Australian Rainfall and Runoff

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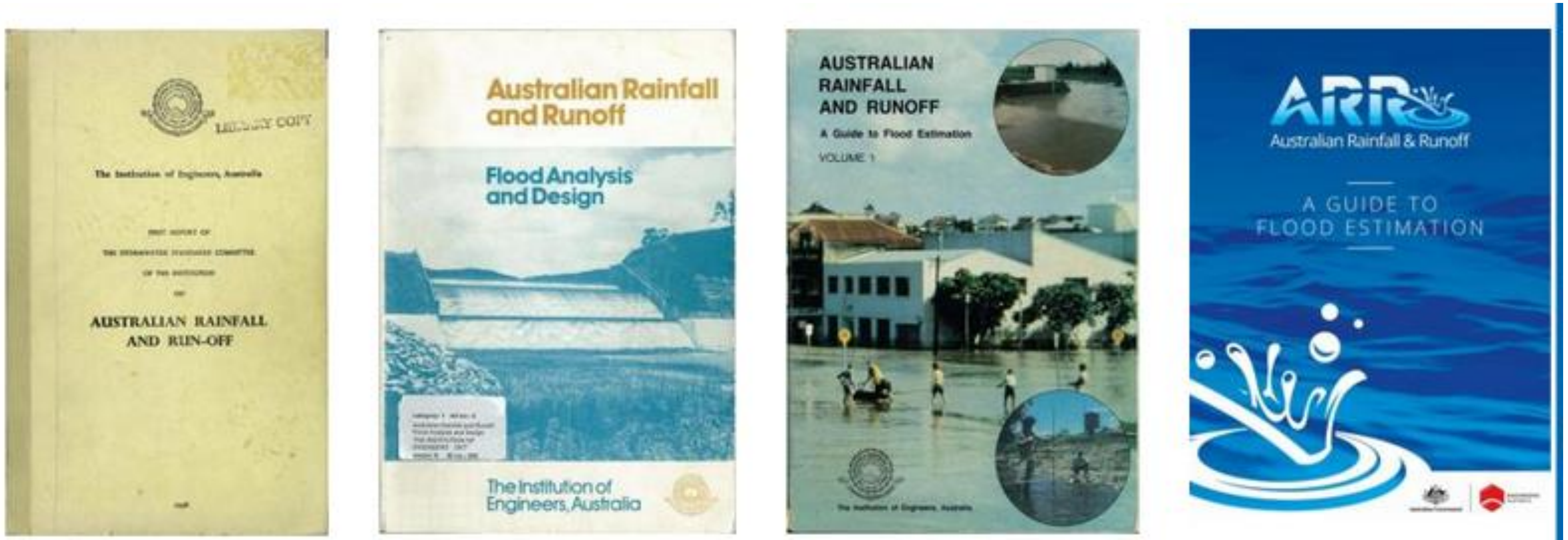
Overview

- General ARR
- ARR data hub
- Temporal patterns – Ensemble hydrology

History

Australian Rainfall & Runoff

- 1958 (version 1)
- 1977 (version 2)
- 1987 (version 3)
- 1999 (version 3.1 update for extreme floods)
- 2016/2019 (version 4)



Big Changes In Practice

- Ensemble and Monte Carlo approaches to better capture variability
- Move away from simple burst approaches
- Less reliance on the rational method
- RFFE method
- Incorporation of Climate change
- Incorporation of blockage of hydraulic structures

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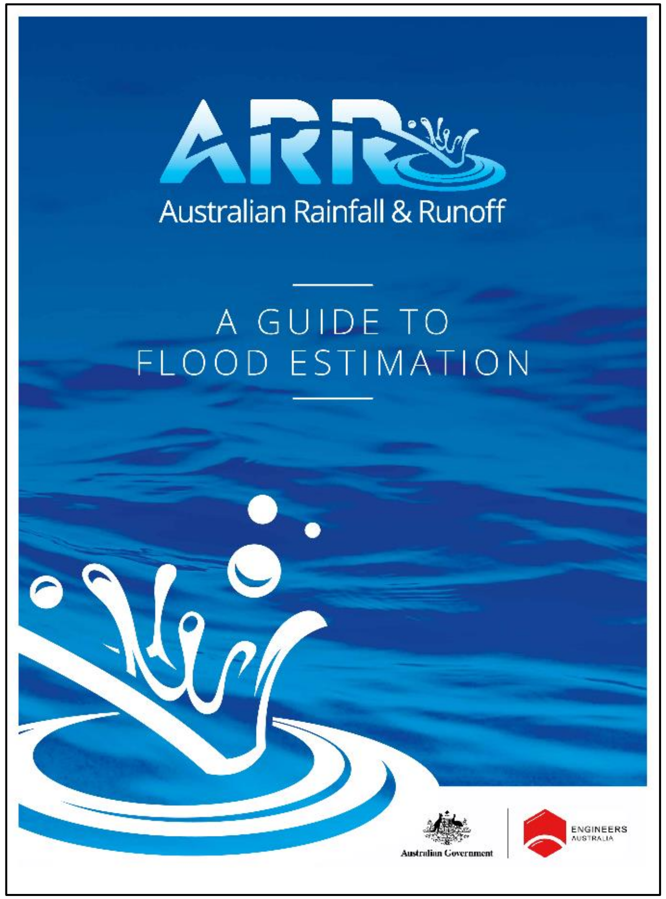
- Reuse with attribution
- Web – arr.ga.gov.au
- Epub - (not recommended) arr.ga.gov.au
- Pdf (full version and by book) -
- http://www.arr-software.org/arrdocs



The Books

- 9 Books 53 chapters

Book 1 – Scope and Philosophy
Book 2 – Rainfall Estimation
Book 3 – Peak Flow Estimation
Book 4 – Catchment Simulation for Design Flood Estimation
Book 5 – Flood Hydrograph Estimation
Book 6 – Flood Hydraulics
Book 7 – Application of Catchment Modelling Systems
Book 8 – Estimation of Very Rare to Extreme Floods
Book 9 – Runoff in Urban Areas

