AMAPs radioactivity story

Past and Present Scientific Achievements and Future directions for AMAP

Helsinki, 29.11.2016

Rovaniemi Declaration

To protect the Arctic ecosystem, including humans

Six priority areas:

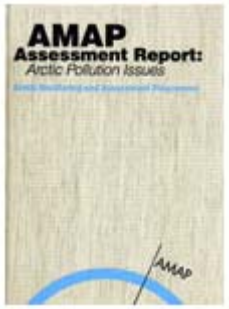
- Persistent organics
- Oil Pollution
- Heavy Metals
- Noise
- RADIOACTIVITY
- Acidification

AMAP radioactivty expert group

Assessment and monitoring

- Assessment of past releases
- Future and potential risks
- Actions initiated

AMAP monitoring data



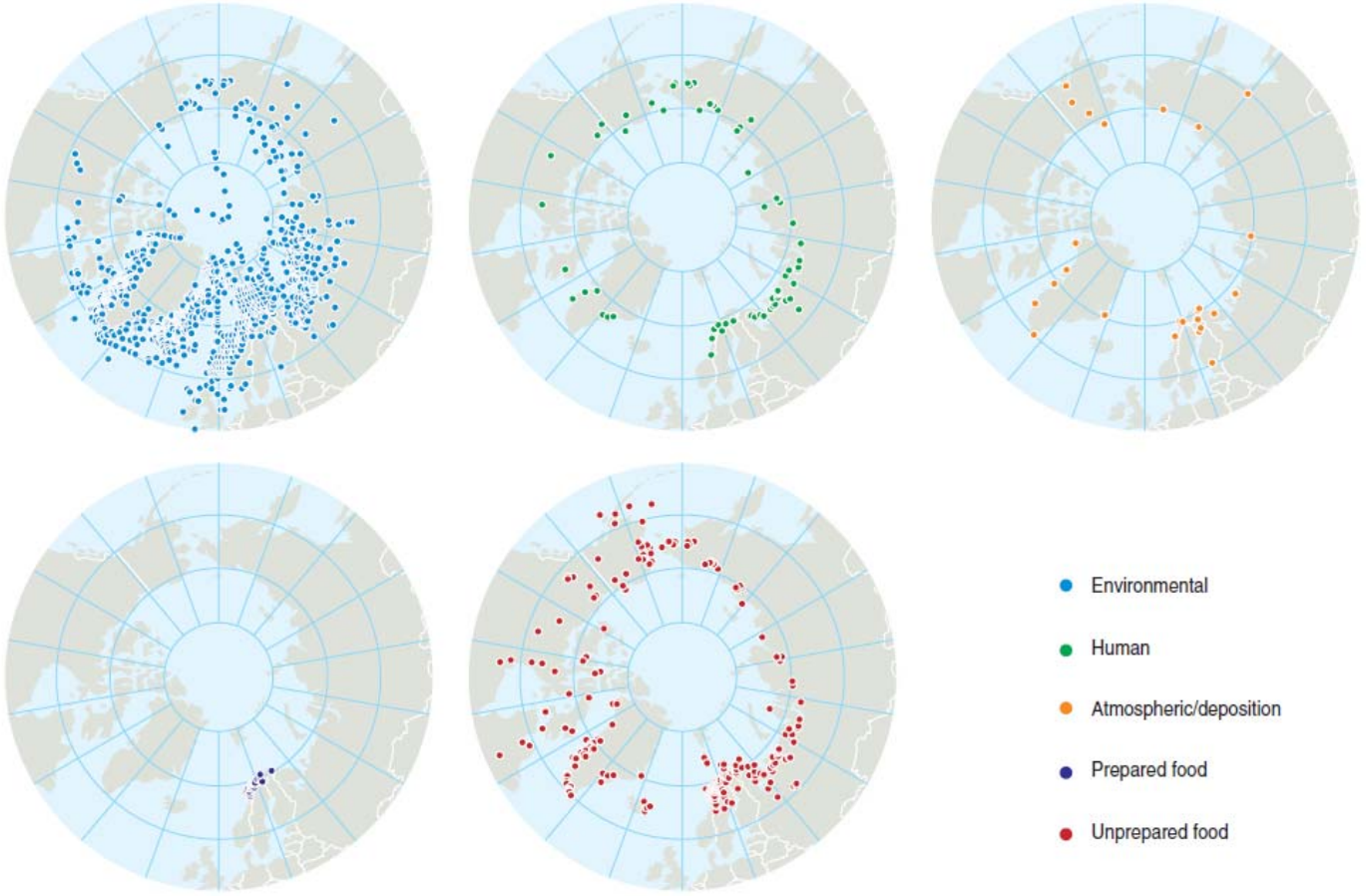
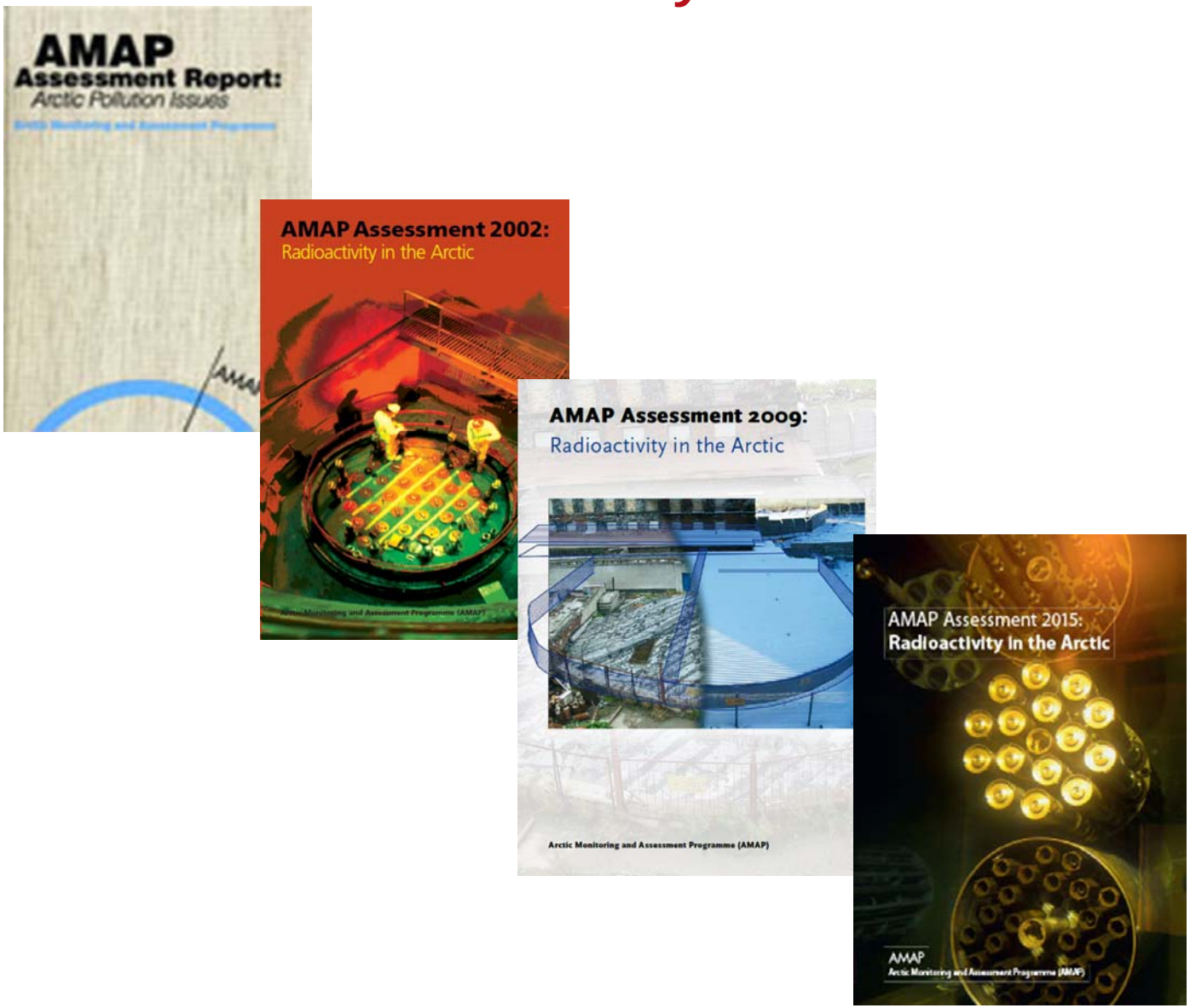
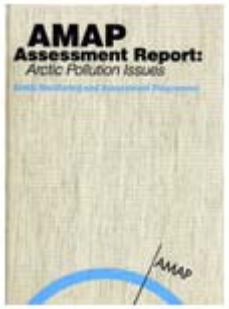


