1月30日（土）
第29回
我孫子サイエンスカフェ

wiki

GPSと相対論

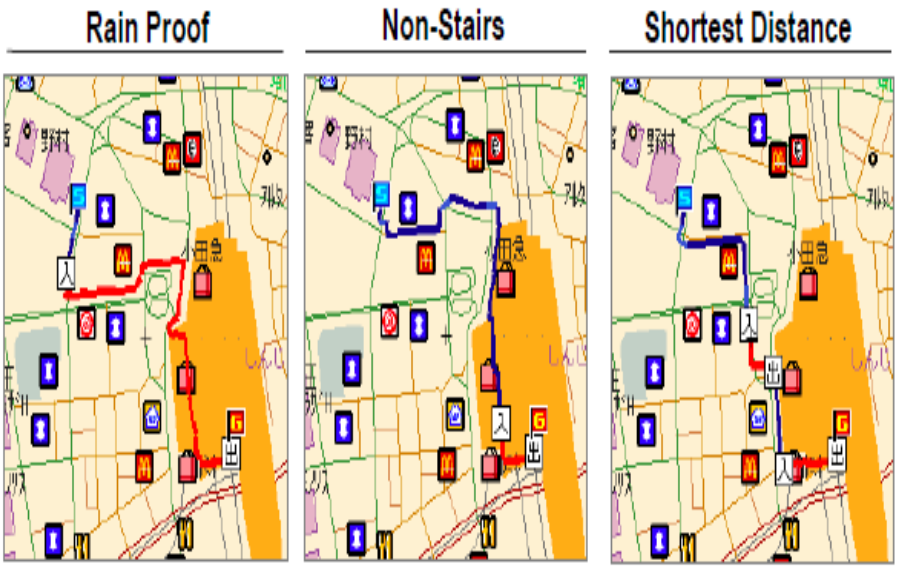
我孫子の物理学者
細谷暁夫

1. GPSの使われ方

GPS機能付き
キッズ携帯

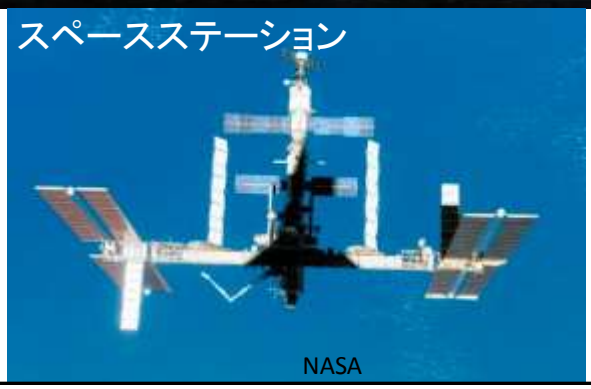
