

HYACINTS

Hydrological Modelling for Assessing Climate Change Impacts at Different Scales

Project leader:

Professor, Dr. Scient
Jens Christian Refsgaard
GEUS



GEUS

Institutions

- Geological Survey of Denmark and Greenland (GEUS)
- Danish Meteorological Institute (DMI)
- Institute of Geography and Geology, KU
- Institute of Geology, AU
- DHI
- GRAS (Geographic Resource Analysis & Science)
- Watertech ? Birch & Krogboe ? ALECTIA
- Odense Water
- Copenhagen Energy
- Public Utilities of Aarhus, Water and Waste Water
- Environmental Centre Odense
- Environmental Centre Roskilde



Volume and timing

- Total budget of 25.2 mill Dkr ~ 3.4 mill EURO
- 15 mill Dkr ~ 2 mill EURO from research council
- Period: 2008 – 2012
- 5 PhD's and 3 Post Docs



Background

- Presently: Climate model ? Hydrological model
- No coupling between hydrological and climate models
 - Current hydrological module very simple: Errors in feedback (LE, H, T_s)
- Resolution of hydrological system
 - Less than e.g. 50 km (climate model grid size)
- Bias in climate model results ?
- No quantification of uncertainty ?



Objective

- To assess the effects of climate change on water resources at both regional and local scales
 - Higher precision
 - Quantification of uncertainty



Work packages

- Coupling of HIRHAM and MIKE SHE model codes
- Hydrological change
- Scaling of hydrological models
- Uncertainty



Coupling of HIRHAM and MIKE SHE model codes

- Objective:
 - To develop a full dynamic coupling of a climate model and a distributed physically based hydrological model code
- Contents:
 - Exchange of (P, T_a, V_w, R) ? (LE, H, T_s)
 - Different platforms (Workstation/Windows)
 - OpenMI coupling



Hydrological change

- Objectives:
 - To establish a coupled climate-hydrological model for the entire Denmark
 - New methods for estimation of precipitation from remote sensing data (mountainous regions)
- Contents:
 - Coupling of DK-model (MIKE SHE) and regional climate model (HIRHAM)
 - Geostatistical downscaling procedures based on measured data (50 km ? 1 km)
 - Downscaling of remote sensing data



Scaling of hydrological models

- Objectives:
 - To develop grid refinements methods
 - To develop methodologies for downscaling of complex geological environments
- Contents:
 - Dynamic coupling of regional and local MIKE SHE model (OpenMI)
 - Alternative conceptual geological models versus alternative discretization methods



Uncertainty

- Objectives:
 - To assess the uncertainties related to prediction of climate change effects
- Contents:
 - Climate model uncertainty: emission scenarios; climate model; downscaling method
 - Hydrological model uncertainty: model scale; model structure (geological interpretations); value of geological information (mapping) on uncertainty

