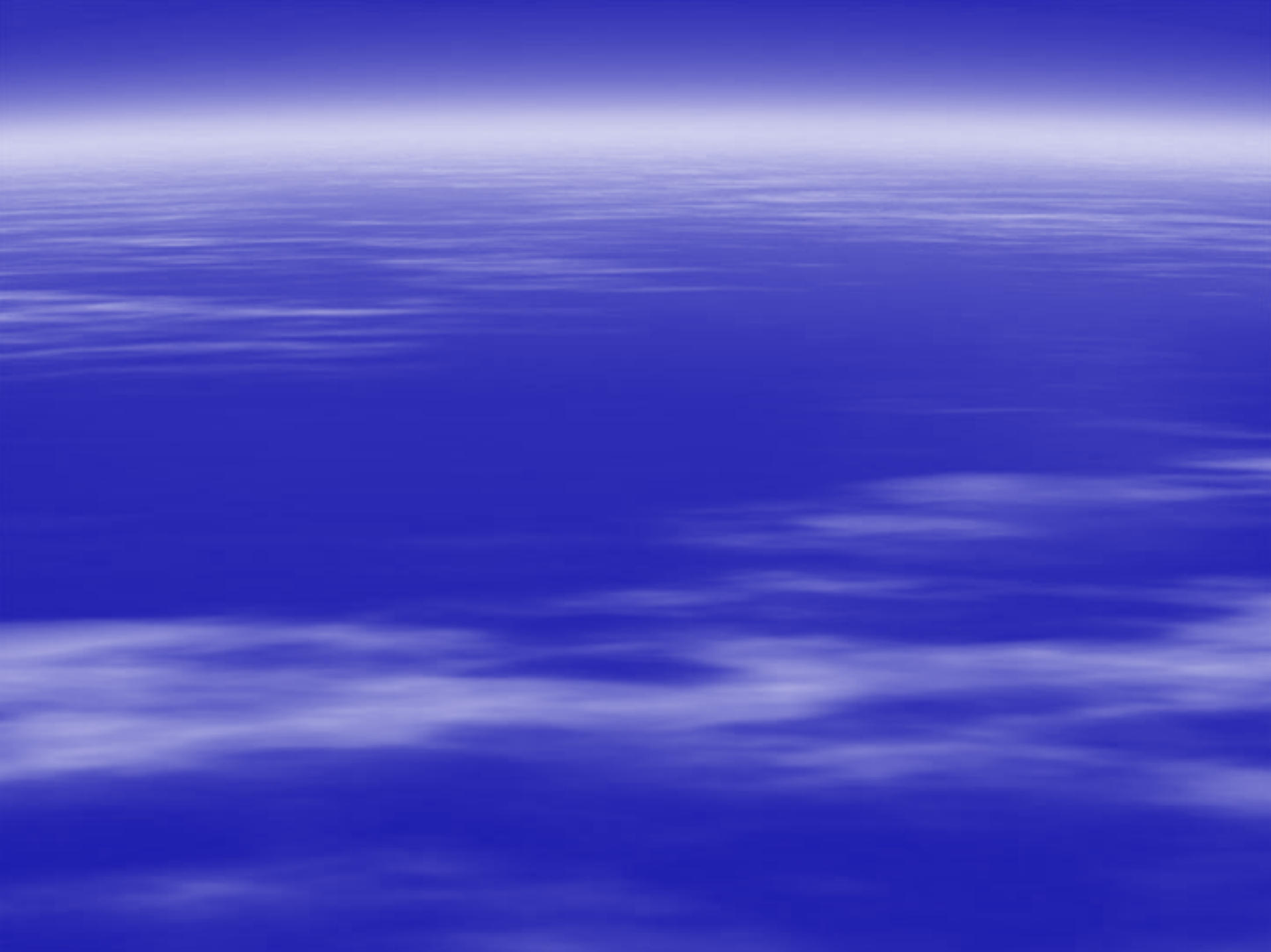


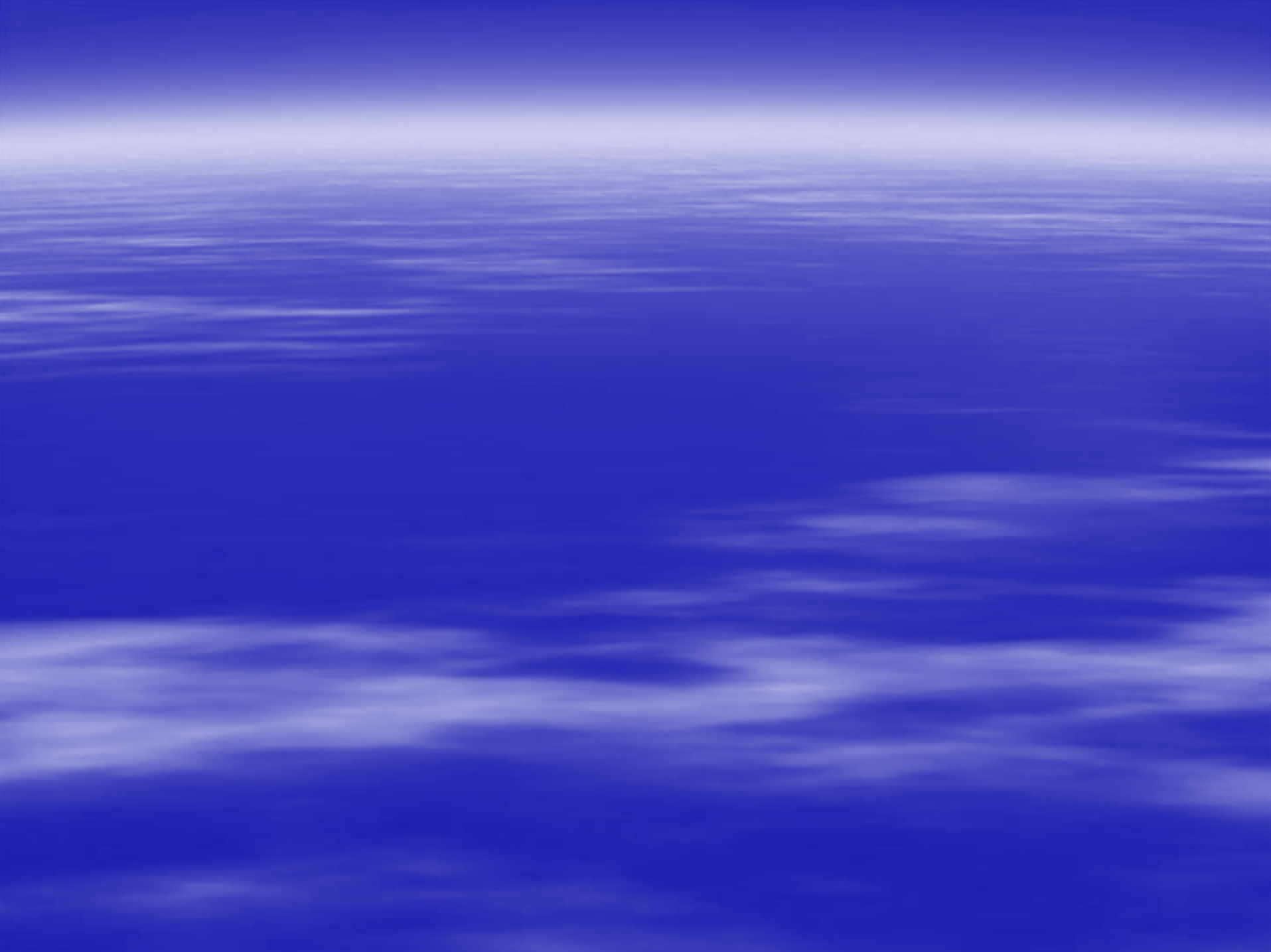
Gridded Met. Data Workgroup

