Atlantic precursors of Mediterranean cyclones: modeling at kilometer scale

Jean-Pierre CHABOUREAU¹

with contributions from Florian PANTILLON¹, Gwenaëlle PAQUE¹, Christine LAC², Patrick MASCART¹

¹Laboratoire d’Aérologie, University of Toulouse and CNRS, France
²CNRM/GAME, Météo-France, France

4th HYMEX workshop, Bologna, Italy, 9 June 2010
Importance of upper-level troughs

Severe weather events, either cyclones or heavy precipitating events, are often associated with upper level troughs. As an example, a climatology of rain and deep convection of using satellite AMSU observations:

**Occurrence of rain and deep convection in SON from AMSU/B3-5**

**Composite of troughs for events in SON over South France from AMSU/A8**

Data: NOAA-16 2001-2007

Funatsu et al., MWR 2009
The 2006 Medicane

Summary with the different stages

1412 UTC 26 Sep

Moscatello et al. MWR 2008

Shaded: AMSU/B3-5; Contours: AMSU/A8

Claud et al. NHESS, submitted
**Forecasts of the Medicane**

Poor forecasts of the Medicane in location and depth at day+1 and day+2, very poor at day+3, and no Medicane at day+4.

Track on 26 Sept from 00 UTC to 18 UTC (a point every 6h) for ECMWF and ARPEGE forecasts starting on 00 UTC 26, 25 and 24 Sep.

Time evolution of mean sea level pressure for ECMWF and ARPEGE forecasts starting on 00 UTC 26, 25 and 24 Sept. A minimum of 986 hPa was recorded at 0915 and 1700 UTC.

- Poor forecasts of the Medicane in location and depth at day+1 and day+2, very poor at day+3, and no Medicane at day+4.
Helene and the Medicane
ECMWF forecasts at 0600 UTC 26 Sep 2006

Shaded: PV at 300 hPa; Contours: MSLP
Experiments with Meso-NH
0000 UTC 22 Sep 2006

5-day simulation (\(\Delta x=25\) km; \(\Delta z=600\)m free troposphere) starting at 0000 UTC 22 Sep from ECMWF analysis and with lateral coupling with either analysis or forecasts.

Shaded: PV at 250 hPa; Contours: MSLP
Extratropical transition of Helene

Helene’s track

- < 20 Sep: tropical stage
- 20-22 Sep: begin of ET
- 22-25 Sep: re-intensification
- > 25 Sep: extratropical stage

MESO-NH forecast: OK till 25 Sep
ECMWF forecast: poor after 24 Sep

MSLP minimum

Re-intensification
Interaction with the jet stream
0000 UTC 25 Sep 2006

ECMWF analysis

MESO-NH t+72

Shaded: wind speed at 250 hPa; Contours: MSLP

- ECMWF analysis: jet splitting and poleward acceleration of Helene
- MESO-NH forecast: good phasing, but too low poleward acceleration
Helene as seen from space
1200 UTC 23 Sep 2006

- AMSU-B/analysis: deep convection at NE, cold air rolling from SW
- MESO-NH: good forecast of Helene’s structure, but less intense

Shaded: $T_b$ at 150 GHz; Contours: MSLP (black), $\theta_e$ at 850 hPa (pink)
Summary

From the extratropical transition of Helene to a Medicane over Italy

- Importance of an upper level trough in the Medicane life cycle, at least for the development of the initial lee cyclone.

- The trough was downstream of a Rossby wave amplified by the extratropical transition of Helene.

- The interaction of Helene with the polar jet stream was poorly forecasted. This impacts the forecast of Helene, the downstream trough and the Medicane.

- Sensitivity of Helene’s extratropical transition forecast to model: better forecasts with Meso-NH ($\Delta x=25$ km) compared to ECMWF.

- On-going work: simulations with a $\Delta x=4$ km grid for resolving convection explicitly to better describe diabatic processes. This should be a common tool for analysis of HYMEX events.
Preliminary test

Observation / analysis

MESO-NH

$\Delta x = 4 \text{ km}$

- $3072 \times 1536$
- $100$ gridpoints
- $16,384$ cores
- $95 \text{ Gb per output}$
The Medicane and the trough

0600 UTC 26 Sep; MSLP=992 hPa

1200 UTC 26 Sep; MSLP=986 hPa