Introduction to GPS
Or "Where the Hell Are We?"
John Gardner Dunn & Damon K. Broglie

Given 20 to 30 highly motivated undergraduates, a classroom environment with PowerPoint slide capabilities, computer terminals, several hand held global positioning system receivers and large outdoor venue, the instructor will conduct a three hour block of instruction including an explanation, demonstration and practical application of GPS capabilities.

At the conclusion of three modules of instruction each student will be able to:

- Find their position on the earth in at least one of three coordinate systems by means of a GPS receiver
- Create waypoints in the GPS
- Find objects hidden a field at BFL using the GPS
- Upload data from the GPS to a computer and
- Construct a simple map with the above data

Module I (50min): Didactic in WEL 2.256.

Materials: PowerPoint slide projector and handouts to each student

•Introduction to the graticule (grid), Universal Transverse Mercator (UTM), degree minute second, and decimal degree systems.
•Brief history and theory of GPS, satellite array and differential
•Capabilities and limitations including sources of error
•Operating instructions

Module II (25 min): Field demonstration, Suzie's Meadow (BFL)

Materials: 1 GPS receiver, 1 GPS for instructor

•Powering up and satellite acquisition
•Converting between UTM, ddd mmm' ss"and dd.dddddd
•Entering waypoints and enabling tracklog
•Map displays
•Goto feature

Module III (60 min): Practical application, BFL
Materials 1 GPS per student/pod, items hidden in the field but marked as waypoints in each GPS to include: homework drop coupons, test points etc.
•Scavenger hunt
•Rally back at BFL Room 119

Module IV (50 min): uploading and mapping, BFL Room 119

Materials: 1 GPS, computer per pod

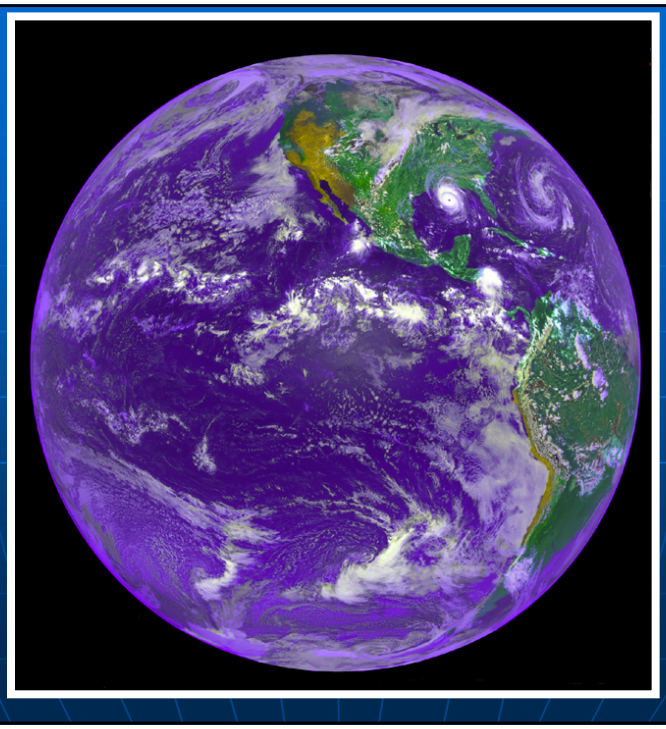
•Connecting
•Uploading
•Map software, displaying and printing
•GIS introduction

Please take your seats.

Introduction to Global Positioning Systems (GPS)

or

"Where the hell are we?"



