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Multi-hazard assessment of long- and short-term extreme hydrometeorological events in southeastern South America

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Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET)

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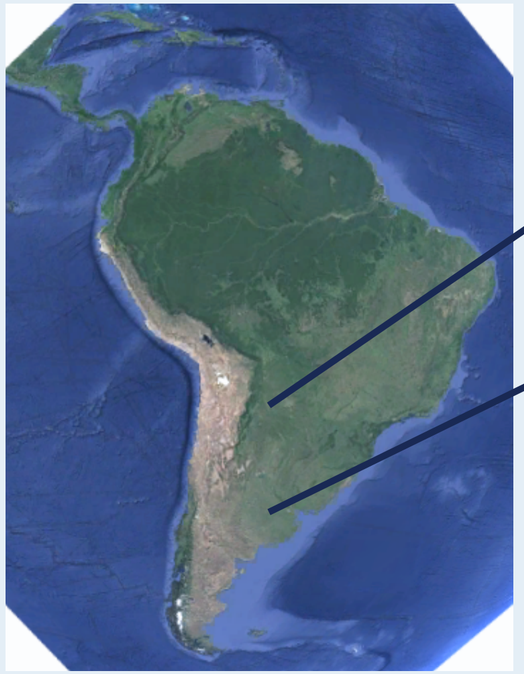
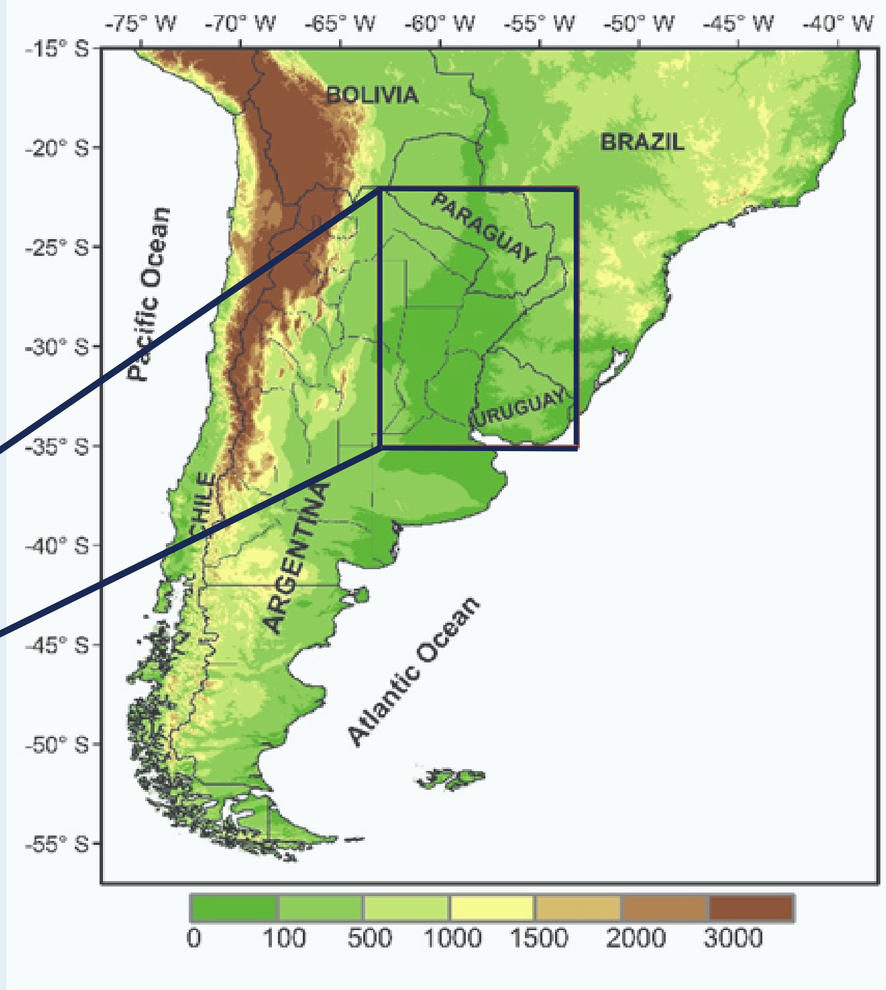
Study region

South America



[Google Earth, 2024]

Southeastern South America (SESA)



Vulnerable to extreme events.

High population rates and important agricultural activities.

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Objective

This study presents a **multi-hazard analysis** of long- and short-term extreme hydrometeorological events (EHEs) and their changes over SESA.

[Landon Parenteau /Unsplash]

[Lucy Chian /Unsplash]

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Data

ERA5 reanalysis

Herbash et al. 2023

Precipitation, soil moisture and temperature

- Spatial resolution: 0.25°×0.25°
- Temporal resolution: monthly and daily.

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Methods

Hazard quantification

For each EHE:

1- Decadal frequency (DF), average duration (AD), and mean maximum intensity (MMI).

2- **Individual hazard components (h)** (Tabari et al., 2021):

$$h = DF * AD * MMI$$

3- **Normalized individual hazard (H(0,1)).** Rescale to a range of 0-1.

