Introduction to RINEX, GPS Raw Data

Geodetic Survey Section
Miss CHAN Wing-yee

21 June 2006

RINEX

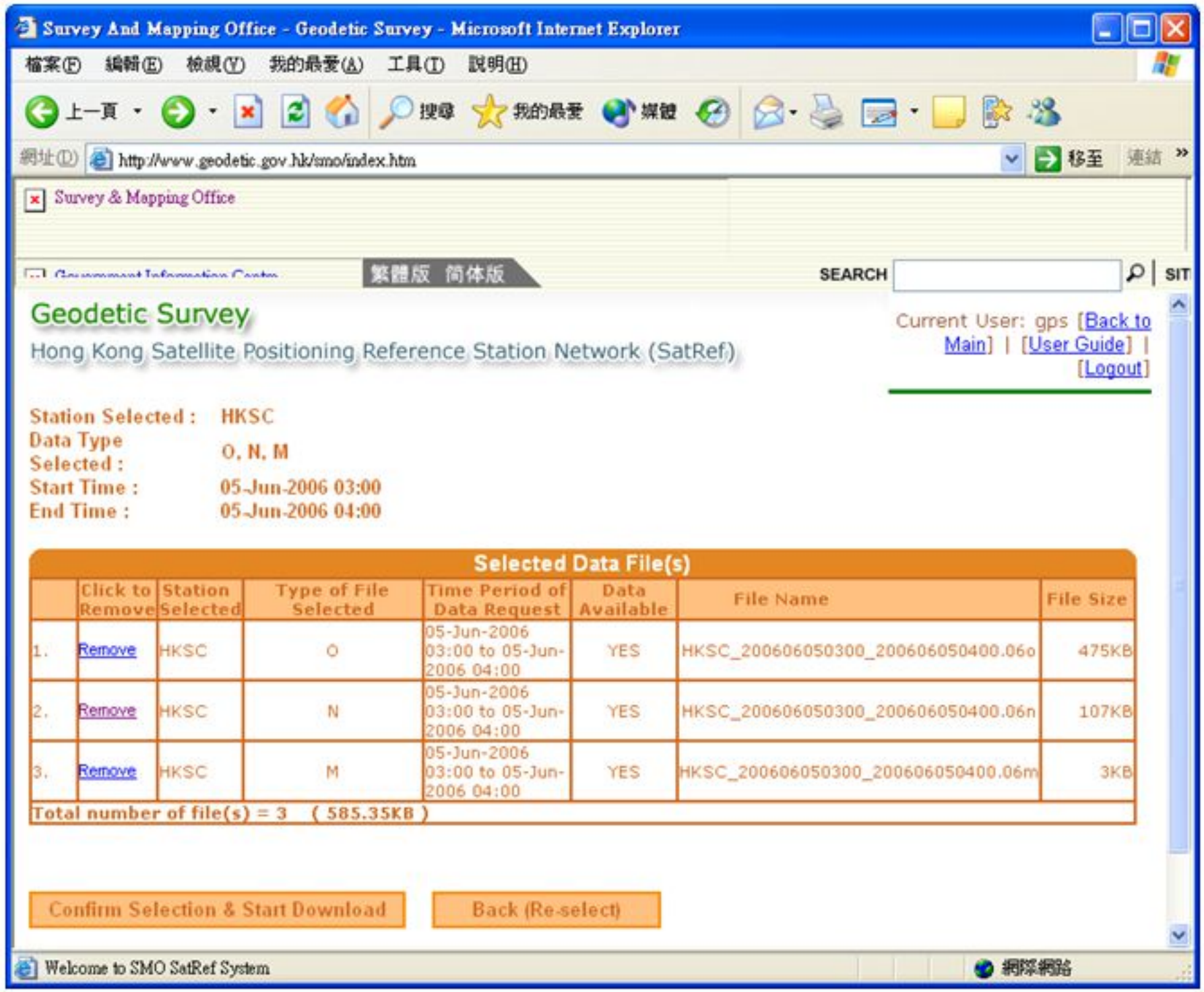
- Receiver Independent Exchange Format
- Developed by the Astronomical Institute of the University of Berne in 1989
- For the easy exchange of the GPS data to be collected
- For processing in various software
- Version 2.10 used in SatRef System

