An Algorithm for Downscaling Wind Speed in Areas of Pronounced Terrain

StatPP Workshop 2016 (NCWCP)

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January 20, 2016

Objectives

- To generate downscaled gridded model wind speed guidance in areas with pronounced terrain by leveraging 10-m model wind speed **and** wind gust forecasts.

- To capture the same spatial detail as NDFD forecasts without introducing regional and artificial boundary discontinuities.
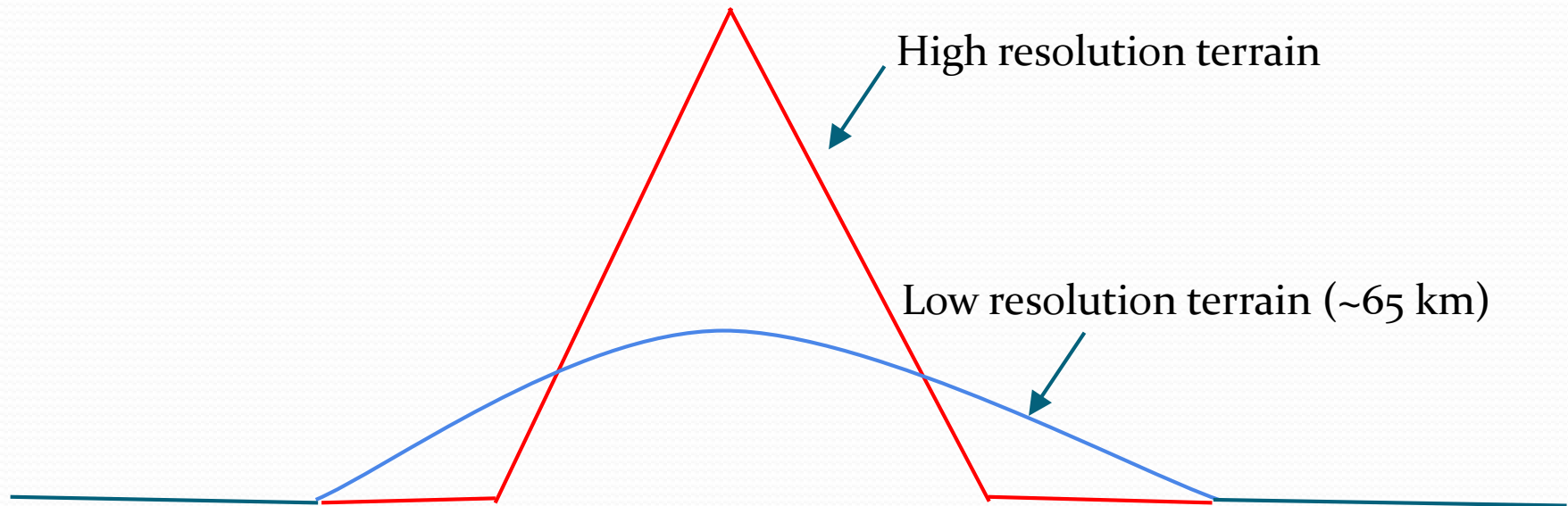
Identifying Areas of Pronounced Terrain

- To identify pronouced local terrain features such as ridge-tops, we compare the elevation of each gridpoint to the average elevation in its vicinity.

- We substract a high-resolution elevation dataset from a smoothed elevation dataset (~65 km) to find the elevation difference.

