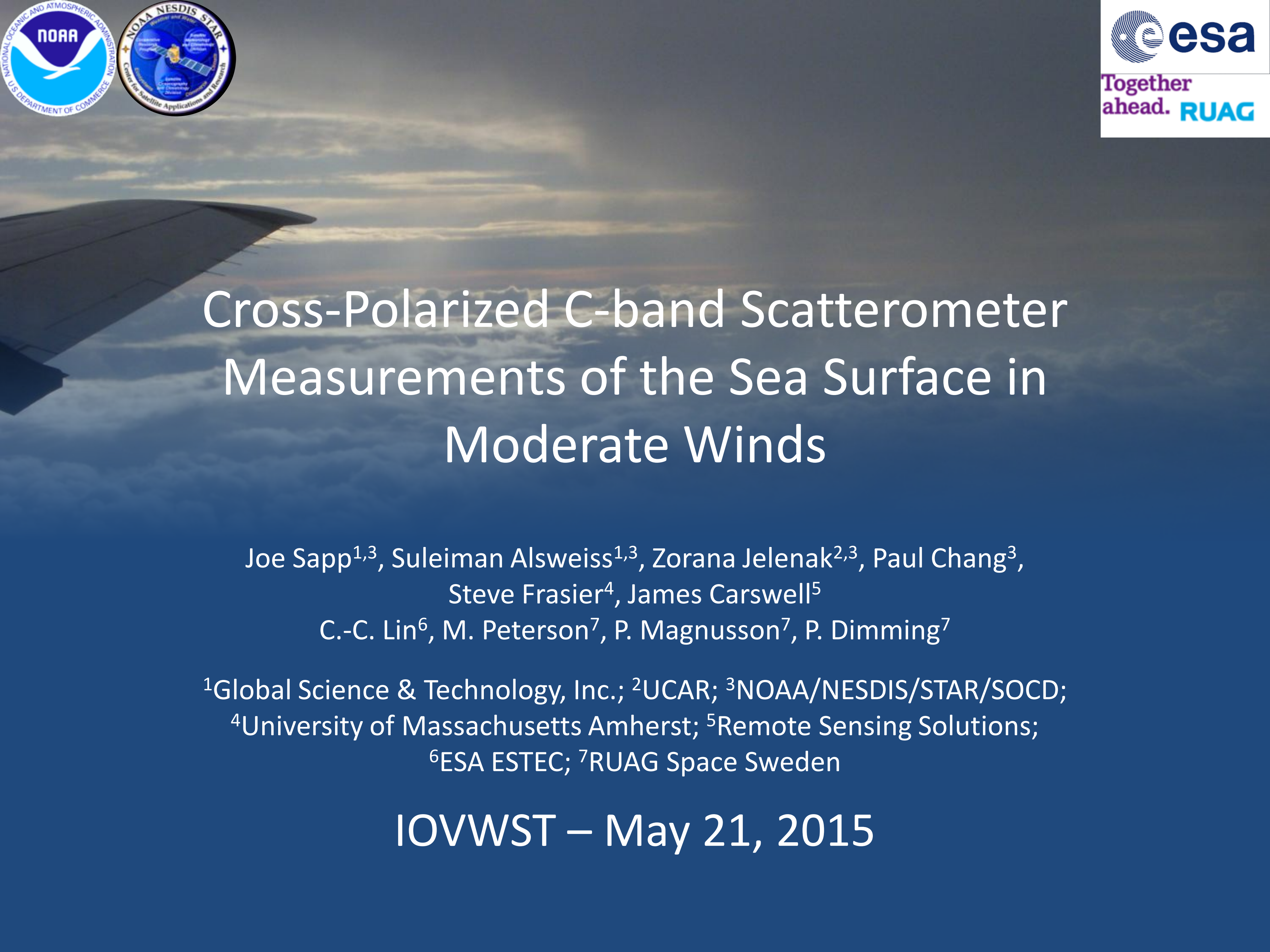
Cross-Polarized C-band Scatterometer Measurements of the Sea Surface in Moderate Winds
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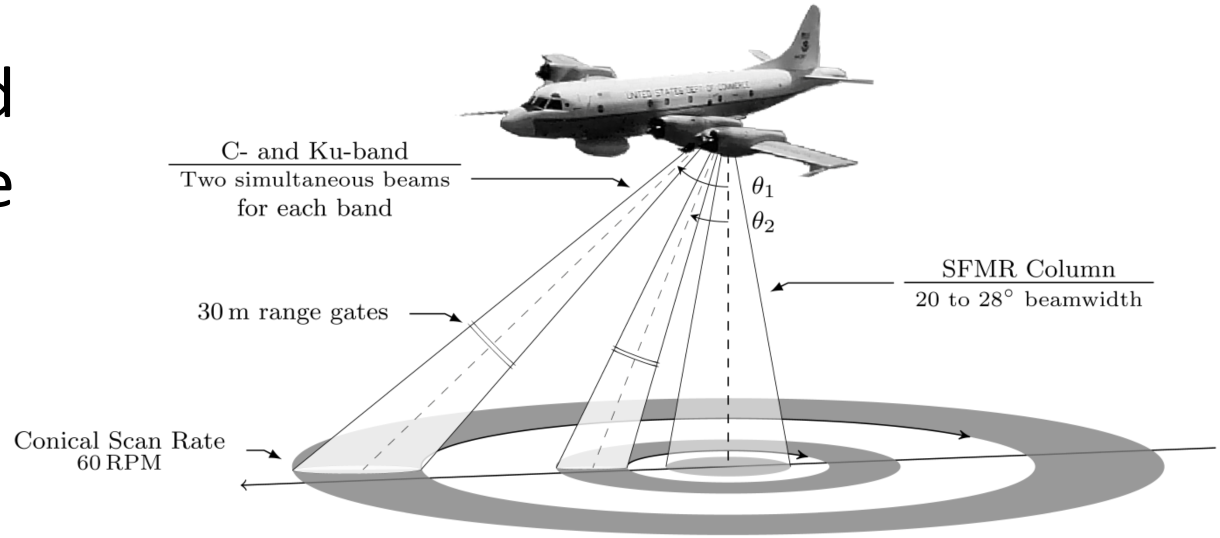
IOVWST – May 21, 2015