RINEX

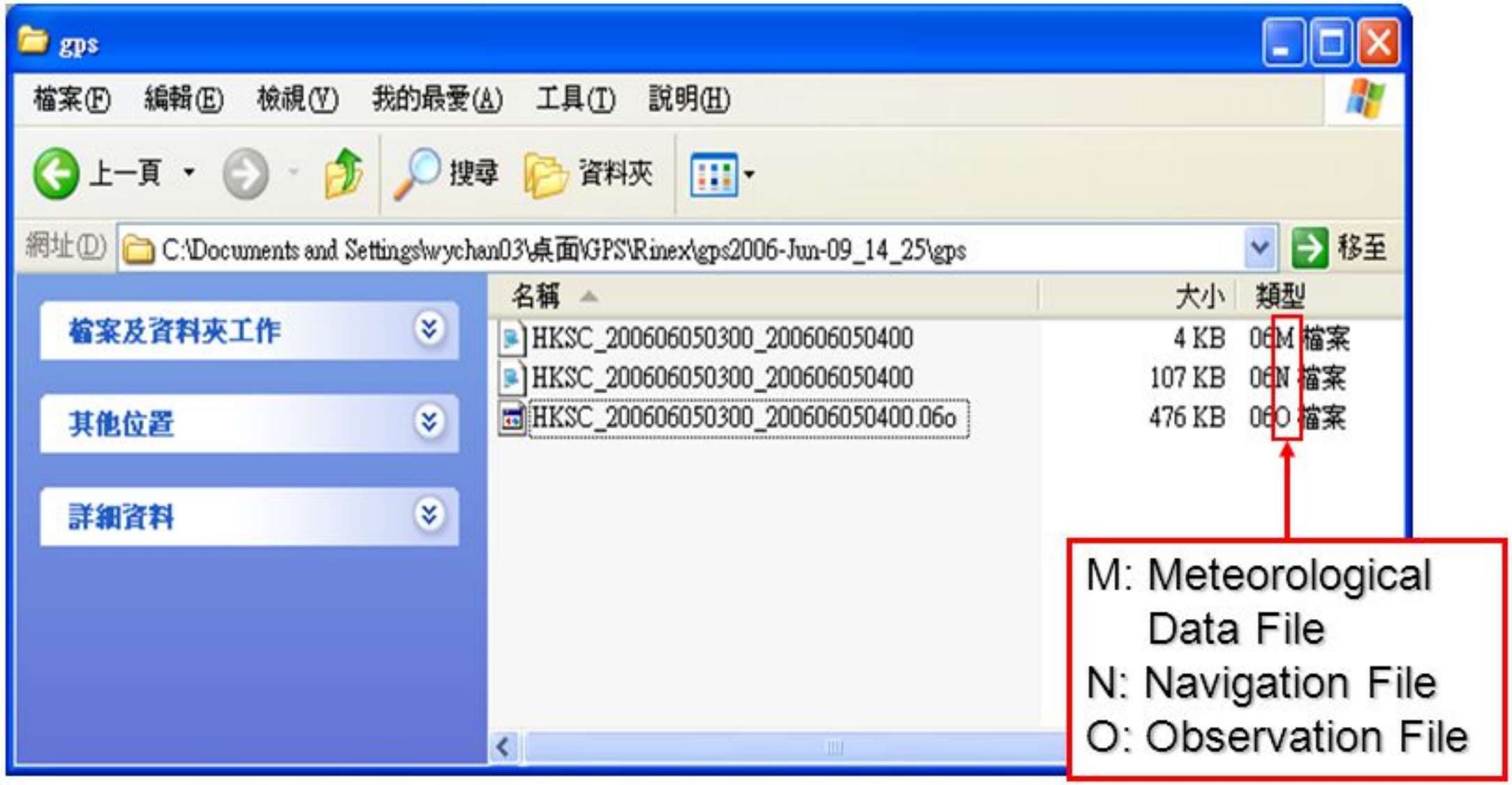
- Consists of 3 ASCII file types available to be downloaded from SatRef System

File Type	Containing Information
Observation Data File	GPS Measurements
GPS Navigation Message File	Ephemeris (Orbit information)
Meteorological Data File	Pressure, Temperature, Relative Humidity, etc

RINEX


Survey And Mapping Office - Geodetic Survey - Microsoft Internet Explorer
檔案(F) 編輯(E) 檢視(V) 我的最愛(A) 工具(T) 說明(H)
上一頁 搜尋 我的最愛 媒體
網址(D) http://www.geodetic.gov.hk/smo/index.htm
移至 連結
Survey & Mapping Office
繁體版 简体版
SEARCH
SIT
Geodetic Survey
Hong Kong Satellite Positioning Reference Station Network (SatRef)
Current User: gps [Back to Main] | [User Guide] | [Logout]
Station Selected : HKSC
Data Type Selected : O, N, M
Start Time : 05-Jun-2006 03:00
End Time : 05-Jun-2006 04:00
Selected Data File(s)
Click to Remove
Station Selected
Type of File Selected
Time Period of Data Request
Data Available
File Name
File Size
1. Remove HKSC O 05-Jun-2006 03:00 to 05-Jun-2006 04:00 YES HKSC_200606050300_200606050400.06o 475KB
2. Remove HKSC N 05-Jun-2006 03:00 to 05-Jun-2006 04:00 YES HKSC_200606050300_200606050400.06n 107KB
3. Remove HKSC M 05-Jun-2006 03:00 to 05-Jun-2006 04:00 YES HKSC_200606050300_200606050400.06m 3KB
Total number of file(s) = 3 (585.35KB)
Confirm Selection & Start Download
Back (Re-select)
Welcome to SMO SatRef System
網際網路

RINEX



RINEX Data of the station HKSC on 5 June 2006 from UTC Time 3:00 to 4:00

Observation File

HKSC_200606050300_200606050400 - 記事本

檔案(F) 編輯(E) 格式(O) 檢視(V) 說明(H)

