

HURACANS I MEDICANES: RESPOSTA A L'ESCALFAMENT GLOBAL

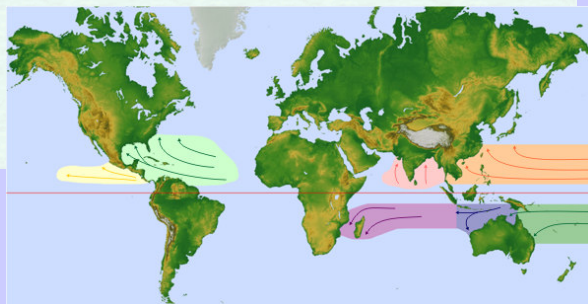
XIII JORNADES DE METEOROLOGIA EDUARD FONTSERÈ
(Barcelona, Novembre 2007)

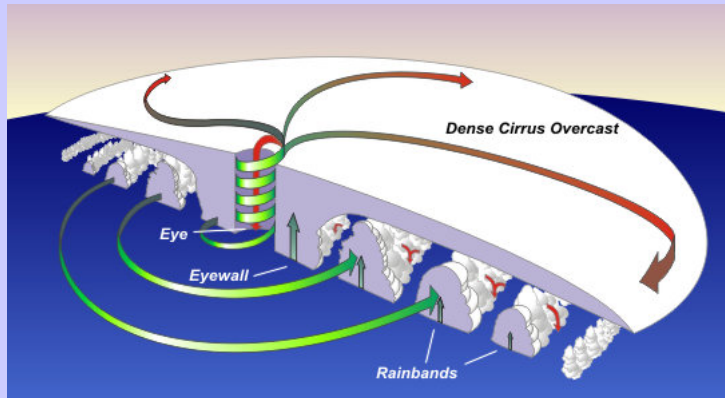
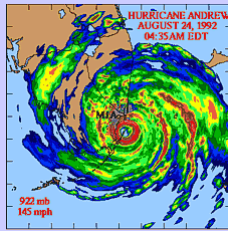
Romualdo Romero March

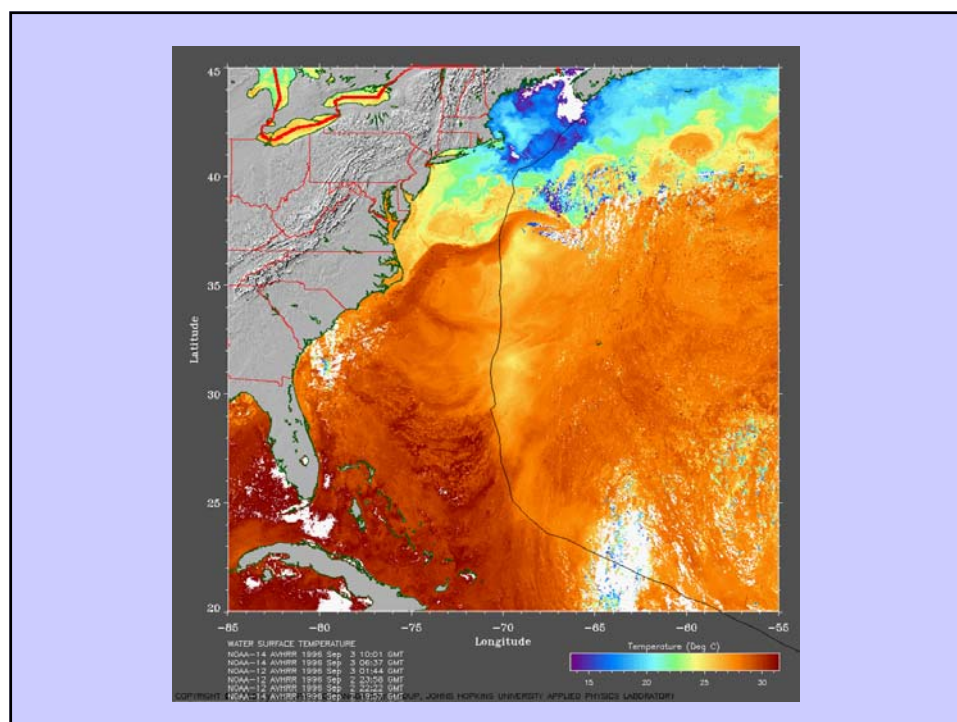
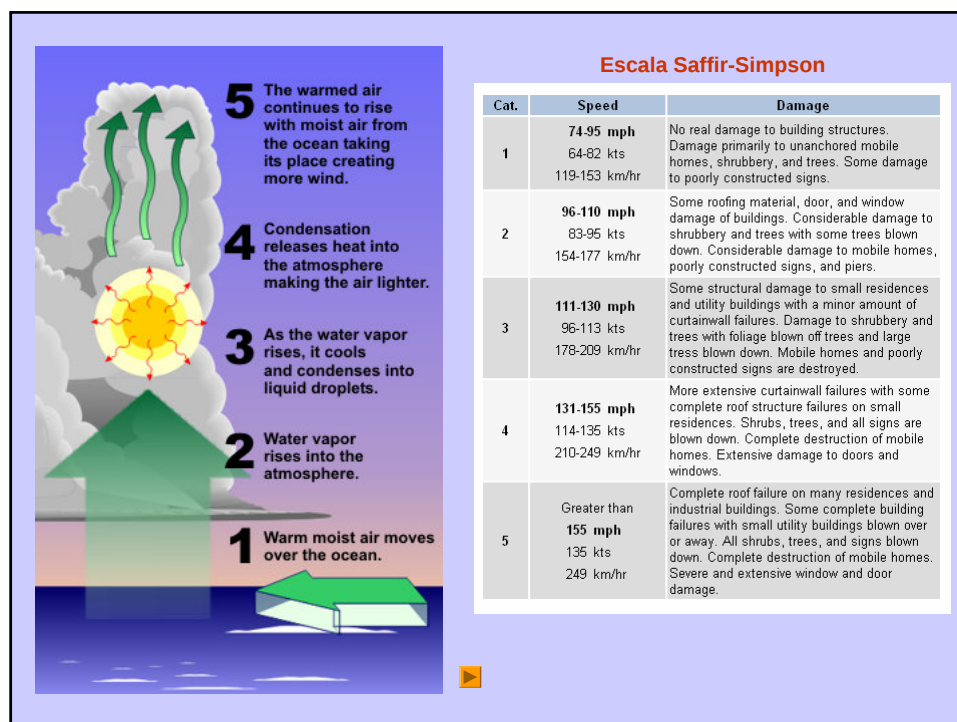


Agraïments: *Lluís Fita y Ángel Luque (Grup de Meteorologia, UIB)*
Agustí Jansà (CMT del INM en Illes Balears)
Kerry A. Emanuel (MIT, Boston, USA)

