SOUTHERN LAUNCH

Closing the loop between small satellites & timely space access

MAGIC for MATLAB EXPO 2021
05/05/2021

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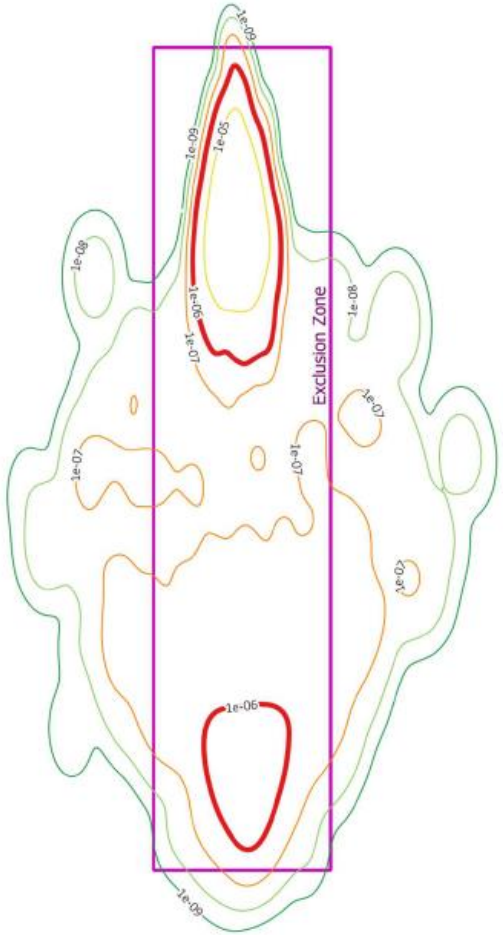
Contents

- Project & Company Introduction
- Problem Statement
- Solution
- MATLAB Benefits
- Tools Used
- MAGIC Benefits
- Results
- Takeaways/Conclusion



Project & Company Introduction

Southern Launch is a South Australian company that aims to be a global leader in the Space Launch Services market

