

**AON**

# Canada Earthquake Model:

A Case Study of  
Collaborative and Current  
Age Model Development

Oasis Insight

May 4<sup>th</sup>, 2023



# Agenda

**Section 1**

Introduction

**Section 2**

Collaboration

**Section 3**

Benefits



# Presenters



**Svetlana Stripajova**  
Earthquake Model  
Developer  
Aon Impact Forecasting



**John Schneider**  
Secretary General  
GEM Foundation

# 1

Introduction

**AON**





# Impact Forecasting Canadian earthquake model

Country- specific solution

## Strong Local / Global Collaboration



Government of Canada



Collaboration

Latest official science

Enhancements

Industry ready

## Enhancements & Secondary Perils

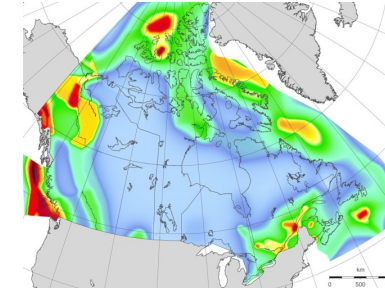
Spatial correlation of the earthquake ground motion

Upgraded geotechnical model

Liquefaction, landslides, fire-following earthquake, tsunami

Country-specific vulnerability component

Demand surge



