MENA REGION – SUMMARY OF CURRENT AND PROJECT CLIMATE TRENDS

Rob Wilby, Climate Change Science Advisor, 5 July 2008 (Tel. +44 56018 77522)

1. Introduction

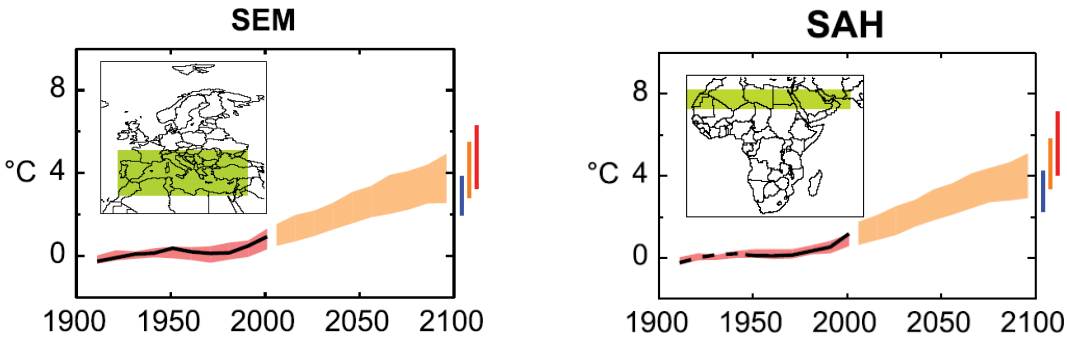
This note provides a few summary paragraphs describing current trends in rainfall, temperature and associated impacts for the MENA region, taking into consideration the quality of underlying meteorological data sets and published research. Comparable information is provided for regional climate change projections, drawing largely from the climate model experiments reported in the IPCC Fourth Assessment Report, and work recently supported by the World Bank. Statistics are also provided on the percentage of population residing in urban areas, recognising the high vulnerability of the urban poor to climate risks. Supporting literature and evidence are provided in accompanying Annexes.

2. Current climate and trends

Long-term, systematic records of precipitation and temperature are very scarce in the MENA region. Data are often tied to specific projects such as irrigation schemes, or to short-lived monitoring campaigns. Evaluation of extreme events is especially problematic.

MENA region temperatures are moderated by elevation, and in coastal areas, by proximity to the sea. Even by global standards, North Africa and the Middle East have experienced rapid warming (especially in summer). There have also been reported declines in the number of cold nights. Observed rises in annual mean temperatures for the Mediterranean basin and North Africa as a whole fall within the range expected by the IPCC climate models given past emissions of greenhouse gases (Figure 1).

Figure 1 Temperature anomalies with respect to 1901-1950 for the Mediterranean basin (SEM) and the Sahara (SAH) land regions for 1906-2005 (black line) and the IPCC climate model ensemble (red envelope) under known forcing; and projected to 2100 under A1B (orange), B1 (blue) and A2 (red) emission scenarios. Source: Christensen et al. (2007).



Annual precipitation totals of arid- and semi-arid zones typically exhibit considerable spatial and temporal variability. Observations and climate reconstructions show that over multiple decades and century timescales the North Atlantic Oscillation (NAO) has been the dominant influence on large scale patterns of winter precipitation, river flow and surface temperature across the Middle and Near East. Winter rainfall over Southern Europe and North Africa has

declined since the 1970s as a consequence of a strongly positive phase in the NAO since that time. In southern parts of MENA, such as Yemen, summer monsoon rains are affected by the northward migration of the Inter Tropical Convergence Zone (ITCZ). In common, with the Sahel, this region has witnessed a decline in monsoon rainfall since the late 1960s.

Unfortunately, there are insufficient data for long-term trend analysis even of annual totals for much of the MENA region (see grey areas in Figure 2). Several notable high-intensity precipitation events and attendant societal impacts have been reported (e.g., Algeria in 2001, Morocco in 2002, Tunisia in 2003, Oman in 2007 – see Figure 3) but, again, observing networks are too sparse and records to short for formal trend detection in extremes.

Figure 2 Trend of annual land precipitation amounts for 1901 to 2005 (% per century) using the GHCN precipitation data set from NCDC. The percentage is based on the means for the 1961 to 1990 period. Areas in grey have insufficient data to produce reliable trends. The minimum number of years required to calculate a trend value is 66 for 1901 to 2005. An annual value is complete for a given year if all 12 monthly percentage anomaly values are present. Note the different colour bars and units in each plot. Trends significant at the 5% level are indicated by black + marks. Source: Trenberth et al. (2007).

