



UNIÓN EUROPEA  
Fondos estructurales  
*Invertimos en su futuro*



  
**Comunidad  
de Madrid**

*Programas de Actividades de I +  
D entre grupos de investigación  
de la Comunidad  
de Madrid en Tecnologías 2018*



# AIRTEC-CM

Evaluación del efecto del confinamiento en Madrid por la COVID-19  
y propuesta de simulaciones

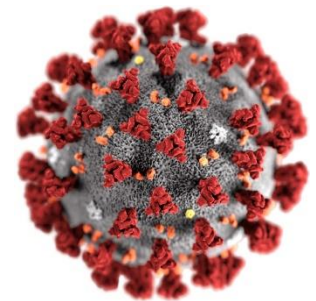
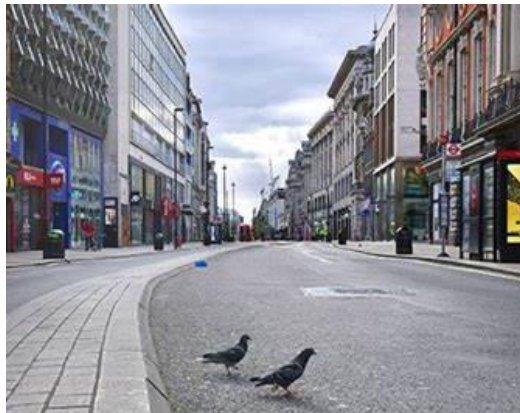
P2018/EMT-4329

**2ª Reunión del Comité Científico-Técnico**

25 Noviembre 2020, ETSI Industriales UPM y telemática

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- Modelled meteorology-normalized 2020 time-series
  - Time-series prediction  $\text{NO}_2$
  - Time-series prediction  $\text{PM}_{10}/\text{O}_3$
- % Relative Differences
- Conclusions



## Introduction

- ✓ The meteorology affects the pollution, examples:
  - ✓ Capping, subsidence inversions
  - ✓ Wind dispersion

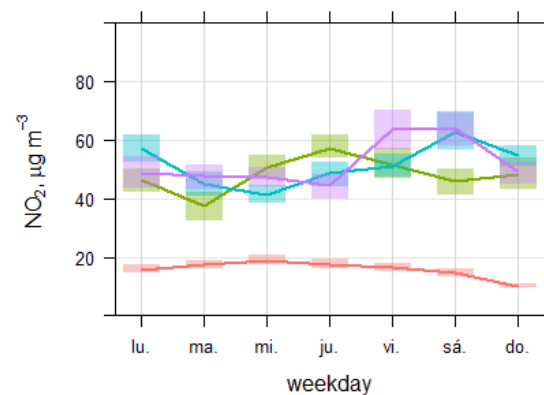
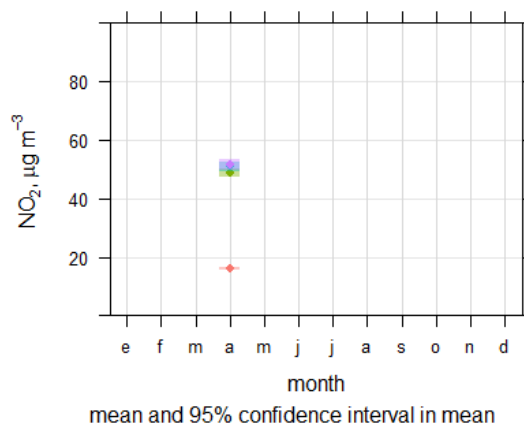
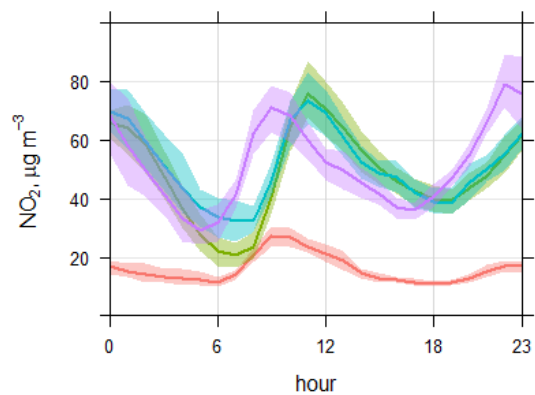
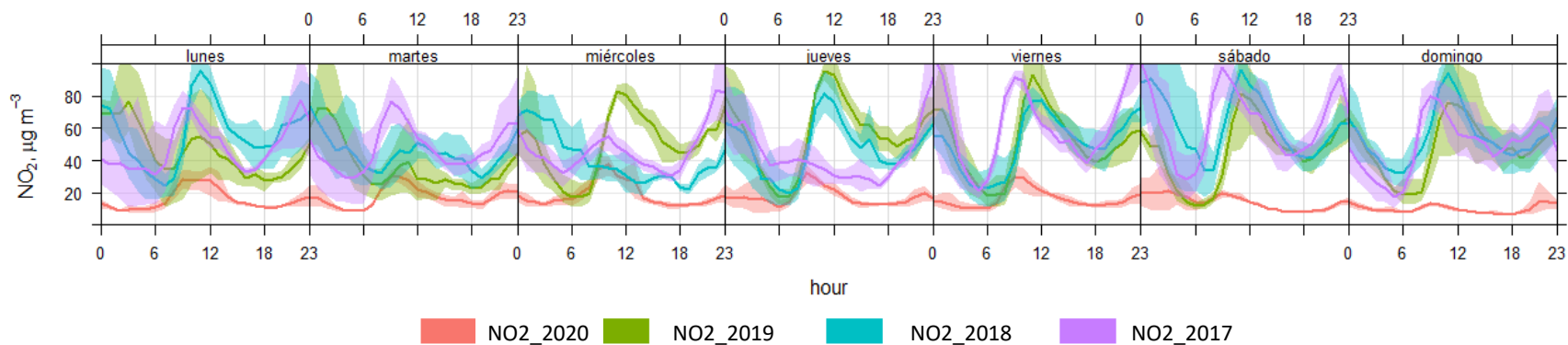
- ✓ **One solution:**
  - ✓ predict one normal day
  - ✓ compare with the actual measured concentrations

