BLANkET[1] Technical Report 18

An agricultural burn at Nile, North–central Tasmania, 21 December 2011

Air Section, EPA Division, March 2013

Context of the BLANkET reports

BLANkET (Base-Line Air Network of EPA Tasmania) reports are compiled using BLANkET and other Tasmanian air quality data, as well as data from other sources. The topics and events chosen for these reports are selected for one or more of the following reasons: Scientific interest – for example if the event demonstrates a principle or principles of general value in understanding smoke movement and dispersal in the Tasmanian context; Well-documented events – such as if the event is captured by two or more stations and hence provides general information on smoke movement; General public interest – this includes large–scale or other smoke events that have generated comment at the time or are of intrinsic public interest for other reasons.

Figure 1: A burn at Nile, north–central Tasmania, 21st December 2011, photographed from the the junction of the Nile (C416) and Deddington roads. The camera time–stamp is in AEST.

[1] Base–Line Air Network of EPA Tasmania

Contents

1 Summary

Smoke from a planned burn on agricultural land near Nile, north–central Tasmania, on the afternoon of 21st of December 2011 moved generally north–westerly towards Launceston. Elevated $PM_{2.5}$ levels were measured at air stations in the Tamar region which was likely due to this burn. Additionally a car–based, mobile survey was also conducted. Near Nile, a few kilometres from the burn, the instantaneous $PM_{2.5}$ concentrations sampled in the plume reached over 140 μg m^{-3}. At Ti Tree Bend (Launceston) and South Launceston stations peak $PM_{2.5}$ levels on the afternoon of the 21st of December 2011 were near 40 μg m^{-3} (although there was one higher value at Ti Tree Bend of over 100 μg m^{-3}). Elevated $PM_{2.5}$ levels were also seen in the Tamar stations down to George Town overnight on the 21st–22nd of December and into the morning of the 22nd. It is possible that there was a down–river movement of air in the Tamar valley overnight on the 21st–22nd, as is regularly seen in the cooler months of the year, which transported the Nile smoke from Launceston down to George Town.

2 Location Map – North–Central Tasmania

A guide to the region to be discussed in this report is given in map shown in Figure 2. The air monitoring stations are denoted by the red 'balloon' symbols. The location of the burn at Nile is indicated at bottom right. Also shown as small circular symbols are car–based smoke survey data, to be discussed below.

Figure 2: A map (from Google Earth) showing the region to be discussed in this report. Features of interest include the air stations shown as red balloon symbols: GAMS=George Town (George Town Air Monitoring Station); RO=Rowella; EX=Exeter; TT=Ti Tree Bend (Launceston); SL=South Launceston; CA=Carrick. The location of the burn at Nile is indicated at bottom right. The smoke survey route is delineated by the small circular symbols. Also shown are Lilydale (LD) and Scottsdale (SC) air monitoring stations. The Tamar valley essentially runs from Launceston to George Town. The Nile burn location is shown at lower right.

3 A smoke plume visible from near Launceston 21st December 2011

On the afternoon of the 21st of December 2011 an Air Section officer was travelling southwards on the West Tamar Highway after carrying out calibrations at various air monitoring stations in the Tamar area. When north of Legana a smoke plume was seen to the south. The sky was generally clear of cloud, so the plume appeared relatively prominent.

The officer was equipped with an AeroTrak 9306V particle counter[2] and a GPS unit. As the officer continued southwards, past Launceston, the plume was still visible. Logging of particle counts and GPS positions commenced while the car was parked on the roadside verge of the A1 (Midland Highway) about 3.5 km north of the Breadalbane roundabout. The particle counter was run in a continuous mode of counting particles for 9 seconds, holding the count for 1 second (to allow the operator to see the count) then commencing a new 9 second count integration. The GPS position was logged every 5 seconds to a laptop PC. The on–board clocks on the AeroTrak and laptop were synchronised to the GPS time prior to commencing datalogging.

A number of digital images of the smoke plume were also obtained. The first image is shown in Figure 3, taken from the Midland Highway near the Breadalbane Roundabout. At this time it was noted that there was significant smoke in the North Esk river valley (Figure 4). It was also seen that the plume was to the east of the Midland Highway. Consequently the survey was continued along the Evandale Road (B41) past Western Junction to Evandale, and then southeastwards on the C416 Nile Road (Figure 5). The smoke plume was to the east of the C416.

4 Data

4.1 Air quality data

4.1.1 Mobile survey

After passing through Nile it was realised the smoke was rising from a location to the south of the junction of the C416 and the Deddington Road (see Figure 1 at the front of this report). The plume was passing to the east of the C416, but appeared to be at low altitude, possibly reaching the ground. The survey therefore was continued eastwards along the Deddington Road. The plume was intercepted after about 3 km, and was relatively narrow in extent. At approximately 6 km the car was turned around and the plume was again encountered on the westward return journey to the C416. The car was turned around again, and parked at the approximate plume centre for about 30 minutes, after which the car was driven back to the C416 junction. A short stop was made for some

[2]See BLANkET Technical Report 13 for a brief description of the AeroTrak 9306V. In summary, the AeroTrak 9306V records particle counts in 6 size channels via laser scattering from particles in ambient air drawn into a sampling chamber by a pump. The smallest size channel is from 0.3 to 0.5 μm. Experience with this instrument has shown that a good proxy for $PM_{2.5}$ can be found, when smoke is the dominant aerosol, from the count rate in this smallest size channel. A dead–time correction (determined in the laboratory) needs to be applied at high count rates.

Figure 3: The smoke plume as seen when approaching the Breadalbane roundabout on the Midland Highway, travelling southwards. The camera time–stamp is in AEST for this and the following images.

further photographs at this junction, then the survey was continued southwards along the C416 and back to the Midland Highway near Conara[3].

The raw time–series of particle count rates (in Hz) in each of the six size–channels of the AeroTrak are shown in Figure 6. Time is given in AEST. Woodsmoke in a plume is largely composed of particles less than 1 μm in effective diameter. Hence most of the smoke signature appears in either channel 1 or channel 2 (shown in the upper panel of Figure 6) of the AeroTrak data record. Specifically, the elevated count-rates in channels 1 and 2 (top panel) from approximately 15:10 to 15:45 represent the signature of smoke. The spike–like (short–duration) increases in count rate seen in the larger size channels (in the lower panel) are indicative of dust, likely to have been raised when driving over road verges when turning the car. The longer–duration elevated signal from approximately 16:00 to 16:30 in the larger channel sizes (e.g. in channel 4 – 3.0 to 5.0 μm) corresponds to the car travelling over a section of gravel road

[3]Measurements with the AeroTrak were continued until south of Oatlands, but no further smoke was encountered. Several more photographs were obtained, including several from the C416 closest to the actual burn. These are included in the appendix.

Figure 4: Looking across the North Esk valley towards the Ben Lomond plateau, from near the Breadalbane roundabout on the Midland Highway. There is smoke in the North Esk valley between the Ben Lomond plateau and the camera.

Figure 5: View while driving southwards on the Nile road (C416) towards the plume origin.

