A Deep Learning Approach to Improving Projections of Future Climate in Hawaii

Yusuke Hatanaka, Amila Indika, Peter Sadowski
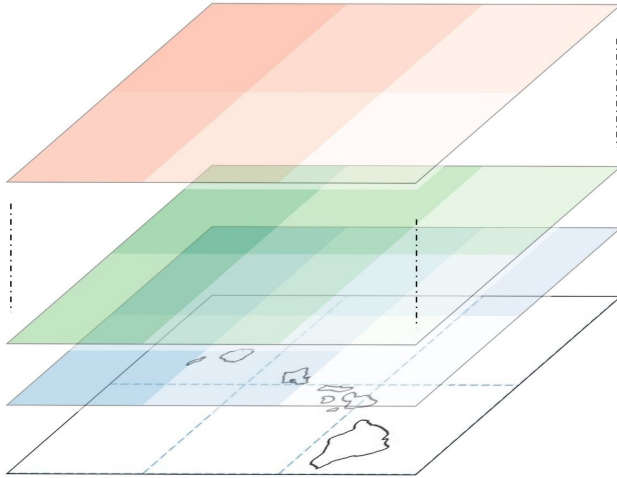
University of Hawaii at Manoa
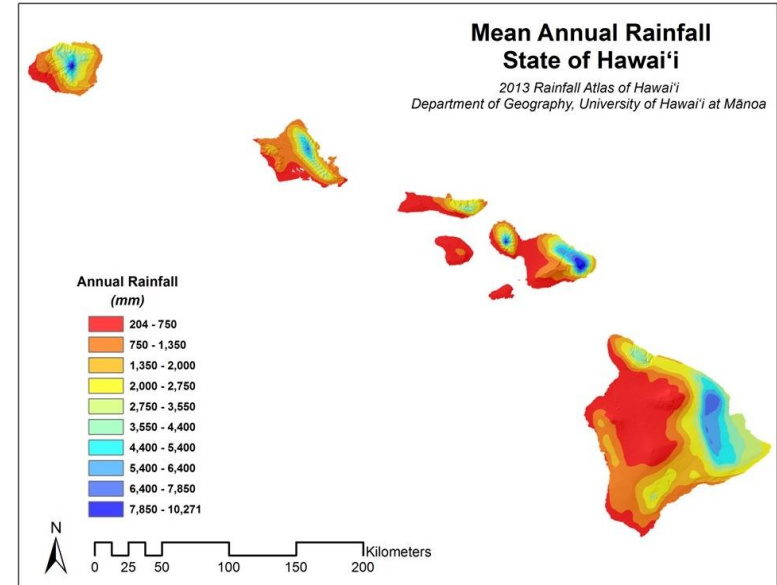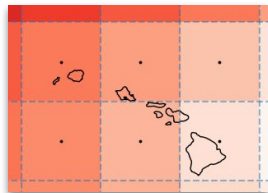
Statistical Downscaling for Rainfall

Ocean & Surface Conditions
in Coarse Resolution

Giambelluca +, 2013: Online Rainfall Atlas of Hawai'i. *Bull. Amer. Meteor. Soc.* 94, 313-316, doi: 10.1175/BAMS-D-11-00228.1.
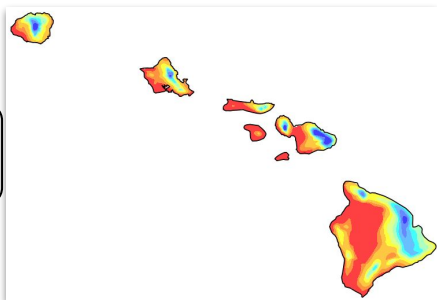
Our Approach

Coarse
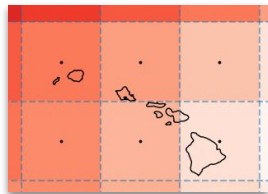Reanalysis Data

Site Specific Linear
Regression (x1000)

Sparse Rainfall

Gaussian Process
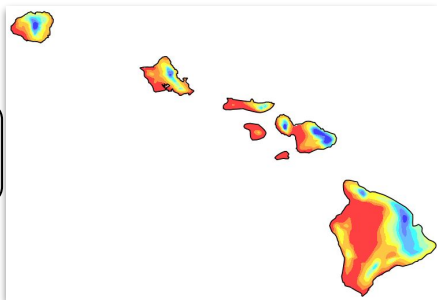Interpolation

Gridded Rainfall

Our Approach

Coarse Reanalysis Data

Sparse Rainfall

Gridded Rainfall

Site Specific Linear Regression (x1000)

