# A meteorological perspective on changing flood and landslide hazard

**Translation of the results of climate change models to expected changes in triggering conditions of hydro-meteorological hazards**

**CHANGES meeting, April 2014**

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# Overview

1. Observed meteorological changes

2. Meteorological conditions important for triggering hydro-meteorological hazards

3. Downscaling techniques for hydrometeorological hazards

# 1. Observed meteorological changes

- Trends in the data can provide insights into how the area is responding to climate change
- May be indicative for future changes
- However, need long timeseries, and these often contain inhomogeneities (changes NOT associated with the climate)

# 1. Observed meteorological changes

- Checked for inhomogeneities for Ubaye Valley and Fella River
  - Temperature
  - Precipitation
- For each, used three different tests:
  - Pettit, Standard Normal Homogeneity, Penalized maximal f-test
- Generally homogeneous, except:
  - Shift in temperature in Ubaye in 1997-1998,
  - And some of the rainfall stations in Fella ~1942

# 1. Observed meteorological changes

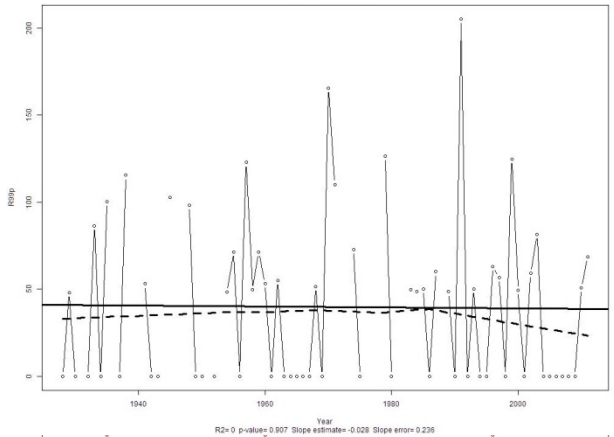
- Looked at 27 climate indices for extremes
- Many more significant trends for temperature than precipitation
- Precipitation trends varied depending on indices…

# 1. Observed meteorological changes

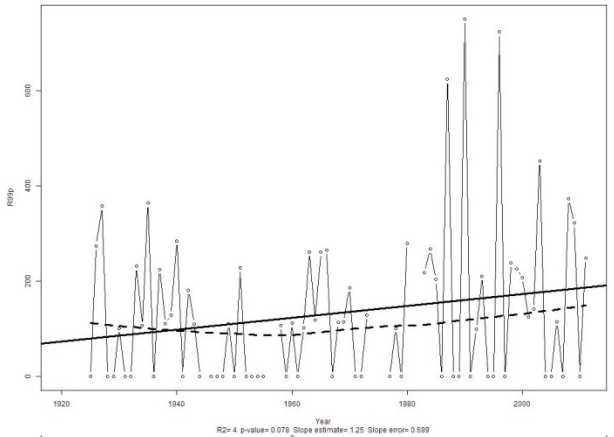
Barcelonnette

Pontebba

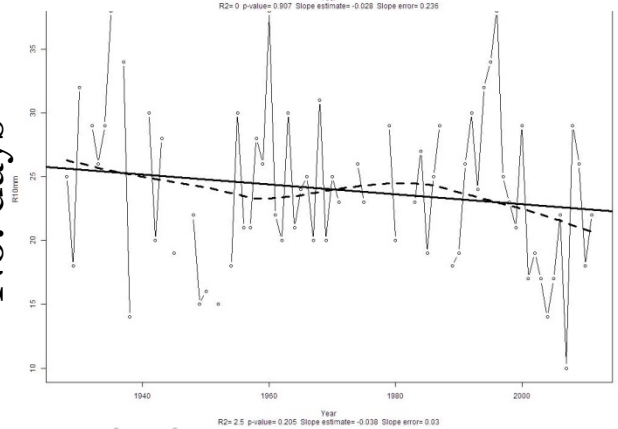
Rainfall (mm)



