EUROPEAN JOINT PROGRAMME
FOR THE INTEGRATION OF
RADIATION PROTECTION RESEARCH
CONCERT

TERRITORIES

Group picture at the kick off meeting on 27th January

IRSN INSTITUT DE RADIOPROTECTION ET DE SÛRETÉ NUCLÉAIRE
Bundesamt für Strahlenschutz
cepn A team dedicated to radiological protection
Ciemat Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas
NMBU Norwegian University of Life Sciences
Statens strålevern
Public Health England
SCK·CEN STUDIECENTRUM VOOR KERNENERGIE CENTRE D'ÉTUDE DE L'ÉNERGIE NUCLÉAIRE
STUK
TARTU ÜLIKOOL 1632
MUTADIS

This project has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 662287.

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TERRITORIES objectives

- To fill in the needs emerged after the recent Fukushima experience and the publication of International and European Basic Safety Standards

- To reduce uncertainties to a level that can be considered fit-for-purpose (graded approach)

- To bridge NORM vs post-accident (after transition phase), monitoring vs modelling, human vs wildlife population, experts vs decision makers vs the public in management (integrated approach)

TERRITORIES = To Enhance unceRtainties Reduction and stakeholders Involvement TOwards integrated and graded Risk management of humans and wildlife In long-lasting radiological Exposure Situations

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CONCERT TERRITORIES

TERRITORIES in few figures

- 3 years: 1st of January 2017-31 of December 2019
- 11 partners (P1 IRSN, P2 BfS, P3 CEPN, P4 CIEMAT, P5 NMBU, P6 NRPA, P7 PHE, P8 SCK.CEN, P9 STUK, P10 University of Tartu, P11 Mutadis)
- 385 p.months
- Total cost: 4 215 k€, Funded by EU: 2 271 k€
- 6 « territories /sites» in the TERRITORIES Library

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TERRITORIES Library

1. Territories affected by Chernobyl deposits, extended in this project beyond exclusion zone
2. Territories affected by Fukushima deposits, extended in this project beyond evacuated zone, Japan
3. West Cumbrian coast (vicinity of the Sellafield site), UK
4. Phosphate NORM observatory site, Belgium
5. Upper Silesian coal basin, Poland
6. Søve Mine, Fen field site, Norway

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TERRITORIES in few figures

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- Total cost: 4 215 k€, Funded by EU: 2 271 k€
- 6 « territories /sites» in the TERRITORIES Library
- 18 milestones, 21 deliverables
- 5 Work Packages

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Uncertainties sources

WP1 - Quantifying variability and reducing uncertainties when characterizing radiological exposure of humans and wildlife by making the best use of data from monitoring and of existing models

Results from WP1 and WP2 will allow an holistic approach for reducing uncertainties in dose assessment

WP2 - Reducing uncertainties when characterizing exposure scenarios, accounting for human and wildlife behaviours, and integrating social and ethical considerations in the management of uncertainties

TERRITORIES Library

Integrated and graded framework for risk assessment and management

WP3- Stakeholder engagement for a better management of uncertainty in risk assessment and decision-making processes including remediation strategies

WP3 and WP4 will consolidate and disseminate the guidance produced in the whole project

WP4- Strategic and integrated communication, education and training

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WP1-Objectives

- To create a database with radioecological data from a set of chosen sites (taken from TERRITORIES LIBRARY).
- To improve some radioecological models based on past experience (mainly within STAR and COMET).
- To test “old” models and “improved models” in given well characterized sites (taken from TERRITORIES LIBRARY).
- To quantify the improvement of “improved models”.
- To identify and analyse sources of uncertainty in the improved models

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WP1-tasks

- Task 1.1 Guidance to design environmental monitoring for dose assessment and for support to remediation
  - Deliverables= TLD (Territories Library Database); Guidance to reduce sampling uncertainty

- Task 1.2 Guidance to select the appropriate level of complexity in models
  - Deliverable= Technical guidance with recommendations about the desirable fit-for-purpose level of complexity

- Task 1.3 Uncertainties propagation and sensitivity analysis in modelling
  - Deliverable= Methodology to quantify improvement in modelling, including temporal and spatial variations

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- Task 2.1 Variability in human behaviour
- Task 2.2 Variability in wildlife behaviour
- Task 2.3 Social and ethical aspects linked to uncertainty in monitoring and modelling

- Main deliverable:
  - Step by step procedure to help identify the most appropriate approach to model the exposure pathways
  - Guidance based on case studies
  - Taking consideration of uncertainties into account
  - Discussions with ICRP, IAEA and NEA to see if guidance can feed into their publications

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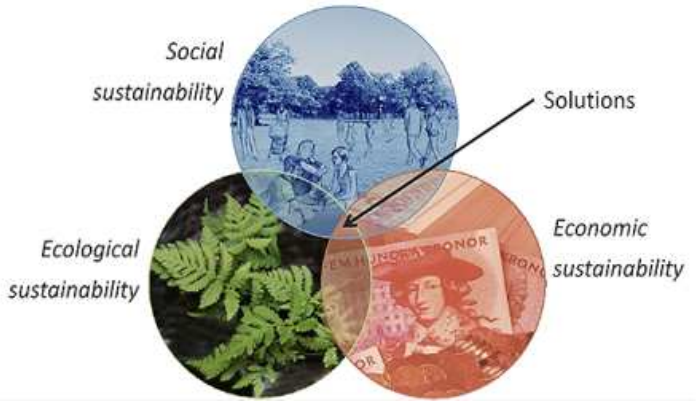
Analysis of Decision-Making Processes and remediation strategies in long lasting exposure situations, management of uncertainty, decision pathways and criteria

