

# Innovation for Smart Dairy Farming

## PRIN2017: PLF and Big Data for the mitigation of the effects of heat stress

Stefano Benni, Marco Bovo, Daniele Torreggiani, Alberto Barbaresi, Enrica Santolini, Miki Agrusti, Mattia Ceccarelli, Patrizia Tassinari

Department of Agricultural and Food Sciences – Alma Mater Studiorum Università di Bologna

**Special Session of the 6<sup>th</sup> International Conference on Safety, Health and Welfare in Agriculture and Agro-food Systems "Ragusa SHWA 2021"**



# Context and Objectives

- The wide-spreading installation of automation devices in dairy farms is providing detailed data that could be used to assess health conditions of cattle, in order to improve animal welfare and increase milk production.
- Environmental parameters and animals' activity data are often measured in dairy barns but seldom recorded and systematically integrated in an overall database.

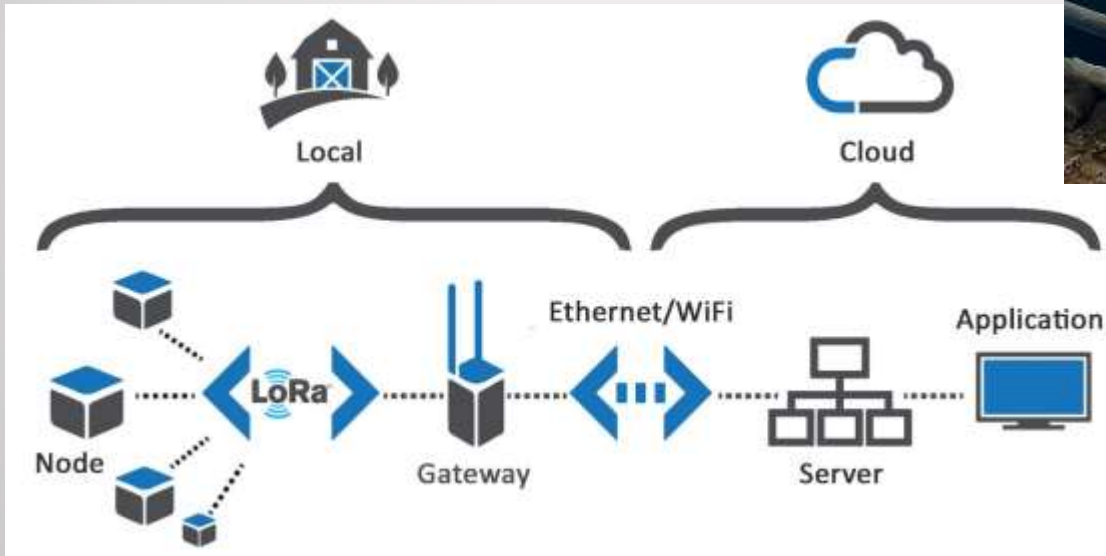
## AIMS:

- To set up a smart system for data collection;
- To define a numerical procedure suitable to integrate databases collected in dairy cattle farms from different devices and to propose numerical models for the quantification of the influence of the thermo-hygrometric conditions on milk production.



# Development of a monitoring system

Customized monitoring system developed and installed in two experimental barns



T, rH, CO<sub>2</sub>, NH<sub>3</sub>, CH<sub>4</sub>, H<sub>2</sub>S, O<sub>2</sub>, VOC, NO, NO<sub>2</sub>, SO<sub>2</sub>, air speed



