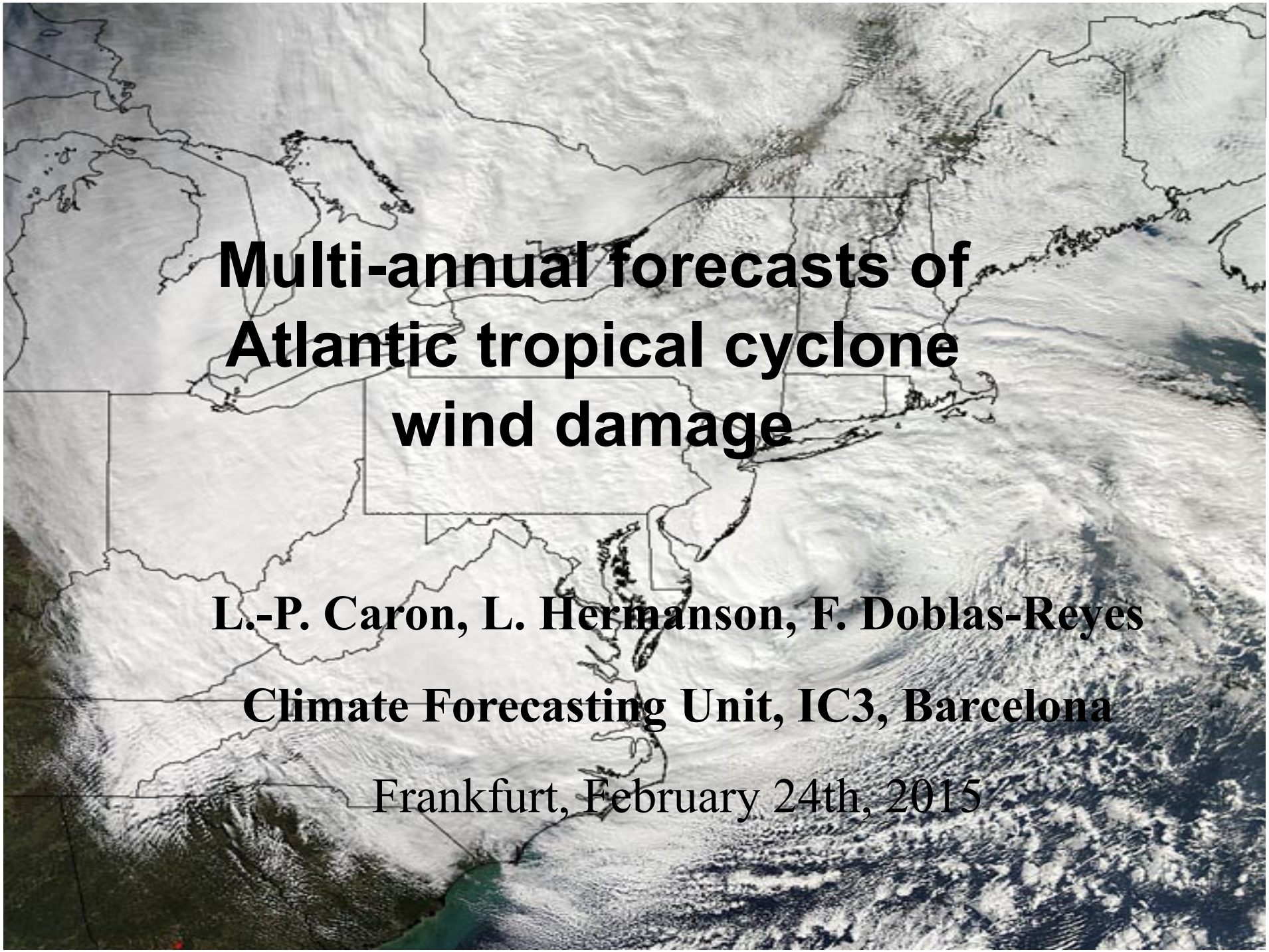
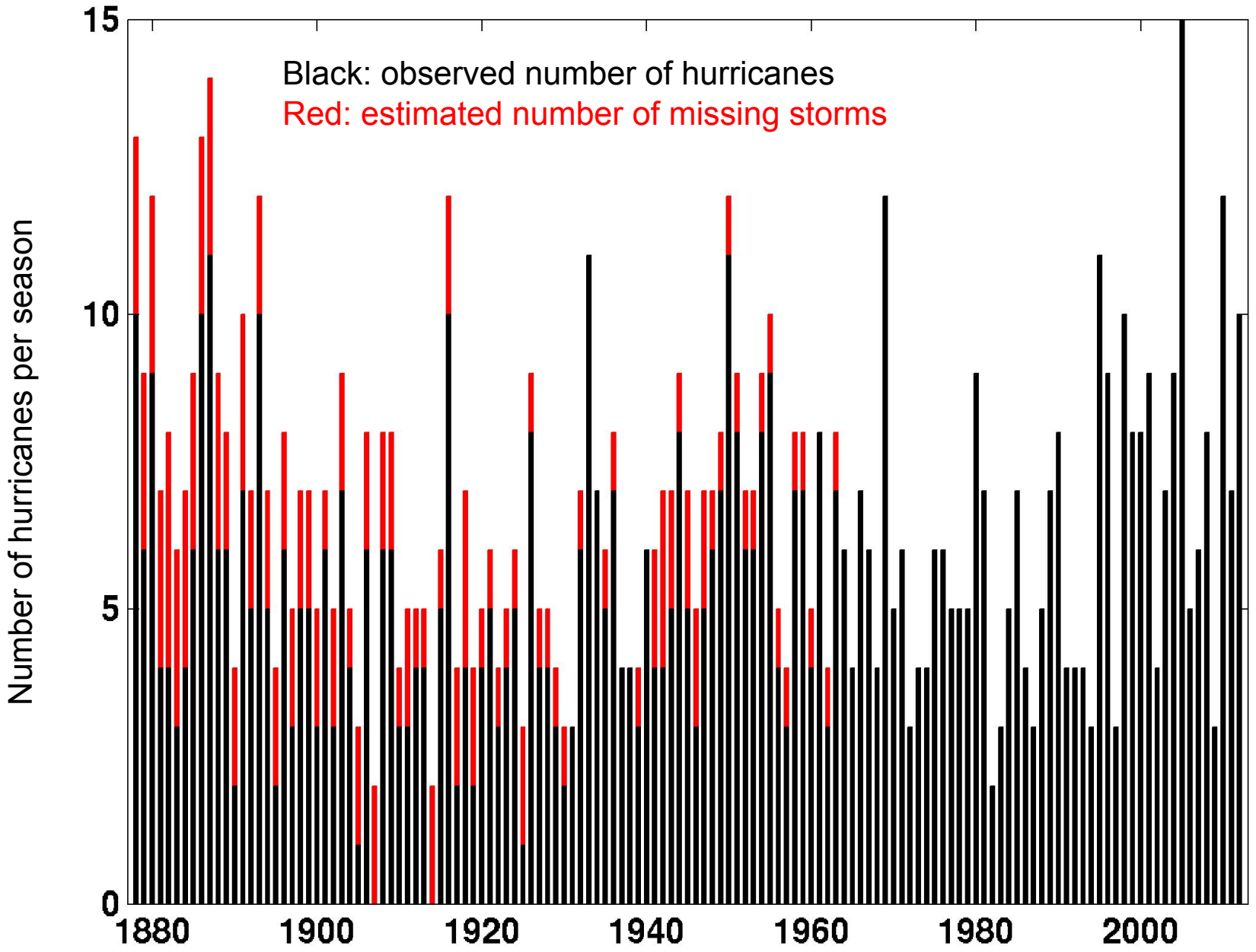


Multi-annual forecasts of Atlantic tropical cyclone wind damage

L.-P. Caron, L. Hermanson, F. Doblas-Reyes

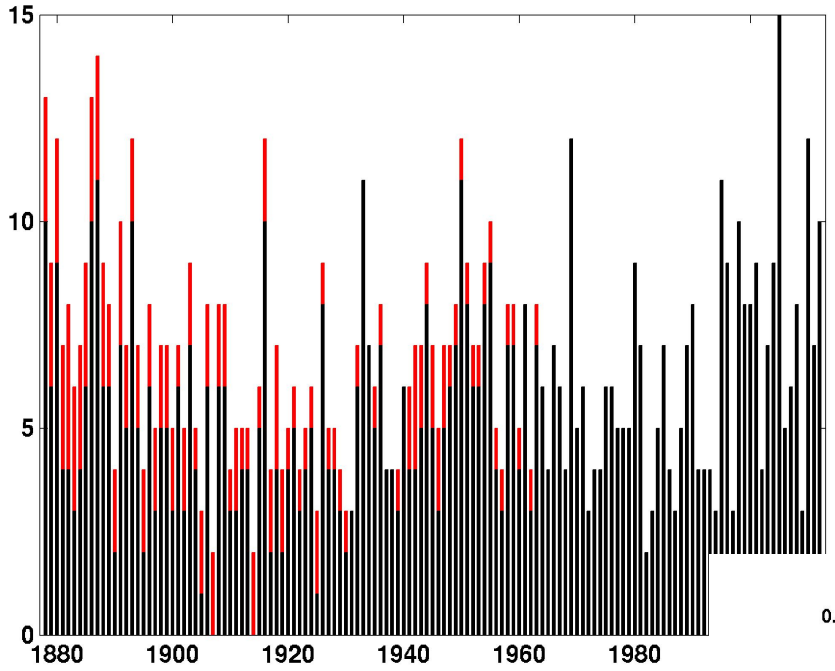
Climate Forecasting Unit, IC3, Barcelona

Frankfurt, February 24th, 2015


Black: observed number of hurricanes
Red: estimated number of missing storms
Number of hurricanes per season
15
10
5
0
1880
1900
1920
1940
1960
1980
2000

