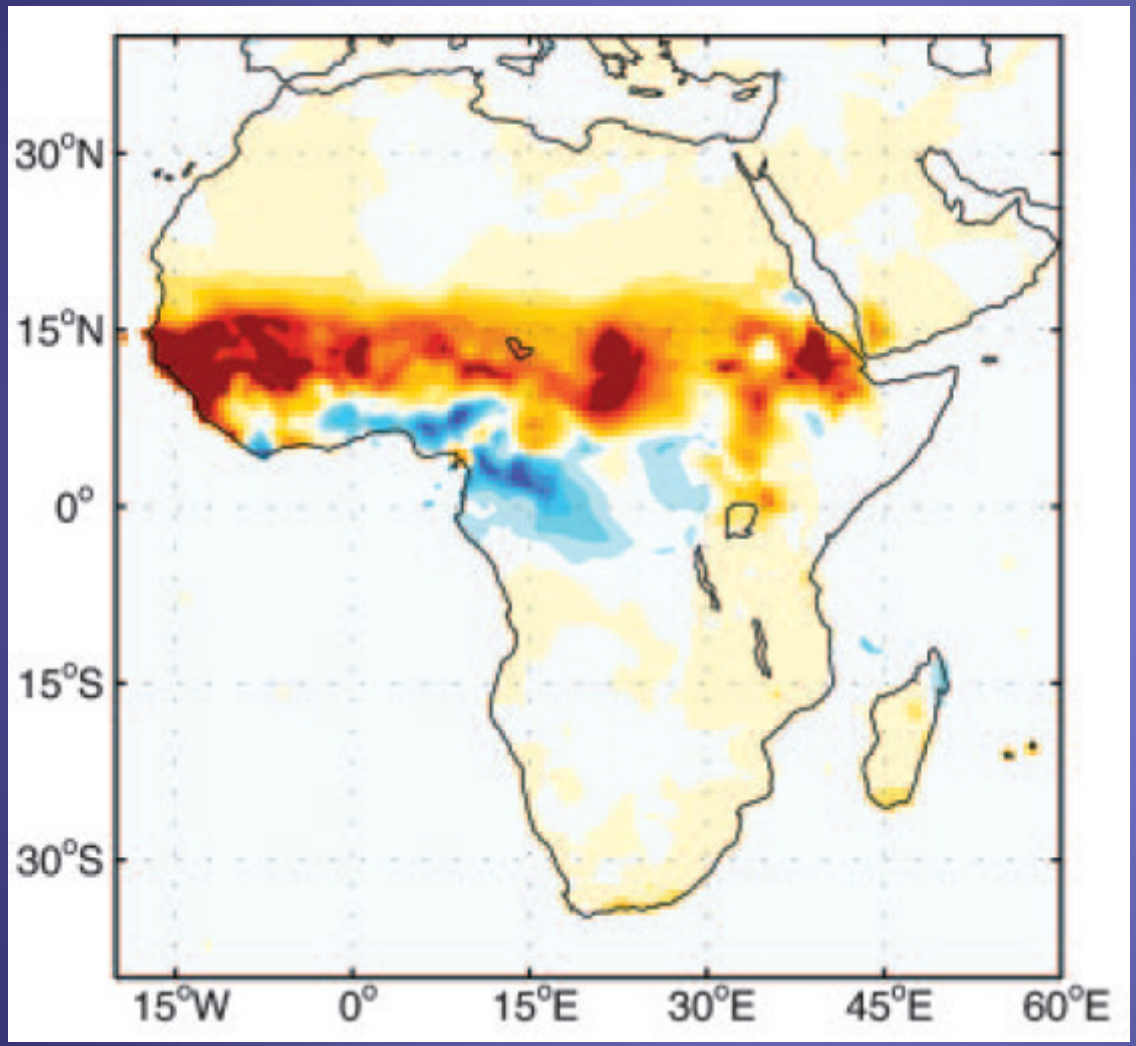
Dealing with uncertainties of future climate: The special challenge of semi-arid regions

Rob Wilby,
University of Lancaster

Photo: Bull (1930)

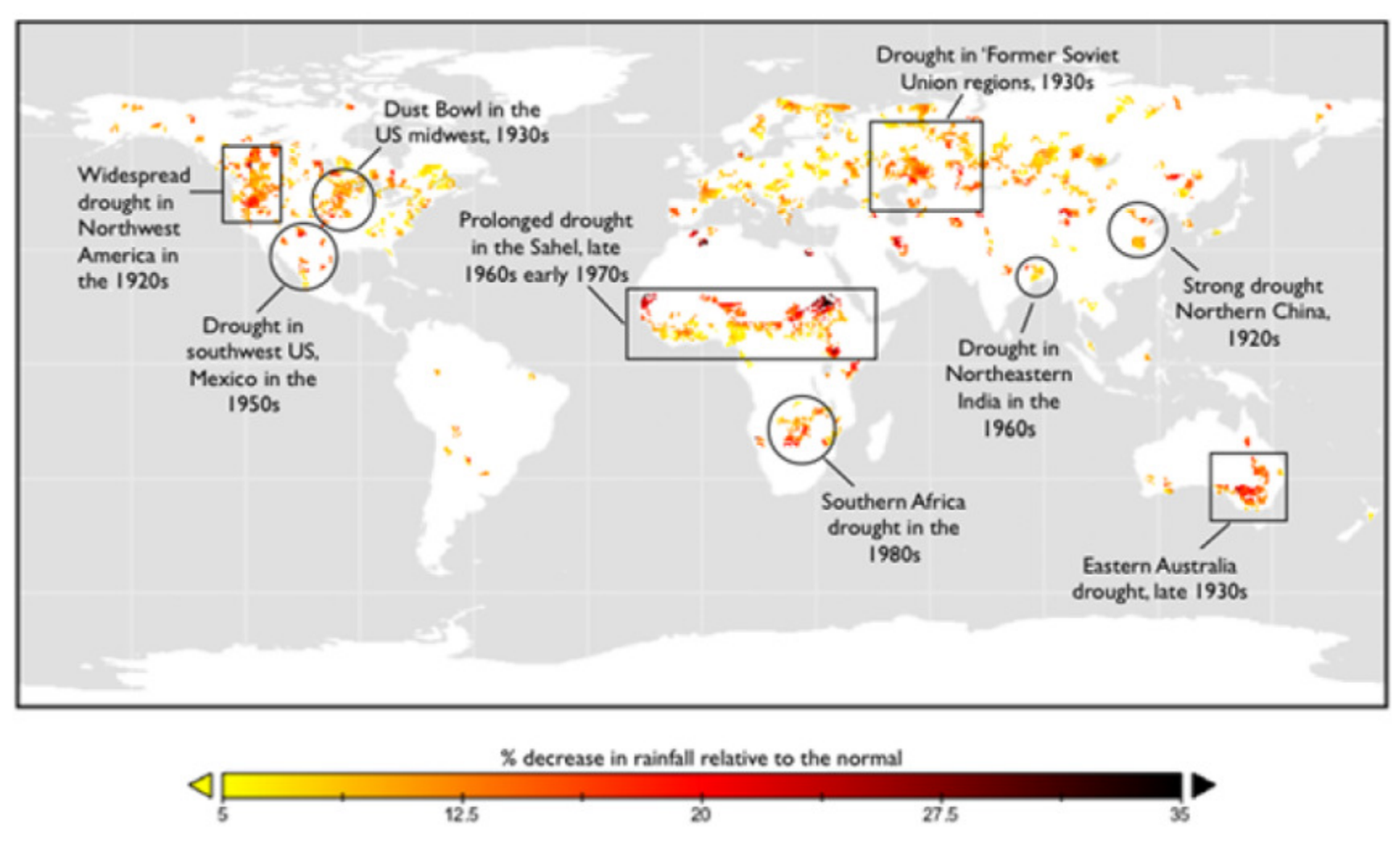
Acknowledgements
Babqiqi Abdelaziz
Driouech Fatima
DMN
CNRM/EC

Regional precipitation trends



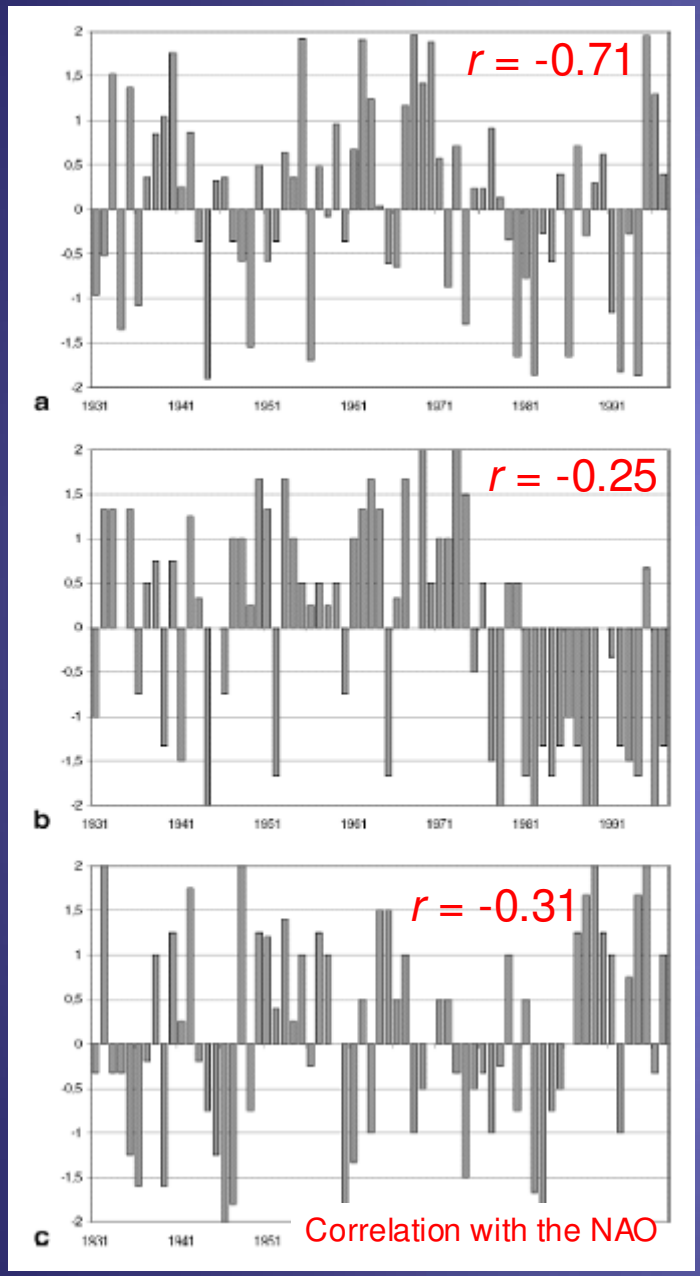
Observed linear trend (mm/month/50yrs) for July Sept rainfall.
Source: Held et al. (2005)

