

Climate Change and Human Migration

Michael Oppenheimer

at

People on the Move:
Impacts of Climate Change

on

Human Well-being
University of Geneva

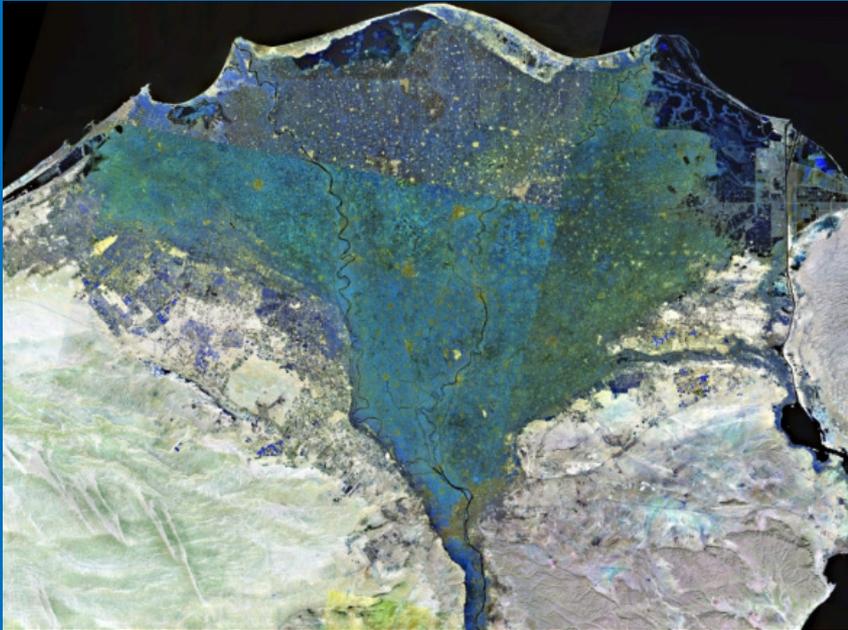
28 October 2010

How Large a Phenomenon Could
Climate-induced Migration
Become Later in This Century?

Some potential drivers of climate-induced migration

- Temperature/climate comfort
- Gradual land loss due to sea level rise
- Land becoming marginally habitable due to episodic flooding, perhaps stronger storms combined with higher sea level
- Relative changes in agricultural production potential

