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El.Adapt: Climate change impacts on electricity demand in Continental Europe

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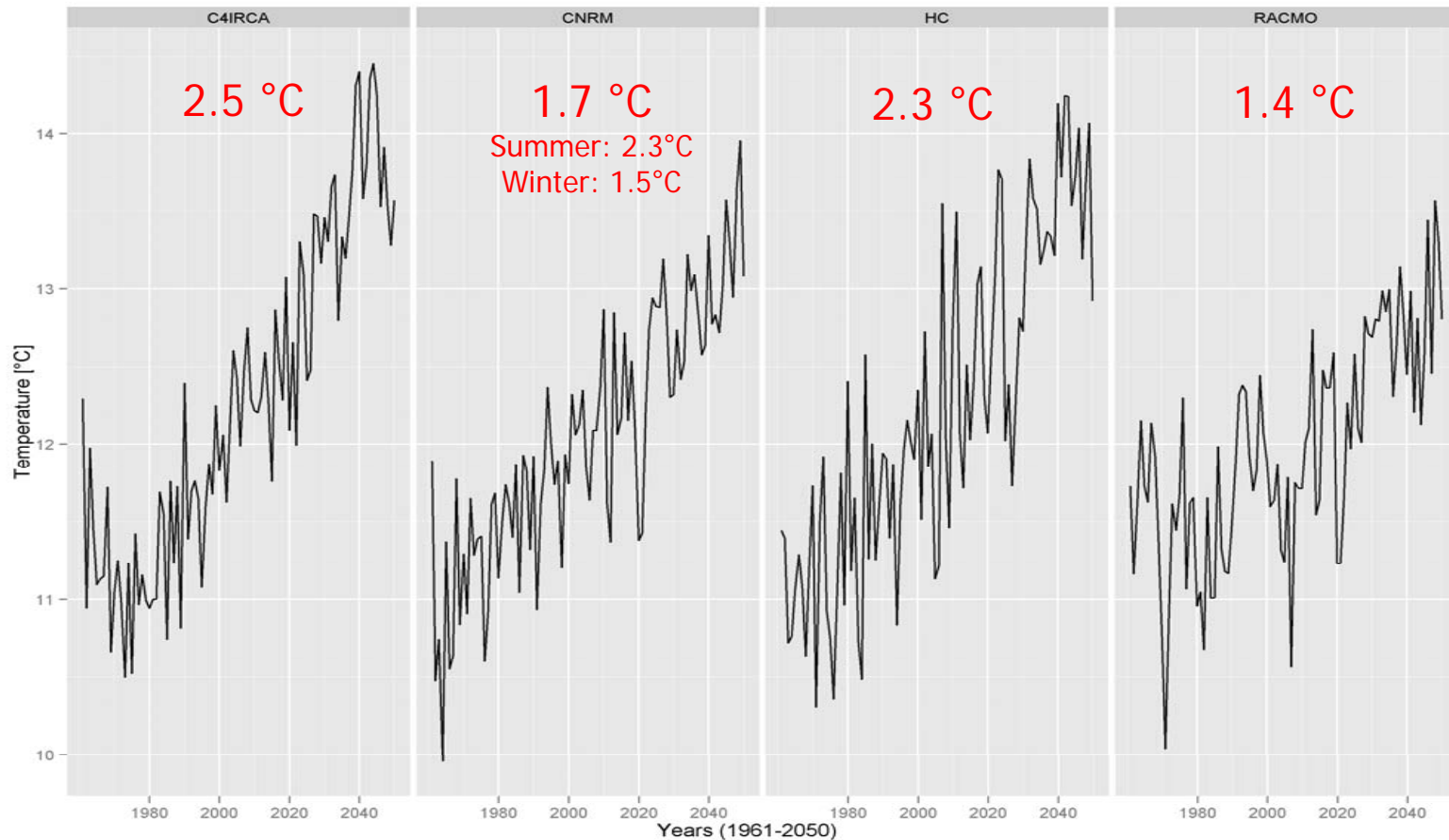
Wegener Center for Climate and Global Change, University of Graz
JOANNEUM RESEARCH, Center for Economic and Innovation Research, Graz

