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CLIMATE CHANGE AND URBAN PLANNING – CASE STUDIES IN FINLAND

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Abstract: Control of and adaptation to climate change should be an established practice in urban planning. Predictions of climate change in the next hundred years were made for six study localities in Finland and their impact on plans were analyzed. "The golden rules for planner" emphasize local conditions, determining flood risk areas, completion of urban form and avoiding urban sprawl, forming good microclimate, control of storm water, relatively compact structure, district heating and renewable energy sources, prerequisites of public transport, walking and cycling, mixing functions and impact assessment.

Introduction

Control of climate change is a major global and national goal. The aim of the study is to promote adaptation to and mitigation of climate change in urban planning and, thereby, to reduce damages caused by floods and storms as well as to reduce greenhouse gas emissions. The study analyses plans at different levels: regional, master and detailed plans. The bases for analyses are estimations about essential impacts of climate change in the case localities. Results of the project are recommendations of practical procedures and means for taking climate change into account in urban planning and impact assessment.

Case studies

The research was based on ongoing planning processes. The study areas and plans were the Kalasatama master plan in Helsinki, the Vanhansatamanlahti master plan in Kokkola, the urban structure alternatives of Uusimaa region, the development plans of Tahko tourist centre in Nilsiä, the City of Islands in Kuopio and the new dwelling area of the former race track in Sodankylä (Figure 1). Plans were considered on the basis of local climate conditions and of the microclimate they will form. Mitigation of climate change was considered by assessing greenhouse gas emissions from realizing the plans.

Prediction of climate change

Predictions of climate change with regards to extremes and certain average changes in the next hundred years were made for all the study localities (Figure 2). The predicted variables were average temperature of a year, maximum temperature, minimum temperature, freeze-thaw cycles, average wind speed of a year, maximum wind speed, average precipitation of a year, 6 hours precipitation maximum, 5 days precipitation maximum, 6 hours snow maximum, snow cover maximum, duration of snow cover and duration of sea ice cover (Table 1). Changes in many variables are significant and differences between localities are great. Near shorelines, changes of sea level and flood risk areas were also estimated.

Adaptation and mitigation

With regards to adaptation to climate change in plans at general levels, important issues are mapping of flood risk areas and avoiding location of functions in such areas (Figure 3). Wind conditions (Figure 4) and increasing precipitation form challenges to detailed planning. Good micro climate can be formed by planning of quarters, plots and houses. Near shore areas, sea level rise and splash of waves, as the sea will be open longer, form special challenges.

Regarding climate change mitigation, advantageous areas are those which are located favorably with respect to traffic conditions, especially those having possibilities to walk, bicycle and use public transportation and which can use district heating or use renewables in separate heating. Study areas in Helsinki, Kokkola, Kuopio and Sodankylä are located favorably in the urban structure. The urban structure alternatives in the Uusimaa region make it possible to form an advantageous structure (Figures 5 - 6). The prerequisites of forming a railway connection to Tahko are worth defining. Well-defined urban areas make it possible to form continuous nature and recreational areas and ecological corridors and networks. Rural building scatters natural areas. New areas should be located in connection to existing urban structure. Functions should be located near each other and mixing of functions should be promoted instead of differentiating.

Discussion and Conclusions

The research shows that mitigation of and adaptation to climate change can be considered at the same time. There were no conflicts between these targets in the study areas. The report introduces planning directions and recommendations for taking climate and its changes into account in spatial planning and building on different planning levels. “The golden rules for planner” emphasize local conditions, determining flood risk areas, completing of urban form and avoiding urban sprawl, forming good microclimate, control of storm water, relatively compact structure, district heating and renewable energy sources, prerequisites of public transport, walking and cycling, mixing functions and impact assessment. Measures for climate change adaptation and mitigation in urban planning are often also favorable as regards other ecological, economic and social impacts, and they can promote sustainable development.