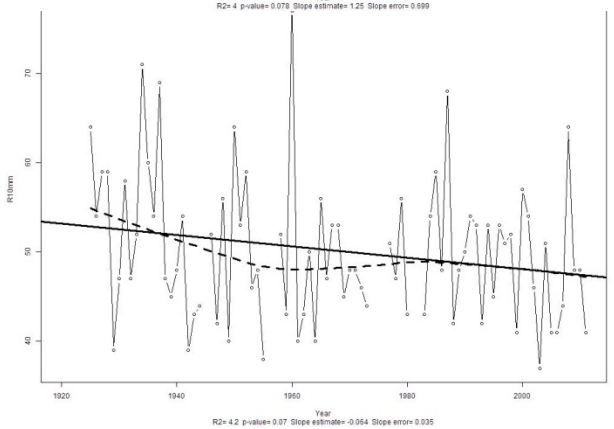
99th percentile rainfall



No. days



No. of days for rainfall more than 10mm



# 1. Observed meteorological changes

Summary:

- For France and Italy:
  - Homogeneity tests
  - Trend detection in ‘extremes’
  - Also general climate of the region (not presented)

# 2. Meteorological conditions important for hydro-meteorological hazards

- Generally caused by different combinations of:
  - Intense, short duration rainfall/hail etc.
  - High antecedent rainfall
  - Snowmelt

- Different meteorological triggers based on the different events (flood, debris flow, shallow slide…)

# 2. Meteorological conditions important for hydro-meteorological hazards

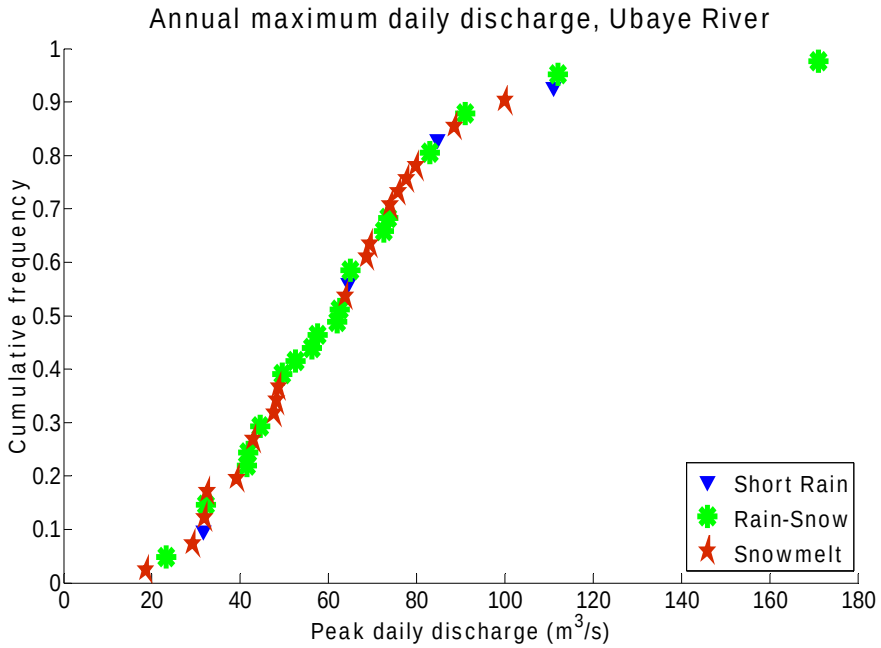
- Also different triggers within each group

Ubaye River:

Short rainfall = high rainfall day before + high antecedent rainfall preceding week

Rain 'n' Snow = similar to above, but discharge already elevation due to snowmelt