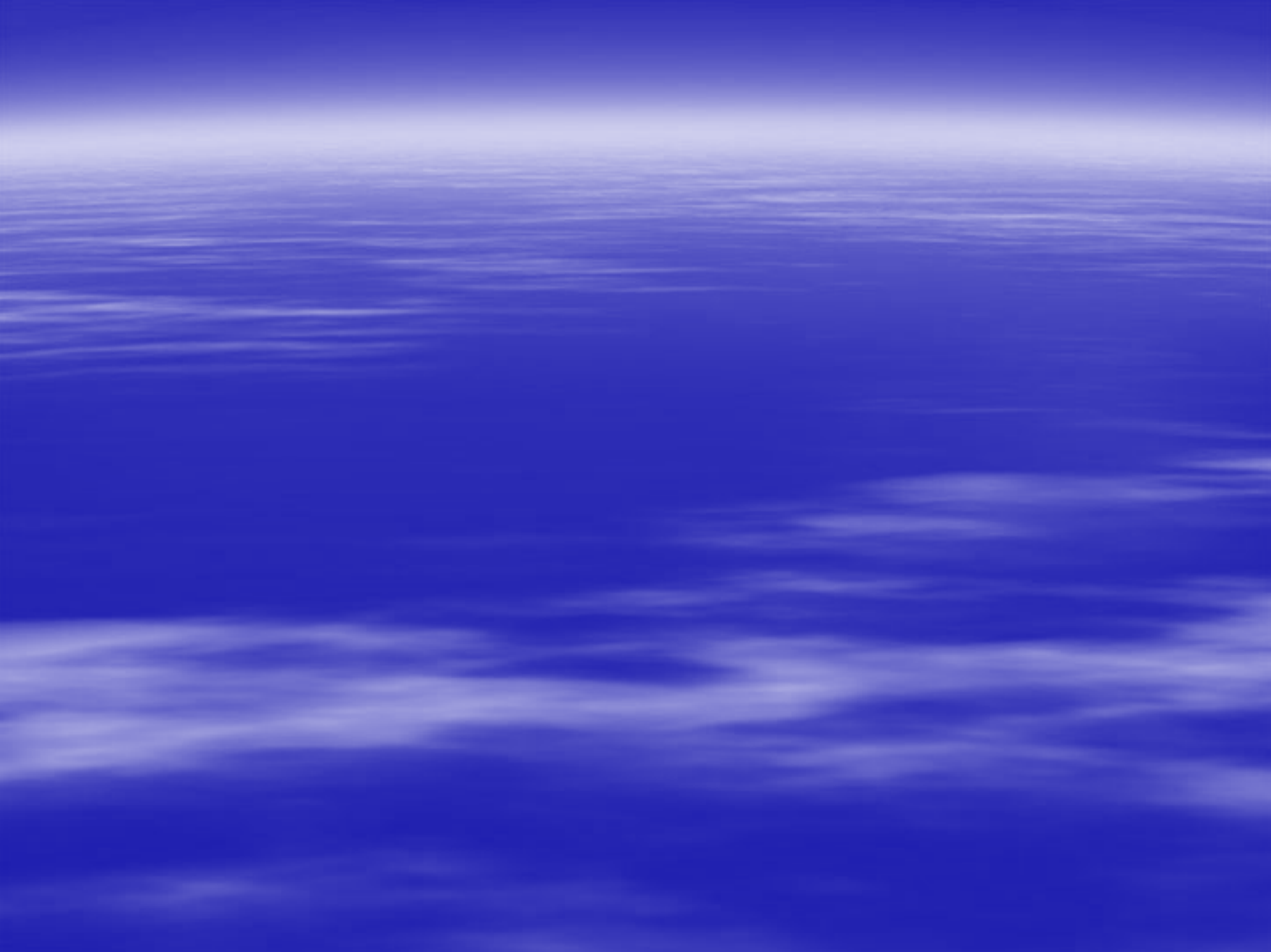
R/S/L Modelers Workshop New Orleans, LA

