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PiPoCooL *Climate change and future pig and poultry production: implications for animal health, welfare, performance, environment and economic consequences*

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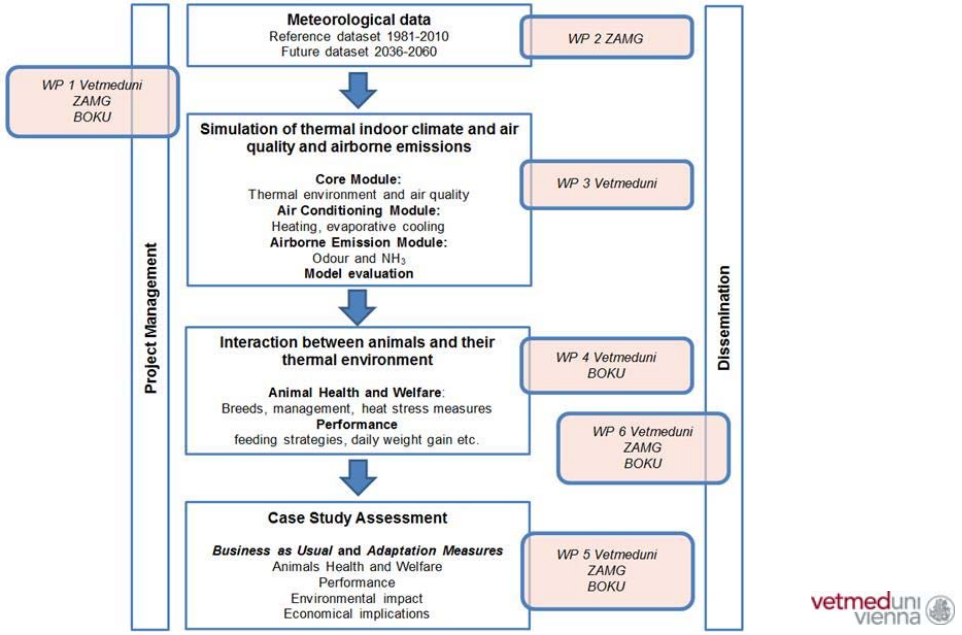
PiPoCooL Project Structure



Overview

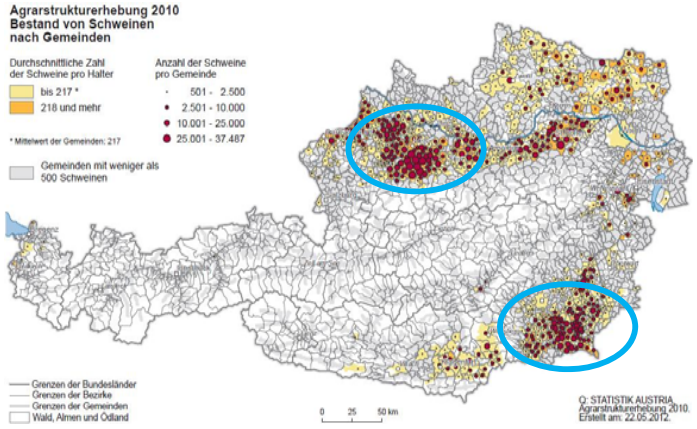
- Pigs and poultry are predominantly kept in confined livestock buildings in Austria
- Indoor climate defines the environment of the animals: Simulation of the indoor thermal climate, air quality, and airborne emissions
- Assessment of the vulnerability of livestock systems: reference (1981-2010) and the future dataset (2036-2065):
- Adaptation strategies: Improvement of the resilience of livestock husbandry

WP 2: Meteorological data

Two sites: high animal density

Wels (Upper Austria)

Feldbach (Styria)



WP 2: Meteorological data

TRY: typical years (ÖNORM EN ISO 15927-4)

TRY 1981-2010

TRY 2036-2065

Hot years

1994 represents 1981-2010

2003 represents 2036-2065

Stability of the atmosphere (2nd year)

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WP3: Simulation of the indoor climate IC

Meteorological Data WP 2

Temperature, humidity, radiation

↓

Simulation ← **Reference buildings** **Adaptation measures** Air treatment, animal density, etc.

