CapTainRain

Capture and Retain
Heavy Rainfalls in Jordan

www.captain-rain.de

When and why does heavy rain occur?

A retrospective analysis on climatic drivers and future projections

Peter Hoffmann & Christoph Menz (WG: Hydroclimatic Risk)

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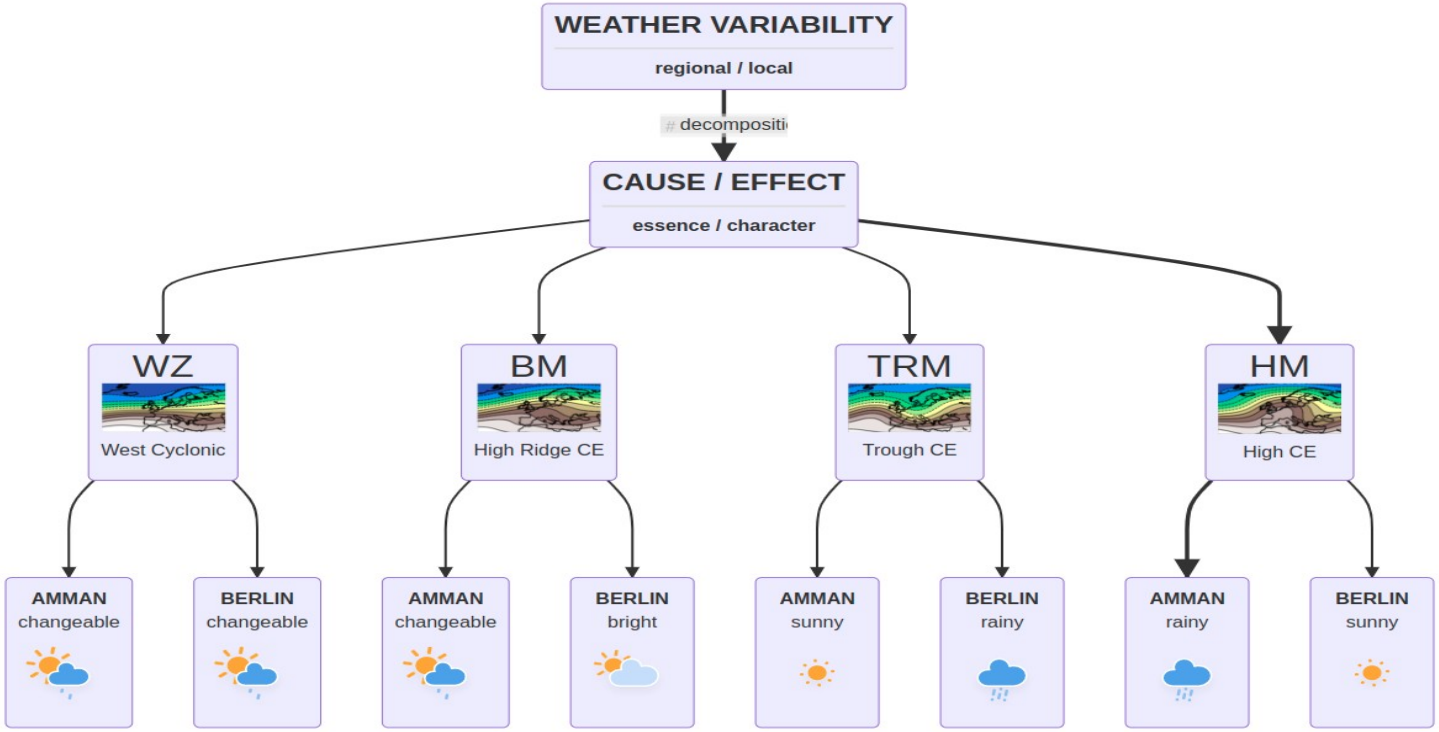
When and why heavy rain occur?
A Scheme



Weather and Climate Database

so far:

- Global and Regional gridded Reanalysis Data (since 1979)
- Hourly Rainfall Estimates from Satellite (since 2001)
- Operational Weather Forecasts (CFS, ICON)
- Long-term Climate Model Projections (CMIP6, Cordex)
- European Weather-Type Classification (DWD)

recommended:

- Subdaily Local Weather/Climate Station Data in Jordan
- High-resolution RADAR Data for Amman (if available)

Developed Products/Software and Analytics

operational:

A: Nowcast of approaching Rainfall areas using Satellite Products

B: Classification of predicted Circulation Patterns

C: Re-calculation of accumulated Rainfall to a Water Level

semi-operational:

D: Retrospective Event Catalogue of Extreme Rainfall

E: Risk Maps of Extreme Rainfall for Return Periods

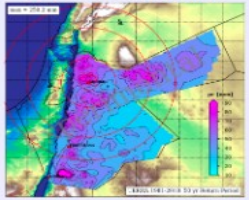
F: Detection of Critical Circulation Patterns

