

# Innovations in managing extreme climate risk: Are there linkages to global and regional commodity prices ?

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Global Food Production and Markets:

Long-term Challenges and Short-Term Fluctuations

Oslo, Norway

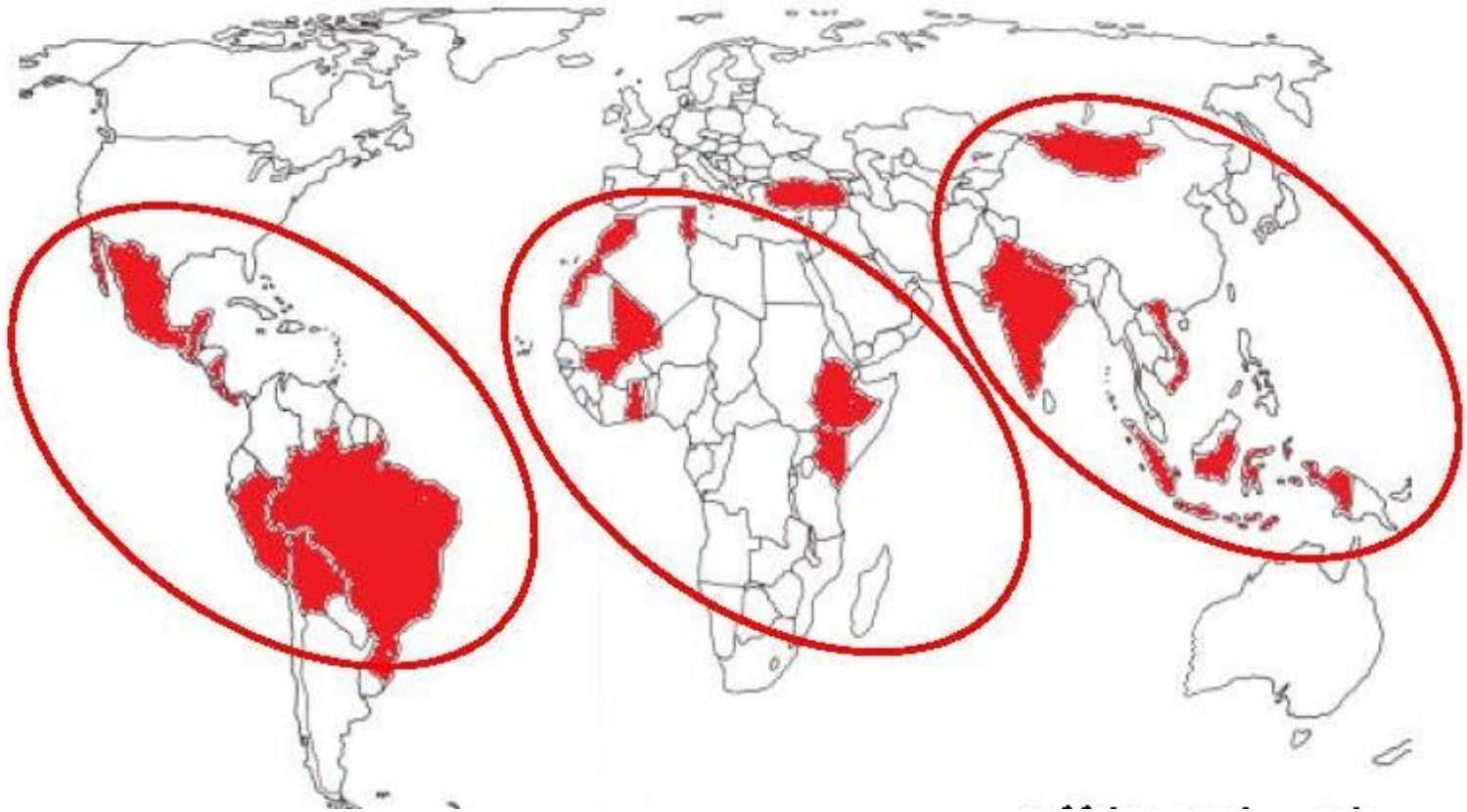
November 21, 2014

Centre for Commodity Market Analysis at the NMBU School of  
Economics and Business

More than 30 years of varied experience focused on discovery of new approaches for risk management

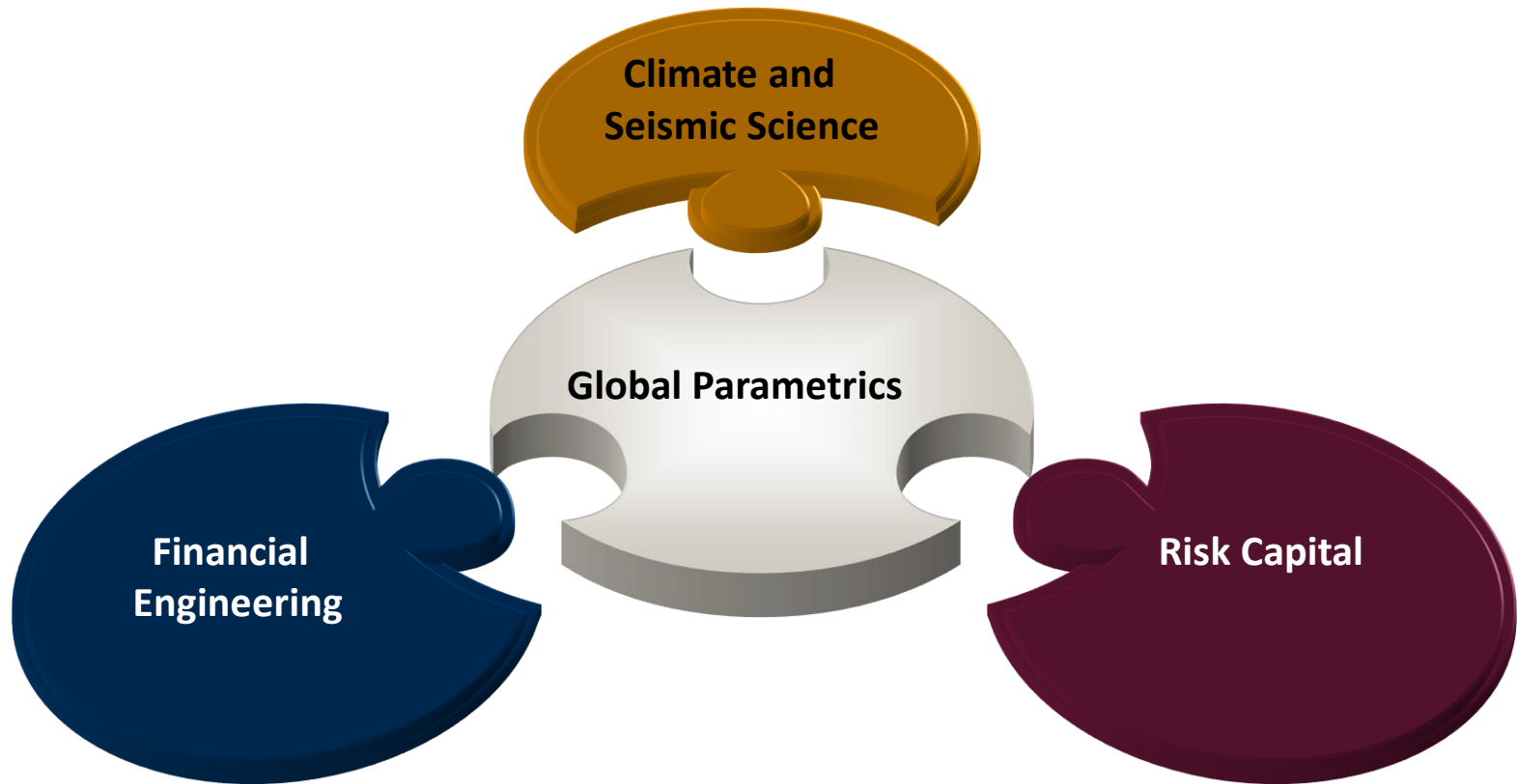
- *Academia* (University of Kentucky)
  - Professor of Agricultural Economics since 1981
- *Government* (US Crop Insurance)
  - Director of Research for Congressional Commission 1989
- *Consultant* (US Crop Insurance Industry)
  - Modeled Standard Reinsurance Agreement 1995-2000
- *Development Community* (GlobalAgRisk)
  - Founded in 2001
- *Entrepreneur* (Global Parametrics)
  - Support England (DFID) and Germany (KfW) 2011-Current

