Squall Detector Ver 1.2

User's Manual

Table of Contents

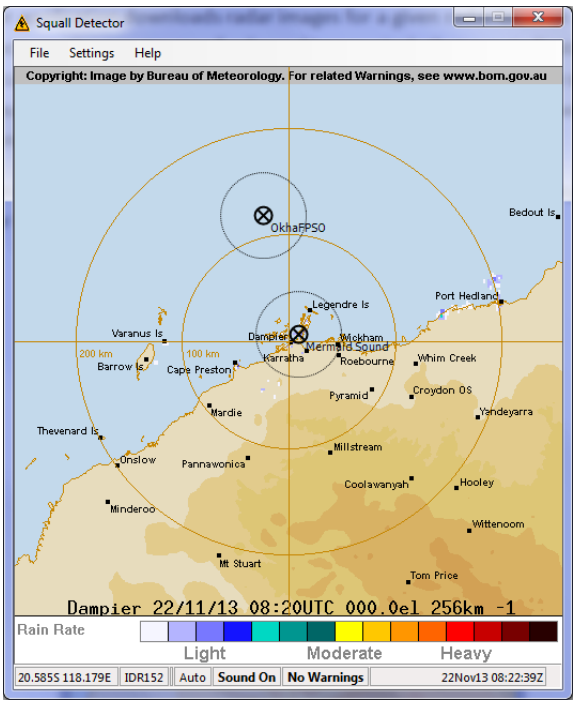
Introduction

Squall Detector alerts the user of:

1) Squalls in the general area covered by a radar location, and
2) An impending squall within a given radius of one or more specific locations of interest

The Squall Detector application downloads radar images for a given radar location at regular intervals, and detects contiguous groups of coloured image pixels that may indicate the presence of a squall. The application will warn the user both visually and audibly that possible squalls have been detected in the area covered by the radar, and if the possible squall is within a given radius of a specific location, another more 'urgent' visual and audible cue will be issued.

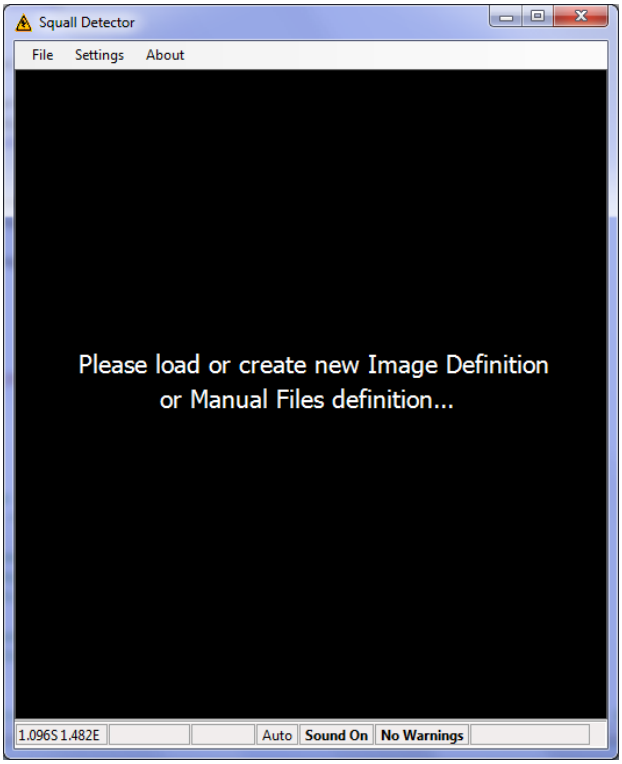
Squall Detector can also be used to loop through historical radar images, to re-play squall events at rates much quicker than real-time.



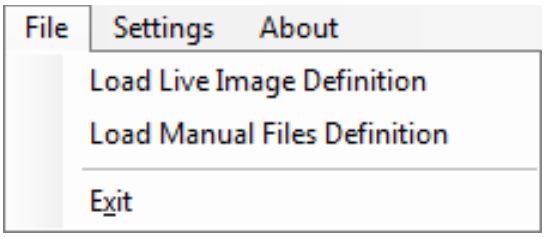
Squall Detector is highly configurable, and is able to use the Australian Bureau of Meteorology's layered radar images (background, topography, legend, range and echo layers).

Starting Squall Detector

Squall Detector starts by inviting the user to load or create an **Image Definition** or **Manual Files Definition**. If the user chooses an Image Definition, then the program runs in Auto mode. If the user chooses a Manual File definition, then the program runs in Manual mode



The user can now load an **Image Definition** or **Manual Files Definition** from the File menu:



Squall Detector may also be invoked from the command line or from a Windows Shortcut, using the arguments:

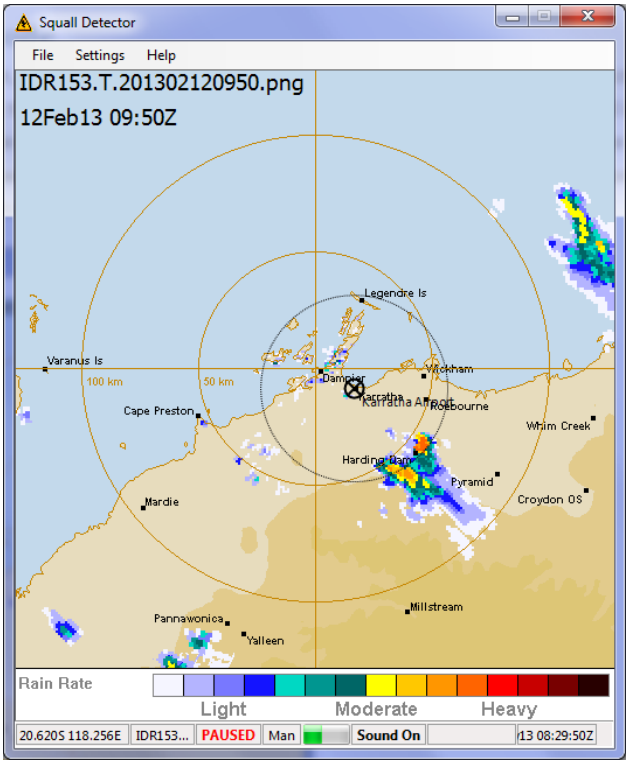
```
SquallDetector.exe -image:NameOfImageDef (e.g. -image:"Perth 128")
SquallDetector.exe -manfiles:NameOfManualFilesDef (e.g. -manfiles:ManualFiles)
```

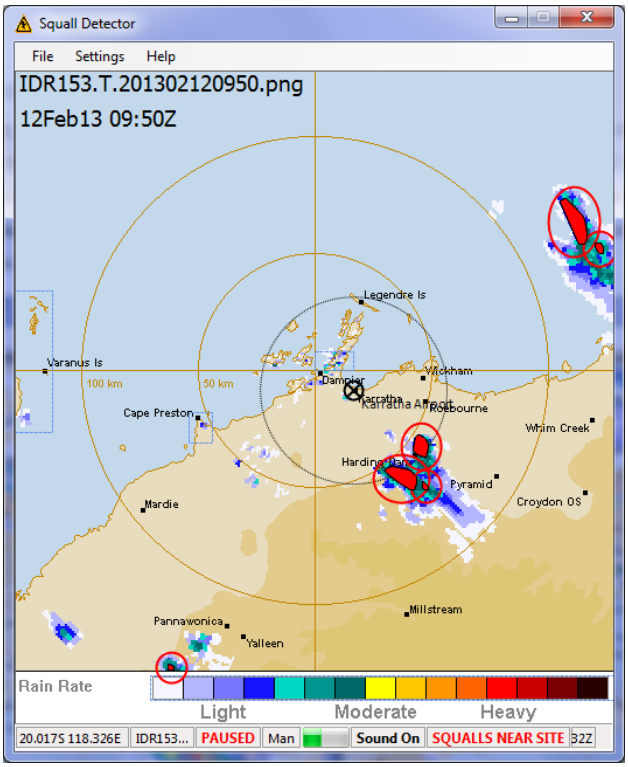
Note that if a space occurs within the definition name, double quotes should be placed around the name. Both arguments may be given simultaneously:

```
SquallDetector.exe -image:NameOfImageDef -manfiles:NameOfManualFilesDef
```

Automatic Mode

In automatic mode, Squall Detector will use the given **Image Definition** (previously created by the user) to download the latest live radar images for the specified radar location and immediately detect any possible squalls, alerting the user when found. The image will loop the last three processed images (with squall outlines and alerts), every second, then alternate between the latest processed image and the original image (one second per image) – both with locations of interest marked:





When a squall is detected anywhere on the radar image (away from any location of interest), a soft warning sound (by default) is emitted alerting the user, together with a (configurable) visible warning on the status bar, e.g. a red “SQUALLS ON IMAGE”. An optional warning message can also be spoken by the application, using the Windows Speech engine.

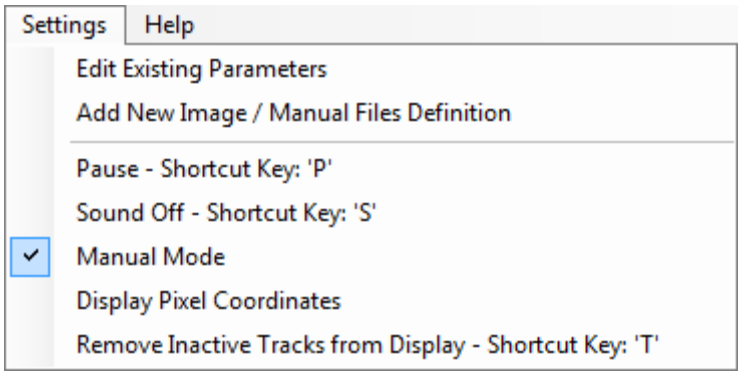
When a squall is detected within the radius of any location of interest, a louder (by default) claxon warning sound is emitted alerting the user, together with a (configurable) visible warning on the status bar, e.g. a red “SQUALLS NEAR SITE”. An optional danger message can also be spoken by the application, using the Windows Speech engine.

Manual Mode

In Manual Mode, Squall Detector will use a given **Manual Files Definition** (previously created by the user) to load the given radar image files from hard disk, using the **Image Definition** defined in the **Manual Files Definition** for the related radar location. As in Automatic Mode, the program will immediately detect any possible squalls on each image, alerting the user when found. The image will alternate between the processed image (with squall outlines and alerts) and the original image (one second per image) – both with locations of interest marked.

