



## Distributional Aspects of Climate Change Impacts

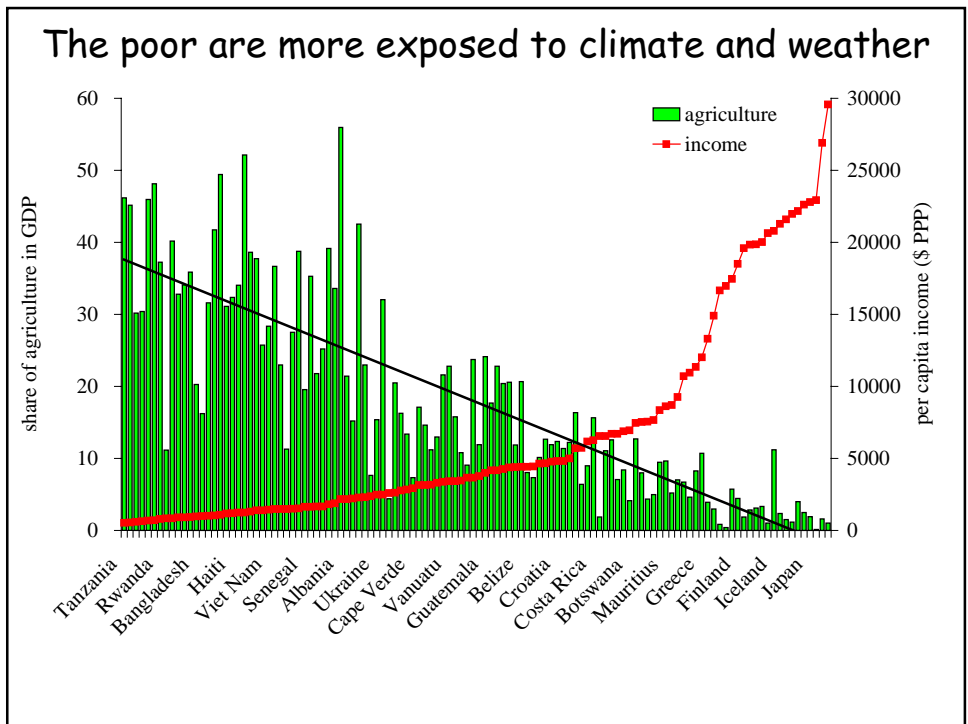
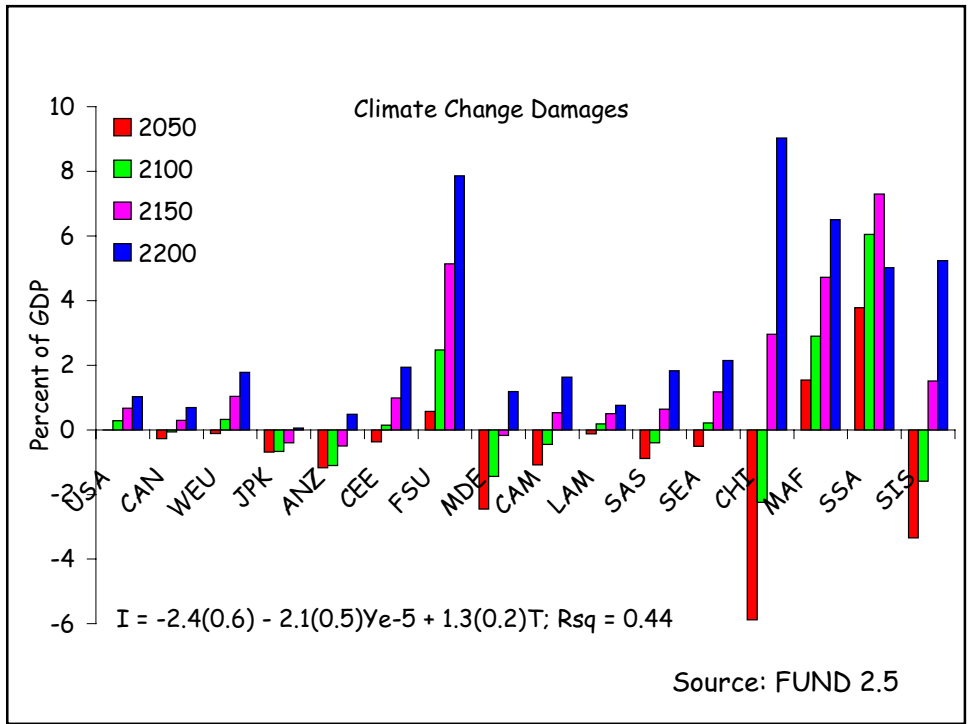
Richard S.J. Tol

