

# Joint Chemical, Biological, Radiological and Nuclear Defence Centre of Excellence



## MilSim CEE 2019

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M&S Section IT Specialist  
16 October 2019  
Brno (CZE)



# Agenda

- **Background**
- **Mission**
- **Structure**
- **M&S Section intro**
- **M&S tools and capabilities with example**



# NATO Centres of Excellence - Overview

## NATO CENTRES OF EXCELLENCE LOCATIONS



JCBRND  
CoE



# FRAMEWORK & SPONSORING NATIONS

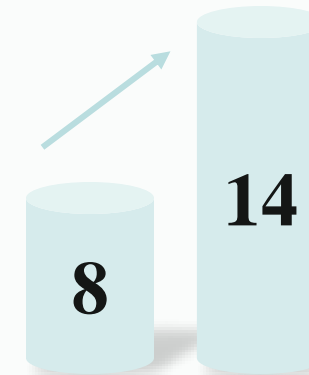
- Multinationally Sponsored
- Framework Nation: Czech Republic
- 13 Sponsoring + 1 Contributing Nations
- Recognized Expertise and Experience





# JCBRN Defence COE - History

- ❑ OCT 06      Founded by  
CZE, DEU, GBR, GRC, ITA, ROU, SVK, SVN
- ❑ MAR 07      NATO Accreditation
- ❑ JUL 07      Status as International Military Organization
- ❑ SEP 08      POL Accession
- ❑ SEP 09      HUN Accession
- ❑ MAR 11      Re-Accreditation
- ❑ JUN 11      USA Accession
- ❑ JUL 13      FRA Accession
- ❑ AUG 16      AUT Contributing Partner
- ❑ July 18      Re-Accreditation
- ❑ Dec 18      CAN Accession



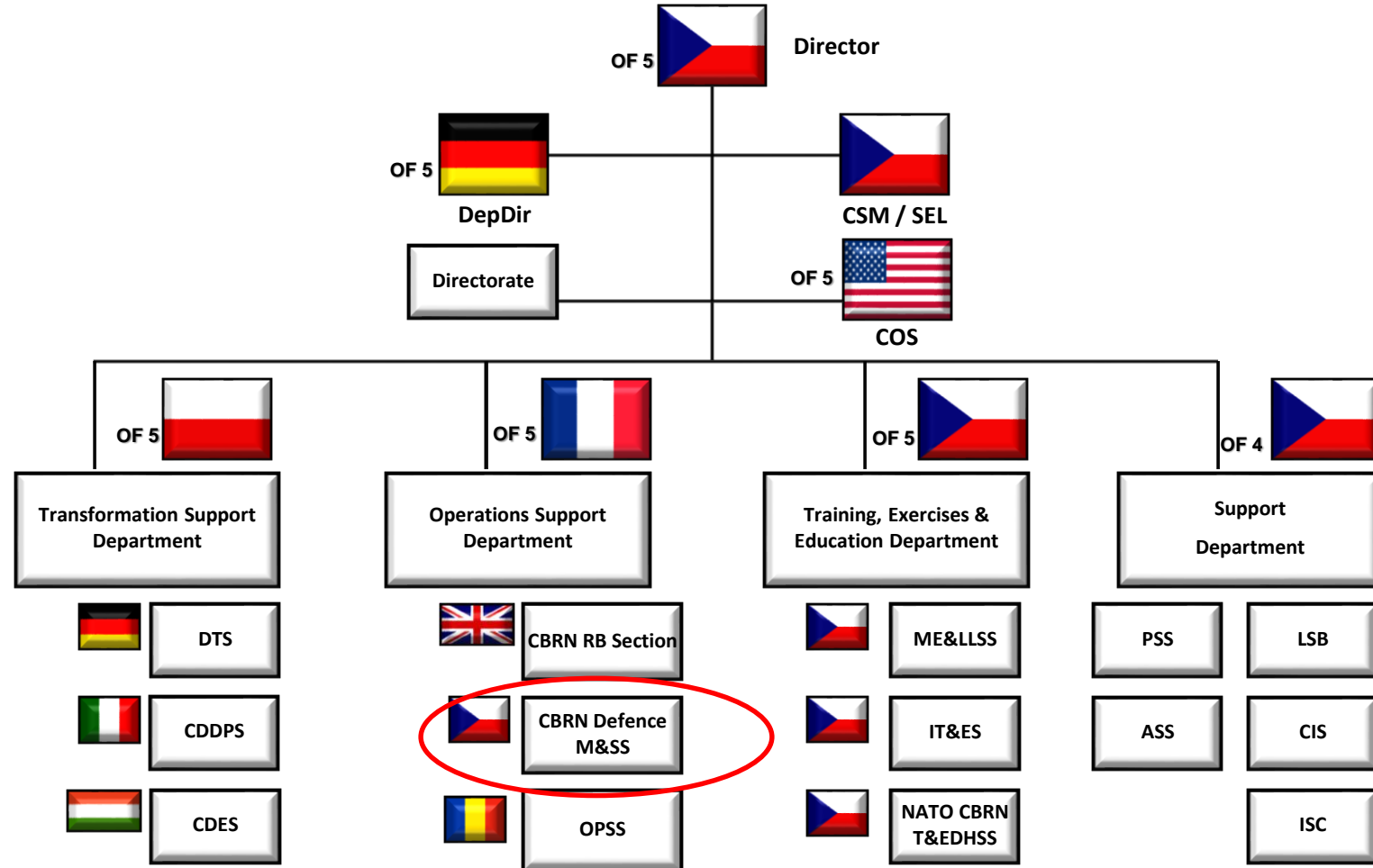
# JCBRN Defence COE - **Mission**

## Within a **Programme of Work**

- ☐ Provide **advice** in all CBRN Defence related areas.
- ☐ Develop CBRN Defence **doctrines, standards, knowledge.**
- ☐ Enhance **education** and **training.**
- ☐ Contribute to the **Lessons Learned Process.**
- ☐ Assist in the CBRN Defence related efforts, including validation through **experimentation.**
- ☐ *provide Operations support, CBRN Reachback (RB) and Modelling and Simulation (M&S)*



# JCBRN Defence COE - Organizational Structure



## **M&S Section Mission**

- **to support and assist in all relevant JCBRN Defence COE tasks in accordance with existing organizational structure, Program of Work, MOUs and other valid agreements.**





# M&S Section Tasks

- **Support to the RBE – simulation, prediction and assistance to the SME training**
- **Support to Training & Exercises**
  - support of wide scale of scenarios, ranging from ultra high resolution urban combat and civil-military operations to lower resolution brigade and higher level operations,
- **Support of expert courses (W&R), Capabilities Development and Experimentation**
  - verification of requirements stated in defence planning process
  - contribution in the identification of capability shortfalls and their testing and verification
- **External activities – NMSG, MSG 147**
- **Operations planning**



