The EUMETSAT Network of Satellite Application Facilities

OSI SAF
Ocean and Sea Ice

NWP SAF
Numerical Weather Prediction

Royal Netherlands Meteorological Institute
Ministry of Infrastructure and the Environment

ASCAT-SG polarization options

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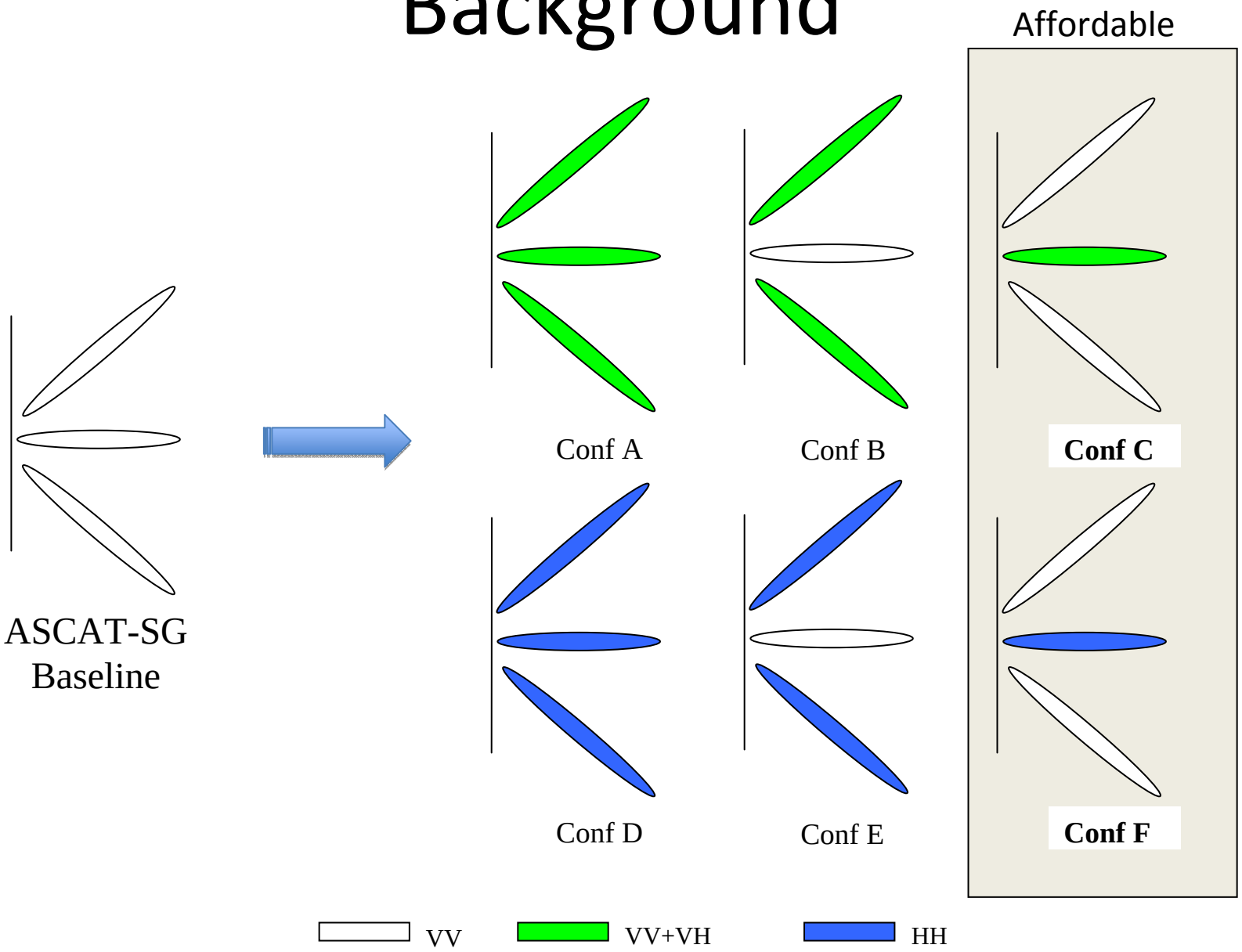
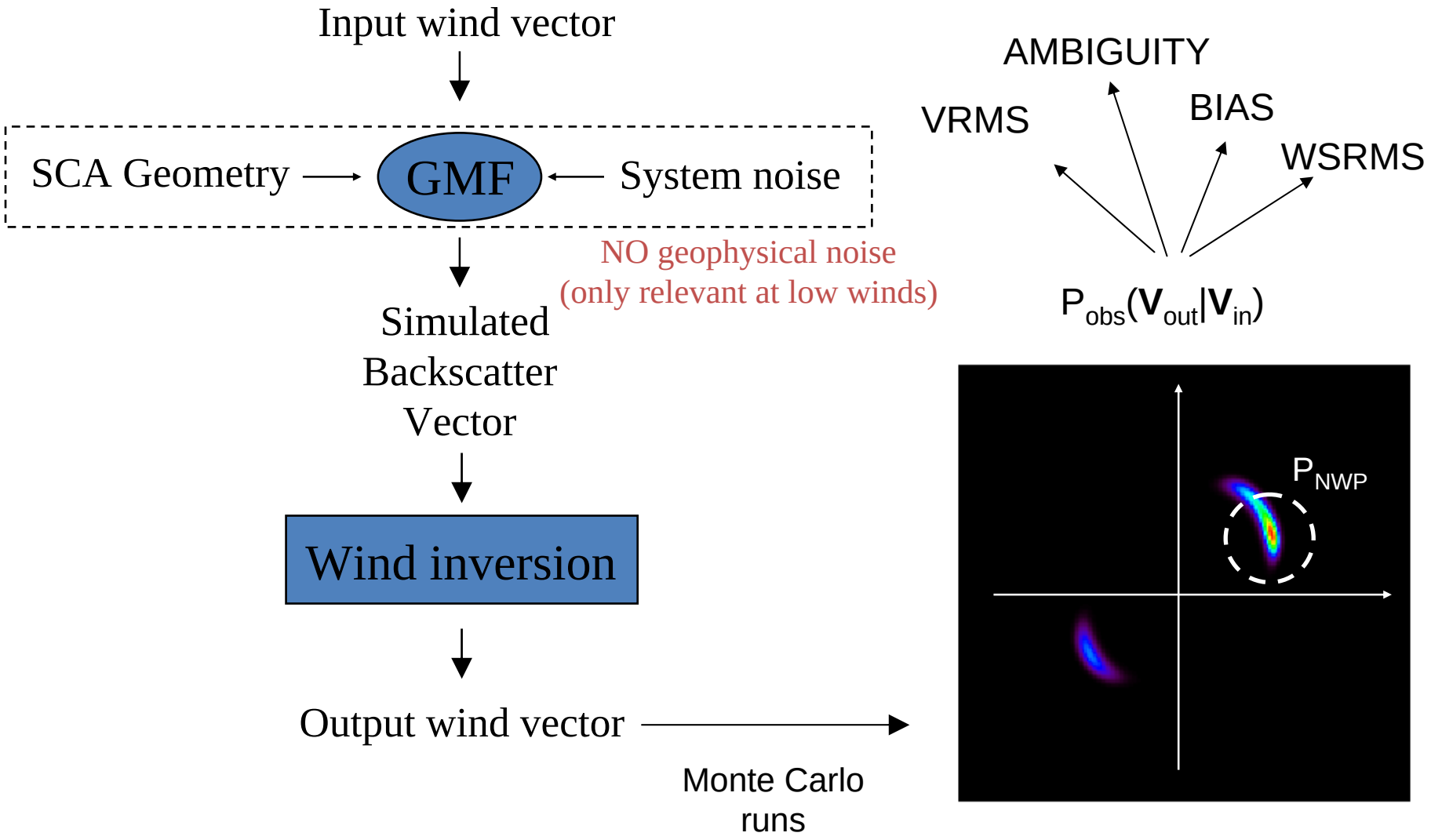
Royal Netherlands Meteorological Institute (KNMI)