### Gradient Boosting Decision Trees

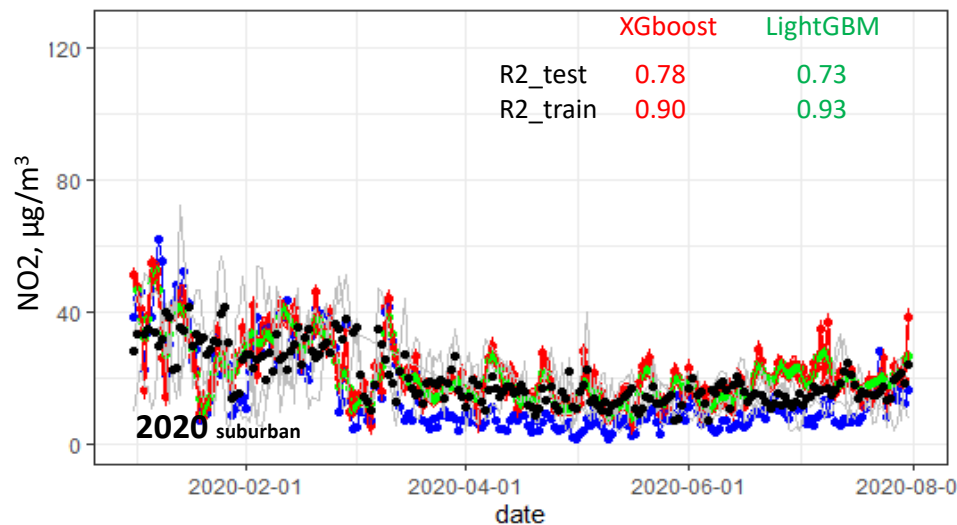
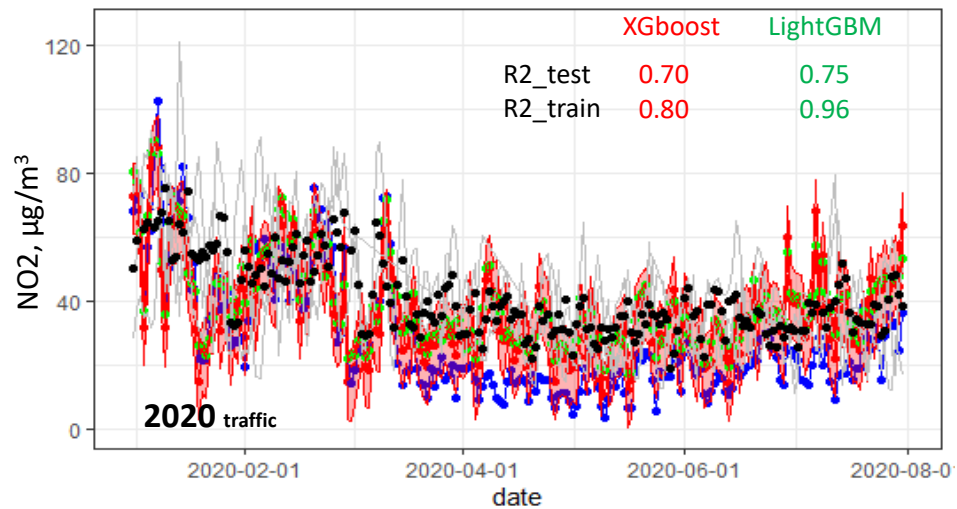


