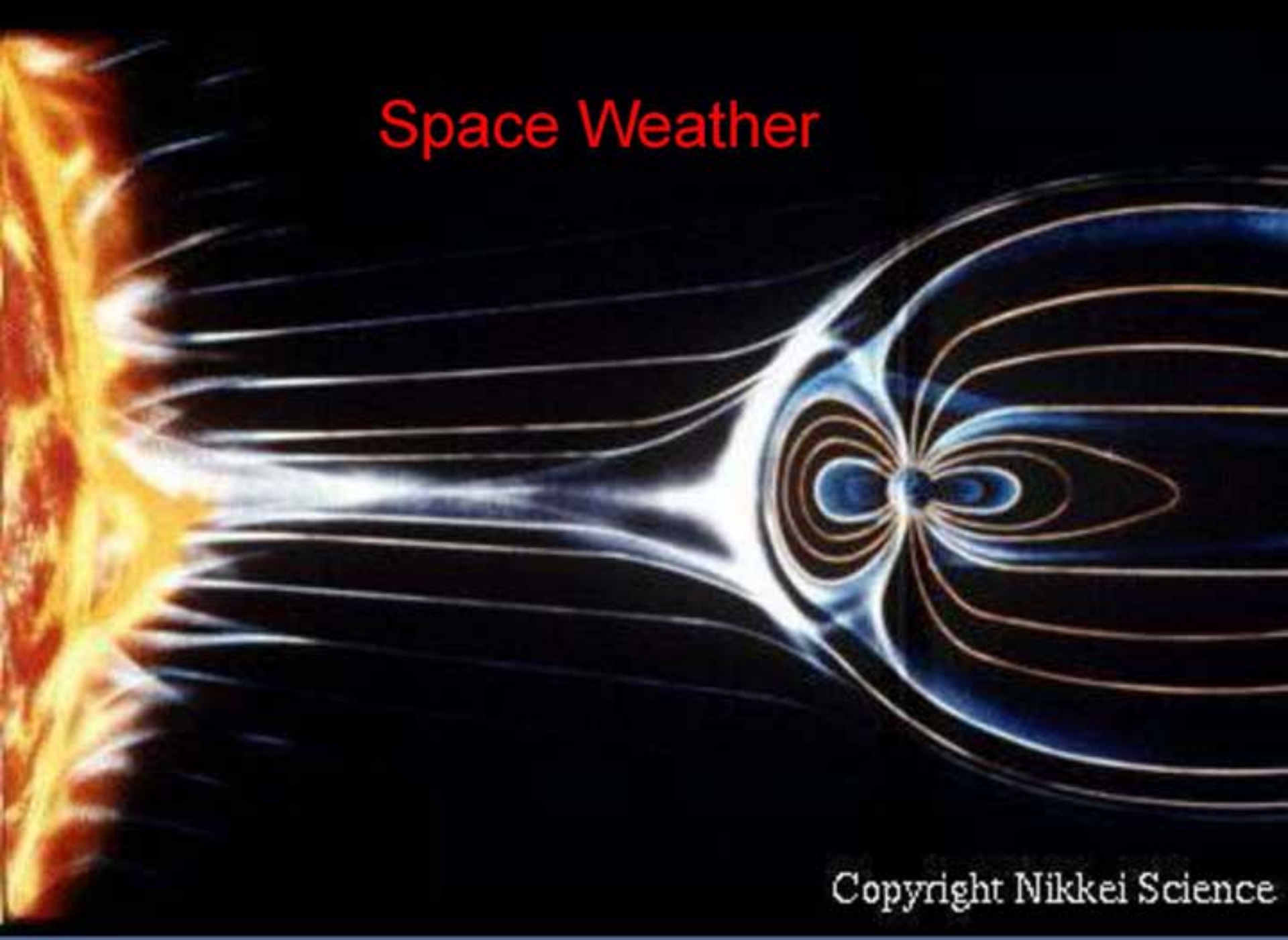
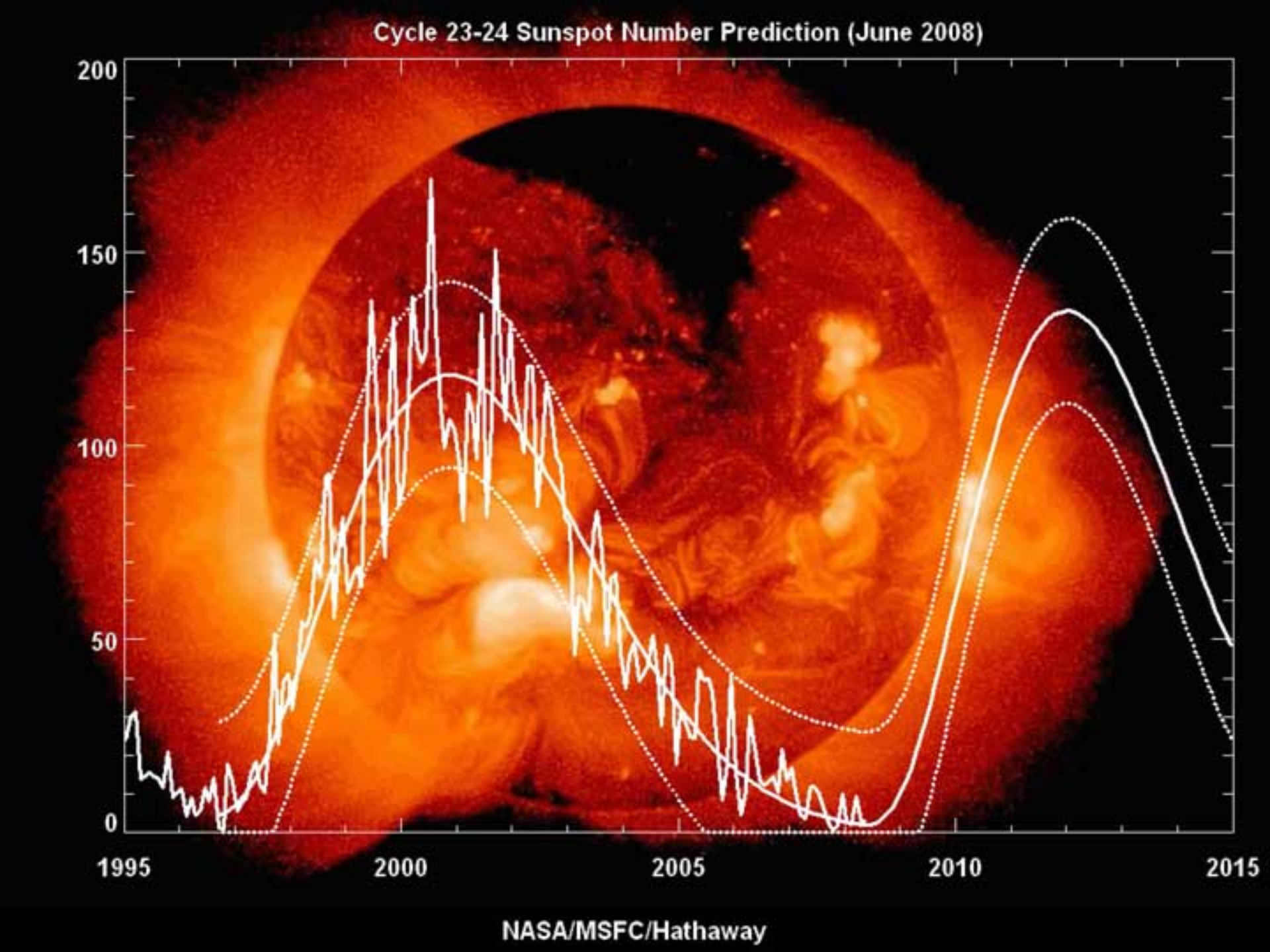
CHALLENGES FROM SPACE FOR CRITICAL INFRASTRUCTURES