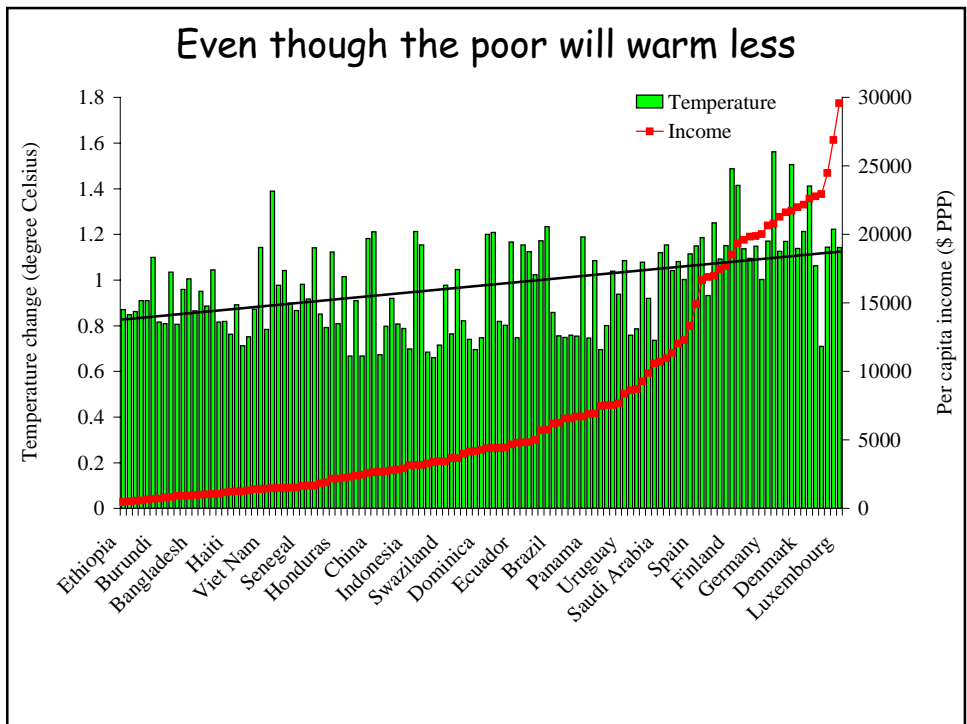
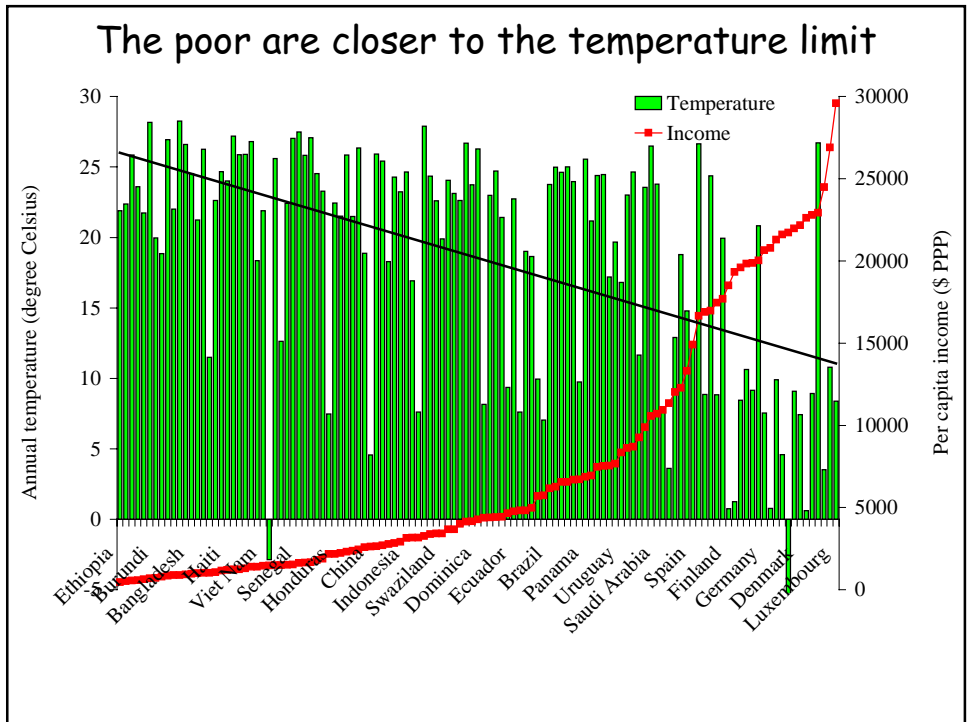
Hamburg, Vrije and Carnegie  
Mellon Universities

