

Copertina

Corso di Fisica dell'Atmosfera

Approccio unitario alla descrizione dei cicloni atmosferici

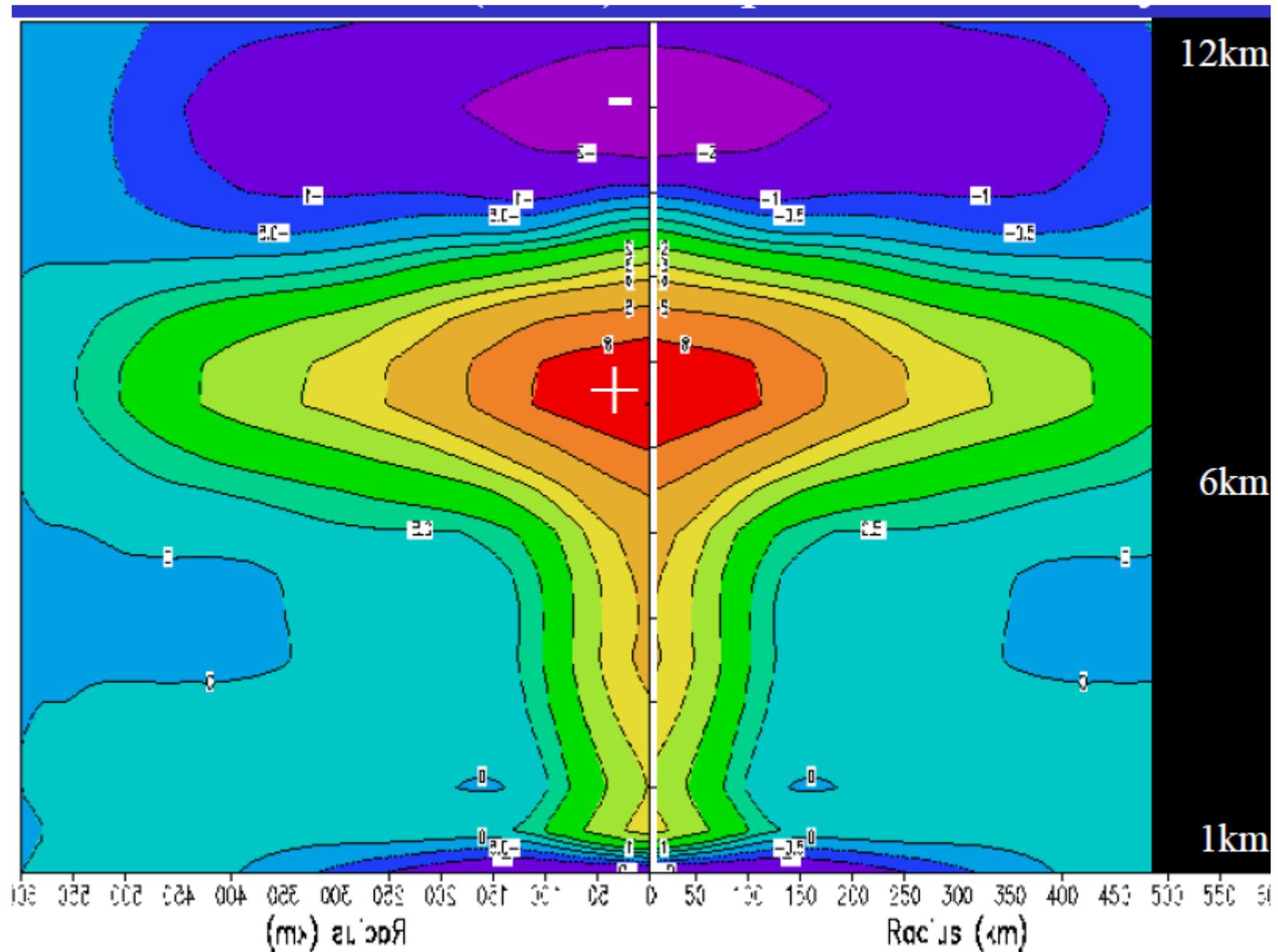
Giaiotti Dario

Sommario della lezione

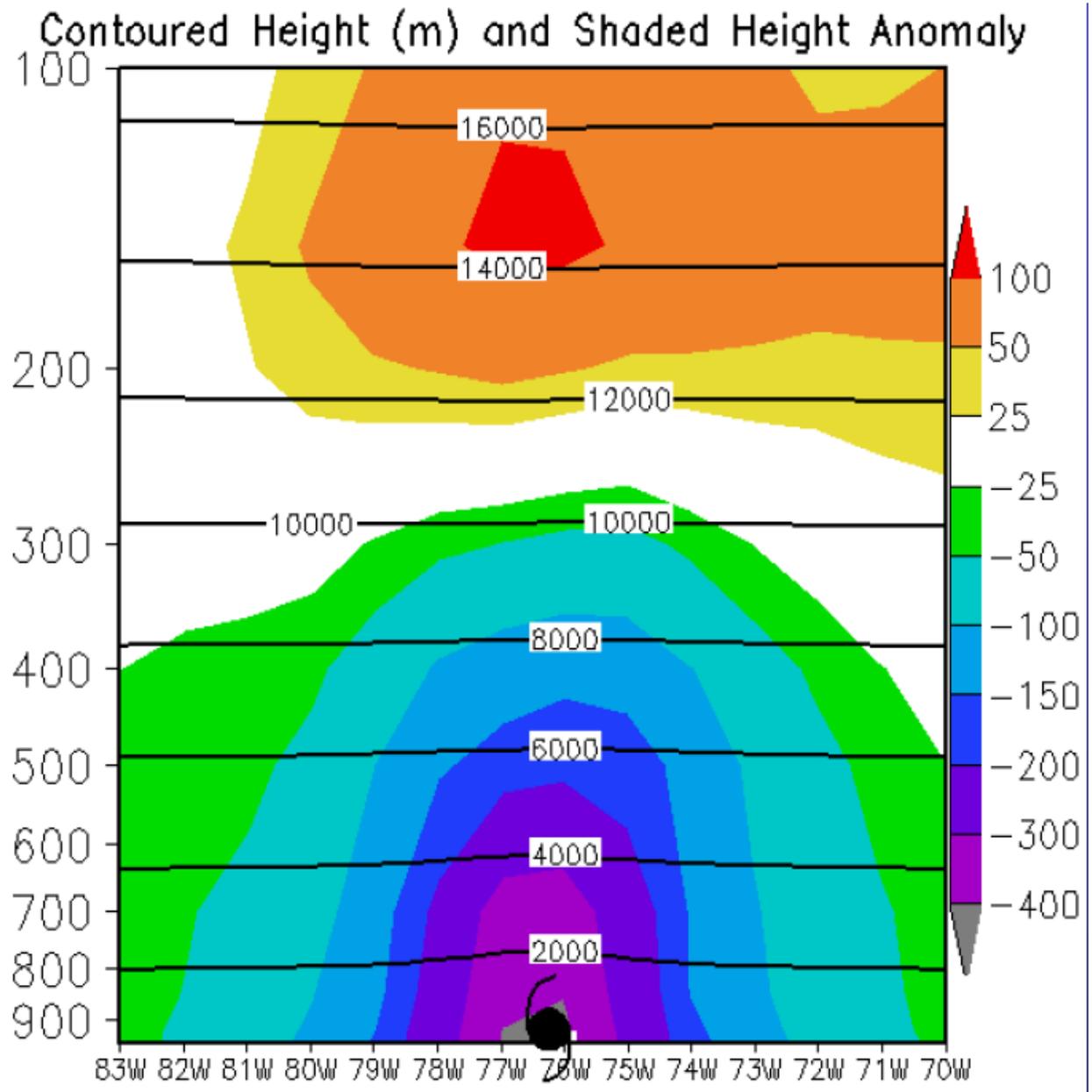
- Lo spazio delle fasi per una rappresentazione dell'evoluzione dei cicloni atmosferici
- Caratteristiche termiche e bariche dei cicloni tropicali
- Caratteristiche termiche e bariche dei cicloni extra tropicali
- Evoluzione di cicloni tropicali in extra tropicali



