The CMIP5/AR5 Global Climate Model Runs: What Do They Say For Latin America And The Caribbean?

Workshop 1: **Initiation of the Regional Climate Change Consortium**

6-10 June 2016 CATHALAC, Panama City, Panama

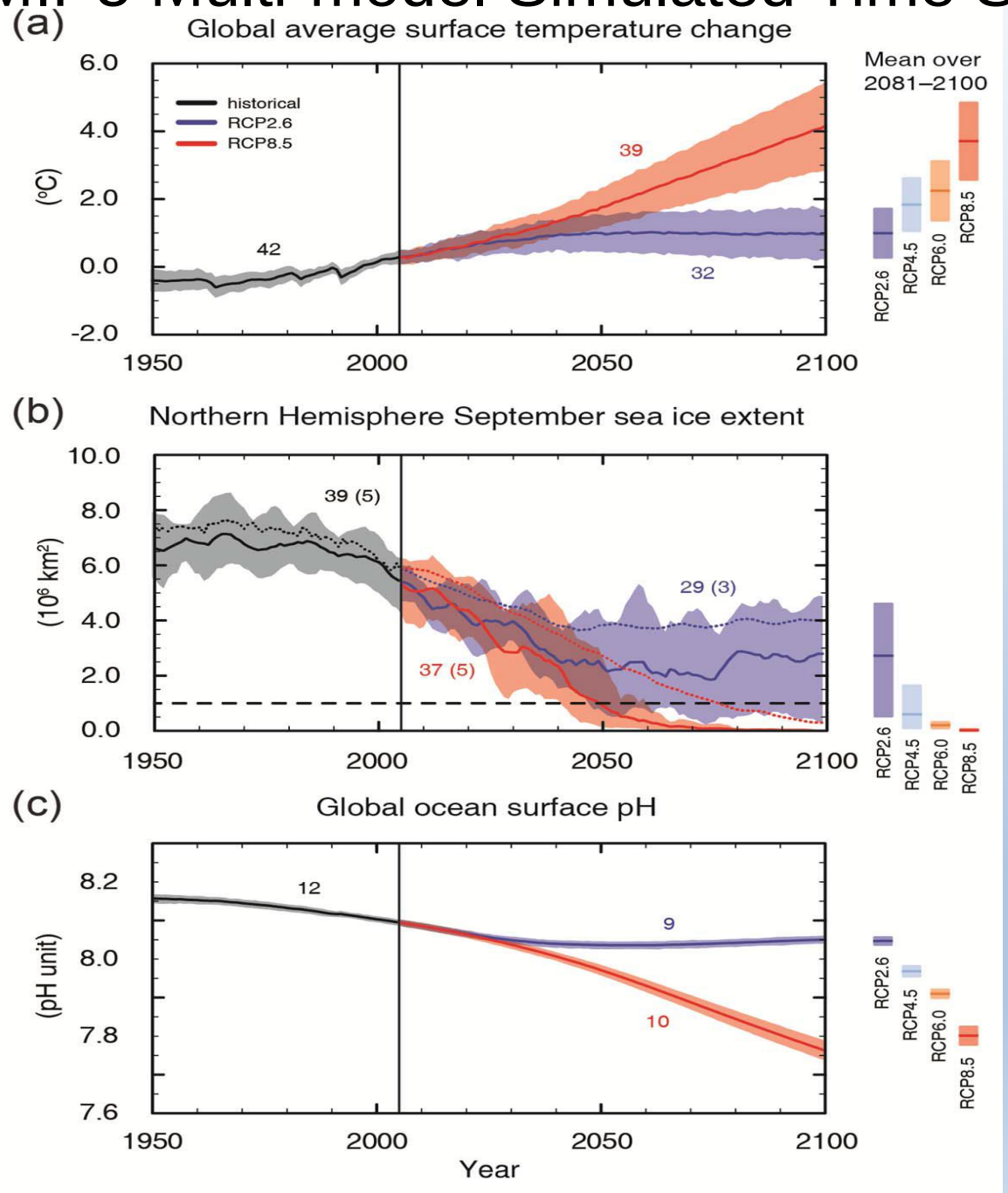
Coupled Model Intercomparison Project Phase 5

- Multi-model experiment (coordinated through the World Climate Research Programme) presents an unprecedented level of information on which to base assessments of climate variability and change.