Smallsat value chain

Upstream

Rocket manufacturing

Satellite manufacturing

Launch services

SOUTHERN LAUNCH

Downstream

Satellite operators

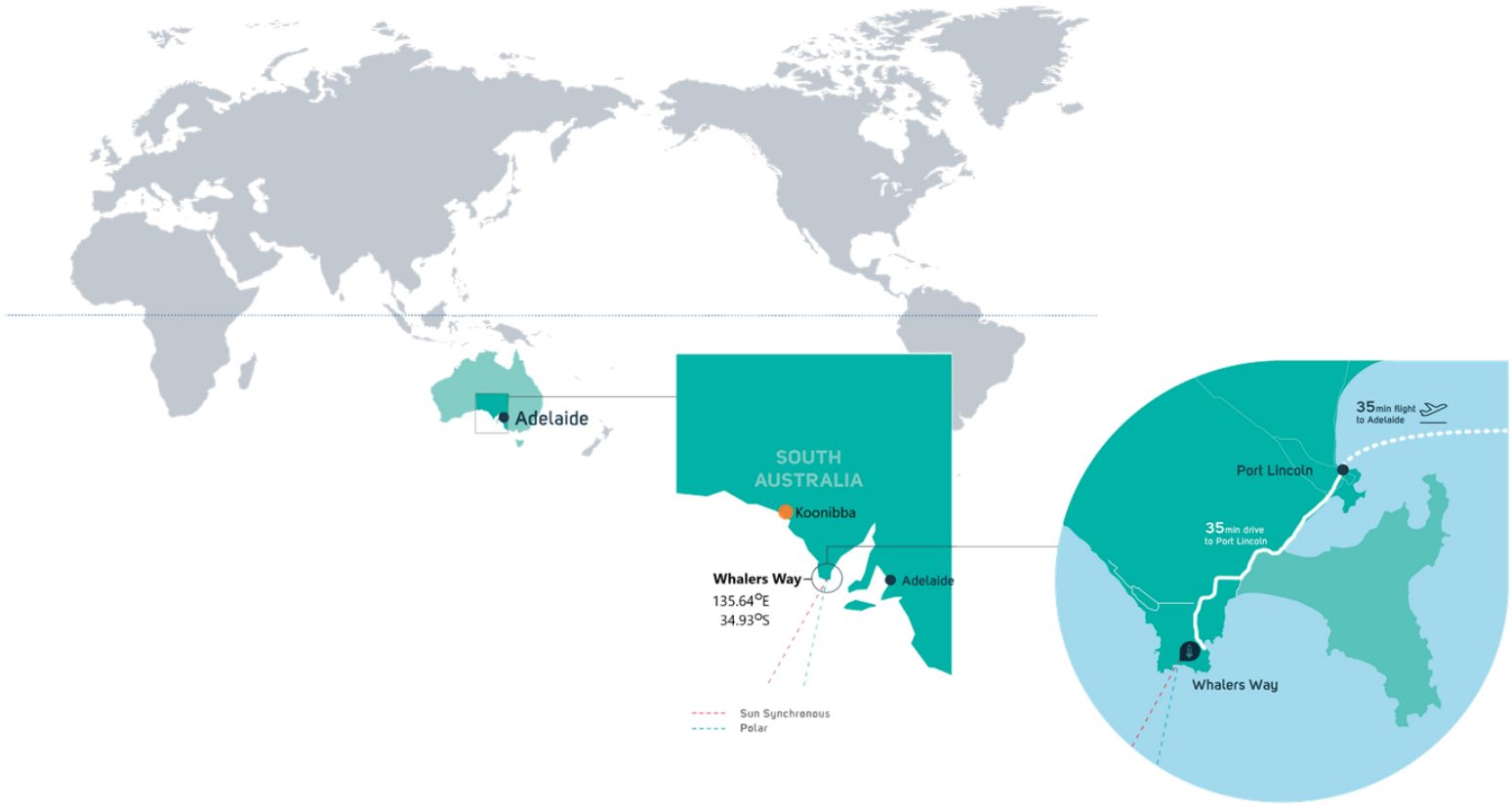
End-user applications

Markets:

- Commercial
- Consumer
- Defence
- Scientific
- Civil

Select application examples:

- Communication
- Earth observation
- Smart device connectivity
