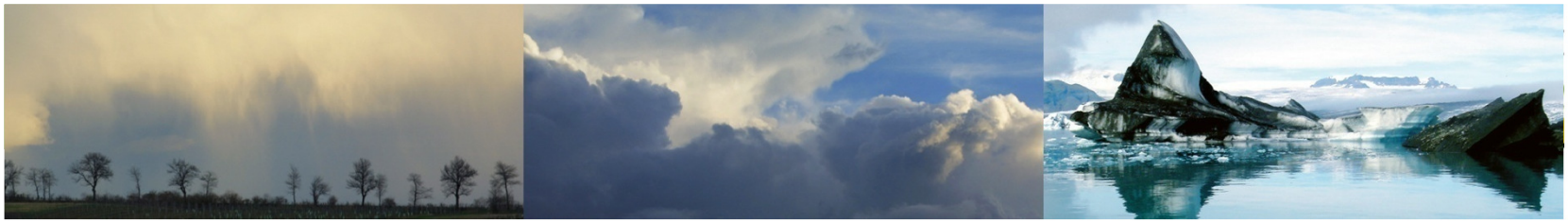
El.Adapt: Climate Change Impacts on Electricity Demand in Continental Europe

Christoph Töglhofer, Clemens Habsburg-Lothringen, Franz Prettenthaler, Nikola Rogler, Matthias Themessl

Wegener Center for Climate and Global Change, University of Graz
JOANNEUM RESEARCH, Center for Economic and Innovation Research, Graz

12. Symposium Energieinnovation
Graz, Austria, 16.2.2012



EL.ADAPT Team:

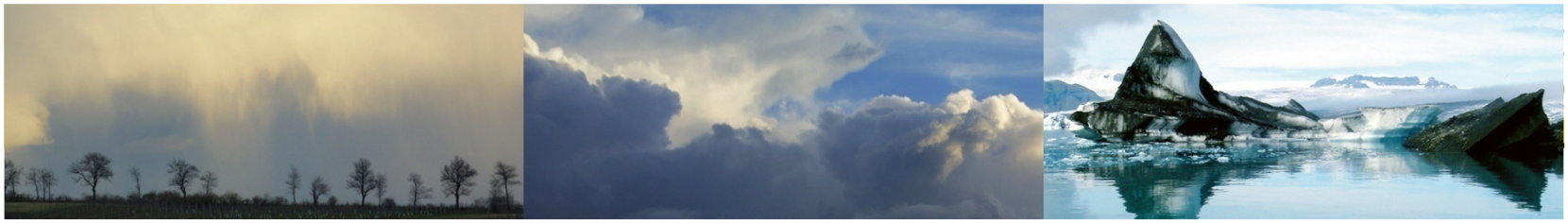
Birgit Bednar-Friedl, Gabriel Bachner, Veronika Kulmer, Thomas Schinko, Karl Steininger, Christoph Töglhofer

