HURRICANES WORKING GROUP

Co-leaders:
Suzana J. Camargo, LDEO, Columbia University
Gabriel Vecchi, GFDL/NOAA
Kevin Walsh, University of Melbourne

Hurricanes WG objectives

- An improved understanding of interannual variability, and trends, in tropical cyclone activity from the beginning of the 20th century to the present.
- Quantifying changes in the characteristics of tropical cyclones under a warming climate.

Hurricanes WG tasks

- Define common experiments for model simulations by participating modeling group
- Supply common data sets and tropical cyclone metrics for those experiments
- Coordinate the evaluation and reporting of common experiments and the storage of model output
- Organize workshops to present and discuss the results

Hurricanes WG membership

Name	Affiliation
James Elsner	Florida State University
Kerry Emanuel	MIT
James Kossin	NOAA
Timothy LaRow	Florida State University
Siegfried Schubert	NASA GSFC
Adam Sobel	Columbia University
Gabrielle Villarini	University of Iowa
Hui Wang	NOAA NCEP
Ming Zhao	GFDL
Lennart Bengtsson	University of Reading, UK
In-Sik Kang	Seoul National University, S. Korea
Kazuyoshi Oouchi	JAMSTEC, Japan
Enrico Scoccimarro	INGV-CCMC, Italy

Additional Contributing Members

Name	Institution
Julio Bacmeister, Kevin Reed	NCAR
Fabrice Chauvin	CNRM, France
Ping Chang, R. Saravanan, and Christina Patricola	Texas A&M Univeresity
Monika Esch	MPI, Germany
Young-Kwon Lim	NASA Goddard Space Flight Center
Hiroyuki Murakami	University of Hawaii
Christiane Jablonowsky	University of Michigan
Tomoaki Ose	MRI, Japan
Malcolm Roberts	Met Office, UK
Pier Luigi Vidale	University of Reading, UK
Michael Wehner	Lawrence Berkeley National Laboratory

Simulations:

- Climatology
- Climatology plus 2K
- Climatology + $2CO_2$
- Climatology plus 2K + $2CO_2$
- Interannual

Model Data:

Model	Resolution	Runs	Number of years
CAM5.1	1 deg 0.25 deg	Climo, p2K, 2CO2, p2K2 CO2	15 years
Echam5 - INGV	0.75 deg	Climo, p2K, 2CO2, p2K2 CO2	10 years
CNRM	0.5 deg	Interannual	40 years
FSU	1 deg	Climo, 2CO2, p2K, Interannual	5 yrs, 10 yrs, 10 yrs, 25 years
HIRAM GFDL	0.6 deg	Climo, p2K, 2CO2, p2K2 CO2, Interannual	20 years 30 years, 3 ens.
GISS	1 deg	Climo, p2K, 2CO2, p2K2 CO2, Interannual	20 years 20 years, 3 ens
GSFC - NASA	0.6 deg	Climo, p2K, 2CO2, p2K2 CO2, Interannual	20 years 30 years

Model Data II

Model	Resolution	Runs	Number of years
HadGEM3	1 deg 0.5 deg 0.25 deg	Climo, p2K, p2K 2CO2	20 years
JAMSTEC	0.14 deg	Climo, GW	4 months
MRI-CGCM3	0.8 deg	Interannual, p1.83K CO2F, SSTf, CO2F	25 years
NCEP	1 deg	Climo, p2K, 2CO2, p2K 2CO2	20 years
WRF	1 deg (Atlantic)	Climo, Interannual	20 years

Issues

- Varying periods, variables and runs among the models.
- Not all modeling groups are providing the data in all time frequencies necessary for the analysis (monthly, data, 6-hourly).
- Serving the data for the community after the WG publishes papers analyzing the dataset is still an unsolved problem.

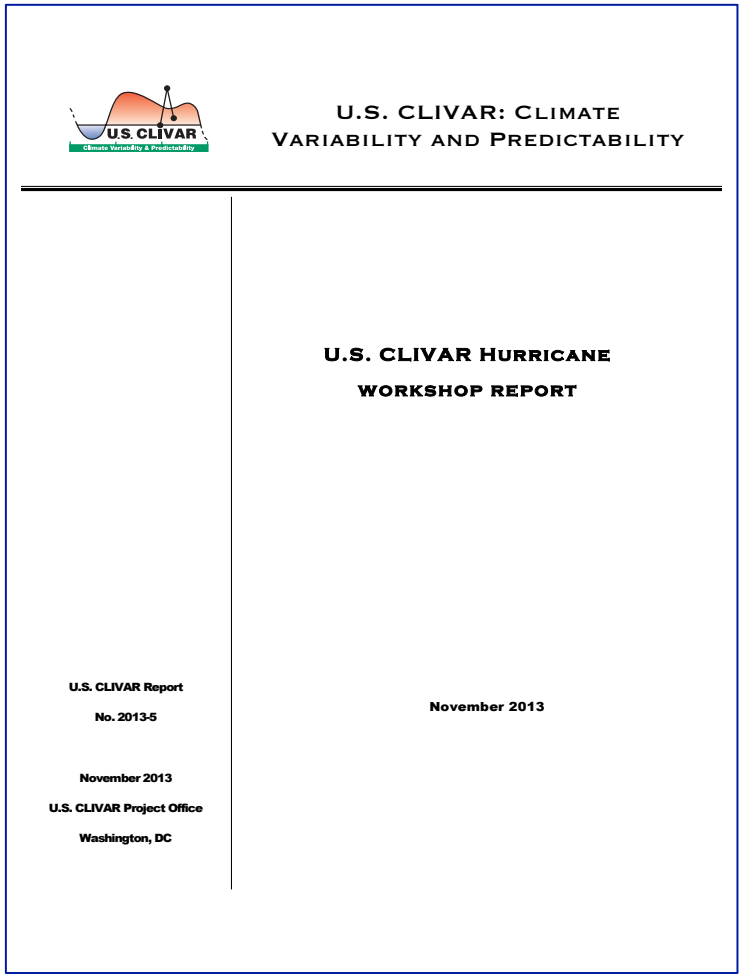
WORKING GROUP OUTPUTS

1st Hurricane WG Workshop: 27-28 January 2012, New Orleans, LA

- Duration 1 and ½ days
- 15 speakers (only WG members, per invitation)
- Planning:
  - Simulations
  - Diagnostics
  - Data storage
- Preliminary results from individual groups

2nd Hurricane WG Workshop: 5-7 June 2013, GFDL, Princeton NJ

- Duration: 2 and ½ days
- 30 speakers: WG members and additional contributors
- Workshop report available at the US CLIVAR website:
  - US CLIVAR Hurricane Working Group report, US CLIVAR Report No. 2013-5, pp. 1-18.