Accelerating climate change demands effective means to provide for. Reducing greenhouse gas emissions will be more important as international commitments will be tighten. Thus every action to reduce emissions is important.

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Reference

[1] Wahlgren, I., Kuismanen, K. & Makkonen, L. 2008. Climate Change in Urban Planning – Case Studies (Ilmastonmuutoksen huomioiminen kaavoituksessa – tapauskohtaisia tarkasteluja). VTT Research Report VTT-R-03986-08. 173 p. (In Finnish)

Figure 1. Case study locations in Finland: City of Helsinki, Uusimaa Region, City of Kokkola, City of Kuopio, City of Nilsiä, Municipality of Sodankylä. (Map: Google)

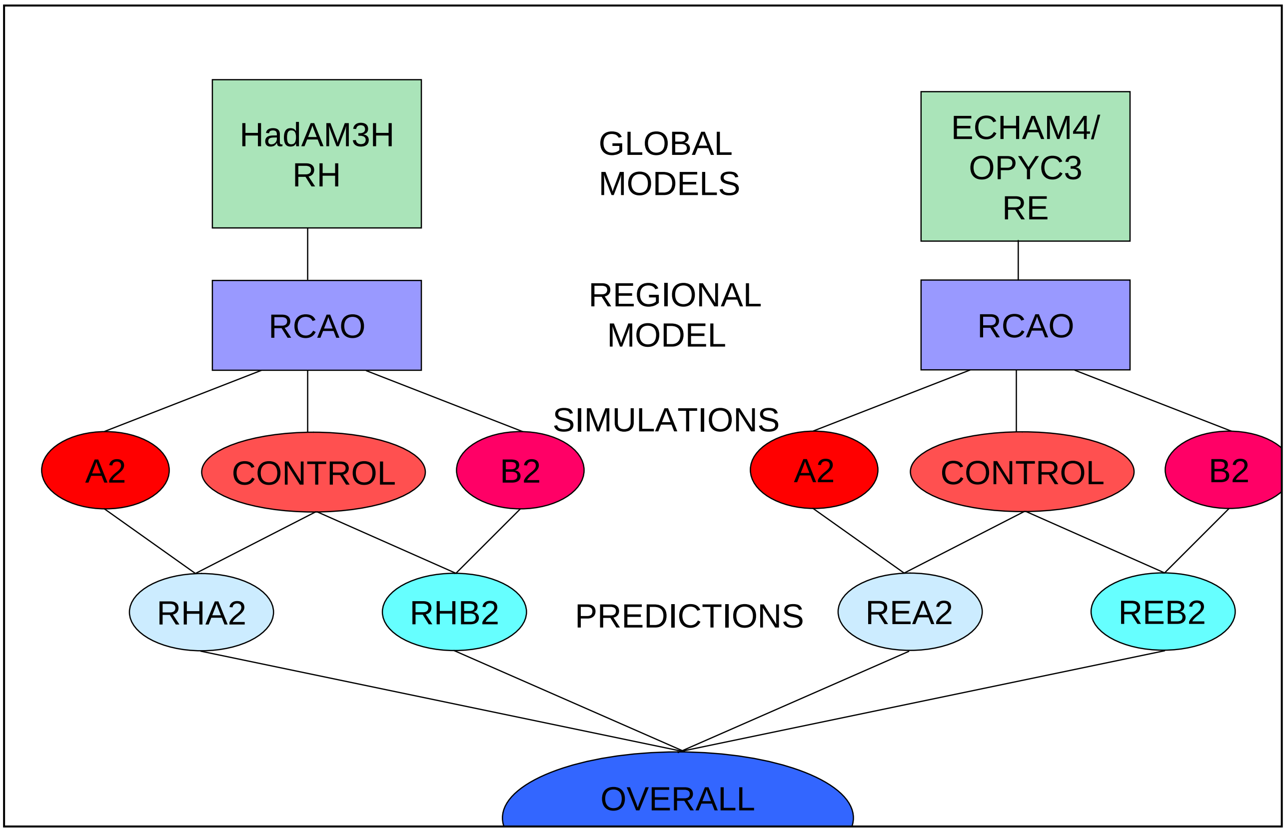

Figure 2. Prediction of climate change in study locations, simulations by global and regional climate models, average of 4 simulations. Control simulations 1961 – 1990, input: measured atmosphere. Scenario simulations 2071 – 2100, input: IPCC emission scenarios A2 and B2. Prediction range 110 years, prediction from today 80 years.

