Software Tools for Consistency and Creativity in ATM Incident Investigations

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Optimistic Overview

- Investigations little changed in 50 years.
  - Lots of tools – almost totally ignored;
  - Islands of good practice but isolated.
- Fresh look with input from US, Europe & Asia:
  - Multiple information sources freely available;
  - Can we develop a new generation of software systems?
- From ADS-B to Debris and Suborbital ops…

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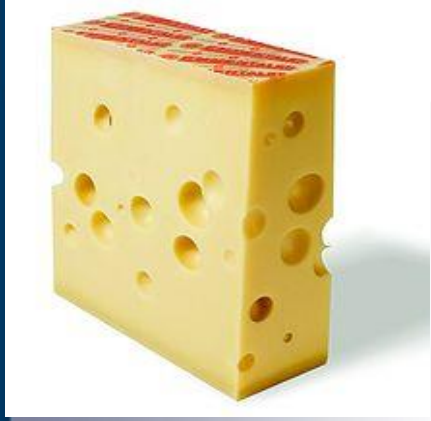
Cheese Can Be Harmful…



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Prof. James Reason (Very Famous)

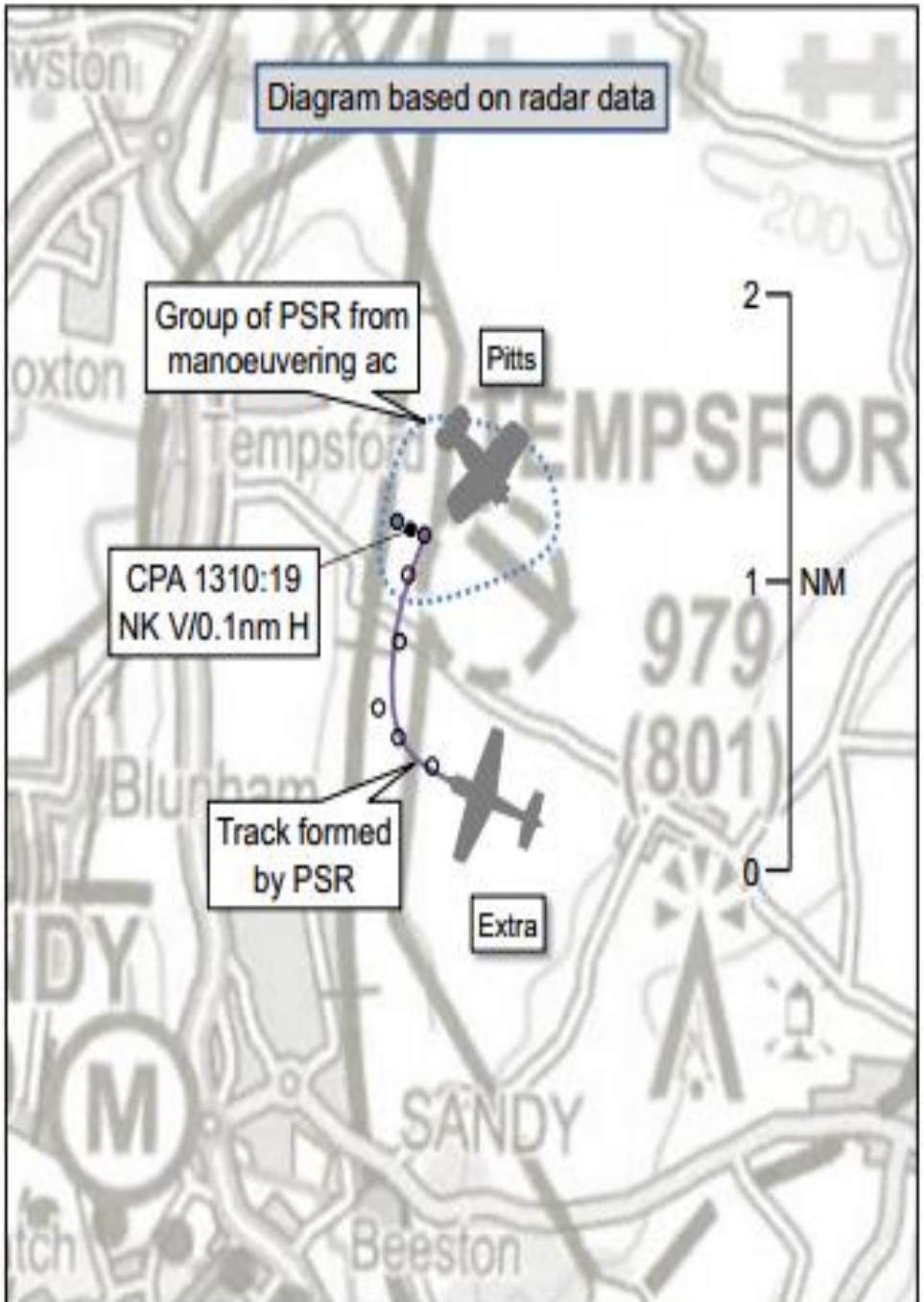
AIRPROX REPORT No 2013158

Date/Time: 10 Nov 2013 1310Z (Sunday)

Position: 5210N 00016W (3.7nm S St Neots)

Airspace: Lon FIR (*Class*: G)

	Aircraft 1	*Aircraft 2*
Type:	Pitts	Extra
Operator:	Civ Pte	Civ Pte
Alt/FL:	1800ft NK	3000ft QFE (NK hPa)
Conditions:	VMC	VMC
Visibility:	>10km	>10km
Reported Separation:	0ft V/30-100m H	500ft V/500m H
Recorded Separation:	NK V/0.1nm H	




FAULT INJECTION


E5


EXIT
4:52

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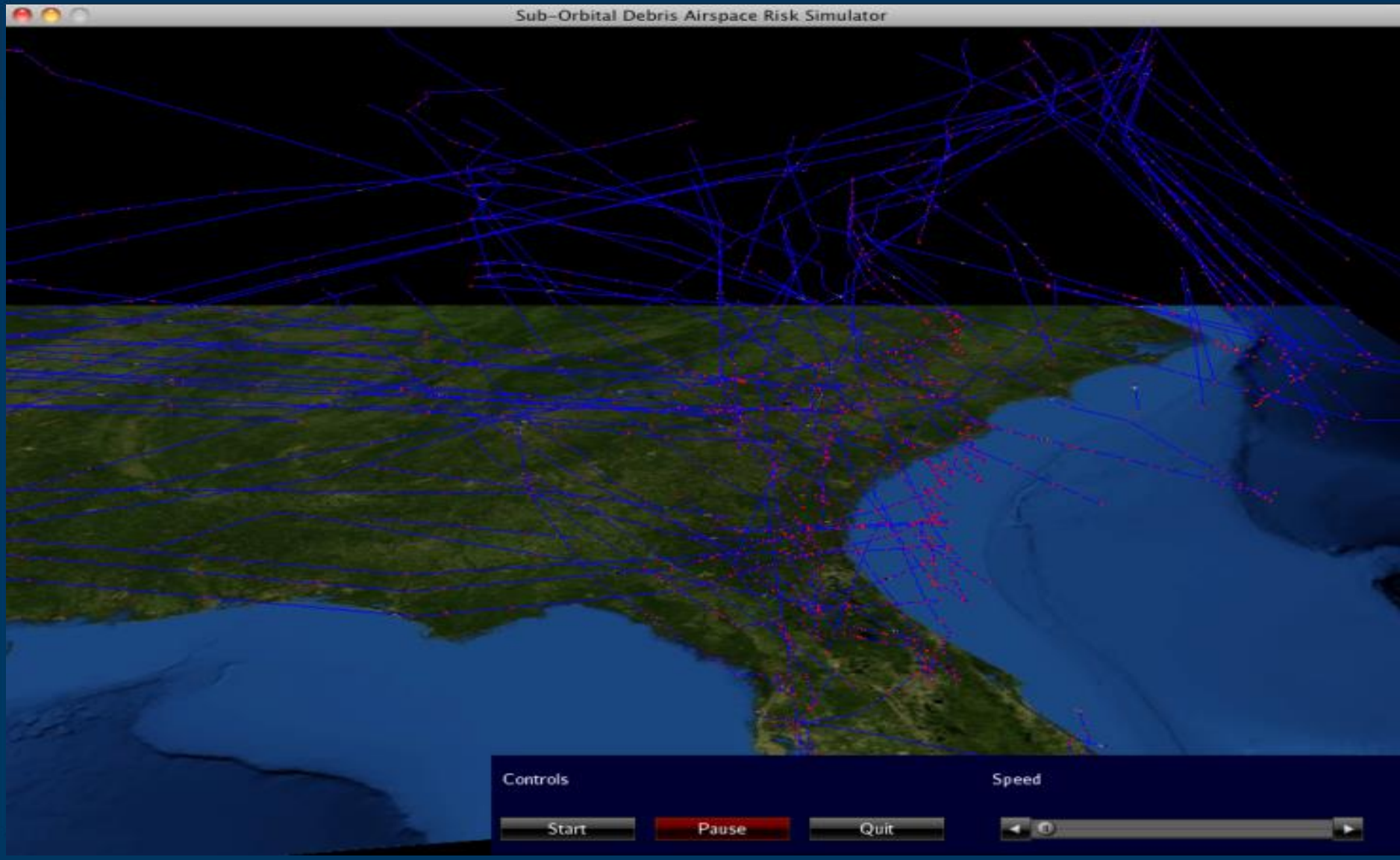
Sub-orbital Debris



The Importance of Bias

- Author bias if individuals reluctant to accept findings that they have not produced.
- Confidence bias if individuals trust those with greatest confidence in their techniques.
- Hindesight bias when investigators use information unavailable to participants in incident.
- Judgement bias if investigators must reach decision within a constrained time period.
- Political bias if high status member commands influence from status not judgement itself.
- Sponsor bias if analysis affects reputation of organisation that an investigator manages.

ERA Investigator's Views (1)

- If in Doubt, Visit the Site.
- Convene a Decision to Investigate Meeting.
- Develop a Preliminary Evaluation Report.
- Provide Guidance for Interviews.
- Build and Maintain a Timeline of Events.
- Link a Reconstruction to the Evidence.

ERA Investigator's Views (2)

- Document/Test Initial Hypotheses.
- Use both Forward and Backwards Analysis.
- Challenge the Analysis through Peer Review.
- Support for Human/ Organisational Issues.
- See if Recommendations Copy Earlier Findings.
- Links Recommendations & Causes.

- Also (fairly poor) manual and software tools.

Determining System Inadequacy(ies) Responsible for Human Error

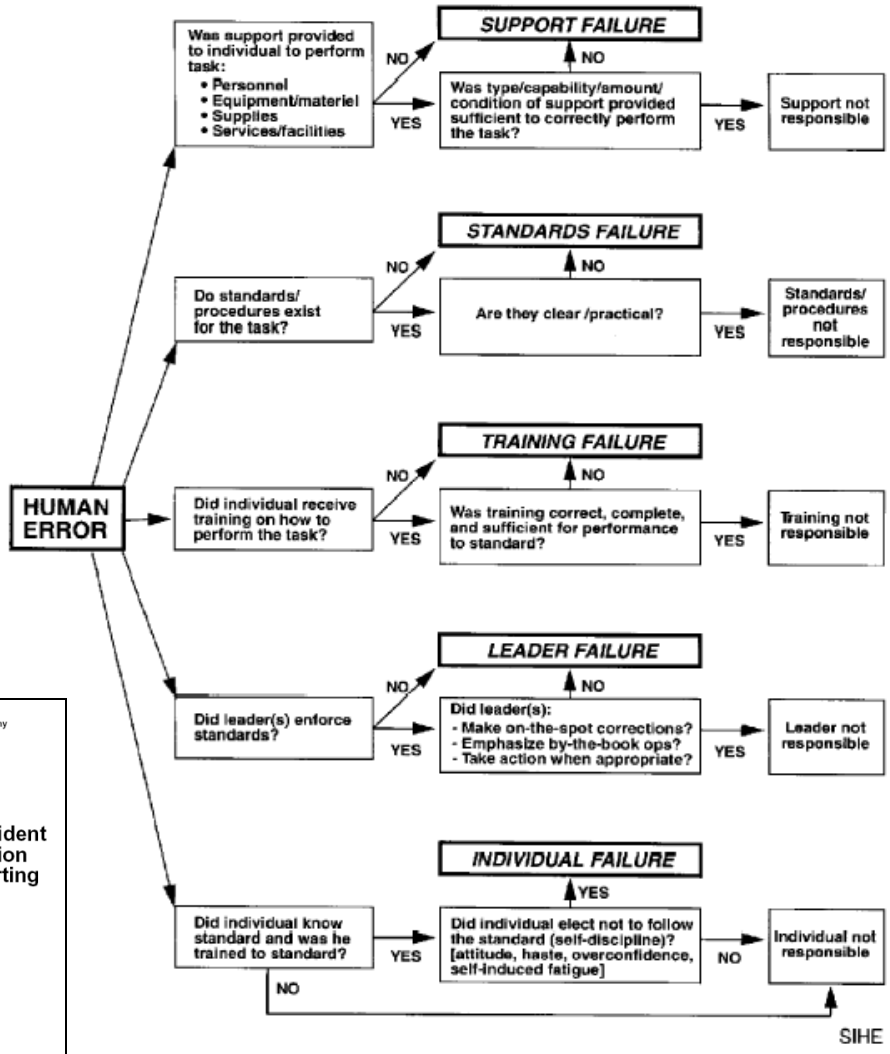


Figure 2-1. Determining system inadequacy(ies) responsible for human error

Department of the Army
Pamphlet 385–40

Safety

Army Accident Investigation and Reporting

Headquarters
Department of the Army
Washington, DC
1 November 1994

Unclassified

System Inadequacies/Readiness Shortcomings/Root Causes

LEADER FAILURE
Code: 01 Key Word/Explanation: Inadequate/improper supervision by higher command.
Code: 02 Key Word/Explanation: Inadequate/improper supervision by staff officer.
Code: 03 Key Word/Explanation: Inadequate/improper supervision by unit command.
Code: 04 Key Word/Explanation: Inadequate/improper supervision by direct supervisor/noncommissioned officer in charge/platoon leader/instructor. NOTE: Inadequate supervision becomes a root cause when it leads to accident–causing personnel mistakes or materiel failure/malfunctions. Inadequate supervision is more clearly identifiable at the immediate–supervisor level.

