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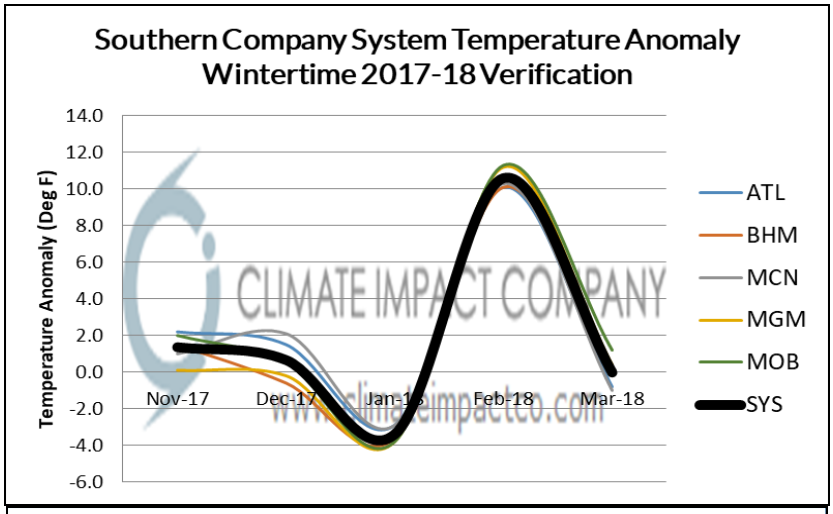
Climate Impact Company Winter 2017-18 Review for Southern Company

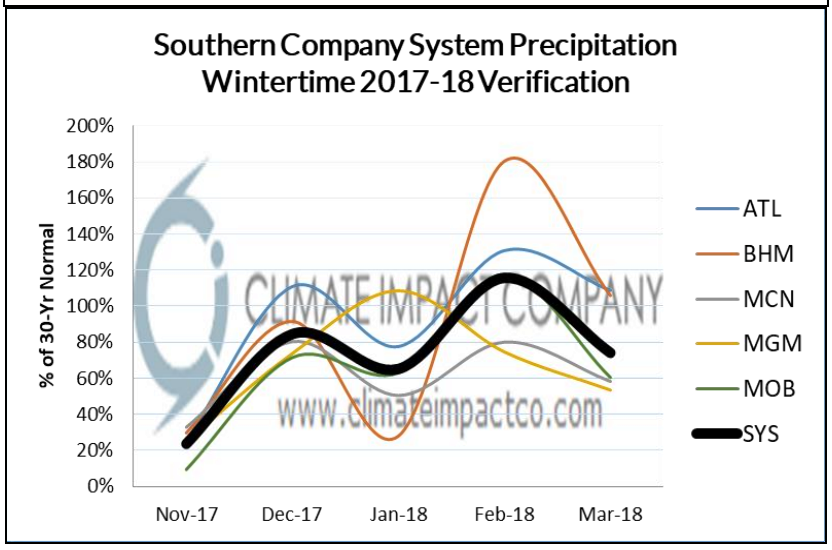
Valid: November 2017 to March 2018

Issued: Friday, April 6, 2018

Executive summary: The winter 2017-18 season across Southern Company featured high volatility including sharp cold in January followed by record warmth in February. Except for February precipitation was below normal.