広告

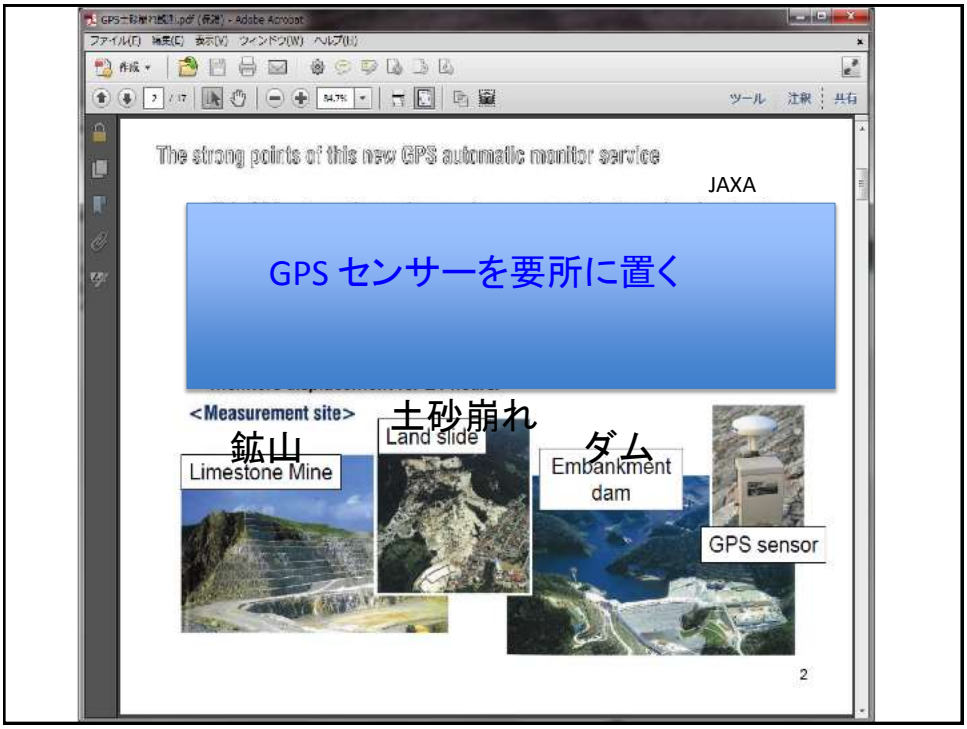
新宿ナビ（3D位置情報）

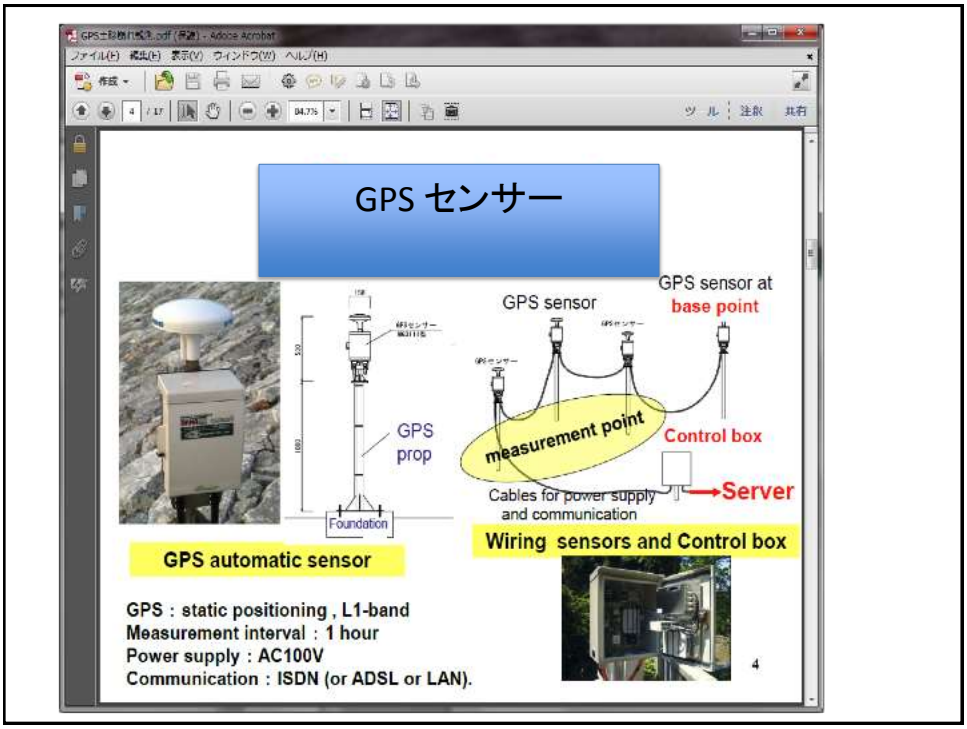


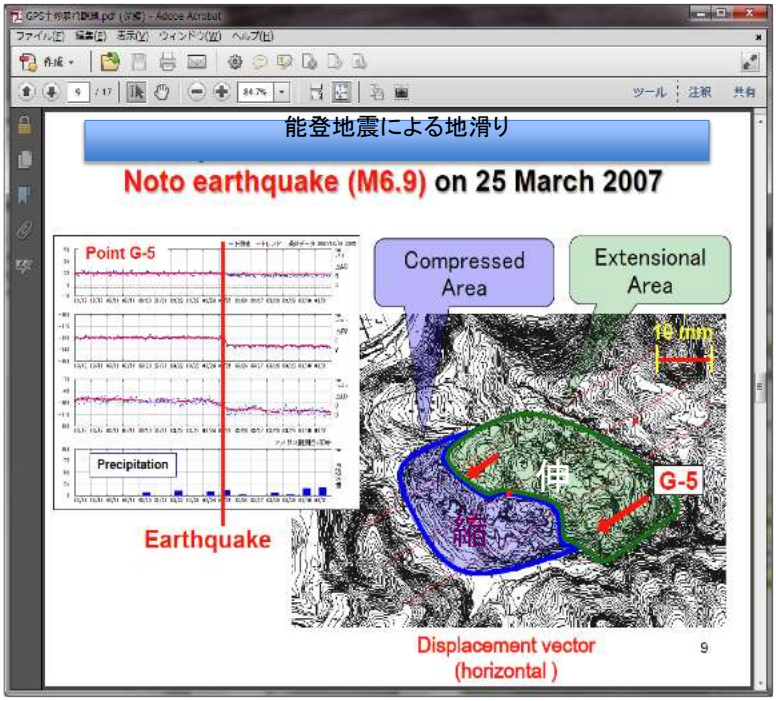
(ZENRIN DATA COM)