Table 1. Predicted climate change during this century in study locations, Finland. Extremes or maxima and minima describe on average once in a 50 year period exceeding (or going below) values.

	Helsinki	Uusimaa, coast	Uusimaa, inland	Kokkola	Kuopio	Sodankylä
Average temperature of a year °C	4	4	4	4	4	4
Temperature maximum °C	4	4	5	5	5	3
Temperature minimum °C	16	16	11	12	8	5
Freeze-thaw cycles %	-40	-40	-30	-25	0	15
Mean wind speed of a year %	2	2	0	0	3	2
Wind speed maxima %	15	15	5	-5	-10	9
Precipitation of a year %	15	15	20	25	15	15
Precipitation maximum 6 h %	0	0	5	40	14	35
Precipitation maximum 5 d %	15	15	30	55	56	55
Snow precipitation maximum 6 h %	0	0	-5	30	1	19
Snow maximum %	-50	-55	-50	-35	-37	-3
Duration of snow cover d	-70	-70	-70	-60	-45	-40
Duration of ice cover of sea d	-120	-120		-80		

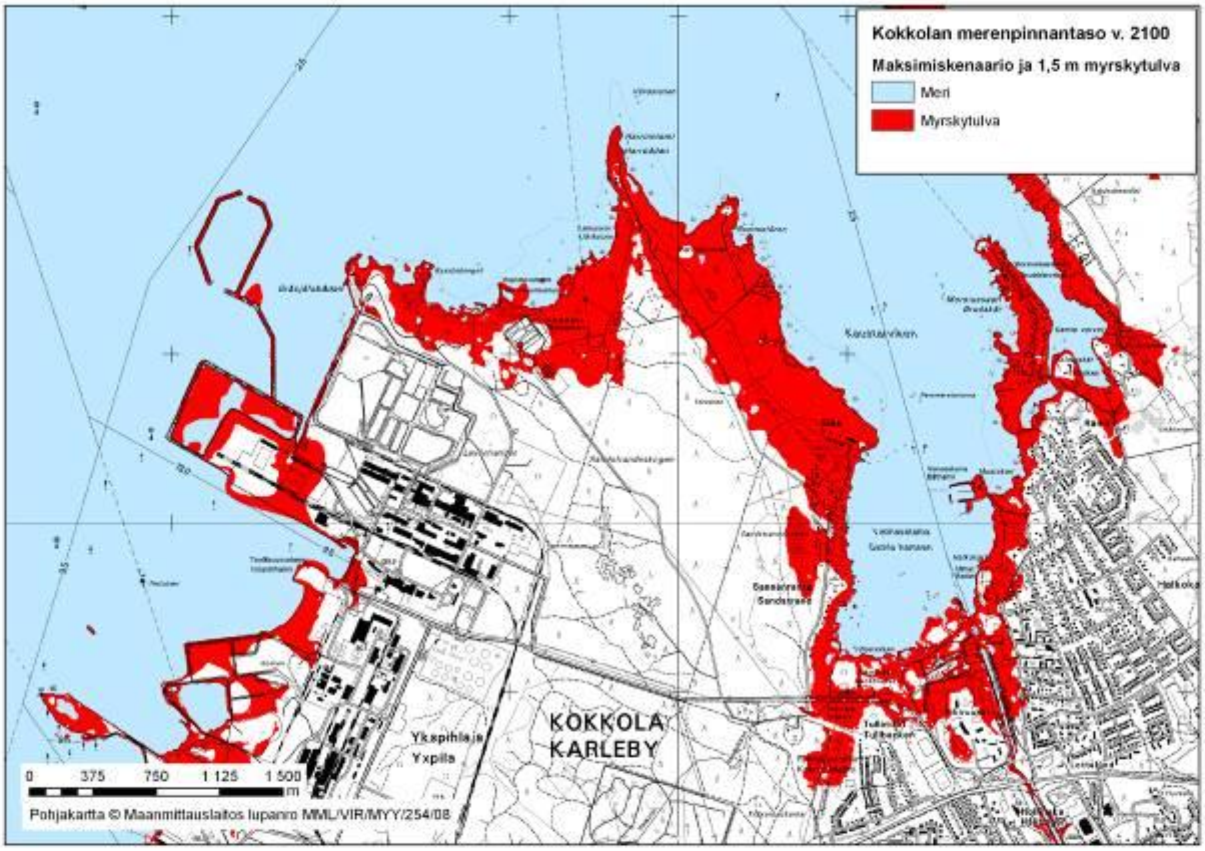

Figure 3. Sea level in Kokkola in 2100 in maximum scenario and 1,5 m storm flood (Astra).

Figure 4. Climate analysis of plans, example from Kokkola.