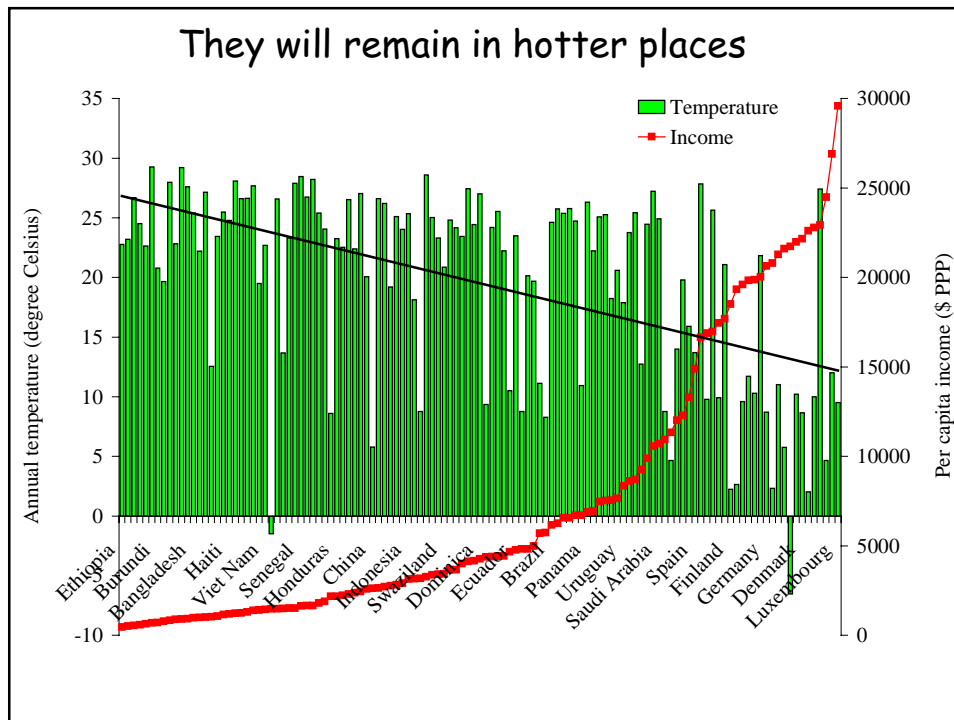


## Climate Change Impacts

- Impact estimates
- The vulnerability of the poor:  
Exposure, adaptive capacity and costs
- Economic development
- Aggregation
- Conclusions

