.8349     LAT =  45 12 58.08108 North
  Y =    -3791941.3772     LON = 122 35 26.91721 West
  Z =     4504340.1907     EHT =     55.3900

Second station : 4S9 D (AA7999)
  X =    -2423846.1436     LAT =  45 13  5.29248 North
  Y =    -3791974.1790     LON = 122 35 12.79711 West
  Z =     4504497.0132     EHT =     55.3900

  Delta height =       .0000
  Ellipsoidal distance  =       380.1037
  Mark to mark distance =       380.1070
  Forward azimuth from north =  54  8 48.0080
  Back azimuth from north    = 234  8 58.0302

  DX =        344.6913     DN =        222.6334
  DY =        -32.8017     DE =        308.0840
  DZ =        156.8226     DU =          -.0113
```

The Ellipsoid



a = Semi major axis

b = Semi minor axis

$$f = \frac{a-b}{a} = \text{Flattening}$$

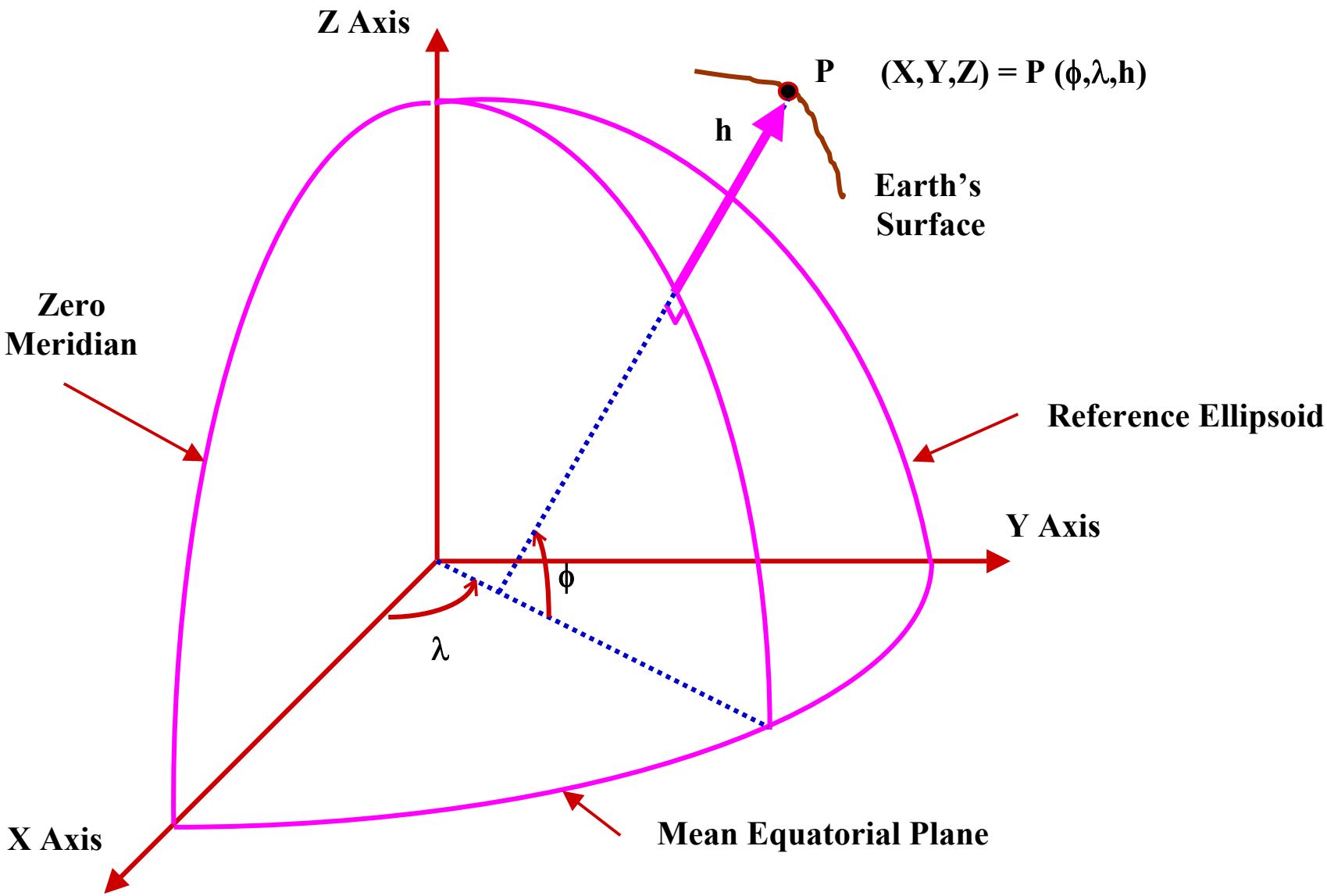
Geodetic Reference System 1980

a = 6,378,137.000 meters (semi-major axis)

b = 6,356,752.3141403 m (semi-minor axis)

1/f = 298.25722210088 (flattening)

Curvilinear Coordinate System



UNITED STATES ELLIPSOID DEFINITIONS

BESSEL 1841

a = 6,377,397.155 m 1/f = 299.1528128

CLARKE 1866

a = 6,378,206.4 m 1/f = 294.97869821

GEODETIC REFERENCE SYSTEM 1980 - (GRS 80)

a = 6,378,137 m 1/f = 298.257222101

WORLD GEODETIC SYSTEM 1984 - (WGS 84)

a = 6,378,137 m 1/f = 298.257223563

HORIZONTAL DATUMS

BESSEL 1841 ----------

LOCAL ASTRO DATUMS (1816-1879)

CLARKE 1866

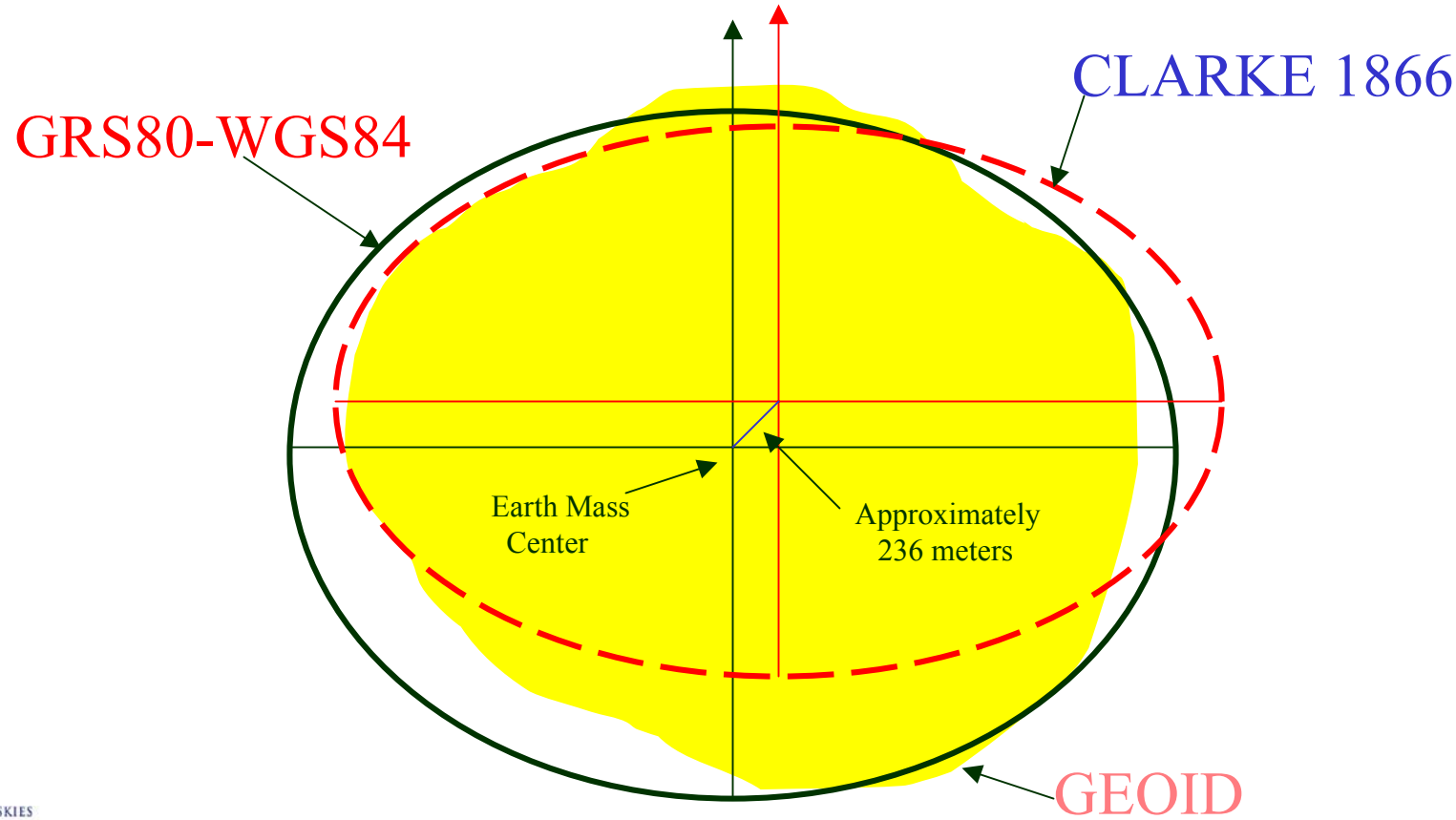
- **NEW ENGLAND DATUM (1879-1901)**
- **U.S. STANDARD DATUM (1901-1913)**
- **NORTH AMERICAN DATUM (1913-1927)**
- **NORTH AMERICAN DATUM OF 1927**
- **OLD HAWAIIAN DATUM**
- **PUERTO RICO DATUM**
- **ST. GEORGE ISLAND - ALASKA**
- **ST. LAWRENCE ISLAND - ALASKA**
- **ST. PAUL ISLAND - ALASKA**
- **AMERICAN SAMOA 1962**
- **GUAM 1963**

GRS80 ----------

NORTH AMERICAN DATUM OF 1983

(As of June 14, 1989)

THE GEOID AND TWO ELLIPSOIDS

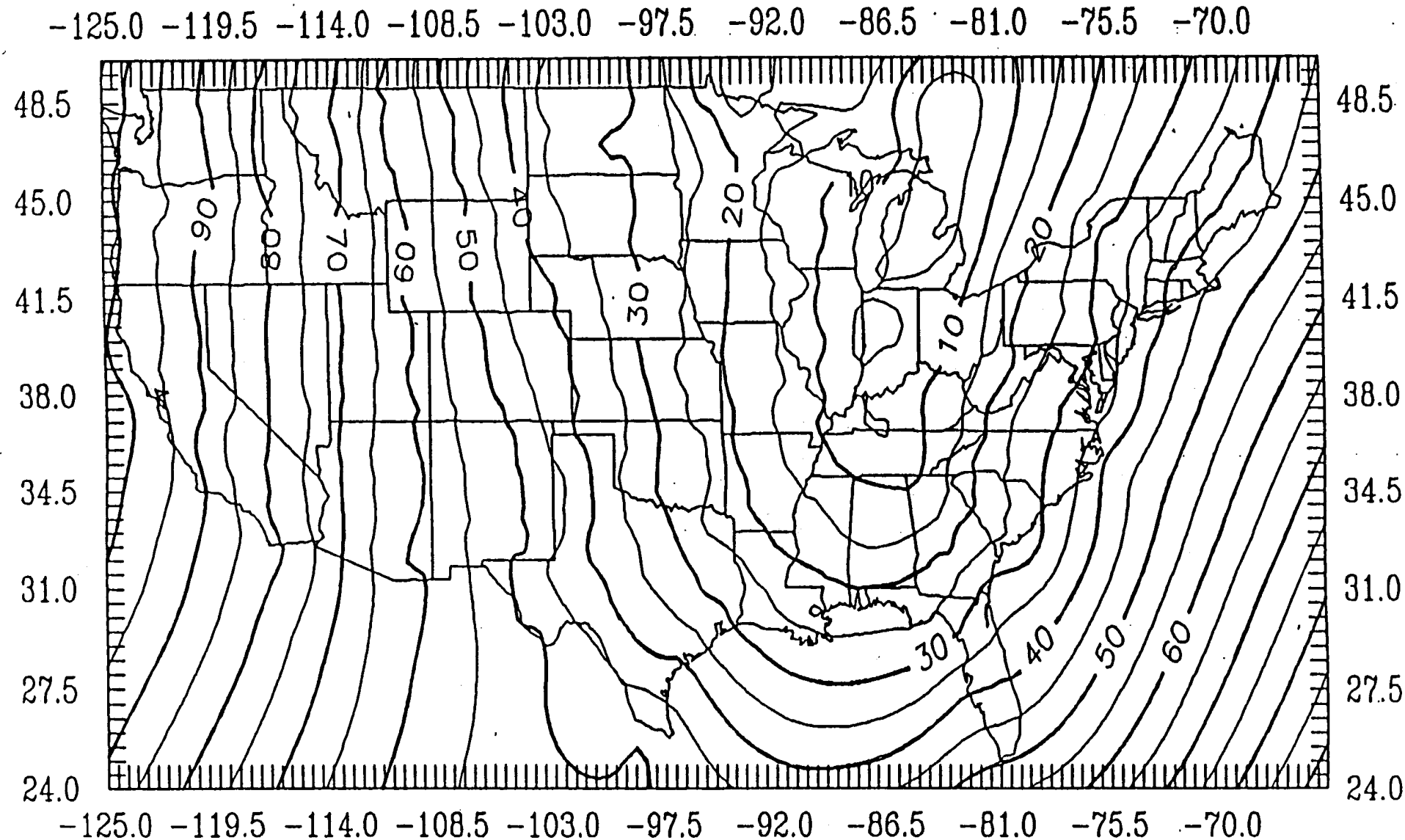


COMPARISON OF DATUM ELEMENTS

	NAD 27	NAD 83
ELLIPSOID	CLARKE 1866 a = 6,378,206.4 m 1/f = 294.9786982	GRS80 a = 6,378,137. m 1/f = 298.257222101
DATUM POINT	Triangulation Station MEADES RANCH, KANSAS	NONE EARTH MASS CENTER
ADJUSTMENT	25k STATIONS Several Hundred Base Lines Several Hundred Astro Azimuths	250k STATIONS Appox. 30k EDMI Base Lines 5k Astro Azimuths Doppler Point Positions VLBI Vectors
BEST FITTING	North America	World-Wide

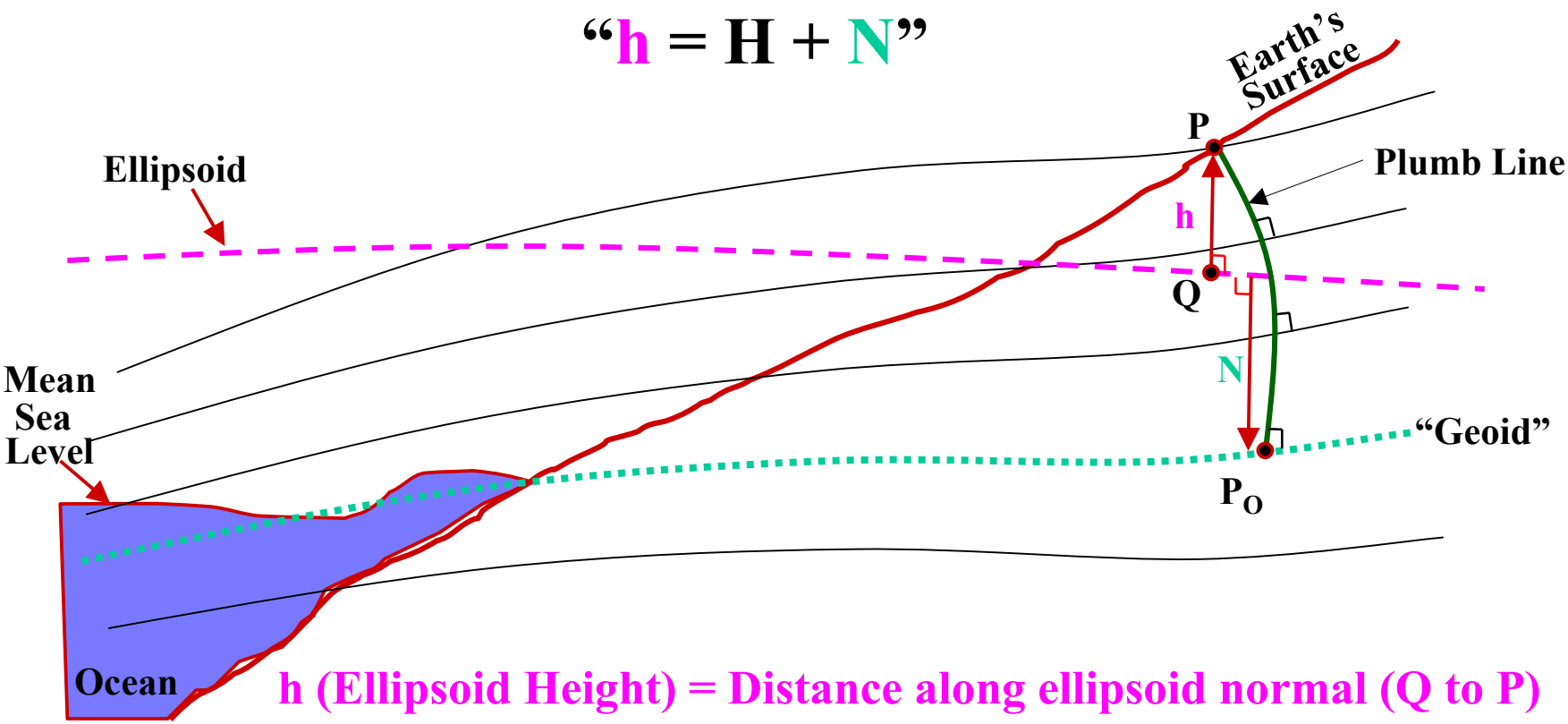
NAD 27 and NAD 83

MAGNITUDE OF DATUM SHIFT (METERS)



Ellipsoid, Geoid, and Orthometric Heights

"h = H + N"

