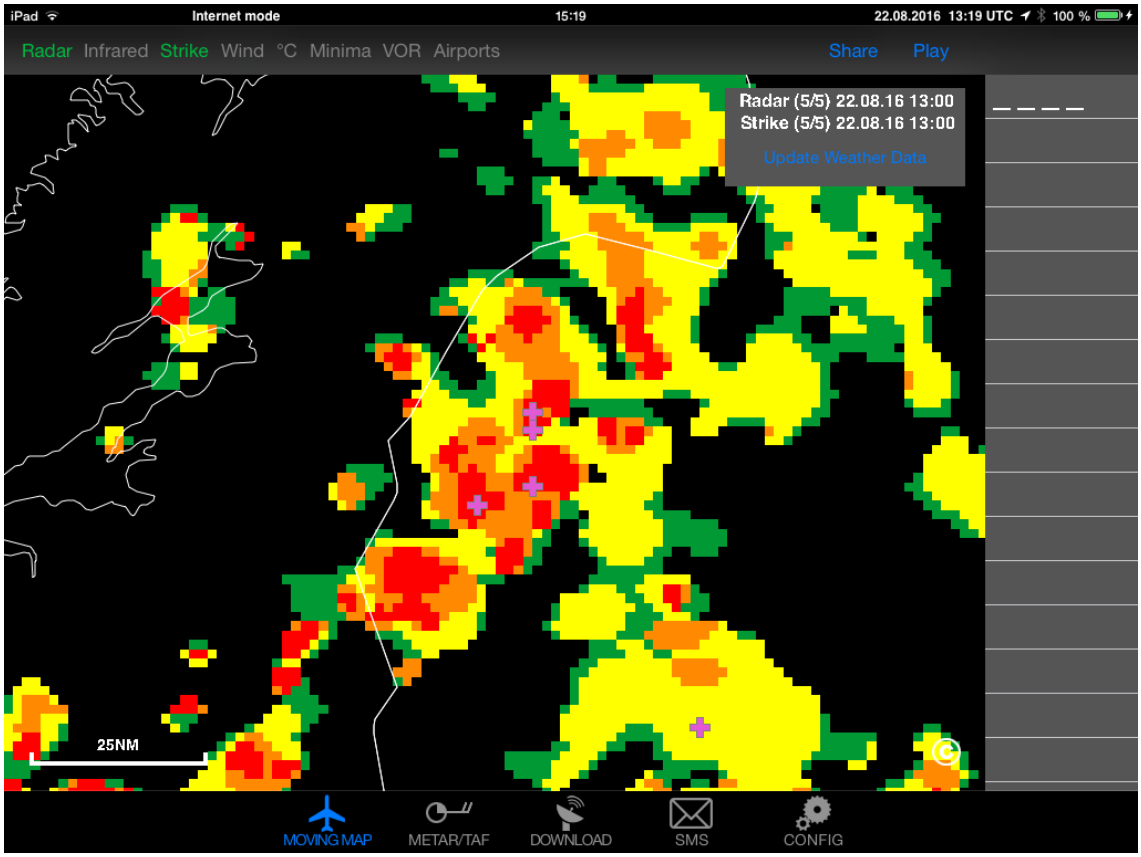


ADL110B ADL120 ADL130 ADL140

How to use radar and strike images

Version 1.00

22.08.2016

WARNING: Like any information of the ADL in flight weather system radar and strike images are for situational awareness only. Pilots shall not use the ADL system as primary mean of weather avoidance. Please use good judgement and common sense in all your weather avoidance decisions.

1 General Description Radar Maps

Ground based weather radar images combine the data from many local radar sites into one composite image. Each radar site operates rotating radar which emits electromagnetic radiation and detects the part of the radiation which is reflected back to the antenna. Such reflection occurs at particles in the atmosphere. Most of the time these particles are water droplets, ice or snow crystals. Those are the wanted returns giving information about the weather.

But one must keep in mind that other objects might also produce radar returns. This could be flocks of birds, sand particles in the atmosphere or big structures like ocean ships. Usually the radar operator tries to filter fixed known objects in the vicinity of his antenna like mountains, high buildings etc. Due to the difficulties and high expenses associated with the operation of a radar antenna most are run by the national weather services only. Thus, most of the radar data available on the ADL system is the same as used by other systems. Only the processing, filtering etc. is different.