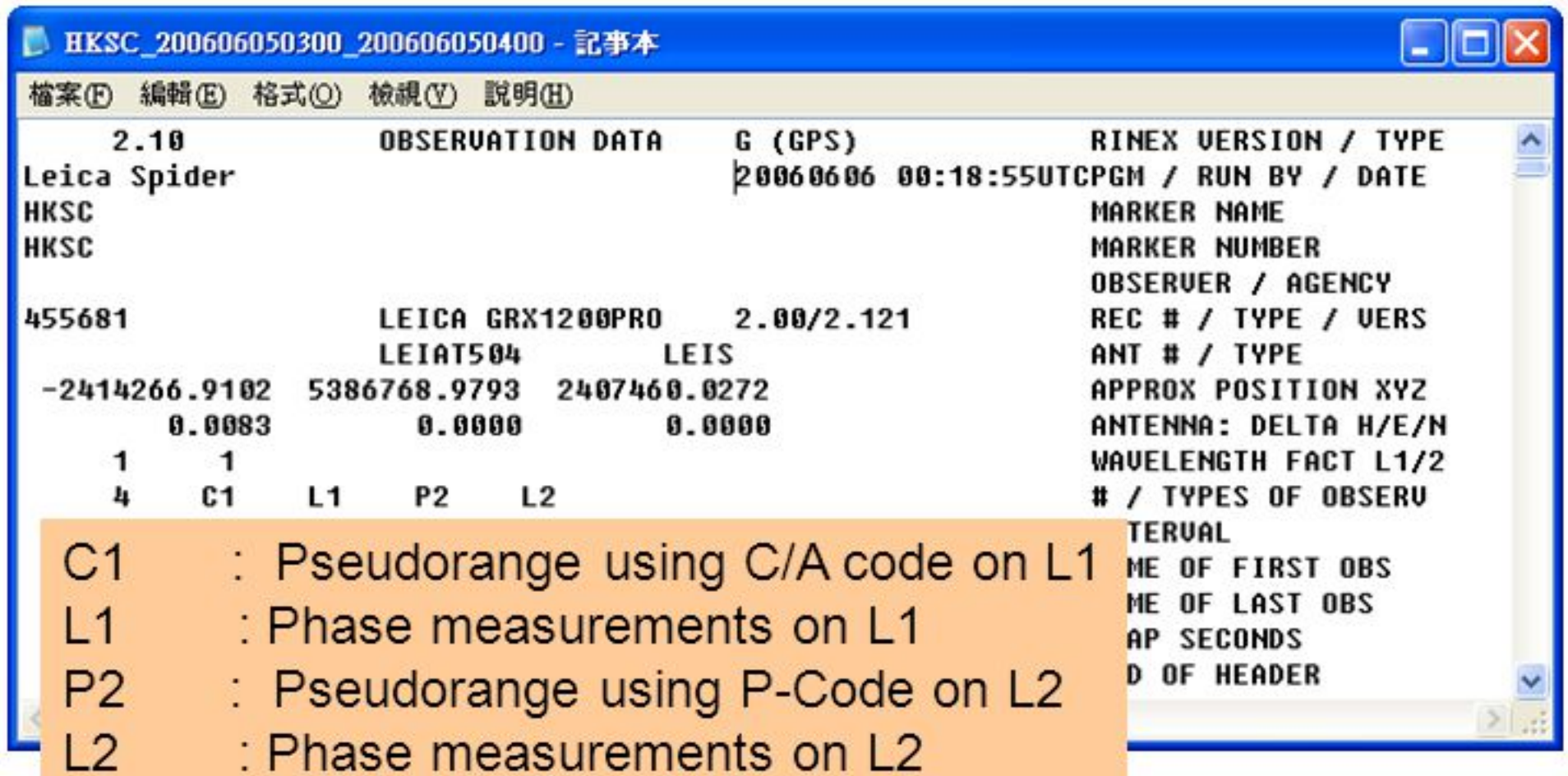
```
     2.10           OBSERVATION DATA    G (GPS)             RINEX VERSION / TYPE
Leica Spider                            20060606 00:18:55UTCPGM / RUN BY / DATE
HKSC                                                        MARKER NAME
HKSC                                                        MARKER NUMBER
                                                            OBSERVER / AGENCY
455681              LEICA GRX1200PRO    2.00/2.121          REC # / TYPE / VERS
                    LEIAT504        LEIS                    ANT # / TYPE
 -2414266.9102  5386768.9793  2407460.0272                  APPROX POSITION XYZ
        0.0083        0.0000        0.0000                  ANTENNA: DELTA H/E/N
     1     1                                                WAVELENGTH FACT L1/2
     4    C1    L1    P2    L2                             # / TYPES OF OBSERV
     5.0000                                                 INTERVAL
  2006     6     5     3     0    0.000000                  TIME OF FIRST OBS
  2006     6     5     3    59   55.000000                  TIME OF LAST OBS
    14                                                      LEAP SECONDS
                                                            END OF HEADER
 06  6  5  3  0  0.0000000  0 10G 2G 6G 7G 8G 9G10G18G21G26G29
  23288740.069   122383102.613 7  23288741.198    95363442.36846
  21880080.633   114980606.034 8  21880082.183    89595291.87246
  25444792.816   133713291.799 5  25444797.337   104192196.61943
  25044883.981   131611749.406 5  25044886.790   102554615.56243
  23132107.018   121560054.186 8  23132109.516    94722138.03345
  22831131.339   119978376.225 8  22831132.526    93489632.07445
  24295861.158   127675626.689 6  24295863.505    99487514.10744
  23541073.298   123709200.932 7  23541074.035    96396801.34144
  20027575.007   105245634.134 9  20027575.488    82009601.79249
  20726963.026   108920944.359 9  20726963.361    84873469.49848
 06  6  5  3  0  5.0000000  0 10G 2G 6G 7G 8G 9G10G18G21G26G29
```