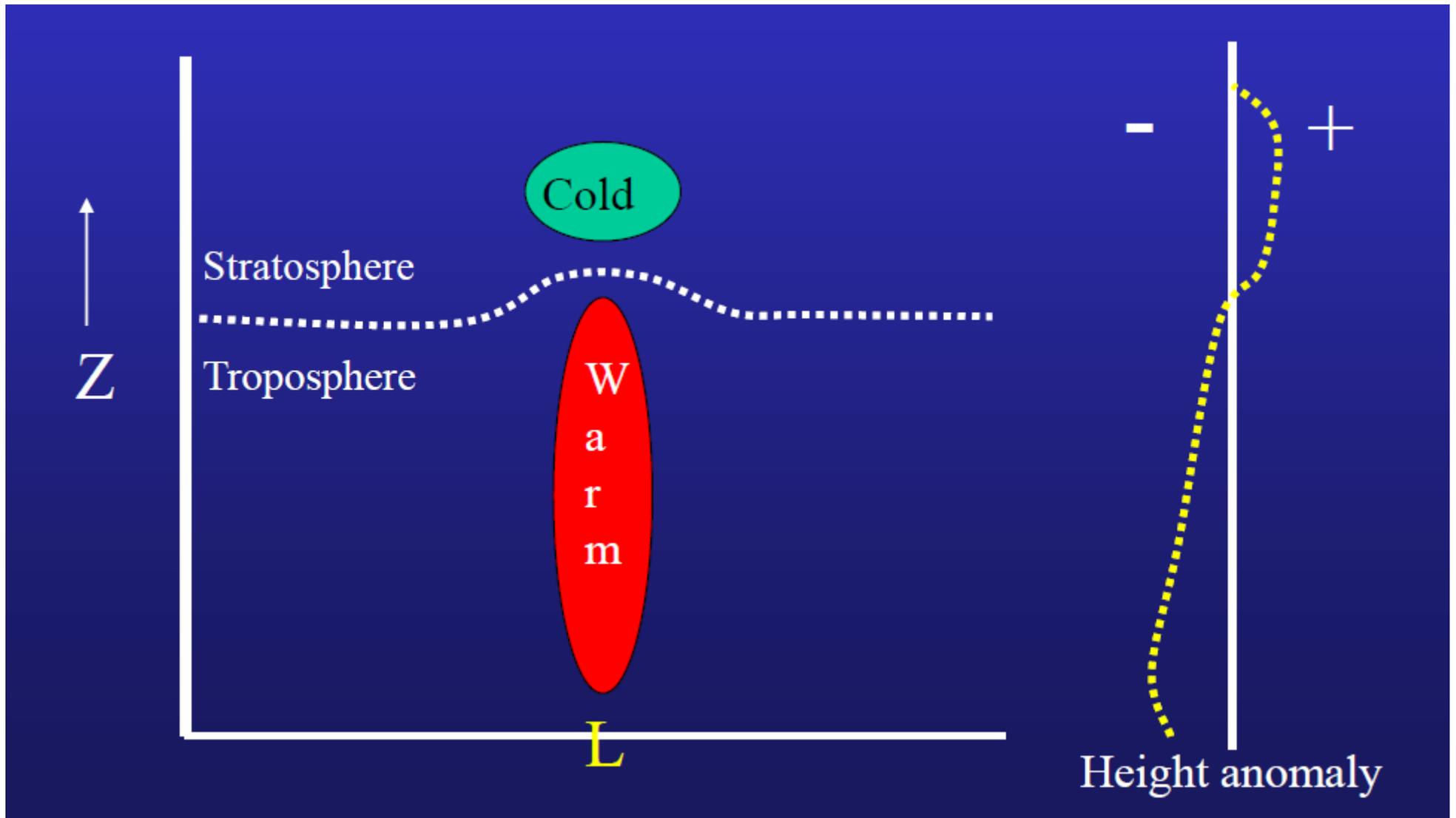
Cicloni tropicali ed extra-tropicali a confronto: ciclone tropicale a cuore caldo