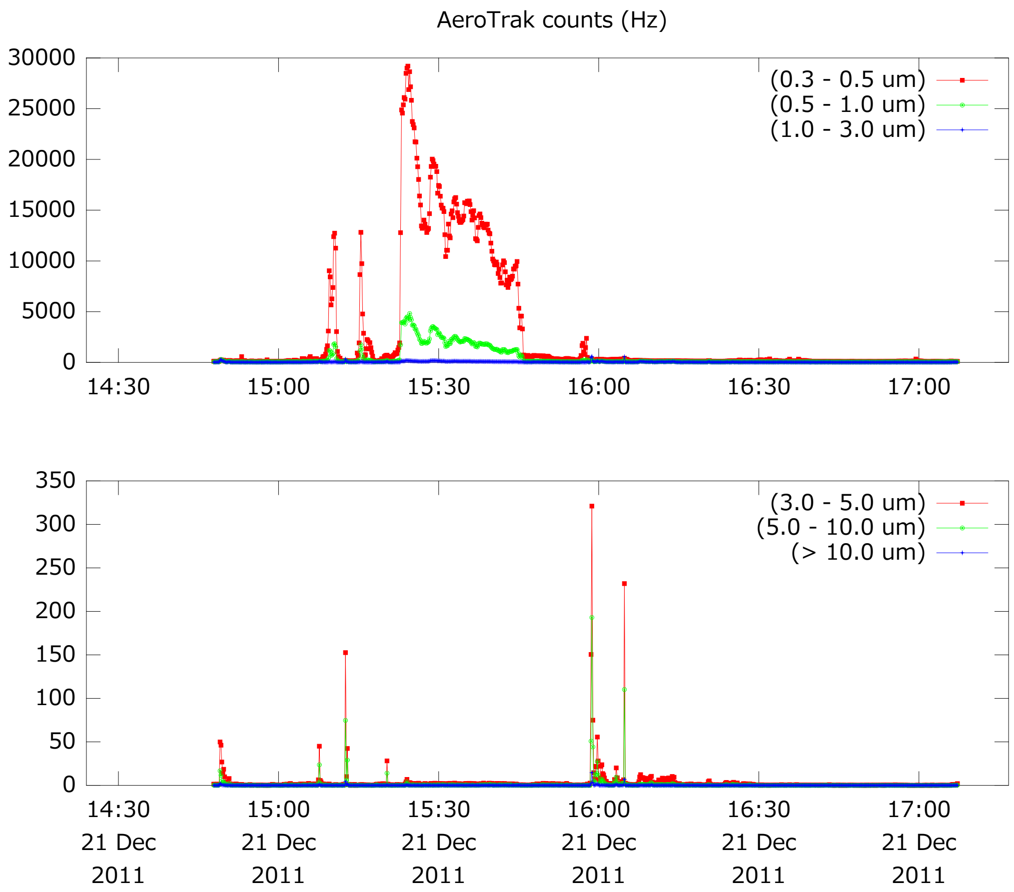

Figure 6: Time-series of AeroTrak 9306V particle counts (in Hz) versus AEST for each instrumental size channel from the mobile (car–based) survey. Top panel: Count rate for channels 1 (0.3 to 0.5 μm), 2 (0.5 to 1.0 μm), and 3 (1.0 to 3.0 μm). Lower panel: Count rate for channels 4 (3.0 to 5.0 μm), 5 (5.0 to 10.0 μm), and 6 (10.0 μm and above).

Figure 7 shows the proxy $PM_{2.5}$ time series, derived from the dead–time corrected channel 1 count rate, for the mobile survey. The two peaks marked 'Transects' near 15:15 AEST represent transects through the plume (west–to–east, then east–to–west) on the Deddington Road. From around 15:25 AEST the car was parked, as noted above, to sample the plume near the peak of the two previous transects. The peak levels near 140 μg m^{-3} would represent to most people very smoky conditions. Even at 50 μg m^{-3} most people would perceive it to be noticeably smoky.

The general decrease in $PM_{2.5}$ levels from 15:25 to 15:45 AEST represents plume movement away from the particle counter (probably mostly due to vertical movement of the plume, judging from observations made on the day) rather than a decrease in smoke production at the burn. This is also indicated by the photograph shown in Figure 8, taken near 15:40 AEST when measured smoke levels had fallen significantly from the measured peak, showing the plume was still present overhead.

From the burn to where the plume crossed the Deddington Road was about 4.5 km as an air–line.

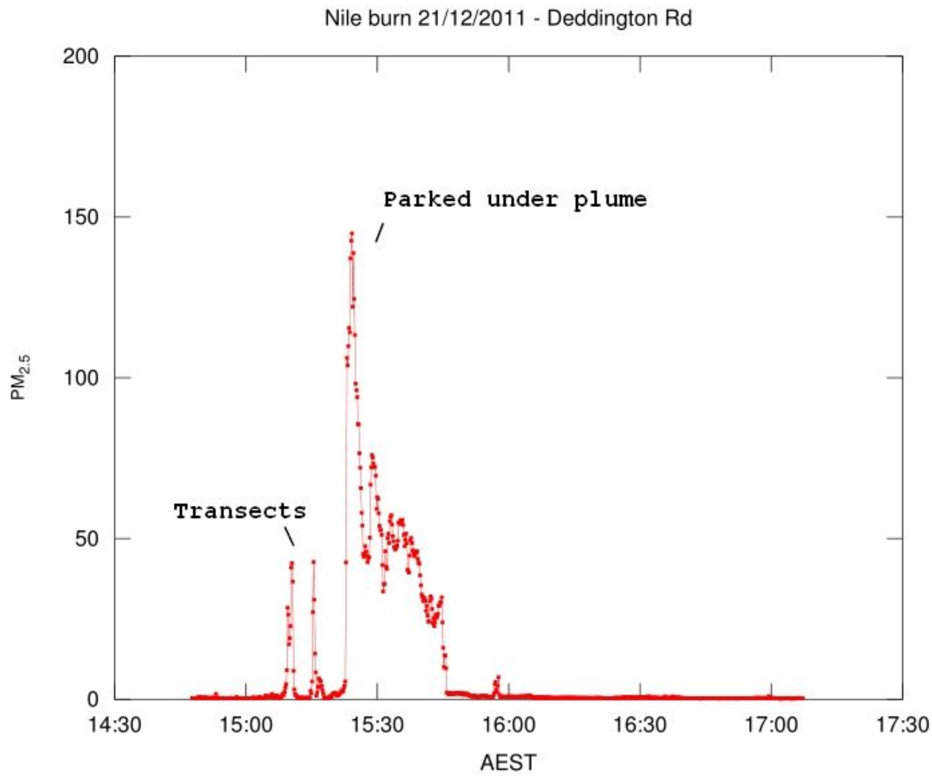

Figure 7: Time series of proxy $PM_{2.5}$ (derived from the channel 1 count rate), in μg m^{-3}, from the mobile (car–based) survey.

Figure 8: Image taken at 15:40 AEST on the Deddington Road about 3 km east of the Nile Road, looking generally northwards, as the plume moved away (seemingly mostly vertically upwards) from the stationary car.

4.1.2 Air station data - Tamar region

The Launceston air monitoring stations at Ti Tree Bend and South Launceston both recorded episodically–elevated $PM_{2.5}$ levels on the afternoon and evening of the 21st of December and in the early hours of the 22nd of December. The smoke concentration at Ti Tree Bend on the afternoon of the 21st momentarily reached over 100 μg m^{-3}, however, the more representative peak may be indicated by the several measurements in the 40 to 50 μg m^{-3} range. At South Launceston on the afternoon of the 21st the peak concentration was 46 μg m^{-3}, comparable with the possibly more representative peak at Ti Tree Bend.

At South Launceston on the 21st of December, $PM_{2.5}$ levels began increasing around 15:00 AEST, as shown in Figure 9. This was very close to the time when the images from near Breadalbane where taken (Figures 3 and 4), when smoke was seen to be moving northwards into Launceston along the lower reaches of the North Esk valley. The measured wind at South Launceston was a light ($\sim$5 km hr^{-1}) easterly during the interval of smoke on the afternoon of the 21st. The measured wind direction at the Bureau of Meteorology station at Launceston Airport near Weston Junction was south–easterly or south–south–easterly, at 25 to 30 km hr^{-1} all afternoon on the 21st. (These data are not plotted here.) Based on the meteorological data from South Launceston and the airport, and from the observed smoke movement on the day, it seems likely that the smoke measured at South Launceston on the afternoon of the 21st was from the Nile burn. The prevailing surface barometric pressure pattern is consistent with south to south–easterly winds in the south of Tasmania tending more to easterly winds in the central north (see Figure 19 in the appendix). The general south–east wind seen to be moving smoke down the lower reaches of the North Esk valley may have decreased and diverged in part also as the North Esk valley opens up at Launceston, giving a reduced and easterly (westward directed) air movement at South Launceston.

The smoke cleared at South Launceston at around 17:00 AEST when the wind shifted to a north–westerly direction. Two further intervals of elevated $PM_{2.5}$ occurred late on the 21st, near 23:00 AEST, and then for a few hours from 03:00 AEST on the 22nd. These were during an extended interval of light easterly winds, which commenced around 22:00 AEST on the 21st. Satellite imagery (presented below) showed that the Nile burn was still active at 20:00 and 22:40 AEST on the 21st. The wind at Launceston airport was generally southerly or south–easterly overnight on the 21st–22nd of December. These data are consistent evidence that the smoke recorded at South Launceston late on the 21st and early on the 22nd also came from the Nile burn.