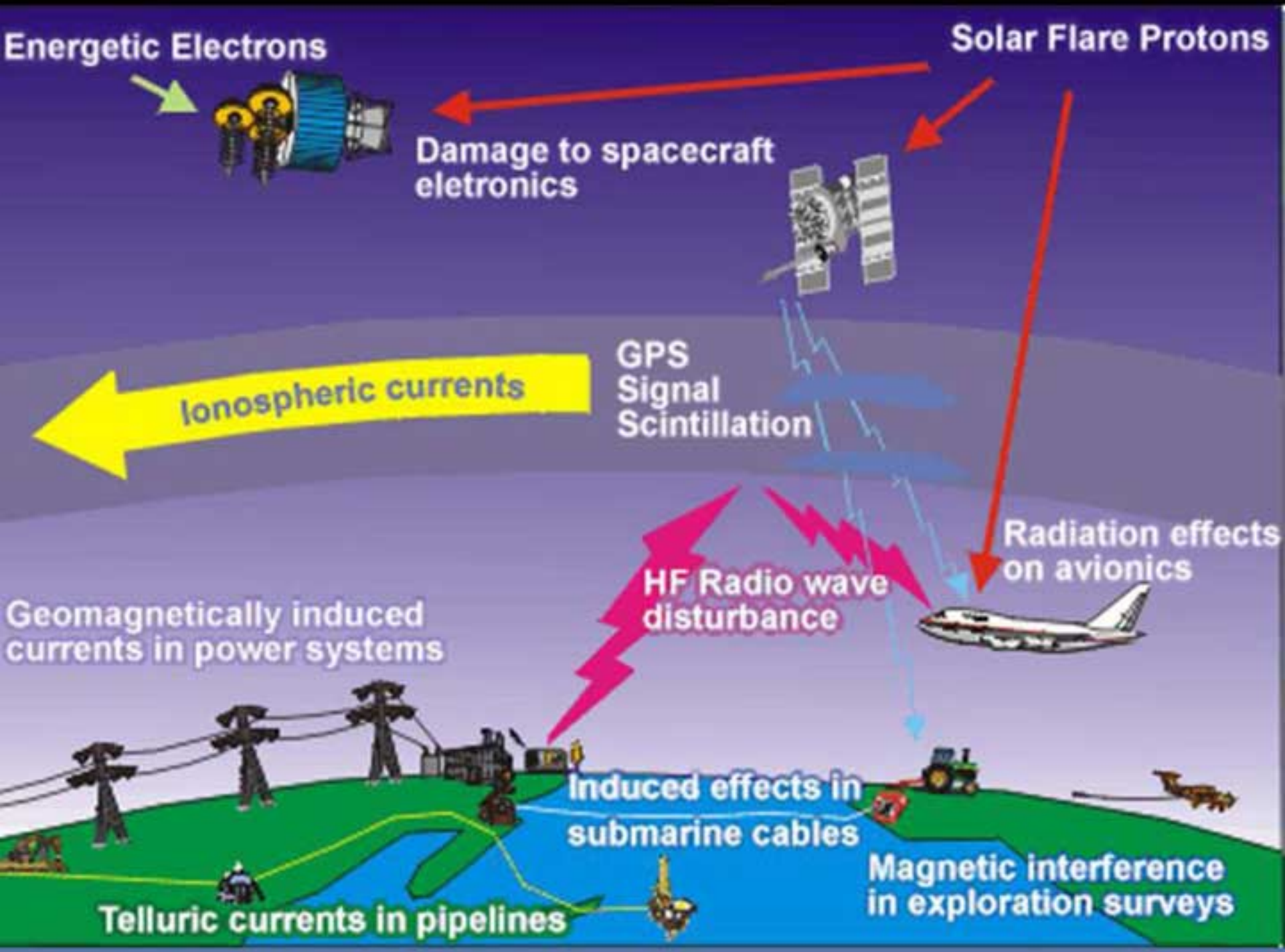
Dumitru-Dorin Prunariu

Bucharest, **27 - 28 October 2011**

Space Weather

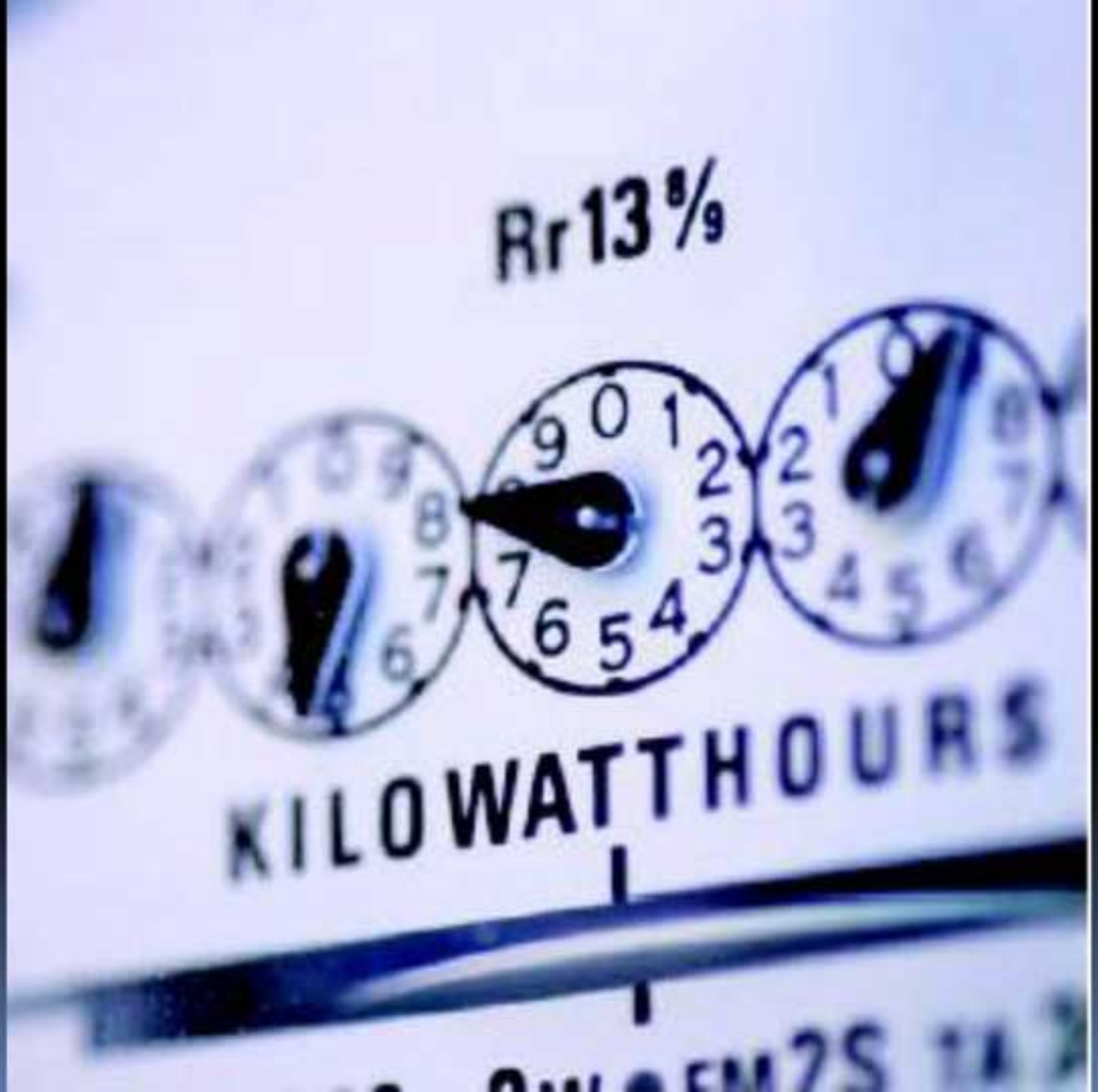


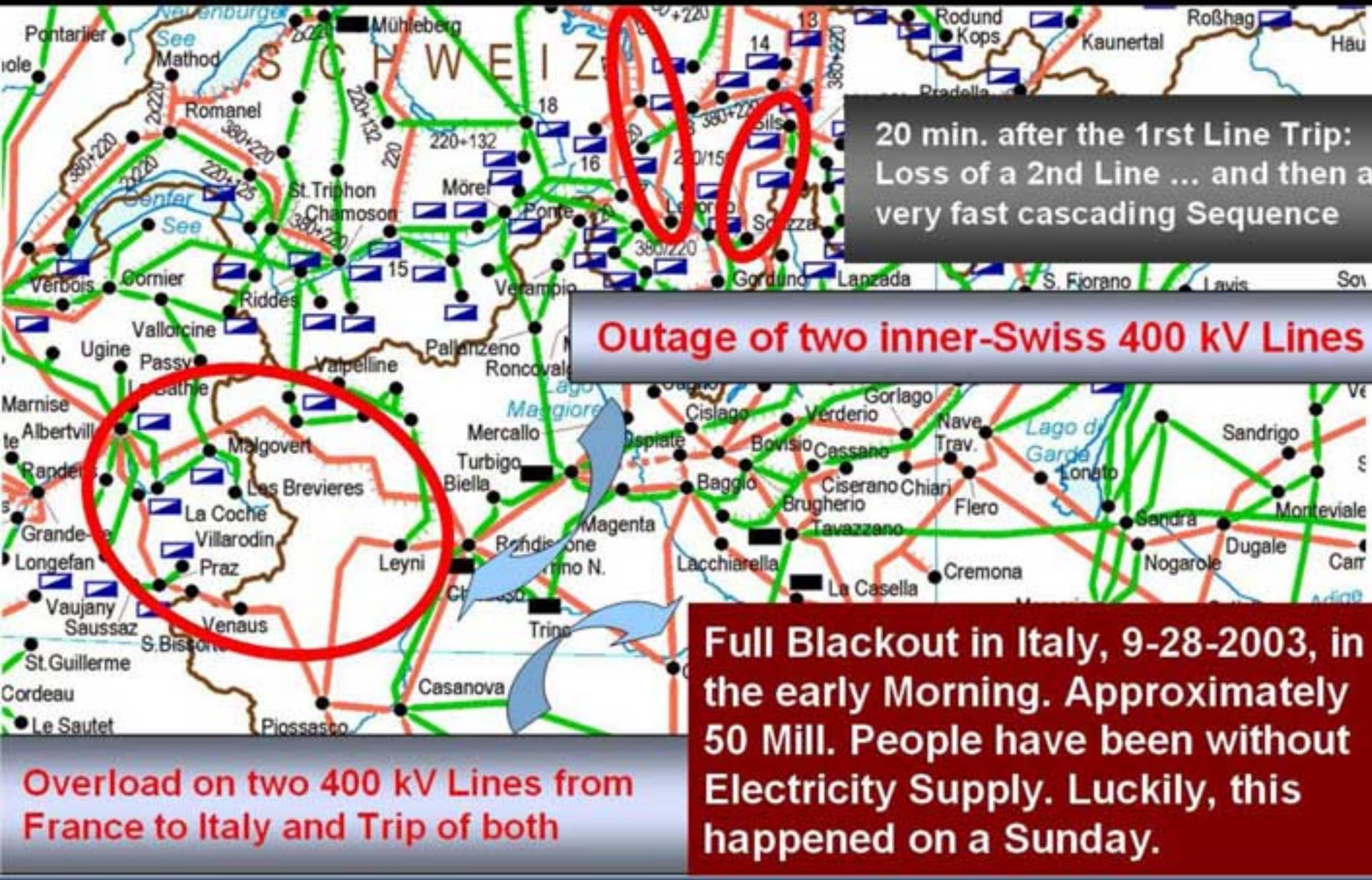

Cycle 23-24 Sunspot Number Prediction (June 2008)
200
150
100
50
0
1995
2000
2005
2010
2015
NASA/MSFC/Hathaway


Energetic Electrons
Solar Flare Protons
Damage to spacecraft eletronics
Ionospheric currents
GPS Signal Scintillation
Radiation effects on avionics
HF Radio wave disturbance
Geomagnetically induced currents in power systems
Induced effects in submarine cables
Magnetic interference in exploration surveys
Telluric currents in pipelines

