Linking producers and users of regional climate information – new opportunities offered by CORDEX

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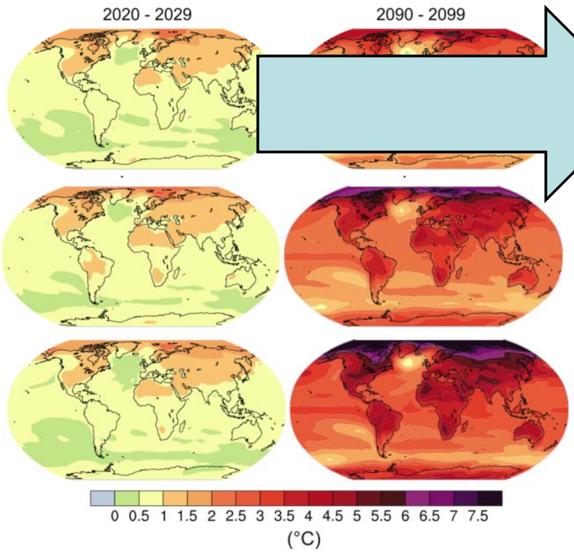
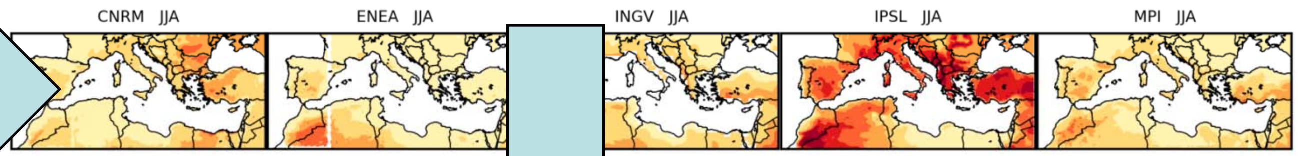
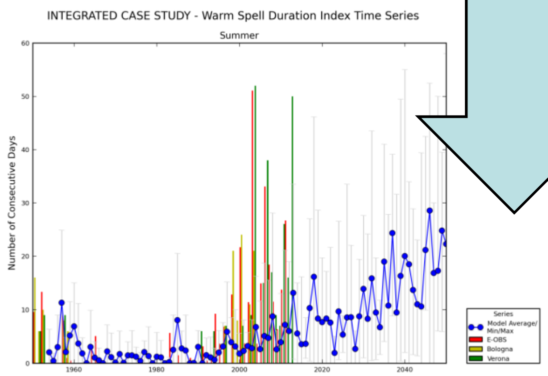
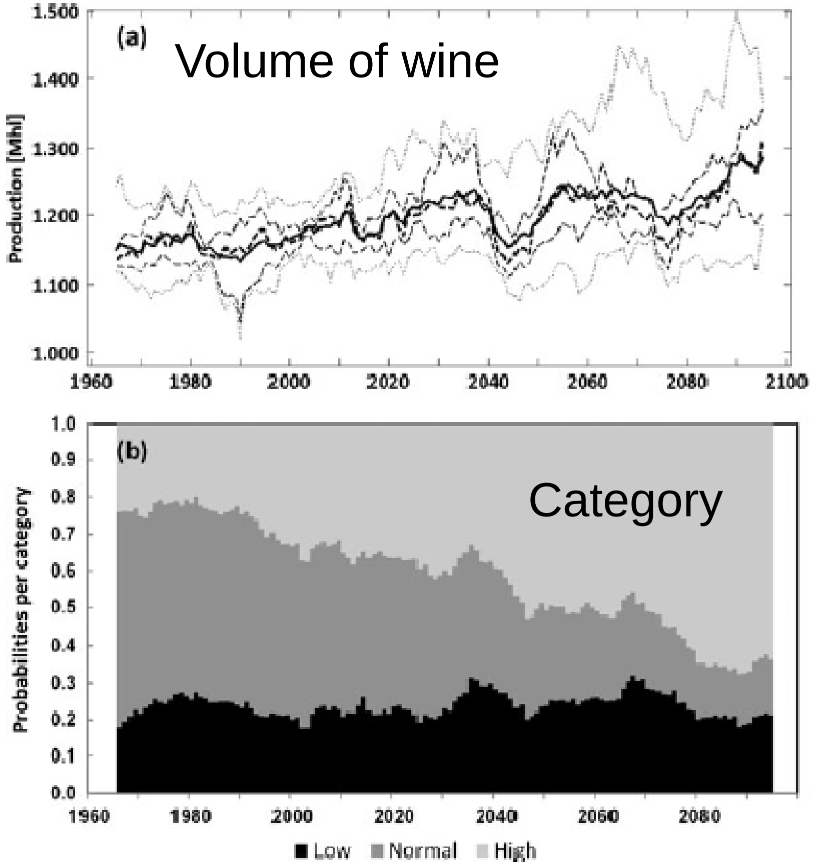