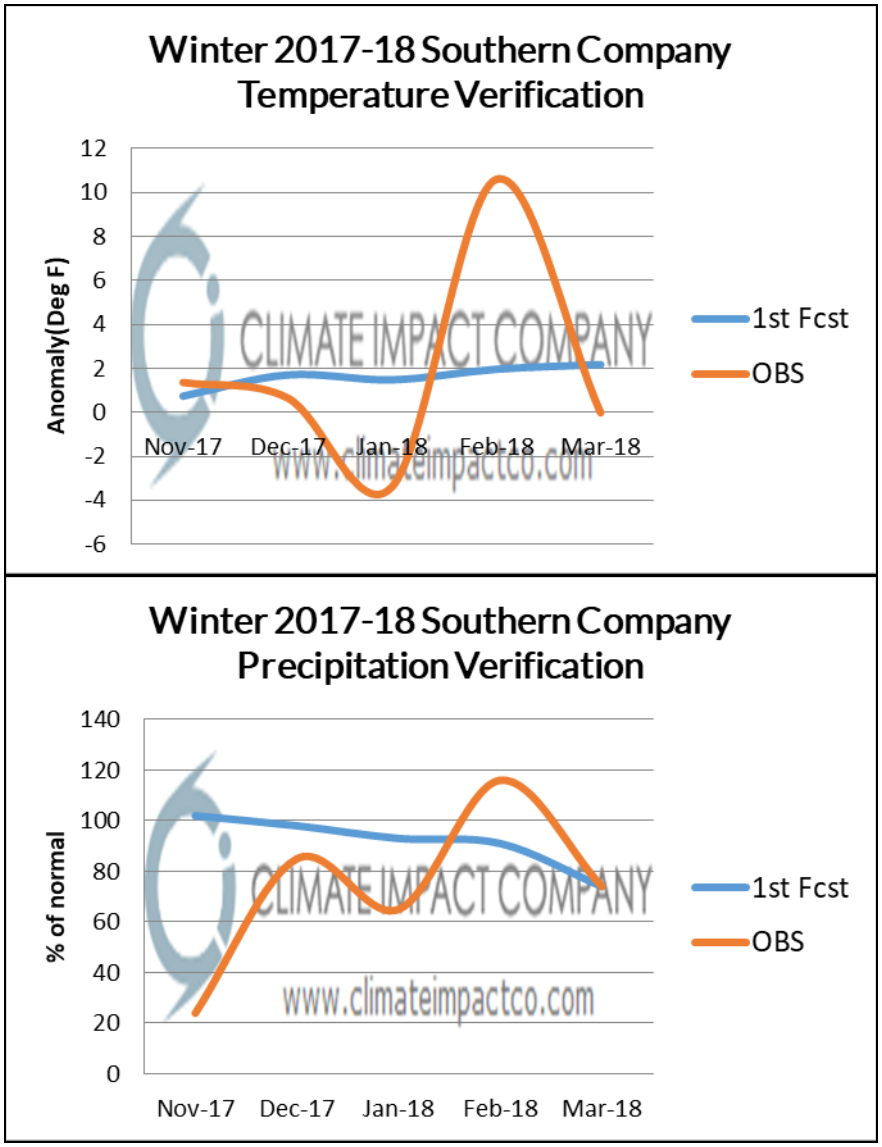
Winter 2017-18 Southern Company Observed Temperature/Precipitation





The Climate Impact Company winter 2017-18 forecast issued last October called for milder-than-normal temperatures each month of the cold season. The forecast did not catch the volatility and extreme nature of the observations although winter did average warmer than normal thanks to a record warm February. The precipitation forecast was drier than normal and that dryness verified although observations went from dry to near normal through the cold season whereas the forecast was north to drier than normal. The 5-month projection of warmer and drier than normal was correct however the volatility of the observed climate was under-forecast.

Winter 2017-18 Southern Company Temperature/Precipitation Verification



Climate discussion: The lead characteristic of the winter 2017-18 climate was presence of La Nina. However, La Nina 2017-18 ranked as one of the weakest on record (***Table 1***) leaving the climate pattern susceptible to other influences. Just prior to Christmas a stratospheric warming episode took place over northern Canada (***Fig. 1***). During stratospheric warming episodes the upper level atmosphere warms and expands causing the weather atmosphere beneath (troposphere) to cool and contract. The cooling causes high pressure at ground level forcing arctic air to form.

	Strong La Nina	La Nina	Weak La Nina	Neutral	Weak El Nino	El Nino	Strong El Nino
1950-2018 (69 years)	1-7	8-15	16-19	20-50	51-54	55-62	63-69
2017-18 La Nina			XXX				

Table 1: *Based on multivariate ENSO index, a measure of the atmospheric reaction to the oceanic ENSO condition the La Nina 2017-18 was one of the weakest on record.*

