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Predicting seasonal landslide activity with Bayesian inference

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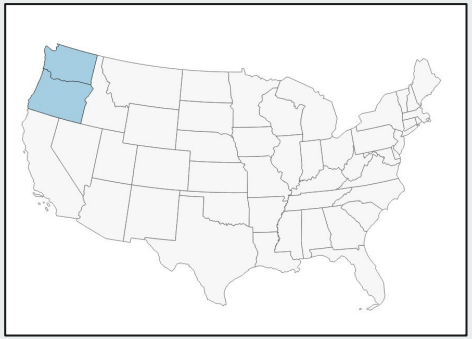
EGU22: NH3.6 - Space and time forecasting of landslides
May 24, 2022

Research objective

characterize the **seasonal pattern of landslide activity** in the Pacific Northwest from landslide inventory data

Study area: Pacific Northwest, USA



Two ways to model seasonal landslide activity

What's the probability of having any landslides in a given month? (*landslide probability*)

J F M A M J J A S O N D

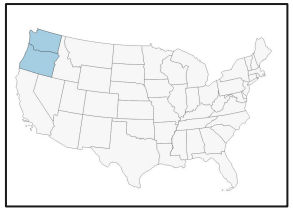
-> Logistic regression

How many landslides do we expect in a given month? (*landslide intensity*)

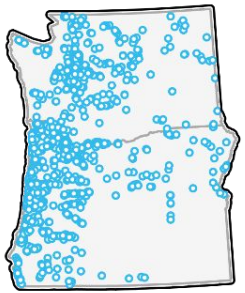
J F M A M J J A S O N D

-> Negative binomial regression

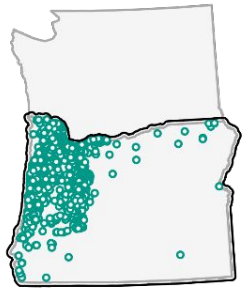
Landslide data from five heterogeneous inventories



