# Combining a bioclimatic and a growth model to assess the effect of management practices and building ambiance on growing pig performances at the batch level

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## Introduction

Most pigs in the EU are reared in rooms with controlled ambient conditions. Bioclimatic models represent and predict the energy balance and the direct energy consumption at the room level, based on characteristics of the building, management of the climate control tool and average performance of pigs. Available growth models usually simulate performance of animals, including indirect energy (i.e. feed intake), under thermoneutral conditions.

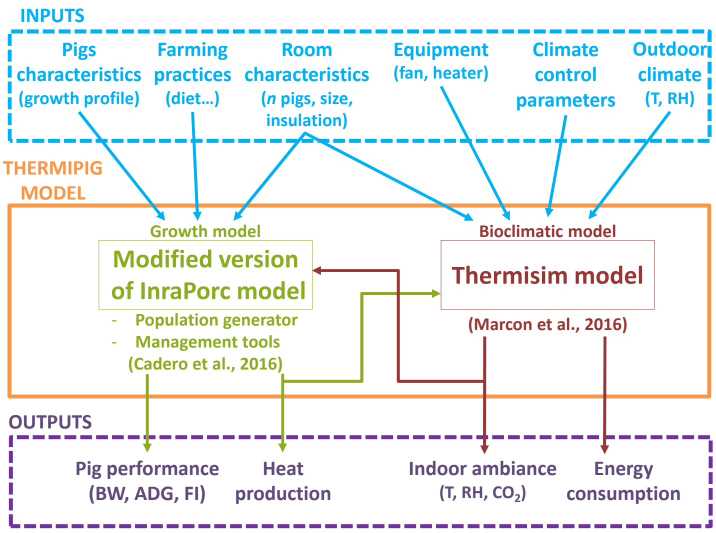
## Objectives

**Connecting a bioclimatic model (Thermisim) and a growth model (InraPorc) to simulate in a dynamic way the performance of growing pigs and energy consumption in different indoor conditions (barn characteristics, feeding strategy, ambiance management …) and outdoor climate conditions.**

## Material and methods

### Model characteristics

- Multi-object, mechanistic, dynamic, determinist and pig centred
- Written in Python




### Developments for sub models combination

- Time step: Thermisim (second), InraPorc (day) → Hour for Thermipig
- Circadian dynamic partition of feed intake and of the thermic effect of digestion (Gamma function, Matis *et al.*, 1999; Le Bellego *et al.*, 2001)
- Lower (NRC, 2012) and upper critical temperature (Renaudeau *et al.*, 2011) based on individual BW
- Ambient conditions at Day D determines individual feed intake at D+1 and corresponding hourly T at the room level

### Model evaluation

- Data obtained in a French experimental unit (Quiniou *et al.*, 2009)
  - September 2007-January 2008
  - Fattening performance of a batch of barrows and gilts fed *ad libitum*
  - Precise description of diets and rooms
  - BW and FI data ➔ calibration of an average growth profile
  - Measurement of indoor and outdoor temperature every 15 minutes
- Simulated performance of 30 virtual batches generated from the average growth profile, in conditions similar to those described above
- Comparison between observed and simulated growth performance and indoor temperature (T) based on the RMSEP

## Results

### Pig's performance

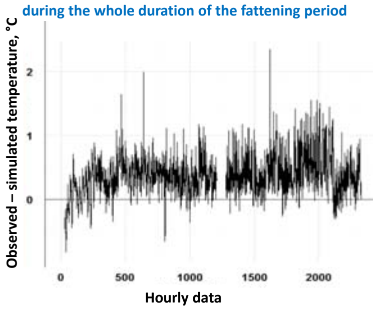
Adequacy of prediction to observed average performance assessed through the RMSEP

| Criteria | Observed value | RMSEP | Relative RMSEP (%) |
|---|---|---|---|
| Feed intake (kg/d) | 2.41 | 0.02 | 0.7 |
| Average daily gain (g/d) | 876 | 22.2 | 2.5 |
| Feed conversion ratio | 2.79 | 0.07 | 2.6 |
| Slaughter weight (kg) | 118.6 | 1.0 | 0.9 |

**Good accuracy of growth performance prediction with the model ThermiPig**
(relative RMSEP < 3%)

### Evolution of hourly indoor T

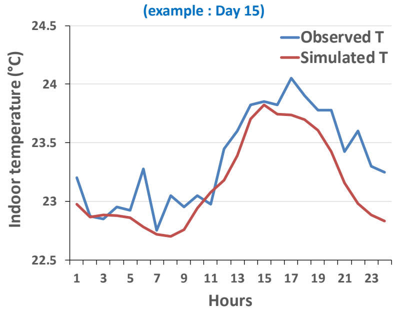
Difference between observed and predicted hourly indoor temperature during the whole duration of the fattening period




**Predicted indoor temperature**
➔ RMSEP (0.49°C) lower than the precision of the probe
➔ Slightly underestimated

### Circadian dynamic of indoor T

(example : Day 15)




**Circadian dynamic well described by the model**
➔ The accuracy of temperature prediction indicates a reliable prediction of ventilation rate

## Conclusions

**The THERMIPIG model allows for a good prediction of performance and indoor temperature. Thereafter this model will be used to evaluate the performance of pigs under different climatic conditions and in different building or feeding conditions and the consequences of the management of the total energy consumption.**

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