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LOCAL ANALYSIS APPROACH FOR SHORT WAVELENGTH VARIATIONS IN THE GEOPOTENTIAL

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OBJECTIVES OF THE TALK

1. Indicate qualitatively the apparent advantages of local analysis and moderate inclination orbits for determining short wavelength variations in the geopotential.

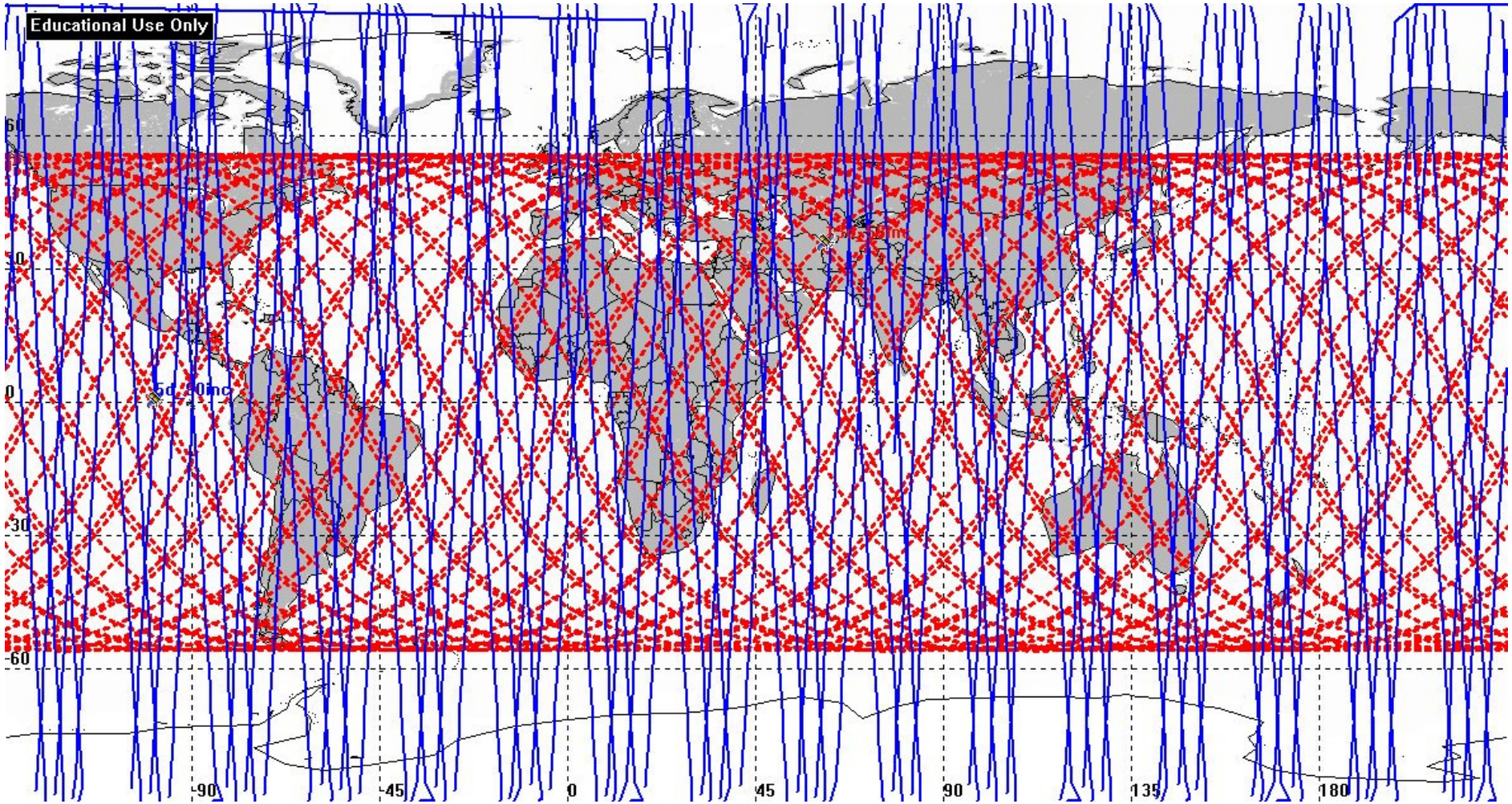
2. Discuss the magnitude of time variations in the atmospheric mass distribution at short wavelengths.

3. Roughly compare the noise in measuring the SST satellite separation with the effects of uncertainties in short wavelength atmospheric mass variations.

