

Multi-year prediction skill of Atlantic hurricane activity in CMIP5 decadal hindcast using a statistical index

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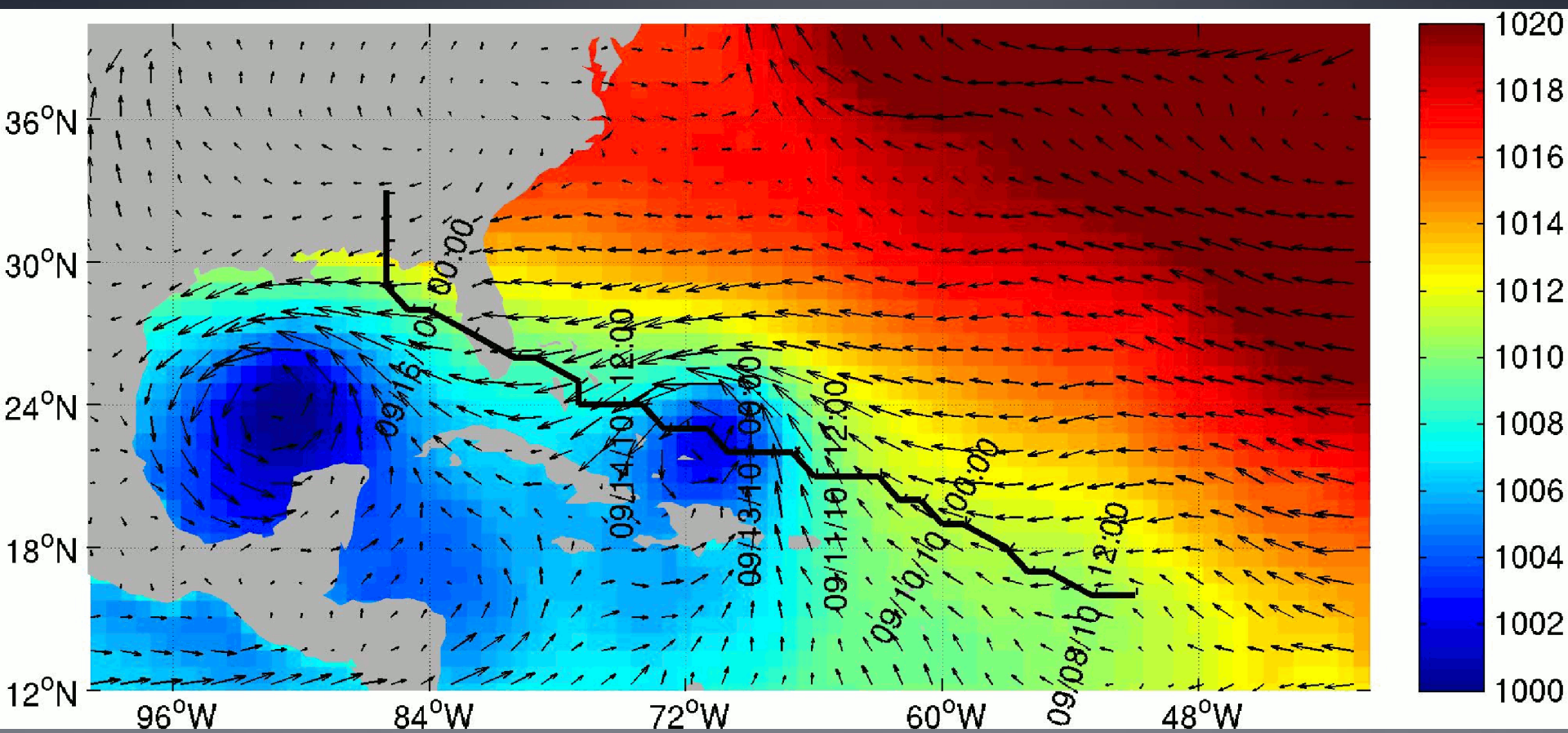
Stockholm University

Toulouse, May 15th, 2013

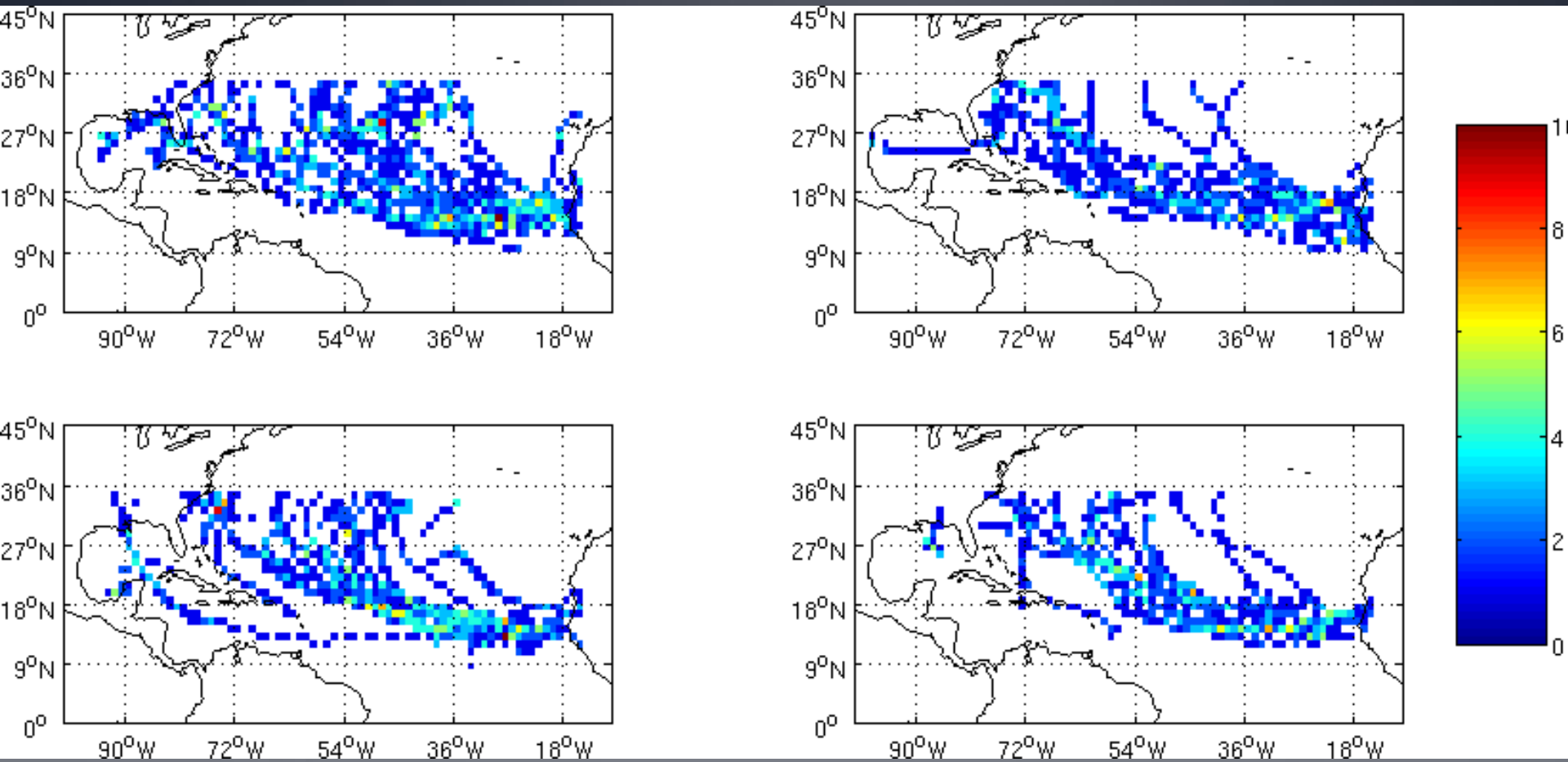
**Collaboration with
C. Jones (SMHI), E. Doblas-Reyes (IC3)**