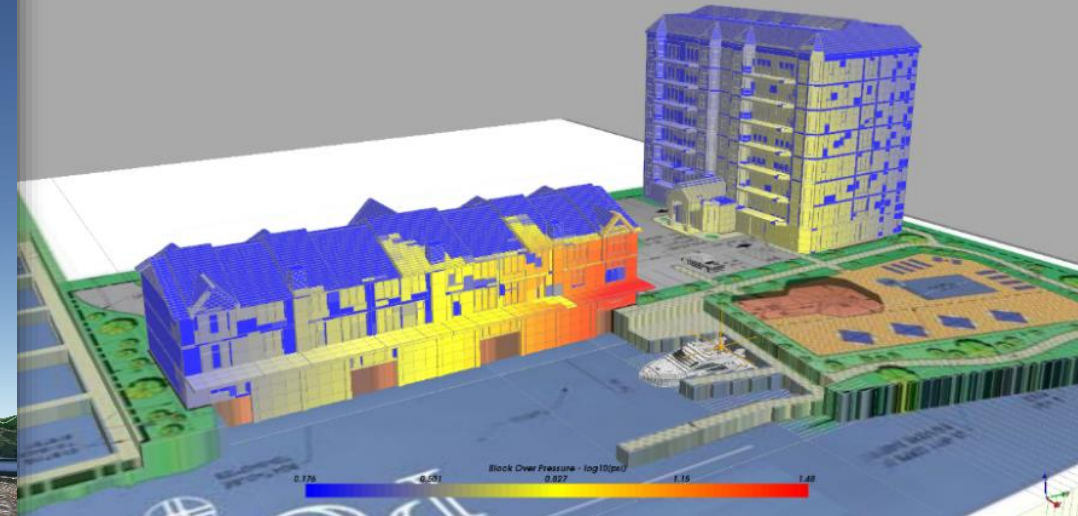


# M&S Tools and capabilities

© 2015 Google  
Image Landsat  
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

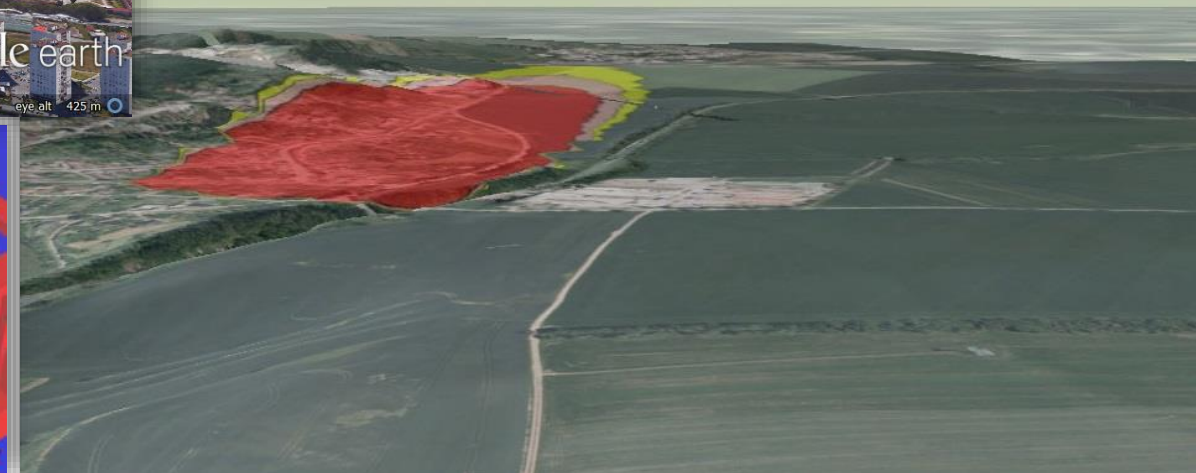
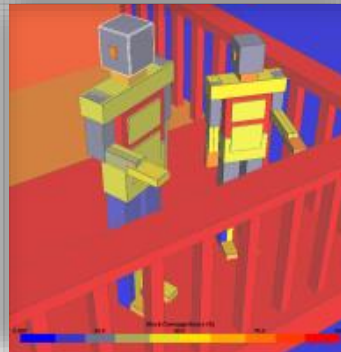
Google earth

Imagery Date: 8/11/2014 lat 40.836650° lon 14.992414° elev 367m eye alt 425m



## ExDAM - Average(Maximum) Damage/Injury/Pressure/Impulse Summary

Explosion		Model Run					
Name: 12.60NTWT		Model: HE/DAM					
Location: -93.22, -193.24, 9.09 (ft)		Date/Time: 9/10/2014, 4:46 PM					
Fuel Type: TNT Trid		Damage/Injury					
Mass: 12.60 (ton)		Severe: > 75 (%)					
		Moderate: > 20 (%)					
		Slight: > 5 (%)					
Structure	Structure			Personnel			
	Damage (%)	Over Press. (psi)	Dyn. Press. (psi)	Injury (%)	Over Press. (psi)	Dyn. Press. (psi)	
Fertilizer Plant - Tanks	95.0 (0.00)	14.1 (0.20)	6.18 (0.01)	-	-	-	
Fertilizer Plant - Bldgs	99.7 (0.00)	135 (0.02E+03)	236 (0.12E+04)	-	-	-	
Residential Homes - East	100.0 (0.00)	6.22 (8.79)	0.822 (0.73)	-	-	-	
Residential Homes - North	42.4 (0.00)	1.28 (0.75)	0.0541 (0.329)	0.2 (8.2)	0.207 (0.18)	0.0056 (0.0023)	
Residential Homes - North West	23.0 (0.00)	0.788 (0.87)	0.0184 (0.168)	0.1 (7.7)	0.0182 (0.08)	0.000423 (0.0007)	
Residential Homes - South West	26.9 (0.00)	0.883 (0.59)	0.0248 (0.159)	0.2 (8.4)	0.134 (0.804)	0.00134 (0.0156)	
Residential Homes - South	13.0 (0.1)	0.301 (0.04)	0.00788 (0.0235)	0.1 (4.0)	0.0012 (0.0005)	0.00012 (0.00005)	
High School	8.2 (0.04)	0.344 (0.883)	0.00479 (0.0185)	0.2 (5.0)	0.14 (0.156)	0.00112 (0.00095)	
Middle School	31.2 (0.00)	1.48 (0.94)	0.0601 (0.207)	0.1 (11.1)	1.85 (0.85)	0.0176 (0.0023)	
Agriculture Buildings	97.9 (0.00)	3.07 (0.07)	0.224 (0.194)	0.1 (7.6)	3.48 (4.32)	0.0227 (0.0048)	
Shopping Center	32.3 (0.00)	1.31 (0.82)	0.0159 (0.201)	0.4 (13.3)	0.454 (0.52)	0.0189 (0.015)	
Commercial Bldgs - West	25.9 (0.5)	0.86 (0.31)	0.0204 (0.0412)	0.1 (4.3)	0.0872 (0.42)	0.000761 (0.00429)	



# Software Tools



- Hazard Prediction Assessment Capability (HPAC) + supporting tools
- Explosion Damage Assessment Model(ExDAM)
- Geographical Information System (ArcGIS)
- CBRN Analysis



# Hazard Prediction Assessment Capability

**HPAC has been developed to be:**

- **a counter proliferation, counterforce tool that predicts the effects of hazardous material releases and its collateral effects on civilian population and military force;**
- **a tool assisting warfighters in destroying targets containing weapons of mass destruction and responding to hazardous agent releases.**