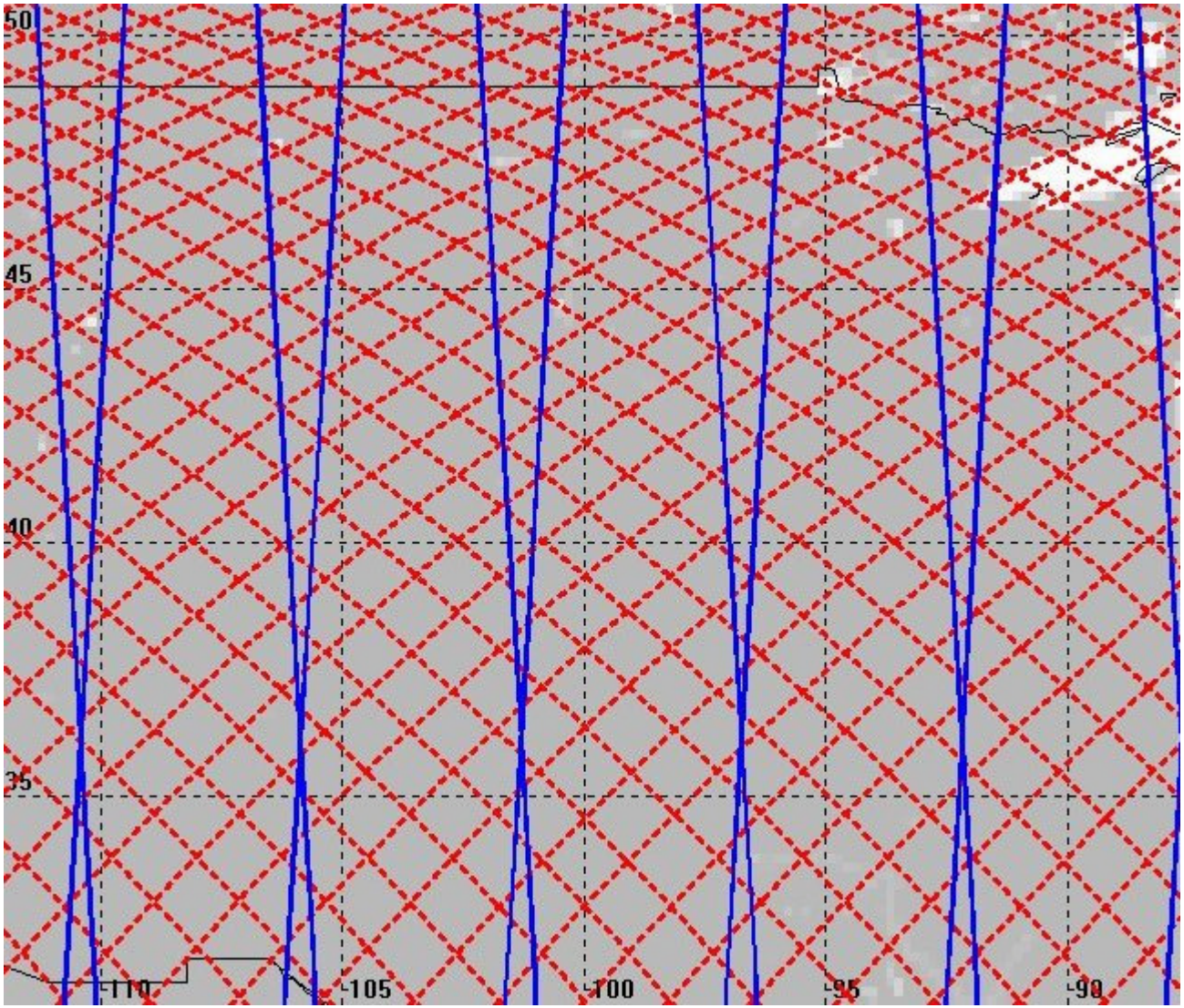
4. Discuss the spatial resolution limitations for a very simplified model.

5. Describe the possible benefits of frequent observations over limited regions of the globe.

3-day GT; 13-day RP (55^{o} inc) + 5-day RP (90^{o} inc)



13-day GT over Local Region (North America)



RELATIONSHIP OF SATELLITE SEPARATION TO GEOPOTENTIAL HEIGHT

Let: T = the potential energy per unit mass at the midpoint between the two satellites

