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# Scientific applications of GNSS: Could Galileo Really Make a Difference?

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# SUMMARY

- Potential scientific interests of Galileo
- Simulations at JPL:GPS+Galileo
  - Precise orbit determinations with GNSS
- Others applications
  - Reference Frames issues
  - Atmospheric sciences
- Conclusions



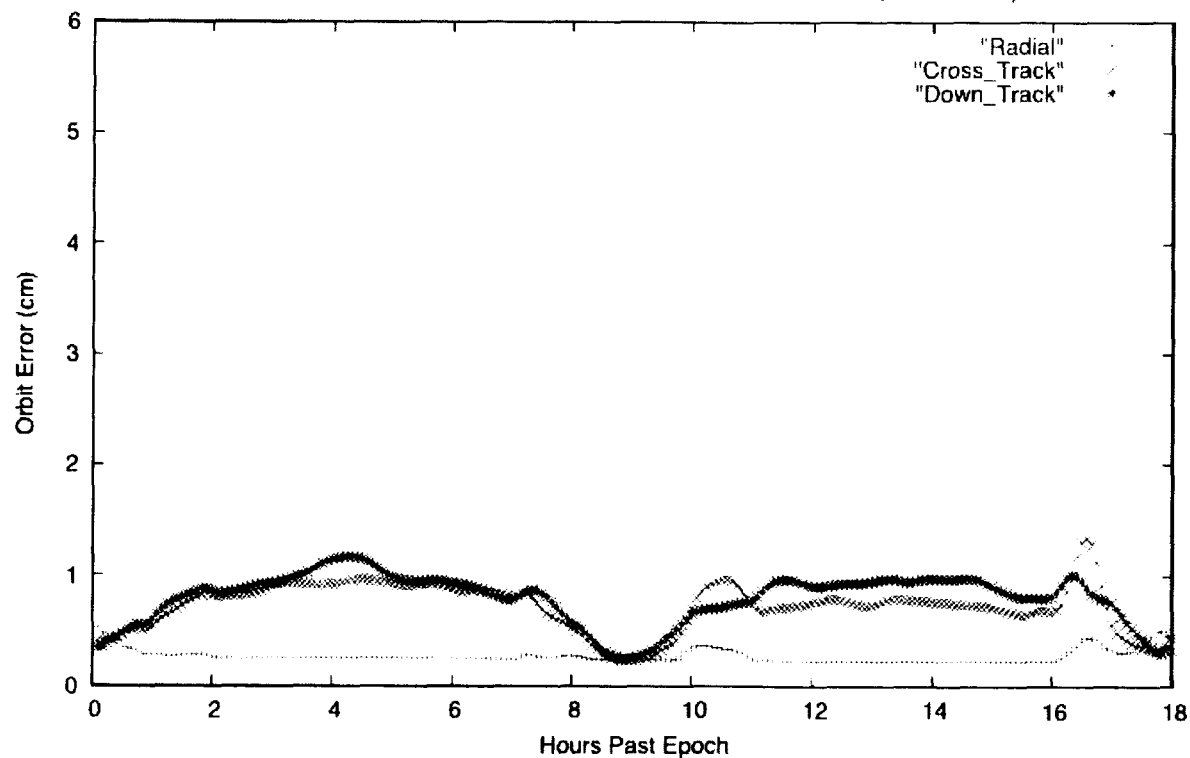
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# GPS+Galileo POD simulations

- Objectives:
  - POD of a highly elliptical satellite (VSOP)
- Simulations hypothesis
  - simulated data GPS+Galileo on-board the satellite
  - Different tests with noise measurements
  - Different estimation strategy/ reduced dynamics