Climate factors influencing Atlantic hurricane activity

Climate factor	Description	Timescale
Atlantic Multidecadal Oscillation (AMO or AMV)	Oscillation in North Atlantic Ocean Temp.	Decadal
El Niño Southern Oscillation	Oscillation in Tropical Pacific Ocean Temp.	Annual (~3-5 yr cycle)
West African Monsoon	Rainfall over Sahel region	Annual
North Atlantic Oscillation (NAO)	Seesaw pattern in sea level pressures b/w Iceland and the Azores	Annual
Solar activity		11-year cycle
Ozone concentration in upper atmosphere		Annual
Dust/aerosols over the Atlantic	Dust originating from Sahara desert	Annual
Maidden-Julian Oscillation	Eastward propagating disturbances in the tropics	Intra-seasonal

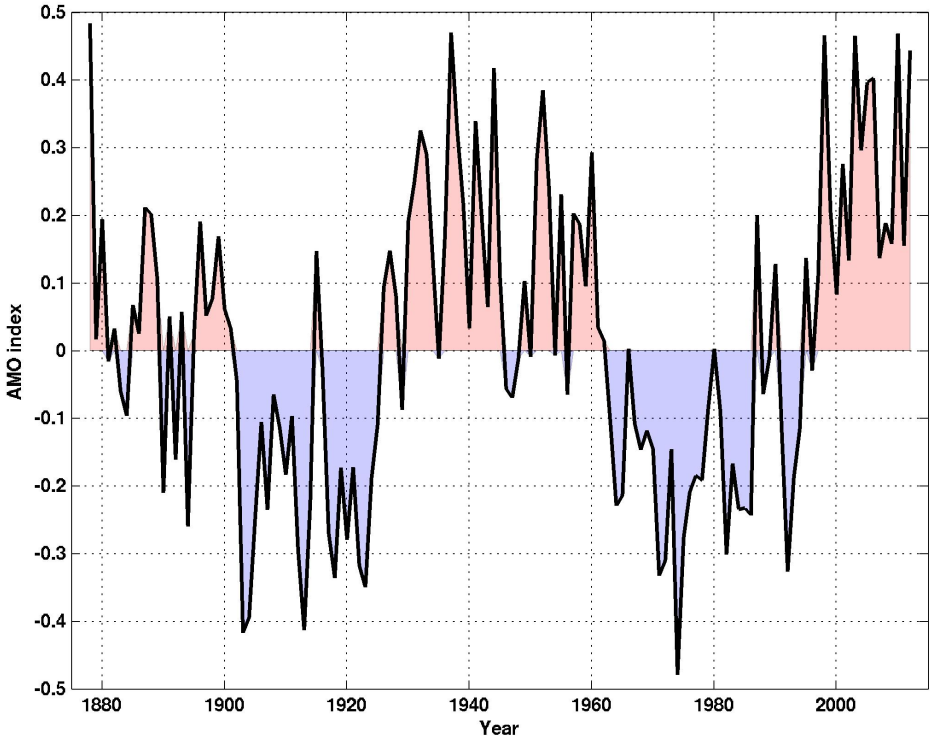


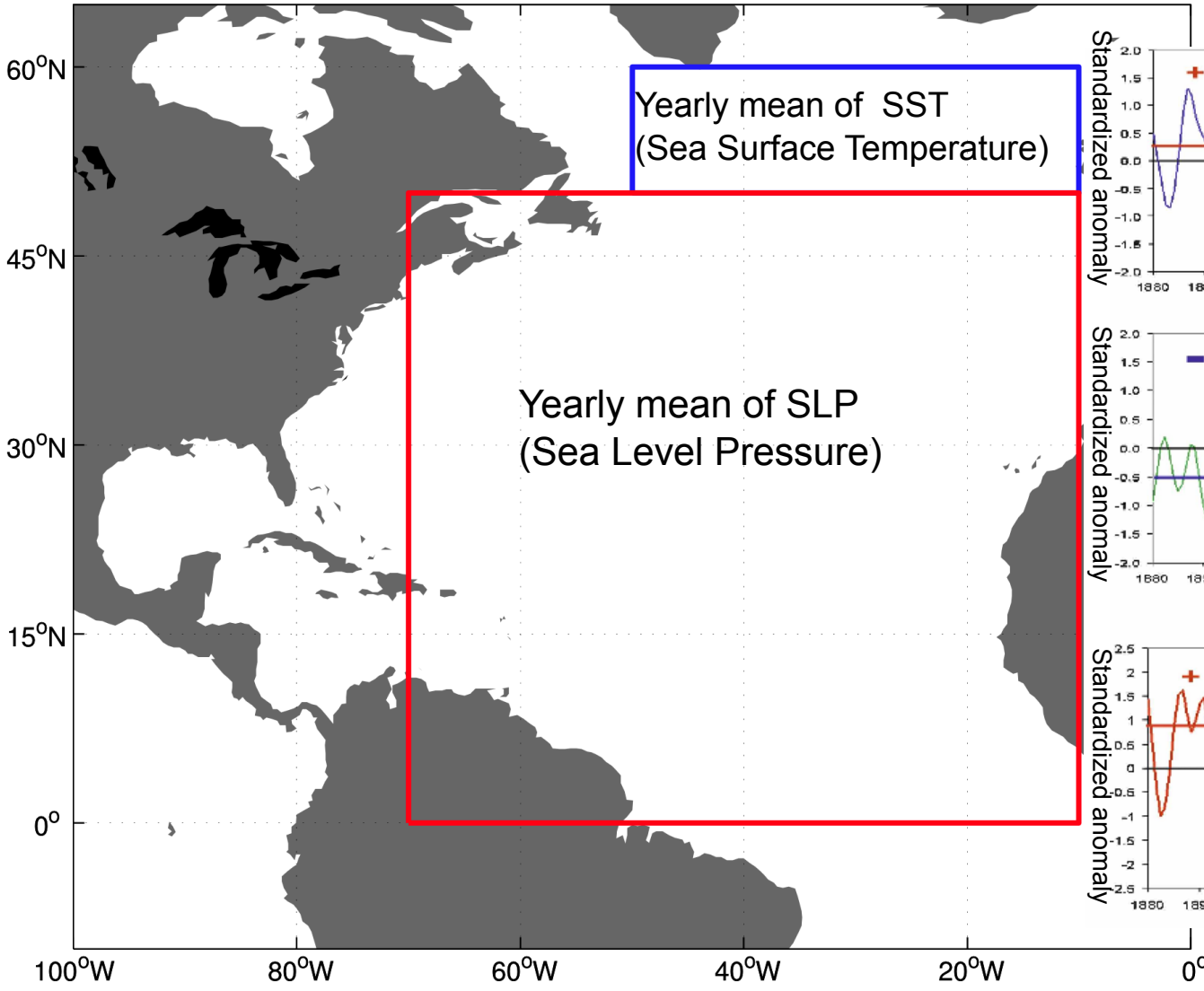
SPECS
Seasonal-to-decadal climate Prediction for the improvement of European Climate Services

RPI2.0
Connecting Science and (Re)Insurance

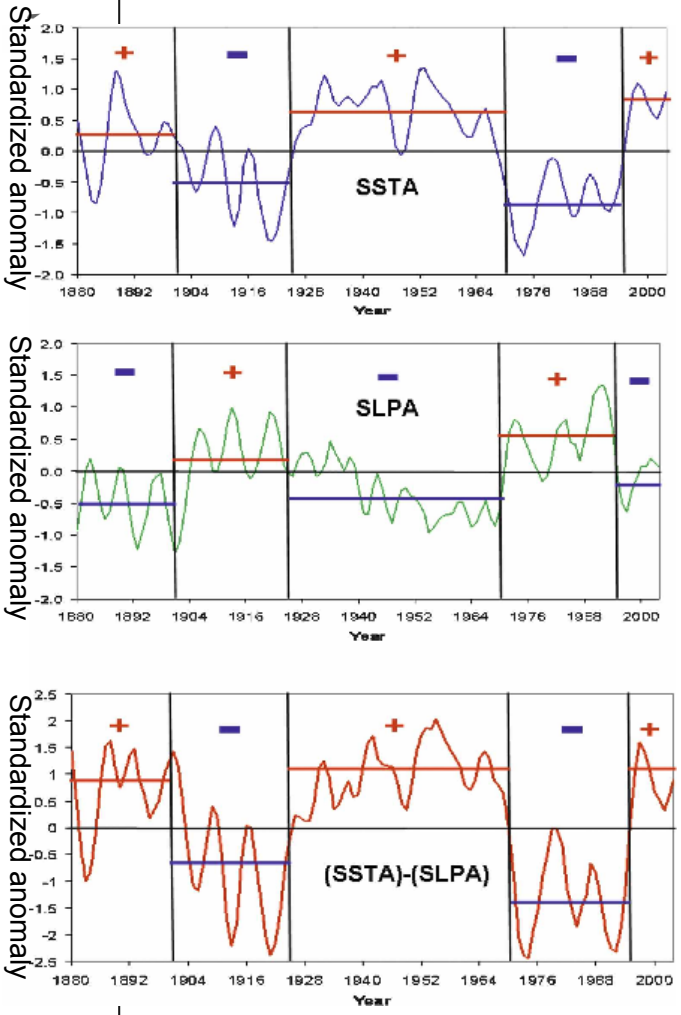
Strong link b/w **AMO** and **hurricane** numbers