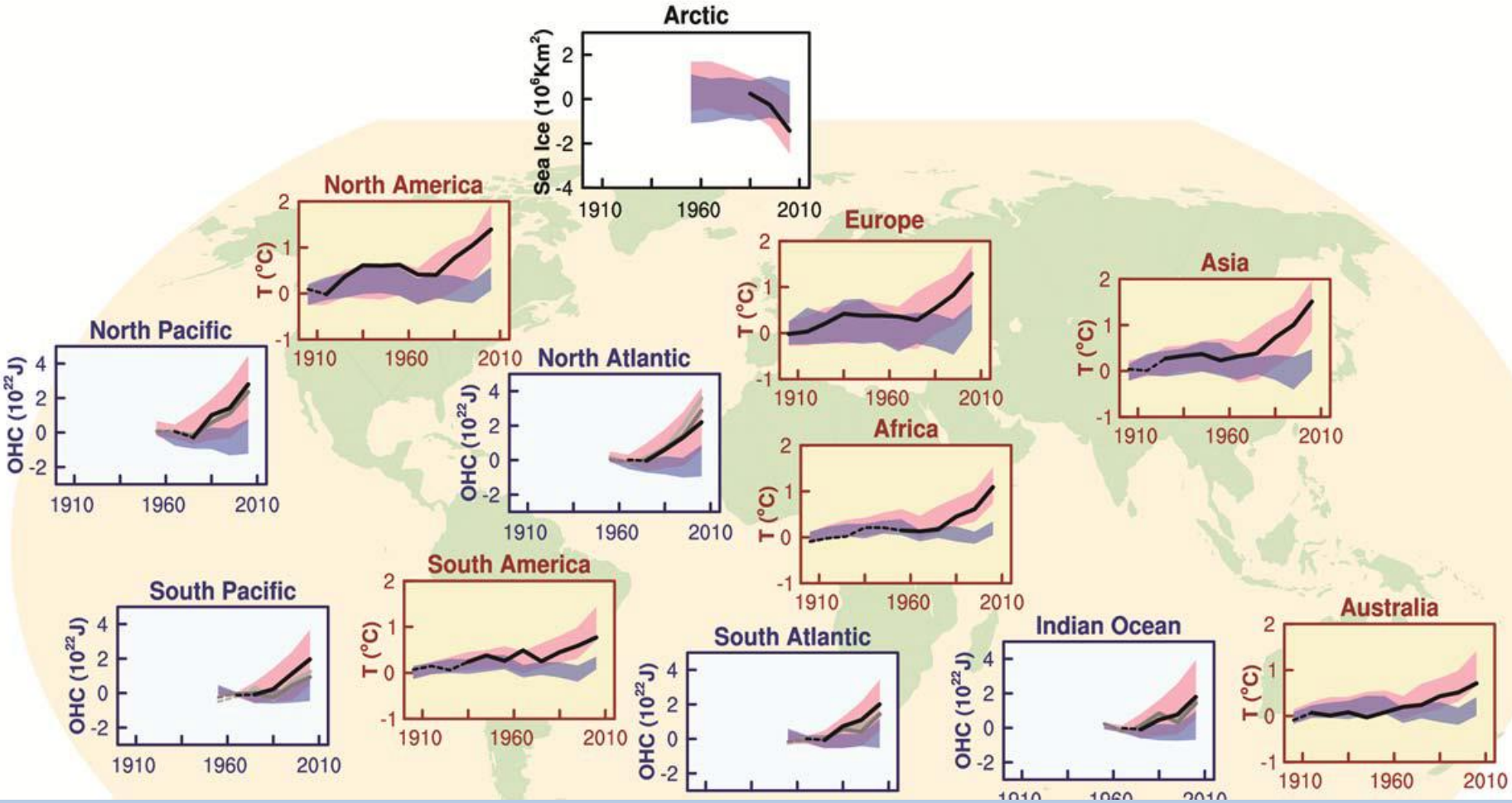
- Much more comprehensive than the preceding *CMIP3* multi-model experiment that was available at the time of the *IPCC AR4*.