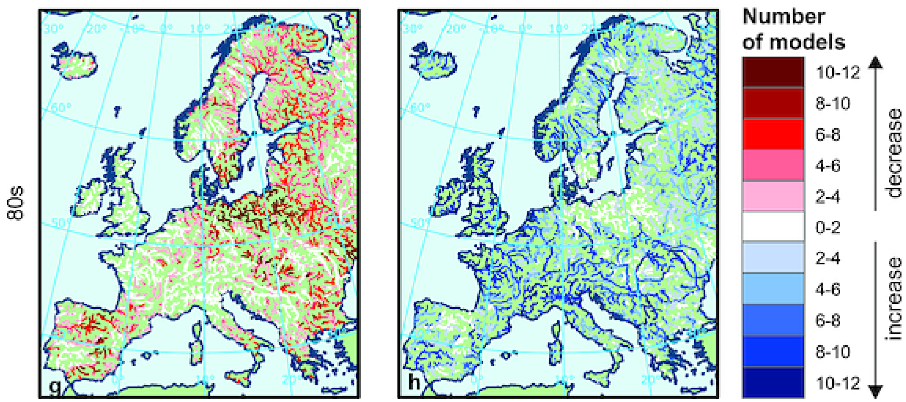
WCRP VAMOS/CORDEX Workshop, 11 September 2013

Using the ENSEMBLES RCM ensemble for impacts modelling



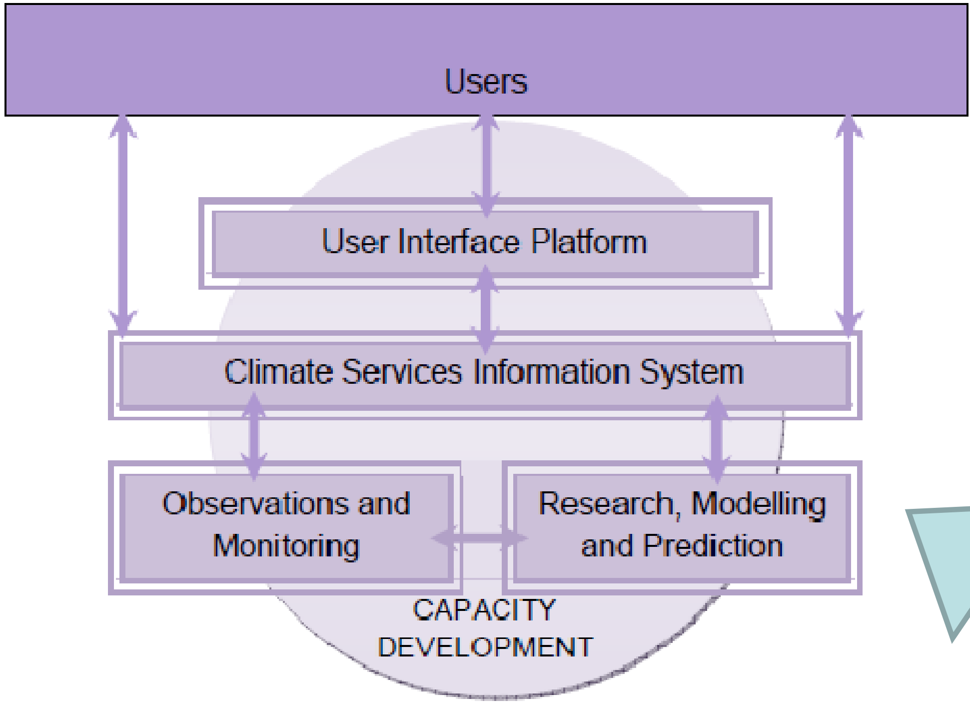
Santos et al., 2013: Ensemble projections for wine production in the Douro Valley of Portugal, *Climatic Change*

Number of RCM runs agreeing in decrease (left) or increase (right) of more than 5% in Q100. 2080s minus 1961-90



Rojas et al., 2012: Assessment of future flood hazard in Europe using a large ensemble of bias-corrected regional climate simulations. *JGR*

Global Framework for Climate Services (GFCS)



So what do users need?

“Actionable science”

The application of regional climate science

WCRP CORDEX

Climate Local Information in the Mediterranean region Responding to User Needs

SEVENTH FRAMEWORK PROGRAMME

CLIM-RUN

The CLIM-RUN case studies:

Tourism: Tunisia, France (Savoie), Cyprus, Croatia

Energy: Spain, Morocco, Cyprus, Croatia

Wild Fires: Greece (Spain)

Integrated Case Study: North Adriatic – Veneto/Venice, Croatia

ENEA(Italy) EEWRC(Cyprus) CNRM(France) ICTP(Italy) IC3(Spain) NOA(Greece)
CMCC(Italy) TEC(France) PlanBleu(France) PIK(Germany) UEA(UK)
GREVACHOT(Tunisia) JRC (Spain) DHMZ (Croatia) USMD(US) UC(Spain)

http://www.climrun.eu

The ‘who’ and the ‘what’

- Who are the climate services stakeholders?
  - – Why is climate variability and change relevant to them?
  - – How do climate issues fit within their decision making mechanisms and their perception of risk?
- What do they need/want from climate services?
  - – Specific data
  - – Analysis tools
  - – Guidance and training
  - – Other things…..