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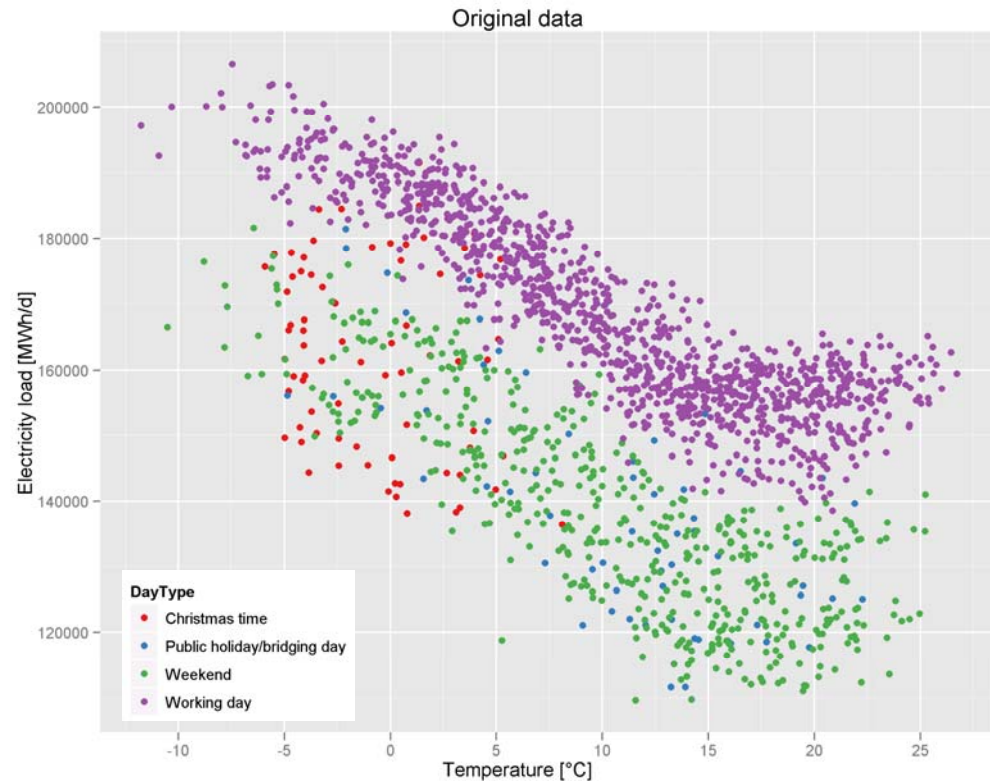
- El.Adapt
 - Study commissioned by the Austrian Climate Research Programme (ACRP) and funded by the Austrian Climate and Energy Funds
 - Climate change impacts on the electricity industry
 - hydropower, wind power, photovoltaic, heating and cooling
 - Austria and Continental Europe
 - Up to 2050
 -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

