Surface Dust Flux Model Test Plan

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1 Introduction

The Surface Dust Flux model uses MM5 forecasted surface winds to estimate the rate at which ground level dust is being produced from source areas within a mesoscale theater. Surface dust fluxes vary in desert regions from 10 – 100 μgm/m^{2}-s for small to moderate fluxes, and 500 to 2000 μgm/m^{2}-s or more under dust storm conditions.

The model uses MM5 forecasted wind fields, estimated precipitation as input. As a proxy for soil moisture, precipitation data is used to suppress dust generation where there has been significant rainfall. The dust flux is calculated at each MM5 model grid location (~45 km intervals) in the mesoscale theater. The flux is calculated using forecasted 10 meter wind speeds and the dust source database model developed by Dr. Paul Ginoux at NASA GSFC/GIT.

The dust model can make forecasts for 2 MM5 mesoscale regions covering Northern Africa and the Middle East (T9z) and Southwest Asia (T4y). The surface dust fluxes are displayed as regional maps with color overlays showing dust fluxes in μgm/m^{2}-s. The user should note that this model does not forecast the transport of dust in the atmosphere or local dust concentrations. It only makes a prediction of the rate at which dust is generated at the surface.

2 Applicable Documents

Dey, Clifford H., The WMO Format for the Storage of Weather Product Information and the Exchange of Weather Product Messages in Gridded Binary Form as used by NCEP Central Operations.

Chin, M., Ginoux, P., Kinne, S., Torres, O. Holben, B. Duncan, et al., Tropospheric aerosol optical thickness from the GOCART model and comparisons with satellite and sunphotometer measurements, J. Atmos. Sci. June 2001.

Ginoux, P. Chin, M., Tegen, J., Pospero, B. Holben, O. Dubovik and S. J. Lin, 2001, Sources and global distributions of dust aerosols simulated with the GOCART model, J. Geophys. Res., 106, 24,698-24712.

Prospero, J., P. Ginoux, O. Torres, S. Nicholoson and T. E. Gill, Environmental characterization of global sources of atmospheric soil dust identified with the imbus 7 total ozone mapping spectrometer (TOMS) absorbing aerosol product, Reviews of Geophysics, 40, 1, February 2002.

3 Scope

The Surface Dust Flux Model test strategy divides the evaluation into two parts: 1) accuracy and correctness of computations and 2) general operation. The Surface Dust Flux Model test procedures will comprise tests of a selected set of cases that fully evaluate these parts. For completeness the test procedures are included in this document in Appendix B. The test procedures and the requirements cross-reference matrix will also be included in the *Surface Dust Flux Model Test Report*, a UPOS deliverable document.

3.1 Accuracy and Correctness of Computations

The Surface Dust Flux Model software uses MM5 data as input. To verify that the UPOS version of the Surface Dust Flux Model software duplicates the accuracy and correctness of the original APL version, the UPOS software will be executed using the same data and the output results compared.

3.2 General Operation

The Surface Dust Flux Model software must read MM5 data and generate flux emission maps as GIF images for output. Program execution is controlled via an executive script to generate the desired output results. Tests will be executed to ensure that the proper normal outputs are generated given the proper inputs. In addition, the executive script and Surface Dust Flux Model software will be tested for the correct identification and output of error messages given erroneous input or configuration, e.g., failure to find parameter input files.

4 Test Configuration

The Surface Dust Flux Model software will be installed on the UPOS/SWXS User Support System. The software will execute on the UPOS/SWXS User Support System and remotely access a copy of the input parameter files located on the UPOS/SWXS Development System. Output text will be written to the UPOS/SWXS User Support System.

5 Resources

The following resources are necessary for proper operation and completion of the tests:

- Specific input MM5 files must reside on the UPOS/SWC Development System.

- A graphical viewer tool that can display the gif image files.

6 Reporting Requirements

A test report will be produced containing a copy of the as-run procedures with pass/fail indications.

APPENDIX A: Acronyms and Abbreviations

AACGM	Attitude Adjusted Corrected Geomagnetic
AFCCC	Air Force Combat Climatology Center
AFOSR	Air Force Office of Scientific Research
AFRL	Air Force Research Laboratory
AFSCN	Air Force Satellite Control Network
AFSPACECOM	Air Force Space Command
AFSWC	Air Force Space Weather Center
AFWA	Air Force Weather Agency
AFWIN	Air Force Weather Information Network
AF/XOW	Air Force Director of Weather
APL	Applied Physics Laboratory of Johns Hopkins University
ASCII	American Standard Code for Information Interchange
ASPAM	Atmospheric Slant Path Analysis Model
AVHRR	Advanced Very High Resolution Radiometer
AVN	Aviation Model
AVO	Alaska Volcano Observatory
BATS	Biosphere-Atmosphere Transfer Scheme
CLASS	Canadian Land Surface Scheme
COE	Common Operating Environment
DII	Defense Information Infrastructure
DMSP	Defense Meteorological Satellite Program
ECMWF	European Center for Medium-Range Weather Forecasts
FAC	Field Aligned Currents
FNMOC	Fleet Numerical Meteorology and Oceanography Center
FSL	Forecast Systems Laboratory
FTP	File Transfer Protocol
GI	Geophysical Institute
GIC	Ground Induced Currents
GIF	Graphic Interchange Format
GIT	Georgia Institute of Technology
GMT	Generic Mapping Tools
GOLD	Geophysical On-Line Data
GRIB	Gridded Binary
GSFC	Goddard Space Flight Center
HLBL	High Latitude Boundary Layer
IDL	Interactive Data Language
IMF	Interplanetary Magnetic Field
JHU	Johns Hopkins University
LAN	Local Area Network

