

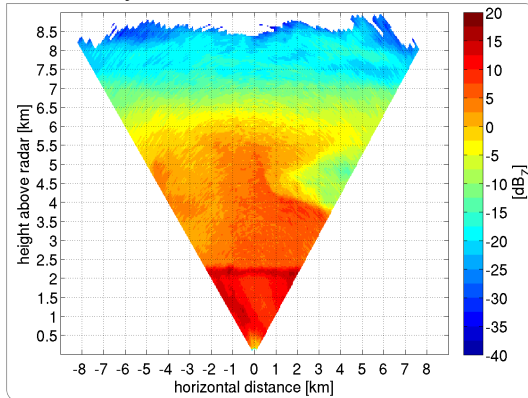
# Identifying Dynamic Structures Using Residual Velocities

An Application on RHI Cloud Radar Data  
(Jens Grenzhäuser, Jan Handwerker | Oct. 24, 2011)

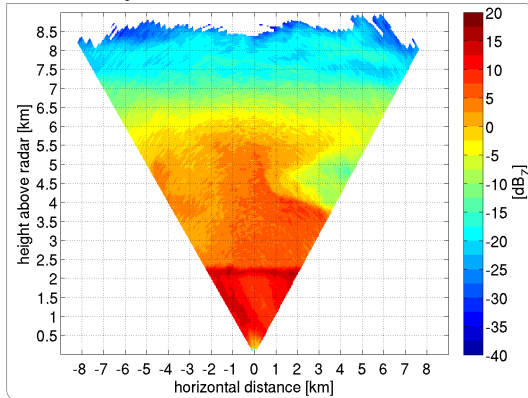
Institut für Meteorologie und Climate Research



## Reflectivity

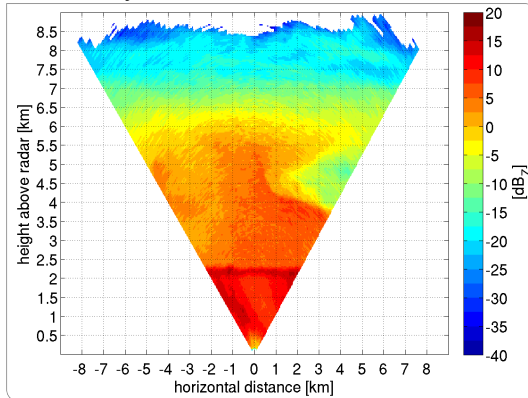


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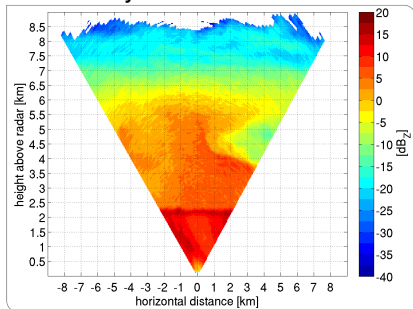
RHI in wind direction  
(from PPI)  
BB at 2.2 km

## Reflectivity

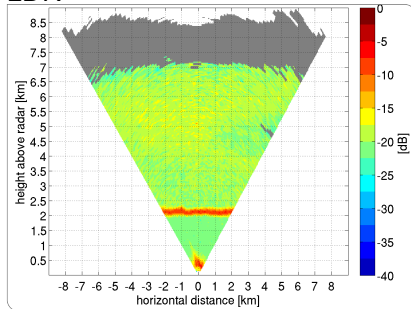


RHI in wind direction  
(from PPI)  
BB at 2.2 km  
Boring! Isn't it?

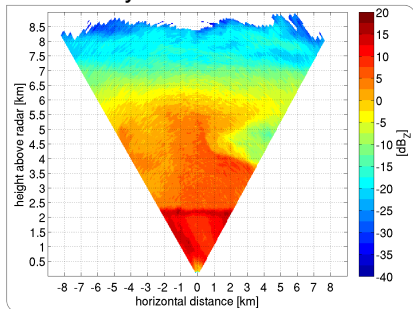
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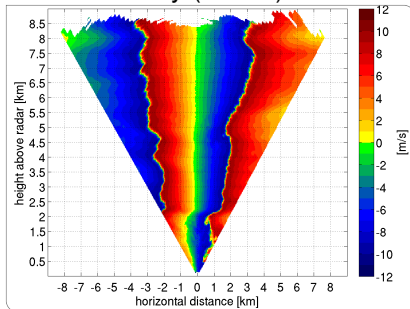
## LDR