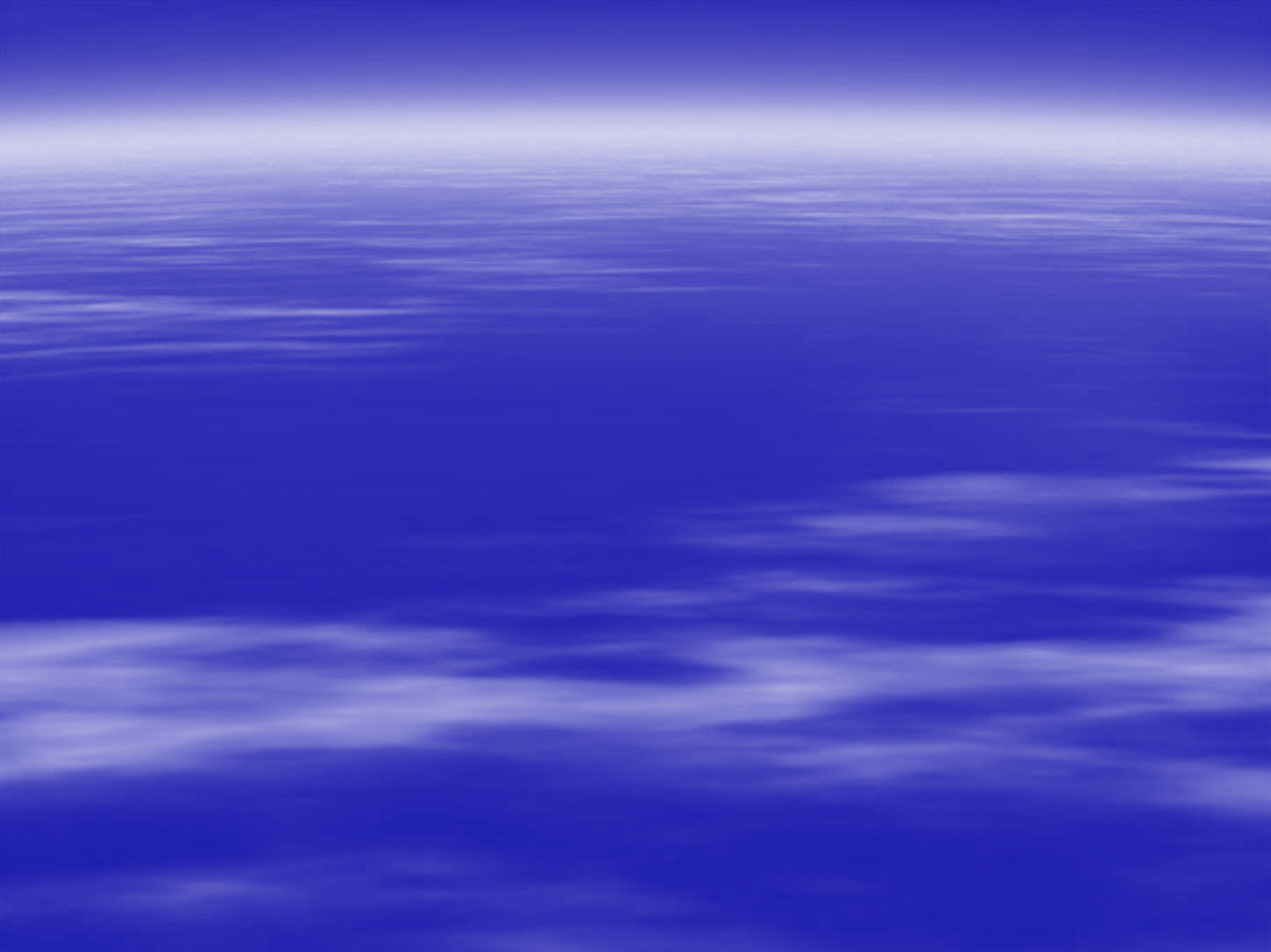
Dennis Atkinson

May 17, 2005









Outline

- Background
- Gridded Met. Data Project (CALPUFF & AERMOD)
- Gridded Met. Data Workgroup
- New Developments in NOAA/NCEP Products