Background


Affordable
ASCAT-SG
Baseline
Conf A
Conf B
Conf C
Conf D
Conf E
Conf F
VV
VV+VH
HH

SCA end-to-end simulator

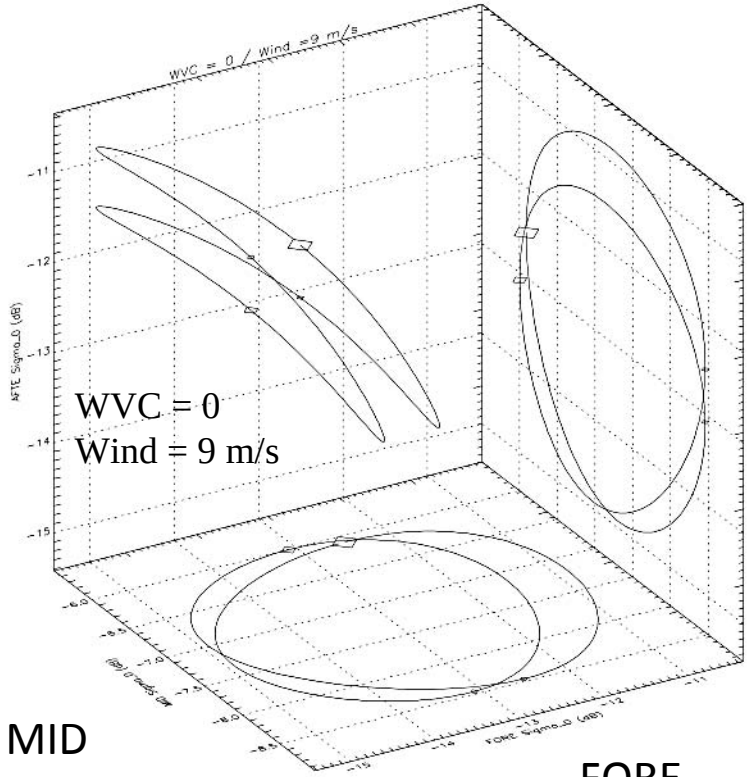


NOTE: P_{NWP} STDDEV = 3 m/s (U_{10} < 20m/s) and 10 m/s (U_{10} > 20m/s)

C-band VV GMF

CMOD5n VV

AFT



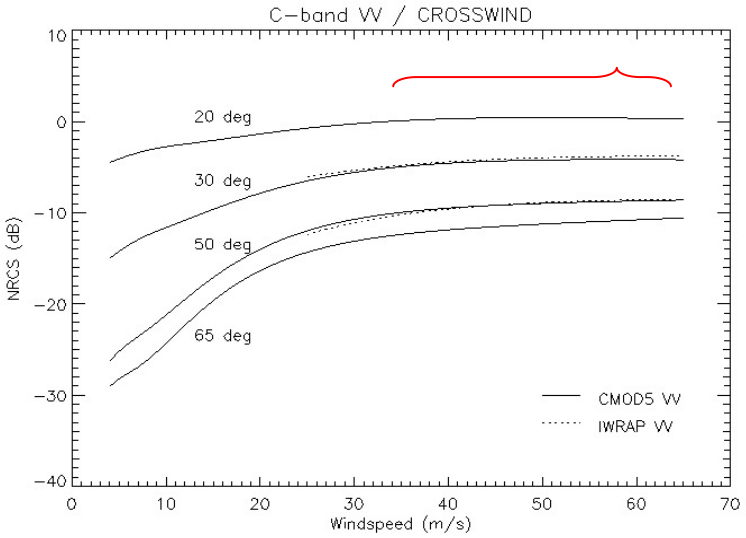
MID

FORE

$$\sigma^0_{VV} = CMOD5(incidence, azimuth, U_{10} + 0.7)$$

[Hersbach, JGR, 2006]

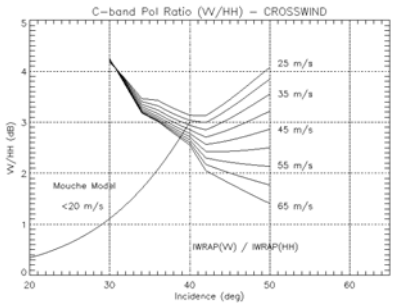
Valid for winds from 4 to 65 m/s and incidence angles from 20 to 65 degrees



NOTE the saturation behavior U_{10} > 25 m/s

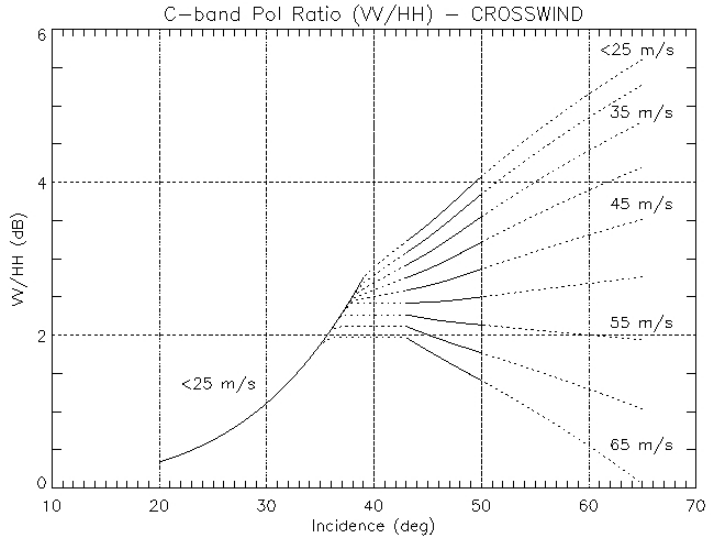
C-band HH GMF

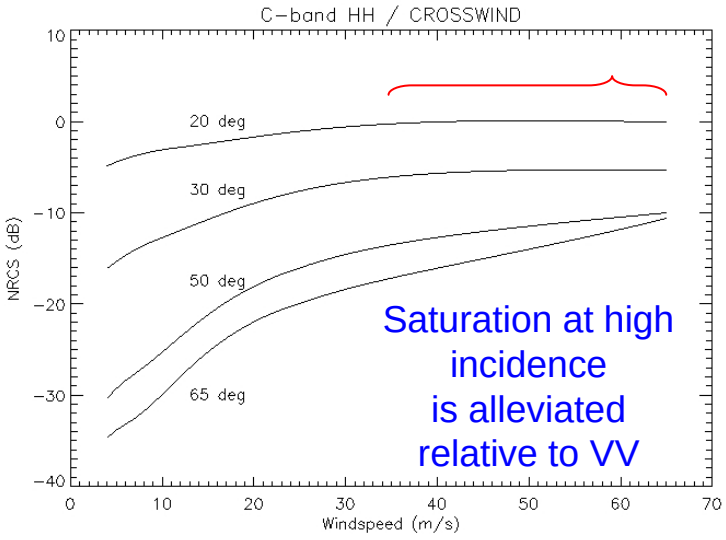
$$CPR = \sigma^0_{VV}(\theta, U_{10}, \phi) / \sigma^0_{HH}(\theta, U_{10}, \phi)$$



Empirical HH to VV Co-Polarization Ratio at C-band based on:

- STORM data at low incidence and low wind speeds [Mouche, 2005]
- IWRAP data at high incidence and high wind speeds [Esteban, 2006]





