Introduction to JPL's GPS Time Series

Edited Time Series, Velocity Field, and Web Site
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Point Positions
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Orbits and Clocks
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GPS Time Series - Four Basic Steps

Step 1 – Orbits and Clocks
Get data from roughly eighty global GPS receivers
Compute precise GPS orbits and clocks in NNR GPS reference frame
Compute transformation parameters from NNR GPS frame to IGS14

Step 2 - Point Positions
Compute point positions for thousands of global GPS receivers in NNR GPS reference frame
Resolve phase ambiguities
Apply transformation parameters to obtain positions in IGS14

Step 3 – Time Series
Search for breaks
Remove outliers
Estimate positions, velocities, breaks, and seasonal parameters

Step 4 – Web Site
Create tables and plots which are posted on the web site
Create edited time series and residuals which can be downloaded

Step 1 – Orbits and Clocks

Input Data
Daily rinex files from roughly eighty global GPS receivers

Fit Parameters
Satellite initial conditions
Satellite non-gravitational forces
Satellite clocks
Receiver tropospheric zenith delay and gradients
Receiver positions
Receiver clocks except for one reference clock
Polar motion and rate
UT rate
Resolved phase ambiguities
Transformation parameters from NNR GPS frame to IGS14

Models
Gravity from Earth, Sun, Moon, and other planets
DE421 planetary ephemeris
GSPM10 satellite solar pressure model
IAU06 model for precession and nutation
IERS2010 tides
FES2004 ocean loading
IGS satellite and receiver antenna phase center models

Step 2 - Point Positions

Input Data
Daily rinex files for thousands of global GPS receivers
Satellite orbits from step 1
Satellite clocks from step 1
Phase ambiguities from step 1
Transformation parameters from step 1

Fit Parameters
Receiver tropospheric zenith delay and gradients
Receiver position
Receiver clocks
Resolved phase ambiguities

Reference Frame
NNR orbits and clocks are used for point positioning
Transformation parameters from step 1 are applied to obtain position estimates in IGS14

Step 3 - Time Series

Input data
Daily GPS point positions

Fit Parameters
Receiver positions
Receiver velocities
Receiver breaks
Receiver seasonals

Breaks
CHI^2 is computed with and without each break candidate and those with F > 150 are accepted
F = [(Chi^2(without) – Chi^2(with))/Chi^(with)] * [(ndata – pwith)/(pwith-pwithout)]
ndata is the number of position observations being fit
pwith is the number of parameters with the break included
pwithout is the number of parameters without the break included

Outliers
Points with formal errors > 10 mm in any component

Error Scaling
Parameter errors multiplied by 20 to make them consistent with one sigma data decimation results

Step 4 - Web Site

Web Launch date
November 29, 1994

Implementation
HTML
KML
Javascript

Interface
Google map
List of sites

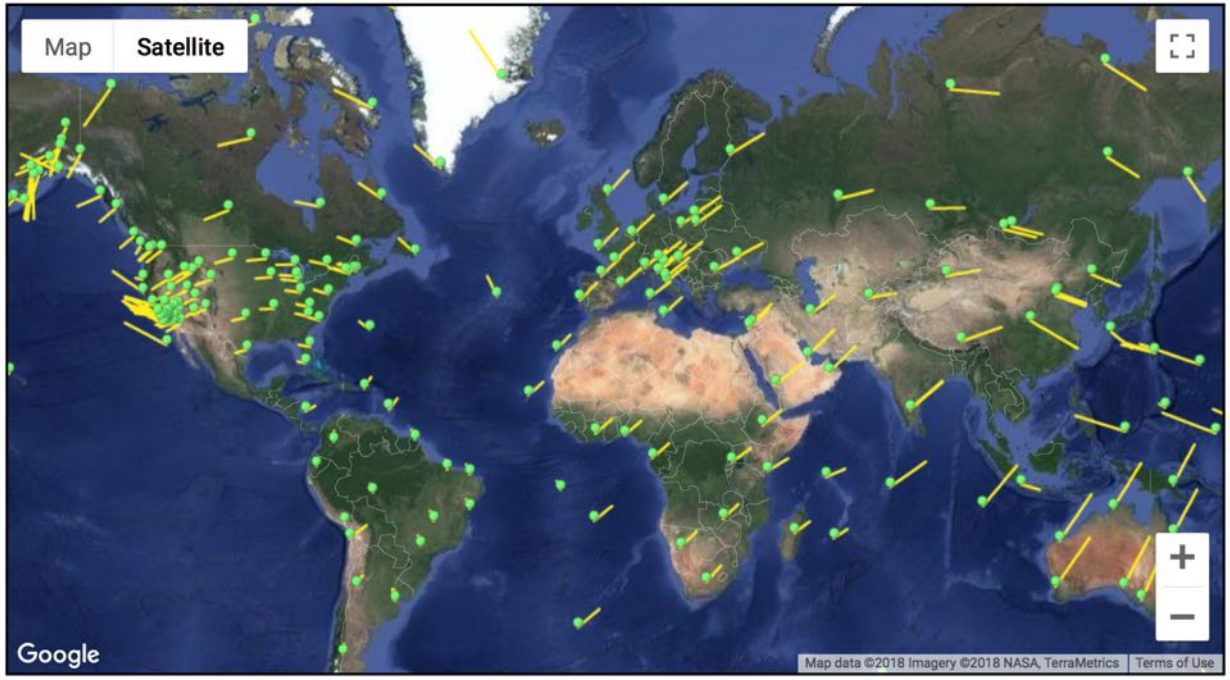
Tables
Positions
Velocities
Breaks
Seasonals
Methods

