Applied Engineering and Technology Directorate

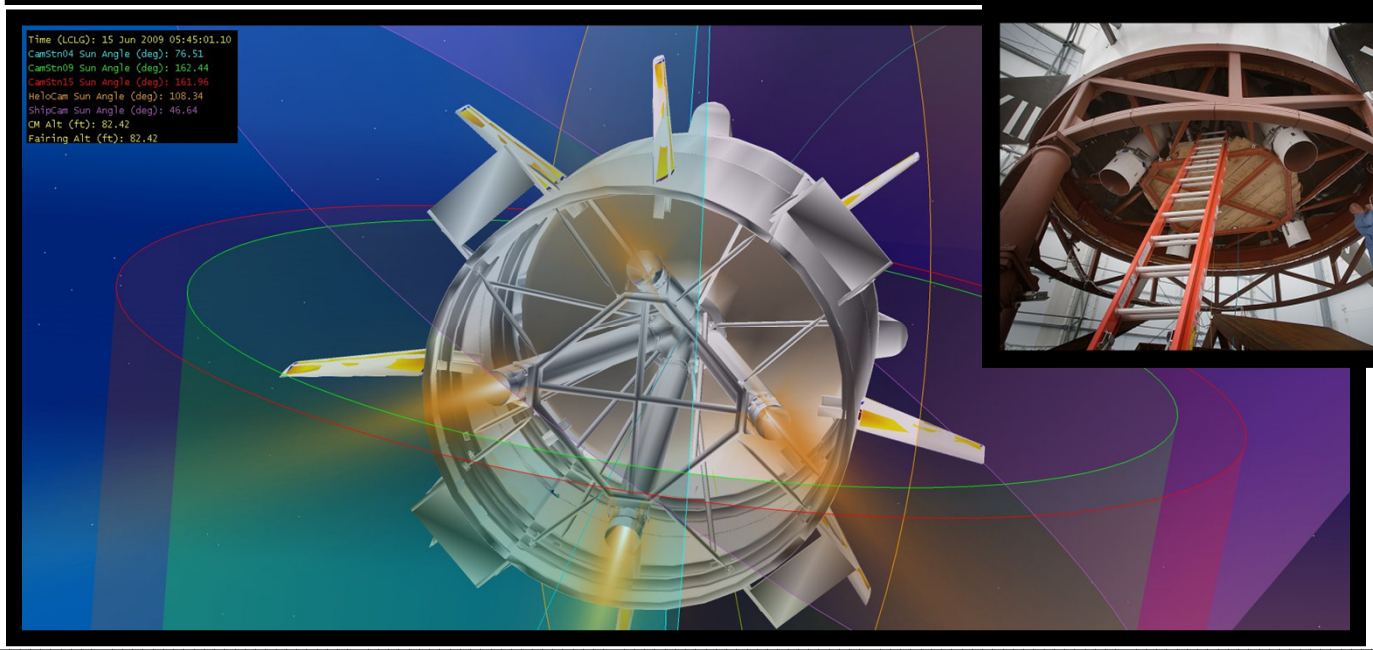
Mission Planning Lab 2010

A collection of COTS, GOTS, and custom software, MPL provides in-depth analysis of mission characteristics supporting pre-launch mission formulation and planning, real-time data monitoring and display, and post-flight data analysis and investigation.

Visibility → Feasibility → Variability → Certainty

MPL – Kleckner/589 (lead), Cervantes/589, Ray/548, Arroyo/569, Daugherty/589, Fernandez/548

MPL is a suite of software visualization and analysis tools.



MPL is a Collaborative Team

Sandy Kleckner, Code 589
Lead Engineer

Ben Cervantes, Code 589
Software Engineering,
Visualizations, Analysis

Sarah Daugherty, Code 589
Software Engineering
Visualizations, Analysis

Cooperative Education
University Student Software
Engineering
Visualizations, Analysis

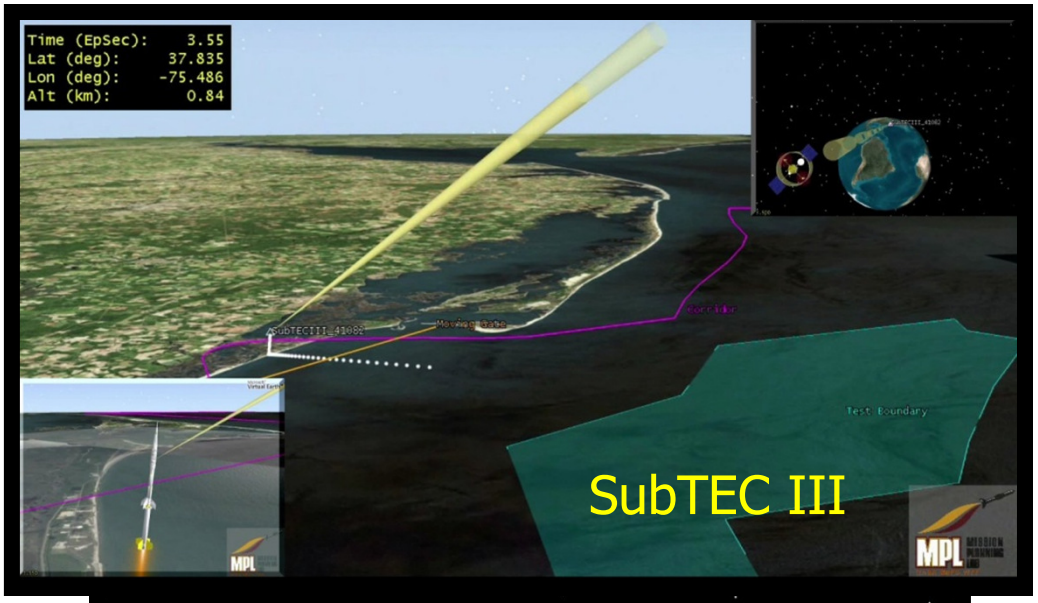
USRP Intern
Visualizations, Analysis

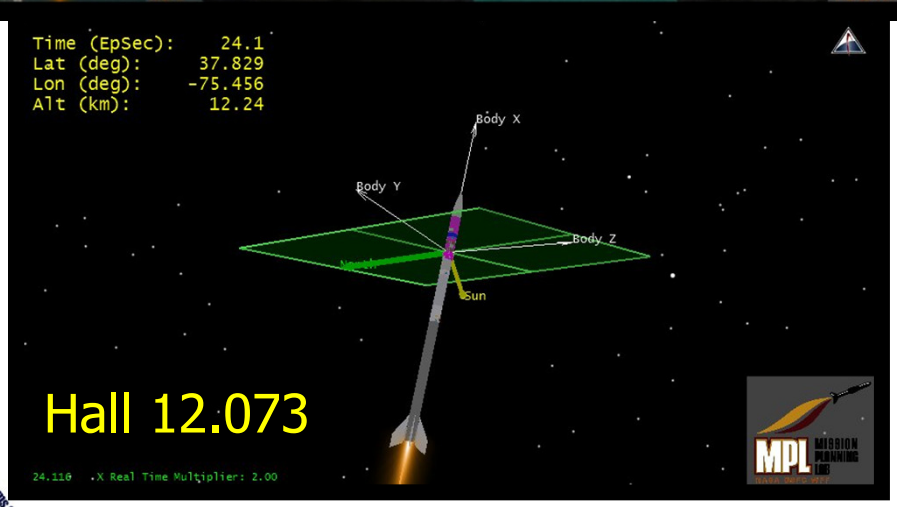
Maggie Fernandez, Code 548
Mechanical Engineer
Vehicle & Payload Analysis

