



Toward Globally Consistent Impact Forecast for Tropical Cyclones-related Population Displacement

Pui Man Kam et al.
mannie.kam@usys.ethz.ch

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What is impact warning?

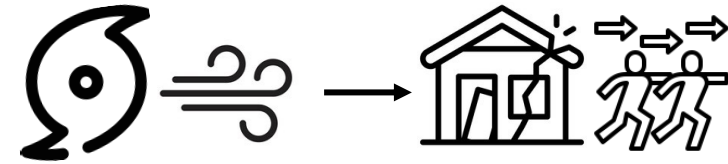
Hazard Warning

Tomorrow TC XXX is expected to make landfall at Country A with max wind gust reaches **40 m/s**.



Impact Warning

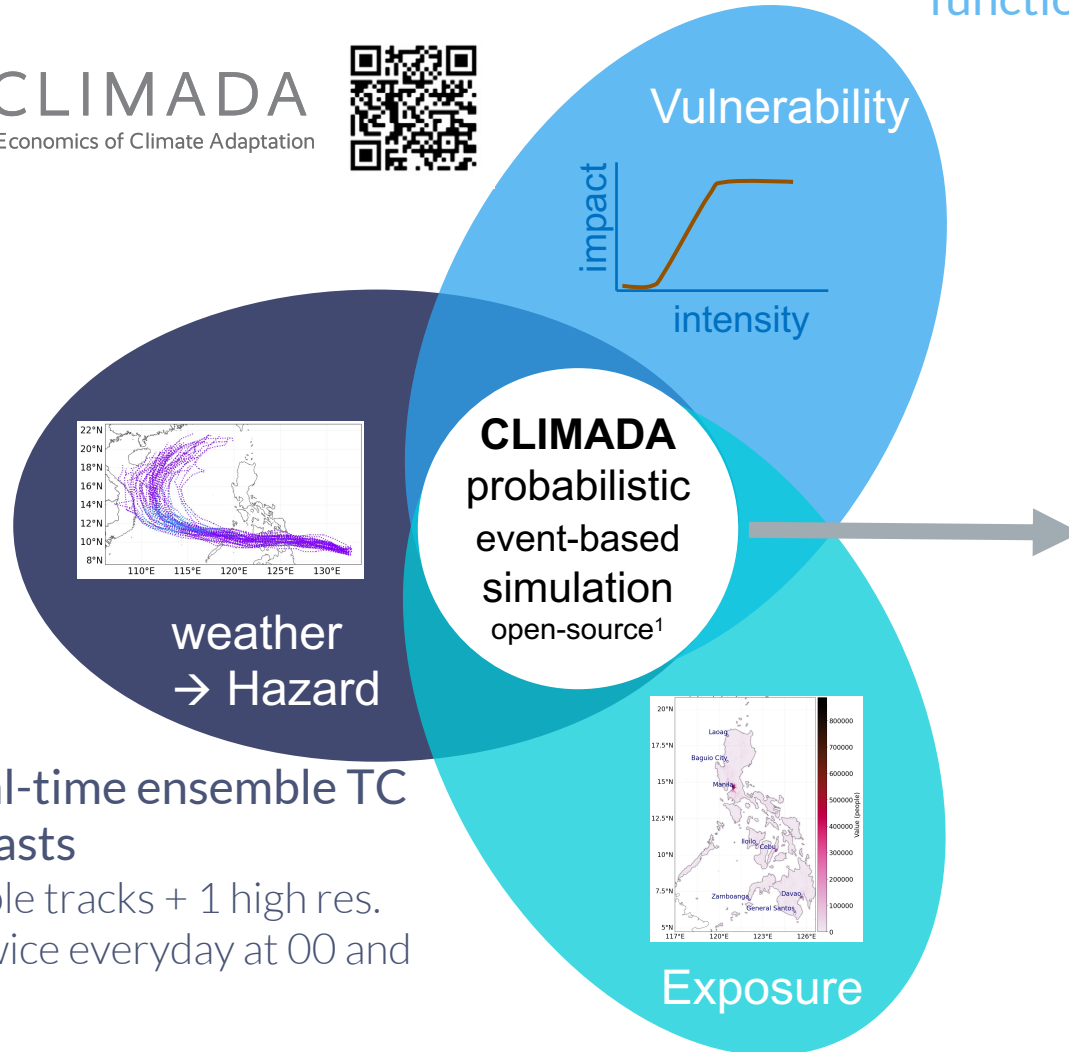
Tomorrow 5000 people in Country A are expected to be displaced due to landfall of TC XXX.



Examples adopted from *WMO guidelines on multi-hazard impact-based forecast and warning services (2015)*

CLIMADA (CLIMAtE ADAdptation)

Statistically fitted impact functions for displacement²

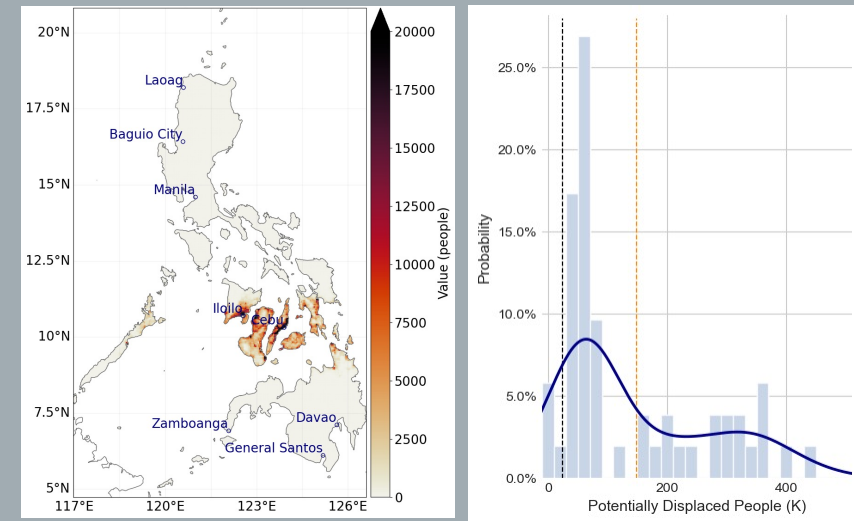


ECMWF real-time ensemble TC tracks forecasts

- 51 ensemble tracks + 1 high res.
- updated twice everyday at 00 and 12UTC

Outputs:

- Number of potentially displaced people
- Warning maps
- Uncertainties of the forecast

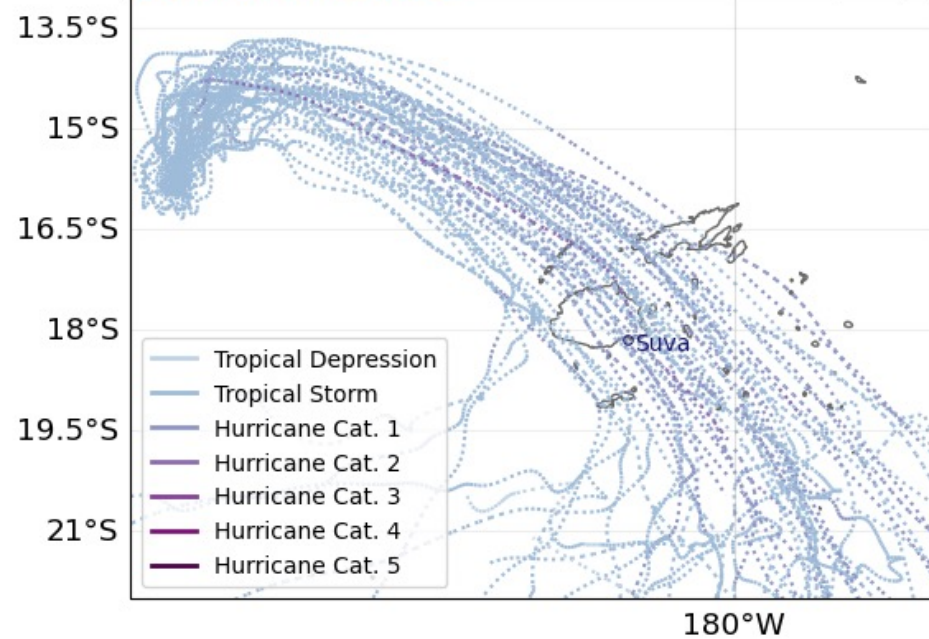


Case study – Cyclone Yasa

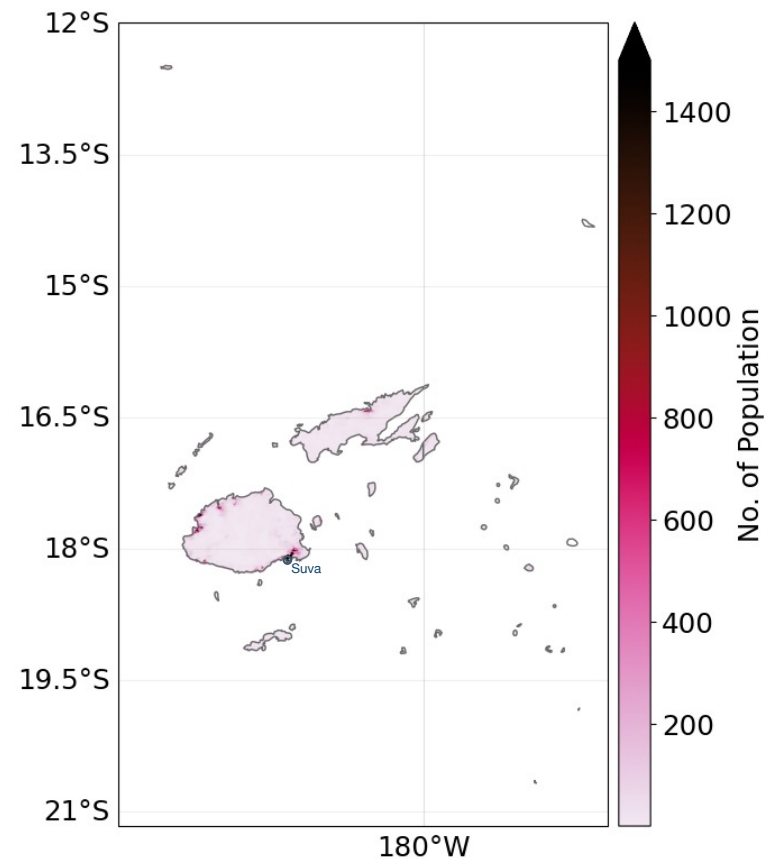
- Landfall at Fiji on 17 December 2020
- Reported displacement from IDMC: 23414 people