# Monitoring system of water use

Water consumption

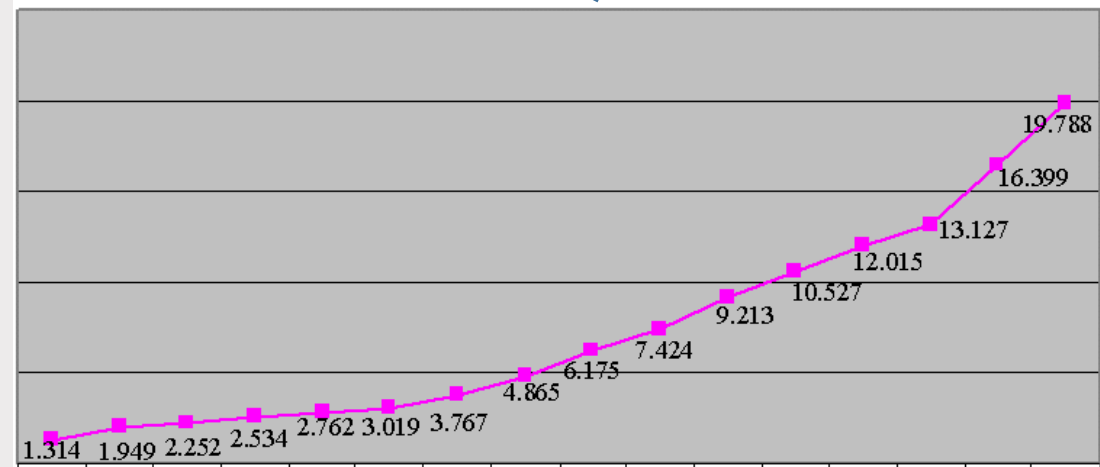
flowmeters



concentrator

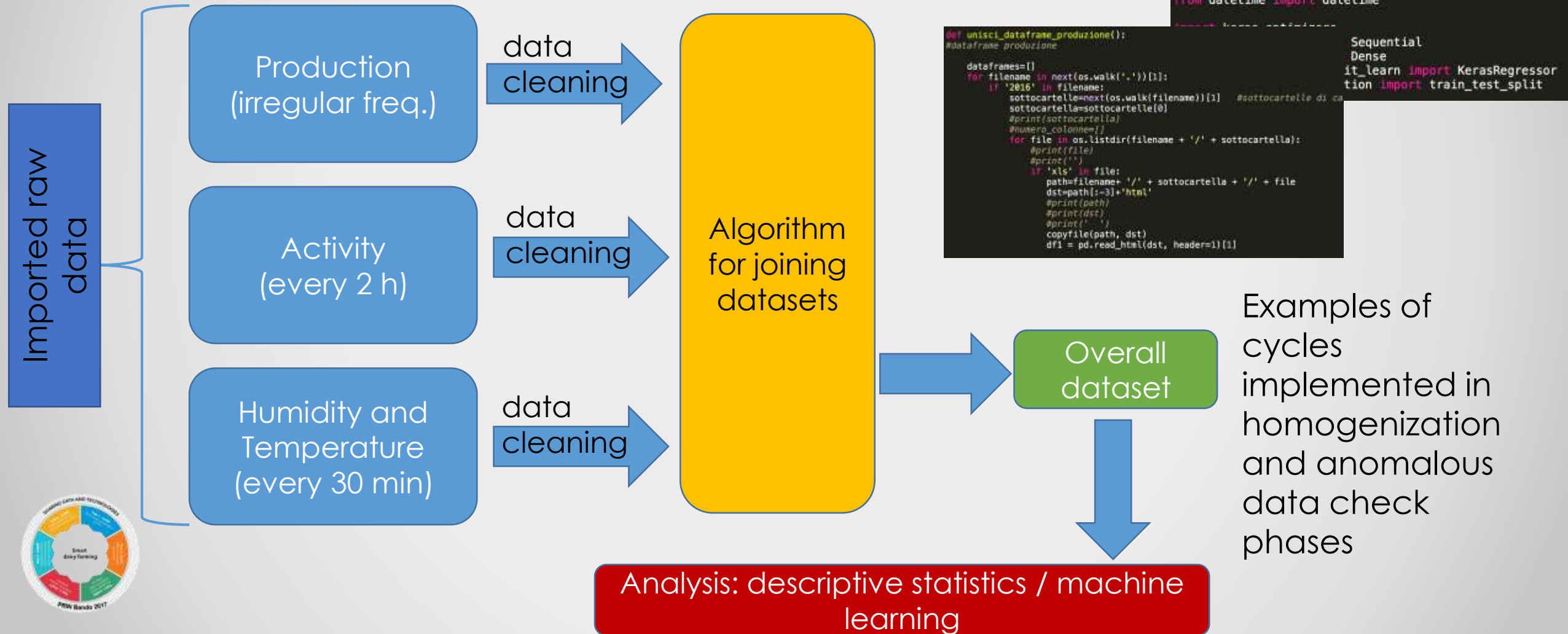


