



SMALLSATS SOLUTIONS CAN YIELD **BIG RESULTS**

GLOBAL SCIENCE & TECHNOLOGY, INC.

Dr. Darrel L. Williams, Chief Scientist | Global Science & Technology, Inc., 7855 Walker Drive, Greenbelt, Maryland 20770 | E-mail: darrel.williams@gst.com

"Why are we only building and launching 1970s-era IBM 360 mainframe computer equivalents in an era of laptops, iPads, and smartphones?"

— Professor Samuel Goward, Department of Geographical Sciences, University of Maryland

PROBLEM STATEMENT:

Satellite missions, even for critical operational measurements, have become too expensive given today's economic and budgetary challenges. This is fueling a demand for dramatically lower cost solutions.

SUBSTANTIATION #1:

Senator Barbara Mikulski stated, "We need to see more Chevy-priced mission concepts, not just Cadillac-priced missions with uncapped cost growth." (SpaceNews; April 2010) (see "cartoon" analogy in middle column)

SUBSTANTIATION #2:

The U.S. Air Force issued a Broad Area Announcement (BAA) seeking lower cost solutions for future weather satellite measurements.

("U.S. Air Force Targets 2015 To Start Weather Satellite Program"; SpaceNews; Oct. 1, 2012)

SOLUTION:

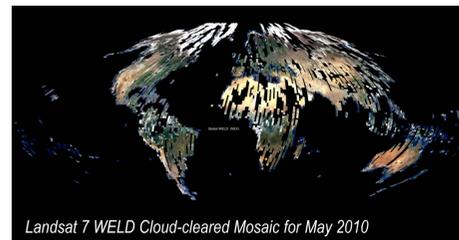
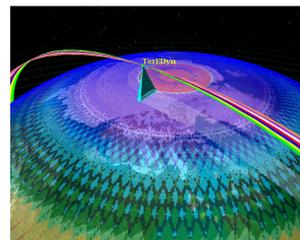
- ~3 years ago, GST began exploring the viability of augmenting the operational Landsat mission using small satellites.
 - Our Conclusion:** Smallsat technology has progressed to the point where it offers a viable solution for augmenting Landsat temporal repeat while also offering risk mitigation against a crippling data gap.
- In 2012, GST started looking at NOAA's weather and climate measurement requirements since the type of reliable performance required to meet Landsat's operational status is similar to NOAA's requirements for reliable weather and climate sensors/measurements/missions.
 - Our Conclusion:** Smallsats also offer a viable alternative to fly some of NOAA's operational weather and climate sensors.
 - Other companies, such as Microcosm, Inc. and Boeing have independently come to the same conclusions.
- Smallsats offer significant savings in time and money. Because new technologies can be more readily adopted, they can often match, even enhance, the performance and reliability of traditional satellites at a fraction of the cost.
 - Conclusion:** Smallsats would provide NOAA with maximum programmatic flexibility to better accommodate budgetary uncertainty.
- Overall Conclusion:** Smallsats are capable of supporting critically important applications such as Earth imaging and weather and climate measurements.

CASE STUDY #1:

LOUD-CLEARED GLOBAL DATA SETS AT 30m COULD SUPPORT MULTIPLE APPLICATIONS

GST's TerEDyn (Terrestrial Ecosystem Dynamics) smallsat concept would provide critical new data at the field scale (i.e., TM bands 1 - 4 at 15m, and TM band 5 at 30m) to support a multitude of scientific, humanitarian, strategic, and commercial applications.

The user community wants global cloud-cleared 30m data sets bi-weekly, and the significantly lower costs of TerEDyn smallsats makes that dream attainable.



Graphic above courtesy of Dr. David Roy, South Dakota State U.

ANALOGIES: COMPARING A LANDSAT FLAGSHIP "CADILLAC" MISSION (LEFT) TO A SMALLSAT "CHEVY" SOLUTION (RIGHT)

Landsat	TerEDyn
Landsat Data Continuity Mission build started 2005	Designed to acquire 4x - 5x the imagery of Landsat
	
2005 Cadillac Deville MSRP \$46,045	2012 Chevy Cruze MSRP \$16,800
Both cars provide a VG to E driving experience and either will get you to your destination but there are obvious differences in cost and expectations. Also, high cost options in '05 are likely standard equipment in the lower cost '12 model.	
	
EOS-1v	PowerShot A800
Both cameras provide VG to E pictures, and each fills a niche with obvious differences in cost and expectations. Without the convenience of smaller size, however, many great picture opportunities would likely be missed.	

"Smallsat technology has progressed far enough that there is no technical reason why smallsats can't equal the performance and reliability of traditional satellites."

— Dr. Bryant Cramer, GST Senior Consultant and former manager of NASA's New Millennium Program

"I would far rather have decent quality data all the time than slam-dunk high precision data sets that might have gaps in coverage availability. If I don't have the data, there isn't much I can do to fill in gaps."

— Dr. C.J. Tucker (NASA Goddard)

CASE STUDY #2:

MICROCOSM, GST & OTHERS PARTNER TO DEVELOP A SMALLSAT "WEATHERSAT" CONCEPT



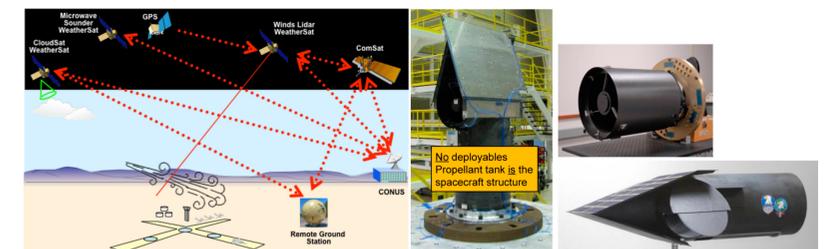
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- The WeatherSat concept was developed to address the U.S. Air Force's call for dramatically lower cost weather satellite options.
- The Microcosm-GST WeatherSat Team includes:
 - NASA Ames' Mission Design Center (bus systems engineering and system evaluation)
 - Universal Space Network (commercial ground net)
 - GATR Technologies (transportable/inflatable antennas)
 - Scorpius Space Launch Co (composite structures)
 - Innoflight Inc. (avionics)
 - HRP Systems Inc (flight software)
 - CrossTrac Engineering (attitude control)
 - Pumpkin Inc. (CubeSat component vendor)
- WeatherSat architecture and capability would provide a plug-and-play model for future weather requirements
 - Our initial focus is on developing a cloud monitoring mission
- WeatherSat will be capable of operating in multiple orbits/mission modes with a recurring cost for each baseline deployment being a very small fraction of current solutions.
 - Architecture can be rapidly deployed to address data latency issues with the rapid adaptation of possible payloads and low-cost launch options

THE WEATHERSAT CONCEPT GOAL

Creation of a low-cost, highly capable, yet flexible system that can accommodate a wide variety of payloads using technology already under development by Microcosm for DoD and NASA. When coupled with GST's existing ground systems hardware, weather monitoring software, and visualization terminal, the WeatherSat concept serves to dramatically reduce weather monitoring costs.



The time gap between overflights of a geographic area of interest will vary as a function of the number of satellites in the constellation, satellite altitude, and the latitude/orbit inclination of interest for a particular constellation. Low costs put constellations within budgetary reach and maximize flexibility in deployment.