NASA GLC

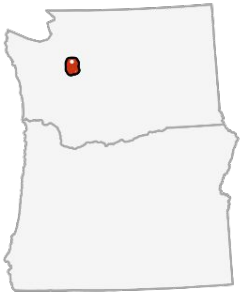


SLIDO Points

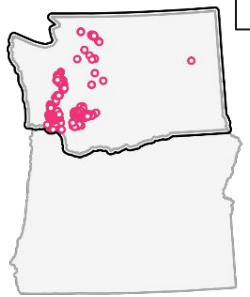


SLIDO Deposits

City of Seattle

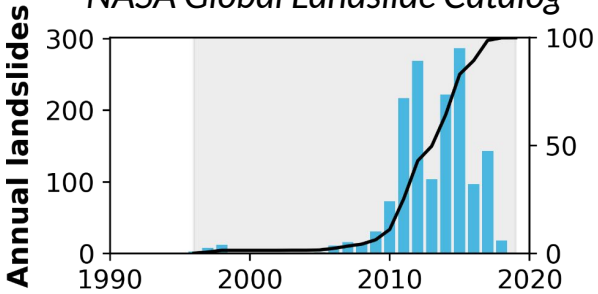


WLC

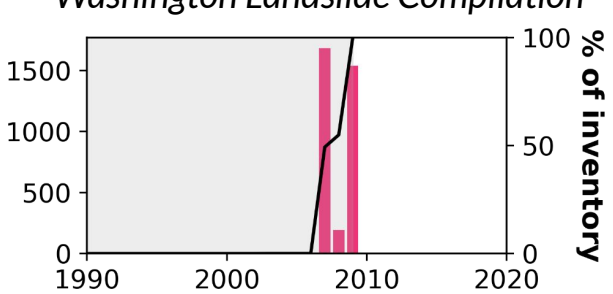


News reports and highway reports

NASA Global Landslide Catalog



Washington Landslide Compilation

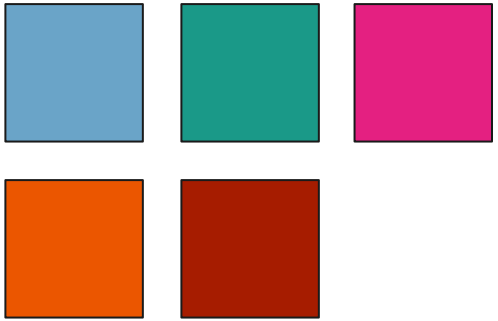


Mapping after widespread shallow landslide episodes

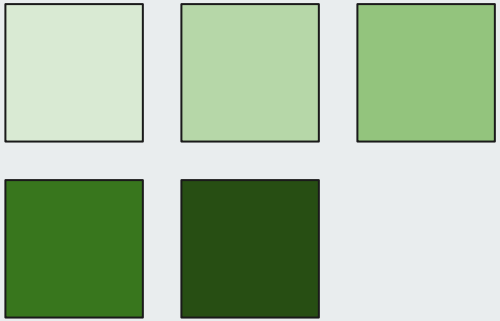
Why use Bayesian multi-level models?

Option 1: Combine the inventories and fit one model

Option 2: Fit one model to each inventory individually



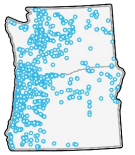
Option 3: Fit model to each inventory, but allow it to learn from the other inventories



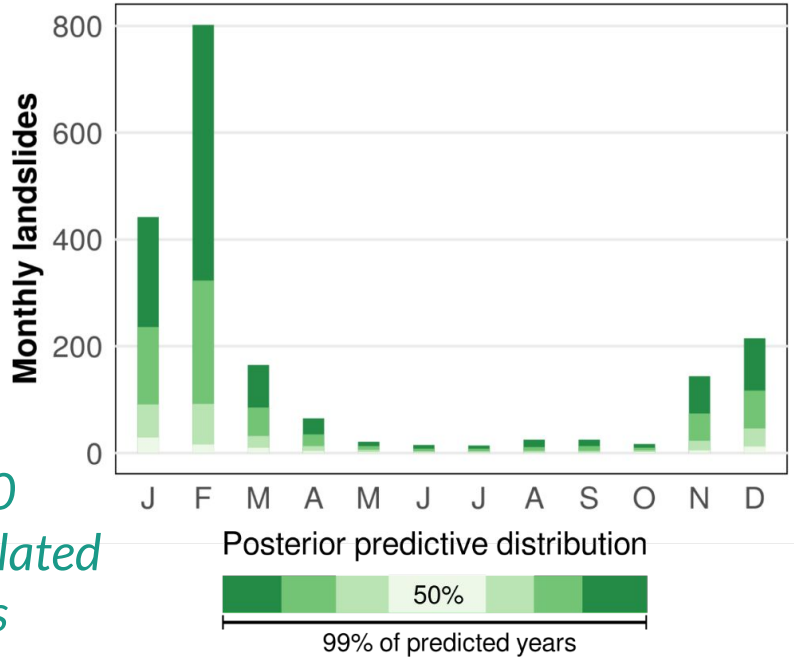
Multi-level models share information between inventories, while preserving individual information about each inventory

Landslide seasonality in the Pacific Northwest

Posterior predictive distributions for the NASA Global Landslide Catalog

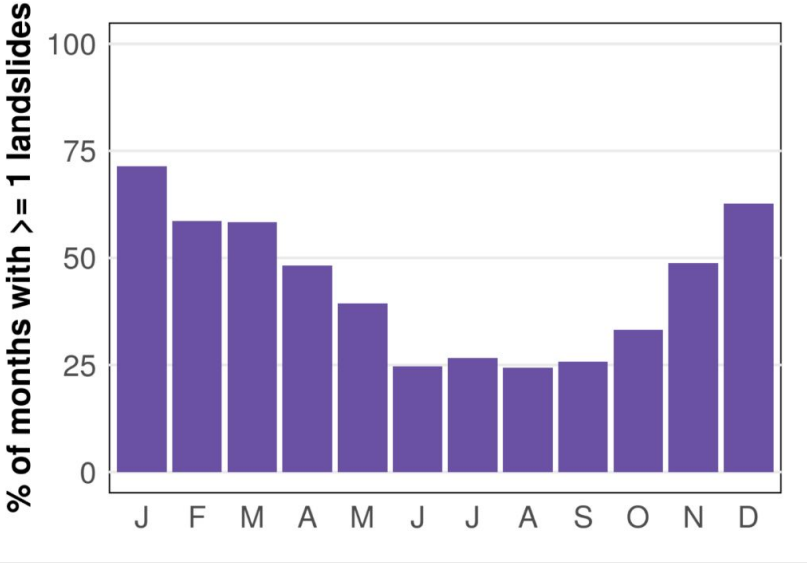


How many?



