UK Air Quality Public Data Sources and the Olympics

Background: There are a range of data providers in the UK providing air quality data to the public through a variety of media including websites, apps, text services and twitter. With the Olympics approaching and a likely increased focus on London's air quality, it is anticipated that data providers may be asked to explain why different data sources do not always provide the same forecast or observation. Considering forecasting and latest data services separately, there is a simple and rational explanation as to why forecasting services do not always predict the same levels; use of different models, inputs to models and approaches to post processing and dissemination will all have different attributes. These differences are worth discussing to compare and contrast approaches. For latest data, it is important to understand how these are generated and in particular how the daily air quality index is applied.

Objective of the discussion:

1) To review the extent of different products in existence and their different purposes:

2) To discuss, understand and agree on:

   a) the main reasons as to why differences in outputs from forecasting models will exist, and if possible, under what conditions these are most likely to occur.

   b) how the AQUM and CMAQ models compared within the regional group Phase 2 MIE exercise.

   c) the main reasons as to why differences in the latest air quality data may be seen from different information systems.

**Observations/Discussion points from Defra**

Comparison of inputs into models

- different emissions inventories/ inventory years
- different met inputs
- different approaches to boundary conditions

Which are likely to have greatest influence on outputs?

Other aspects on comparability of the different data sources:
- DAQI application for measured data and forecast data
- Forecast resolution- km: are those with more London monitoring stations and higher resolution modelling more likely to predict/measure higher bands?
- Pollutants: some not doing SO_2.
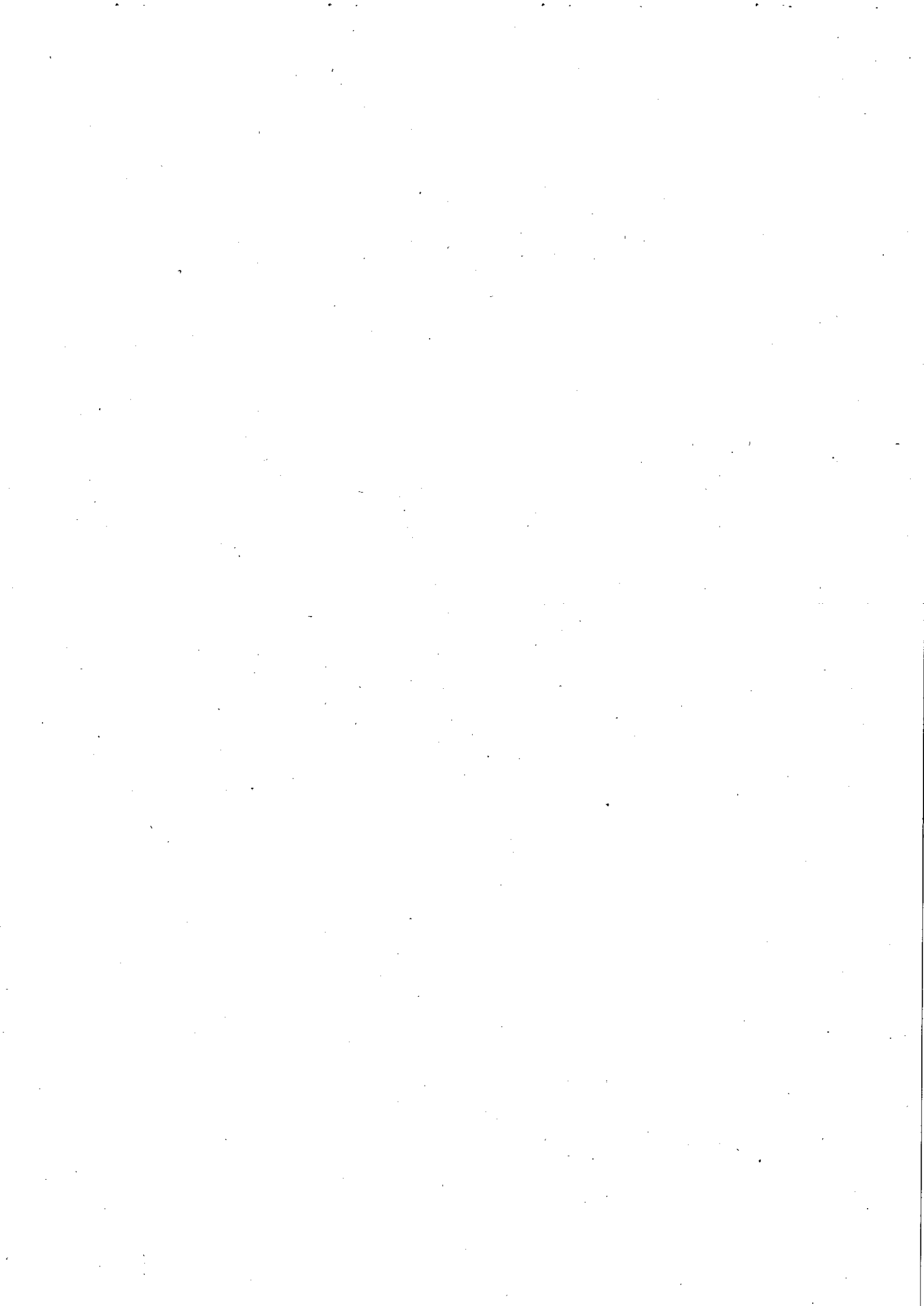
London 2012 Olympics UK/London Data Air Quality Sources and Details of Forecasting Models