Background

- ~1998 – “Irwin’s world”...requests initiated in AQMG budget for seed money for incorporating gridded meteorological data into dispersion models
- 2004 – Renewed interest in “Irwin’s world” ideas, including gridded meteorological data
- Sept. 2004 – Meteorological Team formed (under Mark Evangelista)

Background

- Why use gridded met. data?
 - NWS surface and upper air sites often not co-located
 - more representative than distant NWS site
 - overcomes limitations of ASOS data
 - state-of-the-science product (cloud physics, land/air moisture exchange, spatial density)
 - NOAA approved (NCEP); accepted by the modeling community (MM5)

Background

- Advancement of science at EPA
 1. CAAAC (Clean Air Act Advisory Committee) – references to using more advanced tools for air quality modeling and pairing national/regional scale with more local scale modeling
<http://www.epa.gov/air/caaac/report1-17-05.pdf>

Background

- Advancement of science at EPA
- 2. National Academy of Science (NAS) – suggests that models in a 4-dimensional data assimilation mode would provide superior air quality forecasts in the future

http://www.nap/edu/openbook.php?record_id=10728&page=239#pagetop

Background

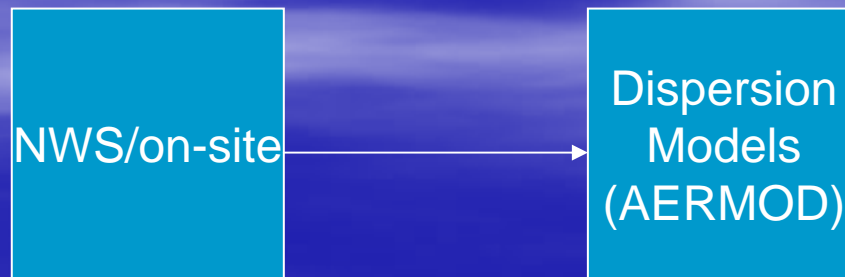
- Which gridded met. product should be used?
 - GFS (Global Forecast System) – used for aviation, 00 06 12 18Z (95km grid)
 - ETA – regional mesoscale model, 00 06 12 18Z (12km grid)
 - NARR (North American Regional Reanalysis) – every 3 hrs (32km grid)
 - RUC (Rapid Update Cycle) – every 3 hrs (20km)
 - MM5 (PSU/NCAR Mesoscale Met. Model) – available 36km, some 12/4 km domains; hourly

