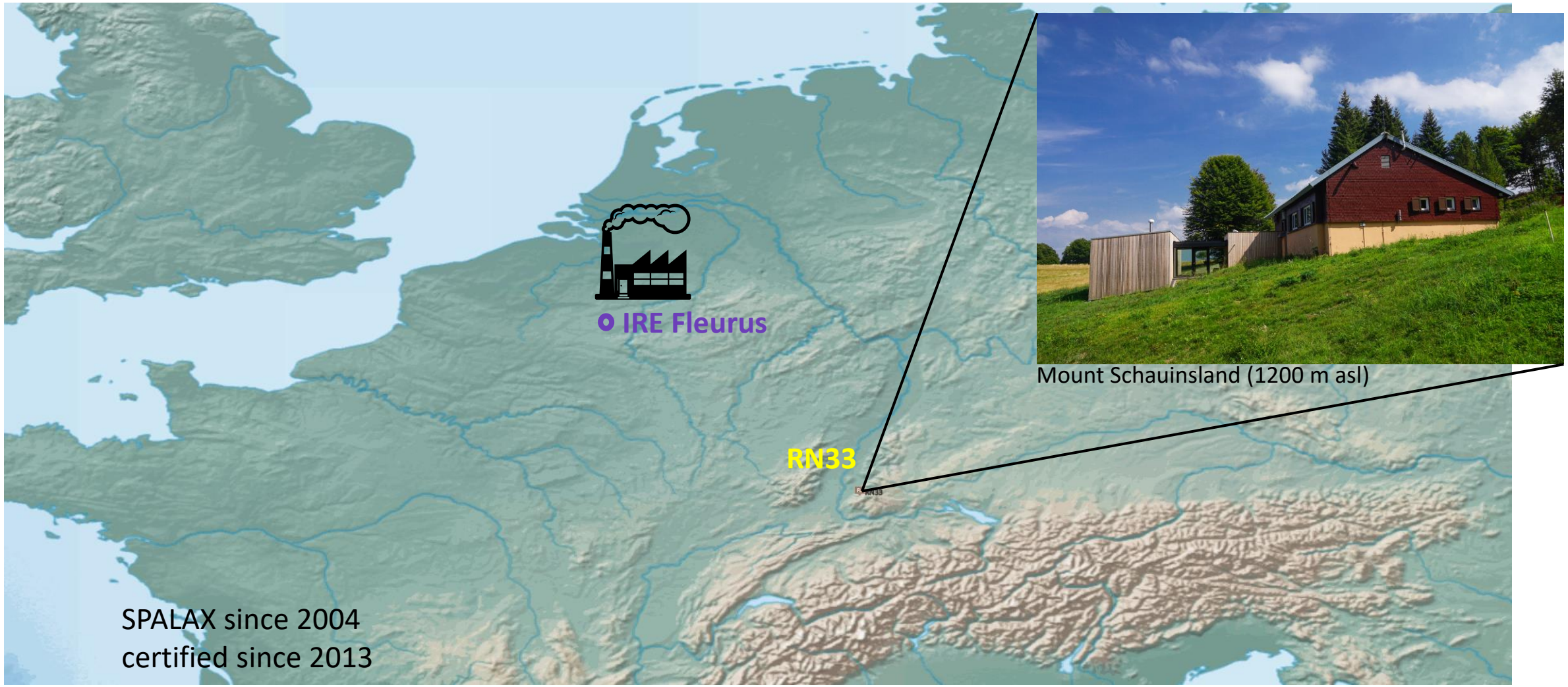
Federal Office for
Radiation Protection

Evaluation of the Phase II test of Xenon International on Mount Schauinsland – Identifying detections of interest

Sofia Brander, J. Ole Ross, Sandra Baur, Roman Krais, Andreas Bollhöfer

WOSMIP, Santiago de Chile, Dec 2023

RN33


IRE Fleurus
RN33
Mount Schauinsland (1200 m asl)
SPALAX since 2004
certified since 2013

Xenon International Phase II

Phase II: July 14th, 2021 to Jan 22nd, 2022
Install: June 28th, 2021
Deinstall: April 27th, 2022

Second generation system for the International monitoring system
6 h sampling time
ca. 2.5 mL Xe per sample
βγ-coincidence (^{131m}Xe / ^{133}Xe / ^{133m}Xe / ^{135}Xe)

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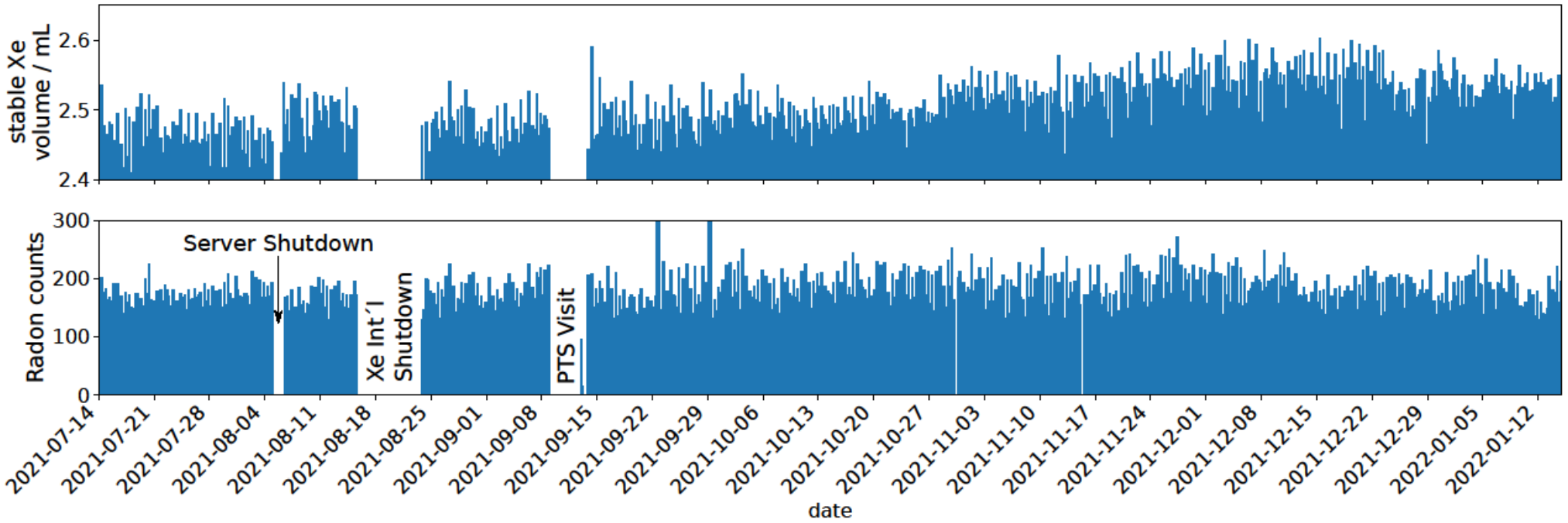
State of health and downtimes



- Aug 4th to 8th: mail server outage
- Aug 15th to 24th: heater failure in vacuum can

Data analysis

CTBTO‘s Inspire 2.0.0

generally good agreement with PNNL‘s beta-gamma viewer software

Sample re-analysis: IMS lab or accredited (DIN EN ISO/IEC 17025) BfS Noble Gas Laboratory

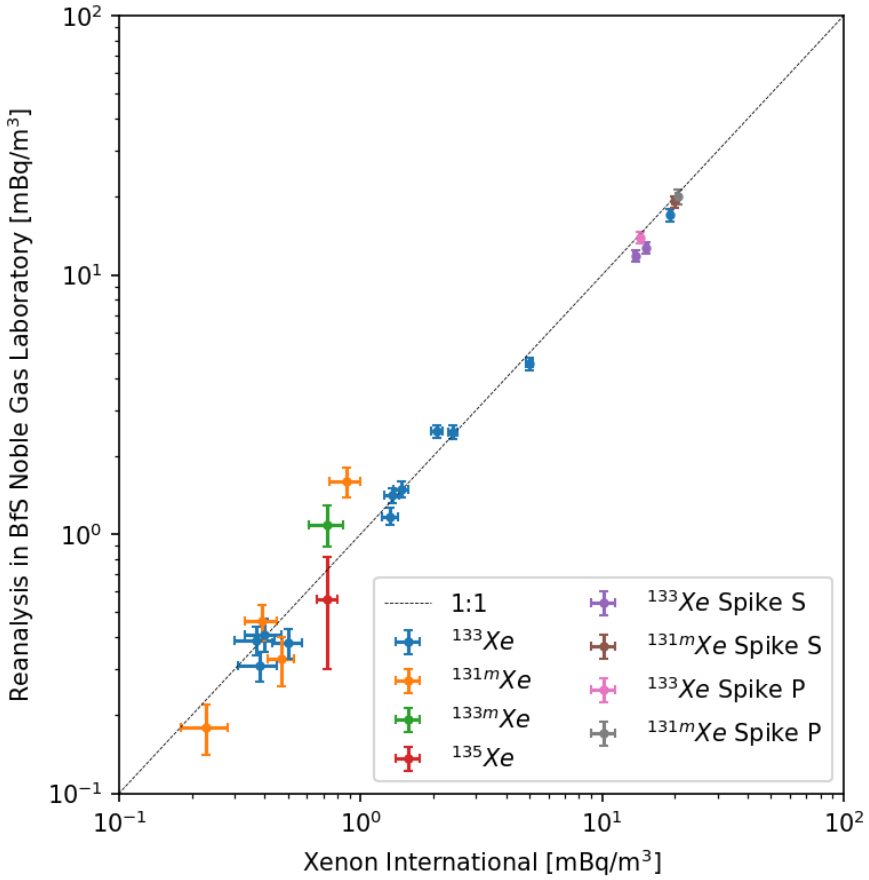
SAUNA – Lab
β-γ coincidence detection system

