Dynamical Downscaling of CFS forecast for 2014-2015 winter season in Caribbean Region

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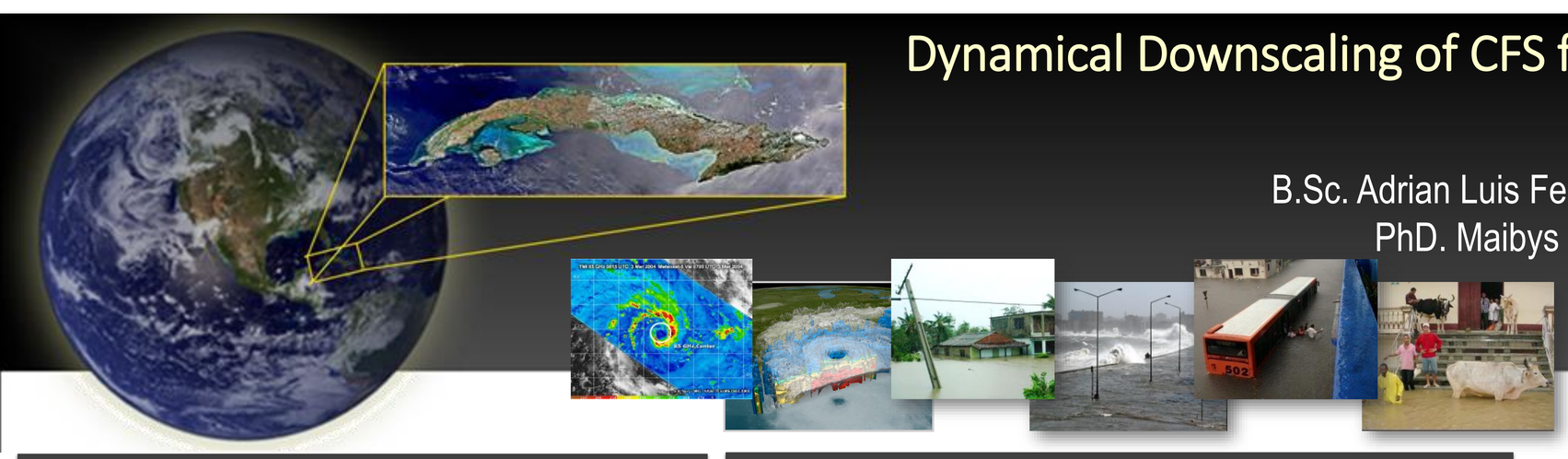
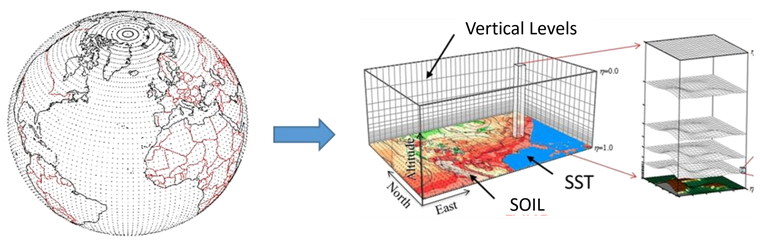


Abstract

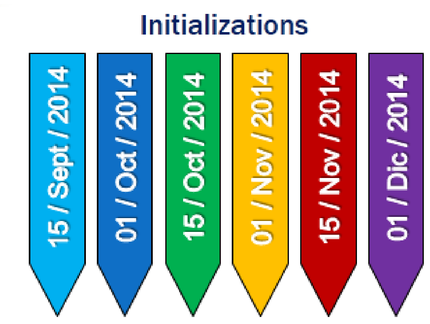
In the present work, data from the global CFSv2 model (NCEP / NOAA) were taken to initialize the WRF model with which a dynamic downscaling was performed on a domain defined by CORDEX for the Caribbean region. The study period was the 2014-2015 winter season and 6 initializations were made between September 15 and December 1, with intervals of approximately 15 days, predicting all these the common period covering the quarter December-January-February. In addition, simulations were performed with 2 configurations of physical parameterizations. For the verification of the numerical forecast, the observations of the meteorological stations were used for the grid-to-point analysis, while the TRMM-3B43 and CRU products were taken for the spatial analysis of precipitation behavior. The CFSR reanalysis data were also used for the grid-to-grid comparison and the verification of the forecast of climatic anomalies. In the elaboration of scripts, data processing and visualization, the Python programming language was used. Within the results obtained an improvement of the temperature at 2m and precipitation variables predicted with the WRF model was found, which had its best performance with CONF 02 (Lin + Grell-F. + MYJ + RRTMG + NOAH) used, while that with CONF 01 (WSM6 + KF + YSU + CAM + NOAH) it is appreciated that it has to spatially overestimate the monthly accumulations of rainfall and the intensity of them.

