Impact of digital filtering initialisation DFI on CANARI analysis increments

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1. Introduction

The meteorological models are based on primitives equations. These equations have not only meteorological solutions but also other solutions without signification like acoustic waves and gravity waves.

The hydrostatic approximation filters vertical acoustic waves, but it doesn't affect the horizontal ones. There are other oscillations (gravity waves) that can noise the meteorological solution if they aren't filtered.

Several methods were developed to filter high frequency oscillations; such as normal mode initialisation (NMI) and digital filtering initialisation (DFI). Digital filtering provides an approach to initialisation that is conceptually simple and easier to implement than NMI. It involves generating a sequence of model fields and then applying a filter to the resulting time series for each model grid point and variable or for each model spectral coefficient. The filter is chosen to reduce the amplitudes of high frequency components of the time series to acceptable levels, but care should be taken to not destroy the increments. So what can be the impact of DFI on the analysis increments?

Concerning 3d-var analysis, Dziedzic (2000) demonstrates that DFI strongly dumps the analysis increments, but what about CANARI analysis. This study aim to quantify the influence of DFI on analysis increments produced by the model ALADIN/MOROCCO.

2. Description of the experiments

Two sets of experiments were run for 21/11/2001 at 0 h UTC. The first is performed without DFI (CANARI analysis). The second with DFI ; after CANARI analysis, the 0 h integration of the model follow to apply digital filtering.

In the beginning, the approach was to use an observation file containing just one observation extracted from a TEMP. The object was to avoid the superposition of increments resulting from different observations. The parameters chosen were :

- Geopotential (Z) at 500 hPa.
- Temperature (T) at 500 hPa.
- Humidity (HU) at 700h Pa.
- Zonal (U) and meridian (V) components of wind at 850 hPa.

Later, experiments using the full observation file were run with and without DFI.

3. Results

Maps of the analysis increments for each experiments were prepared to evaluate the impact of digital filtering. This results are presented below.

For each parameter, we drop analysis increments without DFI (left) and with DFI (right).

The summary of the comparison between the two sets of experiments (with and without DFI) demonstrates that digital filtering destroys the increments (values). Further, it strongly modifies the structure of the increments.

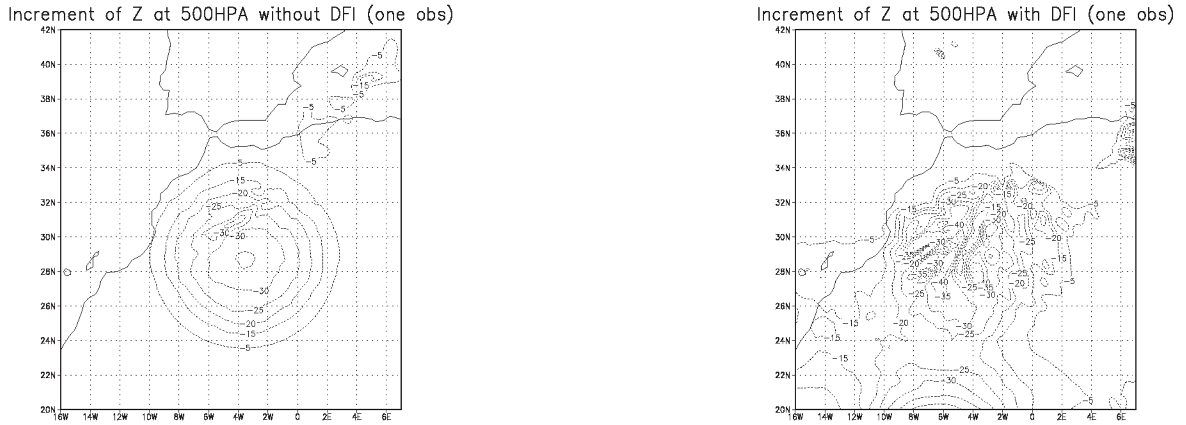

Figure 1. Increments of geopotential at 500 hPa without (left) and with (right) DFI.

