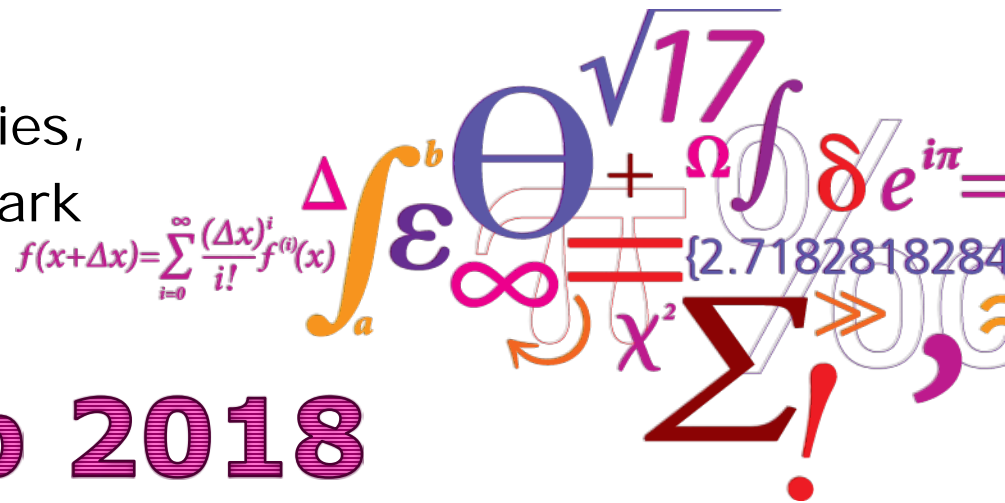


Radioecology Section at DTU-Nutech

Jixin Qiao

DTU Nutech
Center for Nuclear Technologies,
Technical University of Denmark



Radworkshop 2018

- **Academics (10)**

- 1 professor (Xiaoin Hou)
- 4 senior scientists (Sven Nielsen, Per Roos, Kasper Andersen, Jixin Qiao)
- 2 engineer (Gunnar Jakobs, Jacobus)
- 3 PhD students

- **Technicians (6)**

- 5 lab technicians
- 1 technician

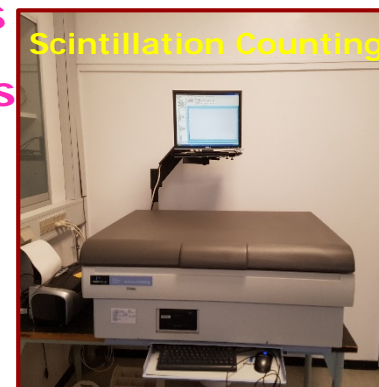
- **Guests**

- Visiting scientists
- Guest PhD students
- Trainees



Facilities at DTU Nutech

- 6 x Chemistry lab
- 1 x seawater lab
- 1 x sample preparation building
- 32 x low-level alpha spectrometers
- 18 x low-level gamma spectrometers
- 35 x low-level gas flow beta counters
- 2 x LSC (Quantulus, Tricap)
- 2 x ICP-MS (ICP-QQQ, Quadrupole)
- 1 x ICP-OES