Andreas Gobiet, Matthias Themeßl

Steffen Birk, Thomas Wagner

Gerald Feichtinger, Christoph Gutschi, Andreas Schüppel, Heinrich Stigler

Franz Prettenthaler, Nikola Rogler



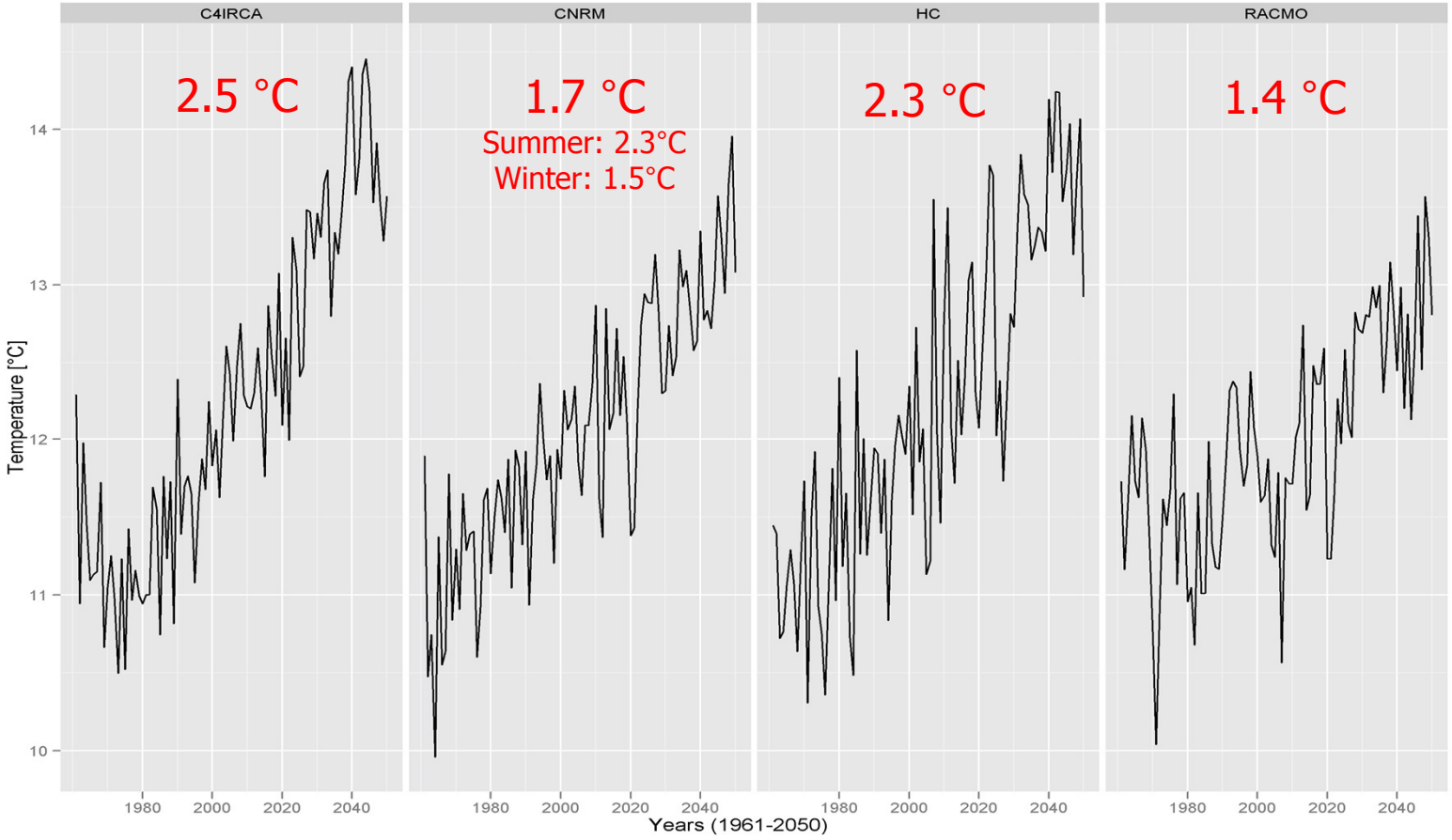
- El.Adapt
  - Study commissioned by the Austrian Climate Research Programme (ACRP) and funded by the Austrian Climate and Energy Funds
  - Climate change impacts on the electricity industry
    - hydropower, wind power, photovoltaic, heating and cooling
    - Austria and Continental Europe
    - Up to 2050
  - Interdisciplinary approach
    - Climate scenario runs
    - Hydrological model
    - Electricity Demand model
    - ATLANTIS
    - CGE (Computable general equilibrium) model

Data and Methodology

- Impacts of temperature change on electricity demand
  - 16 Continental European countries
  - Daily electricity consumption 2006-2010 (ENTSO-E)
  - 4 different climate scenarios
- Modelling approach
  1. Calculate population-weighted national temperature indices
  2. Correct national electricity load for non-climatic effects
  3. Estimate the statistical relationship between temperature indices and the corrected load
  4. Estimate effects of changing climate conditions
  5. Estimate effects of changing consumption patterns

