

# Topography effects on projected rainfall change in mid-latitude mountain regions.

Michael Grose, Jozef Syktus, Marcus Thatcher,  
**Jason Evans**, Fei Ji, Tony Rafter, Tom Remenyi

# Regional climate models

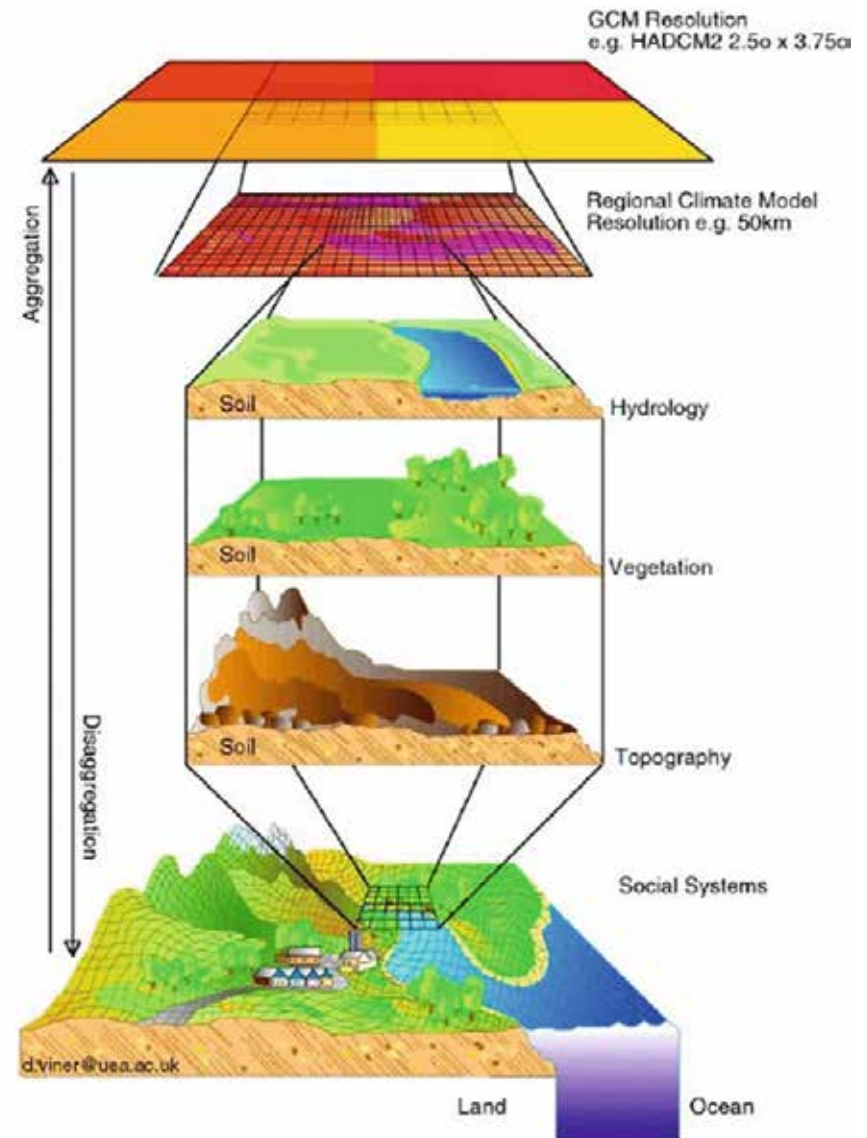
Where and when do regional climate models (RCMs) add value to the climate change signal of average rainfall change?

What does downscaling do?

Resolves topography, coastlines and simulates convection to a finer scale – what could this mean?