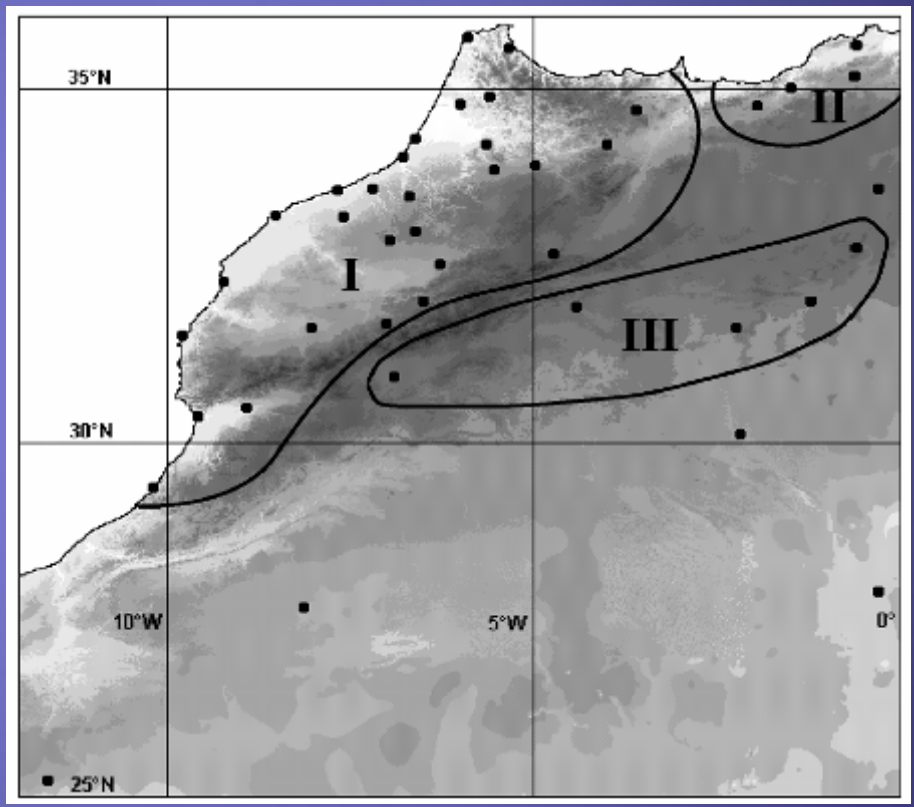
Abrupt changes in rainfall



Source: Narisma et al. (2007)

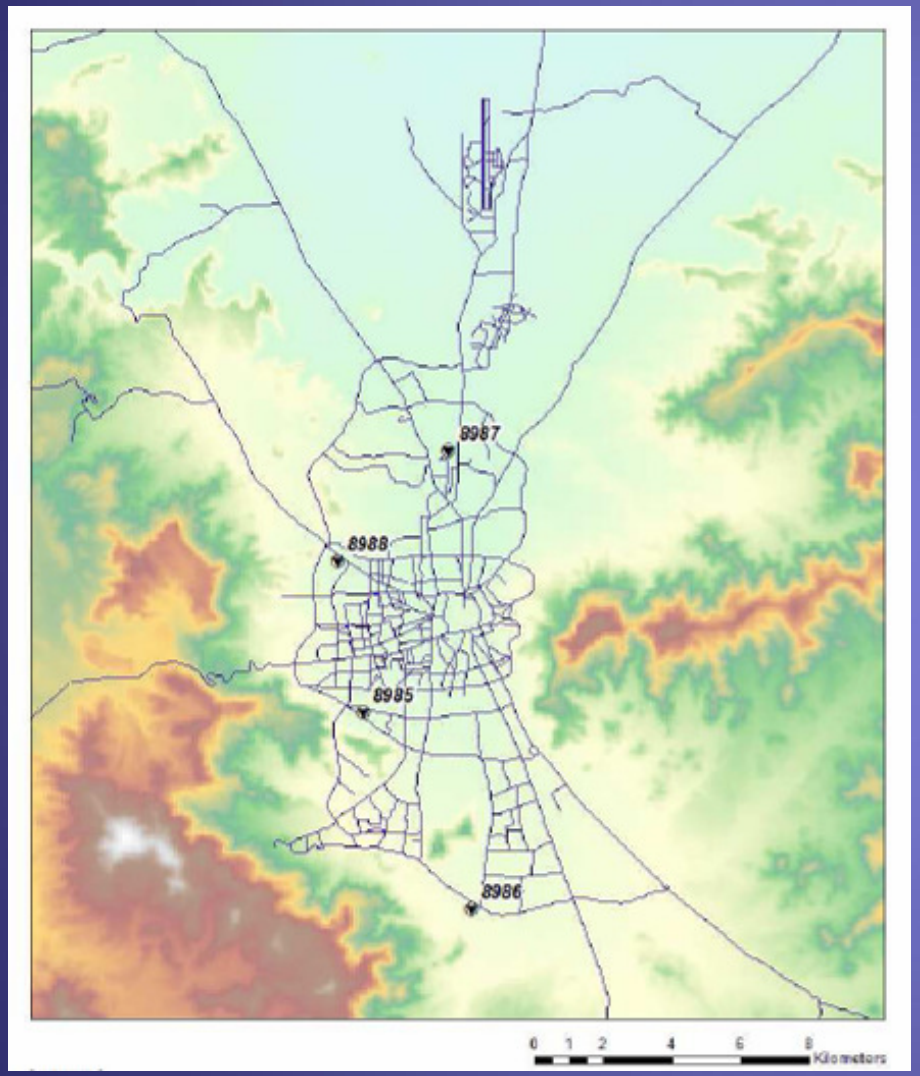
Large year-year variability

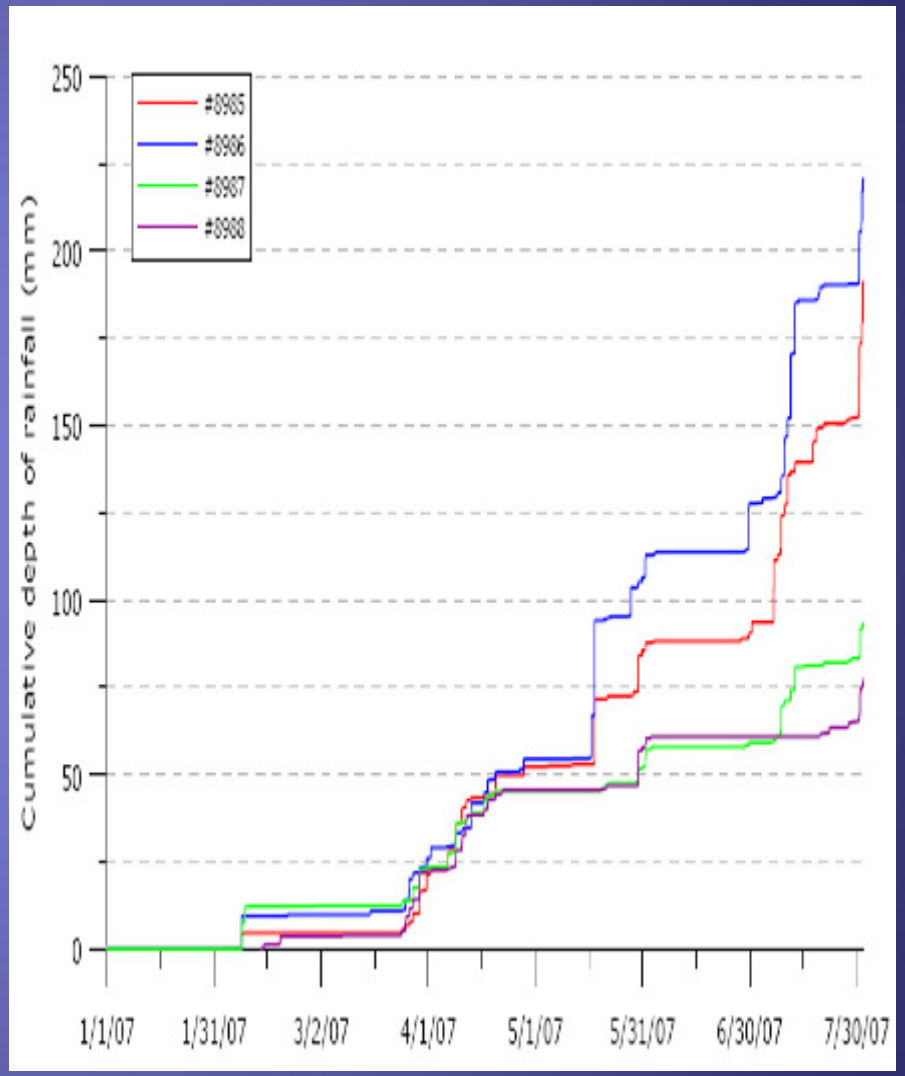




Regional rainfall zones for Morocco:
ATL (I), MED (II) et SOA (III).
Source: Knippertz et al (2003).