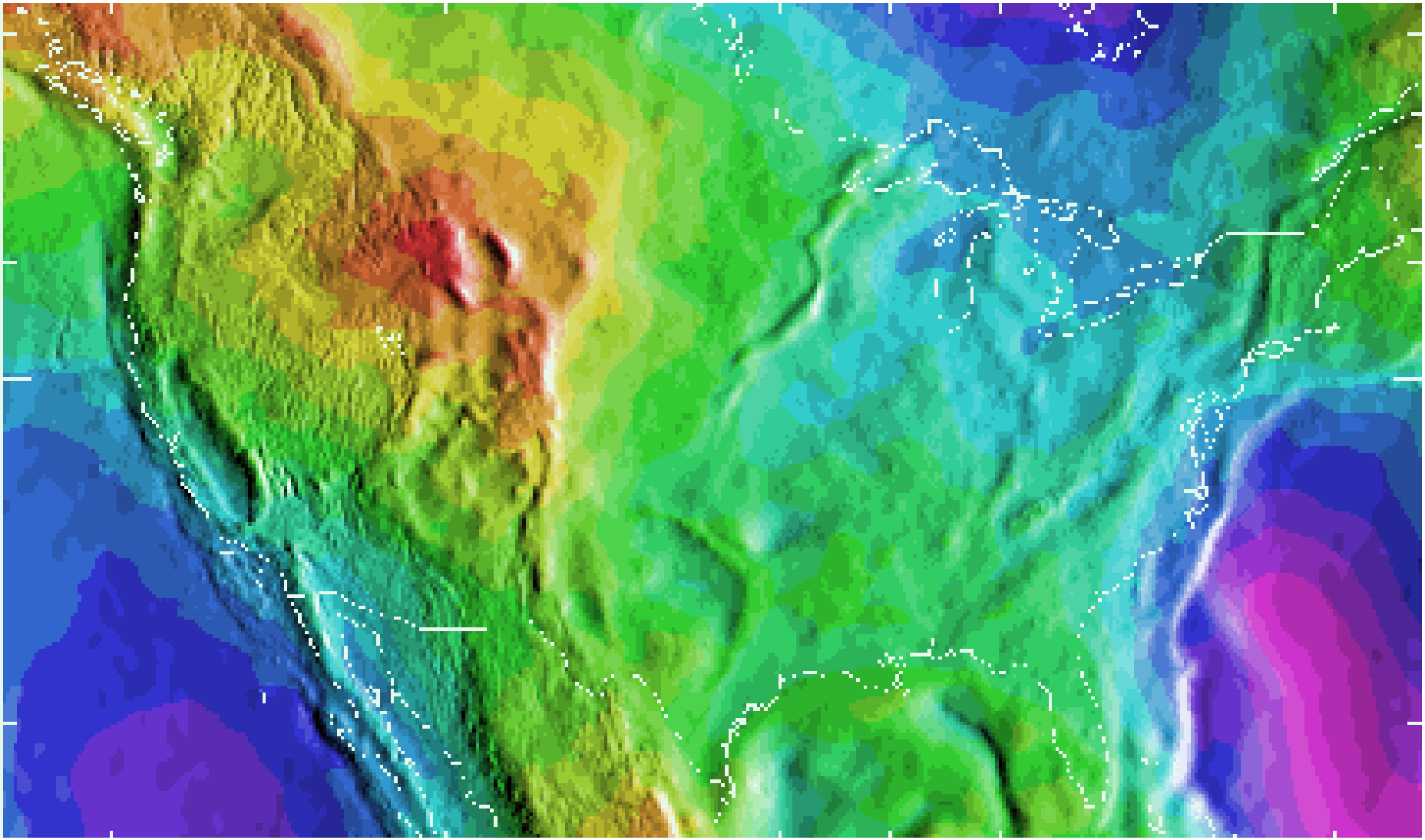


h (Ellipsoid Height) = Distance along ellipsoid normal (Q to P)

N (Geoid Height) = Distance along ellipsoid normal (Q to P_O)

H (Orthometric Height) = Distance along plumb line (P_O to P)

GEOID99



For the conterminous United States (CONUS), GEOID99 heights range from a low of -50.97 meters (magenta) in the Atlantic Ocean to a high of 3.23 meters (red) in the Labrador Strait.

Vertical Datums and GPS

- GPS; X, Y, Z E-C-E-F Coordinate System
  - Process GPS/ITRF in curvilinear coordinate system
  - Adjust GPS/ITRF coordinates to NAD83
  - Produce NAD83 ellipsoid heights
- Relate to Conventional Orthometric Height
  - Geoid Model; GEOID99
  - Constrain NAVD 88 orthometric heights
- Improved from 1998 HARN Re-Observations

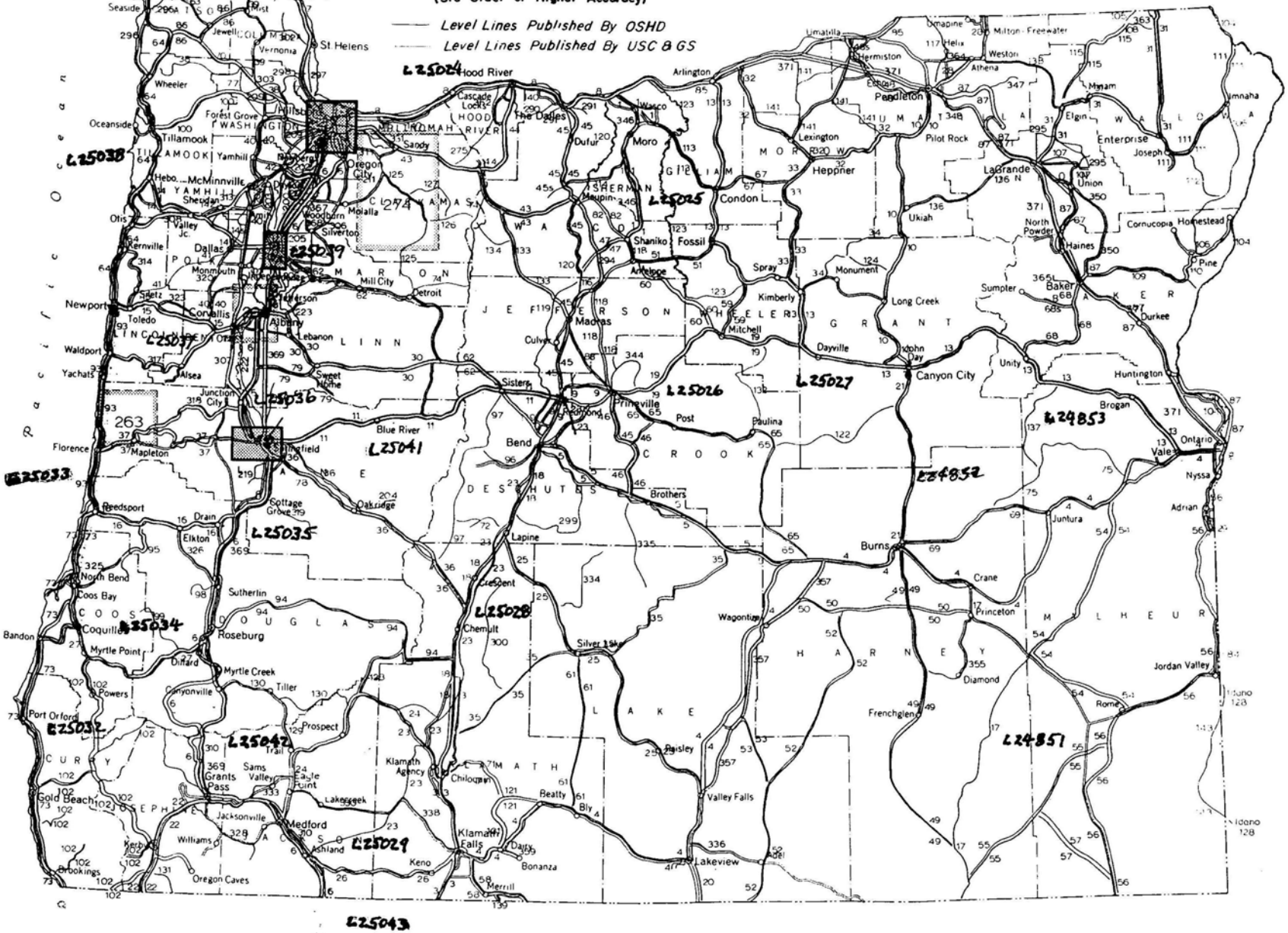
OREGON STATE HIGHWAY DIVISION

INDEX OF LEVEL LINES

(3rd Order or Higher Accuracy)

Level Lines Published By OSHD

Level Lines Published By USC & GS


L25040
L25024
L25038
L25039
L25025
L25037
L25036
L25026
L25027
L24853
L25041
L25033
L24852
L25035
L25034
L25028
L25032
L25042
L24851
L25029
L25043
Pacific Ocean
Astoria
Seaside
Westport
Clatskanie
Rainier
St. Helens
Vernonia
Wheeler
Oceanside
Tillamook
Hillsboro
Forest Grove
Hood River
Cascade Locks
The Dalles
Arlington
Umatilla
Hermiston
Pendleton
Milton-Freewater
Weston
Athena
Pilot Rock
Enterprise
Joseph
Elgin
Imnaha
Lexington
Heppner
Moro
Condon
Fossil
Shaniko
Antelope
Madras
Prineville
Bend
Sisters
Redmond
Burns
Crane
Princeton
Frenchglen
Diamond
Jordan Valley
Rome
Adrian
Nyssa
Ontario
Vale
Brogan
Huntington
Unity
Canyon City
John Day
Dayville
Long Creek
Mitchell
Spray
Kimberly
Monument
Ukiah
Baker
Sumpter
Durkee
Haines
North Powder
Cornucopia
Homestead
Pine
Union
LaGrande
Milwaukie
Sandy
Oregon City
Molalla
Silverton
Mill City
Detroit
Dallas
Monmouth
Independence
Salem
Albany
Lebanon
Sweet Home
Corvallis
Newport
Toledo
Waldport
Yachats
Alsea
Junction City
Florence
Mapleton
Reedsport
Drain
Elkton
Sutherlin
Roseburg
Myrtle Creek
Tiller
Canyonville
Oakridge
Cottage Grove
Blue River
Lapine
Crescent
Chemult
Silver Lake
Brothers
Paulina
Post
Wagontire
Paisley
Valley Falls
Lakeview
Klamath Falls
Bonanza
Merrill
Keno
Chiloquin
Klamath Agency
Beatty
Bly
Medford
Ashland
Jacksonville
Grants Pass
Sams Valley
Eagle Point
Prospect
Trail
Lakecreek
Gold Beach
Brookings
Oregon Caves
Williams
Kerby
Powers
Port Orford
Bandon
Coquille
Myrtle Point
Coos Bay
North Bend
Diffard
Yamhill
McMinnville
Sheridan
Dayton
Newberg
Hebo
Otis
Valley Jc.