Smoke onset at Ti Tree Bend on the afternoon of the 21st was about 1 hour later than at South Launceston. Ti Tree Bend is about 4 km north–west of the South Launceston air station. It seems likely that the Nile smoke also reached Ti Tree Bend on the afternoon of the 21st, and in a similar way as was discussed for South Launceston above, probably also caused the later two instances of elevated $PM_{2.5}$ at Ti Tree Bend later on the 21st–22nd.

There is evidence that the Nile smoke was also recorded at other station in the Tamar region. Figure 10 shows the $PM_{2.5}$ time series from (top to bottom) George Town, Rowella, Exeter, Ti Tree Bend, South Launceston, and Carrick air monitoring stations. (Note the greater vertical scales for the Ti Tree and South Launceston plots compared to the other stations.)

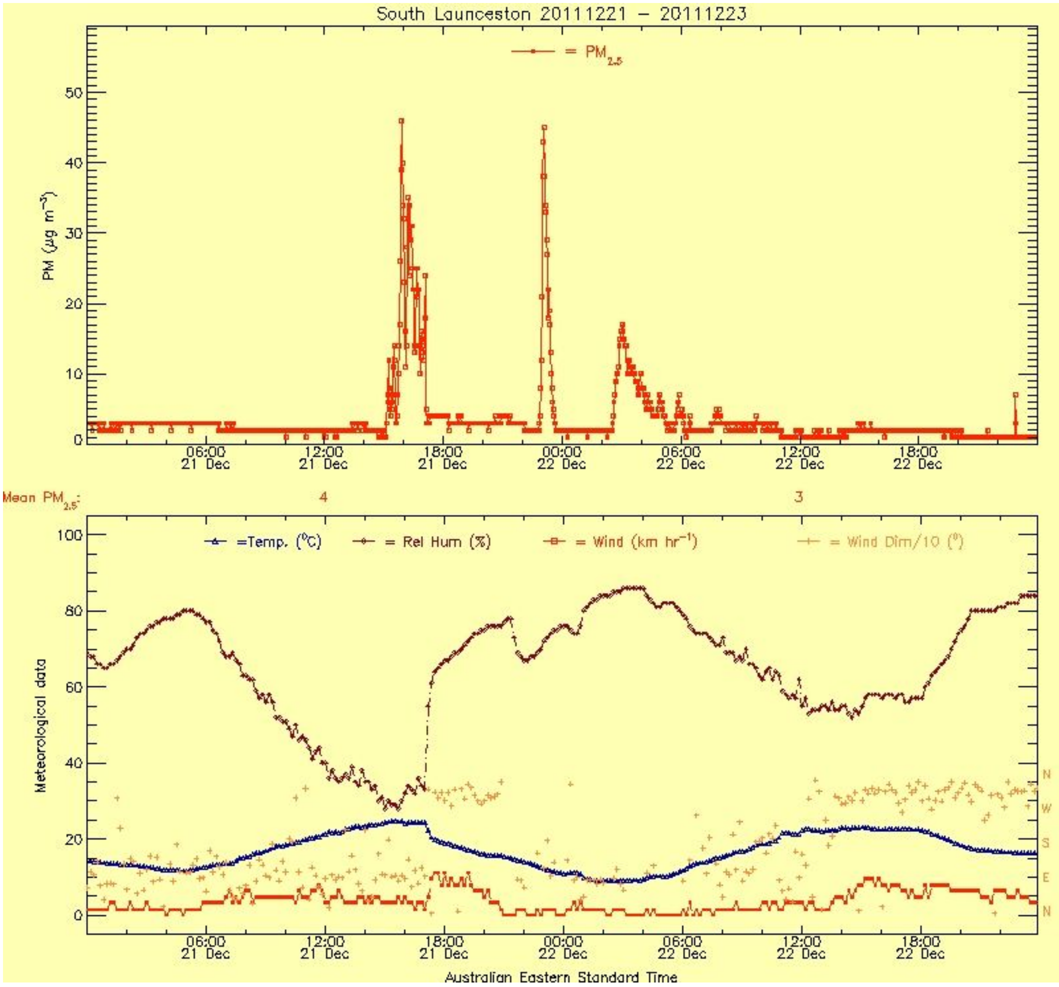

Figure 9: Data from the South Launceston air monitoring station for 21–22 December 2011. Top panel: Time series of 2–minute $PM_{2.5}$. Lower panel: Meteorological data. Time is given in AEST.

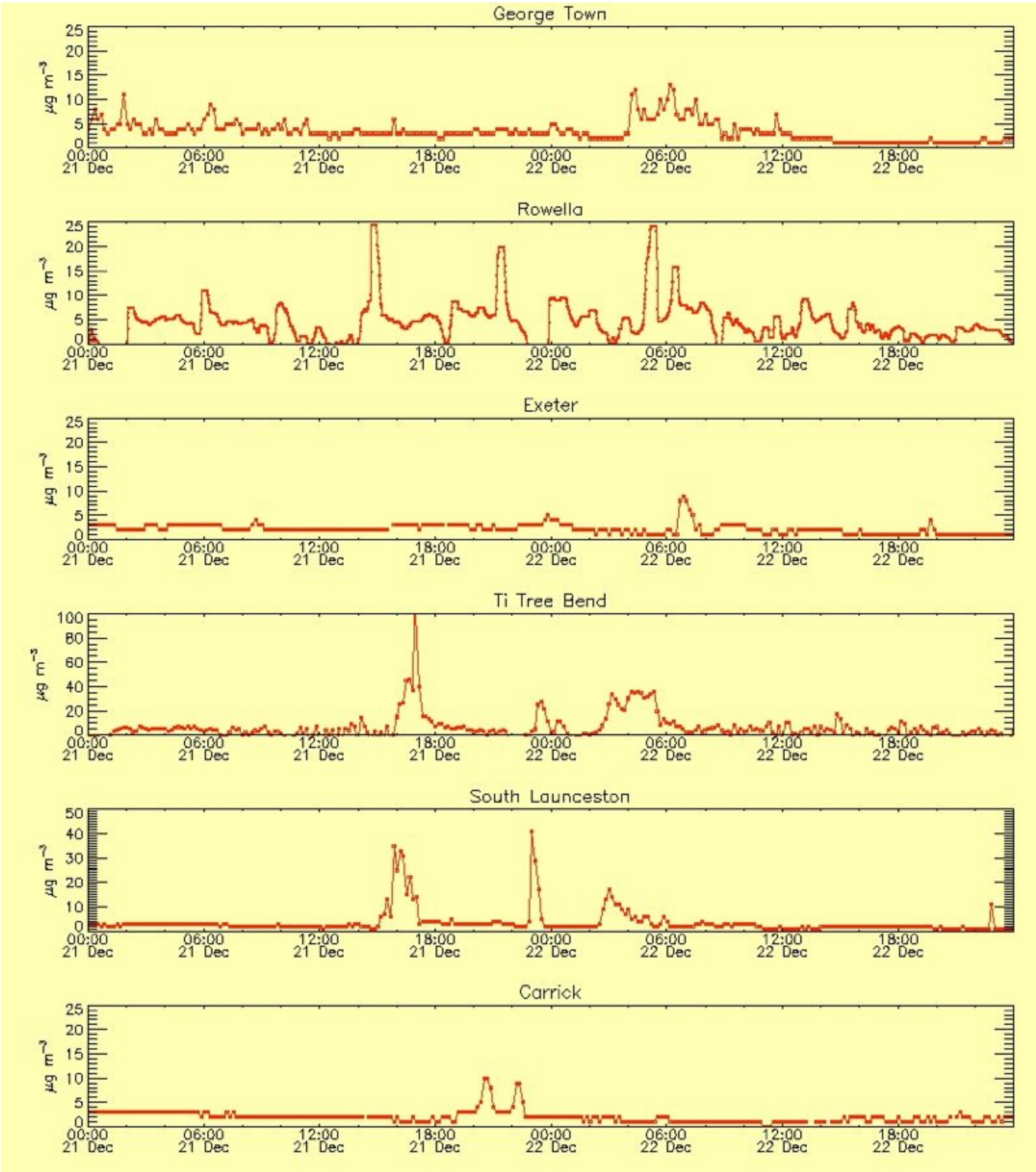

Figure 10: Time series of 2–minute $PM_{2.5}$ data from the Tamar region air stations, 21–22 December 2011. Top to bottom: George Town, Rowella, Exeter, Ti Tree Bend (Launceston), South Launceston, and Carrick. Time is given in AEST. Note the greater vertical scales of the Ti Tree Bend and South Launceston plots compared to the other stations.

