REGIONAL CLIMATE CHANGE PROGRAMME

SOUTHERN AFRICA

RESEARCH BRIEF 13

Rainfall and temperature projections for southern Africa

Global warming will cause warmer temperatures over most of southern Africa. The outlook for rainfall is more varied because the way in which global circulation affects the tropical rain belts that brings much of the region's summer rainfall is less well understood. Some wetting is expected in the north and east, and drying in the south-west.

Global warming affects climate over southern Africa

Greenhouse gas (GHG) emissions through human activity are expected to increase global average temperatures by 2–5.4°C by 2100 (SRES A2 Emissions Scenario: IPCC, 2007). Emissions scenarios are estimates of GHG emissions that could be emitted according to views of future economic activity. Warming may shape future southern African climate variation by controlling the El Niño Southern Oscillation (ENSO) in the Pacific Ocean. ENSO affects the position of the Inter-tropical Convergence Zone (ITCZ) over southern Africa during summer, which in turn influences seasonal rainfall and temperature. The location of the ITCZ is already the driver of much variability of southern African rainfall. During an El Niño phase of ENSO, southern Africa usually experiences drought as the ITCZ moves north and east. During a La Niña phase, the ITCZ moves further south and much of southern Africa experiences a wet period with flooding. This link between ENSO and wet and dry phases brings a measure of, but not full, predictability.

Projected rainfall changes

Global Circulation Model (GCM) multi-model predictions indicate a general wetting trend in the north-eastern parts of southern Africa (Tanzania, Malawi). In the far south-west (South Africa, parts of Namibia), conditions may become drier (Christensen *et al.*, 2007). The projections show a reduced rainfall for much southern Africa in winter (May – July), but increased annual rainfall in the north-eastern tropical regions linked to increasing summer rainfall. Small shifts in the tropical rain belts (the ITCZ in particular) could result in large changes in local rainfall.

The position of the ITCZ during the summer rainfall season is fundamental to the water situation in the major river basins (Congo, Zambezi, Okavango, Limpopo, Lake Malawi and Ruaha). How the dynamics of the ITCZ will be affected by future climate change as influenced by ENSO is not well understood. Seasonal shifts in rainfall can be expected in future. In the summer rainfall regions, the arrival of the first rains is likely to become more unpredictable and occur later than at present, but with more intensity.

