

# Nuclear Use Scenarios on the Korean Peninsula

by

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# Nuclear Use Scenarios on the Korean Peninsula

- Recent Changes in U.S. Nuclear Policy;
- Potential Targets for U.S. Earth-Penetrating Nuclear Weapons in North Korea;
- Nuclear Weapons Effects Simulation and Modeling

# U.S. Nuclear Posture Review (December 2001)

- "More than 70 countries now use underground facilities (UGFs) for military purposes. In June 1998, the Defense Science Board Task force on Underground Facilities that there are over 10,000 UGFs worldwide. **Approximately 1,100 UGFs were known or suspected strategic (WMD, ballistic missile basing, leadership or top echelon command and control) sites. Updated estimates from DIA reveal this number has now grown to over 1,400.** A majority of the strategic facilities are deep underground facilities. These facilities are generally the most difficult to defeat because of the depth of the facility and the uncertainty of the exact location. **At present the United States lacks adequate means to deal with these strategic facilities.**"
- **"The United States currently has a very limited ground penetration capability with its only earth penetrating nuclear weapon, the B61 Mod 11 gravity bomb.** This single-yield, non-precision weapon cannot survive penetration into many types of terrain in which hardened underground facilities are located. Given these limitations, the targeting of a number of hardened, underground facilities is limited to an attack against surface features, which does not does not provide a high probability of defeat of these important targets."

# U.S. Defense Science Board Task Force on Future Strategic Strike Force (February 2004)

“ Nuclear weapons are needed that produce much lower collateral damage (great precision, deep penetration, greatly reduced radioactivity): have robust performance margins: are devised for ease of manufacture and maintenance: and produce special effects (e.g., enhanced EMP, enhanced neutron flux, reduced fission yield).

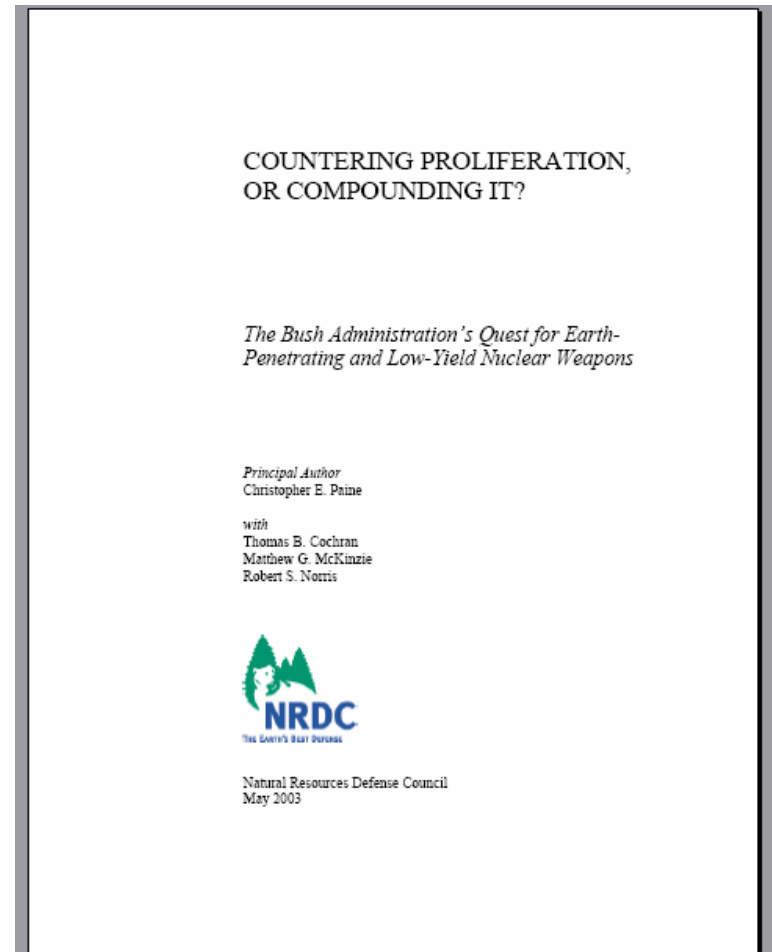
***The Task Force recommends that research be initiated on weapons that meet this new vision.***”

# Proposed candidates for the Robust Nuclear Earth Penetrator (RNEP)

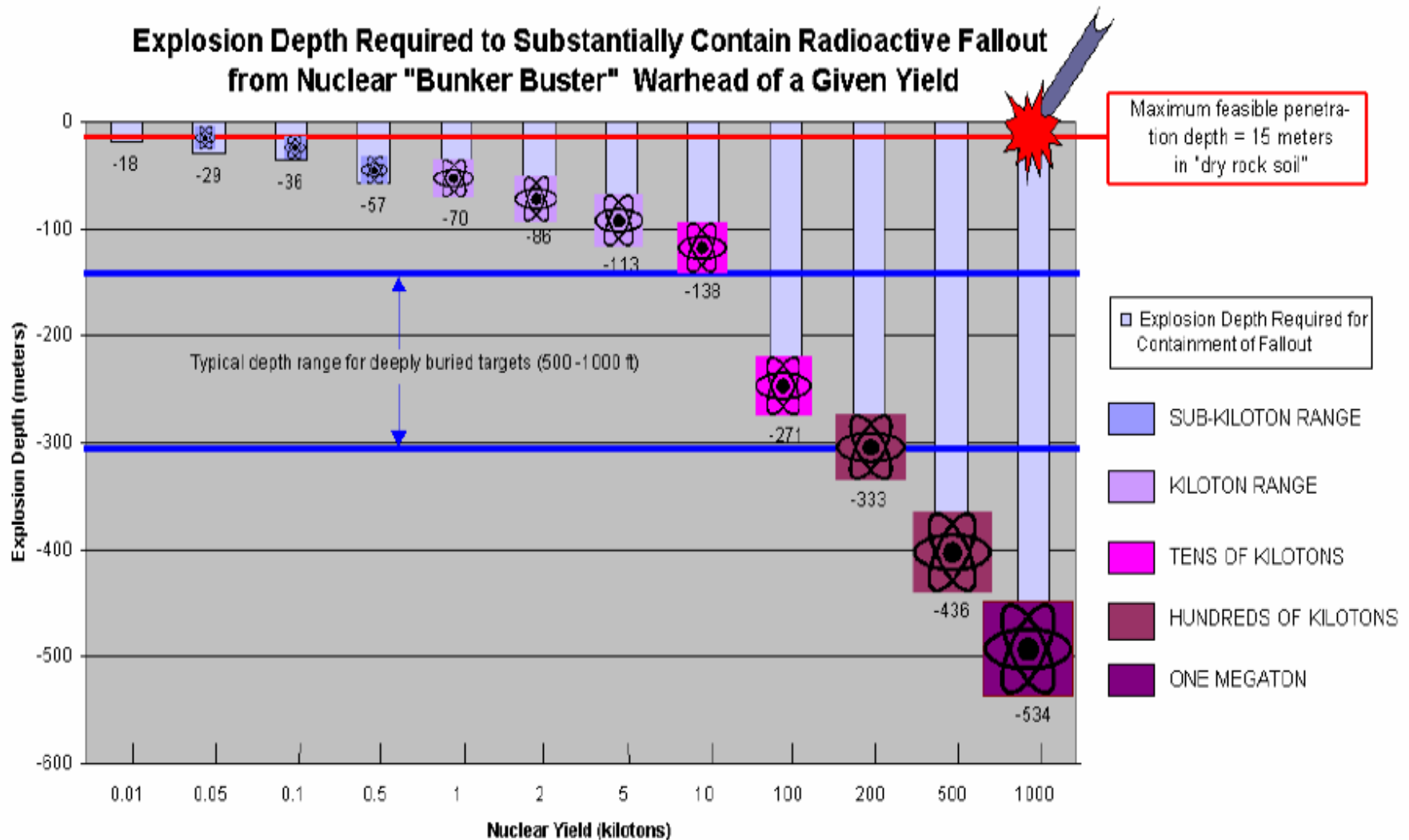
- DOD asked for a study to determine if an existing warhead can be adapted, without nuclear testing, to destroy hardened, deeply buried targets.
- B61-11 – a 400 kiloton, fixed yield bomb weighing ~545 kg – approximately 50 were converted in mid-1990s from the B61-7 nuclear bomb. LLNL design
- B-83 – selectable yield, to 1.2 megatons weighing 1090 kg, LLNL design
- For FY 2005 administration requested \$27.5 million to continue feasibility and cost studies. The five year budget request (FY2005-2009) was \$484.7)
- House Energy and Water Development subcommittee on appropriations cut all of the money for the study (House Report 108-554, June 18, 2004, pp. 114-115)

# Technical Limits of Earth-Penetrating Nuclear Weapons

- Limited penetration – in soil, concrete or rock, maximum 10-15 meters
- Cannot penetrate deeply enough to contain the nuclear explosion
- 1 kt at 20 foot depth – eject 1 million cubic feet of radioactive debris, crater size of ground zero at World Trade Center
- Higher yield = more fallout

