

Mapping of precipitation in Iceland using numerical simulations and statistical modeling

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Abstract

Precipitation in Iceland during a period of 10 years is simulated with the PSU/NCAR MM5 model. The results are compared with precipitation estimated by a statistical model based on observations and a number of topographic and geographic predictors. The simulated precipitation pattern agrees with the statistical model in areas where data is available and gives a credible precipitation pattern in data-sparse mountainous regions. The simulation is however in general overestimating the precipitation, but the magnitude and the seasonal and geographical distribution of the overestimation indicate that it is to some extent associated with observation errors that are due to wind-loss of solid precipitation. There are also uncertainties associated with the representativeness of the observations as well as with the reference model itself.

Zusammenfassung

Niederschlag in Island wurde mit dem PSU/NCAR MM5 Modell für eine 10-Jahresperiode simuliert. Die Modellresultate werden mit Niederschlagsschätzungen eines statistischen Modells verglichen, das auf Beobachtungen und auf einer Reihe von topographischen und geographischen Prediktoren basiert. Das simulierte Niederschlagsmuster stimmt für Gebiete, in denen Daten verfügbar sind, mit dem statistischen Modell überein und liefert in Gebirgsregionen mit schlechter Datenabdeckung glaubwürdige Niederschlagsmuster. Die Simulation ueberschätzt jedoch generell die Niederschlagsmengen. Dabei deuten die Amplitude und die saisonale und geographische Verteilung der Abweichung darauf hin, dass dies zu einem Teil mit Beobachtungsfehlern verknüpft ist, die durch windbedingte Verluste von festem Niederschlag entstehen. Zudem existieren Unsicherheiten in Zusammenhang mit der Repräsentativität der Beobachtungen sowie des Referenzmodells selbst.

1 Introduction

The aim of this study is to verify the precipitation simulated by a limited area atmospheric model, the PSU/NCAR MM5 (WANG et al., 2001), in Iceland. One of the reasons for using a limited area model to simulate precipitation is to obtain a dataset of the current climate for comparison with down-scaling of future climate from coupled atmospheric and oceanic simulations by GCMs.

Attempts have been made to simulate precipitation in mountainous terrain. In the recent PRUDENCE project simulations with five numerical models were compared to an observation-based reference in the Alps. The models performed quite satisfactorily, but produced consistently too little precipitation (FREI et al., 2003).

Precipitation in Iceland is largely associated with extra-tropical synoptic systems. It often occurs during strong winds and can be greatly enhanced locally by the mountainous terrain (DE VRIES and ÓLAFSSON, 2003).

Due to this and a coarse observation network, the direct use of an interpolation method for mapping precipitation is considered not to be sufficiently reliable. To map the reference precipitation and to minimize the uncertainties related to scale issues (see TUSTISON et al. (2001)), some further modeling is therefore needed.

In the past years, various studies have described the statistical links between precipitation and topographic parameters (see for instance BENICHO and BRETON (1987); DALY et al. (1994); BASIST et al. (1994); WOTLING et al. (2000); KIEFFER et al. (2001) and DROGUE et al. (2002)) and the joint effect of topographic and atmospheric parameters (KYRIAKIDIS et al., 2001). In the present paper, a similar approach is considered to model and map the precipitation of reference (hereafter called REF) used to verify the MM5 simulations.

This paper is organized as follows: In the next section we will give a short introduction to the observational data, followed by a short description of the models. The results will be presented in section 4, followed by discussions and concluding remarks. A more detailed

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