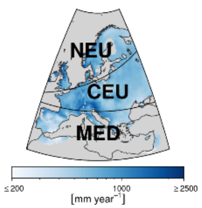
ETH Zürich

Human inuence on meteorological drought risk in Europe

L. Gudmundsson & S. I. Seneviratne



Drought constitutes a significant natural hazard in Europe. Here we investigate whether anthropogenic emissions have altered drought risk in Europe using *an observational and a model driven approach*. We investigate how the probability of years with unusually little precipitation in pre-industrial condition (20 year return period), has changed in Northern Europe (NEU), Central Europe (CEU) and the Mediterranean (MED). Changes are quantified in terms of the Risk Ratio,

$$RR = p_1/p_0$$

which puts the probability of drought occurrence with (p_1) and without (p_0) anthropogenic emissions into context

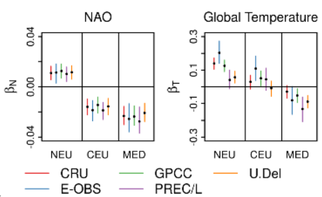
Observational changes in drought risk are estimated assuming that annual precipitation, P, is Gamma distributed with the density

$$f(P) = \frac{1}{\Gamma(k)\theta^k} P^{k-1} e^{-P/\theta}$$

The mean, $\mu = k\theta$, of the distribution is allowed to depend on the North Atlantic Oscillation index, NAO, and on global mean temperature, T_G, such that

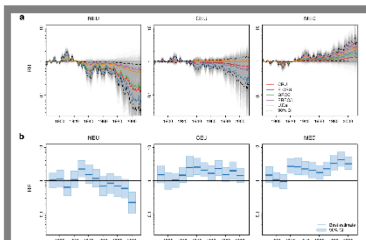
$$\log(\mu) = \beta_0 + \beta_N NAO + \beta_T T_G$$

to account for internal north Atlantic variability and anthropogenic effects on the climate. p_1 is then estimated by taking bot NAO and T_G variability into account. p_0 is estimated by considering NAO variability only.



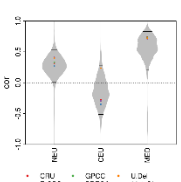
Effect of NAO and T_G on the distribution of annual precipitation; identified from 5 different precipitation estimates.

Model based changes in drought risk are estimated from a multi model ensemble of CMIP5 simulations. p_1 is estimated from historical simulations with anthropogenic and natural forcing. p_0 is estimated from historical simulations with natural forcing only.



Changes in European drought risk. a: Observational estimates of changes in drought risk, conditional on global warming. Coloured lines represent the best estimate for each data product under consideration. Thin grey lines correspond to individual bootstrap replications. Dashed lines indicate the 90% confidence interval. **b:** Climate model based estimates of drought risk. Shown are the best estimate, as well as the 90% bootstrap confidence intervals. Model based estimates are computed for 10 year long time blocks.

The results show that Medeterranean drought risk has increased in response to global warming, whereas drought risk in Northern Europe has decreased. The fact that both estimates are significantly correlated highlights the consistency of the observational and the model based assessment. Therefore ***we conclude that it is very likely that anthropogenic climate change has altered drought risk in the Mediteranean region and Northern Europe.***



Correlation between observational and model based drought risk. The grey area indicate the probability density derived from bootstrap replicates. Horizontal lines mark the 90% confidence interval. Coloured dots show the best estimates for the considered precipitation data.

Drought:
A significant natural hazard in Europe

Observational
and
model based assessment

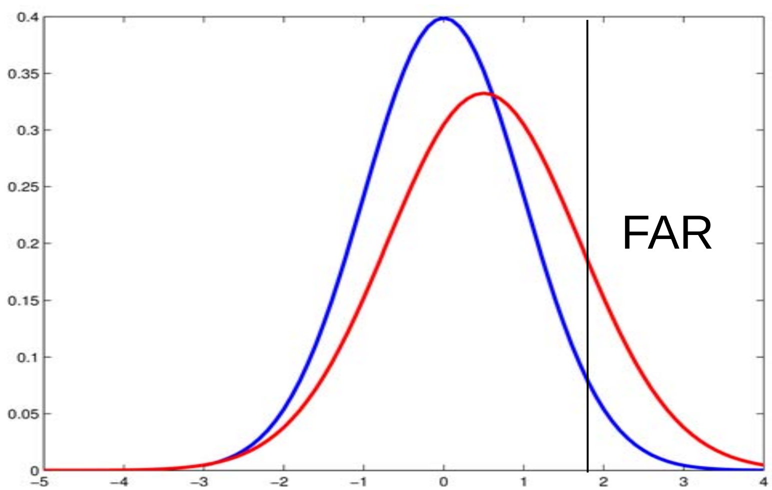
Human influence
on drought risk
is *very likely*

