Migration and climate change in Senegal

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Abstract.

In this study, we analyze the effects of climate changes on migration through a conceptual analysis applied to a specific case study. In the first part, we conduct a conceptual analysis by integrating demographic/social sciences models of migration with models and information derived from climate sciences. In the second part, we conduct an empirically driven analysis on the case of Senegal. A developing country, with a relatively large diaspora, Senegal is expected to experience sea level increase, changes in temperature and precipitation due to climate changes. To estimate the changes in temperature and precipitation we use Climate Wizard at 0.5 degrees with all available models and the three scenarios downscaled at the country level. For sea level increases, we use Vermeer and Rahmstorf (2009) global estimates for upper/lower limits combined with an estimate of local subsidence for Senegal. In order to estimate a migration model, we use World Bank survey on migration and remittances in Senegal (2009).

Extended abstract

Although the rate of population growth has slowed down in the recent years and there is a high probability it will stop growing in the near future (Lutz, Sanderson & Scherbov 2001), by 2050 world population is expected to reach 9.3 billion and population in the high fertility countries is expected to triple by 2100 (UN, 2011). While growth is most often highlighted as the only relevant dimension in the discussions relating population sustainability, other characteristics such as changes in household size and urbanization might also have an (even stronger) effect on the relationship between population and environment. As a recent cyber-seminar on *Population and Environment Network* showed, a large number of researchers and community leaders are pessimistic about the general sustainability of world population when climate change, urbanization, growth and increasing consumption generated by economic development are taken into account.

The relationship between population, on one hand, and climate change, on the other hand is reciprocal: while climate change has been shown unequivocally to be produced by human activities, on long term climate change will have a significant effect on human population. Climate change, for example, is expected to increase the risk of many extreme natural occurrences such as including flood, drought, and heat waves, which will affect crops, sea level and water supply of various human settlements (Li et al., 2009; IPCC, 2011). Changes in climate will add to the already present environmental problems in many part of the world such as drought, soil degradation and sea level rise (figure 1). Many developing countries are expected to feel a disproportionate share of these problems due to their geographical location, existing environmental degradation and lack of financial resources to cope with the changing climate. It is estimated that 83 million people already have felt the effects of environment and climate changes since 2000 (Piguet et al., 2011) and up to 250 million people are projected to be exposed to these effects in the next 10 years (IPCC, 2007).

Climate change is expected to have, directly or indirectly, a significant effect on human migration as well as the alteration of living conditions and access to food and water will enhance the risks of migration, exacerbate social conflicts, and destabilize communities. Between 25 million and 1 billion people are expected to be displaced by these changes by mid-century (IOM, 2009).

While climate change driven changes in the temperature, precipitations and sea level rise can all have an effect on migration but quantifying the effect is not easy. Although environmental changes were historically considered to be relevant factors in explaining migration trends (Ravenstein, 1889), establishing the exact role played by them in migration is a difficult task. Community case studies show the relationship between migration and environment changes is strongly dependent of a large variety of factors such as culture, gender, income, existence of migration of networks and population growth in the region (Kniventon, Smith and Black, 2011; Massey, Axinn and Ghimire, 2007; Shrestha and Bhandari, 2007; Each-For, 2009)

In this proposed study, we focus on the effects of climate changes on migration. We argue that interdisciplinary analyses from social and earth scientists are required to understand this link and develop a quantitative models capable connecting migration patterns as well as projecting future responses to environmental influences. Our study has two parts. First of all, we conduct a conceptual analysis by integrating demographic/social sciences models of migration with models and information derived from climate sciences. We will use this analysis to reinterpret recently published empirical studies on migration and climate changes. Secondly, based on this conceptual analysis, we conduct an empirically driven analysis on the case of Senegal.

The case of Senegal: overview

Senegal is a West African country with one of the highest rates of population growth (2.7% in 2010). The majority of population depends of agriculture but the country is prone to drought and only about 5% of the land is irrigated. On the other hand, one of the most developed and densely lived areas of the country, Dakar (12,000 per sqmi) is already affected by the sea level increase. Due to its geographical location (African dryland and in the vicinity of the sea), Senegal is expected to experience significant changes in average temperature, precipitations and sea level increases due to global climate change. A UNDP country report shows that the mean annual temperature in Senegal is expected to increase 1.7 to 4.9°C by the 2090s. The interior regions will warm faster than the coastal ones (Sweeney et all, 2012).