At Carrick (bottom panel of Figure 10) there is are two intervals of slightly elevated $PM_{2.5}$ near 20:30 AEST and 22:00 AEST. These followed a slight wind change when the wind direction changed from easterly to a more south–south–easterly wind. The second peak precedes by about 1 hour the return of the smoke to South Launceston (and after a short interval to Ti Tree Bend).

At Exeter (3rd panel of Figure 10), approximately midway between Launceston and the coast, there is a small increase in $PM_{2.5}$ at around 07:00 AEST on the 22nd. This occurred on a north–east wind. During winter, Exeter often shows an increase in $PM_{2.5}$ in the mid–morning when the local katabatic wind ceases and a north–easterly wind commences. It was hypothesised that the north–east wind brings in from the Tamar River, smoke that has moved downriver overnight from Launceston[4]. Based on the data to hand, it is suggested that a similar process was also in operation on this day – that is, the smoke seen at Exeter on the morning of the 22nd was smoke from the Nile burn that reached Launceston overnight, and was carried down river until the mid–morning wind change brought some of it to Exeter.

At George Town, a south–easterly (downriver) wind was present from late on the 21st into the morning of the 22nd. $PM_{2.5}$ showed a small increase at George Town commencing at 04:00 AEST. It is possible that this was due to smoke from the Nile burn, which had entered the Tamar valley at Launceston, being carried downriver overnight to George Town.

The Rowella air station employs a TEOM[5] for measuring $PM_{2.5}$. This instrument exhibits more instrumental and measurement noise than the dustraks used at the BLANkET stations. The Rowella data are shown for completeness in the second panel of Figure 10.

4.2 Satellite Images

The colour image for north–central Tasmania for the 14:50 AEST on the afternoon of the 21st of December 2011, from the MODIS Aqua satellite, is shown in Figure 11. The image was imported into Google Earth for the purposes of displaying here. A faint smoke plume is seen, aligned approximately north–west to south–east, between Nile and Deddington. This image was taken at almost the same time as the car–based survey commenced just south of Launceston. The smoke plume seen on the satellite image is identified as the same plume as was seen and photographed at this time. The smoke plume can be traced from the source, south of Nile, almost to White Hills, adjacent to Launceston's southern suburbs.

Images from the AVHRR[6] of north–central Tasmania for ∼15:30 AEST (i.e. 40 minutes after the MODIS Aqua image in Figure 11) are shown in the composite views in Figure 12. The burn and smoke plume can also be identified in these images, although the spatial resolution is reduced compared to the Aqua image.

The infrared AVHRR image for 20:00 AEST on the 21st of December also shows the burn to be continuing at that time, as the hotspot at the known burn location is still prominent, as shown in Figure 13.

[4]See BLANKET Technical Report 10 for more details.
[5]Tapered Element Oscillating Microbalance
[6]Advanced Very–High Resolution radiometer

Figure 11: MODIS Aqua image of north–central Tasmania for 14:50 AEST on the afternoon of the 21st of December 2011 displayed via Google Earth. A faint smoke plume located between Nile and Deddington is labelled.

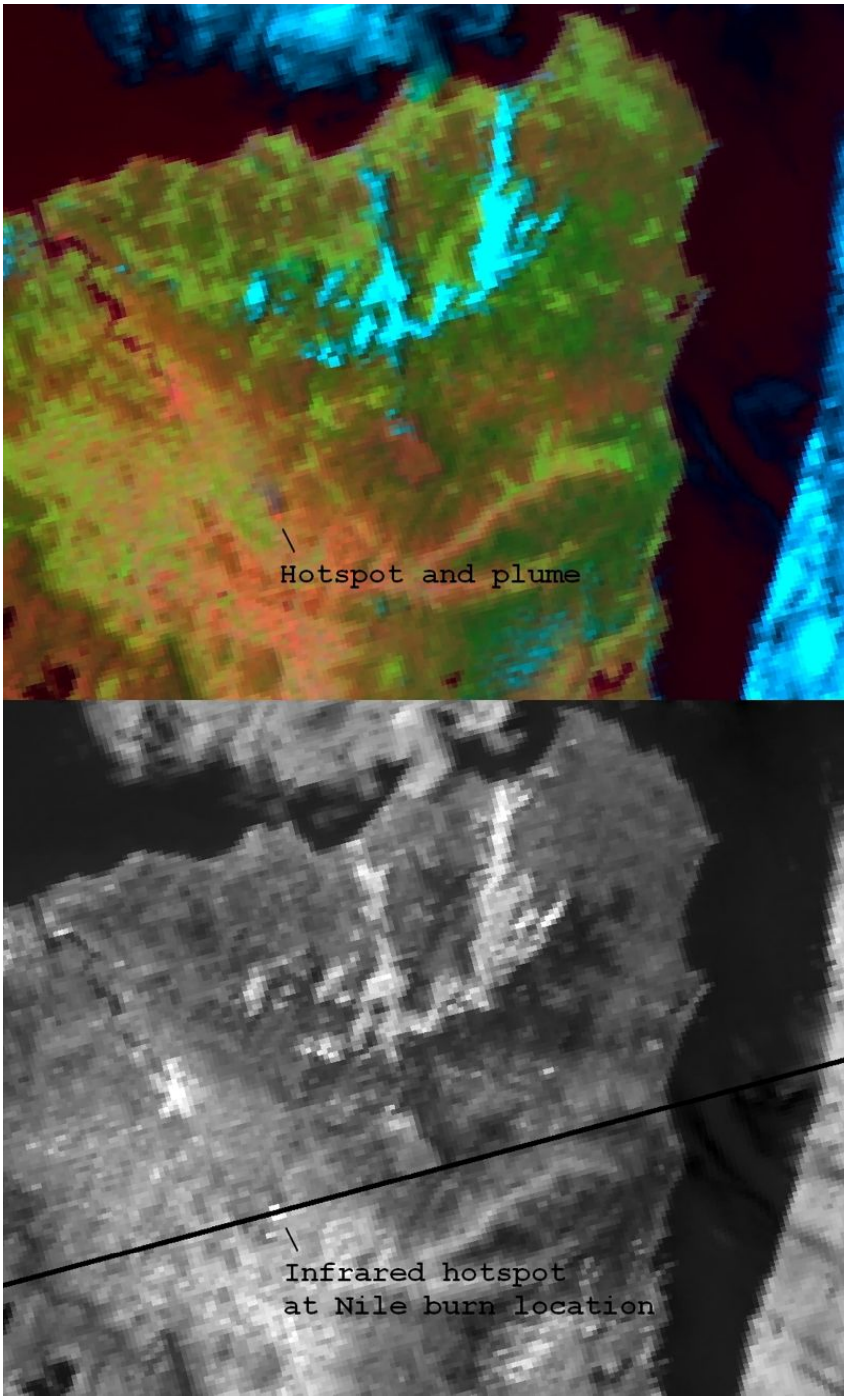

Figure 12: Composite views of AVHRR images of north–central Tasmania for 15:30 AEST on the 21st of December 2011. Top image: a composite false colour image using AVHRR channel 1 for blue; channel 2 for green, and channel 4 for red. Lower image: Channel 3b image. A region of enhanced infrared radiance (a hotspot) is seen at the location of the Nile burn in the lower image. The upper image shows a faint smoke plume and hot spot at this location.