Let's look at mountains

Bringing together various RCM ensembles – also brings together the community (authors from Qld, NSW, Tas, Vic projects)



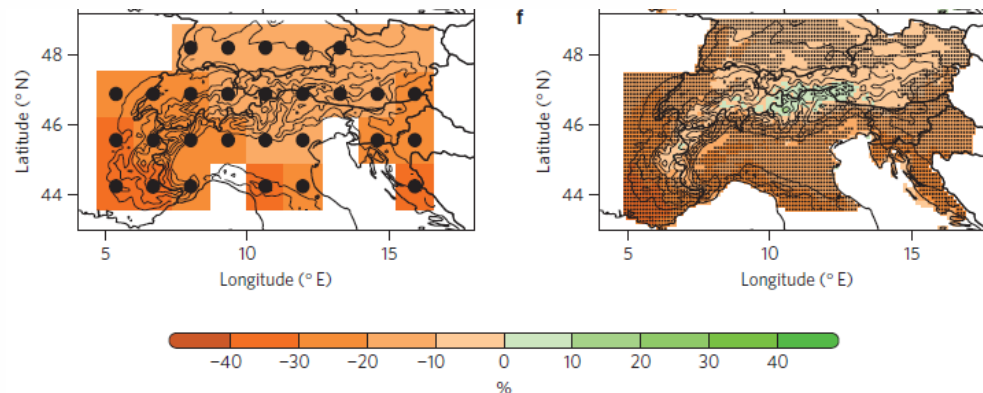
Grose, M. R., J. Syktus, M. Thatcher, J. P. Evans, F. Ji, T. Rafter, and T. Remenyi, 2019: The role of topography on projected rainfall change in mid-latitude mountain regions. *Climate Dynamics*, <https://doi.org/10.1007/s00382-019-04736-x>.

# Previous work – setting some hypotheses

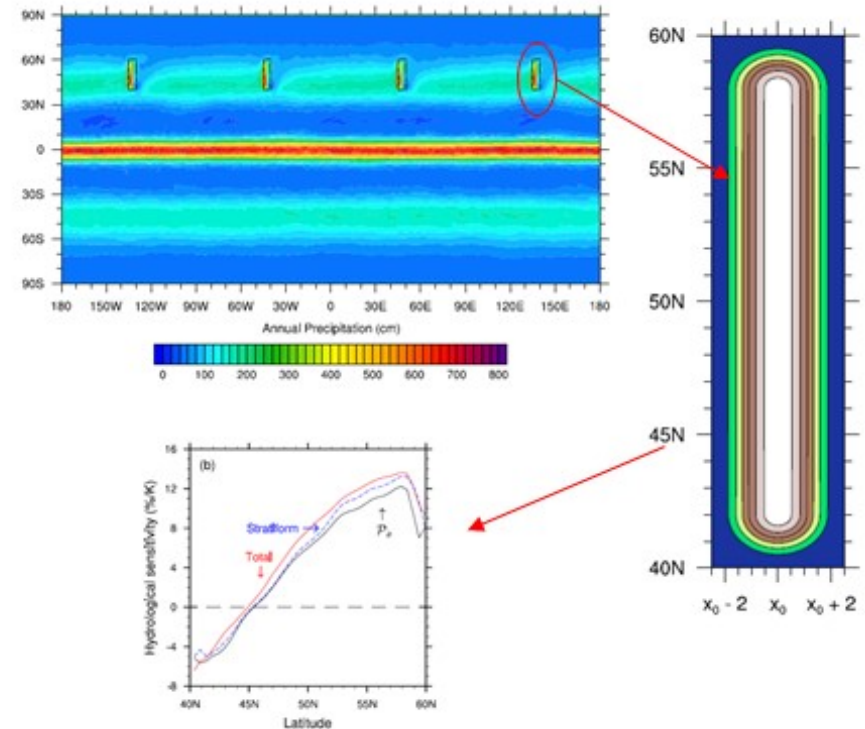
Annual and winter – previous work under Climate Futures for Tasmania suggested enhanced drying in highlands.

