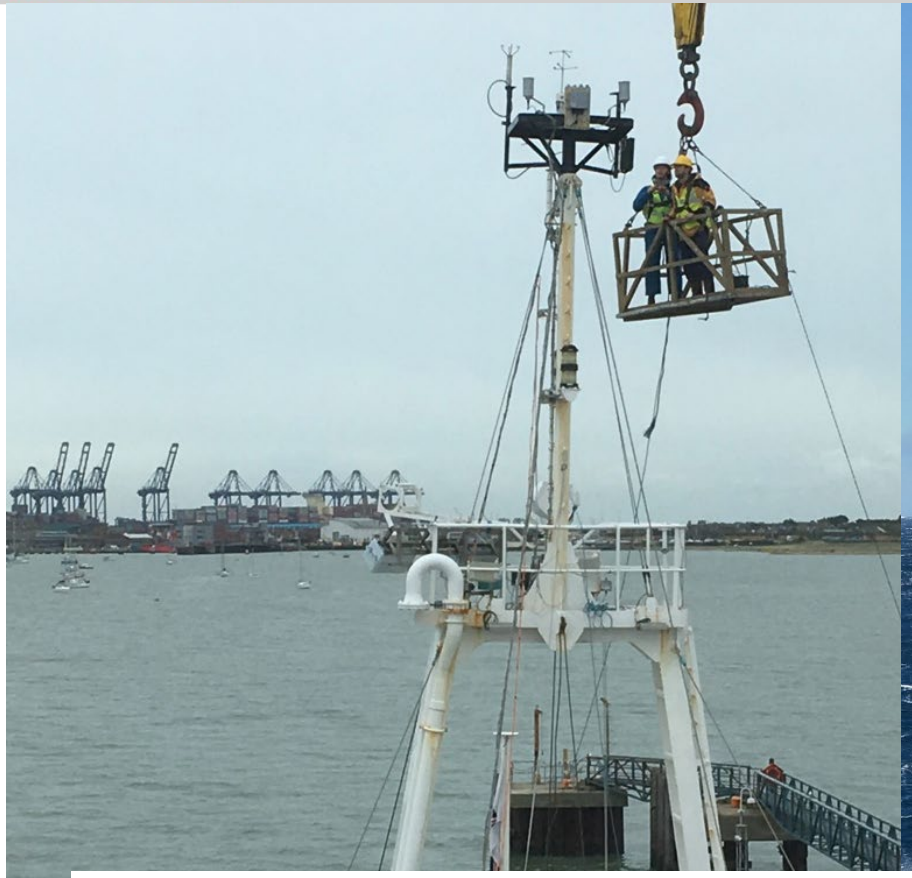
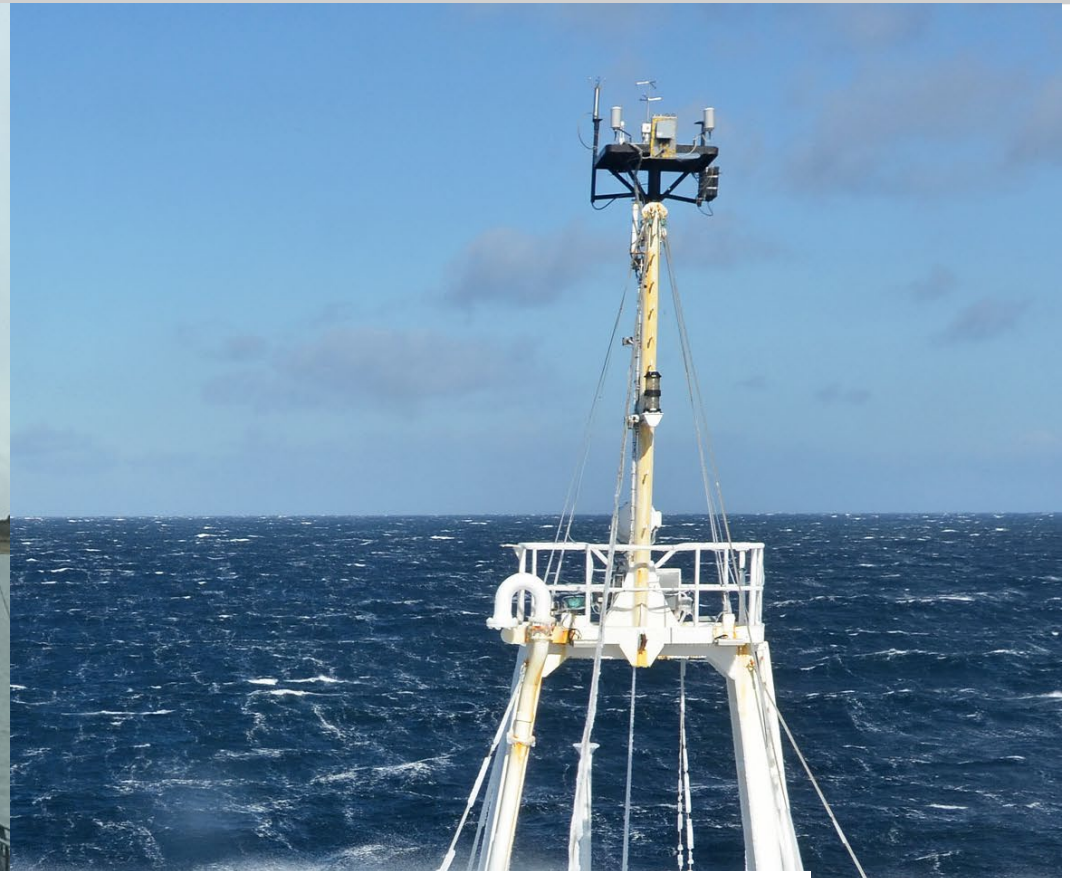




Relationship between K_{CO2} and waves (radar backscatter)

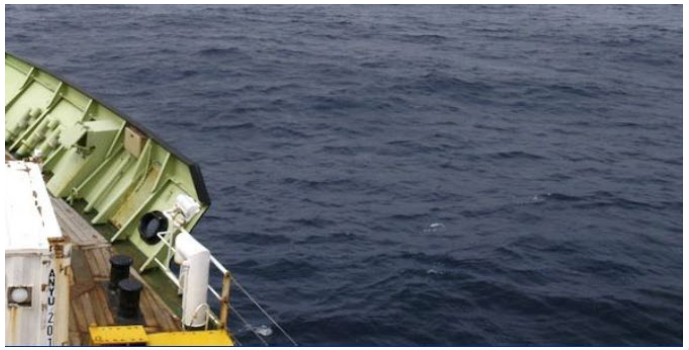
T.G. Bell[1], M. Yang[1], Y. Dong, T. Smyth[1], L. Marie[2], V. Kitidis[1], I. Brown[1], J. Bidlot[3]

amt4oceansatflux

Ocean Regulation of Climate by Heat and Carbon Sequestration and Transports

esa

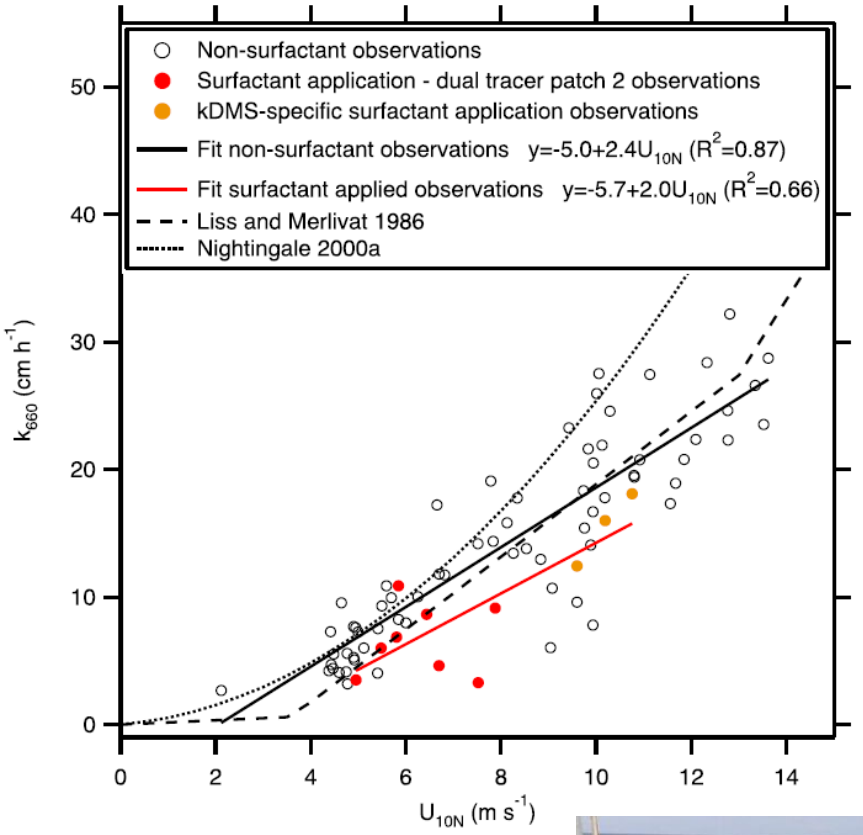
K vs U (sea state)