Large variations in rainfall over short distances





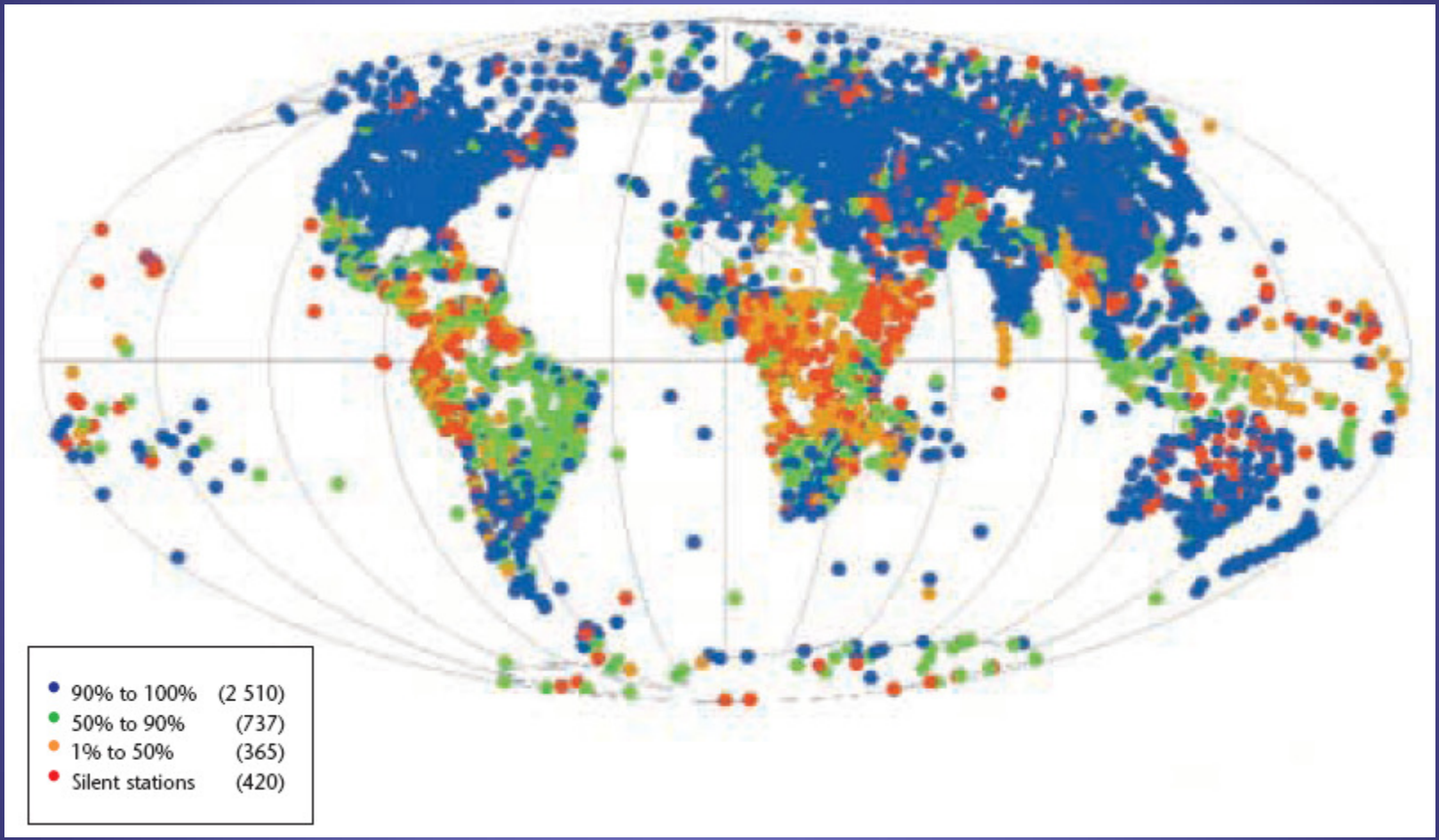
Rainfall measurements at four sites around Sana'a January July 2007.
Source: Zabara et al. (2007)

Extreme weather events

Tropical cyclone Guno 5 June 2007
Source: http://omaniidiot.blogspot.com/2007/06/cyclone_guno_to_hit_oman.html

Aftermath in Oman
Source: http://www.andy coates.com/blog/2007/06/15/tropical cyclone visits oman aftermath pictures/

Decaying observing networks



The global network of the World Weather Watch (WWW) stations colour coded to indicate silence (red dot) or reporting rates in 2004. Source: WMO (2005)

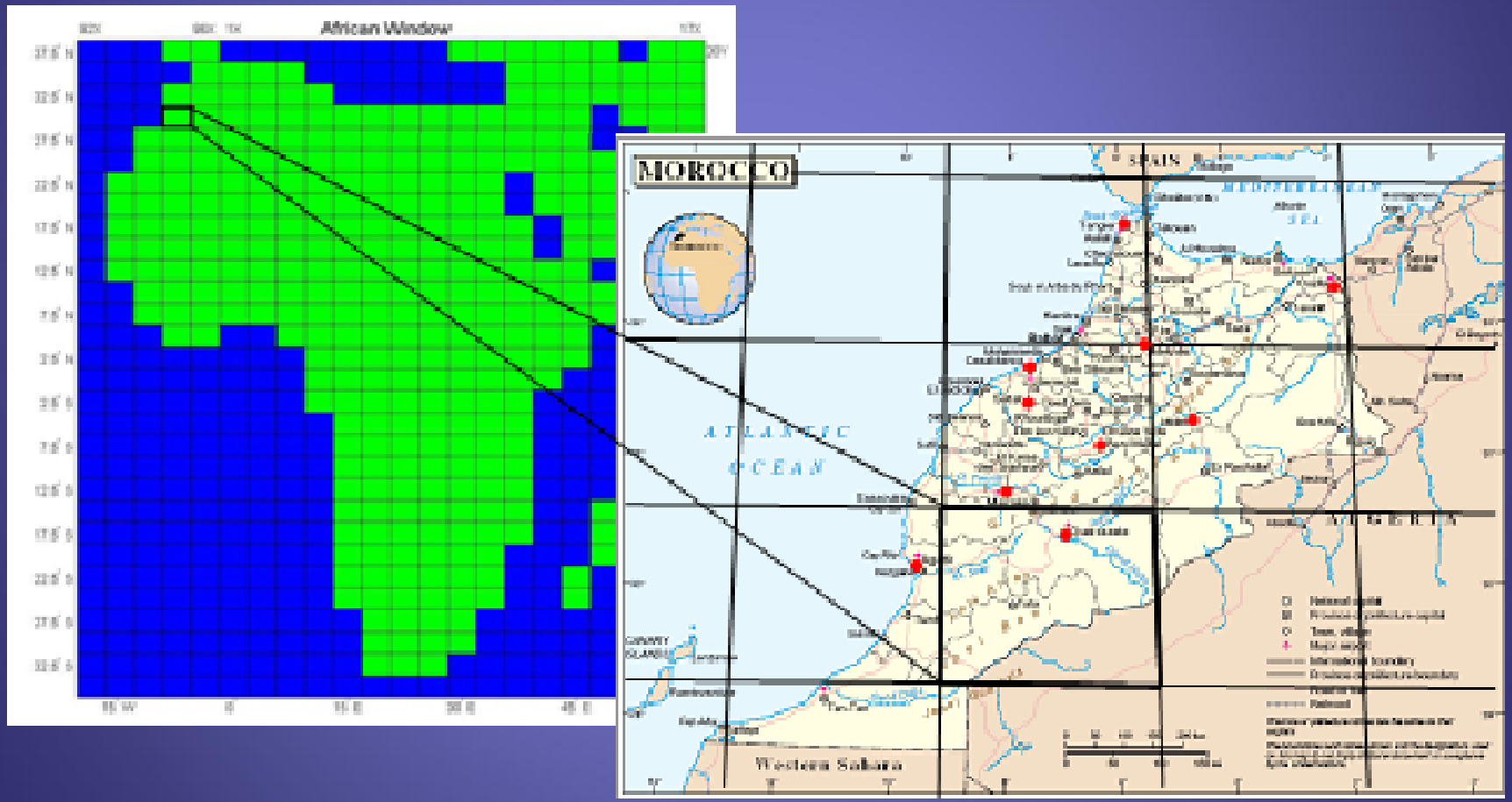
MENA: a region of growing water scarcity

	Morocco	Yemen	Spain
Population (1000)	31,478	20,975	43,064
Growth rate (%)	1.5	3.1	1.1
Water per capita (m^3/yr)	921	195	2578
GDP agriculture (%)	16	13	3
Rural water access (%)	56	65	100

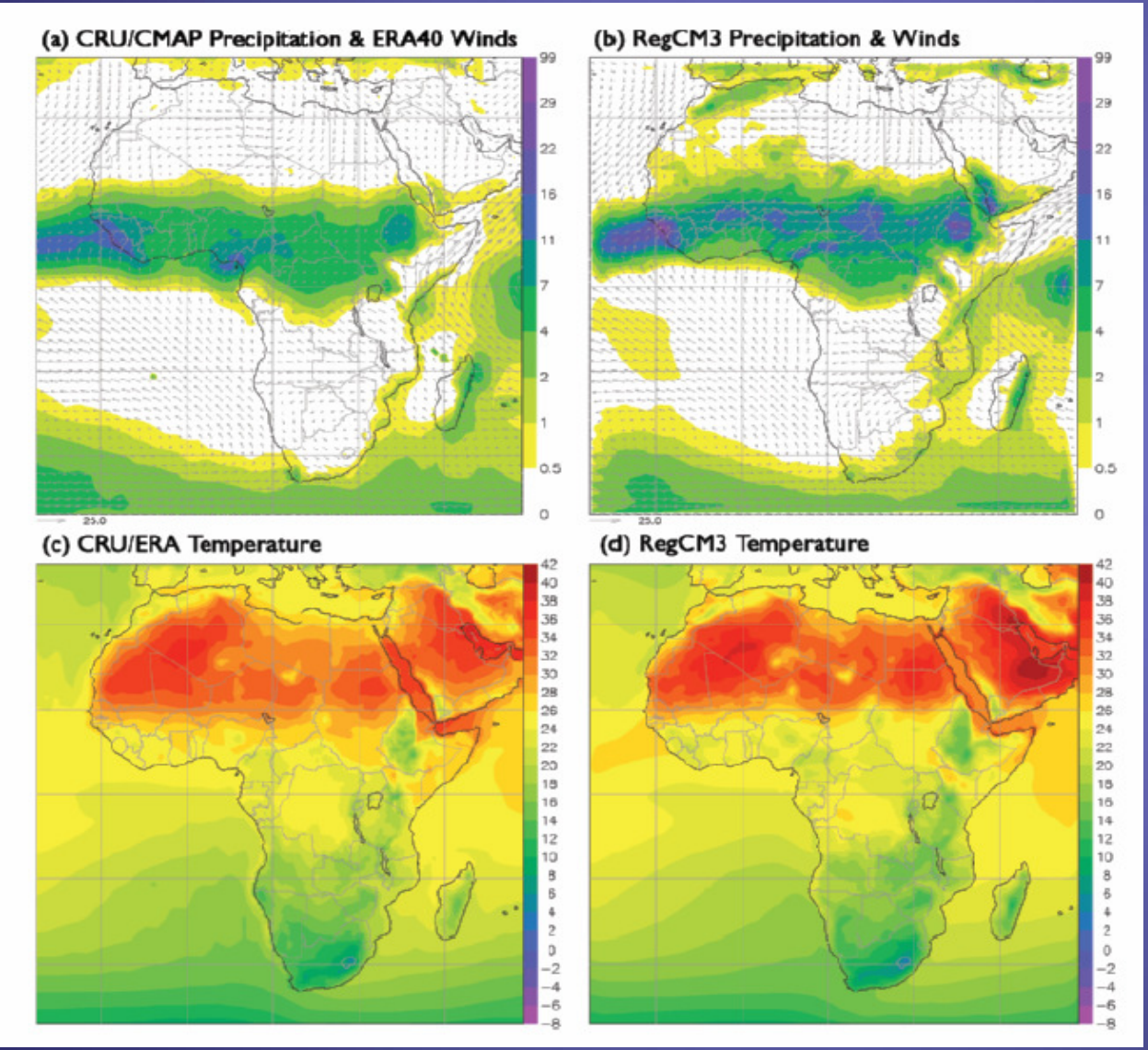
Source: United Nations Statistics Division (2005)

