



Dispersion Modeling & Simulation in DoD

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**Office of the Deputy Under Secretary of Defense
(Science and Technology)**

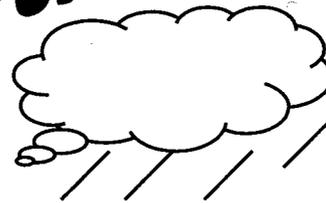


NBC Hazard Dispersion Model Components



Source

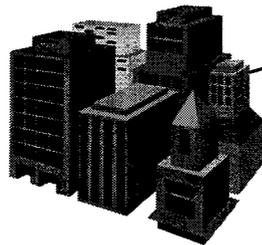
Meteorology



Transport & Dispersion of Matter & Energy



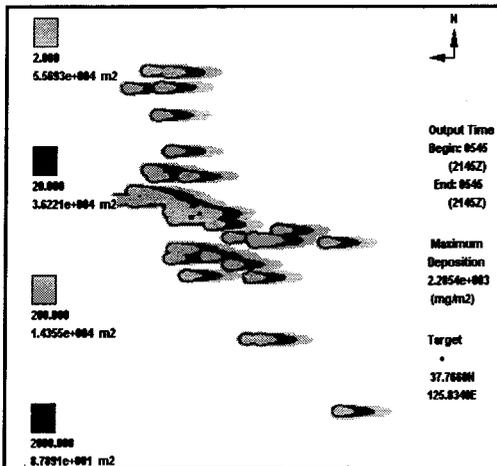
Decay, Deposition Processes



Terrain



Human Response





Joint Service M&S for C/B Defense NBC Dispersion Model REQUIREMENTS

- ♦ **JFOCS: J-1: NBC Battle Management: “assimilate, disseminate, predict NBC weapons effects within the multidimensional battlespace for planning/modifying operations.....training, planning, analysis....track and maintain situational awareness....interface with local weather....automated predictive capability and recommended course of action.”**
- ♦ **OSD/Service SBA Policy and JSMG Acquisition Strategy: Provide simulations to support requirements, design, development and military worth evaluation as a part of the SBA process for emerging CB Defense systems.**
- ♦ **JSMG JSNBCD RD&A Plan: NBC defense battlespace management**
- ♦ **JWST 97: Ability to track threat agent clouds. Integrate T&D models for C, B, R hazards. Ensure ability to sustain operations and accomplish mission in a CB environment.**
- ♦ **Various Service/CINC guidance (CENTCOM #1 priority)**
- ♦ **e.g. DoN STRG Chapter 12: Battlespace Environment**
 - **Develop 3-D models and simulations of containment and dispersion effects in the marine environment with special attention to toxic persistence.**
 - **Develop environmental warfare countermeasures to include dispersion and effects models.**
 - **Develop tools for assessing collateral damage/contamination from weapons of mass destruction.**



Model Purpose and Threat Matrix

MODEL PURPOSE

- ◆ Immediate warning or evacuation notice to unprepared non-combatant civilians
- ◆ Battlefield warning for prepared soldiers and civilian support staff
- ◆ NBC effects analysis, without specific warning requirements or populations at risk

THREAT EVENT

- ◆ Use or testing of NBC weapons threatening U.S. forces and civilians
- ◆ Disruptions of NBC materials containment in weapons-related systems
- ◆ Disruptions of NBC containment in civilian systems



Representative CBW Dispersion Model Utility

CONOPS development

Defensive Hardware Design, Development, and Acquisition

CBW THREAT EVENTS	Immediate evacuation notice for unprepared civilians	Battlefield Warning for combatants	NBC Effects analysis, w/o specific warning or populations at risk
Threats from CBW weapons	<ul style="list-style-type: none"> • Civil Defense • Prompt assessment • Terror resp 	<ul style="list-style-type: none"> • Attack Warning • Analysis • C3I systems 	<ul style="list-style-type: none"> • CP targets • Forensics • Civil Defense planning
Disruption of CBW Materials	<ul style="list-style-type: none"> • Chem Demil • Accidents • Waste storage 	<ul style="list-style-type: none"> • CP effects • Weapons security • Decon 	<ul style="list-style-type: none"> • WMD forensics • CP effects • Weapons safety
Disruption of CB Matl (civ systems)	<ul style="list-style-type: none"> • Terror resp. • Emer. Resp. • CIP recovery 	<ul style="list-style-type: none"> • Enemy SOF Planning • Security anal. • Collateral damage 	<ul style="list-style-type: none"> • WMD Forensics • Logistics support • Security