Hazard

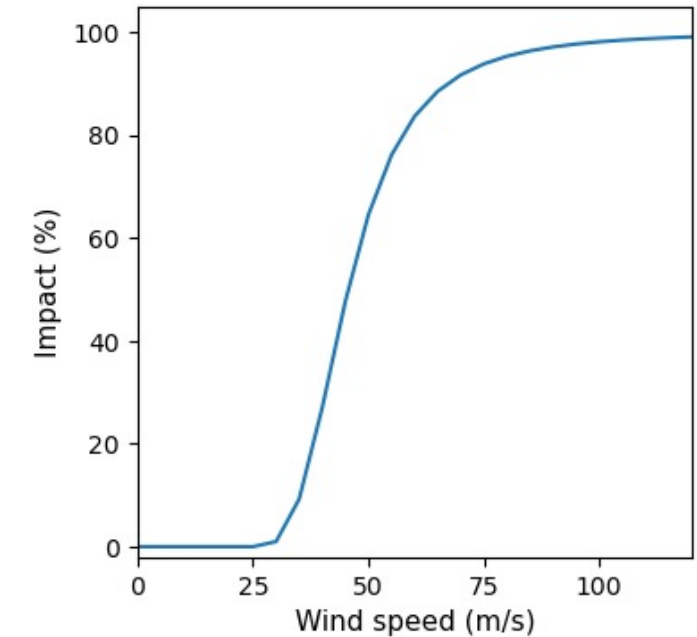
Tue 15 Dec 2020 00UTC Lead time: 48 hours (2 days)