Kernville
Sheridan
Wood Burn
Scotts Mills
Jefferson
Shedd
Tangent
Halsey
Harrisburg
Scio
Mehama
Gates
Detroit
Culver
Madras
Maupin
Sherman
Wasco
Moro
Condon
Fossil
Shaniko
Antelope
Spray
Kimberly
Mitchell
Dayville
John Day
Canyon City
Long Creek
Monument
Ukiah
Baker
Sumpter
Durkee
Haines
North Powder
Cornucopia
Homestead
Pine
Union
LaGrande
Enterprise
Joseph
Elgin
Imnaha
Milton-Freewater
Umapine
Helix
Weston
Athena
Pendleton
Pilot Rock
Hermiston
Umatilla
Arlington
Hood River
Cascade Locks
The Dalles
Dufur
Wasco
Moro
Lexington
Heppner
Condon
Fossil
Shaniko
Antelope
Madras
Prineville
Bend
Sisters
Redmond
Burns
Crane
Princeton
Frenchglen
Diamond
Jordan Valley
Rome
Adrian
Nyssa
Ontario
Vale
Brogan
Huntington
Unity
Canyon City
John Day
Dayville
Long Creek
Mitchell
Spray
Kimberly

Height Differences Between NAVD 88 and NGVD 29

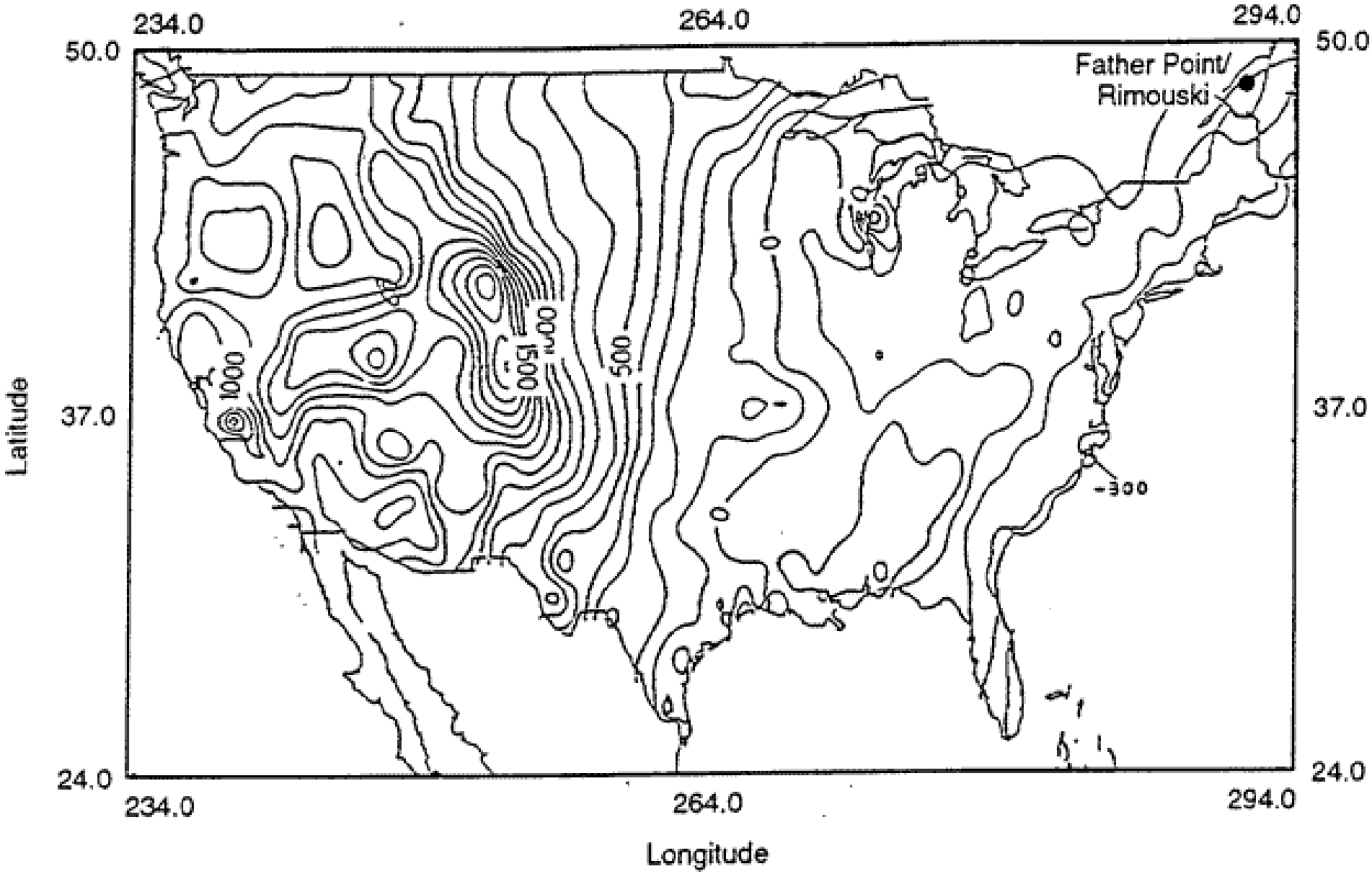
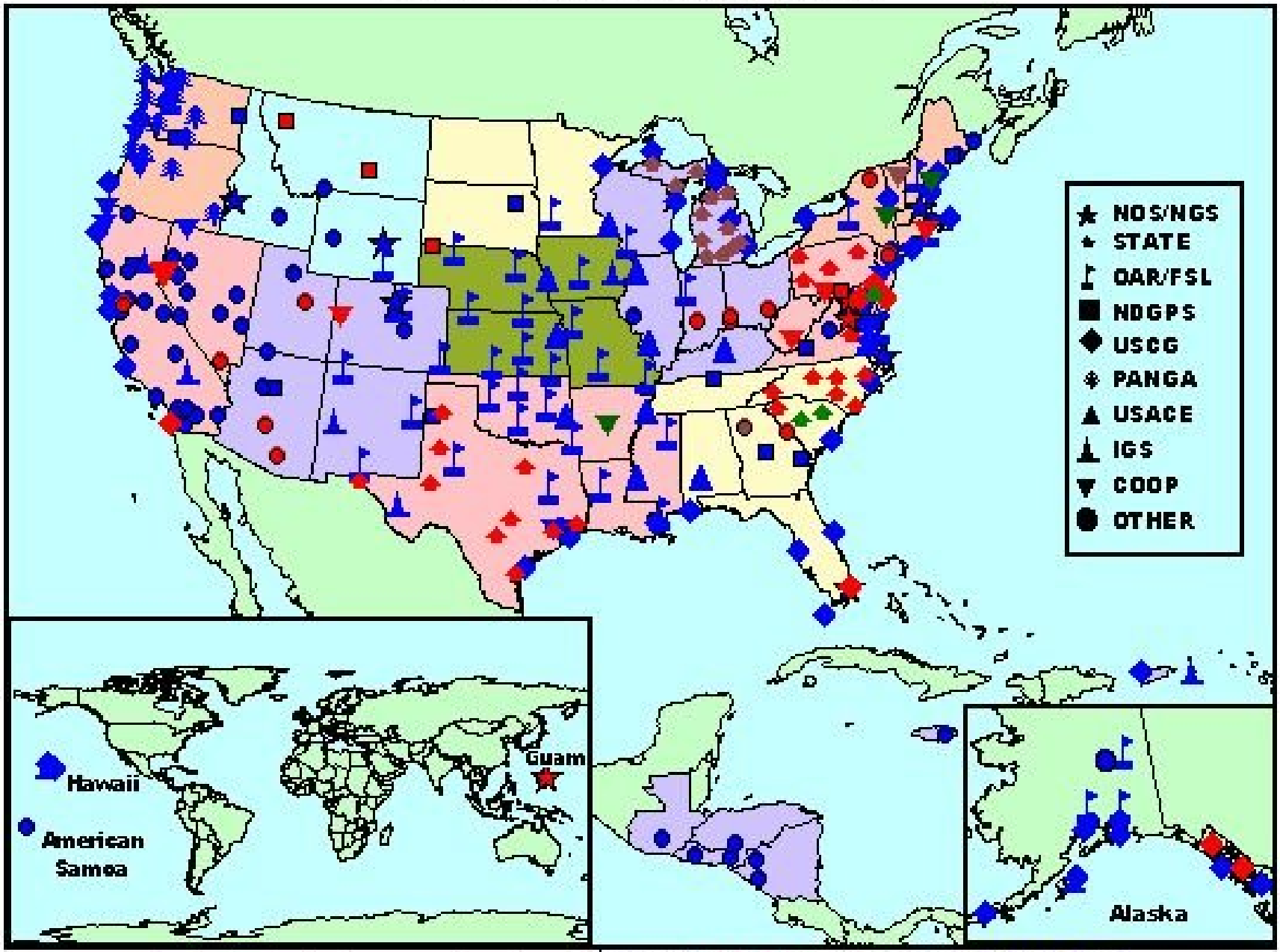
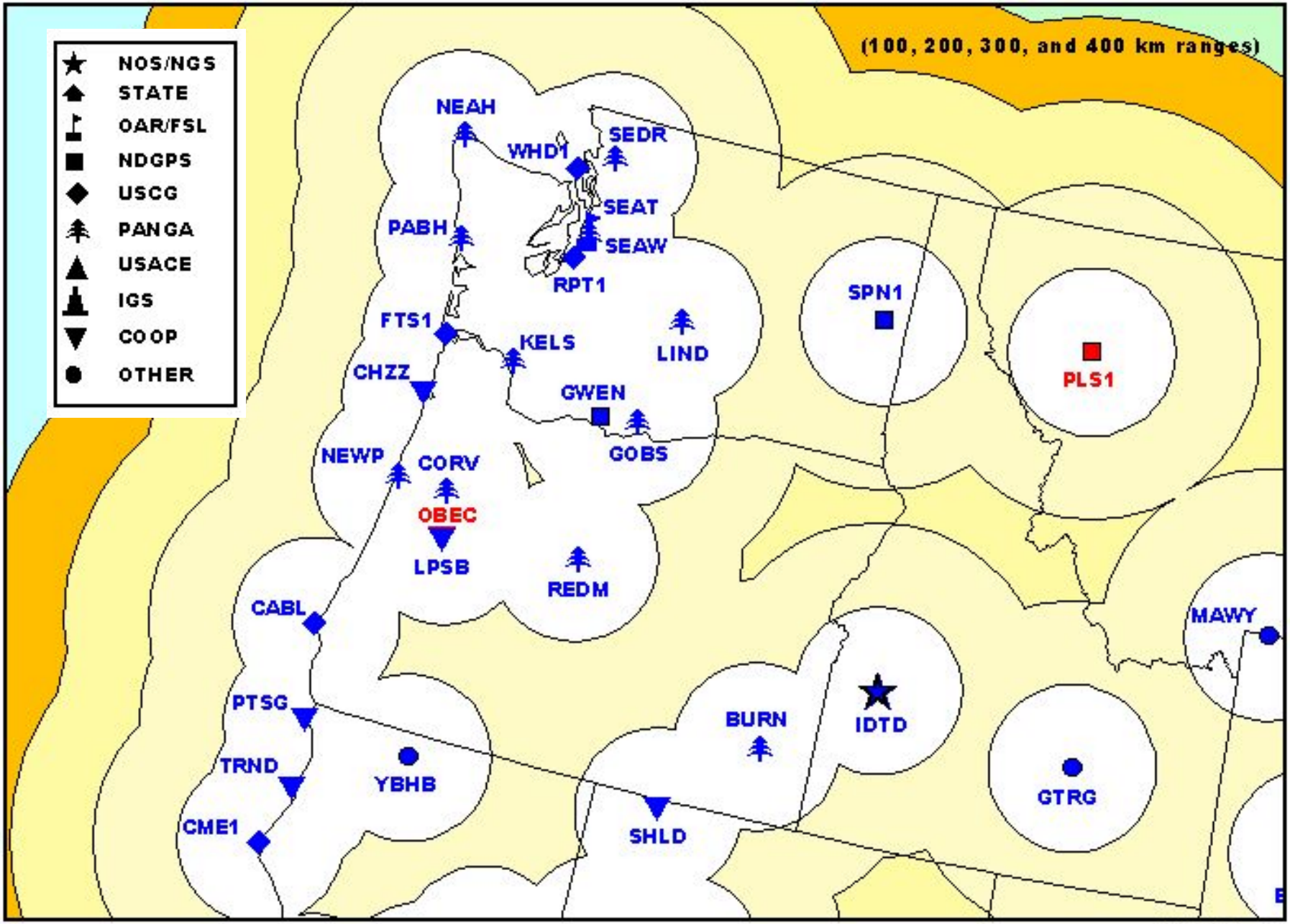


Figure 4. Contour map depicting height differences between NAVD 88 and NGVD 29 (units = mm).

CORS Coverage - September 2001



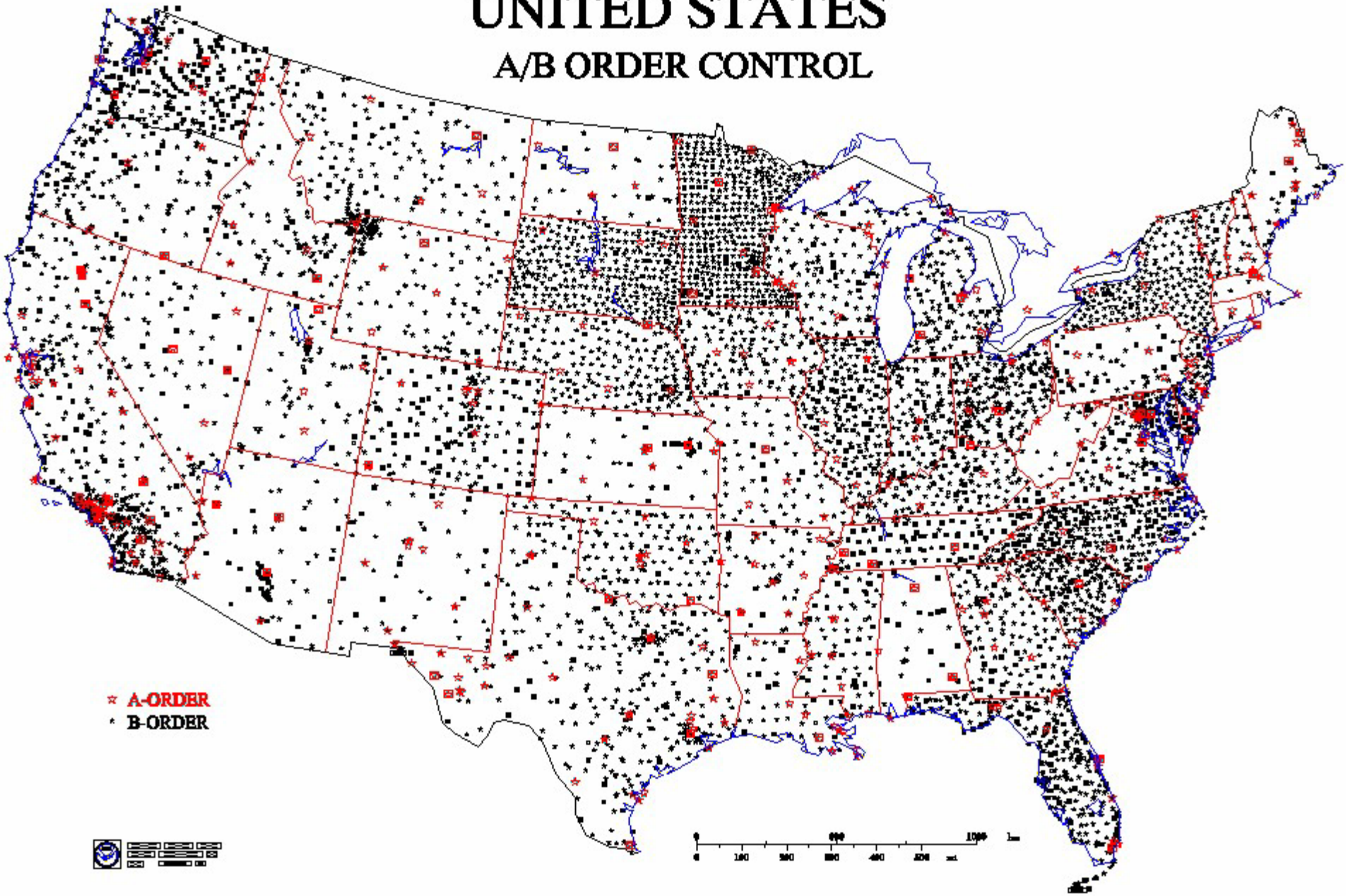
Symbol color denotes sampling rates: (1 second) (5 seconds) (15 seconds) (30 seconds)

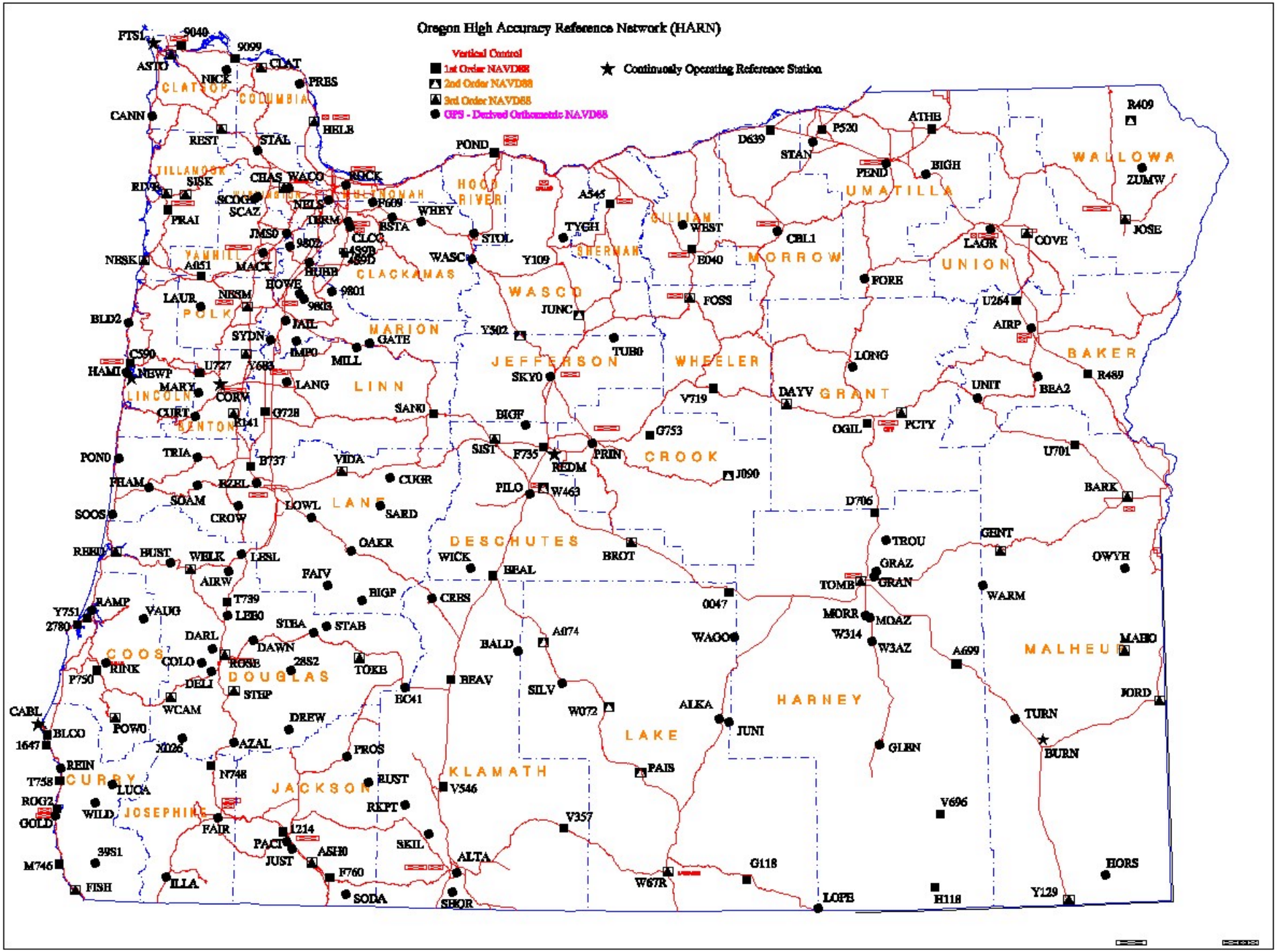


Symbol color denotes sampling rates: (1 second) (5 seconds) (15 seconds) (30 seconds)

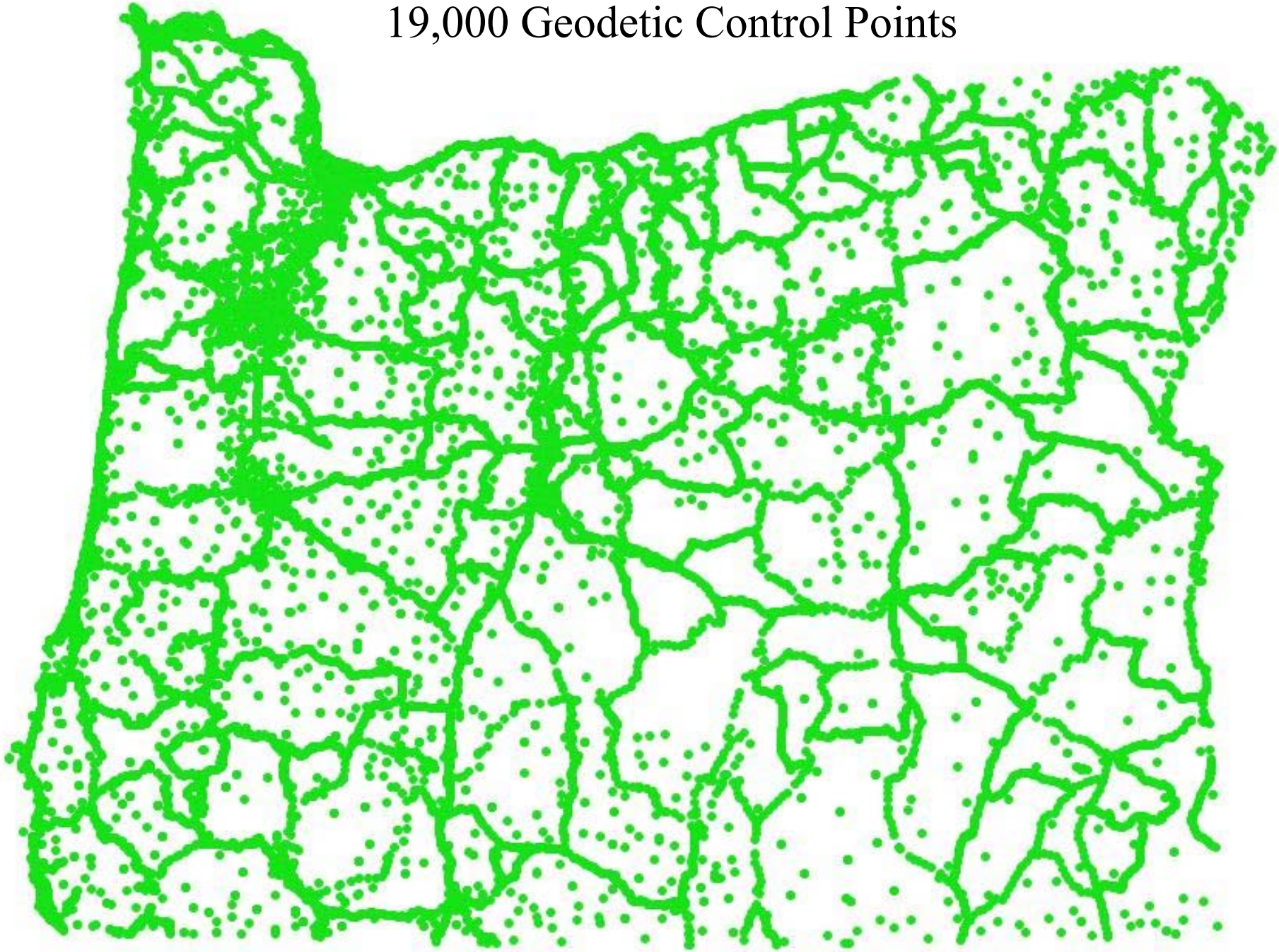
UNITED STATES

A/B ORDER CONTROL




Oregon High Accuracy Reference Network (HARN)
Vertical Control
1st Order NAVD88
2nd Order NAVD88
3rd Order NAVD88
GPS - Derived Orthometric NAVD88
Continuously Operating Reference Station
CLATSOP
COLUMBIA
TILLAMOOK
WASHINGTON
MULTNOMAH
HOOD RIVER
SHERMAN
GILLIAM
UMATILLA
WALLOWA
YAMHILL
CLACKAMAS
MORROW
UNION
WASCO
POLK
MARION
JEFFERSON
WHEELER
BAKER
LINCOLN
LINN
GRANT
BENTON
CROOK
LANE
DESCHUTES
COOS
DOUGLAS
HARNEY
MALHEUR
LAKE
CURRY
JACKSON
KLAMATH
JOSEPHINE
FTS1
9040
9099
ASTO
CLAT
NICK
PRES
CANN
HELE
REST
STAL
POND
ATHE
R409
D639
P520
STAN
PEND
BIGH
ZUMW
RIVE
SISK
CHAS
WACO
ROCK
SCOG
SCAZ
NELS
F609
WHEY
A545
PRAI
TERM
BSTA
TYGH
WEST
CBL1
JOSE
JMS0
9802
CLCC
STOL
LAGR
COVE
NESK
A051
MACK
HUBB
WASC
Y109
E040
FORE
HOWE
9801
9803
LAUR
NESM
FOSS
U264
BLD2
JAIL
JUNC
AIRP
SYDN
GATE
Y502
TUB0
C590
IMP0
MILL
LONG
HAMI
NEWP
U727
Y683
SKY0
R489
MARY
CORV
LANG
V719
DAYV
UNIT
BEA2
CURT
R141
G728
SAN0
BIGF
G753
OGIL
PCTY
PON0
TRIA
B737
VIDA
SIST
F735
REDM
PRIN
U701
FHAM
EZEL
CUGR
J090
PILO
W463
BARK
SOAM
LOWL
SARD
D706
SOOS
CROW
GENT
TROU
OAKR
REED
BUST
WELK
LESL
WICK
BROT
OWYH
GRAZ
AIRW
FAIV
BEAL
TOMB
GRAN
T739
BIGP
CRES
0047
WARM
RAMP
Y751
VAUG
LEB0
MORR
MOAZ
2780
STEA
STAB
A074
WAGO
W314
W3AZ
MAHO
DARL
DAWN
BALD
A699
COLO
ROSE
28S2
TOKE
RINK
P750
DELI
BEAV
SILV
JORD
STEP
EC41
ALKA
WCAM
W072
TURN
CABL
POW0
DREW
JUNI
BLCO
1647
X026
AZAL
PROS
GLEN
BURN
REIN
N748
PAIS
T758
LUCA
RUST
V546
ROG2
WILD
RKPT
V696
GOLD
FAIR
1214
V357
PACI
SKIL
39S1
ASH0
ALTA
M746
JUST
F760
G118
HORS
FISH
ILLA
SODA
SHOR
W67R
LOPE
H118
Y129

19,000 Geodetic Control Points



NGS Internet Page

www.ngs.noaa.gov

National Geodetic Survey

NGS, Positioning America for the Future

U.S. Department of Commerce

National Oceanic and Atmospheric Administration

National Ocean Service

aeronautical data | CORS GPS data | data sheets Find/Update a point | geodetic tool kit | PC software

Site Contents

- What We Do
- What's New
- Products & Services
- State Advisors
- Contracting Opportunities
- Our History
- FAQ
- Search

Project & Division pages

- FBN

NGS in the News

Check these out...

Request for Testers

Learn about opportunities to participate in the High Accuracy Nationwide Differential Global Positioning System (HANDGPS) sponsored by the Federal Highway Administration (FHWA), in association with the U.S. Coast Guard, the National Geodetic Survey, and several other Federal agencies.

CORS Users Forum

The National Geodetic Survey is organizing a one-day CORS Users Forum to be held on Friday, April 19, 2002 at the NOAA campus in Silver Spring, MD. The Forum's theme is "Coordinating Regional and Statewide CORS Networks."

NGS Data Sheets

formats and options for retrieving and updating NGS Data Sheets

DATA SHEETS (also known as DSDATA)

DSDATA is the traditional format of NGS data sheets.
It is the format found on NGS diskettes, and CD-ROMs
Program DSWIN may be used to search DSDATA files on the PC.

Documentation

- View a sample data sheet in DSDATA format
- View the DSDATA format specifications

NGS DataBase Search & Retrieval

A retrieval of DSDATA will result in one or more data sheets being returned to your browser, where, depending on the capabilities of your browser, you may view them and/or save them to a file for further processing.

- **Retrieve NGS Data Sheet(s)**
  - PIDs - Permanent Identifiers
  - Radial Search - provide center coordinates and radius in Miles
  - Rectangular Search - provide min/max coordinates
  - Station Name
  - Project Identifier
  - USGS Quad
  - Map Search - Interactive MAP retrieval.
- **Determine if a control point is publishable**

