A New Method to Compile Global Multi-Hazard Event Sets

Judith N. Claassen, *Elco E. Koks, Timothy Tiggeloven, and Marleen C. de Ruiter*

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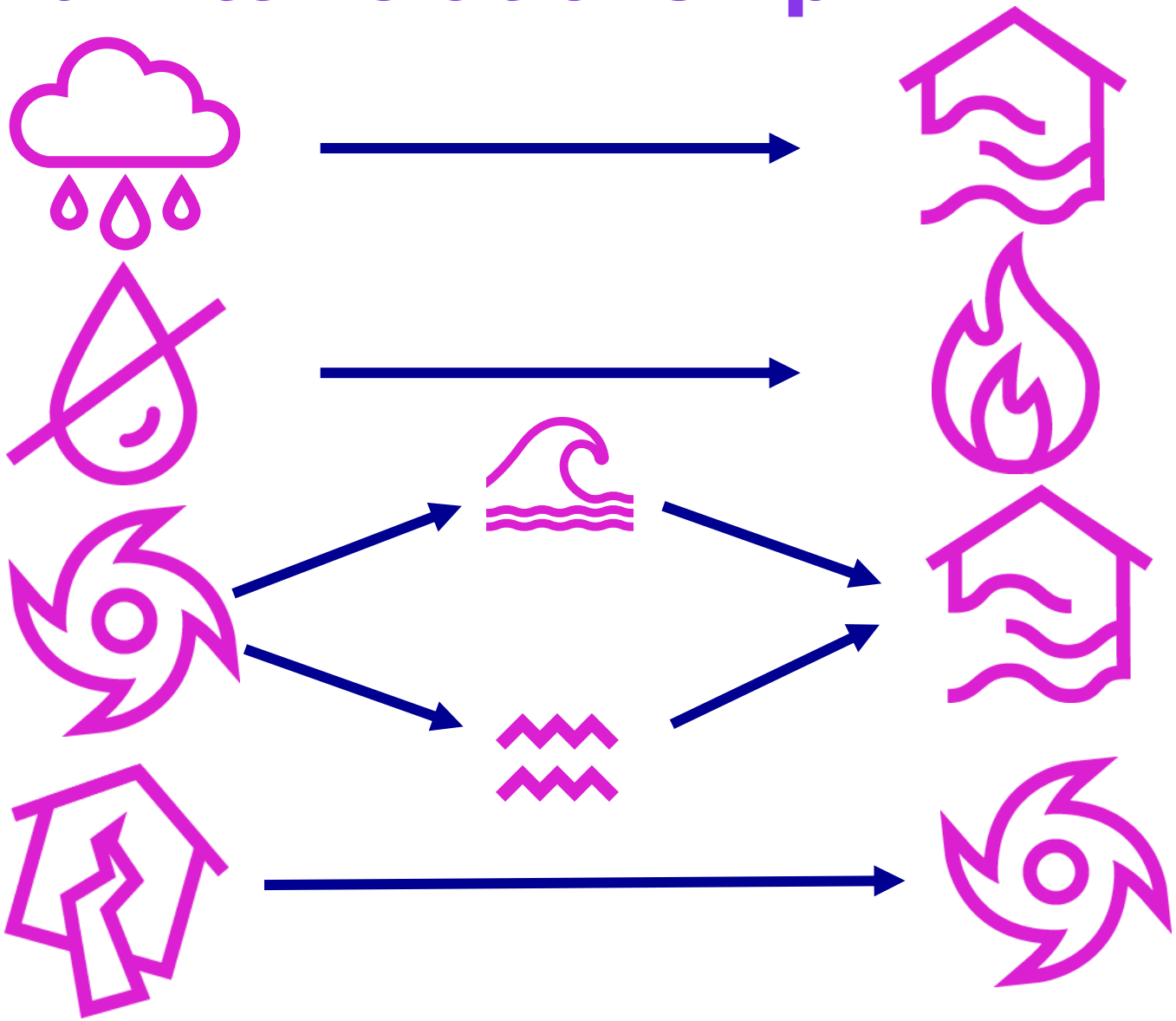
The MYRIAD-EU project has received funding from the European Union's Horizon 2020 research and innovation programme call H2020-LC-CLA-2018-2019-2020 under grant agreement number 101003276

Multi-Hazard Interrelationship

- Triggering
- Amplification
- Compound
- Consecutive



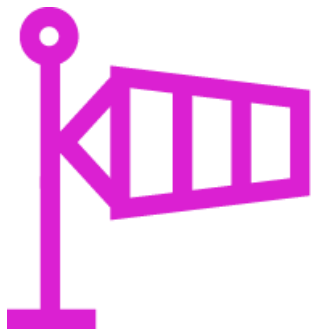
Research Gap

Triggering

Amplification

Compound

Consecutive



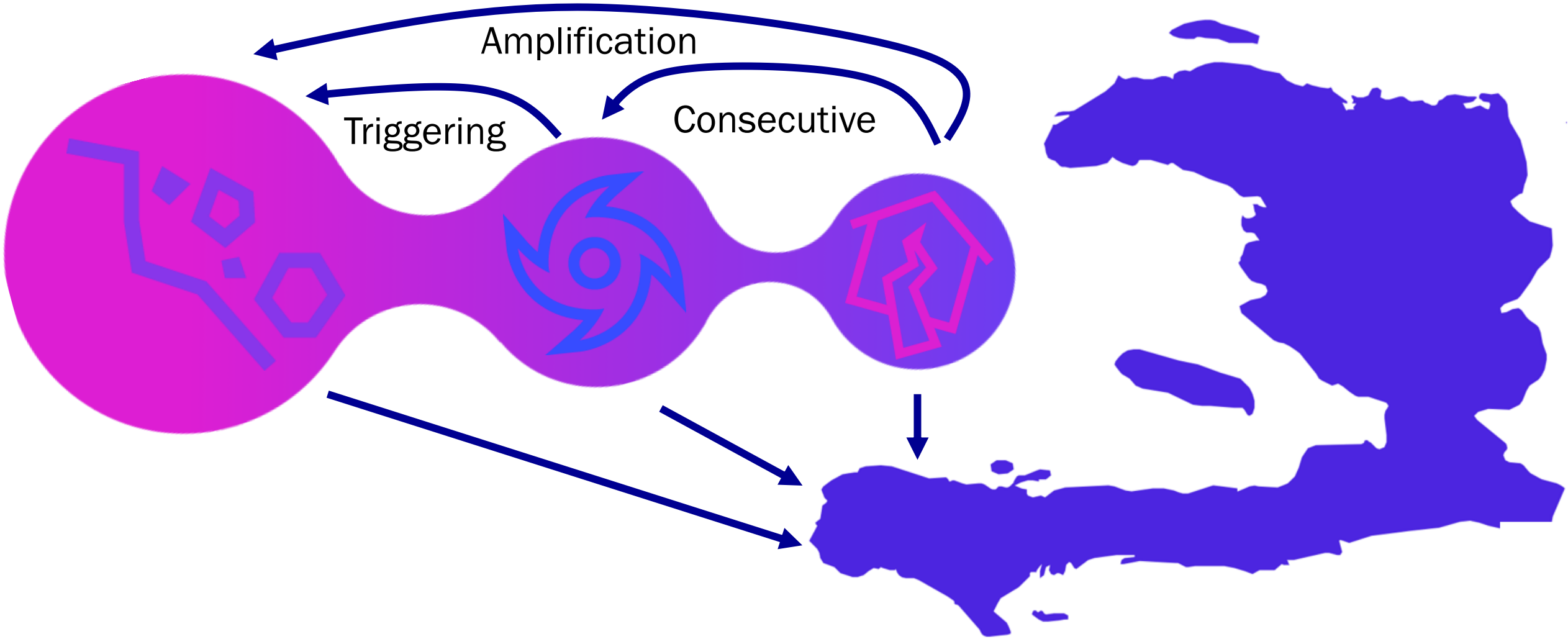
Meteorological

Climatological

Geophysical

Hydrological

Why is This Important?