# Hazard Prediction Assessment Capability

**HPAC was designed to be used by two types of users, operational and analytical:**

- Operational users – in other words, field users responding to actual or expected events using default values for user inputs in order to simplify complex inputs;**
- Analytical users/analysts generally are involved in research and development. Analytical users are changing the default inputs based on their subject matter expertise.**



# ExDAM

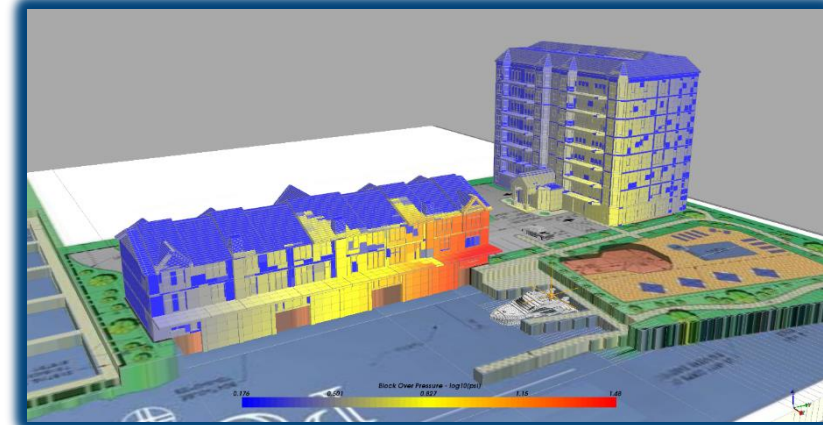
- **3D Consequence Modeling Application for Open Air Explosions**
  - **Macro-level: Entire petrochemical plant**
  - **Micro-level: An onsite facility control room**
- **Two Numerical Models**
  - **HExDAM: High explosives**
  - **VExDAM: Vapor cloud explosions**
- **3D Extended Module**
  - **Facilitate the creation of buildings/structures**
- **Fragmentation Module for High Explosives: HExFRAG**
  - **Model secondary injuries caused by fragmentation**





# ExDAM Structure/People Damage/Injury Results

- **Color-coded**
  - Peak incident pressures/impulses
  - Percent damages/injuries
- **Graphical Results**
  - 2D contour plans
  - 3D iso-surface/volume rendering
- **Tabular Results**
  - HTML format for reporting



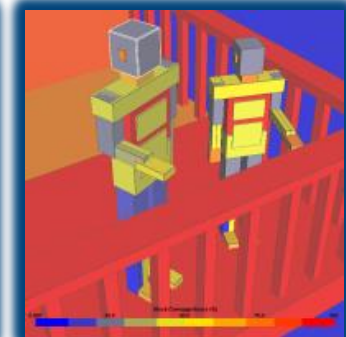
**ExDAM - Average(Maximum) Damage/Injury/Pressure/Impulse Summary**

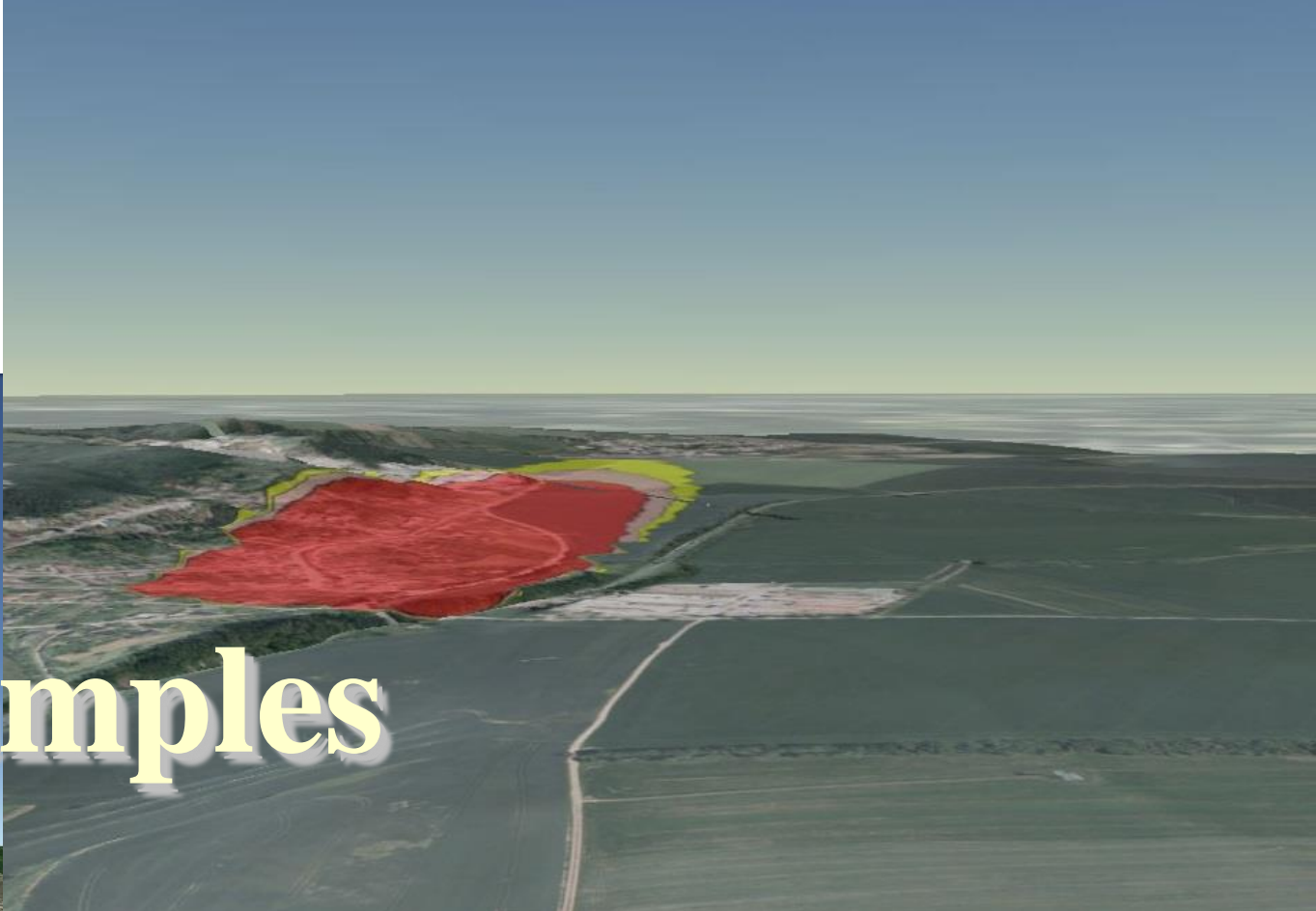
**Explosion**  
 Name: 12-600-TNT  
 Location: -93.22, -193.24, 9.09 (ft)  
 Fuel Type: TNT Yield  
 Mass: 12.60 (ton)