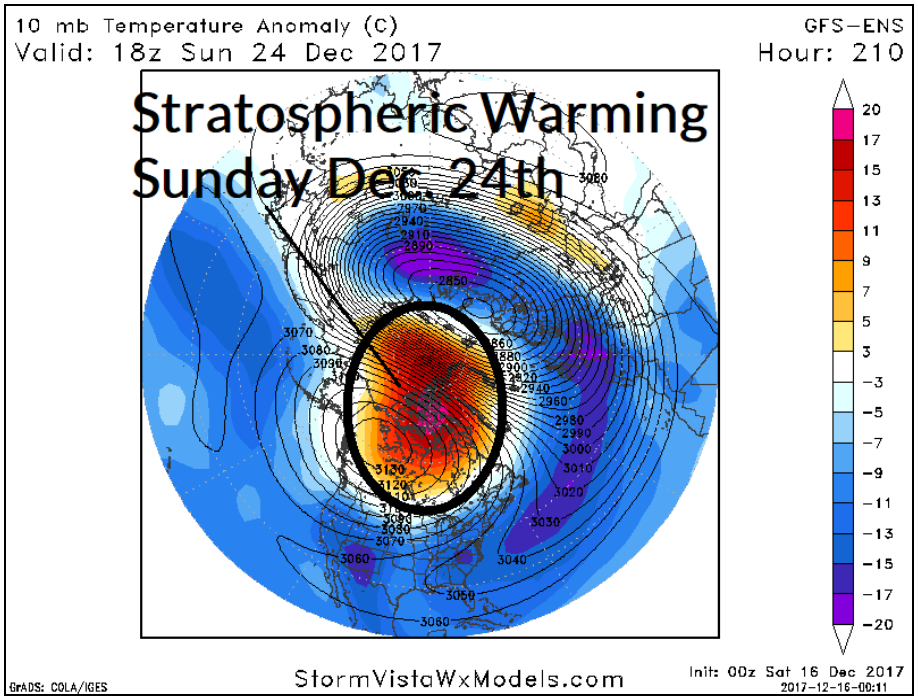


Fig. 1: *On Dec. 16th Climate Impact Company issued a statement identifying a stratospheric warming event was forecast on Christmas Eve likely producing a large reservoir of arctic air to follow.*

A large reservoir of frigid air formed over Canada during this event leading to surges of cold into the Southeast U.S. on several occasions from late December to middle January (***Fig. 2-3***). During these events peak cold (mornings) were impressive! The coldest 3 mornings for Birmingham and Atlanta included a 9°F in Birmingham on Jan. 17, the coldest climatological time of winter and a 13°F in Atlanta on the same morning (***Table 2***).

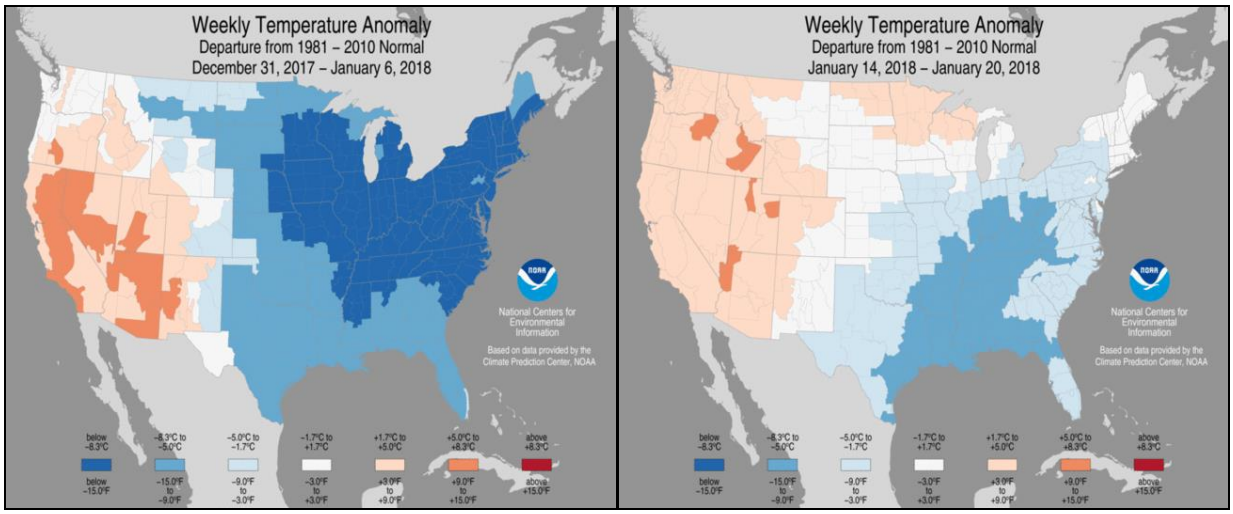


Fig. 2-3: *Weekly U.S. temperature anomalies for Dec. 31, 2017 to Jan. 6, 2018 and Jan. 14-20, 2018 in which the Southeast U.S. was very cold.*

	BHM Coldest Morning	Date	ATL Coldest Morning	Date
1	9	Jan. 17	13	Jan. 2
2	11	Jan. 2	14	Jan. 17
3	14	Jan. 18	15	Jan. 18

Table 2: *The coldest 3 mornings of January when arctic air was present across the Southeast U.S. in Birmingham and Atlanta.*

Of course, snow cover widened quickly with the evolving cold regime making the air mass even colder into the southern latitudes of the U.S. in January. The early December snow cover was well north and most of the East U.S. had bare ground as meteorological winter started warm (***Fig. 4***). Note that a sneak snow storm did occur in the Southeast Dec. 8 when Birmingham recorded 4 in. However, the mid-January snow cover advance was impressive as record snows extended to the Gulf Coast (***Fig. 5***). Following the mid-January snows the entire Southeast experienced peak winter cold.