Each file will be looped in order every 10 seconds (configurable) before starting over again.

The Settings Menu



Pause

Clicking the Settings | Pause menu item to *checked*, or pressing the 'P' or 'p' key, will pause the image updates, and the status bar will display the word "**PAUSED**".

Sound Off

Clicking the Settings | Sound Off menu item to *checked*, or pressing the 'S' or 's' key, will turn the warning sounds off. *Note that the sound will automatically turn on again after 30 minutes (configurable)*.

Manual Mode

Clicking the Settings | Manual Mode menu item will switch run modes between Manual Mode and Automatic Mode.

Display Pixel Coordinates

Clicking the Settings | Display Pixel Coordinates menu item to *checked*, will cause the status bar to display pixel coordinates instead of Latitude and Longitude when the mouse is moved over the image

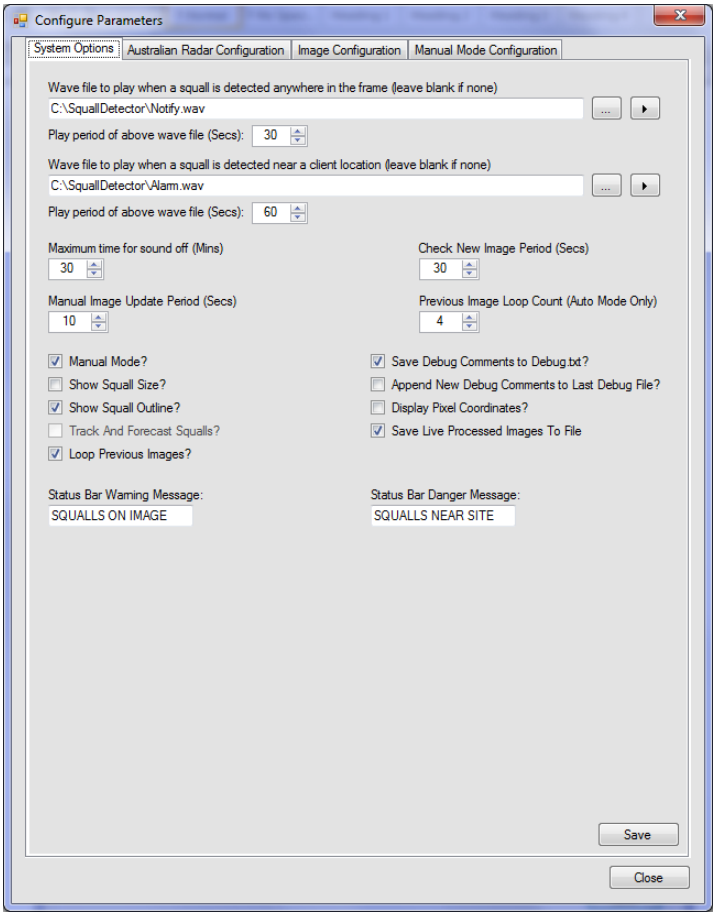
Remove Inactive Tracks from Display

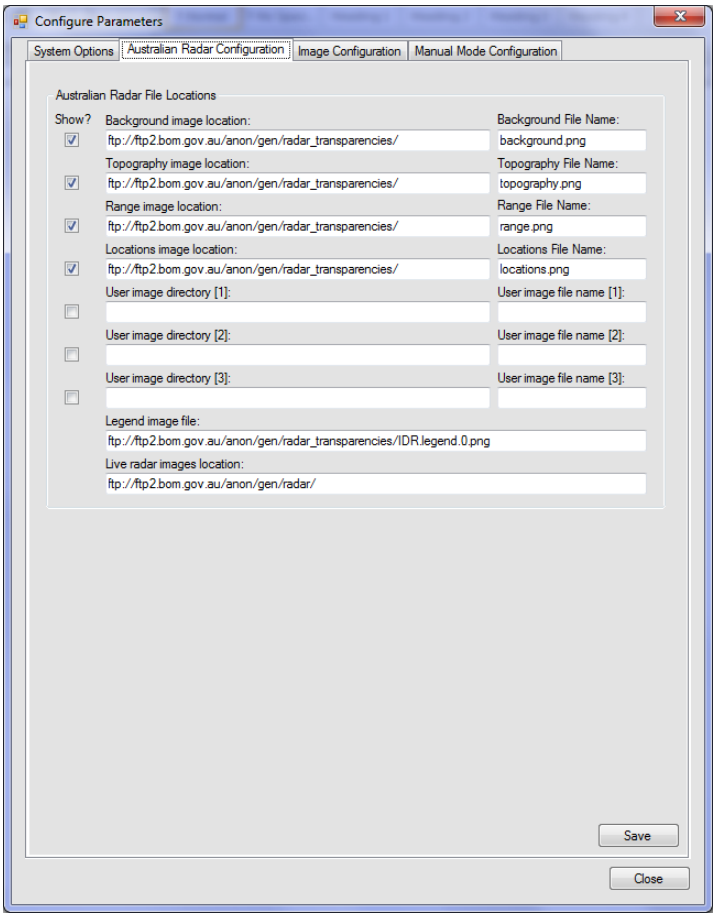
Future development - Used only when the tracking and forecasting mode is enabled

