Workpackage 2

When and why does heavy rainfall occur?

A retrospective analysis on climatic drivers and future scenarios on heavy rainfall

Peter Hoffmann

Potsdam Institute for Climate Impacts Research (PIK)
Climate Resilience / Hydro-Climatic Risks

What is it about and why is it important?

Local heavy rainfall events ...

- ... can trigger severe flash floods in urban areas or wadi systems *worldwide*
- ... recently occured in the eastern Mediterranean (Greece 2023, Lybia 2023)
- ... will *thermo-dynamically* intensified by global warming
- ... are *dynamically* associated with characteristic large-scale weather patterns
- ... require enhanced data and forecast model driven early warning systems
- ... prediction is limited, due to the spatial and temporal scale of the phenomena

Key findings

⇨ opposite trend directions of mean and extreme precipitation

decreasing/increasing

⇨ dynamical drivers for extreme rainfall in Jordan are instabilities over the eastern Mediterranean often accociated with a transport of cold air masses from north to south

such weather patterns determine the frequency of events

⇨ short-term events (convective storms) shorter than 6-hr show a consistent future increase (ca.15%) in the context of global warming

according to thermodynamic changes (+7% by +1K)

⇨ less frequent, but if then possibly more intensive

catastrophic events cannot by excluded under the present pathway of global warming