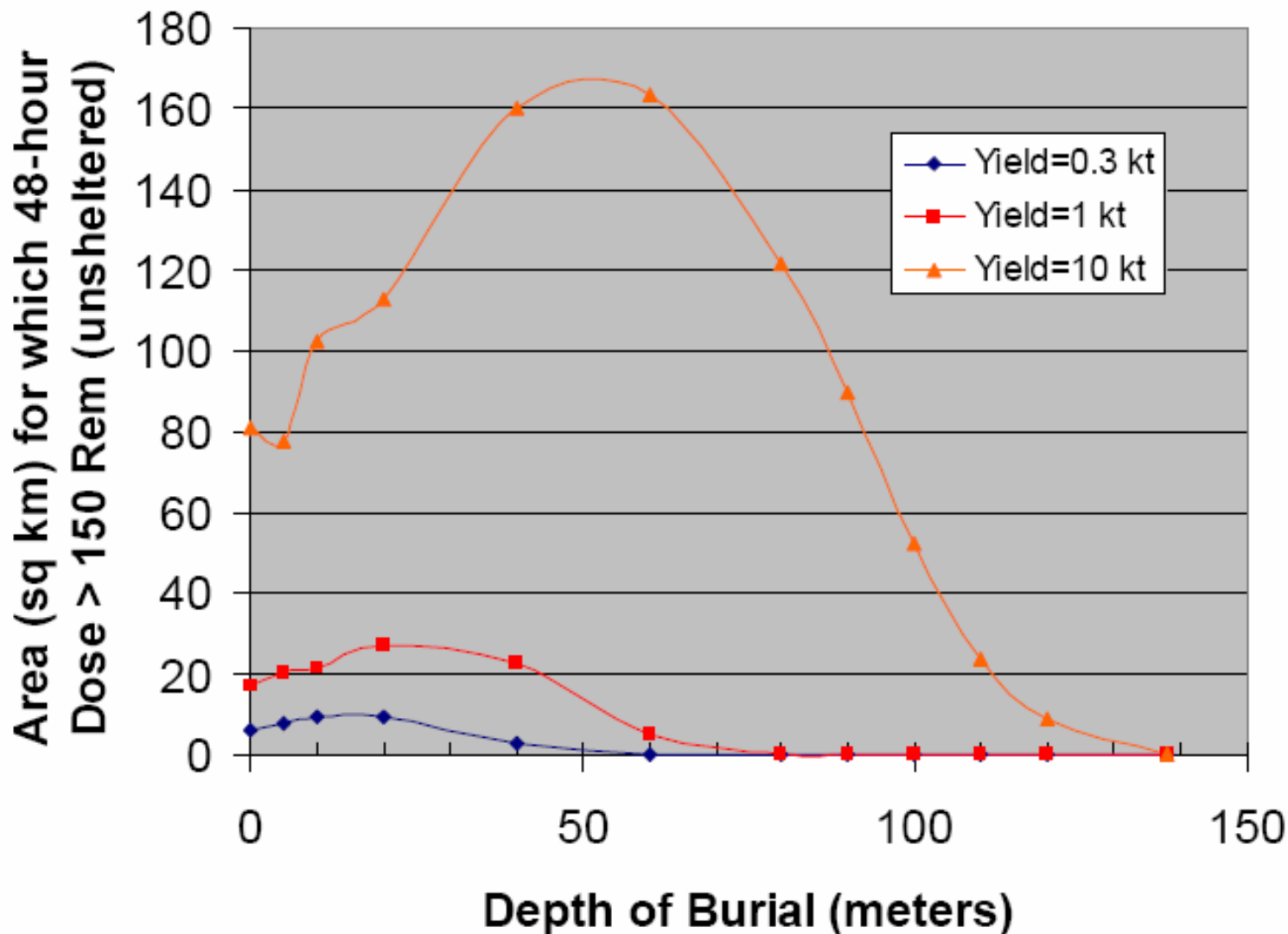


# Explosion Depth Required to Substantially Contain Radioactive Fallout



# Radioactive Fallout Area as a Function of Depth of Burial for 0.3-kt, 1-kt and 10-kt Earth Penetrator Nuclear Weapons

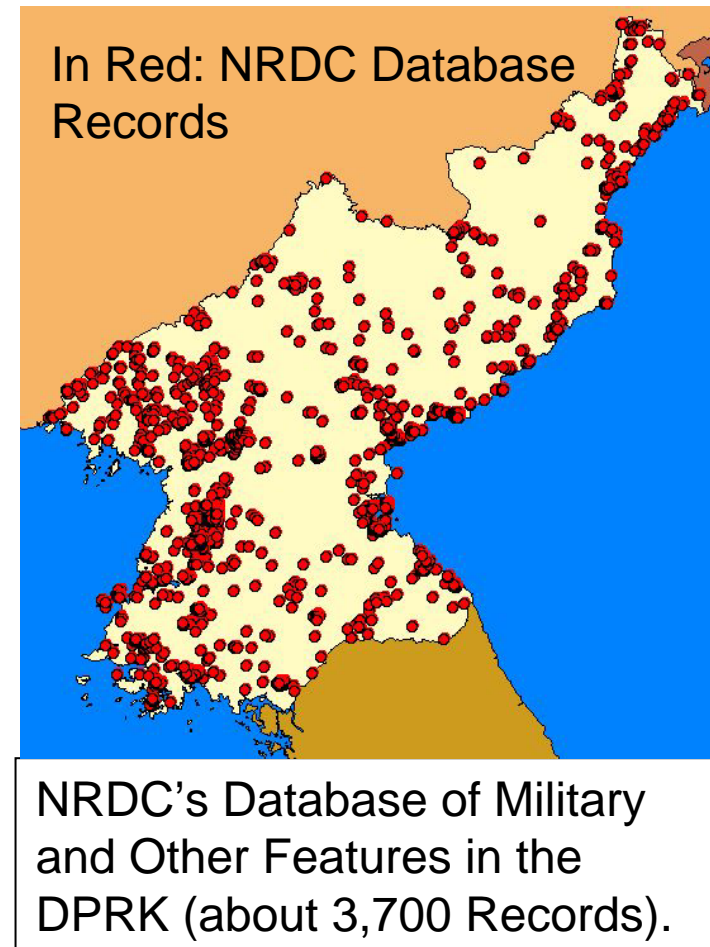
[www.nrdc.org/nuclear/bush/abb.pdf](http://www.nrdc.org/nuclear/bush/abb.pdf)





# Finding Likely Targets for Earth-Penetrating Nuclear Weapons: NRDC's geo-spatial database of North Korea

- High resolution commercial satellite imagery – first available to non-governmental researchers in 1999
- Ikonos (Space Imaging) – sun-synchronous, 98-minute orbit – produces a color photo at one-meter resolution
- QuickBird (DigitalGlobe) – can achieve 61-centimeter resolution under some conditions.
- Today's commercially available imagery is comparable to U.S. intelligence community of early 1970s
- Computing power – current laptops have speed and memory comparable to the Cray II that went to LLNL in 1985
- New research can refine military estimates, provide additional verification by the public



# Democratic Peoples Republic of Korea

## *Basic Facts*

- Occupies 120,000 sq km – slightly smaller than Mississippi or Fujian province
- Population 22,700,000
- Coastline – 2,495 km
- Borders - Russia (19 km), China (1,416 km), ROK (238 km DMZ)
- DMZ – extends 2 km on either side of a military demarcation line for 238 km from the Yellow Sea to the Sea of Japan



LandSat7 Image of the DPRK Capitol, P'yongyang, built along the Taedong River.

# DPRK Military Facts

*Most militaristic state in the world...*

- 23% of GDP for military (\$5.2 billion in 2002) (ROK 4%)
- 40 of 1,000 are in uniform (ROK 14 of 1,000)
- 1,200,000 active forces, 5,000,000 reserve, 4<sup>th</sup> largest in the world
- Army, Air Force, Navy and Special Operations Force (SOF)
- Military strategy – 1) reunify Korean Peninsula under North Korean control within 30 days of the beginning of hostilities 2) defend North Korea
- Most important facilities underground
- DPRK Steadily Building a Nuclear Weapons Capability

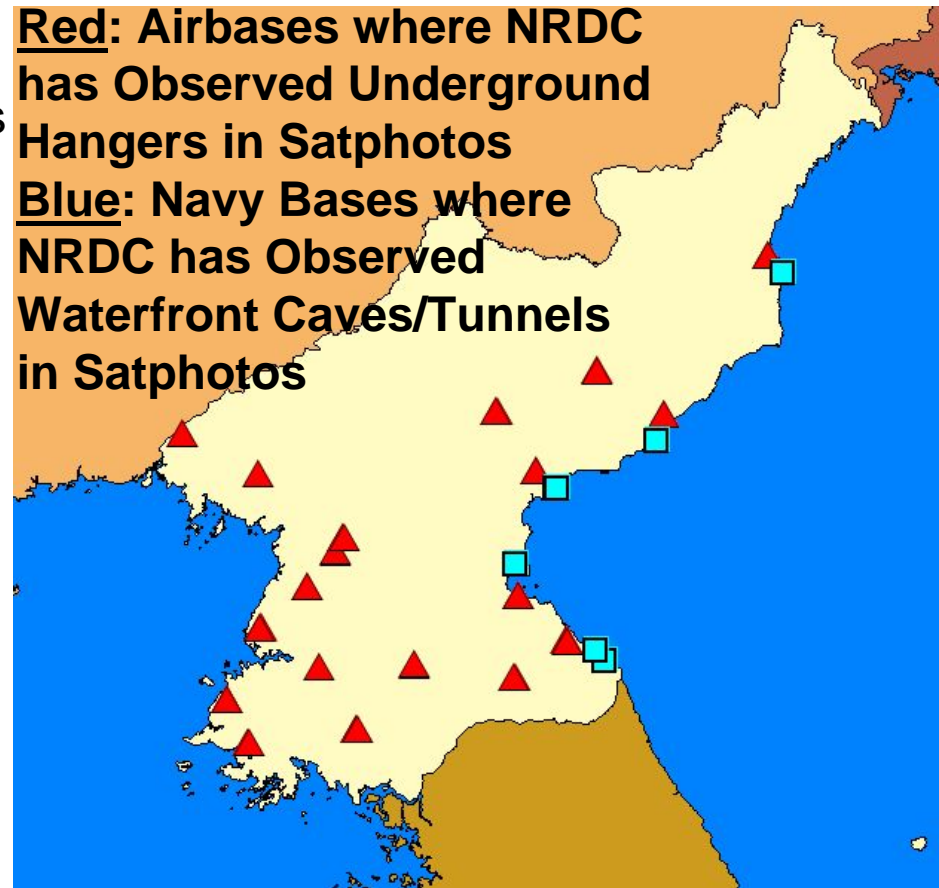


DigitalGlobe photo of “Juche Tower,” P’yongyang.

# DPRK: an Underground Nation and Military

*After the Korean War experience, Kim Il Sung said:  
“The entire nation must be made into a fortress.”*

- The degree to which the DPRK military is based underground is unique in the world – takes advantage of mountainous topography;
- Virtually everything of military significance is underground – several hundred large facilities, more than 10,000 smaller facilities;
- It is reported that thousands of artillery pieces are at underground sites; four tunnels have been discovered under the DMZ;
- Concealment of their military infrastructure from satellites and aerial reconnaissance make it an intelligence challenge;
- A verification nightmare for agreements limiting nuclear or other military developments in the DPRK.



# Underground Air Force

## Nineteen air bases that have associated underground aircraft hangers

• Airfield Name	Coordinates	
	Latitude	Longitude
• Changjin-up Air Base	40 21 51.9	127 15 50.1
• Hwangju Air Base	38 39 13.3	125 47 17.3
• Hwangsuwon Air Base	40 40 56.0	128 08 55.5
• Hyon-ri Air Base	38 36 47.8	127 27 04.5
• Iwon Air Base	40 21 37.9	128 43 08.4
• Koksan Air Base	38 41 19.5	126 36 08.4
• Kuum-ni Air Base	38 51 55.1	127 54 12.6
• Kwait Air Base	38 25 32.2	125 01 09.4
• Nuchon-ni Air Base	38 14 16.7	126 07 13.4
• Onch'on Air Base Auxiliary Airstrip	38 53 14.0	125 16 49.9
• Orang Air Base	41 25 45.3	129 38 52.7
• Panghyon Air Base	39 55 38.4	125 12 28.1
• Pukch'ang Air Base	39 30 16.5	125 57 52.9
• Sunan Air Base/International Airport	39 12 25.7	125 40 09.8
• Sunch'on Air Base	39 24 41.8	125 53 27.5
• Taet'an Air Base	38 07 50.4	125 14 43.1
• Toksan Air Base	39 59 47.8	127 36 43.3
• U'iju Air Base	40 09 00.4	124 29 50.9
• Wonsan Air Base	39 09 56.4	127 29 06.9

# Underground Navy

Navy Bases with Submarine Caves

## Coordinates

- **Ch'aho-nodongjagu Navy Base**
  - Entrance (1) 40 12 15N 128 39 00E
  - Entrance (2) 40 12 06N 128 39 03E
- **Kosong Naval Facility**
  - Entrance (1) 38 44 04N 128 12 45E
  - Entrance (2) 38 44 00N 128 12 44E
- **Namae-ri Navy Base**
  - Entrance 38 48 12N 128 08 17E
- **Puam-dong Navy Base**
  - Entrance (1) 41 19 18N 129 46 05E
  - Entrance (2) 41 19 30N 129 46 12E
- **Songjin pando Navy Base**
  - Entrance 39 22 18N 127 26 18E
- **Yoho'ri Naval Facility**
  - Entrance (1) 39 52 33N 127 47 39E
  - Entrance (2) 39 52 39N 128 47 17E

