National Weather Service Wave and Wind Modeling Efforts over Lake Mead and Lake Mohave

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Utilization of the WRF NMM and ARW Cores

WRF (Weather Research and Forecast Model)

- Operationally running 4 versions of the WRF at 4-km grid spacing, each encompassing the WFO Las Vegas county warning area (CWA).
- Two different dynamical cores (NMM -- run by the National Centers for Environmental Prediction; ARW -- the “research” version used by the broader meteorological community)
- Two different larger-scale (coarser) initializing models (NAM and GFS)
- Currently testing a 3-km version for the southern Sierra and a 3-km version for the entire CWA with a 1-km nest covering the Las Vegas Valley and Lake Mead.
- Two 9-km simulations are also running operationally. The models are constructed exactly the same, except for the vertical grid spacing.

Operational High-Resolution Models

All four 4-km domains are run twice daily (00 and 12 UTC):

- Each simulation is 60 hours in duration
- Hourly intervals in house; 3 hourly online

Two 9-km runs twice daily:

- Each simulation is 180 hours in duration
- 3 hourly intervals in house and online

The 3-km runs will be run twice daily, with the 1-km nest run once daily, once they become operational.

- Each simulation will be 36-48 hours in duration.
- The 1-km nest will be 24-36 hours in duration.
- Hourly intervals in house; 3 hourly online currently planned.

There also several operational high-resolution “national” models available, including the High-Resolution Rapid Refresh (HRRR), the Short-Range Ensemble Forecast System (SREF), and several versions of the WRF running on larger geographic domains.

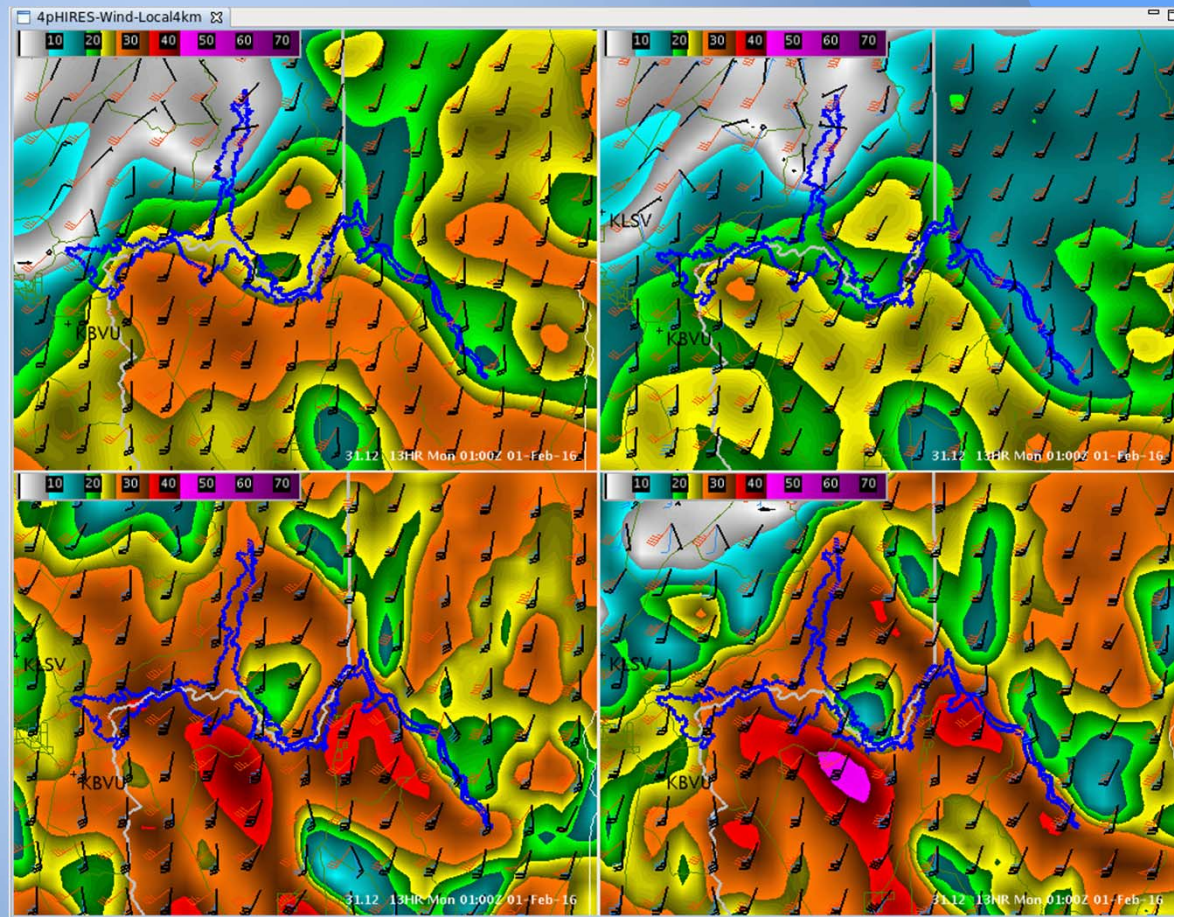
High-Resolution Models Aid in Several Types of Events

Synoptically driven wind events

31 Jan - 1 Feb 2016

Strong south and west winds preceding north winds in Lake Mead and the Colorado River Valley

Large spread model-to-model in this case (though strong winds in all simulations) provides important detail regarding uncertainty in the wind speed forecast.



