
Burnasyan Federal Medical
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# Comparative analysis of the radionuclide composition in fallout after the Chernobyl and the Fukushima accidents


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# Tasks

***Chernobyl and Fukushima***

1) **Analysis of the ratios of $q(R_i)/q(^{137}Cs)$ decay-corrected to the date of the main fallout.**

**[$q(R_i)$ is ground deposition density of radionuclide $R_i$]**

2) **Analysis of the dependence of $q(^{131}I)/q(^{137}Cs)$ vs $q(^{137}Cs)$ decay-corrected to the date of the main fallout.**

# Areas considered

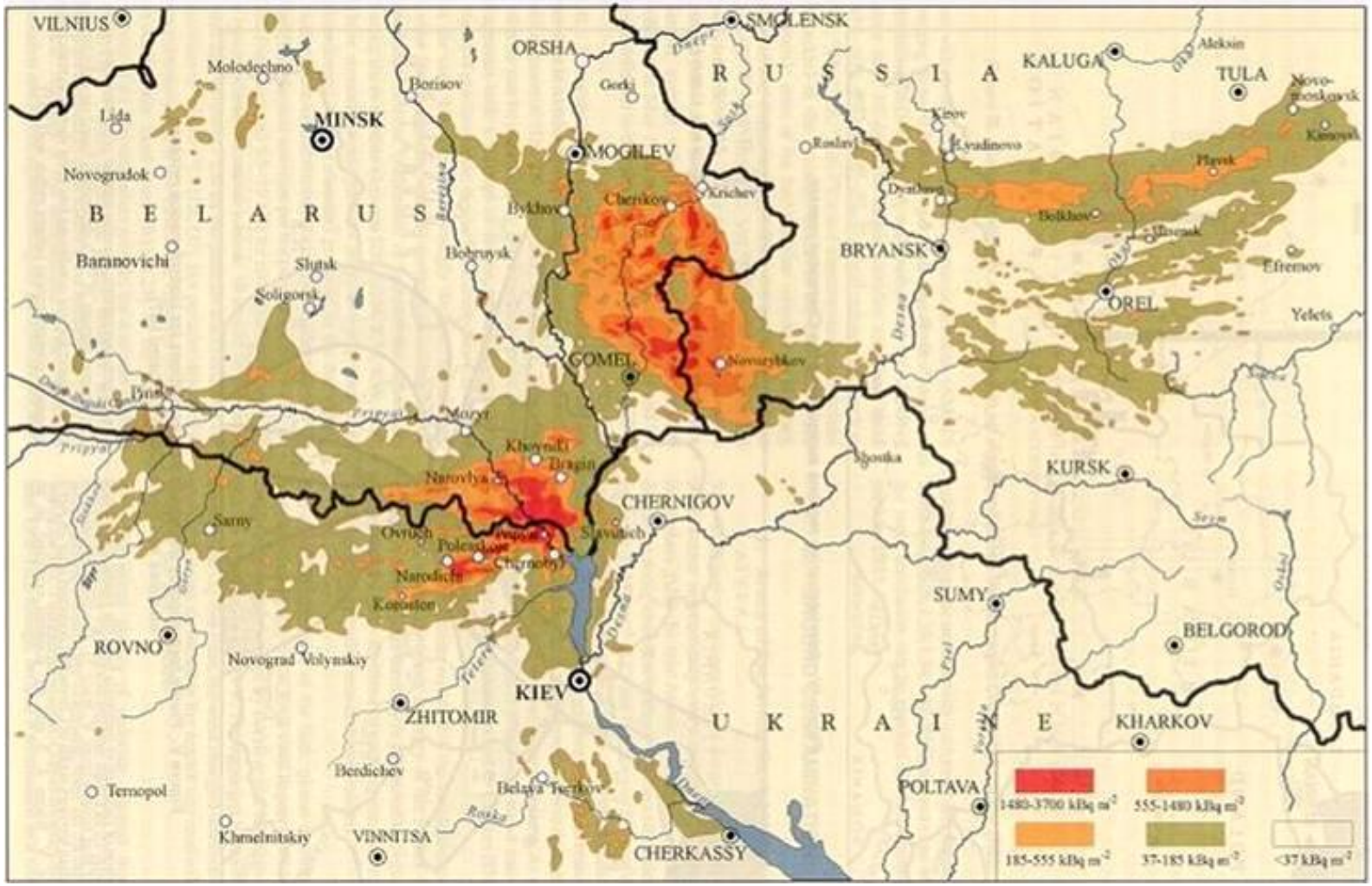
## Chernobyl

- Near zone – Central spot (up to 60 km)
- Far zone – Gomel-Mogilev spot (centered ~200 km)

