# Classification of GNSS interference

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- **Interference Events description**
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# Classification of interference in ICG

GNSS has been applied into almost every aspect of human lives. It would have significant impact on national defense and economic security once GNSS is interfered. People all know about the harm of interference, but

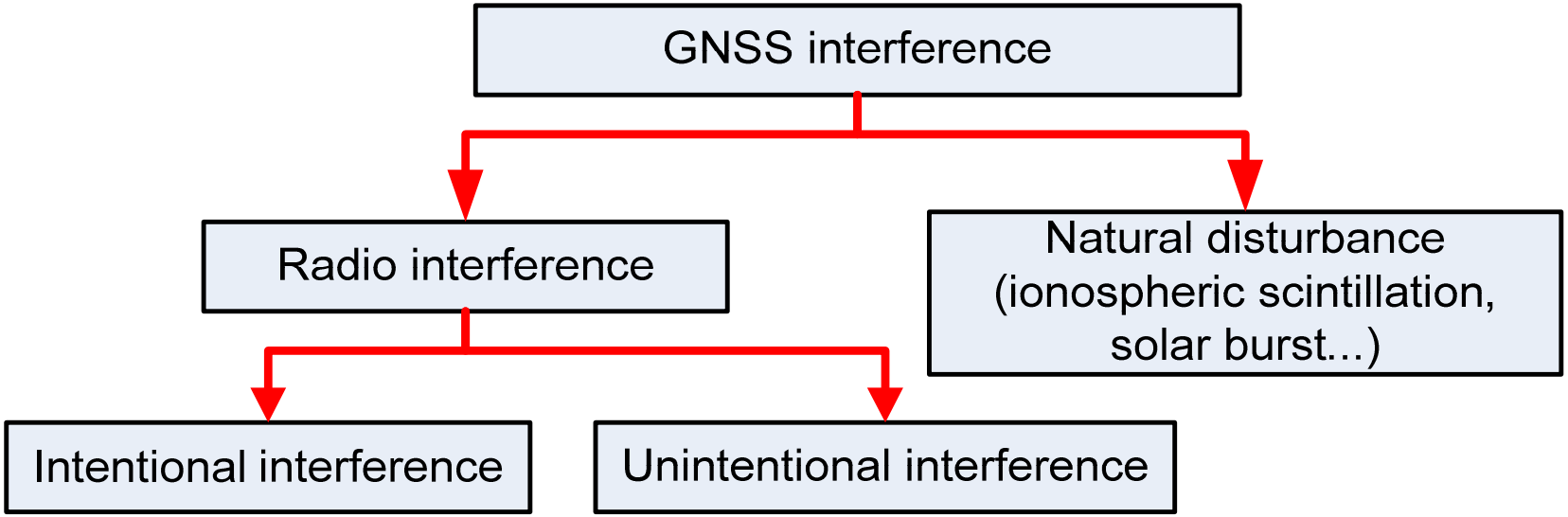
## What is GNSS Interference?


**GNSS applications**

# Classification of interference in ICG

**A definition of GNSS interference has been provided in ICG-7**

- **Radio interference (Interference from radio systems)**
  - Un*intentional interference*
  - *Intentional interference*
- **Natural Disturbance**



