

THE ARCTIC MM5 SYSTEM: CHARACTERISTICS AND A PRELIMINARY EVALUATION OF PERFORMANCE

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1. Introduction

Over the past year, we have initiated a collaborative effort with the National Weather Service and the Alaska Department of Transportation to develop a real-time system to ingest meteorological observations and provide a supplemental meteorological forecast capability within interior Alaska. The observations consist of not only those available routinely from National Weather Service (NWS) sites (both manned and automated), but also from supplemental networks established within Interior Alaska through a data-sharing agreement.

In this paper, we describe our efforts to date, including the design methodology of the system, its current configuration, some preliminary performance data, and plans for future development. While static imagery will be used for illustration in this paper, we hope to provide a demonstration of the various facets of the Web-based delivery system during the workshop.

2. Arctic MM5 Forecasts

The MM5 Forecast Products web page can be found at <http://knik.iarc.uaf.edu/AtmGroup/ForecastGraphics.htm>, and a sample is illustrated in Figure 1. Our version of MM5, dubbed the "Arctic MM5", includes changes to the model configuration reflecting work done at UAF, the National Center for Atmospheric Research, Ohio State University and the Air Force Weather Agency. Most notable are the inclusion of a coupled land surface model (the NOAH model; Mitchell et al, 2002), a coupled ocean mixed layer (Kantha and Clayson, 1994) and a thermodynamic sea ice (Zhang and Zhang, 2001) model, making the Arctic MM5 a true earth system mesoscale forecast model. Table 1 summarizes the current configuration of the model as of spring 2003.

In addition to this standard configuration, which is the standard for all real-time runs, we

also have implemented an experimental Arctic MM5 system which includes a AVHRR-based cloud initialization scheme (Fan and Tilley 2002) and experimental incorporation of MODIS data within our integrated in-flight icing algorithm, described later in this section.

Each of the names of the various forecast products (really MM5 native or postprocessed fields) is a clickable link. When activated, a new pop-up window will appear containing an information file in PDF format. These files are intended to help general scientific users of the site to better understand the nature of the particular forecast product in question. They should also be useful for members of the general public with some scientific background. The authors welcome feedback on these files and will make appropriate modifications as deemed appropriate from such feedback. One change that was made in direct response to such feedback was the inclusion of a direct link to Adobe Systems, Inc. site where a user who does not already have access to Adobe's Acrobat ReaderTM product can download a freeware version of the product in order to read the informational files.

It is also important to note that the domain designations on the MM5 Forecast Graphics page are also clickable links. Activating a link will result in the creation of a new pop-up window that shows a graphical depiction of the topography of the domain chosen, and, for all but the Alaska Region domain, a representation of the relative position of that domain with respect to the others, through a numerical key. The Alaska Domain is designated Domain 1 while the Interior Alaska domain is Domain 2. The Fairbanks Domain is designated Domain 3, and so on.

The hours that forecast products are available for a given domain are listed at the top of each column. All products are available as a series of plots, one for each forecast time listed, and can be accessed by clicking on the "click"

link for the particular product/domain combination desired. Some products are also available as animated loops by activating a "loop" link. In both cases, link activation results in a pop-up window being generated that contains either the series of graphical images or the animated loop. All graphical images available from this page are generated using the MM5 postprocessor *RIP* (Read, Plot, Interpolate) written by M. Stoelinga

Table 1: UAF Real-Time MM5 Configuration

Physical Process	Scheme Utilized
Cumulus Convection	Grell (1993)
Explicit Microphysics	Reisner <i>et al</i> (1998) mixed phase modified following Cassano <i>et al</i> (2001)
Radiative Transfer	CCM2 scheme modified following Cassano <i>et al</i> (2001)
Land Surface	NOAH-LSM (Koren <i>et al</i> 1999) implemented as in Zhang and Tilley (2002a)
Ocean	Kantha/Clayson (1994 mixed layer model)
Sea Ice	Zhang and Zhang (2001) thermodynamic sea ice scheme
Boundary Layer	MRF (Hong and Pan 1996) scheme
Data Assimilation	MM5 standard Newtonian Nudging (Stauffer and Seaman 1990)
Initialization	Operational Alaska version of the NCEP Eta Model with surface observation ingest
Postprocessing Algorithms	UAF IIDA (Tilley <i>et al</i> 2002); Skill score-based verification

of the University of Washington (Stoelinga, 2001).

In addition to standard MM5-type output variables, we have the capability of producing further diagnostics using a variety of algorithms, some of which are standard features of the *RIP*

package (e.g., the Flight Regulation category) and others which have been developed locally (e.g., precipitation category) or in conjunction with other investigators. The prime example of this latter type of product can be seen in the products designated *Icing Potential*, *Ice Type and SLD Potential*. These products are the result of recent work at UAF to adapt, for high latitude application, the NCAR/RAP icing algorithm (e.g., McDonough and Bernstein 1999) now utilized as CIP (current icing potential) by the Aviation Weather Center in Kansas City (M. Politovich, per. comm.). A description of our work to adapt the CIP as it is utilized here, as the so-called UAF Integrated Icing Diagnostic Algorithm (UAF IIDA) can be found in Tilley *et al* (2002). Here we summarize by noting that the UAF IIDA, in its diagnostic mode, incorporates surface observations and satellite observations from the GOES Imager and AVHRR sensors in addition to the MM5 output fields. In its forecast mode, the UAF IIDA is based solely on MM5 output. A sample plot of an *Icing Potential* product will be shown at the workshop.

We stress that all UAF IIDA-related products are still somewhat experimental at this stage and should not be relied on as official guidance. Such guidance is properly obtained from the Alaska Aviation Weather Unit (AAWU) in Anchorage. This fact is clearly stated on all our UAF IIDA-related pages, including direct hyperlinks to the AAWU site (<http://aawu.arh.noaa.gov>).

3. Arctic MM5 Performance and Validation

A thorough discussion of the real-time Arctic MM5 performance during its first year will be presented at the workshop. Here we simply note that many forecast quantities have been verified over an annual cycle against the respective analyses of the fields. Since early 2003 we have been beginning to verify predictions of surface quantities, particularly precipitation, against station observations as well. Samples of plots from our verification pages (accessible from the main forecast pages above) will be shown as part of the poster presentation.

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Welcome to the MM5 Forecast Graphics Page!



Current Run:
09/27/2002 18Z



Click below to see the most current forecast graphics

Click geographic region (domain) names to see terrain maps.

Click field names for text descriptions (PDF format). 

Fields	Alaska Regional (0-36h, every 6h)	Interior Alaska (6,12,18,24,27,30h)	Fairbanks Region (9-24h, every 3h)	Anchorage Region (9-24h, every 3h)	Barrow Region <i>New!</i> (9-24h, every 3h)
Icing Potential	click loop	click loop	N/A	click	click
Icing Potential Cross Sections	click	click	N/A	N/A	N/A
Ice Type	click loop	click loop	N/A	N/A	N/A
SLD Potential	click loop	click loop	N/A	N/A	N/A
Freezing Level	click loop	click loop	N/A	N/A	N/A
Estimated Flight Regulation Category	click loop	click loop	N/A	N/A	N/A
Surface Temperature/Wind Vectors	click loop	click loop	click	click	click
Precipitation Category	click loop	click loop	click	click	click
6 Hr Accumulated Total Precipitation	click loop	click loop	click	click	click
Surface Temperature/Sea Level Pressure	click loop	click loop	click	click	click

Figure 1 Sample of the upper half of the MM5 Forecast Graphics page discussed in text. Several fields are omitted from the lower part of the figure for clarity and legibility. See discussion in section 3.5.2 for details.