

Global Flood Modelling

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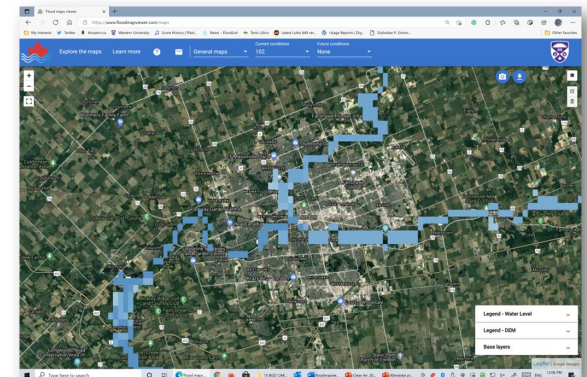


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2| WHY?

- Increasing demand for strategic global assessments of flood risks under current and future conditions.
- Modelling progress: Large-scale hydrological models, Land surface models, Global flood models (Inundation & velocity).
- Implementation scope: (re)insurance, large-scale flood preparedness, and climate change adaptation.
- Availability of data: numerous data sets for global flood risk assessment.
- Future direction: refinement of the models - making maps informative at national scales.

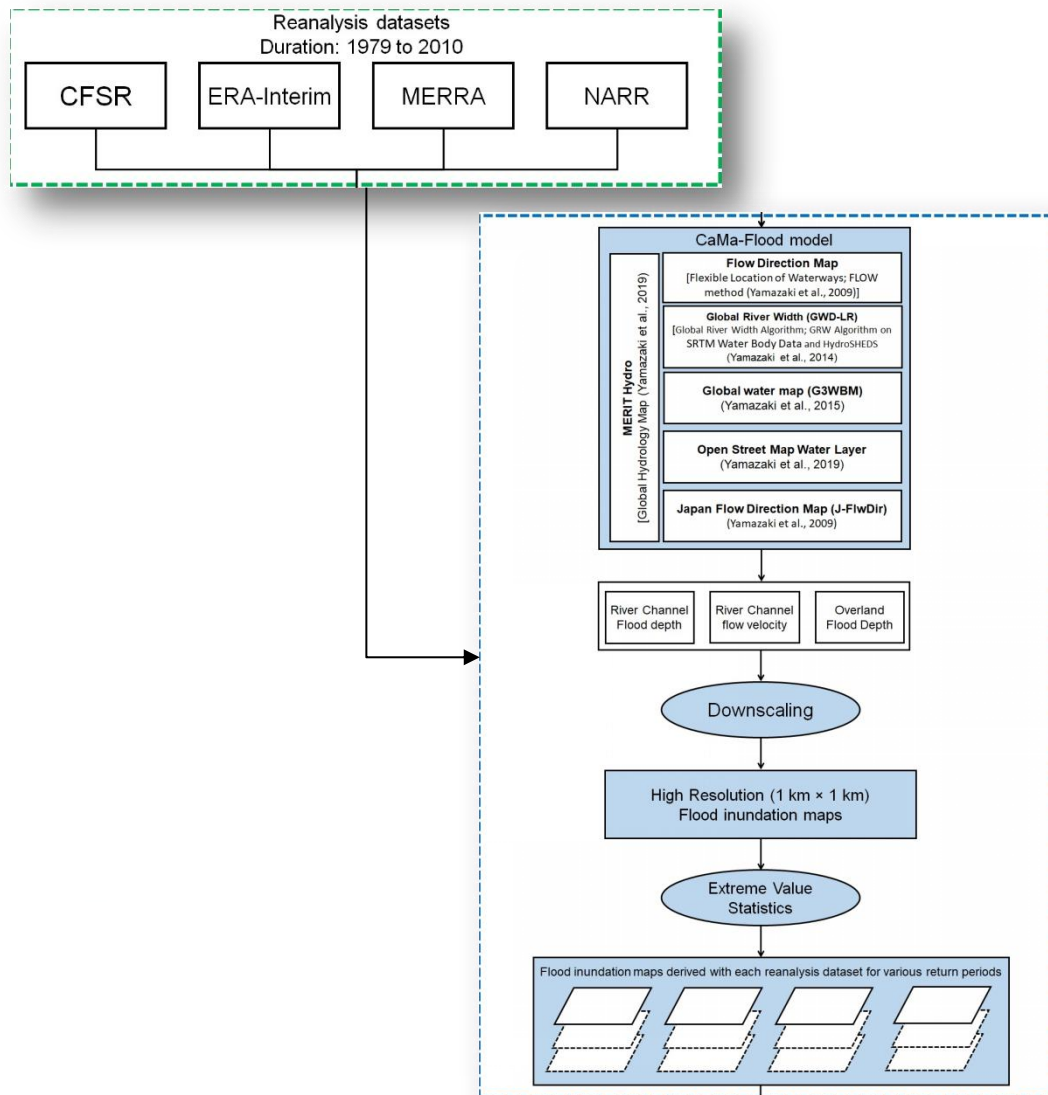


- Flood inundation analyses over large regions –
Canadian case study

- Use runoff data from reanalysis products
- At station locations – comparison between observed and reanalysis runoff values (correlation coefficient)
- Fit GEV distribution to the data – extracting 25, 50, 100, 150, 200, 300 and 500 year runoff values
- Use gridded runoffs with the CaMa-Flood model to derive maximum flood depth (m) and inundation extents (km²) for entire Canada
- Downscaling maps to 1 km x 1 km spatial resolution

5. METHODOLOGY

Floodplain mapping



The runoff data:

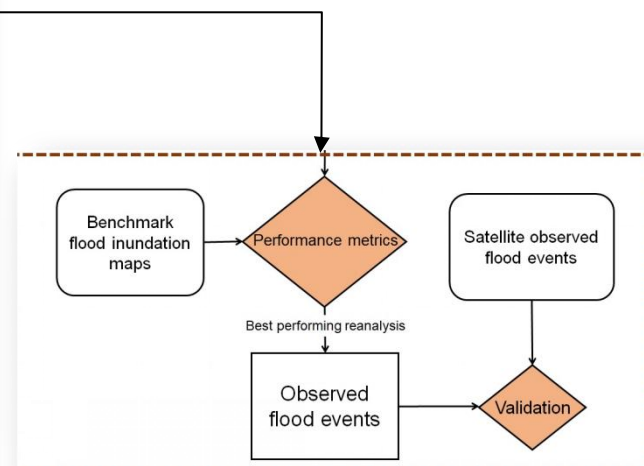
CFSR every 6 h, 1979-2010 at a surface grid resolution of 0.3° .

ERA 3 h, 1979- present, 0.75° .

MERRA 1 h, 1979- present, $2/3^\circ \times 1/2^\circ$.

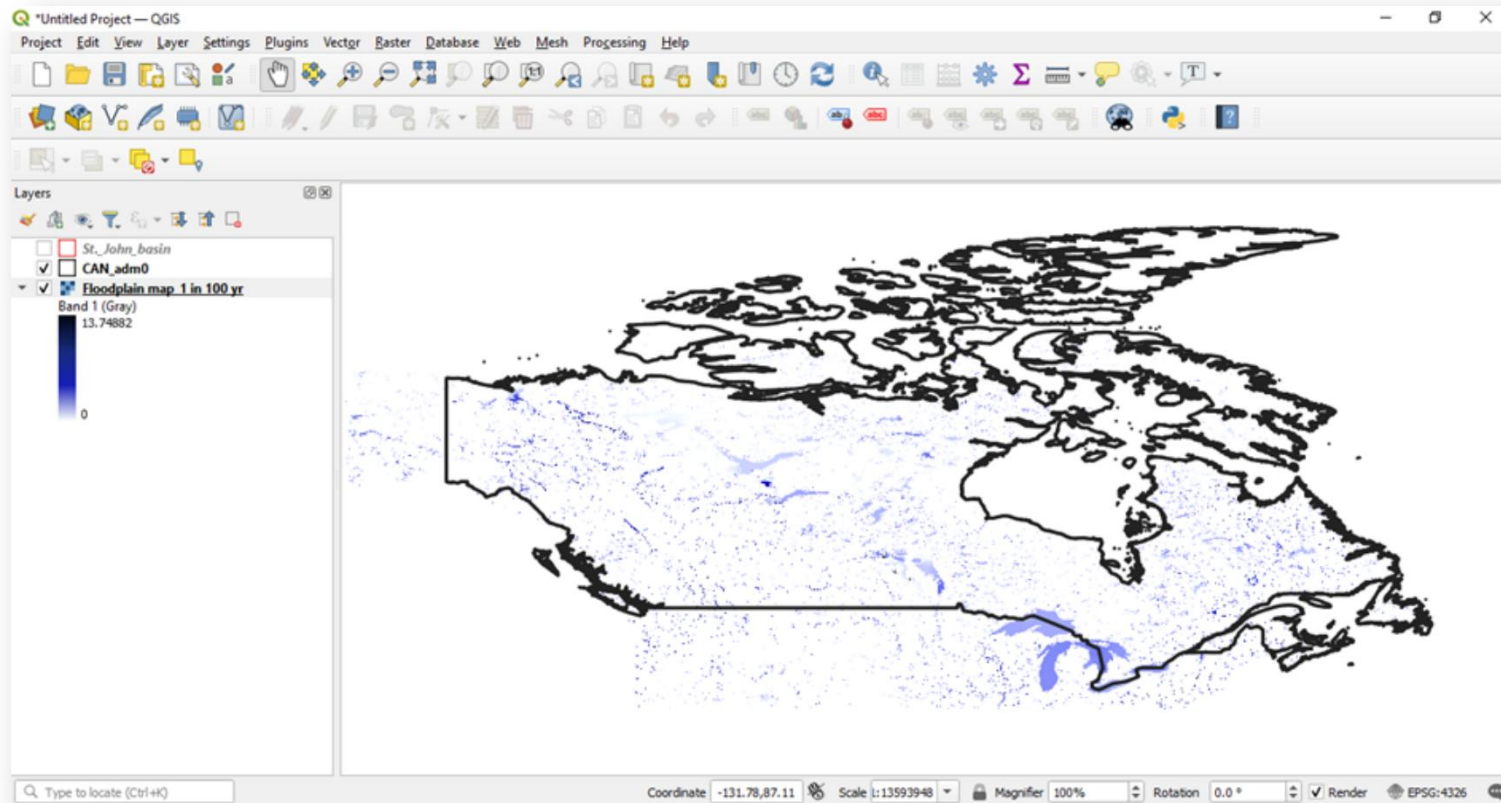
NARR 3 h, 1979 –present, 0.3° .