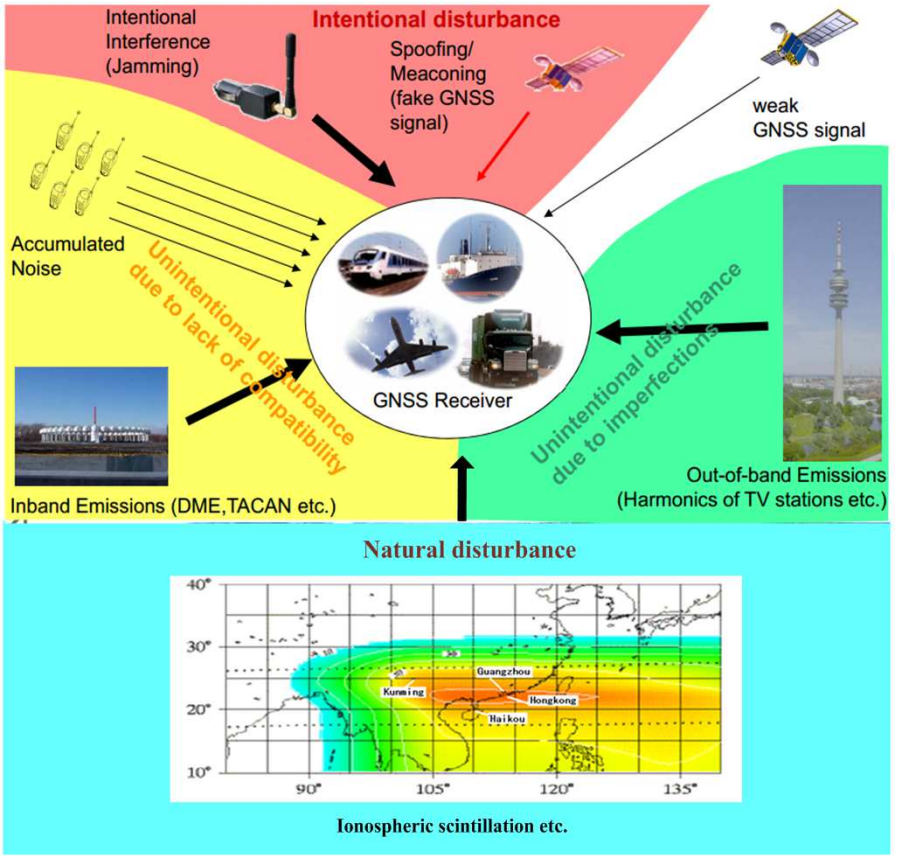

**Definition of GNSS interference**

# Classification of interference in ICG

The main reason why GNSS signal is vulnerable to interference is the weak transmit power.

Unintentional, Intentional and Natural disturbance are three aspects of interference:

- Unintentional disturbance
  - *In-band emission*
  - *Out-of-band emission*
  - ……
- Intentional disturbance
  - *Spoofing*
  - *Jamming*
  - ……
- Natural disturbance
  - *Ionospheric scintillation*
  - ……




**Classification of GNSS interference**

# Interference Events description

*More and more interference events, not only to GPS but also to BDS, have been found. They all have great effect on the performance of GNSS. People should be aware of the harm of interference.*

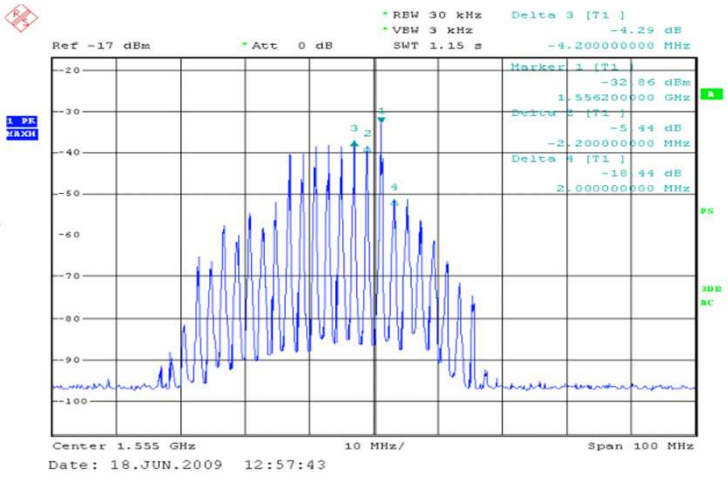
# Unintentional interference

## 1) Unintentional interference to GPS

Aerial GPS signal was interrupted caused by interference in Shenzhen city and Henan province, etc. Backup system was started as a consequence.

