Climate and southern Africa's water-energy-food nexus

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- Seasonal forecasting
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- Impacts
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Climate and southern Africa's water–energy–food nexus

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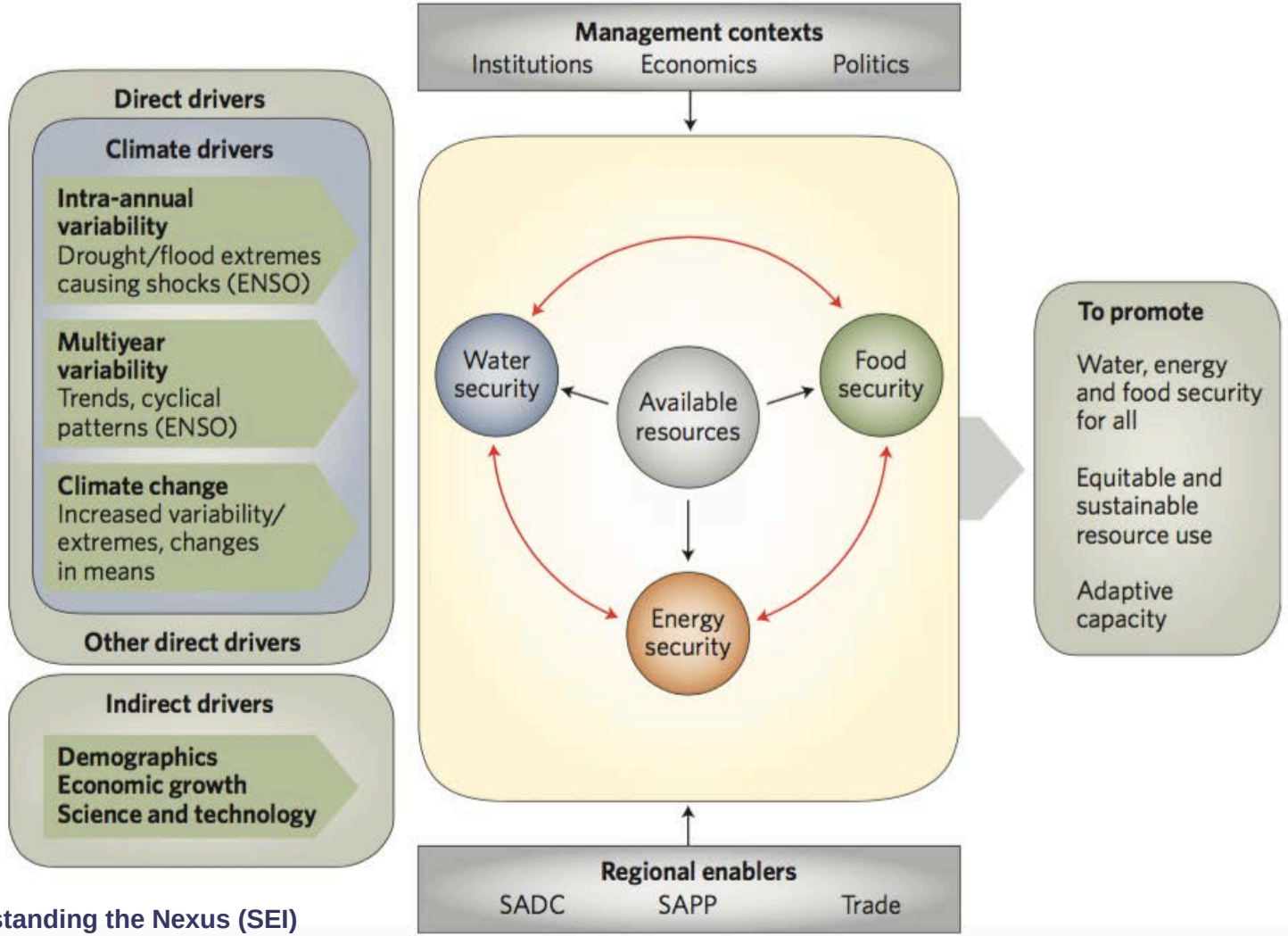
In southern Africa, the connections between climate and the water–energy–food nexus are strong. Physical and socioeconomic exposure to climate is high in many areas and in crucial economic sectors. Spatial interdependence is also high, driven, for example, by the regional extent of many climate anomalies and river basins and aquifers that span national boundaries. There is now strong evidence of the effects of individual climate anomalies, but associations between national rainfall and gross domestic product and crop production remain relatively weak. The majority of climate models project decreases in annual precipitation for southern Africa, typically by as much as 20% by the 2080s. Impact models suggest these changes would propagate into reduced water availability and crop yields. Recognition of spatial and sectoral interdependencies should inform policies, institutions and investments for enhancing water, energy and food security. Three key political and economic instruments could be strengthened for this purpose: the Southern African Development Community, the Southern African Power Pool and trade of agricultural products amounting to significant transfers of embedded water.

