

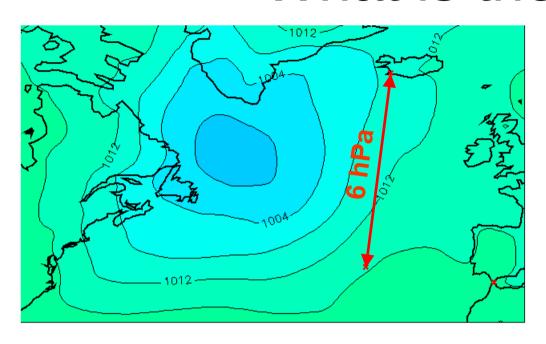


# Scottish Snow Cover and the North Atlantic Oscillation

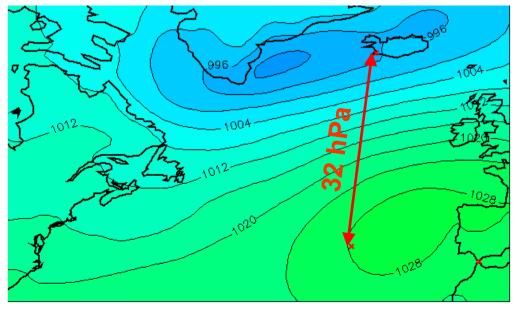
Michael Spencer & Richard Essery



### What is the NAO?



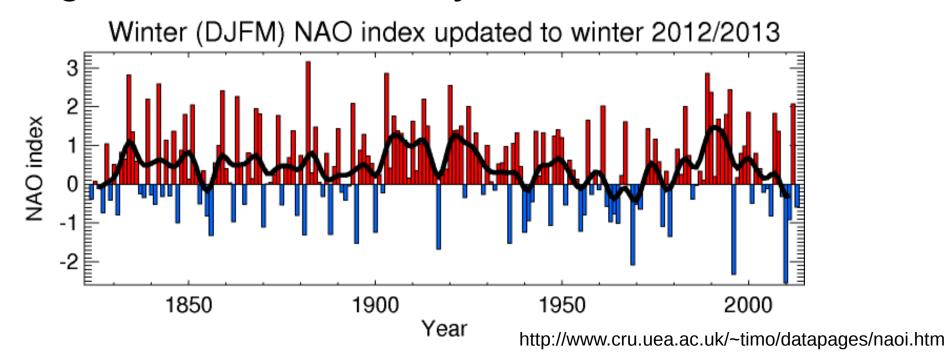
January 2010 mean



January 2012 mean

### What is the NAO?

- Normalised sea level pressure difference
- Stations: Gibraltar (high) and Reykjavik (low)
- Positive NAO = warm wet winters
- Negative NAO = cold dry winters