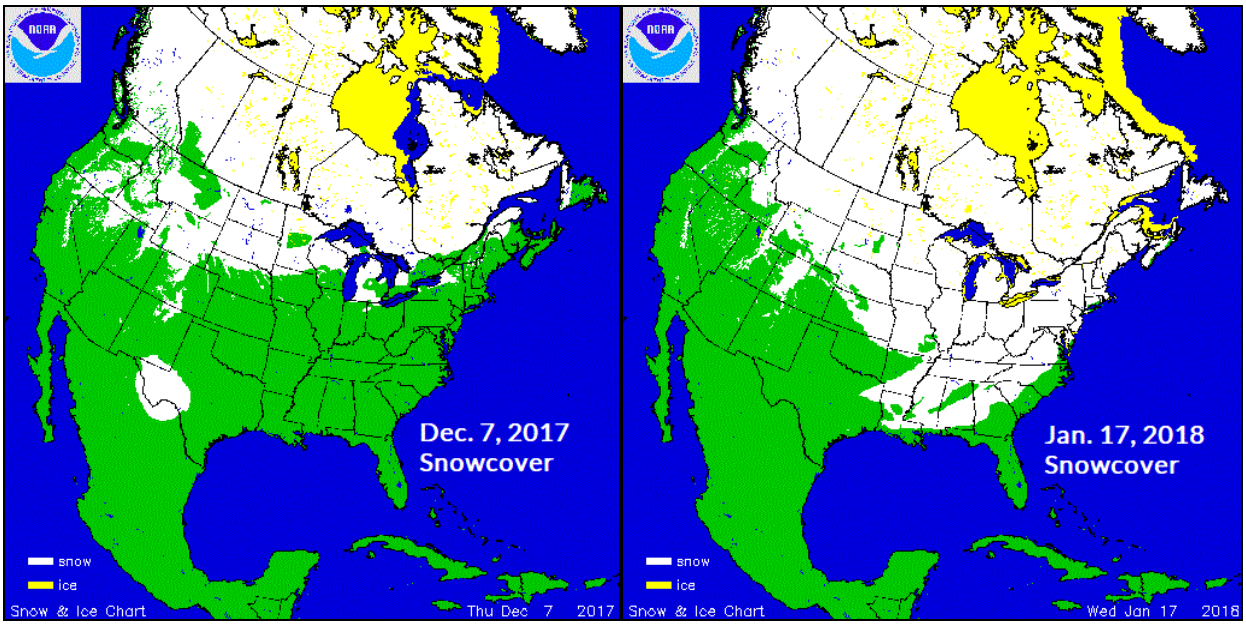


Fig. 4-5: *U.S. snow cover on Dec. 7, 2017 was well north but expanded to the Gulf Coast including the Southeast U.S. by. Jan. 17, 2018 accompanied by shock cold.*

So why was February so warm? Outside of ENSO, 2 climate events dictate the prevailing climate pattern. The first is stratospheric warming events which occurred in December and produced the January arctic outbreaks. The second is a transient Madden Julian oscillation (MJO) across the equatorial Pacific which encourages mild subtropical air to spread across the U.S.

In early February the MJO was intense and located over the West Pacific tropics (phase 7). The MJO shifted eastward slowly (***Fig. 6***) maintaining a steadily warmer thermal pattern across the eastern U.S. (***Fig. 7-8***). The warmer climate melted the January snow which further enhanced the warming. The month of February produced record warmth in the Southeast (***Fig. 9***) caused by the MJO.

During late February another stratospheric warming event took place this time over northwest Russia and northern Europe. Eventually, arctic air and deepening snow cover spread from Western Russia to Europe. Snow fell as far south as Rome, Italy. Part of that event spread farther westward into Canada causing re-emerging snow cover and a cold pattern that has followed for early spring sometimes affecting the Southeast U.S.