INDIVIDUAL FAILURE
Code: 15 Key Word/Explanation: Fear/Excitement/Anger (inadequate composure). Each person is a part of the system. Therefore, his state of mind is a system element. Inadequate composure is a temporary state of mind that becomes a root cause when a person makes an accident–causing error because of fear, excitement, or some related emotional factor made clear, rational thought impossible.
Code: 16 Key Word/Explanation: Overconfidence/complacency in abilities. Overconfidence is a temporary state of mind that becomes a root cause when an accident is caused by a person's unwarranted reliance on: his own ability to perform a task, the ability of someone else to perform a task, the performance capabilities of equipment or other materiel.
Code: 17 Key Word/Explanation: Lack of confidence. Lack of confidence is a

Table B–5
System Inadequacies/Readiness Shortcomings/Root Causes—Continued

temporary of mind that becomes a root cause when an accident is caused by a person's unwarranted lack of reliance on: his own ability to perform the task, the ability of someone else to perform the task, the performance capabilities of equipment or other materiel.
Code: 18 Key Word/Explanation: Haste/Attitude (poor motivation). Haste/ attitude (poor motivation) is a temporary state of mind that becomes a root cause when a person makes an accident–causing mistake because he/she is in a hurry (haste), or has a poor/bad attitude.
Code: 19 Key Word/Explanation: Fatigue (self–induced). Fatigue is a temporary physical and/or mental state that becomes a root cause when a person makes an accident–causing error because of reduced physical or mental capabilities resulting from previous activity and/or lack or rest.
Code: 20 Key Word/Explanation: Effects of alcohol, drugs, illness. The temporary effects of alcohol, drugs, or illness become a root causes when a person makes an accident–causing error because of reduced physical or mental capabilities resulting from one or more of these effects.
Code: 21 Key Word/Explanation: Environment conditions. Unknown or unavoidable conditions, which result in materiel failure or induce human error.
Code: 97 Key Word/Explanation: Insufficient information to determine system inadequacy/cause.

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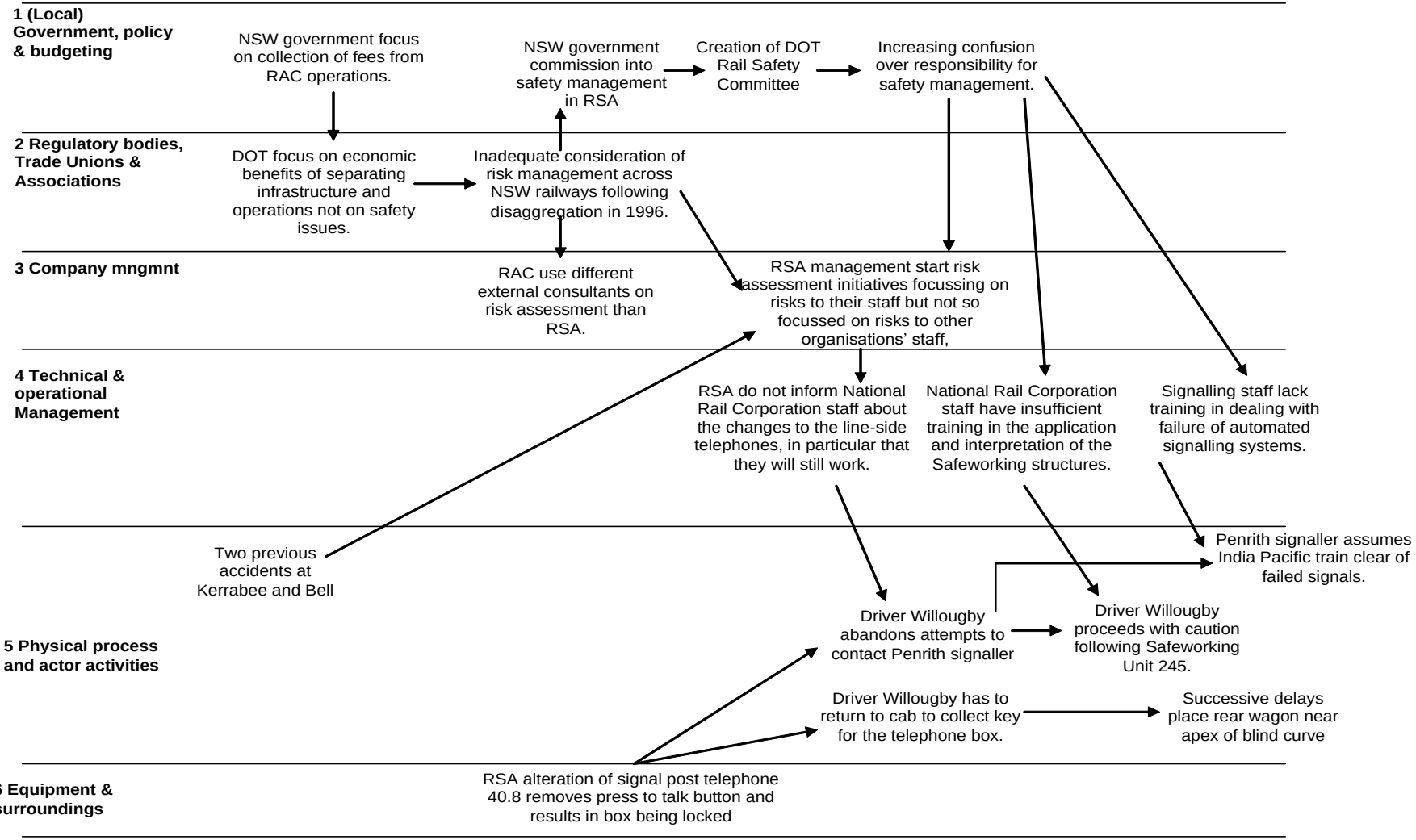
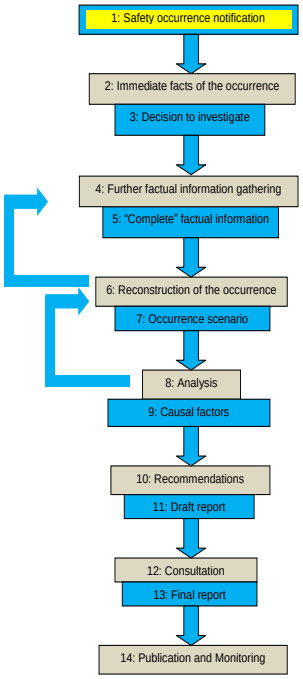
ACCIMAP



Identifying Tools, Methods and Techniques

Accident Analysis Framework,
Accimaps (Rasmussen)
Accident Investigation Training Course (UK Rail)
Adverse Incident Tracking System, see AITS
Adverse Event Reporting System, (US Food and Drugs Administration)
Australian Incident Monitoring System, see AIMS
ATSB Aviation Safety Action Programme
Aviation Safety Reporting System (ASRS, National Transportation Safety Board)
ABCA Coalition Operations Lessons Learned Database,
Australian Office of Transport Safety Investigations,
Confidential Safety Reporting Information Scheme
Barrier Analysis,
Bayesian Analysis
Bayesian Networks
Bias,
Biomechanical models
Canadian National Defence General Accident Information System, and Safety Digest,
Case-based reasoning
Causal trees
Counterfactual reasoning
Cause-context summaries
Cause-Consequence Models[1]
CD-ROM
Chain of events
Change Analysis
Chat Rooms
Checklists
Confidential Incident Reporting System (CIRS)
Cockpit Voice Recorders,
Composite Risk Management (CRM)
Computerised Accident Incident Reporting System (CAIRS)
Conclusion, Analysis and Evidence diagrams, (CAE)
Confidential Human Factors Incident Reporting Programme (CHIRP)
Confidential Incident Reporting and Analysis System (CIRAS)
consequence assessment
Cooperative Compliance Programme (OSHA's)
CREAM
Cryptography
Current Reality Tree
Databases
Data Mining
Data Recorders
Data Reporting Analysis and Corrective Action System (DRACAS)
Decision Theory
DesktopVR
Dynamic Querying
Decision Trees
Domino Theory
Eindhoven Classification Model,
Electronic mail
Enhanced Cognitive Interviews for Rail Investigations
European Space Agency Alert System,
EUROCONTROL Risk Assessment Worksheets
Event trees
Events and Causal Factor Charts (ECF)
Failure Modes, Effects and Criticality Analysis (FMECA)
Failure Reporting, Analysis and Corrective Actions (FRACAS)
Fault trees
Fax machines
Five Whys
Flight Operations Quality Assurance programmes
Flowchart
Formal methods
FRA Highway-Rail Crossing Web Accident Prediction System,
FRA Confidential Close Call
GEMS, Generic Error Modelling
Generic Occurrence Classification
Global Aviation Information Network (GAIN)
Goal Structured Notation (GSN)



HAZOPS
HEIDI
Heinrich Rratio
Human Reliability Analysis
Iceberg model
Incident Analysis Method for Railway Safety Management
International Nuclear Event Scale
Japanese Maritime Incident Reporting System
Joint Center for Lessons Learned
Kepner-Tregoe Problem Analysis
Kjellen's criteria
Latent failure
Likelihood Assessment
Logic,
Causal Logic, Deontic Logic, Explanatory Logic,
First Order Logic, Modal Logic, Temporal Logic,
Major Hazard Incidents Data Service (MHIDAS)
Management Oversight and Risk Trees (MORT)
Manufacturer and User Facility Device Experience database (MAUDE)
Multilinear Events Sequencing (MES)
MTO (human, technology and organisation) Japanese Rail Accident Method
National Patient Safety Agency, see NPSA National Patient Safety Database
Non-Compliance Analysis
PARDIA (WBA)
Performance Shaping Factors
Petri Nets
Peturbation Theory, P-Theory (part of MES/STEP)
Physical Reconstructions
Prevention and Recovery Information System for Monitoring and Analysis (PRISMA)
PRISMA-Rail
Precursor Indicator Model
QuicktimeVR
Rail-Program for Risk Informed Safety Managements
Railway Technical Research Institute (RTRI) type accident analysis method
Rail Data Recorders
Reason Root Cause Analysis Tools
Safety Cases
Safety Management Information System
Sequentially Timed and Events Plotting (STEP)
SHELL
Simulations
Skills, Knowledge, Rules (Rasmussen)
Skybrary Accident Information and Safety Information System
SMORT
Safety by Organisational Learning (SOL)
Systems Theoretic Accident Model and Processes (STAMP)
Systemic Causal Analysis Technique (SCAT)
Systematic Accident Scenario Analysis (SASA)
Systemic Safety Management System[1]
Taproot[1]
Theory of Constraints (TOC, Zotov, …)
Time-lines
Toulmin's Argumentation Structures
Technique for the Retrospective and Predictive Analysis of Cognitive Errors: TRACEr-rail version
Tripod
Tripod-Beta, Tripod-Delta
US Air Force Automated Security Incident Measurement
US Army 5 stage model
US Air Force 8-Step Problem Solving Methods
Virtual Reality
VRML
Why Because Analysis (WBA)
Witness Guidelines, (US Department of Justice)
Westrum's Taxonomy
World Wide Web
Worst Plausible Outcome
Yellow Book (Guidance on UK Rail Accident Analysis)

Distribution of Techniques

- Step 1: Safety occurrence notification (22 out of 130)
- Step 2: Immediate facts of the occurrence (17 out of 130)
- Step 3: Decision to investigate
- Step 4: Further factual information gathering (28 out of 130)
- Step 5: Complete factual information
- Step 6: Reconstruction of the occurrence (30 out of 130)
- Step 7: Occurrence scenario
- Step 8: Analysis (67 out of 130)
- Step 9: Causal factors
- Step 10: Recommendations (33 out of 130)
- Step 11: Draft report
- Step 12: Consultation (20 out of 130)
- Step 13: Final report
- Step 14: Publication and Monitoring (23 out of 130)

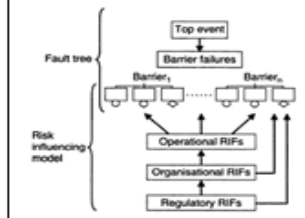
Template-Based Comparisons

B

Barrier Analysis

Evaluation Criteria	Assessment
Name of the method/tool/technique	Barrier Analysis
References to the method/tool/technique	W.A. Trost and R.J. Nertney, Barrier Analysis, August 1995, SCIE-DOE-01-TRAC-29-95, US Dept of Energy. http://www.jklld.net/trac29.pdf E. Albrechtsen and P. Hokstad, An Analysis of Barriers in Train Traffic Using Risk Influencing Factors, Page 25-31. In Safety and reliability: Proceedings of ESREL 2003, European Safety and Reliability Society, Annual Conference. Edited by T. Bedford, P. H. A. J. M. van Gelder
Other names or speciality names	Originally part of MORT analysis but now a more general technique.
Primary objective of the method/tool/technique: the original purpose or function of the method/tool/technique	Barriers are important for the understanding and prevention of accidents in two different, but related, ways. Firstly, the very fact that an accident has taken place means that one or more barriers have failed – either because they did not serve their purpose adequately or because they were missing or dysfunctional. The search for barriers that have failed should therefore be an important part of accident analysis. Secondly, once the aetiology of an accident has been determined and the causal pathways identified, barriers are used as a means to prevent that the same, or similar, accidents take place in the future. In order to facilitate this, the consideration of barrier functions should be a part of system design[2].
A description of the process which must be followed to apply the method/tool/technique –this description is a digest of information drawn from the references or subject matter experts	"Barrier Analysis" was written to support the total MORT Programme. It is a reminder to the system safety person or the accident investigator that there are three factors to be considered when evaluating an accident or a potential accident situation. Those three factors are (1) the energy or environmental condition present, (2) the target, the person or object of value and (3) the barrier and control, those things that are in place or should be in place to keep the energy and the targets apart". The following figure illustrates different types of barriers. Barriers Control Safety • Control of wanted energy flows Examples • Conductors • Approved work methods • Job training • Disconnect switch • Pressure vessel • Control of unwanted energy flows Examples • Protective equipment • Guardrails • Safety training • Work permit • Emergency plan

