

# Objectives of the Workshop

- ✓ To obtain an overview of the current operational air quality forecasting tools and their requirements, including measurement needs
- ✓ To obtain an overview of the current status of relevant research that can be expected to improve operational models in the next few years
- **To develop recommendations for the direction of improving air quality forecasting**
- **To present the above information in such a way that it is useful for NMHSs that are starting or developing their air quality forecasting activities**

# Why Forecast Air Quality?

- Provide information to the public *operationally* to help them better manage their health and welfare (heat stress, comfort, pollen, flight operations, large scale pollution/fire events, safer more effective conditions to apply chemicals)

# Why Forecast Air Quality?

- Strategic issues – if weather services don't do it others certainly will !
- Weather infrastructure is invaluable – measurement, models, assimilation expertise.

# Charge to Working Groups

- Identify research needs and priorities to advance air quality forecasting capabilities.
  - 1) Underlying science perspective - What are the science issues that need to be addressed to advance our capability to forecast air quality?
  - 2) Operational perspective – What are the major issues/barriers to providing air quality forecasts? ---- methods, verification, measurements, dissemination.....

***Breadth of perspectives sought -- from those with on-going efforts and those with interests in initiating and/or expanding activities.***

# Identified Key Science Issues

- Scale
- Local Winds
- Measurements
  - Meteorology
  - Chemistry
- Processes
- Chemical Transformations, Models
- Emissions
- Uncertainty

# Identified Key Operation Issues

- Reasons for forecasting (Why)
- Barriers to forecasting
- Monitoring Networks Needed to Support AQF
- Dissemination of AQF
- Developed vs. Developing Country Needs
  - Capacity Building
  - Pilot Projects

# Is a prognostic air pollution forecasting system worth the considerable effort?

## Why not a use a statistical forecasting system?

- + Are spatial and temporal information needed from the forecast?  
(e.g. hour-by-hour, suburb-by-suburb)
- + Support air quality management & policy development? (e.g. VOC controls)
- + Are monitoring data limited?  
(no extensive network)?

# Need to Gain Experience

- ✚ The Australia experience: started with a trial version of System
- ✚ Problems in joining models
  - Mass conservation easy to disturb!
  - Turbulence schemes mis-match in NWP, CTM
  - Errors in code for vertical advection
- ✚ Substantially wrong VOC budgets
  - Boundary conditions for VOC difficult
- ✚ Particle inventory and weather-dependent emissions fraught with difficulties



# Levels of Complexity

1. Embedded in a operational National Weather Forecasting System – AAQFS
2. Extension of Numerical Weather Forecasting Capability – *e.g.*, Beijing
3. NMHS seeking to develop both a national numerical weather and pollution forecast – Malaysia?
4. NMHS focussed on forecasting air pollution for a limited region – is this you?

# Judging Performance

- ✚ Daily verification against monitoring data important
- ✚ Adequate spatial resolution fundamental
- ✚ Australian cities isolated, so mostly a test of the science, but data assimilation important
- ✚ Use case studies
- ✚ Use statistical tests of performance
- ✚ Use qualitative information too
- ✚ Data management issues are substantial

# The Need for High Resolution

- + Leads to improved weather forecasts
  - Changes in space and time important
- + Necessary to resolve regional flows
  - For air pollution, wind *trajectory* vital
- + Boundary layer must be resolved
  - For air pollution levels, *mixing height* vital

# Working Group Identified Issues (summary)

- + Emissions Inventories *must* be validated – our biggest problem
- + Wind-blown dust, other particle sources, difficult – effort by Met. Service of Canada commendable
- + Timeliness and quality of air pollution monitoring data are vital for warm starts (assimilation)
- + Simple chemistry adequate for urban ozone forecast, not for secondary aerosol, other reactive chemicals
- + Routine verification of forecasts against monitoring data important for identifying weaknesses
- + Backgrounds/domain-size an issue elsewhere
- + Cooperation between Agencies is important
- + Uptake by others is slow – patience!

# Support AQ Management, Policy

- + Detailed knowledge of emissions is *required* for Policy actions
- + An AQFS will exercise the inventory like no other means!
- + Collaboration with other Agencies leads to success

# Plenary Workshop Summary

- There is growing experience and interest in air quality forecasting.
- There are a variety of tools for forecasting air quality.
- Improvements in air quality forecasting will come from:
  - Increasing accuracy in the meteorological forecasts
  - The act of doing – increase experience needed
  - Improvements in emission estimates
  - Better understanding of key processes
- Simple models outperform complex numerical models at present.
- Urbanization of meteorological models needed to improve physical representation of weather at urban scales.

# Summary (continued)

- Resolution matters in many circumstances
  - But there are limits to when increasing resolution increases quality – we need to understand this better.
- Emissions are important but not a limiting factor.
- Tools commonly used to improve meteorological forecasts need to be explored in the air quality forecasting arena (e.g., data assimilation, ensemble forecasts, etc.)
- Satellites as a key element of air quality forecasting system is an important topic as they hold promise for providing key information that can be used anywhere around the globe.

# Summary (continued)

- Use of aircraft data (AMDAR)
- Research and operations are complementary activities
- Measurement needs to support operational air quality forecasting need must to be articulated – met, chem/aerosols, surface & vertical, etc.



# GURME's Roles—some things that are *already* being done!

- ✚ facilitate contacts, fora for sharing experiences, ...
- ✚ collate these experiences
- ✚ run a Web site for sharing information
- ✚ provide an international reference to support/give credibility for local efforts.
- ✚ capacity building
- ✚ future activities
  - expand pilot projects
  - regional workshops

