Institute of Geophysics, University of Tehran, Iran

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The role of blocking in the structure of Mediterranean cyclones which affect Middle-East and Iran

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OUTLINE:

- *introduction*
- *Definitions*
- *Methodology*
- *Region of Interest*
- *Events of Interest and their Structures*
- *Analysis of Physical and Dynamical Model Outputs*
- *Conclusion*

BLOCKING

Atmospheric Blocking(Rex, 1950), at 500 mb:

- To Sprit the Atmospheric Flow into two Branches
- Carrying the Considerable air Mass in Each Branches
- To Spread the Jet in at least 45 degrees in the zonal Direction
- Converting the zonal Flow to Meridional Flow
- At least 10 Days period

Blocking

Main Locations:

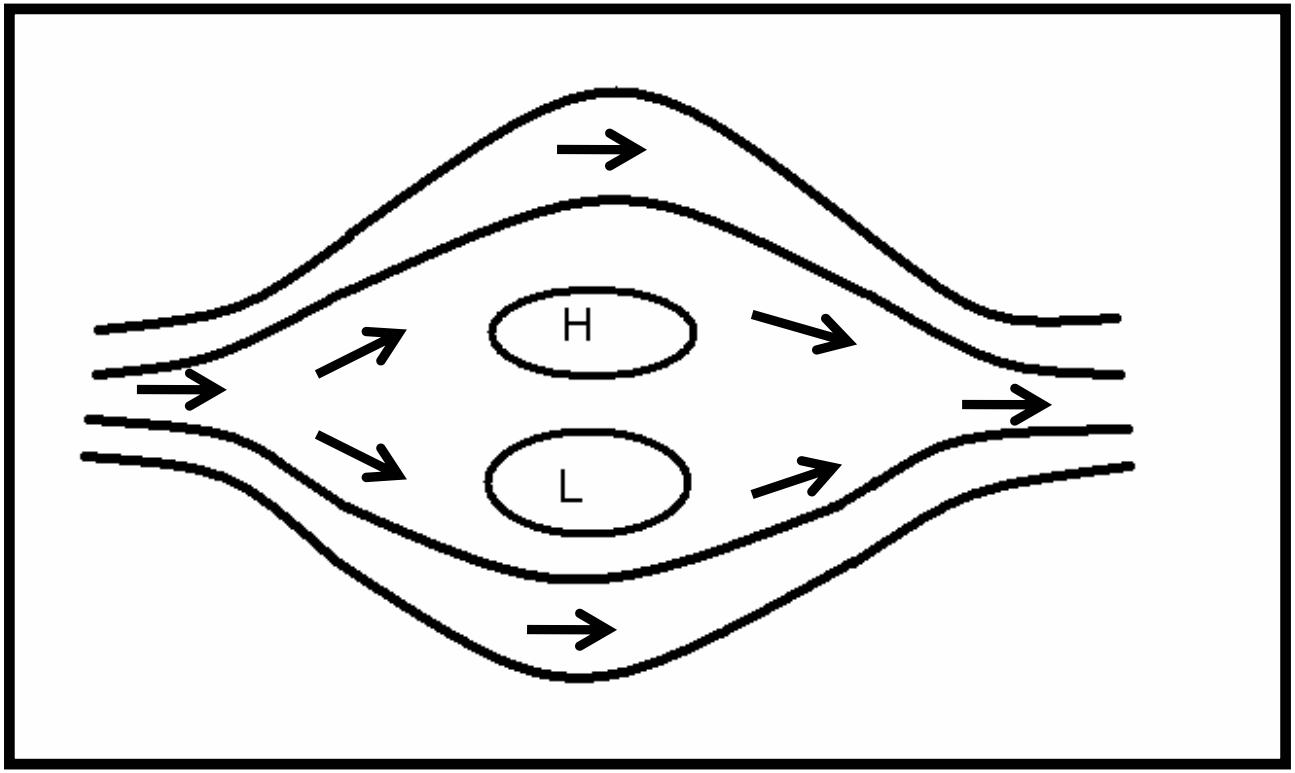
- Atlantic Ocean
- Pacific Ocean
- Europe

Period Time:

- One Week to One month

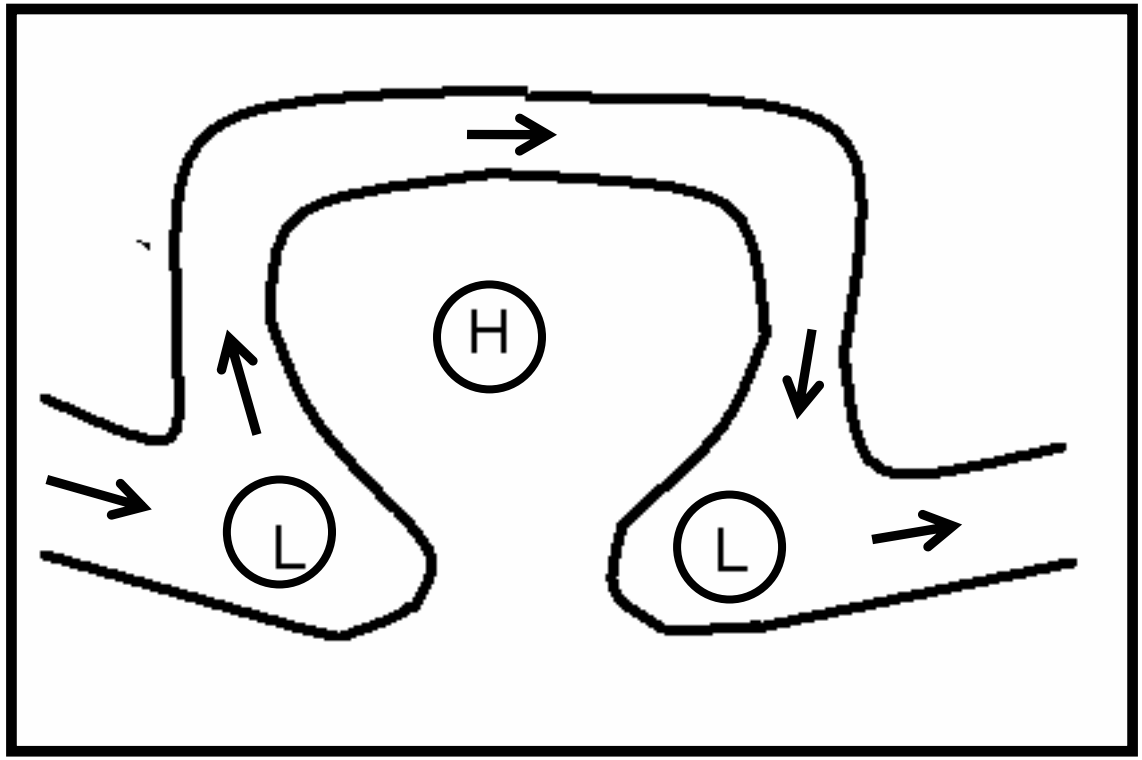
Types of Blocking Events:

- Dipole Block



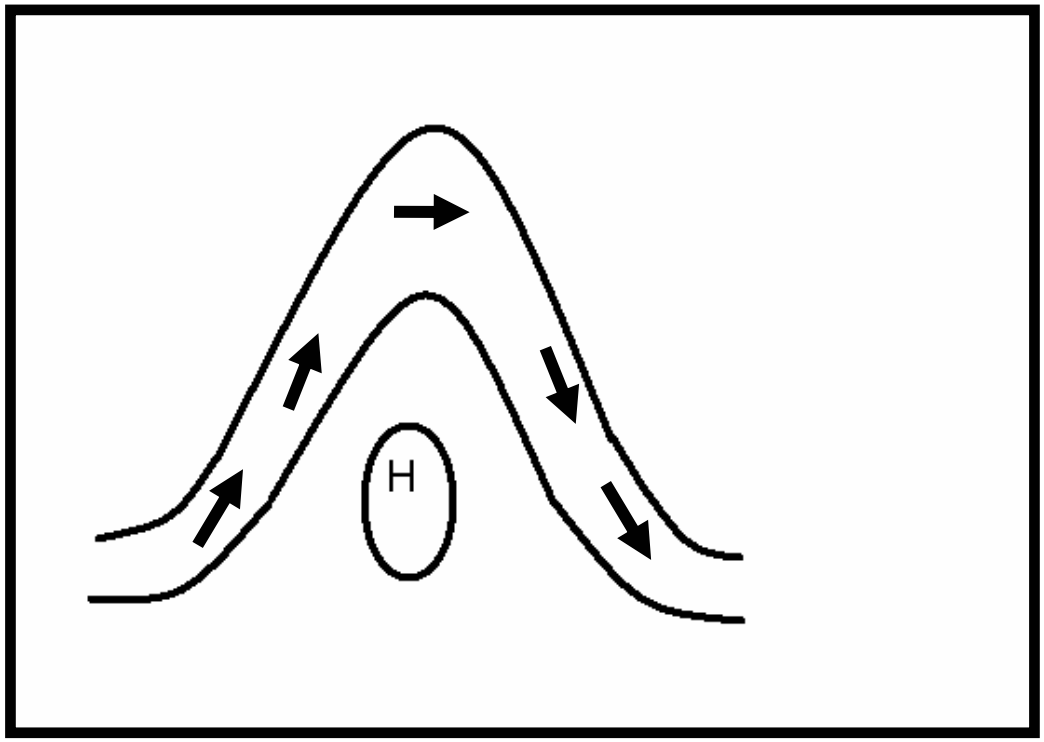
Types of Blocking Events:

- Omega Block



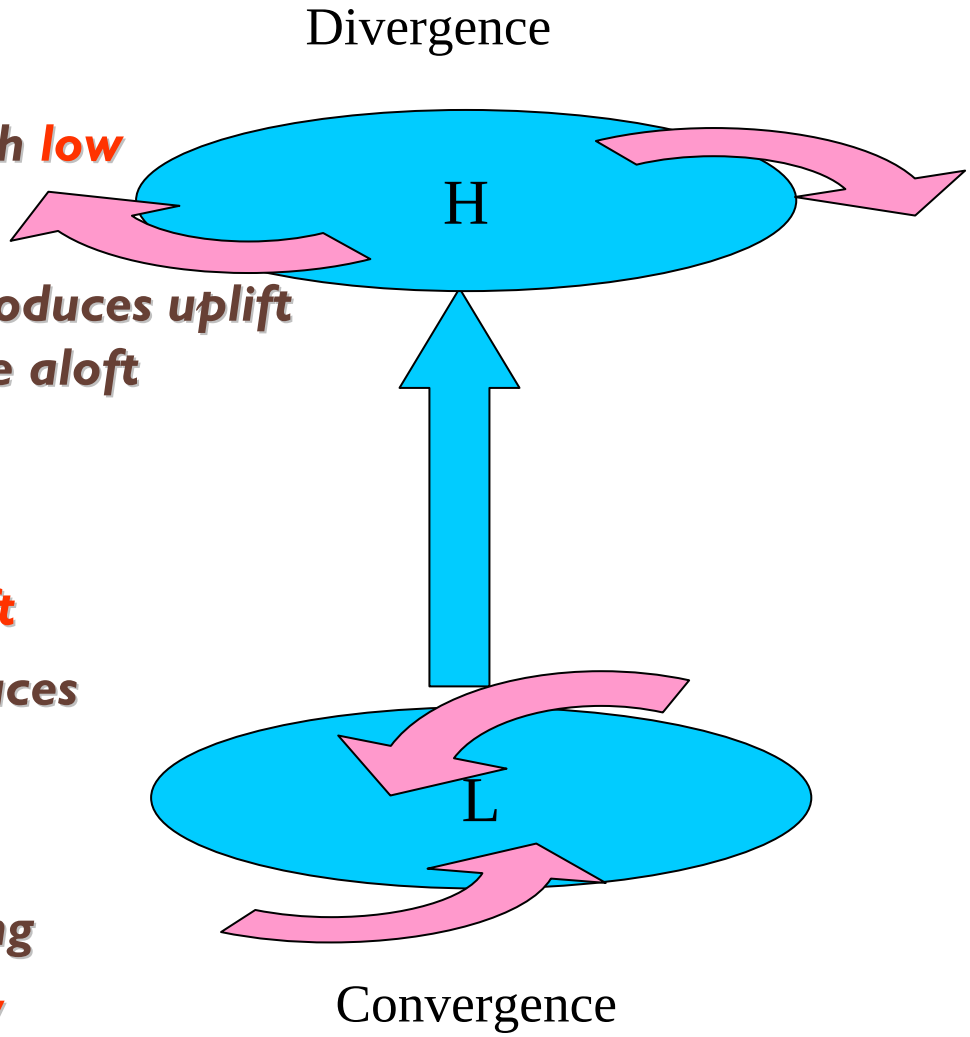
Types of Blocking Events:

- Stationary, high-amplitude ridge block



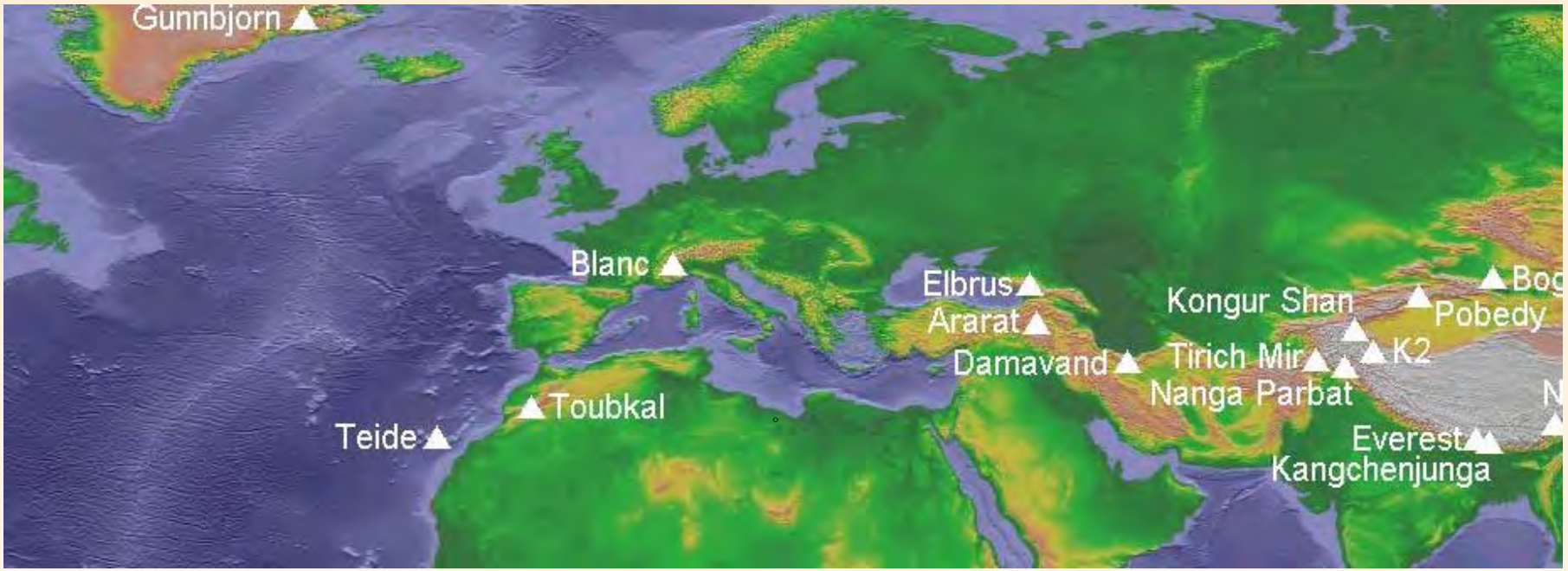
Cyclones

- Cyclones are associated with low pressure centers
- The related convergence produces uplift in the center and divergence aloft
- As we know, divergence is associated with high pressures, i.e., we find high pressures aloft
- Remember uplift also produces adiabatic cooling
- Low pressures are typically associated with weather ranging from mild cloud cover to heavy precipitation