- 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

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



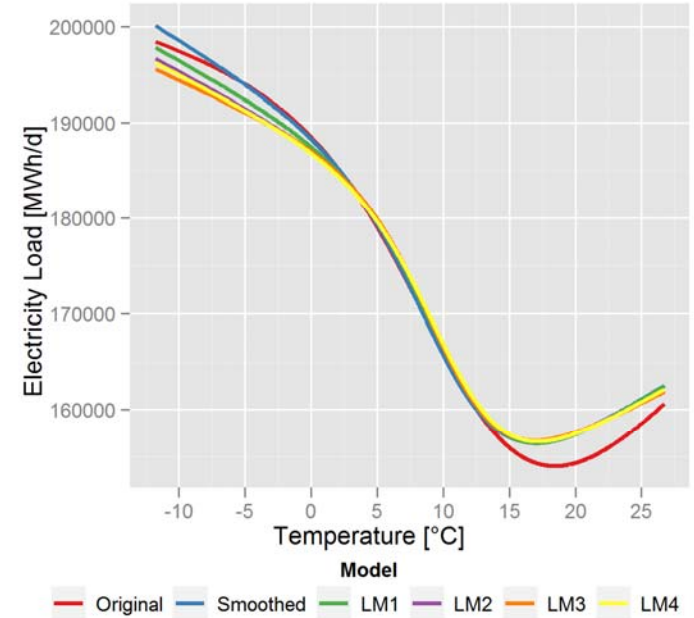
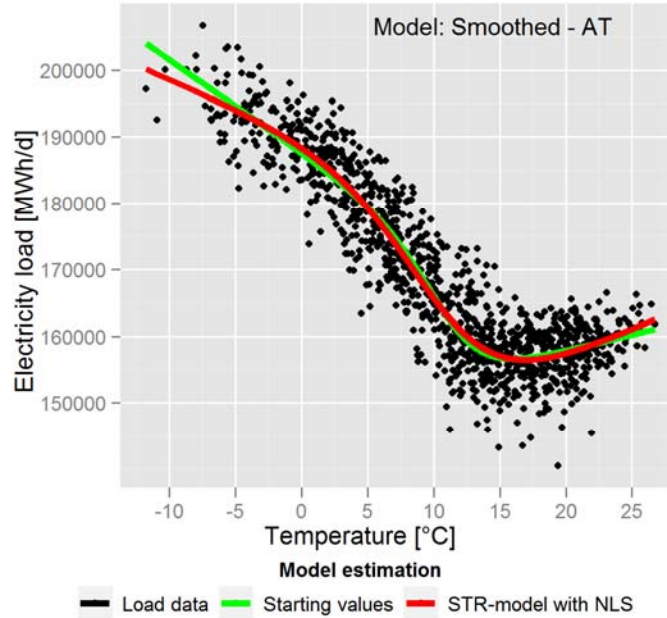
- Load correction
 - Econometric Models
 - E.g. Moral-Carcedo and Vicéns-Otero (2005)
 - Non-climatic effects
 - Weekdays
 - Public holidays
 - Bridging days
 - Christmas time
 - Summer holiday
 - Industrial production
 - Recession years



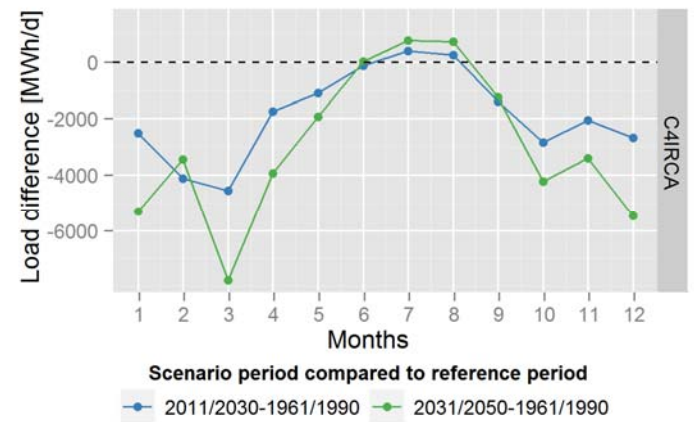
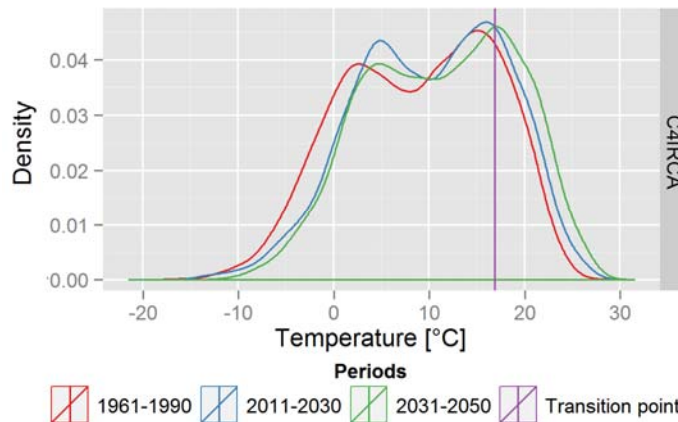
- Relationship between temperature and corrected load
 - Smooth Transition Regression Model
 - allows to model transition from cooling to heating
 - not a sudden, but a gradual process
 - Model choice from 6 different models based on statistical criteria
- Climate change impacts
 1. Under current heating 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)