## Other Underground Facilities (Purpose Unknown)

- Haqap 40 04 54N; 126 11 22E
- Kumchang-ni 40 06 43N; 125 07 47E  
(under construction)
- Other suspect underground facilities, whose locations are not publicly known, are cited in the literature

# Pukch'ang Air Base

Image Source: DigitalGlobe  
Photographed March 10, 2002

Railroad

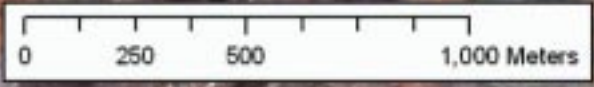
Underground  
Hangers

Main  
Runway

Aircraft  
Revetments

Ferry

Taedong  
River





# Pukch'ang Air Base

Image Source: DigitalGlobe  
Photographed March 10, 2002

MiG-23 Floggers (2)

MiG-23 Floggers (7)

MiG-23 Floggers (10)

Aircraft Hangers

MiG-23 Floggers (7)

Aircraft Hangers

Aircraft Hangers



# Pukch'ang Air Base

Image Source: DigitalGlobe  
Photographed March 10, 2002



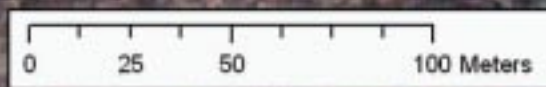
Hillside

Underground Hanger

Underground Hanger

MiG-23 Floggers  
(12 Visible)

Underground Hanger



# Pukch'ang Air Base

Image Source: DigitalGlobe  
Photographed March 10, 2002



22 MiG-21 Fishbed and  
6 UI MiG Aircraft

# Ch'aho-nodongjagu Navy Base

Image Source: DigitalGlobe  
Photographed June 29, 2002

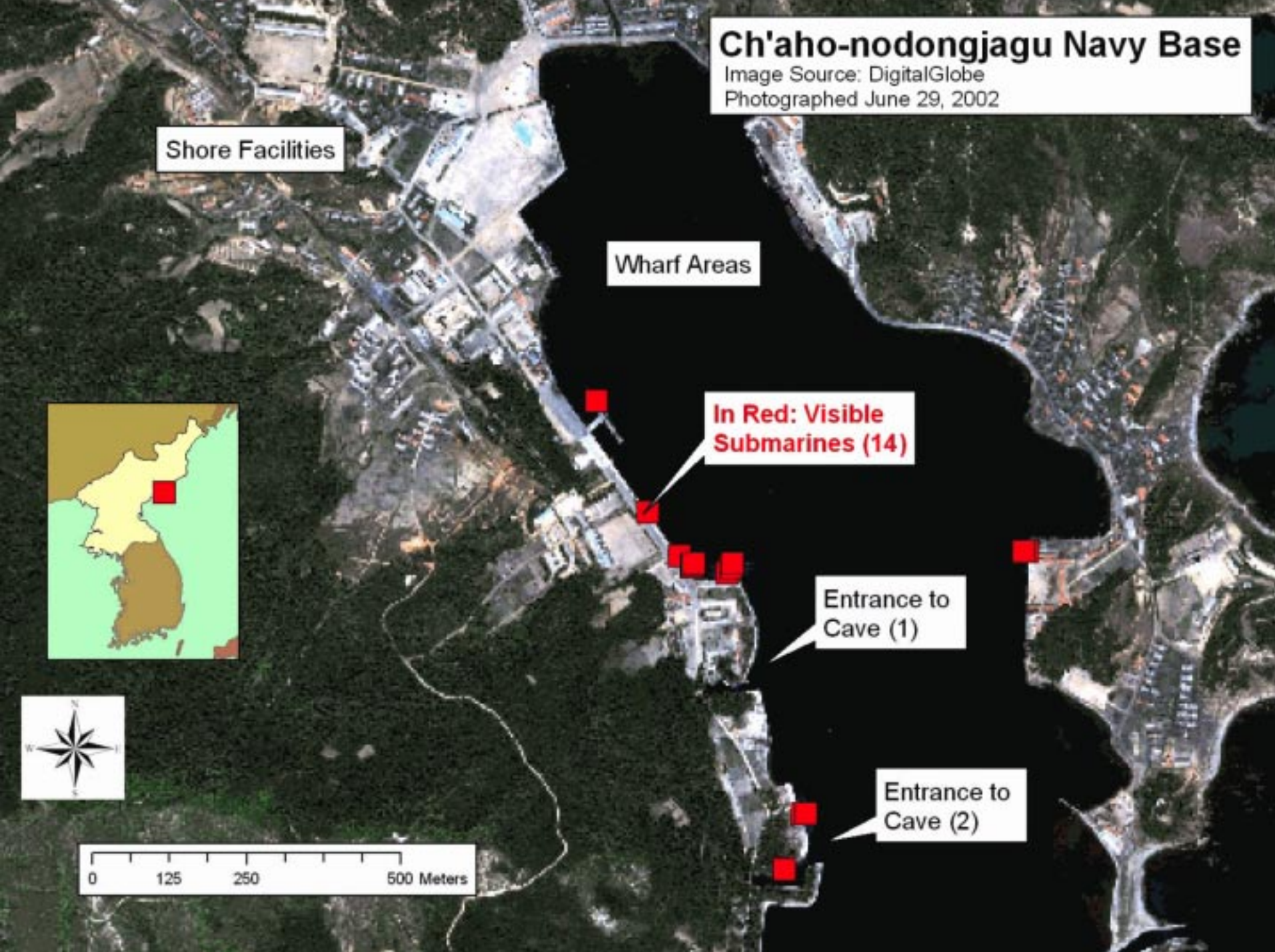
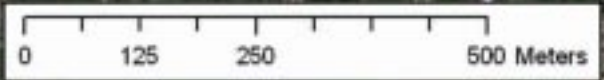
Shore Facilities

Wharf Areas

In Red: Visible Submarines (14)

Entrance to Cave (1)

Entrance to Cave (2)





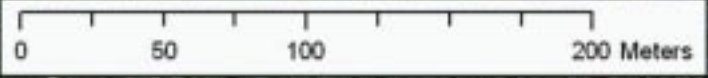
Sang-O Class Submarines

Romeo (or Whiskey) Class Submarines

Entrance to Cave (1)

**Ch'aho-nodongjagu Navy Base**  
Image Source: DigitalGlobe  
Photographed June 29, 2002

Romeo (or Whiskey) Class Submarines



# Ch'aho-nodongjagu Navy Base

Image Source: DigitalGlobe  
Photographed June 29, 2002



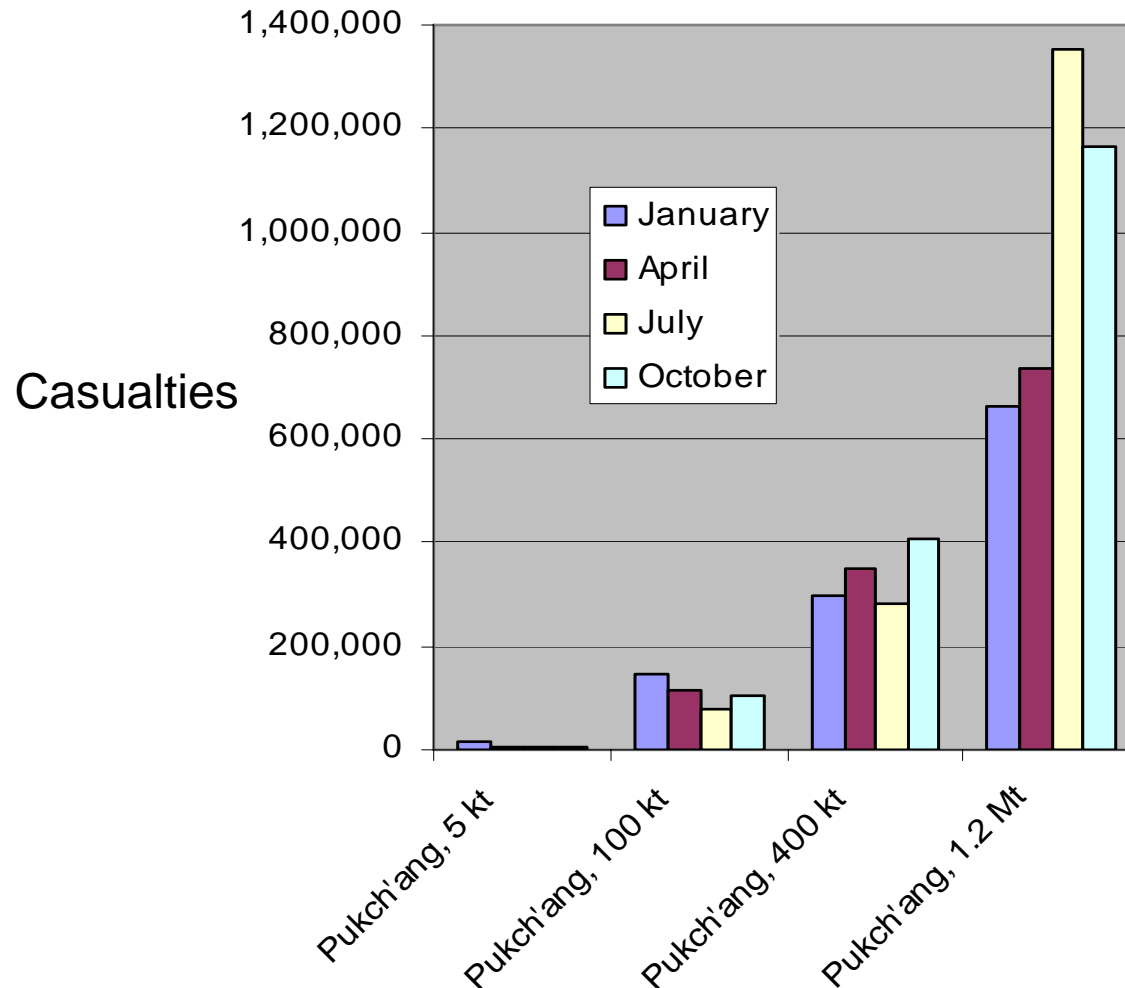
Romeo (or Whiskey)  
Class Submarines

Entrance to  
Cave (2)

