Use of a Synthetic Environment to Support Acquisition

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Introduction

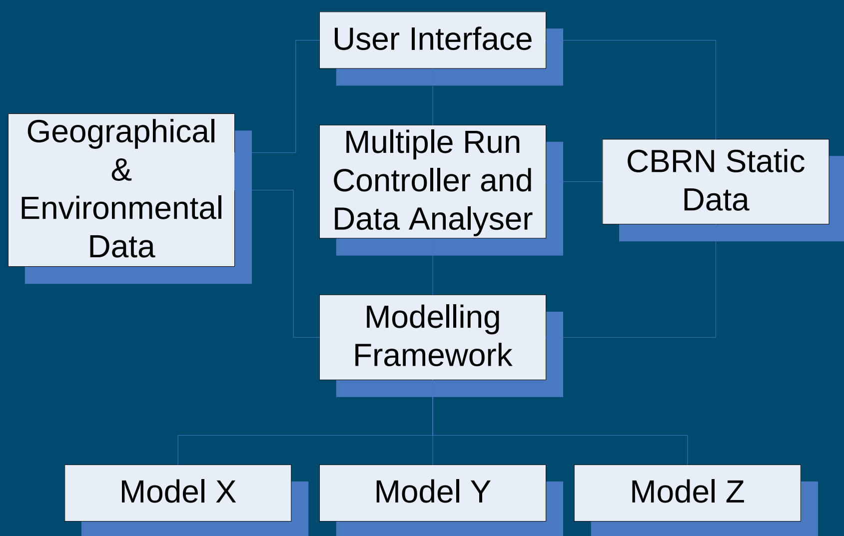
- There is a growing use of synthetic environments to augment laboratory and field experiments that support the acquisition of improved military capability
- The synthetic environments can be used in several ways
  - To make the initial business case for a new acquisition program or to identify new lines of development
  - To shape the research program
  - To test and evaluate equipment
- Dstl's Virtual Battlespace has been used to support the acquisition program in areas including
  - Biological area detection
  - Low-burden protective clothing

What is the Virtual Battlespace?

- A synthetic environment including (some under development)
  - State-of-the-art dispersion models (UDM & SCIPUFF)
  - Models of CBR defence system (detection, protection, MCMs)
  - Representation of movement of entities (aircraft, army units)
  - Links to combat & facility models (WISE, OneSAF, STAFFS)
  - Multiple run controller
  - Wargaming mode

The Virtual Battlespace Models

- Dispersion Modelling
  - CBR sources and hazard plumes (weapons, IEDs, RDDs, TICs & TIMs)
  - Urban and Rural (SCIPuff & UDM)
  - Concentration Realisation
- Meteorology
  - Terrain
  - Local Wind Turbulence
  - Sea Breeze



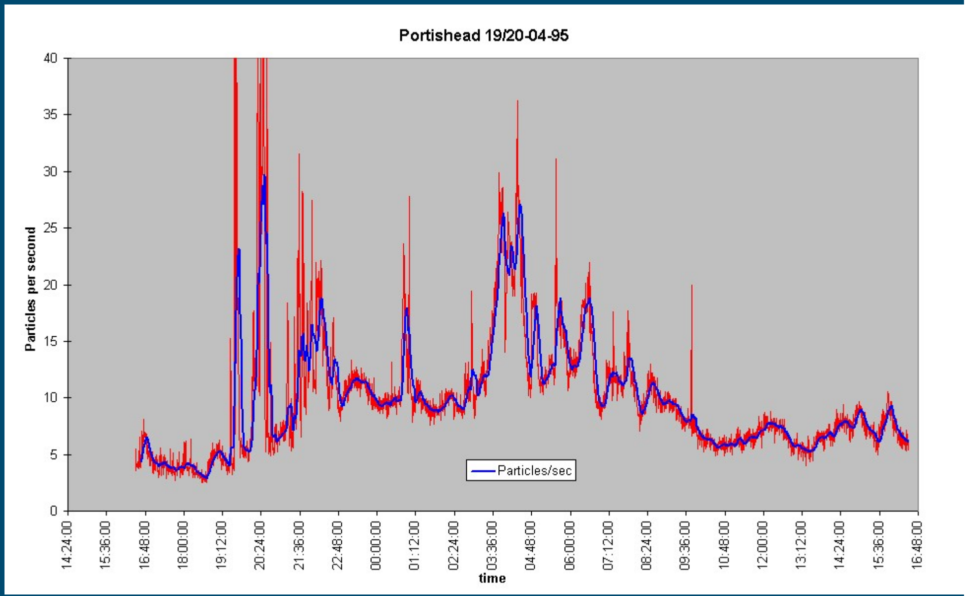
- Military Units/Personnel
  - Effects (casualties)
  - Inhalation & Contact Hazard (liquid pickup)
  - Medical Countermeasures
  - IPE
  - Physiological Burden
  - Aggregation
  - Value of Information
- Detectors
  - Simple (threshold)
  - Generic
  - Specific
  - Standoff
  - Biological Background
  - Single & Network Alarms
- Modes of Use
  - Wargaming
  - Assessment