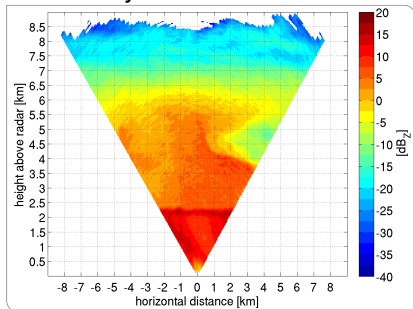
## Reflectivity



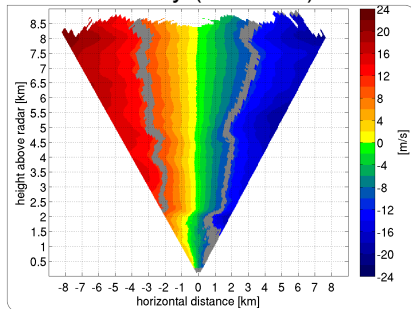
## Radial Velocity (folded)



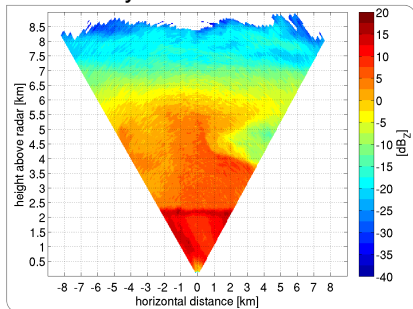
## Reflectivity



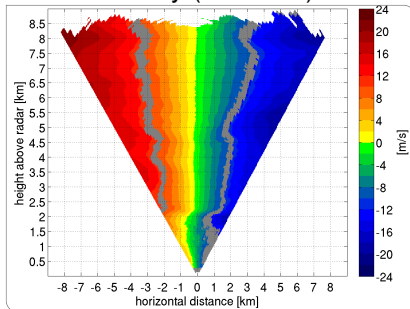
## Radial Velocity (unfolded)



## Reflectivity



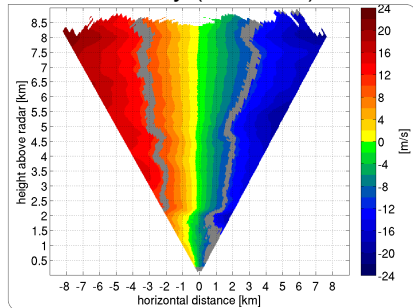
## Radial Velocity (unfolded)



How do we learn something about the dynamics?

$$V_{\text{rad}} = V_{\text{rad,ls}} + V_{\text{res}}$$

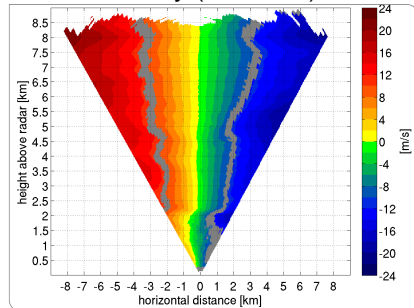
## Radial Velocity (unfolded)



$$V_{\text{rad}} = V_{\text{rad,ls}} + V_{\text{res}}$$

$V_{\text{rad,ls}}$ : radial velocity, large scale

## Radial Velocity (unfolded)

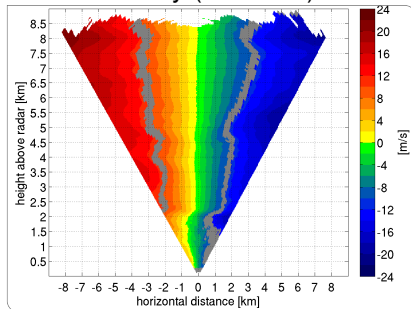


$$V_{\text{rad}} = V_{\text{rad,ls}} + V_{\text{res}}$$

$V_{\text{rad,ls}}$ : radial velocity, large scale

consists of mean horizontal and vertical wind ( $u$ ,  $w$ ) and their horizontal gradients ( $\partial u/\partial x$ ,  $\partial w/\partial x$ ), projected to line of sight.

