



Susanna Salminen-Paatero^{1,2} and Jussi Paatero²

¹ Laboratory of Radiochemistry, P.O. Box 55, 00014 University of Helsinki, Finland. Present address.

² Finnish Meteorological Institute, Observation Services, P.O. Box 503, 00101 Helsinki, Finland

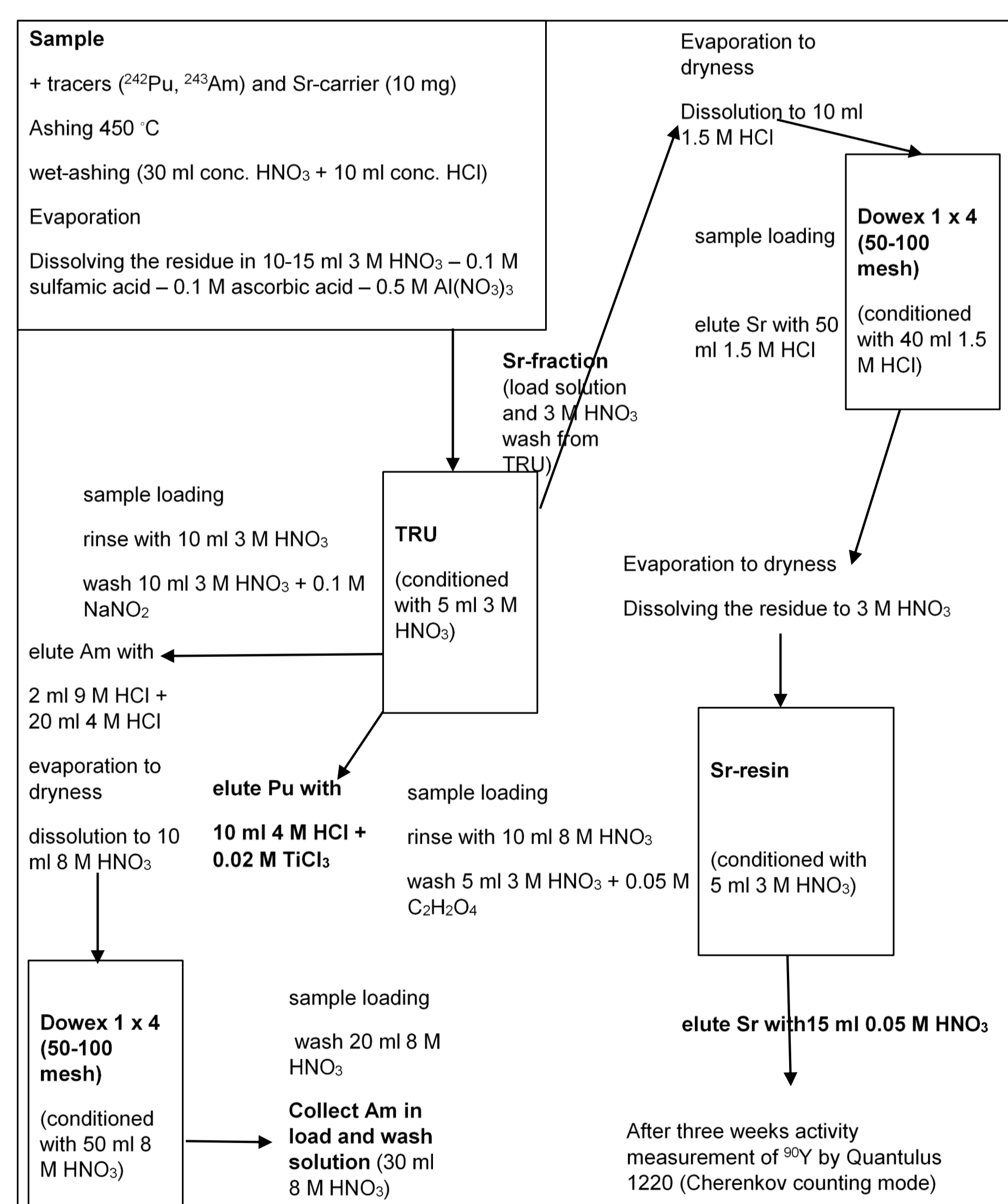
Nuclear contamination sources in surface air of Finnish Lapland in 1965-2011 studied by means of ¹³⁷Cs, ⁹⁰Sr, total beta activity, ^{238,239,240,241}Pu, and ²⁴¹Am

