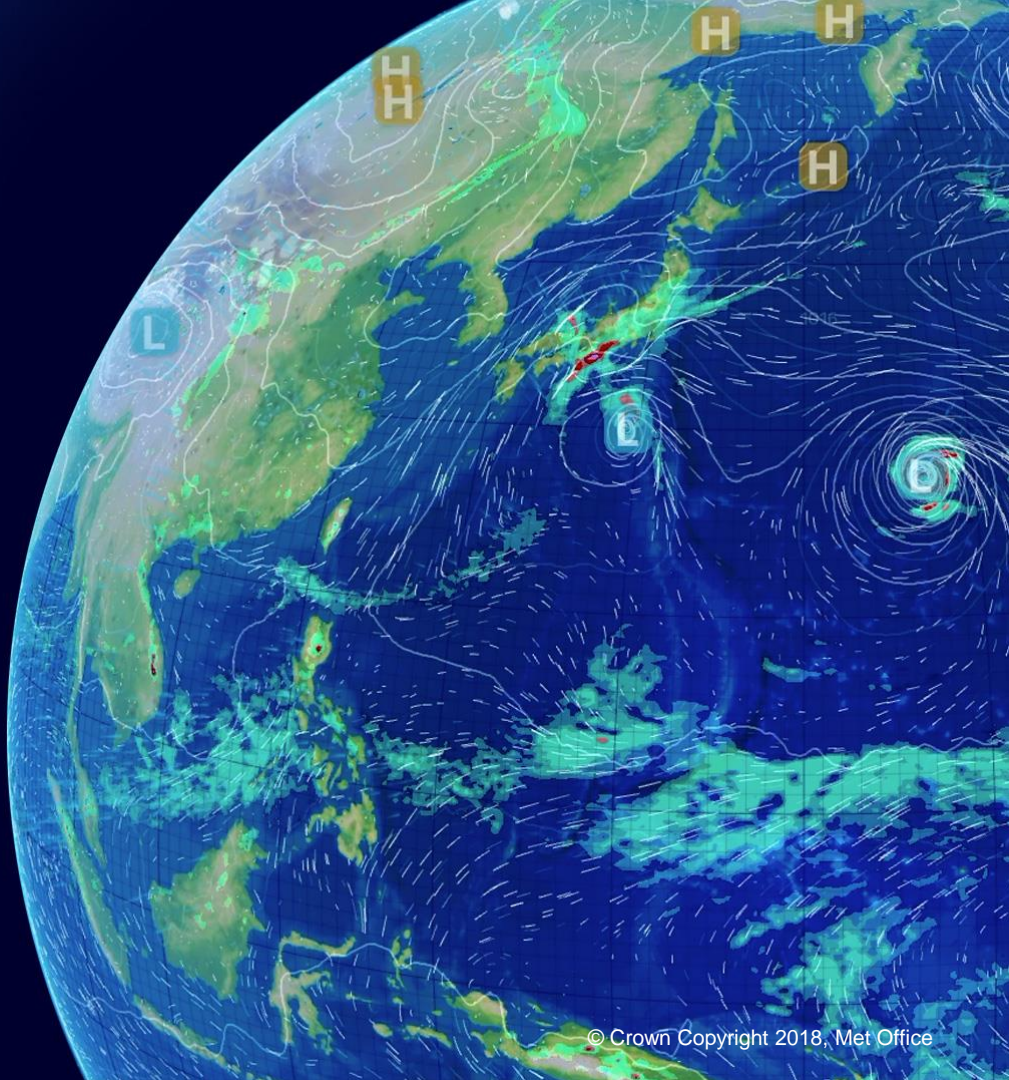


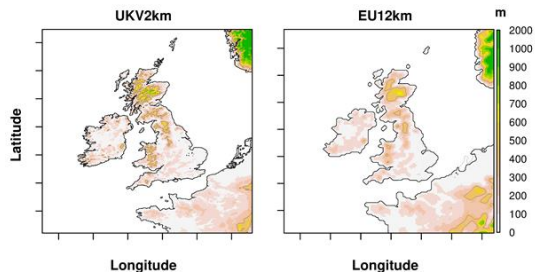
# Water impacts and climate change in Wales