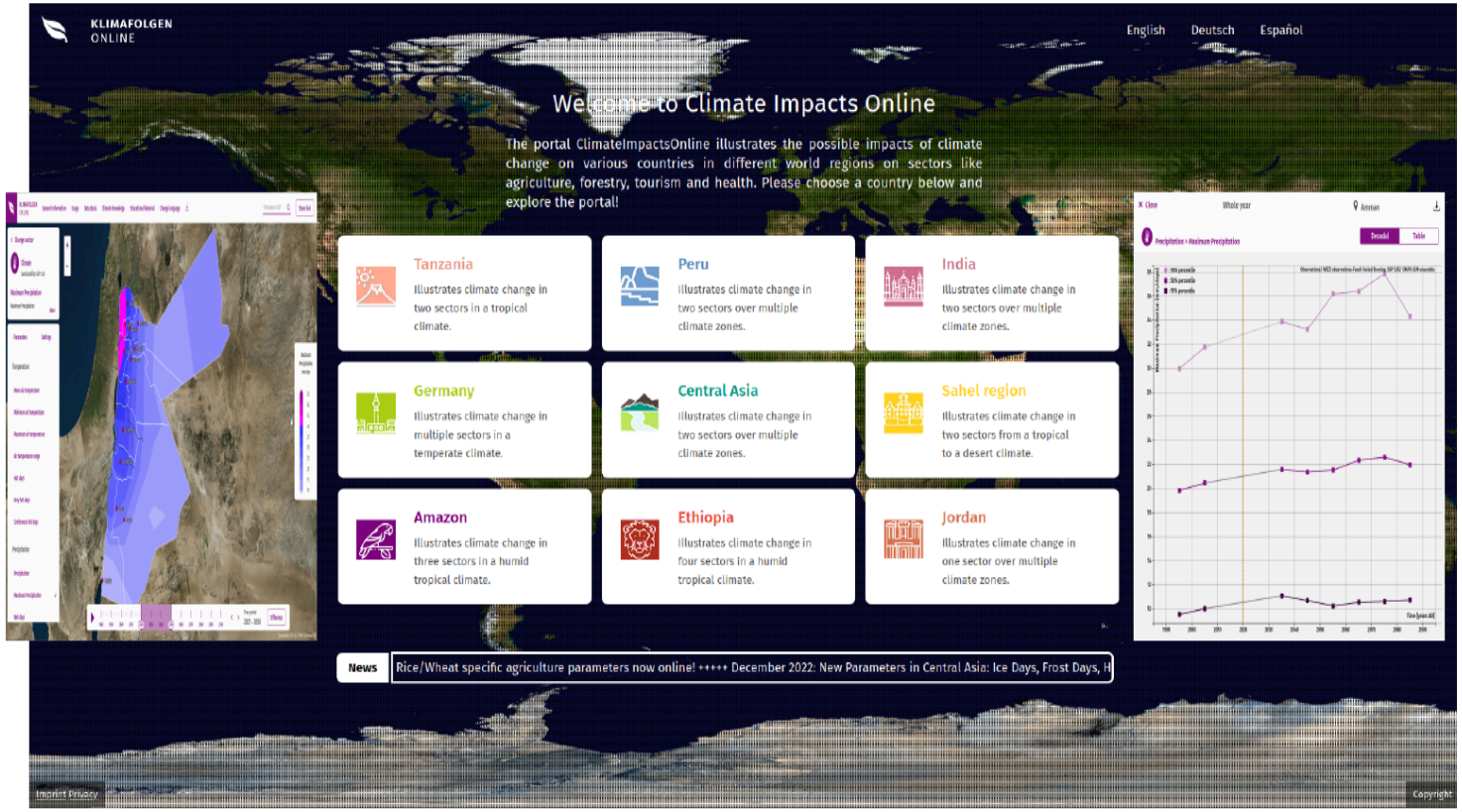
Main products

Heavy rainfall in Jordan:

- ⇨ Large-Scale Context
- ⇨ Very Early Warning
- ⇨ Long-Term Trends
- ⇨ Future Scenarios
- ⇨ Climate Service Portal

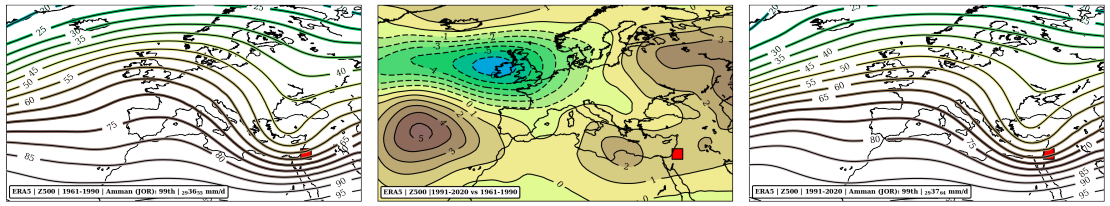
Climate Service Portal for Jordan:

www.climateimpactsonline.com hosted and maintained by PIK

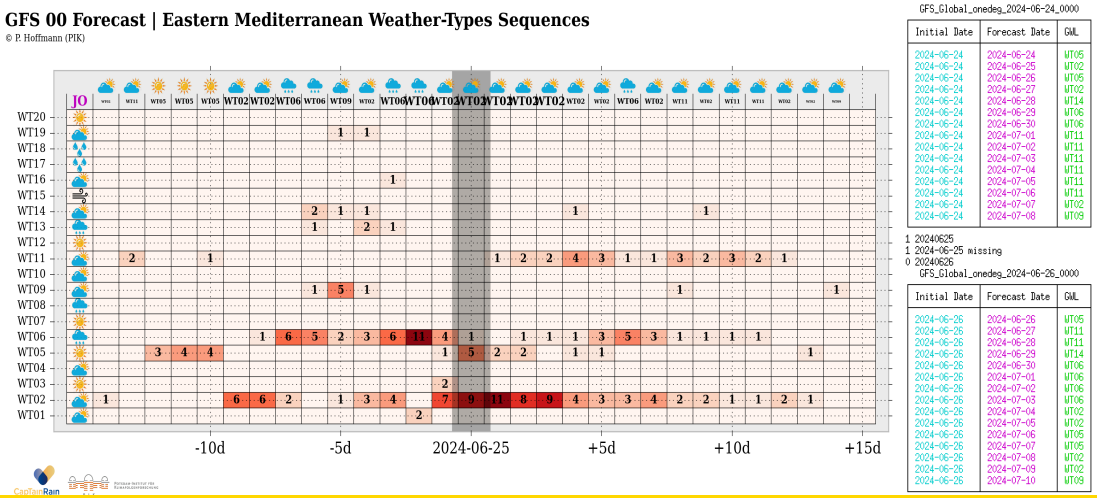


Main products

Large-Scale Context:
detection of critical weather patterns



Very Early Warning:
hybrid monitoring of predicted weather patterns



GFS_Global_onedeg_2024-06-24_0000

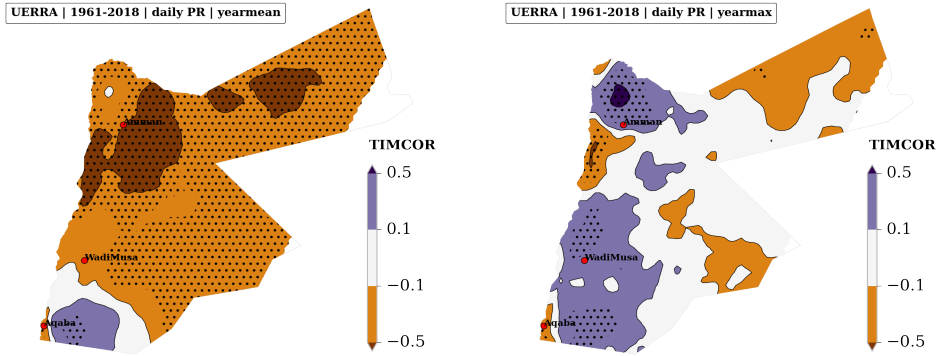
Initial Date	Forecast Date	GWL
2024-06-24	2024-06-24	WT05
2024-06-24	2024-06-25	WT02
2024-06-24	2024-06-26	WT05
2024-06-24	2024-06-27	WT02
2024-06-24	2024-06-28	WT14
2024-06-24	2024-06-29	WT06
2024-06-24	2024-06-30	WT06
2024-06-24	2024-07-01	WT11
2024-06-24	2024-07-02	WT11
2024-06-24	2024-07-03	WT11
2024-06-24	2024-07-04	WT11
2024-06-24	2024-07-05	WT11
2024-06-24	2024-07-06	WT11
2024-06-24	2024-07-07	WT02
2024-06-24	2024-07-08	WT09

1 20240625
1 2024-06-25 missing
0 20240626

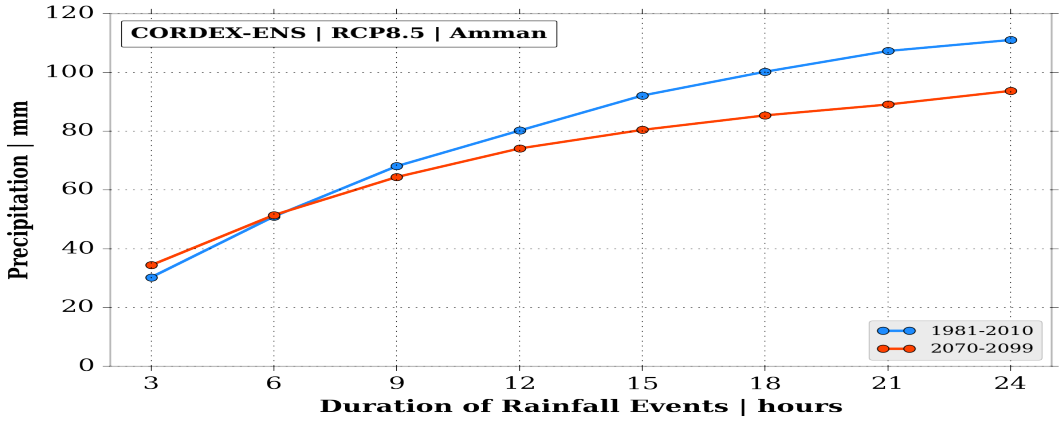
GFS_Global_onedeg_2024-06-26_0000

Initial Date	Forecast Date	GWL
2024-06-26	2024-06-26	WT05
2024-06-26	2024-06-27	WT11
2024-06-26	2024-06-28	WT11
2024-06-26	2024-06-29	WT14
2024-06-26	2024-06-30	WT06
2024-06-26	2024-07-01	WT06
2024-06-26	2024-07-02	WT06
2024-06-26	2024-07-03	WT06
2024-06-26	2024-07-04	WT02
2024-06-26	2024-07-05	WT02
2024-06-26	2024-07-06	WT05
2024-06-26	2024-07-07	WT05
2024-06-26	2024-07-08	WT02
2024-06-26	2024-07-09	WT02
2024-06-26	2024-07-10	WT09

