

Characteristics of joint heavy rain and high sea level events on the Finnish coast in 1961-2020

Mika Rantanen, Kirsti Jylhä, Jani Räihä, Jani Särkkä, Ulpu Leijala
Finnish Meteorological Institute

- Excessive precipitation together with high sea level cause much higher risk for coastal flooding than if these hazards occur in isolation

The aims of this study:

1. Characterize the climatology, variability and possible trends of joint heavy rain and high sea level events (hereafter compound events)
2. Investigate the synoptic patterns driving the events
3. Study the atmospheric circulation patterns promoting the events in a temporally longer time scale



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Data and methods

1. Sea level observations from Finnish tide gauges
2. Gridded precipitation data (FMI ClimGrid)

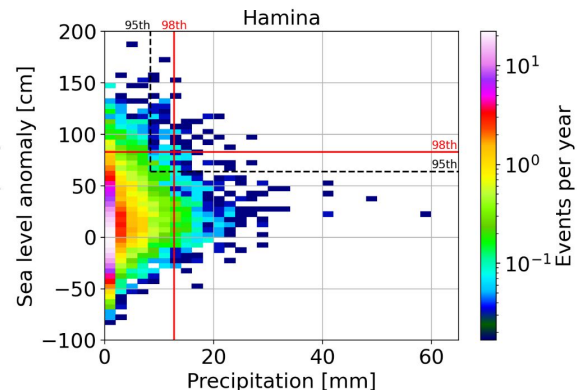
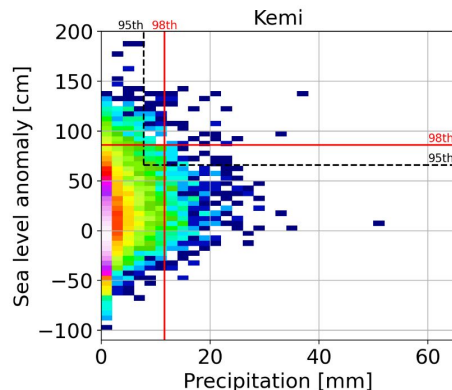
-> time series of daily precipitation and maximum sea level in 1961-2020 at nine tide gauges

3. ERA5 reanalysis and monthly indices of atmospheric circulation patterns

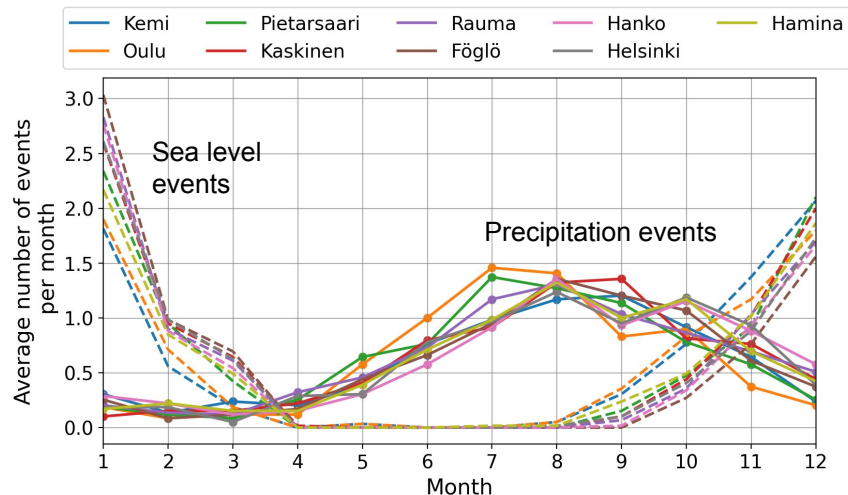
Two levels of extremeness were defined, using percentiles:

(a) **elevated** (95 %) and (b) **high** (98 %).

- Elevated-level compound event was defined as days when both precipitation and sea level reached 95 %, and same applied for high level