Bob Ray, Code 548
Mechanical Engineer
Vehicle & Payload Models

Felipe Arroyo, Code 569
Communications Engineer
Link Analysis

MPL Supports GSFC at Wallops

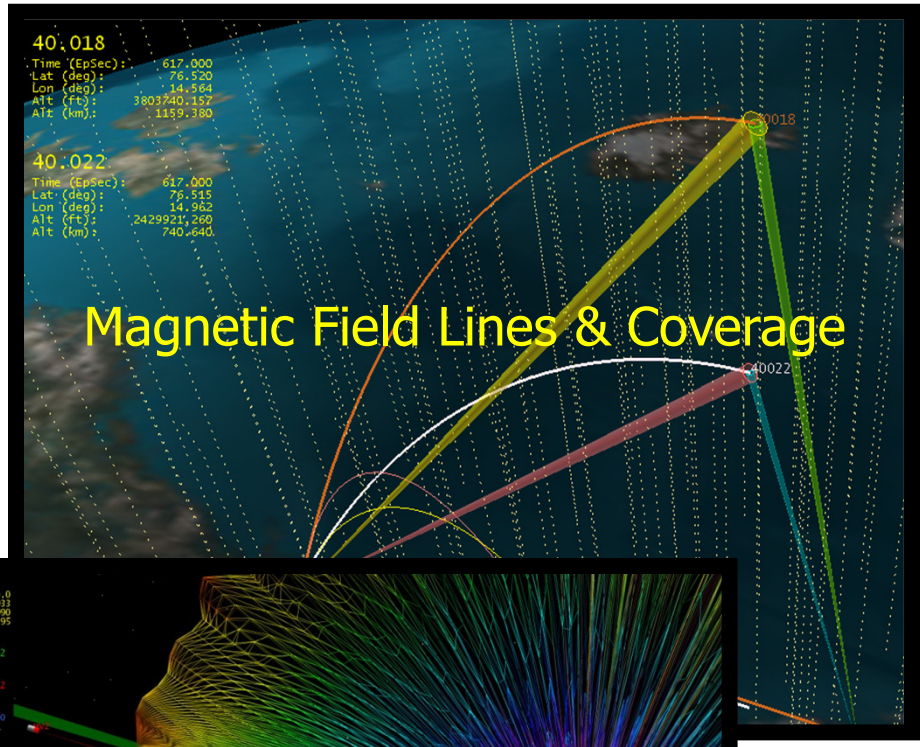


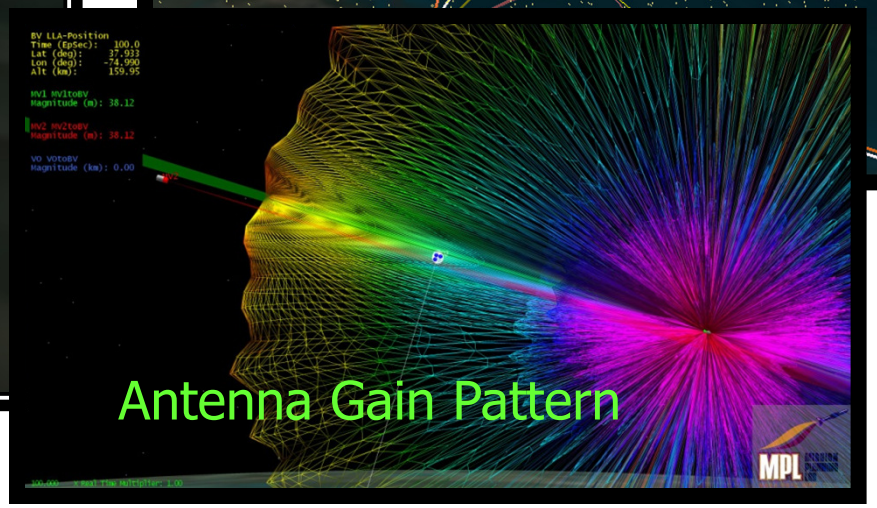


- TacSat III
- MLAS
- Bounds 36.242
- Lynch 40.023
- LaBelle 40.025
- Lehmacher 41.076-79
- Bernhardt CARE 39.009
- Cheatwood IRVE II 36.254
- EDSR
- Hall 12.067, 12.073
- SubTec III Bull AFSS 41.082
- LADEE
- Constellation
- P-3 Greenland Ice Mapping
- CloudSAT
- ORS I
- COTS Taurus II
- 6U SmallSat

Visibility → Feasibility → Variability → Certainty

- How will it look?
  - Pre-mission planning
  - Models, GIS, attitude
- How did it look?
  - Post-flight analysis





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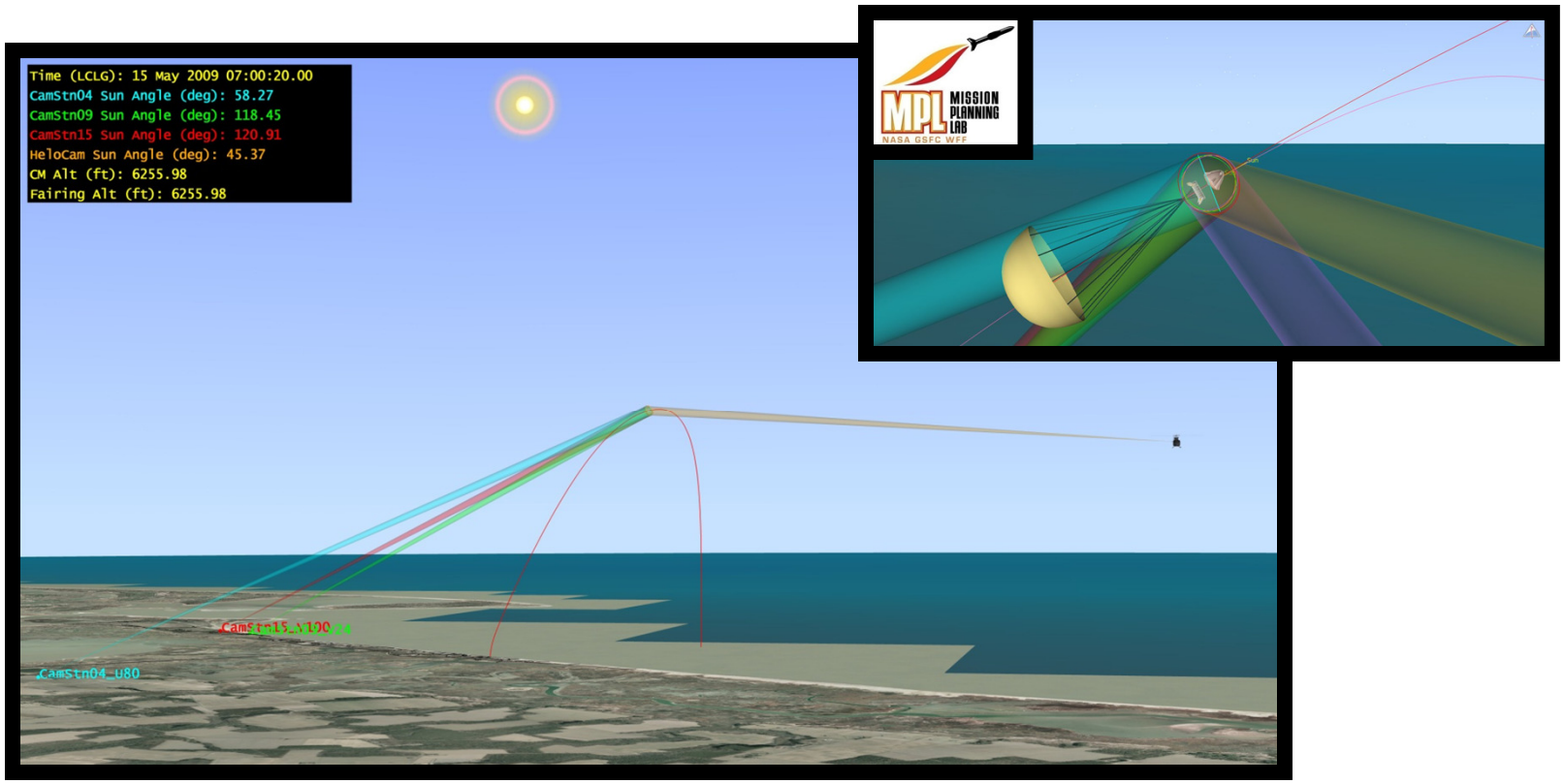
Visibility → **Feasibility** → Variability → Certainty

