FACULTY OF BIOSCIENCE ENGINEERING

DEPARTMENT OF DATA ANALYSIS AND MATHEMATICAL MODELLING

Improved monitoring with historical data, expert knowledge and context measures integration applied to dairy cow heat stress

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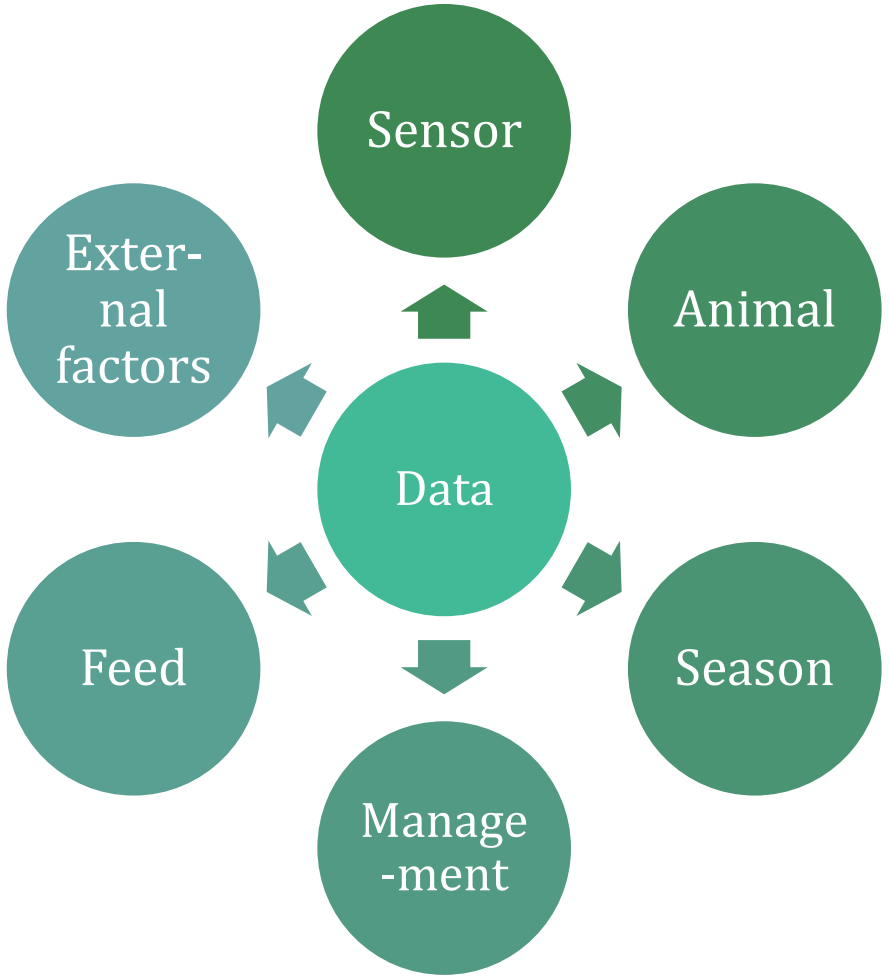
INTRODUCTION

PLF sensors generate complex data

Data ≠ information ≠ knowledge ≠ actions



To *maximize modelling outcomes*, we need to (partially) deal with:

- *high (irregular) frequency*
- *noise / measurement error*
- *non-linear trajectories*
- *outliers (meaningful?)*
- *animal-identification issues*

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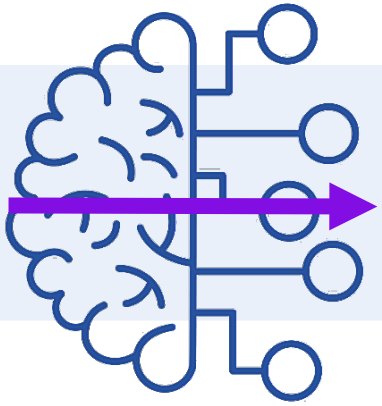
➡ *what tools/information can we use to help us with this?*

RESEARCH QUESTIONS & GOAL

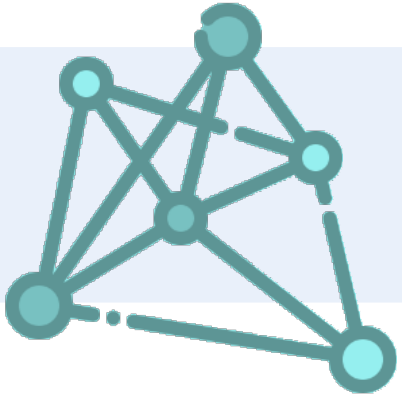
Can we improve sensor data usage

1. for decision making on farms
2. for getting post-hoc insights / phenotyping?