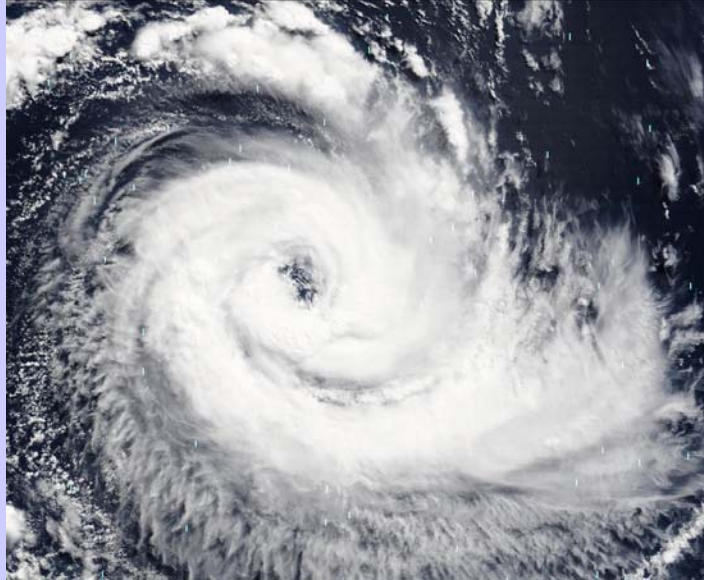
Tropical Cyclones



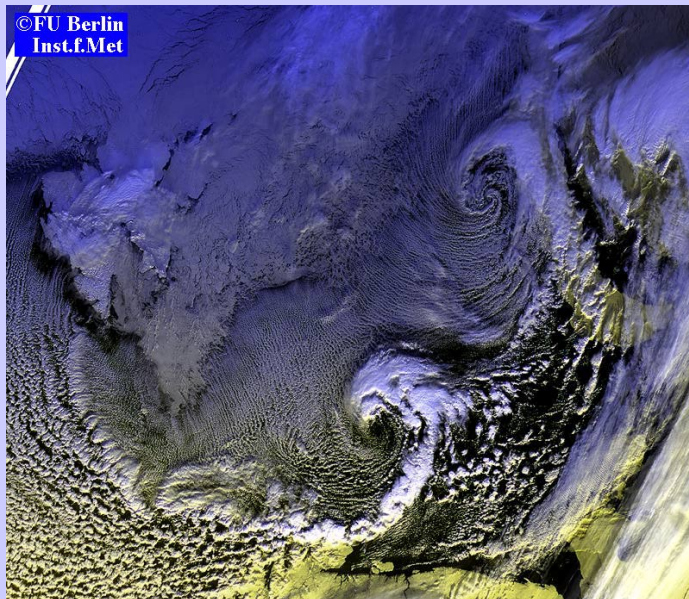




**Huracán Catalina (Brasil, marzo 2004),
formado a partir de una depresión fría en altura**



Bajas Polares

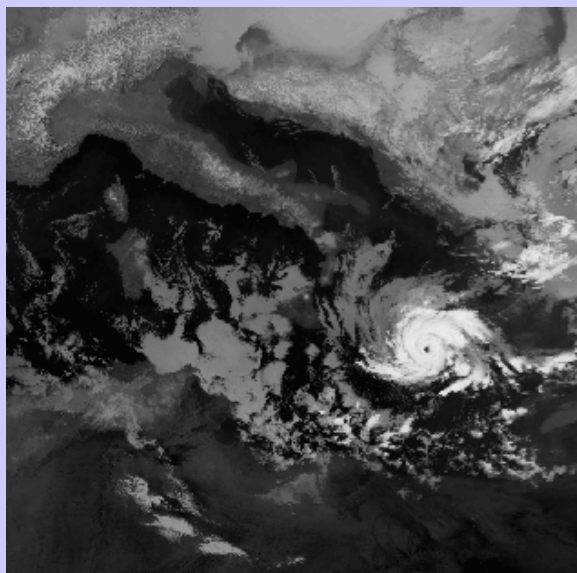




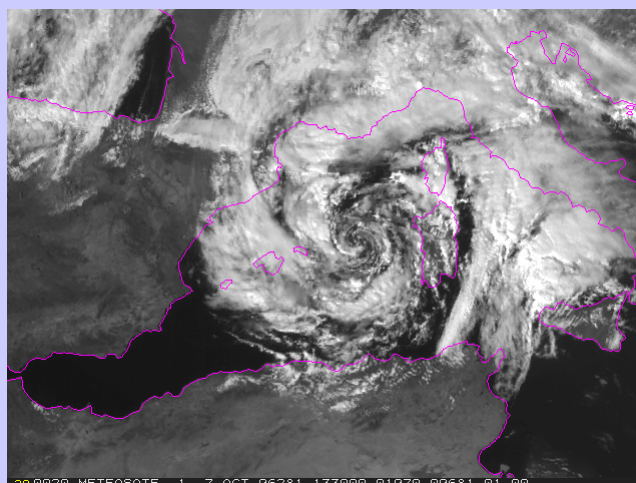
MEDICANES

- Varios por año en el conjunto de la cuenca mediterránea, rara vez alcanzando la categoría de huracán (120 km/h).
- Típicamente, se forman bajo el efecto de una depresión fría y aislada en los niveles medio-altos de la troposfera.
- Se sustentan en el elevado desequilibrio termodinámico aire-mar propiciado por la perturbación primaria. Son más frecuentes en otoño.

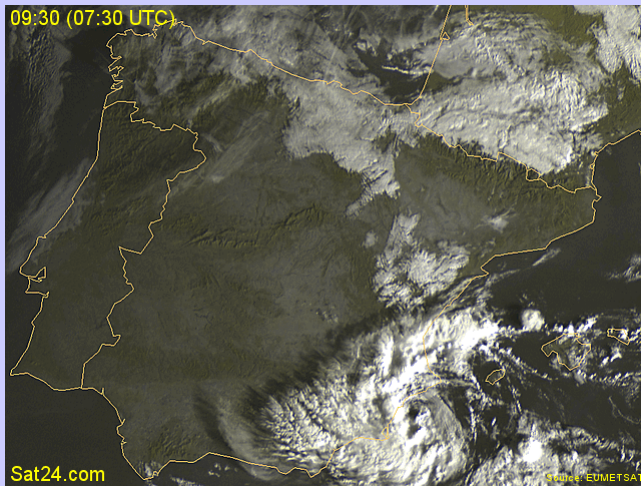
Medicane del 15-17 Enero 1995



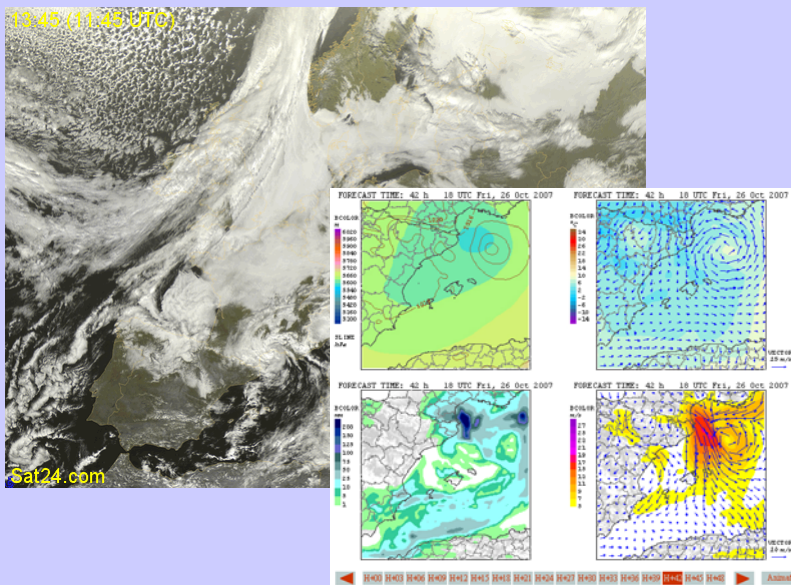
Medicane del 7-10 Octubre 1996



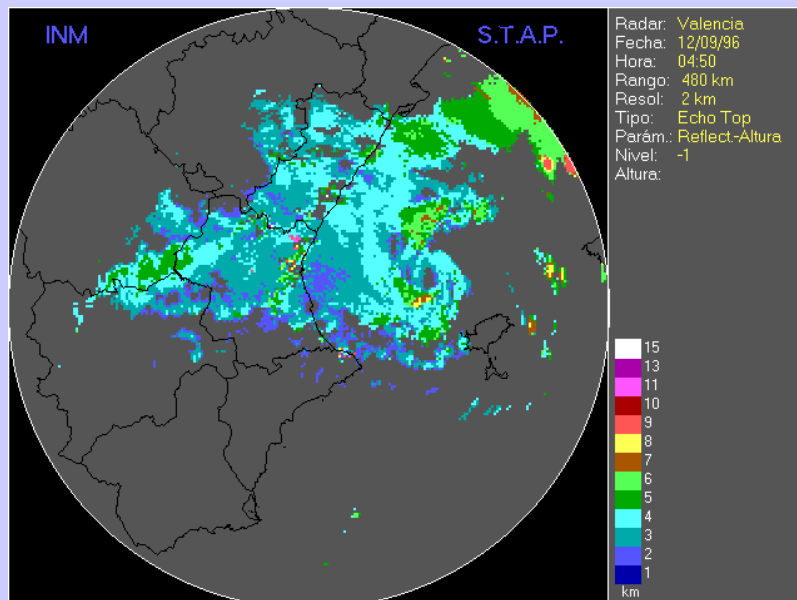
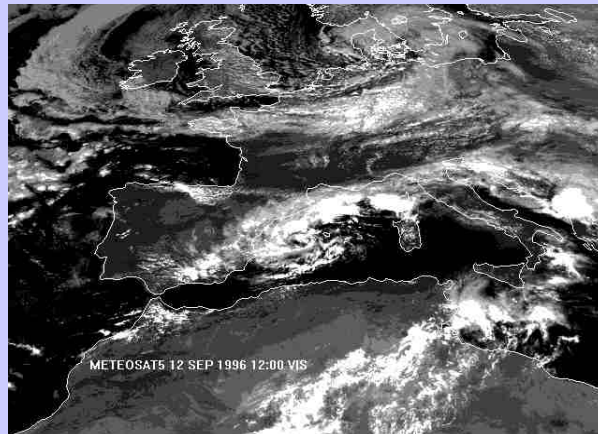
Medicane del 18 Ottobre 2007