## Latest Official Seismic Hazard

6<sup>th</sup> Generation Seismic Hazard Model for Canada

Published by GSC NR Canada for 2020 NBCC

## Insurance Industry Ready Model

Tested and reviewed

Available in the ELEMENTS platform and as OASIS model in the Nasdaq platform

2

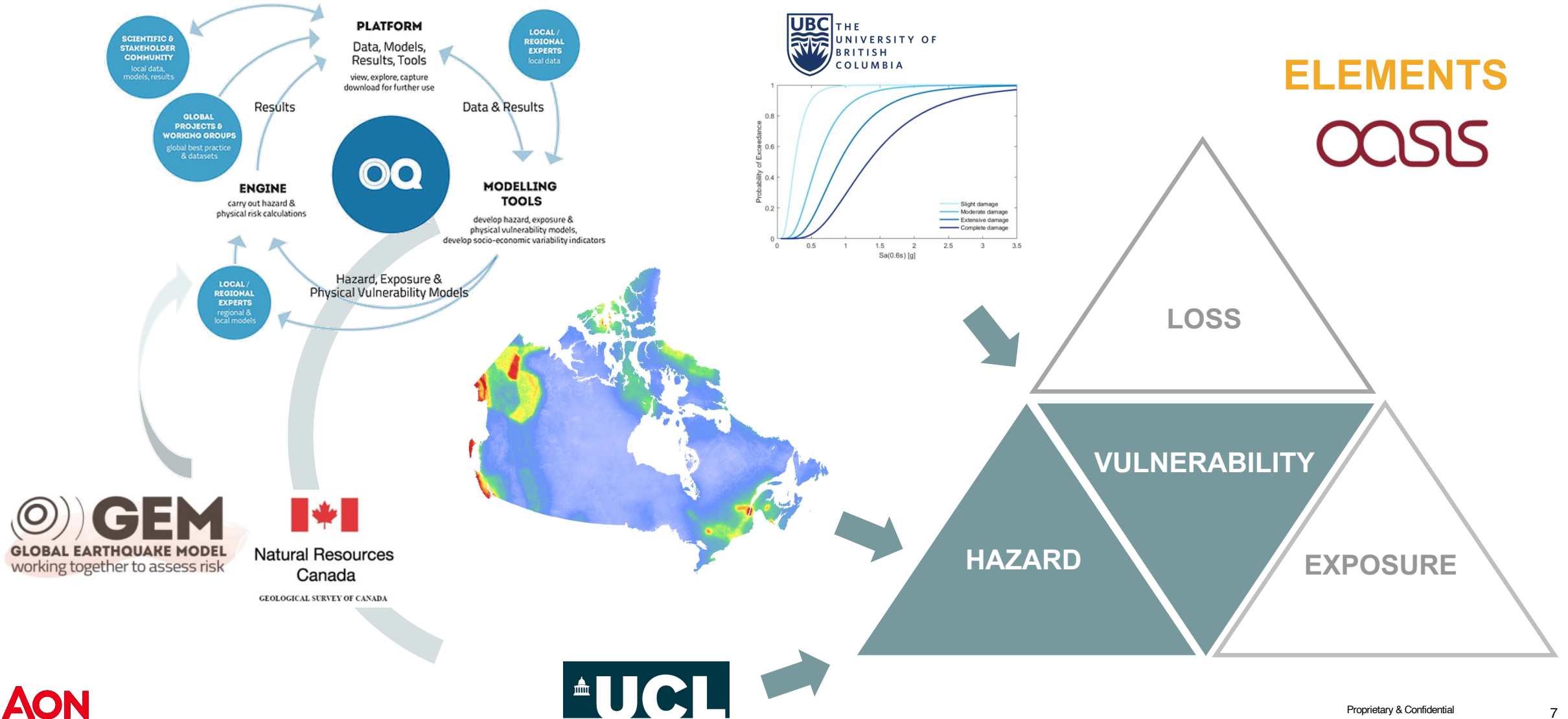
Collaboration

AON





# Public-private partnership



**ELEMENTS**  
OASIS

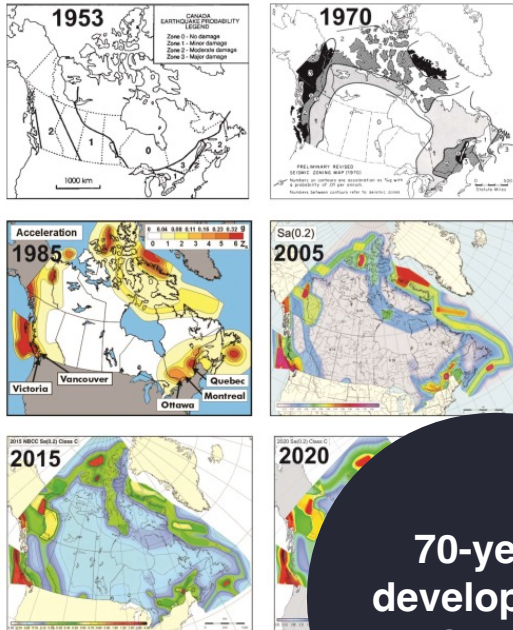
**GEM**  
GLOBAL EARTHQUAKE MODEL  
working together to assess risk

  
**Natural Resources Canada**  
GEOLOGICAL SURVEY OF CANADA



**AON**

# 6<sup>th</sup> generation Seismic Hazard Model for Canada (2020)



Source: Adams et al. (2019)

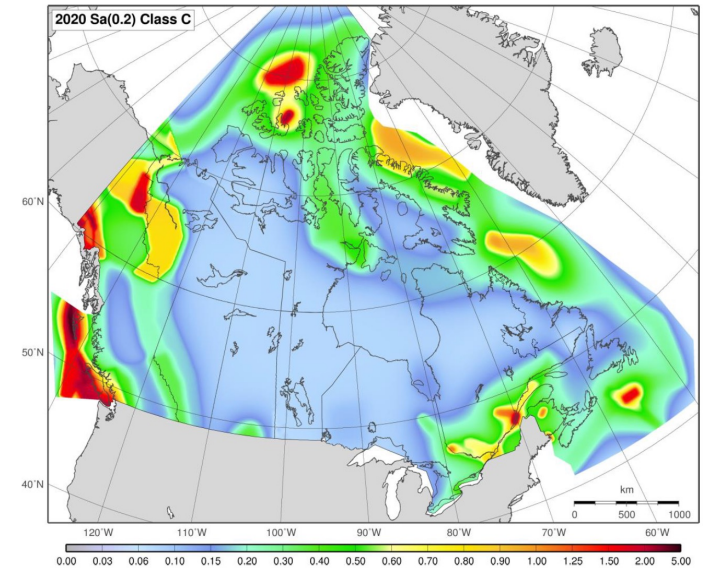
**70-years  
development  
SHMC**

**Significant  
update**

**OpenQuake  
engine**

**6<sup>th</sup> gen  
SHMC**

- Non-black box implemented in OpenQuake
- Capability of accounting for representative Vs30 values
- Full transparency and flexibility