**Model Run**  
 Model: ExDAM  
 Date/Time: 9/10/2014, 4:46 PM

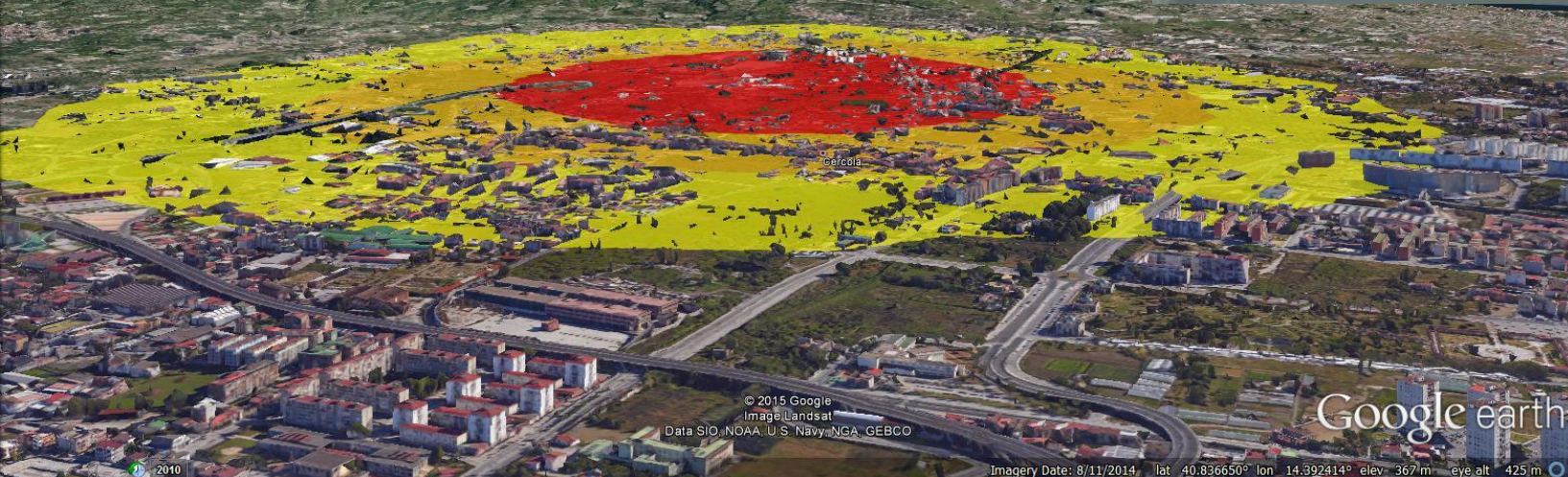
**Damage/Injury**  
 Severe: > 75 (%)  
 Moderate: > 50 (%)  
 Slight: > 5 (%)

Structure	Structure		Injury (%)	Personnel	
	Damage (%)	Over Pres. (psi)		Over Pres. (psi)	Over Pres. (psi)
Perish Place - Trade	81.0 (100.0)	14.1 (120)	6.18 (181)	-	-
Perish Place - Bridge	96.1 (100.0)	151.0 (128-145)	104.0 (128-145)	-	-
Residential Home - East	100.0 (100.0)	6.22 (3.70)	0.822 (3.70)	-	-
Residential Home - North	42.4 (100.0)	3.26 (2.70)	0.041 (0.329)	0.2 (0.2)	0.207 (0.16)
Residential Home - North West	35.6 (100.0)	0.760 (2.47)	0.014 (0.146)	0.1 (7.7)	0.0162 (0.02)
Residential Home - South West	26.9 (100.0)	0.860 (2.59)	0.014 (0.150)	0.2 (6.4)	0.156 (0.04)
Residential Home - South	13.0 (01.4)	0.501 (1.56)	0.00798 (0.0226)	0.1 (4.5)	0.0022 (0.47)
High School	8.2 (28.0)	0.144 (0.810)	0.00479 (0.0180)	0.2 (0.0)	0.14 (0.396)
Middle School	51.2 (100.0)	1.43 (2.96)	0.001 (0.207)	0.8 (11.3)	1.03 (0.83)
Apartment Buildings	87.9 (100.0)	3.07 (3.07)	0.254 (0.394)	0.8 (0.8)	0.48 (0.32)
Needing Stone	32.3 (100.0)	1.31 (2.82)	0.0109 (0.302)	0.4 (0.3)	0.454 (0.12)
Commercial Bldg - West	25.0 (05.3)	0.86 (1.33)	0.0204 (0.0412)	0.1 (4.3)	0.00761 (0.00426)

