AUSTRIAN FLOOD TYPOLOGY

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Motivation

Flood processes

- At-site extrapolation to large return periods
- Similarity measure for regionalisation
- Flood dynamics in flood forecasting

Objective

Flood process typology for all observed annual flood peaks in Austria

$\rightarrow$ 490 catchments (5-50000 km^2), 1971-1997

Process types

Floods due to

- Long-rain floods
- Short-rain floods
- Flash floods
- Rain-on-snow floods
- Snow-melt floods

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Hypothesised processes:

Synoptic or frontal type rainfall events over several days or longer, filling up of storage capacity, often flood events cover large area up to several thousands of km^2

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- Rain-on-snow floods
- Snow-melt floods

Hypothesised processes:

Rainfall of short duration and high intensity, flood flow as combination of runoff from saturated areas, Horton flow & fast subsurface flow

Process types

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Hypothesised processes:

Convective short duration high intensity rainfall, fast catchment response, limited spatial coverage, mainly in summer

Process types

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Hypothesised processes:

Rain on existing snow cover, saturated catchments due to antecedent snowmelt & snow cover → surface runoff

Process types

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- Short-rain floods
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Hypothesised processes:

Snow melt during fair weather periods & increasing air temperature are saturating the soils, continuously raising the flows

Process indicators

- Soil moisture state (runoff generation index)
- Snow melt & snow water equivalent

→ Daily water balance simulation in 490 gauged catchments, period 1971-97

- Rainfall duration & intensity

→ 1029 daily precipitation time series & data base of extreme rainfall events

- Runoff dynamics

→ Derived from ratio of flood peak and daily runoff

- Spatial coherence

→ Spatial clustering of catchments according to flood timing and catchment locations

Process indicators

- Soil moisture state (runoff generation index)
- Snow melt & snow water equivalent
- Rainfall duration & intensity
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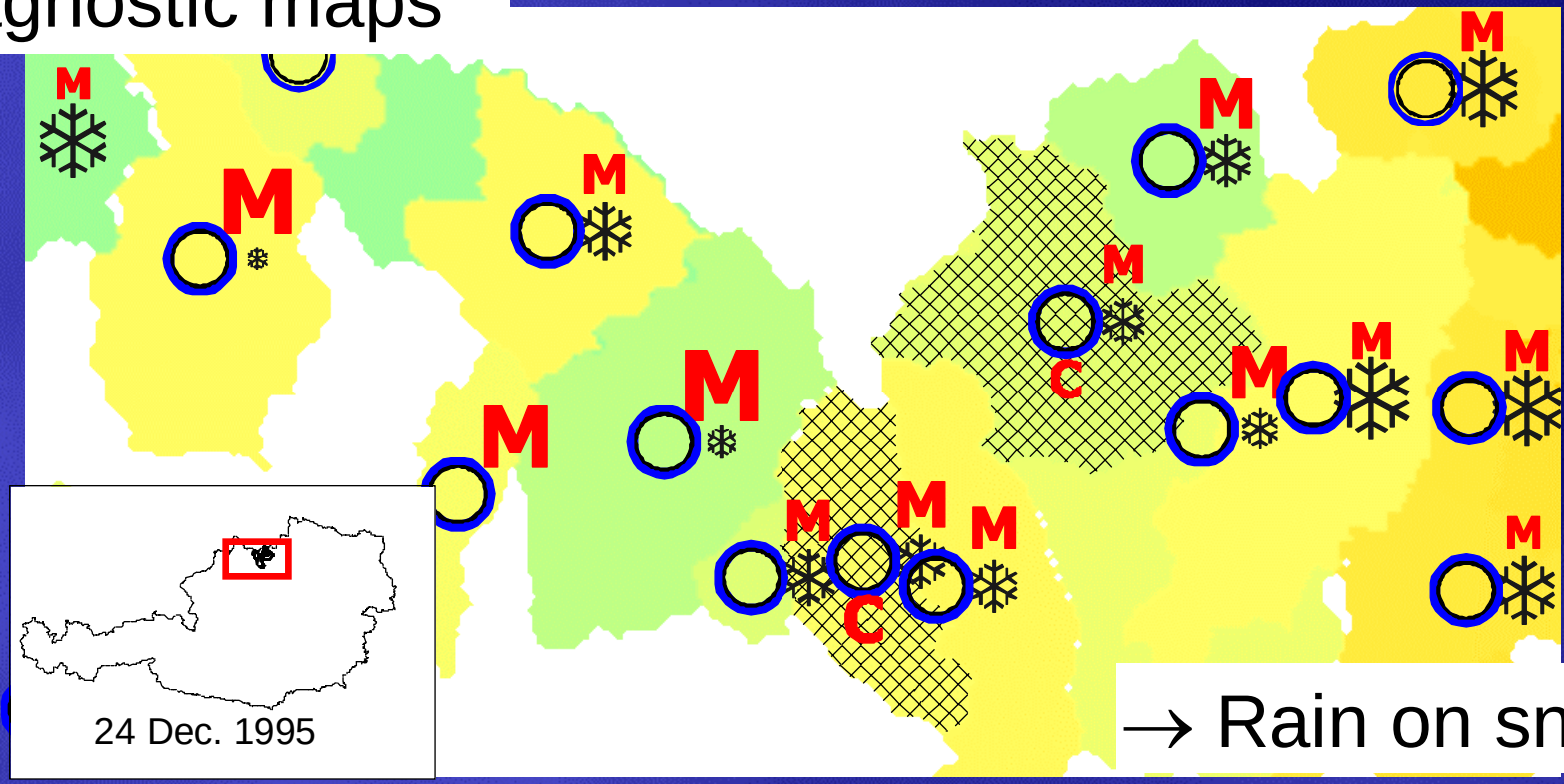
- Spatial coherence