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- Variability of Atlantic TC activity
 - Interannual timescale: ENSO
 - Decadal timescale: AMO
 - 2 techniques are typically used to evaluate TC activity in climate simulations:
 1. Direct analysis of tropical cyclones statistics
 - Track storms directly
 - Compare storms statistics
 2. Indirectly through changes in large-scale fields that impact TC activity
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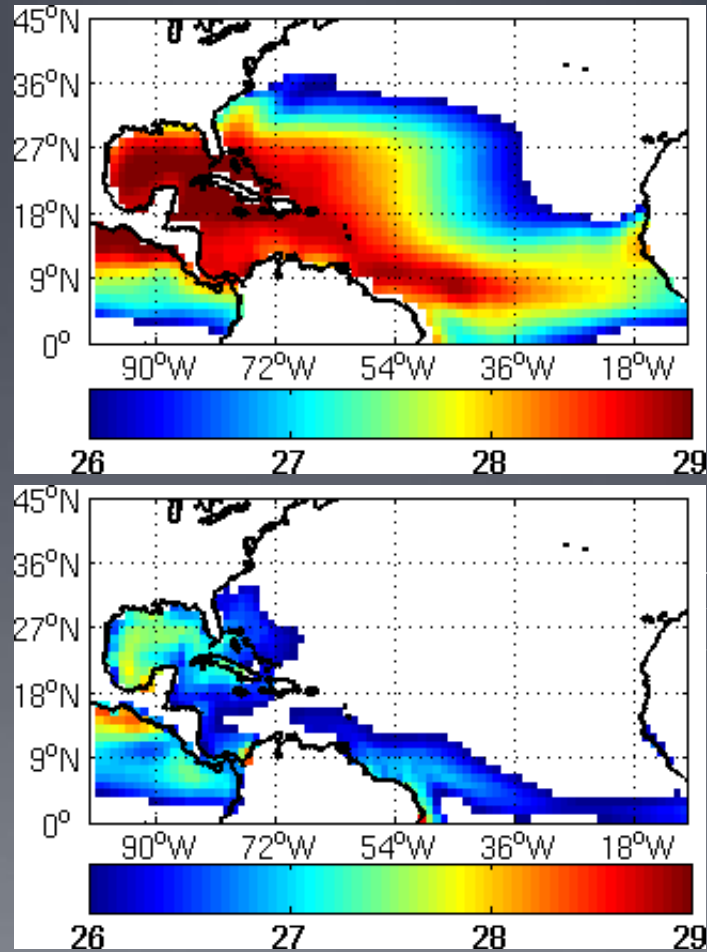
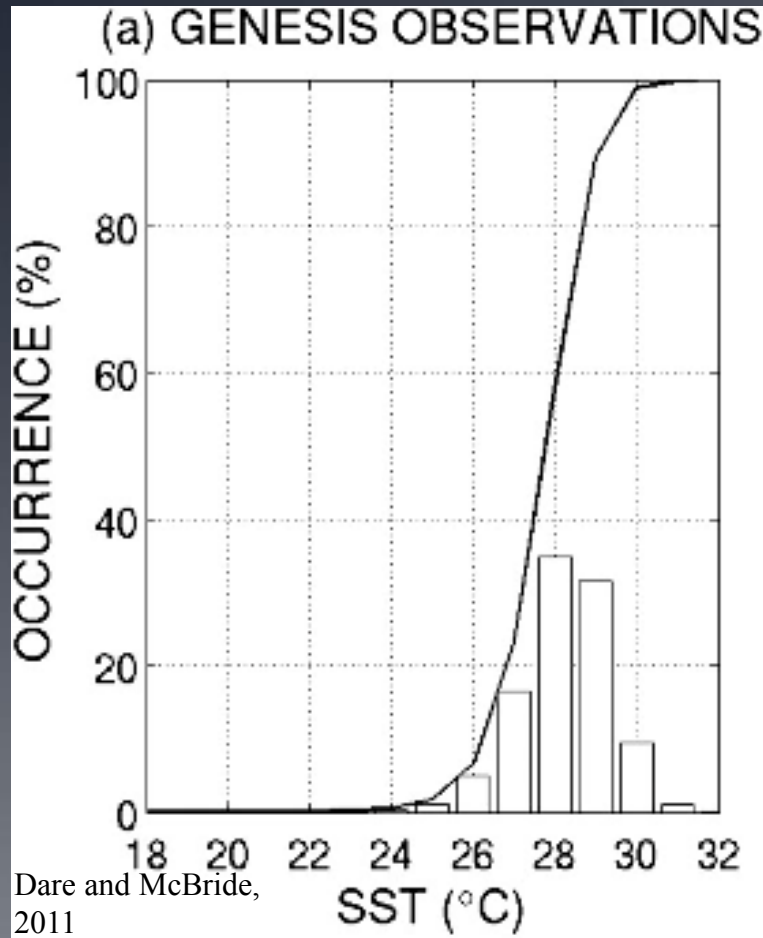