Class and Lab

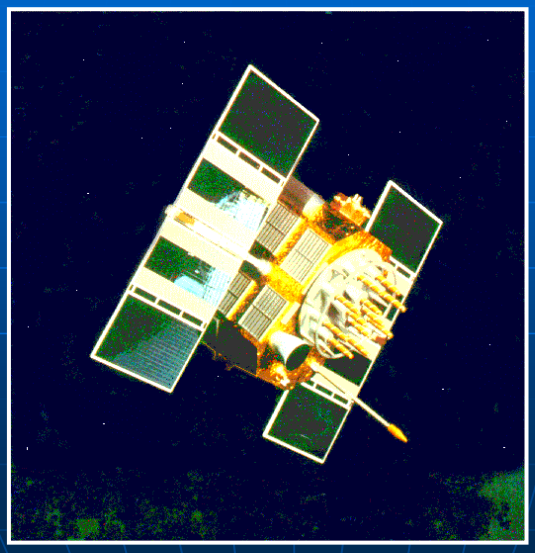
- Explanation
- Demonstration
- Practical Application

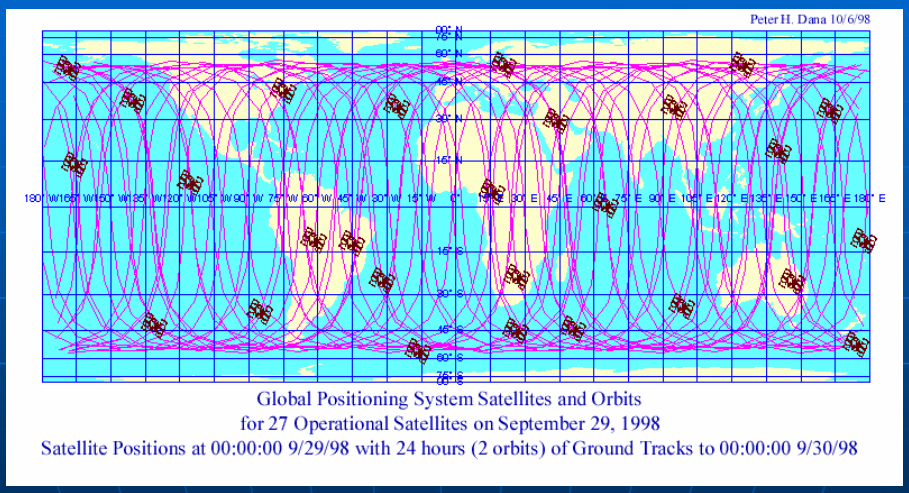
GPS
(Global Positioning System)

[acronym, noun]

A network of satellites that continuously transmit coded information, which makes it possible to precisely identify locations on earth by measuring distance from satellites.

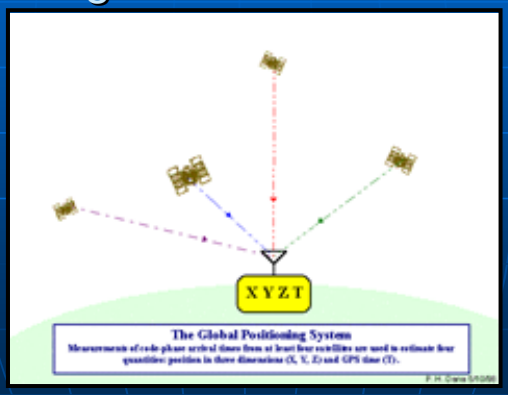
A network of satellites…



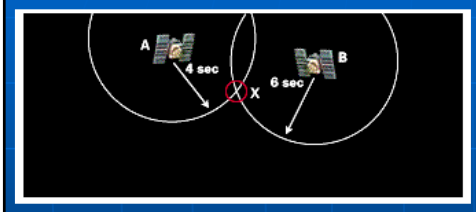


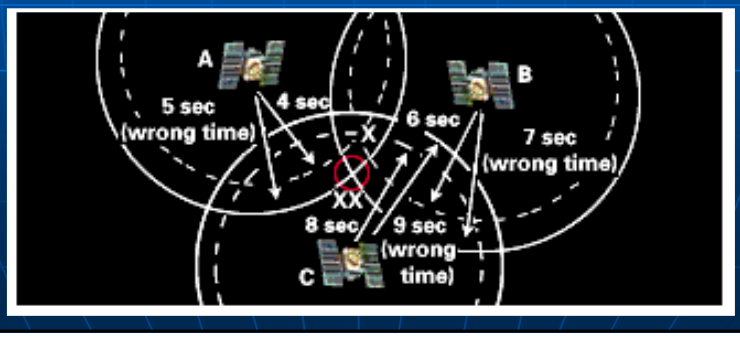
...that continuously transmit coded information…

