COST733 Final workshop
Classifications in atmospheric sciences and their applications, present state & future directions.
Vienna, Austria
22-24. November 2010

Application of a weather type classification to assess the impact of climate change on flood occurrence in Austria

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Floods

Large floods in Austria 2002, 2005
(picture: Steyr 2009)

- “more floods due to climate change”

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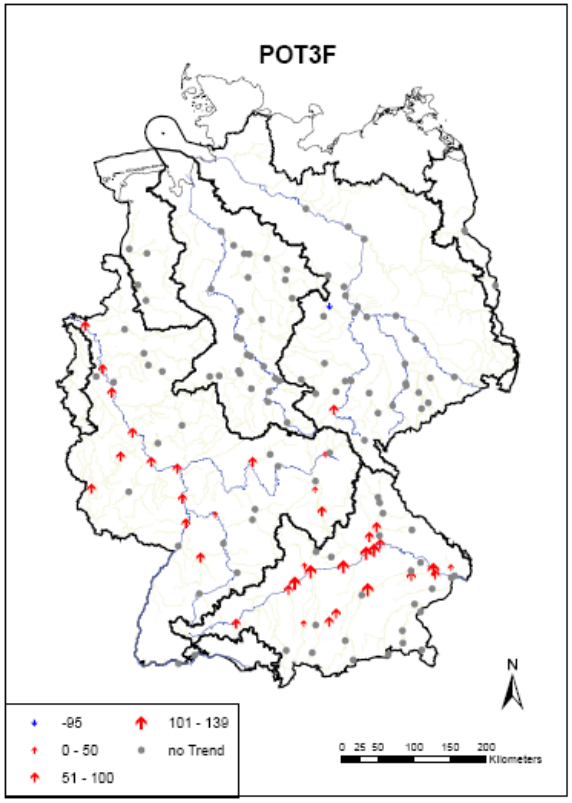
Large floods in Austria 2002, 2005
(picture: Steyr 2009)

- "more floods due to climate change"
- no general trends observed

Flood trends in Austria, Nobilis&Lorenz 1997

Period	Stations	Number of floods per year Trend ($p = 0.05$) positive	negative
1952–1961	177	15	3
1962–1971	232	2	10
1972–1981	336	96	10
1982–1991	441	16	24
1952–1971	162	5	11
1972–1991	321	38	11
1952–1991	142	29	11



