

# The legacy of Chernobyl Health Effects

European Parliament April 7, 2016

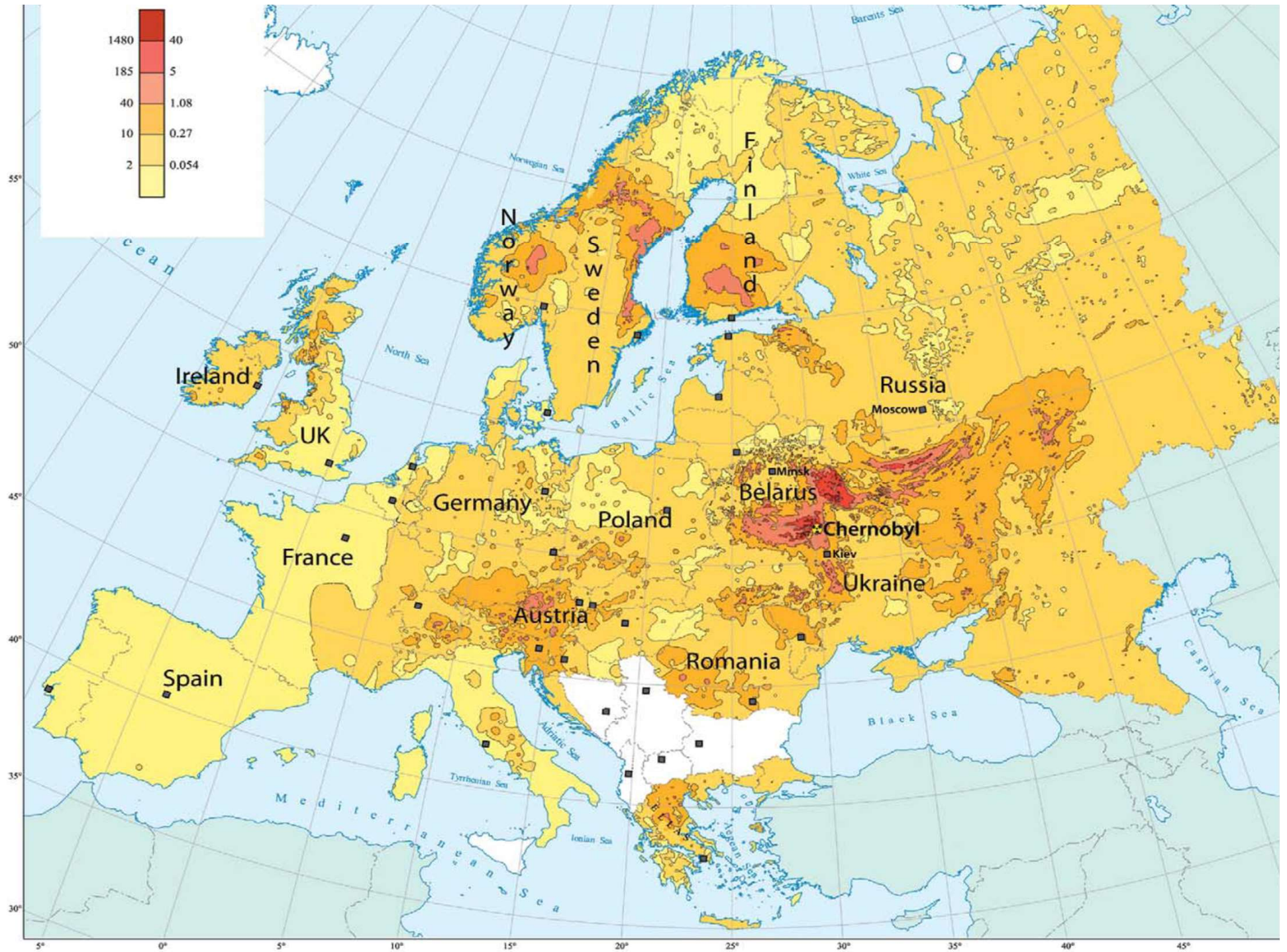
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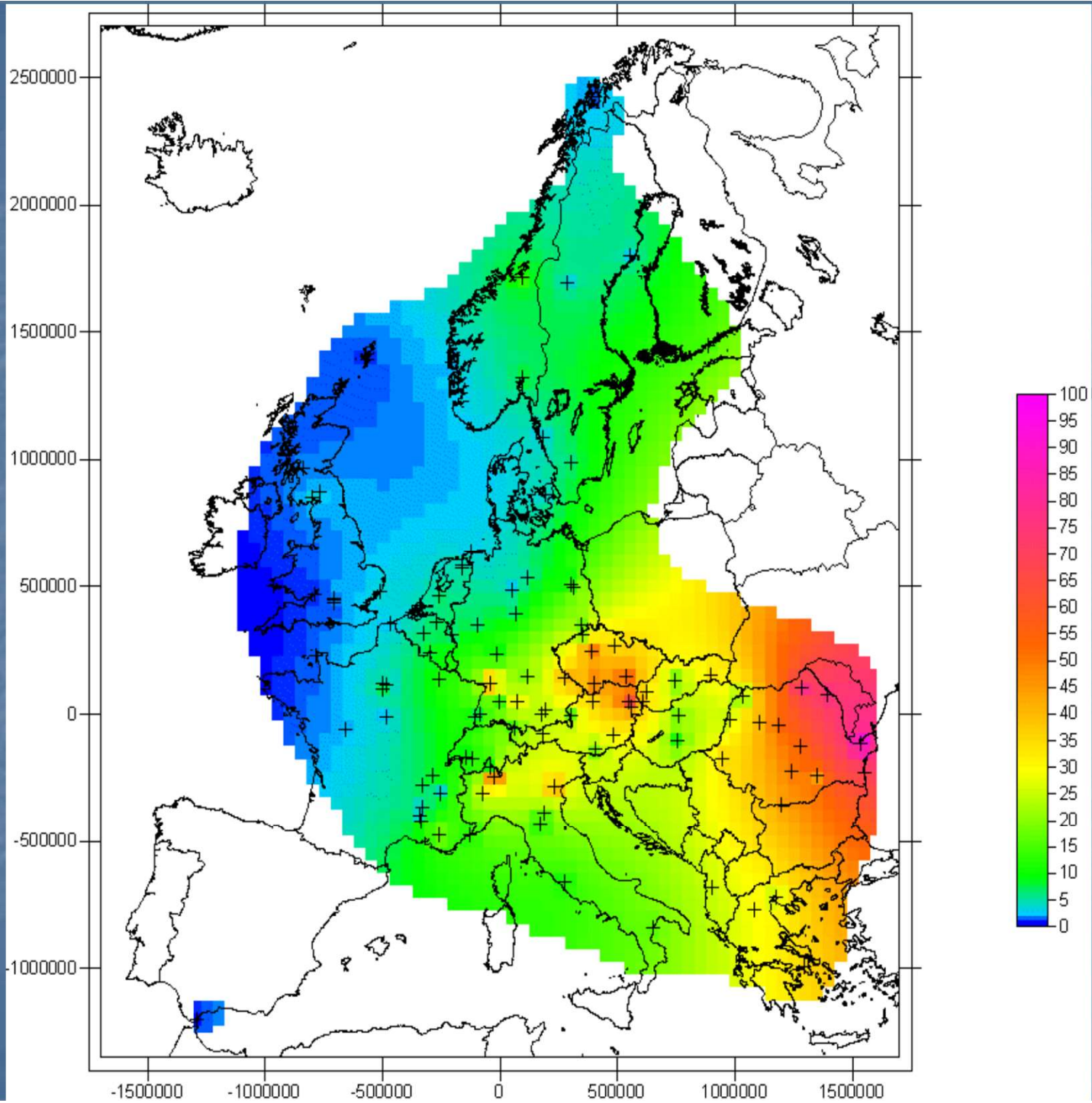