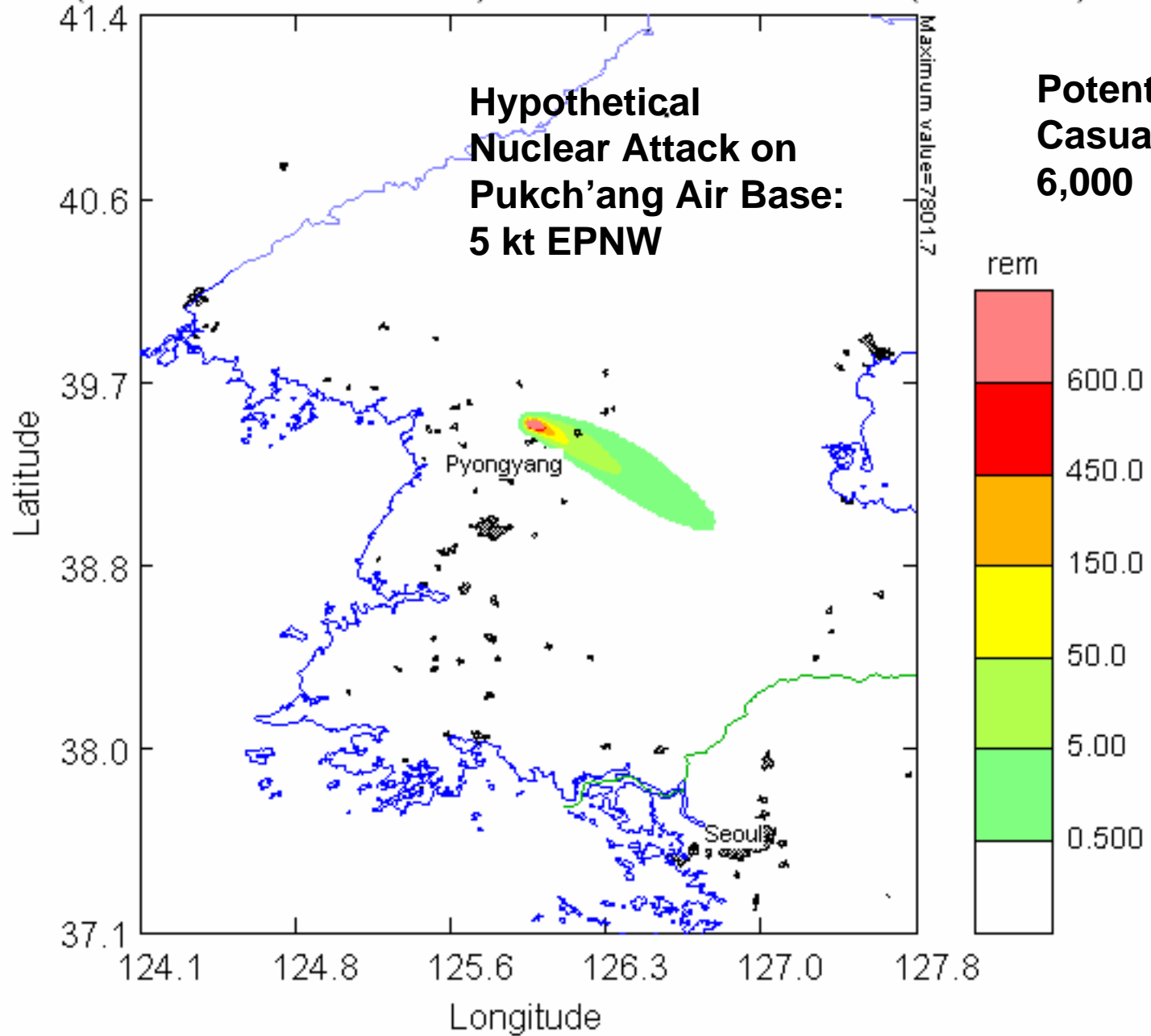
Romeo (or Whiskey)  
Class Submarine



# Casualty Calculations from a Hypothetical Nuclear Attack on the Pukch'ang Air Base

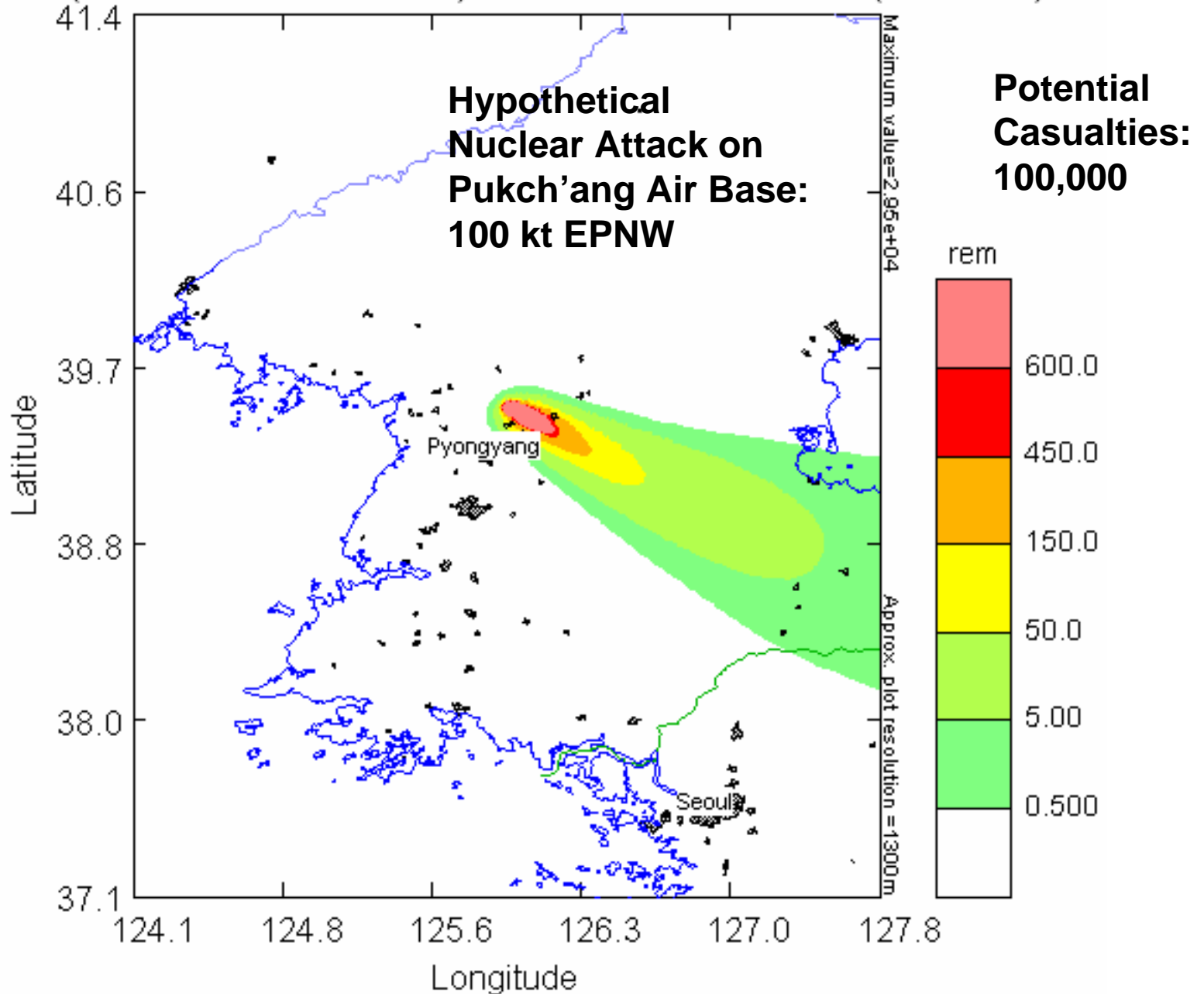


# Nuclear Weapon Fallout Radiation Dose Total (9.54-1048.1 microns) at 17-Oct-04 12:00Z (48.0 hrs)

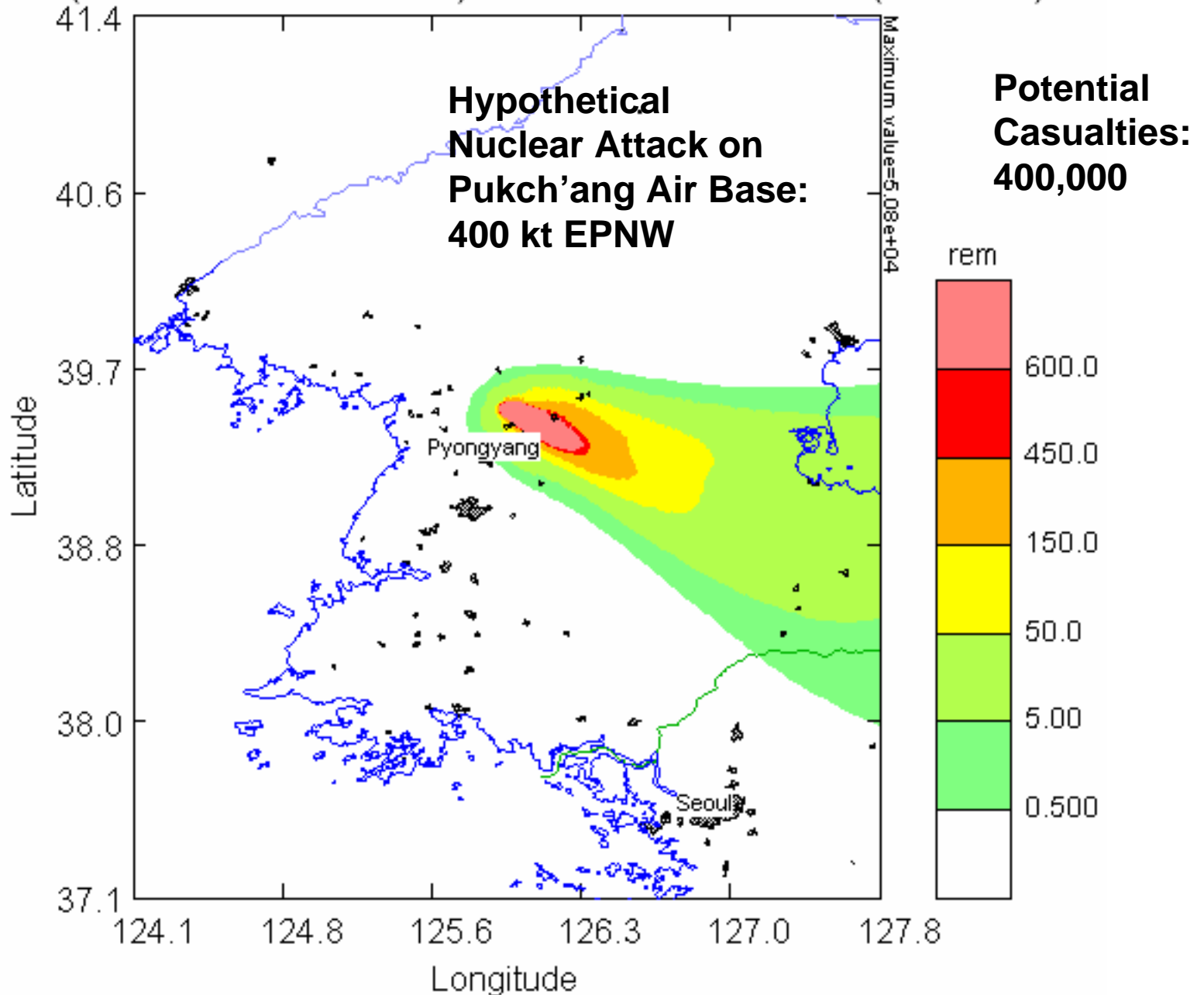