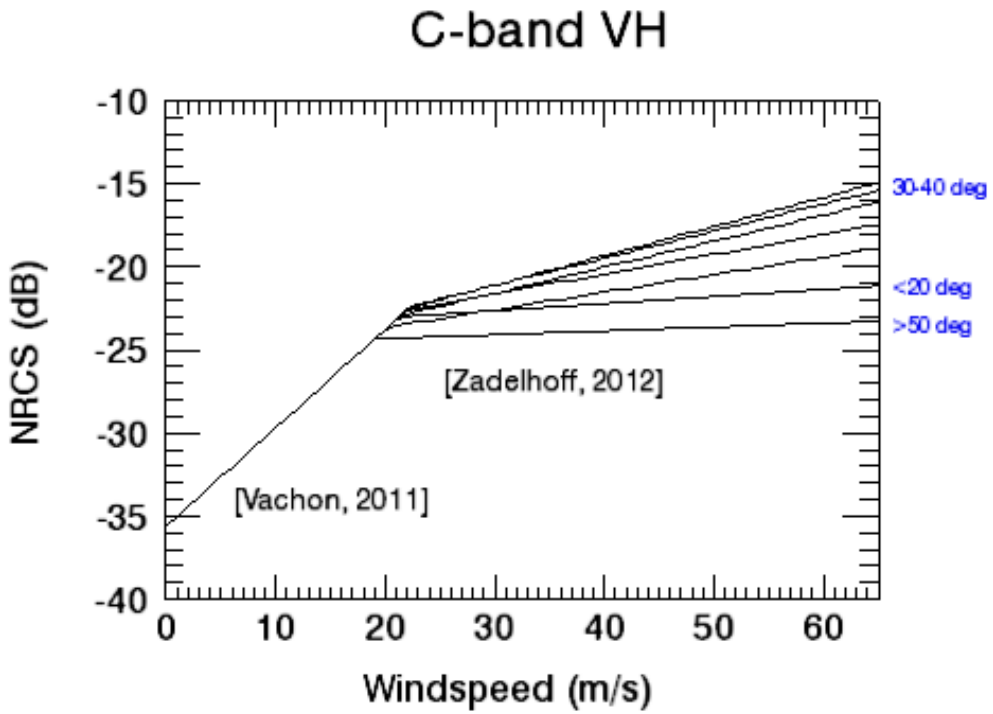
$$\sigma^0_{HH}(\theta, U_{10}, \phi) = (1/CPR) \cdot \sigma^0_{VV}(\theta, U_{10}, \phi)$$

NOTE the saturation behavior U_{10} > 25 m/s

Composite model for winds from 4 to 65 m/s and incidence angles from 20 to 65 degrees

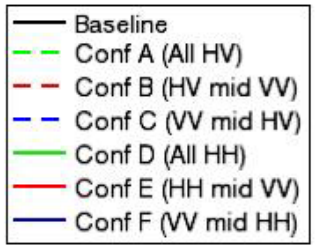
C-band VH GMF

- Vachon model based on RADARSAT-2 data [Vachon, 2011] valid from 0 to 20 m/s.

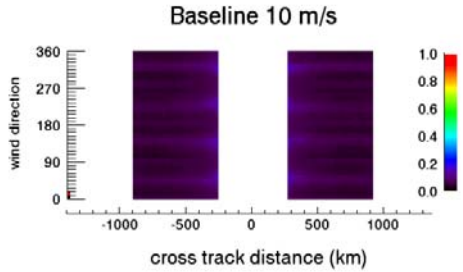


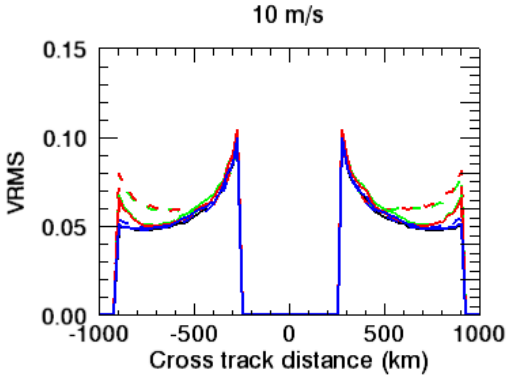
→ Under hurricane conditions, RADARSAT-2 collocations with SFMR winds performed at KNMI give an extended VH GMF [Zadelhoff, 2012]