Idealised experiments show effect on upslopes

Summer – downscaling revealed role of convective rainfall in creating area of rainfall increase over peaks



Giorgi et al. 2016 NCC

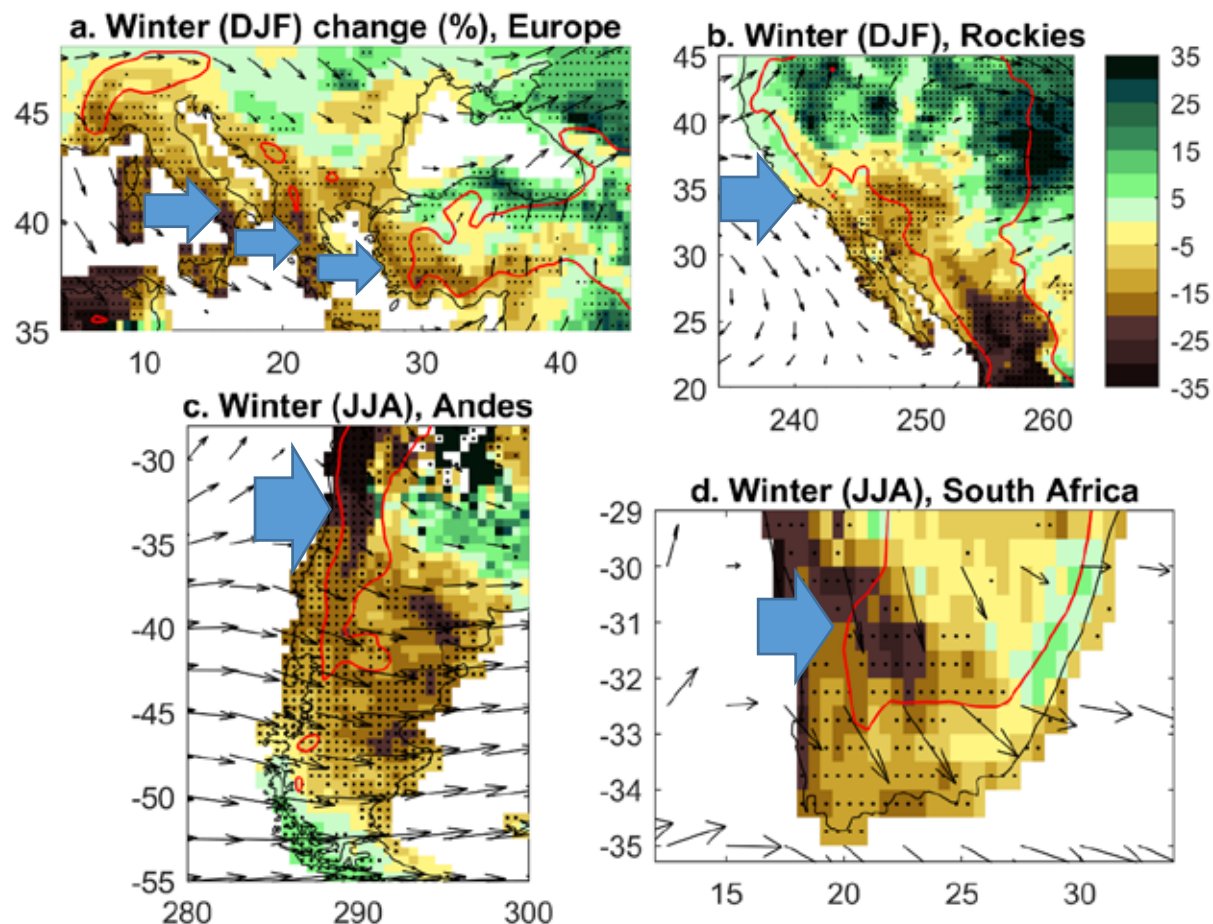


Shi and Durran 2014 JCLim

# Rainfall projections – 50 km CCAM (11 member)

Winter - do we see enhanced drying on upslopes in 35-45 °N/S in simulations of realistic topography of the real world?