Air filter samples collected in Rovaniemi in 1965-2011 were analyzed and the activity concentrations of ¹³⁷Cs, ⁹⁰Sr, total beta activity, ^{238,239,240,241}Pu, and ²⁴¹Am were determined.

The goal of this study was to investigate anthropogenic radionuclide contamination sources in the surface air of Finnish Subarctic.

Nuclear events during 1965-2011 include e.g. global fallout from atmospheric nuclear weapons testing, SNAP-9A satellite accident (²³⁸Pu), atmospheric nuclear weapons tests by China (the largest ones in 1967-1980), the nuclear accidents in Chernobyl in 1986 and in Fukushima in 2011.

The radiochemical separation of ⁹⁰Sr, ^{238,239,240}Pu and ²⁴¹Am from air filters



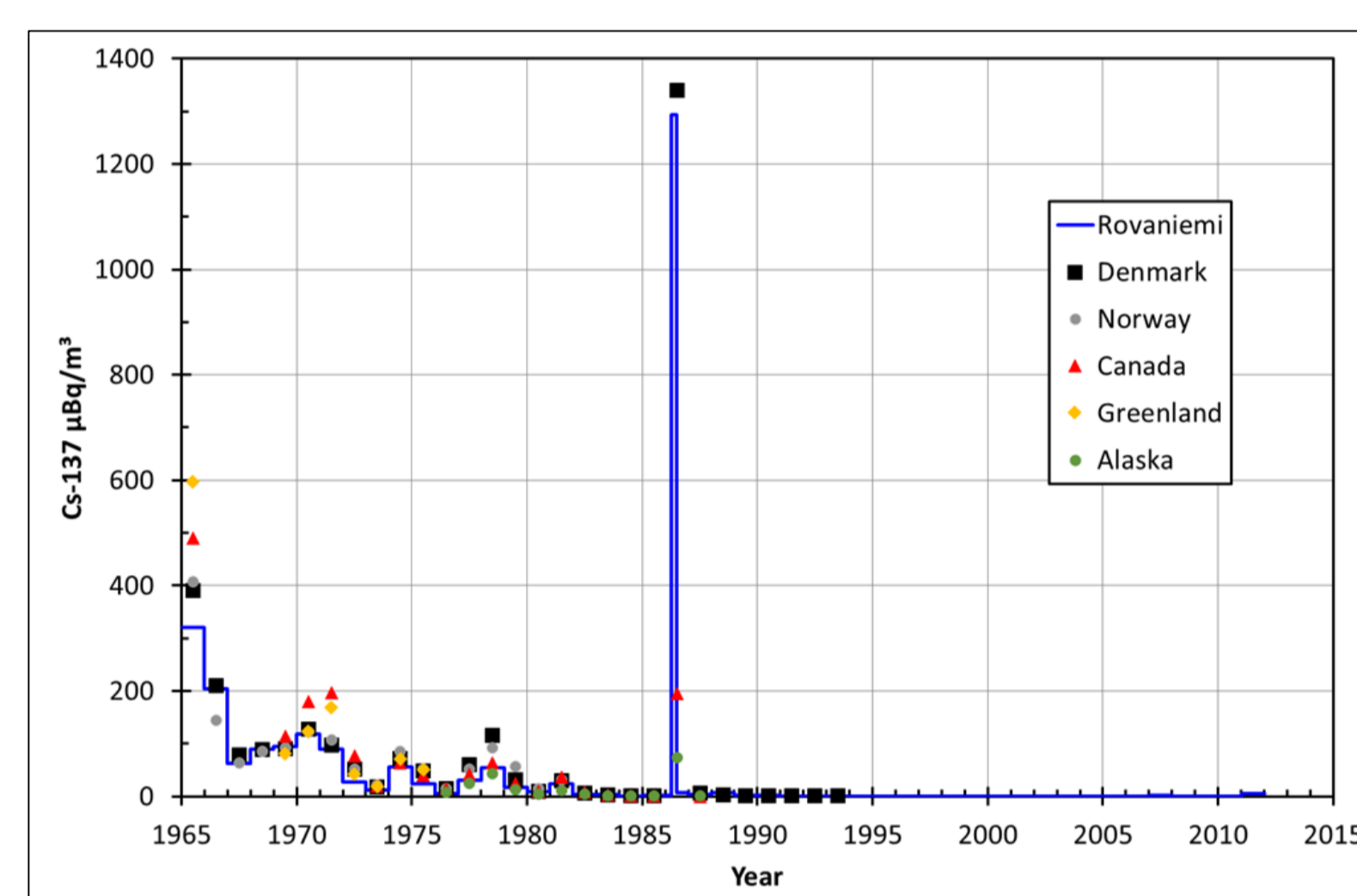
Further reading

- Salminen-Paatero et al.
- Nuclear contamination in surface air of Finnish Lapland 1965-2011 studied by means of ¹³⁷Cs, ⁹⁰Sr, and total beta activity. Environmental Science and Pollution Research (2019).
 - Measurements and modelling of airborne plutonium in Subarctic Finland between 1965 and 2011. To be submitted in summer 2019.