Directional sensitivity

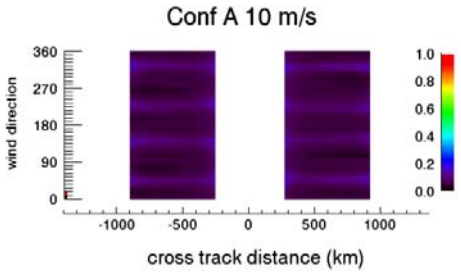


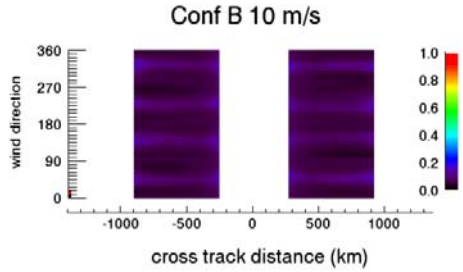
10 m/s

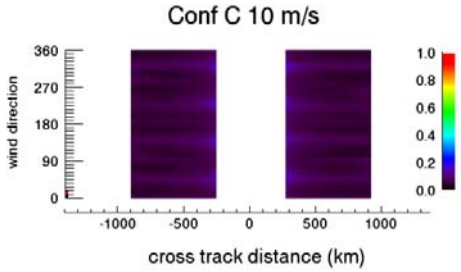


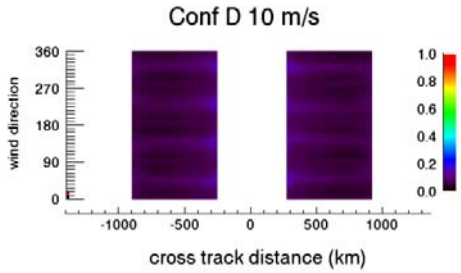


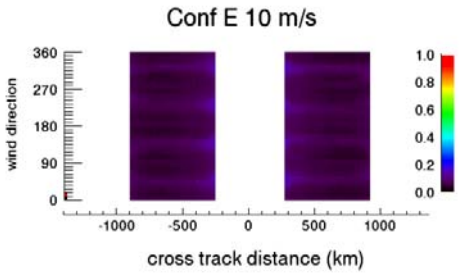
VRMS with σ_{NWP} = 3.2 m/s

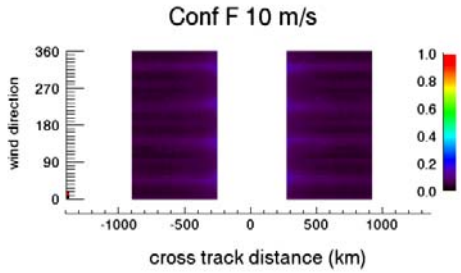




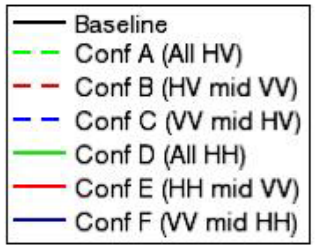




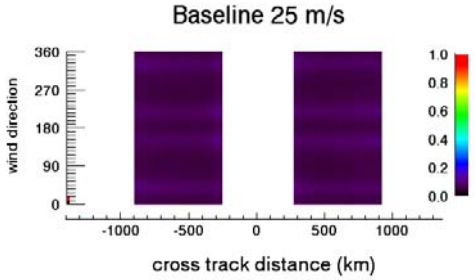


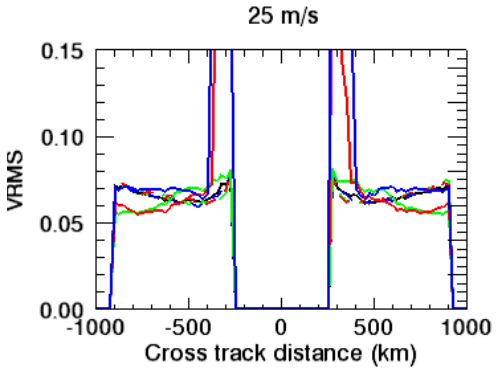


Directional sensitivity

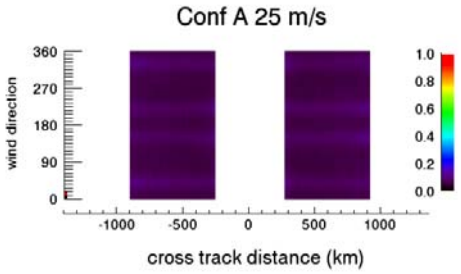


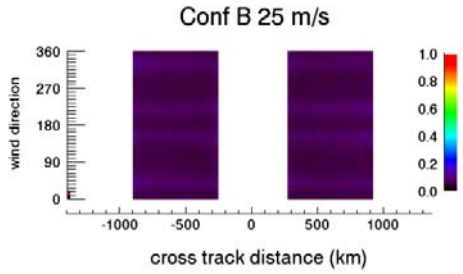
25 m/s

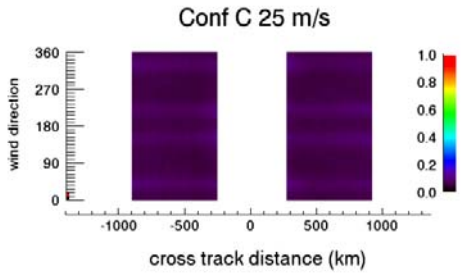


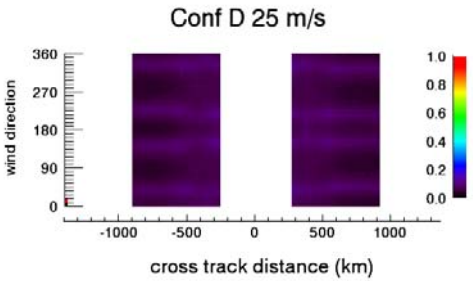


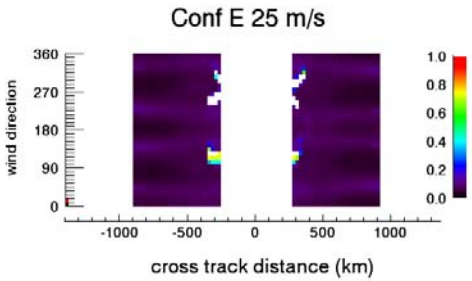
VRMS with σ_{NWP} = 10 m/s

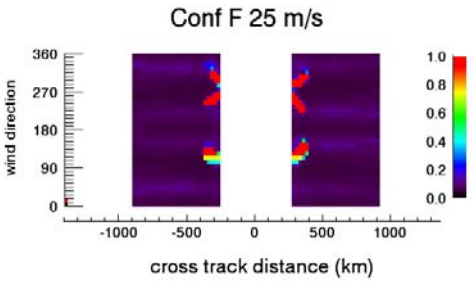




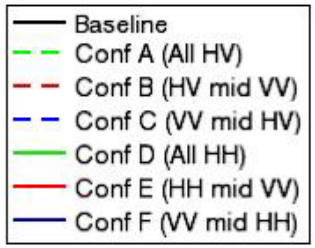




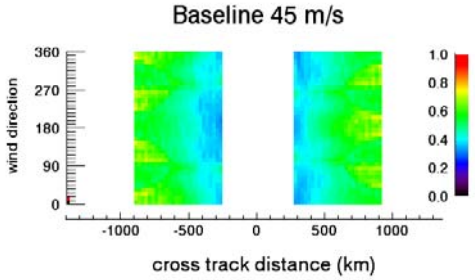


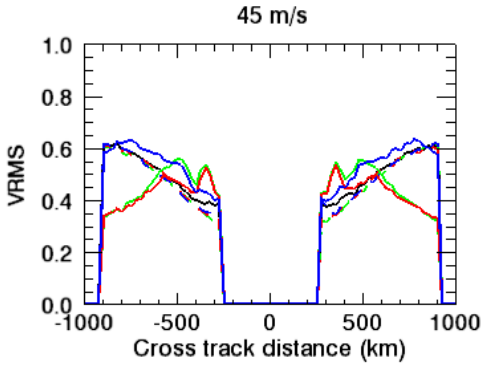