Long-Term Trends:
temporal correlation of means and extremes

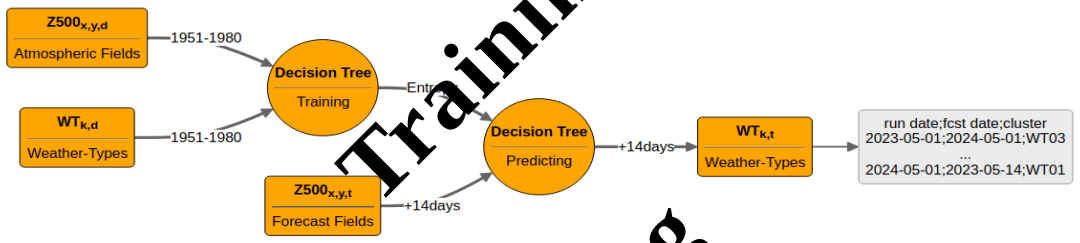


Future Rainfall Scenarios:
analysis of return levels for short-term events

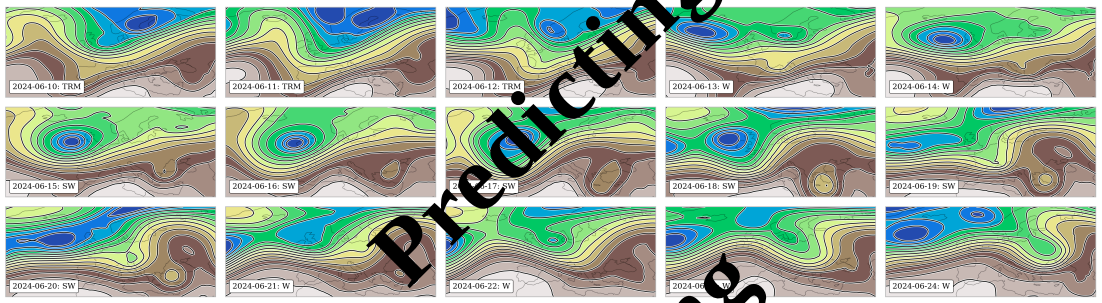


Very Early Warning:

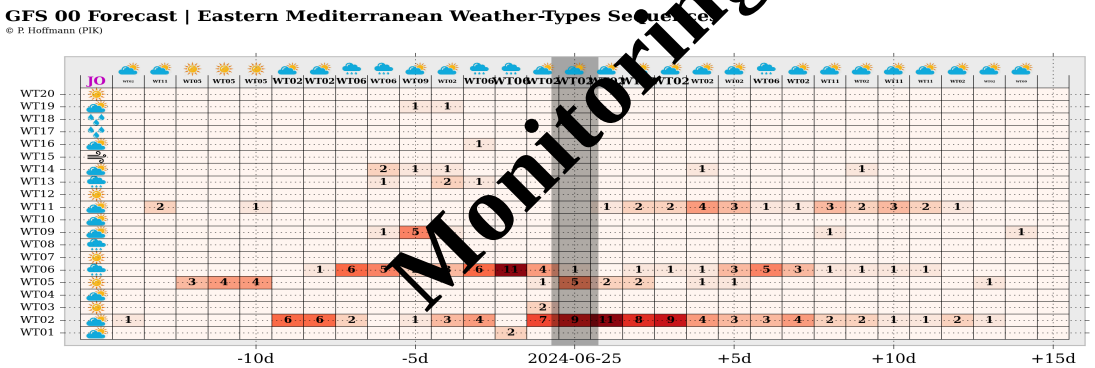
hybrid monitoring of predicted weather patterns



