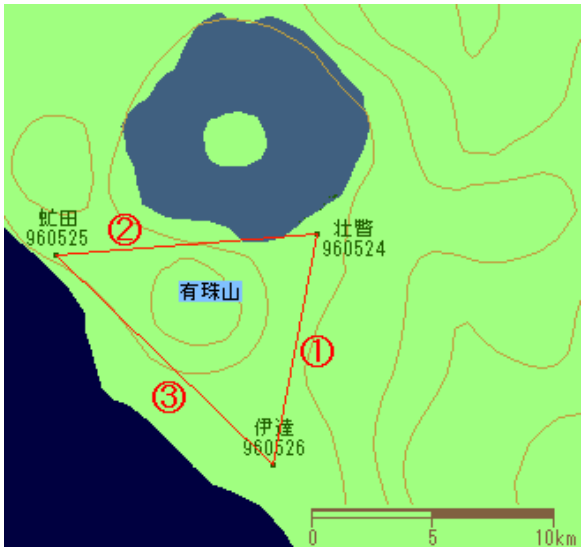
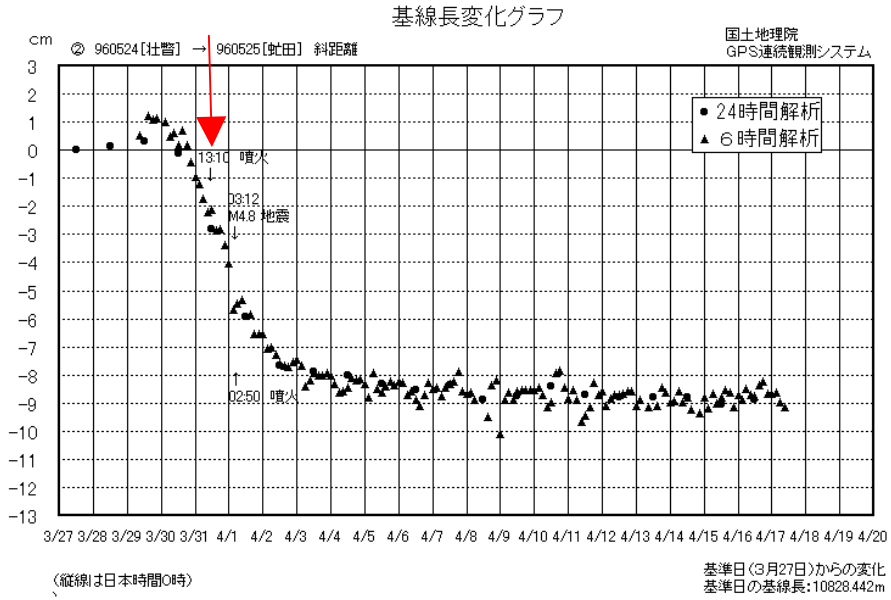
Addition of real-time capability to the Japanese dense GPS network

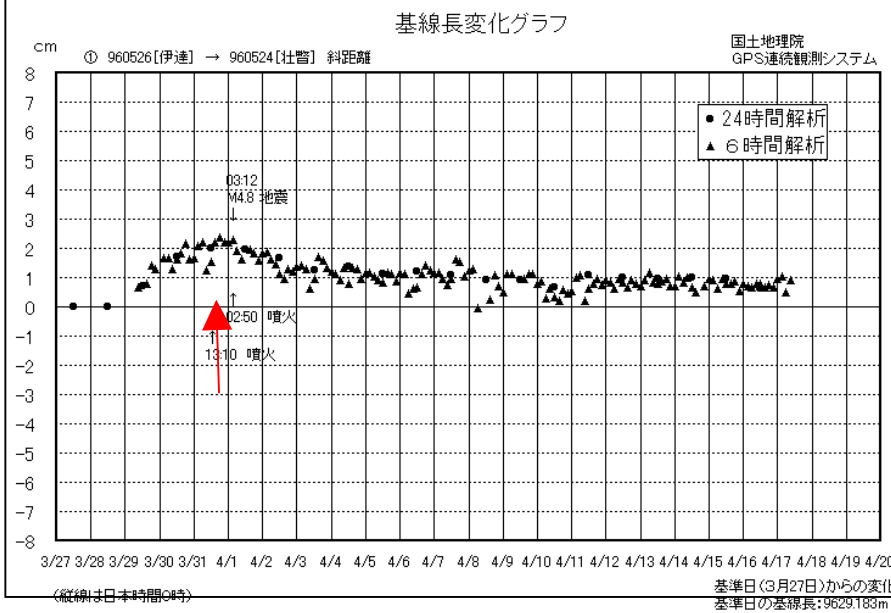
Y. Hatanaka, A. Yamagiwa, M. Iwata, S. Otaki