DATA



PREPARE
PREPROCESS



MODEL

INTERPRET

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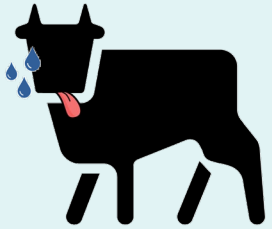
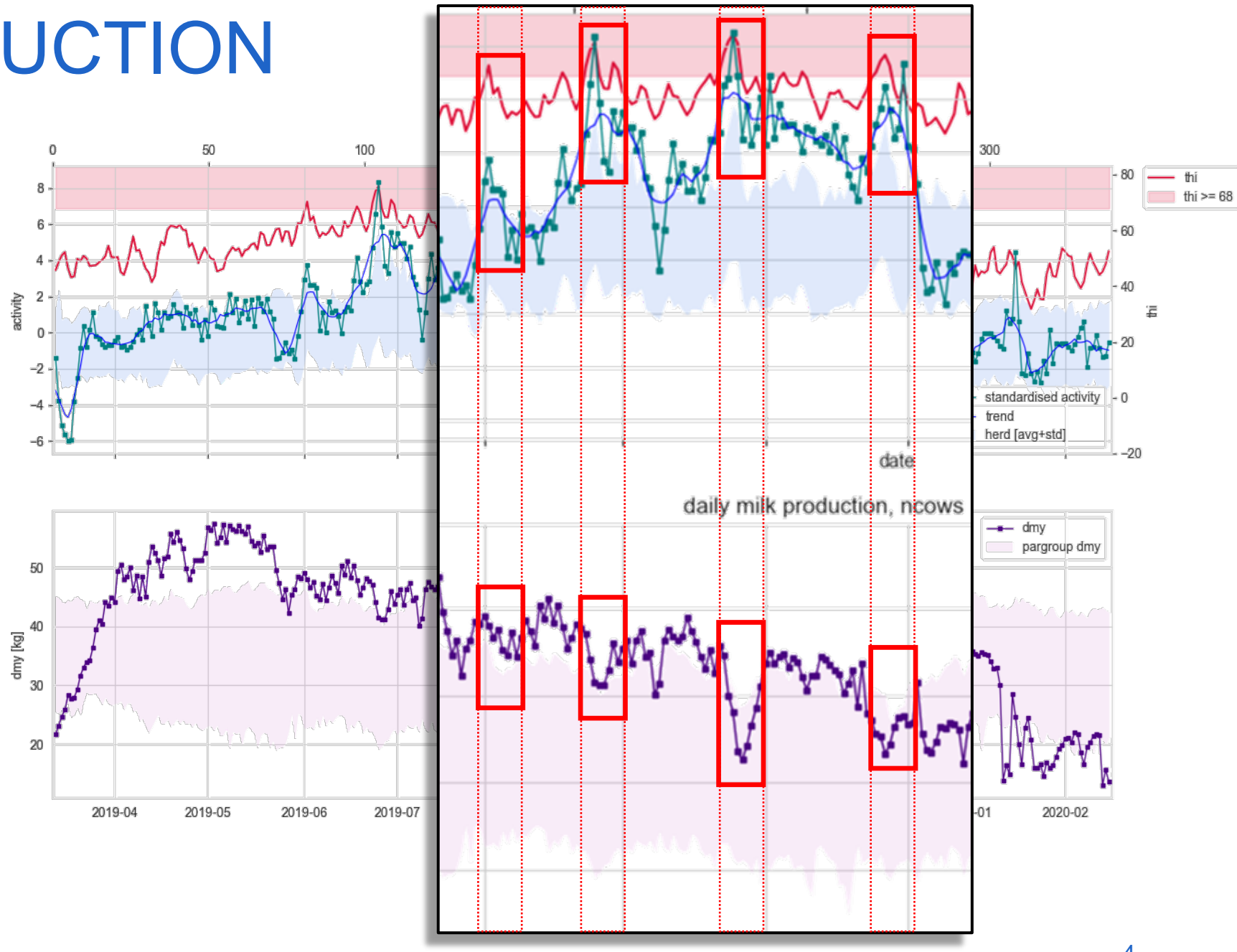
CASE INTRODUCTION

