

# Verification of Kain-Fritsch/Rasch-Kristjansson Convection/Condensation Scheme

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## Abstract

The Kain-Fritsch/Rasch-Kristjansson (KF) convection/condensation scheme is compared with the STRACO scheme in a parallel HIRLAM run. Verification results show relatively small differences in the standard scores but heavy precipitation events associated with rapidly deepening depressions appear to be better described by KF. KF also has a positive impact on cloud cover and 2-metre temperature forecasts.

## Introduction

The Kain-Fritsch/Rasch-Kristjansson convection/condensation scheme (hereafter referred to as KF) is not part of the reference HIRLAM system that by default uses the STRACO scheme. However, local adaptations of HIRLAM have included KF as an extra option and the scheme has been used, for example, in FASTEX studies. In specific cases, it appears to offer positive benefits over STRACO, particularly in the description of cloud development associated with intense cyclones.

This note describes the verification results from a parallel run comparing KF with STRACO.

## Model Configuration

HIRLAM version 4.9.1 was used, suitably modified to incorporate KF as an independent option. The test area is identical to Met Éireann's main operational area but the horizontal resolution was increased to approximately 0.15 x 0.15 km and the number of vertical levels increased to 31 (NLON x NLAT x NLEV = 438 x 284 x 31). Other details:

- SL scheme + DFI + CBR
- DT=180 sec (6th order diffusion, NLDYNVD=T)
- 3-Hour assimilation cycle (OI analysis system); 48-hour forecasts at 00/12
- ECMWF operational boundary fields

Identical observational data and boundary fields were used for both runs.

## Test period

The period 22 November – 7 December 2000 was chosen as the weather was particularly active around that period with Atlantic depressions bringing rain and strong winds to western Europe. Two systems in particular, involving rapidly deepening depressions, caused heavy flooding in parts of Ireland and the UK during this period.

## Results

Forecasts were verified by comparing them against observations using the HIRLAM verification system. The following is a summary of the main results (•REF• refers to STRACO - the reference system).

- The conventional mean error (ME) and root-mean-square error (RMSE) scores for mean-sea-level pressure and 500 hPa geopotential height do not reveal any significant differences (see figure 1 as an example). For wind, KF is perhaps slightly better (less noisy – see figure 2). For temperature, the KF results show a small improvement in the bias below 850 hPa, slightly worse at higher levels (figure 3). For relative humidity the scores are very similar.
- There is some evidence to suggest that the KF rainfall forecasts are slightly more accurate in cases of heavy precipitation. See, for example, the time series plot of the 6-12 hour precipitation forecasts for the E and SE of Ireland (figure 4).
- The depth of rapidly deepening depressions appears to be better forecast by KF. The two main examples in this study favoured KF (the depths of the depressions were verified against observations over Ireland) but the differences are small.
- KF has less bias in the 2-metre temperature and total cloud cover forecasts (figures 5 and 6).

The positive results for cloud cover and 2-metre temperature forecasts need to be treated with caution as there is some evidence to suggest that KF systematically under-predicts cloud cover (when compared with satellite imagery). Also, it is difficult to judge the accuracy of the observed cloud cover reported in the SYNOP message used in the verification.

## Conclusions

In comparison with STRACO the impact of the Kain-Fritsch/Rasch-Kristjansson convection/condensation scheme is mostly neutral or slightly positive on scores of mean-sea-level pressure and upper-level geopotential, temperature, wind and humidity. The impact is also slightly positive in handling rapidly deepening depressions (more accurate central pressures) and associated heavy precipitation but the number of cases (2) in the test period is small. The impact on 2-metre temperature and cloud cover is positive but a subjective assessment, based on comparing forecast cloud cover with satellite imagery, suggests the Kain-Fritsch/Rasch-Kristjansson scheme systematically under-predicts the cloud cover.

**HIRLAM VERIFICATION OF MSL PRESSURE: STATION LIST - EWG**  
**LEVEL: Surface**  
**DATA: 00 UTC 22 NOV - 00 UTC 9 DEC 2000**