Population in Fiji

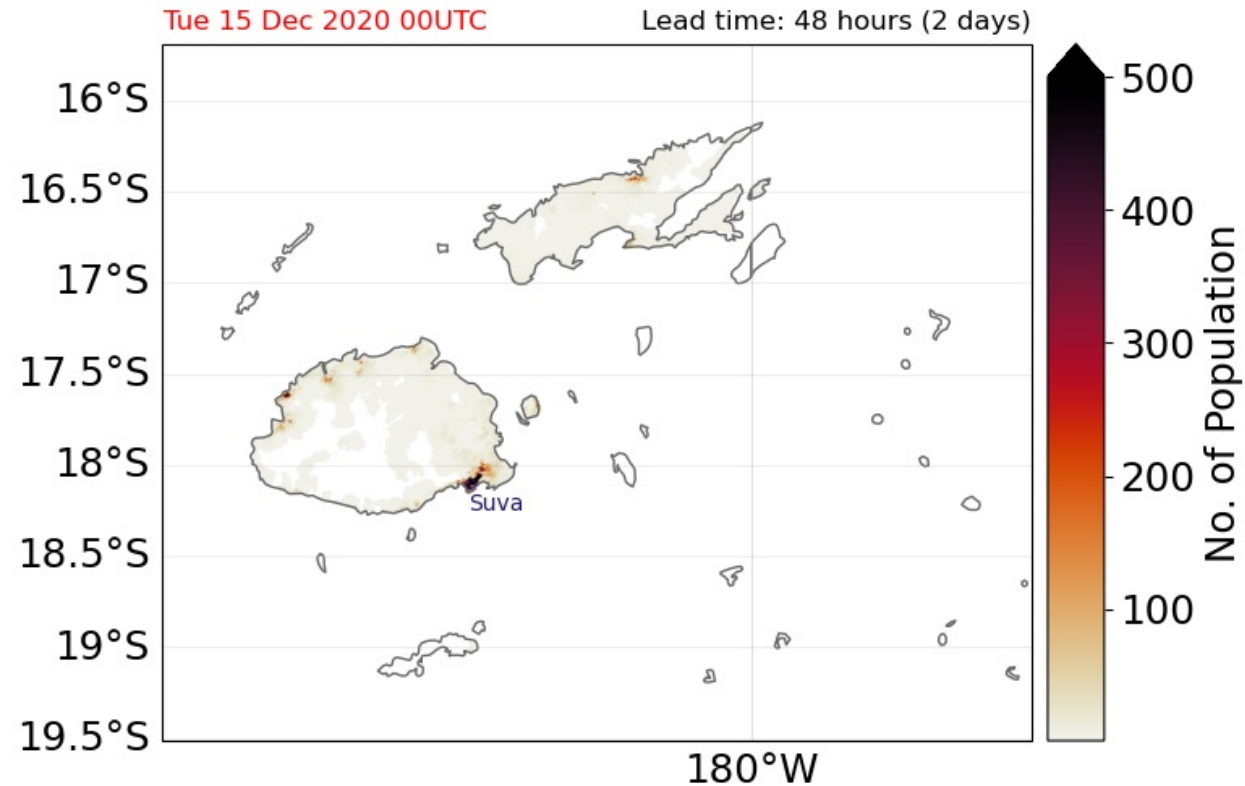


Impact function



Ensemble Averaged Impact

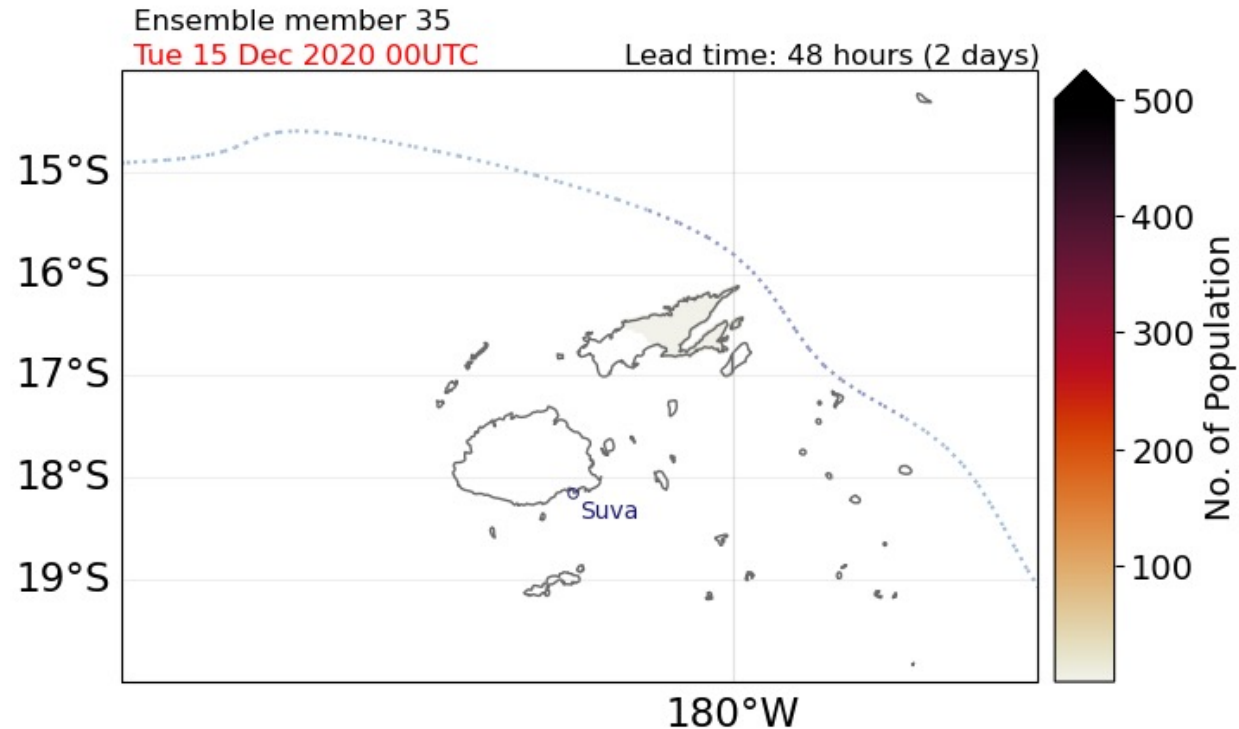
Ensemble averaged no. of potentially displaced people in Fiji



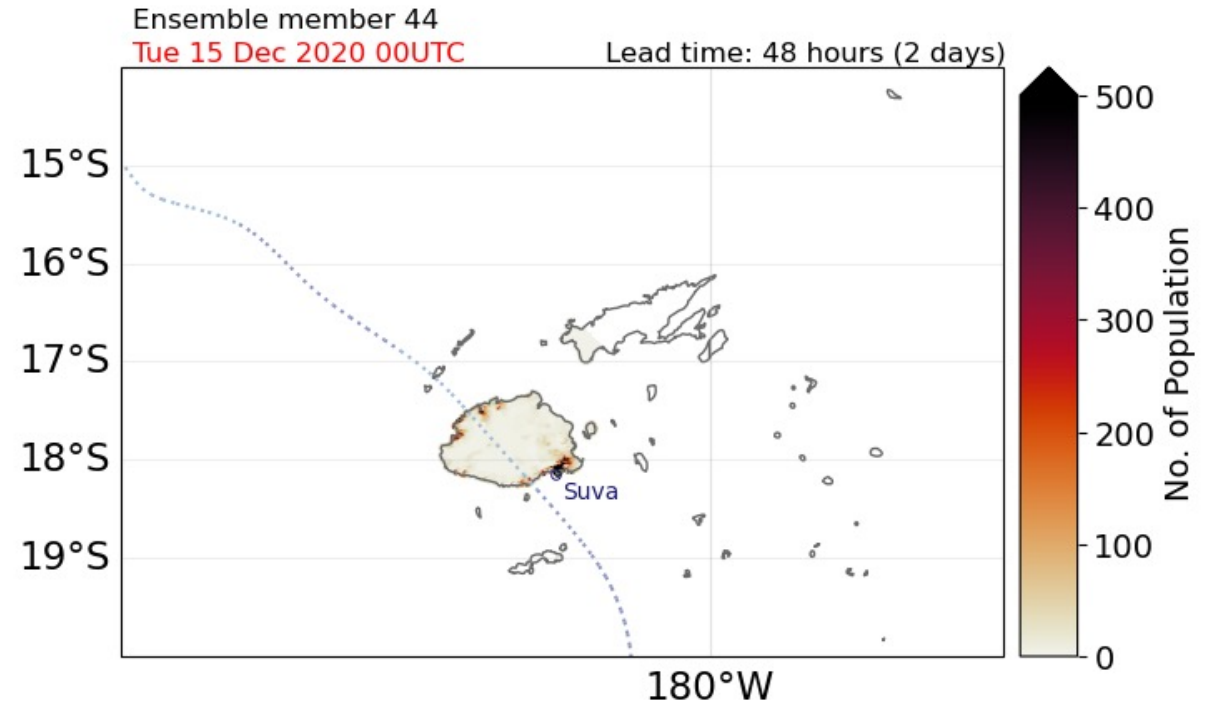
Total number: **147 K** people

Forecast range: **3.5 K – 449 K** people

Ensemble forecast– What does it mean?