Directional sensitivity

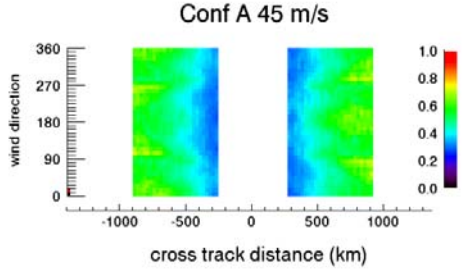


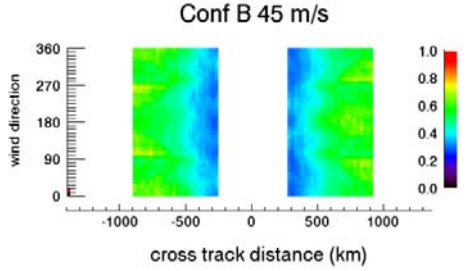
45 m/s

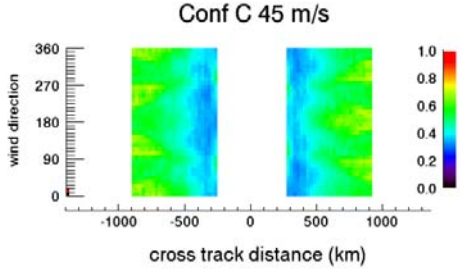


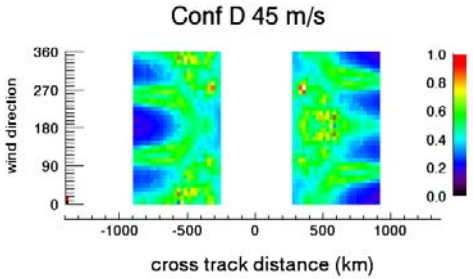


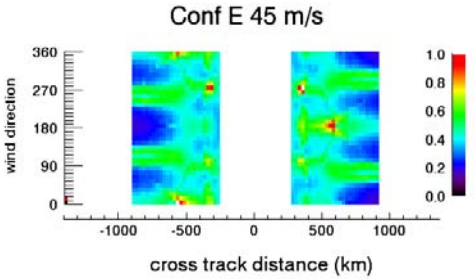
VRMS with σ_{NWP} = 10 m/s

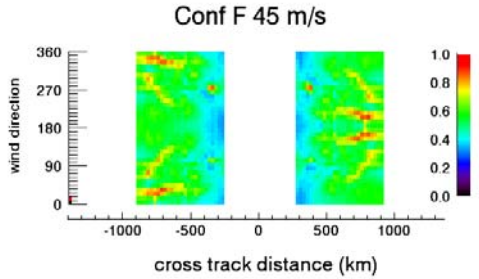




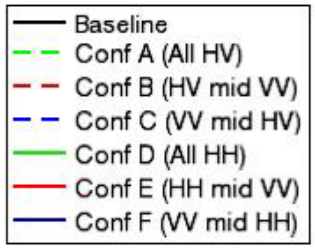




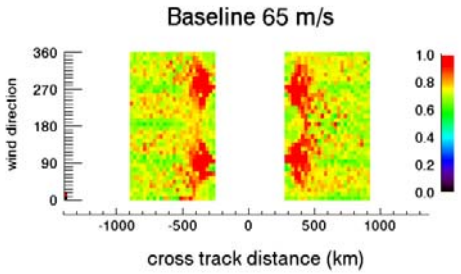


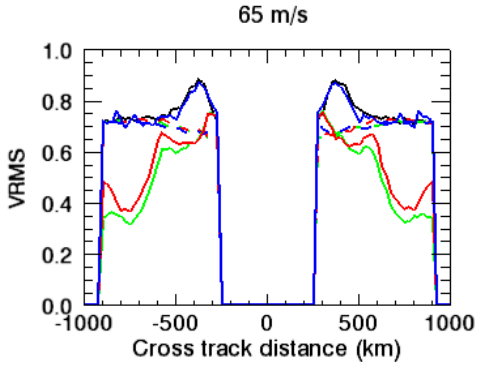


Directional sensitivity

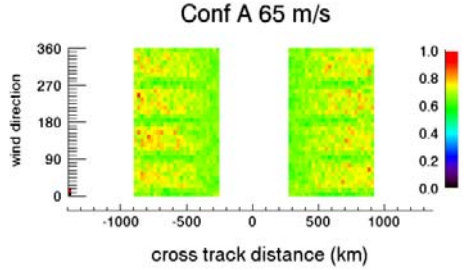


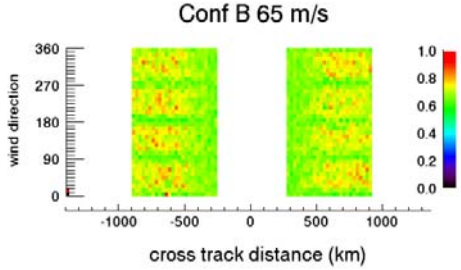
65 m/s

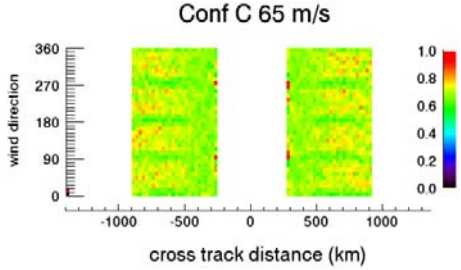


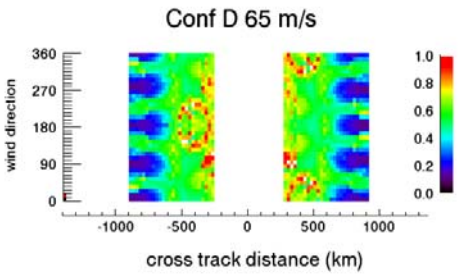


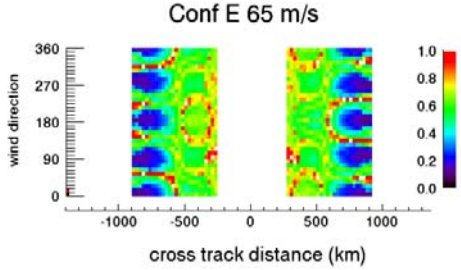
VRMS with σ_{NWP} = 10 m/s

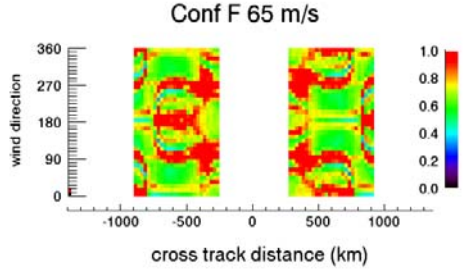




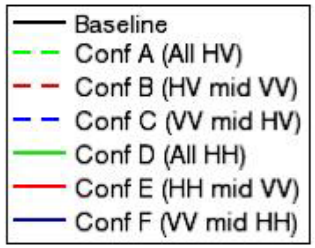




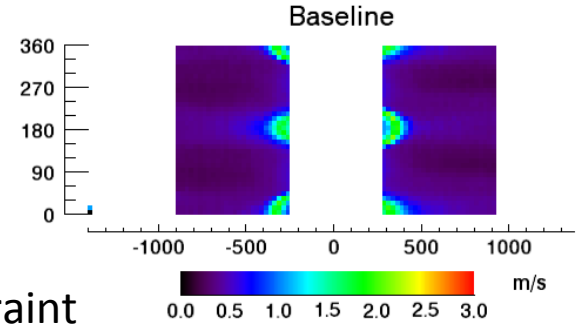


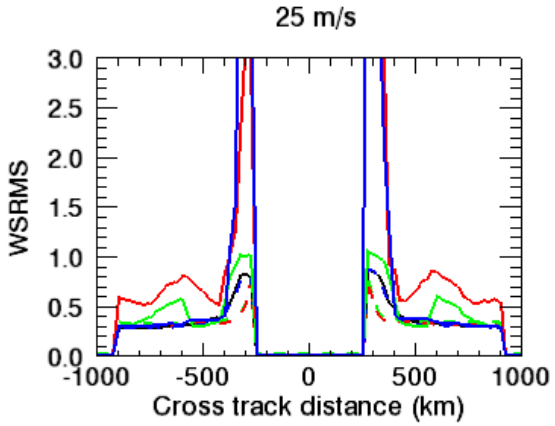


Wind speed sensitivity

