

# Recent Activities on SSA in NATO SCI-229 RTG

M. Messerotti and C. Cid

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# NATO SCI-229 Research Task Group

- **Aim**
  - Analysis of space environment support to NATO SSA
- **Proposed definition**
  - NATO *Space Situational Awareness is the knowledge and the understanding of military and non-military events, activities, circumstances and conditions within and associated with the space environment or space-related systems that are relevant for current and future NATO interest, operations and exercises*
- **Synergy with US and ESA SSA Programmes**
- **Start / End: 2011 / 2013**

# Deliverables

- Final Report
- Topical meetings for dissemination
- Series of lectures for education
- Prototype Expert System as didactic tool

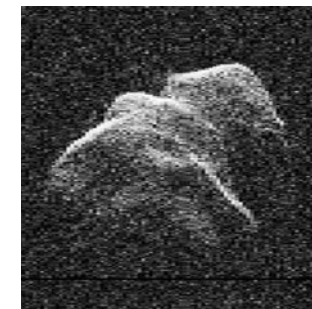
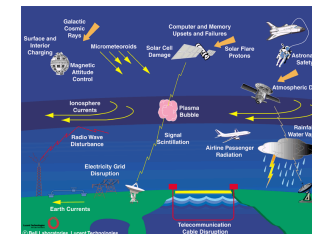
# Organisation of Work for Space Event Risk Assessment and Mitigation

Three main topics → Three Focus Groups:

1. Space Weather

2. Near Earth Objects (NEOs)

3. Space Debris (SDs)

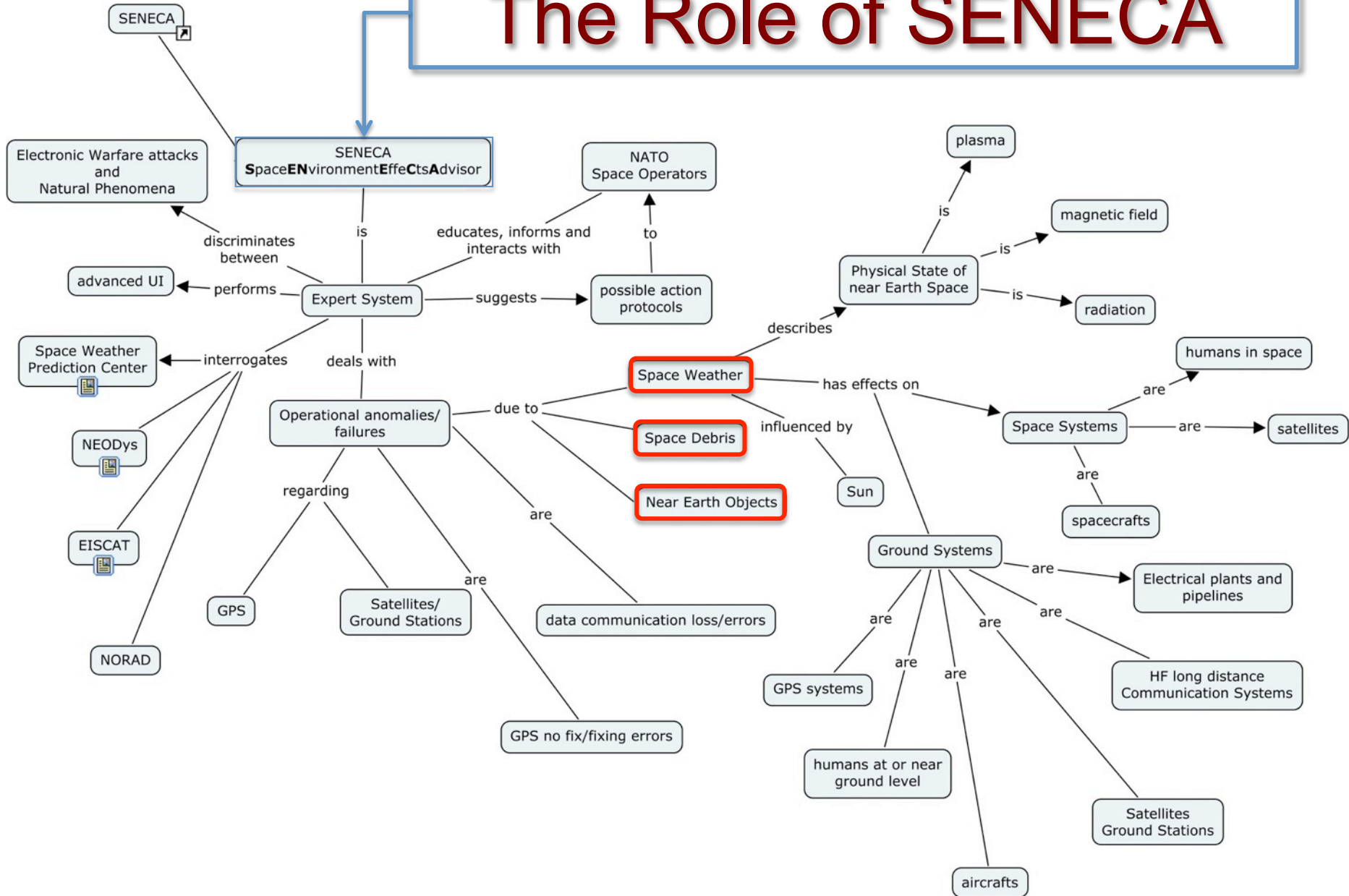


# SENECA

## Space ENvironment EffeCts Advisor

- A prototype expert system as a knowledge support and as a didactic tool
- Its implementation requires the availability of domain knowledge organised in schematic form → synoptic tables of space events impacting on space and space-related systems