GlobalAgRisk a research and development firm  
Major efforts in Peru, Mongolia, Vietnam, and Indonesia



# Global Parametrics:

## An innovative, socially-oriented venture



.Late stage discussions underway with DFID to act as lead investor in GP with full launch targeted for 2015 – Financial disaster risk management for low and middle income countries

# Price volatility and disruption in food and agricultural markets

“Variations in prices become problematic when they are large and cannot be anticipated and, as a result, create a level of uncertainty which increases risks for producers, traders, consumers and governments and may lead to sub-optimal decisions. Variations in prices that do not reflect market fundamentals are also problematic as they can lead to incorrect decisions.”

Interagency Document – 2 June, 2011

# Supply disruptions, including climate, are increasingly contributing to price volatility

“Simulations and empirical evidence show that climate change continues to initiate volatility in food grain markets (Nelson et al. 2009; Abbott et al. 2011; Gilbert 2010).”

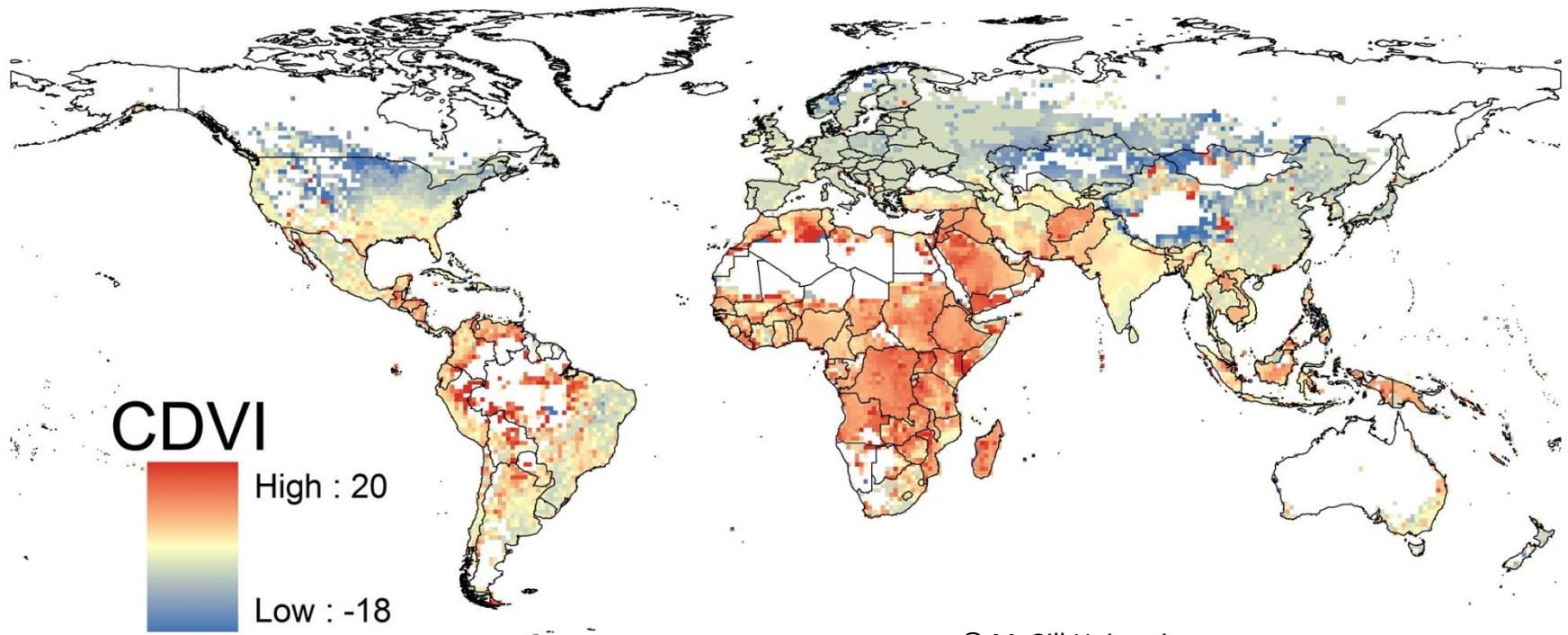
Correlation between supply shocks and price volatility

<b>Years</b>	<b>Maize</b>	<b>Wheat</b>
<b>1970–79</b>	-0.29	-0.28
<b>1980–2005</b>	0.24	0.48
<b>2006–09</b>	0.59	0.56

Von Braun and Tadesse (2013)

# Future Regional Vulnerability of Human Populations

## *Climate-Demography Vulnerability Index (CDVI)*



Regions with a high CDVI are expected to be most negatively impacted by climate change.

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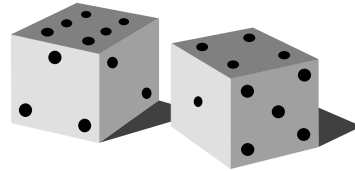
Source: Samson, J. et al. (2011) Geographic disparities and moral hazards in the predicted impacts of climate change on human populations. *Global Ecology and Biogeography*.