Failure of GPS time synchronization system in mobile station.

Source: Unknown interference.




**Failure of GPS time synchronization system in mobile station**

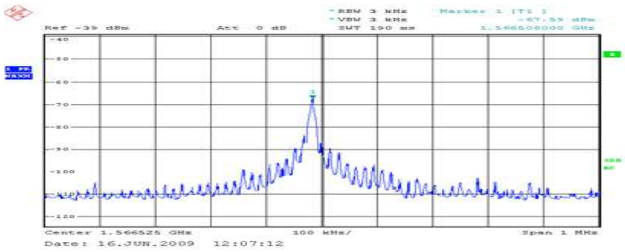
# Unintentional interference

## 2) Unintentional interference to BDS

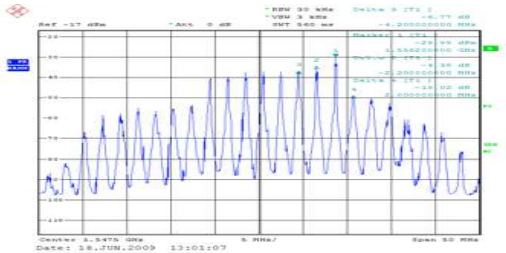
Interference was found in all the three frequencies of B1,B2 and B3 in Xi'an.

Sources:

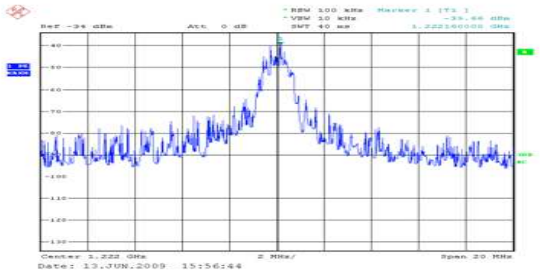
- TV/mobile transmit tower (at B1)
- microwave device (at B2)
- airport radar (at B3)



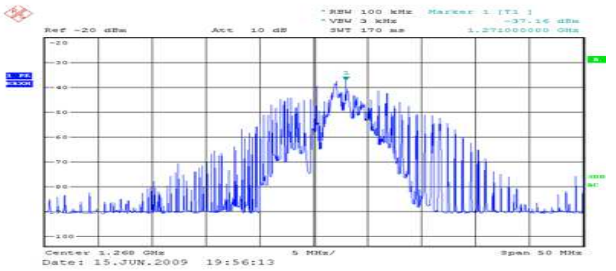
**B1 frequency 1566MHz**
**TV transmitter**



**B1 frequency 1556MHz**
**mobile transmitter**



**B2 frequency 1222MHz**
**Microwave device**



**B3 frequency 1268MHz**
**Air traffic radar**

**Interference at B1, B2 and B3 in Xi'an**

# Intentional interference

## Intentional interference to BDS

A bus driver was caught at Luzhou Passenger Transport Center with a GNSS jammer in his bus.
The jammer was used to avoid being tracked by the transportation manage department.