Modelling the present climate

Coarse resolution global climate models

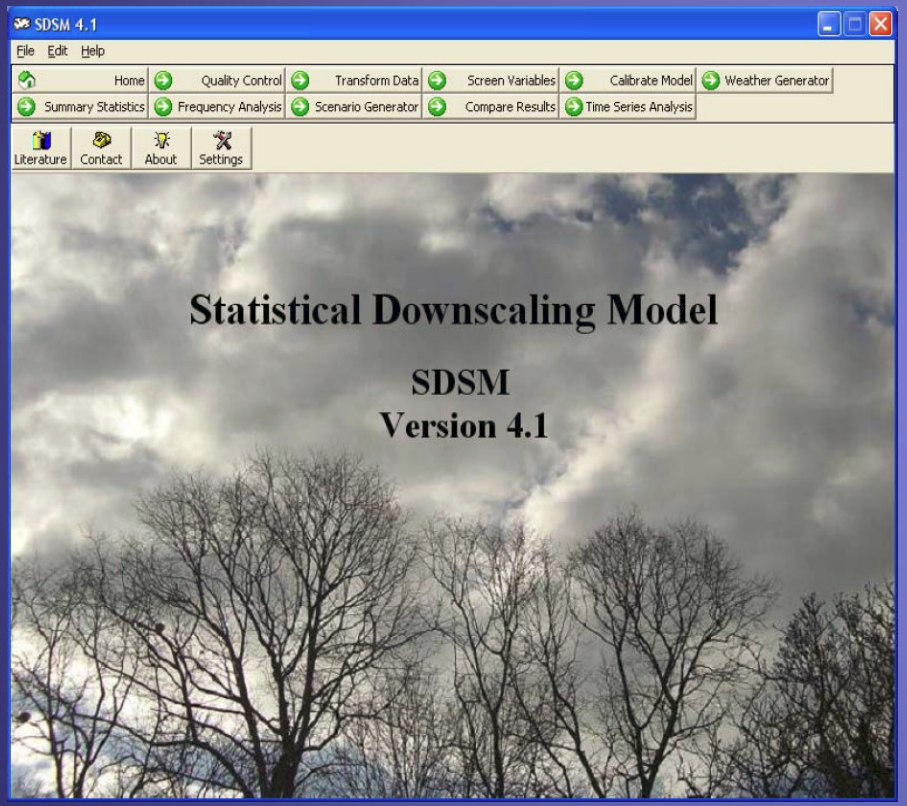


Regional climate models

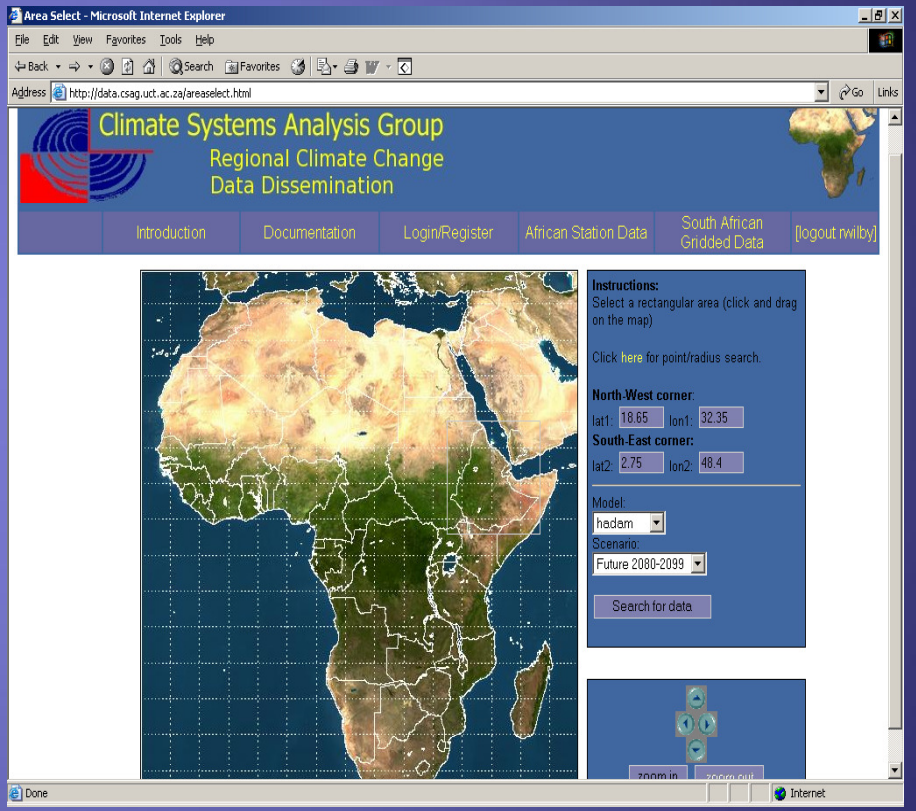


Observed (left column) and RegCM3 simulation (right column) of near surface winds, precipitation and surface temperature for summer 1987 2000.
Source: Pal et al. (2007)

