# Assessing Predictability of Climate Indices Related to Local Impact

**Wei Li and Chris Forest**

**Pennsylvania State University**

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Stanford University

# Linking global climate to local impacts

$$\Delta T_g \xrightarrow{\phantom{ii}1\phantom{ii}} \Delta SST(x,t) \xrightarrow{\phantom{ii}2\phantom{ii}} \Delta\theta(x,t) \xrightarrow{\phantom{ii}3\phantom{ii}} \Delta IAM(x,t)$$

- Step 2 is the GTO based prediction that linking the ocean forcing ($\Delta SST$) to variables relevant to impact community ($\Delta\theta$) under global climate change ($\Delta T_g$);

- $\Delta\theta$ = Prominent teleconnection patterns (NAO) dominating the climate variability of Northern Hemisphere especially the U.S.

# Motivation



http://www.windows.ucar.edu/
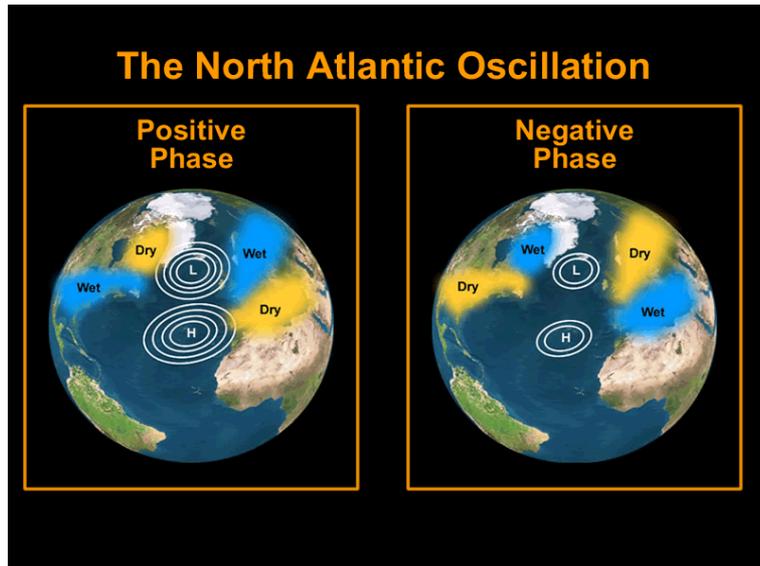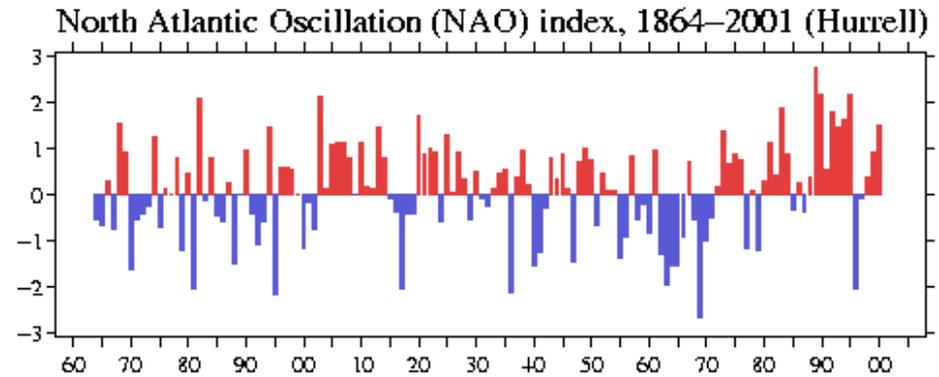


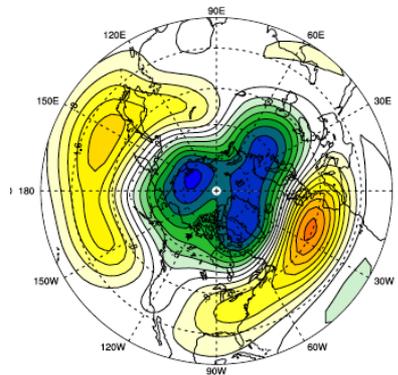http://www.jisao.washington.edu/data_sets/nao/

- **Uncertainty in variability of NAO on different time scales and NAO could contain a ocean forcing component (***Hurrel et al. 2004***);**
- **NAO impact on crop yield.** Early NAO phase announcements can benefit subsequent crop mix, storage and consumption adjustments (*Kim and McCarl, Climate Change, 2005* );
- **NAO anomalies has influence on hydropower, electricity consumption and prices** (*Cherry et al., Water Resources Management, 2005*);
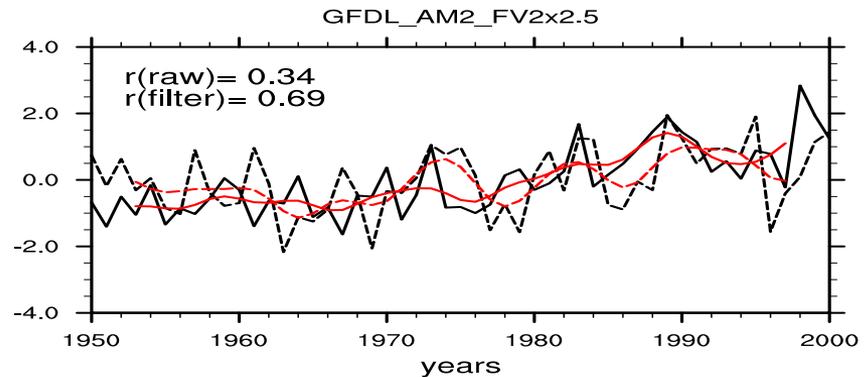
## *Current Result:*
## SST induced predictability