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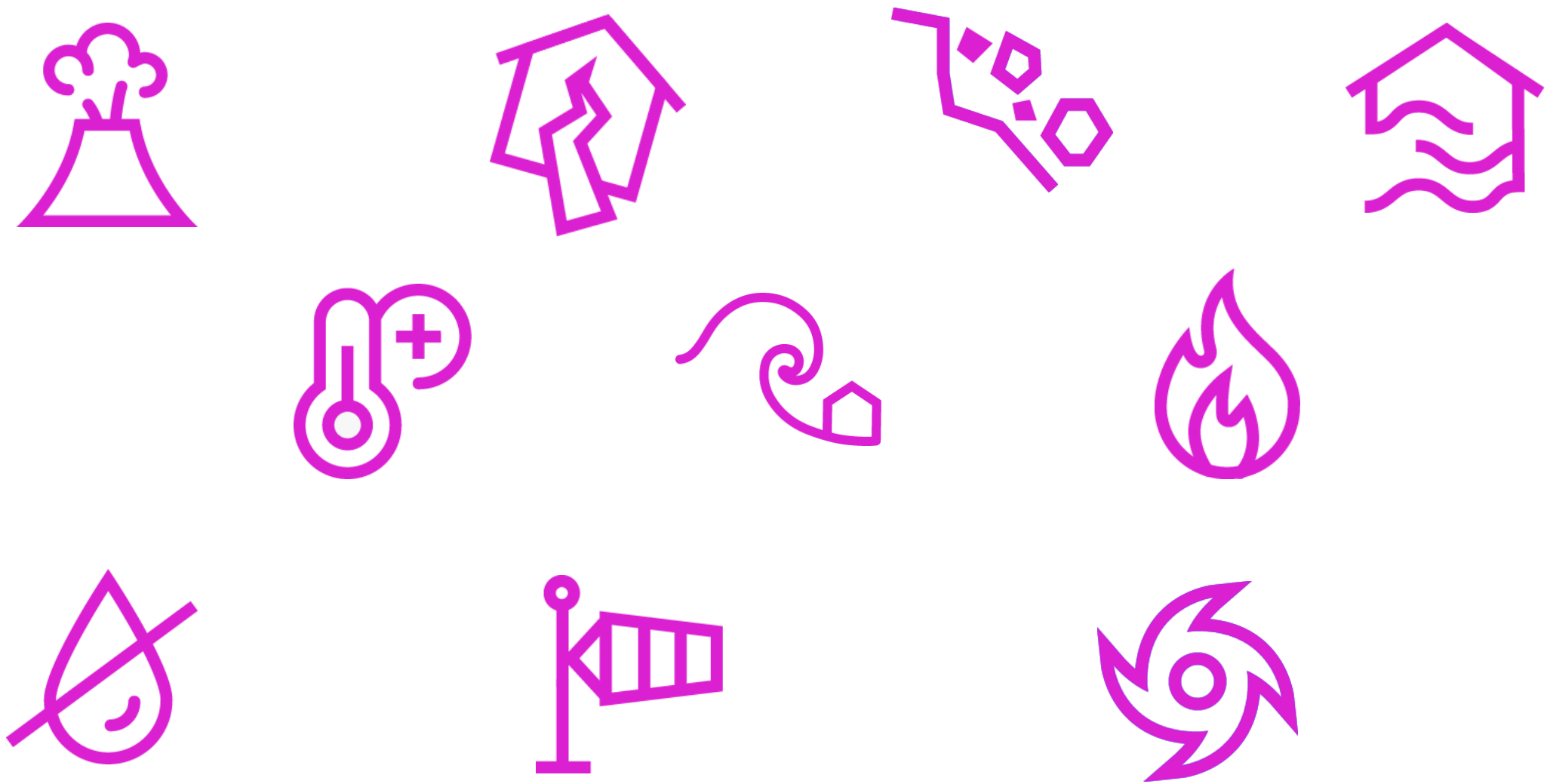
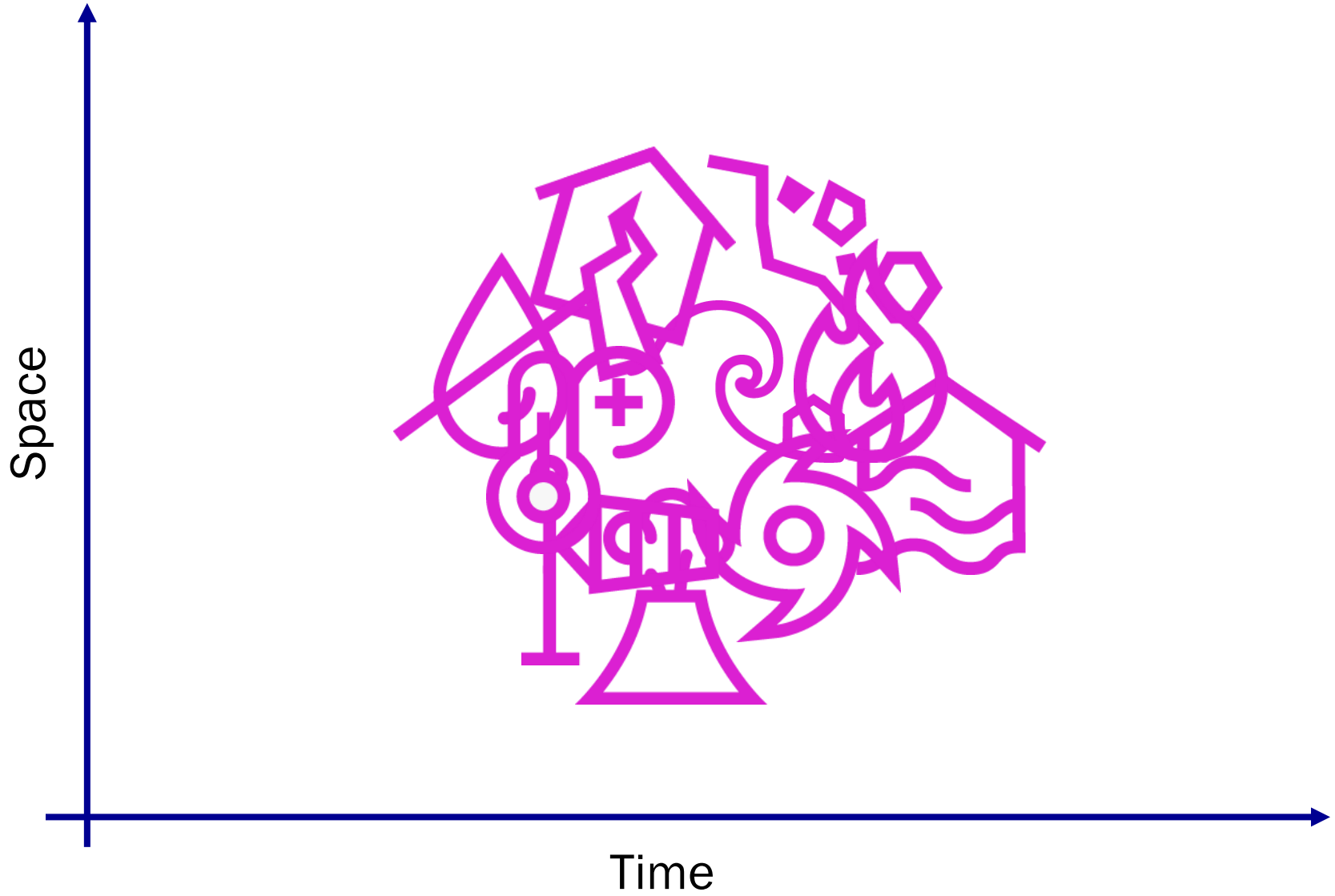
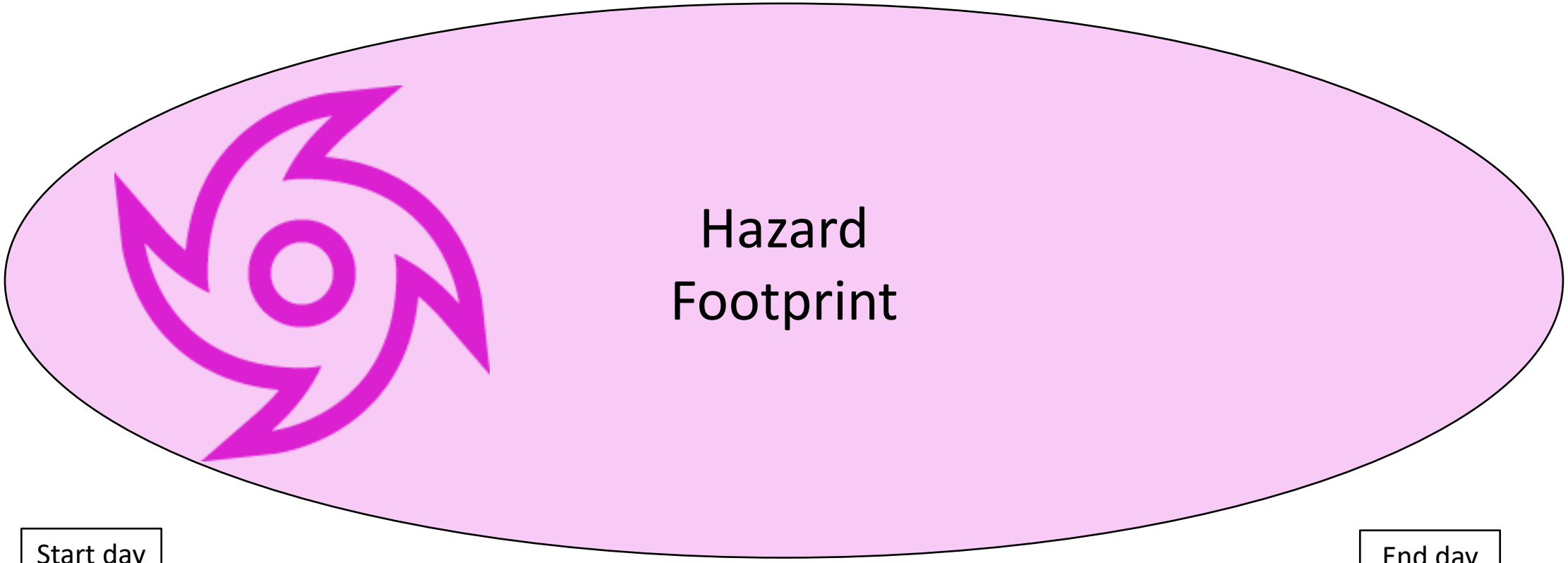
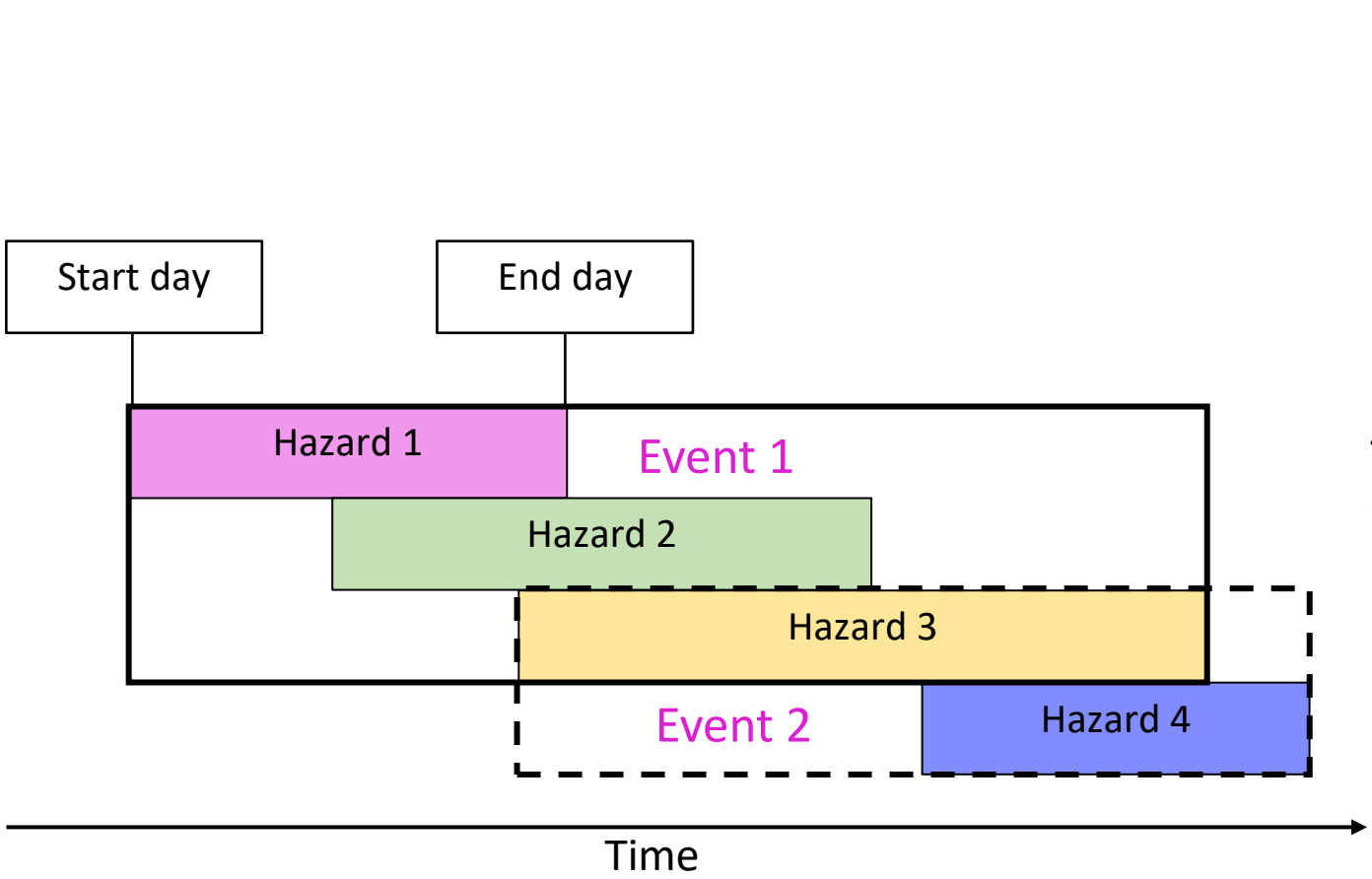
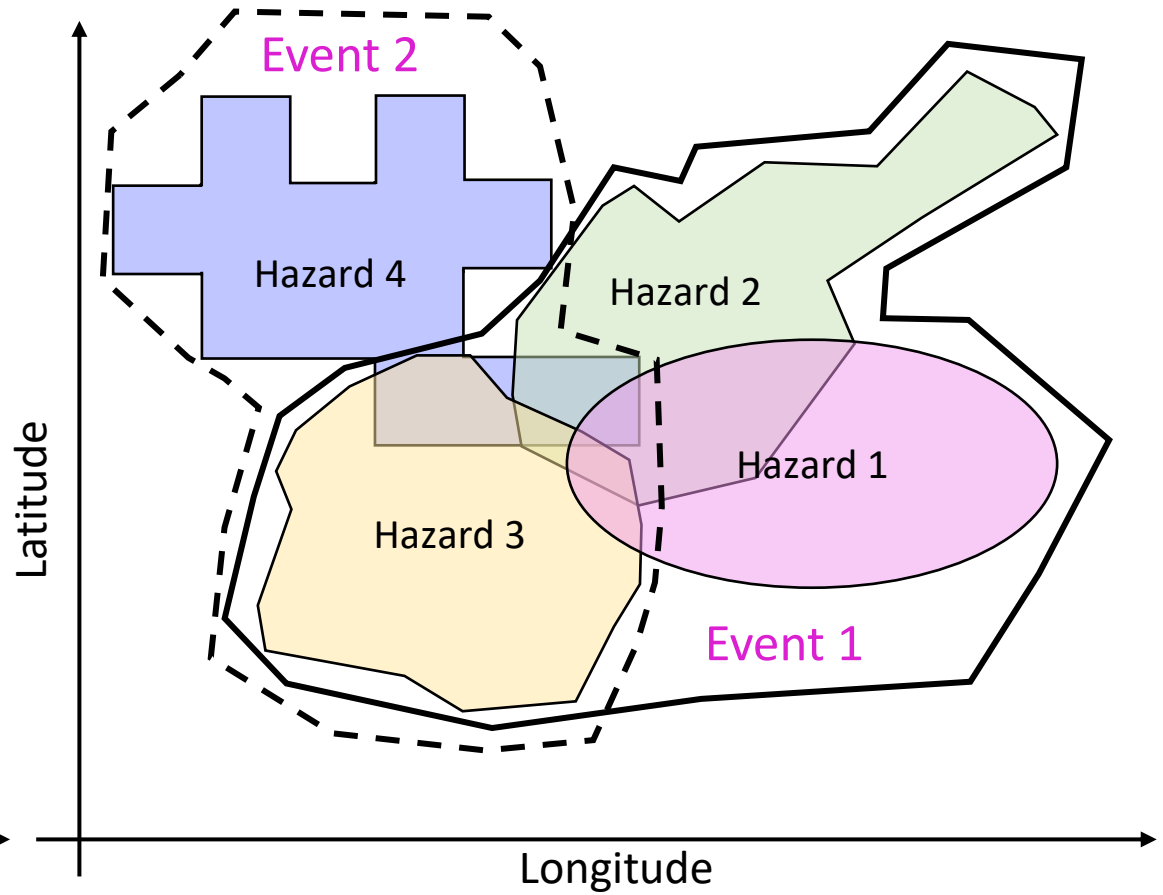