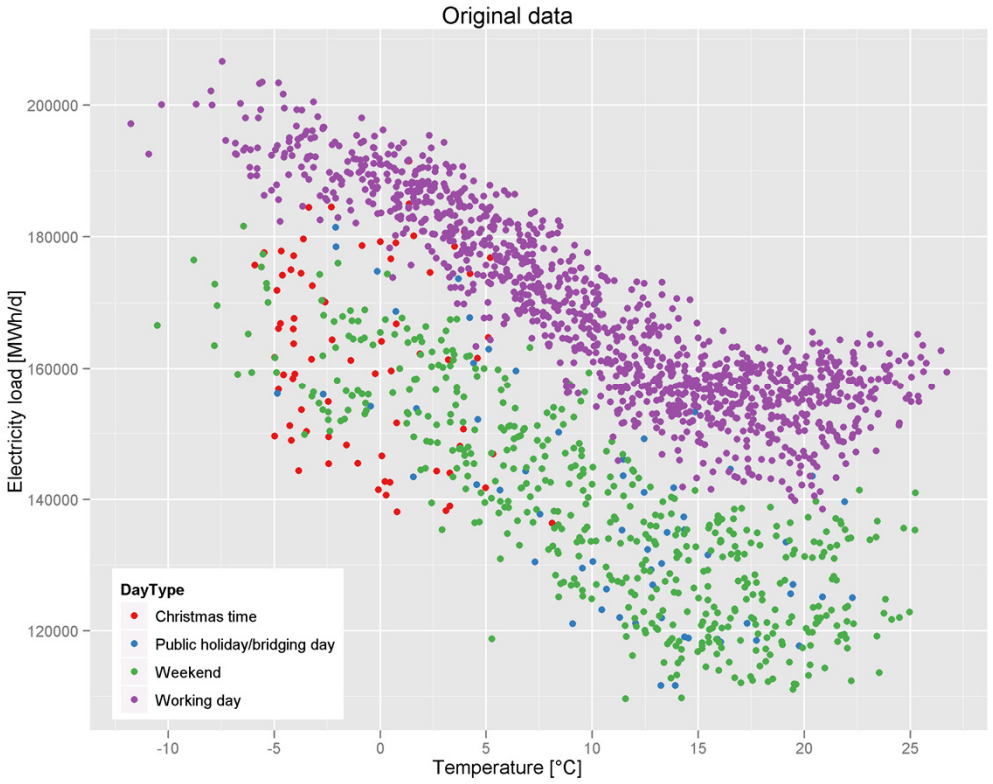
Temperature Data

- 4 Climate Scenario runs
  - ENSEMBLES project (Van der Linden and Mitchell 2009)
  - Continental European Average (2031-50 vs. 1961-90):



Non-climatic Effects

- Load correction
  - Econometric Models
    - E.g. Moral-Carcedo and Vicéns-Otero (2005)
  - Non-climatic effects
    - Weekdays
    - Public holidays
    - Bridging days
    - Christmas time
    - Summer holiday
    - Industrial production
    - Recession years

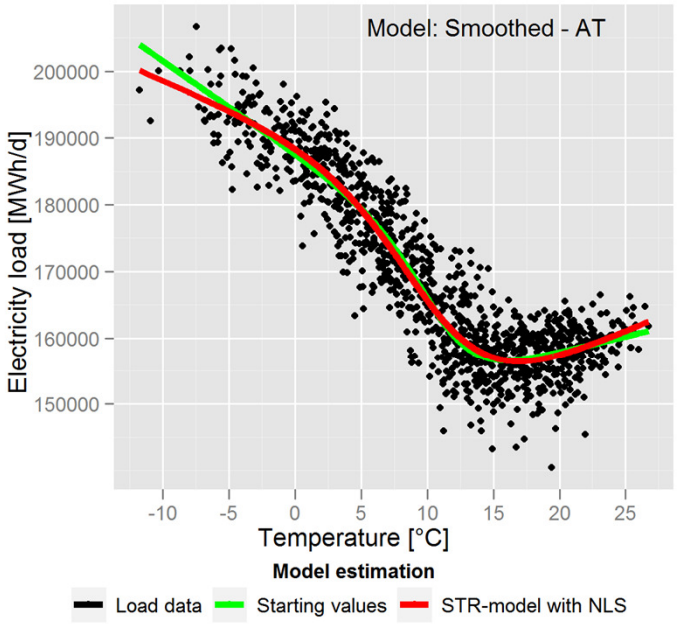


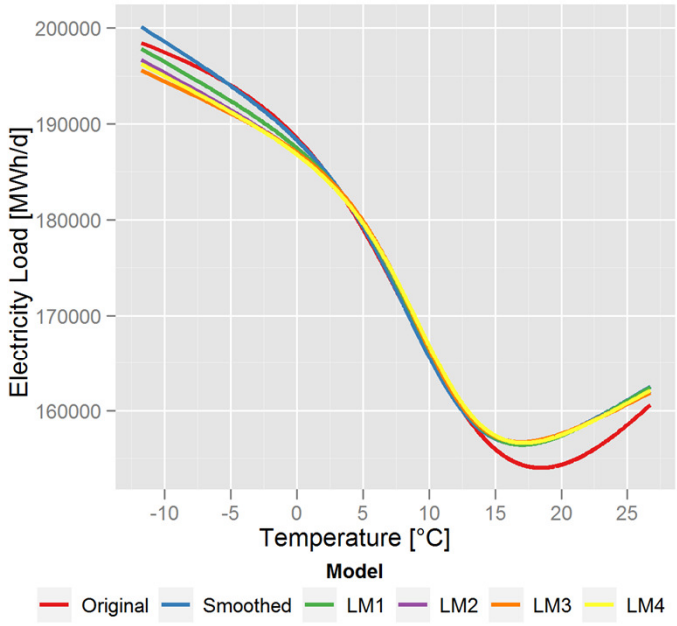
Temperature Impacts

- Relationship between temperature and corrected load
  - Smooth Transition Regression Model
    - allows to model transition from cooling to heating
      - not a sudden, but a gradual process
  - Model choice from 6 different models based on statistical criteria
- Climate change impacts
  1. Under current heating and cooling patterns
  2. Under changing heating and cooling patterns
     - More cooling electricity
       - higher market penetration of cooling, general changes in behavior and comfort levels etc.
     - Changes in heating electricity?
       - Energy efficiency, Electric heating, thermal heat pumps etc.