MODIS – near real-time global flood mapping project: a few historic flood events.

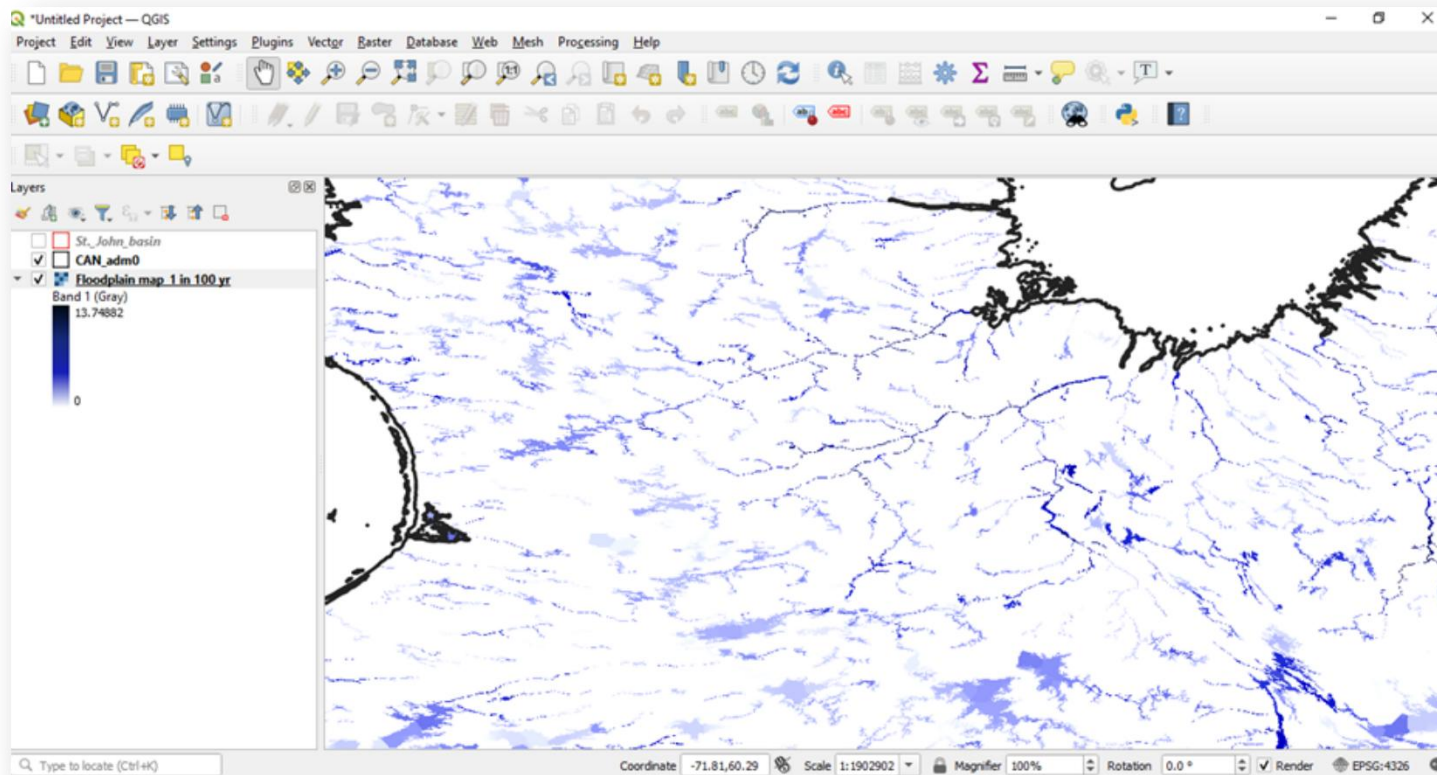


METHODOLOGY

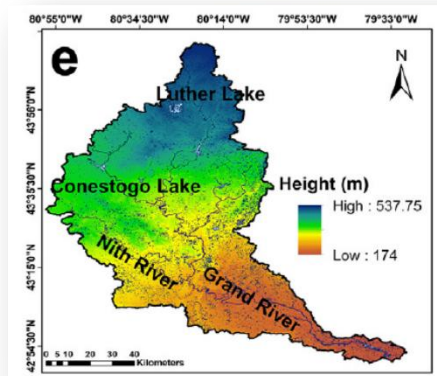
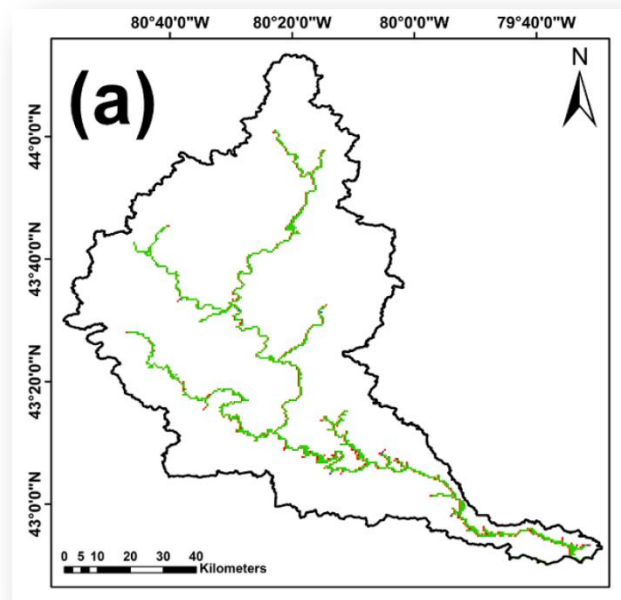
Representative floodplain map



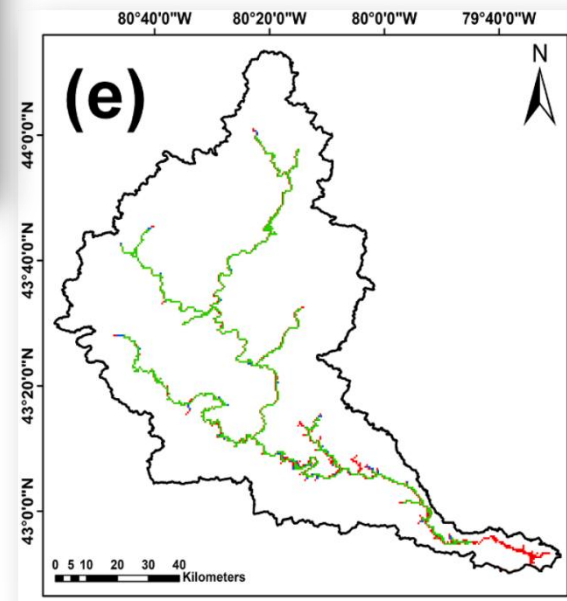
100 yr floodplain map of Canada (opened in QGIS)



100 yr floodplain map of Canada (zoomed illustration)