## Climate change/production risk/price volatility

- Greater climate driven supply disruptions are a reality
- Policy prescriptions are needed to address price shock impact on the most vulnerable; Mechanisms are needed to help manage impact of production shocks
  - Agricultural lenders
  - Value chain firms
  - Vulnerable households
- What market-based solutions are available to manage large climate production shocks and price volatility?



# Markets for different types of risk



## Examples:

Auto Accidents

*Natural Disasters*

Commodity Prices

Heart Attacks

*Extreme Events Disasters*

Interest Rates

## Institutions:

Insurance Markets

*CAT BONDS & Govt*

Futures Markets

Index insurance

## In-between risk: Derivatives/ Insurance /Cat Bonds

- 1980s some first weather insurance (California)
- Mid-90s attempt to trade Iowa corn yields on CBOT
- Mid-90s attempt to trade hurricane risk on CBOT
- Late-90s weather trades for energy companies
- Late-90s CAT Bonds are implemented
- 1997 World Bank work begins on weather index ins.
- 2002-2007 Ground work for hedging food security
- 2005-2007 CME weather derivate contracts
- 2005 Gov't of Malawi purchased call option
- 2005-2010 Developed El Nino Insurance in Peru
- 2007 Caribbean Catastrophe Risk Insurance Facility
- 2013 African Risk Capacity is launched

# Weather drivers of Price Volatility

- Weather shocks (supply)
- Reactions to Weather shocks (policy)
  - Contribution of gov't actions with trade policies
    - Rice
      - 2006-8, 45% increase
    - Wheat
      - 2005-8, 30% increase

Source: Martin & Anderson (2011)

## Where is the knowledge?

- All major agribusiness today have climate scientists working beside commodity analyst
- In 2002, weather – corn model for Midwest corn in the US that used rainfall and temperature extremes in the top corn producing states
- Model had ability to forecast national yields with in-sample and out-of-sample data
- When regional weather 10 day forecast were added, the model improved the forecasting ability and the ability to make the early call on national crop yield (late June)
- Air World-wide has such modelling services to U.S Crop insurance sector

# Food price volatility hurts the poor the Most

- People in developing countries spend as much as 75% of their income on food
- Price spikes can lead to undernourishment in children with life-long developmental consequences
- Price crises lead to coping strategies of changing diets, selling productive assets, withdrawing children from school, early marriage, migration, etc.
- Vulnerability to price shocks also affects smallholders, most of whom are net food consumers. They also typically lack access to credit to expand production when prices are high, while also lacking hedging mechanisms to protect them from future collapse in prices

## Ethiopia Food Security 2002-2007

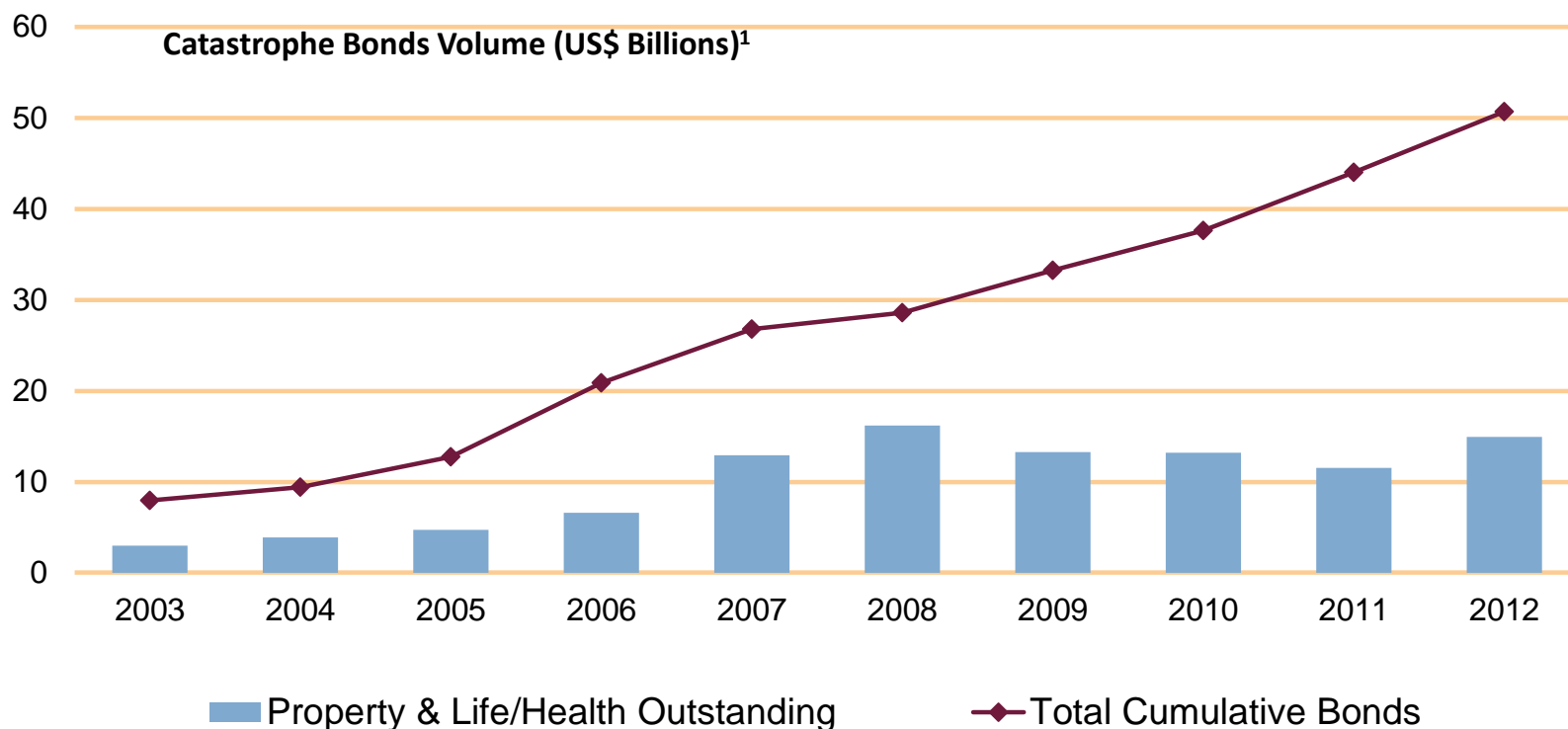
- World Bank took idea of using insurance-like solutions to hedge for food security to the World Food Program
- 2003 Built a portfolio model of crop yields tied to local production and weather to create a national index of Ethiopia food production
- Model demonstrated a high correlation with infusion of food aid into Ethiopia
- 2005 the first weather derivative was purchased to pay out if an Ethiopia crop failure were forecasted
- 2013 the African Risk Capacity was founded to hedge food security for African Union States