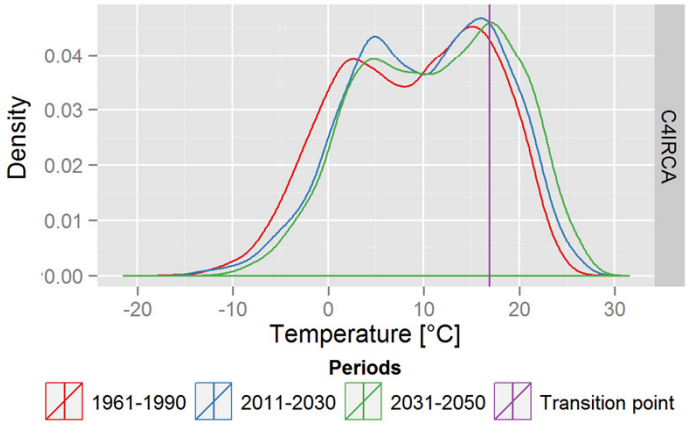
Temperature Impacts: Austria – C4IRCA

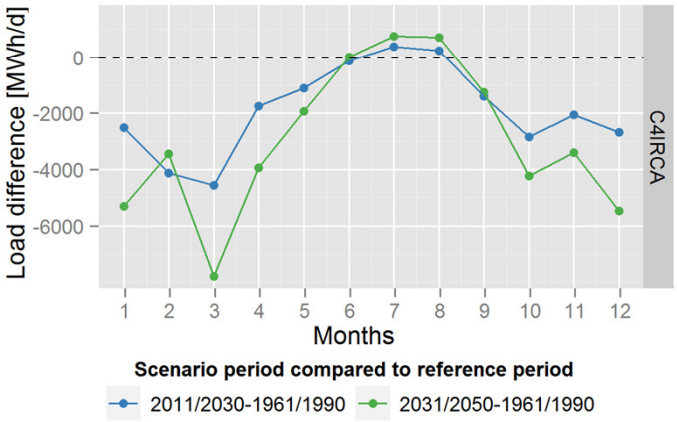
2006/10:
(working days)





Climate Change:
(C4IRCA)





Temperature Impacts: Austria – CNRM

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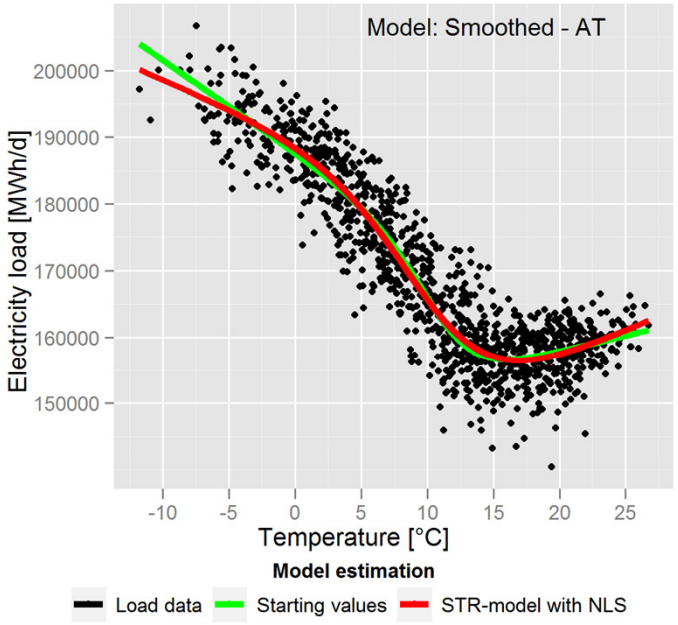
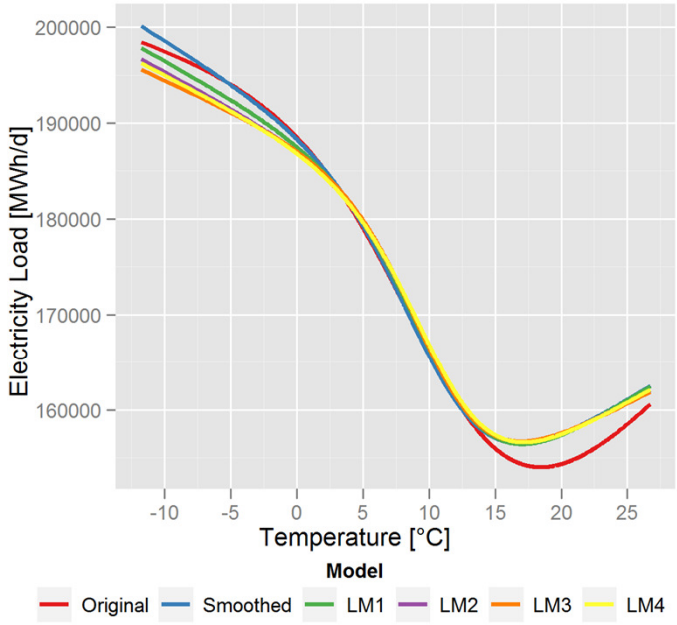
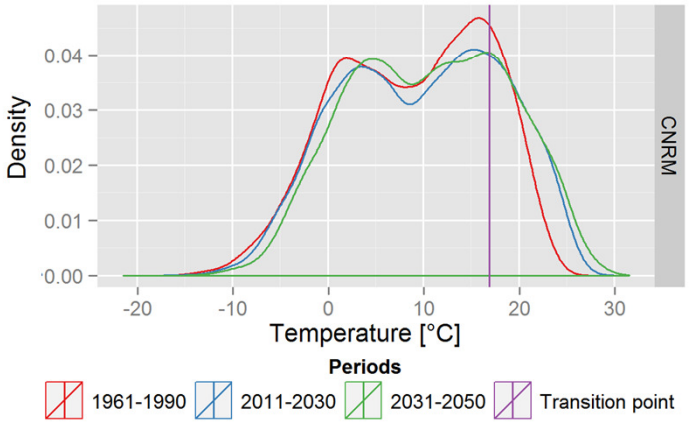
(working days)