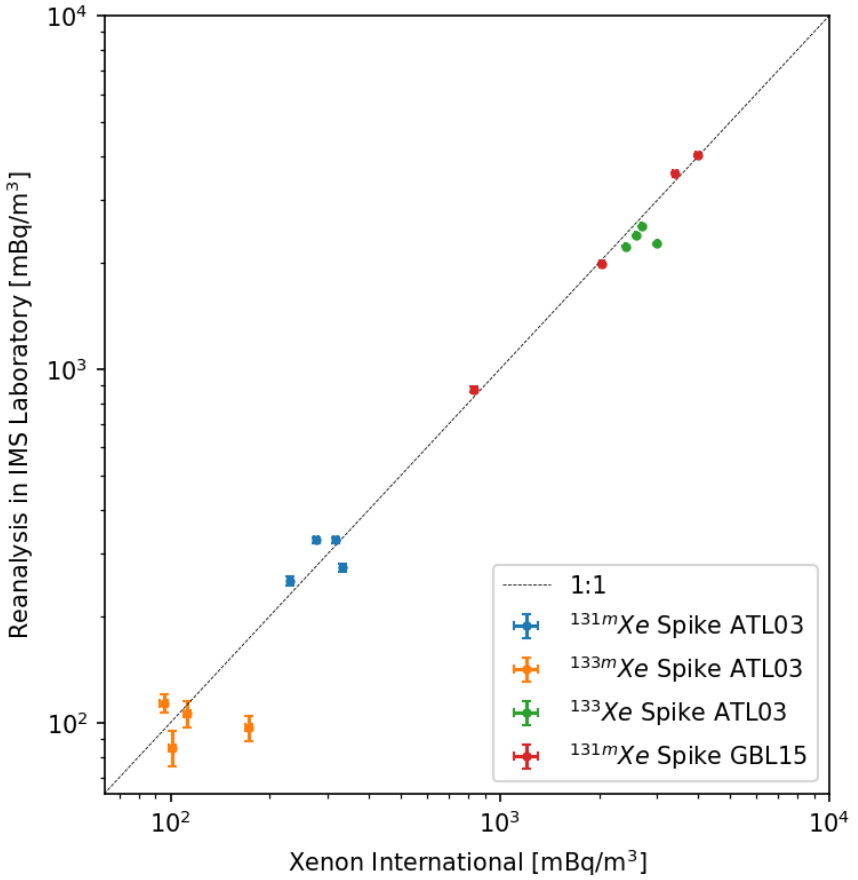
MDA ^{133}Xe (2 m^3 air, 24 h aq.): ≈ 1 mBq
^{131m}Xe / ^{133}Xe / ^{133m}Xe / ^{135}Xe
Analysis of βγ-data with openSpex

Proportional counters
custom built **proportional gas counters**,
Pb-shielding & anticoincidence counters

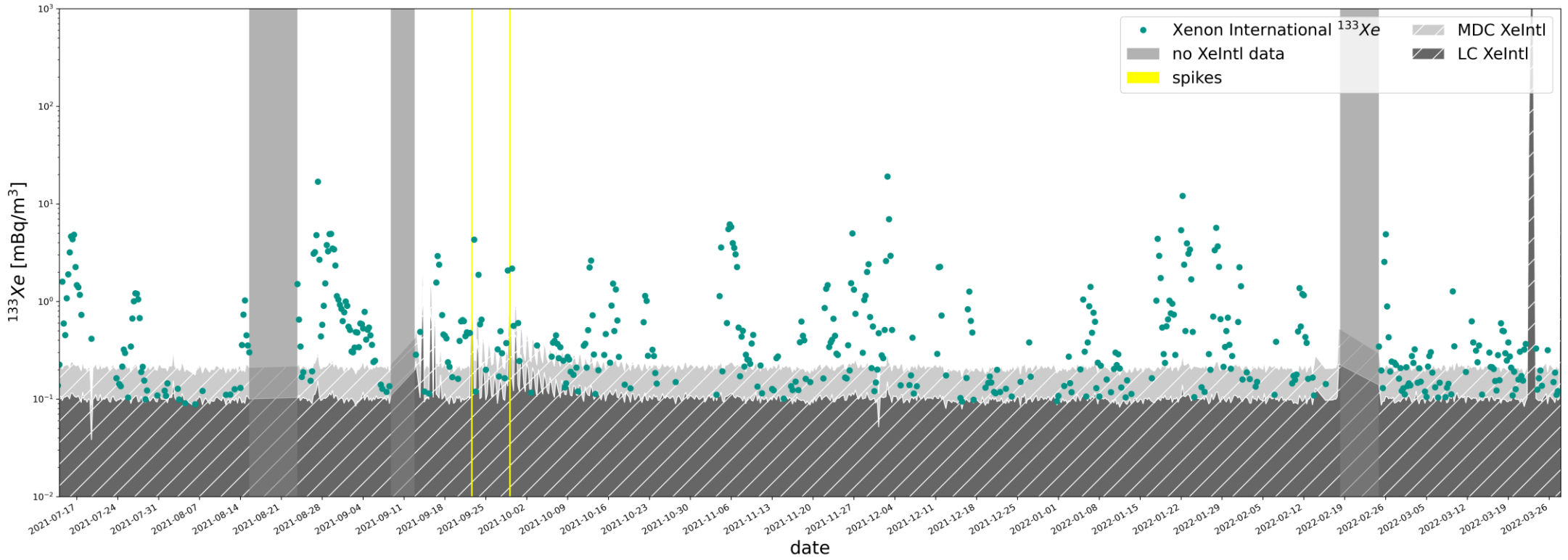
MDA ^{133}Xe (2 m^3 air, 36 h aq.): ≈ 8 mBq
^{131m}Xe / ^{133}Xe or ^{133}Xe / ^{135}Xe
Isotope analysis via decay analysis