Download
Time series
Residuals

GPS Time Series

The Global Positioning System (GPS) is a constellation of 30 satellites which is used for navigation and precise geodetic position measurements. Data from over 2000 receivers have been analyzed at the Jet Propulsion Laboratory, California Institute of Technology under contract with the National Aeronautics and Space Administration. JPL's GipsyX software is used to produce these time series and other useful data products. Horizontal velocities, mostly due to motion of the Earth's tectonic plates, are represented on the map by lines extending from each site. Click on a dot or name to see detailed time series for a particular site. Additional information may be obtained from mbh@jpl.nasa.gov.

Geodetic Positions and Velocities II Cartesian Positions and Velocities
Break Estimates II Seasonal Estimates
Time Series II Residuals
Methods



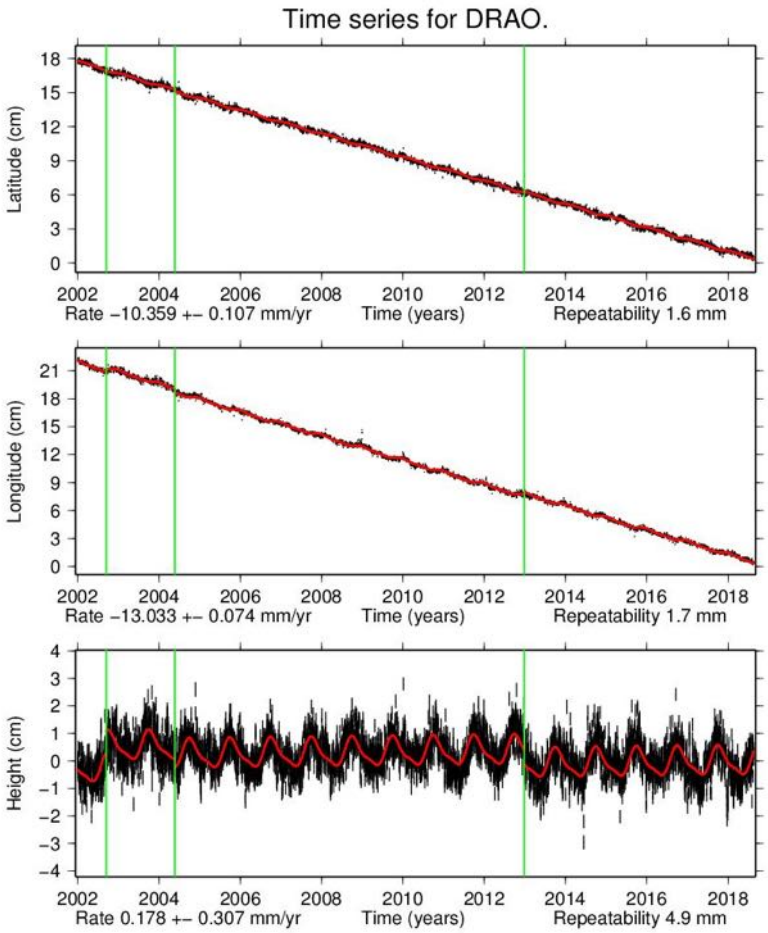
Formats and Plots

Time Series and Residual Format
Column 1: Decimal_YR
Columns 2-4: East(m) North(m) Vert(m)
Columns 5-7: E_sig(m) N_sig(m) V_sig(m)
Columns 8-10: E_N_cor E_V_cor N_V_cor
Column 11: Time in Seconds past J2000
Columns 12-17: Time in YEAR MM DD HR MN SS

Observations
Black points with error bars

Fit
Red points

Breaks
Green bars



Download Instructions

Download edited time series for a single site
Click “Time Series” on web site
Right click site of interest
Choose “Download Linked File”

Download residual time series for a single site
Click “Residuals” on web site
Right click site of interest
Choose “Download Linked File”

Download all edited time series
wget -r -nd -np -R "index.html*" -A "*.series"
"https://sideshow.jpl.nasa.gov/pub/JPL_GPS_Timeseries/repro2018a/post/point" .

Download all residual time series
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