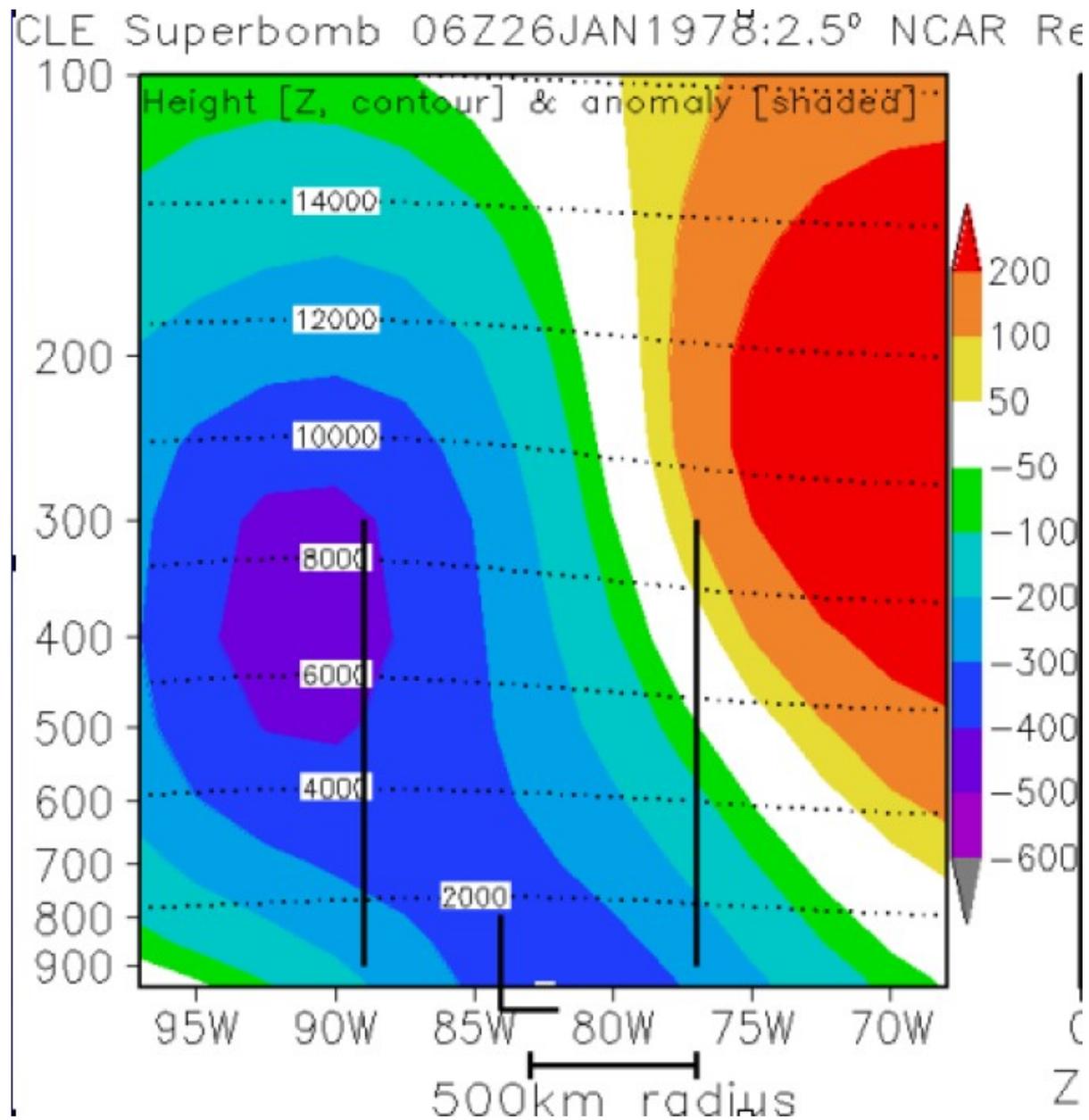
Cicloni tropicali ed extra-tropicali a confronto: ciclone a cuore caldo



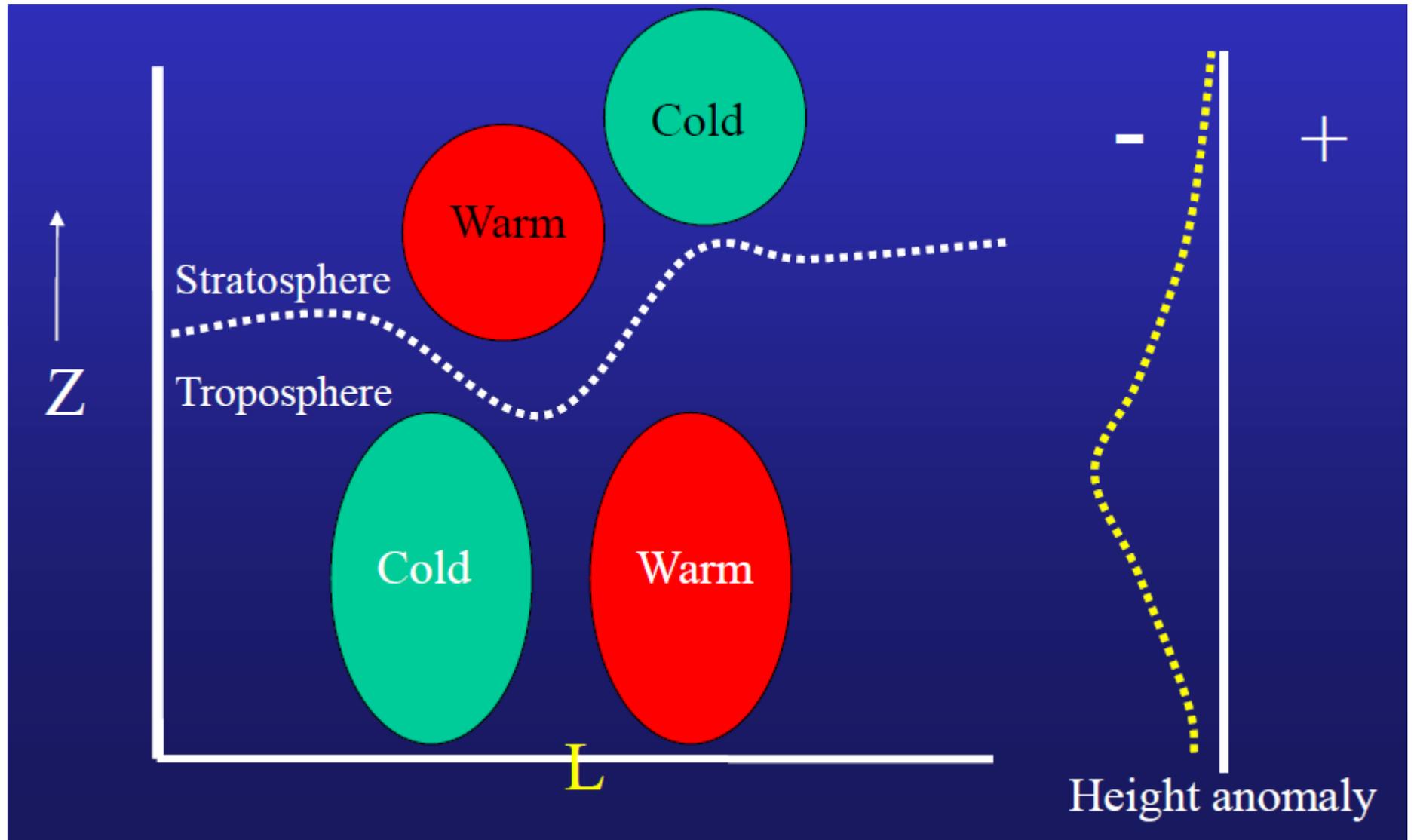
Cicloni tropicali ed extra-tropicali a confronto