Please also note that radar technology only detects water droplets with a certain minimum size. Simple clouds, fog etc. will usually not be detected. Also very low weather obscured by terrain will not be detected if it is far away from the antenna. In addition the radar antenna will not be able to measure straight up. But this is not a big issue in the final image since most of the time a neighboring radar site will cover this area with its beam.

Radar antennas are usually operated on land only. So taking into account a maximum range of about 240 kilometers only coastal waters will be covered. There is no radar coverage on the ocean and all weather systems pretending such coverage are in fact using inferior satellite based data, predictions etc.

So why do we use radar data in aviation? In fact the presence of big water droplets in the atmosphere in itself is no hazard for a properly equipped aircraft. But the area with such big water drops usually correlates with the areas of strong vertical movement in convective weather. Those are the areas with strong turbulence which is the main flight hazard we try to avoid. So avoiding the radar returns proves to be a good strategy to avoid unpleasant and dangerous turbulence.

2 Limitations of radar maps

While data link radar images are a very powerful tool there are some important limitations:

- Weather detection can be obscured by terrain or obstacles next to the radar antenna

- The radar data might be false due to display or processing errors

- The radar data will always be delayed as the data have to be measured by the antenna, processed, transmitted to the aircraft and displayed. So the information visible in flight represents the situation at a certain point in the past. Especially convective weather could have changed significantly in the meantime.

- Clear air turbulence can not be detected by current weather radar

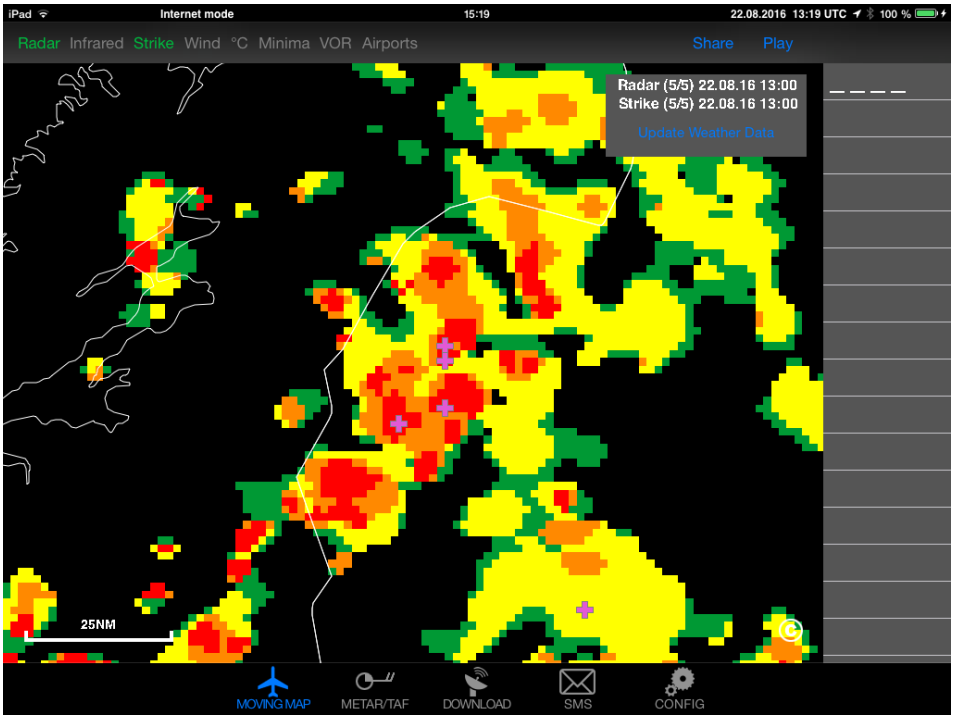
- Radar images usually give no indication of the vertical extend of the detected echoes. Only in some cases this information can be deducted using other technologies like infrared images etc.

3 Which radar scale does the ADL system use?

	Transparent / background map -> outside coverage area
	No radar echos but in coverage area
	Light echos / typical precipitation 0,2-2,0 mm/h
	Moderate echos / typical precipitation 2-10 mm/h
	Heavy echos / typical precipitation 10-30 mm/h
	Very heavy echos / typical precipitation 30 or more mm/h

Please note that we try our best to calibrate the different national radar sources in order to get a uniform image. But nevertheless there might still be differences in the calibration. We do know that Italian radar underestimates the returns while Norwegian radar tends to overestimate the echoes.

The following map shows a typical radar map containing all available colours except the transparent background "colour".