## Radial Velocity (unfolded)



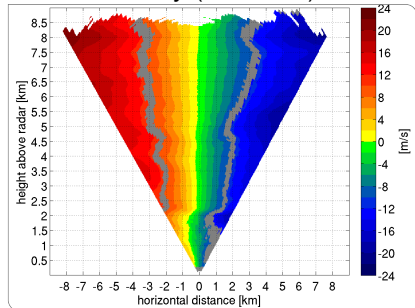
$$V_{\text{rad}} = V_{\text{rad,ls}} + V_{\text{res}}$$

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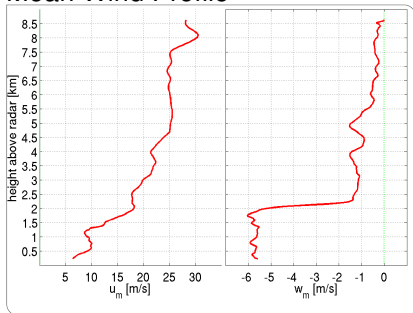
consists of mean horizontal and vertical wind ( $u$ ,  $w$ ) and their horizontal gradients ( $\partial u/\partial x$ ,  $\partial w/\partial x$ ), projected to line of sight.

Least Square Fit in each height level leads to estimates for  $u$ ,  $w$ , and  $\partial u/\partial x$  in each height level.  $\partial w/\partial x$  is neglected.

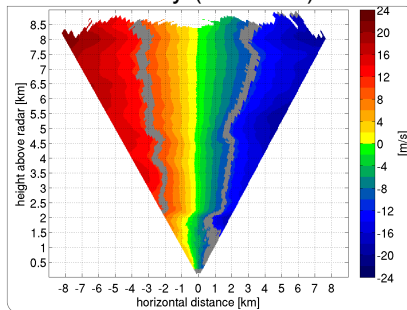
## Radial Velocity (unfolded)



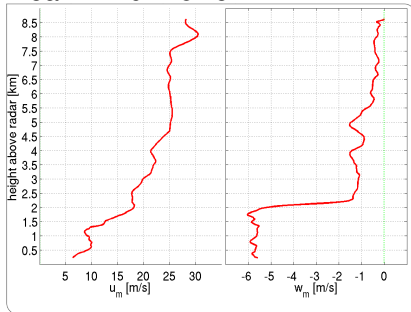
## Mean Wind Profile



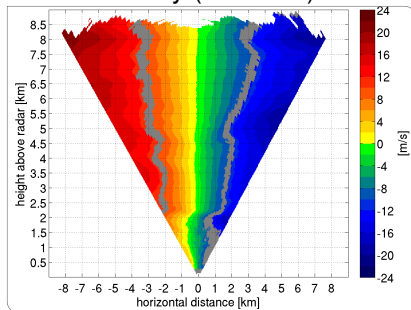
## Radial Velocity (unfolded)



## Mean Wind Profile

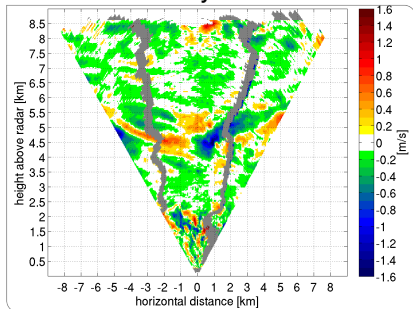


## Radial Velocity (unfolded)

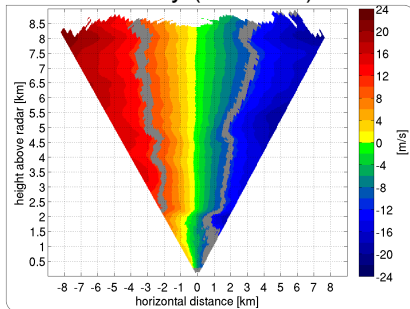


And now subtract the mean wind from the radial velocity. . .

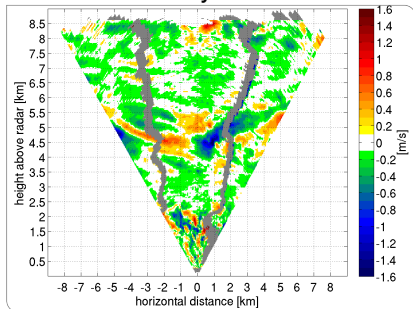
## Residual Velocity



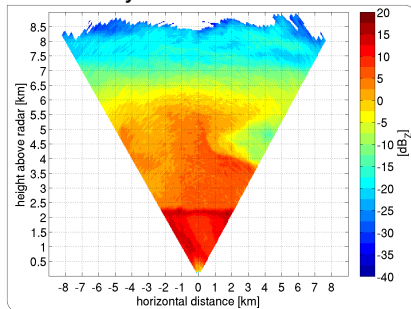
## Radial Velocity (unfolded)