[2] http://www.ituu.se/research/project/train/papers/AccidentAnalysis.pdf

	
An indication for which of the phases in the generic occurrence investigation process (Figure 1) it could be applicable	Step 8: Analysis Step 9: Causal factors Step 10: Recommendations Step 11: Draft report
Has the method/tool/technique previously been applied in railway occurrence investigations, or could it be adapted to the railway context?	Yes, see citation above and similar examples in the EBREL collection.
Alternative, overlapping or complementary method/tool/technique, e.g. methods/tools/techniques that can be used preliminary or successively to the method/tool/technique	MORT, Fault Tree Analysis.
An indication whether the method/tool/technique is in use	Yes, it is in widespread use in many industries around the globe – taught as part of many engineering courses and as can be seen above has been integrated with fault tree analysis closing loops between incident investigation and hazard analysis/design.
Computer tools that can support application of the method/tool/technique	Barrier analysis is a conceptual approach that has been integrated into a number of different tools but the generic nature of the ideas mean the actual version implemented differs greatly from tool to tool.
Evidence of successful application of the method/tool/technique	Considerable evidence of successful use of the tool.
The required level of expertise to apply the technique: is it relatively easy to understand and use? Is specific training needed?	There are different flavours of Barrier Analysis – the basic concepts are easy to pick up but training is offered by a range of companies to use the approach in conjunction with other techniques such as MORT or FTA.
The degree to which the technique lends itself to reviewable documentation	In most instances the products of Barrier Analysis are easy to comprehend and can be represented in a range of visual forms, even for complex systems.
The consistency of the technique, such that if used on two occasions by independent investigators, reasonably similar results are derived	It remains a relative subjective approach – there are choices to be made both in the nature of appropriate barriers – technological, procedural etc and also where they might be deployed in design or where they failed in an accident hence some disagreement might be expected -
Any restrictions on application, e.g. problem scale, generality, accuracy, ease of use, cost, availability, maturity, use of resources, data requirements, etc.	Barrier analysis is amongst the most mature techniques for accident investigation and has many benefits in terms of the number of case studies and training courses.
Do the tools and techniques provide equal benefits for both small and large member states?	In this case, training investments for smaller organisations are probably justified in terms of the benefits reported by previous applications of the approach.
Do the tools and techniques provide support for all aspects of a failure (Human, organisational, technical) in equal measure or must they be integrated with other approaches?	In it's generic form Barriers take many forms – including procedural and organisational although there is controversy about how much we can rely on these and other human factors measures.
Can the tools and techniques provide credible support for the future requirements given increasing complexity and integration in railway operations?	Yes, barrier analysis remains a significant approach as a precursor to some more recent ideas in resilience engineering and so will most likely offer support into the

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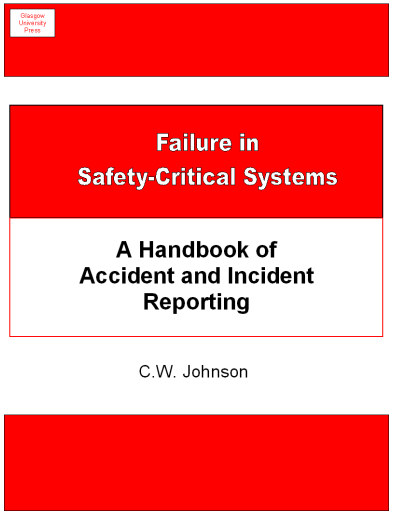
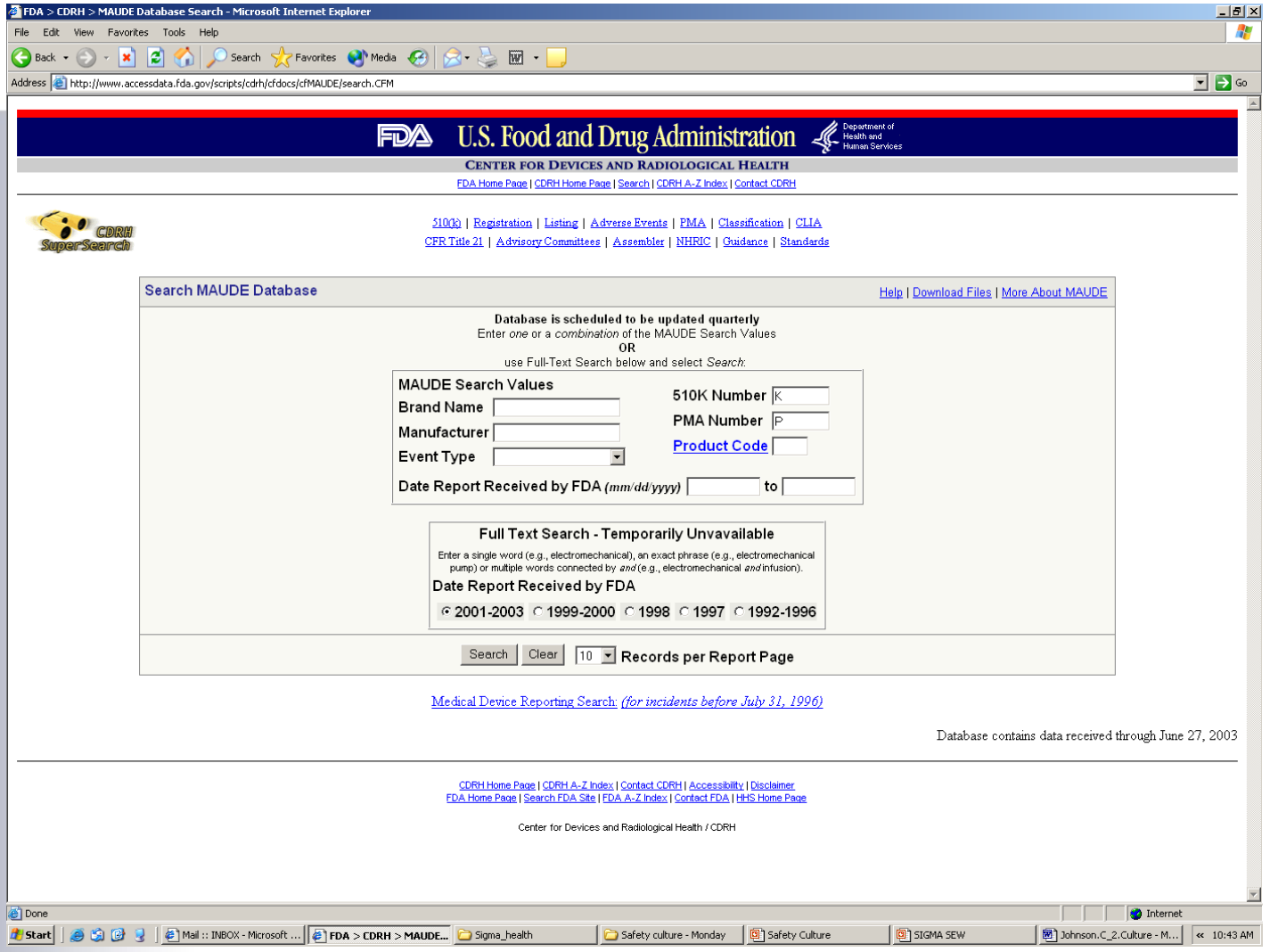
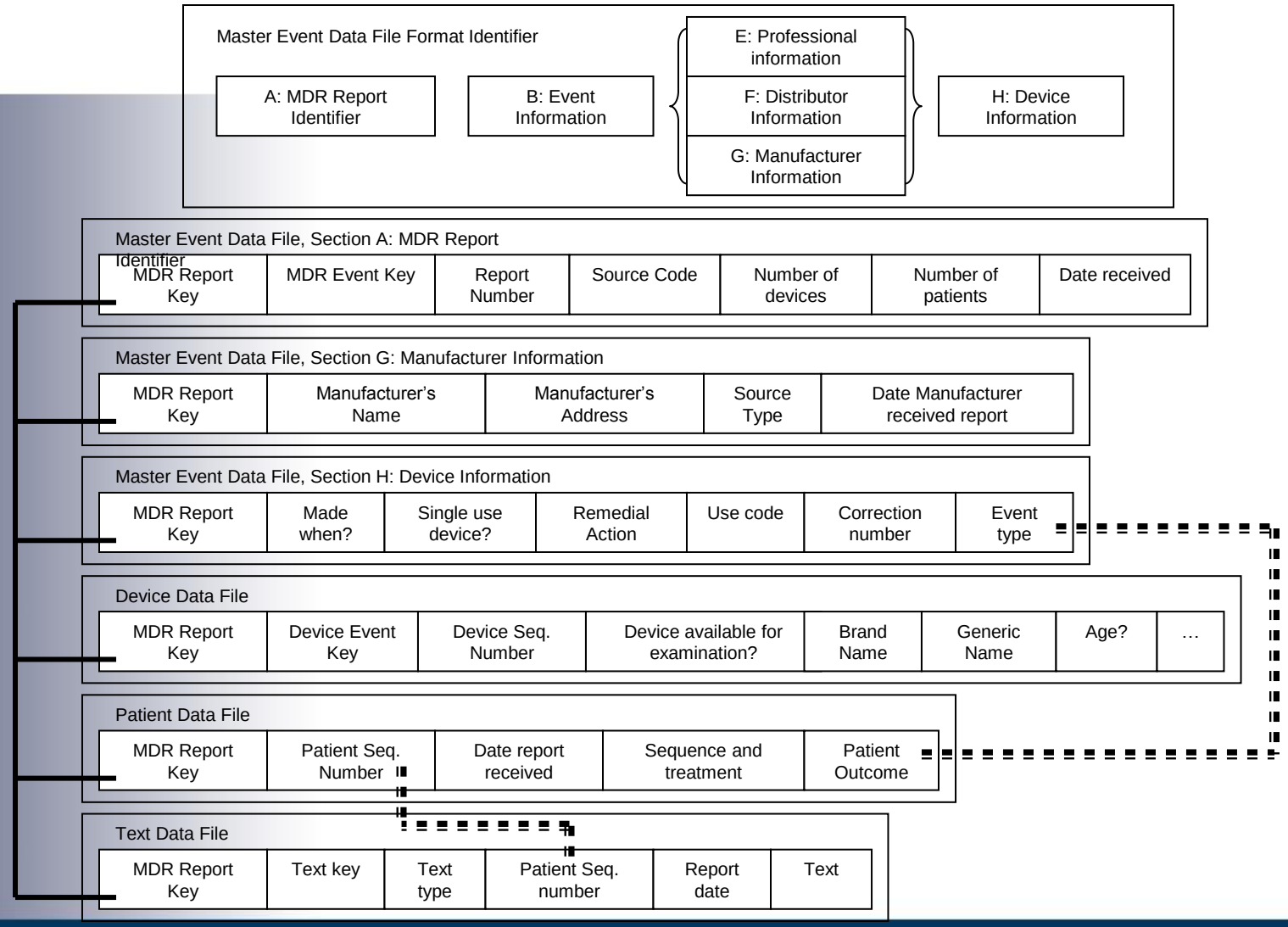
http://www.dcs.gla.ac.uk/~johnson/book



European Complacency

North American Complacency




Master Event Data File Format Identifier
A: MDR Report Identifier
B: Event Information
E: Professional information
F: Distributor Information
G: Manufacturer Information
H: Device Information
Master Event Data File, Section A: MDR Report Identifier
MDR Report Key
MDR Event Key
Report Number
Source Code
Number of devices
Number of patients
Date received
Master Event Data File, Section G: Manufacturer Information
MDR Report Key
Manufacturer's Name
Manufacturer's Address
Source Type
Date Manufacturer received report
Master Event Data File, Section H: Device Information
MDR Report Key
Made when?
Single use device?
Remedial Action
Use code
Correction number
Event type
Device Data File
MDR Report Key
Device Event Key
Device Seq. Number
Device available for examination?
Brand Name
Generic Name
Age?
…
Patient Data File
MDR Report Key
Patient Seq. Number
Date report received
Sequence and treatment
Patient Outcome
Text Data File
MDR Report Key
Text key
Text type
Patient Seq. number
Report date
Text

US and North American Complacency: Data Mining

SPAD Visualisation

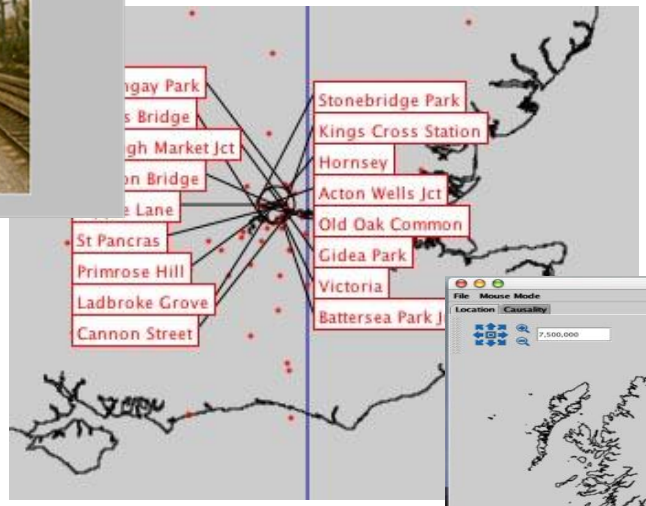
Description of location of signal SN109

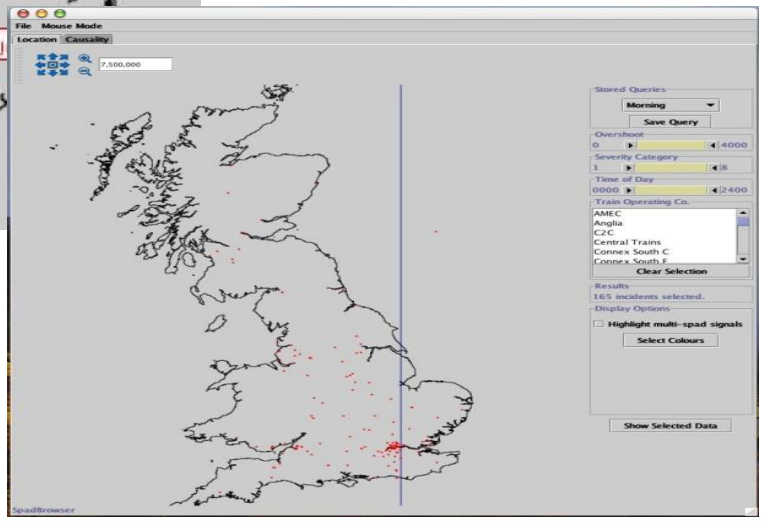
SN109 signal is located on Gantry 8 at Ladbroke Grove and applies to line 3 in the Down direction. The signal is out of use at present following the Ladbroke Grove accident.