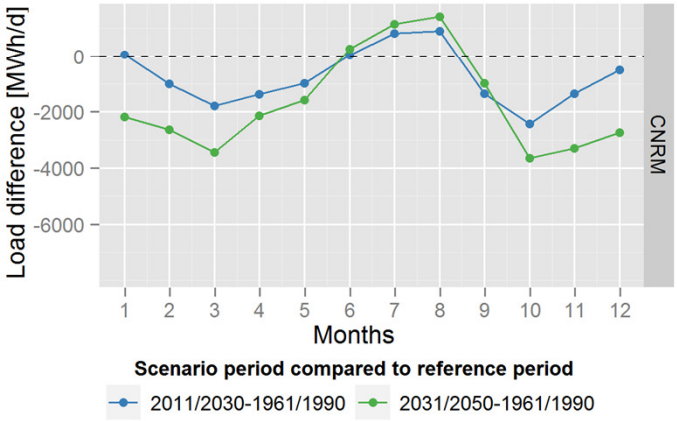




Climate Change:

(CNRM)





Temperature Impacts: Austria – HC

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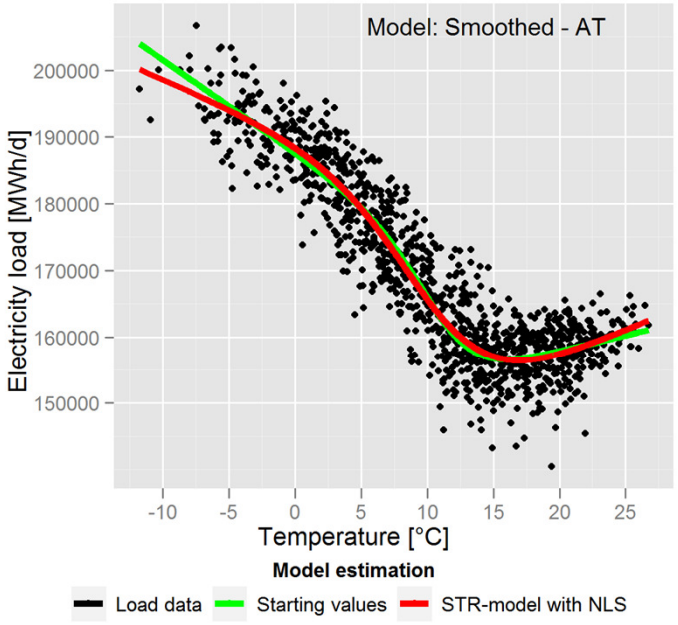
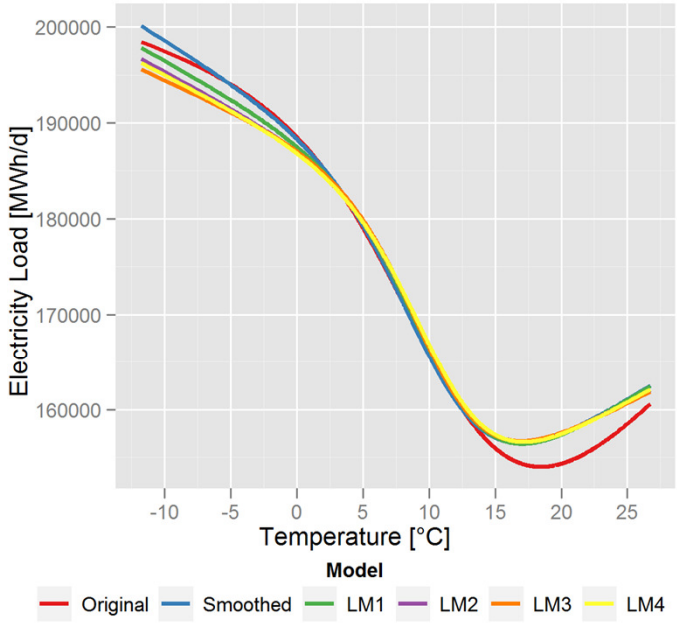
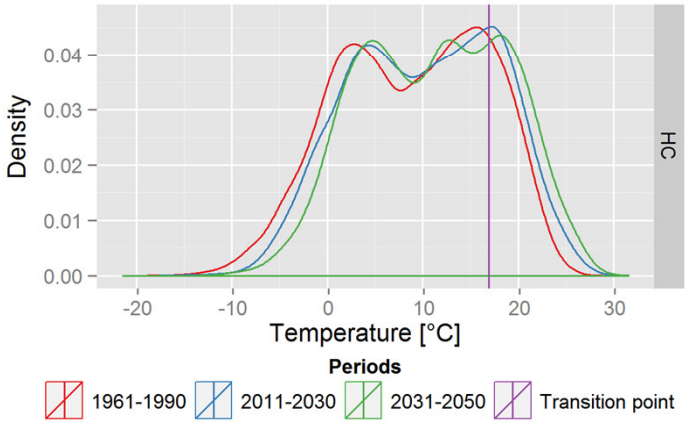
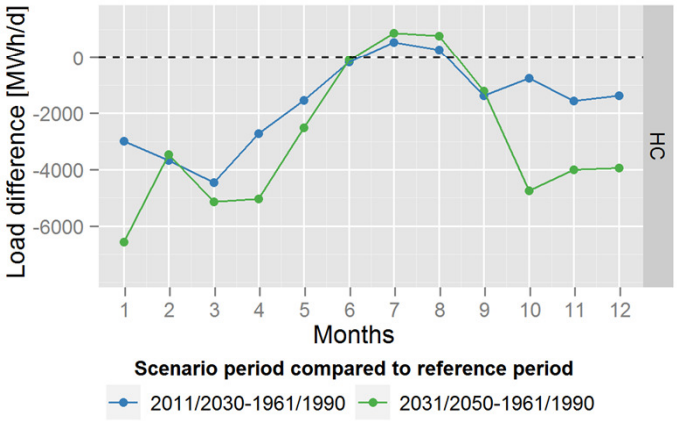