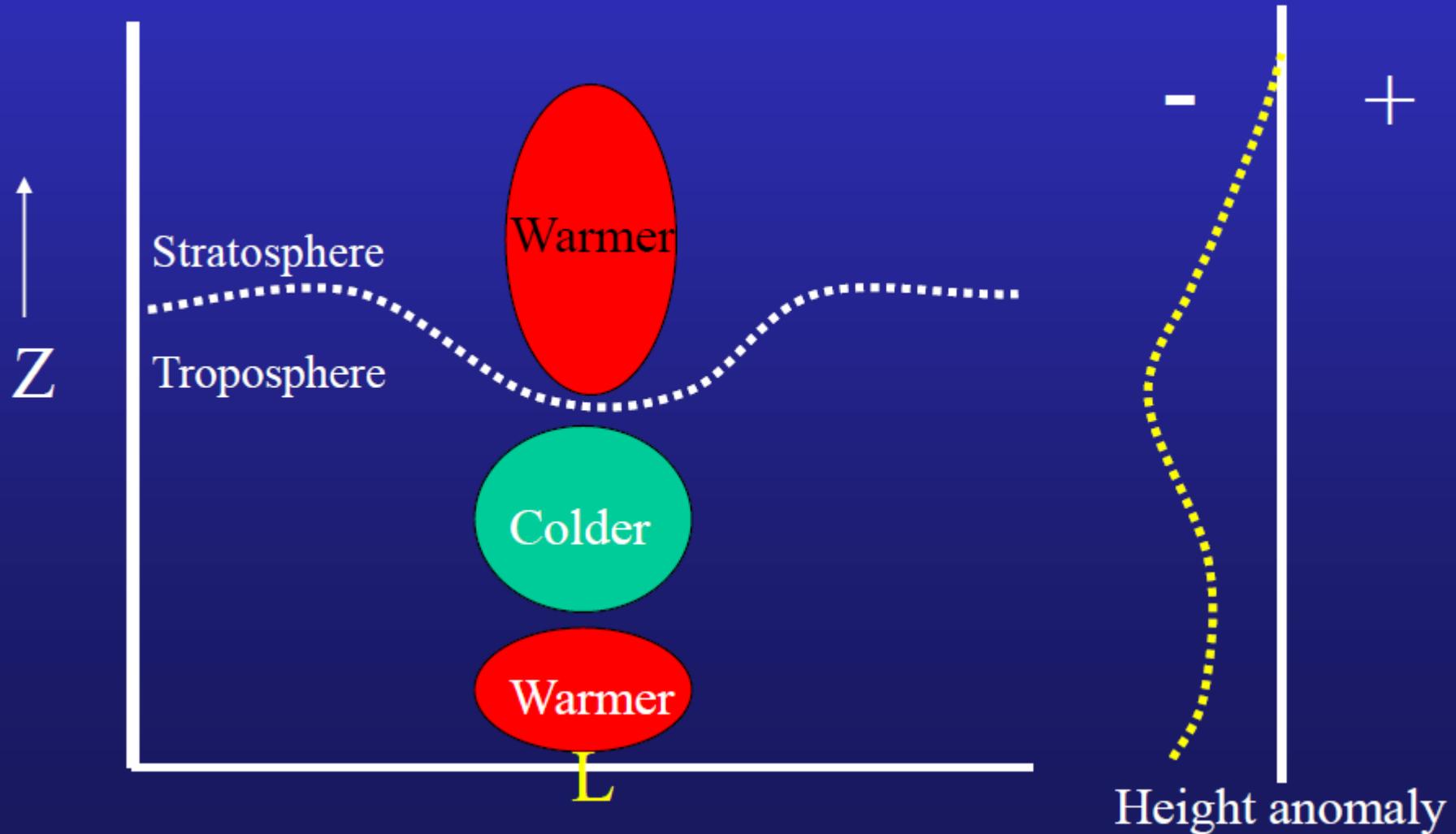
Cicloni tropicali ed extra-tropicali a confronto: ciclone a cuore freddo



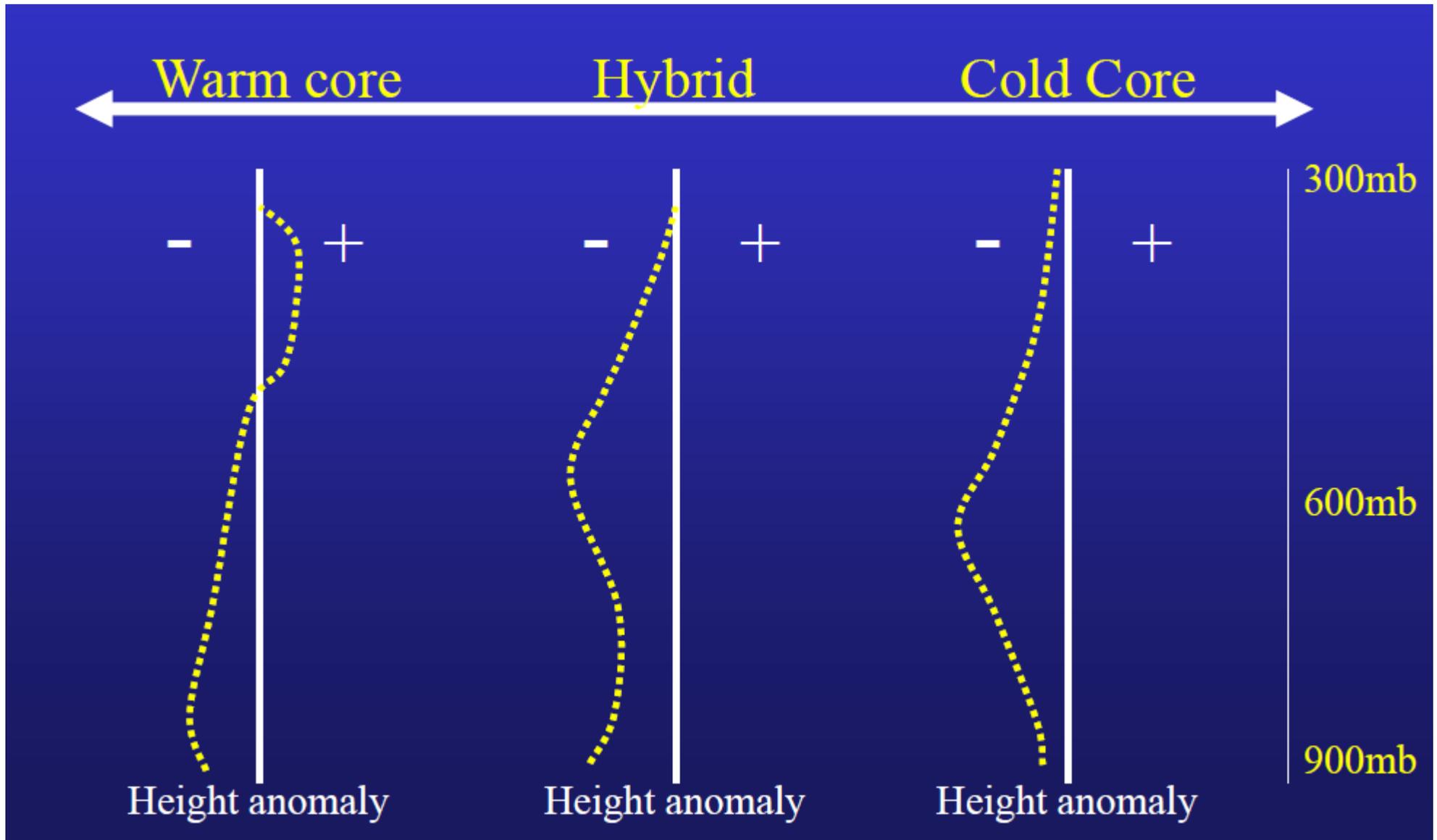
Cicloni tropicali ed extra-tropicali a confronto: ciclone a cuore freddo