G: Climate Service and Scenario Analyses

A Chain of (very) Early Warning Products

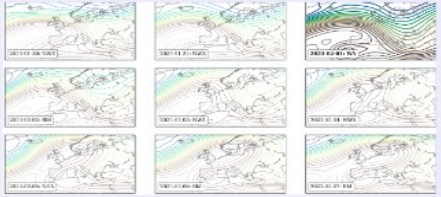
CapTainRain

MANAGEMENT



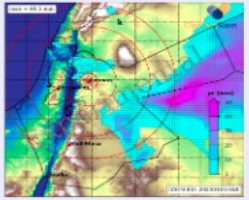
Risk Mapping

VERY EARLY WARNING: 01-10 DAYS



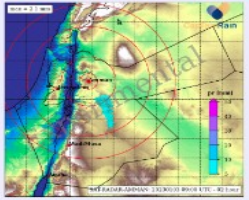
Predicted Circulation Patterns

EARLY WARNING: 01-02 DAYS



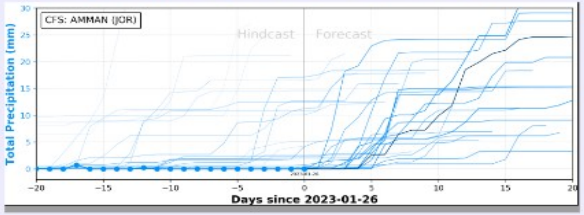
Predicted Rainfall Patterns

WARNING: 01-12 HOURS



Approaching Rainfall Areas

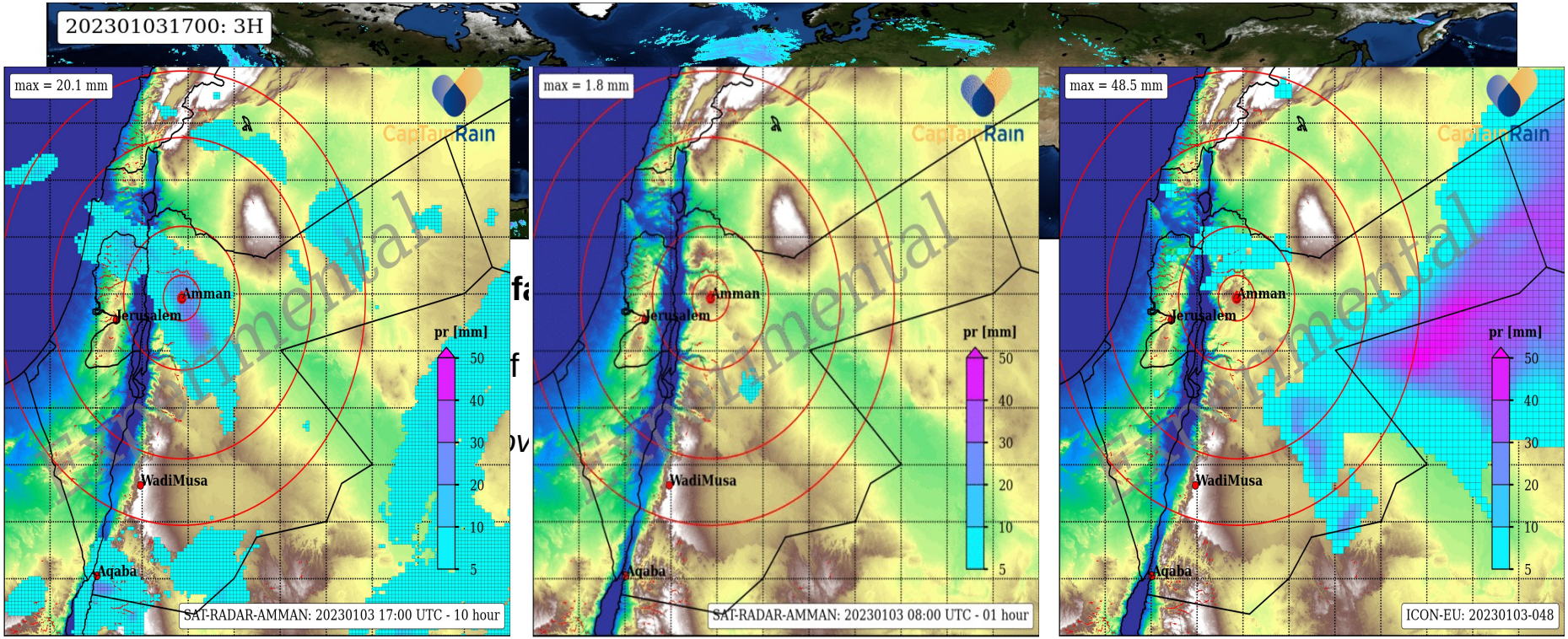
Hindcast/Forecast



Model Uncertainties

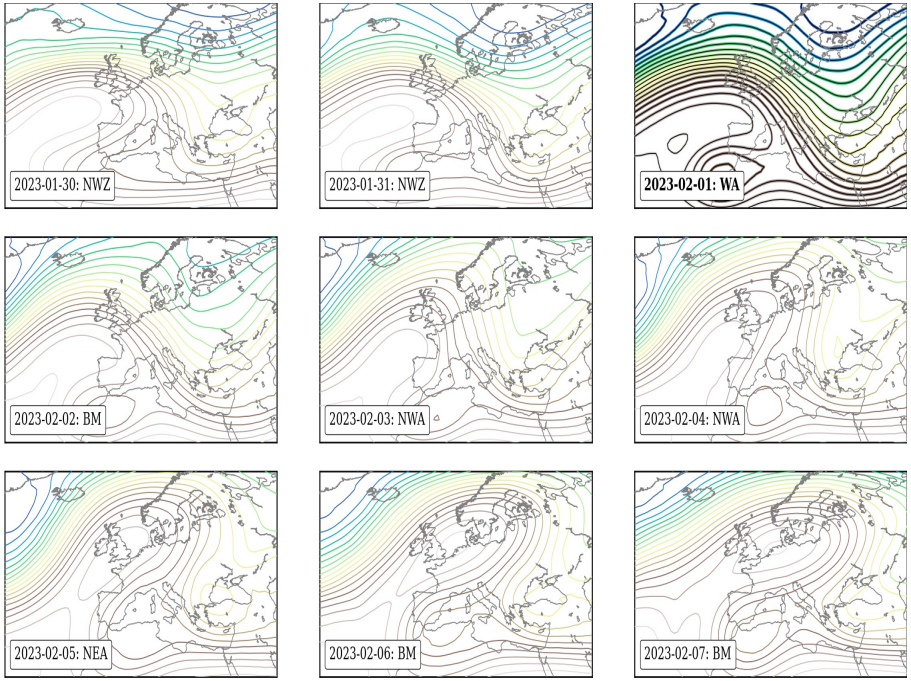
A: Nowcast of approaching Rainfall areas using Satellite Products