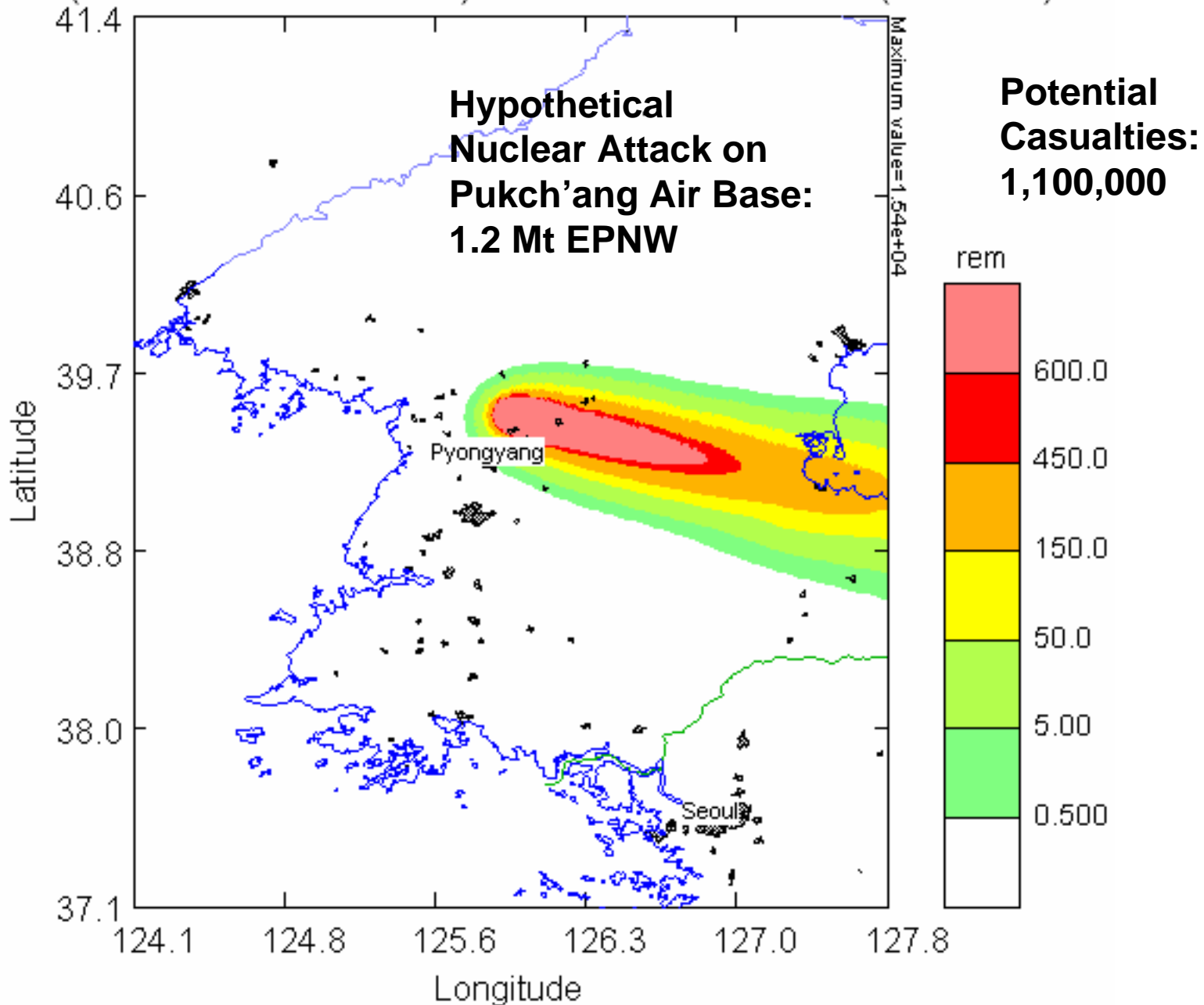
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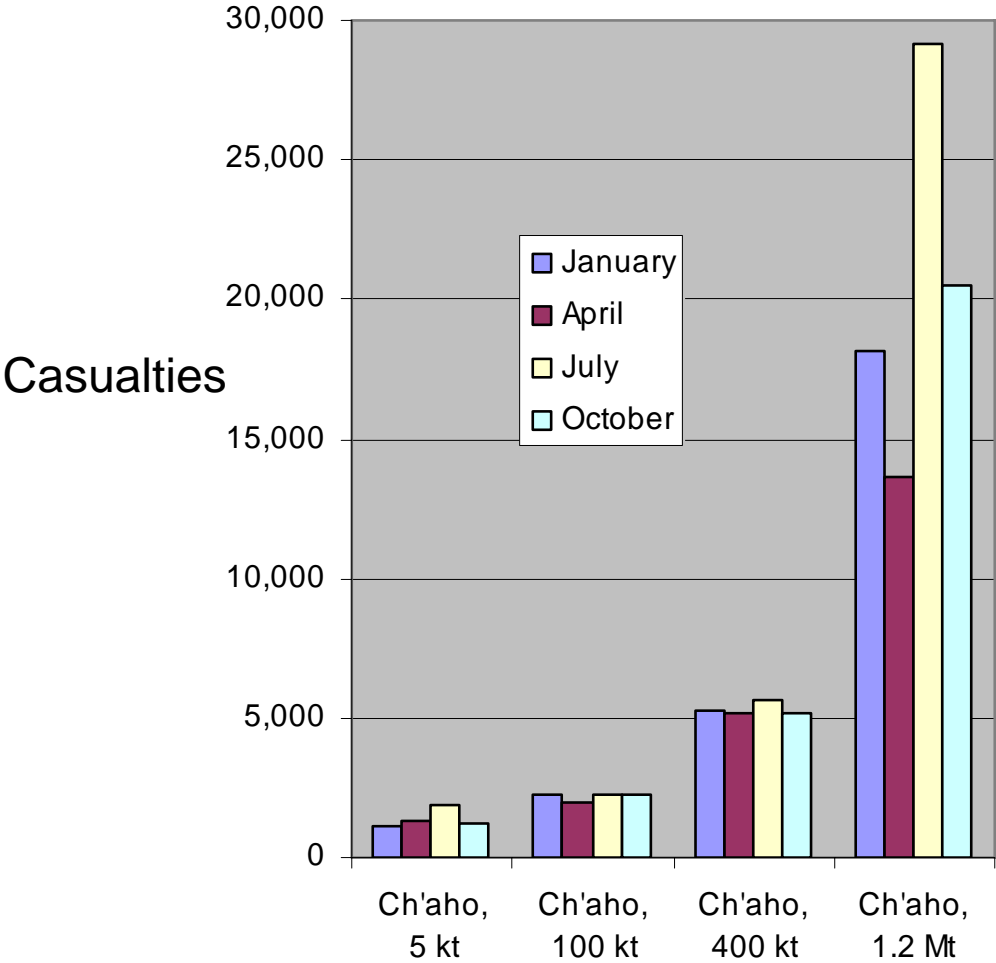
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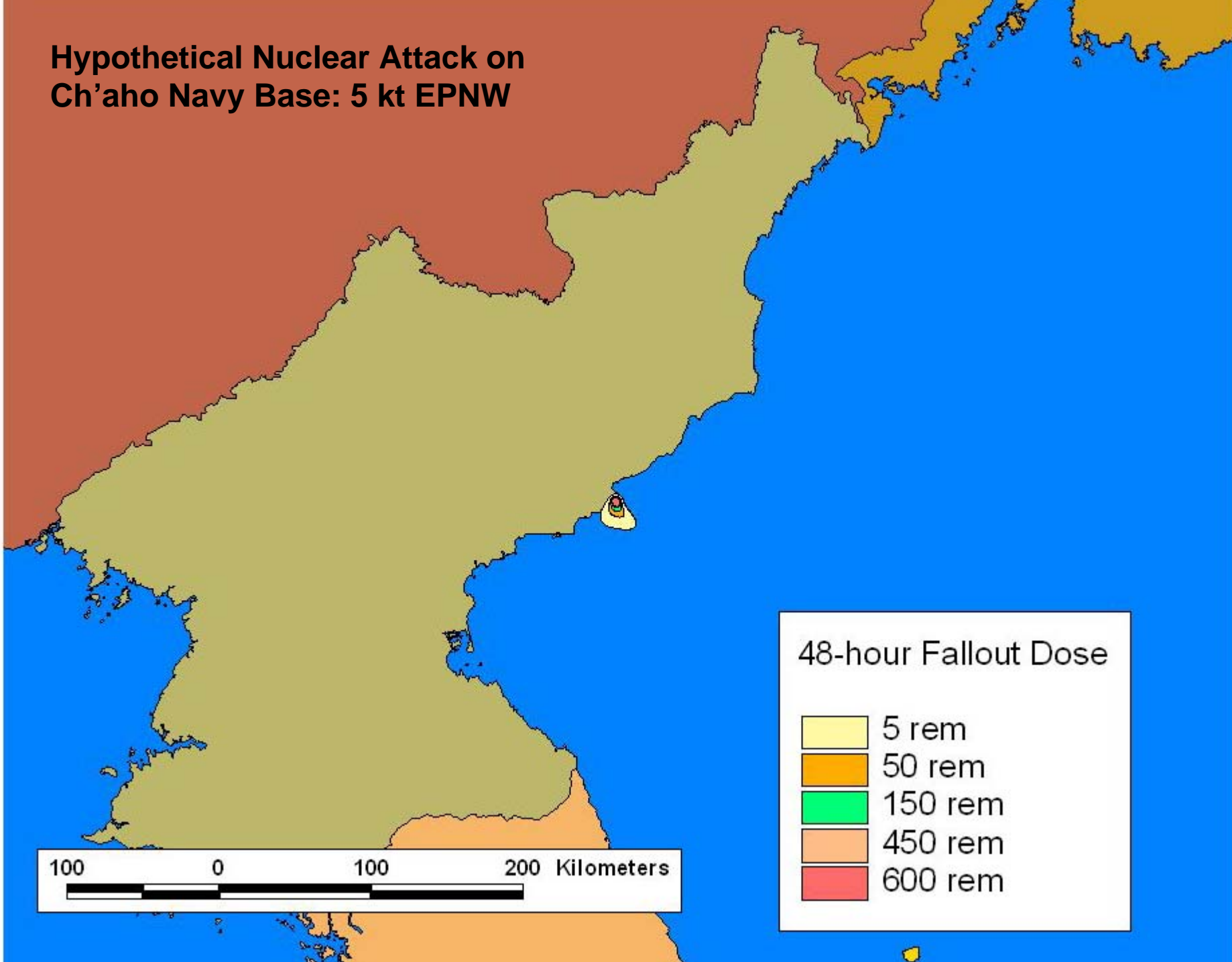
# Nuclear Weapon Fallout Radiation Dose Total (3.54-4769.5 microns) at 17-Oct-04 12:00Z (48.0 hrs)