Gaussian Process Interpolation

Neural Network

Historical Data Set

- Rainfall data from Hawaii Climate Data Portal
  - monthly cumulative rainfall observed at 1000+ rainfall gauges
- NCAR/NCEP Reanalysis at 2.5°
  - monthly average for 16 climate variables
- Digital Elevation Map (DEM) at 250m
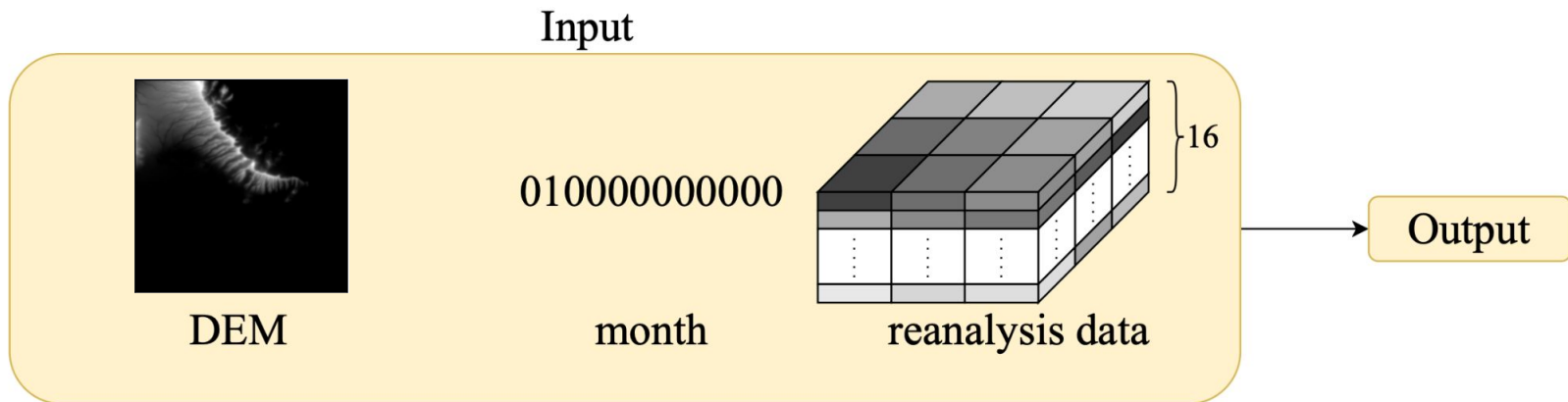- Train on [1948-1999], Test on [2000-2012]
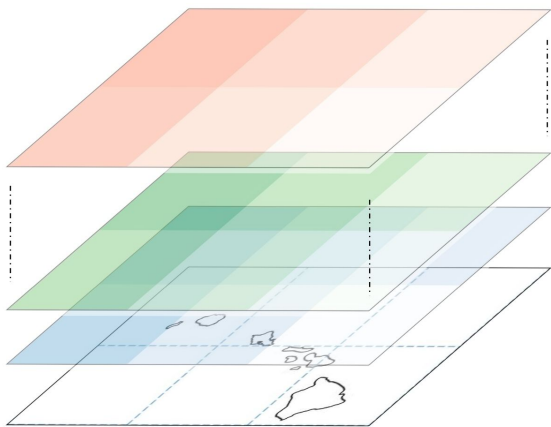
Neural Network Model
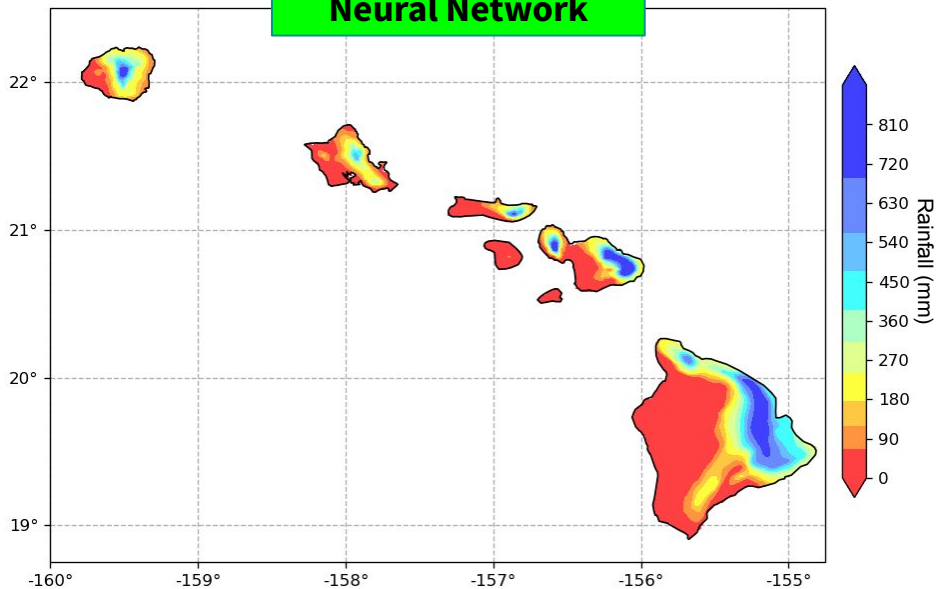
Single model makes prediction at any location