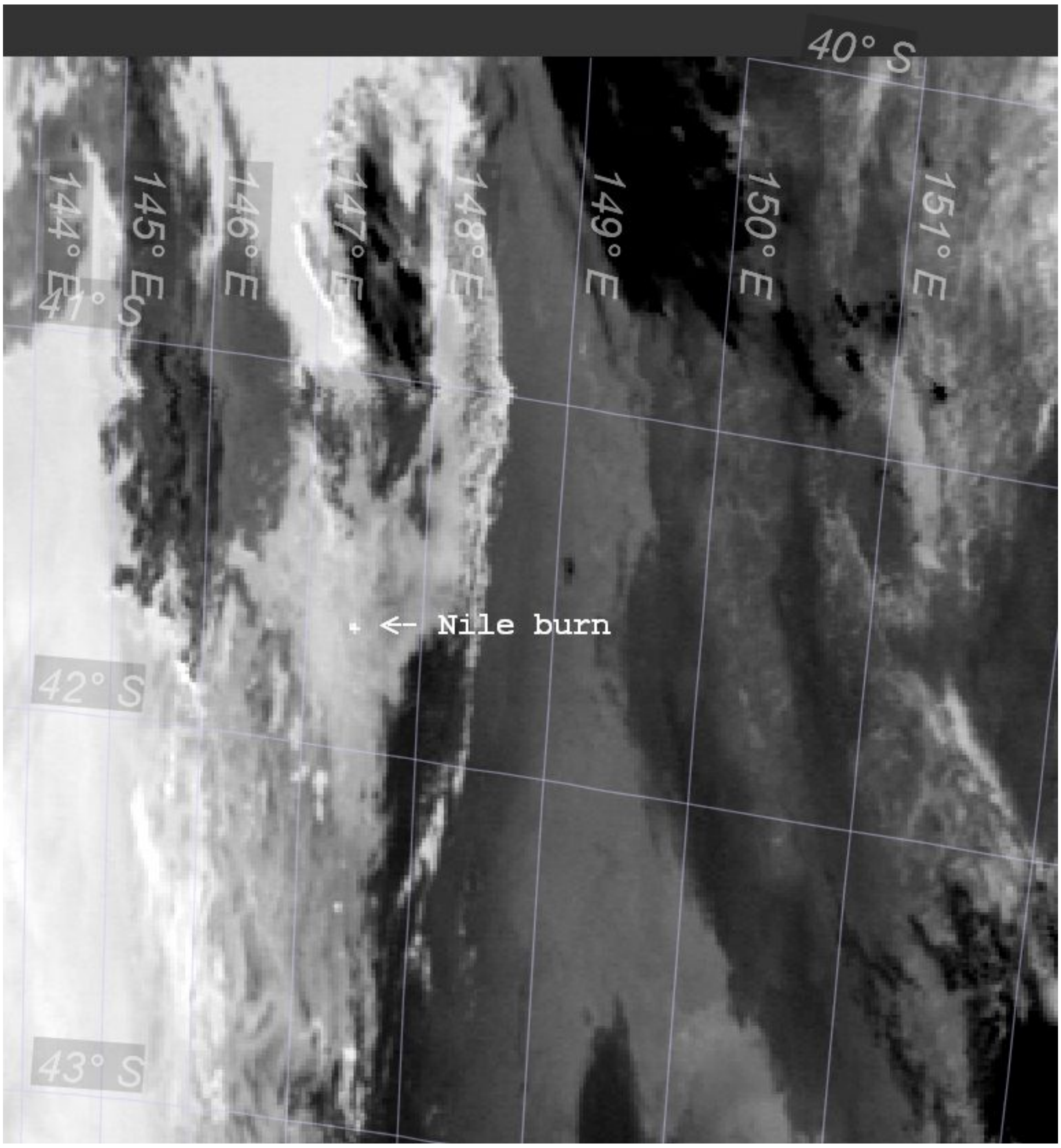

Figure 13: Raw AVHRR infrared image of north–central Tasmania for 20:00 AEST on the 21st of December 2011. A region of enhanced infrared radiance (a hotspot) is still visible at the location of the Nile burn.

Analysis obtained from the Sentinel website of Geosciences Australia shows that the burn was still visible as an infrared hotspot on a MODIS pass at 22:40 AEST on the 21st of December, as shown in Figure 14. This is around 8 hours from when the burn was first photographed from near Breadalbane just before 15:00 AEST that afternoon.

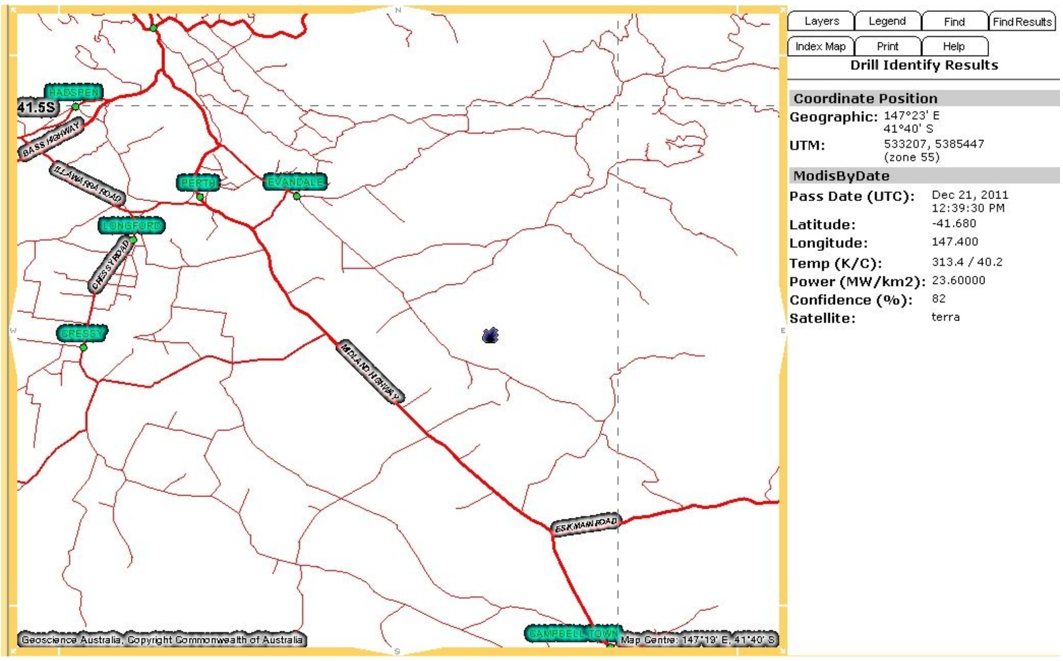

Figure 14: Analysis showing the Nile burn was detected as a hotspot on a MODIS image from 22:40 AEST of the 21st of December 2011. (Map obtained from the Sentinel web pages of Geosciences Australia.)

4.3 Data from the Tasmania Fire Service

The webpages of the Tasmania Fire Service (TFS) listed a burn as having taken place south of Nile on the 21st of December 2011. Figure 15 shows the region of interest from the TFS webmap downloaded on the 21st of December. The burn location is marked as the green triangle at lower right.

The TFS was contacted for further details regarding this burn, and supplied the following information. 'The burn was listed as a permit burn, but was actually a registered burn as the permit interval only commenced at midnight on the 21st/22nd of December. The burn area and type were not recorded, but it was probably for gorse removal[7].'

[7]Observations conducted over a few minutes of the burn by the air section officer from a vantage point on the C416 Nile road noted a number of instances of very visible localised flames, and significant smoke, which would be consistent with burning gorse. The fire activity was clearly highly variable, which may relate to the episodic combustion of localised fuel such as clumps of gorse. The smoke plume was consequently non–uniform and at least partly discontinuous. See also the photos in the appendix.