Biological Area Detection

- Previous work on acquiring the Integrated Sensor Management System
- Now a soft OA workshop study will define the concepts of use for an area detection capability
- This will quantify capability provided by networks of generic, specific and stand-off detectors in the CBVB
- Two main aims of the work:
  - Guide the research programme by estimating the performance of current and planned detectors
  - Allow stakeholders to make informed decisions by demonstrating what is and isn't feasible

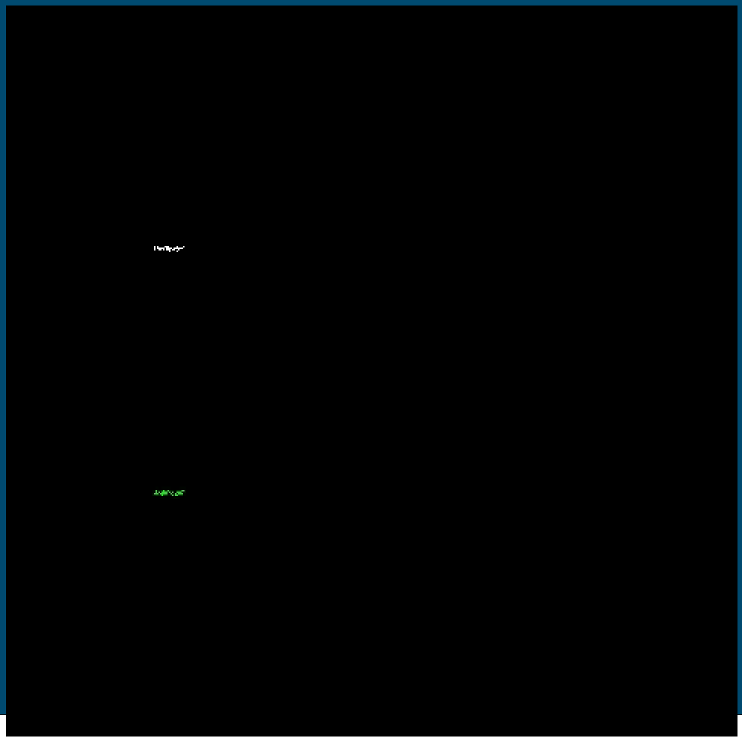
Integrated Sensor Management System (ISMS)

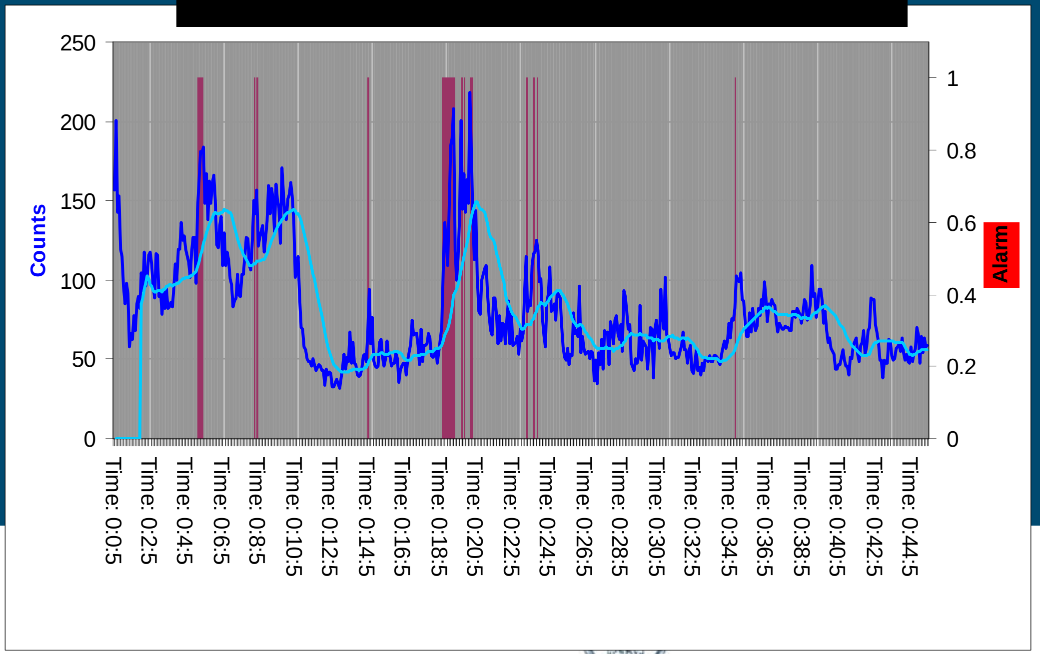
- Dstl supported the Defence Procurement Agency’s assessment of systems developed by industry
  - Field trials expensive; detectors not available
- Therefore the assessment carried out in the Virtual Battlespace
  - Realistic simulation of biological background & turbulent, meandering plumes