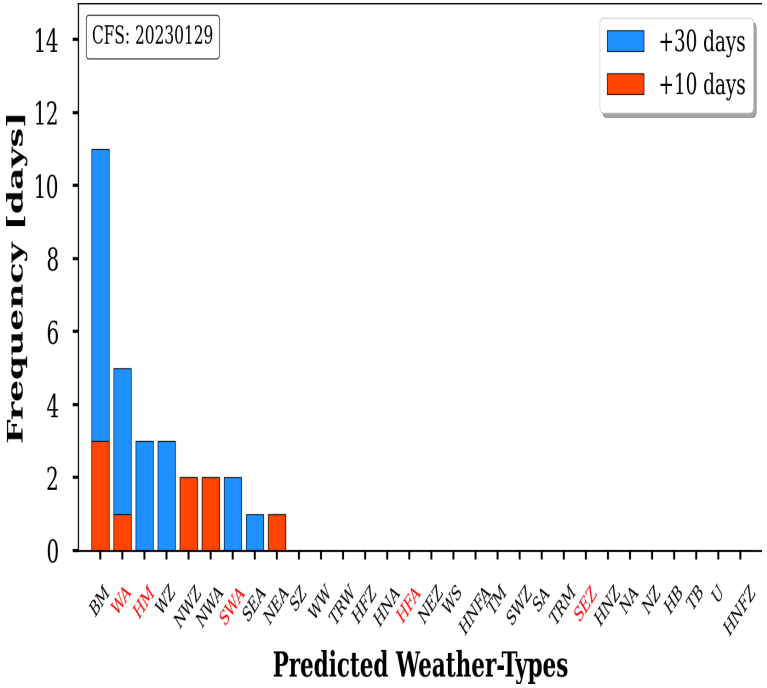
Accumulated Rainfall Estimates in a Design of a RADAR



http://www.pik-potsdam.de/~peterh/sünoptik/jordan/#jordan

B: Classification of predicted Circulation Patterns
Climate Forecast System (CFS)

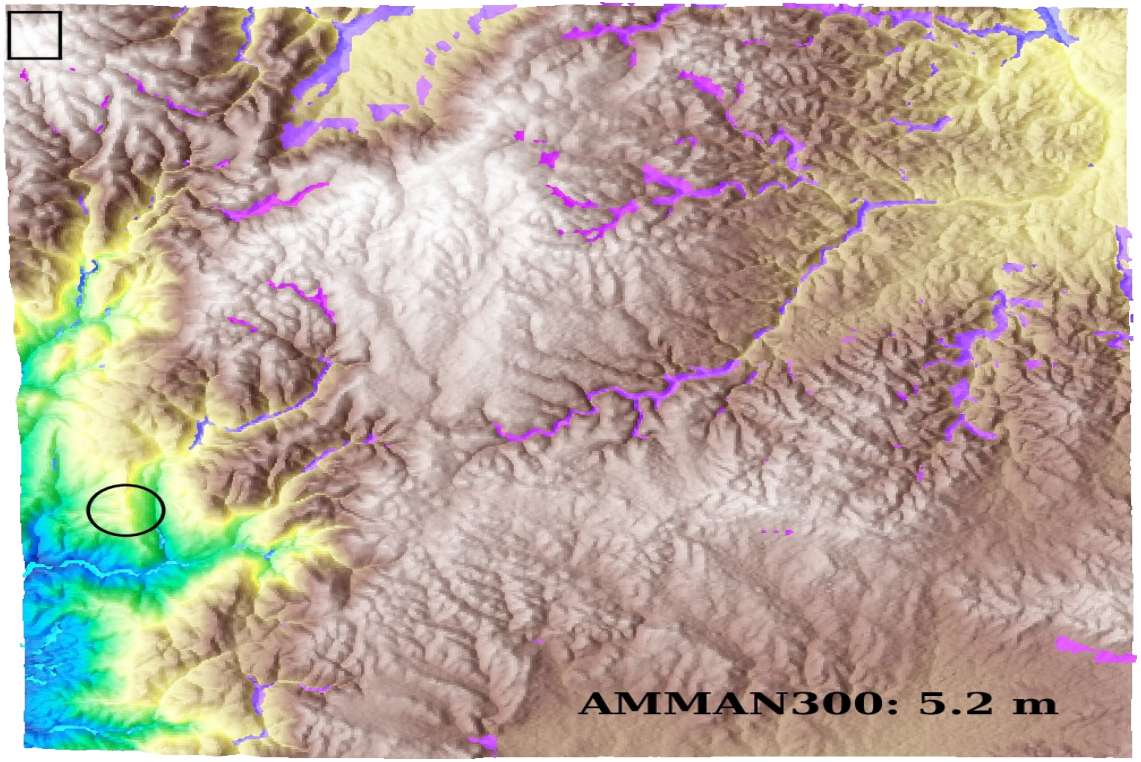


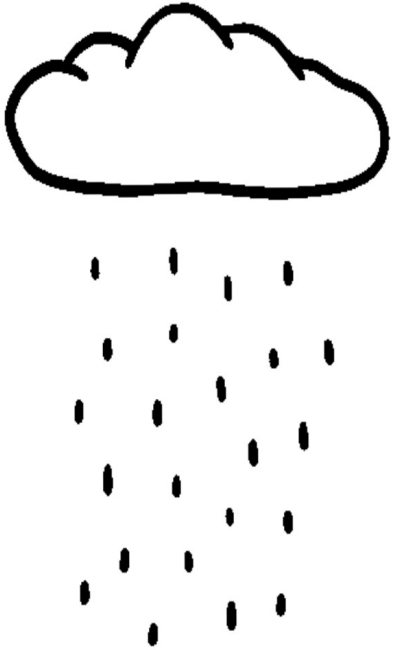


predicted → classified → assessed

C: Recalculation of accumulated Rainfall to a Water Level Index

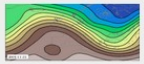
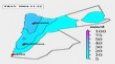
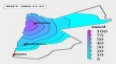
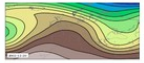
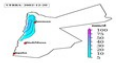
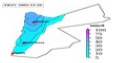
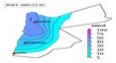
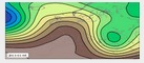
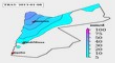
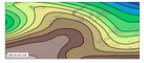
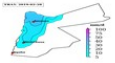
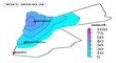
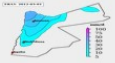
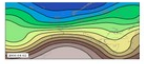
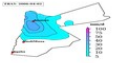
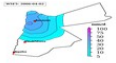
Possible Index for Operational Services