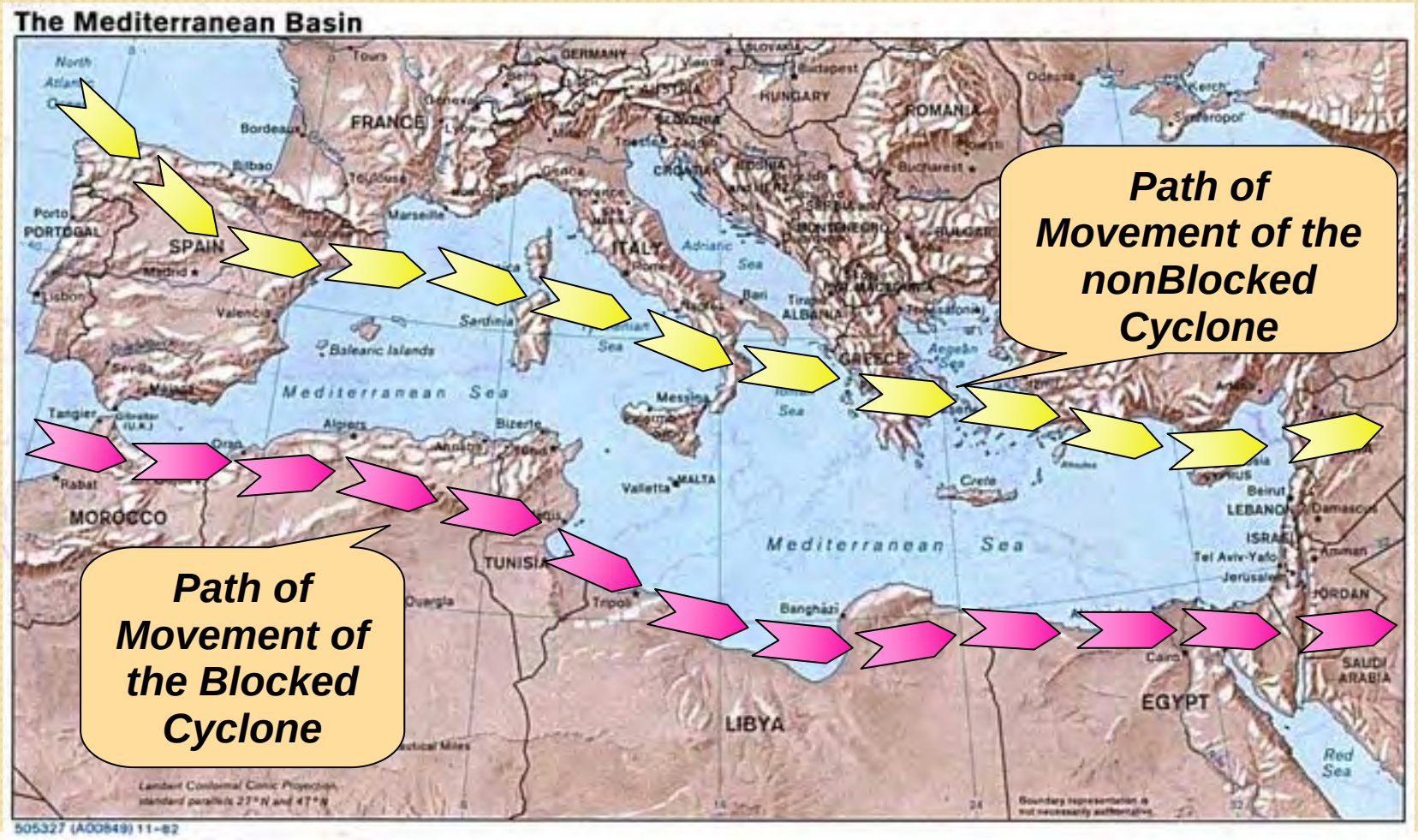


Methodology

- Analysis of surface and Upper Level synoptic maps During the Wintertime from 2004 to 2007
- Detecting the Region of Interest
- Selecting Two Cyclonic Systems (One in the presence and another in the Absence of blocking)
- Running MM5 Model, Using GFS Data
- Analysis of Physical and Dynamical MM5 Outputs



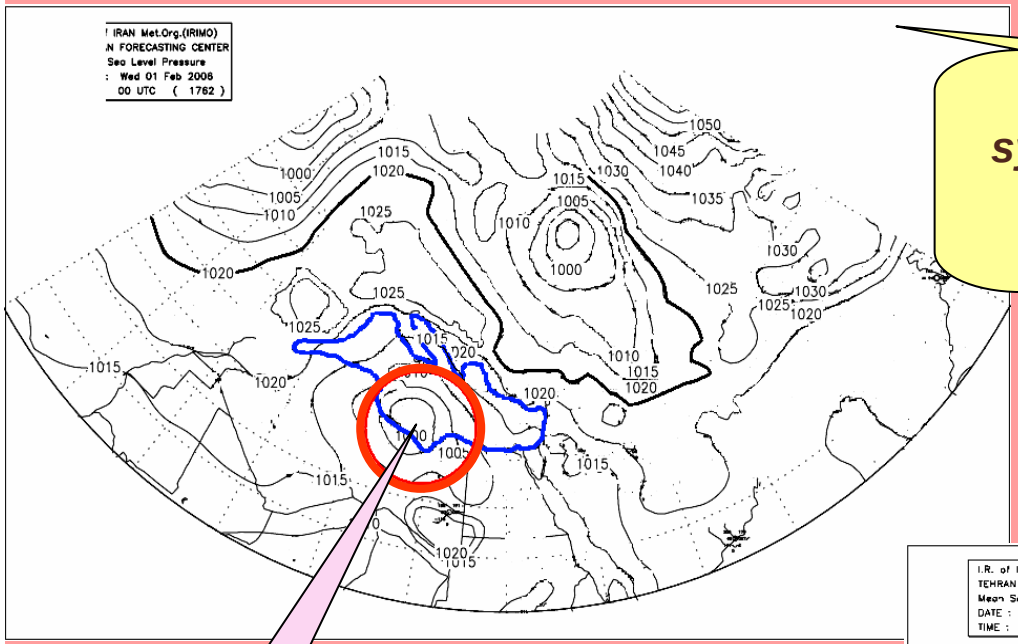
Region of Interest: 30 W- 90 E, 15 N- 65N