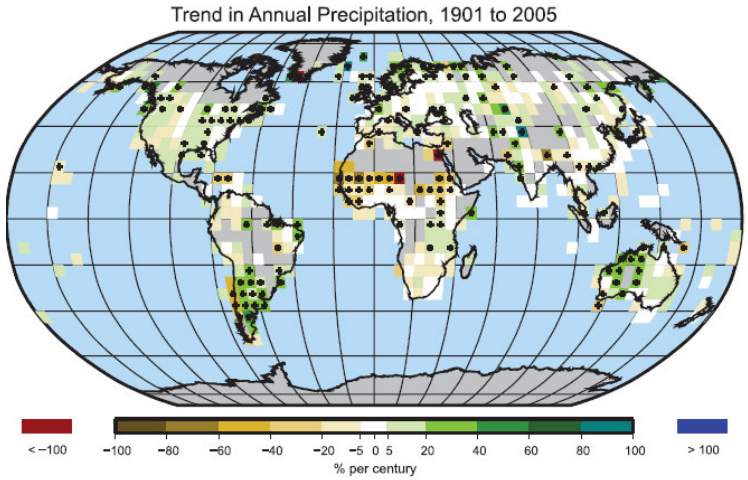
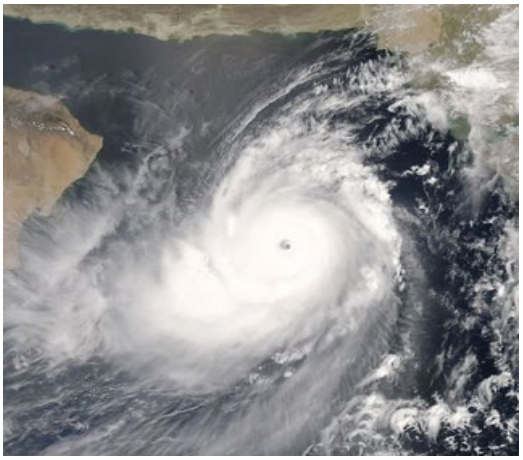


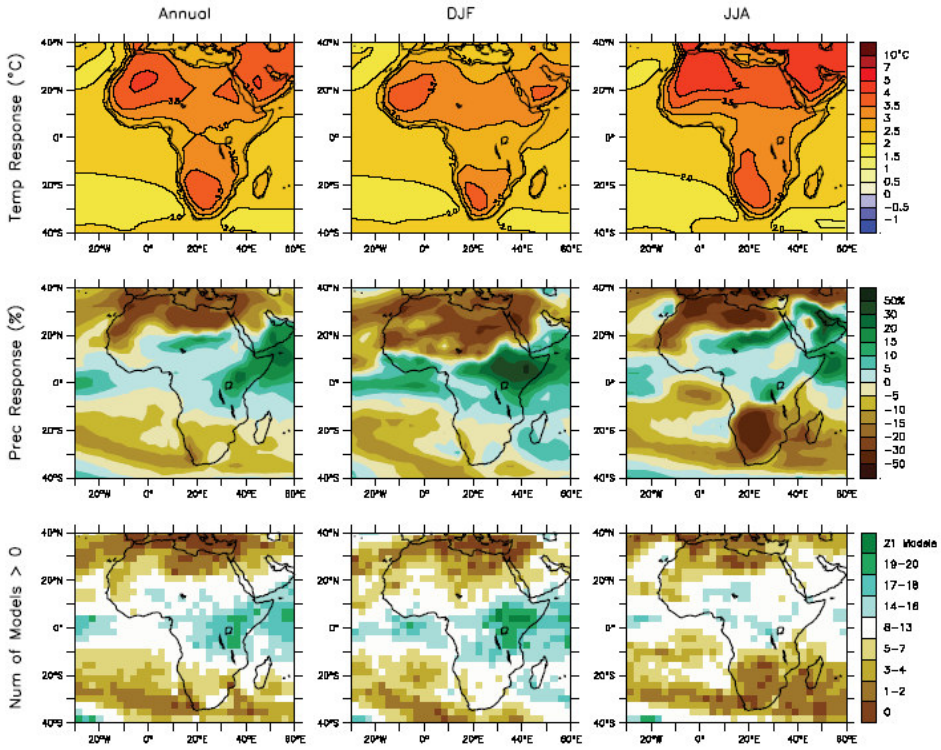
Figure 3 Tropical cyclone Guno which struck Oman on 6 June 2007. Sources: http://omaniidiot.blogspot.com/2007/06/cyclone-guno-to-hit-oman.html (left panel) http://www.andy-coates.com/blog/2007/06/15/tropical-cyclone-visits-oman-aftermath-pictures/ (right panel)



3. Future climate projections

Africa is expected to experience more rapid warming than the global average during the 21st century, with the drier subtropics warming more than the moist tropics. The largest temperature changes in North Africa are projected to occur in summer (Figure 3). Annual rainfall is expected to decrease over Mediterranean Africa and the northern Sahara. The annual number of precipitation days is very likely to decrease and the risk of summer drought is likely to increase around the Mediterranean basin (Figure 4).