ARR Australian Rainfall & Runoff

Supporting Documents

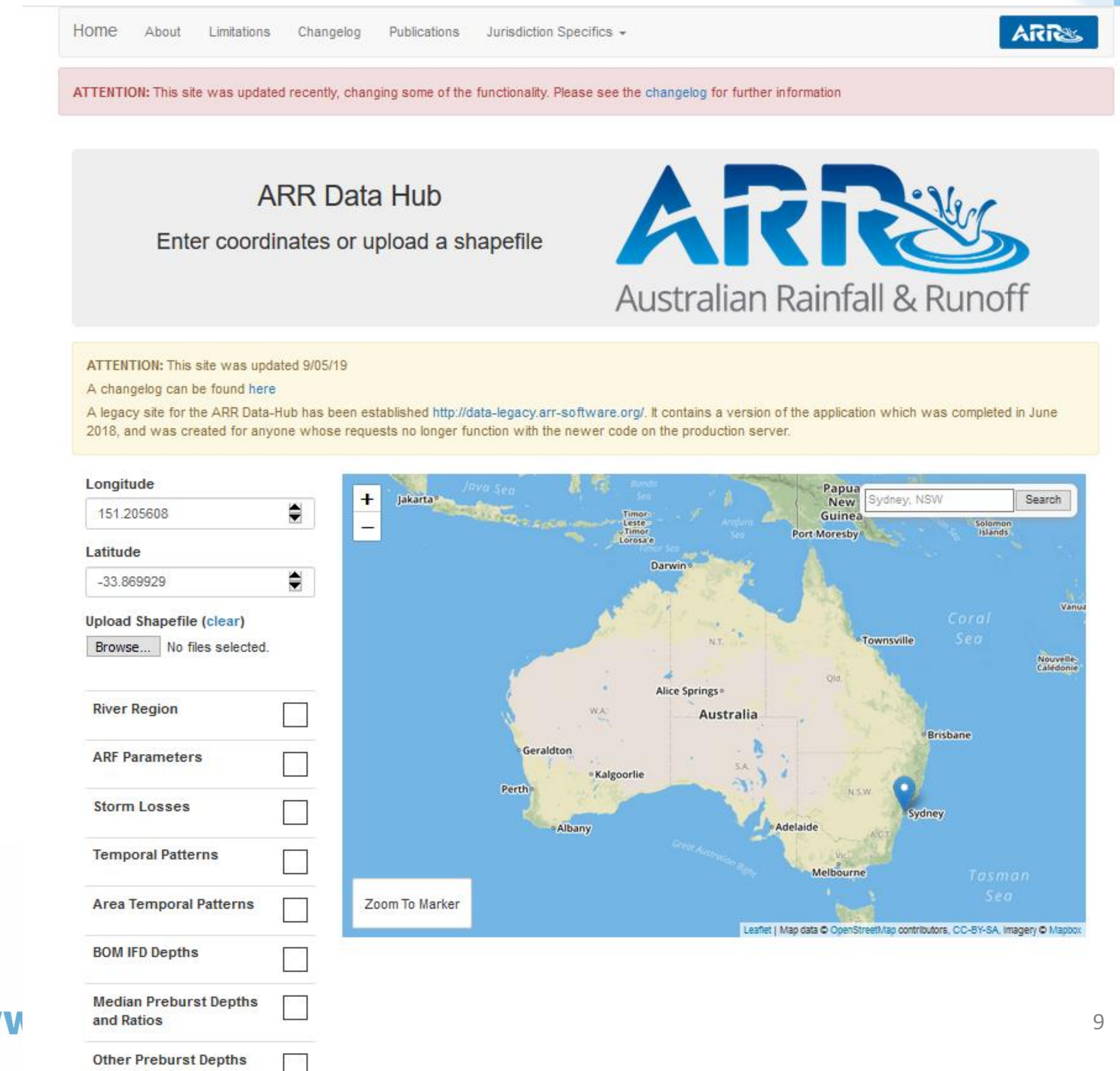
- Two dimensional modelling in urban and rural floodplains
- Monte Carlo simulation techniques
- Project reports

Key changes in ARR 2016

Design Input	ARR 1987	ARR 2016
Intensity Frequency Duration (IFD)	Used BoM rainfall gauges Presented as static A2 maps	Uses BoM and other agency gauges Online
Areal Reduction Factors (ARF)	Based on USA data Not available for long durations	Based on Australian data
Losses	Based on jurisdictional based advice (personal communication only)	National advice for rural and urban catchments
Baseflow	Methods but no ungauged catchment advice	Australia wide advice
Temporal Patterns	Average Variability Method Peak Burst Patterns for less than 30 year average recurrence interval (ARI) and rarer than 30 year ARI	Temporal patterns based on historic records, multi pattern for each design quantile and complete storms, with pre burst considered.

ARR Data Hub

data.arr-software.org



Home About Limitations Changelog Publications Jurisdiction Specifics

ATTENTION: This site was updated recently, changing some of the functionality. Please see the changelog for further information

ARR Data Hub

Enter coordinates or upload a shapefile

Australian Rainfall & Runoff

ATTENTION: This site was updated 9/05/19

A changelog can be found here

A legacy site for the ARR Data-Hub has been established http://data-legacy.arr-software.org/. It contains a version of the application which was completed in June 2018, and was created for anyone whose requests no longer function with the newer code on the production server.

Longitude

153.36

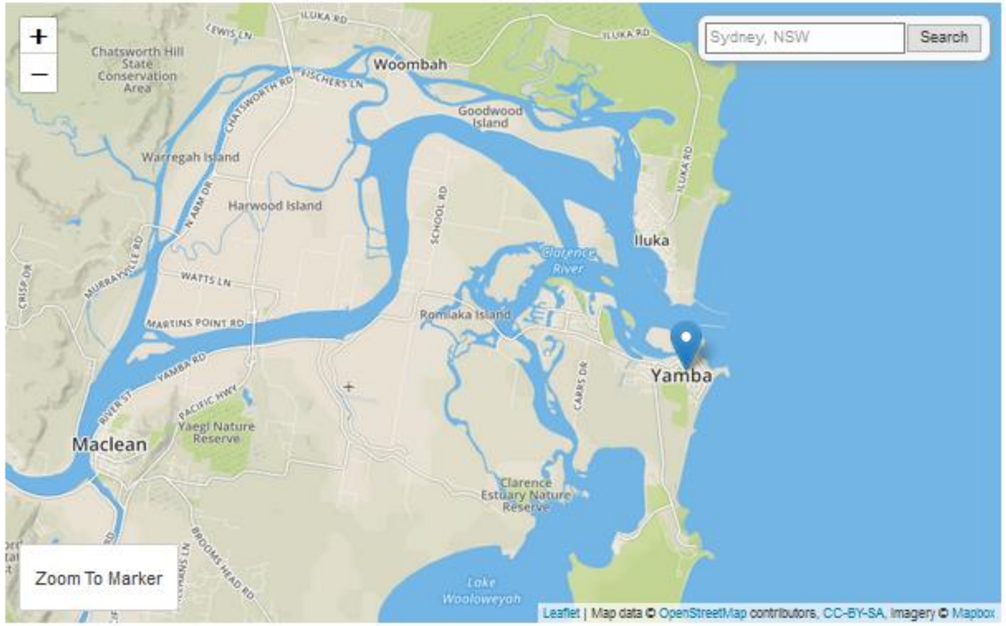
Latitude

-29.439

Upload Shapefile (clear)

Browse... No files selected.

- River Region
- ARF Parameters
- Storm Losses
- Temporal Patterns
- Area Temporal Patterns
- BOM IFD Depths
- Median Preburst Depths and Ratios
- Other Preburst Depths and Ratios



Home | About | Limitations | Changelog | Publications | Jurisdiction Specifics

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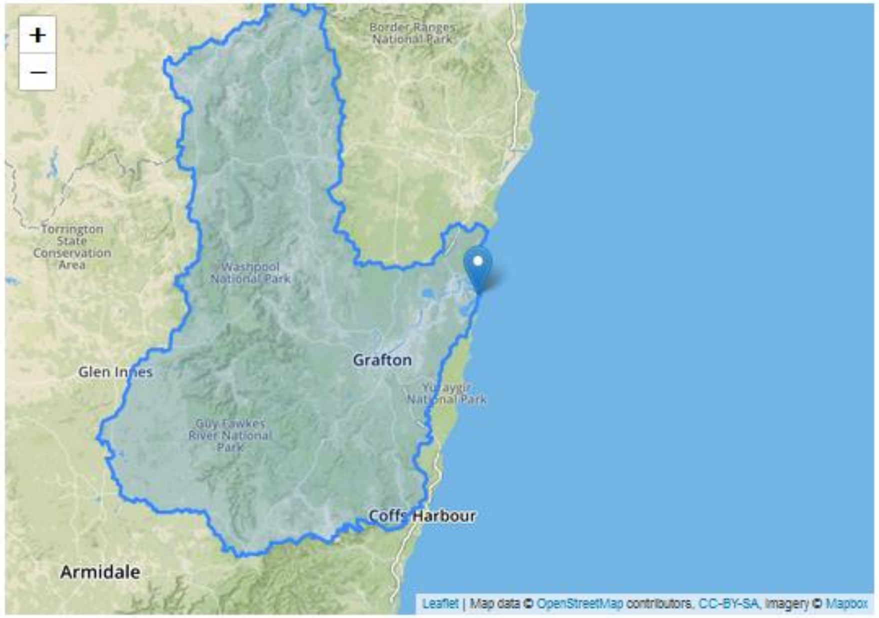
Australian Rainfall & Runoff Data Hub - Results