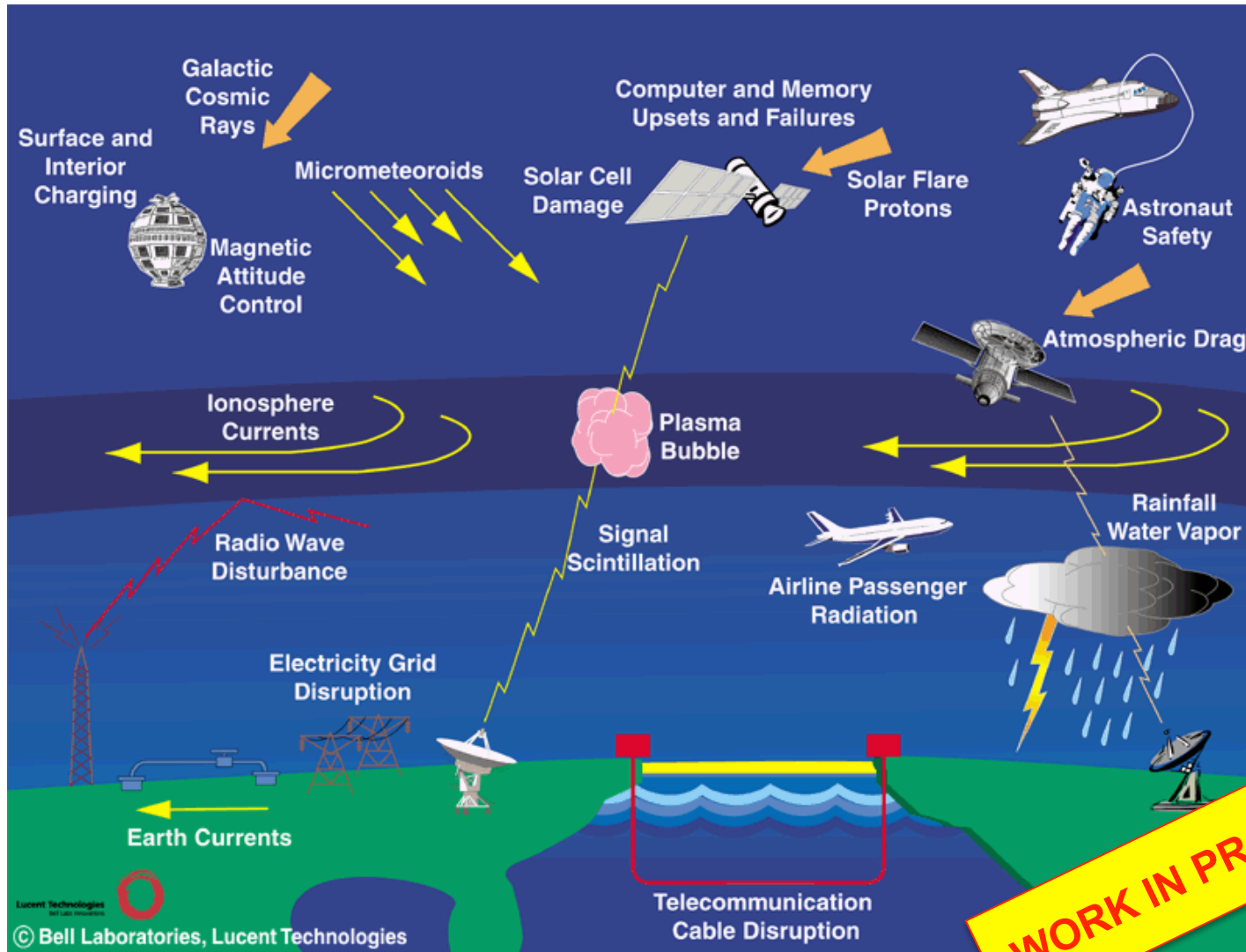
# The Role of SENECA



# Synoptic Tables of Space Events Impacting on Space and Space-Related Systems

- Are needed as an organised knowledge base, because the available information is typically:
  - Fragmentary
  - Incomplete
  - Inhomogeneous
  - Distributed over a variety of sources
  - Biased according to the context (e.g. academic textbook, operational manual, etc.)

# Space Weather Event Synopsis





# Space Environment Perturbation and Effects Synoptic Table

## SPACE WEATHER Template

Event Name	Event Type	Event Nature	EM Band	Energy Range	Speed [km s <sup>-1</sup> ]	Time of Flight [days]
CME	halo	plasmoid			1000	1.736
em	outburst	photon flash	EUV		300000	0.00579

# Space Environment Perturbation and Effects Synoptic Table

## SPACE WEATHER Template

(cont'd)

Affected Geospace Subsystem	Response Time	Response Phenomenon	Expected Start Time	Time of Maximum	Expected End Time	Max Intensity
	[hours]					
magnetosphere		geomagnetic storm				
thermosphere ionosphere		heating ionisation				

# Space Environment Perturbation and Effects Synoptic Table

## SPACE WEATHER Template

(cont'd)

Occurrence Probability	Effectiveness Threshold	Predictability	Affected Area	Affected Technological Systems	Affected Biological Systems
			sunlit hemisphere		

# Space Environment Perturbation and Effects Synoptic Table

## SPACE WEATHER Template

(cont'd)

Societal Impact Level	Military Impact Level	Associated Event	Observing Facility	Prediction Tool	Modelling Tool	Originating Event	References

