

# Traffic Monitoring With

TERRA SAR X

Advanced SAR Workshop 2005

H. Runge / DLR

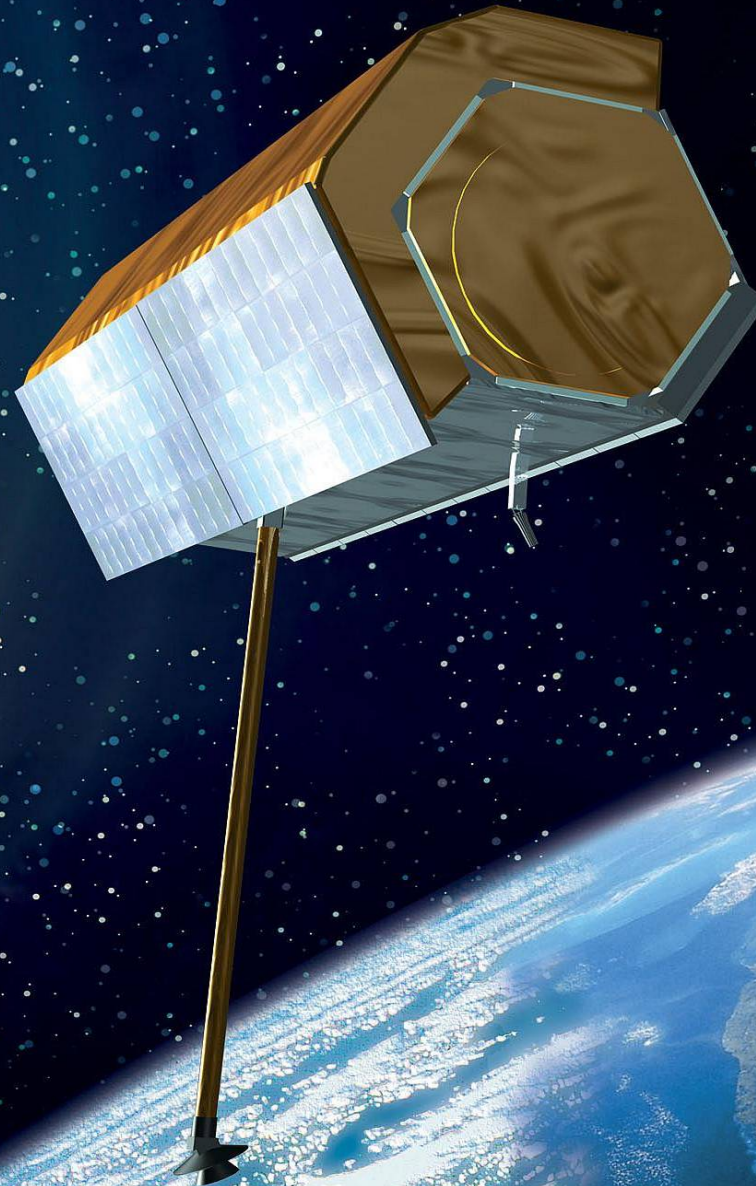
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Deutsches Zentrum  
für Luft- und Raumfahrt e.V.  
in der Helmholtz-Gemeinschaft

# TerraSAR-X

- Launch: June 2006
- Mass: 1023kg
- Transmitting Power: 2kW
- Orbit: 515 km Höhe
- Launcher: Dnepr / Baikonur