Spike campaigns and environmental sample re-analysis



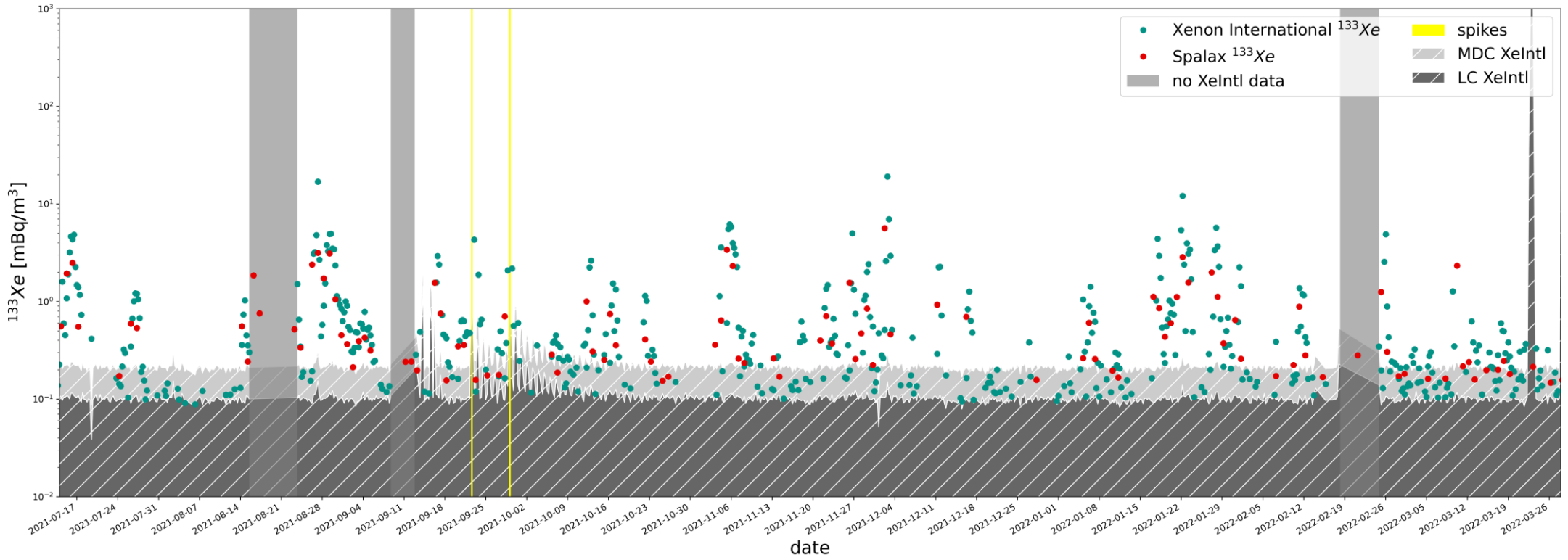


Detections – Xe-133

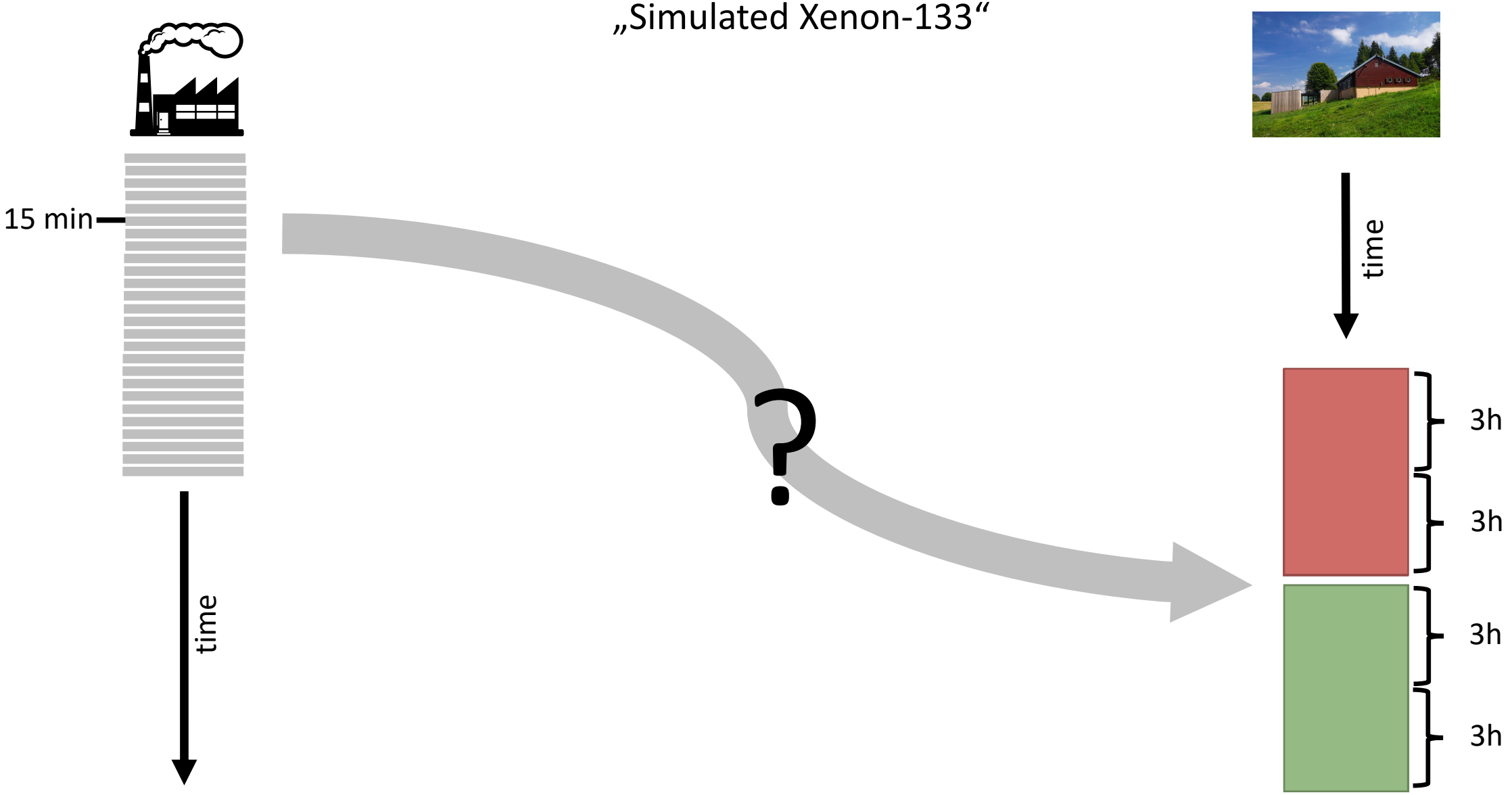


MDC:
(0.163 ± 0.105) mBq/m^3

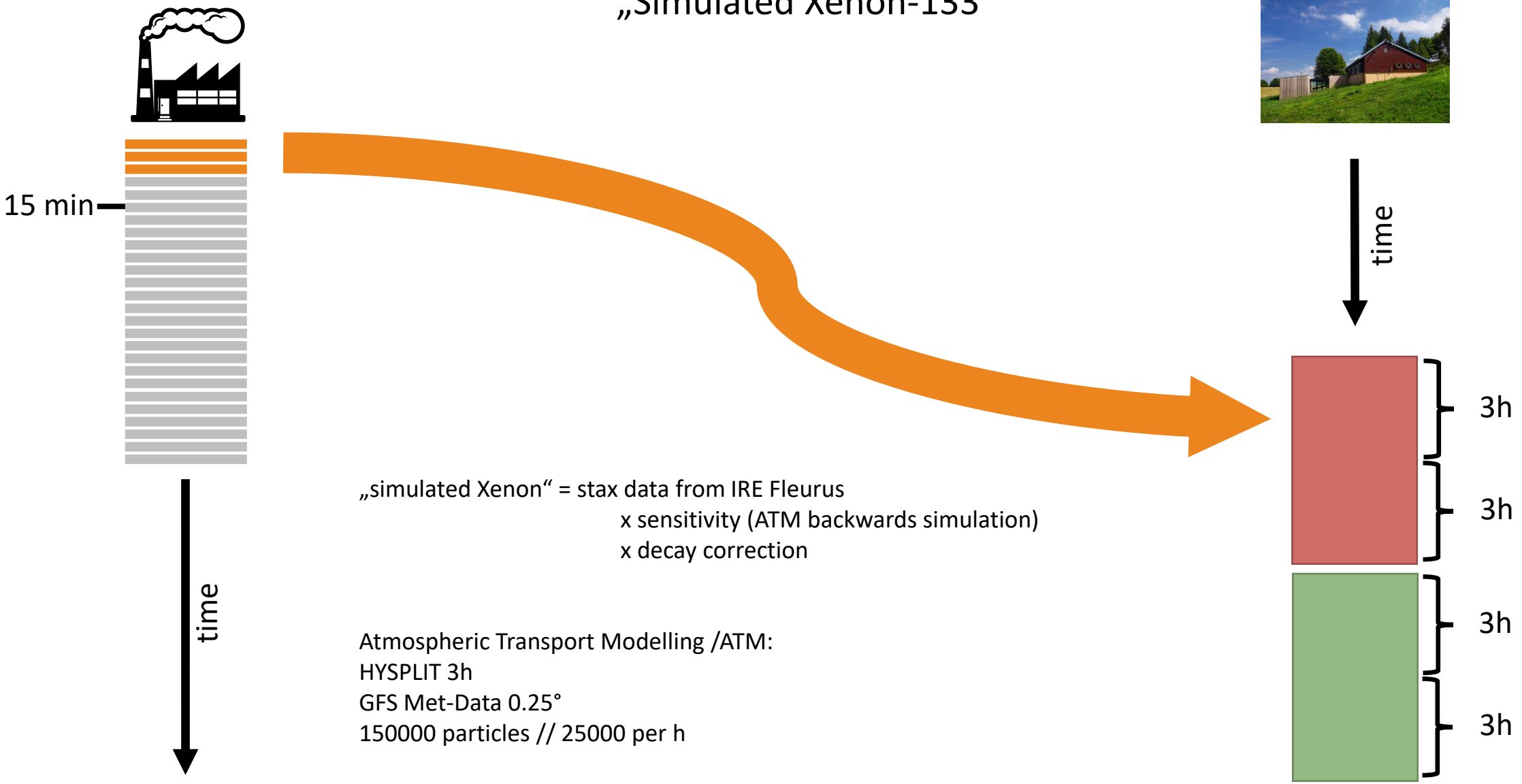
Detections – Xe-133



„Simulated Xenon-133“