Radioecology & Tracer study

**Development
of analytical
methods &
modeling**

**Environment
monitoring**

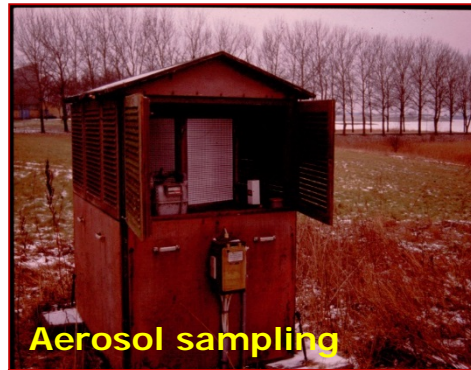
Scientific advice

Radioanalytical methods at RAS

Radionuclides	Chemical Analyses	LSC	Total Beta Counting	Gamma Spec	Alpha Spec	ICPMS	AMS
³ H	X	X					
¹⁴ C	X	X					
³⁶ Cl	X	X					
⁴¹ Ca	X	X					
⁵⁹ Fe	X	X					
⁶³ Ni	X	X					
⁷⁹ Se	X					X	
⁹⁰ Sr	X	X	X				
⁹³ Mo	X	X					
⁹³ Zr	X					X	
⁹⁴ Nb	X			X			
⁹⁹ Tc	X		X			X	
¹²⁶ Sn	X					X	
¹²⁹ I	X						X
¹³⁵ Cs	X			X		X	
¹³⁷ Cs	X			X			
²¹⁰ Pb				X			
²¹⁰ Po	X				X		
²²⁶ Ra	X	X		X			
²³⁰ Th	X				X		
²³² Th	X				X	X	
²³⁴ U, ²³⁸ U	X				X	X	
²³⁶ U	X						X
²³⁷ Np	X					X	
²³⁹ Pu, ²⁴⁰ Pu	X					X	
²³⁹⁺²⁴⁰ Pu	X	X			X		
²⁴¹ Am	X			X	X		
Other gamma emitters				X			