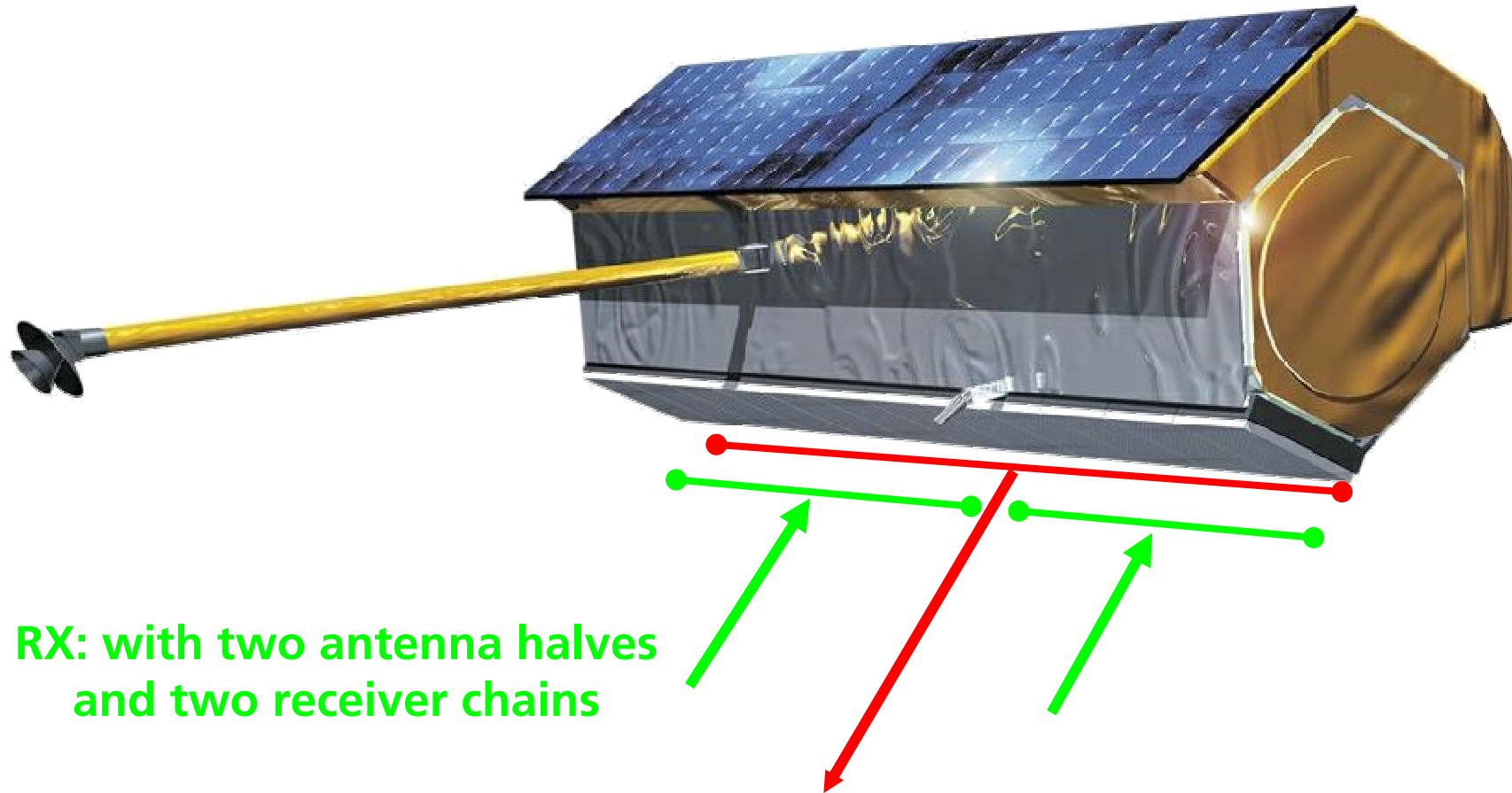


Courtesy of EADS Astrium



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# TerraSAR-X „Dual Receive Antenna Mode“



**RX: with two antenna halves  
and two receiver chains**

**TX: with the overall antenna**



## Tasks Of The “Traffic Processor”:

- **Detection and measurement of moving objects (location, time, heading, velocity, object type, accuracy)**
- **Assignment to a road network**
- **Detection and quantification of non-moving cars in congestion and car parks**
- **Archiving of derived information in a GIS**

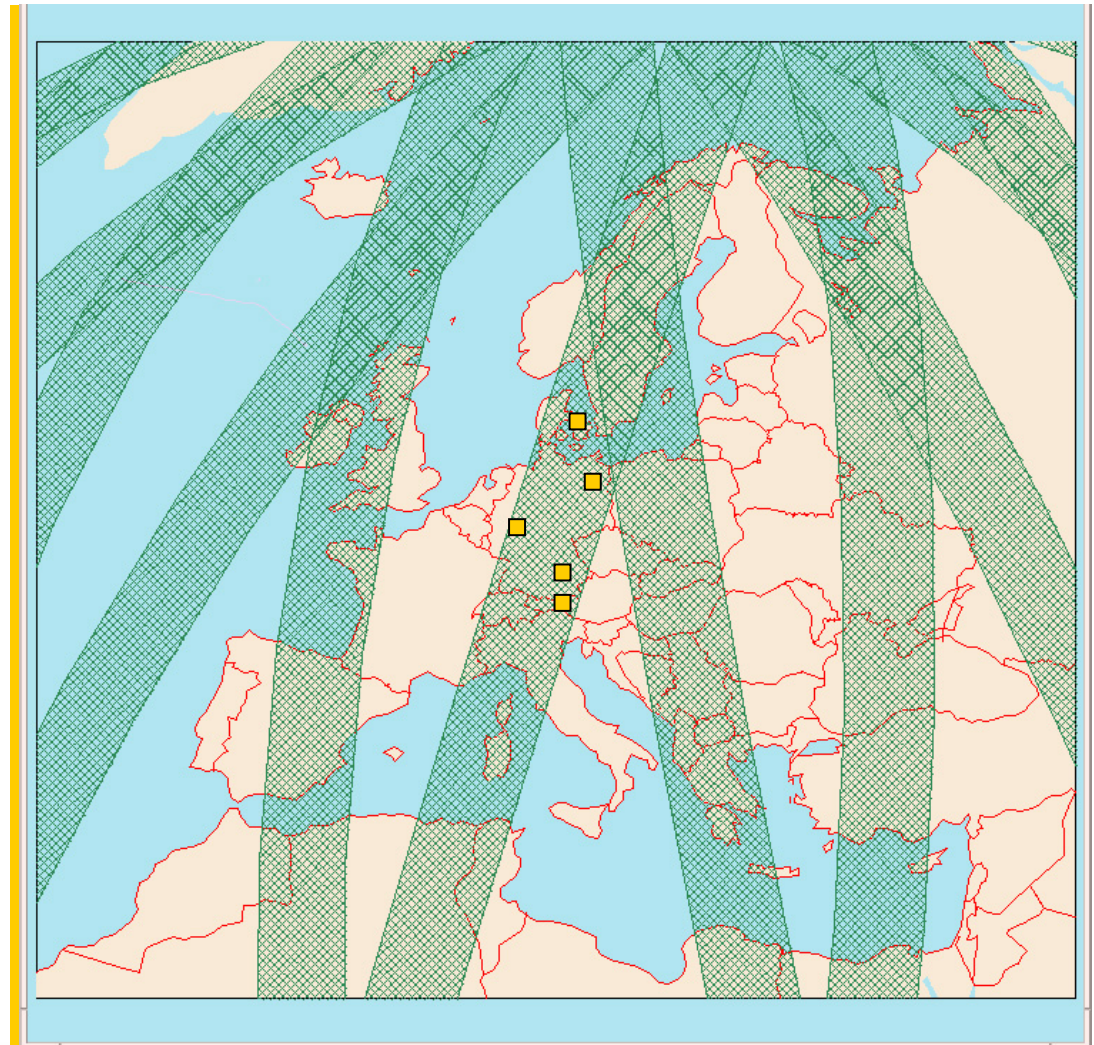
# TerraSAR-X Enables Traffic Monitoring in a Global Scale