Experiment Overview

IWRAP Airborne Scatterometer Overview

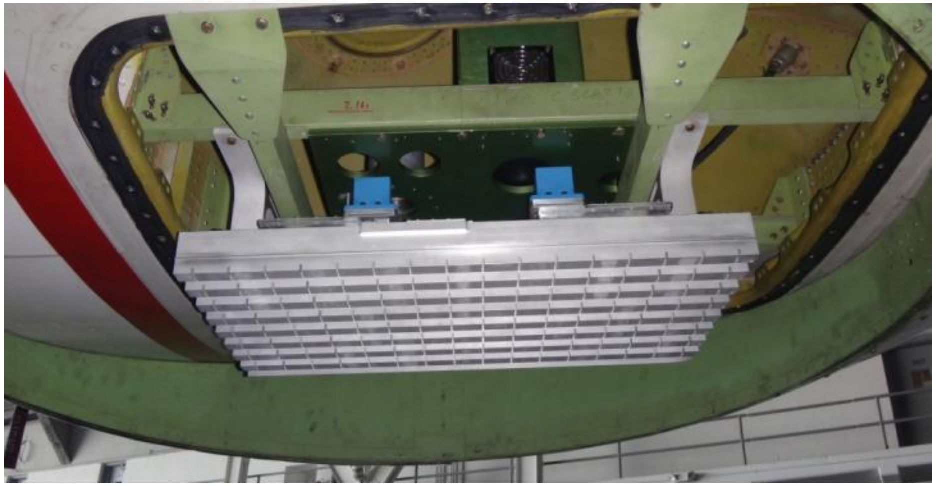
The Imaging Wind and Rain Airborne Profiler (IWRAP)



- Operated from a NOAA WP-3D "Hurricane Hunter" aircraft
- Developed and maintained by the University of Massachusetts Amherst's (UMass) Microwave Remote Sensing Laboratory (MIRSL)
- Capable of measuring the sea-surface NRCS at all polarization combinations (VV, HH, VH, and HV)

