# Assimilation of MSG-SEVIRI All-sky IR Radiances into MLEF-HWRF as a GOES-R ABI Proxy

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## Introduction

- Data Assimilation (DA) of Meteosat Second Generation (MSG) satellite's Spinning Enhanced Visible and Infrared Imager (SEVIRI) all-sky infrared radiances.
- SEVIRI has resolution of 3km for IR and 1km for the visible channel, it scans the earth every 15 min (Figure 1).
- We utilize the Maximum Likelihood Ensemble Filter (MLEF), interfaced with the NOAA operational Hurricane WRF model (HWRF) and with the Gridpoint Statistical Interpolation (GSI) and the Community Radiative Transfer Model (CRTM) as observation operators.
- SEVIRI data as a proxy allows allows an early look at the future Advanced Baseline Imager (ABI) data that will be aboard the next generation of NOAA's GOES–R sat. (Figure 2).
- ABI's spatial resolution will be 2 km for IR and 0.5 km for one visible channel, it will scan the full disk once and the continental US three times every 15 min.

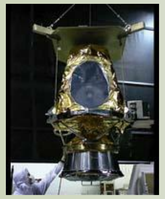

**Figure 1.** SEVIRI instrument. Astrium, 2002.

**Figure 2.** GOES-R. Northrop-Grumman, 2009.

## Motivation

- In preparation for the launch of GOES-R, pre-testing of aboard instruments (e.g., ABI) is necessary.
- Assess the impact of GOES-R ABI in NOAA computational environment, using NOAA operational codes and scripts

## Motivation cont.

- High resolution ABI data (2km) will be beneficial for tropical cyclones and severe weather: need to focus on regional data assimilation

## Objectives

- Evaluate the potential impact of ABI all-sky radiance DA for improving the forecasting of clouds and cloud microphysical species related to hurricane analysis and prediction.
- Assimilate MSG-SEVIRI all-sky radiances as a proxy to ABI
- Focus on water vapor (WV) and infrared IR channels

## Case Study

**Hurricane Fred (September 7 – 19, 2009)**

- Fred was a powerful hurricane that rapidly intensified into category three, with wind speeds of 185 km/hr and dissipated a few days later in the far eastern Atlantic Ocean without any recorded damages, or fatalities.
- This hurricane was chosen due to it's proximity to the African West-coast with spatial-coverage by European satellites i.e., MSG-SEVIRI
- Hurricane Fred provides the opportunity to study the early stages of hurricane development

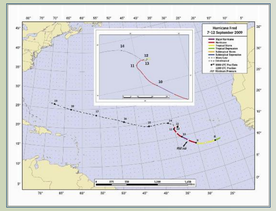

**Figure 3.** Fred's track and intensity. Brenan, M. J., Tropical Cyclone Report Hurricane Fred (2009).

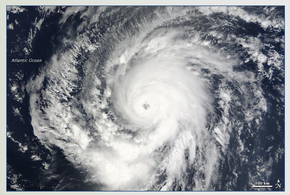

**Figure 4.** True-color image of Hurricane Fred captured by the MODIS sensor on NASA's Terra Satellite at 12:55 UTC on September 9, 2009.

## Components of HWRF-MLEF DA

- HWRF modeling system --- NCEP/EMC operational model. Two nested domains of 27 and 9 km resolution with a moving inner-domain (Figure 6)
- GSI (forward components) and CRTM as observation operator for satellite radiance data.
- CSU hybrid variational-ensemble DA system (MLEF)
- MLEF calculates optimal states of model state variables and errors, boundary conditions errors and uncertainties
- Pre-processing of satellite data is done at CIRA: MSG-SEVIRI native McIDAS is converted to: ASCII, then to NetCDF and finally to bufr with converter tools which are being installed and tested at NCEP's super-computers

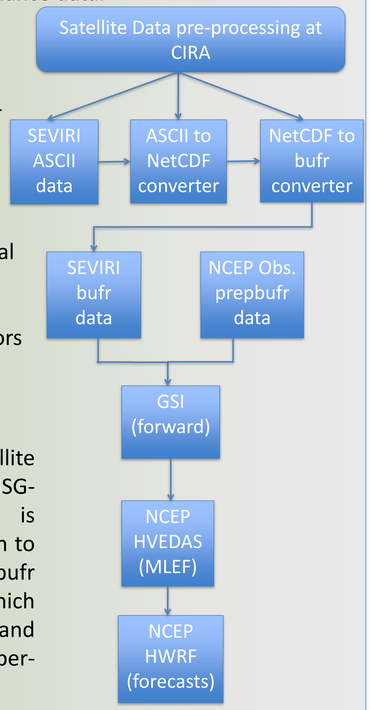


**Figure 5. System flow of the HWRF-MLEF DA.**

Acknowledgements
JCSDA Grant No. NA10NES4400012 and NCEP/EMC (Hurricane Forecast Improvement Project)

## Data Sets

- We utilize brightness temperature measurements from the SEVIRI radiometer onboard MSG-8 geosynchronous satellite (Figure 5).
- SEVIRI provides measurements over 12 spectral bands with a resolution of 3 km at nadir.
- Our research focuses on channels 5, 6 and 9 (SEVIRI) and 8, 10 and 14 (ABI) as shown in Table 1.

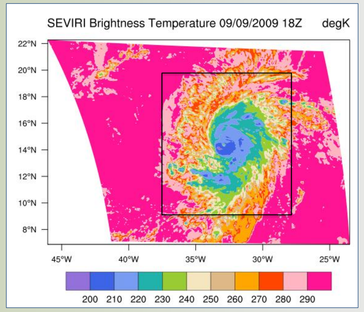


**Figure 6.** SEVIRI brightness temperature for hurricane Fred on September 9, 2009 at 18Z.. The black box represents HWRF's moving nest.

| SEVIRI Channel | SEVIRI λ (μm) | ABI Channel | ABI λ (μm) | Use |
|---|---|---|---|---|
| 5 | 6.2 | 8 | 6.2 | Upper level water vapor |
| 6 | 7.3 | 10 | 7.34 | Lower level water vapor |
| 9 | 10.8 | 14 | 11.2 | Cloud and surface temp. |

**Table 1.** SEVIRI and ABI spectral bands and use

## Future Work

- Assess the impact of all-sky SEVIRI radiances on the analysis and forecast of tropical cyclones – hurricane Fred (2009)
- Sensitivity runs will be performed with and without SEVIRI brightness temperature to assess the value-added to DA