

# Recent and future developments in Europe with LAPS system coupled with regional NWP models

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## Introduction

Heavy rain events often affect Italian areas, sometimes determining destructive flash floods, which can produce huge damages in terms of human lives and to properties. In a couple of weeks between October and November 2011, two severe convective events affected Liguria. In one of them, a stationary system produced more than 500 mm in 6 hours over Genoa on 4 November and determined 6 casualties, showing some similarities with an episode affecting Genoa in October 1970. The event was characterized by finger-like auto-regenerating convective cells.

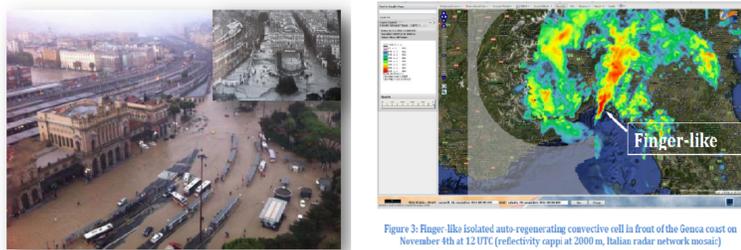


Figure 3: Finger-like isolated auto-regenerating convective cell in front of the Genoa coast on November 4th at 12 UTC (reflectivity capped at 2000 m, Italian radar network mosaic)

## Motivations

Although limited area model progress permit to improve short-range predictions with respect to a few years ago, due to the newer parameterization scheme and to their high horizontal resolution, several issue remain to be solved. In particular, the very short-term weather forecasting of heavy rain remains problematic, as it is still difficult to produce accurate rainfall prediction of how much, when and where it will rain even a few hours in advance. For these reasons, some Italian regional Civil Protection agencies decided to experiment a system of forecasts based on LAPS. LaMMA (Tuscany region meteorology laboratory) and ARPAL (Liguria region Environmental Protection Agency), with the support of METEOCAT and of ISAC-CNR, intend to implement a "nowcasting" system based respectively on WRF model and on BOLAM model, using LAPS analysis as initial condition.

## Implementation

The two suites implemented at LaMMA and at ISAC-CNR are able to ingest:

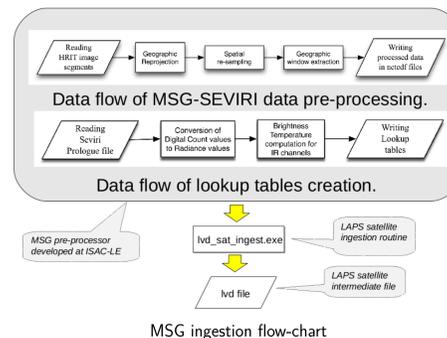
- METAR data;
- radiosoundings;
- Meteosat-Second-Generation (MSG);
- ECMWF analysis/forecasts;
- WRF model output.

## Next steps

The following step will be the ingestion of radar mosaic data, available from the National Civil Protection Department at 4 different pressure levels and covering most of the Italian peninsula. Also, it is planned to use LAPS analysis as initial condition for the BOlogna Limited Area Model (BOLAM) and BOLAM as background field for LAPS. However, the different coordinate (rotated lat-lon) and different vertical level systems require the development of nontrivial interpolation routines that may deteriorate the meteorological information and produce non-balanced fields. Thus, the way to make LAPS communicate with BOLAM is still under study.

## Experience with LAPS at ISAC-CNR

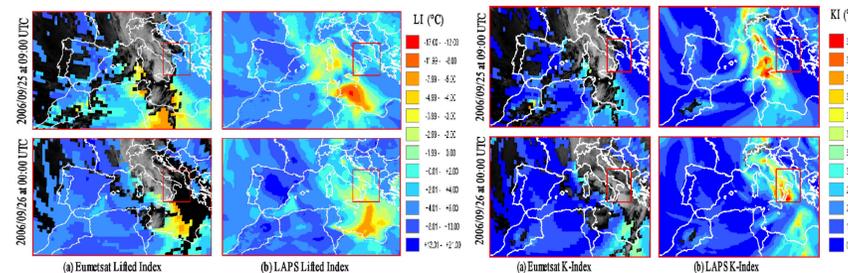
LAPS was implemented over southern Italy in the framework of two projects financed by Apulia region. A new procedure for the ingestion of 4 MSG channels into LAPS was developed. The methodology consists of transforming raw MSG data into gridded netcdf file which are similar to GOES netcdf file.