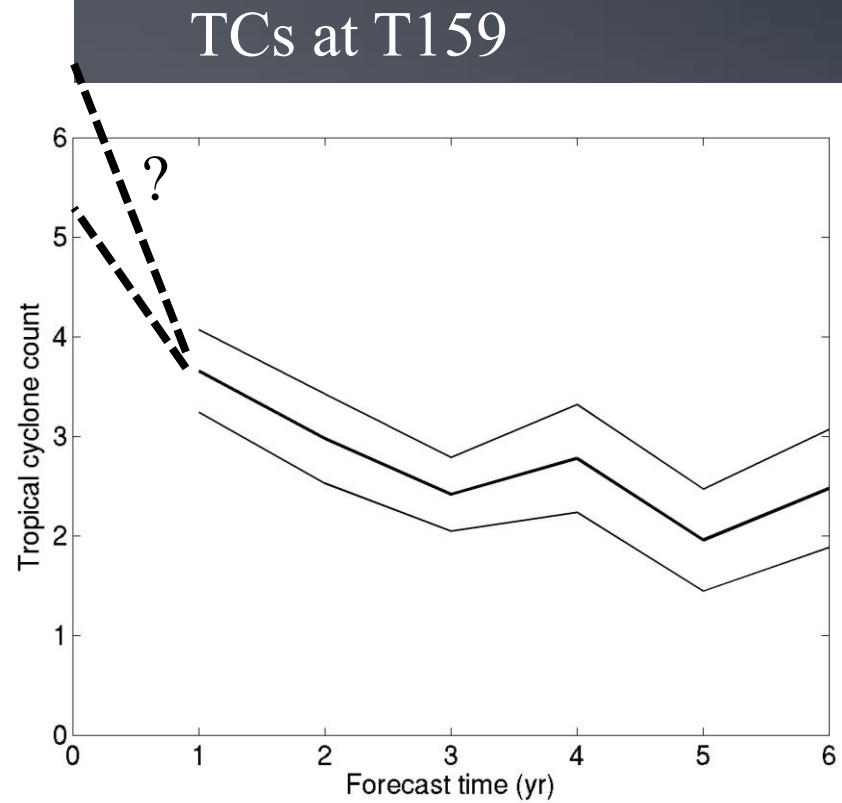
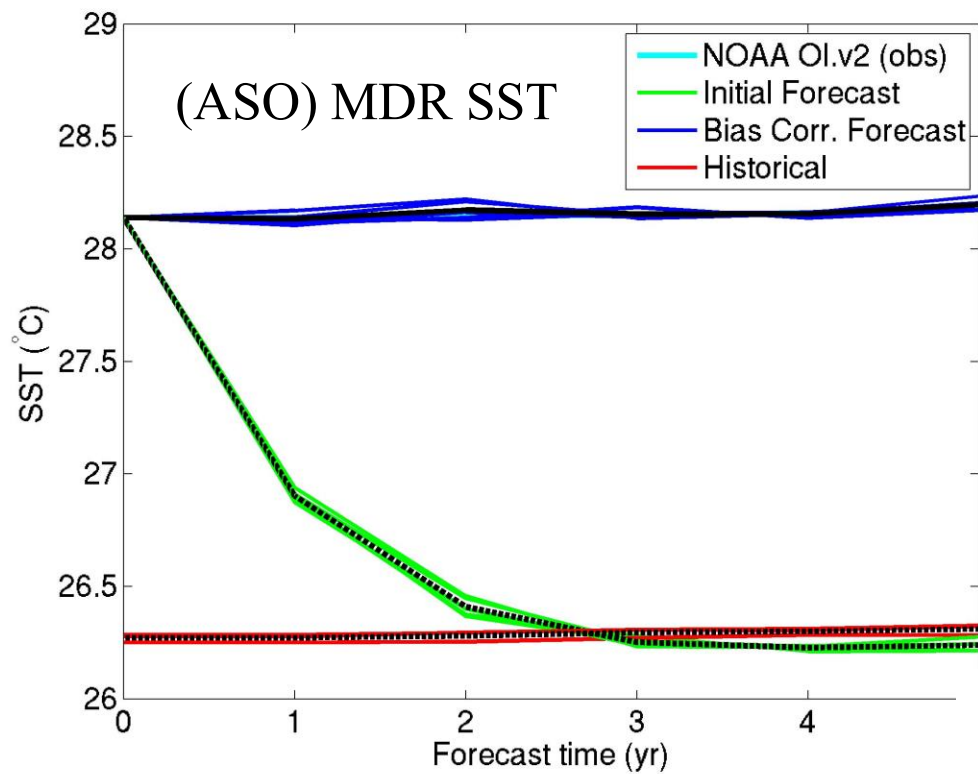
Track densities for 4x10-year simulations with EC-Earth 2.3 (T159)



But <30% of observed activity

SSTs in EC-Earth



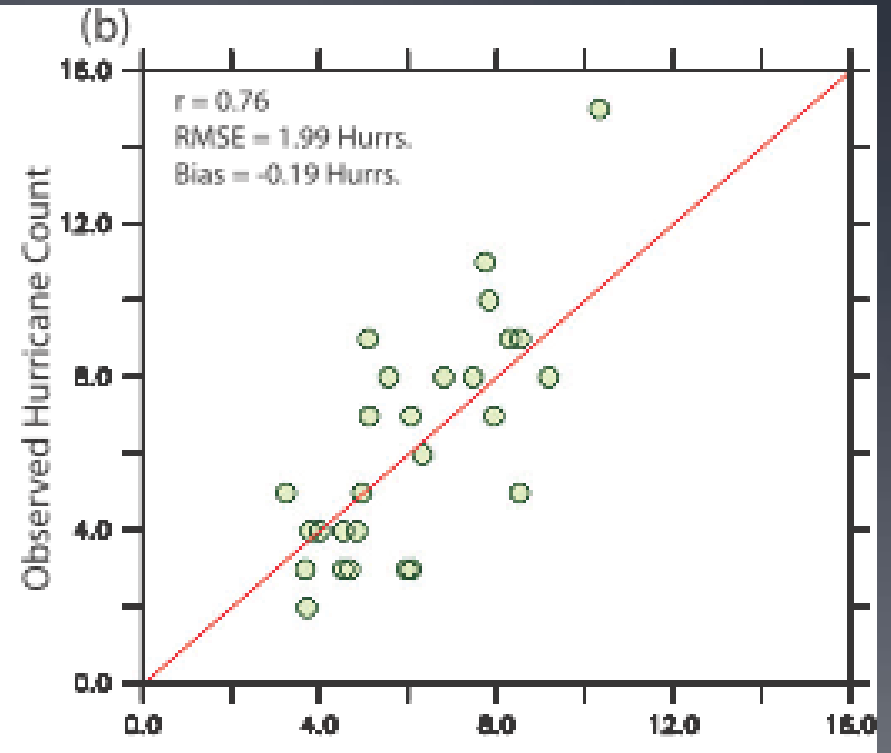
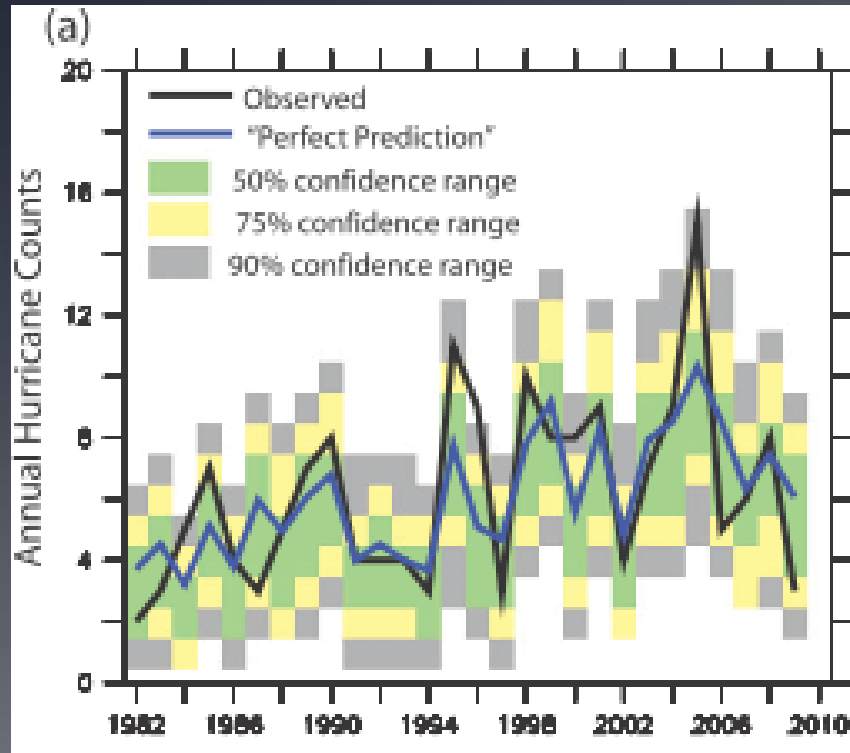