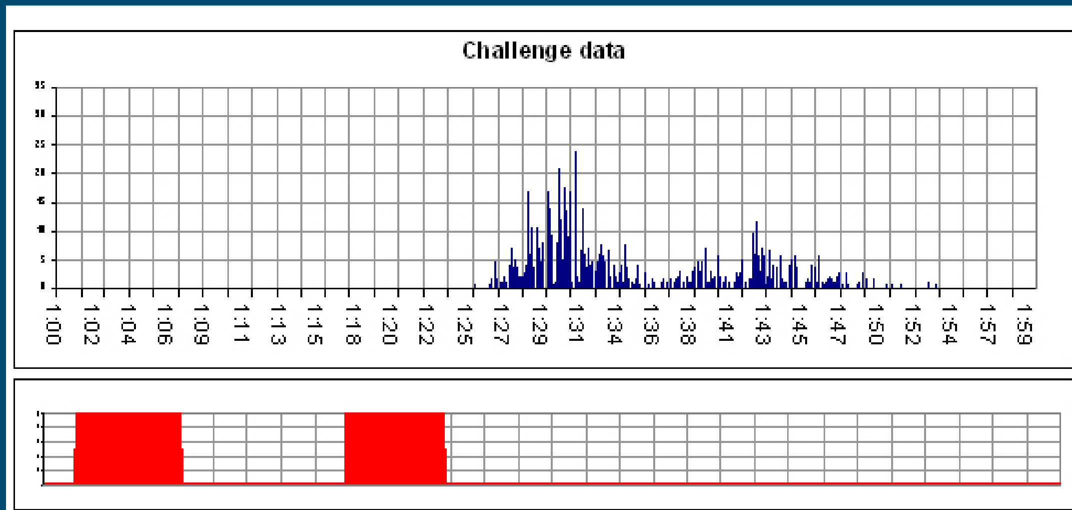
Modelling

- Meander turbulence model linked with UDM to provide a simulation of meandering plumes
  - required for realistic stimulation of detectors etc.
- Biological background model developed
  - based on field data
- Generic biological detector models developed
  - include measurement noise and sampling noise