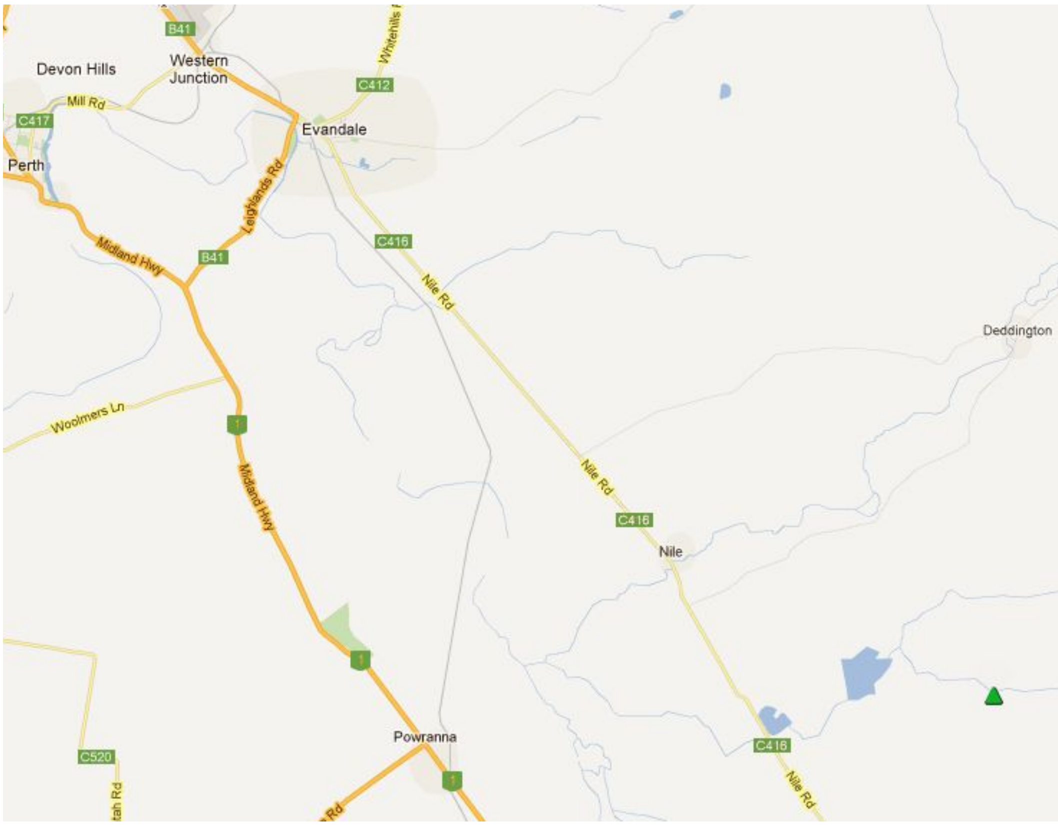

Figure 15: The location of a burn near Nile, registered with the Tasmania Fire Service (TFS) on 21st December 2011, is shown as the green triangle at lower right. (Map obtained from the TFS web pages.)

The absence of detailed information prevents an estimates of the total fuel weight consumed and smoke particle production for the burn. An order–of–magnitude calculation can however be performed as a very approximate assessment of the quantities likely to be involved. The plume on the MODIS satellite image can be traced approximately as an isoceleses triangle with the apex at the burn, of length at least 16 km, and width 4 km at the base. If the vertical extent of the plume is estimated at 200 m (based on observations on the day), this gives a volume near 6.4×10^9 m^3. If we adopt a representative concentration in the plume of 50 μg m^{-3} (e.g. from Figure 7 and from the measurements at Ti Tree Bend and South Launceston later on the 21st of December), this gives about 320 kg of particles in the plume. Assuming a particle production of 0.015 kg per kg of fuel consumed (an approximate figure, reasonably applicable to but possibly underestimating particle production in bushfires), this indicates that about 21,000 kg (21 tonnes) of fuel were consumed to produce the plume. Further, assuming a fuel loading of 5 to 10 t ha^{-1} (typical for grassland or fuel–reduction burns targeting undergrowth and leaf litter) yields an estimated area of 2 to 4 ha burnt. This calculation is indicative only, and is provided solely for illustrative purposes.

4.4 Car–based survey data in a spatial view

For completeness, Figure 16 shows the burn location, the approximate plume position from the Aqua image, and the car–based smoke survey data in a spatial view: The Nile burn location is shown as the red cross at lower right. The blue shaded area is the approximate location of the smoke plume shown in the Aqua image. The small spherical symbols represent the $PM_{2.5}$ levels measured with the car–based survey. Smoke concentrations are indicated both by the colour (as red, yellow, green, blue, purple as increasing concentration) and height above local ground level (greater local altitude represents higher concentrations. The mobile survey on the Deddington road was commenced at 15:10 AEST, about 20 minutes after the satellite image was obtained at 14:50 AEST. It is clear that the car–based mobile survey sampled in the plume from the Nile burn. The plume appears to have moved slightly westward (to the right in the image) between the time of the satellite image and the interval of the car–based survey.

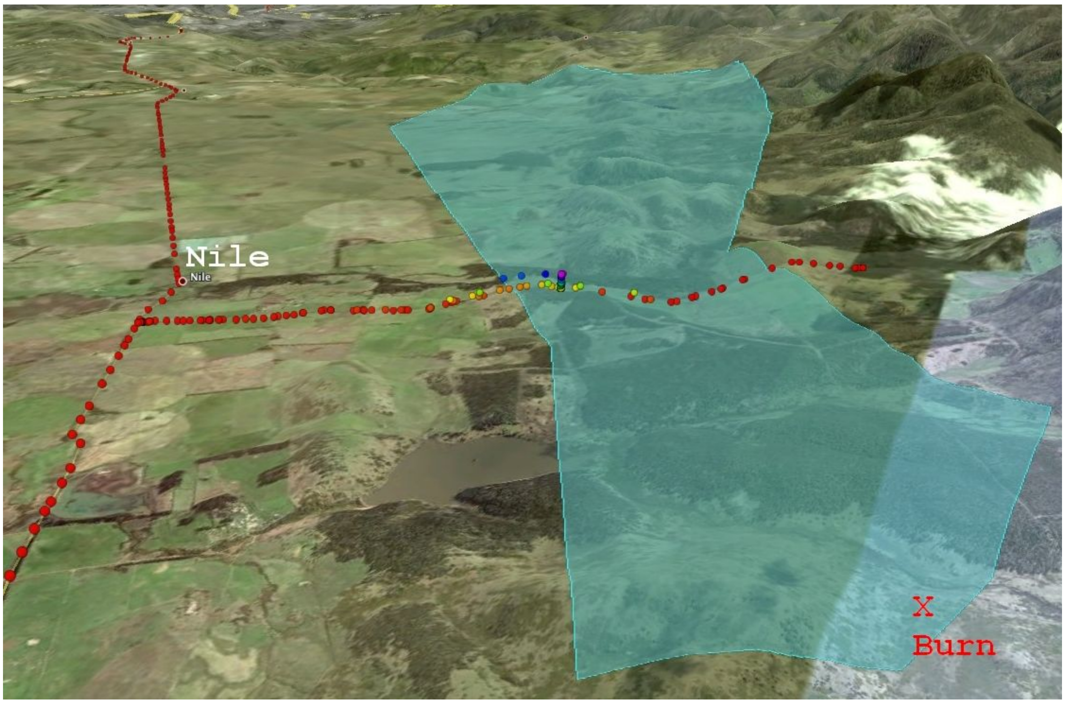

Figure 16: Composite image displayed via Google Earth showing the burn location (red cross), representative plume position from the MODIS Aqua image (blue shading), and the car–based smoke survey measurements (small circular symbols). Smoke concentrations are indicated both by the colour (as red, yellow, green, blue, purple as increasing concentration) and height above local ground level (greater local altitude represents higher concentrations.

Figure 17 shows detail from Figure 16. The cluster of points just left of centre marks the location where sampling was conducted with car stationary. The two high values to the left of this (of 104 and 115 μg m^{-3}) where obtained immediately before stopping the car. The lower values under these (e.g. the points of 19, 24, and 43 μg m^{-3}) were obtained on an earlier transect of the plume.

