RETROSPECTIVE TIME SERIES ANALYSIS OF 8 YEARS OF COMMERCIAL EGGS PRODUCTION DATA IN ARTEMISA PROVINCE, CUBA.

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INTRODUCTION

Commercial egg production is important for Cuban livestock economy (>7.5 millions of laying hens). Early detect diseases occurring in this industry is crucial for minimizing production and economic losses.
When a disease occurs, egg production may decline before the disease is detected. Routinely monitoring egg production curves could thus help with early detection of poultry diseases. However, before using these data, production curves without epidemics have to be carefully described and modelled.

Egg production curves vary over the laying period and the relationship between number of eggs produced and hens' age is well known [1]. However, in Cuba egg production might be also influenced by meteorological events because no artificial environment control exists.

Objective: To carry out a retrospective analysis of 8 years of commercial egg production in the province of Artemisa, Cuba.

MATERIAL AND METHODS

Data used
- 8 years (2008-2015) of weekly egg production data from10 All-In/All-Out Laying farms (White Leghorn, 18 to 72 weeks age)

Data modelling
- Linear mixed models (R software, package lme4)
- Model basis:
  McNally's model [2]: $ln(egg_{hen}) \sim ln(week) + week + \sqrt{week}$
  (week = hens' age in week, egg_{hen} = ratio of the total eggs produced to the number of hens)
- Other fixed effects tested based on meteorological data: *Atlantic Hurricane season (June to November), average temperature* (°C), and *humidity* (%) [3]
- Random effects: *farm, production cycle, farm/production cycle*

95%CI of model predictions also used to replace outlier values present in the data

Model selection: AIC, variance partition coefficient (VPC) and Likelihood ratio test (Lrtest)

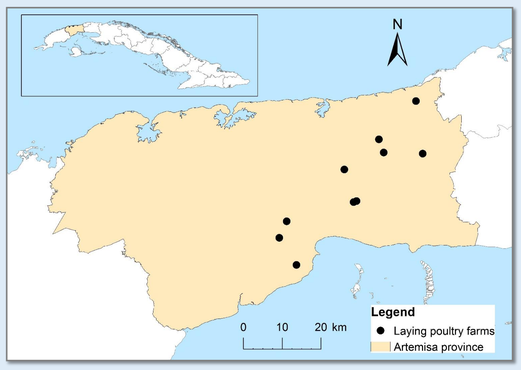

Fig. 1, Province of Artemisa (in yellow), Cuba

Fig. 2, Laying hens farm

RESULTS

Data description:
- 50 egg productions cycles in total
- Average of 5 cycles/farm (56.24 weeks/cycle), 84 939 hens/cycle