Information has come from:

- **Perception & data needs questionnaire**
- **Stakeholder interviews**
- **Local workshops (15 events)**

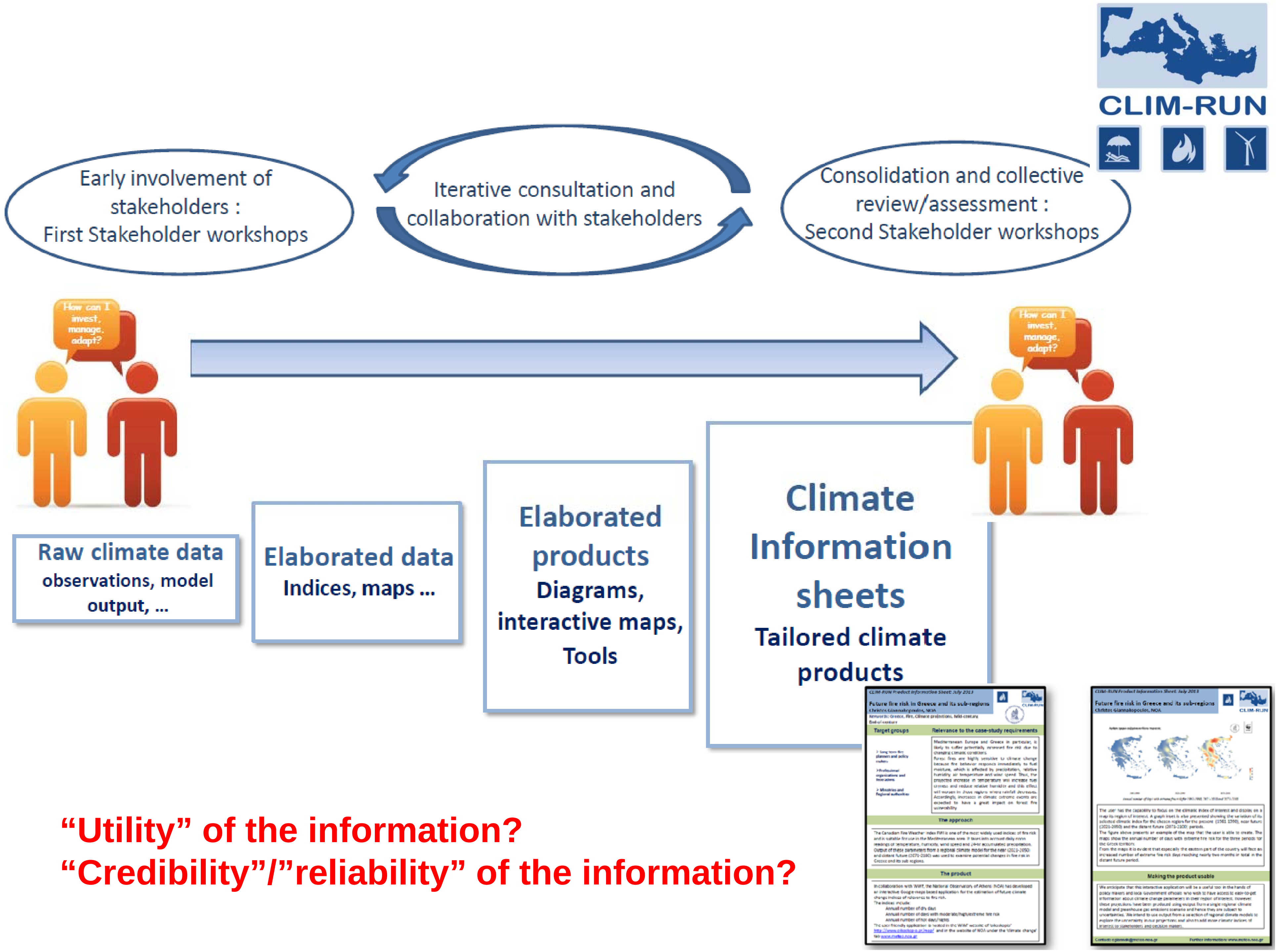
So ‘what’ <u>do</u> stakeholders need?

In addition to temp/prec and derived indices/extremes:

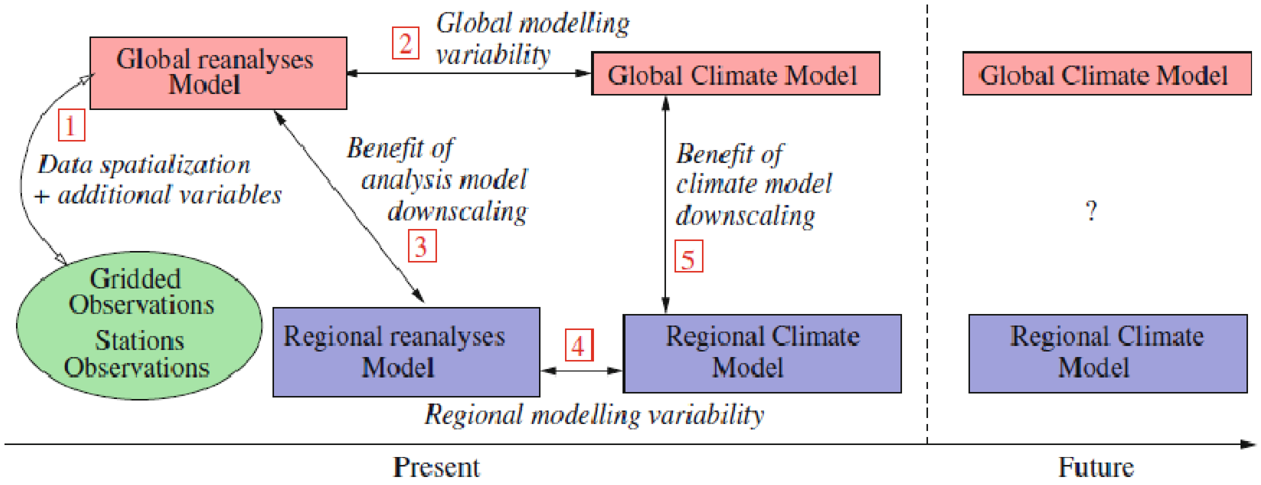
- Wind (speed, dir., ‘consistency’), snow, humidity, cloud
- Radiation (esp. DNI for solar energy)
- Sea bathing water T, SLR, storm surge, wave height
- Local winds (Bora, Scirocco) and dust storms
- Tourism comfort indices & Fire Weather Index