Space
Time


Hazard
Footprint
Start day
End day
Duration

MYRIAD-HESA: MYRIAD – Hazard Event Sets Algorithm





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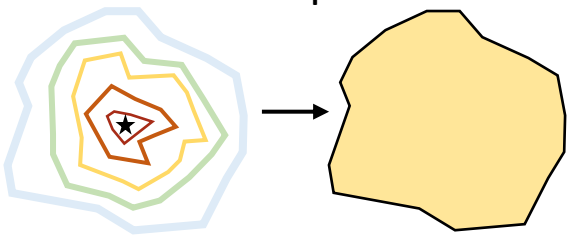
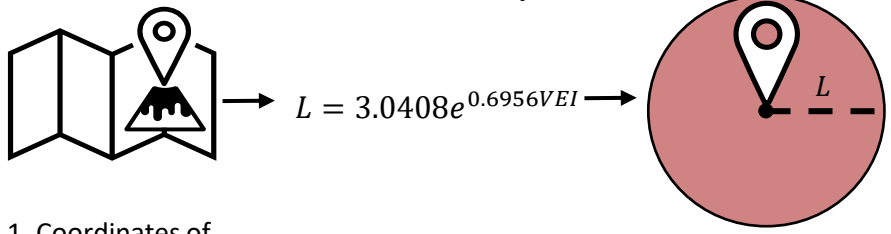
Earthquake



1. Define the outer bound where the MMI is at least five

2. **Final polygon**

Volcanic Eruption

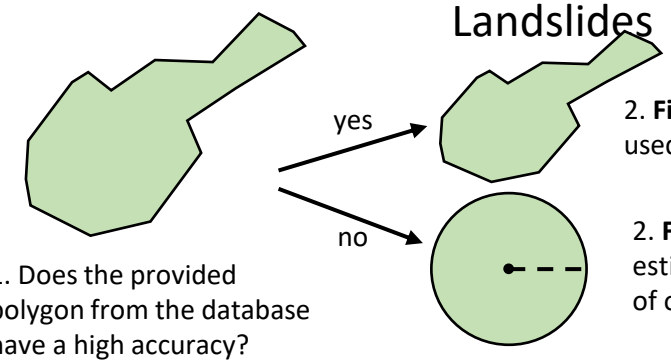


1. Coordinates of volcanic eruption and VEI

2. Calculate radius of influence

3. **Final polygon**

Landslides

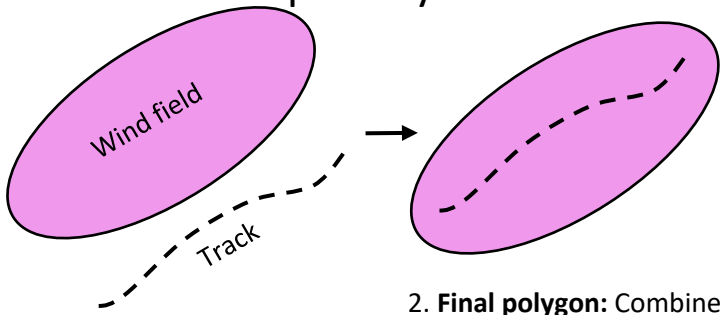


1. Does the provided polygon from the database have a high accuracy?

2. **Final polygon**: polygon is used as provided

2. **Final polygon**: polygon is estimated based on coordinates of occurrence and fixed radius

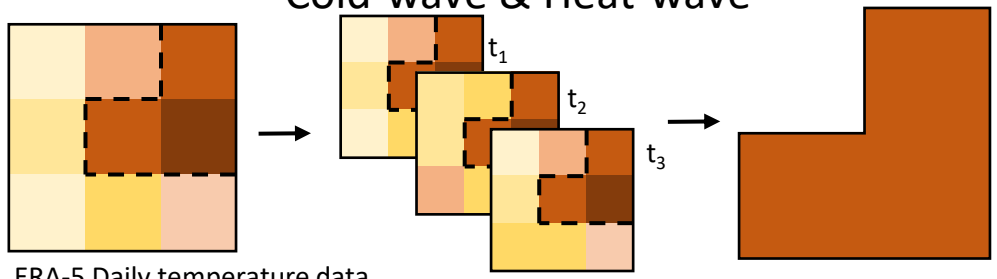
Tropical Cyclone



1. Wind field from WRN-TC and track from IBTrACS

2. **Final polygon:** Combine track and wind field based on tropical cyclone name and year

Cold-wave & Heat-wave

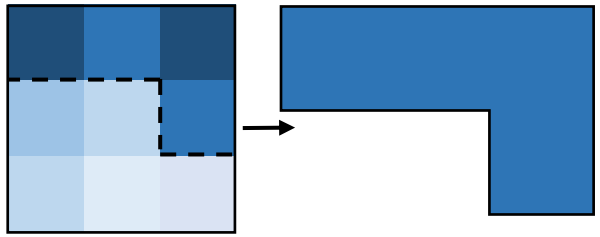


1. ERA-5 Daily temperature data, calculate the daily extremes (< 5 percentile for cold wave, > 95 percentile for heat-wave).