AMO/AMV:
Oscillation in North Atlantic sea surface temperature

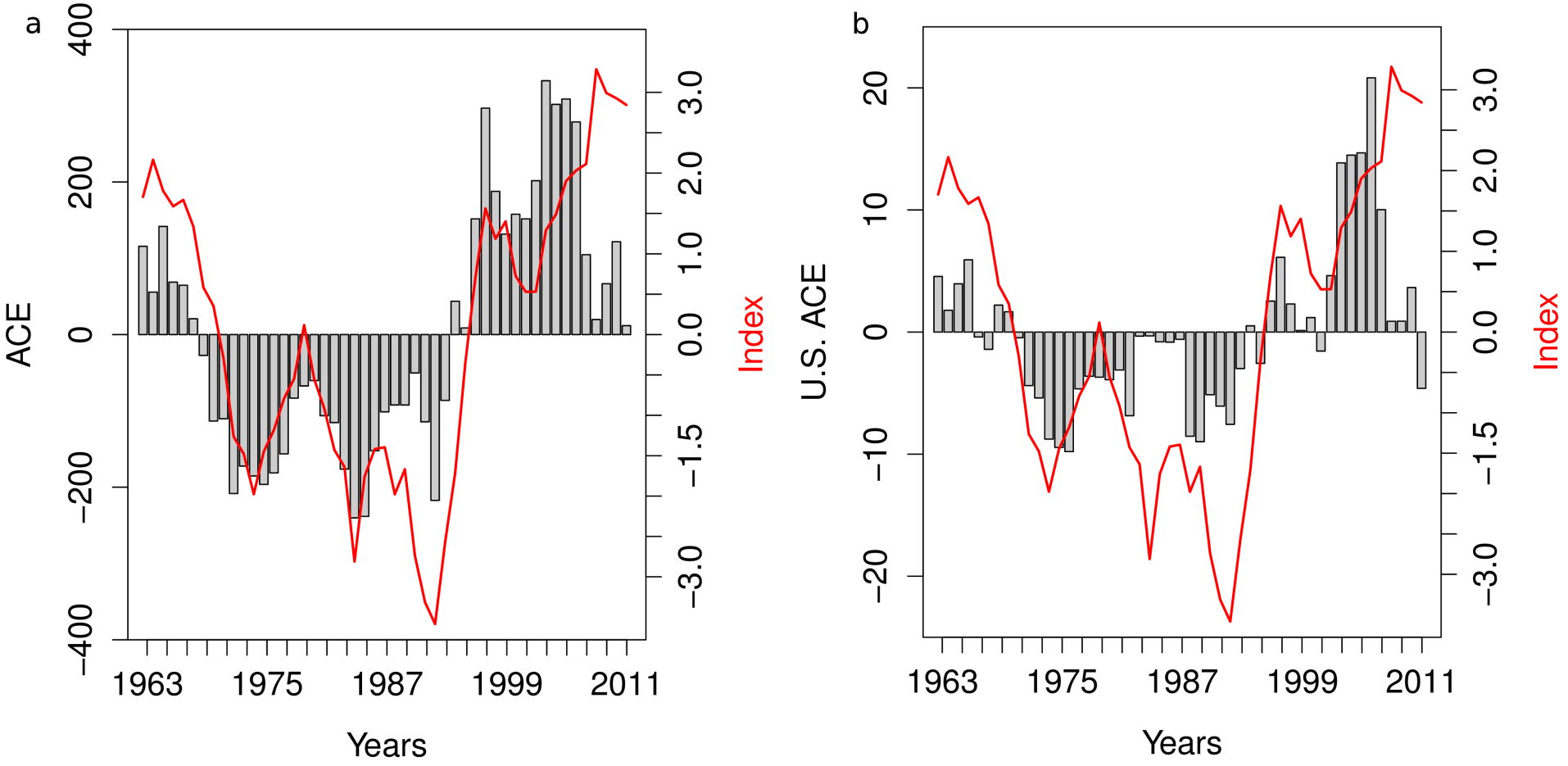




Klotzbach AMO index:



from Klotzbach and Gray (2008)



Accumulated Cyclone Energy (ACE): is the square of the max wind speed every 6 hours. The ACE of a season is the sum of the ACE for each storm and takes into account the number, strength, and duration of all the tropical storms in the season.

GCMs	Initialized	Non-Initialized
GFDL CM2.1	10	10
HadCM3	10	10
MIROC5	6	3
MPI-ESM-LR	5	3

CMIP5
SPECS

Start dates: yearly, 1961 to 2009
5-year mean predictions (1961-1966 to 2009-2013)

IC3 Climate Forecasting Unit

SPECS Seasonal-to-decadal climate Prediction for the improvement of European Climate Services

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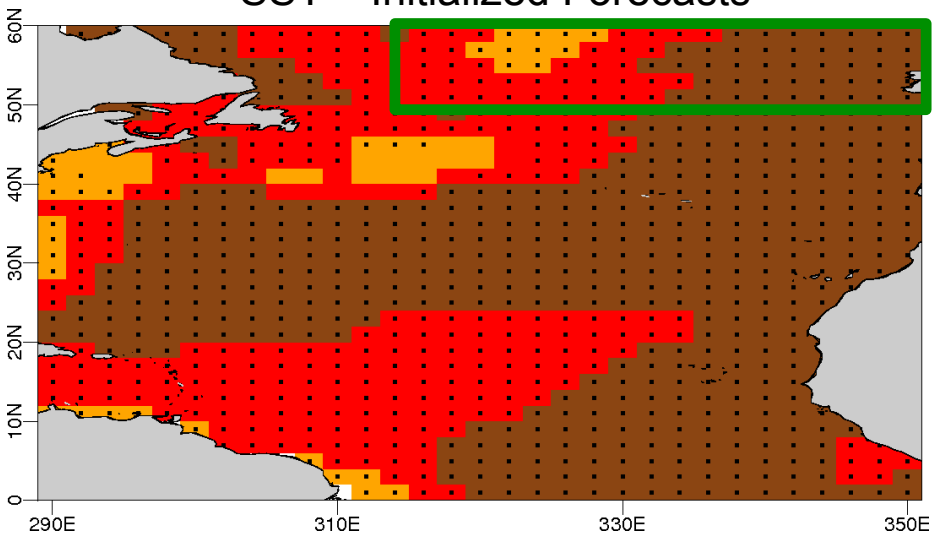
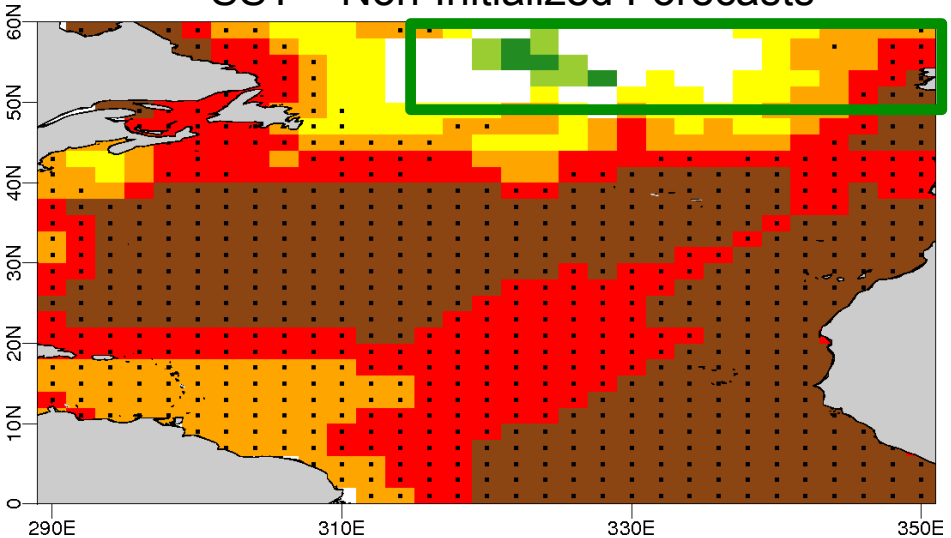
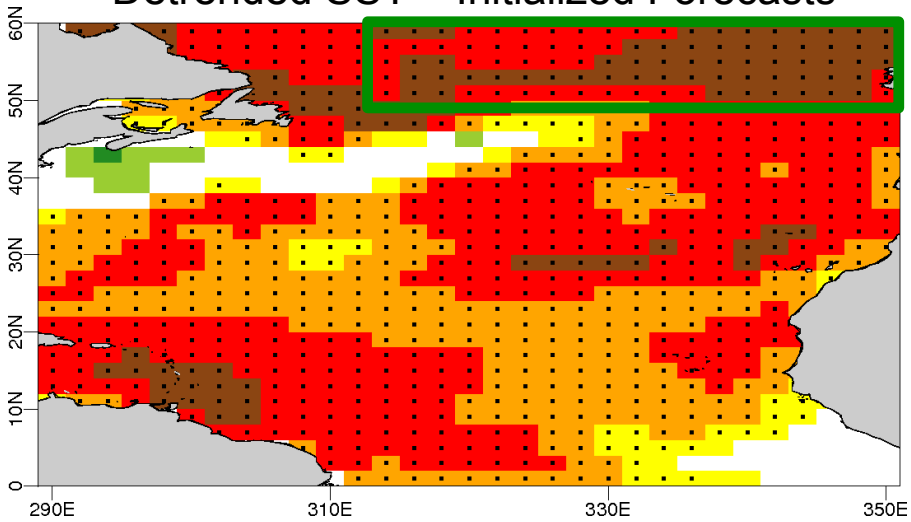
SST – Initialized Forecasts