Figure 8-2. Geographical distribution of sample information in the AMAP radioactivity database.

AMAP Radioactivity assessments



AMAP past assessments

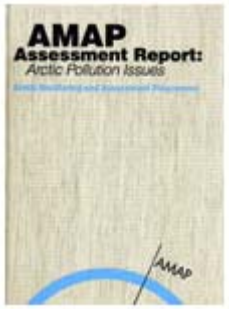


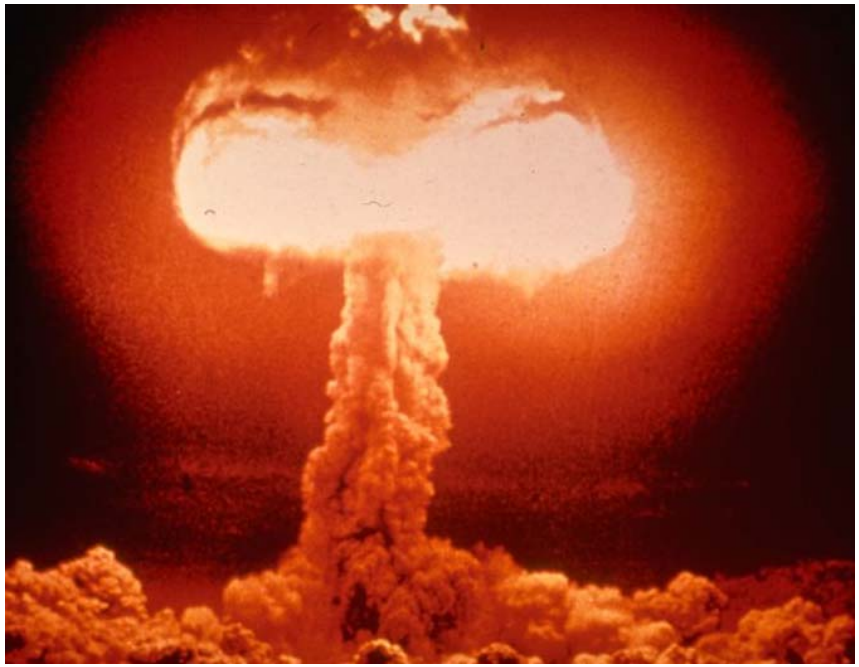
Main historic sources are

- Fallout from nuclear weapons tests
- Reprocessing in Europe
- Chernobyl

The Arctic terrestrial ecosystem is more vulnerable than temperate areas

Nuclear weapons fallout





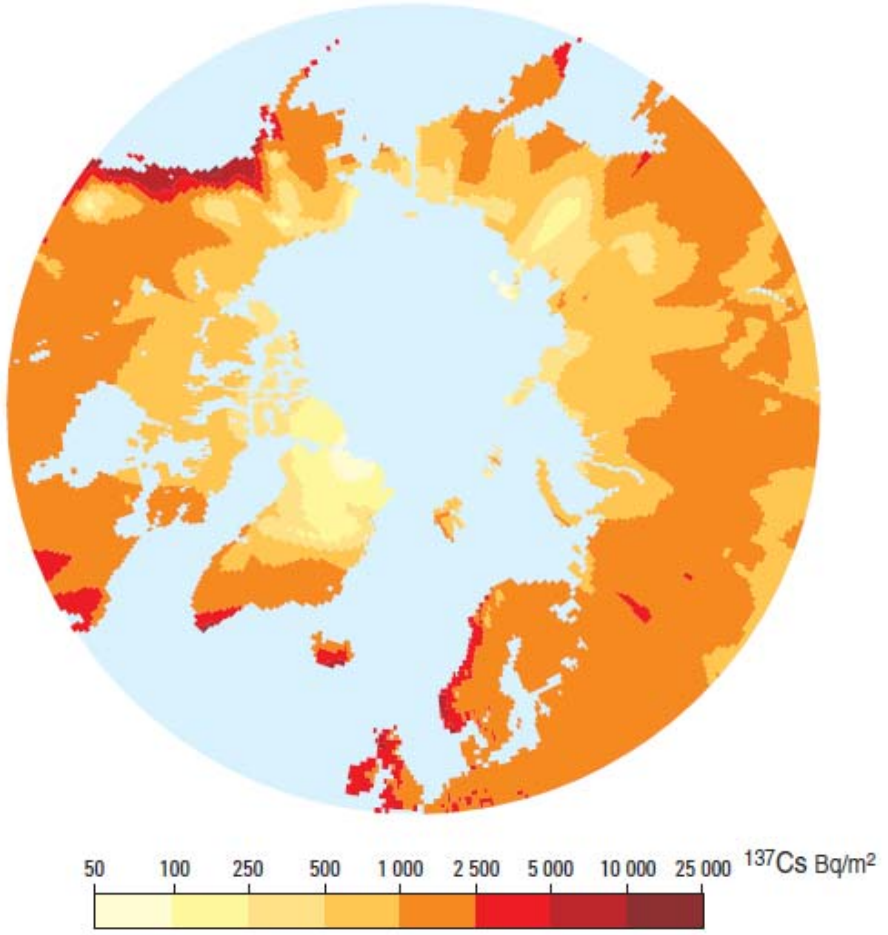
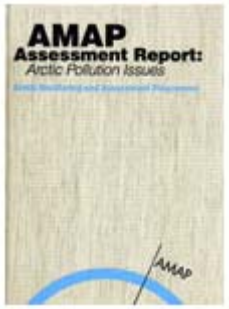


Figure 8-4. Estimated ground deposition of nuclear weapons fallout of ^{137}Cs based on precipitation data, decay corrected to 1995.