More interest in next 20-30 years (50 years at most)

i.e., seasonal/decadal rather than ‘climate’ timescales


CLIM-RUN
Early involvement of stakeholders : First Stakeholder workshops
Iterative consultation and collaboration with stakeholders
Consolidation and collective review/assessment : Second Stakeholder workshops
How can I invest, manage, adapt?
How can I invest, manage, adapt?
Raw climate data
observations, model output, …
Elaborated data
Indices, maps …
Elaborated products
Diagrams, interactive maps, Tools
Climate Information sheets
Tailored climate products
"Utility" of the information?
"Credibility"/"reliability" of the information?

Evaluation should go beyond comparing reanalysis-forced RCM runs and observations [3]



Menut et al., 2013: Evaluation of regional climate simulations for air quality modelling purposes, *Clim. Dyn.*

Teichmann et al., 2013: How does a regional climate model modify the projected climate change signal of the driving GCM: A study over different CORDEX regions using REMO, *Atmosphere*

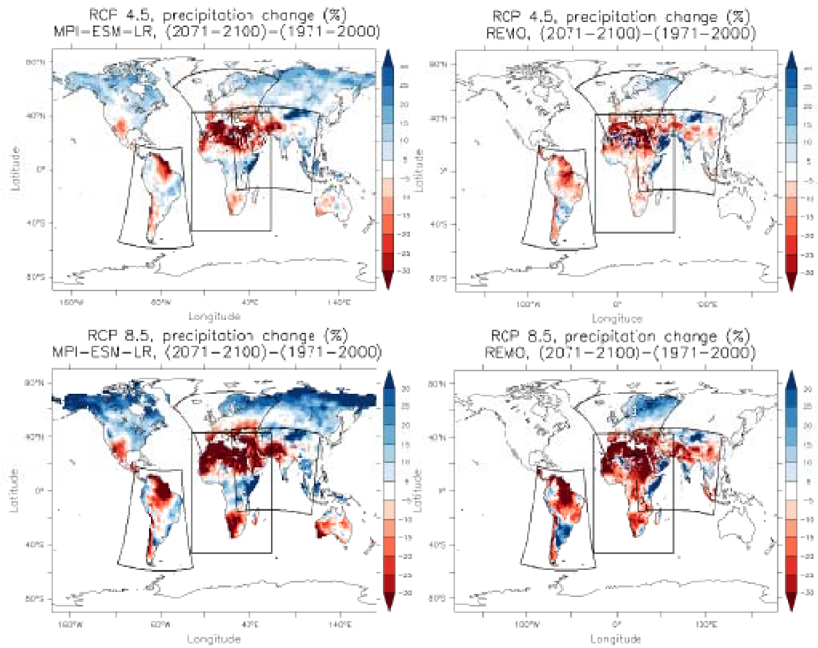
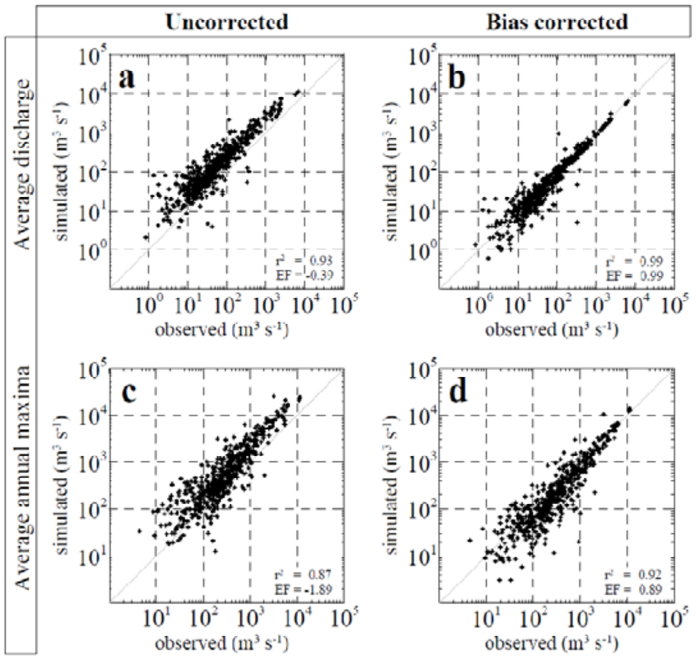


Figure 5. MPI-ESM (LR) and REMO climate change signals for annual precipitation sums. The climate change signal for precipitation is plotted in mm/day as simulated by the Earth system model MPI-ESM (LR) (left panels) and the regional climate model REMO (right panels). In the upper panels the climate change signal for RCP 4.5 is shown, while the lower panels show the climate change signals for RCP 8.5. The future time period 2071–2100 is compared to the reference time period 1971–2000.