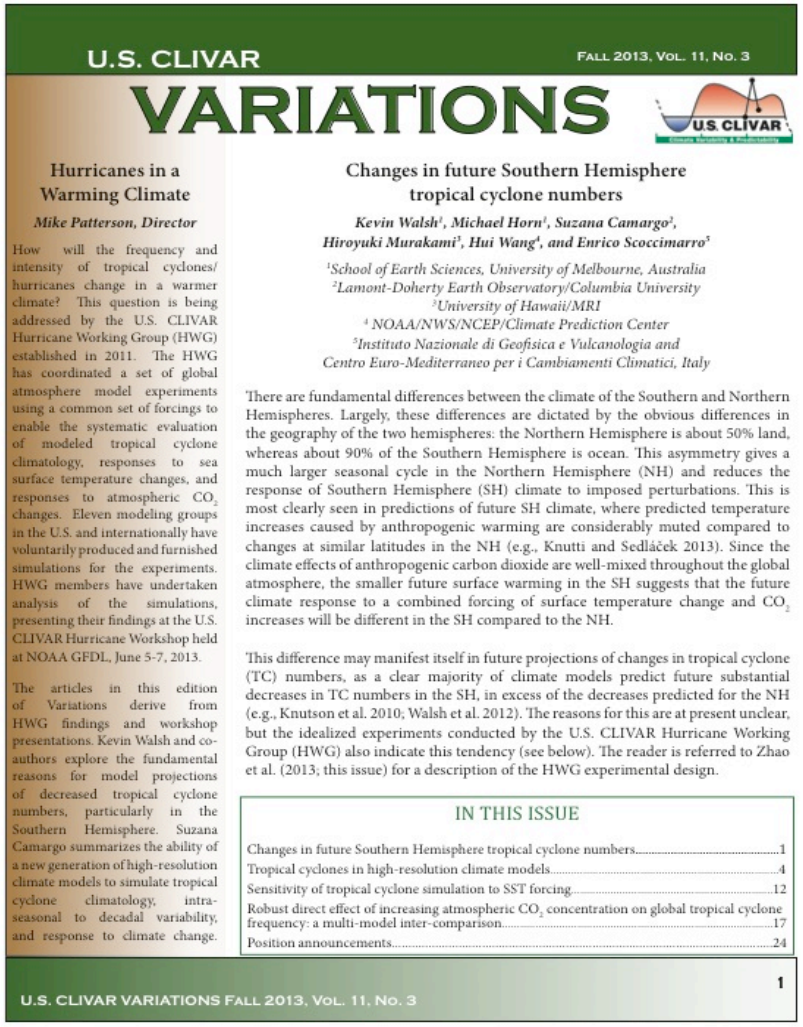


Special Session: AMS 31st Conference on Hurricanes and Tropical Meteorology, 31 March – 4 April 2014, San Diego, CA

- 2 oral Sessions: April 4 morning and afternoon: 15 talks
- Speakers: WG members and contributors
- Additional posters

US CLIVAR Variations – Fall 2013: Hurricane Working Group

- 4 articles by WG members:
  - K. Walsh et al.
  - S.J. Camargo
  - M. Roberts et al.
  - M. Zhao et al.



U.S. CLIVAR

FALL 2013, VOL. 11, NO. 3

VARIATIONS

U.S. CLIVAR

Hurricanes in a Warming Climate

Mike Patterson, Director

How will the frequency and intensity of tropical cyclones/hurricanes change in a warmer climate? This question is being addressed by the U.S. CLIVAR Hurricane Working Group (HWG) established in 2011. The HWG has coordinated a set of global atmosphere model experiments using a common set of forcings to enable the systematic evaluation of modeled tropical cyclone climatology, responses to sea surface temperature changes, and responses to atmospheric CO_2 changes. Eleven modeling groups in the U.S. and internationally have voluntarily produced and furnished simulations for the experiments. HWG members have undertaken analysis of the simulations, presenting their findings at the U.S. CLIVAR Hurricane Workshop held at NOAA GFDL, June 5-7, 2013.

The articles in this edition of Variations derive from HWG findings and workshop presentations. Kevin Walsh and co-authors explore the fundamental reasons for model projections of decreased tropical cyclone numbers, particularly in the Southern Hemisphere. Suzana Camargo summarizes the ability of a new generation of high-resolution climate models to simulate tropical cyclone climatology, intra-seasonal to decadal variability, and response to climate change.

Changes in future Southern Hemisphere tropical cyclone numbers

Kevin Walsh[1], Michael Horn[1], Suzana Camargo[2], Hiroyuki Murakami[3], Hui Wang[4], and Enrico Scoccimarro[5]

[1]School of Earth Sciences, University of Melbourne, Australia
[2]Lamont-Doherty Earth Observatory/Columbia University
[3]University of Hawaii/MRI
[4] NOAA/NWS/NCEP/Climate Prediction Center
[5]Instituto Nazionale di Geofisica e Vulcanologia and Centro Euro-Mediterraneo per i Cambiamenti Climatici, Italy

There are fundamental differences between the climate of the Southern and Northern Hemispheres. Largely, these differences are dictated by the obvious differences in the geography of the two hemispheres: the Northern Hemisphere is about 50% land, whereas about 90% of the Southern Hemisphere is ocean. This asymmetry gives a much larger seasonal cycle in the Northern Hemisphere (NH) and reduces the response of Southern Hemisphere (SH) climate to imposed perturbations. This is most clearly seen in predictions of future SH climate, where predicted temperature increases caused by anthropogenic warming are considerably muted compared to changes at similar latitudes in the NH (e.g., Knutti and Sedláček 2013). Since the climate effects of anthropogenic carbon dioxide are well-mixed throughout the global atmosphere, the smaller future surface warming in the SH suggests that the future climate response to a combined forcing of surface temperature change and CO_2 increases will be different in the SH compared to the NH.