Source: Adams et al. (2019)

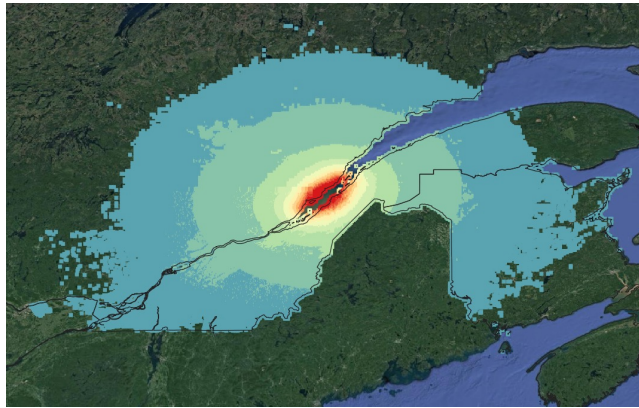
- Several new data sources were included
- Fault frequency rates
- GMM selection

- Lessons learned and advances from past 10 years included
- Changes of +100% in some populated zones

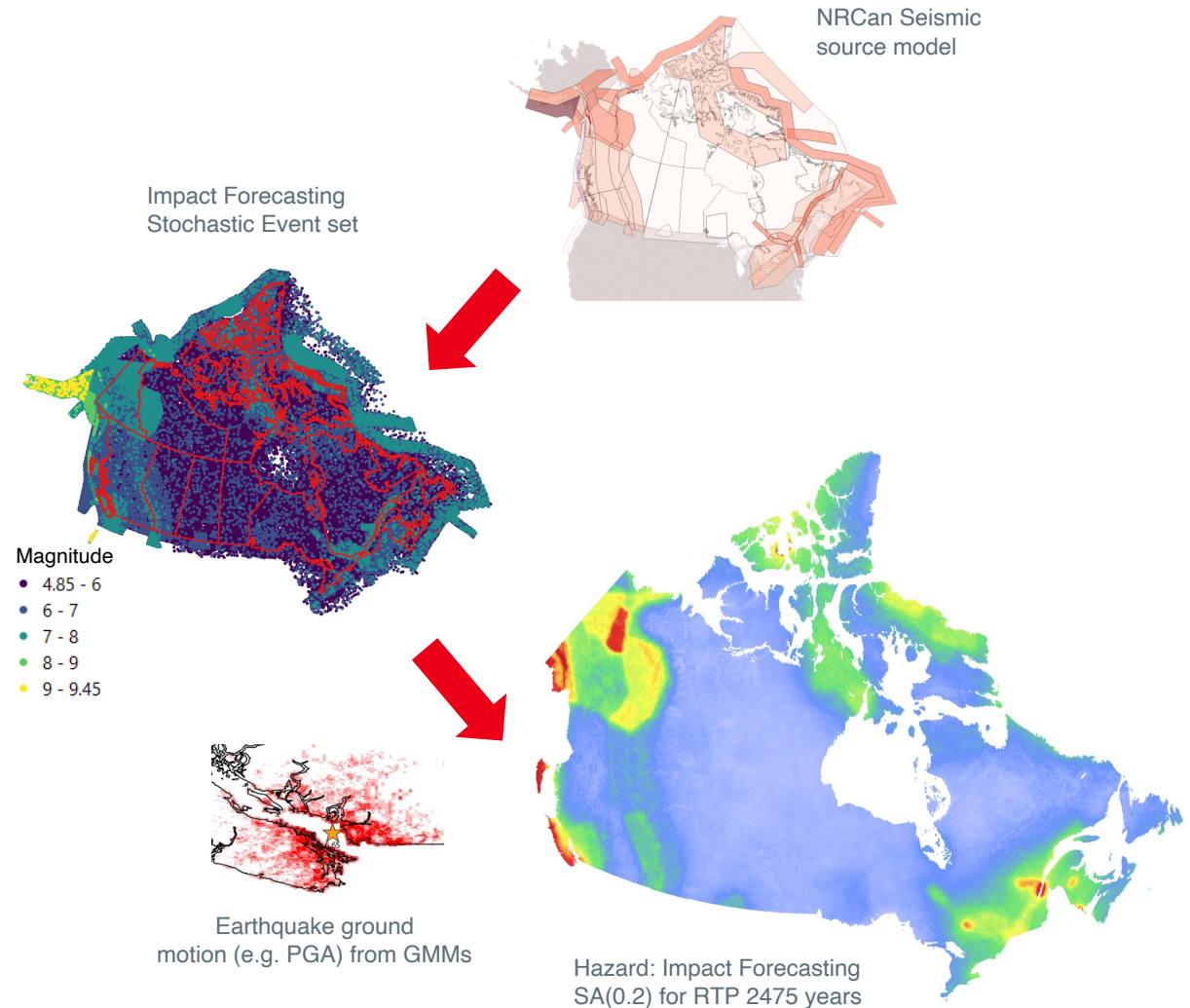


# Impact Forecasting Implementation of the 6<sup>th</sup> Generation