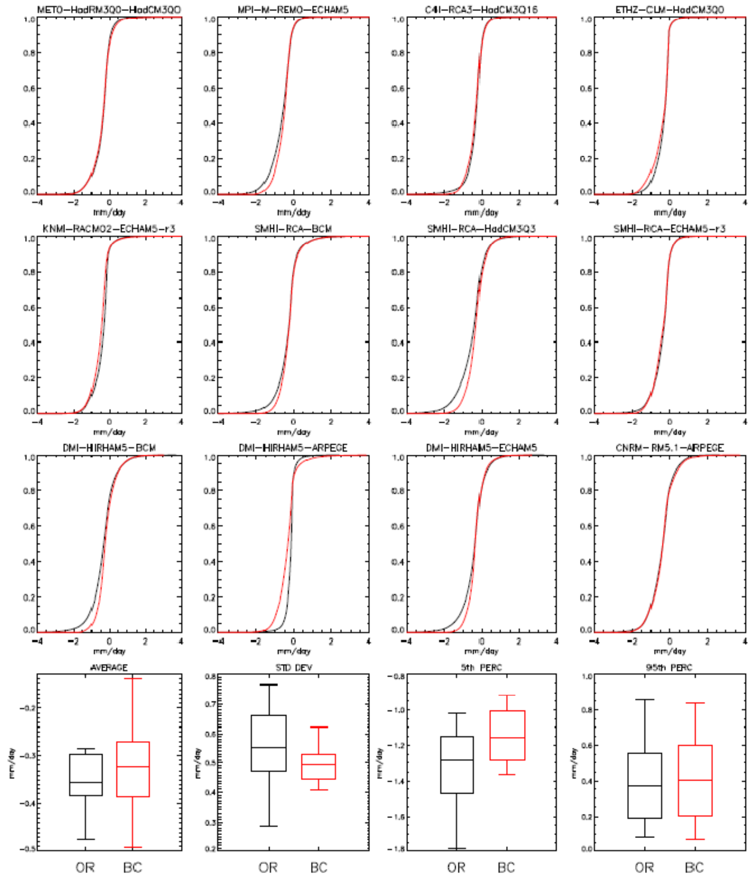
Bias correction of RCMs

The quantile mapping method of Piani et al 2010 has been applied to 12 ENSEMBLES RCMs for the purposes of hydrological modelling. (Rojas et al. 2011 & 2012; Dosio & Parulo, 2011; Dosio et al. 2012;



Better simulation of present-day pan-European discharge e.g. HIRHAM5-ECHAM5 vs E-OBS

Iberian Peninsula. BC in red.



But has some effect on projected changes – seen in extreme precipitation (above) and 100 year discharge return levels.

Sensitivity of impact projections to data processing and ensemble techniques – and the need for care in using bias correction (MOS)

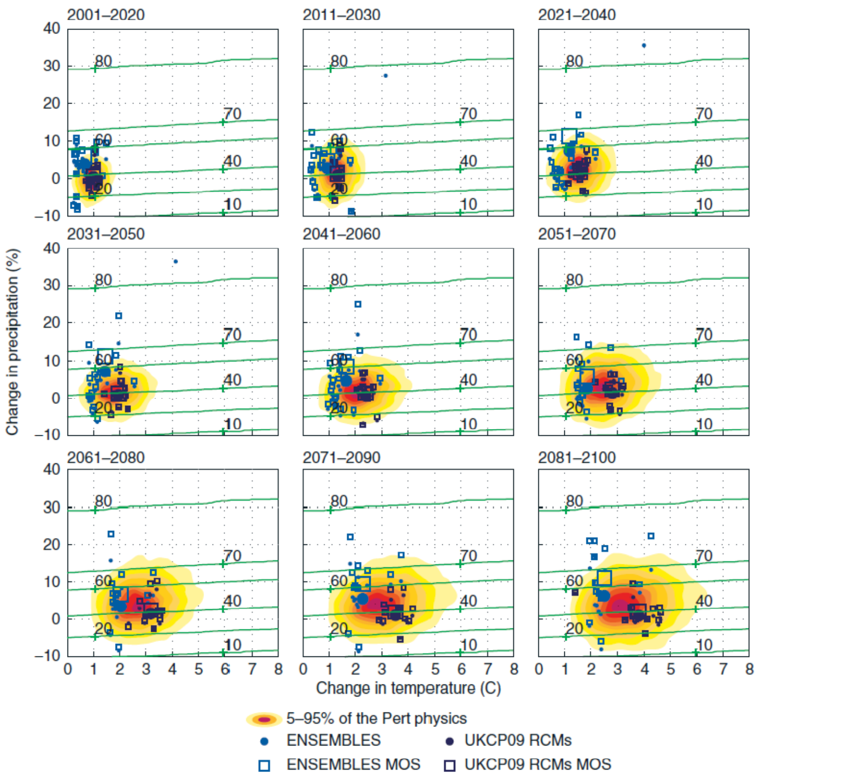


Figure 9. Perturbed physics experiment for the probability that the flood warning level is exceeded for the Montford catchment. The contours show the probability of exceeding the threshold and the shaded plot the density of runs from the perturbed physics experiment. The thicker dots denote the mean of the groups of RCMs. The squares indicate the RCMs after MOS. This figure is available in colour online at wileyonlinelibrary.com/journal/qj