V = the mean velocity

B = the baseline distance between the satellites

N = the geopotential height

a = semi-major axis

Then, if the initial velocities are the same and there are no other sources of differential accelerations:

$$\Delta B \cong B \cdot (\Delta T)/(\overline{\mathrm{V}})^2$$

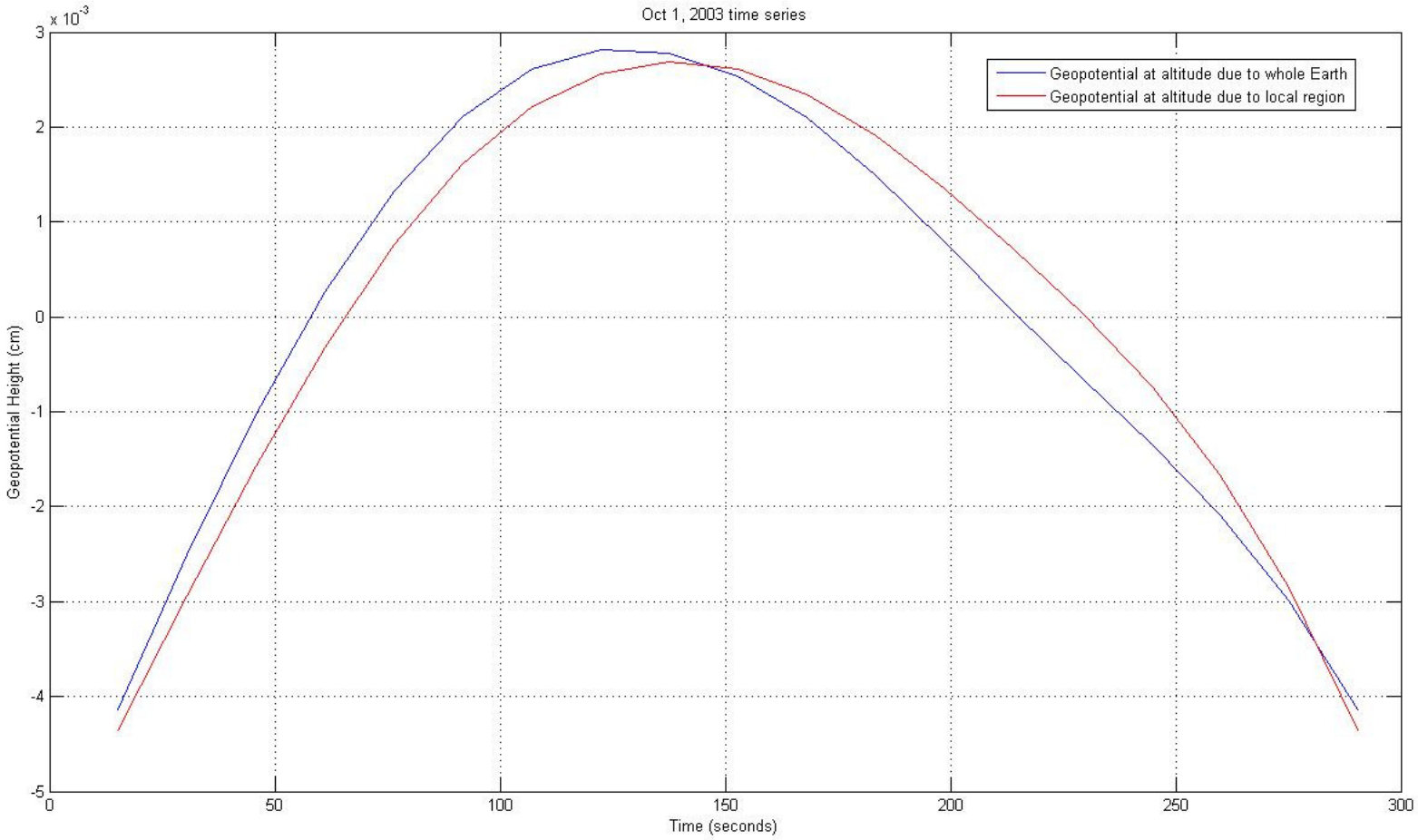
$$\Delta N = (\Delta T)/\, g$$

$$\Delta B \cong \left[B \cdot g\,/(\overline{\mathrm{V}})^2\right] \cdot (\Delta N) = (\Delta N)/(\mathrm{a}\,/\,B)$$