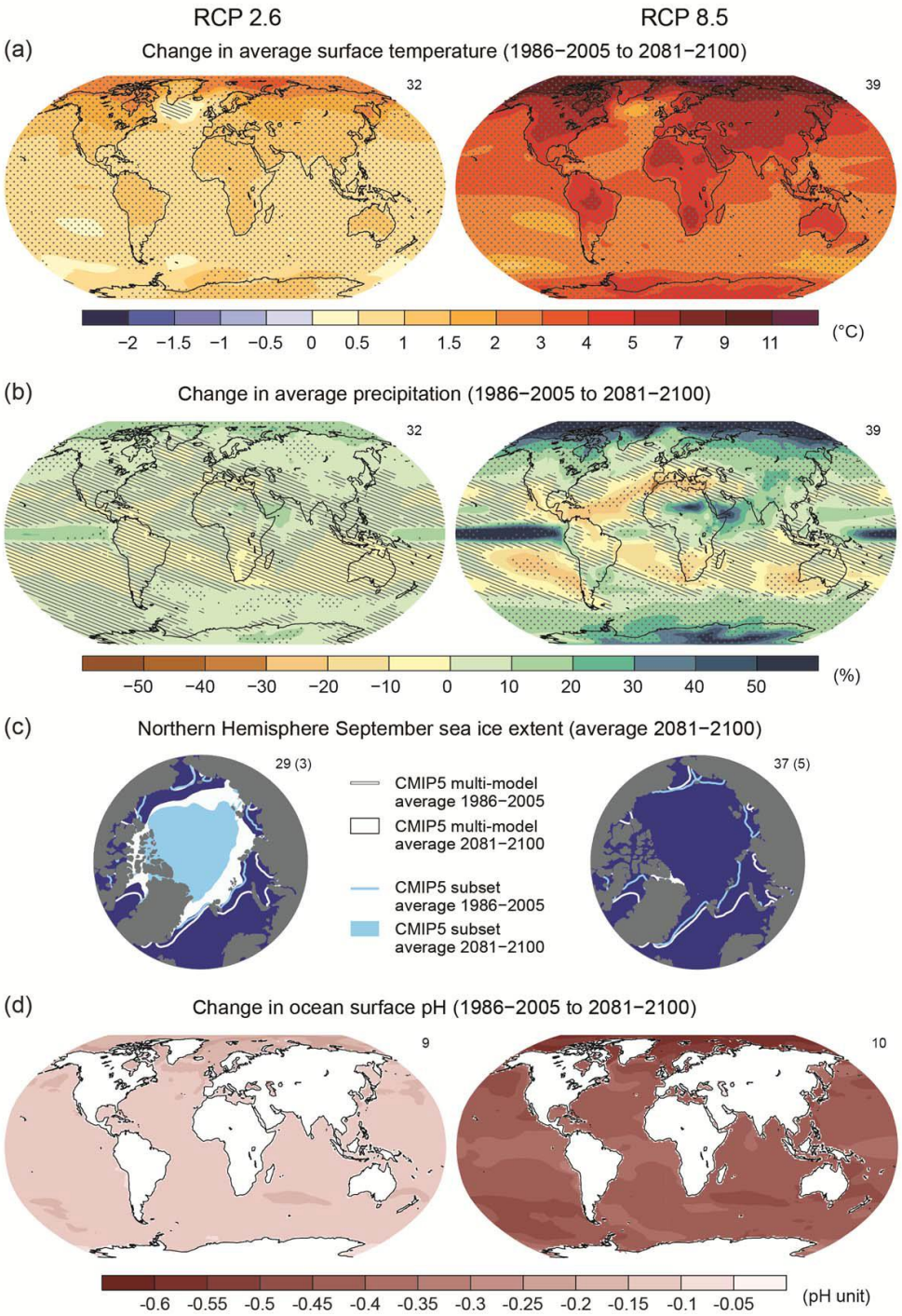
- Has more than twice as many models, many more experiments (that also include experiments to address understanding of the responses in the future climate change scenario runs), and nearly 2 □ 1015 bytes of data (as compared to over 30 □ 1012 bytes of data in *CMIP3*).

