# Models predict a decrease in tropical cyclone activity

Increased tropical Atlantic wind shear in model projections of global warming [Vecchi, 2007]

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# Outline



# 2 Connections





### 5 Conclusion

# Impact of Vertical Wind Shear

#### Factors

- Several environmental factors influence the development of tropical cyclones
- You know that from the lectures.

#### Vertical Wind Shear

Of particular importance: vertical wind shear  $(V_s)$ 

- Big  $V_s \Rightarrow$  inhibits the development of tropical cyclones
- $V_s > 10 \,\mathrm{ms}^{-1} \Rightarrow$  impact is substantial

"strong shear of  $15 \text{ ms}^{-1}$  literally tore an intense strom apart in about one day" [Frank and Ritchie, 2001]

### Connections

#### What depends on what

- weakening of the Pacific Walker circulation
- stronger wind shear in the Caribbean Sea
- Is break down of tropical cyclones

# **Pacific Walker Circulation**



Source: [Matthias Forkel]

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# Weakening of the Pacific Walker Circulation

#### Simulation

- Different rate of response to surface warming of water vapour and precipitation
- weakening of the boundary layer/troposphere mass exchange
- $\approx$  5% per °C warming

[Vecchi, 2006]

## Correlation between Shear and Walker Weakening



- Box indicates the region of strong ensamble mean shear increase.
- Explains  $\approx$  50% of the inter-model variability in shear enhancement region (SER).

## Profiles of Wind at Start and End of 21st Century



Shear Enhancement Region (SER)

Main Development Region (MDR)

Definition

$$V_s = |u_{850} - u_{200}|$$

# Main Development Region (MDR)



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## June–November ensemble mean: $V_s$



## Other Tropical Cyclones Related Indices



Relative humidity at 700 hPa

## Conclusion

#### Change in Wind Shear

- Within 5° of the Equator a noticeable weakening of  $V_s \Rightarrow$  development of tropical cyclones is not possible in this region (lack of corriolis force)
- Main Development Region (MDR) no change in wind shear
- Shear Enhancement Region, more wind shear ⇒ weakening of tropical cyclones

# List of figures I

#### G. A. Vecchi et al.

Increased tropical Atlantic wind shear in model projections of global warming.

Geophysical Research Letters, 34:L08702, 2007.

#### Matthias Forkel

#### Walker-Zirkulation und El Niño

http://www.m-forkel.de/klima/walkz-eln.html

# Bibliography I

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#### G. A. Vecchi et al.

Weakening of tropical Pacific atmospheric circulation due to anthropogenic forcing.

Nature, 441, 73-76, 2006.

W. M. Frank and E. A. Ritchie

Effects of vertical wind shear on the intensity and structures of numerically simulated hurricanes. *Monthly Weather Review*, 129, 2249–2269.

### June–November ensemble mean: $V_s$