- Space exploration
- Military and navy
- Navigation and asset monitoring



Southern Launch Ranges

Orbital launch site: Whalers Way Launch Complex

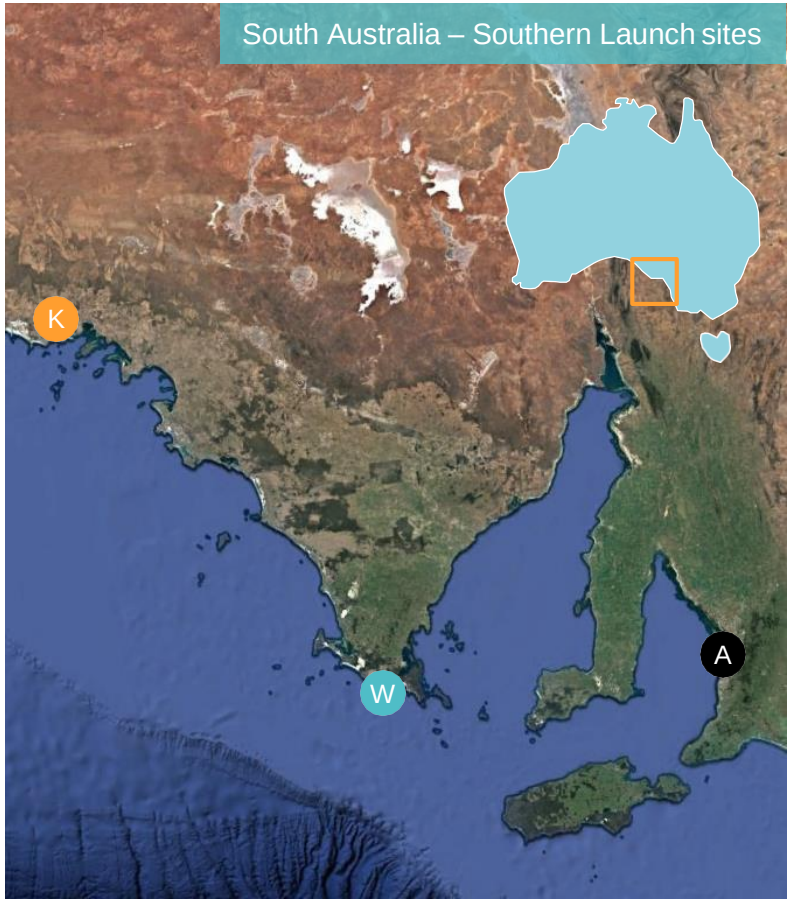
Whalers Way offers unrivalled access to high inclination launch corridors out over the Great Australian Bight from its 6km of southward facing ocean frontage

