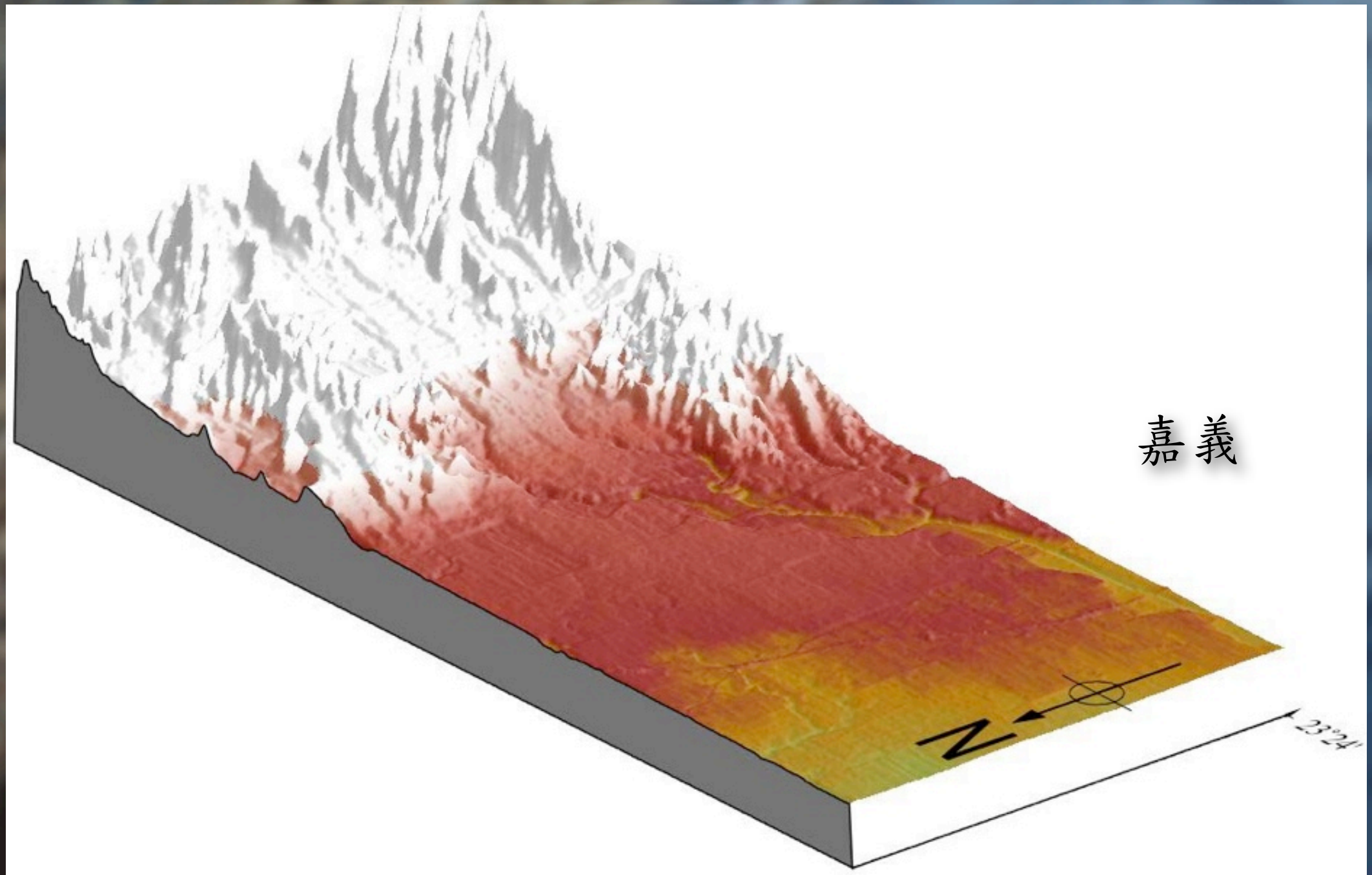
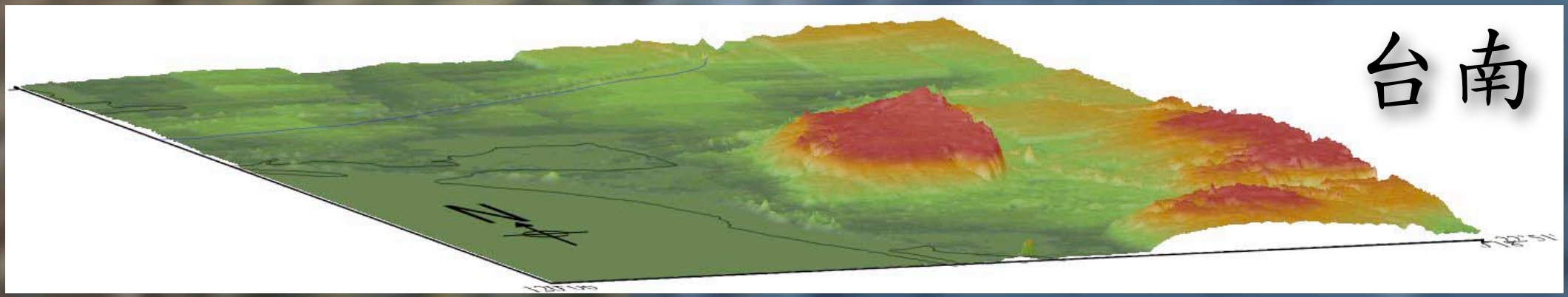
從衛星看地球

通識教育課程


嘉義
N
23°24'


台南

- 前面的兩張圖中是在電腦中利用數值高程模型繪製而成;
- 繪製得到的圖可以使我們對地形以及地形差異有更多了解

數值高程模型

Digital Elevation Model (DEM)