LAPS	Local Analysis and Prediction System
LSM	Land Surface Model
MM5	Fifth Generation Mesoscale Model
NASA	National Aeronautics and Space Administration
NCAR	National Center for Atmospheric Research
NCEP	National Centers for Environmental Prediction
netCDF	Network Common Data Form
NGDC	National Geophysical Data Center
NGM	Nested Grid Forecast Model
NOGAPS	Navy Operational Global Atmospheric Prediction System
NWP	Numerical Weather Prediction
OWS	Operational Weather Squadron
PACE	Poloar Anglo-American Conjugate Experiment
PBL	Planetary Boundary Layer
PCA	Polar Cap Absorption
PFRR	Poker Flat Research Range
SABER	Sounding of the Atmosphere using Broadband Emission Radiometry
SD	Space Department of the Applied Physics Laboratory
SDP	Software Development Plan
SEC	Space Environment Center
SEE	Solar EUV Experiment
SEON	Solar Electro-optical Observing Network
SFOC	Spaceflight Operations Center
STP	Solar Terrestrial Physics
SWOC	Space Weather Operations Center (Offutt)
SWXS	Space Weather Squadron
Tcl	Tool Command Language
Tk	Toolkit
Tix	Tk Interface Extension
UAF	University of Alaska, Fairbanks
UCAR	University Corporation for Atmospheric Research
UPOS	University Partnering for Operational Support
UTC	Coordinated Universal Time
WDC	World Data Center
WF	Weather Flight
WMO	World Meteorological Organization
XDR	External Data Representation

APPENDIX B: Test Procedures

1 Accuracy and Correctness of Computations

1.1 Surface Dust Emission

Objective: Verify that the program calculates the surface dust emission.

Setup:

1. Provide input MM5 data files that have valid MM5 data.
2. Run the existing APL version of the program and produce results for purposes of comparison.

Procedure:

1. Run Surface Dust Flux Model software and verify that the program correctly calculated surface dust emission by inspecting the output in the .gif files produced by the Surface Dust Flux software against results generated by the APL version of the program.

Results:

Pass/Fail: Program results must agree with the APL version.

2 General Operation

2.1 Input Files

2.1.1 No input parameter files

Objective: Verify that the program detects lack of input parameter files (*dust_startup.txt*), reports an error message, and terminates gracefully.

Setup:
1. Remove the input parameter files from the setup directory located in the base installation directory.

Procedure:
1. Run the program and verify by inspecting the error window that the program correctly reports no setup file exists.

Results:

Pass/Fail: Program must produce an error message describing the problem.

2.1.2 Insufficient MM5 data

Objective: Verify that the program detects insufficient MM5 data, reports an error message, and terminates gracefully.

Setup:
1. Remove the MM5 data files from the input directory (indir) which is set in *dust_startup.txt.*

Procedure:
1. Run the program and verify by inspecting the error window that the program correctly reports missing MM5 data.

Results:

Pass/Fail: Program must produce an error message describing the problem.

2.2 Output Files

2.2.1 Create all requested output files

Objective: Verify that the program produces the proper set of output files.

Setup:
1. Execute the program given valid input parameter files, valid input parameters, and valid MM5 data.

Procedure:
1. Run the program and verify by inspecting the output files that the program correctly produces results for the date specified.

Results:

Pass/Fail: Program must produce a complete set .gif images.
1. There should be no error messages displayed in the error window.
2. A set of gif images containing surface dust emission should be generated reflecting the user's input parameters.

2.2.2 Accept Parameters via a GUI Interface

Objective: Verify that the program accepts MM5 data and analyst parameters via a GUI interface.

Setup:
1. Execute the program given a valid input parameter files, valid input parameters and valid MM5 data.

Procedure:
1. Run the program and verify by inspecting the output files that the program correctly produces results for the parameters entered.

Results:

Pass/Fail: Program must accept all input parameters entered by the user.
1. There should be no error messages displayed in the error window.
2. A set of gif images containing surface dust emission should be generated reflecting the user's input parameters.

Appendix C - Requirements Cross-Reference Matrix

Verification methods are (A) analysis, (I) inspection, (D) demonstration, and (T) test.

Requirement Paragraph	Test Procedure Paragraph	Verification Method
2 SDFM Process		
2.1 Functional Requirements		
2.1.1 process MM5 gridded binary weather data	1.1	T,D
2.1.2 process 24 consectuive MM5 weather forecast files	1.1	T,D
2.1.3 generate color maps showing the surface dust emission	1.1	T,D A
2.1.4 store the flux emission maps as GIF images	1.1	T,D,
2.2 Interface Requirements		
2.2.1 ingest MM5 data	2.1.1	T
2.2.2 write the SDFM gif output file	2.2.1	T,D
2.2.3 accept MM5 Data and analysis parameters via a GUI interface	2.2.2	T,D
2.3 Operational Requirements		
2.3.1 run under the Solaris operating system on a SUN workstation		D
3.3.2 begin execution upon direction of the user		D