In the Presence of Blocking: Formation on 26 January 2006, Period: 11 days

In the Absence of Blocking: Formation on 8 February 2007 , Period: 6 days

Analysis of Synoptic Surface maps

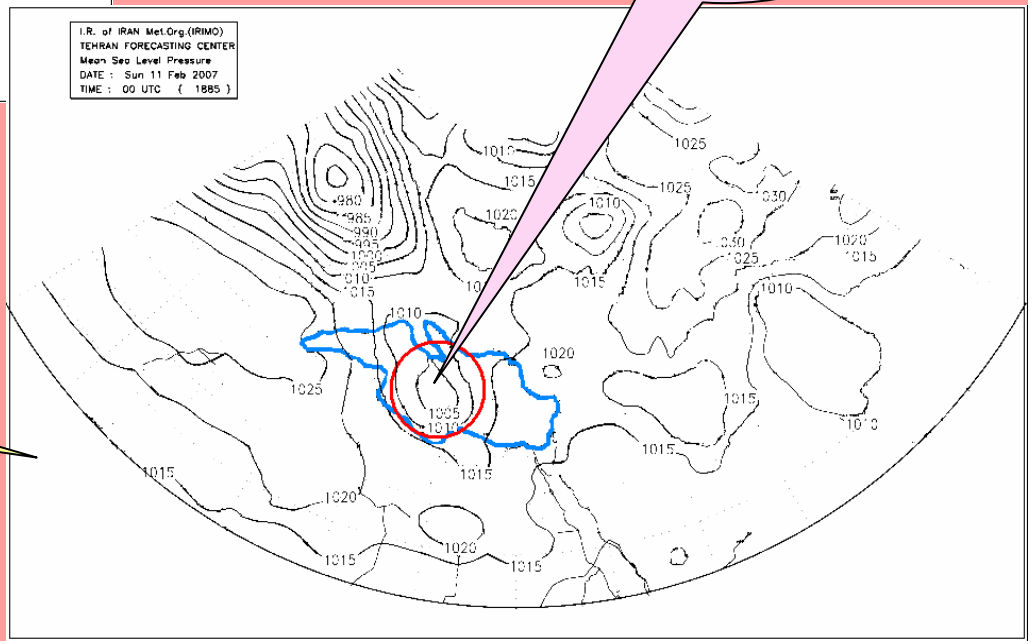


Mean Sea Level synoptic map at the Mature Stage of blocked- cyclone

1005*hPa*

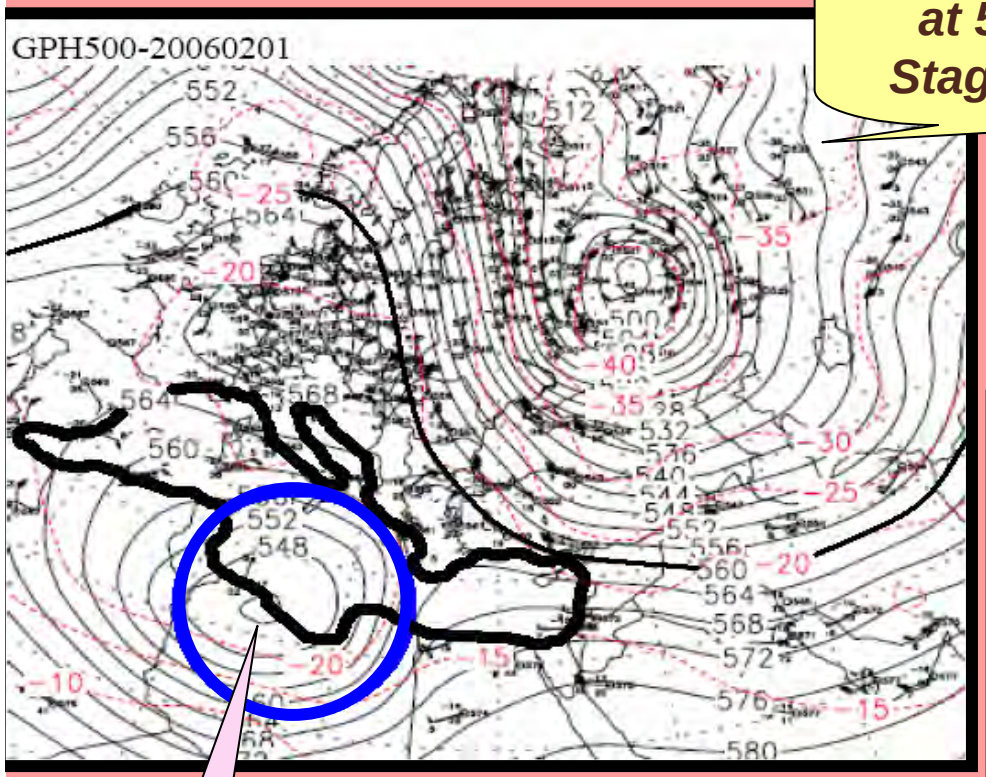
1000*hPa*

Mean Sea Level synoptic map at the Mature Stage of nonblocked- cyclone