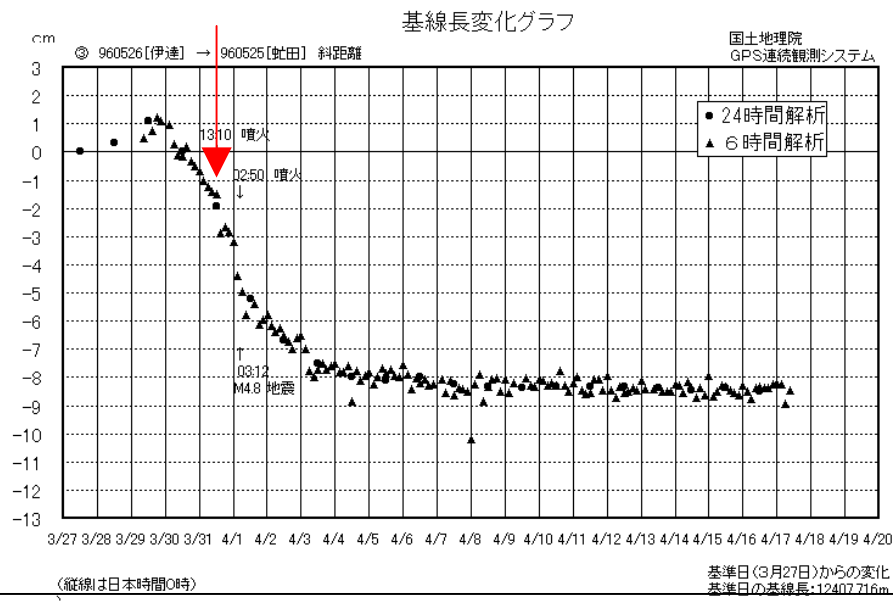
(Geographical Survey Institute, Japan)

Eruption of Usu volcano (Mar. 2000)







