Supplemental Materials for "Broken Environment–Storm Coupling in Global Kilometer-Scale Simulations"

Dié Wang[1*], Andreas F. Prein[1] and Praveen K. Pothapakula[1]

[1]Institute for Atmospheric and Climate Science, ETH Zürich, Universitätstrasse 16, Zürich, 8092, Switzerland.

*Corresponding author(s). E-mail(s): die.wang@env.ethz.ch;
Contributing authors: aprein@ethz.ch;
praveen.pothapakula@env.ethz.ch;

1 Figures and Tables

Table 1 Acronyms and abbreviations used in this manuscript.

Acronym	Definition
CAPE	Convective Available Potential Energy
CIN	Convective Inhibition
CORDEX	Coordinated Regional Climate Downscaling Experiment
CWV	Column-integrated Water Vapour
DAG	Directed Acyclic Graph
DYAMOND	DYnamics of the Atmospheric general circulation Modeled On Non-hydrostatic Domains
ERA5	Fifth-generation European Centre for Medium-Range Weather Forecasts atmospheric reanalysis
GPM IMERG	Integrated Multi-satellite Retrievals for Global Precipitation Measurement
GT4Py	GridTools for Python
ICON	Icosahedral Nonhydrostatic Model
IFS	Integrated Forecasting System
LHF	Surface Latent Heat Flux
LIFE	MCS life duration
LLMC	Moisture convergence below 850 hPa
LLS	Maximum wind speed below 700 hPa
LRH	Mean relative humidity below 850 hPa
LWSR	Wind vector difference between the surface and 850 hPa
MAXP	Maximum of the maximum precipitation throughout the MCS lifecycle
MCS	Mesoscale Convective Systems
MERGIR	Merged multi-satellite geostationary infrared brightness temperature
MOAAP	Multi-Object Analysis of Atmospheric Phenomena
MPAS	Model for Prediction Across Scales
MRH	Mean relative humidity between 850 and 500 hPa
MWSR	850–500 hPa wind difference
NICAM	Nonhydrostatic ICosahedral Atmospheric Model
NOTEARS	Non-combinatorial Optimization via Trace Exponential and Augmented LagRangian for Structure Learning
SAM	System for Atmospheric Modeling
SCREAM	Simple Cloud-Resolving E3SM Atmosphere Model
SHF	Surface Sensible Heat Flux
SIZE	Maximum size of the MCS throughout its lifecycle
TOTP	Maximum of the total precipitation throughout the MCS lifecycle
TURBDIFF	TURBulent DIFFusion
TWP	Tropical Western Pacific
WRF	Weather Research and Forecasting

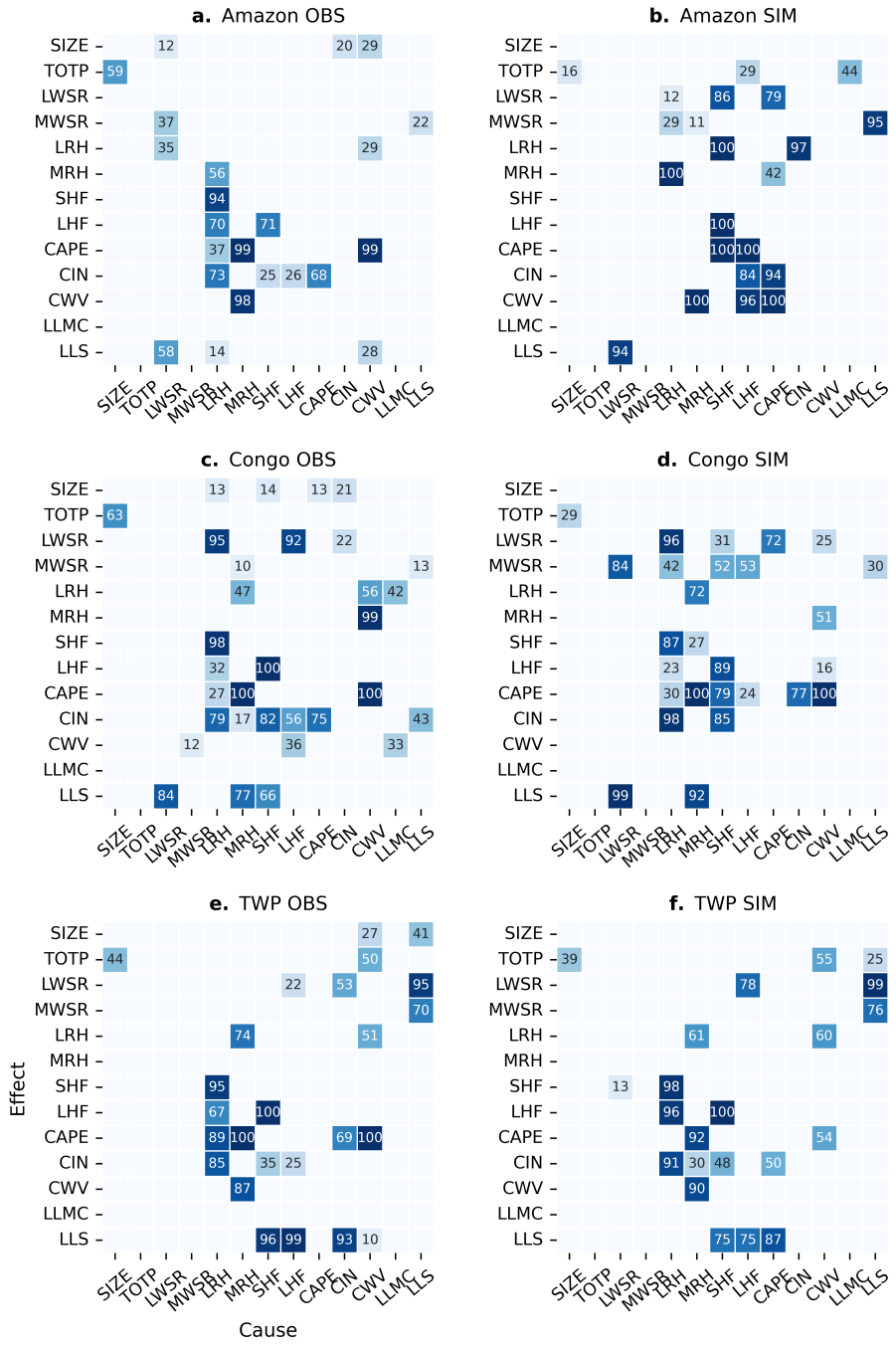

Fig. 1 Robustness of inferred causal links across bootstrap realizations. Values indicate the frequency with which each causal connection is recovered across the bootstrap resampling procedure (1,000 times) in the three study regions, providing a measure of the robustness of the inferred causal structure. Observational results are shown in the left column, and simulation results are shown in the right column.