- The elevation difference is used to identify localized terrain features at the NDFD grid resolution.
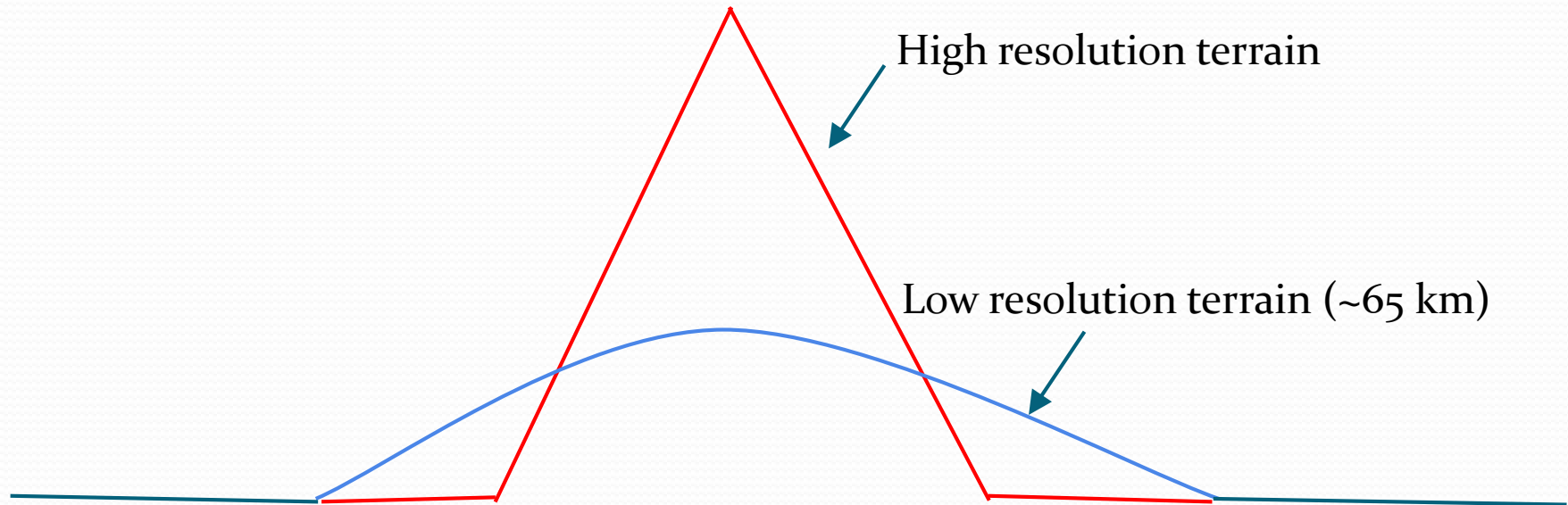
Identifying Areas of Pronounced Terrain (Cont.)

High resolution terrain

Low resolution terrain (~65 km)

Identifying Areas of Pronounced Terrain (Cont.)

- Compute difference between high and smoothed resolution elevations: Terrain Difference (TDIFF)

High resolution terrain

Low resolution terrain (~65 km)

Algorithm for Downscaling Wind Speed

Downscaled Wind Speed = β_{gust} * WG + (1-β_{gust})*WS

Where, β_{gust} = Weight assigned to the wind gust (see below)
WG = Wind gust forecast after interpolation to high resolution grid
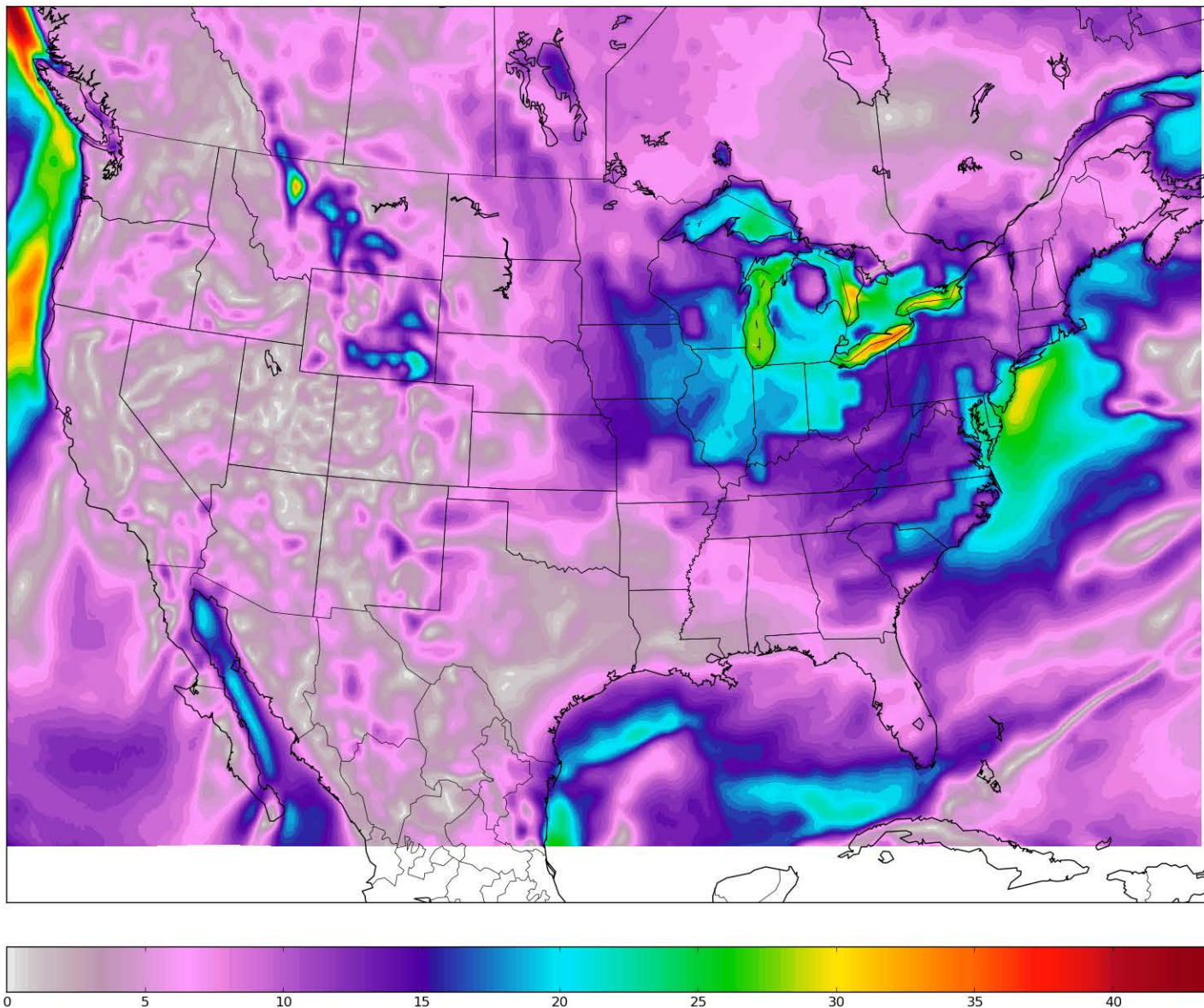**WS** = Wind speed forecast after interpolation to high resolution grid