Releases from reprosessing plants



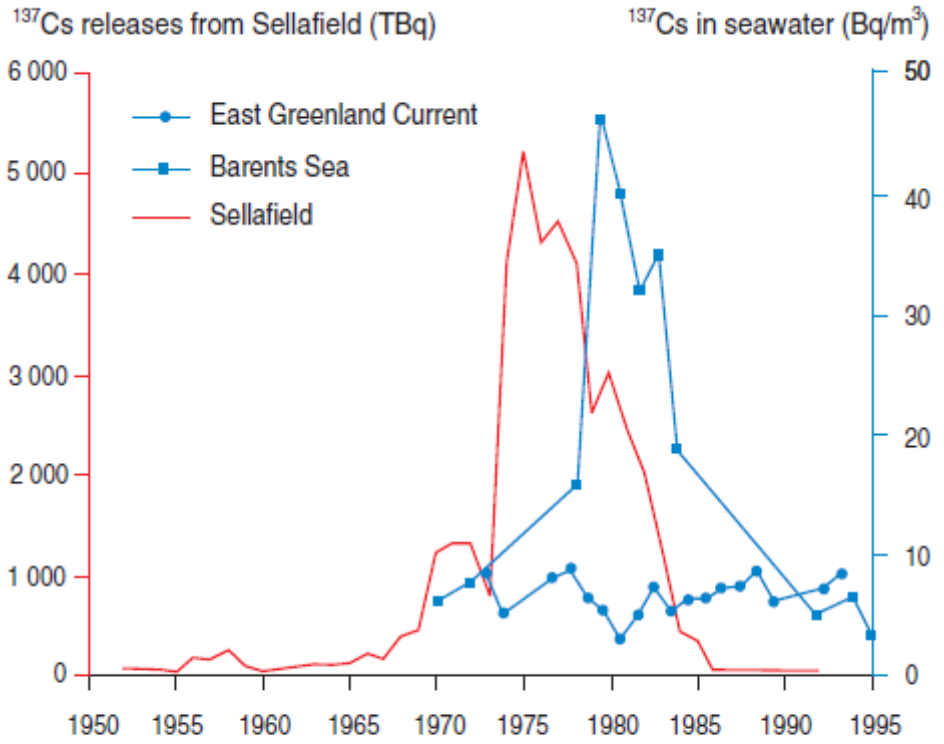
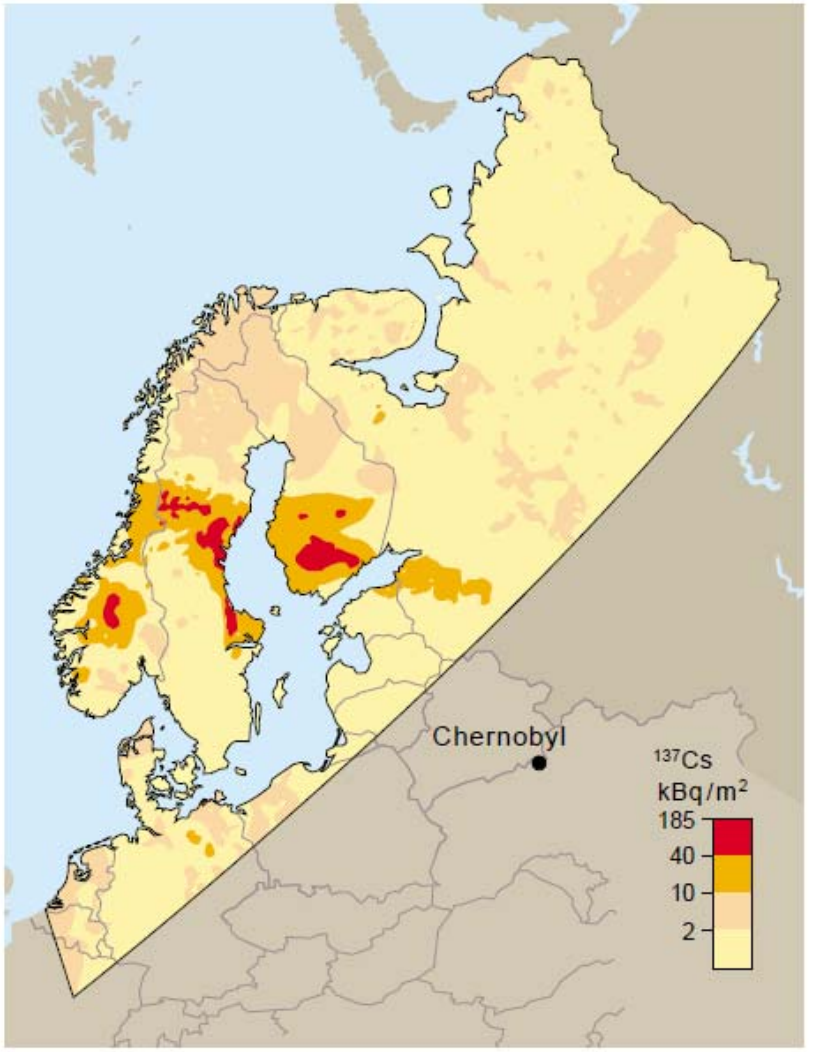