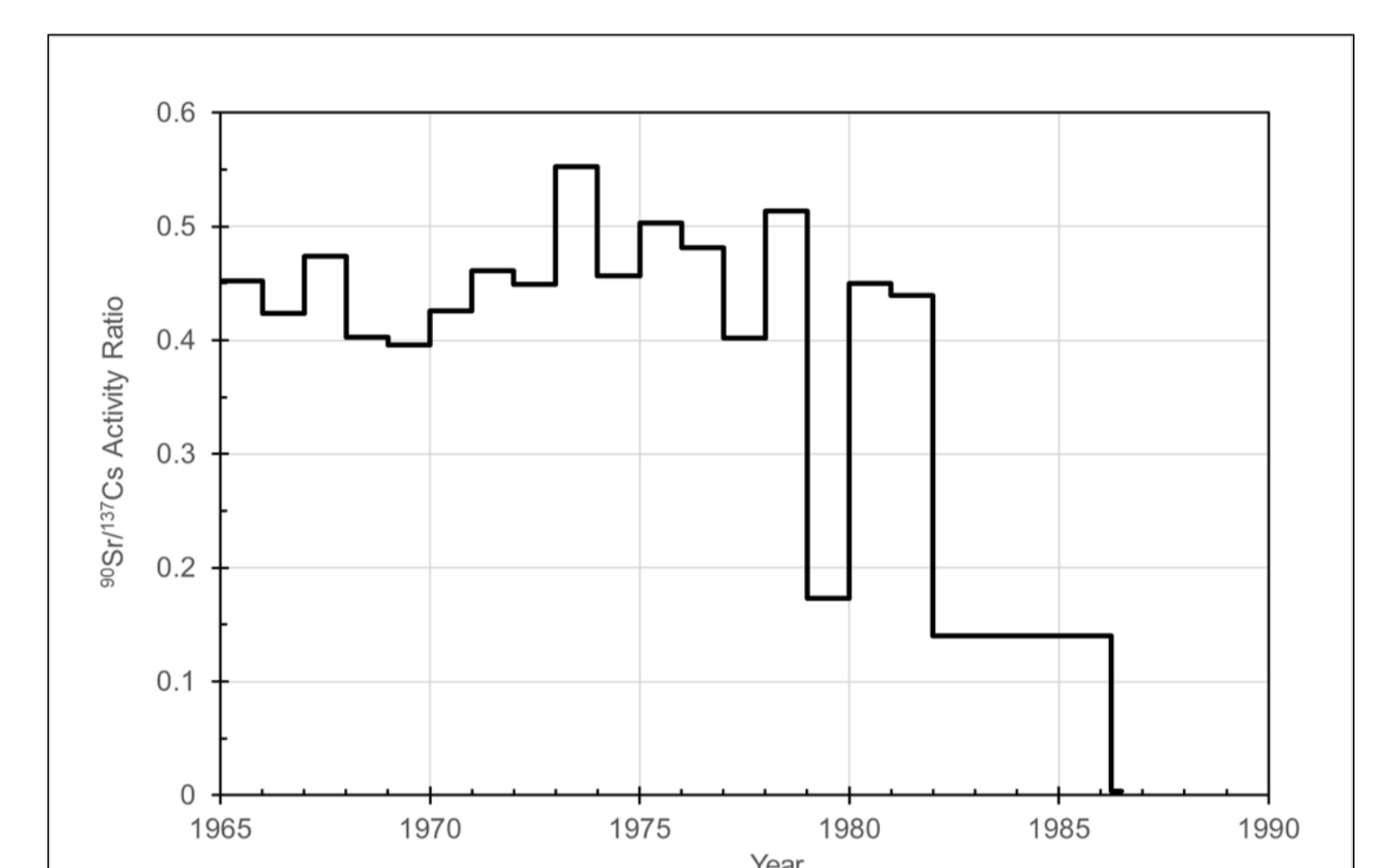
Acknowledgements

- Collaboration Network on EuroArctic Environmental Radiation Protection and Research "CEEPRA" project in EU Kolarctic ENPI CBC 2007-2013 programme
- "TOXI Triage" project (id. 653409) of EU H2020 program