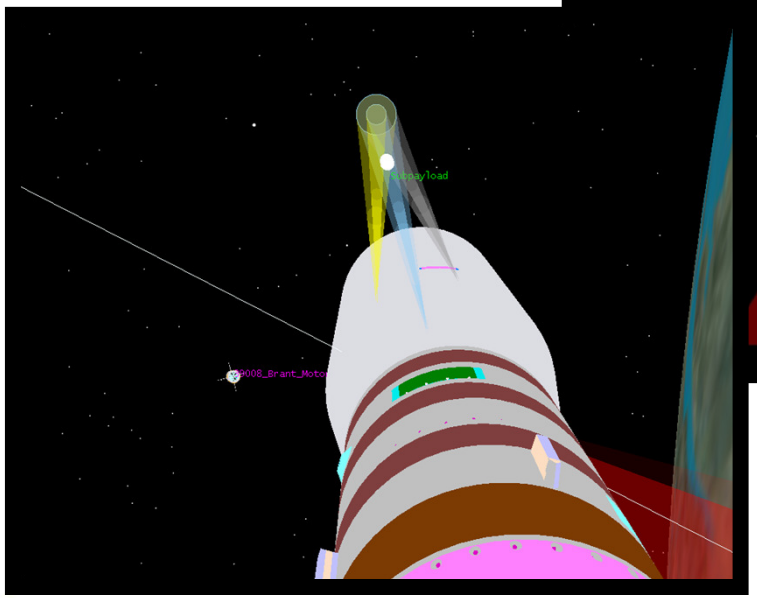
- Analyze ground & space-based tracking asset line of sight
  - Visualized preflight analysis to *emphasize* drop events for MLAS
  - Determined time vehicle could launch for ideal sun angle & lighting for video capture & optical tracking systems for MLAS *(see below)*

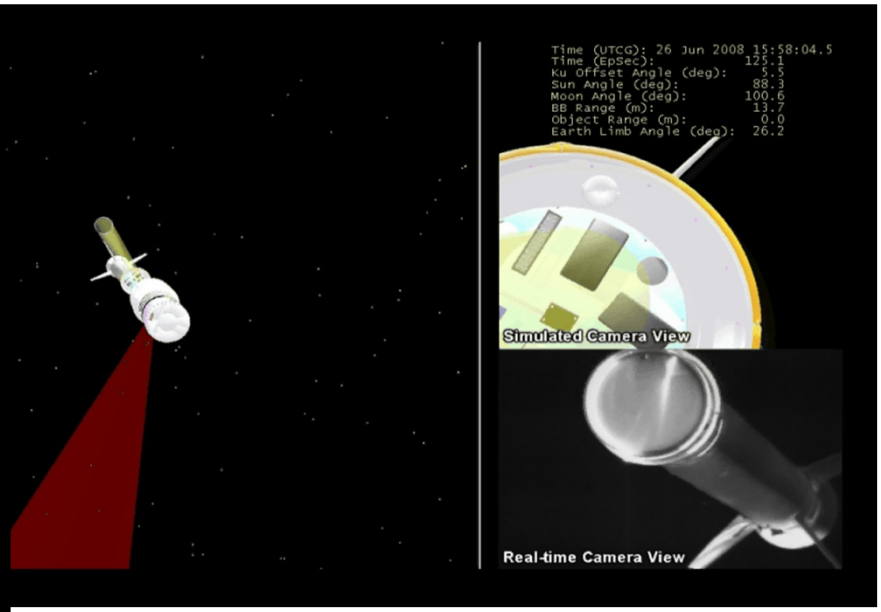


Visibility → **Feasibility** → Variability → Certainty

- Enable trades on aspects of vehicle and payload
- Formulate trajectories and attitude maneuvers provided by customer sources