- After nuclear Accidents
- After contamination by NORM

Stakeholder panels - Critical evaluation of alternative remediation strategies

- Socio-Economic Analyses
  MCA vs CBA



- Guidelines & Recommandations & Final Territories Event

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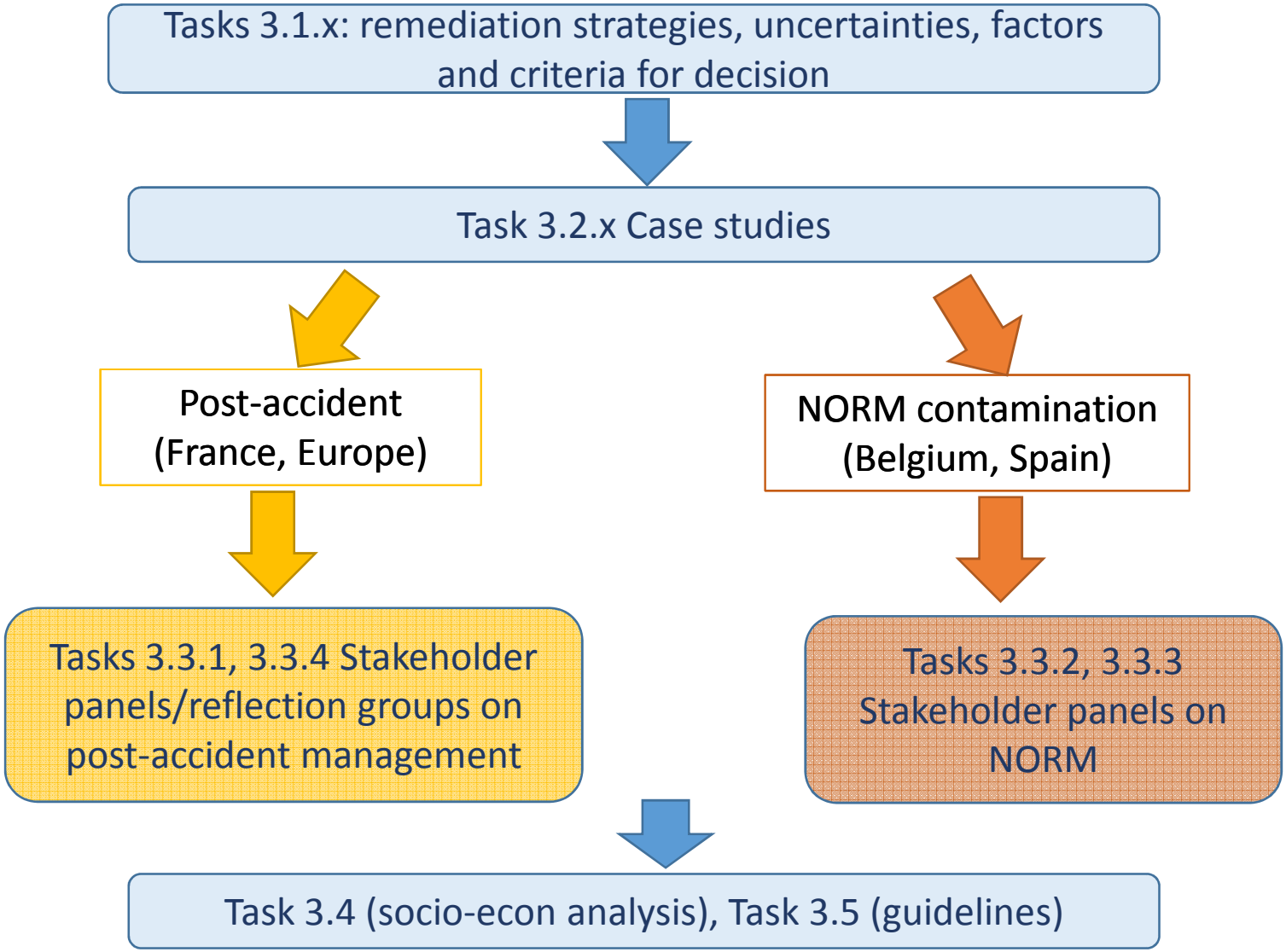
WP3 - Tasks



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- Wide dissemination (& discussion) of recommendations and guidance
  - to reduce sampling uncertainty in field characterization,
  - to select fit-for-purpose level of model complexity,
  - to quantify improvement in models,
  - to reduce uncertainties related to the exposure scenarios,
  - to manage existing situations NORM/post-accident
  - etc.
- On the web:
  - TERRITORIES Website: http://territories.eu
  - TERRITORIES Blog: https://territoriesweb.wordpress.com/
  - EU CORDIS: http://cordis.europa.eu
- During events:
  - (Training) Worshops in 2017 (mid-November), in 2018, and in 2019
  - Final Event in October 2019

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TERRITORIES WP2

Work plan of IRSN – Belarus case-study

Jean-Marc Bertho et al.

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Variability in a Belarusian village

- A study in a limited field, the size of a village, Kamaryn (2000 inhabitants), the closest to Chernobyl exclusion zone in Belarus
- Inhabitants of this village were already involved in past European projects aiming at developing a practical radiation protection culture through monitoring of living places : ETHOS (1996-2001), SAGE (2002-2005), CORE (2004-2008)
- There is a ground of data available both in the Belarussian Research Institute of Radiology (RIR, Gomel) and in the Centre for Local Radiation Control (CLRC, Kamaryn). These data will be explored with specific objectives:
  - Temporal variability on selected reference sites over a decade period, more if possible
  - Spatial variability by analysis of some specific calendar years with a high number of measurements
  - Influence of agricultural practices on the contamination level of some specific foodstuff locally produced: foodstuff to be defined.
  - Influence of the socio-economic status and individual behaviour. This point will be studied through the discussions with selected families to delineate the role of these parameters.
- These data will be completed with new studies during the TERRITORIES project (interactions with local NGO)