Input Data

Longitude	153.359
Latitude	-29.439
Selected Regions (clear)	
River Region	show
ARF Parameters	show
Storm Losses	show
Temporal Patterns	show
Areal Temporal Patterns	show
BOM IFDs	show
Median Preburst Depths and Ratios	show
10% Preburst Depths	show
25% Preburst Depths	show
75% Preburst Depths	show
90% Preburst Depths	show
Interim Climate Change Factors	show
Probability Neutral Burst Initial Loss	show



Data

River Region

Division	South East Coast (NSW)
River Number	4
River Name	Clarence River

Layer Info

Time Accessed	07 July 2020 10:12PM
Version	2016_v1

Data

River Region

Division	South East Coast (NSW)
River Number	4
River Name	Clarence River

Layer Info

Time Accessed	07 July 2020 10:12PM
Version	2016_v1

ARF Parameters

$$ARF = Min\left\{1, \left[1 - a\left(Area^{b} - c\log_{10}Duration\right)Duration^{-d} + eArea^{f}Duration^{g}\left(0.3 + \log_{10}AEP\right) + h10^{iArea\frac{Duration}{1440}}\left(0.3 + \log_{10}AEP\right)\right]\right\}$$

Zone	a	b	c	d	e	f	g	h	i
East Coast North	0.327	0.241	0.448	0.36	0.00096	0.48	-0.21	0.012	-0.0013

Layer Info

Time Accessed	07 July 2020 10:12PM
Version	2016_v1

Short Duration ARF

$$ARF = Min\left[1, 1 - 0.287\left(Area^{0.265} - 0.439\log_{10}(Duration)\right).Duration^{-0.36} + 2.26 \text{ x } 10^{-3} \text{ x } Area^{0.226}.Duration^{0.125}\left(0.3 + \log_{10}(AEP)\right) + 0.0141 \text{ x } Area^{0.213} \text{ x } 10^{-0.021\frac{(Duration-180)^2}{1440}}\left(0.3 + \log_{10}(AEP)\right)\right]$$

Storm Losses

Note: Burst Loss = Storm Loss - Preburst

Note: These losses are only for rural use and are **NOT FOR DIRECT USE** in urban areas

Note: As this point is in NSW the advice provided on losses and pre-burst on the NSW Specific Tab of the ARR Data Hub is to be considered. In NSW losses are derived considering a hierarchy of approaches depending on the available loss information. The continuing storm loss information from the ARR Datahub provided below should only be used where relevant under the loss hierarchy (level 5) and where used is to be multiplied by the factor of 0.4.

ID	16670.0
Storm Initial Losses (mm)	24.0
Storm Continuing Losses (mm/h)	3.6

Layer Info

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Version	2016_v1

Temporal Patterns | Download (.zip)

code	ECsouth
Label	East Coast South

Layer Info

Time Accessed	07 July 2020 10:12PM
Version	2016_v2

Areal Temporal Patterns | Download (.zip)

code	ECsouth
arealabel	East Coast South

BOM IFDs

Click here to obtain the IFD depths for catchment centroid from the BoM website

Median Preburst Depths and Ratios

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	1.5 (0.039)	4.2 (0.084)	6.3 (0.108)	8.3 (0.124)	6.4 (0.080)	6.1 (0.068)
90 (1.5)	4.7 (0.105)	6.2 (0.107)	7.3 (0.107)	8.3 (0.106)	12.4 (0.133)	15.5 (0.148)
120 (2.0)	6.6 (0.136)	10.3 (0.161)	12.8 (0.170)	15.1 (0.174)	19.2 (0.185)	22.3 (0.190)
180 (3.0)	11.4 (0.204)	19.2 (0.258)	24.3 (0.276)	29.2 (0.286)	35.0 (0.285)	39.3 (0.282)
360 (6.0)	8.2 (0.114)	21.9 (0.224)	31.0 (0.264)	39.7 (0.288)	60.8 (0.363)	76.6 (0.399)
720 (12.0)	9.5 (0.100)	24.5 (0.185)	34.5 (0.214)	44.1 (0.230)	63.1 (0.269)	77.3 (0.286)
1080 (18.0)	7.2 (0.065)	16.2 (0.102)	22.1 (0.113)	27.8 (0.119)	51.2 (0.179)	68.8 (0.209)
1440 (24.0)	6.4 (0.051)	14.4 (0.080)	19.7 (0.089)	24.8 (0.093)	37.6 (0.115)	47.1 (0.126)
2160 (36.0)	1.5 (0.010)	7.0 (0.033)	10.7 (0.040)	14.2 (0.045)	27.1 (0.070)	36.9 (0.083)
2880 (48.0)	0.1 (0.000)	3.9 (0.016)	6.5 (0.022)	8.9 (0.025)	18.1 (0.042)	25.0 (0.051)
4320 (72.0)	0.0 (0.000)	1.3 (0.005)	2.2 (0.007)	3.1 (0.008)	6.6 (0.014)	9.3 (0.017)

10% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)

Layer Info

Time Accessed	07 July 2020 10:12PM
Version	2016_v2

Layer Info

Time Accessed	07 July 2020 10:12PM

Layer Info

Time Accessed	07 July 2020 10:12PM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

Layer Info

Time Accessed	07 July 2020 10:12PM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide

wmawater

Interim Climate Change Factors

	RCP 4.5	RCP6	RCP 8.5
2030	0.869 (4.3%)	0.783 (3.9%)	0.983 (4.9%)
2040	1.057 (5.3%)	1.014 (5.1%)	1.349 (6.8%)
2050	1.272 (6.4%)	1.236 (6.2%)	1.773 (9.0%)
2060	1.488 (7.5%)	1.458 (7.4%)	2.237 (11.5%)
2070	1.676 (8.5%)	1.691 (8.6%)	2.722 (14.2%)
2080	1.810 (9.2%)	1.944 (9.9%)	3.209 (16.9%)
2090	1.862 (9.5%)	2.227 (11.5%)	3.679 (19.7%)

Layer Info

Time Accessed	07 July 2020 10:12PM
Version	2019_v1
Note	ARR recommends the use of RCP4.5 and RCP 8.5 values. These have been updated to the values that can be found on the climate change in Australia website.

Probability Neutral Burst Initial Loss

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	11.8	7.3	8.4	7.9	7.5	4.5
90 (1.5)	11.5	7.6	8.4	7.8	6.2	3.1
120 (2.0)	11.4	7.4	7.9	6.8	6.6	2.2
180 (3.0)	10.2	6.3	6.7	6.6	6.6	2.1
360 (6.0)	10.8	6.7	6.6	6.5	7.8	2.8
720 (12.0)	12.8	7.1	6.5	6.7	6.4	4.1
1080 (18.0)	14.4	8.8	9.7	8.3	8.3	4.6
1440 (24.0)	15.8	10.5	10.0	9.6	7.7	5.6
2160 (36.0)	19.1	12.9	13.5	11.4	11.8	5.9
2880 (48.0)	21.8	14.7	15.0	12.5	13.9	6.5
4320 (72.0)	24.4	18.2	17.4	13.8	17.3	7.0

Download TXT | Download JSON | Download PDF

Layer Info

Time Accessed	07 July 2020 10:12PM
Version	2018_v1
Note	As this point is in NSW the advice provided on losses and pre-burst on the NSW Specific Tab of the ARR Data Hub is to be considered. In NSW losses are derived considering a hierarchy of approaches depending on the available loss information. Probability neutral burst initial loss values for NSW are to be used in place of the standard initial loss and pre-burst as per the losses hierarchy.