Edit Existing Parameters

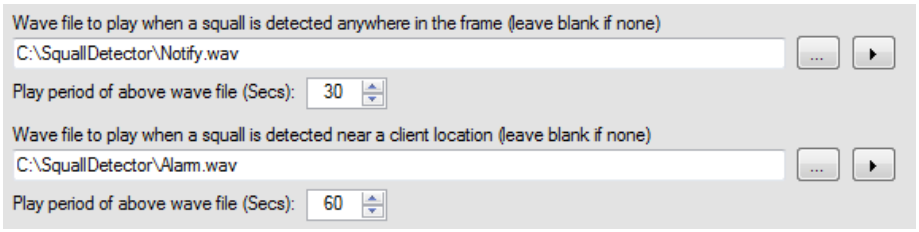
System Options:

The System Options apply to the running system for all Image and Manual Files Definitions:


Configure Parameters
System Options
Australian Radar Configuration
Image Configuration
Manual Mode Configuration
Wave file to play when a squall is detected anywhere in the frame (leave blank if none)
C:\SquallDetector\Notify.wav
Play period of above wave file (Secs): 30
Wave file to play when a squall is detected near a client location (leave blank if none)
C:\SquallDetector\Alarm.wav
Play period of above wave file (Secs): 60
Maximum time for sound off (Mins)
30
Check New Image Period (Secs)
30
Manual Image Update Period (Secs)
10
Previous Image Loop Count (Auto Mode Only)
4
Manual Mode?
Show Squall Size?
Show Squall Outline?
Track And Forecast Squalls?
Loop Previous Images?
Save Debug Comments to Debug.txt?
Append New Debug Comments to Last Debug File?
Display Pixel Coordinates?
Save Live Processed Images To File
Status Bar Warning Message:
SQUALLS ON IMAGE
Status Bar Danger Message:
SQUALLS NEAR SITE
Save
Close

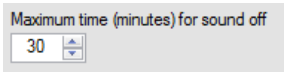

Configure Parameters
System Options
Australian Radar Configuration
Image Configuration
Manual Mode Configuration
Australian Radar File Locations
Show?
Background image location:
ftp://ftp2.bom.gov.au/anon/gen/radar_transparencies/
Background File Name:
background.png
Topography image location:
ftp://ftp2.bom.gov.au/anon/gen/radar_transparencies/
Topography File Name:
topography.png
Range image location:
ftp://ftp2.bom.gov.au/anon/gen/radar_transparencies/
Range File Name:
range.png
Locations image location:
ftp://ftp2.bom.gov.au/anon/gen/radar_transparencies/
Locations File Name:
locations.png
User image directory [1]:
User image file name [1]:
User image directory [2]:
User image file name [2]:
User image directory [3]:
User image file name [3]:
Legend image file:
ftp://ftp2.bom.gov.au/anon/gen/radar_transparencies/IDR.legend.0.png
Live radar images location:
ftp://ftp2.bom.gov.au/anon/gen/radar/
Save
Close

Wave Files:



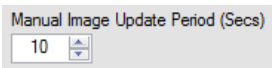
The user may change the default wave files to play when squall warnings are active, as well as the period between sounds.

Sound Off Timeout:



The user may change the default period that governs when the sound is automatically switched back on.

Manual Image Update Period:



The user may change the default period between image file updates in Manual Mode.

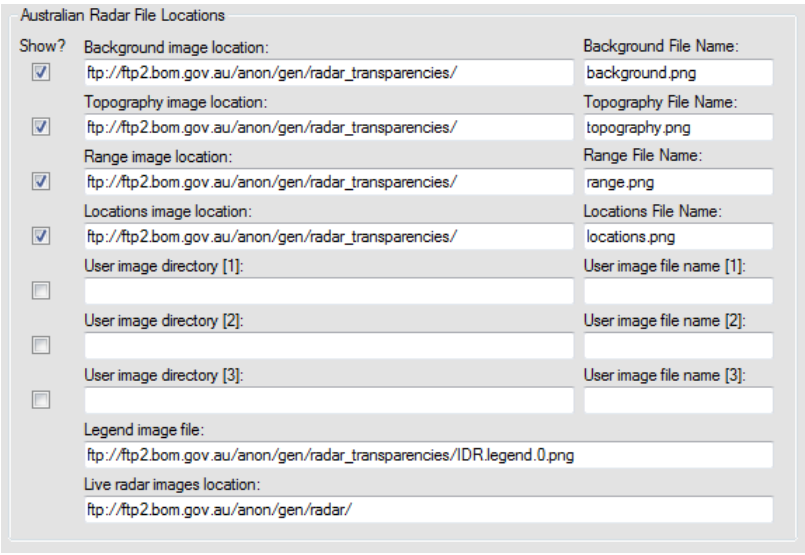
Options:

Option	Explanation
☑ Manual Mode?	Toggle between Manual and Automatic Modes
☐ Show Squall Size?	If checked, displays the size of the squall area in square pixels
☑ Show Squall Outline?	If checked, outlines the detected squall area in blue
☐ Track And Forecast Squalls?	For future development…
☑ Loop Previous Images?	If checked, the last 3 received (processed) images will loop before the current image
☑ Save Debug Comments to Debug.txt?	If checked, saves internal debug comments to the file Debug.txt in the working directory. Useful for fixing any bugs
☑ Append New Debug Comments to Last Debug File?	If checked, internal debug comments are appended to an existing Debug.txt file, instead of starting a new file every time Squall Detector restarts
☐ Display Pixel Coordinates?	If checked, Squall Detector's status bar displays mouse coordinates in pixels instead of Lat/Long
☑ Save Live Processed Images To File	If checked, the processed images will be saved to hard disk, in "today's" directory off the working directory

Status Bar Warning Messages:

The user may change the message that gets flashed on the status bar in red when squalls appear on the radar image (warning) and when a squall is near a location of interest (danger).