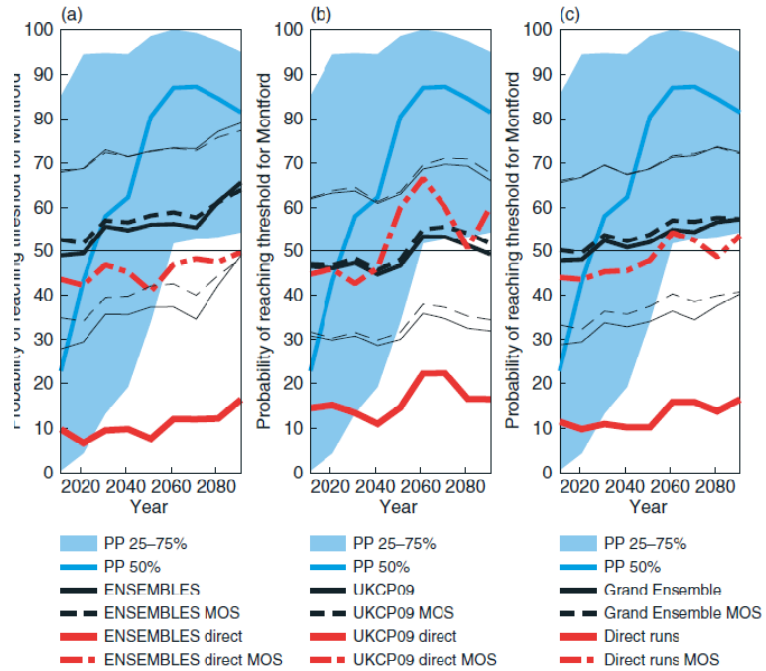


Figure 11. Changes in the 2-year return period of flood warning level at Montford (horizontal line). The left-hand plot shows the ENSEMBLES results; the middle plot shows the UKCP09 results; the right-hand plot shows the combined ENSEMBLES-UKCP09 grand ensemble. The median and 25–75% percentiles of the perturbed physics experiment used with the response surface technique are also shown. The black lines show the results for the RCMs used with the response surface technique and the dark grey lines (red online) show the direct simulations using the RCMs. The solid lines are uncorrected and the dashed lines are MOS corrected results. This figure is available in colour online at wileyonlinelibrary.com/journal/qj

"If you must use MOS then don't use it alone" – Cloke et al., 2013: Modelling climate impact on floods with ensemble climate projections, *QJRMS*

Stationarity – an issue for bias correction and statistical downscaling

- Maraun, 2012, *GRL*: 'pseudo-reality' used to explore non-stationarity of mean T/P in RCMs. Biases generally relatively stable – but some issues, e.g., winter T in Alps related to biased forcing sensitivity of surface albedo.

- Gutiérrez et al., 2013, *J. Clim*: robustness of statistical downscaling under warm historical conditions – provides objective criteria for discarding non-robust models for future (e.g., weather type-only methods for Spain).

- Christensen et al., 2008, *GRL* and Boberg & Christensen, 2013, *Nat. Clim. Change*: temperature dependence of biases – argue that Mediterranean temperature projections are overestimated (by up to 1°C).

Observations
Observations!
Observations!!
Observations!!!
Observations!!!!

- For RCM evaluation (variables including extremes, processes)
- For bias correction
- For calibration/validation of statistical downscaling models
- But also a source of uncertainty

Post-processing of climate model output is a source of uncertainty, as well as choice of impact model

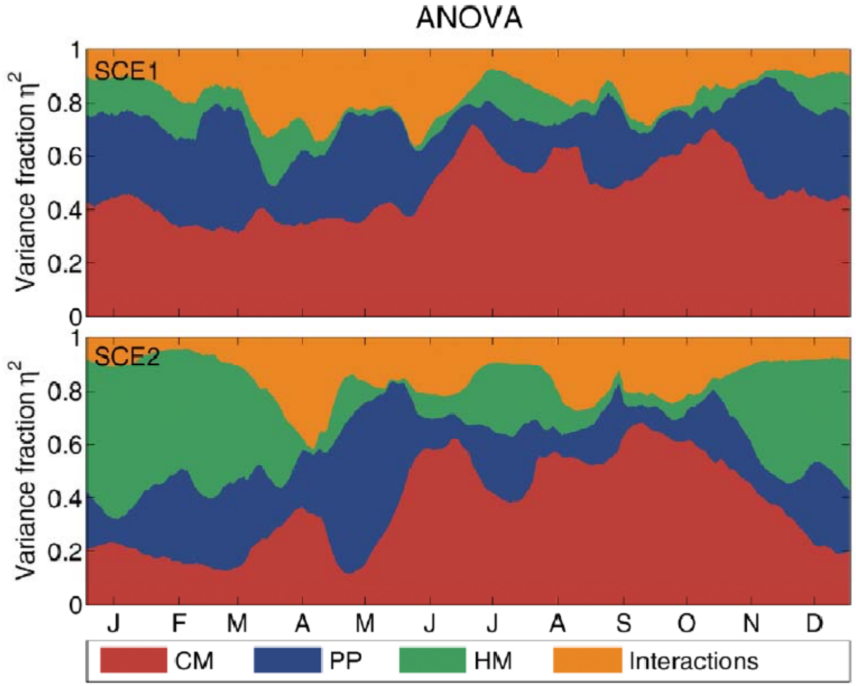


Figure 9. Variance decomposition of the uncertainty in mean runoff changes at the gauge Diepoldsau in the course of the annual cycle. The uncertainty sources are CM, PP, and HM.