Summary of SPAD history of signal SN109

9 SPADS have occurred since 1993 (8 since 1/4/1994)

02/08/1993 - misjudgement
13/02/1995 - misread
15/03/1996 - disregard
23/06/1996 - disregard
03/04/1997 - misread
04/02/1998 - disregard
06/08/1998 - disregard
22/08/1998 - disregard
05/10/1999 - not categorised





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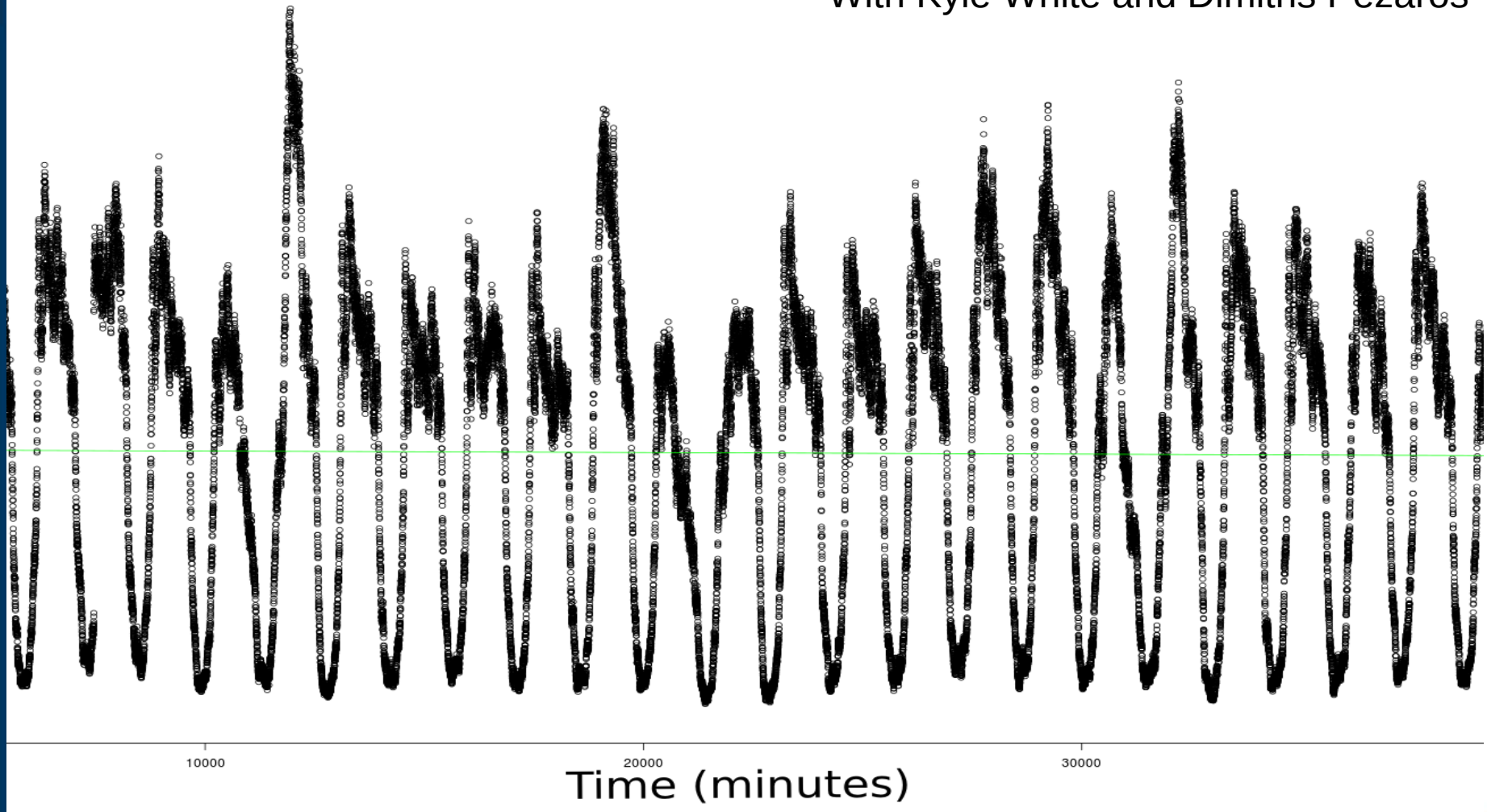
Now for Something Completely Different 1

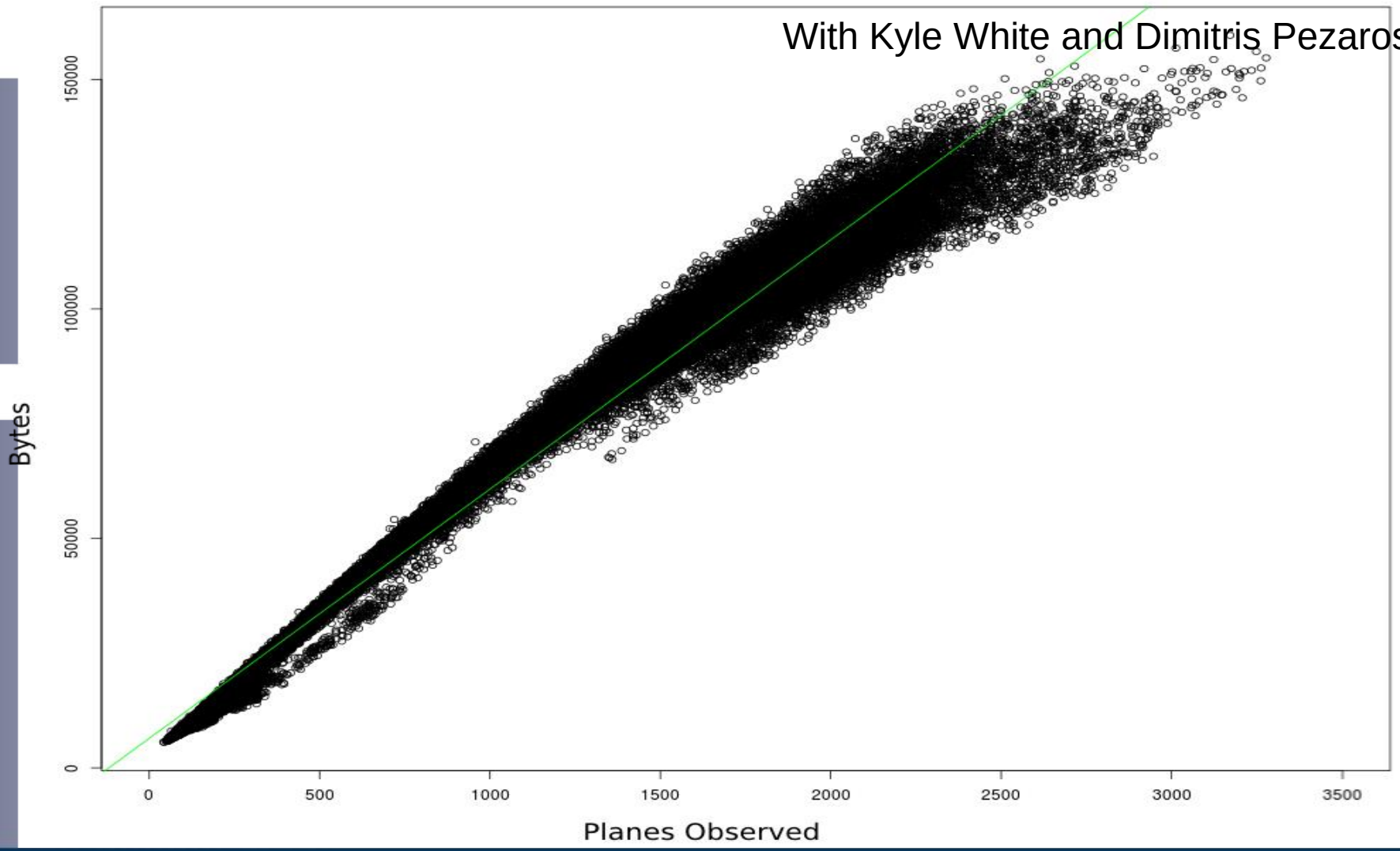
One Month of Radar Targets in an ACC

With Kyle White and Dimitris Pezaros



Number of Radar Targets-Bytes over Network

With Kyle White and Dimitris Pezaros



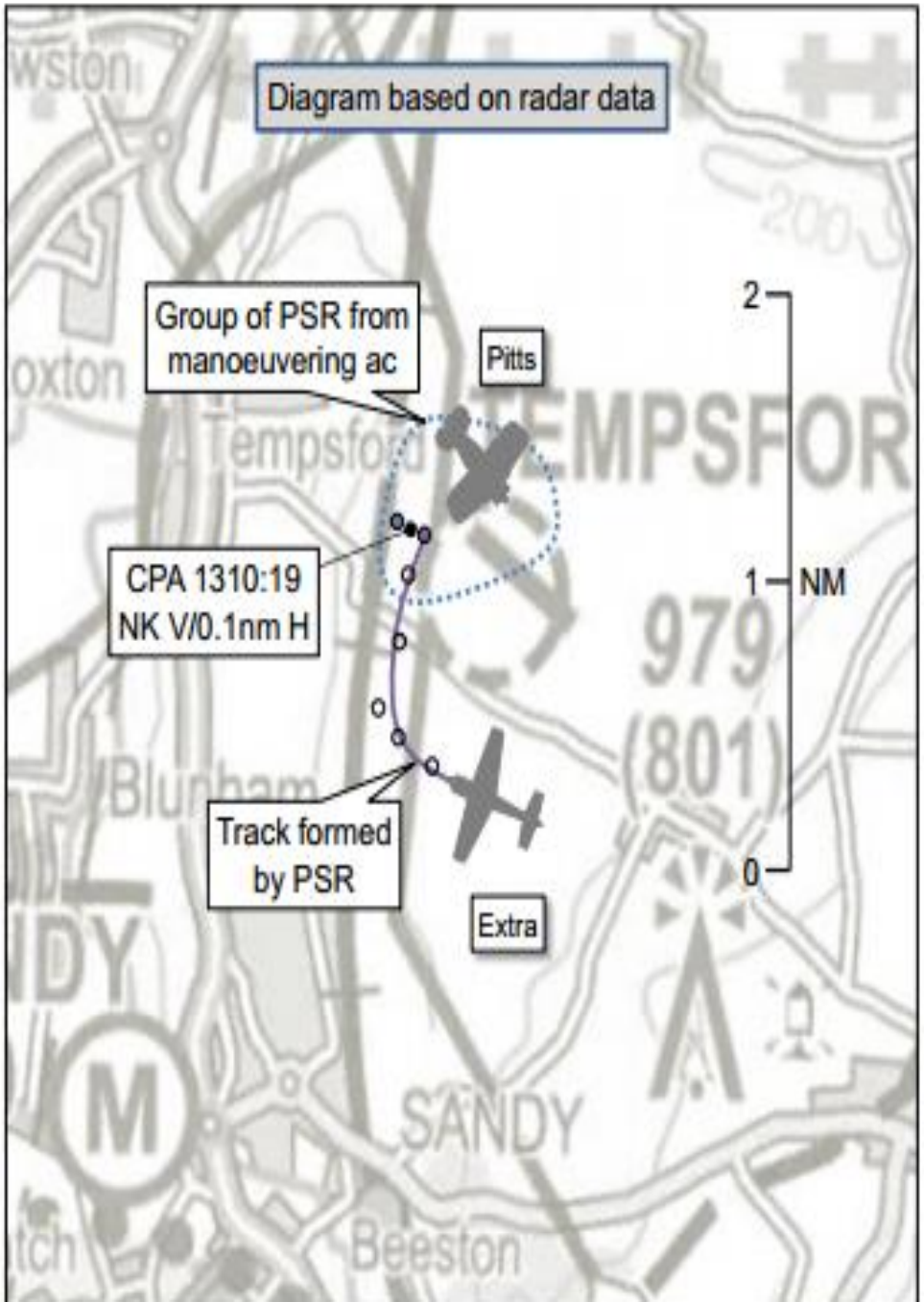
AIRPROX REPORT No 2013158

Date/Time: 10 Nov 2013 1310Z (Sunday)

Position: 5210N 00016W (3.7nm S St Neots)

Airspace: Lon FIR (*Class*: G)

	Aircraft 1	*Aircraft 2*
Type:	Pitts	Extra
Operator:	Civ Pte	Civ Pte
Alt/FL:	1800ft NK	3000ft QFE (NK hPa)
Conditions:	VMC	VMC
Visibility:	>10km	>10km
Reported Separation:	0ft V/30-100m H	500ft V/500m H
Recorded Separation:	NK V/0.1nm H	



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Limitations

- Most ANSPs have AIRPROX replay tools.
- Many limitations:
  - Can be time consuming to retrieve data;
  - Cannot always trust the data when it is received;
  - Can be very hard to interpret the data;
  - Many data feeds not integrated in simulations;
- Want to increase flexibility:
  - Hard to develop ‘worst case’ scenarios.
  - Hard to consider ‘plausible case’ scenarios.