Prof Lizzie Kendon

Thanks to Steven Chan, Kate Halladay, Leanne Archer, Laura Devitt



# UKCP Local (2.2km) Transient projections



New set of 12 fully transient 100y convection permitting projections (launch 30 March 2023)

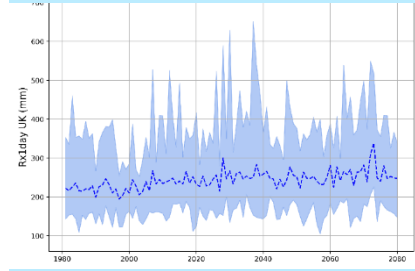


Understand how changes in local precipitation extremes emerge through time.



Put observed events into context of climate change

Estimates of evolving flood risk

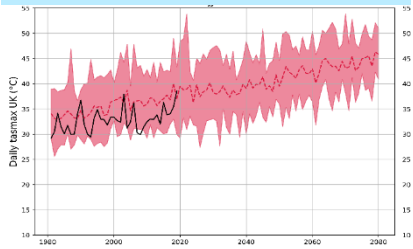
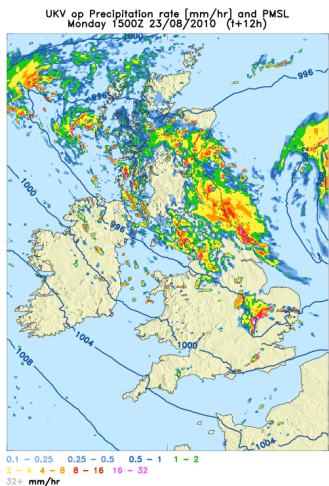


Impact-relevant change for global warming levels



**UKCP Local 2.2km transient ensemble**

- 2.2km resolution for UK
- 12 members
- 100y projections 1981-2080
- High emissions scenario RCP8.5



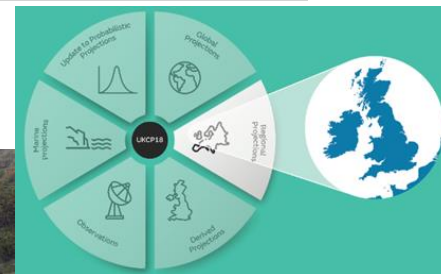
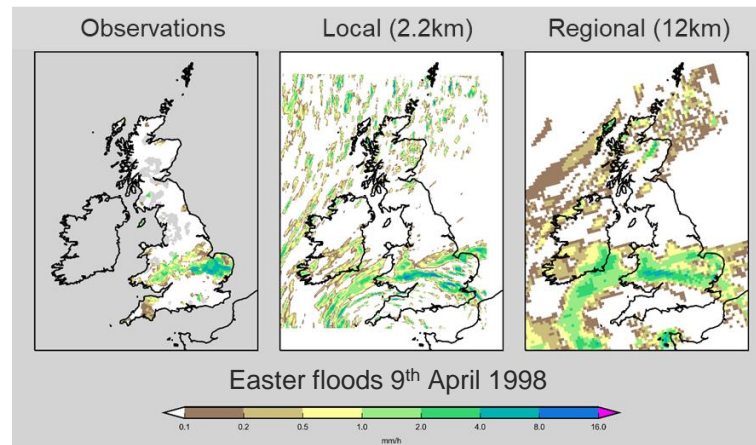
Supports UK risk assessments

## UKCP Local (2.2km) provides detail on local weather extremes over coming years and decades

UKCP Local (2.2km) better simulates how rainfall varies hour to hour. For first time, provides credible information for changes on hourly scales.

UKCP18 headline message: “greater chance of warmer wetter winters and hotter drier summers” in future across UK. UKCP Local (2.2km) adds detail for local weather extremes.

Frequency of days with hourly rainfall >30mm/h almost doubles by 2070s under RCP8.5.