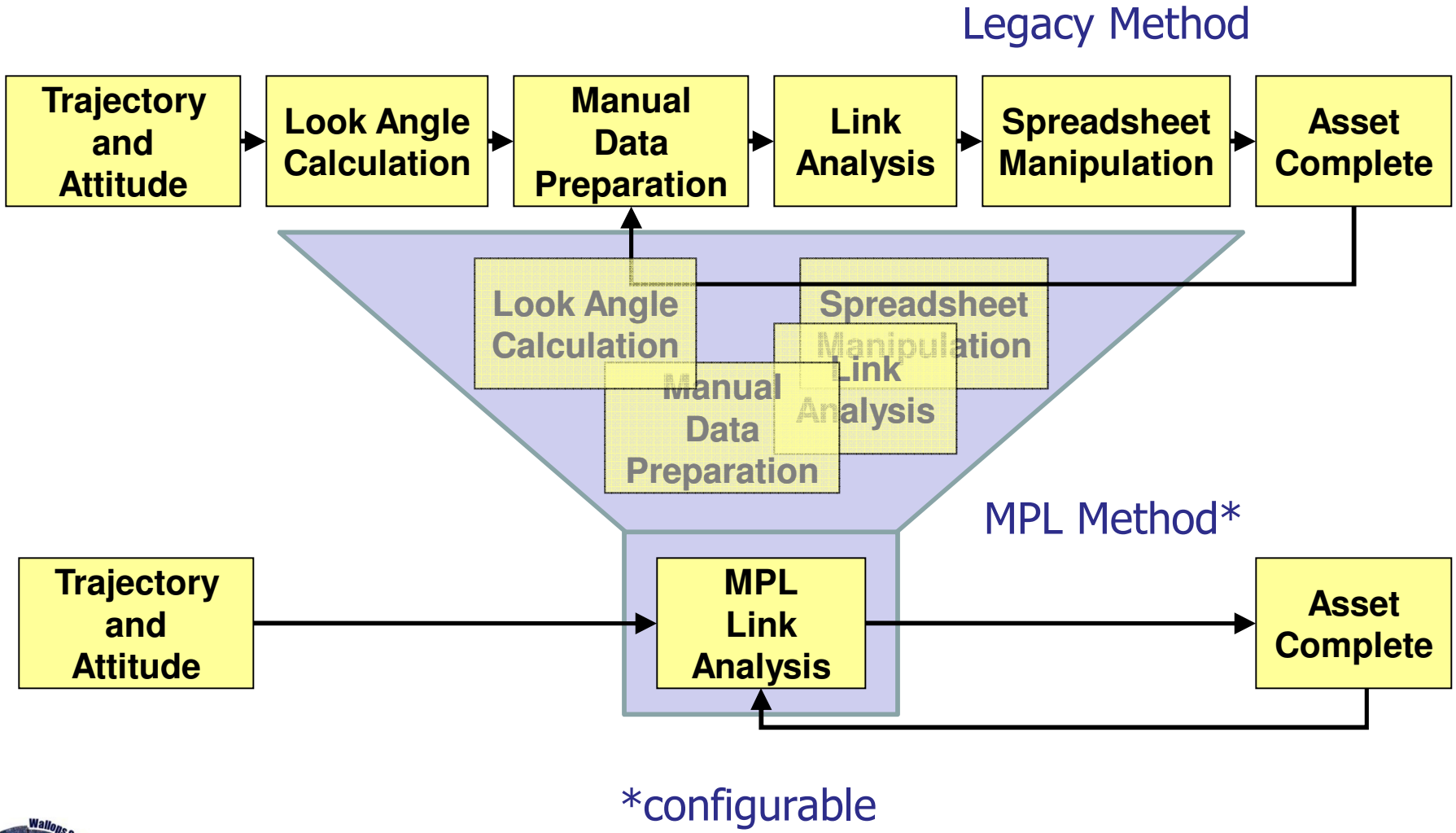
Pre-flight analysis for camera pointing





Post-flight visualization depicting simulation vs. real-time

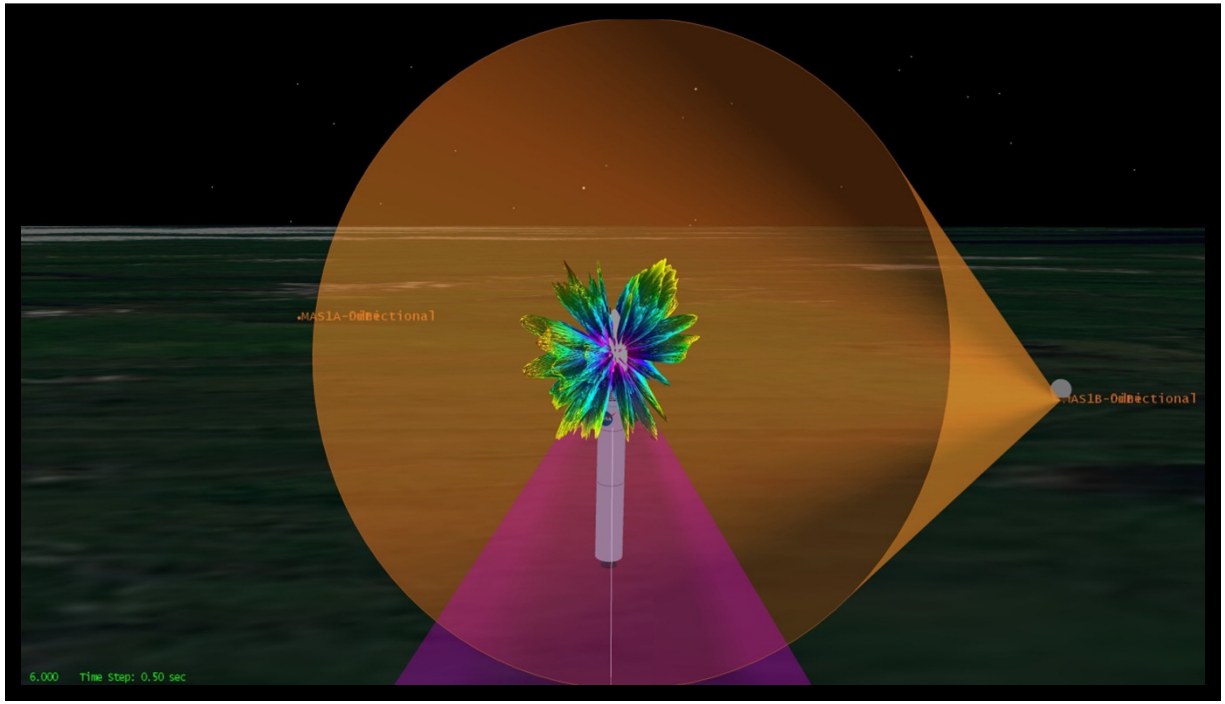
Link Analysis



*configurable

Visibility → Feasibility → **Variability** → Certainty

- What should or can be changed?
- Adjust various vehicle & mission characteristics to create different trajectories
- Examine trade-offs (i.e. through link analysis)
- Allow customers to make cost benefit or mission assurance decisions for missions



MPL is supporting Code 569 with link analysis on larger plume attenuation model for upcoming Minotaur mission

Visibility → Feasibility → Variability → **Certainty**

- Progressing with Independent V&V
  - Verifying pre- and post- flight analysis results
  - Documenting in Verification and Validation log
- Enabling more rapid safety analysis
  - Working with Range Safety on an ongoing basis