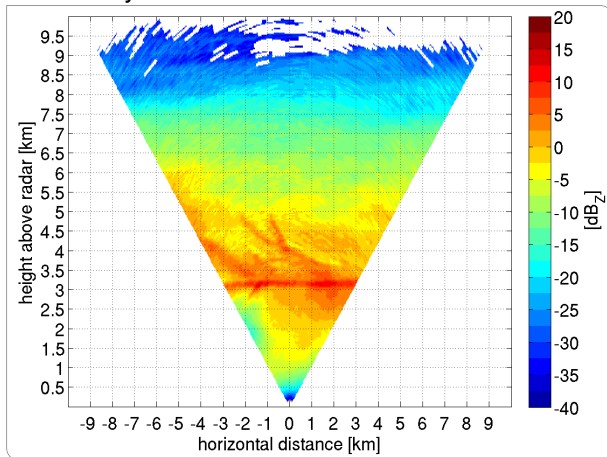
## Residual Velocity



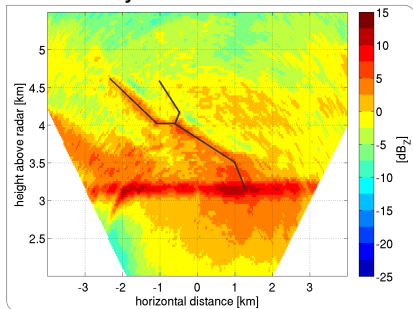
## Reflectivity



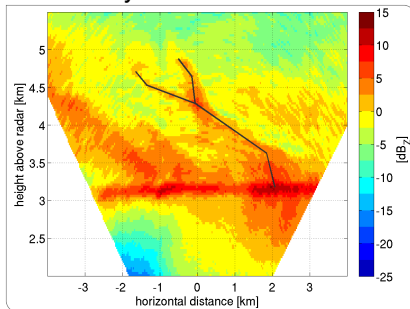
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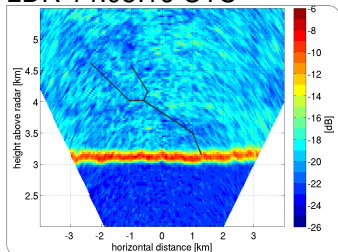
## Reflectivity 14:08:16 UTC