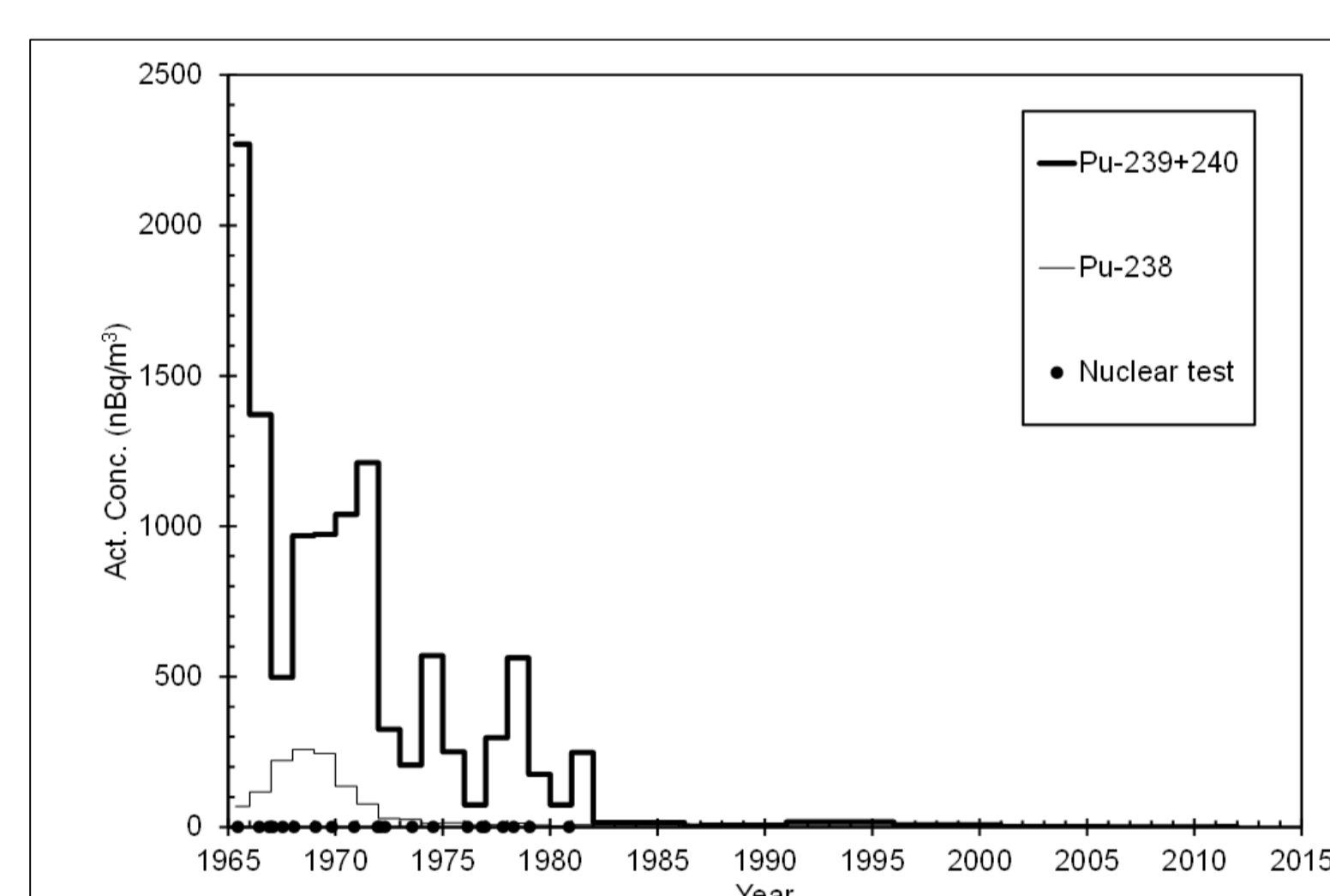
Results



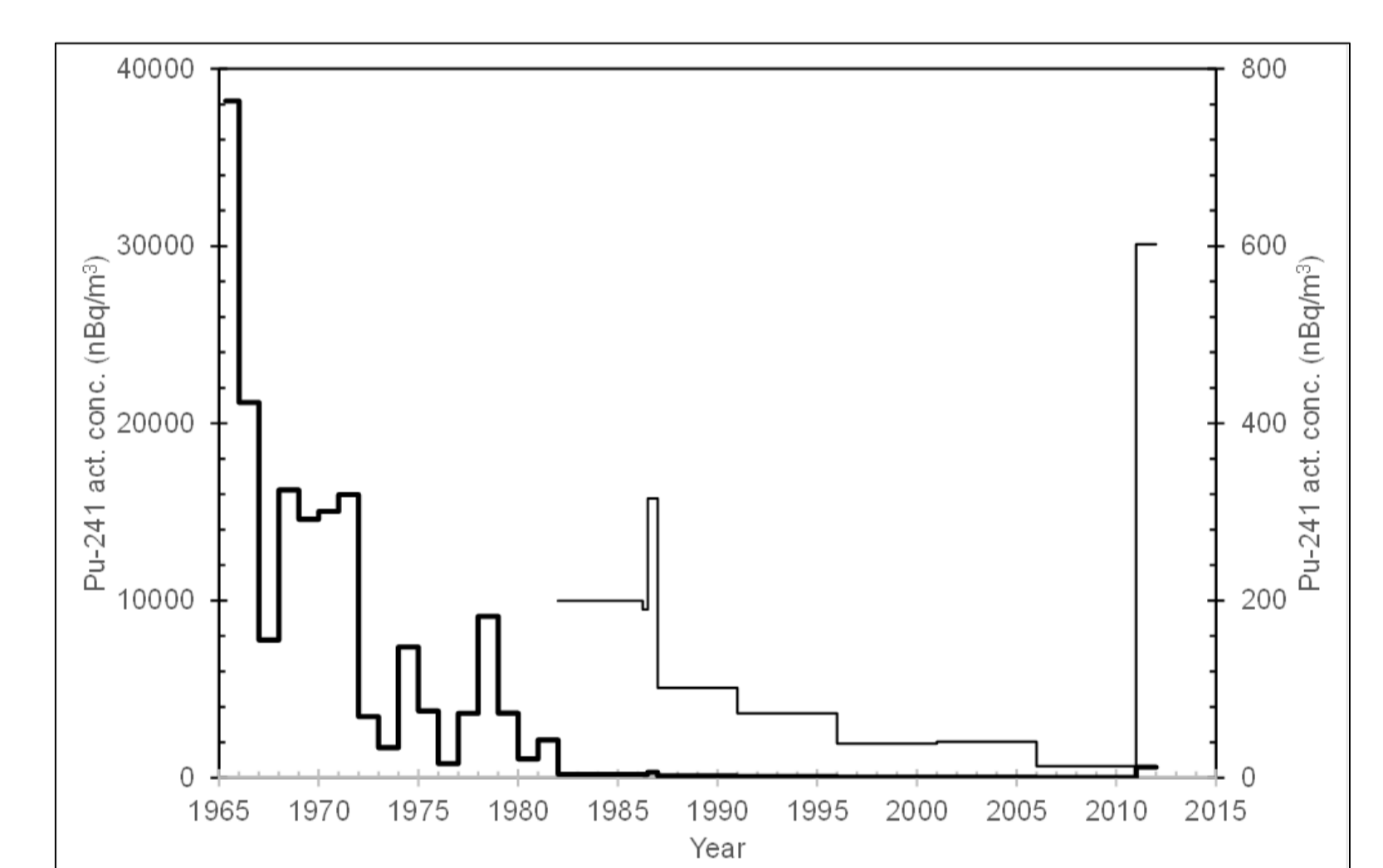
The activity concentration of ¹³⁷Cs in surface air of Rovaniemi in 1965-2011 compared with other long-term time series (Bergan 2002, Aarkrog et al. 1995, EML database 2000).