…which makes it possible to precisely identify locations on earth by measuring distance from satellites

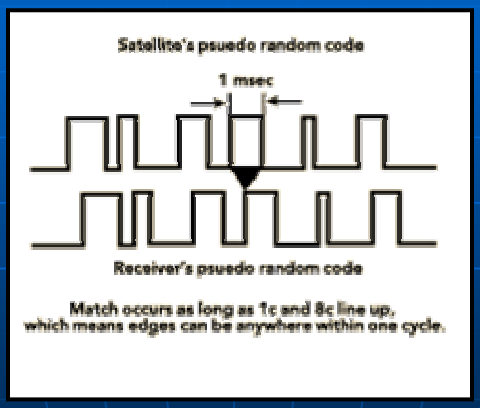


How does it all work?





Pseudo Random Code



So what if I'm a little off?

v = d/t

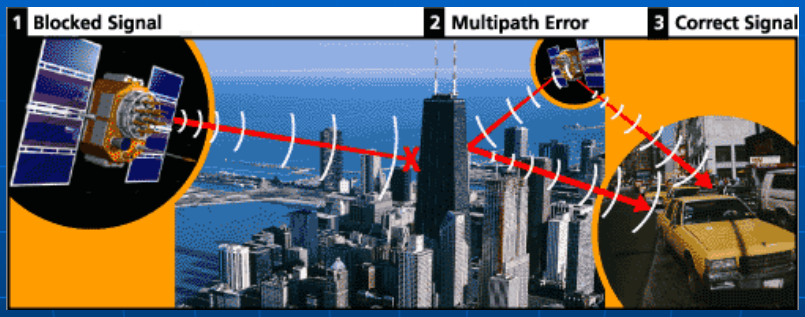
300000000 m/s = d/.001 sec

300000000 * .001 = d

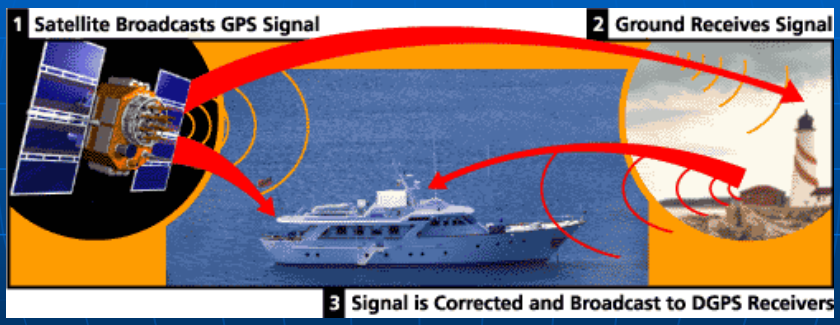
300000 meters = d

That's 186 miles!