Statistical downscaling models

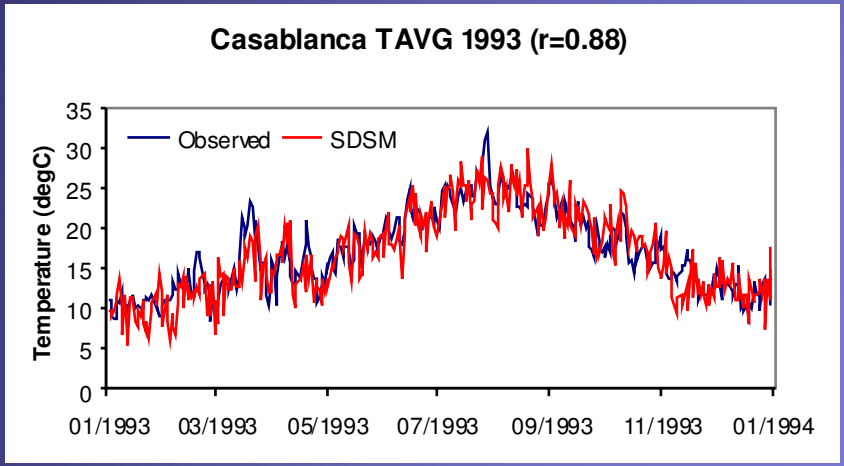


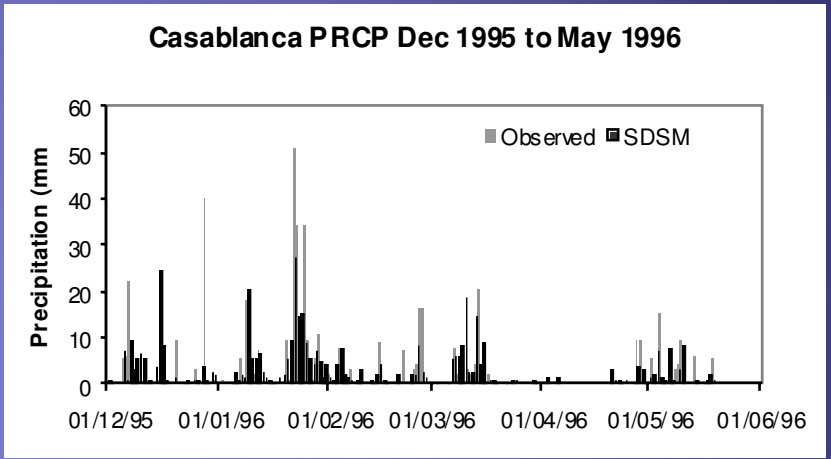
http://www.sdsm.org.uk

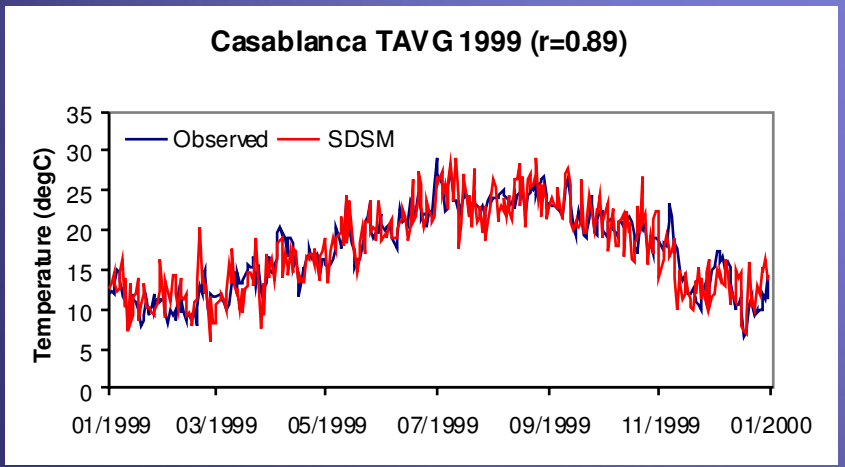


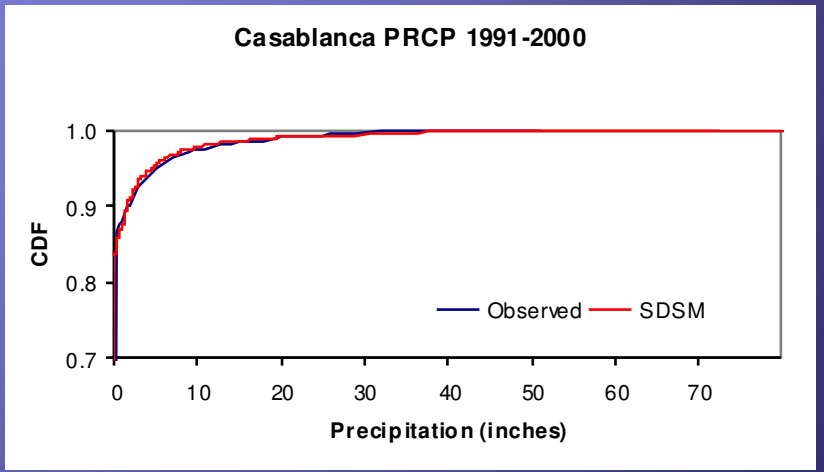
http://data.csag.uct.ac.za/

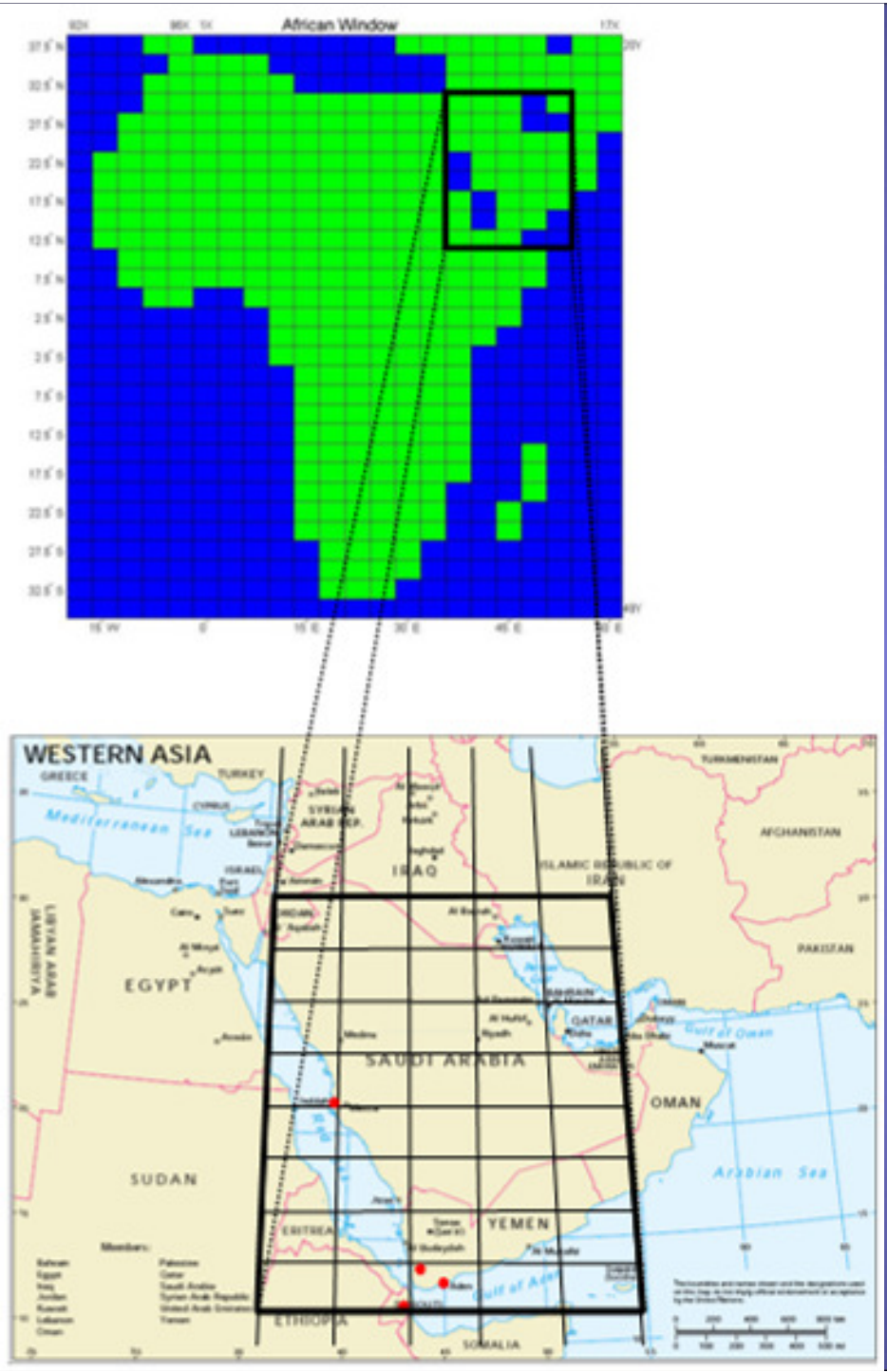
Downscaling daily weather in Morocco...