For MLAS, MPL provided: visibility, feasibility, variability, and certainty

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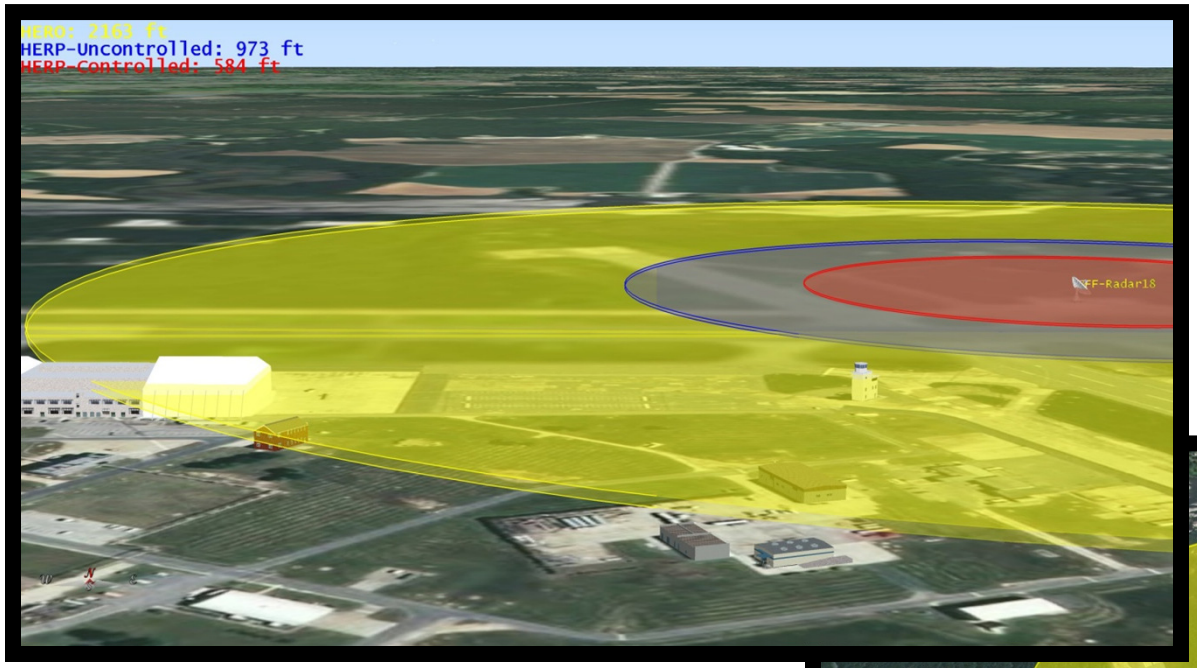
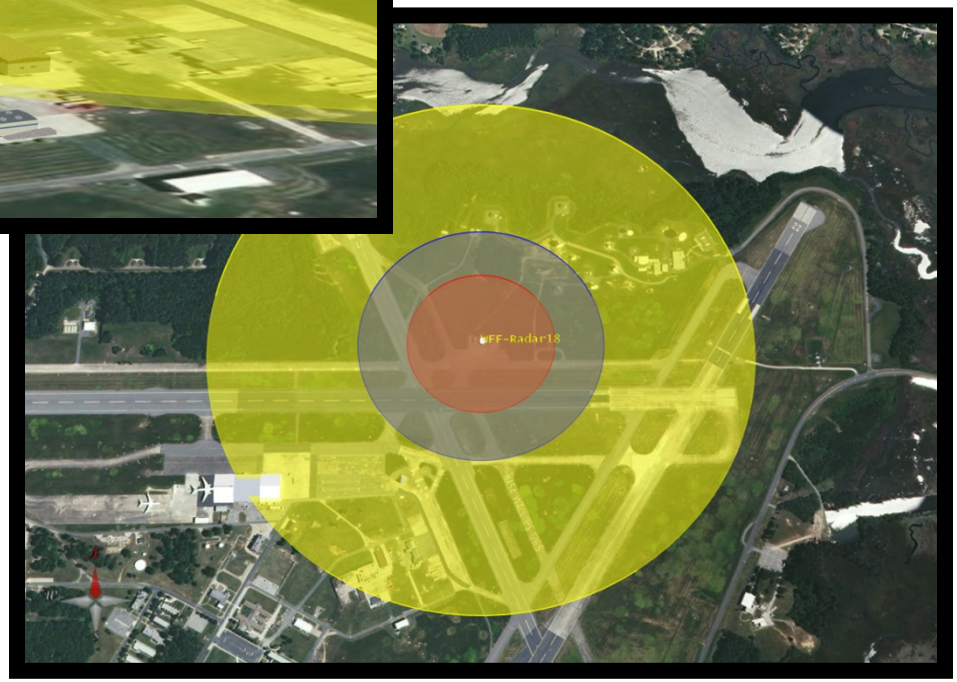
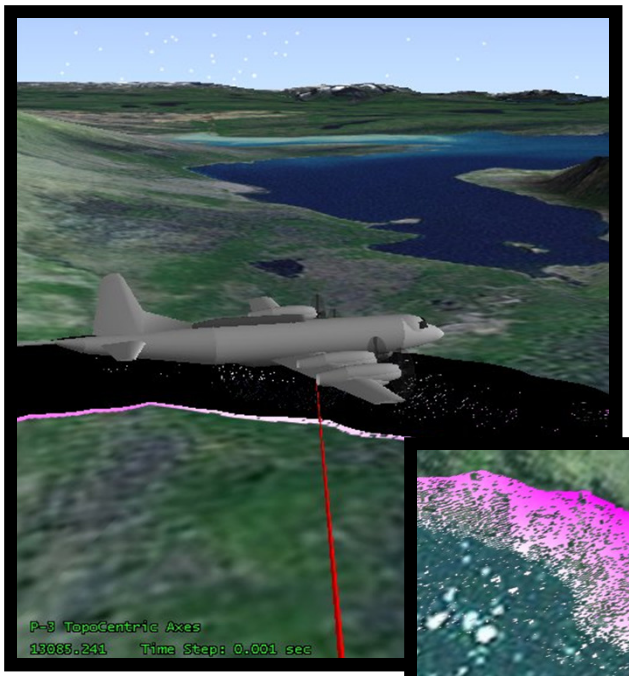
Range Safety Analysis





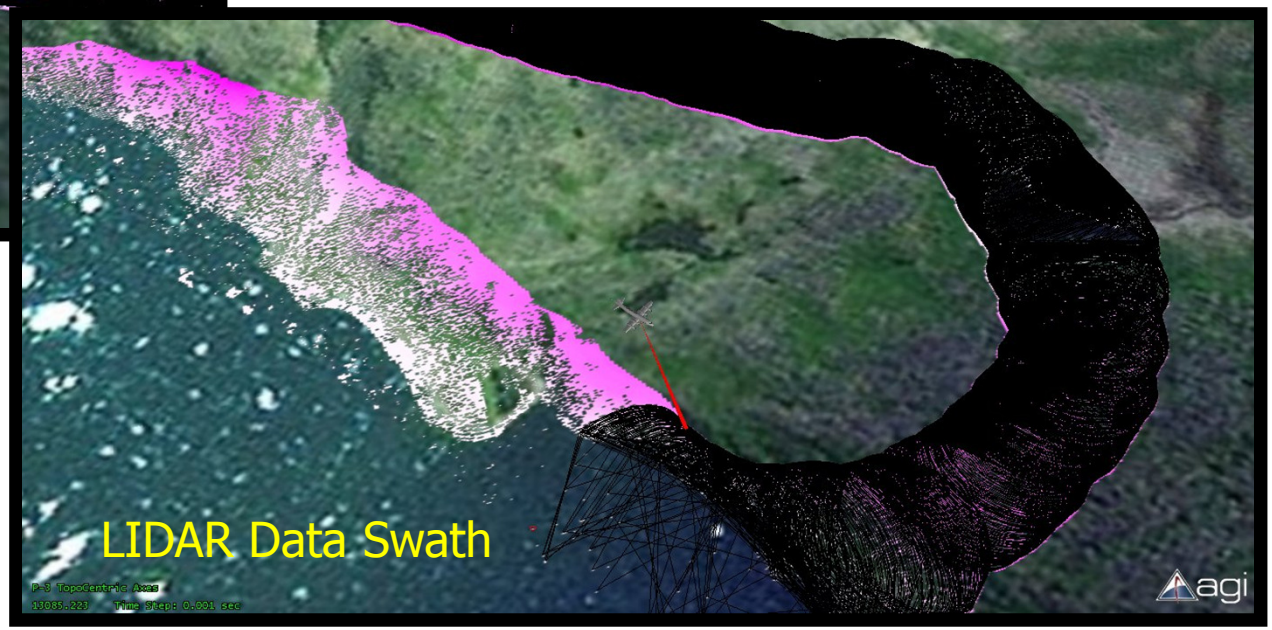
Three dimensional RF Hazard area analysis