Australian Radar File Locations:



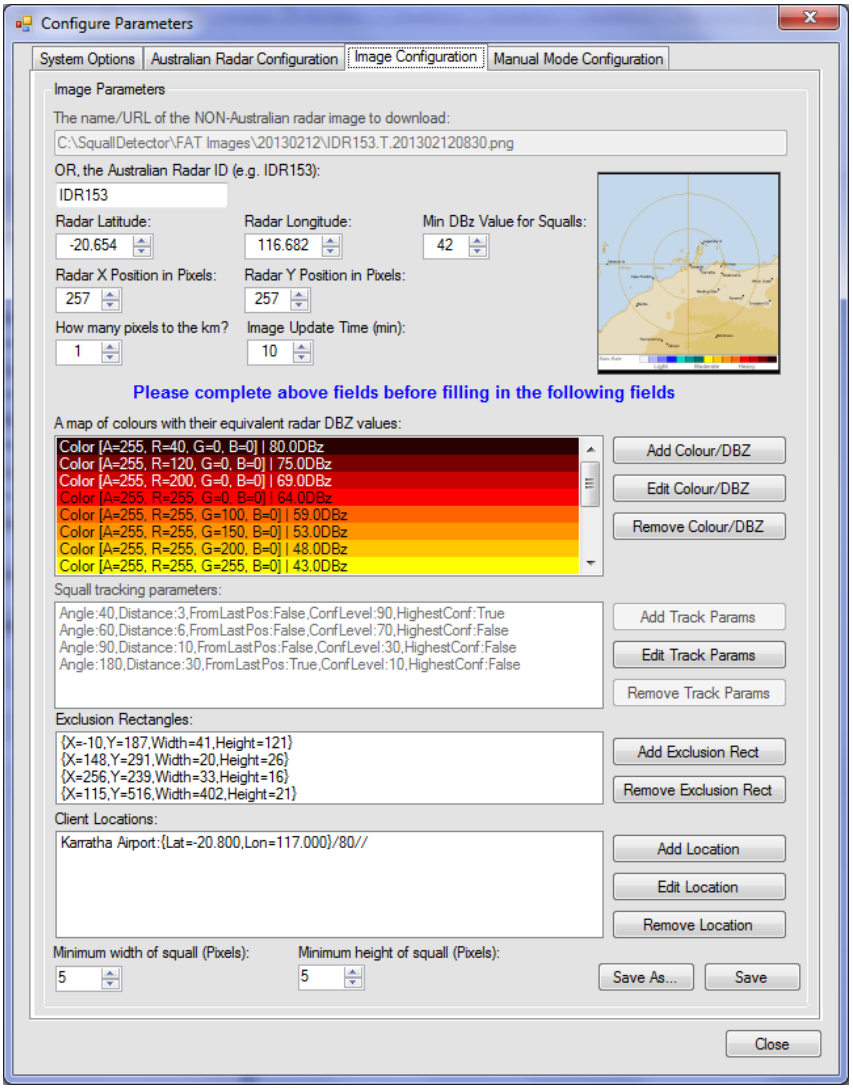
The user may change the default FTP locations of the BoM radar files, should BoM decide to relocate their FTP radar images.

The user may turn off layers that are displayed in Squall Detector when using Australian Radar images but unchecking the appropriate *Show?* check box. The legend and live radar echo layers cannot be turned off.

Three user overlays may also be specified, and if the appropriate [Show] check box is checked, these overlays will be included on the processed image.

Image Configuration:

The Image Definition is created and maintained in the following tab:

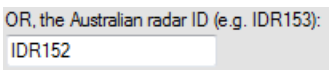


The following information MUST be supplied before adding colours, exclusion rectangles and locations to the Image Definition.

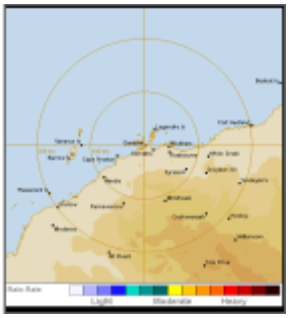
The Name/URL of the Radar Image to Download:

The user may supply the name of a radar image to download from a source other than the Australian BoM. This option is currently disabled as no testing has been done on this feature.

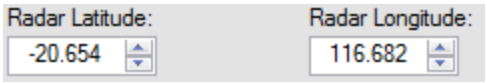
The Australian Radar ID:



To download and view Australian BoM images, the user must enter the Radar ID. This ID is used to format all the appropriate Australian radar image layers. Once the user has entered a valid ID, the thumbnail image to the right of the tab will update with the appropriate overlay images:

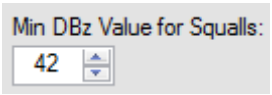


The Radar Latitude and Longitude:

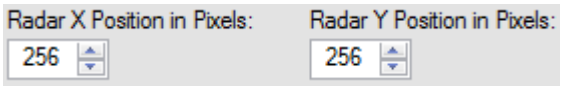


The user must supply the radar's latitude and longitude in decimal degrees, to 2 or 3 decimal places. This information is used to compute the lat/long of locations of interest.

