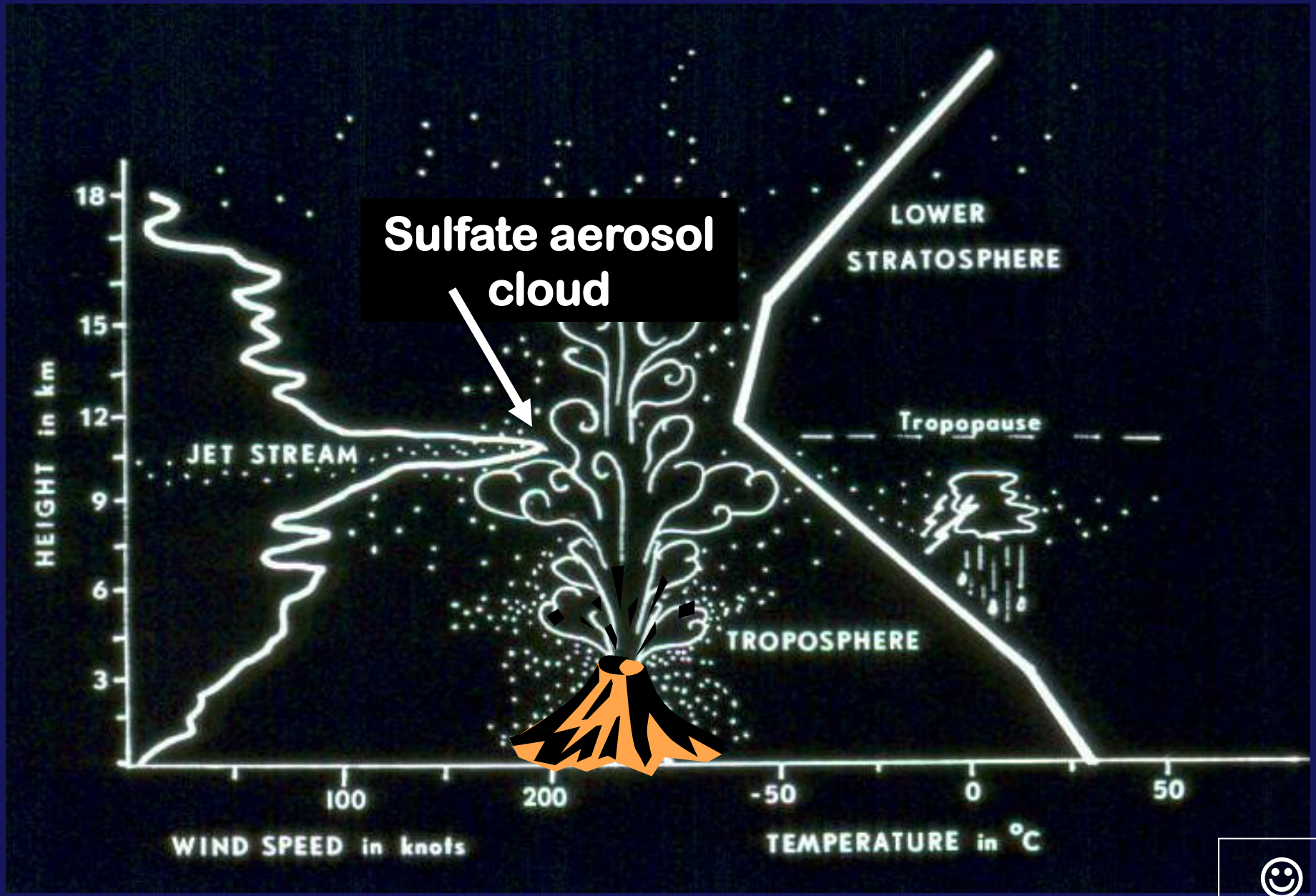
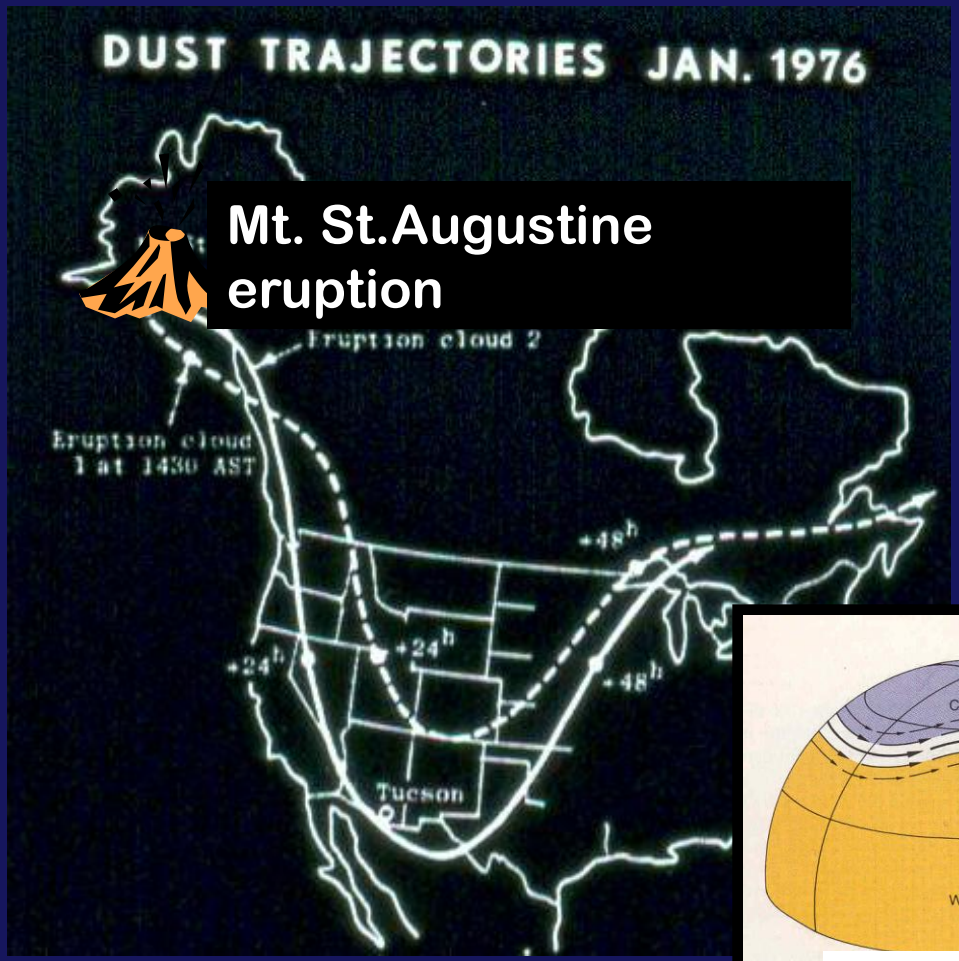
WRAP UP OF VOLCANISM & CLIMATE FORCING . . .

