The IMILAST project :
Influence of including open cyclones in storm identification schemes

M.Reale (1) , P.Lionello (1,2) , A.Cocozza (1,2) and the IMILAST team (3)
(1) University of Salento, via per Monteroni, 73100 Lecce-Italy (reale.marco82@gmail.com) , (2) CMCC, Centro Euromediterraneo per i Cambiamenti Climatici, 73100 Lecce-Italy

INTRODUCTION

The present study provides a comparison between two methods (LeA, used at Univ. Salento , and BeA, used at FU Berlin) characterized by two different approaches in cyclone identification and tracking which allows to identify two different kind of systems : closed system (LeA, fig,1-a) and open and closed system (BeA, fig.1-a,b) .Both schemes have been applied to the mean Sea Level Pressure field, ERA Interim reanalysis 1.5°x1.5°, 1989-2009.

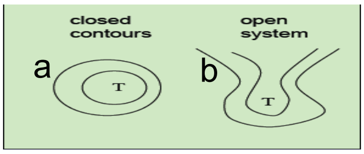

Fig. 1 Closed (a) and open (b) system

CYCLONE IDENTIFICATION AND TRACKING

Lecce Algorithm LeA	Berlin Algorithm BeA
Lionello et al. 2002	Murray and Simmonds 1991, Pinto et al. 2005
Search for SLP minimum	Search for Laplace SLP maximum and SLP minimum in the vicinity
Only closed systems	Open and closed systems
Operates on original grid	Interpolation to 0.75°x0.75° grid
Search for next track element inside search area, which depends on previous dislocation	Prediction of core pressure and location for the next time step. Most likely system chosen as next track element

EXPLOSIVE MEDITERRANEAN CYCLONES

An explosive cyclone (or bomb) is characterized by exceptional deepening:

$$NDRc = \frac{\Delta p}{12h} \times \frac{\sin 60°}{\sin \Phi}$$

where ∇p is the central pressure change of a system over 12h that occurs at latitude Φ

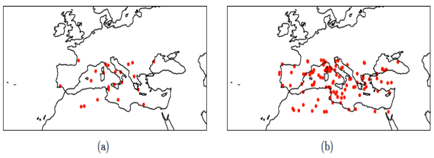

Fig. 4 Cyclogenesis processes producing cyclones becoming explosives inside MR detected using LeA (a) and BeA (b)

The number of cyclogenesis events associated with explosive developments inside MR detected by BeA is larger than by LeA. Reasons for this fact are (a) LeA tends to detect cyclones at a later stage than BeA and (b) most explosive cyclones experience the fastest deepening rate during the first stages of their development, which is often missed by LeA.

SUMMARY

Considering cyclones statistics, differences between the two tracking algorithms involve :

- the detection of cyclones at different stages of their development

- a different count of cyclogenesis processes in the main cyclogenesis areas inside MR , nonetheless identified by both tracking algorithms

- a different count of cyclones becoming explosive inside MR

- in some cases the attribution of same extreme event to two different cyclone located nearby the location where it occurs.

CYCLOGENESIS IN THE MR

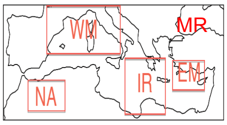

Fig.2.-Mediterranean region (MR) and the areas selected for this study

Region	LeA	BeA
MR	1630(77)	2177(103)
WM	470(22)	730(34)
EM	117(5)	186(8)
NA	97(4)	89(4)
IR	63(3)	63(3)

Tab. 1: Number of cyclogenesis processes detected ; values reported between brackets represent annual averages

- Both methods are able to identify the main cyclogenesis areas in the MR (Fig. 3).
- BeA identifies more cyclogenesis events than LeA inside the Mediterranean region, mainly in WM and EM. This is attributed to the consideration of open systems in BeA and the merging of small systems in LeA.
- BeA identifies in MR 2177 systems (1181 closed and 986 open), 730 in WM (429 closed and 301 open) , 186 in EM (124 closed and 62 open).
- LeA identifies in MR 1630 closed systems , 470 in WM and 117 EM.
- At seasonal scale (in spring and summer) LeA identifies more cyclogenesis events than BeA over NA and the Eastern Black Sea. This suggests that the two schemes react differently to heat lows generated in summer and spring.
- Mediterranean cyclones detected by BeA tend to be deeper in the first stage of their development (Fig .4).