## Example: Coverage of Europe in One Day

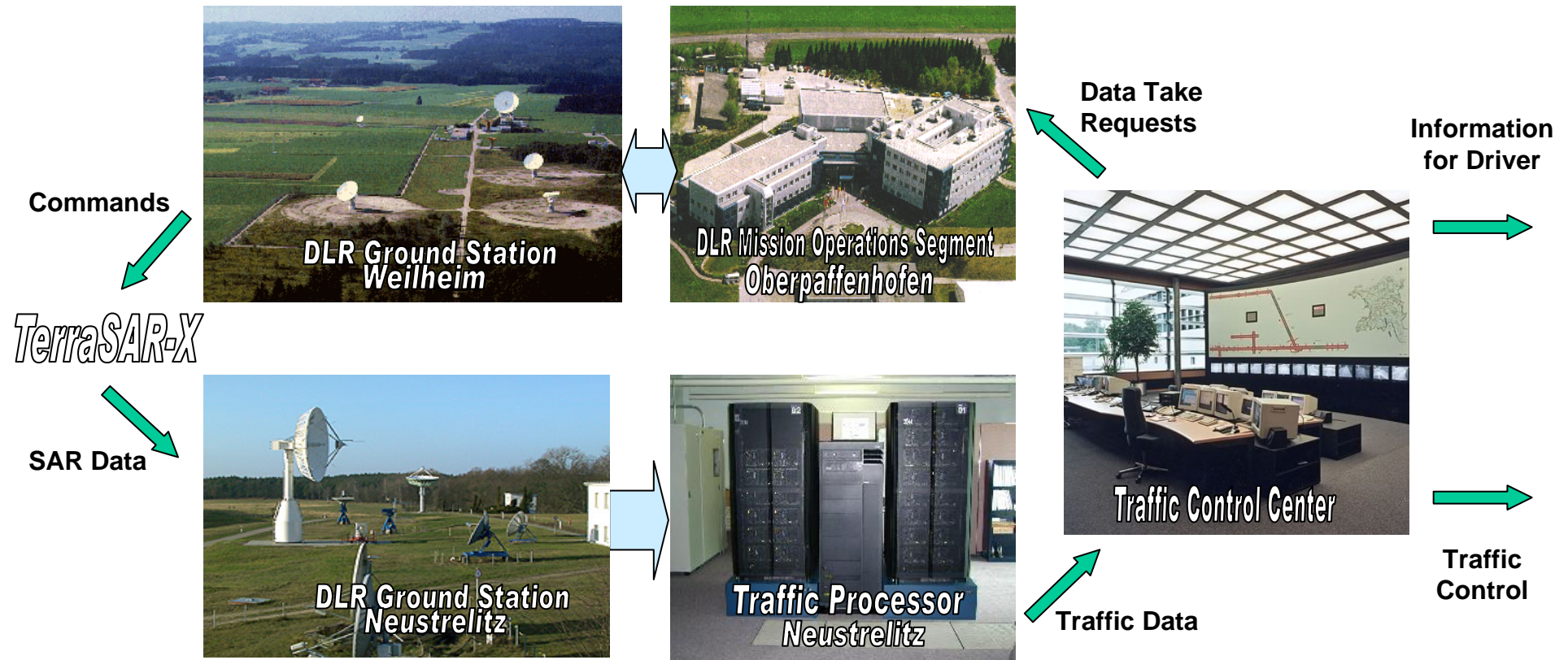
The data acquisition is performed with 25.000 km/h!

Copenhagen	05:57:26
Berlin	05:58:09
Cologne	05:58:51
Munich	05:59:22
Innsbruck	05:59:36

The coverage pattern shifts daily.  
The revisit time for a scene in Europe is two to three days.