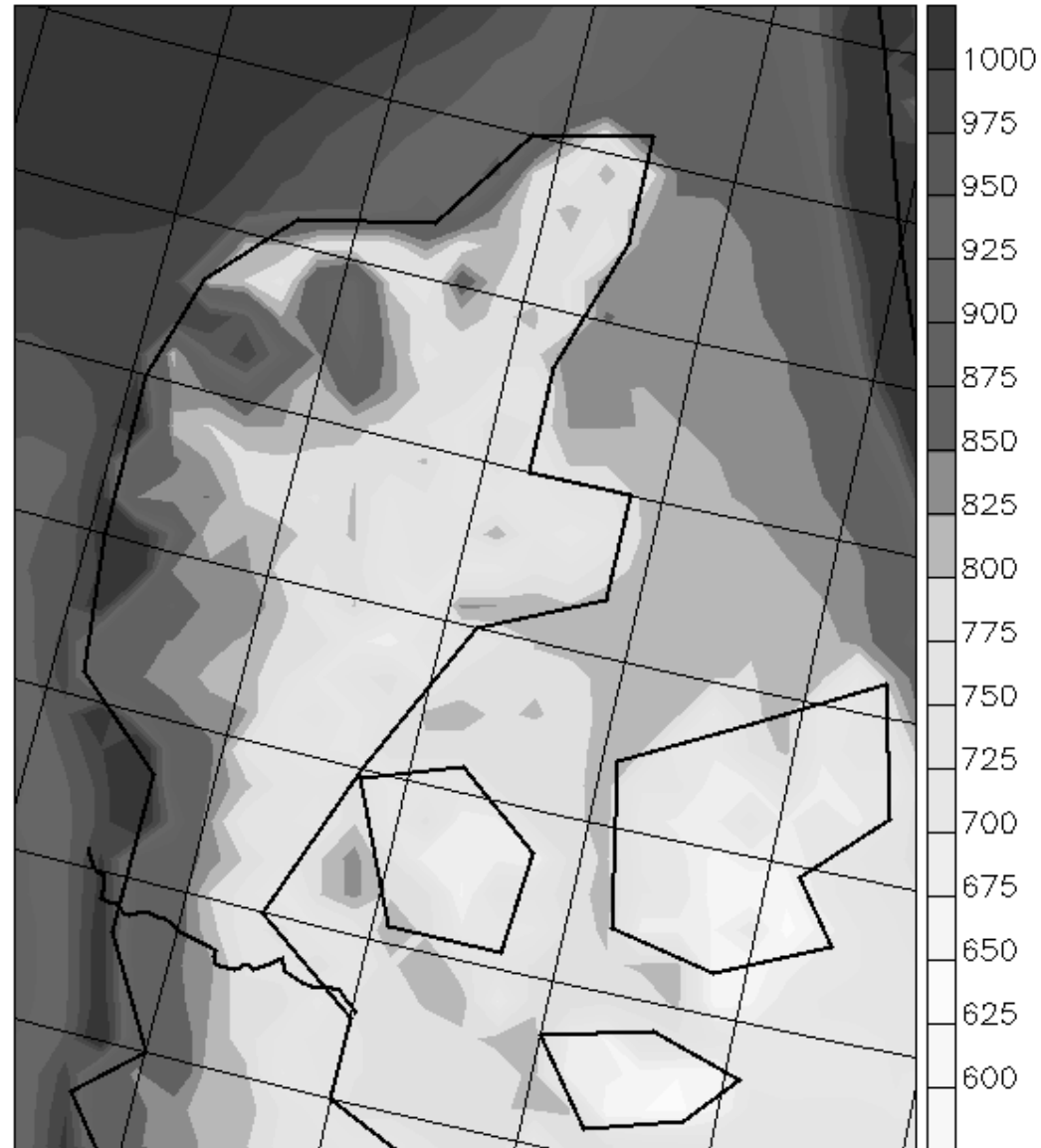


Expected main project results

- Coupled code for simulating hydrological change
- Coupled climate-hydrological model for Denmark (more accurate predictions)
- Downscaling procedures
- Assessment of climate change in data sparse (mountainous) catchments
- Quantification of uncertainties in hydrological change predictions