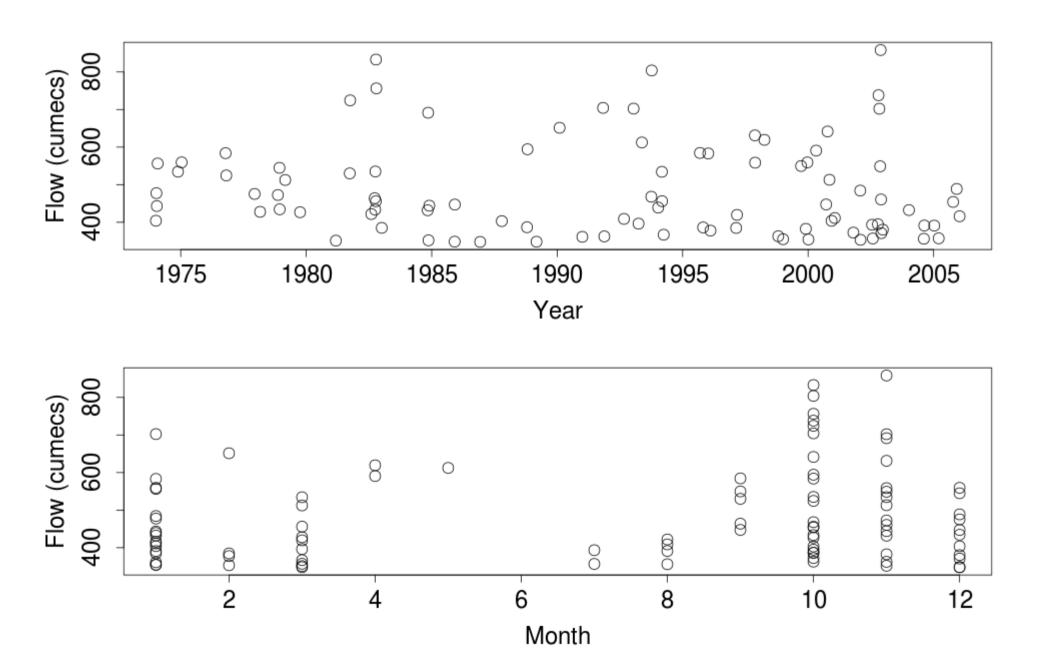
### Scottish snow cover

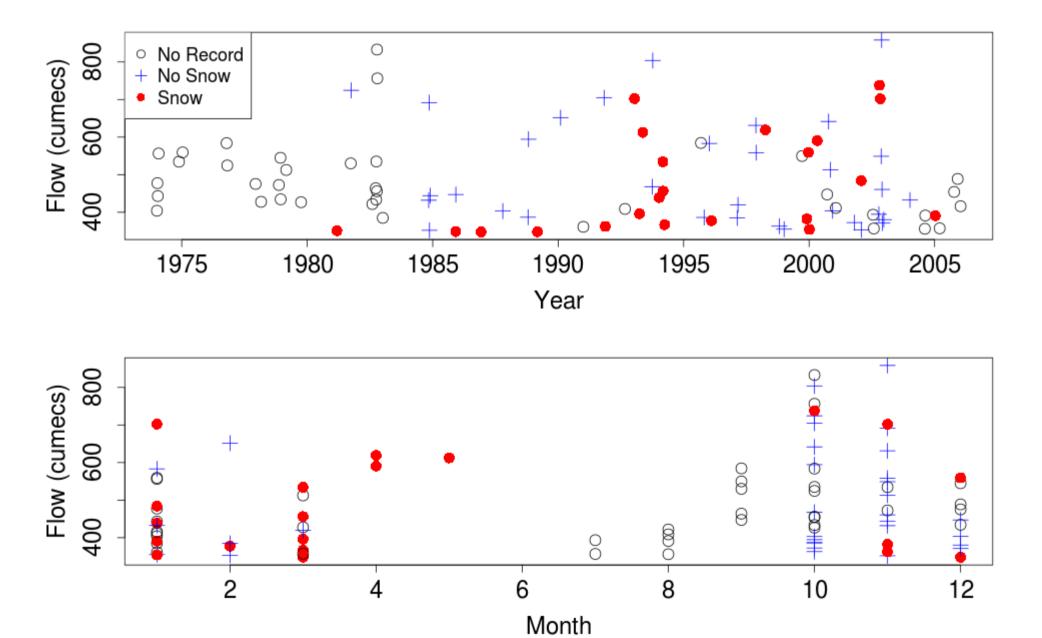
- Ephemeral in space and time
- Snow wet, sky cloudy remote observation hard
- Important for water resources, ecology, land management, snow sports, etc..