Flood trends in Germany, Petrow&Merz 2009

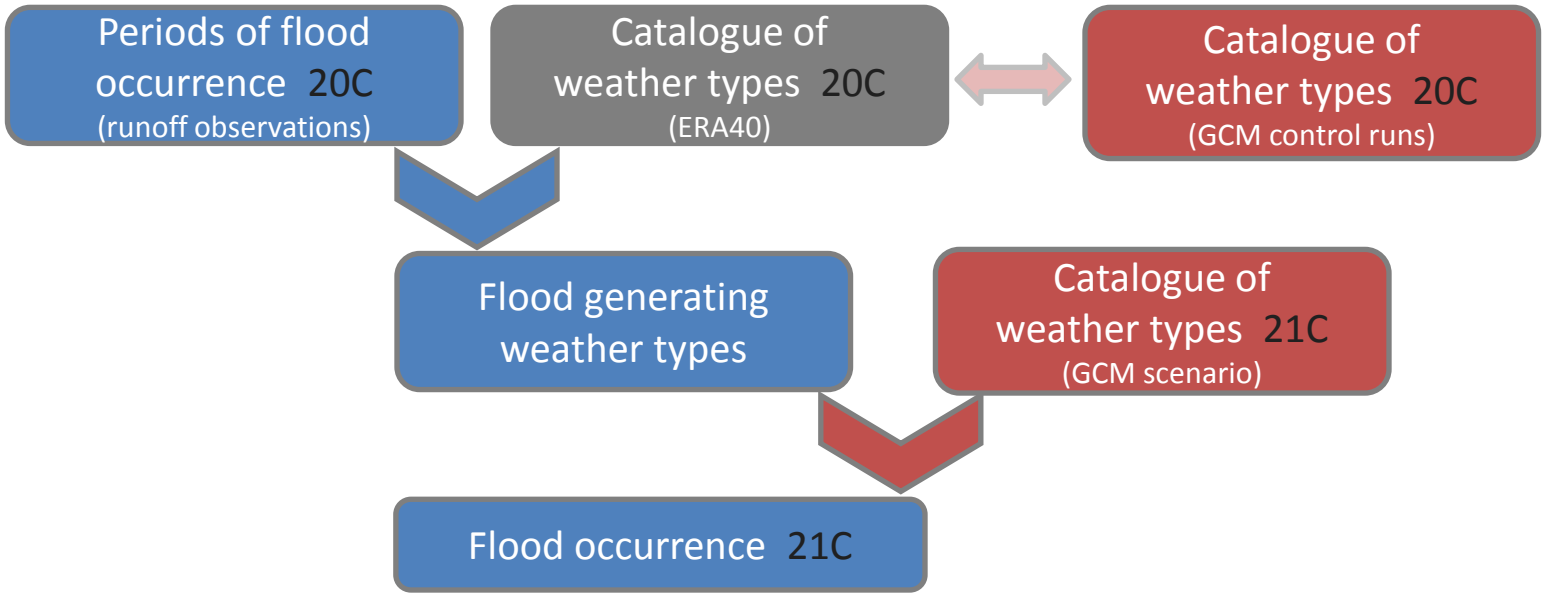
Method

– Aim:

Investigate possible changes in occurrence of flood events due to climate change in Austria

- Using climate model data
- Focusing on meteorological impacts

– Approach:



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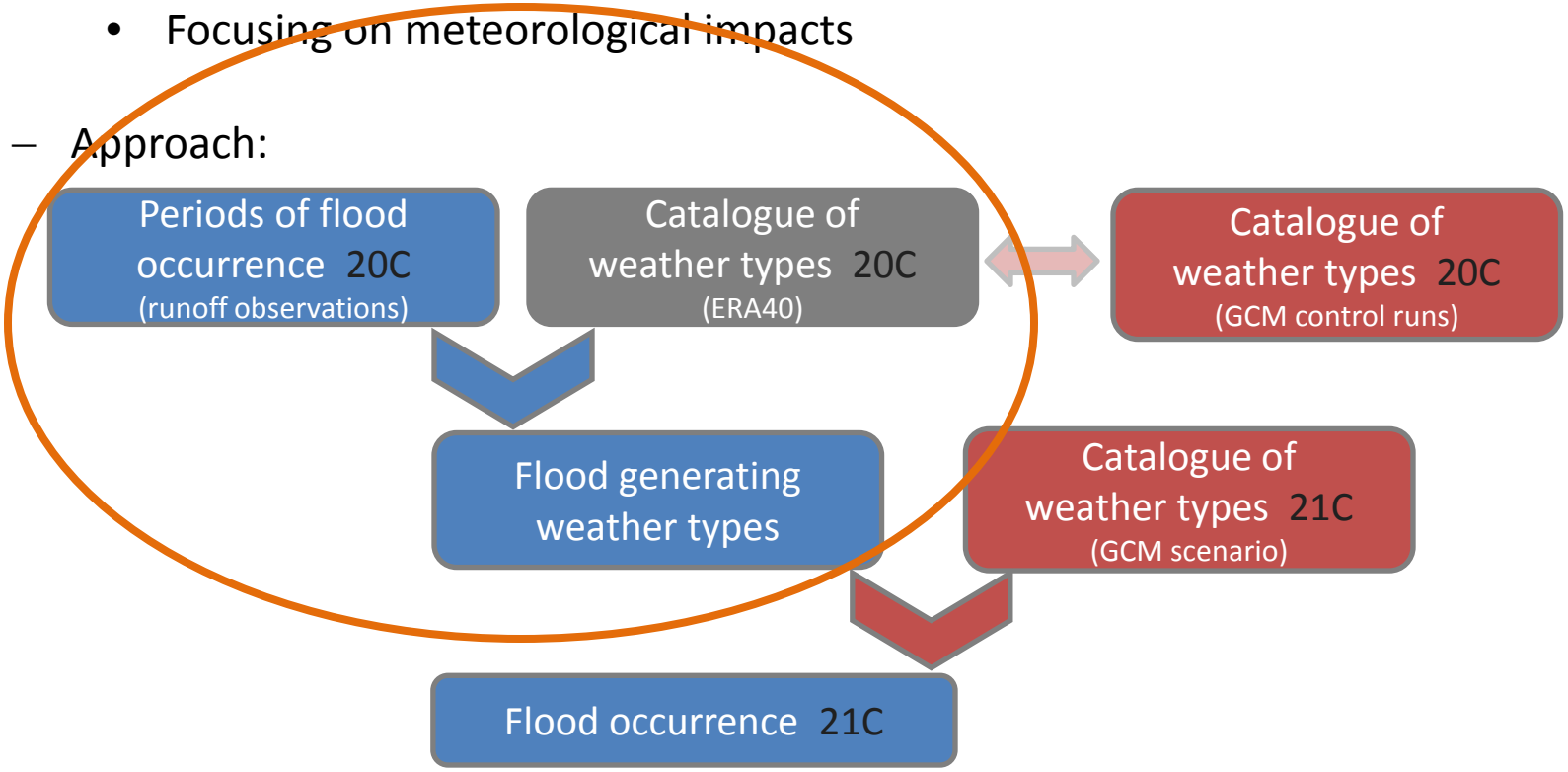