Example: Increasing Risk to Deltas



Projected Sea Level Rise for Bangladesh

Shading Indicates Population Density



Sea level rise
could
prove
disastrous
in some regions

Courtesy J. Broadus



Deltas Worldwide Population 500,000,000

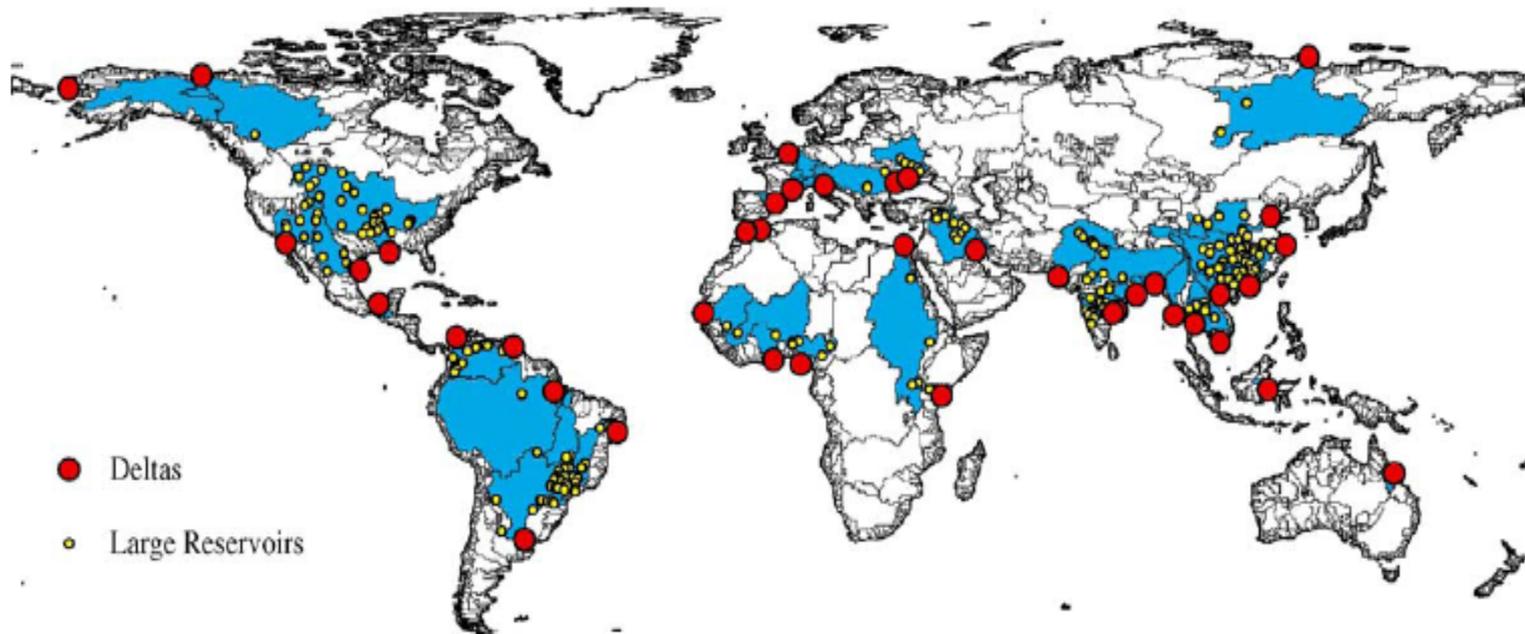
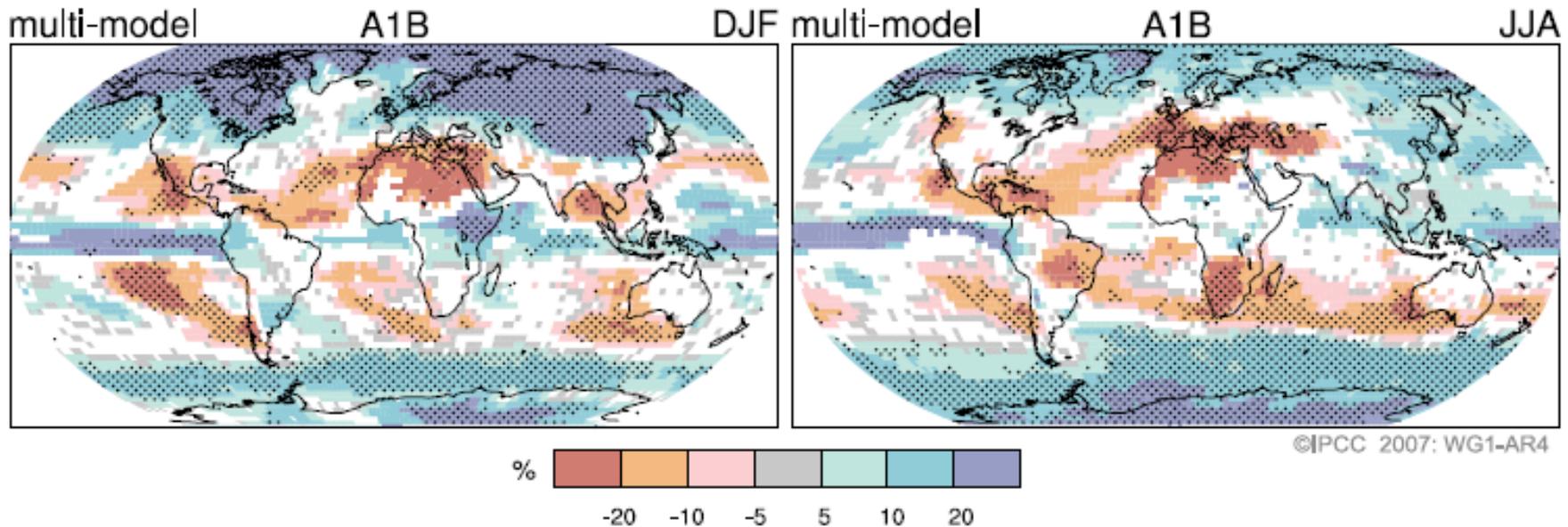


Fig. 1. Global distribution of the 40 deltas analyzed in this study, the potentially contributing drainage basin area of each delta (blue) and the large reservoirs (>0.5 km³ maximum capacity) in each basin.