# ILS Fund Managers Balance a Fund of Investments in Catastrophe Risk

- Earthquake and Wind Storm risks that have return periods of 1 in 100 (long tail risk) are pooled into a ILS fund to create a well-diversified portfolio of risk
- Pension fund investors are increasingly drawn to investing in these funds
  - Great hedge for equity stock investments
  - Extreme catastrophe risk may be less volatile than investing in the stock market

# CAT Bonds: Growth in Securitization Risks

## Insurance linked securities (ILS) securitization of disaster risk

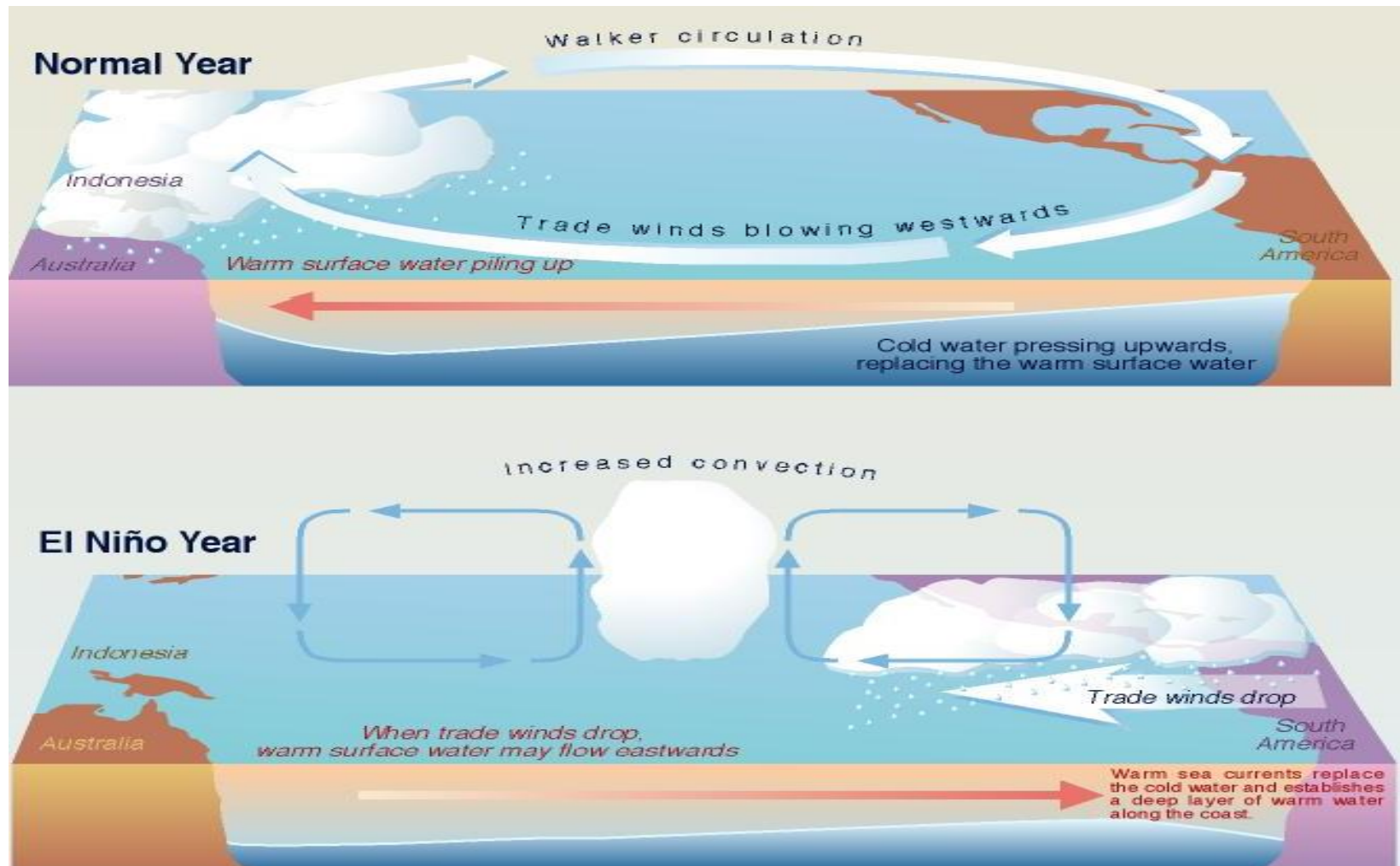


*1. Source: Aon Benfield Securities*

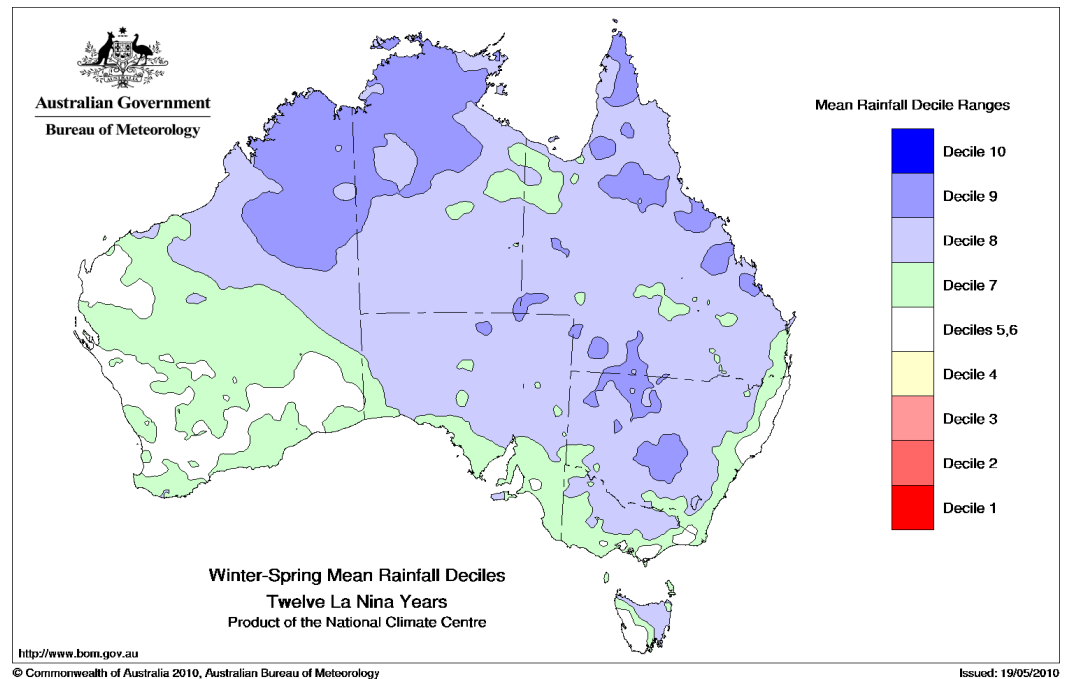
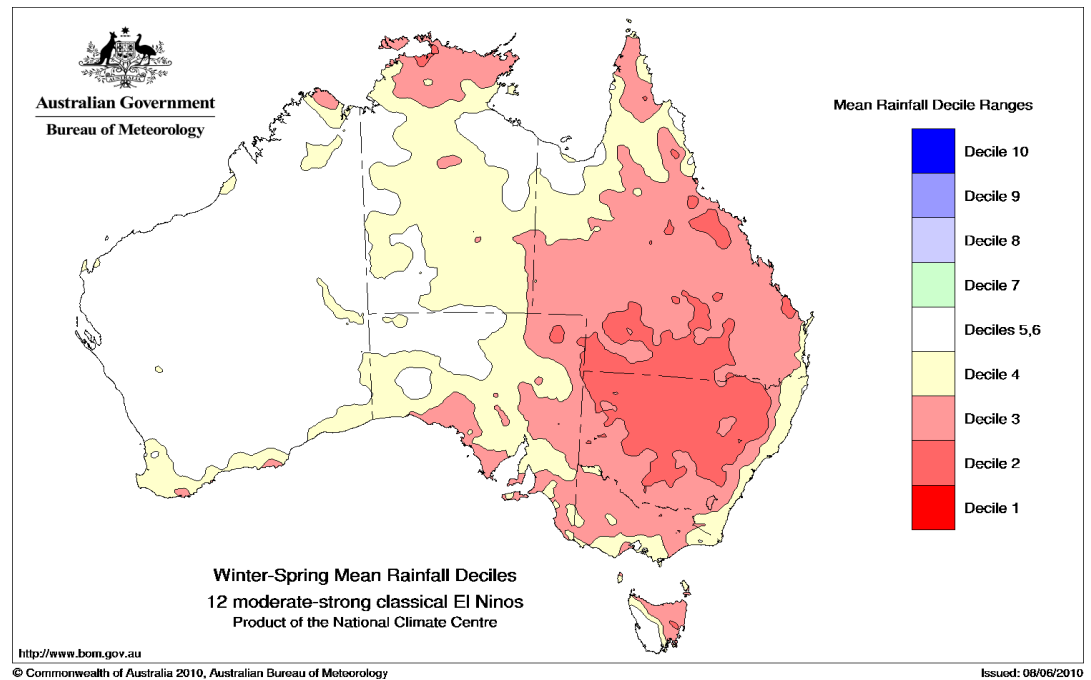


# El Nino Southern Oscillation (ENSO)

## Teleconnection impacting many regions of the world

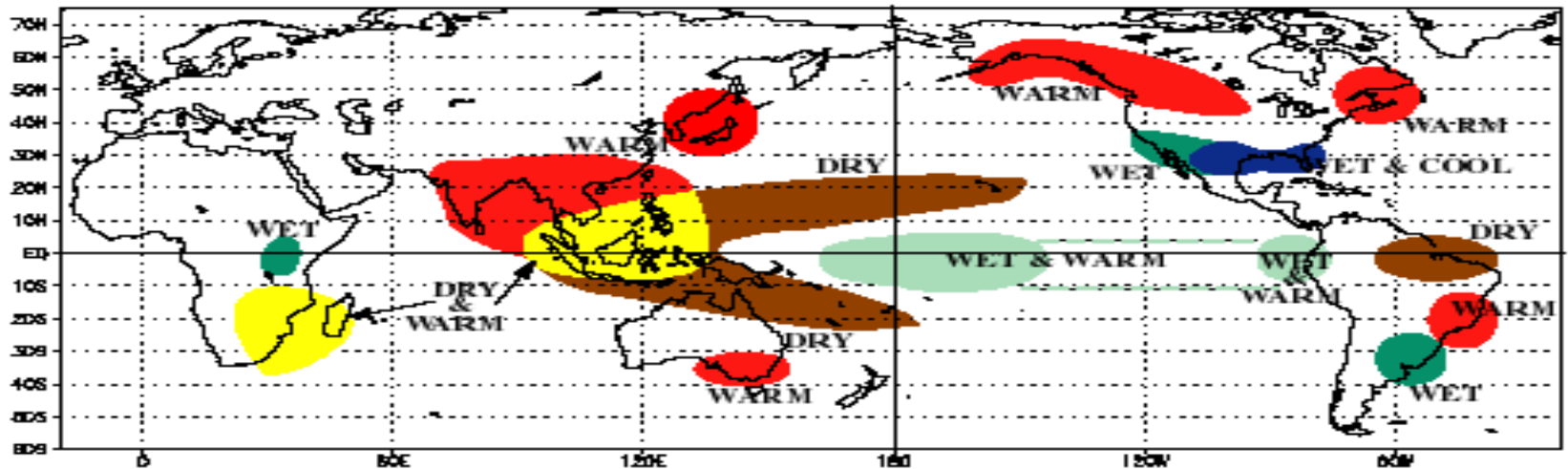


- Representation of rainfall anomalies associated with El Nino and La Nina over Australia.

