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Towards Plans for Mitigating Possible Socio-economic Effects due to a Physical Impact of an Asteroid on Earth

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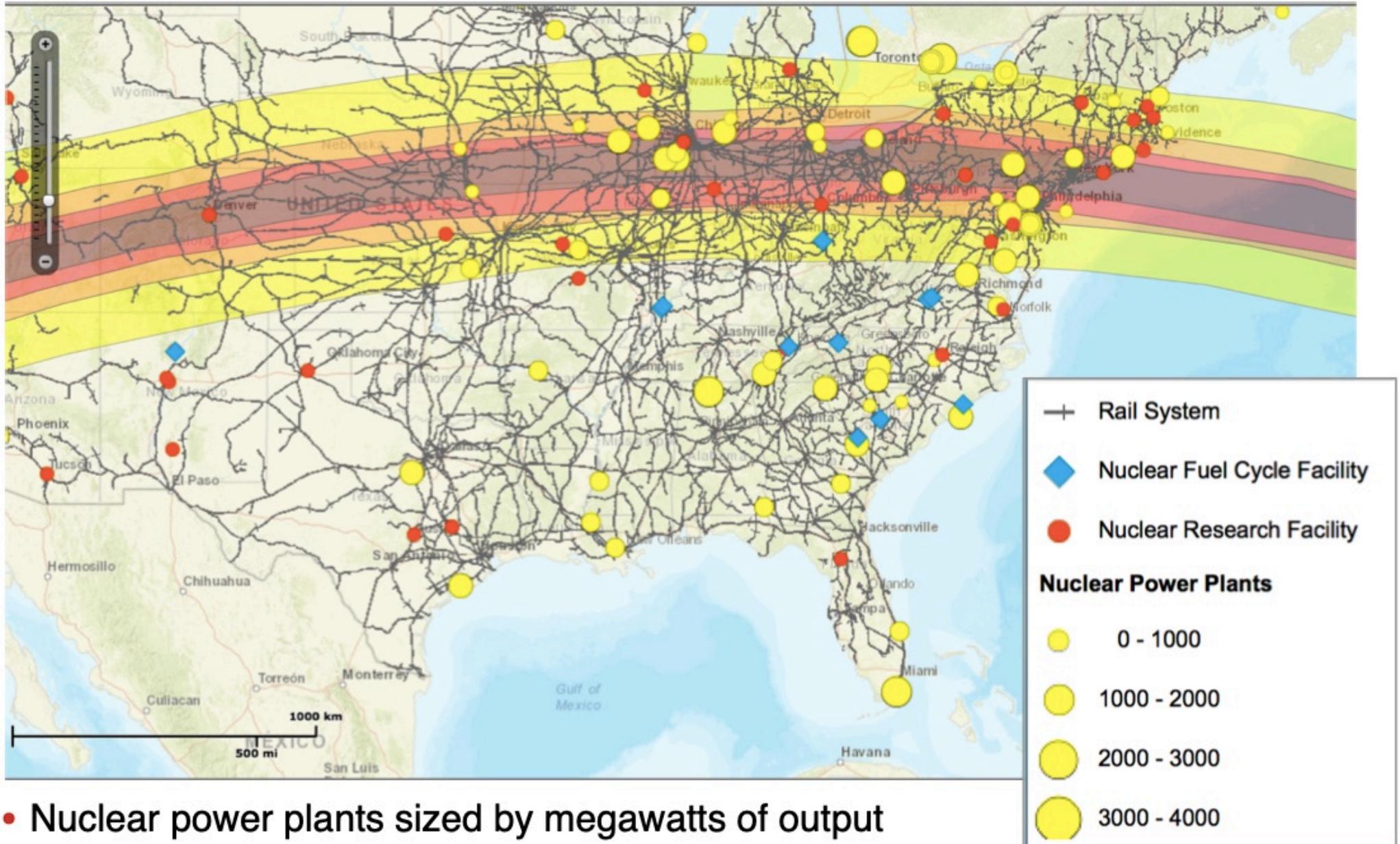
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The Mitigation Scenario

- Assumption: possible impact of a 100+ meter object in 5 to 10 years.
- Mitigation to be attempted
- UN/COPUOS: awareness, preparation, coordination
- IAWN: discovery, warning
- SMPAG: possible technical solutions
- International Community: planning, decisions and funding
- Local/regional government: implementation
- Media: Education and information
- Space Agencies, aerospace industry: develop technological solutions
- *The COVID experience shows that this chain might not work as expected*