and, **TDIFF** = High Resolution Terrain – Low Resolution Terrain
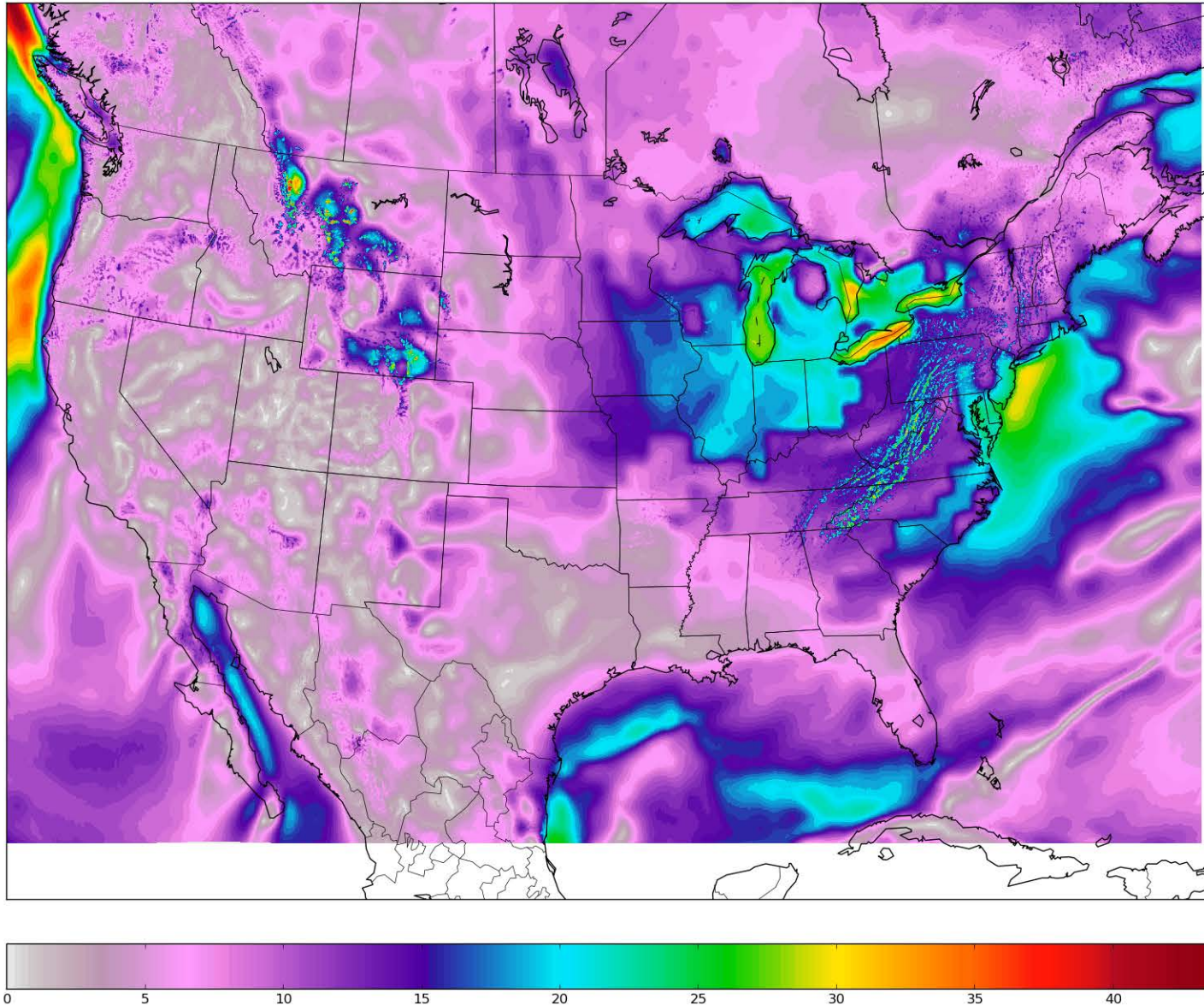β_{gust} (**TDIFF > 55 meters**) = Minimum(1,TDIFF/200)
β_{gust} (**TDIFF $\leq$ 55 meters**) = 0