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- Bias-correct SSTs of original hindcasts
 - Increase resolution of atmosphere model from T₁₅₉ (110km) to T₂₅₅ (70km)
 - Run EC-Earth in atmosphere only mode using biased/drift corrected SSTs
 - Go count cyclones again
 - Work in progress...
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Second technique: Statistical Emulator

- Predictors:
 - Atlantic (MDR) SSTA
 - Tropical SSTA
 - Drivers of large-scale conditions impacting hurricanes (potential intensity, vertical wind shear, ...)
 - Explains much of past observed hurricane activity (Swanson 2008, Vecchi et al. 2008)
 - Explains inter-model spread of high-resolution dynamical AGCM projections (Zhao et al. 2009)
 - **Can be computed easily from many models**
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Statistical Emulator



$$\lambda = e^{1.707 + 1.388 SST_{MDR} - 1.521 SST_{TROP}}$$

SST: ASO anomalies w.r.t.
1982-2005 mean

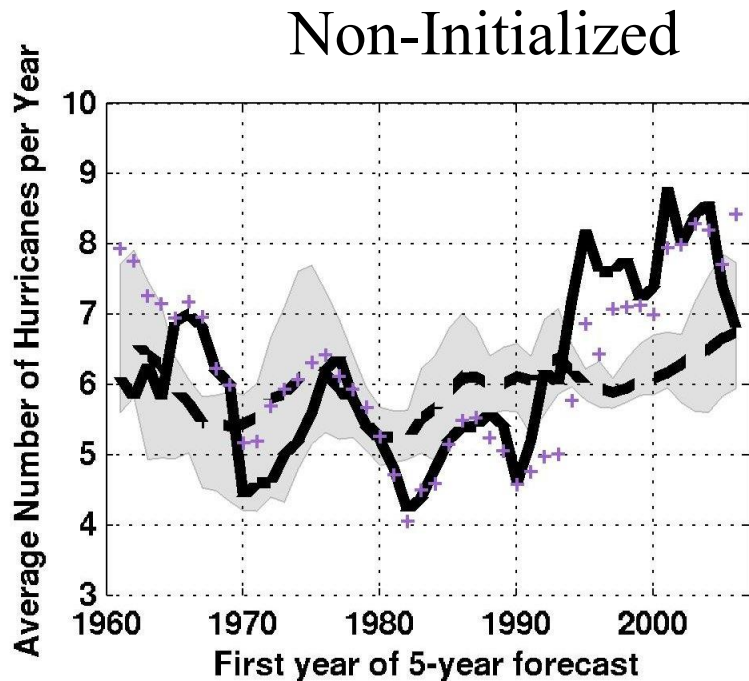
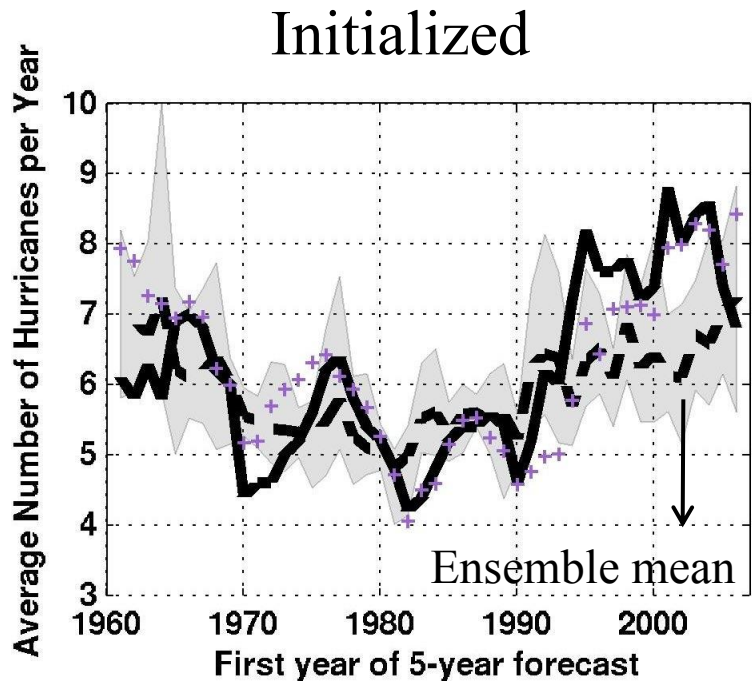
Models with yearly start dates: 1960-2005

- EC-Earth - IC₃ (5)
- EC-Earth - SMHI (8/10)
- GFDL CM2.1 (10)
- HadCM₃ (10)
- HadCM₃ (10)
- CanCM₄ (10)
- Miroc₅ (6)

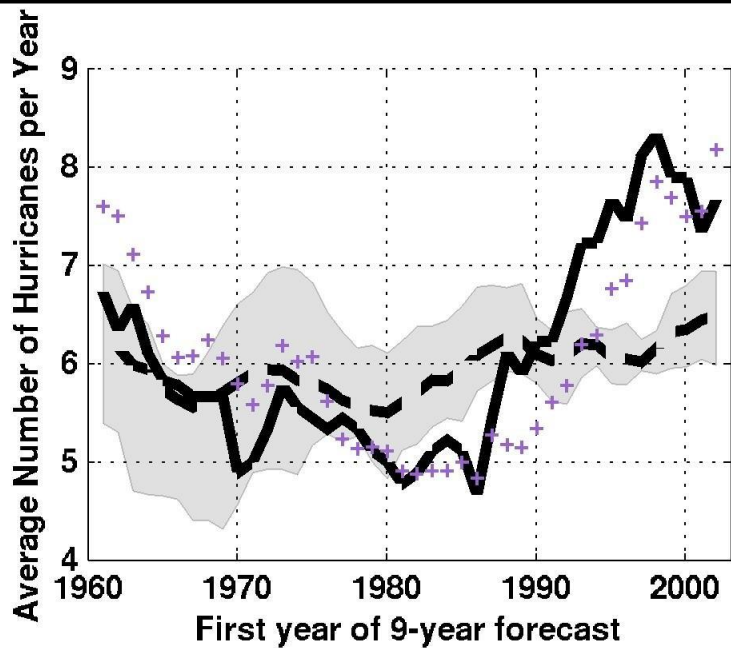
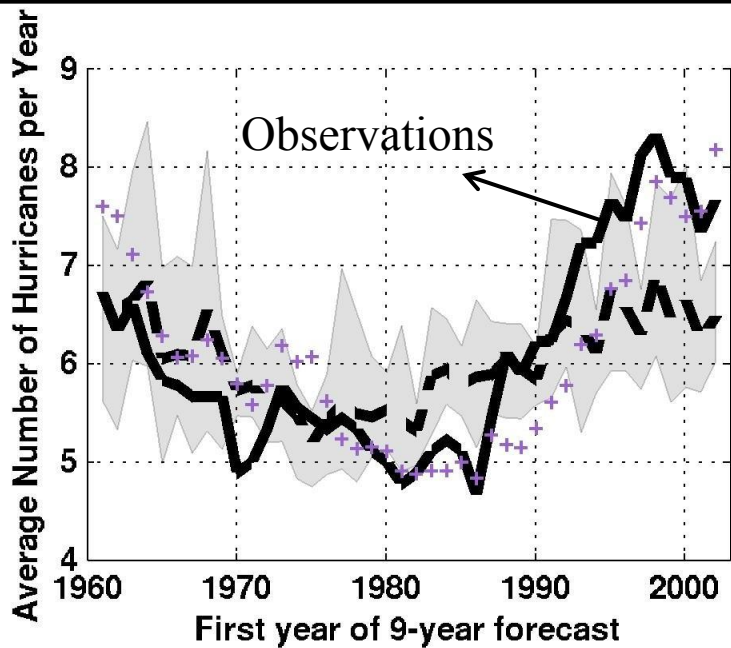
Full-field Initialization