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Visualisation and Simulation of Incidents

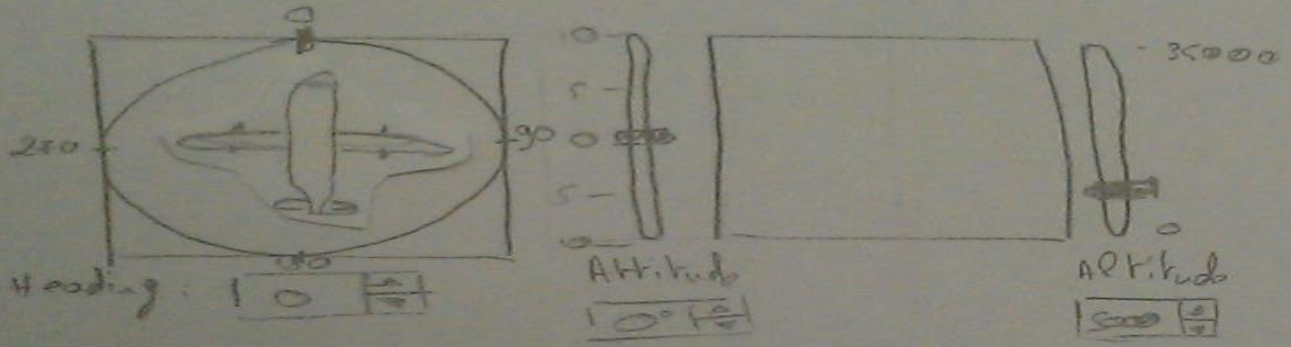
Your Scenario

Collision Place

Longitude: [ ] Latitude: [ ] Altitude: [ ]

Aircraft 1

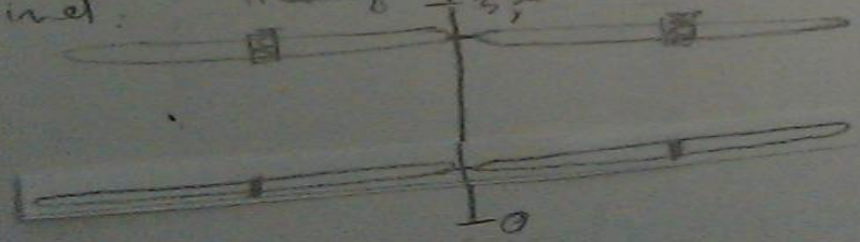
Type: [B747]



Aircraft 2

Weather

Wind: Heading for 35,000 speed



Add a wind Information

☐ Take weather forecast from this date: [ ]

ADS-B Data

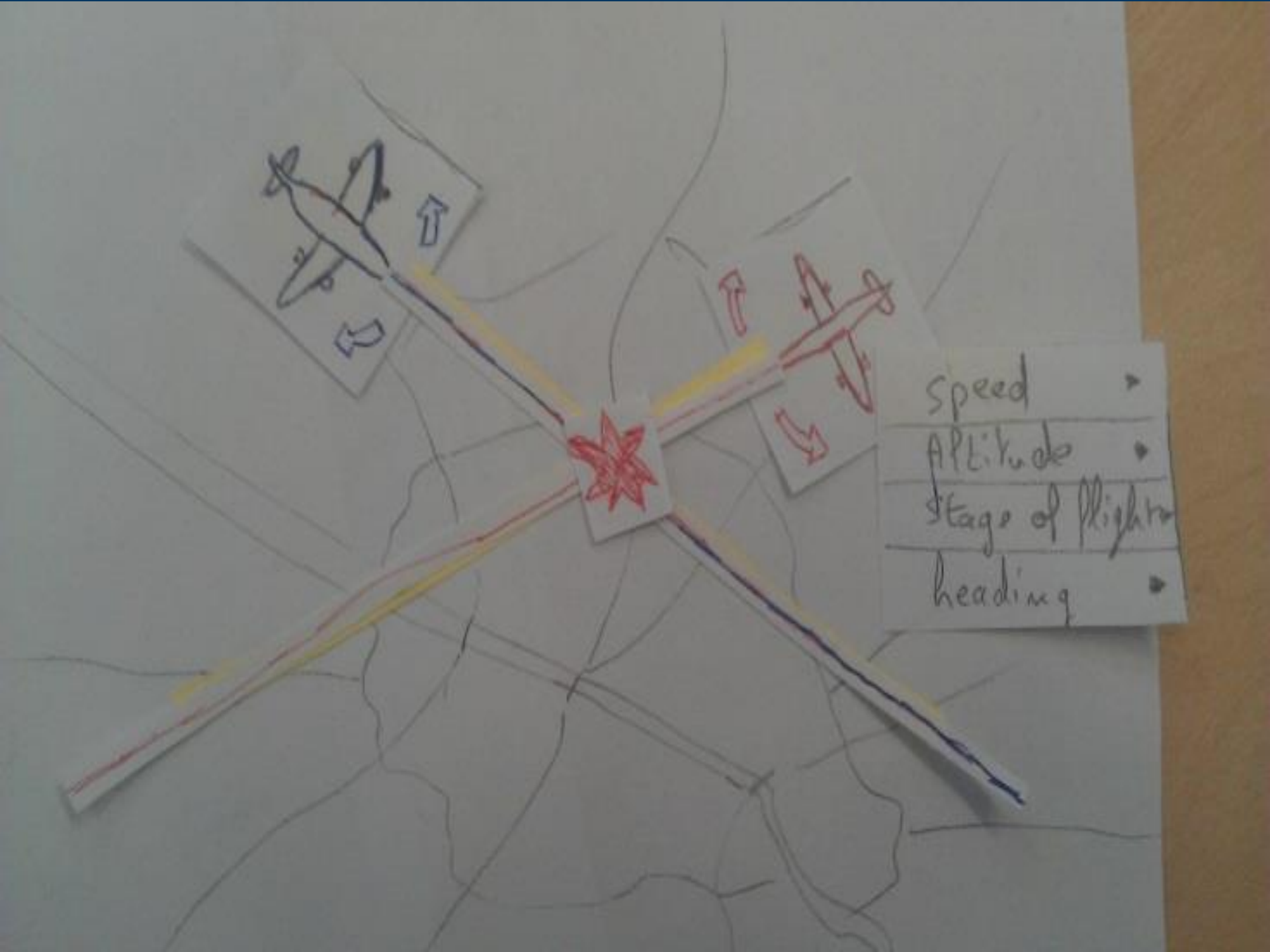
○ Take live data

○ Import data from this file:

[ ] Browse

Save the Scenario

Back | Start

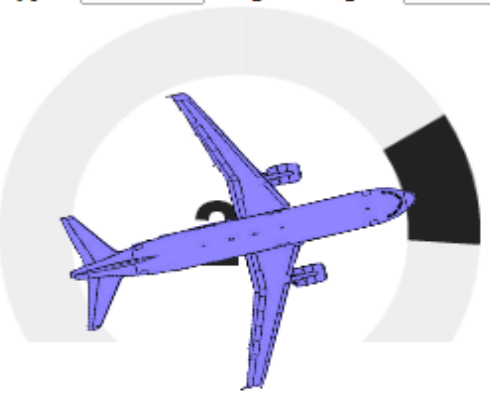

Speed
Altitude
Stage of flight
heading

Location

Longitude : Latitude : Altitude :

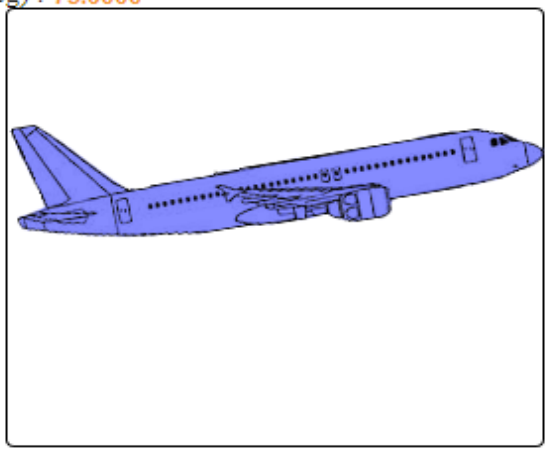
Aircraft 1

Type : B747 Stage of Flight : Cruise Standard Value



Heading (deg) : 75.6000

Altitude (ft) :



Attitude (deg) :

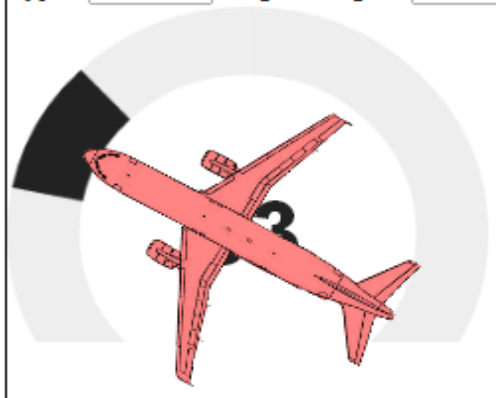
2678 10

Speed (kts) :

279

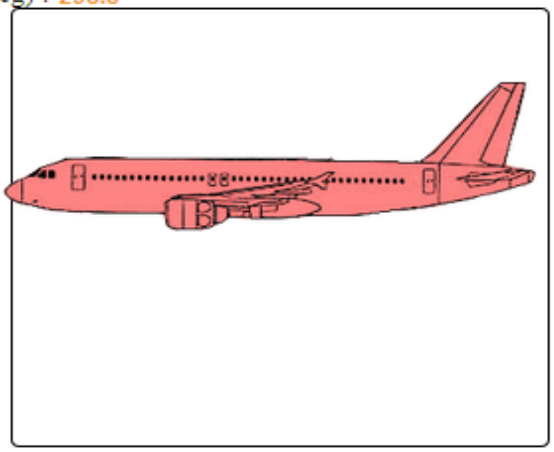
Aircraft 2

Type : B747 Stage of Flight : Cruise Standard Value



Heading (deg) : 298.8

Attitude (deg) :



Altitude (ft) :

0 2718

Speed (kts) :

298

Weather

Altitude (ft) Speed (kts) Heading (deg)

Add Wind Information

Take weather from this date :

ADS-B Data

Take live data

Import data from a file :

Choose File No file chosen

Save < Back Start >

Glasgow, UK

< Back Start >

ILS Approach and Airprox

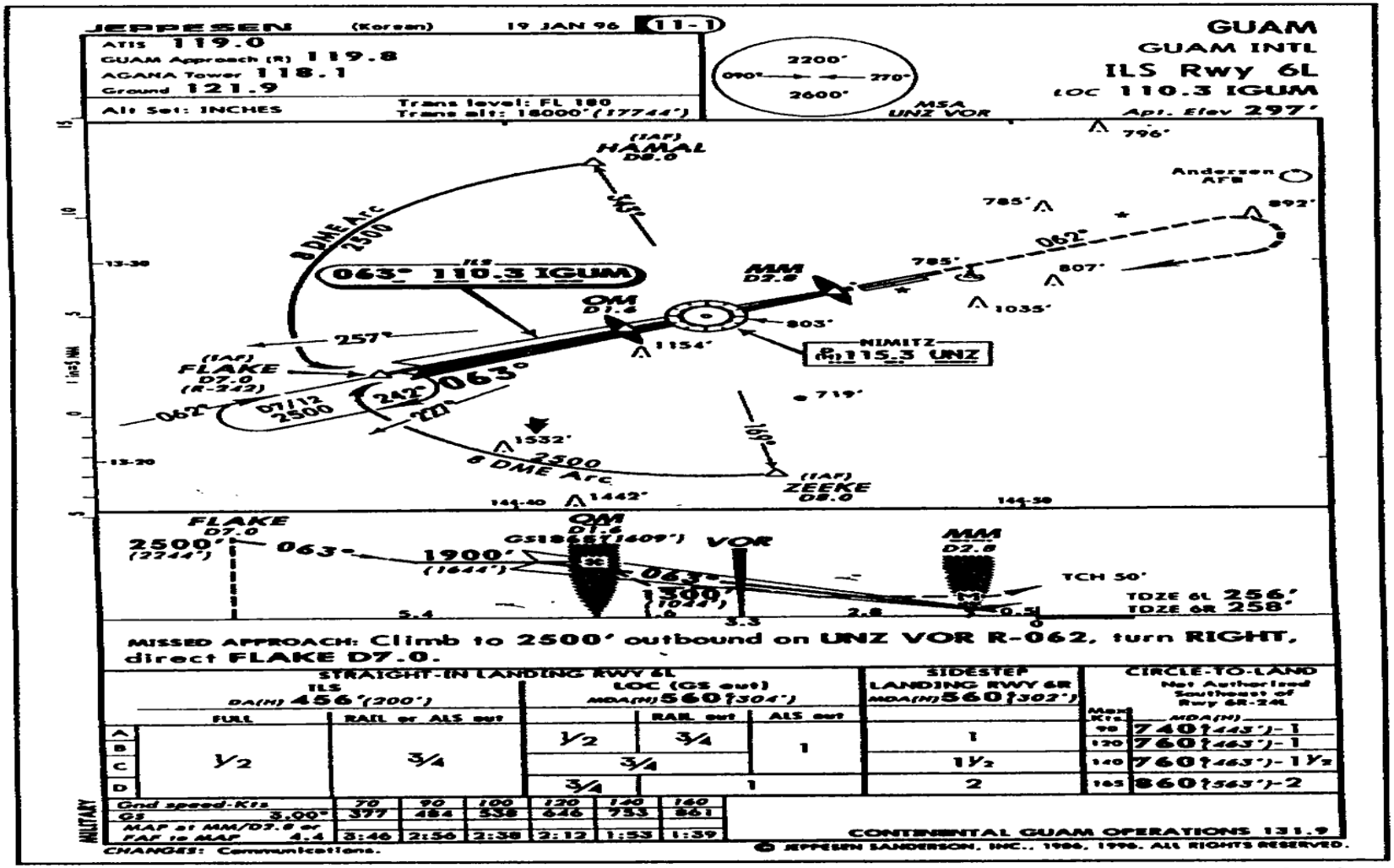
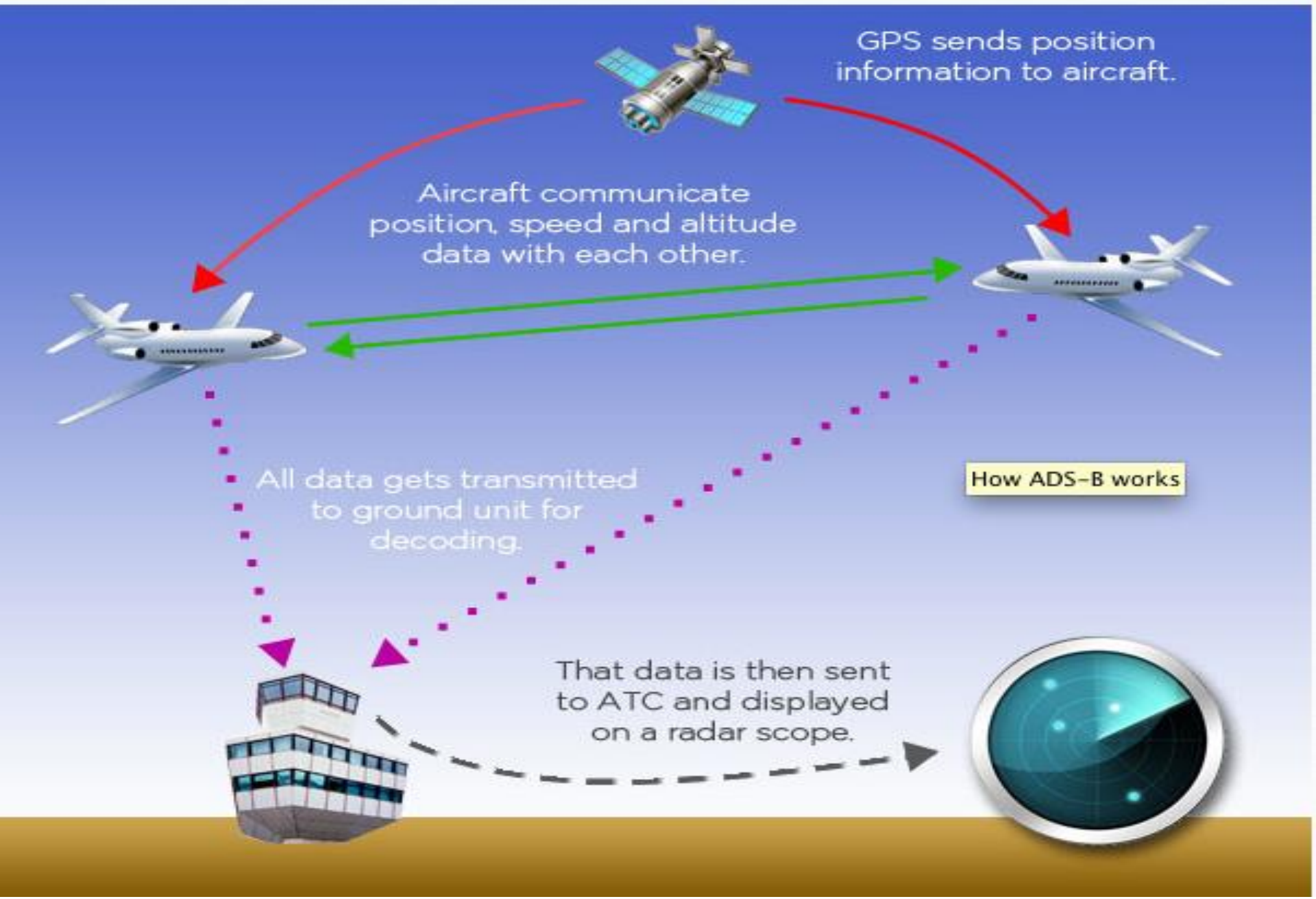