↓

Indoor Climate + Emission

Temperature, humidity, thermal indices, air quality, volume flow rate, energy demand, emissions (NH_3, odour) energy consumption

↓

Indoor climate – Animal Interaction ← Daily weight gain, feed conversion, laying performance WP 4

↓

Livestock performance / health / well-being WP 5

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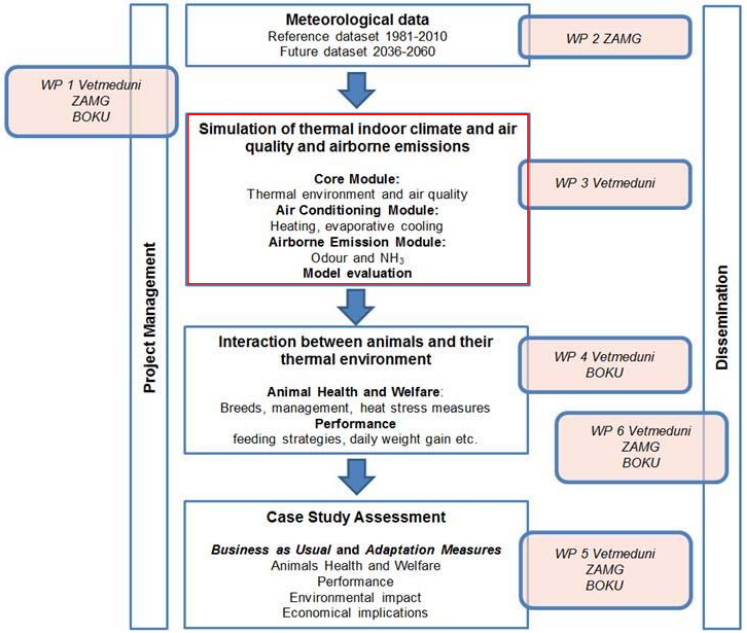
PiPoCooL Structure



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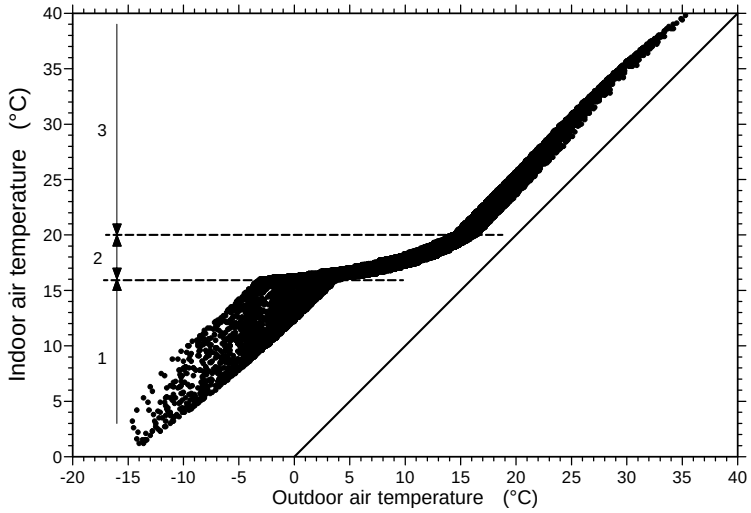
IC: Thermal environment



Schauberger et al. (2000)

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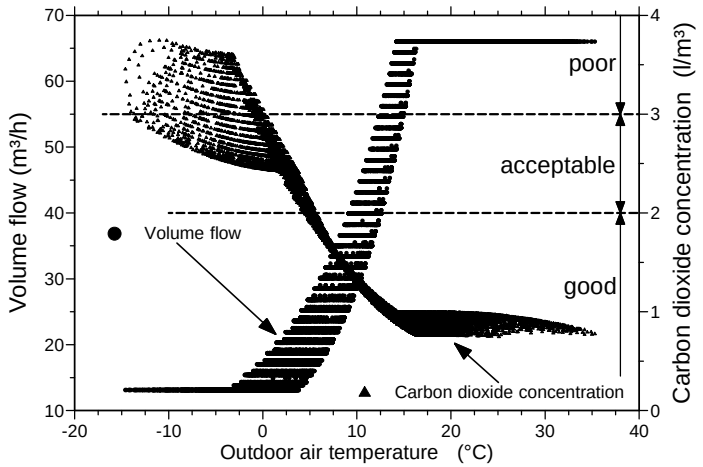
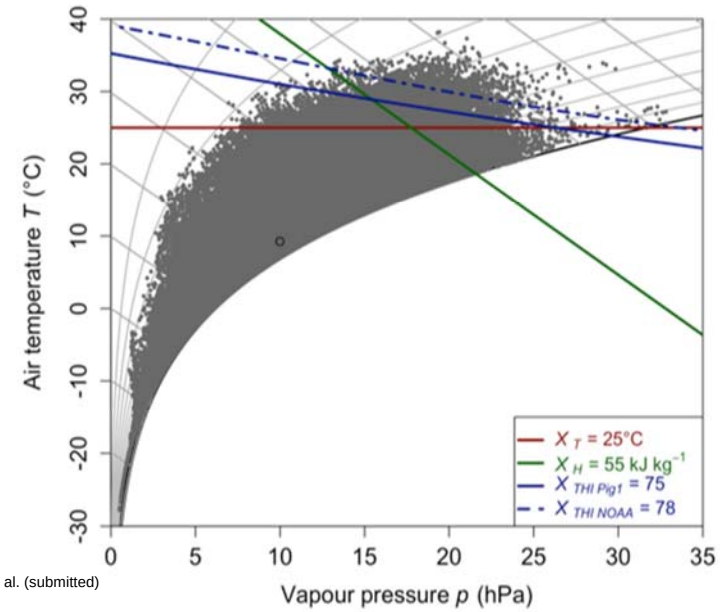
IC: Air quality