This document provides a summary of UK/London air pollution information sources which will be available to the public during the Olympics. The first table lists products by organisation highlighting their purpose and key features. The second part of this document provides a detailed look at air quality forecasting models to understand the inputs and outputs.

Organisation	Product	Content	Purpose	Key features/similarities/difference from other products
Defra	UKAIR - Forecasts	UK forecasts from CMAQ Model for 16 regions displayed as a text summary and maps according AQ Index. 5 pollutants – PM2.5, PM10, O3, SO2 and NO2.	Inform public of air quality over next 24-48 hours. Used as key input to HPA Sit Rep.	Modelled forecast entirely separate from monitoring data. Doesn't incorporate triggers; looks further ahead at outlook and not the currently changing situation. Based on 24 hour running mean PM. During the Olympics will operate on a 2km resolution for London and South East. Usually a 10 and 50 km resolution.
Defra	UKAIR - Nowcasts	Monitoring Data from UK AURN Network - latest data, maps of regions by AQ Index for 5 pollutants: PM2.5, PM10, O3, SO2 and NO2 in realtime.	Inform public of latest monitored data across UK.	Index based on running 24 hour mean and not midnight to midnight daily mean for PM. Focus is on exposure at the time/over relevant retrospective averaging period – doesn't consider changing picture as triggers would. Using 24 hour running mean can lead to delays in communicating an episode, and can lead to a "worst case" reporting situation. Data from the previous day will affect averages and data displayed the following day. Intention is to use trigger values to improve

Organisation	Service	Description	Purpose	Notes
				the written messaging/warnings within the website to close gap between forecasts, measured data and communicating an episode.
				Data presented for individual stations and for 16 regions. Intra-regional differences beyond that at the monitoring station cannot be determine.
Defra	@DefraUKAIR twitter feed	Forecasts and latest monitoring data (nowcas) Proposals to include changing situation based on triggers too.	Inform public of latest forecast and monitored data across UK.	Based on the webcontent on UKAIR - no health advice tweeted.
Defra	Freephone information service.	Latest data, forecast and relevant health advice.	Based on information on UKAIR.	
KCL	Londonair.org.uk	The content of the London Air website is broad and varied. The website contains hourly 'dots on maps' maps as well as hourly Nowcast maps which model London's pollution to 20m resolution. The site also contains daily and annual dots on maps and modelled maps. The site contains DEFRA air pollution health advice in the guide section along with commonly asked questions. The site contains data download and a variety of statistical analysis tools. The site also contains 10 short videos on common aspects of air pollution and urban living and health. The site features regular news stories of ERG's	Used by public, researchers and local authorities to gain thorough understanding of all aspects of air pollution in London	'Dots on map' maps which all air quality sites feature. DAQI fully implemented on londonair. Most visibly this means some dots on the map have stripes which indicate they are predicted index levels. Site features modelled 20m resolution 'Nowcast' maps of whole of London both hourly and annual. These modelled outputs do not know about road closures during Olympics and will have disclaimer. Extensive data download, graphing and stats analysis tools. The Guide section and videos are distinct to londonair.
				Summaries of recent episodes and their causes are available.