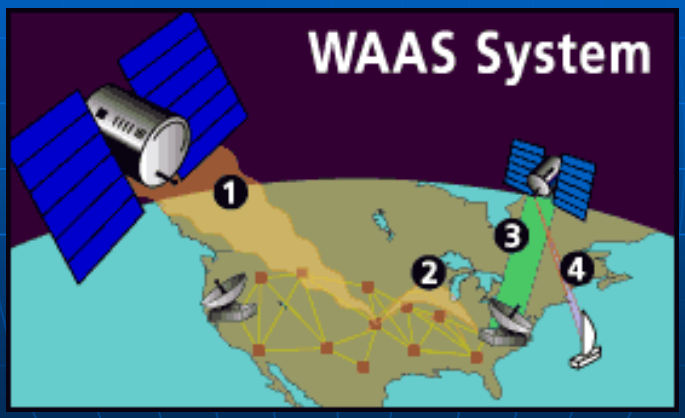
Errrors

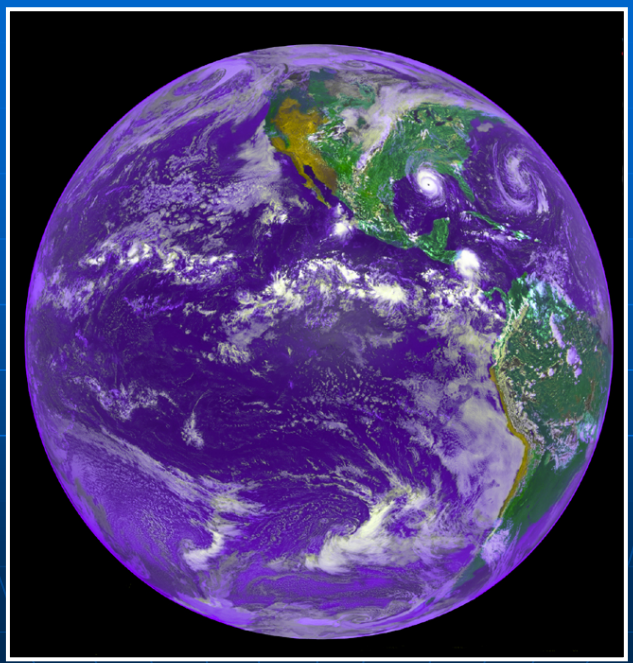


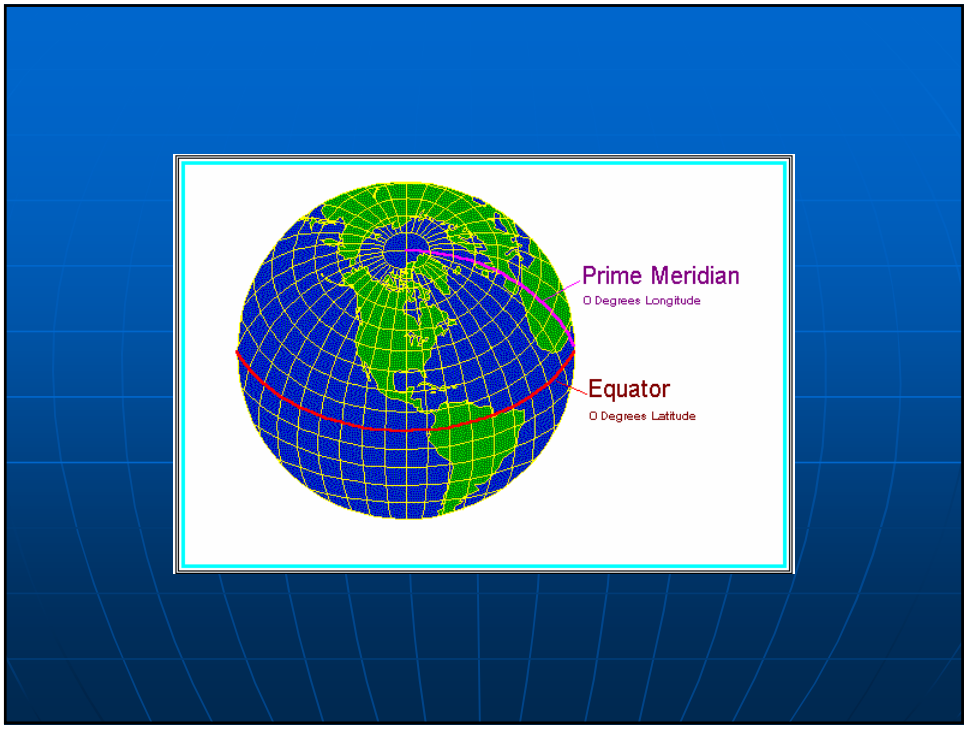
DGPS
(Differential Geographic Positioning System)