6000 simulated years

How probable?



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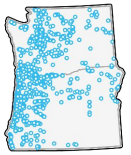
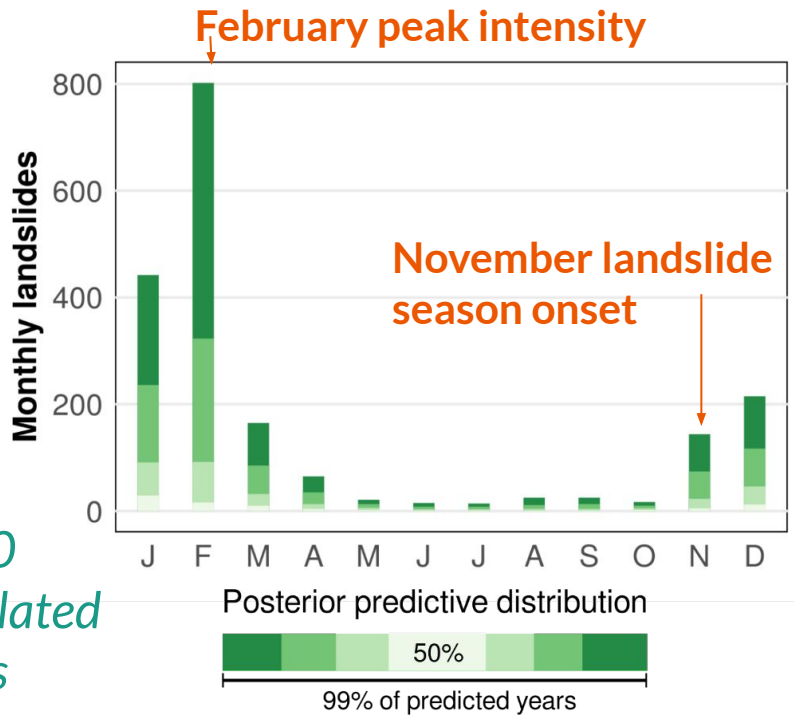


How many?



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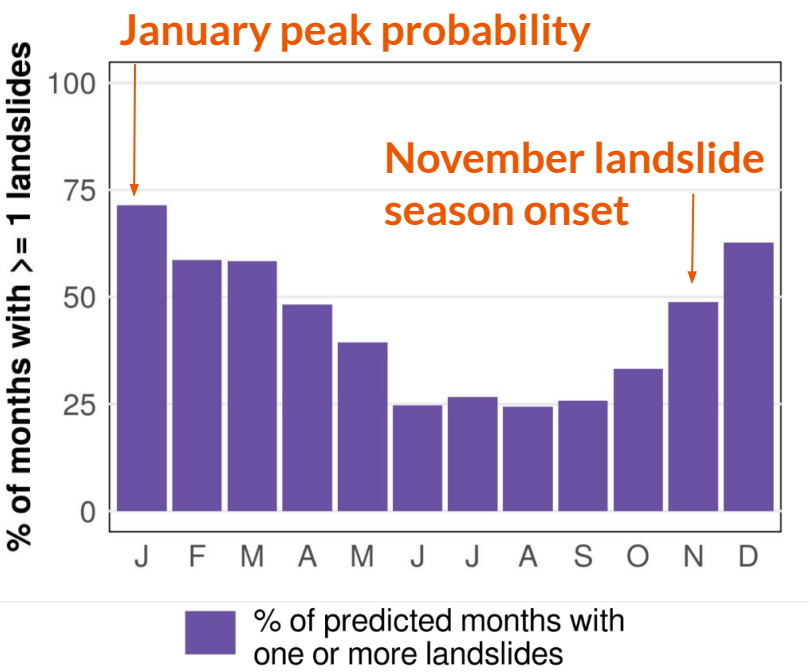