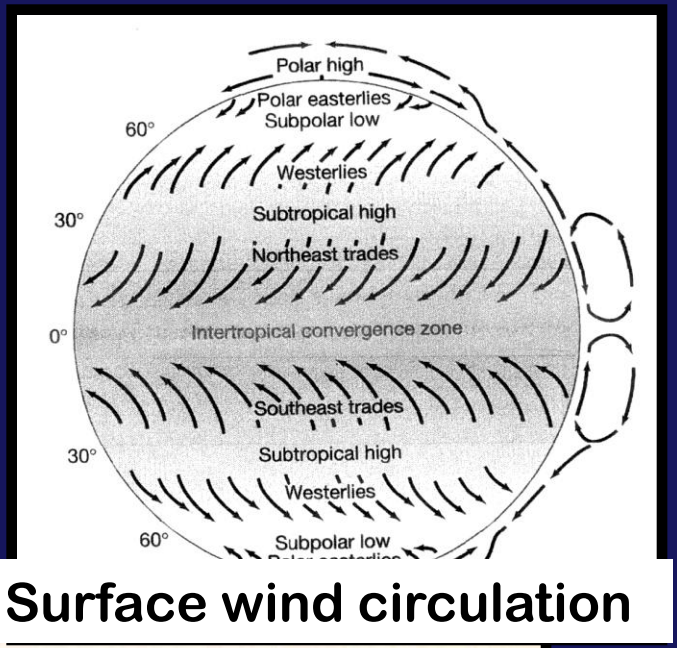
WHICH ERUPTIONS ARE THE MOST CLIMATICALLY EFFECTIVE?

- EXPLOSIVE
- high SULFUR content in magma
- whose eruption clouds inject into the STRATOSPHERE
- Low Latitude Eruptions

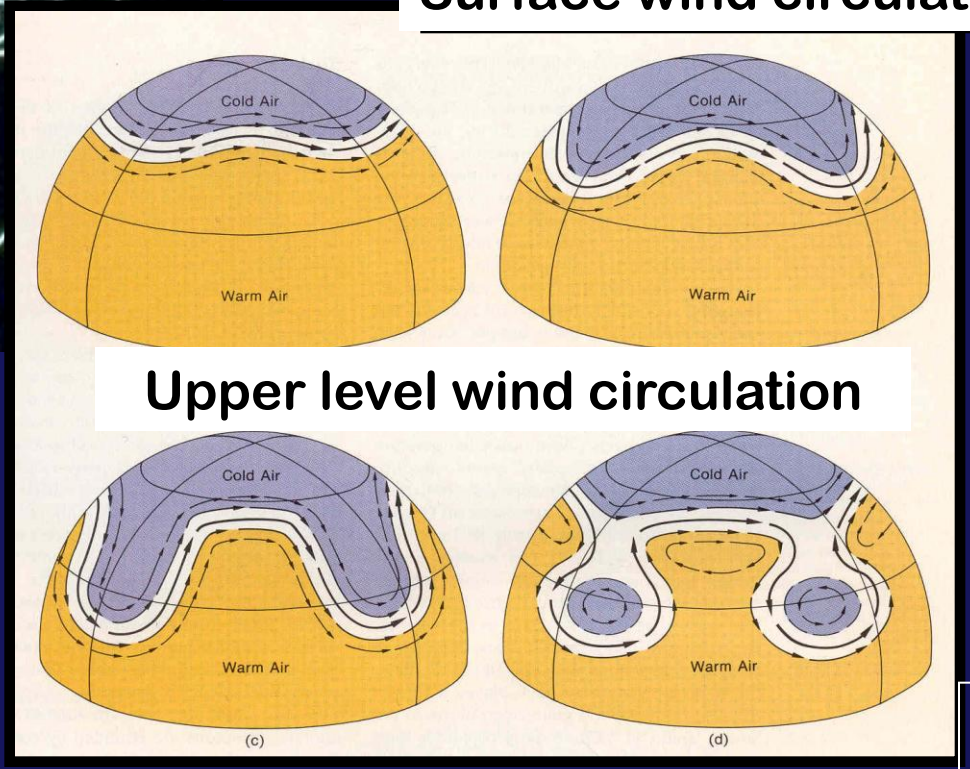
How an eruption's effects can become GLOBAL:







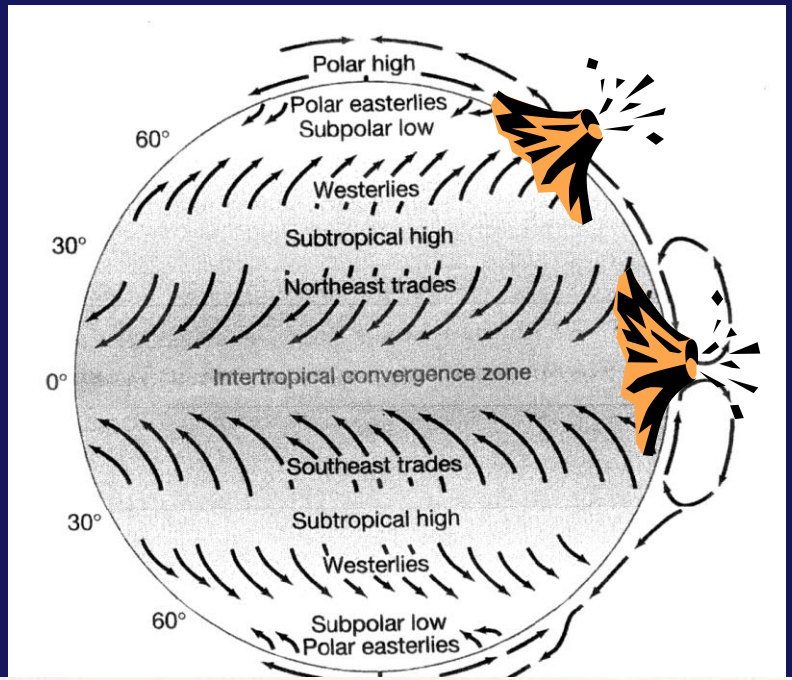
Surface wind circulation

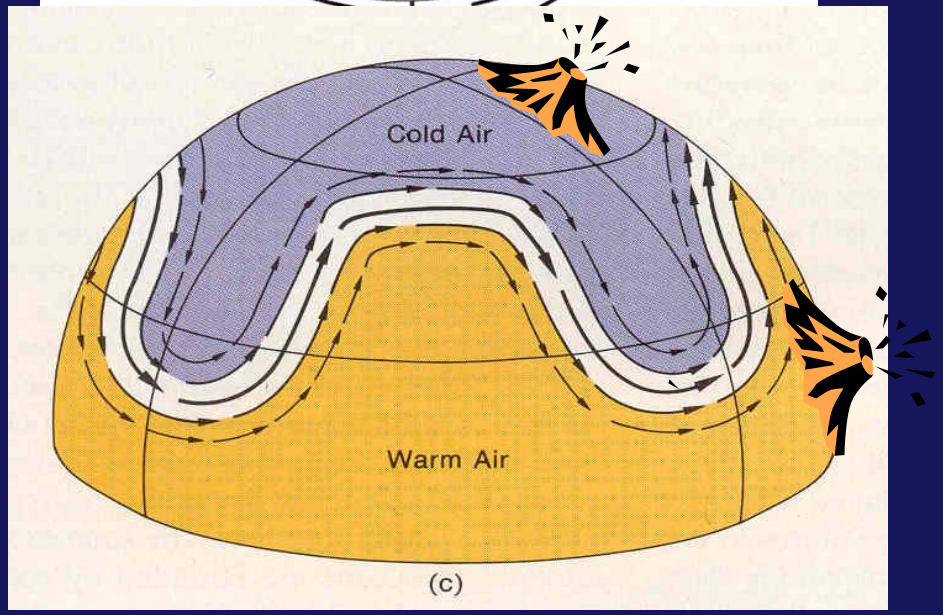


Through the atmospheric circulation!

- The GEOGRAPHIC LOCATION of the erupting volcano influences the climatic effectiveness of an eruption because of the General Circulation of the Atmosphere.

- Low latitude eruption clouds get circulated more broadly & in both hemispheres





See box on p 79
for a good summary of
which eruptions are
CLIMATICALLY EFFECTIVE

G-6 ACTIVITY ON VOLCANISM & CLIMATE

P.S. This is one of my favorite questions to ask on the FINAL EXAM!!!!

Comparison Table of Eruptions

Latitude

How much magma → how big an eruption

How much aerosol got into each hemisphere

Sulfur-rich if high H_2SO_4

Estimated N.H. temperature change °C

COMPARISON TABLE OF ERUPTIONS

Eruption & Latitude	Year	Amount of Magma Erupted (km^2)	Stratospheric Aerosol (Mt) S.H.	Stratospheric Aerosol (Mt) N.H.	H_2SO_4 estimate (Mt)	Estimated N.H. Temp change (°C)
Tambora (8°S)	1815	50	150	150	52	-0.4 to -0.7
Krakatau (6°S)	1883	10	~34	55	2.9	-0.3
Santa Maria (15°N)	1902	9	22	<20	0.6	-0.4
Katmai (86°N)	1912	15	0	<30	12	-0.2
Agung (8°S)	1963	0.6	30	20	2.8	-0.3
Mt St. Helens (46°N)	1980	0.3	0	*no info*	0.08	0 to -0.1
El Chichón (17°N)	1982	~ 0.3	<8	12	0.07	-0.2
Pinatubo (15°N)	1991	~ 5	*no info*	~25	~0.3	-0.5
		(Large eruption if lots of magma)	*(How much got into each hemisphere)*		*(Sulfur-rich if high)*	

IMPORTANT: if
NO INFORMATION IS AVAILABLE,
this does not mean the value is zero!

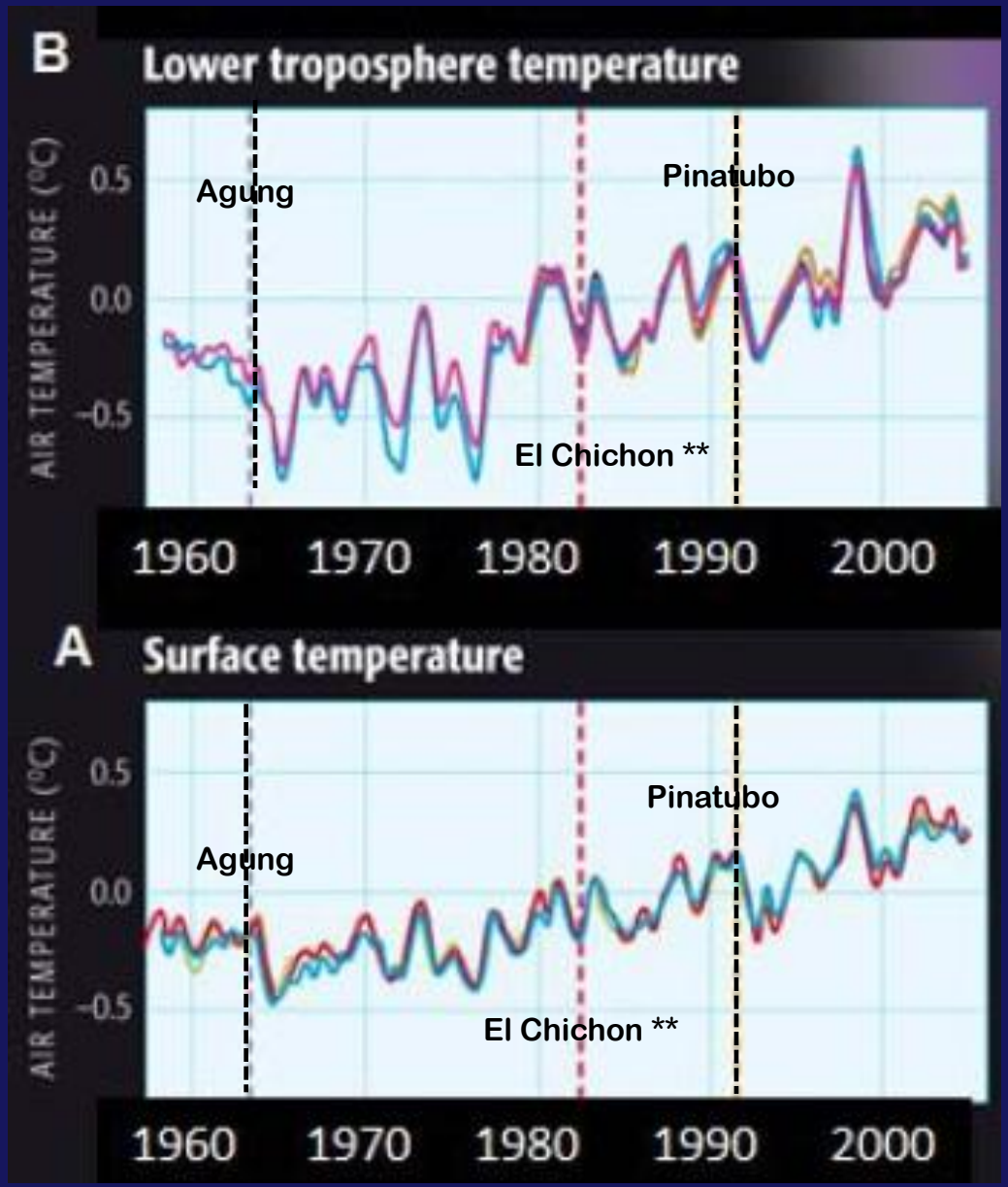
#1. List 4 reasons why Tambora in 1815 resulted in the largest GLOBAL cooling:

 # 2. Give at least two reasons why the eruption of Mt St. Helens was NOT a very climatically effective eruption:

P.S. This is one of my favorite questions to ask on the FINAL EXAM!!!!