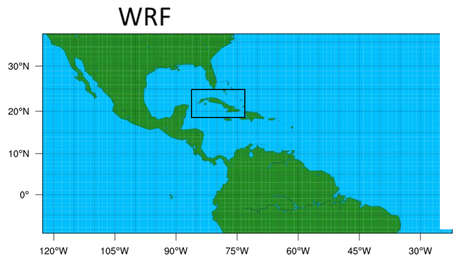
Data and Experimental Description



CFSv2

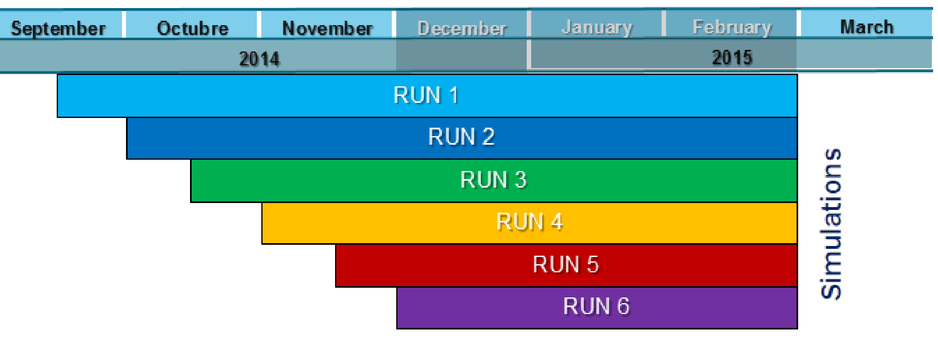
WRF





Cordex Domain (~25 km)

Period of interest



Configurations used in the WRF model:

WRF (v3.5.1) Parameters	Caribbean Domain (CORDEX Recommendation)	
	CONF 1 (25 km)	CONF 2 (25 km)
Microphysics	WSM 6	Lin
Cumulus	Kain-Fritsch	Grell-Freitas
Longwave radiation	CAM	RRTMG
Shortwave radiation	CAM	RRTMG
Surface layer	Revised MM5 Monin-Obukhov	Monin-Obukhov (Janjic Eta)
Land-surface	Unified Noah land-surface model	Unified Noah land-surface model
PBL	YSU	Mellor-Yamada-Janjic (Eta) TKE

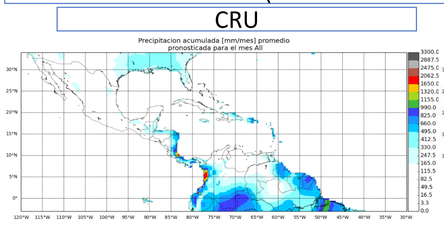
Data used in the verification:

Variable	Product
Precipitation	TRMM-3B43 (~25 km), CRU (~55 km)
Temp. 2m	CFSR (~55 km), CRU (~55 km)

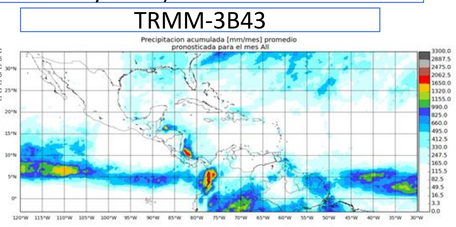
Results

Accumulated precipitation observed in the quarter (December 2014-February 2015)