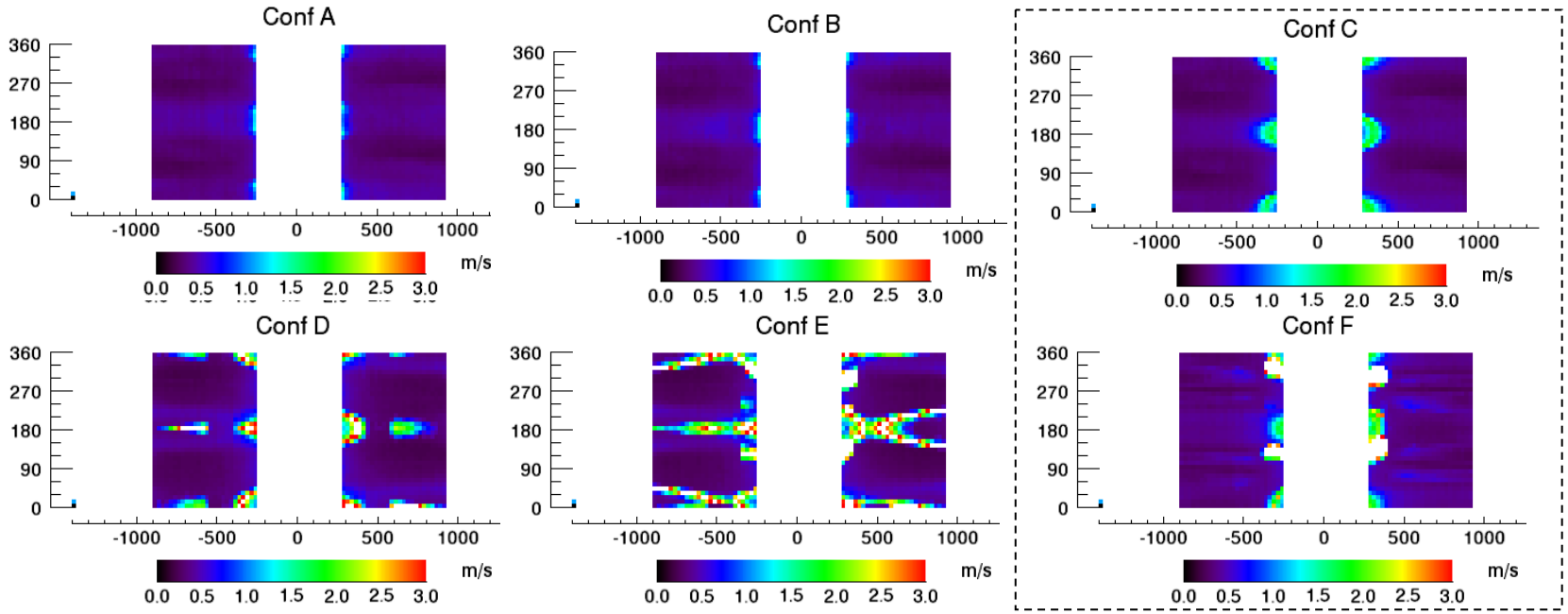


25 m/s

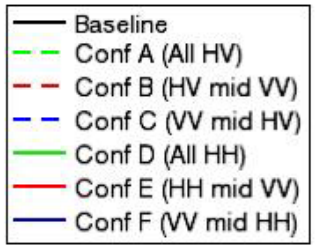




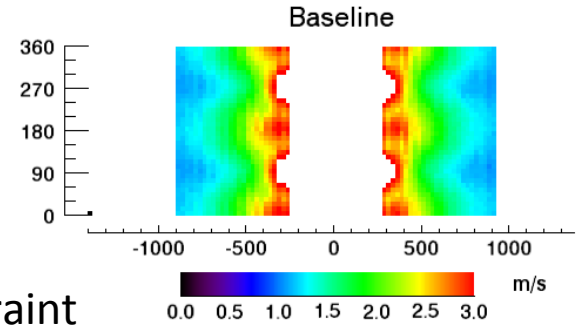
WSRMS without NWP constraint

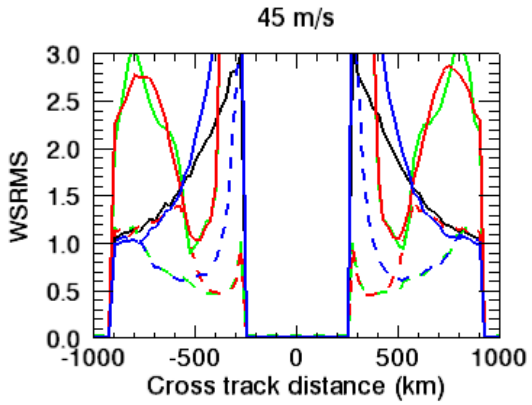


Wind speed sensitivity

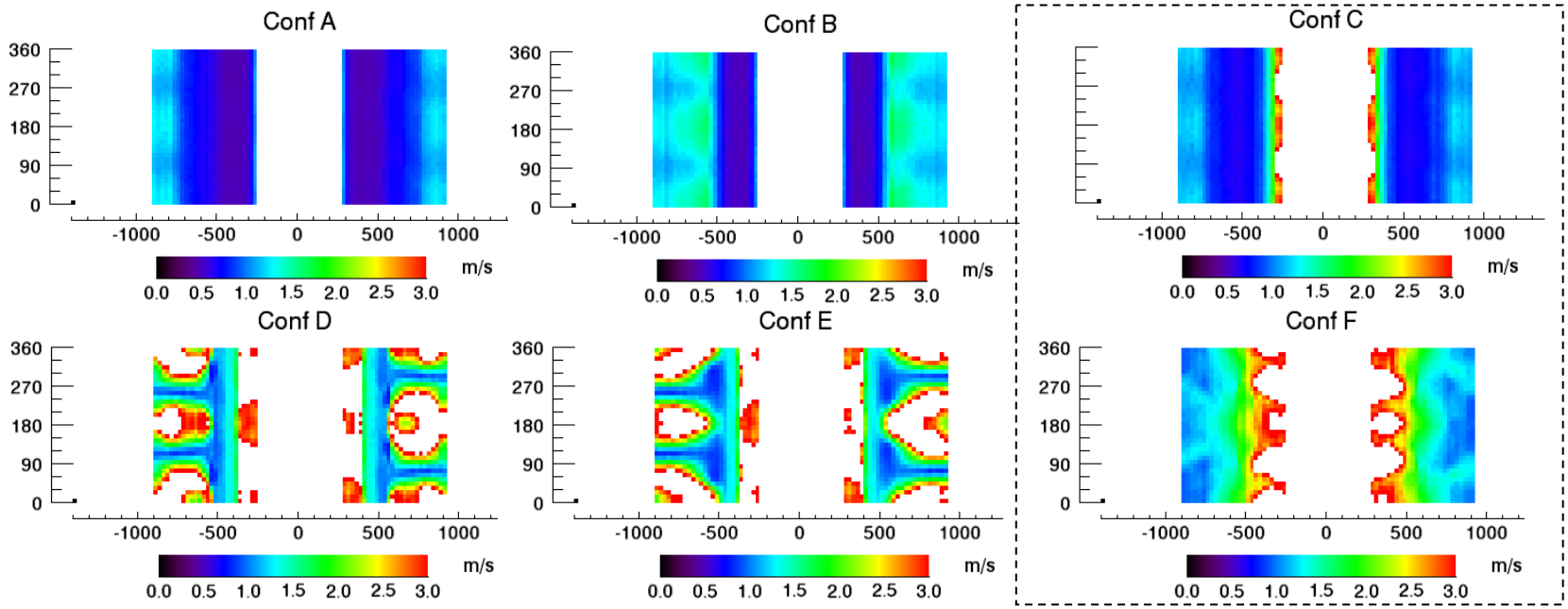


45 m/s





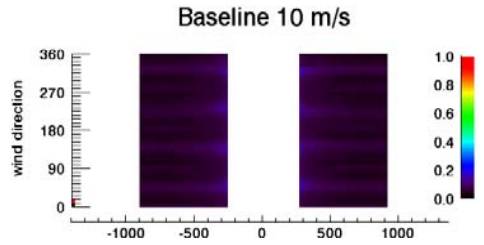
WSRMS without NWP constraint

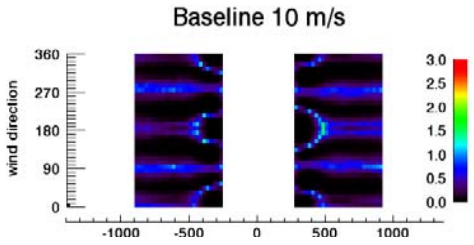


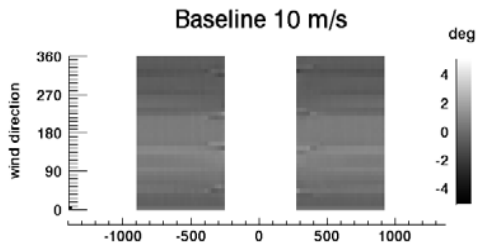
Focus on Midbeam VH option

Baseline

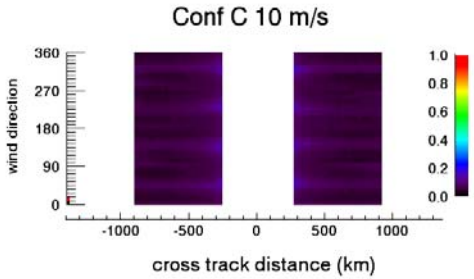
10 m/s

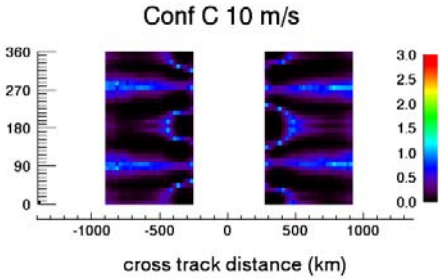


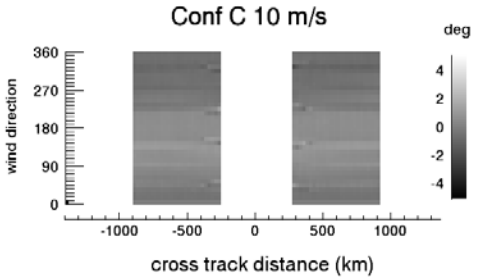




Conf C







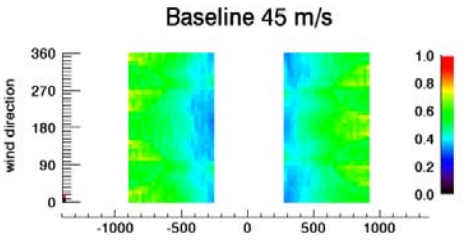
VRMS

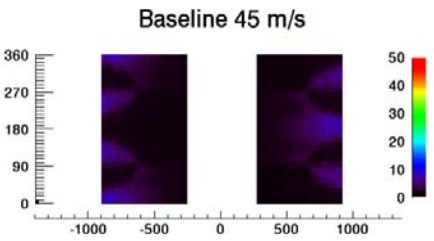
AMBI

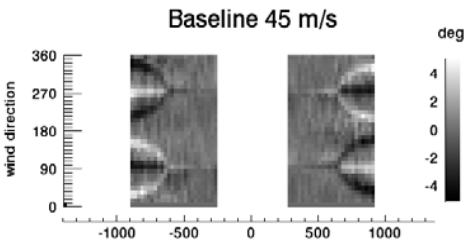
BIAS

Baseline

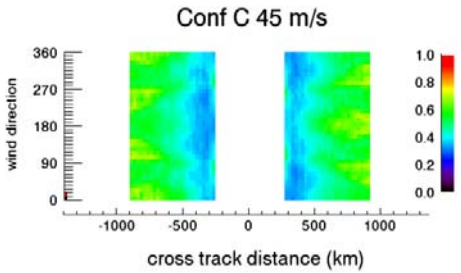
45 m/s

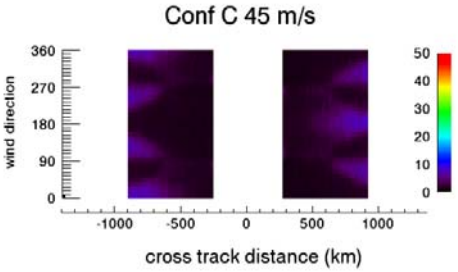


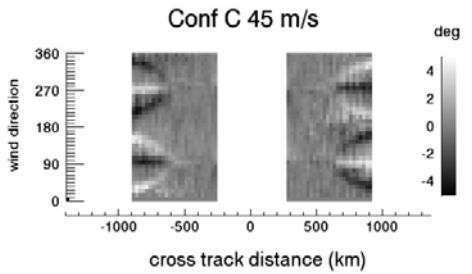