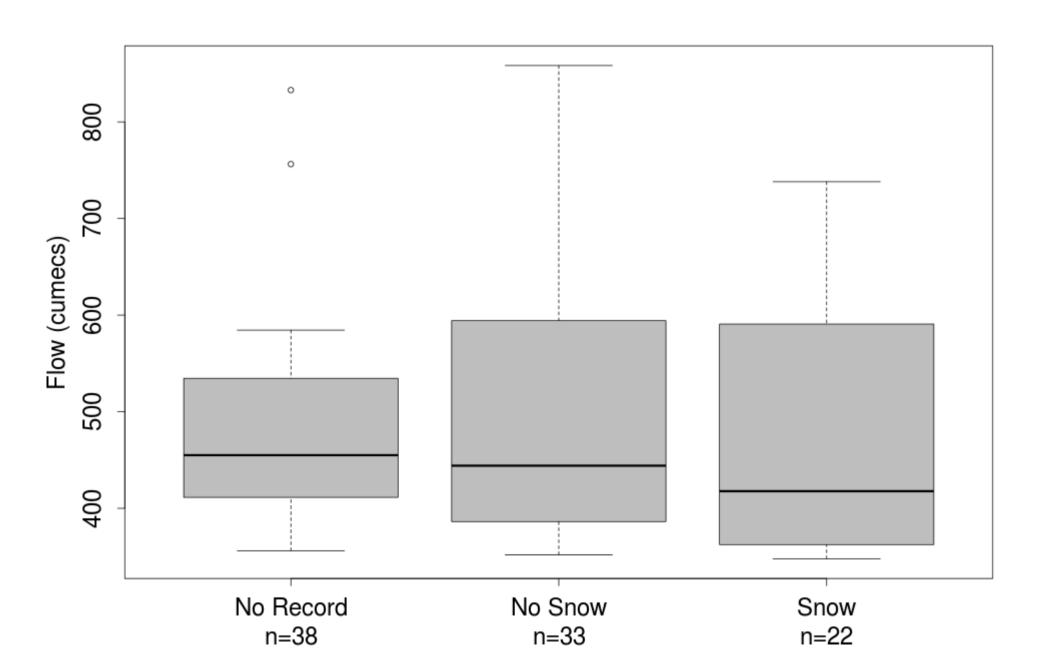


#### © Database Right/Copyright NERC - Centre for Ecology & Hydrology. Contains Ordnance Survey data © Crown copyright and database right 2014. Buckie P Fraserburgh Elgin Forres Aberchirder Keith Charlestown of Aberlour Inverness Huntly Dufftown Ellon Grantown -on-Spey Oldmeldrum Carrbridge / Tomintoul Inverurie CAIRNGORMS Aberdeen The Cairngorm Kinaussie Banchory Stonehaven Laurencekir Inverbervie Montrose Pitlochry Kirriemuir Forfar Blairgowrie Coupar Angus Arbroath Dundee Tay Rd Bridge omrie to St Fillans) Newport-on-Tay Crieff St Andrews Bay St Andrews Auchtermuchty, Fife Ness Anstruther Crail Falkland Clenrothes Dunfermline Kirkcaldy Berwick Forth Rd Br **EDINBURGH** East Lintor Haddington St Abb's Head Eyemouth

- Park gauging station
- Catchment 1844 km<sup>2</sup>
- Max alt. 1309 m
- Upstream of Aberdeen (pop. 220k)