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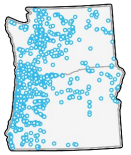

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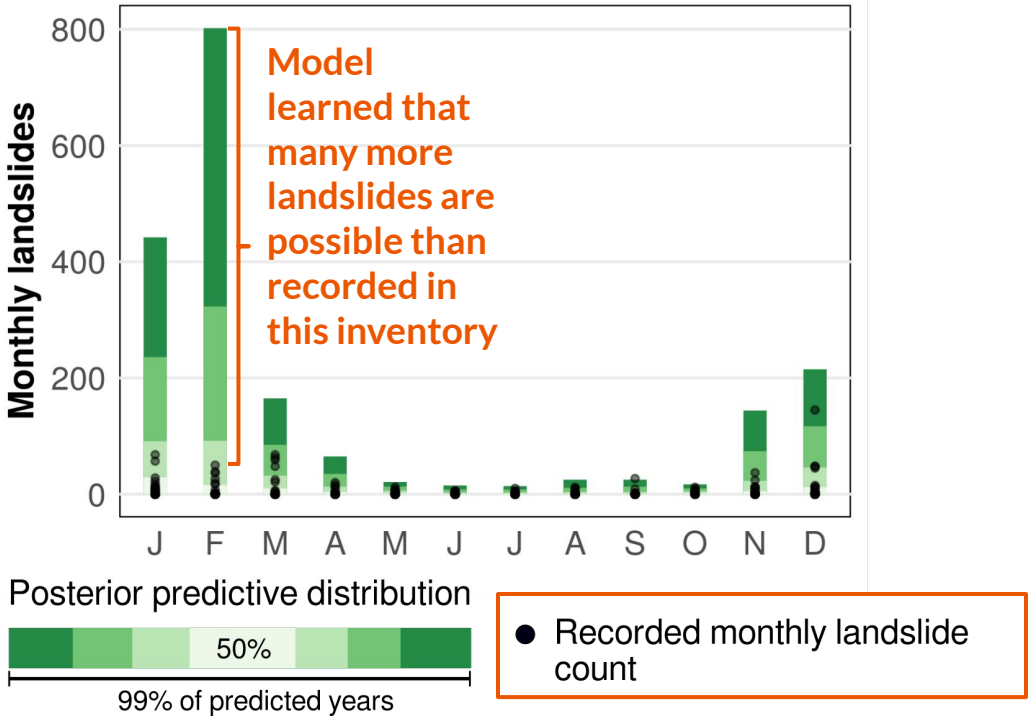

6000 simulated years

Key points

- We used **Bayesian inference to characterize the seasonal pattern of landslide activity** in the PNW from five heterogeneous inventories
- **Pacific Northwest landsliding is distinctly seasonal** with highest probability in January and intensity in February
- **Multi-level models that learn from multiple inventories** reveal a seasonality that some individual inventories fail to show

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Luna and Korup, 2022. **Pacific Northwest Landslide Seasonality.** *Submitted to GRL*

Landslide Inventory Data:
NASA Global Landslide Catalog via https://data.nasa.gov/Earth-Science/Global-Landslide-Catalog/h9d8-neg4 (accessed 2021-04-13). Open Database License. (NASA, 2018)
Statewide Landslide Information Database for Oregon, release 4.2 (SLIDO-4.2) via https://www.oregongeology.org/pubs/dds/p-slido4.htm (accessed 2021-01-15). Public. (Franczyk et al., 2020)
Seattle Historic Landslide Locations ECA.
https://data-seattlecitygis.opendata.arcgis.com/datasets/6ac72973a5784d90bda0a5f8a001d9f3_22/explore?location=47.616250%2C-122.328600%2C11.91 (accessed 2021-04-13). PDDL License. (City of Seattle, 2020)
Washington Landslide Compilation.
https://fortress.wa.gov/dnr/geologydata/publications/data_download/ger_portal_landslide_compilation.zip (accessed 2021-04-13). Public. (Washington Geological Survey, 2020)