Header Section

Data Section

Observation File of HKSC on 5 June 2006 from UTC Time 3:00 to 4:00

Observation File: Header Section



C1 : Pseudorange using C/A code on L1
L1 : Phase measurements on L1
P2 : Pseudorange using P-Code on L2
L2 : Phase measurements on L2

PGM/ RUN BY / DATE	Program, Agency, date of creating the file
REC # / TYPE / VERS	Receiver Number, type, version
ANT # / TYPE	Antenna Number, TYPE
APPROX POSITION XYZ	Approximation marker position (in WGS84)
ANTENNA: DELTA H/E/N	Antenna height, Eccentricities of antenna centre relative to marker in east and north (in metres)
WAVELENGTH FACT L1/2	Wavelength factors for L1 and L2
# / TYPES OF OBSERV	Number of observation types, observation types
TIME OF FIRST OBS	Time of first observation record

Observation File: Data Section

HKSC_200606050300_200606050400 - 記事本

檔案(F) 編輯(E) 格式(O) 檢視(V) 說明(H)

```
     4    C1    L1    P2    L2                                  # / TYPES OF OBSERV
     5.0000                                                     INTERVAL
  2006     6     5     3     0    0.000000                     TIME OF FIRST OBS
  2006     6     5     3    59   55.000000                     TIME OF LAST OBS
    14                                                          LEAP SECONDS
                                                                END OF HEADER
 06  6  5  3  0  0.0000000  0 10G 2G 6G 7G 8G 9G10G18G21G26G29
  23288740.069   122383102.613 7  23288741.198    95363442.36846
  21880080.633   114980606.034 8  21880082.183    89595291.87246
  25444792.816   133713291.799 5  25444797.337   104192196.61943
  25044883.981   131611749.406 5  25044886.790   102554615.56243
  23132107.018   121560054.186 8  23132109.516    94722138.03345
  22831131.339   119978376.225 8  22831132.526    93489632.07445
  24295861.158   127675626.689 6  24295863.505    99487514.10744
  23541073.298   123709200.932 7  23541074.035    96396801.34144
  20027575.007   105245634.134 9  20027575.488    82009601.79249
  20726963.026   108920944.359 9  20726963.361    84873469.49848
 06  6  5  3  0  5.0000000  0 10G 2G 6G 7G 8G 9G10G18G21G26G29
  23291559.271   122397917.273 7  23291560.326    95374986.22846
  21880617.447   114983427.385 8  21880619.188    89597490.32046
  25442764.306   133702631.753 5  25442768.975   104183890.06743
  25046659.646   131621080.776 5  25046662.260   102561886.72244
  23128799.496   121542673.822 8  23128801.914    94708594.89645
  22832491.735   119985525.278 8  22832492.731    93495202.76146
  24294351.121   127667691.106 5  24294353.332    99481330.54944
  23537923.383   123692647.640 7  23537924.019    96383902.67844
  20028745.148   105251783.331 9  20028745.740    82014393.37349
  20728854.360   108930883.386 9  20728854.771    84881214.19448
 06  6  5  3  0 10.0000000  0 10G 2G 6G 7G 8G 9G10G18G21G26G29
```


Observation File of HKSC on 5 June 2006 from UTC Time 3:00 to 4:00

Observation File: Data Section

HKSC_200606050300_200606050400 - 記事本

檔案(F) 編輯(E) 格式

Number of Satellites

Event Flag

Epoch

Satellite Number

```
     4    C1                                                  # / TYPES OF OBSERV
     5.0000                                                   INTERVAL
  2006                                0    0.000000          TIME OF FIRST OBS
  2006                               59   55.000000          TIME OF LAST OBS
    14                                                        LEAP SECONDS
                                                              END OF H
 06  6  5  3  0   0.0000000  0 10G 2G 6G 7G 8G 9G10G18G21G26G29
  23288740.069    122383102.613 7   23288741.198     95363442.36846
  21880080.633    114980606.034 8   21880082.183     89595291.87246
  25444792.816    133713291.799 5   25444797.337    104192196.61943
  25044883.981    131611749.406 5   25044886.790    102554615.56243
  23132107.018    121560054.186 8   23132109.516     94722138.03345
  22831131.339    119978376.225 8   22831132.526     93489632.07445
  24295861.158    127675626.689 6   24295863.505     99487514.10744
  23541073.298    123709200.932 7   23541074.035     96396801.34144
  20027575.007    105245634.134 9   20027575.488     82009601.79249
  20726963.026    108920944.359 9   20726963.361     84873469.49848
06  6  5  3  0   5.0000000  0 10G 2G 6G 7G 8G 9G10G18G21G26G29
  23291559.271    122397917.273 7   23291560.326     95374986.22846
  21880617.447    114983427.385 8   21880619.188     89597490.32046
  25442764.306    133702631.753 5   25442768.975    104183890.06743
  25046659.646    131621080.776 5   25046662.260    102561886.72244
  23128799.496    121542673.822 8   23128801.914     94708594.89645
  22832491.735    119985525.278 8   22832492.731     93495202.76146
  24294351.121    127667691.106 5   24294353.332     99481330.54944
  23537923.383    123692647.640 7   23537924.019     96383902.67844
  20028745.148    105251783.331 9   20028745.740     82014393.37349
  20728854.360    108930883.386 9   20728854.771     84881214.19448
06  6  5  3  0  10.0000000  0 10G 2G 6G 7G 8G 9G10G18G21G26G29
```