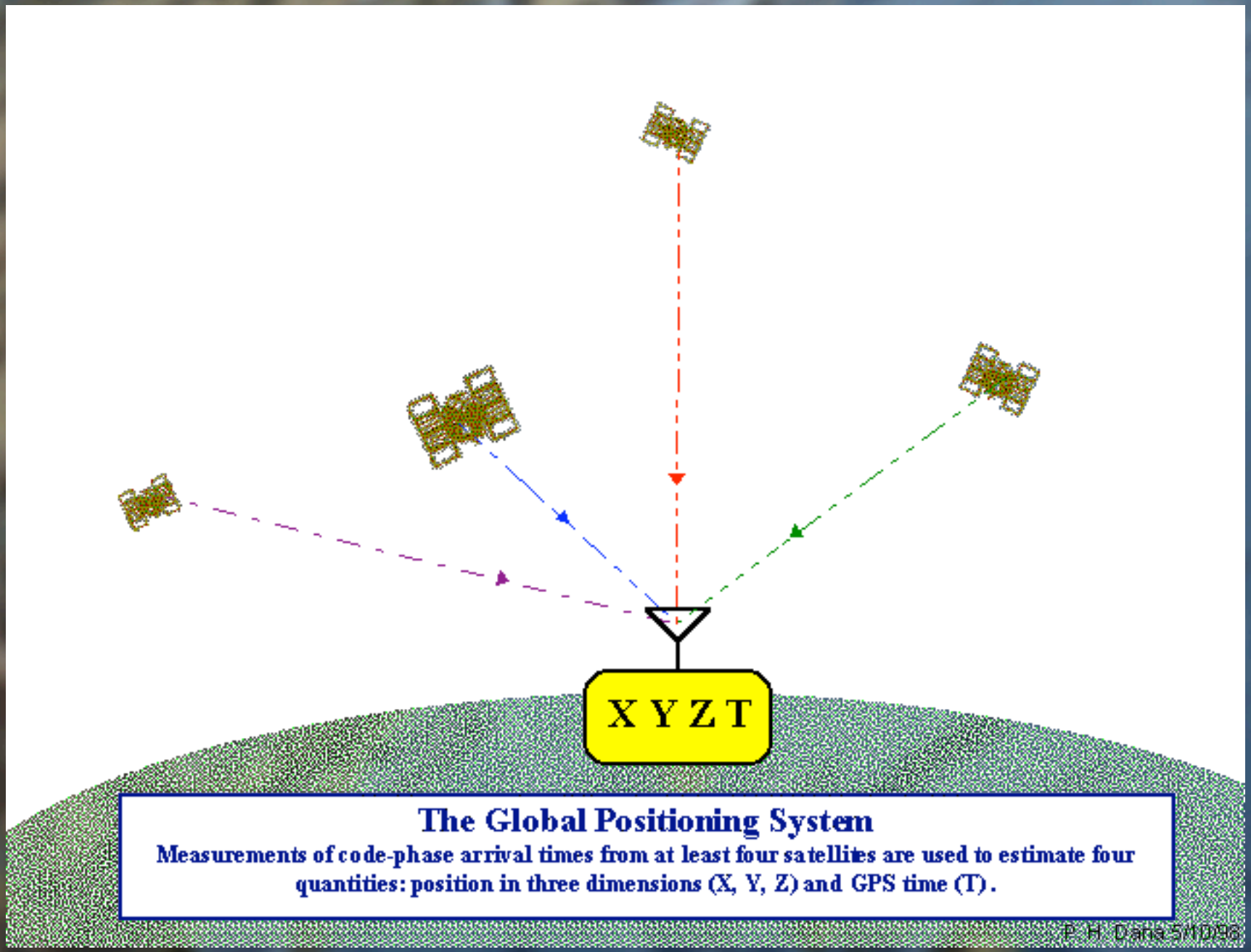
- 數值高程模型包含了:
  - Digital Surface Model (DSM) - 包含地表地物的高程資訊
  - Digital Terrain Model (DTM) - 去除地表植被、房屋等物體後的地形模型，DEM 與此類似。

- DEM的產生方式有很多種，從傳統的大地測量、光學衛星影像立體對、航空照片立體對、雷達差分干涉、光達掃描等等的方法。

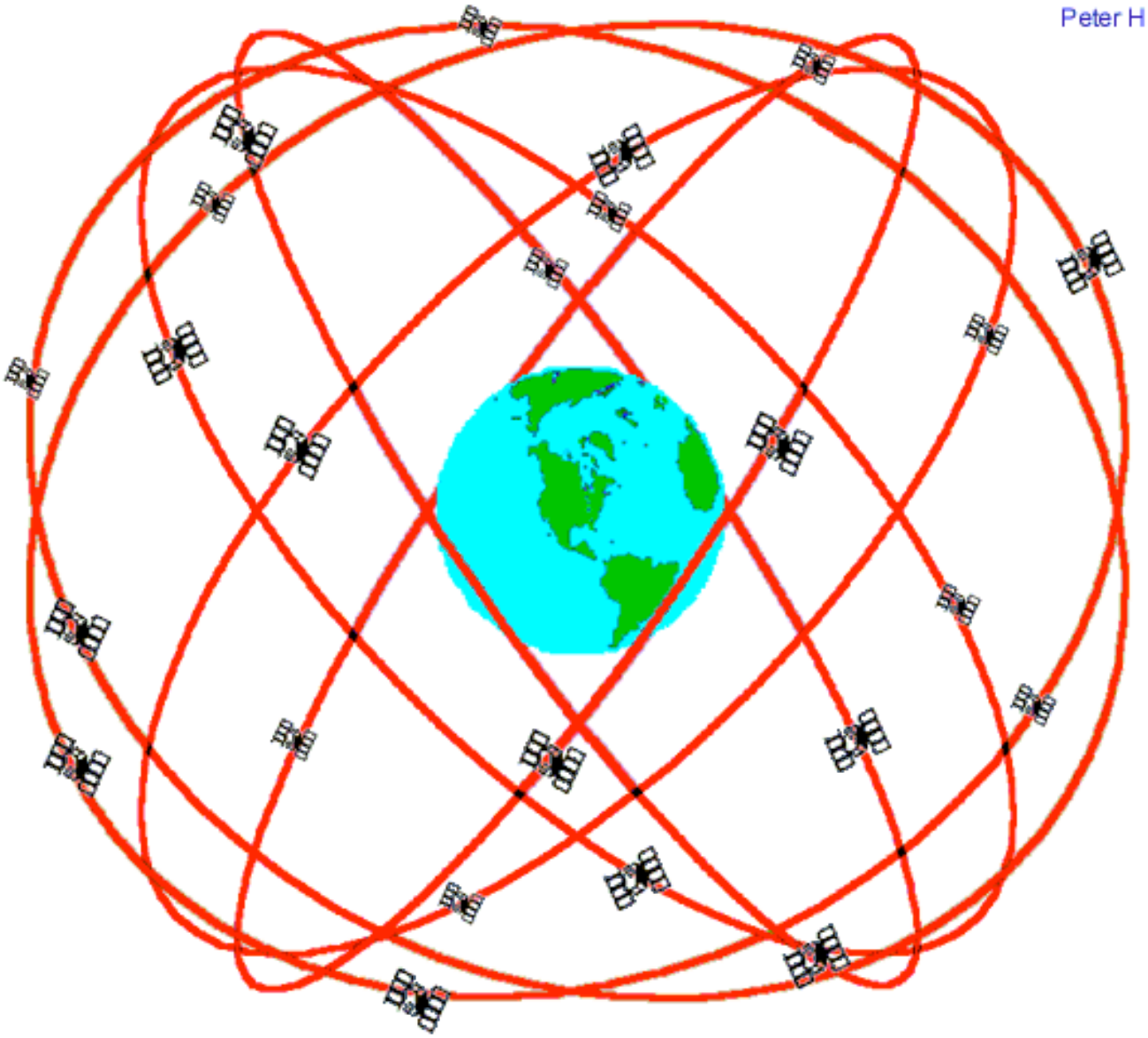
- 主要的功用
  - 觀察地表的一些係數： 例如坡度、粗糙度等
  - 模擬水流方向
  - 製作有高差資訊的地圖
  - 製作3D立體圖
  - 校正衛星影像
  - 地形模型的邊界條件

- GTOPO30, ETOPO5, SRTM(Shuttle Radar Topography Mission), 農航所之數值高程模型


GPS


X Y Z T
The Global Positioning System
Measurements of code-phase arrival times from at least four satellites are used to estimate four quantities: position in three dimensions (X, Y, Z) and GPS time (T).
P. H. Dana 5/10/96