Numerous challenges coalesce to make southern Africa emblematic of the connections between climate and the water–energy–food nexus, which has important economic influence throughout the region. Physical and socioeconomic exposure to climate is high in socioeconomically vulnerable areas and crucial sectors, such as agriculture, but also in energy generation and mining. For example, almost 100% of electricity production in the Democratic Republic of Congo (DRC), Lesotho, Malawi and Zambia is from hydropower. Hydropower further comprises a major component of regional energy security through extensive sharing as part of the Southern African Power Pool (SAPP). The region's population is concentrated in areas exposed to high levels of hydrometeorological variability[1] and is projected to roughly double by 2050[2]. Of the 13 mainland countries and Madagascar (Table 1) that comprise the Southern African Development Community (SADC), six are defined as low income, three as lower-middle income and four as upper-middle income, according to the World Bank classification (using 2012 gross national income per capita). There are few quantified examples of the links between climate and economic activity in the region, although South Africa experienced a decrease in gross domestic product (GDP) in the 1983 El Niño year[3], and forecasting has been the subject of many studies in sub-Saharan Africa (SSA)[4,5] and the Southern Africa Regional Climate Outlook Forum provides advance information about the likely character of seasonal climate. Yet, despite more than a decade of research on hydrological applications of seasonal forecasts, there is limited evidence of their operational use in the water sector[6]. With ongoing climate change, annual precipitation, soil moisture and runoff are likely to decrease, while rising temperatures could increase evaporative demand in large parts of the region[10] (Fig. 1).

The past decade saw rapid growth in research and policy interest in natural resource scarcity, with water–energy–food interdependencies increasingly framed as a nexus, or resource trilemma. The Bonn nexus conference in 2011[11] is notable in this process of recognizing the complex interactions between sectors and resource systems, and the need to minimize the trade-offs and risks of adverse cross-sectoral impacts[11,12]. The nexus is increasingly prominent on policymakers' agendas, partly in relation to the post-2015 agenda for the sustainable development goals[13]. The private sector was another early promoter of the nexus concept[14] owing to growing associated risks affecting production security along supply chains, such as (but not exclusively) for water[15]. In southern Africa, for example, South

Presentation and figures from; Conway, D., et al., 2015. Climate and southern Africa's water-energy-food nexus. *Nature Climate Change*, *5*(9), pp.837-846.