- ✓ Years 2017-2019 (except the last two months) for training
- ✓ Last 2019 two months for testing

## Data Visualization

NO<sub>2</sub>, Escuelas Aguirre, April

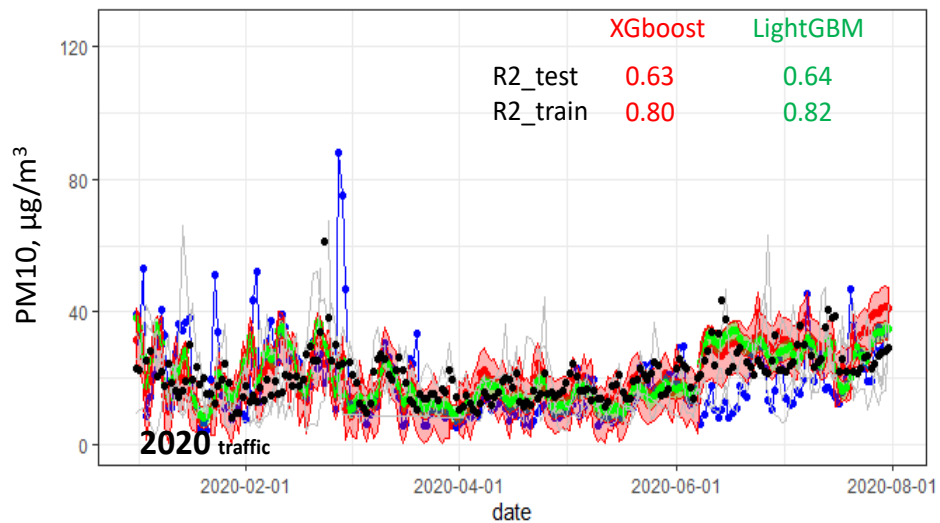
## Time-series prediction NO<sub>2</sub>



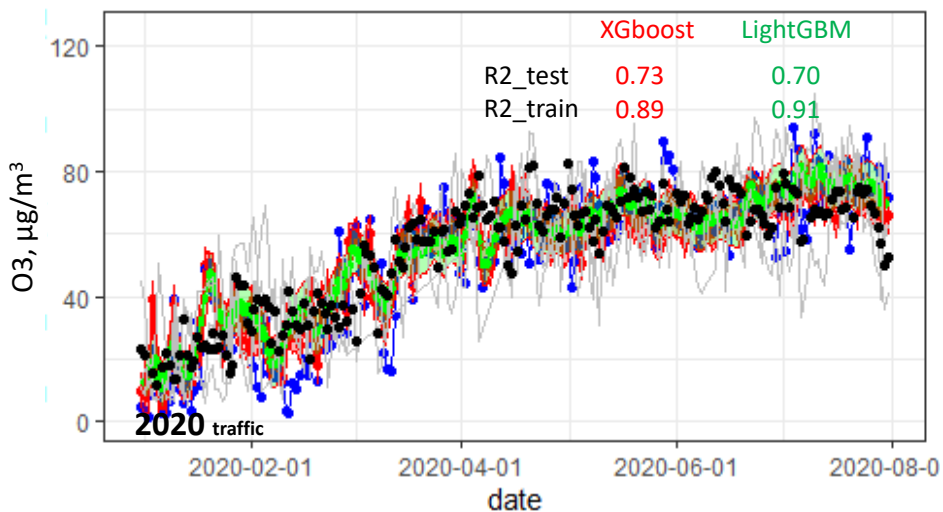
- Averaged measured NO<sub>2</sub> previous 3 years
- 2020 NO<sub>2</sub> averaged
- LightGBM predictions
- XGBoost predictions
- previous 3 years time-series