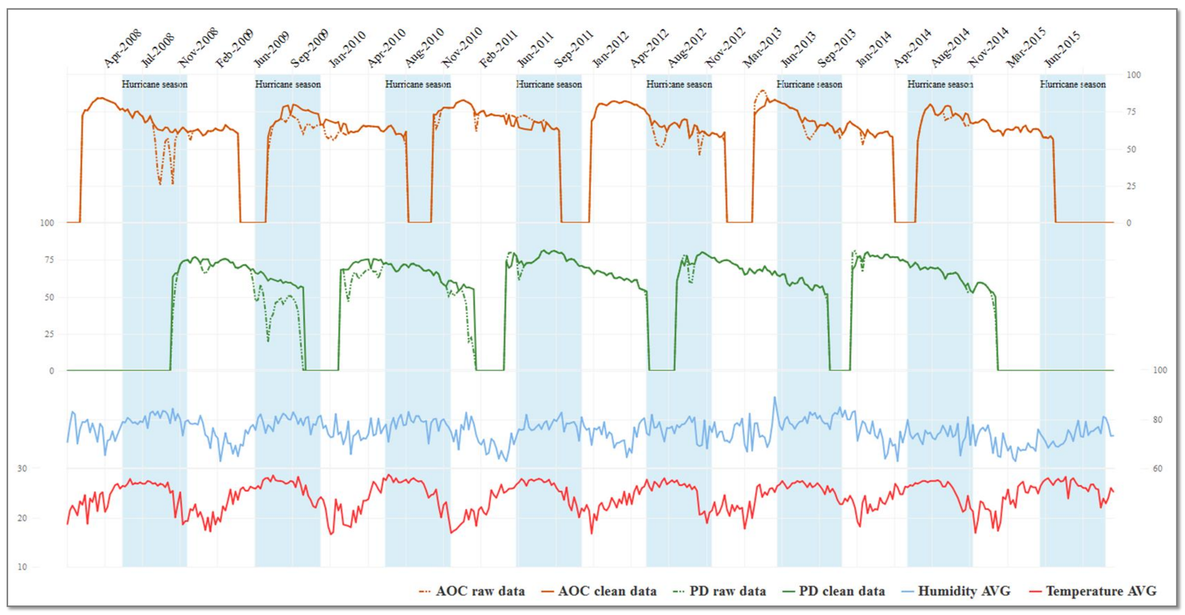

Fig. 3, Eight years of meteorological data and weekly egg production curves in the province of Artemisa, Cuba. Only 2 farms (AOC and PD) are shown.

Best model =
- Random intercept correlated with a random slope on the variable *Hurricane_season*
- Random effect production cycle (VPC between cycle 53% *vs* VPC between farm 1.5%)
- Fixed effects:
  $ln(week) + week + \sqrt{week} + Temperature + Humidity + Hurricane\_season$

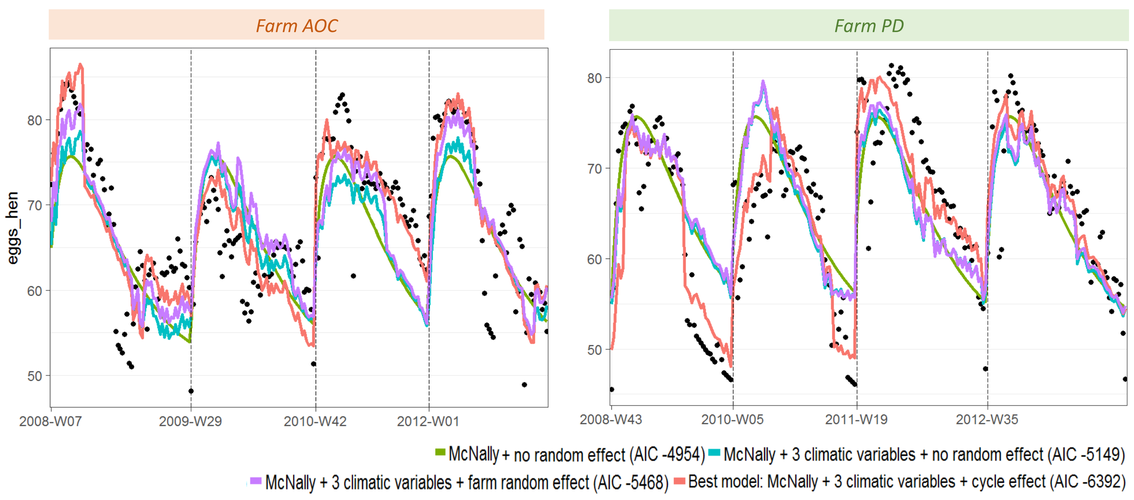

Fig. 4, Comparison raw data (black points) and mean fitted values obtained with 4 different models. Example of the 4 first egg production cycles in 2 farms. Periods outside of production cycles not shown.

CONCLUSIONS

- Meteorological variables have an impact on eggs production in Artemisa.
- Little difference between farms:
  - ➔ Homogenous practices and productivity
  - ➔ Same model can be used for all farms
- Important difference between production cycles.
  - ➔ Problem: cycle random effect cannot be used for predict the shape of a new production cycle which is important to implement a syndromic surveillance system

Next steps :
- Test other variables to try to reduce the cycle effect (e.g., wind, rain, thunderstorm, real hurricane events)
- Train aberration detection algorithms to implement a syndromic surveillance system for Cuban poultry industry based on egg-production curves

ACKNOWLEDGEMENTS: This research was supported by the Swiss Federal Commission for Scholarships for Foreign Students (FCS)
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Poster presented at SVEPM held in Inverness, Scotland (29-31 March 2017)