Weather type classification

– Simplified version of the WLKC733 classification scheme developed in the framework of COST733

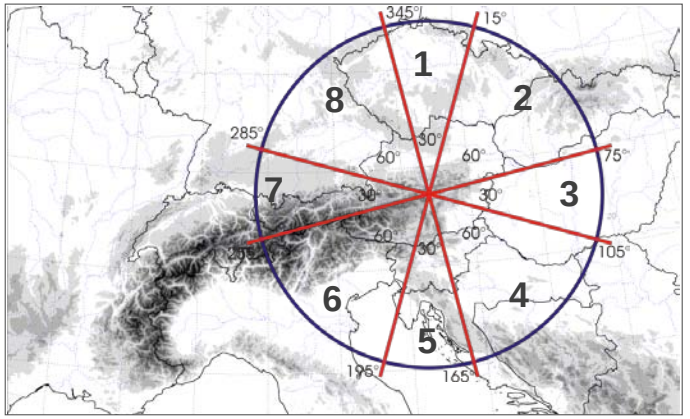
– Input variables:

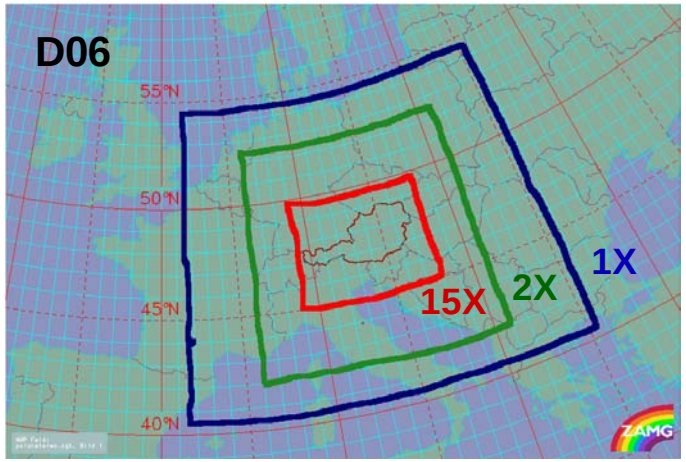
- geopotential height at 500 hPa and 925 hPa
- true wind at 700 hPa

