The dependence between extreme rainfall and surge in the coastal zone of Australia

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Flooding in Australia

- 85% the population now live in the coastal region

- Coastal region is more likely to be subject to flooding

- Flooding risk assessment for the coastal catchments is very important
Flooding in Australia

Flooding in the coastal region can be caused by:

- the extreme rainfall

or the combination of both processes occurring simultaneously or in close succession

Toowomba floods

Hurricane Sandy storm surge

Life Impact The University of Adelaide
Joint probability of extreme rainfall and surge

- **Statistical dependence** between the extreme rainfall and the extreme storm surge is likely as both are often driven by common meteorological forcings (such as cyclonic systems).

- **Partially dependent** with extreme storm surges also often occurring in the absence of extreme rainfall and vice versa.
Methods

\[ \alpha = 0 \]

\[ \alpha = 0.5 \]

\[ \alpha = 0.8 \]

\[ \alpha = 1 \]

- \( y > u_y \)

Total: 10,000 data pairs

100 joint events

52 joint events

21 joint events

No joint events
Methods

- Extreme rainfall (1% top)
- Extreme surge (1% top)
- Joint events (7 events per 10,000 days)

**Observed data**

**Data removed dependence**

- Joint events (1 event per 10,000 days)
- Extreme rainfall (1% top)

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The number of joint events is more than 7 times higher than complete independence.
Results

Brisbane (1404 rain gauges)

Bundaberg (1568 rain gauges)

Bunbury (688 rain gauges)

Fort Denison (4076 rain gauges)
Results

Brisbane

Dependence parameter value

Storm burst duration (hours)

Bundaberg

Dependence parameter value

Storm burst duration (hours)

Bunbury

Dependence parameter value

Storm burst duration (hours)

Fort Denison

Dependence parameter value

Storm burst duration (hours)
Results

Brisbane (pluviometer=40458)

Durations:
- 1 hour
- 12 hours
- 24 hours
- 3 hours
- 48 hours
- 6 hours

Bundaberg (pluviometer=39128)

Durations:
- 1 hour
- 12 hours
- 24 hours
- 3 hours
- 48 hours
- 6 hours

Bunbury (pluviometer=9510)

Durations:
- 1 hour
- 12 hours
- 24 hours
- 3 hours
- 48 hours
- 6 hours

Fort Denison (pluviometer=66062)

Durations:
- 1 hour
- 12 hours
- 24 hours
- 3 hours
- 48 hours
- 6 hours
Conclusions

Many coastal catchments will be flooding affected in future due to:

- sea level rise (if say 0.5 m-1 m)
- increase in the intensity of extreme rainfall.

The conservative method, i.e. assuming of very high or total dependence probably served us well.

However, we now need more precise methods for estimating flood risk, to ensure future investments are justified.

The Australia Rainfall and Runoff flooding guidelines are currently being revised to take the joint dependence into account.
Thank you

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