Peter H. Dana 9/22/98

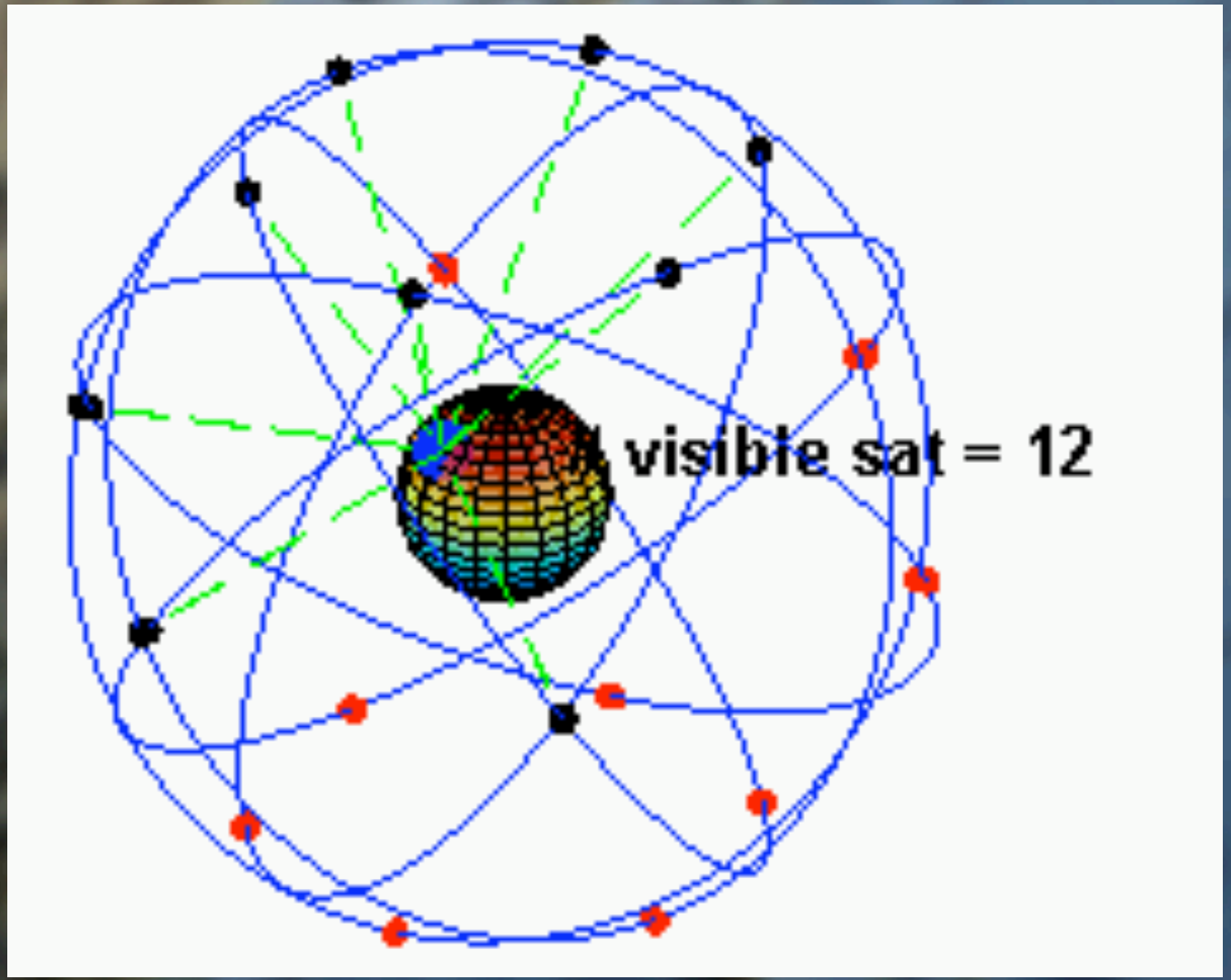


GPS Nominal Constellation

24 Satellites in 6 Orbital Planes

4 Satellites in each Plane

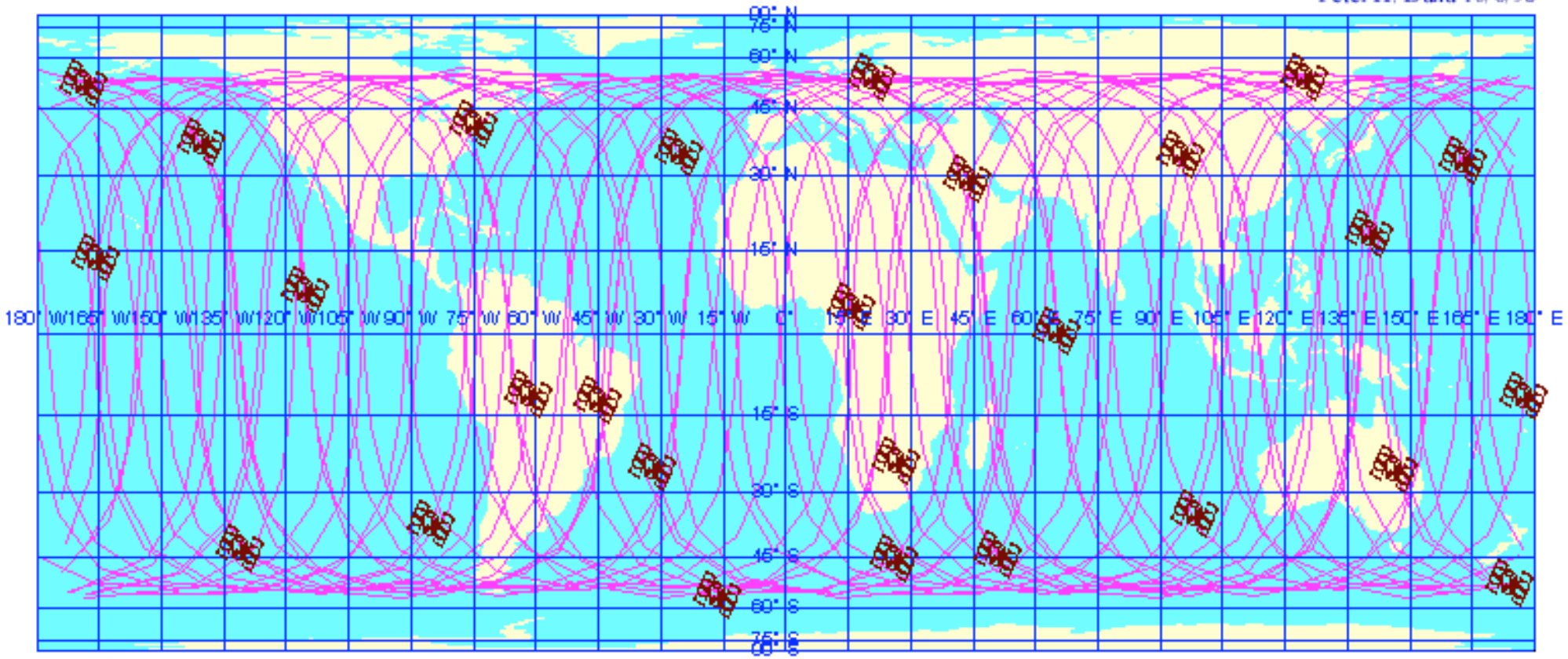
20,200 km Altitudes, 55 Degree Inclination