Figure 4 Temperature and precipitation changes over Africa under SRES A1B emissions. Top row: Annual mean, winter (DJF) and summer (JJA) temperature change between 1980-1999 and 2080-2099, averaged over 21 climate models. Middle row: same as top, but for fractional change in precipitation. Bottom row: number of models out of 21 that project increases in precipitation. Source: Christensen et al. (2007).



Overall, there is a tendency for climate models to simulate a shift to more positive NAO conditions in the future, implying long-term reductions in rainfall over North Africa and the Middle East (Figure 4). However, there are large differences between individual models (for example, CCSM3 and PCM suggest increased annual rainfall over much of the Arabian Peninsula [Annex 2]). Uncertainty in regional rainfall projections is further compounded by the large inter-annual variability which is expected to dominate over anthropogenic trends during the first half of the 21st century.

The World Bank has been piloting a web-based climate scenarios portal for the MENA region (see: http://go.worldbank.org/NT4CG9W6K0). If Phase II of the project is supported, the tool will weight scenarios originating from different climate models and downscaling techniques, as well as provide "point-and-click" access to ensembles of daily temperature and precipitation series at individual meteorological stations across the region. Preliminary testing suggests that the tool can also be used to reconstruct/infill missing data.

4. Rural and urban populations

The MENA region has no standard definition, so the World Bank list is applied here. "Urban" is defined as the population living in towns of 2000 or more, or in national and provincial capitals. On this basis, the percentage of population urbanised ranges from 26% in Yemen, to ~100% in Bahrain, Kuwait and Qatar.

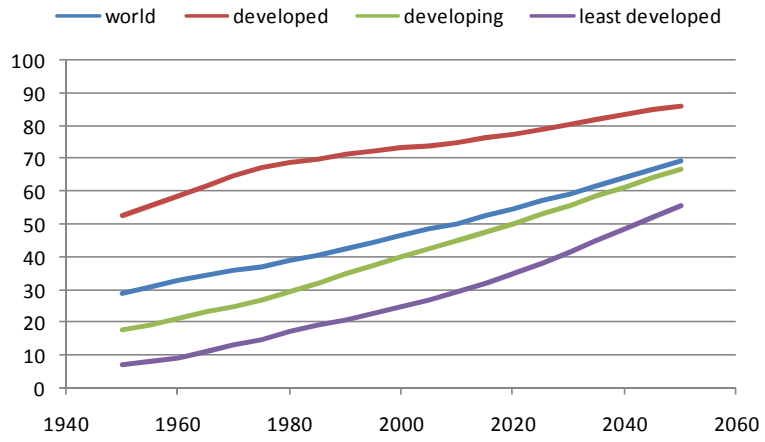
Table 1 Percentage of population living in urban areas in 2007

Country	Urban (%)	Country	Urban (%)
Algeria	58	Libya	85
Bahrain	100	Morocco	55
Djibouti	82	Oman	71
Egypt	43	Palestine	NA
Iran	67	Qatar	100
Iraq	67	Saudi Arabia	81
Israel	92	Syria	50
Jordan	82	Tunisia	65
Kuwait	98	UAE	74
Lebanon	87	Yemen	26

Source: Population Reference Bureau, 2007 World Population Data Sheet, available at: http://www.prb.org/Publications/Datasheets/2007/2007WorldPopulationD....

At present, roughly 50% of the world's population live in cities, but this figure is expected to rise to more than 60% over the next 30 years. Most of the future growth of the urban population is anticipated in the developing world (Figure 5). There is growing recognition that urban populations of many low-income countries are already vulnerable to shortages of clean drinking water and poor sanitation, poor air quality and heat stress, and often occupy high-risk areas such as floodplains and coastal zones. Without adaptation measures, climate change is expected to exacerbate these problems.

