The Global Differential GPS (*GDGPS*) System

Operating since 2000 with 99.999% reliability
Sub-10 cm positioning accuracy globally
Customer-supported by industry, NASA, and DoD

National Security

Real-Time Tracking Network
(100+ sites)

Triple Hot Redundant Operation Centers

Precision Industrial Positioning
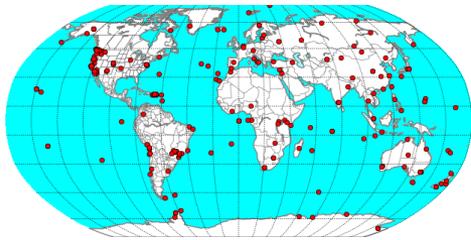
Measurements

Internet, Frame

Products, Services

Internet, Frame

Personal Geolocation
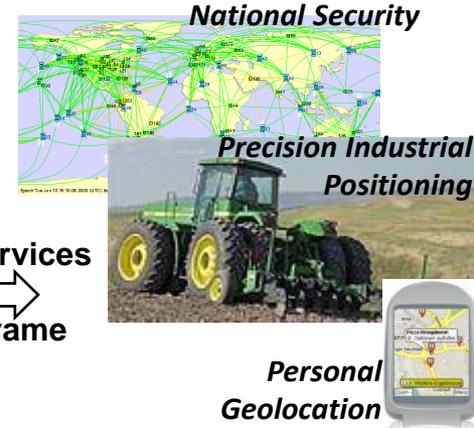
Based on Real Time GIPSY (RTG) software

• Licensed to FAA and to Raytheon for WAAS, MSAS (Japan), and GAGAN (India)

Prototype system and software for the Next Generation GPS Control Segment (OCX)

• Testbed for the development of *RTGX* – the new OCX orbit determination and positioning software

***RTGX* has now replaced RTG in *GDGPS* operations**

• Deliver OCX software with years of operational soaking

• Keeping a live software will reduce lifecycle cost

GDGPS Product Line and Applications Provide Mission Critical Services and Societal Benefits

GDGPS
Jet Propulsion Laboratory

Assisted GPS
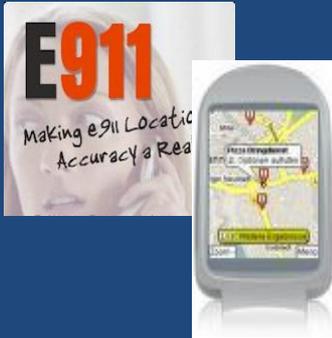
Precise positioning anywhere

The sky is not the limit...

- 10000 km
- GPS 10-20 cm
- 1000 km — Jason-1 10 cm
- 100 km
- GRACE 20 cm 8 cm relative
- 10 km — 10-20 cm
- 1 km
- 10-20 cm
- 0.1 km

Integrity monitoring and situational awareness

Epoch Tue Jun 10 16:10:06 2003 (UTC) (local time at JPL: Tue Jun 10 09:10:06 2003)

Space weather monitoring

Ionospheric TEC
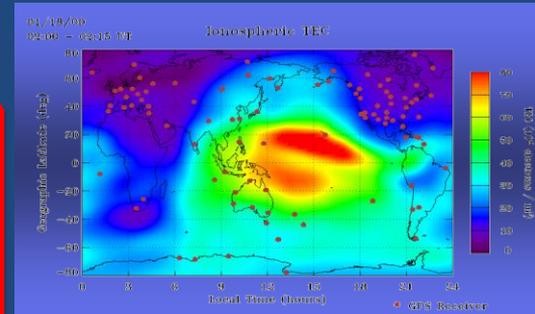
Free public services:

Automatic Precise Positioning Service (APPS)

Tsunami prediction

(b) GPS-Predicted Tsunami (Feb 27 Chile M8.8)

Concepcion (GPS+3.03 m)

SanBago (GPS+0.36 m)

Jason-1 & 2 pass
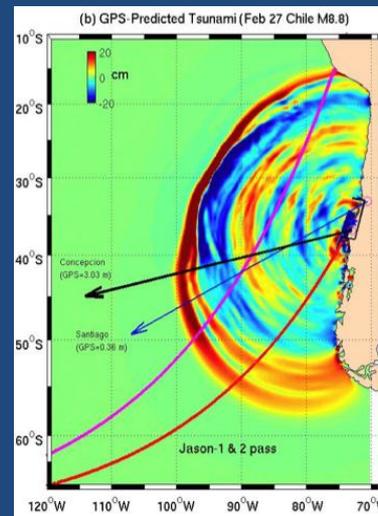
Repeat path interferometry with UAV-SAR