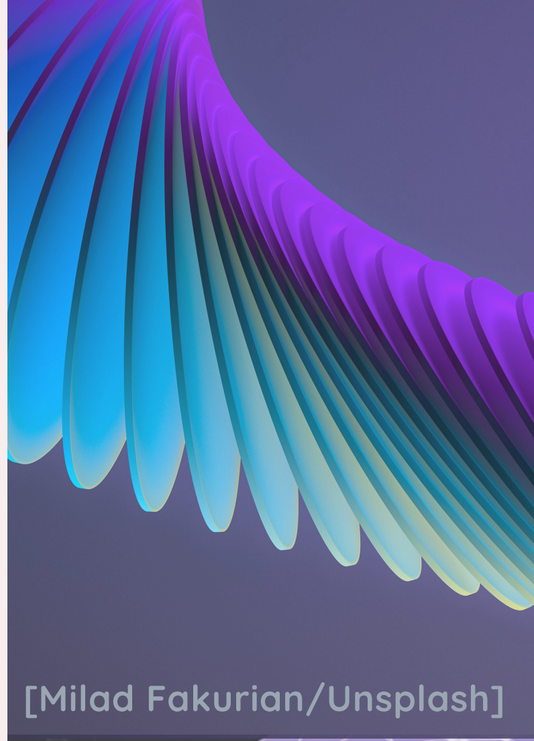
Combining EHEs:

Multi-hazard index (mHI) (KC et al., 2021):

$$mHI(0,1) = \Sigma (Hi\ (0,1)) / n$$

Periods:

1961-1990 (past)
1991-2020 (present)



[Milad Fakurian/Unsplash]

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Methods

Hazard quantification

Long-term EHEs

Wet: SPI3

Wet: SPI18

Wet extreme precipitation

Dry: SPI3

Dry: SPI18

Dry extreme precipitation

Normalized Hazard

Long-term Multi-hazard Index

Total Multi-hazard Index

Short-term EHEs

Heatwaves

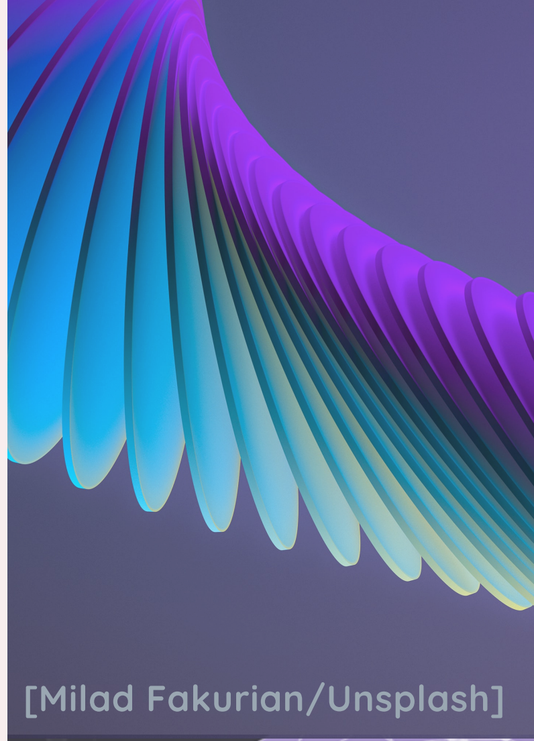
Heavy precipitation

Flash droughts

(Lovino et al., 2024)