***Application**: individual dairy cow activity as a proxy for heat stress effects on milk yield*





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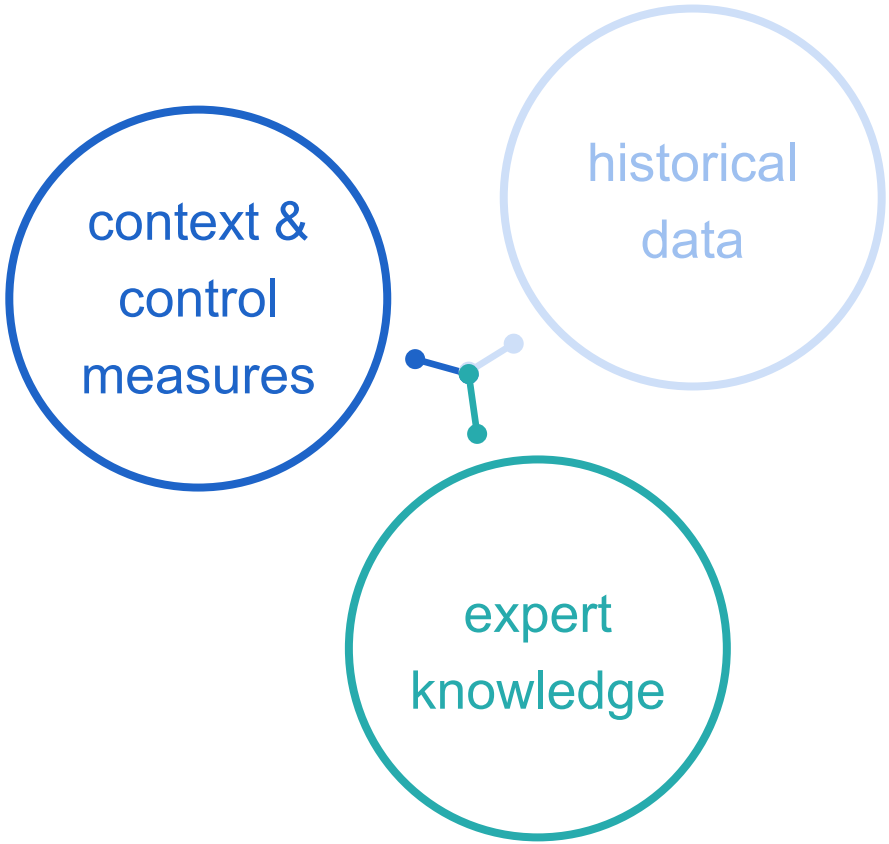
METHOD OVERVIEW

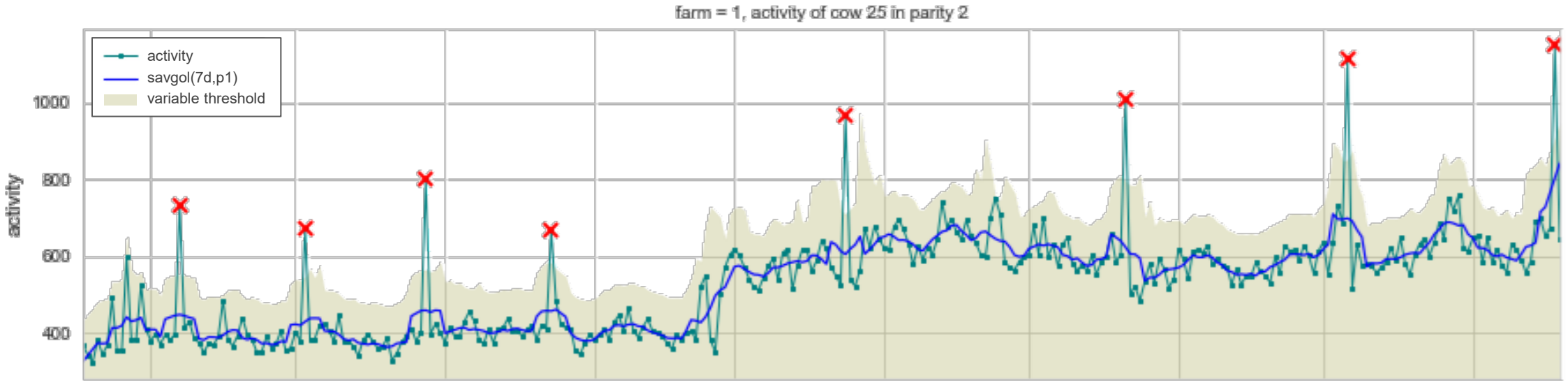
IDEA:

- Build the model based on most meaningful data features for your purpose
- Use knowledge of farm context, animal (health) history, physiology, nutrition, etc. to better mold data into interpretable shape readily accessible for AI/statistical/machine learning model



Disclaimer:
! only *examples* many more possibilities

EXPERT KNOWLEDGE FOR FEATURE DESIGN



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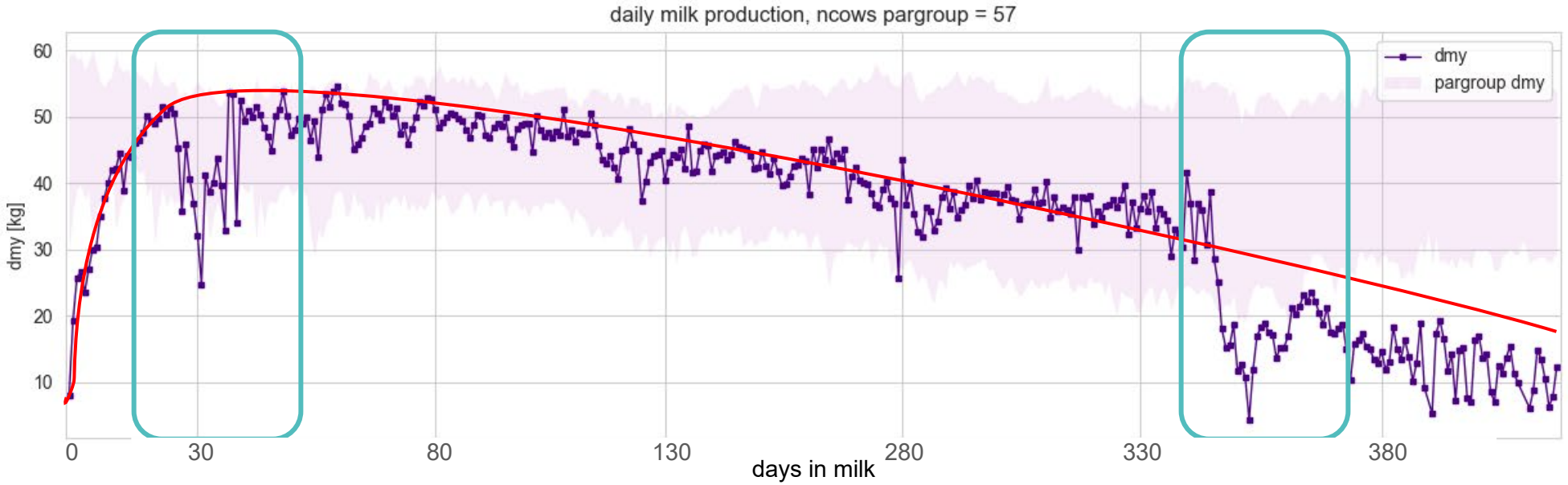