server



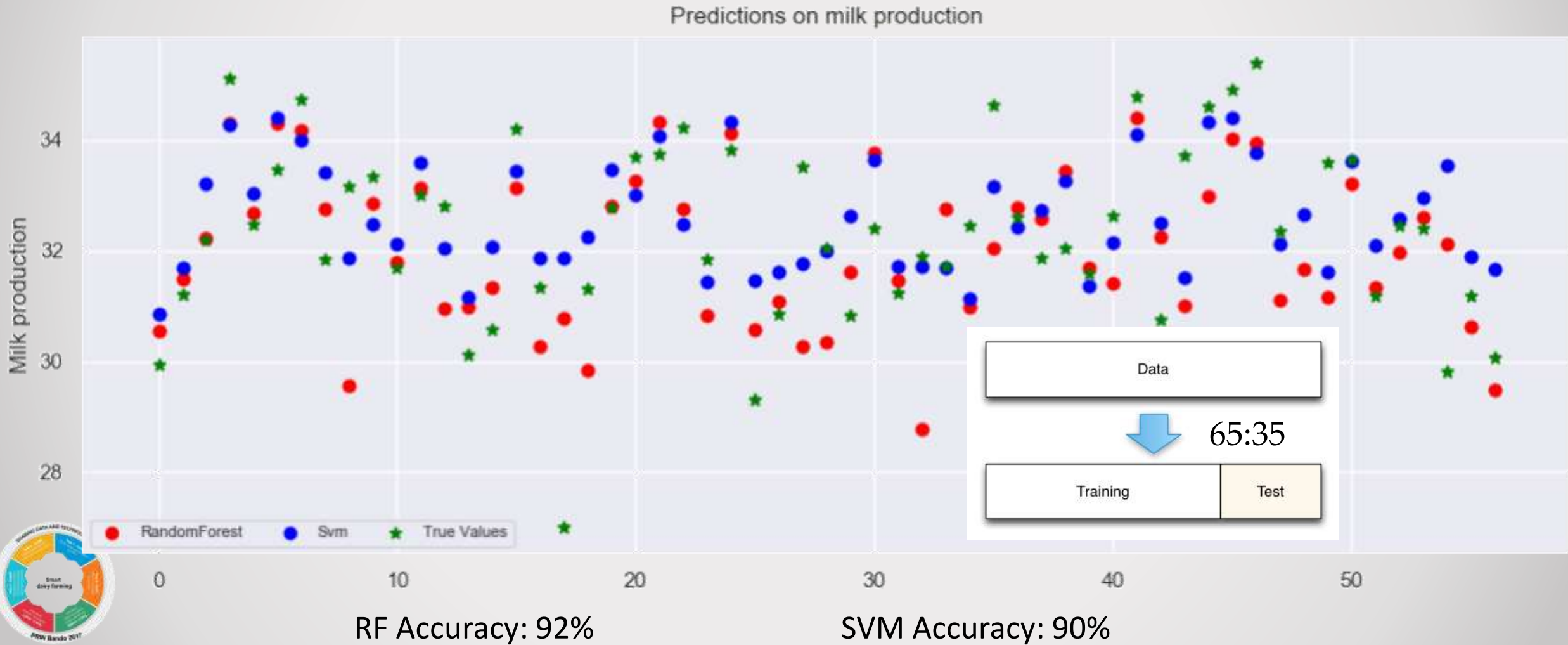
# Data collection from sample farms: routine for homogenization of different data sets