Normalized Hazard

Short-term Multi-hazard Index



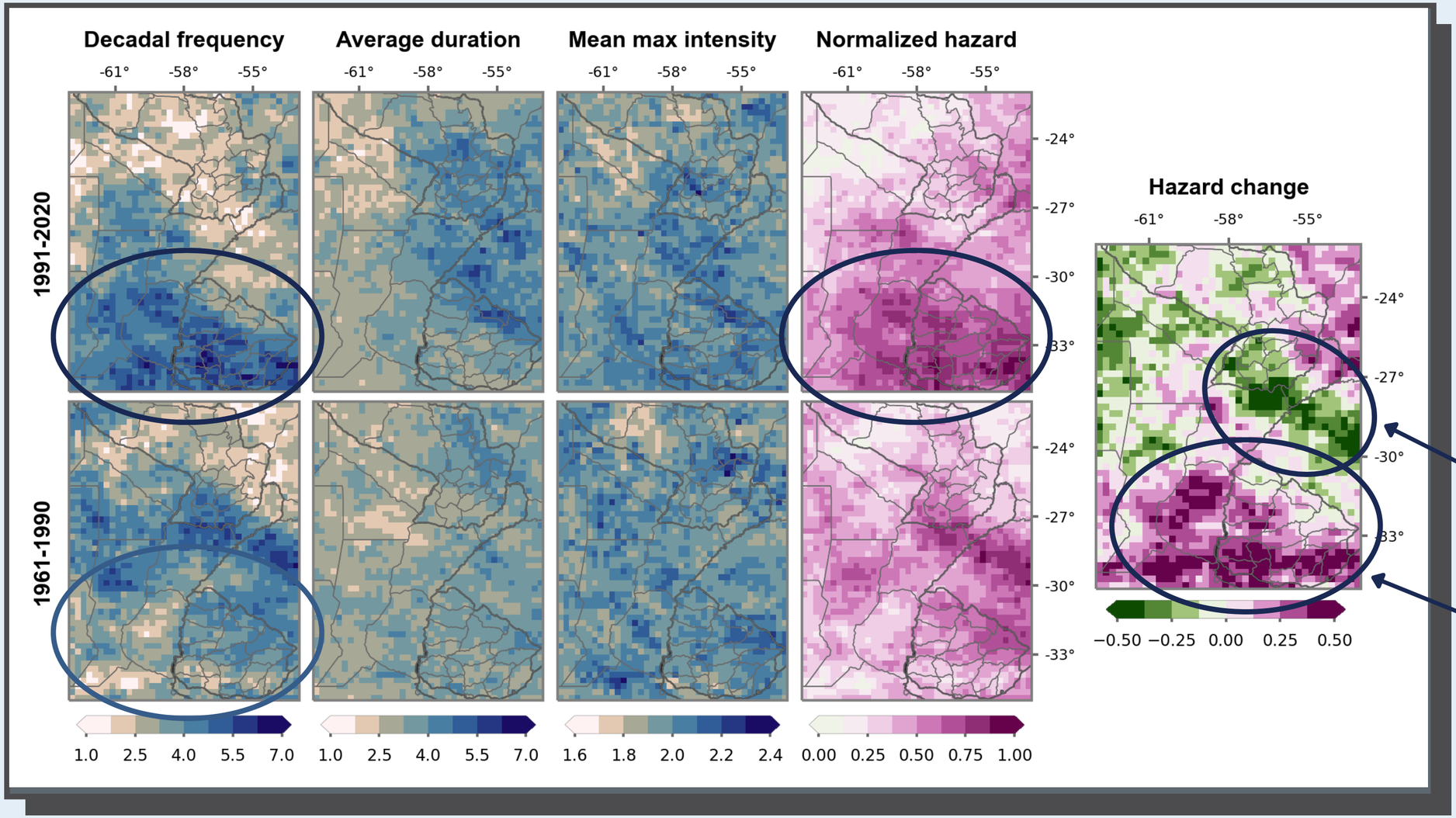
[Milad Fakurian/Unsplash]

[Brynne Ramella/G2]

Results

Long-term precipitation hazard

Wet extreme precipitation events for SPI3



Change in frequency.