```
AI2002  DESIGNATION -  NELSON
AI2002  PID         -  AI2002
AI2002  STATE/COUNTY-  OR/MULTNOMAH
AI2002  USGS QUAD   -  LAKE OSWEGO (1984)
AI2002
AI2002                        *CURRENT SURVEY CONTROL
AI2002  ___________________________________________________________________
AI2002* NAD 83(1998)-  45 28 09.59603(N)    122 43 12.11644(W)     ADJUSTED
AI2002* NAVD 88     -       125.3    (meters)     411.     (feet)  GPS OBS
AI2002  ___________________________________________________________________
AI2002  EPOCH DATE  -        1997.00
AI2002  X           -  -2,421,934.847 (meters)                     COMP
AI2002  Y           -  -3,769,651.479 (meters)                     COMP
AI2002  Z           -   4,524,152.594 (meters)                     COMP
AI2002  LAPLACE CORR-           2.76  (seconds)                   DEFLEC99
AI2002  ELLIP HEIGHT-         102.48  (meters)                     GPS OBS
AI2002  GEOID HEIGHT-         -22.79  (meters)                     GEOID99
AI2002
AI2002  HORZ ORDER  -  A
AI2002  ELLP ORDER  -  THIRD     CLASS I
AI2002
AI2002.The horizontal coordinates were established by GPS observations
AI2002.and adjusted by the National Geodetic Survey in April 2000.
AI2002.This is a SPECIAL STATUS position.  See SPECIAL STATUS under the
AI2002.DATUM ITEM on the data sheet items page.
AI2002.The horizontal coordinates are valid at the epoch date displayed above.
AI2002.The epoch date for horizontal control is a decimal equivalence
AI2002.of Year/Month/Day.
AI2002
AI2002.The orthometric height was determined by GPS observations and a
AI2002.high-resolution geoid model.
AI2002
AI2002.The X, Y, and Z were computed from the position and the ellipsoidal ht.
AI2002
AI2002.The Laplace correction was computed from DEFLEC99 derived deflections.
AI2002
AI2002.The ellipsoidal height was determined by GPS observations
AI2002.and is referenced to NAD 83.
AI2002
AI2002.The geoid height was determined by GEOID99.
AI2002
AI2002;                    North         East     Units   Scale      Converg.
AI2002;SPC OR N     -   202,701.071 2,326,430.160   MT  0.99990832 -1 34 27.9
AI2002;UTM  10      - 5,035,127.530   521,884.847   MT  0.99960589 +0 11 58.5
AI2002
AI2002                          SUPERSEDED SURVEY CONTROL
AI2002
AI2002  NAD 83(1991)-  45 28 09.59419(N)    122 43 12.11647(W) AD(       ) B
AI2002  ELLIP HT    -         102.60  (m)                      GP(       ) 3 1
```

Current Survey Control

Superseded Survey Control

NGS Data Sheet

www.ngs.noaa.gov

NGS Data Sheet
(Continued)
www.ngs.noaa.gov

```
AI2002
AI2002.Superseded values are not recommended for survey control.
AI2002.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
AI2002.See file dsdata.txt to determine how the superseded data were derived.
AI2002
AI2002_MARKER: DH = HORIZONTAL CONTROL DISK
AI2002_SETTING: 7 = SET IN TOP OF CONCRETE MONUMENT
AI2002_STAMPING: NELSON 1998
AI2002_MAGNETIC: N = NO MAGNETIC MATERIAL
AI2002_STABILITY: C = MAY HOLD, BUT OF TYPE COMMONLY SUBJECT TO
AI2002+STABILITY: SURFACE MOTION
AI2002_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR
AI2002+SATELLITE: SATELLITE OBSERVATIONS - 1998
AI2002
AI2002  HISTORY     - Date     Condition        Recov. By
AI2002  HISTORY     - 1998     MONUMENTED       NGS
AI2002
AI2002                          STATION DESCRIPTION
AI2002
AI2002'DESCRIBED BY NATIONAL GEODETIC SURVEY 1998 (CLS)
AI2002'THE STATION IS LOCATED IN SOUTHWEST PORTLAND, IN THE WEST EDGE OF
AI2002'MULTNOMAH VILLAGE, IN THE SOUTH END OF GABRIEL CITY PARK, AT THE TOP
AI2002'OF A GRASSY SLOPE ON THE NORTH EDGE OF THE PARKING AREA FOR LITTLE
AI2002'GABRIEL CITY PARK.  OWNERSHIP--CITY OF PORTLAND.  CONTACT PORTLAND
AI2002'PARKS AND RECREATION, 6437 SE DIVISION STREET, PORTLAND, OR 97206.
AI2002'PHONE 503-823-3641.  TO REACH THE STATION FROM THE NEW POST OFFICE,
AI2002'MULTNOMAH STATION, IN THE NORTHWEST QUADRANT OF THE INTERSECTION OF
AI2002'MULTNOMAH BOULEVARD AND SW 40TH AVENUE, GO NORTH ON SW 40TH AVENUE FOR
AI2002'0.16 KM (0.10 MI) TO ITS T-JUNCTION WITH SW CANBY STREET.  TURN LEFT,
AI2002'WEST, ON SW CANBY STREET FOR 0.16 KM (0.10 MI) TO ITS DEAD END AND
AI2002'PARK ENTRANCE ON THE RIGHT.  TURN RIGHT, NORTHEAST, INTO THE PARKING
AI2002'AREA FOR 40 M (131.2 FT) TO THE STATION ON THE LEFT.  THE STATION IS A
AI2002'STANDARD NGS HORIZONTAL DISK SET INTO THE TOP OF A 30 CM ROUND
AI2002'CONCRETE MONUMENT FLUSH WITH THE GROUND.  IT IS 34.1 M (111.9 FT) EAST
AI2002'FROM A WATER FOUNTAIN, 30.2 M (99.1 FT) NORTHWEST AND ACROSS PARKING
AI2002'AREA FROM A POWER POLE NUMBER 1243 WITH GUY WIRE, TRANSFORMER AND
AI2002'STREET LIGHTS, 24.0 M (78.7 FT) WEST FROM THE EAST END OF THE CONCRETE
AI2002'CURB ON THE NORTH EDGE OF THE PARKING AREA AT OPENING FOR ASPHALT
AI2002'PATHWAY LEADING NORTHWEST, 23.8 M (78.1 FT) NORTHEAST FROM THE
AI2002'NORTHEAST LEG OF A GABRIEL PARK SIGN, 9.2 M (30.2 FT) SOUTH FROM THE
AI2002'SOUTH EDGE OF THE ASPHALT PATHWAY, AND 4.9 M (16.1 FT) NORTH FROM THE
AI2002'NORTH EDGE OF THE CONCRETE CURB.