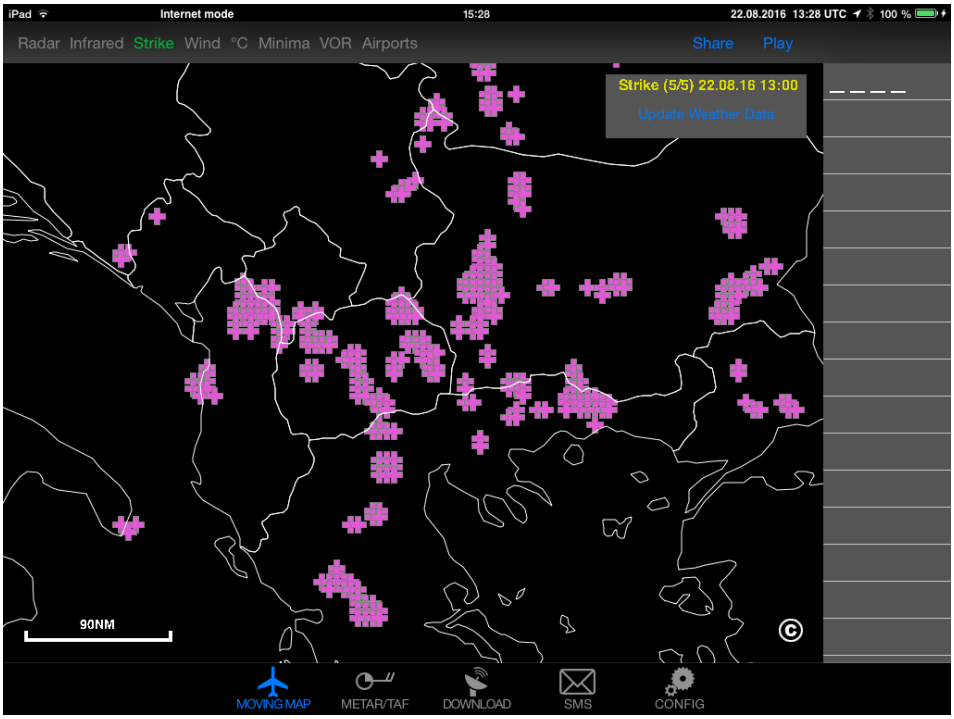


4 General description strike maps

In addition to the radar maps the ADL system can display lightning strike maps. The strikes are detected by a ground based networks of radio detectors. Due to triangulation this network is able to determine the location of the individual strikes very precisely while classical on board detectors operate with a much bigger error. Cloud to ground and cloud to cloud discharges are detected. In contrast to radar technology different strike data providers exist and we currently cooperate with nowcast for European strike data.

Strikes are shown as magenta crosses on the moving map. One cross indicates one or more strikes at this location in the last 15 minutes before the timestamp. European strike data is updated every 15 minutes in sync with radar data.

The following images shows an area of intensive strike activity:



5 Limitations of strike maps

Due to the superior range of the detectors compared to radar technology strike data is available far beyond typical radar coverage. But nevertheless there are some limitations:

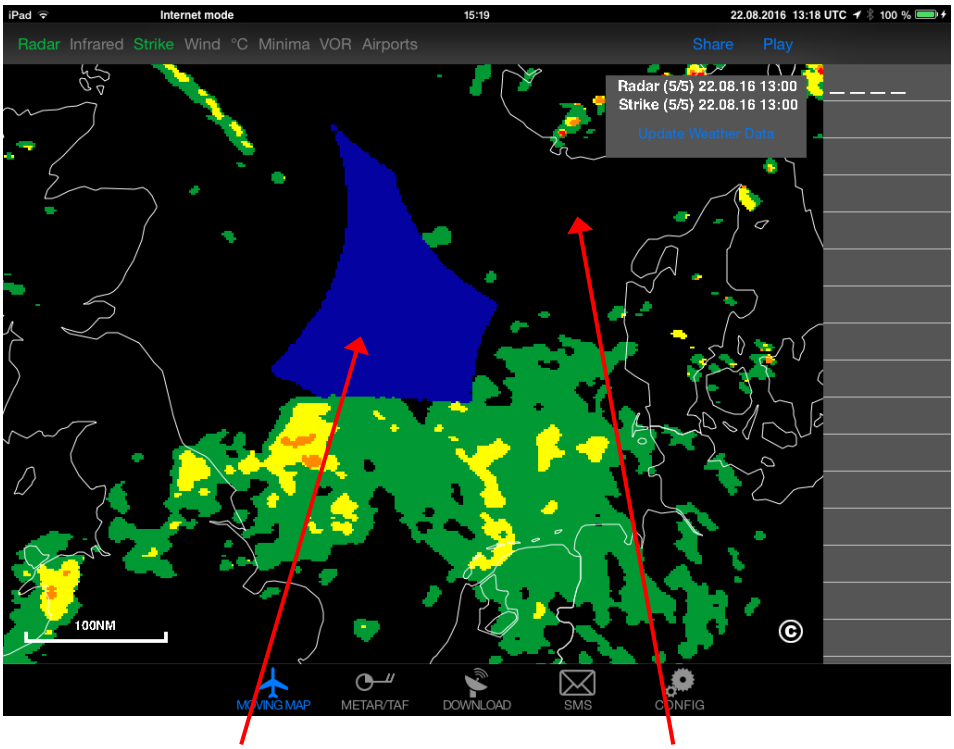
- The radar data might be false due to display or processing errors