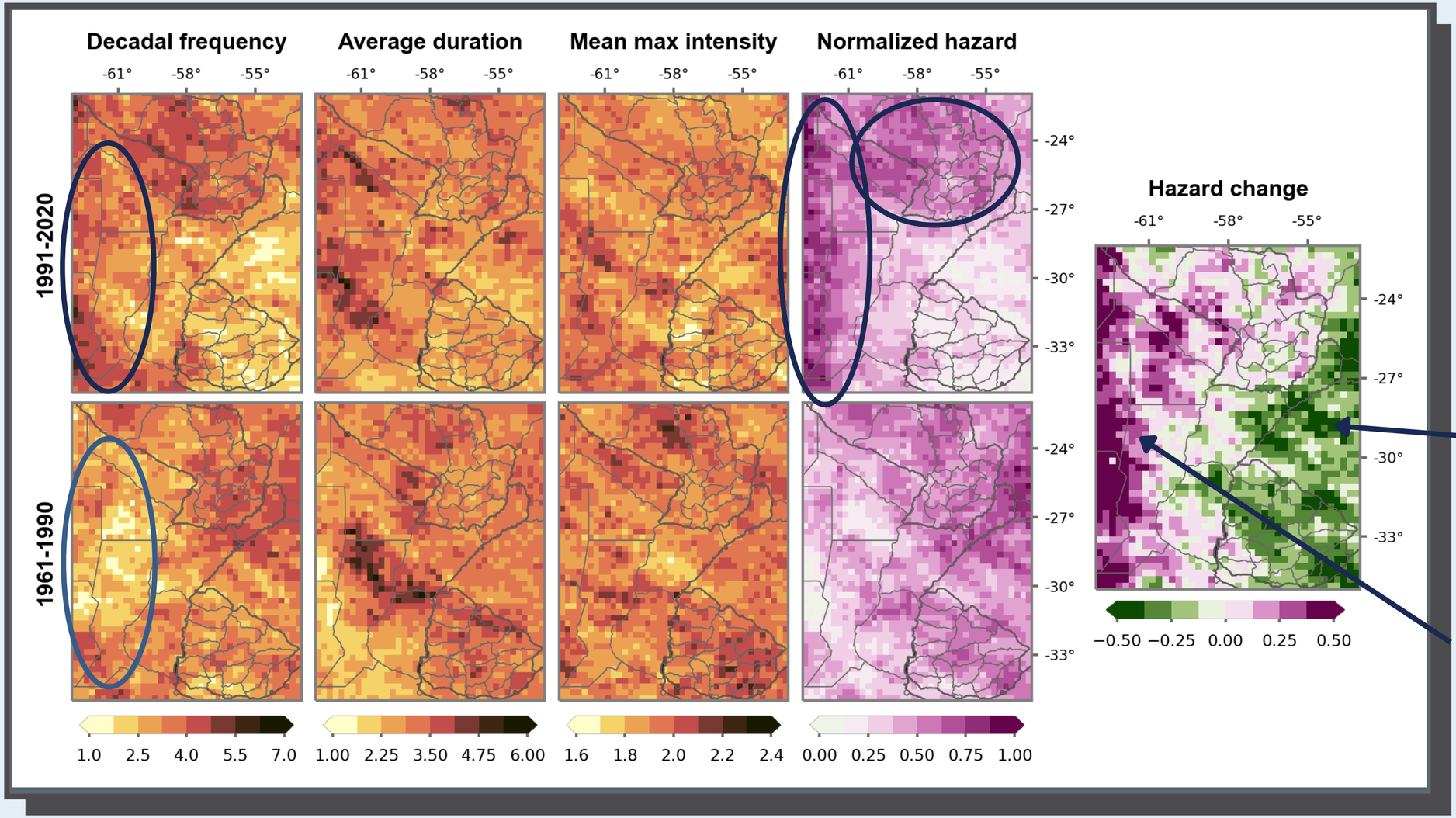
Decrease

Increase

Results

Long-term precipitation hazard

Dry extreme precipitation events for SPI3



Change in frequency and duration

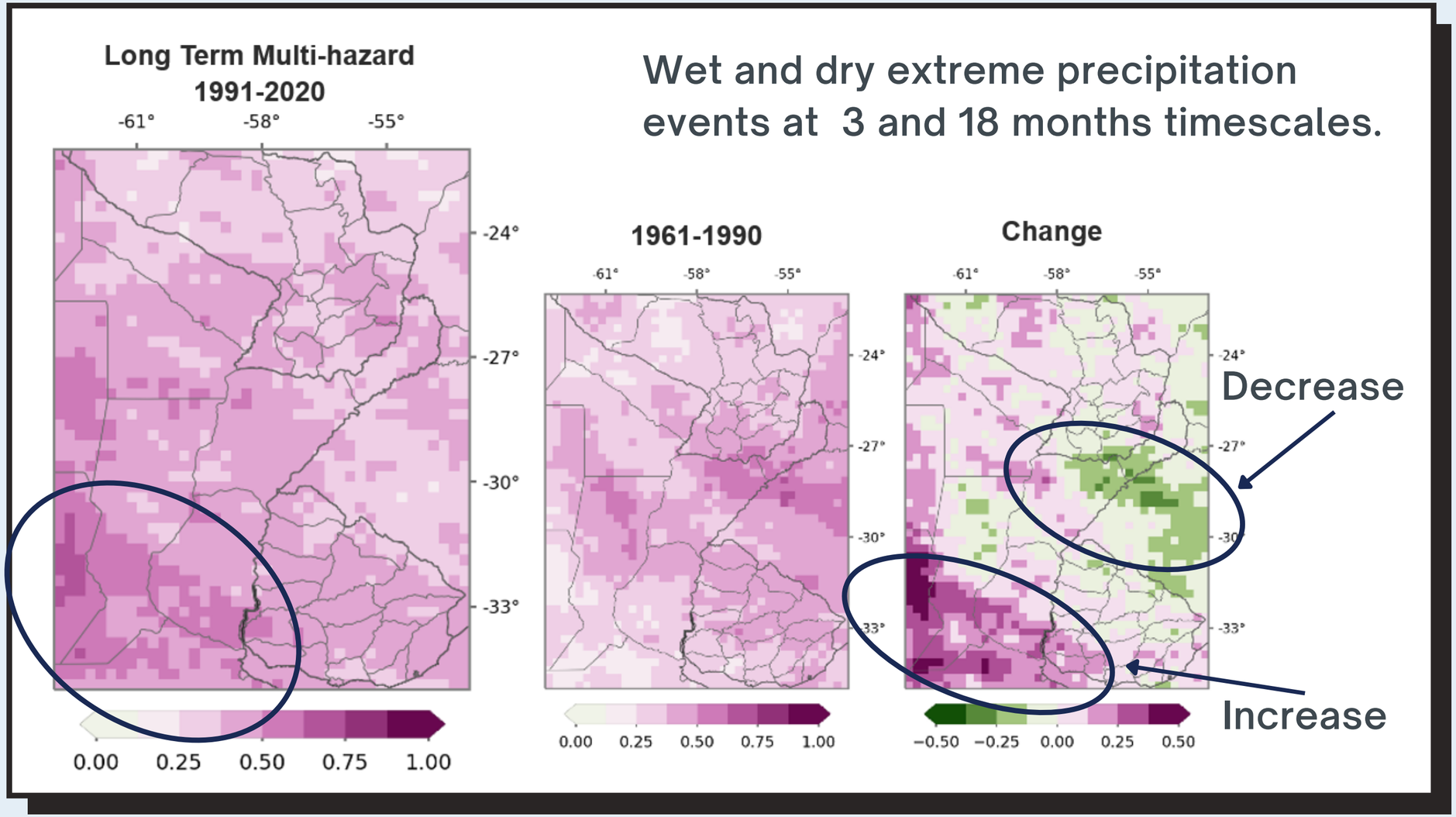
Decrease

Increase

Results

Long-term precipitation hazard

Long-term Multi-hazard.



