

THE AMPS ARCHIVE ON THE EARTH SYSTEM GRID

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1. INTRODUCTION

The Antarctic Mesoscale Prediction System (AMPS) (Powers et al. 2012) is a real-time numerical weather prediction (NWP) system built to provide forecast guidance for the United States Antarctic Program (USAP). AMPS is funded by the National Science Foundation Office of Polar Programs, and its priority mission is serving the USAP forecasters. The system employs the Weather Research and Forecasting (WRF) model (Skamarock et al. 2008) to generate twice-daily guidance, and its products are posted freely at <http://www.mmm.ucar.edu/rt/amps>. The AMPS effort is a collaboration of the National Center for Atmospheric Research (NCAR) and The Ohio State University (OSU). Apart from its USAP support role, AMPS serves a range of science activities over Antarctica, including research and planning. This often involves the analysis of previous AMPS forecasts that have been stored in its archive.

The AMPS archive is the repository of model output and forecast products from AMPS. It is used for research, verification, and logistical studies. Its applications have ranged from climatologies of specific regions to case studies of weather events to evaluations of the NWP models. NCAR's High-Performance Storage System (HPSS) has housed the AMPS archive since April 2011. Previously, the archive files were held under the NCAR Mass Storage System (MSS).

Until recently, use of the AMPS archive by researchers was hindered by administrative and technical obstacles. Access to this archive, however, has now been much improved via a data-sharing portal at NCAR, the Earth System Grid (ESG). The ESG now allows entry to, review of, and downloading of materials on the AMPS archive via the web.

2. ARCHIVE ACCESS ISSUES

Historically there have been two main problems with users trying to access the contents of the AMPS archive. First, users needed to log into an NCAR computer with access to the MSS. This typically required that a system account be set up for the user and that a login security device be obtained. Second, users needed NCAR computer resource time for the

accessed systems. While university users could request and obtain these through an application, often prospective users were just added to an existing, general AMPS account as a courtesy. That account, however, was not set up for extensive archive work—it lacked the resources to support community use of the NCAR computer systems. Thus, the AMPS group sought a way to make the archive available without significant administrative overhead and without a need for resources for using the NCAR computing facilities. The solution has been the ESG, detailed below.

3. ARCHIVE DATA

The AMPS archive holds system forecast output from 2001 to the present. From 2001–2009 AMPS ran the MM5 model, and thus the archive has MM5 output files through 2009. In 2006 AMPS began running WRF as well, and the archive's WRF holdings date from 2006.

The archive holds three types of files: 1) model output in native format; 2) model output in GRIB format; and 3) graphical forecast plots (since 2008). For the files available through the ESG, the file prefixes are, respectively: "wrfout_yyyymmddhh", "wrf_grb_yyyymmddhh", and "products_yyyymmddhh", where "yyymmddhh" reflects the year, month, day, and hour of the AMPS forecast initialization.

The native WRF output format is netCDF. The WRF output files ("wrfout") contain all the model fields saved during the given run and are on the model's vertical coordinate surfaces and horizontal grids. For the 2006–2013 (Mar 2013) period, these grids are shown in Fig. 1. In December 2012 the grid resolutions were enhanced to 30 km, 10 km, 3.3 km, and 1.1 km, and in April 2013 the grid areas were adjusted to those shown in Fig. 2.

Since April 2013, stored output files contain a single forecast hour for a given initialization; prior to this, files contained multiple forecast hours. Thus, there are no longer tarfiles of multiple WRF output times. The new packaging means that there are more individual files, but of smaller size, and users do not have to download and untar volumes of forecast times

that may be irrelevant. In addition, the archived WRF output files now use NetCDF4 format, with internal compression. Thus, to read the newest WRF files from the archive, the user will need NetCDF4-aware programs.

The archived GRIB files contain selected fields (e.g., temperature, winds) and vertical levels in gridded binary format. Given that they have a subset of the full model output, these are significantly smaller than the raw model files.

The third type of file contains forecast products. These are the forecast plots and tables that are posted on the AMPS page, and they provide a record of the graphical guidance that was made available in real time. Full information on the contents of the archive files may be found at: http://www.mmm.ucar.edu/rt/amps/information/archive_info.html.

As noted, the ESG hosts AMPS WRF datasets from 2006 to the present. The archive on the ESG does not currently include MM5 output from 2001–2009. Publishing at least some of this material remains a possibility for the future, but will depend on demand and resources.

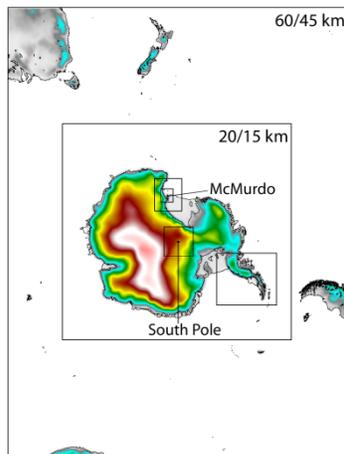
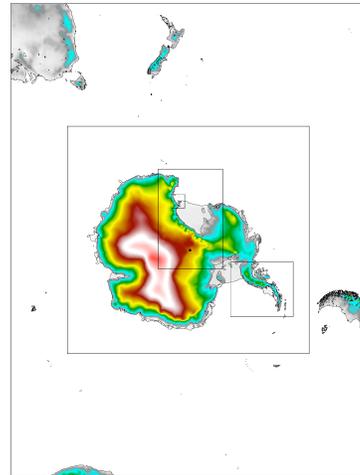


Fig. 1: AMPS WRF domain configurations with outermost (coarsest) grid sizes of 60 km and 45 km. The inner grids have 20/6.7/2.2-km or 15/5/1.67-km grid sizes. The 60/20/6.7/2.2-km setup ran from Mar 2006–Nov 2008, while the 45/15/5/1.67-km setup ran from Oct 2008–Jan 2013.

