# Report on 90-day Weather Projection for the Northern Half of New Mexico

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Introduction:

This is the latest 90-day weather forecast for the northern half of New Mexico. The forecast area covers a region bounded by the state borders on the north, west, and east, and Interstate 40 on the south.

The report contains a summary weather outlook for February through April (directly below), a brief review of the current El Nino Southern Oscillation (ENSO) condition—including a discussion about the models used to forecast oceanic temperature conditions, and an overview of current weather trends along with outlook maps for the next 90 days.

*Summary, Ninety-day weather outlook for forecast area:*

- *A La Nina has not been officially declared*, but the trend in that direction is intensifying. Long-range computer models are in reasonable agreement that an official La Nina will not develop in the next six months.
- *The atmosphere continues to behave as though a moderate La Nina condition exists and it is expected to create below normal precipitation and much higher than normal temperatures over the forecast area in the next 90 days.*
- *The Pacific Decadal Oscillation (PDO ) is decidedly negative and it may be exacerbating the dry and warm weather in most of northern NM.* The PDO is a reflection of temperature conditions for northern Pacific waters and it is believed that cool water will suppress precipitation in the SW US.
- Precipitation throughout the forecast area has been much below average over the past 30 days. Temperatures have been well above normal in the same period.

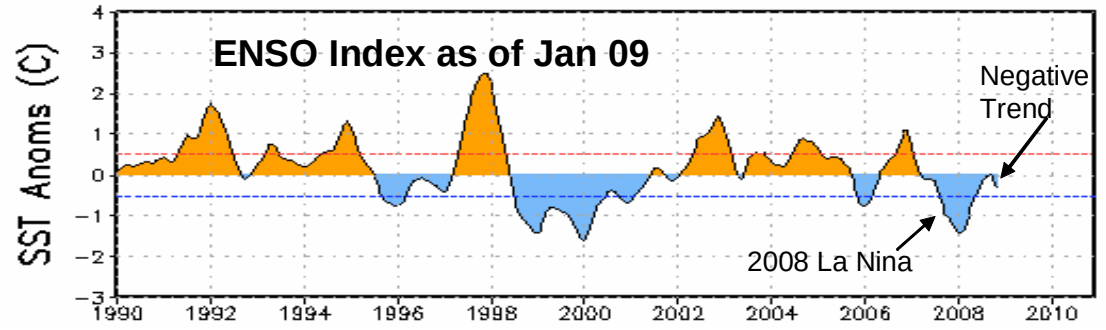
Review of Current El Nino Southern Oscillation Situation and Discussion:

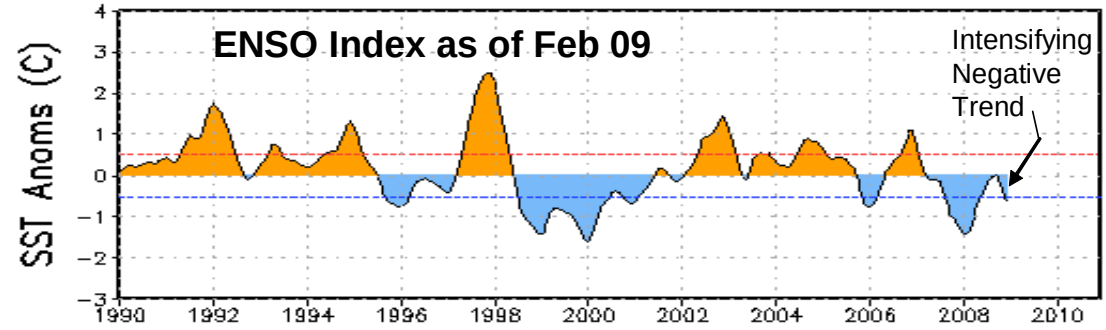
The Historic Oceanic Nino Index, which is the official metric from which a La Nina or El Nino is declared, is at -0.6C, double the value for last month and a definite change toward a La Nina condition. However, it is not an official La Nina. To be declared such, the 3-month moving average index must be greater than -0.5C for five consecutive averaging periods. The graphic below (from Climate Prediction Center) shows the history of the Nino Index.