Grand River DEM

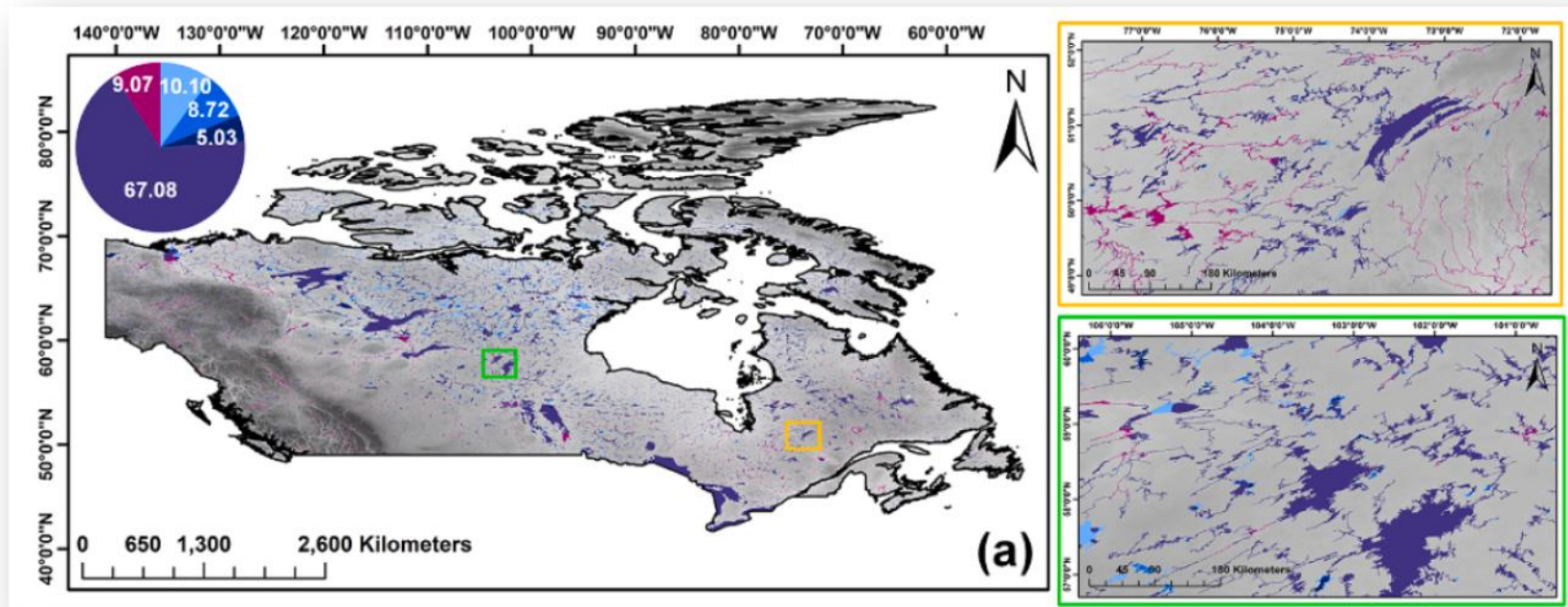


- What are these maps for?

10 IMPLEMENTATION

Understanding the overall flood hazard across the country

100-yr flood



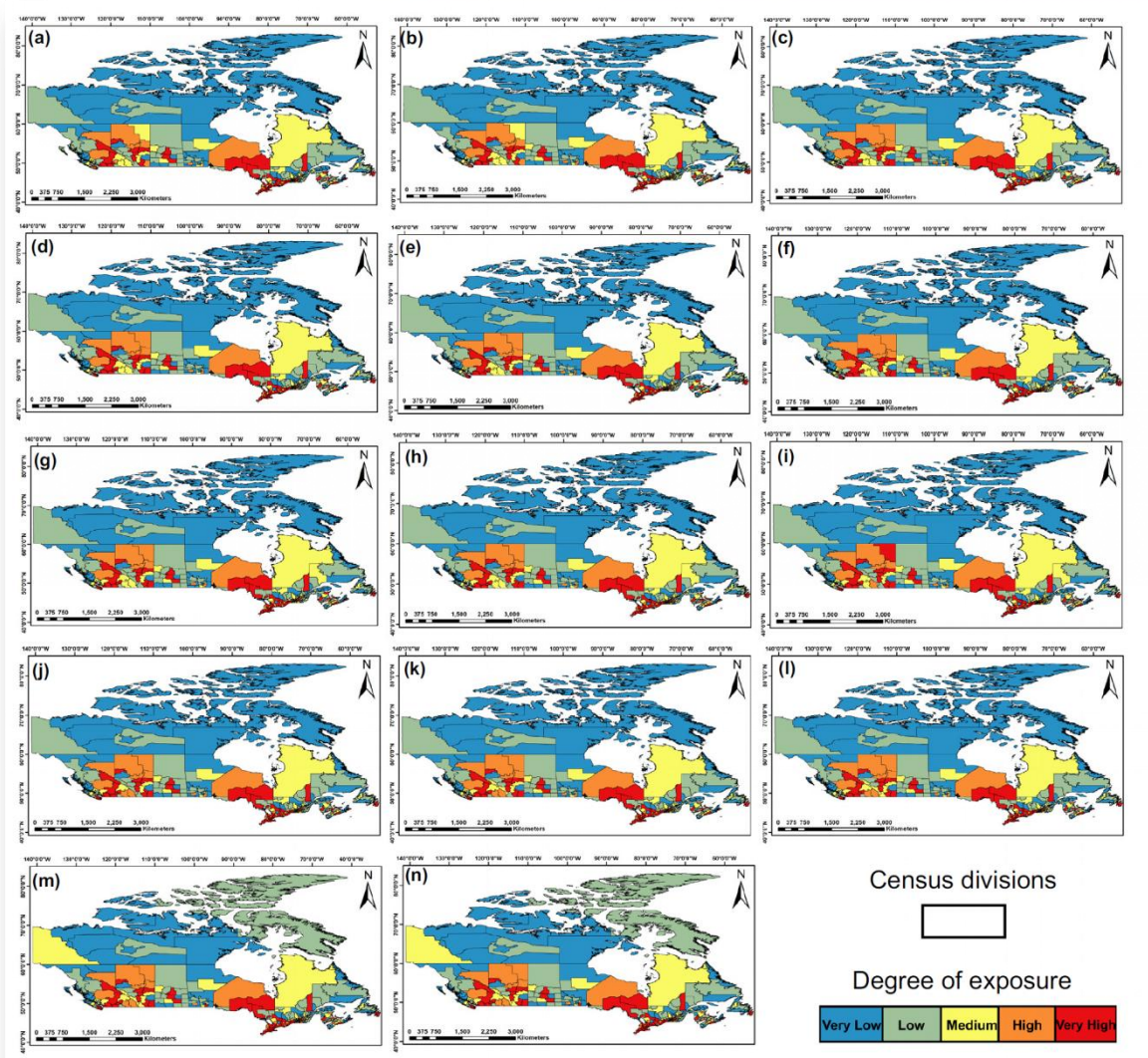
11. IMPLEMENTATION

Identification of regional impacts - population exposure assessment



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$$\epsilon_f = \begin{cases} \text{very-low, } 0 \leq (p_f/p_r) \leq 5\% \\ \text{low, } 5\% < (p_f/p_r) \leq 10\% \\ \text{moderate, } 10\% < (p_f/p_r) \leq 15\% \\ \text{high, } 15\% < (p_f/p_r) \leq 20\% \\ \text{very-high, } (p_f/p_r) > 20\% \end{cases}$$

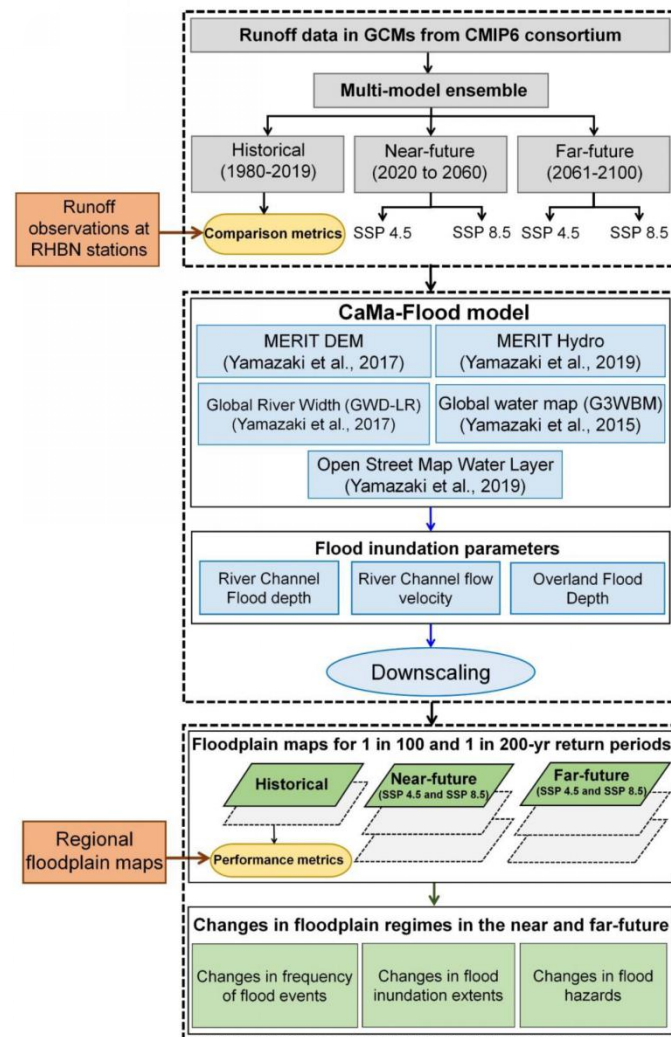


Divisions with various degrees of flood exposure from 2006 to 2019.

