Lessons learnt from the STARDEX project

http://www.cru.uea.ac.uk/projects/stardex/

The STARDEX team

- University of East Anglia, UK
- King's College London, UK
- Fundación para la Investigación del Clima, Spain
- University of Bern, Switzerland
- Centre National de la Recherche Scientifique, France
- Servizio Meteorologico Regional, ARPA-Emilia Romagna, Italy
- Atmospheric dynamics group, University of Bologna, Italy
- Danish Meteorological Institute, Denmark
- Eidgenössische Technische Hochschule, Switzerland
- Fachhochschule Stuttgart - Hochschule für Technik, Germany
- Institut für Wasserbau, Germany
- University of Thessaloniki, Greece

Principles of verification

- Predictor dataset : NCEP reanalysis
- Predictand datasets: “FIC dataset” and regional sets
- Regions
- Stations within regions
- Core indices
- Verification period: 1979-1993 (for compatibility with ECMWF-driven regional models)
- Training period: 1958-1978 & 1994-2000
- Statistics: RMSE, SPEARMAN-RANK-CORR for each station/index (also BIAS & STDEV ratios)

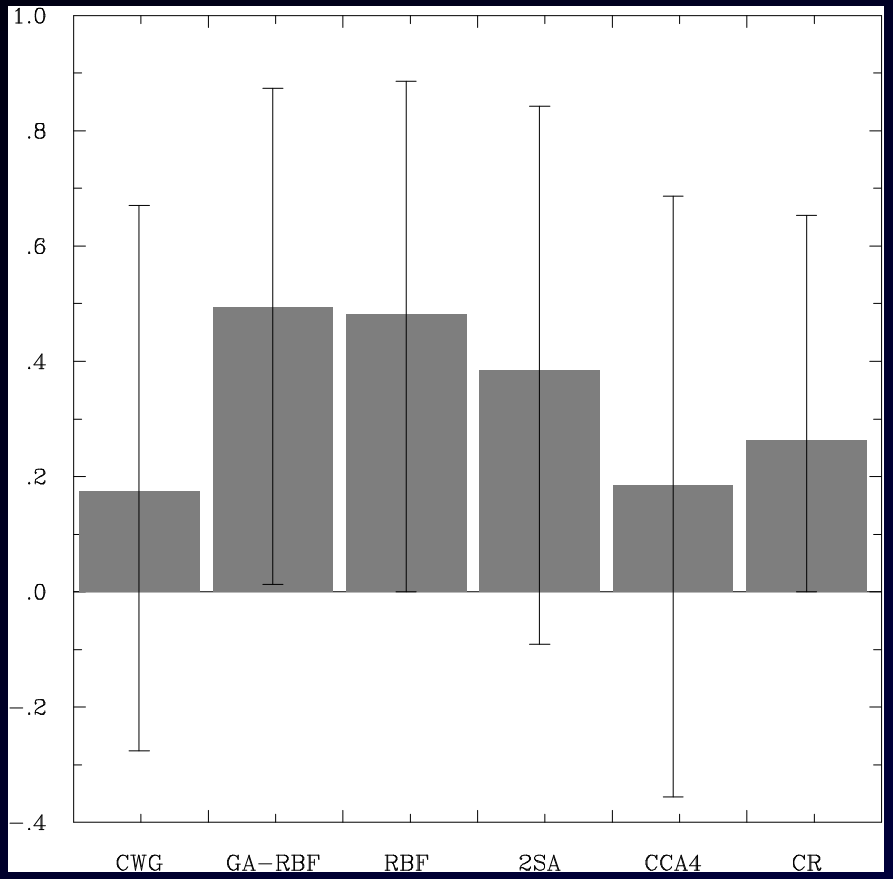
The STARDEX methods

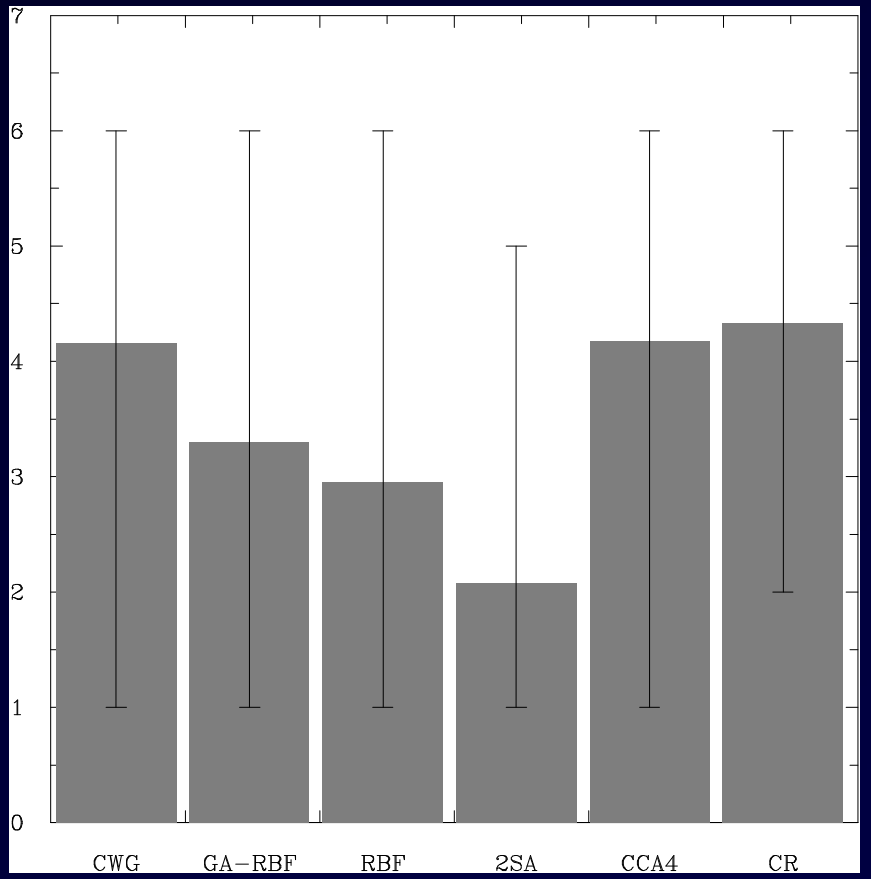
- multiple linear regression
- canonical correlation analysis
- artificial neural networks
- multivariate autoregressive model
- conditional re-sampling & other analogue-based methods
- methods based on a potential precipitation circulation index & critical circulation patterns
- conditional weather generator
- local & dynamical scaling

Partners/regions

	Iberia	Greece	Alps	Germany	UK	Italy
UEA	x	x	x	x	x	x
KCL	x				x	
ARPA-SMR		x				x
ADGB						x
AUTH		x				x
USTUTT-IWS & FTS			x	x		
ETH			x		x	
FIC	x	x	x	x	x	x
DMI	x	x	x	x	x	x
UNIBE			x			
CNRS	x		x			

Iberia (16 stations)
Averaged across all seasons, indices and stations
5th & 95th percentiles are also shown





Spearman correlation

Rank of abs(bias)

A few of our key messages

- Skill varies **station-station**, season-season, index-index, method-method
- But not systematically, so hard to pick single best method in most cases
- Methods/indices with highest corrs. are often not those with lowest bias/rmse