} Diagnostic maps

Diagnostic maps



→ Rain on snow

Runoff generation index: 1, 0.5, 0

1 day rainfall: 5 mm, 30 mm, >100 mm

3 day rainfall: 15 mm, 90 mm, >300 mm

Storm duration: 1 hr, 4 hrs

Annual flood

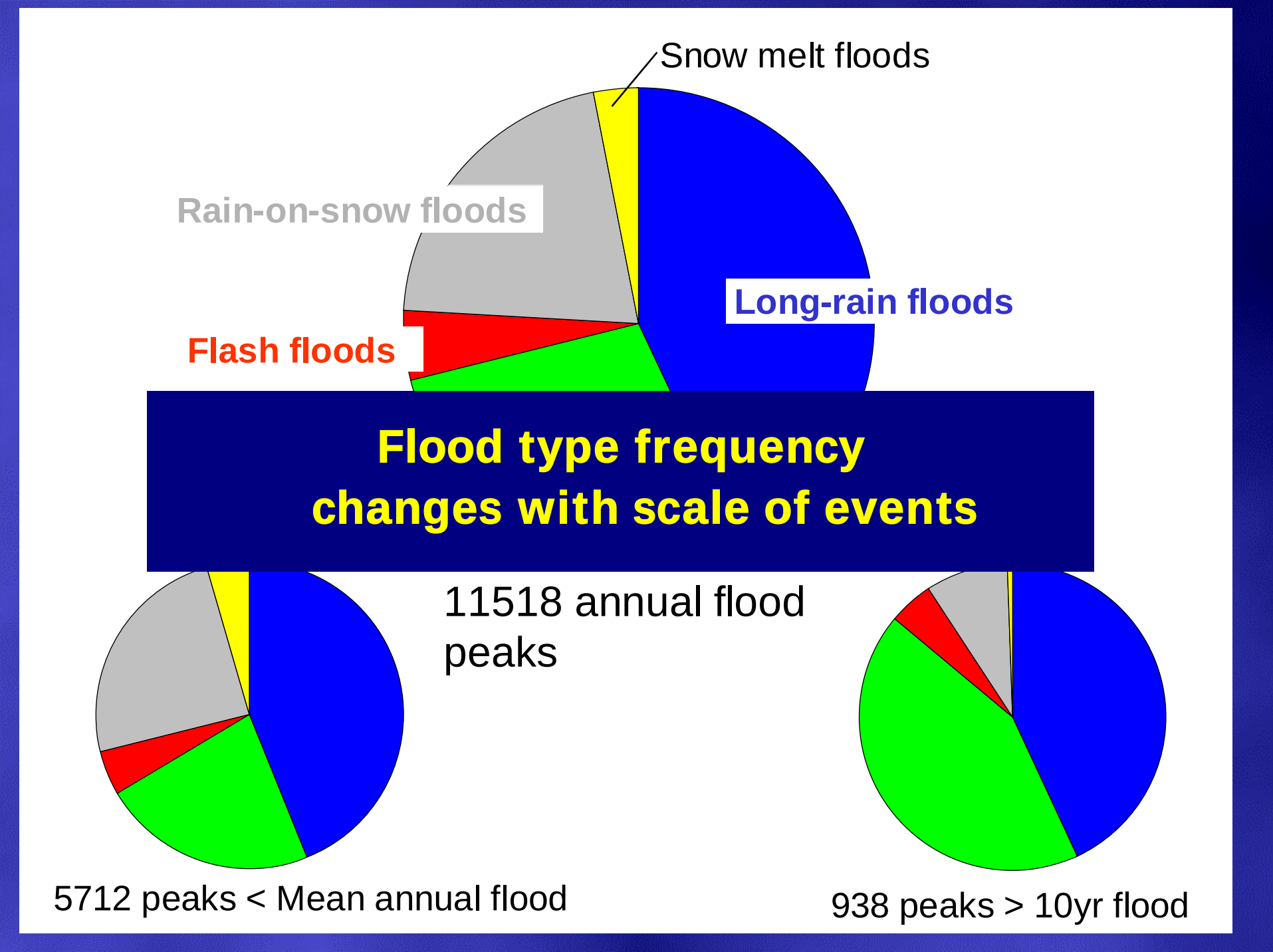
SWE: 50 mm, 100 mm

Snow melt: M 10 mm/d, M 20 mm/d

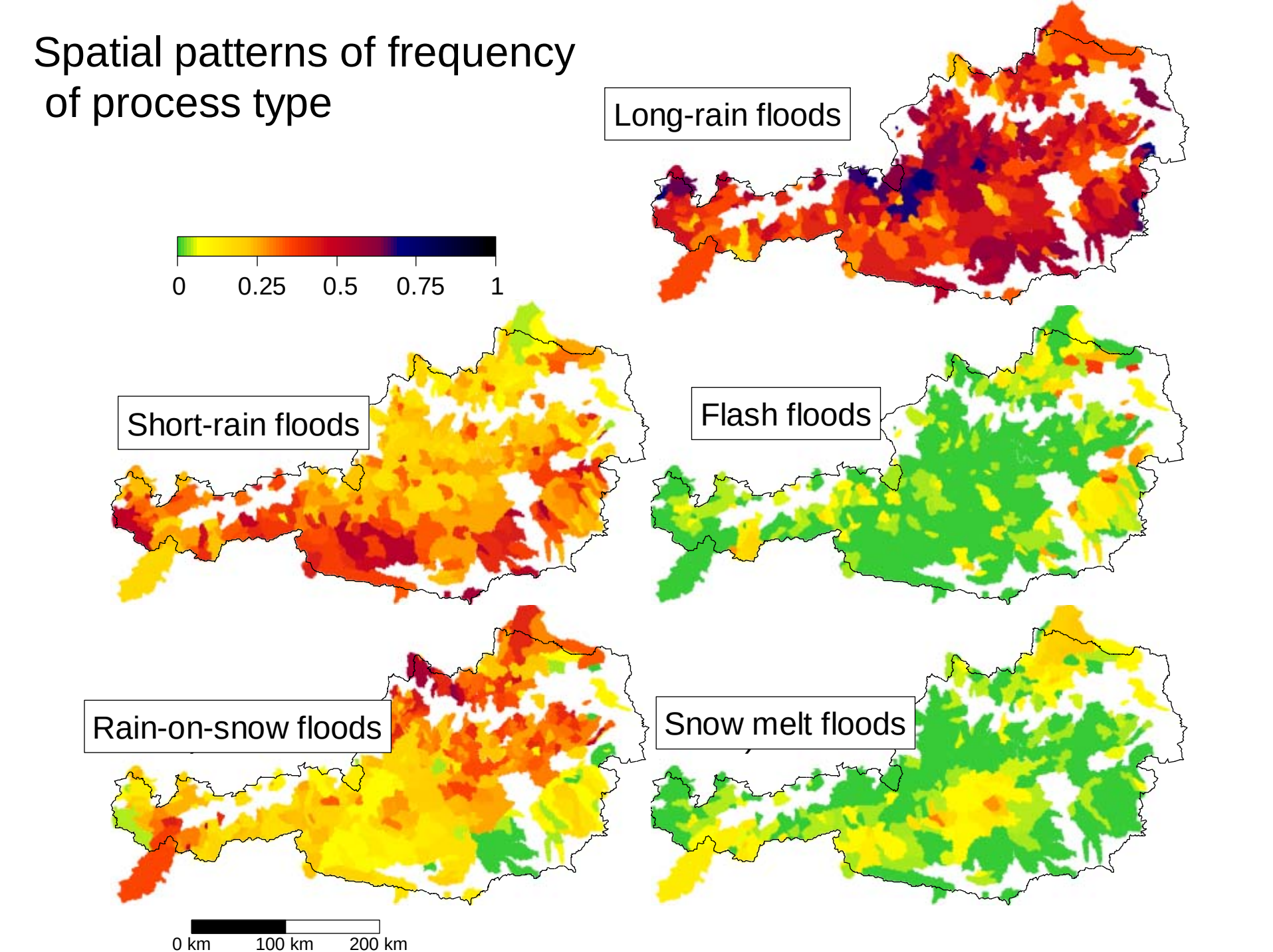
Stand. time of concen-tration: C 2.0, C 0.1