Figure 7. The January 19, 1996, 11-1 ILS runway 6L instrument approach chart.

Reproduced with the permission of Jeppesen Sanderson, Inc. NOT TO BE USED FOR NAVIGATION.



FAA: ADS-B Out compliance by January 1, 2020

Leeds-Bradford Airport - Runway 32 Approach Public Safety Zone Map

Boundary of area subject to individual risk of 1 in 10,000 per yr or greater

Boundary of Public Safety Zone

N

0 200 400 600 800 1,000 Metres

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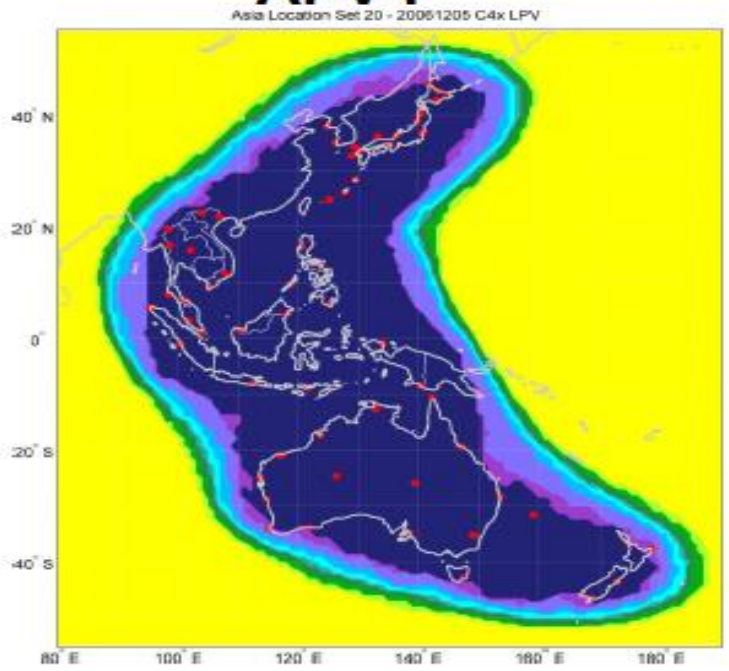
MSAS: Multi Function Satellite Augmentation System

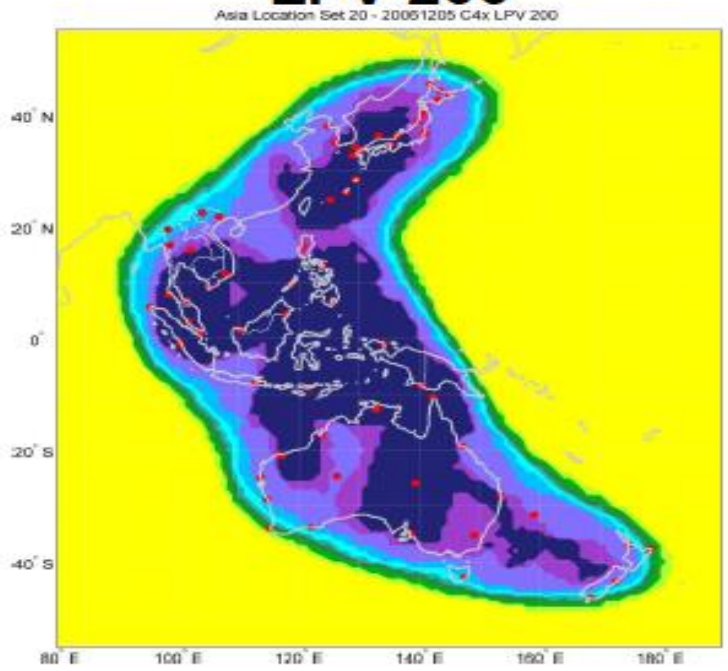
Raytheon's Expansion Study for MSAS Asia (2006 December 5)

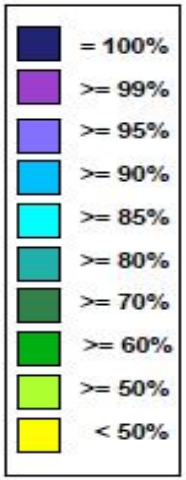
Raytheon
Network Centric Systems

APV-I



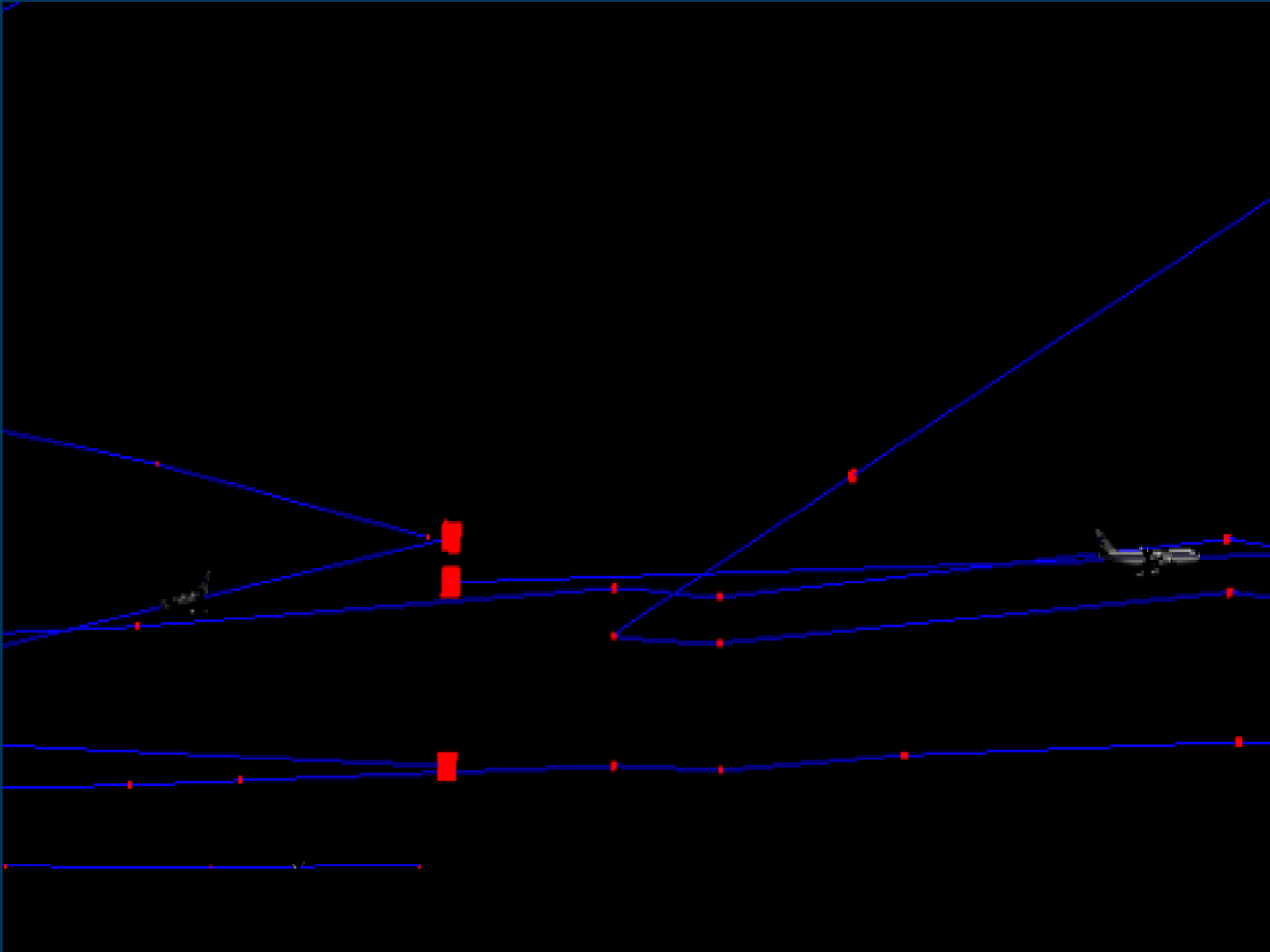
LPV 200





MSAS + Asia Station Configuration - 61 Stations

- Japan – 16 stations (C4x)
- Australia – 16 stations (1 from existing MSAS station)
- New Zealand - 4 stations
- Vietnam – 4 stations
- Philippines – 4 stations
- Singapore – 1 station
- South Korea – 2 stations
- Thailand – 5 stations
- Malaysia – 3 stations
- Indonesia – 6 stations



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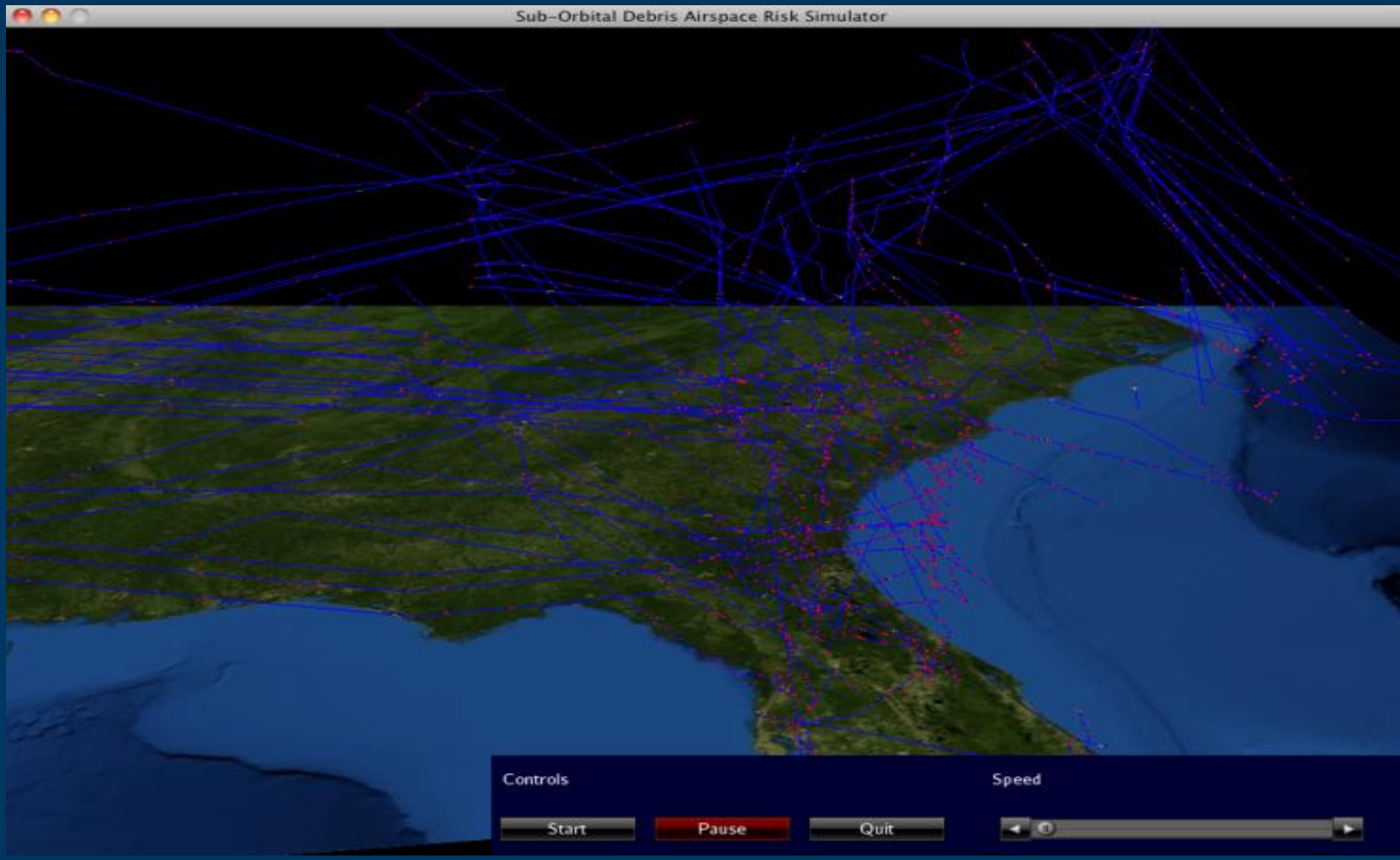
Visualization 2



Runway Planning

- 4 October 1992, El Al Flight 1862.
  - Boeing 747 El Al cargo plane;
  - Hits Groeneveen and Klein-Kruitberg flats.
- 43 killed:
  - 4 crew, 39 people on the ground
- Worst aviation accident in Netherlands:
  - plane exploded, starts large fire after the crash.