Anomaly Initialization

5-yr mean forecast



9-yr mean forecast



Mean square skill score

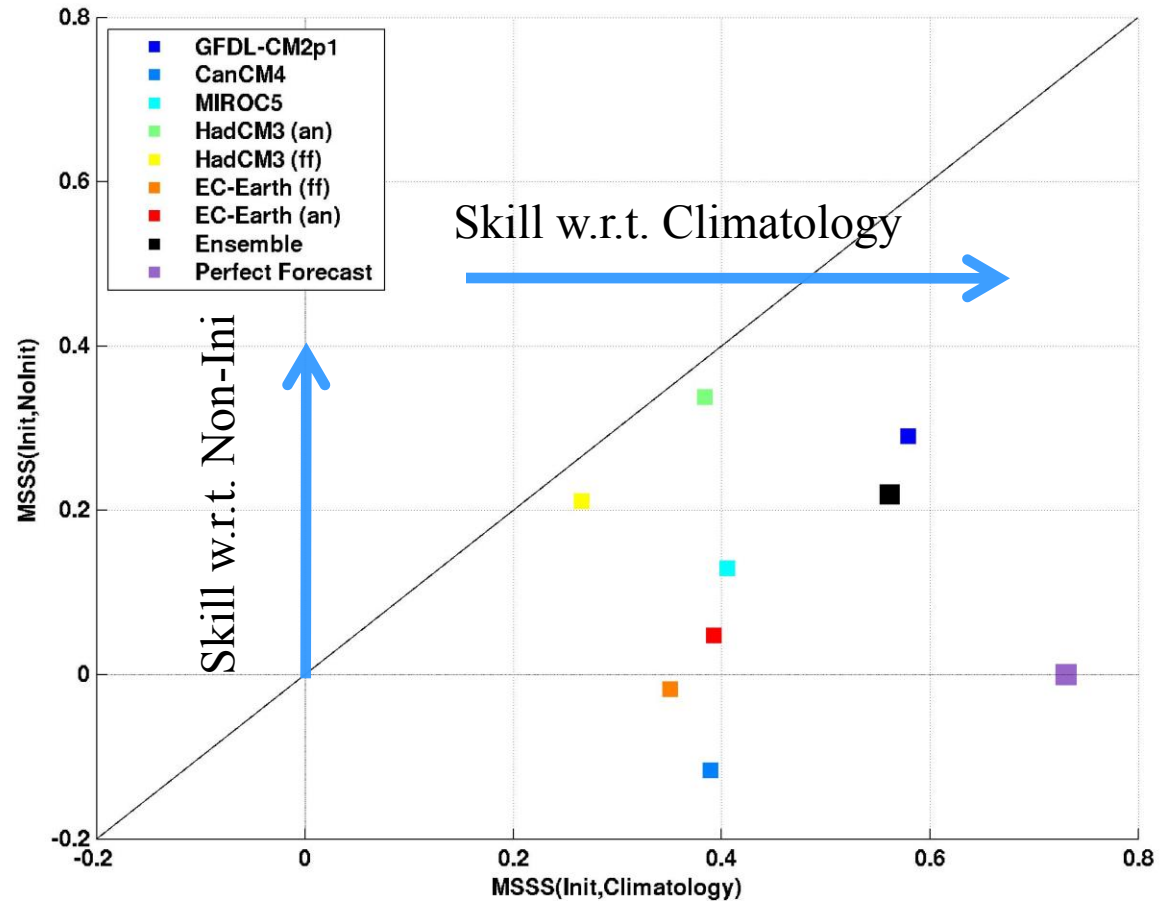
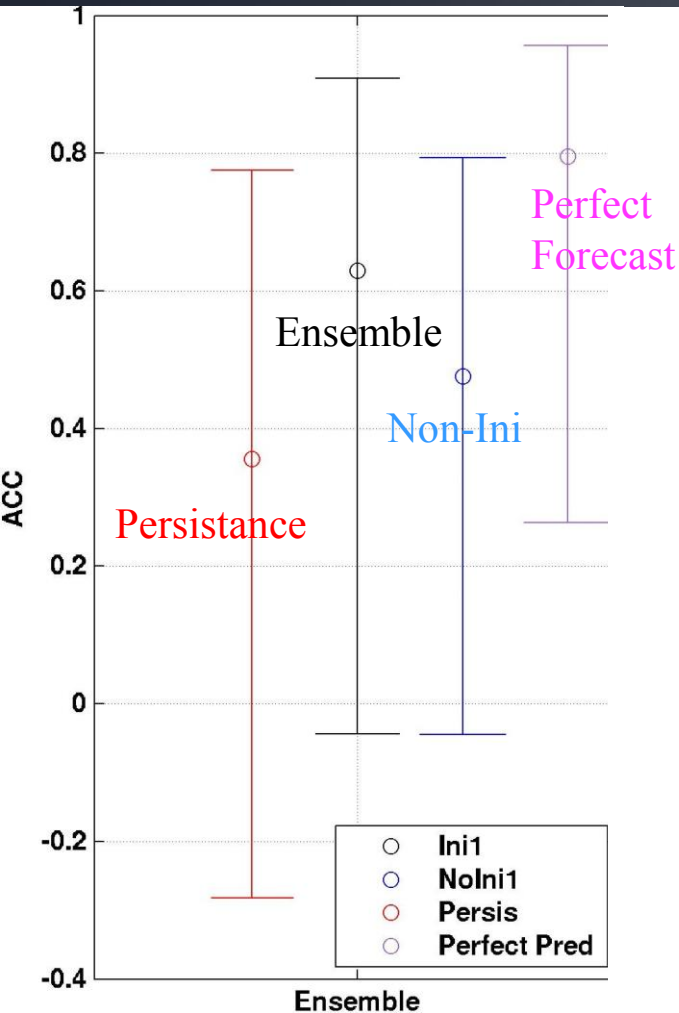
$$MSSS = 1 - \frac{MSE_{forecast}}{MSE_{reference}}$$