# Chernobyl Accident (1986)

“...the foremost nuclear catastrophe in human history” IAEA (1996)

“...its magnitude and scope, the size of the affected populations, and its long-term consequences make it, by far, the worst industrial disaster on record” IAEA/WHO (2005)





# People exposed to Chernobyl's fallout

	Number
Clean-up workers	530,000
Evacuees	131,000
In high contaminated areas of Belarus, Russia, Ukraine	6.4 million
In low contaminated areas of Belarus, Russia Ukraine	98 million
In Western Europe	500 million
Total	>600 million

# Estimated Fatal Cancers (all Europe)

	Year	Deaths
IAEA/WHO	2005	9,000
TORCH (2006)	2006	30,000 - 60,000
Cardis et al	2015	16,000 (6,700 to 38,000)
TORCH (2016)*	2016	<b>40,000</b>

\*from UNSCEAR 2008

# Observed health effects

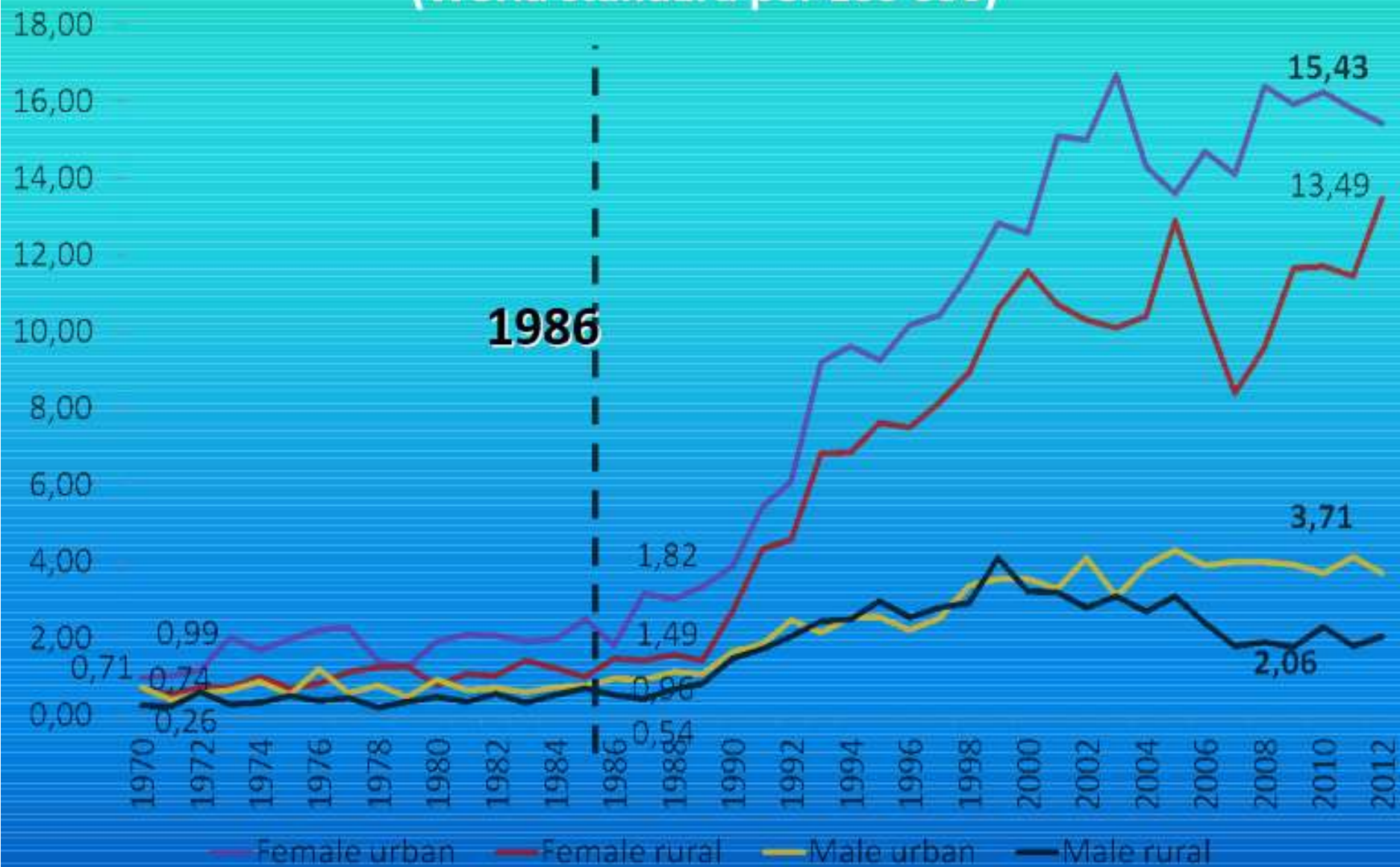
- thyroid cancers
- leukemias and solid cancers
- cardiovascular diseases/strokes
- birth defects
- ill health among children



# Thyroid Cancer



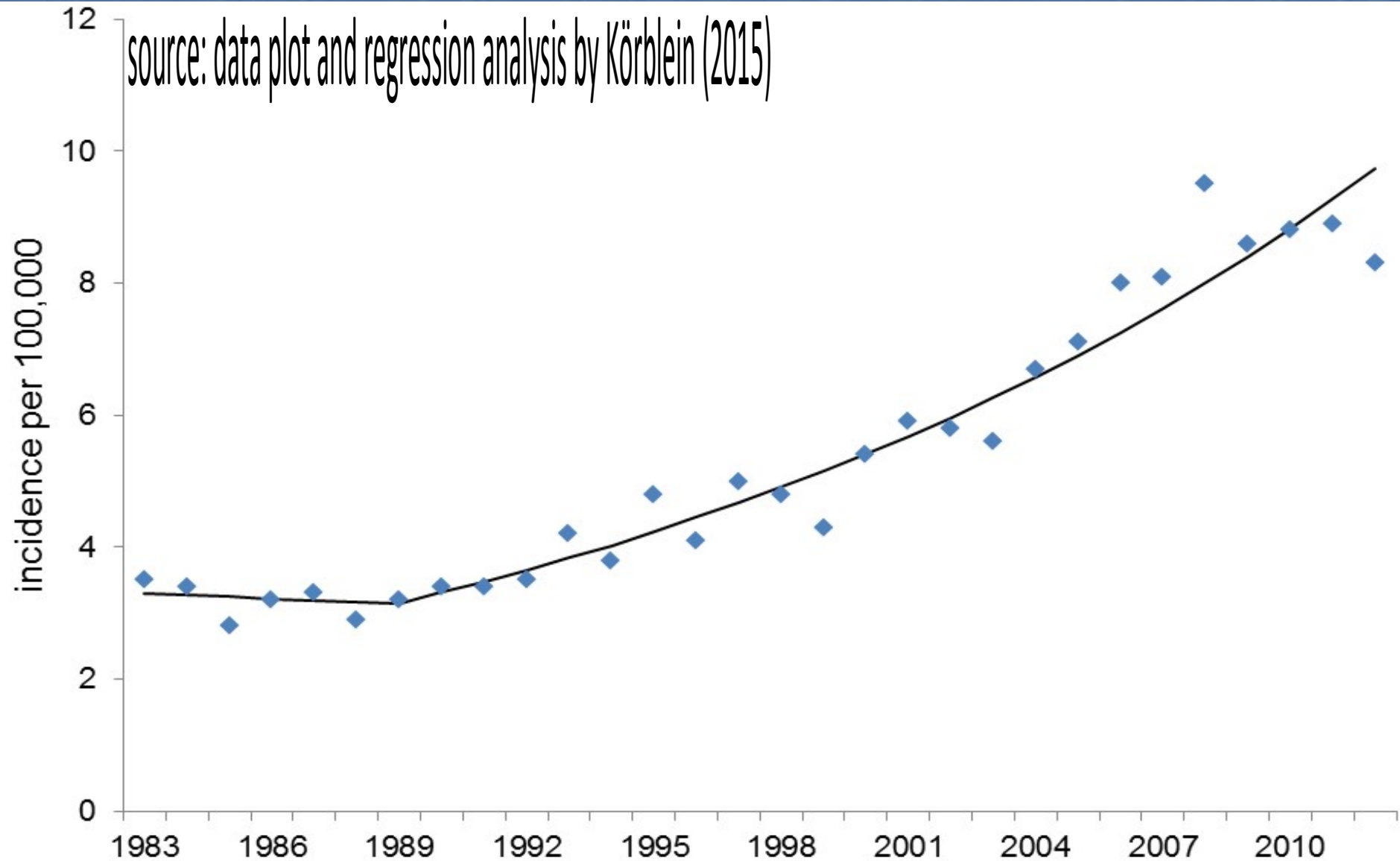
## Age standardized incidence rates of thyroid cancer (World standard per 100 000)



