P1.29 THE AMPS ARCHIVE: AN ATMOSPHERIC RESOURCE FOR THE ANTARCTIC RESEARCH COMMUNITY

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1. INTRODUCTION

In response to the need for improved weather prediction capabilities in support of the U.S. Antarctic Program's Antarctic field operations, the Antarctic Mesoscale Prediction System (AMPS) was implemented in October 2000 (Powers et al. 2003). AMPS employs the Polar MM5, a version of the Pennsylvania State University / National Center for Atmospheric Research Fifth Generation Mesoscale Model (Grell et al. 1994) optimized for use over ice sheets by the Polar Meteorology Group of the Ohio State University's Byrd Polar Research Center (Bromwich et al. 2001, Cassano et al. 2001). AMPS is a collaborative effort between The National Center for Atmospheric Research's Mesoscale and Microscale Meteorology group and the Polar Meteorology Group.

AMPS consists of several domains ranging in horizontal resolution from 90 km covering a large part of the Southern Hemisphere, to 3.3 km over the complex terrain surrounding McMurdo Station (Fig. 1). Several published studies have shown the model performs with good skill on hourly to seasonal timescales (e.g., Bromwich et al. 2003, Guo et al. 2003, Monaghan et al. 2003, Bromwich et al. in press; Fig. 2). On seasonal timescales the intraseasonal and interseasonal variability in pressure, temperature, wind, and moisture are well-resolved.

In addition to the real-time applications of AMPS, a continually evolving database of archived forecasts yields high-resolution climatological data that are useful to a broader Antarctic research community. For example, temperatures, 3-dimensional winds, and several moisture proxies are available for about 30 levels in the atmosphere from twice-daily forecasts at 3-hourly temporal resolution on a 30-km grid covering the entire continent. Precipitation, cloud fraction, and complete energy flux fields are also available. These forecasts can be integrated to compute time-mean fields on monthly, seasonal, and annual timescales. Soon the AMPS archive will be available to the Antarctic research community via an Internet database.

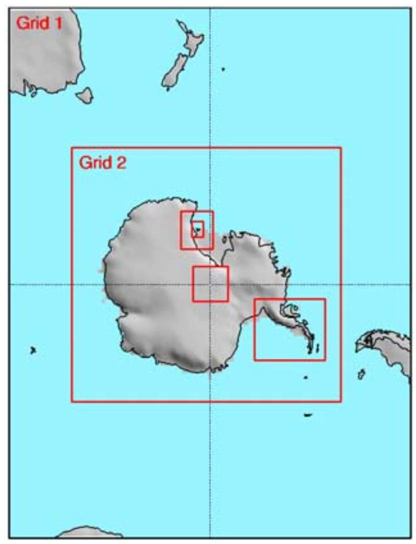

Figure 1. The 6 AMPS domains. The AMPS Archive contains forecasts since January 2001. The 3.3-km Ross Island domain and 10-km South Pole domain were implemented in December 2001. The 10-km Antarctic Peninsula domain was implemented in November 2003.

2. APPLICATIONS OF DATABASE

2.1 *Example: Ice Core Studies*

Figure 3 shows the temporal correlations for the International Trans-Antarctic Science Expedition (ITASE) Byrd and Siple core sites with all other gridpoints on the AMPS 30-km domain for temperature and precipitation. The results are based on AMPS 6-hourly forecasts for a 1 year period from Sep 2001-Aug 2002.

Despite their close proximity, the Byrd and Siple ice core sites are representative of climatologically different regions. The Byrd core site is mainly influenced by weather systems in the

Amundsen Sea, and especially the Ross Sea embayment, while the Siple core site is influenced by systems in the Bellingshausen Sea. The weather between these two regions on monthly and longer timescales is often anticorrelated (e.g., Yuan and Martinson 2001, Bromwich et al. 2004). This is most apparent in the precipitation correlations, and appears to be due to the ridge in topography between the two regions which acts to isolate the two regions from one another (see Fig. 4). The difference is less marked for temperature, and both sites appear to be most representative of the plateau environment, having fairly strong correlations (>0.6) with most of the East Antarctic Plateau.

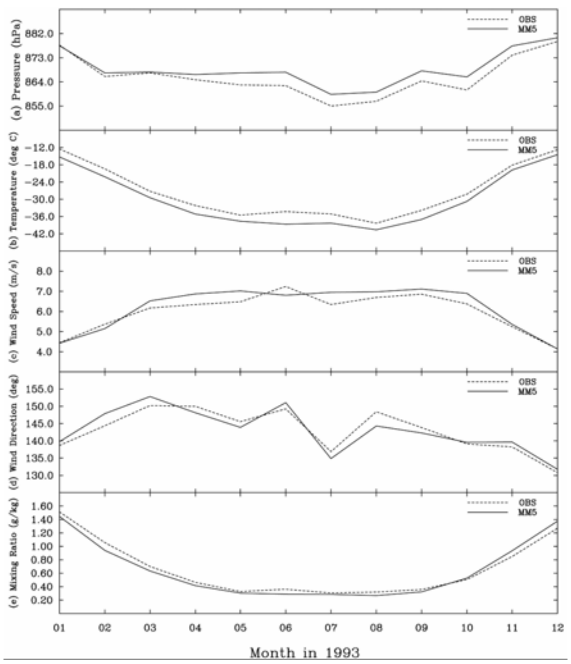

Figure 2. Monthly mean values calculated from Polar MM5 simulations (solid lines) and from automatic and manned stations (dashed lines). The monthly mean values have been averaged over 28 sites (and model grid points). Figure adapted from Guo et al. (2003).