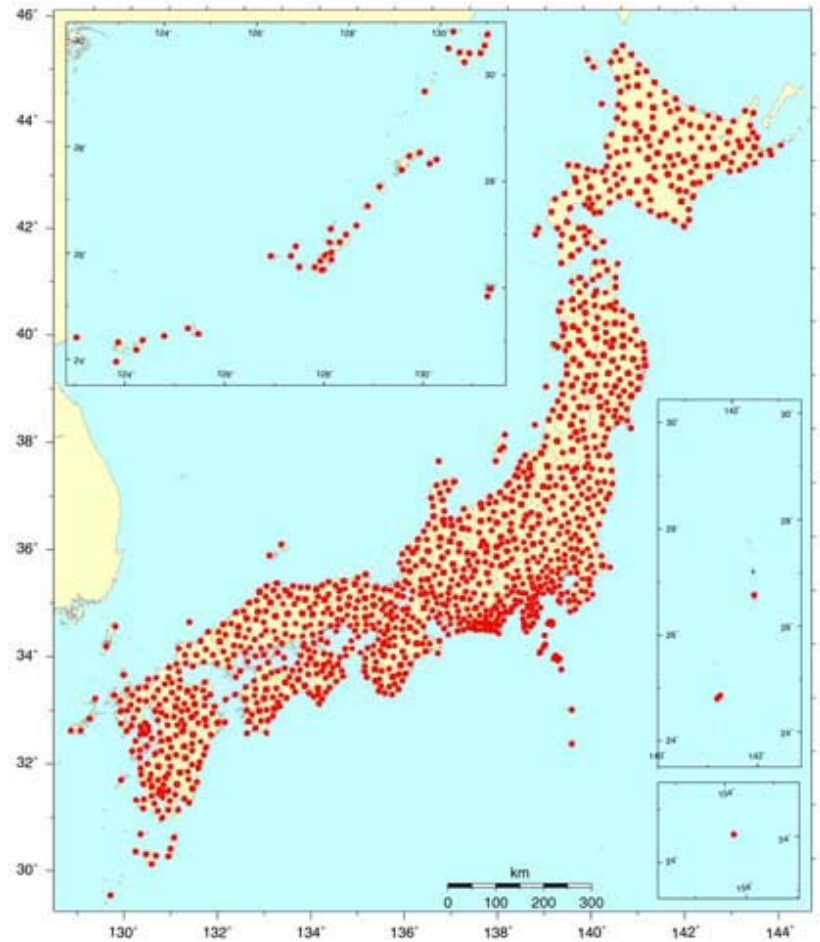


Upgrade of GEONET

Motivation:

- More efficiency for cope with emergency situation
  → Quickness of data transfer & analysis
- To enhance functions as social infrastructure (to aid development of positioning industry)
  → high rate sampling
  → Real-time data transfer & provision

GPS Earth Observatinon NETwork (GEONET)