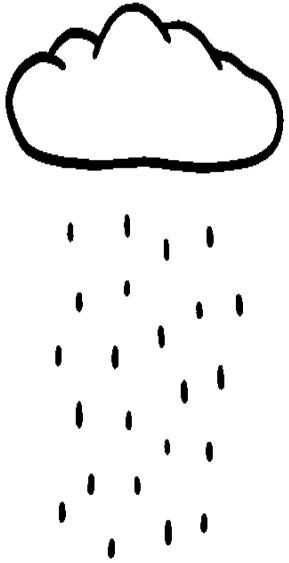




D: Retrospective Event Catalogue of Extreme Rainfall
Event Table and Patterns for Amman

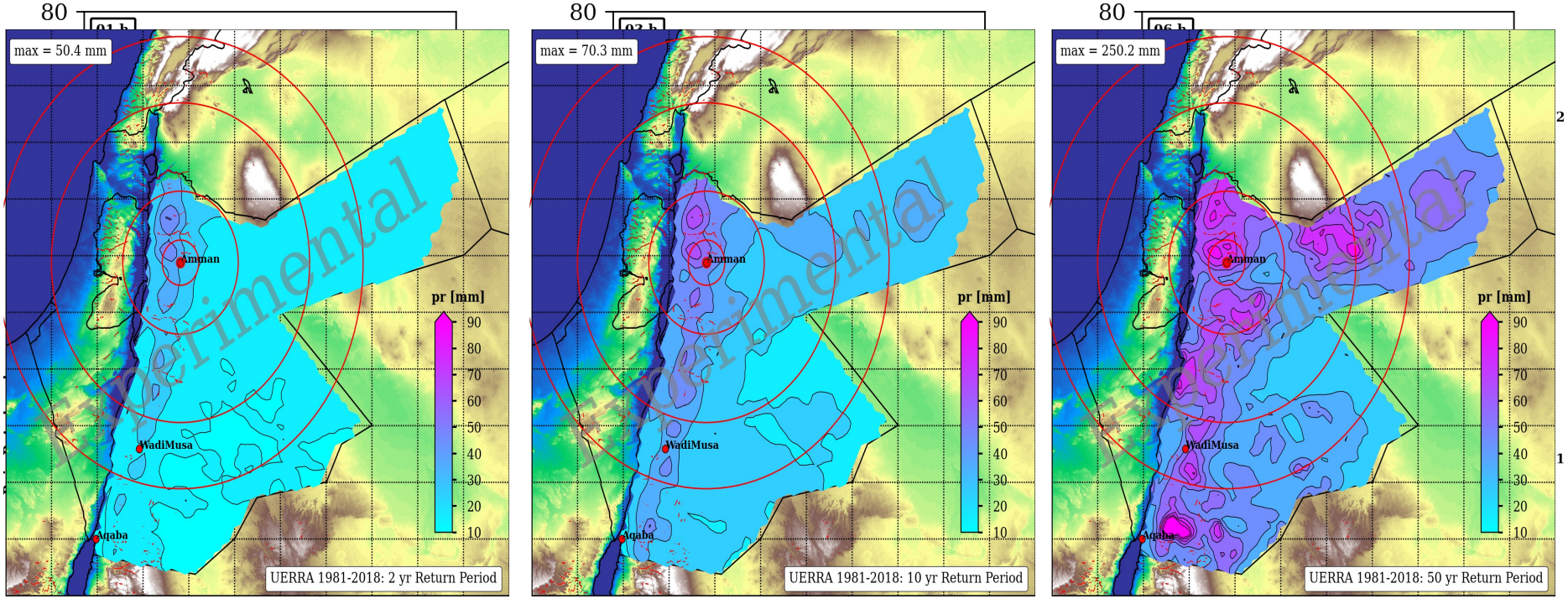
Amman

DATE	UERRA	ERA5	W5E5	GWL	Z500	UERRA	ERA5	W5E5
2004-11-22	009.4	023.3	051.3	NWZ				
2002-12-20	008.1	031.7	045.2	HM				
2013-01-08	047.8	031.9	044.3	BM				
2019-02-28	-999.9	023.3	040.6	NWA				
2012-03-01	030.6	026.8	040.5	HM				
2006-04-02	017.1	027.7	035.9	WZ				



E: Risk Maps of Extreme Daily Rainfall for Return Periods

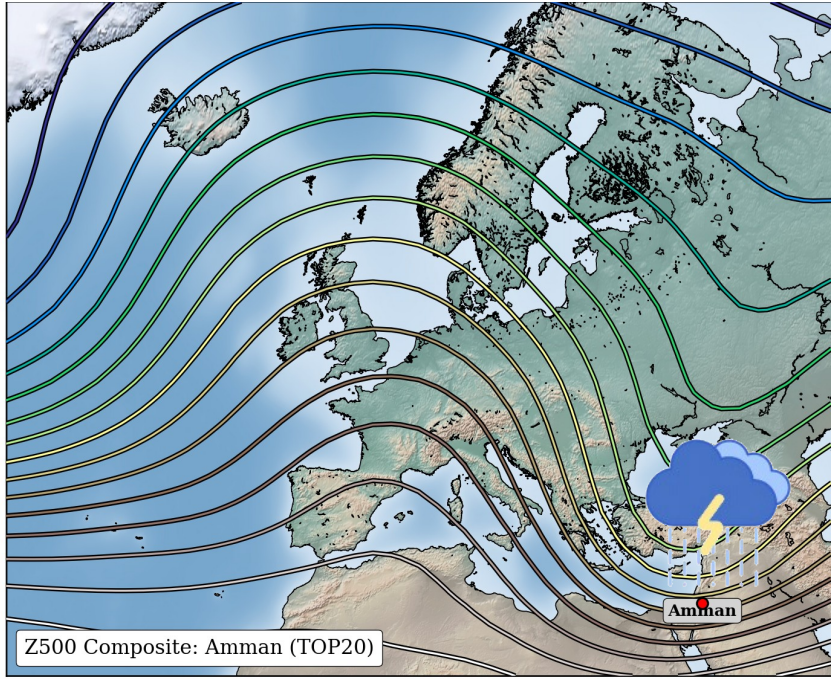
Return Levels for 1h to 24h Rainfall Events