		activities and recent pollution episodes.		
		A Olympics pages are being created within Londonair which mainly link to existing content. The current project plan includes dissemination of data to the WHO short-term guidelines to provide increased transparency for overseas visitors and forecasts from UK-Air.		
KCL	iPhone & Android apps	Apps are functionally identical to each other. Include hourly levels using DAQI for all sites in LAQN and Sussex network. Also included 'means' screen – averages of pollutants across each network. Users can drill down from authority to site to see individual pollutant & banding health info. All health advice taken from DAQI. Users can subscribe to receive free hourly notifications if sites or means change banding level. Phrasing of notifications for PM and O3 based on triggers includes word 'predicted'. App also includes map of London with monitoring site locations. Updated version to be released late May / June will include hourly & annual 'Nowcast' maps for NO2, O3, PM10.	Inform public of real time air pollution levels on LAQN and Sussex networks, links AQ levels to pollutants & related health advice. Provide access to AQ info while out and about. Provides notifications to users even when app is closed.	Midnight to midnight PM data – not rolling 24 hour mean. Triggers implemented as additional data source – represented by shading. Phrasing of notifications based on triggers includes the word 'predicted'. Includes COMEAP DAQI health advice. Includes London & Sussex networks for broad coverage. Will include Nowcast maps. Only dedicated London AQ mobile apps.
	m.londonair mobile site	Mimics design and UI of main part of iPhone and Android apps. Users can	To allow users of all mobile devices to	Shares graphics and UI elements with the apps, navigation & layout is the same as the apps.

Organisation	Product	Description	Purpose	Limitations
		drill down from authority to sites and pollutant/banding info. Does not include maps yet, does not include notifications. AS with apps & website, bandings based on triggers represented by striped badges.	access simplified version of notifications. / londonair, hourly updated AQ from across the LAQN	Does not include maps, does not include notifications.
	Google Chrome extension	Downloadable from Chrome web app store. Sits in browser address bar. Changes colour depending on highest level from any site on LAQN. Provides access to hourly updated AQ from LAQN sites. Separate tab gives access to COMEAP DAQI health advice. Health advice is separate, unlike in apps & mobile site. App provides notifications same as apps do, wording the same, graphics the same. All users automatically opted into notifications.	Many more people use browsers than have smartphones. People tend to spend more time in browsers during the day than smartphones.	Features similar although not identical navigation from authorities to sites and pollutant/banding health info. Shares same graphics, UI elements and notification wording as apps. Difference to apps is all users automatically receive notifications, there is no opt-out of notifications.
KCL	Twitter.com/londonair	Provides general updates of news stories from londonair, occasional AQ related stories of note from other sites/twitter feeds. Mainly used to disseminate KCL forecasts. Forecasts issued in 140 character format and link to full forecast text on Google Docs.	Communication of KCL's news and updates and forecast. Engagement with our followers	Doesn't really share any features with our other apps, mainly meant as a channel to disseminate our stories and updates and forecasts.
KCL	Twitter.com/londonairnow	Provides hourly summary of pollution levels on the LAQN. Condenses AQ levels on the network into 140 characters using algorithm. Eg if only one site is moderate it will say 'Moderate NO2 at site:	Communication of simplified summary of pollution levels across the LAQN to users who spend a lot of time on	Does not yet indicate difference between measured bandings & trigger bandings, we have an idea how we can do this within the 140 character constraint.

