

IRSN
INSTITUT
DE RADIOPROTECTION
ET DE SÛRETÉ NUCLÉAIRE

Relevé scientifique de sûreté nucléaire

Site-Specific and Landscape-Level Environmental Modeling Following Radioactive Releases:

A Case Example Around a French Nuclear Power Plant



C. Mourlon
NRC/RIC 2012
International Panel Discussion on
Assessing Environment Risk from
Radioactive Releases
March 13, 2012

Context and objective

- IRSN + EDF collaborative R&D framework
- Test the feasibility of a detailed site-specific impact study with SYMBIOSE
- SYMBIOSE is a platform for:
 - Predicting fate to assess impact of radionuclides in ecosystems
 - Performing radiological risk assessments
 - Managing data and knowledge
 - Developing modules and simulators

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Scenario

- Releases of the NPP:
 - 2004 → 2008, normal operating conditions
 - to the river & atmosphere
 - 22 radionuclides considered (including ¹⁴C and ³H) + progenies
- Area of interest:
 - 5 km around NPP (terrestrial)
 - 150 km downstream the river
- Endpoints:
 - activities in abiotic and biotic components of atmosphere, river and terrestrial media
 - (doses to human populations)

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Site-specific & landscape-level environmental modeling



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Biosphere model

SOURCE	Release	Release					
	ATMO Migration Decay	Deposition		Deposition Assimilation(H, ¹⁴ C)	Deposition Assimilation(H, ¹⁴ C)	Deposition Assimilation(H, ¹⁴ C)	Inhalation (H, ¹⁴ C)
		RIVER ABIOTIC Migration Decay	Accumulation Ingestion		Irrigation	Irrigation	Watering
			RIVER BIOTIC Trophic chain Decay				
				GRASS Decay			Grazing
				VEGETABLE Decay			
					ANNUAL CROP Decay		Feed
							ANIMAL Decay

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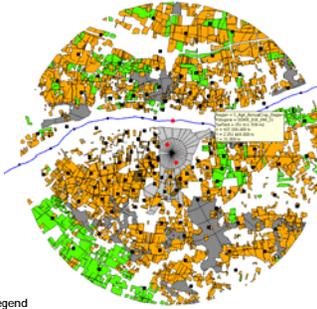
Spatial Model

Landscape model

- Set of geographic frames dedicated to biosphere components

Spatial interactions

- Interactions between biosphere components with spatial transfers



Legend

- X_ReleaseToRiver_Station
- X_Agri_Grass_Region
- X_ReleaseToAtmo_Station
- X_Agri_Ani_Population
- X_River_Network
- X_Man_Population
- X_Agri_AnnualCrop_Region
- X_BareSoil
- X_Agri_Vegetable_Region

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Site specific data

- Landscape
- Releases
- Meteorology
- River data
- Agricultural data

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Site specific data

- Landscape
- Releases
- Meteorology
- River data
- Agricultural data

- Georeferenced land cover & digital terrain model databases from:
 - European organization
 - National organization
 - Parcel-level survey within 5 km around NPP

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Site specific data

- Landscape
- Releases
- Meteorology
- River data
- Agricultural data

- EDF measurements at a fine available time sampling:
 - Liquid releases from one outlet
 - Atmospheric releases from 2 stacks

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Site specific data

- Landscape
- Releases
- Meteorology**
- River data
- Agricultural data

- Hourly to daily measurements:
 - Wind speed & direction
 - Rainfall height
 - Cloud cover

Wind rose at the NPP station, 2004-2008

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Site specific data

- Landscape
- Releases
- Meteorology
- River data**
- Agricultural data

- Daily measurements & mean monthly data:
 - Flow rate
 - Suspended matter load
 - Temperature

River flow rate, 2004-2008

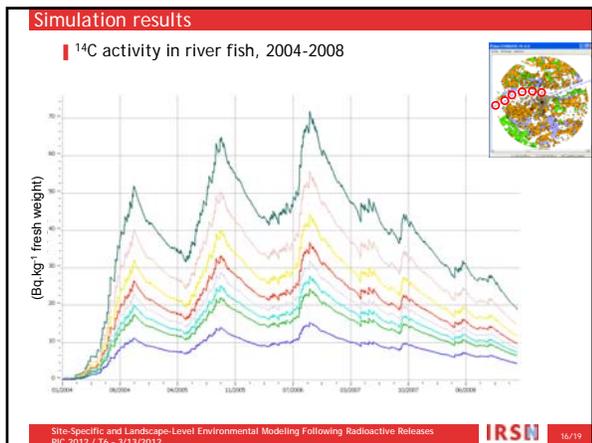
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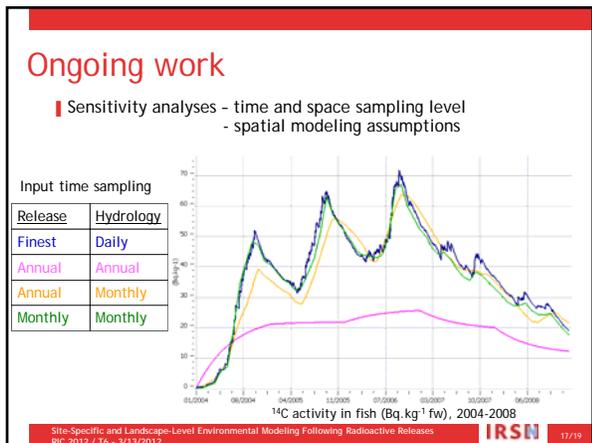
Site specific data

- Landscape
- Releases
- Meteorology
- River data
- Agricultural data**

- Agricultural calendars
- Soil types

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Conclusion

- Proven feasibility of site-specific & landscape-level modeling**
- Assets of such quantitative assessments**
 - **Integrated approach:** multiple release points and types, media, exposures, receptors
 - **Addressing time and space variability:**
 - Complex time kinetics and seasonal variability, even for routine release
 - Significant spatial heterogeneity
- Importance of collating and preprocessing site-specific data**
 - Ongoing reflexion on sensitivity to hypotheses, data quality
- Possible benefits**
 - Risk assessments: increased realism whether for human or non human biota
 - Monitoring: could guide strategy & help interpret data

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Thank you for your attention

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