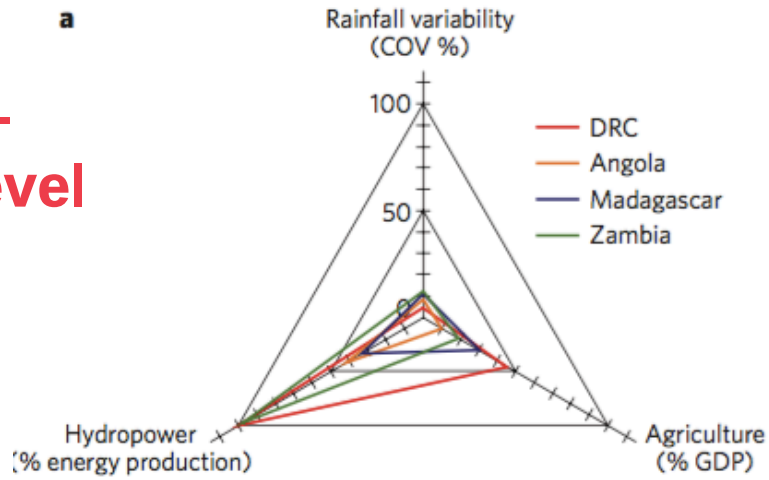
Climate and the nexus

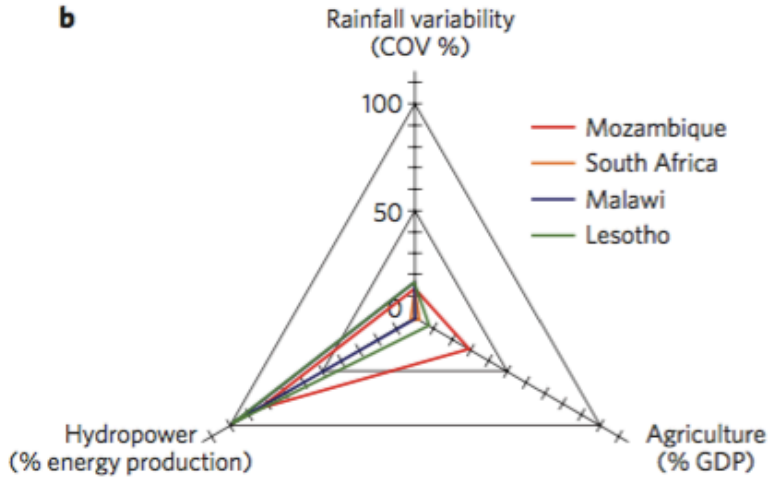


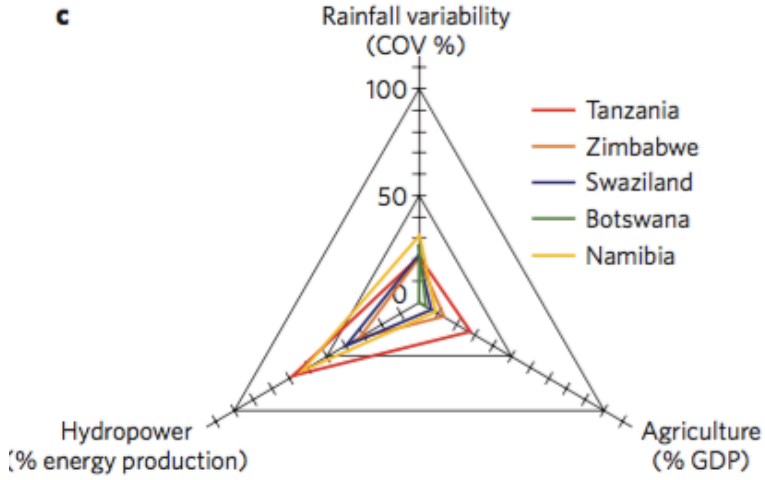
Adapted from Hoff, 2011 Understanding the Nexus (SEI)