Write in the ERUPTIONS at top of page

Agung (1963) Pinatubo (1991)



#3. Which levels show a COOLING and which show a WARMING immediately after the eruption?

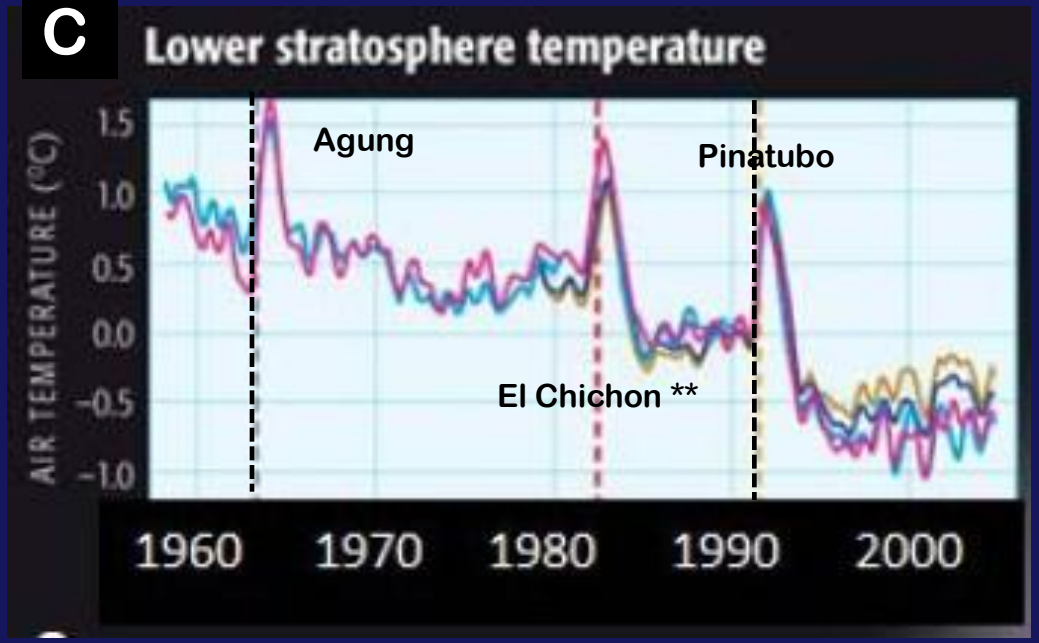
** NOTE: At the time of the El Chichon eruption, there was warming taking place due to a strong El Nino, hence the temperature change after this eruption shows a different response.

When ANSWERING # 3 & #4 – focus on Agung & Pinatubo only

Write in the ERUPTIONS at top of page

Agung (1963) Pinatubo (1991)

C

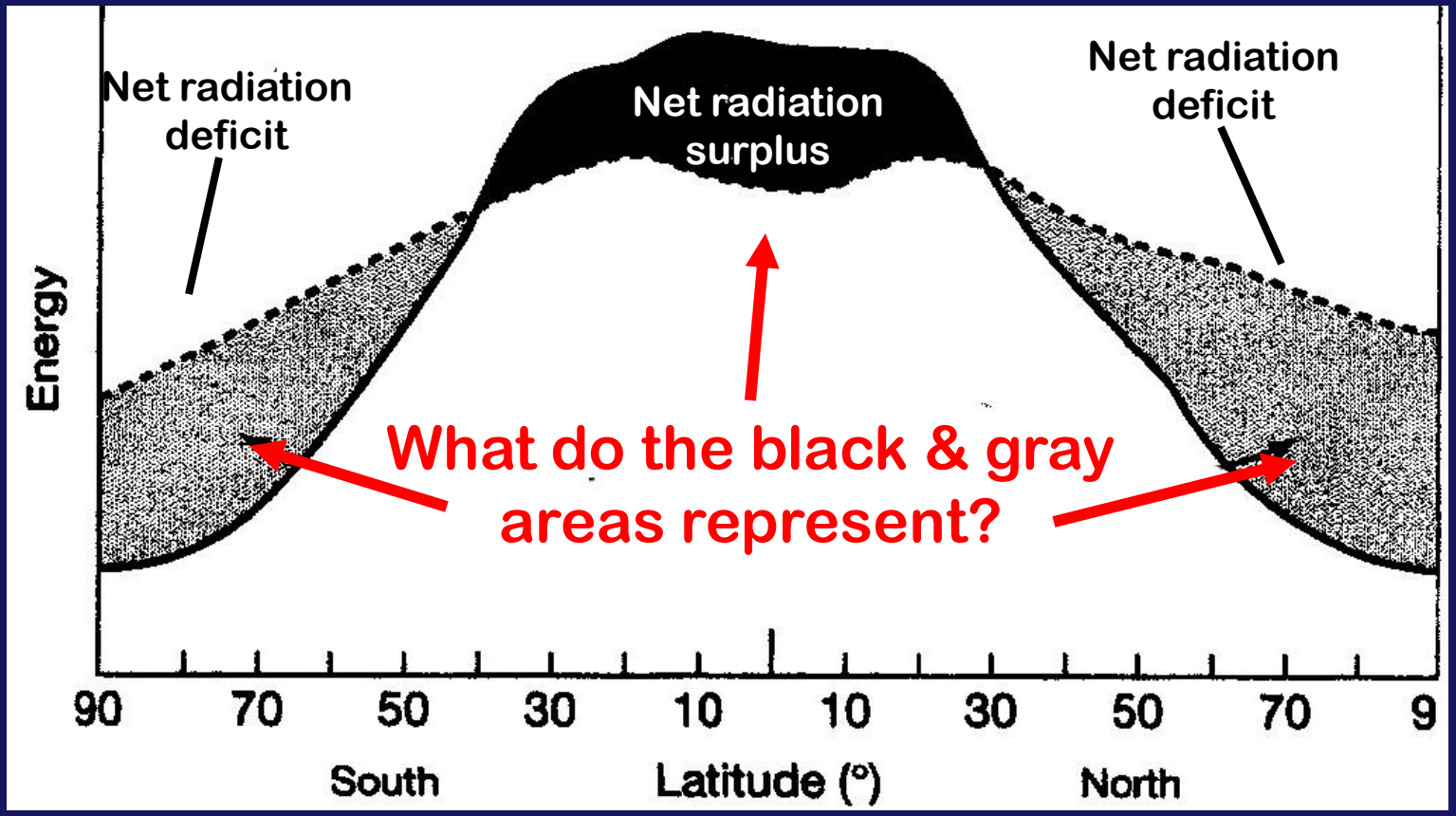


#4. Explain WHY each level's TEMPERATURE responded as it did to the Agung & Pinatubo eruptions?