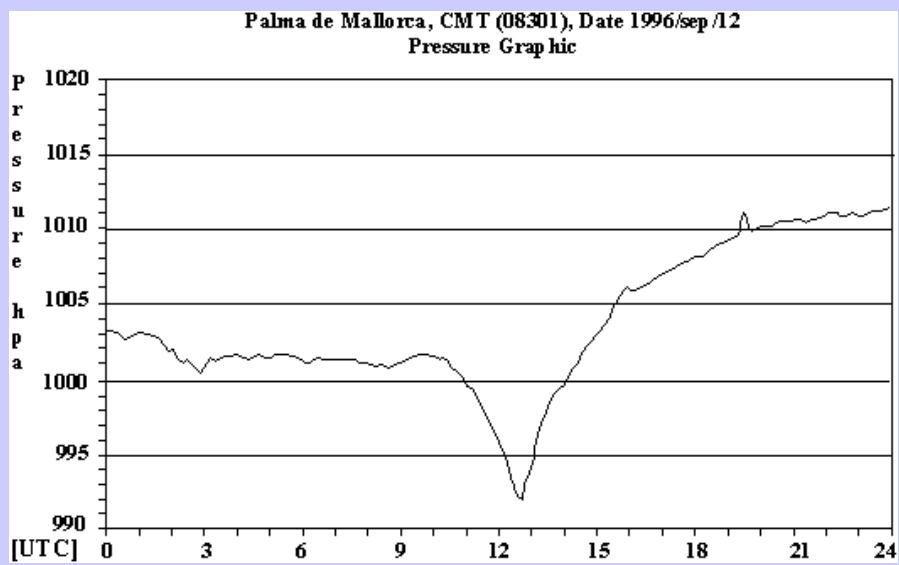
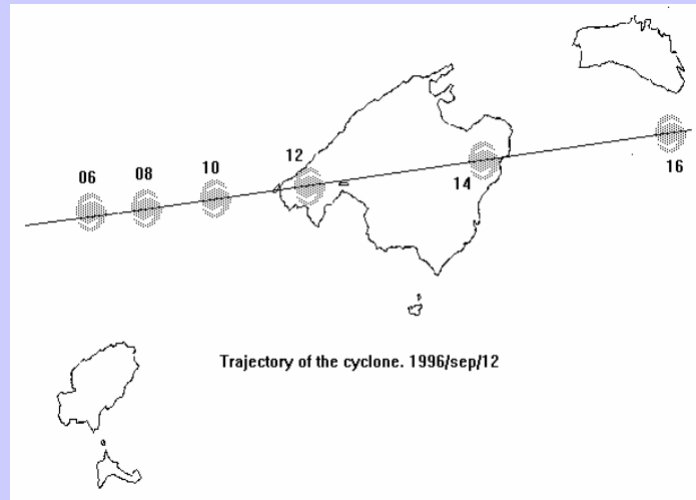


Medicane del 26 Ottobre 2007

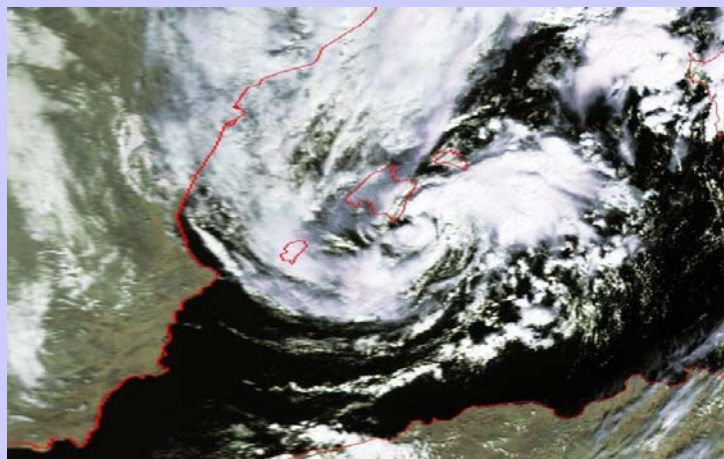
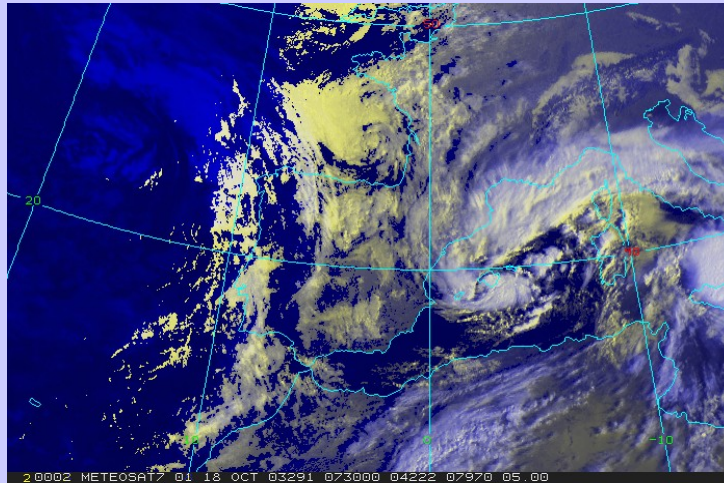


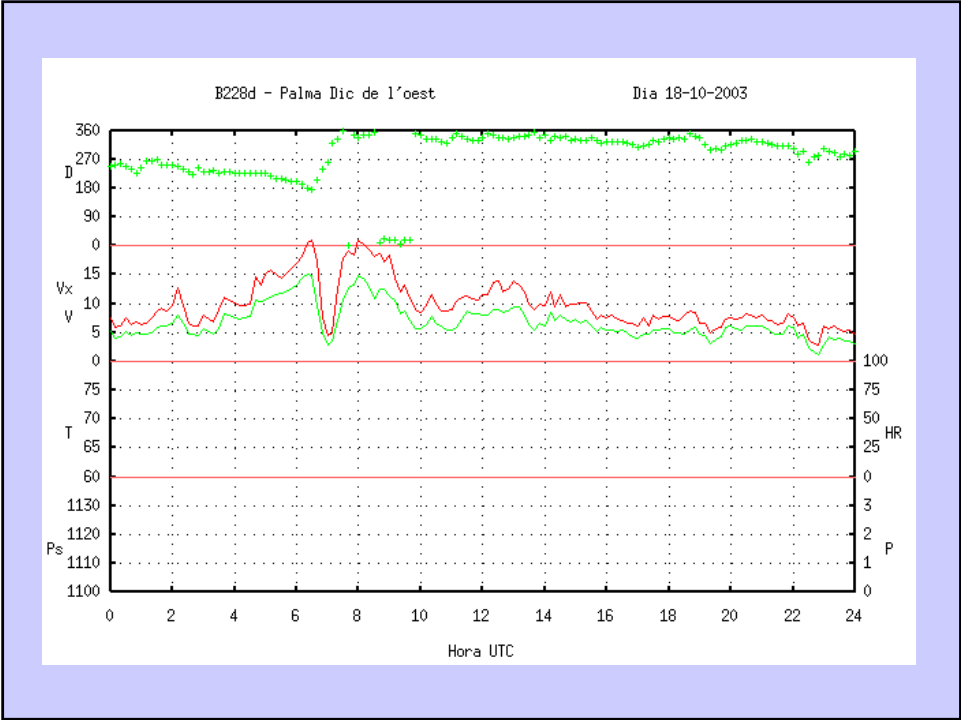
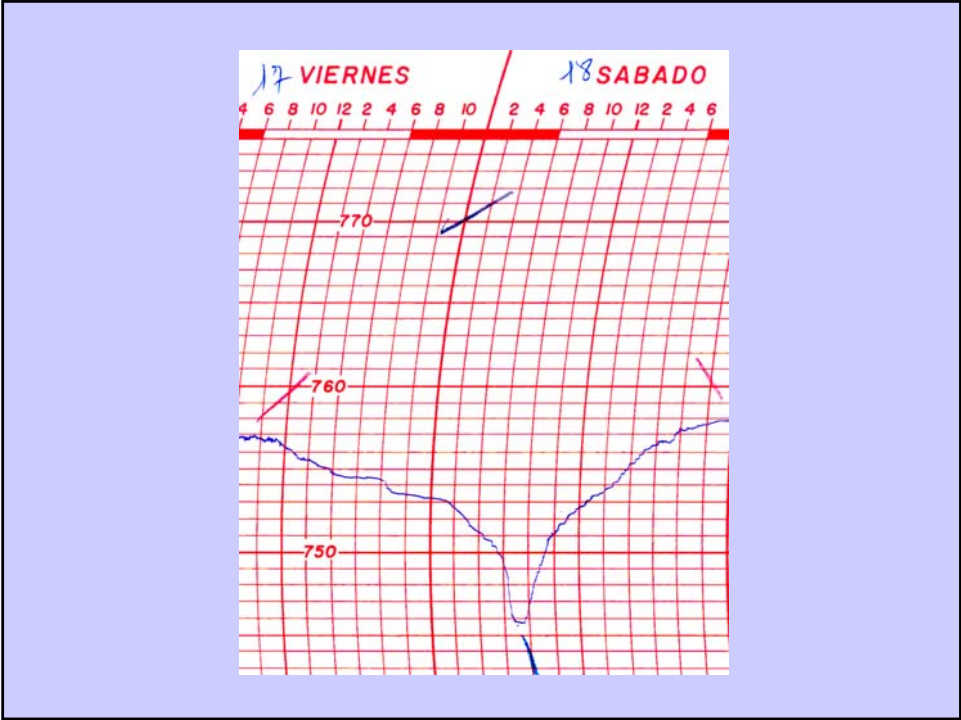
Medicane of 12 September, 1996

