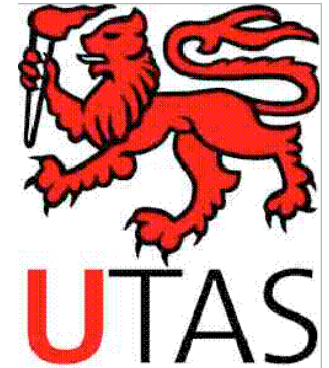


How and Why to do VLBI on GPS

John Dickey

University of Tasmania

8 February 2010

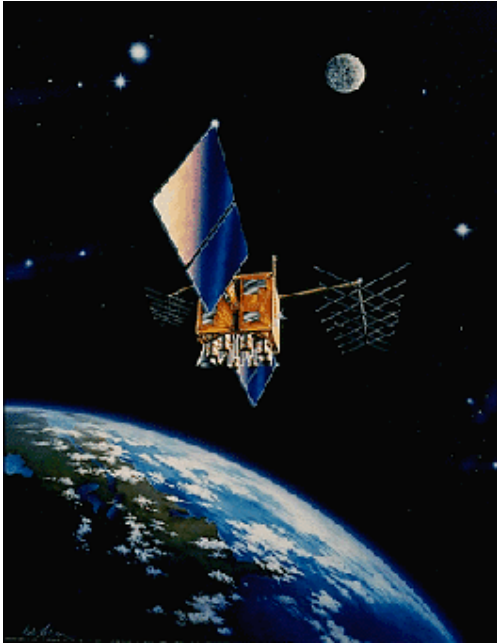


Suggestions and ideas from :

Paul Tregonning, Chris Watson, Jim Lovell, Oleg Titov

Previous work by:

Hase (1999), Niell and Corey (2001), Petrachenko et al. (2002)

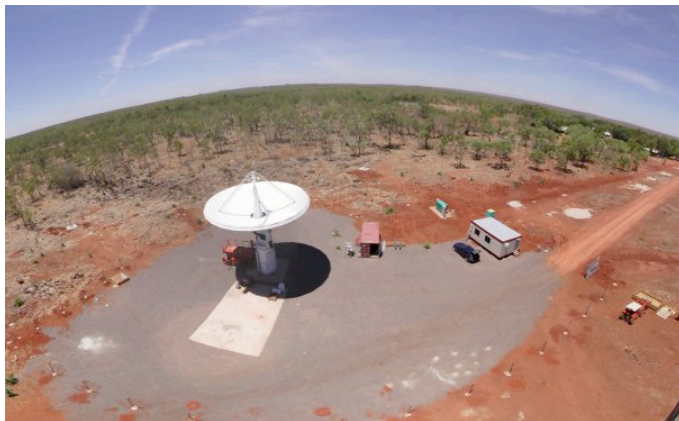


Two approaches to the GPS + IVS technique:

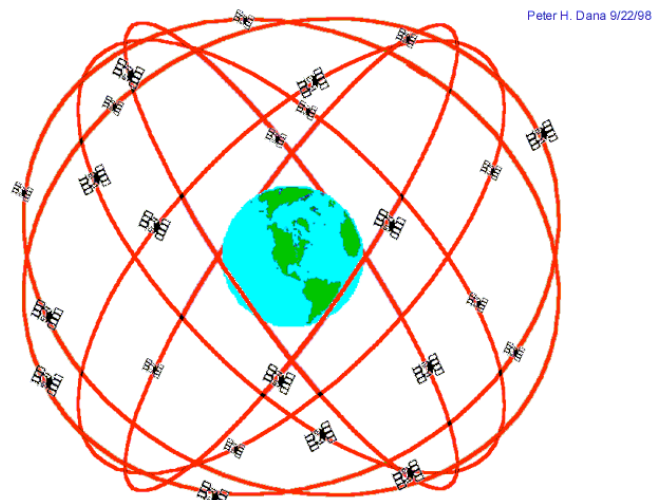
1. Point the telescopes at a GPS satellite in between ICRF sources:

Disadvantages:

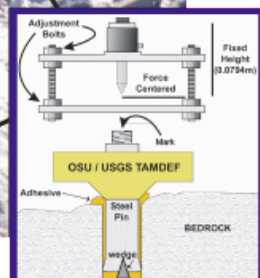
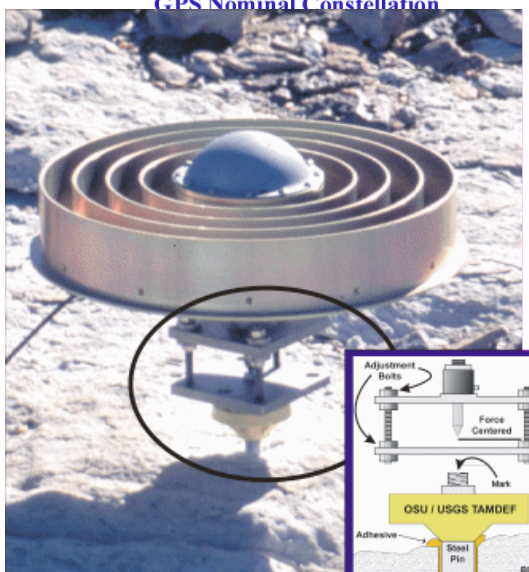
- wrong frequency
- complicated ephemeris (site-specific)
- one satellite at a time



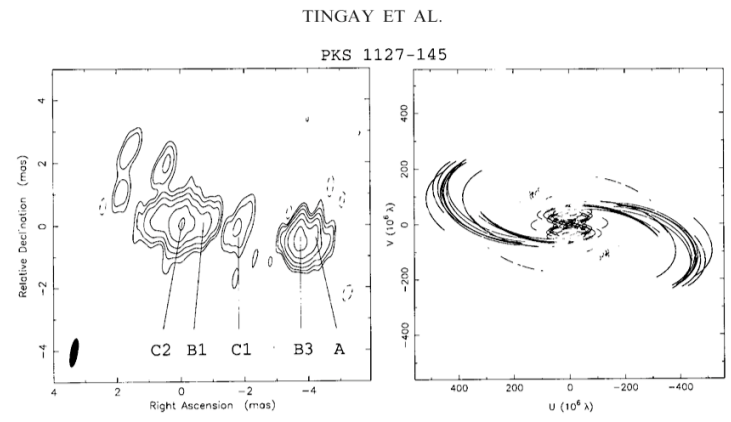
Two approaches to the GPS + IVS technique:



GPS Nominal Constellation



2. Tie together a GPS receiver and an IVS antenna



Two approaches to the GPS + IVS technique:

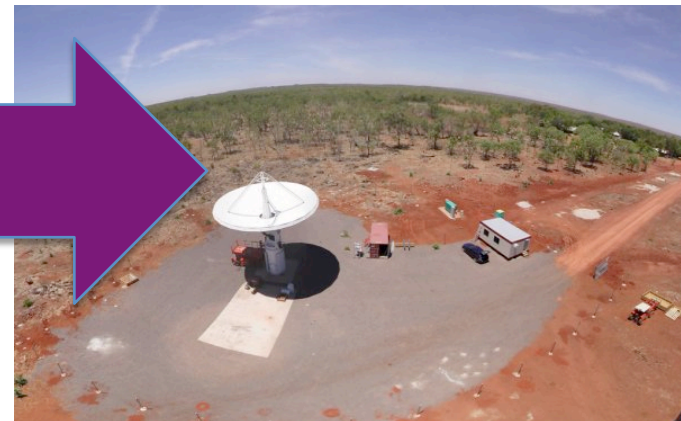
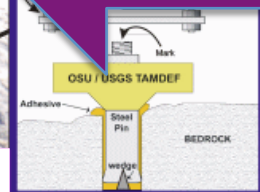
Disadvantages:

- need accurate frame-tie
- need locked LO's
- broadband recording (simultaneous data)

2. Tie together a GPS receiver and an IVS antenna

Advantages:

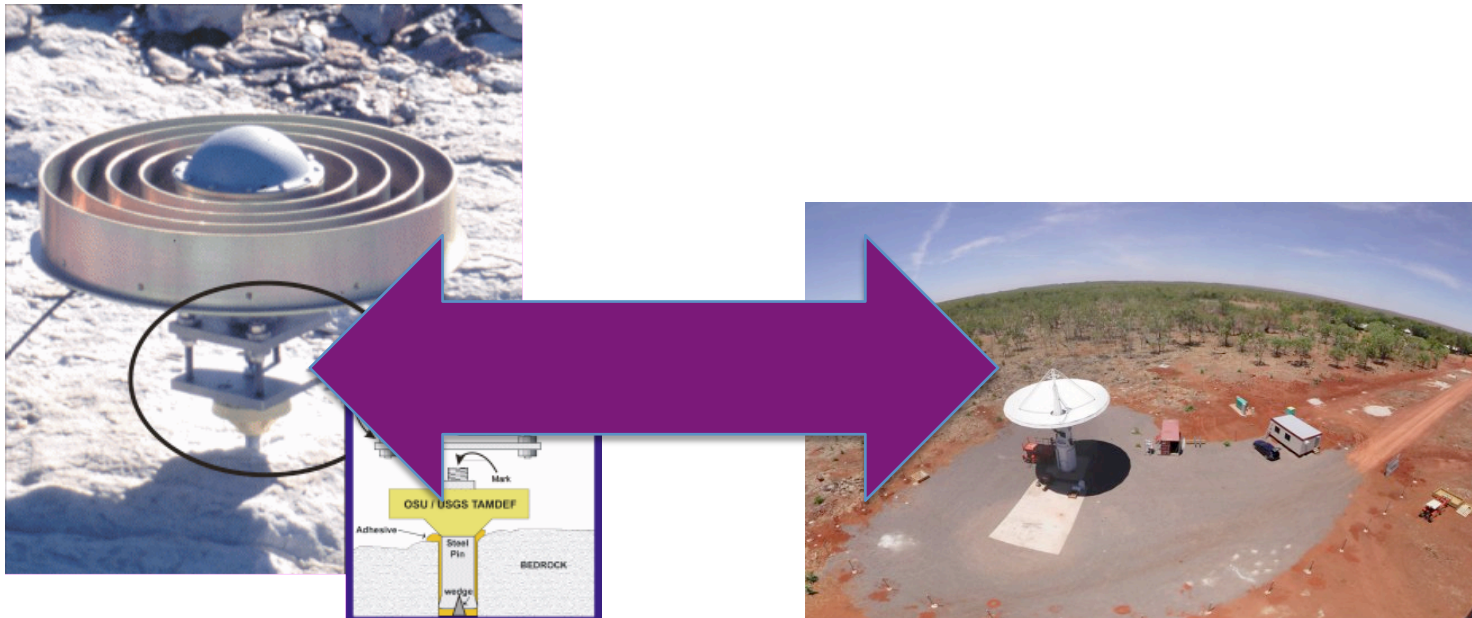
- celestial sources give atmospheric corrections, clock offsets, positions for each station as part of standard IVS solutions