Hints of it yes

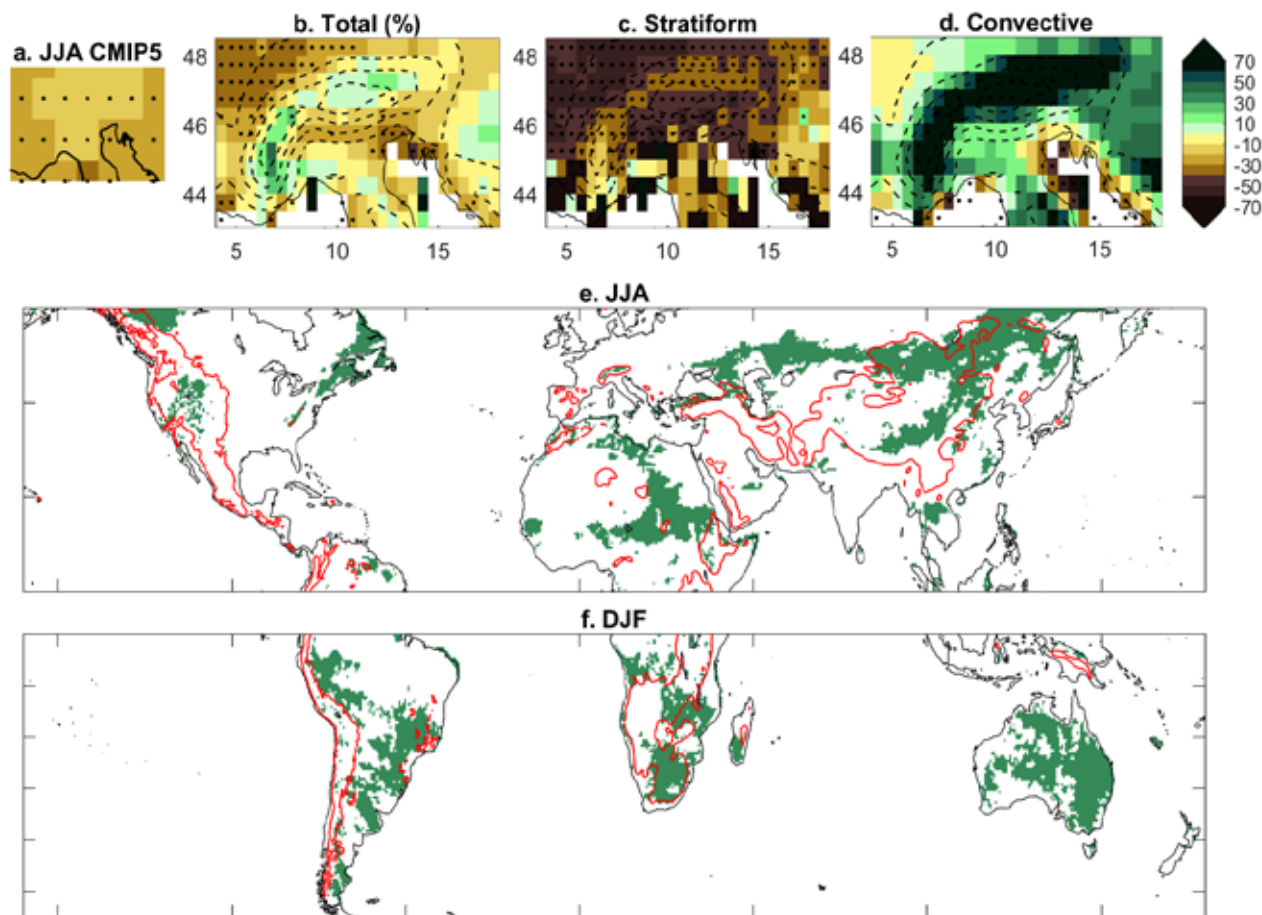




# Rainfall projections – 50 km CCAM (11 member)

Summer - do we reproduce Giorgi in the European Alps, and is the same effect found elsewhere?