There are two plots, one generated late last month and another generated this week. The intensification of the ocean cooling is obvious.

Computer models are converging on a prediction that no official La Nina will develop in the next six months. Nearly all of the models predict cooling conditions in the Nino area of the Pacific this spring, with a return to fully neutral conditions by summer. But this situation coupled with the ocean cooling in the north Pacific (i.e., the Pacific Decadal

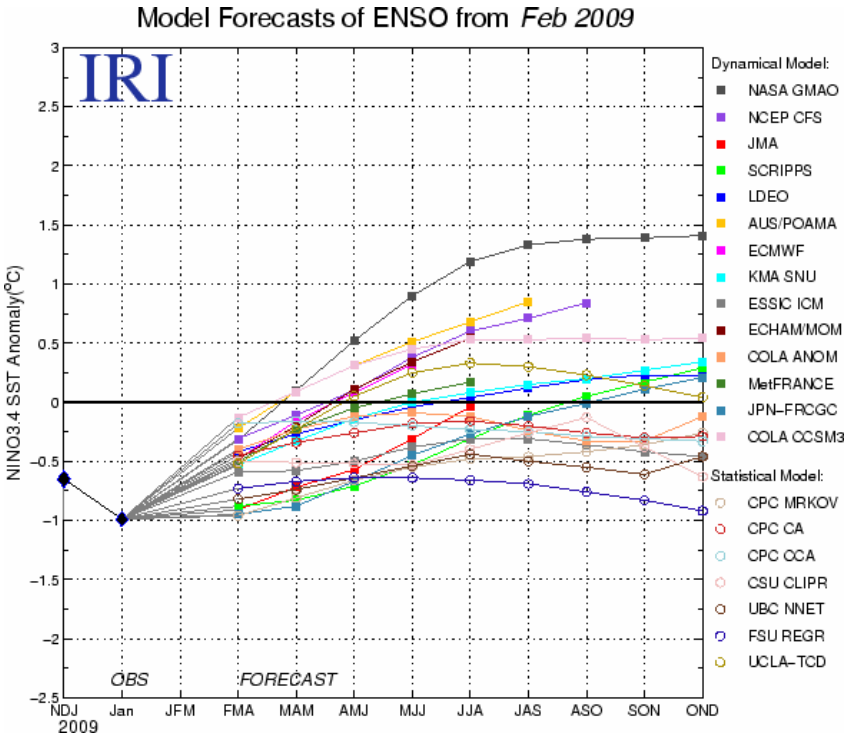
Oscillation region—see last month's report for more info on the PDO) may foreshadow a dry, windy, and dusty spring. (Sorry.)




Interesting Computer Modeling Trends.

There has been an interesting development in the computer predictions about the future temperatures of the ocean in the ENSO region. In the graphic at left, the prediction from each model is plotted as an individual line with data point indicators at each monthly step[1]. The data point indicators on each prediction line indicates whether the model is dynamical or statistical. A hollow indicator is for statistical models and solid ones are for dynamical models.




[1] Each prediction is for a 3-month average, but the interval is monthly. For example, the Feb prediction is for the average of Jan, Feb and March. The next month, Mar, includes the months of Feb, Mar and Apr.

As shown in the graphic, most of the dynamical models appear to be optimistically forecasting warmer oceanic temperature conditions into fall. The statistical models are more pessimistic and predict a lingering cool ocean in the ENSO region.

The difference between the model types is stark for periods later in the summer and fall. For example, in the prediction for July-Aug-Sep (JAS) six of the eight dynamical models are predicting positive oceanic temperature departures and for the two that are negative in this time period, they are trending positively. Conversely, in that same period, all but one of the statistical models are in the negative category and the one that is positive is trending negatively.

Fundamentally, dynamical models are based on physics of the atmosphere and they attempt to forecast the ocean conditions based on complex mathematical equations that include the starting conditions (i.e., today's conditions) and the physical changes to various weather elements as they vary over time. These elements include humidity, wind speed, temperature, and the like. These dynamical models take into account measures of these elements at the starting point and then make a prediction for how these elements have changed at various points in time. Then, the ocean temperature is predicted for those points in the future.