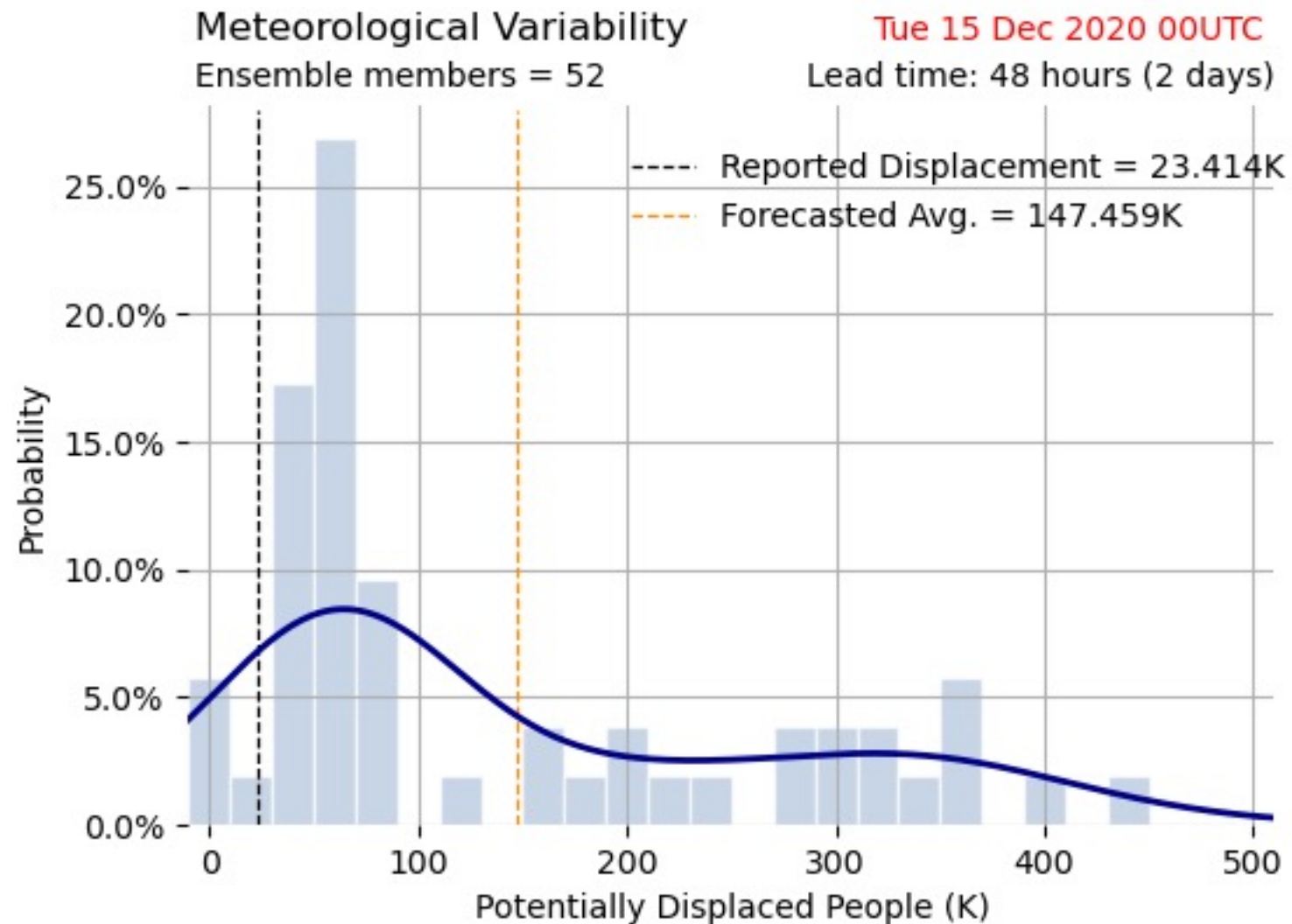


No. potentially displaced people: **~3.5** thousands



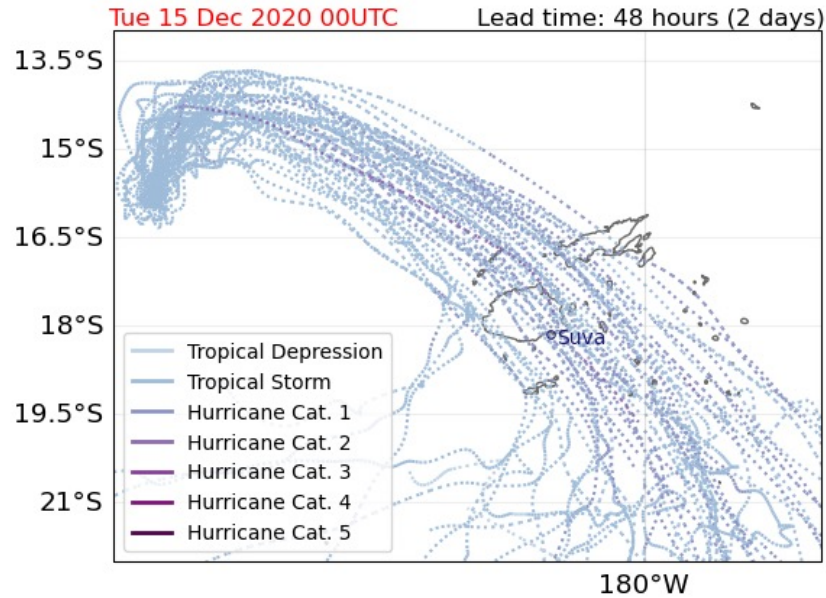
No. potentially displaced people: **~449** thousands