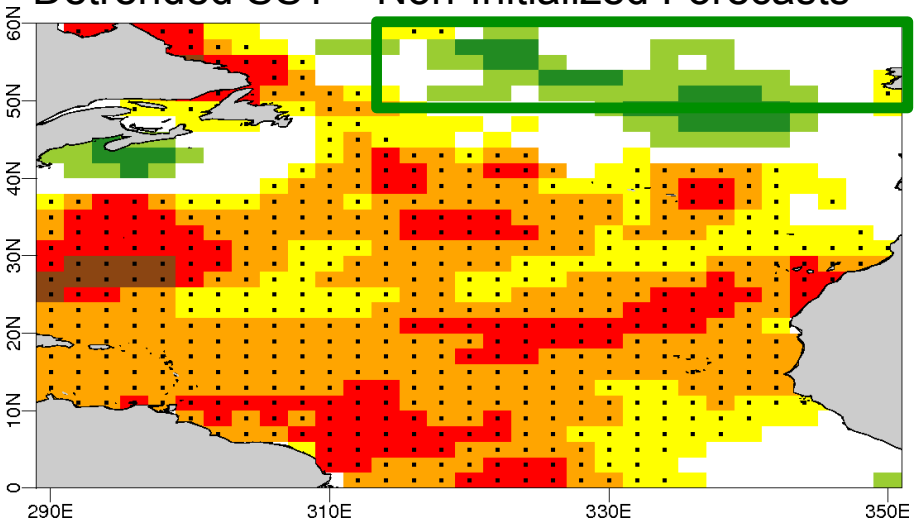
SST – Non-Initialized Forecasts

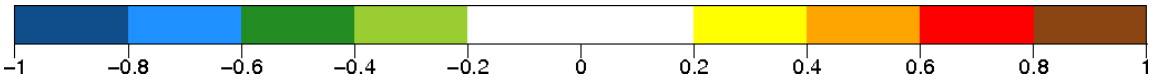


Detrended SST – Initialized Forecasts



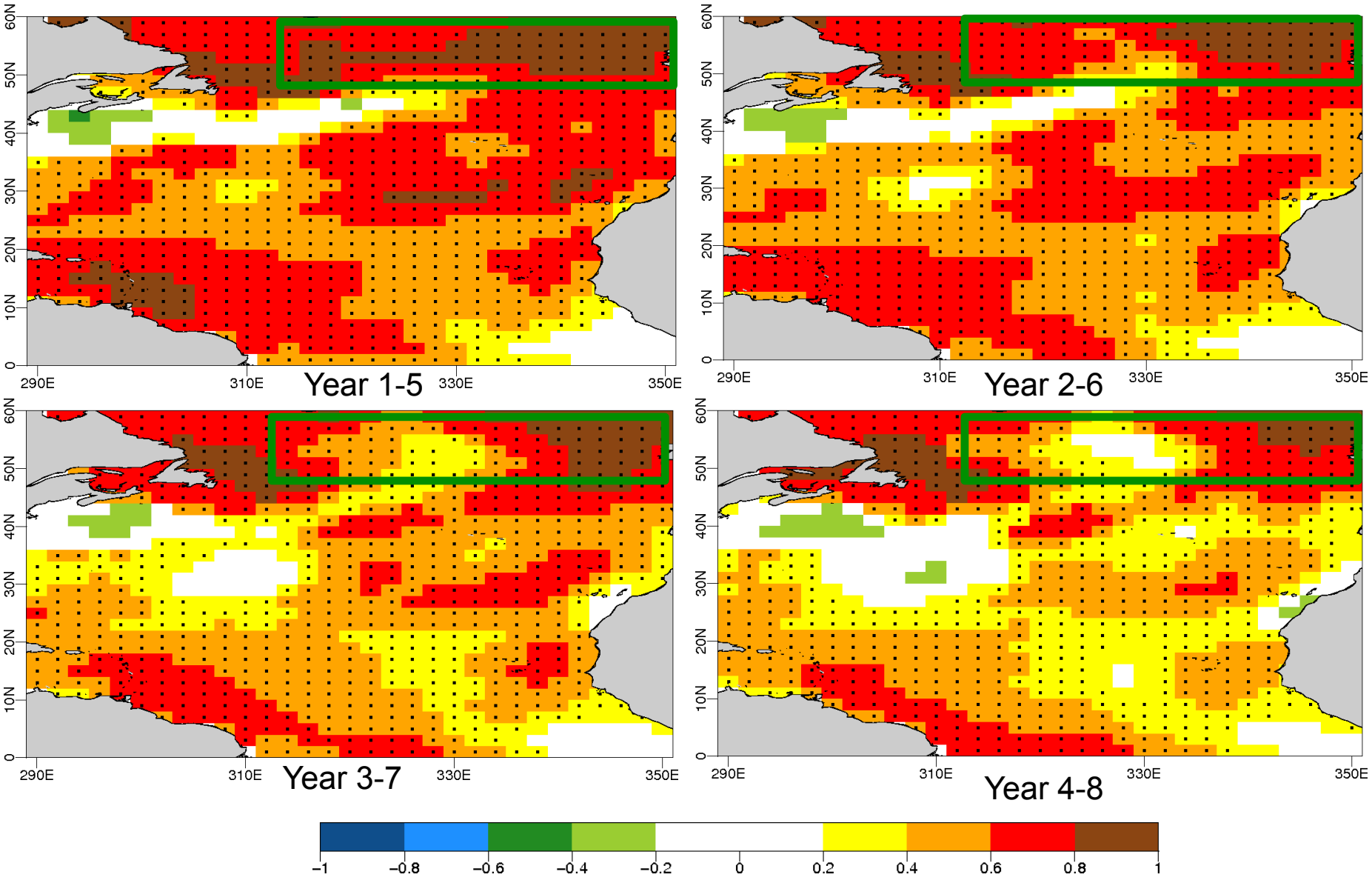
Detrended SST – Non-Initialized Forecasts



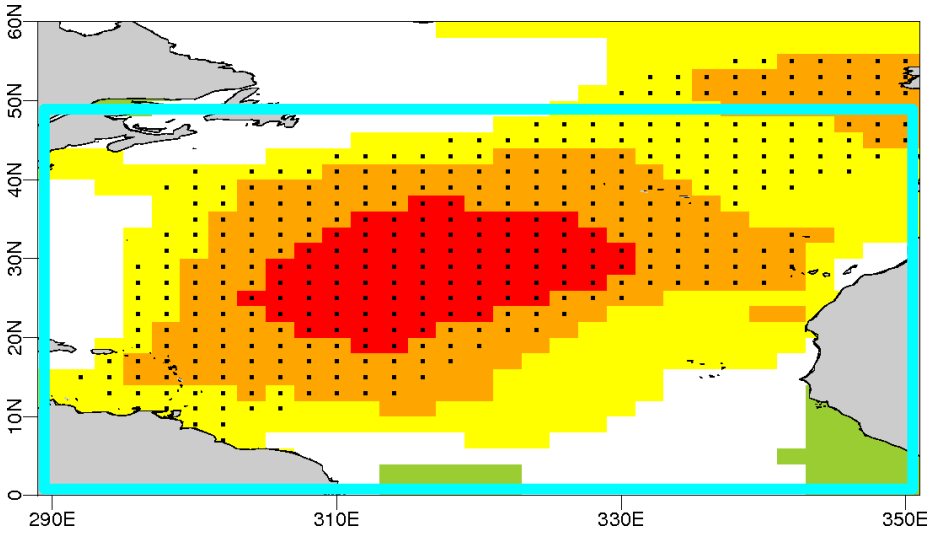


Anomaly Correlation Coefficient (ACC)-Year 1-5

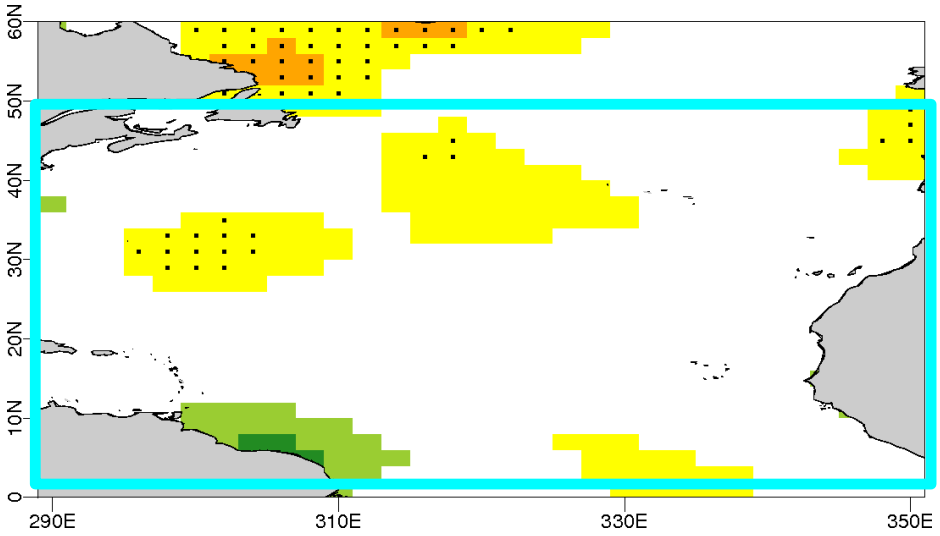
ACC, 5-year mean detrended SST – Initialized Forecasts