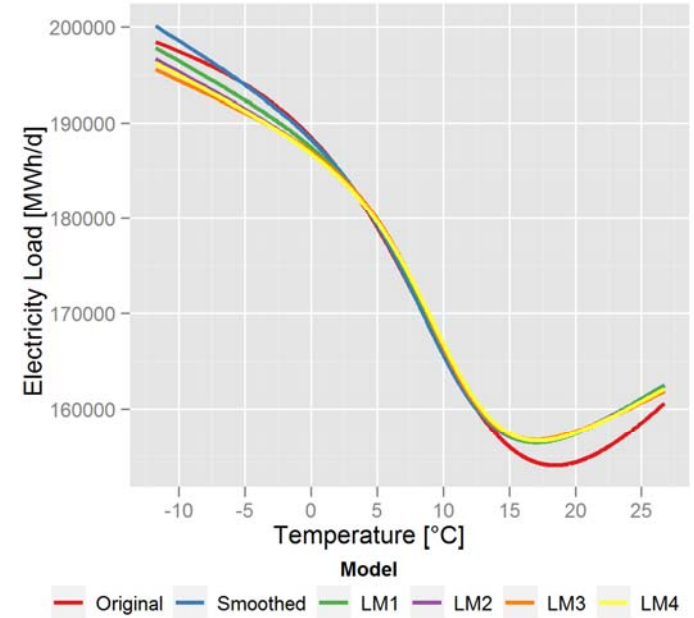
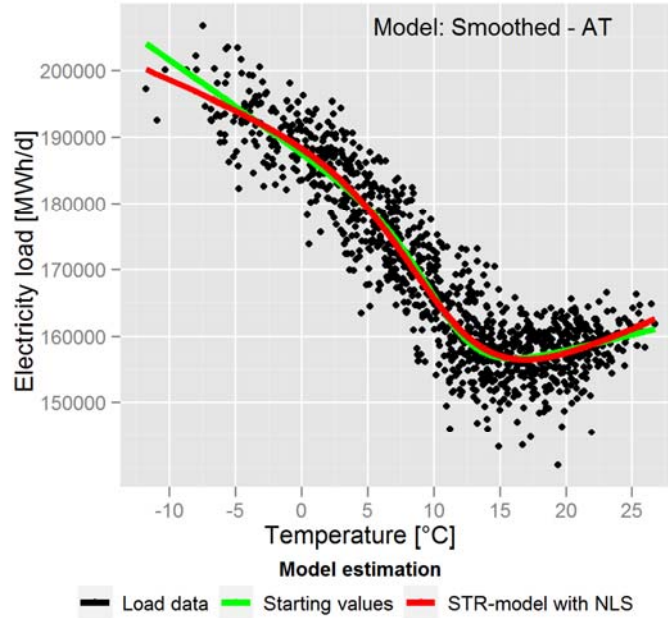