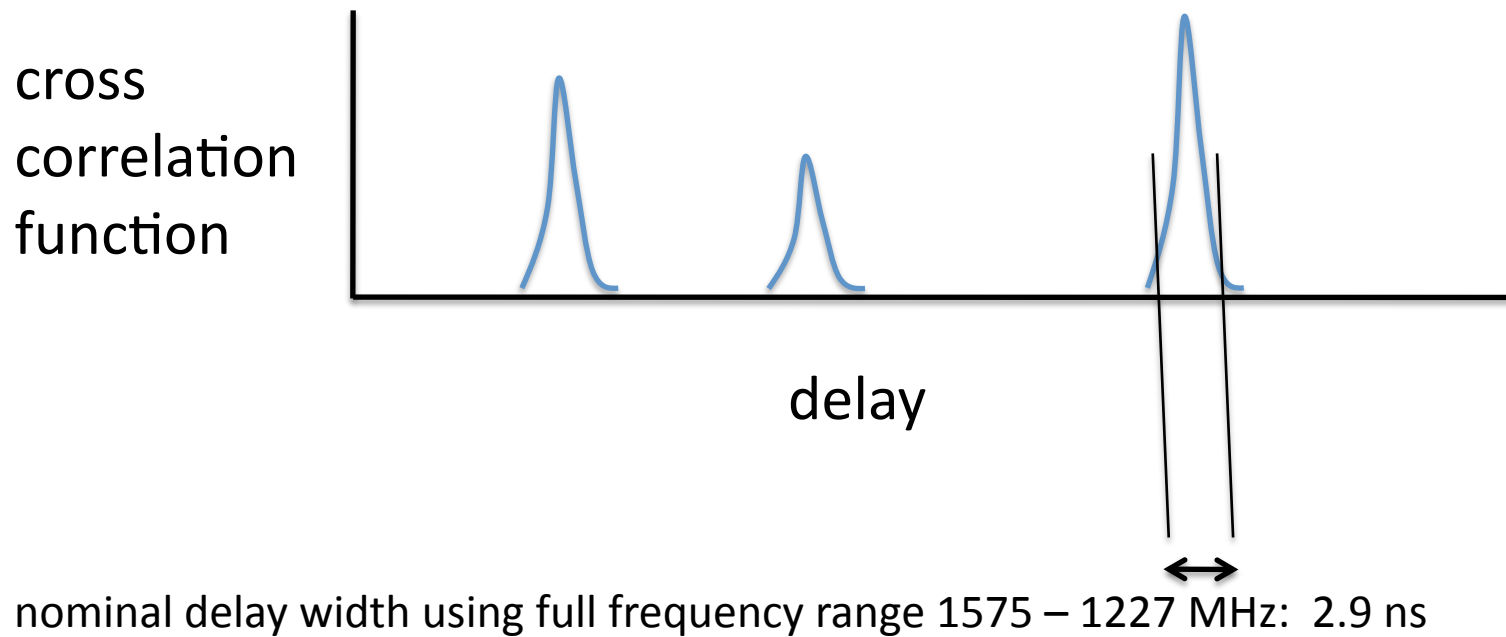
2. Tie together a GPS receiver and an IVS antenna

More Advantages:

- celestial sources give atmospheric corrections, clock offsets, positions for each station as part of standard IVS solutions
- correlation gives dynamic delays for all GPS spacecraft (above the horizon) for all baselines at once
- simultaneous data for entire IVS run

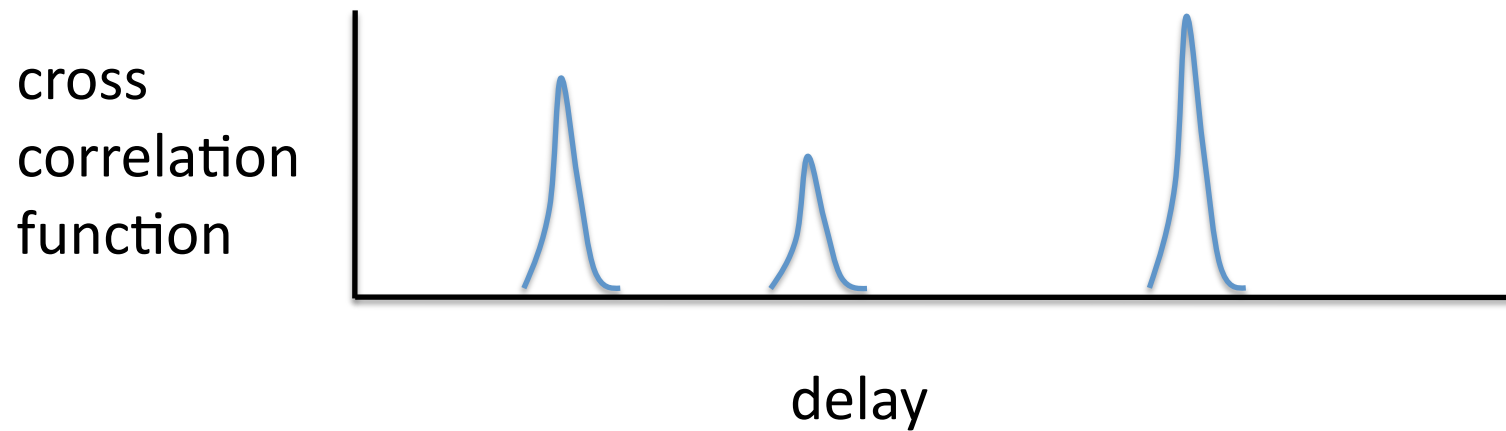


What we want to see at L band:



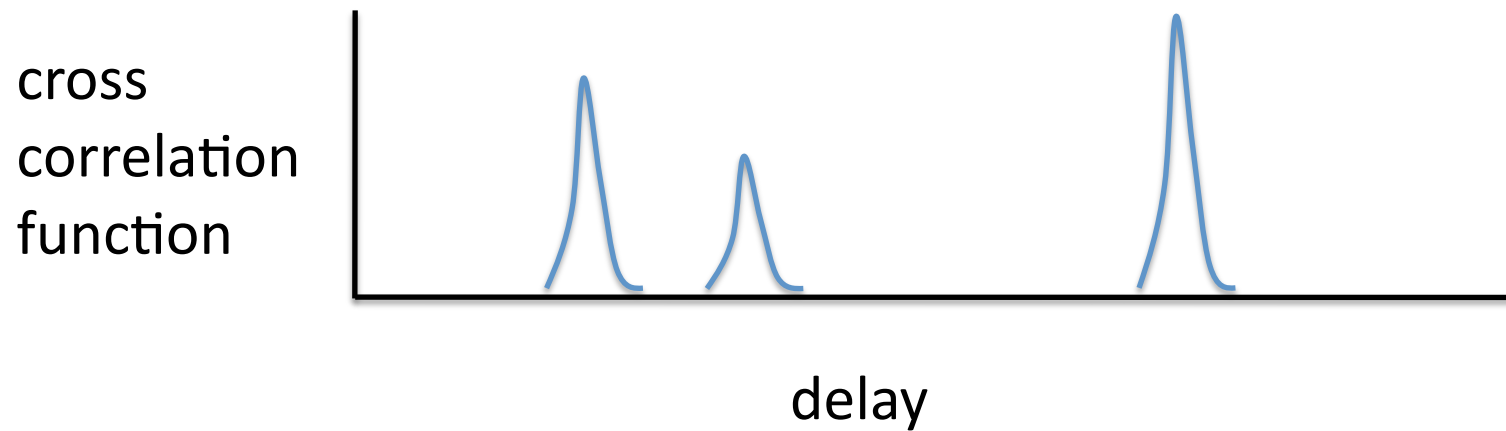
Peaks for each satellite on each baseline

What we want to see at L band:



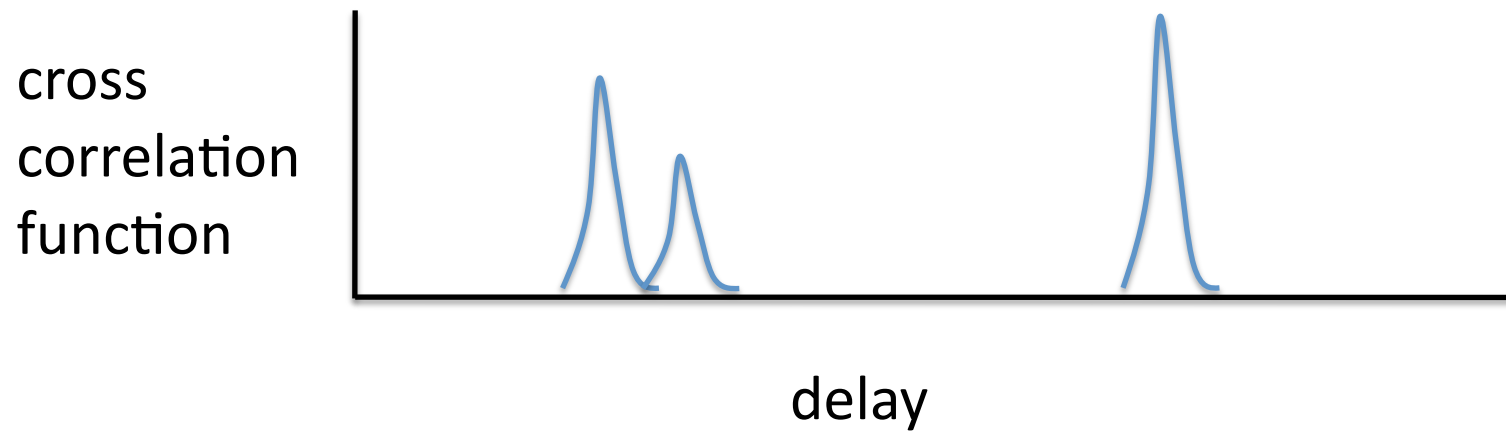
Peaks for each satellite on each baseline
moving as the satellites and antennas move...