This difference may manifest itself in future projections of changes in tropical cyclone (TC) numbers, as a clear majority of climate models predict future substantial decreases in TC numbers in the SH, in excess of the decreases predicted for the NH (e.g., Knutson et al. 2010; Walsh et al. 2012). The reasons for this are at present unclear, but the idealized experiments conducted by the U.S. CLIVAR Hurricane Working Group (HWG) also indicate this tendency (see below). The reader is referred to Zhao et al. (2013; this issue) for a description of the HWG experimental design.

IN THIS ISSUE

Journal of Climate: US CLIVAR Hurricanes and Climate Special Issue

- Kevin Walsh – collection organizer
- As of today: published papers: 9 papers
- Other papers in various stages of publication
- Initial plan ~ 20 papers

Bulletin of the American Meteorological Society (BAMS) paper

- Submitted: May 2014
- Lead author: Kevin Walsh
- Contribution of all WG members (co-authors)

Hurricanes and climate: the U.S. CLIVAR working group on hurricanes

Kevin J.E. Walsh, Suzana J. Camargo, Gabriel A. Vecchi, Anne Sophie Daloz, James Elsner, Kerry Emanuel, Michael Horn, Young-Kwon Lim, Malcolm Roberts, Christina Patricola, Enrico Scoccimarro, Adam H. Sobel, Sarah Strazzo, Gabriele Villarini, Michael Wehner, Ming Zhao, Jim Kossin, Tim LaRow, Kazuyoshi Oouchi, Siegfried Schubert, Hui Wang, Julio Bacmeister, Ping Chang, Fabrice Chauvin, Christine Jablonowski, Hiroyuki Murakami, Tomoaki Ose, Kevin A. Reed, R. Saravanan, Y. Yamada, Colin M. Zarzycki, Pier Luigi Vidale, Jeffrey A. Jonas and Naomi Henderson

High-resolution climate models can now simulate many aspects of tropical cyclone climate, but a theory of tropical cyclone formation remains elusive.

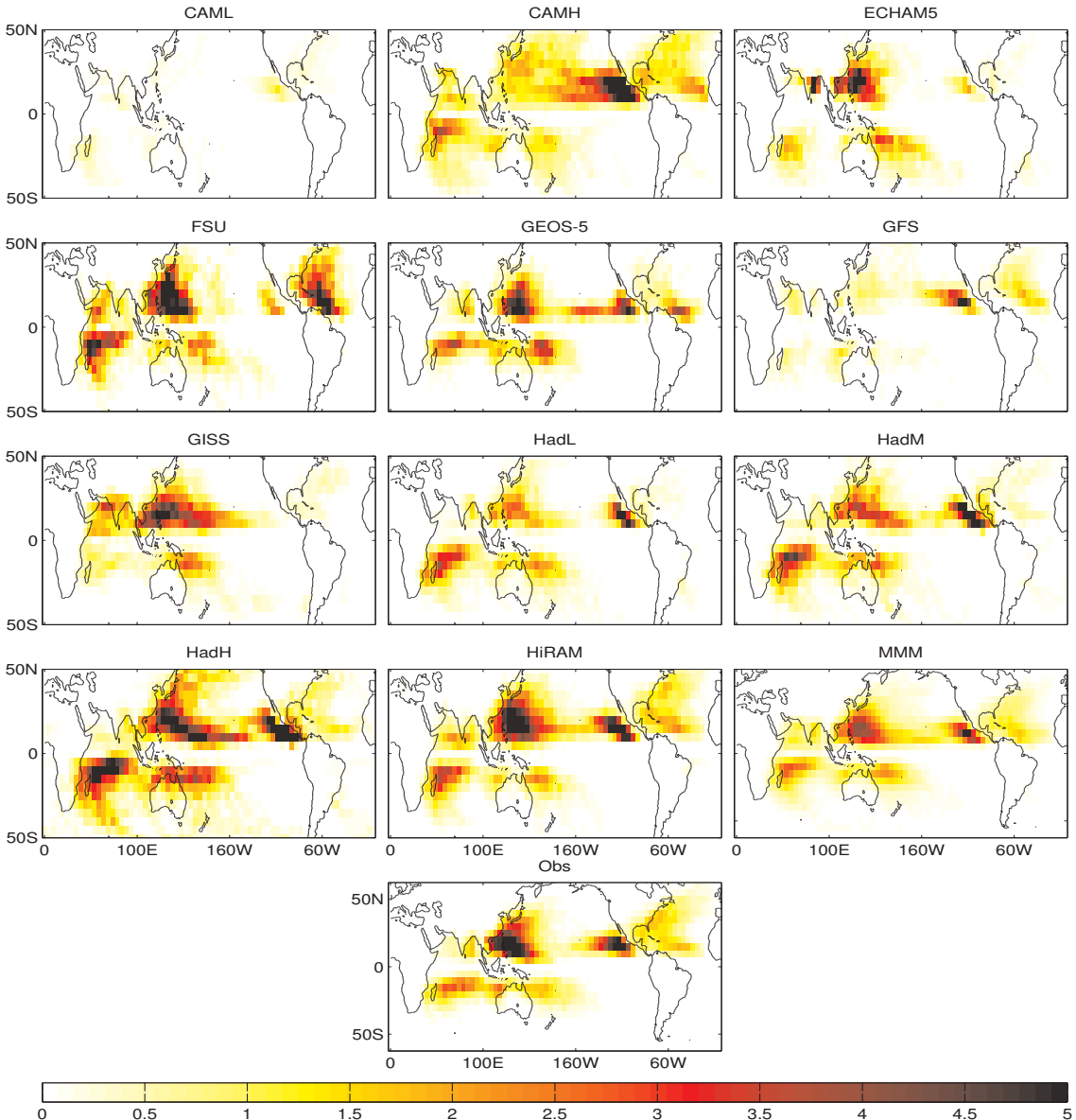
For submission to the *Bulletin of the American Meteorological Society*.