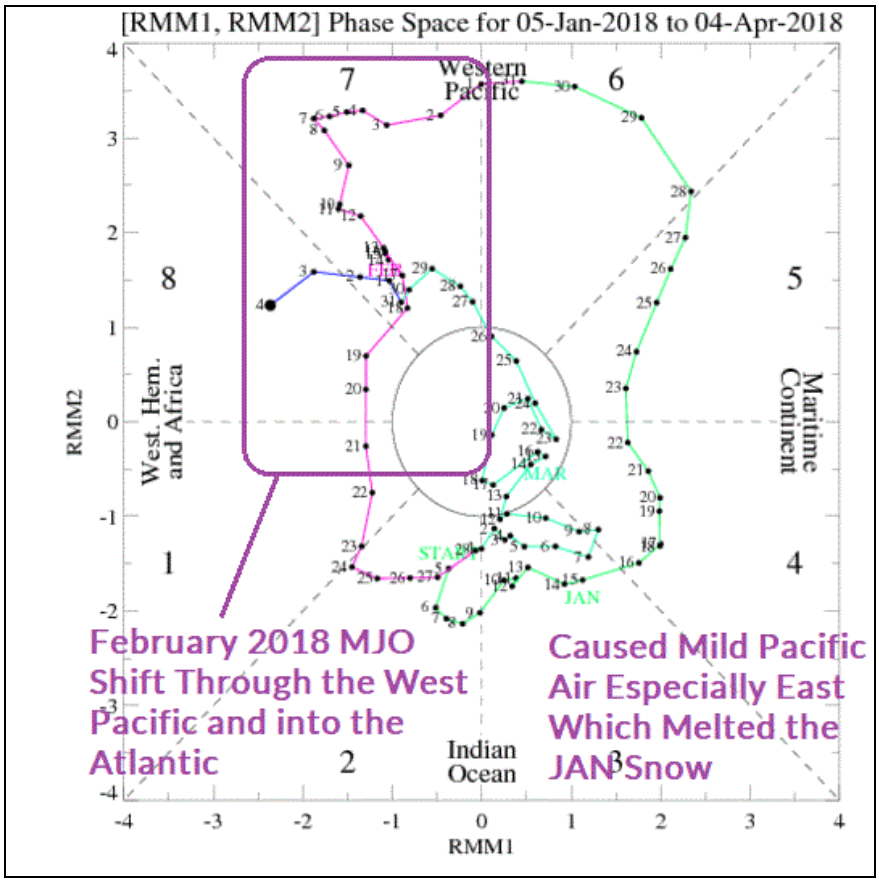


Fig. 6: *An early February MJO episode across the Pacific encouraged warming of the East U.S. which lasted to late month enhanced by the sudden loss of snow cover.*

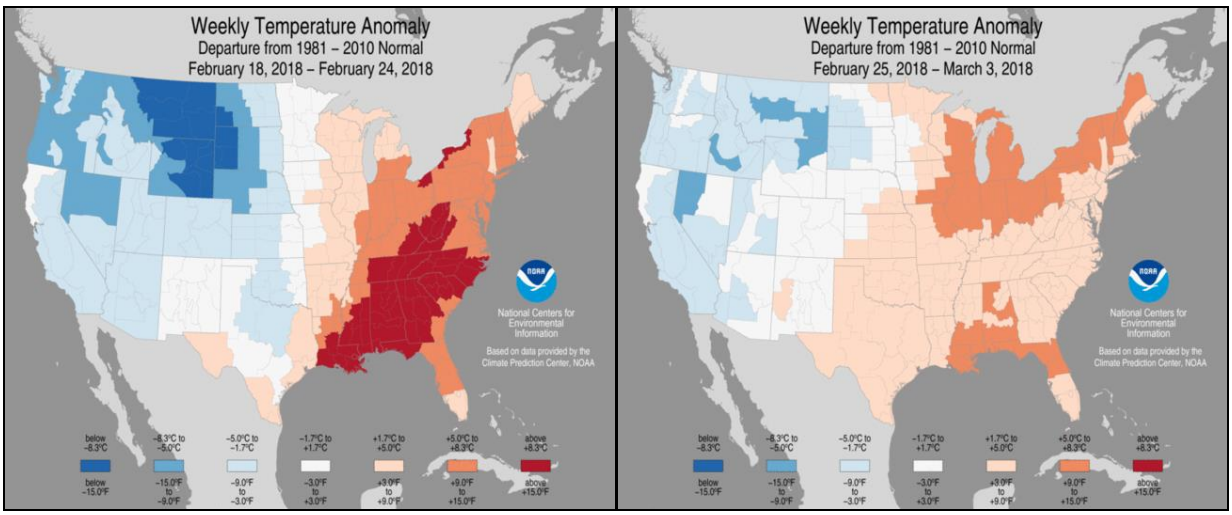


Fig. 7-8: *An early February MJO episode across the Pacific encouraged warming of the East U.S. which lasted to late month enhanced by the sudden loss of snow cover.*