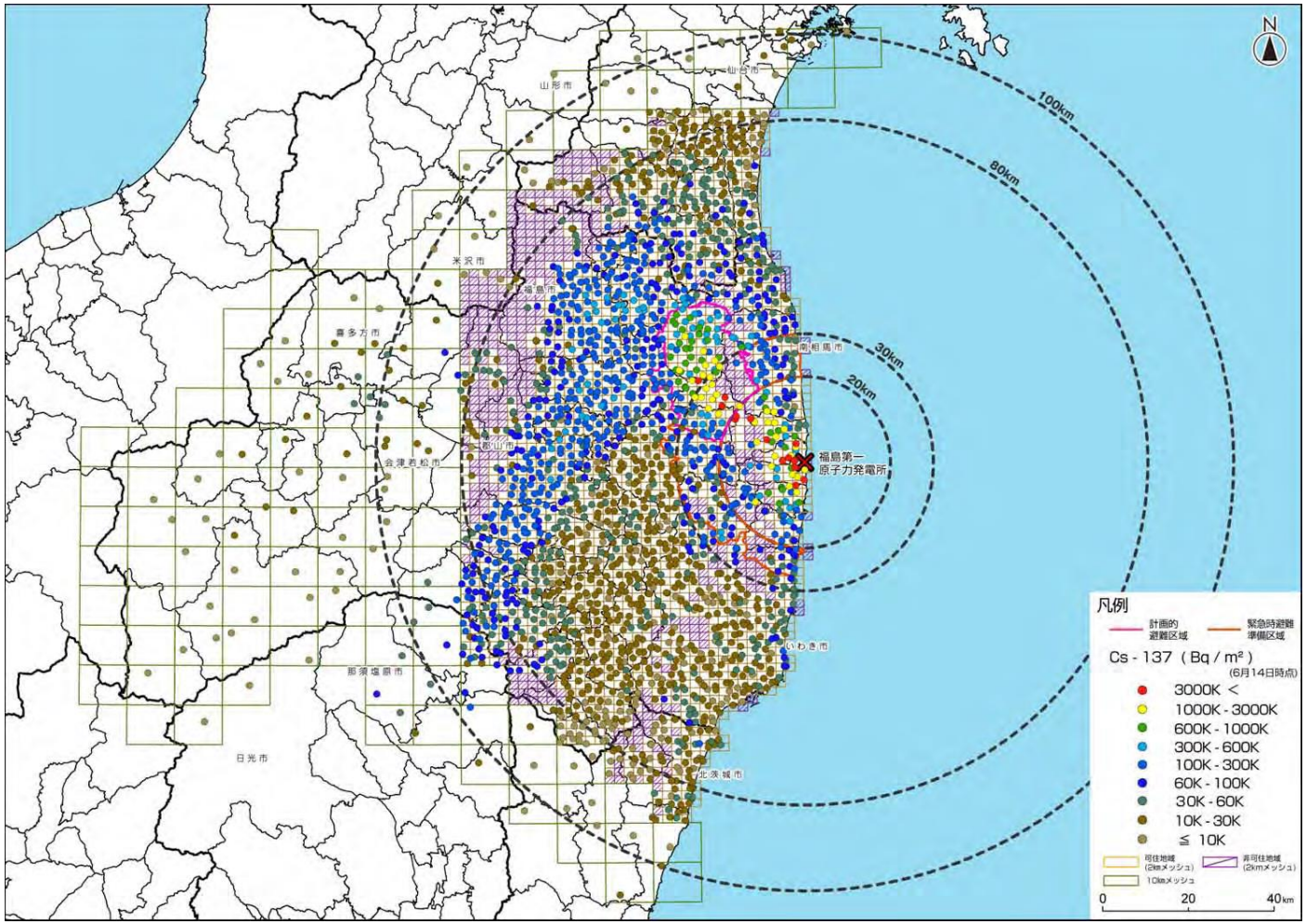
## Fukushima

- Near zone – circle (up to ~60 km)

# Chernobyl: Map of $^{137}$Cs deposition



# Fukushima: Map of $^{137}$Cs deposition



# Input data

## *Chernobyl*

- Spectometrical measurements of soil samples. For $^{131}I$ – only measurements conducted up to 2 months following accidents (up to June 23, 1986).
- Units – kBq $m^{-2}$
- Measurements were carried out by the specialists from:

Institute of Nuclear energy (Minsk, Belarus) and
Institute of Biophysics (Moscow, Russia)

# Input data

## *Fukushima*

- Spectometrical measurements of soil samples. For $^{131}I$ – only measurements conducted up to 2.5 months following accidents (up to May 31, 2011).
- Units – Bq $kg^{-1}$
- Measurements were carried out by Japanese specialists and placed at the website of MEXT (Ministry of Education, Culture, Sports, Science and Technology)

# Task

***Chernobyl and Fukushima***

**1) Analysis of the ratios of $q(R_i)/q(^{137}Cs)$ decay-corrected to the date of the main fallout.**

**[$q(R_i)$ is ground deposition density of radionuclide $R_i$]**

# Average ratio of $R_i$ to $^{137}Cs$ in soil

| Area | Average relative ratio to $^{137}Cs$ | | | | |
|---|---|---|---|---|---|
| | $^{95}Zr$, $^{95}Nb$, $^{141}Ce$, $^{144}Ce$ | $^{106}Ru$, $^{103}Ru$ | $^{140}Ba$, $^{140}La$ | $^{132}Te$ | $^{134}Cs$ |
| Central spot | 2-5 | 1-3 | 3 | 20 | 0.5 |
| Gomel-Mogilev spot | 0.06-0.11 | 0.7-2 | 0.7 | 10 | 0.5 |
| Fukushima (northwest zone) | ND | ND | traces | 5-9 | 0.8-0.9 |