12. IMPLEMENTATION

Climate change impacts

- Coupled Model Intercomparison Project 6 (CMIP6)
- 17 GCMs considered (runoff)
- SSP2 4.5 (medium range of future forcing pathway) and SSP5 8.5 (high range of future forcing pathway) scenarios used
- Three timeframes (historical, near future and far future)



13 | IMPLEMENTATION

Climate change impacts - flood inundation

Name of river basin	Near future (SSP 4.5)	Far future (SSP 4.5)	Near future (SSP 8.5)	Far future (SSP 8.5)
Pacific Coastal				
Fraser-Lower Mainland				
Okanagan-Similkameen				
Columbia				
Yukon				
Peace-Athabasca				
Lower Mackenzie				
Arctic Coast Islands				
Missouri				
North Saskatchewan				
South Saskatchewan				
Assiniboine-Red				
Winnipeg				
Lower Saskatchewan- Nelson				
Churchill				
Keewatin Southern Baffin Island				
Northern Ontario				
Northern Quebec				
Great Lakes				
Ottawa				
St. Lawrence				
North Shore Gasp				
Saint John St. Croix				
Maritime Coastal				
Newfoundland Labrador				

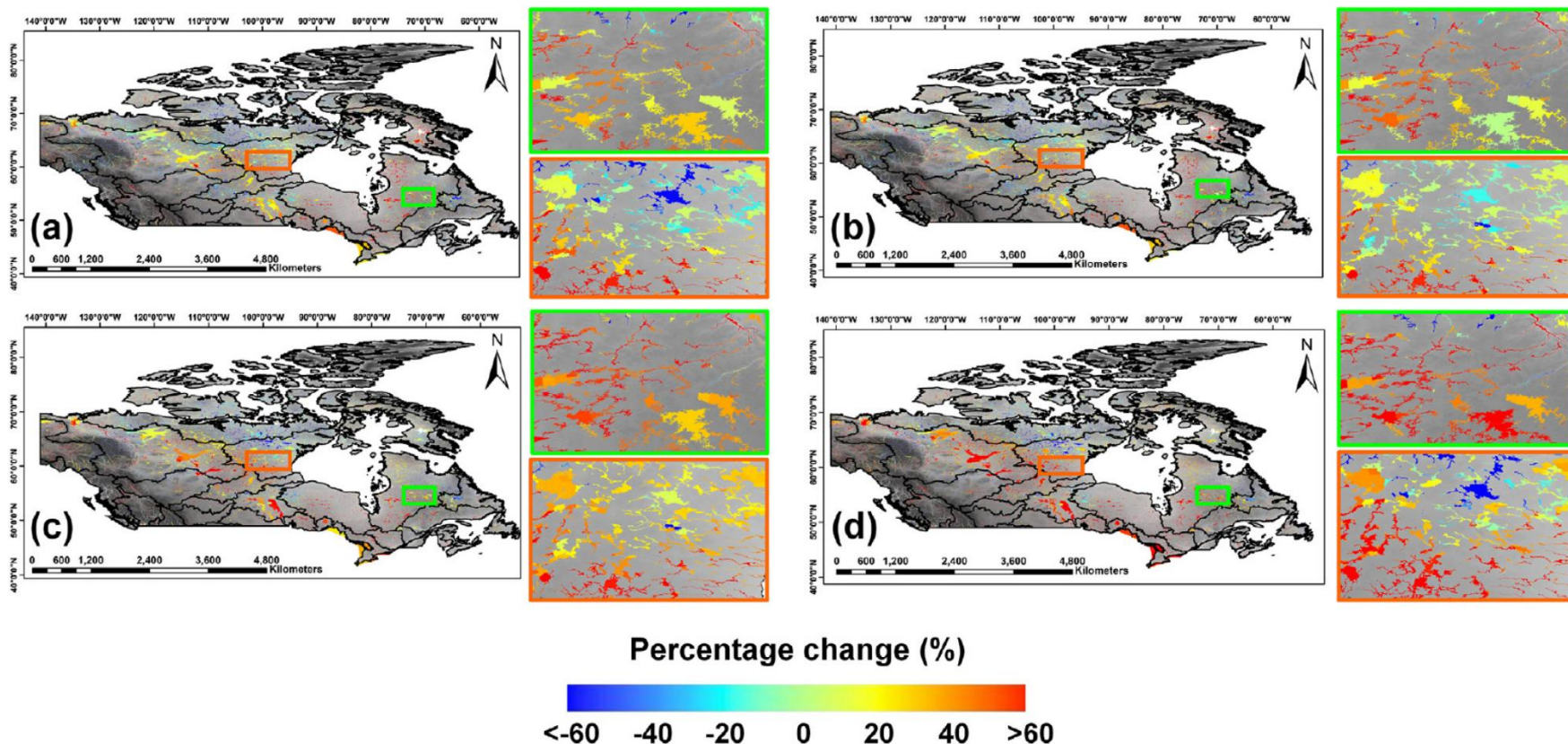
Percentage change (%)



100 yr

14 | IMPLEMENTATION

Climate change impacts - flood depth (hazard)

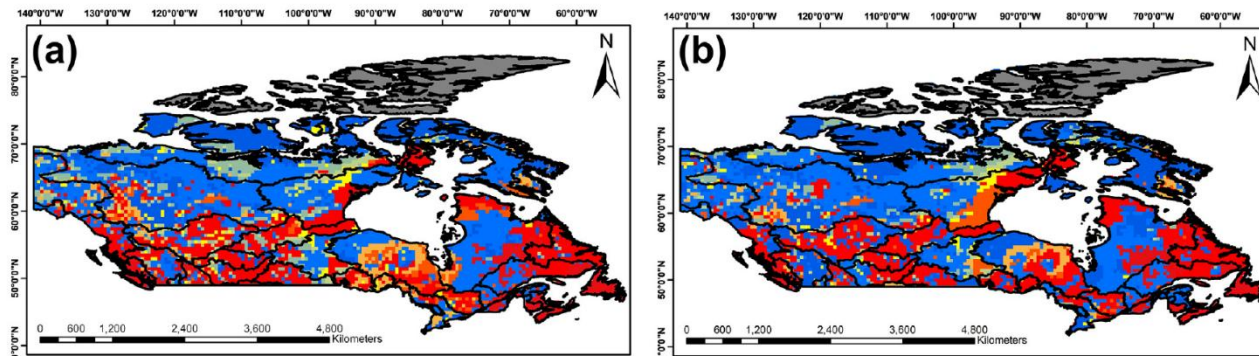


100 yr (near future SSP 4.5; near future 8.5; far future SSP 4.5 far future SSP 8.5)

15 | IMPLEMENTATION

Climate change impacts - flood frequency

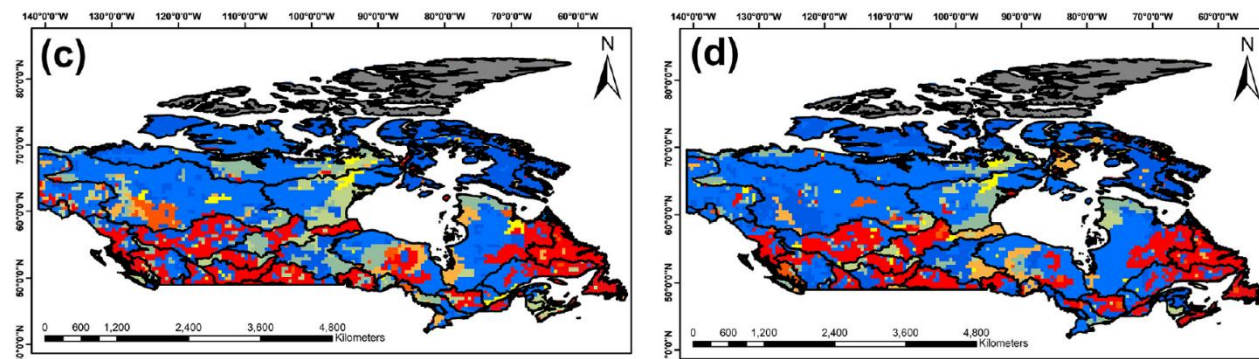
100 yr
far future
SSP 4.5



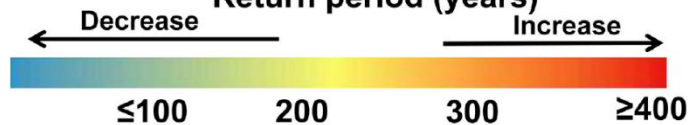
Return period (years)