Model output database

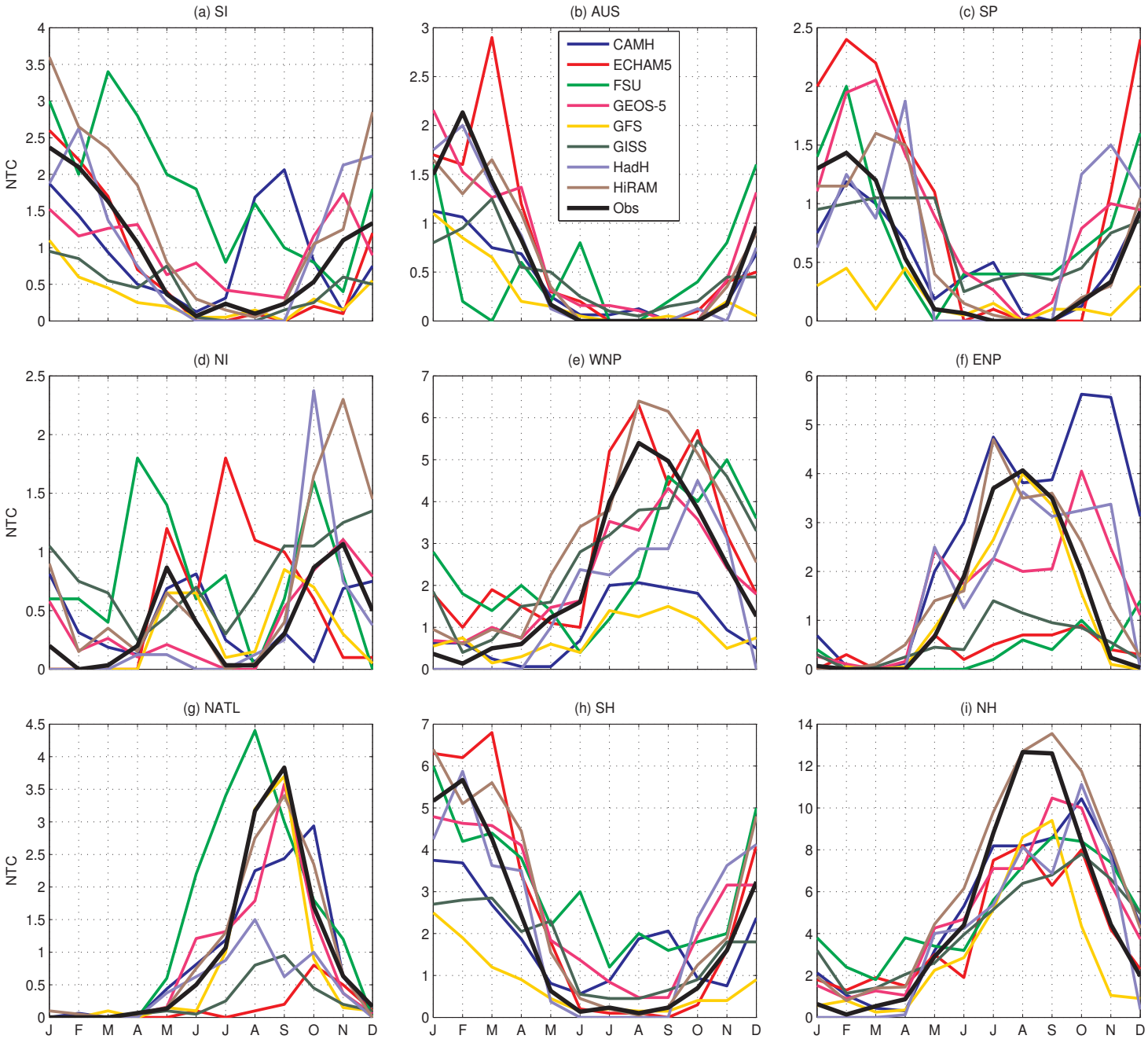
- Will soon be available to other scientists
- Currently hosted by Lamont-Doherty Earth Observatory, Columbia University
- Monthly data can be available from Lamont to the general public
- Daily and six-hourly data: a different host will be needed – no resources for that at Lamont. We are currently investigating the possibility for the data to be hosted in Australia.