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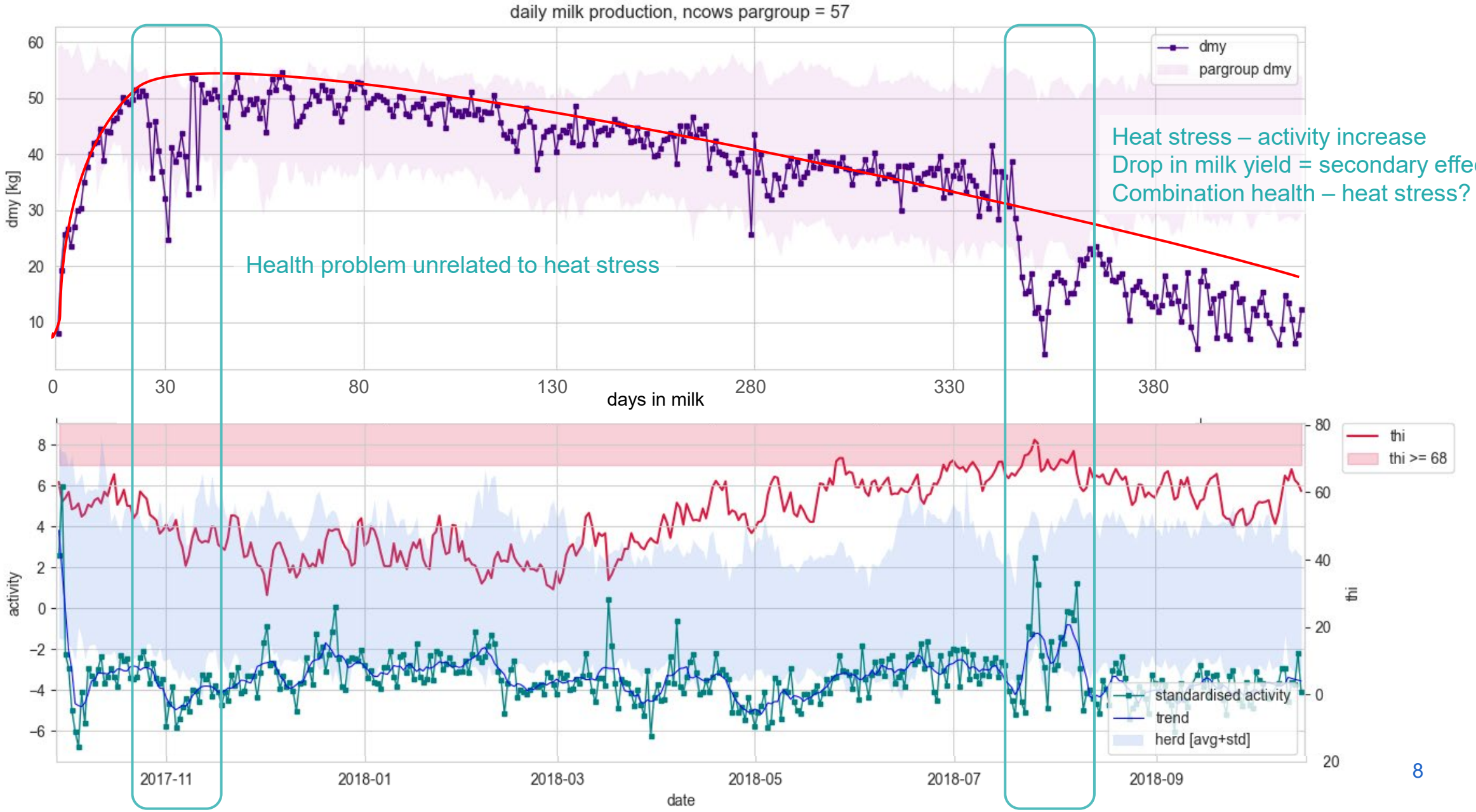
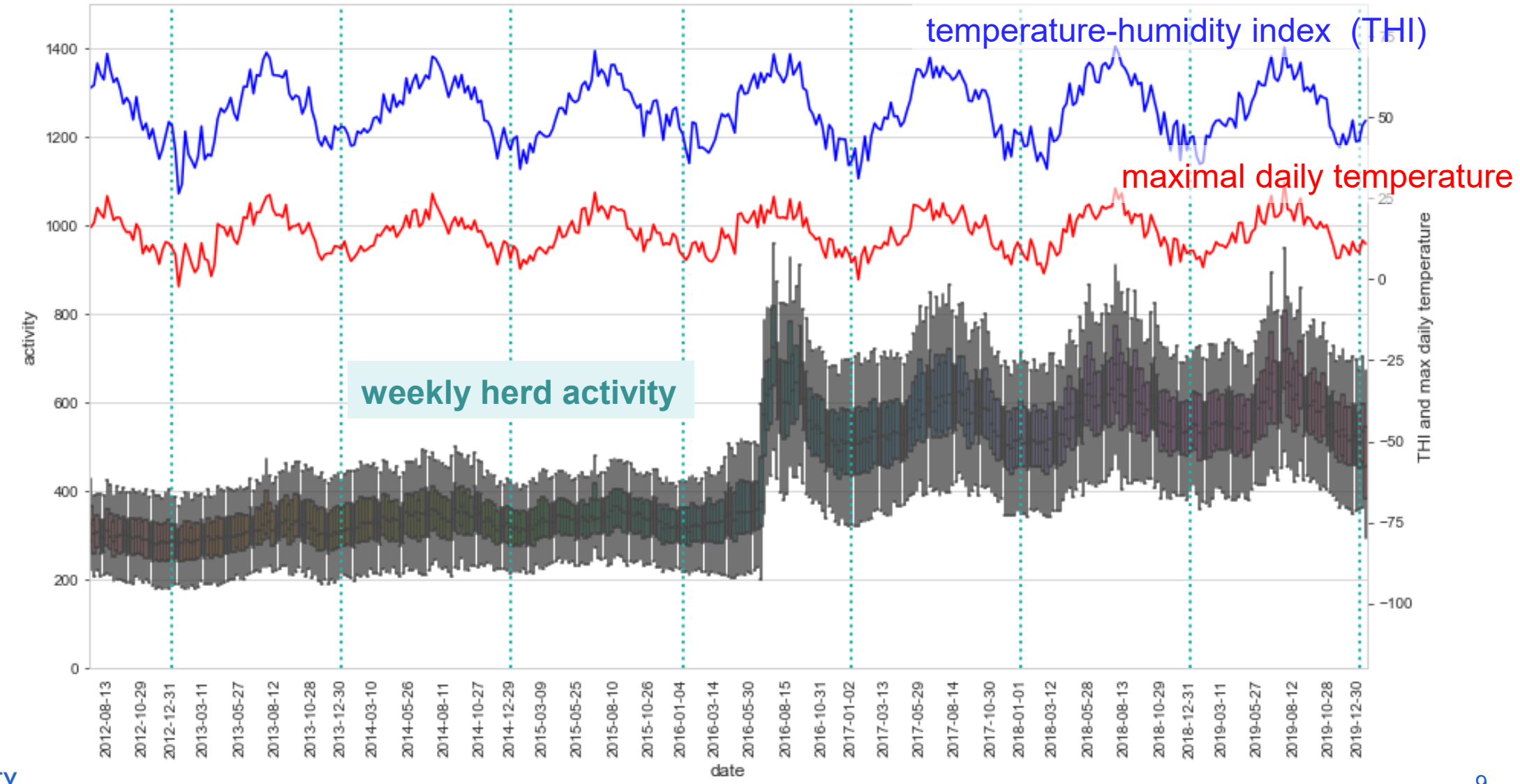