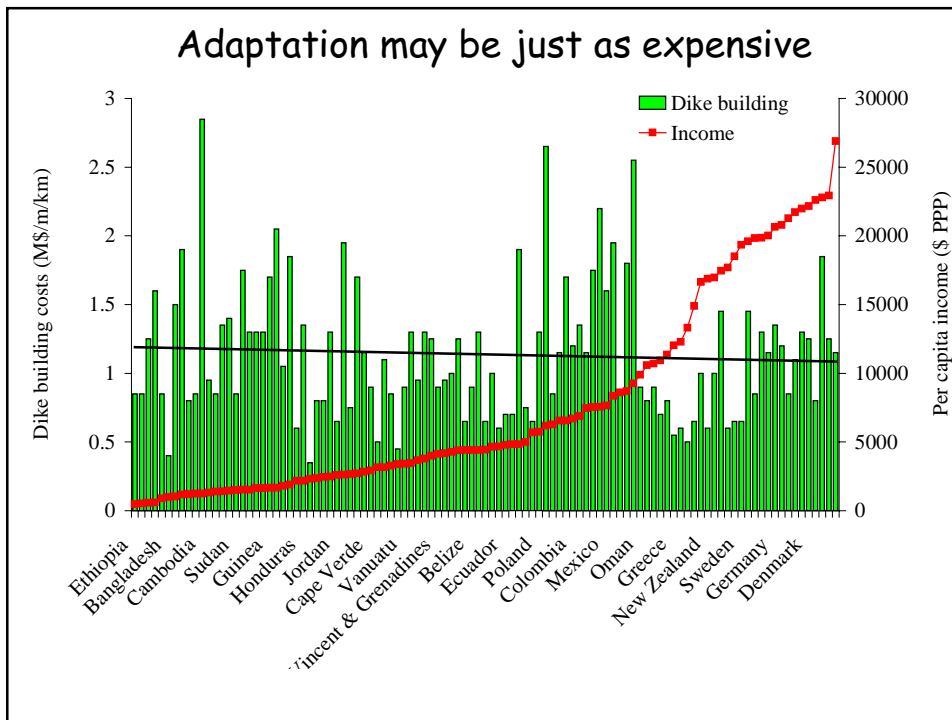






## Adaptive Capacity

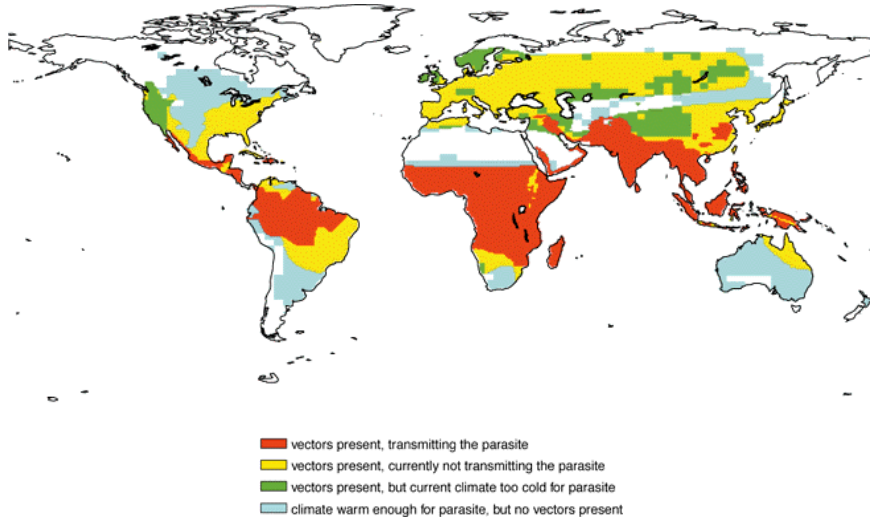
- Is the ability to adapt
- Depends on technological ability, economic resources, and human, political and social capital
- All of which are more limited in poor countries
- The poor are more exposed, and less able to adapt
- Moreover ...