2.2 *Example: Climatology*

Figure 4 shows the topography and several annual climatological fields over West Antarctica, derived by combining daily forecasts from the AMPS 30-km domain. The relatively low topography of West Antarctica (compared to East Antarctica, Fig. 4a) is strongly influenced by synoptic activity originating in the Southern Ocean. This can be seen in the annual precipitation (Fig. 4e), which is high in the coastal areas due to orography, but is also significant in the interior compared to East Antarctica (not shown). One interesting feature is the tongue of high precipitation values that roughly follows the ridgeline along ~260^{o}E longitude. This is the same ridgeline that separates the two core sites discussed above. Similar features are apparent in the potential temperature (Fig. 4c) and cloud fraction (Fig. 4f) fields and are caused by the poleward tropospheric air flow. The influence of katabatic winds is apparent in the confluence zones near the coast, which have annual mean temperatures that are higher than surrounding areas. An example is near the Gould Coast.

3. SUMMARY

The AMPS archive will soon be made available to the Antarctic community via an internet database. As the database continues to mature, it will become possible construct a more accurate climatology of the region and to assess interannual variability. The relatively high spatial resolution of AMPS compared to other models, and its optimization for use over polar ice sheets, makes it an ideal tool for biologists, geologists, and paleoclimatologists as they endeavor to understand the Antarctic climate and how it influences their respective areas of interest.

4. ACKNOWLEDGMENTS

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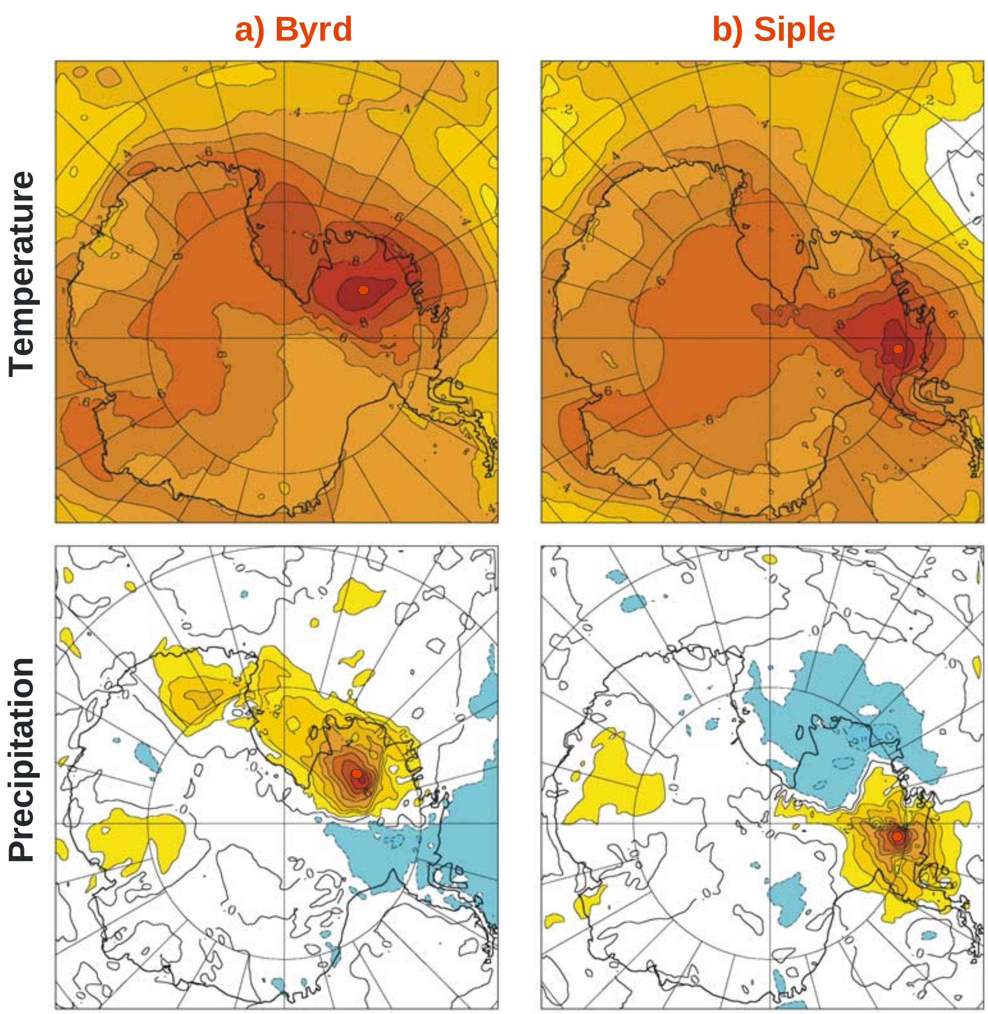