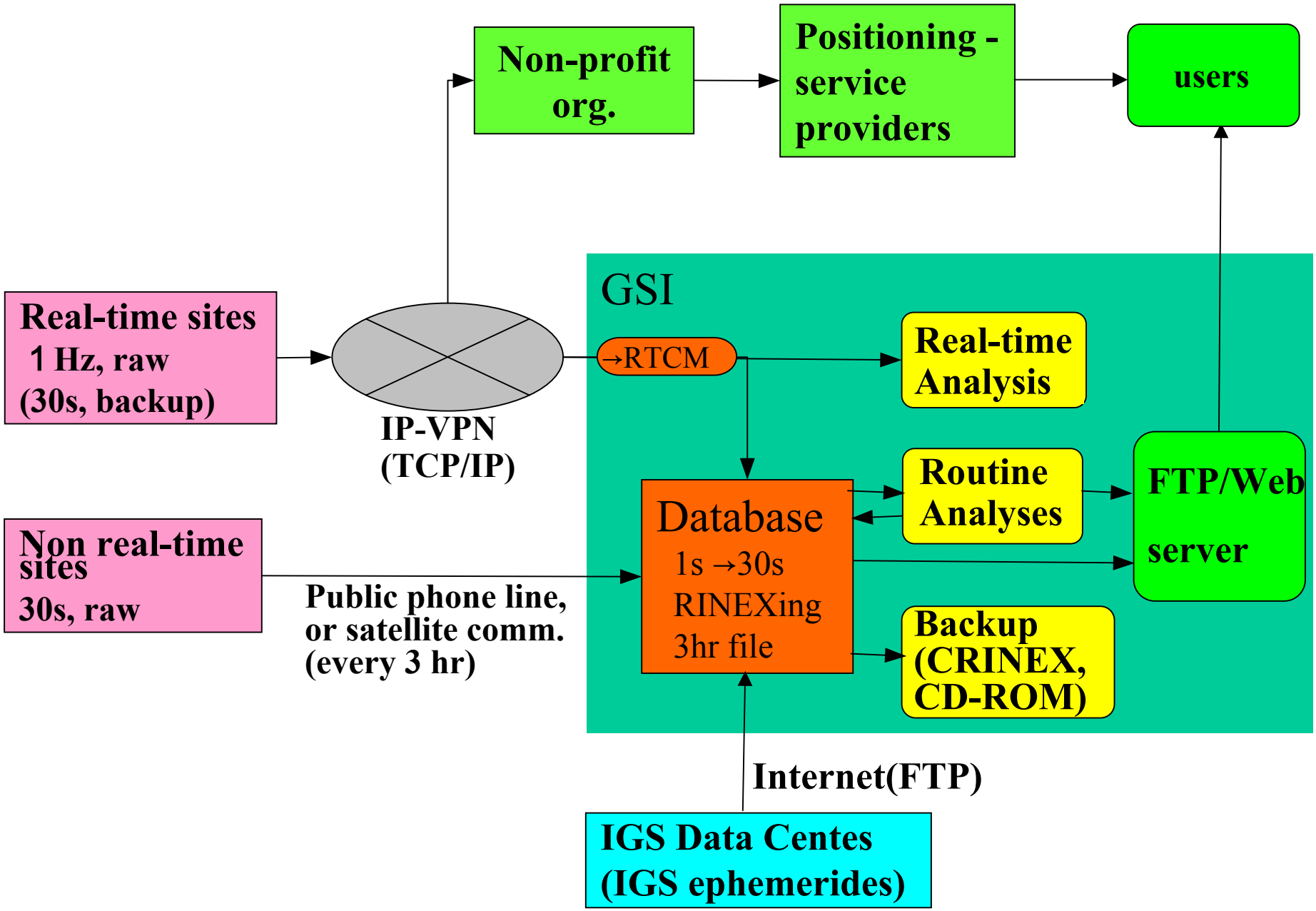


Reinforcement of the network

- Modification and addition of stations:
  - 947 sites →1200 sites
  - Replacement of antennas to choke ring
  - Replacement of receivers for 1 Hz & real-time capability
- Observation:
  - 1 Hz sampling with 5 deg. elevation mask
- Real-time data transfer: IP-VPN
- Analysis:
  - Quick analysis (every 3 hours, whole network)
  - RTK capability for selected stations (<50 sites)

Real-time data transfer

- Internet Protocol - Virtual Private Network (IP-VPN)
  - IP-connection to the station
  - Virtually closed network within limited users
    →high security
  - Provided by telecommunication companies


Non-profit org.
Positioning - service providers
users
GSI
Real-time sites
1 Hz, raw
(30s, backup)
IP-VPN
(TCP/IP)
→RTCM
Real-time Analysis
Routine Analyses
FTP/Web server
Database
1s →30s
RINEXing
3hr file
Backup (CRINEX, CD-ROM)
Non real-time sites
30s, raw
Public phone line, or satellite comm. (every 3 hr)
Internet(FTP)
IGS Data Centes
(IGS ephemerides)

Data Analysis

- Routine analyses (whole network)
  - Software: BERNESE ver.4.2
  - Three types of analyses

type	Sess.	Freq.	eph.	remarks
Quick	6hr	every 3 hr	IGU	near real-time
Rapid	24hr	daily	IGU	
Final	24hr	weekly	IGS	reanalysis done