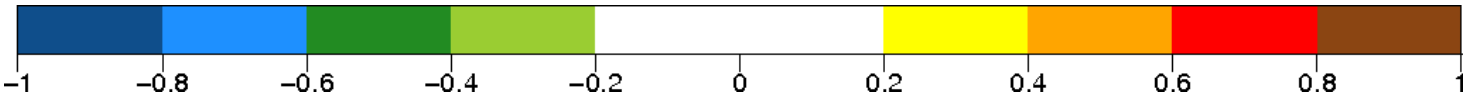


MSLP – Initialized Forecasts



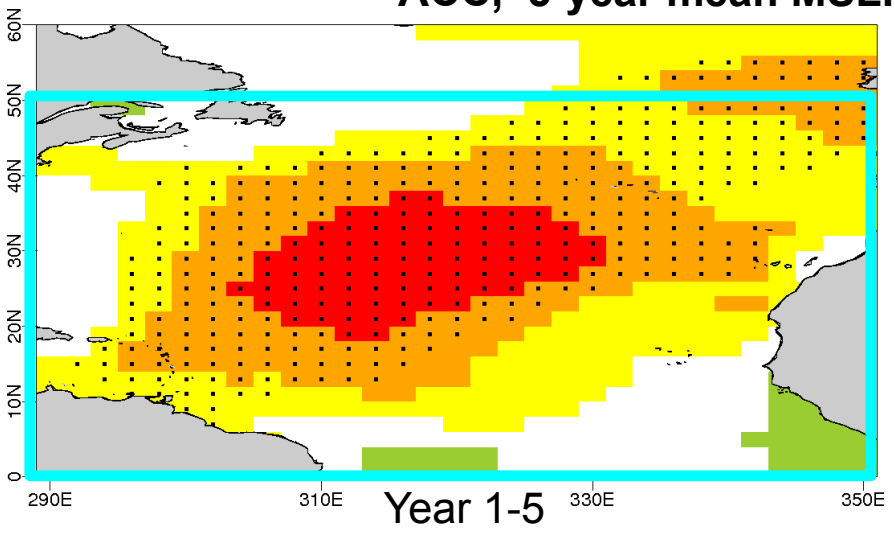
MSLP – Non-Initialized Forecasts

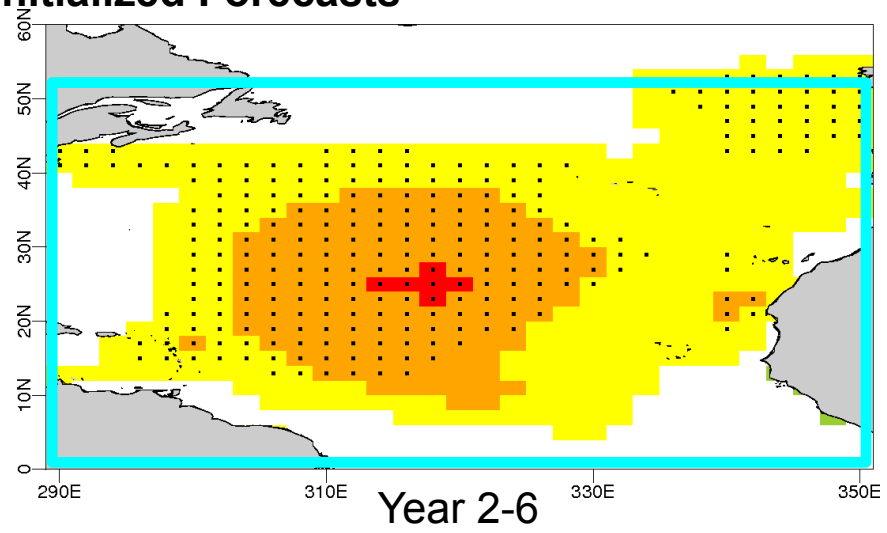


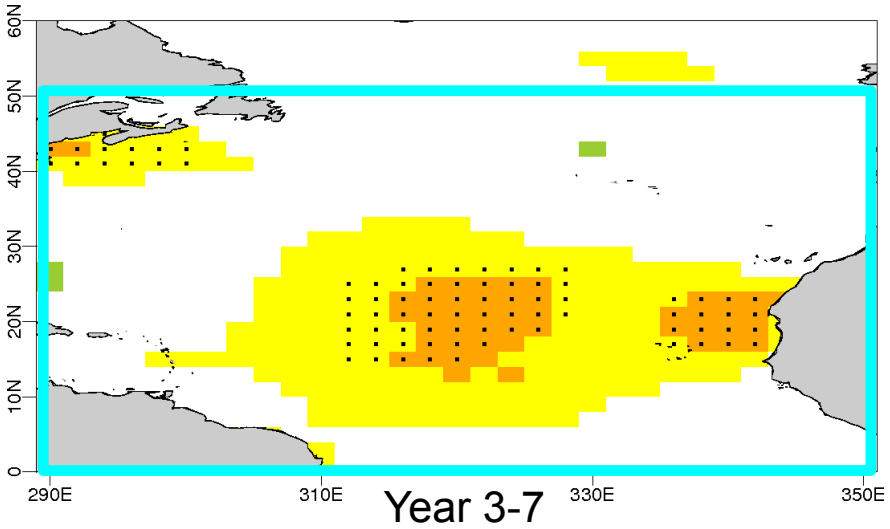


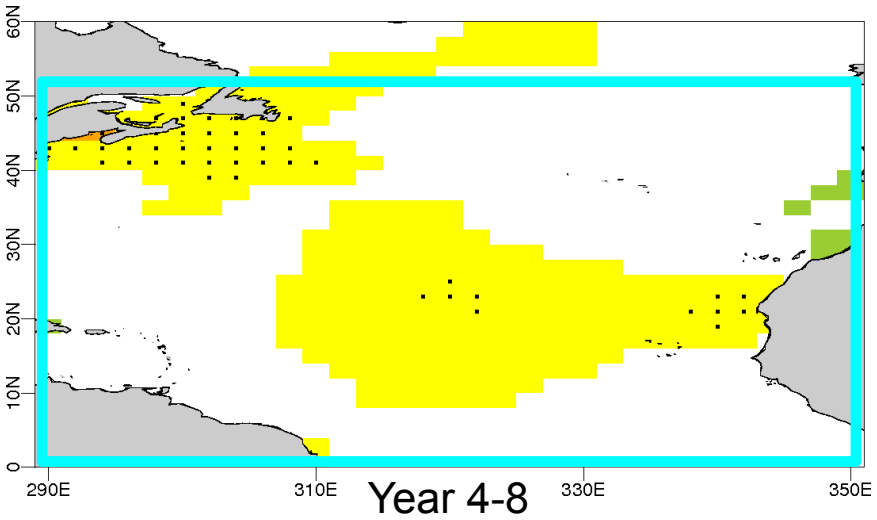
ACC Year 1-5

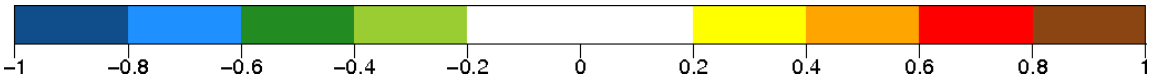
ACC, 5-year mean MSLP – Initialized Forecasts