Cicloni tropicali ed extra-tropicali a confronto: la transizione tra i due tipi

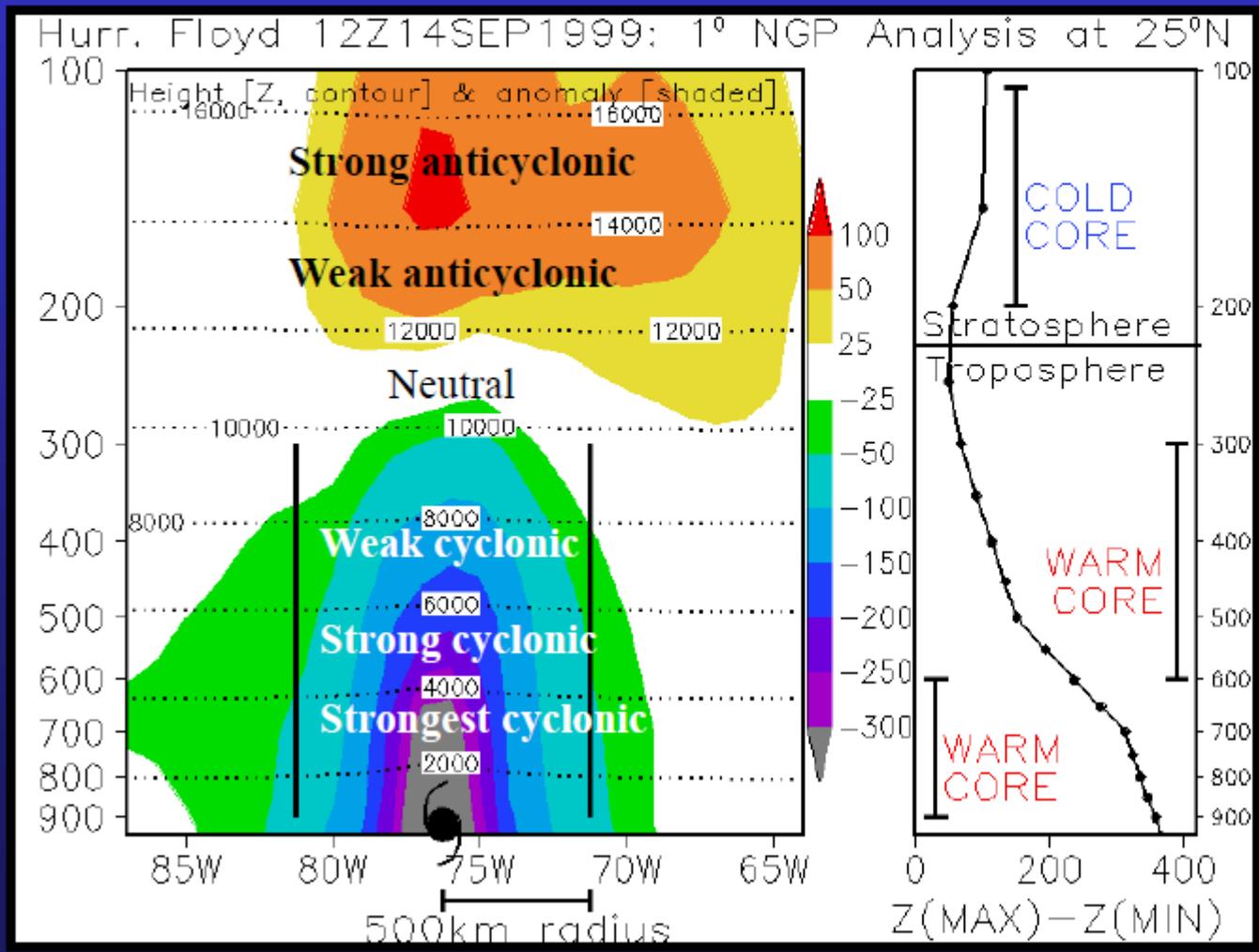


Cicloni tropicali ed extra-tropicali a confronto: anomalia di altezza geopotenziale



Cicloni tropicali ed extra-tropicali a confronto

Warm-core example: Hurricane Floyd 14 Sep 1999



Vertical profile of $Z_{MAX} - Z_{MIN}$ is proportional to thermal wind (V_T).