CMIP5 Multi-model Simulated Time Series



Comparison of Observed and Simulated Climate Change




RCP 2.6
RCP 8.5
(a)
Change in average surface temperature (1986–2005 to 2081–2100)
32
39
−2 −1.5 −1 −0.5 0 0.5 1 1.5 2 3 4 5 7 9 11
(°C)
(b)
Change in average precipitation (1986–2005 to 2081–2100)
32
39
−50 −40 −30 −20 −10 0 10 20 30 40 50
(%)
(c)
Northern Hemisphere September sea ice extent (average 2081–2100)
29 (3)
37 (5)
CMIP5 multi-model average 1986–2005
CMIP5 multi-model average 2081–2100
CMIP5 subset average 1986–2005
CMIP5 subset average 2081–2100
(d)
Change in ocean surface pH (1986–2005 to 2081–2100)
9
10
-0.6 -0.55 -0.5 -0.45 -0.4 -0.35 -0.3 -0.25 -0.2 -0.15 -0.1 -0.05
(pH unit)

A CRITICAL POINT

- The assessment of the mean values and ranges of global mean temperature changes in **AR4** *would not have been substantially different* if the **CMIP5** models had been used in that report.

- ***The differences in global temperature projections can largely be attributed to the different emission scenarios.***

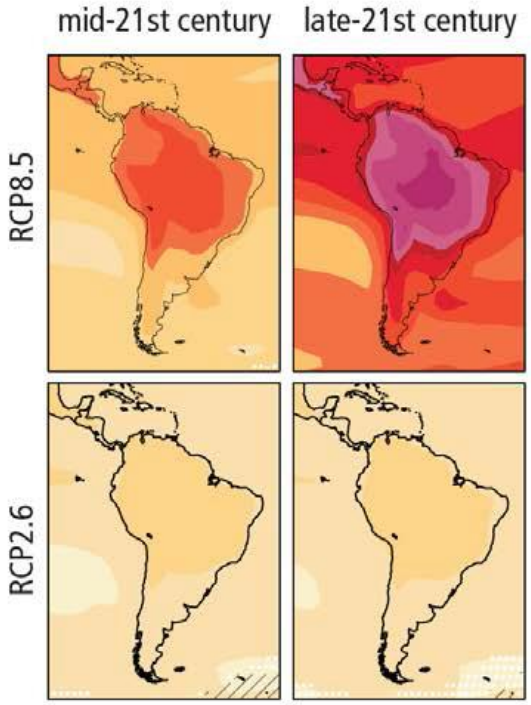
- The global mean temperature response simulated by CMIP3 and CMIP5 models *is very similar*, both in the mean and the model range, transiently and in equilibrium.

RESULTS WITH IMPLICATIONS FOR LATIN AMERICA AND THE CARIBBEAN

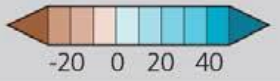
- Significant trends in precipitation and temperature have been observed in Central America (CA) and South America (SA) (*high confidence*).
- Changes in climate variability and in extreme events have severely affected the region (*medium confidence*).
- Climate projections suggest increases in temperature, and increases or decreases in precipitation for CA and SA by 2100 (*medium confidence*).

Annual Temperature

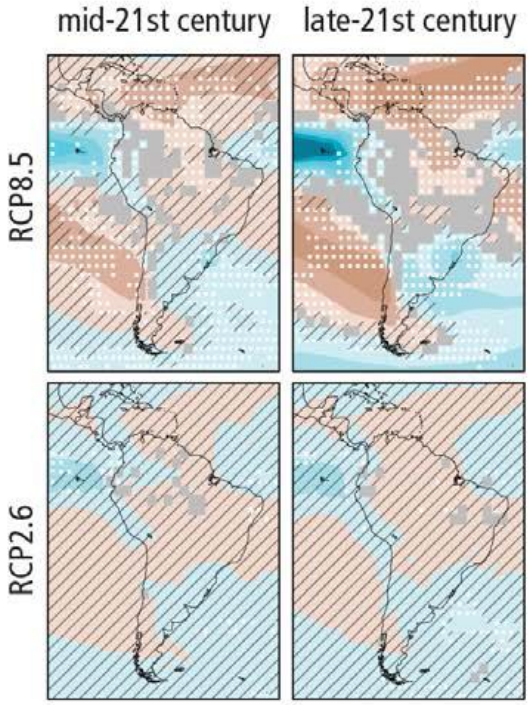
Difference from 1986-2005 mean (°C)