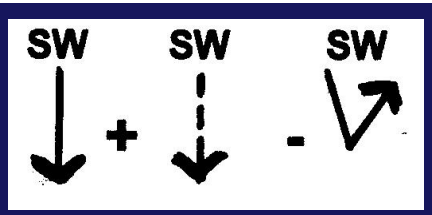
(by referring to the Radiation Balance)

When ANSWERING # 3 & # 4 – focus on Agung & Pinatubo only

REMEMBER THIS IMPORTANT GRAPH?



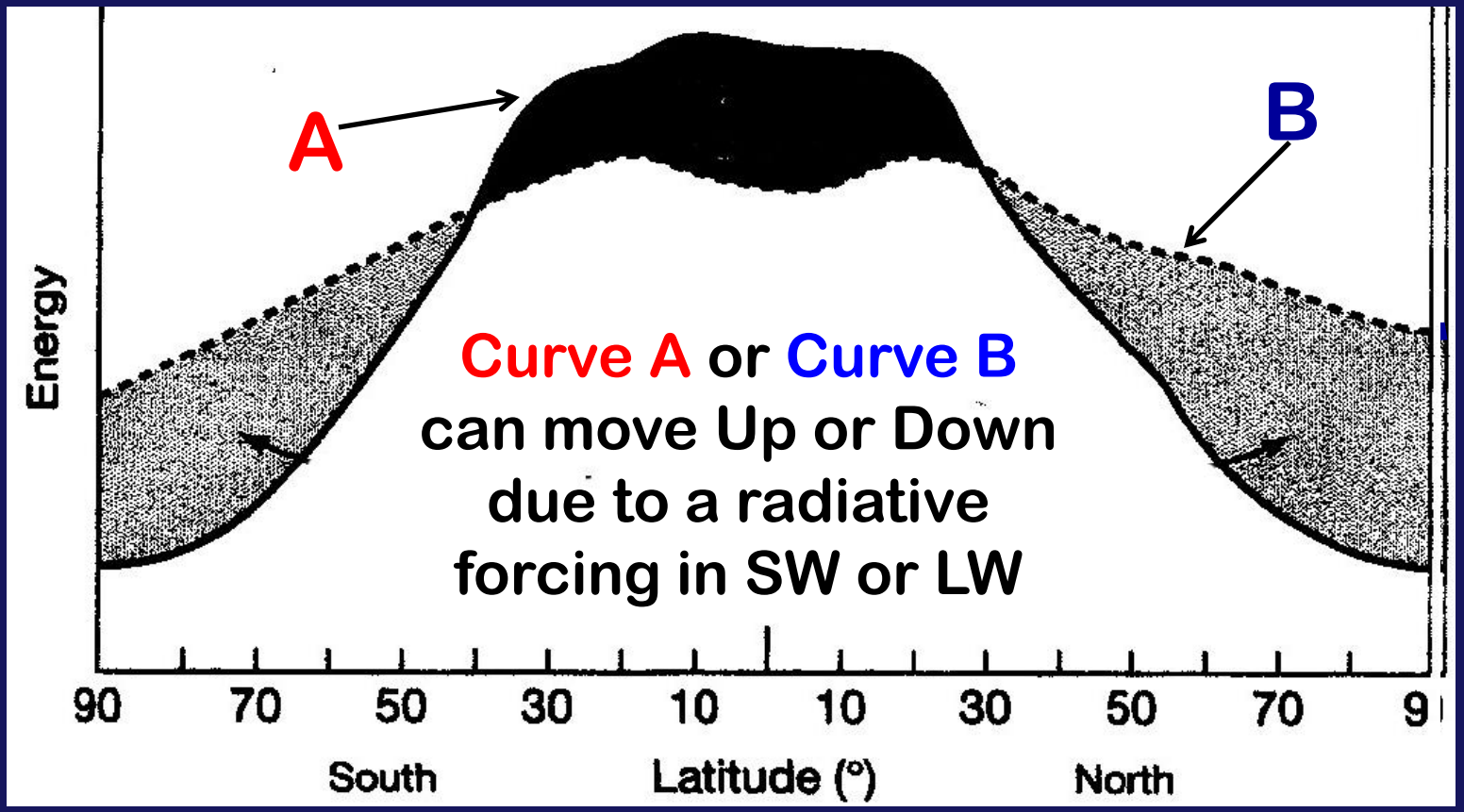
Absorbed solar energy



Emitted infrared energy

(at top of atmosphere)