visible sat = 12

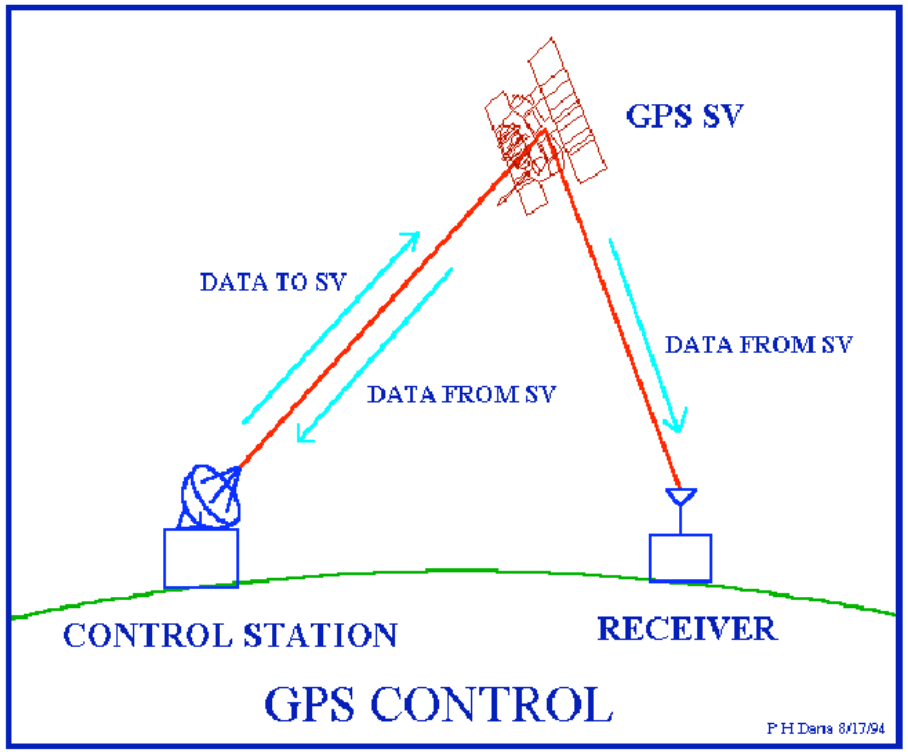

3
1
2


3
4
1
2

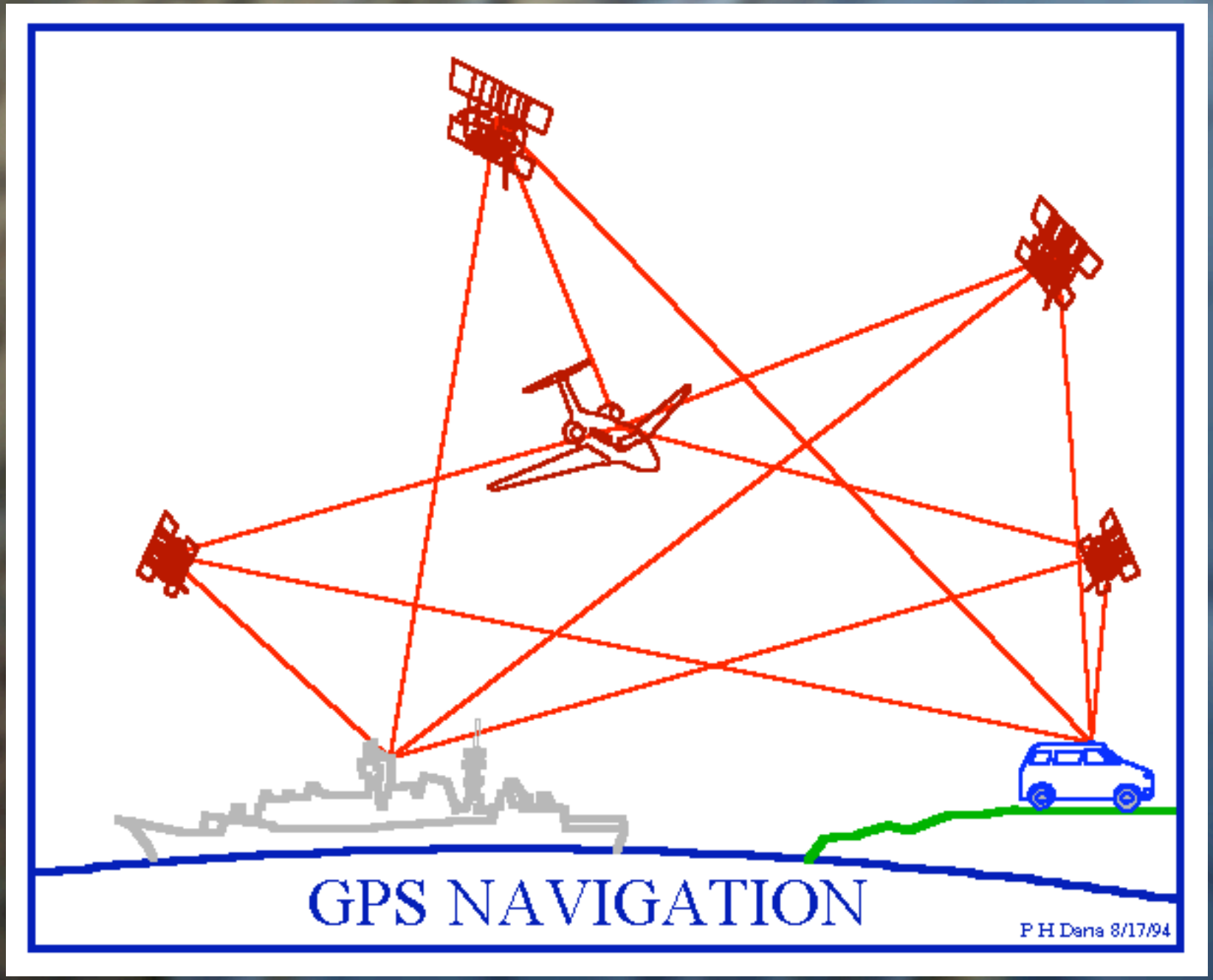
Peter H. Dana 10/6/98



Global Positioning System Satellites and Orbits
for 27 Operational Satellites on September 29, 1998
Satellite Positions at 00:00:00 9/29/98 with 24 hours (2 orbits) of Ground Tracks to 00:00:00 9/30/98