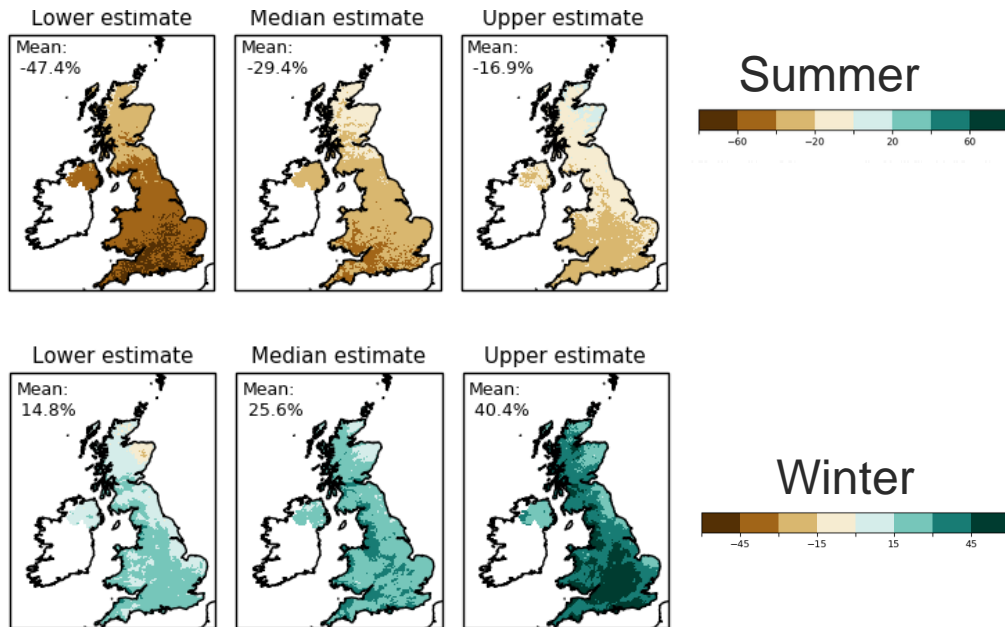
Local (2.2km) provides credible projections of local weather extremes

# Projecting future seasons using the Local (2.2km)

The Local (2.2km) ensemble suggests:

Summers will be drier by 17-47% and winters will be wetter by 15-40%.

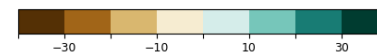
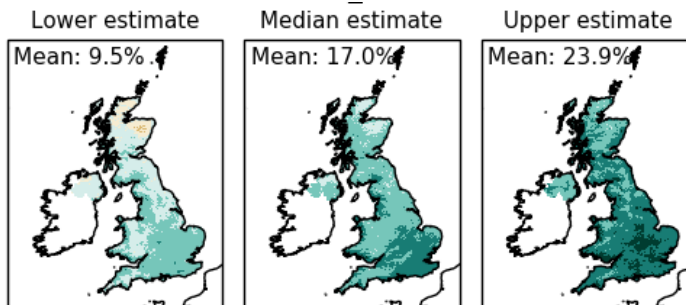
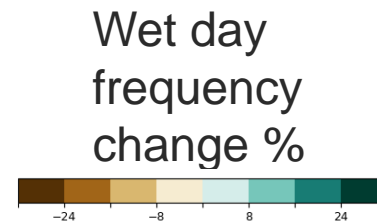
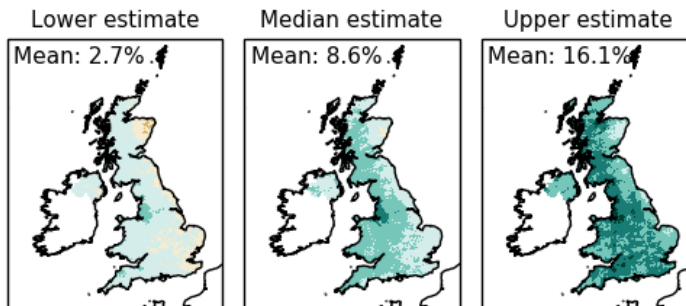
*Projected changes to 2061-2080  
for RCP8.5 as %*



Winter precipitation increases are substantially larger in Local (2.2km) than Regional (12km)