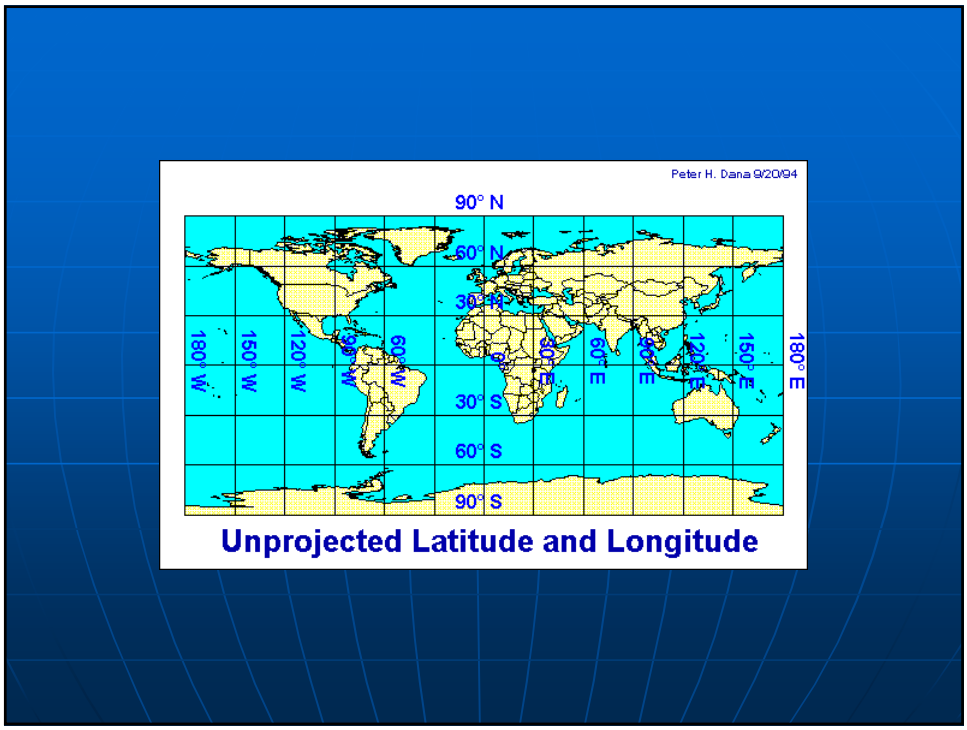


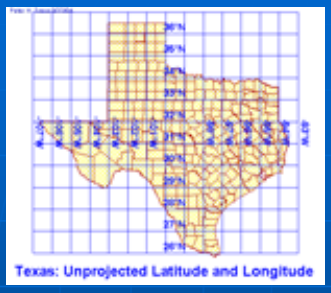
WAAS
(Wide Area Augmentation System)

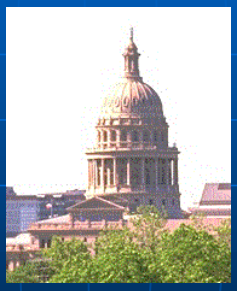





Prime Meridian
0 Degrees Longitude
Equator
0 Degrees Latitude


Peter H. Dana 9/20/94
90° N
60° N
30° N
0°
30° S
60° S
90° S
180° W
150° W
120° W
90° W
60° W
30° W
30° E
60° E
90° E
120° E
150° E
180° E
Unprojected Latitude and Longitude


Texas: Unprojected Latitude and Longitude



The Austin Capitol Dome Liberty Star Horizontal Control Station
(The star in the hand of the Goddess of Liberty)

Datum	Coordinate System	Coordinates	Units
NAD 83	Geodetic Latitude, Longitude	30:16:28.82 N, 97:44:25.19 W	deg:min:sec
NAD-27	Geodetic Latitude, Longitude	30:16:28.03 N, 97:44:24.09 W	deg:min:sec
WGS-72	Geodetic Latitude, Longitude	30:16:28.68 N, 97:44:25.75 W	deg:min:sec
NAD-83	UTM Easting, Northing, Zone	621160.98, 3349893.53 14 R	meters
NAD-27	UTM Easting, Northing, Zone	621193.18, 3349688.21	meters
NAD-83	Military Grid Reference System	14RPU2116149894	meters
NAD-27	Military Grid Reference System	14RPJ2119349688	meters
NAD-83	State Plane, TX C 4203 Easting, Northing	949465.059, 3070309.475	meters
NAD-27	State Plane, TX C 4203 Easting, Northing	2818560.55, 230591.76	feet
NAD-83	State Plane, TX SC 4204 Easting, Northing	721201.977, 4271229.432	meters
NAD-27	State Plane, TX SC 4204 Easting, Northing	2397741.25, 889749.98	feet
WGS-72	World Geographic Reference System	FJHA1516	deg. and min.
	VOR-DME Bearing, Distance, VOR ID	230.46, 2.271, 114.6 Ch.93 AUS	deg,nmi,id
	Loran-C GRI 7980 W, X, Y, Z TDs	10998.9,24795.0,47040.8,63902.3	microsec.
	U.S. Postal Zip Code (5-digits)	78705	