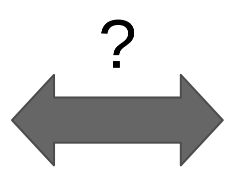
Predictability of the NAO in seasonal hindcasts from 1900-2009

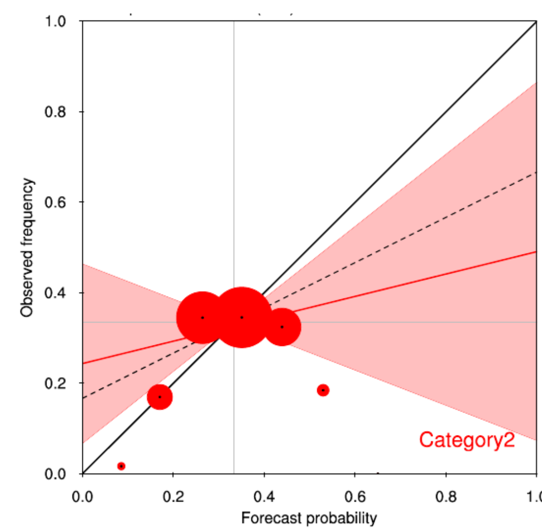
Nathalie Schaller, Antje Weisheimer and Tim Palmer

A) How well do seasonal forecast models predict winter NAO and extreme winter weather in Europe?

B) What does an event attribution statement mean if forecast is unreliable?



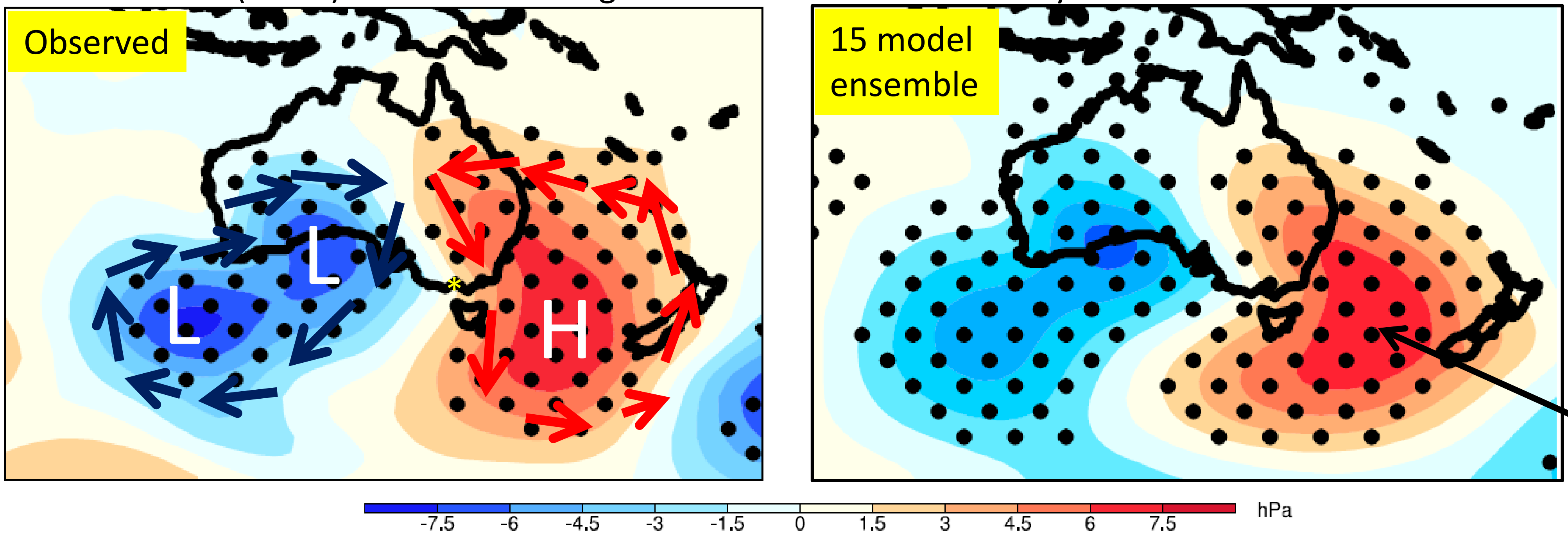




Synoptic and oceanic conditions during heat wave events: A case study for southern Australia