## Winter precipitation increases in both frequency of wet days and intensity on wet days

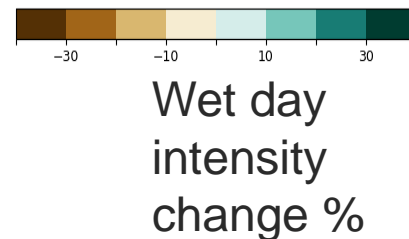
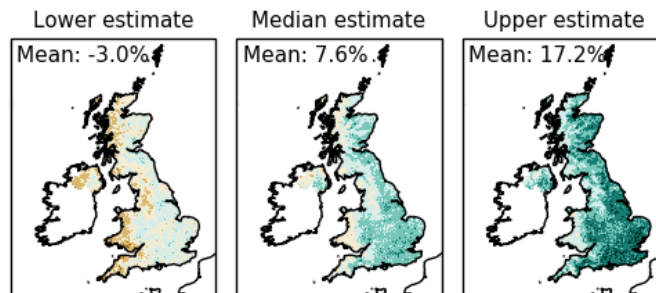
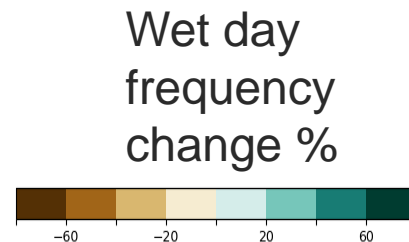
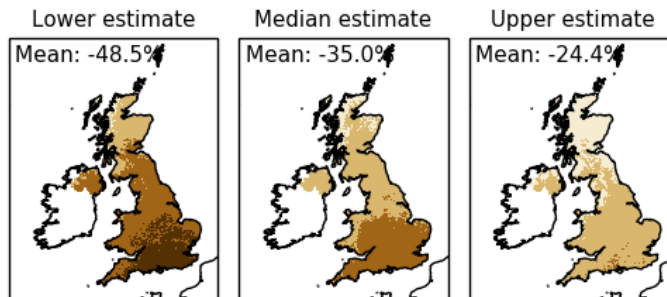
*Projected changes to 2061-2080  
for RCP8.5 as %*



Local (2.2km) shows larger increases in wet day frequency than Regional (12km)

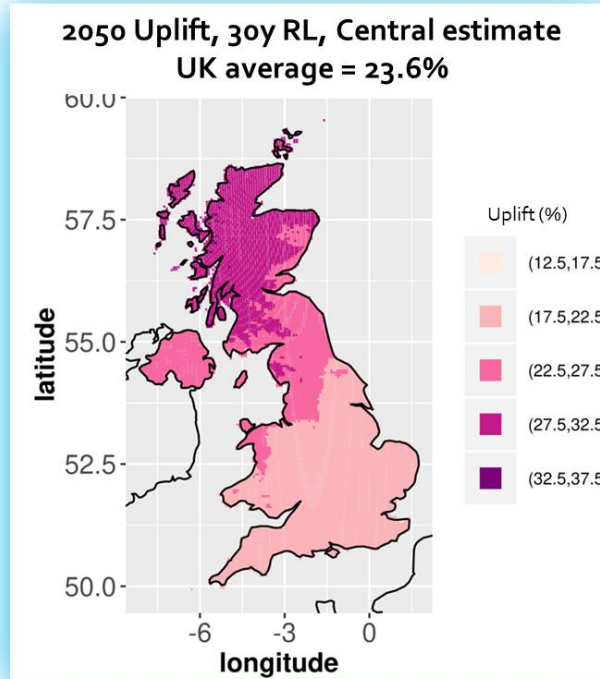
**Despite overall summer drying, Local (2.2km) suggests future increases in the intensity of summer rainfall.**

*Projected changes to 2061-2080 for RCP8.5 as %*



Local (2.2km) shows greater increases in summer rainfall intensity than Regional (12km).