USE HISTORICAL (HERD) DATA



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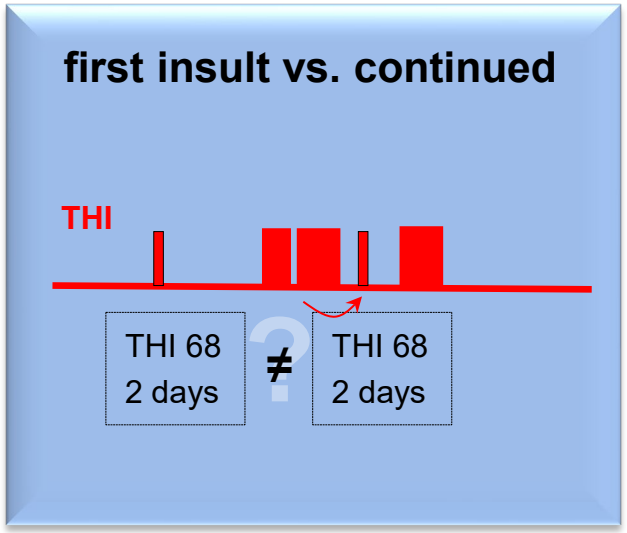
10-90% IQR
median activity
rolling median
farm = 64, summary stats of activity data, corrected for estrus + no. of cows
median - IQR of activity
rolling median corrected activity
count - number of animals
THI
date
2017-01
2017-07
2018-01
2018-07
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
1000
900
800
700
600
500
400
300
200
100
0
−100
−200
160
140
120
100
80
60
40
20
0
75
50
25
0