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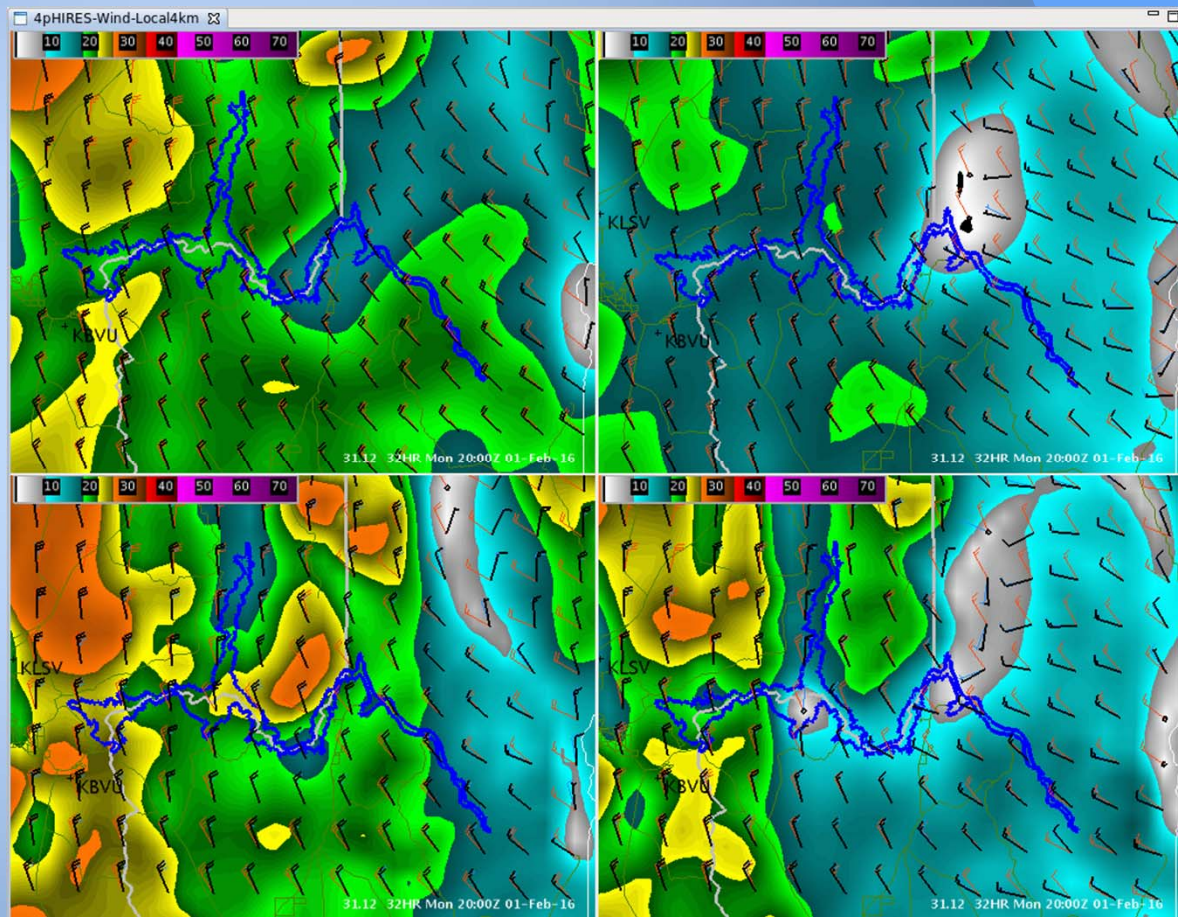
Strong south and west winds preceding north winds in Lake Mead and the Colorado River Valley

As winds change to northerly, the large spread model to model continues, suggesting continued uncertainty in the wind forecast (severity of winds) at Lake Mead.