Observation File of HKSC on 5 June 2006 from UTC Time 3:00 to 4:00

Observation File: Data Section

HKSC_200606050300_200606050400 - 記事本

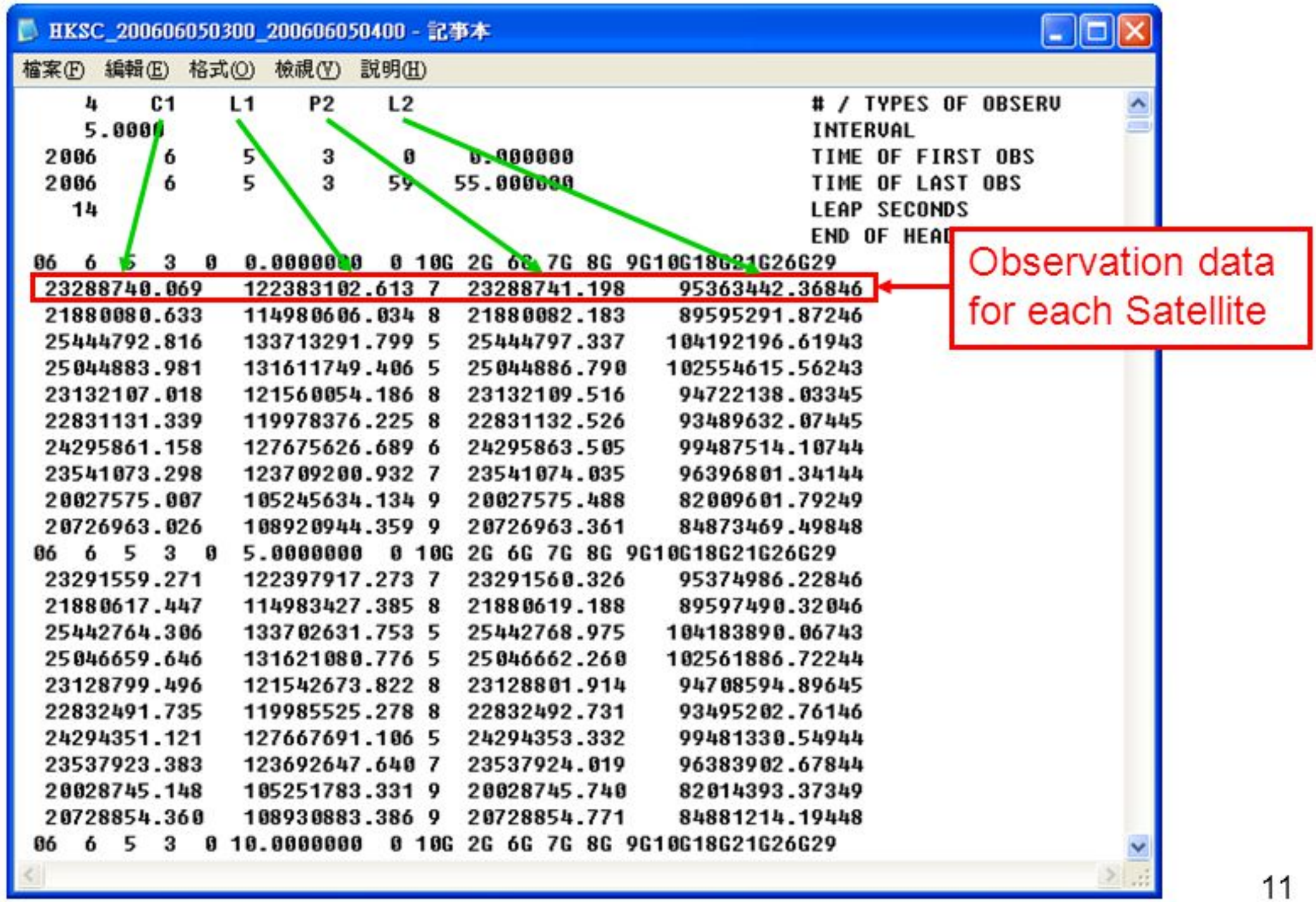
檔案(F) 編輯(E) 格式(O) 檢視(V) 說明(H)

```
     4    C1    L1    P2    L2                                # / TYPES OF OBSERV
    5.0000                                                    INTERVAL
  2006     6     5     3     0    0.000000                    TIME OF FIRST OBS
  2006     6     5     3    59   55.000000                    TIME OF LAST OBS
    14                                                        LEAP SECONDS
                                                              END OF HEAD
 06  6  5  3  0  0.0000000  0 10G 2G 6G 7G 8G 9G10G18G21G26G29
  23288740.069   122383102.613 7  23288741.198    95363442.36846
  21880080.633   114980606.034 8  21880082.183    89595291.87246
  25444792.816   133713291.799 5  25444797.337   104192196.61943
  25044883.981   131611749.406 5  25044886.790   102554615.56243
  23132107.018   121560054.186 8  23132109.516    94722138.03345
  22831131.339   119978376.225 8  22831132.526    93489632.07445
  24295861.158   127675626.689 6  24295863.505    99487514.10744
  23541073.298   123709200.932 7  23541074.035    96396801.34144
  20027575.007   105245634.134 9  20027575.488    82009601.79249
  20726963.026   108920944.359 9  20726963.361    84873469.49848
 06  6  5  3  0  5.0000000  0 10G 2G 6G 7G 8G 9G10G18G21G26G29
  23291559.271   122397917.273 7  23291560.326    95374986.22846
  21880617.447   114983427.385 8  21880619.188    89597490.32046
  25442764.306   133702631.753 5  25442768.975   104183890.06743
  25046659.646   131621080.776 5  25046662.260   102561886.72244
  23128799.496   121542673.822 8  23128801.914    94708594.89645
  22832491.735   119985525.278 8  22832492.731    93495202.76146
  24294351.121   127667691.106 5  24294353.332    99481330.54944
  23537923.383   123692647.640 7  23537924.019    96383902.67844
  20028745.148   105251783.331 9  20028745.740    82014393.37349
  20728854.360   108930883.386 9  20728854.771    84881214.19448
 06  6  5  3  0 10.0000000  0 10G 2G 6G 7G 8G 9G10G18G21G26G29
```