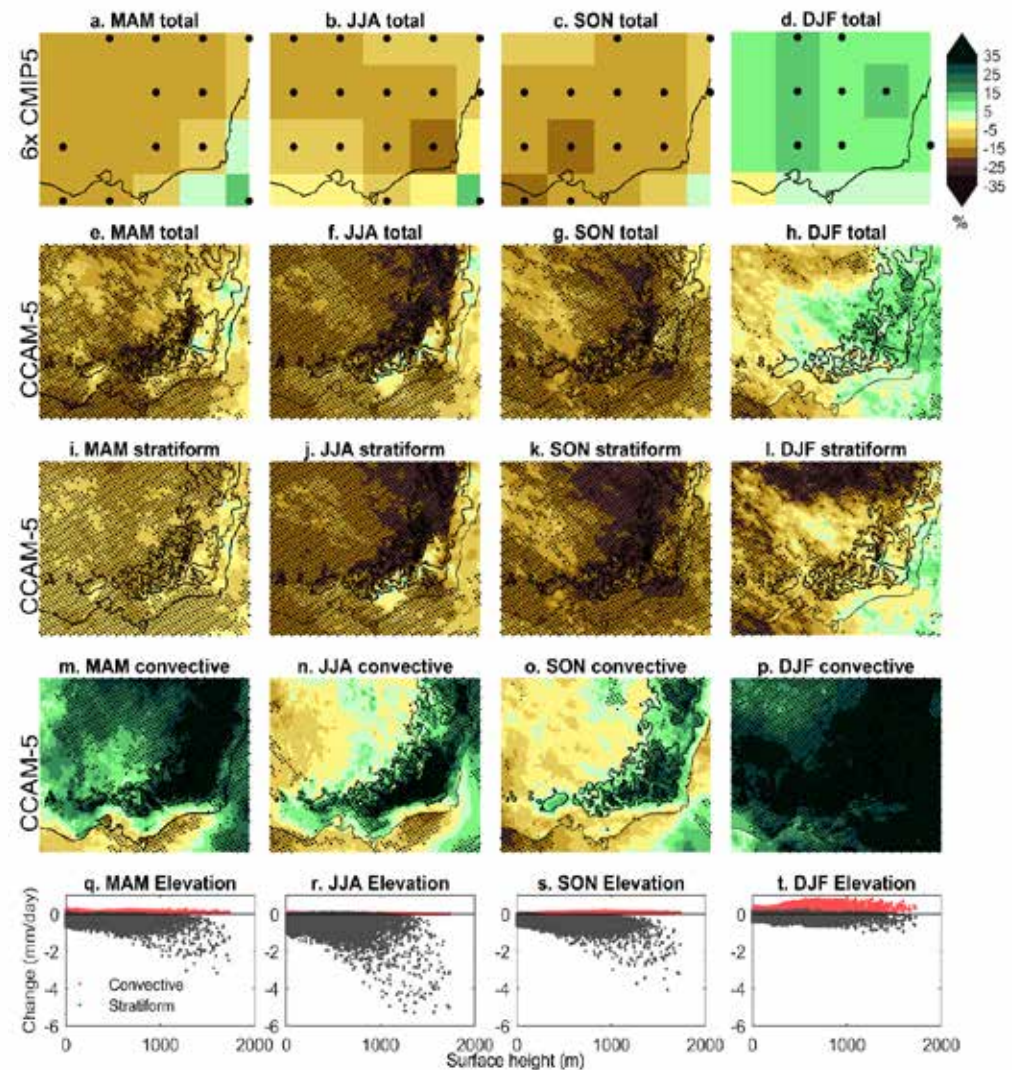
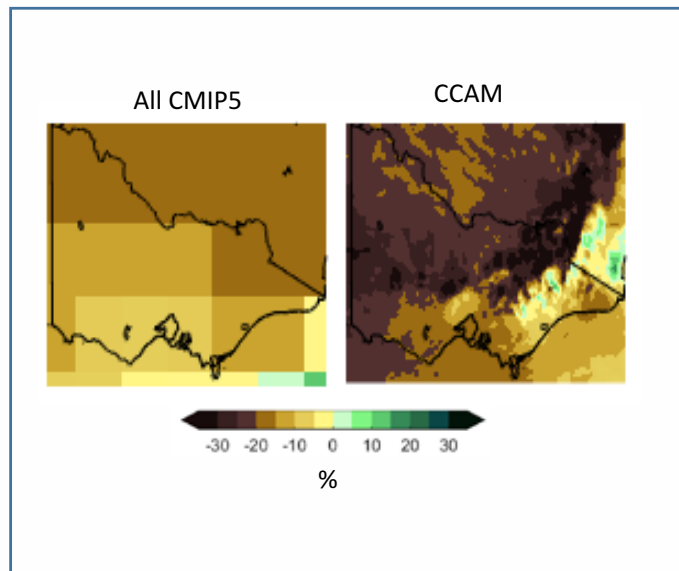
Yes and yes (and not just on mountain peaks!)



