The Potential of Smartphone Pressure Observations Evaluated in a Convective Case Study

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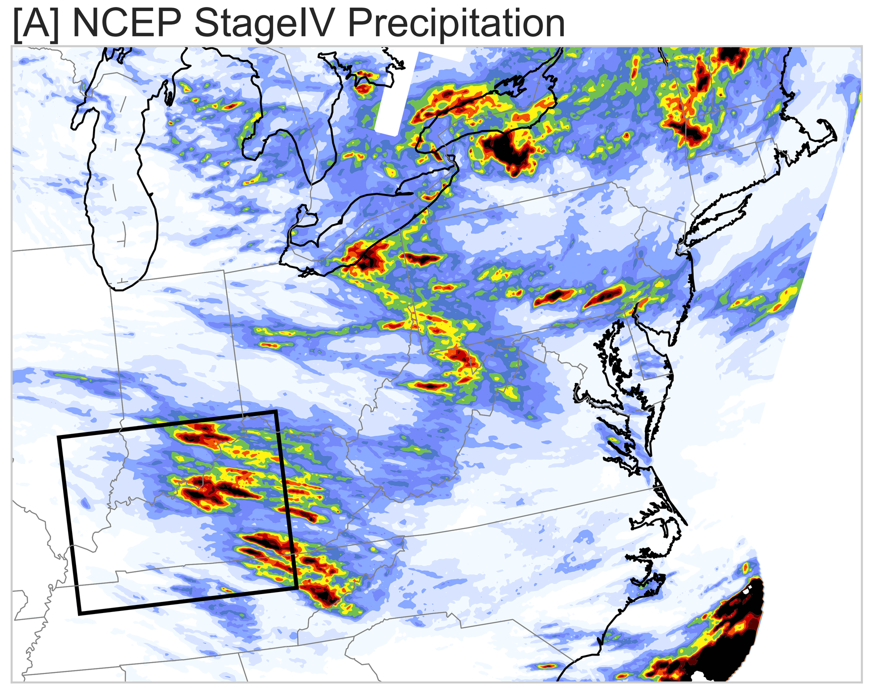
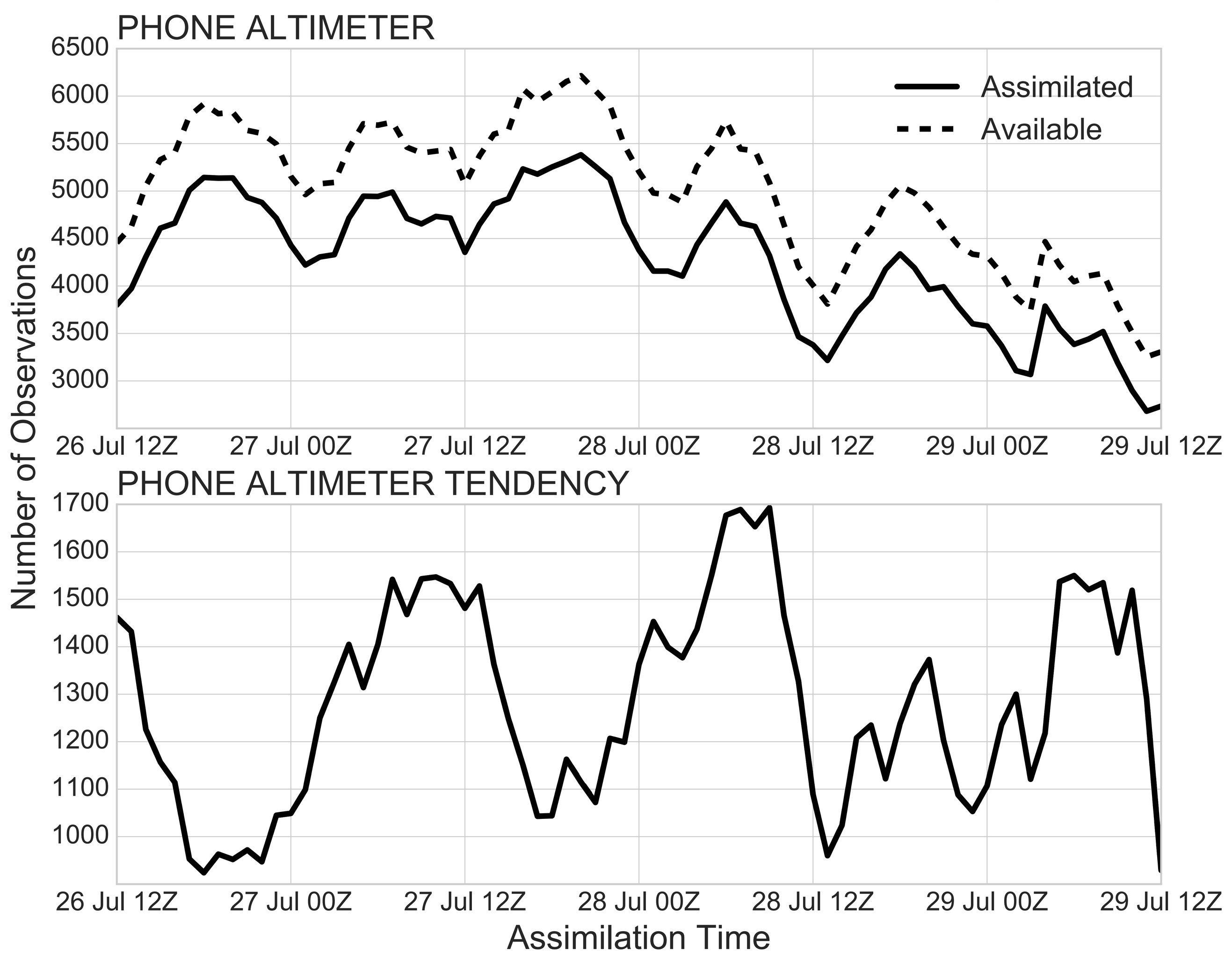