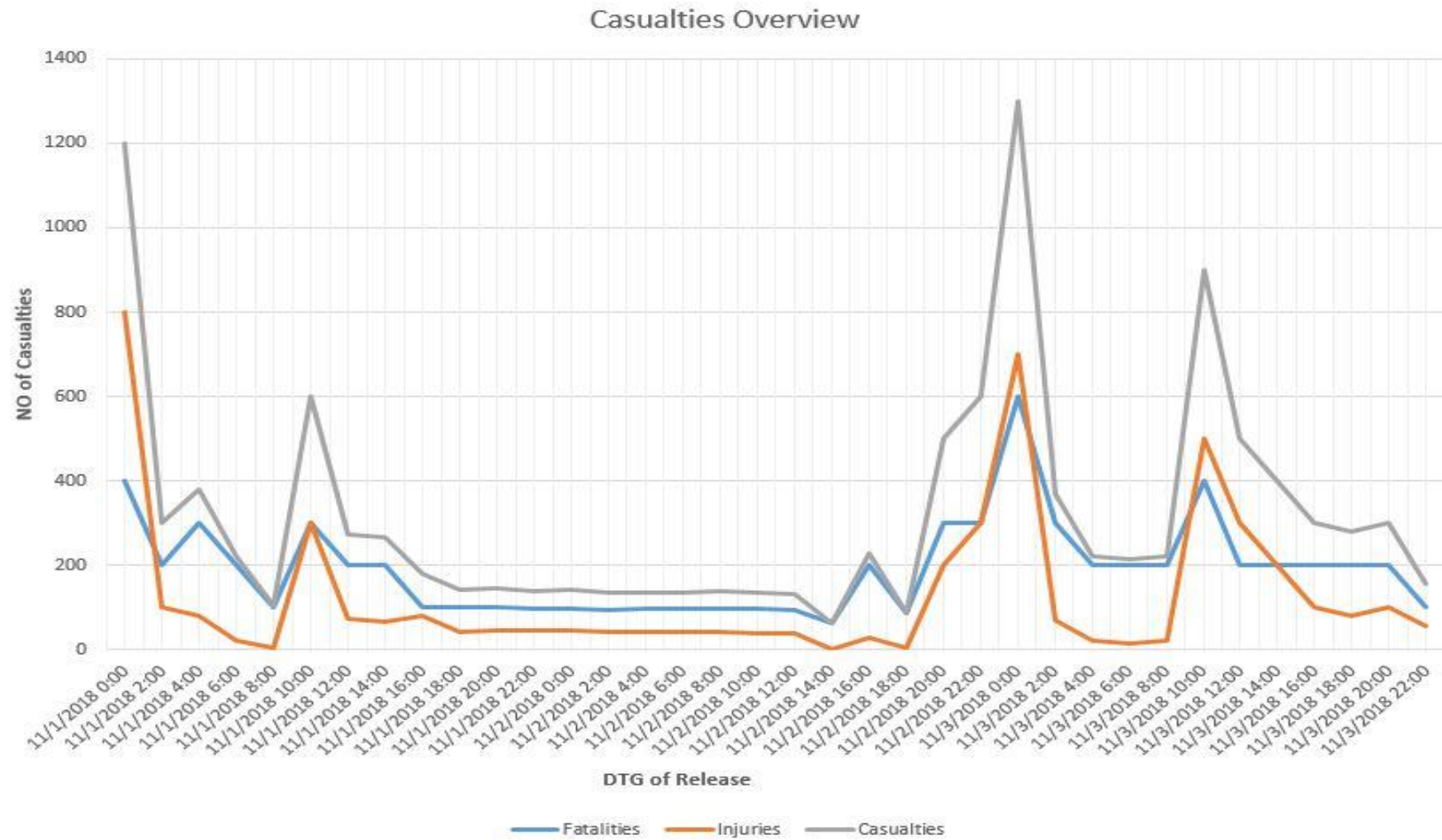




# Examples

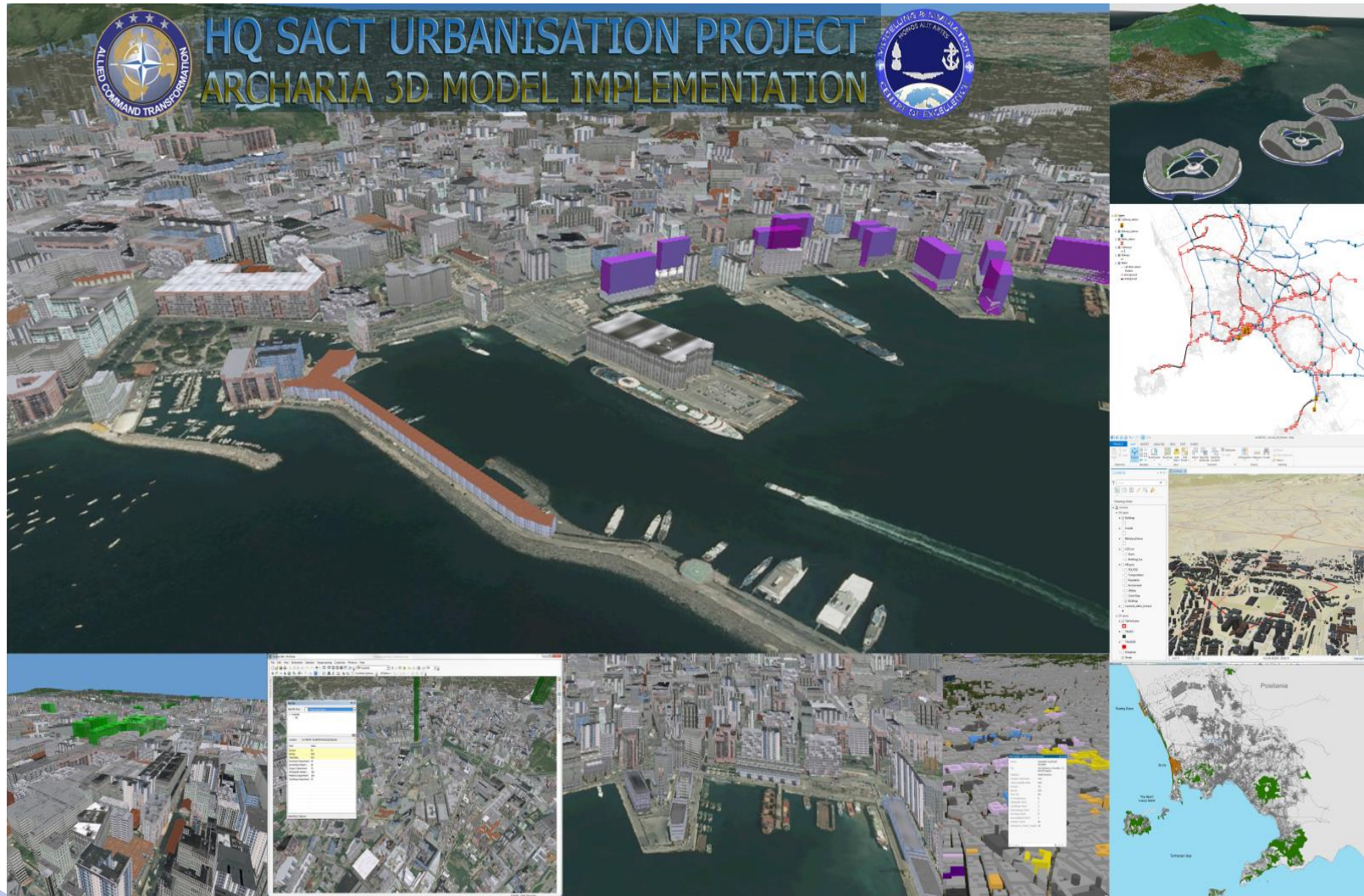


# TARGETING support





# M&S support to Urbanisation Project



# **M&S support to Urbanisation Project**

## **Urban vs Standard environment Modelling and Simulation**

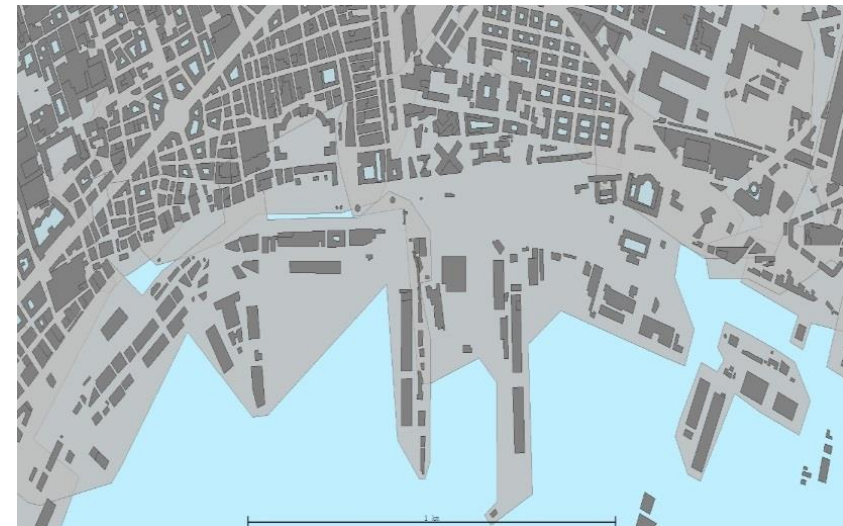