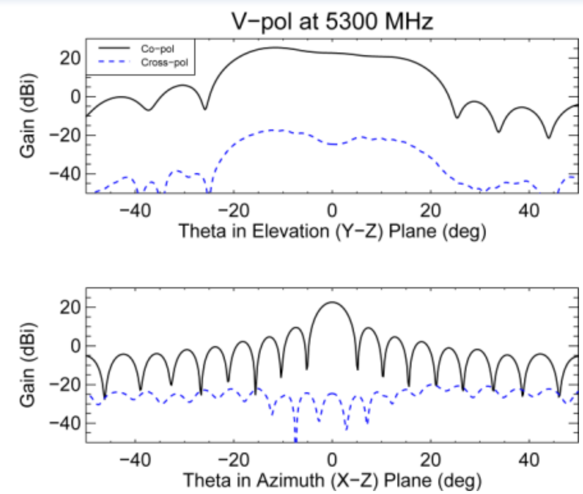
Winter 2015 Experiment Description

- The IWRAP C-band radar was configured to use a dual-polarized fan-beam antenna **developed by RUAG for ESA** for the next-generation European scatterometer
- Antenna is a dual-pol fan-beam antenna with cross-pol isolation > 40dB
- Antenna was mounted in a **fixed position** with bore sight at nadir



Winter 2015 Experiment Design

- To sample in azimuth, aircraft performed 360° orbits at fixed roll angles up to 60°
- IWRAP operation was limited to 2 polarization configurations at a time (e.g., VV/VH), so multiple orbits were usually performed back-to-back to sample all polarizations at C-band
- Continuous circle patterns performed:
  - VV and VH: 71
  - HH and HV: 79
- Ku-band operated normally (VV/HH)