2. See where temperatures are extreme for at least three consecutive days

3. **Final polygon**

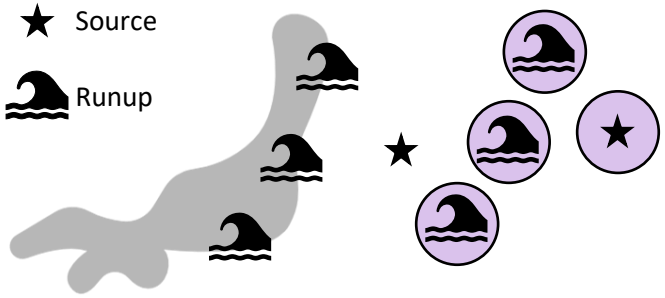
Extreme Wind



1. ERA-5 Maximum daily wind gust data, calculate the daily extremes (> 99 percentile). Max wind of polygon above 15 ms-1

2. **Final polygon**

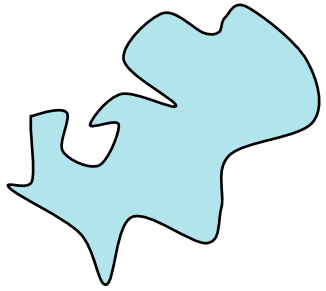
Tsunami



1. Source and runup data Global Historic Tsunami database

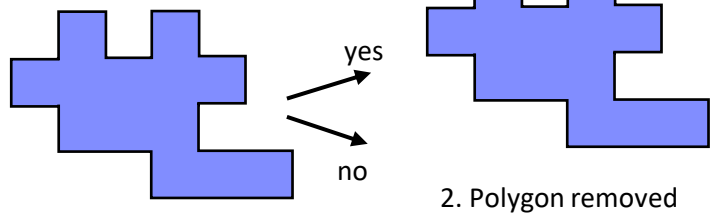
2. **Final polygon**

Flood



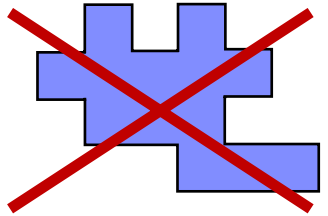
1. **Final polygon:** taken directly from The Global Flood Database

Wildfire



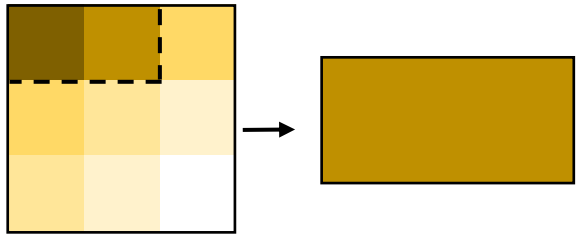
2. **Final polygon**

2. Polygon removed from dataset



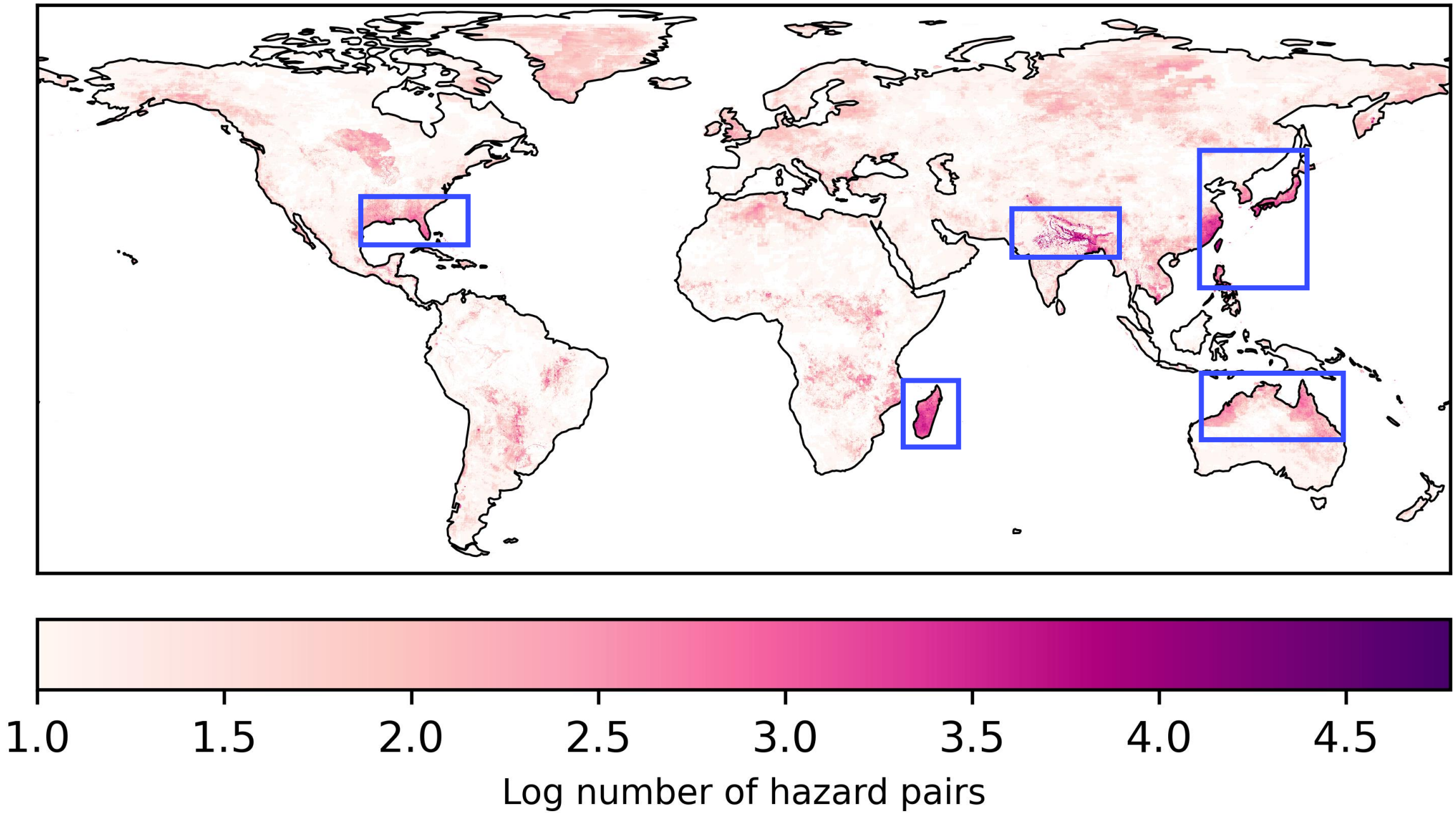
1. Polygon from the global wildfire dataset. Is the area of the polygon above 5 km^2 and the duration of the wildfire at least 3 days?