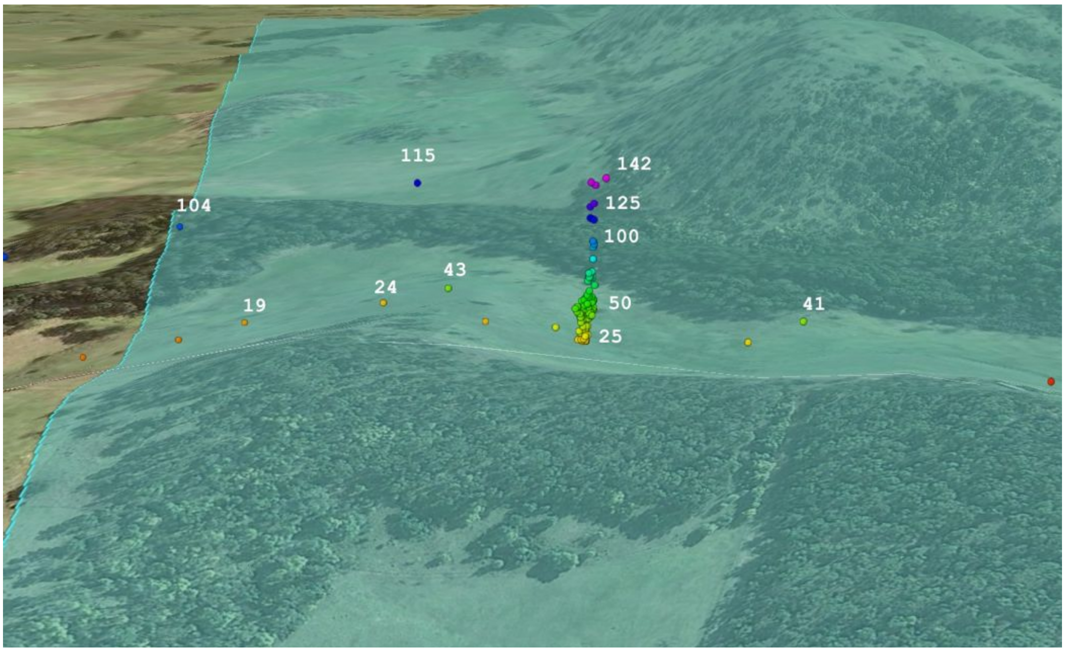

Figure 17: Detail from Figure 16, showing representative $PM_{2.5}$ measurements from the mobile survey. The multiple points at the one location shows where samples where obtained with the car stationary.

These data also illustrate the level of spatial information that can be obtained from a car–based survey when a smoke plume is accessible by public roads.

5 Discussion

A general question of relevance to the issue of planned burn smoke–management in Tasmania concerns the size and frequency of smoke impacts from agricultural burning. In general, the BLANkET air stations were not sited to monitor agricultural burns. However, at the Fingal station in the South Esk valley, there have been three documented smoke events where local agricultural burning was identified as the origin[8]. Additionally a plume from crop–stubble burning in the northern Midlands was measured in a car–based survey in February 2011[9].

For two of the smoke events at Fingal the peak $PM_{2.5}$ levels were near 140 μg m^{-3}, which is comparable to the peak level measured on the Deddington Road on the 21st of December, about 4.5 km from the Nile burn. The Fingal and the new data from the Nile burn indicate that smoke impacts from agricultural burning can be significant, although such significant effects may mostly only occur relatively locally to the burn. For the Nile burn, smoke was also measured in Launceston, approximately 35 km away: At Ti Tree Bend on the 21st–22nd of December there were three instances when the hourly averaged $PM_{2.5}$ concentrations were above 25 μg m^{-3}.

Smoke events of this size, while being large enough to give noticeably smoky conditions, are generally lower in concentration and shorter in duration than many planned burn smoke impacts measured by the BLANkET network[10], and are also below the level of pollution produced by domestic woodheating in some communities and towns.

It is however also possible that the car–based survey of the Nile plume on the Deddington Road may not have sampled the maximum concentration in the plume. As noted earlier, the in–plume sampling with the car stationary was only conducted for about 30 minutes, while the burn was in progress for at least 8 hours on this day. Also, the appearance of the plume when viewed from the Deddington road was that the plume centre (and hence the likely maximum concentration) may have been 50 to 100 m above local ground–level. It is also possible that the Launceston air stations did not sample at local plume centre. In this context, while these current data on the Nile burn are of interest, it would be important to obtain further data on smoke concentrations from agricultural burns at a range of distances from the burn, preferably as transects across the plume.

The data from Exeter and George Town air stations in the mid and lower Tamar indicate there was a movement of smoke (and air) downriver overnight from Launceston. This downriver movement is often seen under synoptically calm conditions in winter. In winter the downriver wind is a katabatic flow. For the Nile smoke it seemed more likely that the general, synoptically–driven, southerly wind was the mechanism for the transport of air. The local topography

[8]See BLANkET Brief Reports 1, 3, and 9

[9]BLANkET Brief Report 11

[10]For example, see BLANKET Technical Report 10 for a summary of the smoke events in 2010.

of the Tamar Valley no doubt also likely contributed by acting to confine the smoke the the valley itself.

The smoke plume from the Nile burn was relatively limited in vertical extent. It was visible but not prominent on the satellite image. Visibility of a plume on a satellite image depends on many factors, with the likely major factor being the total number of smoke particles in the vertical column. This is a different physical quantity to a concentration. That is, a vertically–confined plume with a high average–particle–concentration (i.e. in terms of particles per cubic metre) may be just as visible on a satellite image as a much more vertically extended plume with a lower average–particle–concentration if the satellite is 'looking through' a similar total number of particles when viewing the ground through the plume. Hence the lack of a prominent plume on a satellite image of an agricultural burn does not necessarily mean that the local particle concentration in the plume is not high[11]. Plumes produced by high–fuel–weight forest industry burns are often clearly visible on satellite images. As noted above, this relates to the high total number of particles in the vertical extent of the plume. BLANkET data has also shown that ground–level smoke concentrations in such plumes can also be high. More measurements of plumes from agricultural burns will aid in understanding the potential and actual impacts from this source.

The work presented here indicates the utility of monitoring smoke plumes by combining a car–based survey with the fixed air station network. The study was opportunistic[12]. It was fortuitous that the plume crossed a public road and was at ground–level (at least for some time) only a few kilometres from the burn location. It is intended that further surveys will be carried out as there is potential for significant information gain.

6 Conclusions

Smoke from an agricultural burn at Nile, north–central Tasmania,on the 21st of December 2011, was measured using both a car–based survey method and with fixed air stations. The plume concentrations 4.5 km from the burn peaked at approximately 140 μg m^{-3} during a 30 minute measuring interval, but it is noted that as the burn was carried out over at least 8 hours and as the plume centre may not have reached ground level at the sampling location, this value may underestimate the true peak concentration in the plume.

Smoke from this burn was likely to have reached the Launceston air stations during the afternoon of the 21st of December, and then returned later on the 21st and in the early hours of the 22nd. A downriver movement of air overnight on a southerly wind took the smoke, as reduced concentration, to Exeter and George Town stations on the morning of the 22nd.

There is little detail available concerning the burn size and fuel type, other than the fuel probably included gorse, so it is not known how this burn compares to a 'typical' agricultural burn. The burn lasted at least 8 hours, as it was obviously ignited before it was first seen by the air section officer near 15:00 AEST on the 21st, and was visible as an infrared hotspot on a MODIS image from

[11]While an estimate of the plume vertical–extent might be available in some circumstances, ground–based measurements of particle concentration will still be needed when assessing impacts.

[12]The EPA does not generally receive advance notification of planned burns.

22:40 AEST that night. The smoke from this agricultural burn measurably affected air quality in Launceston, some 35 km distant.

7 Acknowledgements

BLANkET stations are sited at properties owned or operated by Ben Lomond Water, Break O'Day Council, Cradle Mountain Water, Dorset Council, the Department of Education, Hobart City Council, Huon Valley Council, Southern Water, and West Tamar Council.

The Tasmania Fire Service is thanked for providing information for this report.

MODIS images are from the NASA/Goddard Space Flight Center 'MODIS Rapid Response' website[13]. Use of the NOAA AVHRR satellite images and Sentinel analysis (Geosciences Australia) is also acknowledged.

Report compiled by J. Innis.

[13]http://rapidfire.sci.gsfc.nasa.gov/

8 Appendix

This appendix presents Bureau of Meteorology surface pressure charts for the 21st of December, as well as several images of the Nile burn not included in the body of the report.