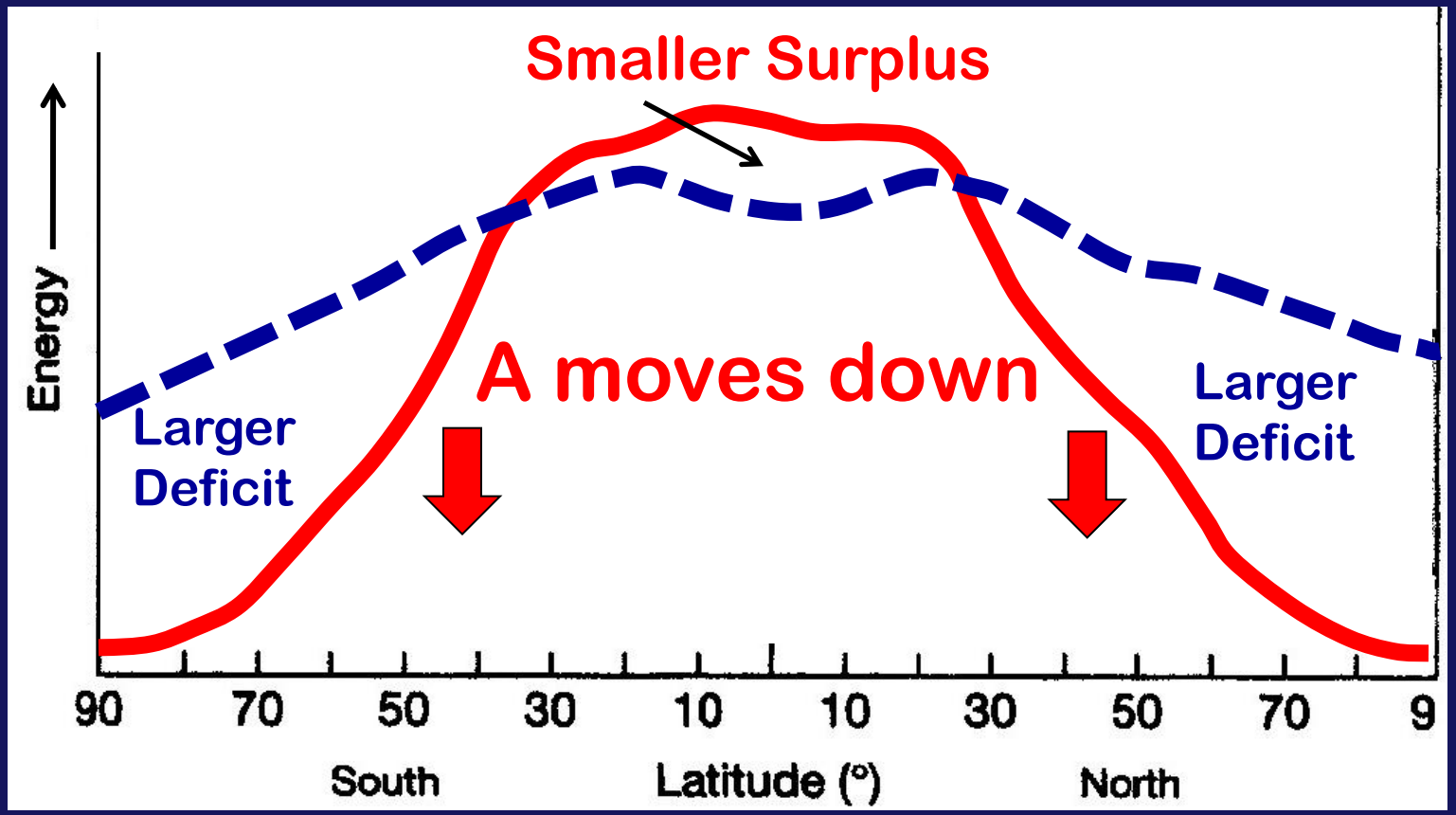
SKETCH A NEW CURVE A OR NEW CURVE B to show how the energy balance would change if a major volcanic eruption occurred .



CURVE A SW + SW - SW

CURVE B LW LW

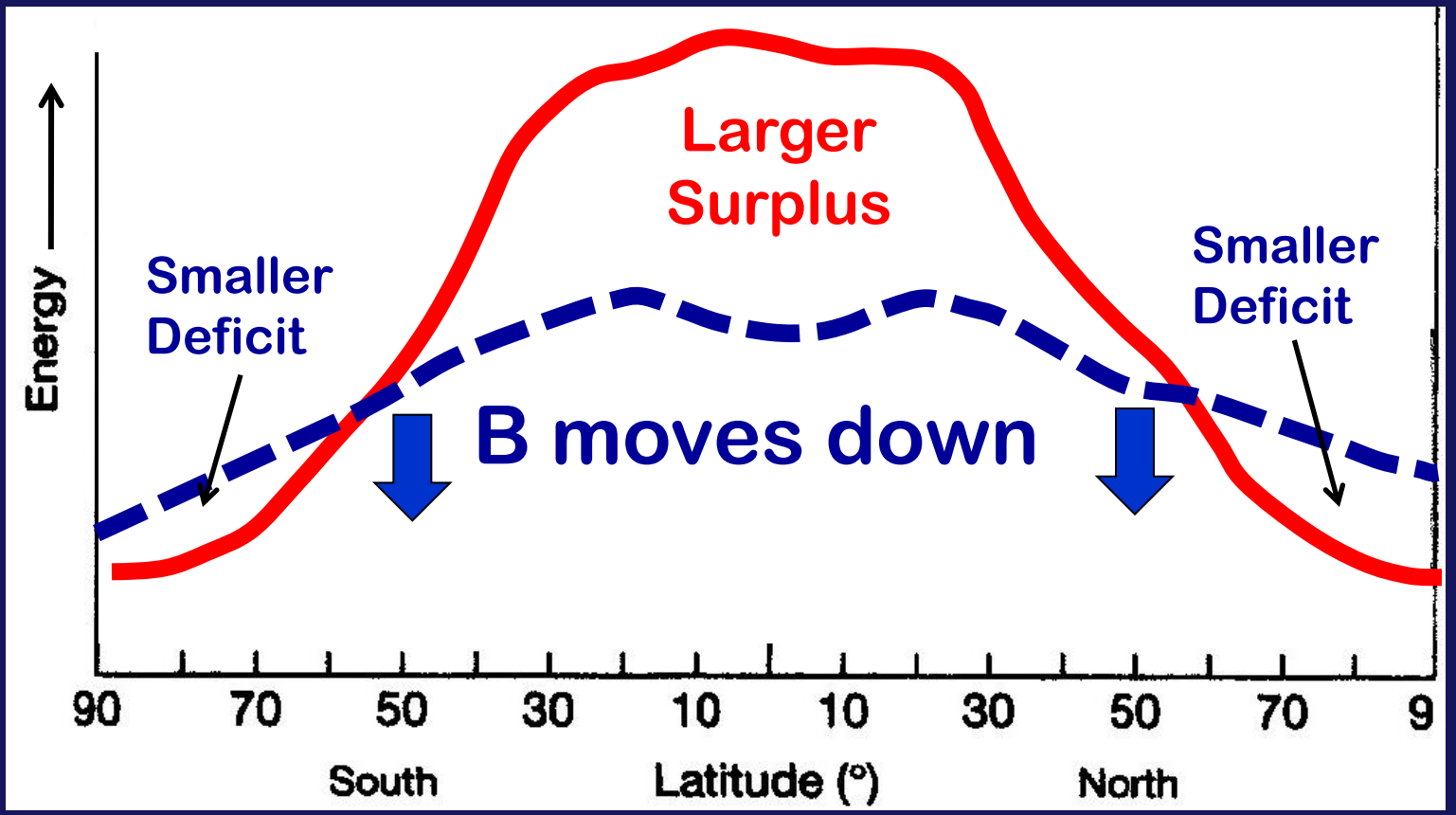
IF CURVE A moves down: SW ↓ + SW ⇣ - SW ↘



SW ↓ + SW ⇣ - SW ↘

If incoming energy represented by Curve A is reduced (A curve goes down)