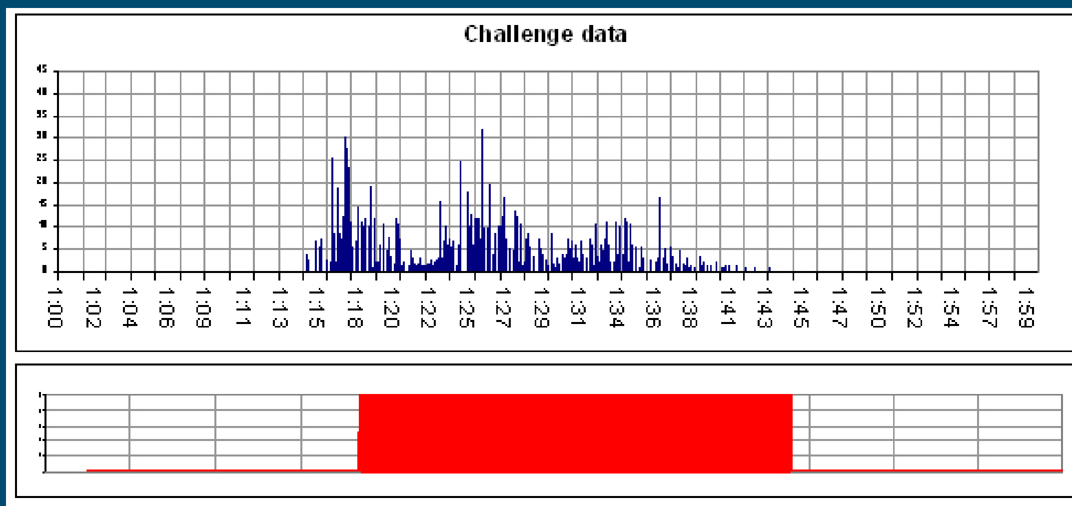




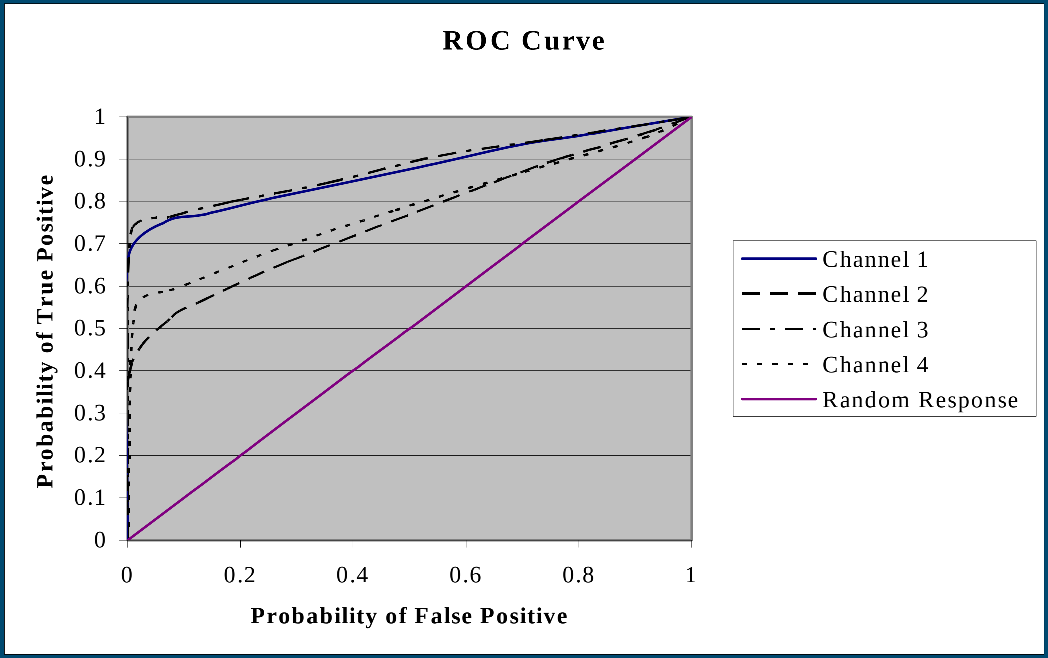
Outcome



- Successful study
  - Scored systems objectively
  - Guided number of sensors required
  - Assessed performance in difficult environments (rural, urban)



Sensor Networking



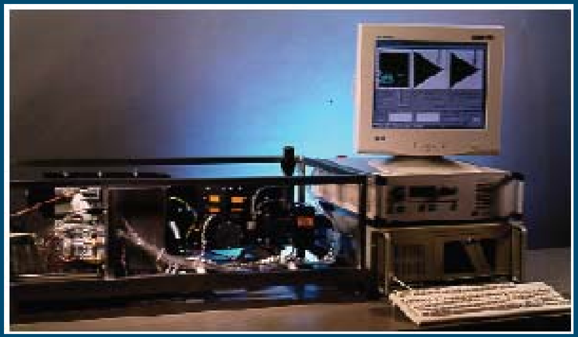
- Last year looked at networking WIBS1 sensors using GARCH
- WIBS1 network not sensitive enough but GARCH improved performance
- Plan to extend to other sensors and evaluate new and existing network fusion algorithms in the CBVB