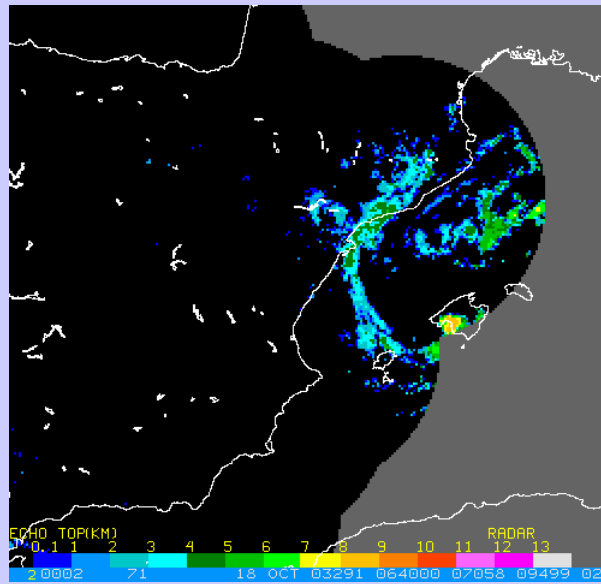




Medicane del 18 Ottobre 1996

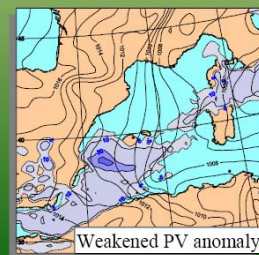
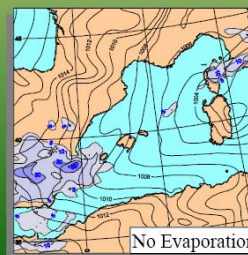
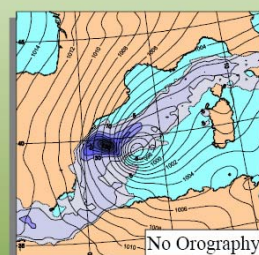
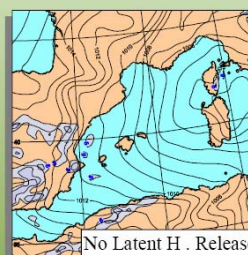
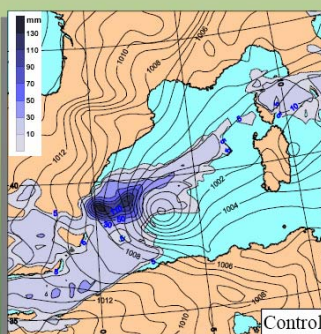






Sensitivity

• Results of the sensitivity experiments in terms of surface pressure and accumulated precipitation at 1200 UTC:



Simulaciones numéricas del
Medicane de 12 Septiembre 1996
(Homar et al. 2003)

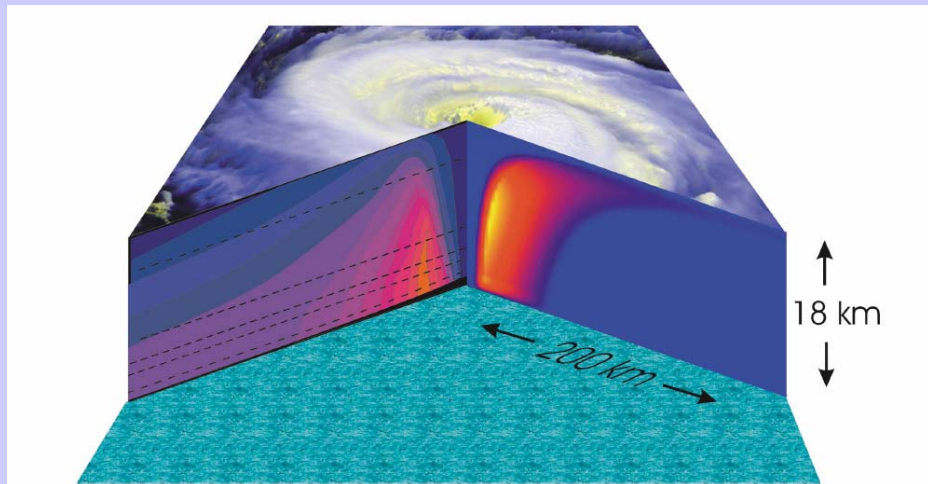
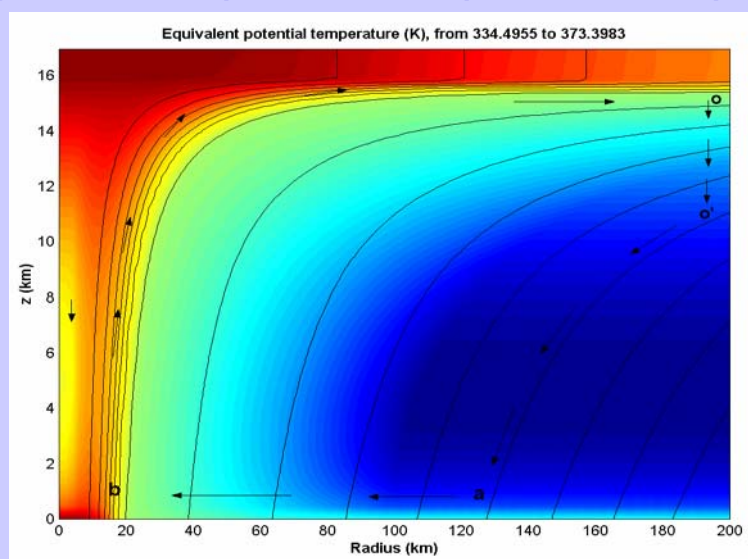


Figure 3 Cutaway view of the structure of a tropical cyclone. The top of the storm is based on a satellite photograph of the cloud structure of Hurricane Fran of 1996. The right-hand cut shows the vertical component of velocity, from a numerical simulation of a hurricane using the model of Emanuel (1995a); maximum values (yellow) are approximately 8 ms^{-1} . The left-hand cut shows the magnitude of the tangential wind component measured in Hurricane Inez of 1966 by aircraft flying at levels indicated by the black dashed lines; from Hawkins & Imbembo (1976). Maximum values are approximately 50 ms^{-1} .

Energía del Huracán (ciclo de Carnot)

a-b: Expansión isotérmica b-o: Expansión adiabática o-o': Compresión isotérmica o'-a: Compresión adiabática



Balance Energético (Estado Estacionario)

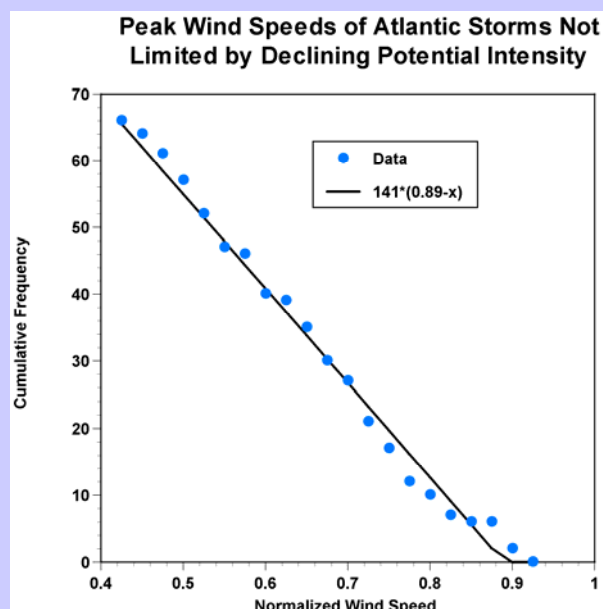
$$P = 2\pi \frac{T_s - T_o}{T_s} \int_a^b \left[C_k \rho |V| \left(k_0^* - k \right) + C_D \rho |V|^3 \right] r dr$$