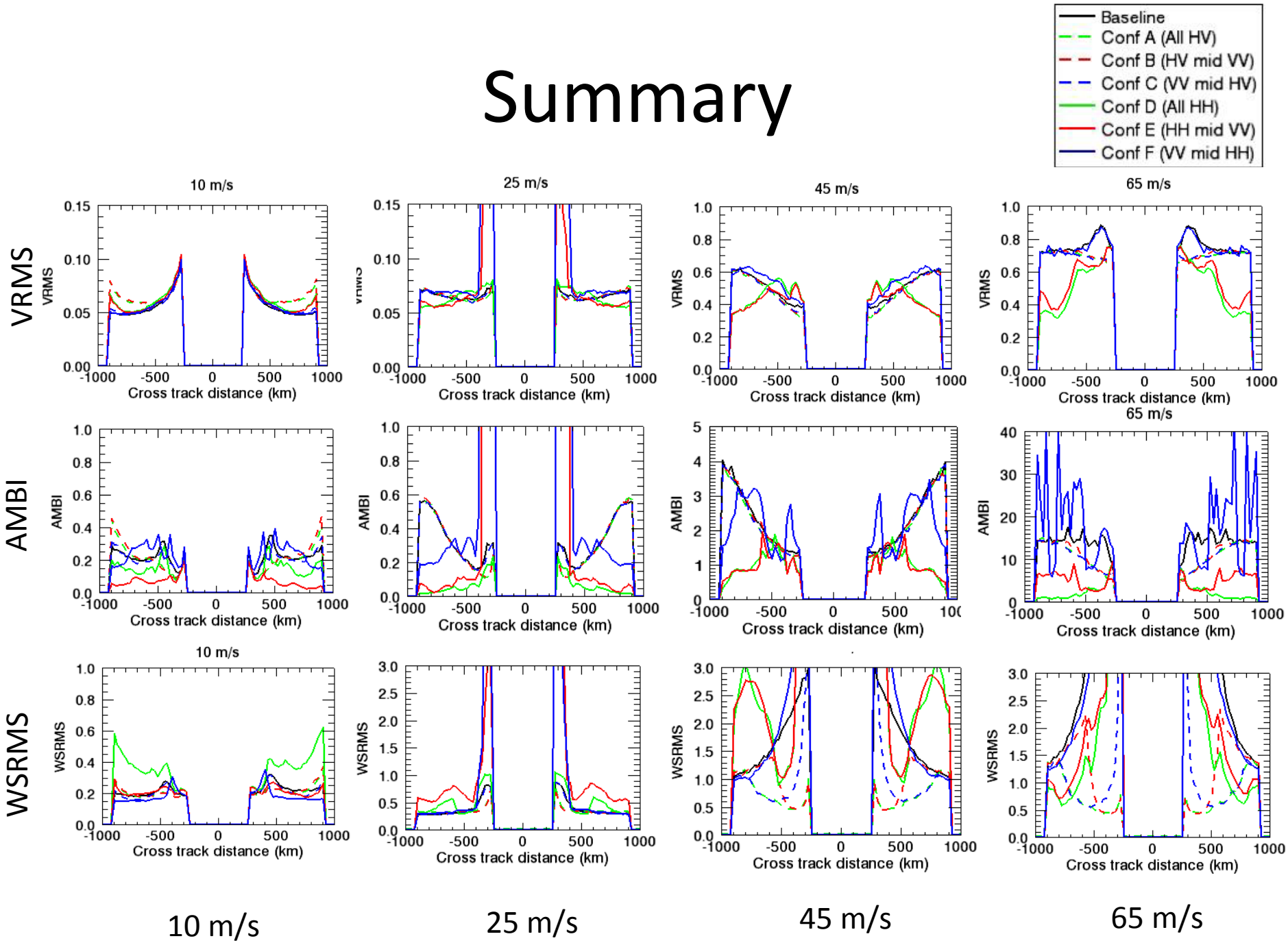
Conf C







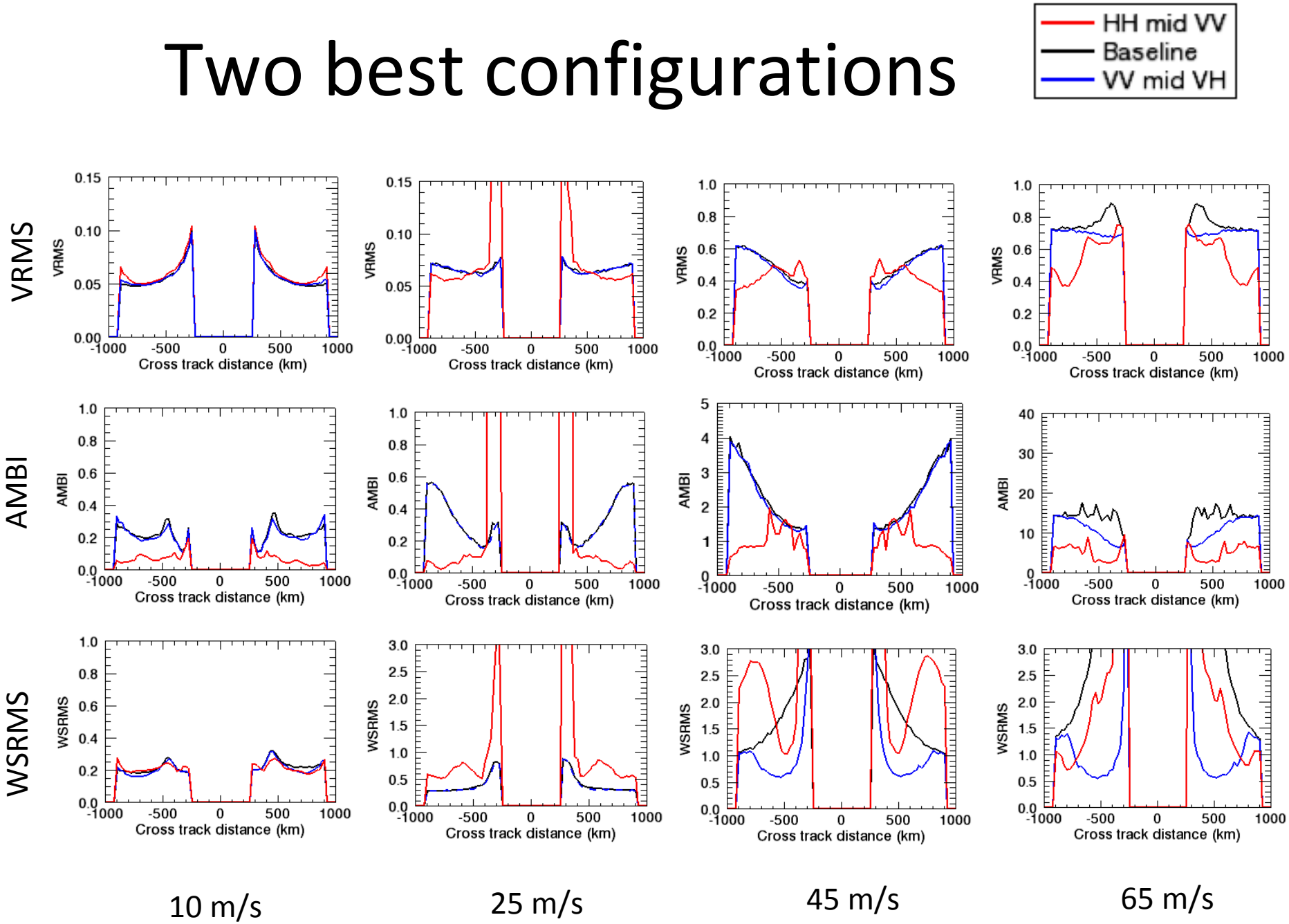
Summary


Baseline
Conf A (All HV)
Conf B (HV mid VV)
Conf C (VV mid HV)
Conf D (All HH)
Conf E (HH mid VV)
Conf F (VV mid HH)
VRMS
AMBI
WSRMS
10 m/s
25 m/s
45 m/s
65 m/s
Cross track distance (km)
10 m/s
25 m/s
45 m/s
65 m/s

Summary

1) **All configurations** (except all HH) show directional sensitivity at low-moderate winds similar than baseline → comply with nominal ASCAT-SG requirements.
2) **The all HH with mid VV configuration** displays better directional wind sensitivity (better VRMS and AMBI) at high wind speeds, esp. in outer swath. But wind speed accuracy (WSRMS) is worse. The all HH configuration is best at high winds but has poor performance at low-moderate winds and should be discarded.