```

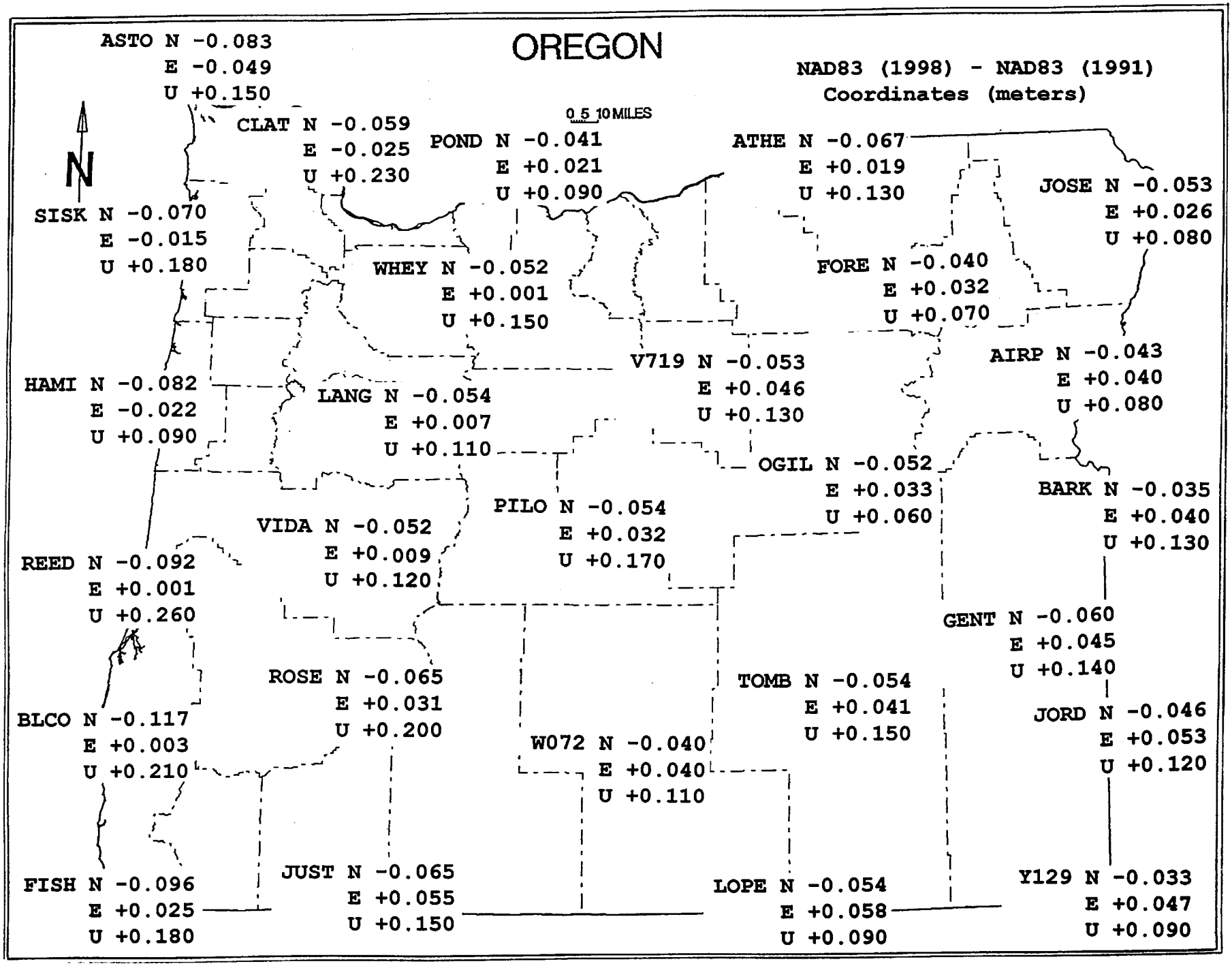
```
RB1314 ***********************************************************************
RB1314  DESIGNATION -  ATHENA
RB1314  PID         -  RB1314
RB1314  STATE/COUNTY-  OR/UMATILLA
RB1314  USGS QUAD   -  ATHENA (1974)
RB1314
RB1314                        *CURRENT SURVEY CONTROL
RB1314  ___________________________________________________________________
RB1314* NAD 83(1998)-  45 48 45.21128(N)    118 28 15.16974(W)     ADJUSTED
RB1314* NAVD 88     -       570.509  (meters)    1871.74   (feet)  ADJUSTED
RB1314  ___________________________________________________________________
RB1314  EPOCH DATE  -        1998.80
RB1314  X           -  -2,123,116.550 (meters)                     COMP
RB1314  Y           -  -3,915,037.939 (meters)                     COMP
RB1314  Z           -   4,551,145.007 (meters)                     COMP
RB1314  LAPLACE CORR-           9.23  (seconds)                    DEFLEC99
RB1314  ELLIP HEIGHT-         550.12  (meters)                     GPS OBS
RB1314  GEOID HEIGHT-         -20.25  (meters)                     GEOID99
RB1314  DYNAMIC HT  -         570.445 (meters)    1871.54   (feet) COMP
RB1314  MODELED GRAV-     980,485.7   (mgal)                       NAVD 88
RB1314
RB1314  HORZ ORDER  -  A
RB1314  VERT ORDER  -  SECOND    CLASS I
RB1314  ELLP ORDER  -  THIRD     CLASS II
RB1314

RB1314|-------------------------------------------------------------------|
RB1314
RB1314                        SUPERSEDED SURVEY CONTROL
RB1314
RB1314  NAD 83(1991)-  45 48 45.20911(N)    118 28 15.16884(W) AD(       ) B
RB1314  ELLIP HT    -       550.25   (m)                       GP(       ) 3 1
RB1314  NAD 83(1991)-  45 48 45.20934(N)    118 28 15.17237(W) AD(       ) 3
RB1314  NAD 83(1986)-  45 48 45.21302(N)    118 28 15.16344(W) AD(       ) 3
RB1314  NAD 27      -  45 48 45.73533(N)    118 28 11.26759(W) AD(       ) 3
RB1314  NGVD 29     -       568.9    (m)         1866.     (f) VERT ANG
RB1314
```

Station - ATHENA

Datum / Adjustment	Latitude	Longitude	Ellipsoid Height	Diff. (meters)
NAD27	45 48 45.73533	118 28 11.26759	n/a	
NAD83(1986)	45 48 45.21302	118 28 15.16344	n/a	N –16.128 E –84.119
NAD83(1991) (Adjusted)	45 48 45.20934	118 28 15.17237	n/a	N -0.114 E -0.193
NAD83(1991) (GPS)	45 48 45.20911	118 28 15.16884	550.25	N -0.007 E +0.076
NAD83(1998)	45 48 45.21128	118 28 15.16974	550.12	N +0.067 E -0.019 U -0.130
NAD83(NSRS)	45 48 45.21128	118 28 15.16974	550.12	???????

Station - E 141

Datum / Adjustment	Latitude	Longitude	Ellipsoid Height	Diff. (meters)
NAD27	44 23 28.94010	123 17 23.63779	n/a	
NAD83(1986)	44 23 28.38153	123 17 27.98977	n/a	N -17.241 E -96.321
NAD83(1991)	44 23 28.35830	123 17 27.95859	59.08	N -0.717 E +0.690
NAD83(1998)	44 23 28.35994	123 17 27.95932	59.00	N +0.050 E -0.016 U -0.080