Tim Cowan (University of Edinburgh/CSIRO)

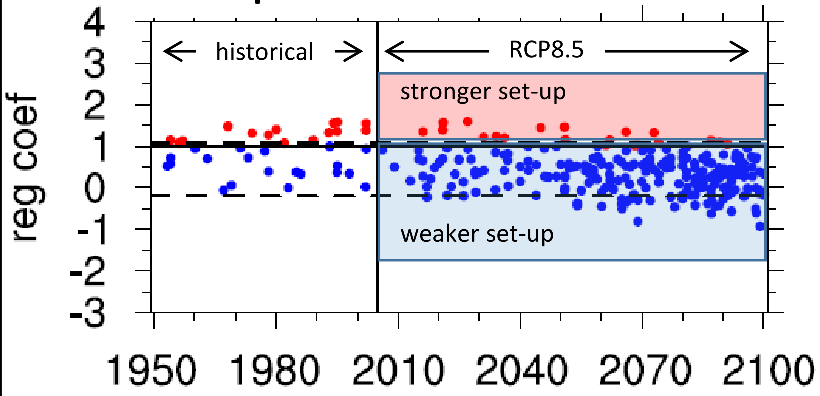
Circulation (MSLP) anomalies averaged over all first heat wave days for southeast Australia



1) CMIP5 models accurately capture atmospheric circulation (pressure couplet) pattern associated with southern Australian heat waves

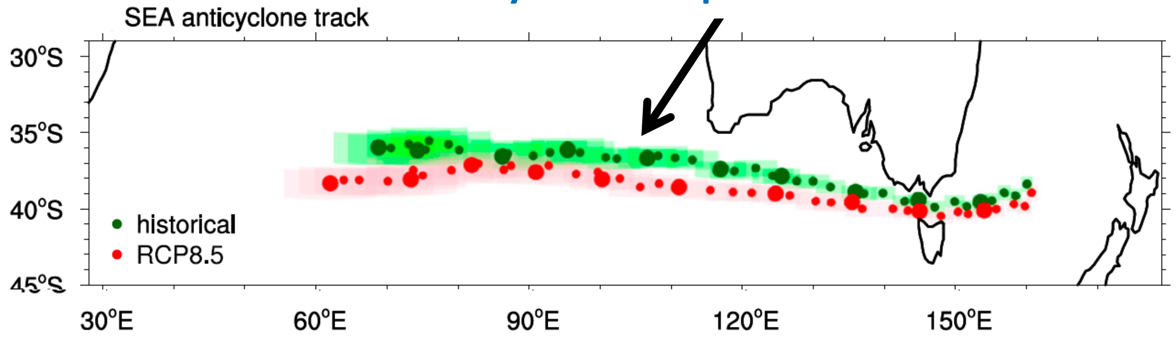
Anticyclone

Example CMIP5 model



2) Non-classical synoptic setup in the future will produce more heat waves given the increased temperatures across inland (e.g. desert) regions of Australia