# Range of ratio of $^{131}I/^{137}Cs$ in soil

***Chernobyl (two spots)***

$^{131}I/^{137}Cs$ = 3-50

***Fukushima (near zone)***

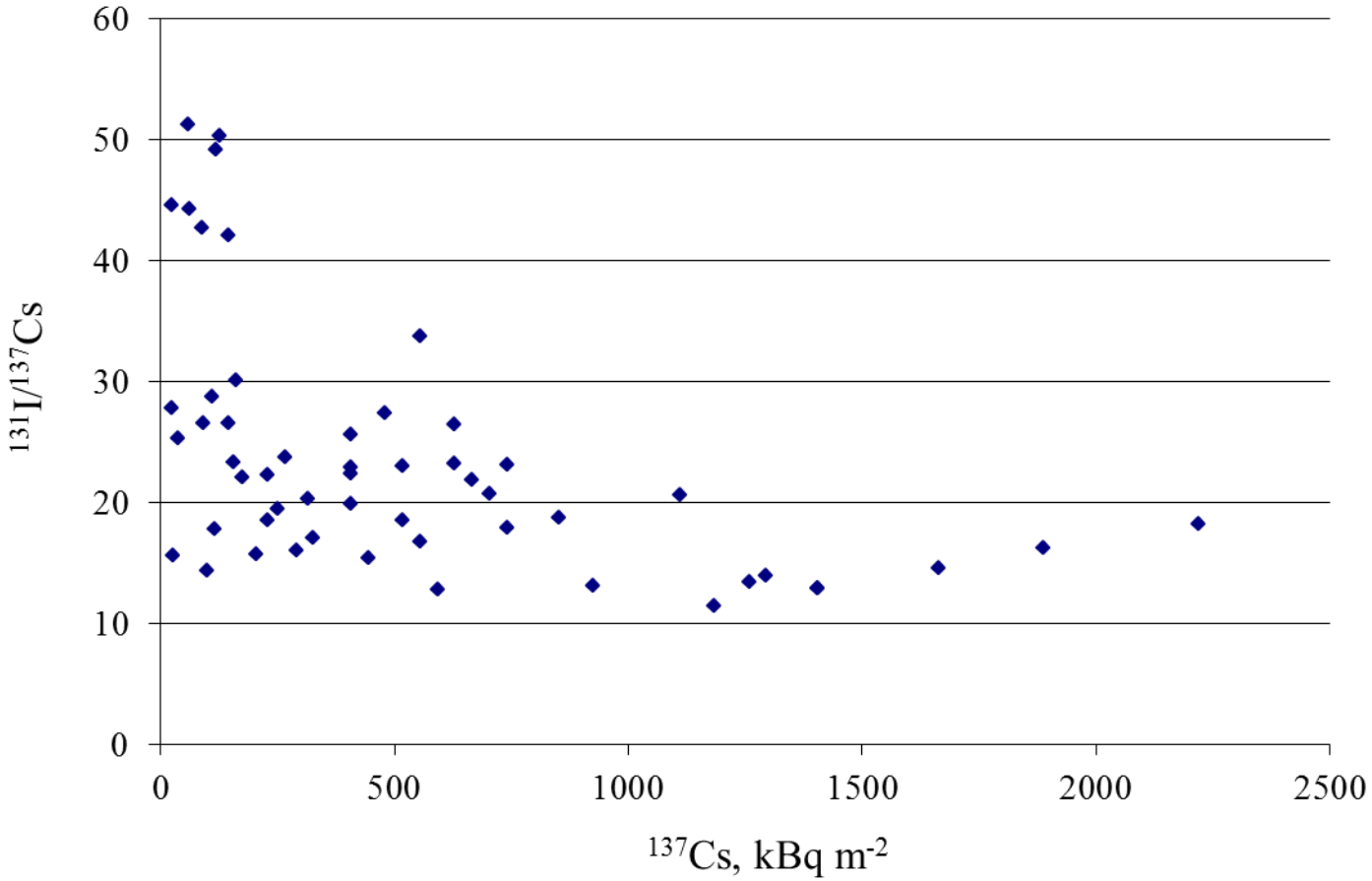
$^{131}I/^{137}Cs$ = 5-80

# Task

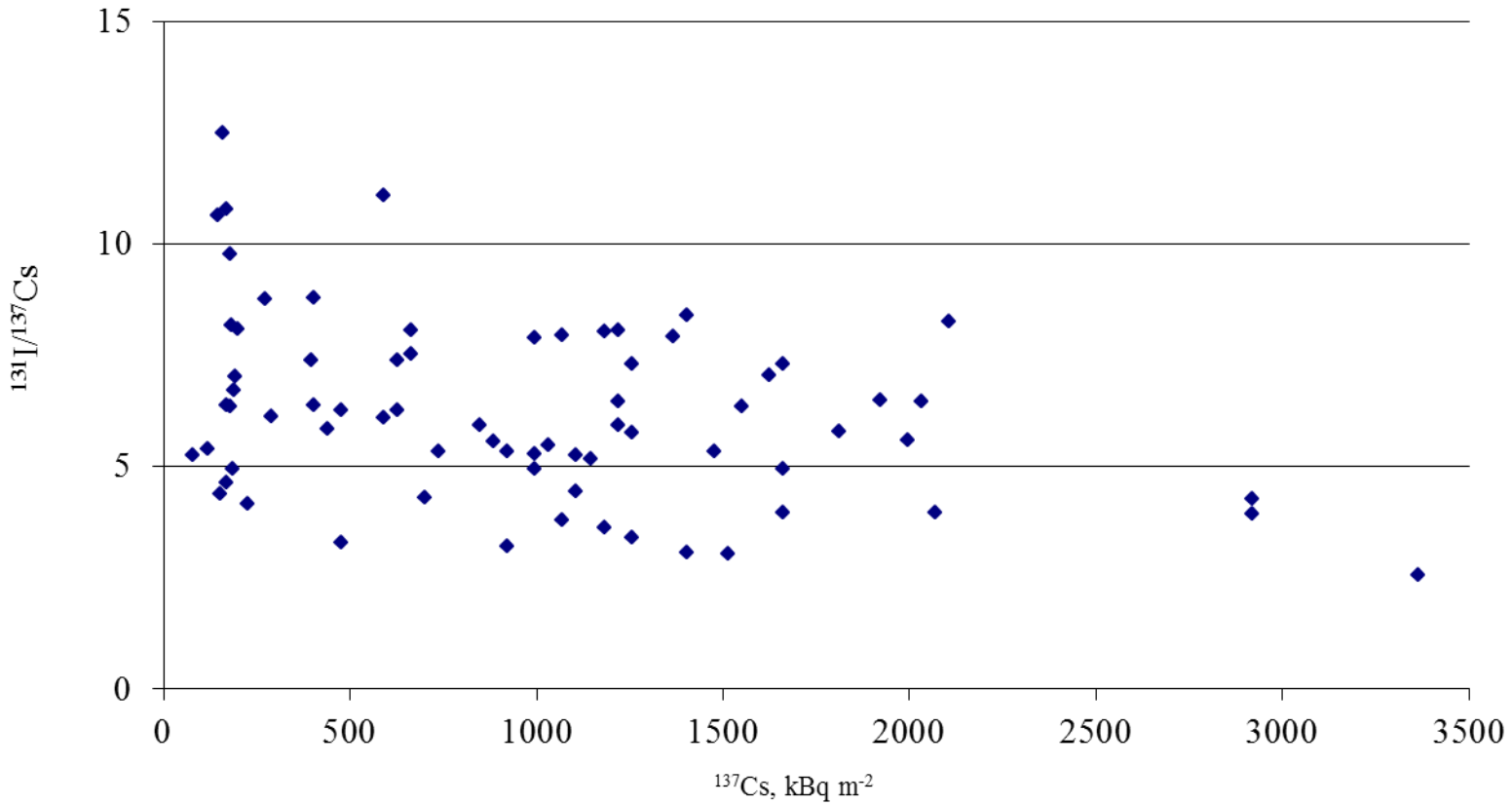
***Chernobyl and Fukushima***

**2) Analysis of the dependence of $q(^{131}I)/q(^{137}Cs)$ vs $q(^{137}Cs)$ decay-corrected to the date of the main fallout.**