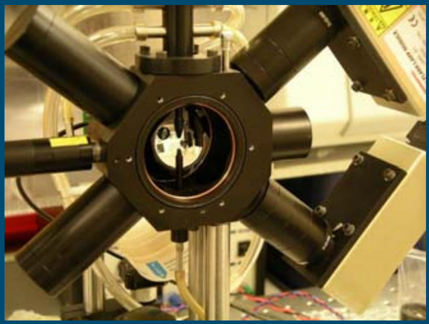
Task 1 – Improve ISMS Network Fusion

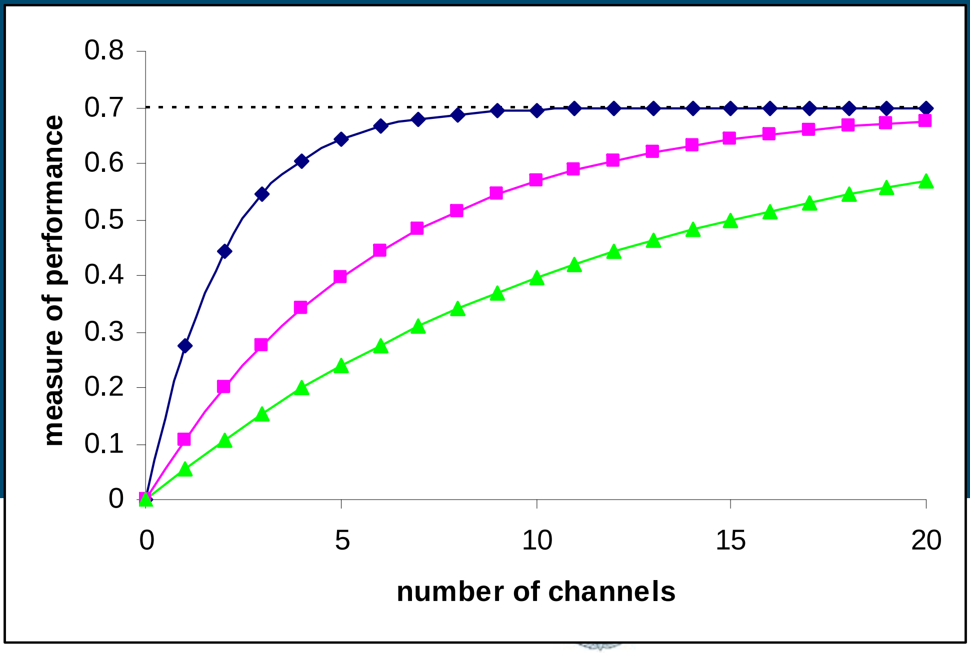
- ISMS uses the Biral VeroTect generic sensor & very simple network fusion algorithms
- GARCH network fusion algorithm shown to be effective on WIBS1
- Compare effectiveness of ISMS algorithm and GARCH against model of VeroTect
- Results to feed into ISMS incremental update in March '07

Task 2 – Find Optimal Generic Detector

- Lots of different generic detector prototypes
- How much size, shape and fluorescence information before we approach maximum performance of a generic detector?







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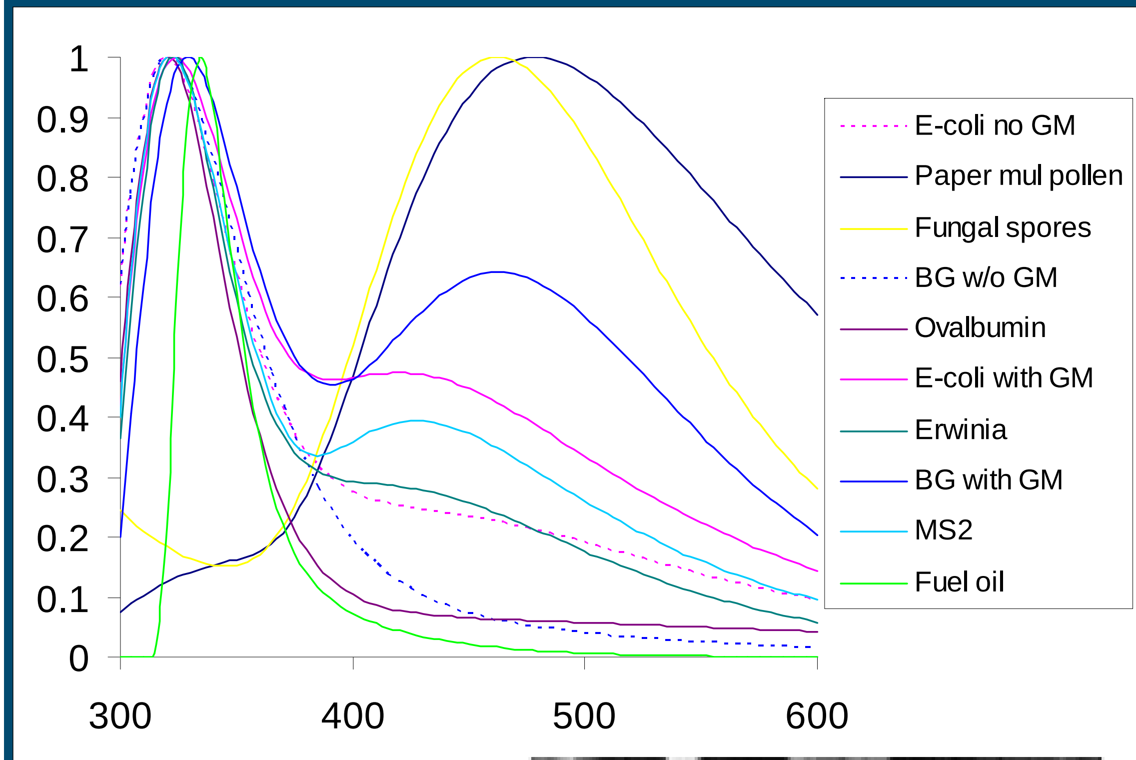
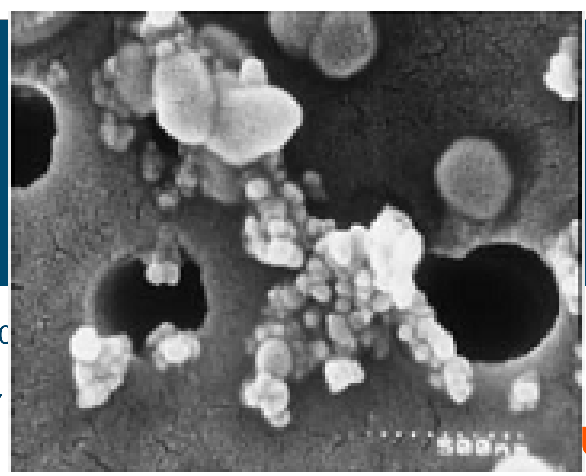
Task 2 – Find Optimal Generic Detector