High-Resolution Models Aid in Several Types of Events

Synoptically driven wind events

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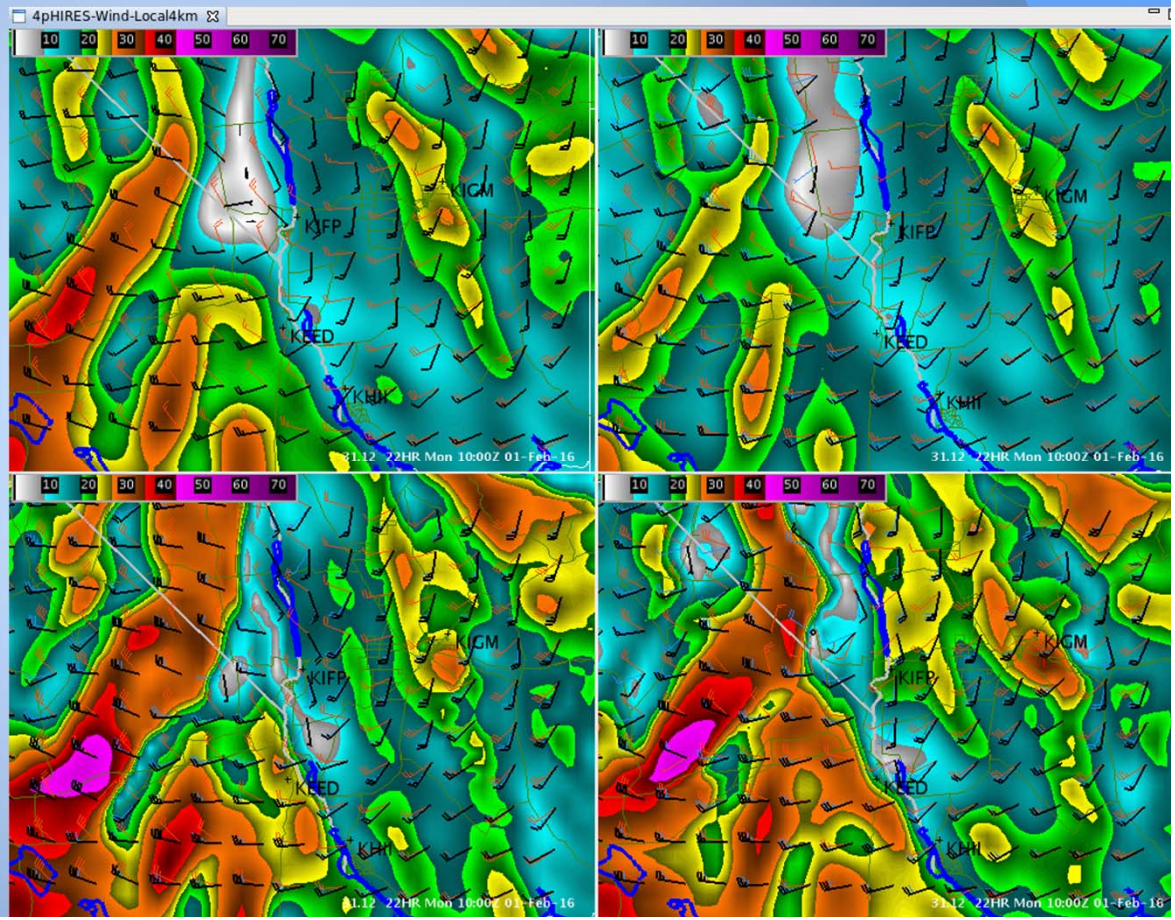
Strong south and west winds preceding north winds in Lake Mead and the Colorado River Valley

Note the much weaker wind speeds in the Colorado River Valley with west winds compared to areas of the eastern Mojave Desert in San Bernardino County.



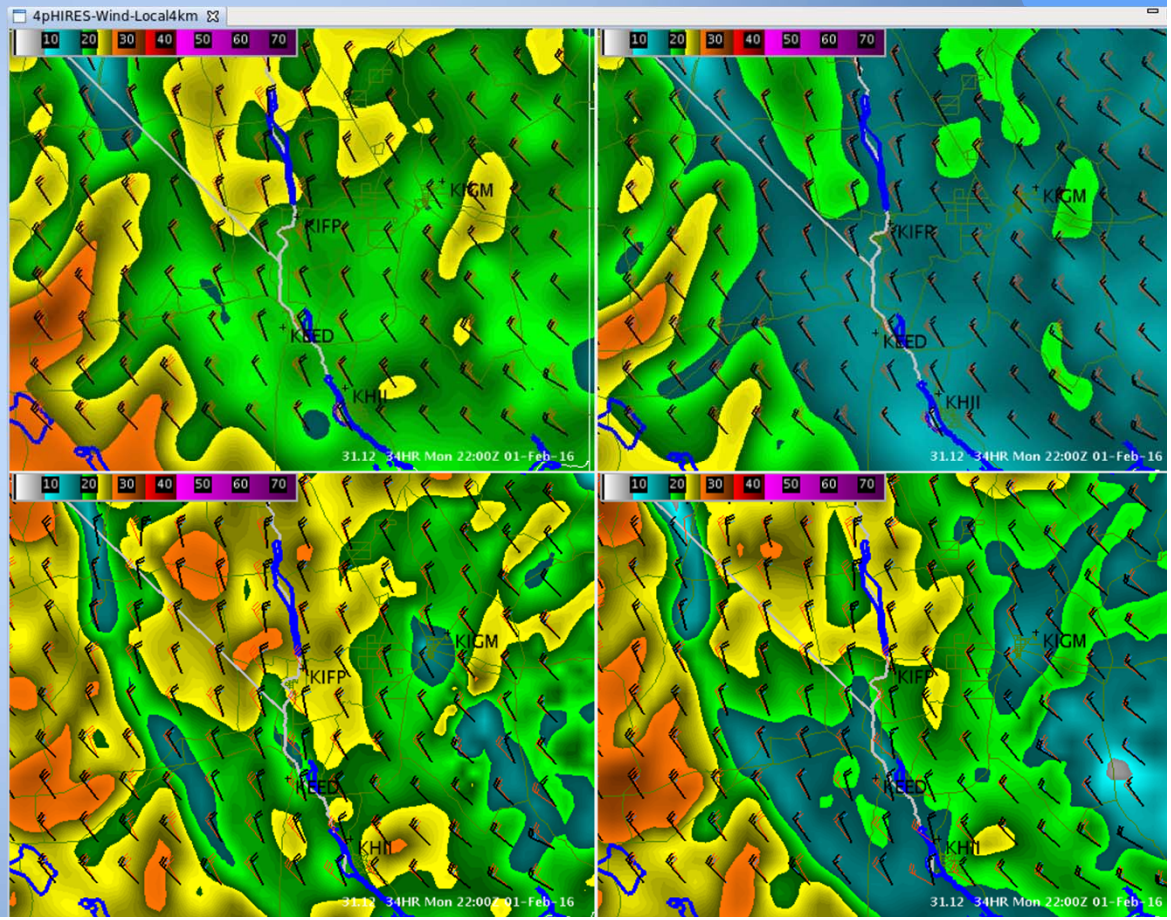
High-Resolution Models Aid in Several Types of Events

Synoptically driven wind events

31 Jan - 1 Feb 2016

Strong south and west winds preceding north winds in Lake Mead and the Colorado River Valley

Note that northerly winds are strong in the Colorado River Valley (and elsewhere) for this event. Local models are capable of identifying prevailing winds that favor stronger flow in the Colorado River Valley.