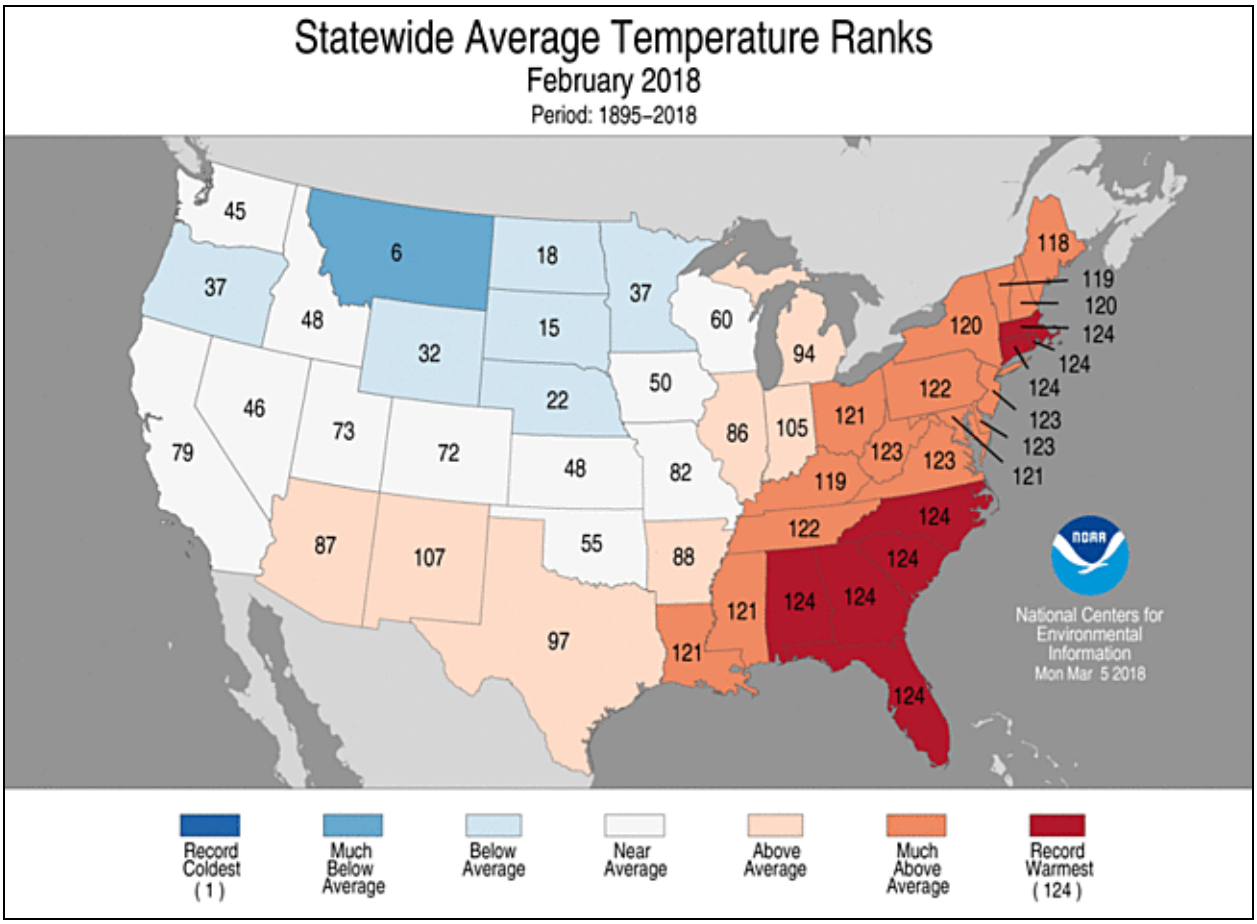


Fig. 9: U.S. temperature ranks for February 2018 include record warmth for the Southeast.

Summary: The gas home heating population weight HDD observations identify the character of the 2017-18 cold season: volatility (***Fig. 10-11***). November into December were mild followed by the arctic chill of January although late month moderated and followed by the warmest February on record. In March, seasonably cold weather returned.

The overall theme of the winter forecast was milder and drier than normal for Southern Company which verified (***Fig. 12-13***) however the temperature side to that verification was bumpy!

