Palestinian National Authority
Palestinian Water Authority

السلطة الوطنية الفلسطينية
سلطة المياه الفلسطينية

Sustainable Management of the West Bank and Gaza Aquifers

UNIVERSITY OF NEWCASTLE

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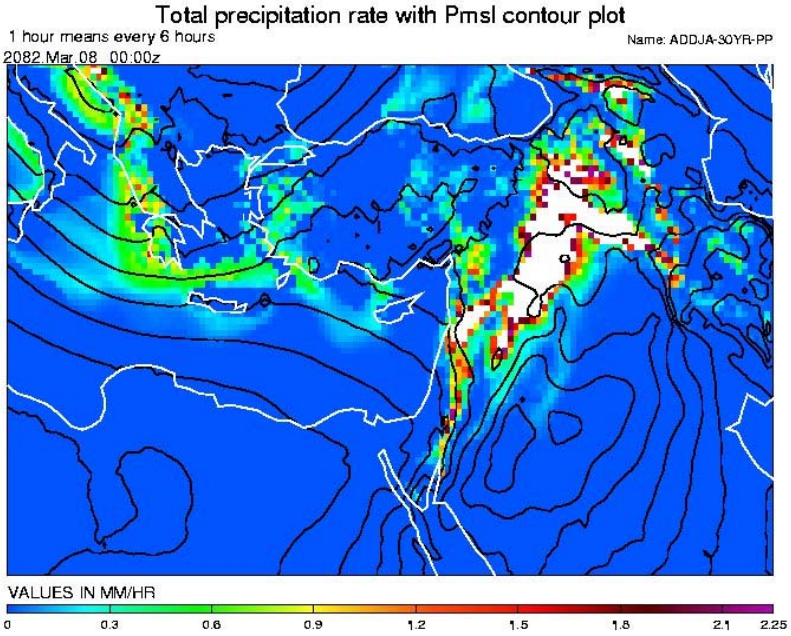
Development and Application of a Regional Climate Model for Assessing the Impacts of Land Use and Climate Changes



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The SUSMAQ Project

The aim of the project is to increase understanding of the sustainable yield of the West Bank and Gaza aquifers under a range of future economic, demographic and land use scenarios, and to evaluate alternative groundwater management options. The project is interdisciplinary, bringing together hydrogeologists and groundwater modellers with economists and policy experts. In this way, hydrogeological understanding can inform, and be informed by, insights from the social sciences. The results of the study will provide support to decision-making at all levels in relation to the sustainable yield of the West Bank and Gaza aquifers.

The project runs from November 1999 to October 2004, and is a partnership between the Palestinian Water Authority, University of Newcastle upon Tyne. The project is funded by the United Kingdom Government's Department for International Development (DfID).

Project Results Dissemination

The project disseminates its results through the project website www.ncl.ac.uk/susmaq, newsletters, workshops, technical meetings, publications in conference and scientific journals.

Bibliographical Reference

This report should be referenced as: SUSMAQ (2005). Development and Application of a Regional Climate Model for Assessing the Impacts of Land Use and Climate Changes. Report No. SUSMAQ - RAIN #44 V2.1, Sustainable Management of the West Bank and Gaza Aquifers, Palestinian Water Authority (Palestine) and University of Newcastle upon Tyne (UK).

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1. Overview and introduction

1.1. Background

As described in the SUSMAQ Rainfall Phase B report, knowledge of the spatial and seasonal variability of rainfall over the mountain aquifers of the West Bank is crucial to the planning and operation of the groundwater resources. Two concerns have been raised regarding changes in rainfall threatening the water resources of the West Bank.

The first concern is the threat from the effects of global warming. Current predictions from General Circulation Models (GCMs) are for significant decreases in annual rainfall over the region by the 2050s. This is combined with an increase in temperatures, causing higher losses from evaporation and changes in snow accumulation and melt. These combined effects pose a serious threat to groundwater resources, which need to be accounted for in planning the sustainable management of resources in the future.

The second concern was raised by recent studies of rainfall over Israel, which have shown evidence of a trend in annual rainfall. The trend is characterized by a decrease in rainfall over northern Israel, and an increase in the more arid south. It is not known whether this trend affects the West Bank itself, as insufficient observational data from the West Bank have been used in the studies to date and the region lies between the zones of most marked increase and decrease.

The rainfall research programme of SUSMAQ therefore aims to assess the impacts of possible changes in rainfall regime on groundwater resources, in order to supply guidance for the sustainable management of the groundwater resources of the West Bank. This was achieved by executing the following tasks:

- Collection and analysis of West Bank rainfall records to identify spatial patterns and temporal trends;
- Relation of spatial patterns and trends to the regional climate and topography;
- Assessment of the likely impacts of climate change or other trends on rainfall and groundwater recharge.

The work was programmed in three phases:
A. Preliminary assessment to provide immediate guidance for management and planning;
B. Detailed risk-based assessment of climate change impacts;
C. Regional climate modelling taking land use and irrigation into account.

Mindful of the need for rapid availability of guidance, the preliminary assessment of climate impacts on aquifer recharge was made using immediately available GCM output and reported in Phase A. The second,

more detailed assessment has been made using existing methods of GCM downscaling to produce future rainfall scenarios. This is referred to as Phase B and is reported separately.

A further phase of work has used a Regional Climate Model to produce finer resolution future scenarios than are available from GCMs. This has allowed topographic influences to be taken into account directly, as well as assessing the effects of possible land use and irrigation changes. This work is referred to as Phase C and is reported here.

The Hadley Centre, with funding from DFID, has developed PRECIS, a version of their Regional Climate Model (RCM) which can be run on a standard PC. This development is intended to provide countries and regions which have no climate modelling capability with a facility for producing their own tailor-made scenarios and regional impact assessments. PRECIS has been used throughout the Phase C work and its capabilities, set up and applications for land use and climate change are described in this report.

1.2. Objectives of Phase C

It was proposed that PRECIS be used within SUSMAQ to investigate two issues:

1. **Climate change** Possible climate change impacts on the region, to be assessed with PRECIS simulations for present and future time-slices (representative of 2070-2090), which can be scaled to provide estimates for intervening periods;

2. **Land use change** The sensitivity of the rainfall regime to changes (observed and predicted) in land use regime. If there are interactions between land use, irrigation and rainfall, it is crucial that they are taken into account when developing sustainable water resource management strategies. An investigation of the interactions between land use, irrigation and rainfall was proposed using the following procedure:
   - Set up PRECIS for the Middle East region using observed global climate fields as boundary conditions
   - Validate the basic model performance using the observed rainfall
   - Perform 2 simulations to assess the impacts of land use change caused by the National Water Carrier (NWC) on rainfall; one using present day land surface parameters, and the other using parameters set to 1950's values (pre-NWC).

The report describes the methods and results of these investigations and is laid out as follows:

- Section 2 Mechanisms for land use and rainfall impacts: an overview of the possible mechanisms by which land use change can affect rainfall

via changes in land surface parameters, with a review of the previous key studies;

- Section 3. PRECIS modelling system: background and operation, design and setup for the West Bank
- Section 4. Climate change impact study, set up, results and discussion
- Section 5. Land use impact study, set up, results and discussion
- Section 6. Summary, conclusions and future developments: capabilities and performance of PRECIS, conclusions and how to interpret results.

Full report/document is not available online