- Generally best winter/worst in summer
- P extremes: persistence better than magnitude/frequency. Occurrence generally better than amount process.

Two ‘headlines’ from the verification work

- In majority of cases no consistently superior model, so a major recommendation is to use a range of the better SDS methods – just as the recommendation is to use a range of GCMs/RCMs
- For many regions and indices, the skill is unacceptably low for summer rainfall – thus we should not attempt to construct scenarios for these cases

STARDEX robustness criteria for statistical downscaling

- ‘Strength and stability’ of predictor/predictand relationships
- ‘Stationarity’ of predictor/predictand relationships
- Uniformity of performance
- Reliability of simulation of predictors

Application criteria for statistical and dynamical downscaling

Method provides:	**Y/N**	**Comments/Notes**
Station-scale information	Y	
Grid-box information	-	
European-wide information	-	
Daily time series	-	
Seasonal indices of extremes	Y	
Temporally consistent temperature and precipitation	Y	
Spatially consistent multi-site information	Y	
Temporally consistent multi-site information	-	
Information at sites with no observations	-	
Method requirements :	**Relatively high/low**	**Comments/Notes**
Computing resources	**High**	
Volume of data inputs	**Low**	
Availability of input data	**High**	

Performance criteria for statistical and dynamical downscaling

	Relative Performance		Confidence
	High	**Medium**	**Low**
Temperature			
Indices	**Txav, Tnav, Tav**	**Txq90, Tnq10, Tnfd, Txhw90**	
Seasons	**Winter**	**Spring, Summer**	**Autumn**
Regions	**W Greece, E Greece**		
Precipitation			
Indices	**Pav**	**Pxcdd, Pnl90**	**Pq90, Px5d, Pint, Pfl90**
Seasons	**Winter**	**Spring, Summer**	**Autumn**
Regions	**W Greece**	**E Greece**	**x**

Overall performance:	
Mean temperature	Good
Temperature extremes	Average
Mean precipitation	Good
Precipitation extremes	Poor
Optimal spatial scale:	**Higher resolution (<2.5^{o})**
Recommended impact applications:	

So that was STARDEX, the next challenge is ENSEMBLES…..

