SPECIAL PROJECT PROGRESS REPORT

Progress Reports should be 2 to 10 pages in length, depending on importance of the project. All the following mandatory information needs to be provided.

Reporting year 2018

Project Title: EFFECT OF SURFACE HETEROGENEITIES AND EVAPOTRANSPIRATION CHANGES ON THE ATMOSPHERIC BOUNDARY LAYER

Computer Project Account: spesturb

Principal Investigator(s): Maria A. Jiménez and J. Cuxart

Affiliation: Universitat de les Illes Balears

Name of ECMWF scientist(s) collaborating to the project (if applicable) ……

……

Start date of the project: January 2018

Expected end date: December 2020

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)	150000	150000	300000	0
Data storage capacity	(Gbytes)	200	100	250	100

Summary of project objectives
(10 lines max)

The aim of the special project is to increase the current knowledge of the surface-atmosphere interface through a combined inspection of simulations and observations from the campaigns that we have organized/participated. Firstly, we plan to continue performing high-resolution mesoscale simulations of observed cases during the Cerdanya Cold Pool experiments in 2015 and 2017 and the 2018 data in the Aura valley at the French side. This is intended to study the cold air pooling and the organization of the flow at lower levels in a complex mountainous terrain region, also considering the presence of snow. Secondly, the interactions between heterogeneous surfaces and the atmosphere will be explored through simulations based on observational campaigns held in Mallorca dealing with surface heterogeneities (Subpixel in 2016) and the in Eastern Ebro valley in zones with extensive irrigated areas, linked to the LIAISE effort from HyMeX.

Summary of problems encountered (if any)
(20 lines max)

None

Summary of results of the current year (from July of previous year to June of current year)
This section should comprise 1 to 8 pages and can be replaced by a short summary plus an existing scientific report on the project

This project is a continuation of previous SPESTURB special projects. Between 2002 and 2011 the special project was focused on study the stably-stratified atmospheric boundary layer of ideal (Large-Eddy Simulations) and real (mesoscale simulations) cases. Later (2012-2014) the aim of the project was to study the atmospheric boundary layer over topographically complex regions. Afterwards, the previous special project (2015-2017) was more focused in study the atmospheric boundary layer features related to the surface heterogeneities (temperature or soil moisture, among others). During the last 8 years all the simulations made at the ECMWF are based on observations (experimental field campaigns) or they are made before an experimental field campaign to help in the finding of the locations to perform the measurements. All the runs are made with the MesoNH model (Lafore et al, 1998).

The first numerical works of the current special project (run with resources of the previous project during December 2017) correspond to some selected IOPs during the Cerdanya Cold Pool experiment 2017 (CCP17) that took place in La Cerdanya valley from January to April 2017. This valley (about 30km long and 9km wide) is located in the central Pyrenees, oriented along the NE-SW direction. It is a clear example of complex terrain region in terms of topography and soil properties because it is covered by heterogeneous surfaces (forest, grass, rock, heterogeneous distribution of snow, etc).

The same area was taken during the previous special project to analyze some selected IOPs during the CCP15 experimental field campaign (October 2015). Now the simulation strategy is similar (2 nested domains at 2km and 400m resolution with a vertical grid of 3 m close to the surface and stretched above), except that during CCP17 snow was present at the mountain peaks but also in the bottom areas of the Valley. In this sense, the snow pack of the model will be activated to include the physical processes that take place in snow-covered regions. Besides, the microphysical scheme will be activated (no rain was present in the CCP15 simulations) to allow the precipitation (rain and snow) in the simulated domain. To start with, 2 IOPs have been selected: one with fresh snow covering all the bottom parts of the valley (18-19 January 2017) and the other one that there were strongly stratified conditions in the bottom of the Valley (26-27 February 2017). All of these runs will be validated with the observations taken during CCP17, that included an enhanced surface network of stations, two locations with the surface energy budget and profiles of the lower atmosphere by remote sensing and balloon soundings. The aim of these runs is to further explore the organization of the flow in the valley at lower levels and to evaluate the impact of the presence of the snow in the evolution of the atmospheric boundary layer.