$$\Delta R(t) = \int G(x) \Delta SST(x,t)\, dA$$

Full Model



Reconstruction



CAM5.0_FV1.9x2.5

r(raw)= 0.41
r(filter)= 0.69



GFDL_AM2_FV2x2.5

r(raw)= 0.34
r(filter)= 0.69



| | | |
|---|---|---|
| rec | IA | |
| obs | IA | |
| rec | ID | |
| obs | ID | |
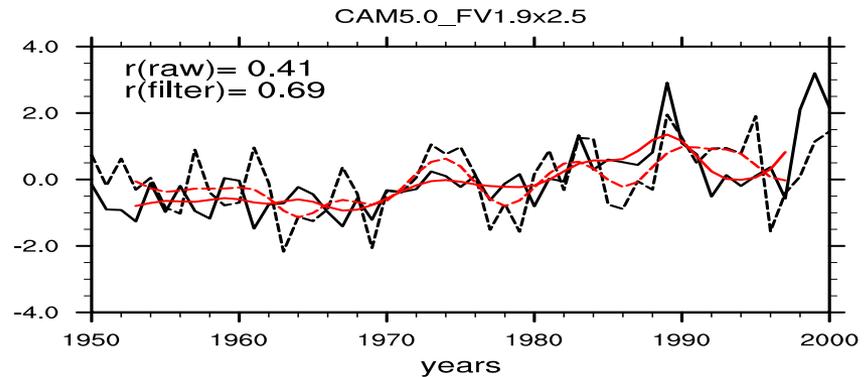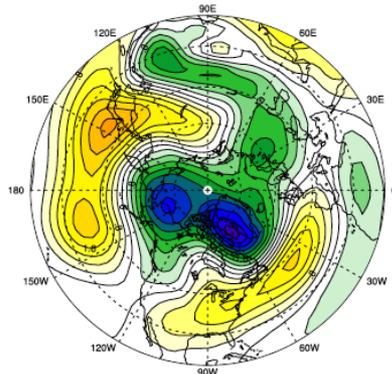
– Li and Forest (2013), in revision.

# *Linking NAO to IA*

- NAO pattern and variability in IPCC models.
- NAO impact (at different phases) on agriculture and energy.
- NAO variation and its impact under the global warming scenarios in IPCC models.
- Data?

# TABLE I

U.S. state level yield effects in terms of ratio of yield under a negative NAO phase to yield under a positive phase as computed from regression results

| | Wheat | Corn | Soybean | Rice | Sorghum |
|---|---|---|---|---|---|
| U.S. wide | 4.52* | 3.31*** | 6.55* | 1.77**** | 10.02* |
| Alabama | 9.97* | 2.40 | 22.02* | | 9.33* |
| Arizona | −0.15 | −3.04* | | | 11.92* |
| Arkansas | 6.80*** | −0.48 | 8.36* | 2.71*** | |
| California | 0.20 | 1.49***** | | 5.48* | |
| Colorado | 4.74*** | 5.62* | | | 9.54* |
| Delaware | 9.93* | 0.89 | 8.36***** | | |
| Florida | 6.50****** | 0.82 | 9.21* | | |
| Georgia | 11.70* | 1.20 | 28.64* | | 12.09* |
| Idaho | 9.59 | 0.39 | | | |
| Illinois | 9.59* | 2.05 | 8.31* | | 8.68* |
| Indiana | 7.53* | 4.33**** | 5.07** | | |
| Iowa | 9.59* | 3.42***** | 4.38**** | | |
| Kansas | 1.35 | 3.14**** | 25.58* | | 10.49* |
| Kenturky | 11.64* | 5.62*** | 14.11** | | 5.57**** |
| Louisiana | 13.84* | −0.76 | 5.85***** | 1.53***** | 3.27** |
| Maryland | 8.84* | 4.77***** | 8.91*** | | |
| Michigan | 6.73* | 3.87*** | 6.20** | | |
| Minnesota | 25.67* | 3.00 | 2.37 | | |
| Missouri | 4.07 | 6.55** | 20.61* | 1.13 | 15.63* |
| Mississipi | 10.08* | −0.71 | 22.49* | 2.01***** | 4.02*** |
| Montana | 2.75 | 5.70* | | | |
| Nebraska | 8.14** | 4.49** | 7.57** | | 10.29* |
| New Jersey | 15.41* | 5.92*** | 8.69* | | |
| New Mexico | 16.62* | −1.64***** | | | |
| New York | 3.60**** | 4.71** | 5.18**** | | |
| North Carolina | 8.14** | −0.67 | 7.57*** | | 2.23 |
| North Dakota | 15.41* | 5.92** | 8.69** | | |
| Ohio | 8.73* | 3.59*** | 6.04** | | |
| Oklahoma | 3.86 | 0.63 | 22.99* | | 7.05** |
| Oregon | 3.74*** | 0.67 | | | |
| Pennsylvania | 6.04* | 7.50* | 9.16** | | 0.08 |
| South Carolina | 16.89* | 6.05***** | 19.68* | | 15.25* |
| South Dakota | 9.97* | 0.99 | 10.50* | | 15.38* |
| Tennessee | 9.38* | 5.49** | 13.96** | | 3.01 |
| Texas | 16.67* | 0.25 | 9.07*** | 1.84 | 2.44 |
| Utah | 4.02*** | 4.22** | | | |