**Climate
Change:
(C4IRCA)**

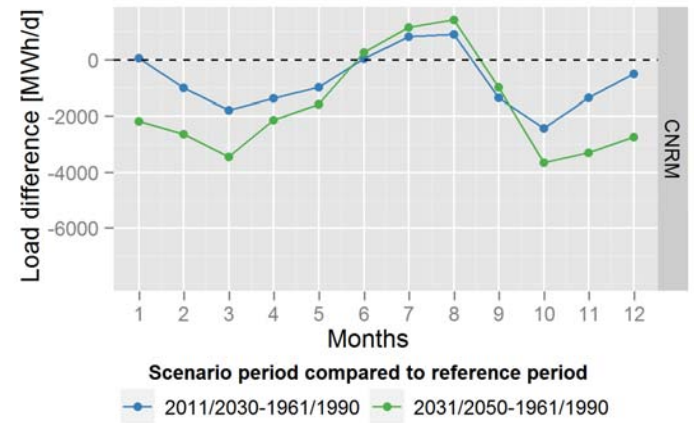
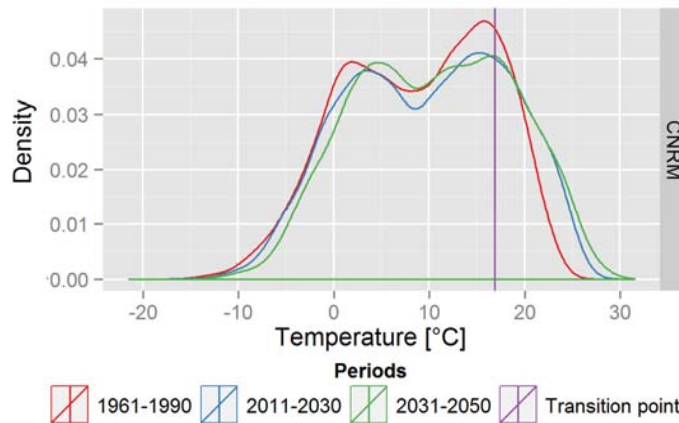


Temperature Impacts: Austria - CNRM

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(working days)

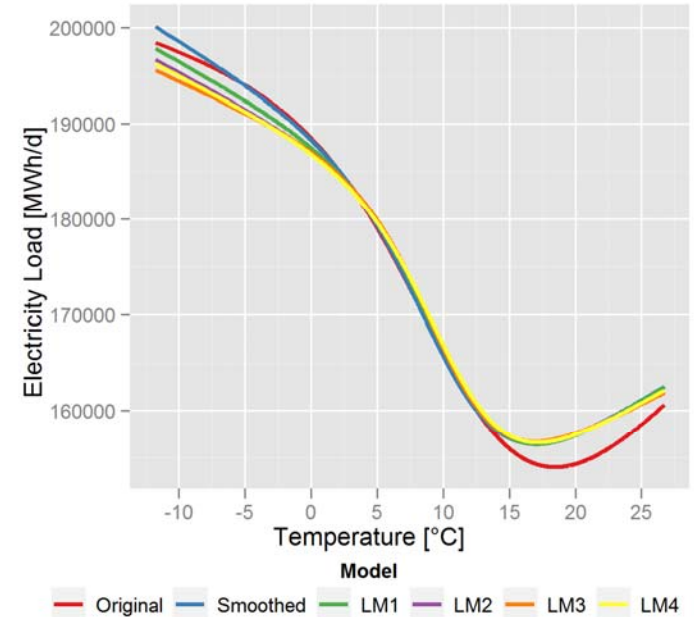
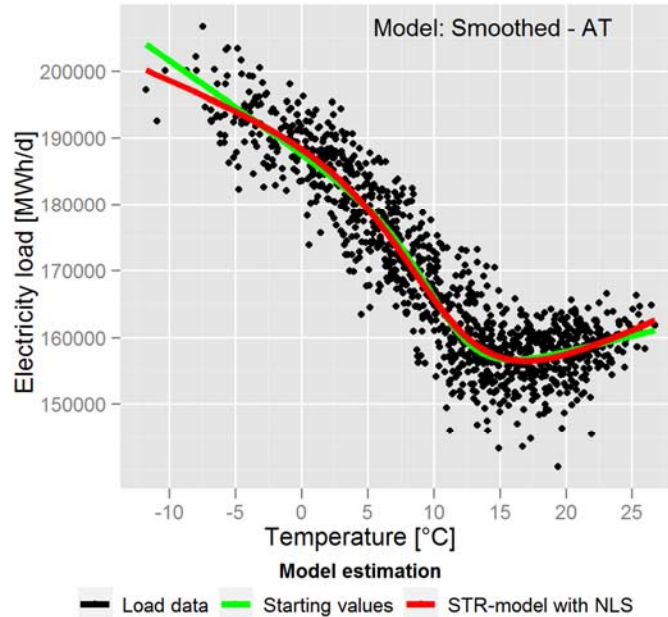


