P1.22 THE ENHANCED ROLE OF THE POLAR ORBITER CONSTELLATION IN TROPICAL SYSTEM MONITORING IN THE WAKE OF A GEOSTATIONARY PLATFORM FAILURE

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1. INTRODUCTION

This research explores to what extent an ensemble of LEO satellites could be used as stopgap substitute for coverage in the event of a GEO failure, particularly within a region and during a period critical to the monitoring of tropical cyclone activity. While most LEO satellites provide at best a few passes per day, the shear number of satellites currently at our disposal allows for a legitimate exploration of this possibility.

The high degree of variability that so often characterizes both the track and intensity of tropical cyclones necessitates an observing system capable of high temporal refresh. Real time storm assessments arm authorities with valuable guidance in making critical decisions. The geostationary (GEO) platform is well suited for providing such real time information, where temporal refresh is practically unlimited.

While some regions (e.g., over the United States and Europe) possess insurance in terms of additional platforms parked in stand-by orbits, much of the world vulnerable to tropical cyclones currently does not have this luxury. A sudden failure of a stand-alone geostationary sensor could translate to a catastrophic loss of life and property. The current situation involving lubrication build-up on the GMS (providing coverage to the typhoon-vulnerable Tropical Western Pacific) has already affected the scanning schedule for the Southern Hemisphere.

2. MULTIPLE LEO PLATFORMS

To examine the coverage provided by multiple LEO satellites as a function of location on the earth, orbital simulations were run for several satellites and their associated sensors (with varying swath widths considered). The non-exhaustive list of LEO platforms chosen for this baseline observing system simulation (instruments in parentheses) were TRMM (TMI), DMSP F13/F14/F15 (SSMI/S), and NOAA (AMSU). Note that only the swaths of the microwave sensors on these platforms were considered, making this a conservative estimate (e.g., on DMSP satellites, SSM/I swath is 1400 km compared to OLS swath of 3000 km).

5-day stats	***Four Satellites*** (DMSP F13/14/15, TRMM)		***Six Satellites*** (DMSP F13/14/15, TRMM,NOAA 15/16)	
Latitude Range	***Ave Wait***	***Max Wait***	***Ave Wait***	***Max Wait***
20S-20N (Tropics)	4.77	14.83	2.47	12.25
20N-40N 20S-40S	3.54	15.42	1.87	10.5
40N-60N 40S-60S	4.00	15.42	1.78	7.42
60N-75N 60S-75S	3.19	11.42	1.35	7.17

Table 1. Average and maximum wait time (hours) as a function of latitude.

Table 1 presents results of simulations in terms of average and maximum wait time (hours) between LEO overpasses for any given pixel residing in the latitudinal belts shown. The general trend is toward shorter wait times with increasing latitude (except for the four-satellite case owing to the additional coverage of the TRMM satellite about 30N/S latitude). Of significance is the marked reduction of average (and in most cases, maximum) wait times by a factor of 2 by including two additional satellites.

3. CASE STUDY: HURRICANE ERIN

This case study focuses on the LEO coverage of Erin on September 9, just prior to the hurricane reaching its minimum barometric pressure of 969 millibars and maximum sustained winds of 105 knots (gusts to 130 knots). Table 2 lists the available LEO passes

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over a 13-hour period. The third column indicates the range (km) from the satellite ground track to the hurricane. The shortest time gap in this example is eighteen minutes, and the longest is four hours and fifteen minutes. The average wait time was 69 minutes, or 54 minutes if the longest and shortest gaps are excluded.

Time (Z)	*Satellite*	*Range (km)*
1043	**DMSP-F13**	**16.7**
1147	**TRMM**	**218.8**
1205	**NOAA-15**	**374.5**
1325	**TRMM**	**262.3**
1356	**DMSP-F15**	**172.2**
1503	**TRMM**	**261.6**
1534	**EOS-Terra**	**646.1**
1654	**Orbview-2**	**495.4**
1749	**NOAA-16**	**218.7**
2204	**DMSP-F13**	**150.4**
2246	**Quikbird**	**497.9**
2321	**NOAA-15**	**374.4**

Table 2. LEO coverage for Hurricane Erin on September 9, 2001.

Figure 2 depicts a segment of the time series listed in Table 2. The images in the left column were produced from the LEO satellites as indicated. The right column contains temporally matched GOES-8. An equivalent animation of storm development is available from both data sets. As suggested in Figure 2, the LEO coverage would also be useful for GEO coverage loss resulting from scanning schedule reductions (e.g., GMS-5).

4. CONCLUSION

This study outlines a viable contingency plan in the event of a GEO platform failure by consolidating existing LEO resources. The disadvantages in terms of variable viewing geometry, swath-dependent coverage, and non-periodicity of temporal coverage are offset in part by the inclusion of additional sensors and potentially much higher spatial resolution. With increasing microwave capabilities in the near future (e.g., the GPM constellation), geostationary-like microwave coverage may come to pass. Discussions are currently underway to substitute GOES 9 for GMS in the event of GMS failure. While this would provide a more attractive solution than the use of LEO satellites, GOES-9 has experienced problems with its momentum wheels causing coherent noise in the visible channel imagery. It would be wise to entertain all options at this time.

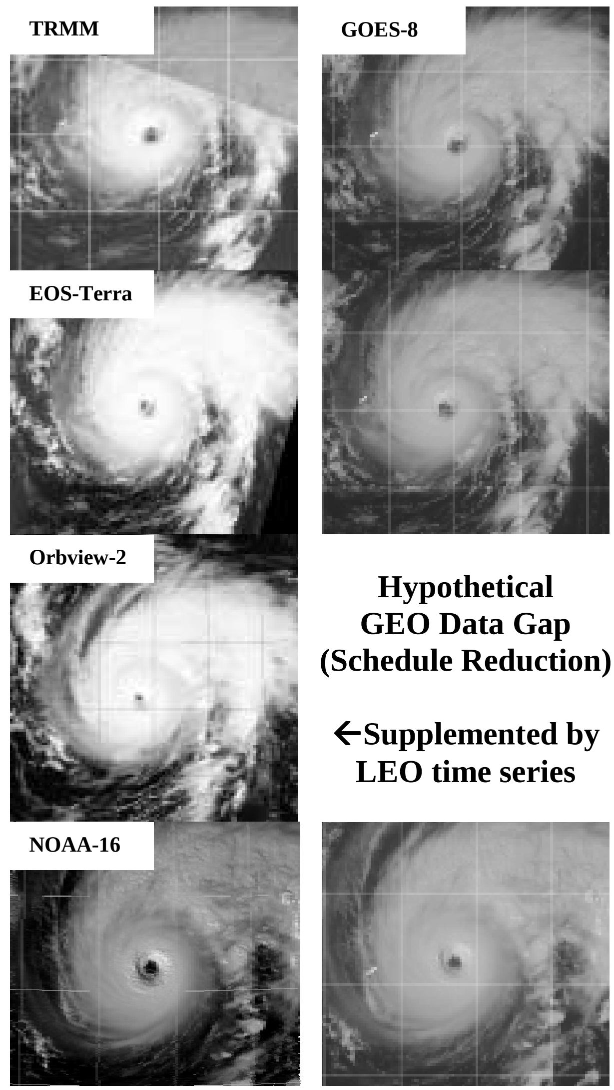

Figure 2. LEO (left) and GEO (right) time series of Hurricane Erin for 1500-1745Z.

5. ACKNOWLEDGEMENTS

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