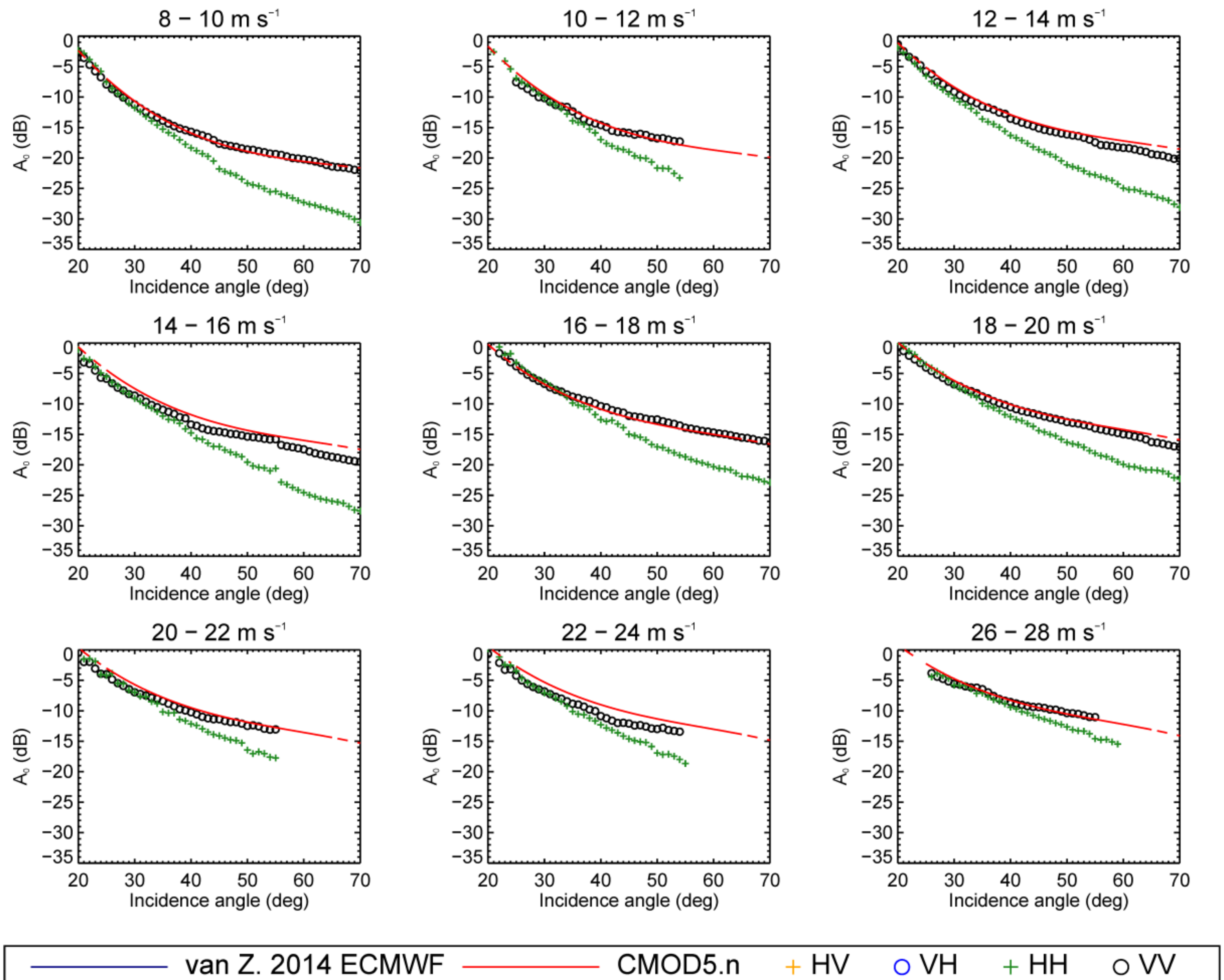


Cross-Polarized Sea-Surface NRCS Measurements

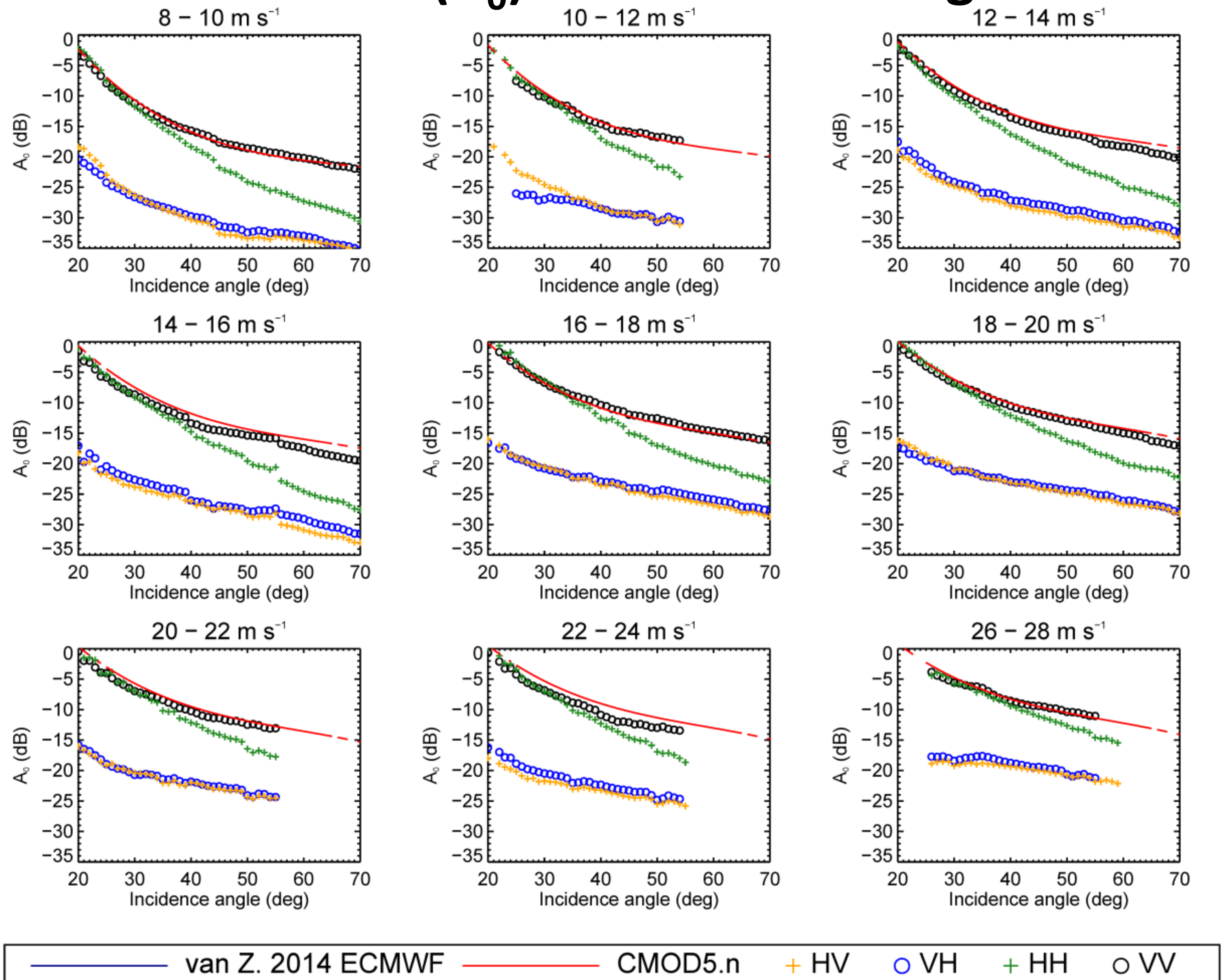
Data Analysis

- Calibration performed at 40° incidence for VV polarization using CMOD5.n model
  - Calibration resulted in a global offset of about -0.5 dB, which was then applied to all NRCS
- For each polarization:
  - NRCS and flight data were grouped into continuous orbits of at least 360°
  - NRCS were grouped in 1° incidence angle bins and 5.625° azimuth bins
- Surface wind information from buoys, dropsondes and GDAS model
  - To sample the surface wind vector, orbits were positioned near buoys or GPS dropsondes
  - Regions of consistent wind and no rain were targeted