- 35mins by road to the regional centre Port Lincoln
- Access to the existing national transport network
- High launch window availability
- Geographically secure location
- Access to ancillary tracking and telemetry sites – Enables observation of launch through to payload separation

Suborbital launch site: Koonibba Test Range

The southern hemisphere's longest civilian overland rocket test range – Offering a unique opportunity for clients to develop and test rocket technologies

- Range Head located in the western part of South Australia on Koonibba community land. Approximately 40km north west of Ceduna
- Offers unhindered flights of up to 145km into an adjoining national parks
- Enables customers to undertake specific tests of civilian and military technologies
- All approvals received to operate from key stakeholders



Key:

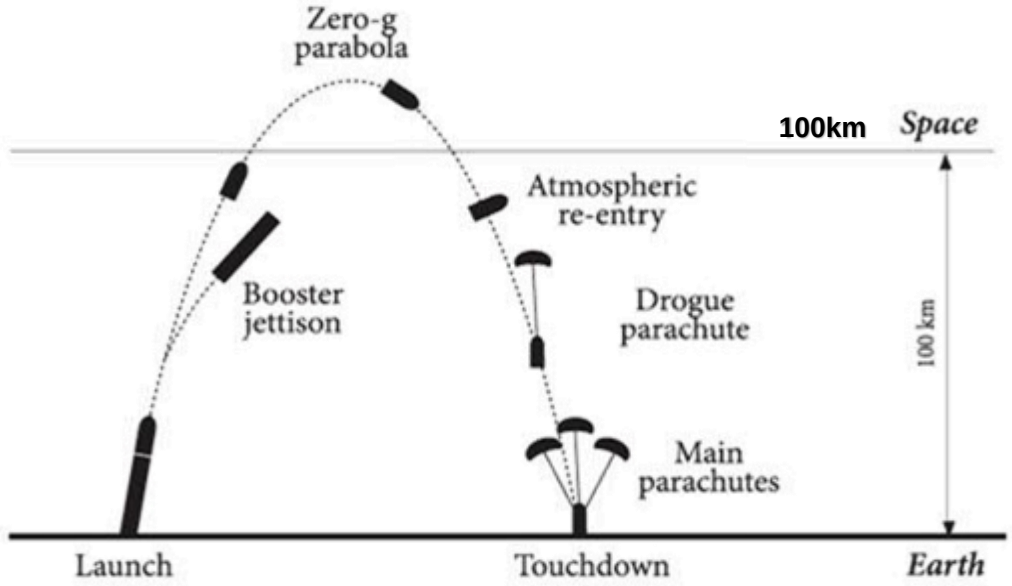
K – Koonibba W – Whalers Way A – Adelaide (HQ)

Problem Statement

- Emerging Small Satellite market
- Rocket launch is complex
  - Aerodynamics
  - Gravimetrics
  - Equations of Motion
  - Launch Operations
- It's also strictly regulated
  - CASA
  - Australian Space Agency
  - FAA

Australian Space Agency

AUSTRALIAN CIVIL AVIATION SAFETY AUTHORITY
CASA



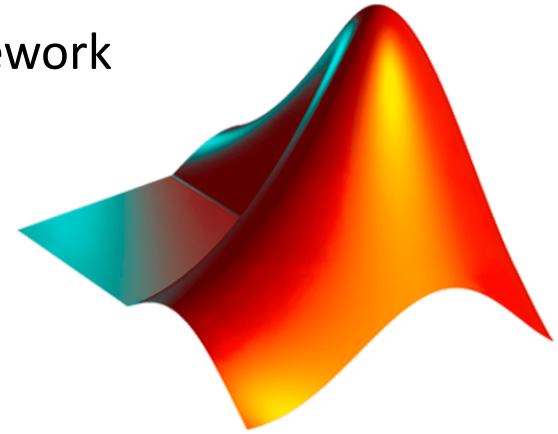
We need a quick and accurate tool that can quickly quantify launch risks in a strict, space launch regulatory environment

Solution

- **M**ATLAB & **A**STOS **G**raphical **I**nterface & **C**ontroller (MAGIC)
- A MATLAB based solution that does the following:
  1. Monte Carlo Simulations of Rocket Launch
  2. Streamlined Range Safety using MAGIC OOP
  3. Compliant with ASA and FAA Regulations
- Used daily by Southern Launch staff
- Under active development and support

MATLAB Benefits

- Why did we use MATLAB?
  - Industry leading
  - Well documented
  - Toolboxes
  - Unit Test Framework
  - OOP