Snowmelt = no rainfall in preceding days, anomalously warm temperatures

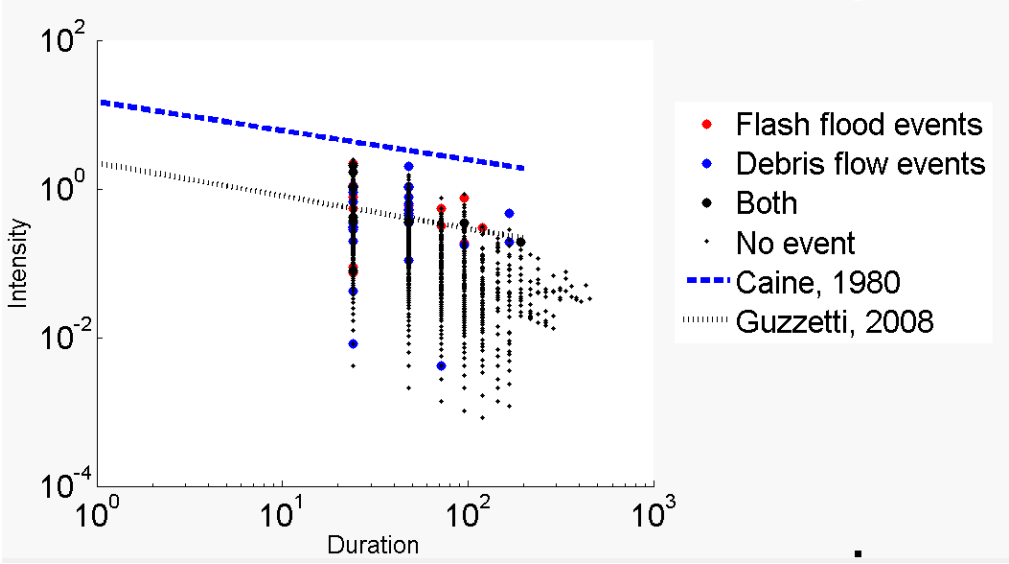


# 2. Meteorological conditions important for hydro-meteorological hazards

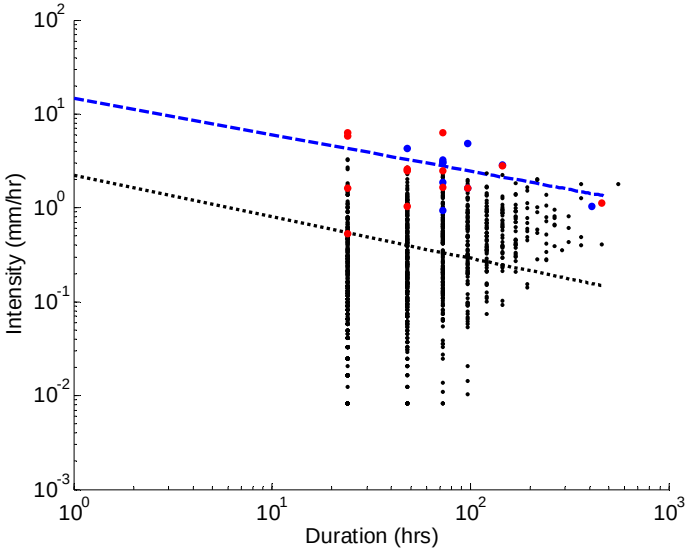
- However, can be difficult to determine the precise trigger because:
  - Incomplete records
  - Did not 'capture' the trigger
  - Rare events
  - Other non-meteorological factors
  - …
- When capturing the meteorological trigger is the problem, can look to the atmospheric conditions