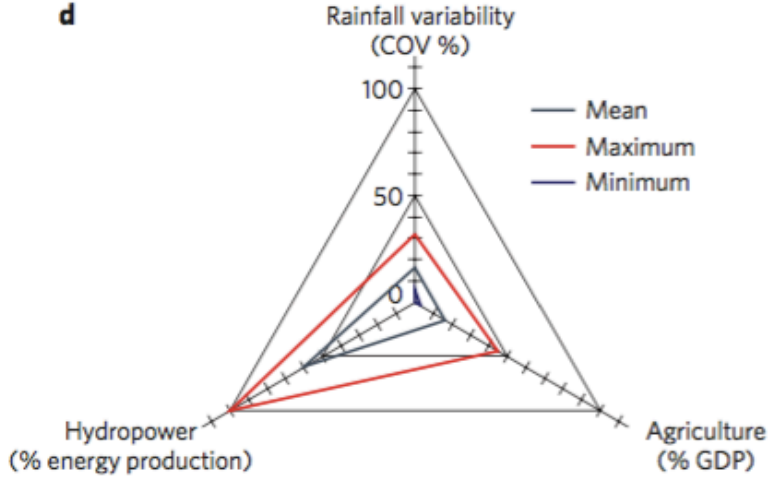
Exposure to climate variability

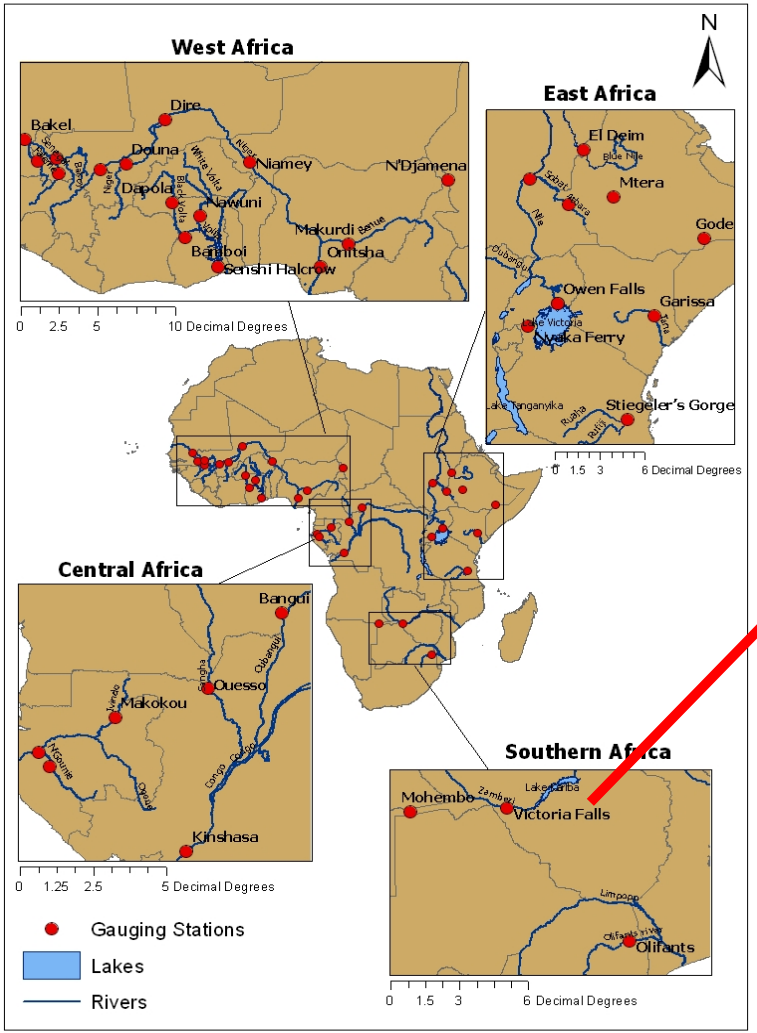
Exposure – national level

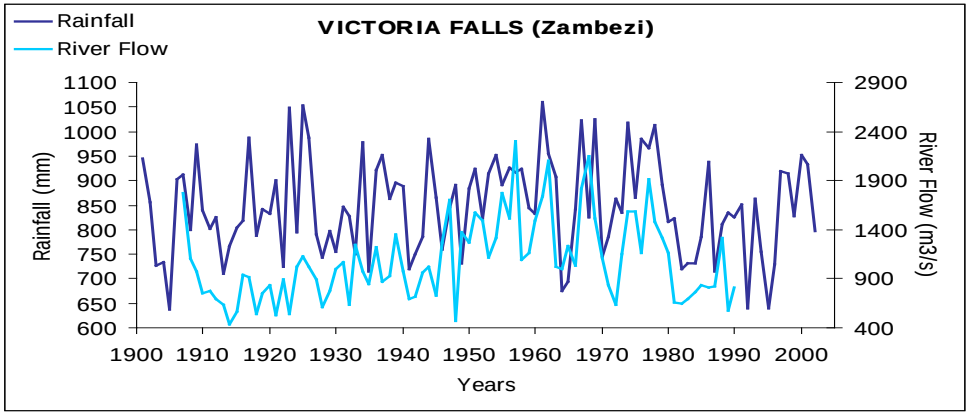