Data Hub - Data And Outputs

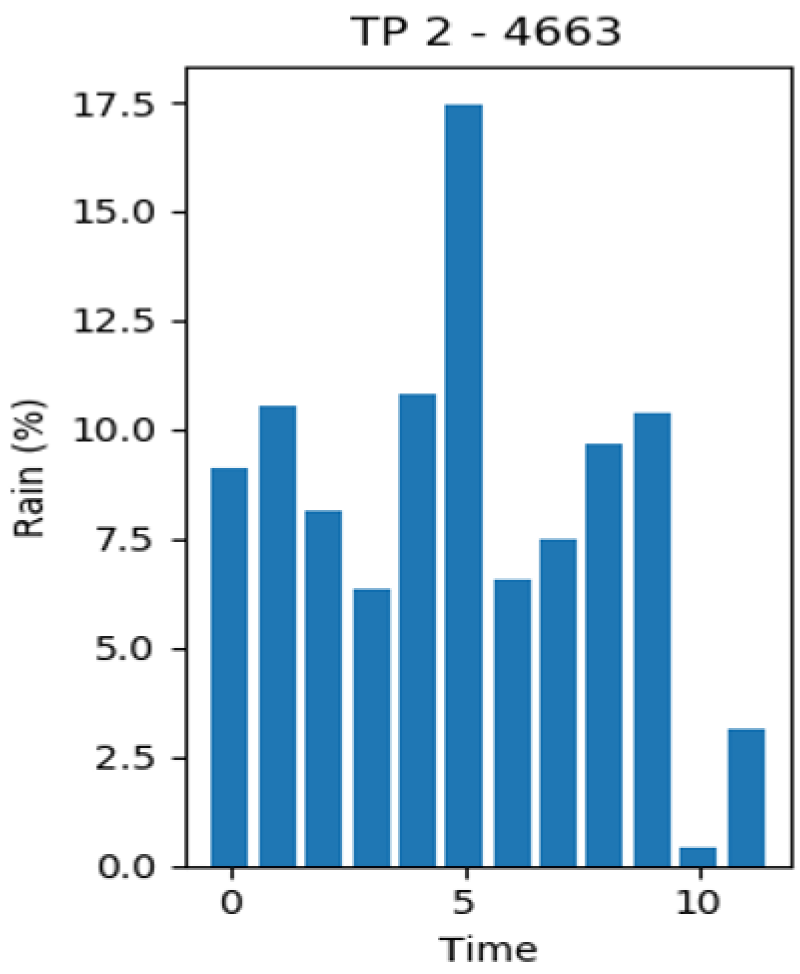
Data	Use
River region and map	check
IFD	Link to BoM
ARF	recommended
Temporal Patterns	recommended
Pre burst	recommended
Losses	In the absence of local data
Climate change factors	In the absence of location specific studies
Baseflow	In the absence of local data

Pooled (IFD, ARF, Temporal Patterns, Pre burst)

Regionalised Predictor (Losses, Climate change factors, Baseflow)

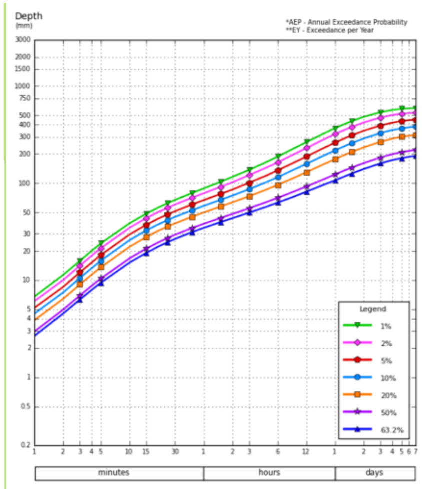
ARR 2019 Temporal patterns – big changes

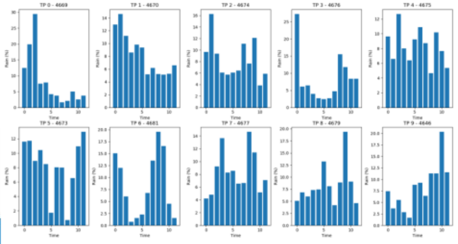
- Considers the variability of real storms
  - Ensemble of 10 patterns
  - Patterns attempt to capture the variability of real storms
  - No such thing as a typical pattern for every catchment
- Consideration of pre-burst rainfall
  - Rainfall before the main burst
  - Better reflect the interaction with losses from real events