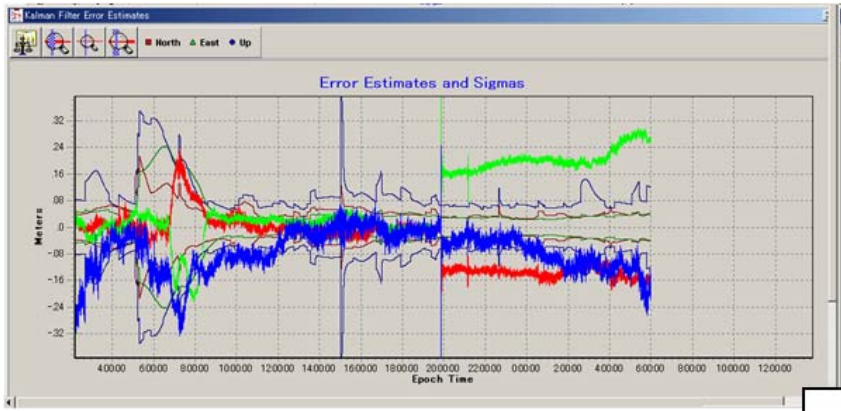
- Emergency analysis (for selected sites <50)
  - To detect large movements (> 5cm) within 5 min.
  - Software: RTNET (GPS Solutions Inc.)
  - IGU products
  - Real time/post-processing

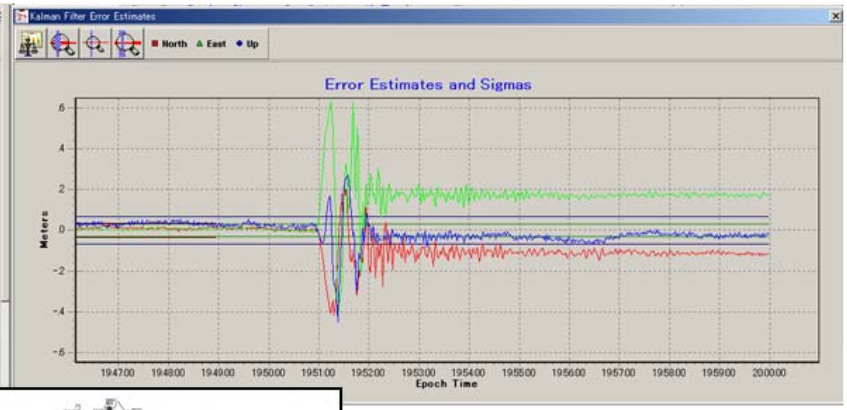
Transfer of IGU products

- IGU orbits are used for the Quick(3hr) and the Rapid(24hr) analysis
- To minimize troubles with getting IGU prod.;
  - Trial to get newest IGU from an IGS DCs
  - When failed: try another IGS DCs
  - Use Broadcast eph. if IGU is not available from any DCs

Examples of RTK-type analysis (post-processing)

(the 2003 off-Tokachi Earthquake, M8.0)