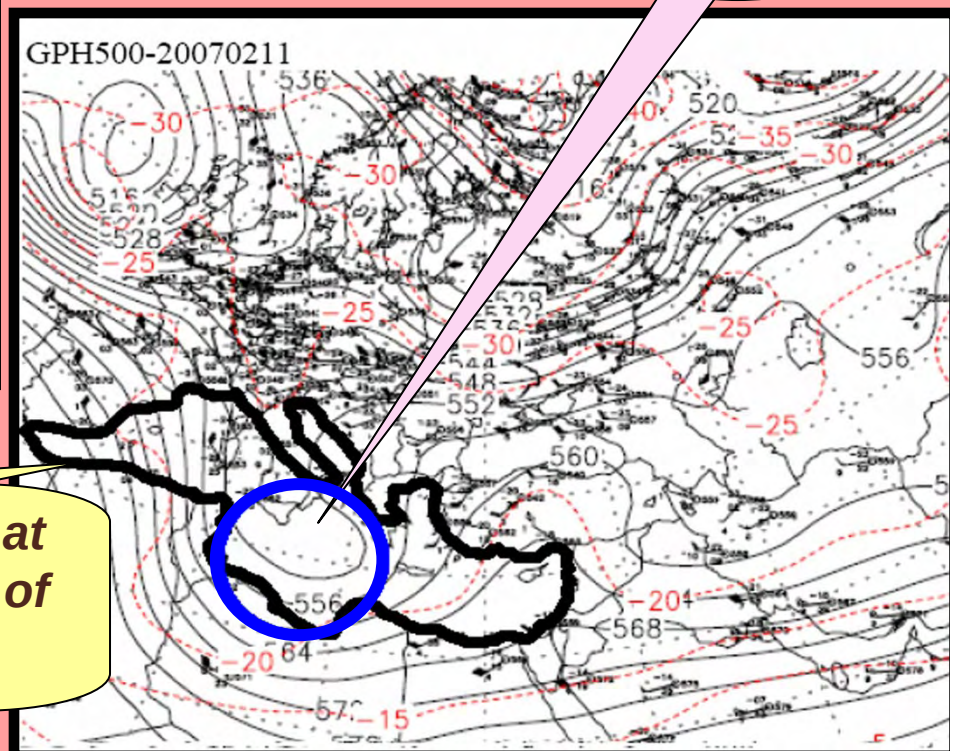


Analysis of Geopotentail synoptic maps

Geopotentail synoptic map at 500 mb at the Mature Stage of blocked- cyclone



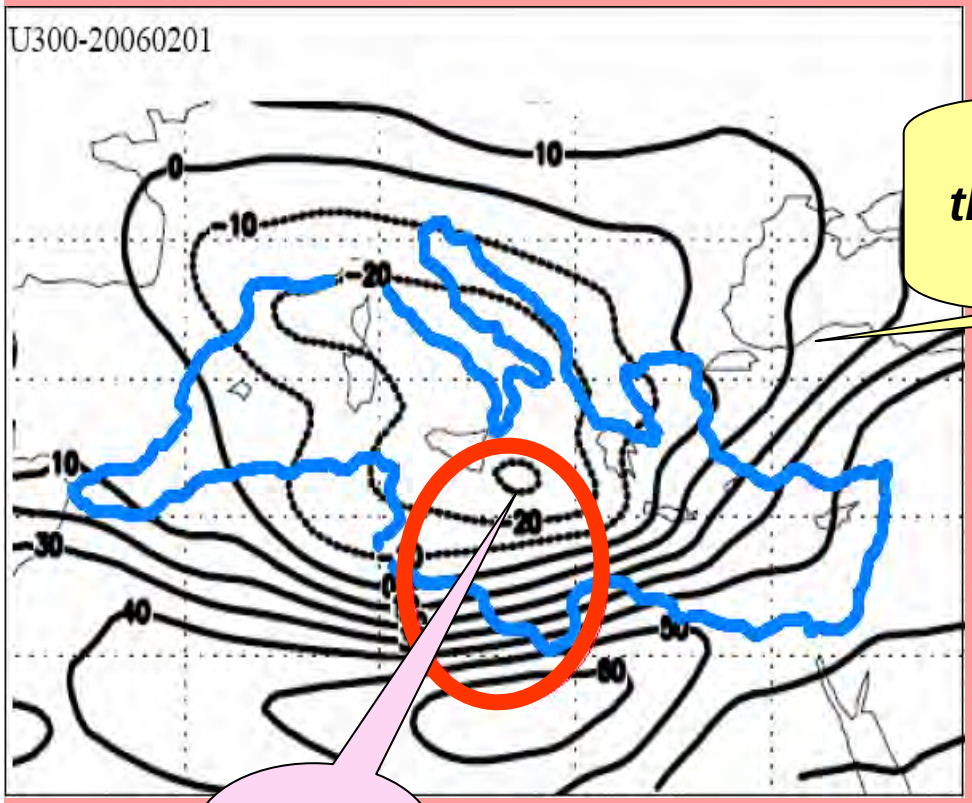
552*dm*



544*dm*

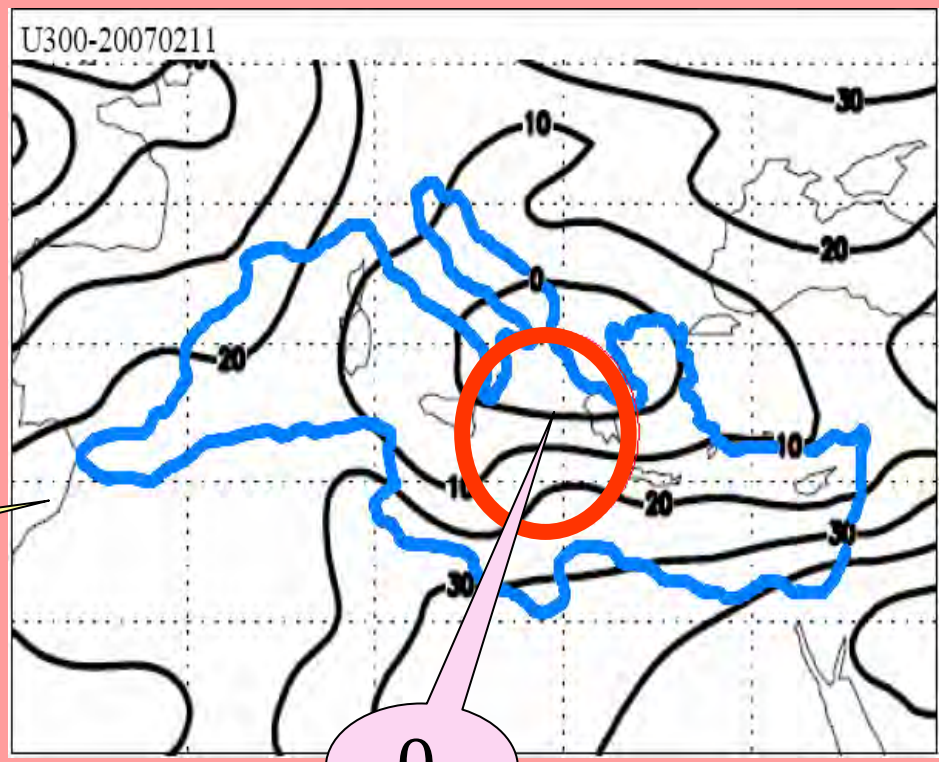
Geopotentail synoptic map at 500 mb at the Mature Stage of nonblocked- cyclone

Zonal Component of Horizontal wind Speed (u)