Monitoring of Environmental Radioactivity

- Risø site
- Denmark
- Greenland
- Faroeland
- Iceland



Aerosol sampling



Total diet samples



Rainwater sampling



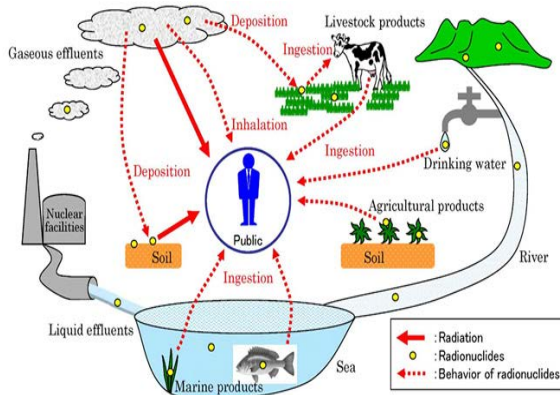
Seaweed sampling



Seafood sampling



Water sampling

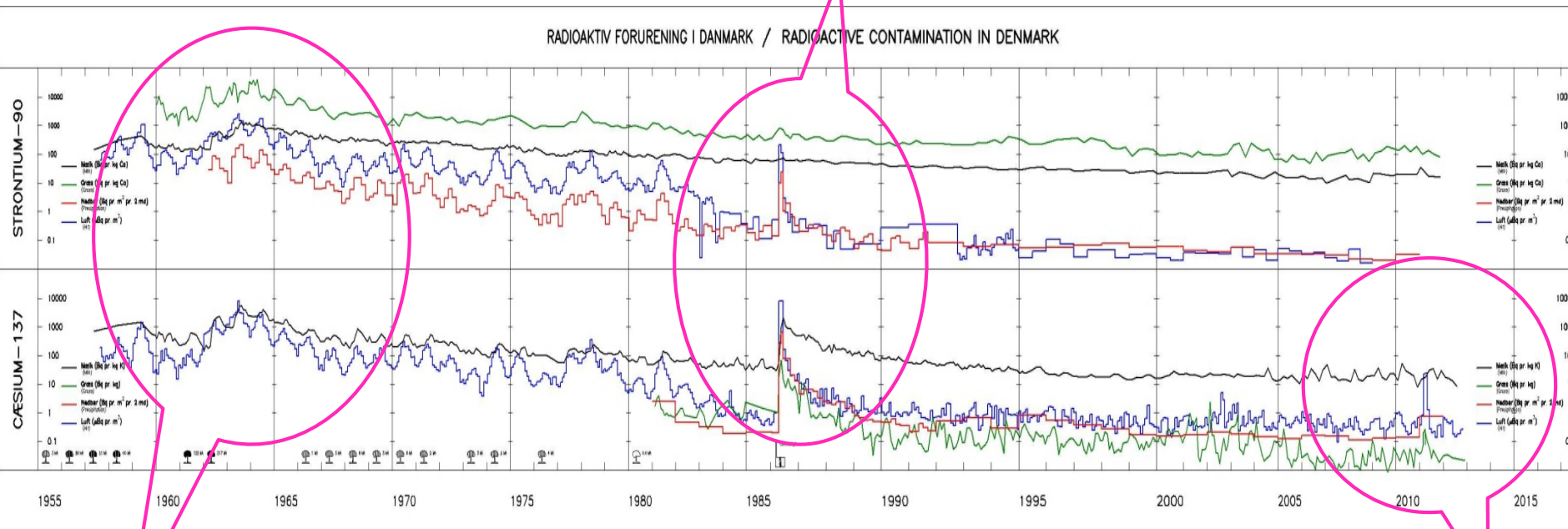


Monitoring of Environmental Radioactivity

Concentrations of Sr-90 and Cs-137 in air, precipitation, milk and grass at Risø and in Denmark since the 1950's

Chernobyl accident

RADIOAKTIV FORURENING I DANMARK / RADIOACTIVE CONTAMINATION IN DENMARK

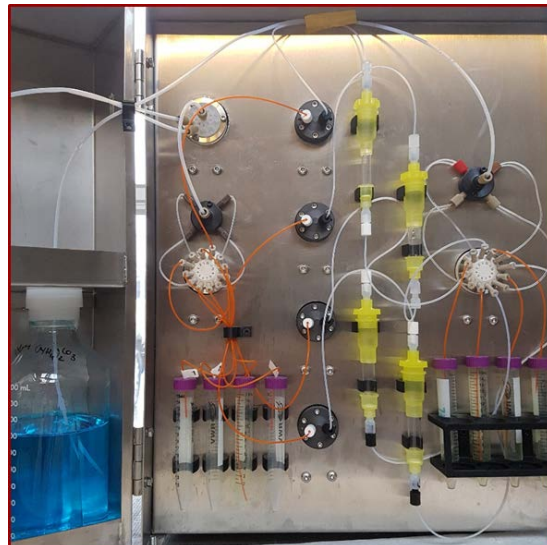
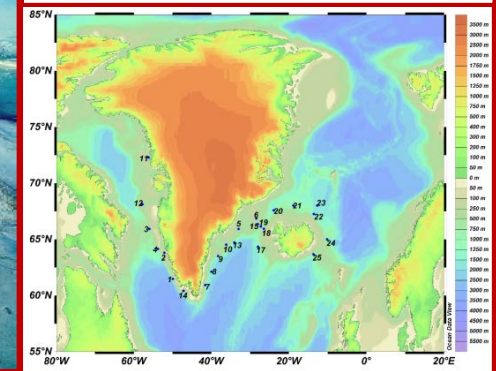
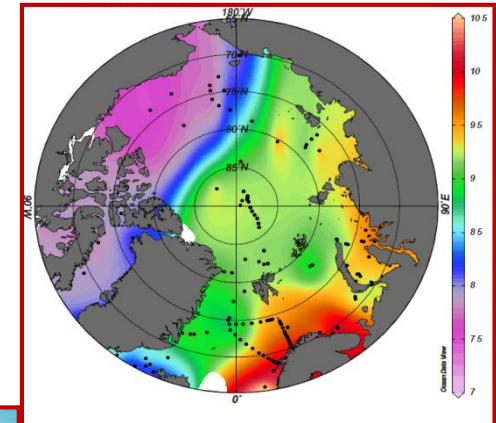


Nuclear weapon tests

Fukushima accident

Research focuses

- **Emergency preparedness**
- **Radioecology and modelling**
- **Radiochemical method development**
- **Automated radiochemical analysis**
- **Environmental radioactivity**
- **Tracer studies**