– Result: 36 weather types

described by

- flow direction class
- cyclonic or anticyclonic vorticity at the two levels





Weather type example: 7 A C

7 : wind dominantly from west

A: anticyclonal at 500hPa

C: cyclonal at 925hPa

- **wind sectors (0 = undefined)**
- **domain of analysis and weights**

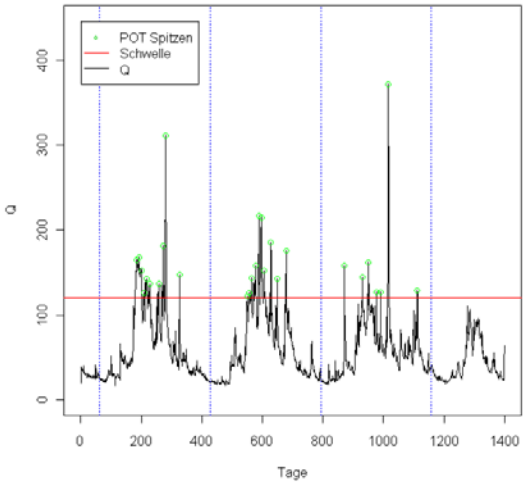
Flood periods

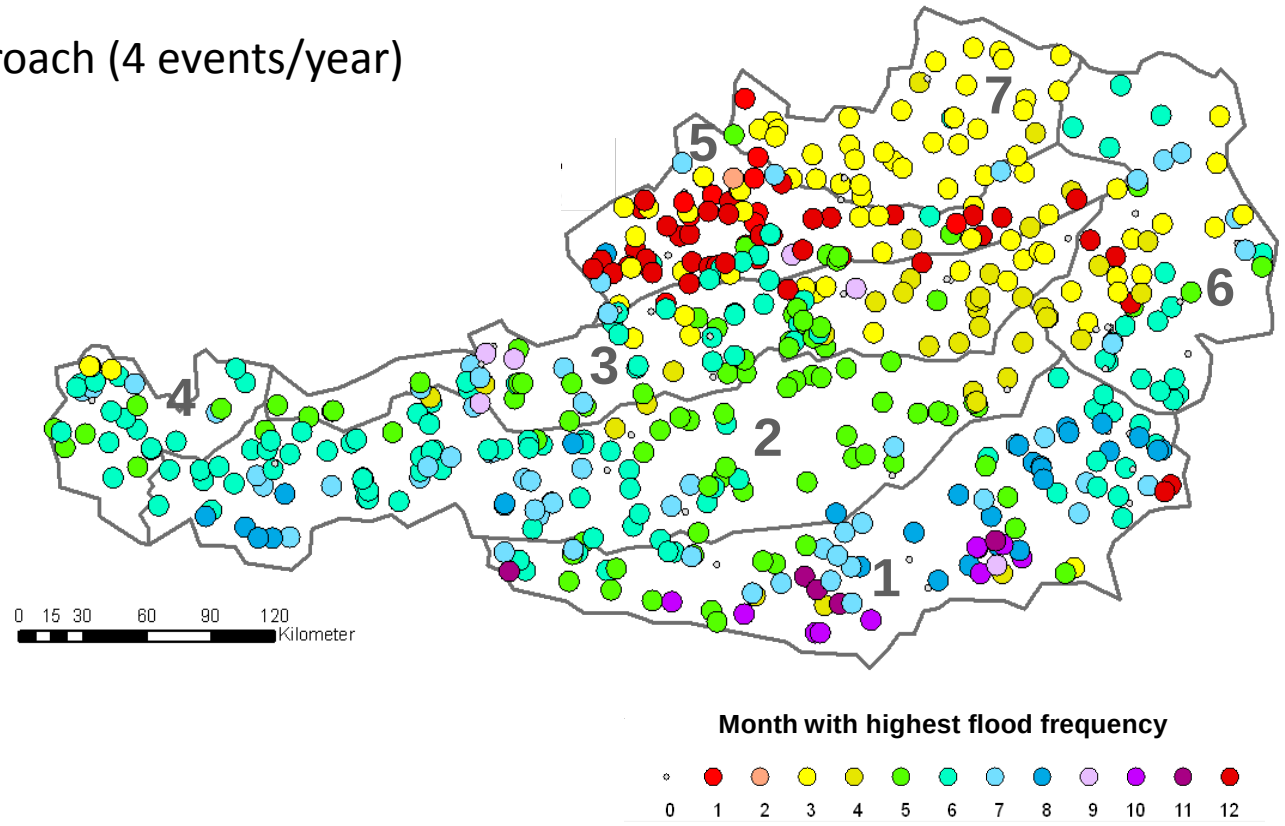
– Runoff data:
  - 554 gauges
  - 1971 - 2000

– Seven climate regions in Austria

– Peak over threshold approach (4 events/year)

– Seasonal analysis





Flood generating weather types

– Flood generating period: day of peak + 2 days before

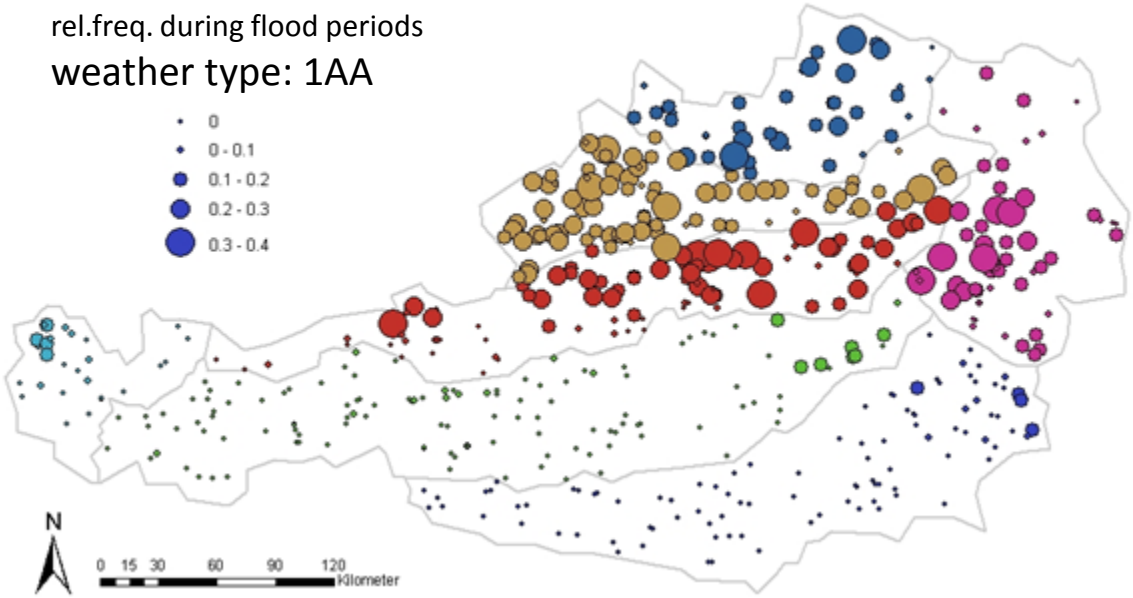
– Weather type catalogue for 1971-2000 from ERA40