# 2. Meteorological conditions important for hydro-meteorological hazards

Ubaye Valley

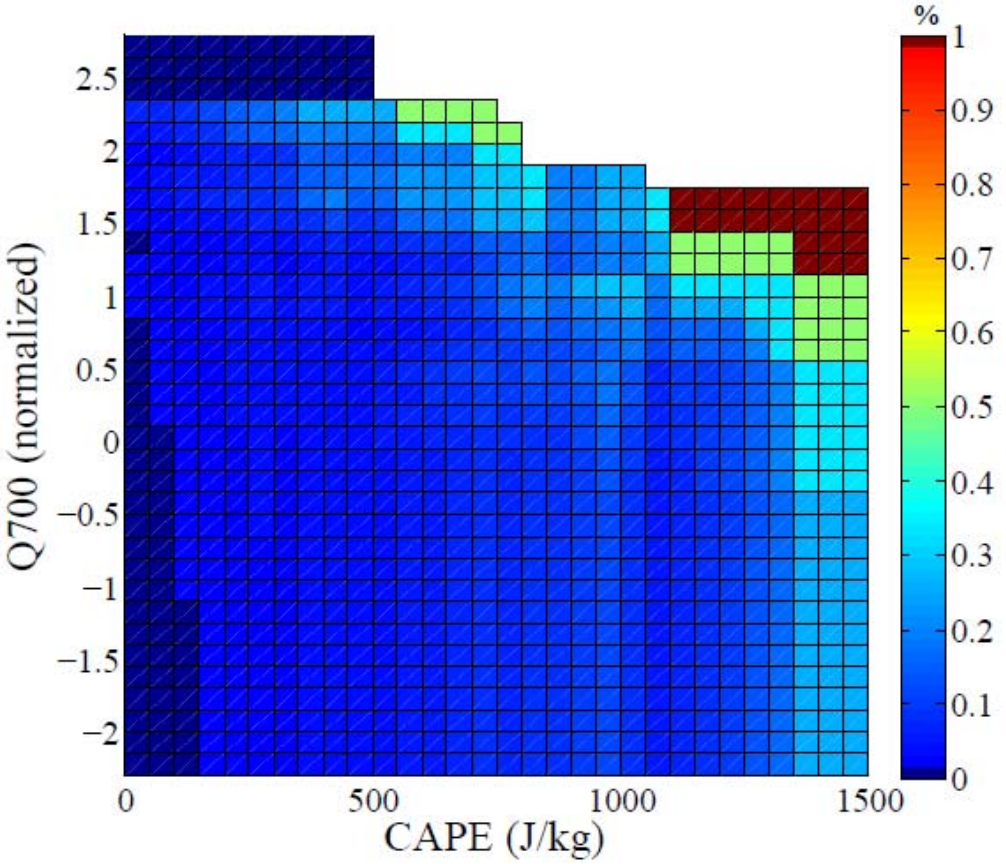



Fella River



# 2. Meteorological conditions important for hydro-meteorological hazards

- Ubaye Valley, flash floods and debris flows:
  - Using atmospheric parameters
  - Specific humidity at 700hPa
  - CAPE (instability of the atmosphere)



# 2. Meteorological conditions important for hydro-meteorological hazards

Summary:

- Investigated triggers for floods, flash events, landslides in Ubaye Valley and started Fella
- Mainly floods and flash events though
- First publication under discussion

# 3. Downscaling techniques for hydrometeorological hazards

- Desire to see potential future scenarios for frequency and magnitude of different hydrometeorological hazards
- However, difficult to just use the large scale climate models
- There are a variety of different methods, techniques, and models

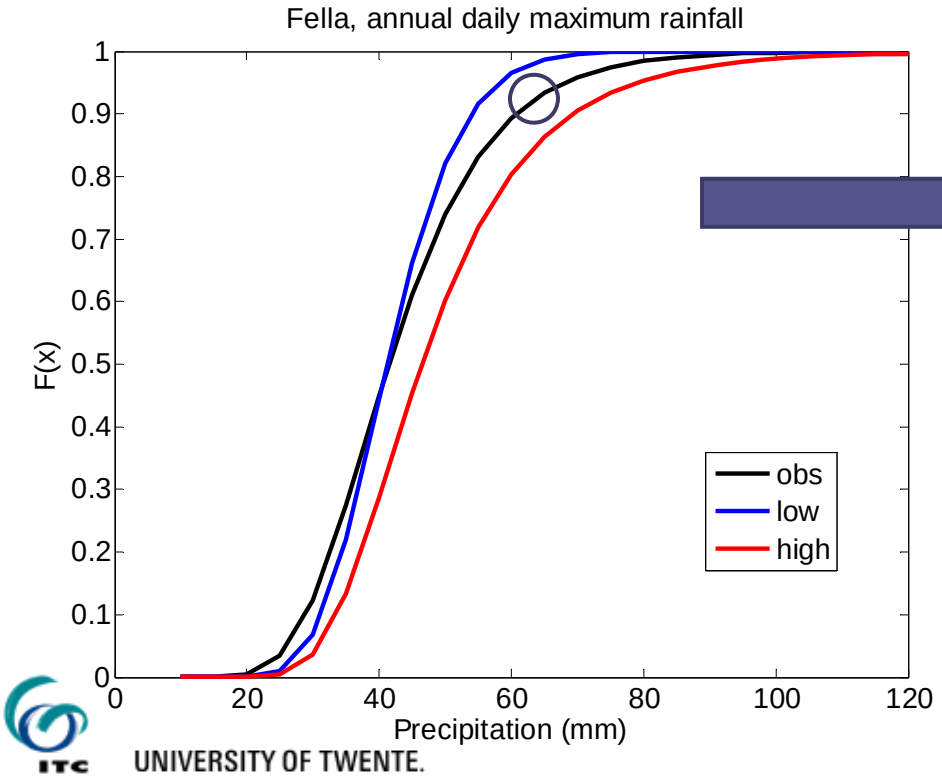
# 3. Downscaling techniques for hydrometeorological hazards