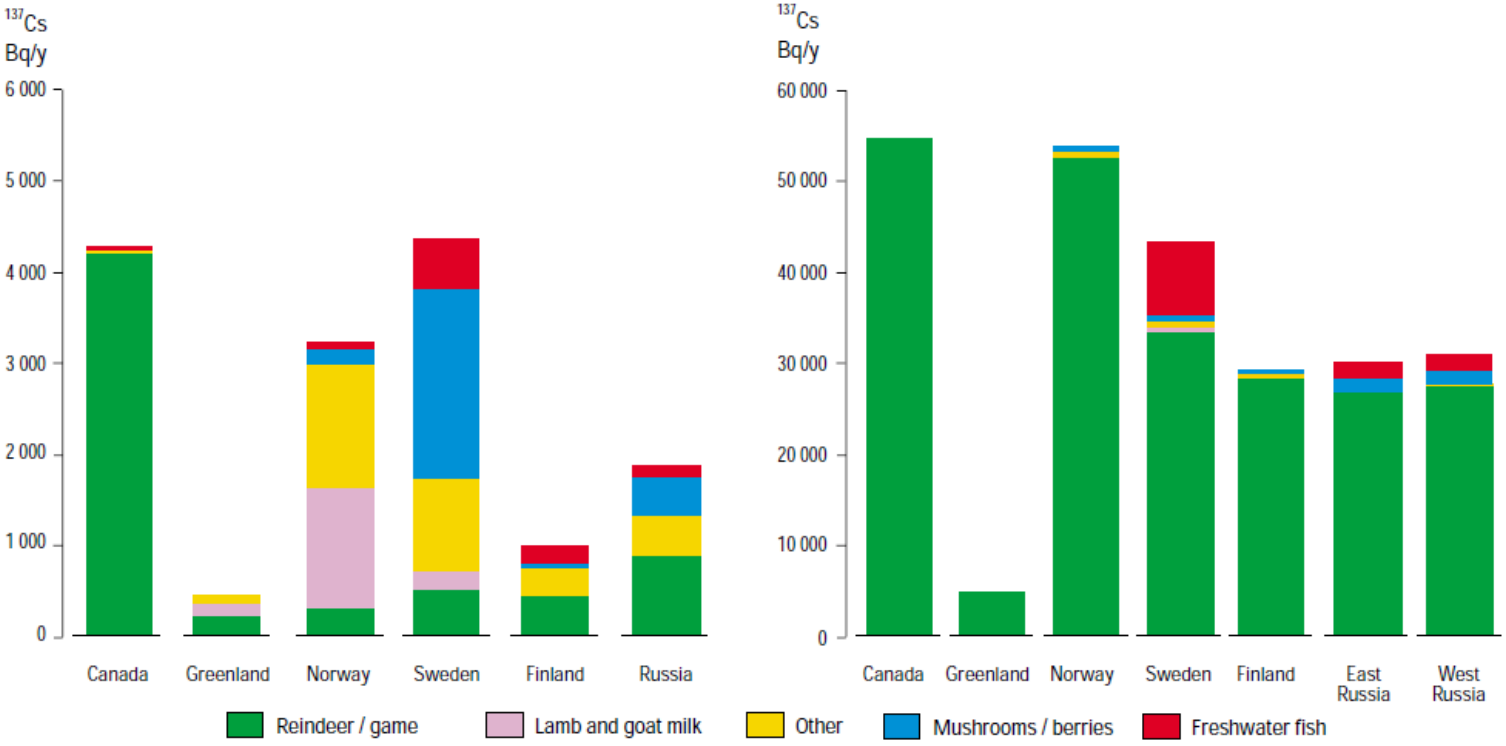
Figure 8·9. Seawater concentrations of ^{137}Cs in the Barents and East Greenland Seas compared to the yearly releases from Sellafield.

AMAP assessment I



Cesium-137 contamination after the Chernobyl accident, 10^3 bequerels per square meter.

Intake of radioactivity in Arctic



Left. Intake of cesium-137 in various food-stuffs by the average populations in the Arctic countries, bequerels per year.

Right. Intake of cesium-137 in various food stuffs by selected groups in the Arctic countries, bequerels per year. Note that the intakes are approximately ten-fold greater than for the average population.

Protection of non-human biota

Another important development was the recognition that the environment required protection in it´s own right – and this has lead to an international consensus on protection of the environment.

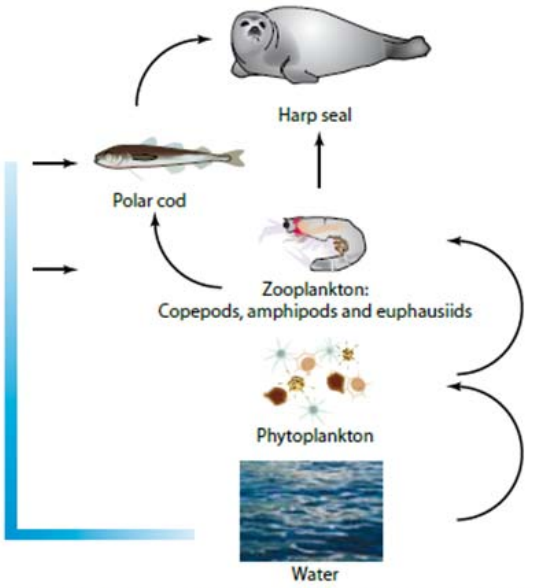


Figure 5-2. Food-chain model for harp seal in the Barents Sea. Source: simplified from Dommasnes et al. (2001).

Time line – protection of the environment from ionising radiation

- **1927-2003** INTERNATIONAL COMMISSION ON RADIATION PROTECTION (ICRP)
  - If Man is protected the environment is protected

- **1994** AMAP Co-operation with INTERNATIONAL UNION OF RADIOECOLOGY (IUR) and INTERNATIONAL ATOMIC ENERGY AGENCY(IAEA)

- **1997-2002** IUR developing a framework - Consensus Conference' 2001
  - Need to be able to assess the consequences for biota and ecosystem

- **2002** IAEA Ethical consideration

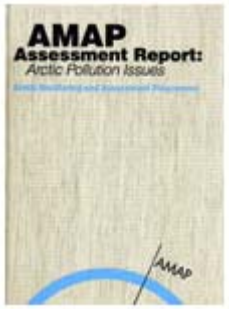
- **2003** ICRP Changed it's position

- **2014** IAEA International Basics Safety Standards

- **2012-2015** IUR ecosystem approach 'Consensus Symposium - Fukushima


Reprocessing plant
Site of atmospheric nuclear tests
Site of underground nuclear tests
Peaceful nuclear explosion
Naval bases
Nuclear accident
Storage depot for nuclear waste
Dump site of radioactive waste
Cosmos 954 Satellite crash
Thule nuclear weapons accident
ARCTIC OCEAN
Svalbard
Sellafield
Windscale accident
Komsomolets sunken nuclear submarine
Norwegian Sea
Barents Sea
Novaya Zemlya
Cap la Hague
Kara Sea
Ob
Yenisey
Chernobyl accident
Mayak
Tomsk
Kyshtym accident
Krasnoyarsk