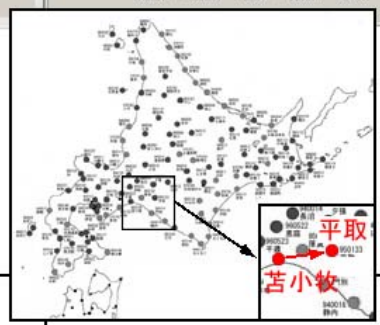


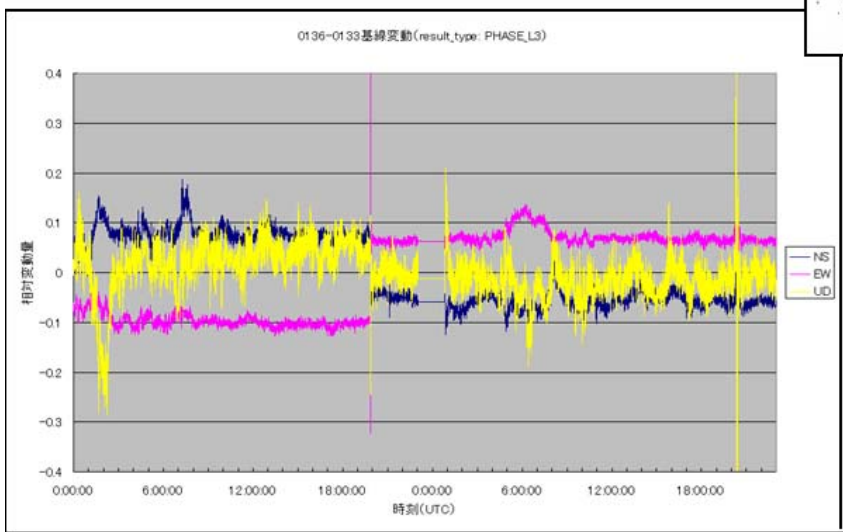


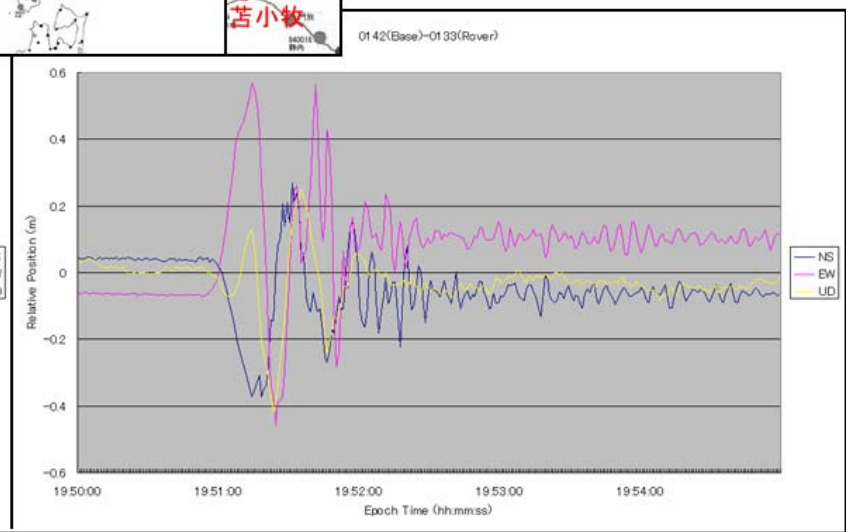
↑ 3D Trackerによる解析結果

基線：苫小牧（基準局）－平取（移動局）

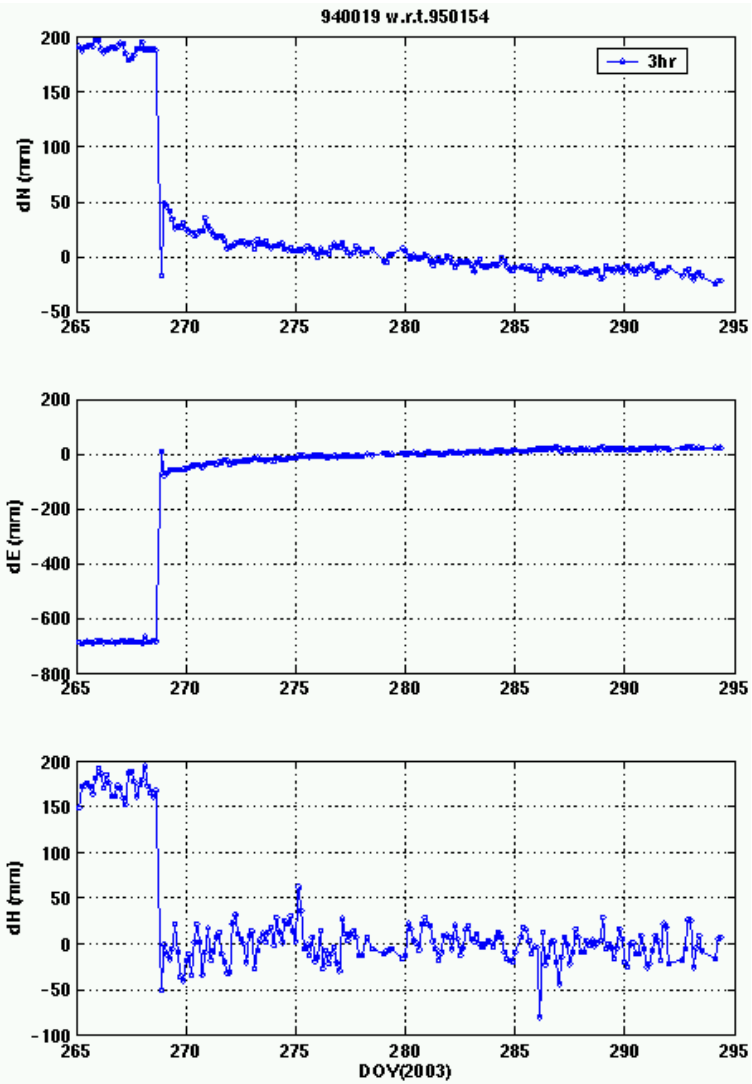
↓ RTnetによる解析結果

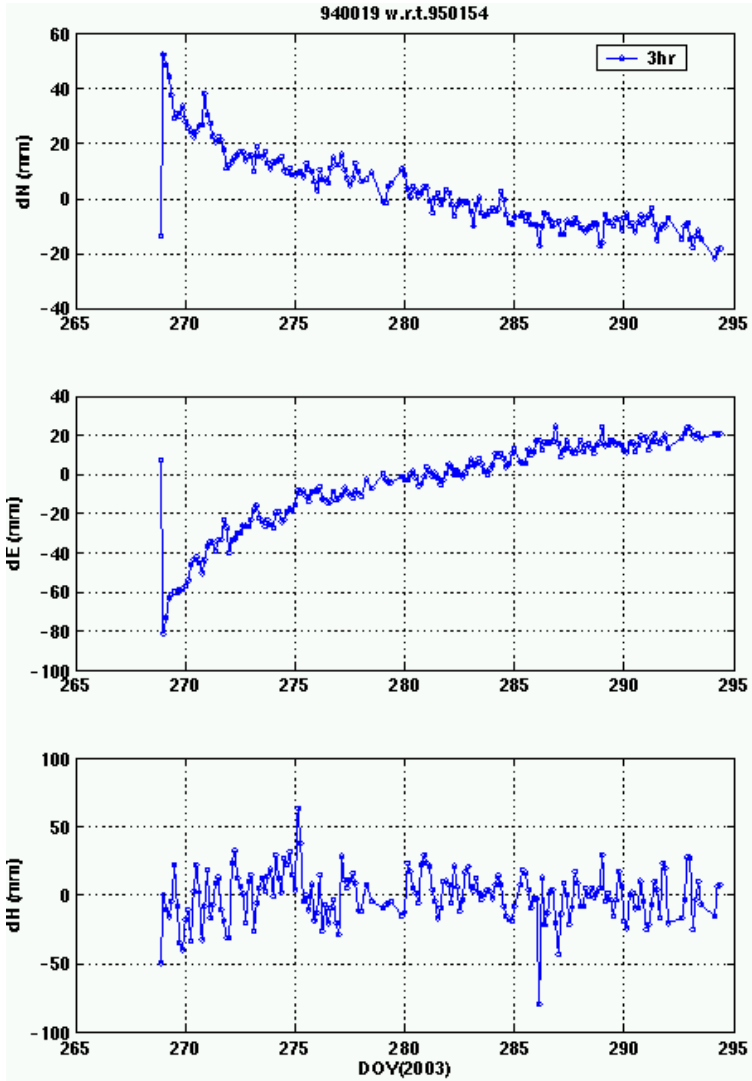