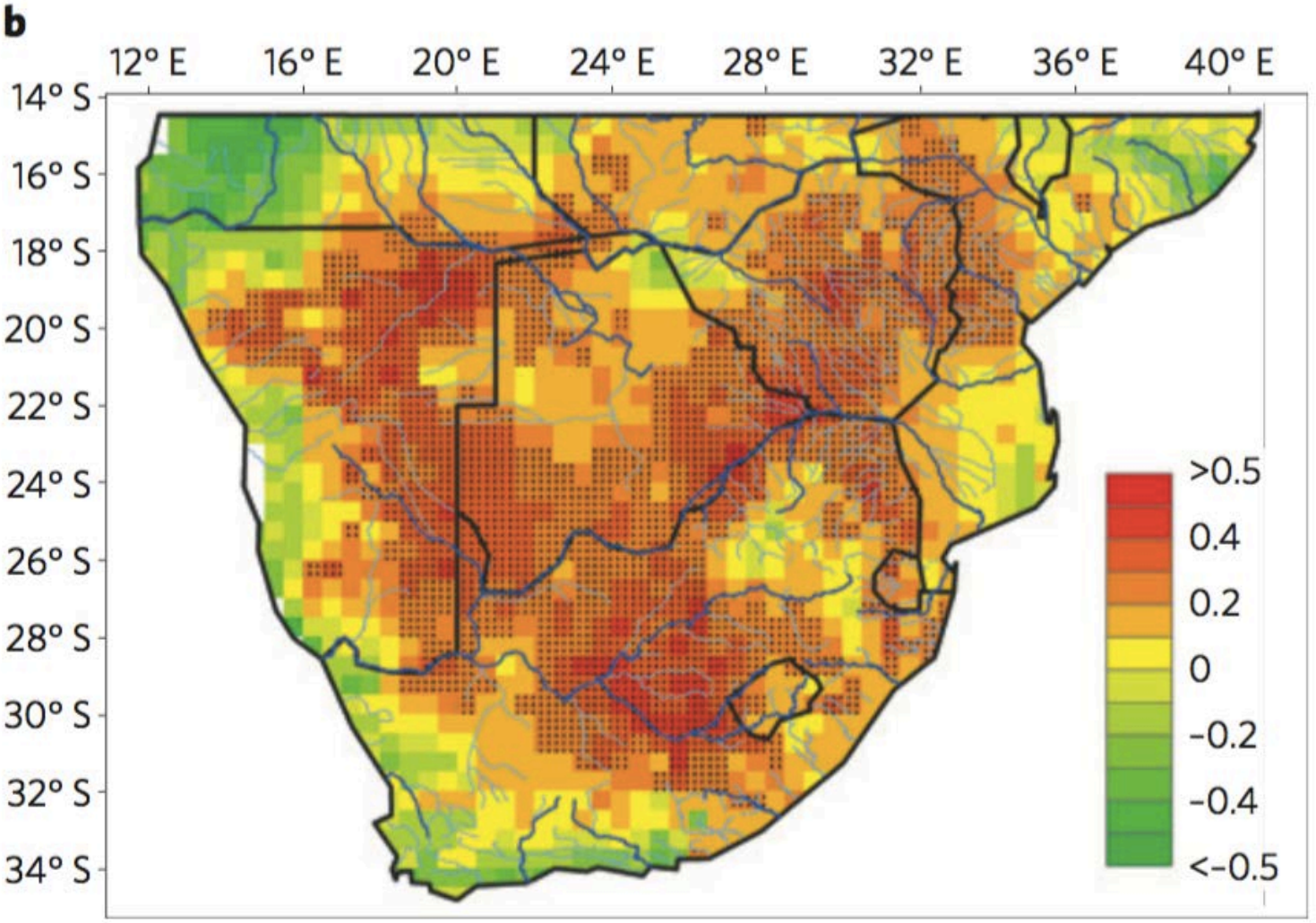






Conway D, et al. Rainfall and water resources variability in sub-Saharan Africa during the 20th century. J Hydrometeorol 2009, 10:4 59. doi:10.1175/2008JHM1004.1.