Results

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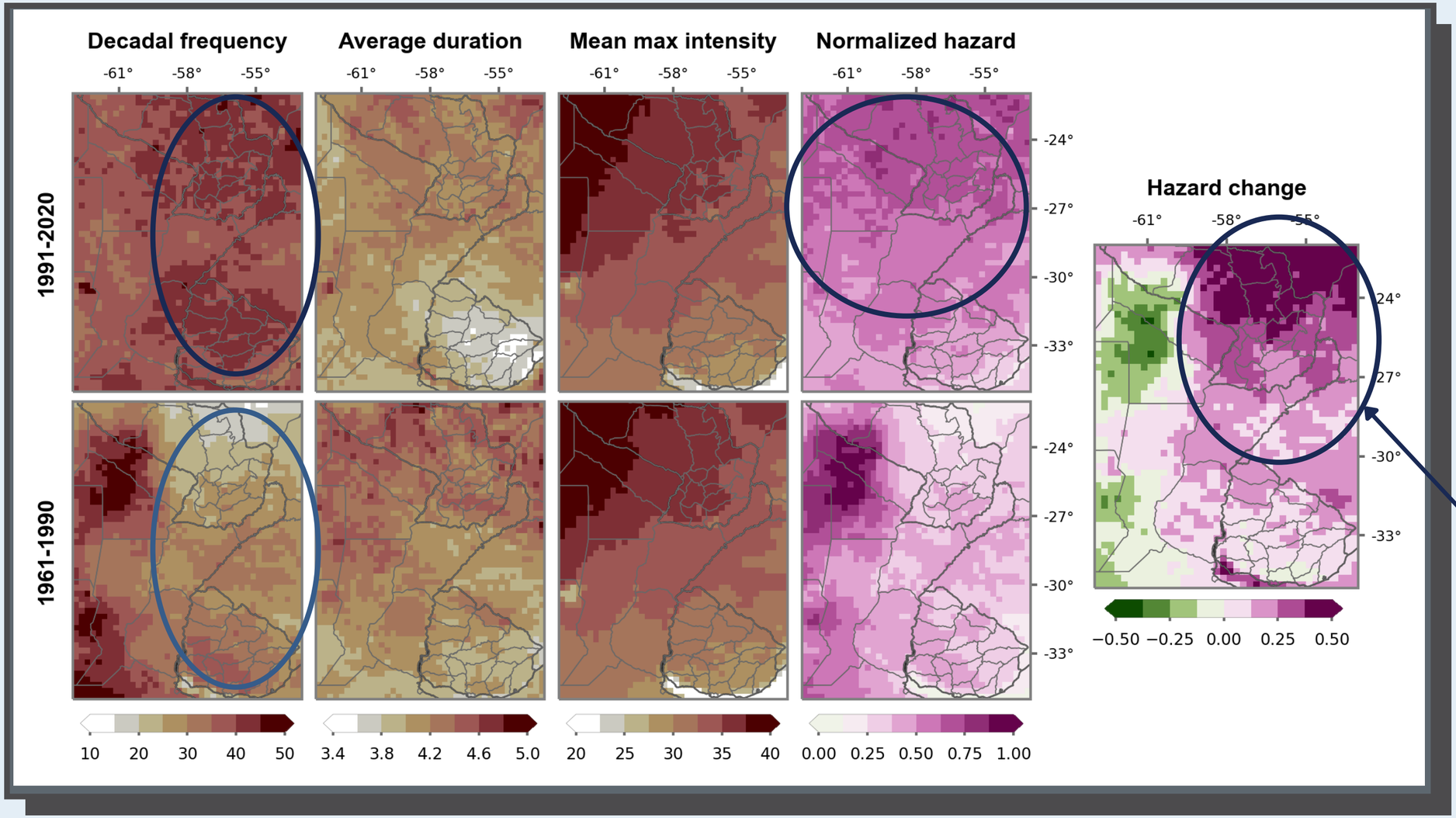
Short-term hydrometeorological hazards