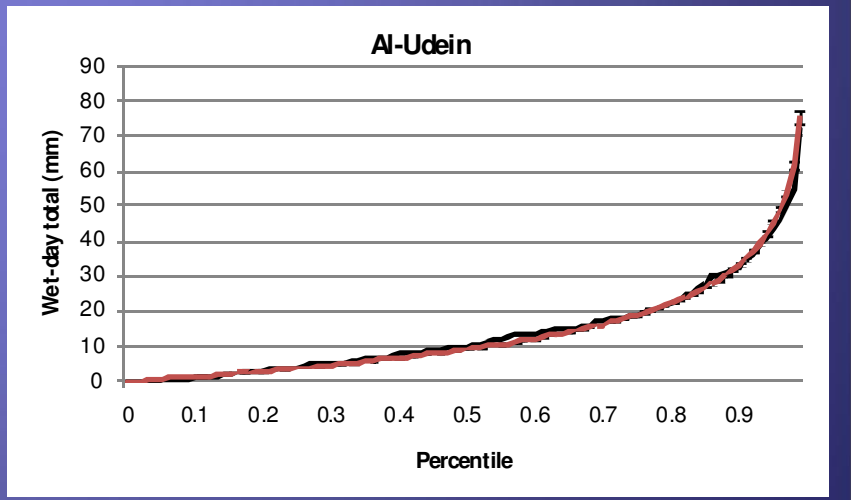




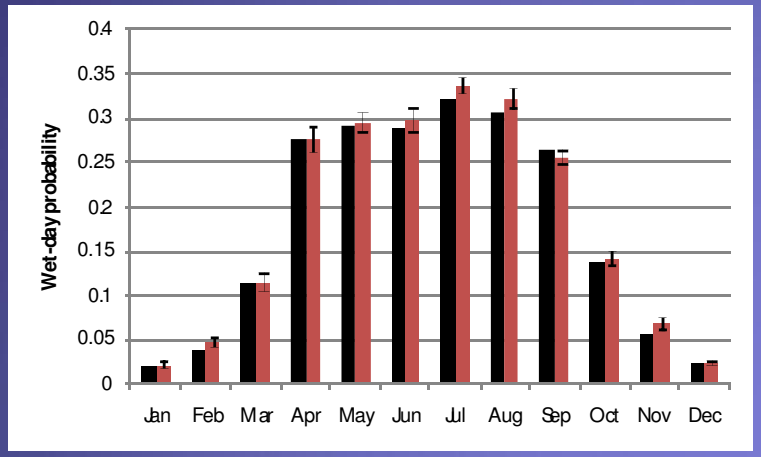


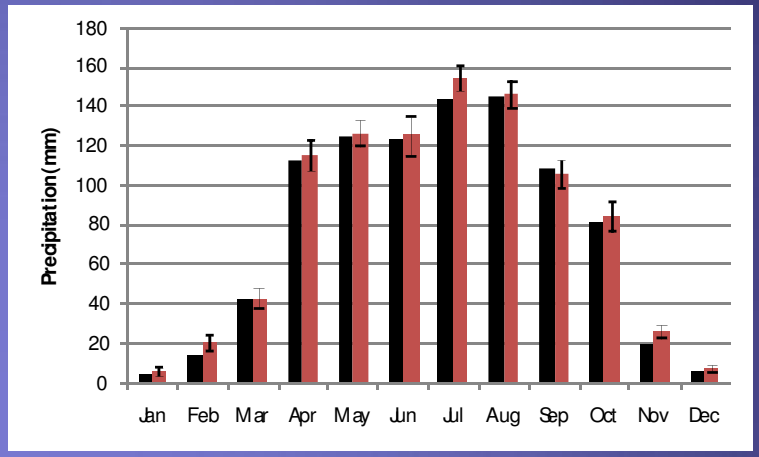
...and Yemen

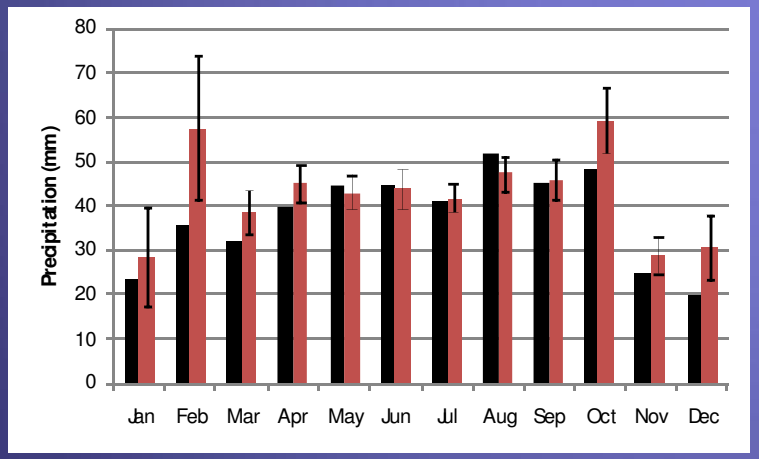
Source: Google Earth

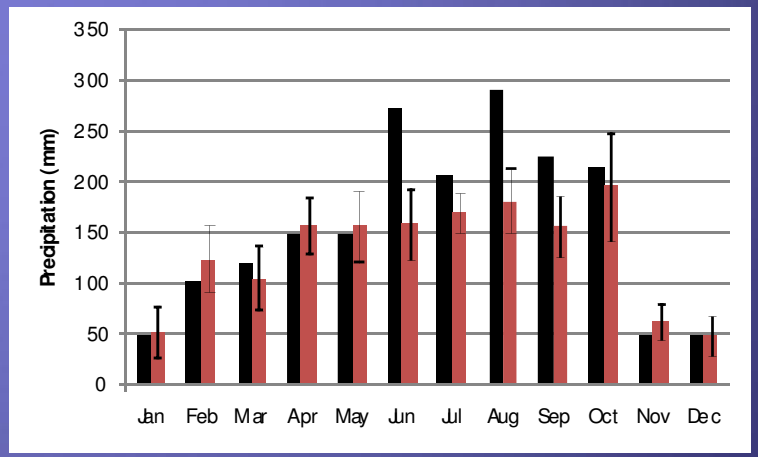


Downscaling daily rainfall at Al-Udein





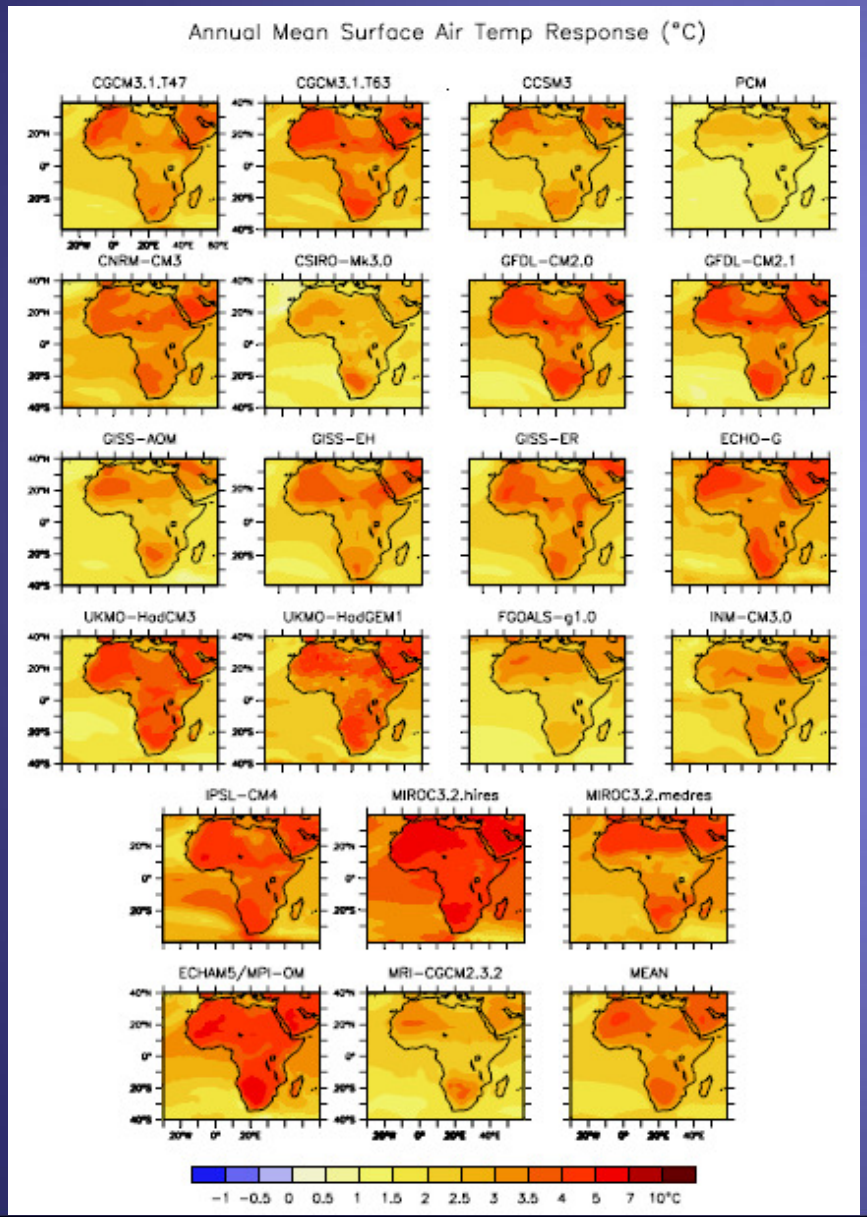


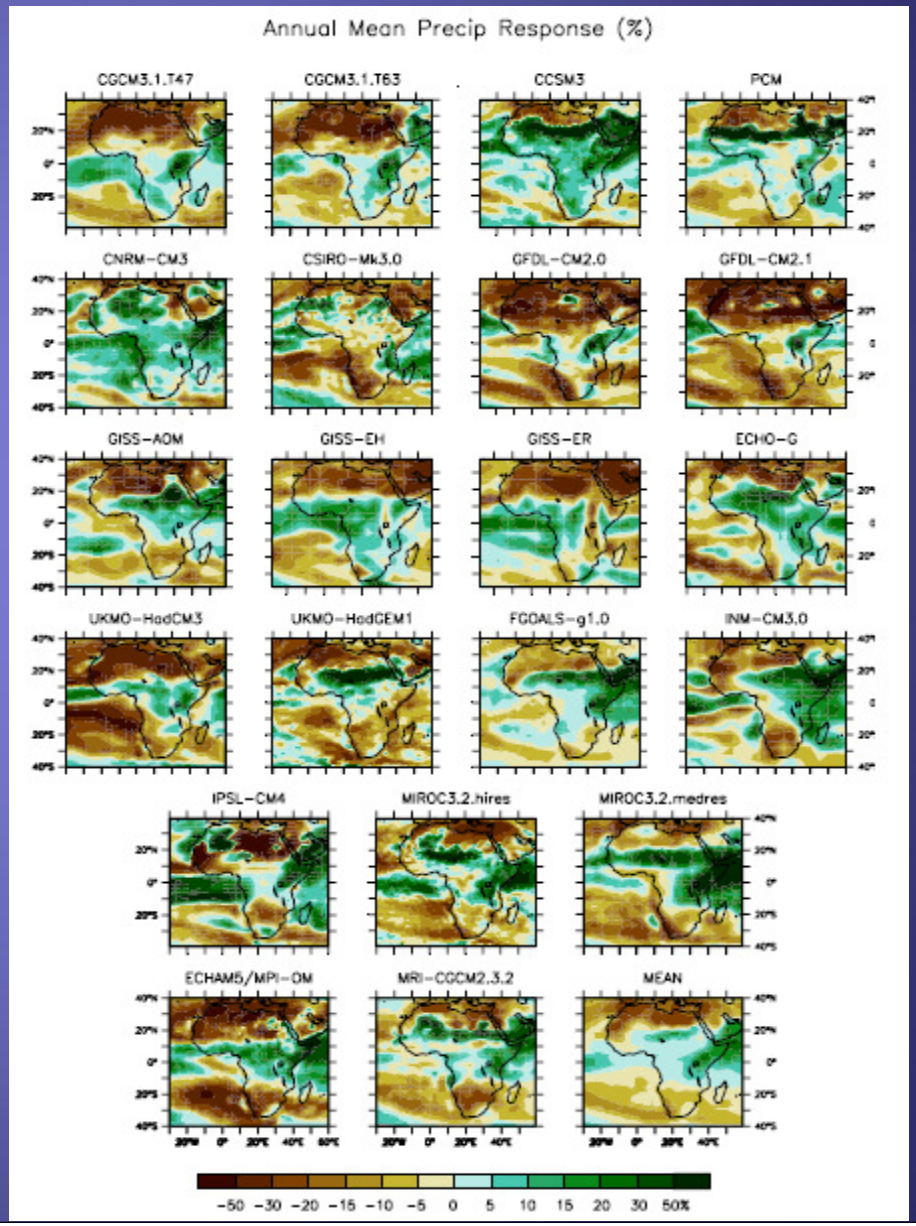


Observed (black) and downscaled (red) monthly rainfall metrics for the period 1961 2000: wet day probability (top left), total rainfall (top right), 95th percentile wet day total (bottom left) and maximum 5 day totals (bottom right). T bars show standard errors of the ensemble.