Representative Detailed DoD CBW M&S Requirements

QDR Support – effects of:

- Dependence on Host nation support (protected/unprotected)
- Force structure
- Fixed site impacts (APODs, SPODs, staging areas)
- Inter/intra theater logistics
 - CP for arriving forces at APODs/SPODs
 - Decon

Conflict Simulation:

- (Doctrine, Training, SBA, QDR) (JWARS, JSIMS, JCATS)
- Degradation from MOPP
- Time phased degradation from agent exposure
- Realistic portrayal of BW attacks in theater simulations
- Warning and reporting
- Civilian casualties
- Fixed site impacts (APODs, SPODs, staging areas, fighter bases)
- Inter/intra theater logistics



Representative Detailed DoD CBW M&S Requirements (cont.)

SBA

- Environment (See above)
- Background aerosol impact on BW detection
- Force structure
- Fixed site effects
- All NBC defense equipment/doctrine



DoD CBW Dispersion Model Technical Needs

NBC Environment (to be used by JWARN, SBA, Doctrine/Training)

- Improved coupling to meteorology
- Transport and dispersion in urban areas
- Releases from intercepted missiles containing NBC warheads
- Releases of TIMs (dense gases, buoyant gases)
- Effects of wide area decon, washdown or even rain
- Effects of reaerosolization
- Microencapsulated agents
- Agent evolution from porous or reactive surfaces
(evap, desorb, permanent adsorb, decomposition)
- New agents
- Addition of time based toxicity
- Realistic source terms for BW weapons
- Faster computations



The Real World

- ◆ **Models are useful approximations for decision support & training**
- ◆ **Uncertainty cannot be eliminated, but we can set statistical bounds**
- ◆ **All Chem/Bio Models are empirical at some level**
 - **Thus, we need to know our models well**
 - Proper documentation is NOT optional
- ◆ **High consequence decisions rely on models**
 - **There are MANY uses of such models - so V V &A *MUST* be tailored to particular model applications**