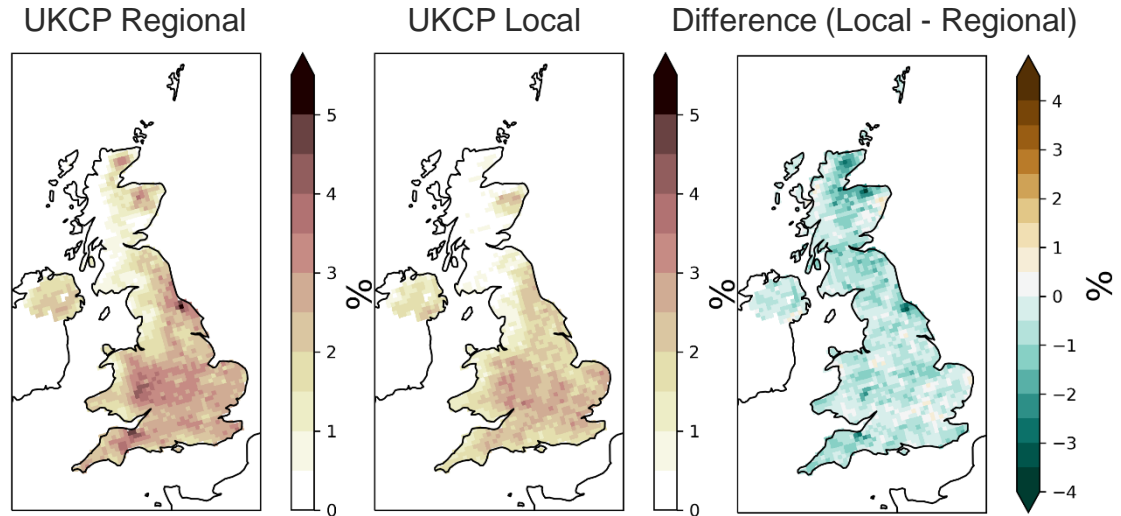
<p><b>UKCP Local projected change</b> Baseline 1981-2000, Target 2061-80</p>	<p><b>Welsh Govt (2021) guidance</b> Baseline 1961-90, Target 2070-2115</p>
<p>1h extremes: +25% (central) +40% (high)</p> <p>1d extremes: +20% (central) +35% (high)</p>	<p>+20% (central) +40% (high)</p>



- 30-y return level of hourly precipitation is projected to increase by 30% (central)/ 45% (high estimate) on average across UK by 2070.
- New estimates are greater than current official guidance in some parts of UK (including Wales).
- For Cardiff, frequency of exceeding 30mm/h locally doubles by 2070s under RCP8.5

## UKCP Local predicts widespread increases in drought

- Both models show an increase in drought conditions
- Increases in drought are greater in the UKCP Regional than UKCP Local projections
- Improved representation of rainfall in UKCP Local, giving greater confidence in the UKCP Local projections



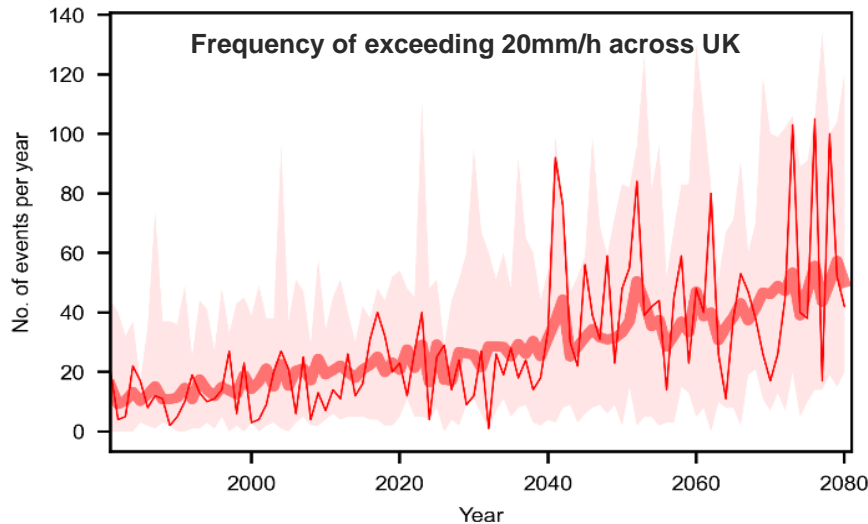
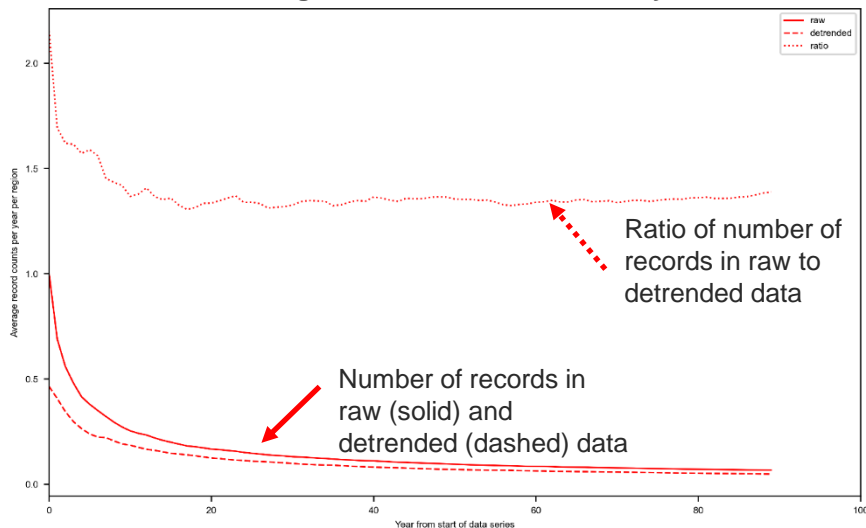
Future change (%) in 3-month Drought Severity Index (DSI):  
GWL 4°C minus baseline (1981-2000)



