# UKCP09 in the light of new CONVEX results

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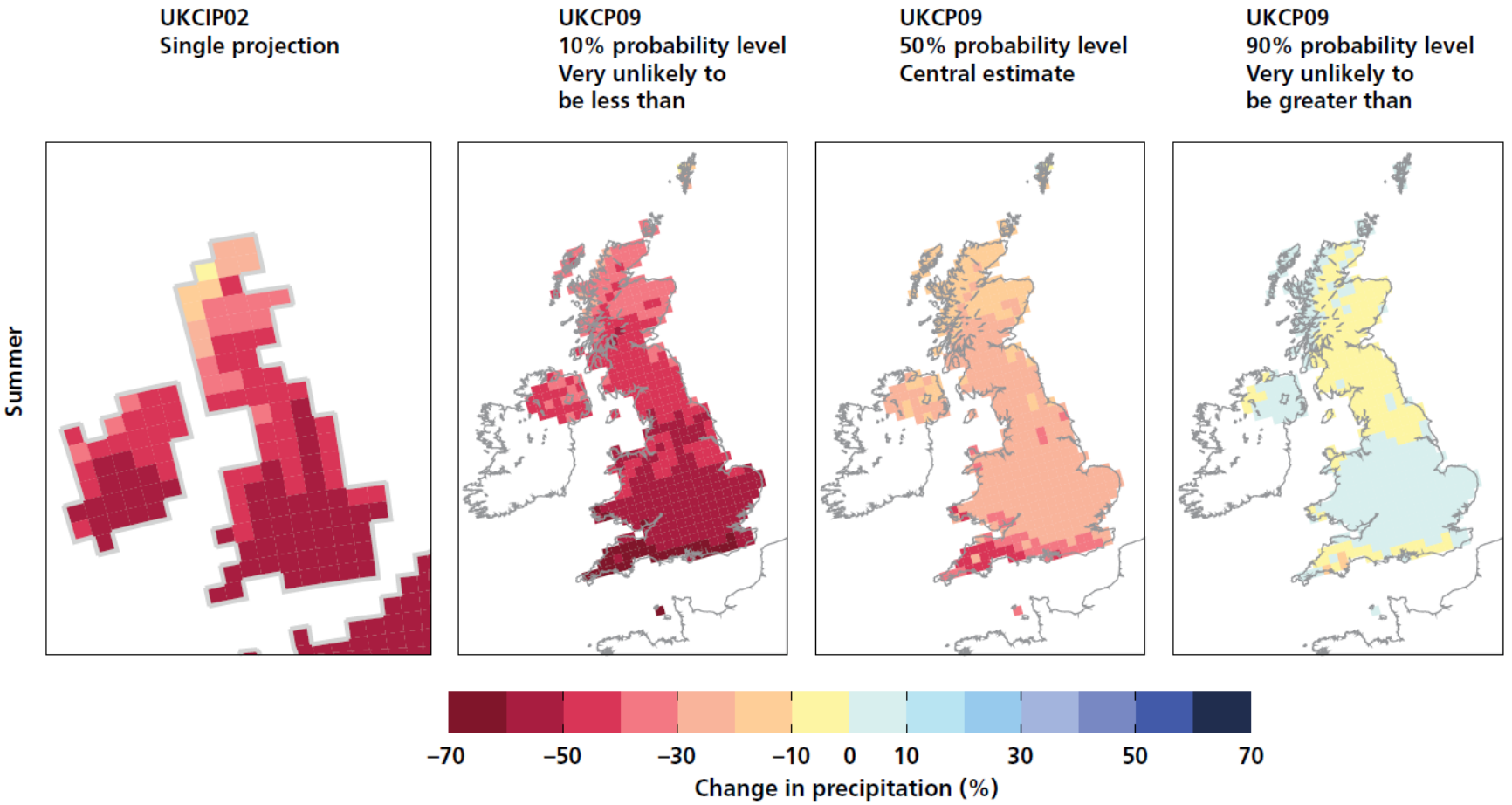
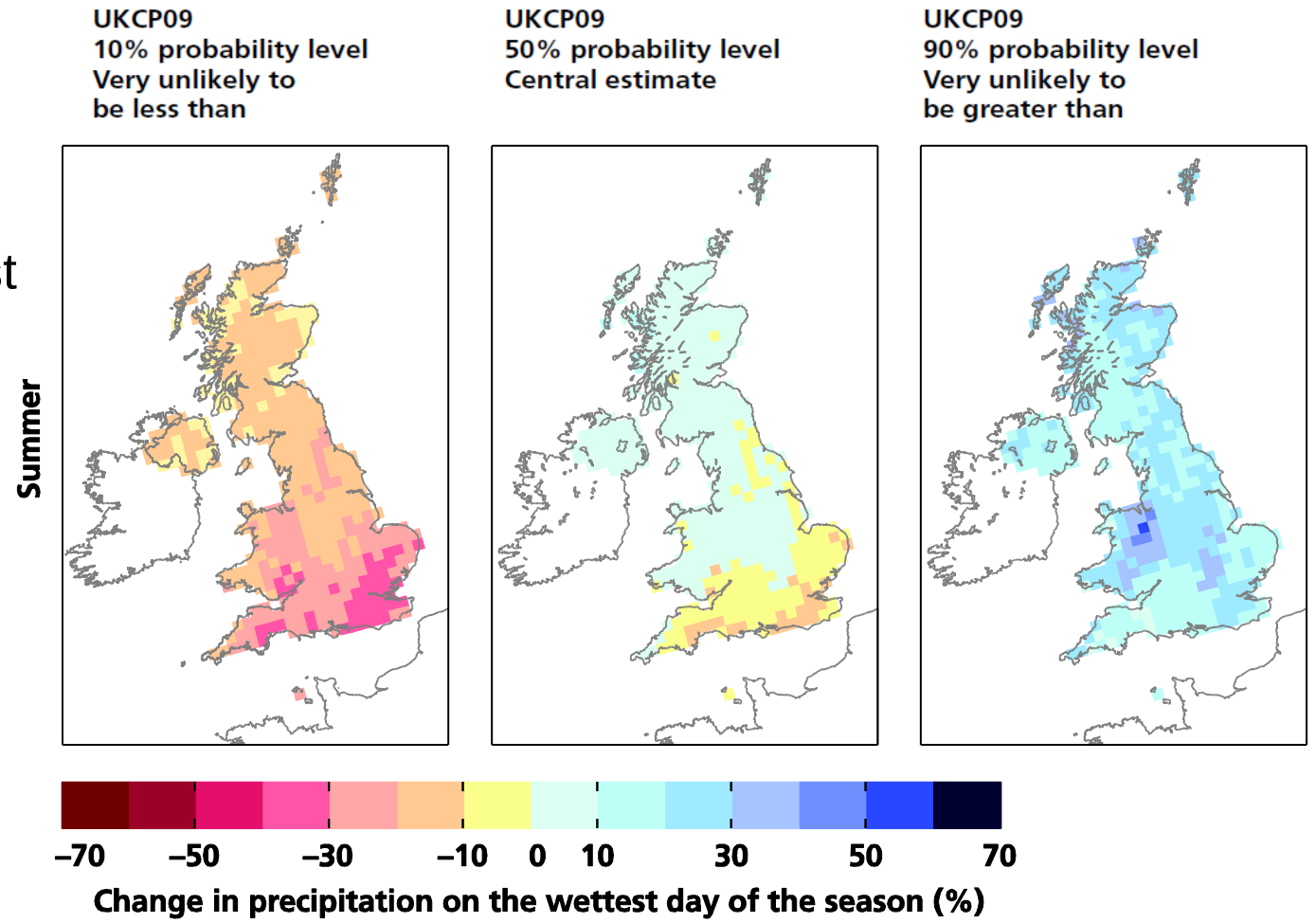
# UKCP09 probabilistic projections