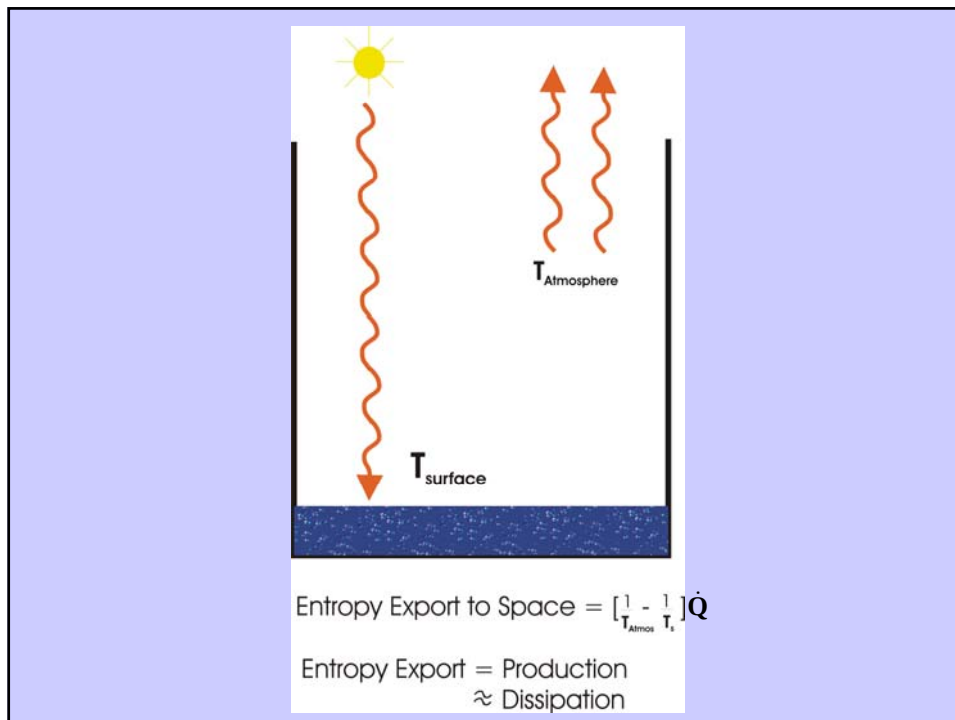
$$D = 2\pi \int_a^b C_D \rho |V|^3 r dr$$

$$\rightarrow |V_{\max}|^2 \cong \frac{C_k}{C_D} \frac{T_s - T_o}{T_o} \left(k_0^* - k \right)$$

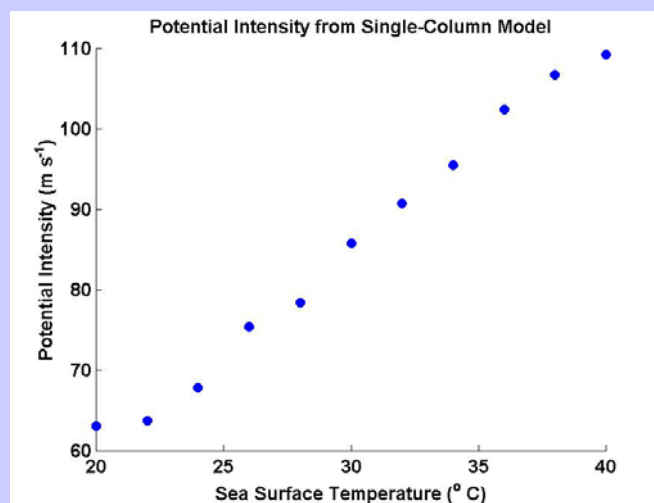
→ $P_{\min}$ using the gradient-wind relationship

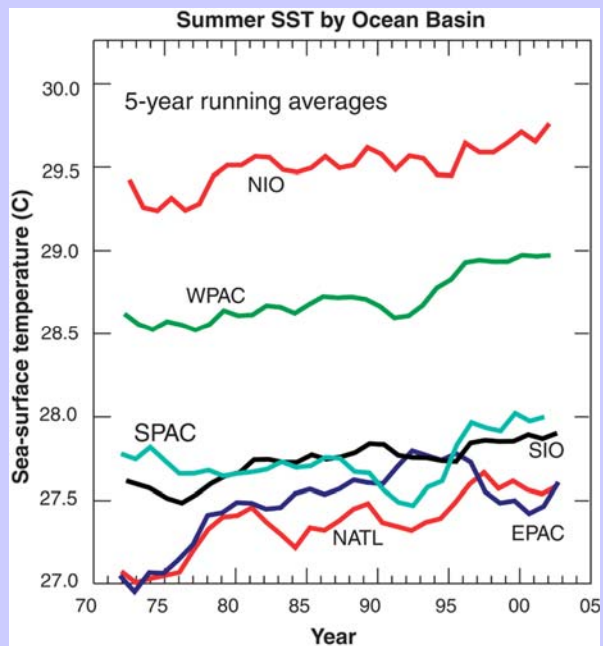
When peak storm intensity is normalized by potential intensity and events are counted, a universal distribution function becomes apparent



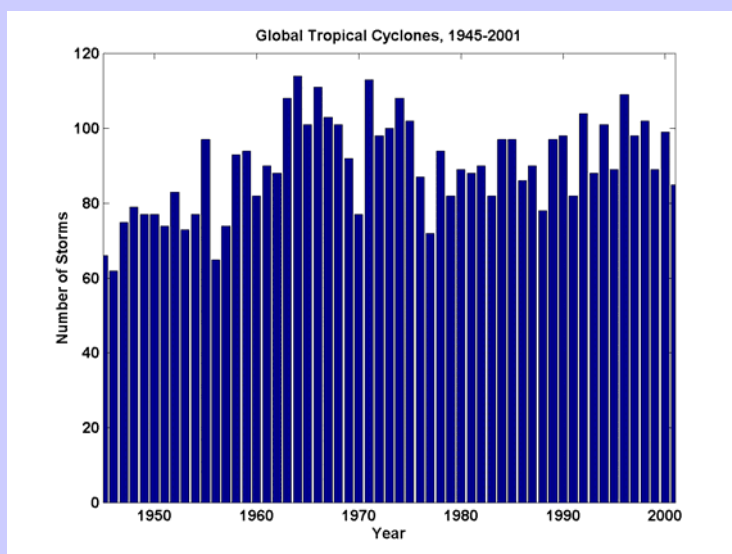


TEORÍA: La Intensidad Potencial Aumenta con la SST (Emanuel, 1987)

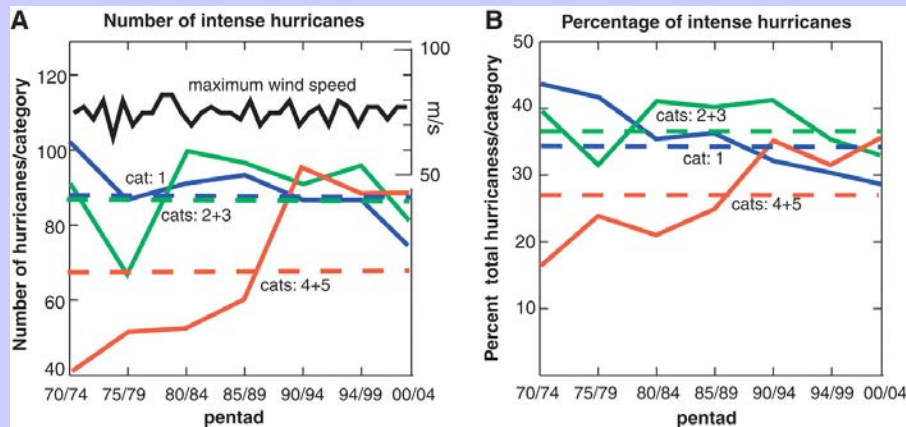




La frecuencia no ha cambiado significativamente



Webster et al. (Science, 2005)