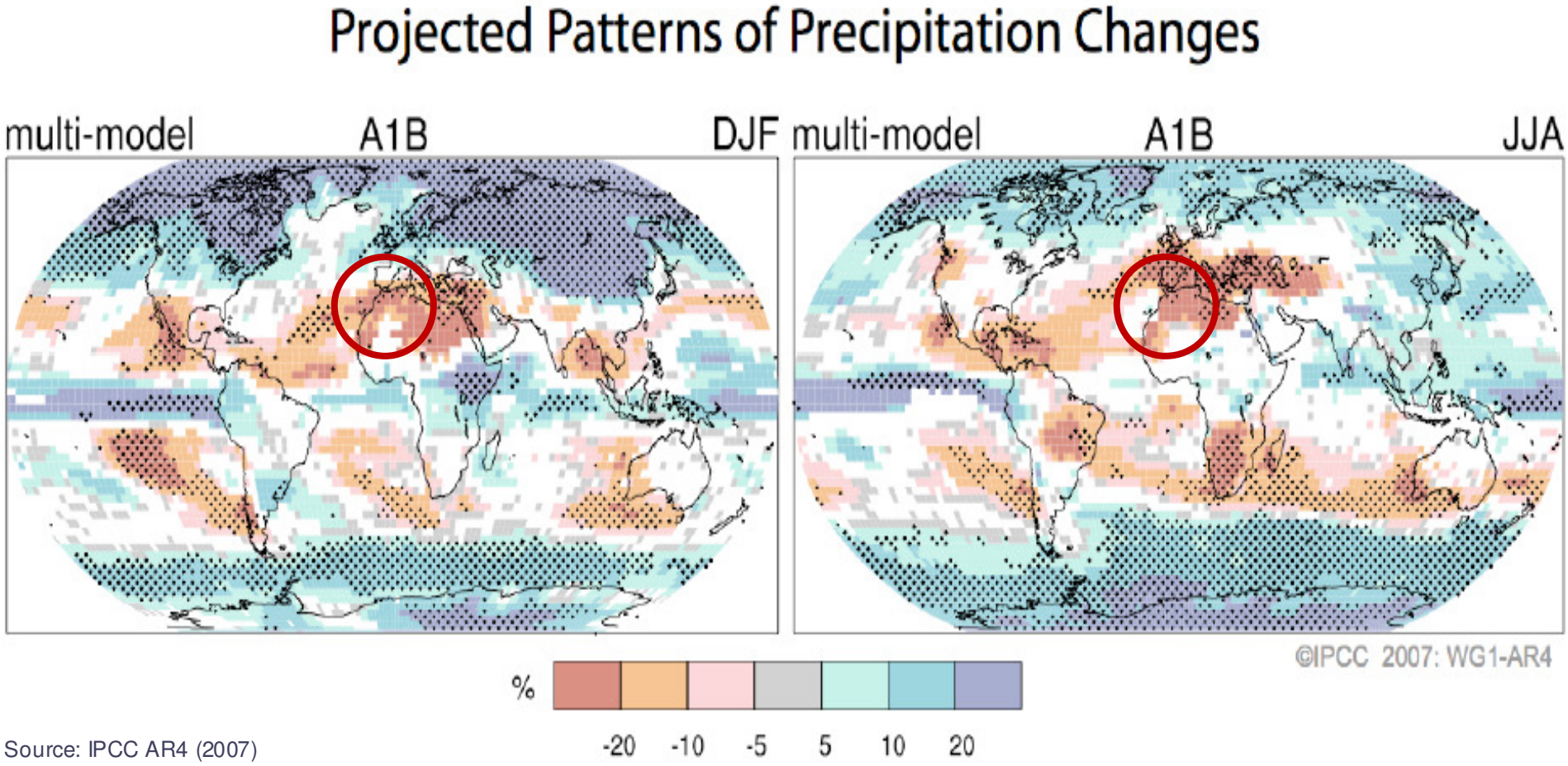
Modelling the future climate

IPCC FAR climate model ensemble



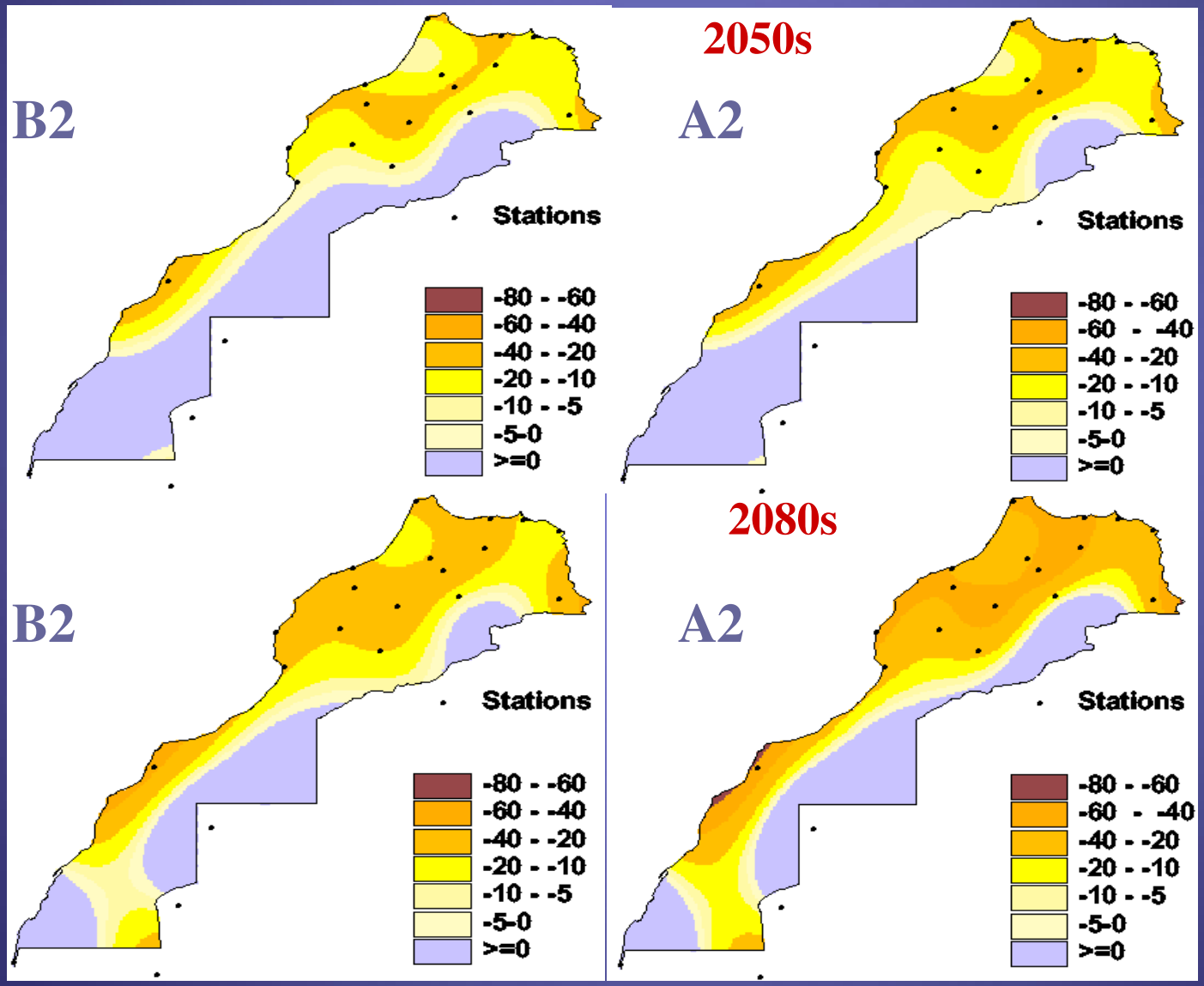


“Top down” approaches make sense where the map is coloured



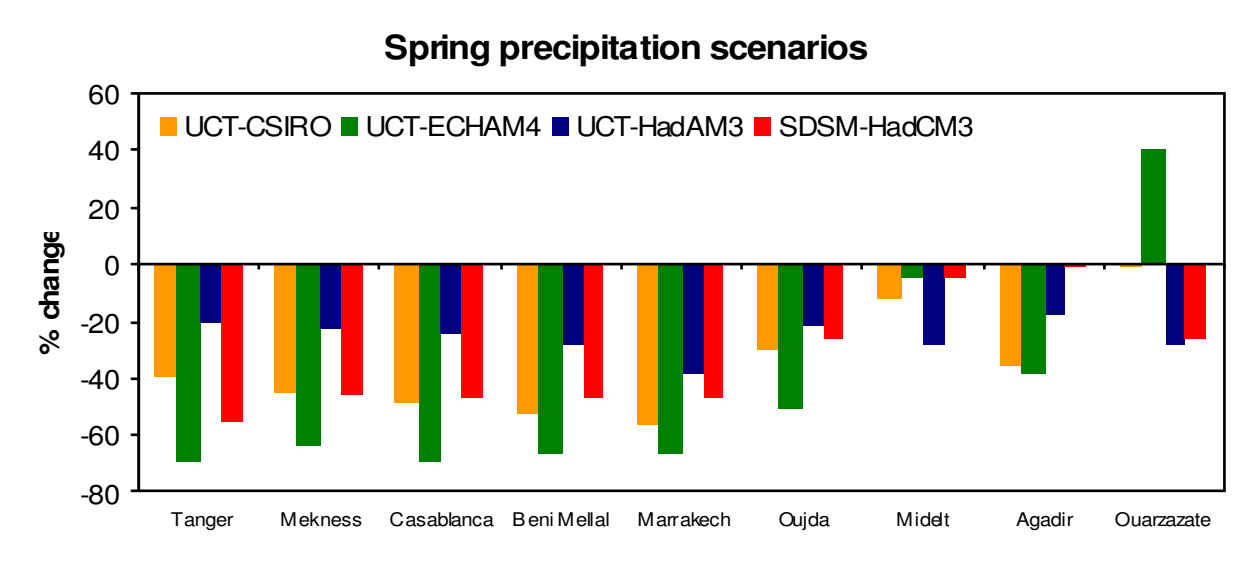
Source: IPCC AR4 (2007)

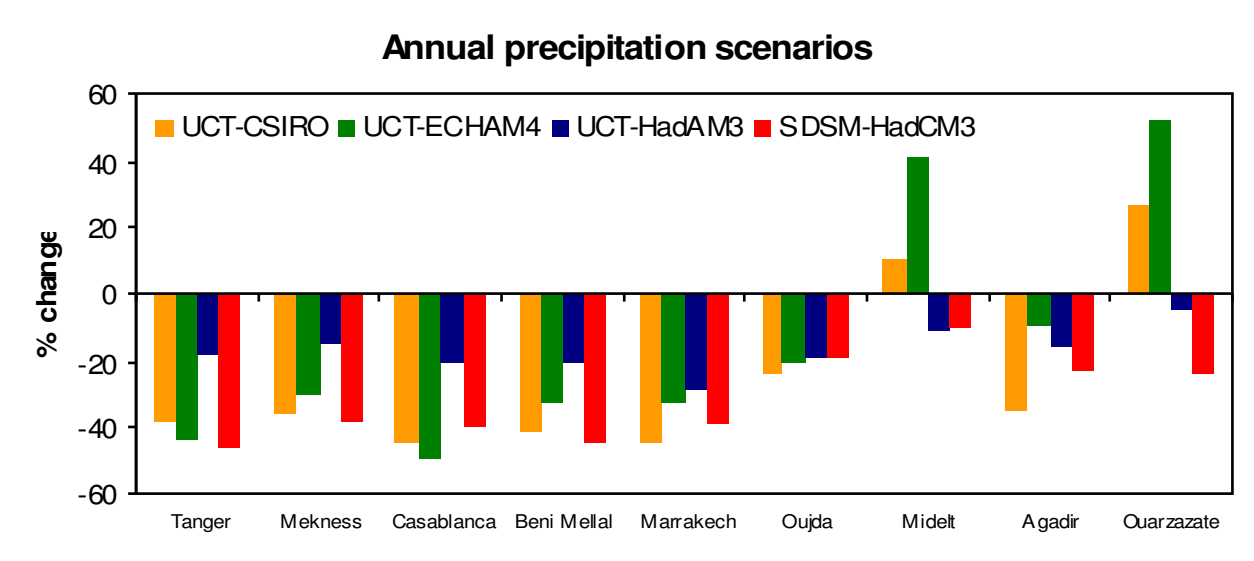
“Top down”: projections under SRES A2 and B2



Source:
DMN (2008)