✓ It seems that NO<sub>2</sub> was below expected

## Time-series prediction for PM10/O3



✓ Not clear for PM10  
✓ Influence of transport?



✓ O3 similar to normal (for traffic case)

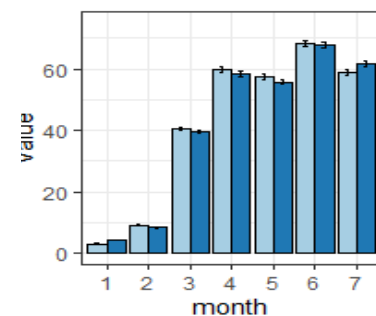
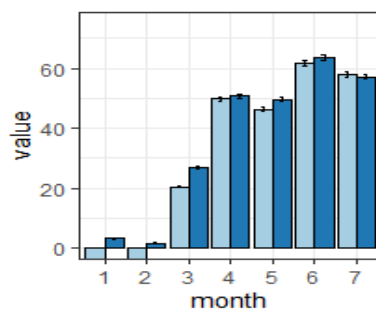
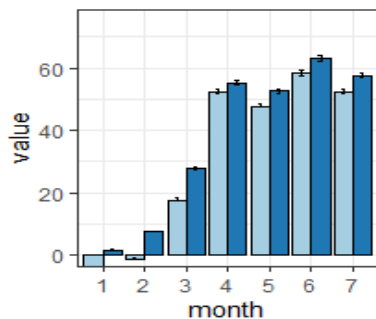
**% Relative Differences**

traffic

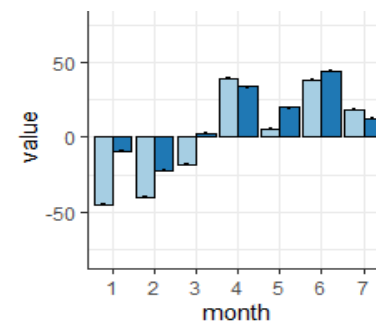
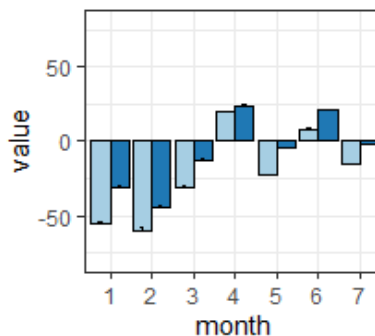
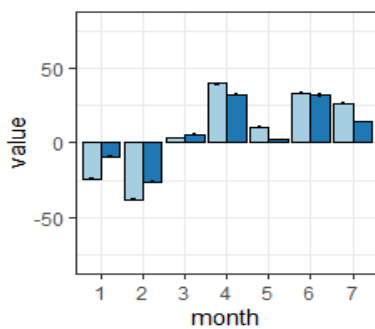
suburban

background

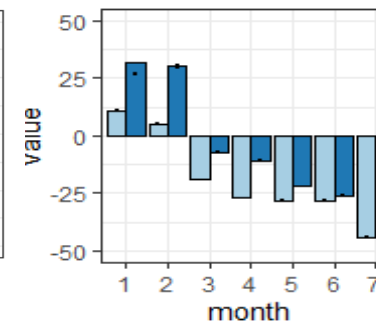
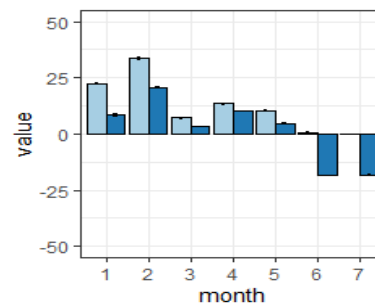
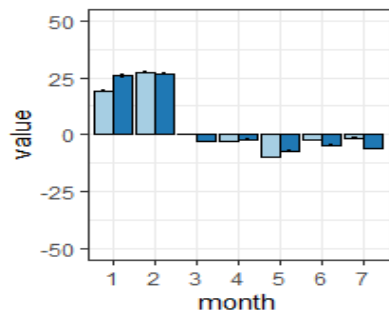
NO<sub>2</sub>