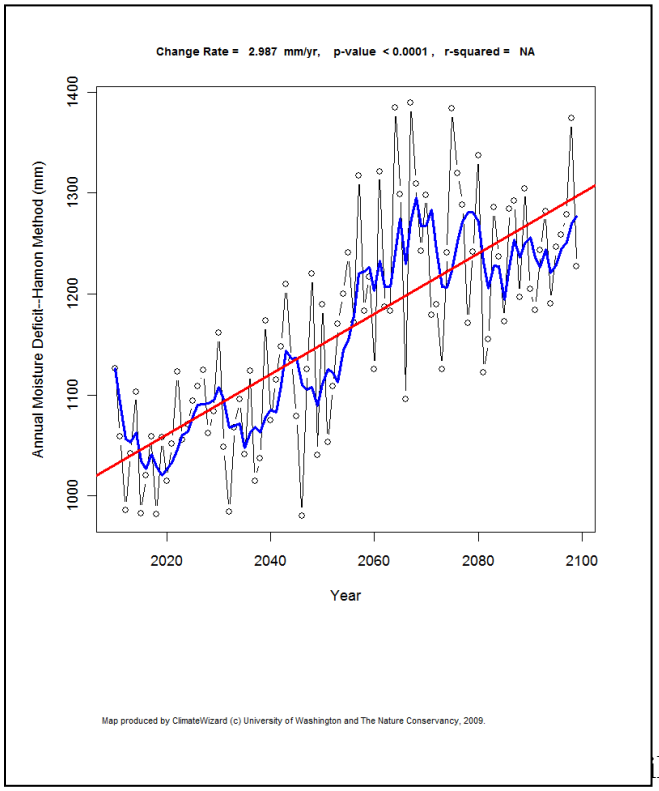
Emigration from Senegal, on the other hand, is already at a significant level and 4.5% to 6.8% of its population is estimated to live abroad ((Ministere des Senegalais de l'Exterieur,

World Bank, INED, 2011). As such, Senegal is an appropriate (as extreme) case study to be researched within the general topic of climate change effects on migration.

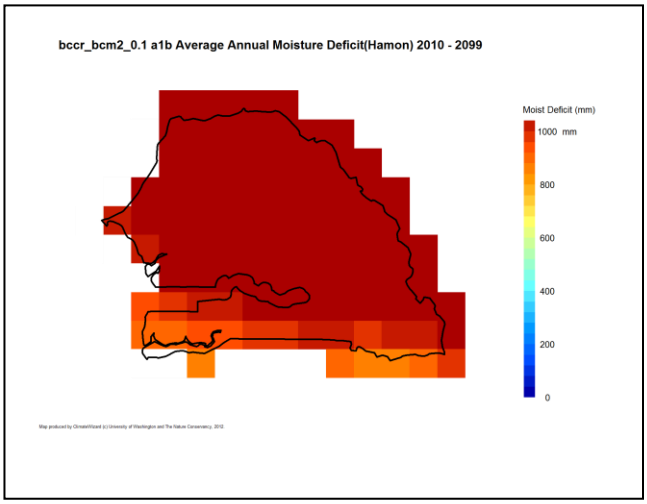
To estimate the changes in temperature and precipitation we will use all models provided by Climate Wizard at 0.5 degrees downscaled at the country level, with all three scenarios (B1, A1B, A2). For sea level increases, we use Vermeer and Rahmstorf (2009) global estimates for upper/lower limits combined with an estimate of local subsidence for Senegal. In order to estimate a migration model, we use World Bank survey on migration (2009) [Migration and Remittances Household Survey 2009].

Figure 1 and Map 1 shows some preliminary results of running a BCCR-BCM2 model with A1B (medium) scenario for moisture deficit for Senegal, 2010-2099, using Climate Wizard; the graph shows the temporal evolution while the map shows the geographical distribution.

