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Interactive comment on "Local models reveal greater spatial variation than global grids in an urban mosaic: Hong Kong climate, vegetation, and topography rasters" *by* Brett Morgan and Benoit Guénard

Anonymous Referee #4

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The authors developed a very high-resolution (30m) gridded dataset of climate, NDVI, and topography for Hong Kong. The meteorological observations from weather stations are interpolated using thin plate spline model. The motivation for fine resolution dataset for Species Distribution Modeling (SDM) is clear and the final product of the study will be useful for SDM and other local applications, however, the manuscript lacks justification for the methodology used and meaningful evaluation of results. It seems to me that the construction of climate data at this high resolution is the novelty of the paper and the main finding (i.e. greater spatial variation in finer resolution data than

the coarser) does not add anything new. The way method section is described is not clearâĂŤeach variable is prepared separately and then they were used as inputs to the statistical model for the climatology interpolation? Why did the authors choose this method over others and how are the 6 predictors chosen? Also, the use of 'climate modeling' in the text is confusing as it usually refers to general circulation models or regional climate models, but the terminology is used for the spatial interpolation model. I recommend changing the title to something like "development of 30 m raster dataset of climate, vegetation, and topography for Hong Kong" and list specific comments below.

1. Gridded meteorological datasets have been generated using station observations and a variety of interpolation methods in the past. A flagship climate dataset may be the CRU climate data (New et al, 2002) which used thin plate spline technique, with functions of latitude, longitude, and elevation (and mean precipitation for precipitation coefficient of variation). The technique seems to be the standard in recently increasing number of global gridded climatological datasets with increasing spatial resolution (eg. WorldClim2, TerraClim). Additional spatial information that represent physical processes are required in order to resolve higher resolution. I understand a unique situation for Hong Kong for the small domain with dense station network, which may allow simplification compared to constructing global data, but it would be helpful to tie into existing gridded climatology data w.r.t. method of prediction. The paper may shed some lights on improving precipitation interpolation.

2. The stations should be indicated in the map of Hong Kong, Figure 1.

3. Methods: I'm aware that R is a statistical package software. But what is the prediction model usedâĂŤlinear regression? Section 3.2, page 5 line 30- page 6 line 17 describes two-step process, which seems to be the main model (as referred to "our model", "local model", "new model"). Either moving section 3.2 to the first section, or giving an overview of the model before subsections begin, and streamlining the reference to the model will help clarify. Does water proximity include inland water bodies such as river, pond, and wetland? Could NDVI be included as a predictorâĂŤwouldn't

it add more physical characteristics? Though annual mean or monthly climatology of NDVI, rather than instantaneous is suitable.

4. As NDVI data is the only remote sensing, physical variable that resolves 30-m, I think it's important to compile climatology. Authors admit that the index values vary seasonally (page 10, line 12), which seems to contradict with the statement earlier on the instantaneous NDVI being representative. With strong seasonality of rainfall pattern in Hong Kong from June to August, I'd expect NDVI would respond. Landsat data extends several decades, so I can't imagine there's not enough data to capture seasonal variation. If no data during monsoon season, dry and winter low and wet summer high would be useful.

5. Precipitation results (4.2.2): I don't understand the last sentence. GCM outputs can be a predictor? If you mean using dynamical models, neither the GCMs nor even higher-resolution regional weather forecast model can't resolve micrometeorlogy at 30-m. Downscaling dynamical model climatology is a possibility but it will be a whole new paper and I'm not sure if it's attainable for 30m with limited information at hand.

6. Climate variables discussion (4.2.4): Though direct validation is not possible, temperature and precipitation could be evaluated qualitatively. Worldclim2 is average for 1970-2000 but your climatology is for 1998-2017, so it's not apple-to-apple comparison. Did you adjust Worldclim data? Could that be the reason for huge discrepancy in precipitation? TerraClimate data set is coarser at $\sim$ 4km but coves 1958-2015 (https://www.nature.com/articles/sdata2017191), so you could get closer climatology of 1998-2015 for the comparison. I would first check if the climatology agrees at station locations, then map out the differences at 4 km. For temperature, you can downscale the 4 km data to 30 m via elevation correction using constant lapse rates of -6.5 °C/km (Willmott and Matsuura, 1995; Maurer et al., 2002) since you have 30 m elevation data which can easily be aggregated up to 4km. The downscaled temperature should provide similar features as the modeled results and physical range of differences to expect. Also, effects of predictors other than elevation would be shown where they dif-

fer. Precipitation is difficult to evaluate or even to predict as indicated in the text. Does Hong Kong have radar data?

7. Skin temperature from Landsat could be another data to evaluate the heterogeneity of the modeled temperature. Though skin temperature is not exactly the same as in-situ 2-m air temperature, it is an observation based, independent data.

8. My understanding is that bilinear interpolation is for coarser to finer spatial interpolation and for aggregating from finer to coarser, arithmetic or area weighted average is appropriate. I'm wondering if using bilinear to aggregate from 30m to 1 km (Figure 7 etc.) results in different 1km if arithmetic averaging is used.

9. Next step: It is important to note what's missing and limited for future enhancement, but you should also encourage people to use this dataset. Isn't the dataset ready to use in SDM to address the issues raised in the introduction section? 30 m is remarkably high resolution and the entire raster data contain valuable information for many modeling studies and local management applications.

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