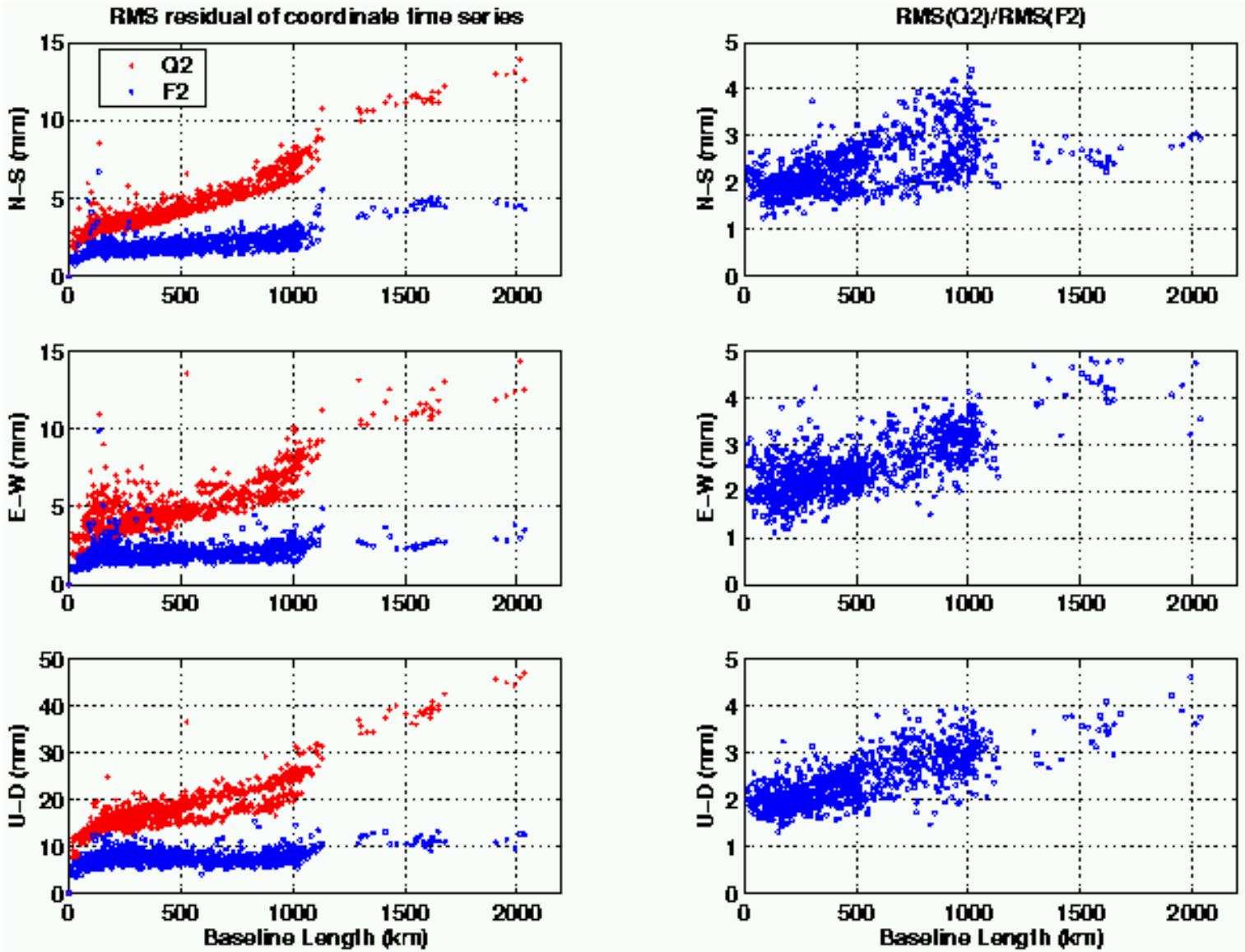


Examples of Quick solutions
(the 2003 off-Tokachi Earthquake, M8.0)





precision of Quick and Final solutions



Summary

- Secure IP connection to the sites by IP/VPN
- real-time transfer of data (1Hz, raw)

  →GSI, positioning-service providers
- Conversion to standard formats at GSI
- Backup 30s data at the site
  - Can be transferred without stopping 1Hz data stream
- (near) real-time analyses in GSI
  - IGU products play key role
  - Helped by redundancy of IGS DCs (fail-safe)