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Runway Planning

- Lockerbie, 21 December 1988.
  - Bomb killed 243 passengers, 16 crew.
  - Killing 11 people on the ground.
- Extend simulator to debris modelling.
- Integrate with GIS and population models.
- Safety of additional runway at Heathrow?

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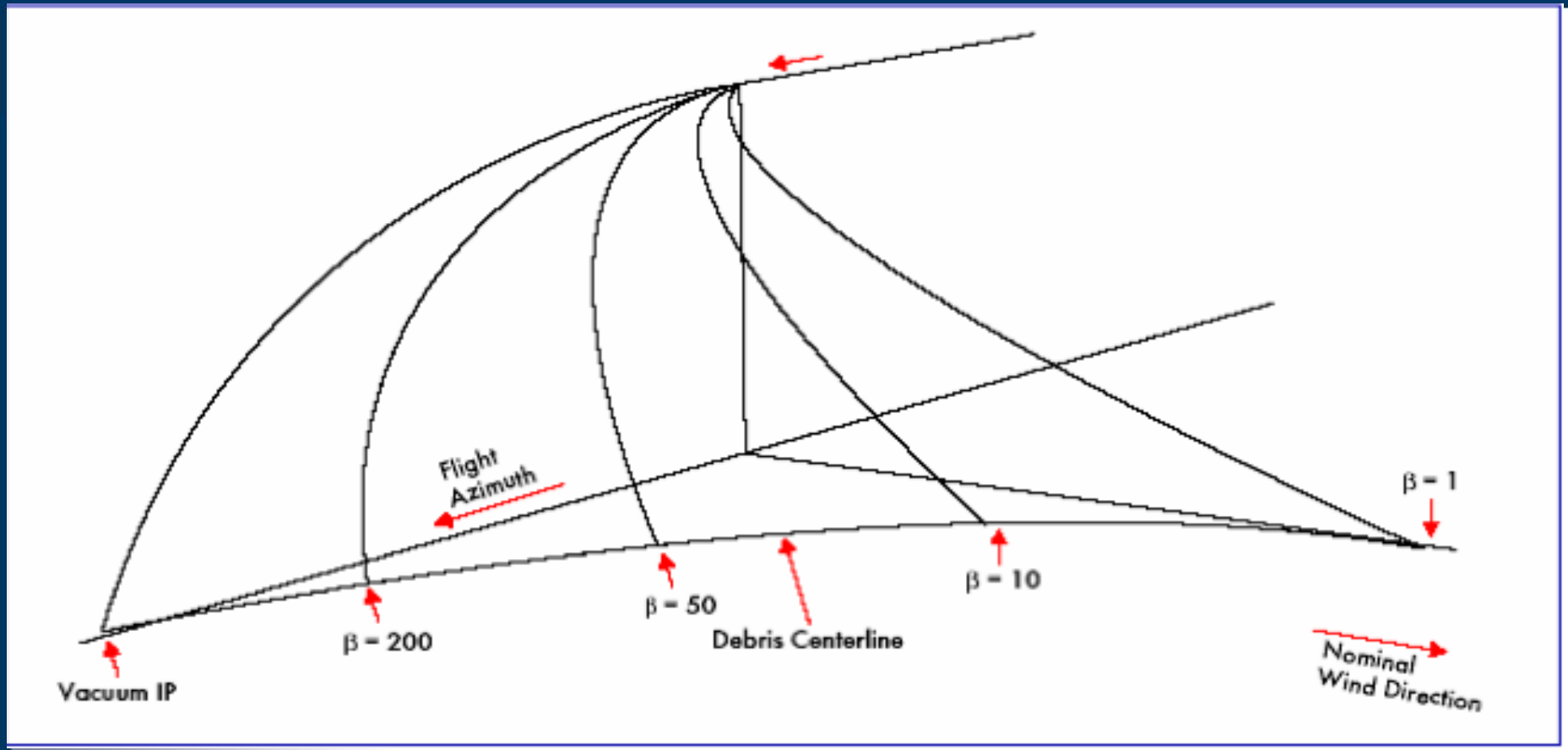
Debris Model



- The influence of the ballistic coefficient, β , and wind upon debris impact points

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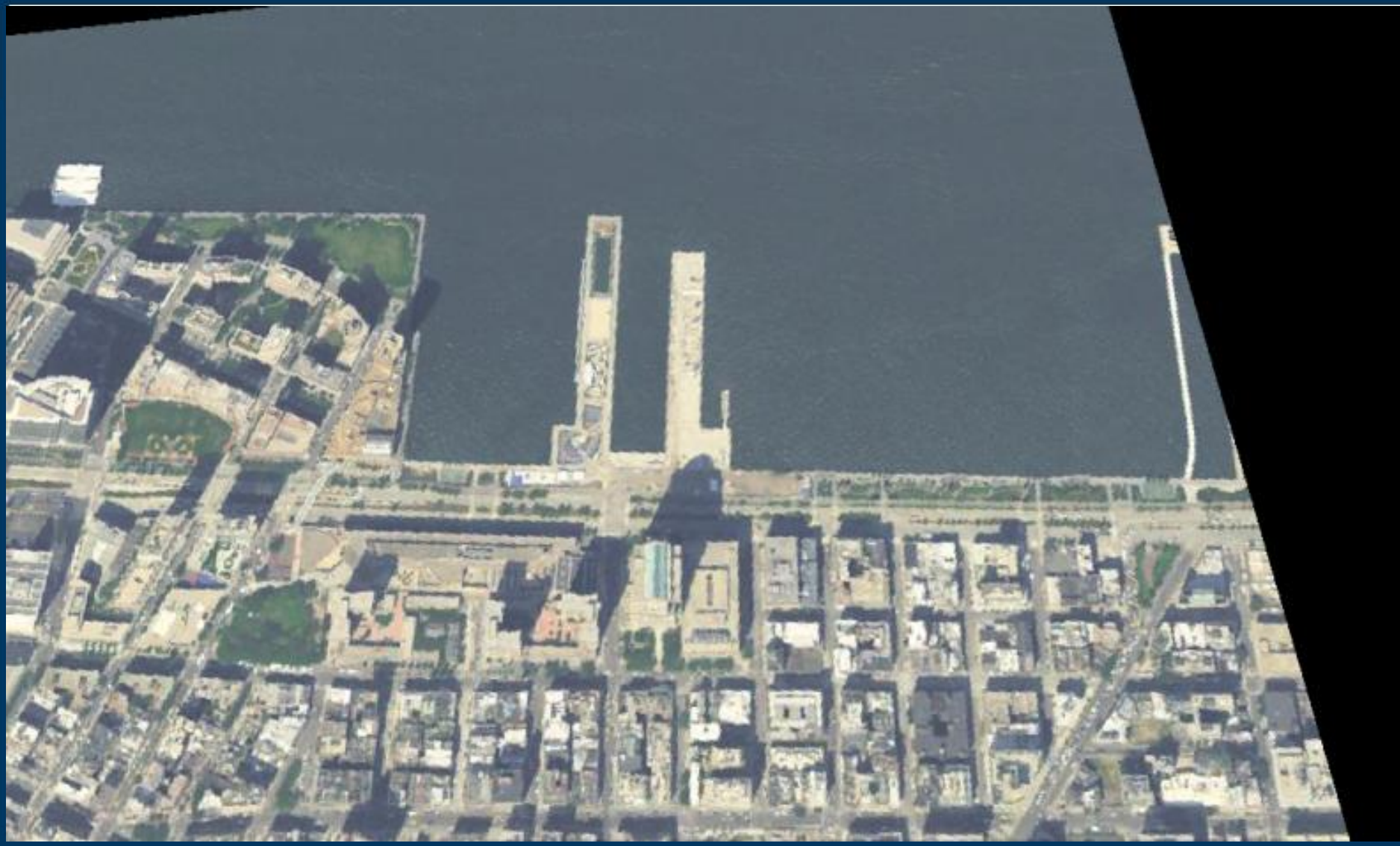
Mapping Down to the Ground



Results:

Number of Aircraft in the Airspace: 10

Number of Aircraft hit by the debris: 0

Length of Debris Footprint: 5000 ft

Width of Debris Footprint: 200 ft

People at Risk: 1200

Nearest sensible site: 200 ft

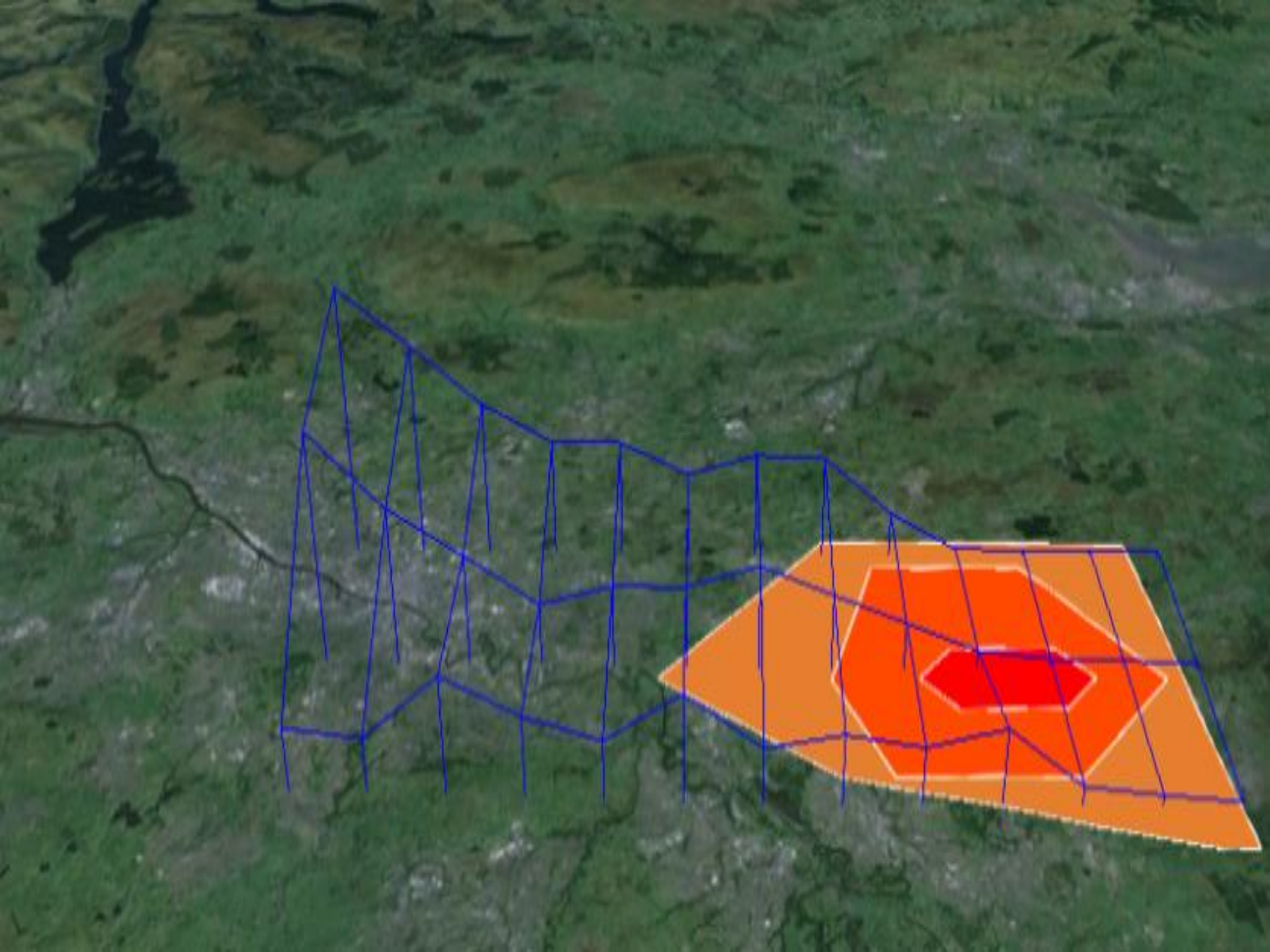
(Hospital of Glasgow)