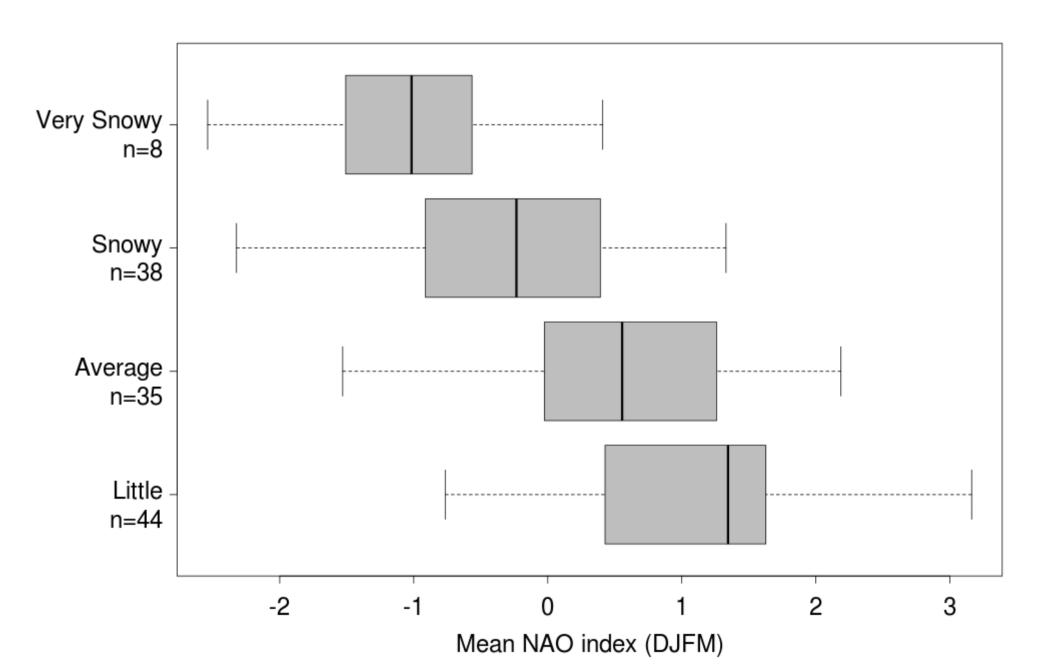
### Scottish snow data

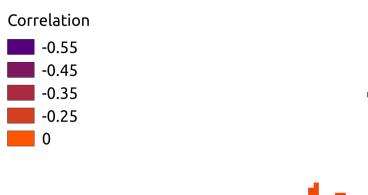
- Bonacina snow catalogue, 1875-2011
- Met Office snow lying at station, 1856-ongoing
- Met Office snow lying grid (UKCP09), 1971-2006
- MODIS satellite snow cover, 2000-ongoing
- Snow Survey of Great Britain (SSGB), 1945-2007

### Scottish snow data

- Bonacina snow catalogue, 1875-2011
- Met Office snow lying at station, 1856-ongoing
- Met Office snow lying grid (UKCP09), 1971-2006
- MODIS satellite snow cover, 2000-ongoing
- Snow Survey of Great Britain (SSGB), 1945-2007