For h = 360, $\Delta B \cong (\Delta N)/(67.4)$

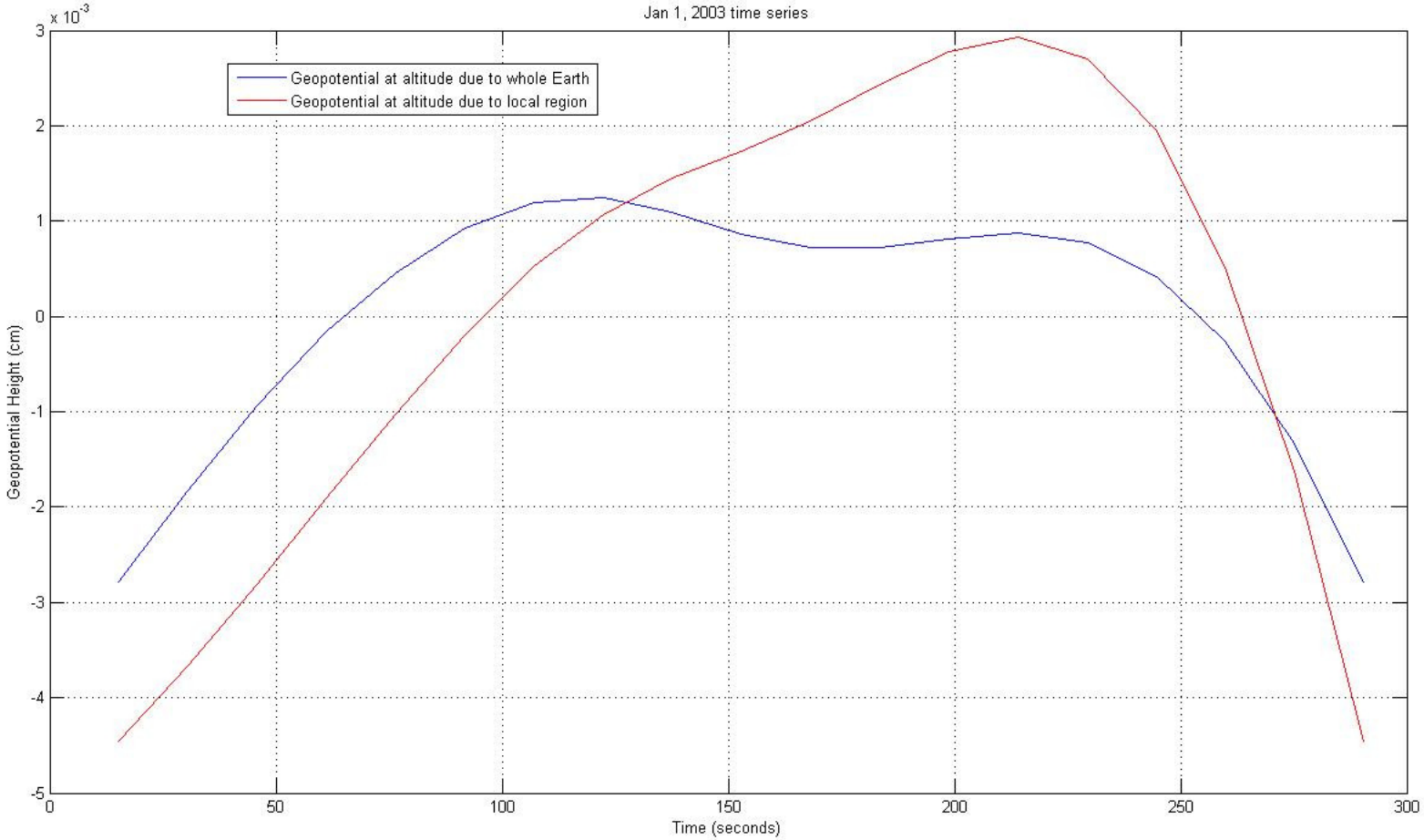
Local Analysis vs. Global Analysis Geopotential Height Comparison