P-3 Ice Mapping in Greenland



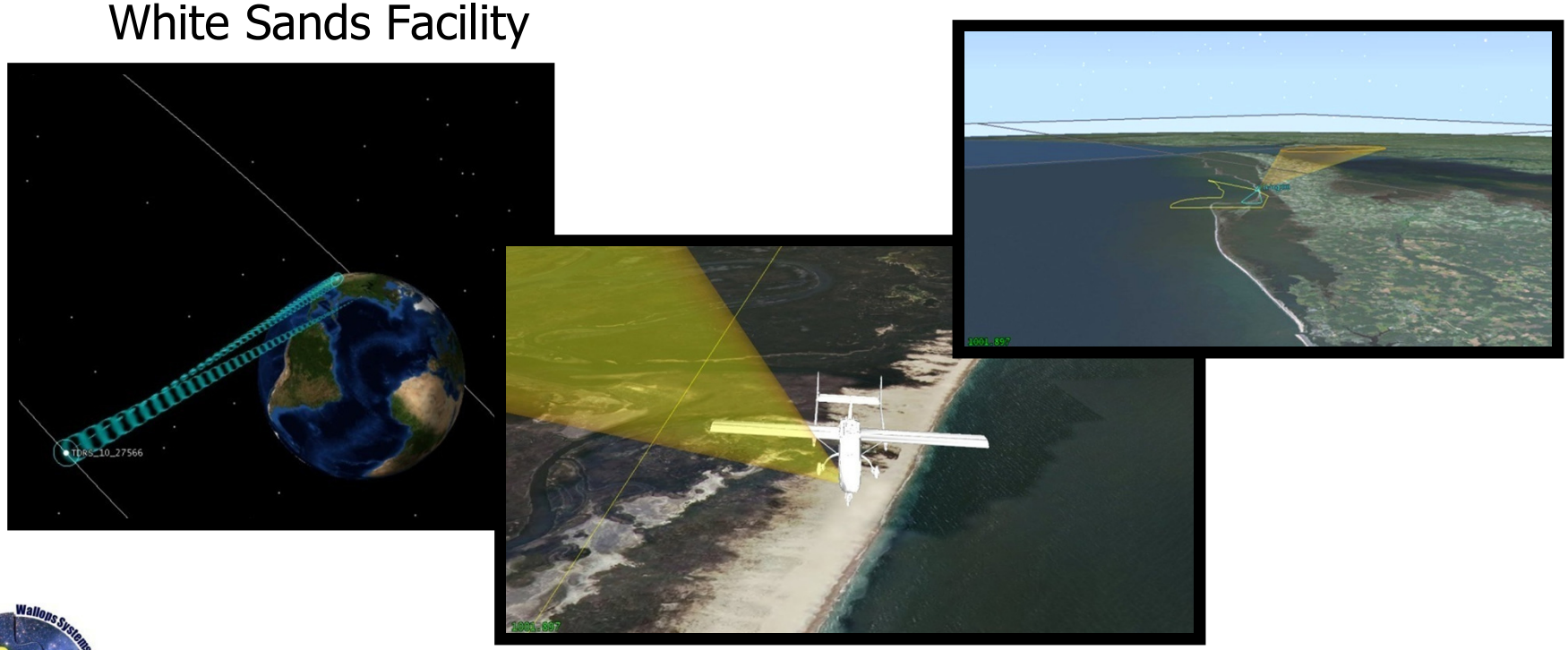
P-3 Model with Sensor

- Visualization of P-3 Ice Mapping Missions using post-flight data from both aircraft and LIDAR sensor measuring ice thickness
- Allows dynamic display of mission to clearly relate mission purpose in presentations.
- Provides context to view past and plan future data collections



Viking 300 CloudSAT Test Flight

- Visualization of CloudSAT sensor on Viking 300 UAV within Wallops restricted airspace
- Possible future use for displaying actual data or mapping out flight plans and coverage offered by sensor
- Depiction of communication from Viking 300 to TDRSS to White Sands Facility



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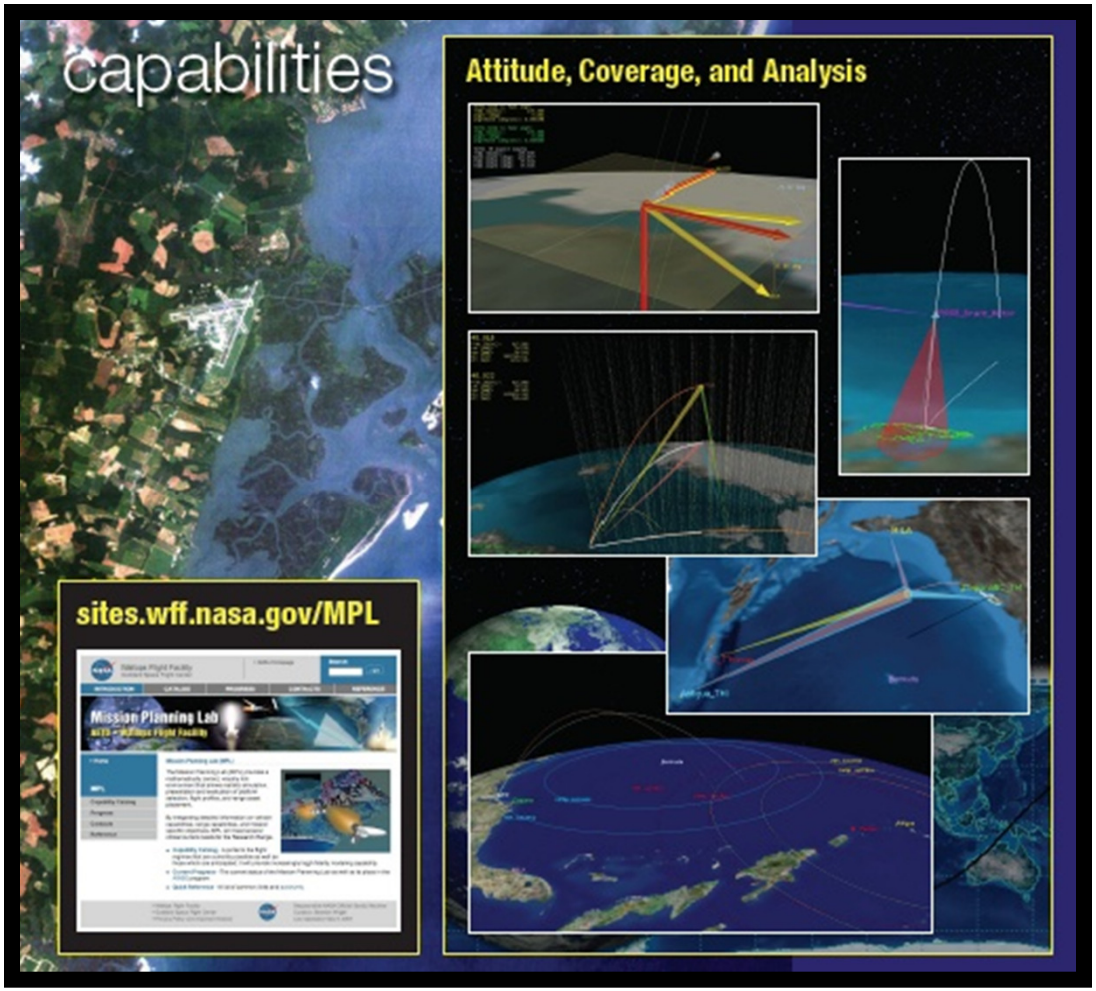
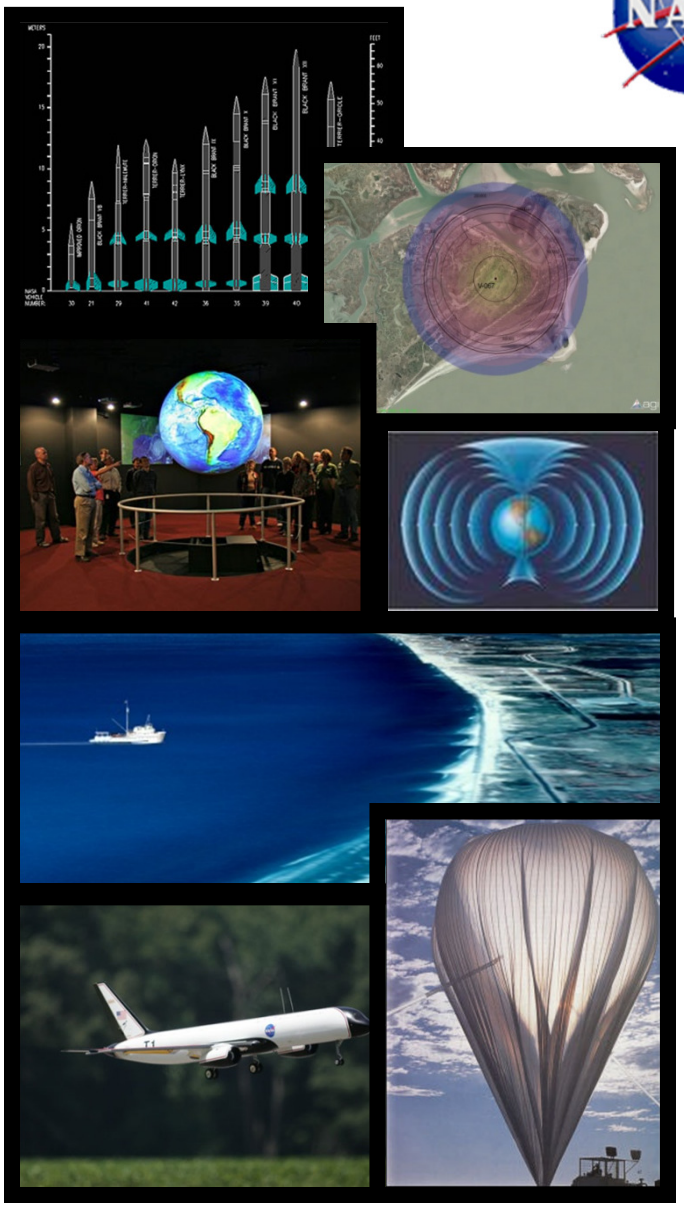
MPL Current Capabilities