Manual classification of 11518 annual flood peaks in Austria

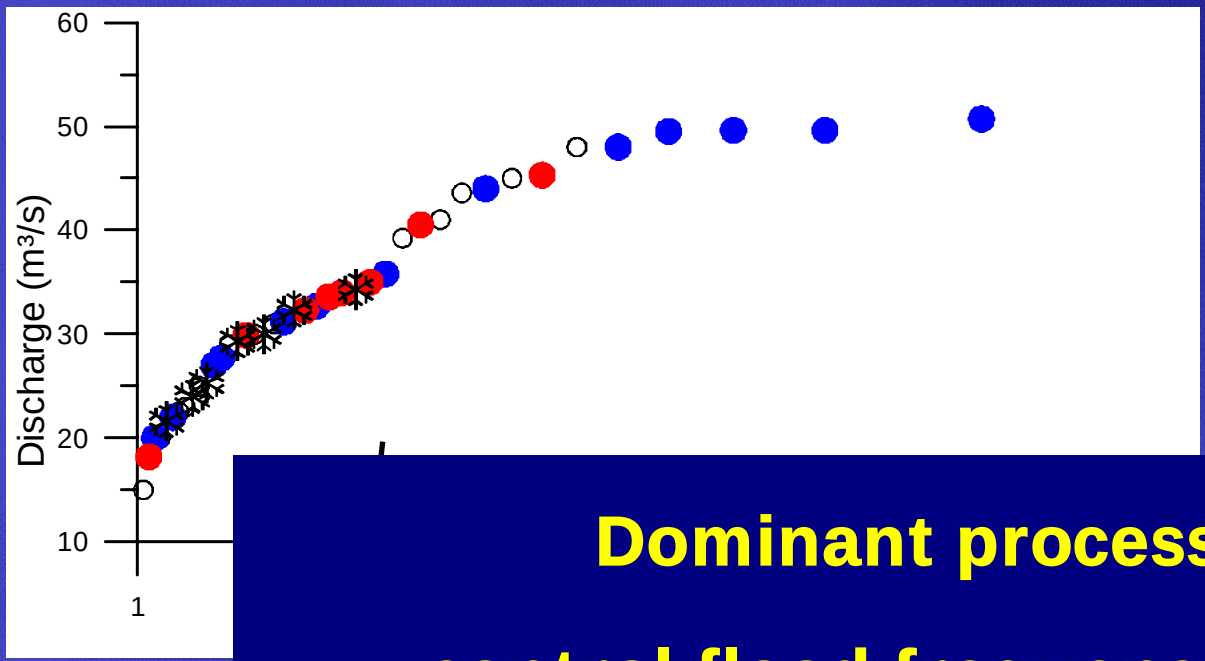
Results ...