SHMC

- Seismic source model and ground motion prediction models follow the data released for NBCC 2020 defined in OpenQuake inputs
- Robust stochastic catalogue length for accurate representation of rare events
- Includes 1.3 mil. events (200k years)
- 11 notable historical events

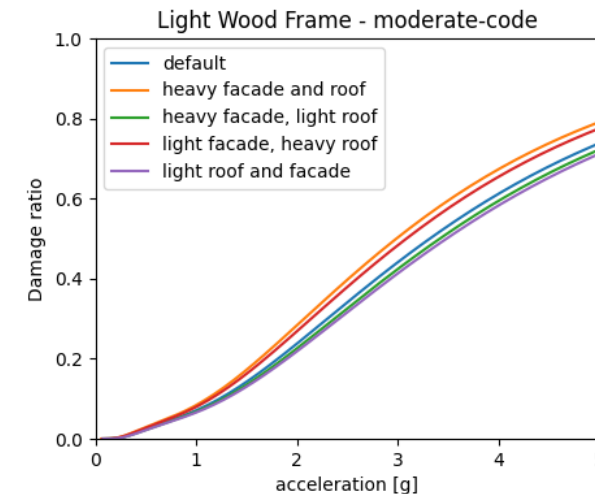
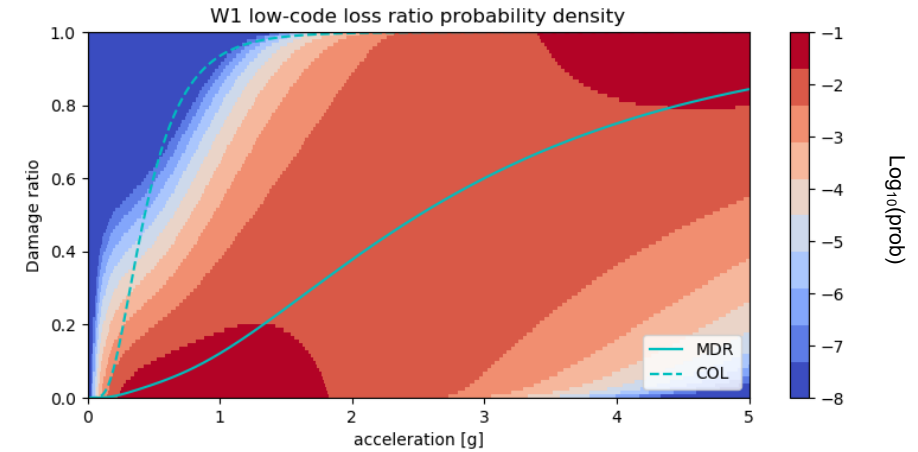