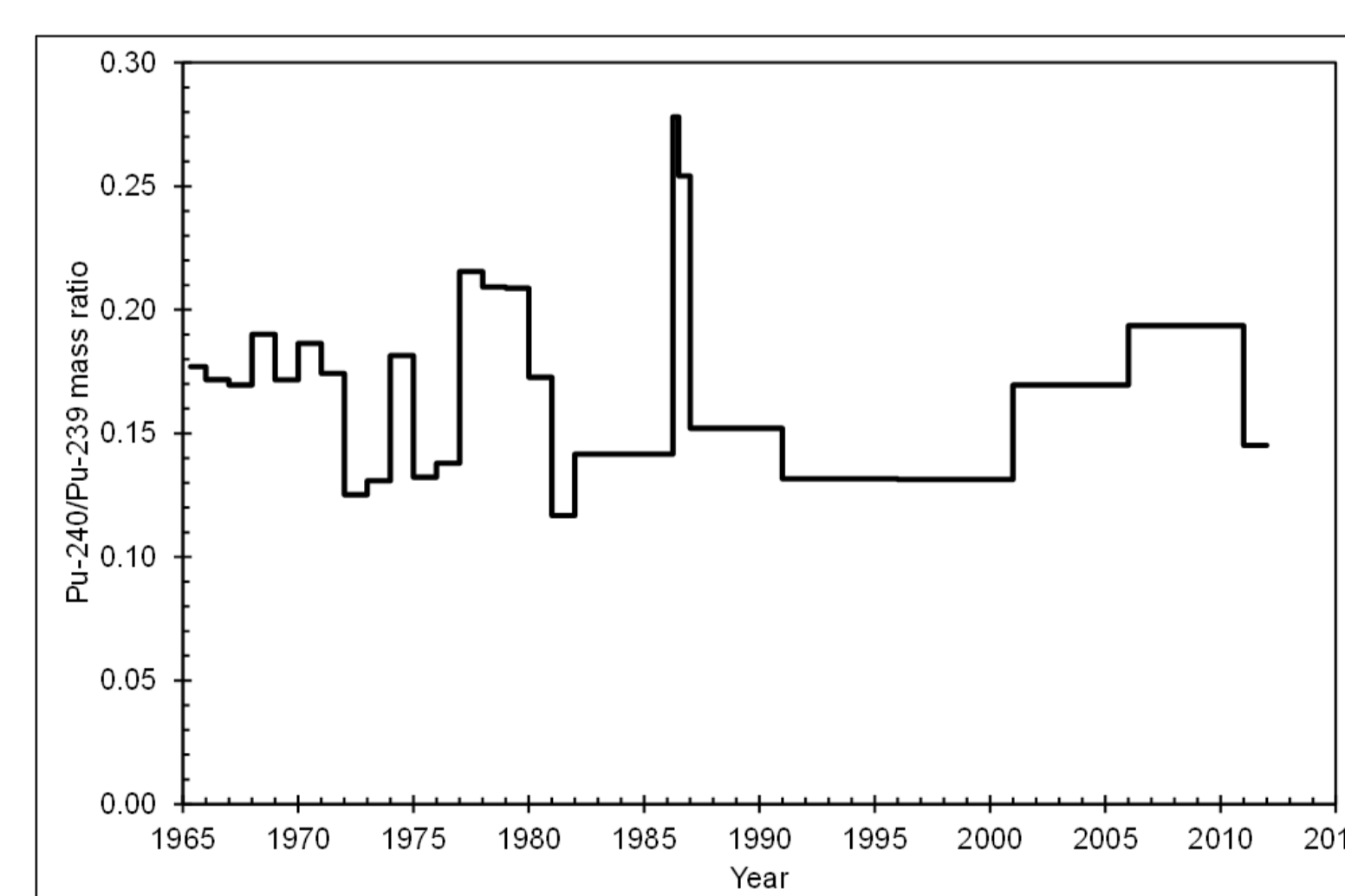
The activity ratio ⁹⁰Sr/¹³⁷Cs in surface air of Rovaniemi during 1965 - June 1986. The activity concentration of one or both isotopes was below the detection limit since then.



The activity concentrations of ²³⁸Pu and ²³⁹⁺²⁴⁰Pu in surface air of Rovaniemi in 1965-2011. Values below the detection limit have been included as half the MDA value. The black dots are the points of atmospheric nuclear tests by the People's Republic of China (UNSCEAR 2000).



The activity concentration of ²⁴¹Pu in surface air of Rovaniemi. Values below the detection limit have been included as half the MDA value. The thin line and the right-side y-axis represent the values of 1982-2011



The mass ratio ²⁴⁰Pu/²³⁹Pu in surface air of Rovaniemi in 1965-2011.

Conclusions

- Based on the activity concentrations, activity and isotope ratios, the most important contamination source has been global fallout from nuclear weapons testing
- The influences from Chernobyl and Fukushima accidents can be seen in total beta activity (not presented here, see Salminen-Paatero et al. 2019) and the activity concentrations of ¹³⁷Cs and ²⁴¹Pu
- The connection between Chinese nuclear tests and elevated activity concentrations of radionuclides in the surface air of Rovaniemi is observed
- It is important to analyze several different isotopes, activity and/or mass ratios in order to determine reliably the nuclear contamination source, e.g. both ¹³⁷Cs and ⁹⁰Sr, and also ²⁴¹Pu in addition to alpha emitting Pu isotopes in this case