MATLAB®

MATLAB enables us to focus on capability development – not software development

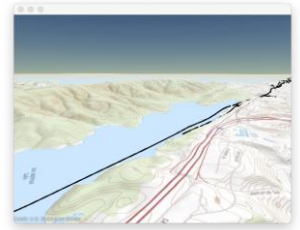
Tools Used

- Excel
  - Data Storage System
- ASTOS
  - Simulations
- MATLAB
  - Toolboxes

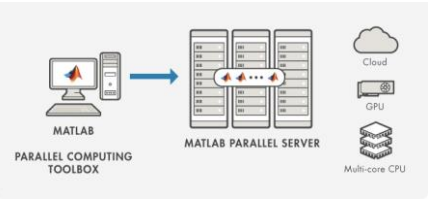
Astos Solutions

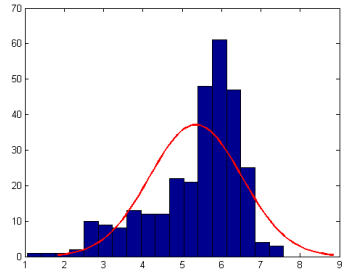
MATLAB

Map Visualisation



Secure Parallelisation

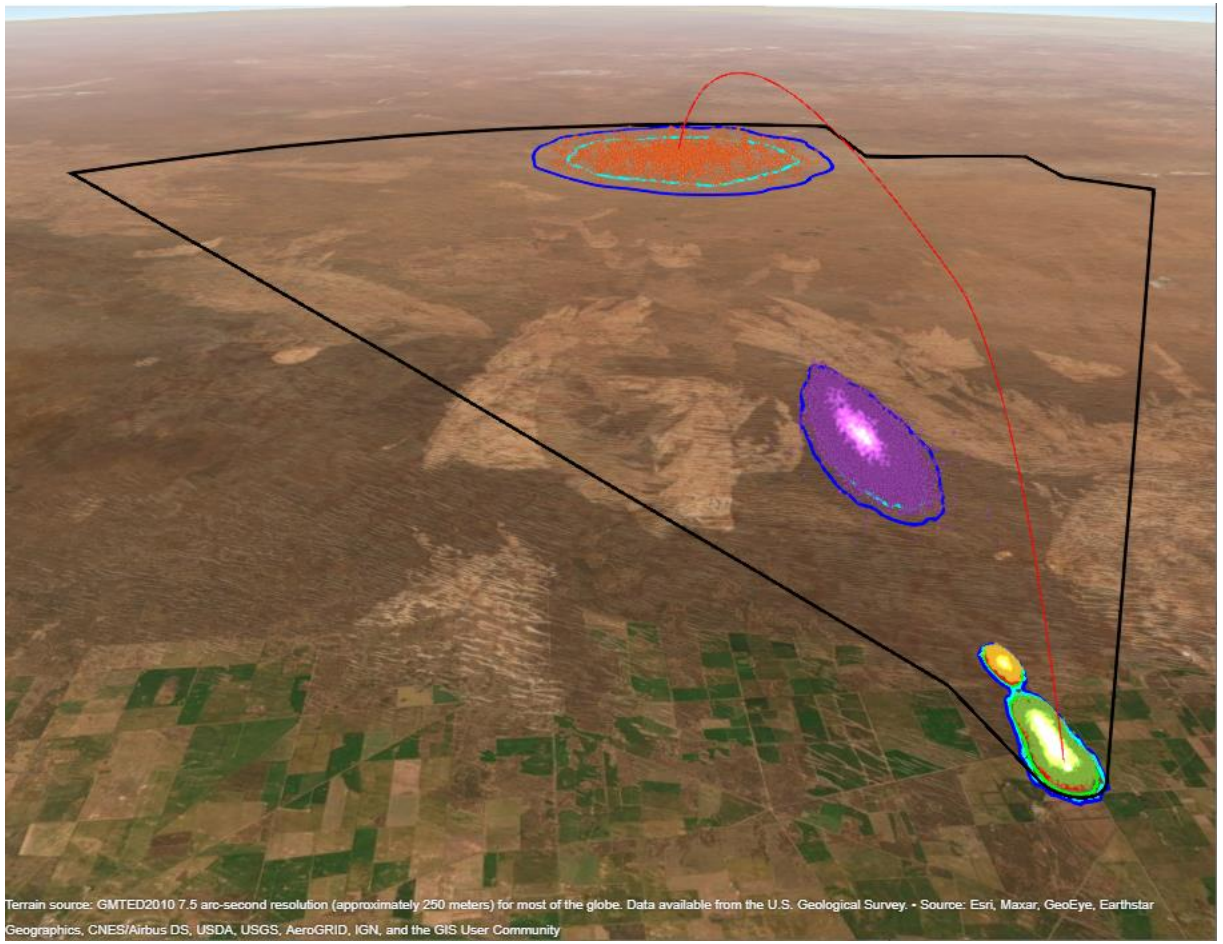




Statistics & Machine Learning

MAGIC Benefits

- What does an example MAGIC output look like?
  - Individual Risk
  - Expected Casualties
  - Maximum Probable Loss
- Benefits
  - Rapidly identify risk to people
  - Advanced post processing of results
  - Model advanced complex FRMs
  - Non-standard probability distributions