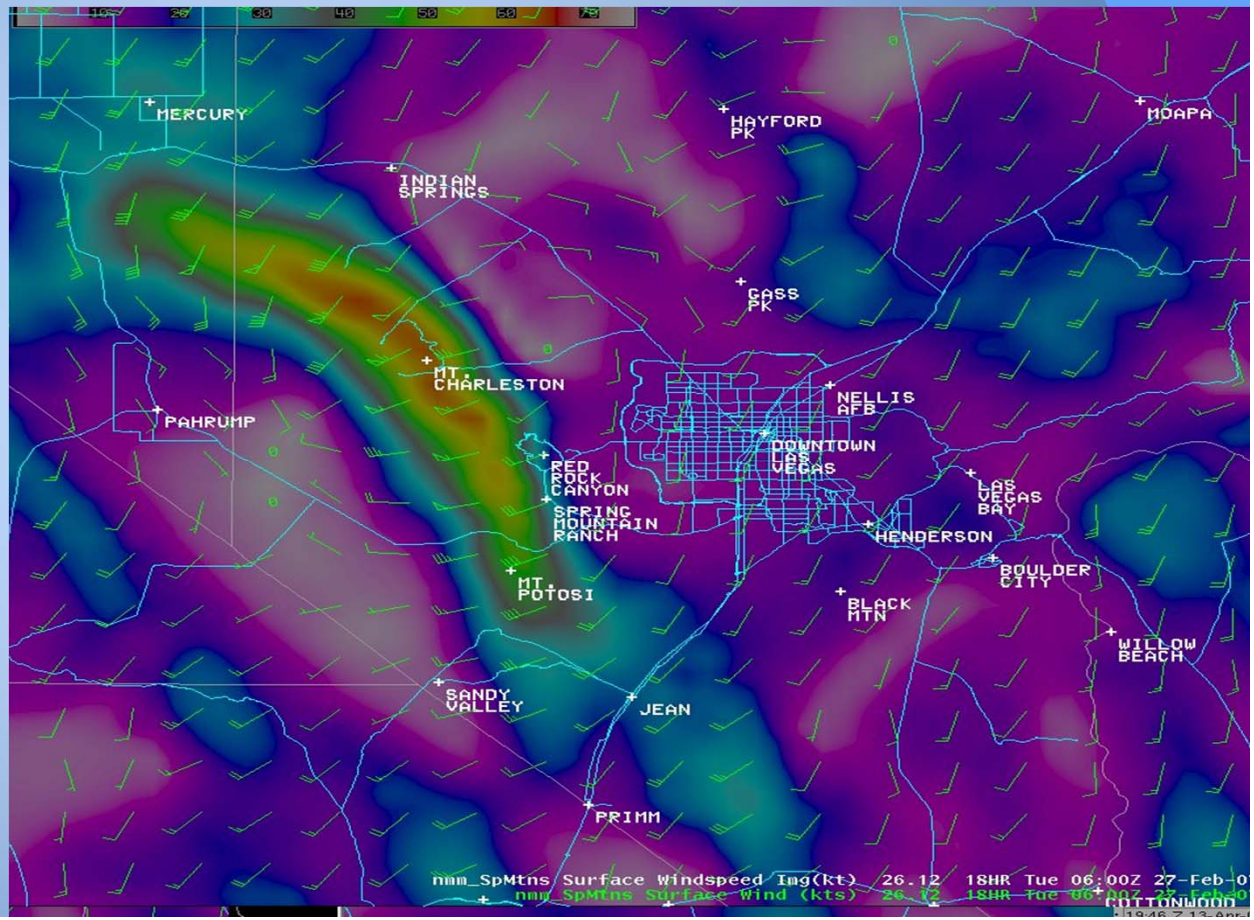
High-Resolution Models Aid in Several Types of Events

Downslope wind events

26-27 Feb 2007

Spring Mountains

Red Rock Canyon reported 62 mph wind gusts during this event.

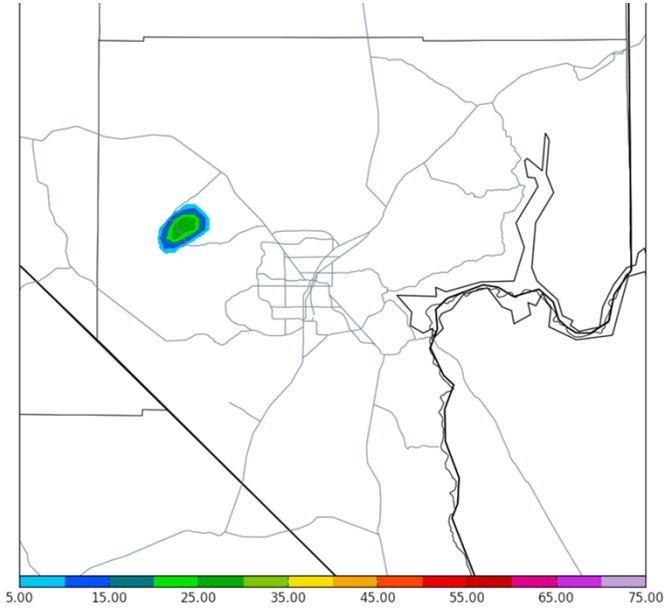


High-Resolution Models Aid in Several Types of Events

Outflow boundaries from convective storms

Monsoon-driven storms approaching Lake Mead generate outflow boundaries with strong wind gusts on 5 July 2015