GPS SV
DATA TO SV
DATA FROM SV
DATA FROM SV
CONTROL STATION
RECEIVER
GPS CONTROL
P H Dana 8/17/94

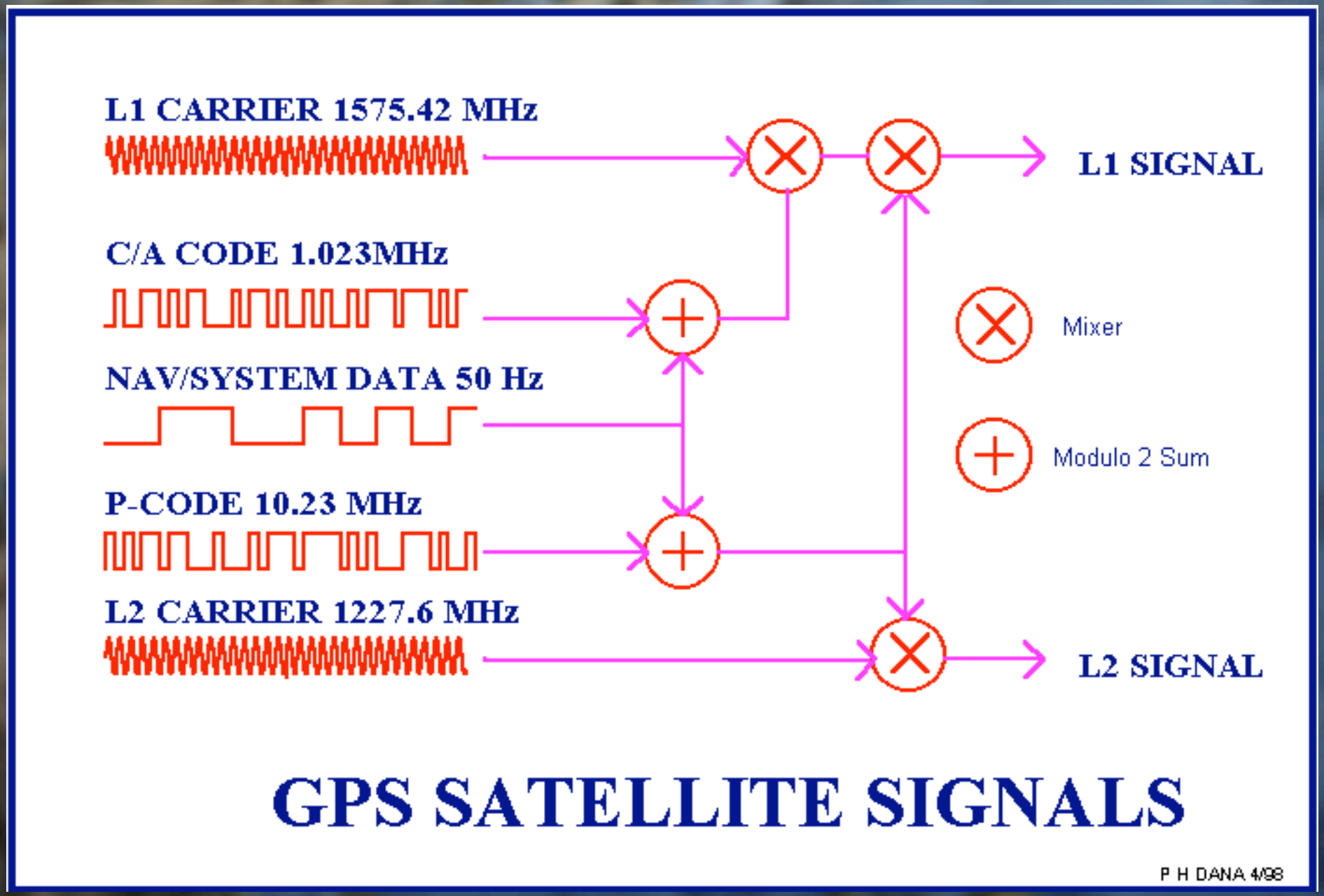

Peter H. Dana 5/27/95
Falcon AFB
Colorado Springs
Master Control
Monitor Station
Hawaii
Monitor Station
Ascension Island
Monitor Station
Diego Garcia
Monitor Station
Kwajalein
Monitor Station
Global Positioning System (GPS) Master Control and Monitor Station Network

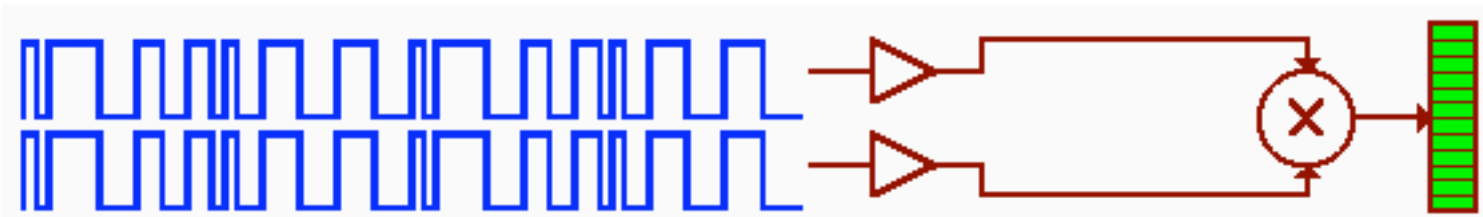

GPS NAVIGATION
P H Dana 8/17/94

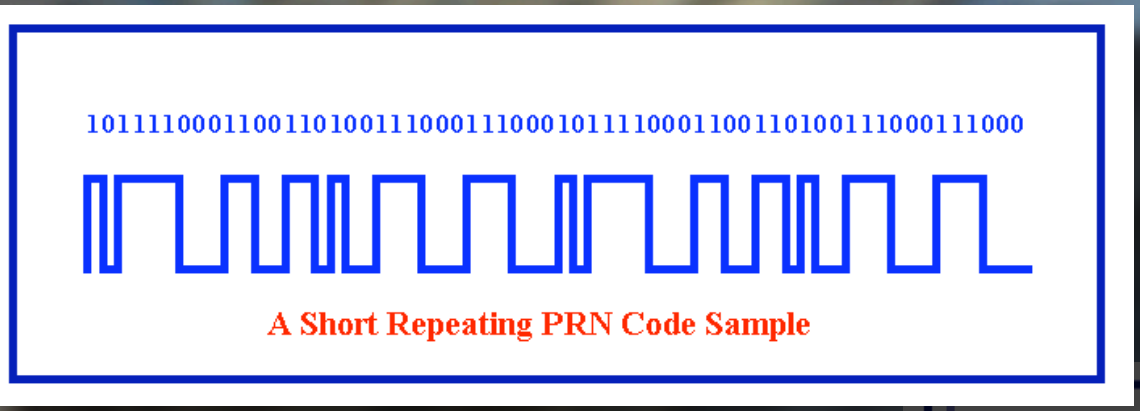
- 每顆GPS衛星上均配有頻率穩定的原子鐘，利用震盪頻率10.23 MHz為基頻，乘上154及120倍，可得到L1與L2兩種頻率的載波。其中L1載波可調制於C/A電碼(Coarse/Acquisition Code)與P電碼(Precision Code)上，而L2載波則僅調制P電碼。訊號中這兩種電碼分別為基本頻率除以10及基本頻率本身，即C/A電碼之頻率為1.023 MHz，P電碼之頻率為10.23 MHz。