Learn the rainfall pattern based on orographic feature

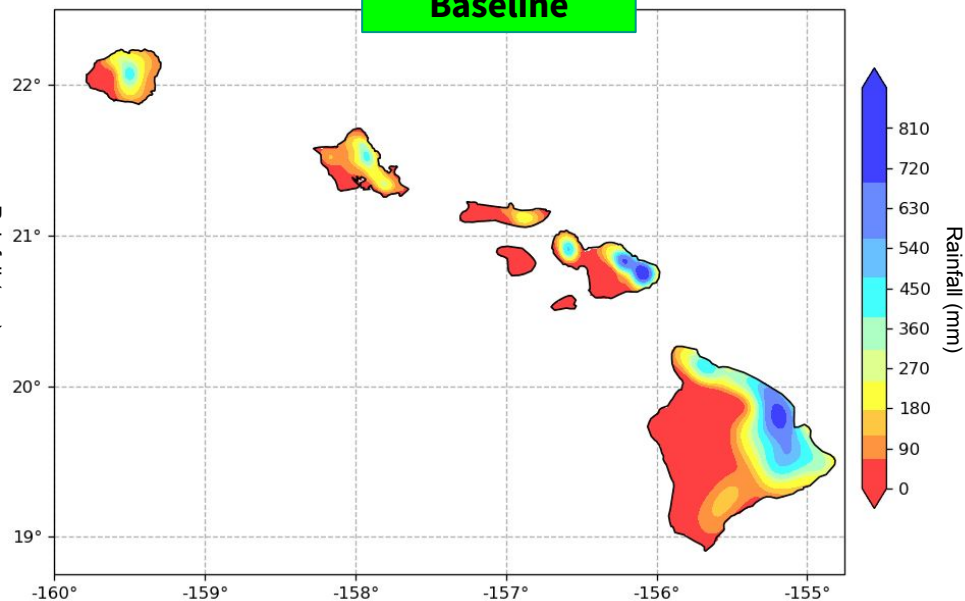"Transfer" the knowledge among weather stations

Results: Predicted Rainfall Maps (Jan, 2000)
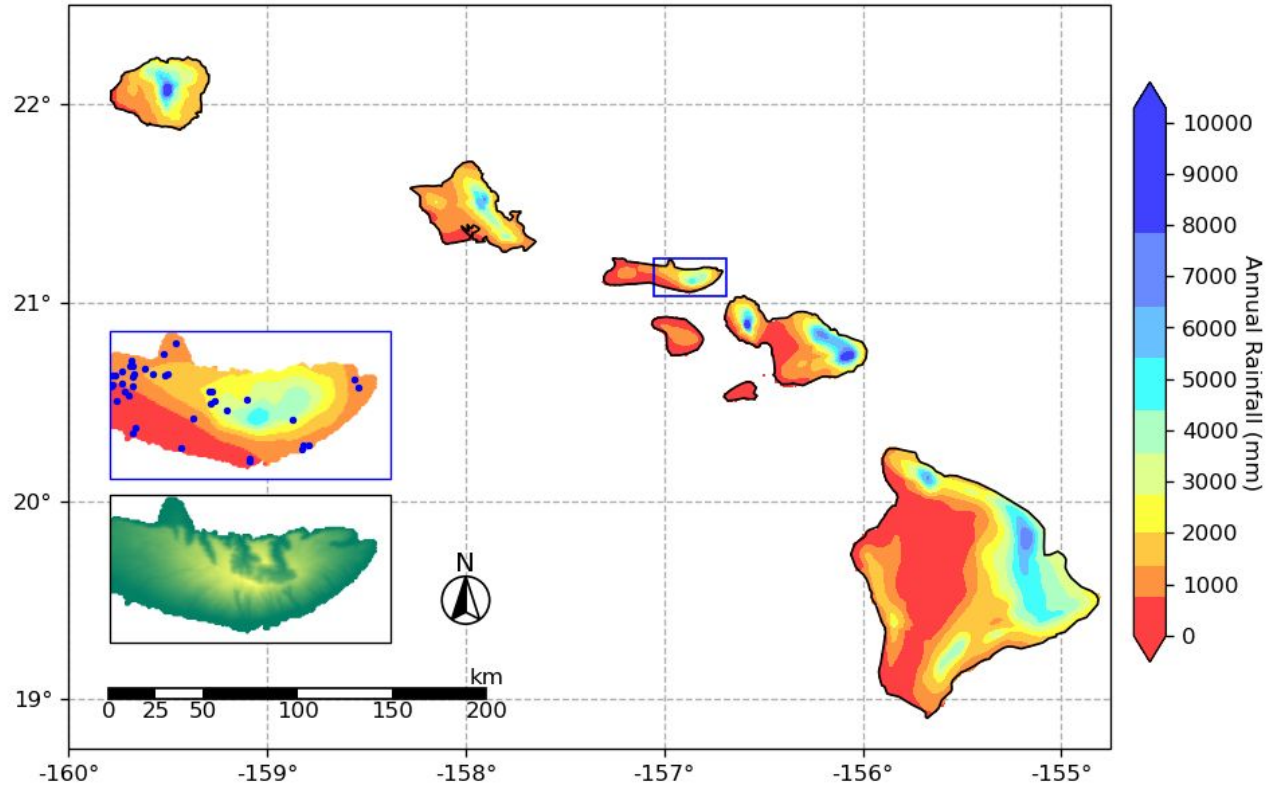