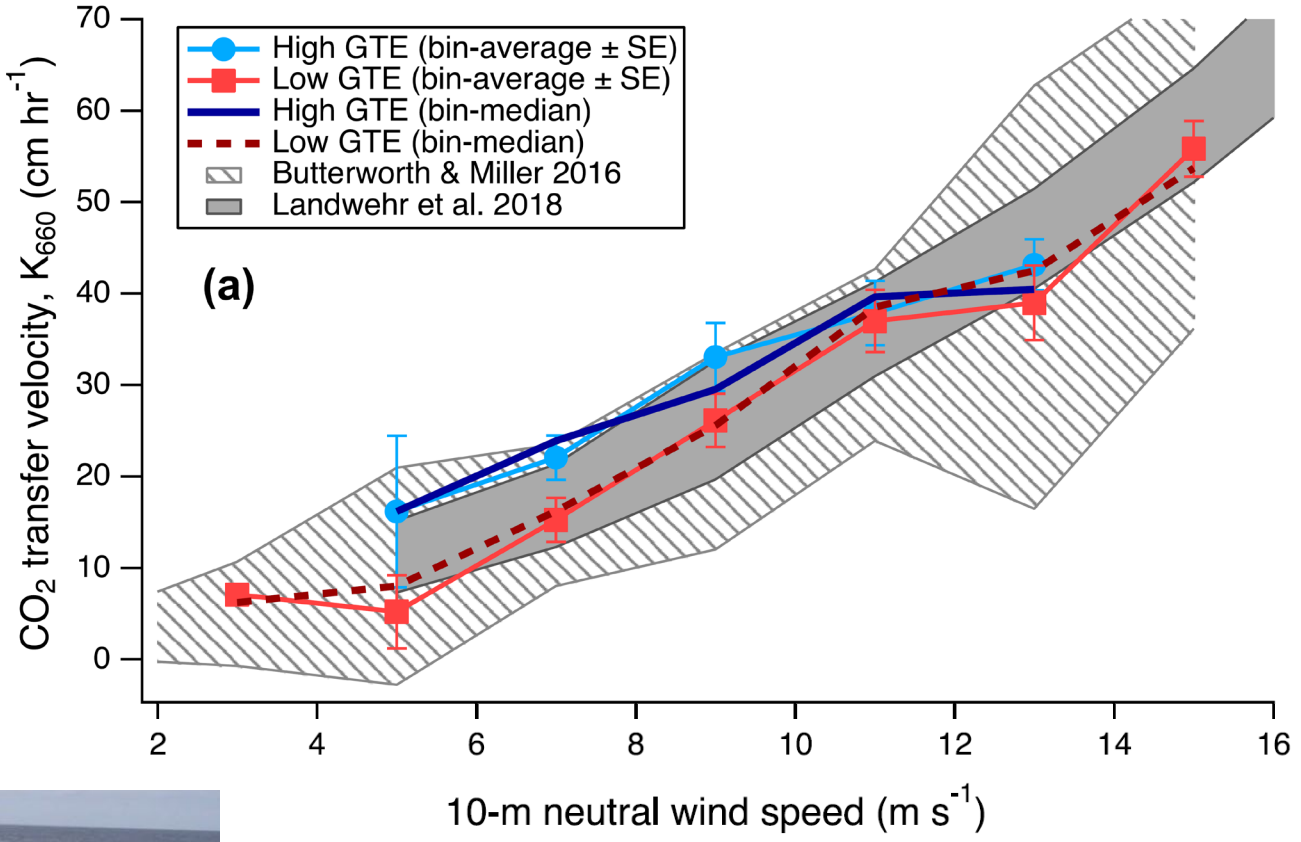
calm (buoyancy) → moderate wind (shear stress) → rough (waves, bubbles)

Yang et al. (In Review)

Impact of surfactants



Salter et al. (2011)



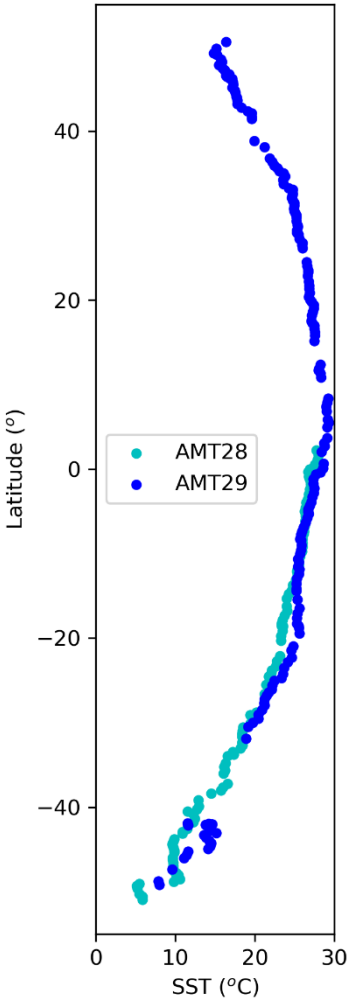
Yang et al., (2021)

See Yang et al. poster

PML | Plymouth Marine Laboratory

Atlantic Meridional Transect (AMT)

Research excellence supporting a sustainable ocean



Autonomous air-sea CO_2 flux systems

Eddy covariance CO_2 fluxes

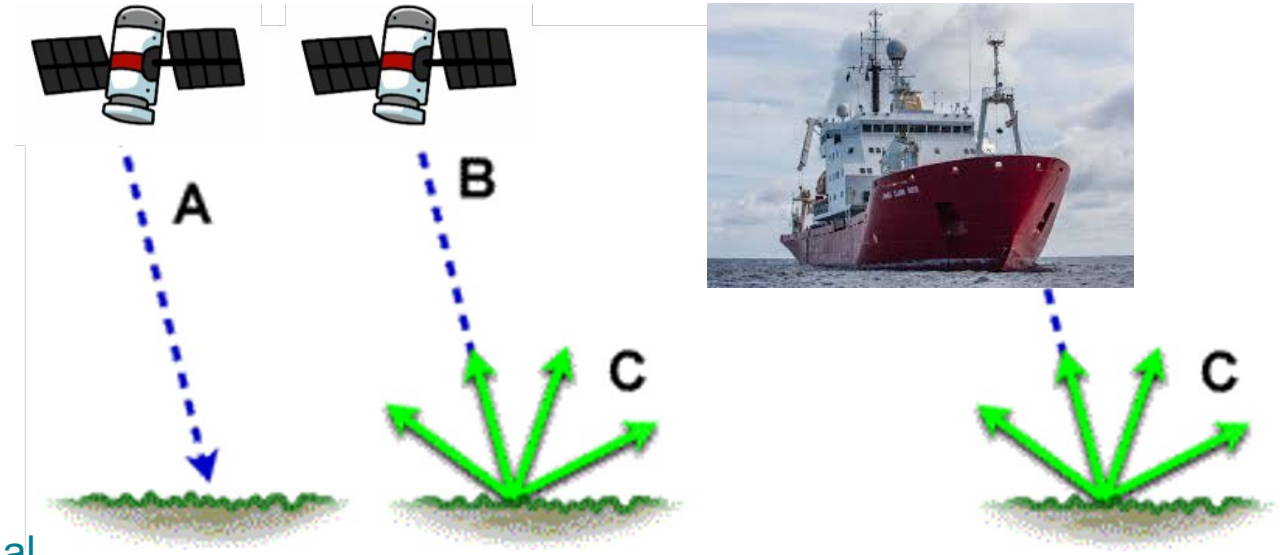
Flux observations:

-Closed path
-Dried
-Licor/Picarro

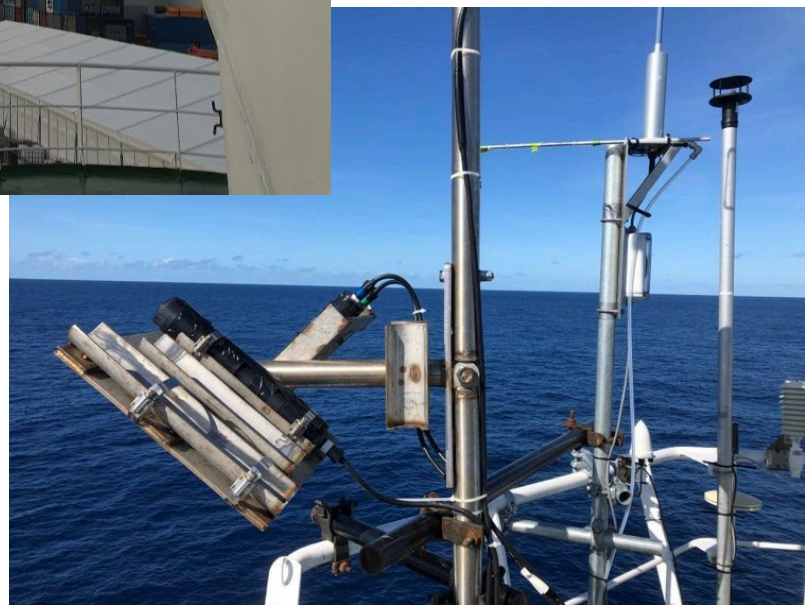
See Dong et al. poster

Seawater pCO_2

Sea surface scattering observations

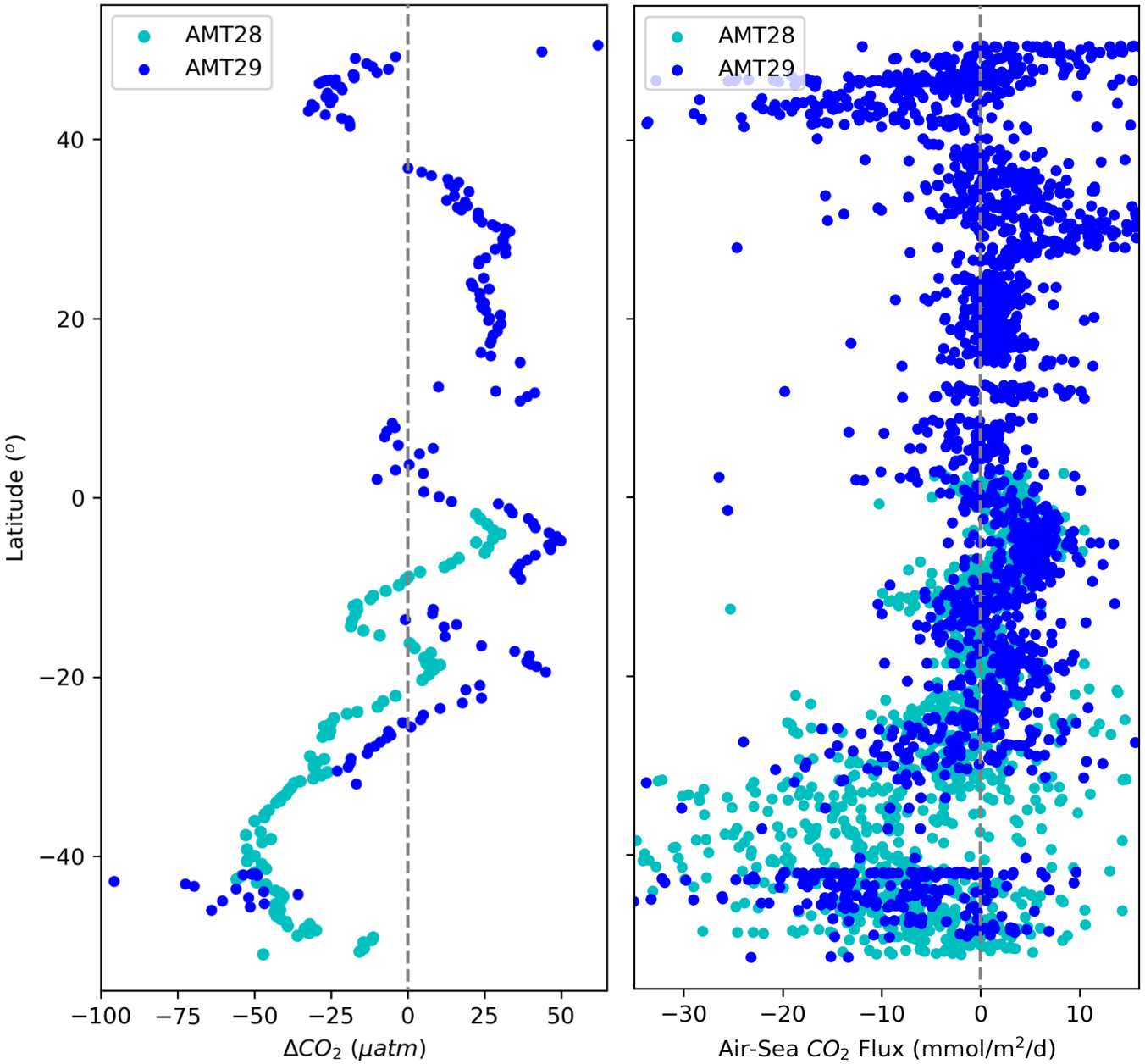


Kudryavtsev et al. (2014)



- ICBR (C-band radar scattering)
- Cross Polarisation (Horizontal/Vertical)
- Angles: 30^{o}-50^{o}
- Small scale waves and breaking waves/foam