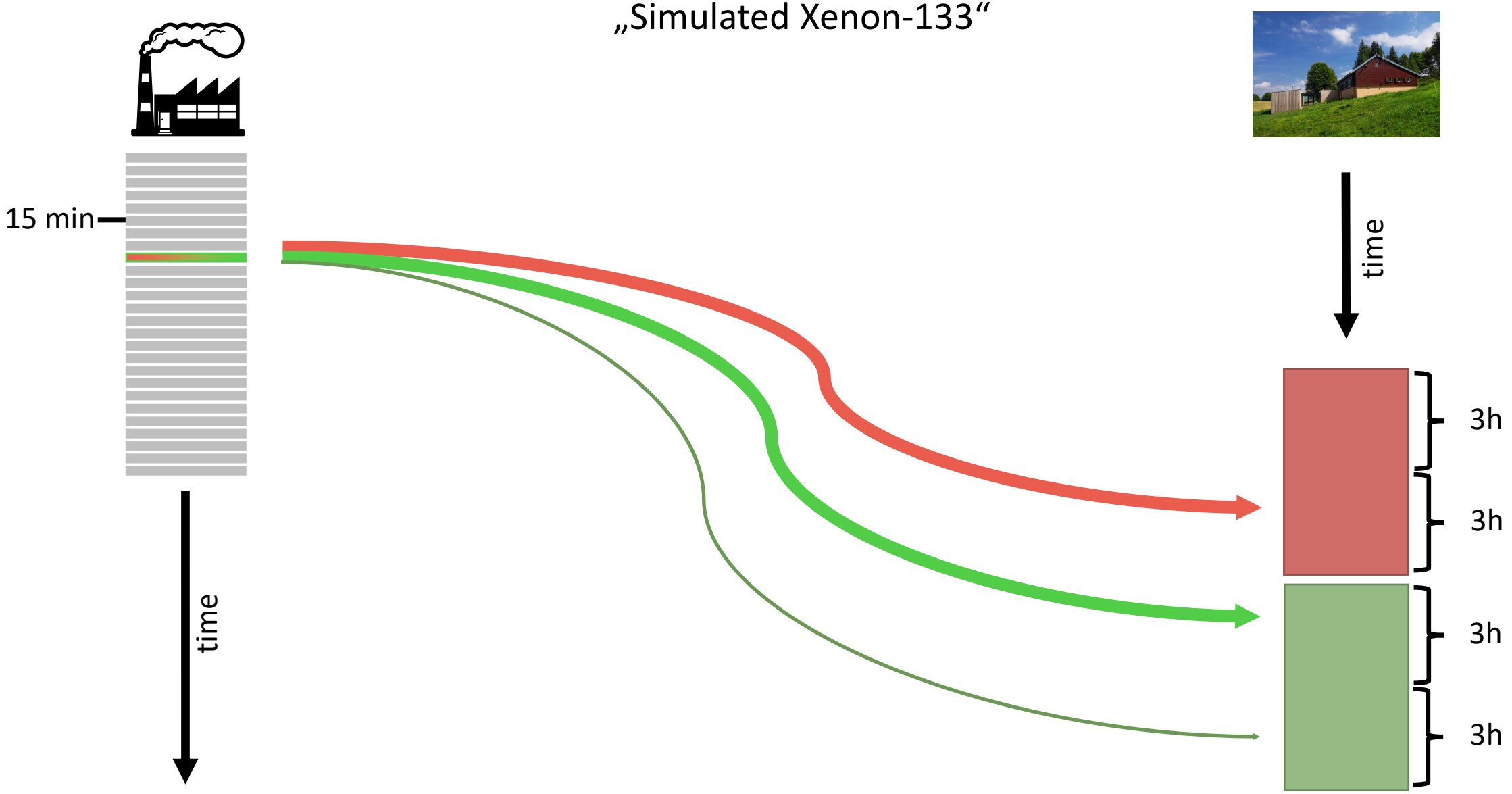
„Simulated Xenon-133“



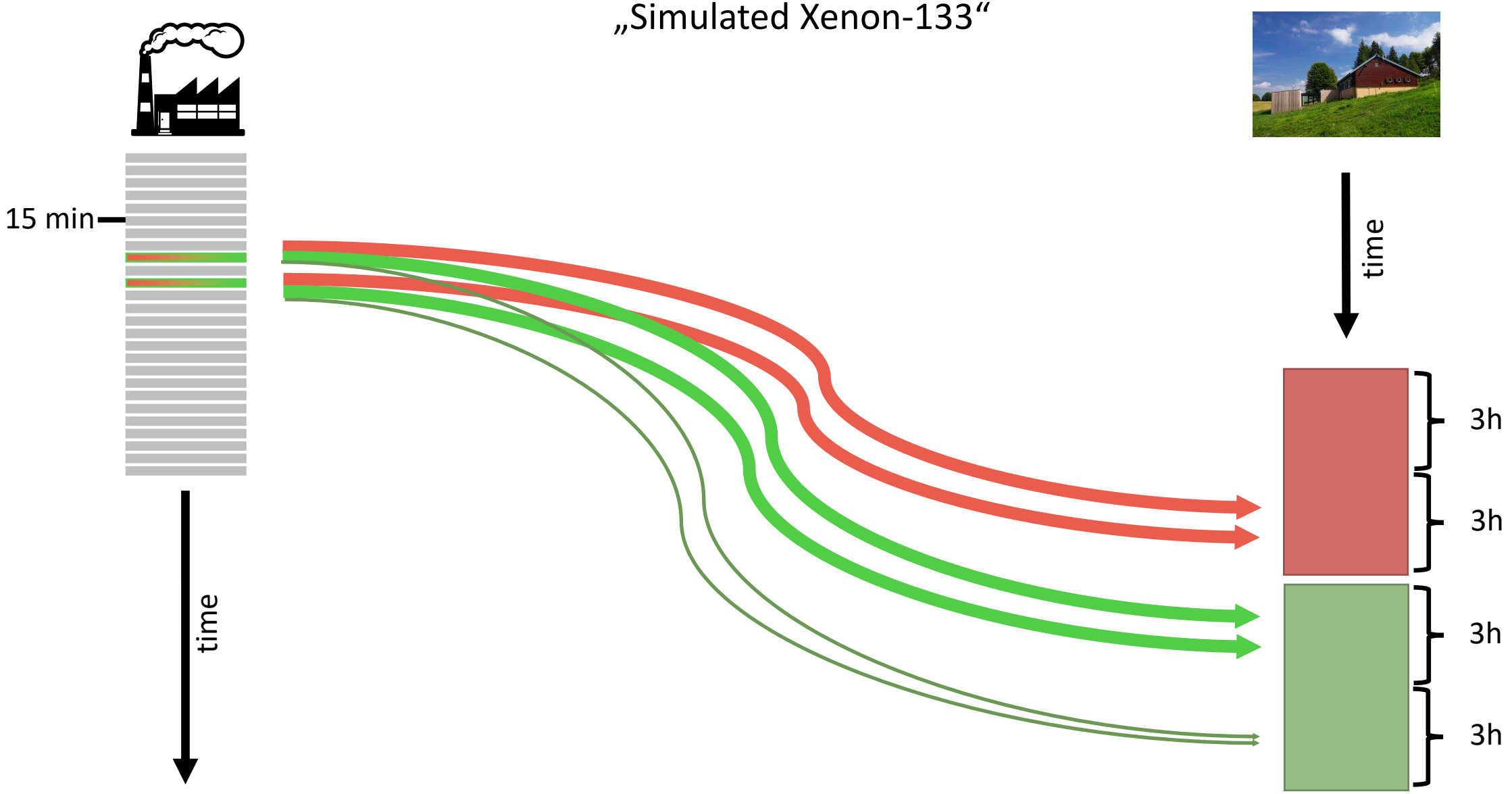
„simulated Xenon“ = stax data from IRE Fleurus
x sensitivity (ATM backwards simulation)
x decay correction

Atmospheric Transport Modelling /ATM:
HYSPLIT 3h
GFS Met-Data 0.25°
150000 particles // 25000 per h