Changes in mean summer rainfall by the 2080s

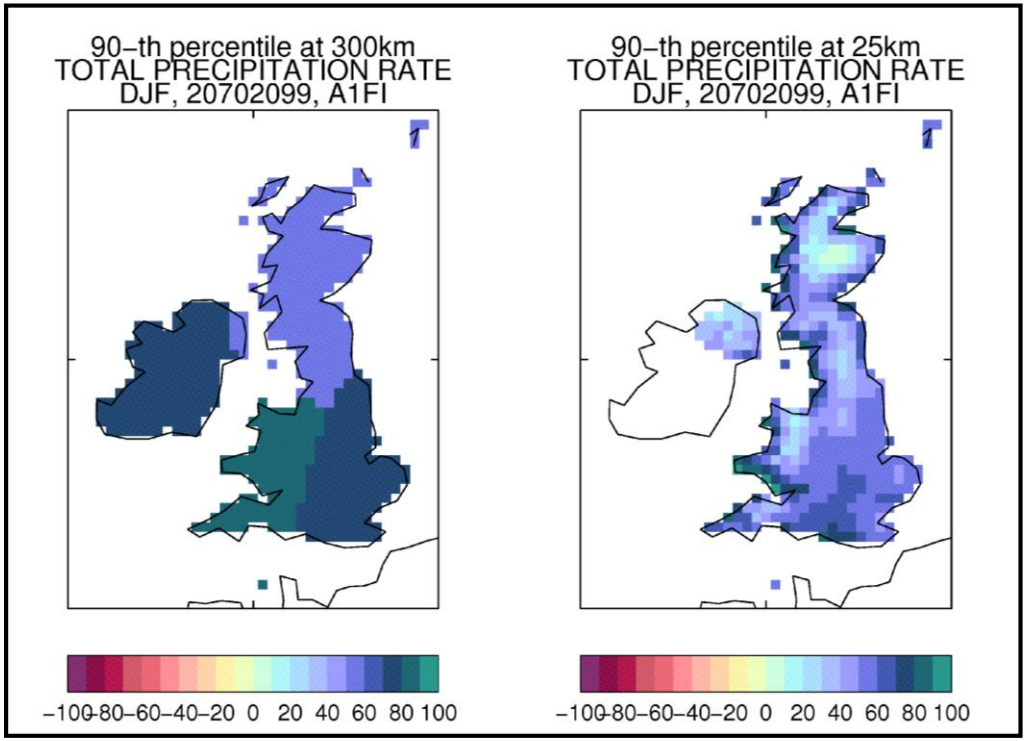
# UKCP09 probabilistic projections

Changes in wettest day of summer by 2080s



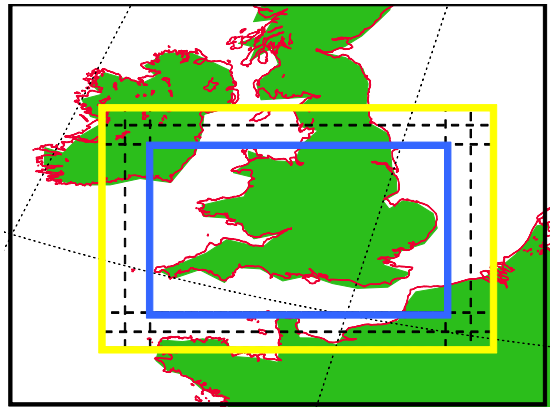
# Downscaling in UKCP09

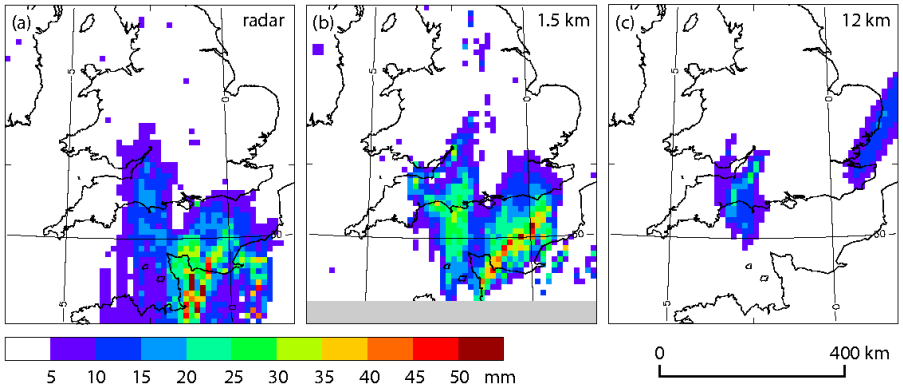
Regional climate model simulations (at 25km scale) were used to convert the global model information into a form suitable for impacts assessments



# New 1.5km model results from CONVEX

- Major step forward in modelling capability
- Allow us to explore extending UK adaptation advice beyond UKCP09 modelling capability
- Allow us to identify aspects of currently available projections (e.g. UKCP09) that are more robust, and those notably different at higher resolution