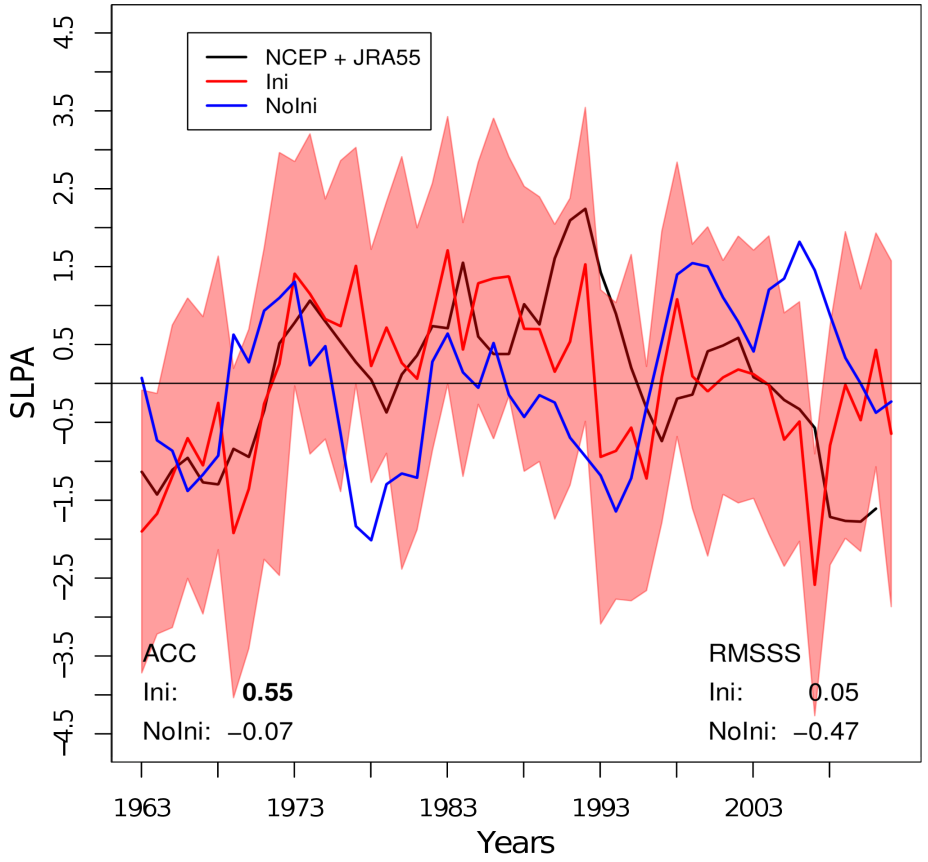




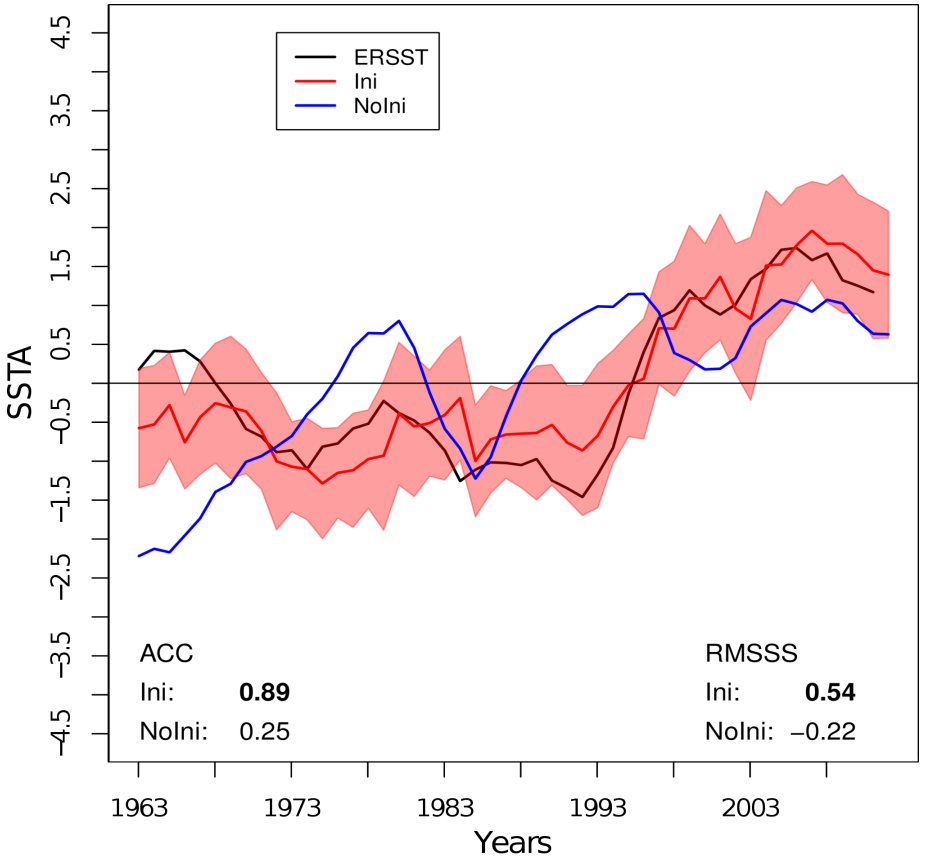




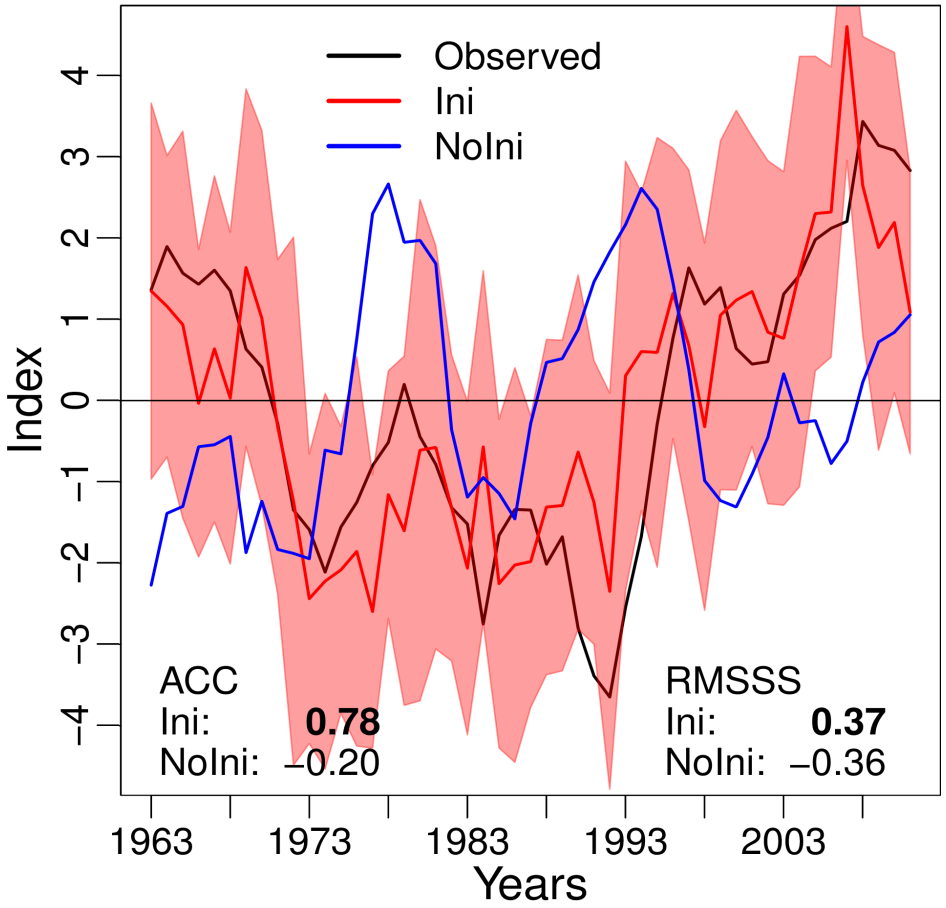
5-year mean standardized SLPA

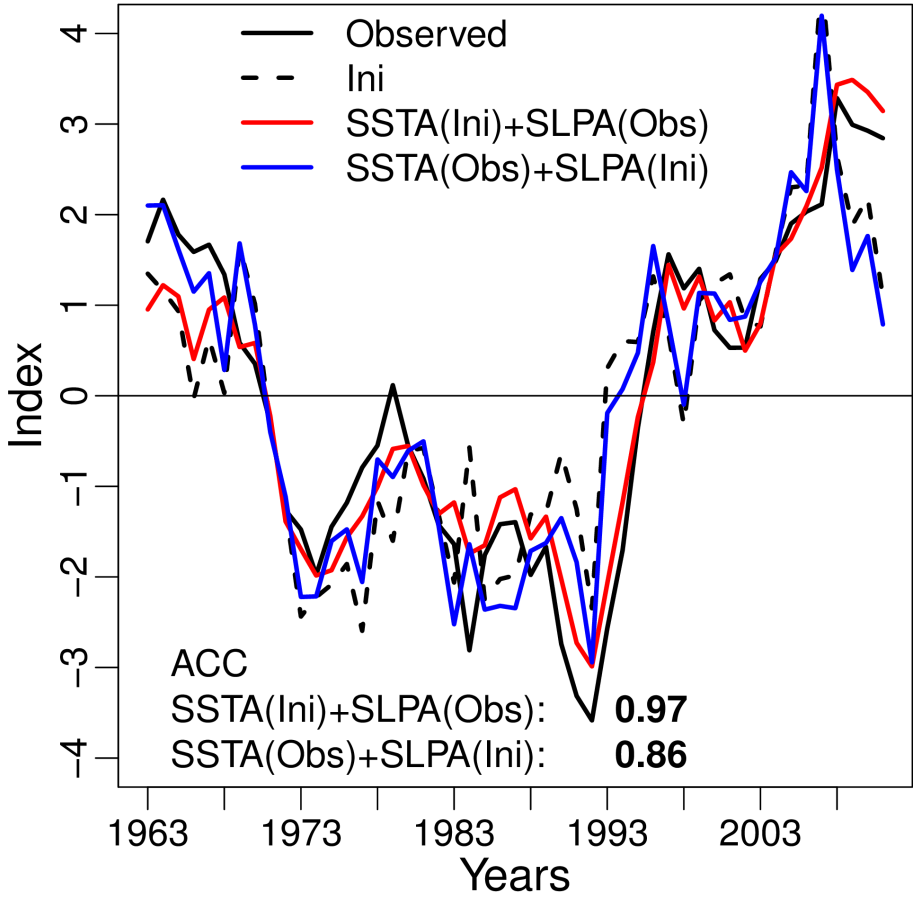


5-year mean standardized SSTA



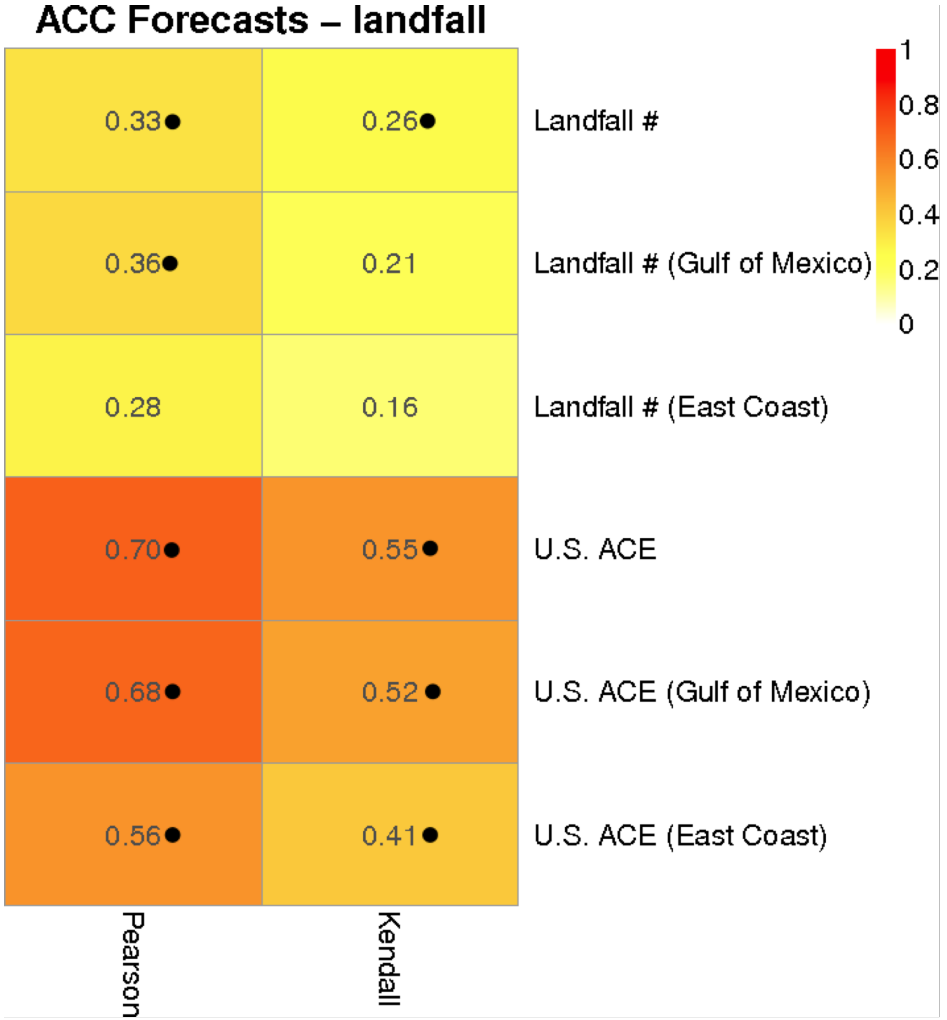
5-year mean index





How does this skill translate into forecasting cyclone activity?