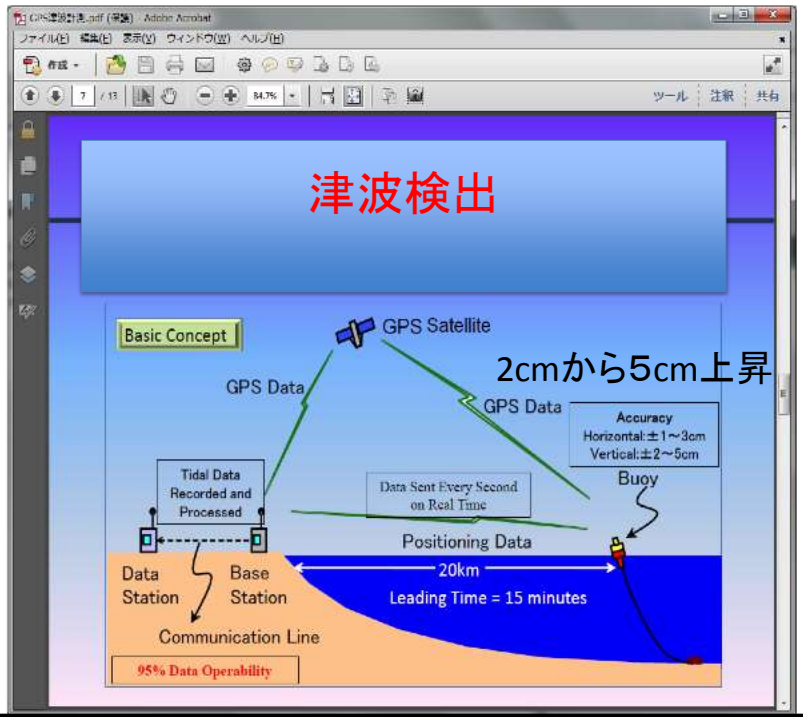
(ZENRIN DATA COM)

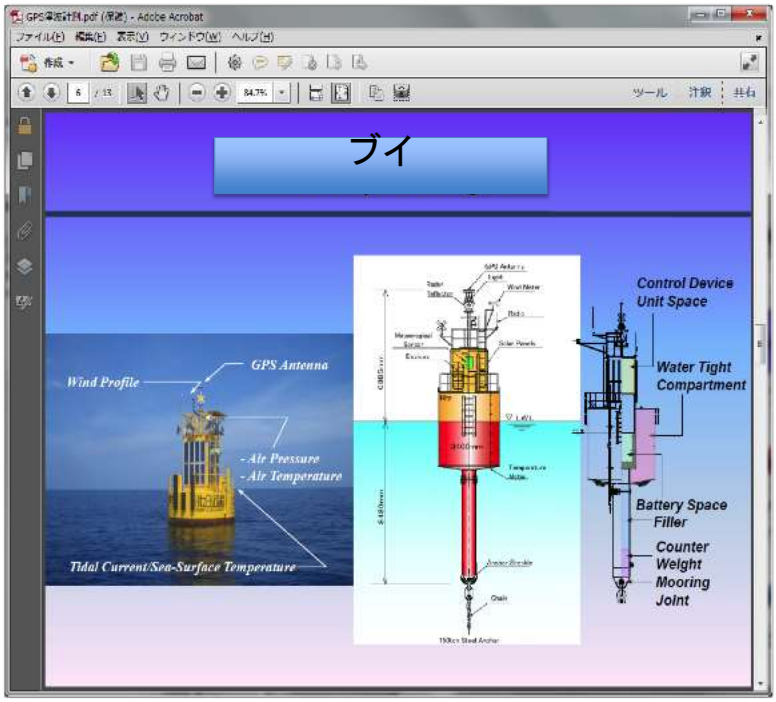



The strong points of this new GPS automatic monitor service
JAXA
GPS センサーを要所に置く
<Measurement site>
鉱山
Limestone Mine
土砂崩れ
Land slide
ダム
Embankment dam
GPS sensor
2