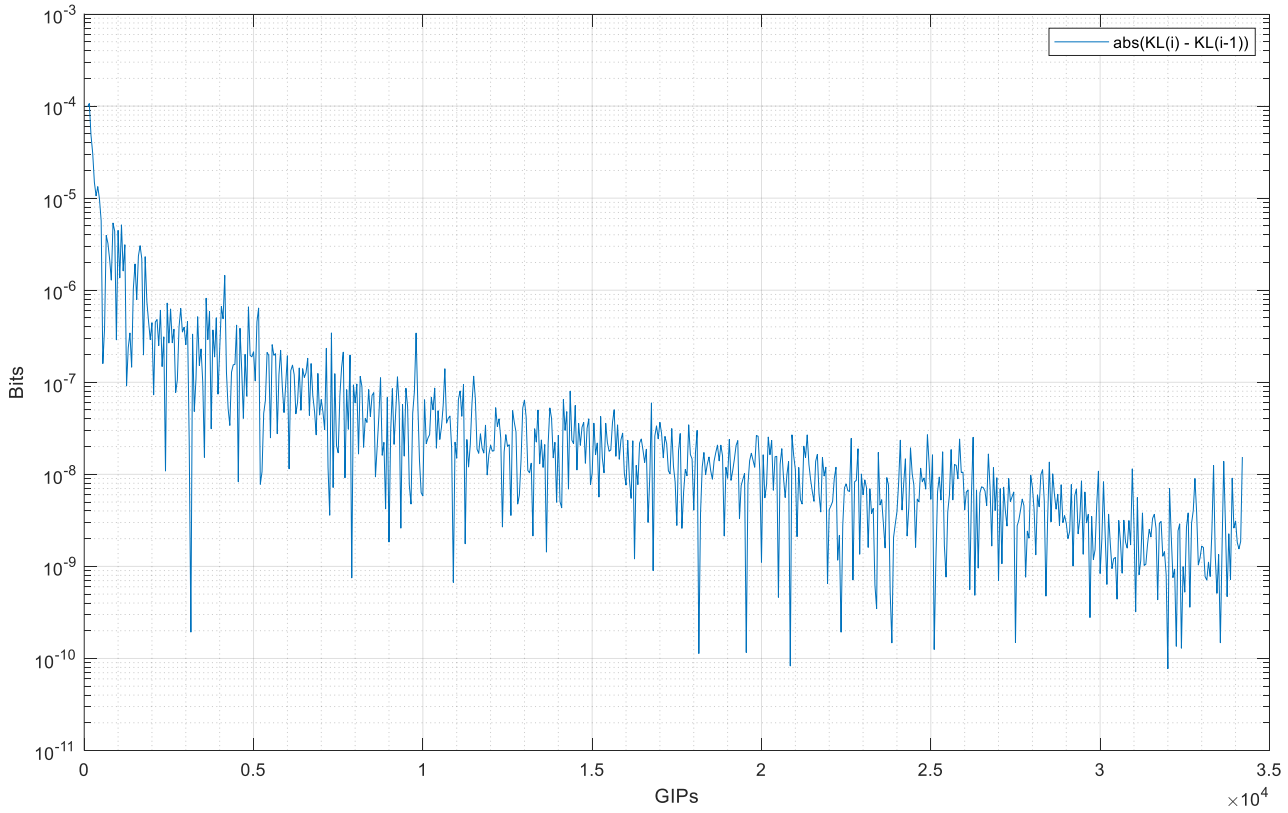


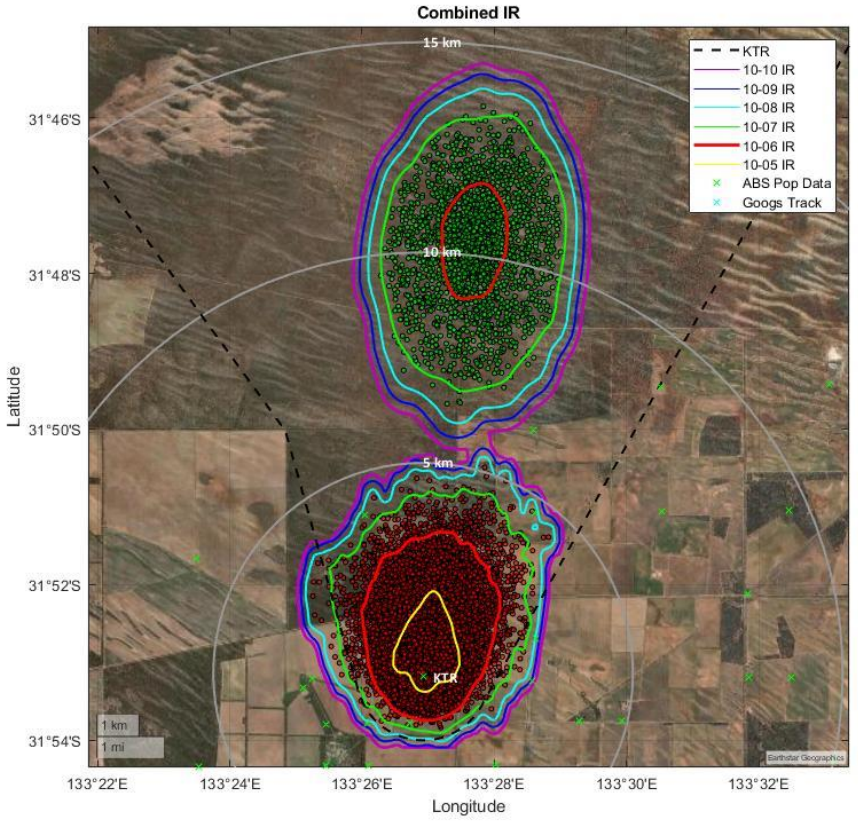
2-Stage Suborbital RST

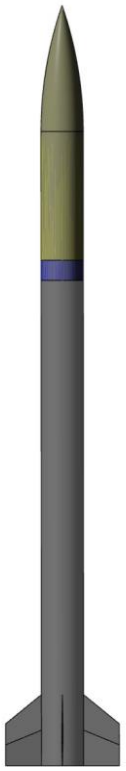
3 FRMs

Convergence Example

- Uses Information Theory to quantify how the risk profile of the Failure Response Mode (FRM) is changing