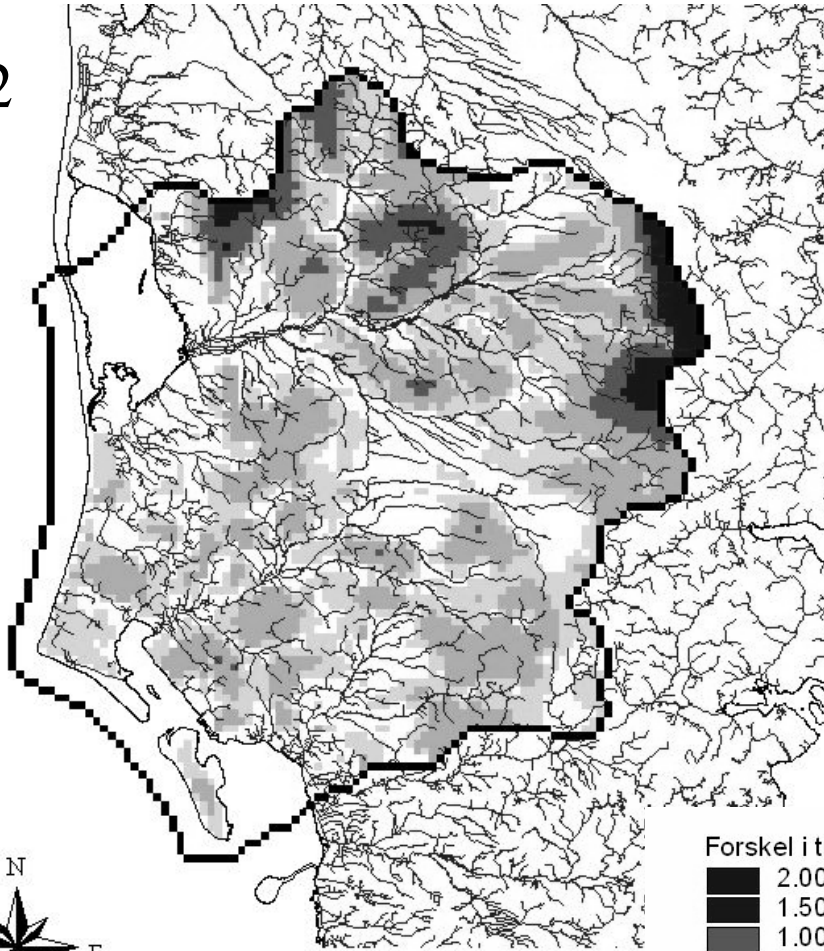


Precipitation (annual) using climate model

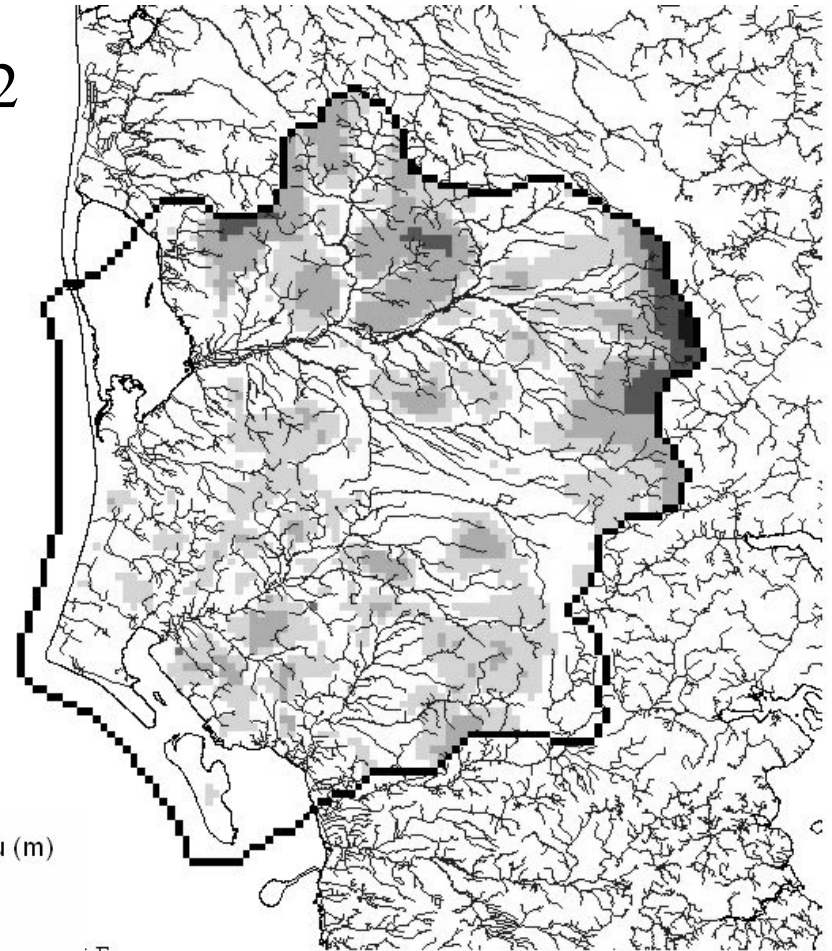


Change in groundwater level

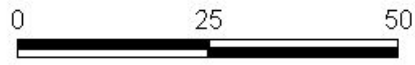
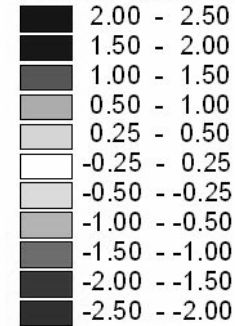
B2



A2



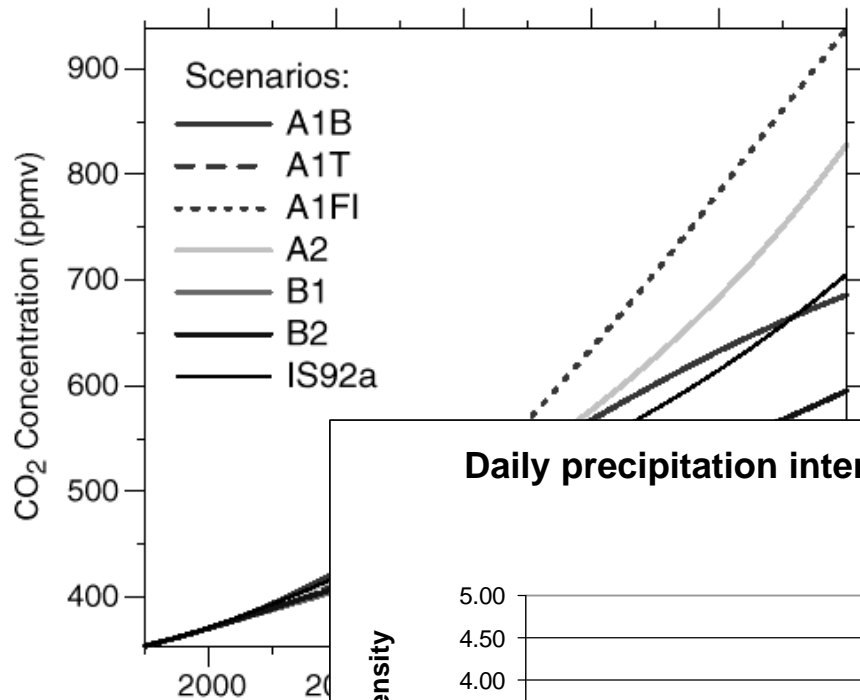
Forskell i trykniveau (m)



Uncertainty sources

- Downscaling
- Hydrological models
 - Input data
 - Parameters
 - Model structure (geology, etc.)
- Management decisions
 - Land use
 - Irrigation
 - Etc.

Climate scenario



Climate model