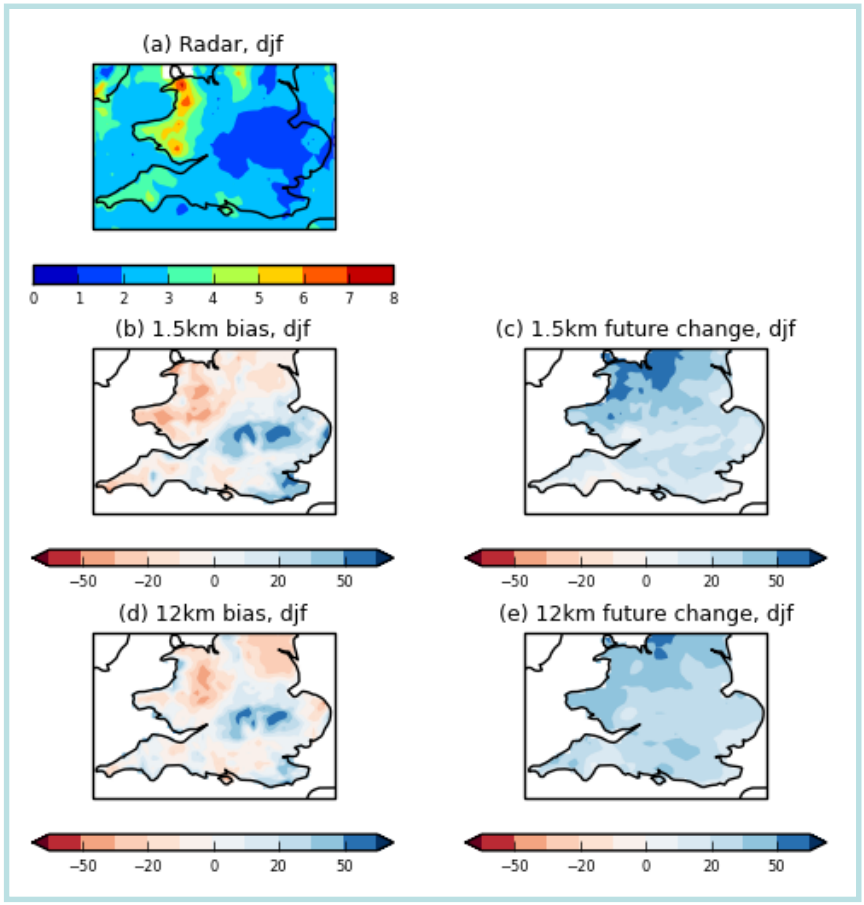



Rainfall accumulations for 5h period 13-18 UTC on 27th July 2013 for (a) radar, (b) 1.5km forecast model, (c) 12km forecast model. The improvement at 1.5km is typical for convective storms.

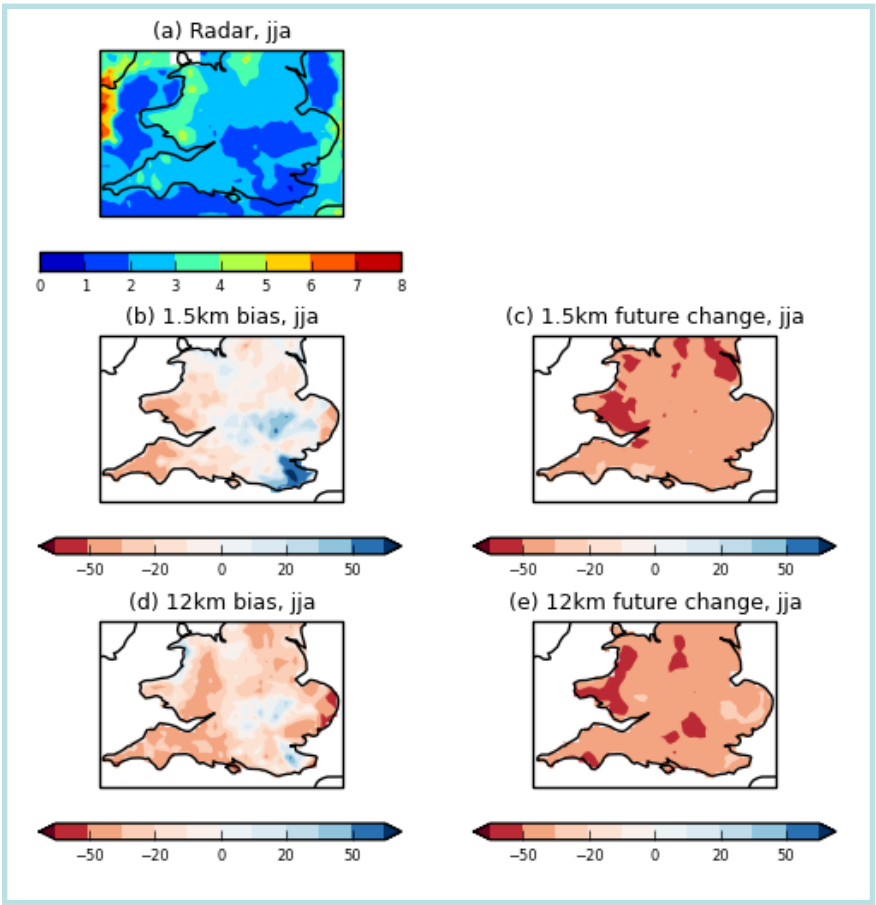
# CONVEX: Future change in seasonal mean rainfall