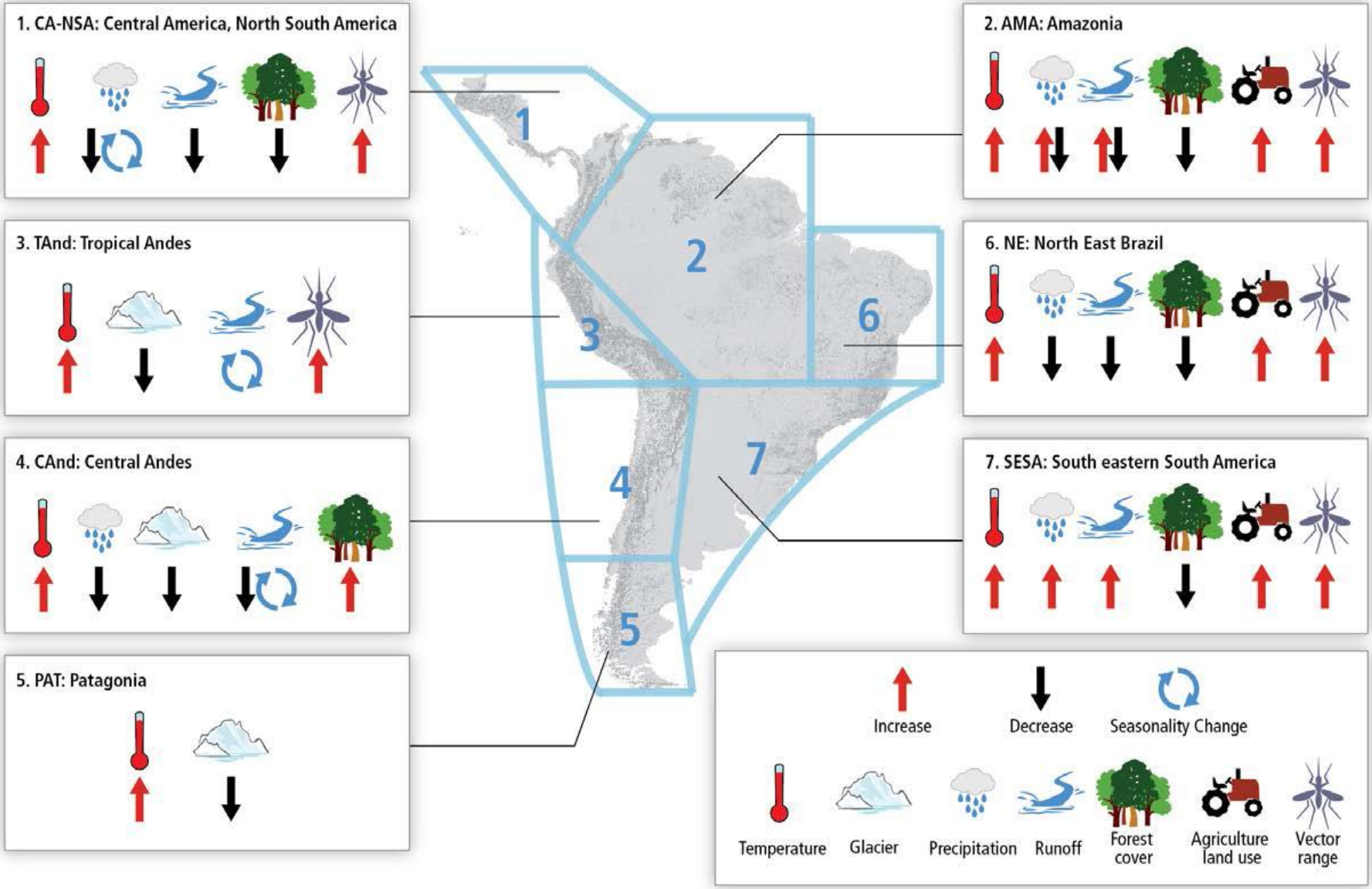
Annual Precipitation