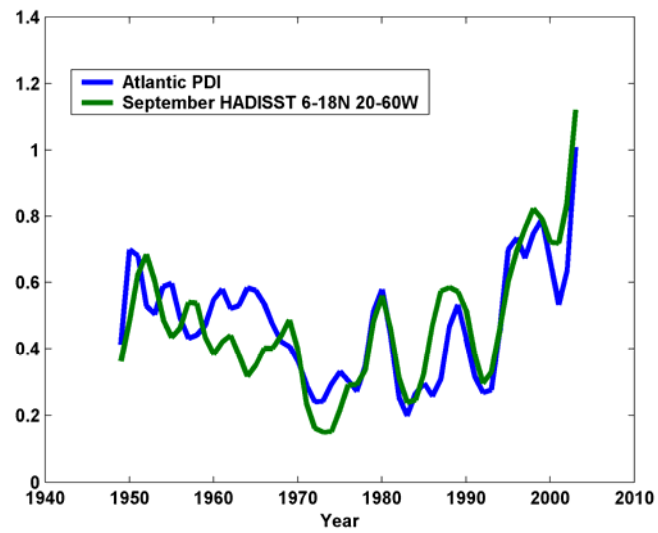
Medida de la actividad del ciclón tropical

$$\text{Power dissipation} = 2\pi \int_0^\tau \int_0^{r_0} C_D \rho |\mathbf{V}|^3 r dr dt.$$

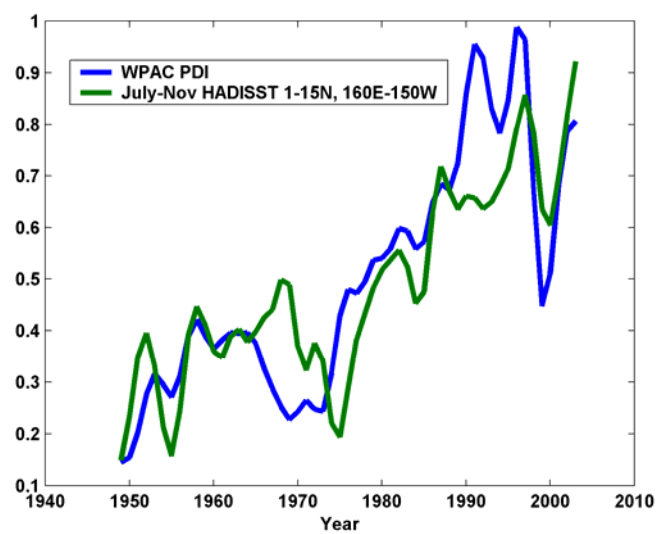
Simplified “Power Dissipation Index”:

$$PDI \equiv \int_0^\tau V_{max}^3 dt$$

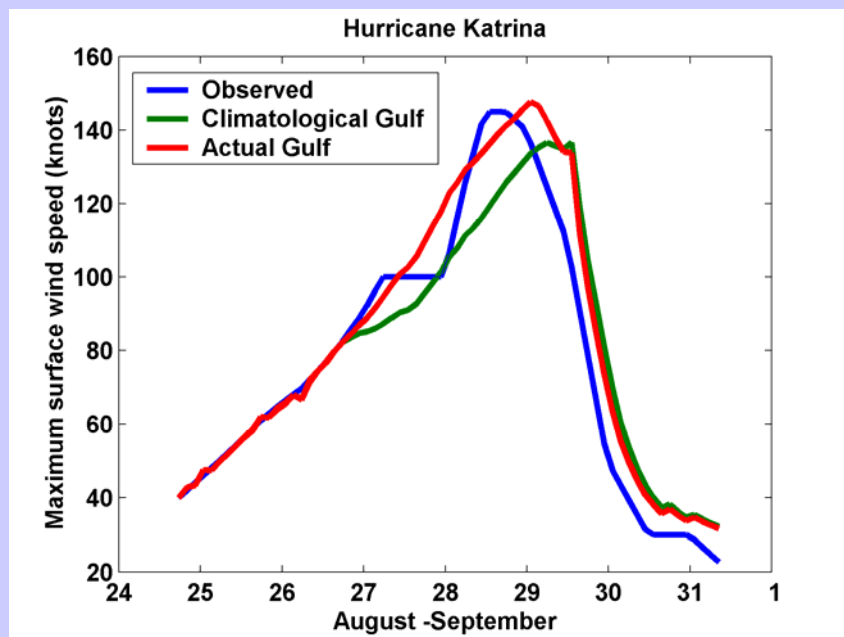
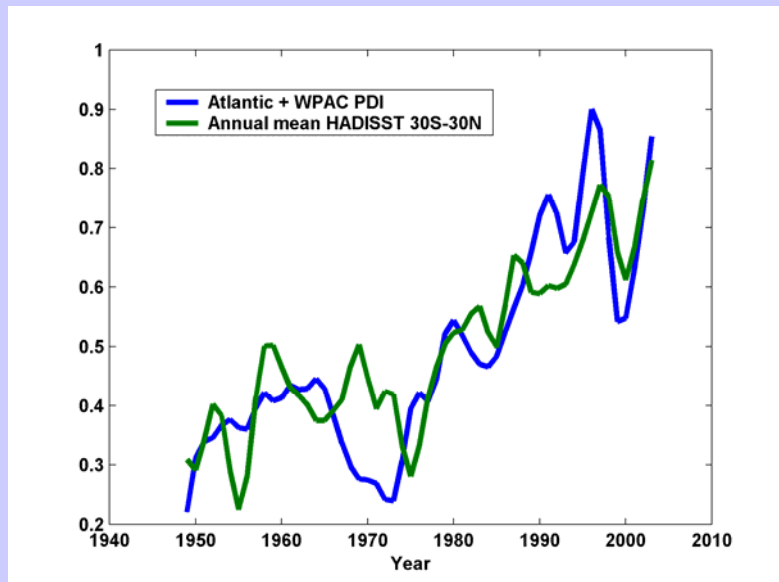
Atlántico