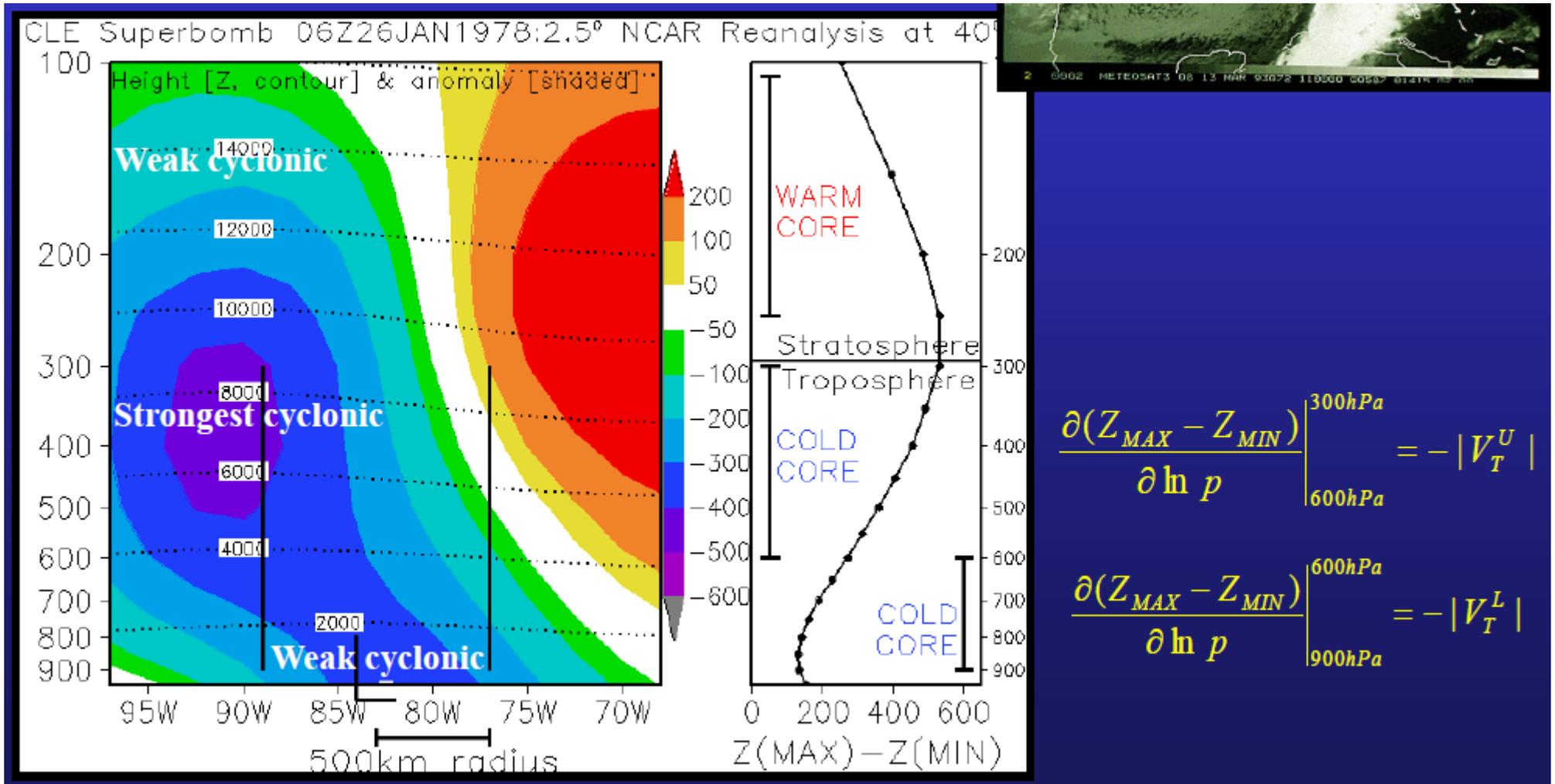
$$\frac{\partial(Z_{MAX} - Z_{MIN})}{\partial \ln p} = - |V_T|$$

Two layers of interest

$$\frac{\partial(Z_{MAX} - Z_{MIN})}{\partial \ln p} \Bigg|_{600hPa}^{300hPa} = - |V_T^U|$$

$$\frac{\partial(Z_{MAX} - Z_{MIN})}{\partial \ln p} \Bigg|_{900hPa}^{600hPa} = - |V_T^L|$$

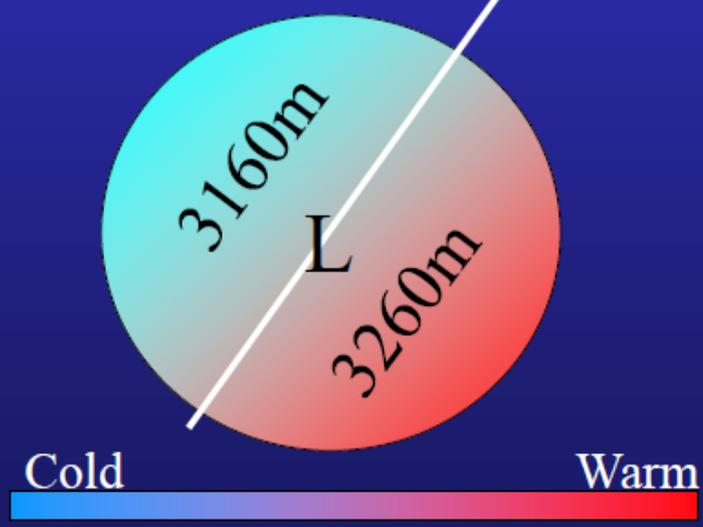
Cicloni tropicali ed extra-tropicali a confronto



Cicloni tropicali ed extra-tropicali a confronto

- Defined using storm-relative 900-600hPa mean thickness field (shaded) asymmetry within 500km radius:

$$B = \overline{Z_{600hPa} - Z_{900hPa}} \Big|_R - \overline{Z_{600hPa} - Z_{900hPa}} \Big|_L$$