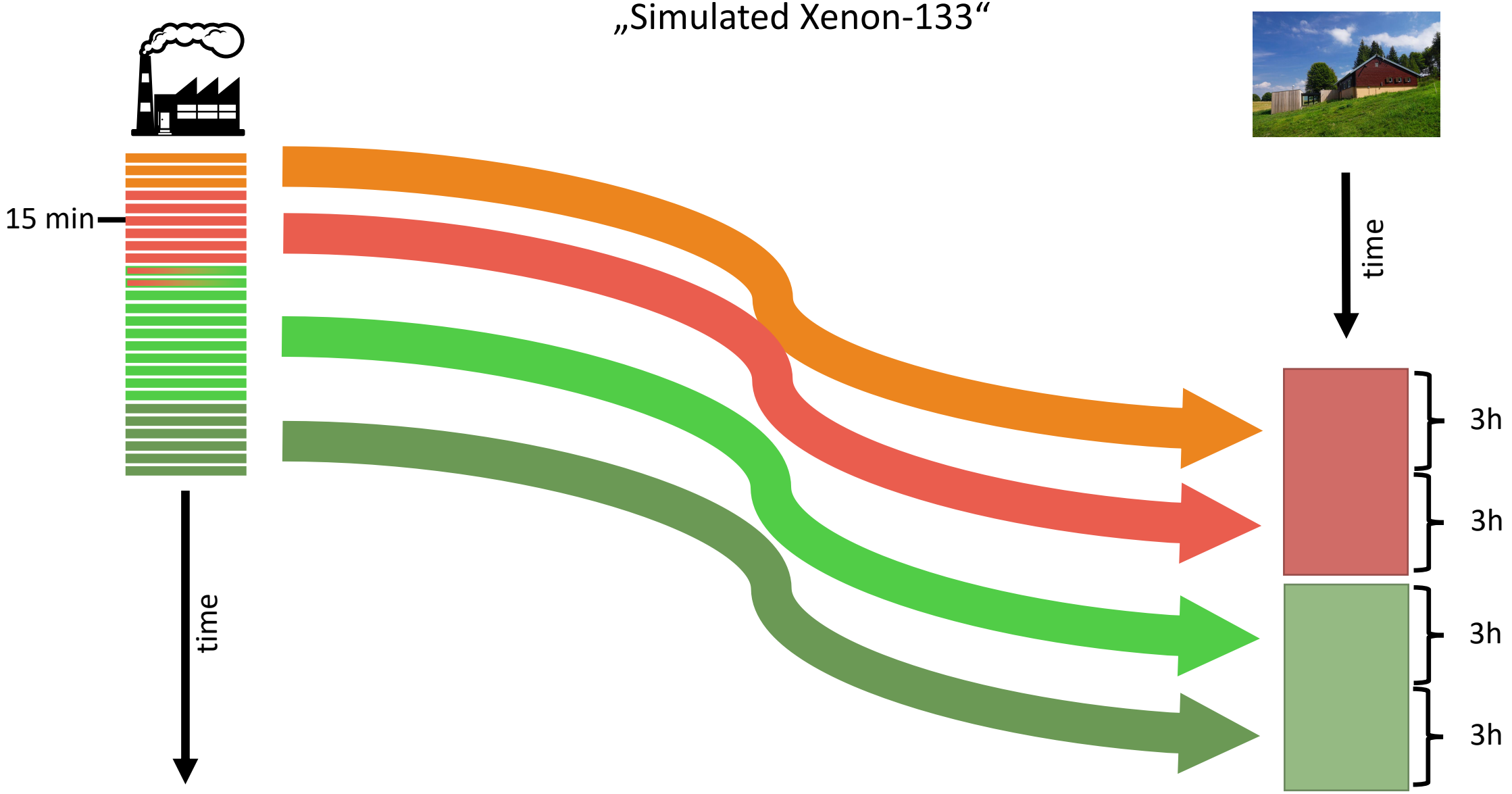
„Simulated Xenon-133“



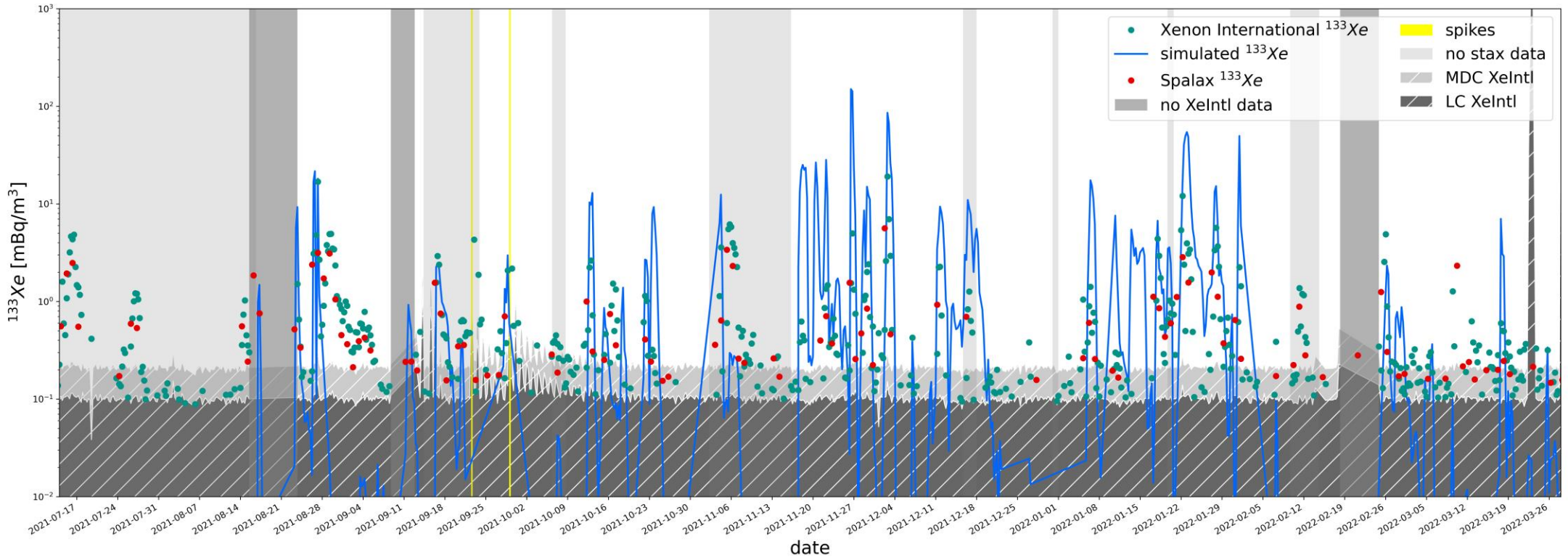
„Simulated Xenon-133“



„Simulated Xenon-133“

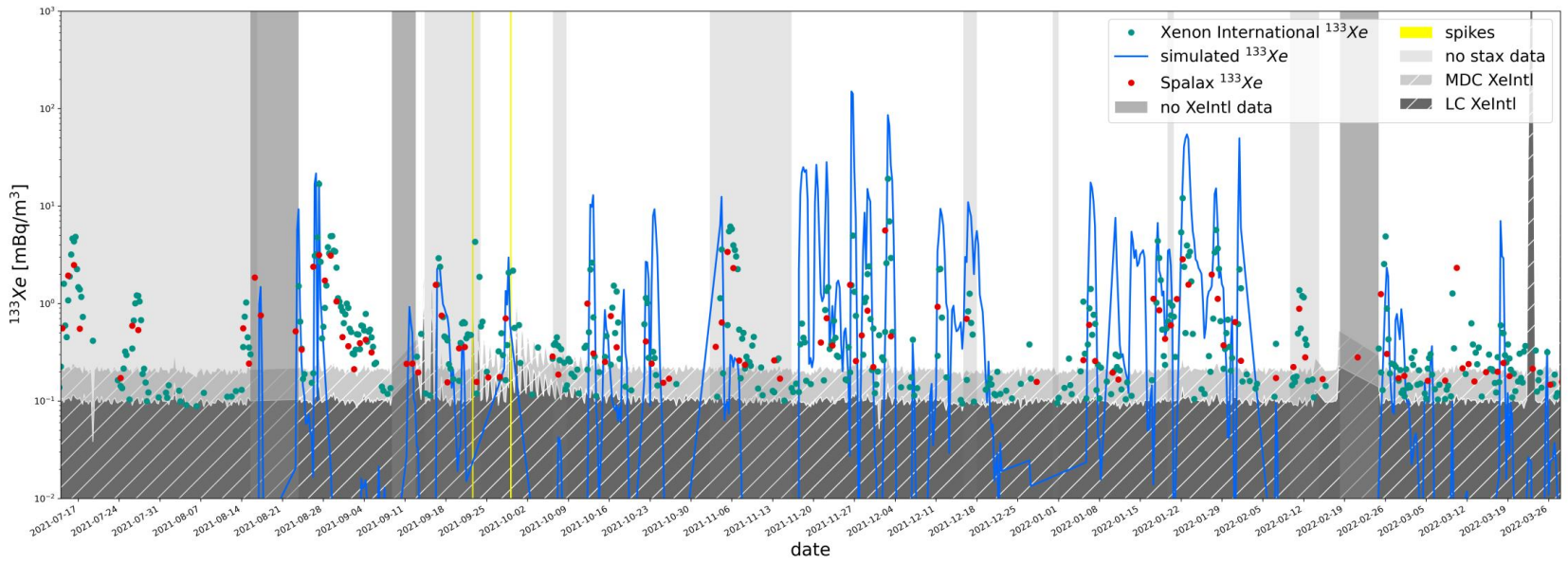


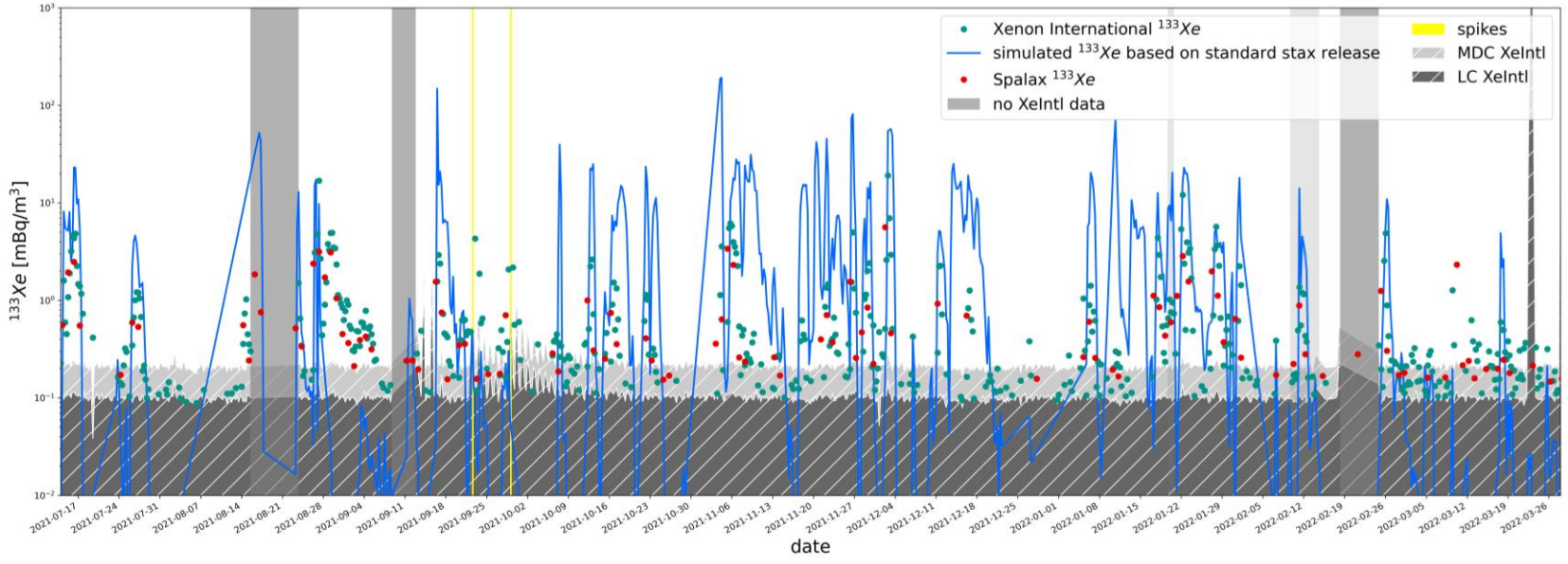
Detections – Xe-133



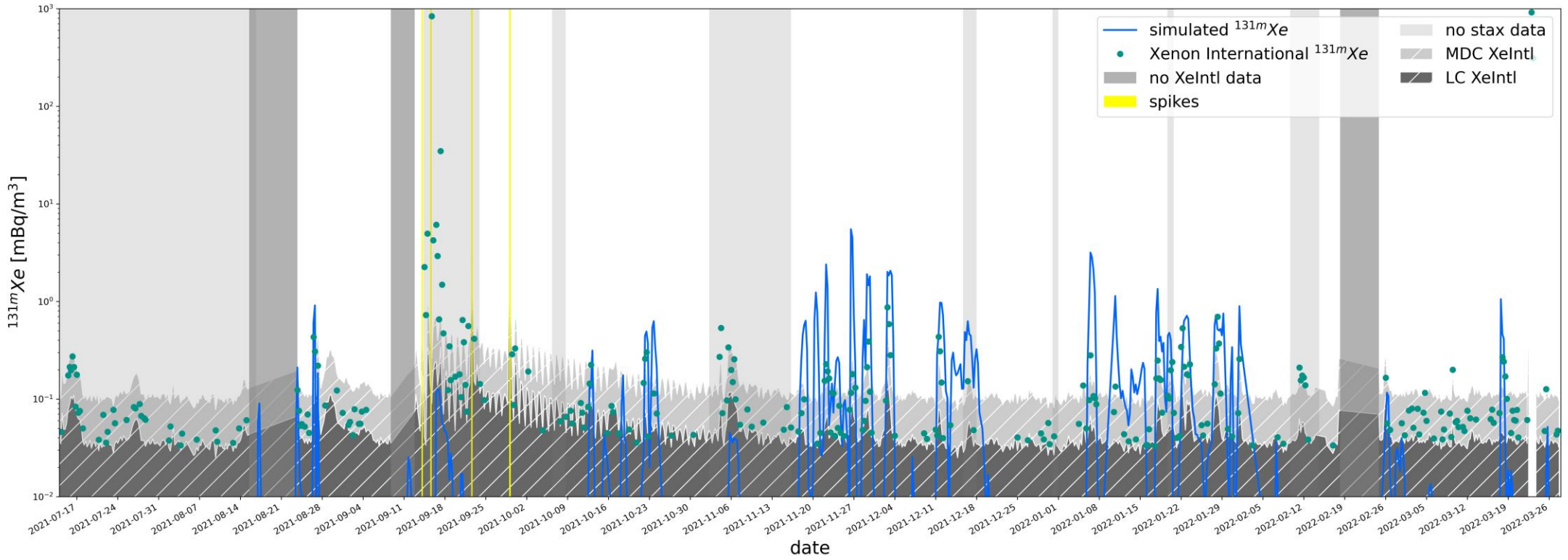
„simulated Xenon“ = stax data from IRE Fleurus * sensitivity (ATM backwards simulation)