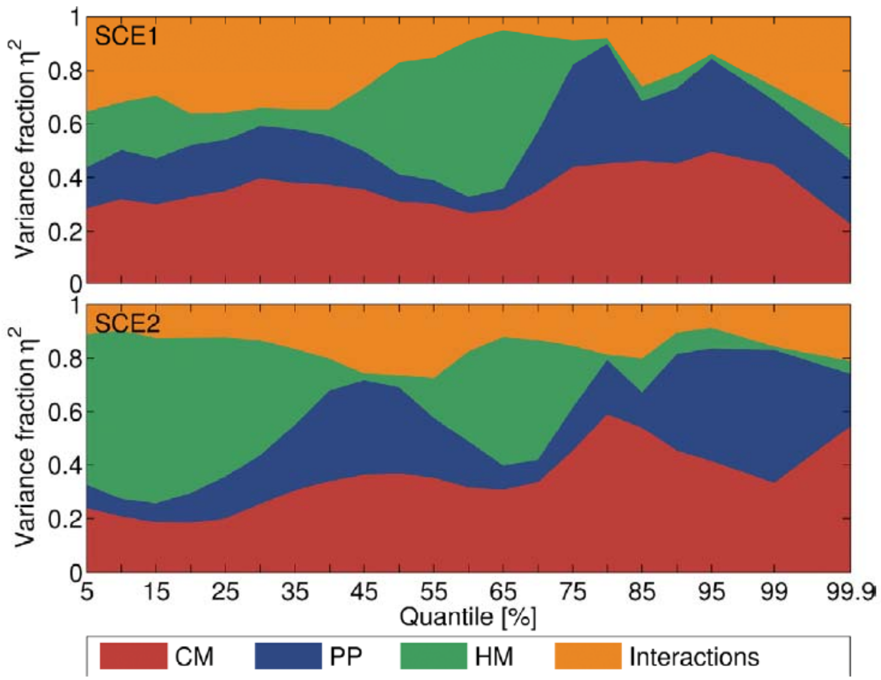


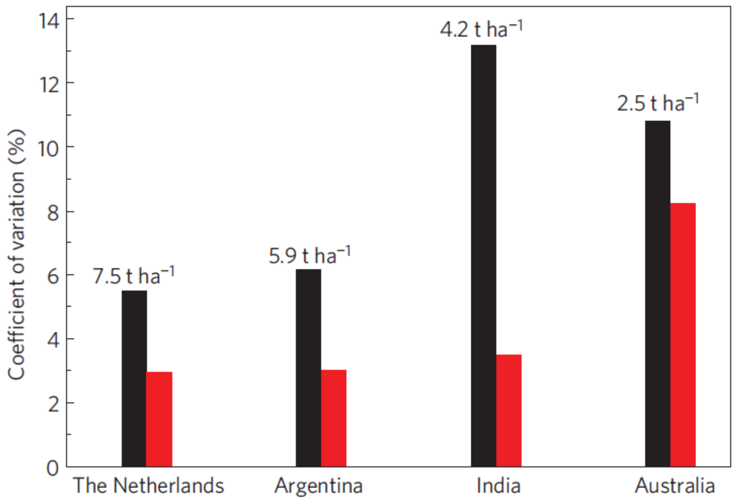
Figure 10. Same as Figure 9 but for variance decomposition of changes in different runoff quantiles.

Bosshard et al., 2013: Quantifying uncertainty sources in an ensemble of hydrological climate-impact projects, *Water Resources Research*

Alpine Rhine; 8 RCMs; bias correction & delta change; 2 hydrological models

Impact model uncertainty and inter-comparison projects

AgMIP The Agricultural Model Intercomparison and Improvement Project



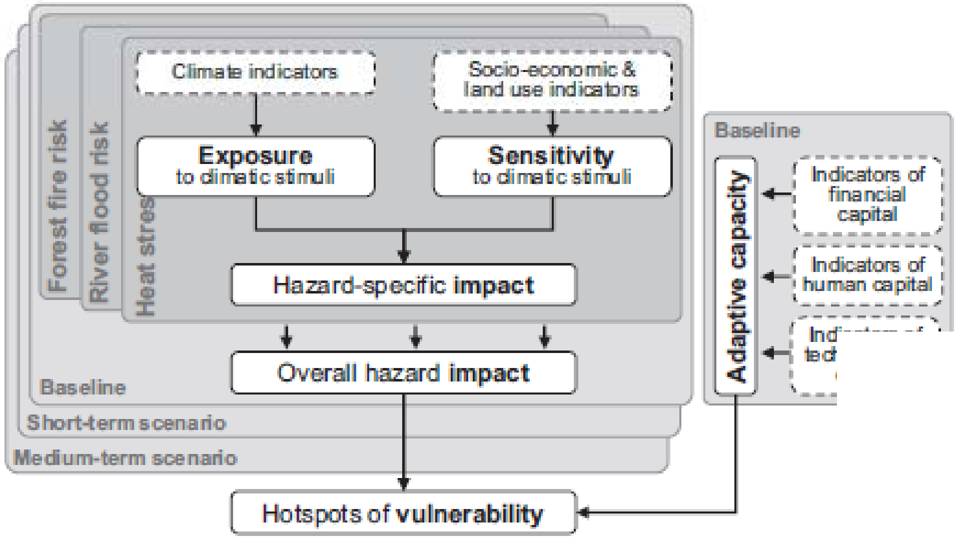
CV in projected wheat yield change due to crop model uncertainty (black – 26 models) and ‘downscaled’ GCM (red – 16 models).
Asseng et al., *Nature Climate Change*, June 2013.