Drought

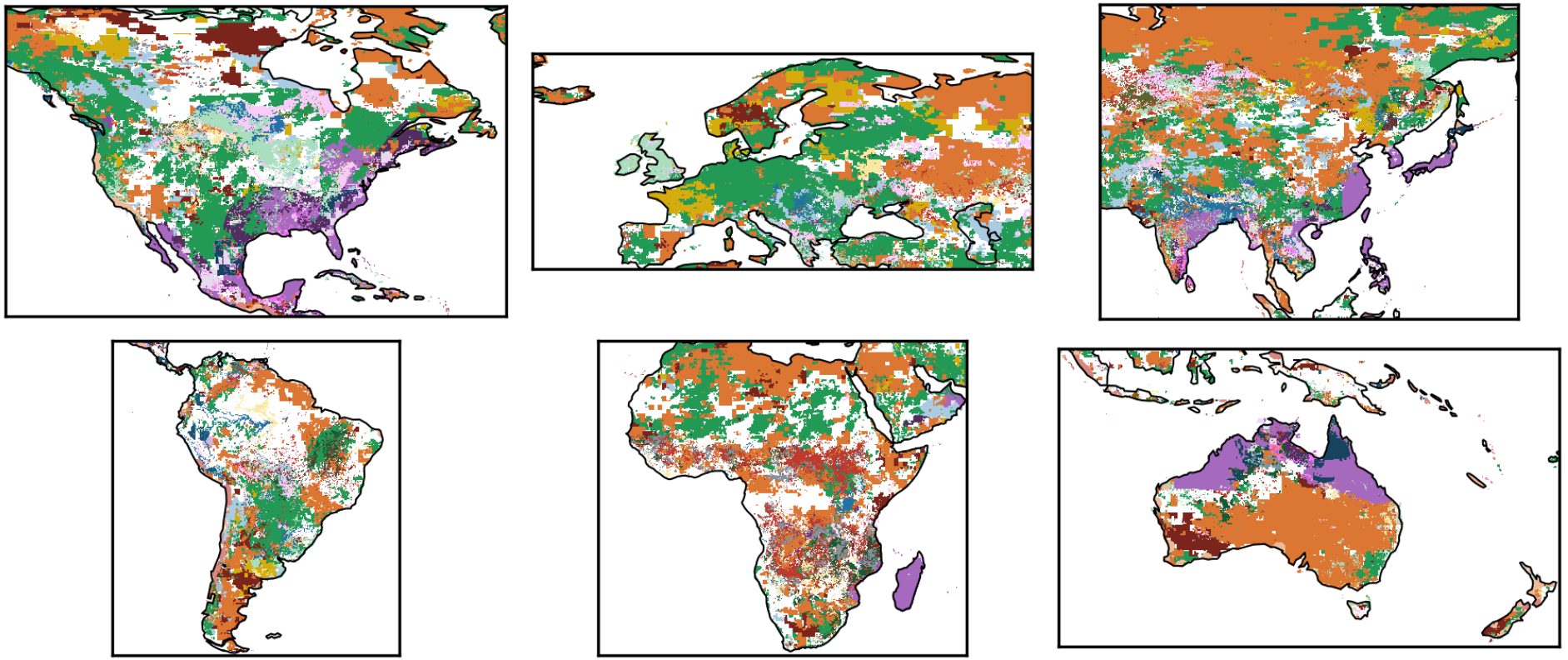


1. GDO SPI-3 (3-month Standardized Precipitation Index) monthly data below 1.3

2. **Final polygon**


1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
Log number of hazard pairs

Most Frequent Hazard Pair Between 2004 and 2017



20 Most Frequent

dr & hw	ew & cw	fl & hw	ew & wf	dr & ts
hw & ew	dr & ew	fl & fl	tc & hw	eq & ts
tc & ew	hw & wf	fl & dr	dr & tc	tc & tc
dr & cw	fl & ew	dr & wf	fl & tc	fl & cw

cw: coldwave

dr: drought

eq: earthquake

ew: extreme wind

fl: flood

hw: heatwave

ls: landslide

tc: tropical cyclone

ts: tsunami

vo: volcanic eruption

wf: wildfire

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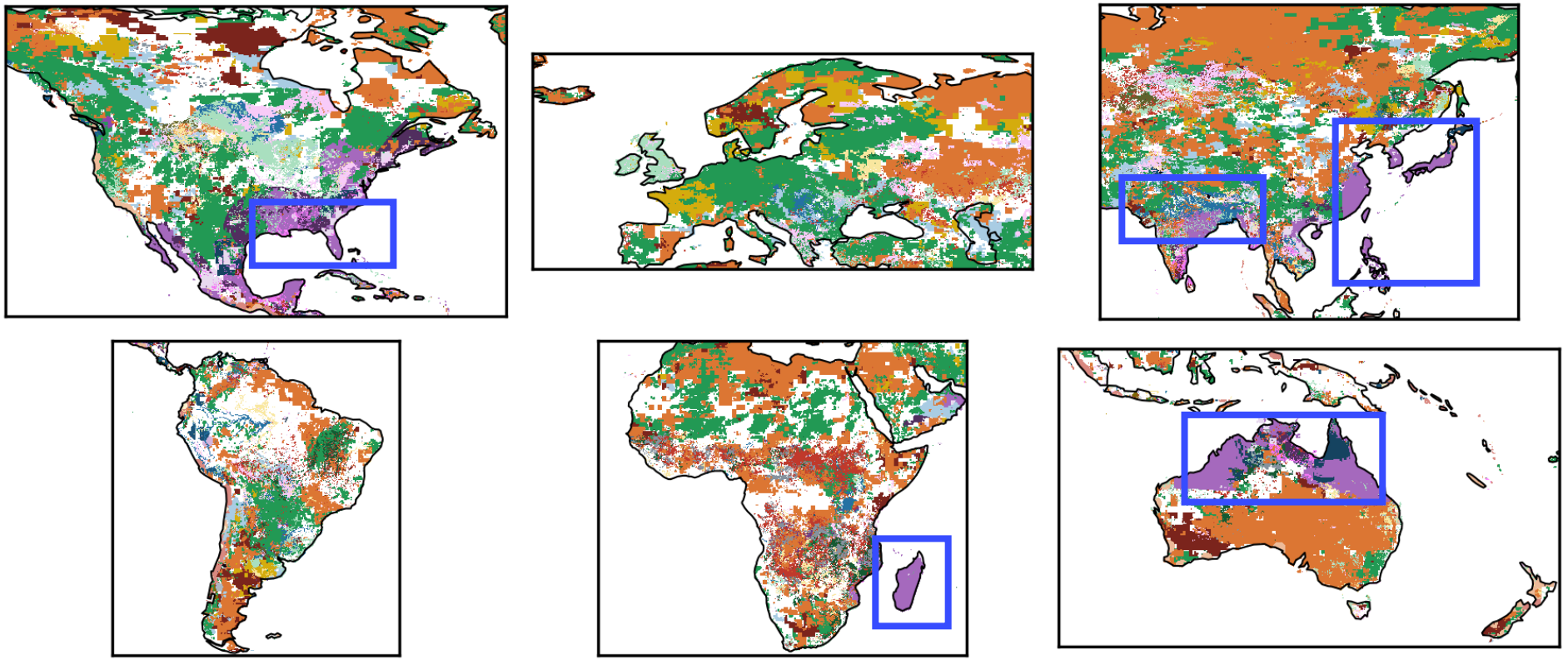
Most Frequent Hazard Pair Between 2004 and 2017



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dr & hw	ew & cw	fl & hw	ew & wf	dr & ts
hw & ew	dr & ew	fl & fl	tc & hw	eq & ts
tc & ew	hw & wf	fl & dr	dr & tc	tc & tc
dr & cw	fl & ew	dr & wf	fl & tc	fl & cw

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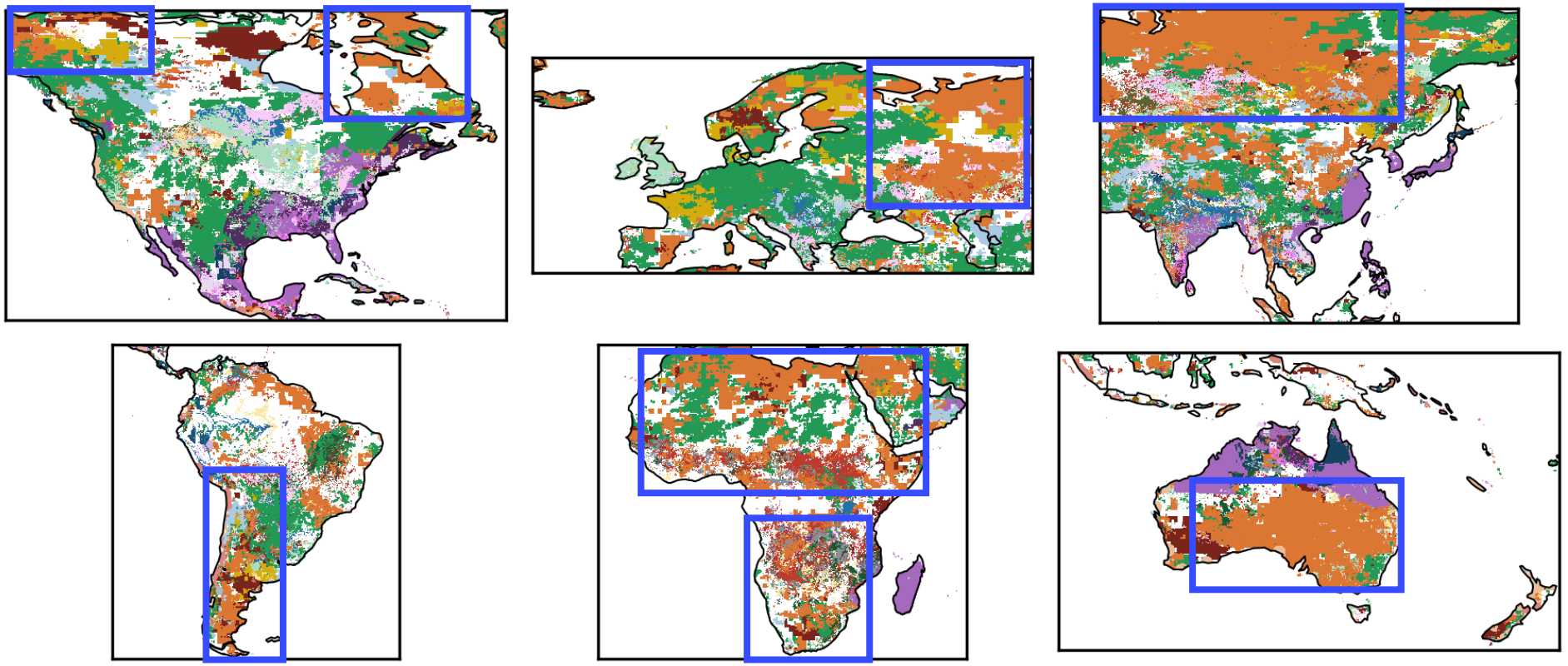

