

Linked Extreme Weather Events during Winter 2009–2010 and 2010–2011 in the Context of Northern Hemisphere Circulation Anomalies

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Motivation:

Winters of 2009–2010 and 2010–2011 are:

- Dominated by a disruption of the NH polar vortex, which enables arctic air to reach lower latitudes
- Marked by El Niño conditions in 2009–2010 and La Niña conditions in 2010–2011
- Characterized by extreme weather along the margins of the arctic air masses

What are the linkages between the extreme weather and large-scale circulation anomalies?

NH Circulation Overview:

- Extreme negative phase of Arctic Oscillation (AO–) dominates during both winters
- In Feb 2011, AO transitions to positive and Pacific–North America pattern transitions from positive to negative (not shown)



Extreme Weather Events in Winter 2009–2010:

	Day	Month	Year	Extreme Weather Events
Feb 2010 Jan 2010 Dec 2009	8-10	Dec	2009	"Coast-to-Coast" Storm (influenced by Typhoon Nida)
	20	Dec	2009	Mid-Atlantic and Southeast New England snowstorm
	14	Jan	2010	Two-week cold-air outbreak sets records in Florida
	22	Jan	2010	Record-breaking West Coast wind/rain storm
	24–25	Jan	2010	Midwest snowstorm
	29-30	Jan	2010	Southern Plains ice storm
	6	Feb	2010	Mid-Atlantic snowstorm
	10-11	Feb	2010	Mid-Atlantic snowstorm
	15	Feb	2010	Second cold-air outbreak sets records in Florida

Synopsis

- TY Nida strengthens jet and provides moisture source for Pacific cyclones in late Nov and early Dec
- Strong 100 m s⁻¹ jet and Pacific cyclone events lead to North Pacific blocking, downstream development, and "Coast-to-Coast" storm
- Coast-to-Coast storm and North Atlantic cyclones establish and maintain North Atlantic blocking in DJF
- North Atlantic blocking contributes to frequent snowstorms and unprecedented snow cover over Europe

Extreme Weather Events in Winter 2010–2011:

	Day	Month	Year	Event
Dec 2010	10-12	Dec	2010	Heavy rain in Pacific Northwest
	18-22	Dec	2010	Heavy rain/snow in southern California
	26-27	Dec	2010	Coastal Northeast snowstorm
Jan 2011	9-10	Jan	2011	Southeast snow and ice storm
	18-19	Jan	2011	NY/NJ and southern New England snowstorm
	20-21	Jan	2011	Northeast snowstorm
	26–27	Jan	2011	Northeast snowstorm
Feb 2011	1-3	Feb	2011	Southern plains to lower Great Lakes snowstorm
	8-10	Feb	2011	OK/AR snowstorm
	10	Feb	2011	OK breaks all-time minimum temperature (-30.5°F)

Synopsis

- North Atlantic blocking and anomalous easterly flow limit ice extent over Hudson Bay and northeast Canada
- Anomalous cold air and snowstorms over Europe again promote extensive U.K. snow cover
- Anomalous cold air over North America promotes extensive snow cover, which favors an equatorward displaced storm track over U.S.
- AO- to AO+ transition and subsequent PNA+ to PNAtransition are associated with southern U.S. storminess

Conclusions:

Winters of 2009–2010 and 2010–2011 are:

- Characterized by AO- regimes and high-latitude blocking
- Associated with extended AO- regimes that occur quasiindependent of ENSO phase
- Dominated by polar-midlatitude interactions and equatorwarddisplaced arctic air masses
- Characterized by frequent storminess and extensive snow cover over North America and Europe



Broader Impacts:

How does the balance between dynamical and thermodynamical forcing govern large-scale flow variability on intraseasonal time scales and the occurrence of extreme weather events? • e.g., how does increased snow cover and reduced arctic sea ice extent modulate the variability of the polar vortex and the phase and amplitude of the AO?

Support: NSF (AGS-0935830) and NOAA (NA09OAR4310192)