Climate Change:
(CNRM)

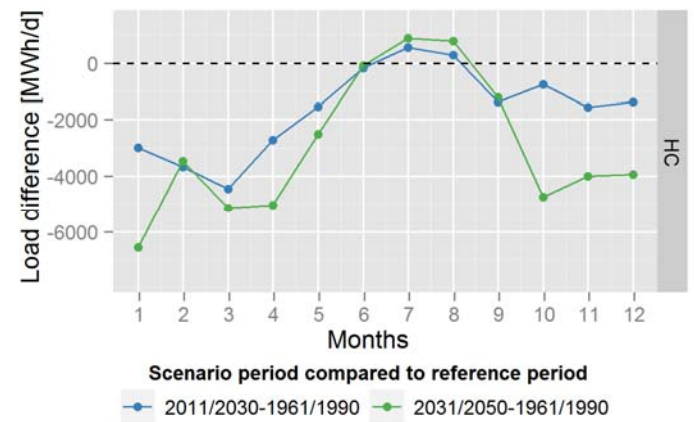
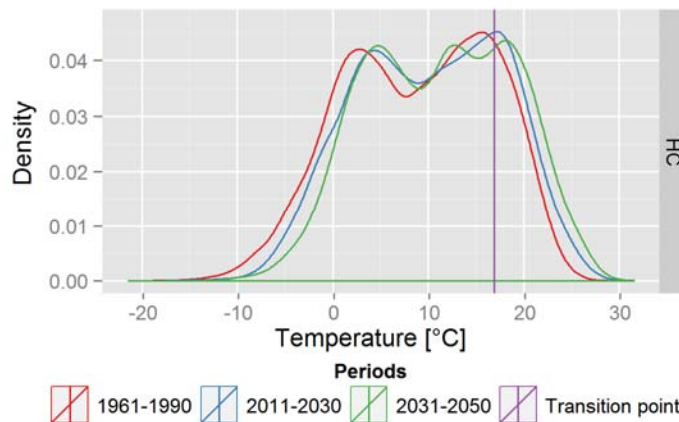


Temperature Impacts: Austria - HC

2006/10:
(working days)

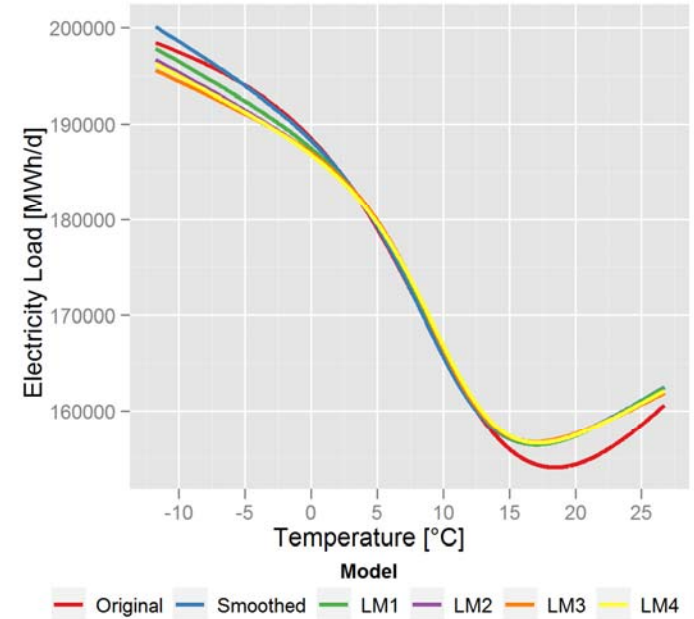
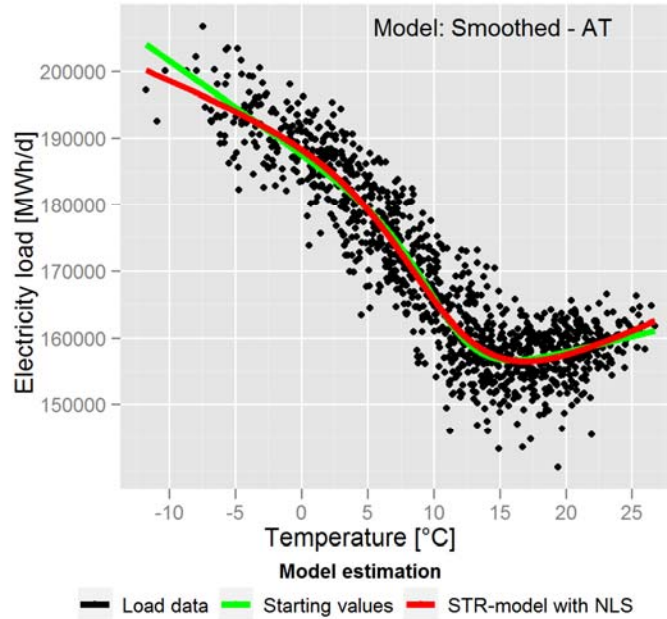