CO_2 fluxes: Uncertainty, QC and averaging

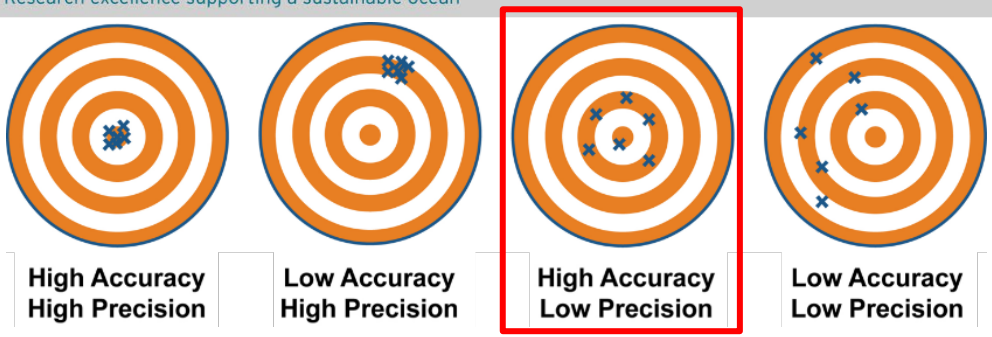


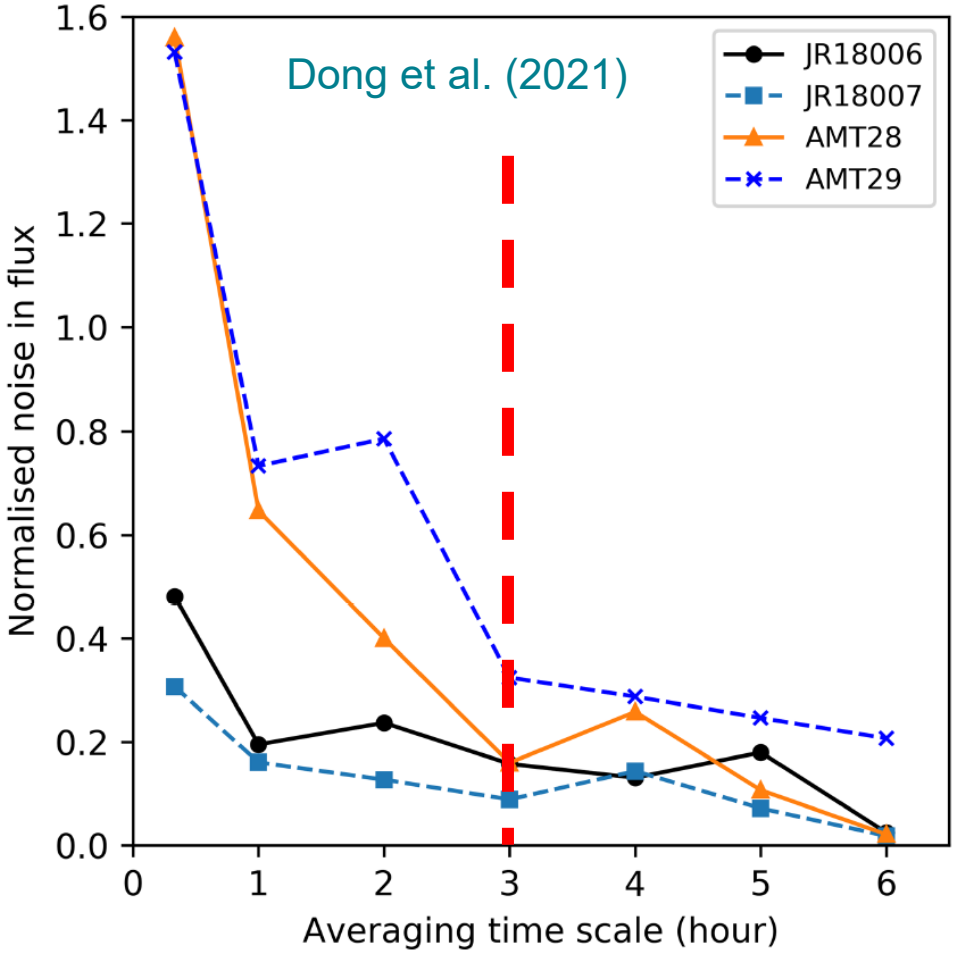
Flux measurements and quality control:

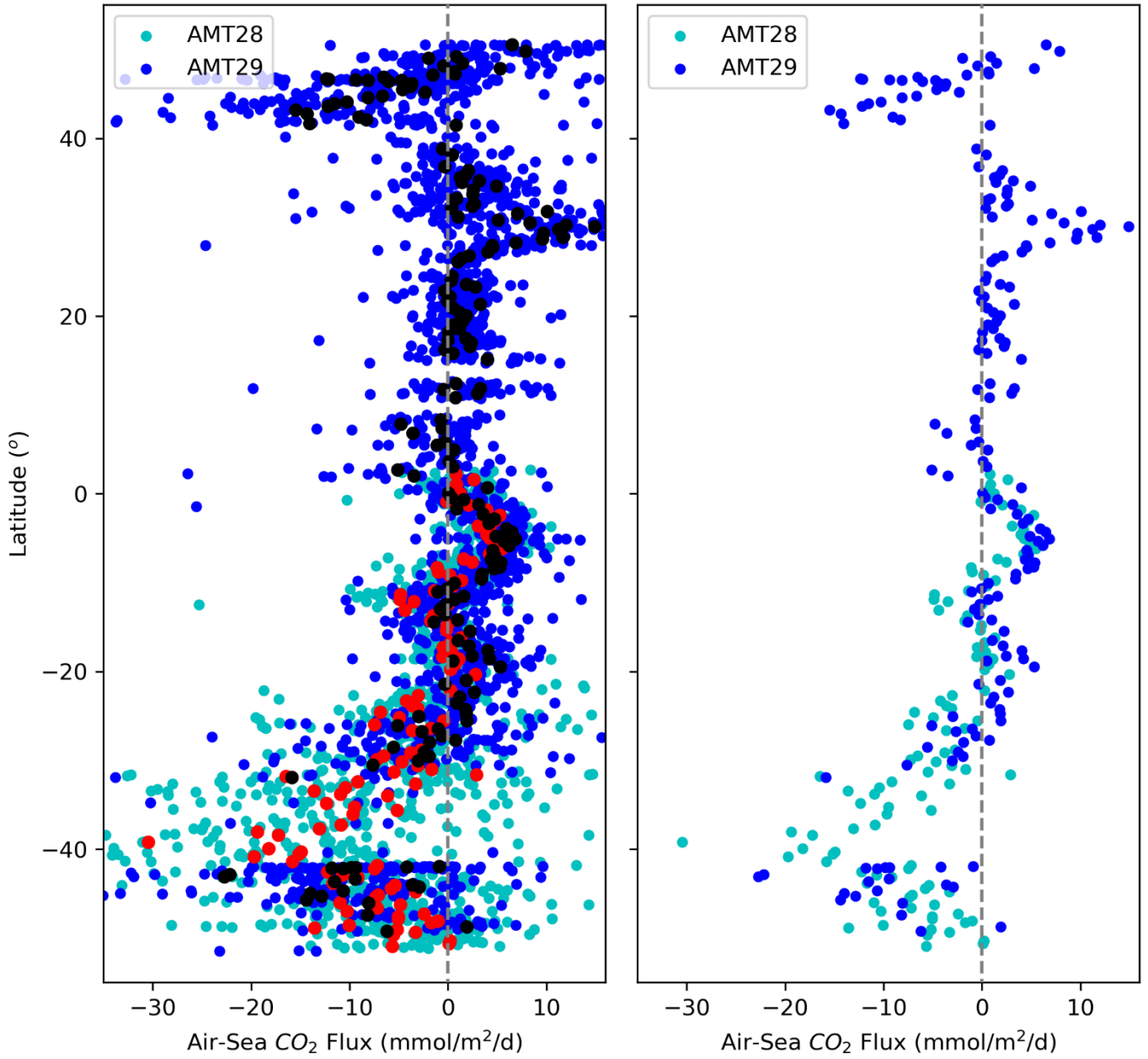
- Wind sector, stationarity, homogeneity, etc. (see Dong et al., 2021)

20 min average data

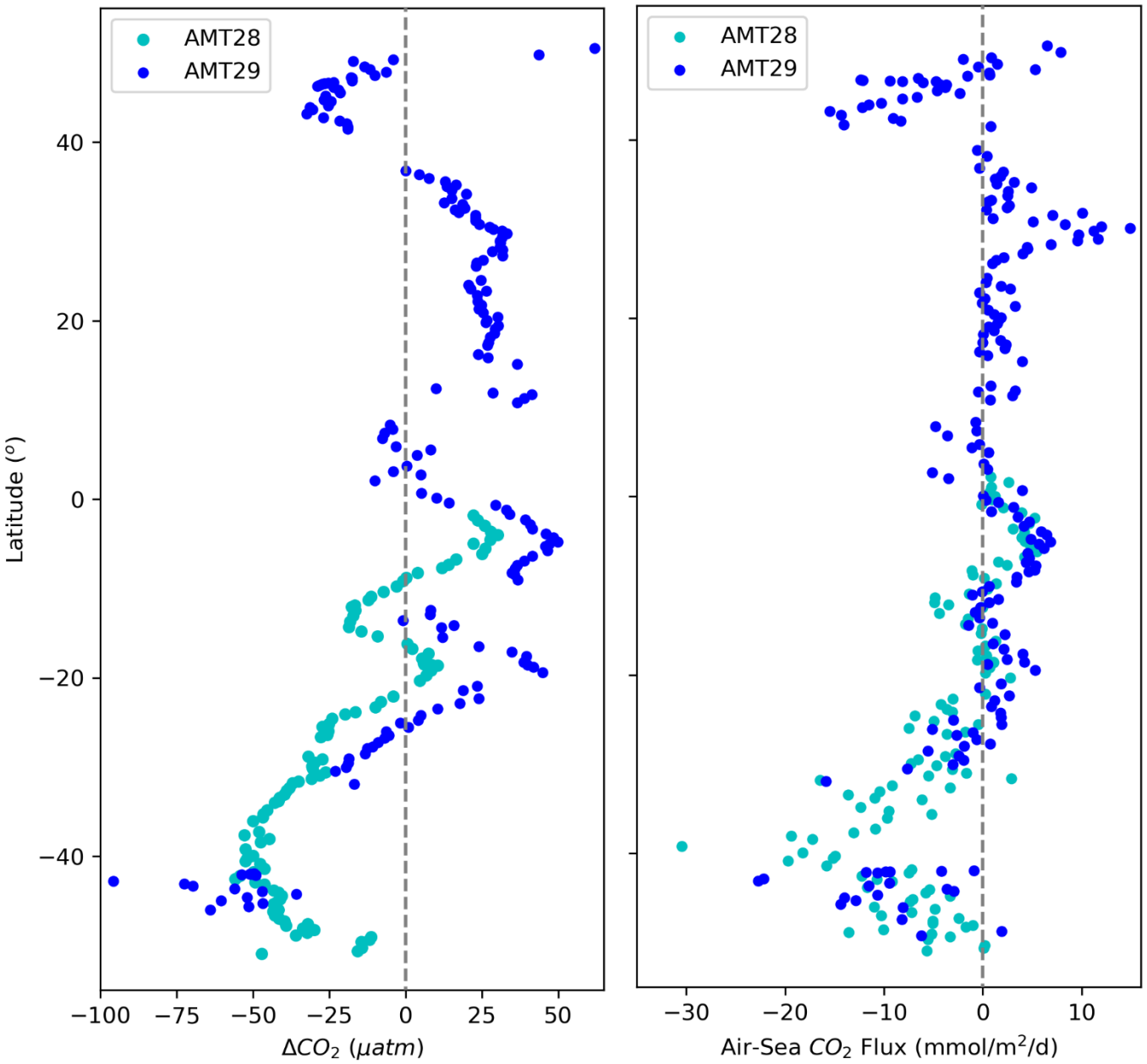
CO_2 fluxes: Uncertainty, QC and averaging (NOT into bins)







