THE ANTARCTIC MESOSCALE PREDICTION SYSTEM – 2023 UPDATE

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1. INTRODUCTION

The Antarctic Mesoscale Prediction System (AMPS) is as real-time, experimental, numerical weather prediction (NWP) system providing tailored NWP products for Antarctic weather forecasters. AMPS is funded by the National Science Foundation Office of Polar Programs (NSF-OPP) to support forecasters for the US Antarctic Program (USAP).

AMPS uses two NWP models for its forecasts, the Weather Research and Forecasting Model (WRF) and the Model for Prediction Across Scales (MPAS). The development of both models is led by the National Center for Atmospheric Research – Mesoscale and Microscale Meteorology Laboratory (NCAR/MMM). The WRF model has been the principal forecast engine in AMPS since 2008; the WRF version used in AMPS makes use of selected polar-specific modifications developed under the Byrd Polar and Climate Research Center/Ohio State University (BPCRC-OSU) Polar-WRF effort. The newer MPAS model is being evaluated, and MPAS configurations are being developed, for application to the Antarctic.

AMPS real-time NWP products are available on the AMPS web page:

https://www2.mmm.ucar.edu/rt/amps

Given the real-time online availability of products, AMPS data have been used by forecasters for the Antarctic programs of many countries. While NSF and USAP interests remain the first priority for AMPS, we welcome the opportunity for collaborations with international partners as resources and personnel time allow.

Other features of AMPS include an ensemble forecast that can give forecasters a sense of the forecast uncertainty, and a 20-year archive of AMPS model output fields that have been used for a variety of retrospective studies of Antarctic weather and NWP. AMPS has also supported a number of field programs, providing customized products for sites of interest, often from high-resolution nests run for limited periods.

2. NEW PRODUCTS

AMPS benefits from a close interaction with USAP forecasters, who periodically offer suggestions and ideas for new AMPS products that can help them in their critical forecast mission. Here we introduce a sample of new products implemented over the past year.

a. NOAA wave model fields

At the request of USAP forecasters, the AMPS web page now includes products derived from the NOAA WAVEWATCH III wave model. Information includes significant wave height, wave direction, and wave period, for selected AMPS plotting windows (Fig. 1).

Note that the WAVEWATCH III model is not coupled with AMPS in any way; it is run by NOAA for their own global and regional modeling efforts. AMPS does not have a wave model of its own, we simply access the wave model output as distributed by NOAA, and remap fields to selected AMPS grids for display. These products are therefore independent of the

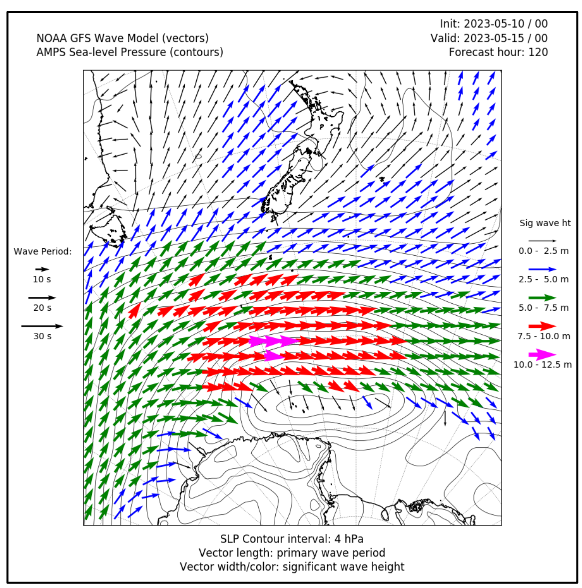

Fig. 1. Example of NOAA wave model output on AMPS Christchurch – McMurdo window.

AMPS representation of features such as storm systems and ocean surface winds that drive wave development.

b. Siple Dome cross sections

New vertical cross sections over Siple Dome have been added to the 2.67-km Ross Sea grid. The Siple Dome site has an active summer camp and fuel depot, and for some flight plans can serve as an alternate landing site. Moisture and clouds that can creep up the slopes of Siple dome represent significant forecast challenges. It is hoped that these cross sections can aid forecasters in identifying such events.

c. Directional visibility

AMPS horizontal visibility plots have been introduced in recent years. These plots represent the reduction in visibility in each model grid cell, but only considering the effects of microphysical species within that grid cell. However, forecasters were interested in seeing the directional variability of visibility from specific sites, representing effects that may greatly vary in the horizontal over several grid cells. A directional visibility product (example: Fig. 2) is now available for two sites, Phoenix airstrip and McMurdo Station.