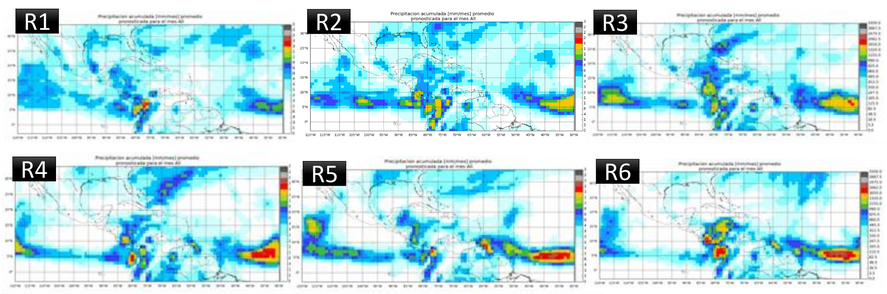
CRU



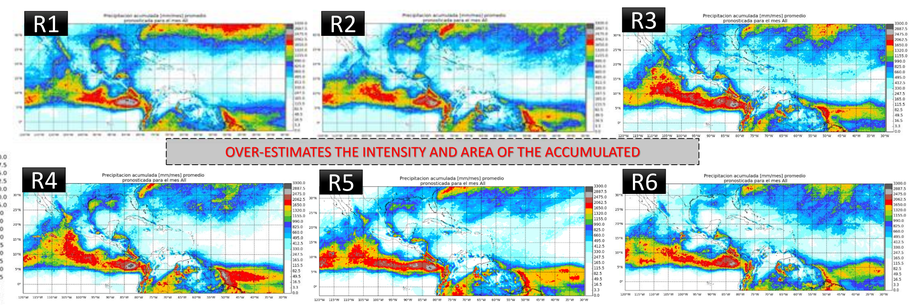
TRMM-3B43



Seasonal Forecast of the CFS model

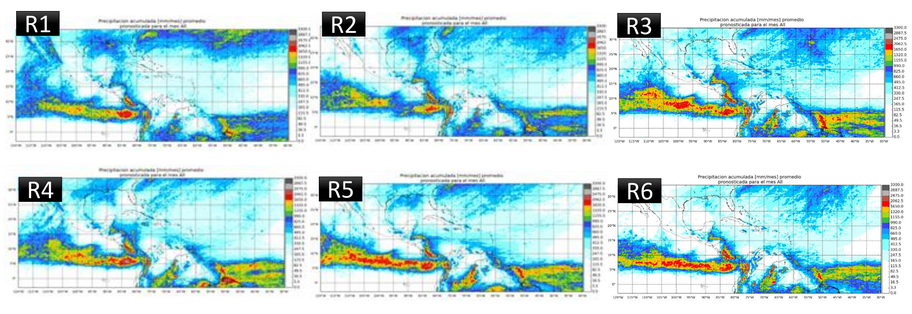


Seasonal Forecast WRF Configuration 1: WSM6+KF

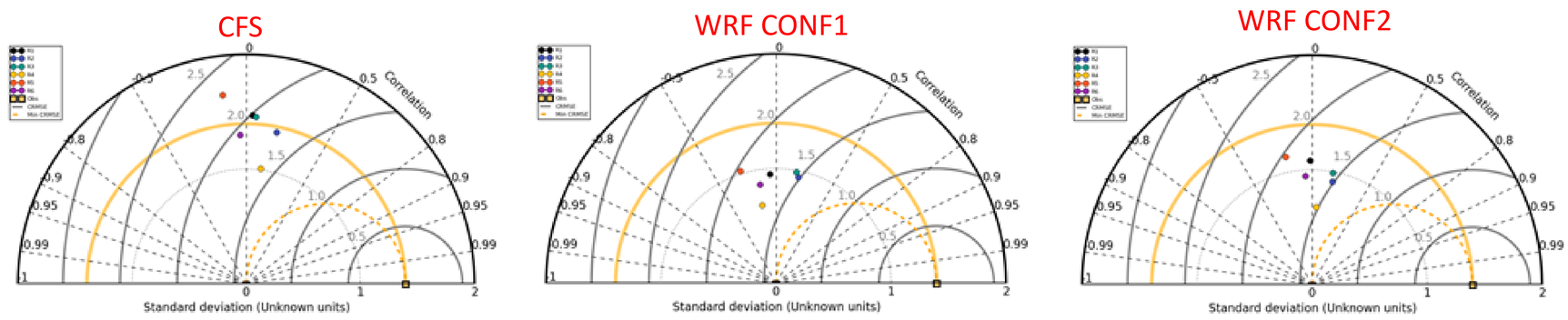


OVER-ESTIMATES THE INTENSITY AND AREA OF THE ACCUMULATED

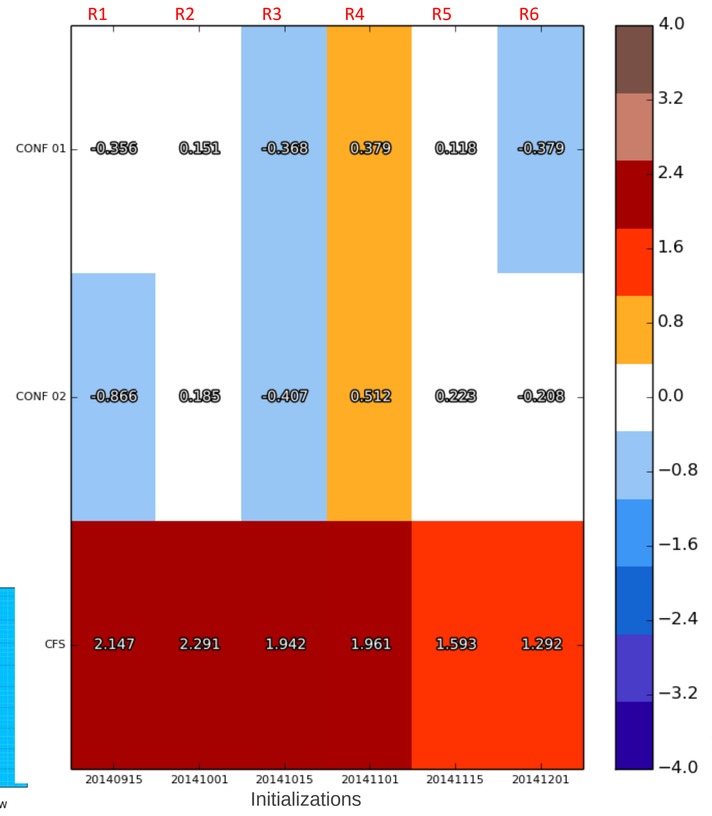
Seasonal Forecast WRF Configuration No.2: LIN+GrellF



Taylor diagrams for the temperature at 2m (Simulations vs. CFSR)



Mean temperature bias compared to CRU products.

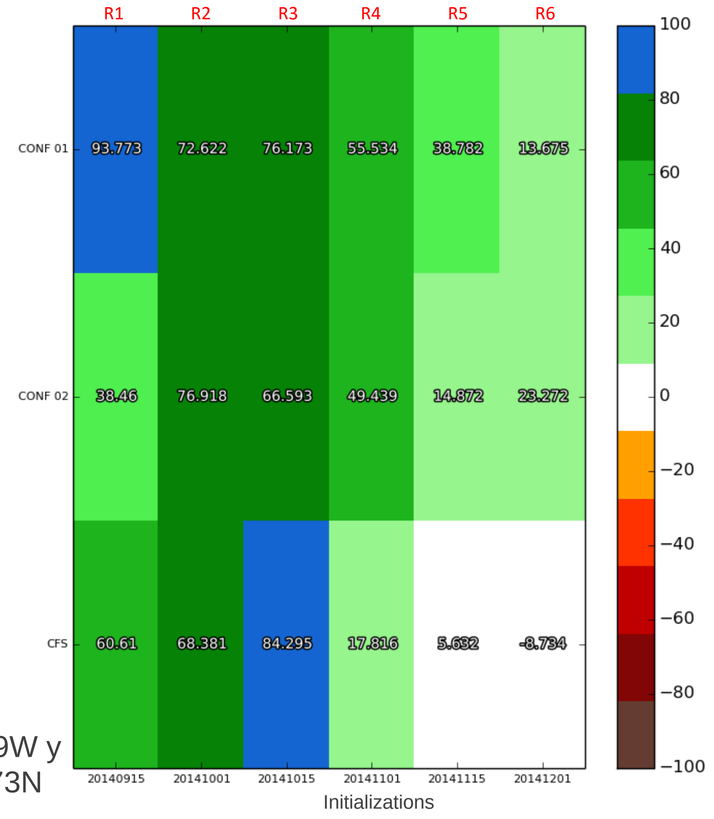


WSM6+KF

LIN+GrellF

CFS

Precipitation bias compared to CRU products.



Sub-region:
85.9043W a 73.2309W y
19.0136N a 23.8273N

Conclusions

It was possible to evaluate the sensitivity of the initialization of the WRF model to predict the behavior of the 2014-2015 winter season in the region of Cuba, where the CFS model forecasts were also analyzed, which were used as initial and boundary conditions of the WRF model. The analysis of all the information generated made it possible to arrive at the following conclusions:

- In the verification of the forecasts for the mean temperature at 2m and the accumulated precipitation, the best results were obtained for the forecasts initialized in the closest dates to the beginning of the December 2014 - February 2015 quarter.
- The analysis for the area of Cuba, reflected that the values of BIAS for the quarter means of air temperature at 2m show a slight improvement in the forecast of the WRF model with respect to that of the CFS model.
- The predictions made with the WRF model and those of the CFS model for the 2m air temperature variable show very low correlation with the observed behavior that is reflected in the reanalysis data. In spite of this, the simulations of the WRF model allow to improve the standard deviation with respect to the values of the CFS model.
- Of the configurations of the WRF model used in the work, the best results were obtained with CONF 02 (Lin + Grell F. + MYJ + RRTMG + NOAH) for all the variables studied. It is seen that, in the case of precipitation, the CONF 01 configuration considerably over-estimates the areas and the intensity of the accumulated values.