# Casualty Calculations from a Hypothetical Nuclear Attack on the Ch'aho Navy Base

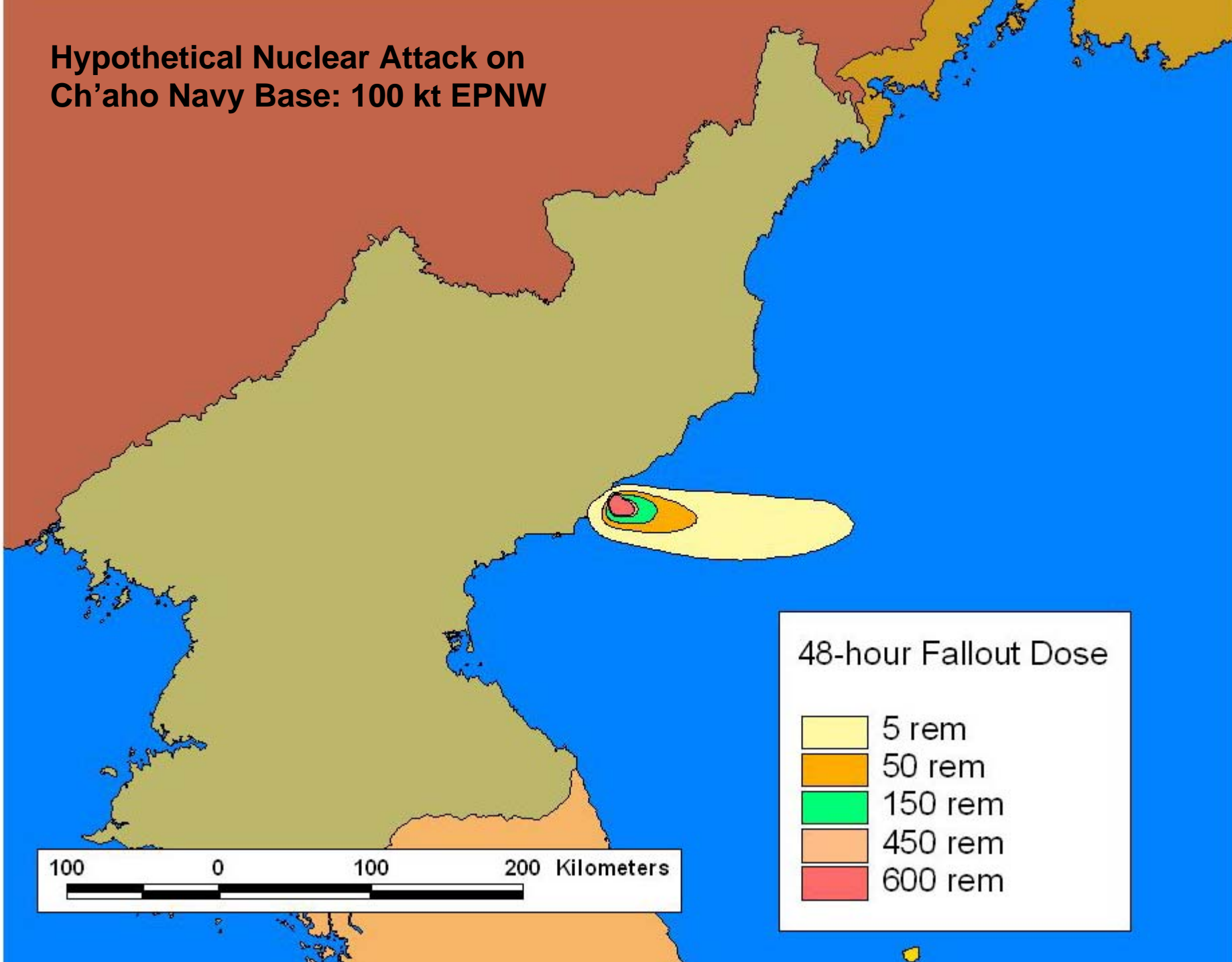


# Hypothetical Nuclear Attack on Ch'aho Navy Base: 5 kt EPNW



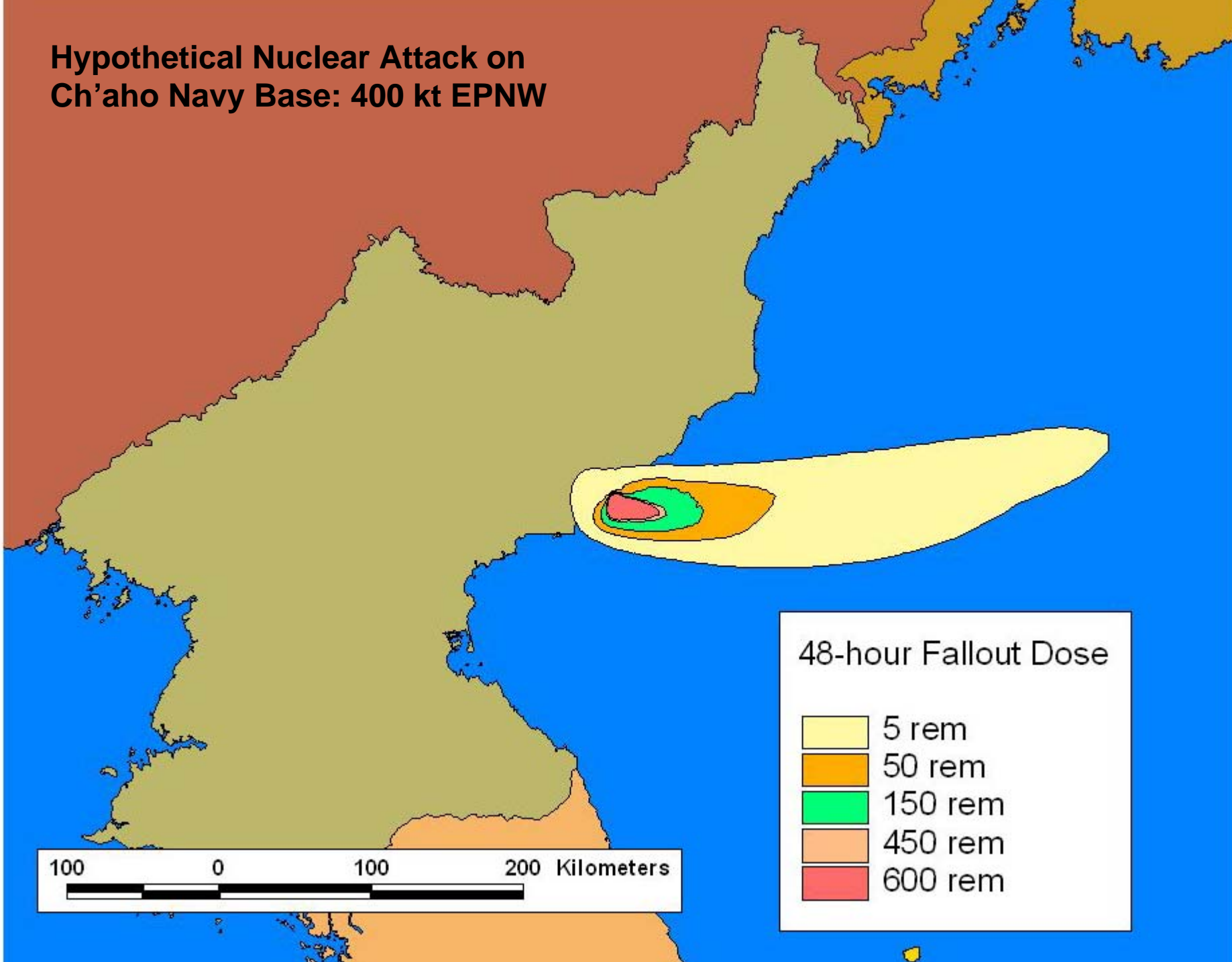
100 0 100 200 Kilometers

# Hypothetical Nuclear Attack on Ch'aho Navy Base: 100 kt EPNW

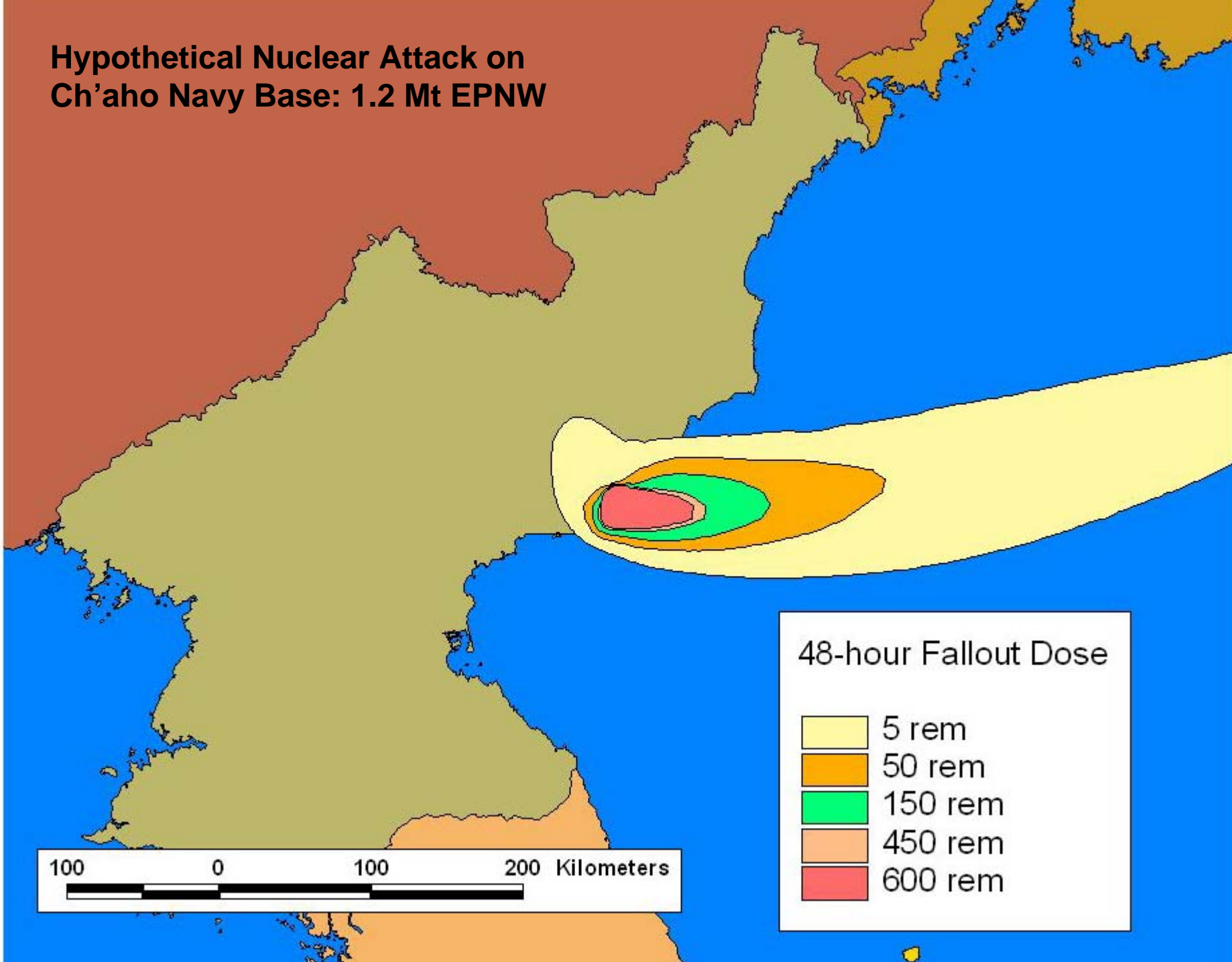


100 0 100 200 Kilometers

# Hypothetical Nuclear Attack on Ch'aho Navy Base: 400 kt EPNW



# Hypothetical Nuclear Attack on Ch'aho Navy Base: 1.2 Mt EPNW

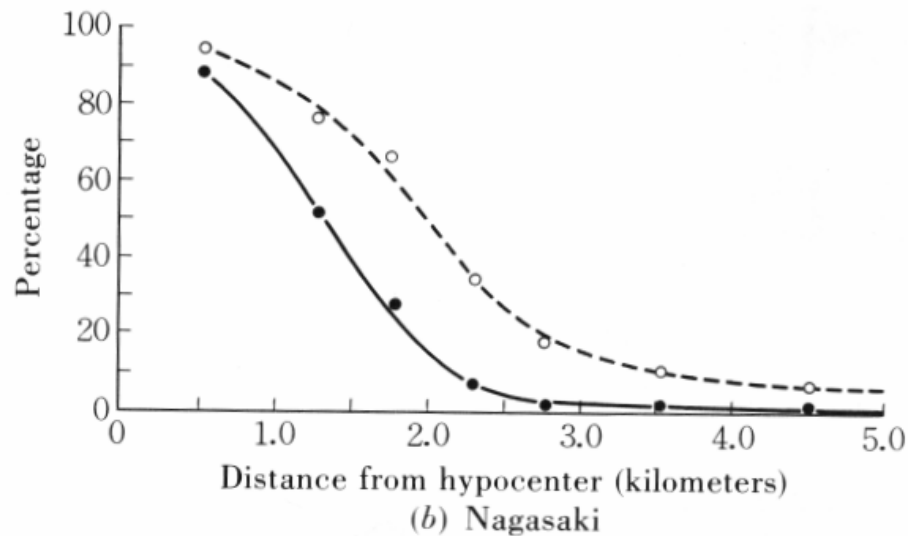
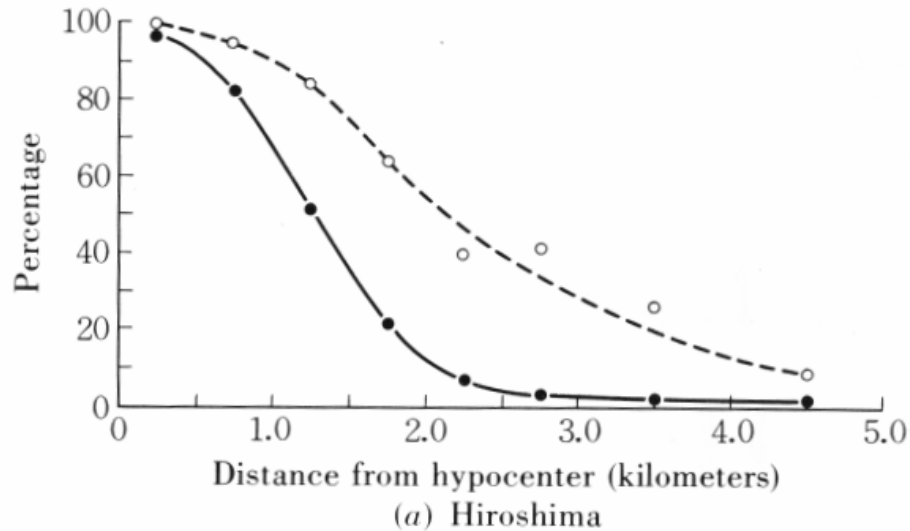




# Ch'aho and Pukch'ang: Discussion

- Casualty estimates—primarily from fallout—will vary greatly depending on target location (potentially controllable) and ambient wind speed and direction (probably not controllable) ...we illustrated this for two specific targets;