Background

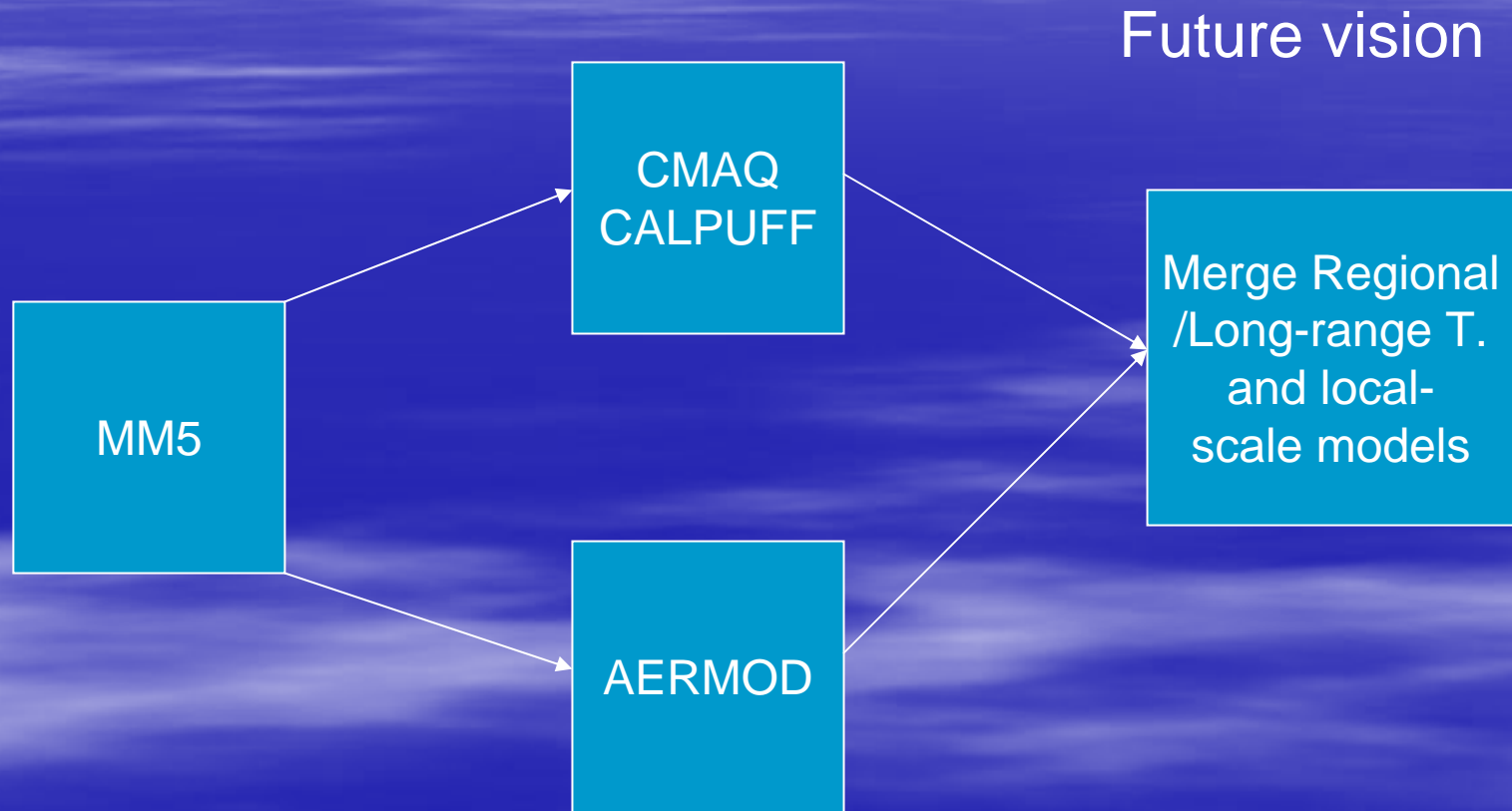
Regional & long-range transport scale models – uses MM5 data



Local-scale models -- uses NWS or on-site data



Background



Background

- Discussions within AQMG – be the leader in applying innovative techniques to air dispersion modeling
- Informing EPA management....
 - Tyler Fox – internal AQMG meetings
 - Peter Tsirigotis – briefing
 - Steve Page – March 24th briefing

Background

- OAQPS Innovations Project submission --
“Developing the Capacity to Convert Routinely Available Meteorological Modeling Data into Inputs for Regulatory Air Quality Modeling Applications”March 25th
 - funding possibility – results in late May

Background

- Internal training -- Tanya Otte (ORD/NERL)
April 13, 2005
 - provided scripts/information on MM5 extractions used on internal (EPA) data
 - resident MM5 expert

Gridded Met. Data Project

GOAL: Incorporate/assess gridded met. data into dispersion modeling world

STEPS:

1. MM5 into CALPUFF

- currently accepts MM5 via CALMM5; soon CALRUC, CALETA
- educate/learn how MM5 is processed through CALPUFF to apply similar procedures to AERMOD
- run MM5 (36 and 12km) and NWS data through CALMET and analyze results
- run processed MM5 (36 and 12km) and NWS data through CALPUFF and analyze results

Gridded Met. Data Project

2. MM5 into AERMOD

2-parts:

- (1) using current variables needed by AERMET from MM5 to drive AERMOD
- (2) utilizing additional variables available from MM5 to improve the physics within AERMOD

Gridded Met. Data Project

- MM5 into AERMOD (Part 1)