Each successive prediction for a specific future time is based on the conditions from the previous point in time. For example, a model based on daily time-step would start by considering the conditions for the starting point (usually called day zero) and then based on how these elements are known to interact with one another, form a prediction for the next day (day one). Then, day two's prediction would be founded on day one's conditions plus the expected change in the elements, thus producing a prediction for day two. Similarly, conditions for consecutive days are predicted.

From a rudimentary perspective, statistical models are based on history, as contained in statistical measures such as means, deviations, and correlations between specific conditions and other conditions. These statistics are collected over time and eventually they can be used to predict the future. In the case of ENSO, it is known that the ocean temperature pattern is cyclic and varies with some regularity. Based on how today's conditions fit into the historical pattern, the likeliness of upcoming conditions can be estimated.

For example, in the entire known history of ESNO, there has never been greater than a -1.5C three-month average oceanic index. If today's value were at or near a sustained -1.5C, then based on history it is likely that ocean temperatures will begin to warm.

There are problems with both types of models. Dynamical model are used to help form the short-term predictions (less than 7-days) that appear on the nightly news. These models are very accurate within 36 hours.

However, the further in time these models predict, the less accurate they are. At 10 days they retain only a fraction of the accuracy of the shorter term predictions. The reason is due to accumulating error. Since the prediction for every time step depends on the conditions from the previous time step and since there is some error in each prediction, these errors accumulate. For example, the prediction for the first time step, let's call it day 1, will have some error. The prediction for day 2 is based on the conditions for day

1, so it carries with it the prediction errors for day 1, plus those that were incurred for the prediction of day 2. The same happens for day 3, which contains the cumulative prediction error for the previous two days. After many days, the error can become significant.

There is some balancing in the error, if it is random error. An over-estimate one day could be compensated with an under-estimate for later days. The problem is that one does not know whether the error is random or not, so the uncertainty rises and that is the basic concern with long-range dynamical models. Some modelers know this and will not use their model to predict beyond a certain time period, even though the computer will happily do so ad infinitum. In the chart above there are some dynamical models that do not predict as long a term as others and so they are truncated on the chart (see yellow and purple lines, NCEP, AUS models).

Statistical models have a simple shortcoming—they cannot consider in a predication what has never occurred previously. These models are based on the assumption that we understand sufficiently well the defined patterns of climatic behavior such that we can depend on this history to predict the future. The problem is that that the historic data may not be sufficiently complete to have incorporated patterns of behavior that have very long cycles, perhaps hundred of years and which might not be noticed with only dozens of year of observation. Also, they would be unaware of unique, random events that might occur in the future.

Over time, as the historic data base grows, the statistical models improve. However, the earth's weather and climatic systems are so complex and intricate, that there is no way to know with certainty how much history is enough to predict the future accurately; modelers do the best they can with what they have.

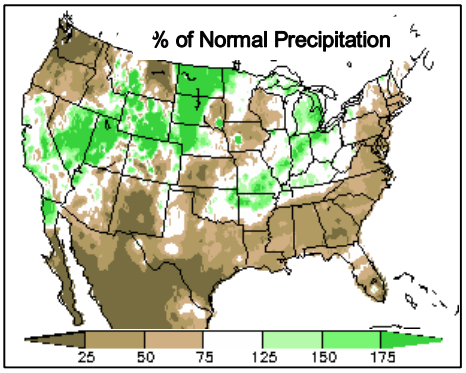
*It is important for the reader to know that the descriptions presented above greatly simplify very complex techniques and that much more sophistication is contained in the real models.*