Neural Network — RMSE=**87.2** (mm)   R²=**0.80**

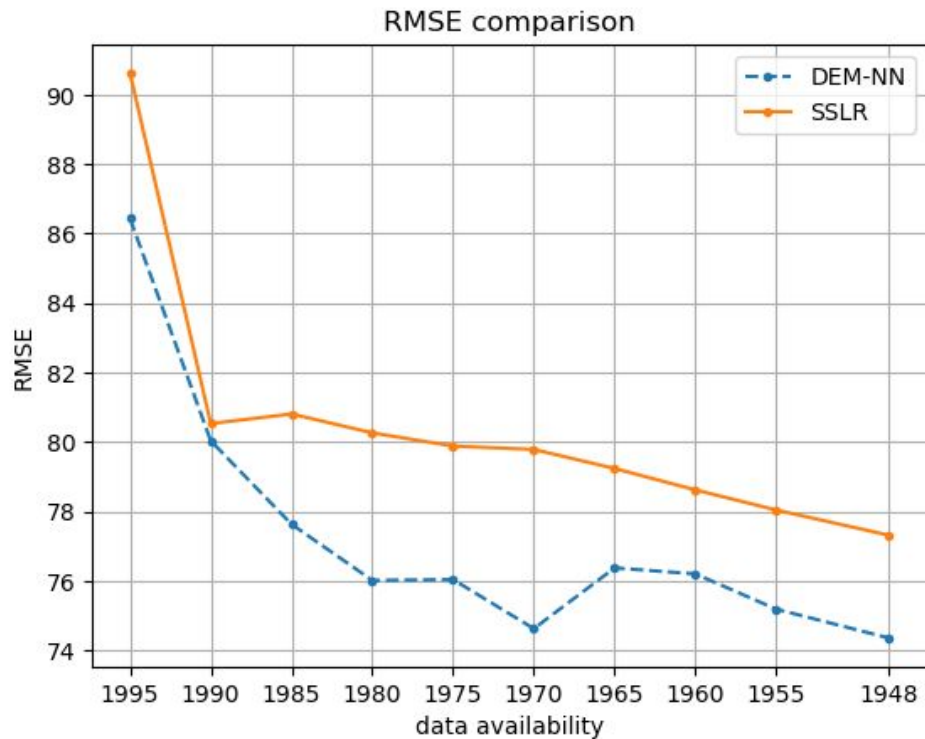Baseline — RMSE=**107.8** (mm)   R²=**0.70**

Results

- Improvement in all metrics
  - **8.5%** improvement for RMSE

Metric	All	
	Base	DEM
r^2	0.55	0.62
R^2	0.54	0.62
Bias	7.44	3.77
$\widehat{\textbf{Bias}}$	0.07	0.03
MAE	56.95	52.41
$\widehat{\textbf{MAE}}$	0.52	0.48
MED	31.87	28.52
$\widehat{\textbf{MED}}$	0.29	0.26
RMSE	104.11	95.16
$\widehat{\textbf{RMSE}}$	0.95	0.86
N	56,620	

higher the better

lower the better

Orographic information improves performance

Transfer learning improves performance

RMSE comparison

Thank you!