- Size information important
- Fluorescence spectra contain 2-3 pieces of information
- Bulk fluorescence offers little discrimination – need fluorescence on a particle basis
- Crude shape information required (liquid spheres)

Aircraft & Aircrew CBRN Survive To Operate

- A large programme to procure CBR protective equipment for aircraft & aircrew
- OA used to determine
  - Is AACSTO necessary?
  - What air capability does AACSTO need to maintain?
  - What hazard levels are be involved in air operations?
  - What is the burden of AACSTO on aircrew?

AACSTO – Phase 1 - 3

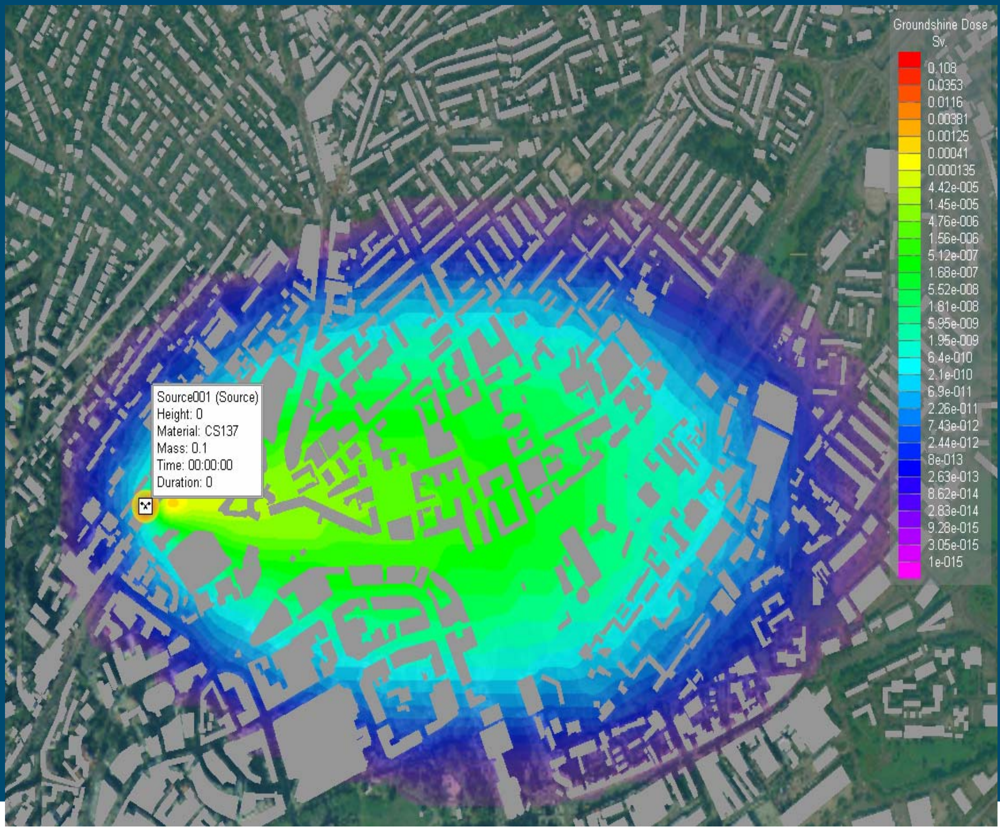
- Phase 1 - Complete
  - Review of existing work undertaken across MOD
  - Concluded that no work tested against comparable threats to those currently faced
- Phase 2 - Ongoing
  - Identify threat scenarios and use of CBRN materials
  - Determine the aircraft involved in these operations and their corresponding missions
  - Identify the concepts & doctrine used to mitigate the use of CBRN
- Phase 3 - Ongoing
  - Series of war-games and workshops to determine the areas in which AACSTO is most necessary