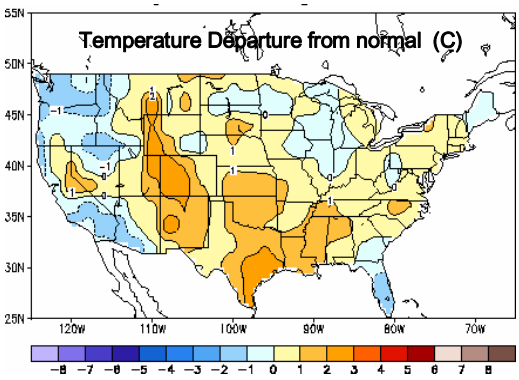
The implications of the current observation—the preponderance of certain types of models to predict warming while others are predicting continued cool conditions—is that there may be new developments in the atmosphere, things that are not part of the statistical database. In this case, the statistical models may be suggesting that based on history, the ocean will stay cool or neutral. But the dynamical models—not being nearly as influenced by history—may be identifying some new conditions that could affect the ENSO waters. Perhaps this new "something" is related to global warming. A condition comparable to the current global warming has not occurred on earth for tens of thousands of years.

<u>Last 90 days.</u>

The maps below (from National Climate Prediction Center) show the precipitation and temperature conditions in the forecast area over the past month. It has generally been much dryer and much warmer than normal. So far, the higher elevations have been able to preserve much of the snow pack because even the higher average temperatures have not been significantly above freezing. Sublimation (direct conversion of solid ice to water vapor), however, is enhanced by the dry conditions.

## Precipitation and Temperature Last 30 Days



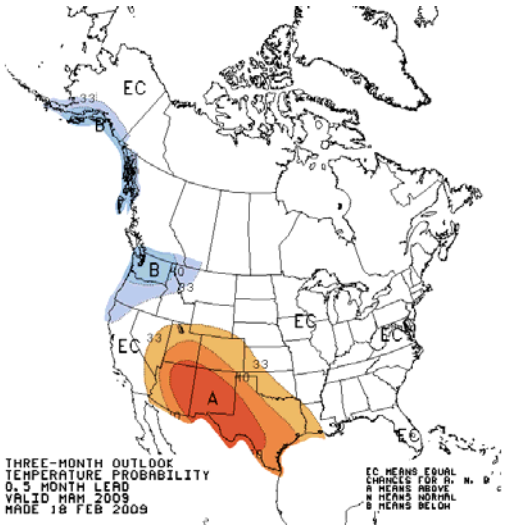




Next 90 days.

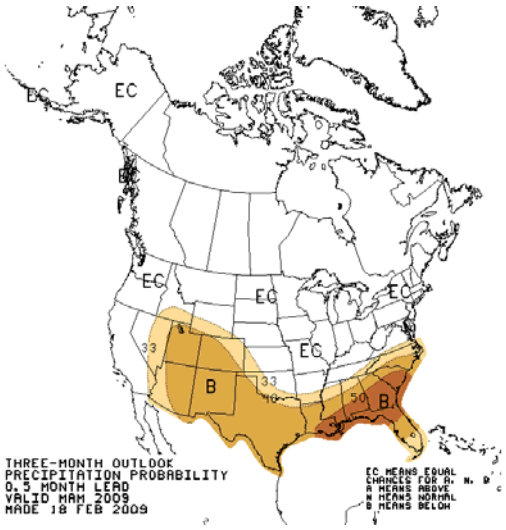
The expectation for the next 90 days is shown in the dual maps below (from the National Climate Prediction Center). Drier and warmer than normal is the expected plan. We could see a dry, warm, dusty spring and quick river runoff. Be ready canoers. The season could be short.

## Outlook for Mar Through May 09

### Temperature




### Precipitation




Recent Weather Trends

The recent weather continues to show a preponderance of high pressure ridges that weaken or block the moisture laden storms that attempt to invade the forecast area. These storms originate in the Aleutian Island area and mid-latitude Pacific regions. They

then move easterly, following roughly the path of the Polar Jet Stream. The Jet Stream moves northward under high pressure, and when NM is under a high-pressure ridge, storms are ushered north and around the state.

Several storms have tried to invade the area over the past few weeks. Although they were strong and moisture-laden on the west coast, they only brought wind and a few spotty showers.

Follow-up reports:

The next report is scheduled for late March.