- Three methods (planned)
  - Biased correction – RCM
  - Analogue method
  - Linear regression
  - ….?

- Started with the first (Quantile Mapping) using climate models from CMIP5 and CORDEX (http://wcrp-cordex.ipsl.jussieu.fr/ )

# 3. Downscaling techniques for hydrometeorological hazards

- First results (CORDEX):



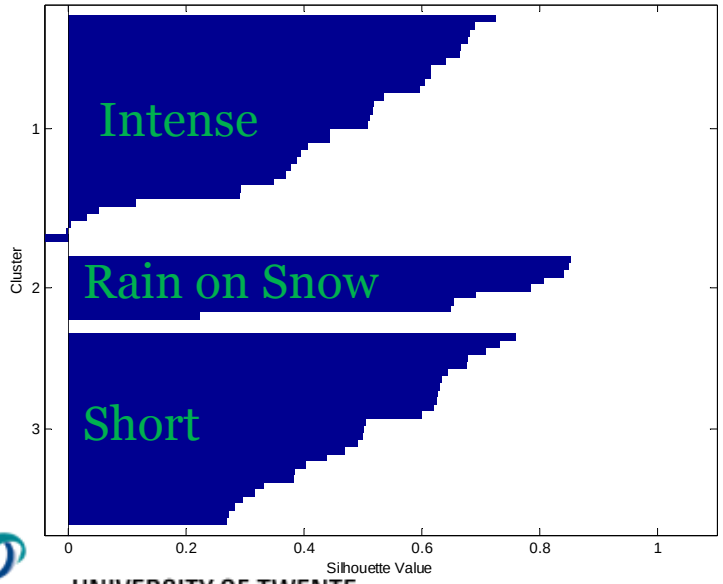

Historical '10 year' daily rainfall event:

- Low = 33 year
- High = 5 year

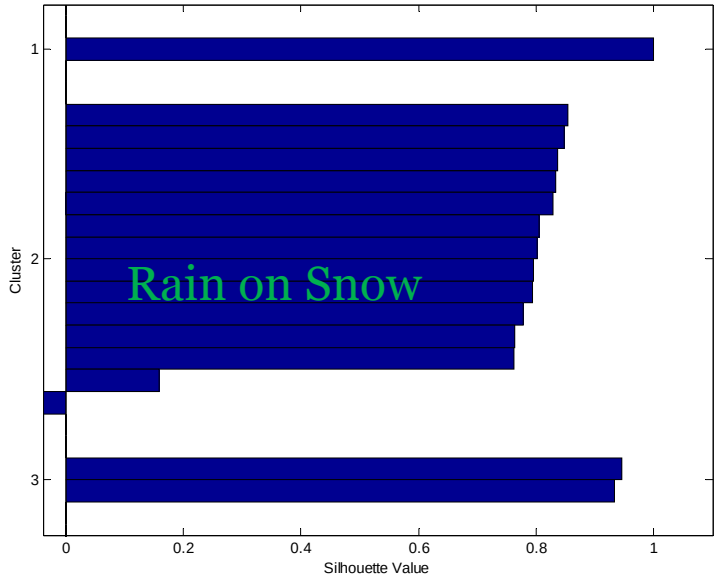
# 3. Downscaling techniques for hydrometeorological hazards