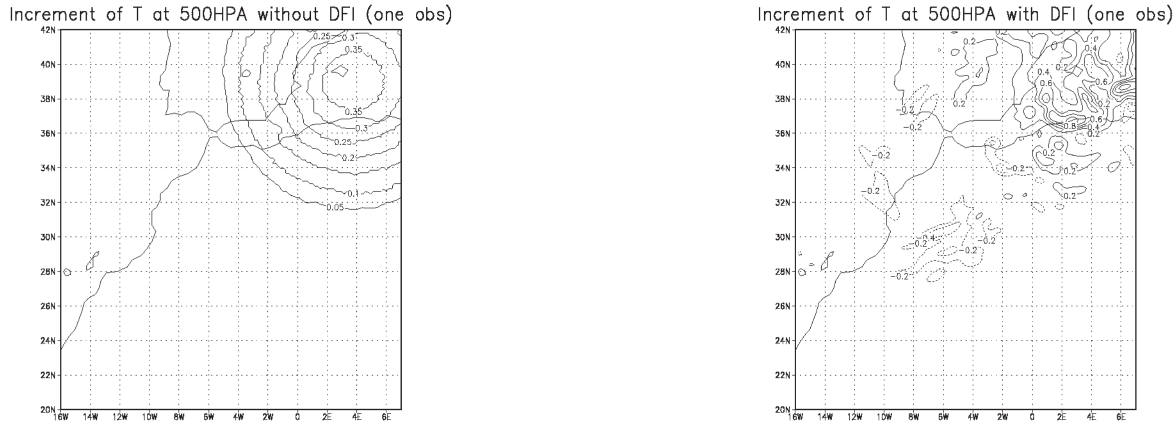

Figure 2. Increments of temperature at 500 hPa without (left) and with (right) DFI.

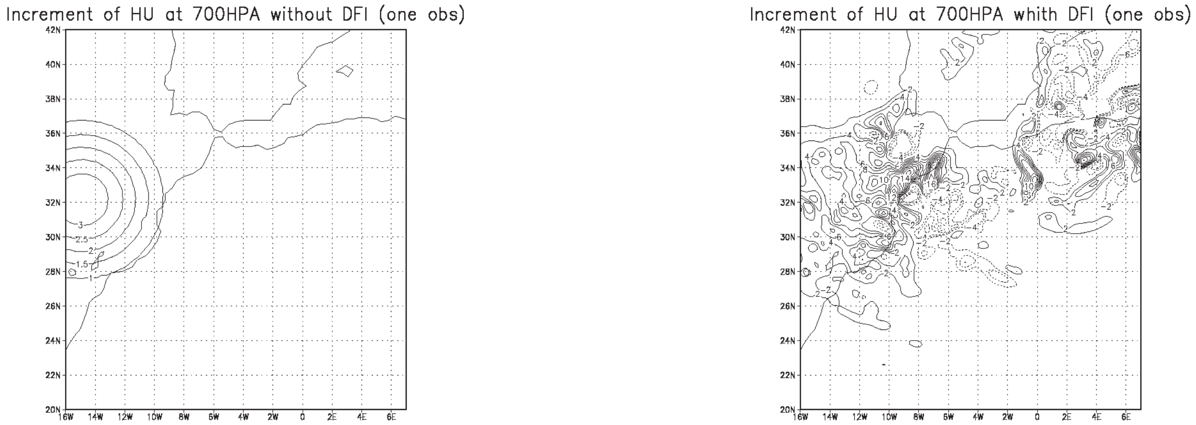

Figure 3. Increments of relative humidity at 700 hPa without (left) and with (right) DFI.

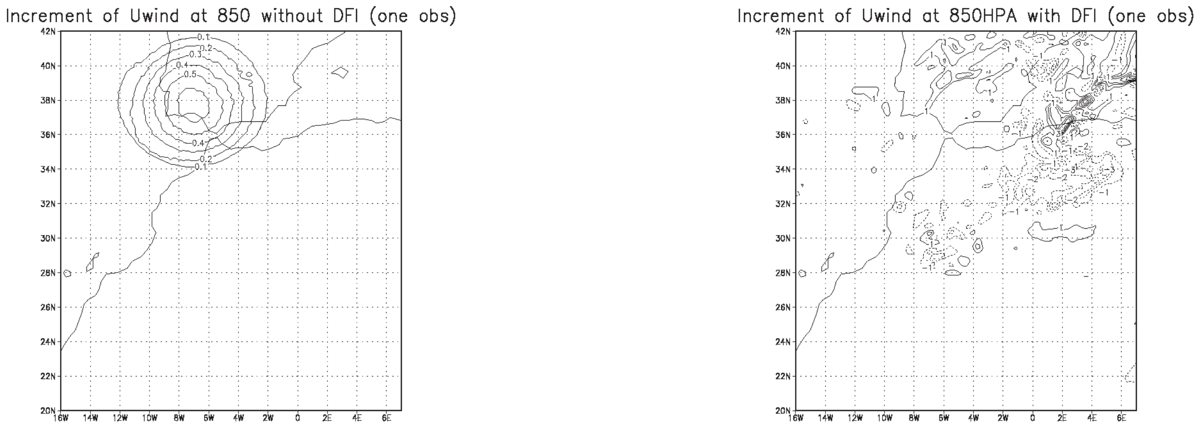

Figure 4. Increments of U wind at 850 hPa without (left) and with (right) DFI.