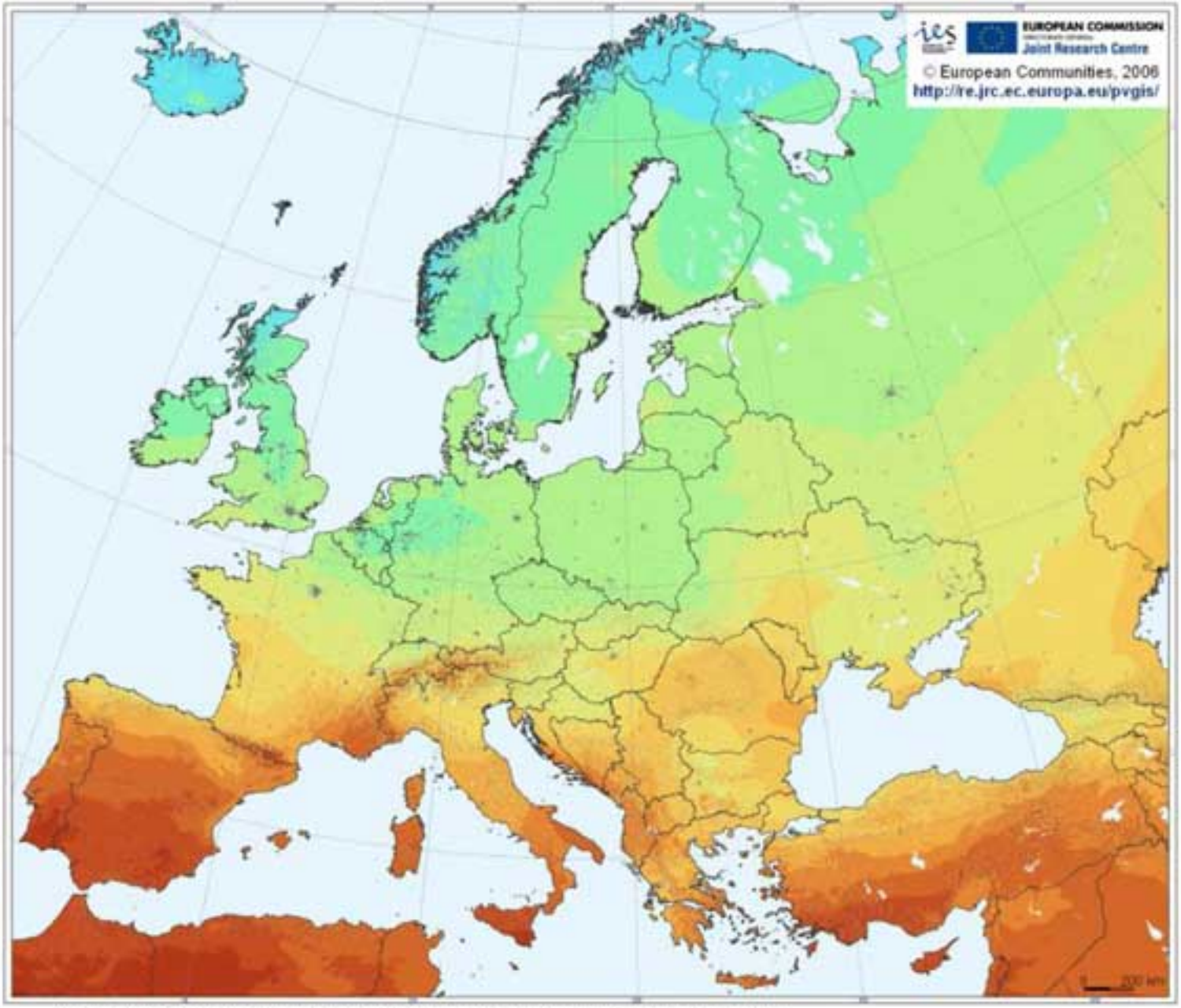
National Aeronautics and Space Administration

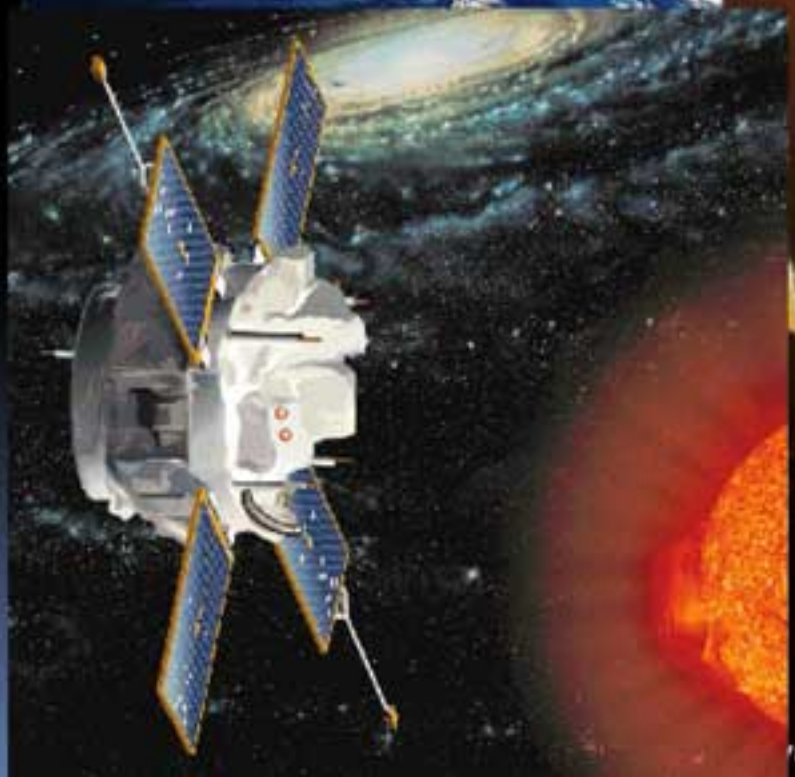
The Aurora Borealis


Rr13⅝
KILOWATTHOURS

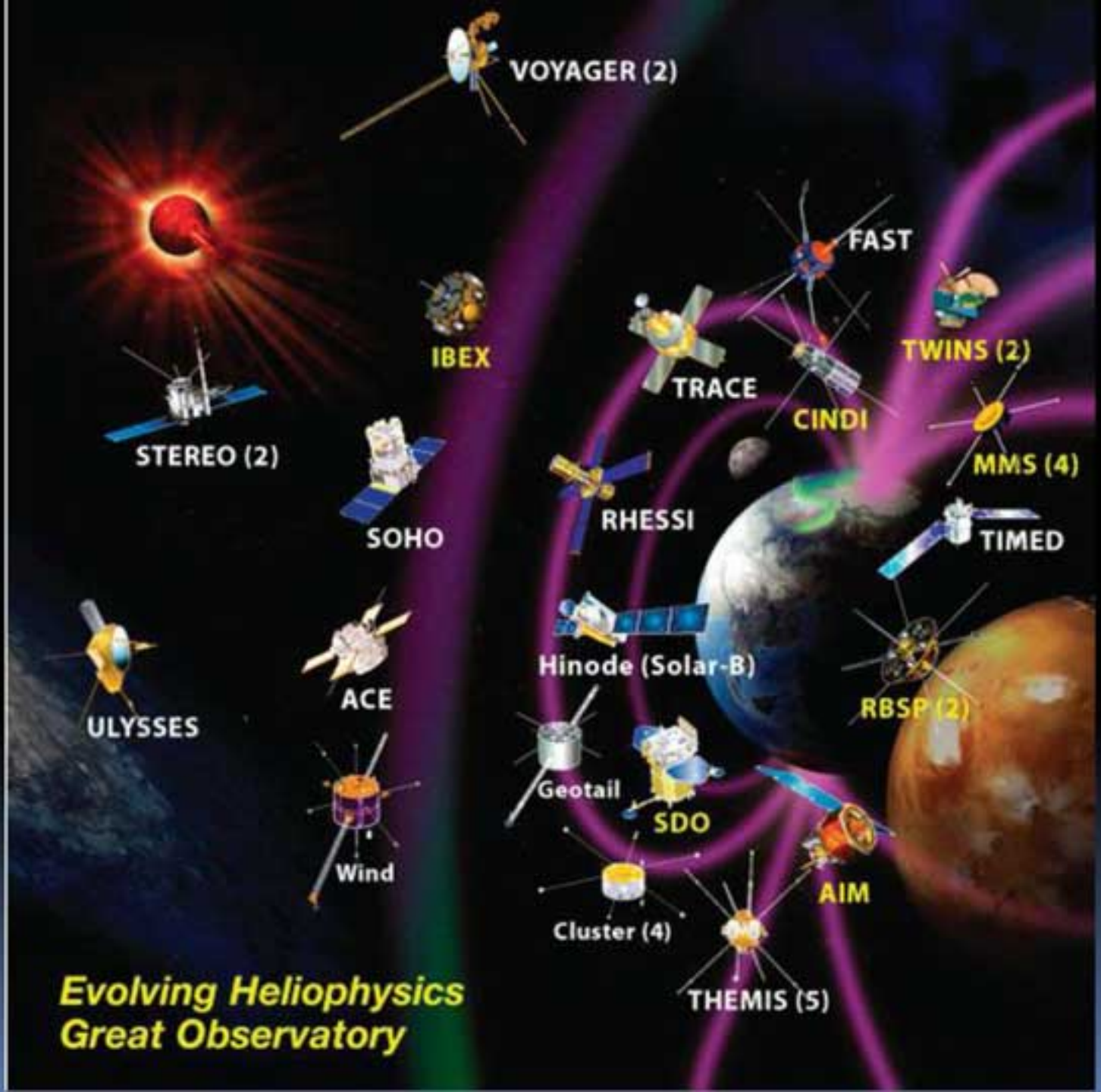

20 min. after the 1rst Line Trip: Loss of a 2nd Line ... and then a very fast cascading Sequence
Outage of two inner-Swiss 400 kV Lines
Overload on two 400 kV Lines from France to Italy and Trip of both
Full Blackout in Italy, 9-28-2003, in the early Morning. Approximately 50 Mill. People have been without Electricity Supply. Luckily, this happened on a Sunday.
SCHWEIZ
Pontarlier
Mühleberg
Mathod
Romanel
St.Triphon
Chamoson
Mörel
Verbois
Cornier
Riddes
Vallorcine
Ugine
Passy
Marnise
Albertvill
Malgovert
Les Brevieres
La Coche
Villarodin
Praz
Longefan
Vaujany
Saussaz
Venaus
St.Guillerme
Cordeau
Le Sautet
Piossasco
Leyni
Casanova
Mercallo
Turbigo
Biella
Magenta
Lacchiarella
Cremona
La Casella
Baggio
Bovisio
Cassano
Cislago
Verderio
Gorlago
Nave
Trav.
Brugherio
Ciserano
Chiari
Flero
Tavazzano
Lonato
Sandrigo
Sandra
Nogarole
Dugale
Rodund
Kops
Kaunertal
Roßhag
Gordunio
Lanzada
S. Fiorano
Verampio
Pallanzeno
Roncovalle
Valpelline