Flow chart of the routine for the homogenization of datasets



# Results (ongoing)

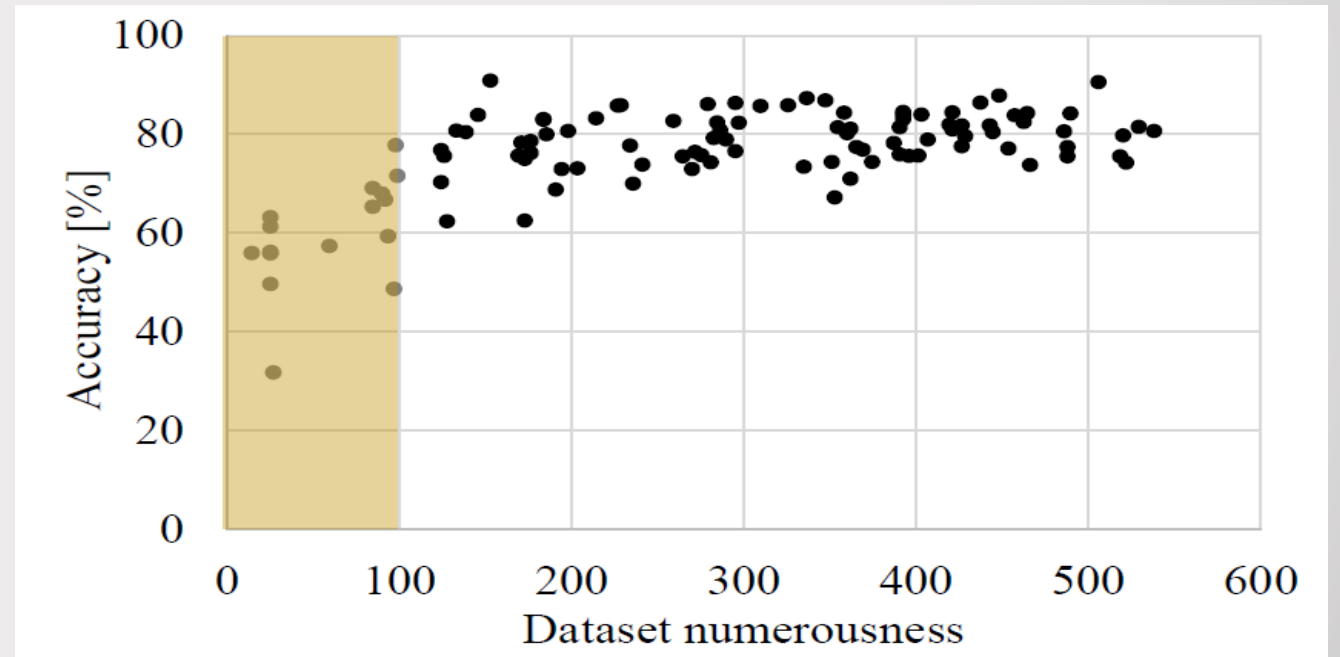
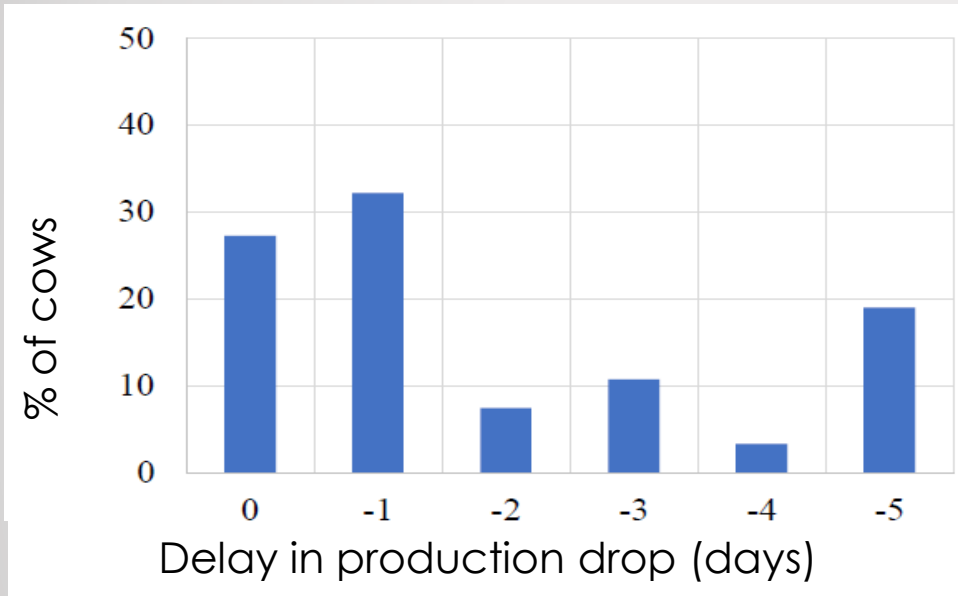
Prediction models based on Machine learning approach:  
Random Forest and Support Vector Machine, avg herd prod.