# TerraSAR-X Traffic Monitoring Ground Segment





## TerraSAR-X Data Products For Transportation Research


### Project Schedule:

- Phase-A Study: until end of 2005
- Requirements and interface definition with Traffic Research Institute: March 2006
- Development Phase: in 2006
- Launch TerraSAR-X: June 2006
- Integration and test phase: in 2007
- Operational phase: in 2008

# Test Cars of the ESAR Flight Campaign at April 20th, 2004







Terra SAR X  
Flugplatz Oberpfaffenhofen  
20.04.2004



DLR

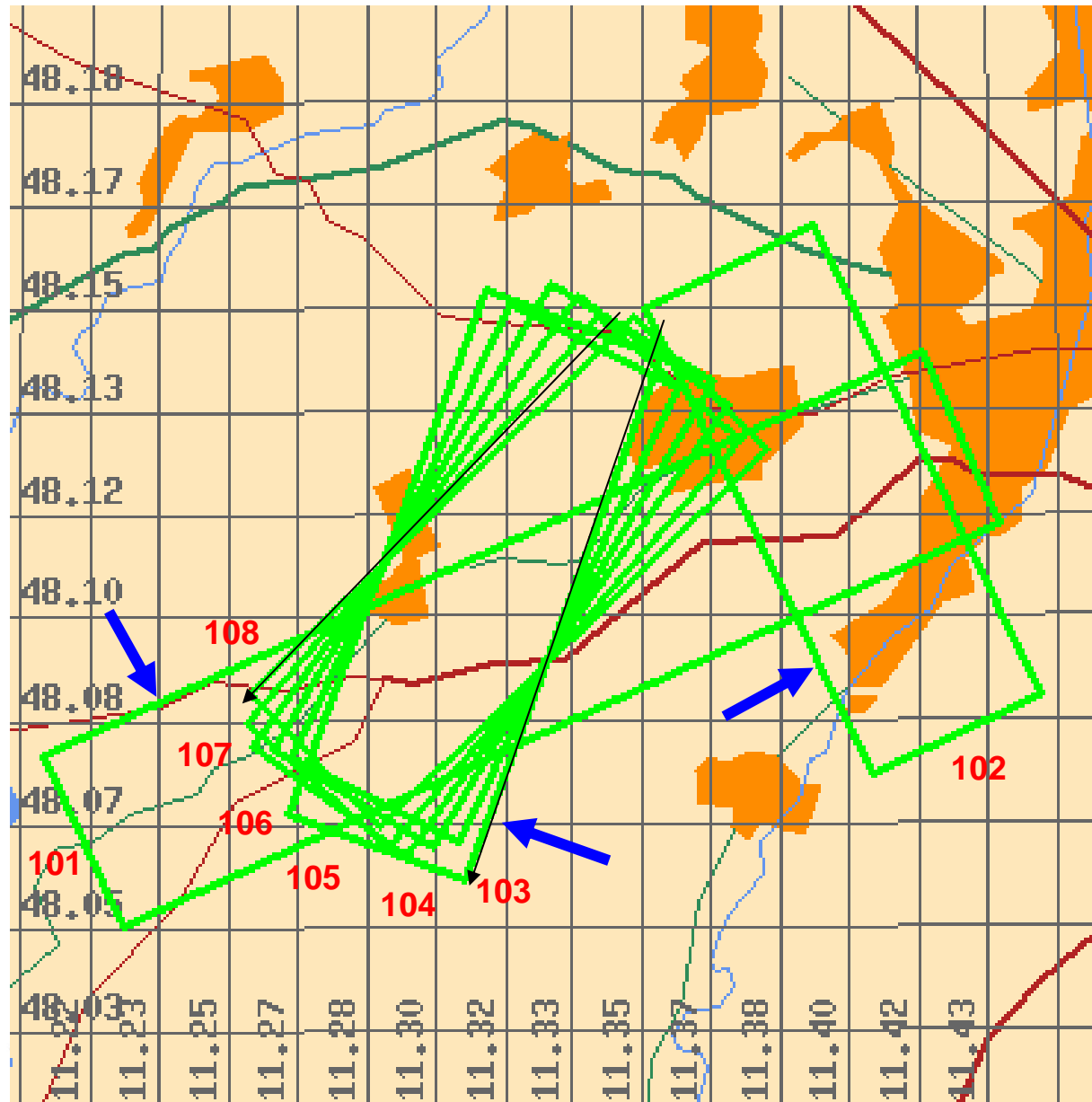
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## Footprints of Data Takes, Germering Campaign 12.05.2005