AACSTO - Phase 4

- Two main goals:
  - Quantify the CBR challenge that aircraft and aircrew may be exposed to
  - Determine the thermal load placed upon aircrew and ground-crew by a range of protective ensembles
- We use the aircraft, missions and threat scenarios that are coming out of Phase 2 (running in parallel)

The CBR Virtual Battlespace (CBVB)

- The CBVB is used for the modelling in Phase 4
- New models have been added to the CBVB as part of this work
  - Airframe Model
  - Heat Strain Model
  - Protection Model
  - Radiological Post Processor



Task 1 – Draw up Mission Profiles

- Mission Profiles will include
  - Activity level (Watts)
  - Waypoints that describe route taken (either absolute or offset via velocity and start point (x,y,z,t))
  - Type of clothing represented as a protection factor and thermal and vapour resistances
  - Local environmental conditions, including temperature, winds & stability
- Take into account different phases:
  - Aircrew at rest on airbase
  - Transference to air platform
  - Take off
  - Level flight at representative height
  - Landing

Task 2 – Safe Core Temperature

- Do mission profiles from Task 1 result in safe core temperatures?
- The Heat Strain Model
  - Based on US SCENARIO model, but improved
  - Now passed V&V testing
  - Is being compared against other models
    - USARIEM model
    - DSTO Werner/Lotens model
    - QinetiQ model
  - Also compared against experimental data

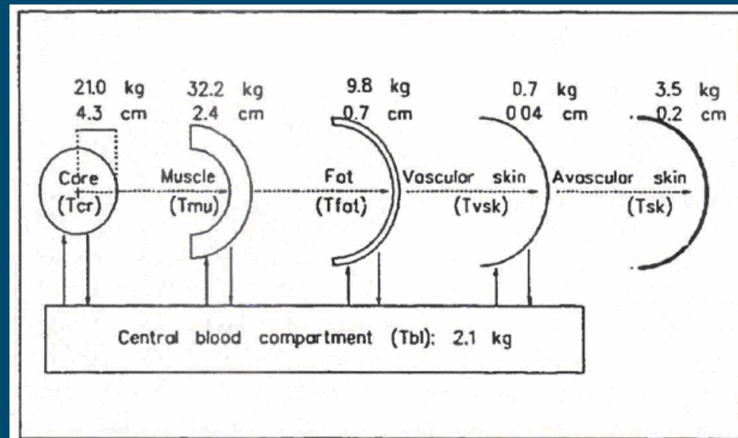
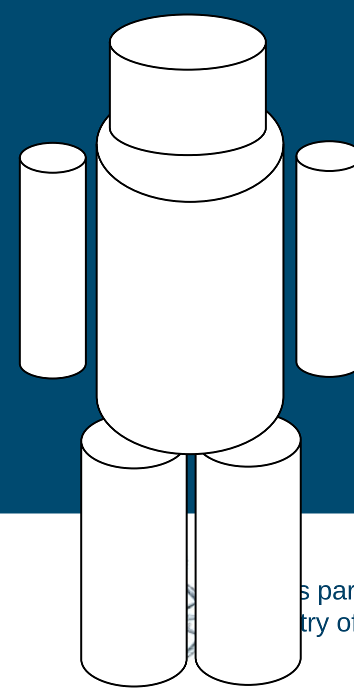