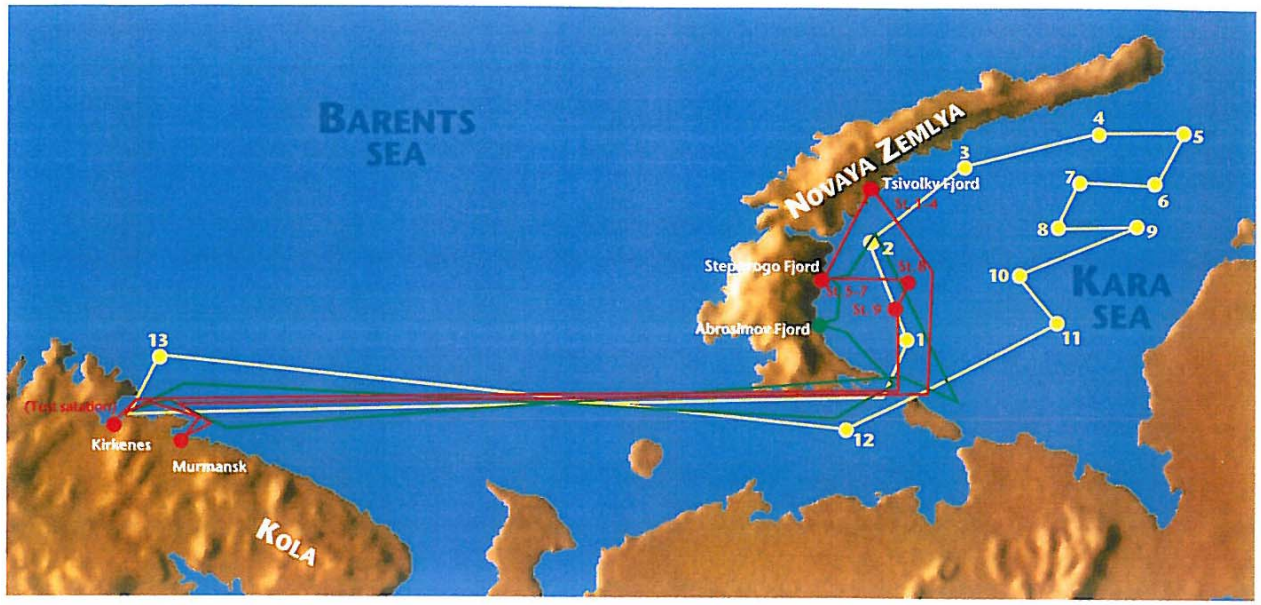
AMAP present and future risks



- **The Arctic contains areas with a high density of high risk sources**

1. **Dumped radioactive waste and reactors**
2. **Radioactive waste and spent nuclear fuel on land**
3. **Old nuclear submarines**
4. **Nuclear reactors**

Cruises to the Kara Sea 1992-1994



yellow: 1992
red: 1993
green: 1994

AMAP future risks

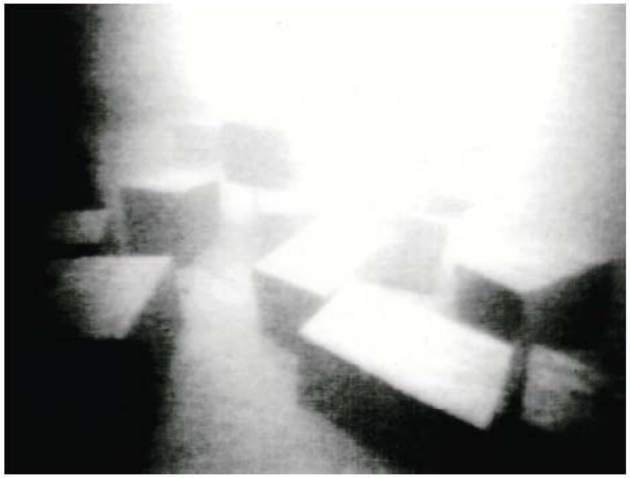
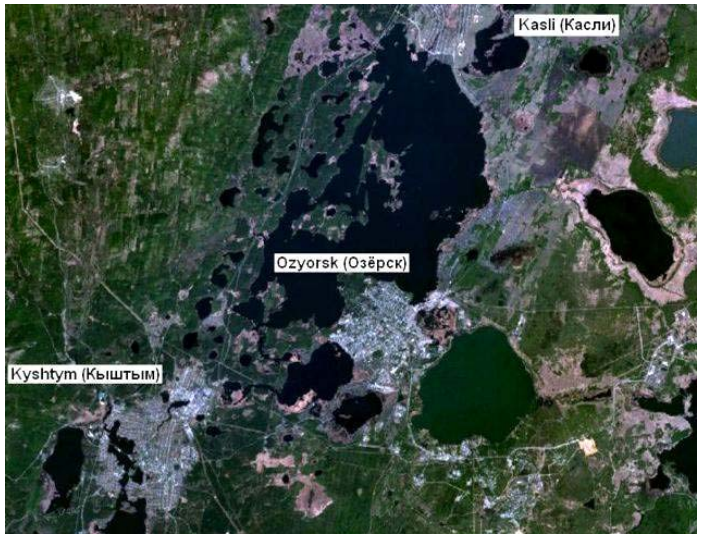


Figure 8-17. Some of the dumped containers in Stepovogo Bay.