Seasonal forecasting



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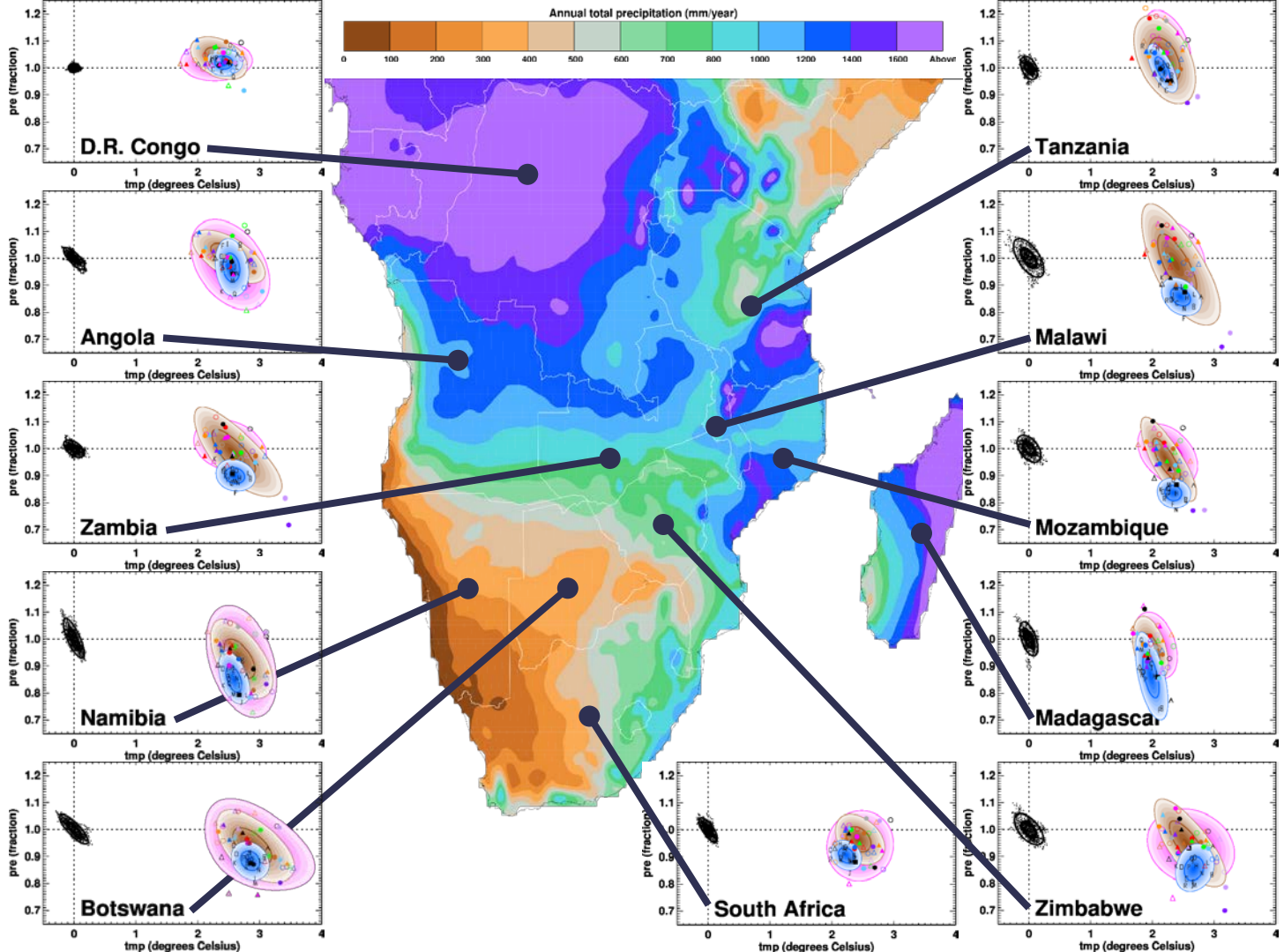
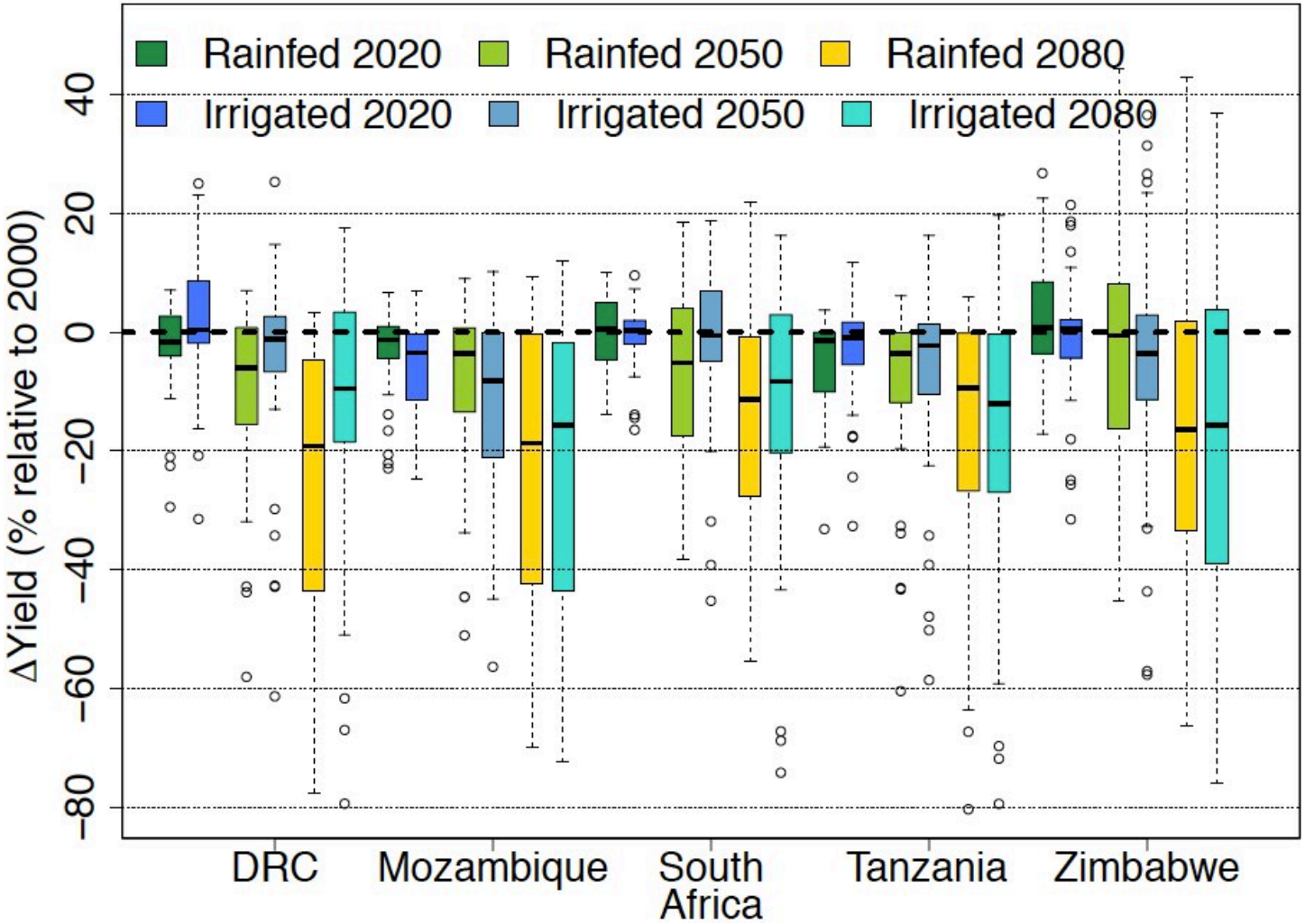
Climate scenarios