Heatwaves



Important increase in the frequency

Increase

Results

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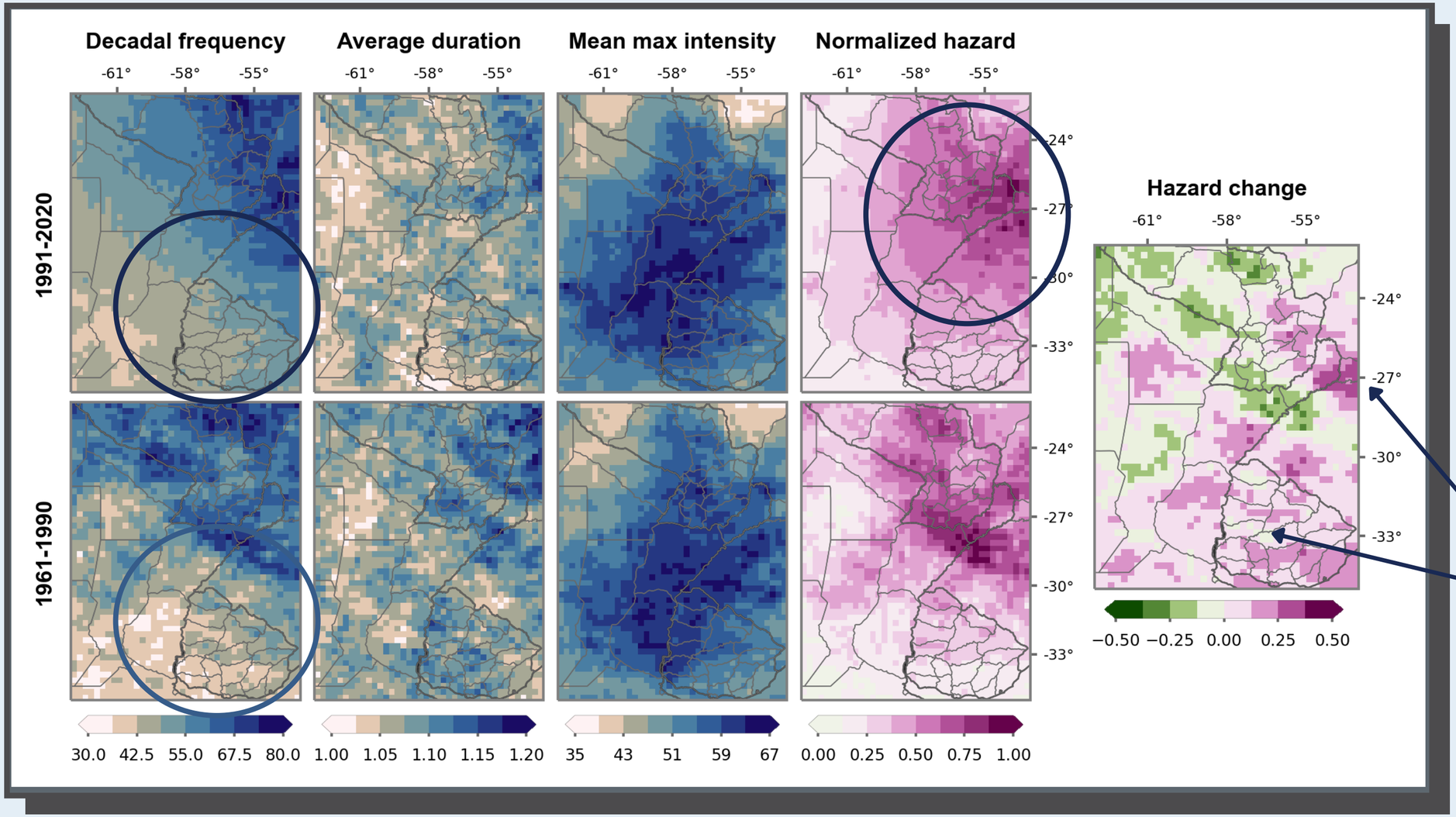
Short-term hydrometeorological hazards