20 Most Frequent

dr & hw	ew & cw	fl & hw	ew & wf	dr & ts
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tc & ew	hw & wf	fl & dr	dr & tc	tc & tc
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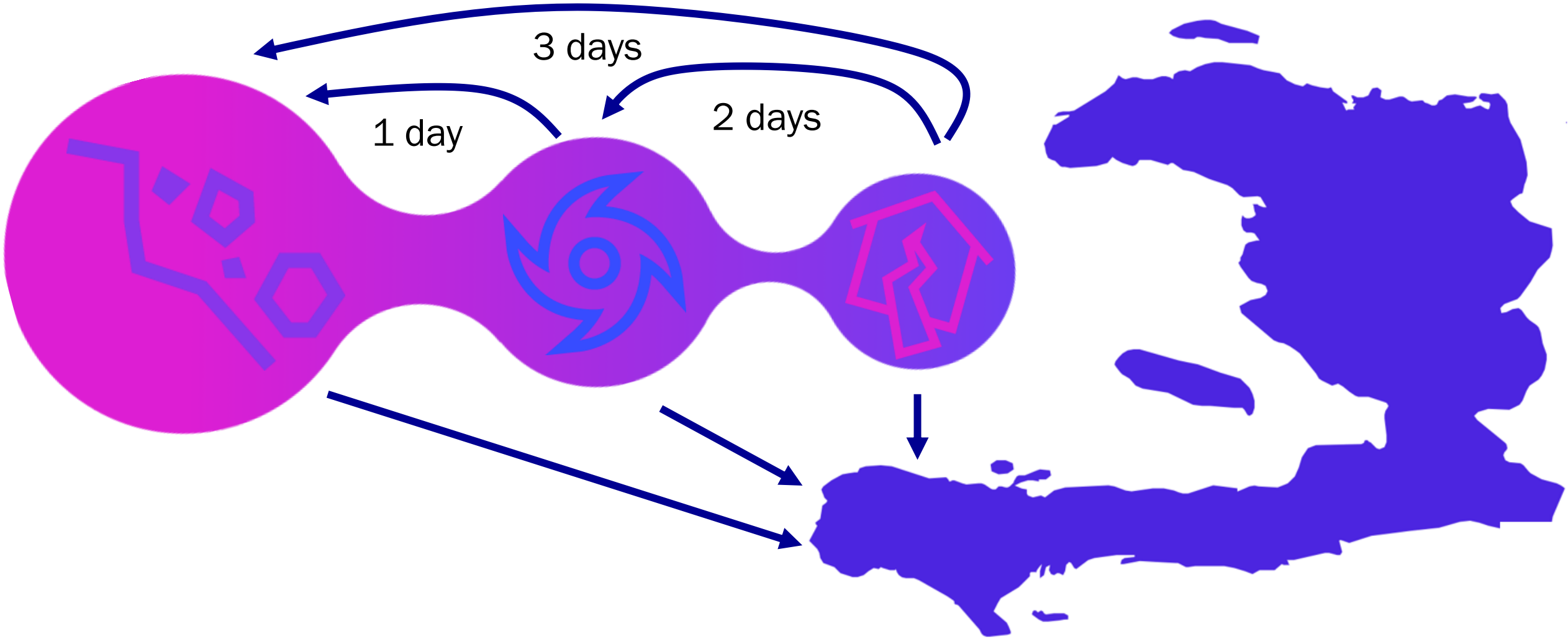
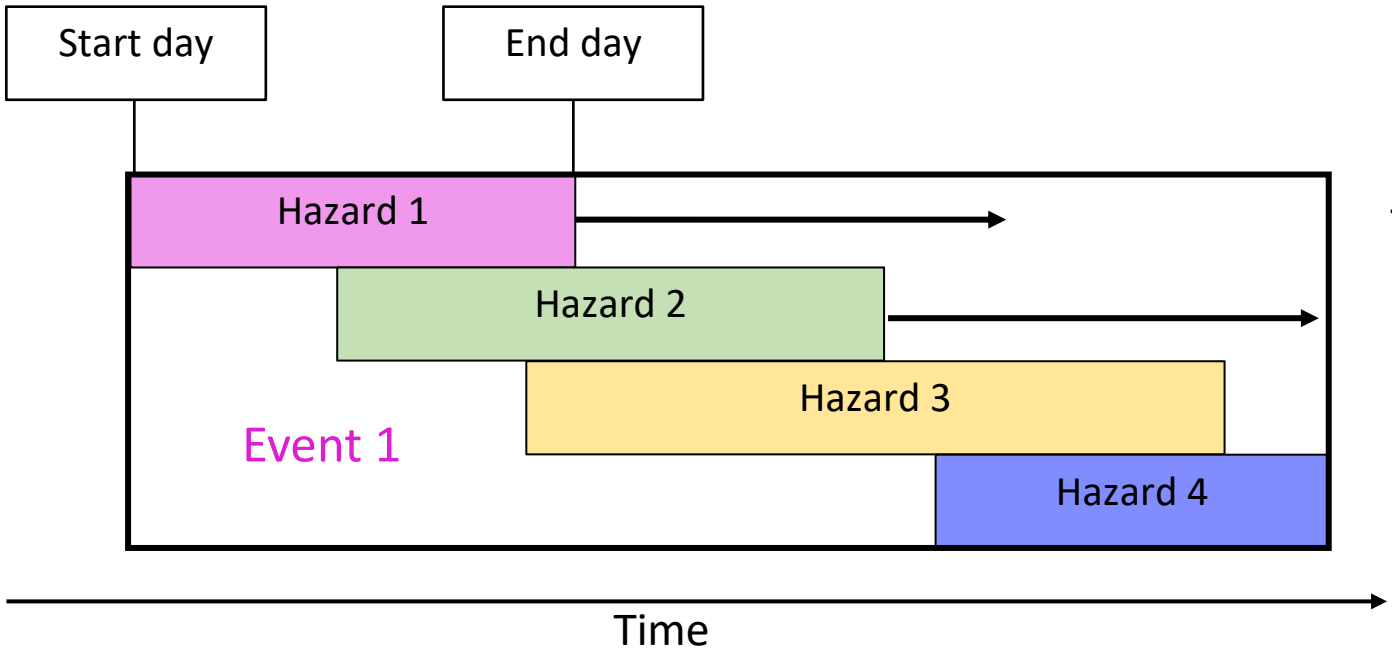
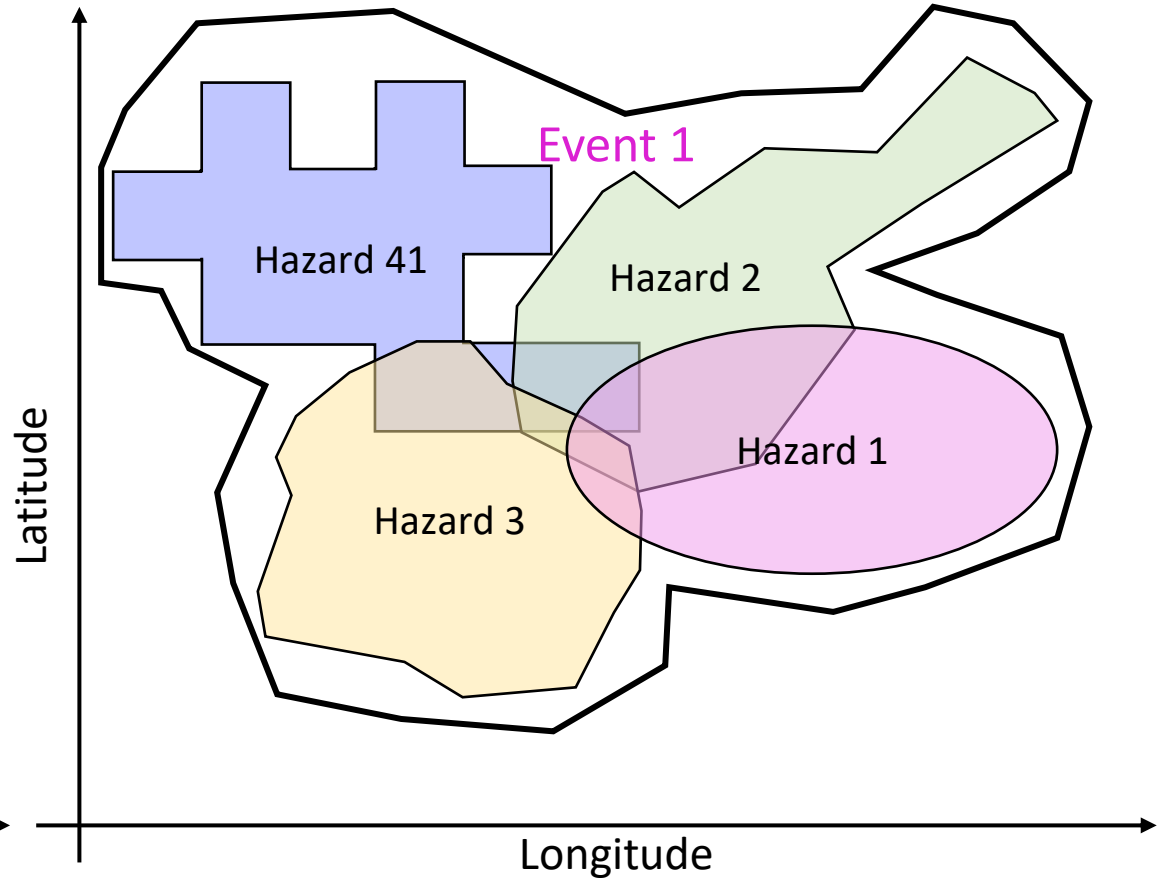
Time-lag