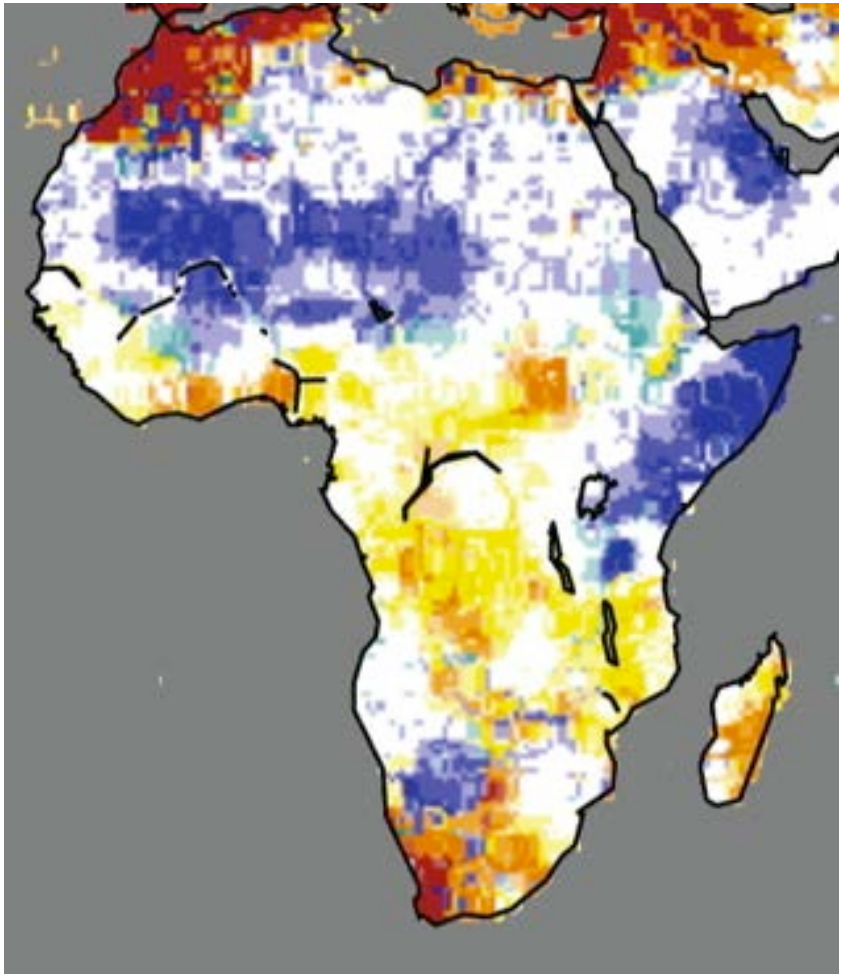

Annual total precipitation (mm/year)
0
100
200
300
400
500
600
700
800
1000
1200
1400
1600
Above
D.R. Congo
Tanzania
Angola
Malawi
Zambia
Mozambique
Namibia
Madagascar
Botswana
South Africa
Zimbabwe
pre (fraction)
tmp (degrees Celsius)