前頁白話文翻譯

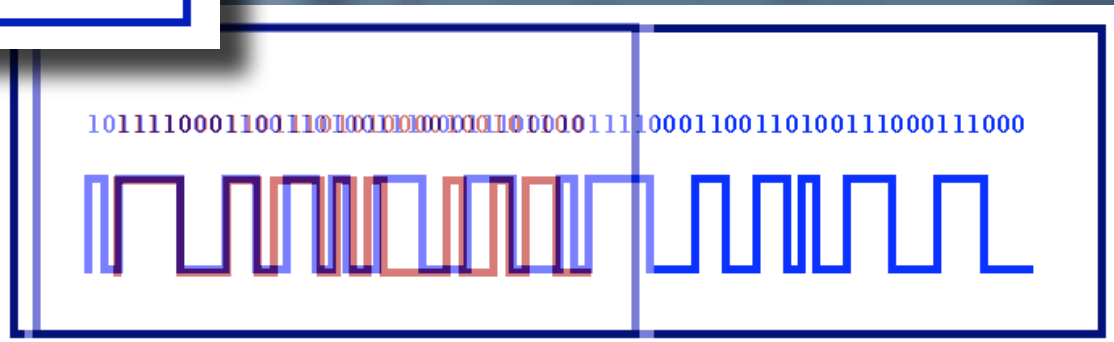
- 每個GPS衛星發送獨特訊號出來，訊號中包含了衛星的時間資訊、軌道資訊以及某種讓GPS接收器計算時間差的密碼。
- GPS接收器收到訊號後，開始解算收到時間與訊號發射時間的差異，得到的時間差乘上光速，即可得到與衛星的距離。
- 有三個以上的衛星訊號即可解得在地球表面上的位置。


L1 CARRIER 1575.42 MHz
C/A CODE 1.023MHz
NAV/SYSTEM DATA 50 Hz
P-CODE 10.23 MHz
L2 CARRIER 1227.6 MHz
L1 SIGNAL
L2 SIGNAL
Mixer
Modulo 2 Sum
GPS SATELLITE SIGNALS
P H DANA 4/98

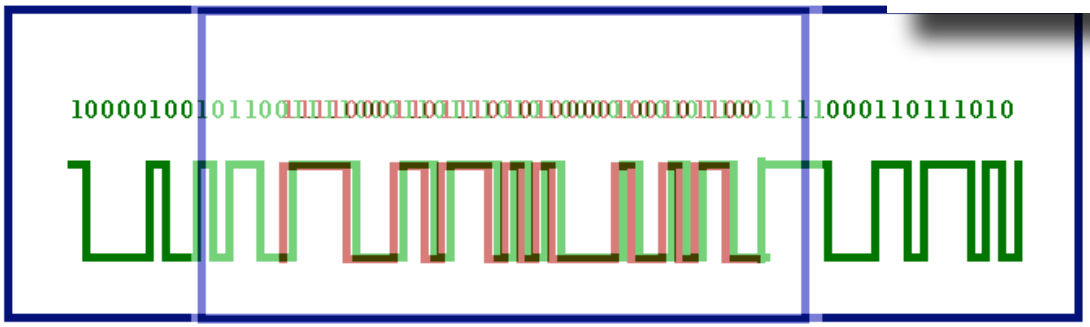




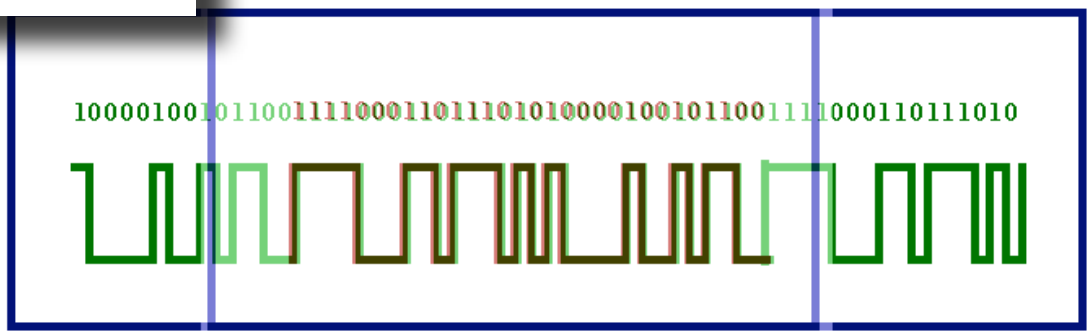
A Short Repeating PRN Code Sample



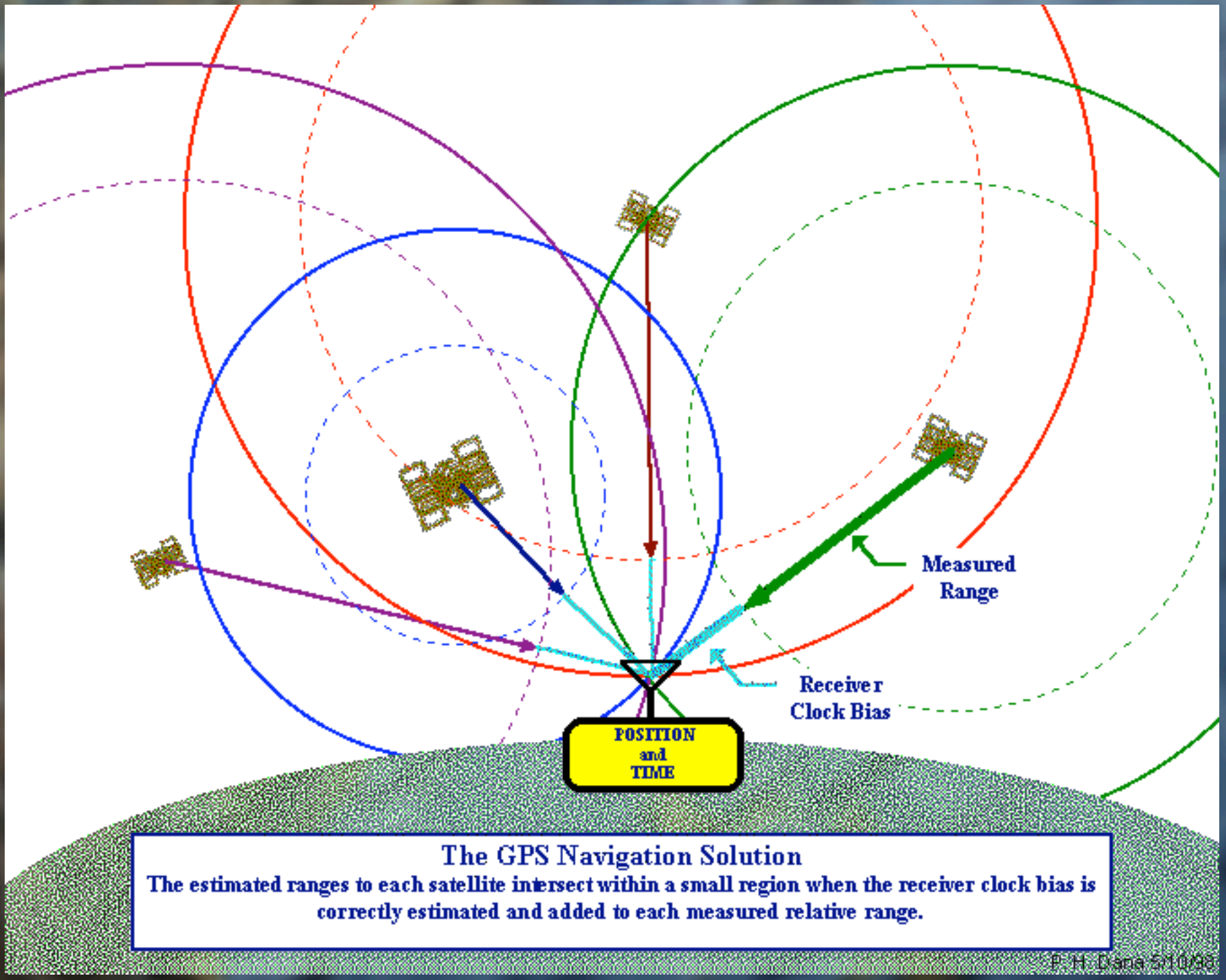
No Correlation with a Different PRN Code