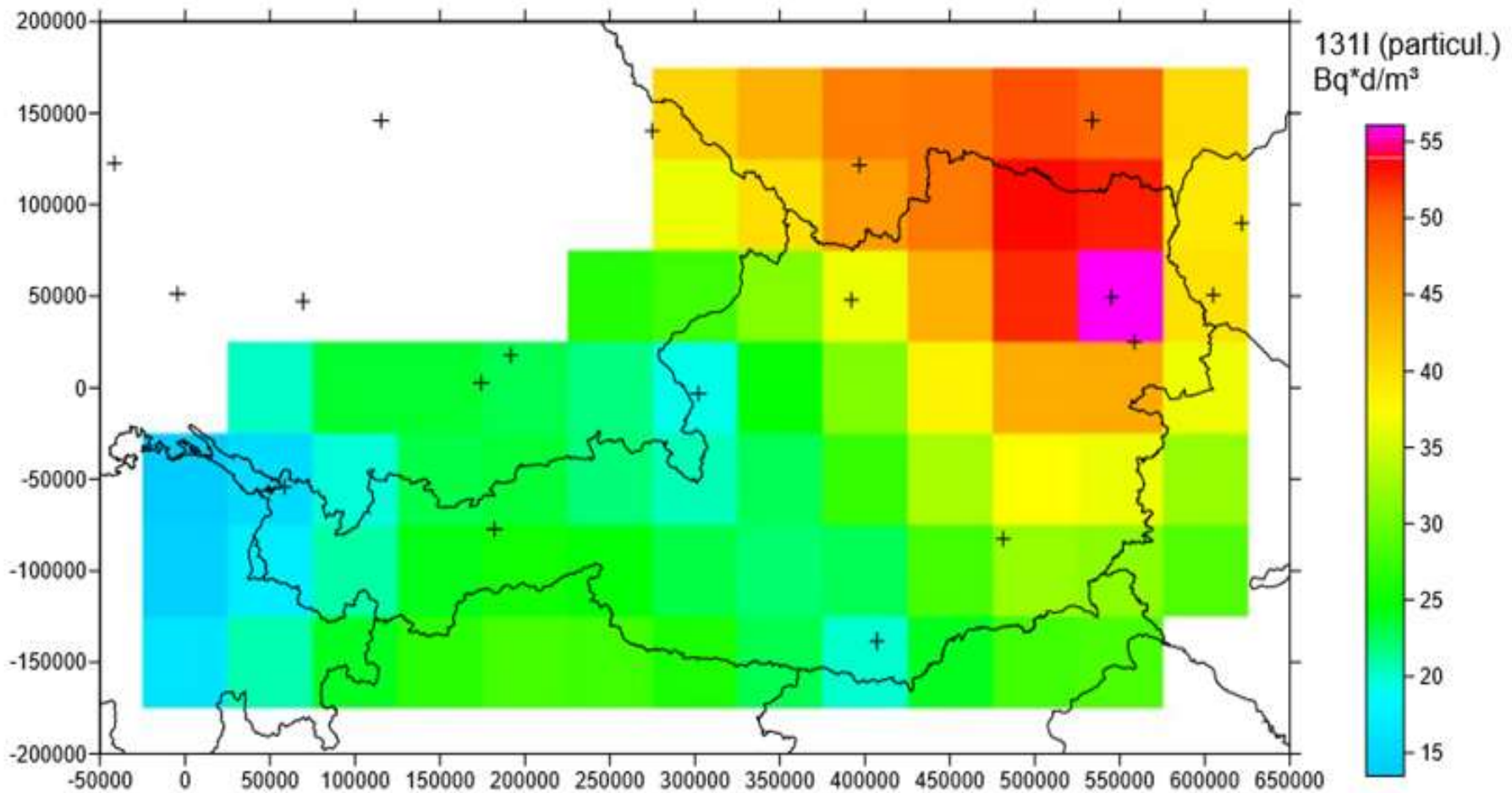
# How large are thyroid cancer risks?