200 yr
far future
SSP 8.5

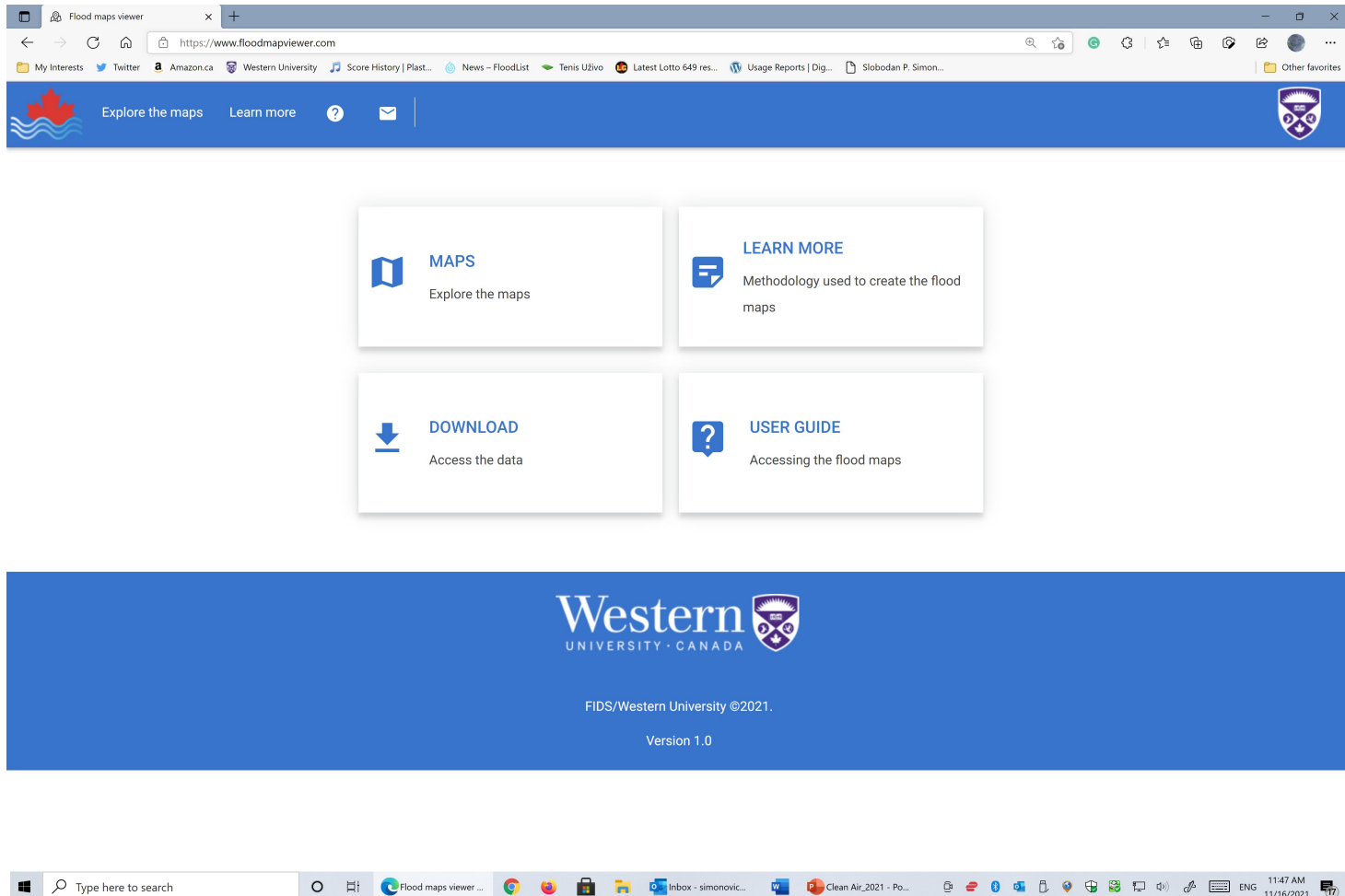


Return period (years)