GPS センサー
GPS sensor
GPS sensor at base point
GPS prop
measurement point
Control box
Server
Cables for power supply and communication
Foundation
GPS automatic sensor
Wiring sensors and Control box
GPS : static positioning , L1-band
Measurement interval : 1 hour
Power supply : AC100V
Communication : ISDN (or ADSL or LAN).
4


能登地震による地滑り
Noto earthquake (M6.9) on 25 March 2007
Point G-5
Precipitation
Earthquake
Compressed Area
Extensional Area
10 mm
伸
縮
G-5
Displacement vector (horizontal)
9


津波検出
Basic Concept
GPS Satellite
GPS Data
GPS Data
2cmから5cm上昇
Accuracy
Horizontal:±1~3cm
Vertical:±2~5cm
Buoy
Tidal Data Recorded and Processed
Data Sent Every Second on Real Time
Positioning Data
Data Station
Base Station
20km
Leading Time = 15 minutes
Communication Line
95% Data Operability


ブイ
Wind Profile
GPS Antenna
- Air Pressure
- Air Temperature
Tidal Current/Sea-Surface Temperature
Control Device
Unit Space
Water Tight
Compartment
Battery Space
Filler
Counter
Weight
Mooring
Joint

日本各地の津波測定
Aburatsubo 1998
Ofunato
Kaiho No.2
Muroto In Operation
Experimental Data Displayed
http://www.tsunamigps.com/
Ofunato
Kaiho No.2
Aburatsubo
Muroto
Buoy installed and operated by Ministry of Land, Infrastructure, Transport and Tourism (NOWPHAS)

GPS ステーション

1992 - 1993　　1994　　1995 - 2001　　2002 -

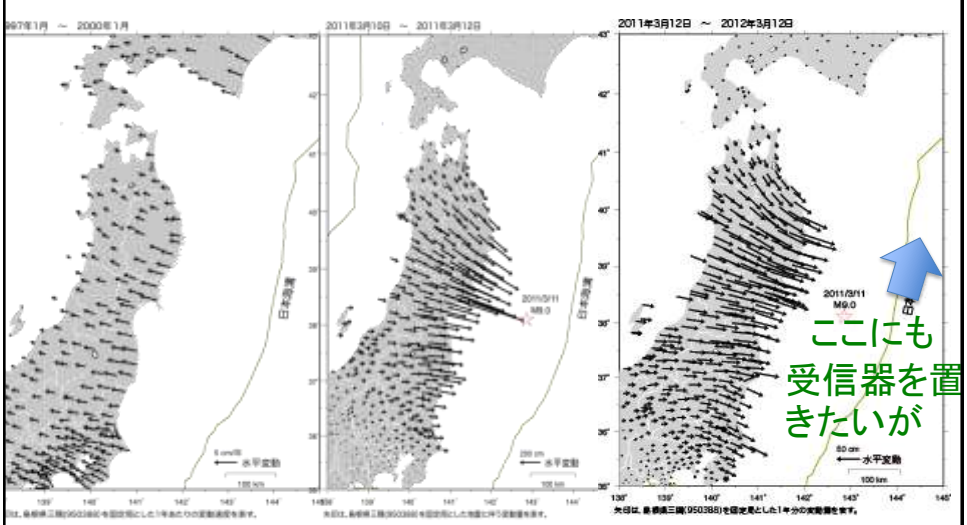
国内のGPS ステーション

- 1,240 stations (April, 2009)
- A spatial resolution: 20-30 km.
- All stations are receiving GPS L1 and L2.