MSSS=1 -> perfect prediction

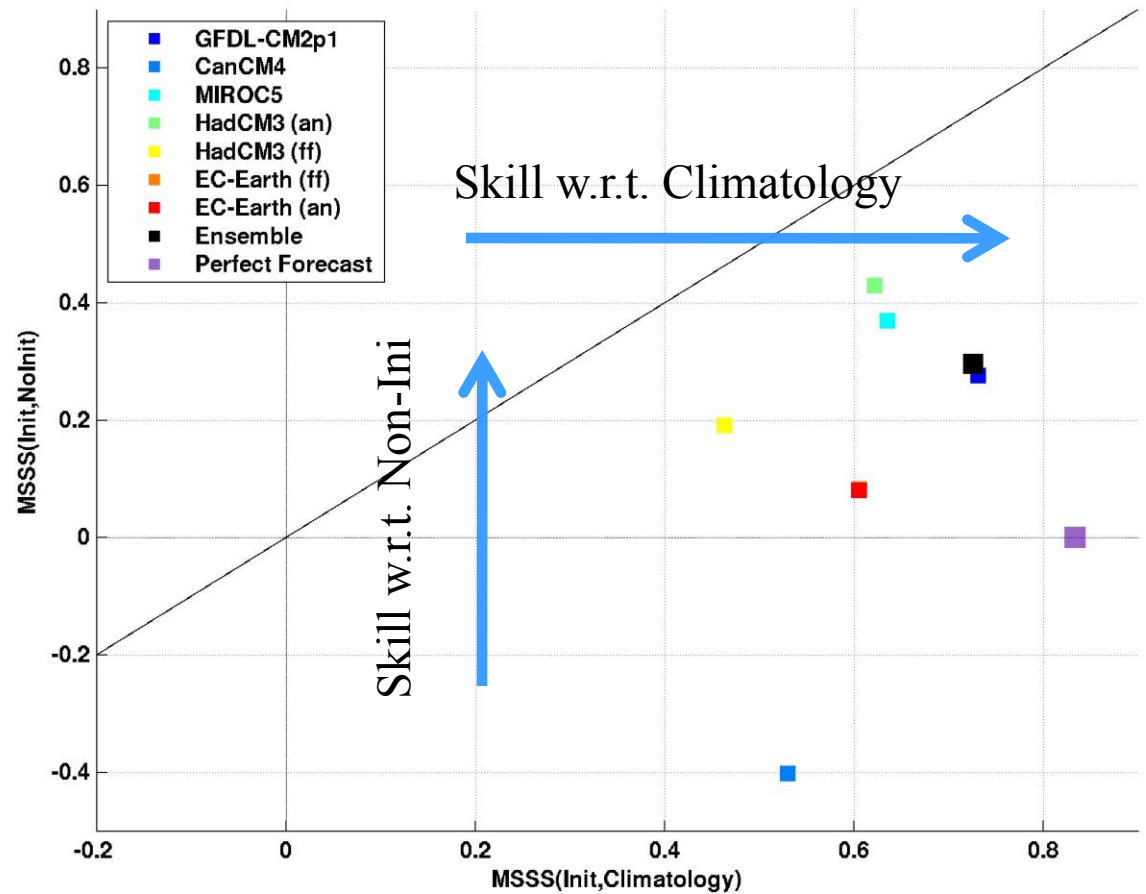
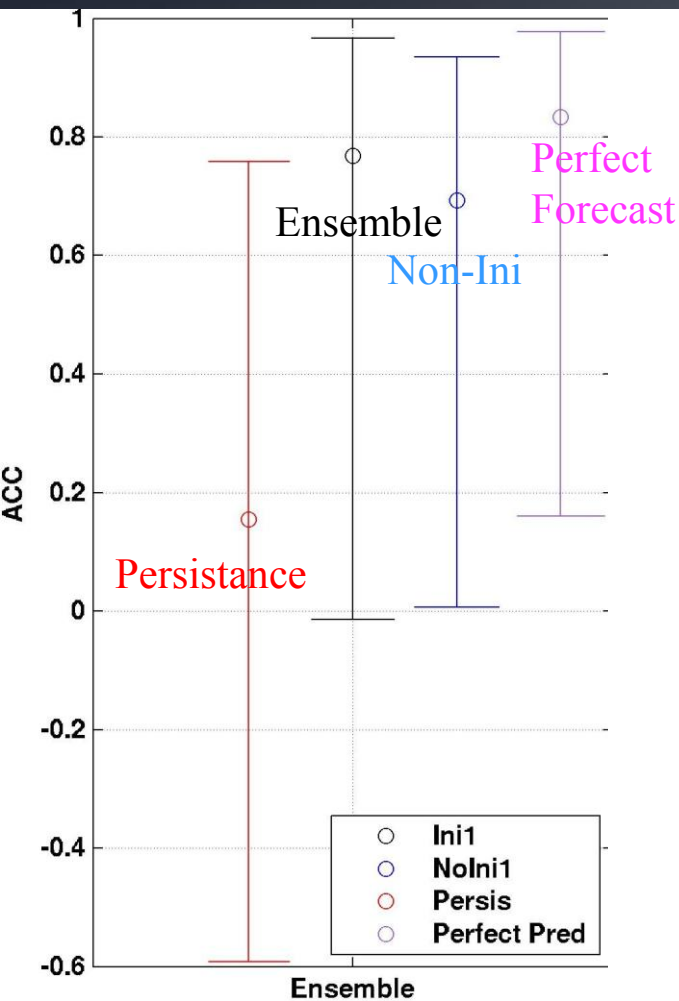
MSSS>0 -> improvement over baseline