3) **VH configurations** afford better determination of wind magnitude at high wind speeds than baseline or HH configurations. All VH is best, but All VV with mid VH offers similar performance with reduced complexity.

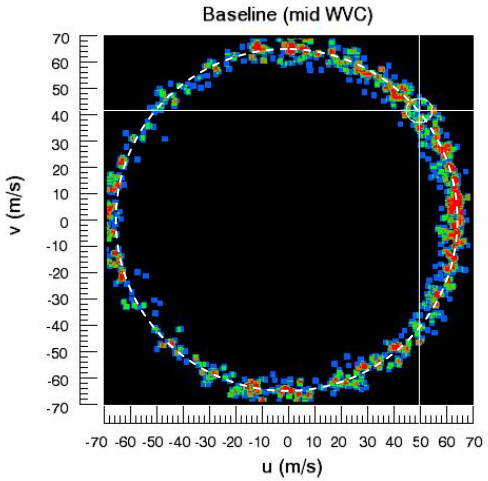
Two best configurations

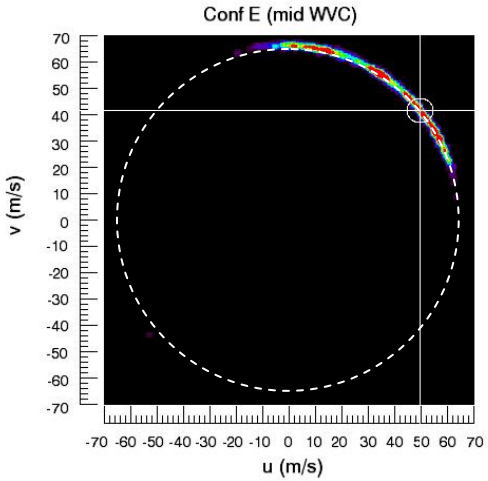


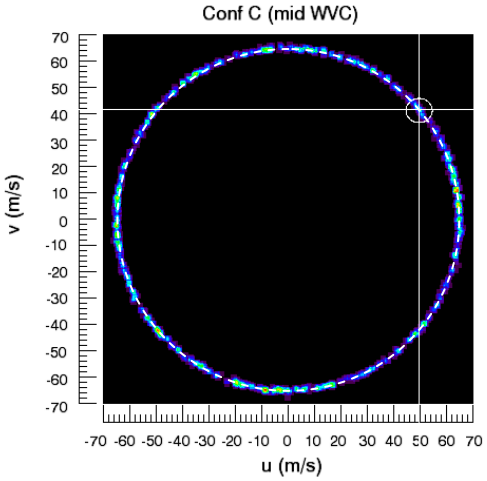
Two best configurations

against baseline:

65m/s

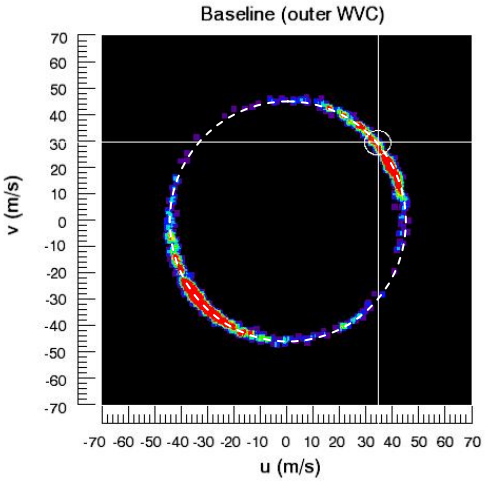




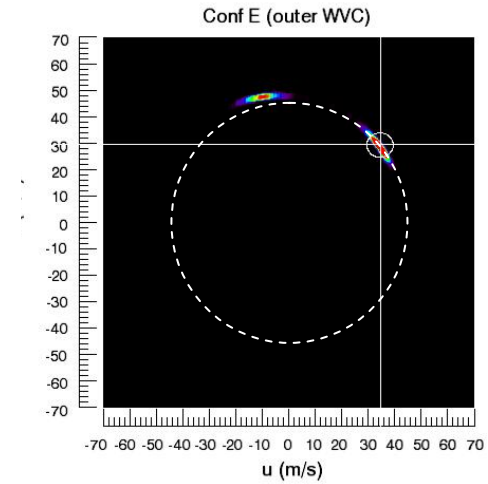


45m/s

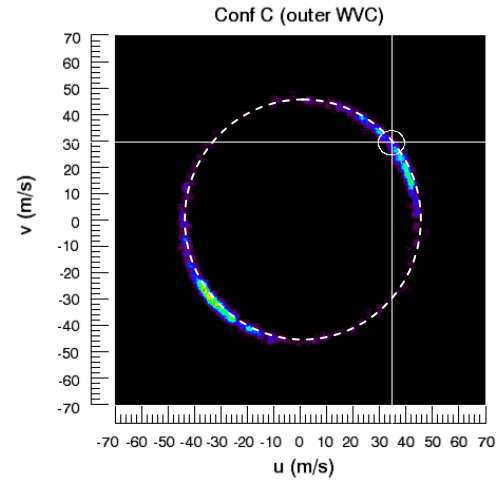
Baseline



HH with Mid VV



VV with Mid-VH



Simulated Output Wind Probabilities (45 deg)

Conclusions

Inclusion of HH or VH to baseline configuration offers distinct advantages:

- **HH with mid VV** provides better directional wind sensitivity – but prone to biases in wind magnitude.
- **VV with mid VH** provides unbiased determination of wind magnitude – but less sensitive to wind direction.

Which one would you choose?