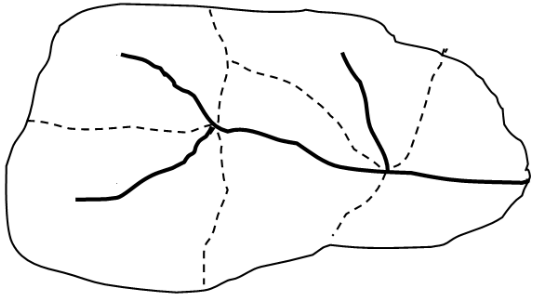
Ensemble Hydrology

Inputs

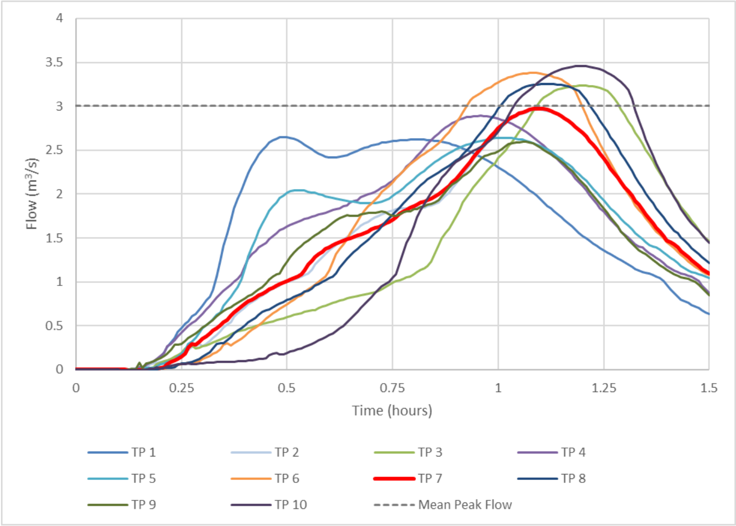




Model

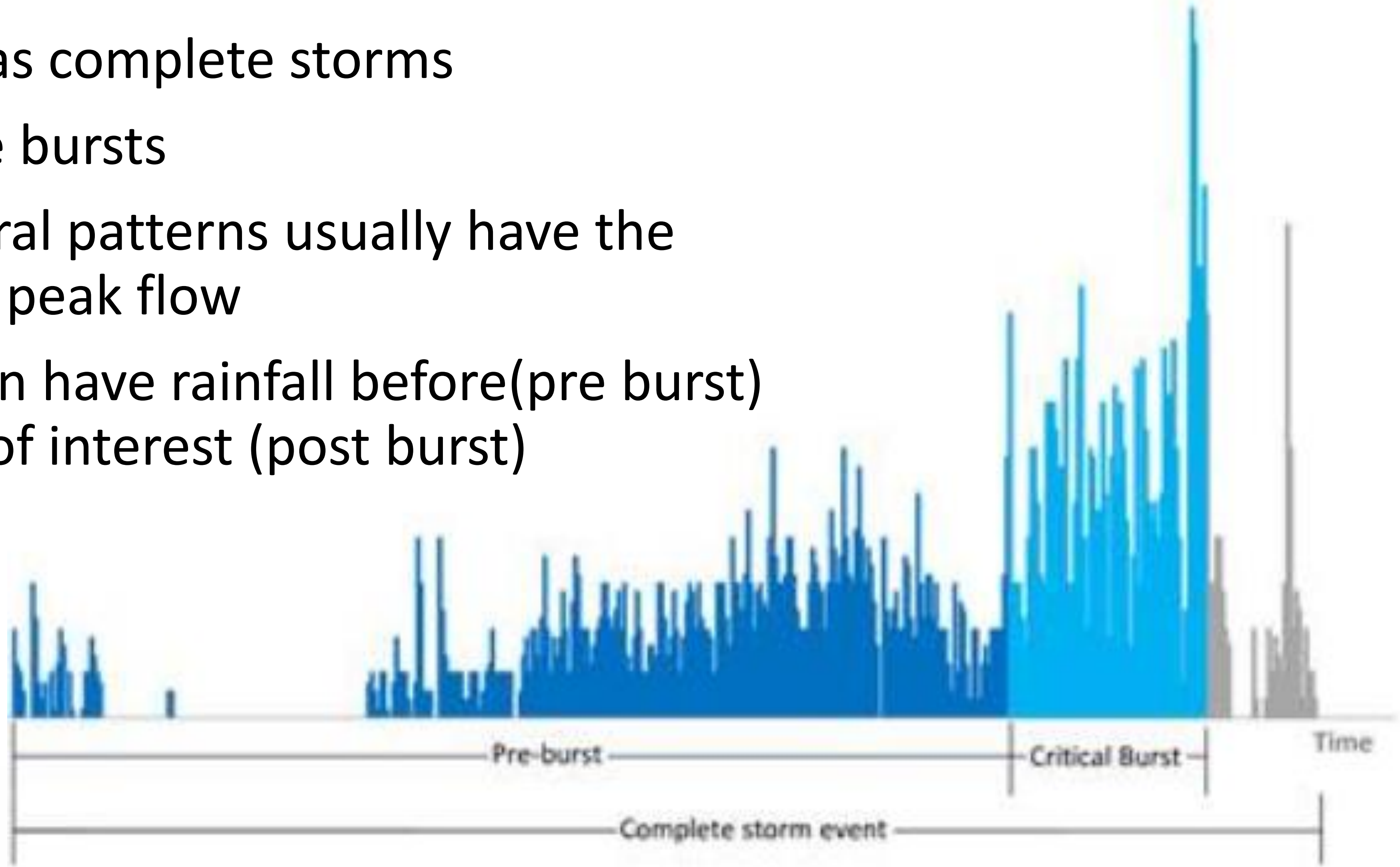


Results

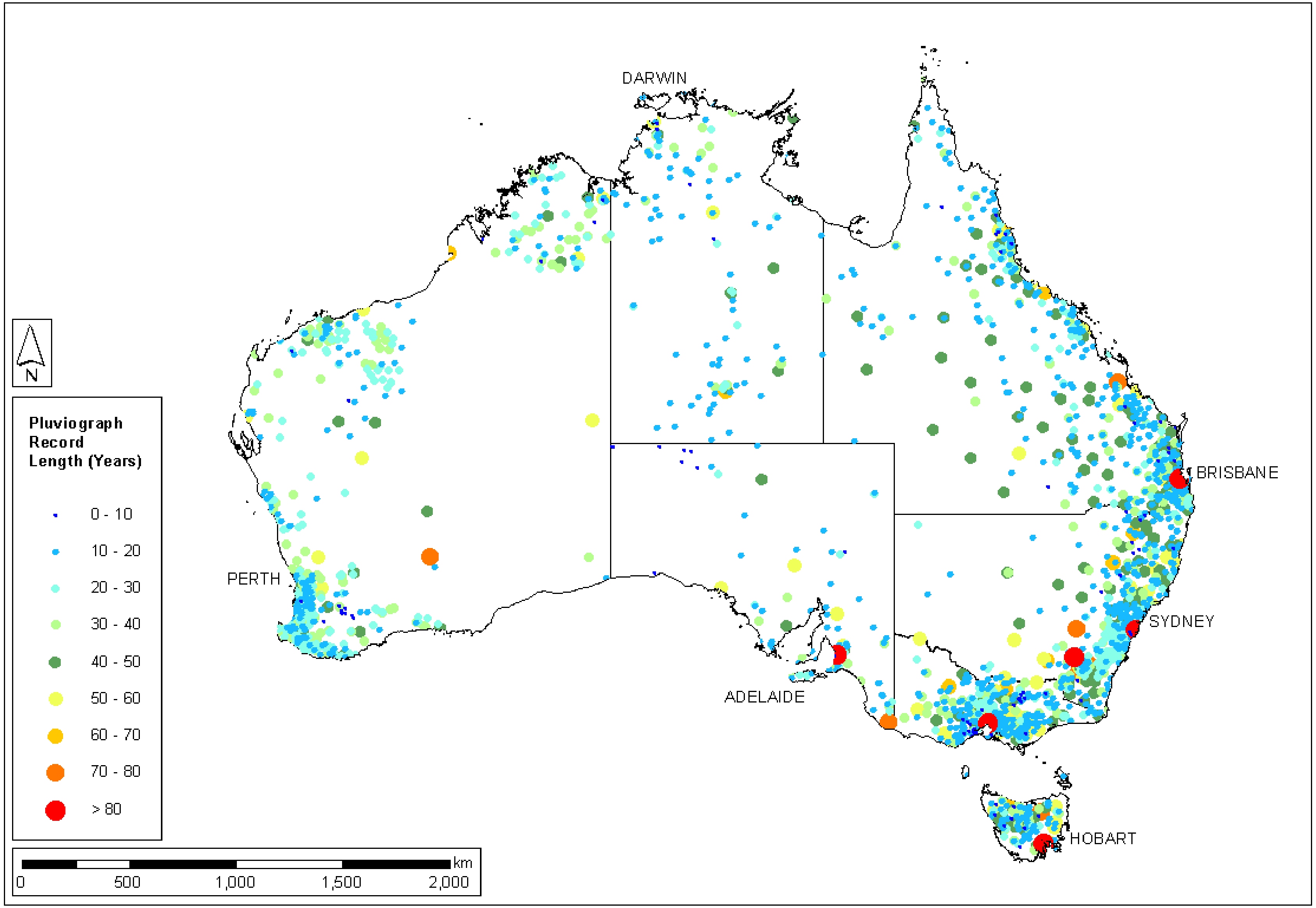


Storms and Bursts (ARR 1987 and ARR 2019)