Observation data for each Satellite

Observation File of HKSC on 5 June 2006 from UTC Time 3:00 to 4:00

Observation File: Data Section



Observation File of HKSC on 5 June 2006 from UTC Time 3:00 to 4:00

Observation File: Data Section

Extracted observation data for GPS Satellite No. 2 at 3:00 on 5 June 2006:

C1	L1	P2	L2
23288740.069	122383102.613_7	23288741.198	95363442.36846

LLI

Signal Strength

LLI

Signal Strength

LLI (Loss of Lock Indicator)
0: OK
1: Cycle Slip
4: Antispoofing
Blank: not known

Signal Strength
-Interval 1-9
1: minimum possible signal strength
9: maximum possible signal strength
0 or blank: not known

Navigation File

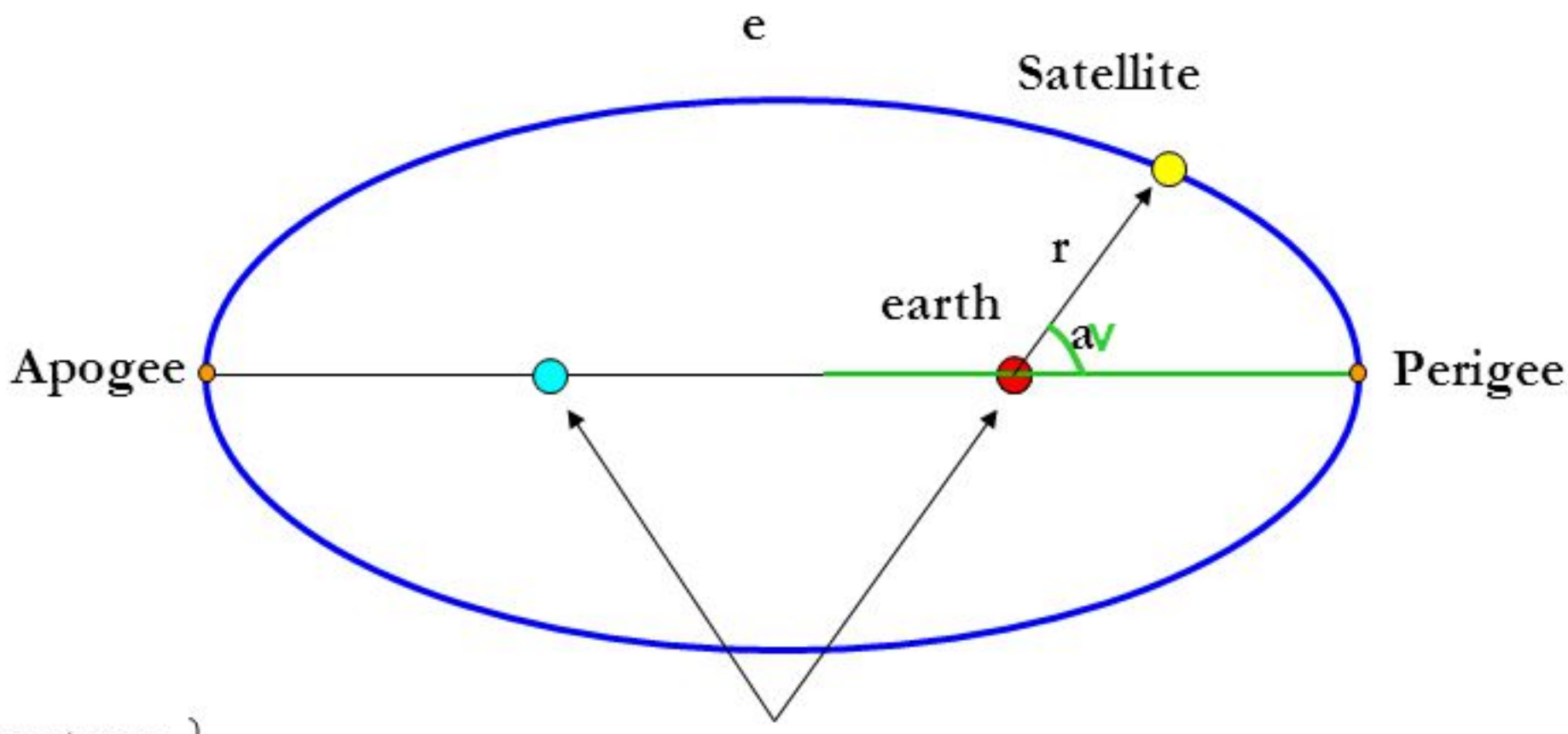
- Data computed for Satellite Position
- Satellite Motion is described by Satellite Orbit
- Satellite Orbit is described by 6 (Keplerian) Elements