CONTEXT AND CONTROL MEASURES

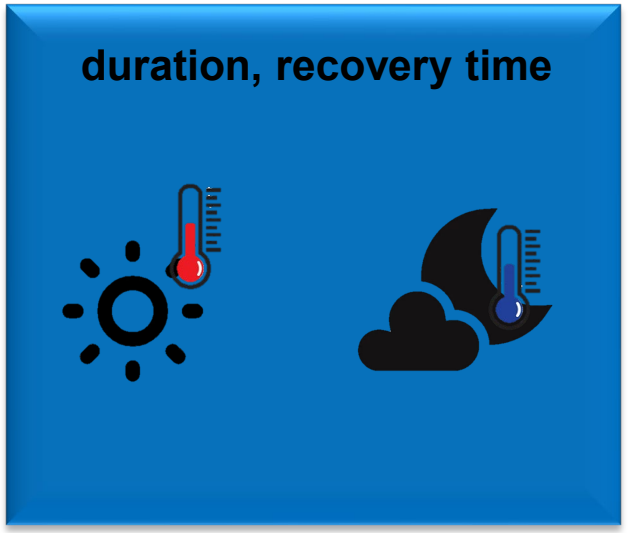
Consider e.g. barn and management conditions

e.g. use indoor-outdoor conversion formula, account for indoor shadow, wind and other mitigation

e.g. vanderZaag et al. 2024
doi.org/10.1139/cjas-2023-0040



e.g. account for “remainder” heat load of previous insults for example with decay function



e.g. consider peak THI, recovery (e.g. hours T° < 18°C) -- “average THI” might not “quantify” the insult

Other examples of implementation context & control: feeding, grazing strategy, nutrients, genetics etc.

OVERVIEW

DATA

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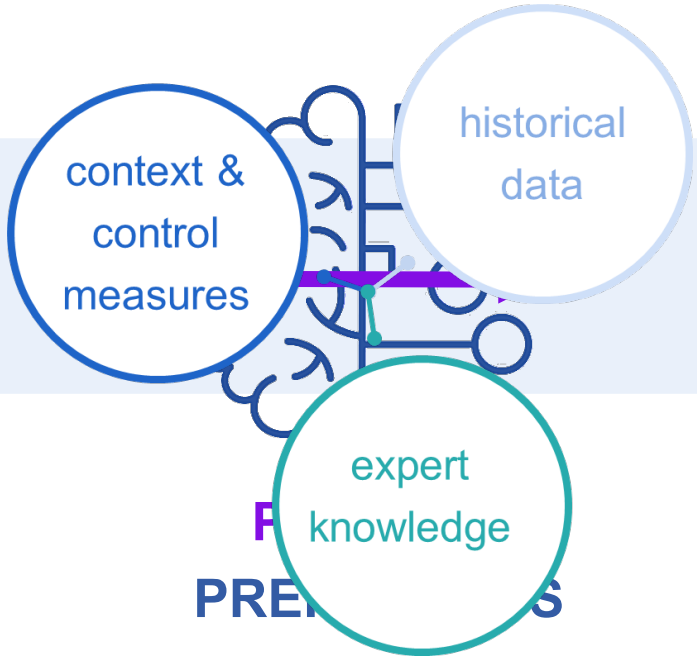

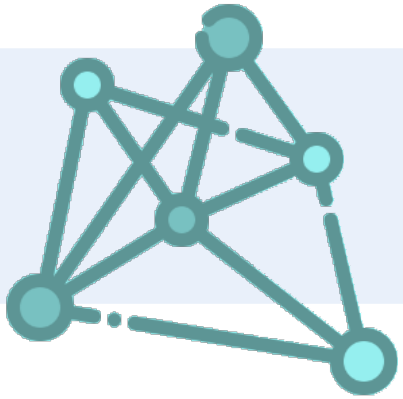

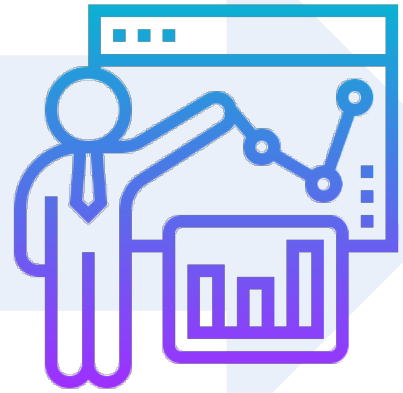

DATA

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TAKE HOME

- Start from proper visualization techniques
  (outliers, overview, inspect individual curves)

- Smart preprocessing to unlock potential information in data

- Find compromise that is sensible and gives the best results

- Tell model (only) what it needs to know

- Use modelling technique appropriate for quantity **and** quality of your data

THANK YOU

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