- Communication of results to general public

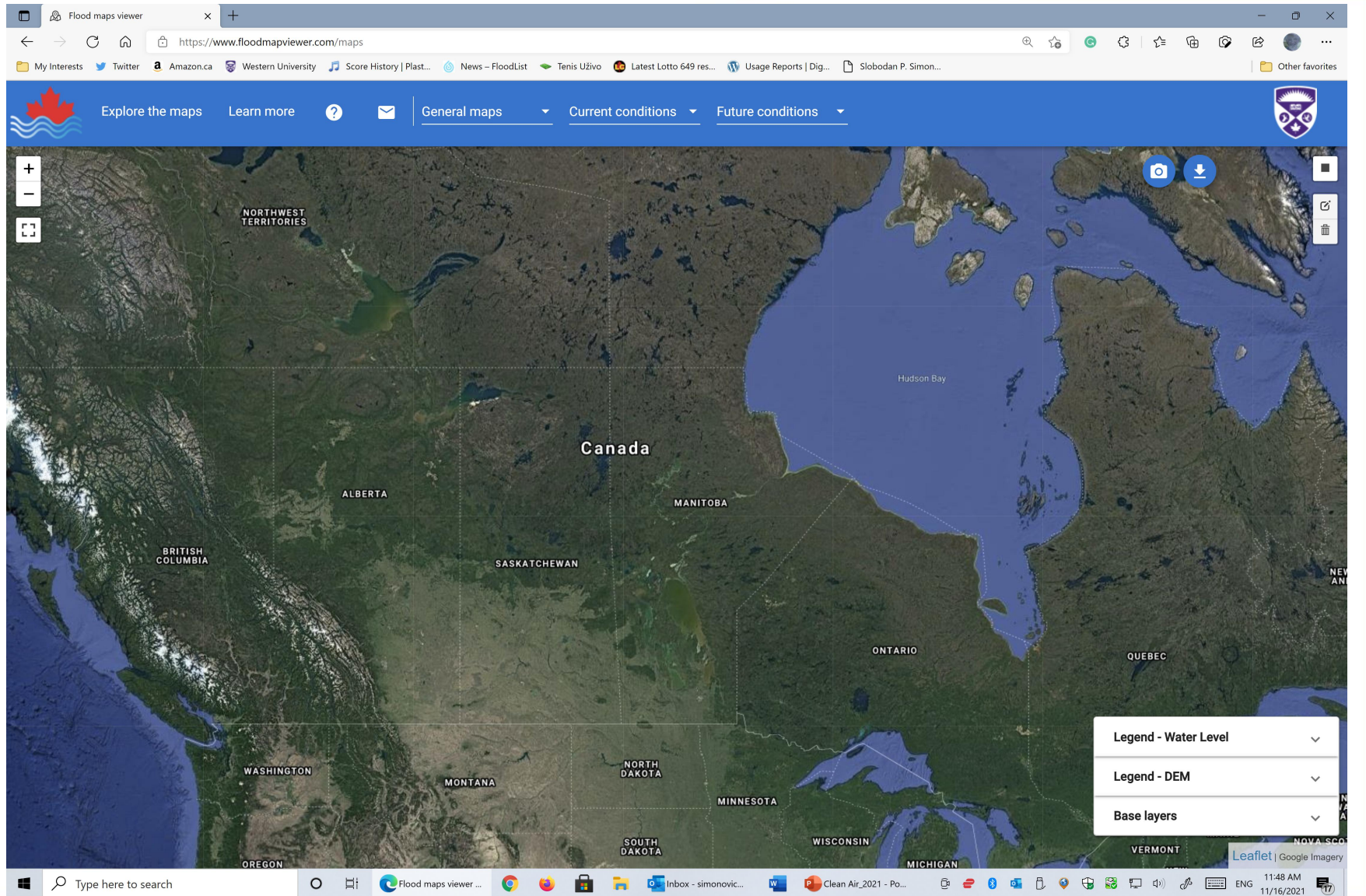
17| RESULTS COMMUNICATION



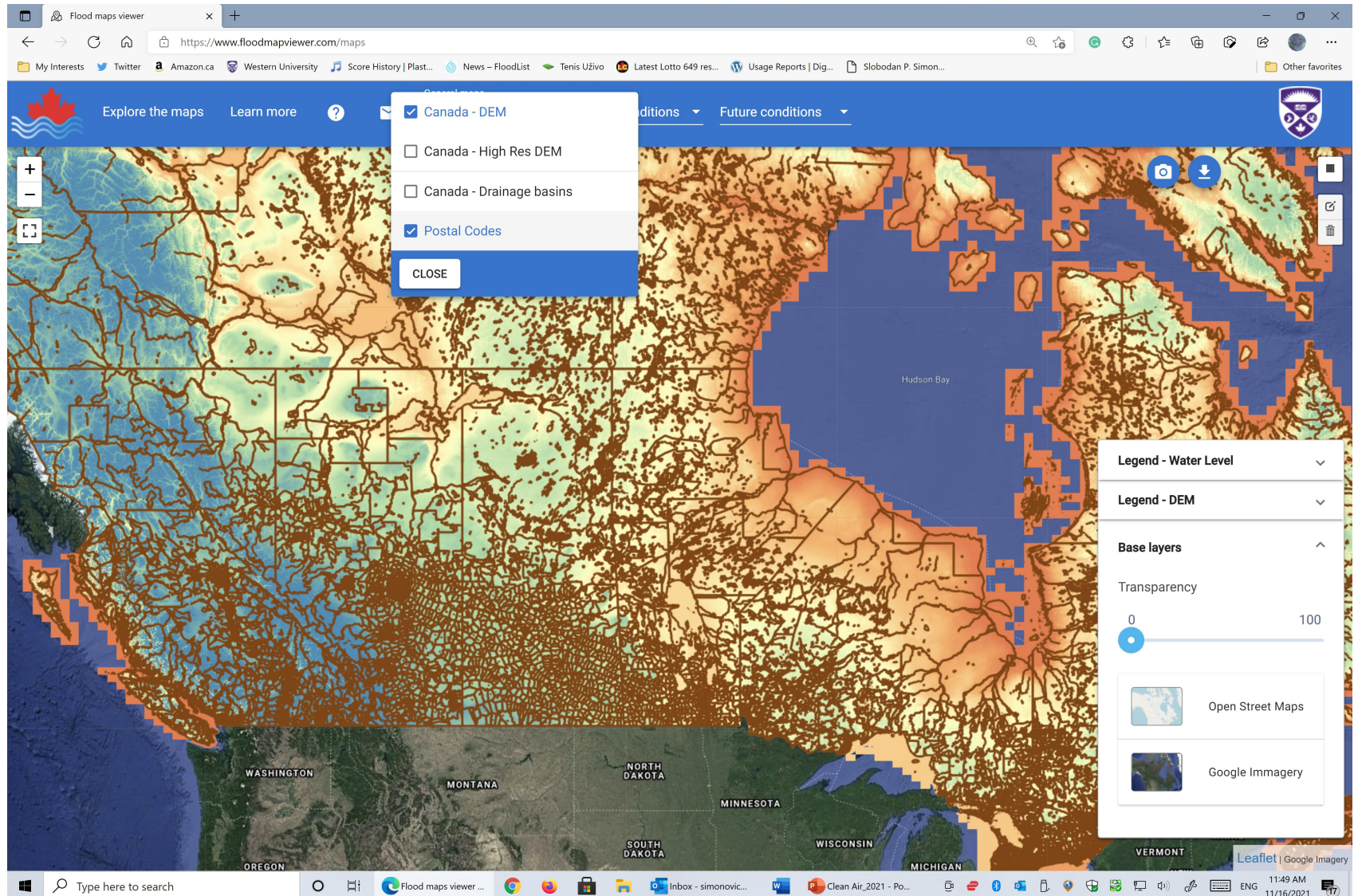
The screenshot displays the 'Flood maps viewer' web application. The browser's address bar shows the URL <https://www.floodmapviewer.com>. The website's header is blue with a navigation bar containing 'Explore the maps', 'Learn more', a help icon, and an email icon. The main content area features four white cards with blue icons and text: 'MAPS' (Explore the maps), 'LEARN MORE' (Methodology used to create the flood maps), 'DOWNLOAD' (Access the data), and 'USER GUIDE' (Accessing the flood maps). The footer is a solid blue bar with the Western University logo, the text 'FIDS/Western University ©2021.', and 'Version 1.0'. The Windows taskbar at the bottom shows the search bar and several open applications, including the Flood maps viewer, Google Chrome, and various email and document files.