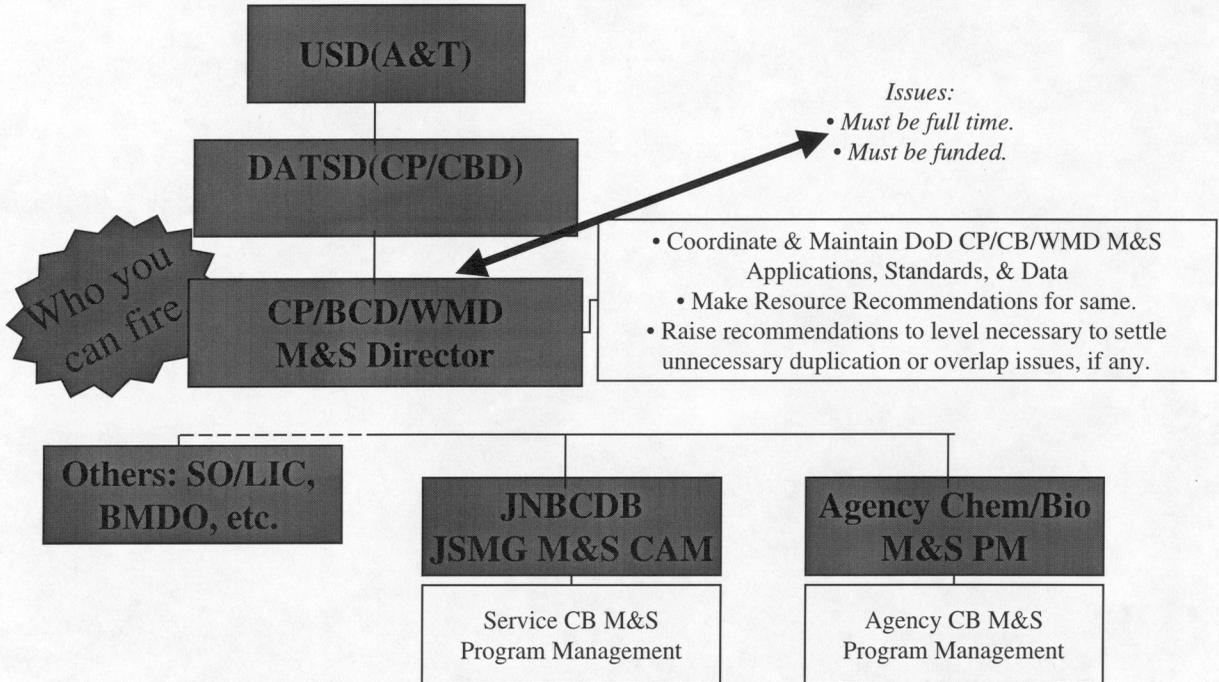


Oversight Solution Space

- ◆ **“Common Use CB Hazard Prediction” too narrow...**
 - *Must include all M&S tools representing Chem/Bio.*
 - *Warfighter wants CP/NBCD/WMD in one integrated package.*
 - *Should encompass SBA, Training, etc.*
 - *In any event, CB M&S oversight needed beyond hazard prediction.*
- ◆ **Goals:**
 - **Requirements Validation and Prioritization**
 - **Resource Allocation/Program Management/Execution**
 - **Policy: DoD wide standards and common practices.**
- ◆ **Entering Arguments:**
 - **Centralized Responsibility & Authority (*who you can FIRE?*)**
 - **Maximal use of existing organizations and infrastructure**



Oversight Implementation



With budgetary oversight at DATSD(CP/CBD)

Phase Item	Exploratory/ Advanced Technology Development	Validation & Verification	Operational Implementation {Accreditation}	Operations	
Sponsor (Funding Category)	JSMG CAM DTRA PM (6.2/6.3 RDT&E) BAM	DATSD(CB/CP) {or designated agent} (6.4 RDT&E)	DATSD(CB/CP) (6.4 RDT&E and O&M,N)	DATSD(CB/CP) {or designated agent} (6.4 RDT&E and O&M,N)	
Objective	<ul style="list-style-type: none"> Initial Development Through Proof-Of-Concept Completion of Development 	<ul style="list-style-type: none"> Technical <u>Validation</u> Model <u>Verification</u> Demonstrations 	<ul style="list-style-type: none"> Full Integration Accreditation for "classes" of application 	<ul style="list-style-type: none"> Operation & Maintenance Life-Cycle Support 	
Deliverables	<ul style="list-style-type: none"> Journal, Publication or Technical Report 	<ul style="list-style-type: none"> Source Code Model Transition Plan Validation Test Report Preliminary DOD-STD Documentation, etc. 	<ul style="list-style-type: none"> Final DOD-STD Documentation 	<ul style="list-style-type: none"> Upgrades and Fixes 	
Participants	<ul style="list-style-type: none"> Academia, Agencies, Service Labs Contractors, etc. 	CHEM/BIO M&S Oversight Panel		<ul style="list-style-type: none"> Users (ops) Configuration Control Boards (LCM) <i>JSMG CAM</i> 	
Transition I		↑	Transition II		
Transition I			↑	Transition III	
Transition I				↑	<i>DTRA PM</i>



SUMMARY

- ◆ **Established a single Point of Authority for DoD Chem/Bio M&S oversight**
 - ◆ **Requires that ALL DoD-funded, common-use CB M&S development efforts:**
 - **Be authorized by individual exercising top-level oversight**
 - **Based on annual review of Departmental needs and submitted proposals (by ALL Service & Agency stakeholders)**
 - **Are in response to validated requirements**
 - **Undergo the SAME independent, rigorous VV&A (with approved data)**
 - **“Separate but equal” VV&A is not acceptable**
 - **Are reviewed at Chem/Bio TARA**
- GOAL ➡ Attain consensus on “System of Systems” DoD model suite**
ONLY THOSE CB MODELS DEVELOPED UNDER THESE
CRITERIA ARE ELIGIBLE FOR DoD COMMON-USE
ACCREDITATION