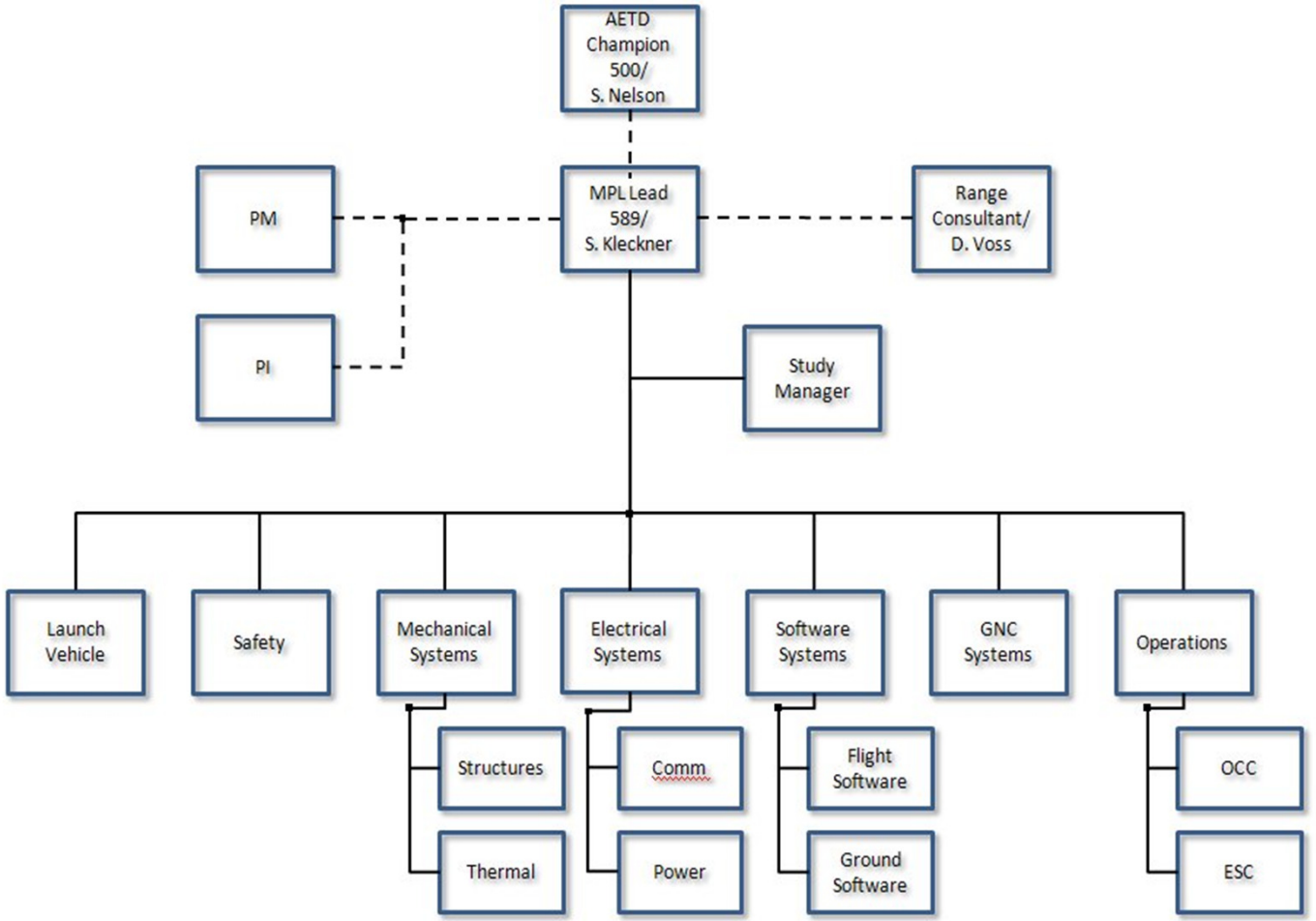
- Ingest, generate trajectories
- Incorporate attitude maneuvers
- Depict stage separation
- Show payload deployment
- Utilize 3D models
- Simulate line of site & coverage
  - Range and Space-based
- Show atmospheric layers
- Depict terrain with GIS
- Simulate ship data
- Visualize grids
- Generate auto reports
- Provide mixed media (KML, live video)
- Generate COLA reports
- Conduct link analysis