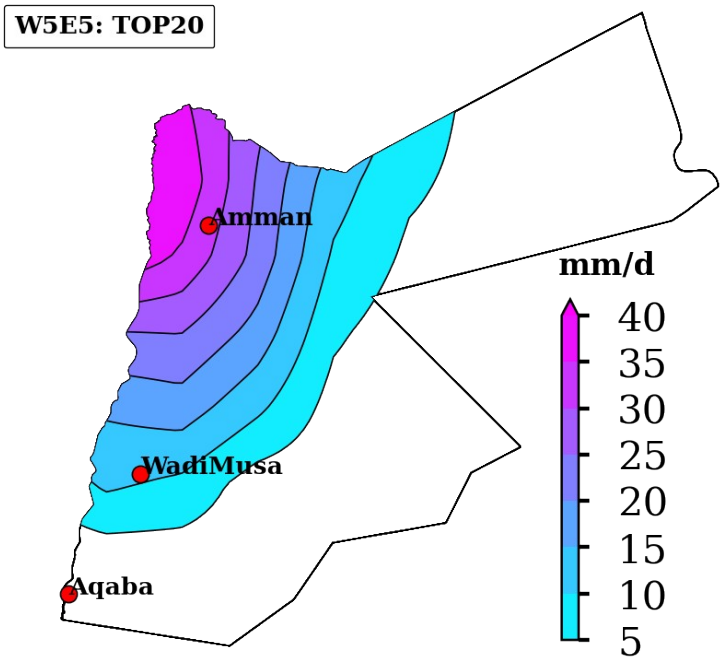


GSMaP & UERRA

F: Detection of Critical Circulation Patterns

Composite Patterns of Extreme Rainfall Events in Amman

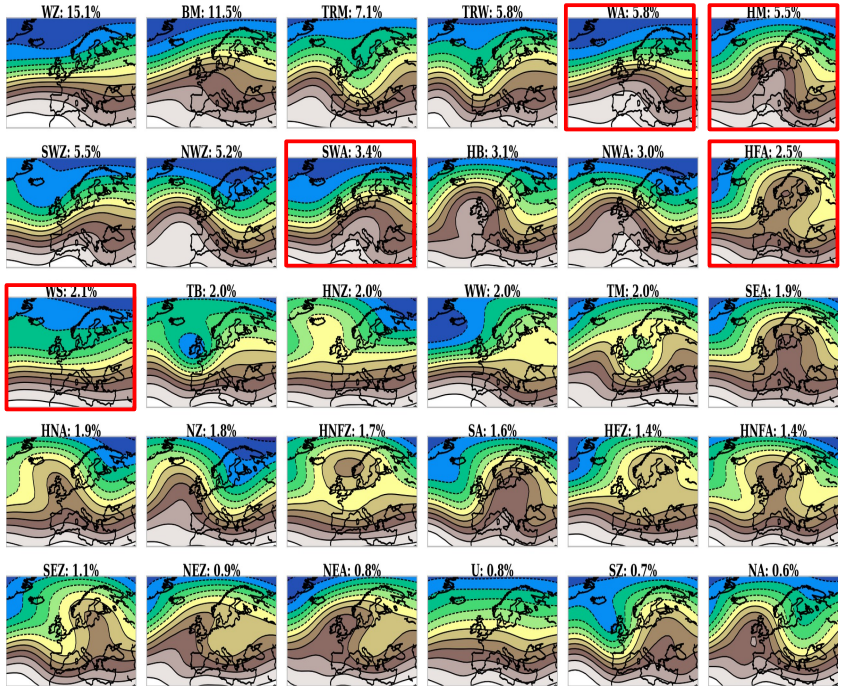


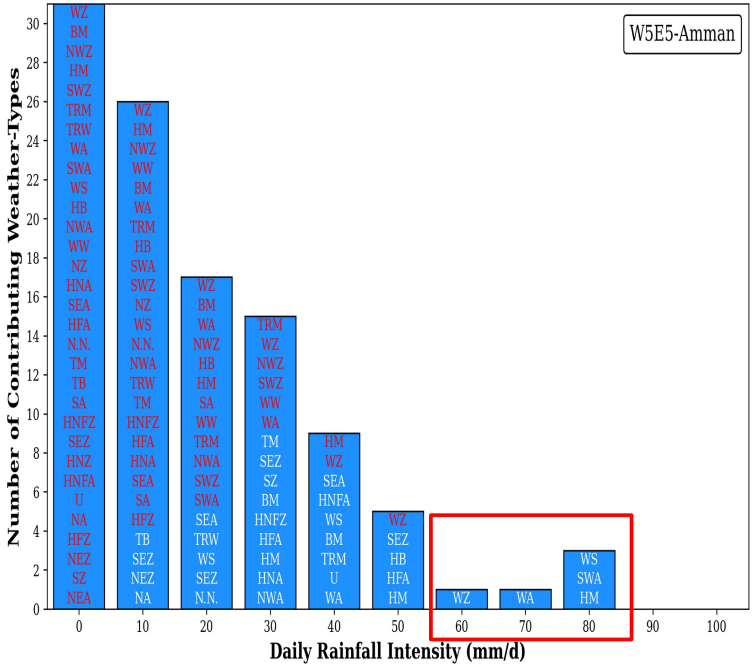


NCEP & W5E5

F: Detection of Critical Circulation Patterns

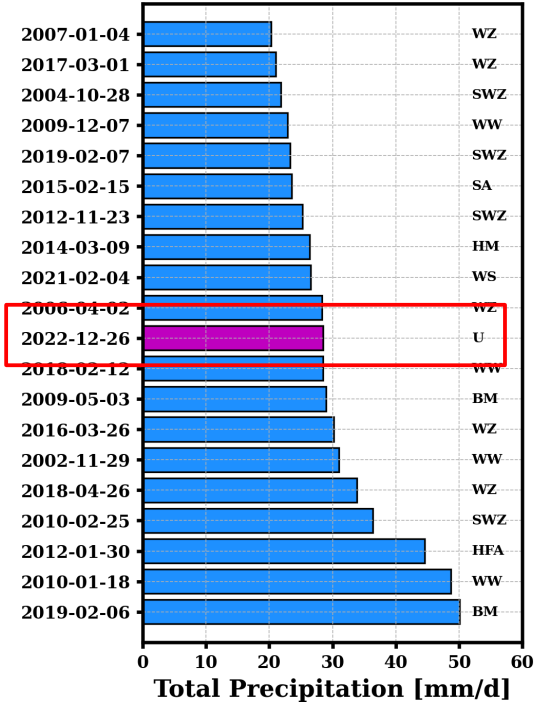
Critical Circulation Pattern for Heavy Rainfall in Amman

