SPECIAL PROJECT PROGRESS REPORT

All the following mandatory information needs to be provided. The length should *reflect the complexity and duration* of the project.

Reporting year	2019
Project Title:	SIMULATIONS OF DIVERSE SUBTROPICAL CYCLONES AND TRANSITIONS TO TROPICAL CYCLONES IN THE EASTERN NORTH-ATLANTIC OCEAN
Computer Project Account:	.........SPESMART............................... ....
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Name of ECMWF scientist(s) collaborating to the project (if applicable)	……………………………………………………………… ………………………………………………………………
Start date of the project:	01/01/2019
Expected end date:	31/12/2019

Computer resources allocated/used for the current year and the previous one
(if applicable)
Please answer for all project resources

		Previous year		Current year	
		Allocated	Used	Allocated	Used
High Performance Computing Facility	(units)			900000	280000
Data storage capacity	(Gbytes)			25000	200

Summary of project objectives (10 lines max)

This project is the first special project that this team has in ECMWF. Our goal is to implement both Harmonie and WRF in ECMWF in order to simulate some STCs and compare differences between both kind of simulations, proposing finally the optimum model to diagnose and forecast these systems. The key objectives in the project can summarized as follow:

- Simulation of different Subtropical Cyclones (STC) with the Harmonie model as well as the WRF model.
- The simulated STCs will be analysed examining the key variables in their genesis, developing and tracking.
- The warm seclusion transitions will be deeply analysed to elucidate physical mechanism favouring such cyclone formation.

Summary of problems encountered (10 lines max)

As this special project is our first project, we have found some problems when Harmonie and WRF are implemented. We have start with our first STC, the Ophelia Hurricane. This system moved from low to high latitudes. Therefore, we need a huge domain in Harmonie and a moving nest in WRF in order to follow properly the track of the cyclone. The Ophelia Hurricane has been already simulated with the Harmonie. However, in WRF we have still problems in the compilation process. We hope than in June we will be able to complete both model setting up in order to finish the previously mentioned tasks.

After contacting ECMWF's users support during 3rd week of June a WRF model, modules and compiler version software stack had been stablished. Our compilation test with the mentioned software stack have been successful. Due to the complexity of the compilation ECMWF has liberated a WRF version 4.0 as a software module under HPCF (https://confluence.ecmwf.int/pages/viewpage.action?pageId=143050100)

Summary of plans for the continuation of the project (10 lines max)

- As soon as the problems with both models are fixed, the Ophelia Hurricane and the other STCs detailed in the original request will be simulated.
- The key simulated variables for Harmonie and WRF in the genesis and development of the STCs will be compared in order to analyse differences and similitudes.
- These high-resolution accuracy simulations will be studied in order to know the possible transitions form STCs to Tropical Cyclones.

List of publications/reports from the project with complete references

Quitián-Hernández, L., J. J. González-Alemán, D. Santos-Muñoz, S. Fernández-González, F. Valero, M. L. Martín (2019): "A subtropical cyclone formation via warm seclusion development: The importance of surface fluxes". *Journal of Geophysical Research: Atmosphere* (submitted).

Summary of results

If submitted **during the first project year**, please summarise the results achieved during the period from the project start to June of the current year. A few paragraphs might be sufficient. If submitted **during the second project year**, this summary should be more detailed and cover the period from the project start. The length, at most 8 pages, should reflect the complexity of the project. Alternatively, it could be replaced by a short summary plus an existing scientific report on the project attached to this document. If submitted **during the third project year**, please summarise the results achieved during the period from July of the previous year to June of the current year. A few paragraphs might be sufficient.

The Harmonie model has been implemented in order to simulate some STCs (detailed in the original request). In particular, the Ophelia hurricane has been already simulated with Harmonie at 2.5 x 2.5 km and we have started to simulate the Vince Hurricane, both systems with the Harmonie model.