US Infrastructure at Risk

Barbara Jennings (Sandia National Laboratory), Bill Fogleman (GRIT)



- Nuclear power plants sized by megawatts of output

Possible economic effects of an impact (*)

- 1. Damage up to 5 billion \$, fatalities up to hundreds, 10^{*4} injured. Local infrastructure damaged. Example; 1989 San Francisco earthquake. Recovery: months. Can be handled by one country
- 2. 5 - 20 billion damages, 10^{*4} killed, 10^{*5} injured/homeless. Local infrastructure destroyed. Example: 1995 Kobe earthquake. Recovery: years. Can be handled by countries
- 3. Several 100 billion \$ in damages, loss of a major city (e.g. San Diego). 10^{*5} fatalities, 10^{*6} injured, 10^{*6} homeless. Loss of regional infrastructure. Loss of regional governance. Recovery: many years. Requires international collaboration.
- 4. damage in the trillions of \$, 10^{*6} fatalities. (e.g. New York City; PDC 2019!). Major loss of infrastructure, cascading effects., domestically and internationally. Recovery: decades. Requires global collaboration.
- 5. Loss of a whole country. Depending on the country this might be a serious blow to the global economy (Switzerland, UK). For a developing nation this means financial default, with all consequences to the creditor nations/institutions. Recovery: many decades. Requires global collaboration
- 6. Global catastrophe. All bets are off

(*)Dore, M. "The Economic Consequences due to Asteroid and Comet Impacts".

In: "Asteroid Impacts on Human Society" Springer 2007.

The mechanisms of the economy and the **pre-encounter** uncertainties

- For a working economy the following elements are required (but not necessarily sufficient)

Production units:

Will they continue to be available? How long? Will the work force be available? How long? Will maintenance work be performed? Will spare parts be delivered? Will power be available? How long?

Customer-producer communication

Will there be customers? Will there be demand? Will communication channels be available? How reliable will they be? Will the road/rail infrastructure be available? Will customer preferences change?

Payment system:

Most payments are electronic. Will the system remain available? Will the currency remain stable? Serious devaluation will have consequences for the value of the currency reserves world wide. Cryptocurrencies? Barter? Taxation? Developing countries? Corruption? Fraud? Black markets?

Banking system:

How reliable will it be? Will there be a shortage of cash? Will people still accept computer payments? Availability of loans?

Investor confidence:

All investments in or near the impact corridor will slow down or stop. Insurance? Hedging? Short selling? Predatory buying? Fraud? Fake news? Rumors?

Mechanisms, cont'd.

Markets (stocks, commodities, real estate):

Real estate prices in or near the impact corridor will fall. Mortgages will default. People might sell off assets and buy durable goods. Stocks will fall. Some commodities will spike. Futures contracts and other derivatives will behave erratically. Trading might have to be stopped.

Legal system, rule of law, enforcement:

Will the legal system continue to work? How long? Will law enforcement agents be available? Can fraud, embezzlement, loan defaults, etc. be prosecuted? Will there be looting, vandalism?

Central bank, federal reserve:

Will the currency remain stable? Will the national authorities be able to support the currency? (Fiat money is not backed by commodities, but only by the confidence in the financial construct).

All tied together by IT:

Will it continue to be available and reliable? For whom? Conditions, priorities? Saturation? Cyberattacks?

Problem: since the economy is multi-factorial there is no set of conditions which guarantees stability

- **There is a major difference for the pre-encounter consequences, especially in the case of the possible impact of a large object, which might be detected years ahead of time and for which the impact probability increases and the impact location is uncertain during this time. Additional uncertainty will be introduced by a mitigation mission which might only be partially successful, but which will change the impact location in unforeseen ways.**

Example: 9/11 Lost Wall Street for a few days

Uncertainty: for about one week it was not clear whether and where the attacks might continue.

The Federal Reserve added \$100 billion in liquidity **per day**, during the three days following the attack, to help avert a financial crisis and to stabilize the Dollar

Gold prices spiked 30% in London trading. Oil prices also spiked upwards. Gas prices in the United States also briefly shot up, though the spike in prices lasted only about one week.

Currency trading continued, with the US Dollar falling sharply.

The next day, European stock markets fell sharply, including declines of 4.6% in Spain, 8.5% in Germany and 5.7% on the London Stock Exchange.

Stocks in the Latin American markets also plunged, with a 9.2% drop in Brazil, 5.2% drop in Argentina, and 5.6% decline in Mexico, before trading was halted.