Schauberger et al. (2000)

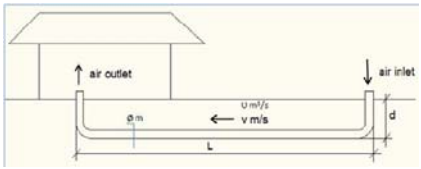
Outside temperature and humidity



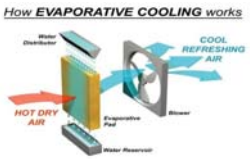
Vitt et al. (submitted)

Energy saving air treatment devices

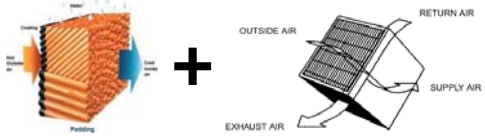
- **Earth-air heat exchanger EAHE**



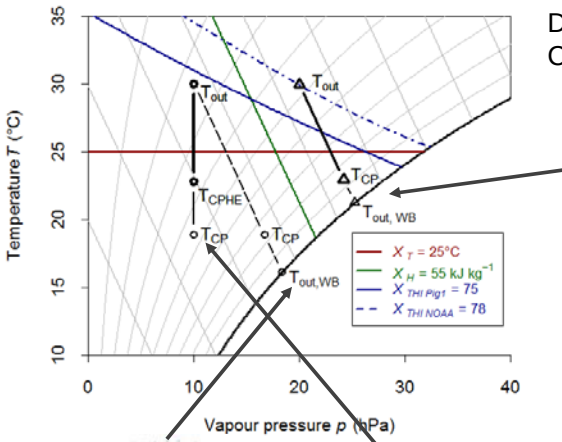
- **Direct evaporative cooling: Cooling pads**



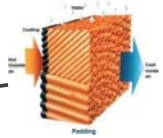
- **Indirect evaporative cooling: Cooling pads combined with a regenerative heat exchanger**



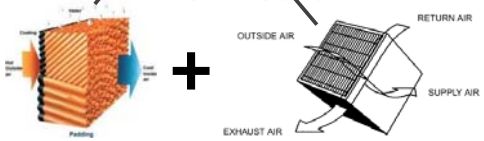
Comparison of evaporative cooling devices



Direct evaporative cooling: Cooling pads

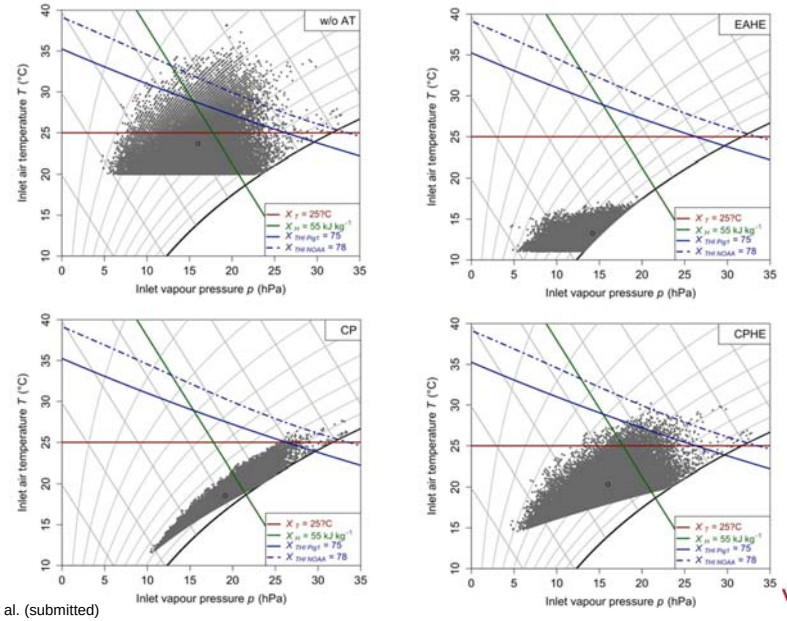


Vitt, R., Weber, L., Zollitsch, W., Hörtenhuber, S.J., Baumgartner, J., Niebuhr, K., Piringer, M., Anders, I., Andre, K., Hennig-Pauka, I., Schönhart, M., Schauberger, G., 2017. Modelled performance of energy saving air treatment devices to mitigate heat stress for confined livestock buildings in Central Europe. submitted