– Relative frequency of occurrence of weather types in flood generating periods (relative to overall occurrence)

$$hhw_{WL} = \frac{\sum_{i=dHW} WL}{\sum_{i=d} WL}$$

rel.freq. during flood periods

weather type: 1AA

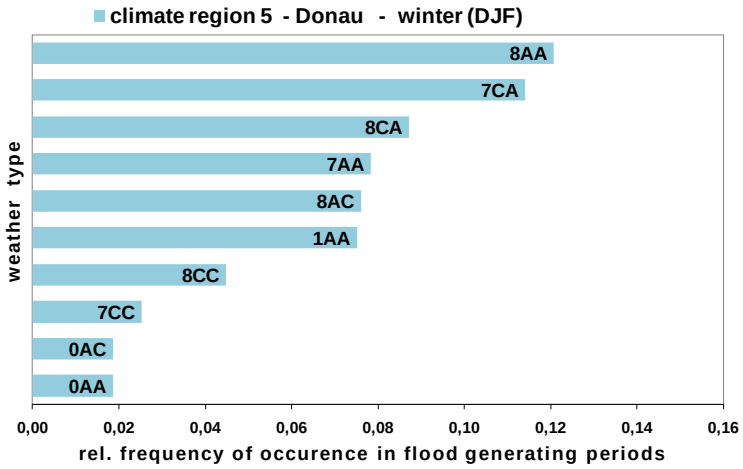


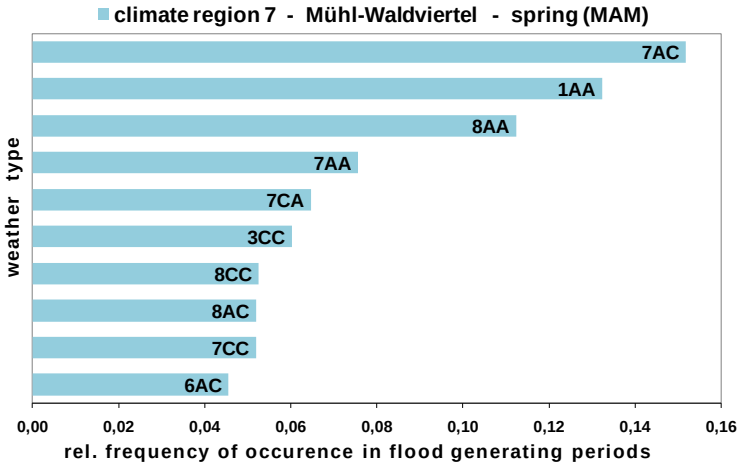
Flood generating weather types