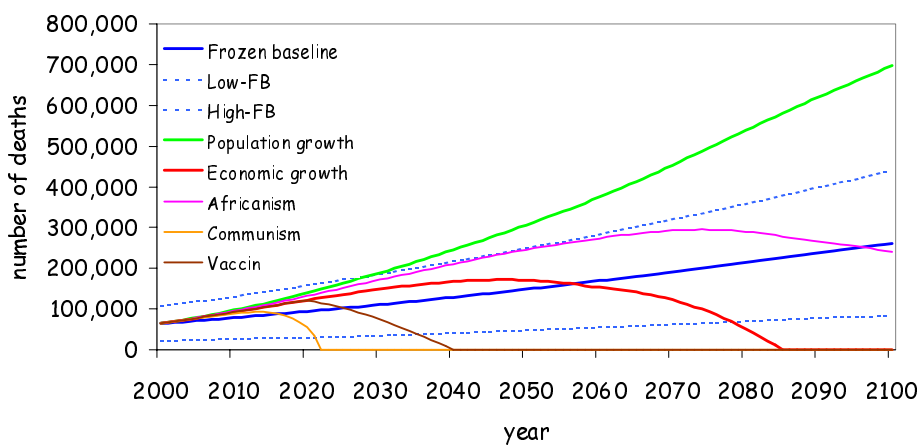
## Economic Development

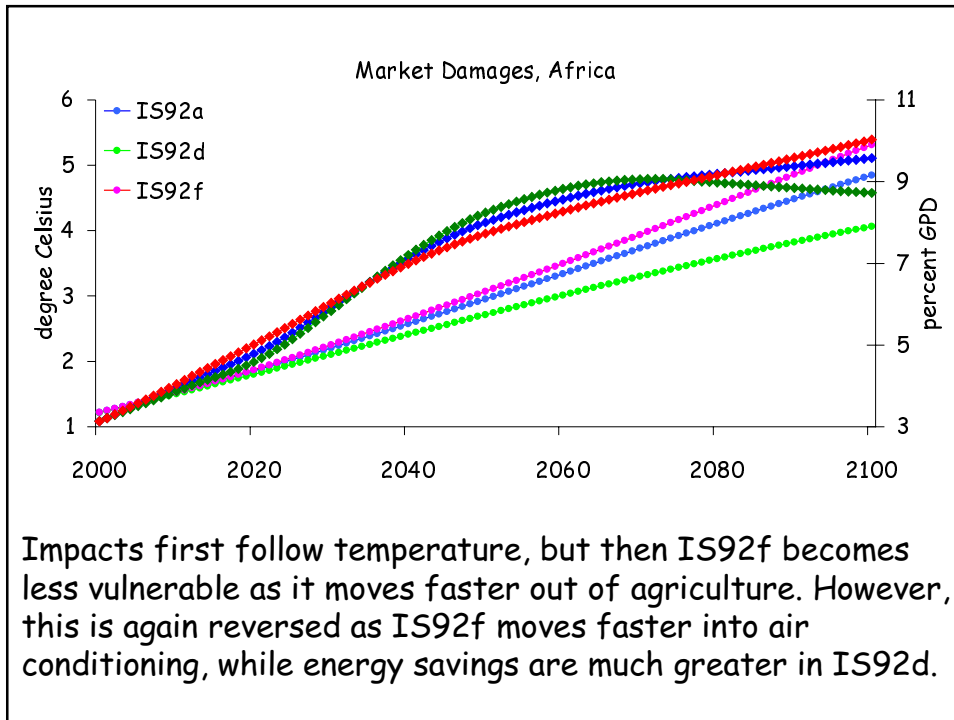
- I have argued that there is a strong link between poverty and vulnerability to climate change
- Therefore, vulnerability would fall if people grow richer - this is indeed part of almost all long-term scenarios
- Let's look at malaria first and then complicate the story with agriculture and energy consumption - all in Africa

## Malaria is a disease of climate and poverty



## Climate change induced vector borne mortality





### Global Aggregate Damage

%GDP	Pearce	Nordhaus	Tol
Output	1.5-2.0	1.5	0.0
Population		1.9	
Equity			0.8

## Equity Weighing

- Equity weights

$$D^{world} = \left( \frac{W_1 u_1^1}{W_M} \right) D^1 + \dots + \left( \frac{W_n u_n^n}{W_M} \right) D^n$$

- Utility and welfare functions

$$u = \frac{y^{1-e}}{1-e}; W = \frac{\sum_i (u^i)^{1-\gamma}}{1-\gamma}$$

- If  $\gamma \neq 0$  and  $e=1$ , or if  $\gamma \neq 1$

$$D^{world} = \left( \frac{y^{world}}{y^1} \right) D^1 + \dots + \left( \frac{y^{world}}{y^n} \right) D^n$$

## Conclusions

- Climate change impacts strongly depend on development, so
- The distribution of climate change impacts is very skewed
- Future vulnerability will be very different from current vulnerability
- The exact relationships are very uncertain, however, and hardly studied
- When aggregating over a skewed distribution, one should be very careful and aware of the implicit moral assumptions