The Minimum dBZ Reflectivity Value That Defines a Possible Squall:

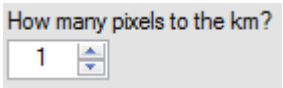


The Radar Pixel Location:



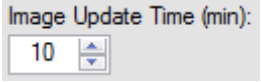
The user must supply the radar's pixel position. This data is initially computed from the loaded image (when the user supplied the Radar ID), but may be updated. This information is used to compute the lat/long of locations of interest.

The Pixel to Kilometre Conversion:



The user must supply the number of pixels per kilometre. The Australian radar images for 128km range usually have 2 pixels per km, whilst images for 256km range are 1 pixel per km.

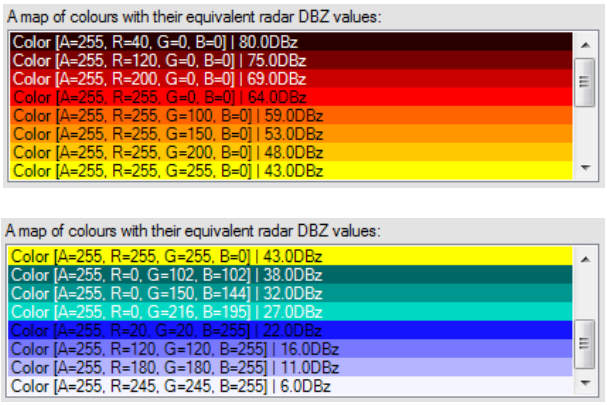
The Image Update Time:



The user must give the frequency of images supplied by BoM. These differ from radar site to radar site. Perth and Dampier update their images every 10 minutes, whilst Melbourne and Sydney update their images every 6 minutes.

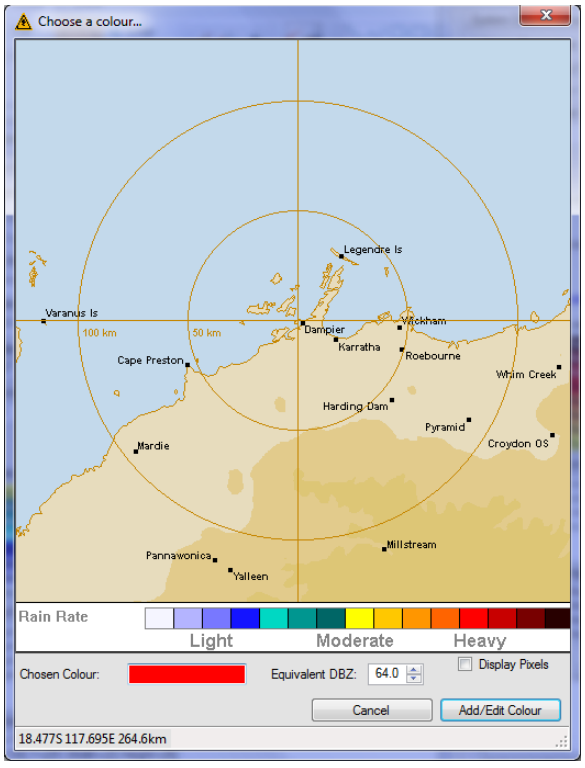
The following fields may now be created or updated.

Squall Colour to dBZ Mapping:



The user must specify the colours and their equivalent dBZ reflectivity values used on the selected radar image, that Squall Detector will flag as a possible squall. All pixels that have a colour with an equivalent dBZ value greater than "**The Minimum dBZ Reflectivity Value That Defines a Possible Squall"** given above retain their orginal colours, and all other colours are internally changed to black, before the resultant image is analysed for 'blobs'. The polygons for each 'blob' are considered possible squall areas.

To add a colour, click [Add Colour]. The following dialog is displayed with the latest combined radar image:



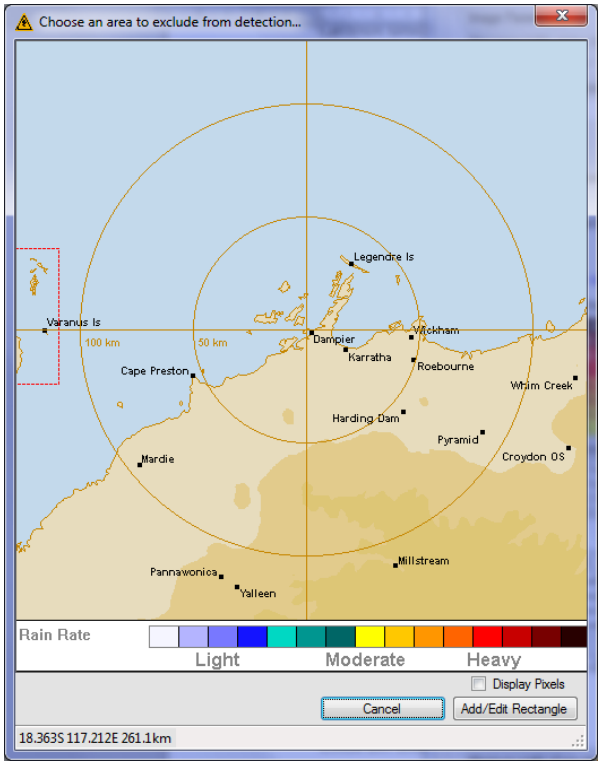
Click a colour on the image's palette:  to record the colour and specify the equivalent dBZ value, then on click [Add/Edit Colour]. This colour will be added to the list of colours, together with it's RGB values and dBZ value. Repeat this process for the other colours in the palette.