Indirect evaporative cooling: Cooling pads combined with a regenerative heat exchanger

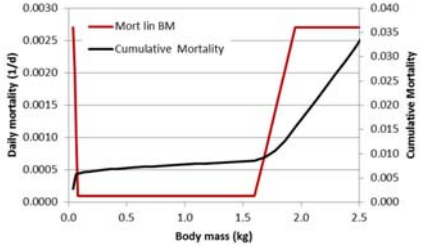
Air treatment: performance



Vitt et al. (submitted)

WP4: Environment - Animal Interaction

Interaction between animals and their thermal environment: performance, health and welfare response to heat stress



Mortality

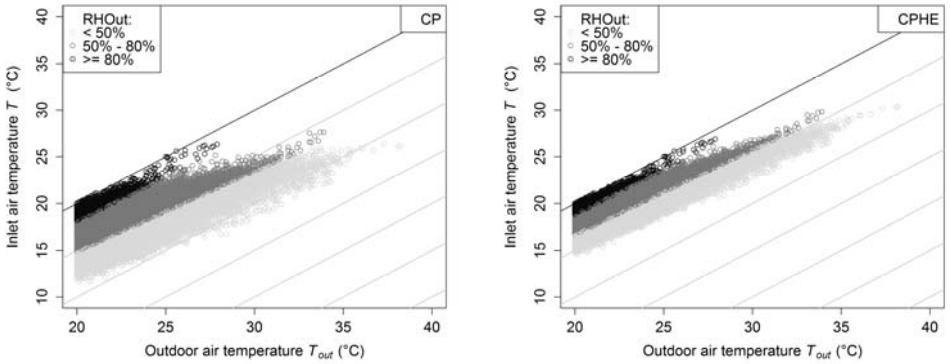
Daily weight gain

Feed conversion factor

Heat stress parameters

Temperature-Humidity-Index THI

Evaporative cooling



Vitt et al. (submitted)

Reference buildings: Livestock

	Fattening Pig	Broiler	Layer
Number of animals (-)	1800 (10 sections for 180 animals)	40000	24000
Area for the animals			
Usable area per animal (m²)	0.70		
Building area per animal (m²)	0.80		
Animal density (m^{-2})			18
Live mass density (kg m^{-2})		30	
Live mass start m_{start} (kg)	30	0.042	1.475
Live mass end m_{end} (kg)			
Pre-harvesting		1.667	
End of the rearing period	120	2.223	2.018
Growth model	Gompertz	Gompertz	Gompertz
Duration of the service period (d)	10	14	14
Cleaning and disinfection in between two rearing periods			
Type of keeping (CONT vs AI AO)	AIAO for each section (180 pigs)	AIAO	AIAO
Relevant for the entire building			

Adaptation measures I

Ventilation system
- Air treatment devices
  - Earth- Air heat exchanger
  - Direct evaporative cooling: Cooling pads
  - Indirect evaporative cooling: Cooling pads combined with a regenerative heat exchanger

Building
- Green roofs and façades
- Sprinkling of the roof
- Solar radiation protect of the building

Livestock
- Increased air velocity by additional ventilators
- Evaporative cooling by fogging
- Cooling of drinking water
- Floor cooling
- Feeding strategies
- Wallows for pigs

Adaptation measures II

Management
- Modification of the animal density during summer month
- Inverting the diurnal pattern (resting during daytime, feeding during night-time)
- Selecting more adapted breeds
- Modification of the design values for planning purpose of livestock buildings

Adaptation measures I

Simulation of the impact

Ventilation system
- Air treatment devices
  - Earth- Air heat exchanger
  - Direct evaporative cooling: Cooling pads
  - Indirect evaporative cooling: Cooling pads combined with a regenerative heat exchanger

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Simulation of the impact

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PiPoCooL Project Goals

Results

Peer Reviewed Journals

Dissemination

- Website www.vetmeduni.ac.at/PiPoCooL/
- Involvement of the stakeholders
- Information sheets (ÖKL)
- Indices for heat stress for livestock
  - Forecast by the Austrian weather service (?)
- Insurance against heat stress damages (?)
- Adaptation of the design values
- Consultancy (Wintertagung, seminars etc.)

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