PM<sub>10</sub>



O<sub>3</sub>



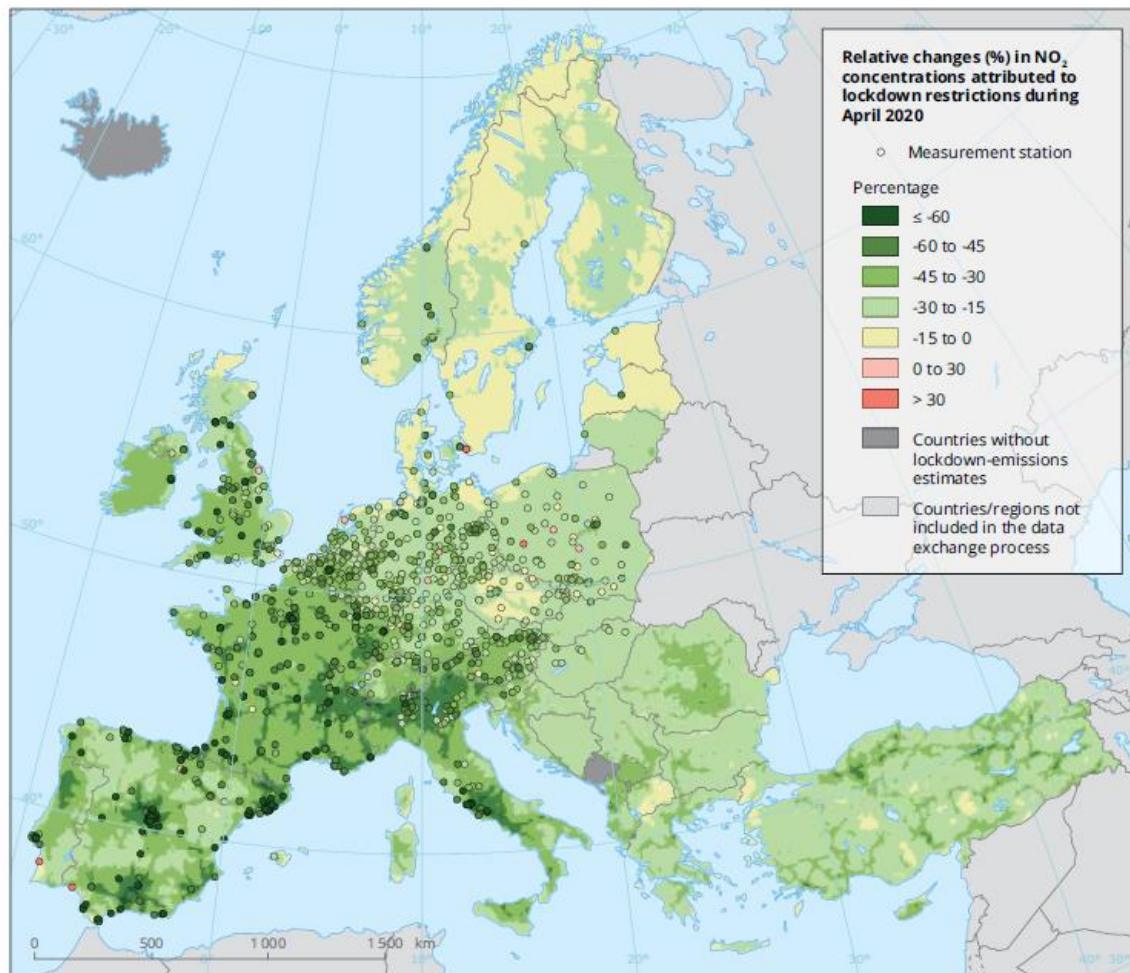
## Conclusions

- A first study on the estimation of the COVID-19 lockdown effects on the reduction of pollution in Madrid was performed.
- The Gradient Boosting algorithms allowed obtaining meteorology-normalized concentrations.
- Whereas  $\text{NO}_2$  sharply decreased from March 2020, the pattern is not clear for  $\text{PM}_{10}$ . For  $\text{O}_3$ , the results vary from place to place and depended on the AQS type.
- Future work:
  - Explain the results obtained