Source
Jammer available on Internet

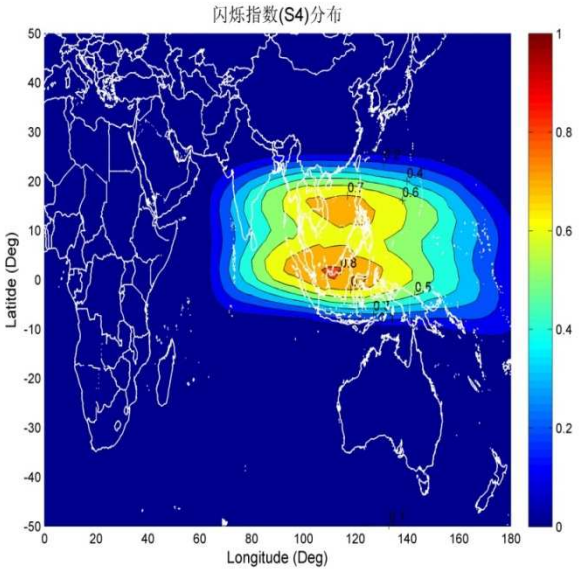

**Intentional interference with jammer**

# Natural disturbance

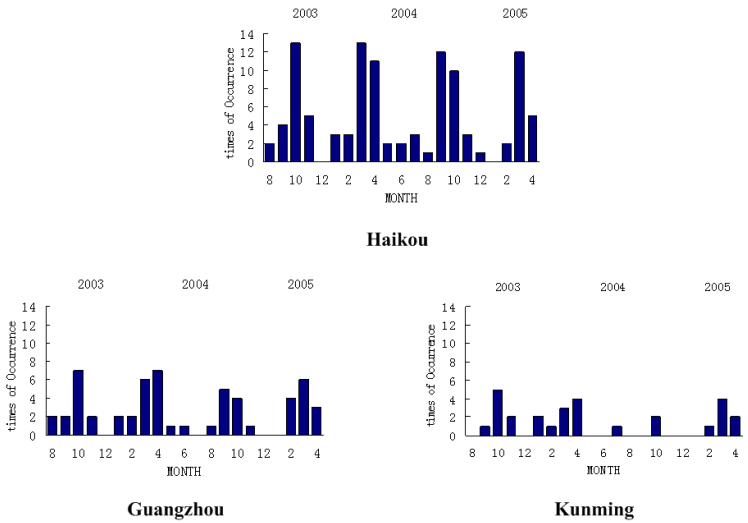
## Ionospheric scintillation

GNSS interference may also be caused by natural disturbance. Among which ionospheric scintillation effect is most important.

Ionospheric scintillation varies with many factors such as time, season and geomagnetic position。