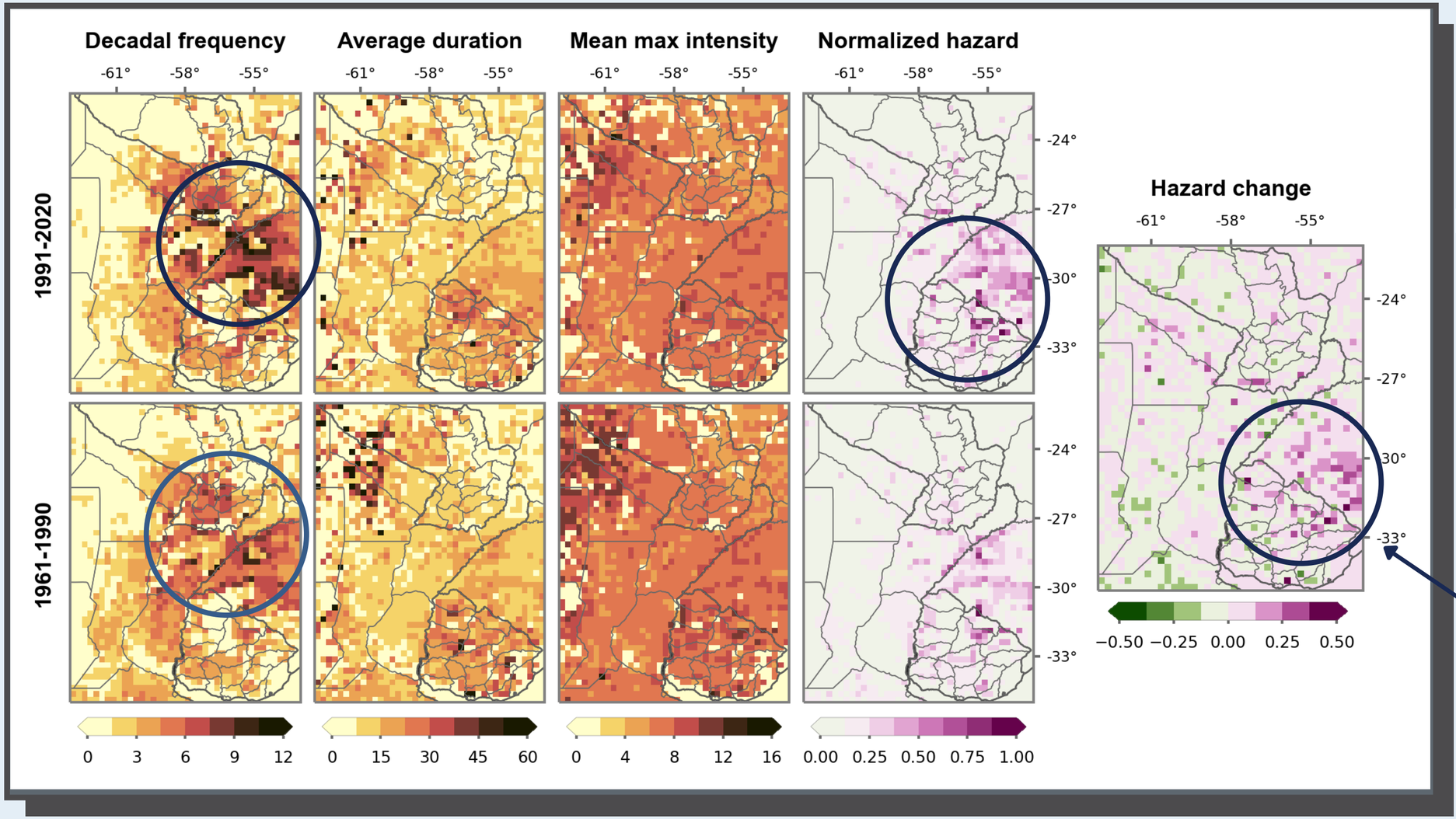
Heavy precipitation events



Results

Short-term hydrometeorological hazards

Flash droughts



Non-homogeneous pattern.

Low change.

Increase

Results

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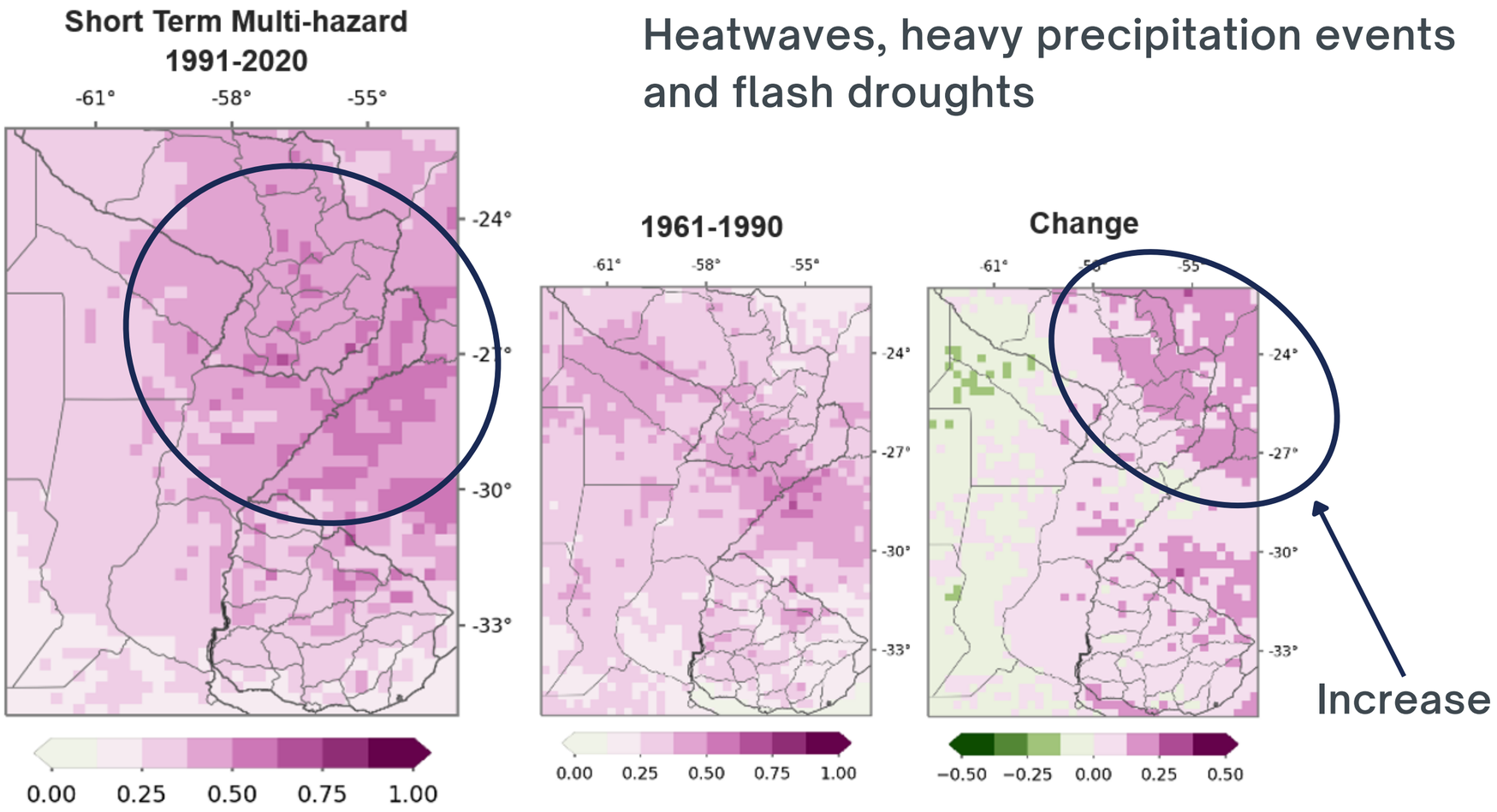
Short-term hydrometeorological hazards