Simulated Reflectivity Loop - 5 July 2015



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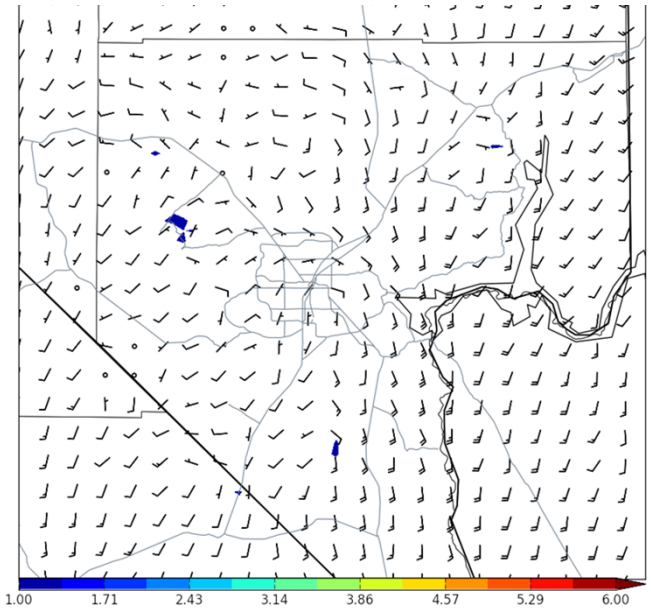
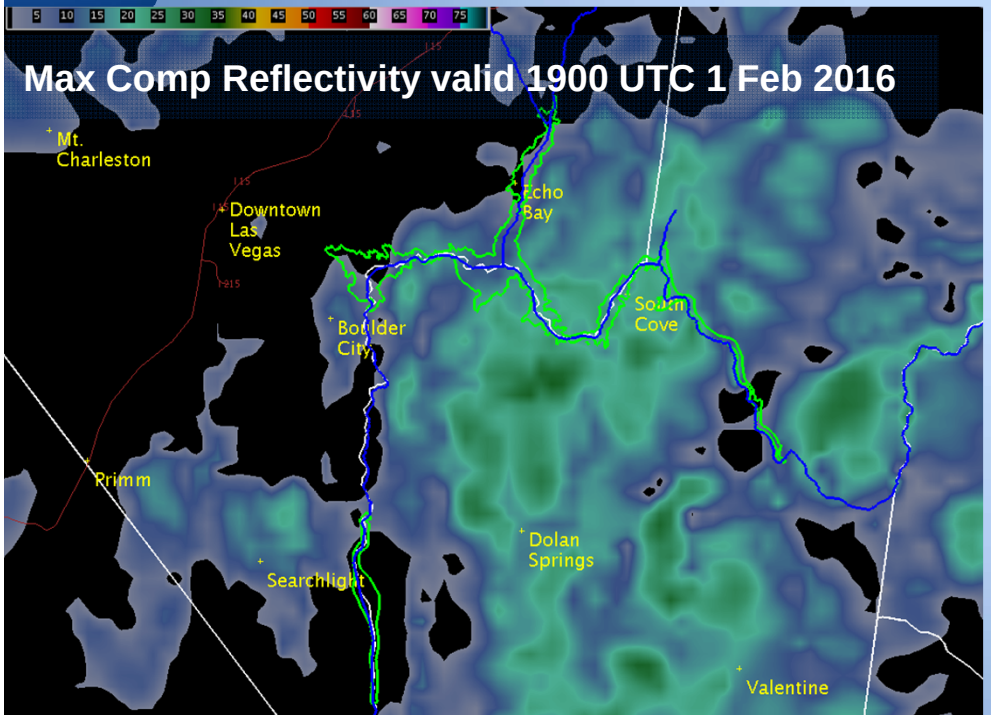
Outflow Boundaries - 5 July 2015