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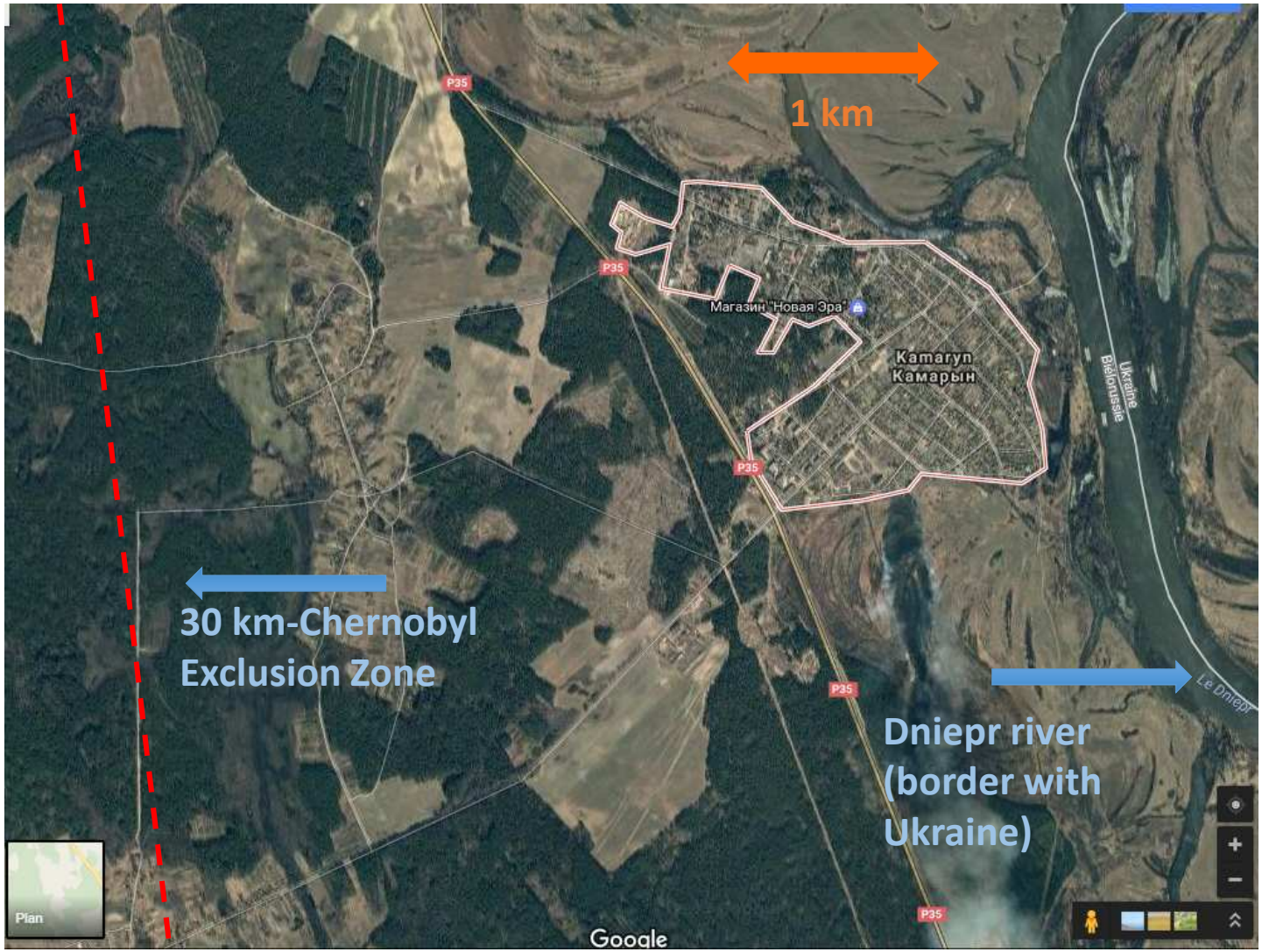
The Kamaryn village



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The local partners

- The partners:
  - RIR, Gomel (sub-contractor)
    - Environmental measurements outside of the radioecological reserve
    - 137-Cs, 90-Sr, 241-Am, etc…
    - 20 years of record
    - Management and follow-up of the CLRC
  - CLRC, Kamaryn
    - 20 years of records, 137-Cs only
    - Local foodstuffs from kitchen gardens and environmental harvests
  - The local NGO "*Sprout of Life*"
    - Already working with schools
    - Contacts with the population (young mothers, elderly people, etc.)
  - CEPN
  - IRSN

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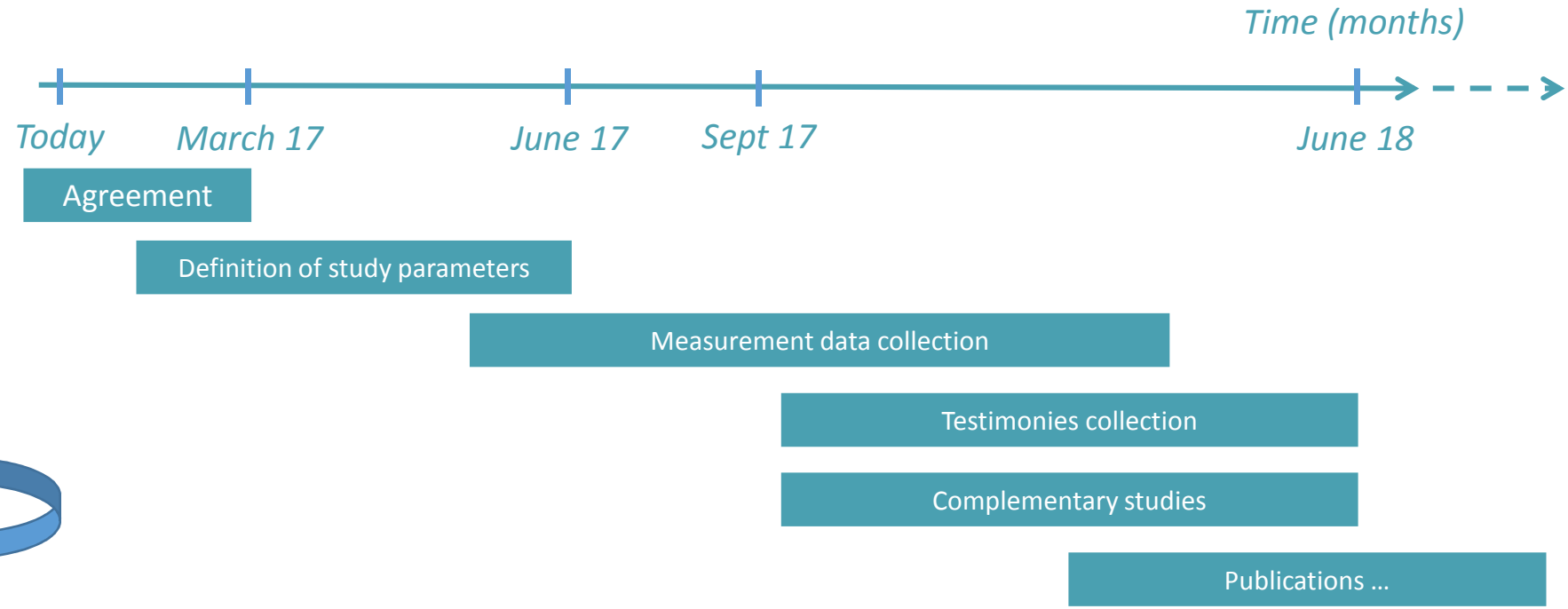
The time table