Provider	Channel	Description	Purpose	Additional features
KCL	Twitter.	Wansdworth - Putney High St'. The more activity there is on the network the more condensed the message becomes, if there are many moderate/high sites, message will be 'Pollution at sites: 17 high PM10, 40 moderate O3, 7 moderate NO2'		
KCL	Facebook.com/londonair	Facebook page used similarly to our /londonair twitter feed. Disseminating our stories & updates. Also used for disseminating our forecasts. Also includes links to monitoring sites map and hourly NO2 and PM10 Nowcast maps. Does not yet include link to DAQI health advice.	Communication of KCL's news and updates and forecast. Engagement with our followers	Similarity of purpose and use to our /londonair twitter feed. Also includes hourly monitoring sites map and Nowcast maps.
KCL	Forecast	Forecasts are provided through AirAlert see www. Airalert.info for Sussex and parts of Hampshire. Other forecasts are supplied to a small number of London local authority officers and those within TfL. These are also being included experimentally in our Twitter feeds.	Airalert provides forecasts to media, schools and the public with a focus on vulnerable people and their carers.	Information by SMS, voicetext, web and RSS with specific emails tailored for schools and media. Forecasts based on current and recent air quality measurements, historic pollutant behaviour, local site knowledge and forecast meteorology. Uses back trajectory analysis and cross checks with the French prevair / chemire forecasting system.
CERC	www.airtext.info & alerts	Forecasts and alerts for Greater London and Slough for up to 48 hours. Forecasts of pollution as contour maps of DAQI (per pollutant and maximum). Alerts issued on a Borough basis to	Inform public of air quality over next 48 hours and alert subscribers who may be sensitive individuals (or carers for sensitive individuals (or carers for sensitive	Unique features are: - high resolution, street-scale, maps of forecasts for the next 2 days - high spatial resolution temperature maps - comparison of air quality in London with other host cities