Short-term Multi-hazard.



Results

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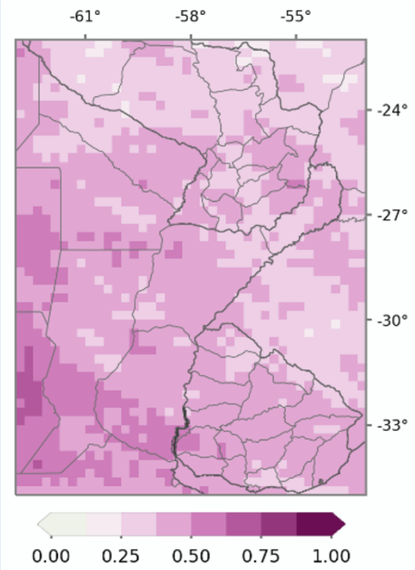
Final remarks

- Long-term multi-hazard is higher in the south and central west.
- Short-term multi-hazard is higher in the north and central east.

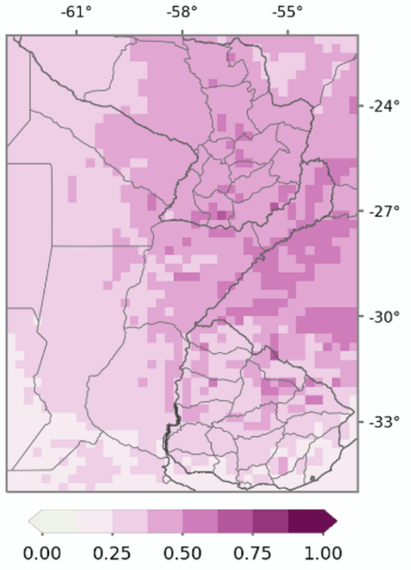
- Agricultural areas of central-eastern Argentina, Uruguay and southern Brazil : present both long-term and short-term multi-hazards.

- Total hazard has increased in most of the SESA region.

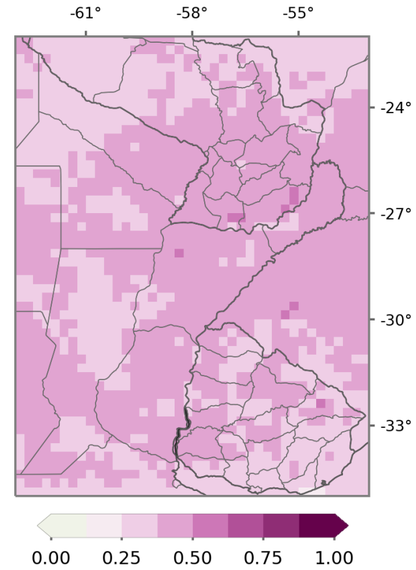
Long-term multi-hazard



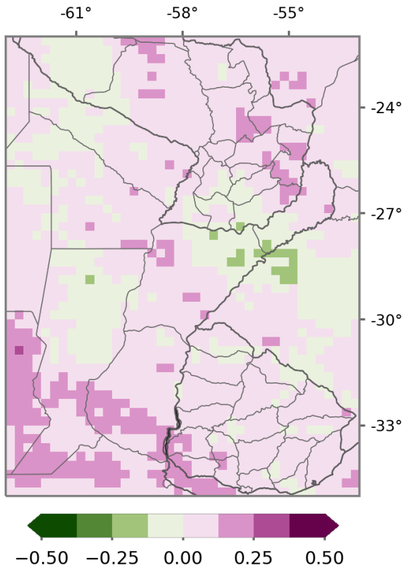
Short-term multi-hazard



Total multi-hazard



Total Change



Thanks for your attention

EGU24 Abstract:

Pierrestegui, M. J., Lovino, M. A., Müller, G. V., and Müller, O. V.: Multi-hazard assessment of long- and short-term extreme hydrometeorological events in southeastern South America, EGU General Assembly 2024, Vienna, Austria, 14–19 Apr 2024, EGU24-9257, https://doi.org/10.5194/egusphere-egu24-9257, 2024.

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References

Scientific color maps (Crameri 2018) are used in this study to prevent visual distortion of the data and exclusion of readers with color-vision deficiencies (Crameri et al., 2020).

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