# 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** | 2020 |
| **Project Title:** | Using Earth Observations to constrain land-atmosphere interactions |
| **Computer Project Account:** | SPPTDUTR |
| **Principal Investigator(s):** | Emanuel Dutra |
| **Affiliation:** | Instituto Português do Mar e Atmosfera |
| **Name of ECMWF scientist(s) collaborating to the project** (if applicable) | Souhail Boussetta and Gianpaolo Balsamo …… |
| **Start date of the project:** | 01/01/2018 |
| **Expected end date:** | 31/12/2020 |

## 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) | 2500000 | 816182 (33%) | 4000000 | 2676091 (67%) |
| **Data storage capacity** | (Gbytes) | 7000 | 4756* | 10000 | 2721* |

*Storage has been accounted under project ptearth by default and not spptdutr

## Summary of project objectives

Processes occurring at the land surface impact weather and climate variability. We propose that constraining land-atmosphere exchanges using Earth Observations (EO) will enhance current weather forecasts skill of near-surface fields, such as temperature, and improve the realism of present day climate models leading the way to increase climate change projections reliability. The project focus on three main components: (i) development of key processes in the land surface model CHTESSEL (ii) use of EO data to constrain model parameters, and (iii) weather forecasts and climate simulations. The computational component includes on a first stage offline simulation with CHTESSEL and on a second stage IFS simulations and EC-EARTH climate simulations.

## Summary of problems encountered

No major problems were encountered.

## Summary of results of the current year

During the last year the work was focused on diagnosing ERA5 and HTESSEL stand-alone land surface temperature biases using LSA-SAF satellite observations. The work has been focused on Iberia Peninsula. A clear cold biased has been identified during summertime, which has been associated with the vegetation cover and the partition between low and high vegetation (Johannsen et al. 2019). Sensitivity tests have shown that the errors can be attributed to the vegetation cover. Offline tests with updated land cover using the ESA-CCI land cover as well as Leaf Area Index proved the added value of updating land-cover and LAI in CHTESSEL over Iberia (Nogueira et al, 2020 in review).
From the developments over Iberia, global simulations have been performed with different configurations, both offline and IFS nudging. The results are under preparation, and Figure 1 shows the changes in biases of the daily maximum land surface temperature during JJA in offline and IFS nudged experiments.
Parallel to the work in CHTESSEL/IFS, EC-EARTH3 AMIP experiments have been also performed using the ECMWF default vegetation fields and vegetation from the CMIP6 coupled model (with LPJG). Figure 2 shows an example of the mean summer diurnal cycle of land surface temperature in the different simulations, comparing it with observations and reanalysis.

A request for additional resources (increase from 2.5MSBU to 4MSBU) was approved allowing for a few extra simulations to be carried out still this year.

## List of publications/reports from the project with complete references

Johannsen, F., Ermida, S., Martins, J. P. A., Trigo, I. F., Nogueira, M., & Dutra, E. (2019). Cold bias of ERA5 summertime daily maximum land surface temperature over Iberian Peninsula. Remote Sensing, 11(21), 2570. https://doi.org/10.3390/rs11212570

Nogueira, M., Albergel, C., Boussetta, S., Johannsen, F., Trigo, I. F., Ermida, S. L., Martins, J. P. A., and Dutra, E.: Role of vegetation in representing land surface temperature in the CHTESSEL (CY45R1) and SURFEX-ISBA (v8.1) land surface models: a case study over Iberia, Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2020-49 , in review, 2020.

## Summary of plans for the continuation of the project

Most of the required simulations have been carried out, with a few more tests still running (e.g. Shrubs and tall grass CHTESEL parameters). Until the end of the year the impact of land cover and LAI changes on the global offline and nudged experiments will be organized as publication. Further

diagnostics are still required on the EC-EARTH3 simulations to disentangle the contribution of the coupled vegetation to the land surface temperature changes in the AMIP simulations.