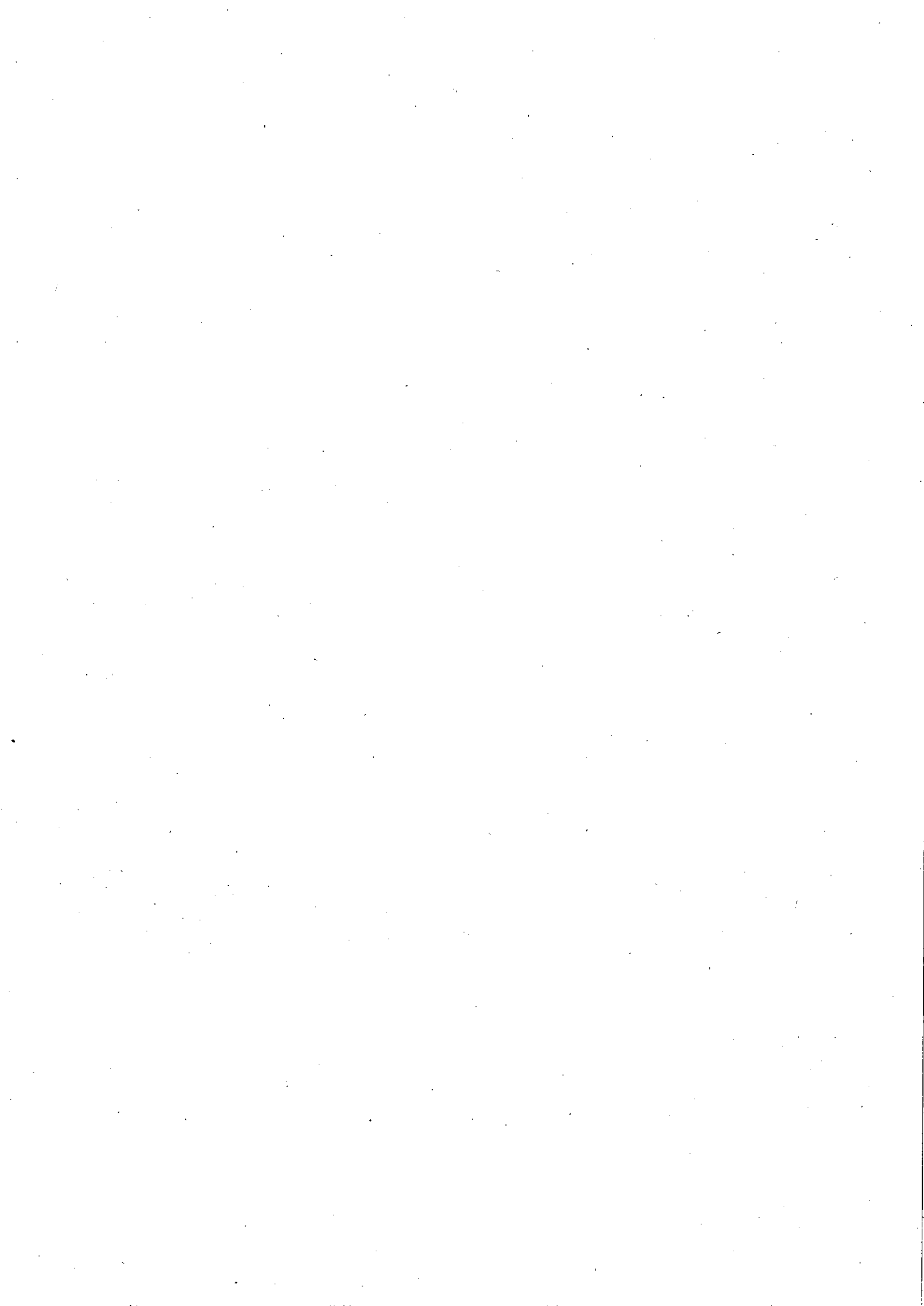| Provider	Product	Description	Purpose	Unique features
		existing subscribers if DAQI is forecast to be MODERATE or higher (SMS, email, voicemail.)	individuals).	
		Forecast maps of temperature around the Olympic Park taking into account the urban heat island.	The temperature maps and comparison with other host cities are for scientific and public interest.	
		Comparison of monitored air quality in other Olympic host cities.		
CERC	iPhone and Android apps	Forecasts for today and tomorrow of pollution (maximum DAQI), UV, pollen and maximum and minimum temperature for each Borough.	Inform public of air quality and other environmental factors over next 48 hours.	Unique features are: - combined forecast at borough resolution in a simple format disseminated via an app
CERC	@airTEXT & Borough accounts	@airTEXT: daily forecast of pollution for Central London Borough accounts: alerts on a Borough basis when the DAQI is forecast to be MODERATE or higher.	Inform public and of air quality alerts over next 48 hours and alert subscribers who may be sensitive individuals (or carers for sensitive individuals).	Unique features are: - alerts on a Borough basis calculated from high resolution forecasting
CERC	Daily Borough bulletins	Forecasts for today and tomorrow of pollution (maximum DAQI), UV, pollen and maximum and minimum	Inform public of air quality and other environmental	Unique features are: - combined forecast at borough resolution in a simple format

		temperature for each Borough.	factors over next 48 hours.	disseminated via email, 1 side of A4 pdf per day
Met Office	Online pollution forecasts using AQUM	Daily AQ Index out to 5 days for 5000 sites. Presented on Met Office website. AQ Information presented alongside weather and UV forecast. Daily AQ Index animations for 5 days.	Inform public of AQ out to 5 days at a location of interest to them.	5 day, site specific forecast produced by the on-line model AQUM. Real-time lateral boundary conditions for pollutants from the MACC global model. Post-processing of raw model output to take into account recent AQ observations. Near-real-time verification to monitor model performance. 24 hour midnight-to-midnight PM10 and PM2.5 means. Includes COMEAP DAQI health advice.
BBC	Online pollution forecasts using AQUM	Daily AQ Index out to 5 days for 5000 sites. Presented on BBC website. . AQ Information presented alongside weather, UV and pollen forecast.	Inform public of AQ out to 5 days at a location of interest to them.	5 day, site specific forecast produced by the on-line model AQUM. Real-time lateral boundary conditions for pollutants from the MACC global model. Post-processing of raw model output to take into account recent AQ observations. Near-real-time verification to monitor model performance. 24 hour midnight-to-midnight PM10 and PM2.5 means.