JAXA

東日本大地震前後の地殻変動

前　　直後　　後



2.GPSとは何だろうか？

Global Positioning System

衛星を使って自分の位置を知る（アメリカの）システム

Current status on GNSS

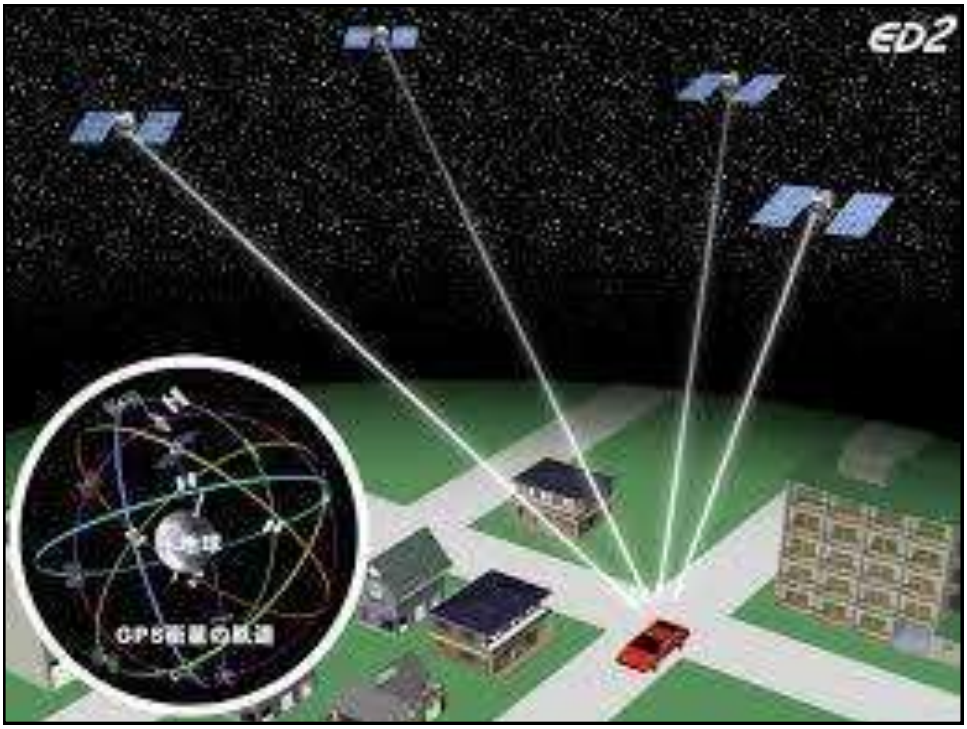
Operating Country	GNSS
USA	GPS
Russia	Glonass
EU	Galireo
China	BeiDou
India	IRNSS
Japan	QZSS

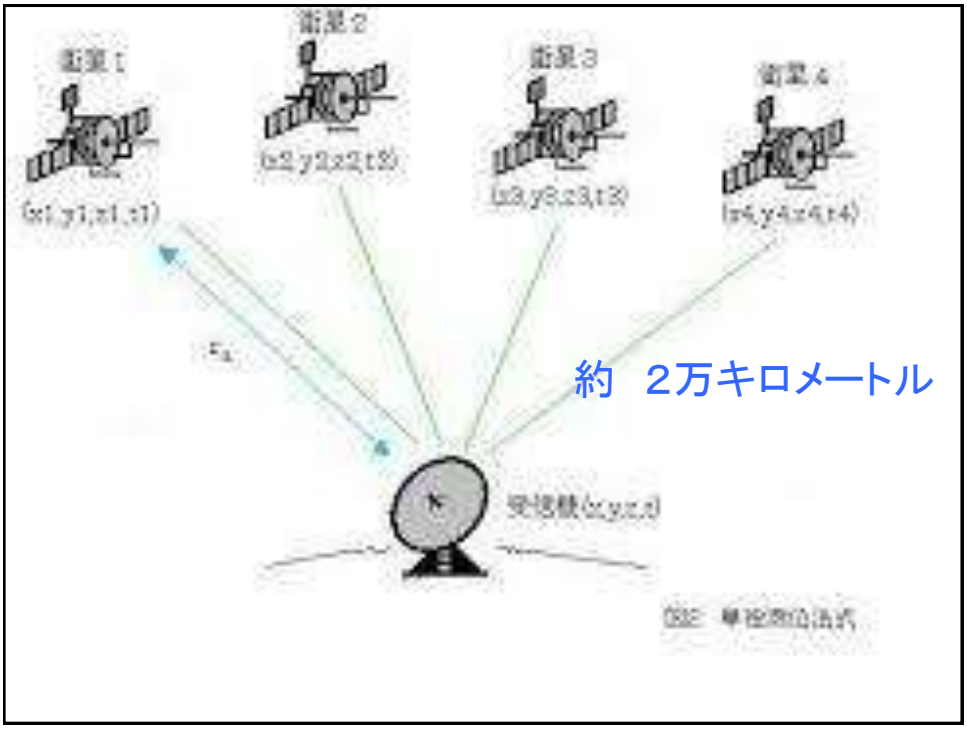
GPSと同様のシステム（含計画中）

JAXA

みちびき1号
QZSS

高度20,200km、軌道傾斜角55度、周期12時間
常時6台視界にあるようにしている


ED2
地球
GPS衛星の軌道


衛星1
衛星2
衛星3
衛星4
(x1,y1,z1,t1)
(x2,y2,z2,t2)
(x3,y3,z3,t3)
(x4,y4,z4,t4)
約　2万キロメートル
受信機(x,y,z,t)