A Cyclone tracking climatology for characterisation of wind events with the ERA-*Interim* reanalysis

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Overview

1. Context
2. Cyclone tracking
3. ERA-I cyclone climatology
   - Comparison with ERA40
   - High intensity cyclones over the Mediterranean
4. Wind properties along cyclone tracks
5. Conclusion
Cyclone tracking


- Mediterranean cyclones main characteristics (versus Atlantic):
  - Smaller spatial extension,
  - Shorter life cycle.
ERA-I reanalysis data

ERA-I orography
Tracking algorithm (F. Ayrault 2000)
Relative Vorticity at 850hPa

INPUT DATA:
\( \zeta \) at 850 hPa
U,V at 850 and 700 hPa
1,5\(^\circ\) x 1,5\(^\circ\), 6hours

SMOOTHING
\( \zeta \)

STEP 1
DETECTION
\( \zeta \) maxima

STEP 2
INITIAL PAIRING
similarity criterion \( \zeta \)

STEP 3
TRACKS REFINING
2nd motion criterion

GUESS

OUTPUT
Tracks

Feedback loop
Comparison with ERA40 tracking

- Cyclones maximum vorticity distribution

Tracks with VOx > 1E-4 s⁻¹ ⇔ Lows (MSLP < 1015hPa)
Cyclone activity in the Mediterranean
Most intense cyclones with max in MED2

Vox > 1.E-4 s$^{-1}$

ERA-I 1989-2009

ERA-40 1982-2002
Cyclones wind environment

- ERA-I 10m average winds (Lat-lon 0.5° grid).
  - Some works using ERA-I winds are in progress, but no validation study at this time.
Wind compositing along the cyclones tracks

\[ \zeta_r = 0.8 \times 10^{-4} \text{s}^{-1} \]

\[ \zeta_r = 1.2 \times 10^{-4} \text{s}^{-1} \]

\[ \zeta_r = 1.7 \times 10^{-4} \text{s}^{-1} \]

\[ \zeta_r = 2.1 \times 10^{-4} \text{s}^{-1} \]

\[ \zeta_r = 4.0 \times 10^{-5} \text{s}^{-1} \]

\[ \zeta_r_{\text{maxima}} \]

- Ring composite (FF):
  - Absolute maximum value
  - Max. average composite
  - Mean value composite
ERA-I 10M-Winds cyclones composites

ATL

MED2
Wind spatial distribution for cyclones VOx in MED2
Wind spatial distribution for cyclones VOx in MED2

FFx distance ranges to the cyclone position:

- $R < 300$ kms
- $300 \text{km} < R < 600$ kms
- $600$ kms $< R$

Winds max within a $> 600$ kms distance to cyclone VOx
Intense Winds (> 15m.s\(^{-1}\)) vectors composites for cyclones with VOx in MED3
Intense Winds (> 15m.s\(^{-1}\)) vectors composites for cyclones with VOx in MED3

Winds max within a >600kms ring from cyclone VOx
CONCLUSIONS

- ERA-Interim provides a refined framework to study the structure of mediterranean stormtrack,
- It improves the capacity to regionalise the properties of cyclones.
- A validation study should be held to evaluate the potential of description of cyclogenesis processes diagnosis.
- Most intense winds are gathered far from the cyclone center (with strong interaction with the local environment)
- We could expect cross-checking of this latter assumption by selecting cyclones related to local intense wind events.
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Tracking algorithm (F. Aryrault 2000)

INPUT DATA:
ζ, a 3850 hPa
U, V a 350 and 700 hPa
1.5° x 1.5°, 6 hours

SMOOTHING
ζ

STEP 1
DETECTION
ζ, maxima

STEP 2
INITIAL PAIRING
similarity criterion ζ

STEP 3
TRACKS REFINING
2nd motion criterion

2nd Motion criterion
Controling tracks acceleration
in a two-levels advection

GUESS

OUTPUT
Tracks
Cyclones with max in Medit and high vorticity

Tracks amplitude maximum location density for Vox > 1.E-4

ERA-I 1989-2009

ERA-40 1982-2002
« Validation » with ERA40 tracking

Tracks density

ERA-I 1989-2009

ERA-40 1982-2002
Cyclones with intense vorticity

ERA-I 1989-2009

ERA-40 1982-2002
Cyclones with max in MED2

Tracks density

ERA-I 1989-2009

ERA-40 1982-2002