Air Quality Forecasting Models Summary

Forecasting Inputs

	AEA - CMAQ	Met Office AQUM	CERC ADMS
Inputs/Tools	1. Current levels at AURN sites 2. Current levels at London sites, especially Newham, Tower Hamlets, Waltham Forest and Hackney (http://www.londonair.org.uk/LondonAir/Default.aspx) and (http://www.airqualityengland.co.uk/) 3. Airtext forecasts (http://www.airtext.info/) 4. BBC pollution forecast for London 5. Hysplit air mass back trajectories 6. WRF model and Met Office weather forecast 7. CMAQ, taking into account the evaluation plots - CMAQ may overestimate roadside ozone and underestimate UB and roadside PM 8. Dust forecast from University of Athens 9. Satellite images from NASA – for Saharan dust, volcanic activity and large fires 10. BBC London news for local incidents which may be emission sources – e.g. local fires, traffic congestion 11. MACC ensemble forecasts (http://www.gmes-atmosphere.eu/services/raq/raq_nrf/)	1. Combined meteorology/AQ model AQUM. 2. Lateral boundary conditions for pollutants from real-time MACC global model. These provide the fluxes from e.g. Saharan dust / forest fire events external to the AQUM domain. 3. Lateral boundary conditions for meteorology from Met Office global forecast model. 4. Recent AURN measurements.	- Emissions: NAEI, LAEI - Met forecasts from a commercial provider - Forecasts of regional concentration from INERIS Prev'Air - Latest AURN monitored data - ADMS-Urban
Data Input description		Data input source/ schedule	
	The global boundary conditions are provided by the Global Forecasting System (GFS) model The GFS data are updated every 6 hours. AEA use the forecast available at 4:00am.	AQUM is an on-line model, generating its own meteorology and coupling this to chemistry. All relevant meteorological fields are available to the atmospheric chemistry sub-model at every time-step.	Forecast of hourly wind speed, wind direction, temperature, cloud cover
Data input description			
	Weather (wind speed, wind direction, temperature, pressure, rain, cloud cover,		

radiation)			
Emissions	Based on 2009 NAEI and EMEP emissions inventories. Biogenic emissions calculated based on the Biogenic Potential Inventory.	2008 NAEI, EMEP and ENTEC (UK shipping) emissions. Biogenic emissions are monthly varying climatologies. Upgrade to 2010 emissions prior to Olympics dependent on parallel suite schedule.	NAEI & LAEI
	Updated to 2010 when the new data are available. The decisions to update the emissions close to the Olympics will be made with the duty forecasters. NAEI maps are available in May and EMEP later in the summer.		
Large Point source emissions	NAEI point source emissions are introduced into CMAQ as elevated sources.	NAEI	NAEI & LAEI
Boundary conditions	European Boundary conditions are provided by STOCHEM. Species - Sulphur dioxide, Nitrogen dioxide, Nitrogen oxide, Ozone, Nitric acid, Hydrogen peroxide, Aldehydes, Formaldehyde, Ammonia, Dinitrogen pentoxide, Peroxyacyl nitrate, Carbon monoxide, Ethene, Alkenes, Toluene, Xylenes, Peroxynitric acid, Methyl glyoxal, Isoprene	Real-time, 6-hourly varying LBCs for gas phase and aerosol pollutants from MACC global model. These allow currently occurring events outside of the AQUM domain such as Saharan dust or forest fires to be accounted for.	Prev'air
	The UK forecast is nested within the European CMAQ forecast and uses hourly changing data for all gas and PM species including all chemical intermediates reported in CMAQ.		www.prevair.org/fr/index.php
	The London forecast is nested with the UK forecast.		
	European Boundary conditions are based on monthly seasonal conditions. UK and London boundary conditions are from the European and UK forecast respectively.		