Detections – Xe-133 real emission data vs. Standardized emission data



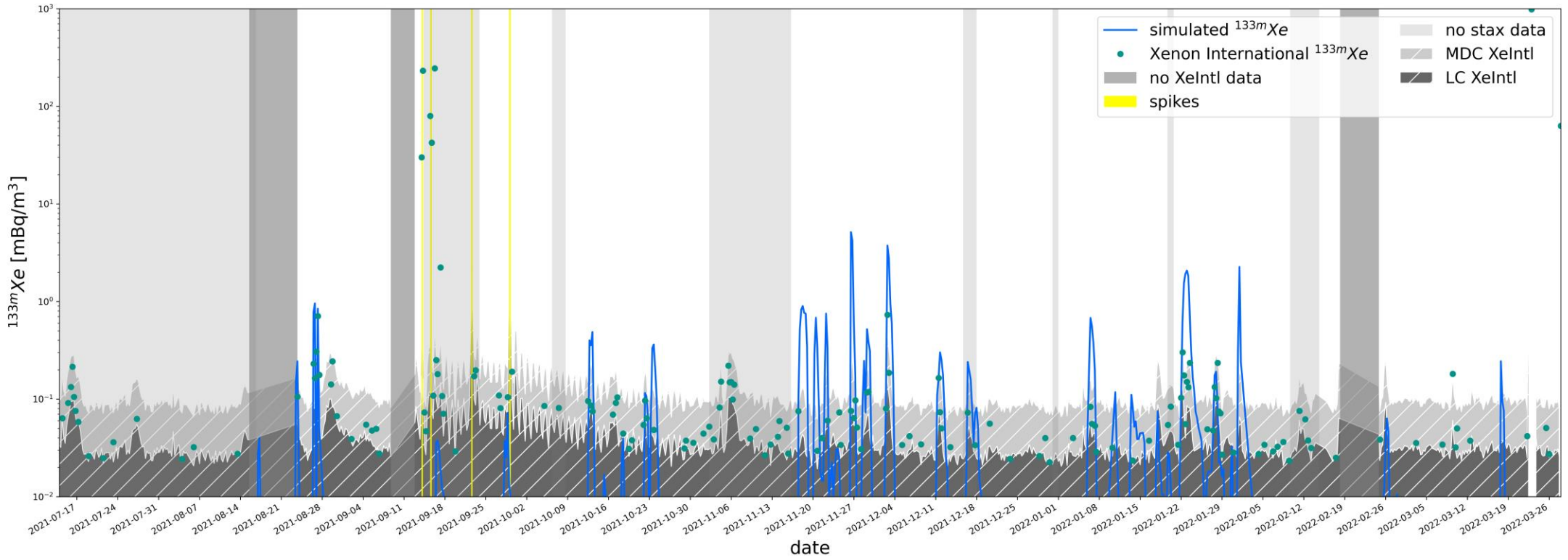


Detections – Xe-131m



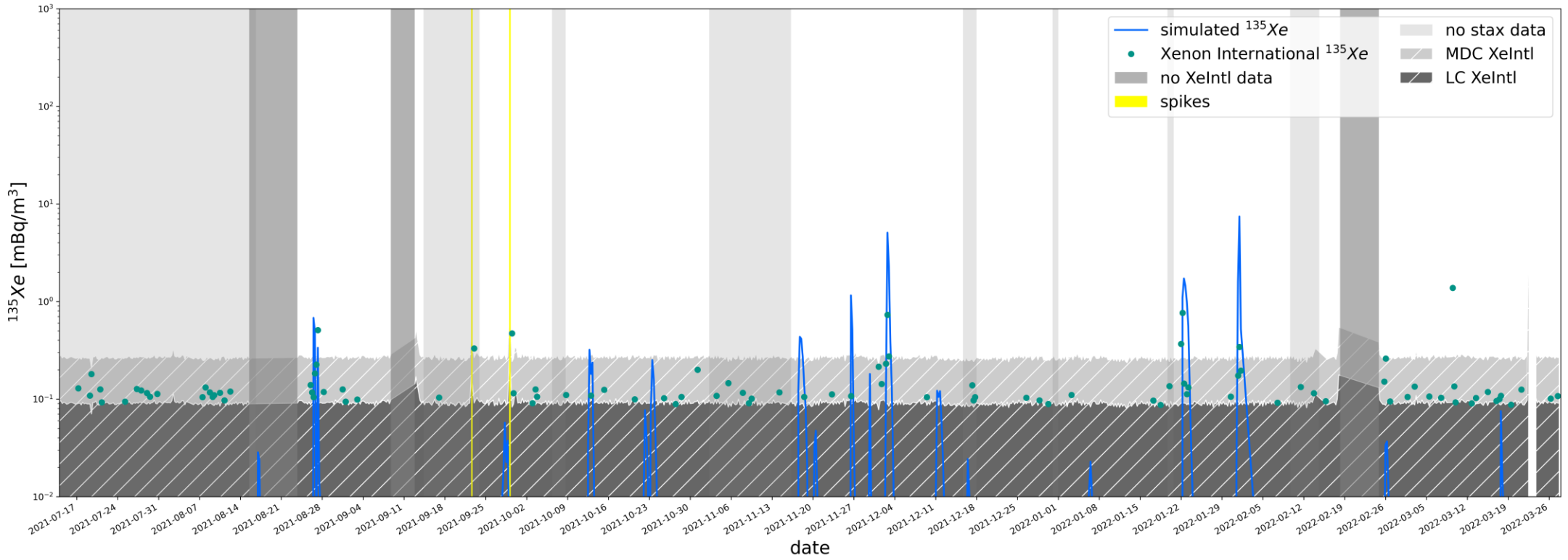
MDC:
(0.126 ± 0.068) mBq/m^3

Detections – Xe-133m



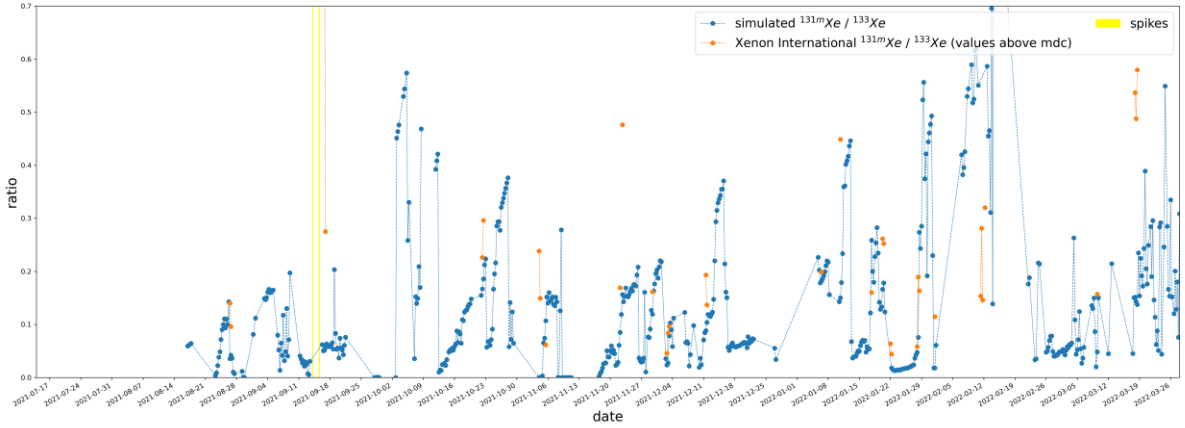
MDC:
(0.225 ± 0.060) mBq/m^3

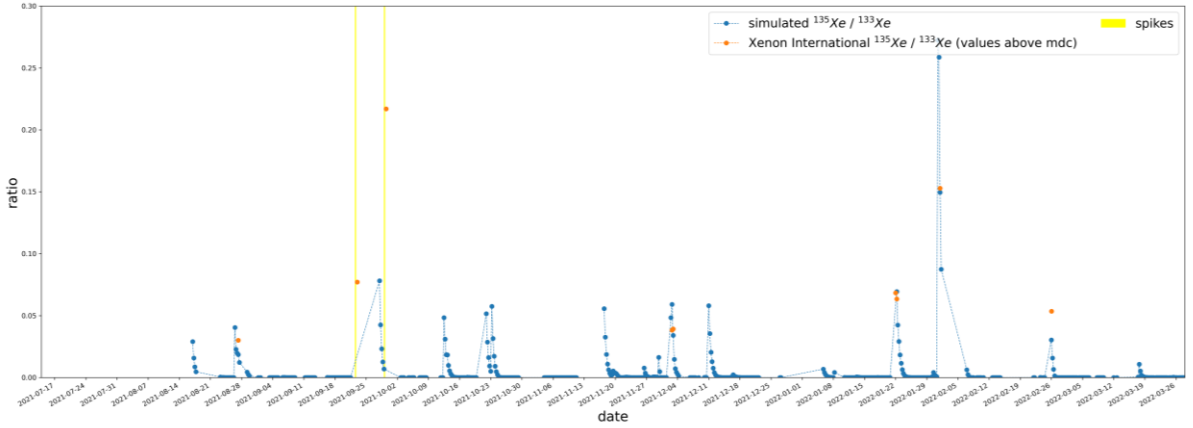
Detections – Xe-135

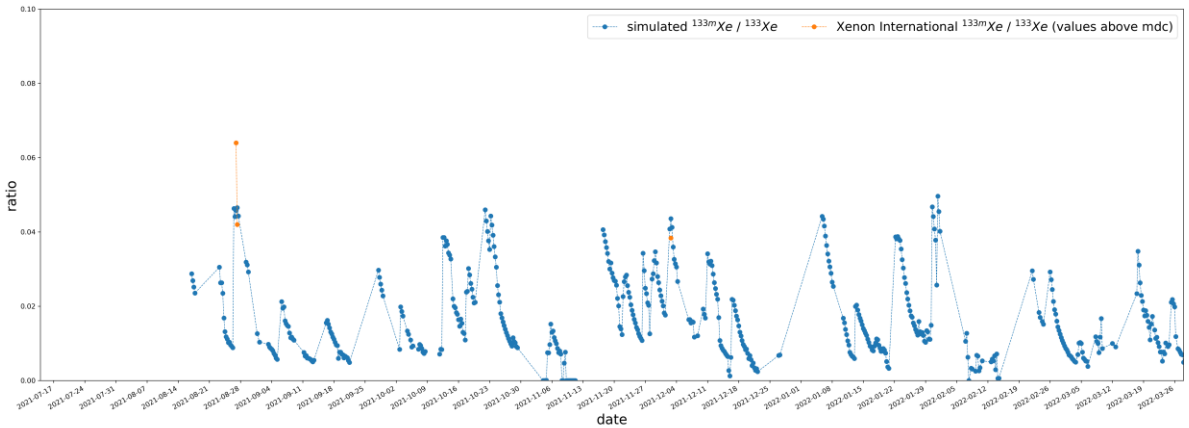


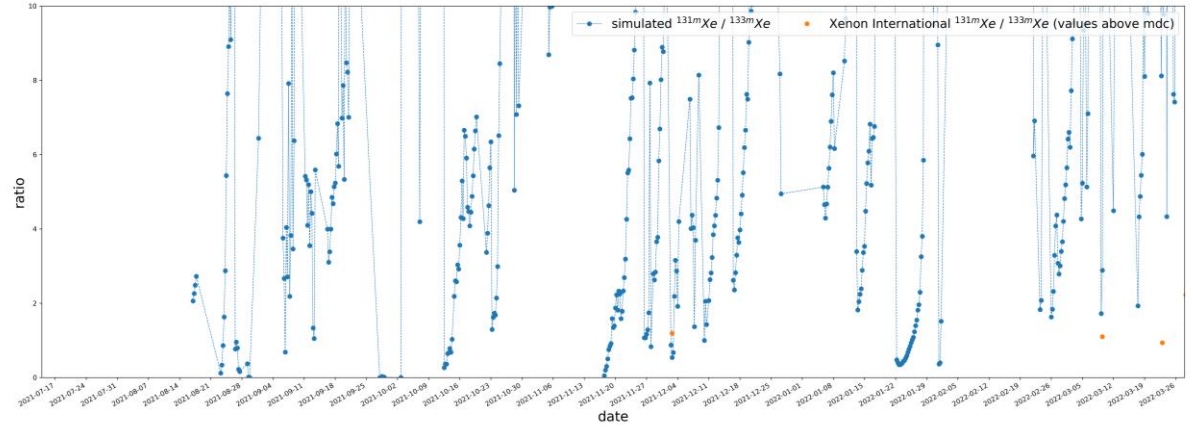
MDC:
(0.268 ± 0.027) mBq/m^3

ratios


simulated ^{131m}Xe / ^{133}Xe
Xenon International ^{131m}Xe / ^{133}Xe (values above mdc)
spikes
ratio
date


simulated ^{135}Xe / ^{133}Xe
Xenon International ^{135}Xe / ^{133}Xe (values above mdc)