Photovoltaic Solar Electricity Potential in European Countries

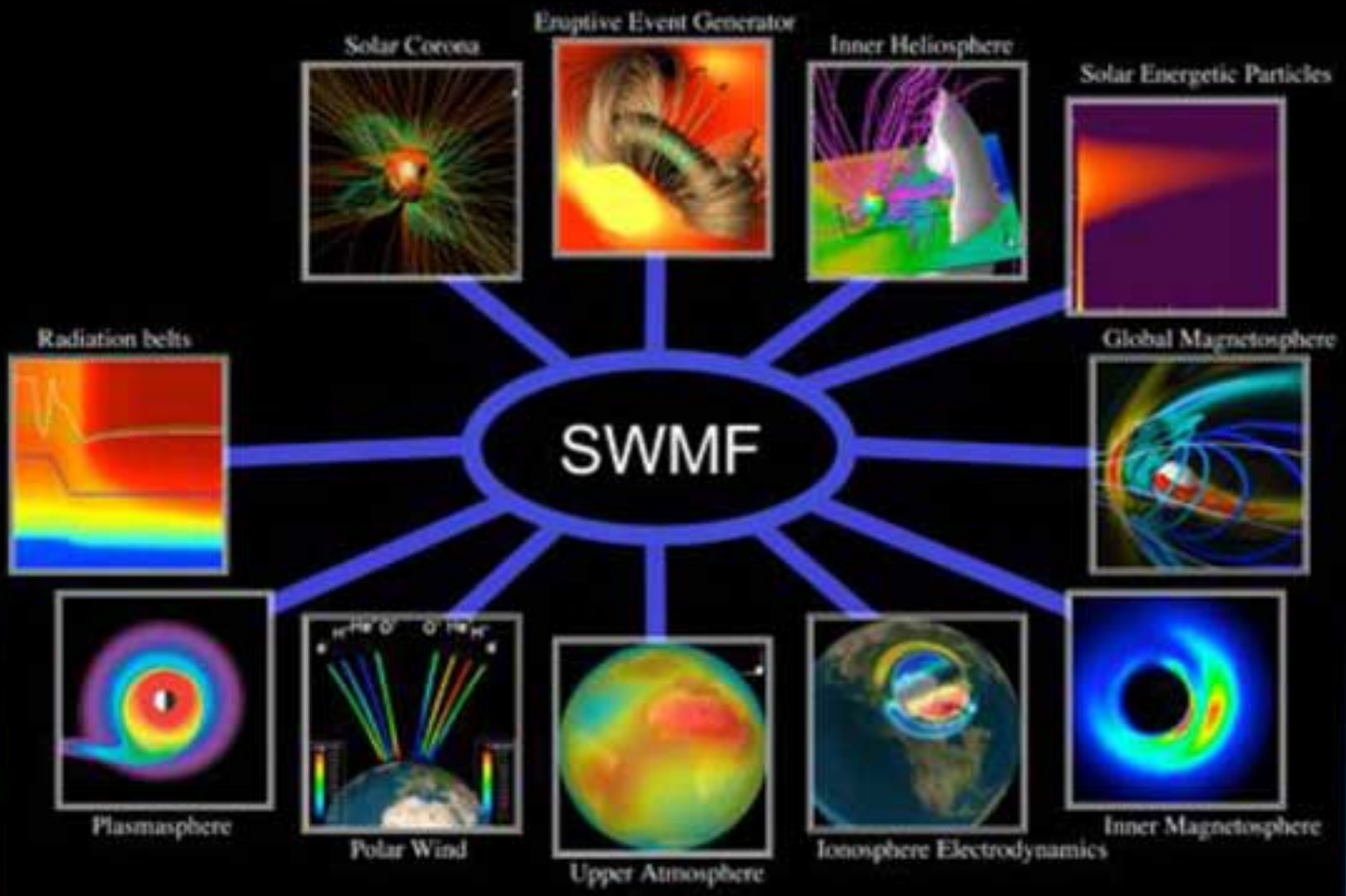


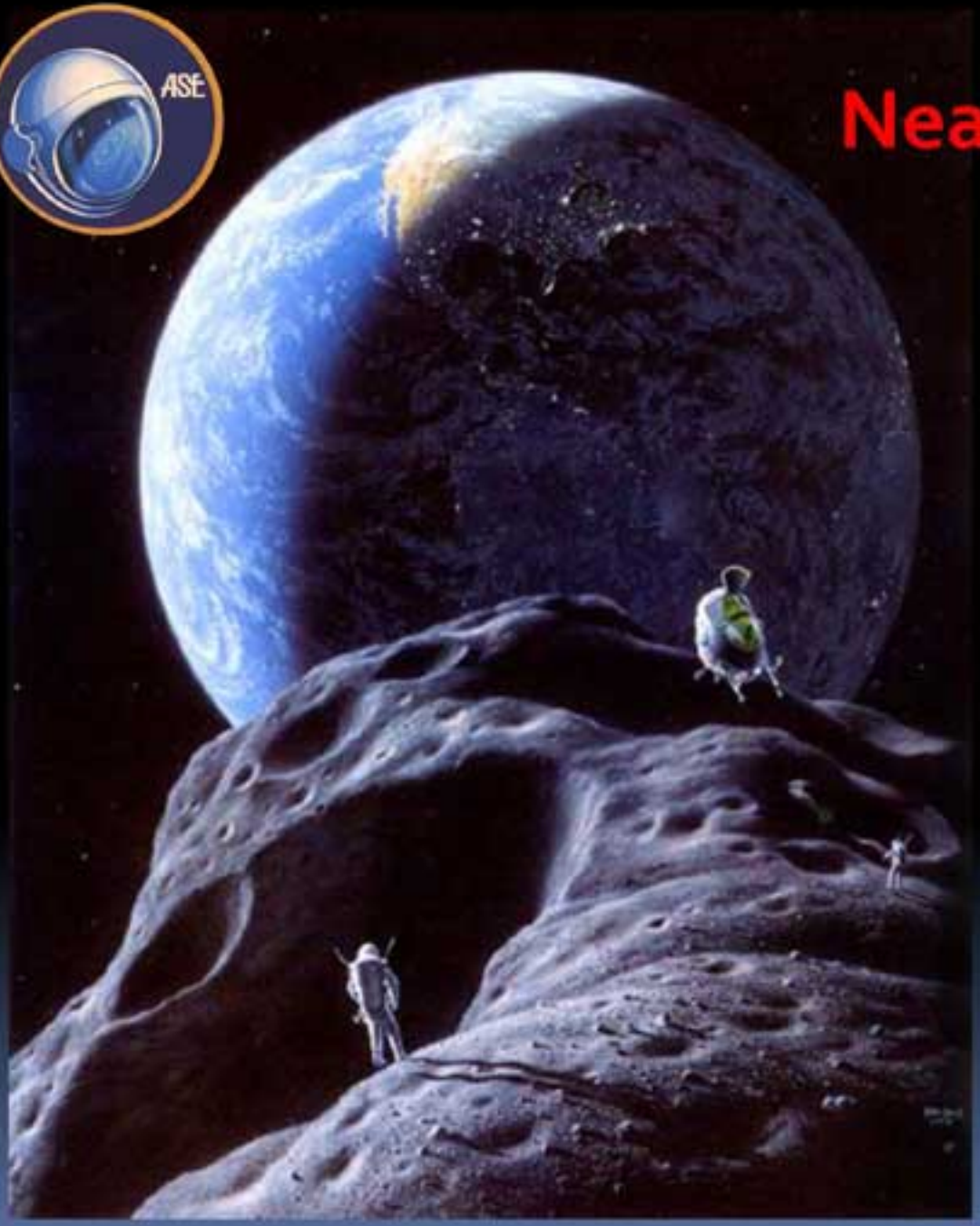


/NASA/JPL/SOHO

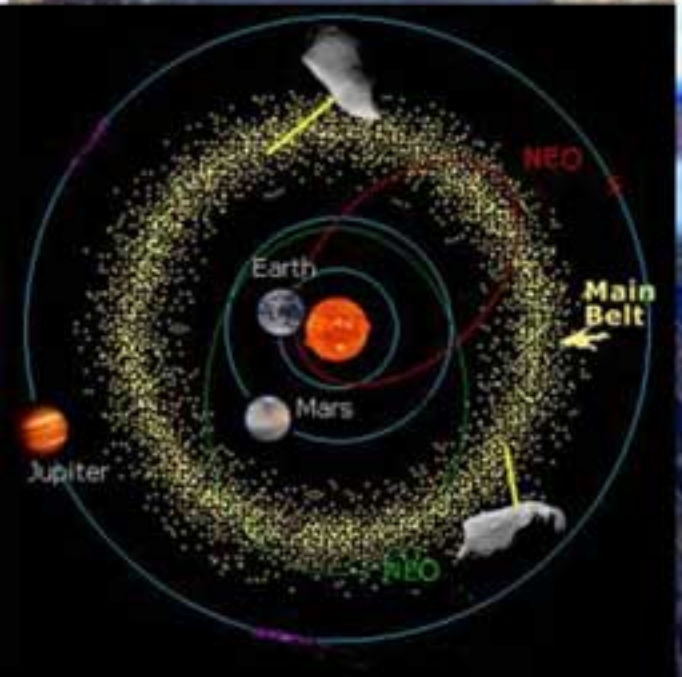

VOYAGER (2)
IBEX
STEREO (2)
SOHO
ACE
ULYSSES
Wind
FAST
TRACE
CINDI
TWINS (2)
MMS (4)
RHESSI
TIMED
Hinode (Solar-B)
RBSP (2)
Geotail
SDO
AIM
Cluster (4)
THEMIS (5)
Evolving Heliophysics
Great Observatory

