



## Assessment of future Nile flow through an ensemble of RCM simulations

Carlo Buontempo (1), Mohamed Ezzat Elshamy (2), Jens Kristian Lørup (3), Richard Jones (1), Mike Butts (3), Richard Betts (1), Mohamed Hassan (2), Doaa M. Amin (1), Alaa-Eldin M. Kotb (2), Erika Palin (1), Michael Sanderson (1), and Rachel McCarthy (1)

(1) Met Office Hadley Centre, FitzRoy Road, EX1 3PB, Exeter, UK, (2) Planning Sector, Ministry of Water Resources and Irrigation Korniche El-Nile, Embaba Giza 12666 Egypt, (3) DHI · Agern Allé 5 · DK-2970 Hørsholm · Denmark

The Nile represents a crucial resource for the economy of eastern and north-eastern Africa. Agriculture, energy production and livelihood in general depend strongly on the river. Assessing the impact that climate change may have on water resources is thus of critical importance for the people living in the Nile Basin. The objective of this study, carried out in close collaboration between the Ministry of Water Resources and Irrigation in Egypt, UK Met Office Hadley Centre and DHI, is to assess the possible impacts of climate change on the Nile river flow and in particular the inflow to the High Aswan Dam. Using climate models to inform water-related policies in the Nile Basin is a complex matter: the range of projections of change in both precipitation and river runoff tends to be wide with no consensus even on the sign of change. Previous studies (e.g. Conway & Hulme 1996; Strzepek & Yates 1996; Strzepek et al. 1996; Yates & Strzepek 1998) have shown the difficulty in assessing the impacts of climate change on Egyptian water resources.

It is important to consider uncertainties in climate projections, since precise forecasts are not possible. Probabilistic projections have previously been generated by the Met Office Hadley Centre for the UK (the UK Climate Projections 2009, or UKCP09), involving a complex hierarchy of global and regional climate models, simple climate models and statistical techniques. Here we use an approach aligned to part of the full UKCP09 methodology, in which we perform a number of simulations with the PRECIS regional climate model driven by boundary conditions from several different variants of the HadCM3 GCM. Each of these versions was characterised by different values for a set of parameters that describe the basic unresolved physical processes (e.g. Palmer and Williams 2008) and simulate a range of plausible climate changes over the region. For this project a set of 5 GCM ensemble members was initially selected from the 17 transient runs available (all members were integrated for the period 1950 to 2100 following the SRES A1B emission scenario). This initial set of runs is currently being expanded to include another 3 ensemble members, an ECHAM5 driven run and a reanalysis run.

The Nile Forecast System (NFS), which is a conceptual distributed hydrological model of the Nile, was used to map the climate projections into impact on the river flow. Delta-change factors have been calculated on a monthly basis for the two climatic input variables required for the hydrological model; precipitation and potential evapotranspiration. The historical climatic input time-series have then been adjusted based on the calculated delta-change factors and the hydrological model has been re-run with the emission scenario data.

The preliminary results indicate a consistent northward movement of the wet region during the summer; this means a three-fold increase in precipitation in East Sahel (Sudan, Eritrea, and the southern part of the Arabic peninsula) and halving of the precipitation on the gulf of Guinea and Nigeria and most of the Mediterranean. Such a shift can probably be interpreted in the frame of an enlarging Hadley cell and a northward movement of the summer position of the ITCZ. The associated change in surface humidity and evaporation leads to significant changes in surface temperatures along the northern edge of the wet region. The presentation will focus on the methodology used in the project along with results of the RCM simulation and preliminary results regarding river runoff.