Distribution of S4 index



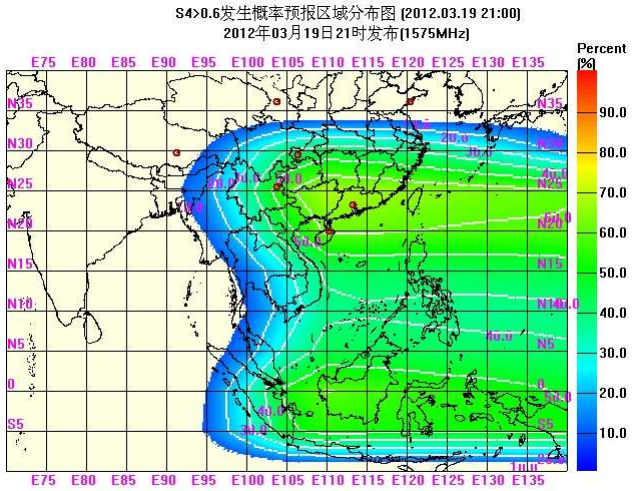

Times of scintillation occurrence

**Factors affecting ionospheric scintillation**

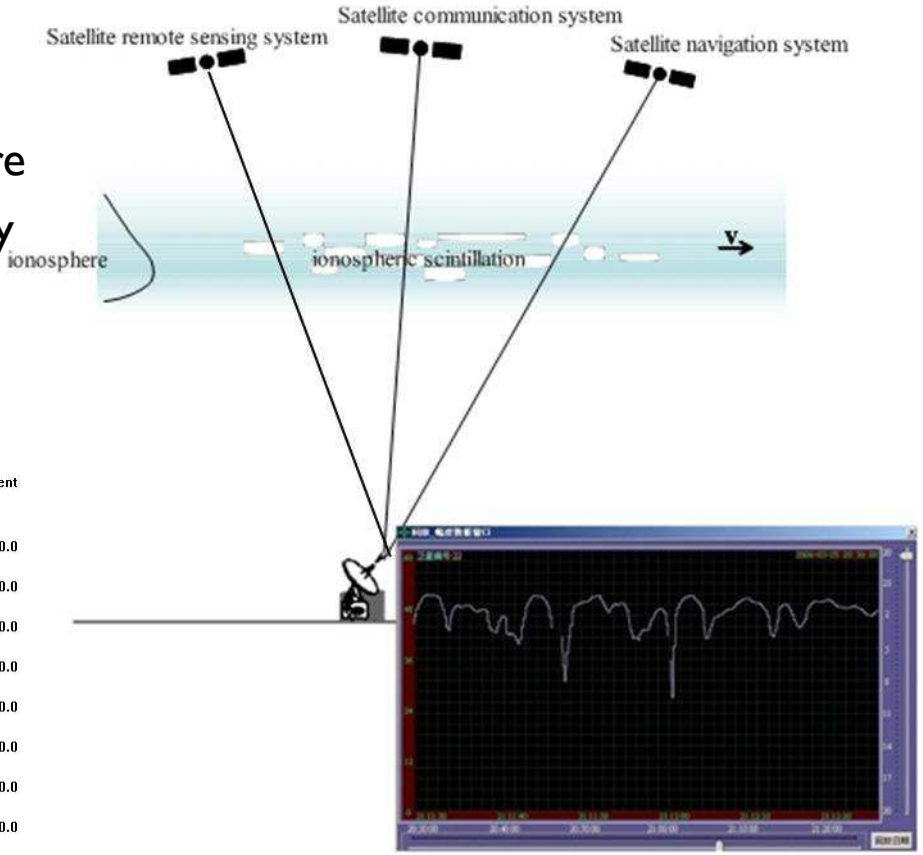
# Natural disturbance

## Ionospheric scintillation

Ionospheric scintillation may degrade the positioning accuracy of GNSS and even cause loss of lock during severe scintillation activities, especially in the low latitude region of China.




**Affected area of ionospheric scintillation**

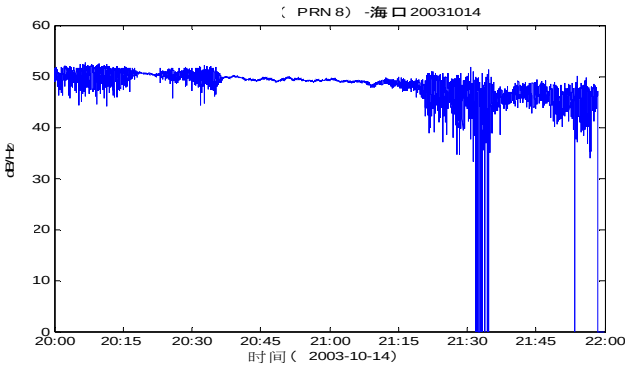



**Loss of lock of GPS signal caused by scintillation**

# Natural disturbance

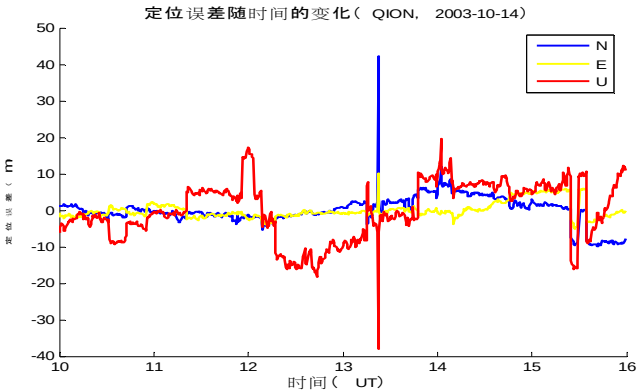
## Ionospheric scintillation —— 2003.10.14

Signal to noise ratio degradation




- The signal to noise ratio fluctuates rapidly while scintillation occurs.
- The track of signal may be interrupted during intense scintillation.