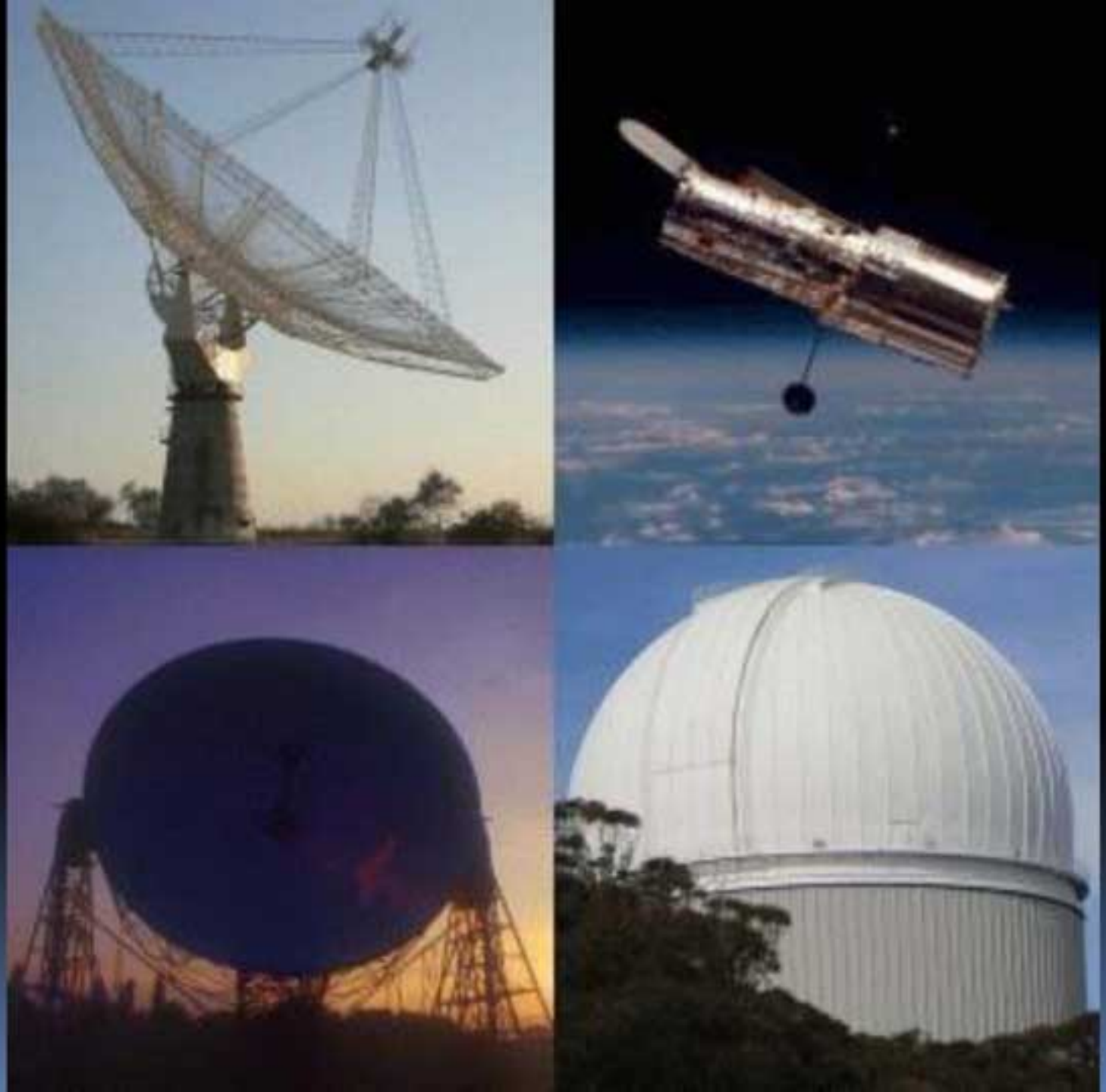
Space Weather Modeling Framework

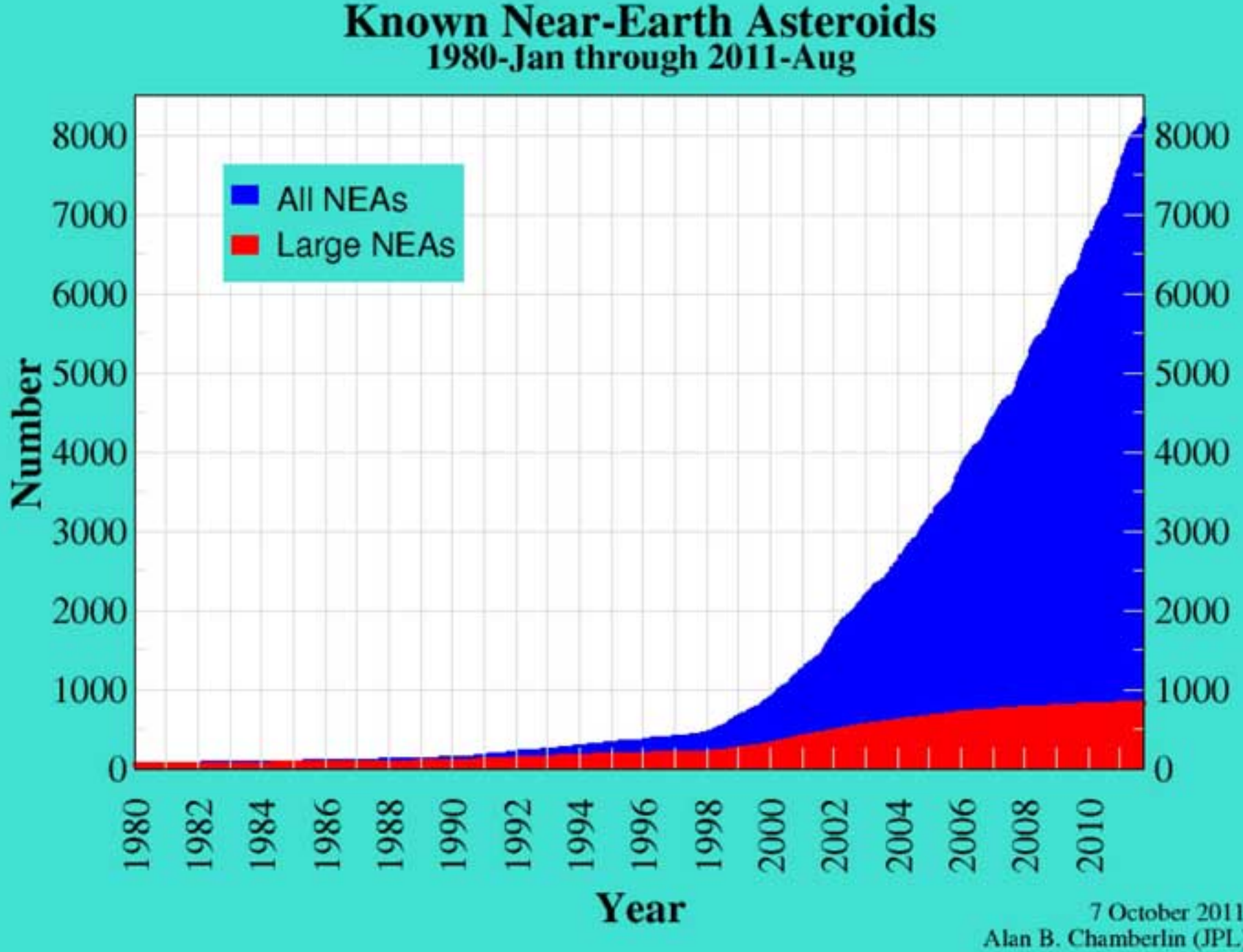


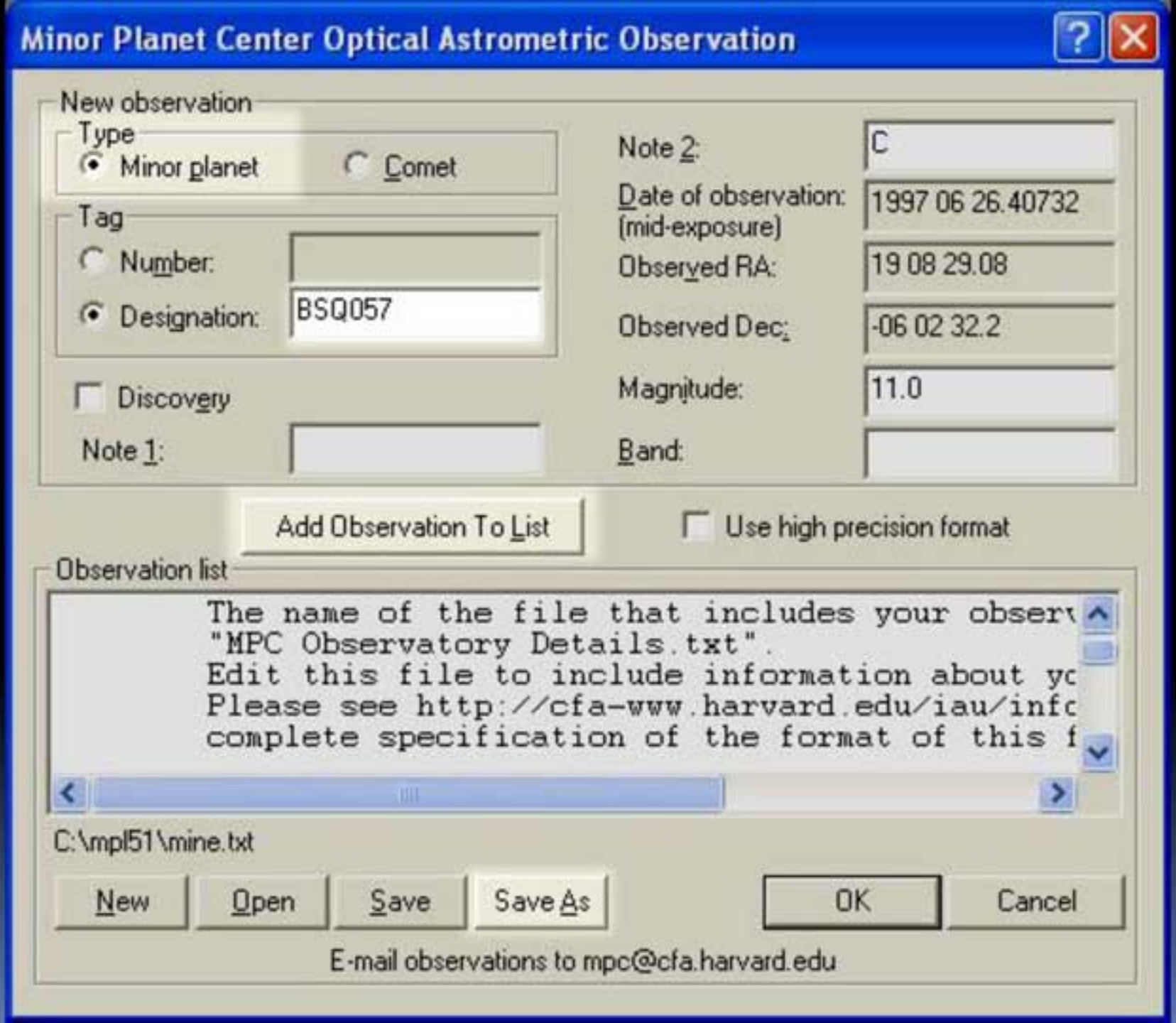


Neart Earth Objects Hazard


NEO
Earth
Main Belt
Mars
Jupiter
NEO




Known Near-Earth Asteroids
1980-Jan through 2011-Aug
All NEAs
Large NEAs
Number
0
1000
2000
3000
4000
5000
6000
7000
8000
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Year
7 October 2011
Alan B. Chamberlin (JPL)