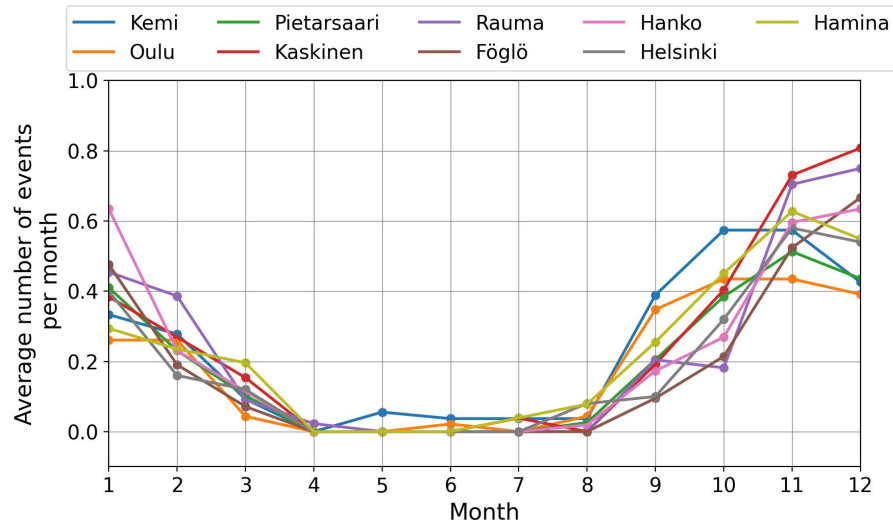


Climatology of extreme precipitation and sea level events



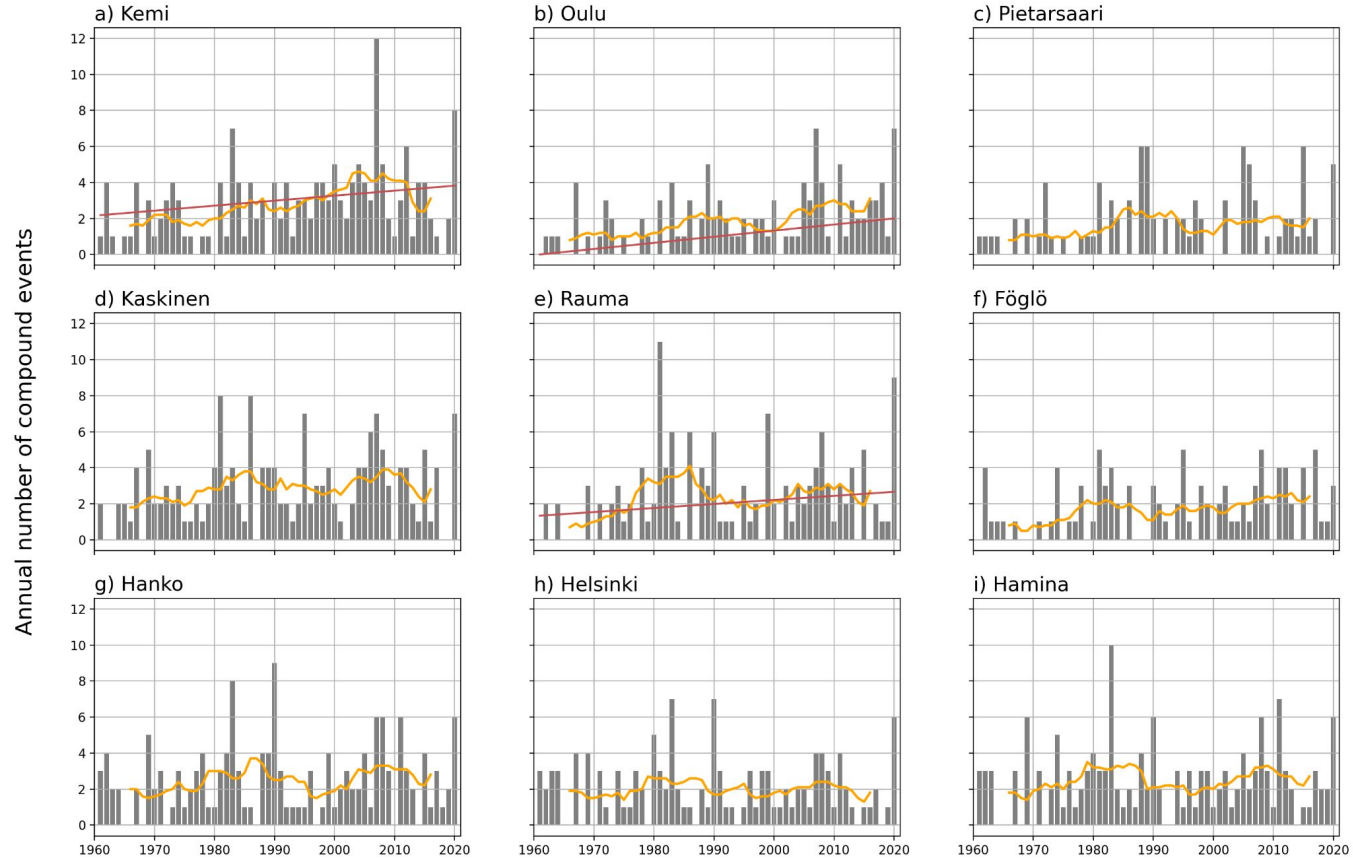
Extreme precipitation events are the most frequent during summer while the high sea level events occur typically in winter

Climatology of simultaneous occurrence of the events (compound events)