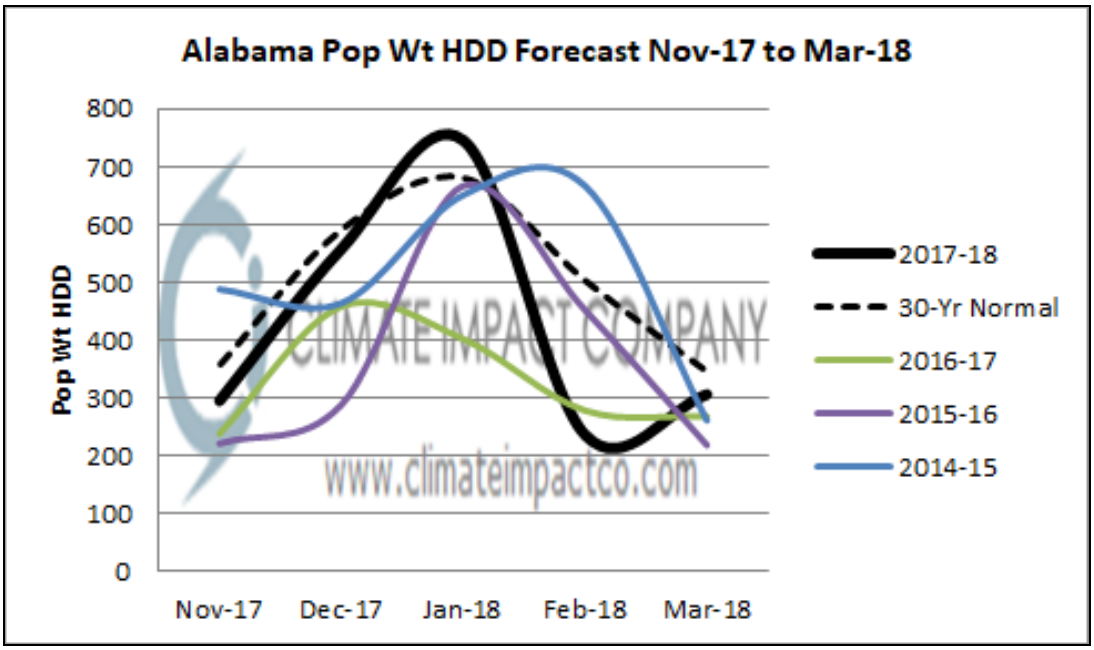


Fig. 10: *Alabama population weight gas home heating HDD for the 2017-18 cold season compared to the 30-year normal and last 3 years is indicated.*

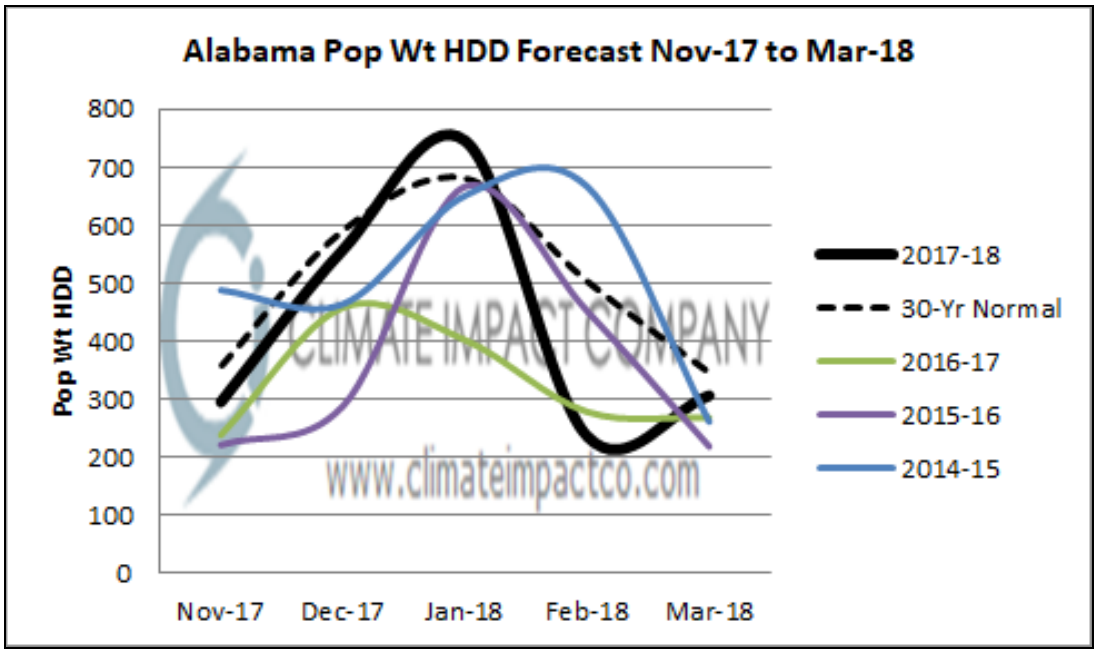


Fig. 11: *Georgia population weight gas home heating HDD for the 2017-18 cold season compared to the 30-year normal and last 3 years is indicated.*