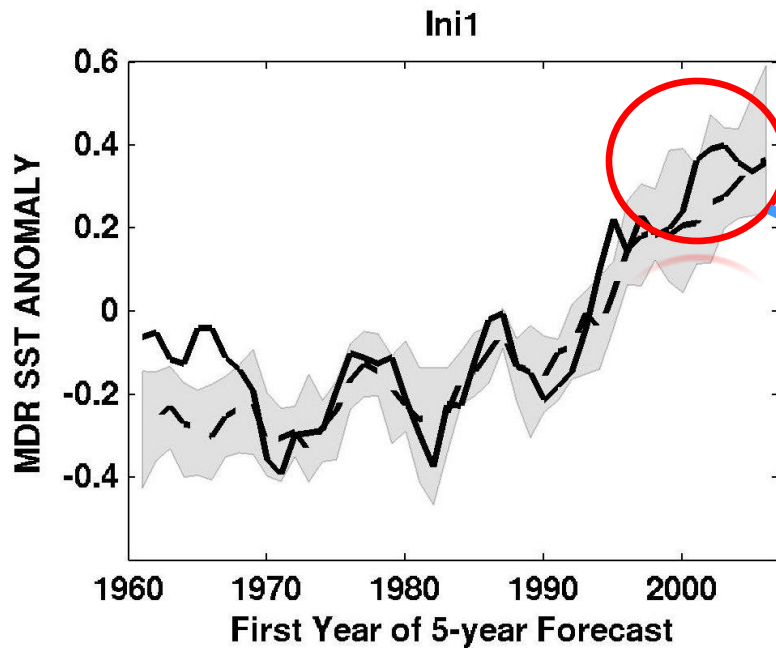
MSSS <= 0 -> no improvement

Skill of 5 year predictions

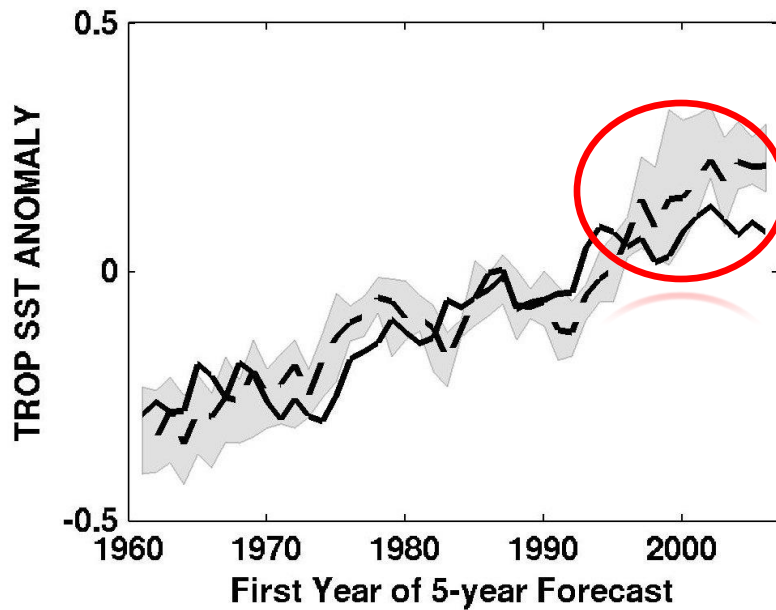


Skill of 9 year predictions





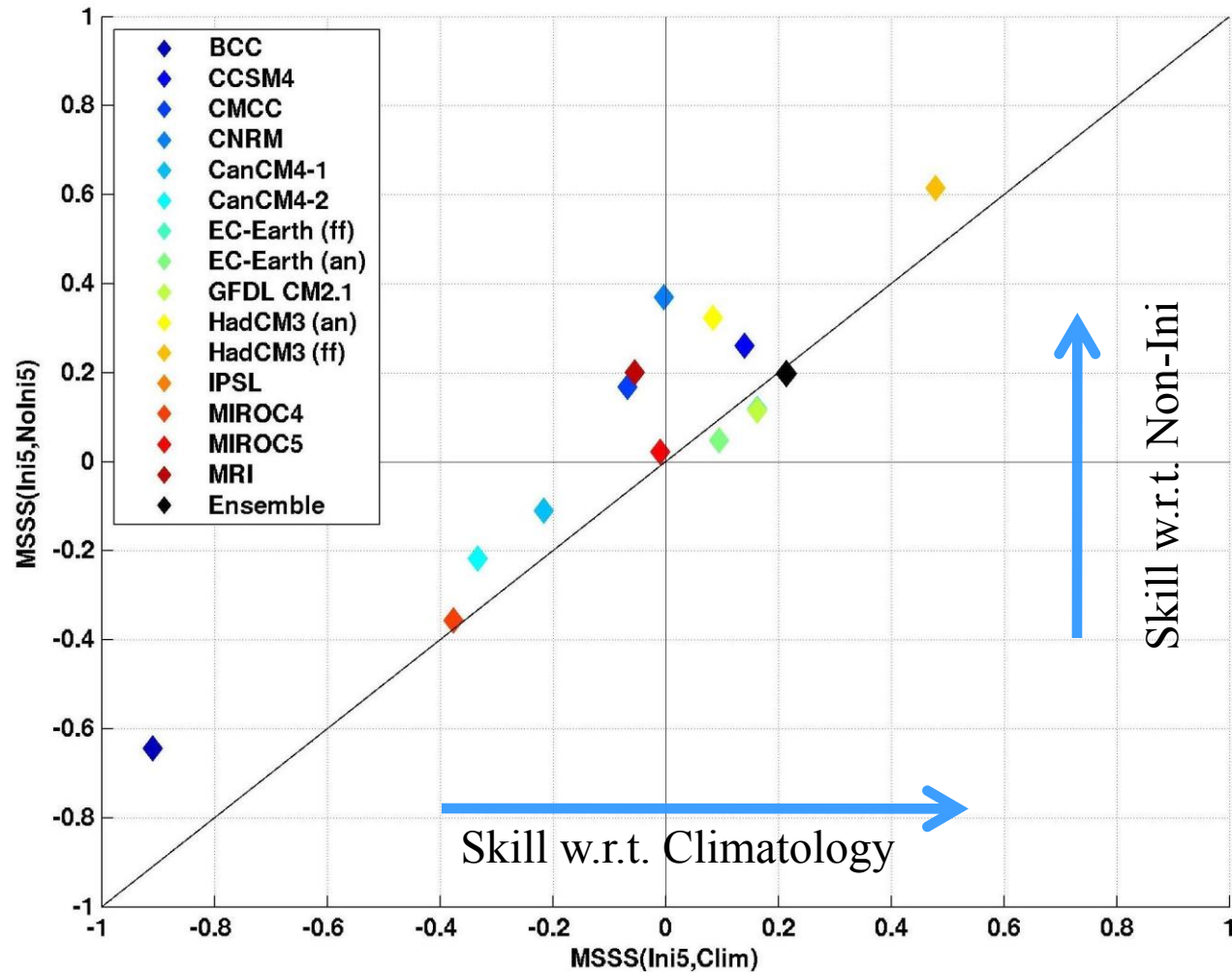
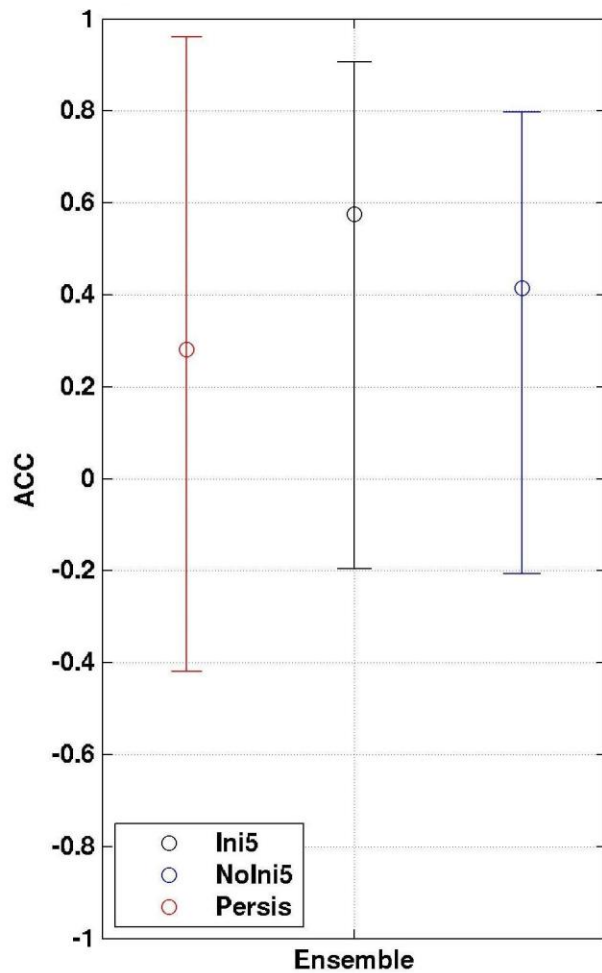
Forecasts
underestimate
Atlantic SSTs