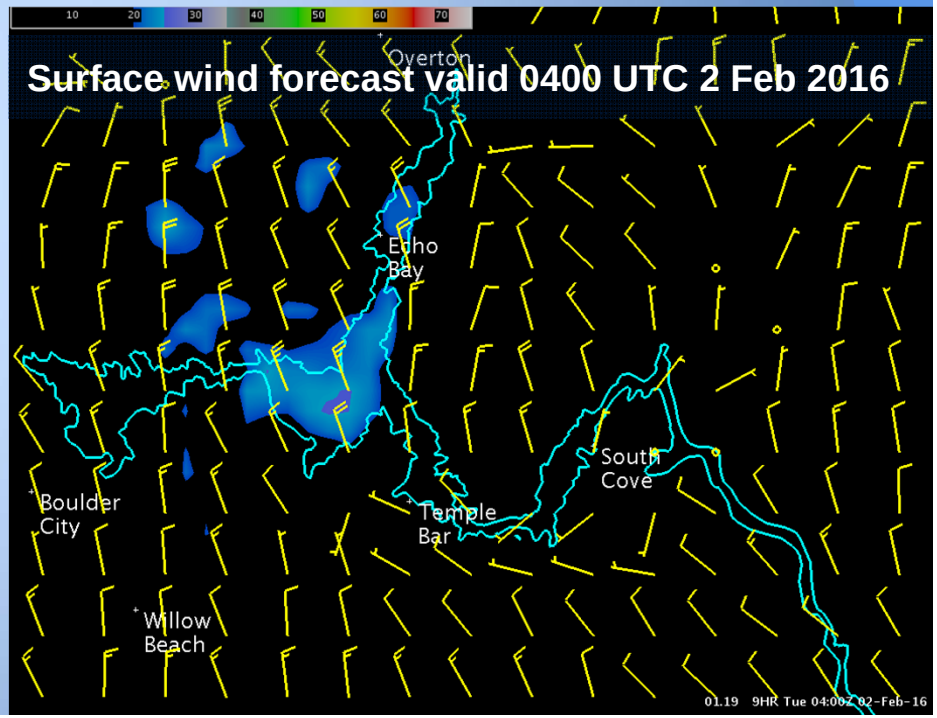


Blowing Dust - Thunderstorm Induced

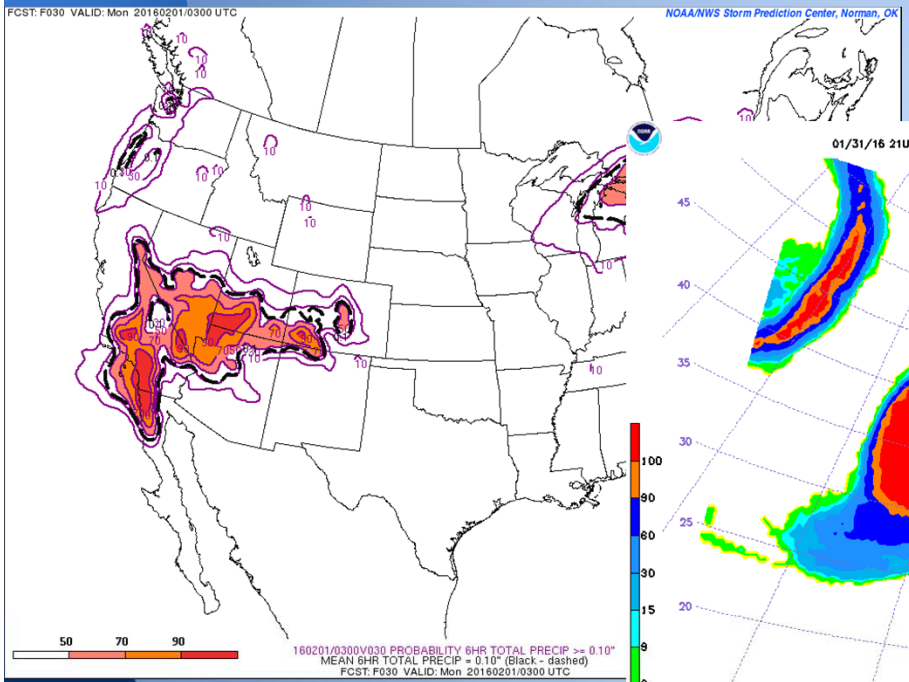
National High-Resolution Models -- HRRR

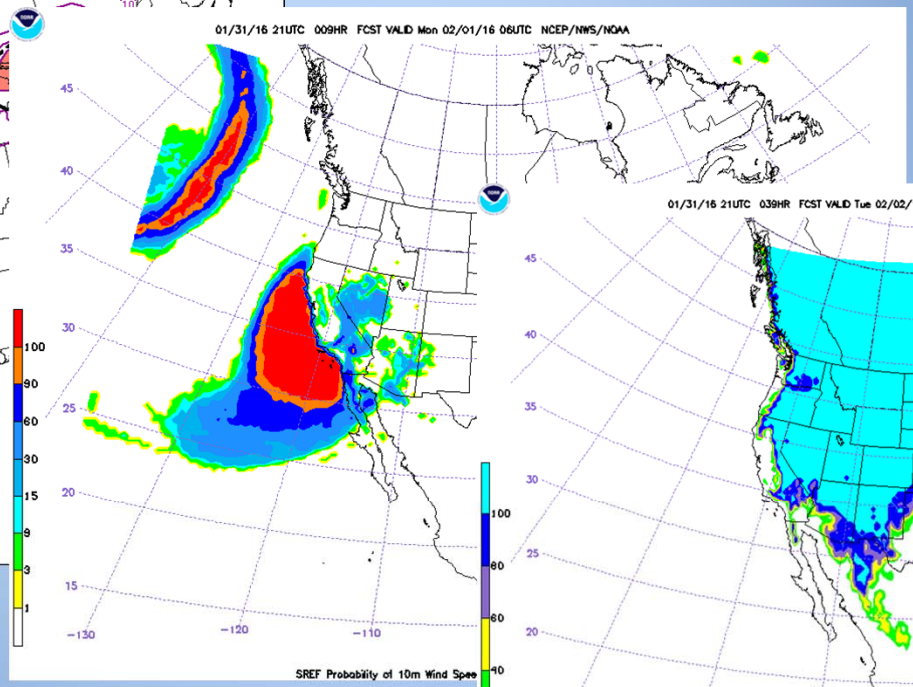
In addition to the locally-run models, high-resolution simulations run for the conterminous United States provide additional guidance for forecasts of small-scale phenomena in our area.