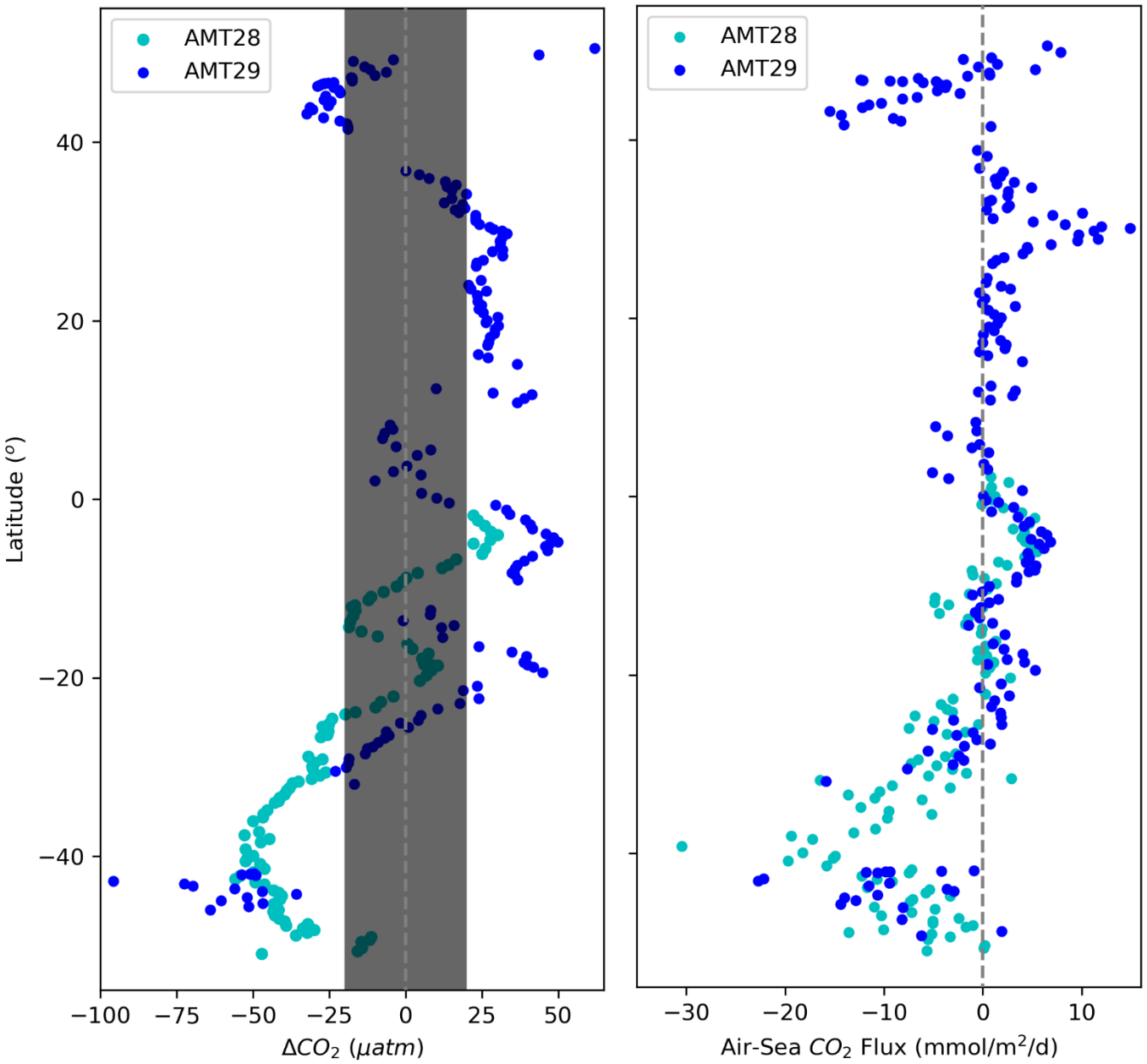
CO_2 fluxes: Uncertainty, QC and averaging



Flux measurements and quality control:

- Wind sector, stationarity, homogeneity, etc. (see Dong et al., 2021)
- Averaging period (3hrs, min. N = 6)

CO_2 fluxes: Uncertainty, QC and averaging

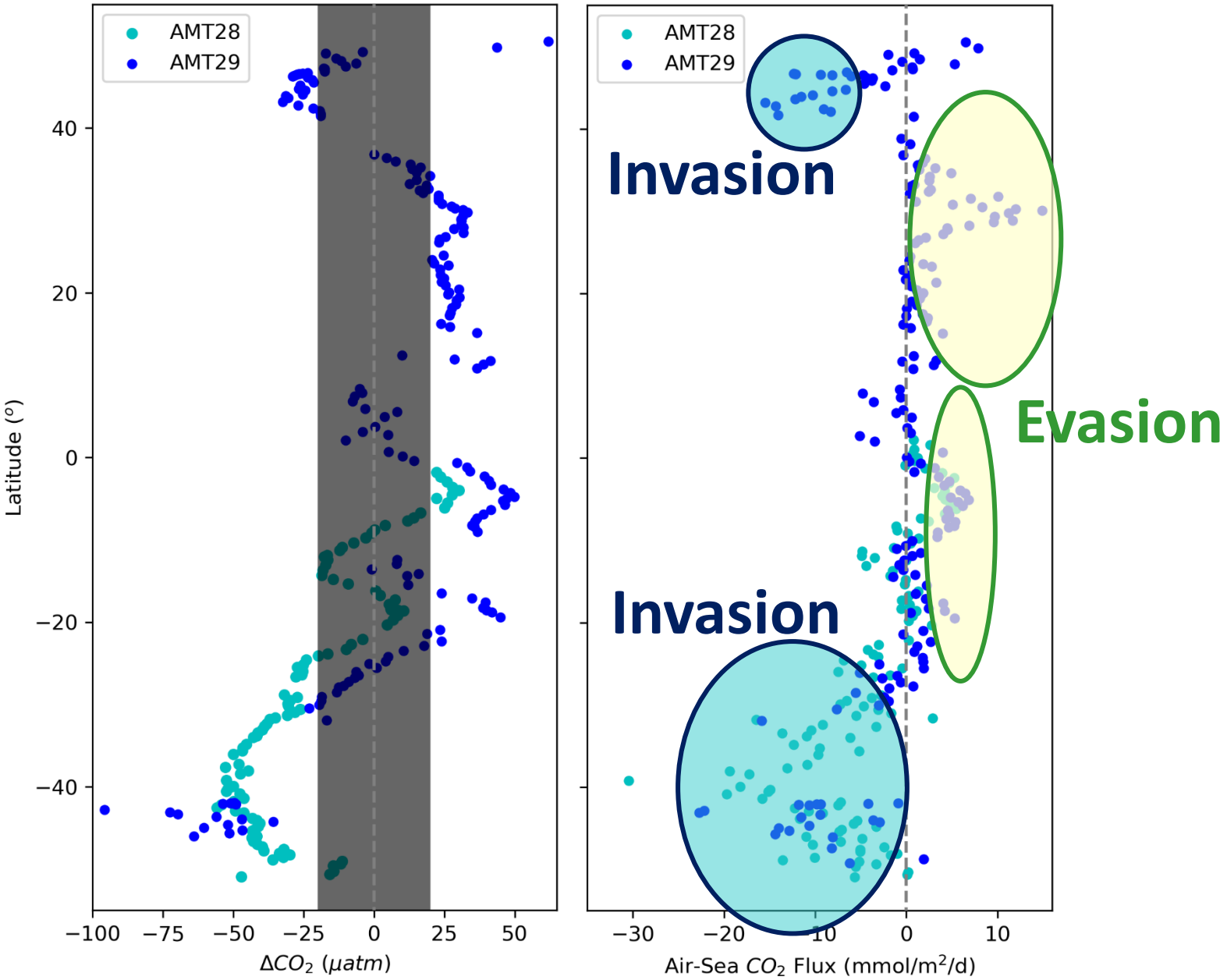


Flux measurements and quality control:

- Wind sector, stationarity, homogeneity, etc. (see Dong et al., 2021)
- Averaging period (3hrs, min. N = 6)
- Threshold for ΔCO_2 Why does it matter?