1663 Charlevoix M7.5 PGA event footprint



# Earthquake Shaking Vulnerability Component

- Vulnerability curves developed in collaboration of GEM, NRCan and University British Columbia for typical Canadian building classes
- HAZUS methodology for contents and BI for specific occupancies
- Automobile curves developed by IF
- **Custom vulnerability** curves for wooden buildings developed by IF: Heavy or light **façade** and **roof type**
- Exposure data used to select vulnerability if some building **characteristics are not known**





# Secondary perils



Landslides



Soil Liquefaction



Fire Following



Tsunami



**Implicitly  
with EQ shaking**

**Cellular automata  
simulations**

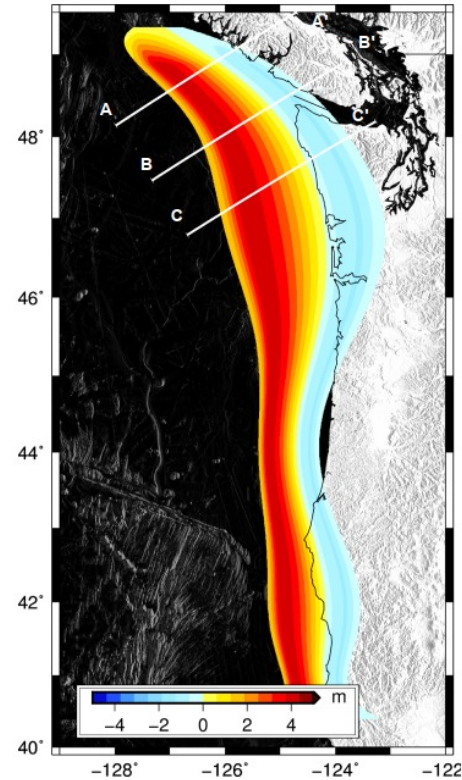
**Cascadia subduction  
interface**