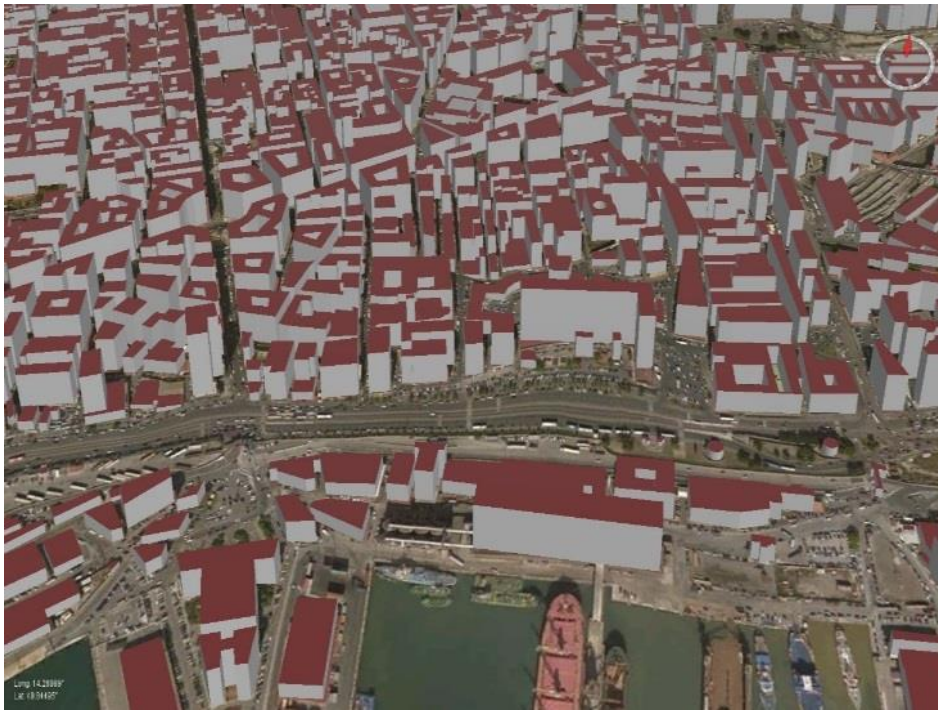
- **Specific meteo conditions – turbulences, contra winds, etc,**
- **Specific terrain conditions – buildings, streets, ....**
- **Need for high definition data:**
  - **3D buildings models**
  - **Detailed weather data**
  - **High resolution terrain data**