$B \gg 0$: Frontal

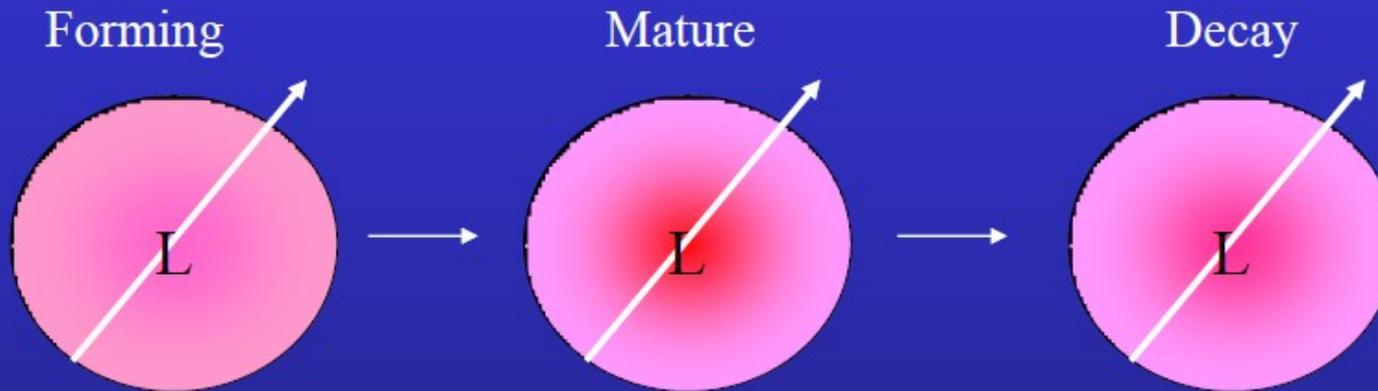
$B \approx 0$: Nonfrontal

Bibliografia

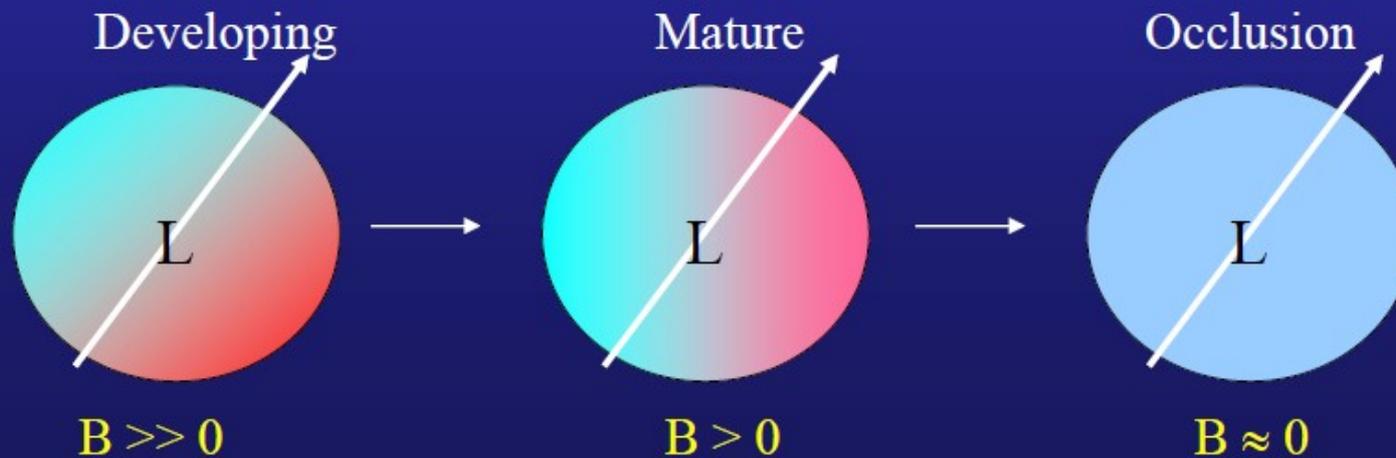
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- A Cyclone Phase Space Derived from Thermal Wind and Thermal Asymmetry (2002) R. E. Hart
https://journals.ametsoc.org/view/journals/mwre/131/4/1520-0493_2003_131_0585_acpsdf_2.0.co_2.xml
- The Extratropical Transition of Tropical Cyclones. Part I: Cyclone Evolution and Direct Impacts (2017)
<https://journals.ametsoc.org/view/journals/mwre/145/11/mwr-d-17-0027.1.xml>
- The Extratropical Transition of Tropical Cyclones. Part II: Interaction with the Midlatitude Flow, Downstream Impacts, and Implications for Predictability (2019) <https://journals.ametsoc.org/view/journals/mwre/147/4/mwr-d-17-0329.1.xml>
- Evolution of the upper-level thermal structure in tropical cyclones (2016)
<https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2016GL070622>
- Objective tropical cyclone extratropical transition detection in high-resolution reanalysis and climate model data (2017)
<https://agupubs.onlinelibrary.wiley.com/doi/10.1002/2016MS000775>

Cicloni tropicali ed extra-tropicali a confronto

Conventional Tropical cyclone: $B \approx 0$



Conventional Extratropical cyclone: B varies



Cicloni tropicali ed extra-tropicali a confronto

Symmetric warm core

- $B \leq 10$ and $-V_T^L > 0$
 - Tropical cyclones, warm seclusions

Asymmetric warm core

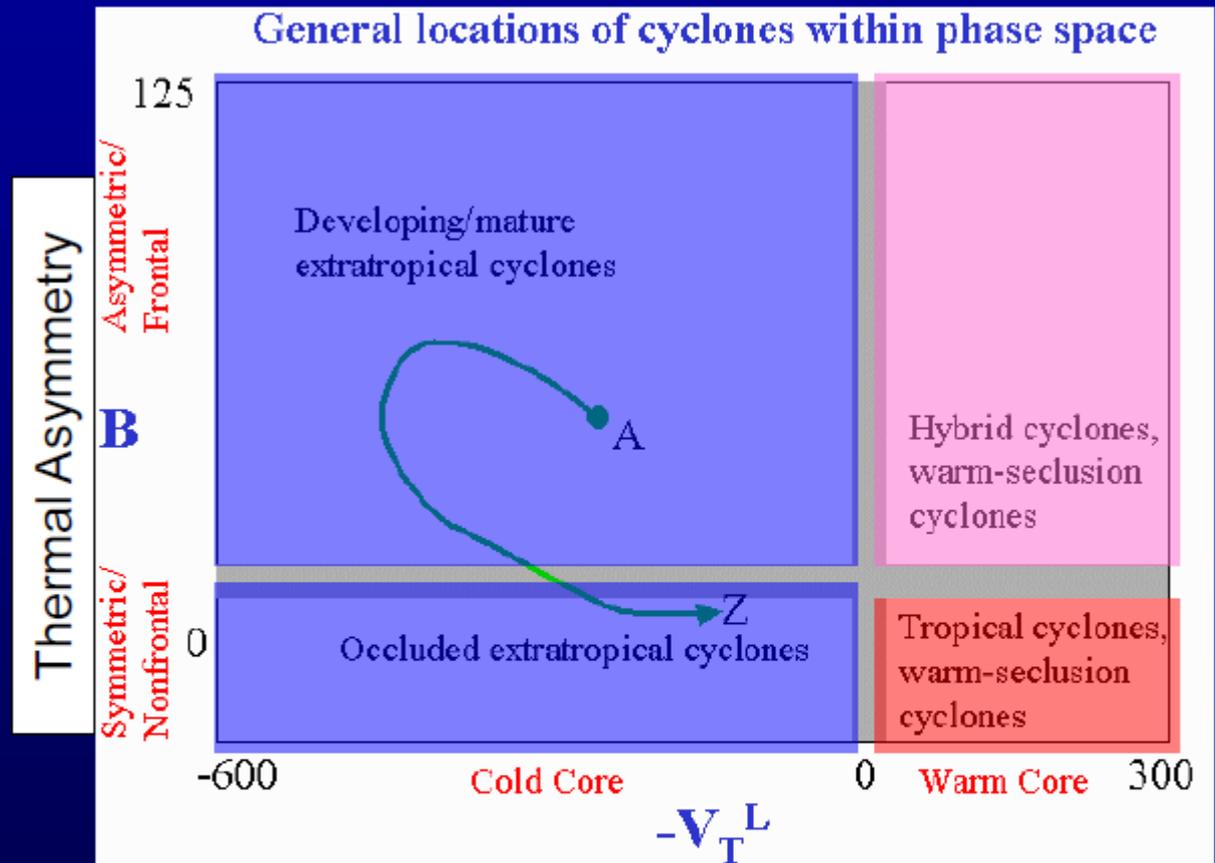
- $B > 10$ and $-V_T^L > 0$
 - Hybrid cyclones, warm seclusions
 - Most cyclones undergoing ET found here

