

UNIVERSIDAD COMPLUTENSE

1. MOTIVATION

Hybrid thermal meteorological structures sharing tropical and characteristics, extratropical namely subtropical cyclones (STC) [1], may have a harmful impact as tropical cyclones or even hurricanes. Therefore, there is an increasing interest in the study of their trajectories and to improve the ability of the current available tools to forecast them accurately. An example in case is the cyclone which, in October 2014, affected the Canary Islands as an STC category event [2], with significant personal and economic costs.

In order to perform a good assessment of STCs, previous research strategies analyzing this of events [3] have kind considered two stages:

- a. **pre-STC**: when the cyclone has a purely extratropical nature
- **pure-STC**: when the cyclone acquired already has subtropical characteristics

In our case of study, these two stages approximately correspond to 19<sup>th</sup> October 2014 at 1800 UTC, and 20<sup>th</sup> October 2014 at 1800 UTC, respectively.

Here we study how can the model HARMONIE characterize STC events such as the one which took place in October 2014.

SATELLITE

### 2. MODEL CONFIGURATION & OBSERVATIONAL DATA

- HARMONIE model is run using version v40h1.1.1 with one 2.5km horizontal resolution domain, roughly covering the area between 22–42°N and 7–43°W. This includes the western coast of the Iberian Peninsula and North-West Africa, as well as the Macaronesia archipelagos except for Cape Verde. 65 hybrid sigma-pressure levels are considered for the vertical resolution, and IFS - MARS analysis from ECMWF feed the model every 6 hours as initial and boundary conditions (0.25° horizontal resolution). Regarding the physics options, default values [4] are used in this work, with the convection-permitting configuration. It uses a non-hydrostatic spectral dynamical core with a semi-Lagrangian and semi-implicit discretization of the equations.

- Observational data to compare with the model outputs correspond to available METAR reports and meteorological soundings from several airports located in the Canary Islands. The MSG–SEVIRI satellite products are considered too.



## 5. SATELLITE IMAGES AND HARMONIE SIMULATIONS: PRE-STC (TOP PANELS) AND PURE STC (BOTTOM PANELS)

Time: 10/18/2014 (18:00) \_ 24 Total Cloud Cover (%) 0.2 0.4 0.6 0.8 1 1.2 1.4 1.6 1.8 2 2.2 2.4 2.6 2.8 Time: 10/18/2014 (18:00) \_ 48

40°W

30°W

20°W

# Simulation of a subtropical cyclone using the HARMONIE-AROME model

Mariano Sastre (1,2), Javier Díaz Fernández (1), Lara Quitián Hernández (1), Pedro Bolgiani (1), Daniel Santos-Muñoz (3), Juan Jesús González-Alemán (1), Francisco Valero <sup>(1)</sup>, Luis Ignacio Sebastián-Martín <sup>(2)</sup>, Laura López <sup>(4)</sup>, José Ignacio Farrán <sup>(2)</sup>, María Luisa Martín <sup>(2)</sup>

(1) Universidad Complutense de Madrid, Spain (<u>msastrem@ucm.es</u>); (2) Universidad de Valladolid, Spain; (3) HIRLAM consortium; (4) Universidad de León, Spain.





Time: 10/18/2014 (18:00) \_ 48

10°W



**PRECIPITABLE WATER** 











20°W



30°W

40°W

Time: 10/18/2014 (18:00) 48

## terms 1-4 <sup>⁰</sup>C.

- for temperature.
- seclusion process.
- water does too.
- cyclone 20 m/s.
- cost.

### **REFERENCES** [1] Evans and Guishard (2009), Monthly Weather Review, 10.1175/2009MWR2468.1 Quitián-Hernández et al. (2016), Atmospheric 10.1016/j.atmosres.2016.03.008 Quitián-Hernández et al. (2018), Atmospheric 10.1016/j.atmosres.2018.01.001 [4] Bengtsson et al. (2017), Monthly Weather Review, doi: 10.1175/MWR-<u>D-16-0417.1</u>

## **ACKNOWLEDGEMENTS**

This work is funded by the Spanish Ministry of Science and Innovation the research project through IBERCANES (PID2019-105306RB-I00). It is also supported by the ECMWF special projects SPESMART and SPESVALE. JDF acknowledges as well the MINECO-FPI program (BES-2017). FV and MLM thank the Interdisciplinary Mathematics Institute of the Universidad Complutense de Madrid.



Universidad de Valladolid

6. <u>CONCLUSIONS</u>

• HARMONIE reproduces very well the whole STC evolution in of near-surface temperature, with a cold bias of

• Vertical profiles are simulated with good agreement for wind speed and excellent agreement

• Both pre- and pure-STC stages are well reproduced

• Warm seclusion via Shapiro-Keyser structure, i.e., the bentback warm/occluded front is observed, undergoing a warm

• Total cloud cover showed by HARMONIE has a similar global structure as the satellite images, and the precipitable

• Intense low-level wind is observed in the NW side of the promoting its intensification, with values over

• The good outcomes yielded by HARMONIE prove that it is a useful tool, worth using in meteorological research, with particularly low computational

> doi: Research, <u>doi:</u> Research, <u>doi:</u>