# Numerical model of heat stress effects

Forecast of production of individual cows with THI as input

Random Forest



# Intermediate remarks (2° year of project)

- ✓ In the context of a national research project focused on the dairy sector, a smart monitoring system has been designed, developed and the tested
- ✓ Data collected from a sample of farms in Northern Italy: a dataset has been built
- ✓ Models developed applicable to datasets collected by PLF devices, and data about barn microclimate
- ✓ Model suitable to characterize herd and individual cows in terms of the effects of THI conditions on milk production
- ✓ Further development ongoing with parametrization of lactation curves of individual cows
- ✓ Inclusion of behavioral data in the numerical model to early detect heat stress
- ✓ Indications to activate precision measures to control heat stress.



## ACKNOWLEDGMENT

The authors wish to thank the Azienda Agricola Piazzini, located in Budrio (Bologna), Italy, and Azienda Agricola Famiglia Montagnini, located in San Pietro in Casale (Bologna), Italy, for the availability and the collaboration during the survey and the research activities.

## FUNDING

The activity presented in the paper is part of the research project PRIN 2017 "Smart dairy farming: innovative solutions to improve herd productivity" funded by the Italian Ministry of Education, University and Research [20178AN8NC].





# Thanks for your attention

E-mail of the components of the RU#4:

[stefano.benni@unibo.it](mailto:stefano.benni@unibo.it)

[marco.bovo@unibo.it](mailto:marco.bovo@unibo.it)

[daniele.torreggiani@unibo.it](mailto:daniele.torreggiani@unibo.it)

[alberto.barbaresi@unibo.it](mailto:alberto.barbaresi@unibo.it)

[enrica.santolini@unibo.it](mailto:enrica.santolini@unibo.it)

[miki.agrusti@unibo.it](mailto:miki.agrusti@unibo.it)

[mattia.ceccarelli5@unibo.it](mailto:mattia.ceccarelli5@unibo.it)

[patrizia.tassinari@unibo.it](mailto:patrizia.tassinari@unibo.it)

**PRIN2017: Smart Dairy Farming – innovative solutions for herd management**

Visit the website of the project: [www.dairysmart.unimi.it](http://www.dairysmart.unimi.it)



UNIVERSITÀ  
DEGLI STUDI  
DI MILANO



ALMA MATER STUDIORUM  
UNIVERSITÀ DI BOLOGNA



UNIVERSITÀ  
DEGLI STUDI  
DI FIRENZE



UNIVERSITÀ  
degli STUDI  
di CATANIA