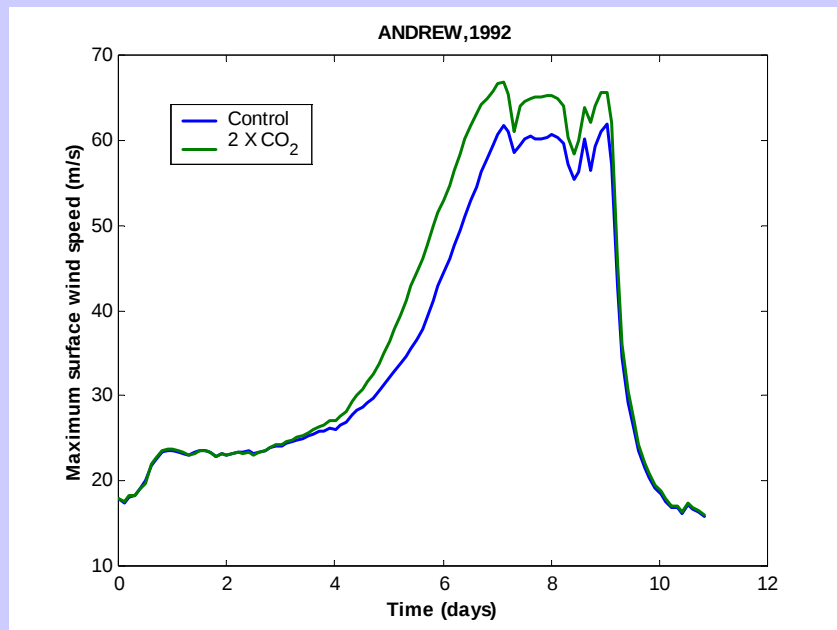


Pacífico NW

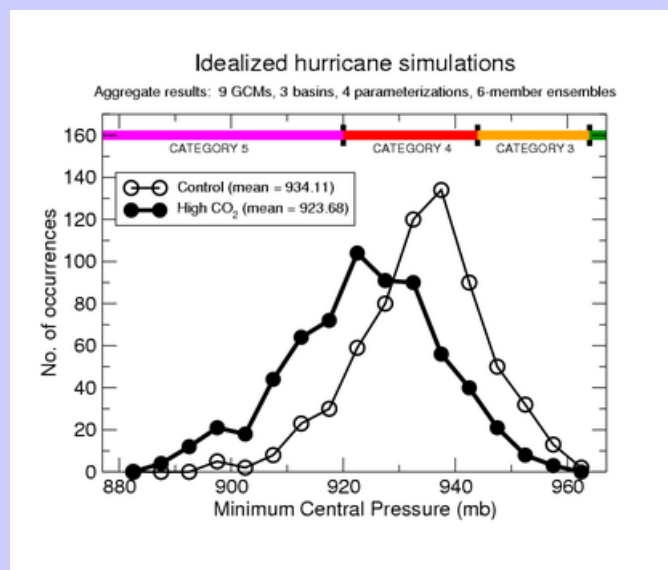


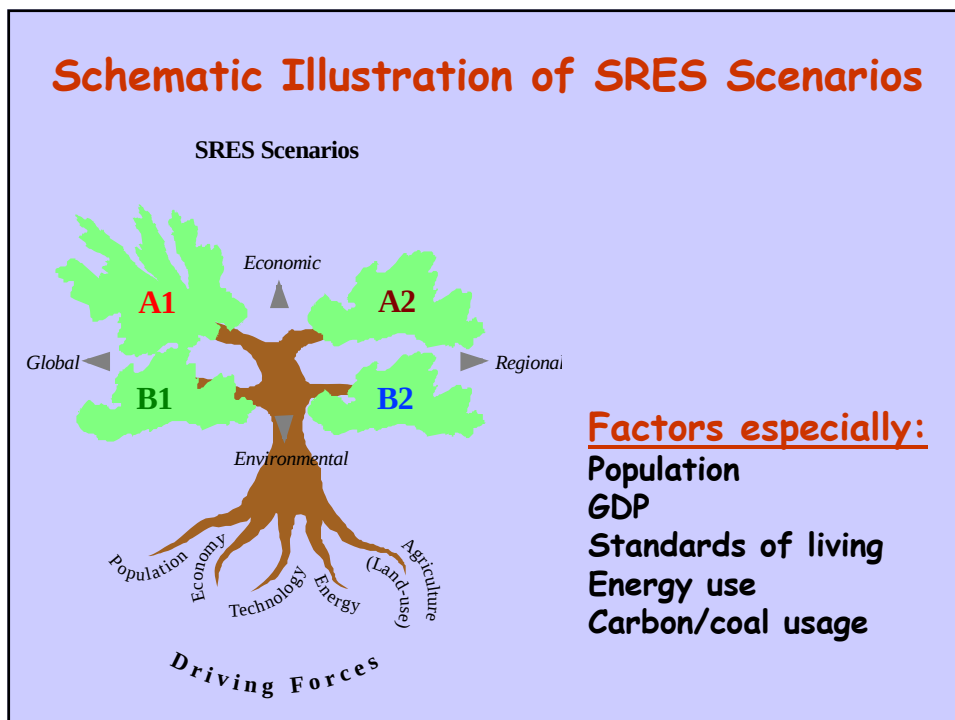
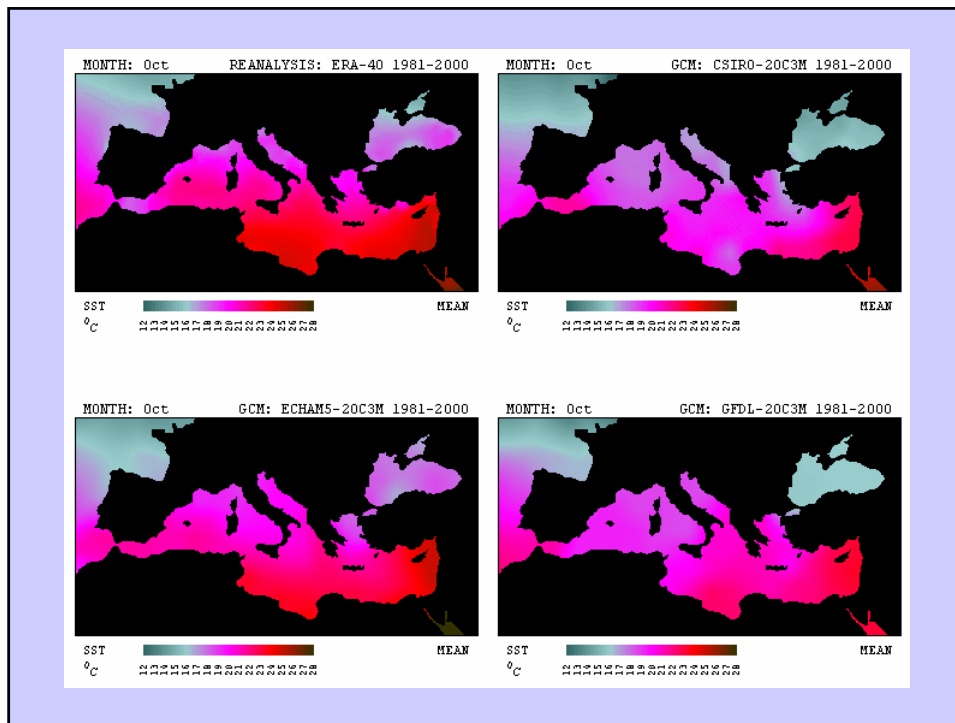
Atlántico + Pacífico NW





Knutson and Toleya (J. Climate, 2004)





Expected greenhouse effect concentration gases

A1B, A1T and A1FI are variations of main A1 SRES: fossil intensive (A1FI), non-fossil energy sources (A1T), or a balance across all sources (A1B)