Green = areas where change in convective rainfall determines direction of total change

# Australian Alps

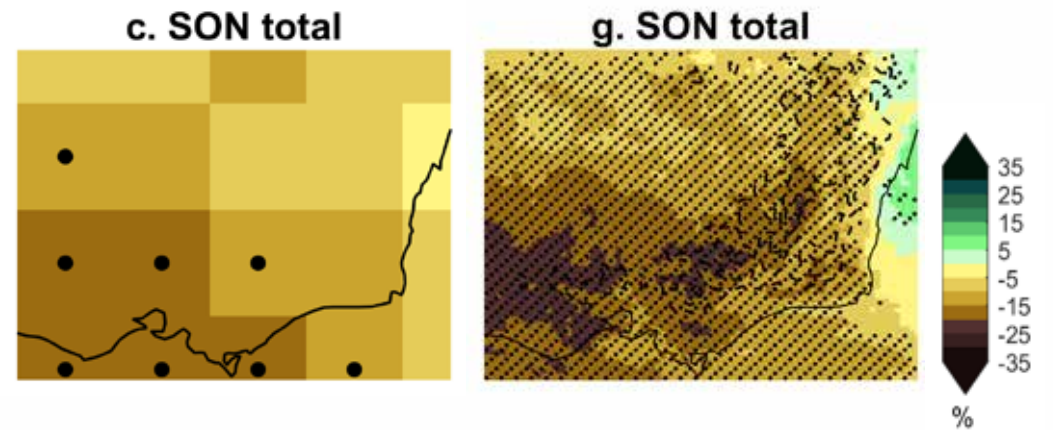
New ~5 km simulations over the Alps shows notable relationships even though mountains are not big



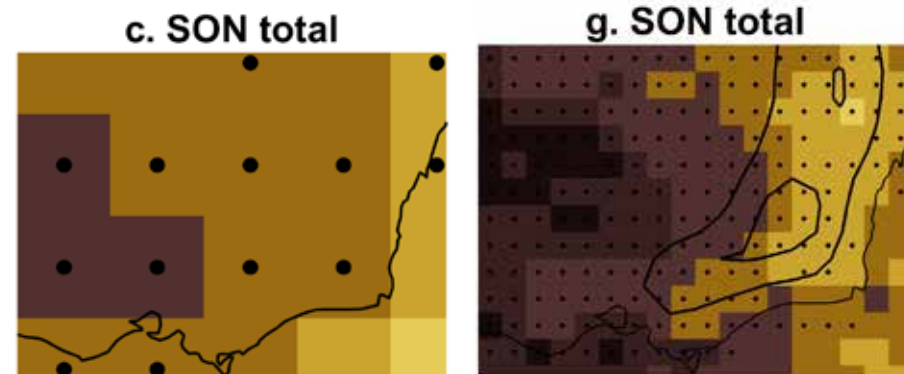
# Australian Alps

Pattern reproduced in other ensembles in some cases:  
NARCLIM in SON  
Qld CCAM in SON

NARCLIM (WRF, CMIP3)