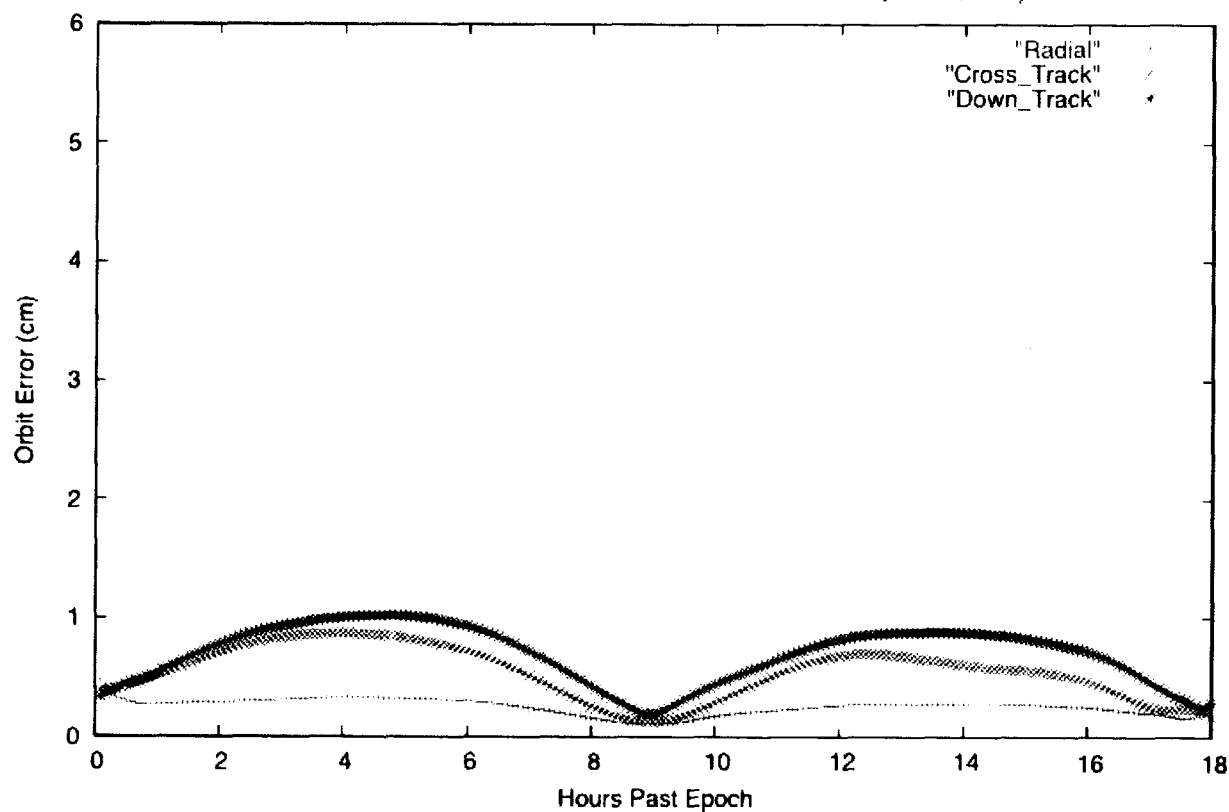


VSOP2 Orbit Error Using GPS+Galileo Pseudorange (10cm) and Carrier Phase (5mm) from 188 Stations  
GPS-Like Pseudorange (10cm) and Carrier Phase (5mm) from 30 Stations  
Reduced Dynamic (50nm/sec<sup>2</sup>); 1e-13 Clocks; All Sites Adjusted (5mm)