- process MM5 for a single grid cell and NWS data into AERMOD (AERMOD will not be modified to accept more than a single grid of data)

- run AERMET using MM5 and NWS data and analyze results

- run AERMOD using MM5 and NWS data and analyze results

Gridded Met. Data Project

- MM5 into AERMOD (Part 2)
 - utilize new variables available within MM5 to enhance current physics by modifying AERMET/AERMOD, as needed
 - run “modified AERMET” using MM5 vs. NWS and analyze results
 - run “modified AERMOD” using MM5 vs. NWS and analyze results

Gridded Met. Data Project

3. RUC,ETA,WRF into AERMOD,CALPUFF

- software needed to convert RUC, ETA, WRF for input to AERMET and CALMET (CALRUC, CALETA coming soon)
- run RUC, ETA, and WRF through AERMET and CALMET; analyze results and compare with MM5
- run AERMOD and CALPUFF using RUC, ETA, and WRF-driven gridded data; analyze results and compare with MM5

Gridded Met. Data Workgroup

Thanks to all who participated,
emailed, provided information!

Members

- Regional Offices
 - Bret Andersen (R-VII)
 - Herman Wong (R-X)
- Fisheries and Wildlife Service
 - Tim Allen
- States
 - many states
- Canada – British Columbia
 -

Activities

- Formed in late February
- 4 productive workgroup calls; email exchanges
- Primary Focus - 7 issues related to gridded met. data
- Survey – State's experience with gridded met. data

Issue #1

- Identify additional meteorological parameters available from the gridded output that would be useful in AERMOD.
- Turbulent Kinetic Energy (TKE) – AERMOD currently uses similarity theory for CBL
- Vertical velocity – potential replacement for convective velocity scale

Issue #1

- PBL Height – profiling is current used (for wind speed, wind direction, potential temp. gradient, potential temp., etc.)
- PBL regime (category, 1-4) – w/PBL height
- Surface sensible heat flux – currently used
- Surface latent heat flux – currently used
- Terrain elevation – currently used; important to determine the dividing streamline in complex terrain

Issue #1

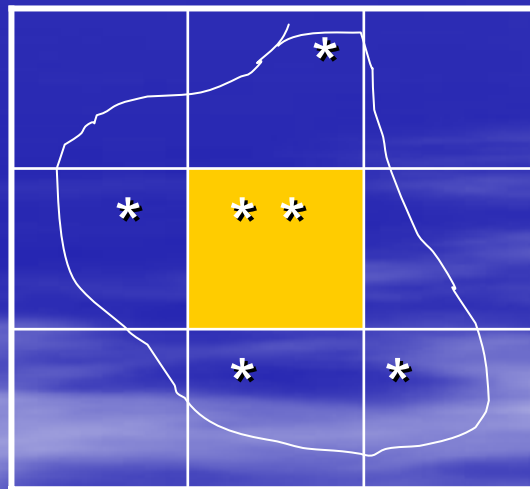
- Land-use category – caution is needed when using MM5 LU information; LU is averaged within a grid cell (and nudged), so local variations will not be captured; smaller grid scales pick up more details

Issue #2

- Multi-grid source fields. How would a single met. source model handle met. data from multiple grid cells?
- Make multiple runs for the sources within each grid cell; add the results together in space and time...labor intensive

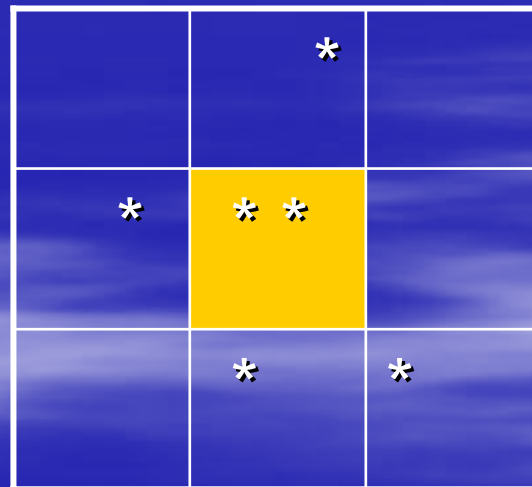
Issue #2

- Use the center grid cell for the source group.



