

# VLBI Network Simulations

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# VLBI Simulation Procedure

- Specify network antenna locations, antenna sensitivities, slew rates, SNR requirements for a simulation network
- Run a 24-hour simulated observation file with the VLBI SOLVE analysis program to estimate Earth orientation parameters or station positions
- Perform Monte Carlo simulations by generating simulated observations and making repeated VLBI analysis runs with different input simulated observations
- ↳ Precision (repeatability) of estimated parameters (e.g. baseline length site vertical, Earth orientation, scale)

# Validation of Simulation Procedure

- Run simulated observations through SOLVE with actually observed experiment observation schedules
- Compare simulation precision with observed precision
- Dominant VLBI errors are atmosphere and clocklike (maser + instrumental) delay errors

## **CONT05 test**

- 15 experiment sessions (September 2005) using nearly the same observing schedule
- Simulated data generated as random walk processes with typical expected atmosphere and clock variances
- Simulation baseline length WRMS precision ~ Observed precision

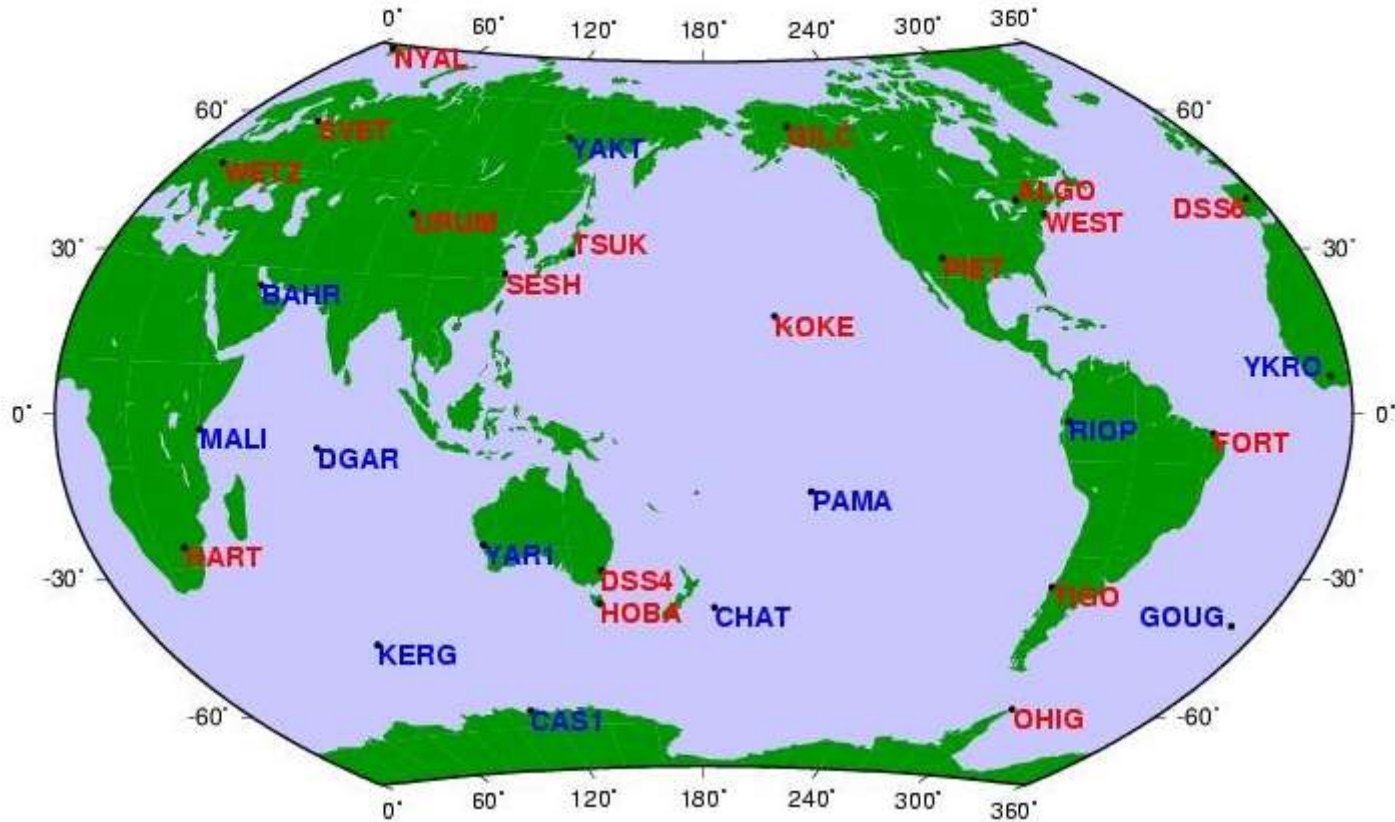
# Network Simulation

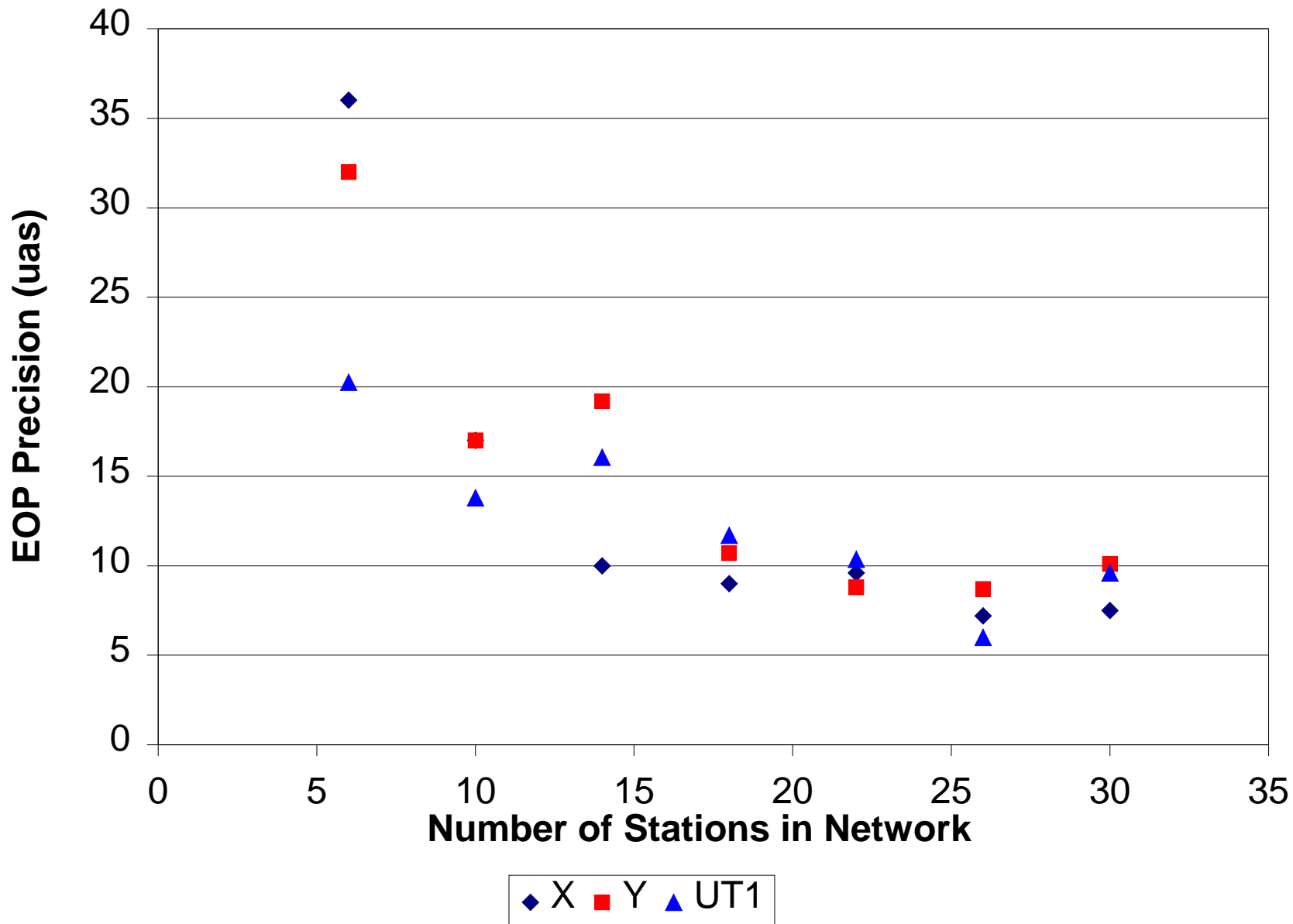
- Generated a 30-station network consisting of
  - 1) 18 current VLBI sites
  - 2) 12 additional sites collocated with IGS antennas chosen to provide better global coverage, mainly in the Southern hemisphere
- The 30 stations are evenly distributed between hemispheres
- Made a sequence of subset networks of the 30 sites: 26, 22, ..., 6 site networks
- Antennas are nominal VLBI 2010 12-meter antennas and the data rate was 2 Gbps
- Ran Monte Carlo simulations to determine EOP precision versus network size

# 12m Antenna Installed at JPL



# GPS (blue) and VLBI (red) Sites





# Next Steps

3. Run simulation data through actual observation schedules to check that simulated EOP scatter is realistic and make adjustments as necessary to simulated data.
7. Look at dependence of scale precision and site vertical precision on network size
3. Improve the simulation model: add tropospheric turbulence and tropospheric azimuthal asymmetry, put in site dependent effects
13. Look at possible systematic effects or biases due to network site distribution
16. Develop candidate networks for colocated VLBI, GPS, SLR sites

# VLBI + SLR Combination Simulation

3. Choose a global network of colocated VLBI and SLR sites
4. Run VLBI solutions for 4-5 years of simulated 24-hour sessions
5. Generate input Geodyn VLBI observation and solution parametrization files for each 24-hour session
6. Create normal equations for each VLBI session using Geodyn
7. Combine VLBI and SLR normal equations in a global solution to estimate site positions and velocities and Earth orientation parameters