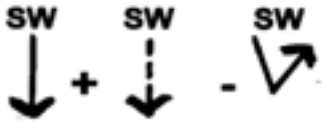
If CURVE B moves down

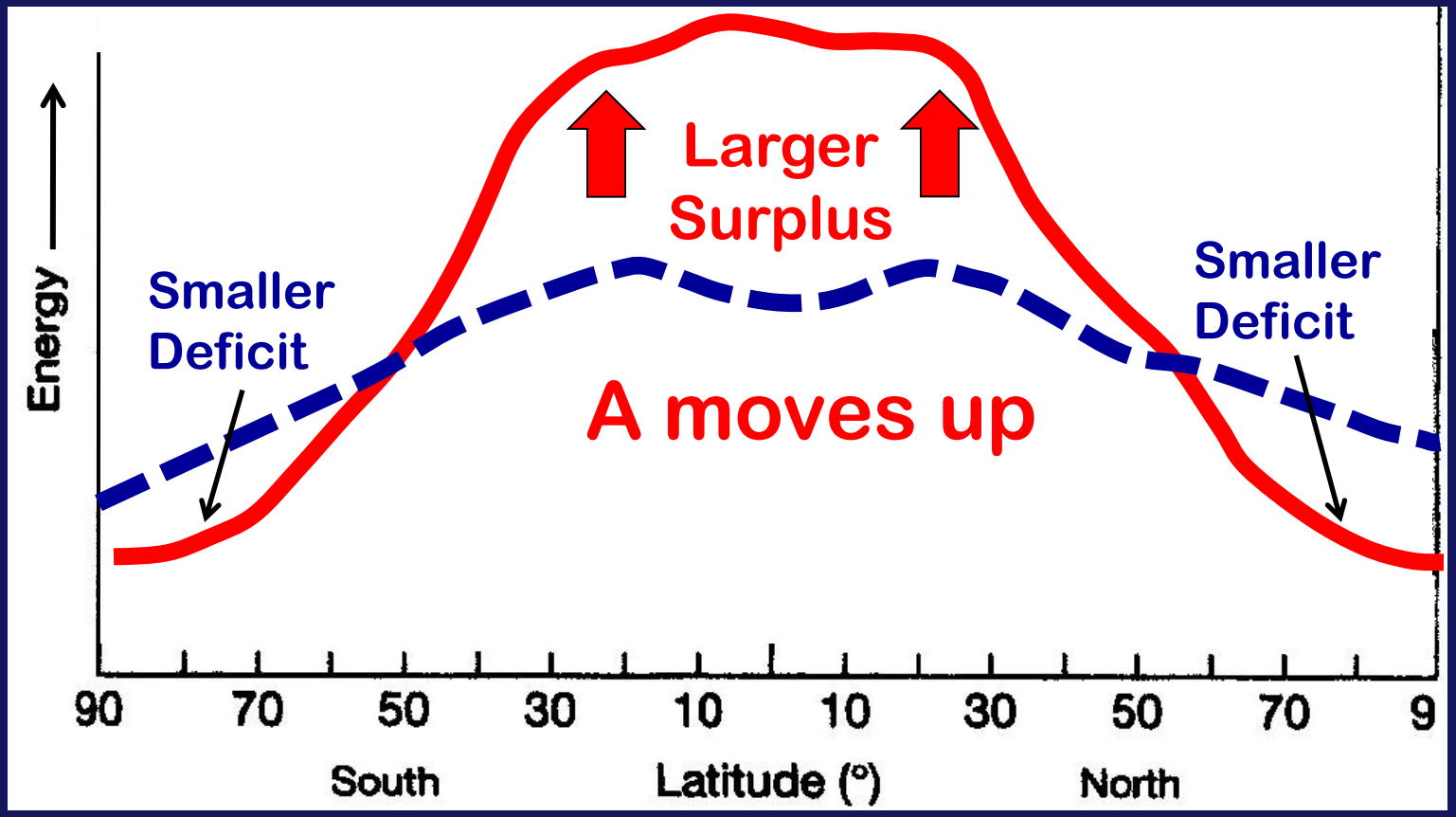


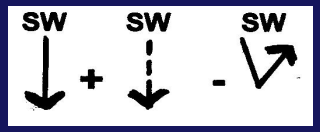
LW

If outgoing energy represented by Curve B is reduced (B curve goes down)

IF CURVE A moves up:

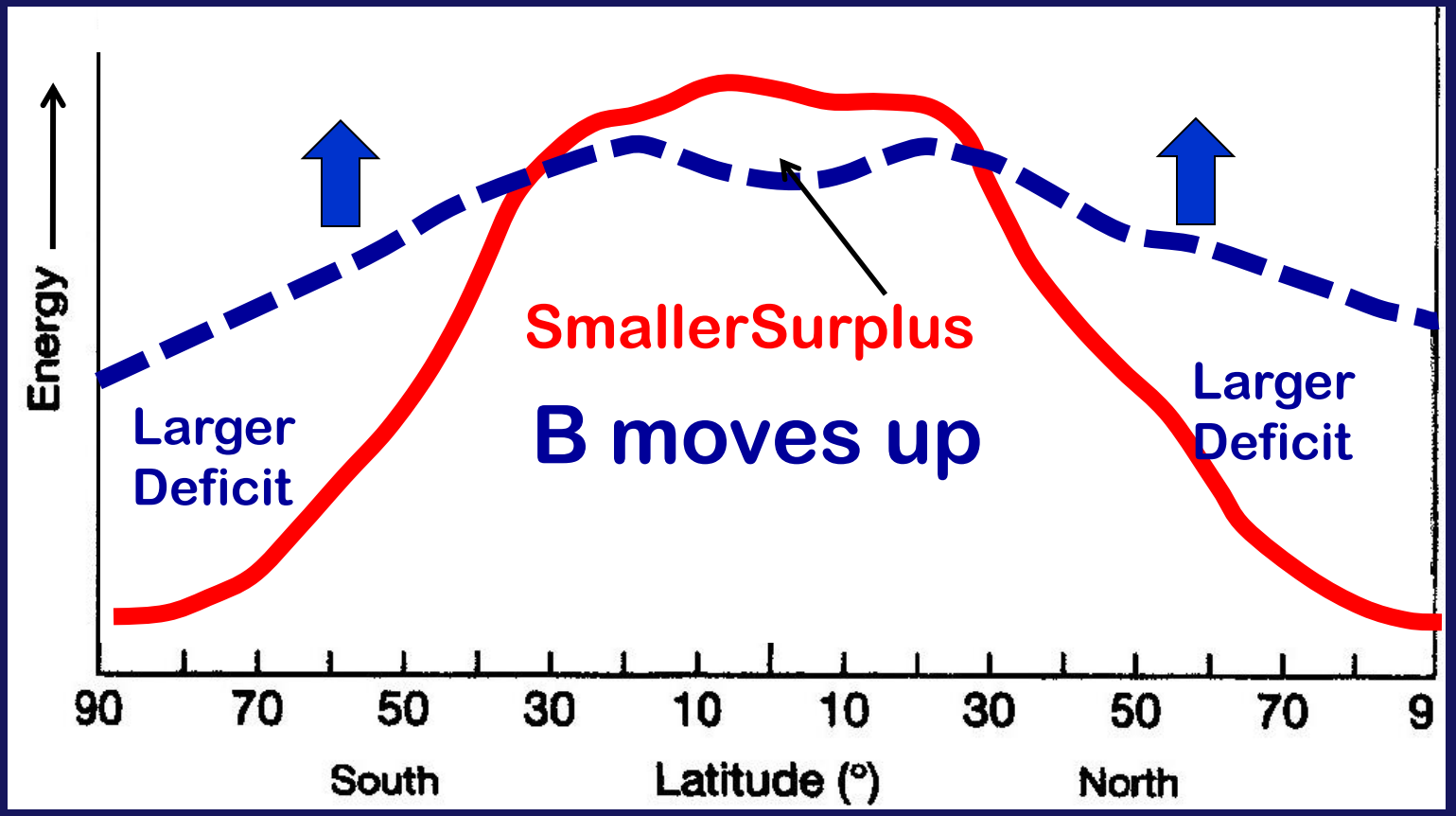






If incoming energy represented by Curve A is increased (A curve goes up)