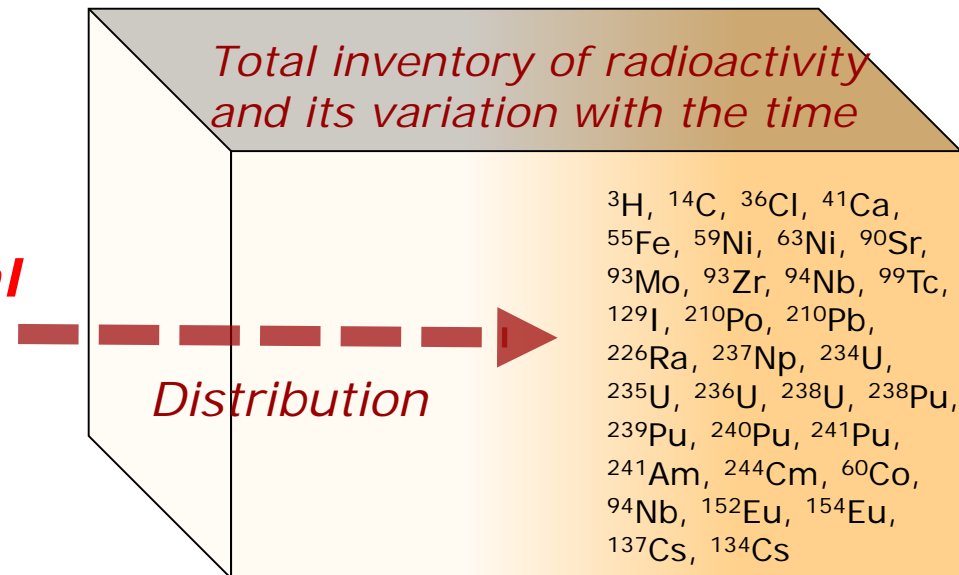


Scientific advice (Commercial service)



- Analytical work under accreditation (ISO/IEC 17025:2005)
- Surveillance and waste characterization for Danish Decommissioning
- Commercial analysis for nuclear decommissioning abroad, industry (import/export) and other research institutes
- Training on radiochemical analysis
- Consultancy in radiation protection, analytical method development, environmental monitoring, etc.

DTU Nutech has long-term experience on radiochemical analyses for nuclear decommissioning





Analyses for decommissioning at DTU Nutech



Operational waste

Loviisa NPP, Finland

- Spent resin and evaporated waste
- ^3H , ^{14}C , ^{55}Fe , ^{36}Cl , ^{90}Sr , ^{99}Tc , ^{129}I , ^{238}Pu , $^{239, 240}\text{Pu}$, ^{241}Am , $^{243, 244}\text{Cm}$

Decommissioning of research reactors

Studsvik AB, Sweden

- Metals, oil, sand and water
- ^{55}Fe , ^{63}Ni , ^3H , ^{14}C , ^{36}Cl

Australian Nuclear Science & Technology Organisation

- Concrete and graphite
- ^3H , ^{14}C , ^{55}Fe , ^{36}Cl , ^{41}Ca and ^{63}Ni

Decommissioning of nuclear facilities

- *Karolinska University Hospital, Sweden*
on-going project



Decommissioning of NPP

- *Barsebäck NPP, Sweden*
on-going project

Welcome to **Radworkshop 2018** !



NKS-B Radworkshop
**Radioanalytical Chemistry for Nuclear
Decommissioning and Waste Management**