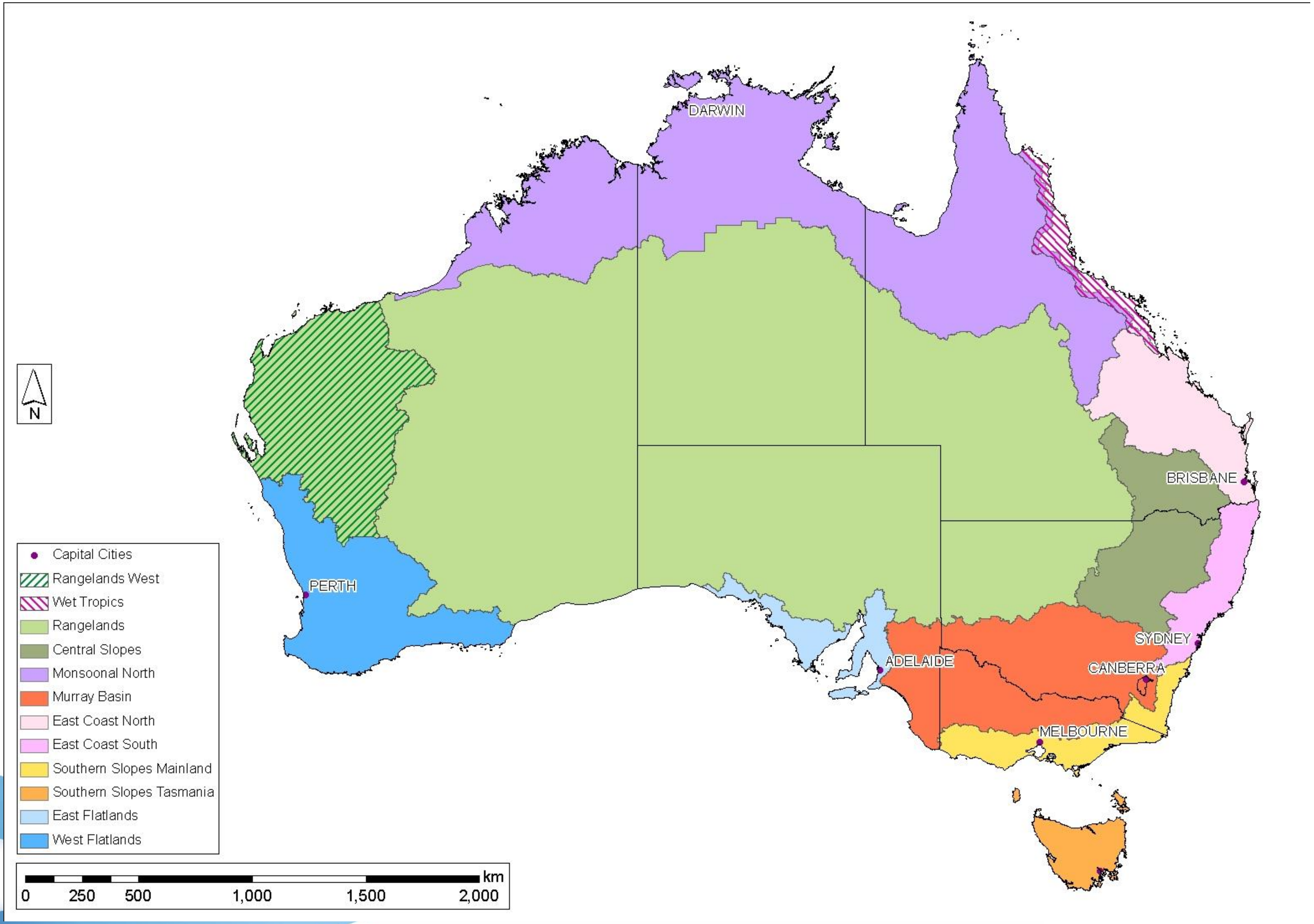
- Real rainfall occurs as complete storms
- Design methods use bursts
- After rainfall temporal patterns usually have the largest influence on peak flow
- Complete storms can have rainfall before(pre burst) and after the burst of interest (post burst)