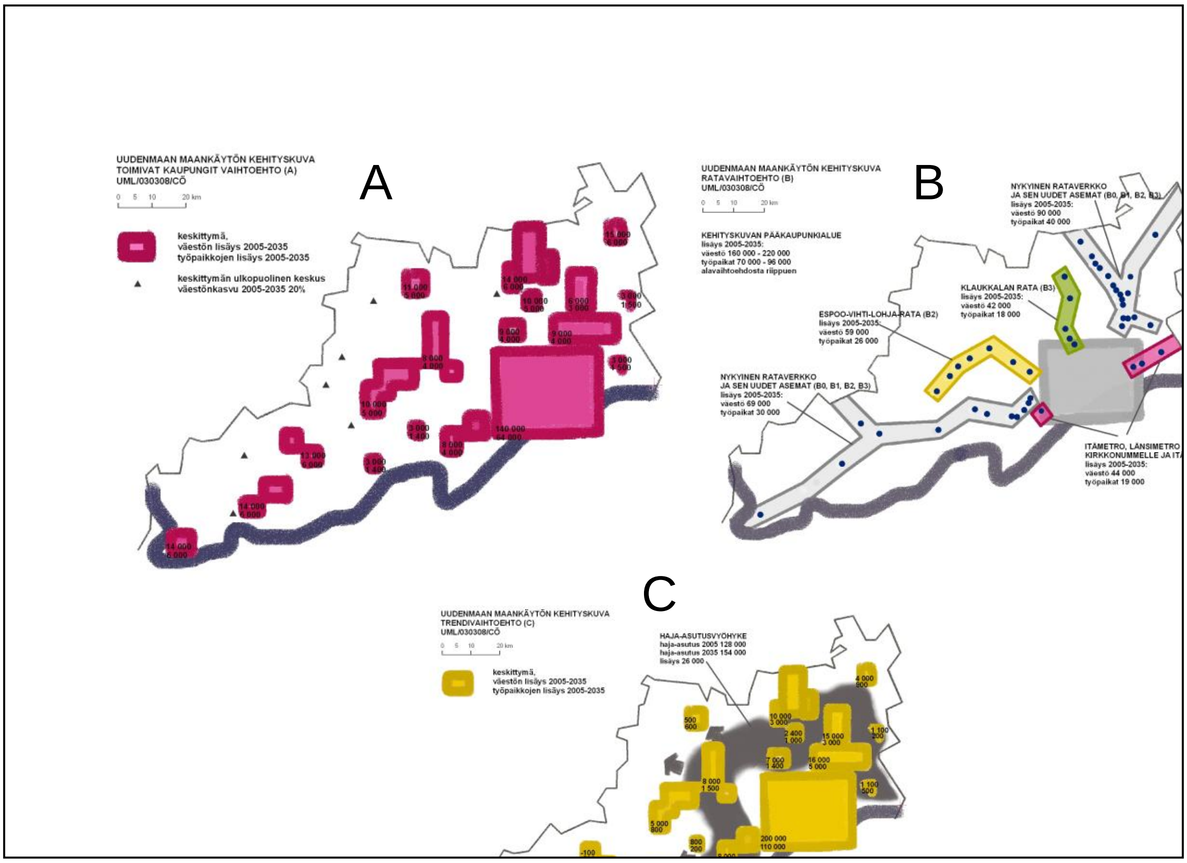

Figure 5. Structure models of Uusimaa region. Model A: developing small towns, Model B: developing railway connections, Model C, Continuing urban sprawl.

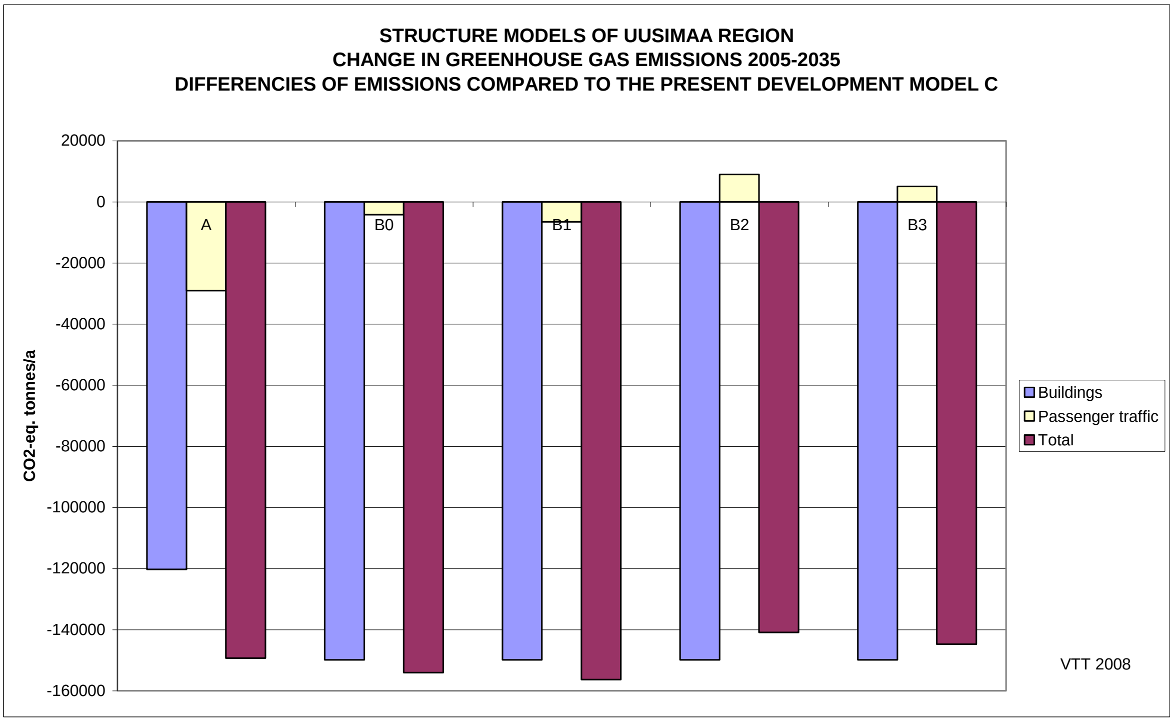

Figure 6. Greenhouse gas emissions of alternative structure models of Uusimaa region, differences of emissions in models A, B0, B1, B2 and B3 compared to the present development model C. Reductions of emissions are about 10 % of emissions in model C.