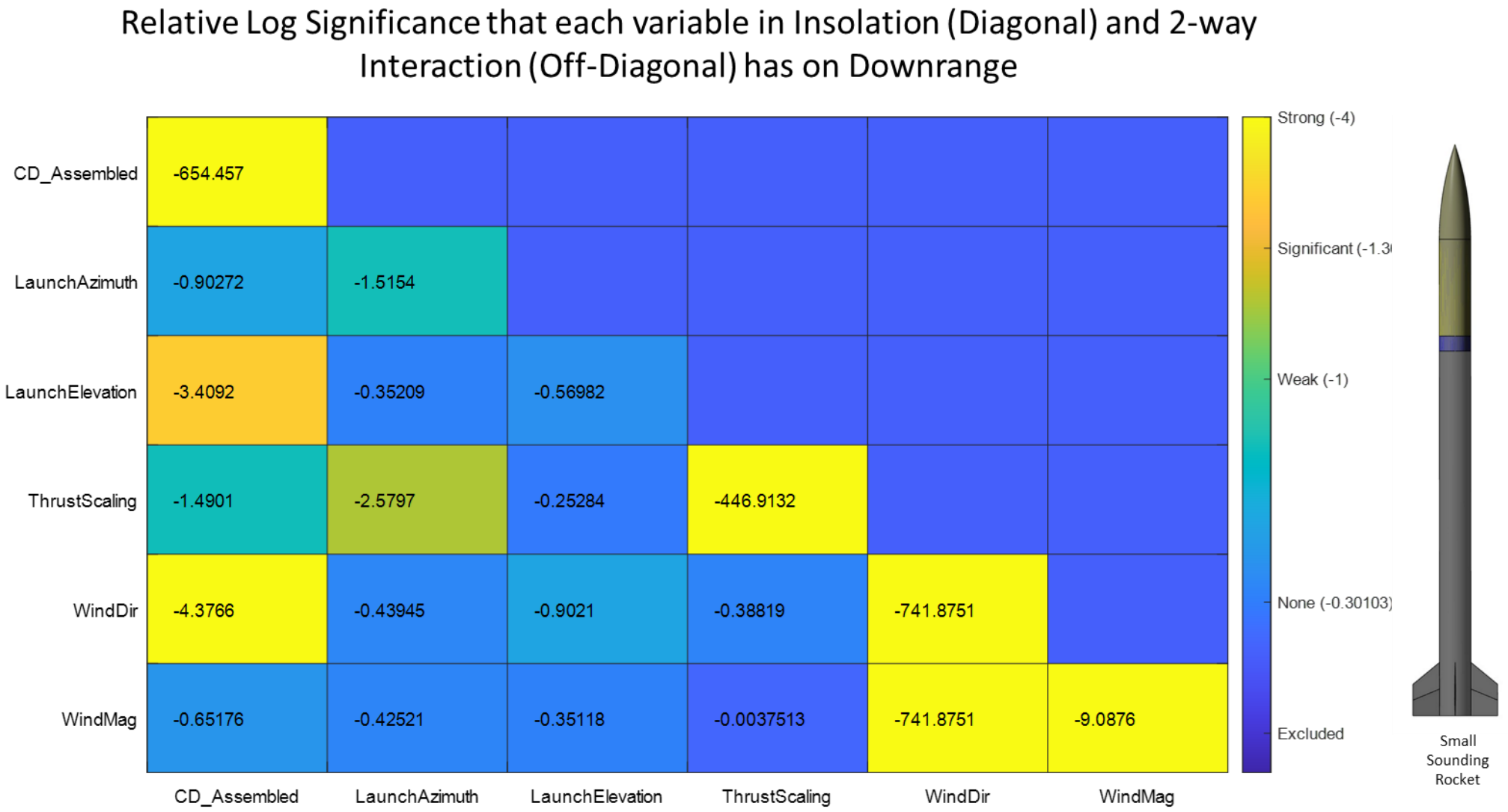






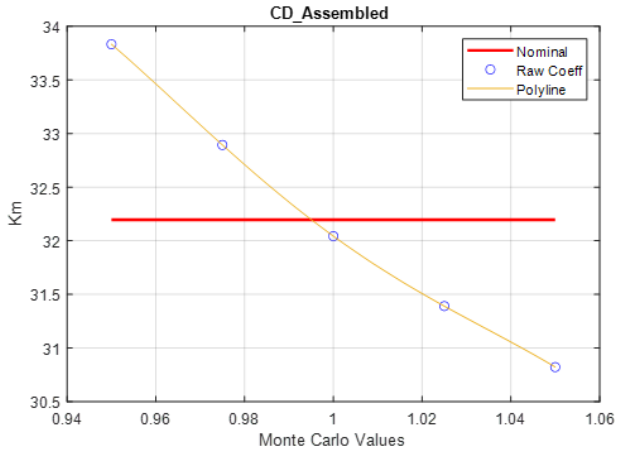
Small Sounding Rocket

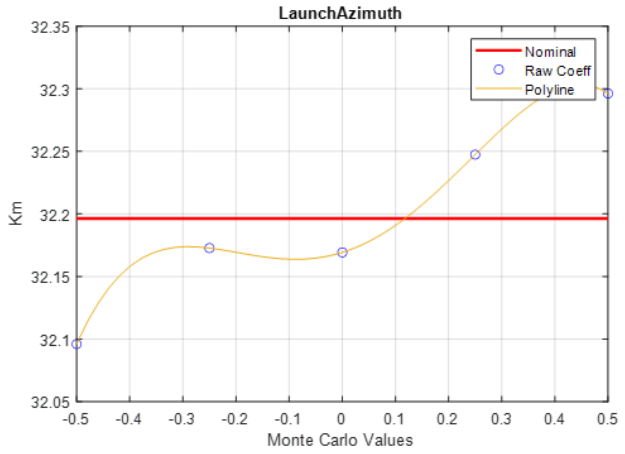
Sensitivity Example

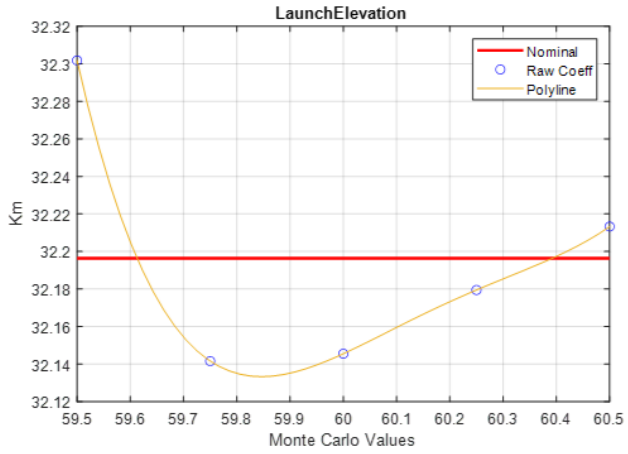


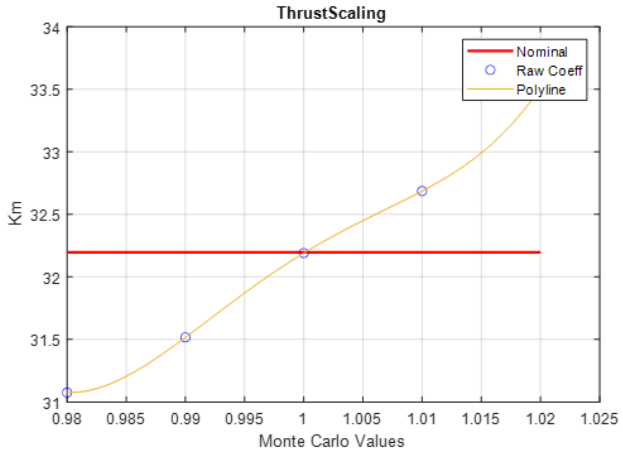
Sensitivity Example

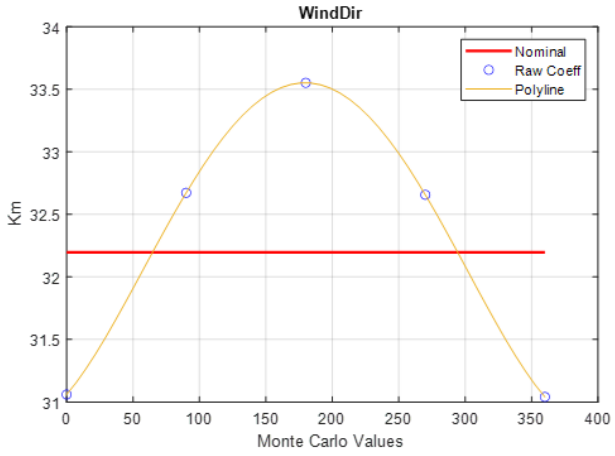
Effect Each Isolated Variable has on Downrange

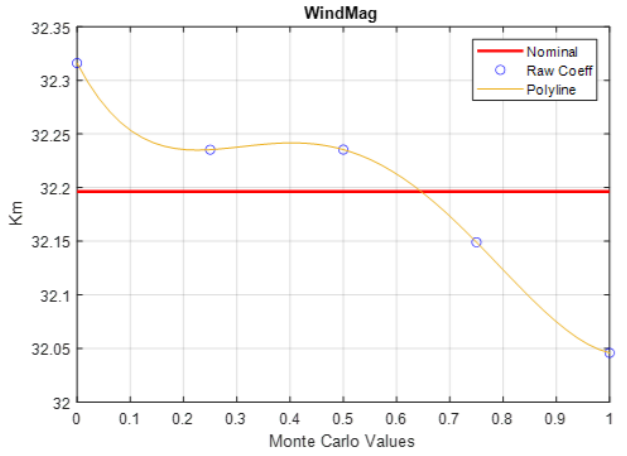


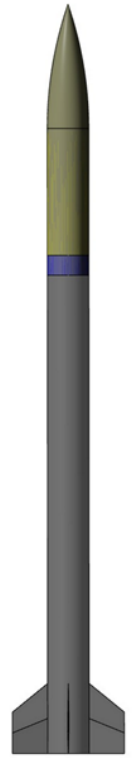












Small Sounding Rocket

Conclusion

- MATLAB has enabled the creation of MAGIC
  - Capitalise on frequent launch
  - Rapid solution for Flight Safety Assessment
- MAGIC has been able to significantly advance due to the support of MathWorks Toolboxes
- MATLAB has enabled us to focus on capability development – not software development