Minor Planet Center Optical Astrometric Observation
New observation
Type
Minor planet
Comet
Tag
Number:
Designation:
BSQ057
Discovery
Note 1:
Note 2:
C
Date of observation: (mid-exposure)
1997 06 26.40732
Observed RA:
19 08 29.08
Observed Dec:
-06 02 32.2
Magnitude:
11.0
Band:
Add Observation To List
Use high precision format
Observation list
The name of the file that includes your obser
"MPC Observatory Details.txt".
Edit this file to include information about yc
Please see http://cfa-www.harvard.edu/iau/infc
complete specification of the format of this f
C:\mpl51\mine.txt
New
Open
Save
Save As
OK
Cancel
E-mail observations to mpc@cfa.harvard.edu

These results were computed on May 22, 2009

2009 KK
Earth Impact Table

These results were computed on May 23, 2009

These results were computed on Jun 03, 2009

2009 KK
Earth Impact Table

Date	Distance	Width	Sigma Impact	Sigma LOV	Stretch LOV	Impact Probability	Impact Energy	Palermo Scale	Torino Scale
YYYY-MM-DD.DD	(r_{Earth})	(r_{Earth})			(r_{Earth})		(MT)		
2022-05-29.76	0.59	1.67e-02	0.000	-1.07384	3.75e+03	9.6e-05	1.11e+03	-1.27	1

These results were computed on May 27, 2009

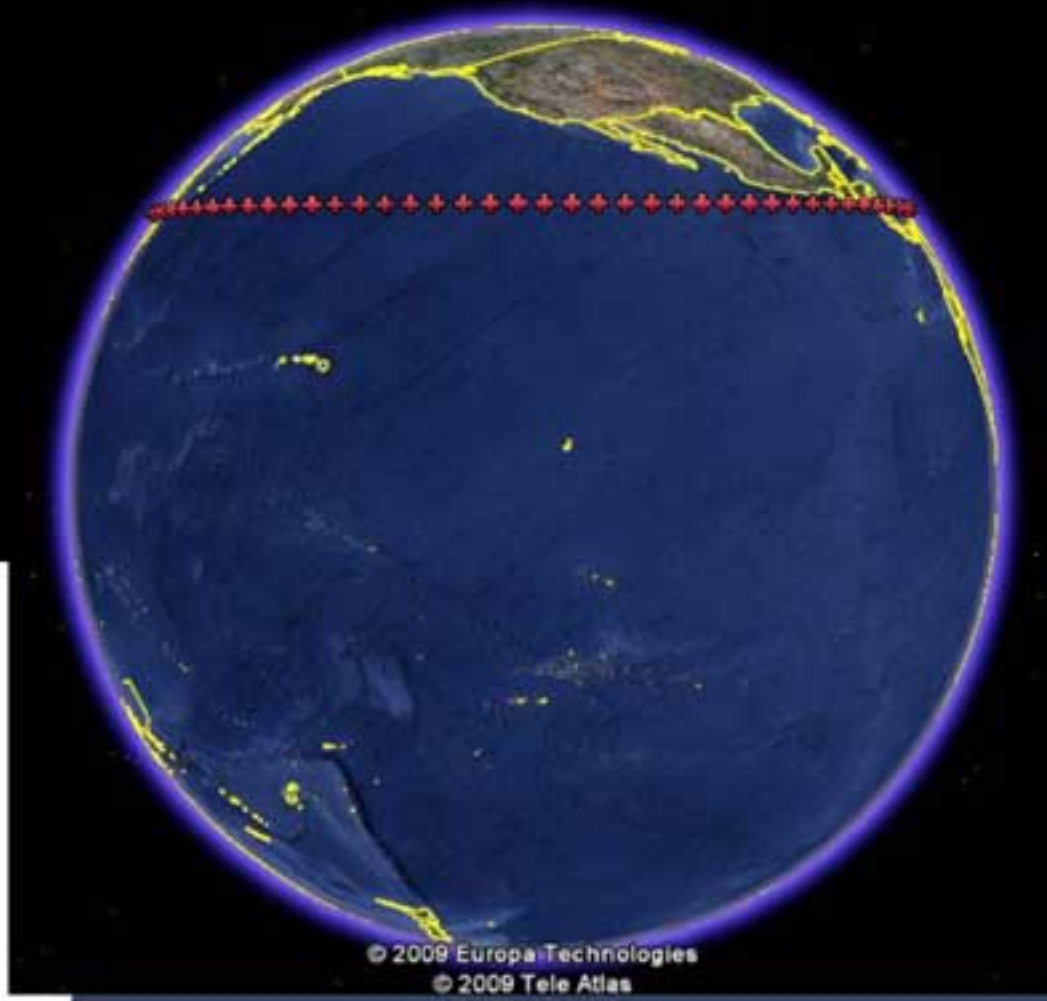
2009 KK
Earth Impact Table

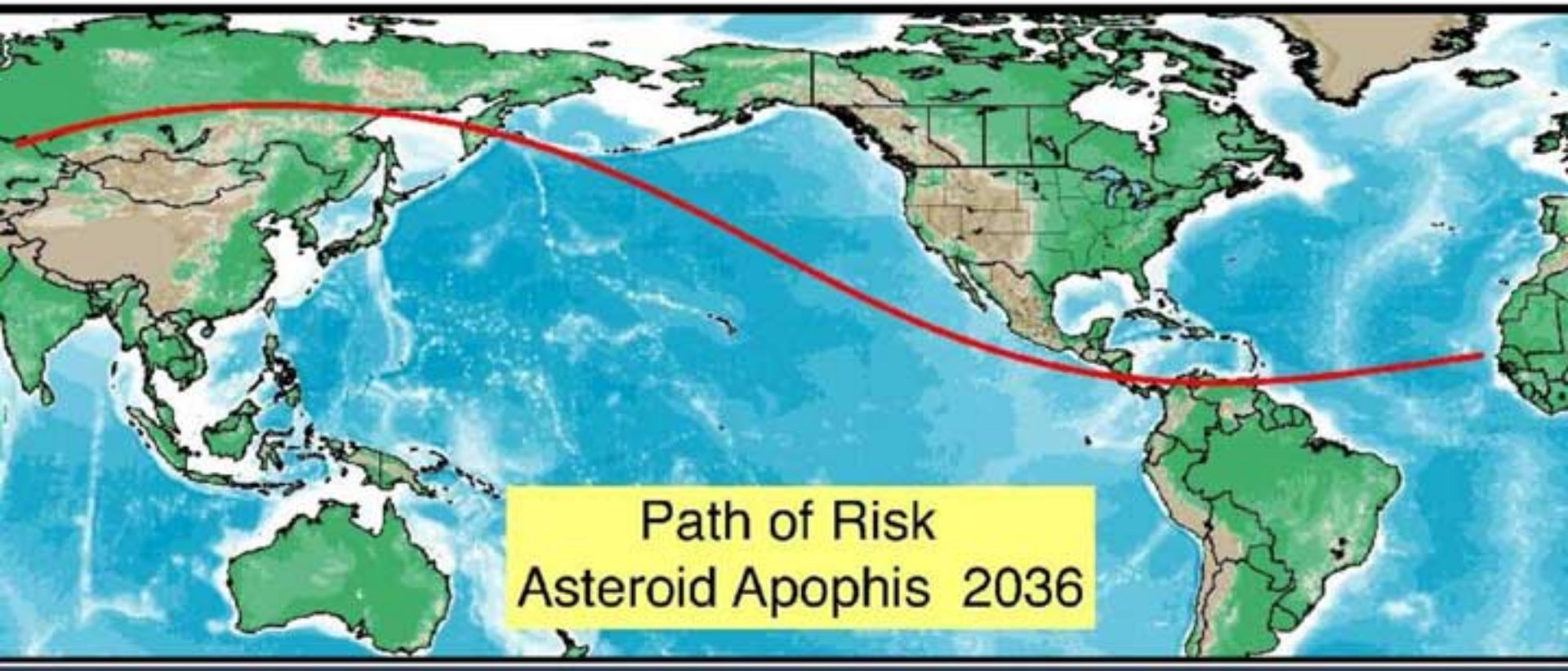
Date	Distance	Width	Sigma Impact	Sigma LOV	Stretch LOV	Impact Probability	Impact Energy	Palermo Scale	Torino Scale
YYYY-MM-DD.DD	(r_{Earth})	(r_{Earth})			(r_{Earth})		(MT)		
2022-05-29.76	0.55	3.95e-02	0.000	-1.37550	7.21e+03	3.6e-05	1.31e+03	-1.60	1