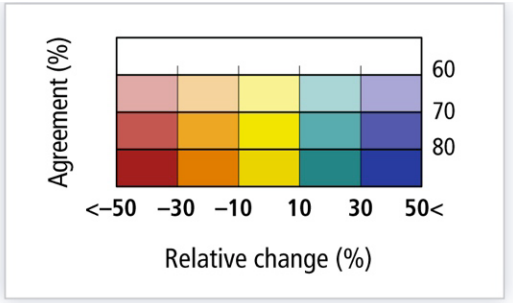
Climate impacts

Impacts – maize yield from global crop models



Impacts – multi-model change in discharge, 2 °C warming





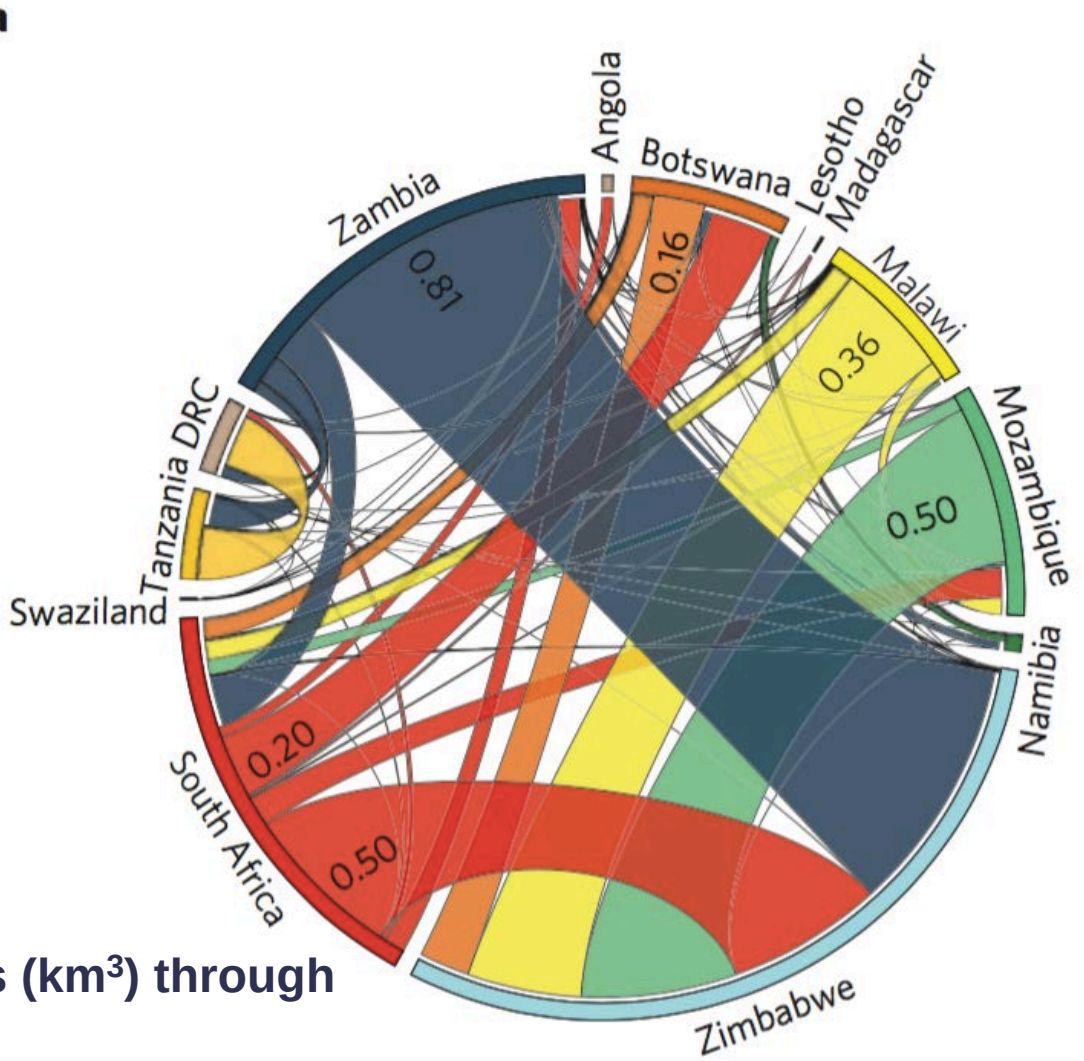
Color hues show the multi-model mean change, and saturation shows the agreement on the sign of change across all GHM–GCM combinations (percentage of model runs agreeing on the sign)

Schewe et al. (2013) Multi-model assessment of water scarcity under climate change. Proceedings of the National Academy of Sciences of the United States of America.

Regional governance mechanisms

Regional / transboundary instruments

- Trade
- Southern African Power Po
- SADC
- River basin organisations



Water resources transfers (km^3) through food trade in 2007

Variability and exposure - high
Climate already a problem
Effects cut across nexus sectors

Thank you