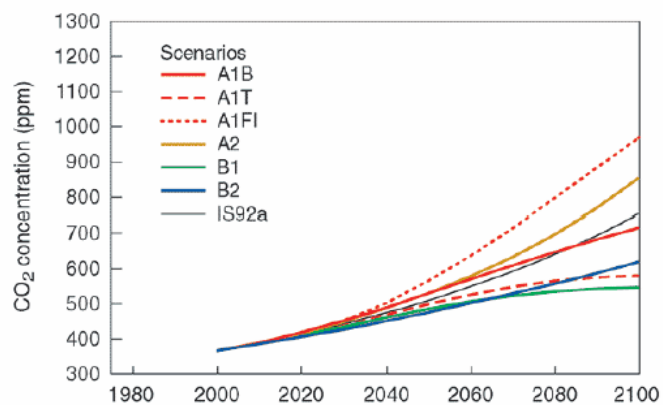
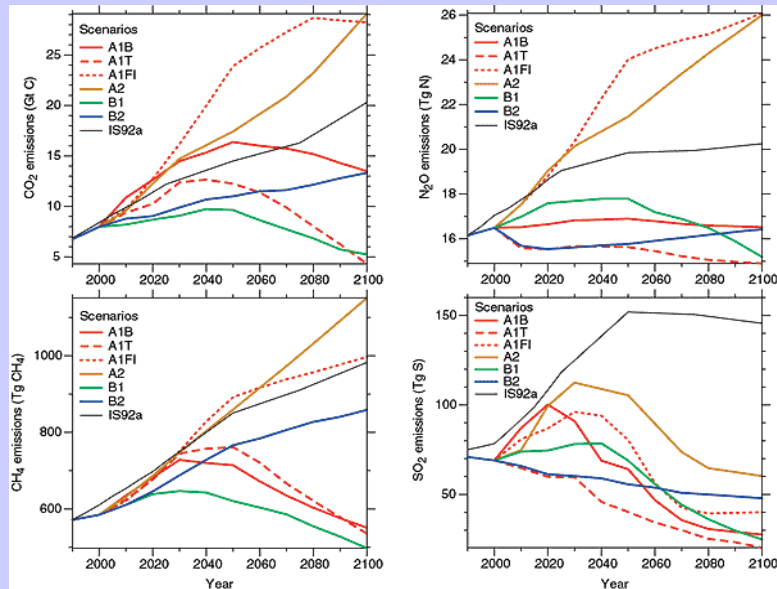
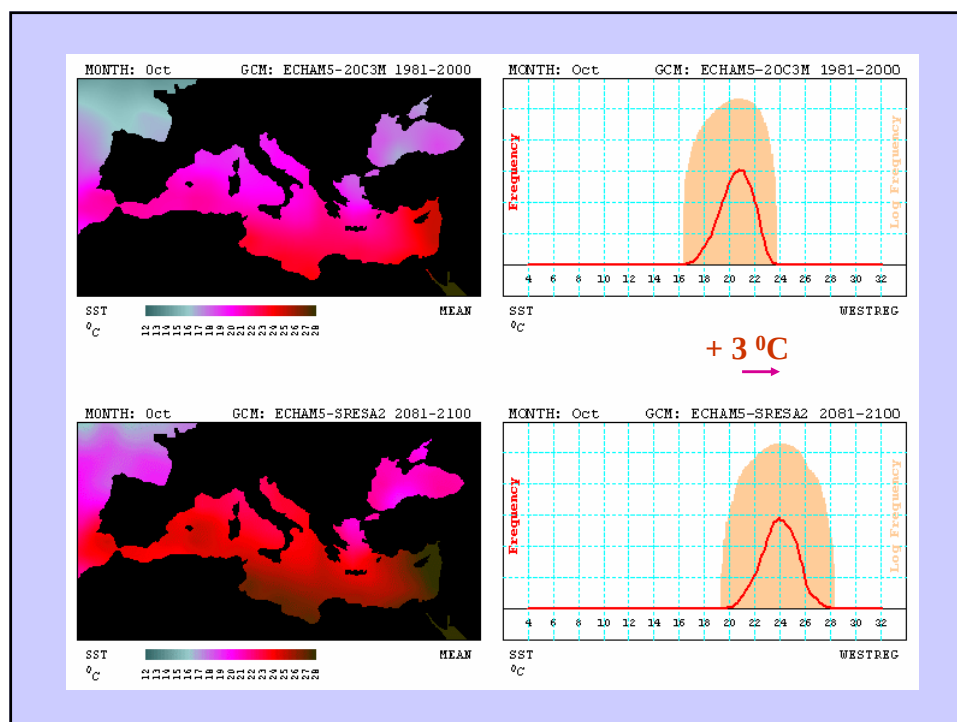
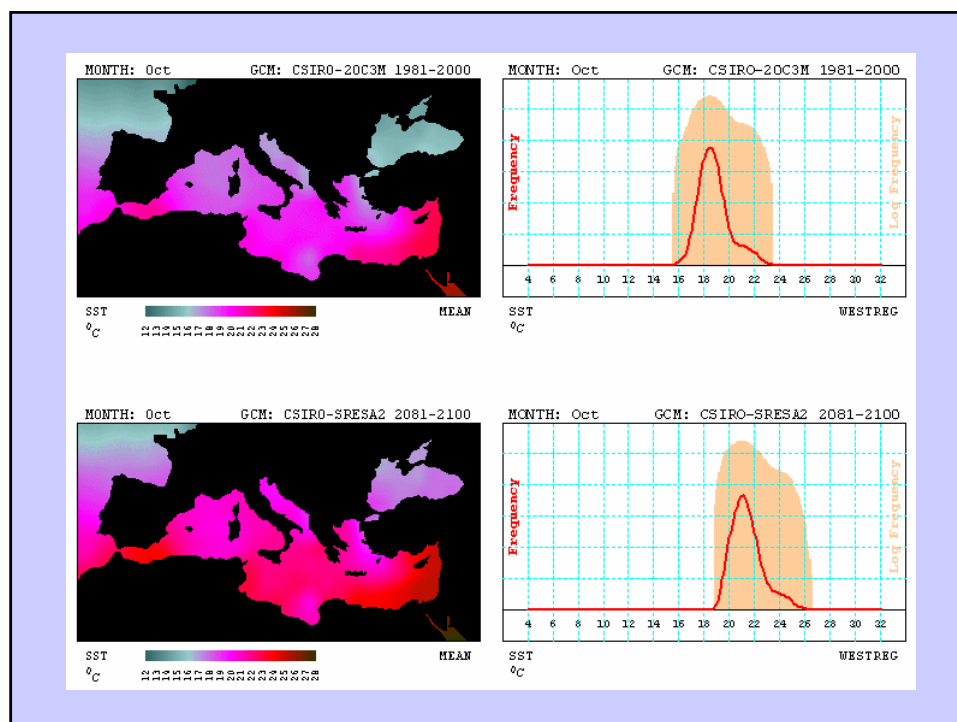
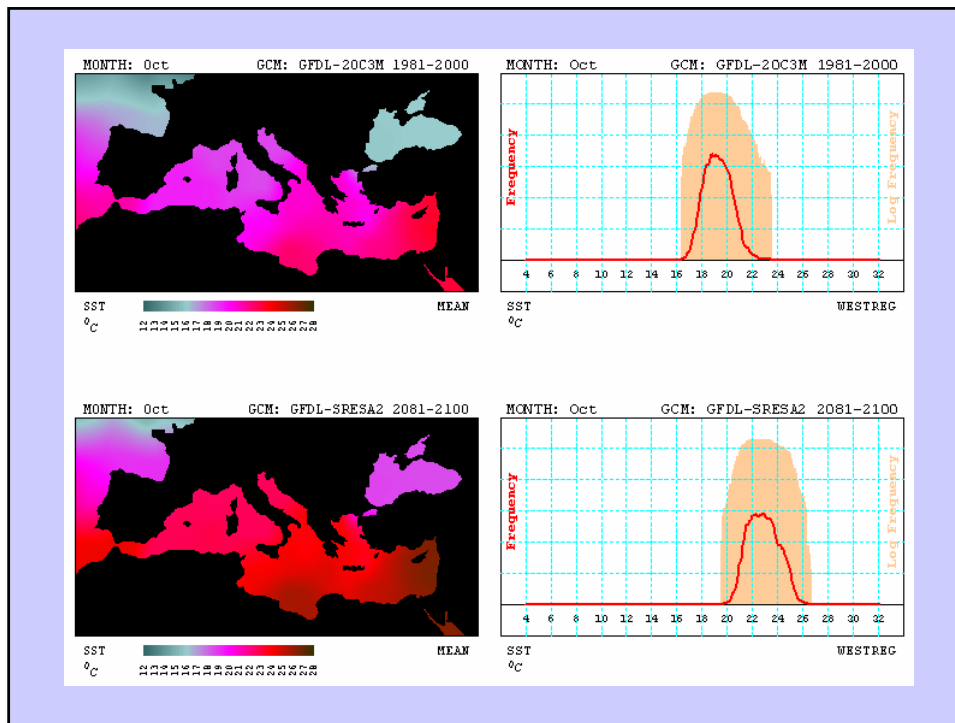


Figura 6.3. La concentració de CO₂ a l'atmosfera, com a resultat de les emissions presentades en la figura anterior. Noteu que malgrat en alguns escenaris les emissions comencen a disminuir cap a mitjan de segle, la concentració segueix augmentant, atès que l'escala de temps característica per assolir un nou equilibri en la concentració de CO₂ és d'uns 200 anys. [Figura extreta de Houghton *et al.*, 2001]





Índice Empírico de Génesis

$$I = 10^5 \eta^{3/2} \left(\frac{H}{50} \right)^3 \left(\frac{V_{pot}}{70} \right)^3 \left(1 + 0.1 V_{shear} \right)^{-2},$$

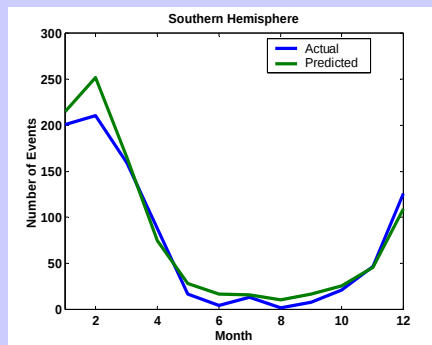
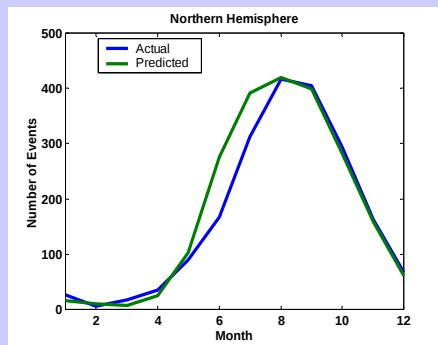
$\eta \equiv 850 \text{ hPa absolute vorticity (s}^{-1}\text{)},$

$V_{pot} \equiv \text{Potential wind speed (ms}^{-1}\text{)},$

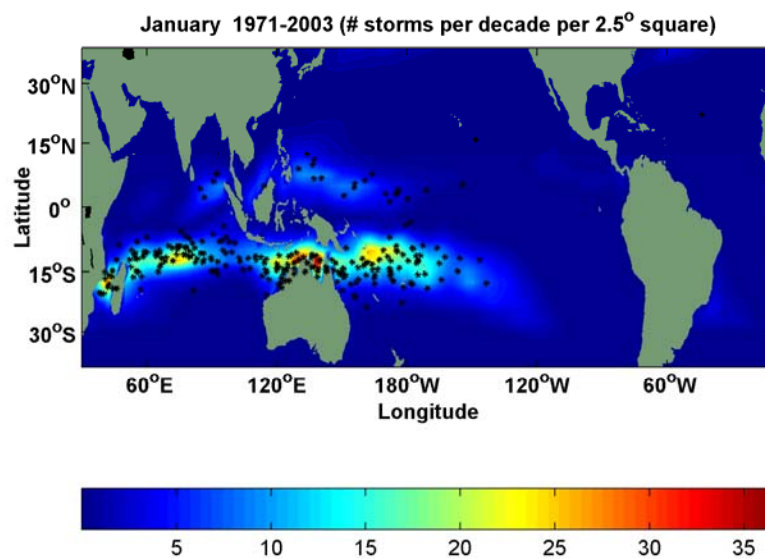
$H \equiv 600 \text{ mb relative humidity (\%)},$

$V_{shear} \equiv \left| \mathbf{V}_{850} - \mathbf{V}_{250} \right| \text{ (ms}^{-1}\text{)}.$

Variabilidad Estacional



Variabilidad Espacial (H.S)



Variabilidad Espacial (H.N)