Navigation File: Satellite Orbit

- Define satellite position in the satellite orbit - *v*
- Define size and shape of the satellite orbit - a, e
- Define the orientation of the satellite orbit - ω
- Define the orbital plane in the equatorial system - Ω, I

v	True Anomaly
a	Semi-major axis of ellipse
E	Eccentricity
I	Inclination of the orbit
Ω	Right ascension of the ascending node
ω	Argument of perigee

Navigation File: Satellite Orbit



- position vector, **r**
- true anomaly, **ν**

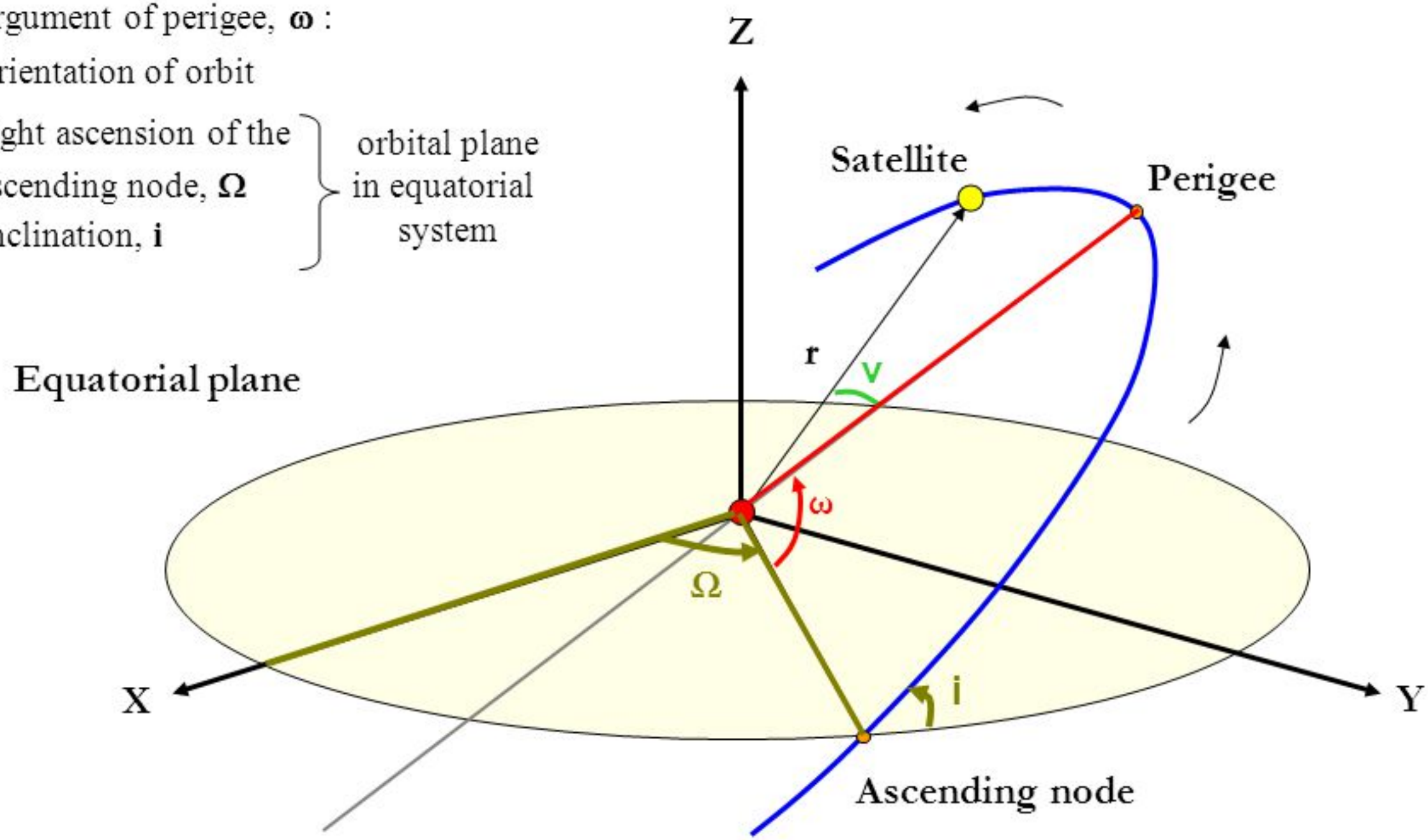
} **Satellite Position**

- semi-major axis, **a : Size of Orbit**
- eccentricity, **e : Shape of Orbit**

Navigation File: Satellite Position

- argument of perigee, **ω** :
  orientation of orbit
- right ascension of the ascending node, **Ω**
- inclination, **i**