Green: footprints

Blue: look directions

Black: desired flight directions

Red: data take id

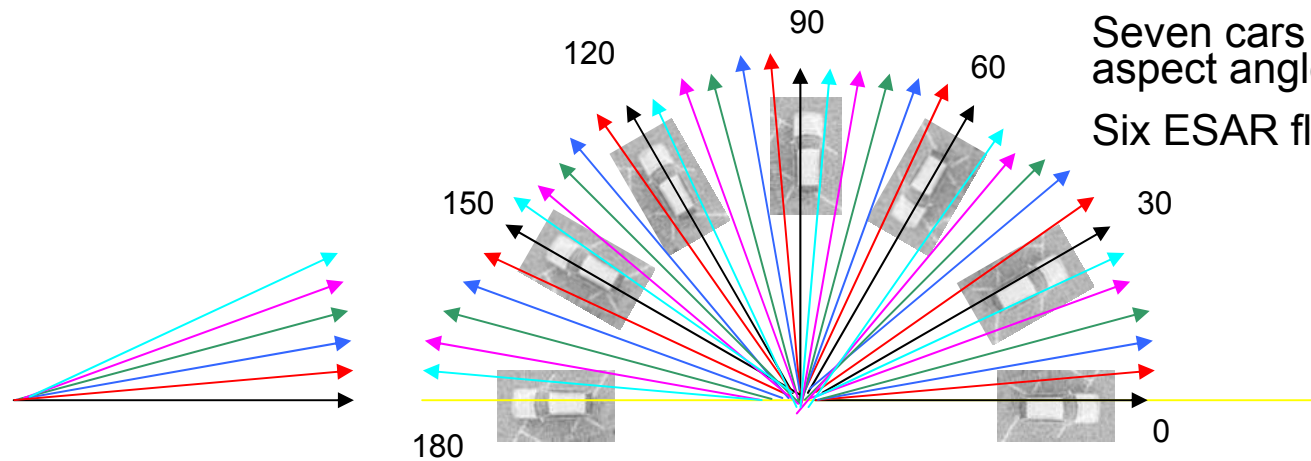
# 180 Degrees RCS Measurement of a Golf-V



## Experiment Setup:

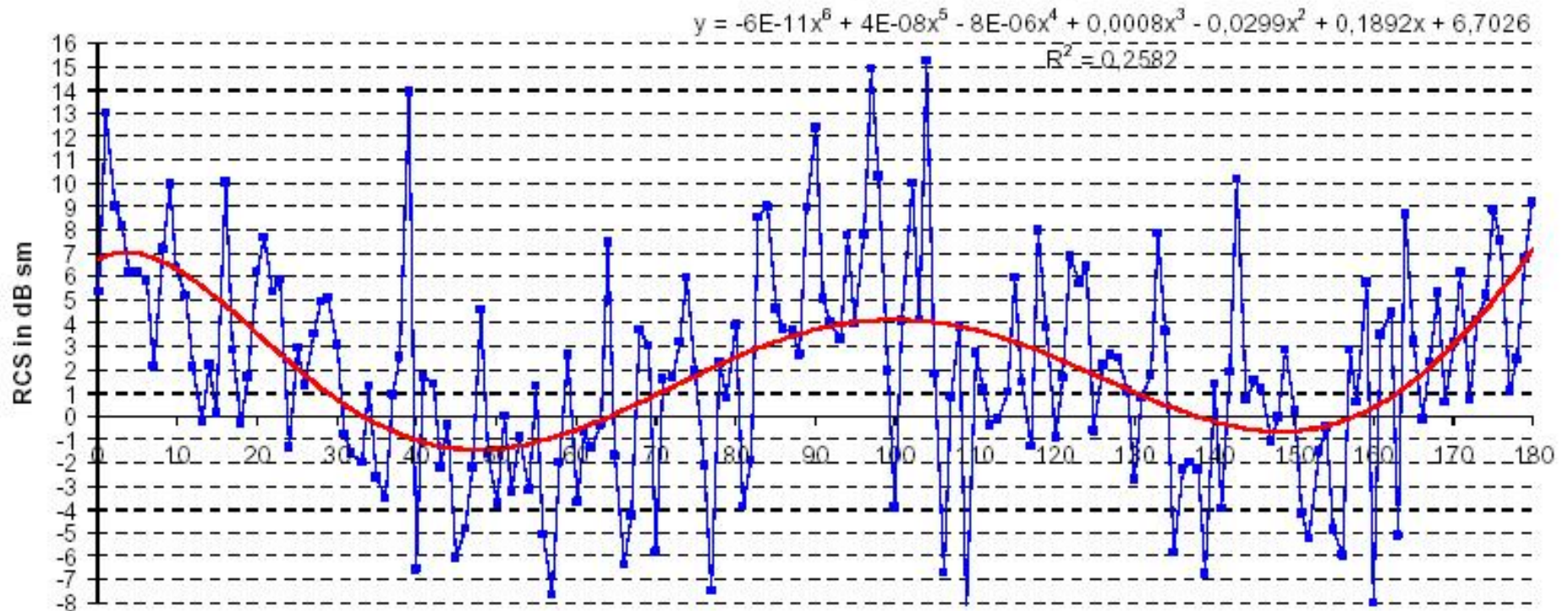
Seven cars of same type at defined aspect angles