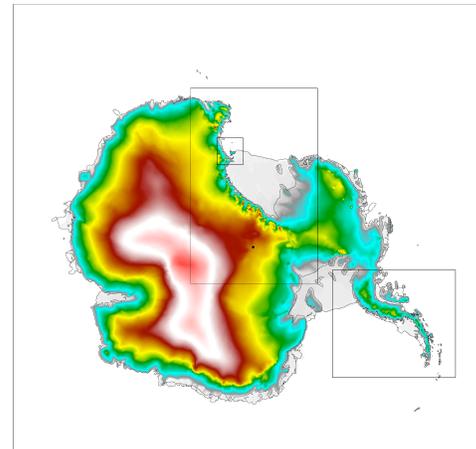
4. ESG ACCESS

In 2012 the AMPS group began discussions with NCAR's Computational and Information Systems Laboratory (CISL) on means for improving the public accessibility of the AMPS archive (i.e., without the

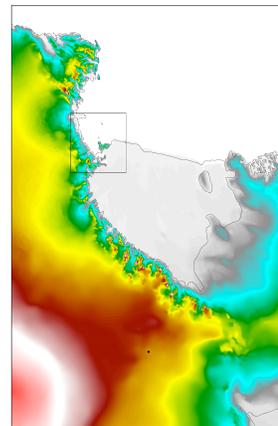
requirements that had hindered previous archive use). The CISL division at NCAR maintains the HPSS and the community computer systems. To make the AMPS archive more public, CISL suggested the Earth System Grid (ESG).



(a)



(b)



(c)

Fig. 2: Current AMPS domain configuration. (a) Full 5-grid layout; outermost domain has 30-km horizontal spacing. (b) 10-km continental grid, containing 3.3-km Ross Sea and Antarctic Peninsula grids. (c) 3.3-km Ross sea grid with 1.1-km Ross island region grid.

The ESG is a cyberinfrastructure interface to data collections. It is a development of the Earth System Grid Federation, an international collaboration to support environmental and climate science. The ESG gateway is a portal to various earth science datasets, which include output from the Community Earth System Model (CESM) as well as other models and projects. Figure 3 shows the ESG home page, and a full description is provided at: <http://www.earthsystemgrid.org>.

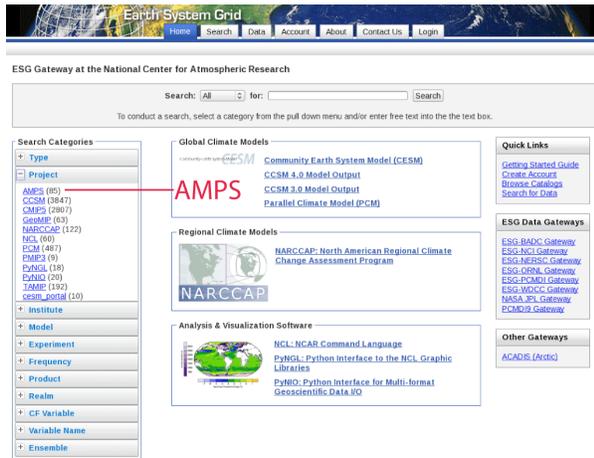


Fig. 3: Earth System Grid page (<http://www.earthsystemgrid.org/home.htm>). AMPS listed under projects hosted and highlighted above.

To access the AMPS archive, users first register on the ESG gateway, found at <https://www.earthsystemgrid.org/ac/guest/secure/registration/htm>. Upon registration, the ESG portal provides the user with a login for download access. Neither NCAR computer accounts nor computer resources (core-hours) are required, however. The login is referred to as an "OpenID" and has the format of a URL, for example— <https://www.earthsystemgrid.org/myopenid/xxxxxxx>. The user sets a password for his given OpenID as well.

Links on the ESG pages direct the user to the AMPS collection, and data are grouped by the different model configurations (e.g., the 45/15/5/1.67-km configuration data). The ESG interface allows for

downloading of individual or multiple files per request. Files may be downloaded through the browser or in bulk via a "wget" script. Thus, the file acquisition process can be scripted.

While accessing the AMPS archive is now simpler, users should note that the archive files are still large. For example, some WRF output files are over 6 GB each. The archive contents are described in full at: http://www.mmm.ucar.edu/rt/amps/information/archive_info.html. The archive remains physically located on the HPSS at NCAR, and it may still also be accessed through the traditional means of logging onto an NCAR machine and pulling contents.

4. SUMMARY

The AMPS archive is the collection of stored forecast model output and forecast products from AMPS over the years. It resides on the HPSS at NCAR and, until recently, has presented some hurdles to access. Now, however, a significant portion of the archive has been published through the Earth System Grid (ESG), a web portal facilitating browsing and acquisition. Users may now see and download contents without the need for an NCAR computer account or computer resources. Although a registration is required, the ESG gives users a login, and it accommodates different ways to pull files.

Moving forward, the most recent AMPS forecasts will periodically be added to the published contents and thus made available for download. The ESG portal greatly facilitates access to the AMPS archive for all, and potential users are encouraged to explore it through <http://www.earthsystemgrid.org/project/amps.html>.

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