"u" Field at 300 mb at the Mature Stage of the Blocked Cyclone

$-30ms^{-1}$

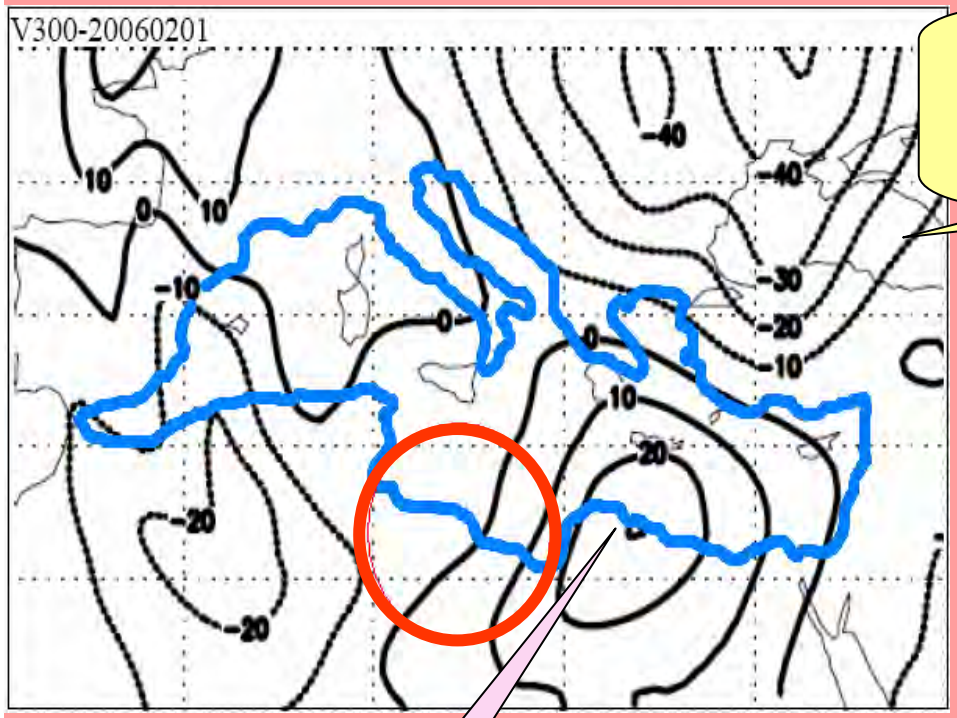


"u" Field at 300 mb at the Mature Stage of the non-Blocked Cyclone

0

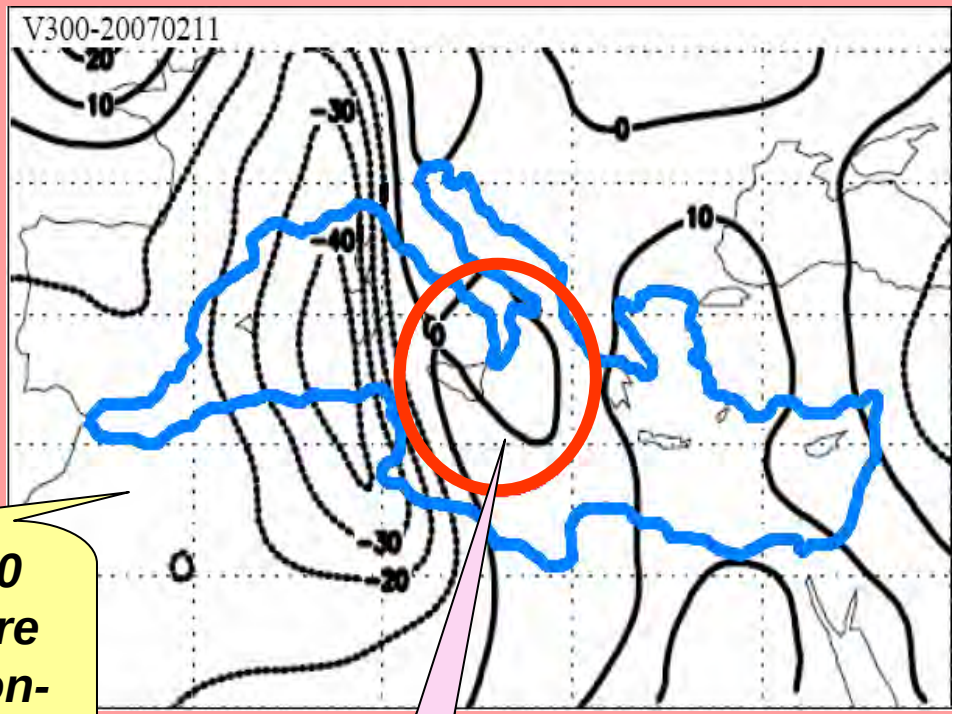
Generation of Easterlies…

Meridional Component of the horizontal Wind Speed (v)



"v" Field at 300 mb at the Mature Stage of the Blocked Cyclone

$30ms^{-1}$



"v" Field at 300 mb at the Mature Stage of the non-Blocked Cyclone

$10ms^{-1}$

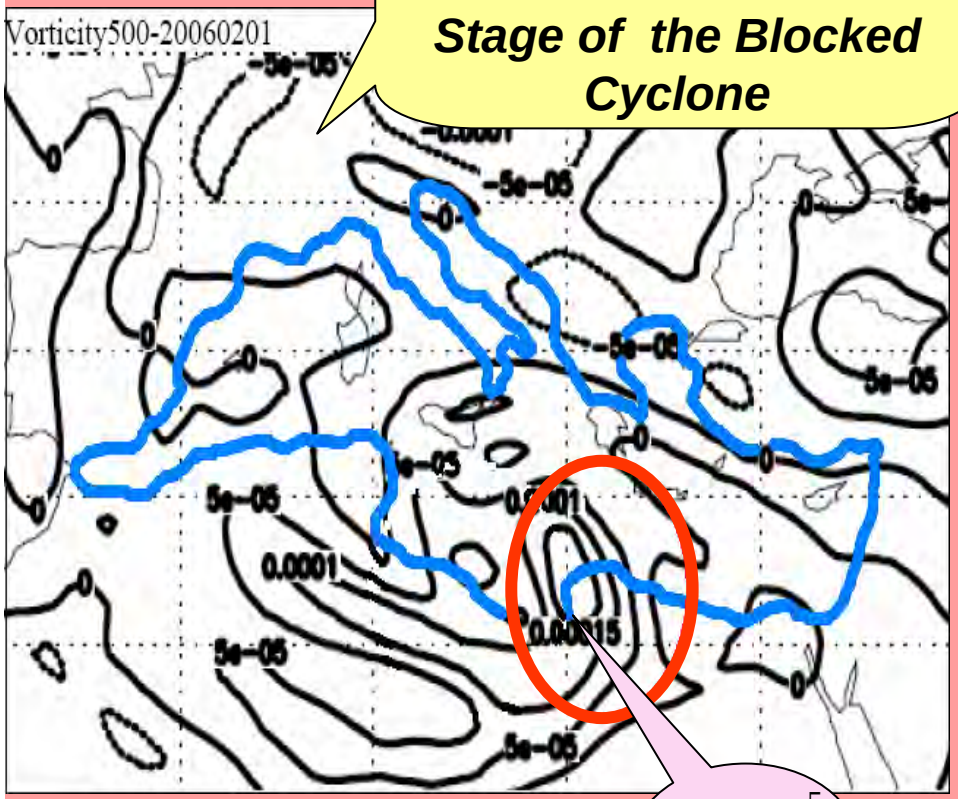
✓ *More Intense Southerlies and Temperature Advection*

$$-\vec{V}.\nabla T = -(u\frac{\partial T}{\partial x} + v\frac{\partial T}{\partial y})$$

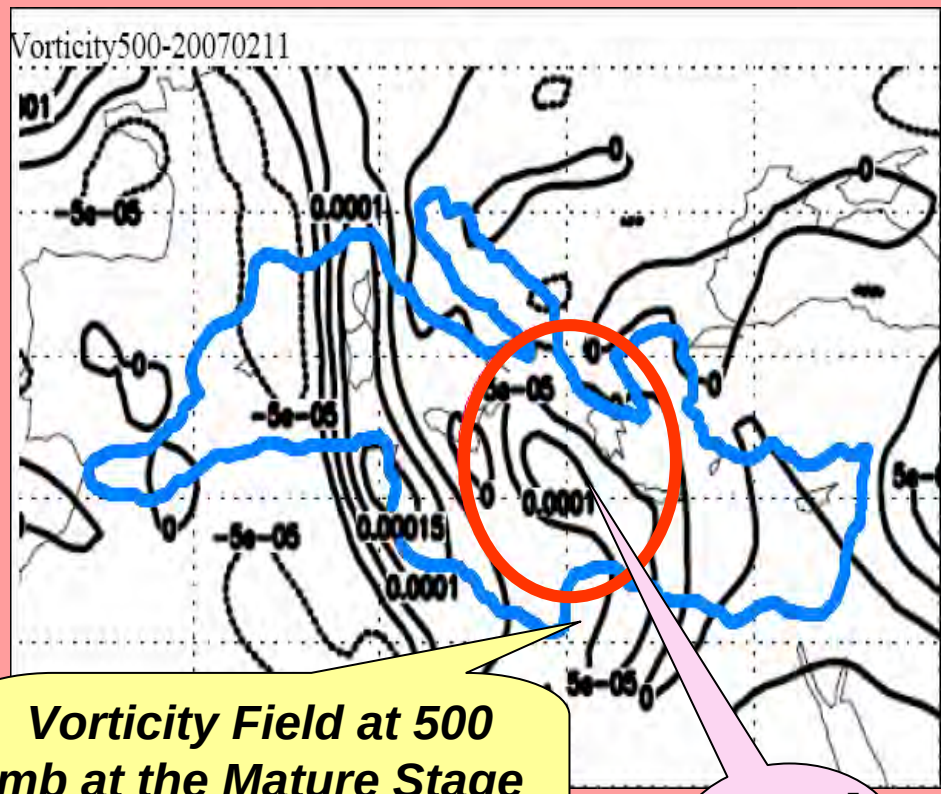
Vertical Component of the Relative Vorticity

Vorticity Field at 500 mb at the Mature Stage of the Blocked Cyclone

$$\xi = \left(\frac{\partial v}{\partial x} - \frac{\partial u}{\partial y}\right)$$



1.5×10^{-5} s^{-1}



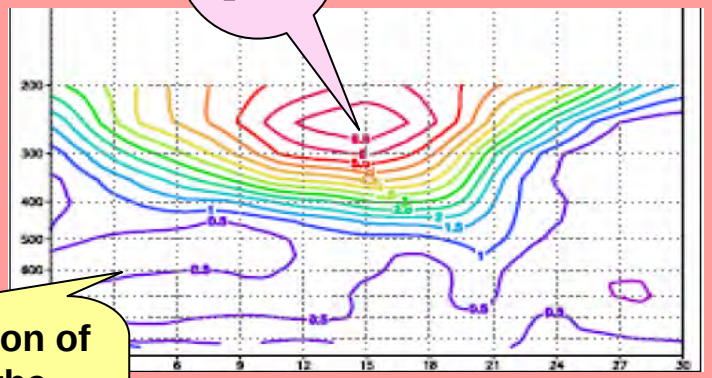
Vorticity Field at 500 mb at the Mature Stage of the Blocked Cyclone