One Location Described by Different Coordinate Systems

P. H. Dana 8/20/98

Degrees, Minutes, Seconds

N30° 30’ 00”

dd° mm’ ss”

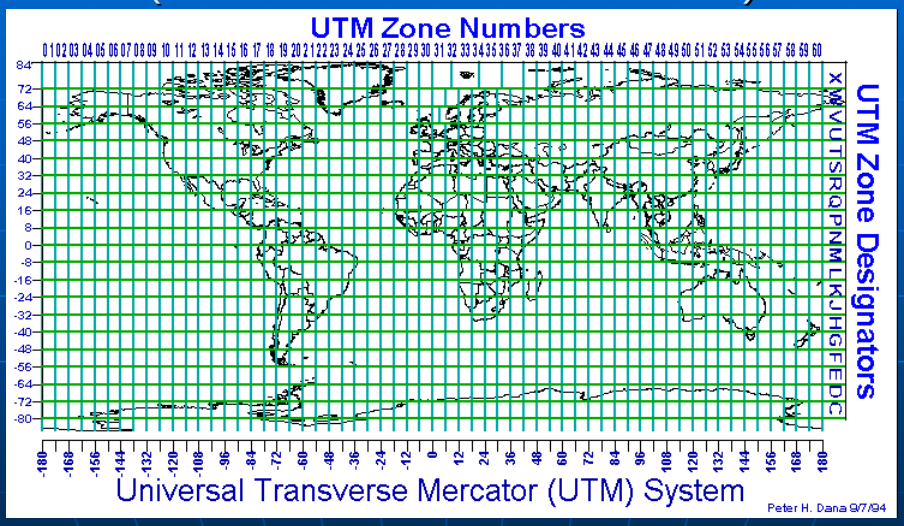
Decimal Degrees

N30.5000°

dd.dddd°

UTM

(Universal Transverse Mercator)



N30° 30’ 00”
W178° 30’ 00”

N30.5000°
W178.5000°

UTM
Northing, Easting
3375148, 356051
Zone 14R

Garmin eTrex

- Vista
- Legend
- Venture

- 5th generation
- WAAS capable

Getting to Know Your Unit

Tasks for the Field Exercise

- Determine position
- Convert the position between UTM, dd.dddd° and dd° mm' ss"
- Create Waypoints
- Enable Tracking
- Find established waypoints (scavenger hunt)

Waypoint

- An electronic “flag” in the ground
- Marks a point of interest
- Appears as a dot on the display
- User named or default numbered
- eTrex will store up to 500 waypoints

Tracklog

- Creates a mini-waypoint at a selected time interval
- Leaves a trail of electronic “bread crumbs through the forest”
- Useful for backtracking if lost
- For marking trails and linear features

GOTO Function

- Guides user to a given waypoint
- Route is straight line and though the shortest and not necessarily the best distance

Caveat

- GPS is a navigation aid, you are the navigator.
- GPS is not a substitute for fundamental skills of terrain association, map and compass and dead reckoning.

On the Web

- http://www.trimble.com/gps/
- http://www.garmin.com/aboutGPS/

Sources

- Armstrong, N. Photograph of E. Aldrin and Flag on the Moon 1969
- Dana, P. illustrations, images and information from The Geographers Craft, Department of Geography, University of Colorado at Boulder 1996
- Doré G. Adam and Eve leaving the Garden, painting 1866
- Wunsch, P. Hansel and Gretel in the Forrest, illustration 1889
- http://www.garmin.com/aboutGPS/

- Special thanks to:
  John Dunn, For letting me plagiarize his original presentation
  Sara Pratt, Disco and Busy Music Consultant