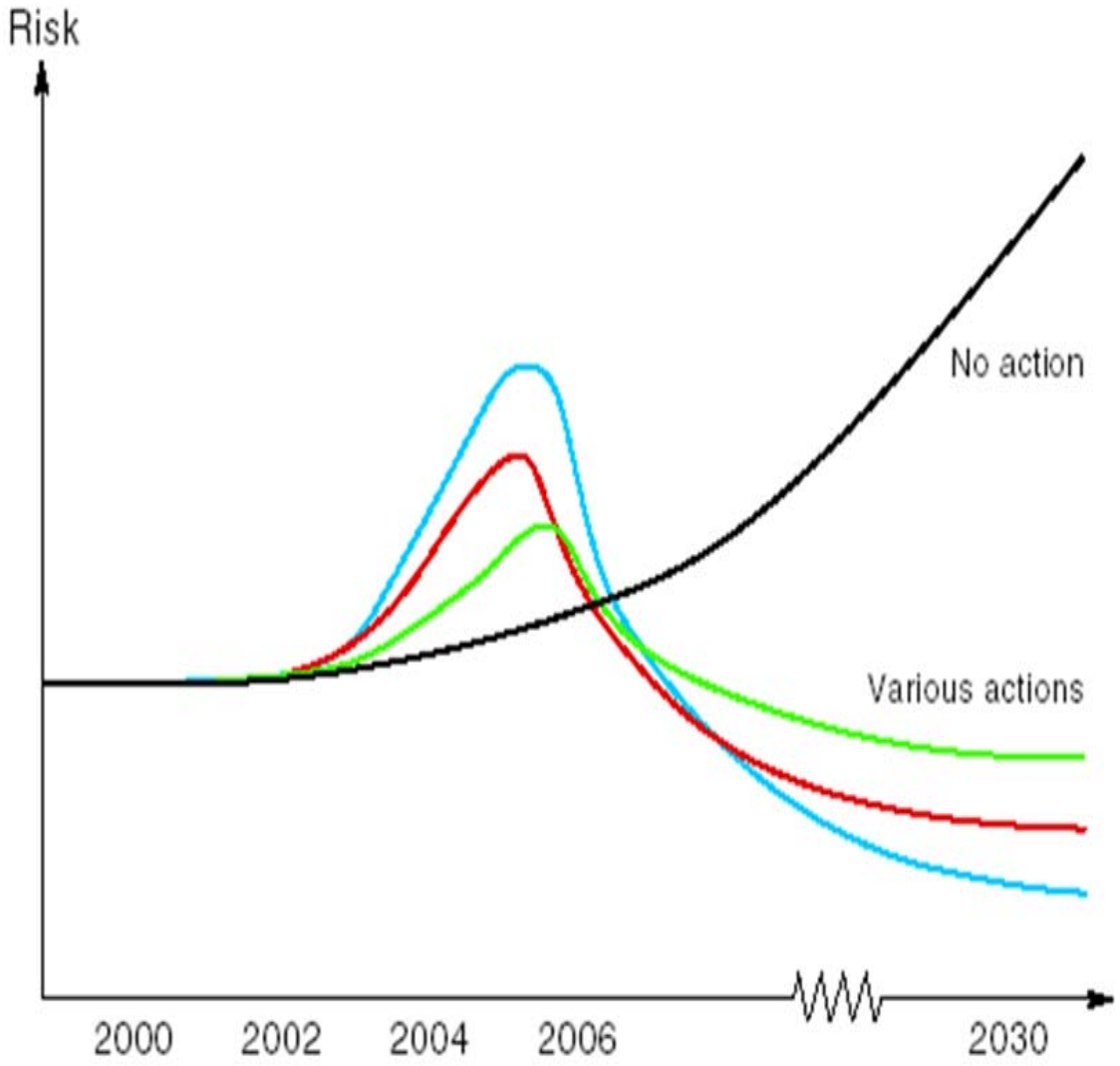
Figure 8-64. Burning nuclear submarine.



AMAP recommendation about risk reduction

- AMAP Expert Groups NEFCO 1995 reports recommendations and all subsequent AMAP activity has highlighted the need for risk reduction with regard to radioactivity in the Arctic.

- This contributed to stimulate international collaboration to provide funding and expertise to carry out risk reduction projects in the region.


Risk
No action
Various actions
2000
2002
2004
2006
2030

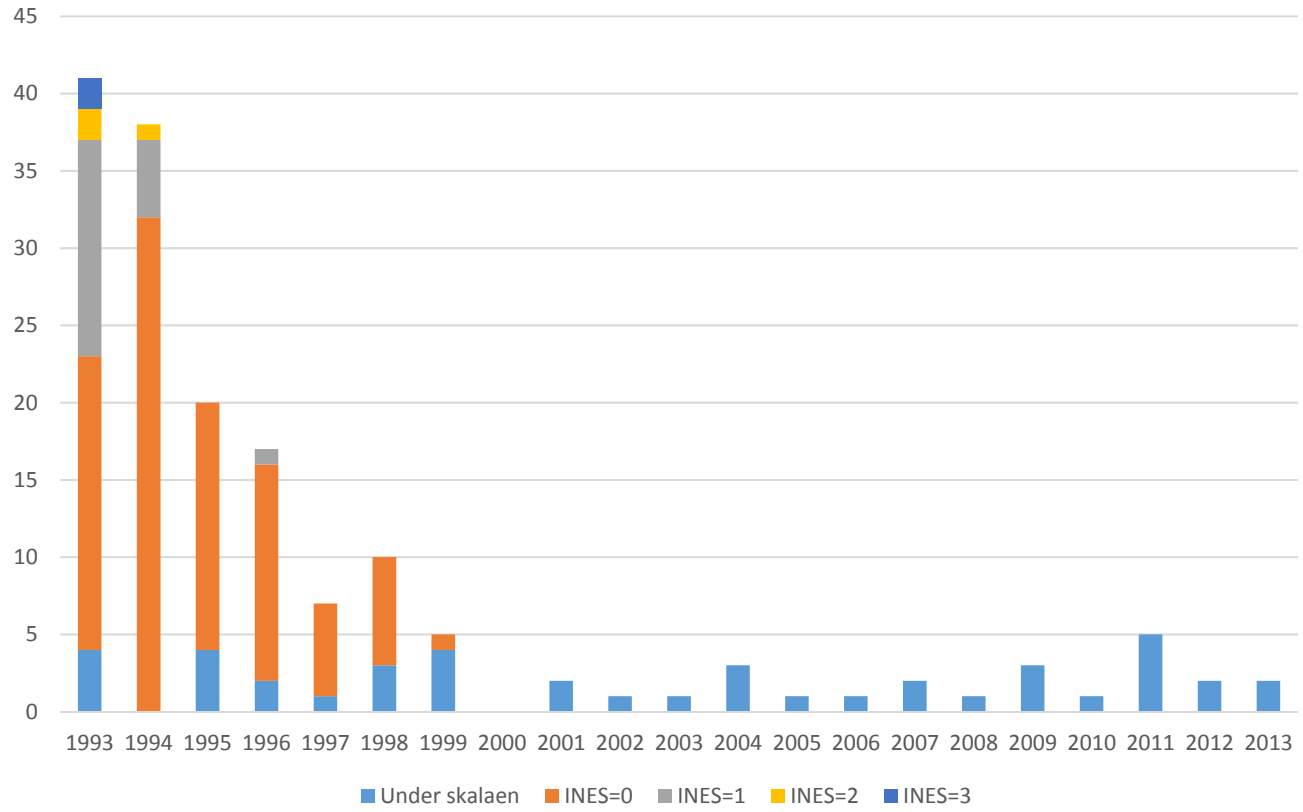
International cooperation

- **Joint Russian Norwegian Expert Group** **1991**
- **Nationals plan of action** **1995**
- **International Cooperation**
  - » IAEA CEG 1996
  - » EU NDEP 1997
  - » G8 GP (10+10) 2002

Decommissioning nuclear submarines

198 nuclear submarines have been dealt with: dismantled with the nuclear fuel removed and in safe storage