- The strike data will always be delayed as the data has to be collected by the antenna, processed, transmitted to the aircraft and displayed. So the information visible in flight represents the situation at a certain point in the past. Especially convective weather could have changed significantly in the meantime.

- Not all hazardous weather phenomena also produce strikes. Strong convective weather can exist without any strike activity at all or strike activity could only begin in the mature stage of the convective cell.

6 Coverage Area

It is very important to distinguish between areas for which currently no weather data is available or downloaded and areas which for which data has been downloaded but not radar or strikes have been detected. The following images illustrate this difference:



Area outside radar coverage

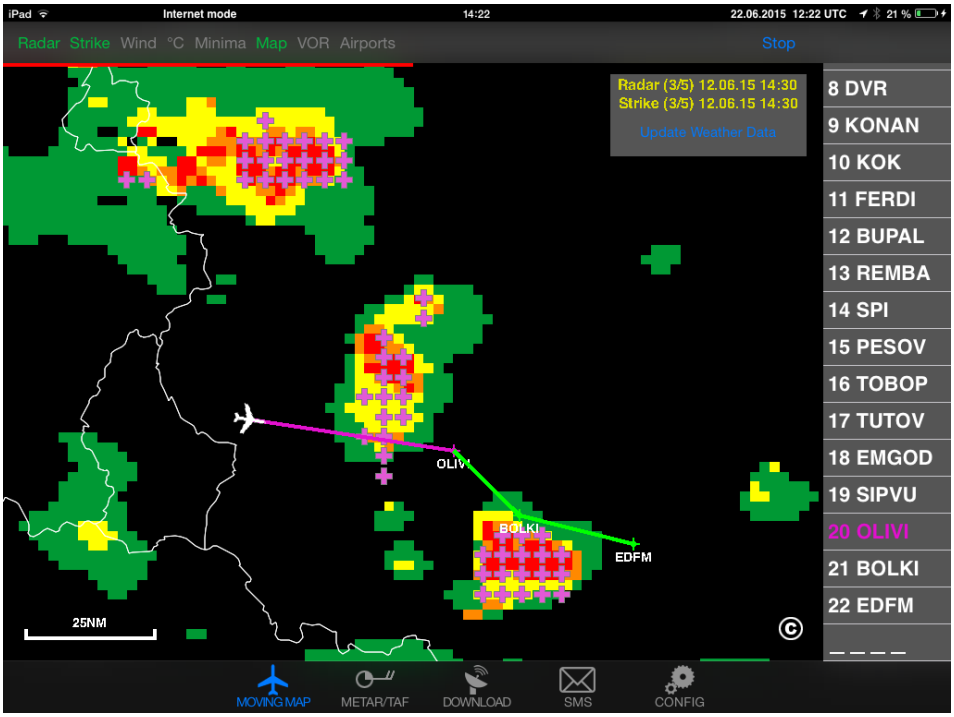
Area with radar coverage but without any echoes

ATTENTION: The current coverage of the strike data is only visible if radar and infrared images are turned off. Else only the magenta crosses for the strike events are visible but no coverage area.

7 Thunderstorms

Thunderstorms show up very well on radar images. You will see orange and red cells surrounded by yellow and green areas. NEVER USE the ADL as your means of primary weather avoidance. We recommend to use good judgment and practice has shown that generously avoiding the thunderstorm system completely including the green areas often brings good results.