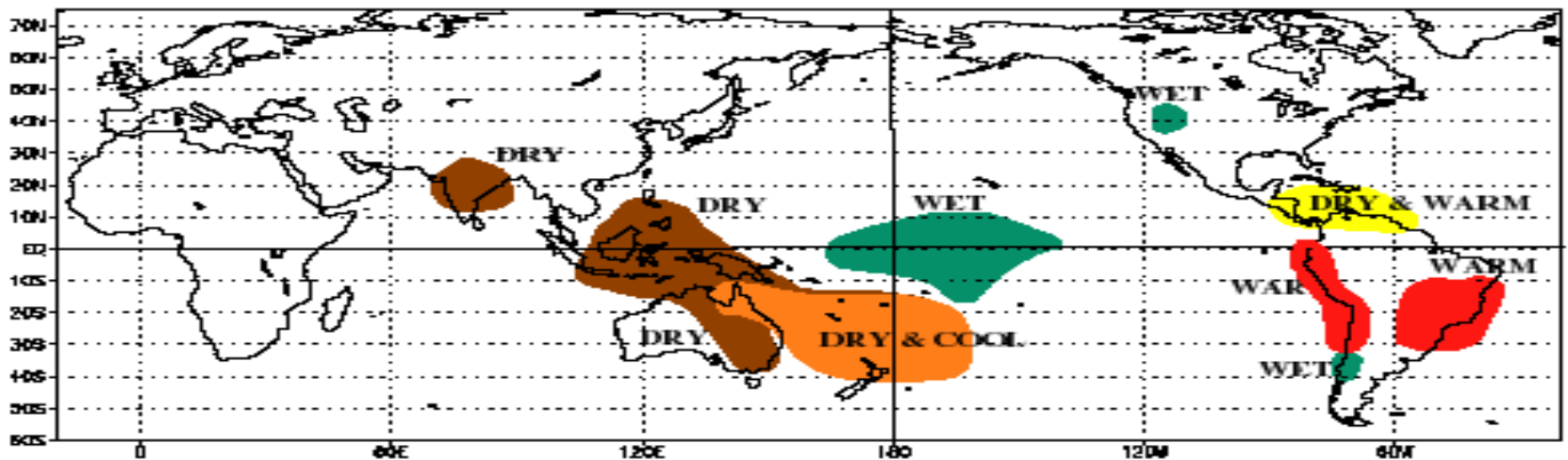


# Precipitation and Temperature Anomalies Associated with El Nino

## WARM EPISODE RELATIONSHIPS DECEMBER - FEBRUARY

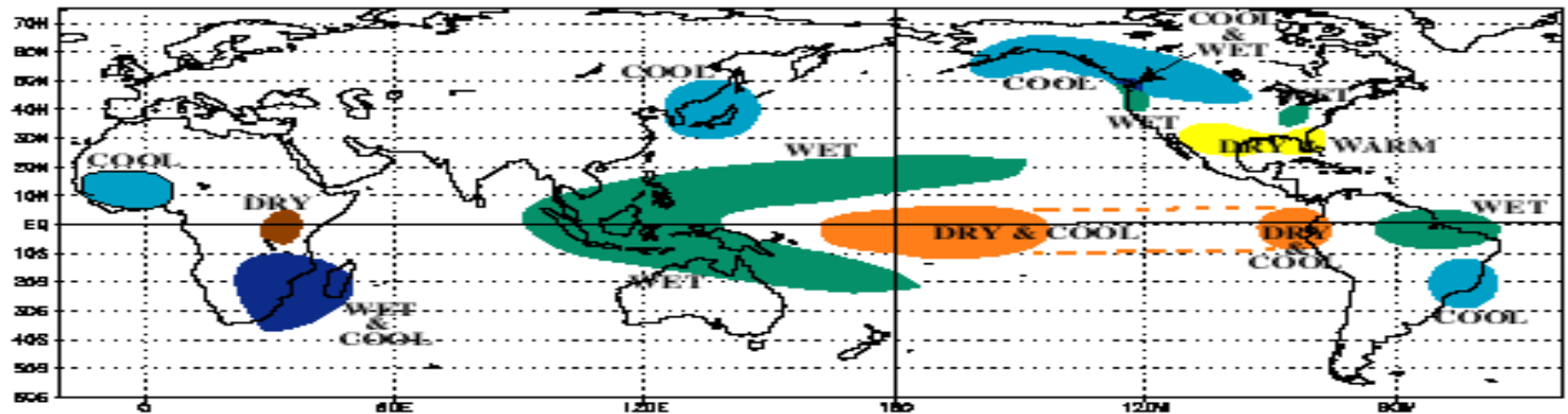


## WARM EPISODE RELATIONSHIPS JUNE - AUGUST

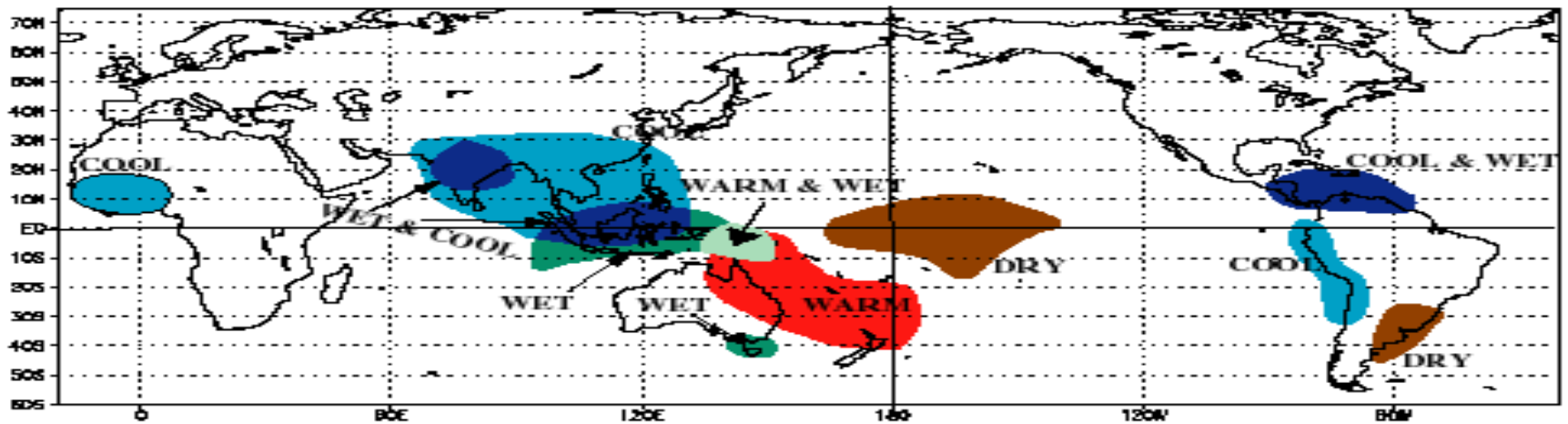


# Precipitation and Temperature Anomalies Associated with La Nina

## COLD EPISODE RELATIONSHIPS DECEMBER - FEBRUARY

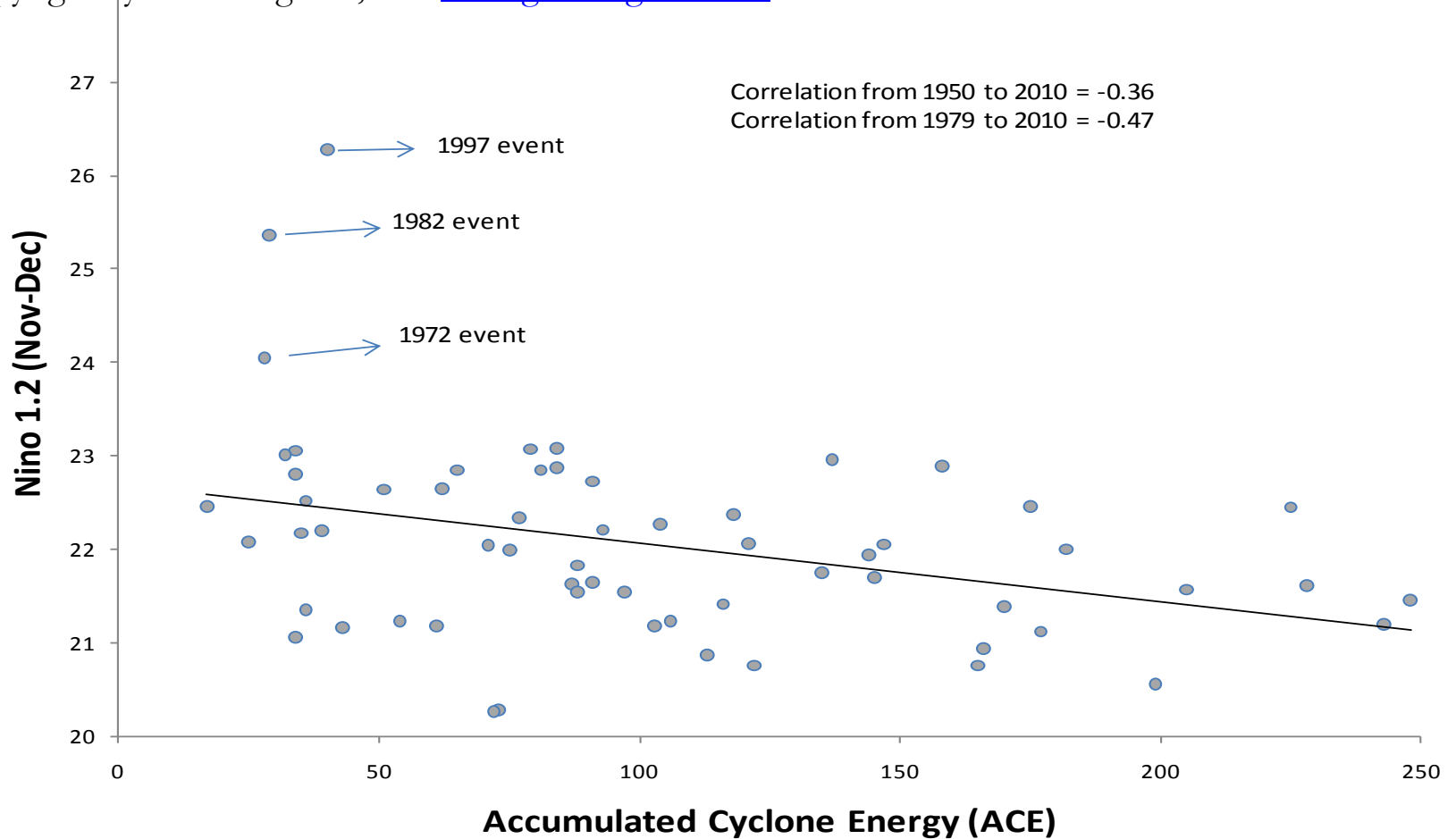


## COLD EPISODE RELATIONSHIPS JUNE - AUGUST



# El Nino is negatively correlated with intensity of Atlantic storms

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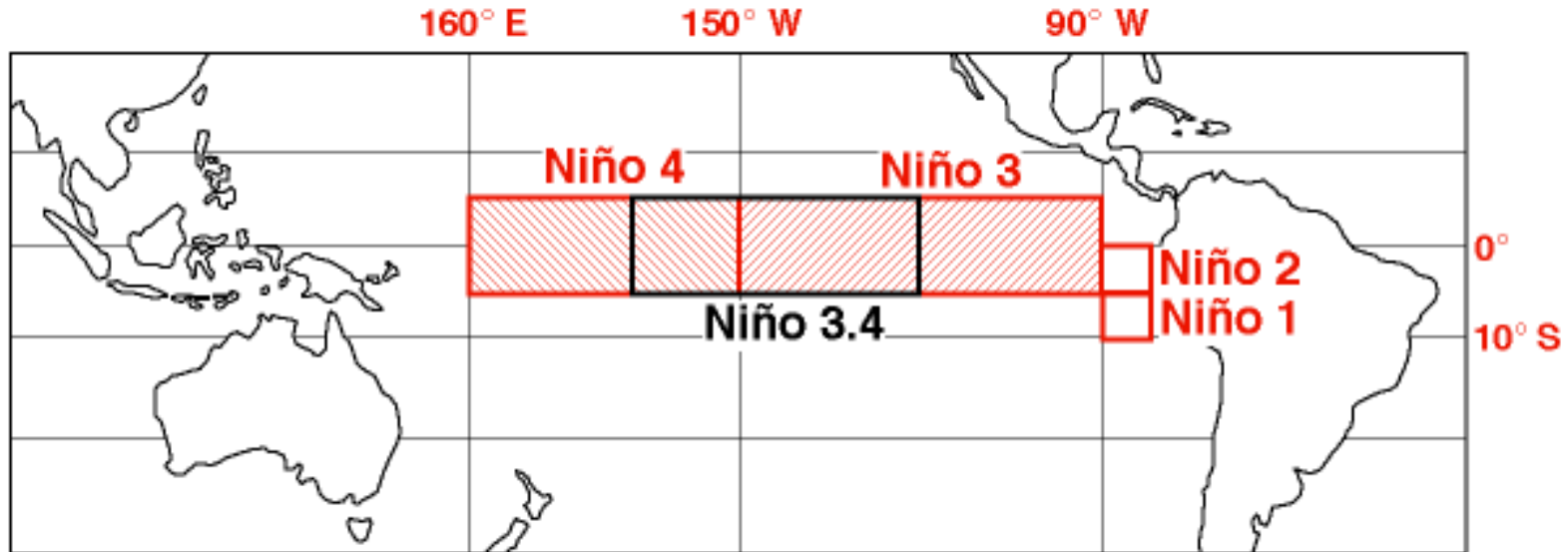
NOAA develops the ACE Index to reflect the "total seasonal activity" which measures the collective intensity and duration of Atlantic named storms and hurricanes occurring during a given season. The ACE index is a wind energy index, defined as the sum of the squares of the maximum sustained surface wind speed (knots)

# El Niño Insurance for Flood: *Innovation in Northern Peru*





# Contract is written using NOAA data



- El Niño estimates derived from —  
Satellite data, observations of buoys, and readings of the temperature on the surface and at deeper levels
- Data are publicly available monthly from NOAA  
(The U.S. National Oceanic and Atmospheric Administration)
- The first regulated ‘forecast insurance’ in the World