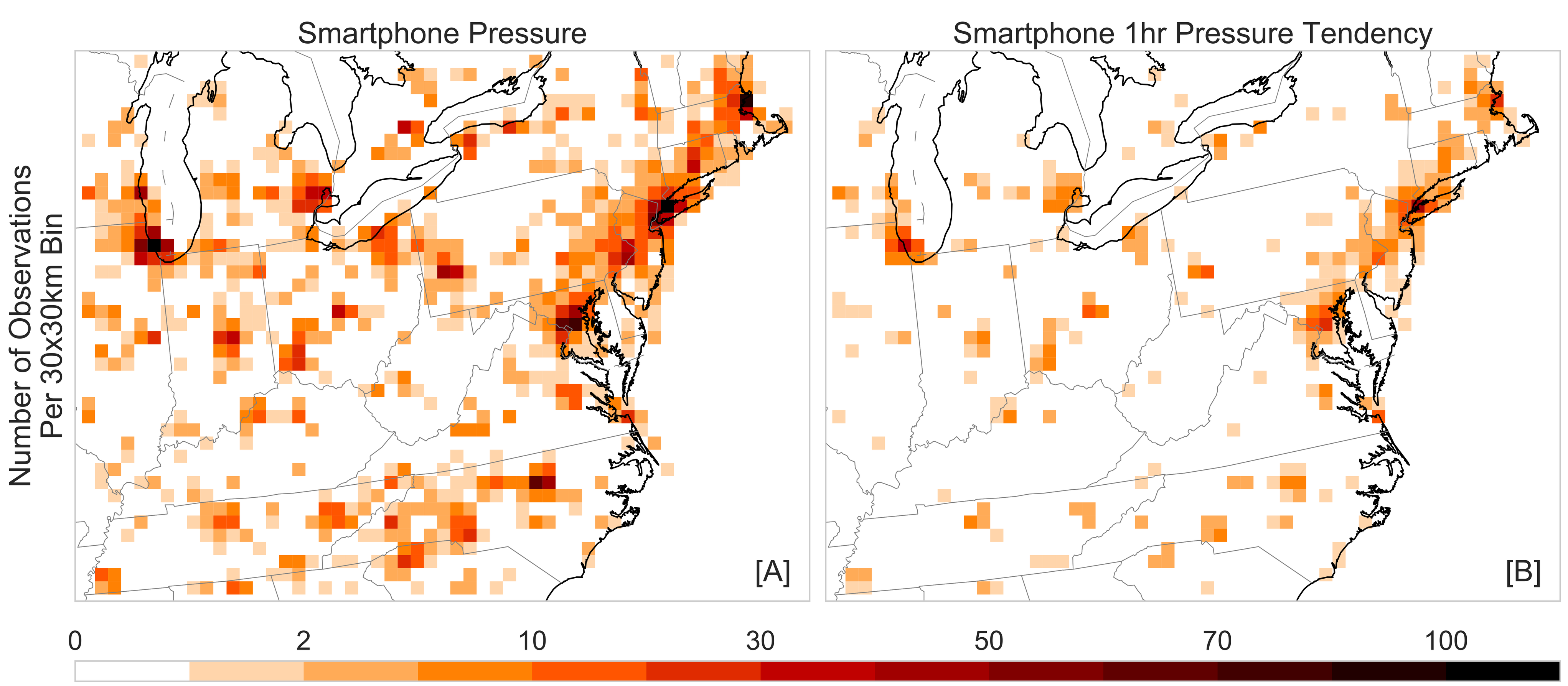
BACKGROUND

We evaluated smartphone pressure and 1-hr pressure tendency observations by assimilating them into a **50-member WRF ensemble based on the HRRR configuration with hourly cycling**. We evaluated analyses and forecasts produced over a three-day period from 26--29 July 2014 in the east-central United States. This period had widespread convective activity as seen in the precipitation analysis for this period



QUALITY CONTROL

Quality control removed observations with physically unrealistic values or in substantial disagreement with neighboring ASOS/METAR altimeter observations. These **QC checks removed over 50% of the available observations**. The remaining obs (shown above) are assimilated using the Data Assimilation Research Testbed (DART) ensemble adjustment Kalman Filter, which further rejects another 20% of the remaining smartphone obs as "outliers". Altimeter tendency observations were rarely rejected. The variability in observations over time is also illustrated in the above figure, including notable diurnal cycles.