To remove a colour from the colour list, select that item and click [Remove Colour].

Exclusion Rectangles:

The user may specify those areas that should NOT be analysed, i.e. areas where false squall echoes are frequent, and the colour palette, which obviously must be excluded, since Squall Detector cannot distinguish between an echo image and a palette colour.

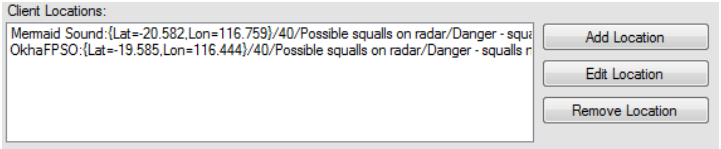
To add an exclusion rectangle, click [Add Exclusion Rect]. The following dialog is displayed with the latest combined radar image:



Click on the map and (holding the right mouse button), drag the mouse cursor to see a dashed red line form a rectangle. Do this for areas on the image that must be excluded from analysis. When one rectangle has been selected, click [Add/Edit Rectangle]. This rectangle will be added to the list of rectangles. Repeat this process for more exclusion rectangles.

To remove a rectangle from the rectangle list, select that item and click [Remove Exclusion Rect].

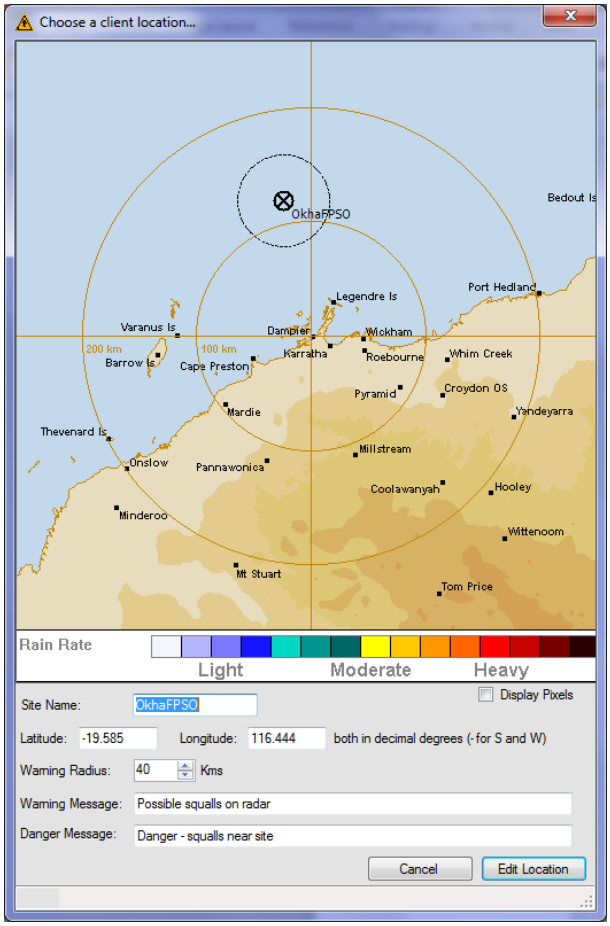
Client Locations:



The user may specify locations of interest (i.e. client locations) on the image, that should a squall approach a location, the application will warn the user that a squall may be imminent. For each location, the following information must be given:

1) The name of the location
2) The Lat/Long of the location
3) The radius from the location that differentiates between a warning and danger
4) Optional spoken sentences for warnings and when the site is in danger. These sentences are spoken using the Windows Speech engine

To add a client location or location of interest, click [Add Location], or to edit an existing location, select a location to edit in the list, and click [Edit Location]. The following dialog is displayed with the latest combined radar image:



Enter or edit the name of the location.

To select the position of a location, either click on the image at the appropriate position, or manually enter the Lat/Long in the Latitude/Longitude text boxes in decimal degrees. Note that the latitude is negative for positions south of the equator, and the longitude is negative for positions west of the UTC meridian.

Enter or edit the warning radius, in km.

Enter or edit the optional spoken warning/danger messages.

To remove a location from the location list, select that item and click [Remove Location].

The Minimum Squall Sizes:

The user must specify the minimum width and height of any 'blob' on the image above which it will be analysed, and below which it will be ignored.