MYRIAD-HESA: MYRIAD – Hazard Event Sets Algorithm





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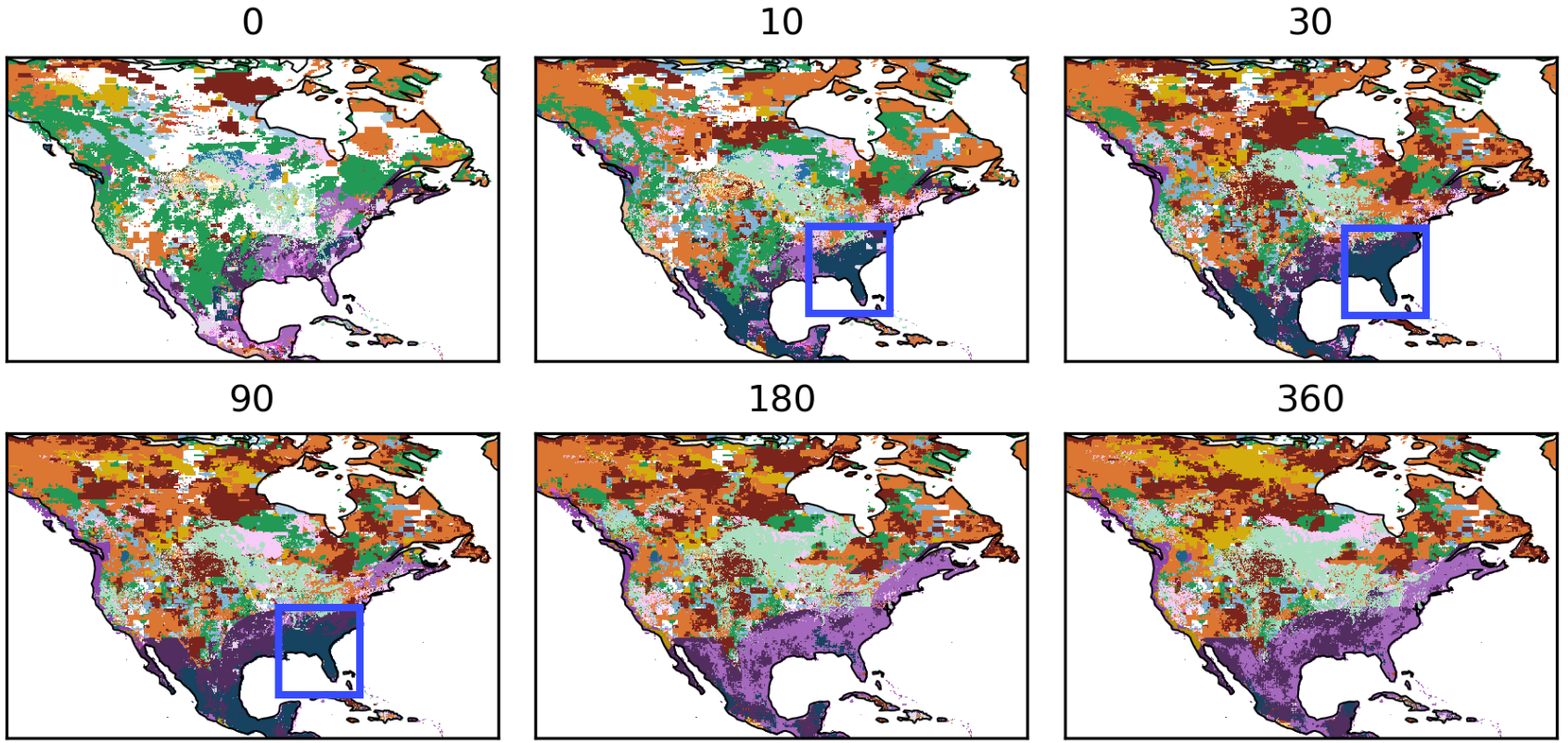
Most Frequent Hazard Pair Between 2004 and 2017 in North America With Different Time-lags



20 Most Frequent

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dr & ew	tc & ew	hw & hw	fl & tc	ts & hw
hw & ew	fl & hw	ew & cw	dr & tc	fl & fl
fl & ew	dr & cw	ts & ew	fl & cw	dr & dr

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Open-source Availability

The Paper

The Algorithm

The Data

FAQ's

What makes a location susceptible to multi-hazards?

How does one hazard affect the likelihood of another hazard to occur?

Is there a method to quantify the time-lags between hazards?

How are multi-hazard impacts different from single-hazard impacts?

How does climate change affect multi-hazard events?

I want to know more about multi-risk in general ! Where should I go?

FAQ's

Dr. Timothy Tiggeloven
(IVM VU Amsterdam)

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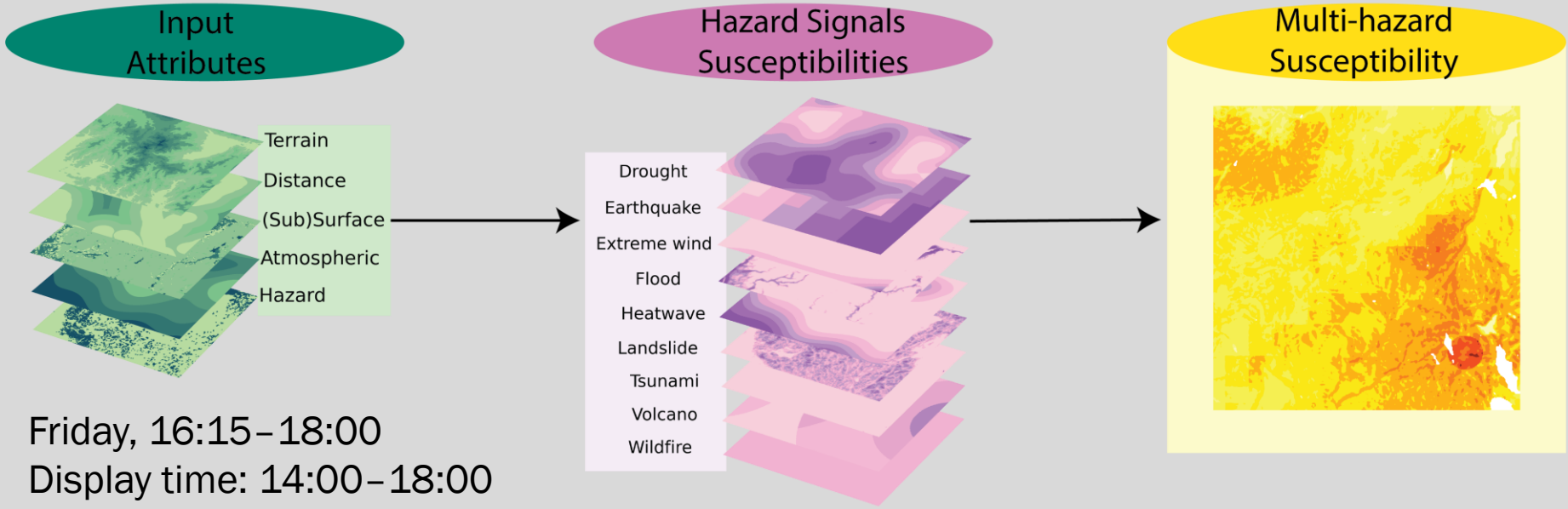

Friday, 16:15–18:00
Display time: 14:00–18:00
Hall X4, X4.74

How does one hazard affect the likelihood of another hazard to occur?

Is there a method to quantify the time-lags between hazards?

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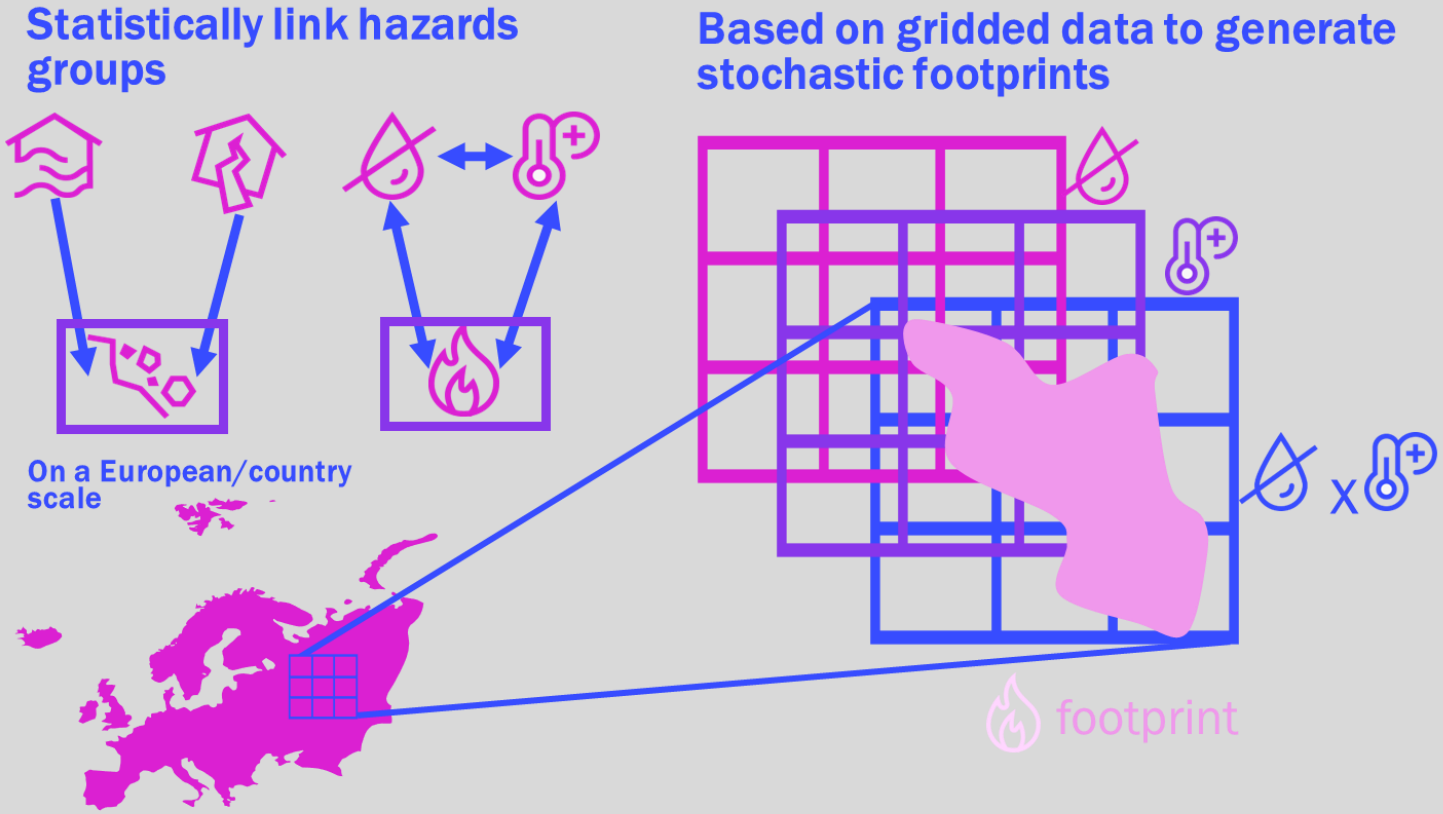