What we want to see at L band:



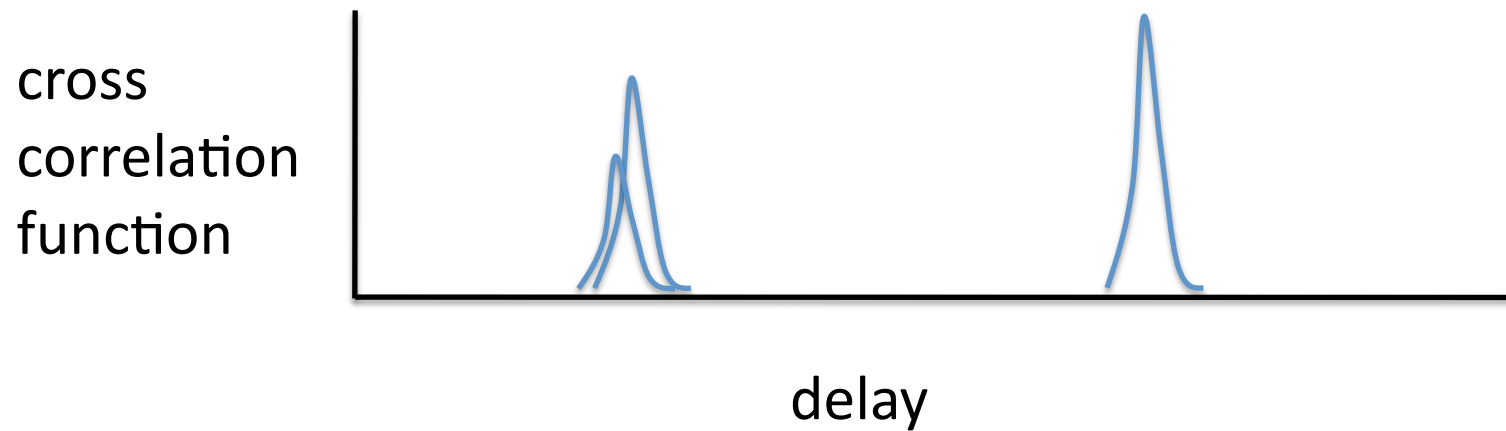
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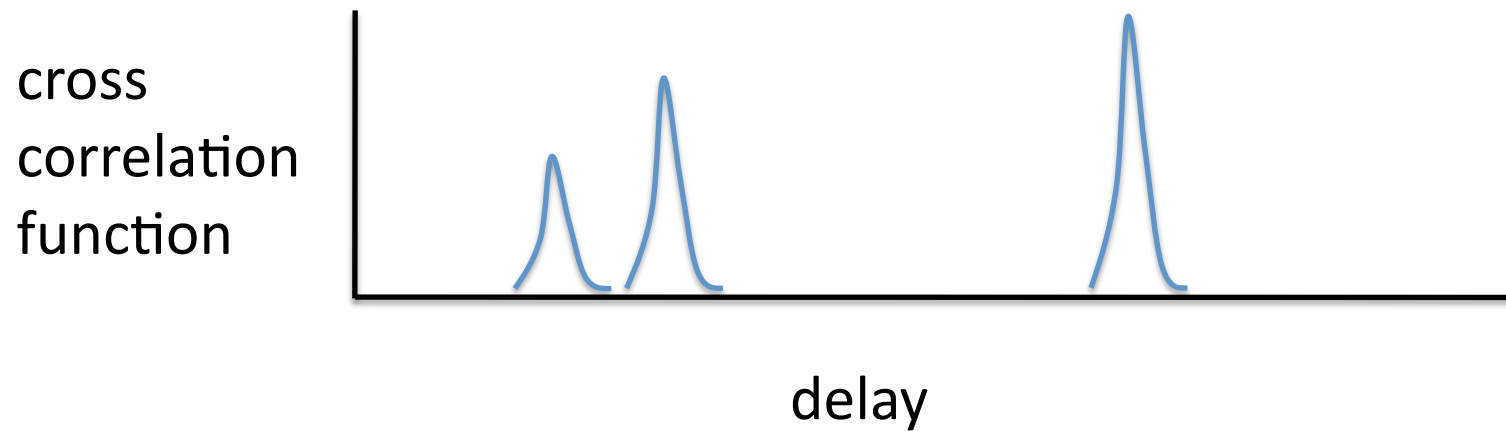
Peaks for each satellite on each baseline
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What we want to see at L band:



Peaks for each satellite on each baseline
moving as the satellites and antennas move...

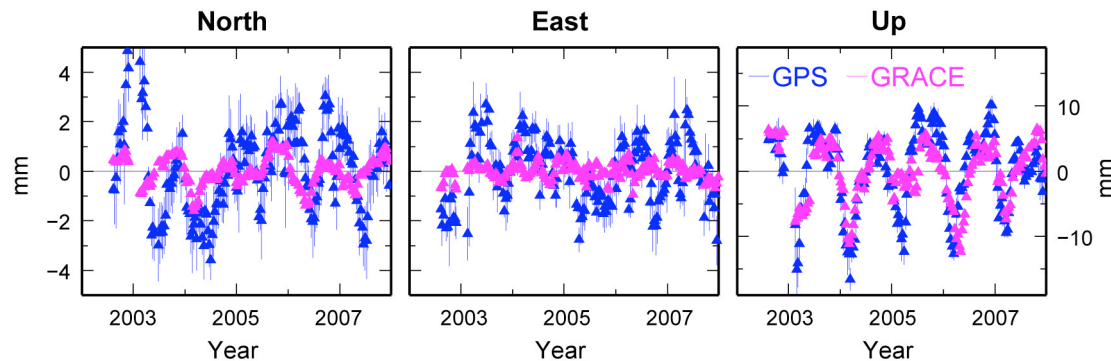
What we want to see at L band:



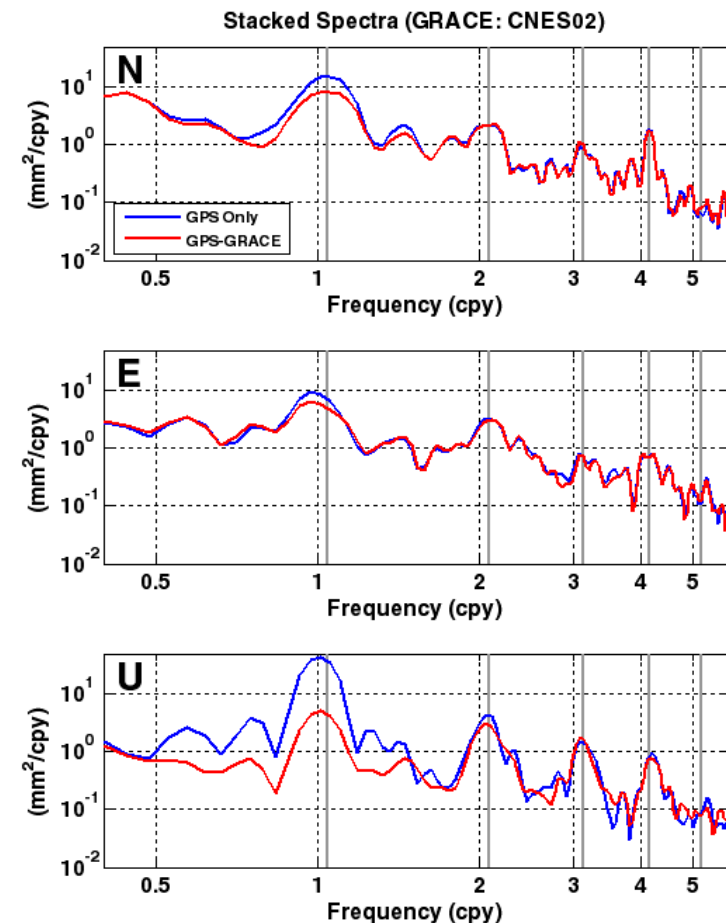
Peaks for each satellite on each baseline
moving as the satellites and antennas move...