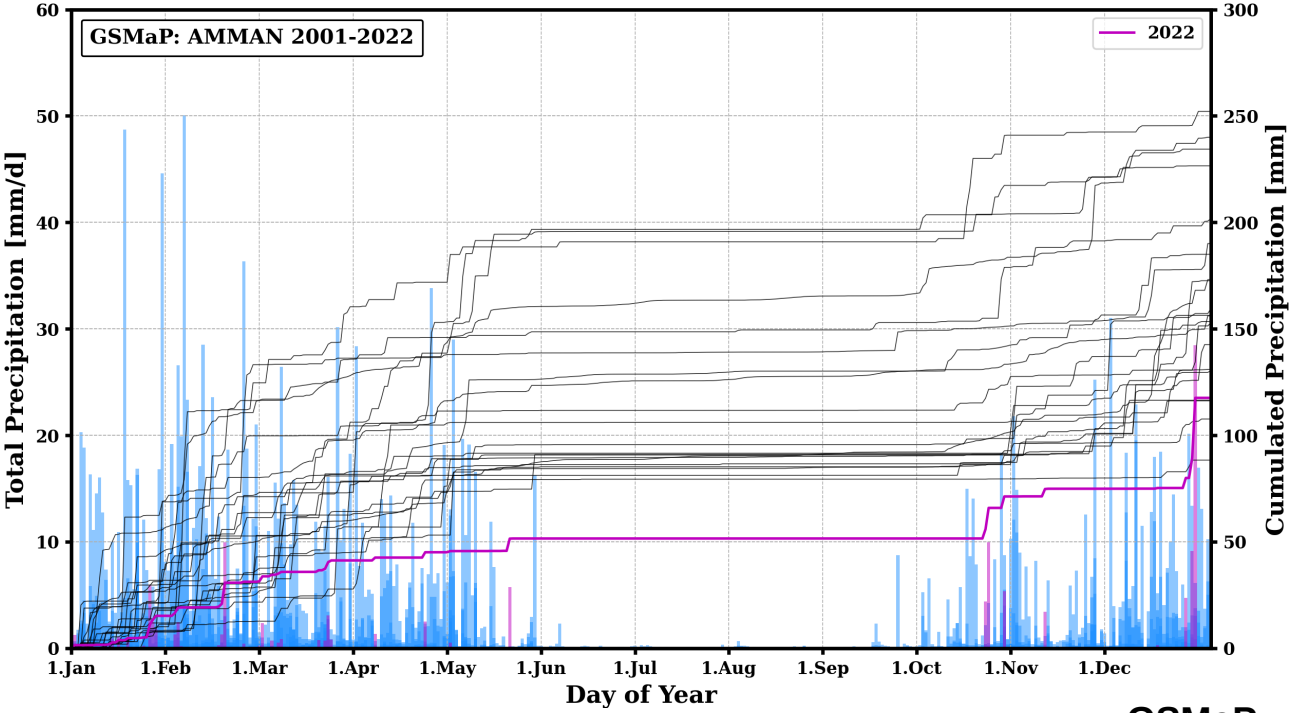




GWL & W5E5

G: Climate Service and Scenario Analyses
Saisonality of Rainfall and Extremes in Amman