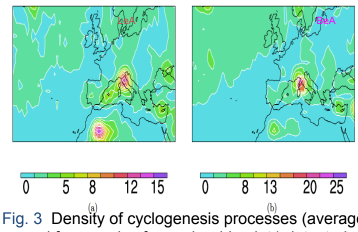

Fig. 3 Density of cyclogenesis processes (average annual frequencies for each grid point) detected using LeA (a) and BeA (b)

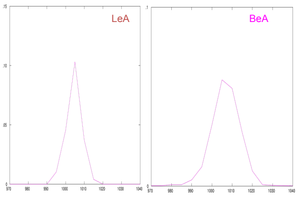

Fig.4 Cyclone core pressure (in hPa) at time step of first detection in MR

CYCLONE PRODUCING SEVERE PRECIPITATIONS

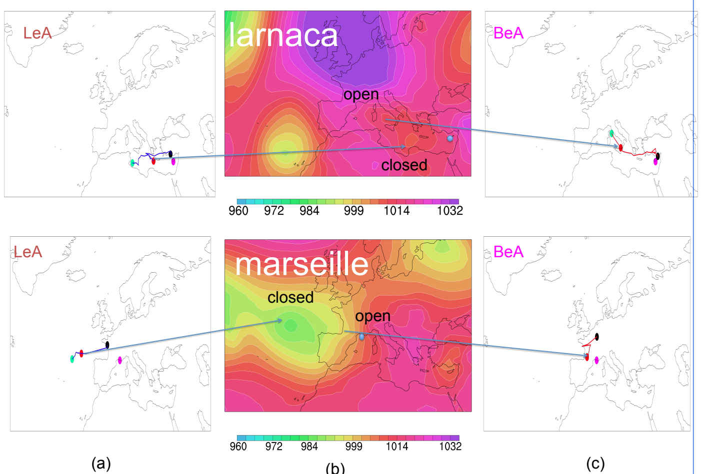

Fig. 5 Cyclone tracks LeA (a) and BeA (c) corresponding to storms producing extreme precipitation in the MR. Red dot: location of storm at time with maximum intensity of precipitation. Green dot: cyclogenesis , Black dot : cyclolysis ; Fucshia dot : location where precipitation has been recorded (b) SLP field in hPa at 12 UTM in the day of maximum intensity of event. Light blue dot : location where precipitation has been recorded

- Different approaches in cyclones identification lead in some cases to attribute the same extreme event to two different cyclones nearby the location where the event has been recorded. Tracks , obviously, are characterized by different length , starting and ending point

The IMILAST team(3): Mirseid G. Akperov and I. Mokhov, A.M. Obukhov Institute of Atmospheric Physics Moscow; Rasmus Benestad and Ina Kindem, Norwegian Met. Office, Oslo; Richard Blender, University of Hamburg; Rodrigo Caballero, University of Stockholm; Sergey Gulev, Natalia D. Tilinina, and Irina Rudeva, P.P. Shirshov Institute of Oceanology, Moscow; John Hanley, University of Dublin; Tim Hewson, ECMWF Reading; Kevin Hodges and Helen Dacre, University of Reading; Masaru Inatsu, Hokkaido University; Kevin Keay and Ian Simmonds, University of Melbourne; Sarah F. Kew, KNMI De Bilt; Gregor C. Leckebusch and Uwe Ulbrich, Freie Universität Berlin; Margarida Liberato, University of Tras-os-Montes e Alto Douro; Piero Lionello, Marco Reale and Angela Cocozza, University of Salento; Urs Neu, Swiss Academy of Sciences; Christoph C. Raible, University of Bern; Isabel Trigo, University of East Anglia; Sven Ulbrich and Joaquim Pinto, University of Köln; Xiaolan L. Wang and Yang Feng, Environment Canada; Heini Wernli, Michael Sprenger, and Cornelia Schwierz, ETH Zürich; Lan Xia and Hans von Storch, GKSS Geesthacht