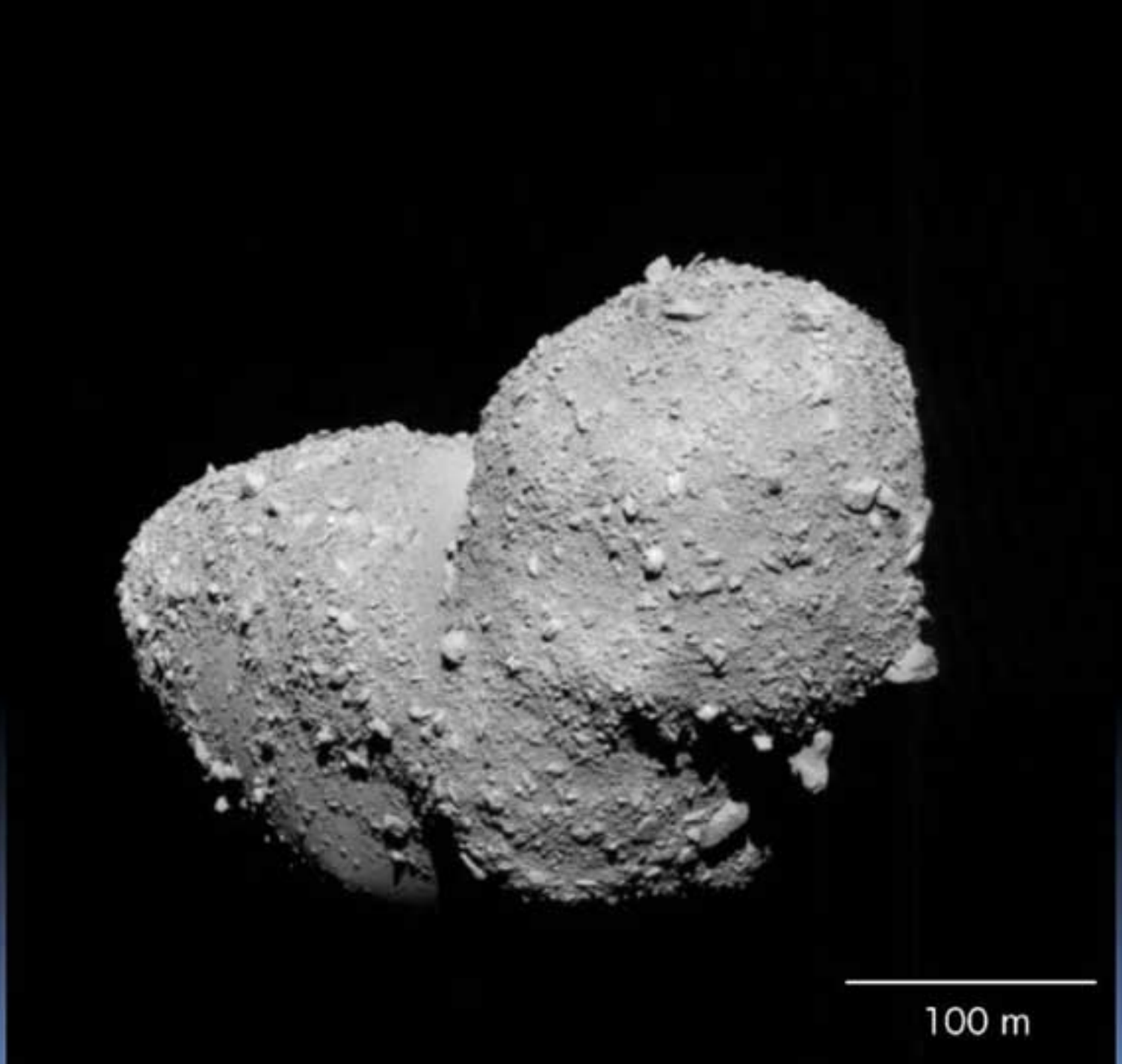
1 in 27,000

1 in 28,000

2036




Path of Risk
Asteroid Apophis 2036


100 m

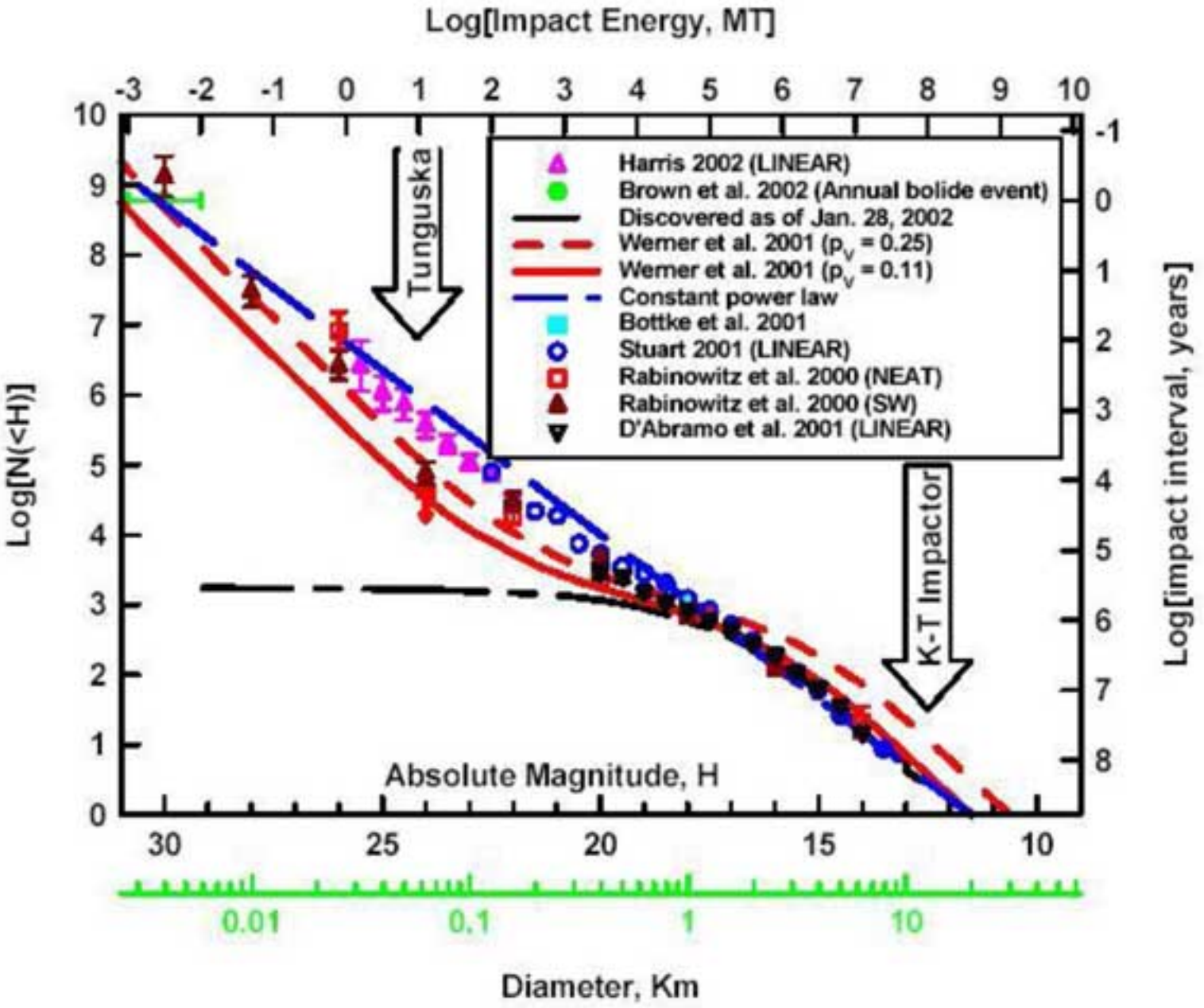
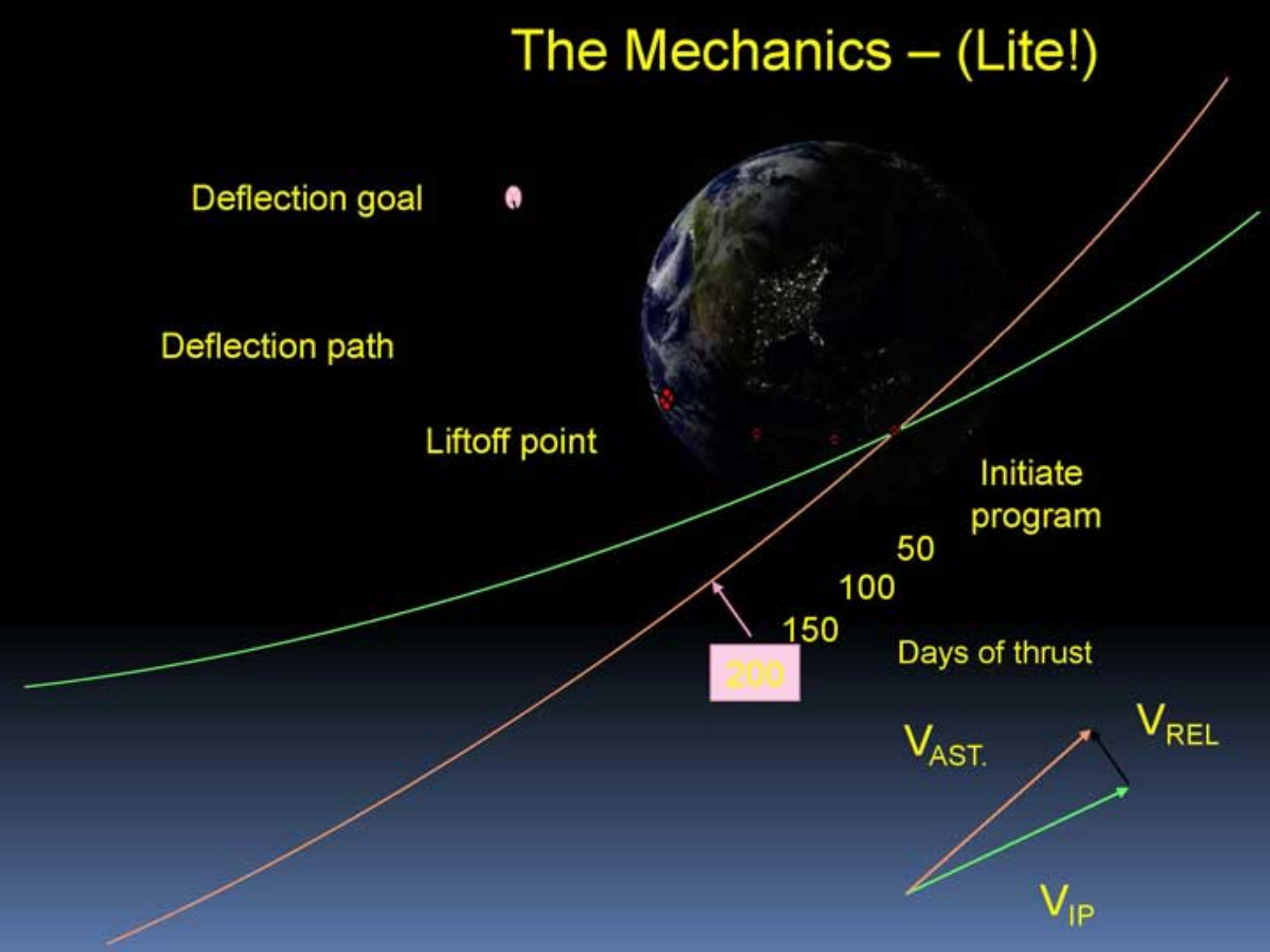
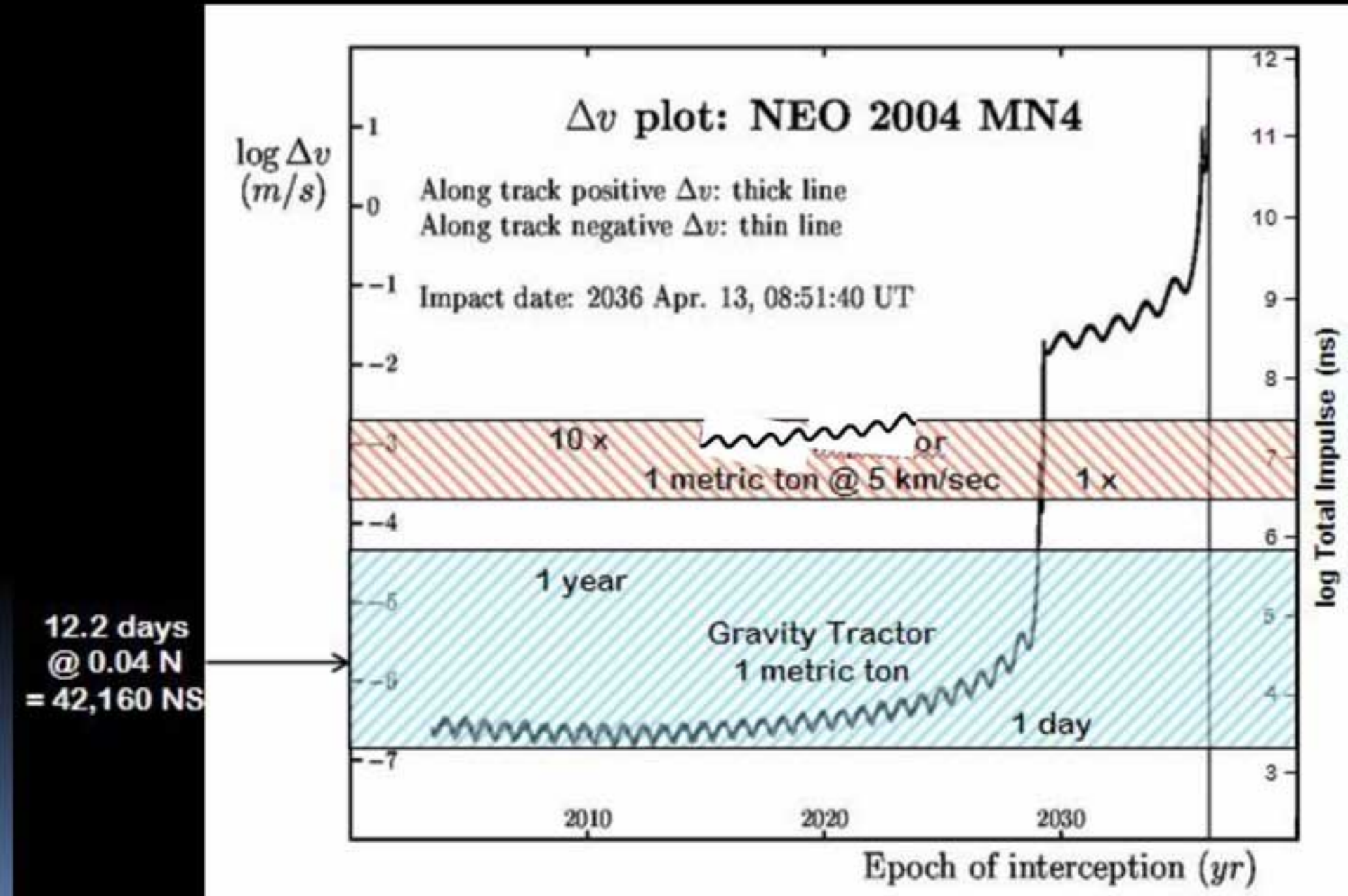