# Tsunami

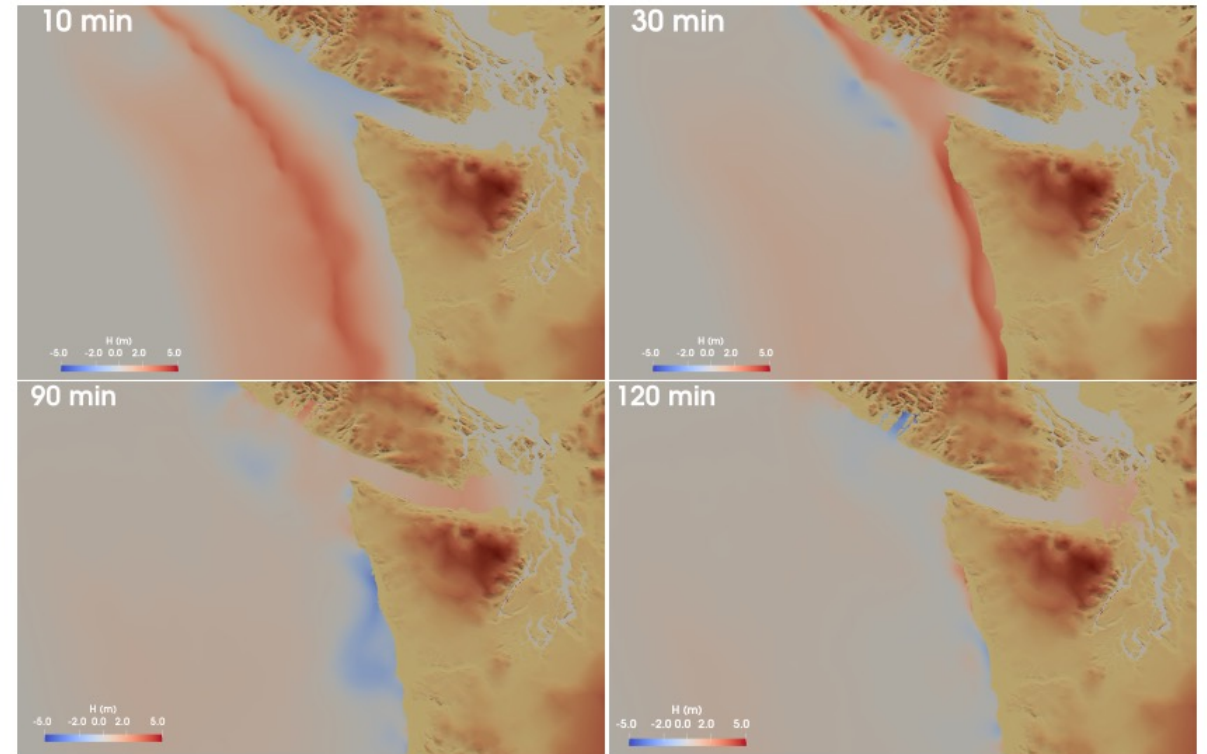
partners  
with UCL

modelling  
seabed  
deformation

SCHEMA  
vulnerability  
classes



Top view of  
the seabed deformation



Snapshots of the tsunami propagation



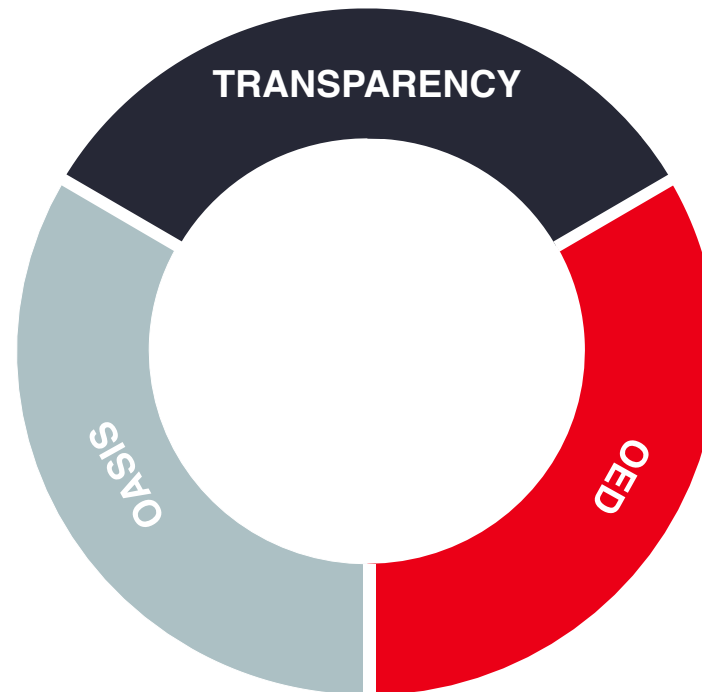
# Oasis native implementation and OED format

## Transparency

- Prioritization the offering of maximum choice and flexibility for clients and model **transparency**
- Availability of **models through a range of channels**, in addition to ELEMENTS
- Client's insight into how models run

## OASIS is the key

- The Canada EQ model implemented in the **Oasis format**, and works directly within the open-source framework
- Upcoming release of CAEQ as a gridcell-resolution model on **Nasdaq Risk Modeling for Catastrophes (NRMC)**