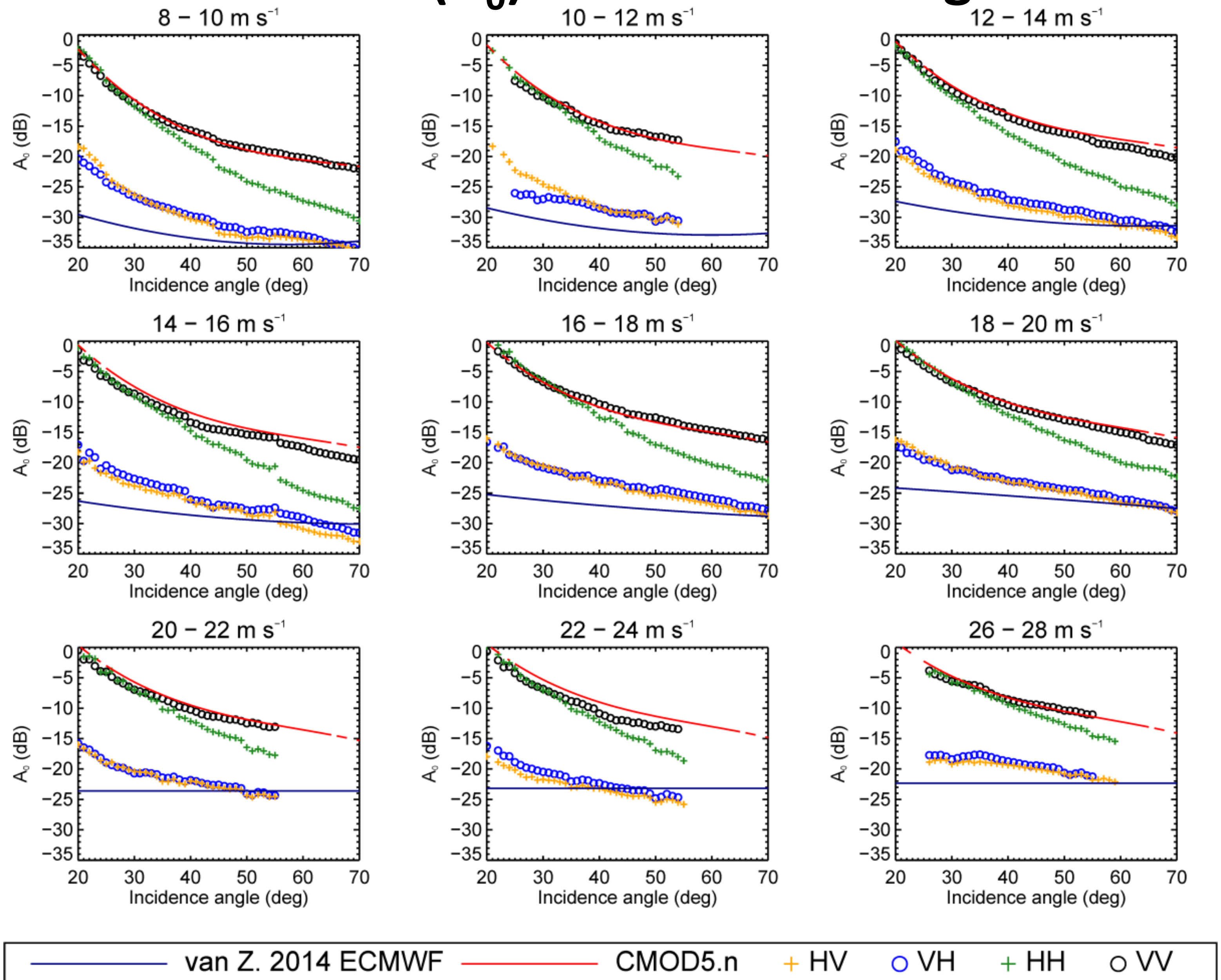
Co-Pol NRCS (A_0) vs. Incidence Angle



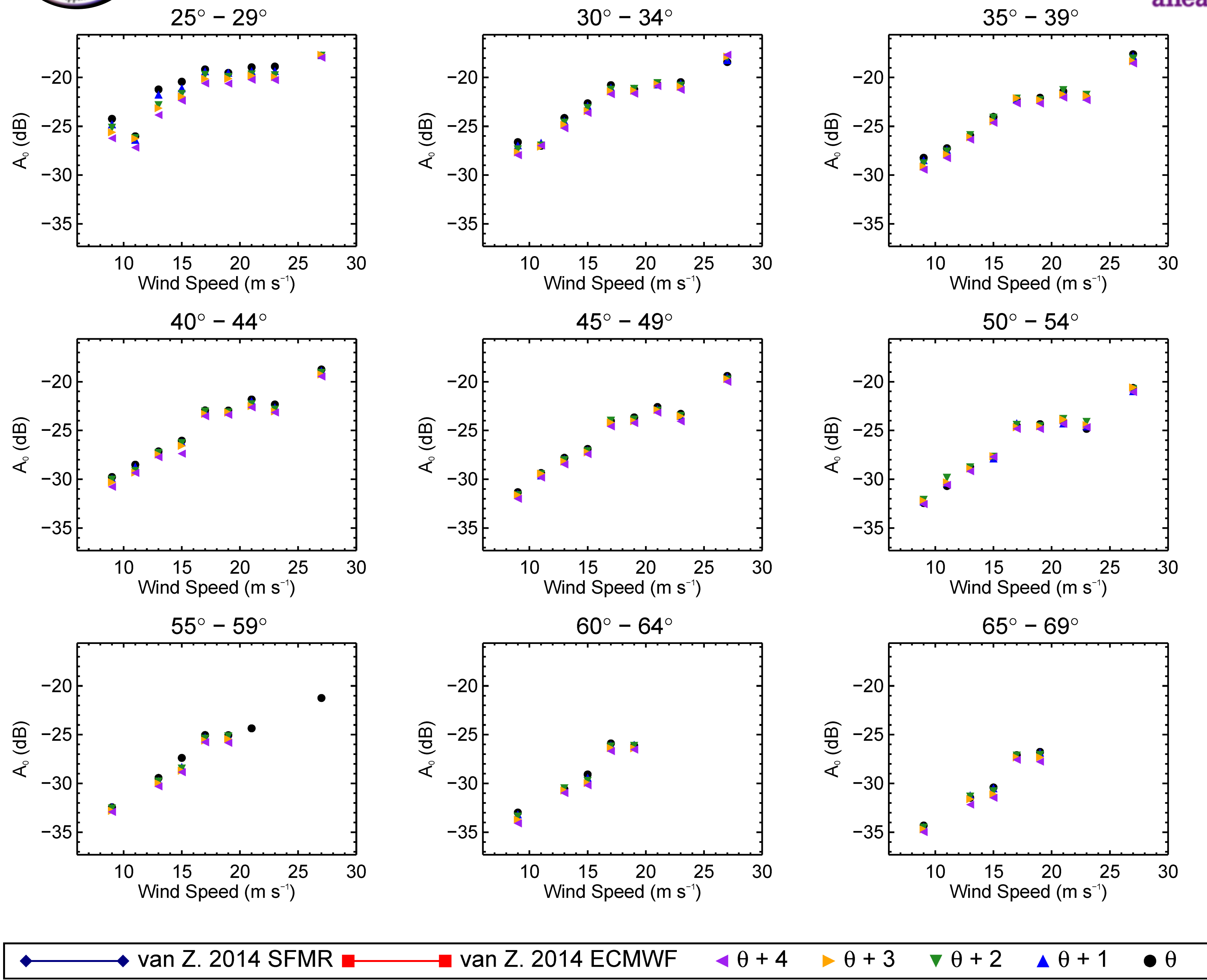
Co-Pol and Cross-Pol NRCS (A_0) vs. Incidence Angle