NAD83(NSRS)	44 23 28.35994	123 17 27.95932	59.00	???????
ITRF (1997)	44 23 28.37982	123 17 28.01013	58.59	N +0.614 E -1.125 U -0.410


OREGON
NAD83 (1998) - NAD83 (1991)
Coordinates (meters)
0 5 10 MILES
N
ASTO N -0.083
E -0.049
U +0.150
CLAT N -0.059
E -0.025
U +0.230
POND N -0.041
E +0.021
U +0.090
ATHE N -0.067
E +0.019
U +0.130
JOSE N -0.053
E +0.026
U +0.080
SISK N -0.070
E -0.015
U +0.180
WHEY N -0.052
E +0.001
U +0.150
FORE N -0.040
E +0.032
U +0.070
V719 N -0.053
E +0.046
U +0.130
AIRP N -0.043
E +0.040
U +0.080
HAMI N -0.082
E -0.022
U +0.090
LANG N -0.054
E +0.007
U +0.110
OGIL N -0.052
E +0.033
U +0.060
BARK N -0.035
E +0.040
U +0.130
PILO N -0.054
E +0.032
U +0.170
VIDA N -0.052
E +0.009
U +0.120
REED N -0.092
E +0.001
U +0.260
GENT N -0.060
E +0.045
U +0.140
ROSE N -0.065
E +0.031
U +0.200
TOMB N -0.054
E +0.041
U +0.150
JORD N -0.046
E +0.053
U +0.120
BLCO N -0.117
E +0.003
U +0.210
W072 N -0.040
E +0.040
U +0.110
FISH N -0.096
E +0.025
U +0.180
JUST N -0.065
E +0.055
U +0.150
LOPE N -0.054
E +0.058
U +0.090
Y129 N -0.033
E +0.047
U +0.090

Sample Data Sheets

```
CJ0085  DESIGNATION -  866 5530 TIDAL 13
CJ0085  ____________________________________________________________
CJ0085* NAD 83(1992)-  32 46 5233453(N)    079 55 28.70969(W)      ADJUSTED
CJ0085* NAVD 88     -         2.219  (meters)       7.28   (feet)  ADJUSTED
CJ0085  ____________________________________________________________
CJ0085  ELLIP HEIGHT-         -30.96  (meters)                     GPS OBS
CJ0085
CJ0085  HORZ ORDER  -  FIRST
CJ0085  VERT ORDER  -  FIRST     CLASS I
```

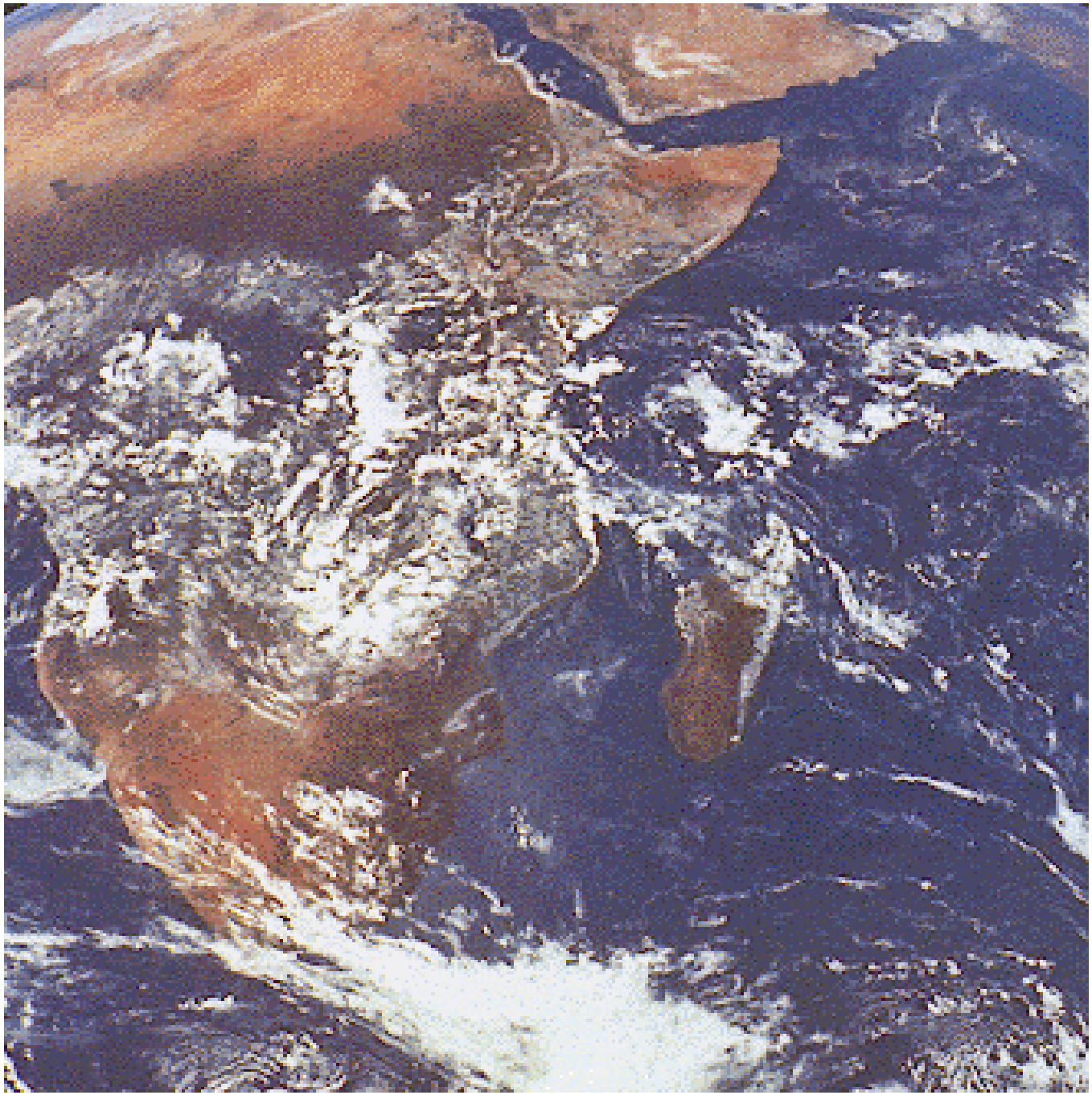
```
*************************************************************************
CJ0578  DESIGNATION -  10 012
CJ0578
CJ0578  ____________________________________________________________
CJ0578* NAD 83(1986)-  32 47 31.79561(N)    079 54 20.99377(W)      ADJUSTED
CJ0578* NAVD 88     -         5.336  (meters)      17.51   (feet)  ADJUSTED
CJ0578  ____________________________________________________________
CJ0578
CJ0578  HORZ ORDER  -  FIRST
CJ0578  VERT ORDER  -  FIRST     CLASS II
```

NOTE - Different adjustments for the positions

Improving Positional Accuracy

Network	Time Span	Network Accuracy	Local Accuracy
NAD 27	1927 - 1986	10 meters	First order (1 part in 0.1 million)
NAD 83	1986 - 1991	1 meter	First order (1 part in 0.1 million)
HARN	1991 - 1997	0.1 meter	B-order (1 part in 1 million) A-order (1 part in 10 million)
CORS	1996 -	0.01 meter	0.01 meter

“Real World”



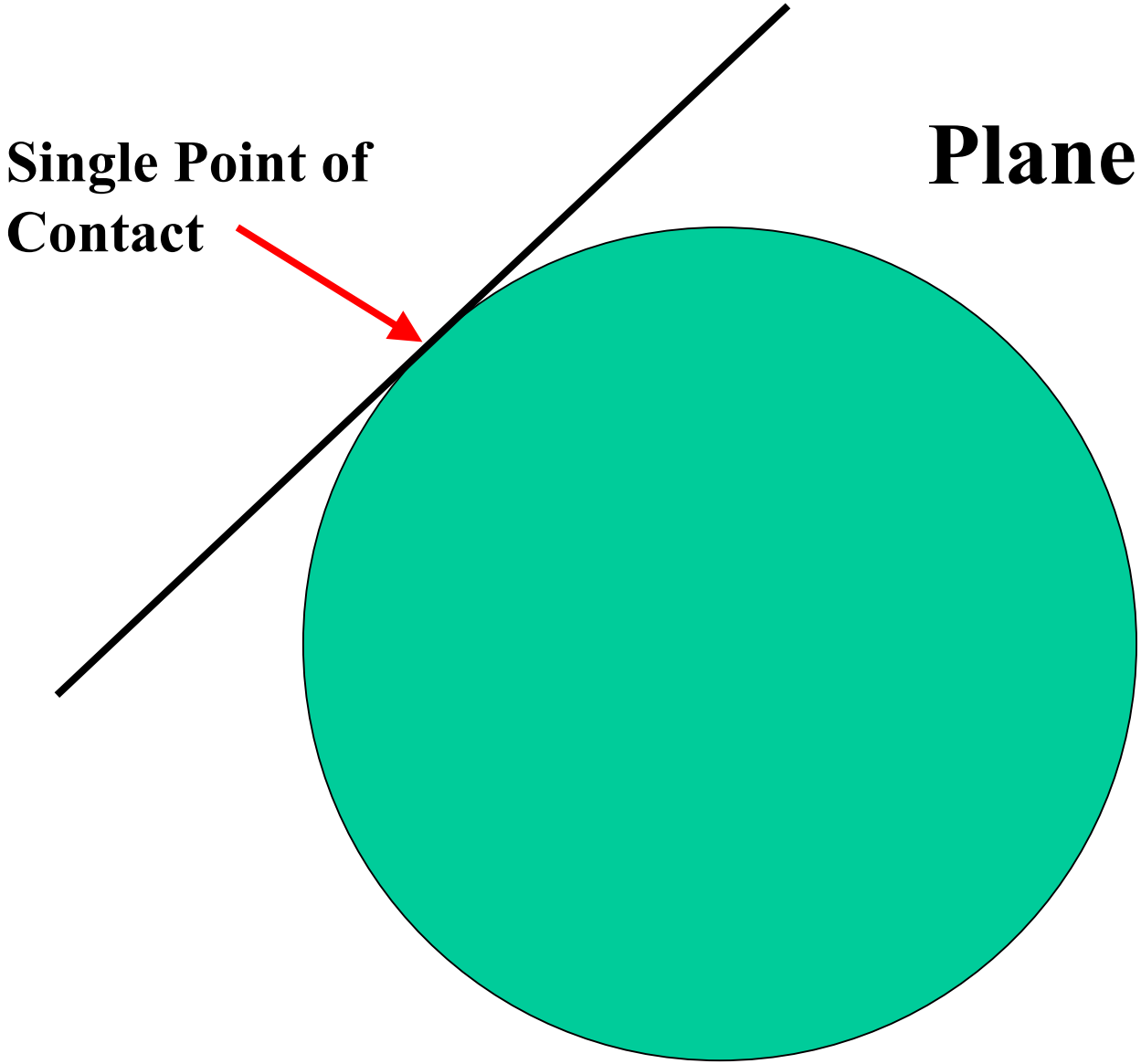
“Mapping World”

Plane Coordinate Systems

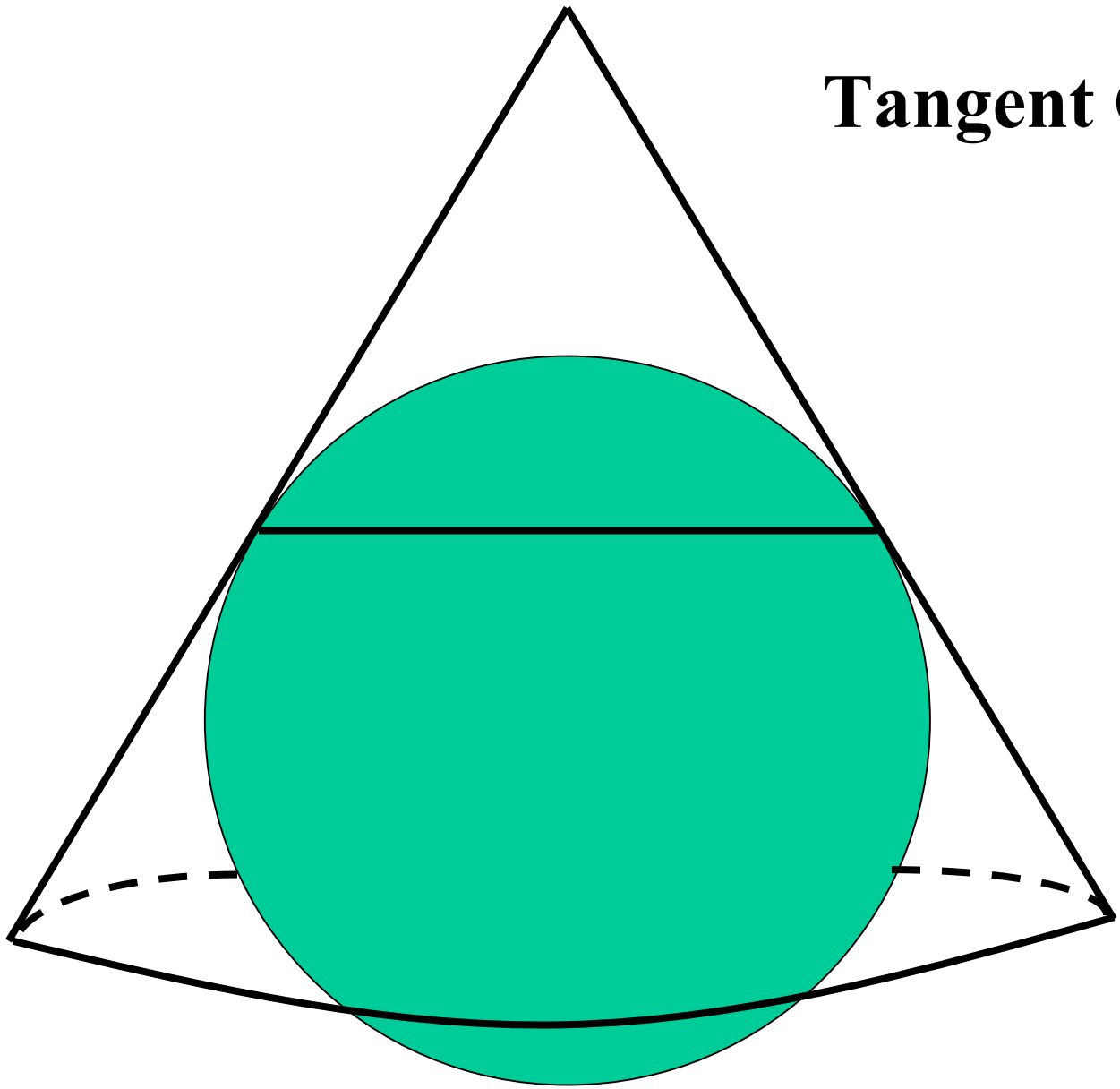
- **State plane and universal transverse mercator grid coordinates are a direct mathematical conversion from latitude and longitude to a cartesian northing and easting (y & x) coordinate system**