Friday, 16:15–18:00
Display: 14:00–18:00
Hall X5, X5.91

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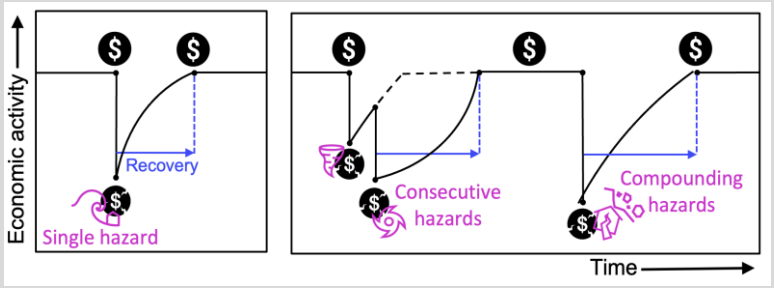
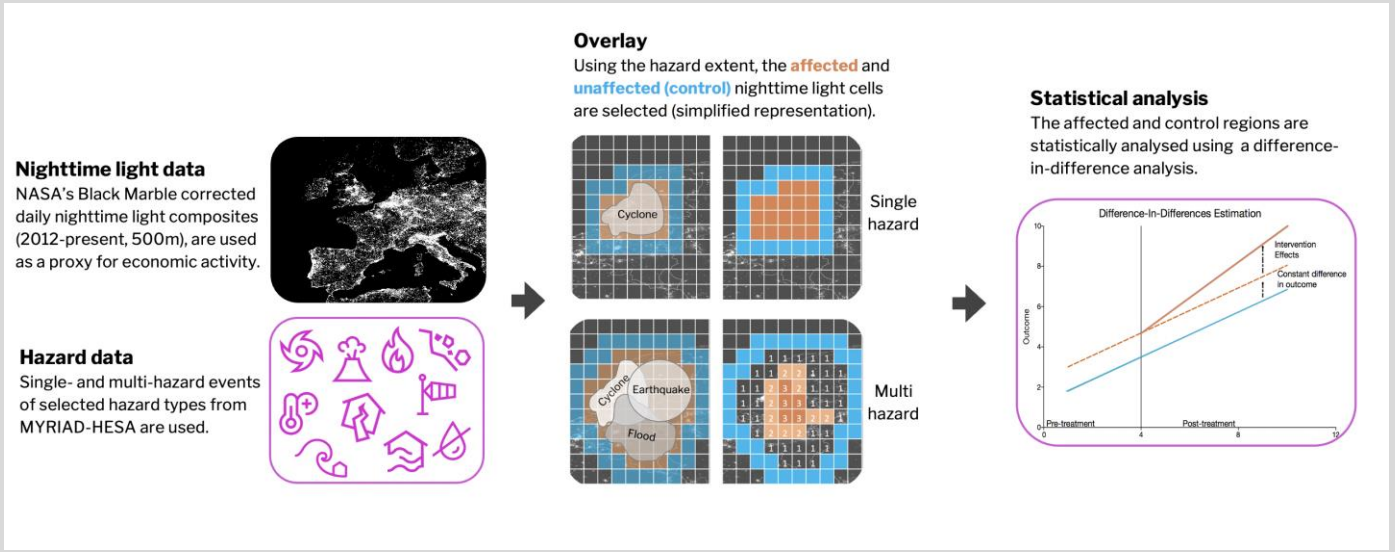
Sophie Buijs
(IVM VU Amsterdam)





How are multi-hazard impacts different from single-hazard impacts?

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Dr. Wiebke Jäger
(IVM VU Amsterdam)

Thursday 15:05–15:15
Room M2

Input data

EM-DAT[1]: Socio-economic impact data

GDIS[2]: Spatial footprints

Period: 2010 – 2018

Hazards:

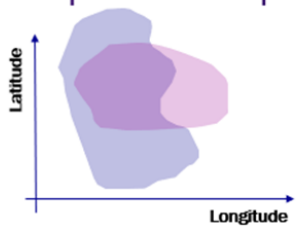
Single & Multi-Hazard Identification

Adapted MYRIAD-HESA algorithm:[3]

1 . EM-DAT multi-hazard information

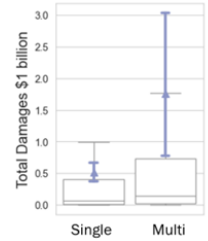
2. Time lag

3. Spatial overlap

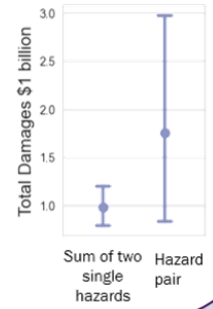


Statistical Analysis of Impacts

Single hazard vs. hazard pair impacts



Sum of two single hazard vs. hazard pair impacts



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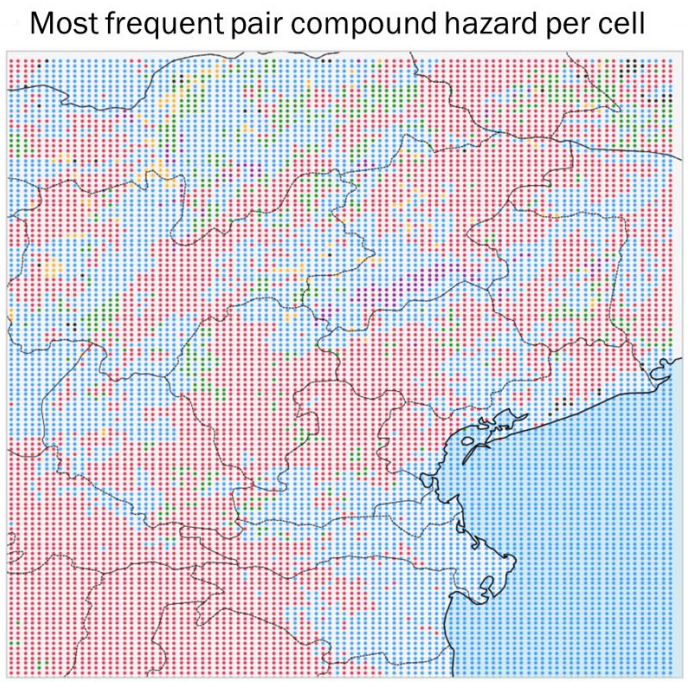
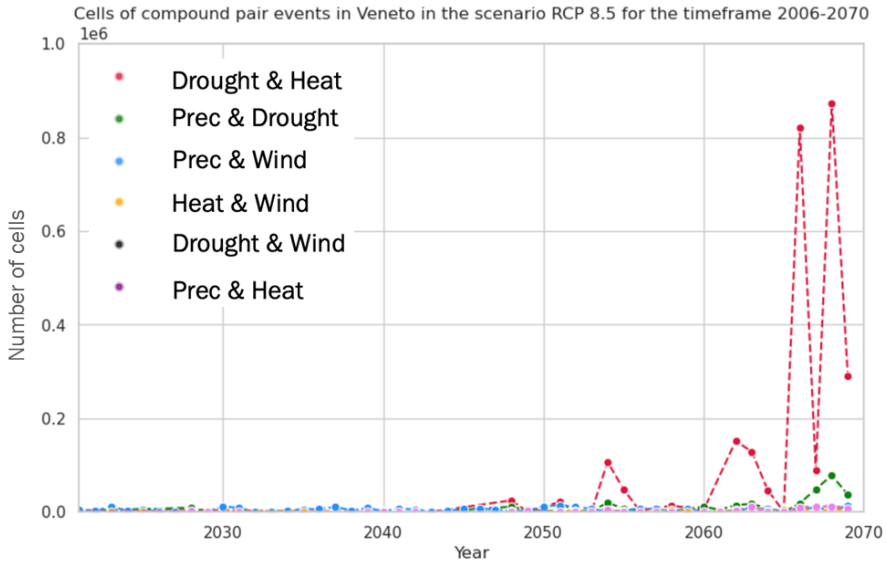
Davide Ferrario
Università Ca' Foscari
Venezia, CMCC

Friday
12:00–12:10
Room 0.15





RCP 8.5 – Number of cells with compound pair events (per year)

I want to know more about multi-risk in general! Where should I go?

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NH 10.1

EDI

Multi-hazard risk assessments: Innovative approaches for disaster risk reduction, management, and climate change adaptation.

Including NH Division Outstanding ECS Award Lecture

Convener: Silvia De Angeli[ECS] | Co-conveners: Stefano Terzi[ECS], Robert Sakic Trogrlic[ECS], Anaïs Couasnon[ECS], Judith Claassen

Orals | Thu, 18 Apr, 14:00–18:00 (CEST) Room M2, Fri, 19 Apr, 08:30–10:15 (CEST) Room M2

Posters on site | Attendance Fri, 19 Apr, 16:15–18:00 (CEST) | Display Fri, 19 Apr, 14:00–18:00 Hall X4

Advancing multi-(hazard)risk science: embracing complexity and cross-disciplinary

Thursday: 14:00–14:30

Room M2

Dr. Marleen de Ruiter (IVM VU Amsterdam)

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The MYRIAD-EU project has received funding from the European Union's Horizon 2020 research and innovation programme call H2020-LC-CLA-2018-2019-2020 under grant agreement number 101003276

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Judith Claassen

IVM VU Amsterdam

j.n.claassen@vu.nl