# Variability conceals emerging trend in local hourly precipitation extremes

- Local extreme hourly precipitation does not intensify gradually with a warming climate
- It may remain rare and unchanging for several decades, followed by a decade of a series of extreme record-breaking events

**Occurrence of regional records of local hourly rainfall**



With benefit of multiple realisations:

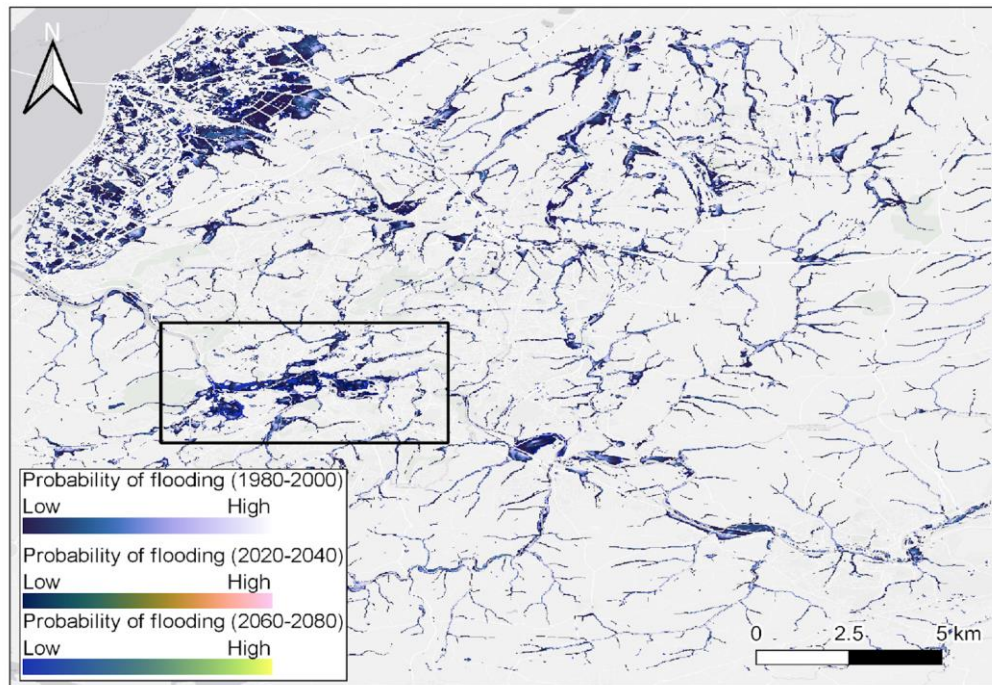
- Occurrence of local hourly rainfall records is 40% larger than in the absence of warming.
- Extreme downpours about 4x more frequent by 2070s, with increase of almost 9 events per year per K warming.

Understanding year-to-year variability in projections reduces scope for misinterpreting observed individual events.