$K = Flux / \Delta CO_2$

CO_2 fluxes: invasion and evasion



Flux measurements and quality control:

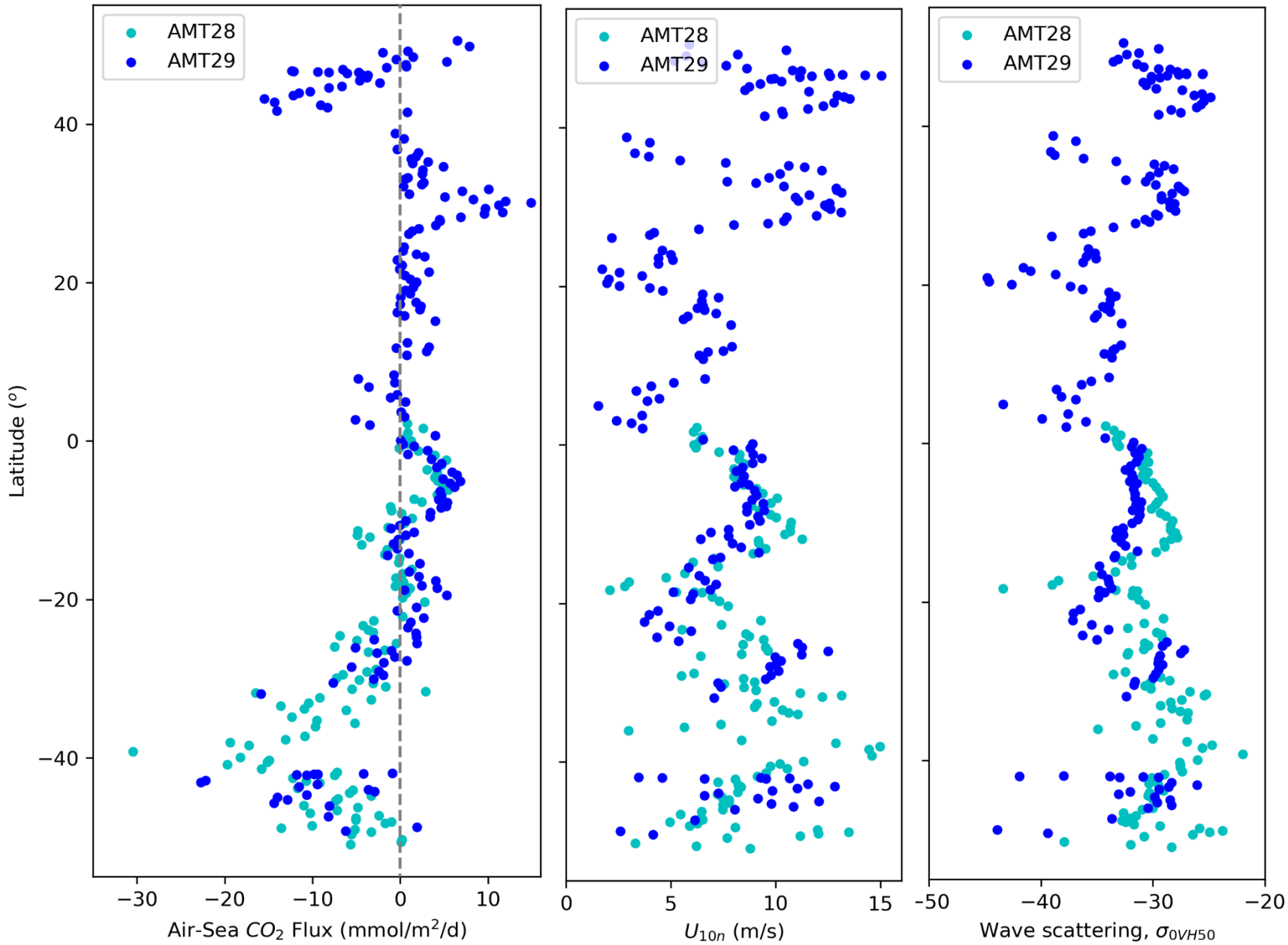
- Wind sector, stationarity, homogeneity, etc. (see Dong et al., 2021)
- Averaging period (3hrs, min. N = 6)
- Threshold for ΔCO_2

Why does it matter?