## OED format

- Use of unified **OED scheme** to code constructions and occupancies

# 3

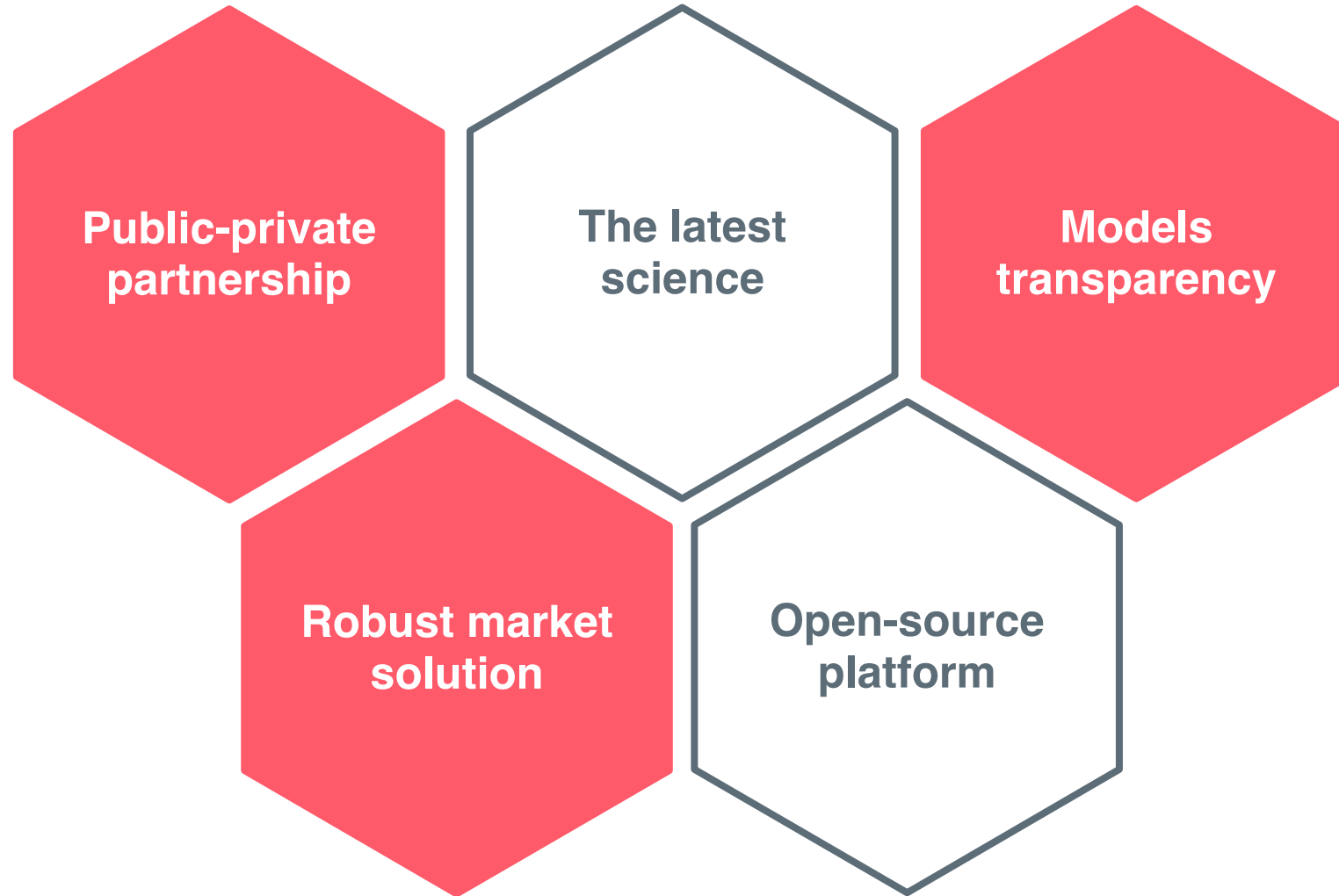
Benefits

**AON**





# Benefits



# Contacts

## **Jakub Aska**

[jakub.aska@aon.com](mailto:jakub.aska@aon.com)

Business Representative for Canada

Aon Impact Forecasting

## **Peter Pazak**

[peter.pazak@aon.com](mailto:peter.pazak@aon.com)

Lead Canada Earthquake Model Developer

Aon Impact Forecasting

## **Goran Trendafiloski**

[goran.trendafiloski@aon.com](mailto:goran.trendafiloski@aon.com)

Head of Earthquake Model Development  
(EMEA, APAC, Canada)

Aon Impact Forecasting

## **Svetlana Stripajova**

[svetlana.stripajova@aon.com](mailto:svetlana.stripajova@aon.com)

Earthquake Model Developer

Aon Impact Forecasting

## **Adam Podlaha**

[adam.podlaha@aon.com](mailto:adam.podlaha@aon.com)

Global Head of Impact Forecasting

Aon Impact Forecasting



**AON**



**Thank You**

# Disclaimer

## Legal Disclaimer

Aon's Reinsurance Solutions business, part of Aon UK Limited (for itself and on behalf of each subsidiary company of Aon plc) ("Aon") reserves all rights to the content of this report ("Report"). This Report is for distribution to Aon and the organisation to which it was originally delivered only. Copies may be made by that organisation for its own internal purposes but this Report may not be distributed in whole or in part to any third party without both (i) the prior written consent of Aon, and (ii) the third party having first signed a "recipient of report" letter in a form acceptable to Aon. Aon cannot accept any liability to any third party to whom this Report is disclosed, whether disclosed in compliance with the preceding sentence or otherwise.