October 1, 2003

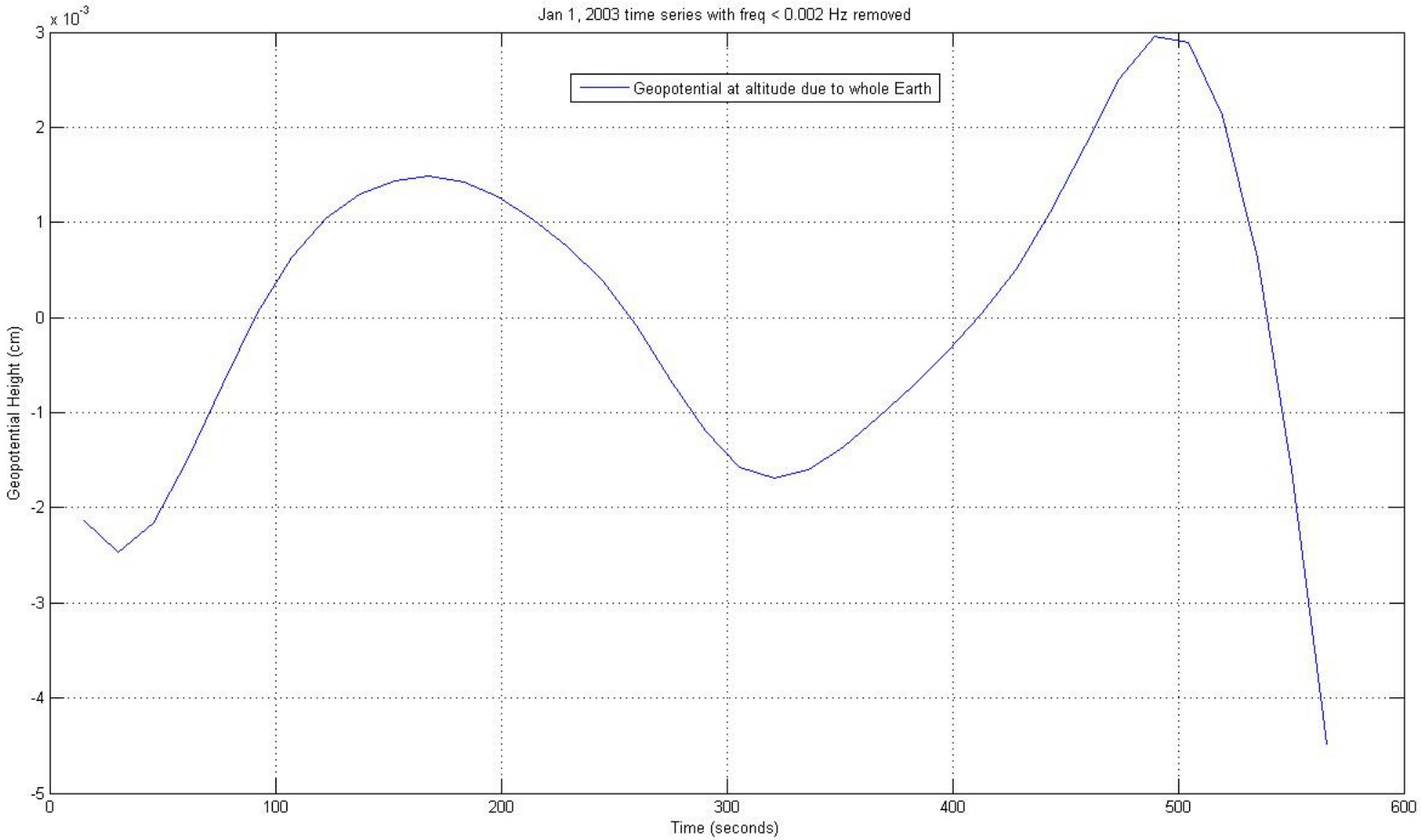


Local Analysis vs. Global Analysis Geopotential Height Comparison

January 1, 2003



Geopotential with freq < 2 mHz filtered out (passes through 38^{o} of latitude)



ROUGH COMPARISONS OF ATMOSPHERIC MASS DISTRIBUTION UNCERTAINTY EFFECTS AND INSTRUMENTAL MEASUREMENT NOISE

1. A local region in North America was used for an initial test.

2. For 2000 km ground tracks, the geopotential height variations along track at satellite altitude were looked at for single passes at a dozen times throughout the year.

3. For a very simplified model, a Gaussian distribution of water around the center of the region, a rough measure of the error in determining the total water mass is the atmospheric mass variation uncertainties at about 2000 km wavelength.

4. For the radius of the Gaussian distribution, the atmospheric mass variation uncertainties at roughly 500-1000 km wavelength appear to be most important.

5. Based on these wavelength sensitivities, a crude estimate can be made of the relative importance of the atmospheric mass variation uncertainties and the instrumental measurement errors.

CONCLUSIONS

1. Based on possible future space gravity measurements with two pairs of SST satellites, the accuracy for determining the spatial distribution of water mass is likely to be limited mainly by the difficulty of separating atmospheric mass distribution uncertainties from changes in the water mass distribution.

2. The use of other hydrological information in the separation process through the land data assimilation approach is desirable.

3. The satellite gravity data could help in providing a useful check on the accuracy of the atmospheric mass distribution solutions.

4. Partially corrected variations in the satellite separation in principle could be provided with fairly low latency for use in local analysis studies, in addition to the regular periodic spherical harmonic or mascon solutions.

5. There appear to be potential benefits for tying together different one revolution arcs of data to considering the frequency crossings near the South Pole, provided that a special analysis is made of atmospheric surface pressure variations near the pole.

1-day GT (polar view)