# M&S support to Urbanisation Project

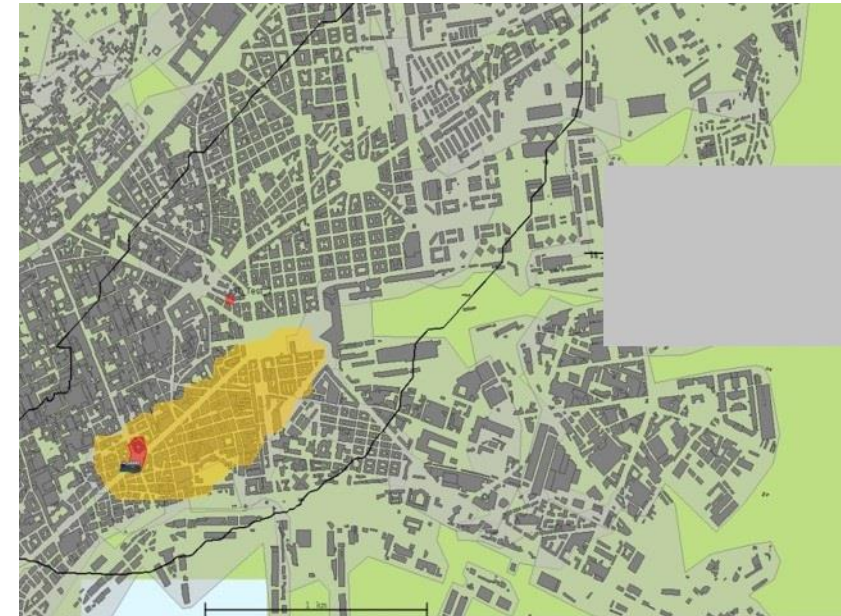
## 3D Urban Data





# M&S support to Urbanisation Project

## Acute Exposure Guideline Levels (AEGLs) (40 minutes after incident)

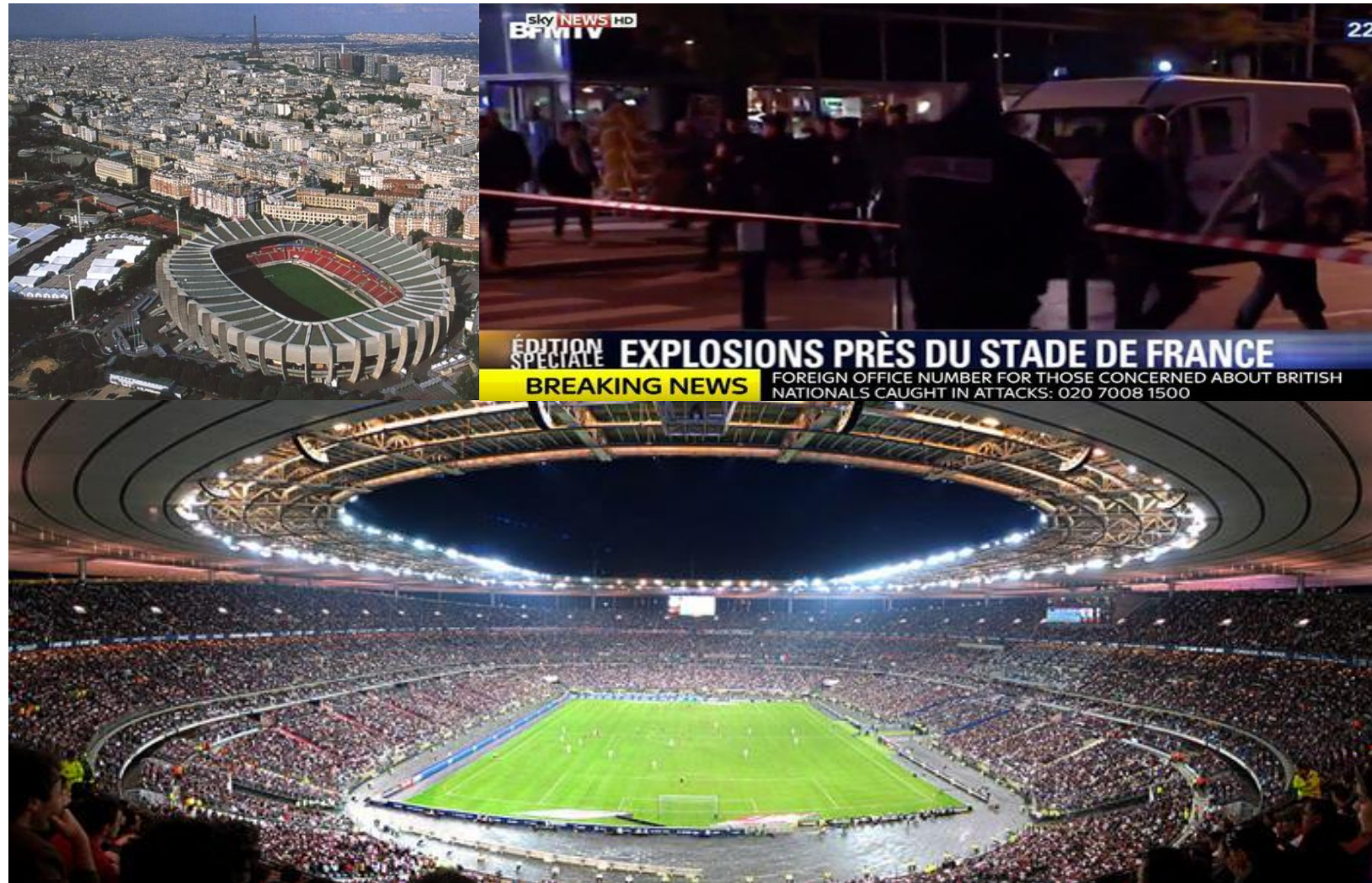


- Lethal or life threatening zone
- Serious adverse health effects



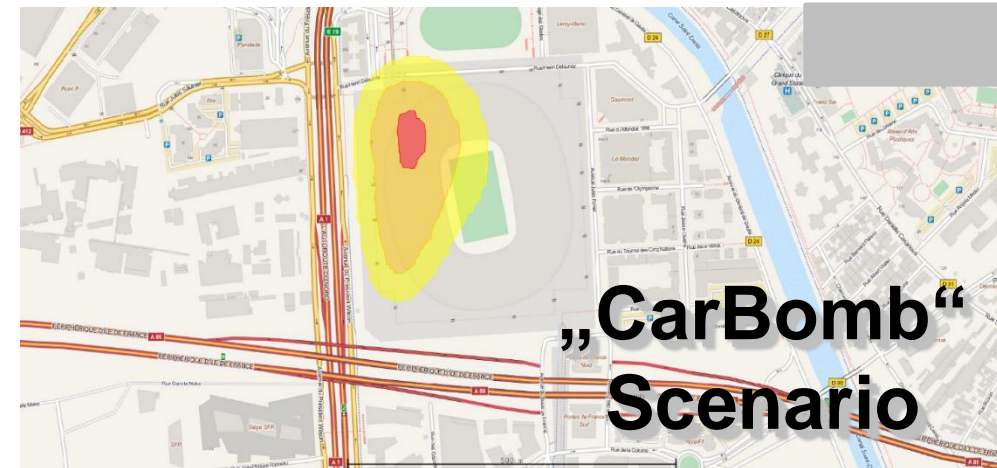
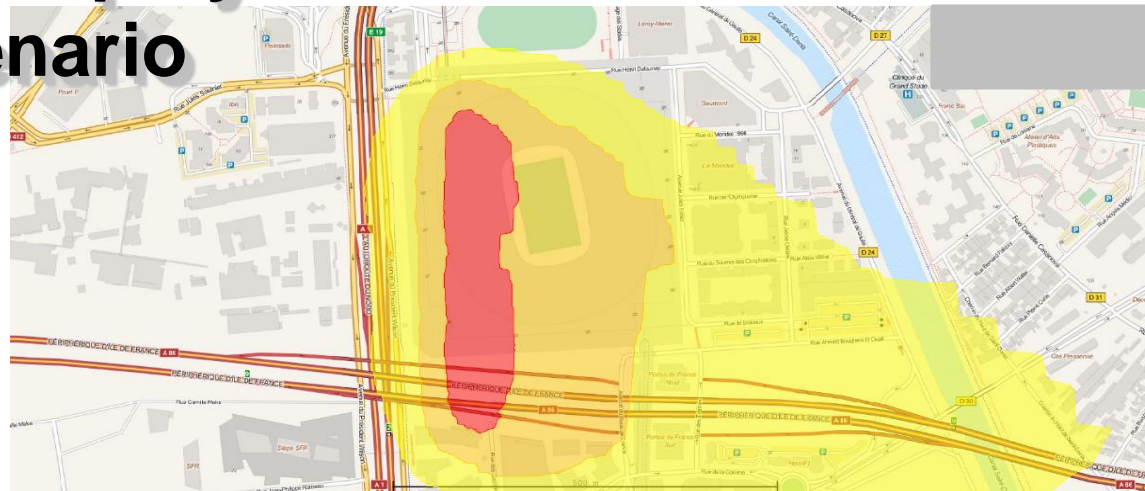


# M&S support to European Football Championship 2016



# M&S support to European Football Championship 2016

„Aerial Spray“  
Scenario



„CarBomb“  
Scenario



# Cooperation with NATO JFTC

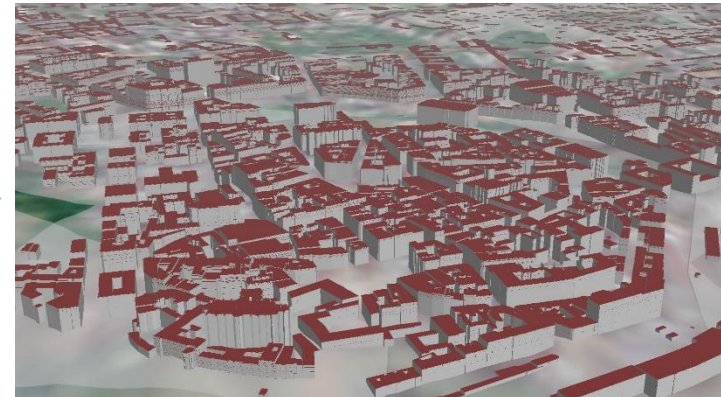
- **Series of workshops**
- **Expert advice on CBRN modelling and simulations**
- **Configuration of CBRN modules of JCATS constructive simulator**
- **JCATS simulations supported by external CBRN prediction**