The following image shows three thunderstorm cells. The cells also show intense lightning collocated with the radar echoes.



Combining the radar with the strike images helps to verify that radar system is working properly. Strike data is processed separately except for the final display. So if the strikes line up with the radar data this is a good indication the whole system is working properly.

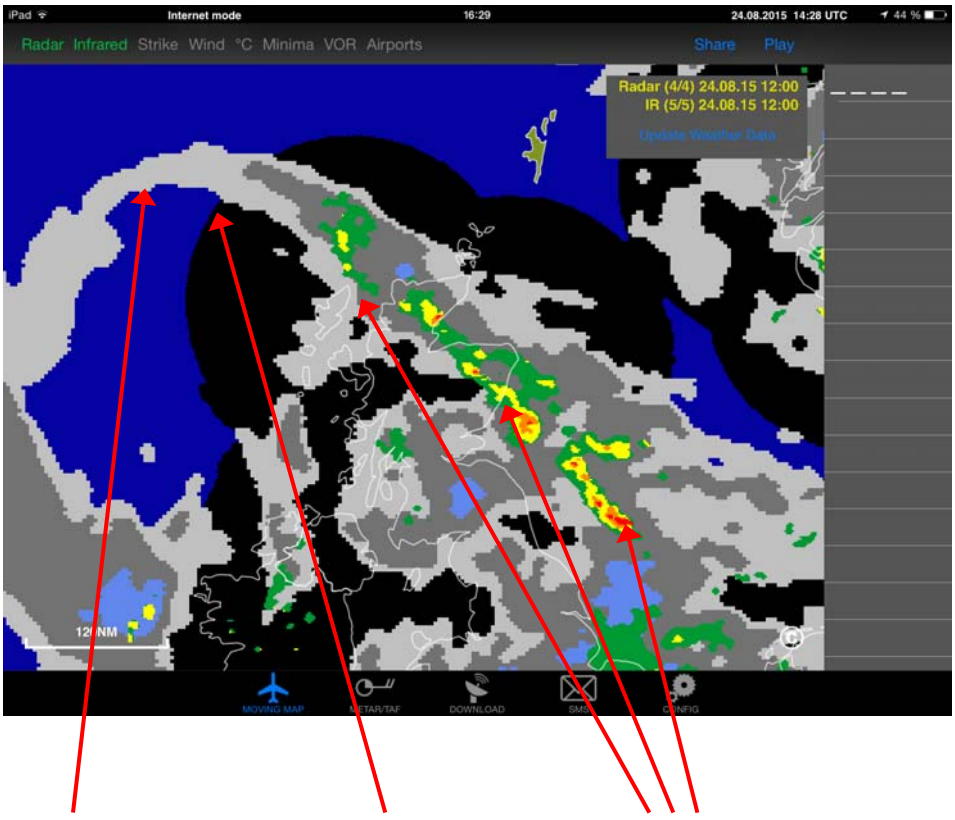
The final decision on how to avoid weather is up to the pilot in command but experience has shown that over flying the thunderstorm cells depicted in red and orange is not possible except in some jet aircraft under certain circumstances. In general lateral avoidance proves to work out best.

8 Frontal weather

Radar will show frontal weather as long torn apart structures. Except in case of an extremely active cold front strikes will only be present in parts of the frontal area. Recognizing the full extend of a frontal area based on strike data alone is usually not possible.

Depending on aircraft type and equipment frontal weather can be over flown in visual meteorological conditions or the frontal area can be crossed. Practice has shown that aiming for the weakest part of the front on the radar image and then verifying the final path using on board radar or visual observations works out best. DO NOT cross frontal areas in instrumental meteorological conditions based on the ADL weather data system only.

The following image shows a front showing radar returns overlaid with infrared data showing how the front extends beyond the radar coverage area.