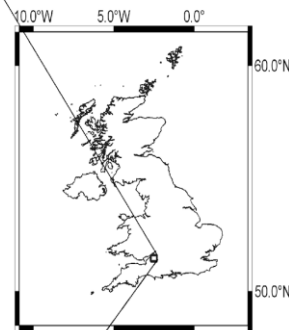
# Using UKCP Local precipitation event set to estimate pluvial flooding over Bristol compared to the standard IDF approach



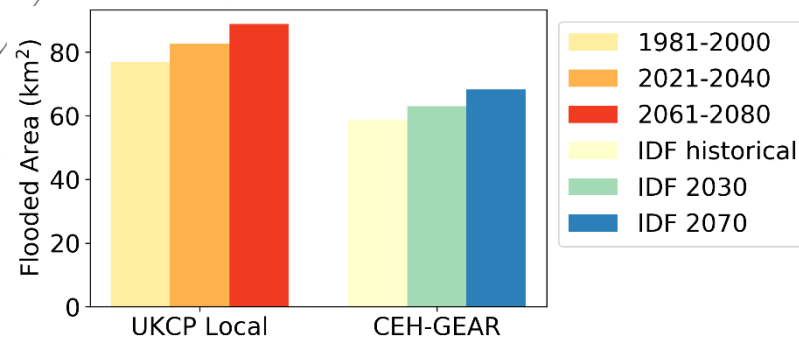
## Thirty Year Return Period Flood Inundation



## Bristol case study area



Comparison of 30y flood extent when using UKCP Local event set compared to standard uplift approach applied to CEHGEAR observations



# Using UKCP Local precipitation timeseries to estimate future change in river discharge compared to EA change factors

## Dyfi

	20-year Q magnitude	
	2.2km Local <i>(50<sup>th</sup> percentile Q5-Q95 range)</i>	NRW Upper Estimate
2020-2040	7.6% <i>(5.5– 10.2%)</i>	30%
2060-2080	29.5% <i>(23.7% - 36.1%)</i>	70%

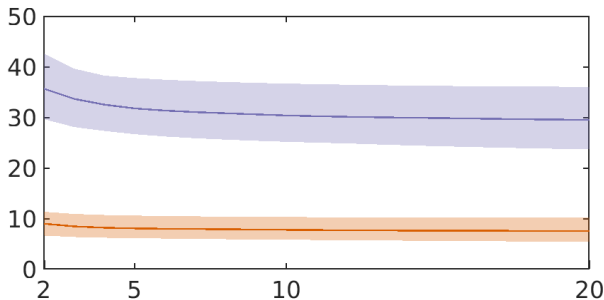
Catchment	Area	Mean Flow	QMED
Dyfi	471km <sup>2</sup>	23m <sup>3</sup> /s	322m <sup>3</sup> /s
Thet	316km <sup>2</sup>	1.9m <sup>3</sup> /s	7.3m <sup>3</sup> /s

## Thet

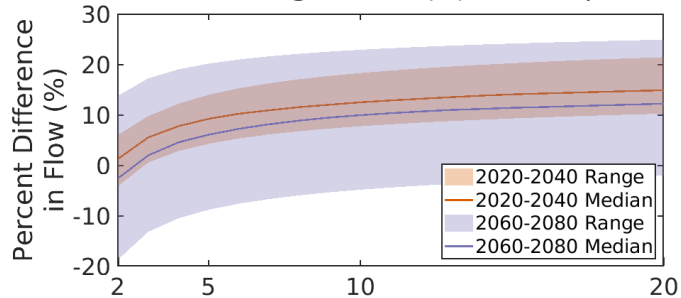
	20-year Q magnitude	
	2.2km Local <i>(50<sup>th</sup> percentile Q5-Q95 range)</i>	EA Central (Upper) Estimate
2020-2040	14.9% <i>(10.2 – 21.5%)</i>	2% (21.5%)
2060-2080	12.2% <i>(-2% - 24.9%)</i>	7% (45%)



Future change in flow (%) v return period



Future change in flow (%) v return period



## Climate change projections for Wales

- Hotter drier summers and warmer wetter winters, with increasing risk of heavy rainfall and drought
- Heavy downpours, that can lead to flash flooding, up to 4x more frequent by 2070s under high emissions
- Local record breaking rainfall events continue to occur erratically, and increases in extremes far from a smooth trend.

## What can users expect in next few years?

- UK local (2.2km) projections sampling wider range of uncertainties (including different global models) giving better estimate of uncertainty in changes in local weather extremes
- New estimates of evolving flood risk using high resolution (km-scale) continuous simulations for the UK (NERC FUTURE FLOOD project)