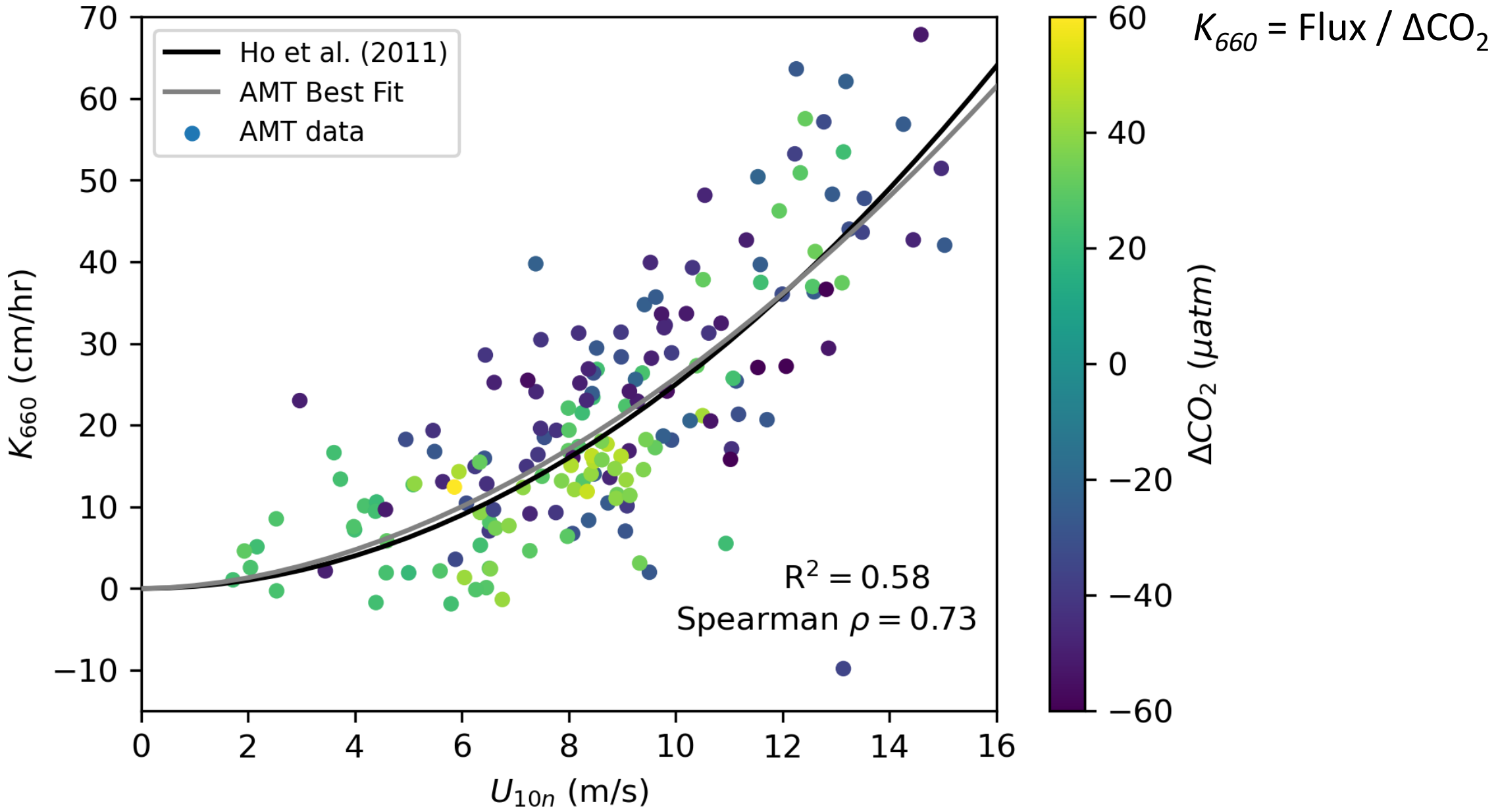
$K = Flux / \Delta fCO_2$

Latitudinal trends

Typically unstable boundary layer on AMT



K vs U

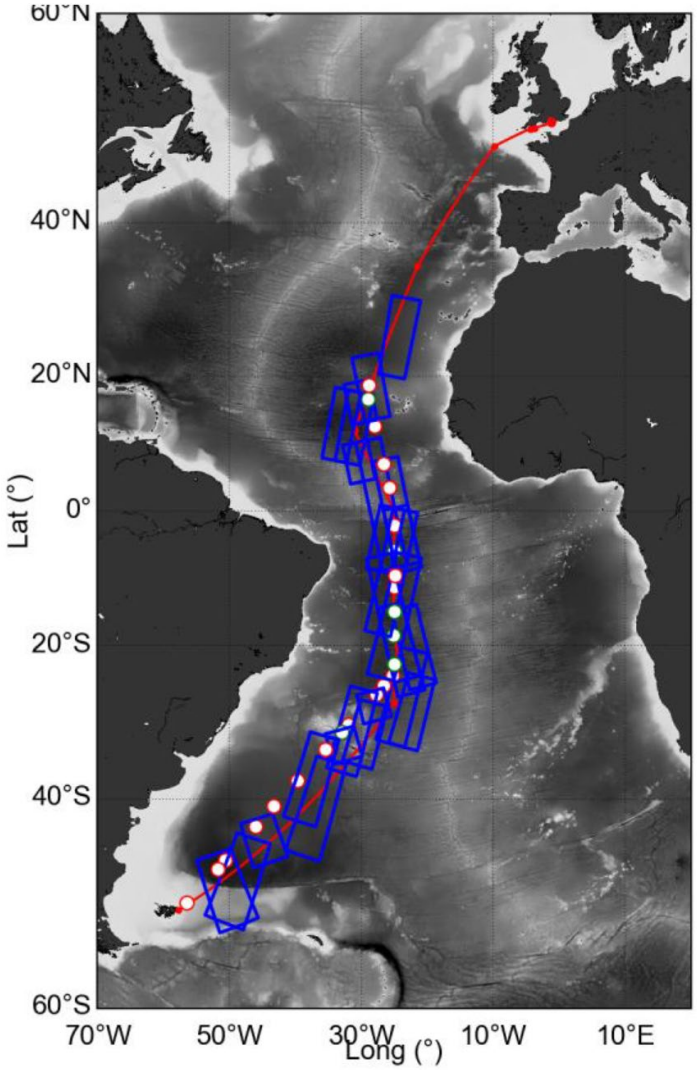

Ho et al. (2011)
AMT Best Fit
AMT data
K_{660} (cm/hr)
U_{10n} (m/s)
$R^2 = 0.58$
Spearman $\rho = 0.73$
ΔCO_2 (μatm)
K_{660} = Flux / ΔCO_2

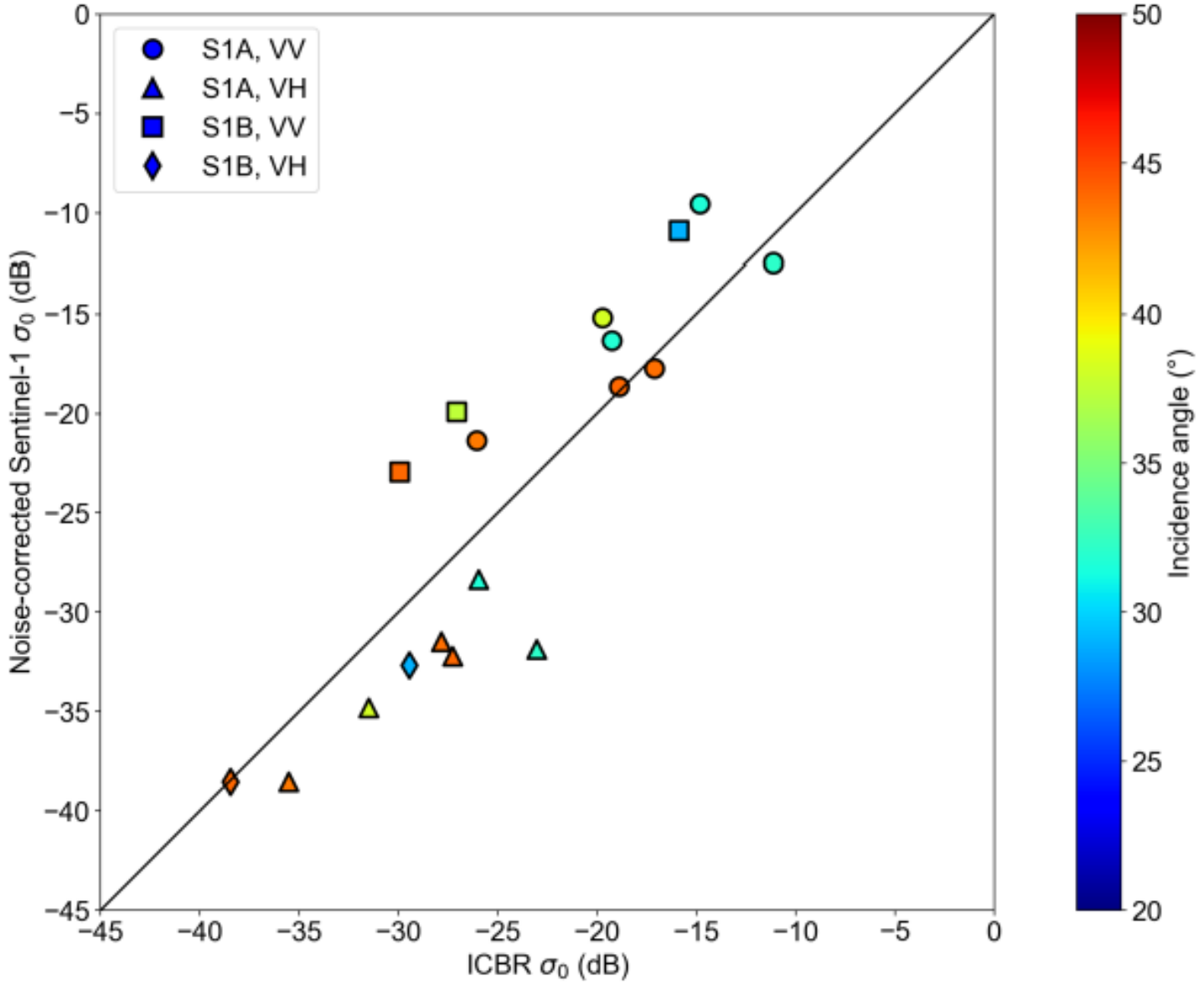
Comparison with scattering observations

Polarization	Angle(°)	Spearman ρ
VV	30	0.72
VV	40	0.74
VV	50	0.74
VH	30	0.68
VH	40	0.77
VH	50	0.78
HV	30	0.77
HV	40	0.77
HV	50	0.77
HH	30	0.75
HH	40	0.75
HH	50	0.75

