Impacts of climate change on the crop invasion of oilseed-rape by the rape stem weevil, *Ceutorhynchus napi*, in North-Western Germany

**Key Findings**
Our study demonstrated that simple models using locally-adjusted weather-based thresholds have the potential to offer sufficiently accurate forecasting of first immigration flights by *Ceutorhynchus napi*. This is the basis for an appropriate timing of insecticide application for controlling this pest. In addition, the new model was combined with regional climate change projections. The onset of the crop invasion by the rape stem weevil was projected to occur between 7 days (near future, 2021-2050) and 17 days (far future, 2069-2098) earlier in comparison to the reference period (1961-1990).

**Results - Projecting air temperature**
The 30-year long-term averages of the multi-model annual mean air temperatures increased from 8.9°C in the reference period to 10.1°C in the near (2021-2050) and 11.7°C in the far future (2069-2098) (Fig. 1).

**Optimizing the forecast model for rape stem weevil**
The impact model adopted to the local climate conditions is able to reproduce the observed dates of crop invasion with a RMSE value of 10.9 (Fig. 3). In most of the years the differences are with less than 3 days very small.

**Materials and Methods**
Based on long-term (1989-2010) observational data at Goettingen (Lat. 51°56’, Long. 9°94’) the threshold values of the forecast model by Debouzie & Wimmer (1992) were optimized. The new approach predicts the crop invasion, when daily maximum air temperature exceeds 12.0°C, 12.5°C, and 13.0°C on three consecutive days up to Mar 15. The daily totals of precipitation on these days must <2 mm. After that date only one day with full field conditions is taken into account. Daily data of maximum air temperature as well as precipitation were retrieved from the data archive of the German Meteorological Service (1971-2010) and used to calibrate the impact model and for the bias correction of different RCMs. We used 15 GCM RCM combinations of the EU ENSEMBLES project, covering the period from 1961 until 2100 with a spatial resolution of 25 km. A non-linear bias correction (quantile mapping) was applied to all meteorological data sets.