	AEA – WRF and CMAQ	Met Office AQUM	CERC Airtext
Resolution	Forecasts are produced for up to 72 hours for Europe (50km), UK (10km) and London (2km)	AQUM runs at 12km resolution. In post-processing output is downscaled to 2km. Hourly output out to T+120	Space: irregularly spaced receptors, resolution up to 10m across major roads. Time: the forecasts refer to a 24 hour period. The relevant DAQI statistic is calculated from hourly means over that 24 hour period only.
Time schedule	Models run 4.30 am to 11.30 am daily for the 48hr forecast and 12:30 for the 72hr.	Model runs at 2330 each day; output available around 0420	Forecasts are published at 8pm for tomorrow and the day after. They are updated at 8am for today and tomorrow.
Forecast locations	Maps are produced for each area, site data are extracted for all active AURN sites and a selection of other sites of interest. (This will be extended to include monitoring data from the LAQN for the London area)	5000 sites across the UK.	Dense, irregularly spaced network of receptors across Greater London and Slough. AURN and LAQN monitoring locations.
Pollutants	PM$_{10}$ PM$_{2.5}$ SO$_2$, NO$_2$ O$_3$ Outputs are available on the forecast dashboard for the forecast produced today and the one produced the previous day. The maps currently available are: 1. Hourly animated maps of each pollutant 2. Running 24hr mean animated maps	Externally available: Animated DAQI maps out to 5 days will be presented for the Olympics. Internally available: Animated, hourly maps are available for all pollutants required for the DAQI, plus speciated components of PM10 and PM2.5. Animation of DAQI for each species and total DAQI, out	PM10, PM2.5, NO2, O3.

	for PM₁₀ PM₂.₅ 3. Running 8hr mean animated maps for O₃ 4. Static maps of the daily maximum hourly value for all pollutants 5. Static maps of the daily maximum 24hr mean for PM₁₀ PM₂.₅. 6. Static maps of the daily maximum 8hr mean for O₃. Standard plots of model evaluation with provisional monitoring data for each pollutant at rural, urban background and urban sites for the previous 14 days are available along with line plots for sites extending into the forecast. CMAQ data are available for more components than are automatically displayed on the dashboard. These can be investigated interactively. In the case of moderate to high reported pollution the model predictions for ozone precursors or PM components can be investigated in more detail between the forecast update at 10:00am and the forecast issued at 2:00.	to 5 days is available. Near-real-time verification plots at all AURN sites are produced daily, with time series for the last 7 days and last 3 months. These are also extended forwards to include 5 day forecast. Real-time calculations of recent statistics, which are also plotted as time-series. Verification also considers day 1 and day 5 forecasts to show skill variation with lead time.	
Weather	Weather animations of temperature, pressure, rainfall and cloud cover for Europe, UK and London. More parameters are available from WRF and can be provided for the duty forecaster if required.	All Met Office meteorology products are available, covering all standard synoptic parameters and satellite imagery.	Maximum daily and minimum nighttime temperature.

	Model evaluation of temperature, wind speed and wind direction based on performance over the previous 14 days are available.	
Time schedule	Forecast updated if necessary at 10am daily	Model runs at 2330 each day; output available around 0420
	Forecast issued at 4pm daily (2pm during Olympics)	Model runs at 2330 each day; output updated at 8am for today and tomorrow.
	Twice weekly email forecasts issued at 1pm Tuesday and Friday	Forecasts are published at 8pm for tomorrow and the day after. They are updated at 8am for today and tomorrow.
Forecast locations	16 zones 16 agglomerations	Greater London and the Borough of Slough.
		5000 sites across the UK.
Pollutants	PM_{10} (Based on the 24 hour running mean concentration)	PM10 (24 hour mean)
	$PM_{2.5}$ (Based on the 24 hour running mean concentration)	PM2.5 (24 hour mean)
	SO_2 (Based on the 15-minute mean concentration)	
	NO_2 (Based on the hourly mean concentration)	NO2 (maximum hourly mean)
	O_3 (Based on the running 8-hourly mean)	O3 (running 8 hour mean)