} orbital plane in equatorial system



Navigation File

HKSC_200606050300_200606050400 - 記事本

檔案(F) 編輯(E) 格式(O) 檢視(V) 說明(H)

```
     2.10           NAVIGATION DATA                         RINEX VERSION / TYPE
SPIDER V2,0,0,2133                        2006 06 06 00:04    PGM / RUN BY / DATE
    6.5193D-09  2.2352D-08 -5.9605D-08 -1.1921D-07           ION ALPHA
    8.6016D+04  9.8304D+04 -6.5536D+04 -5.2429D+05           ION BETA
    5.587935447693D-09 1.598721155460D-14   319488     1378 DELTA-UTC: A0,A1,T,W
    14                                                       LEAP SECONDS
                                                             END OF HEADER
1 06 06 04 16 00  0.0 5.727214738727D-05 2.501110429876D-12 0.000000000000D+00
   4.200000000000D+01 1.412500000000D+01 3.978379847780D-09 4.955239025481D-01
   7.934868335724D-07 6.164086284116D-03 7.648020982742D-06 5.153695802689D+03
   5.760000000000D+04-6.332993507385D-08 2.316258030610D+00 3.725290298462D-08
   9.878682565181D-01 2.488750000000D+02-1.735244248619D+00-7.943902424756D-09
   6.107397226840D-11 1.000000000000D+00 1.378000000000D+03 0.000000000000D+00
   2.800000000000D+00 0.000000000000D+00-3.259629011154D-09 4.200000000000D+01
   5.760000000000D+04 0.000000000000D+00
2 06 06 05 00 00  0.0 2.374406903982D-06 2.955857780762D-12 0.000000000000D+00
   2.400000000000D+01 3.512500000000D+01 4.850916557331D-09-2.243202916805D-01
   1.898035407066D-06 9.033586829901D-03 5.619600415230D-06 5.153686506271D+03
   8.640000000000D+04-1.359730958939D-07 1.792582557630D-01-1.601874828339D-07
   9.504802411915D-01 2.697187500000D+02 2.073989704647D+00-8.402849971390D-09
   2.464388415557D-11 1.000000000000D+00 1.378000000000D+03 0.000000000000D+00
   2.800000000000D+00 0.000000000000D+00-1.722946763039D-08 2.800000000000D+02
   8.640000000000D+04 0.000000000000D+00
3 06 06 04 17 59 44.0 1.041260547936D-04 3.069544618484D-12 0.000000000000D+00
```

Navigation File of HKSC on 5 June 2006 from UTC Time 3:00 to 4:00

Navigation File: Data section

Satellite Number | Epoch	ao	a1	a2
IOD	Crs	Δn	**Mo t0e**
Cus	**e**	Cus	**√ a**
t0e	Cic	**Ω**	Cis
I	Crc	**ω**	Ω dot
I dot	L2	GPS Week	L2 P code
Satellite accuracy	Satellite health	TGD	IODC
Transmission Time	Spare		

Mo t0e: Mean Anomaly
- Mathematical Abstraction of True Anomaly *v*

Navigation File: Data Section

HKSC_200606050300_200606050400 - 記事本

檔案(F) 編輯(E) 格式(O) 檢視(V) 說明(H)

```
     2.10           NAVIGATION DATA                         RINEX VERSION / TYPE
SPIDER V2,0,0,2133                        2006 06 06 00:04    PGM / RUN BY / DATE
    6.5193D-09  2.2352D-08 -5.9605D-08 -1.1921D-07           ION ALPHA
    8.6016D+04  9.8304D+04 -6.5536D+04 -5.2429D+05           ION BETA
    5.587935447693D-09 1.598721155460D-14   319488     1378 DELTA-UTC: A0,A1,T,W
    14                                                       LEAP SECONDS
                                                             END OF HEADER
 1 06 06 04 16 00  0.0 5.727214738727D-05 2.501110429876D-12 0.000000000000D+00
    4.200000000000D+01 1.412500000000D+01 3.978379847780D-09 4.955239025481D-01
    7.934868335724D-07 6.164086284116D-03 7.648020982742D-06 5.153695802689D+03
    5.760000000000D+04-6.332993507385D-08 2.316258036610D+00 3.725290298462D-08
    9.878682565181D-01 2.488750000000D+02-1.735244248619D+00-7.943902424756D-09
    6.107397226840D-11 1.000000000000D+00 1.378000000000D+03 0.000000000000D+00
    2.800000000000D+00 0.000000000000D+00-3.259629111154D-09 4.200000000000D+01
    5.760000000000D+04 0.000000000000D+00
```

e

Ω

ω

i

$\sqrt{a}$

v (mean)

Navigation File of HKSC on 5 June 2006 from UTC Time 3:00 to 4:00

Reference

- PowerPoint - RINEX Computation by CW Lau
- http://gps.wva.net/html.common/rinex.html
- The RINEX Format: Current Status, Future Developments by Werner Gurtner and Gerald M.Mader
- Space and Physical Geodesy by H.Bâki Iz
- GPS Theory and Practice by B.Hofmann et al