Partial Correlation of Identical Receiver and Satellite PRN Codes

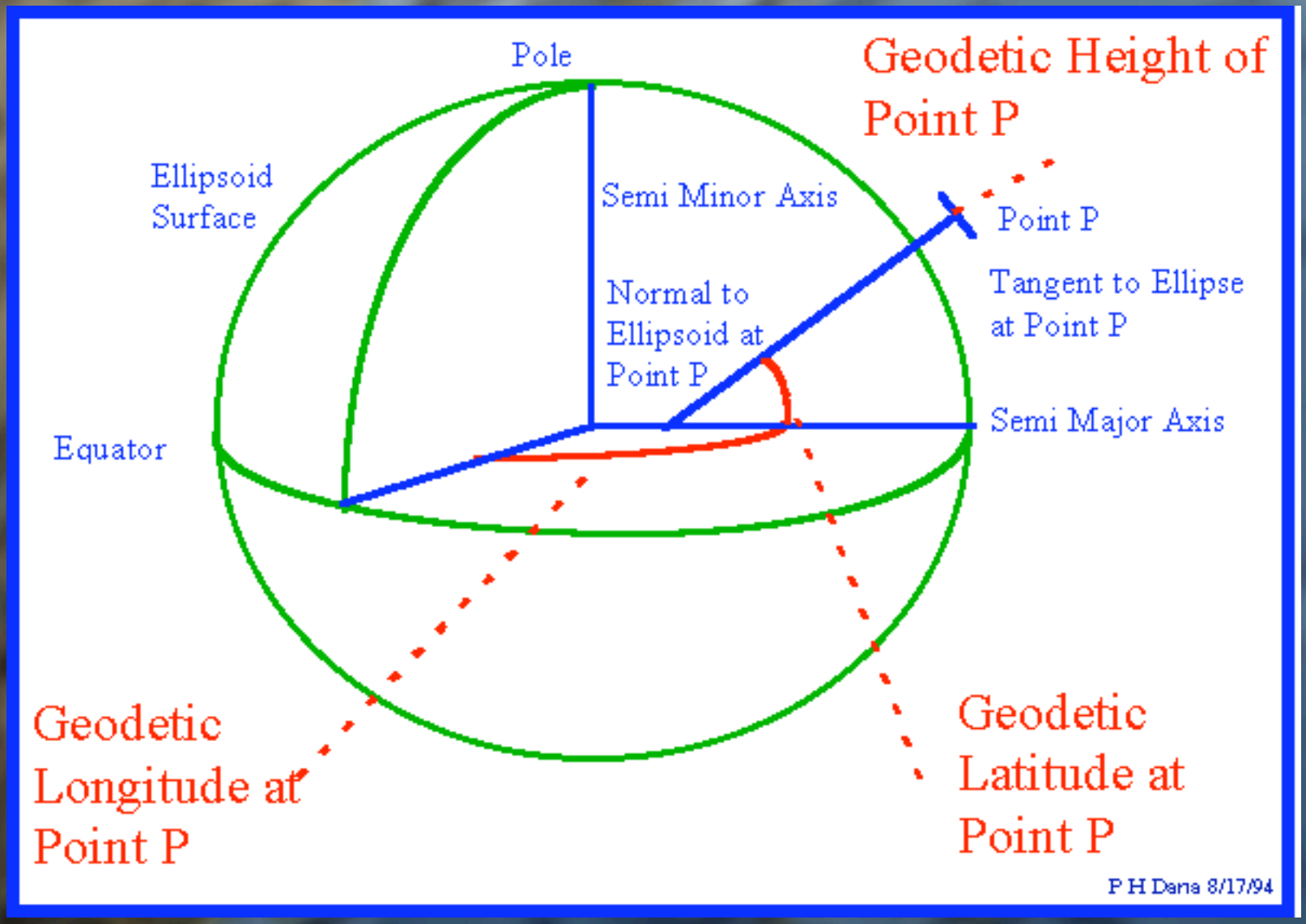


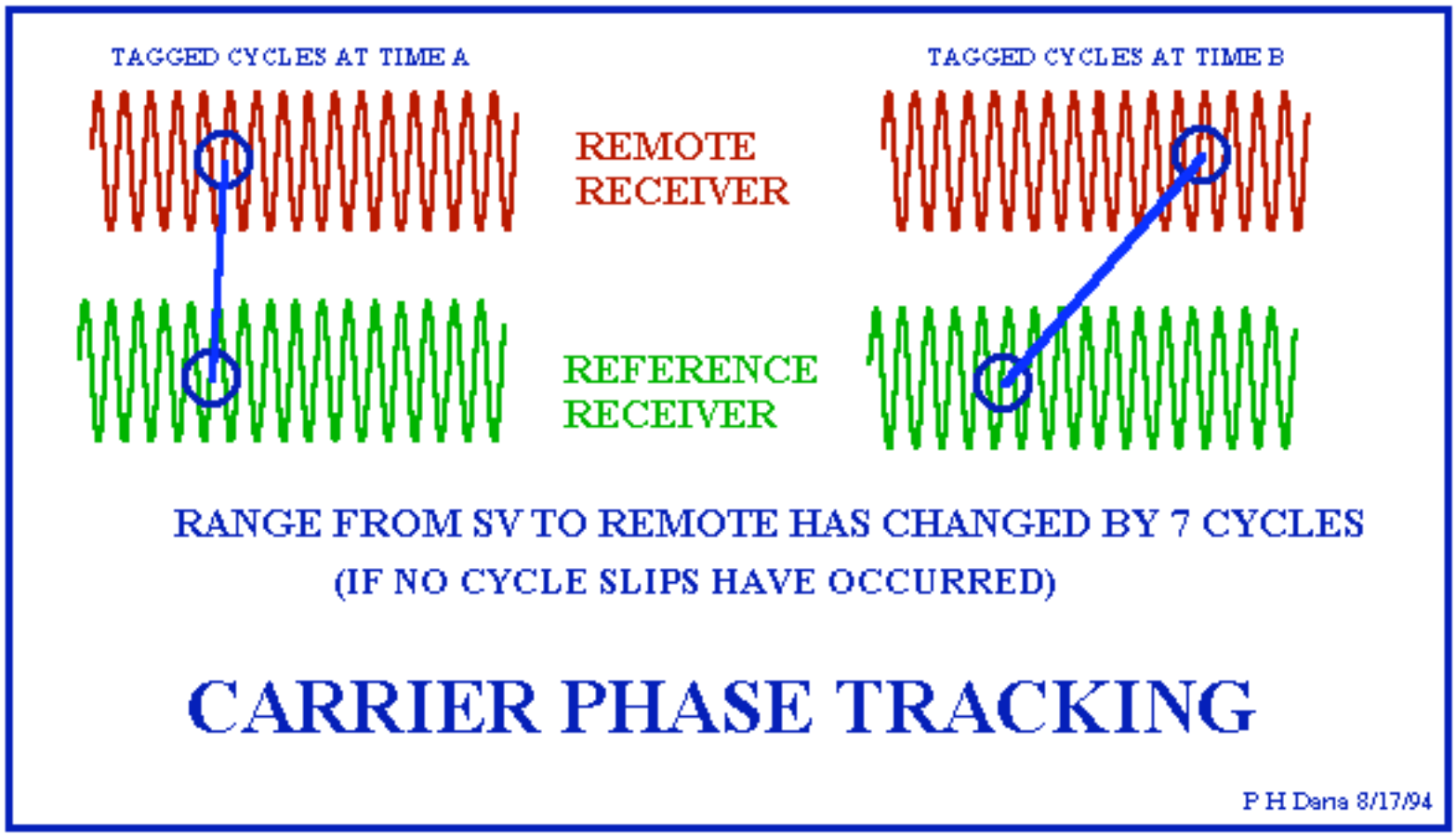
Full Correlation (Code-Phase Lock) of Receiver and Satellite PRN Codes