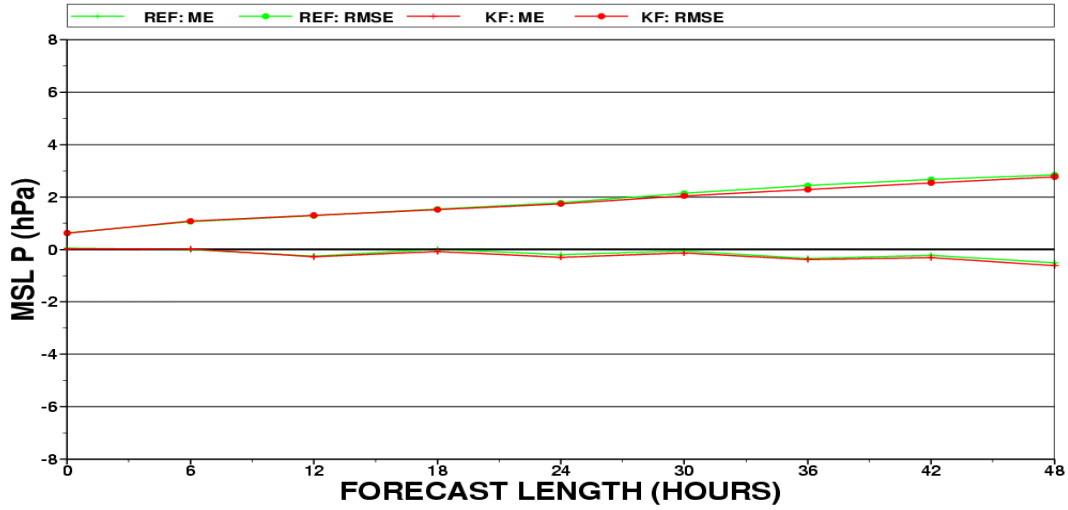


Figure 1

**HIRLAM VERIFICATION OF WIND SPEED: STATION LIST - EWG**  
**36 HOUR FORECAST**  
**DATA: 00 UTC 22 NOV - 00 UTC 9 DEC 2000**