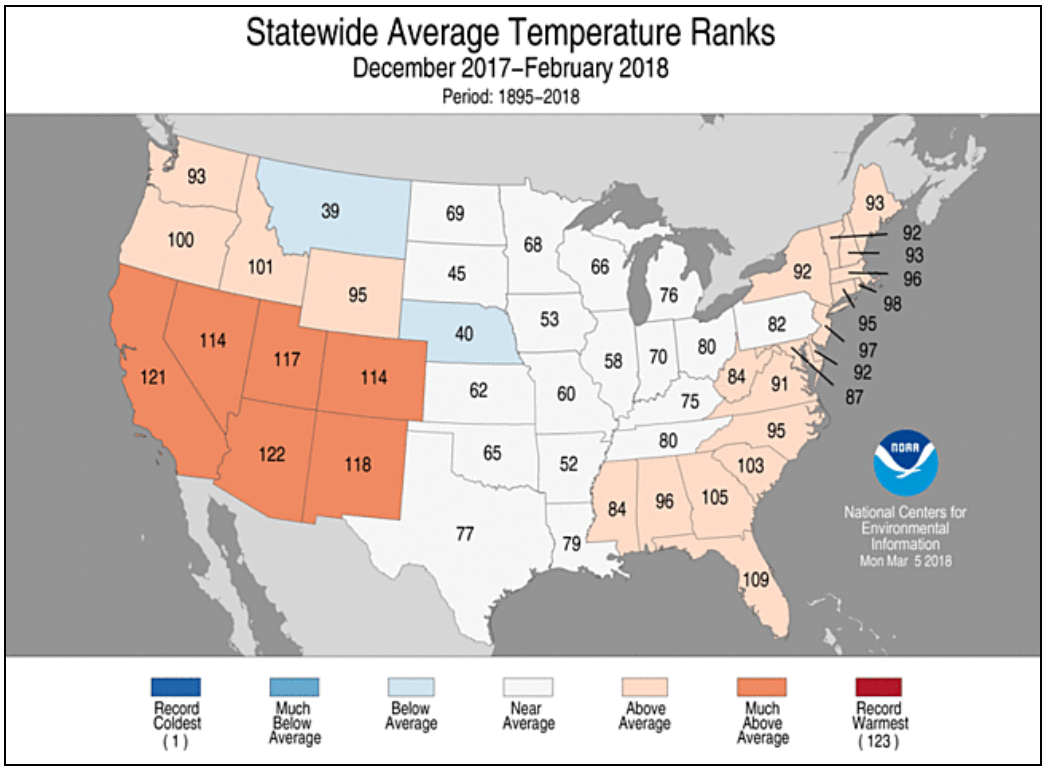


Fig. 12: *U.S. winter 2017-18 state temperature ranks.*

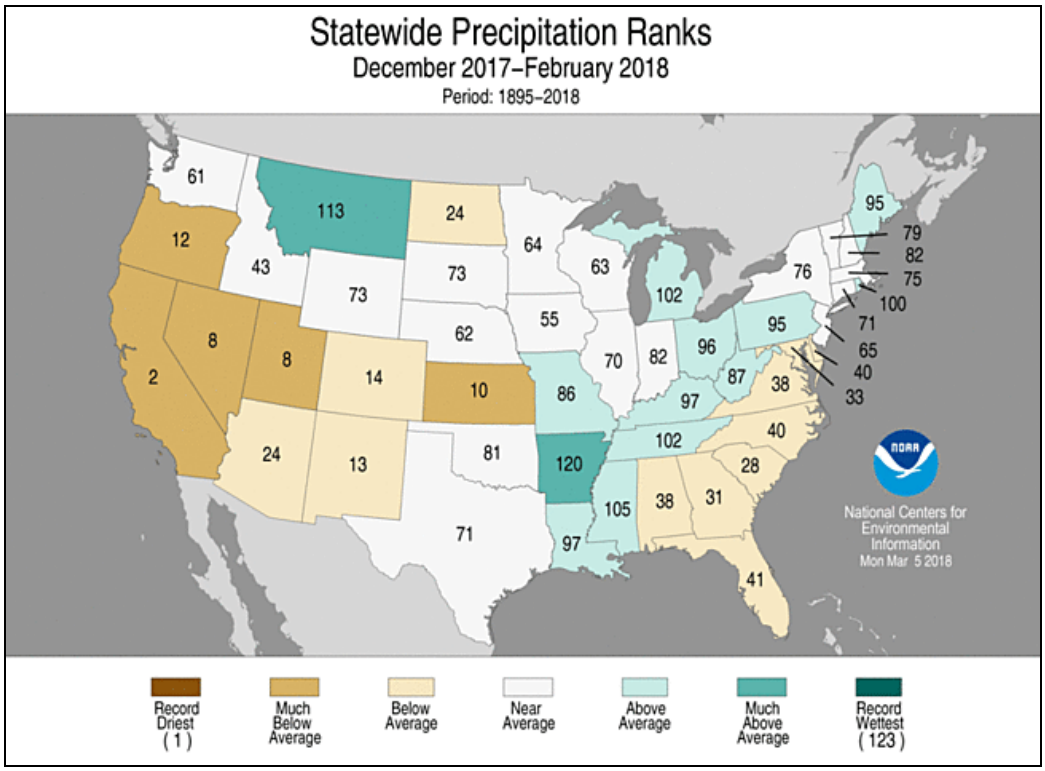


Fig. 13: *U.S. winter 2017-18 state precipitation ranks.*