Met Office Hadley Centre

## Winter

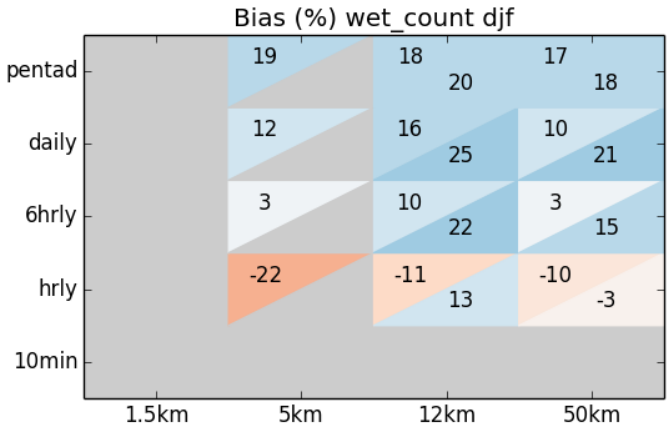
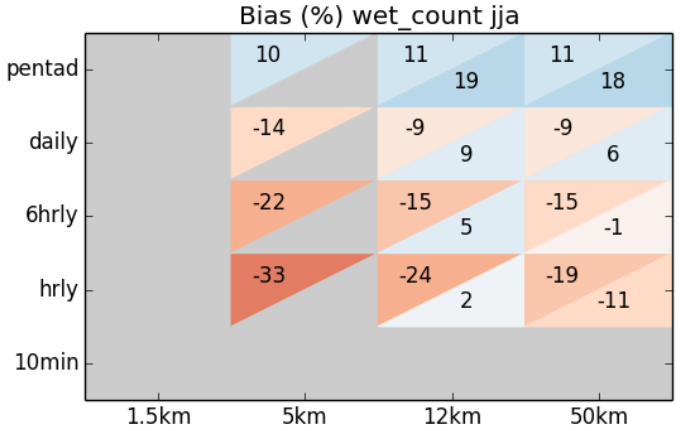
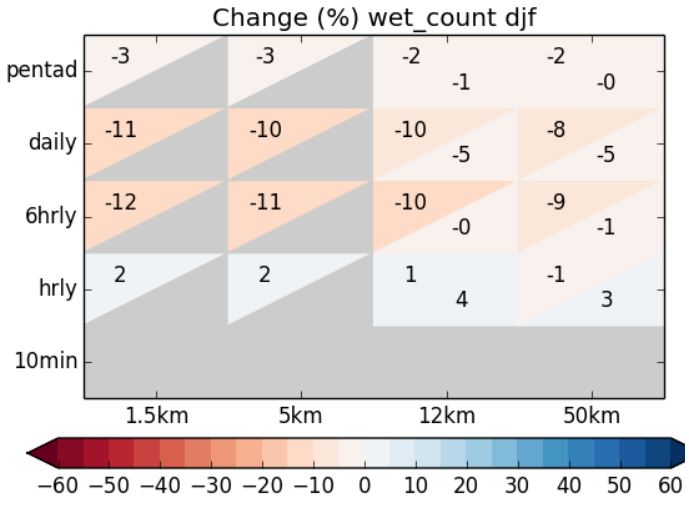
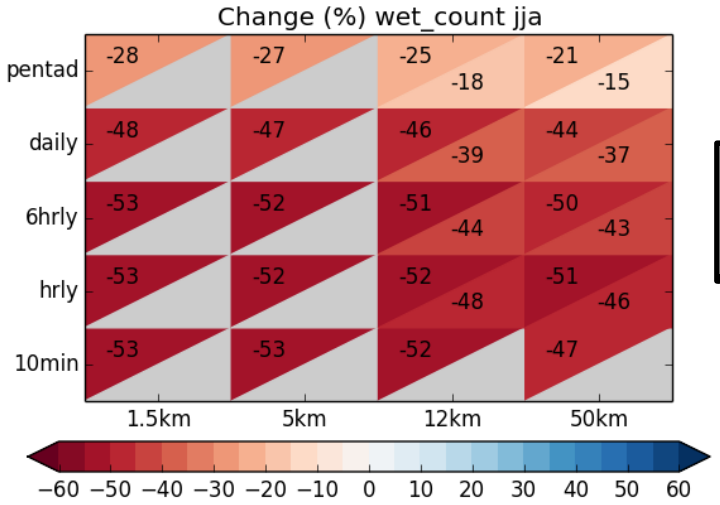



## Summer



# CONVEX: Changes in rainfall occurrence

Met Office Hadley Centre

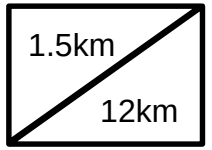
| | Winter | Summer |
|---|---|---|
| Bias |  |  |
| Change |  |  |