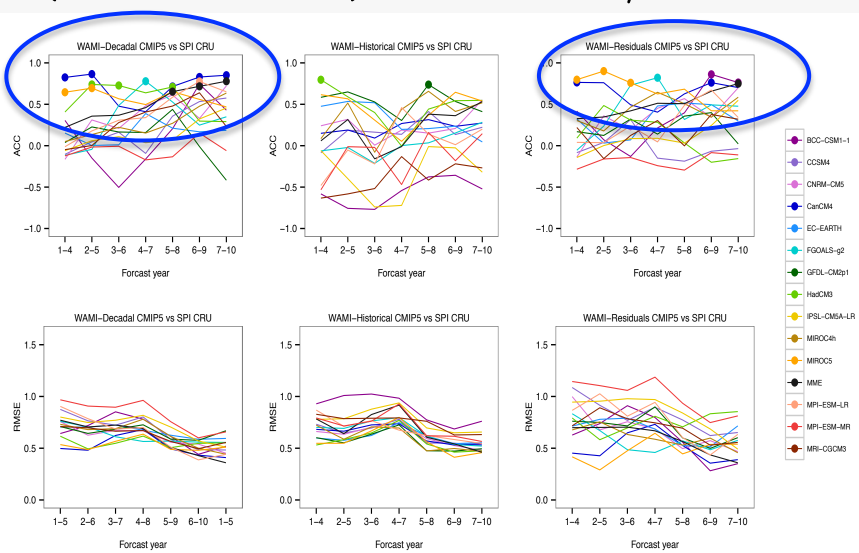
3) Projected poleward shift in the anticyclones responsible for heat waves



Decadal prediction of Sahel rainfall using dynamics-based indices

Objective → Assess the skill of CMIP5 decadal hindcast in predicting Sahelian summer rainfall(JAS) at decadal time scales using dynamics-based indices, and the role of the initialization.

ACC and RMSE metrics between the observed **S**tandardized **P**recipitation **I**ndex (**SPI**: 10N20N-15W15E) and the simulated dynamic index **WAMI**



- Predictive skill model dependent
- Contribution of initialization: better ACC scores for initialized experiments (decadal hindcasts)

Noelia Otero, Elsa Mohino and Marco Gaetani

Standardized drought indices: A novel uni- and multivariate approach

Existing Indices

PDSI
EP
NRI
CDI
SMDI
CMI
SWSI
deciles
SPI
SRI
SMDI
BMDI
RDI
VCI
SPEI
RAI

Different types

- Meteorological drought
- Agricultural drought
- Hydrologic drought
- Ground water drought, ...

Multivariate

- Precipitation
- Soil moisture
- Evapotranspiration
- Stream flow, …

dependent

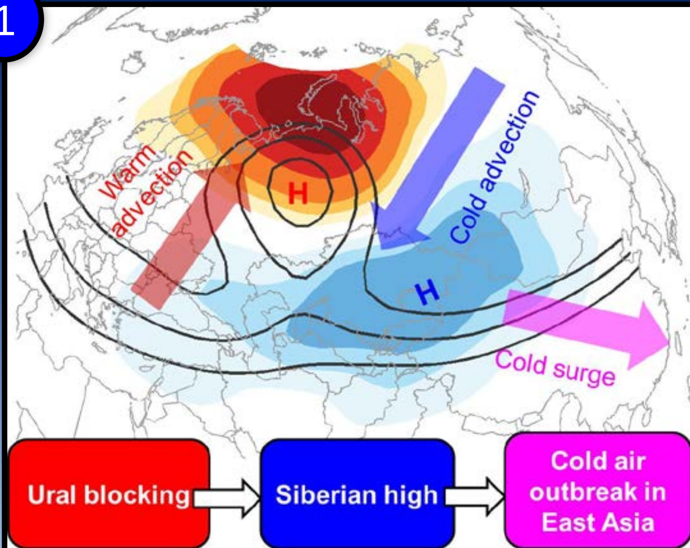
Flexible, general, multivariate, statistically sound approach

Observed and Simulated Linkage between Ural Blocking and East Asian Winter Climate

Hoffman H. N. CHEUNG (hoffmancheung@gmail.com)