Raw GFS Wind Speed Issued: 10 January 2016 00Z, 66-hr Forecast

Downscaled GFS Wind Speed Issued: 10 January 2016 00Z, 66-hr Forecast
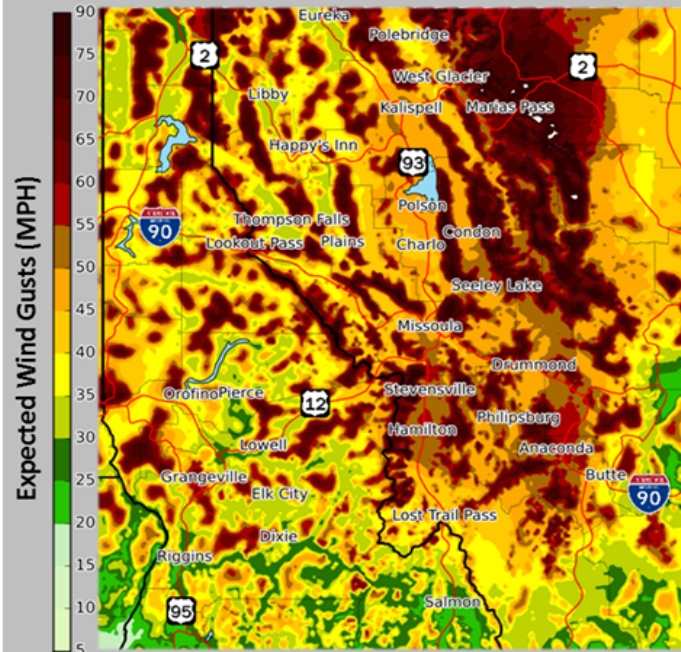
Benefits of this Algorithm

- Local adjustments to wind speeds in pronounced terrain are not tied to predefined terrain height thresholds. The adjustment is made relative to the local terrain features.

- Incorporating the wind gust forecast into the calculation provides a reasonable upper limit to the wind speed forecast.

- The simplicity of this algorithm allows for easy implementation.

- For extreme wind events, this algorithim realistically captures the wind speeds along ridgetops.

WFO Missoula – Ridge Winds

Example of WFO Missoula Forecasters using NBM to increase forecast wind speeds over higher terrain. The forecast was then used in a social media post.

"*The forecaster I worked with merely ran a tool to pull in the NBM wherever it was greater than our going forecast.*"

– Darren Van Cleave (Missoula, MT)

Thank You.