**Backup slides**

(*Kim and McCarl, Climate Change, 2005* )
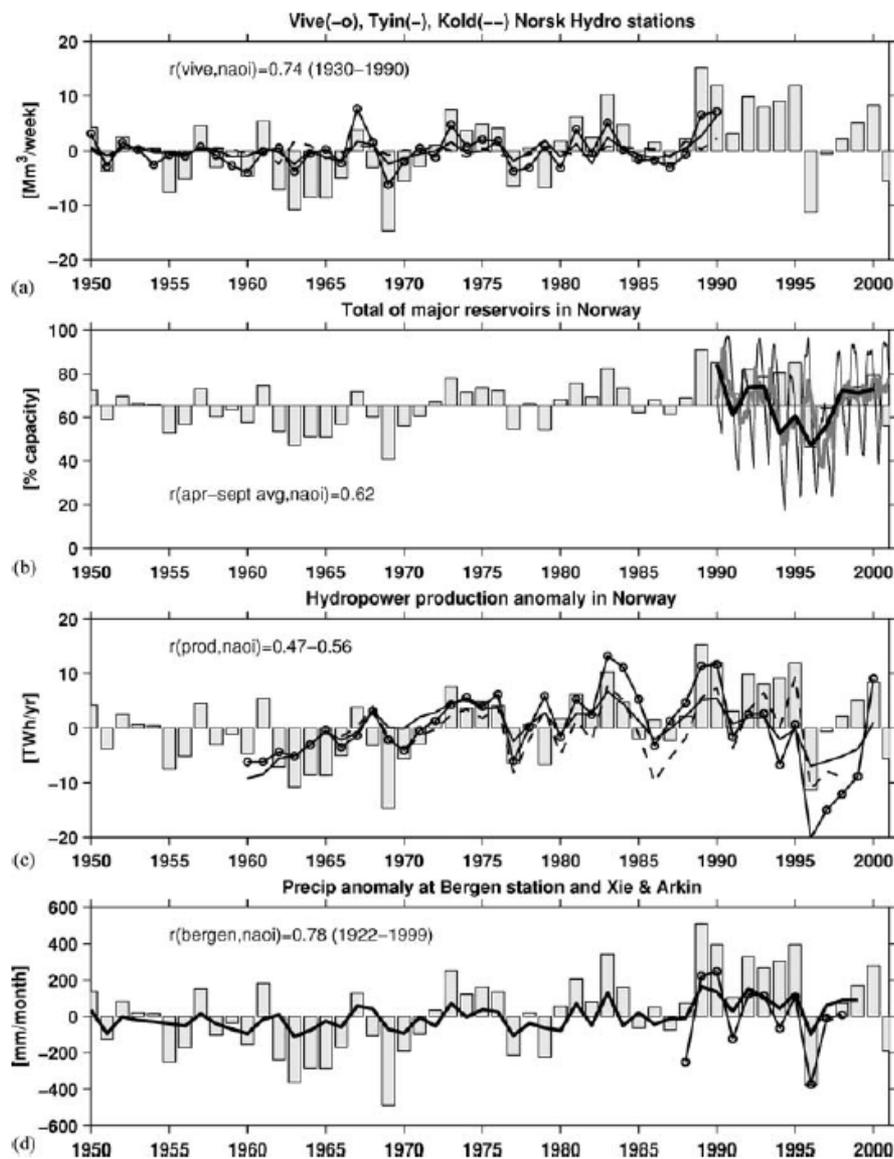
# Backup slides



Figure 5. The supply side of the economic framework is shown. The NAO index is plotted as bars. The melt season (April–September) average streamflow anomaly for Norsk Hydro stations Viveli, Tyinosen, and Koldedalen are plotted in (a). The reservoir levels are shown in (b): weekly (thin line), weekly minus seasonal cycle (grey line), and melt season average (thick line). In (c) the annual hydropower production anomaly is plotted, detrended by per capita constant dollar gross domestic product(−), linearly (−o), and a 12-year highpass filter(−). In (d), the precipitation station average winter (December–March) anomaly from Bergen (−) and the principal component of the Xie and Arkin (1996) winter precipitation anomaly (−o) are plotted. Correlation coefficients are shown for several supply time series and the NAOI.

(*Cherry et al., Water Resources Management, 2005*)