- **<u>Must</u> maintain the same datum tag**
  - **e.g., NAD 83(1991) as the latitude and longitude**

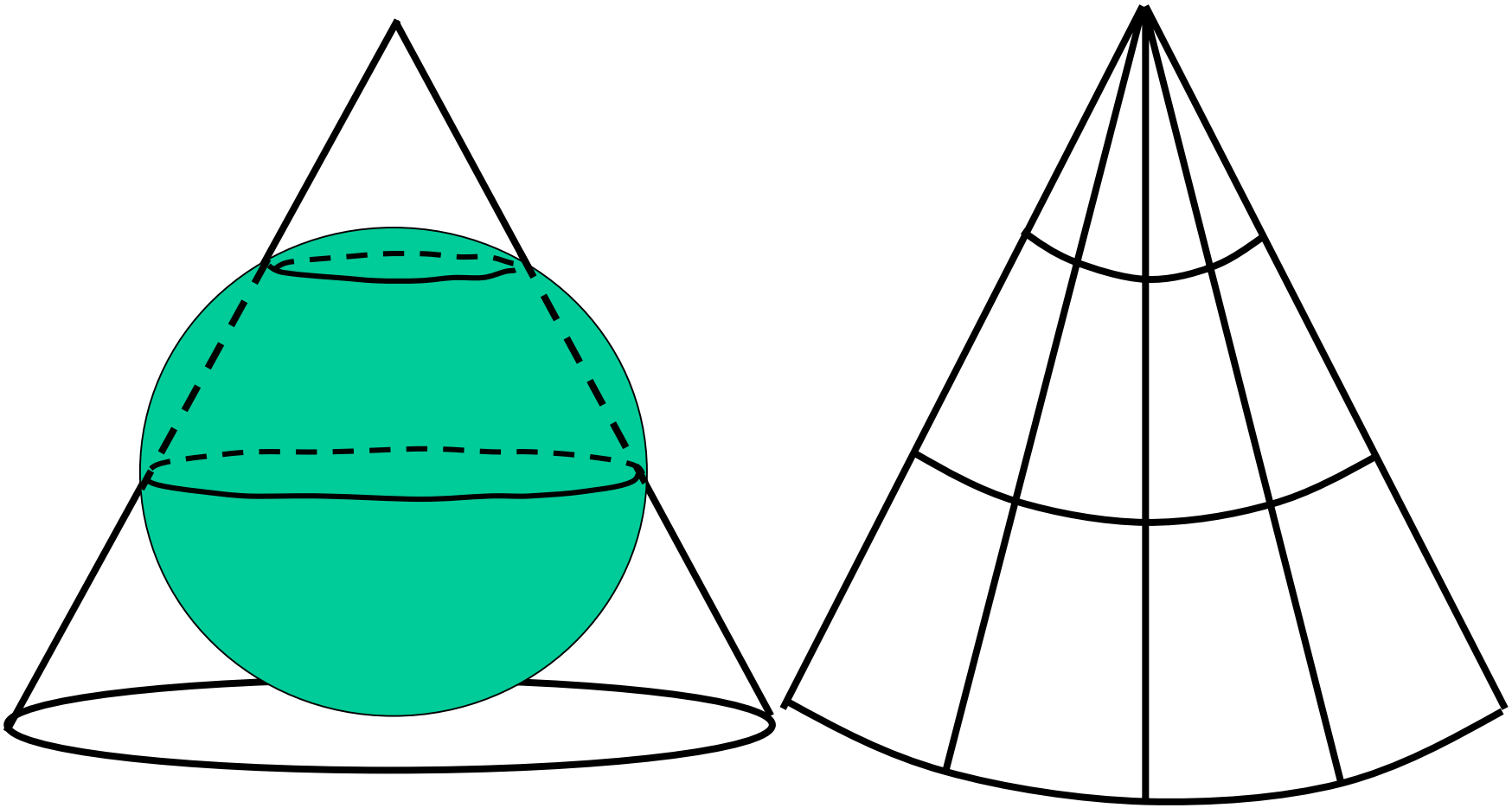
Plane Projection



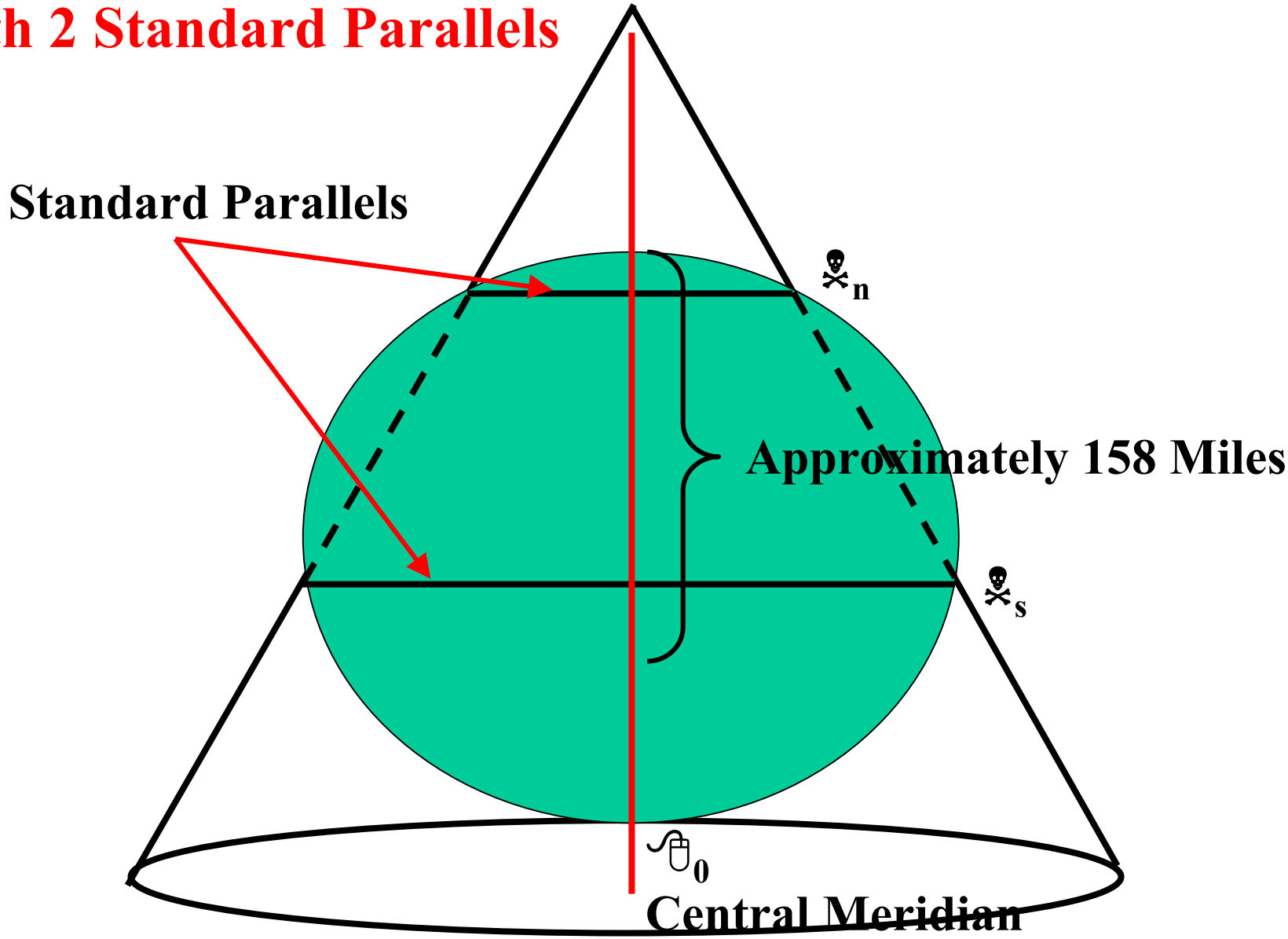
Tangent Cone



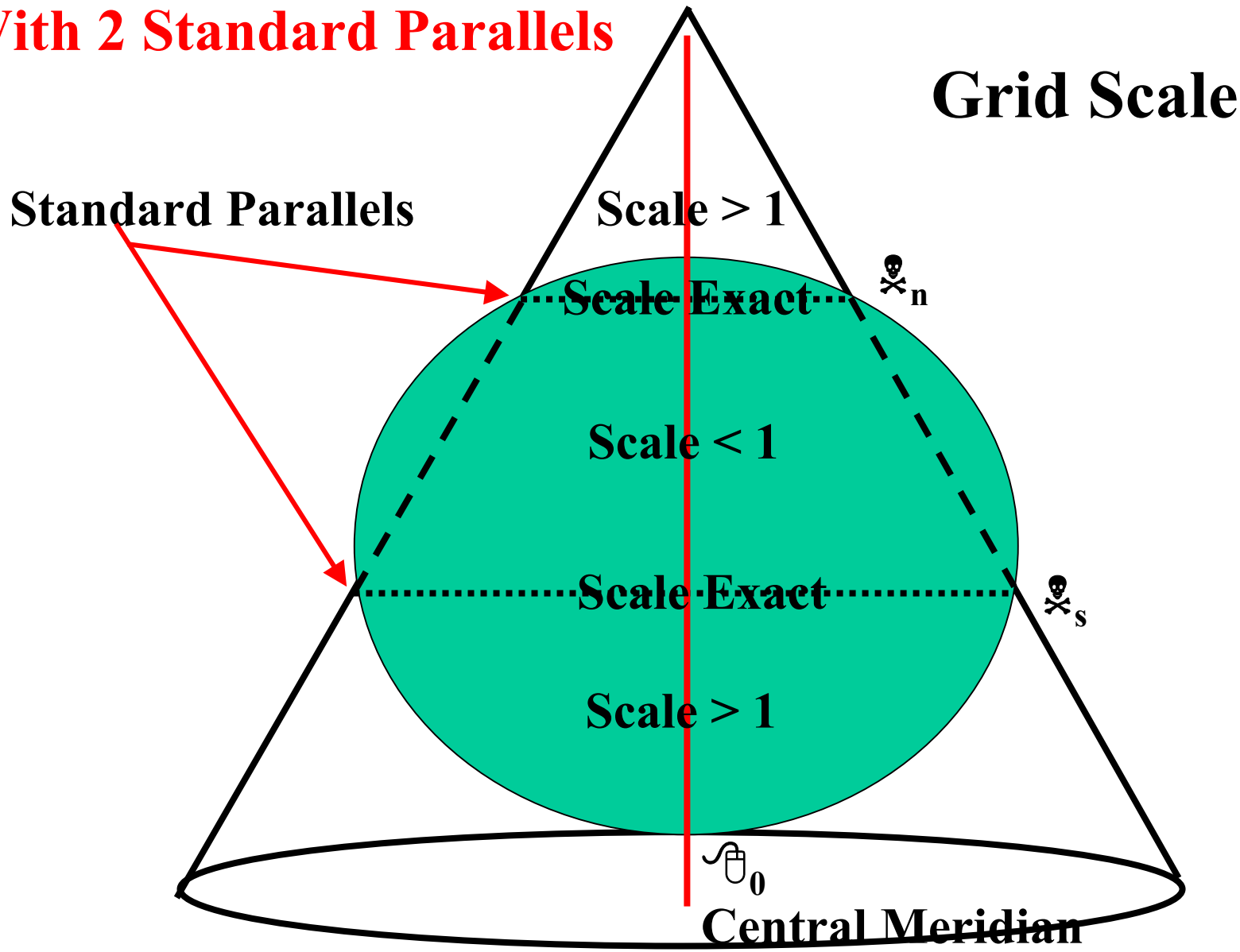
Secant Cone



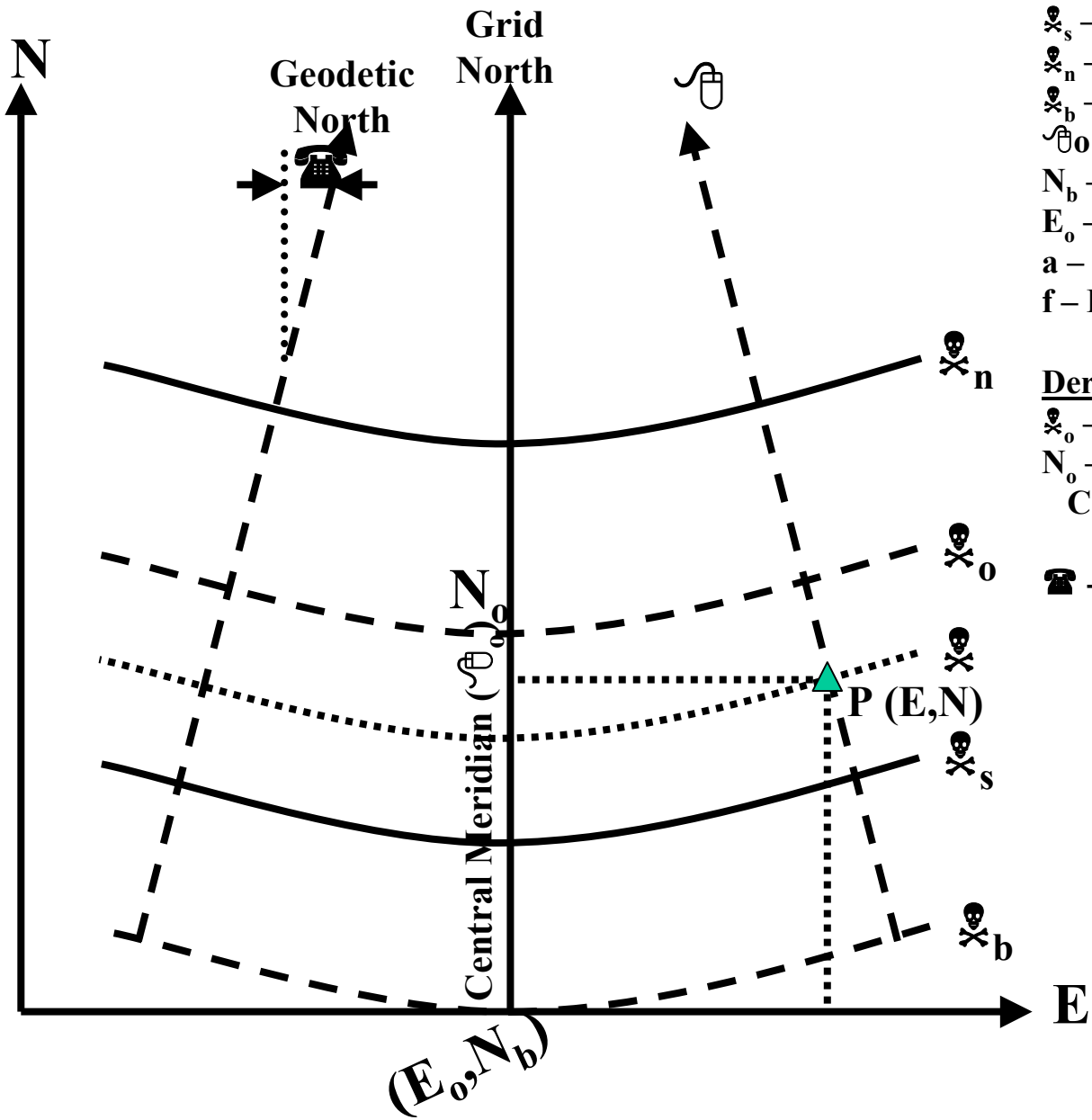
Lambert Conformal Conic With 2 Standard Parallels



Lambert Conformal Conic With 2 Standard Parallels



Lambert Conformal Conic Projection



Zone Defining Constants

- ☠$_s$ – South Standard Parallel
- ☠$_n$ – North Standard Parallel
- ☠$_b$ – Latitude of Grid Origin
- 🖱$_o$ – Central Meridian
- N_b – Northing of Grid Origin
- E_o – Easting of Central Meridian
- a – Semi-major Axis of Ellipsoid
- f – Ellipsoid Flattening

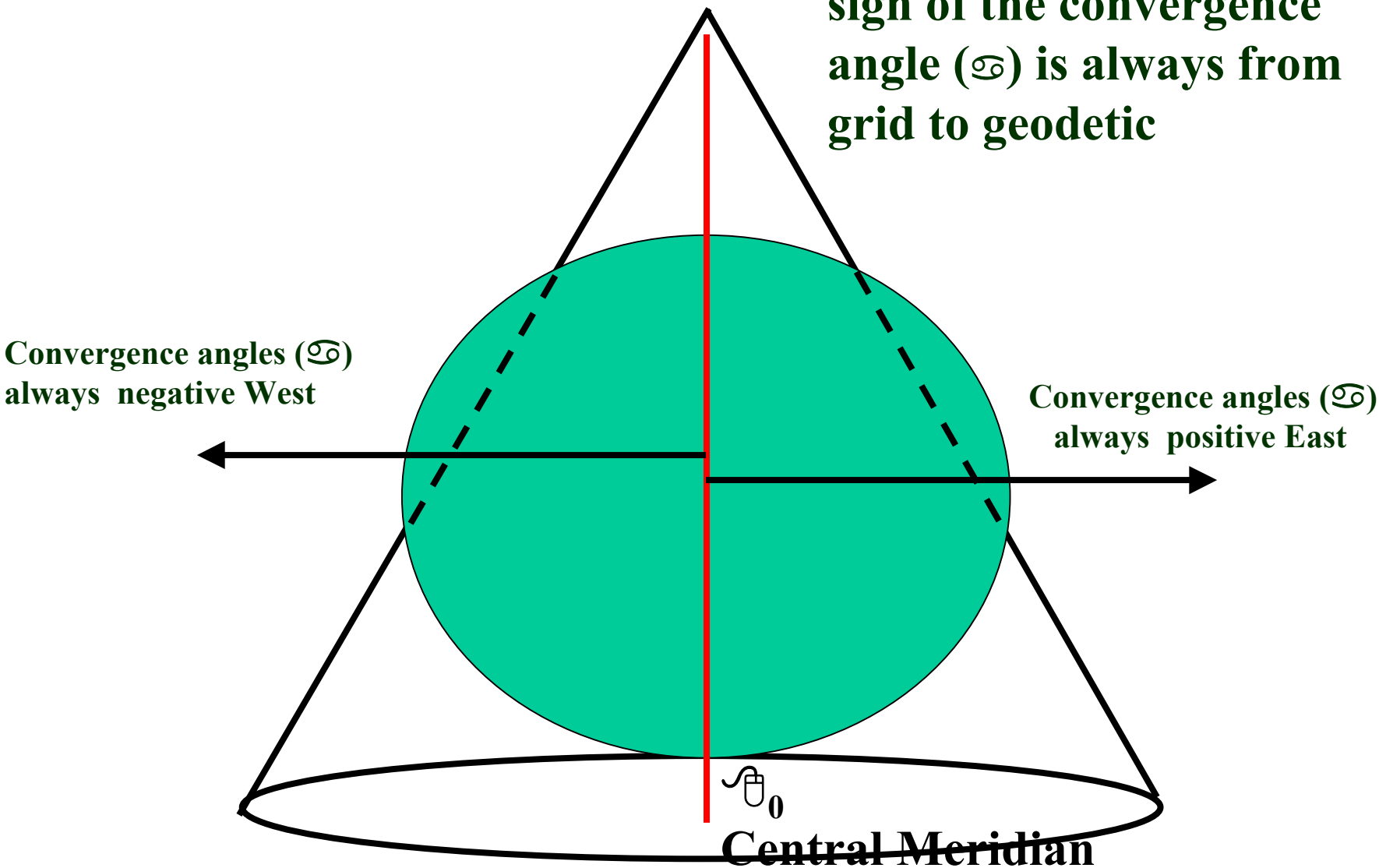
Derived Constants

- ☠$_o$ – Central Parallel
- N_o – Northing at Intersection of Central Parallel / Central Meridian

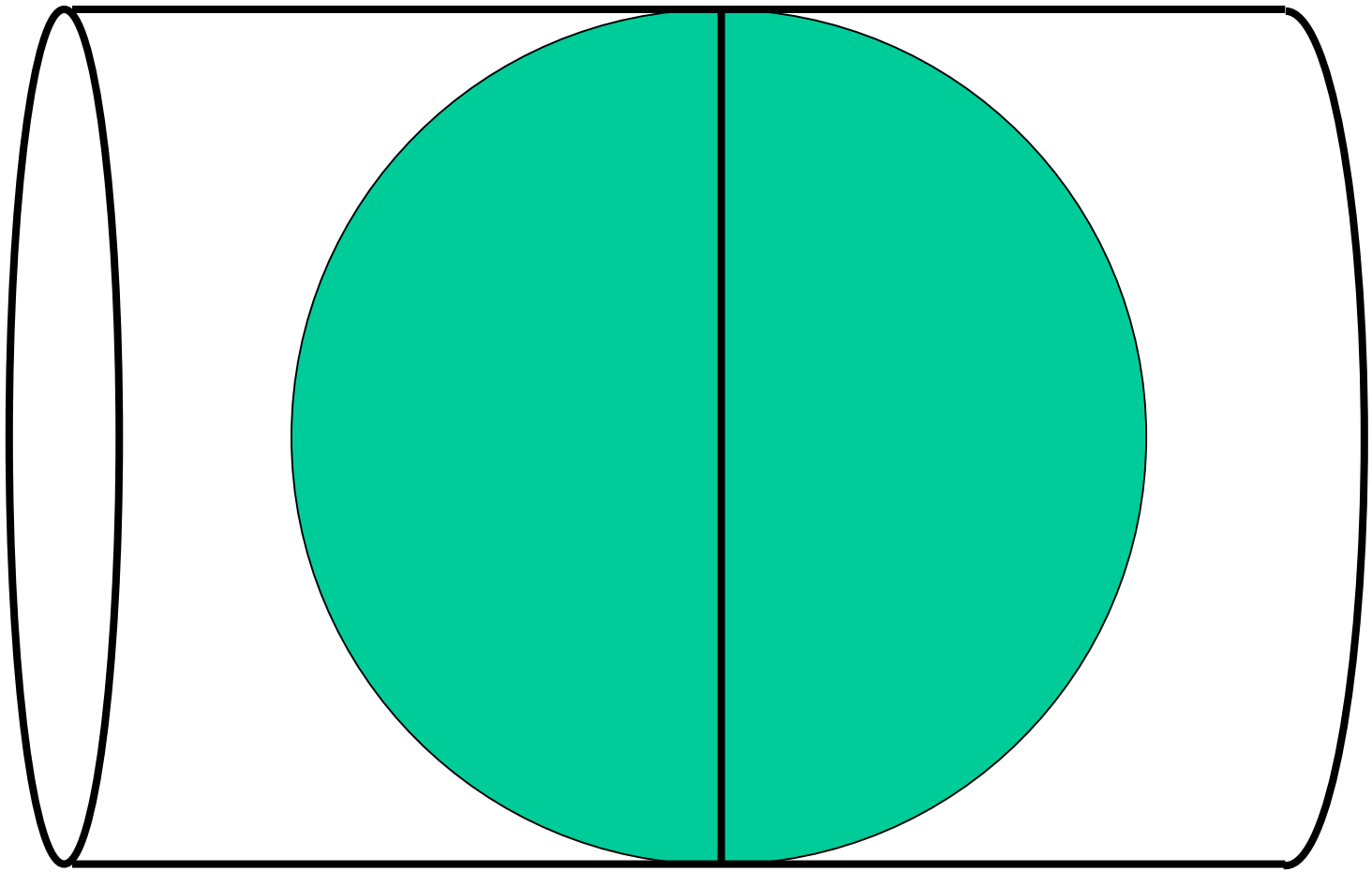
☎ - Convergence Angle

Lambert Conformal Conic With 2 Standard Parallels

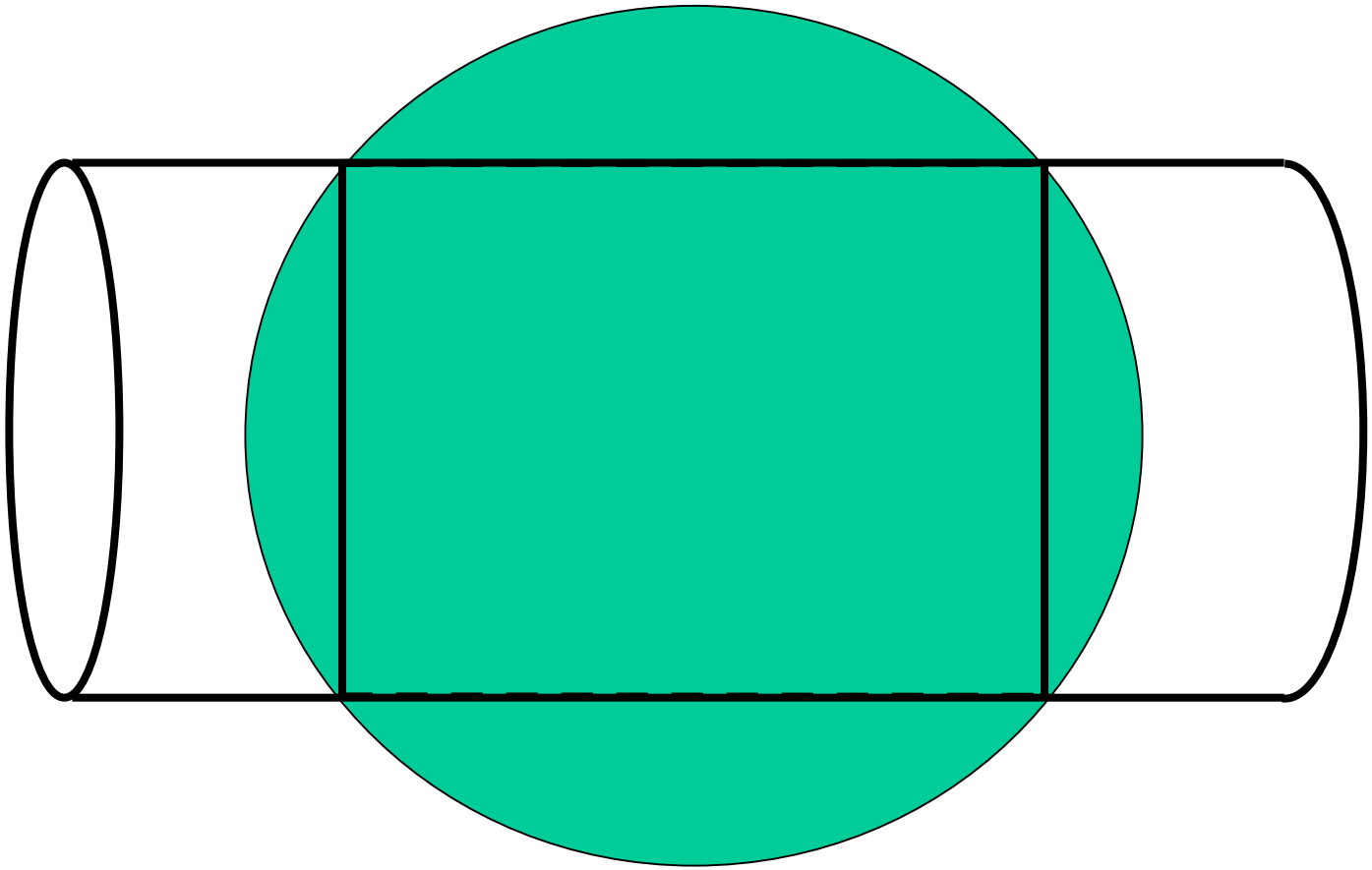
The convention of the sign of the convergence angle (♋) is always from grid to geodetic



Tangent Cylinder

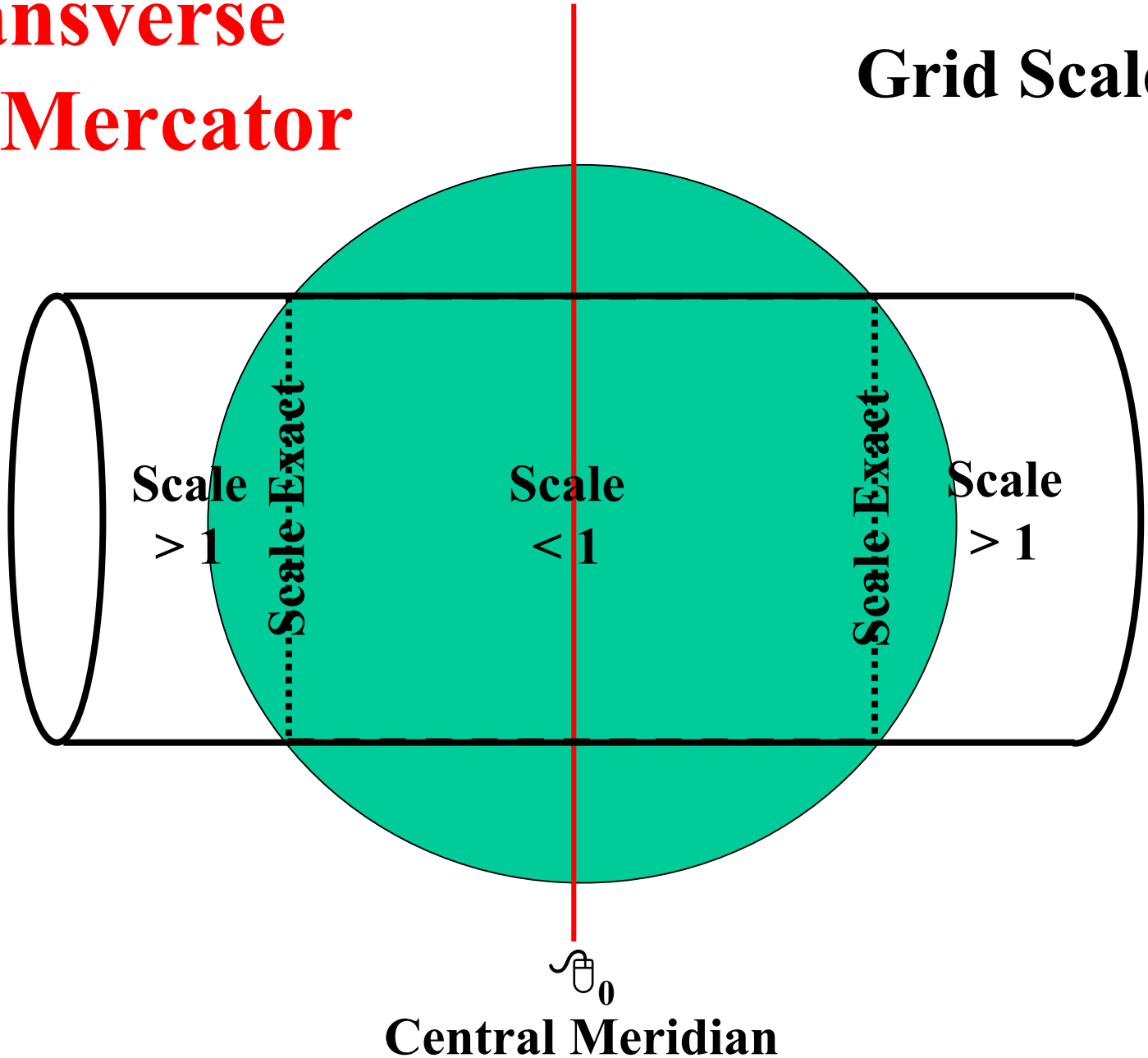


Secant Cylinder

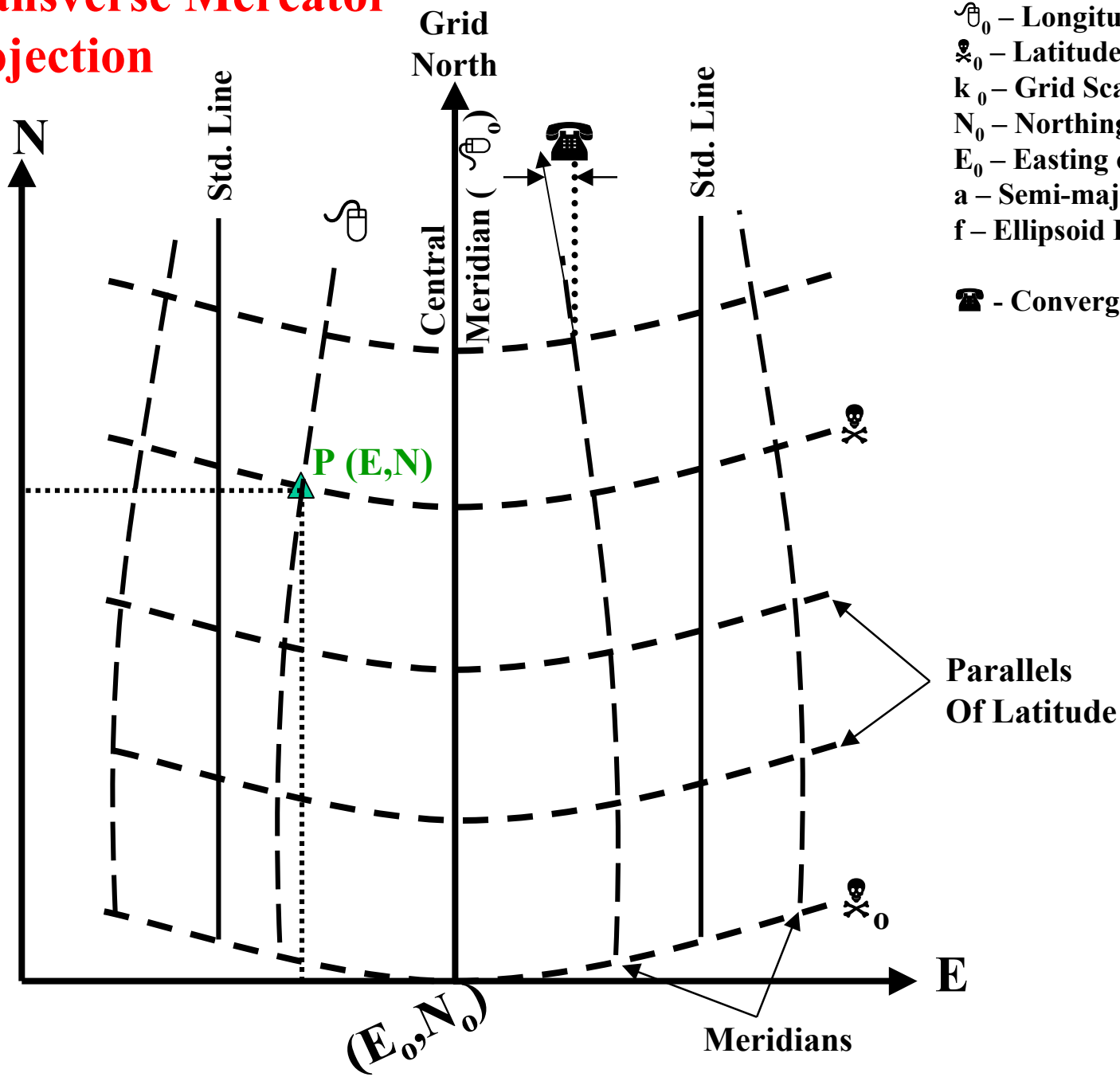


Transverse Mercator

Grid Scale



Transverse Mercator Projection



Zone Defining Constants

λ_0 – Longitude of Central Meridian
ϕ_0 – Latitude of Grid Origin
k_0 – Grid Scale Factor along CM
N_0 – Northing of Grid Origin
E_0 – Easting of Central Meridian
a – Semi-major Axis of Ellipsoid
f – Ellipsoid Flattening

☎ - Convergence Angle

Universal Transverse Mercator (UTM)

http://164.214.2.59/GandG/pubs.html

The Universal Grids: Universal Transverse Mercator (UTM) and Universal Polar Stereographic (UPS) - TM8358.2

Transverse Mercator Projection

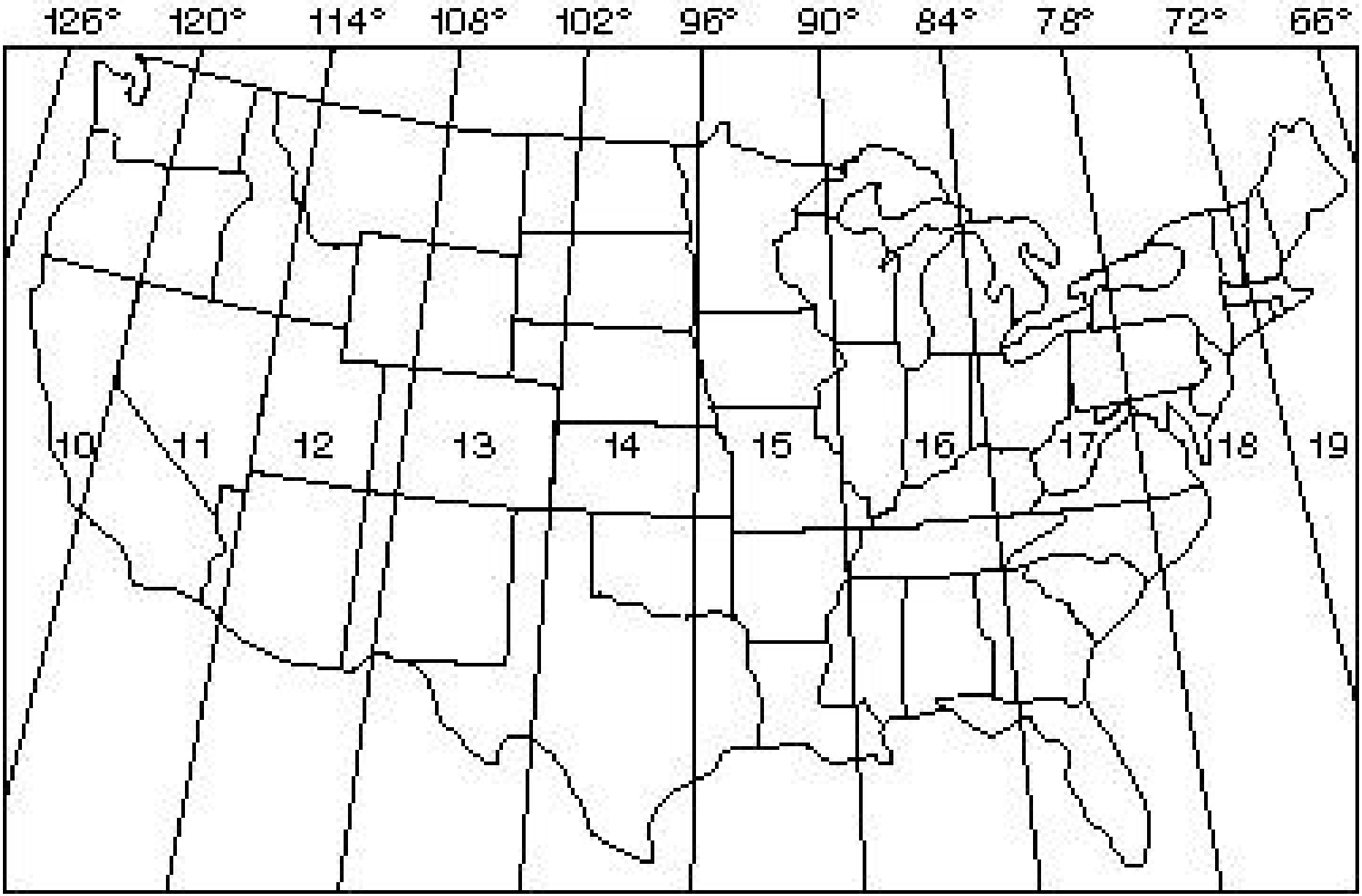
Zones 6° Longitude World-Wide

Northing Origin (0 meters- Northern Hemisphere) at the Equator

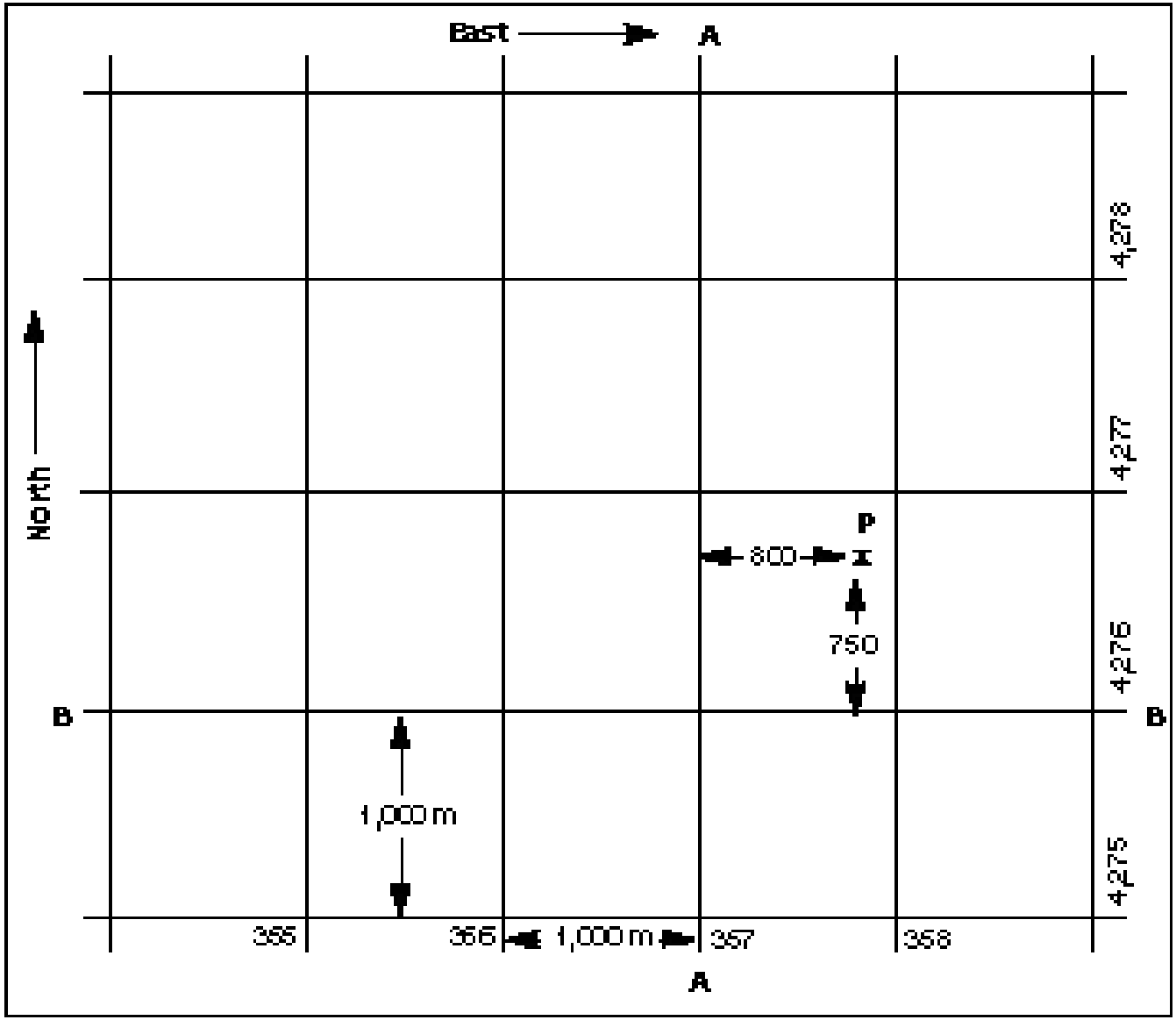
Easting Origin (500,000 meters) at Central Meridian of Each Zone

NAD 27 and NAD 83 both defined in meters

NAD 27 to NAD 83 shift = 200 - 225 meters for U.S.



Universal Transverse Mercator Grid



The grid value of line A-A is 357,000 meters east. The grid value of line B-B is 4,276,000 meters north. Point P is 800 meters east and 750 meters north of the grid lines Therefore, the grid coordinates of point P are north 4,276,750 and east 357,800.

State Plane Coordinate Systems

NOAA Manual NOS NGS - 5 "State Plane Coordinate System of 1983"

Lambert Conformal Conic and Transverse Mercator Projections

International, State and County Boundaries

NAD 27 - Coordinates in U.S. Survey Feet

NAD 83 - Coordinates Metric w/State Defined Foot Conversion