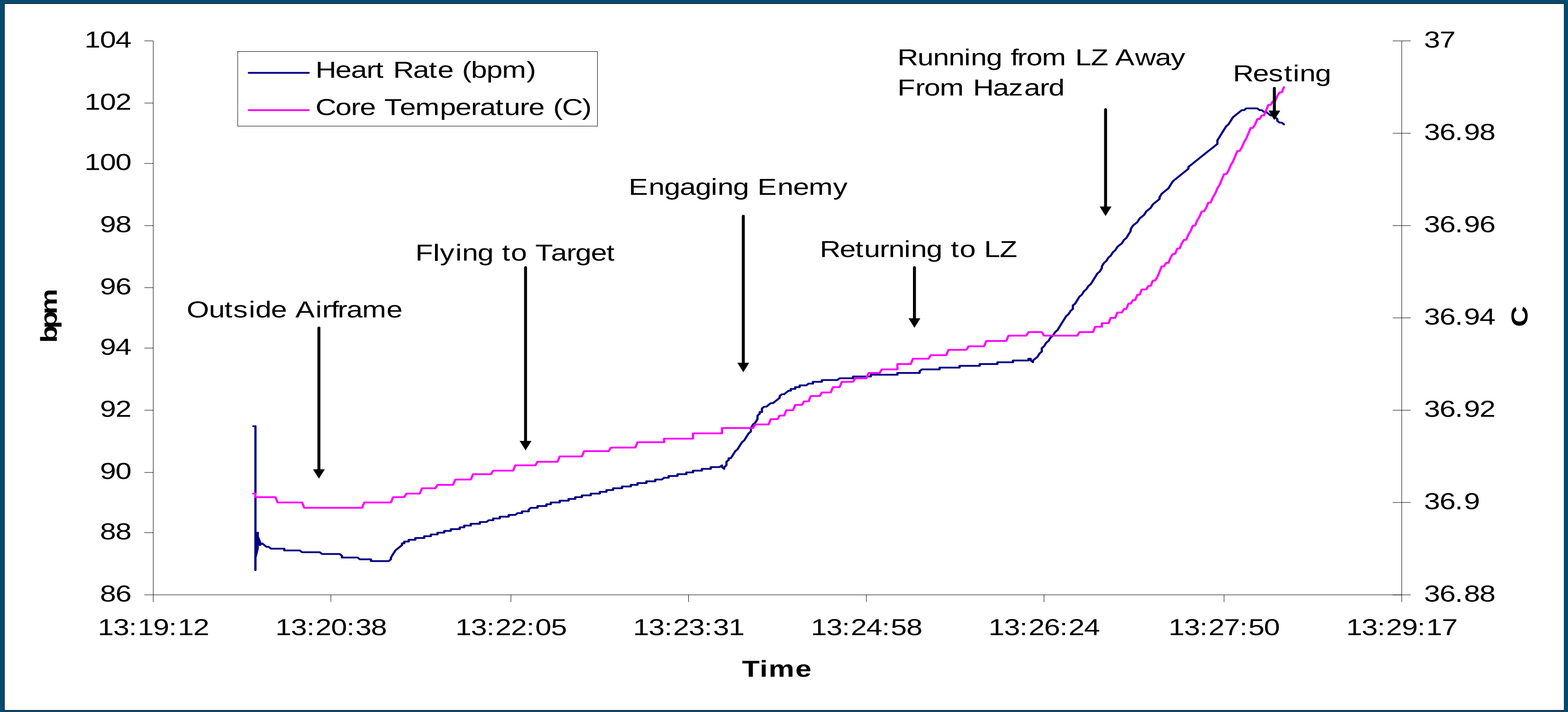
Figure 1. Cross-section of cylindrical model containing 5 concentric annular tissue compartments. Dimensions are for an individual with W = 70 kg, A_D = 1.8 m².



Task 2 – Safe Core Temperature

- The Airframe Model
  - Estimates the environmental conditions inside aircraft (radiant and ambient temperature, humidity & wind-speed)
  - Based on lit search of past trial data & simple atmospheric physics
  - Now integrated into the CBVB
- CBVB can calculate the heat strain associated with current and prototype clothing ensembles
  - Drive future clothing research

Task 2 – Safe Core Temperature



Task 3 – Determine CBR Challenge

- The Protection Model
  - New model to determine the protection factors provided by various types of aircraft now integrated into CBVB
- Predict the CBR hazard to the platforms at various times during the mission profiles:
  - Given that a CBR event is intercepted, determine if a high or low burden protection option is required, and when during the mission it is needed
- Mission profiles from Task 1 against current threat scenarios
  - Use of agent, weapon system and target will be derived from CBR planning scenario development work
  - Meteorological data specific to the location
- Challenge model runs completed for helicopters – fast jet and fixed wing runs underway.

Conclusions

- The Virtual Battlespace has been successfully used to support the acquisition process
  - Used to both test and evaluate existing capability and drive research in new areas
  - Significantly improved capability (includes casualty chain, effects on operations)
  - Widely used (2004-05 – 1 study; 2006-07 – 5 studies)
    - Every study improves VB, benefiting subsequent studies
  - International
    - New TTCP CBR Group AG
    - DSTO involvement