Snow melt floods
Rain-on-snow floods
Long-rain floods
Flash floods
Flood type frequency
changes with scale of events
11518 annual flood peaks
5712 peaks < Mean annual flood
938 peaks > 10yr flood

Spatial patterns of frequency of process type



Controls on flood frequency shape



Long-rain floods

Short-rain floods

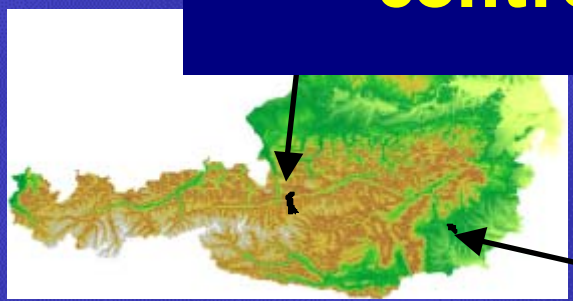
Flash floods

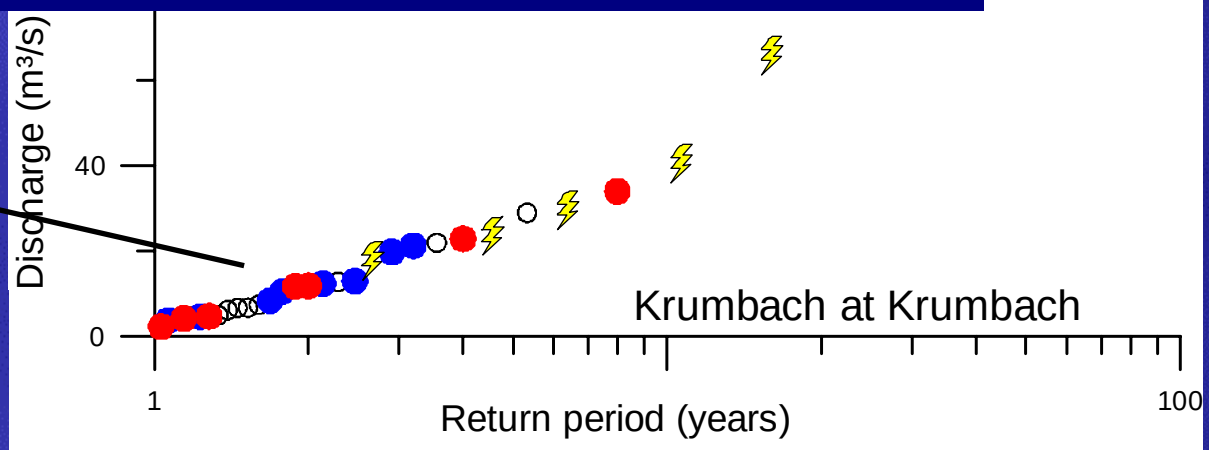
Rain-on-snow floods

Snow-melt floods

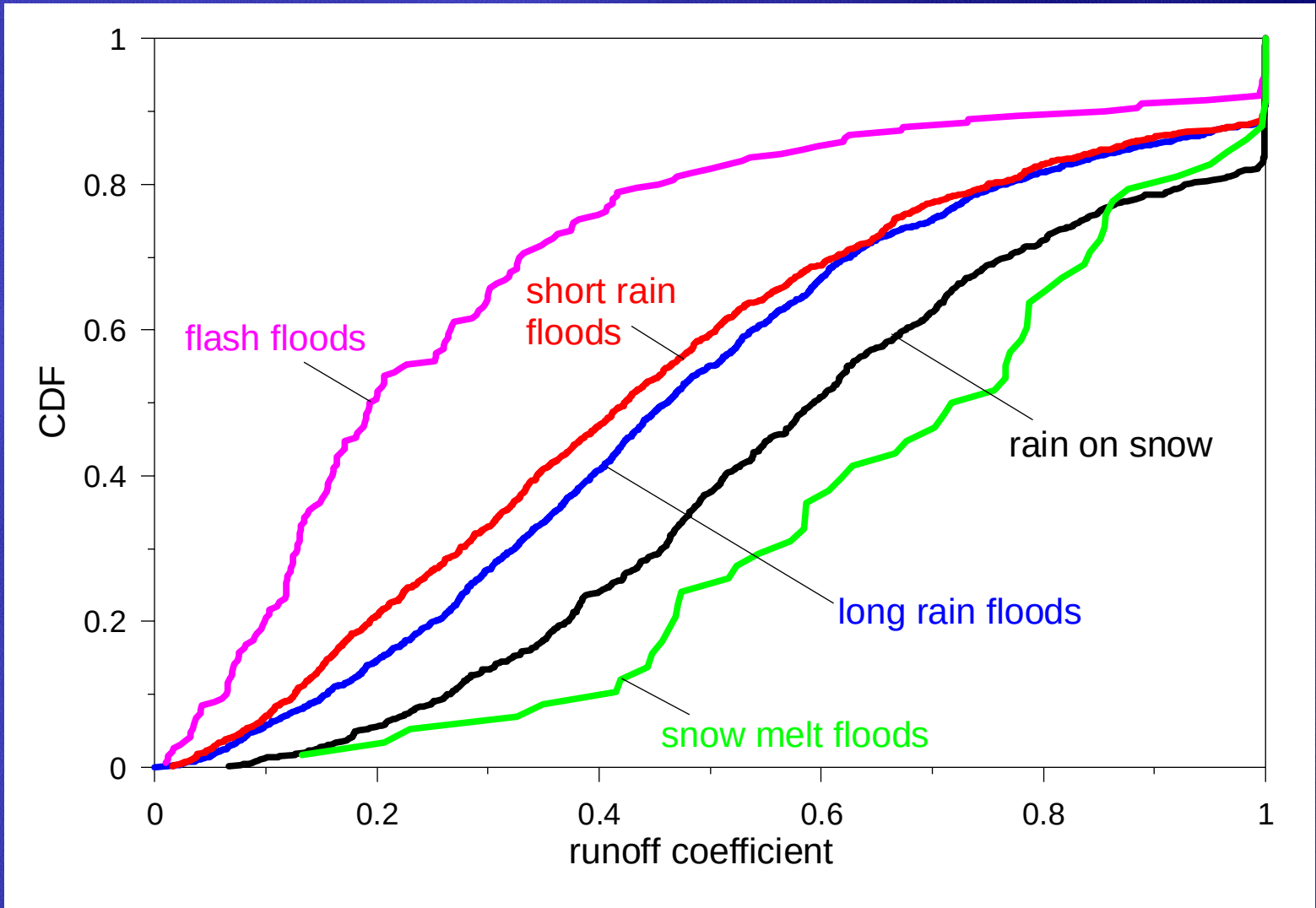