- Four main steps:
  - Collaboration agreement between IRSN and RIR
  - Definition of the parameters of the study: years of interest, reference points, definition of socio-economic and critical groups
  - Collect of measurement data and testimonies
  - Data analysis and publications



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TERRITORIES WP1

Work plan of IRSN – “Symbiose” team

Marc-André Gonze, Christophe Mourlon, Philippe Calmon, Jean-Michel Métivier

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Contribution – Objective

- Task 1.1

  To feed the TLD with a set of spatio-temporal data on radiocesium (Cs) contamination in Fukushima forests (2011-2015) + maps of Cs deposits and ambient dose rates (ADRs) in terrestrial environments (2011)

- Task 1.2

  To test and improve a dynamic model for predicting Cs transfer and ADRs in terrestrial systems, based on the Fukushima dataset

- Task 1.3

  To identify and quantify sources of uncertainty in the improved model for Fukushima case study; perform uncertainty and sensitivity analysis

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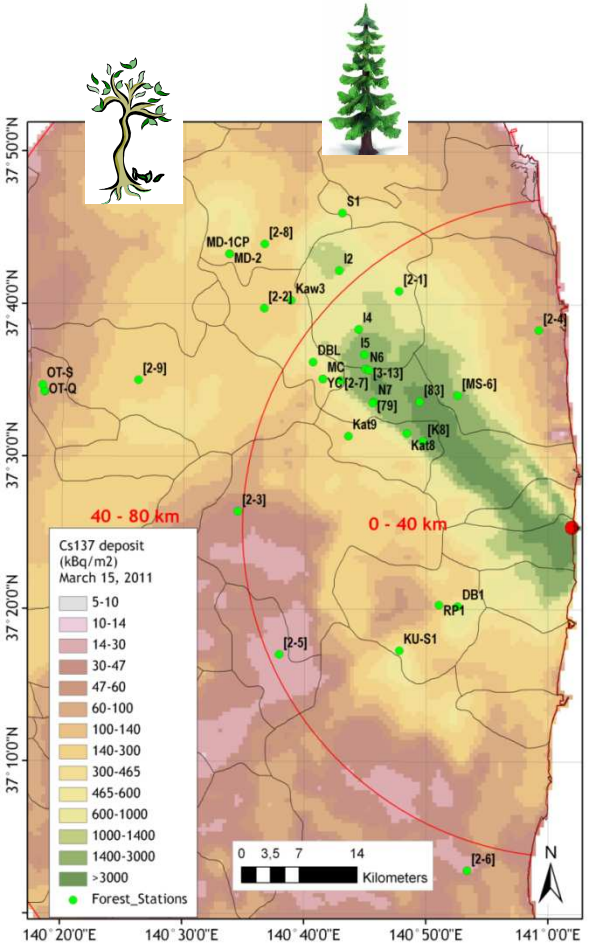
Task 1.1- Fukushima case study

- (MS1.1) existing data in forest vegetation
  - ~1500 spatio-temporal Cs data collected in the literature, from 2011 to 2013, at tens of sites: inventories (Bq/m^2) or concentration (Bq/kg) in tree organs, tree depuration fluxes (Bq/m^2/d)
  - Forest stand characteristics: tree species, age, stand density, trunk diameter, height, above ground biomass, litterfall biomass flux…
  - Precipitation time series
  - The dataset includes **raw data** & **processed data** (eg resampled in time, normalized by the deposit)
- (D1.1) extension of the dataset
  - 2014-2015
  - forest soil



Localization of the forest sites within 60 km from the nuclear site.

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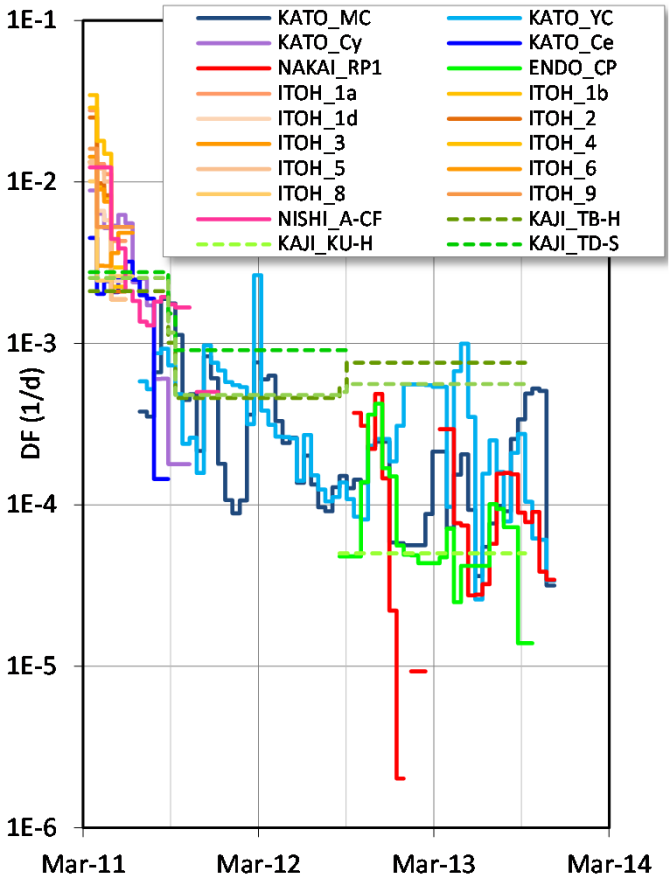
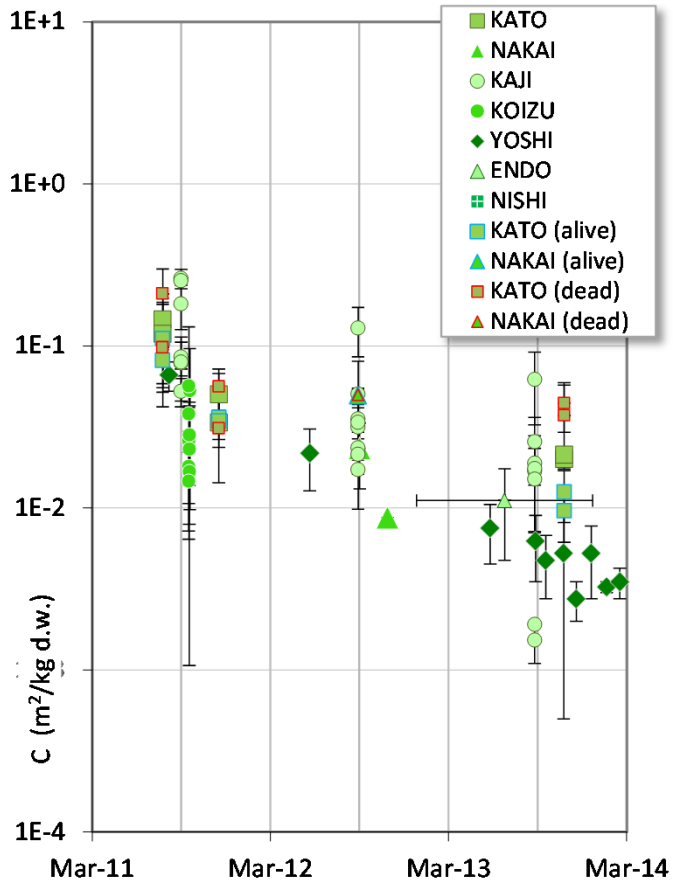
Example of site-specific contamination data