Six ESAR flights at defined headings

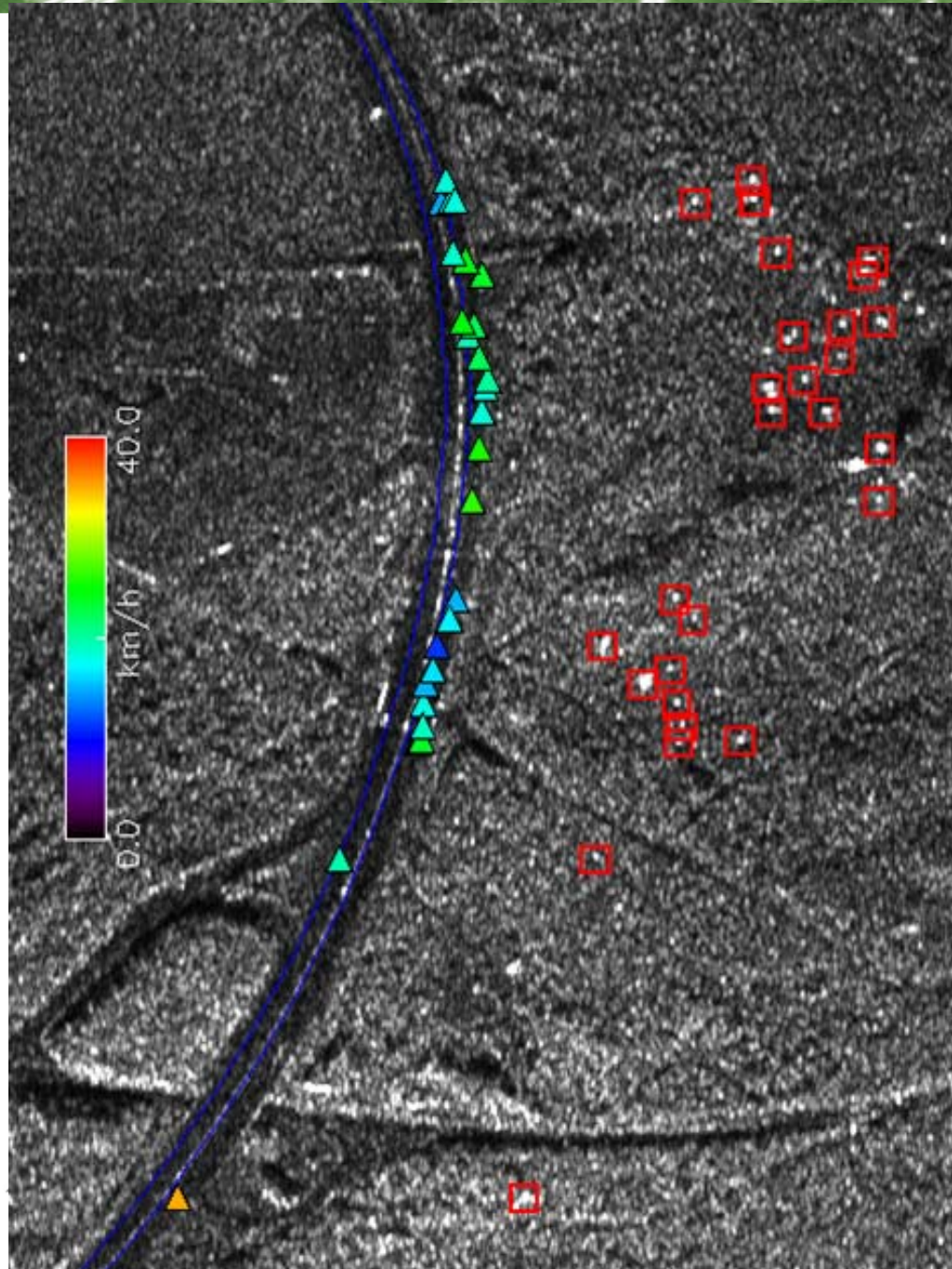


# Measured Radar Cross Section of a GOLF-V

Radar cross section of cars C1-7 (X-VV,  $\theta = 41.5^\circ$ , Gilching2005)