To the extent this Report expresses any recommendation or assessment on any aspect of risk, the recipient acknowledges that any such recommendation or assessment is an expression of Aon opinion only, and is not a statement of fact. Any decision to rely on any such recommendation or assessment of risk is entirely the responsibility of the recipient. Aon will not in any event be responsible for any losses that may be incurred by any party as a result of any reliance placed on any such opinion. The recipient acknowledges that this Report does not replace the need for the recipient to undertake its own assessment.

The recipient acknowledges that in preparing this Report Aon may have based analysis on data provided by the recipient and/or from third party sources. This data may have been subjected to mathematical and/or empirical analysis and modelling. Aon has not verified, and accepts no responsibility for, the accuracy or completeness of any such data. In addition, the recipient acknowledges that any form of mathematical and/or empirical analysis and modelling (including that used in the preparation of this Report) may produce results which differ from actual events or losses.

The Aon analysis has been undertaken from the perspective of a reinsurance broker. Consequently this Report does not constitute an opinion of reserving levels or accounting treatment. This Report does not constitute any form of legal, accounting, taxation, regulatory or actuarial advice.

## Limitations of Catastrophe Models

This report includes information that is output from catastrophe models of Impact Forecasting, LLC (IF). The information from the models is provided by Aon Benfield Services, Inc. (Aon) under the terms of its license agreements with IF. The results in this report from IF are the products of the exposures modelled, the financial assumptions made concerning deductibles and limits, and the risk models that project the pounds of damage that may be caused by defined catastrophe perils. Aon recommends that the results from these models in this report not be relied upon in isolation when making decisions that may affect the underwriting appetite, rate adequacy or solvency of the company. The IF models are based on scientific data, mathematical and empirical models, and the experience of engineering, geological and meteorological experts. Calibration of the models using actual loss experience is based on very sparse data, and material inaccuracies in these models are possible. The loss probabilities generated by the models are not predictive of future hurricanes, other windstorms, or earthquakes or other natural catastrophes, but provide estimates of the magnitude of losses that may occur in the event of such natural catastrophes. Aon makes no warranty about the accuracy of the IF models and has made no attempt to independently verify them. Aon will not be liable for any special, indirect or consequential damages, including, without limitation, losses or damages arising from or related to any use of or decisions based upon data developed using the models of IF.

## Additional Limitations of Impact Forecasting, LLC

The results listed in this report are based on engineering / scientific analysis and data, information provided by the client, and mathematical and empirical models. The accuracy of the results depends on the uncertainty associated with each of these areas. In particular, as with any model, actual losses may differ from the results of simulations. It is only possible to provide plausible results based on complete and accurate information provided by the client and other reputable data sources. Furthermore, this information may only be used for the business application specified by Impact Forecasting, LLC and for no other purpose. It may not be used to support development of or calibration of a product or service offering that competes with Impact Forecasting, LLC. The information in this report may not be used as a part of or as a source for any insurance rate filing documentation.

THIS INFORMATION IS PROVIDED "AS IS" AND IMPACT FORECASTING, LLC HAS NOT MADE AND DOES NOT MAKE ANY WARRANTY OF ANY KIND WHATSOEVER, EXPRESS OR IMPLIED, WITH RESPECT TO THIS REPORT; AND ALL WARRANTIES INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED BY IMPACT FORECASTING, LLC. IMPACT FORECASTING, LLC WILL NOT BE LIABLE TO ANYONE WITH RESPECT TO ANY DAMAGES, LOSS OR CLAIM WHATSOEVER, NO MATTER HOW OCCASIONED, IN CONNECTION WITH THE PREPARATION OR USE OF THIS REPORT.