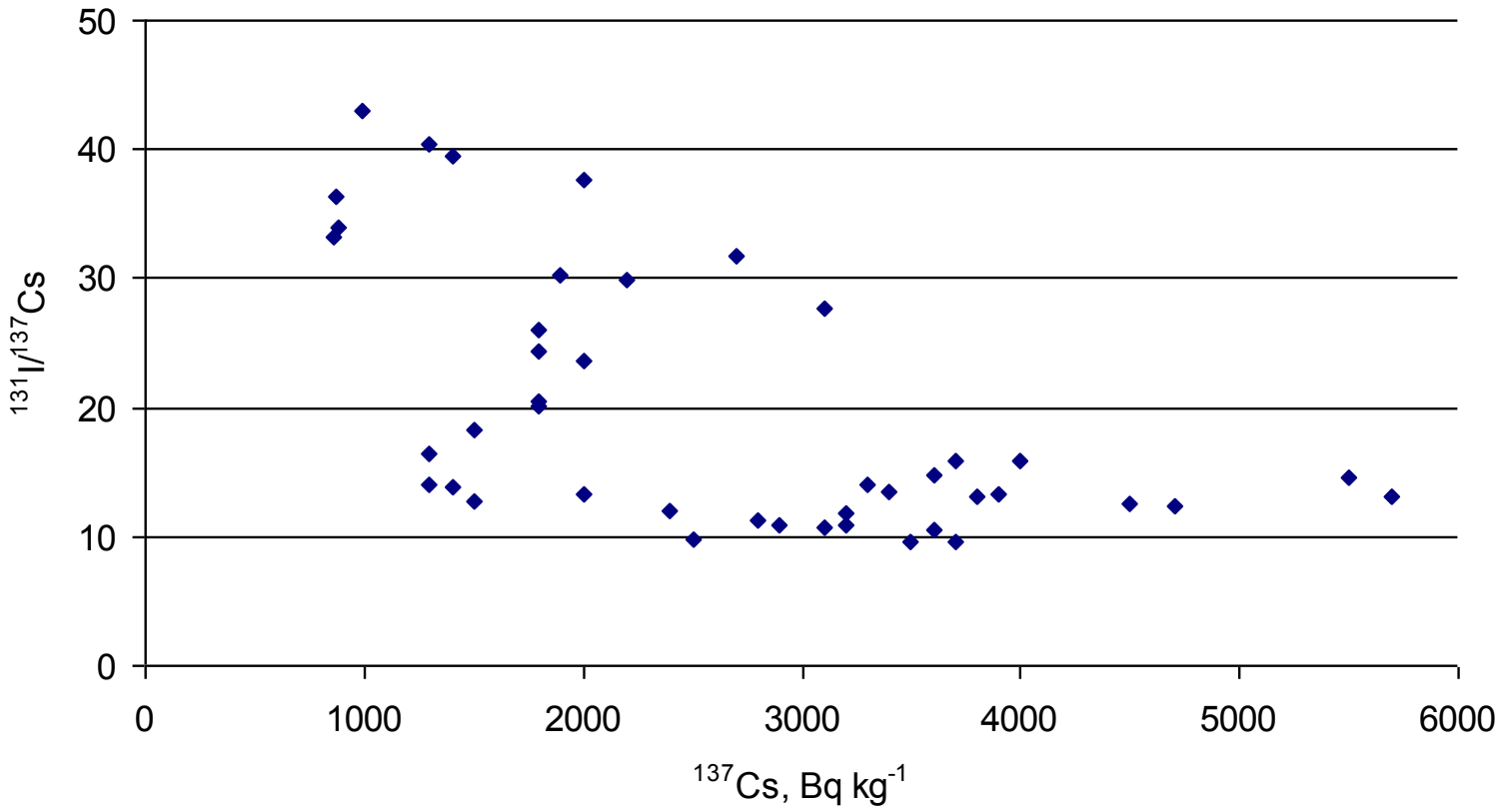
# Chernobyl: Central spot



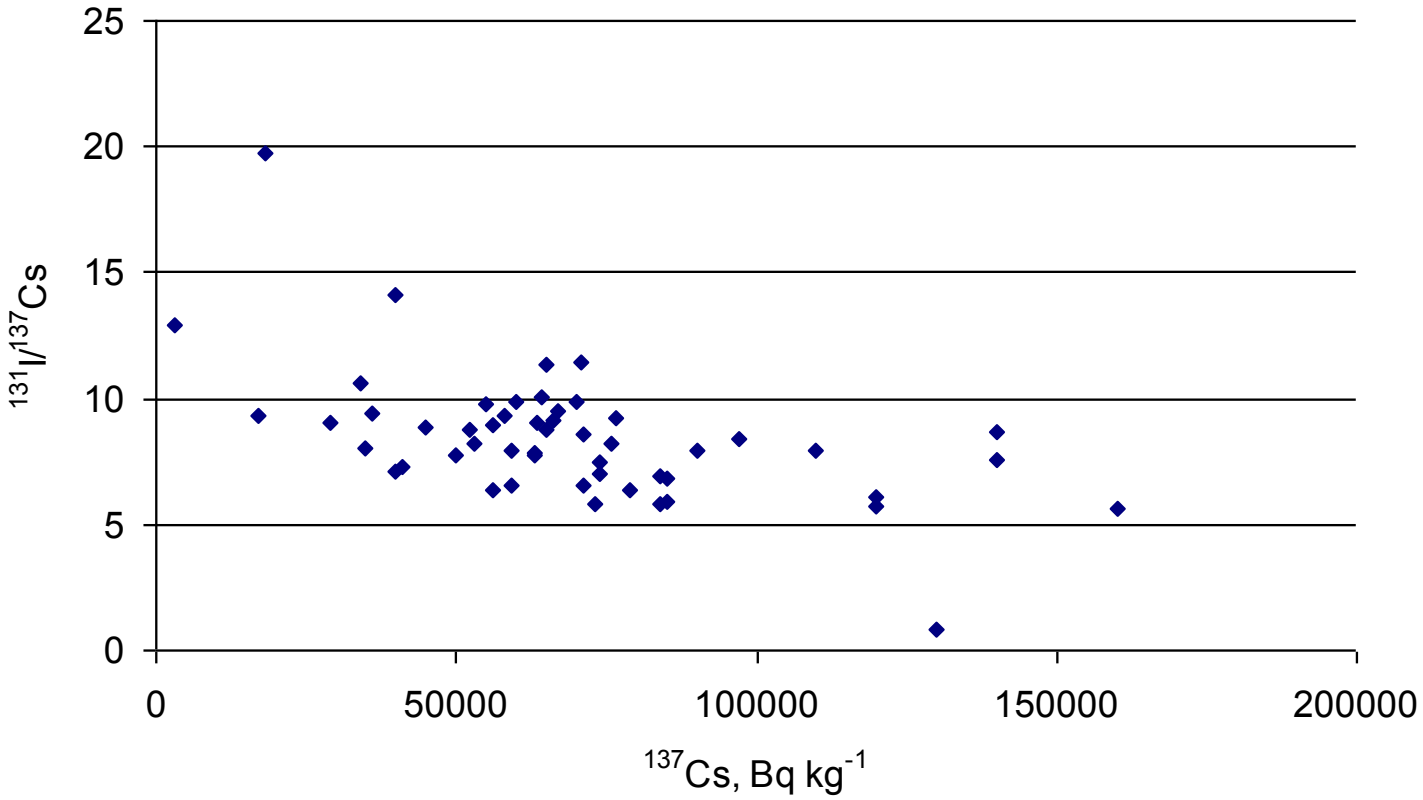
# Chernobyl: Gomel-Mogilev spot



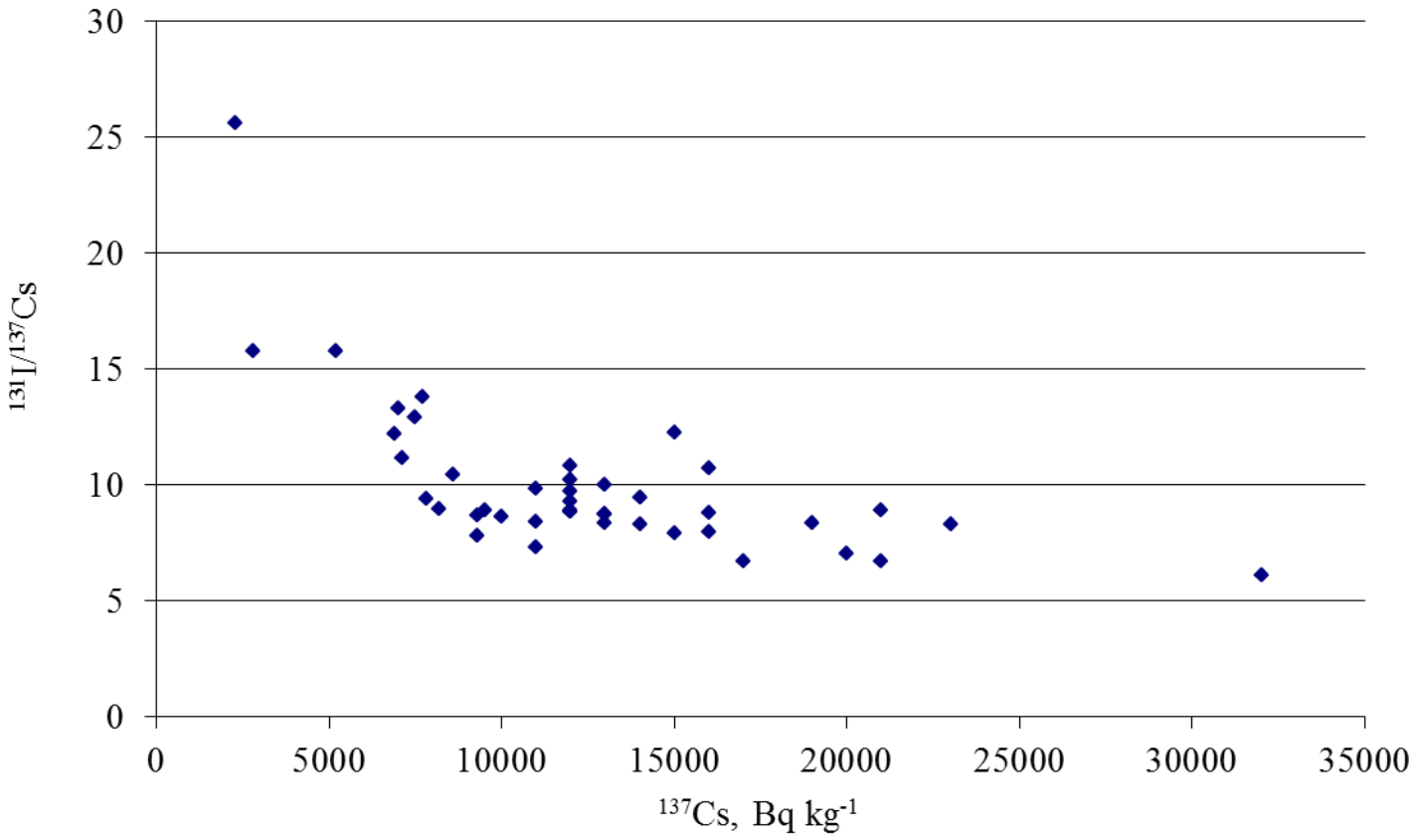
# Fukushima: 24 km north



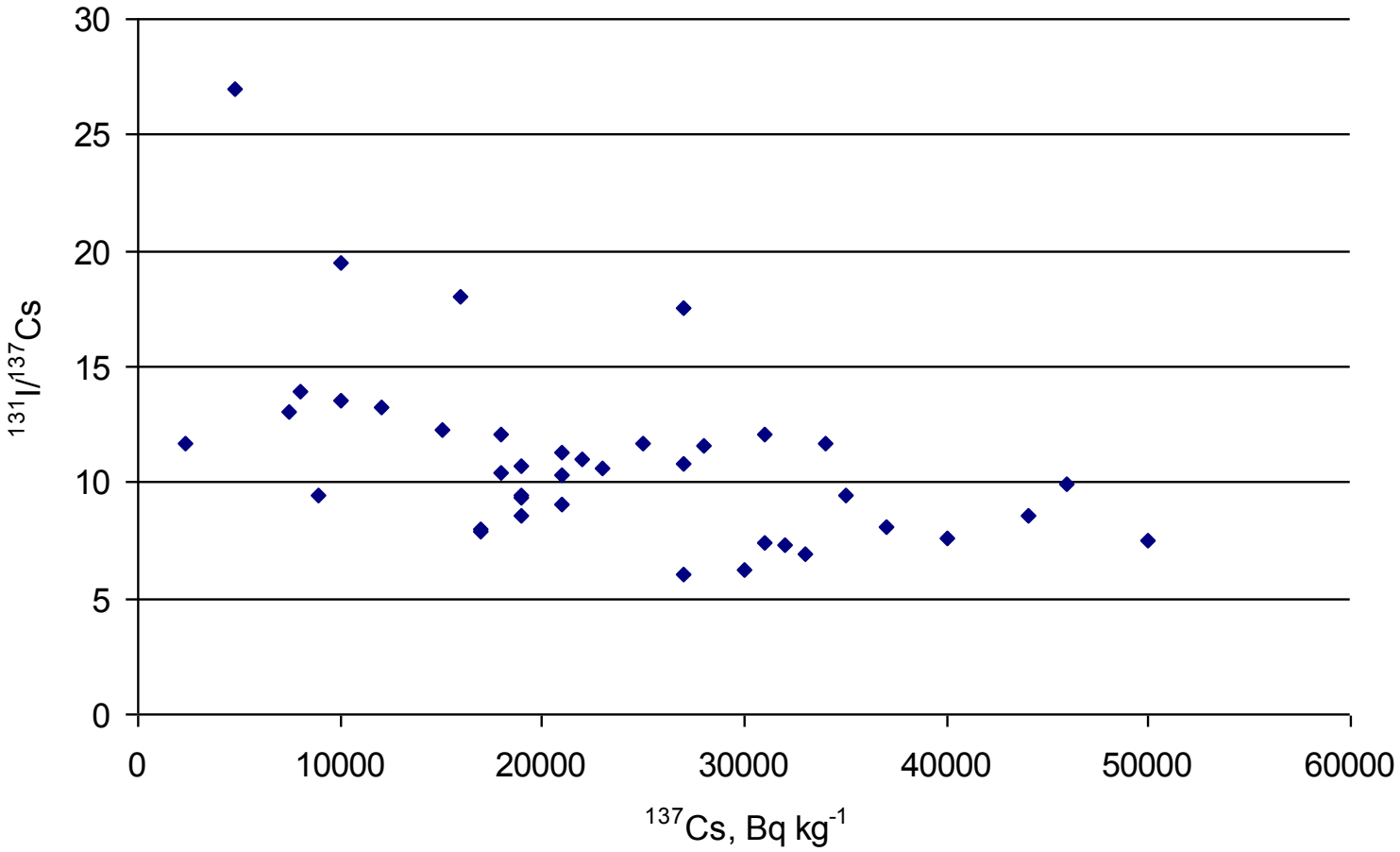
