Gridded Weather and Forecast Data Visualization with Bokeh

Antonio T. Lorenzo, Leland J. Boeman, William F. Holmgren

Department of Hydrology & Atmospheric Sciences, University of Arizona

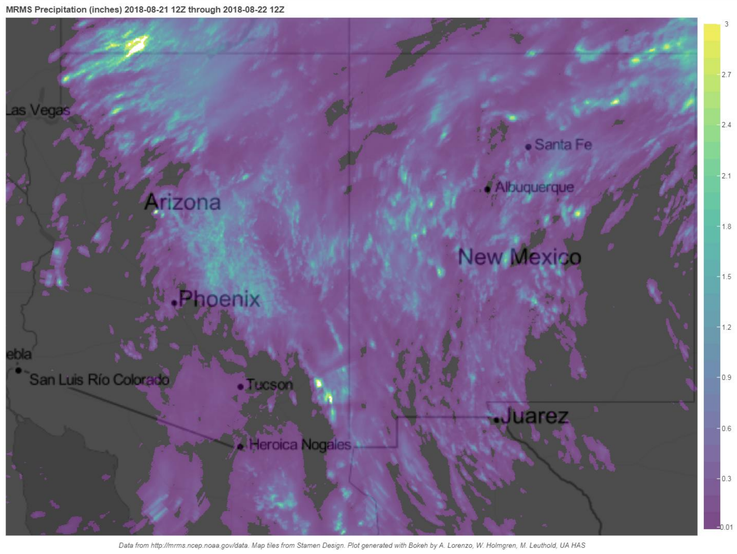
THE UNIVERSITY OF ARIZONA

Summary

- Three applications that utilize Bokeh to visualize gridded weather or forecast data are presented.
- Data plotted on a tiled web map allows users to zoom in on points of interest.
- The interactive applications allow one to explore weather or forecasts to better understand weather model output.
- Code for each application is MIT licensed and available on GitHub.

ARTSy

- The **A**rizona **R**ainfall **T**racking **Sy**stem (ARTSy) is an interactive Bokeh Application that overlays the 24 hour quantitative precipitation estimate (QPE) product from the National Severe Storms Laboratory Multiple Radar Multiple Sensor (MRMS) system onto a tiled web map of the Southwest.
- The 24 hour QPE product helps verify precipitation forecasts for the region and to understand monsoon variability.
- Data are acquired every 12 hours, regridded to the web Mercator projection, and saved to .npz format for fast loading.
- In addition to the map, a histogram displays the distribution of values in the current map view that adjusts as the map is zoomed.
- Saving of the map over HTTPS requires a proxy for the map tiles to avoid cross domain scripting errors.

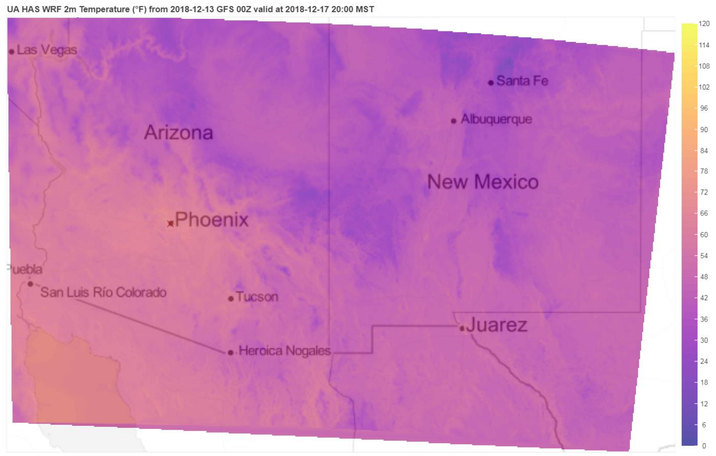


Code**: https://github.com/uarenforecasting/artsy**

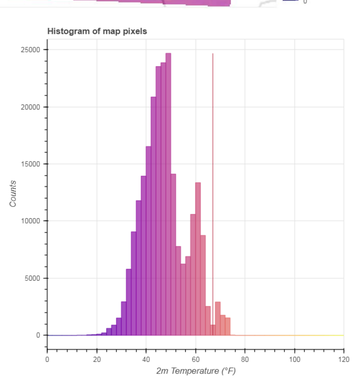
Live Demo**: https://forecasting.energy.arizona.edu/artsy**