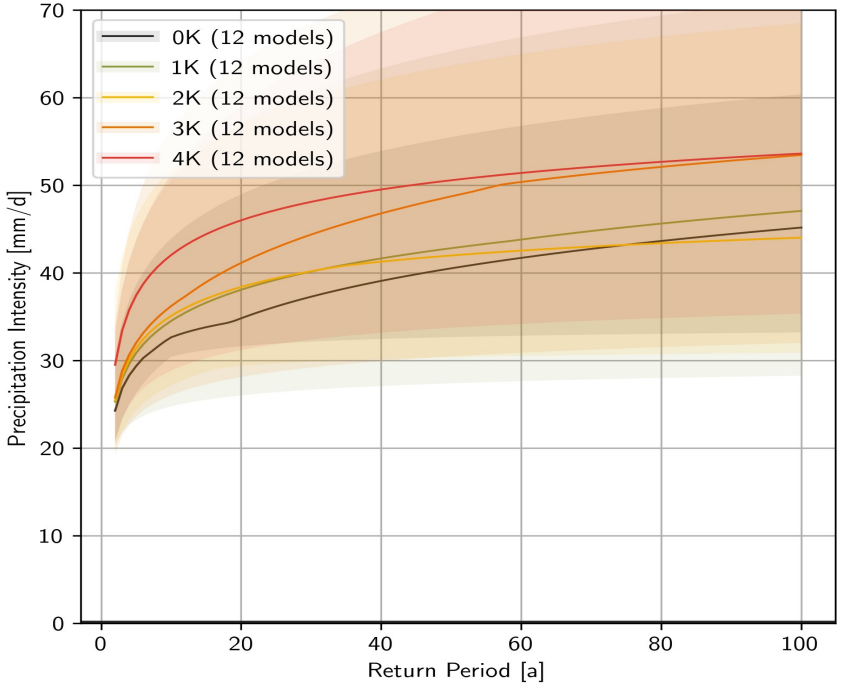


GSMaP

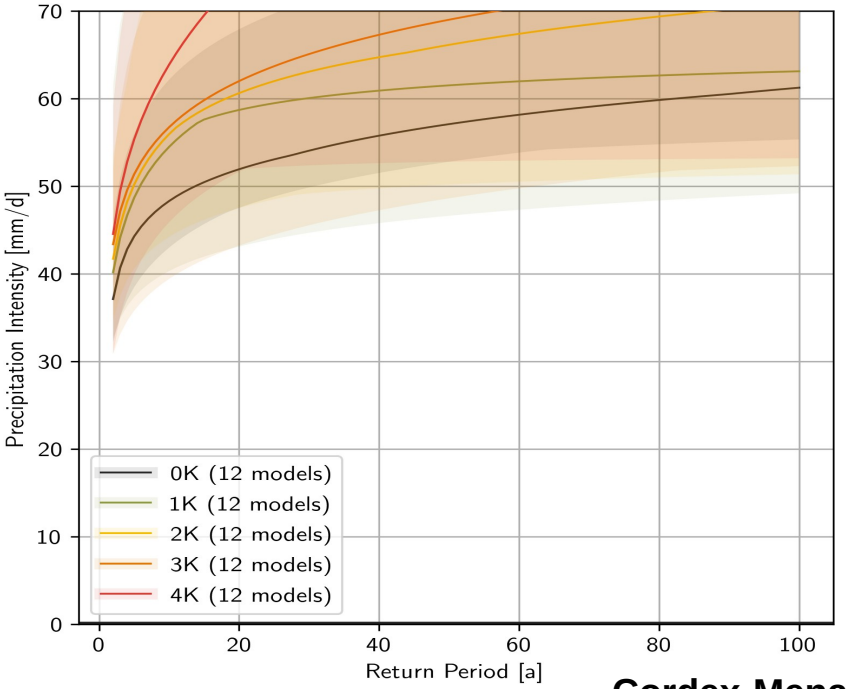
G: Climate Service and Scenario Analyses

Sensitivity of Heavy Rainfall in Amman to Global Warming Level

Amman (grid cell)



Amman (larger domain)



Cordex-Mena

Thanks for your attention!

Data and Models are not perfect, however
with access to data and derived products, trust increases.

Your feedback?

Project Partners

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وزارة المياه والري

Ministry of Environment

Greater Amman Municipality

Jordan Meteorological Department

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Heavy Rainfalls in Jordan

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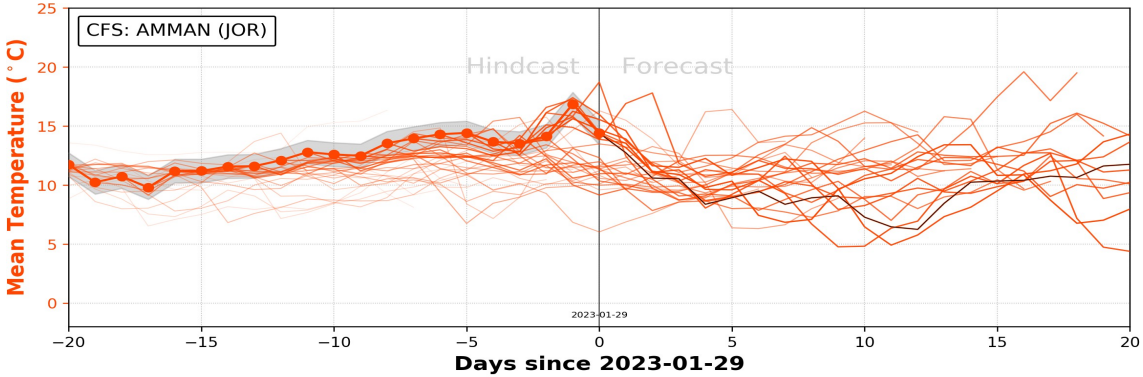
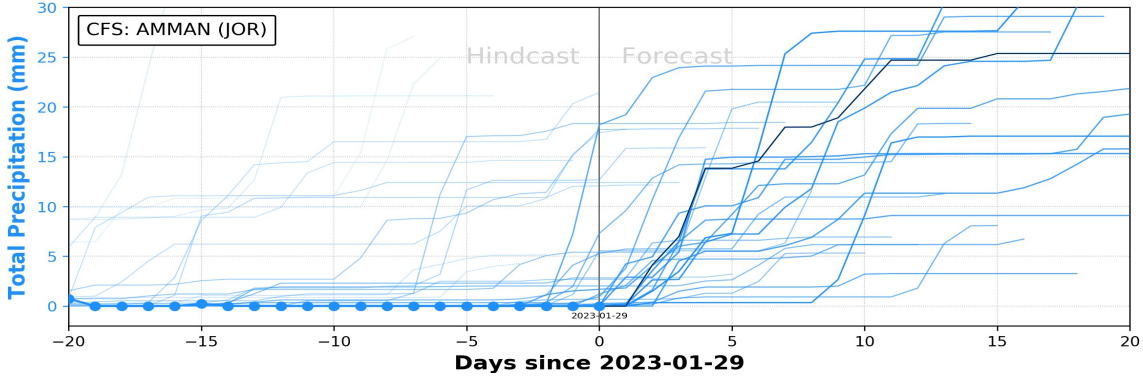
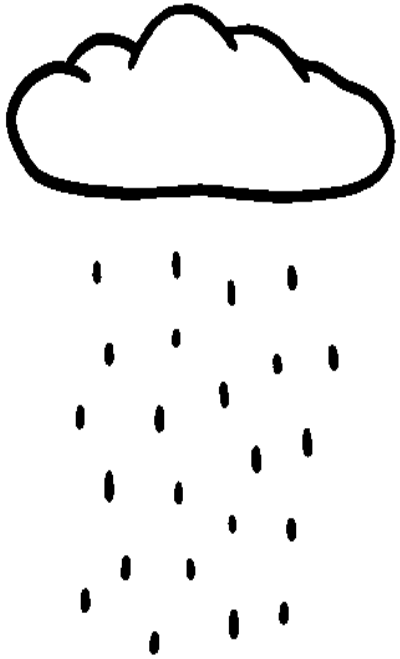
Dankeschön!

شـكراً!