GREAT Alert: Natural hazards monitoring and predictions

Y. Bar-Sever, JPL. May 2013

< 6 cm 1D RMS for high-quality dual-frequency GPS or GPS/GLONASS sites
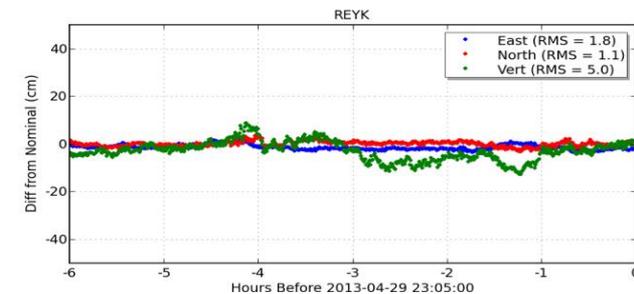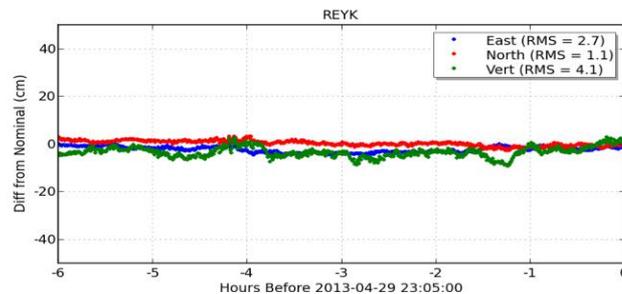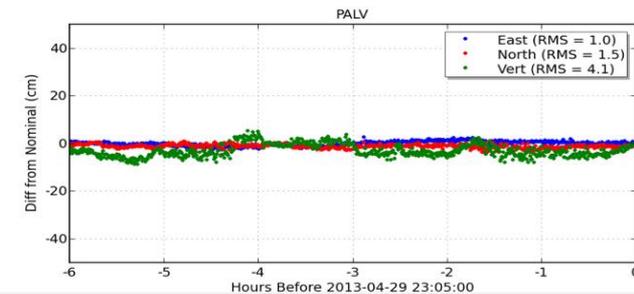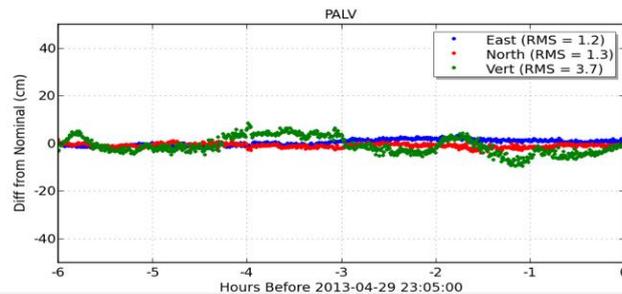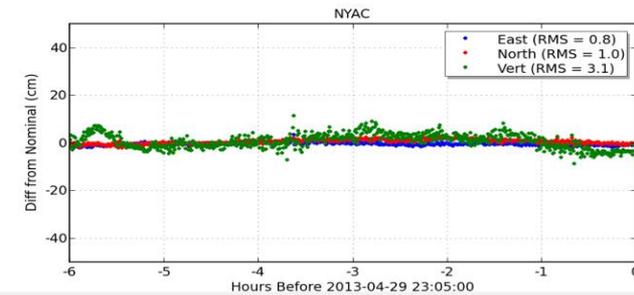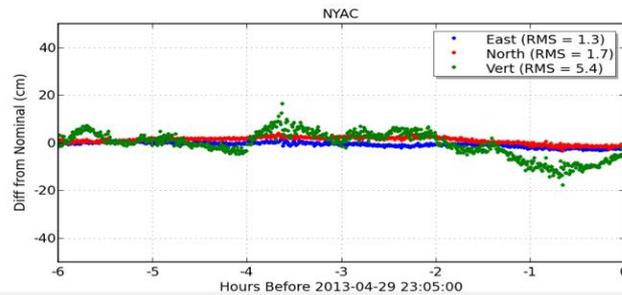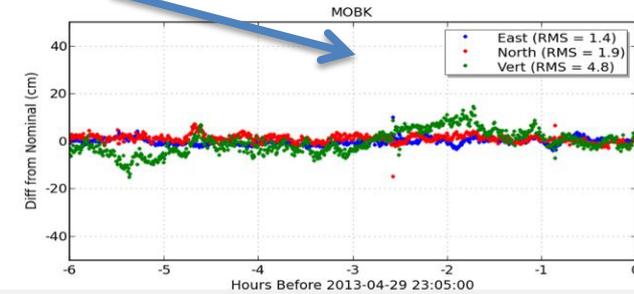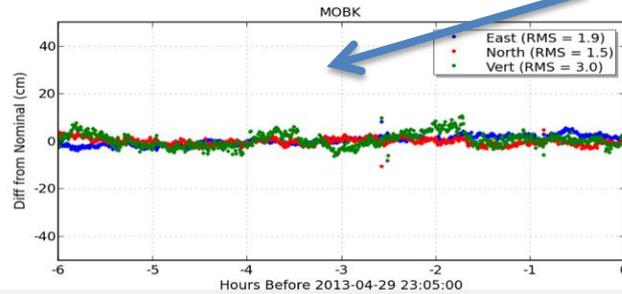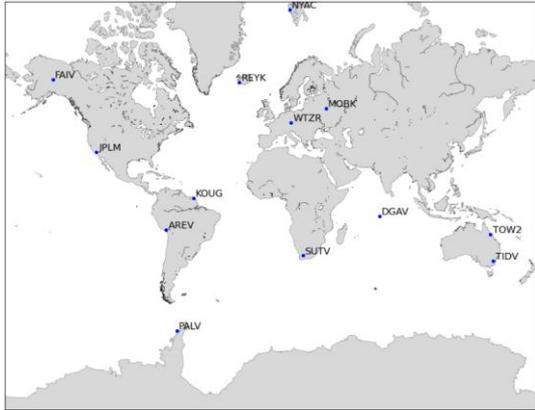
The addition of properly-modeled GLONASS data slightly improves positioning, most of the time…