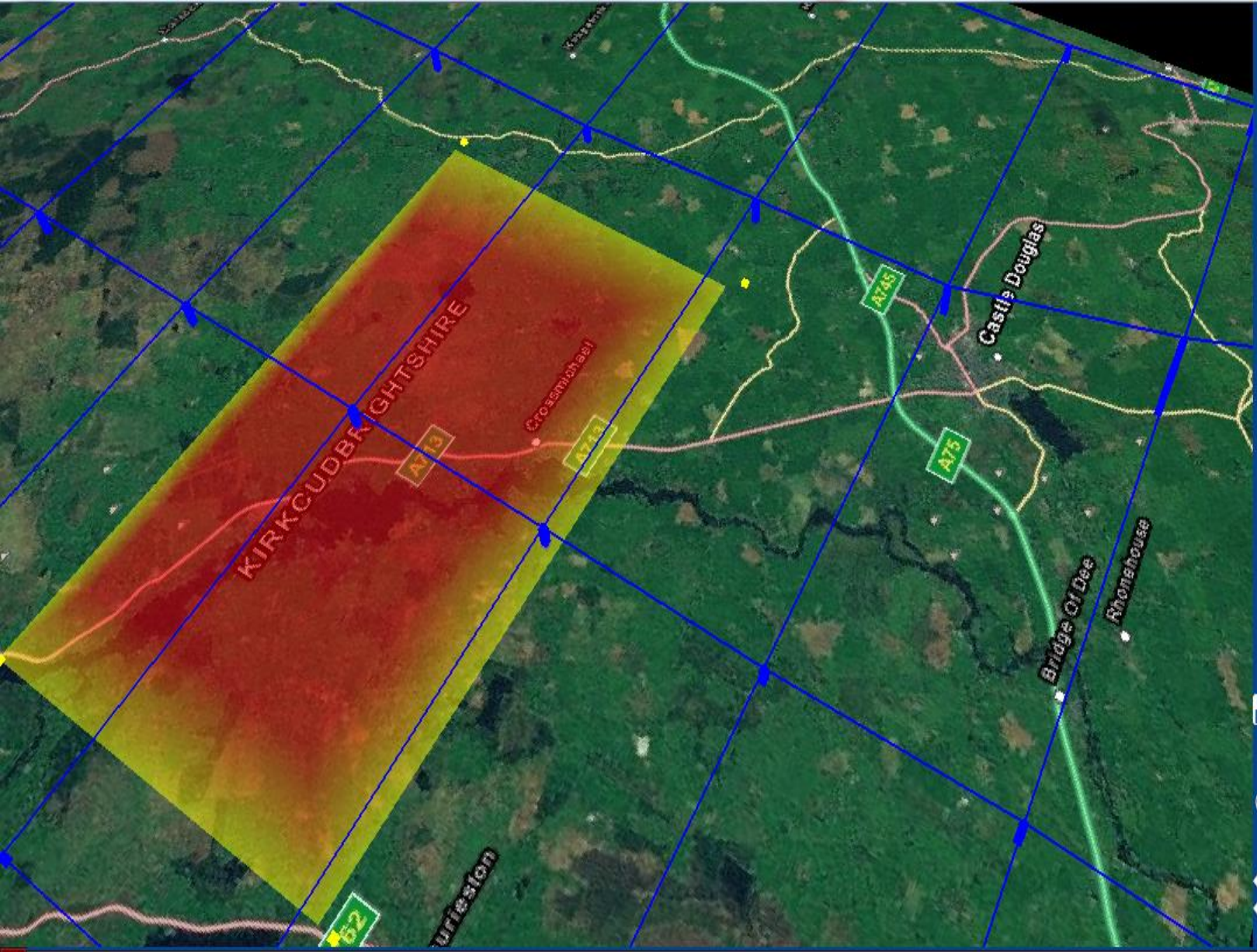
Save the results

Export to Google Map

Back to the scenario

Quit to the main menu





Results :
Number of Aircrafts in the Airspace : 10
Number of Aircrafts hit by the debris : 0
Length of debris field : 500 ft
Width of debris field : 500 ft
People at risk : 100
Nearest sensitive site : Hospital of Glasgow

Save the results

Export to Google Earth

Quit

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Part Two: Extensions

- Environmental modeling (Noise and Fuel).
- Only matters if there are people to hear it?
- Population based models (eg factories).
- Routes to minimize population impact…

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Now for Something Completely Different 2


WINDOW JETTISON HANDLE PIN
REMOVE BEFORE JETTISON


2
3

LOGIN

HOME
NEWS »
THE NEW FRONTIERS
SCOTLAND IN SPACE
REGIONAL POTENTIAL
LOSSIEMOUTH
DEVELOPMENT SPIN-OFF
A GALLERY OF MORAY
FLYING SCOTSMEN

Scotland's great opportunity

News Headlines

- Moray engineer tracks new satellite
- Scottish-built satellite launch today
- Falcon flying, Cygnus supplying
- New European centre refashions the dream
- Mining asteroids – plans to be announced

Aviation Law

- Chicago Convention (1944):
  - State sovereignty over airspace (but no upper limit?);
  - “any machine that can derive support in the atmosphere from the reactions of the air other than the reactions of the air against the earth’s surface”.
- Montreal/Warsaw Conventions:
  - companies liable for injury/delays to passengers;
  - Only applies to international flights not spaceports.
- **Kármán line** altitude of 100 km (62 mi) ASL.

US Space Law

- Space launch Act (1984).
- Commercial Space Launch Amendment Act.
- FAA Office of Commercial Space Transport:
  - licensed approximately 200 launches
  - operator licenses for 8 commercial spaceports.

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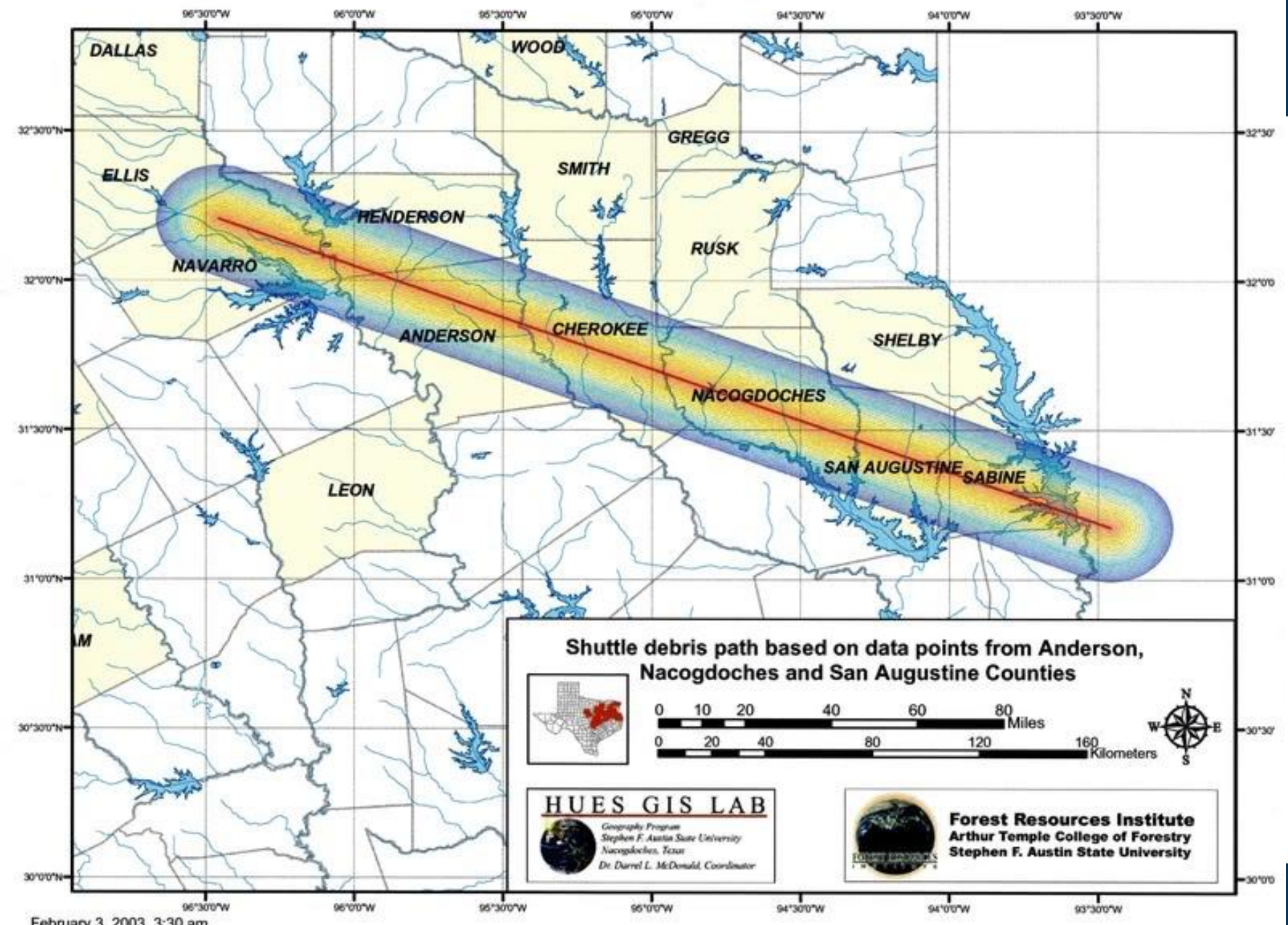
European Space Law

- European Aviation Safety Agency, EC 216/2008:
  - Certification & means of compliance, not legally binding;
  - Extensions to type certificates for sub-orbital aeroplanes;
  - If they derive support from the atmosphere.
- Contrasts with FAA license based approach;
  - Criticise EASA certification as ‘premature’ and costly.
  - Virgin Galactic, FAA in New Mexico, EASA in Kiruna, Sweden;
  - XCOR Aerospace launch from Curacao.
  - ‘Constituent country’ of the Netherlands but outside EASA;
- But it’s a mess

East Texas



February 3, 2003, 3:30 am

To run a new simulation please enter or select the simulation data

Aircraft Vehicle Data	VG SS2	Add	Help
Aircraft Vehicle Data 2	VG SS2	Add	Help
Aircraft Flight Data	FP1	Add	Help
Aircraft Vehicle Data 2	FP1	Add	Help
Location	New York	Add	Help

Use Satellite Imagery (Max zoom 11 outside USA) ☑

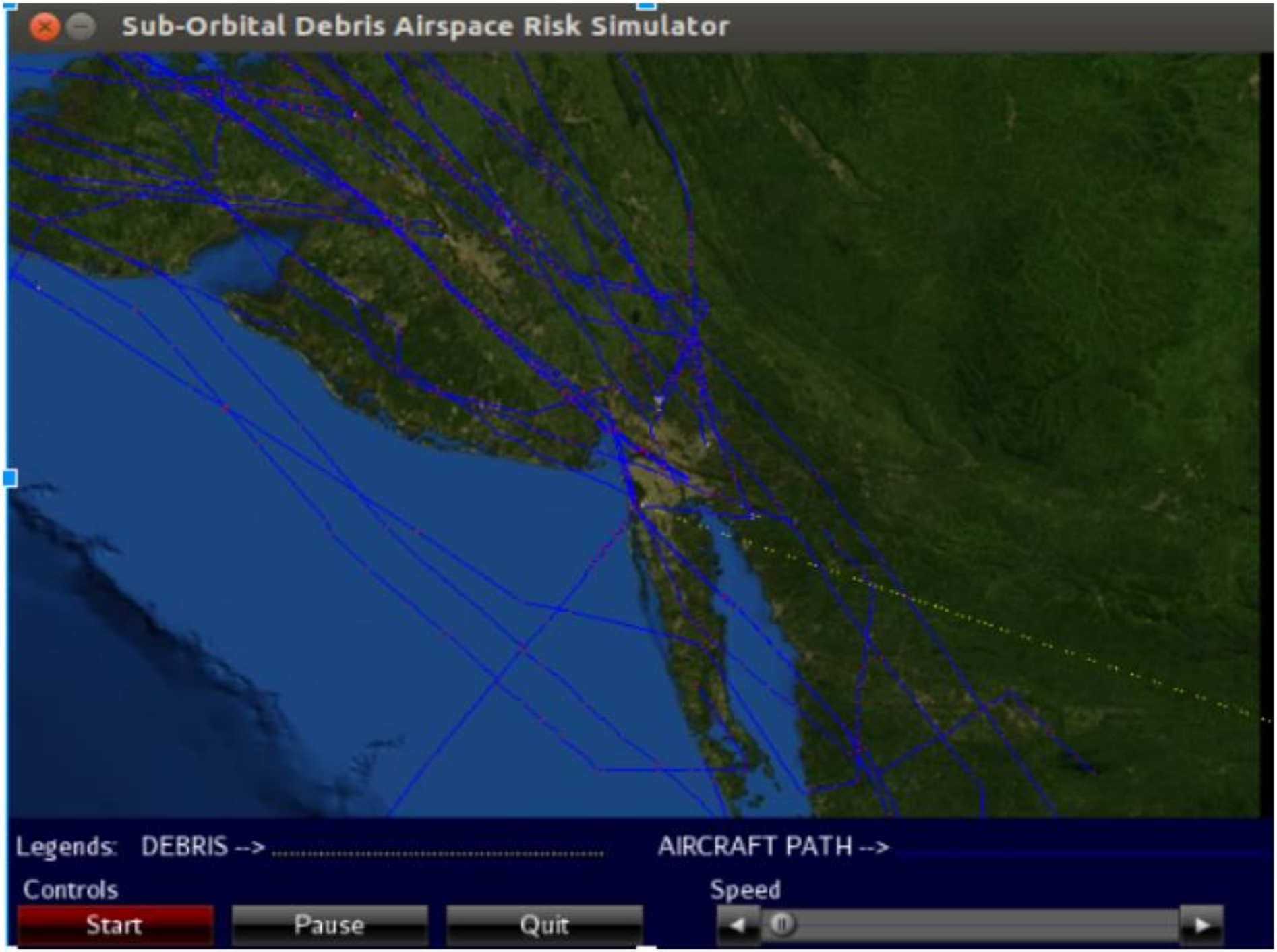
Use Image of Glasgow ☐

Zoom Level 7

Show Waypoints ☑

Import Flight Data File Import

Start Back


Sub-Orbital Debris Airspace Risk Simulator
Legends: DEBRIS -->
AIRCRAFT PATH -->
Controls
Start
Pause
Quit
Speed

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Recap: Optimistic Overview

- Investigations little changed in 50 years.
  - Lots of tools – almost totally ignored;
  - Islands of good practice but isolated.
- Fresh look with input from Europe & Asia:
  - Multiple information sources freely available;
  - Can we develop a new generation of software systems?
- From ADS-B to Debris and Suborbital ops…

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Any Questions?