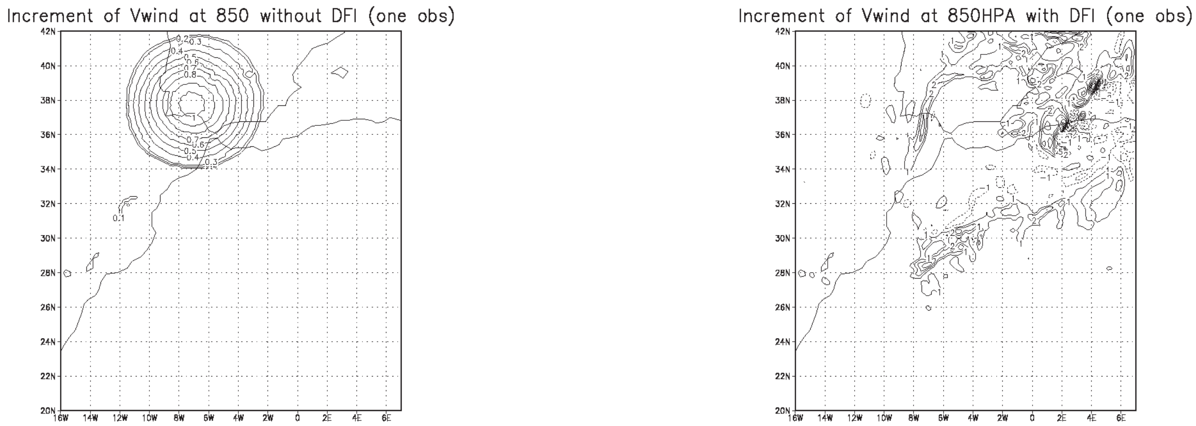

Figure 5. Increments of V wind at 850 hPa without (left) and with (right) DFI

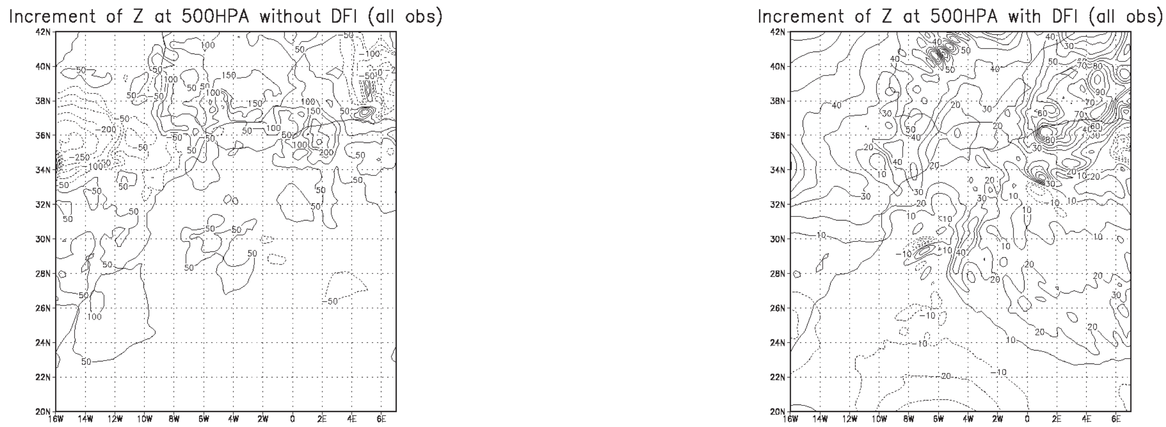

Figure 6. Increments of geopotential at 500 hPa without (left) and with (right) DFI; experiments with a full observation file.

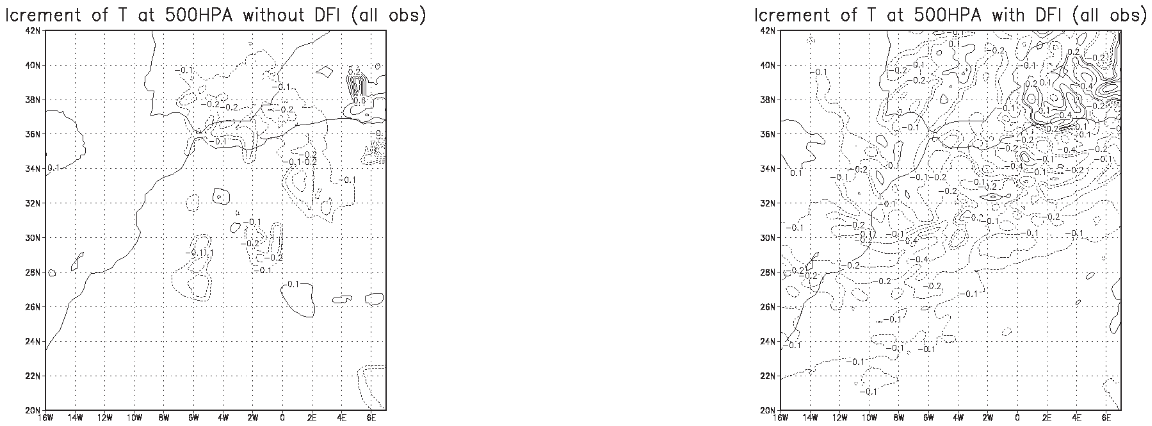

Figure 7. Increments of temperature at 500 hPa without (left) and with (right) DFI; experiments with a full observation file.