1×10^{-5} s^{-1}

✓ *More Intense Relative Vorticity*

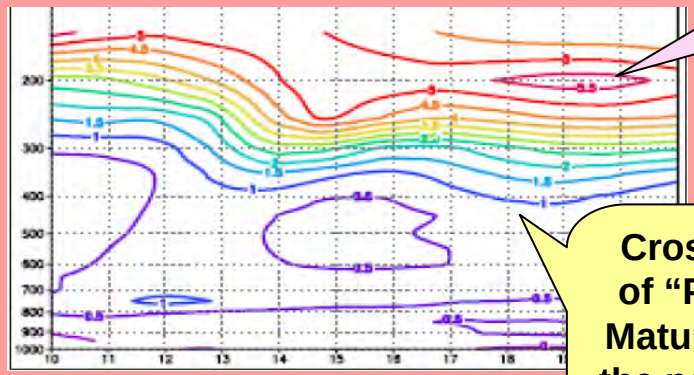
Potential Vorticity and Potential Temperature

6.5 pvu

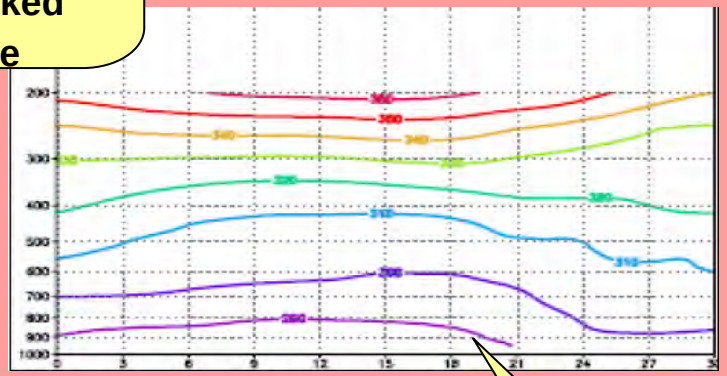


Cross-section of "PV" at the Mature Stage of the Blocked Cyclone

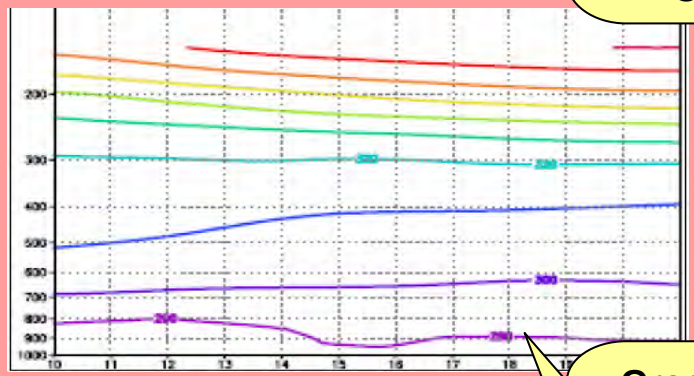
5.5 pvu



Cross-section of "PV" at the Mature Stage of the non-Blocked Cyclone



Cross-section of "th" at the Mature Stage of the Blocked Cyclone

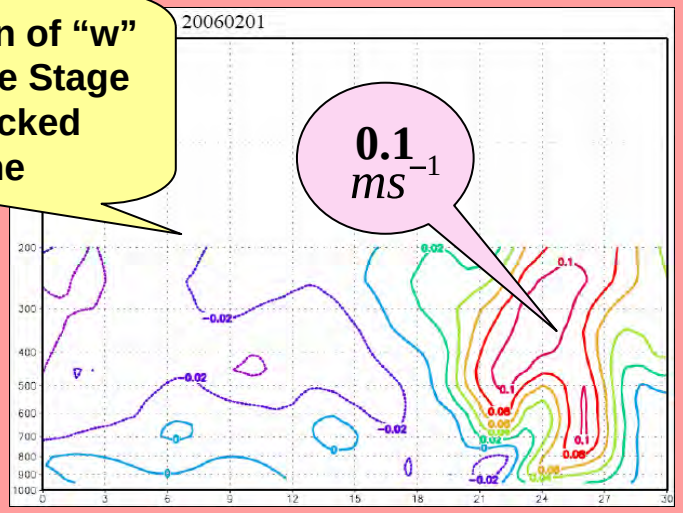


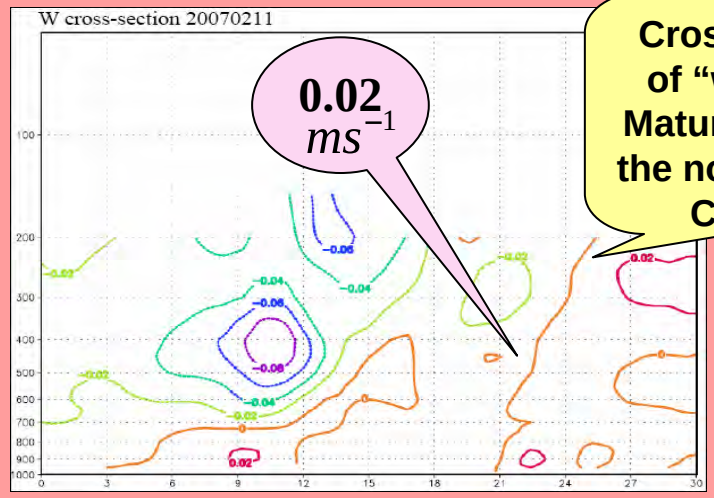
Cross-section of "th" at the Mature Stage of the nonBlocked Cyclone

$$PV = \frac{1}{\rho}\xi\frac{\partial\theta}{\partial Z}$$

Vertical Motion and Relative Humidity

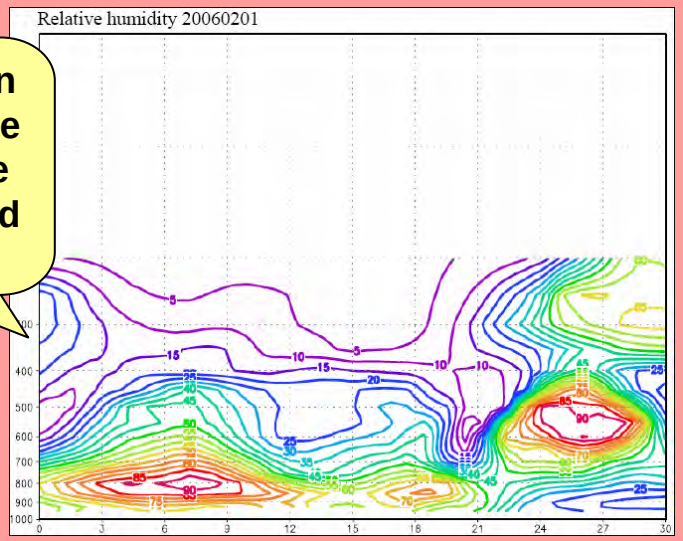
Cross-section of "w" at the Mature Stage of the Blocked Cyclone