Co-Pol and Cross-Pol NRCS (A_0) vs. Incidence Angle

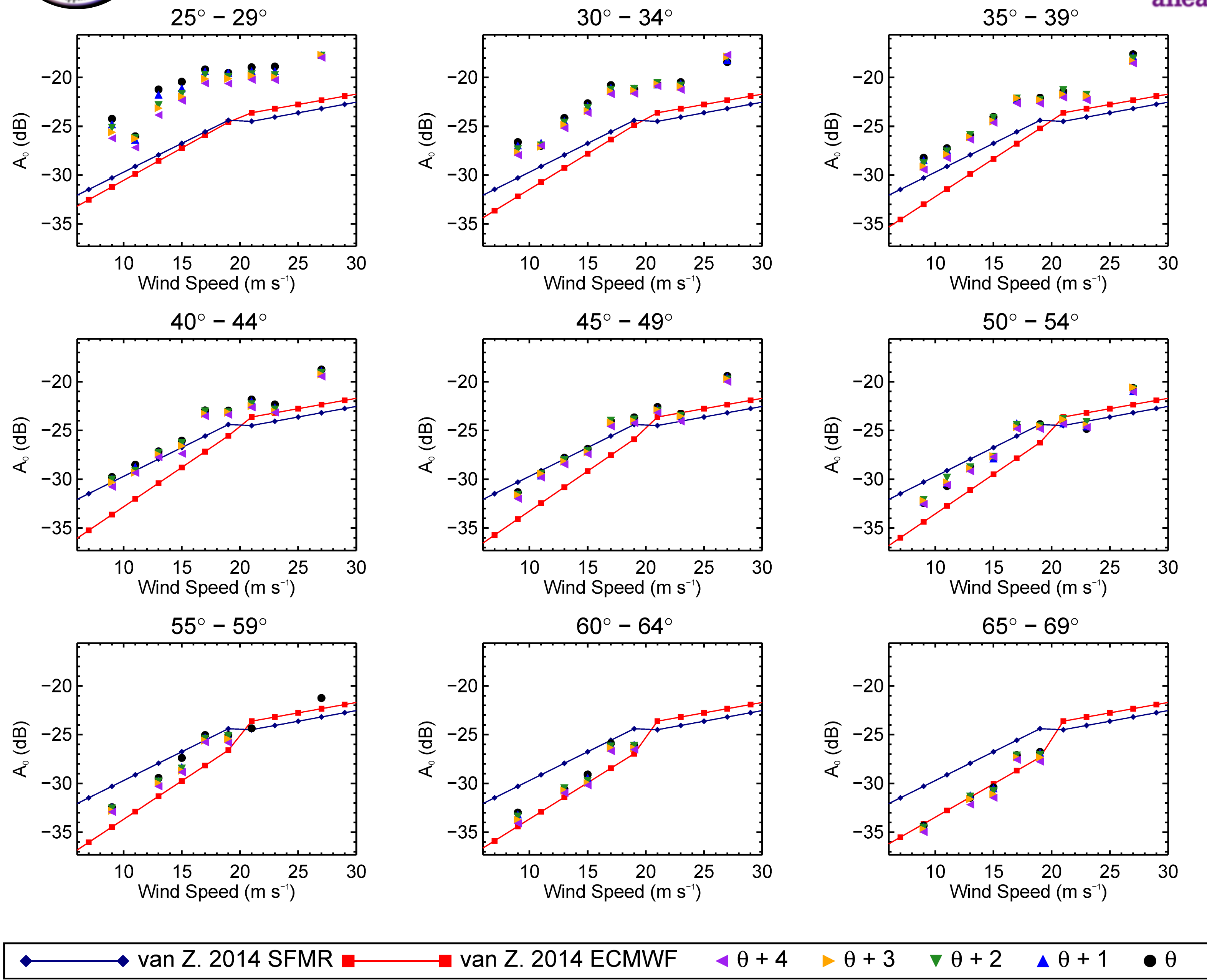


Mean NRCS (A_0) vs. Wind Speed (VH)