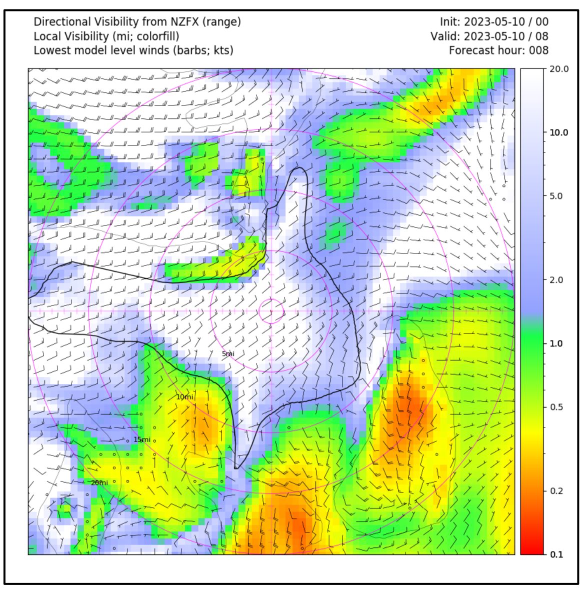

Fig. 2. Example of directional visibility plot from Phoenix airfield site. Color-fill represents the conventional single-grid-cell visibility computation; black outline represents the visibility limit reflecting the horizontal integration of visibility reduction in all directions from Phoenix airfield, at center.

d. Isentropic-level plots

Isentropic level plots are now included on the larger-scale AMPS windows (24-km Southern Oceans window and 8-km Antarctic continent window). See Fig.3 for an example. This chart may be further expanded to higher-resolution grids in the future.

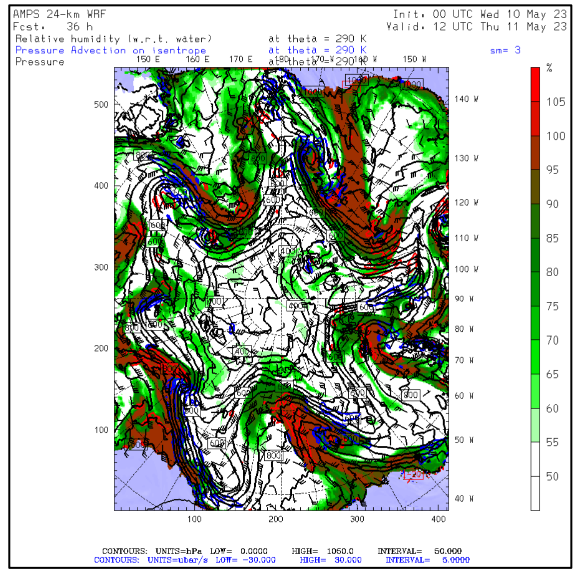

Fig. 3. Example of AMPS Isentropic-level chart, showing relative humidity, pressure, and pressure advection on the 290K isentropic surface.

3. MPAS DEVELOPMENTS

The AMPS implementation of MPAS now uses the Noah-MP land-surface model (LSM), instead of the Noah LSM. The developers of the Noah LSM have ceased development of Noah LSM, and have shifted their focus to the more configurable Noah-MP LSM. Noah-MP has heretofore not been available in MPAS, so AMPS has sponsored porting of Noah-MP into MPAS. When porting of an updated version of Noah-MP as been completed, we hope to contribute this code back to MPAS development and the wider MPAS community.

4. COMPUTING UPDATE

A new supercomputer, named “Derecho”, has been installed and is currently being configured and tested at the NCAR/Wyoming Supercomputing Center (NWSC). This machine, administered by NCAR’s Computational and Information Sciences Laboratory (CISL), will provide computing resources for the entire NCAR community; AMPS is but a small part of Derecho’s tasking. NSF-OPP has contributed funds to Derecho for the purpose of running AMPS; as a result, AMPS is provided with CPU cycles and a high-priority queue for real-time throughput of forecast model runs. The AMPS team also benefits from and is grateful for the full support of the supercomputing experts at CISL.

Derecho is expected to be available to AMPS (and the wider NCAR computing community) beginning in the (boreal) summer of 2023. It is expected that computing power available to AMPS will be two to three times what is currently available on the current NWSC supercomputer, "Cheyenne". Such a boost in computing capacity will enable AMPS to implement such upgrades as a more complete microphysics parameterization, an enhanced AMPS ensemble, and higher-resolution MPAS meshes.

Further details about Derecho may be found at https://www2.cisl.ucar.edu/computing-data/computing