➢Weather types with high relative frequencies in flood periods identified

➢ 10 flood generating weather types selected for CC analysis

➢ for each climate region and season





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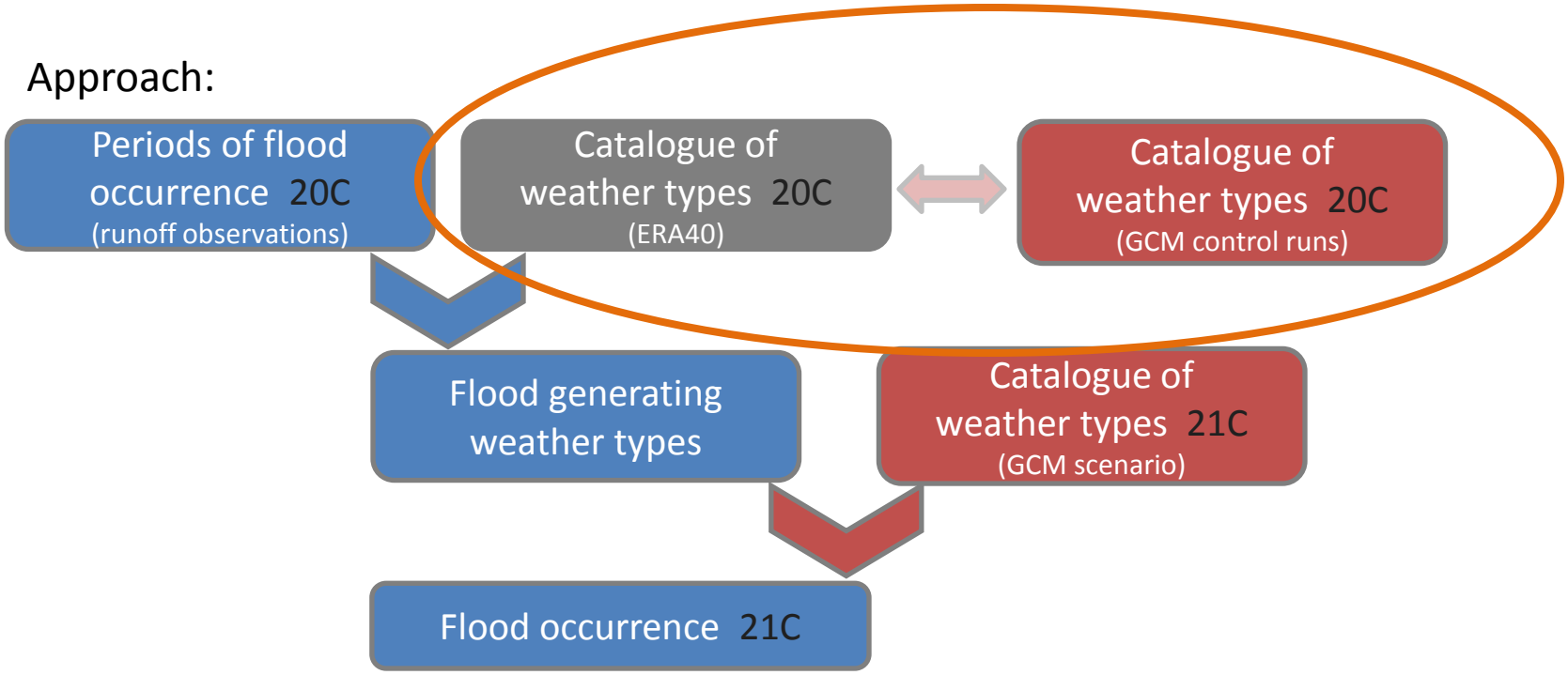
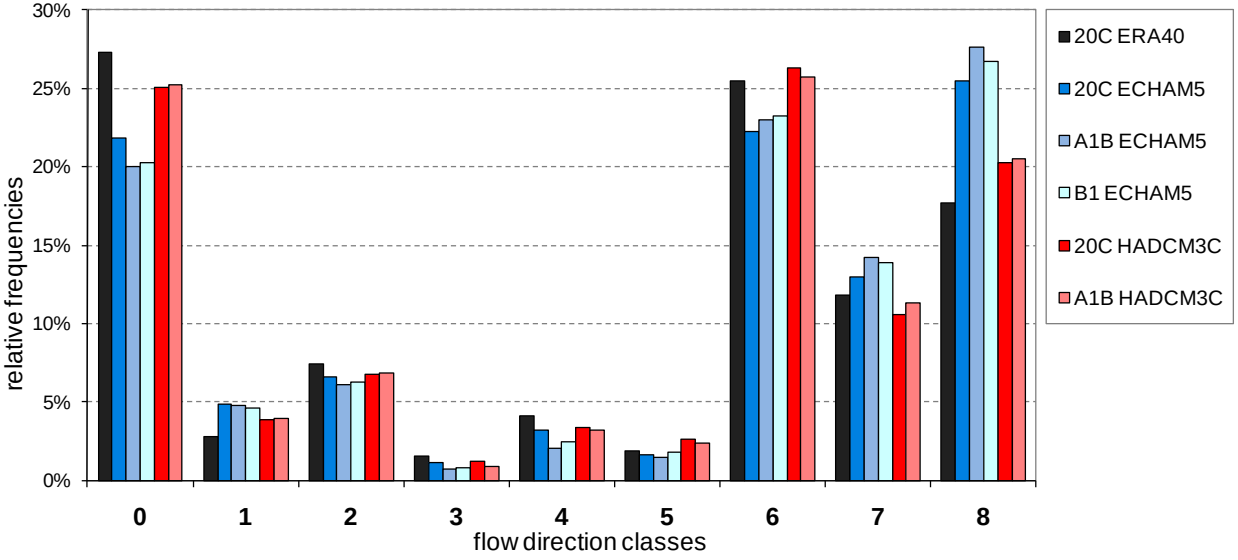