### Bonacina snowiness index

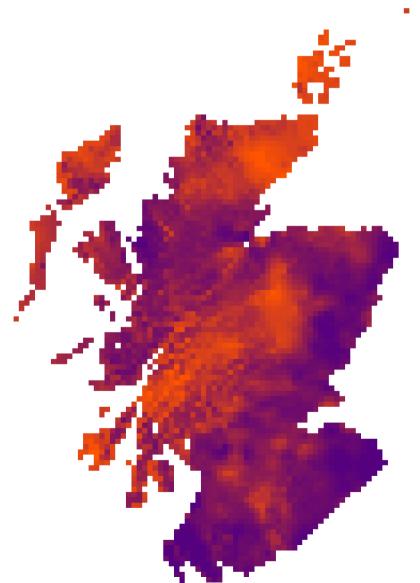




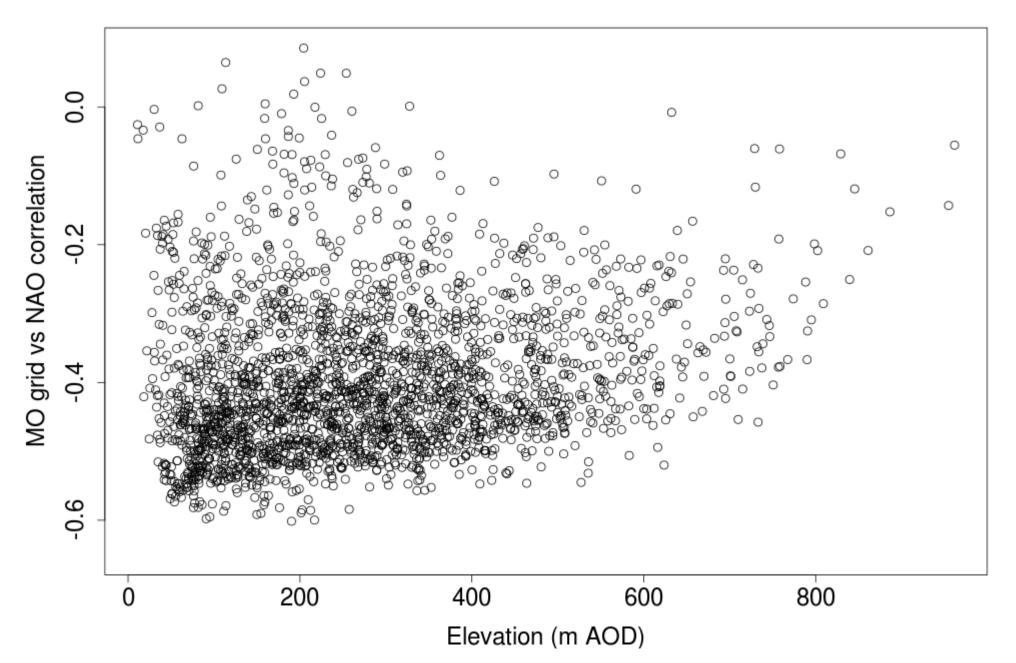
# Spatial correlation



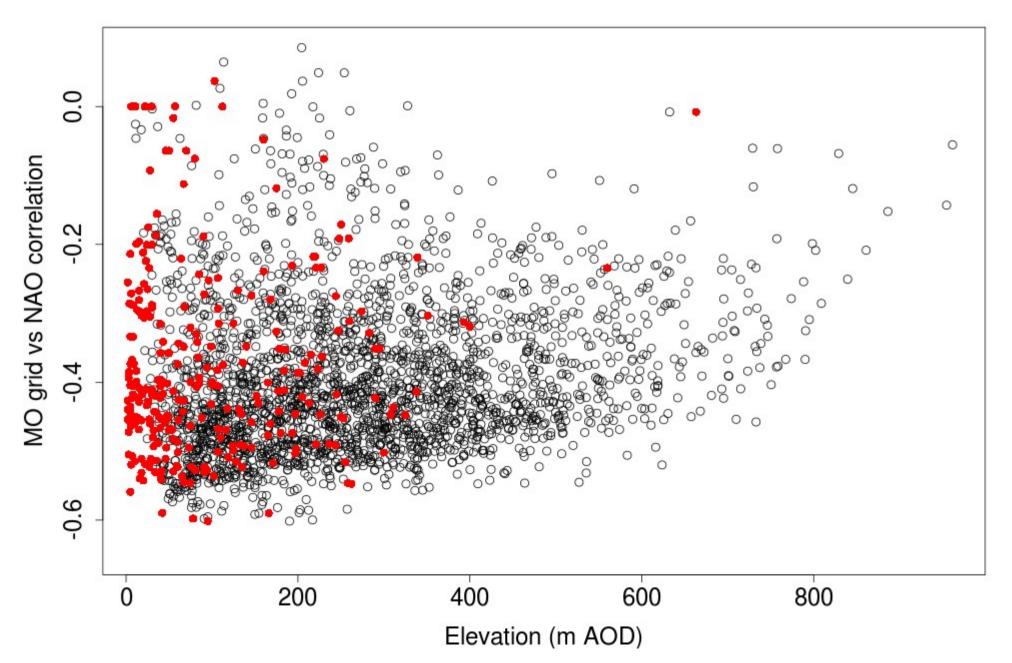
- East is better
- Possibly better further South