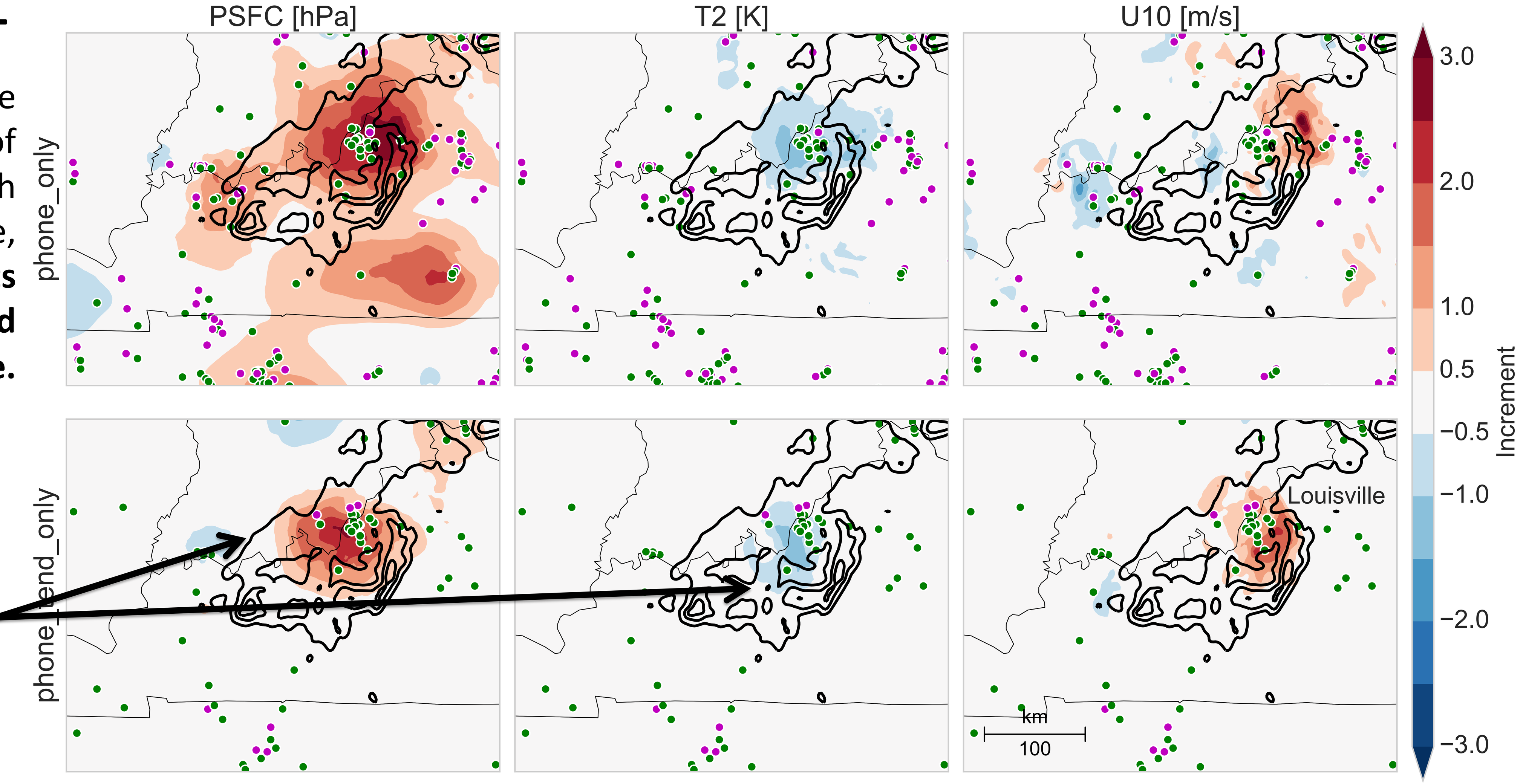
OBSERVATION DENSITY

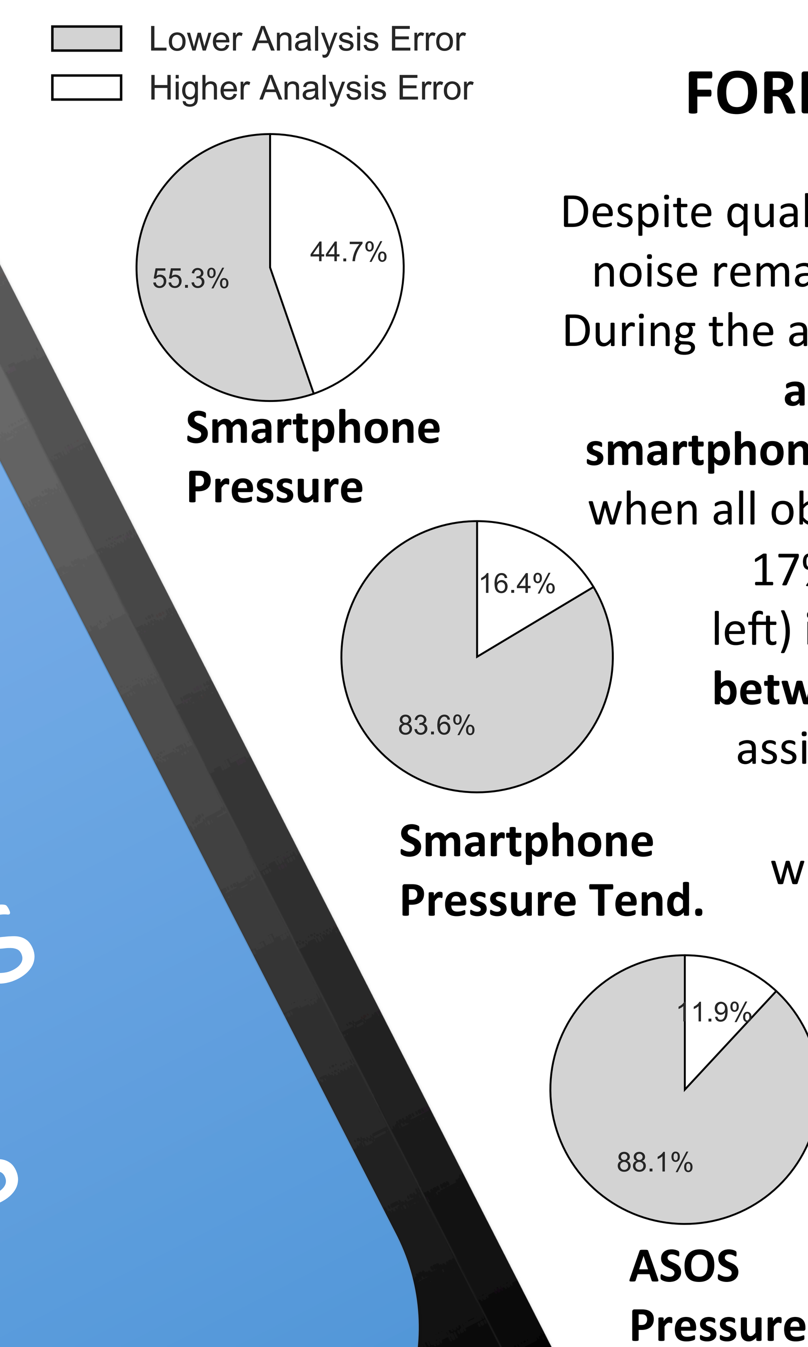
As expected with a "crowdsourced" observation, the density of smartphone observations follows the crowd, with high densities in urban areas. Rural areas are also sampled, but only by transient observations from, for instance, passing vehicles. By requiring phones to be stationary for one hour to compute 1-hr pressure tendencies, the number of altimeter tendency observations is much smaller. Even so, the **observations in this study represent less than 1% of the total smartphones in the US that can record pressure observations!**