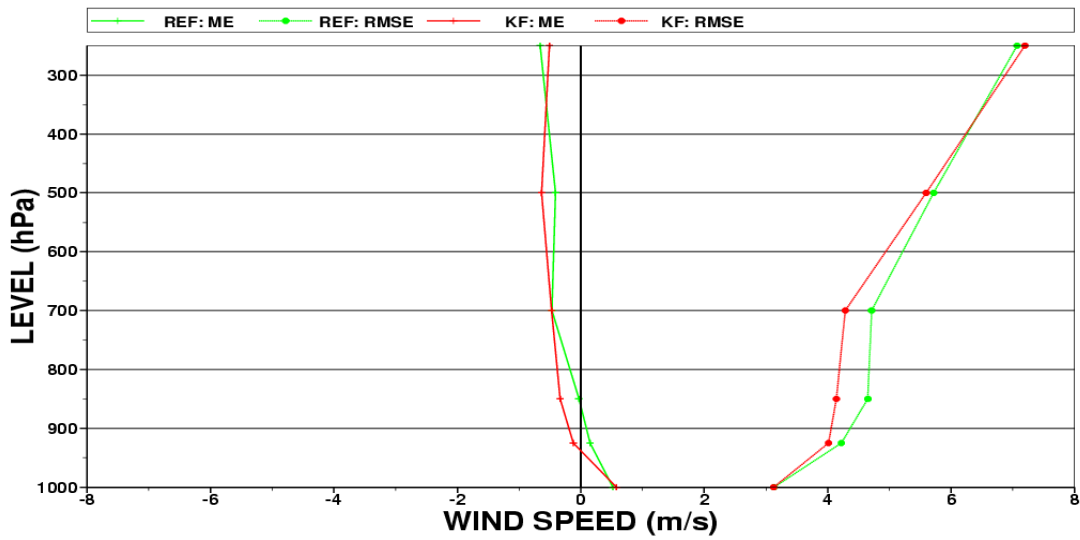


Figure 2

**HIRLAM VERIFICATION OF TEMPERATURE: STATION LIST - EWG  
24 HOUR FORECAST  
DATA: 00 UTC 22 NOV - 00 UTC 9 DEC 2000**

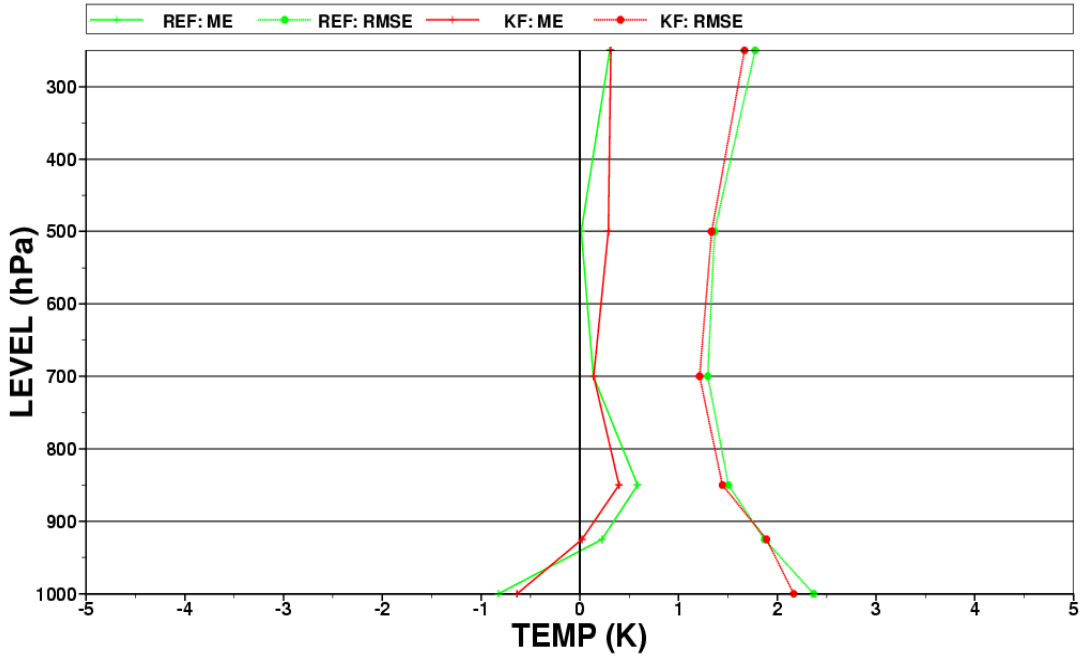


Figure 3

**Mean Rainfall (E/SE Ireland - 4 stations)  
Forecast period: 6-12 HOURS**

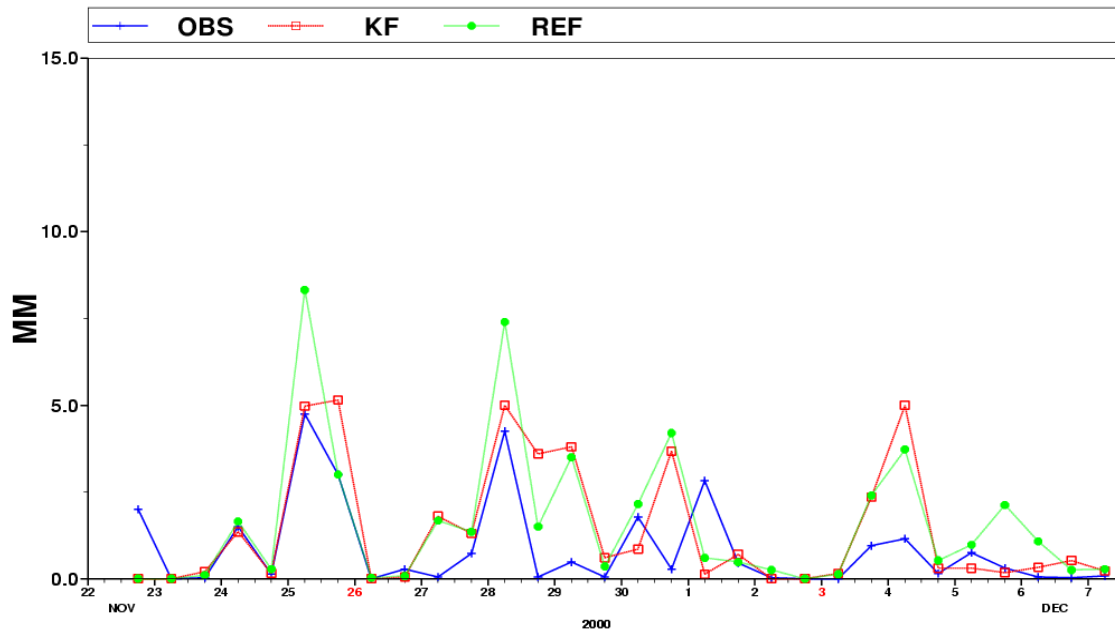


Figure 4

**HIRLAM VERIFICATION OF 2M TEMPERATURE: STATION LIST - EWG**  
**LEVEL: 2m**  
**DATA: 00 UTC 22 NOV - 00 UTC 9 DEC 2000**