1 Meter = 3.280833333 U.S. Survey Feet

1 Meter = 3.280839895 International Feet

NAD 27 to NAD 83 <u>VERY</u> Large Positional Shifts

Coordinate Changes (State Plane)

Station: MACK

Oregon North Zone #3601 (NAD 27 / NAD 83)

Northing	Easting	Converg Angle	Scale Factor
566,621.00 ft.	1,322,228.91 ft.	-1° 51' 53.2"	0.99989466
172,692.357 m.	2,293,325.353 m.	-1° 51' 56.3"	0.99989465

(566,574.84 ft.)*	(7,524,018.26 ft.)*	NAD83
(566,575.97 ft.)#	(7,524,033.31 ft.)#	
(1.13 ft.)	(15.05 ft.)	

* Converted using U.S. Survey Foot, 1 m. = 3.2808333333 ft.

\# Converted using International Foot, 1 m. = 3.2808398501 ft.

What You Need To Use The State Plane Coordinate Systems

N & E State Plane Coordinates for Control Points

Azimuths

- Conversion from astronomic to geodetic
- Conversion from geodetic to grid (mapping angle)

Distances

- Reduction from horizontal to ellipsoidal
  "Sea-level reduction factor"
- Correction for grid scale factor
- Combined factor

```
RD4219 ***********************************************************************
RD4219  FBN          -  This is a Candidate for Federal Base Network Control.
RD4219  PACS         -  This is a Primary Airport Control Station.
RD4219  DESIGNATION -  MACK
RD4219  PID          -  RD4219
RD4219  STATE/COUNTY-  OR/YAMHILL
RD4219  USGS QUAD    -  MC MINNVILLE (1971)
RD4219
RD4219                        *CURRENT SURVEY CONTROL
RD4219  ___________________________________________________________________
RD4219* NAD 83(1991)-  45 11 25.69789(N)    123 07 50.47261(W)     ADJUSTED
RD4219* NAVD 88      -        48.37   (meters)     158.7    (feet)  GPS OBS
RD4219  ___________________________________________________________________
RD4219  X            -  -2,460,907.532 (meters)                     COMP
RD4219  Y            -  -3,770,608.617 (meters)                     COMP
RD4219  Z            -   4,502,309.881 (meters)                     COMP
RD4219  LAPLACE CORR-         -10.11  (seconds)                     DEFLEC96
RD4219  ELLIP HEIGHT-          26.05  (meters)                      GPS OBS
RD4219  GEOID HEIGHT-         -22.13  (meters)                      GEOID96
RD4219
RD4219


RD4219;                     North         East     Units   Scale      Converg.
RD4219;SPC OR N      -   172,692.357 2,293,325.353   MT  0.99989465 -1 51 56.3
RD4219;UTM  10       - 5,004,118.045   489,734.062   MT  0.99960130 -0 05 33.8
RD4219
```

Transformations

- **NADCON**
  - **Geographic coordinates between NAD27 and NAD83**
- **SPCS83**
  - **NAD83 state plane to NAD83 geographic**
- **UTMS**
  - **Geographic to Universal Transverse Mercator**
- **VERTCON**
  - **Elevations between NGVD 29 and NAVD 88**
- **CORPSCON**
  - **All of the above**
- **HTDP**
  - **Horizontal time-dependent position using velocities**