Issue #2

- Interpolation of grid cells...a interpolation scheme would be necessary, i.e. requires a weighting calculation for each grid cell



Issue #3

- Is on-site data necessary if grid cell data is used?
- On-site data captures local-scale phenomenon that does not get resolved by even higher resolution gridded met. data, such upslope/downslope winds, sea/land breezes, mountainous terrain areas, etc.

Issue #3

- Gridded data has been nudged to create a flowing regime.
- When gridded met. data get resolved to 4km or less, then this issue will probably need to be revisited.
- **On-site data is useful/necessary for the foreseeable future.**

Issue #4

- Issues with “data representativeness”?
 - If local (sub-grid scale) effects are important, it may be necessary to incorporate local data (NWS/on-site)
 - Studies show the spatial resolution of MM5 is 3 to 5 times the grid spacing (4km grid can resolve features with a wavelength of 20km); WRF has a resolution of ~3X grid

Issue #4

- Sensitivity tests – necessary to compare gridded met. data with traditional NWS data; done NOT to prove which is better but to explain the differences
- Number of years to be used – currently 3 years has been used (due to data availability) for applications using gridded met. data...5 years should be used when available

Issue #4

- Grid spacing requirement – lower grid resolution captures more local effects

36km - resolves met. features from 108km (3x) to 180km (5x) km in wavelength;
common with current NWS configurations

12km - resolves 36km (3x) to 60km (5x)
(4km - resolves 12km (3x) to 20km (5x))

Issue #4

- Complex terrain -- western states would likely need resolution of 1km to adequately capture the Rockies, bluffs, gorges, etc.
- Fenceline concentrations -- 12km grid resolution should capture sufficient detail to use for NAAQS, PSD, toxics, etc. modeling

Issue #5

- Known shortcomings of current gridded modeling input and their impact...precip. inconsistencies, lack of calms (very few), etc.
- Fewer calms -- then...steady-state models (AERMOD) will use more hours to calculate concentration estimates

Issue #6

- If given the choice, where would we want the gridded data to reside?
- Data should be readily available, regardless of its physical location; URL(s) available on SCRAM
- Data tools should be provided by EPA
- Data for modeling should be public domain

Issue #7

- Logistical issues, such as computer resources of users, acquisition of data, file sizes, etc.
- Dissemination of large files – use the same technique that NCEP uses...tiling
- Data should be easily accessible

Issue #7

- Gridded met. data should be unaltered from its data source after extraction (CALPUFF has adjustment methods to input multiple data sets)
- All data should be public-domain data (not proprietary)
- Data portability is important; data should be usable by multiple models (1 atmosphere)

Gridded Met. Data Survey

- 20 of 50 States reporting....
- 3 pieces of information:
 1. Gridded Met. Data used/dates
 2. Source of data
 3. Other relevant information
- 12 “Some experience” , as inputs to CALPUFF
- 8 “No experience”
- No response...many with no experience
- Email for copy of survey results

Other Issues

- Education -- many States have not used gridded data; assistance in learning needed
- Partnering – on-going dialogue from OAQPS to Regional and State offices, FWS, NPS, and others



2005 NOAA Data and Information Users' Workshop

11-13 May 2005
Asheville,
North Carolina

Availability of NCEP Products

- National Climatic Data Center – archives GFS, ETA (NAM), RUC data starting in 2002
- NOMADS – NOAA Operational Model Archive and Distribution System; collection of portals to data
- <http://nomads.ncdc.noaa.gov/data-access.html>

Latest NOAA Developments

- RUC...20km to 13km (June 2005)
- WRF...initial storage by NCDC ~April, 2006
- CLASS (Comprehensive Large Array data Stewardship System) – IT tool for archival and access to NCEP products; volume to 100 Petabytes by 2015
- MM5 storage by NCDC – possibility in the future

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Thank You!