Front extending beyond the coverage area visible as infrared returns only

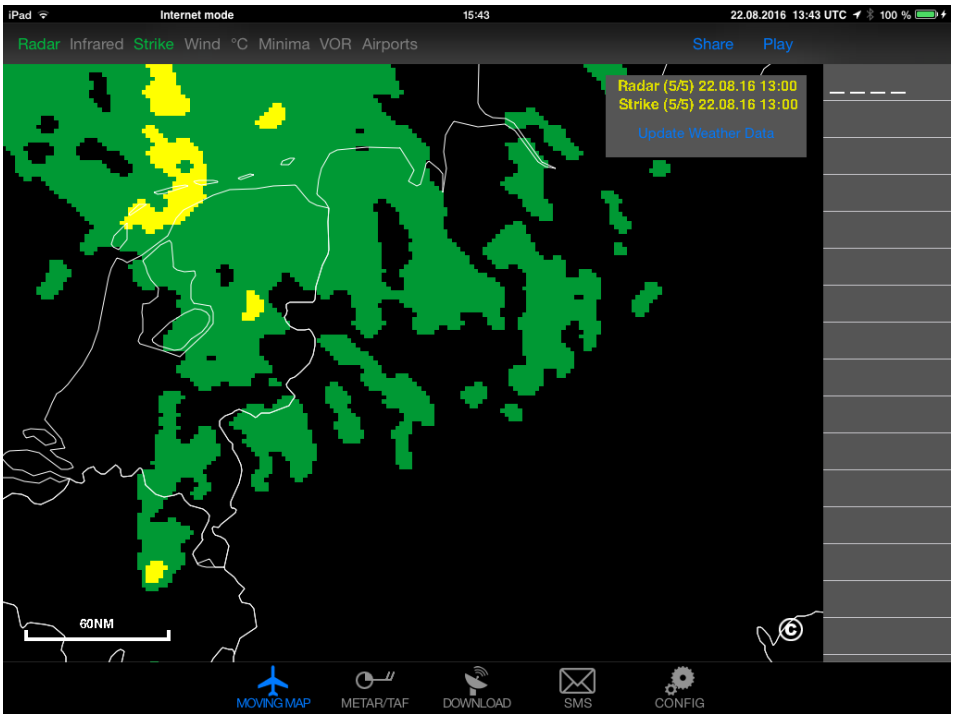
Limit of radar coverage area

Frontal weather

9 Rain and Snow Showers

Rain and snow showers from low hanging clouds often produce only green echoes or when very low no echoes at all. The ADL system can help to distinguish between a shower and a massive rain system producing continuous rain. But this is an indication only. NEVER rely on the ADL system as primary means of landing weather information. Use the official METAR/TAF and ATIS broadcasts. Please note under certain circumstances it can be hard or impossible to distinguish between green areas with rain showers and areas with false radar returns around a radar antenna. Using the animation feature showing multiple radar images as a movie can help as the rain shower will usually move downwind while antenna noise will be stationary.

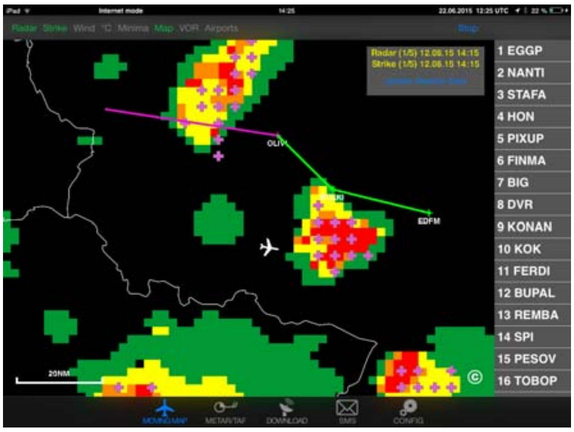
The following image shows green areas which are typical of rain or snow showers.