Figure 3. Temporal correlations between a) ITASE Byrd core site and b) ITASE Siple core site with all other gridpoints (based on AMPS 6-hourly forecasts for a 1 year period from Sep 2001-Aug 2002). The correlations are performed for temperature (top) and precipitation (bottom). Positive correlations are red (darker reds are higher correlations); negative correlations are blue.

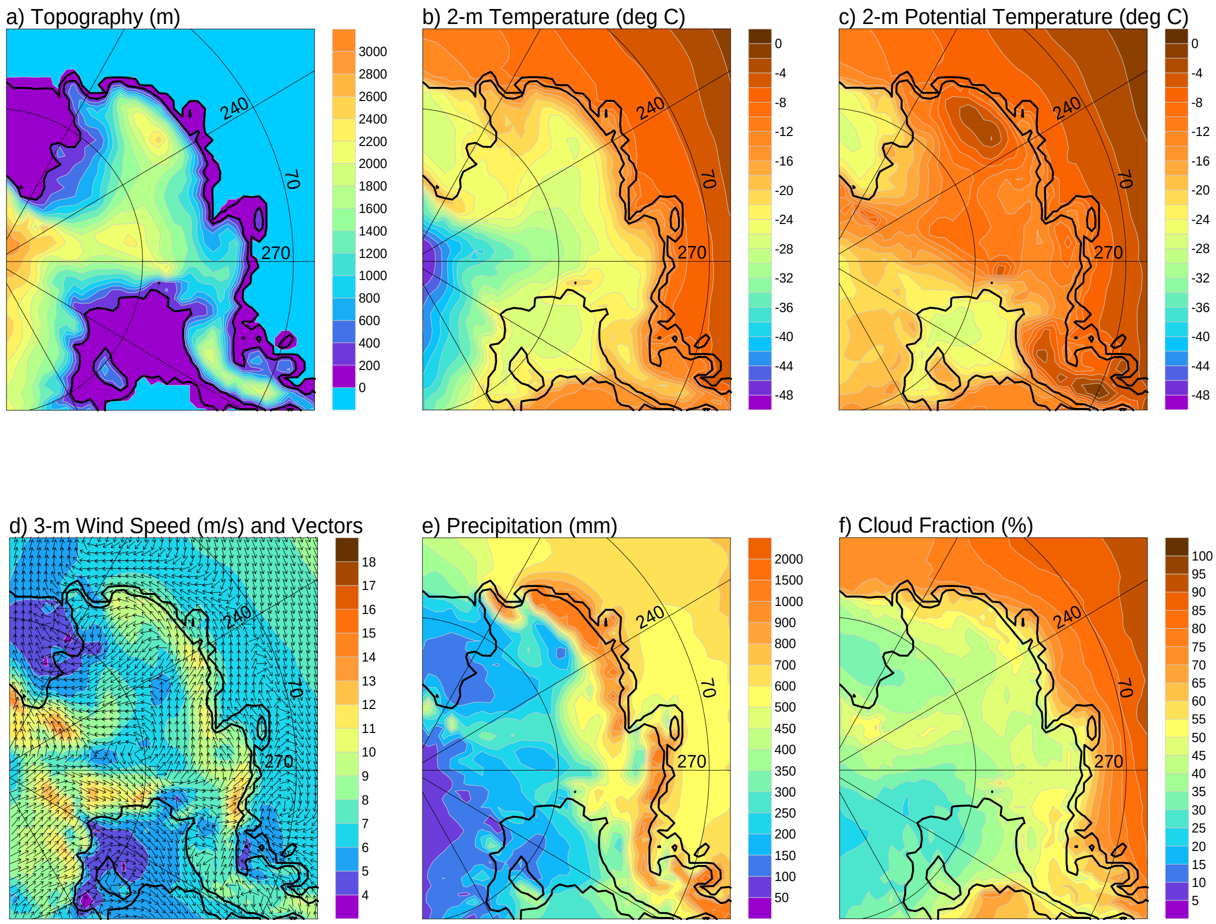

Figure 4. AMPS 30-km domain a) topography and annual (b) 2-m temperature (^{o}C); (c) 2-m potential temperature (^{o}C) (potential temperature removes terrain effects); (d) 3-m winds (Arrows show vector-mean direction and colors show scalar average wind speed (m s^{-1})); (e) precipitation (mm water equivalent); and (f) total cloud fraction (%). The annual values are derived from 2-y of 12-30-h forecasts (Sep2001-Aug 2003).