## Propuesta de simulaciones

Map 2.3 Relative changes (%) in NO<sub>2</sub> concentrations attributed to lockdown restrictions during April 2020



Reference data: ©ESRI

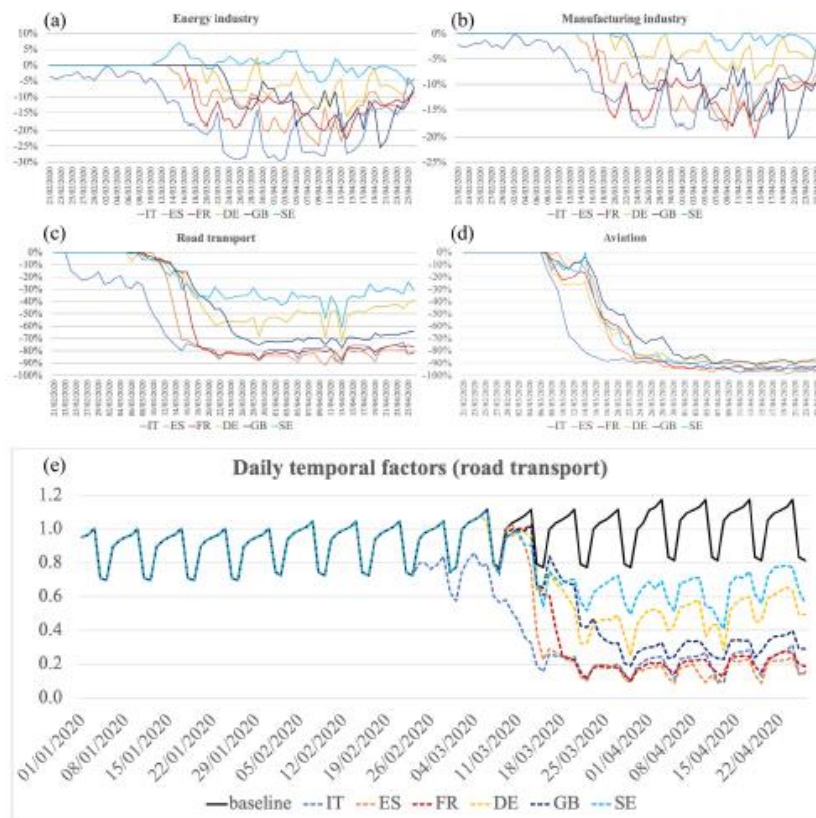
Note: The dots represent measurements stations, where the changes have been estimated using UTD monitoring data and the GAM. The background shading represents the changes estimated using CAMS chemical transport modelling with an emission inventory estimated for the lockdown conditions.

CAMS  
ensamble  
(+GAMs)

- Emisiones:
  - escenario 2020 BAU
  - factores de reducción por país y sector

**TNO** innovation  
for life

**BSC**  
**Barcelona Supercomputing Center**  
Centro Nacional de Supercomputación



0 **Figure 3.** Emission reduction factors computed for the energy (a) and manufacturing (b) industry, road transport (c) and aviation (d) for selected countries (IT, Italy; ES, Spain; FR, France; DE, Germany; GB, Great Britain; SE, Sweden) for the period 21 February to 26 April 2020. Original and COVID-19 version of the emission daily temporal factors computed for the road transport sector and used for emission modelling (e).

- Propuesta de simulaciones:
  - Fase 1: escala nacional emisiones BSC (*MONARCH*, CMAQ, CHIMERE)

*Diciembre 2020 – Marzo 2021*

- Fase 2: desarrollo de inventarios de detalle para Madrid (y *Barcelona*)

*Noviembre 2020 – Marzo 2021*

- Simulación específica CMAQ dominio AIRTEC-CM

*Abril 2021 – Junio 2021*



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PAIDIR TEC 2018

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**THANKS!!!**

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