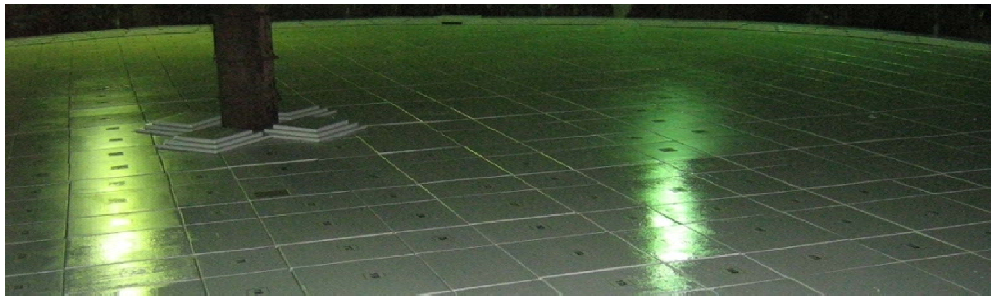
INES Kola NPP 1993-2013



RTGs

- Powerful radioactive sources used for power of light houses
- About 1000 RTGs removed from arctic areas, generally replaced by solar panels
- Risk and environmental assessments were completed

Handling and transport of Radioactive waste and spent nuclear fuel



Other issues

- Tc releases from Sellafield

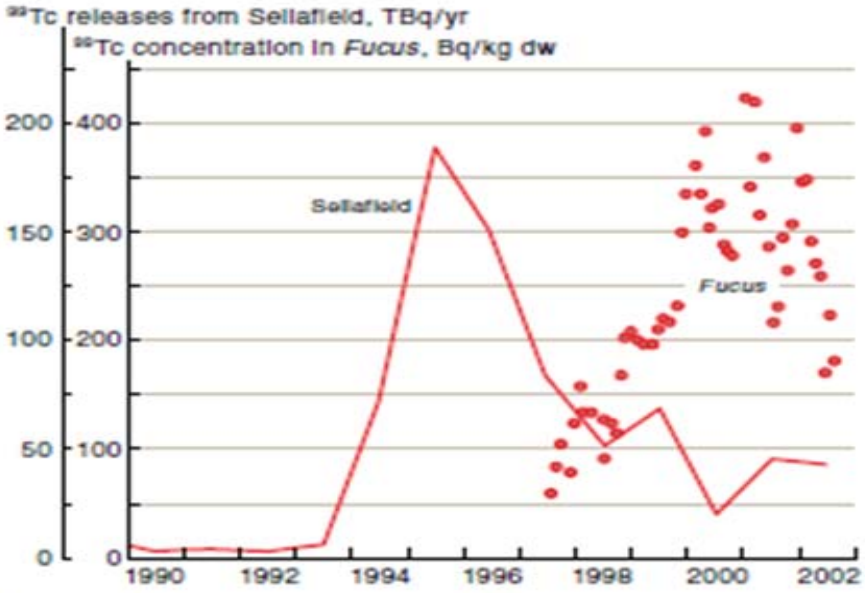
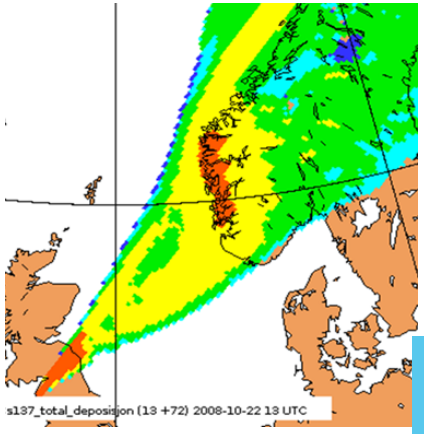
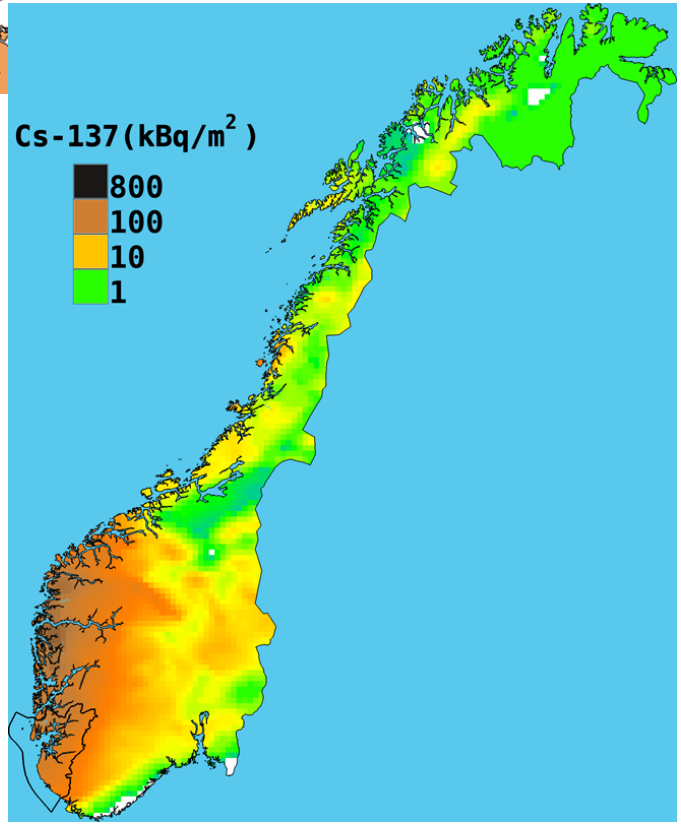
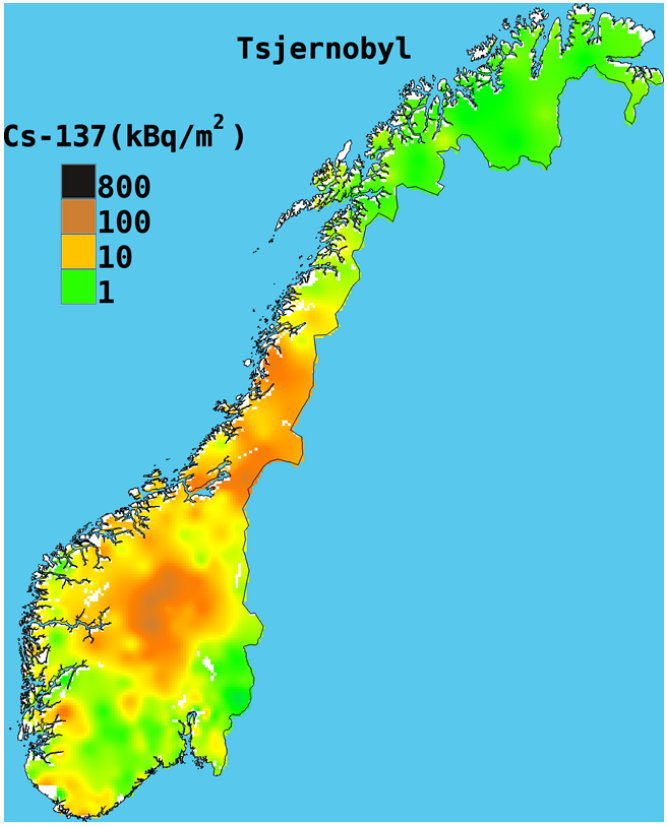


Figure 3-3. Temporal variation in ^{99}Tc activity concentrations in *Fucus* at Hillesøy (northern Norway) and releases from the Sellafield reprocessing plant (Kolstad and Lind, 2002).