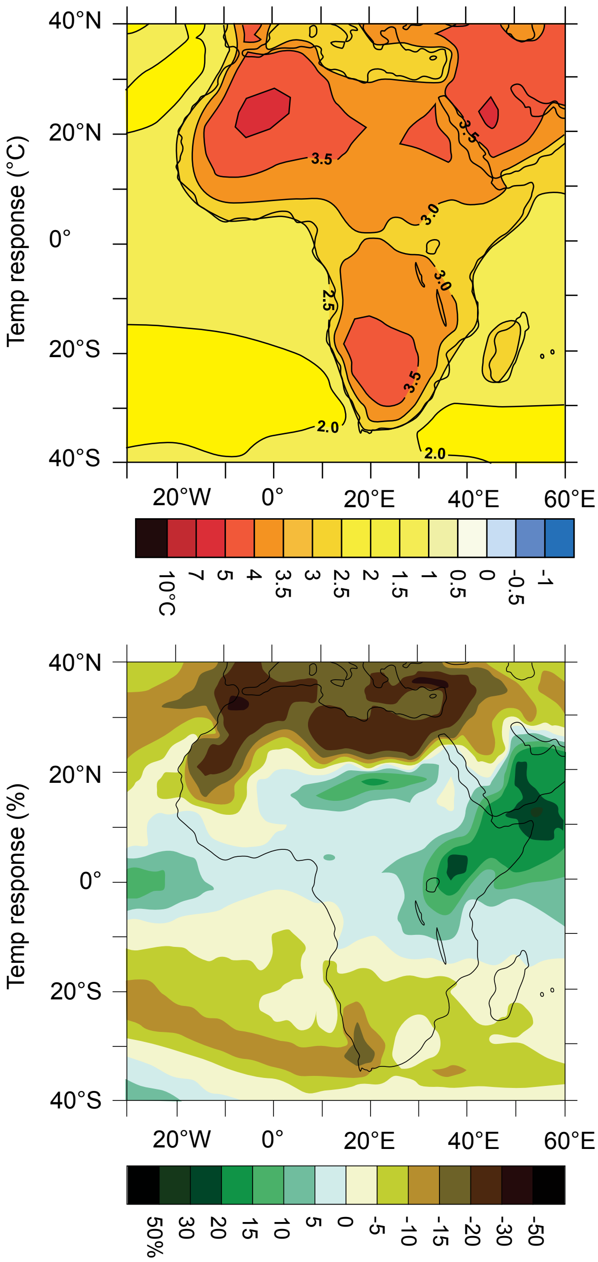

Figure 1: Projected annual temperature and precipitation changes in southern Africa from the multi-model MMD-A1B simulations (A1B Special Emissions Scenario), averaged over 21 models (Source: Christensen et al., 2007).

RCCP SOUTHERN AFRICA

The RCCP Research Briefs are aimed at the non-specialist reader and are intended to provide introductory information on key climate change issues in southern Africa. For more detailed information and analysis, please refer to the RCCP Knowledge for Adaptation series.

Regional temperature changes

Temperature projections to 2100 indicate that during summer, warming is likely to be in the range 1.8 – 4.7°C, depending on the emissions scenario (IPCC-SRES) used, with a median projection of 3.1°C (Christensen *et al.*, 2007). For winter, warming is likely to be 1.9 – 4.8°C, with a median of 3.4°C. The inland countries (e.g. Botswana, Zambia, Zimbabwe and Malawi) show the strongest predicted warming, coastal regions show slightly less. Medium term regionally downscaled (finer resolution) climate change projections for SADC were developed by the Climate Systems Analysis Group at the University of Cape Town (Hewitson, 2007). They used 11 GCM projections together with the SRES A2 Emissions Scenario. These projections show a broad convergence with the GCMs but with local variations. Mean temperatures are expected to increase by an average of 2°C and possibly 3 – 4°C by around 2065, but warming could be higher during late winter and early spring (Hewitson, 2007). The number of hot days and hot nights is likely to increase, heatwaves become more damaging and maximum temperatures endure for longer.

Localised changes to weather

The power of tropical cyclones in the south-west Indian Ocean is increasing as warmer ocean waters increase atmospheric water content (Webster *et al.*, 2005). This trend affects the Mozambican coastline and neighbouring countries. The intensity of local or short duration (1-day) storms should increase because warmer air holds significantly more moisture while dry periods are likely to become longer. This effect is already being widely observed (New *et al.*, 2006).

Uncertainty around climate projections

There is high certainty of increases in air temperature. GCM projections of future rainfall are much more uncertain (-25% to +15% from the current mean). Only the projections for the south-western parts (mostly drying) and the north-eastern portions (mostly wetting) show agreement on the direction, but not magnitude, of change (Christensen *et al.*, 2007). Also, GCMs are poor at simulating the different ENSO phases, reflecting an uncertainty about future ITCZ dynamics. These uncertainties need to be resolved before credible model-based vulnerability assessments can be developed to guide adaptation decision taking.

Planning decisions, or adaptations, should keep these uncertainties in mind. For example, a sensitivity study of a Batoka Gorge, Zambezi hydropower proposal used a range of rainfall projections, from -20% to +20% of mean precipitation. As the IPCC Technical Paper 6 notes (Bates *et al.*, 2008), the appropriate model-based tools are not yet available for evaluating climate change adaptation options across multiple

Intense, unpredictable storms with heavy rain will increasingly impact heavily on informal settlements. Limete District, Kinshasha, DRC.

water-dependent sectors. However, the value of employing a scenario-based approach for impact and adaptation studies, covering the range of probable projections, has been demonstrated by the RCCP and other researchers.

References

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