- While fallout is reduced with reduced yield, a 5 kt EPNW at 20 meters depth of burial still produces a lot of fallout!

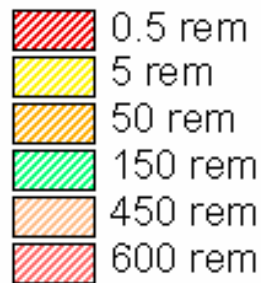
# Calculating a Hypothetical Nuclear Attack on Seoul: *Reviewing the Data from Hiroshima and Nagasaki*



# Calculating a Hypothetical Nuclear Attack on Seoul: *Reviewing the Data from Hiroshima and Nagasaki*

Distance from hypocenter (km)	0	1	2	3	4	5	6
Outdoors (unshielded)	blast injury	high	low				
	burn	high	moderate	low			
	radiation injury	high	moderate	low			
Outdoors (shielded)	blast injury	low					
	burn	low					
	radiation injury	moderate	low				
Inside (wooden house)	blast injury	high		moderate		low	
	burn	low					
	radiation injury	moderate	low				
Inside (concrete building)	blast injury	low					
	burn	low					
	radiation injury	moderate	low				

48-hour Fallout Dose

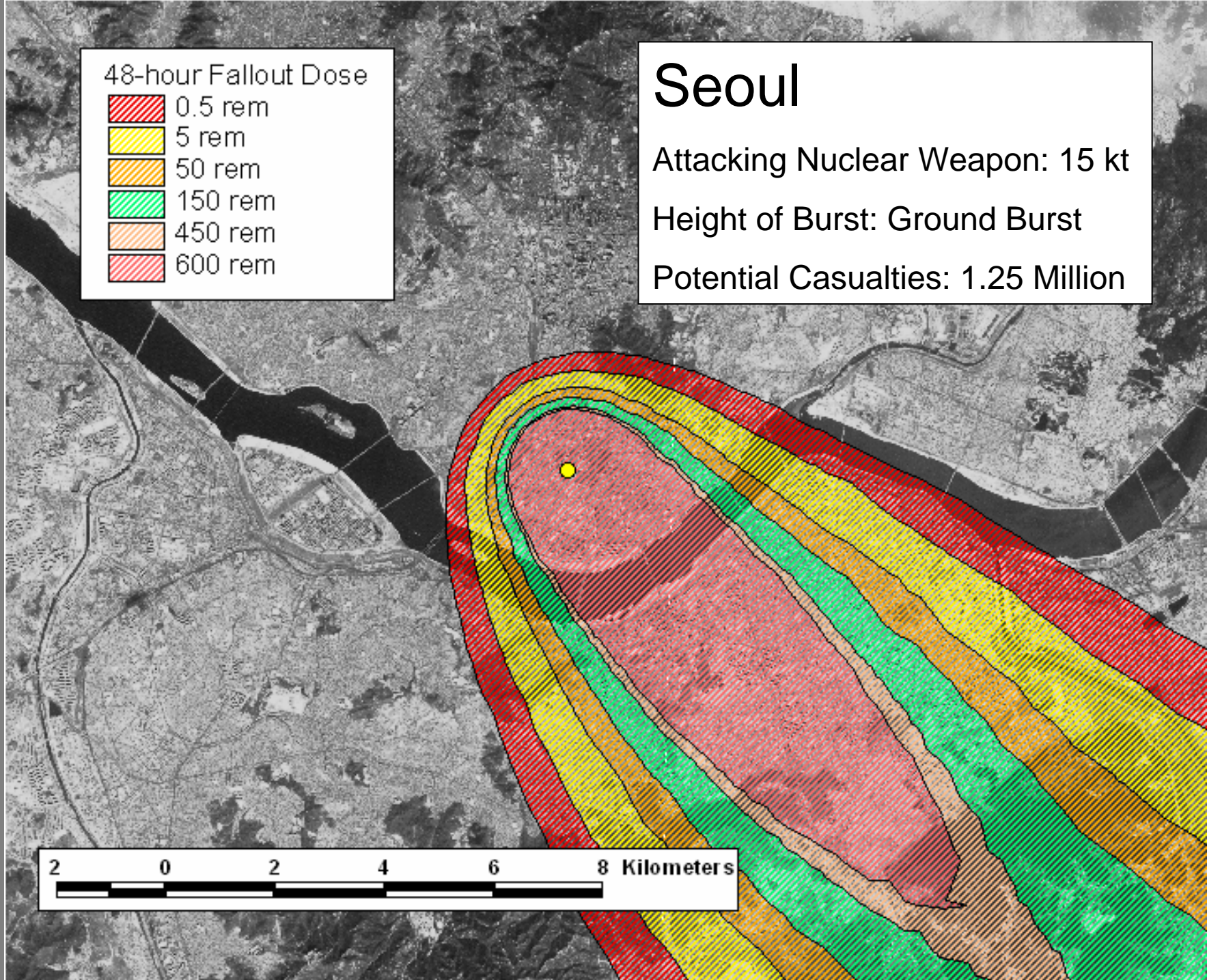
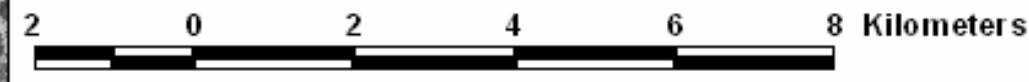