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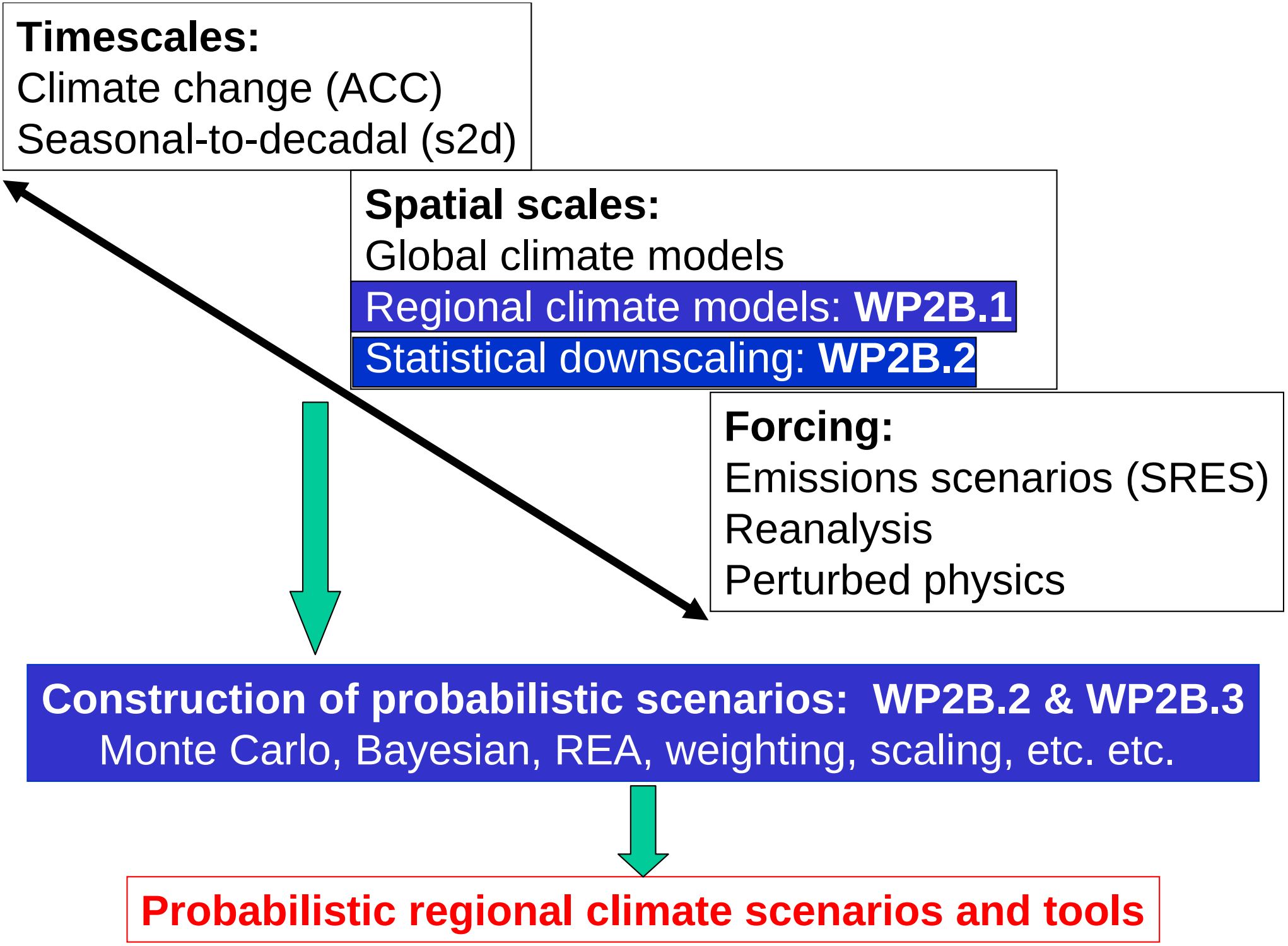
Timescales:
Climate change (ACC)
Seasonal-to-decadal (s2d)
Spatial scales:
Global climate models
Regional climate models: **WP2B.1**
Statistical downscaling: **WP2B.2**
Forcing:
Emissions scenarios (SRES)
Reanalysis
Perturbed physics
Construction of probabilistic scenarios: WP2B.2 & WP2B.3
Monte Carlo, Bayesian, REA, weighting, scaling, etc. etc.
Probabilistic regional climate scenarios and tools

Three major issues

- Modification of methods for construction of probabilistic scenarios
- Integration of work on climate change and seasonal-to-decadal timescales
- Development of sds tools

Shift of emphasis to SDS tools

- potential danger of black box methods
- need for user documentation/education
- need to specify user requirements
- can multiple methods be incorporated?
- and combined with tools (e.g., weighting tools) for generating PDFs/response surfaces etc?