What's the point?

- Frame tie the ICRF with the GPS orbits
- Monitor GPS satellite motion (like SLR)
- Establish the Earth center of mass position in the ITRF



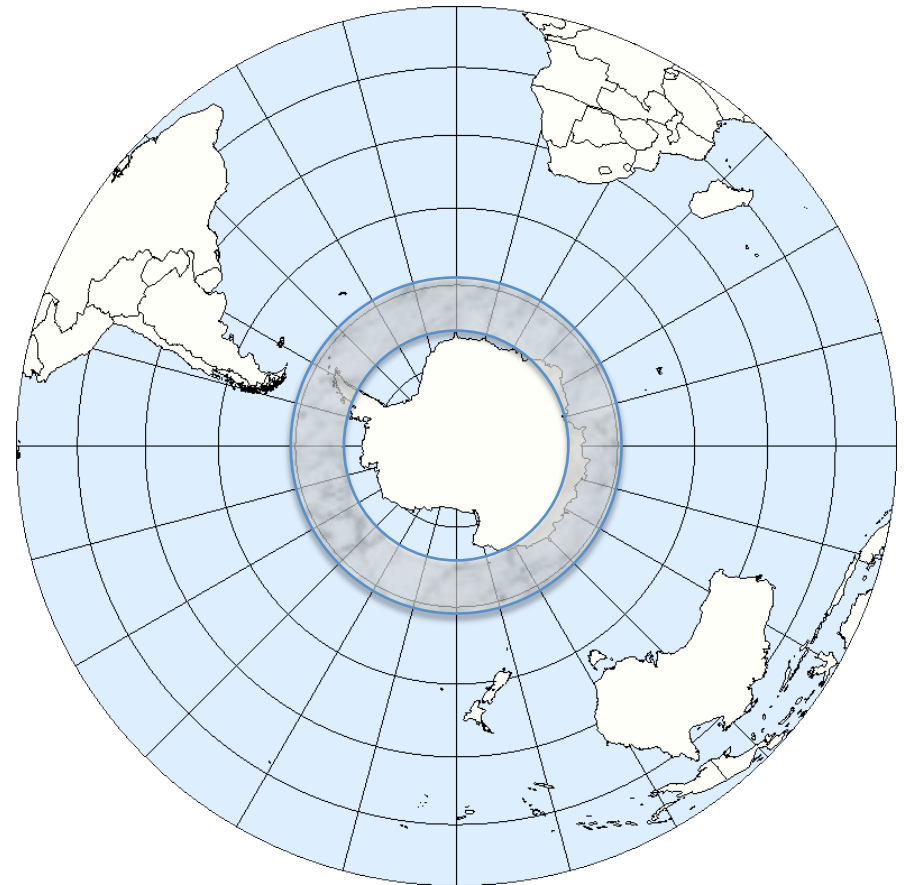
Comparison of GRACE and GPS time series and resulting power spectra for Darwin site. Hydrological effect with annual period is mixed with draconitic (GPS synodic period) errors, from Tregonning and Watson (2009, JGR 114).



As the ice melts, the Earth's center of mass moves:

$$\dot{z} = -R_{\oplus} \left(\frac{f m_i}{2 M_{\oplus}} \right) \left(\frac{\dot{s}}{\text{mm yr}^{-1}} \right) \simeq -0.4 \text{ mm yr}^{-1}$$

$$m_i = 3.3 \cdot 10^{14} \text{ kg}$$



ITRF determination is presently not very sensitive to the Earth's center of mass. In fact, there is a discrepancy between ITRF2000 and ITRF2005 that implies a shift of $+1.8 \text{ mm yr}^{-1}$ (Altamimi et al. 2007, Argus 2007).

Conclusion:

We should try to measure the position of the Earth's center of mass in the ITRF using VLBI observations of GPS signals.