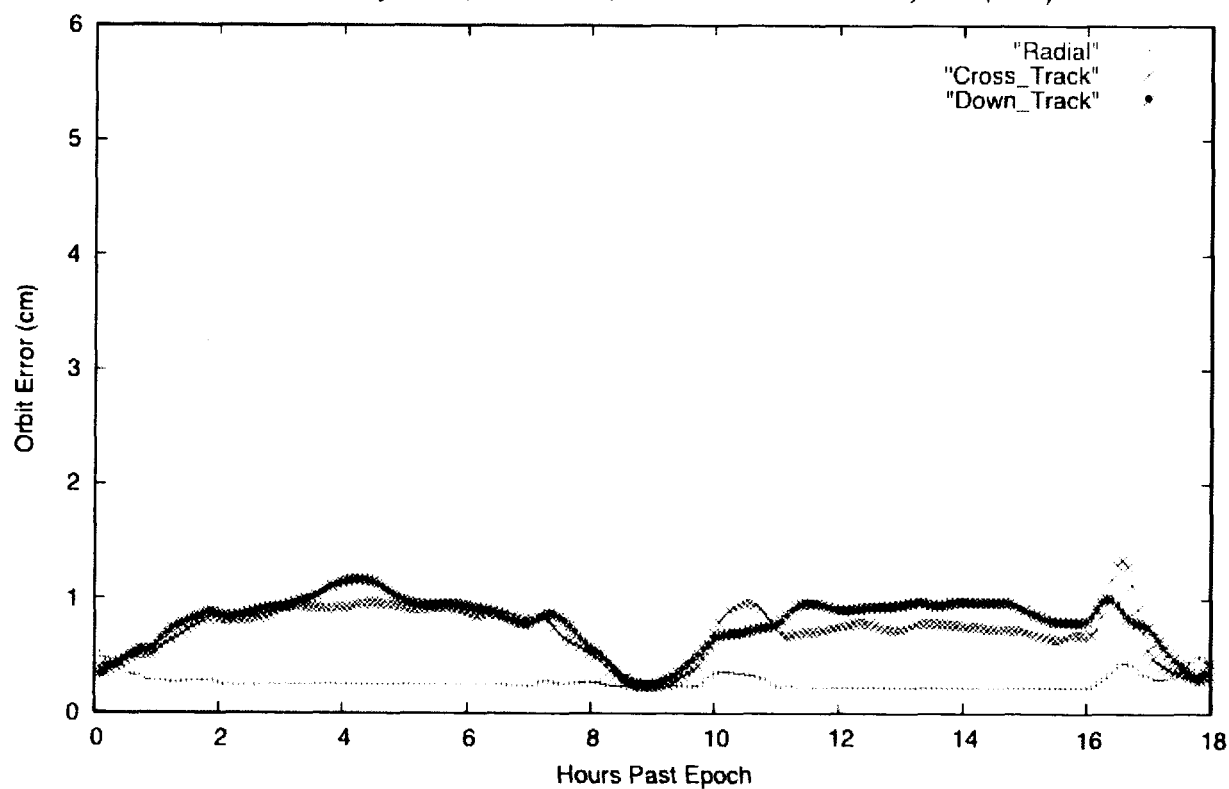


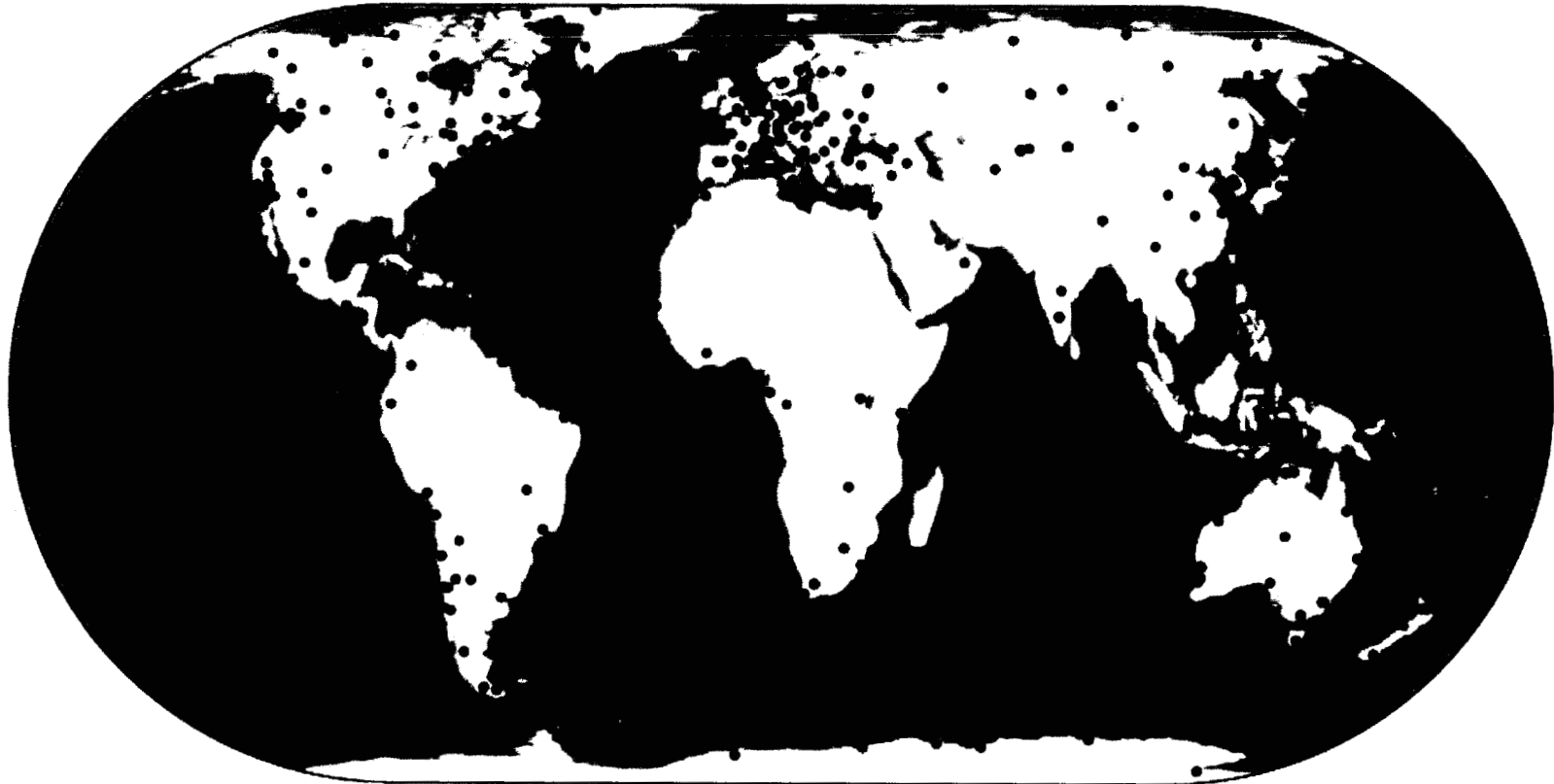
VSOP2 Orbit Error Using GPS+Galileo Pseudorange (10cm) and Carrier Phase (5mm) from 188 Stations  
Accelerometer ( $1\text{nm}/\text{sec}^2$ );  $1\text{e-}13$  Clocks; All Sites Adjusted (5mm)





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GPS-Like Pseudorange (10cm) and Carrier Phase (5mm) from 30 Stations  
Reduced Dynamic ( $50\text{nm}/\text{sec}^2$ ):  $1\text{e-}13$  Clocks; All Sites Adjusted (5mm)





## The IGS tracking network

[http://igscb.jpl.nasa.gov/images/world\\_clean.jpg](http://igscb.jpl.nasa.gov/images/world_clean.jpg)

GMT Mar 17 17:22:15 2004



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# Reference frames

- GPS-only solutions
  - Advantages
    - Current precision: 2 mm H, 6 mm V
  - Weaknesses
    - Remaining issues: radomes effects, antenna patterns calibration, systematic errors with other techniques (SLR, VLBI, DORIS).