Total depuration flux (1/d)



evergreen coniferous forests

Concentration in needles (m^2/kg)



Time series of measured depuration fluxes and concentrations in foliage after normalization by the deposit

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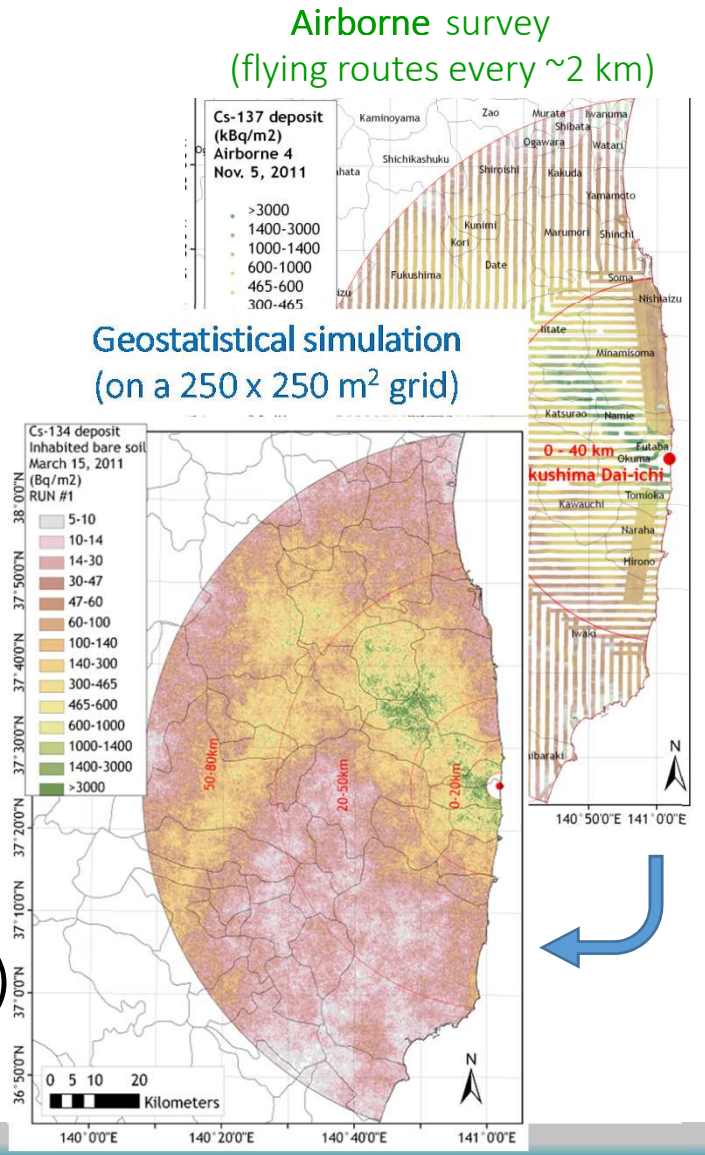
Task 1.1- Fukushima case study (cont'd)

- (MS1.1) existing **raw data** maps
  - ADR (µSv/h) and Cs deposits (Bq/m²)
    - Airborne survey (2011)
    - In situ survey of bare land soil areas (2011)
  - Landuse map (required for distributing terrestrial models in space)
  - DEM (not necessarily required)

- (D1.1) extension to **processed data**
  - High resolution ADR and Cs deposit maps by geostatistical simulations, in collaboration with the other IRSN team (task 1.1)



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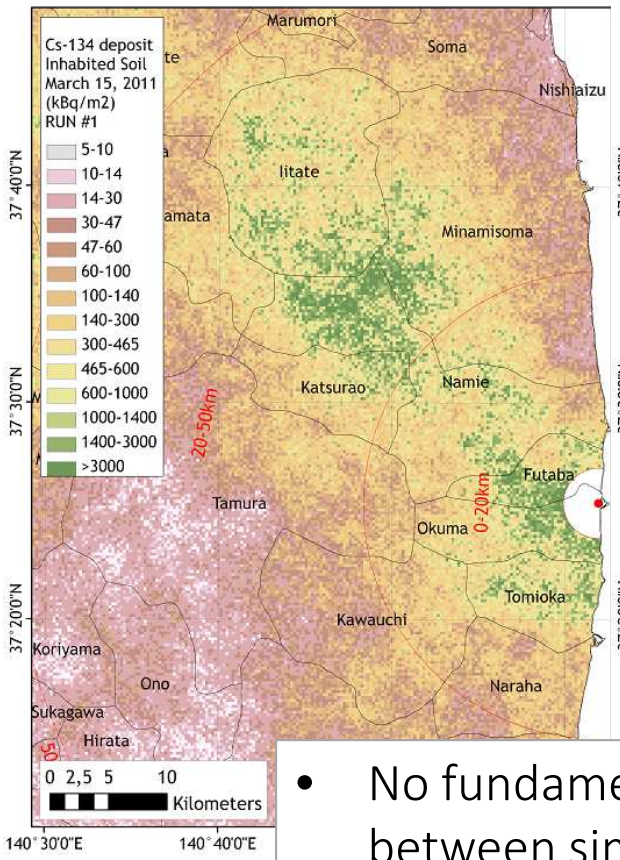
Example of simulated Cs deposit maps