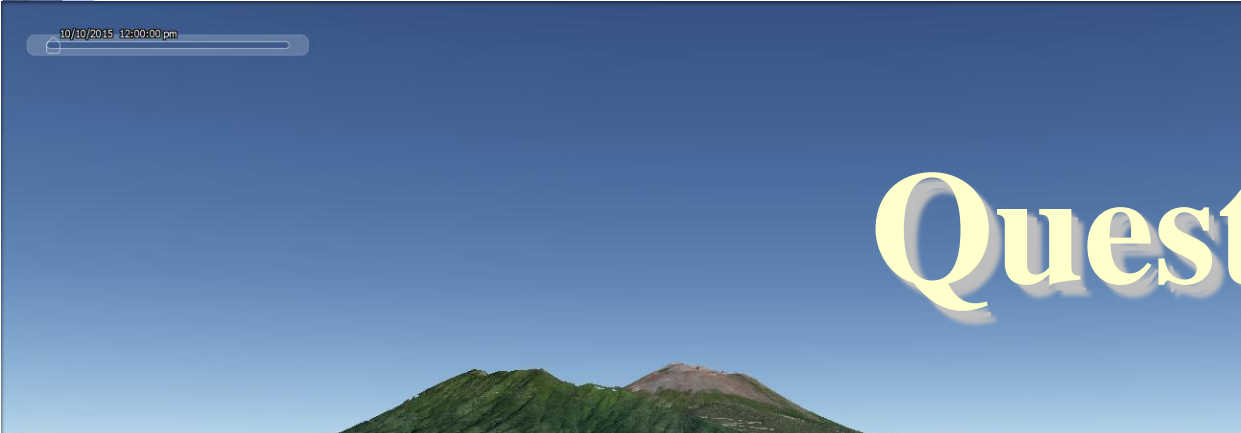
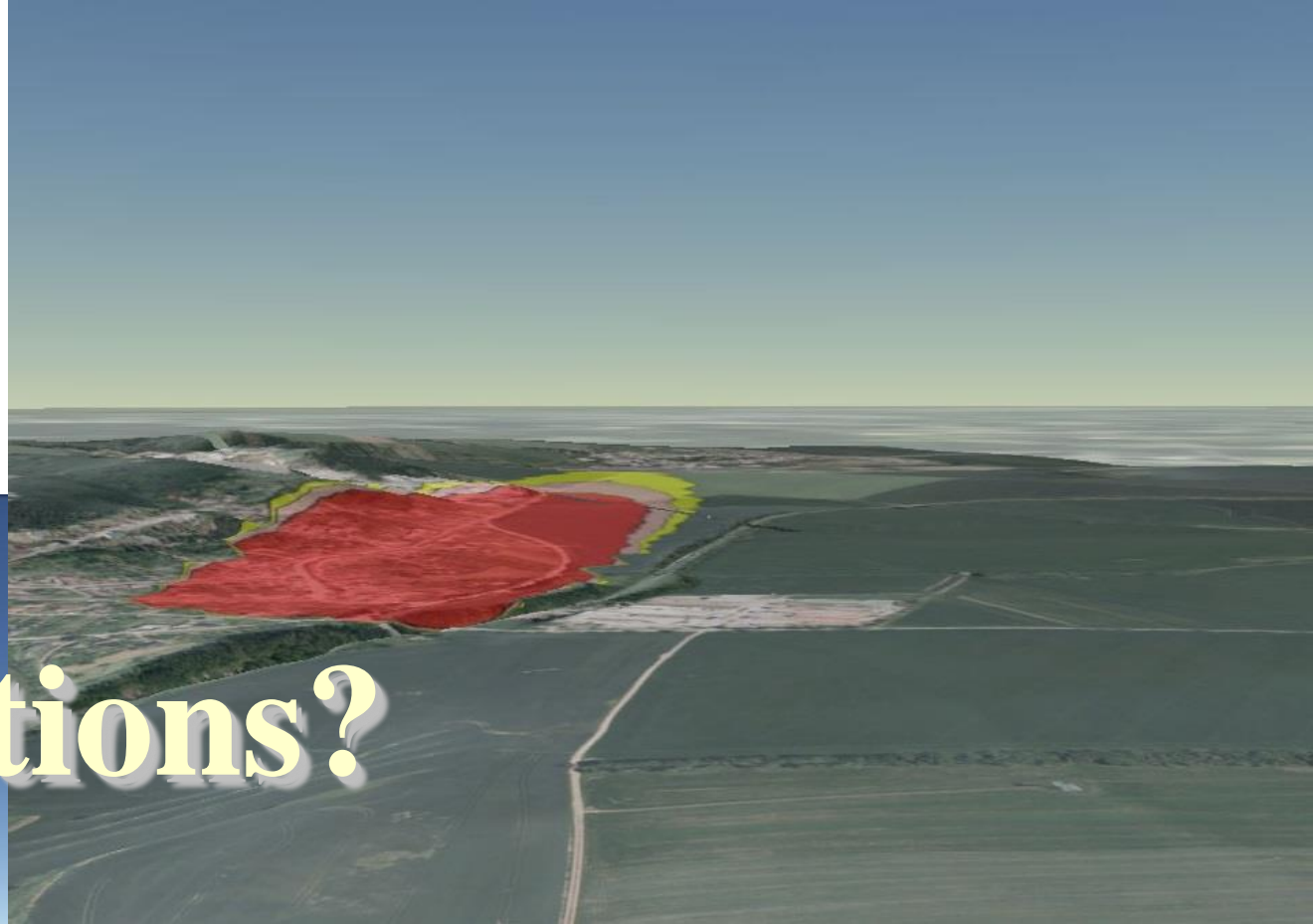




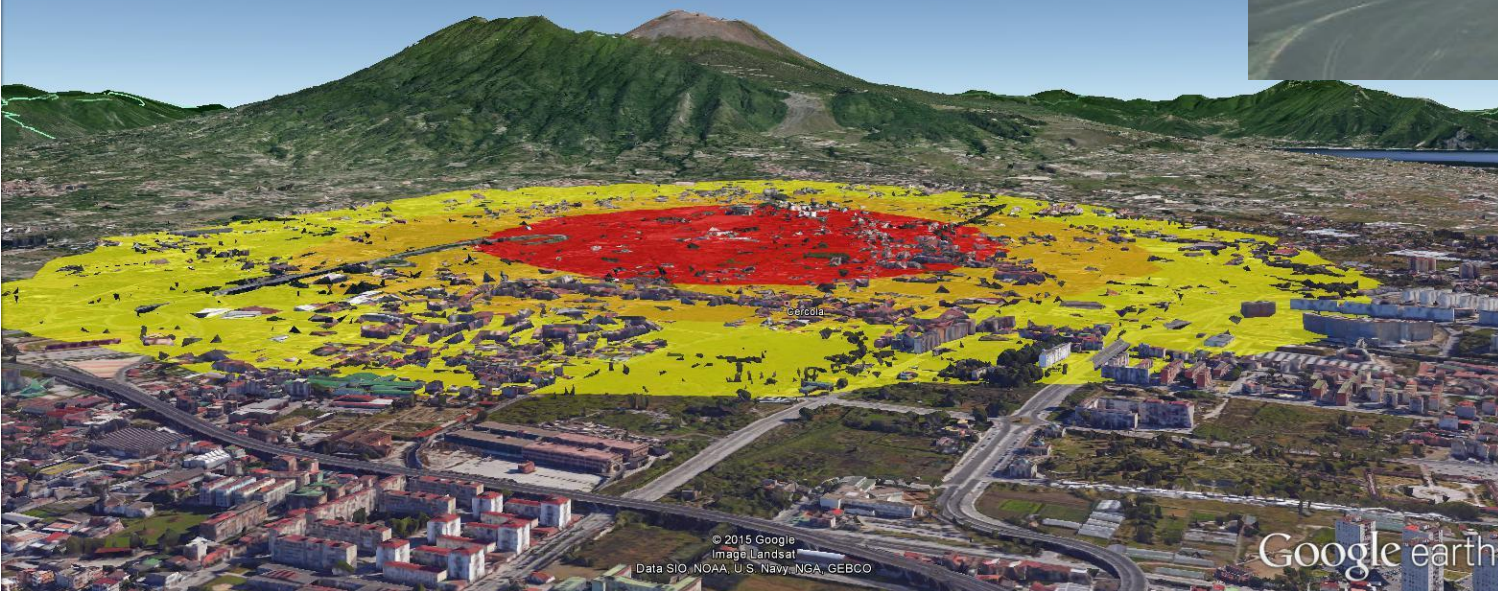
# The M&S future developments

- **More detailed and accurate results**
- **User friendly analytical results with visualization of outputs**
- **Sustainment and development of cooperation with partners**
- **Active contribution to the M&S experimentation**

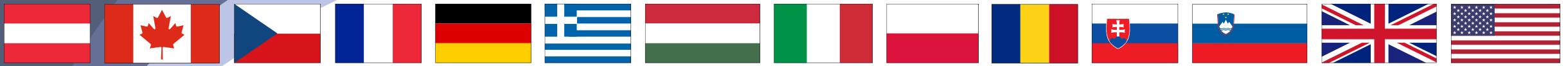




# Questions?







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