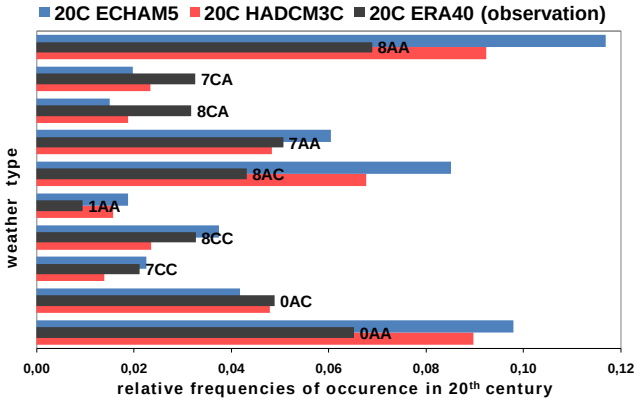
Climate model data and WLK733

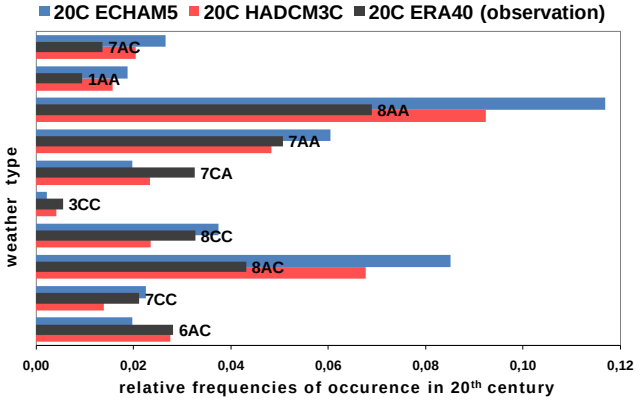
– Climate model data:
  - ECHAM5 : A1B, B1
  - HADCM3C: A1B

–WLK733: ERA40 vs. GCM control runs
  - good agreement for flow directions
  - large discrepancies for specific weather types

–WLK733: scenarios
  - shifts from control runs to scenarios (2nd half of 21st century) smaller than deviations







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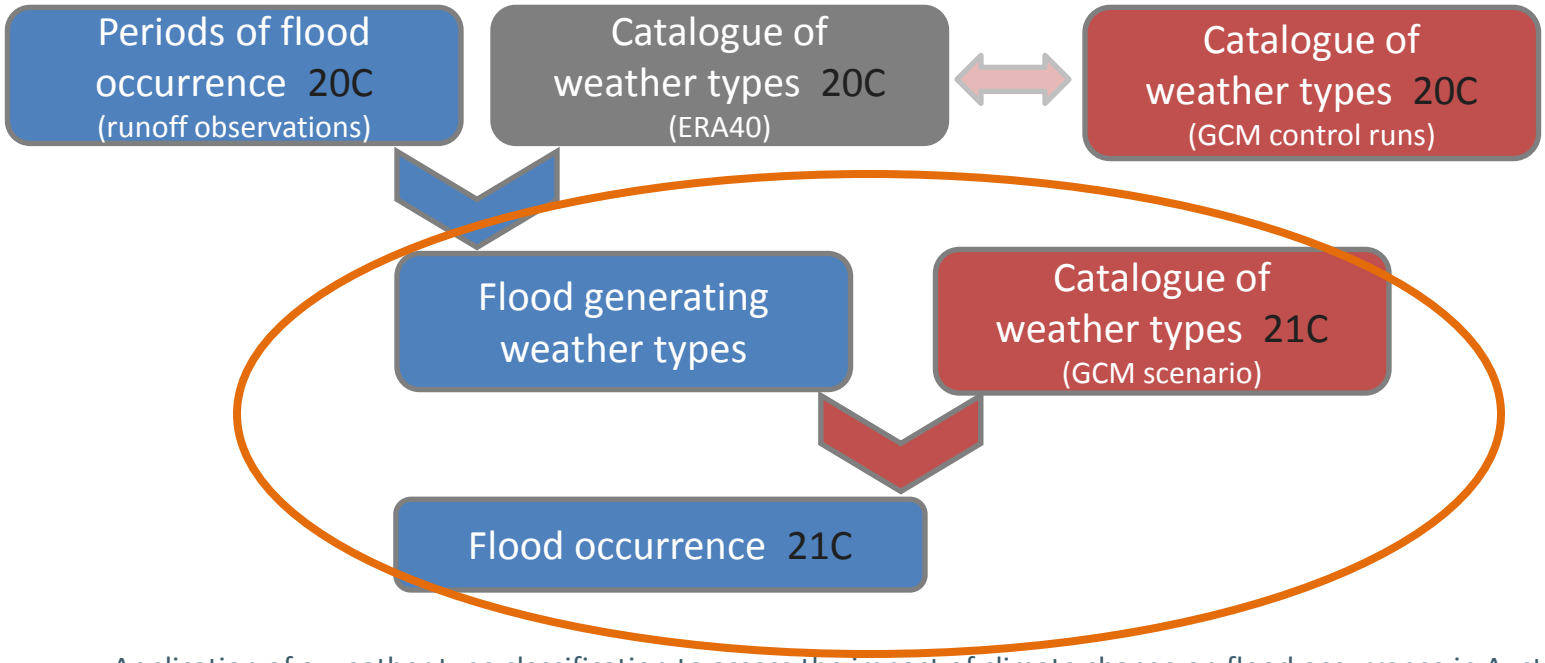