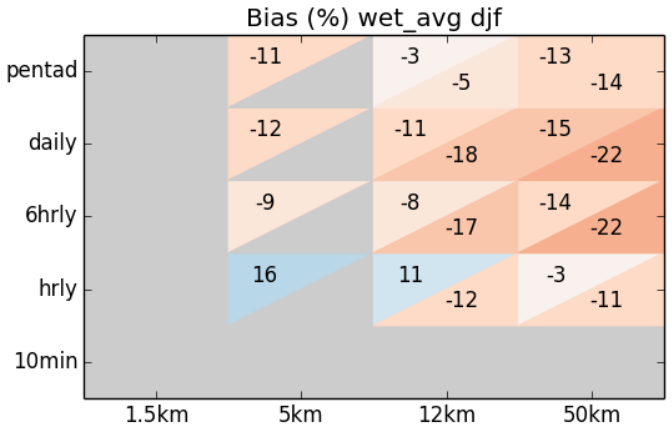
# CONVEX: Changes in rainfall intensity

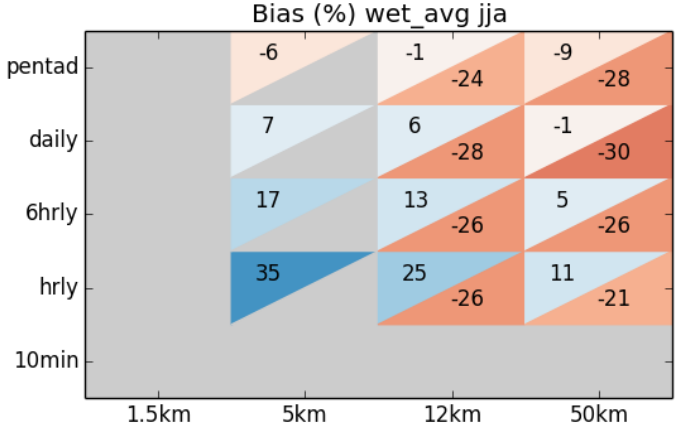
Met Office Hadley Centre

## Winter

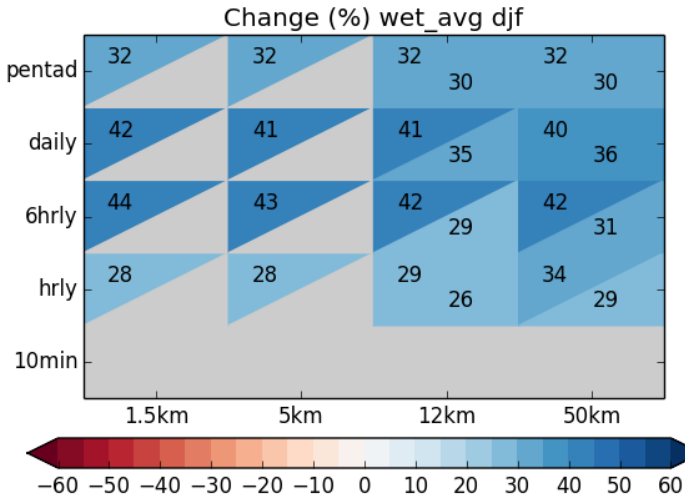
## Summer

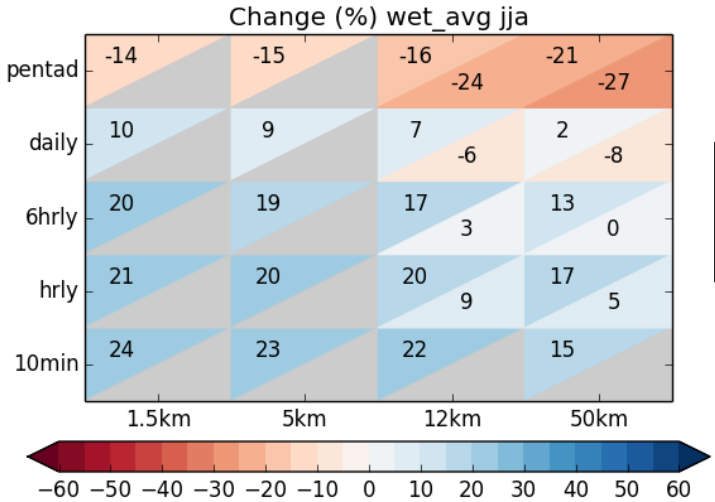
Bias

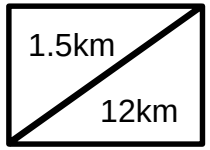


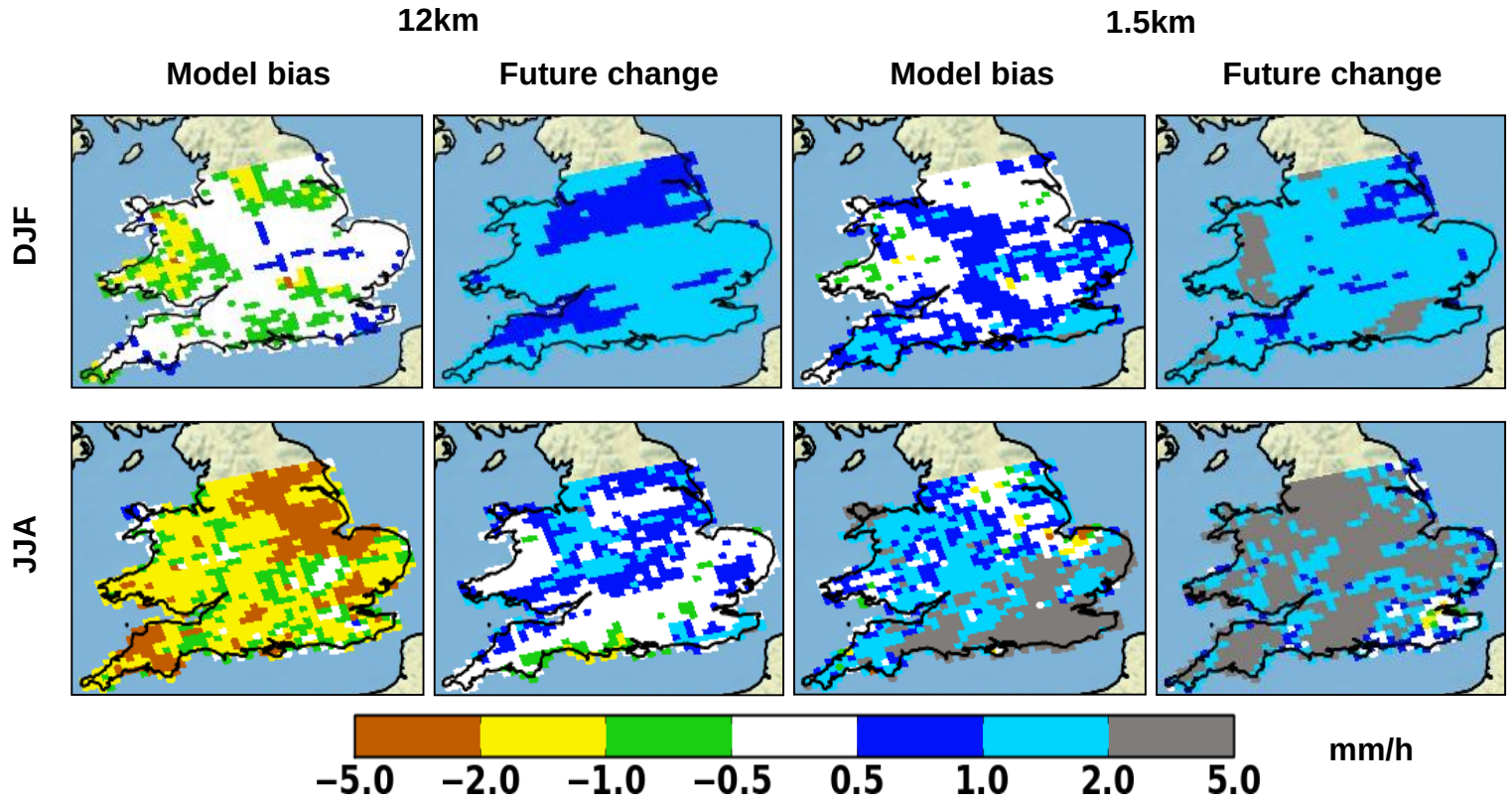

Change



# CONVEX: Changes in heavy rainfall on hourly timescale



# Summary of UK projections

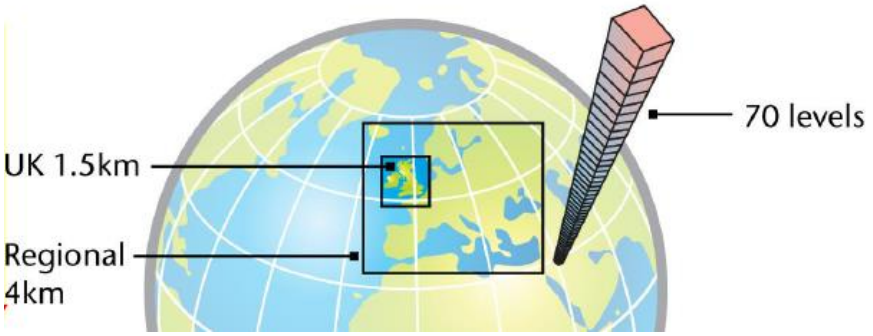
| **Changes which are likely to be robust from coarser to higher resolution models, driven by large-scale changes inherited from global climate model**<br>**=> Confidence in coarse resolution climate model projections** | **Changes for which representation of the local storm dynamics, or high resolution orography, is important**<br><br>**=> Need for very high resolution (km-scale) model for accurate projections** |
|---|---|
| Decrease in summertime mean rainfall | Intensification of hourly rainfall in summer |
| Increase in wintertime mean rainfall | Changes in hourly and daily summertime extremes |
| Increase in heavy rainfall in winter | Increases in multi-hourly rainfall extremes over steep orography in winter |
| Large decrease in rainfall occurrence in summer | Changes in rainfall duration |