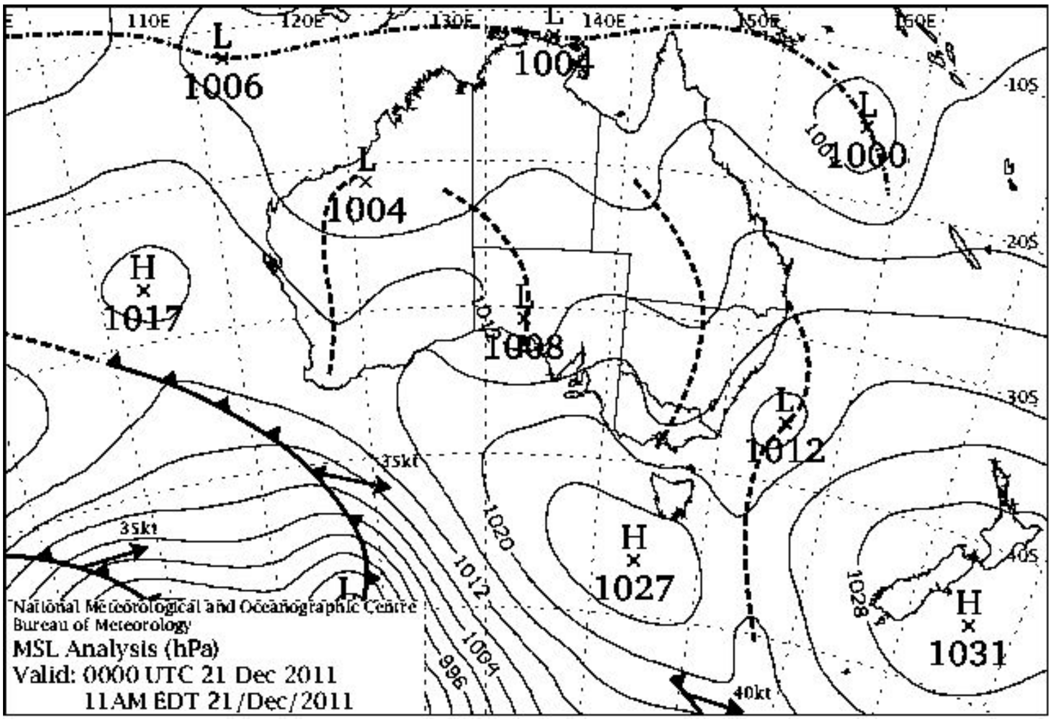

Figure 18: Mean Sea–level pressure for 10:00 AEST on the 21st of December 2011, from the Bureau of Meteorology.

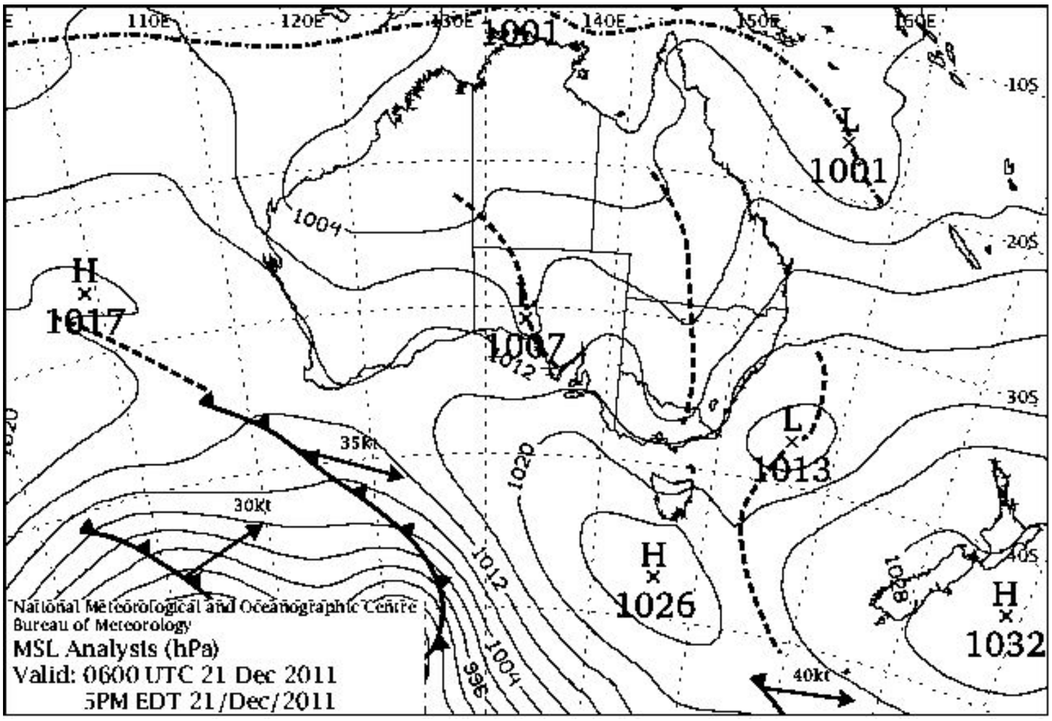

Figure 19: Mean Sea–level pressure for 16:00 AEST on the 21st of December 2011, from the Bureau of Meteorology.

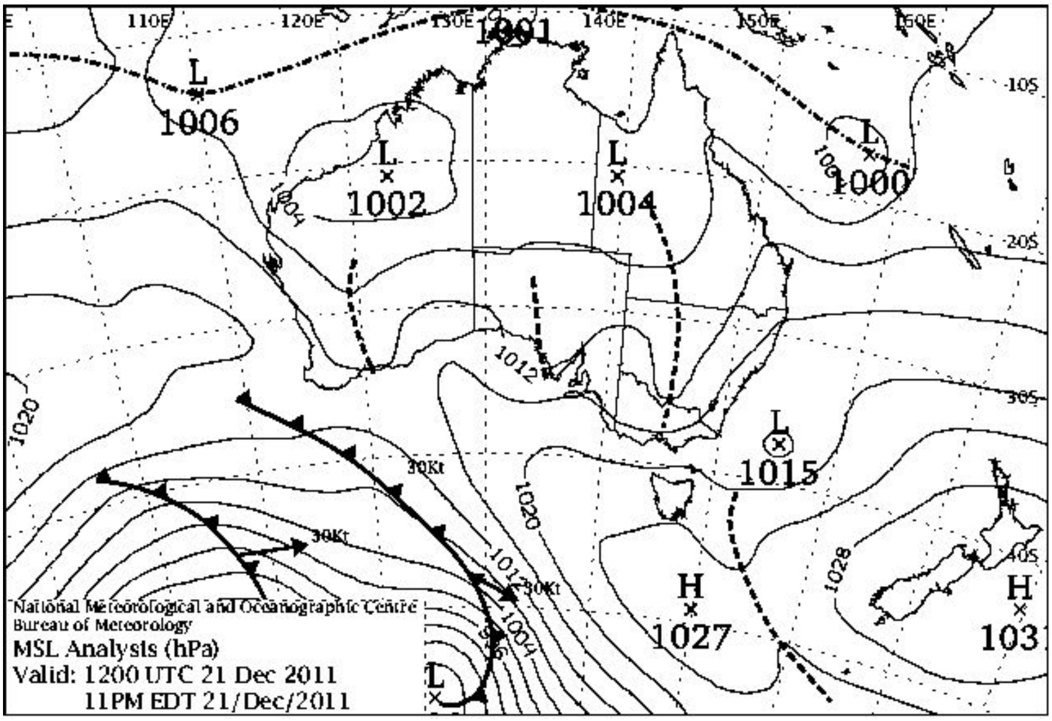

Figure 20: Mean Sea–level pressure for 22:00 AEST on the 21st of December 2011, from the Bureau of Meteorology.

Figure 21: Panorama view of the 21st December 2011 Nile burn smoke plume moving in a northerly direction towards Launceston and the Tamar. Images were obtained at the junction of the Nile (C416) and Deddington Roads just after 15:50 AEST (4:50 pm DST) on the 21st of December.

Figure 22: View of the Nile burn from near the point of closest approach to the C416 Nile Road.

Figure 23: Telephoto view of the Nile burn from near the point of closest approach to the C416 Nile Road.