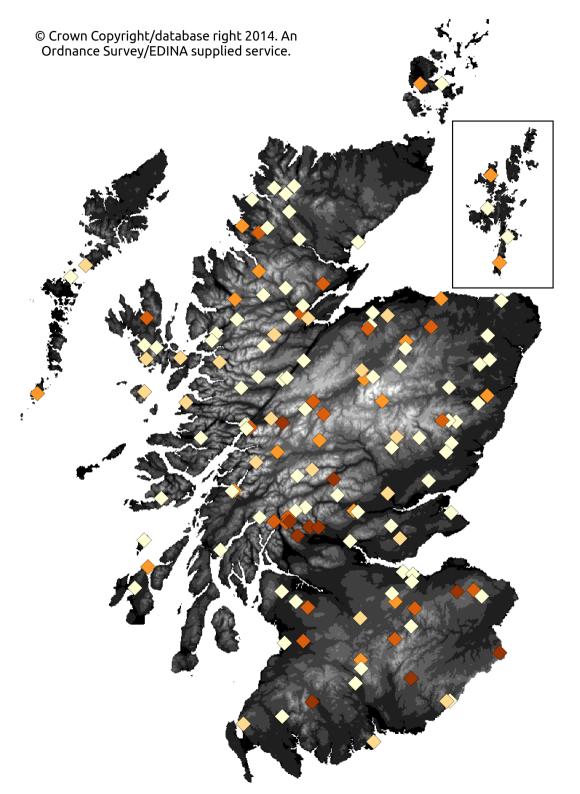


## Explained by elevation?



## Explained by elevation?

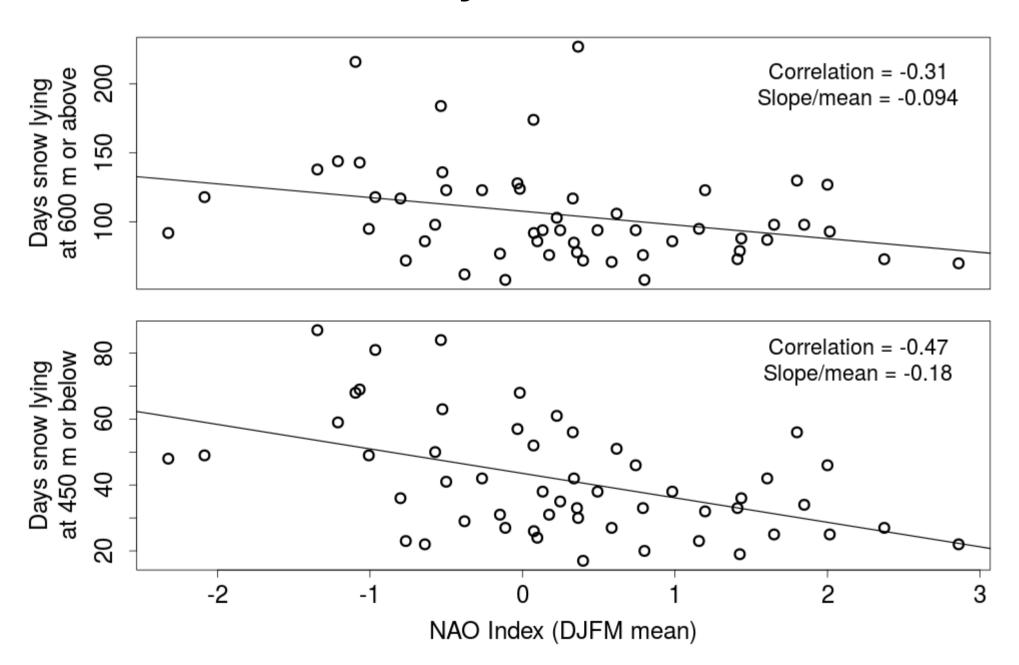