Full GNSS and Modernized Signals Capability

Monitoring GPS with 25-fold redundancy on average, and minimum 10-fold redundancy
- Enabling strong majority voting schemes for high reliability

Monitored signals: CA, P1, P2(semi-codeless), L2C, L5
- Phase and pseudorange measurements at 1 HZ; 1 second latency 99% of the time
- Navigation message bit-by-bit (LNAV and CNAV)
- SNRs

Since 2010 the GDGPS network provides complete GLONASS real-time coverage with
8-fold redundancy on average, supporting full GLONASS orbit determination capability
and augmentation services; site upgrades are ongoing

Rich web-base graphical interface designed
with and for 2SOPS operators

Data archiving for post-event and trend analysis

Coming soon: BeiDou (summer 2013), and Galileo;
scintillation monitoring

GDGPS GLONASS tracking network as of Sep 2011

THE INTERAGENCY GPS EXECUTIVE BOARD

4805 Herbert C. Hoover Building
14th & Constitution Avenue, N.W.
Washington, D.C. 20230
(202) 482-5809

June 19, 2001

MEMORANDUM FOR THE IGEB SENIOR STEERING GROUP

FROM: Greg Finley
                  Director, IGEB Executive Secretariat

SUBJECT: Proposals for Use of FY 2002 GPS Stewardship Funds

JPL submitted a study proposal to the 2001-2003 IGEB Stewardship Fund, and quickly built an operational performance monitoring system that has been serving 2SOPS for the last 10 years

But the study of civil signal monitoring continues to this day, with a cumulative cost of $MM

Most recently Raytheon was funded to study CSM in OCX

So, who Really Needs Civil Signal Monitoring?

It is evident that no one is interested in *doing* civil signal monitoring, only in *studying* it.

The FAA consistently speaks in two voices:
- It is the main (or only) sponsor of the decades of studies
- WAAS constituency within the FAA say that they could do CSM, and distrust any other source

Cost of CSM within OCX is hard to cleanly separate from all other development and operational costs, and it likely contributes to the overall increase in OCX cost, to the chagrin of the AF

NASA's monitoring needs are satisfied with internal GPS capability, but it is probably willing to be the friendly space agency in support of civil users
- NASA is already sponsoring some of JPL's and IGS GPS operations
- May co-sponsor GDGPS real-time monitoring

And what about GNSS monitoring?
- NASA is interested in getting agencies (civil and DoD) input about their needs
- Planning to host a meeting at JPL of interested agencies

But if it is Really Needed…

Let the civil agencies do civil signal monitoring; it bounds to cost less than if the military does it
• May reduce OCX cost

80% of the requirements (out of ~200) can be readily accomplished at low cost with existing GDGPS capability

✔ Just do it!

An additional 10% can be accomplished with a modest investment (eg, receive power measurements, high PRN codes, some signal deformations)
• Receiver upgrades at select GDGPS sites
• Software development for in-situ high-rate data analysis

10% of the requirement are probably not worth doing, or could be revised/relaxed/deferred (eg, non-standard codes, P(Y) tracking)