- 700% increase over background rate
- extraordinarily high, perhaps the largest increases in risk ever measured after exposures to toxic substances
- in Ukraine and Belarus, probably Russia

# Thyroid Cancer in Austria



# Iodine-131 in Austria



**Abbildung 4: Verteilung der gemessenen kumulativen  $^{131}\text{I}$  Aktivitätskonzentrationen (part.) in der Luft über Österreich (1986), Zellengröße: 50 × 50 km**

# Thyroid cancer - other countries

**Czech Republic:** Murbeth et al (2004) TC incidence increased by 2.6% per y (95%-CI: 1.2-4.1) after 1990

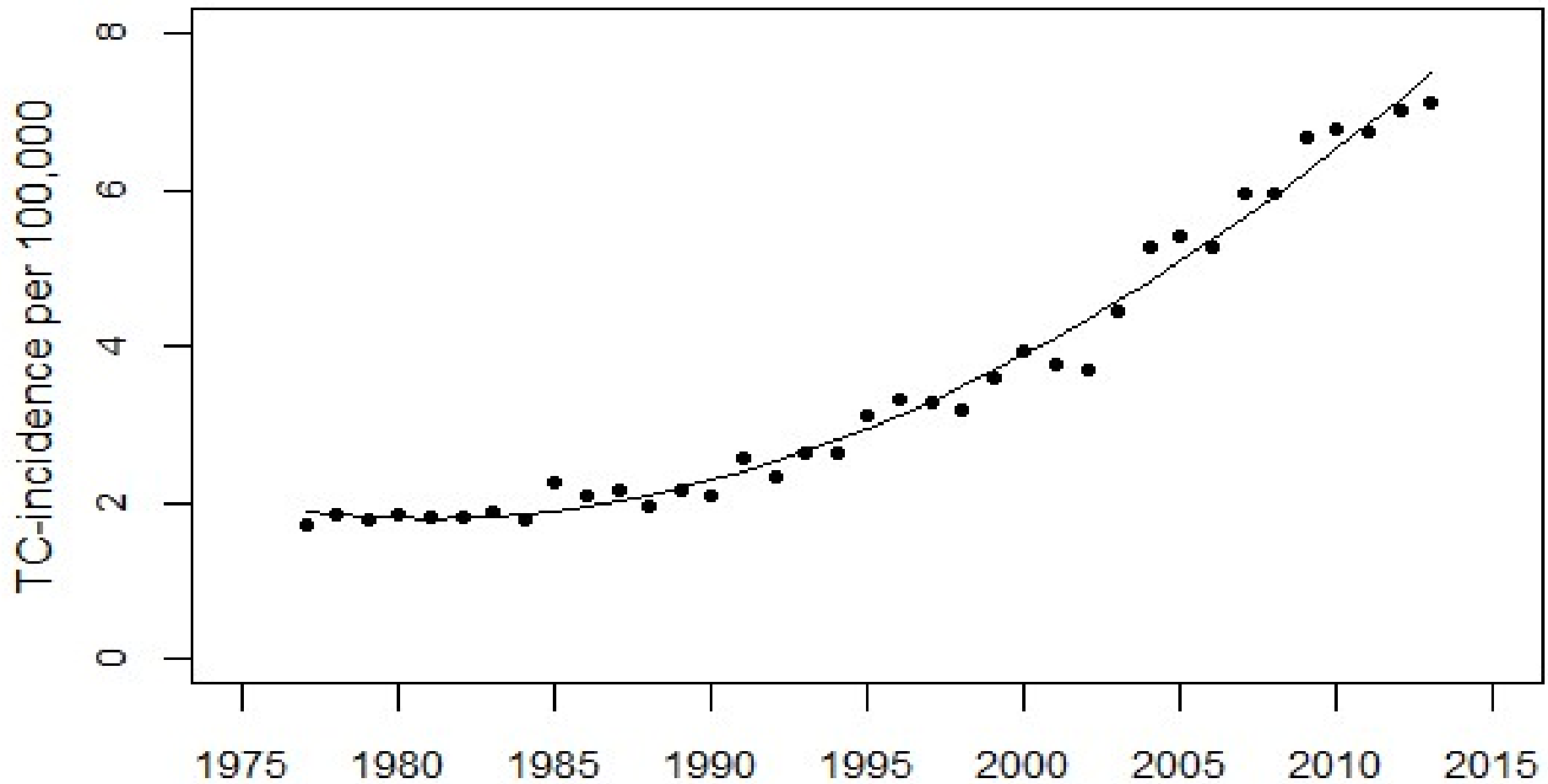
**North England:** Cotterill et al (2001) – incidence in children/young adults, (1987-97)/(1968-1986) = 2.3

**East Slovakia:** Icsó et al (1998) found TC incidence was 1.3x higher in 10 yr period after Francethan before

**Poland:** Roszkowska and Goryński (2004) observed substantial increases in TC incidence after 1991

**France:** Verger et al (2003) reported TC incidence increased x 5.2 in men and 2.7 in women, 1975 to 1995

# Thyroid Cancer in Czech Republic



source: <http://www.svod.cz/analyse.php?modul=incmor#>

# How many excess thyroid cancers will occur?

- So far >6,000 cases (UNSCEAR, 2008)
- >16,000 cases in Belarus alone (Cardis, 2015) estimate