Forecasted impact distribution – Meteorological variability

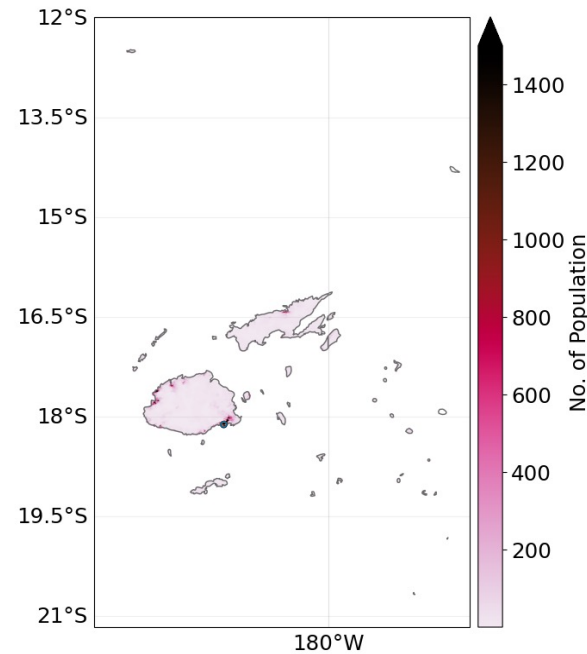


Uncertainties from different parameters

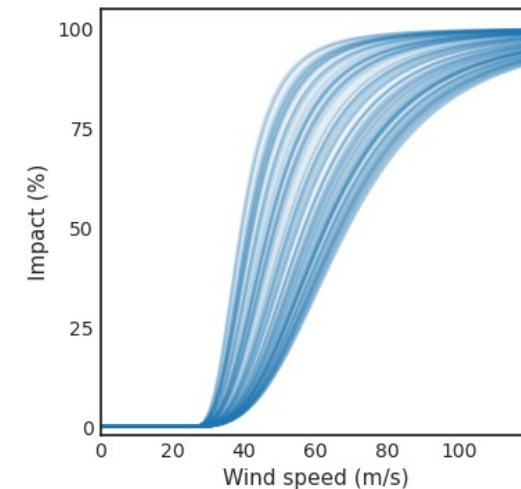
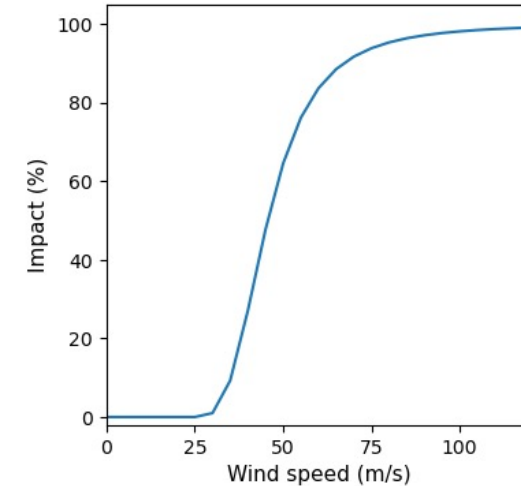
Forecast members