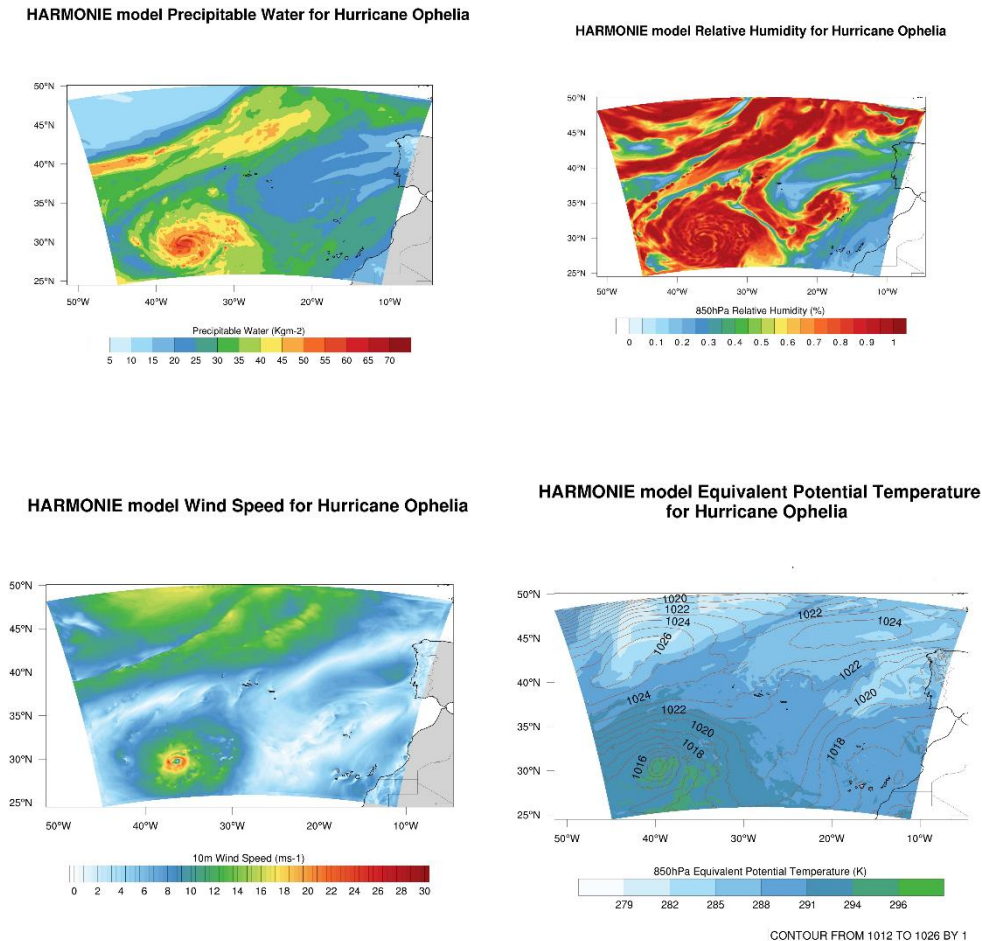Some results related to Ophelia obtained with Harmonie are presented here (Figure 1).

Figure 1: Precipitable water, relative humidity, wind speed and equivalent potential temperature for the Ophelia Hurricane on 11th October 2017 at 18:00.

We have to consider all the outputs throughout the life of the system, examining other variables to finally fully analyse this case study. In particular, we are very interested in the transition of extratropical cyclone to STC and from STC to Tropical Transition. These transitions are very important in the development of the kind of systems and their possible transitions to hurricanes that could affect to Western Europe, such as the Ophelia, the Delta and the Vince Hurricanes.

As it is above mentioned, we have start to run the Vince system and the outputs will be deeply study.

We hope that throughout this month, the WRF model will properly compiled and the same hurricane will be simulated with WRF. As soon as the runs are finished, we will be able to analyse the simulations in order to study differences and similitudes between key simulated variables (for Harmonie and WRF) in the genesis, developing and tracking of the STCs. Once the both models, Harmonie and WRF, run properly, the remainder STCs will be simulated and an ensemble of specific STCs to TCs transition cases will be studied.