Dual frequency positioning accuracy

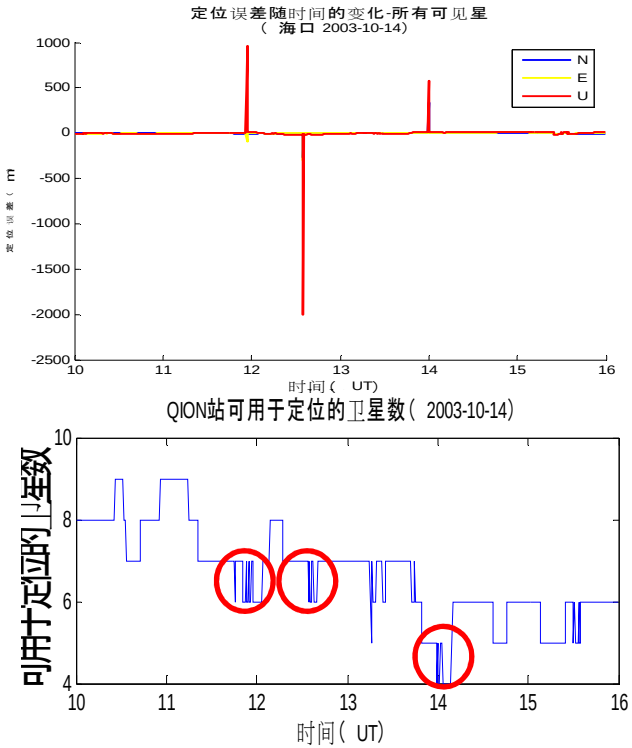



- The error of positioning accuracy of dual frequency receiver becomes large during scintillation.
- Sometimes huge slips may occur.

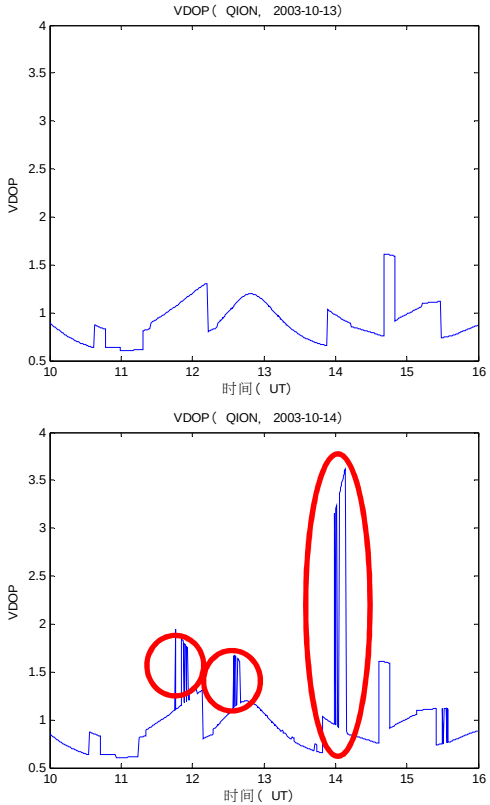
# Natural disturbance

## Ionospheric scintillation —— 2003.10.14

### Number of satellites visible




### Dilution of Precision




No Scintillation

Scintillation

**Both the number of satellites visible and the dilution of precision at Qion station varied significantly with the occurrence of scintillation.**

# Summary

From the harm of interference study, we can realize the importance of IDM tasks, countermeasures should be implemented urgently and some recommendations can be drawn:

- To avoid unintentional interference (such as interference between GNSS and the other services in-band or out-band), compatibility study is of most important;
- To avoid intentional interference (such as jammers available), legislation in spectrum protection and jammer prevention should be promoted;
- To avoid natural disturbance (such as ionospehric scintillation), ionospheric study was encouraged so that pre-countermeasures could be carried out through the prediction of spatial weather.

# Thanks for your attention!

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