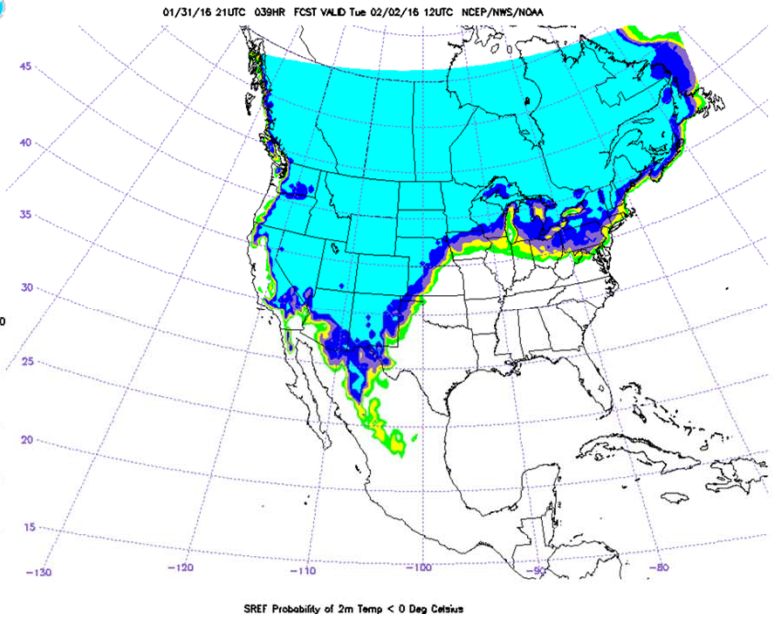




High-Resolution Model Ensemble Output







Marine Models

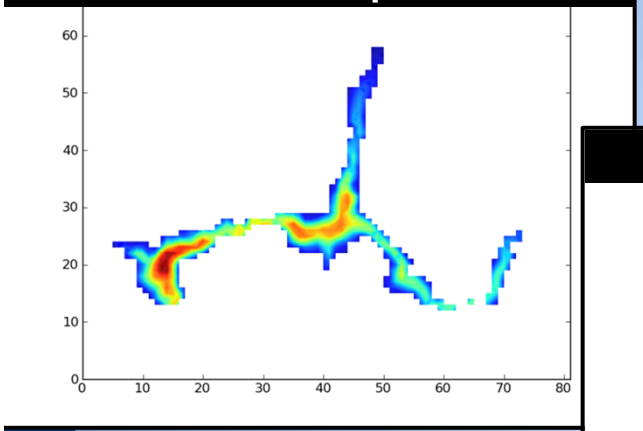
The Nearshore Wave Prediction System (NWPS) is an experimental wave modeling project in use at several National Weather Service (NWS) offices across the country. The NWPS uses the Simulating Waves Nearshore (SWAN) wave model to estimate wave heights, water levels, and wave periods for marine areas, including coastal waters and inland lakes.

The NWPS is used as **guidance** for marine forecasts issued by the NWS.

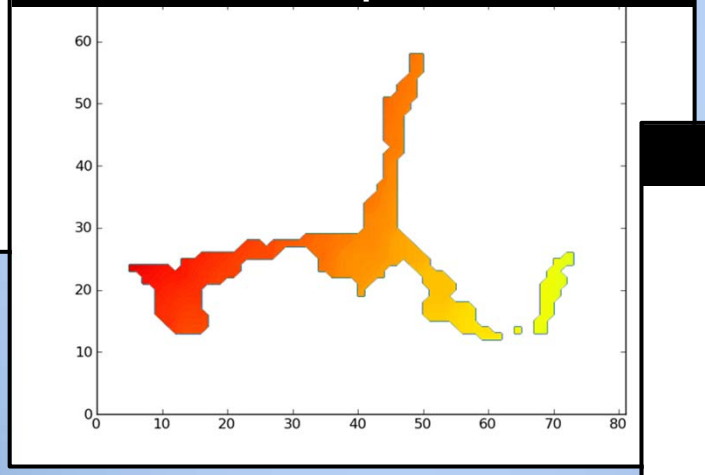
Current plans are to implement the NWPS for Lake Mead as part of the Marine Program at the NWS in Las Vegas. The NWPS has very recently been installed successfully on our local machines, with tests on past cases being conducted presently.