run i



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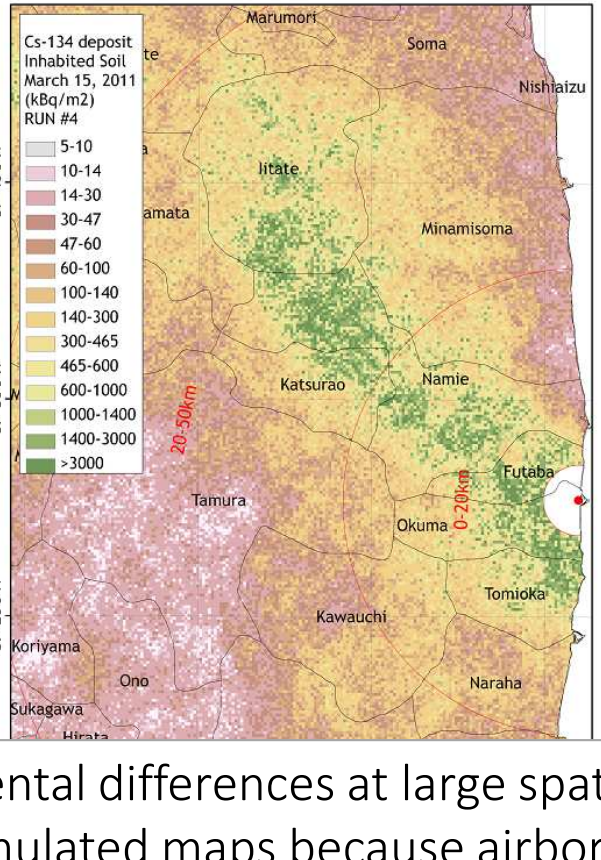

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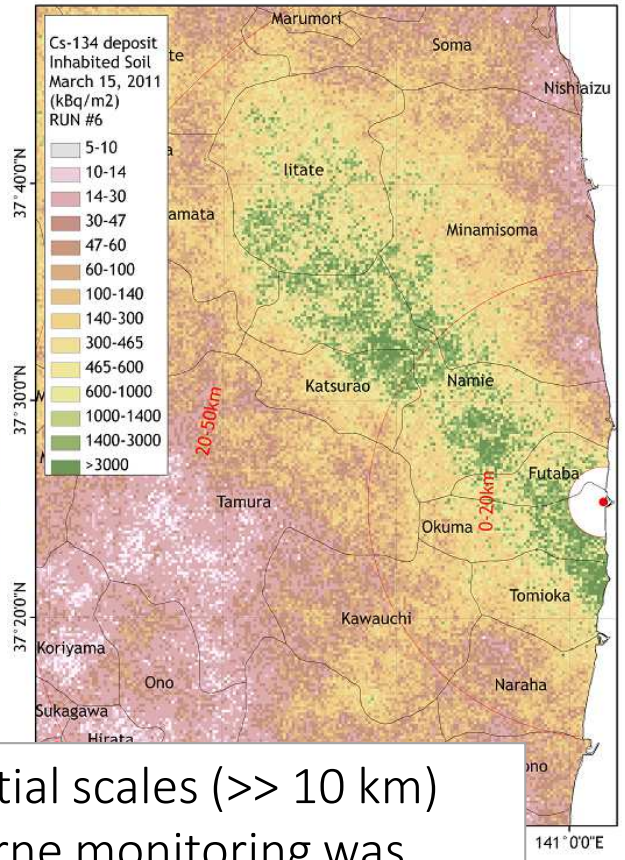

- No fundamental differences at large spatial scales (>> 10 km) between simulated maps because airborne monitoring was performed with a “satisfactory” spatial resolution (every 2 kms)
- But high spatial variability at kilometric scales (< 5 km)

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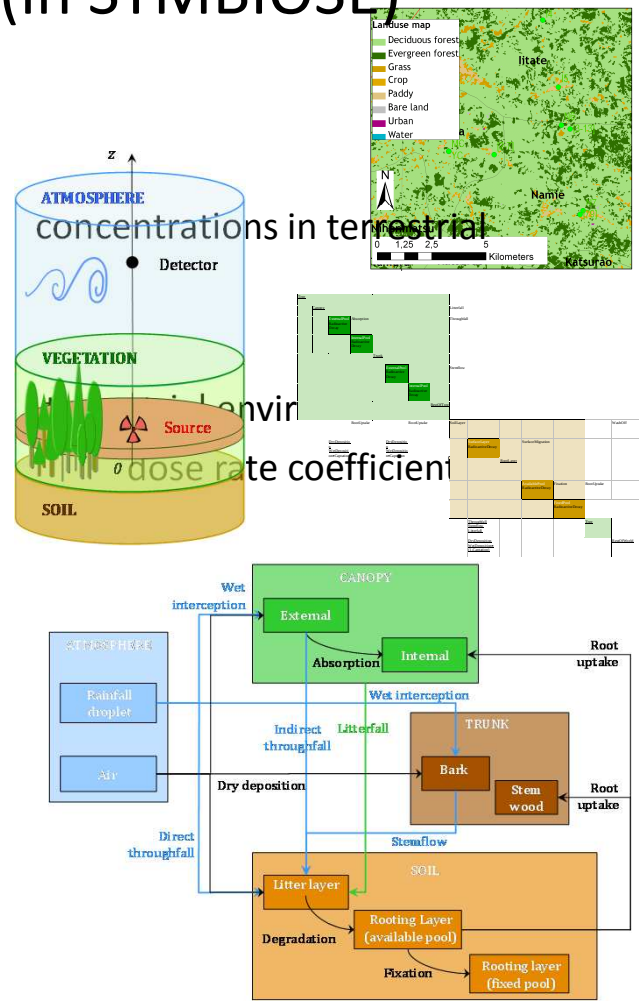
Task 1.2- Testing & improving models