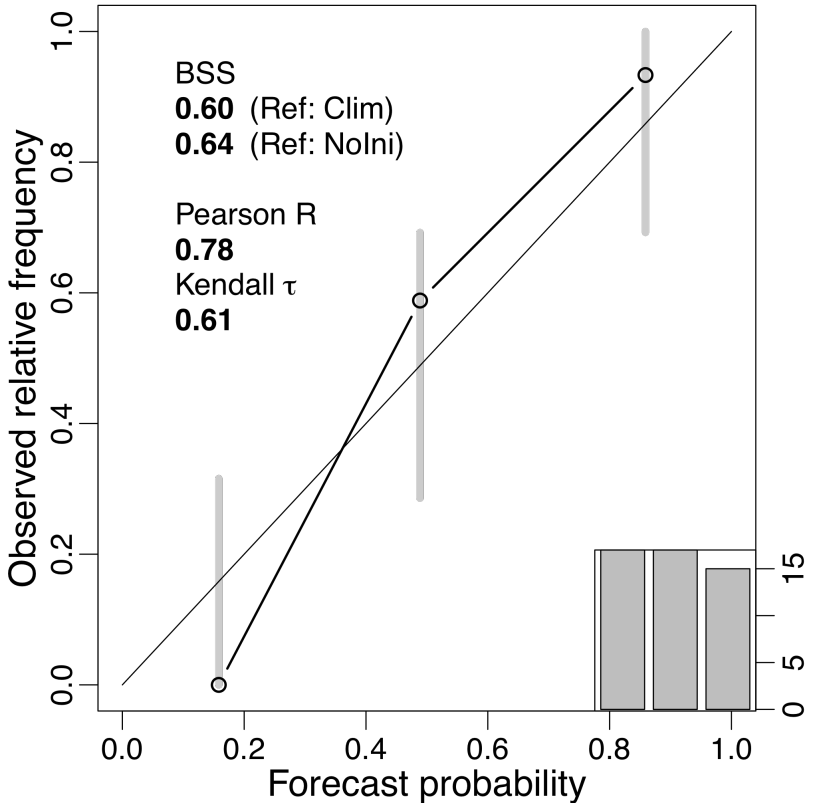
ACC – average year 1-5



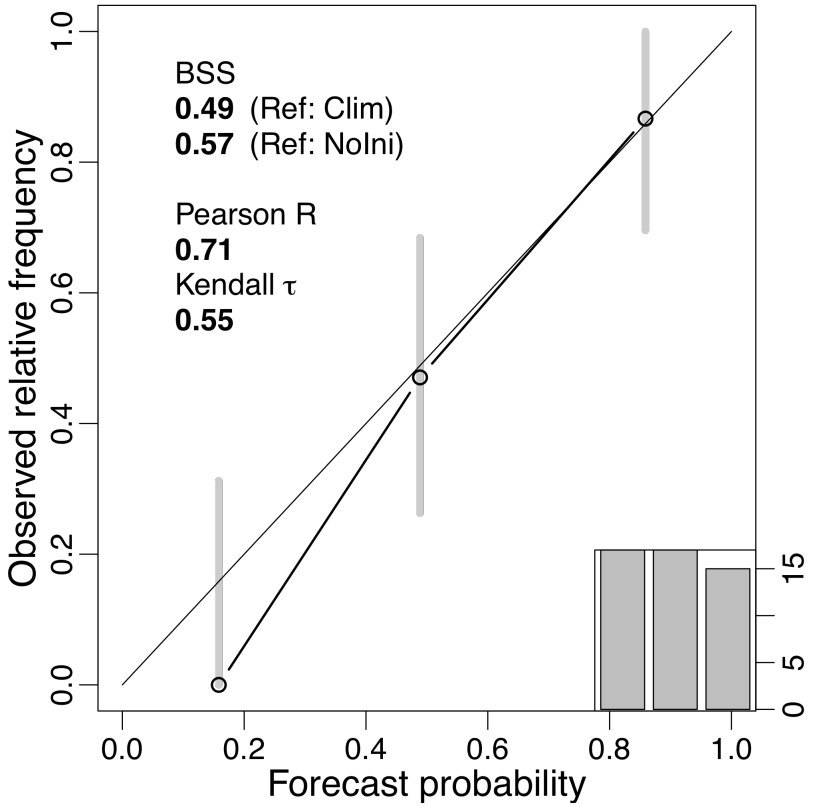
TC: tropical cyclones; HR: hurricanes; HD: hurricane days; MHD: major HD

What is the probability that the 5-yr mean activity will be above the climatological mean?