# Fukushima: 33 km north-west



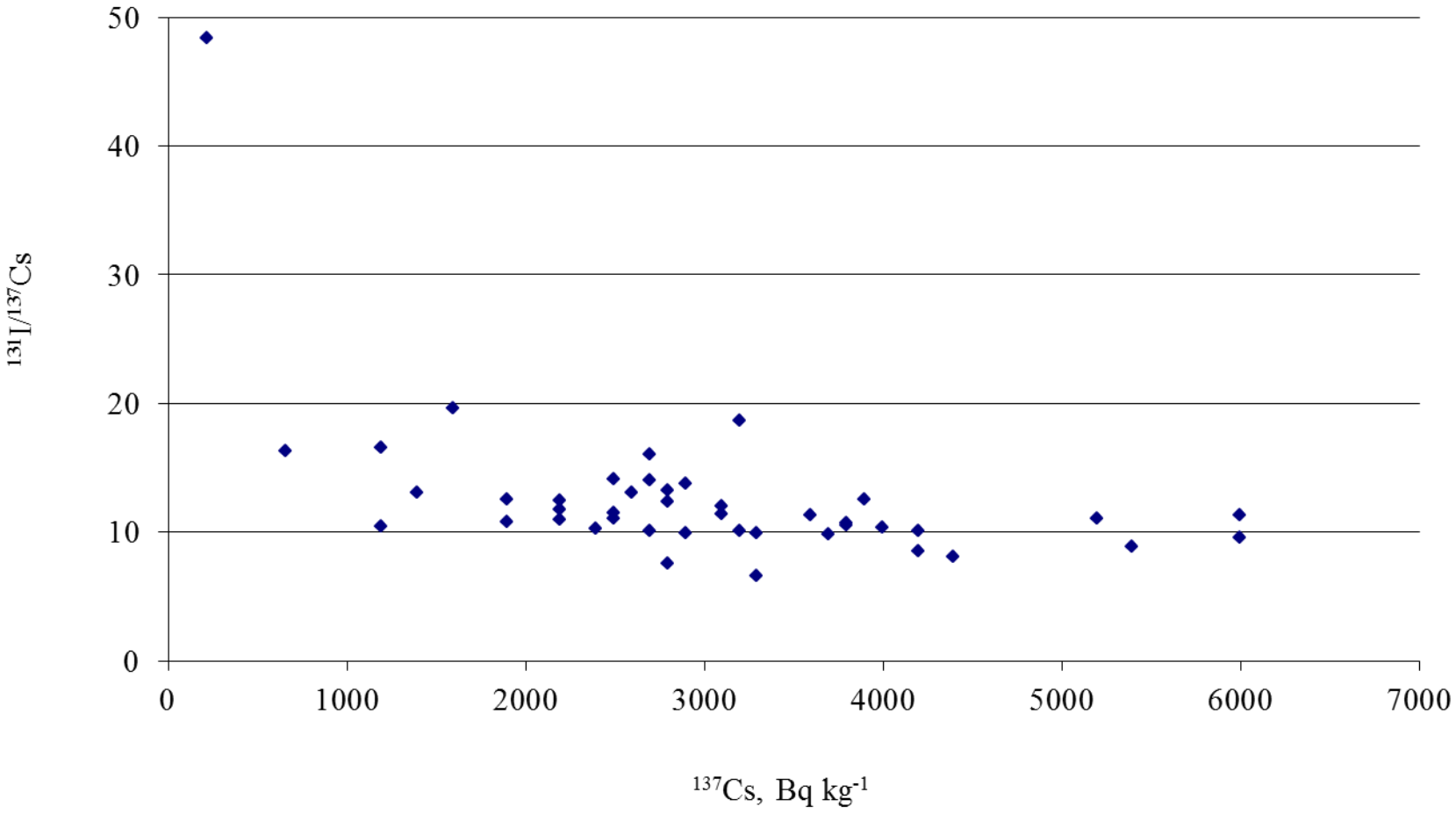
# Fukushima: 62km north-west



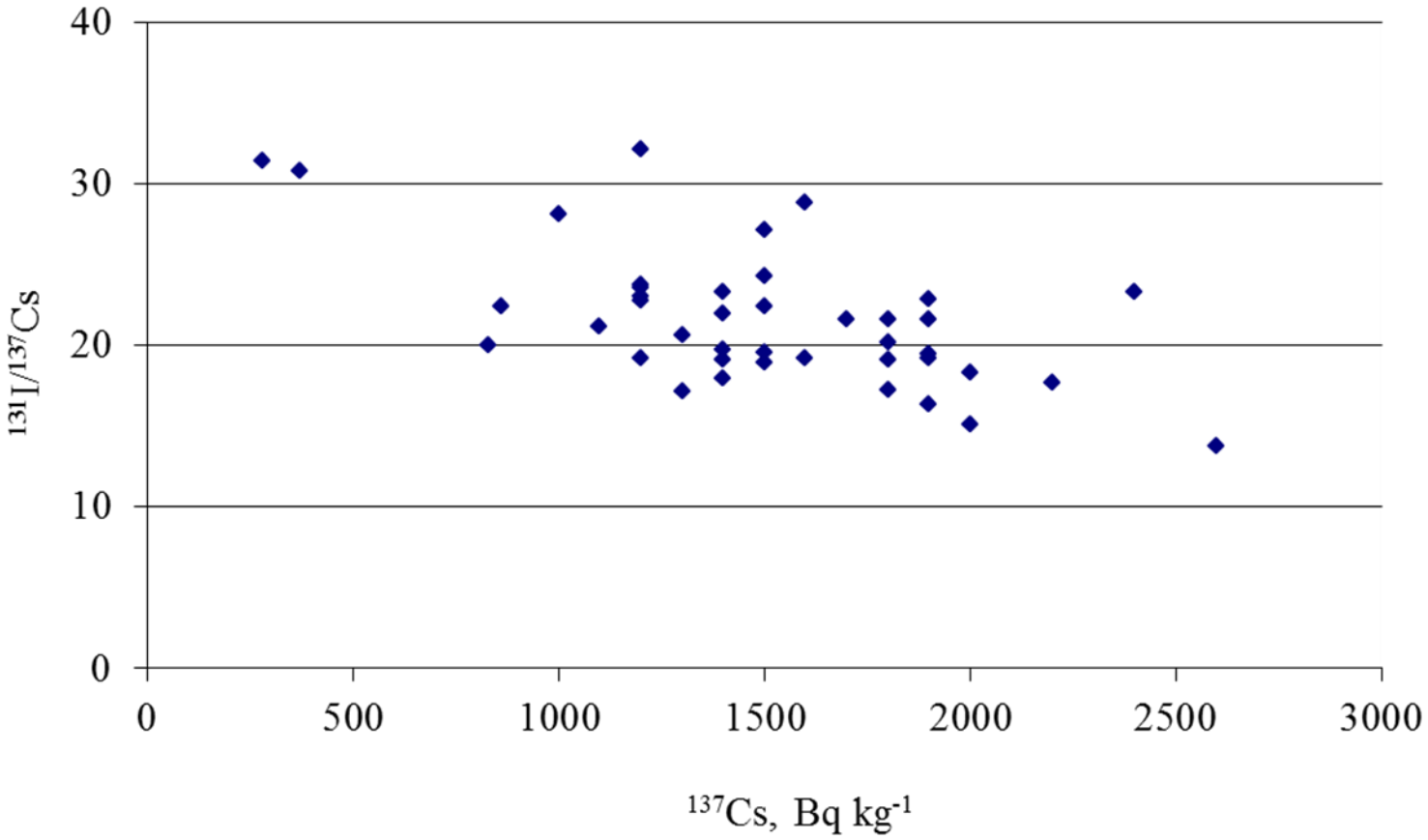
# Fukushima: 30km west-northwest



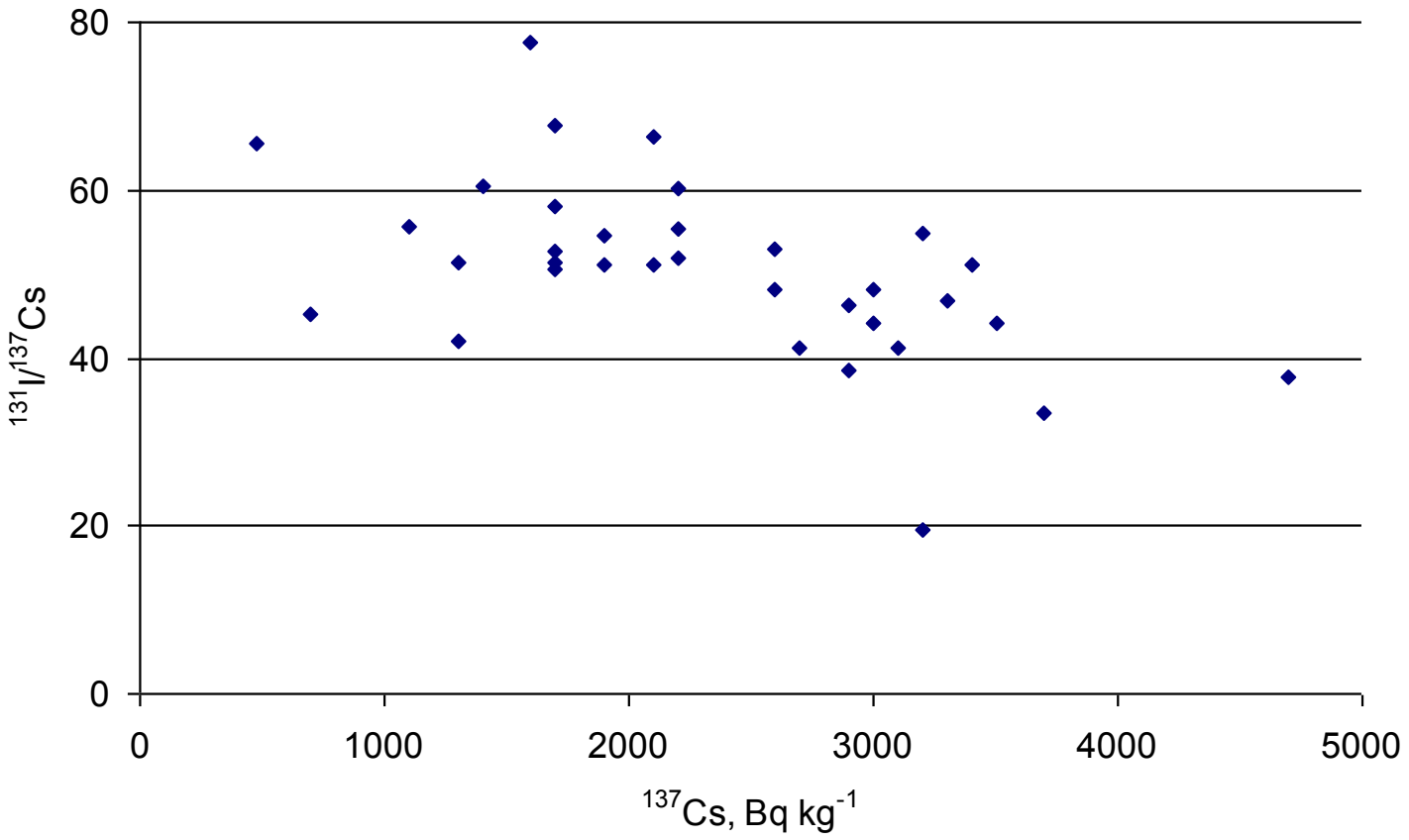
# Fukushima: 32km west



# Fukushima: 22 km west-southwest



# Fukushima: 23 km south



# Discussion

## *Deposition velocity*

- $^{131}I$

(a) aerosols, $V_g \sim 1$ mm $s^{-1}$;

(b) reactive gaseous (elemental iodine), $V_g \sim 10$ mm $s^{-1}$;

(c) non-reactive gaseous (organic compounds), $V_g \sim 0.1$ mm $s^{-1}$.

- $^{137}Cs$

(a) aerosols, $V_g \sim 1$ mm $s^{-1}$.

## *Scavenging processes from the air to the ground*

– Wet deposition

– Dry deposition

# Conclusions

1) Fukushima – volatile and intermediate (I, Cs, Te)

   Chernobyl – all radionuclides (I, Cs, Te, Ru, Ba(La), Zr(Nb), Ce)

2) Fukushima and Chernobyl

   fallout – $^{131}I/^{137}Cs$ decreases with increase of level of the $^{137}Cs$ ground deposition

3) Revealed tendency can be used in dose reconstruction

ФМБА РОССИИ

# Thank you

# for your attention