# Snow Survey of Great Britain

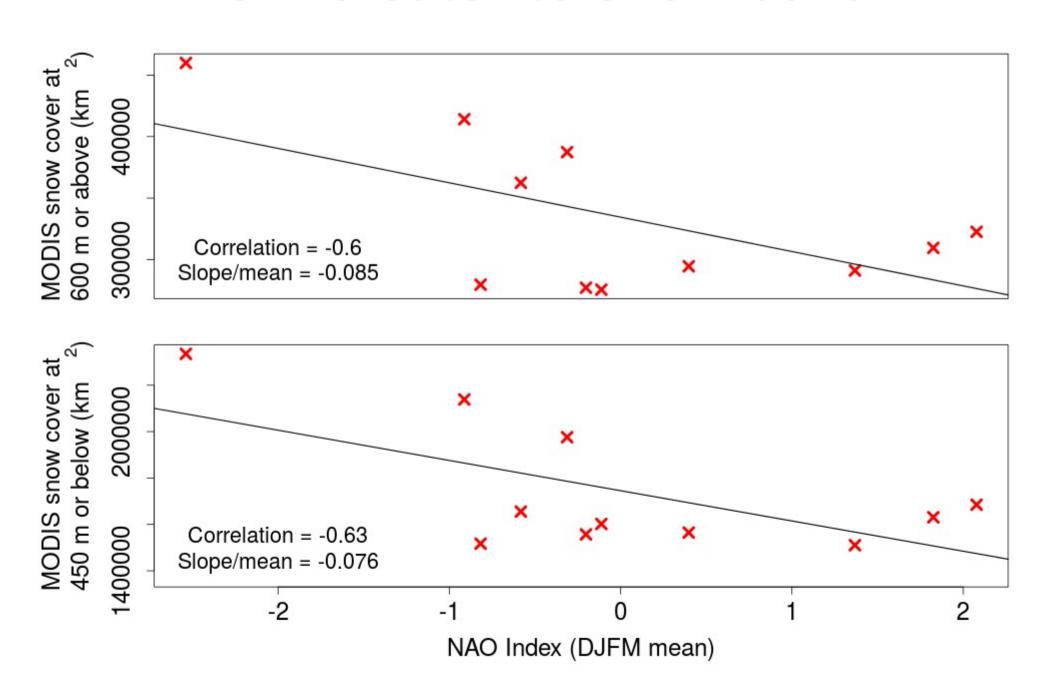
- Volunteer collected
- 1945-2007
- 145 sites
- See poster