# Leukemia



# Leukemia in Europe

- Russian workers (500% increase /Gy)
- Ukrainian workers (240% increase /Gy)
- Also seen in Finland, Slovakia, Germany, Greece and Italy

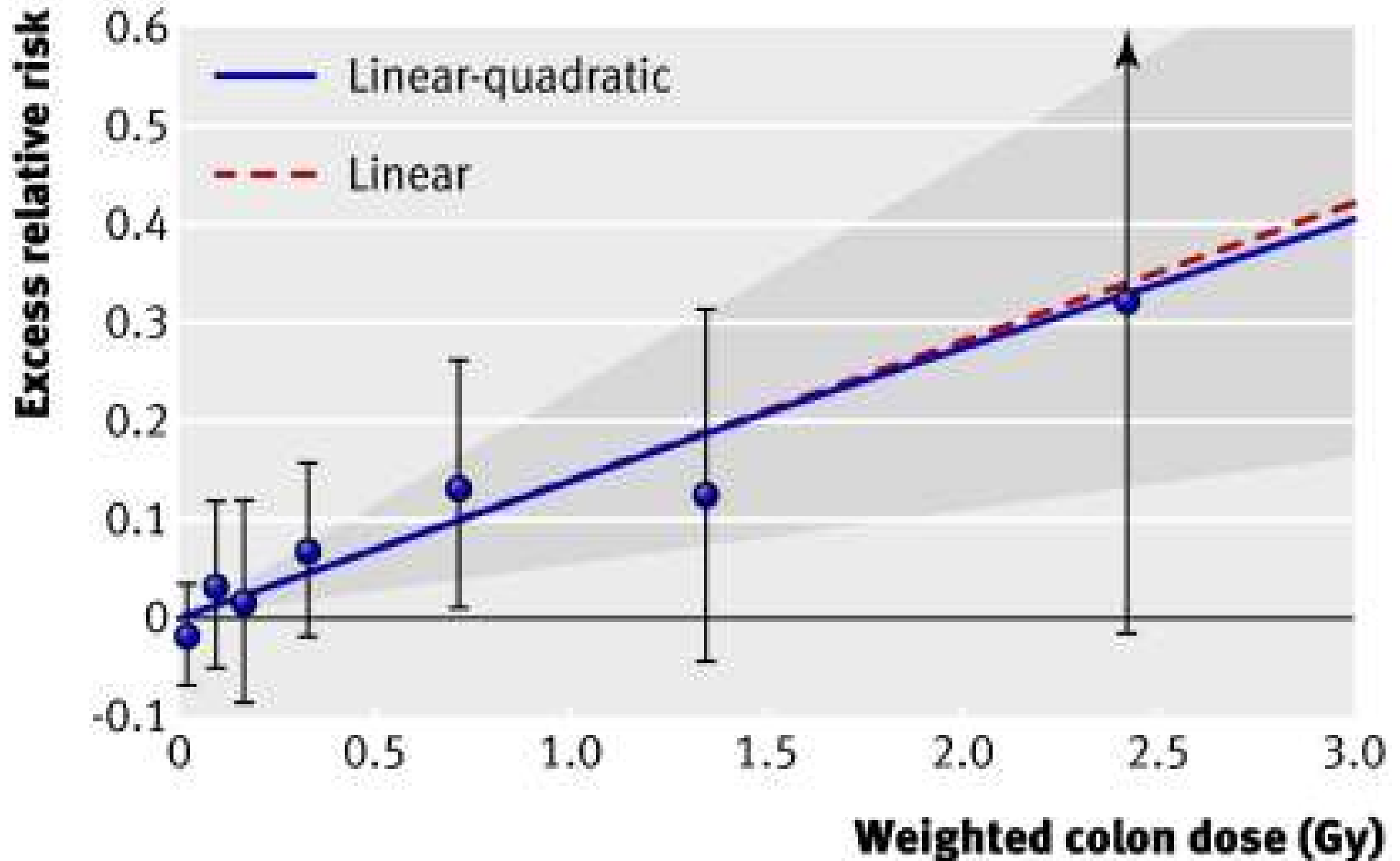
# Solid Cancers

cancer incidence (for ages 20-85 per 100,000 population) in Belarus liquidators 1997-2000, compared with control adults in least contaminated area (Vitebsk)

Cancer	Incidence in controls	Incidence liquidators	increase
All sites	373.3	464.6	23%
Bladder	11.4	18.7	65%
Colon	16.7	22.2	33%
Lung	52.6	66.3	26%
Kidney	15.4	19.1	24%
Stomach	40.8	46.9	15%

source: Okeanov *et al* (2014)