Figure 5 Global urbanization trends (% urbanised)



Data source: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, *World Population Prospects: The 2006 Revision* and *World Urbanization Prospects: The 2007 Revision*, http://esa.un.org/unup, Saturday, July 05, 2008

Supporting materials

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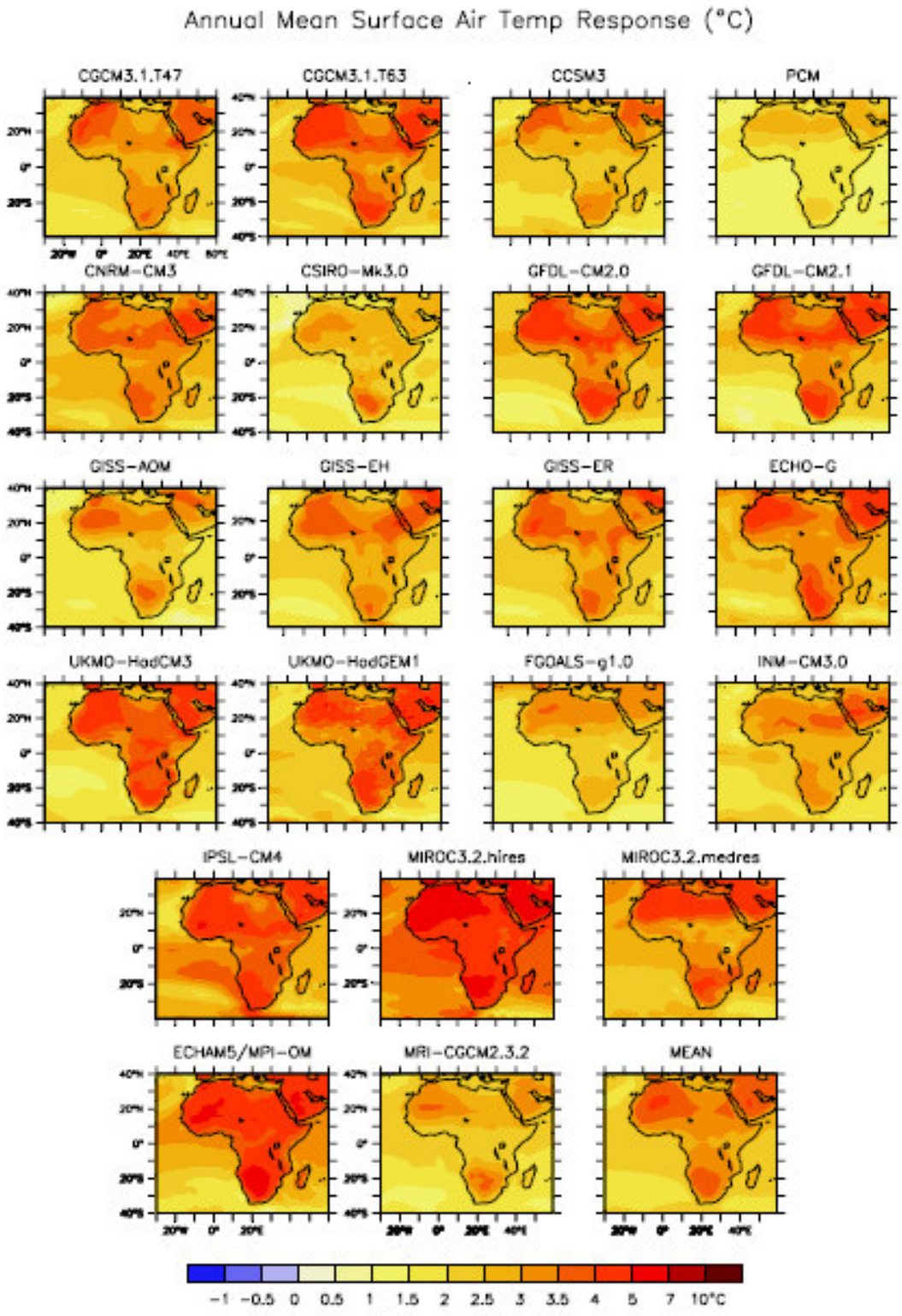
Annex 1 The annual mean temperature response in Africa in 21 MMD models. Shown is the temperature change from the years 1980-1999 to 2080-2099 under the A1B scenario, averaging over all available realizations for each model. The change averaged over all models is shown in the lower right hand corner. Source: http://www.ipcc.ch/ipccreports/ar4-wg1.htm



Annex 2 As in Annex 1 but for annual precipitation. Source: http://www.ipcc.ch/ipccreports/ar4-wg1.htm