- (MS1.3) Testing “simple” dynamic models (in SYMBIOSE)
  - Dedicated to mainly forests and croplands
  - Cs transfer
    - Time evolution of Cs inventories, fluxes and environments
  - ADR dynamics
    - Time evolution of ADRs inside/above
    - Based on Cs calculations and pre-calculated µSv/h/(Bq/m^2))
  - over the period 2011-2015
  - in a simple 0D spatial configuration (“point-scale”)



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Task 1.2- Testing & improving models (cont'd)

- (MS1.4) Improving the forest model, quantifying improvement
  - Refining the conceptual models
  - Improving mathematical parameterizations of transfer processes
  - Improving the ecological forest sub-model
  - Quantifying the improvement of models accuracy while increasing the level of complexity in the conceptual & mathematical approaches
- (D1.3) The modelling exercise will contribute to D1.3 through recommendations for the improvement of the models and appropriate level of complexity

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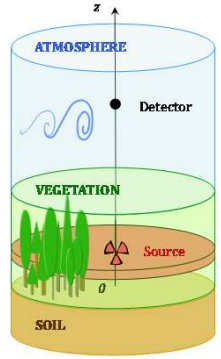
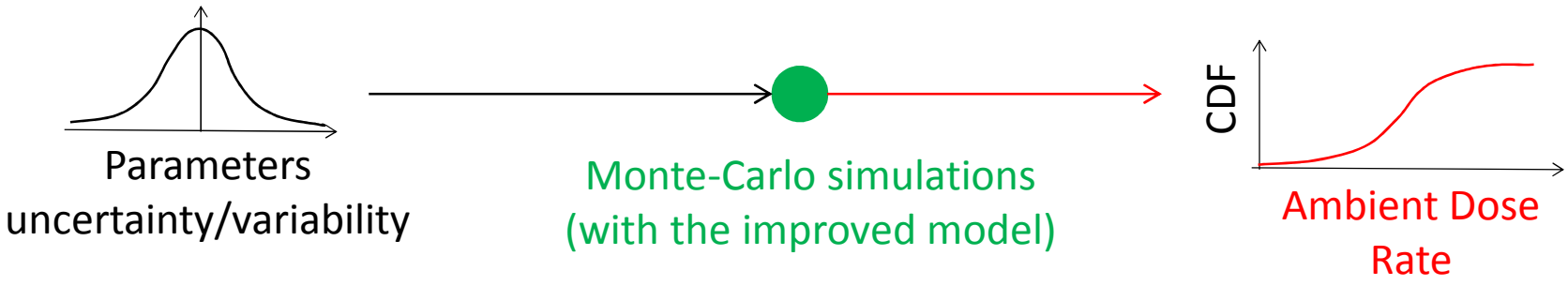
Task 1.2/1.3 - SA/UA with the improved forest model

- "point-scale" dynamic model with a unit deposit (1Bq/m^2)
- (MS1.6) Uncertainty analysis
  - Characterization of the uncertainty/variability sources
    - Parameter variability (eg forest stand or soil characteristics)
    - Parameter uncertainty (eg transfer rates)
    - Conceptual uncertainty (use of various alternative models) ?
  - Propagation method: 1D or 2D Monte Carlo
- (MS1.5) Sensitivity analysis (eg Spearman method)





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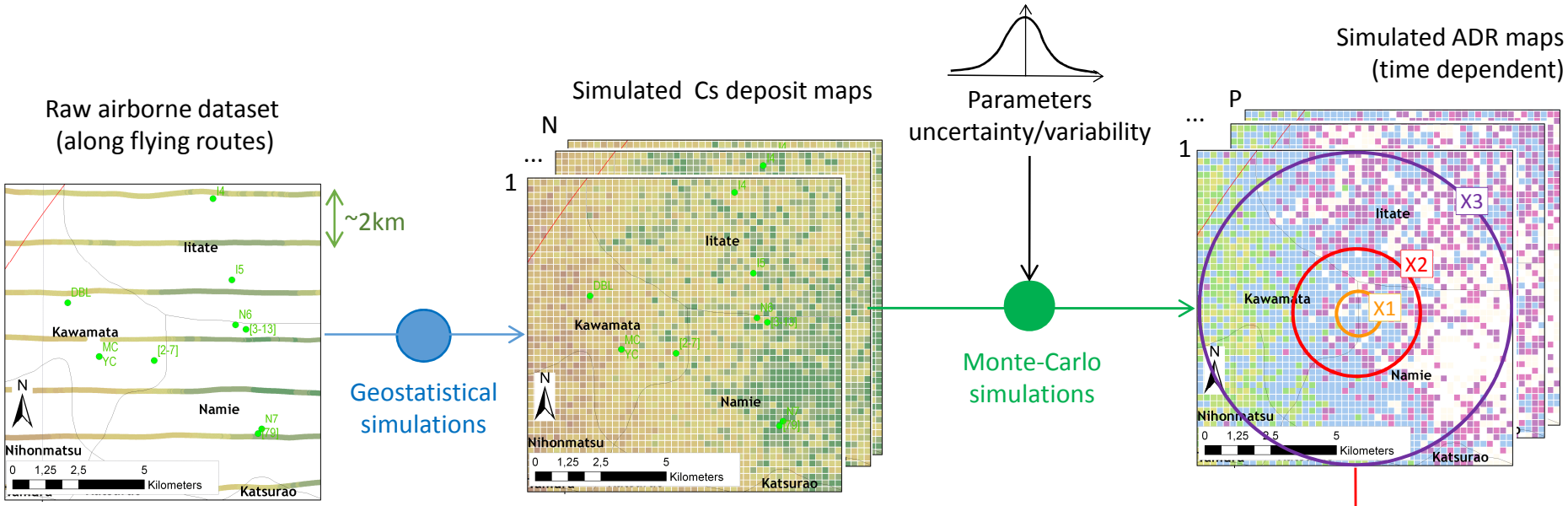
SA/UA including spatial uncertainties