# Cardiovascular Disease (LSS)



# Birth Defects



# Major study on birth defects

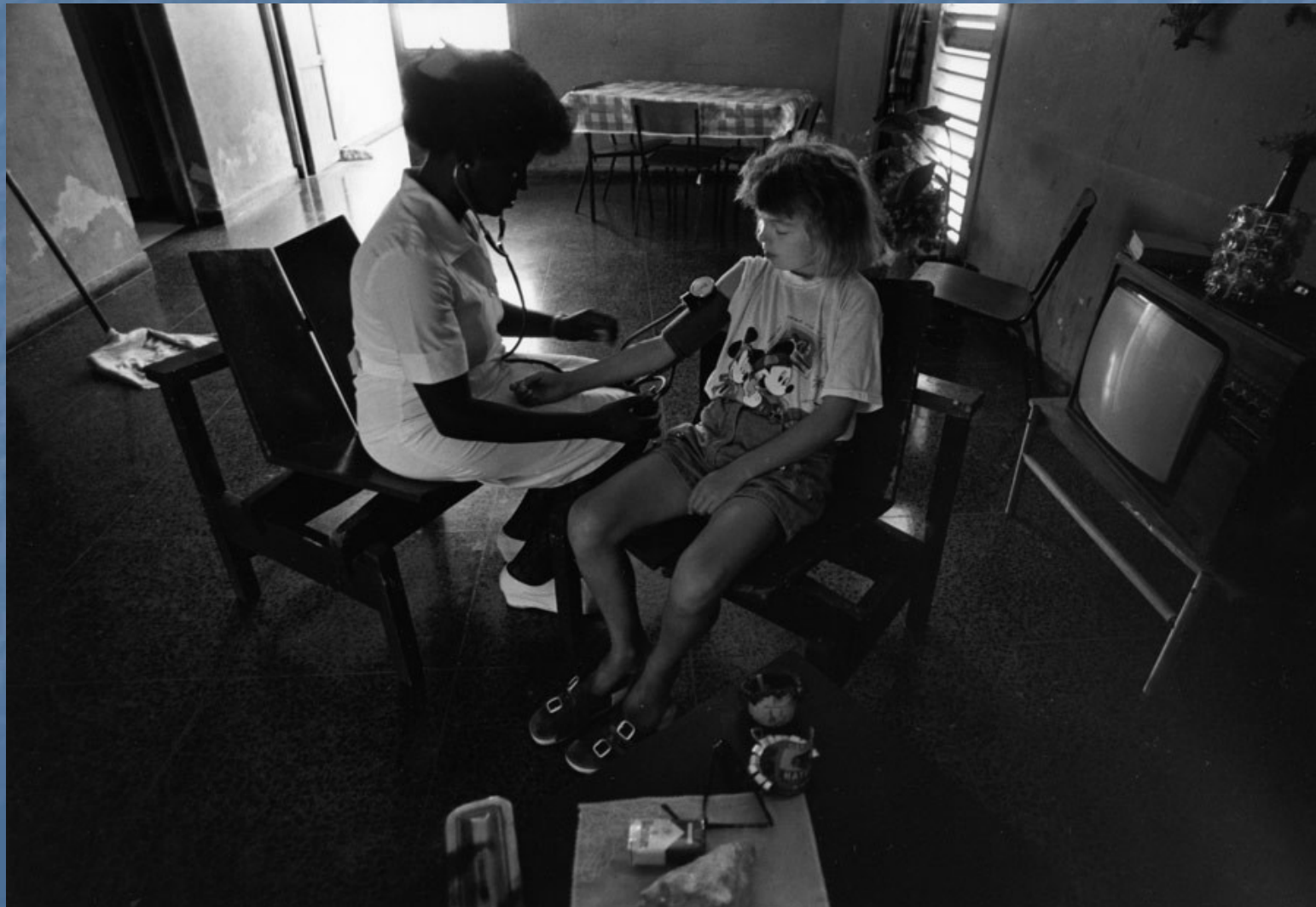
150,000 births, 10 years (Timchenko et al, 2014)

Frequency per 1000 live births	polluted areas	clean areas	% increase
<b>all</b> birth defects	26.10	24.23	7.7%
<b>nervous system</b> birth defects	1.09	0.75	45%

# Down Syndrome

- Scotland (Ramsay *et al*, 1991)
- Southern Germany (Sperling *et al*, 1991)
- Finland (Harjulehto-Mervaala *et al*, 1992)\*
- Hungary (Czeizel *et al*, 1993)\*
- Sweden (Ericson and Kallen, 1994)
- Berlin (Sperling *et al*, 1994, 1994b)
- England (Bound *et al*, 1995)
- Belarus (Zatsepin *et al*, 2007) (26 obs: 9.84 exp; O/E =2.64; CI=1.72-3.76)

# Persistent ill health in children





# Persistent ill health in children

- impaired lung function, increased breathing difficulties Svendsen *et al* (2010, 2015)
- decreased blood counts Stepanova *et al* (2008) Lindgren *et al* (2015)
- increased immunoglobulin factors Titov *et al* (1995) , McMahon *et al* (2014)
- increased anaemias and colds McMahon *et al* (2015)
- improvement with clean food McMahon *et al* (2015)

# Chernobyl in a nutshell

- 5 million people still live in highly contaminated areas
- 500 million people in less contaminated areas
- 42% of western Europe also contaminated
- half of Chernobyl's fallout deposited on W Europe
- 40,000 fatal cancers predicted
- 6,000 thyroid cancer cases, thousands more expected
- possible increased thyroid cancers in Austria and other western European countries
- increased radiogenic leukemia, cardio-vascular disease, breast cancers confirmed
- radiogenic birth defects, mental health effects
- children in contaminated areas suffer radiogenic illnesses