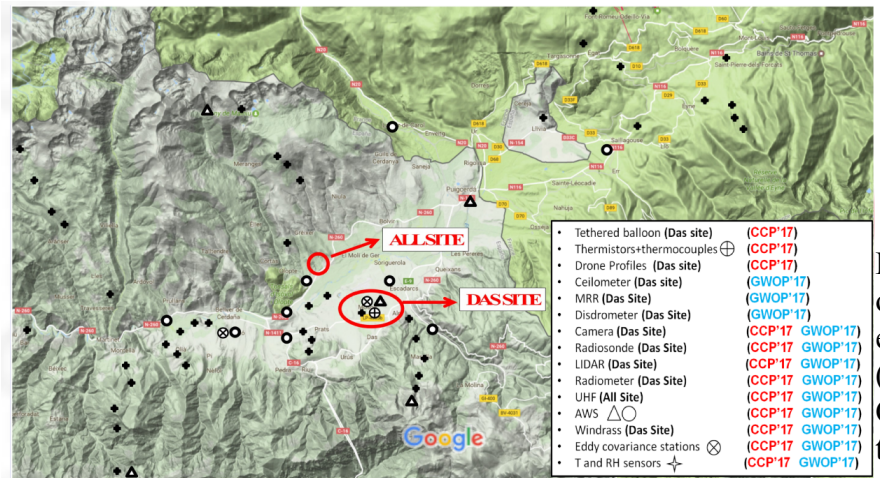

Figure 1. Location of the observations during CCP17 experimental field campaign (January-April 2017) in La Cerdanya Valley (south side of the central Pyrenees).

Since the GABLS4 intercomparison (based in a strongly-stratified case in the Antartic Plateau, DomeC) the snow schemes in the MesoNH model have been revised and some of the improvements are included in the last version of the model, launched un June 2018 (for instance now the snow melting processes are included, among others). Different snow schemes are also introduced in SURFEX but some of them are computationally expensive (CROCUS). For the runs of the CCP17 cases, we will opt to activate the snow package included in the ISBA model (a compromise between the representation of the physical processes and the computational cost). To proceed with the objectives of the current special project we will install the latest version of the MesoNH model at the ECMWF supercomputer and check if the snow cover is properly set in the initial file of the simulation. If not, there is a possibility in the MesoNH model to modify the snow cover before start the run to have a more realistic surface characteristics. After revising the snow packages in the model and to choose the suitable options to run the CCP17 selected IOPs, we plan to start the simulations during July 2018.

List of publications/reports from the project with complete references

Conangla, L.; J. Cuxart; M.A. Jiménez; D. Martínez-Villagrasa; J.R. Miró; D. Tabarelli; D. Zardi, 2018. Cold-air pool evolution in a wide Pyrenean valley. Journal of Applied Meteorology and Climatology. In press

Martínez-Villagrassa, D; Conangla, L.; Cuxart, J.; Jiménez, M.A.; Miró, J.R.; Tabarelli, D.; Zardi, D., 2018. Cold-air pooling in a wide Pyrenean valley. European Geosciences Union General Assembly,Vienna (Austria) 8-13 April 2018.

Summary of plans for the continuation of the project

(10 lines max)

The first part of the current special project will be devoted to the study of the organization of the flow in complex terrain regions. In La Cerdanya valley runs will be based on selected IOPs during the CCP17 experimental field campaign to evaluate the effect of the snow cover in the evolution of the cold pool. Other runs will be based on the observations conducted from May until end of September 2018 in the Aura valley to evaluate if the model is able to reproduce the observed features of the valley exit jet. Afterwards, simulations over surface heterogeneous areas will be made based on IOPs during the SUBPIXEL campaign (Mallorca, summer 2016) to further understand their impact in the evolution of the lower atmospheric boundary layer. At the end of the special project the main focus will be to study the circulations at lower levels in the irrigated area in the center of the Ebro river valley in order to prepare an experimental field campaign during 2020.