Dominant processes

control flood frequency shape



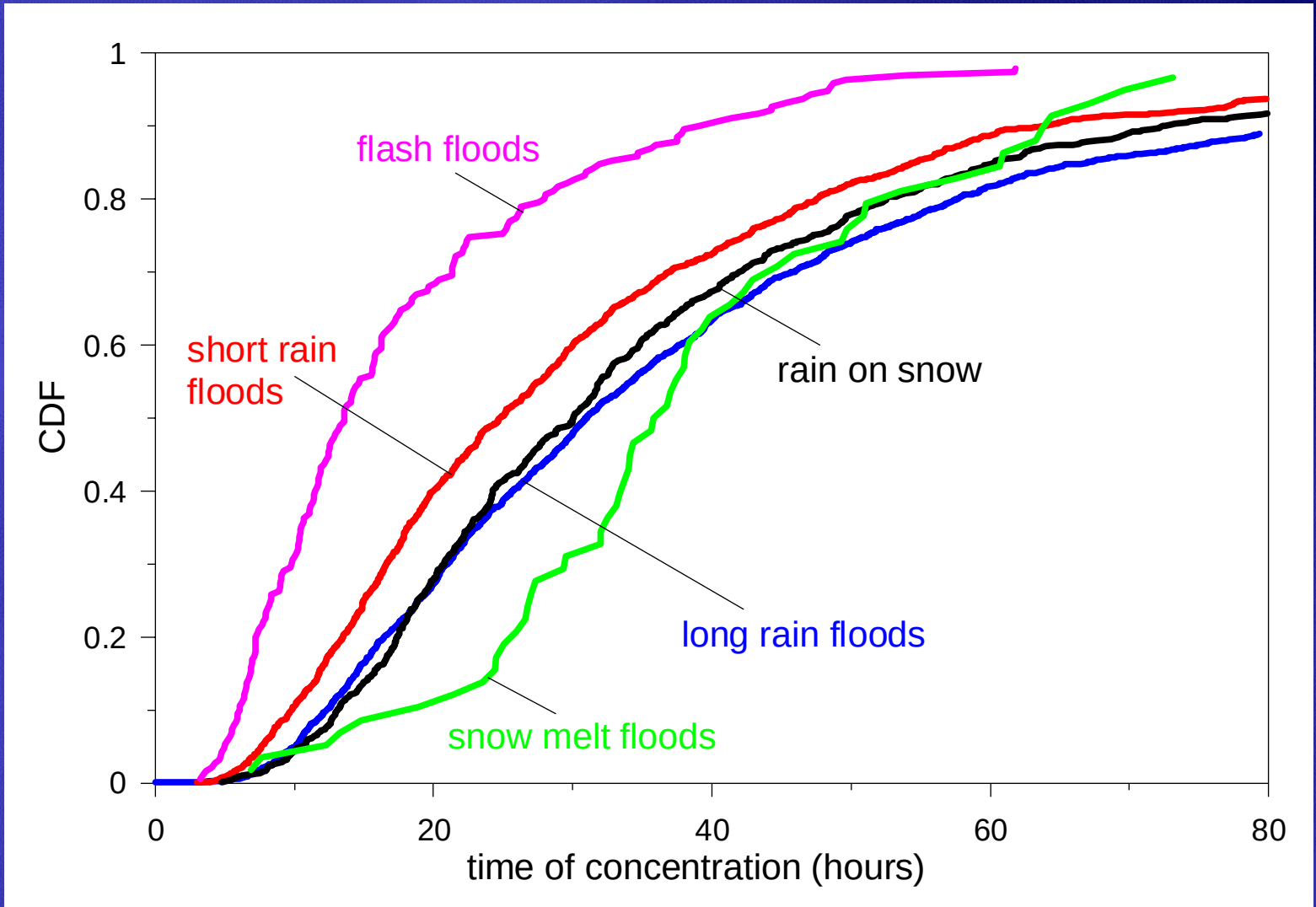


Flood types and runoff coefficients (3032 events)



Runoff coefficients from event analysis of hourly runoff (Merz et al., 2006)