RESULTS HIGHLIGHTS

TC characteristics in the models



Shaevitz et al.,
J. Climate, in review



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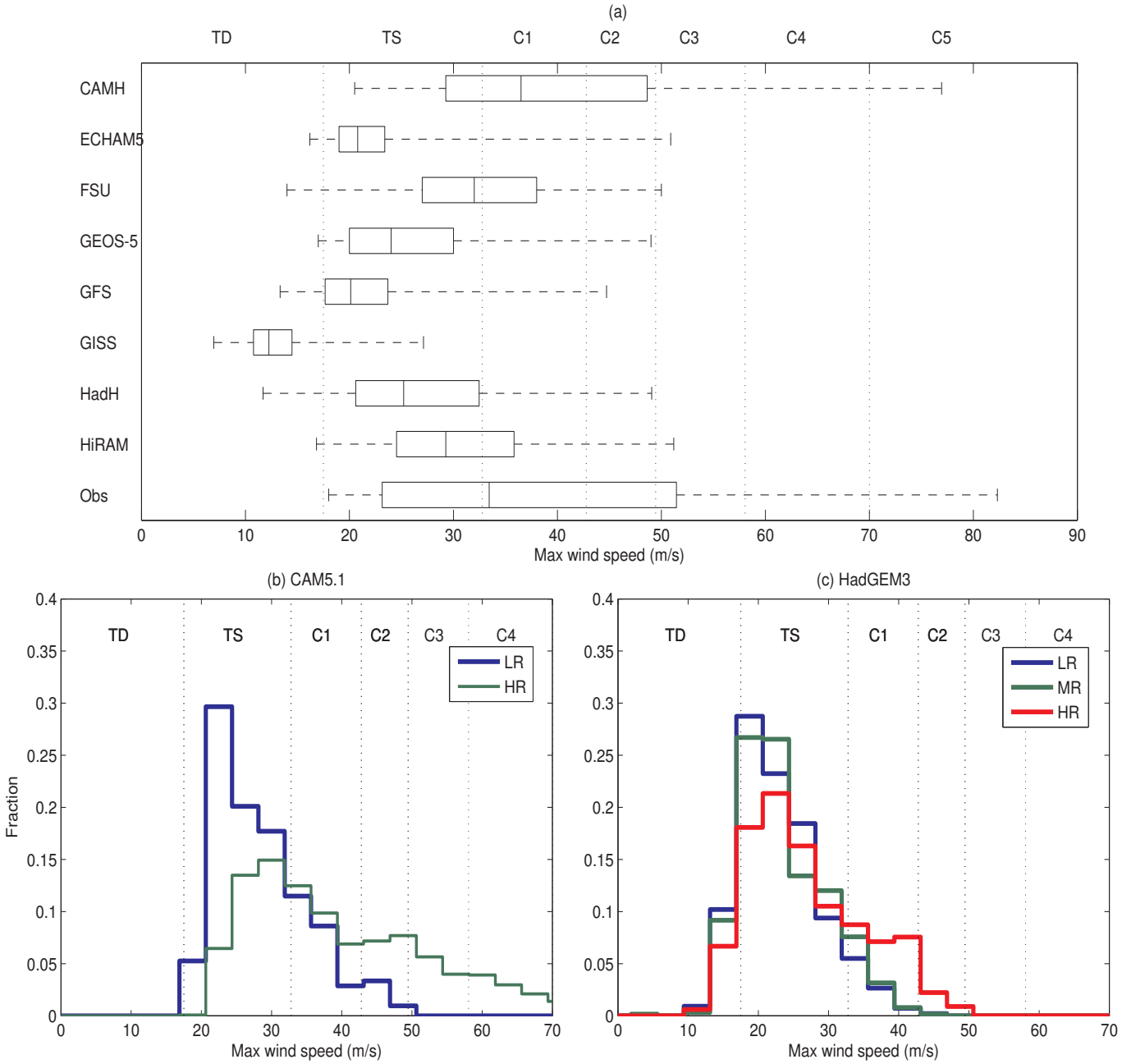
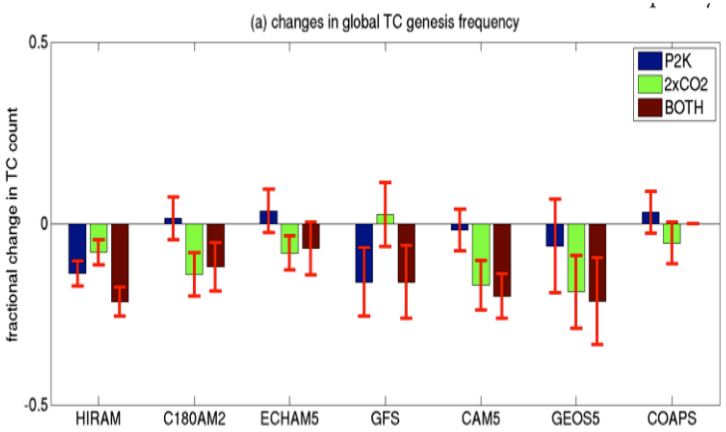
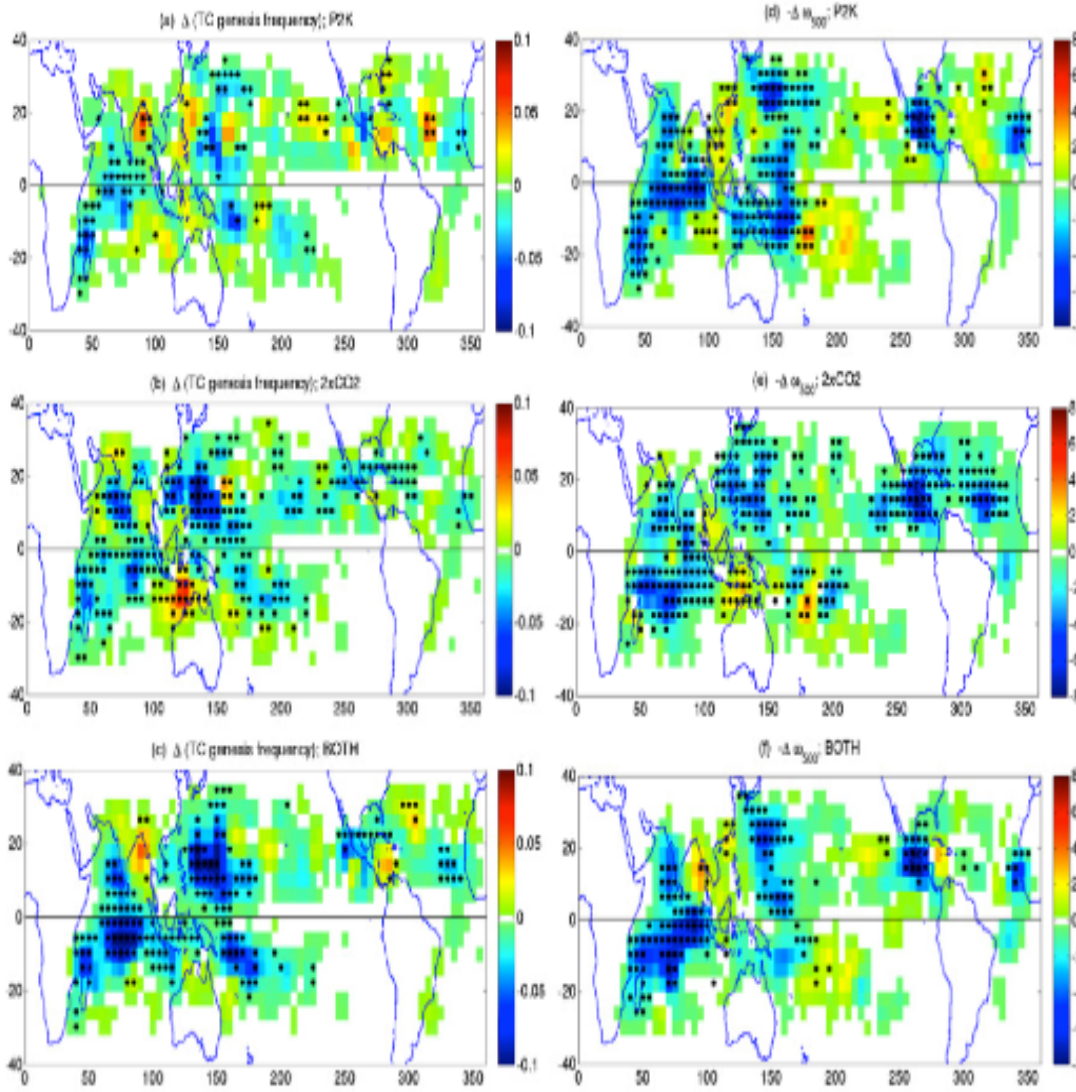
J. Climate, in review