# Chernobyl and Fukushima

	Chernobyl	Fukushima	Factor x
Area contam > 10 kBq/m <sup>2</sup> Cs-137	1,437,000 sq km**	30,000 sq km^	~50
Percent of country	37% of Europe**	8% of Japan^	
Cs-137 source term	85 PBq+	12 PBq*	~7
I-131 source term	1760 PBq*	150 PBq*	~12
Collective dose	400,000* person Sv	48,000* person Sv	~8
Collective dose to thyroid	2,240,000** person-Gy	112,000* person-Gy	~20
No. living in most contam areas	6,400,000+	~1,000,000	~6
Clean-up workers	530,000+	~16,000	~30
Economic costs	?	\$300 - \$500 billion	

sources \* UNSCEAR 2013; \*\*TORCH 2016; +UNSCEAR 2008; ^ Japanese Science Ministry

# Chernobyl: conclusions

- nuclear power is a supremely unforgiving technology
- terrible consequences
- millions still in contaminated areas
- health effects still occurring
- need for more research in Europe
- need for more humanity towards affected peoples, esp children



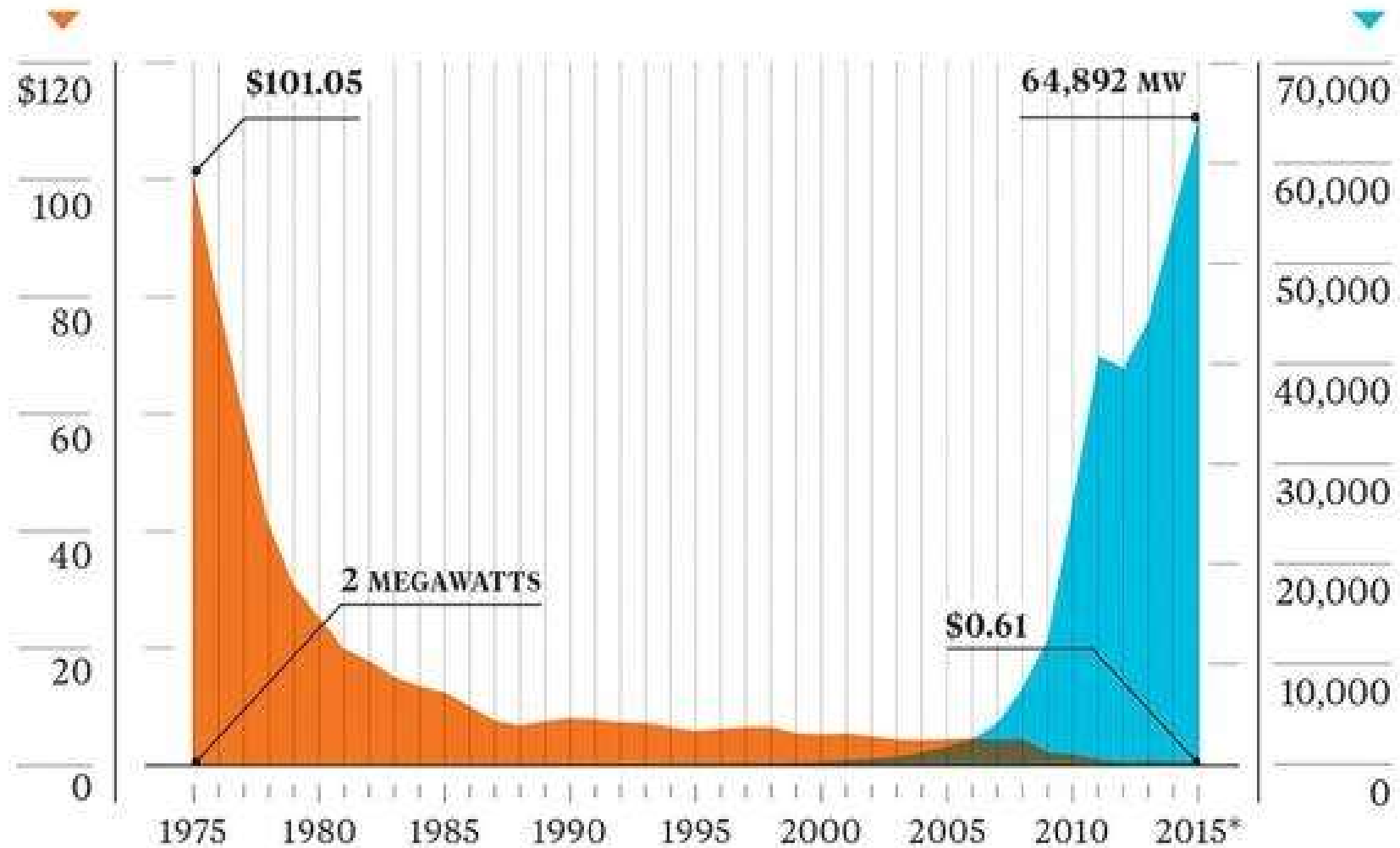
# Chernobyl Children Projects ✓



# the future....

Price of a solar panel per watt

Global solar panel installations



# Good References

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