- SA/UA combining uncertain./var. on parameters and spatial uncertainties on estimated Cs deposit
- Sensitivity of the output (eg average ADR) to the spatial frame of interest (eg X1, X2, X3)

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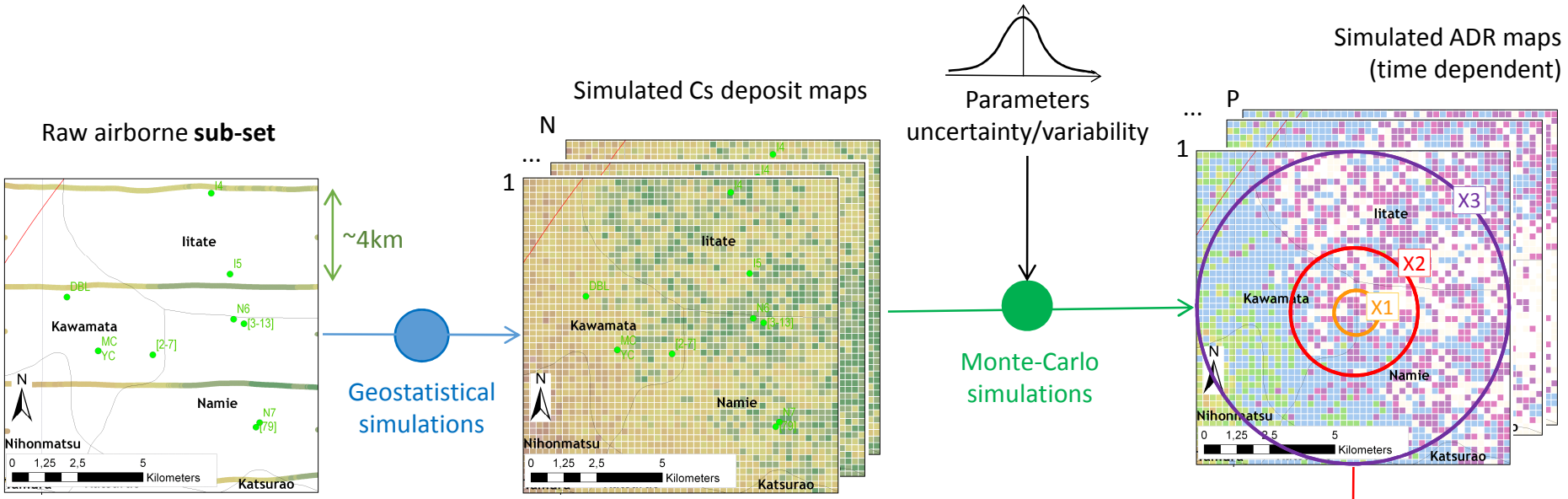
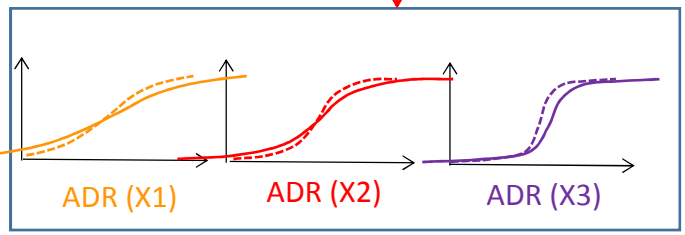
SA/UA including spatial uncertainties (cont'd)



- SA/UA combining uncertainties on parameters and spatial uncertainties on estimated Cs deposit
- Sensitivity of the output (eg average ADR) to the spatial scale of interest (eg X1, X2, X3)
- Sensitivity to the spatial resolution of airborne monitoring (ie distance between flying routes)

Extraction of a statistical property (eg average ADR) at varying spatial scales



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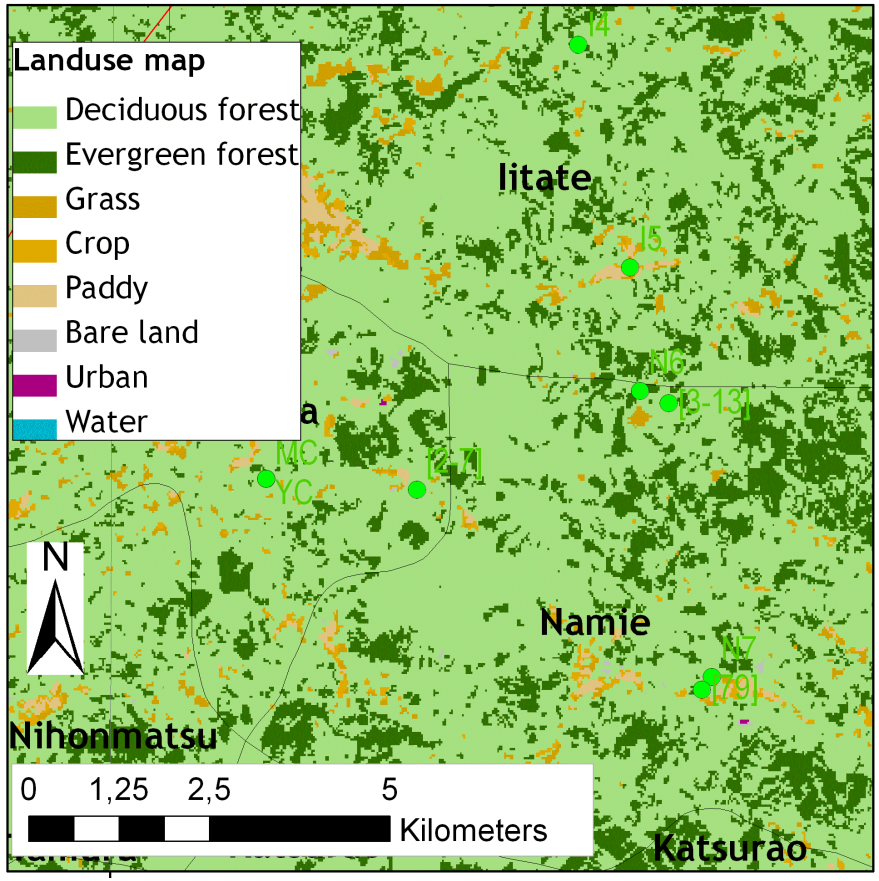
The selected geographical area



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