- First results continued:
  - Flood types - Austria, Q10

1987-2005




2067-2085



# 3. Downscaling techniques for hydrometeorological hazards

- First results continued:
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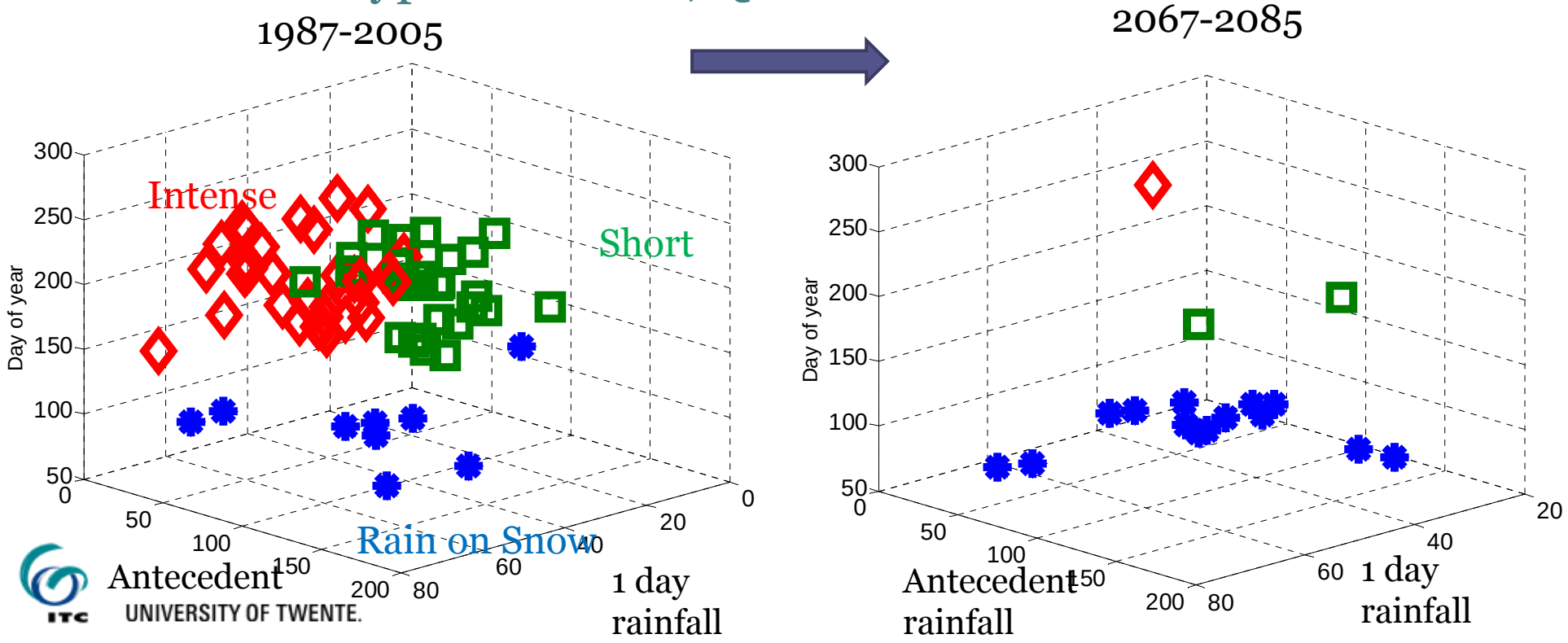

# 3. Downscaling techniques for hydrometeorological hazards

Summary:

- Really only starting on this
- Just looking at one method at the moment (QM)
- Unlikely to be completely finished by end of August
- Working on second paper: 'Changing causal flood types in European Alpine Catchments' (with Korbinian)

# Still to come….

- Continuation with downscaling
- Working on developing ‘local climate scenarios’ (leading to third paper)
- Contract ends November, 2015

# Summary

Meteorological perspective on changing flood and landslide hazard:

1. Observed meteorological changes
   - Important to do, but maybe less important for book?
2. Meteorological conditions important for triggering hydro-meteorological hazards
   - Very important part of the story
   - Collaborate with others for the more 'traditional' approaches?
3. Downscaling techniques for hydrometeorological hazards
   - Also important part of the story
   - How much can I do before submission?

# Thank you for your attention

Questions?