www.floodmapviewer.com

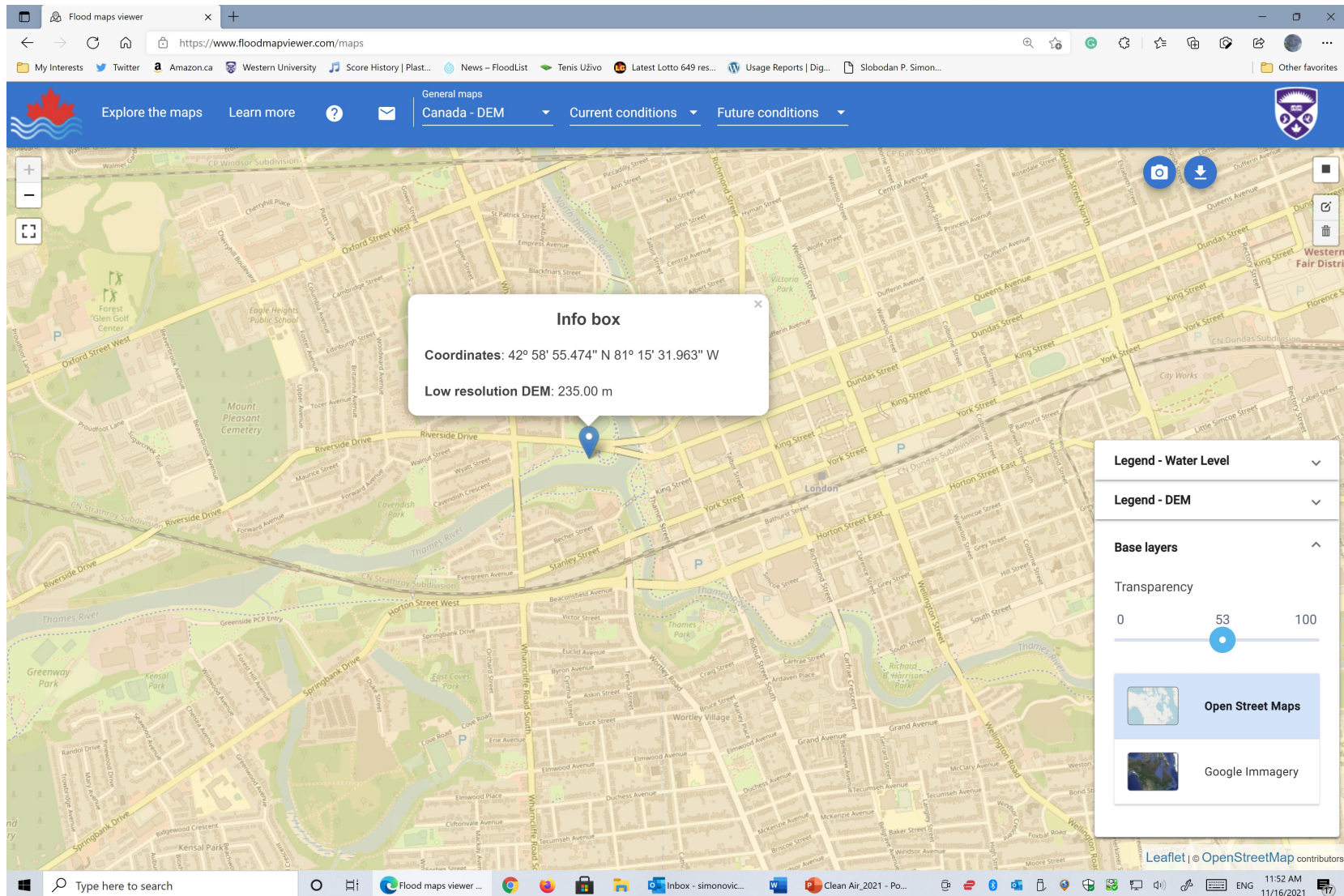
18| RESULTS COMMUNICATION



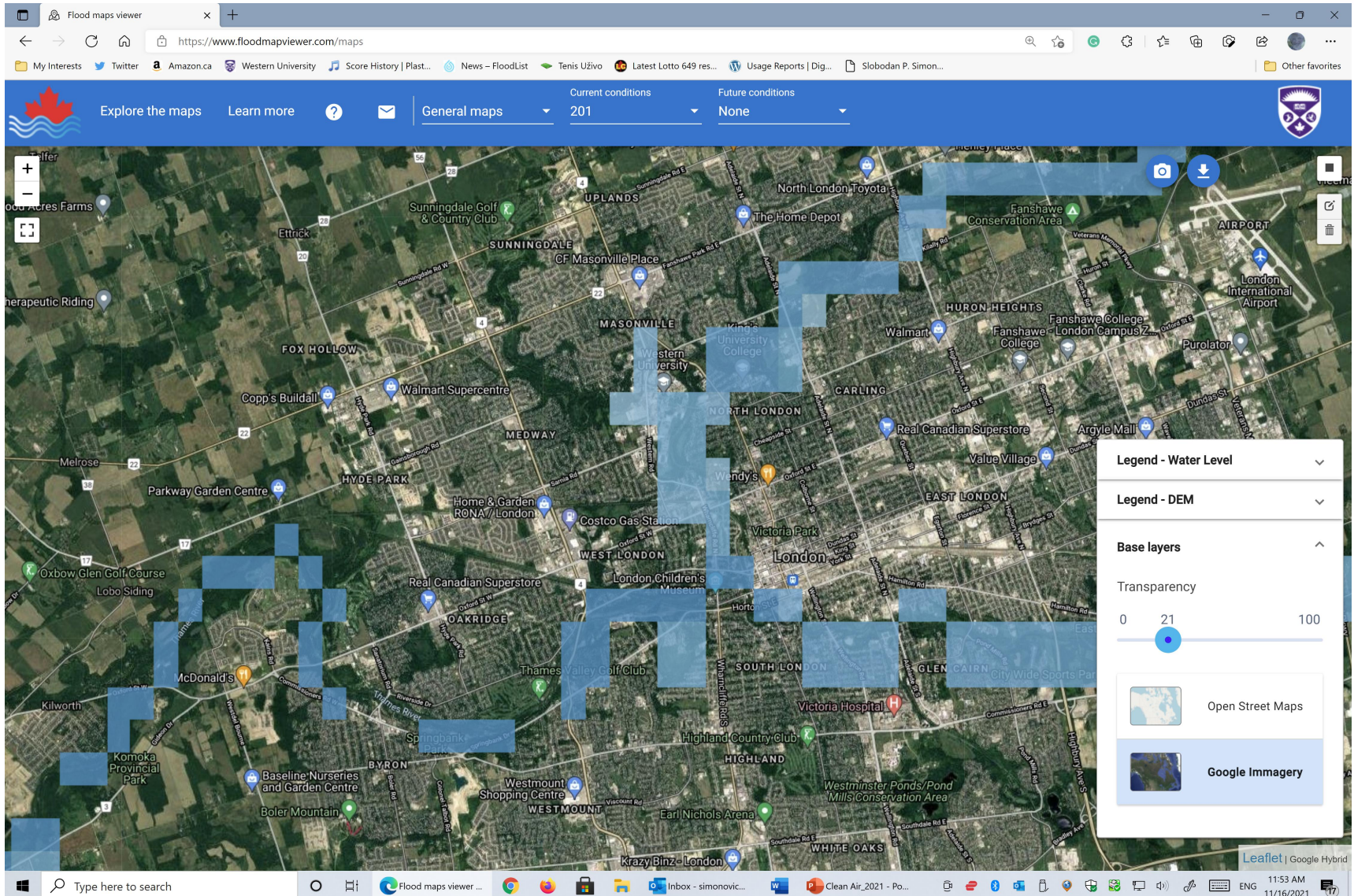
19| RESULTS COMMUNICATION



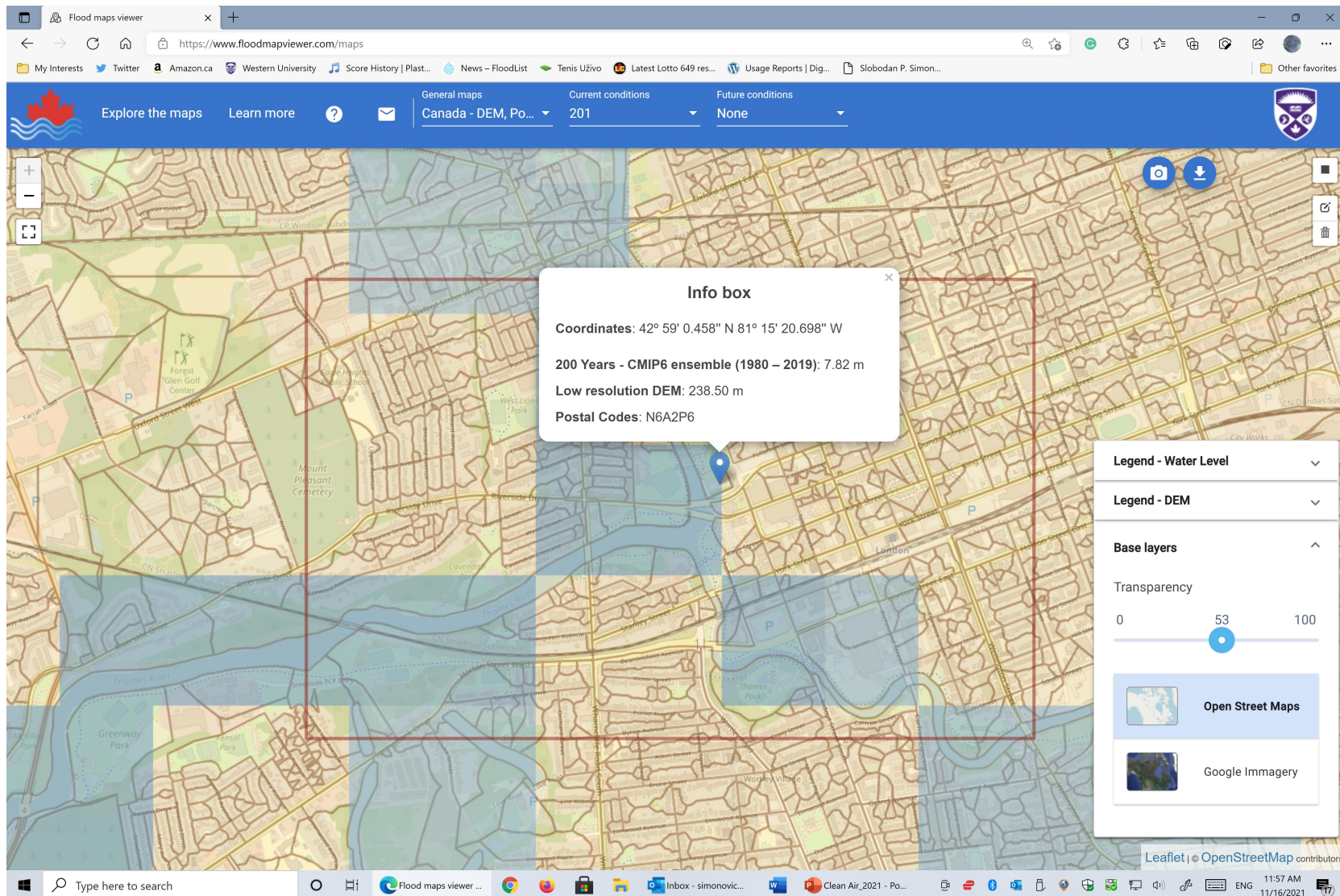
20 RESULTS COMMUNICATION



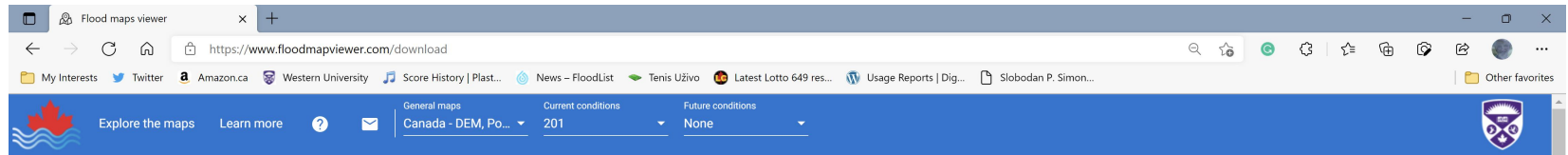
21 RESULTS COMMUNICATION



22| RESULTS COMMUNICATION



23| RESULTS COMMUNICATION



Downloads

Downloading files

Please check the file size before starting your download.

We recommend installing [7-Zip](#) to decompress and open the full files. 7-Zip is free, open source software. You can use 7-Zip on any computer, including a computer in a commercial organization. You don't need to register or pay for 7-Zip.

To open the downloaded files, a Geographic Information System (GIS) processing tool should be used. The recommended software is Quantum GIS (QGIS), a free and open-source tool.

For more details on the files see the help section: [Help](#).

If you have questions or concerns contact us at simonovic@uwo.ca.

Area defined for clipping:

SW point: 42° 58' 25.515" N 81° 16' 38.157" W

NE point: 42° 59' 28.843" N 81° 14' 21.108" W

List of files

TITLE	DESCRIPTION	FILE NAME	DOWNLOAD	SIZE
101	100 Years - CMIP6 ensemble (1980 – 2019)	Map_100_yr_CMIP6_historical.7z	Full file Clipped file	9.96 MB
102	100 Years - NARR (1979 – 2010)	Map_100_yr_NARR.7z	Full file Clipped file	9.56 MB
103	100 Years - CMIP6 ensemble SSP2.45 (2020 - 2060)	Map_100_yr_near_future_ssp45.7z	Full file Clipped file	10.7 MB
104	100 Years - CMIP6 ensemble SSP5 8.5 (2020 - 2060)	Map_100_yr_near_future_ssp85.7z	Full file Clipped file	11.0 MB
105	100 Years - CMIP6 ensemble SSP2 4.5 (2061 - 2100)	Map_100_yr_far_future_ssp45.7z	Full file Clipped file	10.8 MB
106	100 Years - CMIP6 ensemble SSP5 8.5 (2061 - 2100)	Map_100_yr_far_future_ssp85.7z	Full file Clipped file	10.3 MB
201	200 Years - CMIP6 ensemble (1980 – 2019)	Map_200_yr_CMIP6_historical.7z	Full file Clipped file	9.16 MB
202	200 Years - NARR (1979 – 2010)	Map_200_yr_NARR.7z	Full file Clipped file	8.99 MB
203	200 Years - CMIP6 ensemble SSP2.45 (2020 - 2060)	Map_200_yr_near_future_ssp45.7z	Full file Clipped file	9.17 MB



24| RESULTS COMMUNICATION

Flood maps viewer

https://www.floodmapviewer.com/learnmore

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Explore the maps Learn more ? |

The data used in this work are publicly available.