Prototypical SWAN Output for Lake Mead

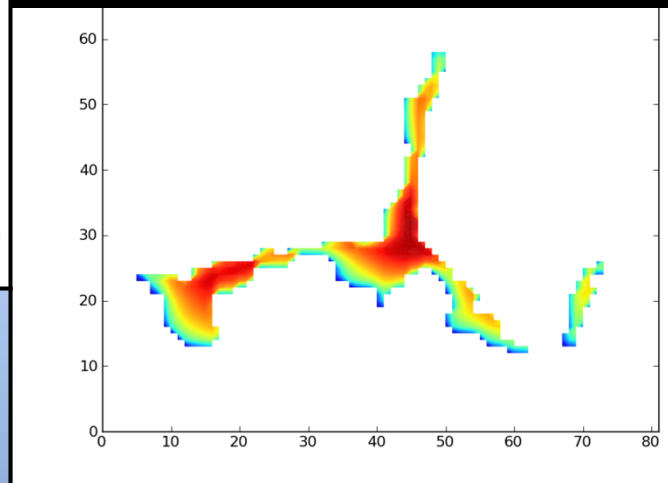
Water Depth



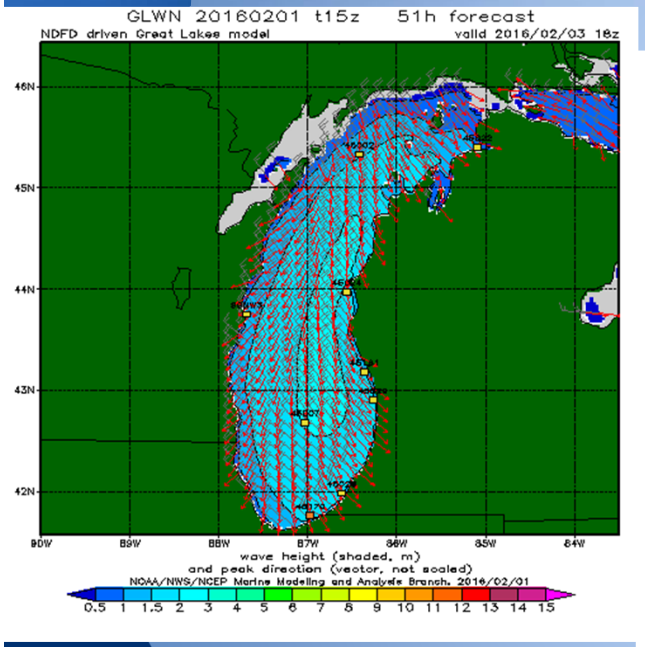
Wind Speeds

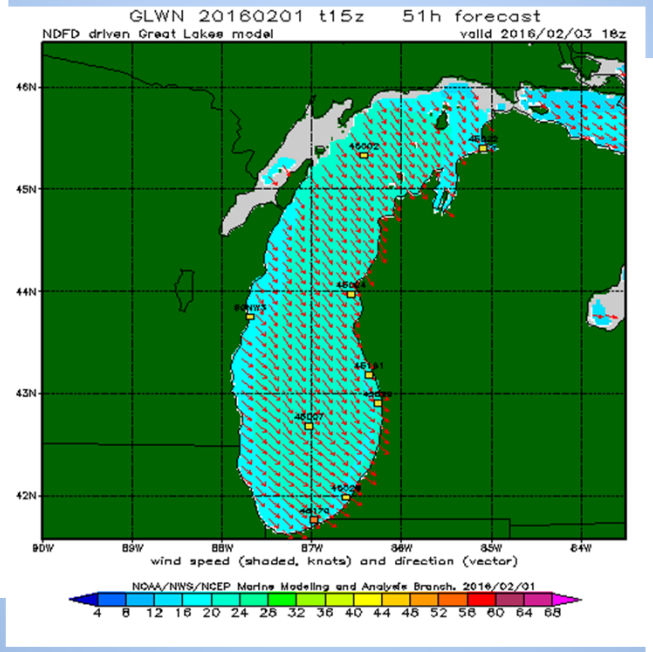


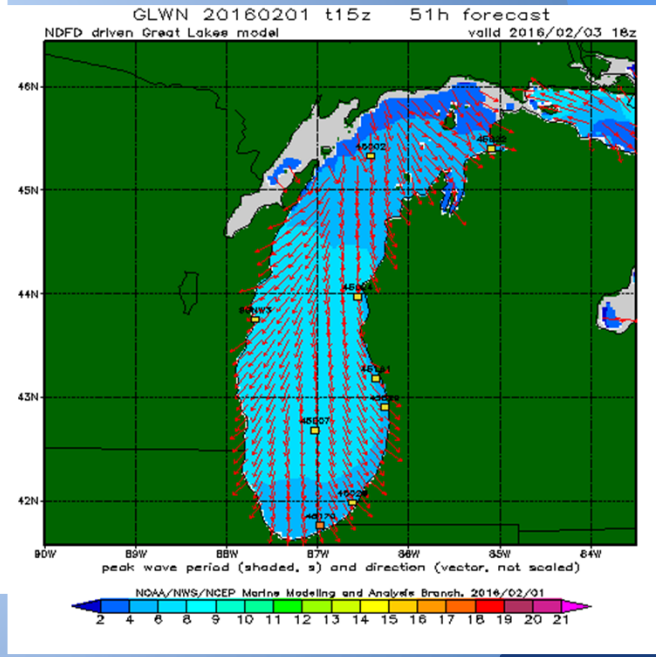
Significant Wave Height



National Products Using Operational Wave Models







http://polar.ncep.noaa.gov/waves/viewer.shtml?-glwn-michigan-

Summary

- Various multiscale meteorological phenomena affect Lake Mead, Lake Mohave, and the Colorado River Valley that result in significant impacts to the marine community. The combination of high-resolution meteorological and wave modeling can provide insight into identifying locations susceptible to impacts from particular meteorological phenomena and can aid us in notifying our core partners and the public to potential hazards these phenomena pose. These meteorological phenomena include:
    - Synoptic-scale high-wind events
    - Outflow boundaries from convective storms
    - Dust storms

- The NWS in Las Vegas currently is running several high-resolution WRF simulations multiple times daily to aid in the forecast of these high-impact meteorological phenomena. This output will be utilized to drive the marine modeling process and to provide relevant forecast services.

- The next step is to implement NWPS to provide guidance in forecasting the behavior of waves in Lakes Mead and Mohave. This is currently in progress.