Total cost is hard to estimate- Department of Homeland Security was installed, extensive security measures were implemented, “war on terror” was started, Iraq was invaded. Total cost until now as high as \$10 trillion.

Example: COVID

Source: Journal of the American Medical Association, October 2020

Table. Estimated Economic Cost of the COVID-19 Crisis

Category	Cost (billions), US\$
Lost GDP	7592
Health loss	
Premature death	4375
Long-term health impairment	2572
Mental health impairment	1581
Total	16 121
Total for a family of 4	196 475
% of annual GDP	90

Abbreviation: GDP, gross domestic product.



TOWARDS MITIGATION AND RECOVERY PLANNING



OVERALL OBJECTIVE: Coordinate and dovetail the various national country strategic NEO action plans: E.g. see US plan: “NATIONAL NEAR-EARTH OBJECT PREPAREDNESS STRATEGY AND ACTION PLAN”, June 2018.

This Plan has 5 Goals:

Goal 1: Enhance NEO Detection, Tracking, and Characterization Capabilities

Goal 2: Improve NEO Modeling, Prediction, and Information Integration

Goal 3: Develop Technologies for NEO Deflection and Disruption Missions

Goal 4: Increase International Cooperation on NEO Preparation

Goal 5: Strengthen and Routinely Exercise NEO Impact Emergency Procedures and Action Protocols

Goals 1 to 3 can be left largely to the 5 Permanent Members of the UN Security Council. While UN bodies (IAWN , SMPAG and UN/COPUOS) are engaged in discussion, they need to work towards an *eventual UN FRAMEWORK CONVENTION ON NEO THREAT (UNFCNEO)*.

UNFCNEO could parallel the admin structures of the UNFCCC, a with first protocol on international cooperation, and country commitments to plan mitigation actions, modelled on a UN template.

Until a UN FRAMEWORK is agreed, each country should focus on articulating MITIGATION PROTOCOLS.

Consider outline of Mitigation PROTOCOLS next.

PLANNED MITIGATION PROTOCOLS

The MOST IMPORTANT PROTOCOLS Will INCLUDE PLANS TO MINIMIZE DISRUPTION OF GOODS AND FINANCIAL MARKETS, POSSIBLY UNDER EMERGENCY AND/OR MARTIAL LAW, such as:

1. MONETARY ACTION PLANS:

- » To enhance financial confidence and declare illegal goods and financial speculative activity to profit from hoarding essential goods and arms; medical supplies; and pre-emptive trading in financial instruments such as stocks, bonds, and other derivative instruments.
- » Provide enhanced liquidity for retail banks, cash distribution points; closure of stock exchanges (as it happened during World Wars, and at 9/11 attacks).

2. BUDGETARY ACTION PLANS

- Treasury action to back monetary authorities through emergency legislation (as during 2008/9 financial crisis), and the Covid Crisis of March 2020 to March 2021.
- Maintain sources of electricity and drinking water; commandeer & maintain internet network for effective communications
- Army and civil defense forces to set up field hospitals
- Where possible, maintain production activity for food, medicines and other essential supplies
- Maintain the PHYSICAL distribution network for food and medical supplies
- Prevent corporations from seeking to cancel shares or redeem bonds
- Prevent banks from foreclosing mortgages and loans
- Enforce emergency laws to curb illegal and black markets

MITIGATION PLANNING Continued:

3. DISASTER RECOVERY PLANS

- » Most businesses and organizations are required to have a Disaster Recovery Plan. National governments would take control of post impact recovery. Most would draw on past recovery activity after weather related adverse events (e.g. hurricanes, tornadoes)
- » The plan should foresee the gradual relaxation of emergency laws, and an attempt to return to normalcy.
- » The plan should be scalable in response to the magnitude of the threat

CONCLUSIONS

- » 1. The global community faces a significant threat from Near Earth Objects, including objects greater 100 meters
- » 2. These NEOs could cause loss of life on an unprecedented scale, together with destruction of infrastructure in the impact corridors.
- » 3. Such events will have severe national, international and global socio-economic consequences, even in the case of a successful mitigation
- » 4. Global threats require global coordination and cooperation, before and after such an event. This also requires global economic preparation and mitigation plans.
- » 5. Preparing the legal framework ahead of time would be part of good mitigation planning.
- » 6. The current international cooperation through IAWN, SMPAG and UN/COPUOS should converge into a global UN “Framework Convention on the NEO Threat”, with regional and national efforts on mitigation planning and disaster recovery plans.
- » 7. Such a UN Framework Convention could have an administrative structure similar to that of the existing UN Framework Convention on Climate Change (UNFCCC).