OBSERVATION IMPACT

Assimilating smartphone pressure observations in the vicinity of strong mesoscale features, such as this MCS near Louisville, KY, **produces increments consistent with anticipated mesoscale structure.**

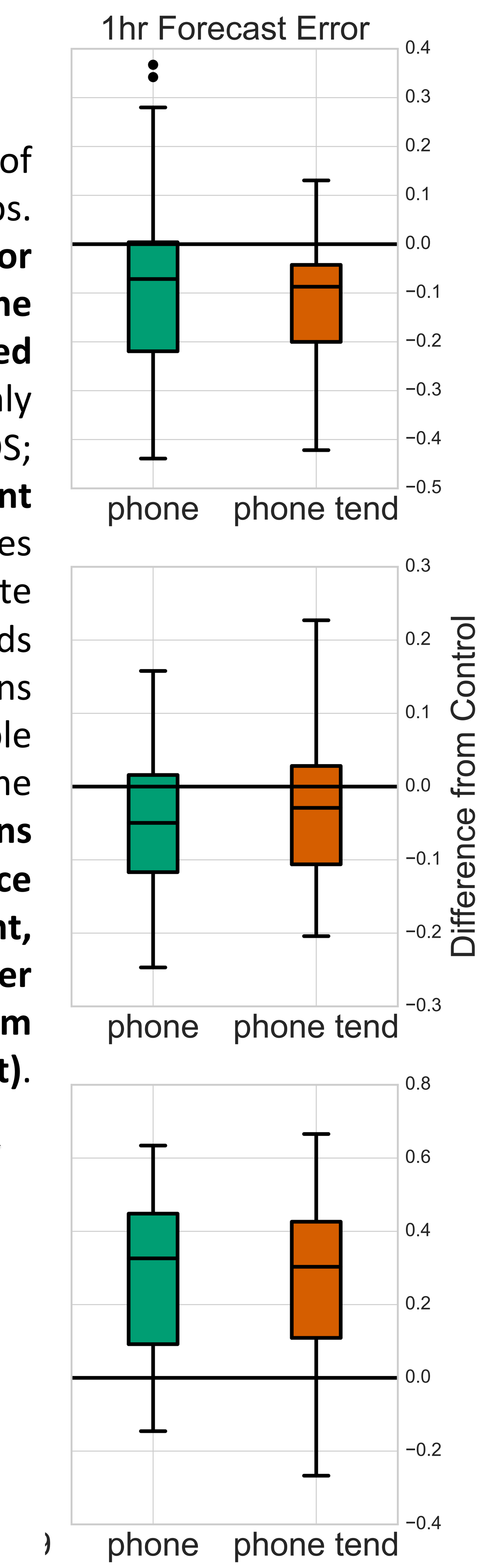
Smartphones detect cold pool pressure rise and increment surface fields accordingly