### **Snow Survey of Great Britain**

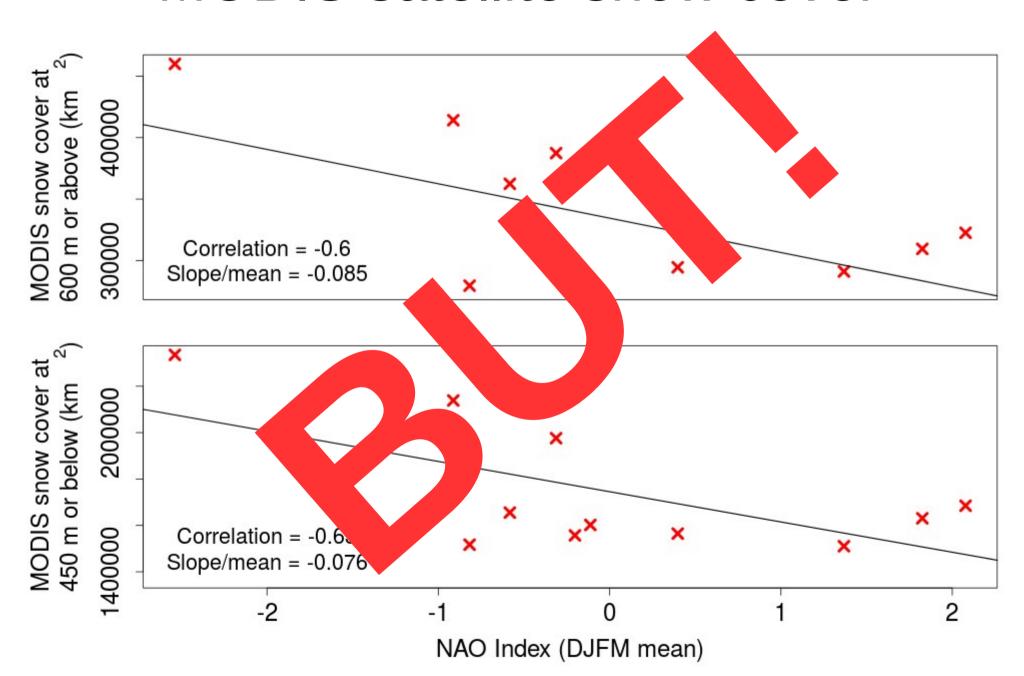




### MODIS satellite snow cover



### MODIS satellite snow cover



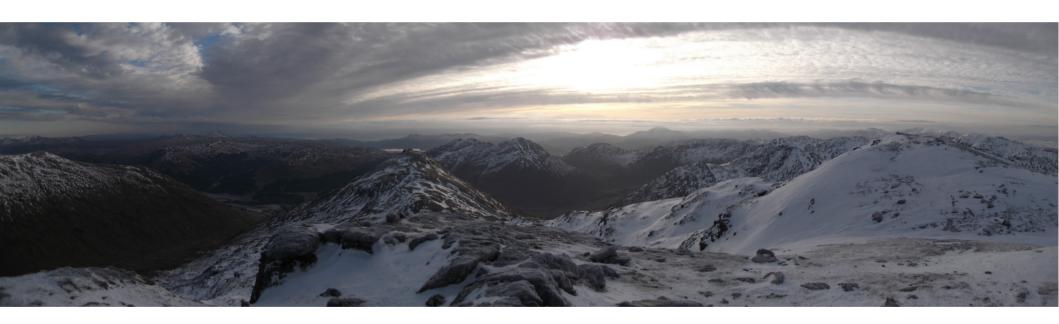
### Conclusions

- Negative NAO = More snow, generally
- Cloud causes observation problems
- NAO probably has larger influence at lower elevations
- 8 18% change in snow cover per NAO 'unit'





#### Many thanks, any questions?



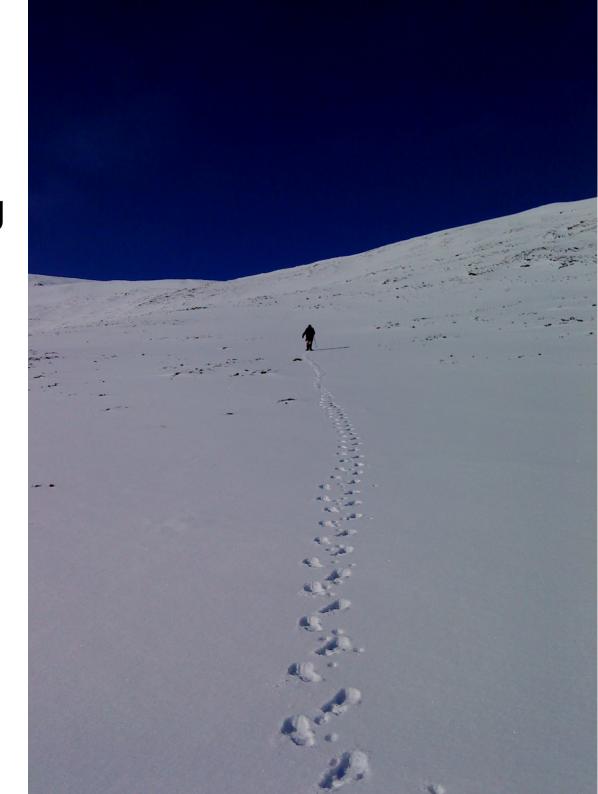
Email: m.spencer@ed.ac.uk

Twitter: @MikeRSpencer

Blog: http://scottishsnow.wordpress.com/

### What next?

- Degree day modelling
- MODIS cloud
- MODIS spatial trends
- Met Office station lying data
- ...
- Write thesis!



### Flow vs NAO