Climate Change:

(HC)

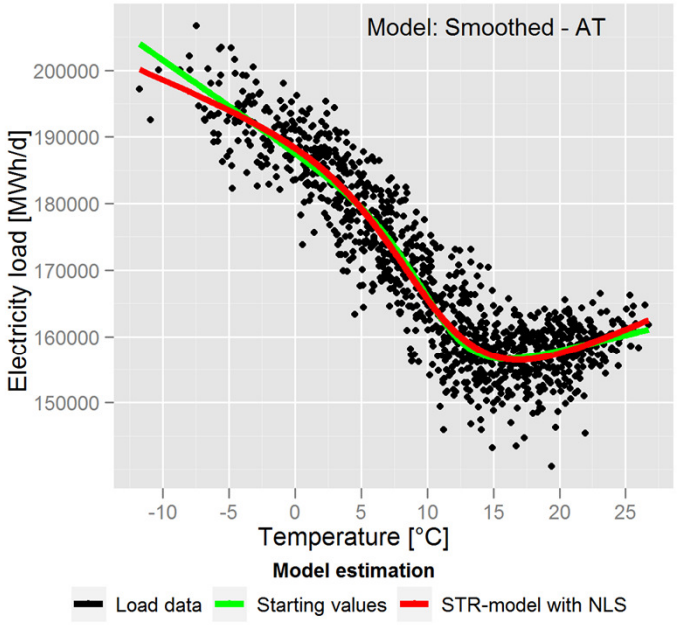


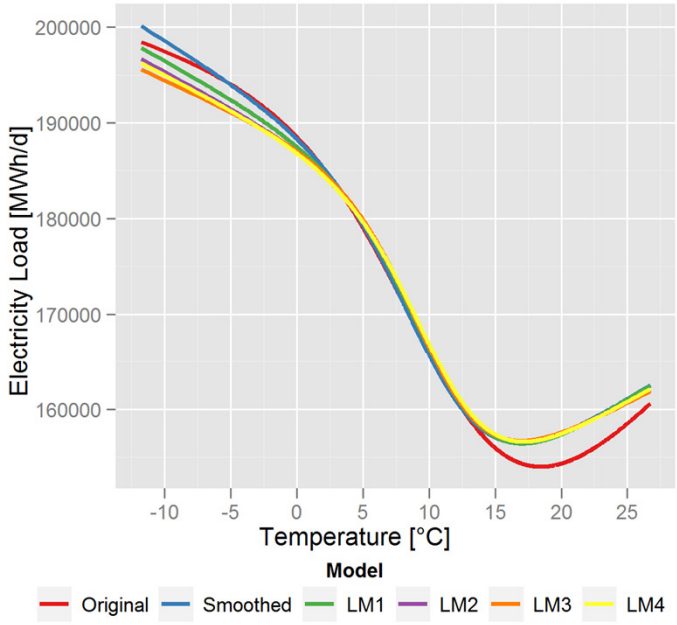


Temperature Impacts: Austria – RACMO

2006/10:

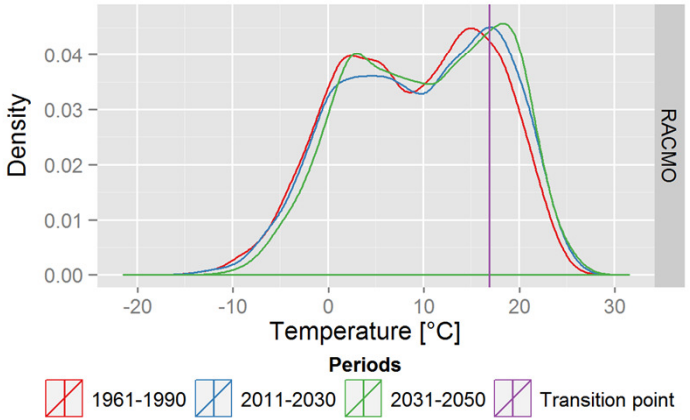
(working days)

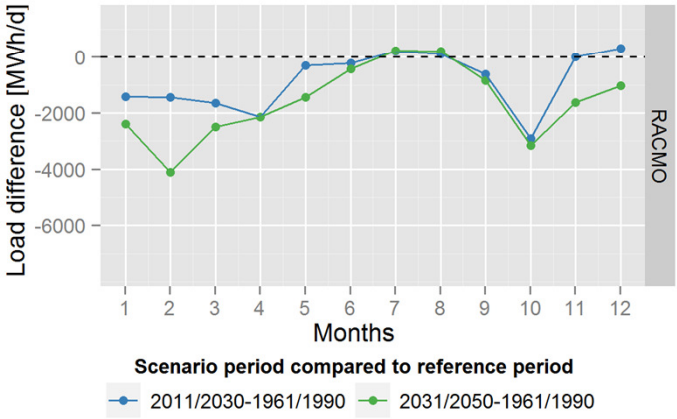




Climate Change:

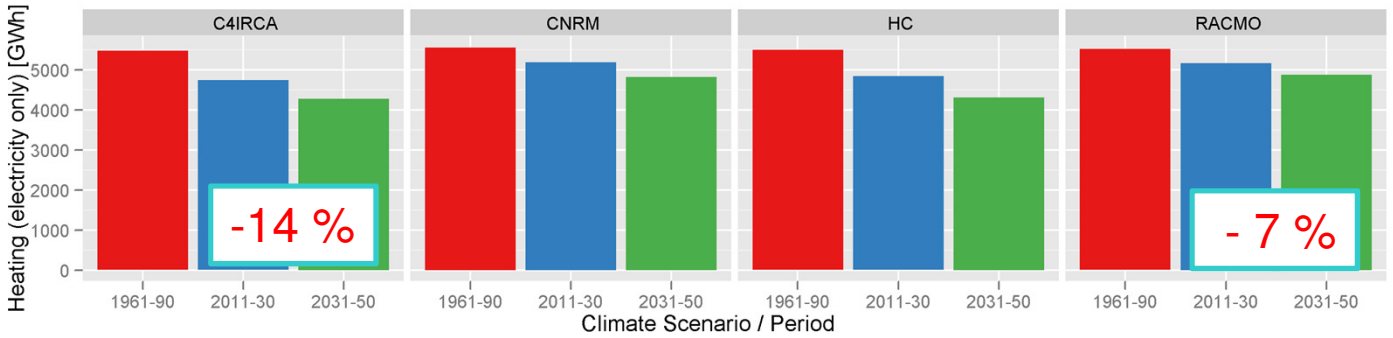
(RACMO)