# NEO Event Synopsis

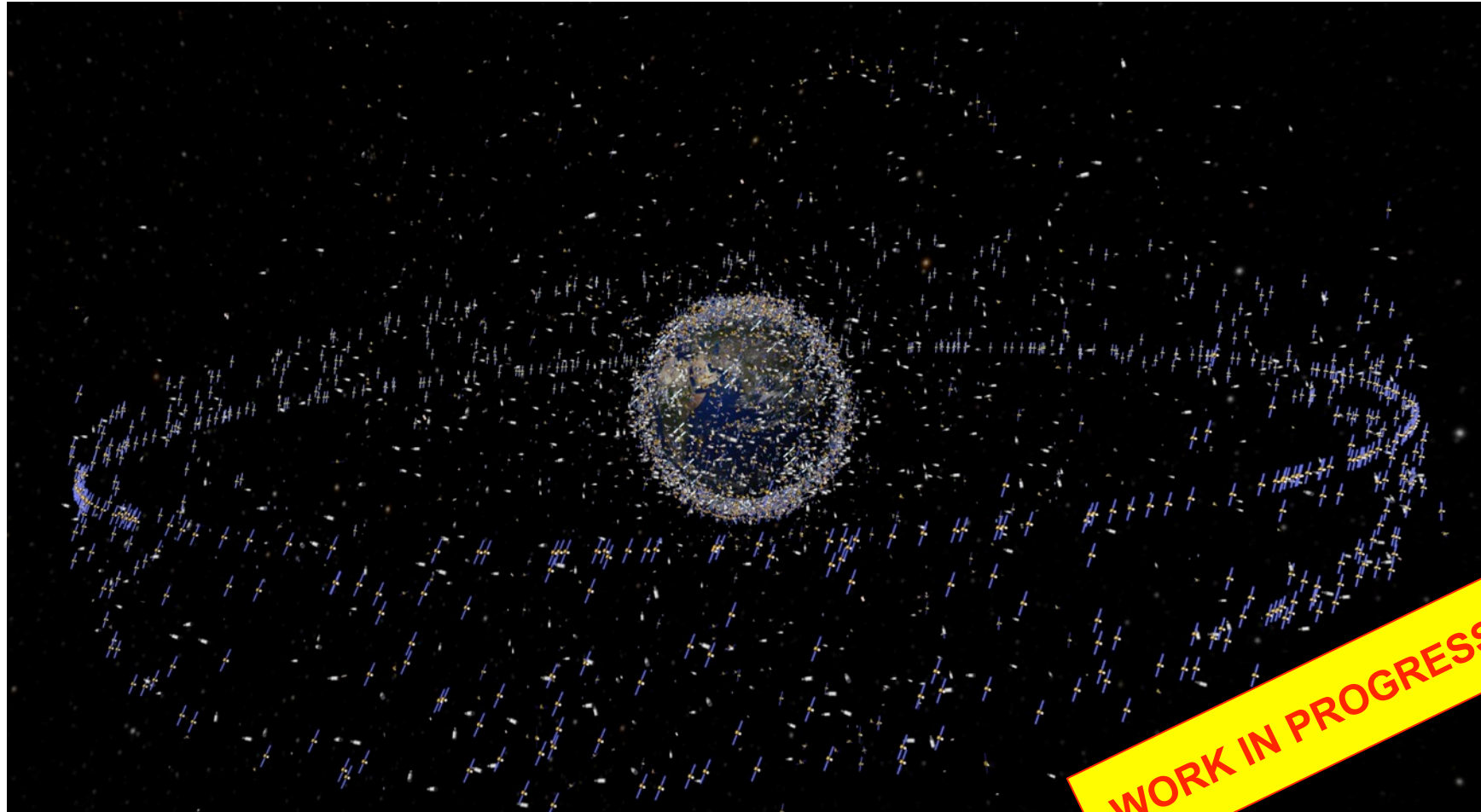


**WORK IN PROGRESS**

# Space Environment Perturbation and Effects Synoptic Table NEAR EARTH OBJECTS

Event Type	Diameter of impactor	Consequences	Energy liberated	Time scale (yr)
<b>Impact</b>	1km and larger	Global	>100000 MT	1.00E+05
<b>Impact</b>	140 m and larger	Local, tsunami if on ocean	>100 MT	10000
<b>Impact</b>	40 m and larger	Local	>1 MT	100
<b>Airburst</b>	1 m and larger	Flash	> 1 kT	0.1
<b>Meteor</b>	1 cm and smaller	Meteors, possible consequences on spacecraft	negligible	Specific dates each year

# Space Debris Event Synopsis



# Space Environment Perturbation and Effects Synoptic Table

## SPACE DEBRIS Template

Event Type	Object involved (target in case of collisions)	Object involved (projectile in case of collisions)	Event Nature	Consequences	Trigger	Epoch of event
<b>Explosion</b>	SL 1 R/B		Fragmentation	Lethal	Residual propellant	NN/NN/NN
<b>Explosion</b>	BrizM		Catastrophic fragmentation	Lethal	Propulsion related	02/28/06
<b>Explosion</b>	COSMOS XX		Localized damage	Lethal	Battery discharge	NN/NN/NN
<b>Collision</b>	Cerise	Ariane R/B debris	Localized damage	Non-lethal		07/24/96
<b>Collision</b>	Iridium 33	Cosmos 2251	Catastrophic fragmentation	Lethal		02/10/09
<b>Collision</b>	Feng Yun 1C	Ground launched warhead	Catastrophic fragmentation	Lethal		01/11/07
<b>Low energy release</b>			RORSAT drops			
<b>Low energy release</b>			Mission related objects release			
<b>Low energy release</b>			Delamination			
<b>Solid rocket motor exhaust</b>	XXXX R/B		Slag+dust release		Solid rocket motor burn	NN/NN/NN



# Space Environment Perturbation and Effects Synoptic Table

## SPACE DEBRIS Template

### (Cont'd)

Orbital zone	Orbital elements of target (a,e,i,node) [km and deg]	Orbital elements of projectile (a,e,i,node) [km and deg]	Affected altitude range [km]	Number of tracked objects	Estimated number of non-trackable objects [larger than 1 cm]	References
LEO						
LEO						
LEO						
LEO						
LEO	7175, 2.2e-4, 86, 122	7170,1.6e-3,74,19	600-1000			Rossi, Valsecchi and Farinella, <i>Nature</i> , 1999
LEO				3700	10000	
LEO			600-1000	1000		
MEO			19500-20000	3		
GEO			10000-37500	2		
GTO			700-36000	15	100	

# WORK IN PROGRESS