Total population



Vulnerability parameter



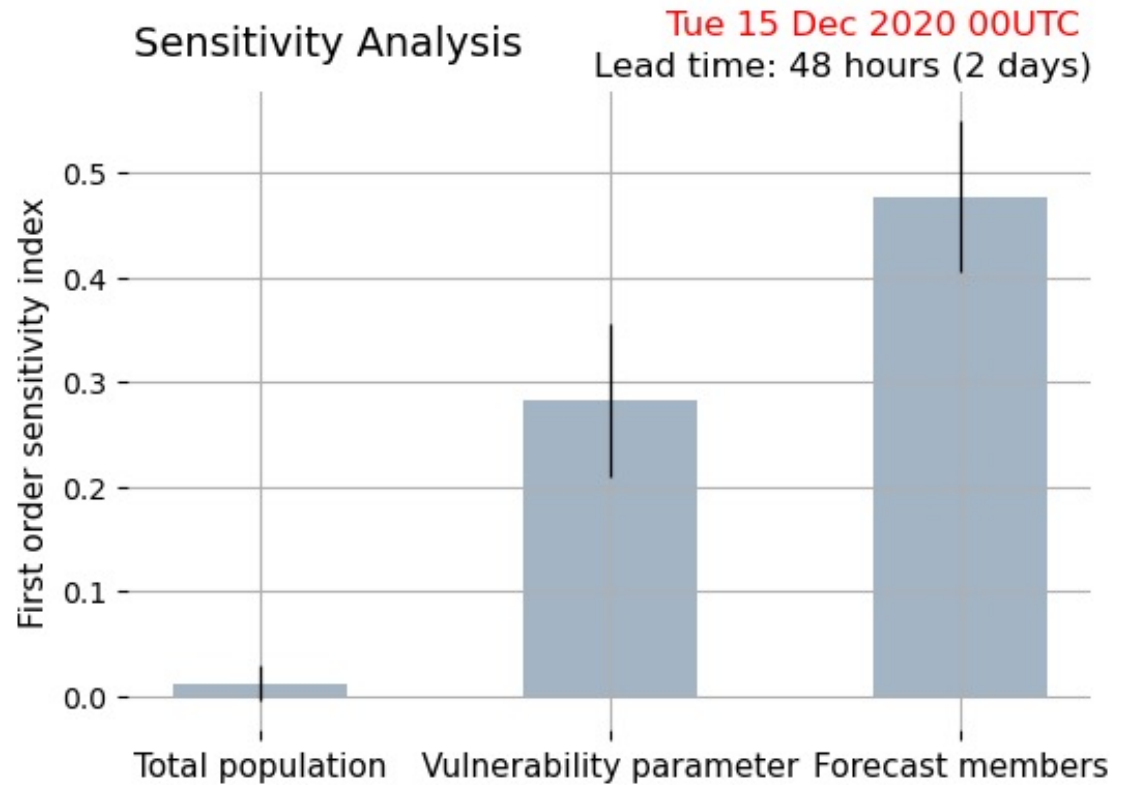
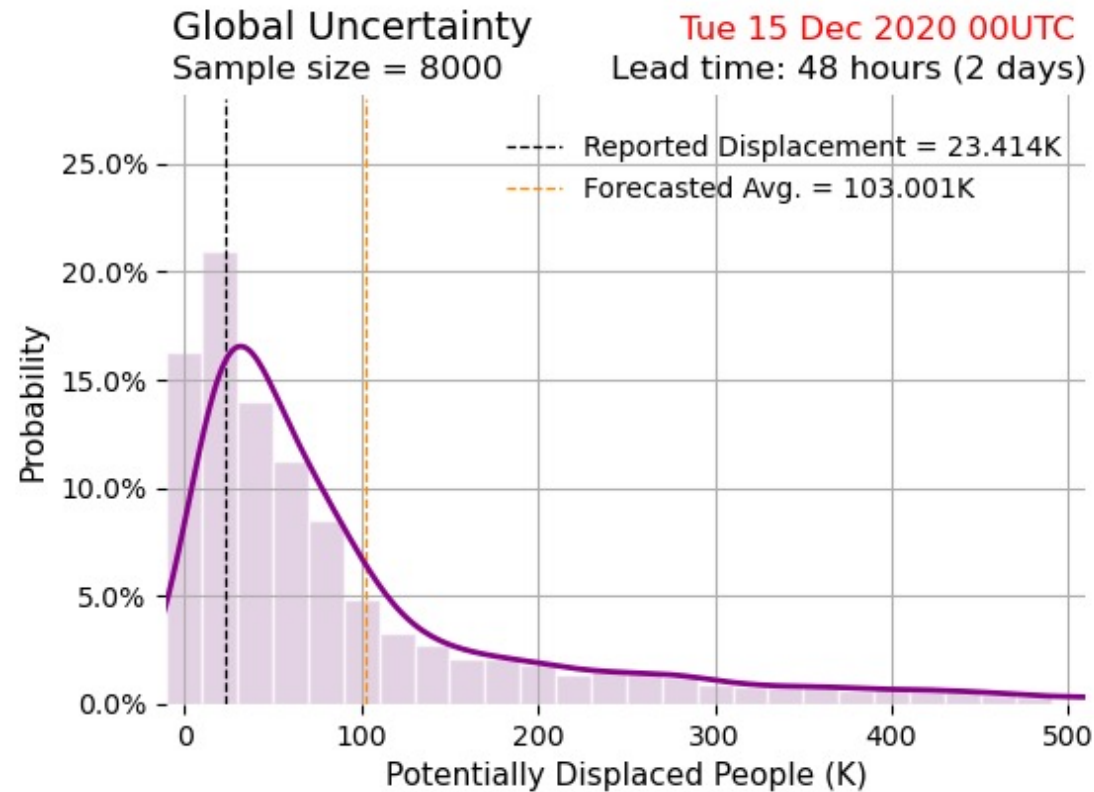
Global uncertainty analysis using (Quasi-) Monte-Carlo sampling with 8000 samples^{3,4}