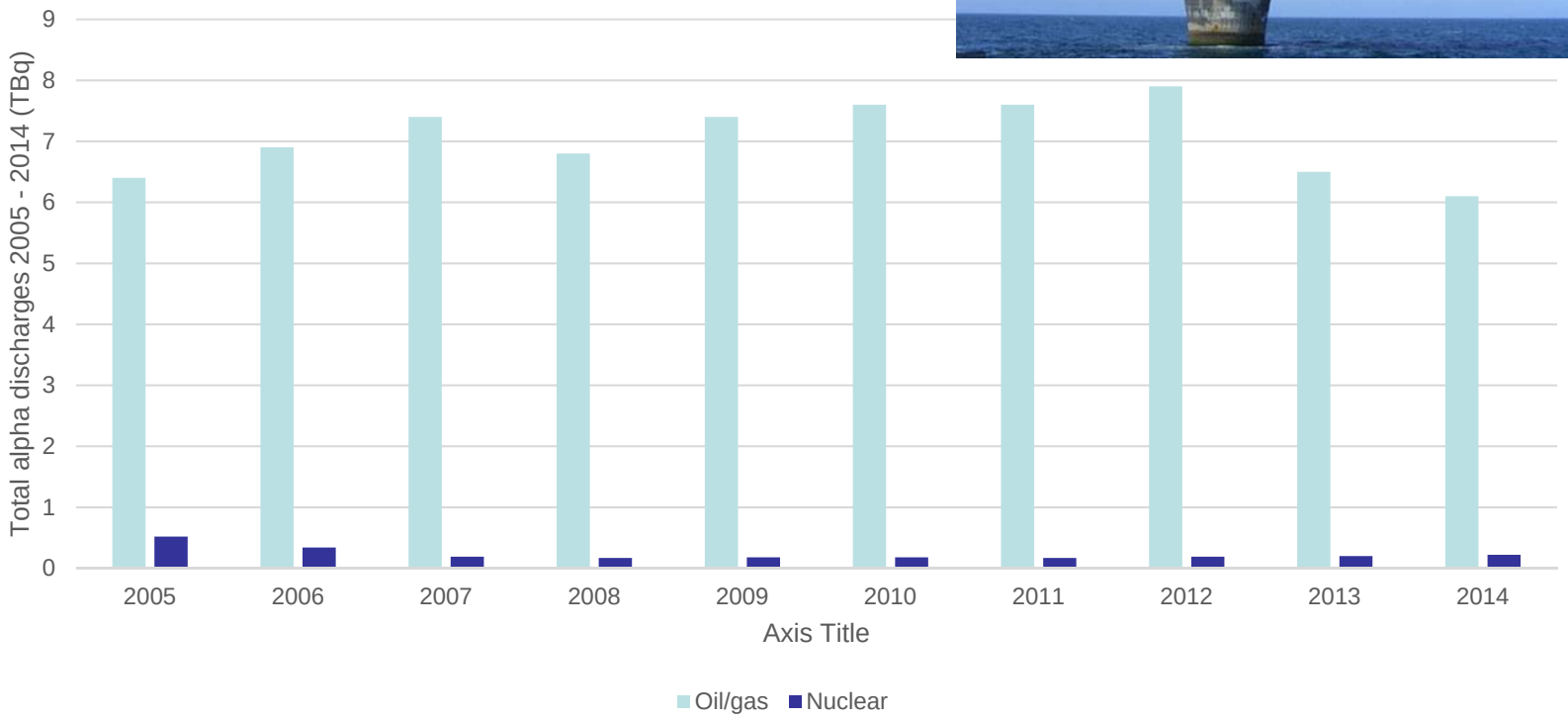

s137_total_deposition (13 +72) 2008-10-22 13 UTC


Cs-137(kBq/m2)
800
100
10
1


Tsjernobyl
Cs-137(kBq/m2)
800
100
10
1

Total alpha discharges 2005 - 2014

- Total alpha discharges 2005 - 2014



Some key points

- AMAP work has made a continued and valued impact on risk assesment and risk reduction concerning radioactivity in the Arctic
- Focusing on sources and assessing present and potential risks
- Stressing the need for impact assessment of different risk reducing actions before implementing them
- Assessment also on non-human biota and not only humans

What happens next?

- Continued monitoring
- Continued risk assessment and hazard reduction
- Ecosystem based approach
- Climate change effects on radioactivity in the Arctic:
  - Assessment of the changing exploitation scenarios for the Arctic regions
  - Focus on potential increases in doses to Arctic human populations.

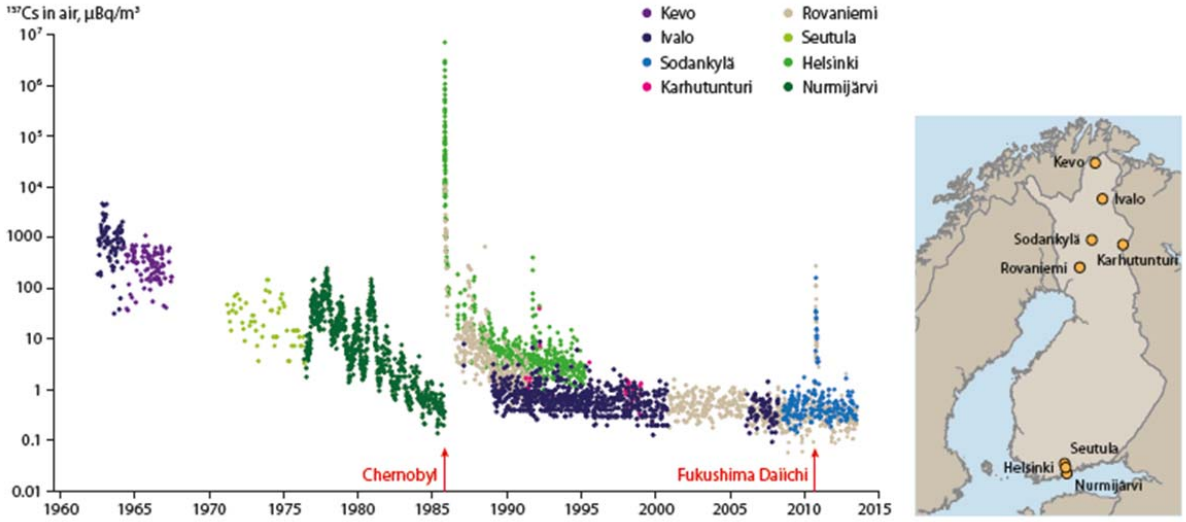


Figure 4.11 Activity concentrations of ^{137}Cs in ground level air at various sites across Finland since the early 1960s.