If CURVE B moves up:



If outgoing energy represented by Curve B is increased (B curve goes up)

Assume:

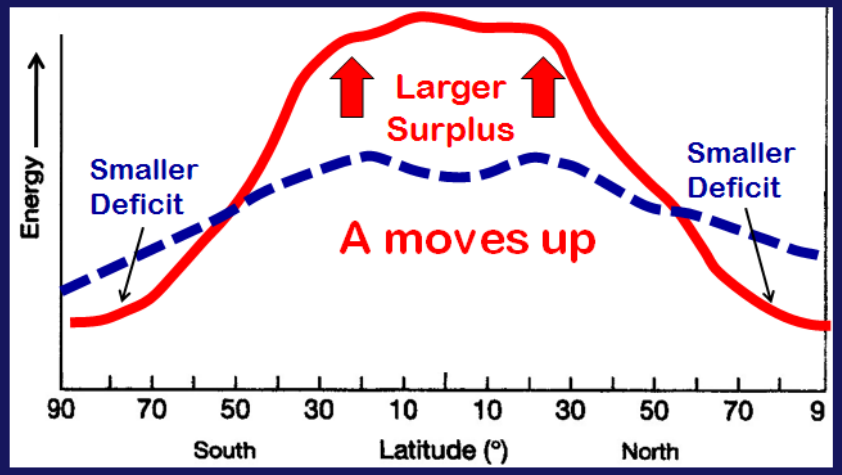
- that the eruption produces a long-lived aerosol veil in the stratosphere over both hemispheres

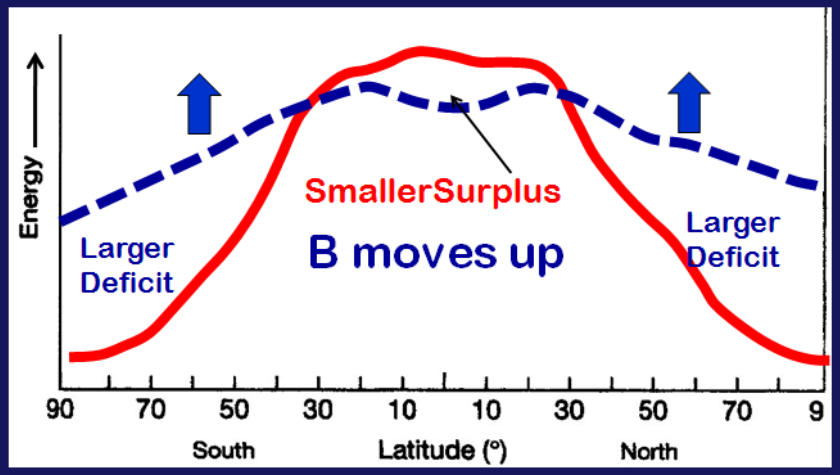
- that this veil reflects large amounts of incoming solar radiation back to space *before* it enters the troposphere's earth-atmosphere system shown in the graph.

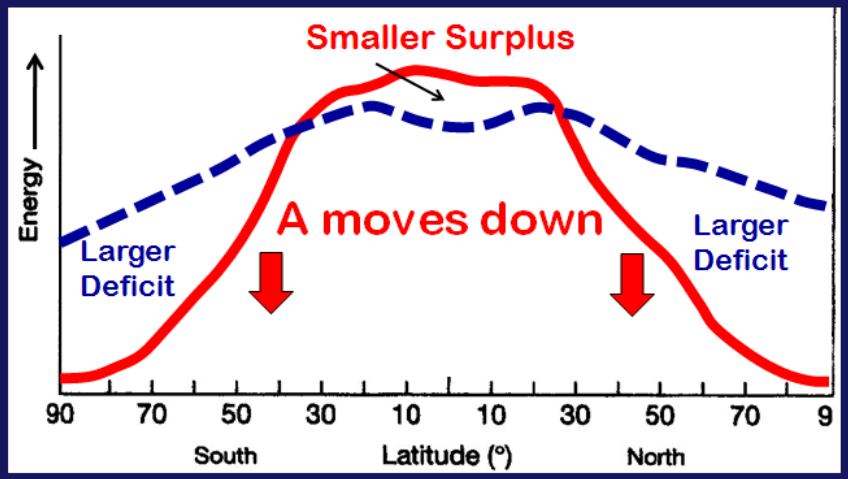
- *Hint: you do not need to worry about stratospheric warming for this question.*

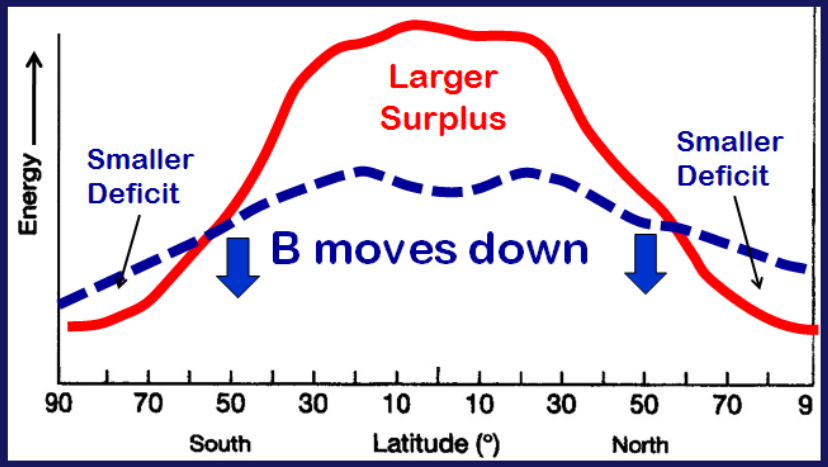
IF CURVE A is affected:

If CURVE B is affected:









Four scenarios are possible for how you should sketch the new graph

HAPPY HOMECOMING!!

GO CATS!