MPL Future

- Building up suite of rocket motor models
- Optimizing Range Safety tools
- Providing displays for Science on a Sphere
- Incorporate Magnetic Field Model
  - Interface with MatLab
- Investigate Missile Modeling Tool
- Remodel plume attenuation
  - Using actual post-flight data
  - Build database
- Utilize more STK reports & graphs
- Modeling historical shipping lanes & air traffic
- Incorporate wind data
- Expand capabilities, including mission design for UAVs, Balloons, Small Satellites
  - Suborbital and special orbital entities

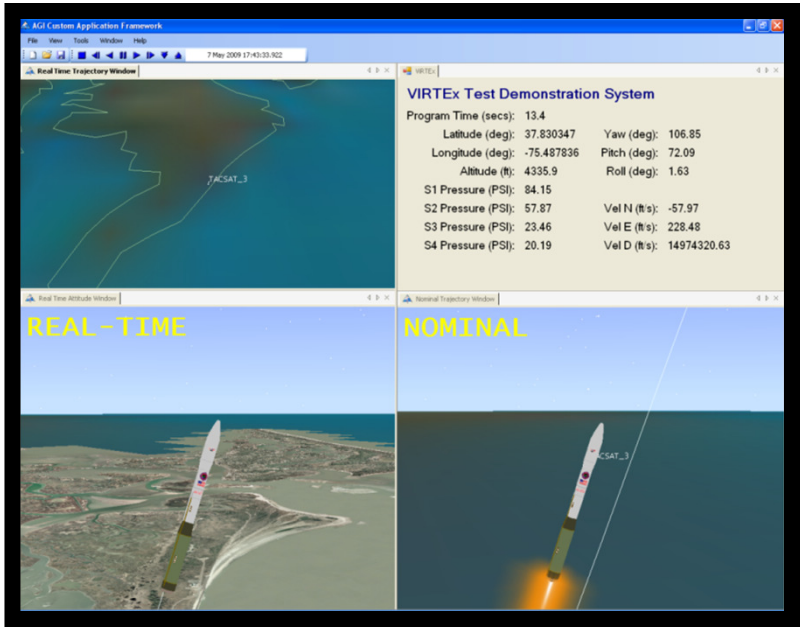


MPL WFF Mission Design Elements



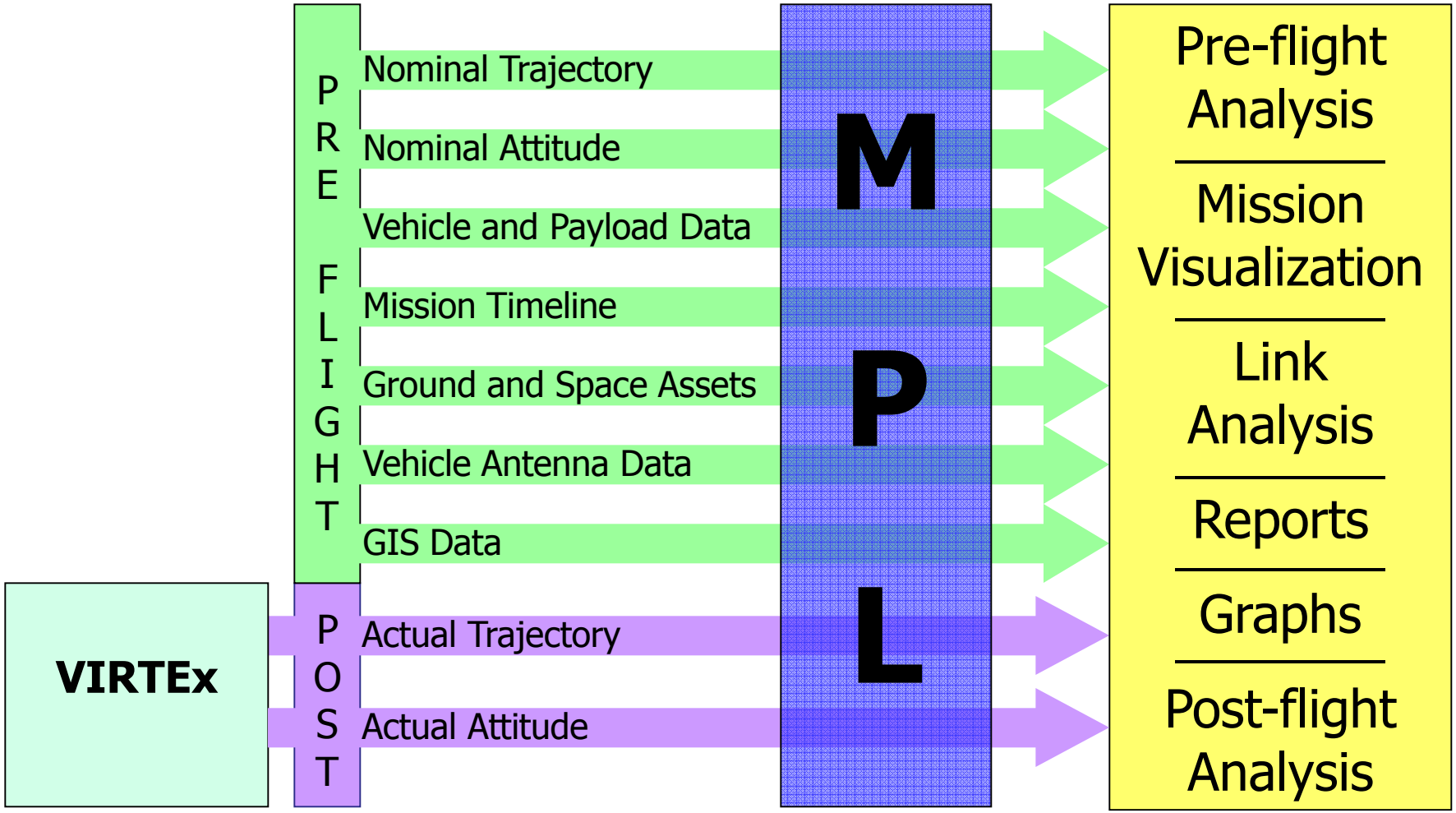
Visualization in Real-Time Experiment (VIRTEx)

- MPL spin-off demonstrates capabilities in real time environment:
  - UAV Control Center success
  - NGSP success
  - SubTec-II/Smith success
  - TacSat-III success
  - MLAS success
  - Hall success with RT3
  - SubTec-III/Bull
- WFF Range Safety has requested footprint for situational awareness



Screen shot during pre-mission simulation tape in Range Control Center (RCC)

In's and Out's of MPL



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MPL Pertinent Points

- Collaborates with:
  - RMMO/840
  - SR Program Office/810
  - Safety/803
  - Advanced Projects/802
  - AETD/500 including Greenbelt
  - GN/452
  - Range Operations, ROC
  - NSROC, WICC
  - KSC, GRC, JPL, LaRC, ORS, SpaceX…
- Provides insight into customer requirements
- Able to propose technology and instrument improvements
- Provides a system of systems exposure to the complexity of a flight project and mission support at WFF
- Follows standard engineering practices including CM
- Support is being requested for more projects, proposal efforts
- Keeps an ongoing list of capabilities to refine and extend

MPL Website

http://sites.wff.nasa.gov/mpl

Wallops Flight Facility

http://www.nasa.gov/wallops