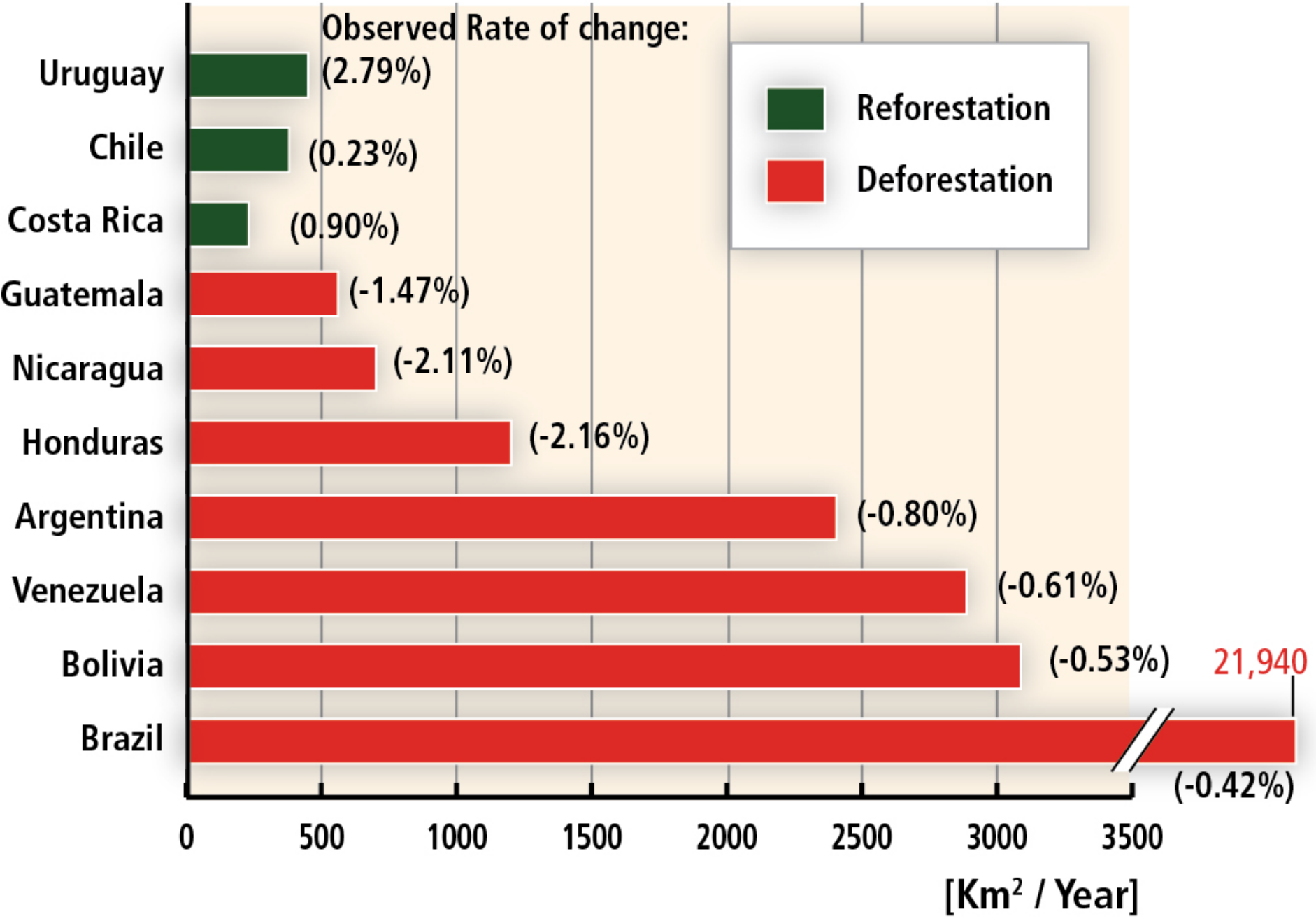


Difference from 1986-2005 mean (%)