S1: Hindcast Evaluation
Climate Forecast System (CFS)

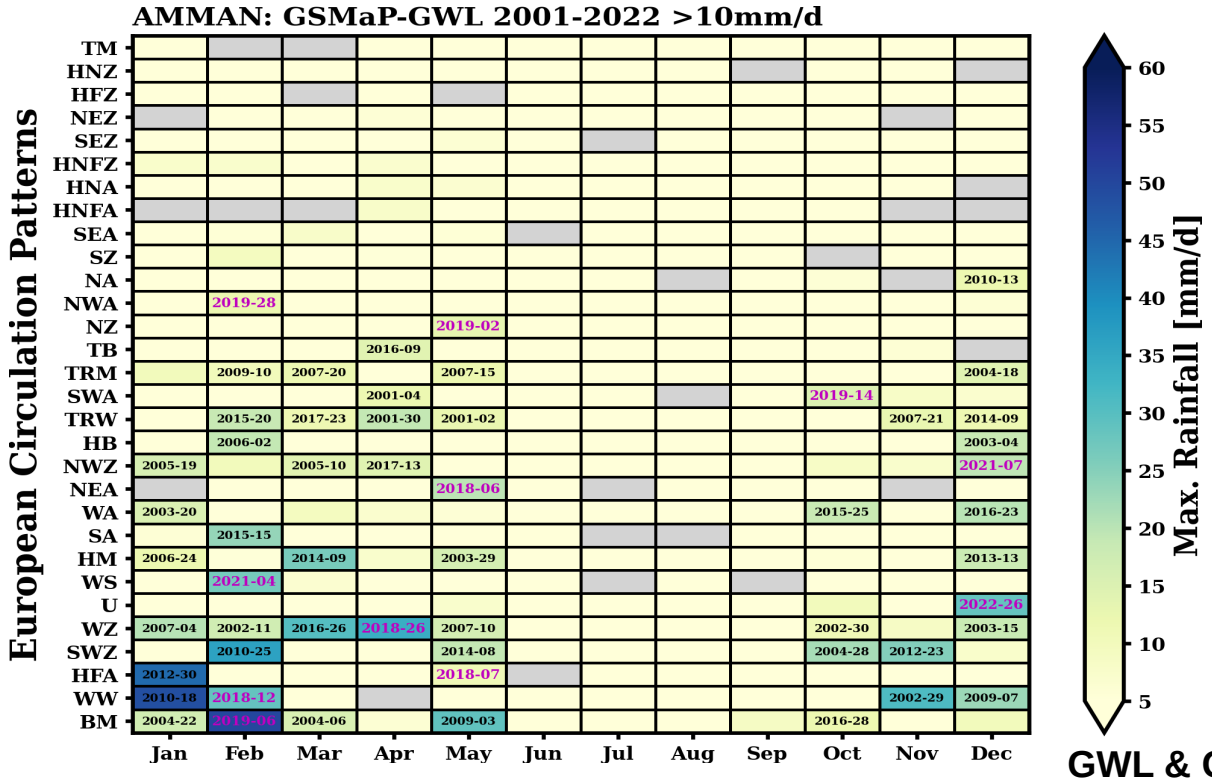


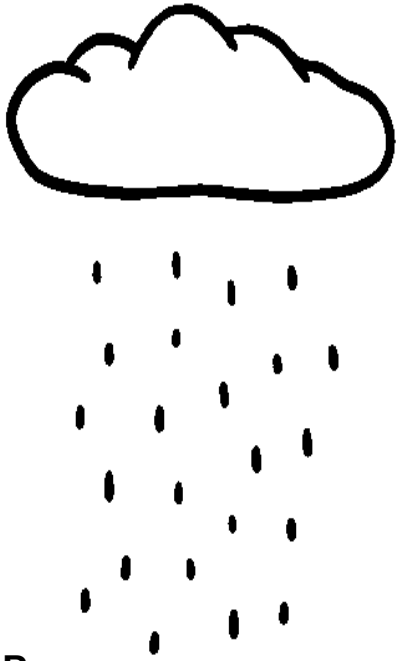




S2: Hindcast Evaluation

Local Character of Circulation Patterns for Amman

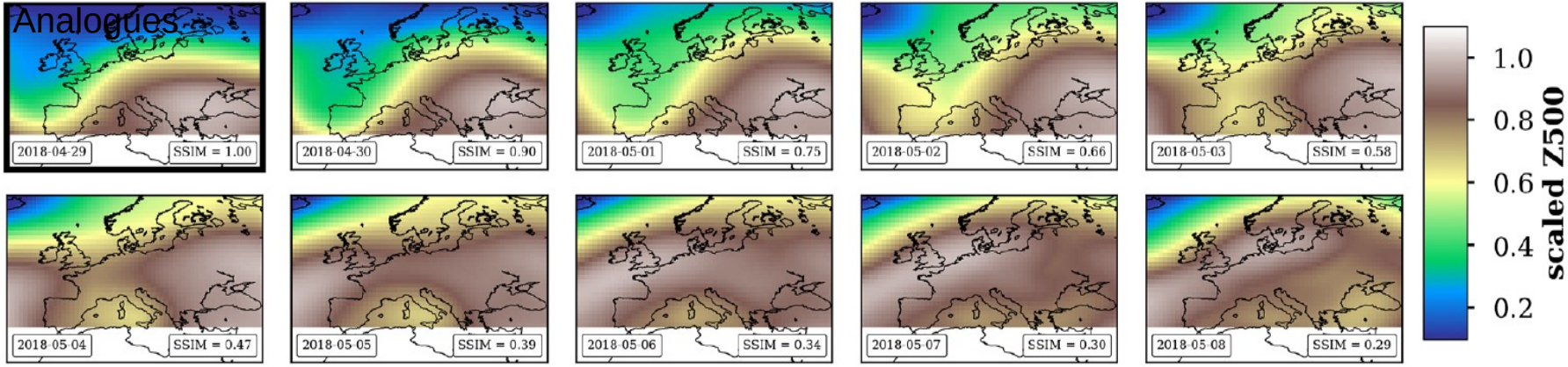




GWL & GSMaP

S3: Python Software for Image Recognition
Strutural Image Comparison applied to Atmospheric Fields

Detection of Similarities and Climate Analogues



$$SSIM_j(\mathbf{x},\mathbf{y}) = \left(\frac{2\mu_x\mu_y + C_1}{\mu_x^2 + \mu_y^2 + C_1}\right)_l \cdot \left(\frac{2\sigma_x\sigma_y + C_2}{\sigma_x^2 + \sigma_y^2 + C_2}\right)_c \cdot \left(\frac{\sigma_{xy} + C_3}{\sigma_x\sigma_y + C_3}\right)_s = \frac{(2\mu_x\mu_y + C_1)\cdot(2\sigma_{xy} + C_2)}{(\mu_x^2 + \mu_y^2 + C_1)\cdot(\sigma_x^2 + \sigma_y^2 + C_2)}$$

S4: Scenario Analysis using public available Services
IPCC Atlas