**Climate
Change:
(HC)**

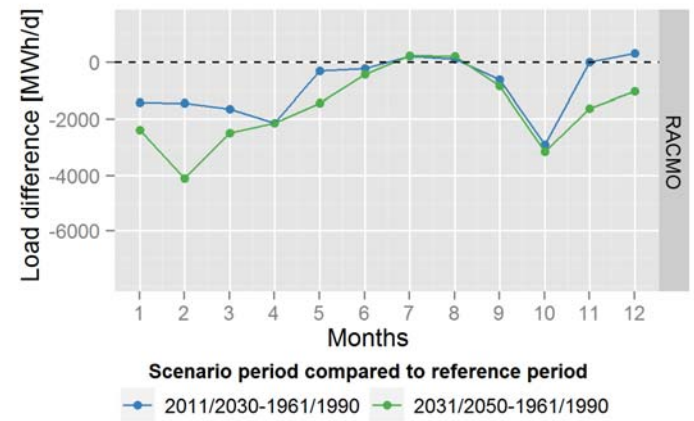
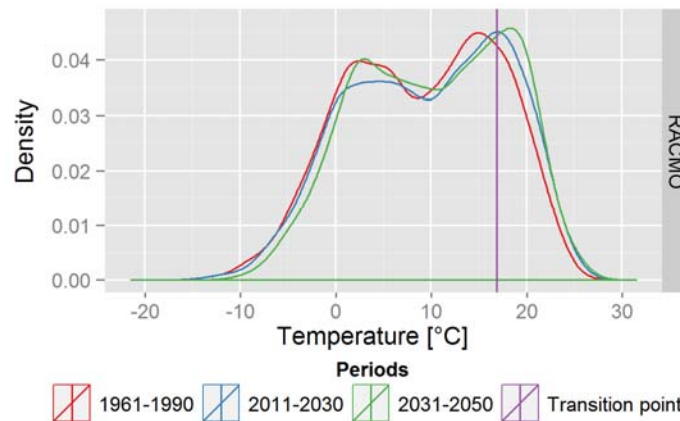


Temperature Impacts: Austria - RACMO

2006/10:
(working days)



**Climate
Change:
(RACMO)**



Temperature Impacts: Austria – All scenarios

**Climate
induced
Change:**



- Changing heating and cooling patterns
 - How much stronger may the change in cooling electricity demand compared to the change in heating electricity demand be, that the overall effect of climate change is a positive one?
 - Dependent on the climate scenario, the difference in the annual growth rate of the temperature sensitivity of cooling and heating electricity demand would have to be 7 - 14 %.
 - 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

- 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)

- Overall, for Continental Europe climate change until 2050 will very 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 investigations in El.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?

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Thanks for your attention!