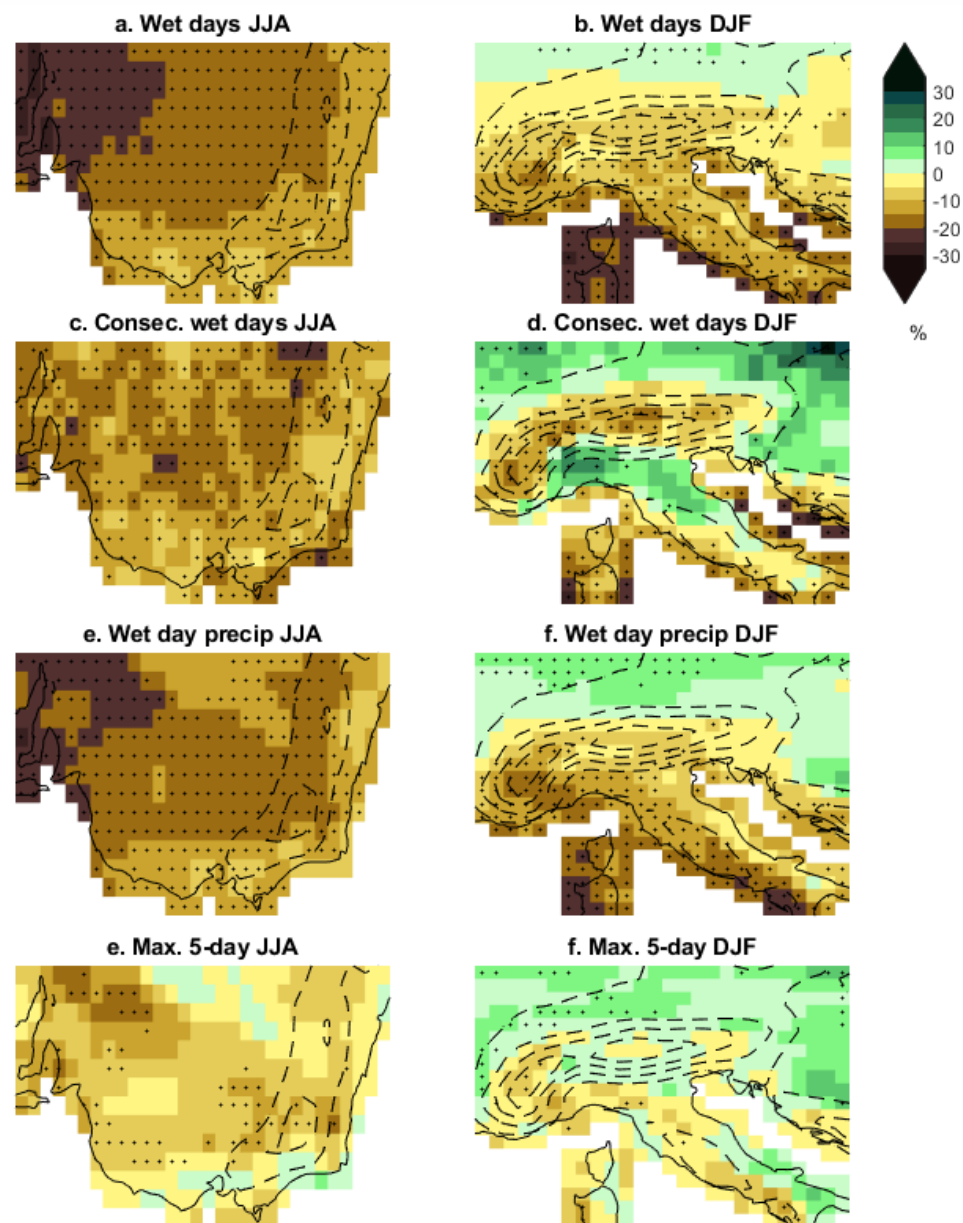


Qld (CCAM, 11 CMIP5)



# ETCCDI

Expressed in wet days, wet day rainfall etc. (also intensity indices)