Training



Predicting



Monitoring

GFS_Global_onedeg_2024-06-24_0000

Initial Date	Forecast Date	GWL
2024-06-24	2024-06-24	WT05
2024-06-24	2024-06-25	WT02
2024-06-24	2024-06-26	WT05
2024-06-24	2024-06-27	WT02
2024-06-24	2024-06-28	WT14
2024-06-24	2024-06-29	WT06
2024-06-24	2024-06-30	WT06
2024-06-24	2024-07-01	WT11
2024-06-24	2024-07-02	WT11
2024-06-24	2024-07-03	WT11
2024-06-24	2024-07-04	WT11
2024-06-24	2024-07-05	WT11
2024-06-24	2024-07-06	WT11
2024-06-24	2024-07-07	WT02
2024-06-24	2024-07-08	WT09

1 20240625
1 2024-06-25 missing
0 20240626

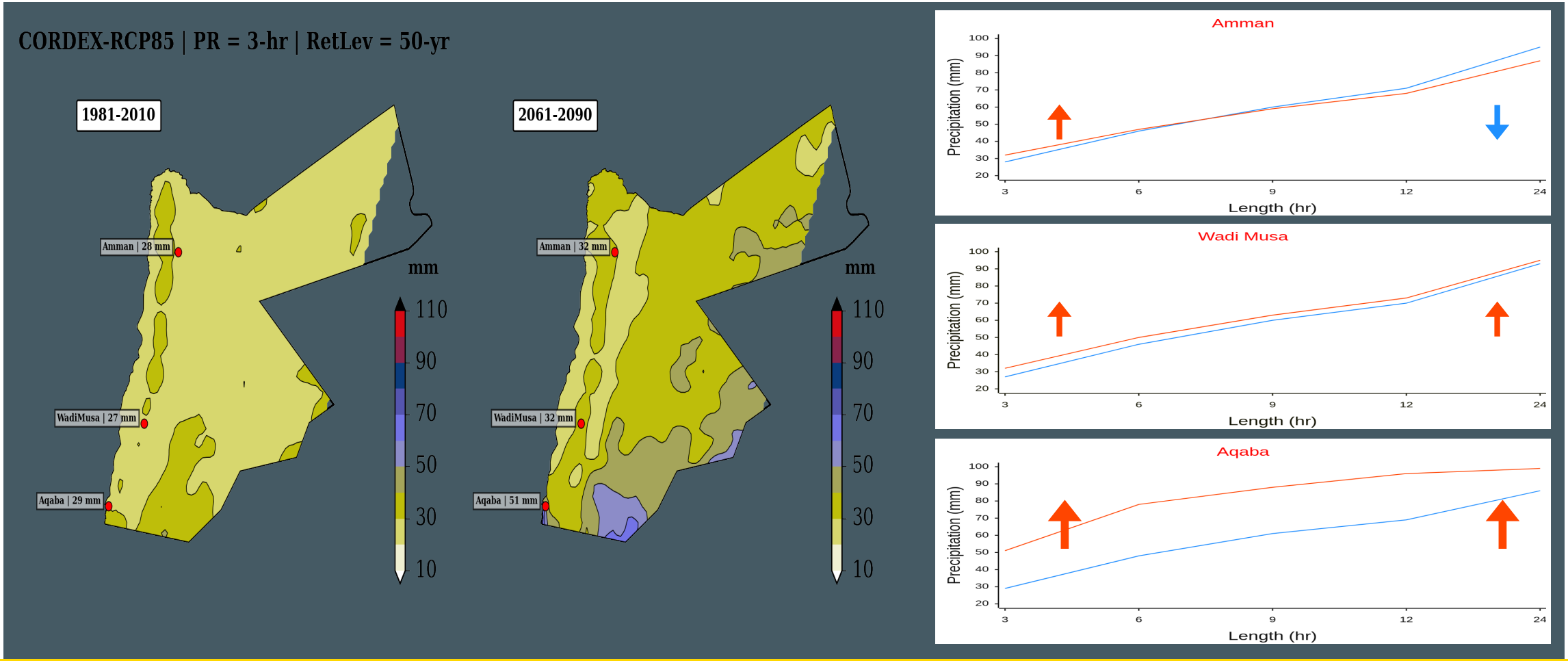
GFS_Global_onedeg_2024-06-26_0000

Initial Date	Forecast Date	GWL
2024-06-26	2024-06-26	WT05
2024-06-26	2024-06-27	WT11
2024-06-26	2024-06-28	WT11
2024-06-26	2024-06-29	WT14
2024-06-26	2024-06-30	WT06
2024-06-26	2024-07-01	WT06
2024-06-26	2024-07-02	WT06
2024-06-26	2024-07-03	WT06
2024-06-26	2024-07-04	WT02
2024-06-26	2024-07-05	WT02
2024-06-26	2024-07-06	WT05
2024-06-26	2024-07-07	WT05
2024-06-26	2024-07-08	WT02
2024-06-26	2024-07-09	WT02
2024-06-26	2024-07-10	WT09

Reporting

Heavy Rainfall Maps:

given in a climatic context using regional climate model ensembles



Outlook

➪ climate impact studies on the local level are challenging

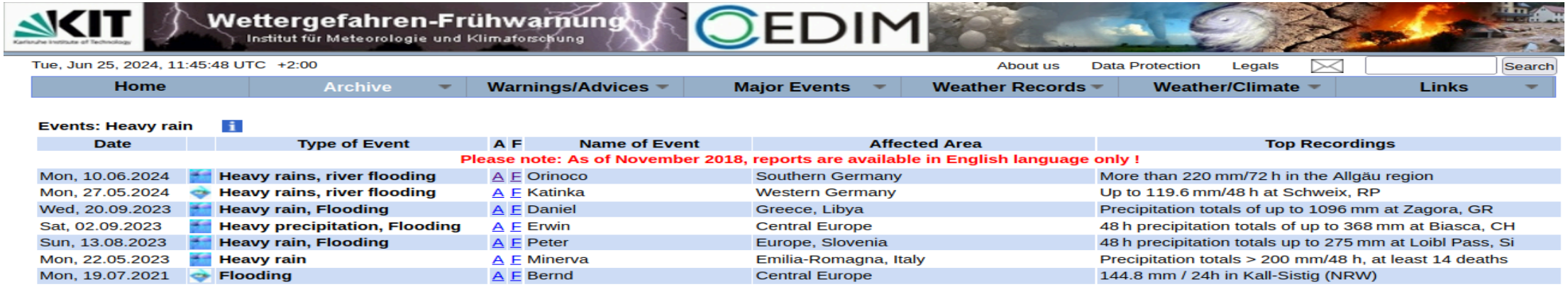