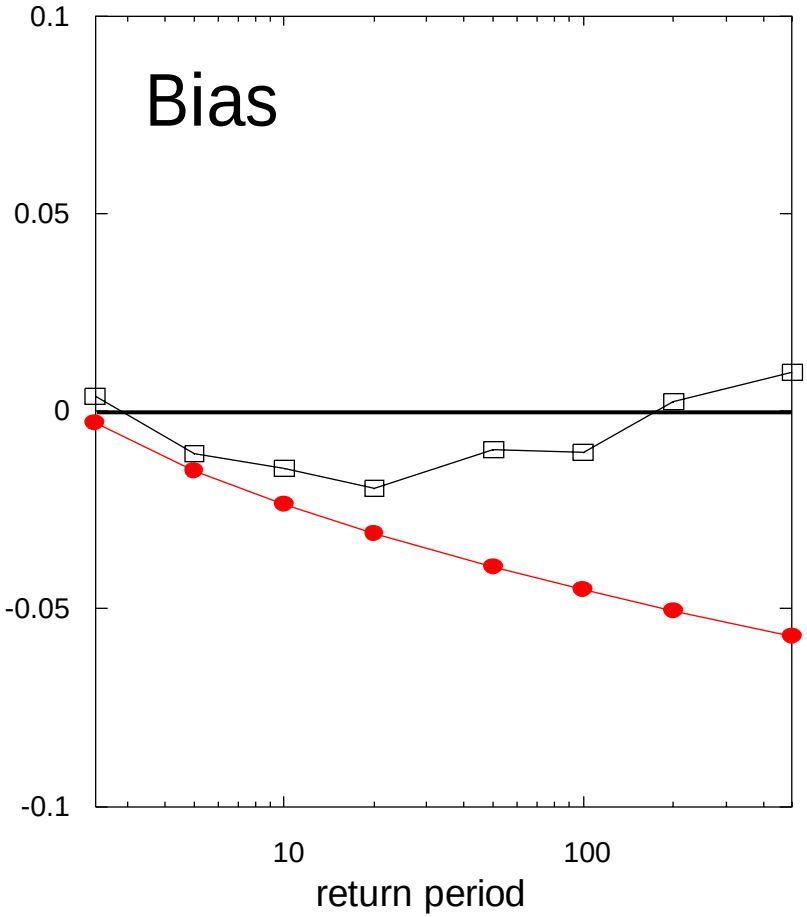
Flood types and time of concentration

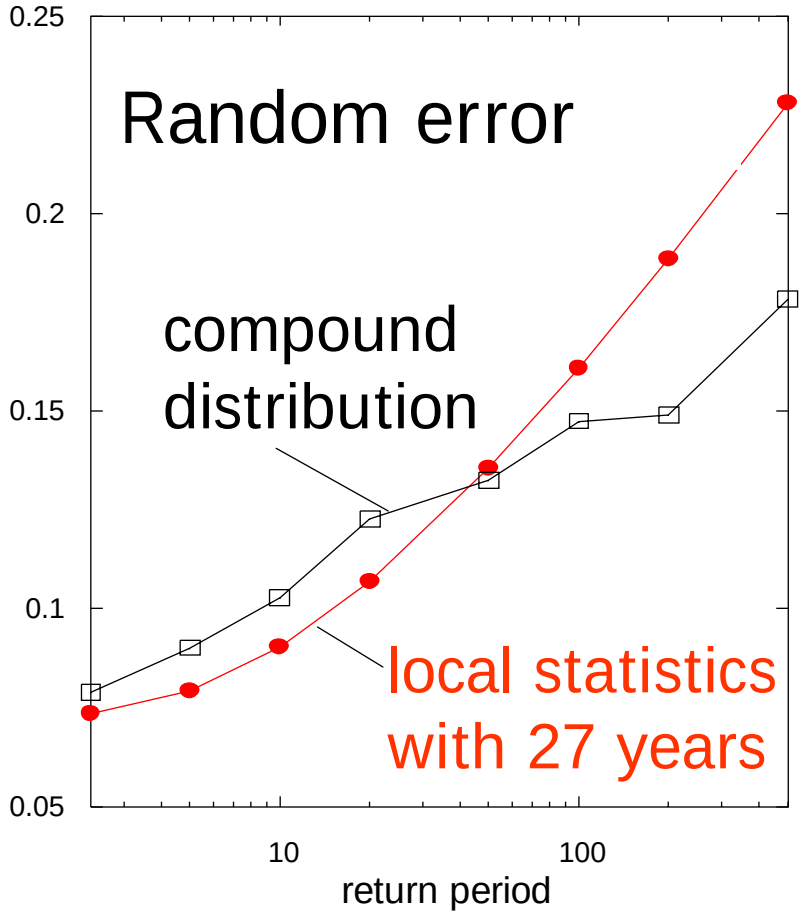


Time of concentration from event analysis of hourly runoff (Merz et al., 2006)

Use process types to create compound flood frequency distribution

Local statistics for 144 catchments
Comparison to long series (>40 years of observation)





Conclusions:

- Plausible stratification of flood peaks
- Applicable to regional scale
- Process indicators from different data sources

$\rightarrow$ Useful diagnostic tool

$\rightarrow$ Potential for flood frequency estimation