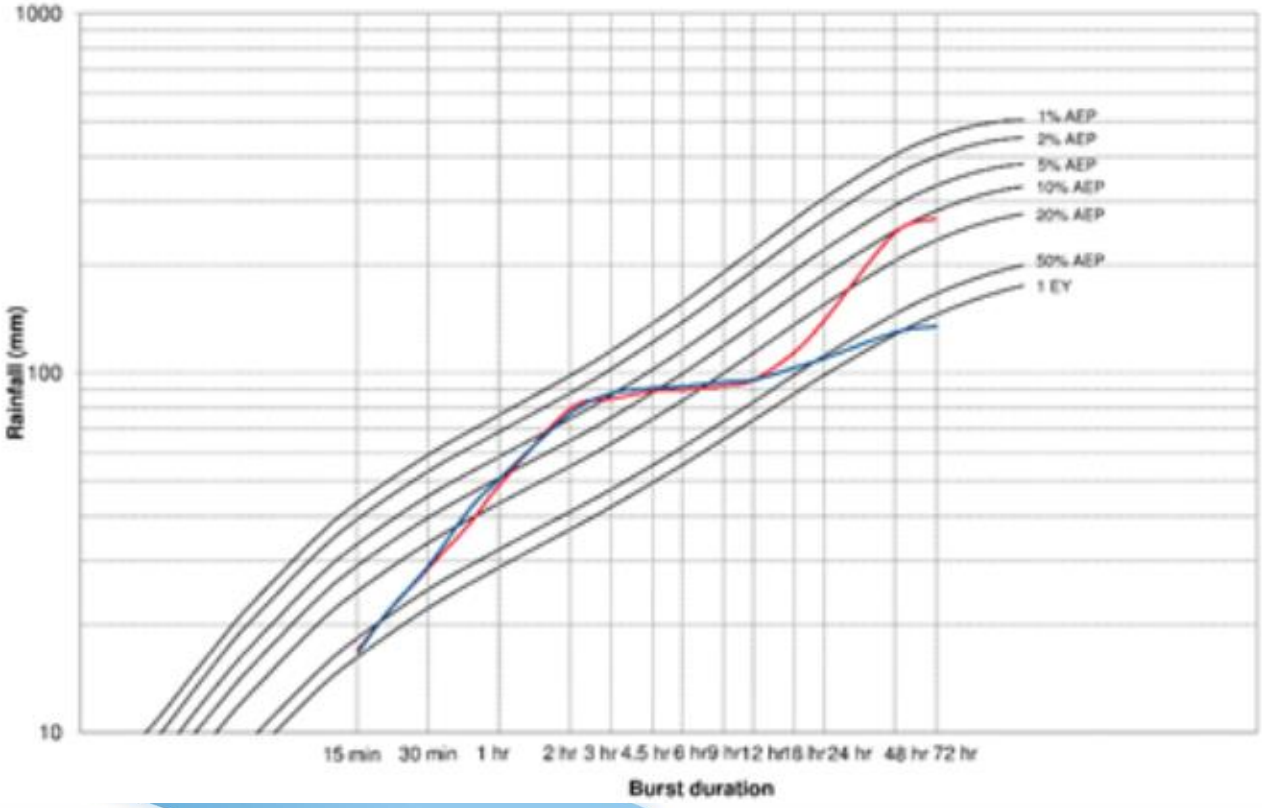
Pluviograph database

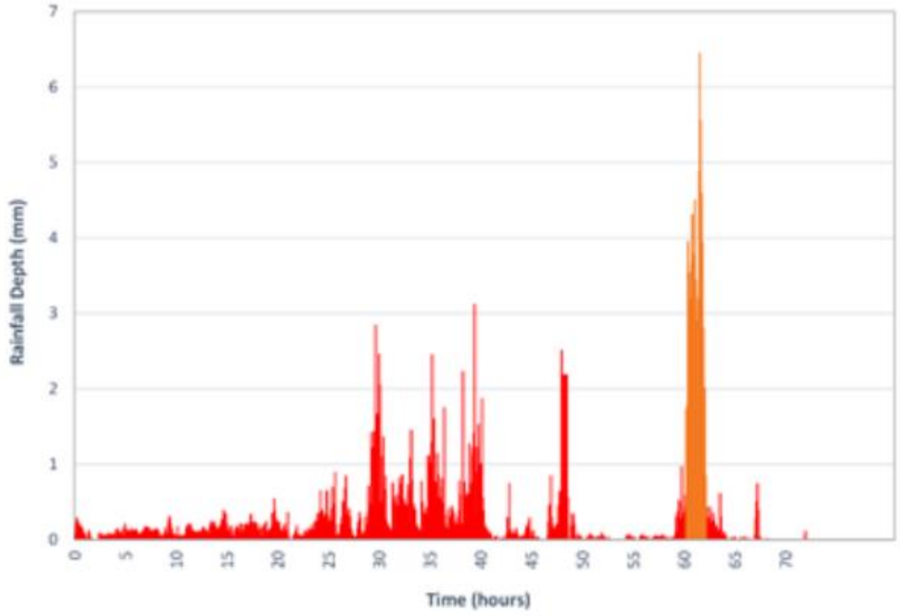


Temporal pattern regions

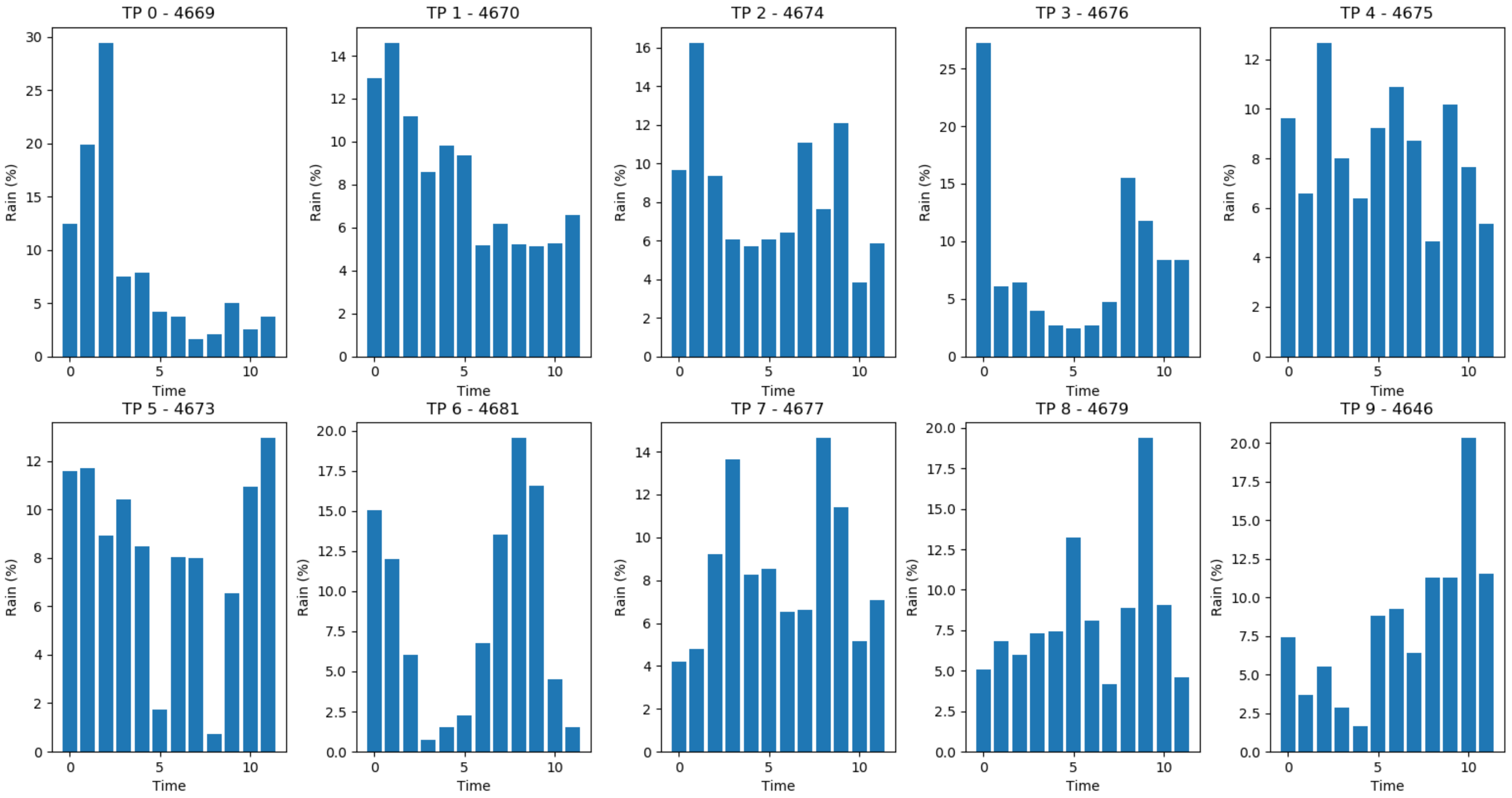


Very different storms can have the same IFD characteristics





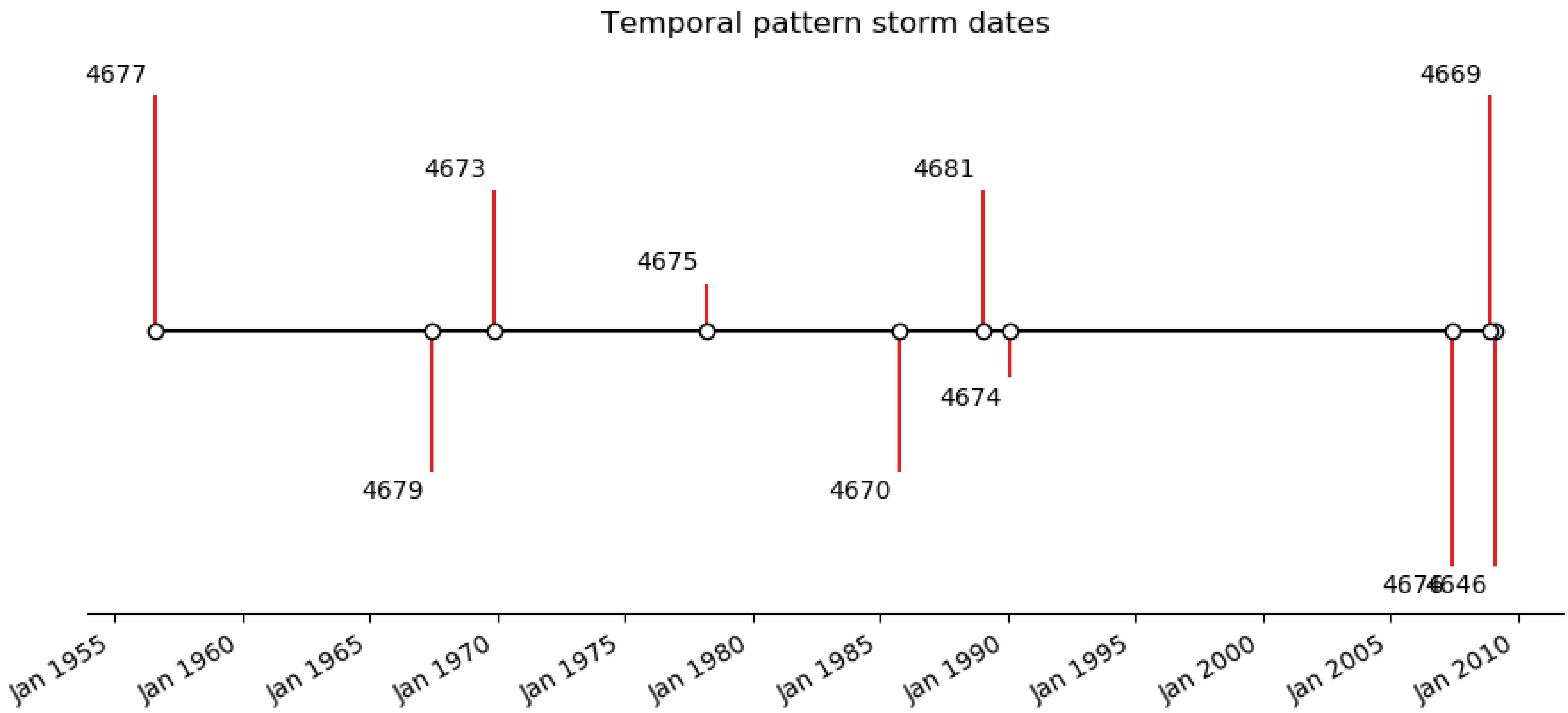
Ensemble patterns capture variability of real patterns