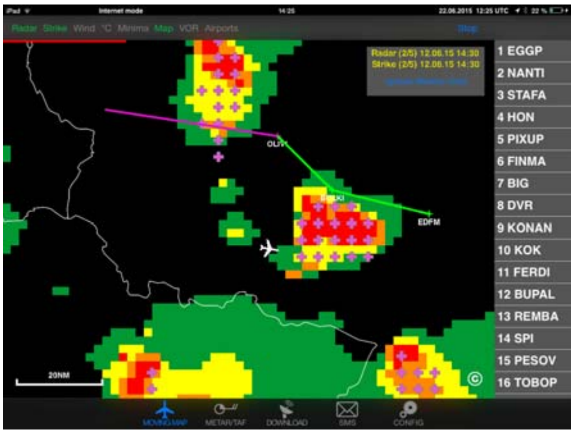


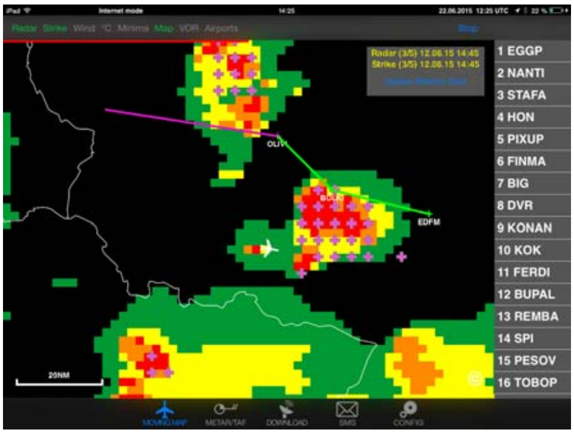
10 Animations

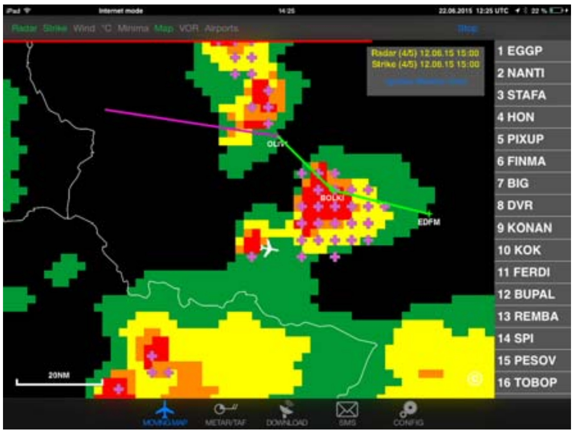
The ADLConnect app is able to display multiple images as an animation. Watching the animation helps understanding in which direction the weather system is moving, if convective cells are getting bigger or smaller etc.
Whenever the app has got two or more images which are within one hour of each other the "Play" button will appear at the right top of the screen allowing to start the animation. A red line at the to of the screen will indicate which image sic currently shown in the sequence.

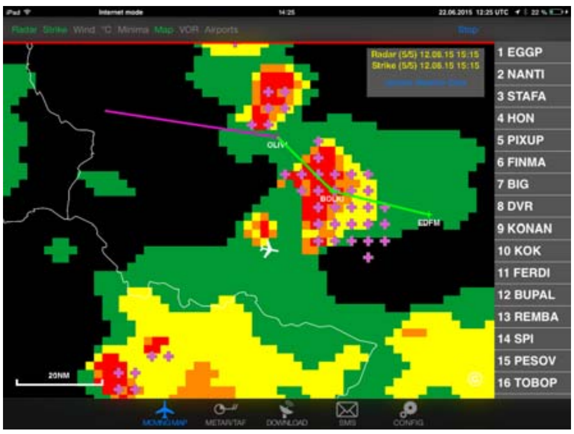
The following images who a five image animation for radar and strike data











11 Aircraft Icing

Radar and strike images are not designed to avoid aircraft icing. We do know that serious icing hazards can exist in thunderstorm cells which can usually be seen on radar images. But super cooled water droplets causing dangerous icing can also exist in clouds which do not have droplets big enough to show up on the radar. Please use certified icing predictions to stay out of dangerous icing conditions if your aircraft is not equipped accordingly.

12 Timestamps

All radar and strike maps come with timestamps which are shown on the right top corner of the map. Before using the radar and strike maps please always take into account the timestamps. The timestamp of a map shows the timestamp of the latest meteorological information contained in the map. Due to measurement delays individual weather features can be older than the timestamp shown.
European radar and strike data is currently published with timestamps 0, 15, 30 and 45 minutes each hour. Due to processing this data is available each hour at 04, 19, 34 and 49. Thus, requesting new weather downloads at those four moments each hour is the most effective. When using the automatic download mode this is done automatically by the ASL system.

13 On Board Radar

The ADL system can not replace a certified on board radar system. The data gathered by an on board radar system is real time data while there is always some sort of delay when using data link weather. Practice has shown that data link weather is a powerful tool for situational awareness and for long range planning around weather system which are so far way that normal GA on board radar can not detect them. But short range navigation between dangerous convective cells requires on board radar.

14 Disclaimer

This document is supposed to give some insight how the ADL data link weather system works. But the final responsibility for safe flight is upon the pilot and command and his certified weather avoidance equipment. The ADL system is for situational awareness only. We are no certified meteorologist but IT people. So this document represents our personal opinion and experiences but is no official meteorological or pilot training publication.

15 Contact

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