spikes
ratio
date


simulated ^{133m}Xe / ^{133}Xe
Xenon International ^{133m}Xe / ^{133}Xe (values above mdc)
ratio
date


simulated ^{131m}Xe / ^{133m}Xe
Xenon International ^{131m}Xe / ^{133m}Xe (values above mdc)
ratio
date

Detections not from Fleurus – systematic approach

- Flag on Xe-133: (measurement – simulation) > 0.5 mBq/m^3
- Flags on unusually high / single isotope detections (Xe-133m, Xe-135)
- Flag on ratio Xe-133m/Xe-133 > 0.3

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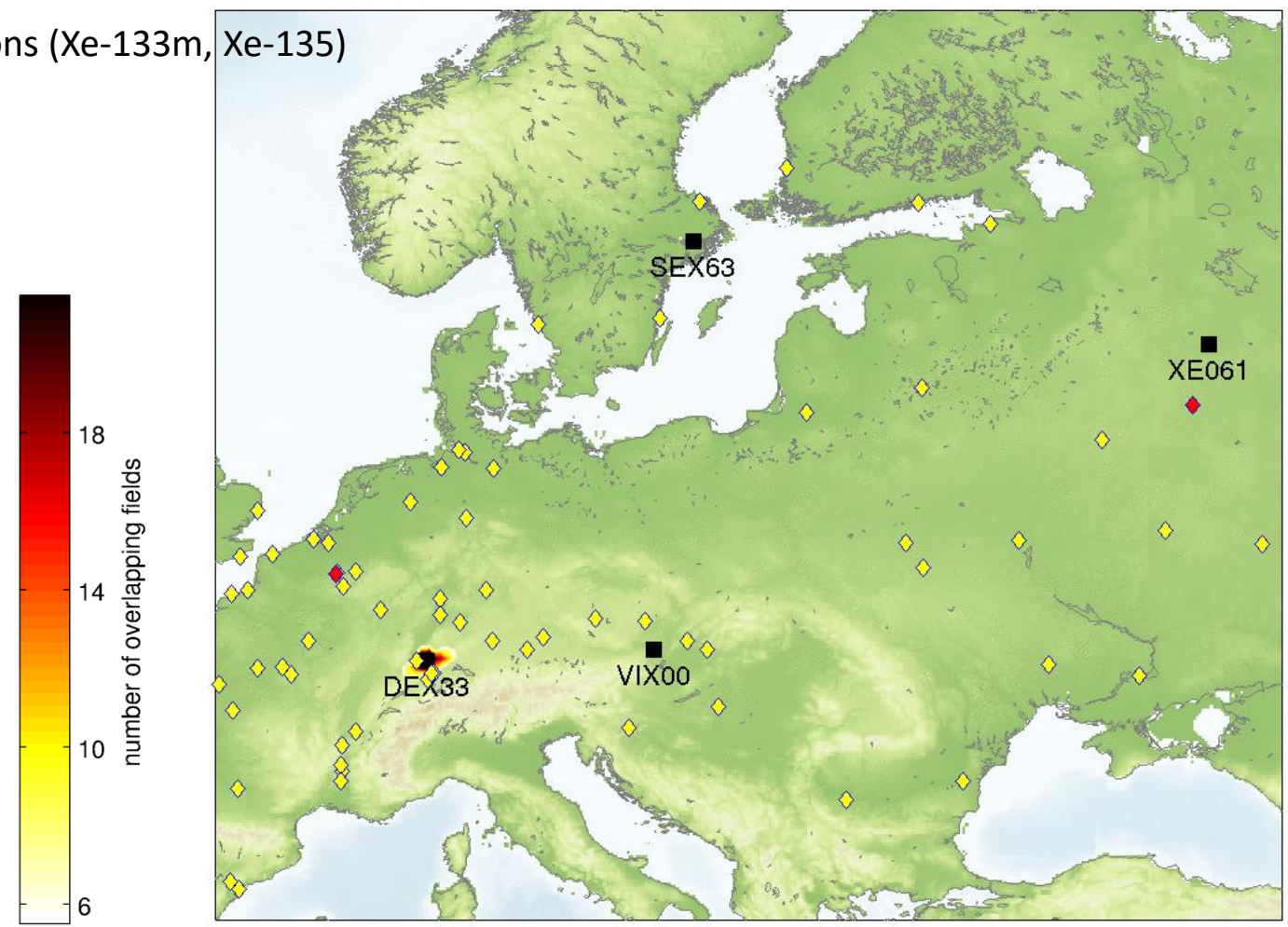
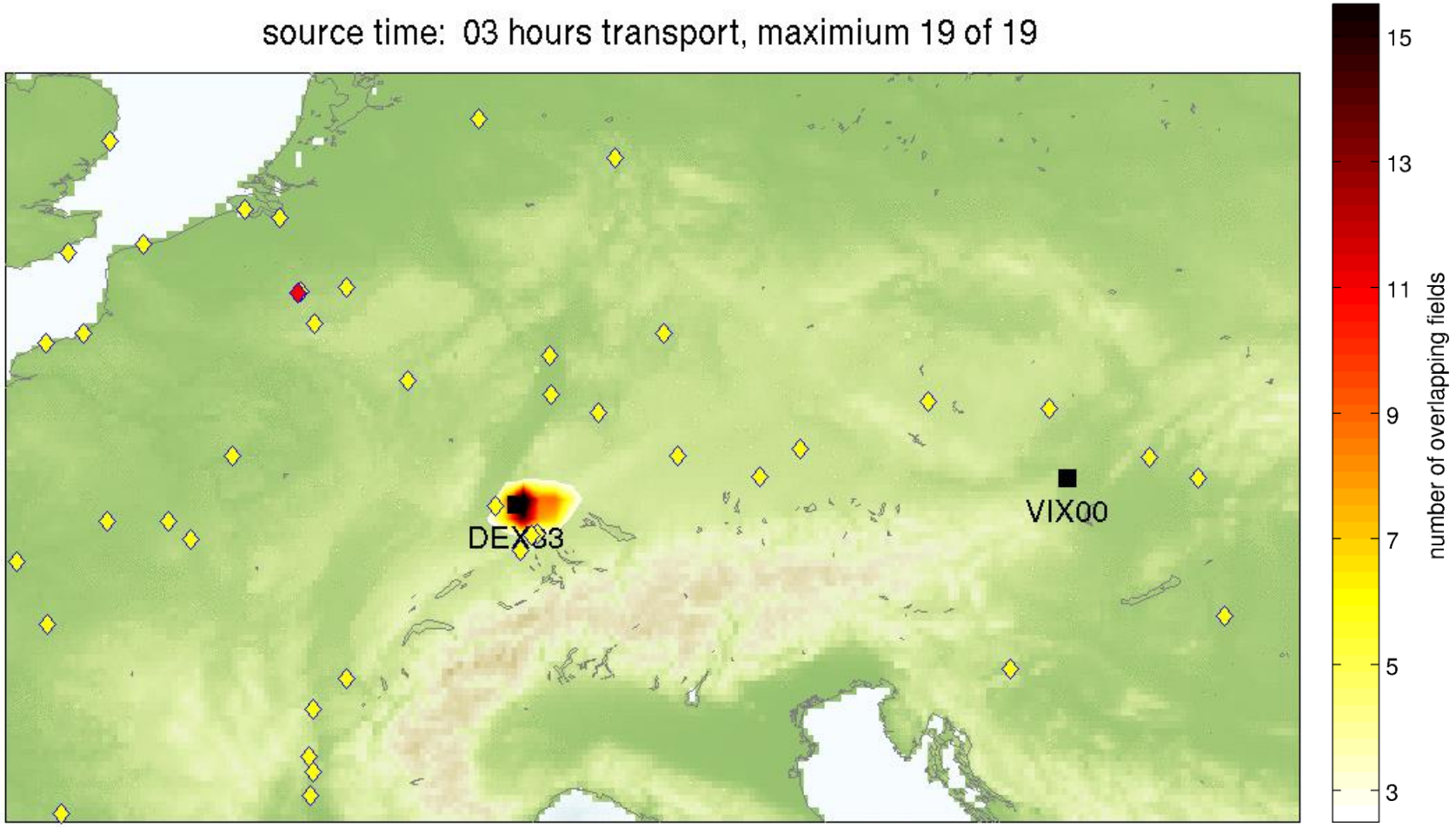
HYSPLIT
GFS Met-Data 0.25°
3h
150000 particles
(25000 per h)