Save Image Definition:

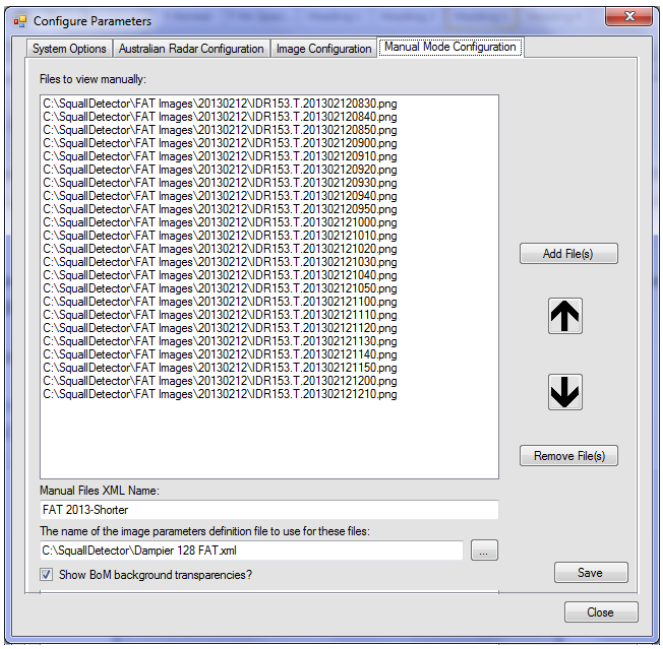
Click the [Save] button to save this **Image Definition** to the current existing image definition. For new definitions, the program will request an Image Definition Name (the file name) for the definition.

Click the [Save As…] button to save this **Image Definition** to a new image definition name. The program will request an Image Definition Name (the file name) for the definition.

The definition will be saved under the given name as an XML file, e.g. *DefName*.xml

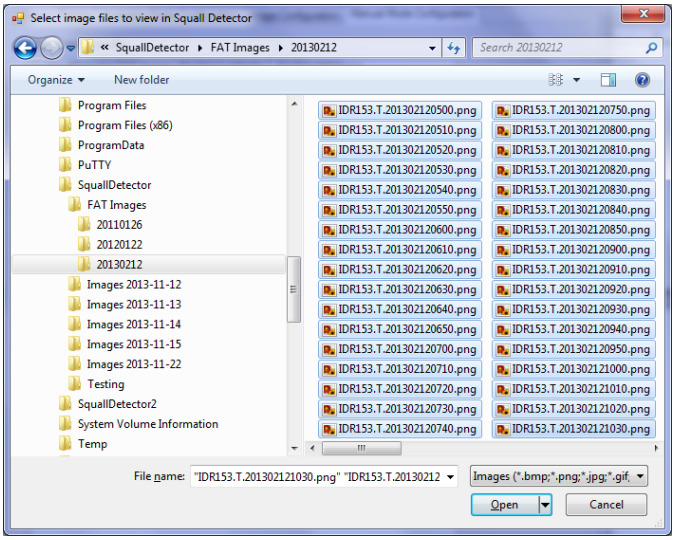
Manual Mode Configuration:

The Manual Mode Definition is created and maintained in the following tab:



Add Files:

To add files to the list of files to view in a loop in Manual Mode, click [Add File(s)]:



Select all the files that must be looped and click [Open]. These files will be added to the list.

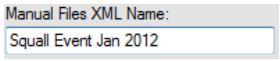
Remove Files:

Select the files to be removed from the list, and click [Remove File(s)]:

Move Files:

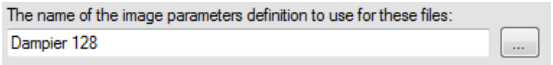
Select one file to be moved and click the [UP] button to move the file upwards in the list, or the [DOWN] button to move the button downwards in the list.

The Name of the Manual Files Definition (File Name):



Enter the name of the manual files definition. The associated XML file will be saved under this name.

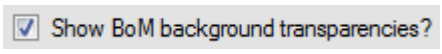
The Image Definition to Use For These Files:



The user must specify the **Image Definition** to use to view these manual files. For example, the file images to loop may from the Melbourne radar, so a Melbourne image definition must be used (to get the appropriate pixels per km conversion and radar positions).

Show BoM Background Transparencies

If the selected images only comprise echoes, and require BoM transparencies (background, topography, range etc), check the following check box. If the images are already composites of all the transparencies, uncheck this box.



Save Manual Files Definition:

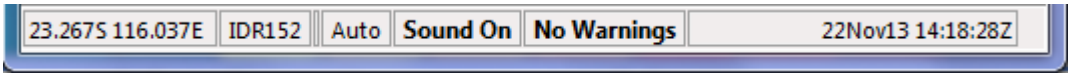
Click the [Save] button to save this **Manual Files Definition**.

Add New Image/ Manual Files Definition

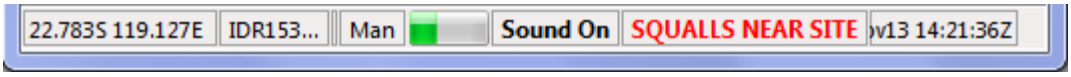
Adding either a new **Image Definition** or a **Manual Files Definition** follows the same process as in "Edit Existing Parameters" above, except that all fields are either blank or initialized to default values on entry.

Status Bar

Auto Mode



Manual Mode



The status bar displays:

1) The current mouse position as Lat/Long, or in pixels if the Settings | Display Pixel Coordinates menu item is *checked*
2) The current image name, or BoM radar ID
3) A red warning message reminding the user that the application has been paused
4) An indication of the current run mode, i.e. Auto or Manual mode
5) In manual mode, a progress bar indicating the progress of the entire image loop
6) A red warning message reminding the user that the application's sound is off
7) A flashing red warning message regarding squalls on the image, or simply "No Warnings"
8) The current date and time in UTC

Help