8-12 OCTOBER 2018

DTU Risø Campus, Frederiksborgvej 399, Roskilde, Denmark

Radworkshop 2018



Monday, 8th October		Tuesday, 9th October		Wednesday, 10th October		Thursday, 11th October		Friday, 12th October	
		8:30	Registration and breakfast	8:30	Registration and breakfast				
		Session-3 Legislation and Status (Chairman: Jonatan Jiselmark)		Session-6 Methodology (Chairman: Mats Eriksson)		9:00-12:00 Lab training		9:00-12:00 Lab training	
		9:00	Marte Varpen Holmstrand, NRPA, Norway (Invited)	9:00	Xiaolin Hou, DTU Nutech	Group -1 Pu-239+240, Am-241 Per Roos	Group -2 Fe-55, Ni-63 Xiaolin Hou	Group -1 Pu-239+240, Am-241 Per Roos	Group -2 Fe-55, Ni-63 Xiaolin Hou
		9:35	Kirsten Hjerrild Nielsen, DD, Denmark (Invited)	9:35	Isabelle Levy, IAEA (Invited)				
		10:10	Henrik Efraimsson, SSM, Sweden	10:10	Kaisa Vaaramaa, STUK, Finland				
10:00	Registration and breakfast	10:35	Coffee break	10:35	Coffee break				
Opening session (Chairman: Jixin Qiao)		Session-4 Methodology (Chairman: Kaisa Vaaramaa)		Session-7 Methodology (Chairman: Xiaolin Hou)					
11:00	Welcome - Jens-Peter Lynov	11:00	Nóra Vajda, RADANAL Ltd., Hungary (Invited)	11:00	Matthias Bothe, VKTA, Germany (Invited)				
11:15	Kasper Andersson	11:35	Jonatan Jiselmark, SSM, Sweden	11:30	Jixin Qiao , DTU, Denmark				
11:25	Jixin Qiao			11:45	Taneli Iso-Markku, Univ. Helsinki				
11:40	Vladan Ljubenov, IAEA (Invited)	11:50	Per Roos, DTU, Denmark	11:45	Taneli Iso-Markku, Univ. Helsinki				
12:15	Lunch	12:15	Lunch	12:00	Damien Braekers, IRE				
Session-1 Legislation and Status (Chairman: Henrik Efraimsson)		Session-5 Legislation and Status (Chairman: Per Roos)		Session-8 Methodology (Chairman: Jixin Qiao)		13:00-16:00 Lab training		13:00-16:00 Lab training	
13:30	David Ulfbeck, SIS, Denmark (Invited)	13:20	Fredrik De la Gardie, SKB, Sweden (Invited)	13:20	Mirela Vasile, SCK-CEN, Belgium (Invited)	Group -1 Pu-239+240, Am-241 Per Roos	Group -2 Fe-55, Ni-63 Xiaolin Hou	Group -1 Pu-239+240, Am-241 Per Roos	Group -2 Fe-55, Ni-63 Xiaolin Hou
14:05	Martin Amft, SSM, Sweden (Invited)	13:55	Anumajja Leskinen, VTT, Finland (Invited)	13:55	Mats Eriksson, SSM, Sweden				
14:40	Mia Ylä-Mella, STUK, Finland (Invited)	14:30	Bernhard Bugenhagen, TÜV NORD Germany (Invited)	14:20	Gaël K Menard, NRG, Netherland				
15:15	Coffee break	15:15	Departure to MS Sagafjord	14:45	Qifan Wu, Tsinghua University, China				
Session-2 Methodology (Chairman: Torbjørn Gäfvert)		16:00-21:00 Radworkshop social event at M/S Sagafjord		15:00	Osváth Szabolcs, DTU, Denmark				
15:40	Danièle Roudil, CEA, France (Invited)								
16:15	Jens Søgaard-Hansen and Mikkel Øberg, DD, Denmark (Invited)								
17:00	Close of day 1			15:30-16:30 Lab tour (Optional)					

- 1. International and national legislation on decommissioning, waste management and clearance of materials, buildings and land**

- 2. Strategies, experience and challenges in decommissioning of nuclear facilities**

- 3. Radiological characterization and radiochemical analysis**
 - 3.1 Sampling technique and strategies
 - 3.2 Radiological characterization methods
 - 3.3 Principles of radiochemical analysis
 - 3.4 Radiochemical methods for hard-to-measure radionuclides
 - 3.5 Measurement techniques (alpha, beta, gamma, LSC, MS)
 - 3.6 Development of new techniques/materials