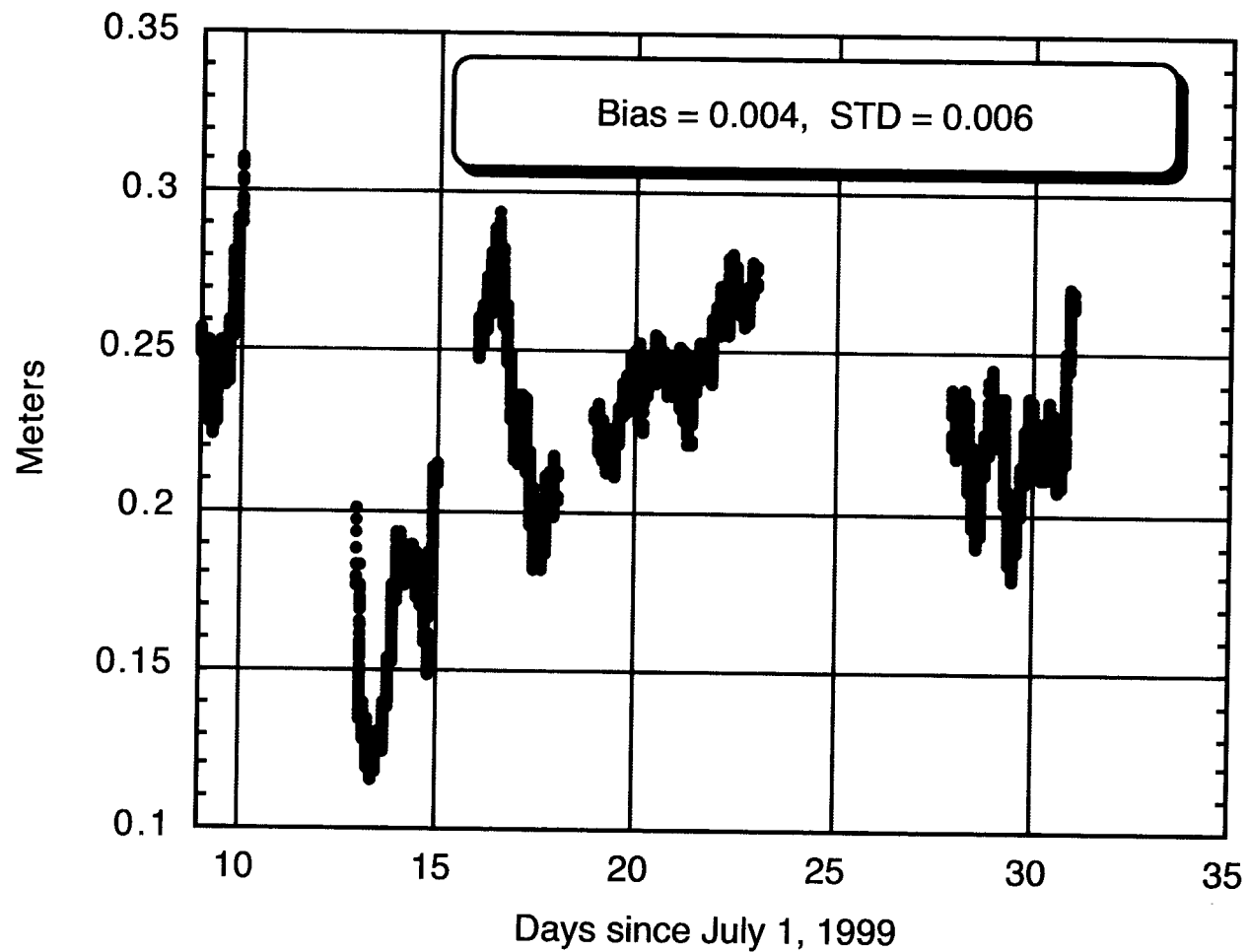
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# Atmospheric sciences

- Applications
  - Using permanent tracking network (for Wet Zenith Delays)
  - Using LEO satellites (for tomography)
- Present weaknesses
  - Integrity
  - Accuracy



Wet zenith delay estimates from GPS and WVR data  
using Kalman filter/smoothing





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# CONCLUSIONS

- GPS is already a powerful tool for sciences
  - Precise orbit determination
  - Reference frame
  - Atmospheric sciences
- Galileo can still provide valuable information
  - More satellites