The seasonal cycles of the events overlap best in autumn and early winter, which is why compound events tend to occur at that time of the year

60-year time series of the compound events at the tide gauges

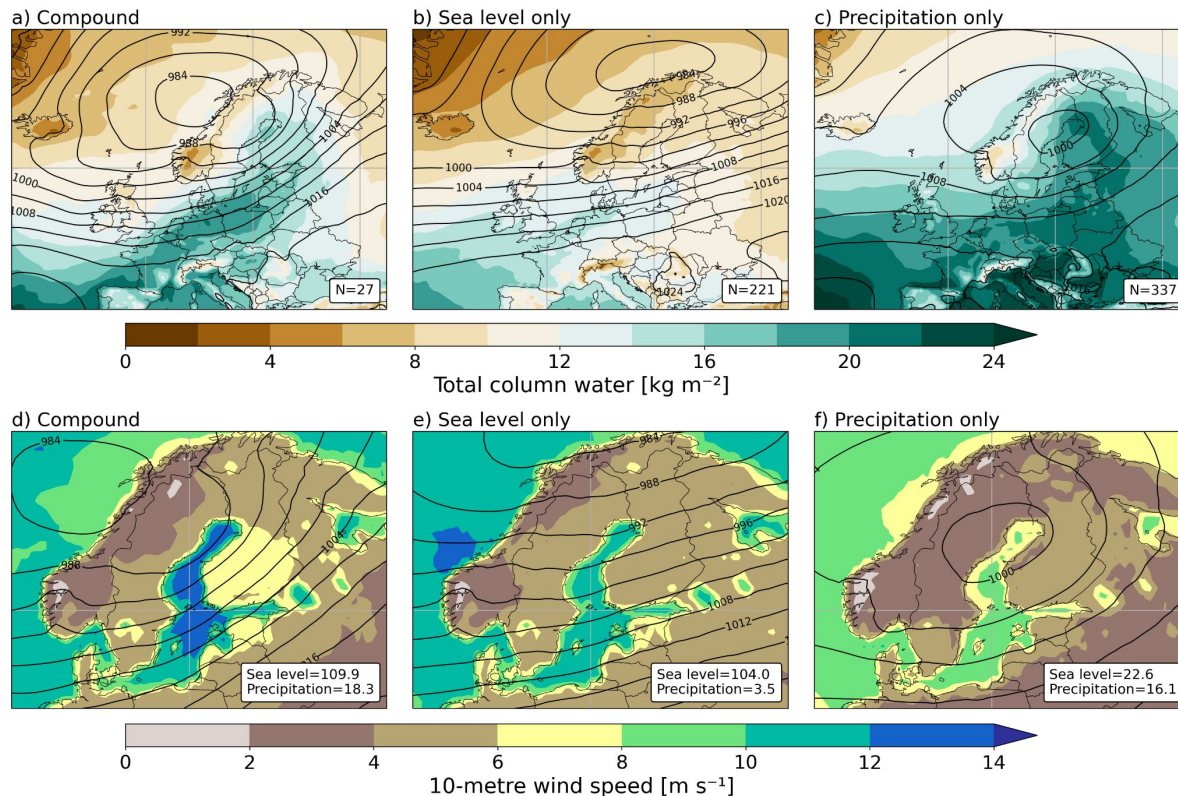


Synoptic patterns driving the events

Compound events:

Low-pressure area in northern Sweden, filament of high moisture content extending from western Europe

Strong winds in the Gulf of Bothnia



Scandinavian pattern is the most relevant in autumn, NAO/AO circulation dominates in winter

Spearman rank
correlation between the
number of events at the
tide gauges and different
atmospheric circulation
patterns



Autumn (SON)				Winter (DJF)			
	AO	NAO	SCA		AO	NAO	SCA
Kemi	0.07	0.07	-0.33	Kemi	0.48	0.38	-0.41
Oulu	0.25	0.3	-0.47	Oulu	0.47	0.4	-0.26
Pietarsaari	0.19	0.06	-0.29	Pietarsaari	0.42	0.32	-0.23
Kaskinen	0.25	0.02	-0.42	Kaskinen	0.55	0.5	-0.33
Rauma	0.34	0.21	-0.45	Rauma	0.54	0.52	-0.46
Föglö	0.12	0.02	-0.12	Föglö	0.29	0.37	-0.24
Hanko	0.38	0.16	-0.43	Hanko	0.52	0.52	-0.44
Helsinki	0.29	0.13	-0.3	Helsinki	0.53	0.47	-0.46
Hamina	0.27	0.09	-0.39	Hamina	0.44	0.44	-0.49
All	0.37	0.19	-0.58	All	0.62	0.6	-0.46