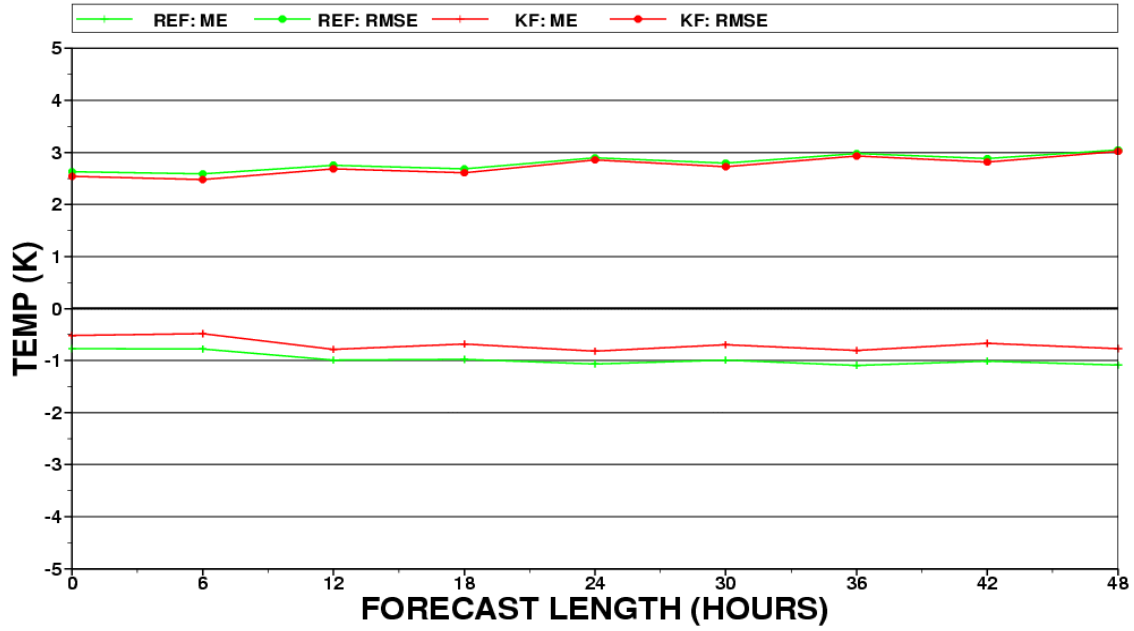


Figure 5

**HIRLAM VERIFICATION OF CLOUD COVER: STATION LIST - EWG**  
**LEVEL: Surface**  
**DATA: 00 UTC 22 NOV - 00 UTC 9 DEC 2000**

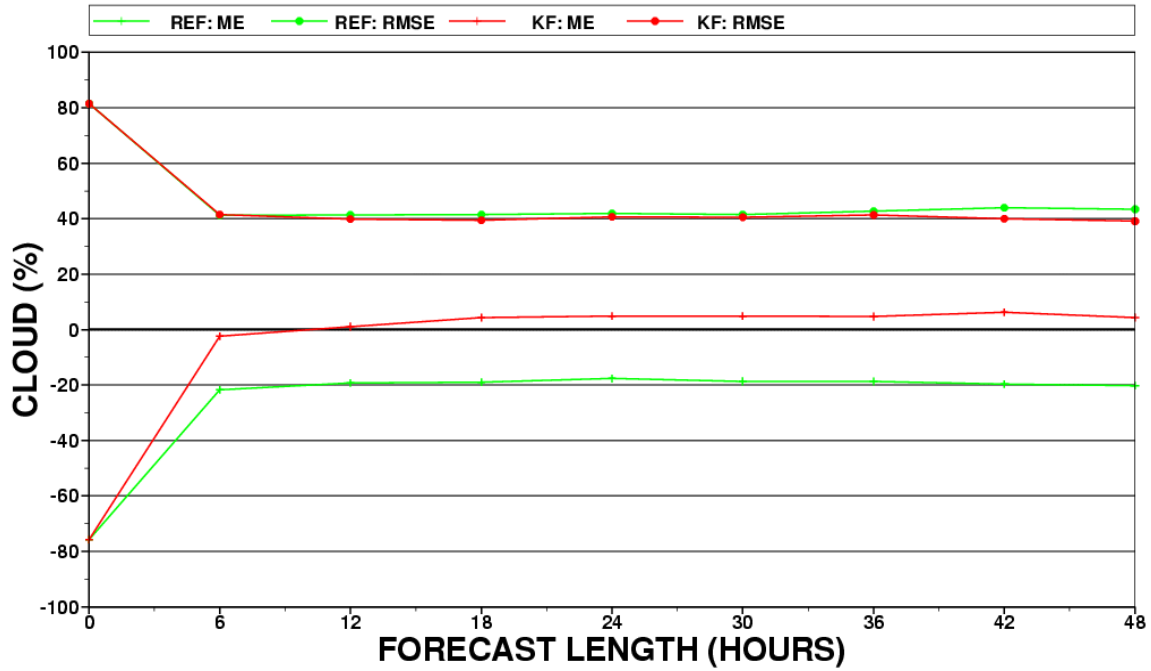


Figure 6