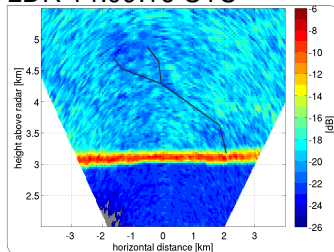
## Reflectivity 14:09:16 UTC



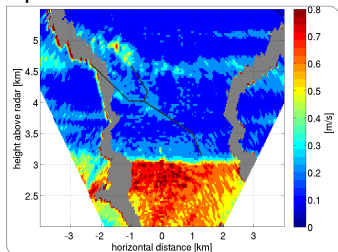
## LDR 14:08:16 UTC



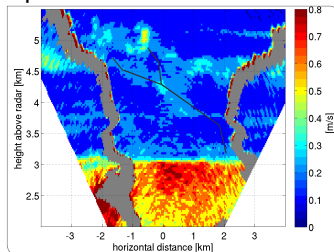
## LDR 14:09:16 UTC



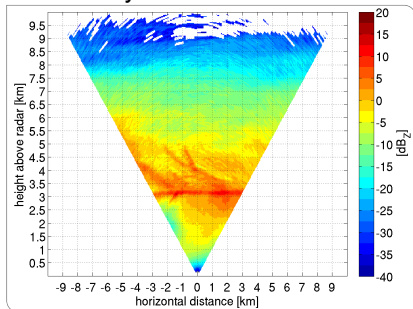
## Spectral Width 14:08:16 UTC



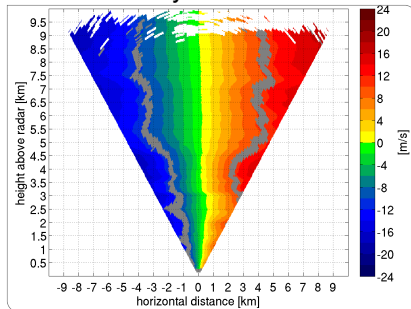
## Spectral Width 14:09:16 UTC



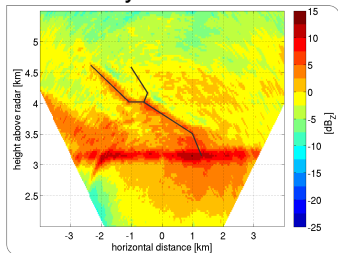
## Reflectivity 14:08:46 UTC



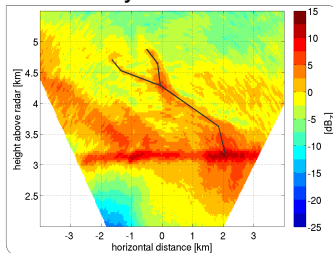
## Radial Velocity 14:08:46 UTC



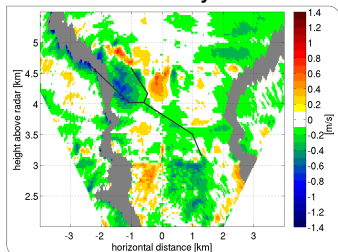
## Reflectivity 14:08:16 UTC



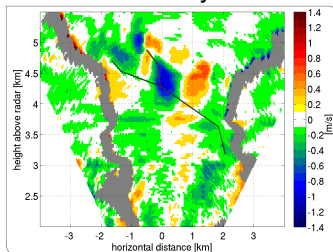
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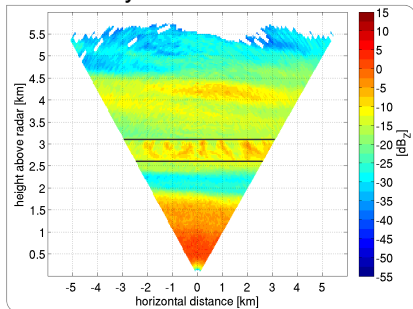
## Residual Velocity 14:08:16 UTC



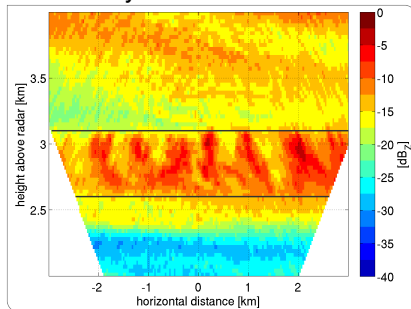
## Residual Velocity 14:09:16 UTC



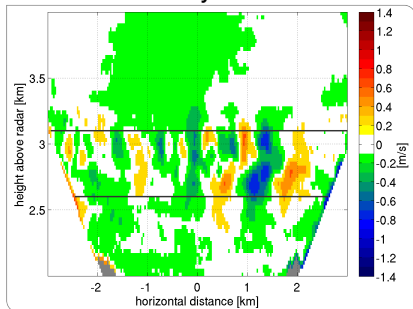
## Reflectivity 13:44:31 UTC



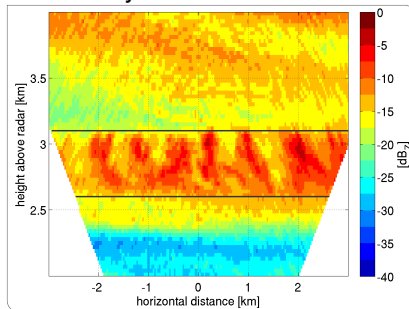
## Reflectivity 13:44:31 UTC



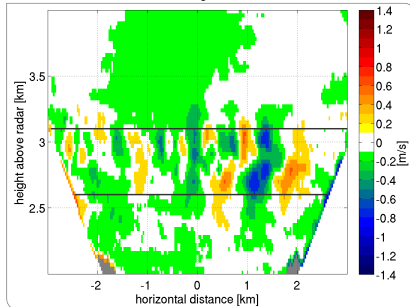
## Residual Velocity 13:44:31 UTC



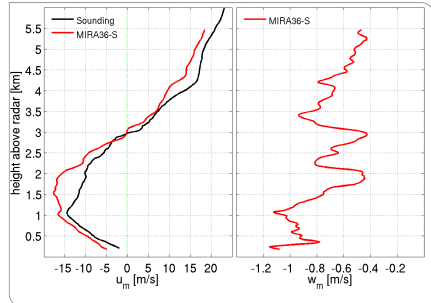
## Reflectivity 13:44:31 UTC



## Residual Velocity 13:44:31 UTC



## Wind Profile 13:44:31 UTC



- Residual velocities provide information on the small scale dynamics motion.
- Nevertheless, interpretation is **not** straight forward, because you have to regard (at least)
  - residual velocity,
  - large scale velocity, and
  - sedimentation of particles.

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Thank you!