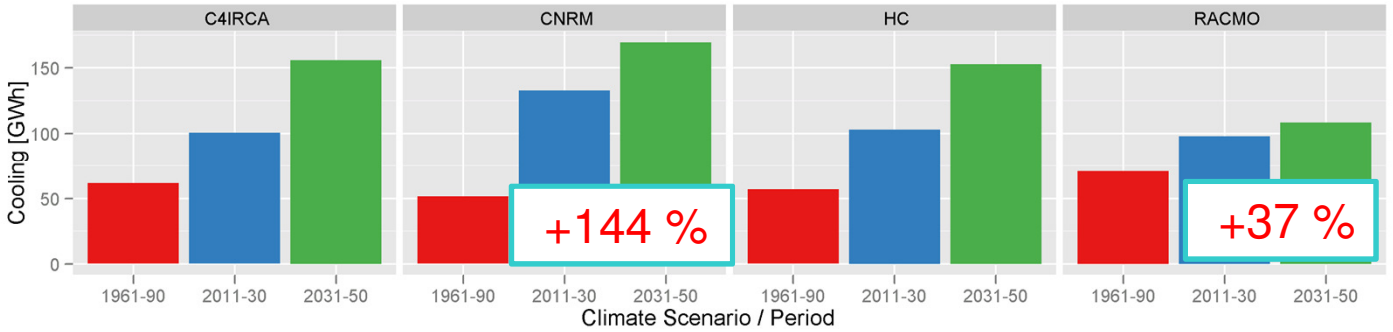


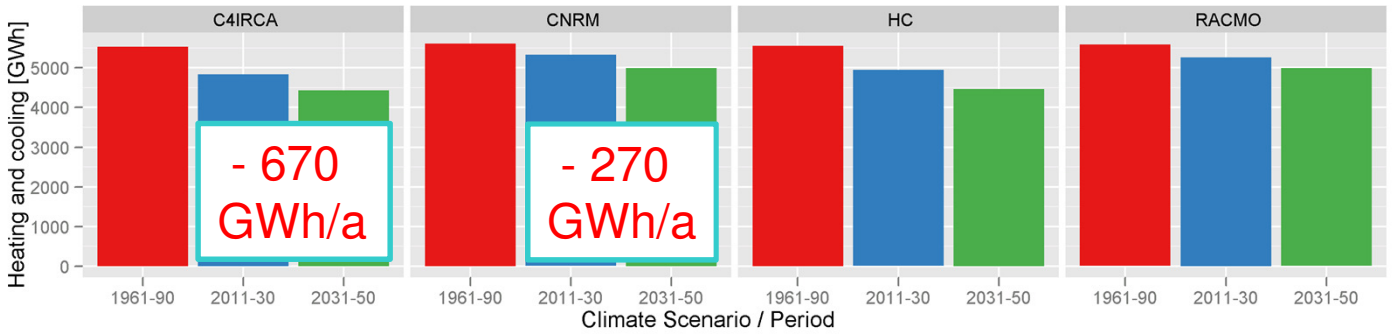


Temperature Impacts: Austria – All scenarios

Climate induced Change:







Temperature Impacts: Austria

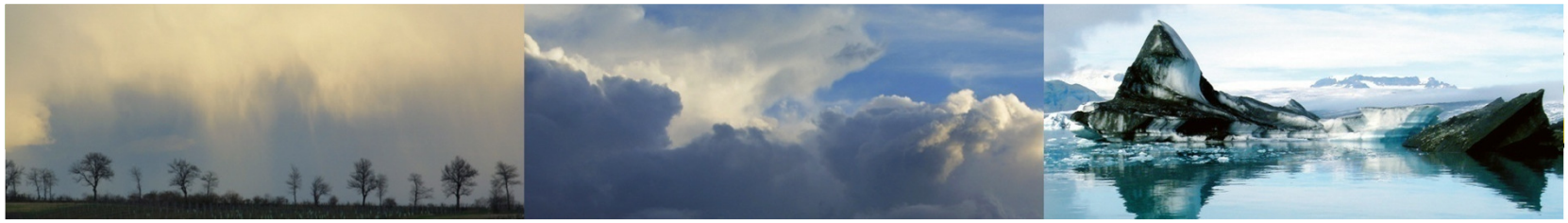
- Changing heating and cooling patterns?
  - If heating sensitivity stays the same, how much is cooling allowed to growth, that the overall effect of climate change until 2050 is a positive one?
    - Dependent on climate change scenario, cooling sensitivity would need to double every 5 to 10 years
- Positive effects on other heating energy carriers
  - Consumer expenditures for heating energy carriers other than electricity ~10 times higher than heating and cooling electricity costs
    - Total consumer savings for energy until 2050: ~500 Mio. €/a

Temperature Impacts: Continental Europe

- AT, BE, BG, CZ, FR, DE, NL, PL, PT, RO, SK, SI
  - Current cooling electricity demand is relatively small compared to heating electricity demand
    - Climate change will very likely lead to a decrease in total electricity consumption
    - FR: Decrease is large (6000-15000 GWh/a)
- ES, HU, HR
  - Size and seasonal distribution of the climate change signal might determine the direction of the effect
- IT
  - Current situation: Peaks in summer > Peaks in winter
    - For all scenarios: Increase in cooling electricity demand > decrease in heating electricity demand (<5000 GWh/a)

Summary and Conclusions

- Overall, for Continental Europe climate change until 2050 will likely have positive effects on electricity demand
  - Unless Europe will switch to a very cooling intensive lifestyle or will abandon the use of electricity for heating
- Austria will remain a heating-oriented country
  - Substantial decrease in winter, but the increase in Italy in summer might have major implications
- Effects of climate change will be small compared to the potential impacts of changes in income, technology etc.
  - Amount of electricity used for heating and cooling purposes
    - less determined by future temperature
    - but by energy policy and the willingness to design a low-carbon, energy-efficient, adaptable heating and cooling system



- Further Modeling Steps in EI.Adapt
  - Interactions between demand and supply side effects (potential reduced hydropower availability in summer, changes in the availability of wind power and photovoltaics)
  - Implications for the electricity sector and the economy

Questions?

christoph.toeglhofer@gmail.com

franz.prettenthaler@joanneum.at

Thanks for your attention!