# PhD Dissertation by Grant Cavanaugh

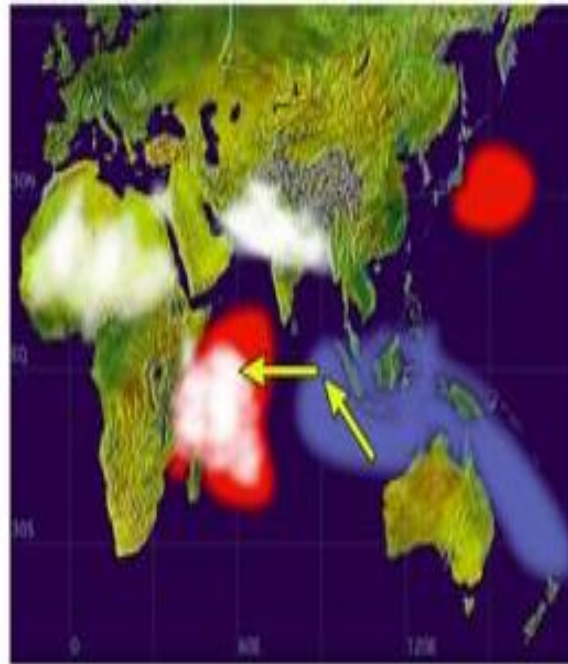
- DIRECT CLIMATE MARKETS: THE PROSPECTS FOR TRADING TELECONNECTION RISK
  - Analytics and interviews with market participants
  - Extreme El Nino and La Nina can't happen at the same time and both have a global profile with costly consequences
  - Student went into this with a view that futures markets might support a contract using an ENSO Index
  - Conclusion was that creating a CAT Bond was likely the first step as a true market test of willing risk buyers



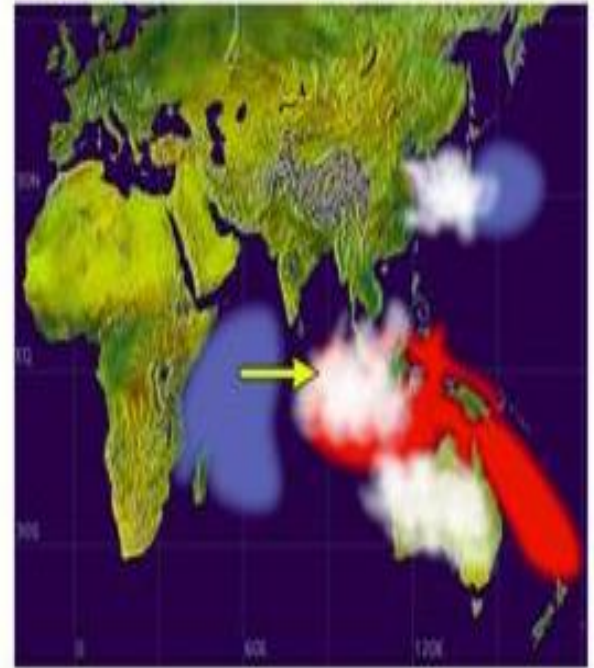
# Other teleconnections also have information

- What about IOD, NAO, PDO, etc?
- What is their signature?
- What about the combination of these indices and the feedback mechanisms?
- ENSO and IOD have positive feedback over Eastern Africa.

Positive Dipole Mode



Negative Dipole Mode



- IOD – Indian Ocean Dipole
- NAO – North Atlantic Oscillation
- PDO -- Pacific Decadal Oscillation

# Combining futures and innovations in weather hedging to manage regional price shocks

- Global drivers of price and supply conditions are difficult to hedge at the country or regional level
  - A direct use of global exchange markets has met with limited success
- Local weather and regional climate drivers
  - A local or regional weather shock can drive prices up even if world prices are low
    - In 2010, better than average harvests in Africa stabilized food prices in the region, staving off a repeat of the 2007/08 food crisis despite a similar spike in world food prices
  - Advances in financial innovation are increasingly facilitating transfer and financing of weather and natural disaster shocks at the local and regional level

# Country level solutions are important but have limitations...

- Country-focused lending plays an important role in public good investments:
  - Financial technology transfer, links between credit organizations, market development support for different types of risk management products, etc.
  - Investments and Technical Assistance at the Country Level – Responding to Price and Weather Shocks
  - Short term solutions: ex post coping and ex ante financing are needed to manage the immediate impacts
  - Long term solutions: strategies that incorporate risk reduction and ex ante financing mechanisms to facilitate greater economic stability, resilience and adaptation.

# Back to Price and Weather Volatility

- New paradigm: how to combine asset risk with asset funds that integrate a portfolio approach to manage risks of both price and extreme natural disasters and regional climate anomalies
- Drawing on regional innovations: CCRIF and ARC
  - Combine risk transfer products for regional climate anomalies with strategies for either lower than expected or higher than expected prices
- Higher than expected prices are of value to producers
- Lower than expected prices are of value to consumer

# Innovations in Sovereign Risk Financing

- Risk pooling
- Risk layering
- Insurance and Alternative Risk Transfer solutions are being used
  - Insurance/reinsurance
  - Catastrophe bonds
  - Derivatives
- Science and parametric or index solutions are being used
  - Reduces moral hazard and adverse selection
  - Can get the liquidity into the system much faster
- Common problems
  - Capacity building
  - Proper consideration of how to use the financing
  - Basis risk
  - Legal and Regulatory System
  - Risk Aversion in the Insurance Sector

# Take Advantage of Offsetting Interests to Organize, Pool, and Transfer Risk

- Potentials for natural swaps to offer greater efficiencies for protecting the positions of the key regional stakeholders
- Example: Extreme El Niño events and extreme La Niña events are 100 percent negatively correlated. Yet, both have regional effects on crop production that create regional food security problems. Having regional forecast insurance creates more opportunities to find market solutions that work on both the price and yield risk problems in the region
- Having experts in global exchange markets work alongside climate experts to create a suite of parametric forecast-based risk transfer solutions will enhance both the price risk management and the weather risk management solutions in the region

# Is it time for a Global facility to manage in-country or regional price and production risks?

Facility	Instruments	Clients
<ul style="list-style-type: none"><li>• Global Insurance Facility</li><li>• With backing by donors</li><li>• Linkages to Global Reinsurance, ILS, and futures exchanges</li><li>• Advanced Scientific Capabilities</li></ul>	<ul style="list-style-type: none"><li>• Derivatives</li><li>• Put and Call options</li><li>• Revenue products</li><li>• Index insurance for regional climate anomalies</li></ul>	<ul style="list-style-type: none"><li>• Commercial Banks</li><li>• Agri Lenders</li><li>• Value chain firms</li><li>• Food importers</li><li>• Food exporters</li><li>• Sovereigns for food security</li></ul>

# Challenges in Starting A Global Risk Facility

- Strong asset base to access financial markets
- Institutional structure to operate within the region and still operate within varying legal and regulatory environments in the region
- Origination professionals with strong relationships in the global capital markets and with stakeholders in the LAC countries
- Highly technical professional staff that understand global financial exchange markets and climate relationships to regional outcomes.



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