³Kropf et al. (2022) doi: 10.5194/gmd-2021-437

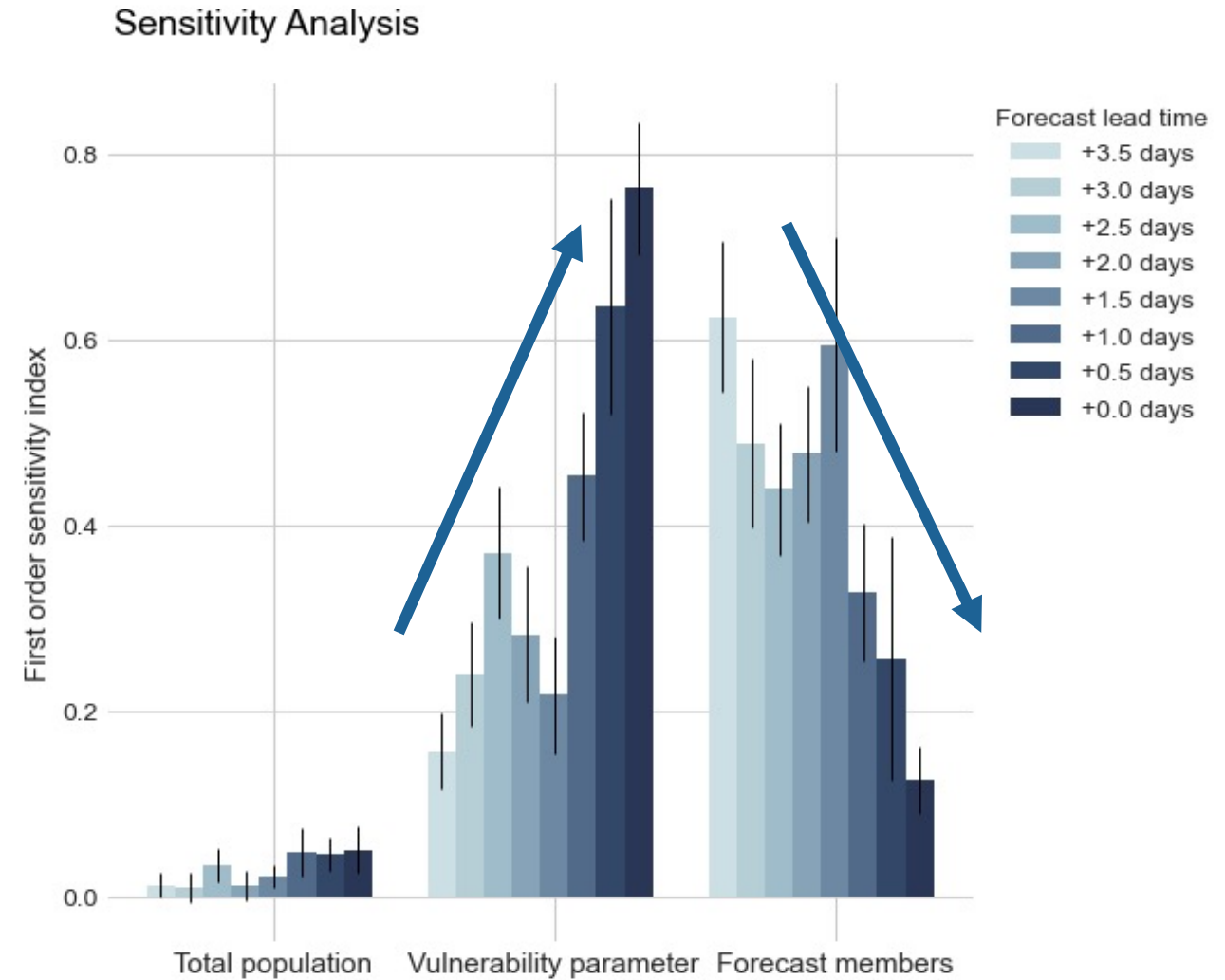
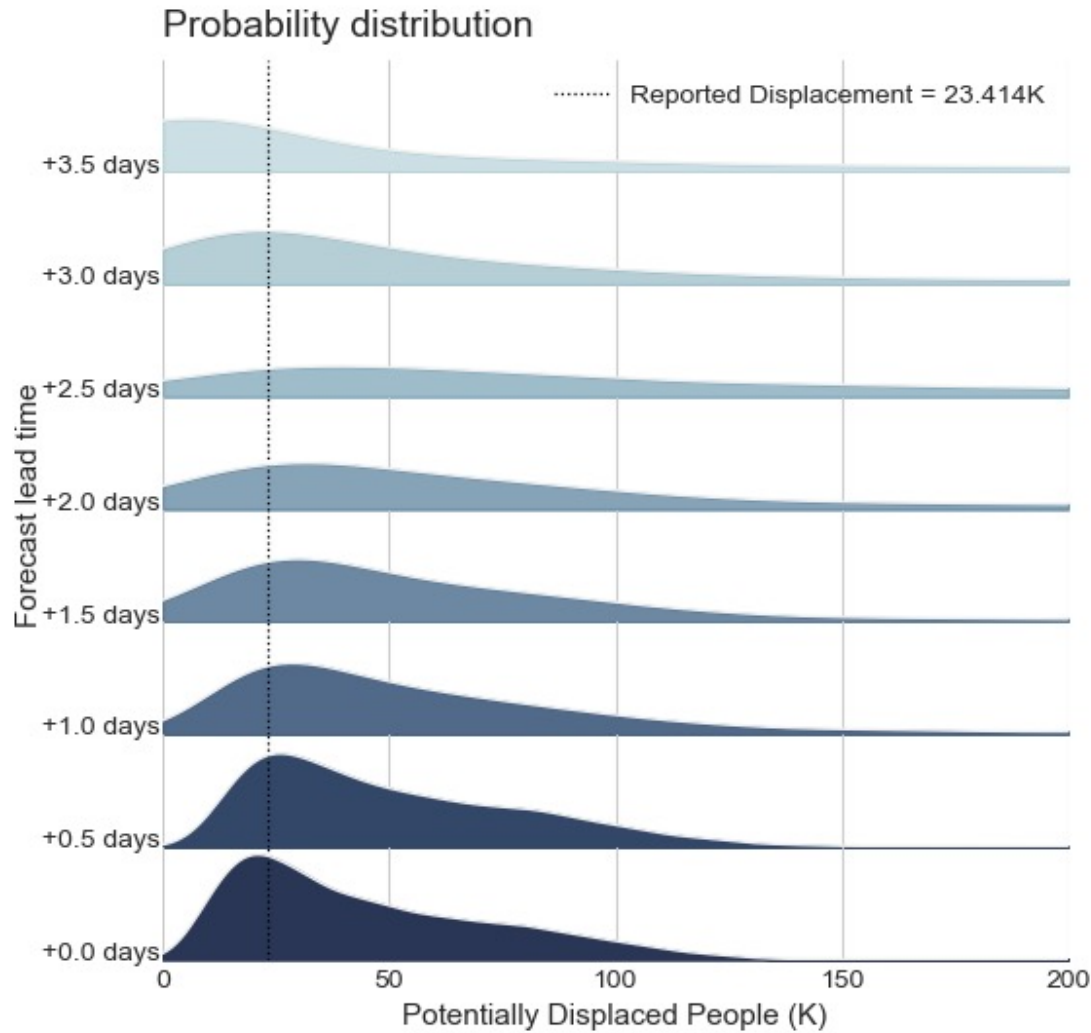
⁴Sobol (2001) doi: 10.1016/S0378-4754(00)00270-6

[-20%, +20%]

Forecasted impact distribution – Global uncertainty



Forecasted impact over time



Conclusions

- Possible to make meaningful **population displacement forecast**
- **Uncertainties** need to be included for decisions about population displacement
- **Meteorological uncertainty** dominates at **first**, but **local vulnerability** dominates towards landfall

Pui Man (Mannie) Kam
mannie.kam@usys.ethz.ch

Doctoral Student
Weather and Climate Risks Group
ETH Zurich
www.wcr.ethz.ch



Thank You!