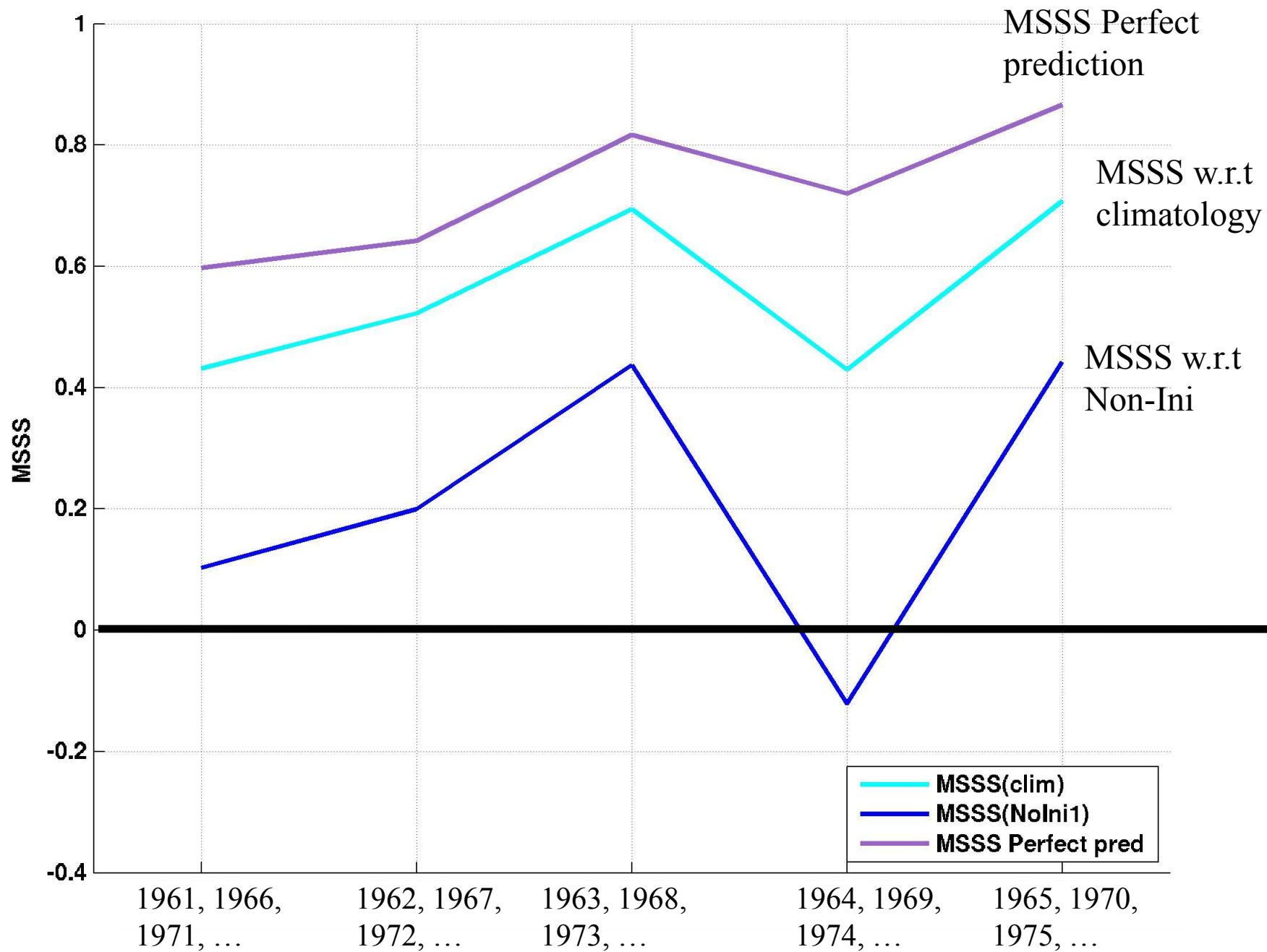


Forecasts
overestimate tropical
SSTs

Underestimation
of TC activity

Skill of 5yr predictions 5-yearly start dates

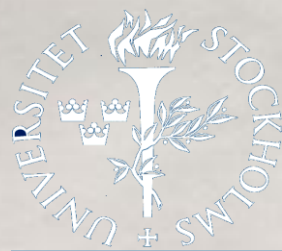




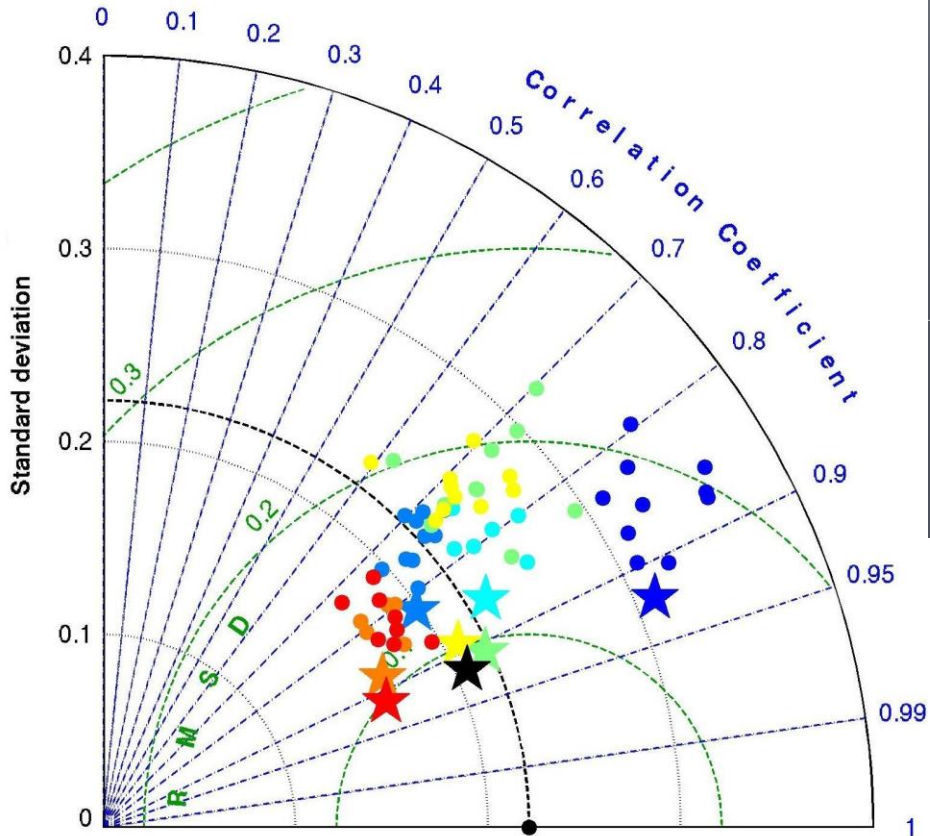
Summary

- Biased low Atlantic SSTs suppresses TC activity in EC-Earth
 - Addressed by biased correcting SSTs and running at higher resolution
 - Statistical index applied to decadal forecasts show improvement over simple persistence/climatology forecast.
 - But, underestimates current activity
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Tack så mycket



MDR SST anomalies



Tropical SST anomalies