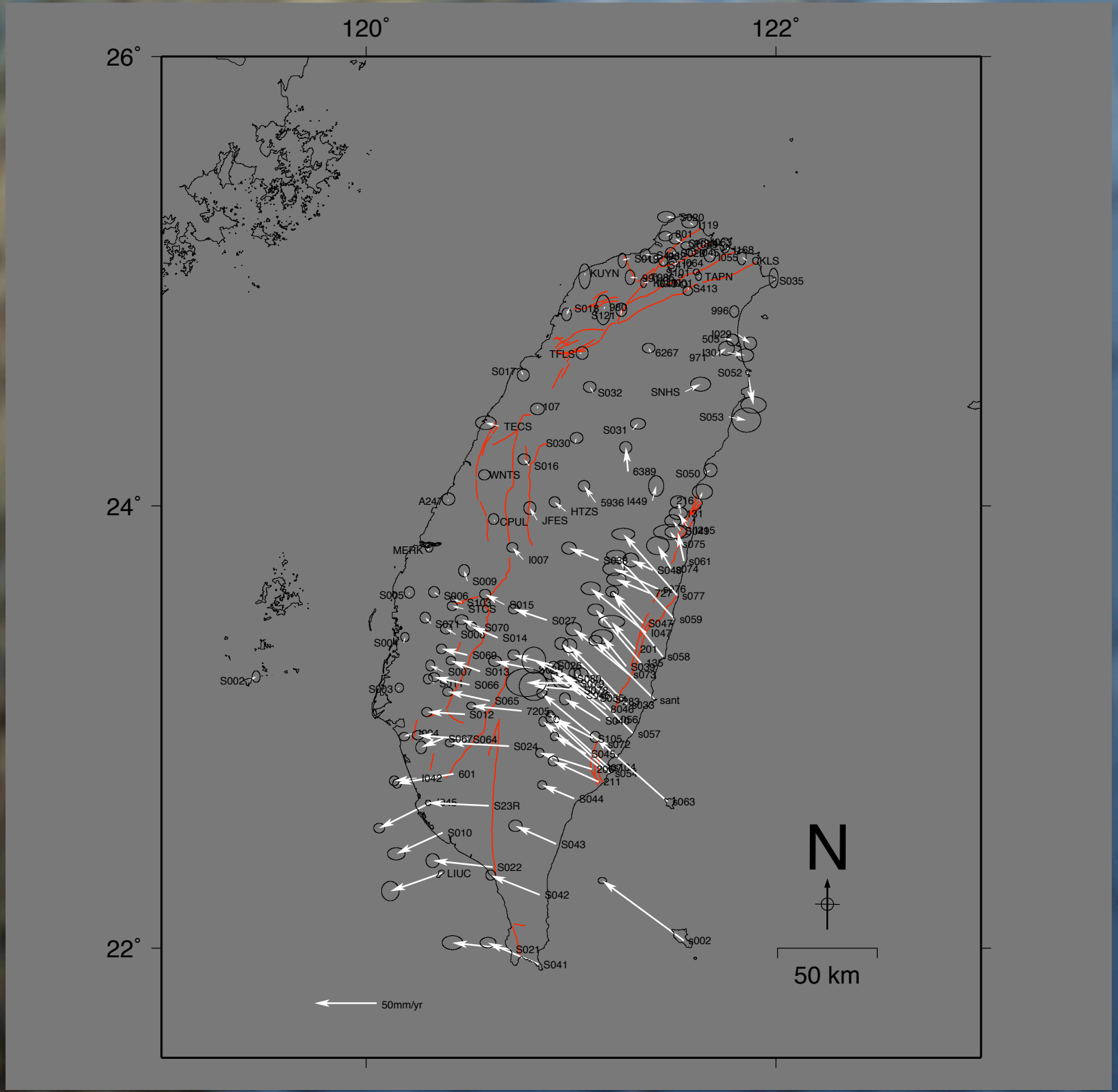


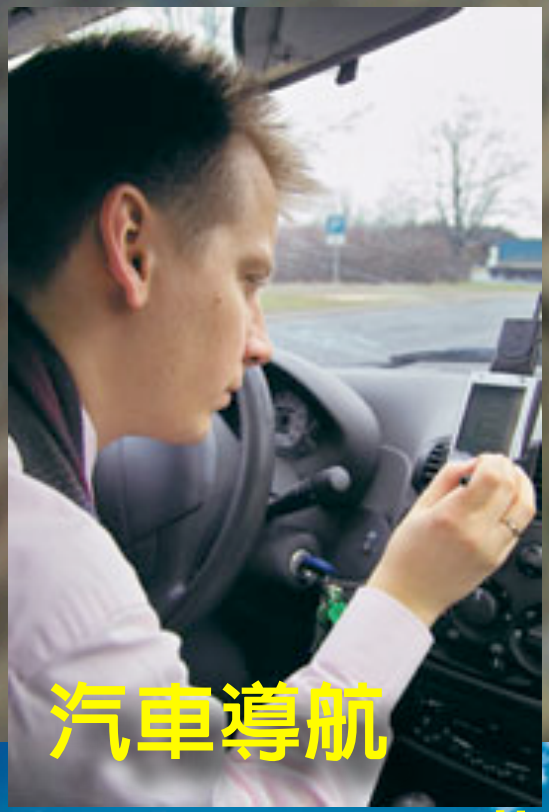
The GPS Navigation Solution

The estimated ranges to each satellite intersect within a small region when the receiver clock bias is correctly estimated and added to each measured relative range.


Pole
Geodetic Height of Point P
Ellipsoid Surface
Semi Minor Axis
Point P
Tangent to Ellipse at Point P
Normal to Ellipsoid at Point P
Equator
Semi Major Axis
Geodetic Longitude at Point P
Geodetic Latitude at Point P
P H Dana 8/17/94


TAGGED CYCLES AT TIME A
TAGGED CYCLES AT TIME B
REMOTE RECEIVER
REFERENCE RECEIVER
RANGE FROM SV TO REMOTE HAS CHANGED BY 7 CYCLES
(IF NO CYCLE SLIPS HAVE OCCURRED)
CARRIER PHASE TRACKING
P H Dana 8/17/94


120°
122°
26°
24°
22°
KUYN
TAPN
CKLS
TFLS
SNHS
TECS
WNTS
HTZS
CPUL
JFES
MERK
A247
LIUC
S23R
sant
N
50 km
50mm/yr



汽車導航

野外導航

飛航管制

環境保護

農業資訊

土地監測