Graphic 1. Annul moisture deficit, 2010-2099, Senegal, model BCCR-BCM2, A1B scenario



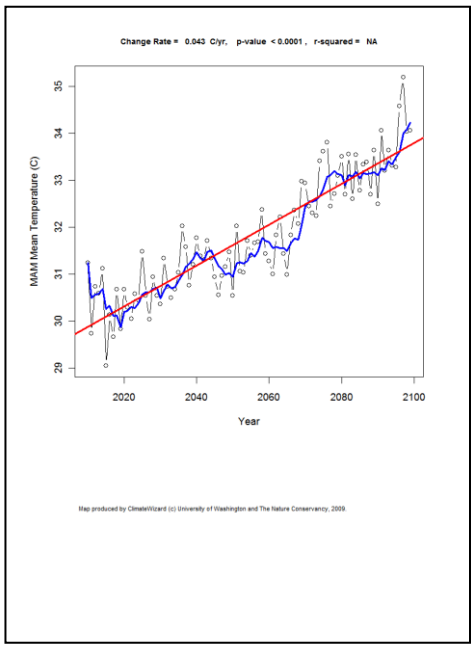
Map 1. Annul moisture deficit, 2010-2099, Senegal, model BCCR-BCM2, A1B scenario



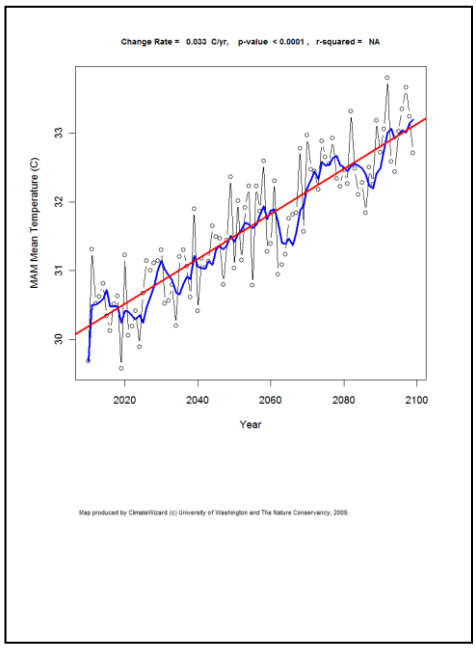
ll experience a large moisture deficit with the Northern regions more affected than the Southern ones.

Graphic 2 shows the projected increase in temperature for 2010-2099, BCCR-BCM2 model with B1, A1B and A2 scenarios.

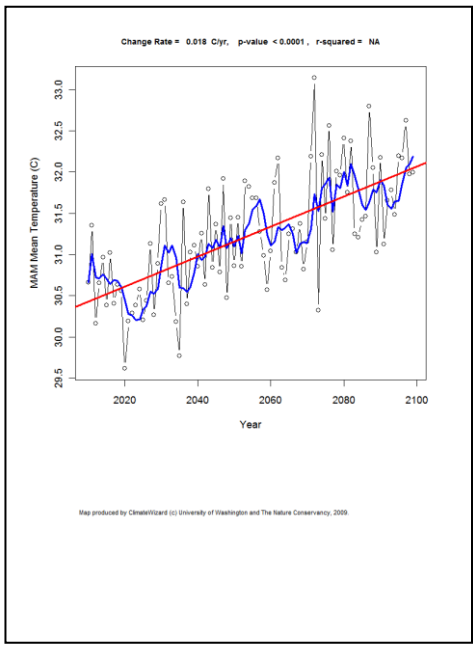
Graphic2. Mean annual temp., model BCCR-BCM2, A2scenario



Graphic3. Mean annual temp., model BCCR-BCM2, A1B scenario



Graphic 4. Mean annual temp., model BCCR-BCM2, B1 scenario



In linking migration and climate change in Senegal we will focus on two aspects: 1) sea level increase affecting especially the highly dense area of Dakar and 2) changes in temperature, precipitation and, as a result, soil moisture in the other parts of the country. A country study report done as part of the EACH-FOR project shows that migration from and within Senegal is already influenced by environmental changes (EACH-For, 2009)

We will use the migration and remittances data from 2009 to develop a regression model modeling probability of migrating and gender, income, existence of networks of migration, population growth, and place of origin and soil degradation in the region. Because we use data applied to this specific country (Senegal) instead of a general model (linking, for example, GDP growth and migration, see Nichollas et all, 2006) our model is tailored to cultural characteristics of the country. We expect to see a significant effect of climate change on migration especially because of the already existent networks of migration. Previous studies show that if a Senegalese is embedded in a migrant network, the odds of migrating are 2.68 (men) to 6.81 (women) higher than for somebody without such connections (Gonzalez & Baizan, 2009).

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