Figure 2-3. The population of near Earth Asteroids

The Mechanics – (Lite!)




Δv plot: NEO 2004 MN4
log Δv (m/s)
Along track positive Δv: thick line
Along track negative Δv: thin line
Impact date: 2036 Apr. 13, 08:51:40 UT
10 x
or
1 metric ton @ 5 km/sec
1 x
1 year
Gravity Tractor
1 metric ton
1 day
12.2 days
@ 0.04 N
= 42,160 NS
2010
2020
2030
Epoch of interception (yr)
log Total Impulse (ns)

Proposal for forming an IAA Study Group made by the president of ROSA

Space Structures and Critical Infrastructures

Overall Goal:

To estimate the level of dependence of Earth civilization on the actual and planned space systems
To estimate the level of dependence of space systems on internal and out of Earth aggressive factors
To produce recommendations for space agencies and political stakeholders regarding actual utilization and future needs of critical space systems

Target Community:

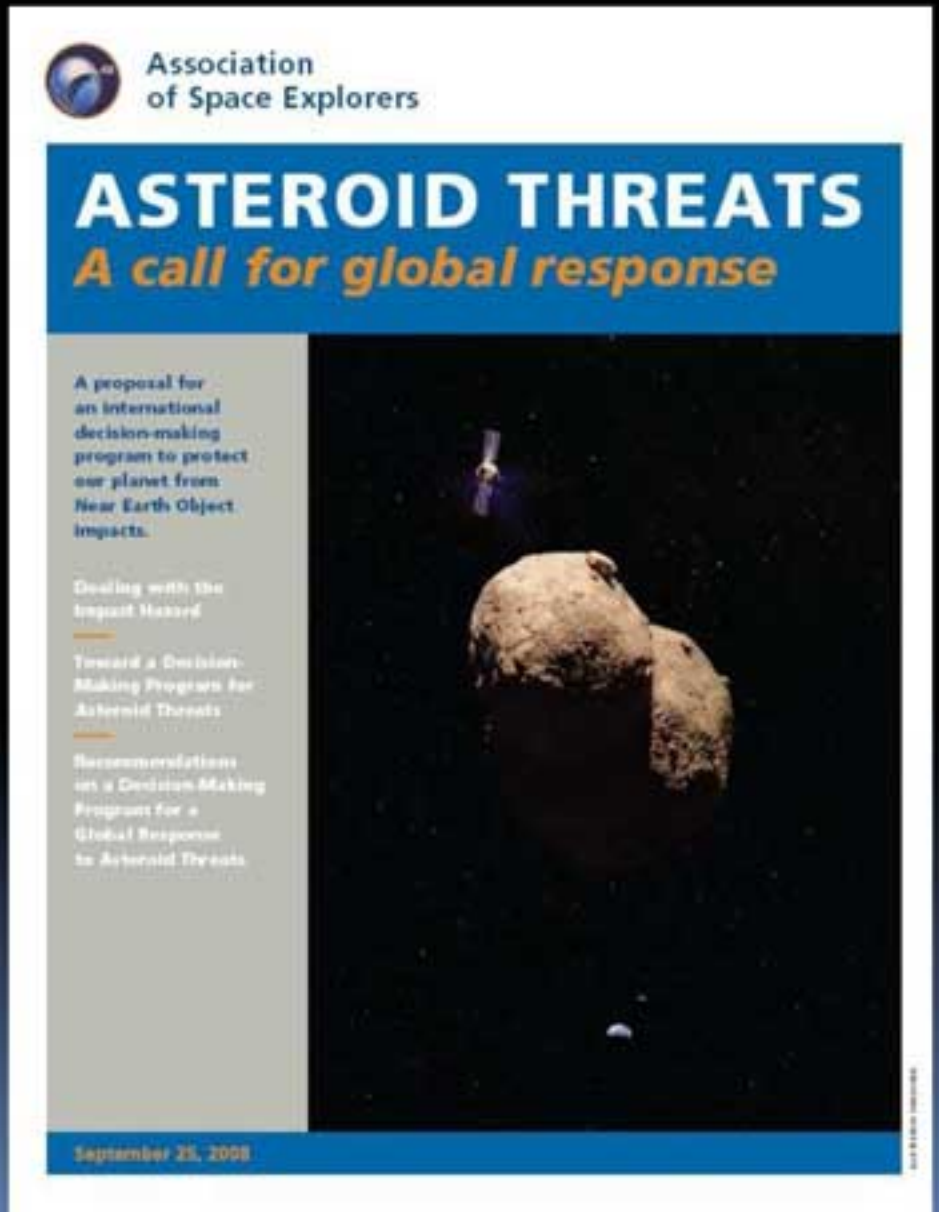
UN-COPUOS
European Level: European Commission ESRIF, ESFRI
NATO RTO

Organizers and Principals of the 1st ASE workshop on Near Earth Objects, Strasbourg, May10, 2007:

Dr. Jim Zimmerman, ambassador Walther Lichem, Dr. Tomifumi Godai, cosmonaut Dumitru-Dorin Prunariu, astronaut Russell Schweickart, Dr. Karlene Roberts, Dr. Sergio Camacho-Lara, Dr. Senjei Kapitza, Dr. Paul Kovacs, Dr. Roger-M. Bonnet, astronaut Thomas Jones, Sir Crispin Tickell


Google

February 09 and being coordinated within COPUOS by Action Team-14




CHAIRMAN