Shaevitz et al.,
J. Climate, in review

TC frequency changes in future simulations





Zhao et al., CLIVAR Variations 2013

Statistical-dynamical downscaling: Synthetic Tracks

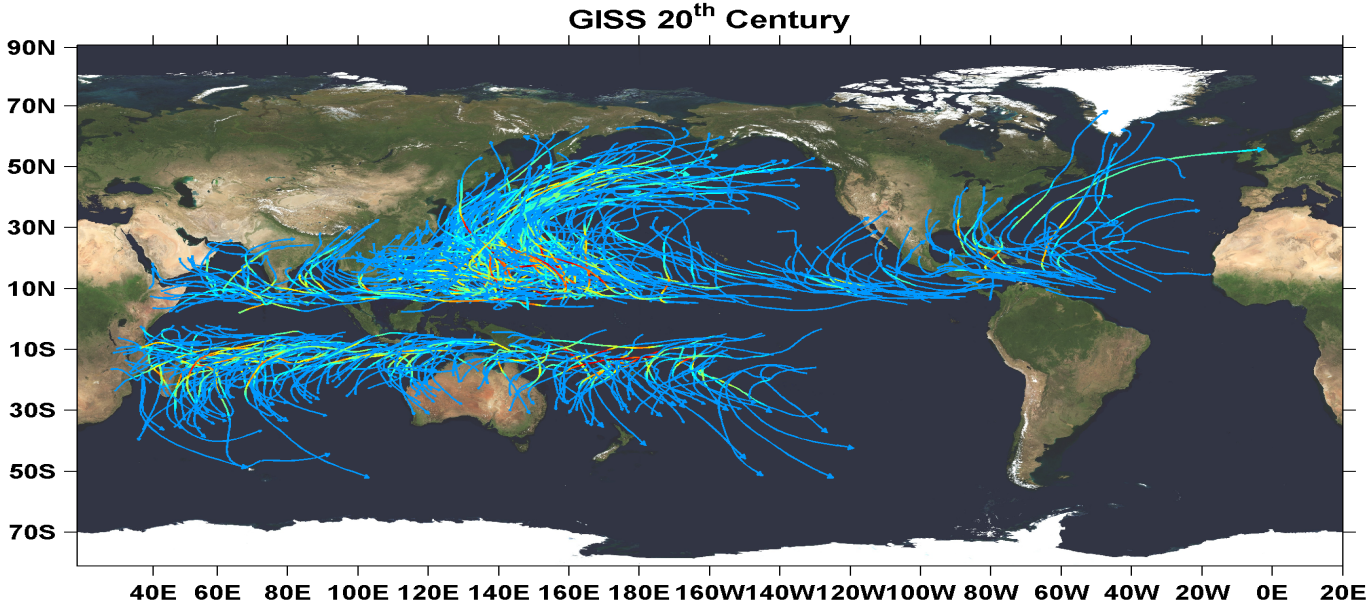
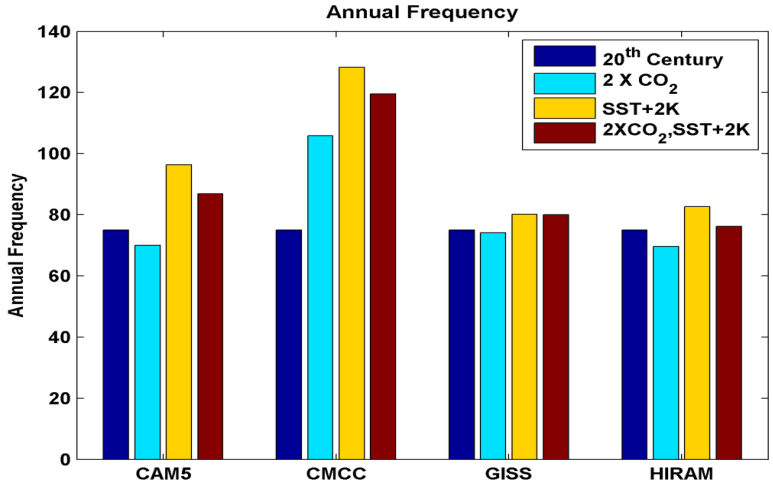
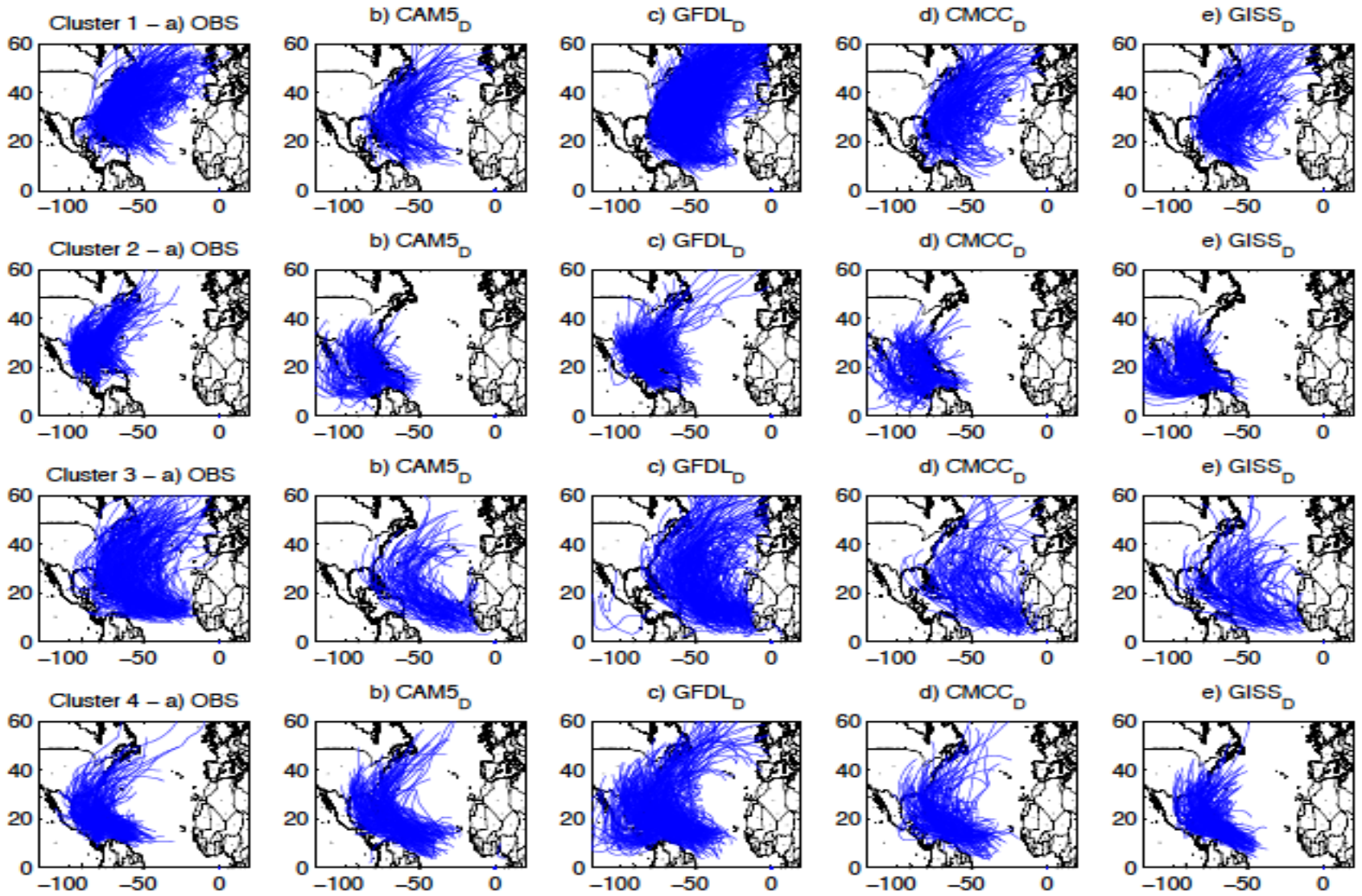