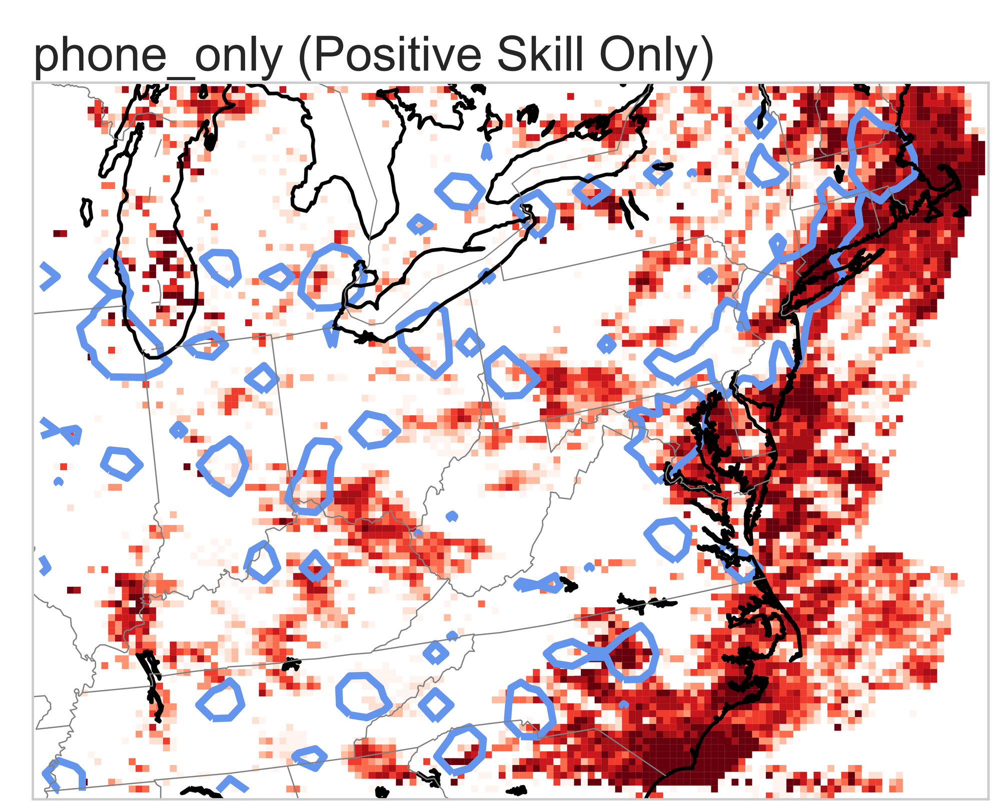


FORECAST PERFORMANCE

Despite quality control measures, a great deal of noise remains in the smartphone pressure obs. During the assimilation cycles, the **analysis error at the locations of almost 45% of the smartphone observations is actually increased** when all obs are assimilated (compared to only 17% of tendency obs and 12% of ASOS; left) **indicating substantial disagreement between nearby obs**. This noise reduces assimilation effectiveness. We evaluate 1-hr forecast errors in surface fields with unassimilated ASOS observations and compare to a control ensemble that assimilates nothing. The **smartphone observations improve forecasts of surface pressure and, to some extent, 10m winds, but show higher forecast errors in the 2m temperature field (right).**



1-hr precipitation forecasts were broadly improved, though mainly for spatial scales >120km and for low precipitation thresholds. Interestingly, **the most significant precipitation improvements occurred downstream from areas of high observation density** (blue; right).



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