Symmetric cold core

- $B \leq 10$ and $-V_T^L < 0$
 - Occluded extratropical cyclones

Asymmetric cold core

- $B > 10$ and $-V_T^L < 0$
 - Developing or mature extratropical cyclones



Lower Troposphere

Cicloni tropicali ed extra-tropicali a confronto

Deep warm core

- $-V_T^L > 0, -V_T^U > 0$
- Tropical cyclones

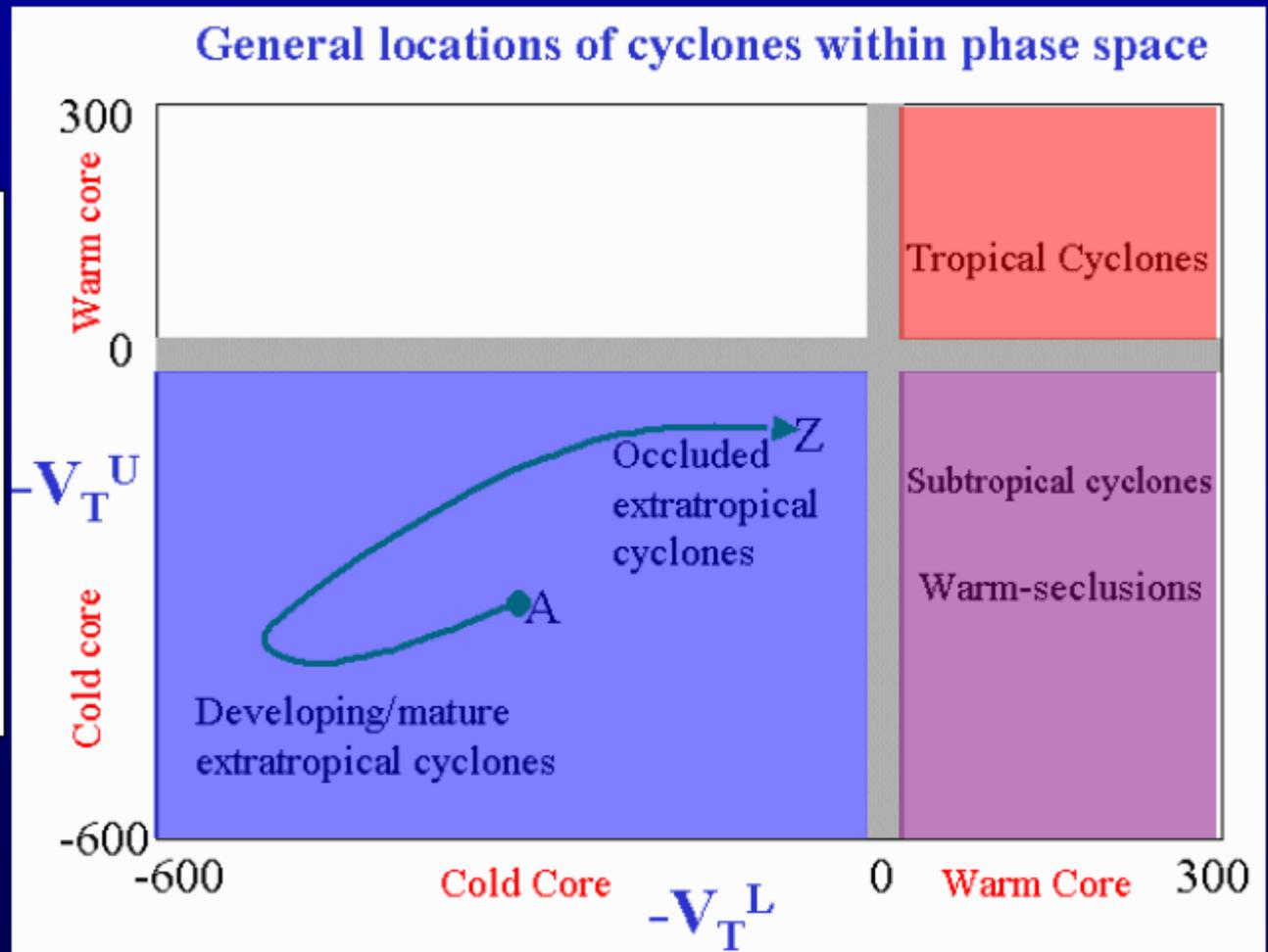
Deep cold core

- $-V_T^L < 0, -V_T^U < 0$
- Extratropical cyclones

Shallow warm core

- $-V_T^L > 0, -V_T^U < 0$
- Subtropical cyclones, warm seclusions

Upper Troposphere



Lower Troposphere

Cicloni tropicali ed extra-tropicali a confronto



Hurricane Bonnie near peak intensity east of the Bahamas on August 23

Formed	August 19, 1998
Dissipated	August 30, 1998
Highest winds	1-minute sustained: 115 mph (185 km/h)
Lowest pressure	954 mbar (hPa); 28.17 inHg
Fatalities	5 overall
Damage	\$1 billion (1998 USD)
Areas affected	Leeward Islands, North Carolina, Mid-Atlantic States

Part of the [1998 Atlantic hurricane season](#)