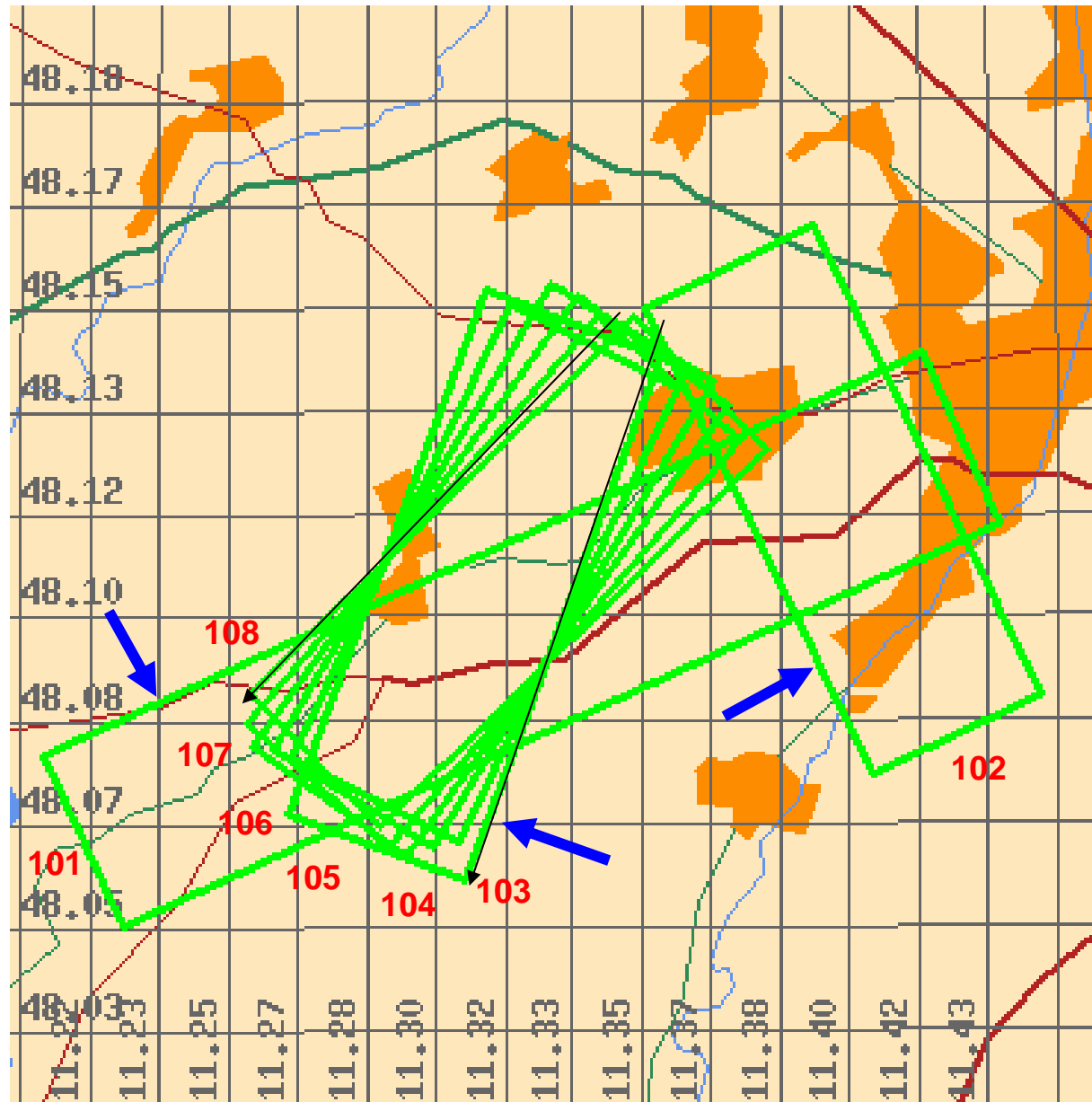


## Traffic Jam at the A96 near Germering

Criteria for the detection of a moving object:

$$v(\phi) - v(\Delta az) < 5 \text{ km/h}$$

## Footprints of Data Takes, Germering Campaign 12.05.2005



Green: footprints







Blue: look directions

Black: desired flight directions

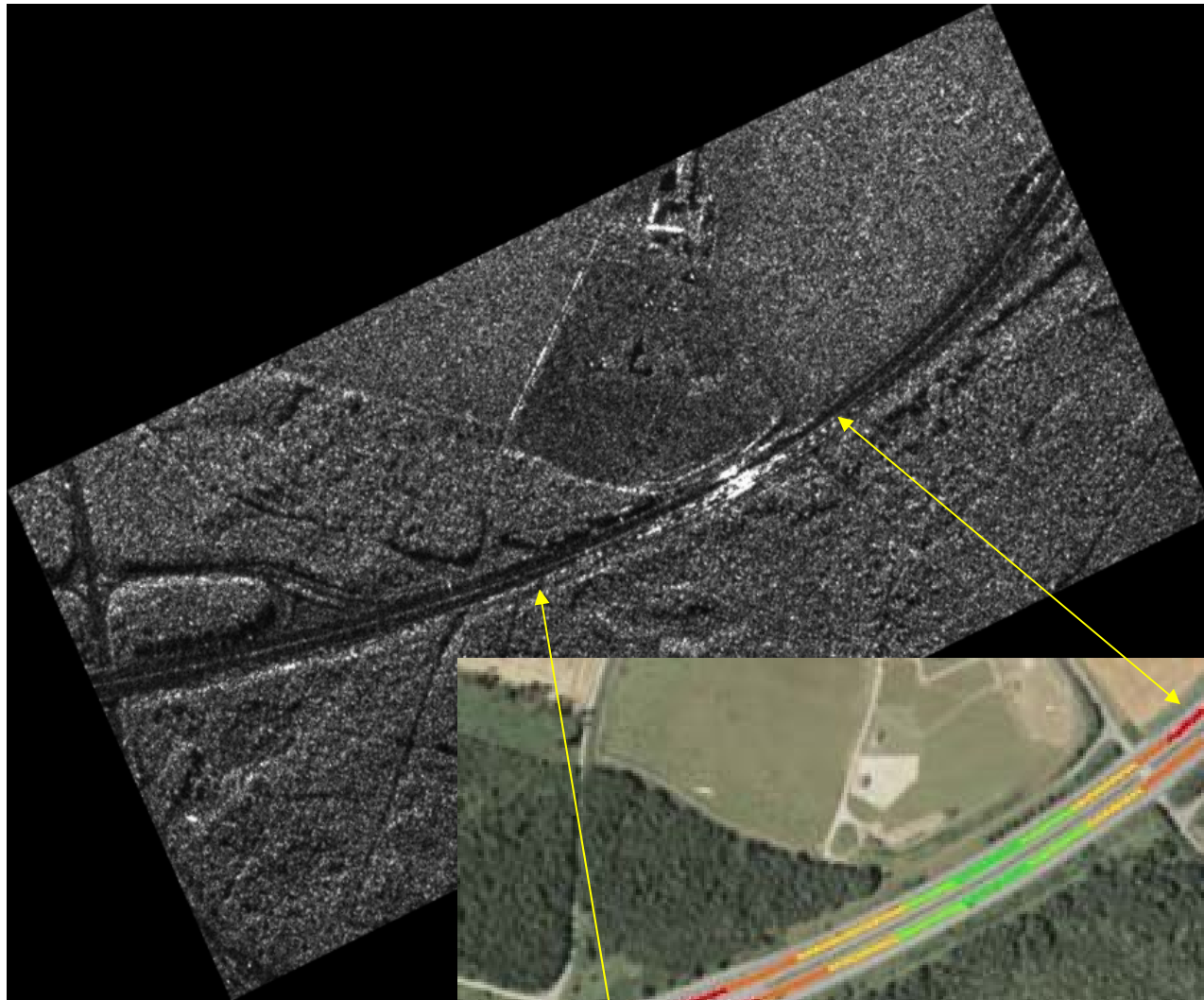
Red: data take id

The motorway has been imaged with a changing aspect angle



Color	Aspect angle
	$ \alpha  \leq 2^\circ$
	$2^\circ <  \alpha  \leq 4^\circ$
	$4^\circ <  \alpha  \leq 6^\circ$
	$6^\circ <  \alpha  \leq 8^\circ$
	$8^\circ <  \alpha  \leq 10^\circ$
	$10^\circ <  \alpha $



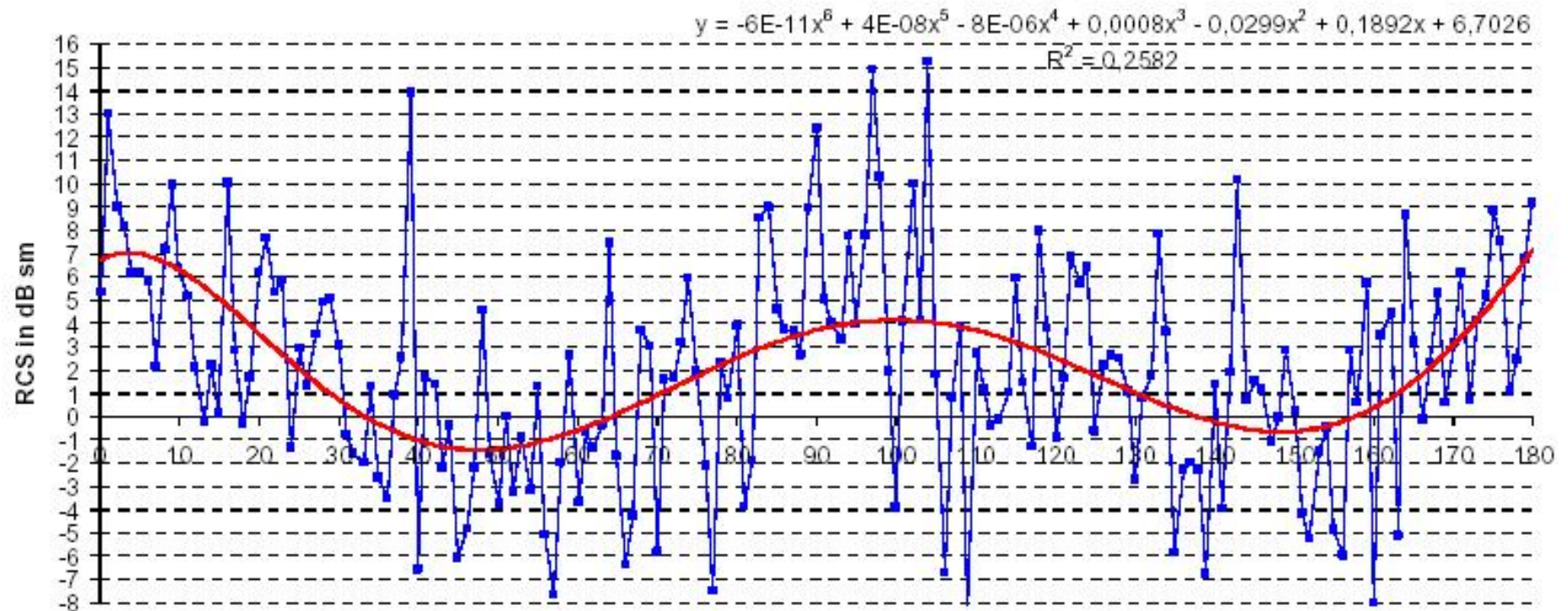


## Visibility of a traffic jam on a bended motorway



# Measured Radar Cross Section of a GOLF-V

Radar cross section of cars C1-7 (X-VV,  $\theta = 41.5^\circ$ , Gilching2005)





## Conclusions

- Traffic monitoring with SAR is a new challenge
- The big advantage is the day and night capability
- Monitoring of truck traffic seems to be possible
- Not all passenger cars can be detected
- Multi Channel SAR is required for clutter suppression
- During a demonstration phase in 2008 selected traffic hot spots with favorite conditions shall be analyzed