| Impact area | UK climate projections currently available | New information from high resolution model |
|---|---|---|
| **Flash flooding (important in urban areas and small steep catchments)** | Heavy rainfall is expected to increase in winter.<br><br>Coarse resolution climate models are unable to provide reliable projections of future changes in short duration intense rainfall, important in summer. | First evidence that intense rainfall events, associated with severe flash flooding (30mm/h), could become several times more frequent by 2100.<br><br>Increases in intensity of hourly rainfall extremes are seen in both winter and summer. |
| **Renewable energy (wind energy)** | Future changes in wind are uncertain.<br><br>12-25km resolution models with appropriate gust diagnostics can represent cyclonic storms and their associated winds, but not the most severe convective wind gusts. | Kilometre-scale models are needed to represent severe wind gusts, associated with convective squall lines. |
| **Transport (flooding, visibility, strong winds and snow)** | Heavy rainfall is expected to increase in winter, with an associated increase in large-scale flooding. See above for flash flooding.<br><br>25km models suggest reduced fog in future in many regions and seasons, but with considerable uncertainties.<br><br>Coarse resolution models should be sufficient for projecting changes in cyclonic storms and temperature-driven changes in snow. | See above for flash flooding.<br><br>High resolution models are required to adequately represent local fog and severe wind gusts, which may be very disruptive to transport.<br><br>High resolutions may be required for accurate snow projections over mountainous regions. |

| Impact area | UK climate projections currently available | New information from high resolution model |
|---|---|---|
| **Urban heat** | Urban areas are warmer than rural surroundings, and can increase heat stress especially into the evening and night.<br>Coarse resolution models show increases in temperature extremes, but do not adequately describe the urban environment. | The km-scale model can better include cities, and hence allows us to examine future temperature projections in urban areas with greater confidence. |
| **Electrical distribution (lightning)** | 25km models suggest increases in the number of lightning day in future, however there is considerable uncertainty regarding the accuracy of coarse model lightning diagnostics. | A new lightning diagnostic, developed for the Met Office km-scale model, has the potential for more accurate lightning predictions. |

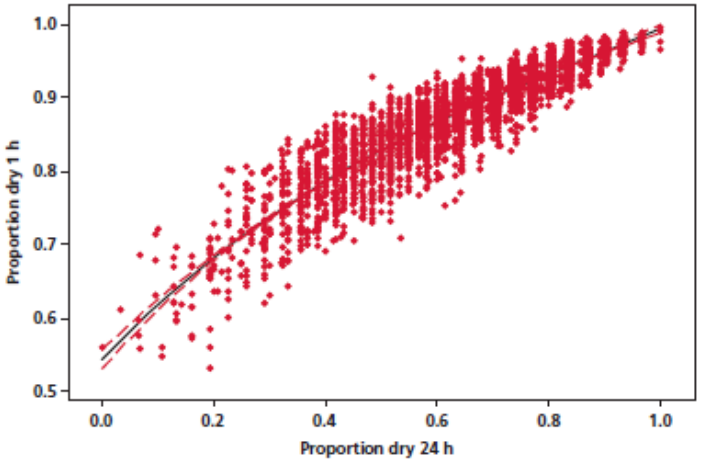
# Downscaling in UKCPnext ?

- Plans to carry out higher resolution regional climate downscaling
- Potential to use km-scale models for the UK (such as those used for operational weather forecasting)
- Could provide opportunity to give new advice on how localised, sub-daily extreme rainfall events may change.




# Incorporating CONVEX results into UKCP09 weather generator

- New hourly observational results -> improve parameterisation of UKCP09 WG for hourly rainfall extremes, currently based on limited data
- Projected changes from km-scale model runs -> reconfigure hourly changes in intense rainfall
- Sit alongside UKCPnext: WG provides numerous stochastic runs used to test system robustness and account for model bias




# Conclusion

- UKCP09 projections form the basis for assessing risk of different outcomes, consistent with climate modelling capability and understanding at the time of release.
- New results from CONVEX allow us to explore possibility of extending UK adaptation advice to aspects beyond UKCP09 modelling capability
- Using CONVEX, we can begin to identify those aspects of coarser resolution model projections (e.g. from UKCP09) which are robust, and those which are notably different at higher resolution:
  - Changes in  seasonal mean rainfall are robust
  - Changes in heavy winter rainfall are robust (expect perhaps for daily extremes over mountains)
  - Changes in the duration and intensity of summertime rain differ at high resolution -> accurate representation of the local storm dynamics is essential
- Results are for single model integration and so we are not able to provide probabilistic projections at kilometre-scales
  - Plans to include downscaling to km-scales in UKCPnext