➪ confrontation with data scarcity

➪ more pragmatic and generalized approaches are required

➪ decoupling of dynamical and thermodynamical factors

➪ Jordan/Germany: common focus on weather systems from the Mediterranean

➪ after the flood is before the flood



Date		Type of Event	A	F	Name of Event	Affected Area	Top Recordings
Please note: As of November 2018, reports are available in English language only !							
Mon, 10.06.2024		Heavy rains, river flooding	A	F	Orinoco	Southern Germany	More than 220 mm/72 h in the Allgäu region
Mon, 27.05.2024		Heavy rains, river flooding	A	F	Katinka	Western Germany	Up to 119.6 mm/48 h at Schweix, RP
Wed, 20.09.2023		Heavy rain, Flooding	A	F	Daniel	Greece, Libya	Precipitation totals of up to 1096 mm at Zagora, GR
Sat, 02.09.2023		Heavy precipitation, Flooding	A	F	Erwin	Central Europe	48 h precipitation totals of up to 368 mm at Biasca, CH
Sun, 13.08.2023		Heavy rain, Flooding	A	F	Peter	Europe, Slovenia	48 h precipitation totals up to 275 mm at Loibl Pass, Si
Mon, 22.05.2023		Heavy rain	A	F	Minerva	Emilia-Romagna, Italy	Precipitation totals > 200 mm/48 h, at least 14 deaths
Mon, 19.07.2021		Flooding	A	F	Bernd	Central Europe	144.8 mm / 24h in Kall-Sistig (NRW)

Dankeschön!

شكرًا

Feedback? Questions?

WikiLink