The Inter-Sectoral Impact Model Intercomparison Project

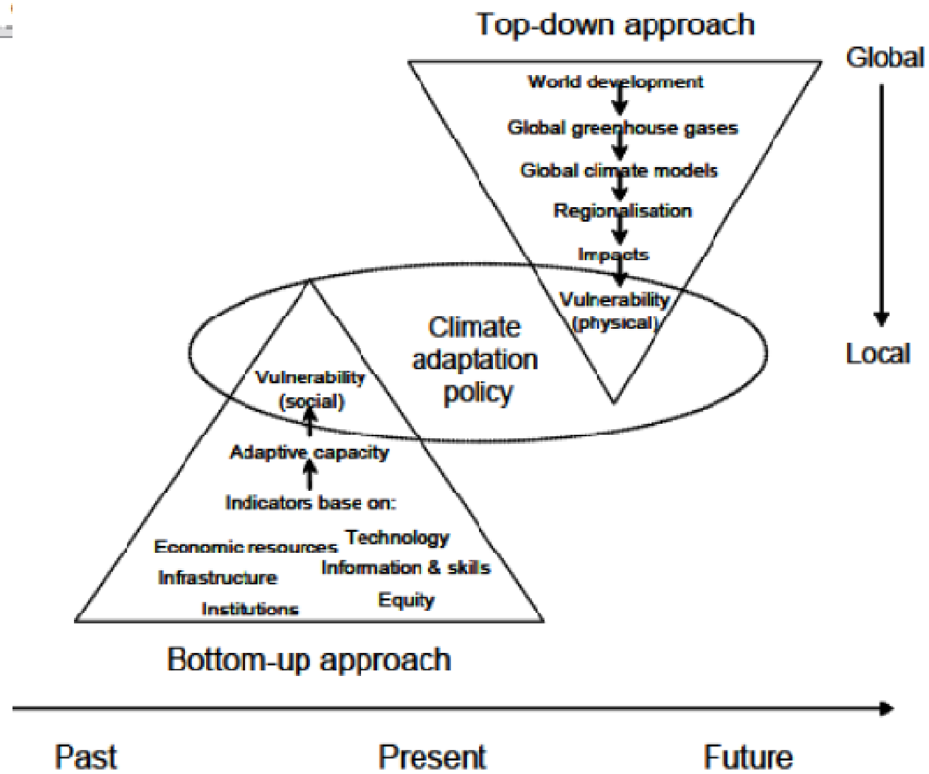
ISI-MIP

http://www.pik-potsdam.de/research/climate-impacts-and-vulnerabilities/research/rd2-cross-cutting-activities/isi-mip

Climate is only one component of Impact, Adaptation and Vulnerability



Lung et al., 2013: Multi-hazard regional level impact asssessment for Europe combining indicators of climatic and non-climatic change. *Global Environmental Change*



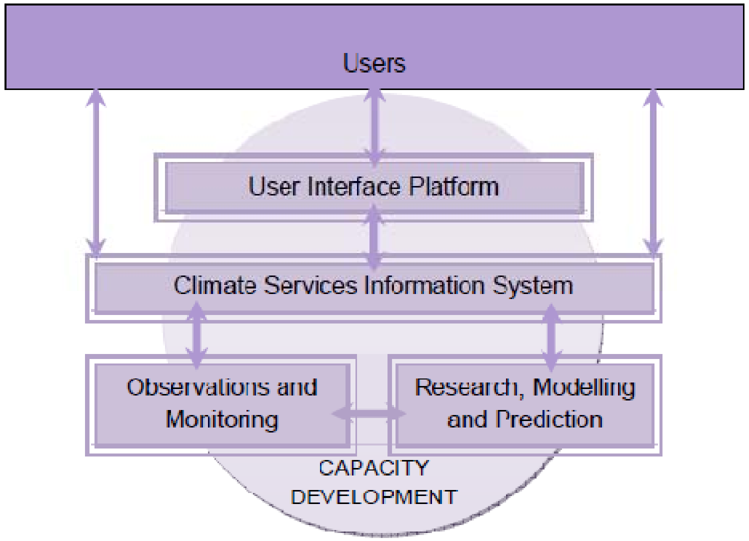
Approaches to climate adaptation, Dessai and Hulme, 2004

WCRP Working Group on Regional Climate

Co-chairs: Clare Goodess and Bruce Hewitson

http://www.wcrp-climate.org/index.php/key-deleverables/regional-climat6

To oversee and promote specific WCRP regional climate research initiatives including CORDEX



To foster communication between the WCRP and the GFCS and Future Earth, and to serve as the point of contact between the WCRP and regional climate information/service entities (e.g. WMO Regional Climate Centers, the Climate Services Partnership etc)

http://www.gfcs-climate.org/

http://www.climate-services.org/

Some more of the WGRC Terms of Reference

• Coordination of WCRP research activities relevant to the provision of regional climate information and related climate services

• Integration of user and decision maker context into the design and development of regional climate science through two-way communication and co-production activities

• Facilitation…of provision of good practice guidance for potential users on the identification, selection, processing, application and interpretation of regional climate information

• Provide advice to WCRP regarding research activities needed to support and improve regional climate science and prediction….

• Provide recommendations to WCRP regarding the provision and communication of information for regional impact assessment, decision making and climate services….This includes helping to ensure that observing networks are optimized, maintained over the long term, and adapted to user needs

• Strengthen the role of regional climate science activity within the WCRP with research results communicated effectively to, or where possible designed in partnership with, climate service institutions.….

• To liaise, as appropriate, with other organizations or bodies developing scenarios of environmental and socioeconomic conditions, and to facilitate the assessment (and develop a set of best practices with respect of) the consistency and plausibility of regional climate projections in the context of integrated science development

Finally, three ‘big’ questions…..

- How to make the Tb of CORDEX data available and accessible?
- How to integrate the user and decision maker context into the application of regional climate science?
- What are the limits to regional information – and how to communicate them?

Also relevant to the WCRP Grand Challenge #1 on Regional Climate Information