Another Driver: Projected Drying Year 2100 (A1B scenarios, compared to current climate)

PROJECTED PATTERNS OF PRECIPITATION CHANGES



Food production tends to decline, low latitudes, 1-3°C

Complexity of migration: multiple factors

- Push/Pull: migration as a strategy rather than tragedy
 - >Policy, economic, and political context
 - >Immigration as a special case
- Each locality/border different: e.g., networks,
- Distance and duration matter
- Complex relation to good vs. bad economy

Quantifying outcomes: Diverse techniques for climate &/or other environmental drivers

- Global estimates (Tickell, Myers and Kent, Stern)
- Nepal (Massey et al)
- Burkina Faso rainfall (Henry et al)
- US Dust Bowl (McLeman and Smits)
- New Orleans (Hurricane Katrina)
- Kniveton et al for IOM

Earlier Studies of Mexico

- Climate disasters (Saldaña-Zorrilla and Sandberg)
- Rainfall (Munshi)

But these methods can't be used to project into future to determine migration/immigration

Motivations for Current Study

(Feng, Krueger, Oppenheimer, PNAS 2010)

- Seek confirmation (or not) that climate-induced migration may be significant
- Complement existing studies
- Test methodology for projection elsewhere

Strategy of Current Study

- Use recent sensitivity of migration to climate-related crop yield changes to project response to future climate changes
- Statistical approach isolates climate factor
- Mexico: large flows, good data, familiar case

Method of Current Study

- Infer immigration from state-level census data, 1995-2005
- Statistical analysis of climate-related crop yield changes (wheat, corn), same period
- Apply instrumental variable (Temp, Precip) method to state-level data (not time series); compare two 5-yr periods
- Infer sensitivity of immigration to climate-related crop yield variations: *change* in immigration associated with climate-related *change* in yields

History is an imperfect guide:
Responses to climate variability may
differ from responses to climate change

In studying past and recent migration,
climate (variability) is often a small signal
amid a welter of “noise” (other factors)

Results of Current Study (response to recent climate variability)

- Every 10% reduction in crop yield due to temp., precip. variations is associated with a 2% increase in immigration (i.e., sensitivity ~ 0.2)
- Robust results: Insensitive to border/non-border states (e.g., to NAFTA), crop type, climate variable, rural/non-rural states

Projections

- Use projected climate-related crop yield changes for late 21st century (moderate warming, 1-3^oC)
- Apply recent sensitivity (0.2)
- *All other things kept constant (ceteris paribus)*
 - >>>relative status of US/Mexico economies
 - >>>demographic distribution
 - >>>vulnerable sector of comparable size

Table 3. Forecast of future Mexican emigration at the national level under different climate scenarios

| Scenario | | Change in crop yields, % | Change in emigrants as percent of population, % | Change in no. of adult emigrants, millions [†] |
|---|-------------|--------------------------|---|---|
| CO ₂ effect | Adaptation* | | | |
| Rosenzweig and Iglesias (38): GISS [‡] | | | | Current in US ~ 12M |
| No | No | -46 | 9.2 | 6.4 |
| Yes | No | -35 | 7.0 | 4.9 |
| Yes | Level 1 | -27 | 5.4 | 3.8 |
| Yes | Level 2 | -13 | 2.6 | 1.8 |
| Rosenzweig and Iglesias (38): GFDL [‡] | | | | |
| No | No | -39 | 7.8 | 5.5 |
| Yes | No | -28 | 5.6 | 3.9 |
| Yes | Level 1 | -20 | 4.0 | 2.8 |
| Yes | Level 2 | -10 | 2.0 | 1.4 |
| Rosenzweig and Iglesias (38): UKMO [‡] | | | | |
| No | No | -48 | 9.6 | 6.7 |
| Yes | No | -37 | 7.4 | 5.2 |
| Yes | Level 1 | -31 | 6.2 | 4.3 |
| Yes | Level 2 | -15 | 3.0 | 2.1 |
| Cline preferred estimates [§] | | | | |
| No | Not Clear | -35 | 7.1 | 5.0 |
| Yes | Not Clear | -26 | 5.1 | 3.6 |

Additional Limitations of Current Study

- Period (1995-2005) of large changes in border policy, NAFTA, climate swings (hidden covariance or robust variation?)
- Mexico a special case (confounds and clarifies):
cannot extrapolate geographically
- Provides no insight on individual motivations
- One very recent 2100 crop yield response estimate lower
- Linear model, possible non-linear immigration response
- Extrapolating response to variations into a trend

General Conclusions

- Suggests *potential* for large response elsewhere
- Future studies planned: domestic migrations (China, US), other borders (comparatives)
- Ideally, combine quantitative and qualitative, local and regional, ethnographic studies, interviews, surveys, local data, agent based approach