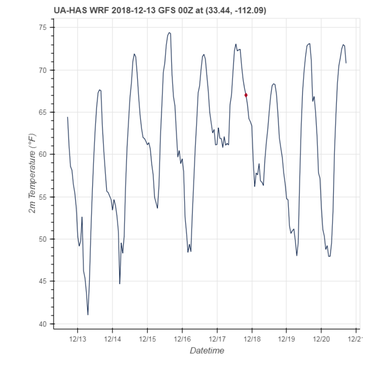
ADVI

The **A**rizona gridded **D**ata **Vi**sualization application is an interactive web application built with Bokeh to display gridded model output from the Weather Research and Forecasting (WRF) model runs produced by the Univ. of Arizona Dept. of Hydrology & Atmospheric Sciences on a 1.8km grid over Arizona and New Mexico. ADVI helps disseminate the forecasts and allows researchers to examine the model performance.



- Model output is overlayed on a tiled web map that allows one to zoom in on areas of interest.
- Data is extracted from the WRF output, regridded to the web Mercator projection, and saved in HDF5 format for fast loading.
- Users can select from recent model runs and step through each output time of the model.
- A histogram of the values currently displayed on the map adjusts as the map is resized.
- A user may click on the map to obtain the timeseries for the entire model run for that location.
- In order to reduce latency, the server sends the color bin for each map pixel as an one-byte integer instead of a four-byte float with custom javascript to color the pixel appropriately.



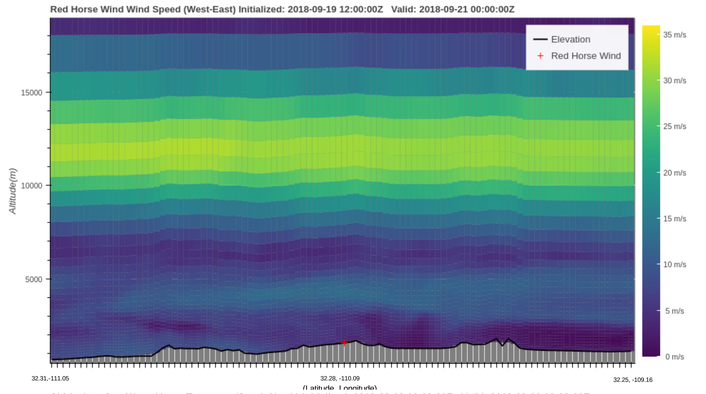


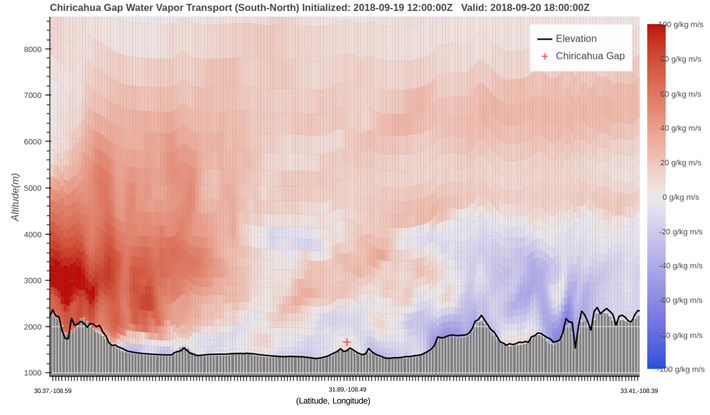
Code**: https://github.com/uarenforecasting/advi**

Live Demo**: https://forecasting.energy.arizona.edu/advi**

WRF Cross-Section

- WRF Cross Sections is an interactive visualization application using Bokeh to plot vertical cross sections of Weather Research and Forecasting (WRF) model runs produced by the University of Arizona Dept. of Hydrology & Atmospheric Sciences.
- Cross sections allow a user to examine model behavior in multiple dimensions at points of interest.
- Cross sections can be made of any 4D variable with current options of wind speed, water vapor mixing ratio and water vapor transport.
- User may select location, orientation, time index, color bar scale and cross-section width.
- South-North or West-East cross sections are made along the WRF grid intersecting the closest point to the specified location's latitude and longitude.
- Altitude is calculated from pressure at each sigma level of the model.
- Surface elevation is plotted from NASA Shuttle Radar Topography Mission (SRTM) Version 1, 3 arc-second data to differentiate true surface elevation from the lowest model levels.





Code: **https://github.com/uarenforecasting/wrf-cross-section**