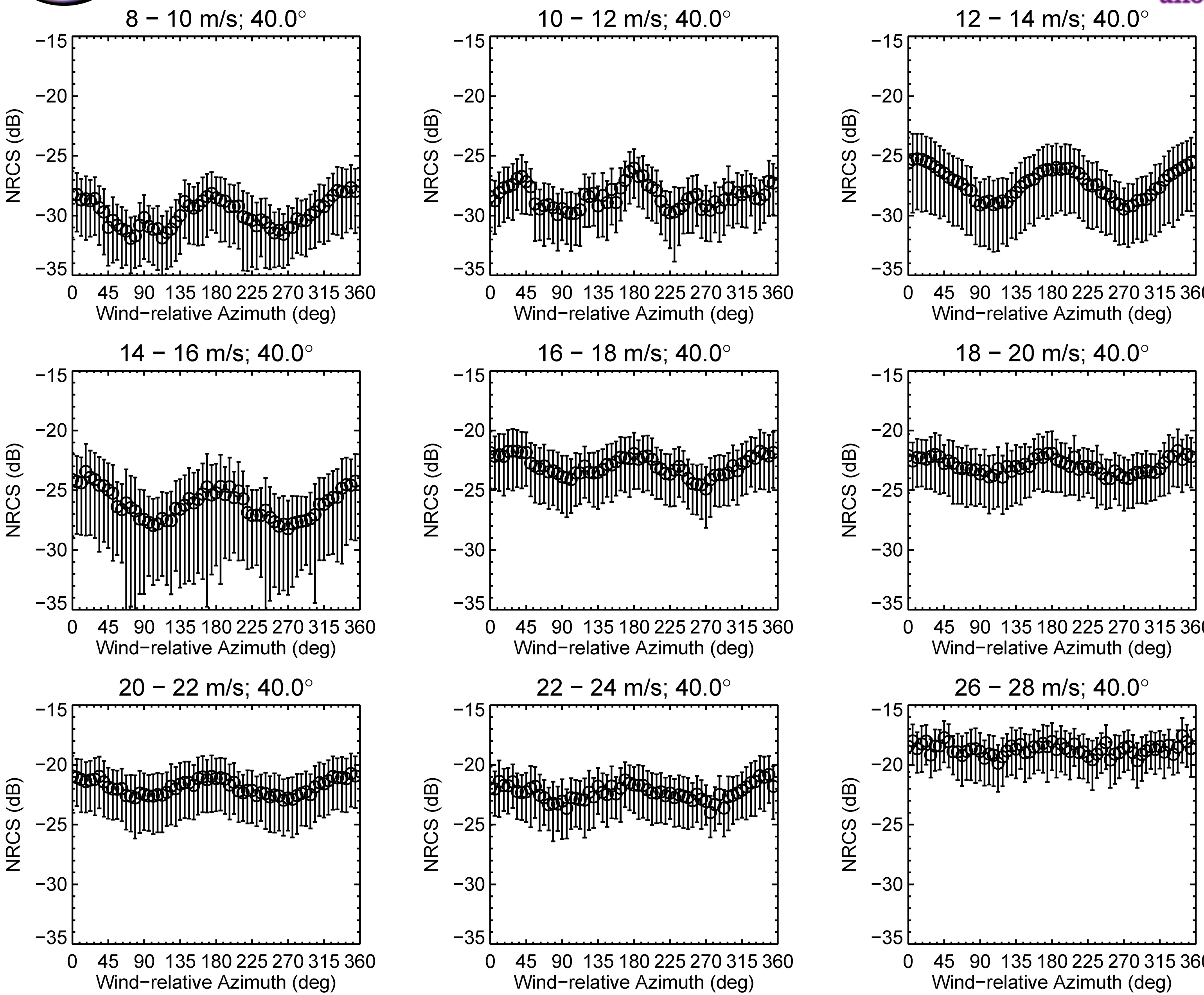


Mean NRCS (A_0) vs. Wind Speed (VH)

Together ahead. RUAG



NRCS vs. Relative Azimuth (VH)



Summary

- Observed VV NRCS matches well with CMOD5.n
- No differences in magnitude between VH and HV NRCS signals were observed
- Cross-pol dependence with incidence angle at all measured wind speeds
  - Dependence is higher in magnitude and slope than that modeled by van Zadelhoff et al., 2014
- Measured cross-pol NRCS wind speed dependence agrees with van Zadelhoff et al., 2014 SFMR-based model for incidence angles between 45° and 60°
  - Lower incidence angle measurements seem to follow the model shape but not magnitude
  - Measurements at higher wind speeds are needed to validate model trends
- Measured cross-pol NRCS exhibits a weak azimuthal modulation at wind speeds up to approximately 20m/s