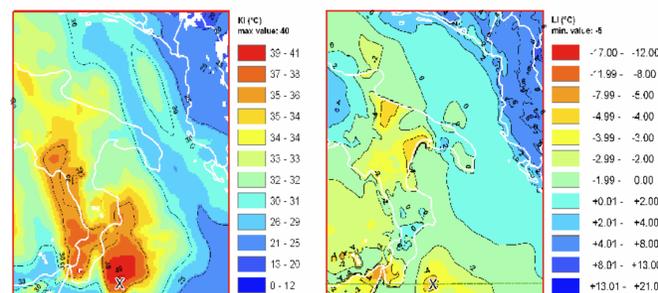
MSG ingestion flow-chart

## Results

The LAPS version implemented at ISAC-CNR for the ingestion of MSG data was applied for the analysis of a tropical-like cyclone over the Mediterranean Sea crossing Apulia region on 26 September 2006 (Conte et al., 2010). Instability indices have been calculated in the LAPS analysis and compared with Global Instability Indices (GII) products developed at EUMETSAT. Results are similar, but LAPS has the advantage, on the opposite of GII, of producing indices also in cloudy regions.



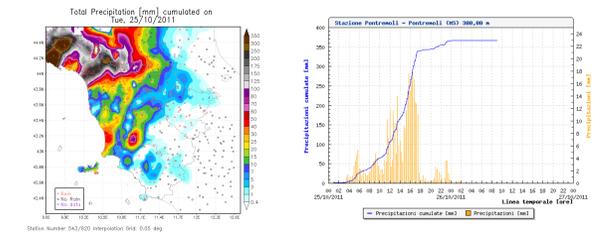
LAPS analysis shows that, only immediately before the explosive deepening of the cyclone, K-INDEX and LIFTED index maximum superimpose above the cyclone location.



LAPS K-INDEX and LIFTED-INDEX determined at 00UTC 26/09/2006

## Preliminary experience at LaMMA/Meteocat

The case study of 25 October 2011 produced heavy rainfall also over Tuscany.

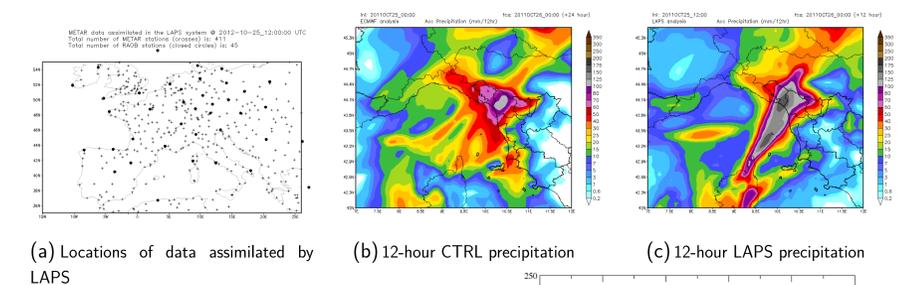


24-hour observed precipitation over Tuscany (northern Italy) on 25 October 2011

LAPS analysis was generated at 12 UTC, 25 October, by using ECMWF forecasts at +12 h (run of 00 UTC) as first guess, and ingesting radiosoundings and METAR data available over the WRF model domain. Two WRF model simulations have been performed, one (CTRL) starting from ECMWF analysis at 00 UTC, 25 October, and lasting 24 hours, and the other (LAPS) initialized with LAPS analysis at 12 UTC and lasting 12 hours. Both use ECMWF forecasts as boundary conditions.

## Results

Results show that the LAPS analysis improves significantly the model results, by making the convective line more stationary over the region affected by heavy rainfall.



Verification statistics performed for 72 rain gauges in the area of interest show a correlation coefficient between observed and simulated precipitation increasing from 0.17 of the CTRL run to 0.58 of the LAPS run while RMSE decreases from 52 mm to 42 mm respectively.

## Acknowledgements

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## References

- [1] Conte D., M.M. Miglietta, A. Moscatello, V. Levizzani, and S. Albers, *Environmental Modeling and Software*, vol. **25**, 2010.
- [2] Conte D., M.M. Miglietta, A. and V. Levizzani, *Atmospheric Research*, vol. **101**, 2011.