- NARR data: <https://psl.noaa.gov/data/gridded/data.narr.html> ; and
- CMIP6 climate data: <https://pcmdi.llnl.gov/CMIP6/>

The information provided should be used at your own risk. By using this Tool you agree with these terms. Please check the Learn section for more information.

Third party software used to build the tool:

- Angular: Angular is a TypeScript-based free and open-source web application framework led by the Angular Team at Google and by a community of individuals and corporations. Angular is a complete rewrite from the same team that built AngularJ.
- Angular Material: Angular Material is a UI component library for Angular JS developers. Angular Material components help in constructing attractive, consistent, and functional web pages and web applications while adhering to modern web design principles like browser portability, device independence, and graceful degradation. It helps in creating faster, beautiful, and responsive websites. It is inspired by the Google Material Design
- Leaflet: Leaflet is the leading open-source JavaScript library for mobile-friendly interactive maps. The map information and photographic imagery contain trade names, trademarks, service marks, logos, domain names, and other distinctive brand features. (<http://leafletjs.com/>)
- Geoserver: GeoServer is an open-source server written in Java that allows users to share, process and edit geospatial data. Designed for interoperability, it publishes data from any major spatial data source using open standards.

Learn More

Project info

Disclaimer

Third party software used to build the tool:

Methodology

Data

Frequently Asked Questions - FAQ

References (all references are open access)

Methodology

The flood maps available for viewing and download were developed using an original methodology developed by Mohanty and Simonovic [1, 2, 3, 4]. Key elements of the methodology are presented here and the users are advised to consult available references for further details.

The provided floodplain maps are developed using globally available data. Four maps are developed to present current conditions, and eight maps are developed to capture changes in floodplain regimes over Canada due to climate change. All the generated maps have 1km by 1 km grid resolution. Table 1 lists the maps available with the tool.

Table 1. Floodplain maps available within the tool

RETURN PERIOD	MAP VERSION	TIME PERIOD	RUNOFF INPUT SOURCE
100 yr	101	1980 – 2019	CMIP6 ensemble
	102	1979 – 2010	NARR
	103	2020 - 2060	CMIP6 ensemble SSP2 4.5
	104	2020 - 2060	CMIP6 ensemble SSP5 8.5
	105	2061 - 2100	CMIP6 ensemble SSP2 4.5
	106	2061 - 2100	CMIP6 ensemble SSP5 8.5

https://www.floodmapviewer.com/learnmore

Type here to search

Flood maps viewer ...

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Clean Air_2021 - Po...

11:59 AM 11/16/2021

25| RESULTS COMMUNICATION

Flood maps viewer


https://www.floodmapviewer.com/userguide#download-export

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Explore the maps Learn more ? |

Exporting and downloading

The following buttons allow the export (create a screenshot of the visible map area and all visible layers, and access the [download page](#), respectively).




Clipping

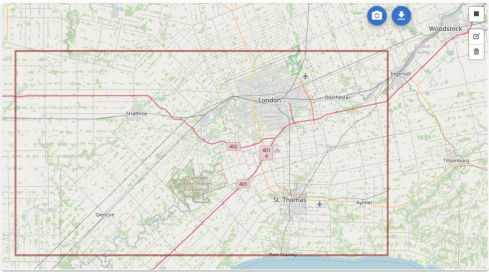
The clipping functionality allows you to select a region of interest to zoom in and download reduced (clipped) map layers. The buttons located on the top right are:

1. Rectangle button: create the clipping region
2. Edit button: edit, change and move the existing clipping area
3. Delete button: remove the clipping area


The list of buttons described is shown on the Map page as follows



Once a clipping area has been selected, a region (rectangle) is displayed to indicate your selection.



When editing a clipping area, dashed lines are shown, and the corners and center point are highlighted.



Type here to search

Flood maps viewer...

Inbox - simonovic...

Clean Air_2021 - P...

12:01 PM
11/16/2021

26 | SUMMARY

Floodplain mapping

- Specific aspects of the methodology
 - Consideration of the whole country (large region almost 10M km²) - standardized
 - Use of publicly available runoff data (runoff observations sparse – reanalysis products; future climate according to CMIP6 (Coupled Model Intercomparison Project) and 17 GCM models from that experiment
 - Use of other public data required for hydrodynamic modelling (global DEM; global river width; global water; open street;....)
 - Modelling outcome: flood depth; flood inundation; and flow velocity in gridded form (1km by 1 km)

27 | REFERENCES



Mohanty, M. and S.P. Simonovic (2021) “Fidelity of Reanalysis Datasets in Floodplain Mapping: Investigating Performance at Inundation Level over Large Regions”, *Journal of Hydrology*, Vol.597, 125757, available online at <https://doi.org/10.1016/j.jhydrol.2020.125757>

Mohanty, M. and S.P. Simonovic (2021) “Changes in floodplain regimes over Canada due to climate change impacts: observations from CMIP6 models”, *The Science of Total Environment*, 792, 148323, open access <https://doi.org/10.1016/j.scitotenv.2021.148323>.

Mohanty, M. and S. P. Simonovic (2020). [A comprehensive framework for regional floodplain mapping](#). *Water Resources Research Report no. 109*, Facility for Intelligent Decision Support, Department of Civil and Environmental Engineering, The University of Western Ontario, London, Ontario, Canada, 58 pages. ISBN: (print) 978-0-7714-3147-0; (online) 978-0-7714-3148-7.

Sredojevic, B., M. P. Mohanty and S. P. Simonovic (2020). [Regional analysis of population exposure to flooding in Canada](#). *Water Resources Research Report no. 110*, Facility for Intelligent Decision Support, Department of Civil and Environmental Engineering, London, Ontario, Canada, 60 pages. ISBN: (print) 978-0-7714-3151-7; (online) 978-0-7714-3152-4.

Mohanti, M. and S.P. Simonovic (2021). [A generic framework to quantify changes in floodplain regimes by incorporating climate change impacts over large regions](#). *Water Resources Research Report no. 112*, Facility for Intelligent Decision Support, Department of Civil and Environmental Engineering, London, Ontario, Canada, 55 pages. ISBN: (print) 978-0-7714-3157-9; (online) 978-0-7714-3158-6.

Additional resources

www.slobodansimonovic.com



10th International Conference on Flood Management (ICFM10)

Adapting to Global Change: Innovative Approaches to Flood Management and
Resilience

May 20-22, 2026, London, Ontario, Canada

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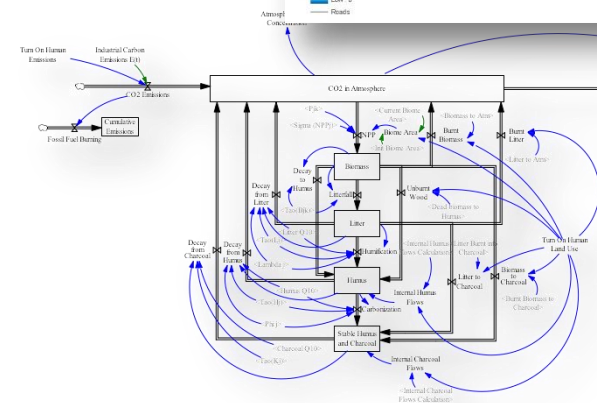
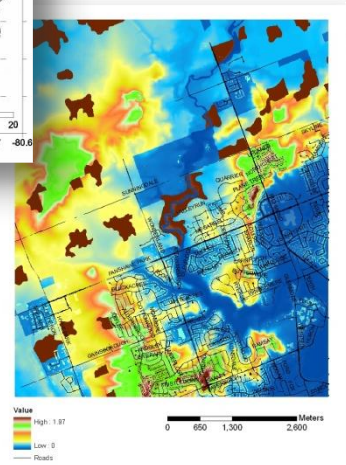
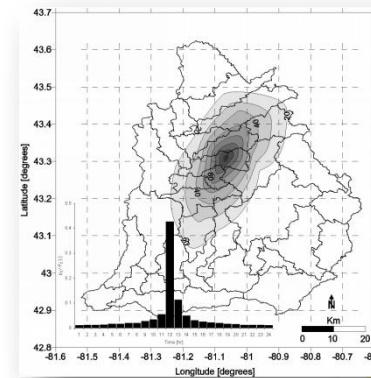
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10th International Conference on Flood Management

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- Research:
 - *Subject Matter* - Systems modeling; Risk and reliability; Water resources and environmental systems analysis; Computer-based decision support systems development.
 - *Topical Area* - Reservoirs; Flood control; Hydropower energy; Operational hydrology; Climatic Change; Integrated water resources management.
- 75 research projects
- 12 visiting fellows
- 21 PosDoc
- 24 PhD and
- 45 MESc



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