Figure by Emanuel

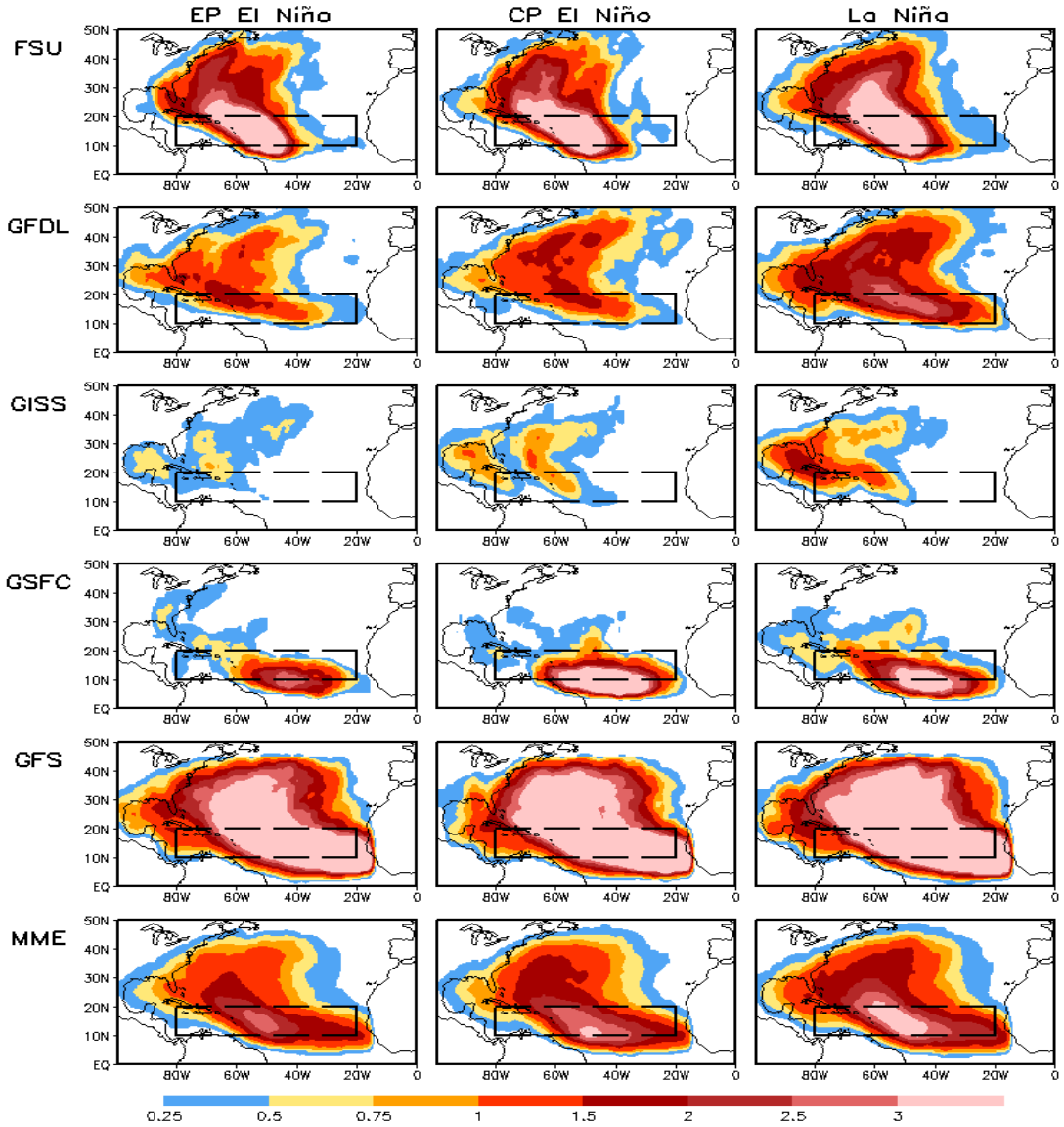


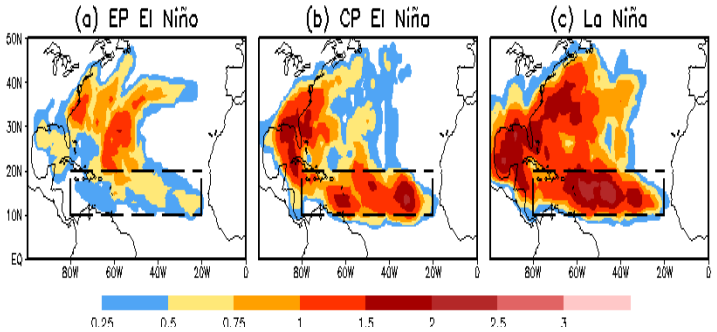
Walsh et al., BAMS, in review



Daloz et al., J. Climate, in review

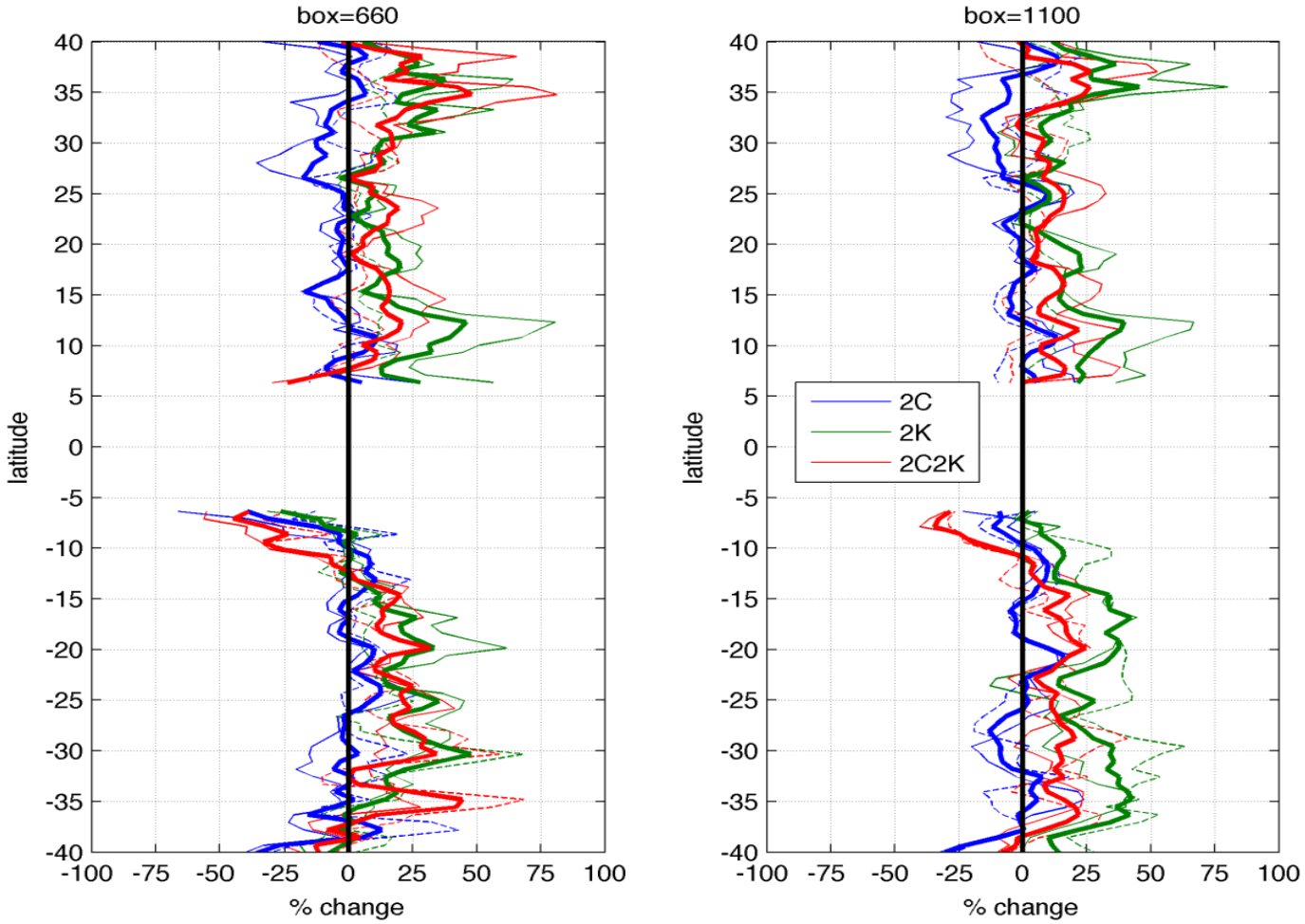
ENSO impacts on Atlantic TCs





Wang et al., J. Climate, in press.

Precipitation



Villarini et al.,
J. Climate 2014

ISSUES – FUTURE WORK

Issues and future work

- Simulations with more realistic SST for future scenarios
- Couple simulations: mixed layer, ocean model
- Sensitivity to model parametrizations, dynamical core, etc
- Discussion of a follow-up working group for CLIVAR led by Kevin Walsh and Isaac Ginis:
  - Ocean impacts of tropical cyclones (main focus)
  - Coupled models and tropical cyclones (alternative idea advocated by others in the WG)