3 hour patterns ranked from front loaded to back loaded

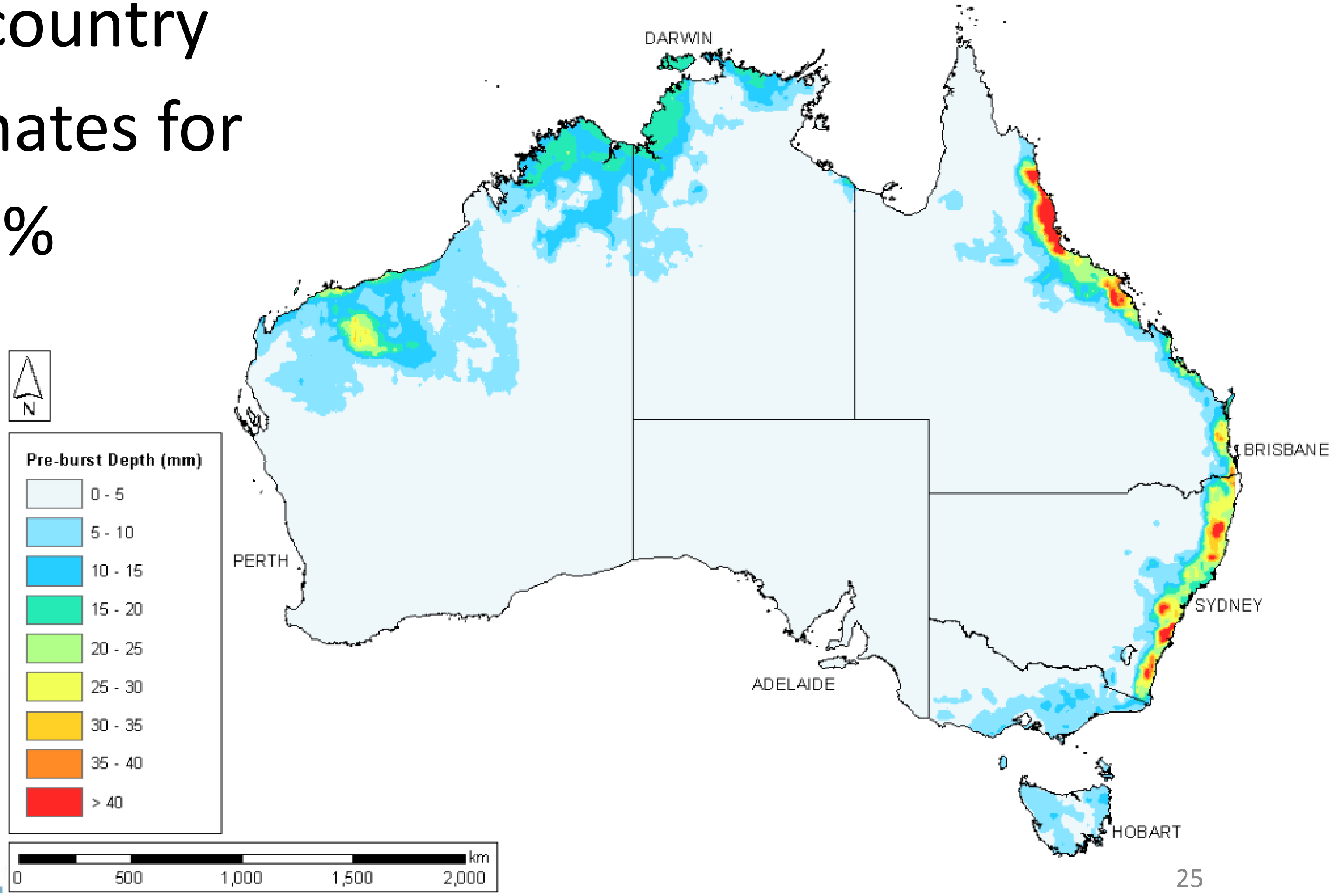
Patterns sourced from locations in the zone

Patterns taken from different storms



Pre burst

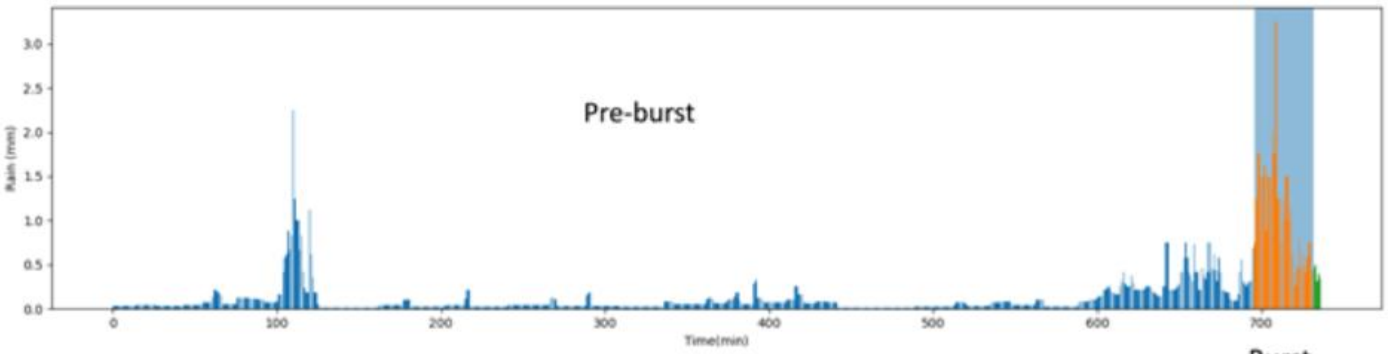
- Important for losses
- Varies throughout the country
- Datahub provides estimates for 10%,25%,50%,75% & 90%

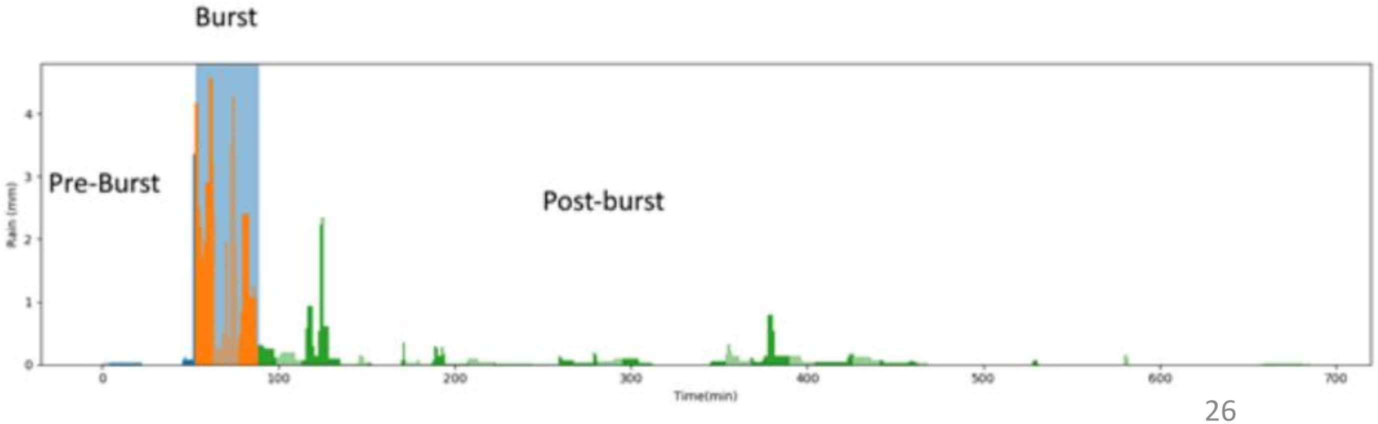


www.

Pre burst cont..

- Varies between storms
- Usually use the median (50%)
- Where its extreme need to consider the distribution





Thank You for Listening

Questions