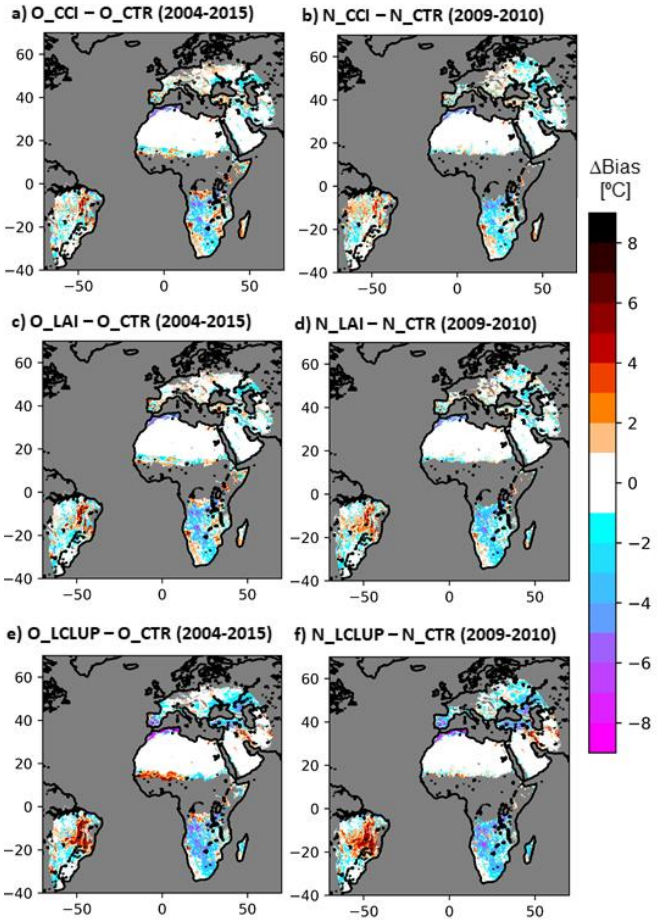


Figure 1: Daily maximum land surface temperature biases changes (in respect to control) for offline (left panel) and IFS nudged (right panels) experiment: change land-cover to ESA-CCI (a,b), land cover and Copernicus Global Land Service Leaf Area Index (c,d) and vegetation seasonality of low vegetation with clumping (e,f).

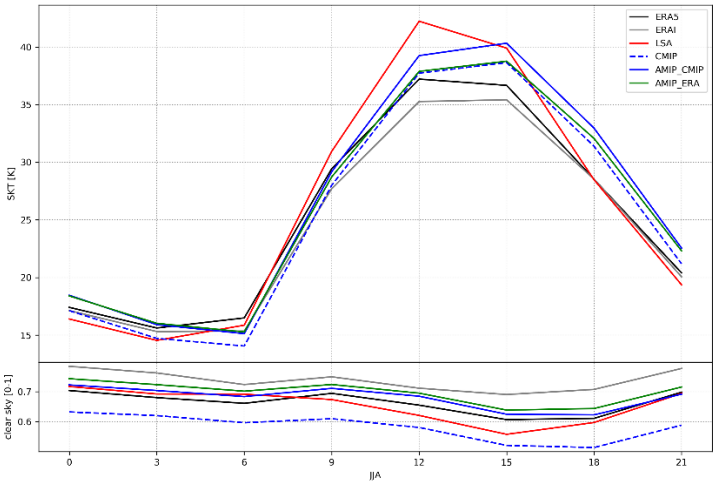


Figure 2: Mean diurnal cycle of Land Surface Temperature during June-August averaged over Iberian Peninsula in ERA5 (black) ERA-Interim (grey), LSA-SAF remote sensing observations (red), EC-EARTH3-Veg coupled CMIP6 (dashed blue), EC-EARTH3 AMIP using CMIP6 vegetation (blue) and EC-EARTH3 AMIP using ECMWF vegetation (green). The bottom panel show the fraction of clear-sky.