# Seoul

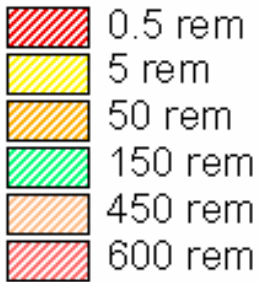
Attacking Nuclear Weapon: 15 kt

Height of Burst: Ground Burst

Potential Casualties: 1.25 Million



48-hour Fallout Dose

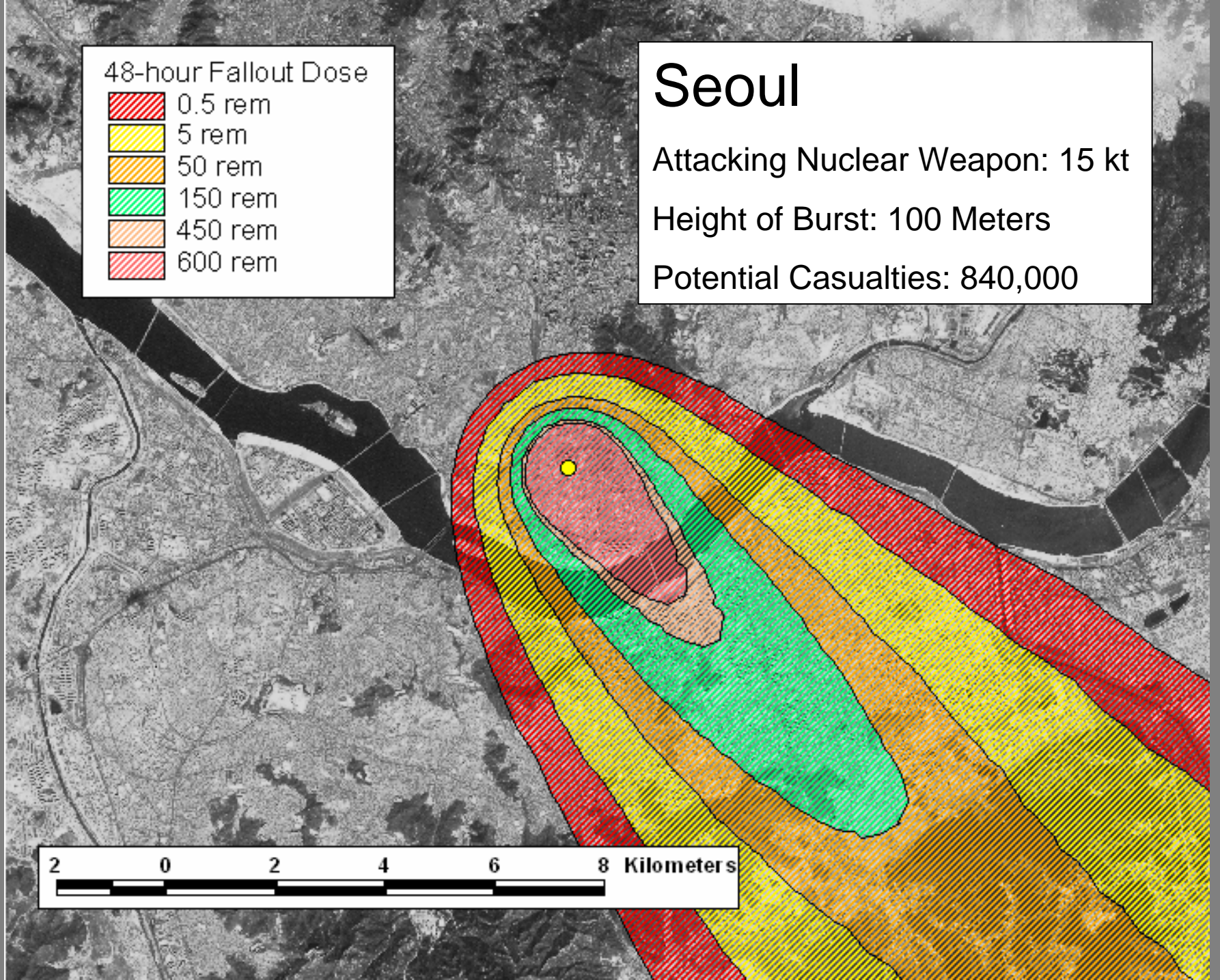
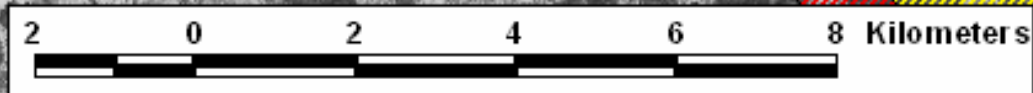


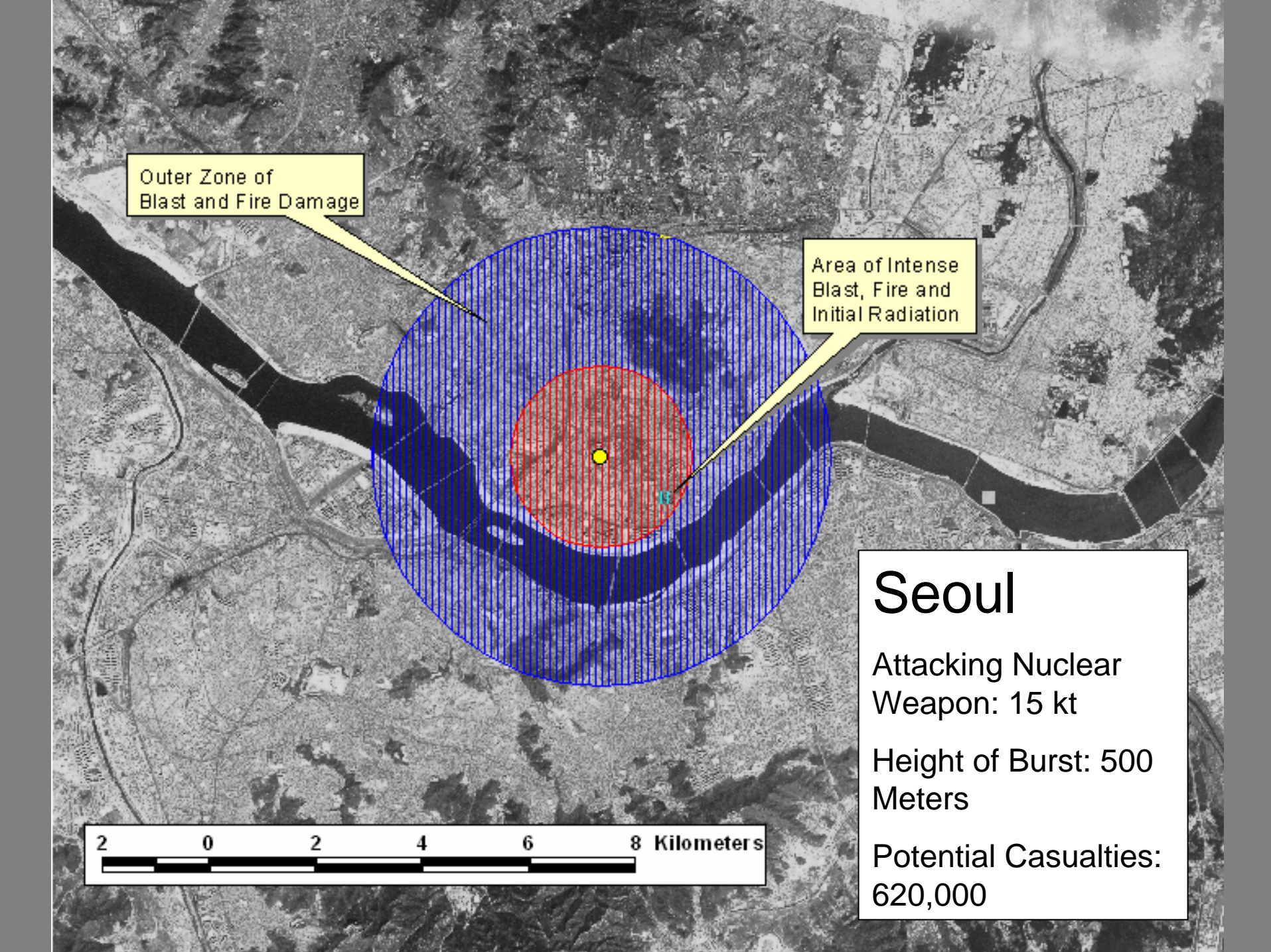
# Seoul

Attacking Nuclear Weapon: 15 kt

Height of Burst: 100 Meters

Potential Casualties: 840,000





Outer Zone of  
Blast and Fire Damage

Area of Intense  
Blast, Fire and  
Initial Radiation

# Seoul

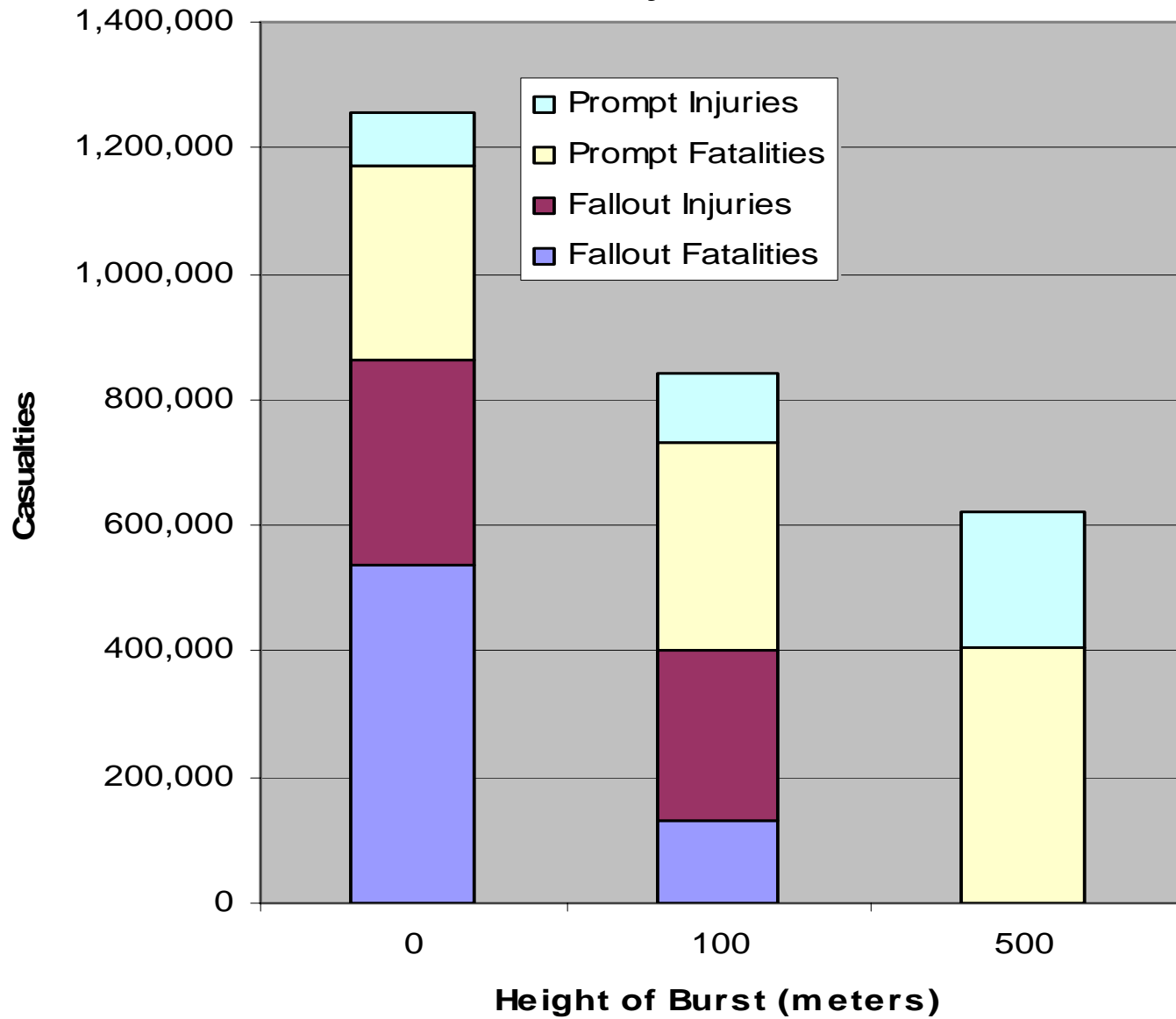
Attacking Nuclear  
Weapon: 15 kt

Height of Burst: 500  
Meters

Potential Casualties:  
620,000

2 0 2 4 6 8 Kilometers

# Calculating a Hypothetical Nuclear Attack on Seoul: *HPAC Casualty Calculations*



# Seoul: Discussion

- Because of the higher population density of Seoul (2004) versus Hiroshima and Nagasaki (1945), predicted casualties for the same kind of nuclear attack (air burst) are as much as six times worse;
- If the attacking nuclear weapon were a ground burst producing fallout, predicted casualties could be more than ten times worse and damage to South Korea would include widespread contamination.



# Conclusions

- Development of nuclear weapons by North Korea and development of EPNW by the United States are destabilizing, dangerous and could lead to their use.
- While not demonstrated here, it would appear that underground aircraft parking areas and navy caves can be defeated by conventional means.
- These potential targets could also be defeated using existing surface burst nuclear weapons. The casualties from earth penetrator weapons will be greater than surface burst weapons of the same yield.
- The only sensible alternative is a diplomatic resolution of the nuclear crisis on the Korean peninsula.