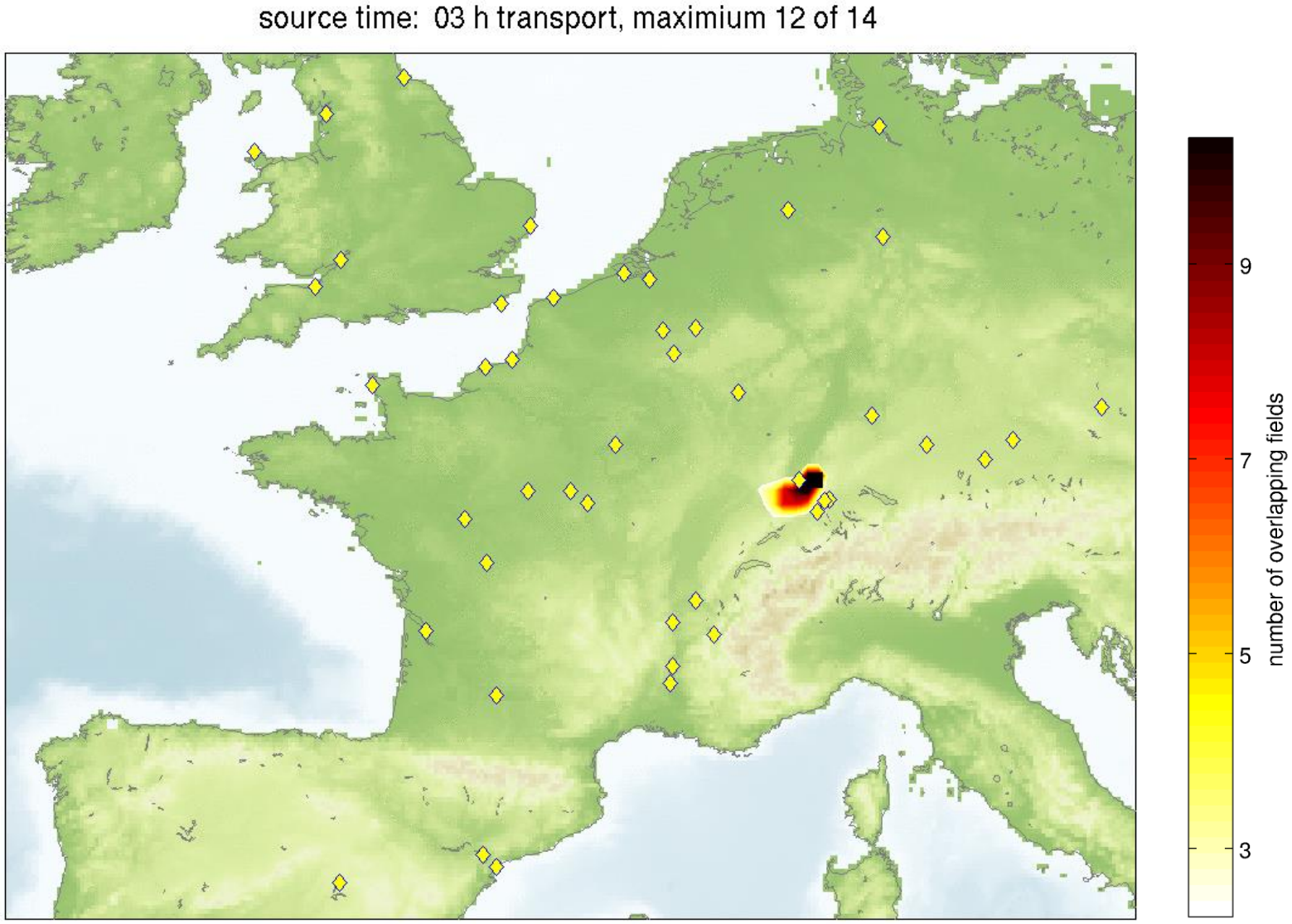


East



HYSPLIT
GFS Met-Data 0.25°
3h
150000 particles
(25000 per h)

West



HYSPLIT
GFS Met-Data 0.25°
3h
150000 particles
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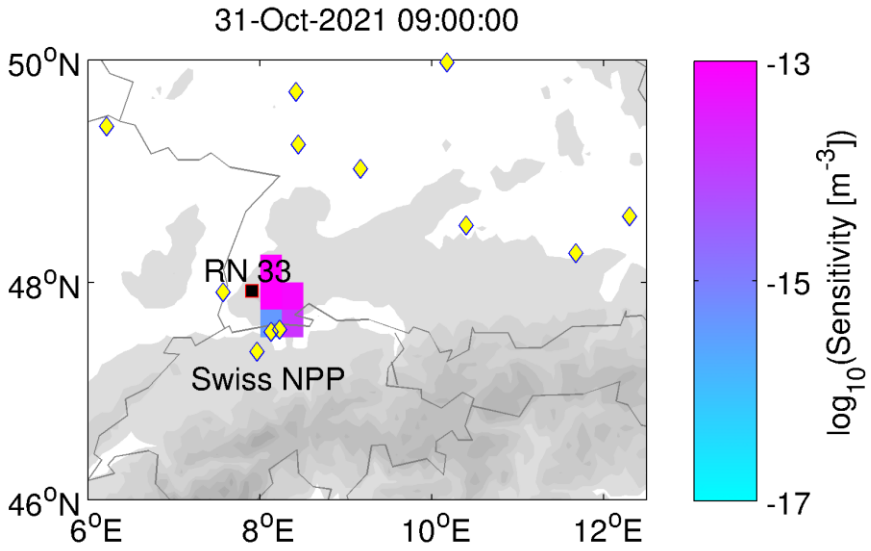
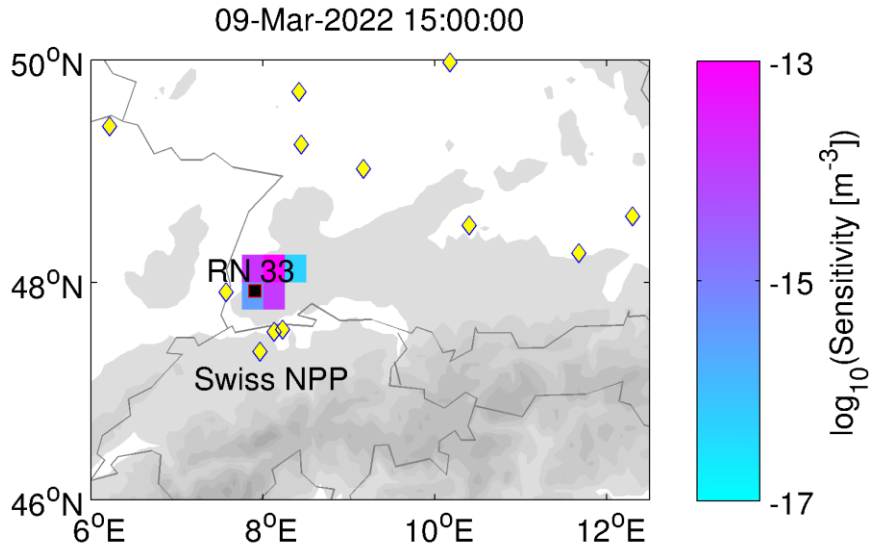
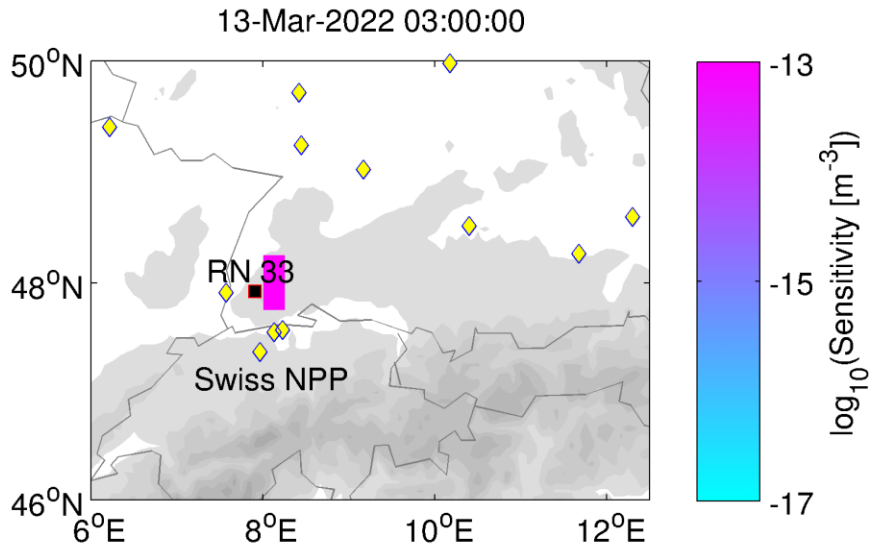
Switzerland (Xe-135 present)







HYSPLIT
GFS Met-Data 0.25°
3h
150000 particles
(25000 per h)

Conclusion – Identifying detections of interest

- ^{133m}Xe and ^{135}Xe only detections flag additional samples (great improvement XeIntl first gen. SPALAX!)
- current stax / ATM simulation set-up: Generally over-estimation due to topography, very good relatively (6h vs. 24h!)

→ Semi-automatic screening

- Sources: „North“ / „East“ / „West“ / Switzerland

- Sofia Brander, Sandra Baur, Roman Krais, J. Ole Ross, Aaron Orr, Ryan Sayne, Michael Howard, Michael Mayer, Mark Panisko, James C. Hayes and Andreas Bollhöfer: **Phase II Testing of Xenon International on Mount Schauinsland, Germany.**

Outlook - Sauna Qb

- delivery this week, initial installation in Munich
- Probably relocation in 2024 to a new location (to be determined)

- Complementary to
  - German Radioxenon network
  - Other European networks ? Data sharing ?

- Second Qb in 2024 ?

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Federal Office for
Radiation Protection

Legal Notice

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