Current climate

1



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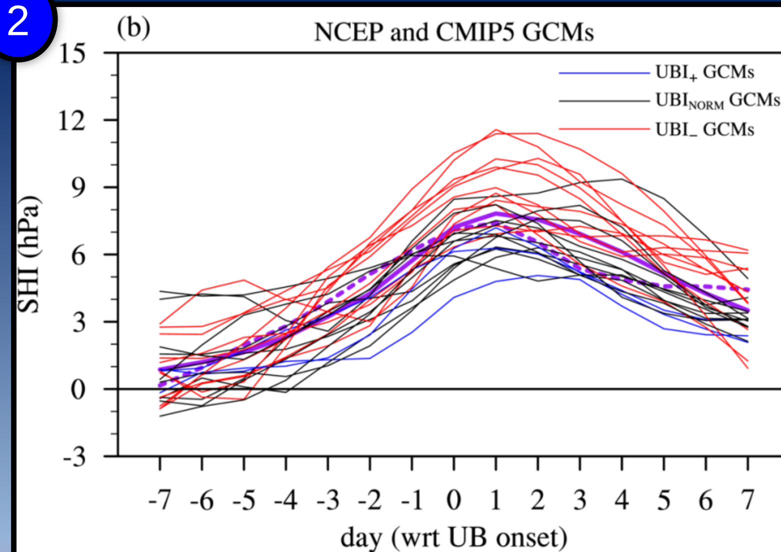
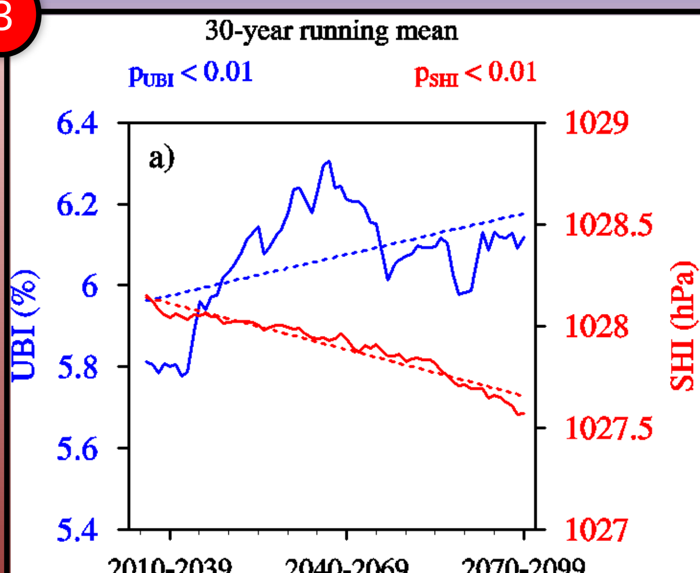


UBI = blocking frequency over 45°–90°E

SHI = MSLP anomaly over 40°–65°N and 80°–120°E

Future climate (RCP8.5)

3



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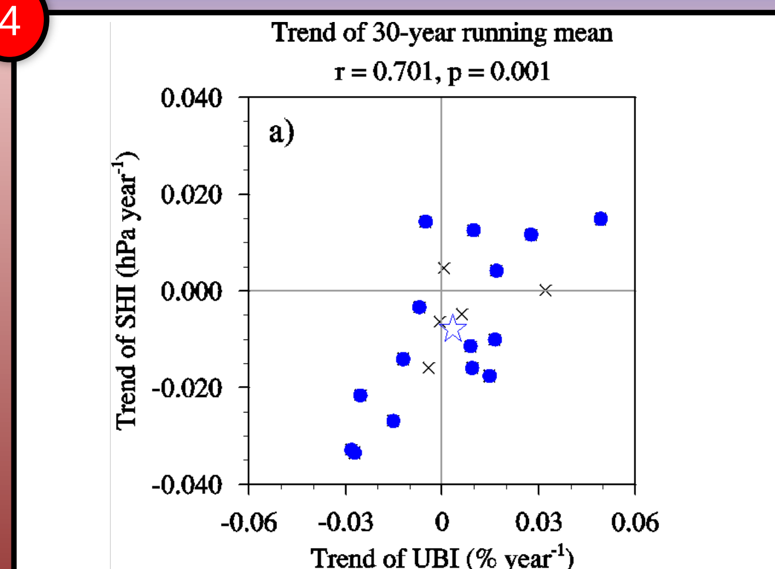

GREENICE

Poster by
Fumiaki Ogawa (University of Bergen)

Impacts of sea ice / SST changes for the observed climate change

Questions to address

• Climatic trend

- Arctic Amplification ? e.g. Screen et al. (2013)
- Weather extremes? e.g. Francis and Vavrus (2012)

• Climate variability

- NAO-like correlation ? e.g. King et al. (2015)

To be shown in the poster

•Ongoing coordinated AGCM experiments - contributed by 7 models

•Prescribing observed sea-ice/SST of the recent 33 years - OI-SST (1982-2014)

•Preliminary results are discussed. - CAM4, EC-EARTH