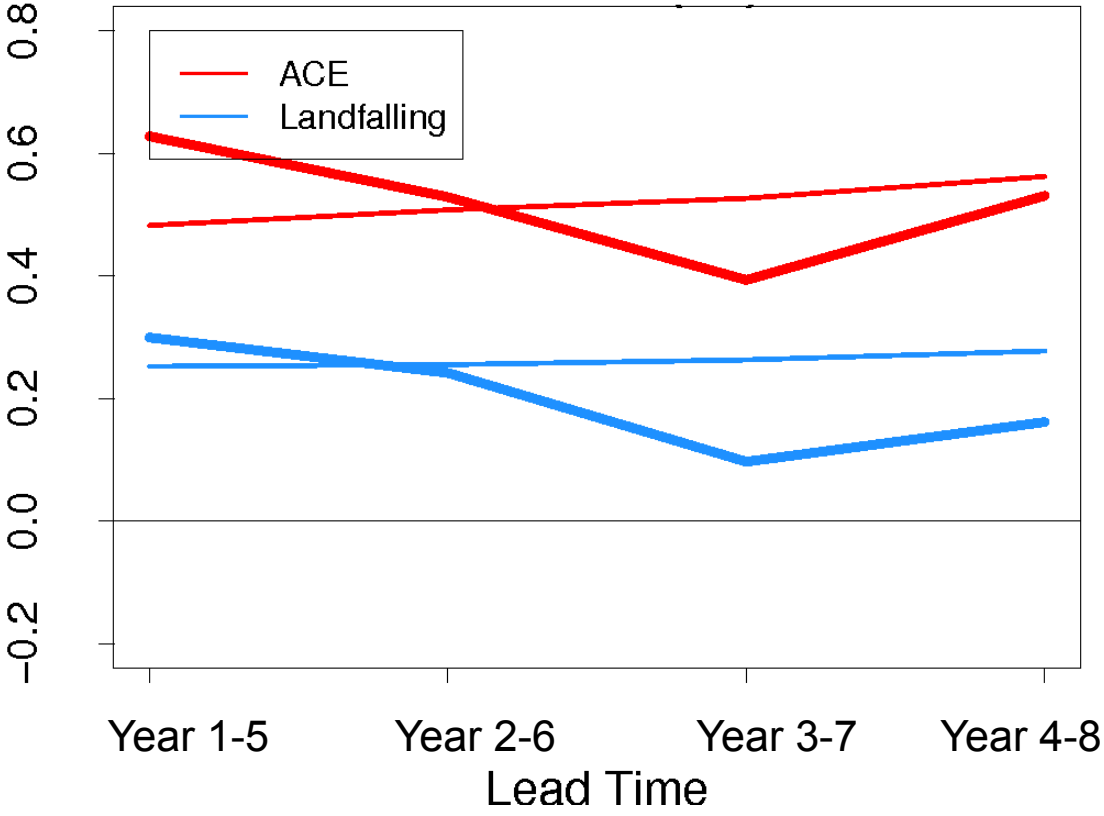
Probabilistic forecast: ACE

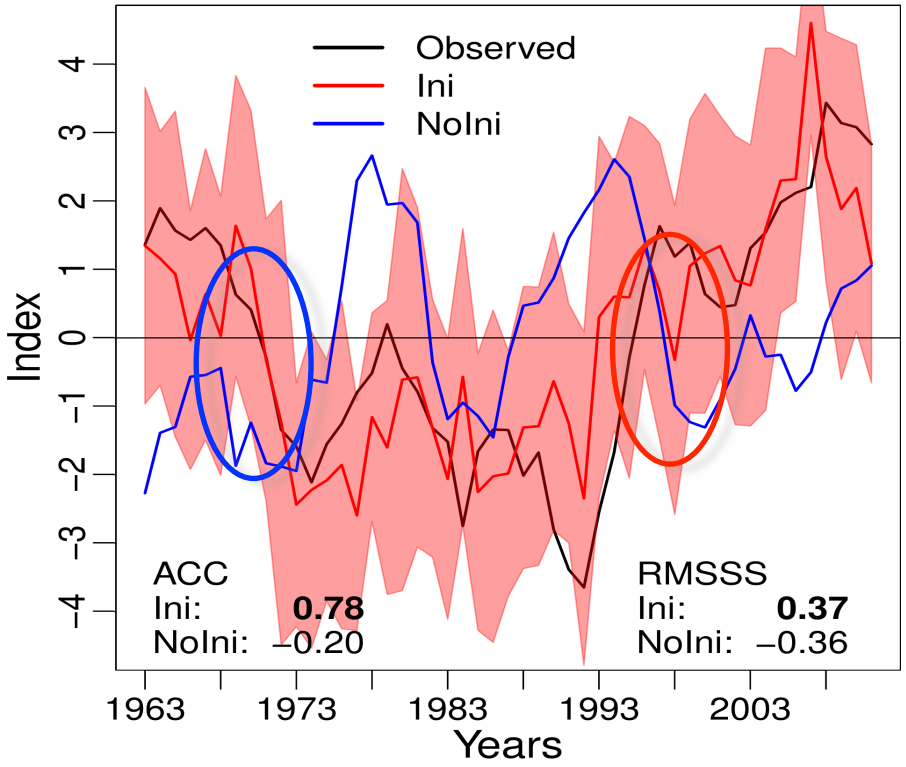


Probabilistic forecast: U.S. ACE

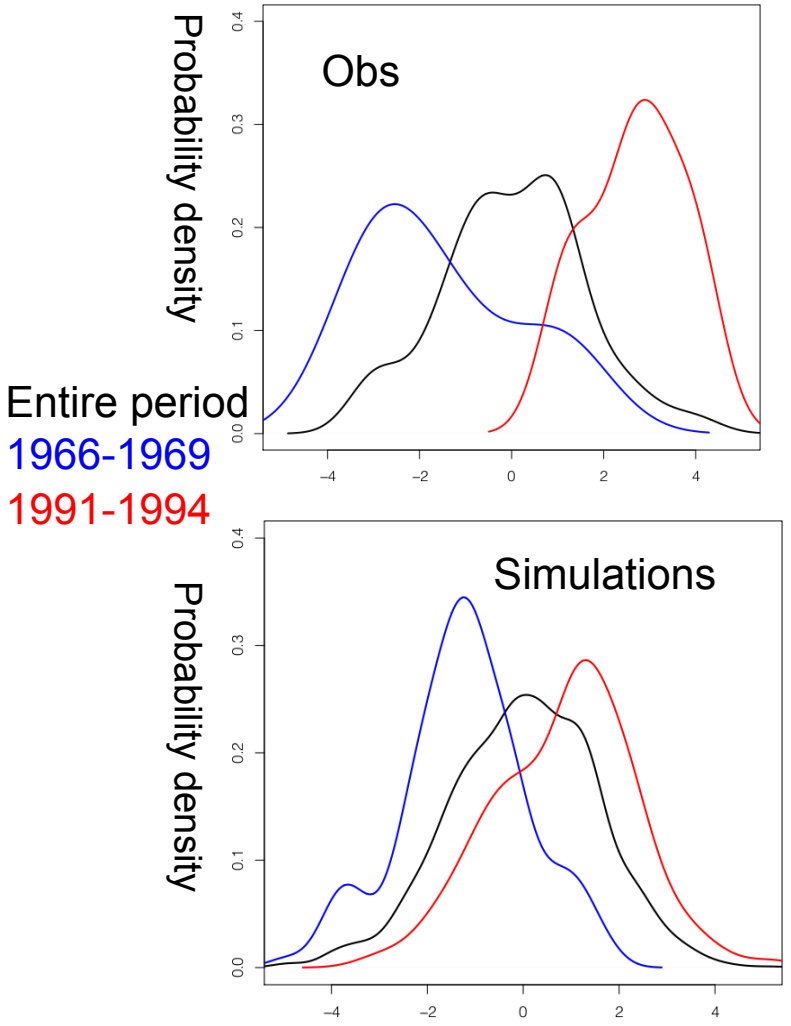


ACC: 5-yr predicted index vs observed activity

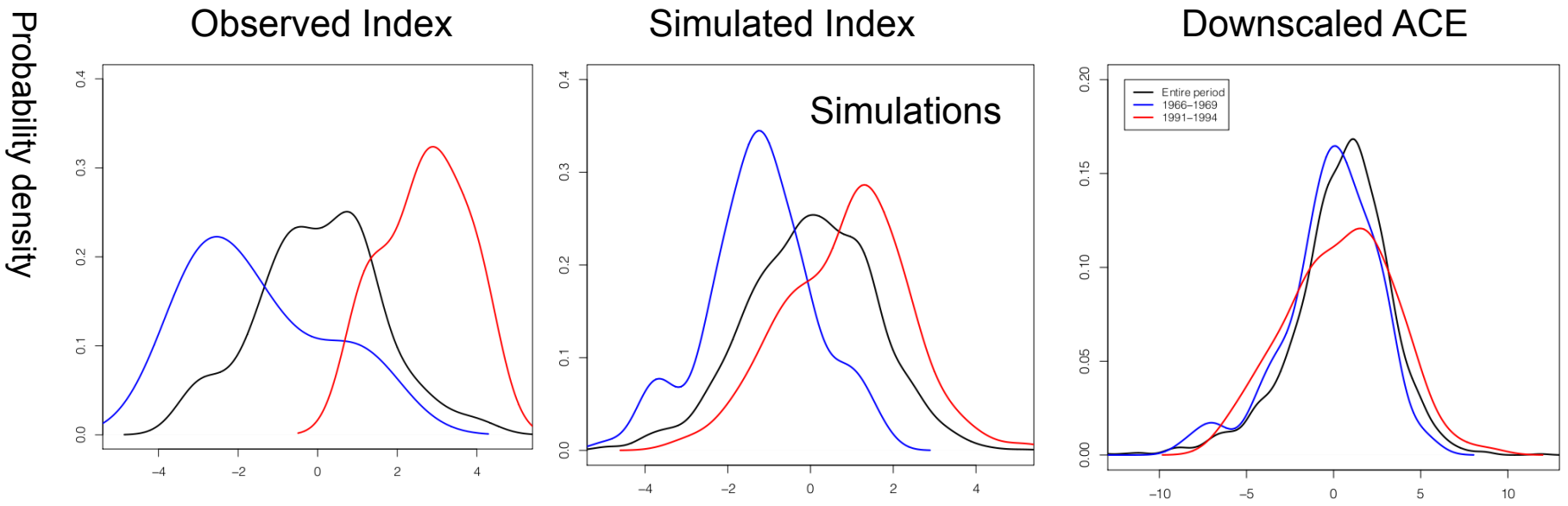




Average Years 2-6 - Year 1



(Average Years 2-6) – (Year 1)



Entire period
1966-1969
1991-1994

$$ACE = e^{1.707 + \beta_1 SST_{MDR} - \beta_2 1.521 SST_{TROP}}$$

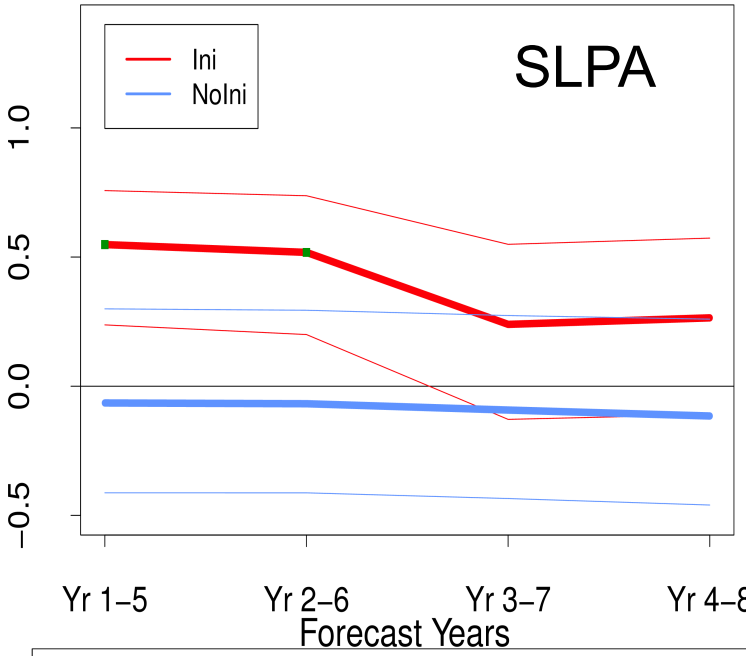
Based on Villarini and Vecchi (2012)

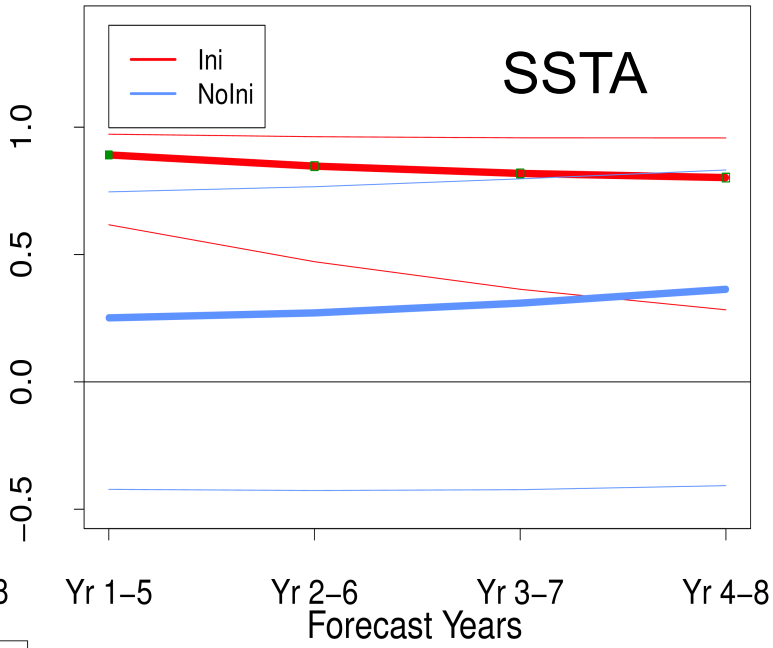
Summary

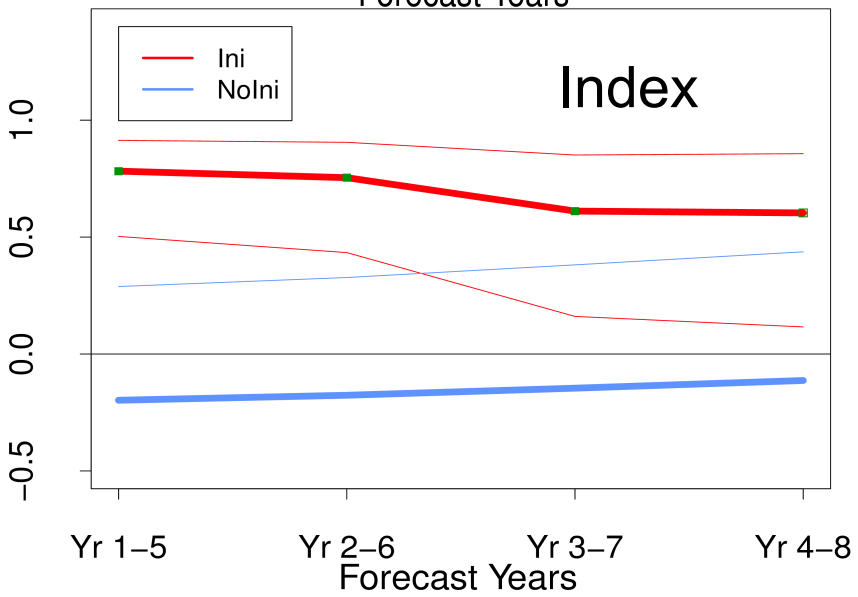
- Initialized GCMs do seem capable of predicting AMV index, which is linked to Atlantic TC level, at multi-annual timescale (5yrs)
- Skill doesn't come only from persistence, i.e. we can predict shift between active and quiet phases

Thank you

ACC
5-year mean







How does this skill translate into forecasting cyclone activity?