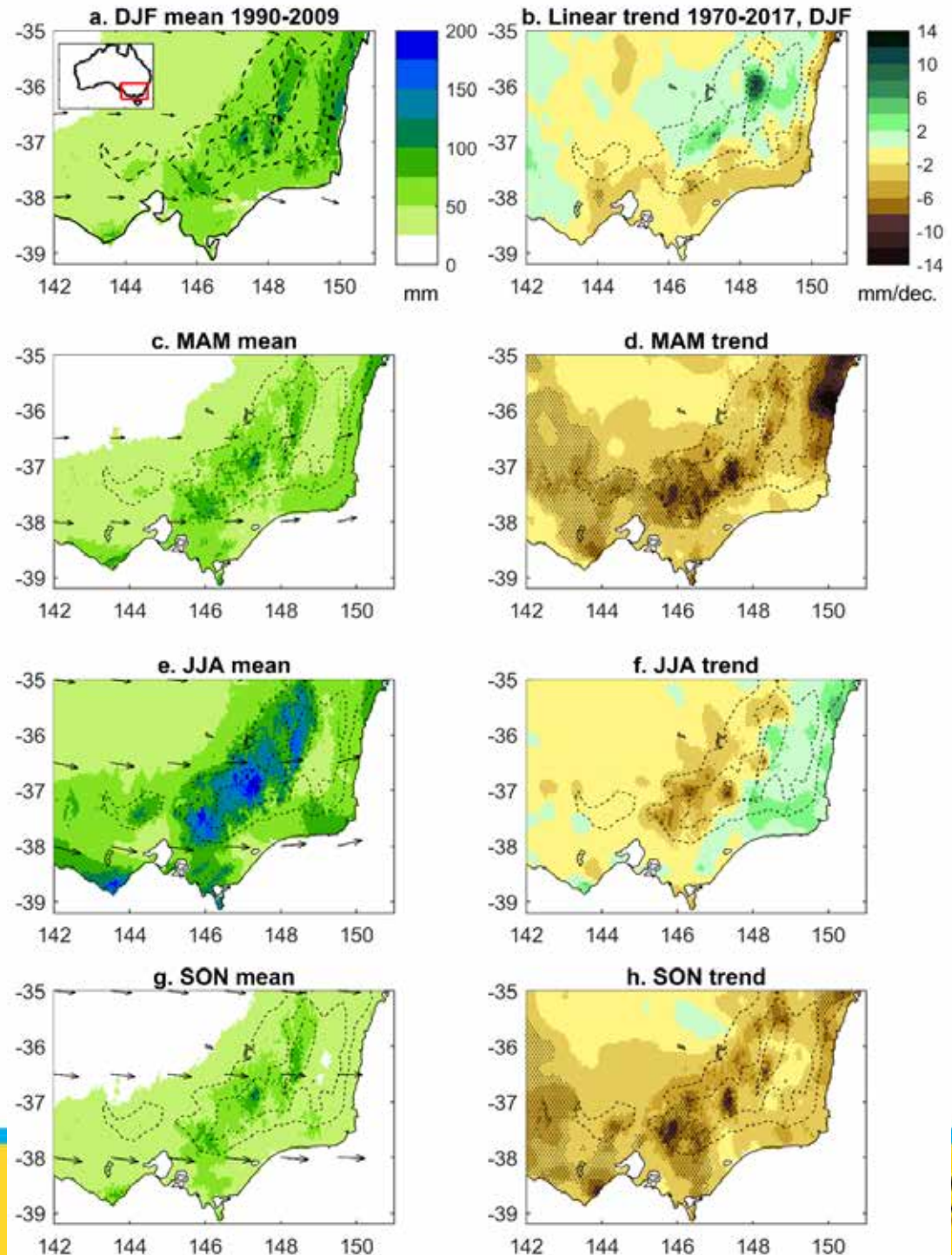




# Past trends

Consistent with observed trends since 1970

AWAP trends – not entirely reliable due to poor station coverage – worth further investigation



# Summary

Winter – enhanced drying on upslopes

- Physical theory - **yes**
- Agreement between models - **some**
- Agreement with past trends - **yes**
- Upshot for the world – **RCMs add value over mountains**
- Upshot for SE Australia – even greater reduction in runoff into Murray-Darling Basin than CMIP5 suggests

Summer

- Physical theory - **yes**
- Agreement between models - **some**
- Agreement with past trends - **apparently**
- Upshot for the world – **worth breaking down changes by type**
- Upshot for Australia – **not different from CMIP5, but adds physical explanation for rainfall change, reason to be cautious with statistical downscaling that doesn't account for convective rainfall**



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Never Stand Still

Science

Climate Change Research Centre

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# Thank You