Solid Color	Very strong agreement	White Dots	Strong agreement	Gray	Divergent changes	Diagonal Lines	Little or no change


1. CA-NSA: Central America, North South America
2. AMA: Amazonia
3. TAnd: Tropical Andes
6. NE: North East Brazil
4. CAnd: Central Andes
7. SESA: South eastern South America
5. PAT: Patagonia
1
2
3
4
5
6
7
Increase
Decrease
Seasonality Change
Temperature
Glacier
Precipitation
Runoff
Forest cover
Agriculture land use
Vector range


Observed Rate of change:
Uruguay
(2.79%)
Chile
(0.23%)
Costa Rica
(0.90%)
Guatemala
(-1.47%)
Nicaragua
(-2.11%)
Honduras
(-2.16%)
Argentina
(-0.80%)
Venezuela
(-0.61%)
Bolivia
(-0.53%)
21,940
Brazil
(-0.42%)
Reforestation
Deforestation
0
500
1000
1500
2000
2500
3000
3500
[Km² / Year]

CLIMATE EXTREMES

- For climate extremes such as *droughts, floods and heat waves*, several factors need to be combined to produce an extreme event.

- Analyses of rarer extremes such as 1-in-20 to 1-in-100 year events using *Extreme Value Theory* are making their way into a growing body of literature.

- Other recent advances concern the notion of "**fraction of attributable risk**" that aims to link a particular extreme event to specific causal relationships.

- We have a project using this concept to examine drought in the central U.S.

Climate Extremes, continued

- It is likely that the *number of heavy precipitation events over land has increased* in more regions than it has decreased *since the mid-20th century*

- There has been *substantial progress between CMIP3 and CMIP5* in the ability of models *to simulate more realistic precipitation extremes*.

- However, evidence suggests that the *majority of models underestimate the sensitivity of extreme precipitation* to temperature variability or trends *especially in the tropics* which implies that *models may underestimate the projected increase in extreme precipitation in the future*.

Climate Extremes, continued

- It is likely that the magnitude of extreme *high sea level events has increased* since 1970 and that most of this rise can be explained *by increases in mean sea level.*

- Projections indicate that it is likely that the global frequency of tropical cyclones will either decrease or remain essentially unchanged, concurrent with a likely increase in both global mean tropical cyclone maximum wind speed and rainfall rates
    - Lower confidence in region-specific projections of frequency and intensity.

- Due to improvements in model resolution and downscaling techniques, it is *more likely than not that the frequency of the most intense storms will increase substantially in some basins under projected 21st century warming*

Nine Cross-Cutting Issues

- *Consistent Evaluation of Uncertainties and Risks*, to serve as useful input for policymakers
- *Costing and Economic Analysis*, to develop common language and common fundamentals in all valuation efforts, including finance and investment
- *Regional Aspects*, based on a geographical approach as suggested in Part B of the WG II contribution
- *Scenarios* and their use in the AR5
- *Water and the Earth System*: changes, impacts and responses to answer the need for a water cycle theme in the AR5

Cross-Cutting Issues, cont.

- *Carbon Cycle* including *Ocean Acidification*, identified as a critical topic
- *Ice Sheets and Sea Level Rise*, with implications for vulnerability and adaptation in coastal zones and islands
- *Mitigation, Adaptation and Sustainable Development*; addressing the human side of the implications of climate change, including human security
- Issues related to Article 2 of the UNFCCC Convention on *stabilization of greenhouse gas concentrations* in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system

‘Heard in the Hallway’

- The decadal-scale predictability runs for CMIP5 have been very problematic

- This means IPCC AR5 does –not- expect a more robust ‘signal’ (century-scale climate change) versus ‘noise’ (decadal-scale variability) than in the past…