Decisions must still be robust to uncertainty

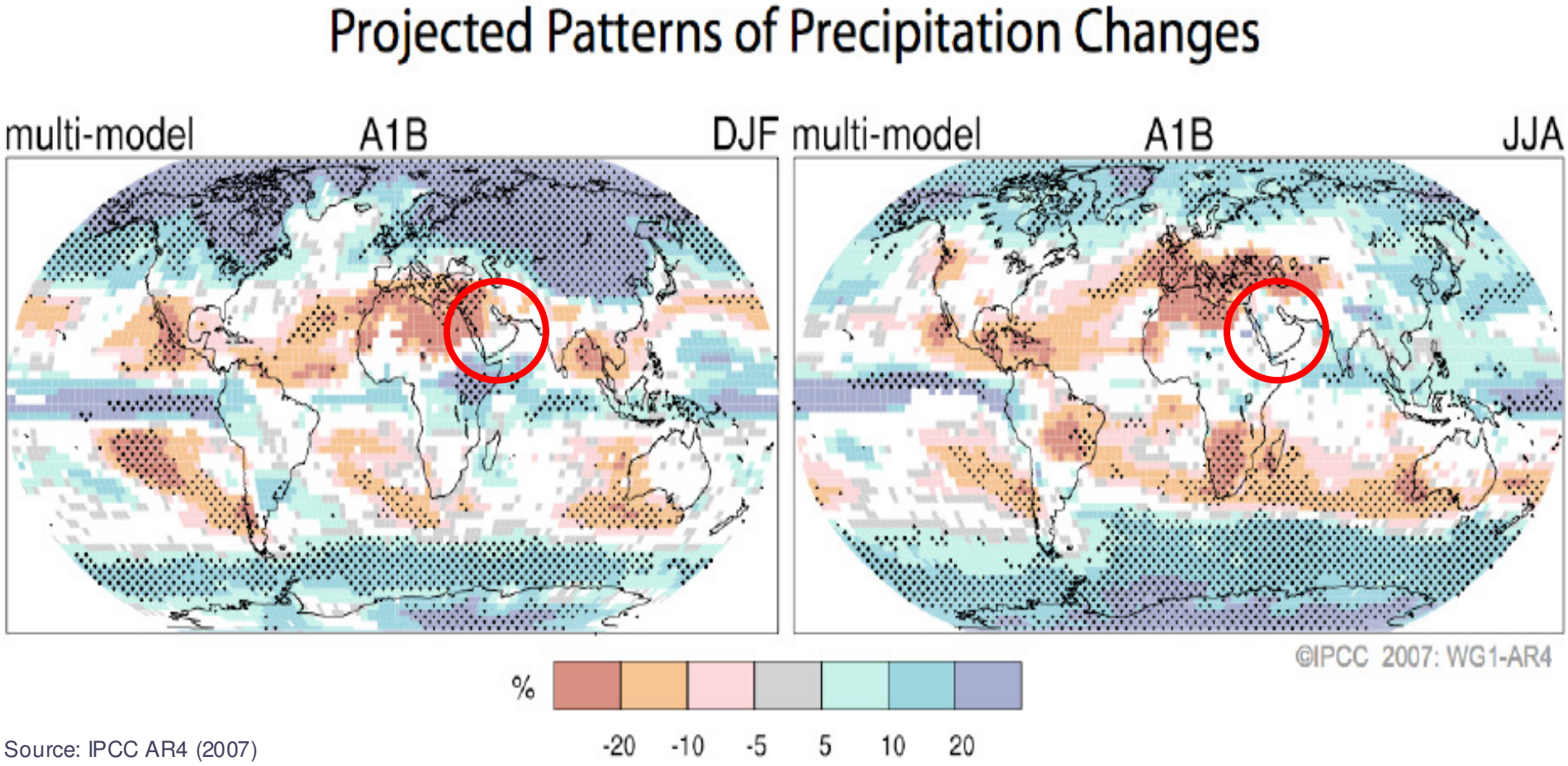




Projected changes in spring and annual precipitation totals for the 2080s for two downscaling methods (UCT, SDSM) and three climate models (CSIRO, ECHAM4, HadCM3) under A2 emissions

Source: Wilby & DMN (2007)

“Bottom up” approaches make more sense where the map is blank



Source: IPCC AR4 (2007)

Bottom up: “low regret” adaptation options

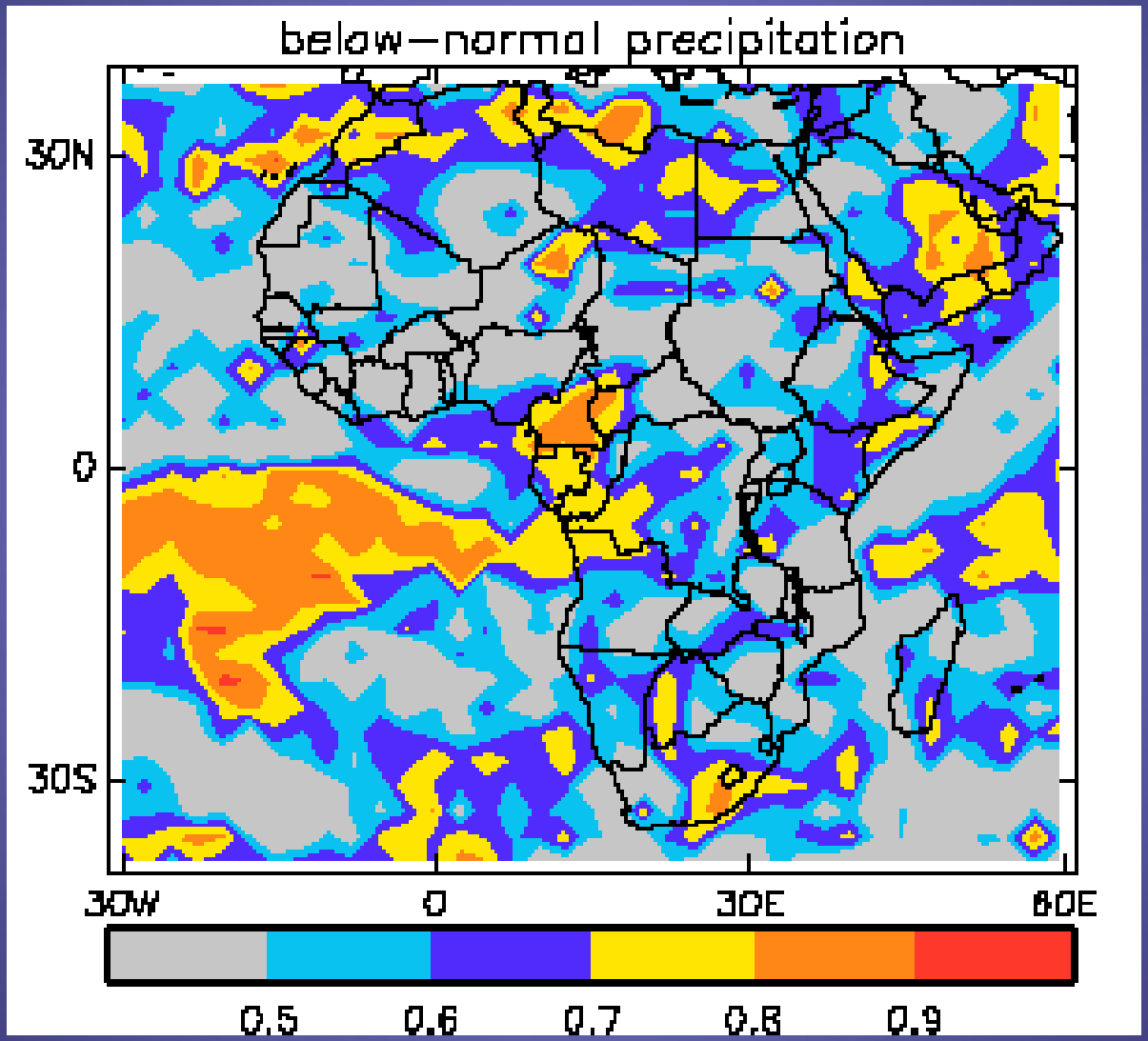
Science and climate risk information

- Data rescue and digitization
- Monitoring baseline & environmental change (indicators)
- Improve surface and groundwater resource models
- Improve scientific understanding of regional climate controls
- Develop real-time, seasonal and decadal forecasting capability

Water management

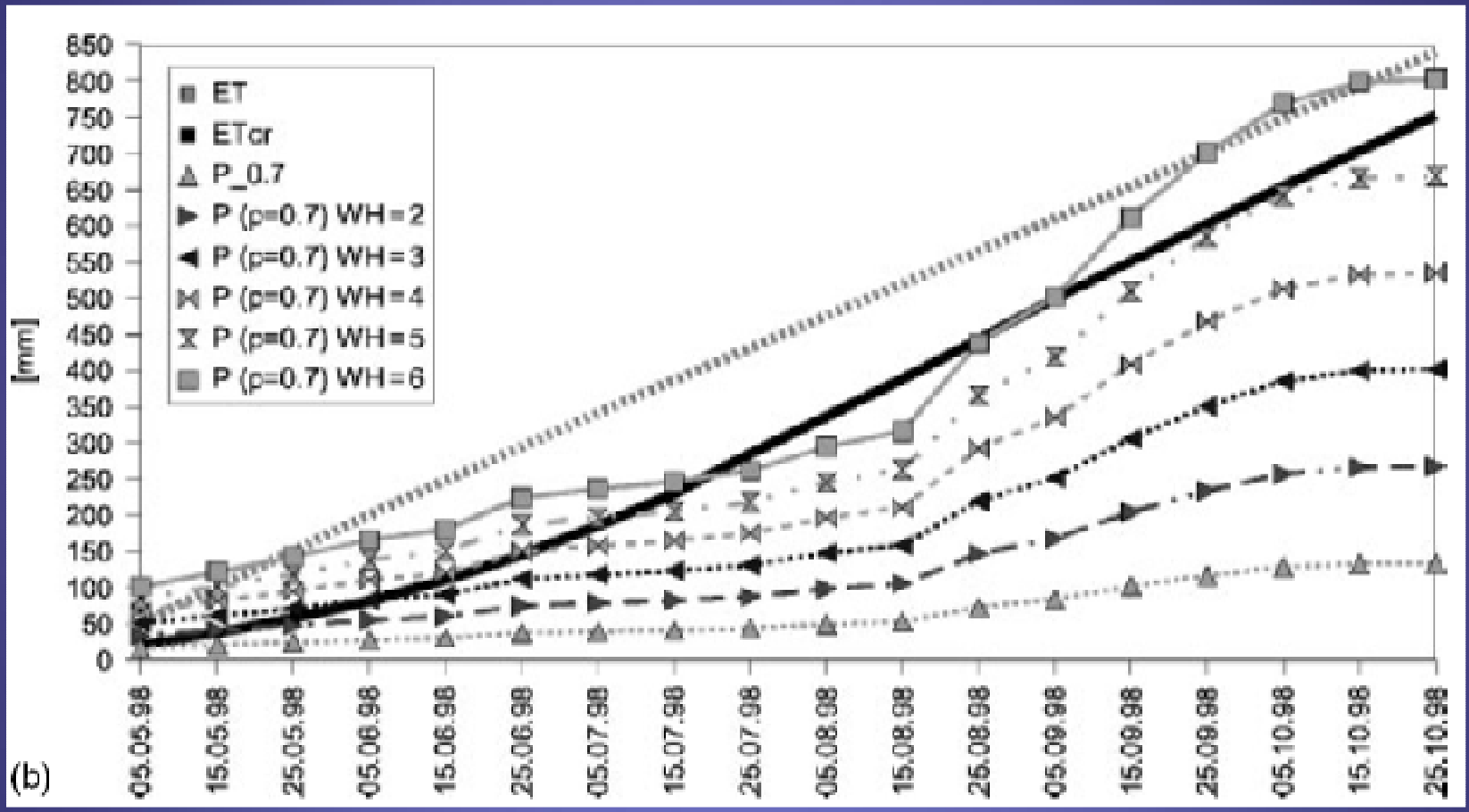
- Improved water governance
- Source protection from pollution and salinization
- Agricultural (and urban) drainage water re-use
- Asset management and maintenance (leakage control)
- Increased water efficiency (domestic, agriculture, industry)
- Faster growing and/or more drought resistant crop cultivars
- Traditional water harvesting and storage techniques

Seasonal forecasts of precipitation anomalies



ROC scores for April June forecast issued in March. Source: UK Met Office

Water harvesting areas for rain-fed agriculture



Cumulative sorghum water need (Etcr) compared with rain fed supply from different water harvesting (WH) areas, to meet crop demand 2 years in 3 (p 0.7)
Source: Rappold (2005)

Concluding remarks

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- Rainfall in semi-arid regions severely tests model capabilities
- Water scarcity is already an issue
- Climate change will be a “multiplier” of existing risks
- Scenario-led adaptation may not be sensible everywhere
- Despite uncertainty there are still “low regret” options

Gracias para su atención!

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Acknowledgements
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Photo: Bull (1930)