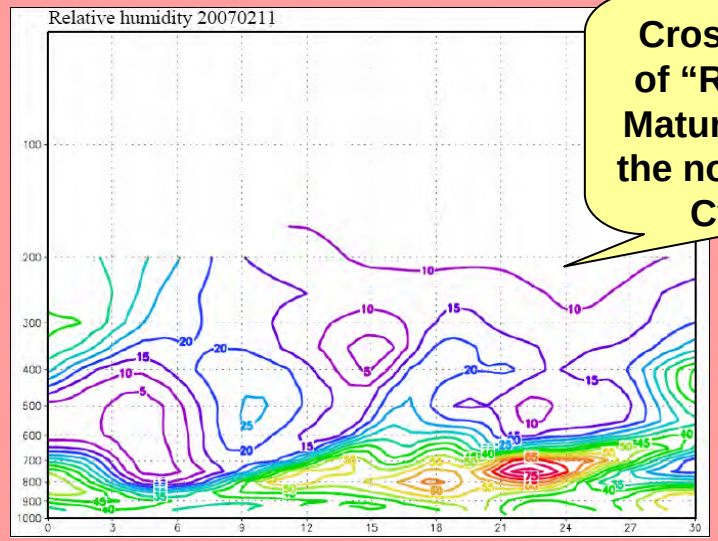




Cross-section of "w" at the Mature Stage of the non-Blocked Cyclone

Cross-section of "RH" at the Mature Stage of the Blocked Cyclone





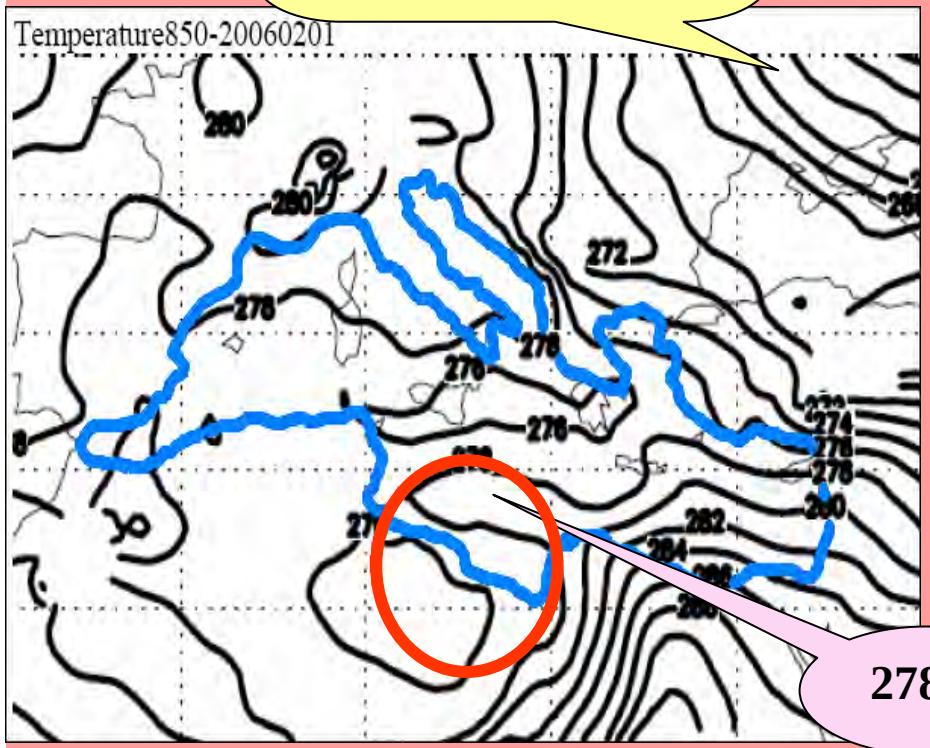
Cross-section of "RH" at the Mature Stage of the non-Blocked Cyclone

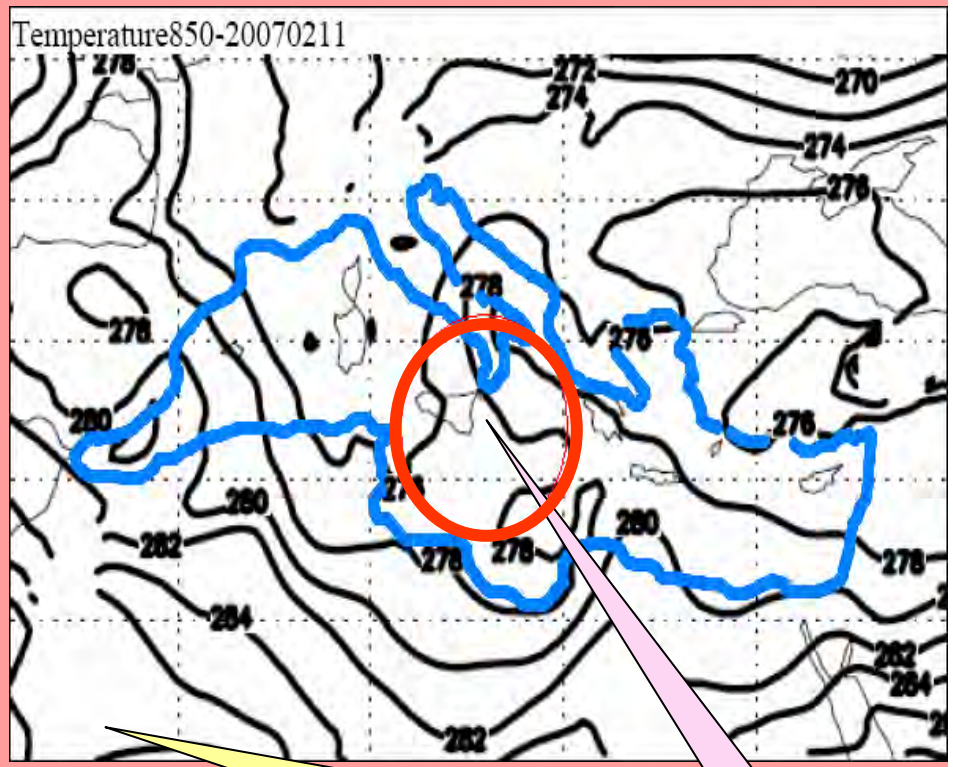
✓ *More Intense Vertical Motion and Relative Humidity*

$w \propto$ Temperature Advection

Temperature

Temperature Field at 850 mb at the Mature Stage of the Blocked Cyclone





Temperature Field at 500 mb at the Mature Stage of the non-Blocked Cyclone

✓ ***No Difference in the Temperature Fields of Cyclones in This Case Study***

Conclusions

The Role of Blocking on Cyclogenesis:

- Longer Cyclones
- Migration in the Lower Latitudes
- Generation Easterlies and More Intense Southerlies
- Increscent in Relative Vorticity
- More Intense Warm Temperature Advection, Static Stability and PV
- Increscent in Vertical Motion and relative Humidity
- No difference in Temperature Fields

HISTORY OF STUDIES

- **Rex(1950):** Blocking action in the middle troposphere and its effect upon regional climate.
- **Petterssen(1956):** Weather Analysis and Forecasting.
- **Trigo et al. (1999):** Objective climatology of cyclones in the Mediterranean region
- **Maheraset al. (2001):** A 4 years objective climatology of surface cyclones in the Mediterranean region (Spatial and temporal distribution).
- **Barriopedro et al. (2006):** Climatology of Northern Hemisphere blocking.
- **Nasr Esfahani (2003):** A 1 year Analysis of cyclogenesis over eastern Mediterranean and its effects on Middle east and Iran weather.
- **Ahmadi Givi et al. (1385):** Climatology of Blocking (potential Vorticity Thinking).
- **Colucci (1986):** Comparative Diagnostic of Blocking Versus Nonblocking Planetary-Scale circulation changes during Synoptic-Scale Cyclogenesis.
- **Colucci and Alberta (1996):** Planetary-Scale Climatology of Explosive Cyclogenesis and Blocking.