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Climate change and flood occurence

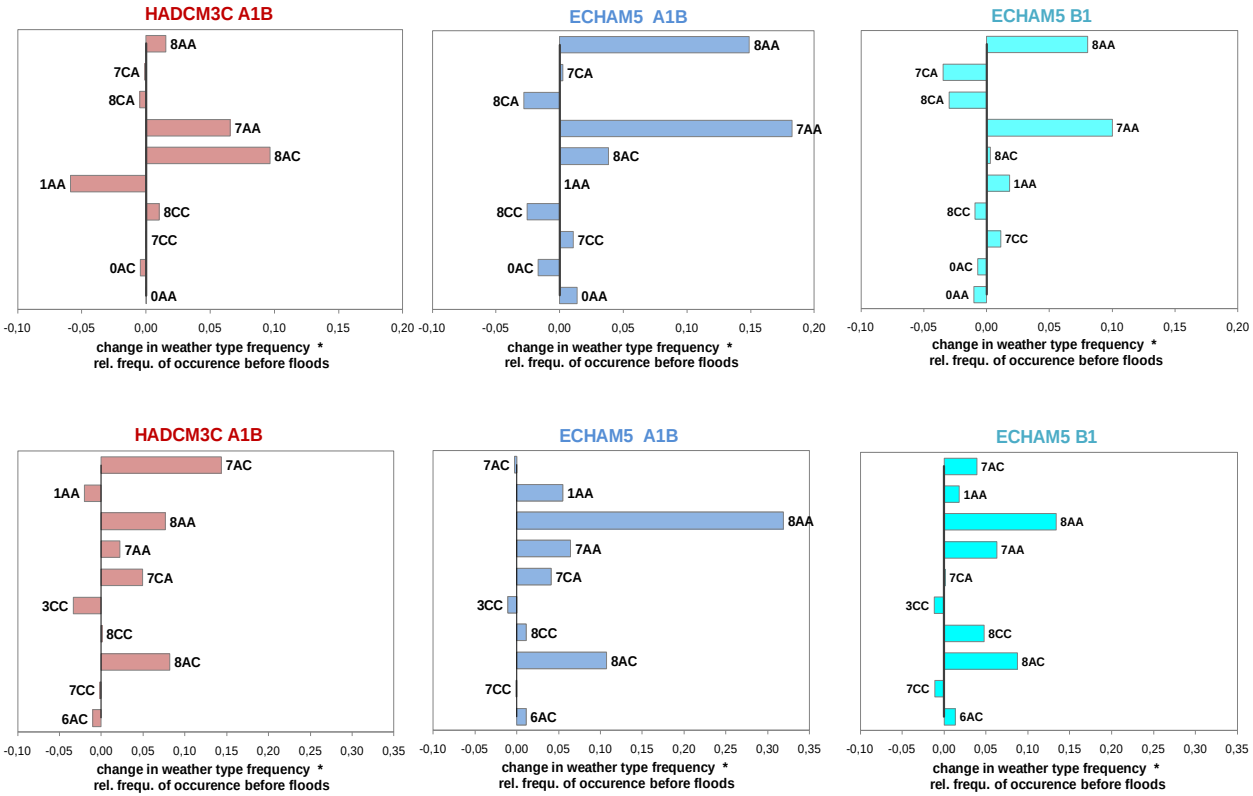
– Change in occurrence of flood generating weather typ:

Indicator for change in flood occurence

– Qualitative analysis

➢ For most climate regions and seasons projected changes varied for different climate models and scenarios

➢ Consistent findings only for winter and spring and western and northern regions: increase in frequencies of flood generating weather types



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Conclusions

- Flood generating weather types can be identified with WLKC733
- Large uncertainties in climate change application:
  - Discrepancies in weather type frequencies from reanalyses and GCM control runs
  - Different projections in different scenarios and different models
- No drastic changes in circulation patterns over central Europe expected
- Consistent trends:
  - Increase in north-western and western flows in winter and spring
  - Indicator for more frequent flood occurrences in northern and western regions of Austria, where these circulation patterns prevalently cause flood events.

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Thank you for your attention!

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The presented work was funded by the Austrian “Klima- und Energiefonds”