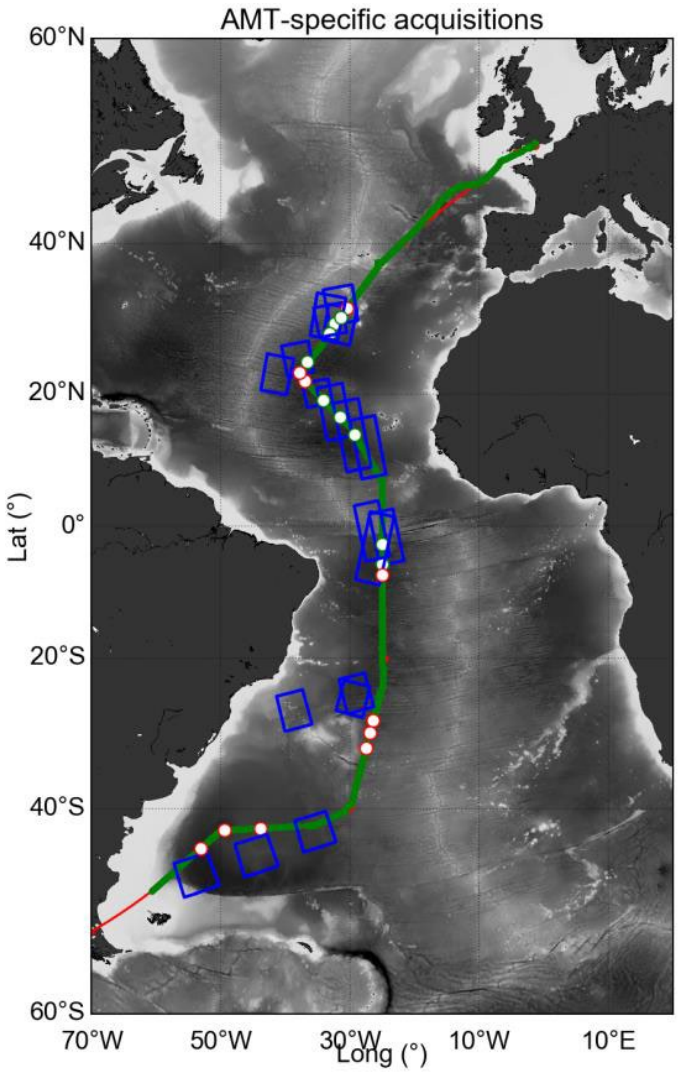
U_{10n} Spearman ρ = 0.73

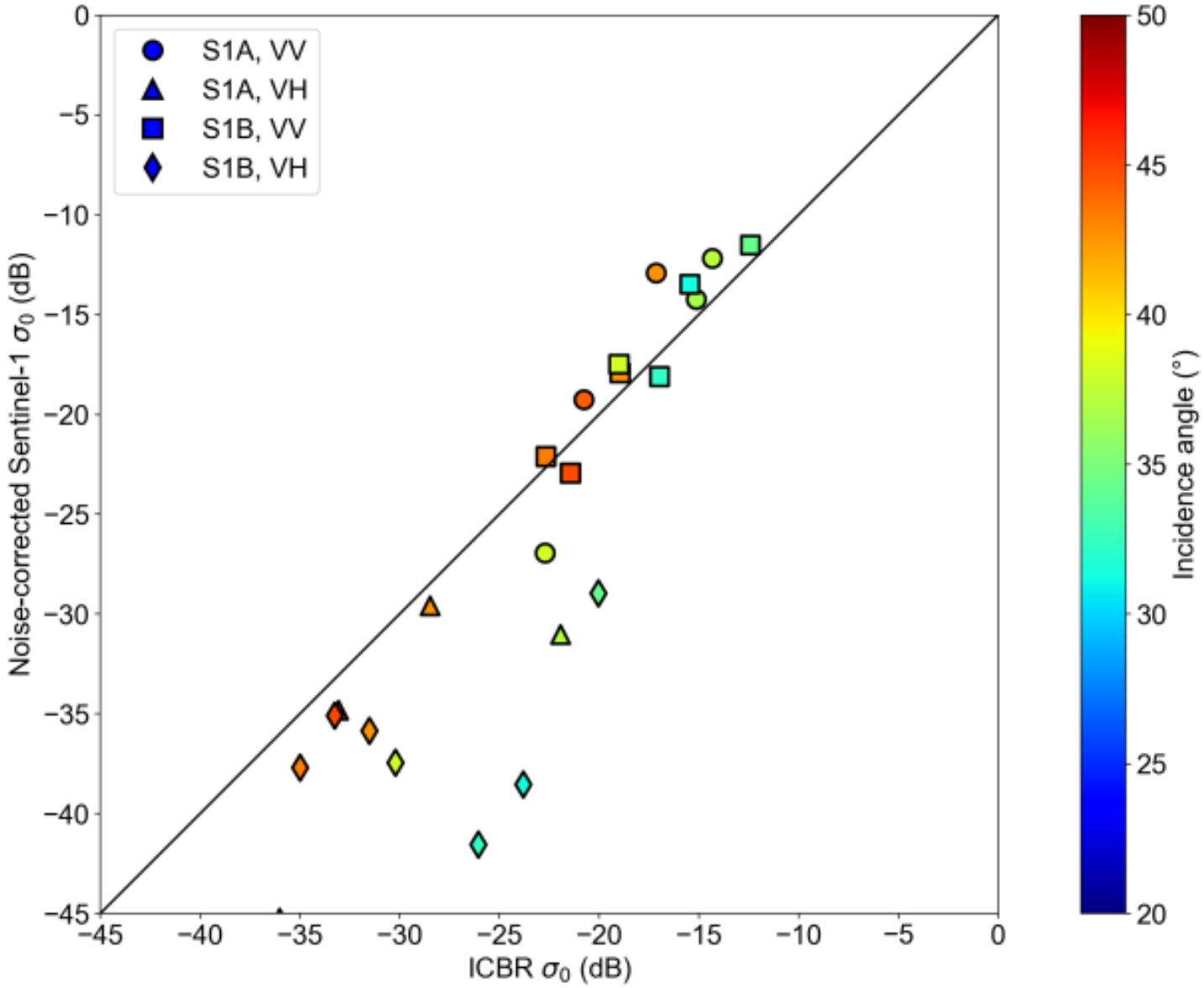
Satellite matchups: AMT28



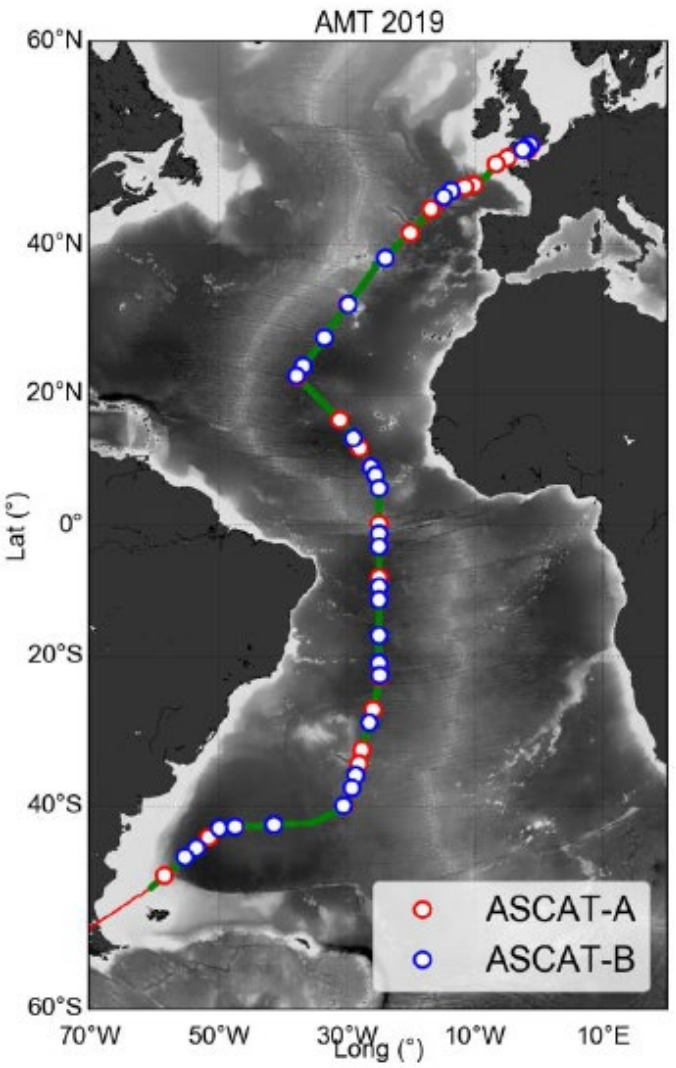


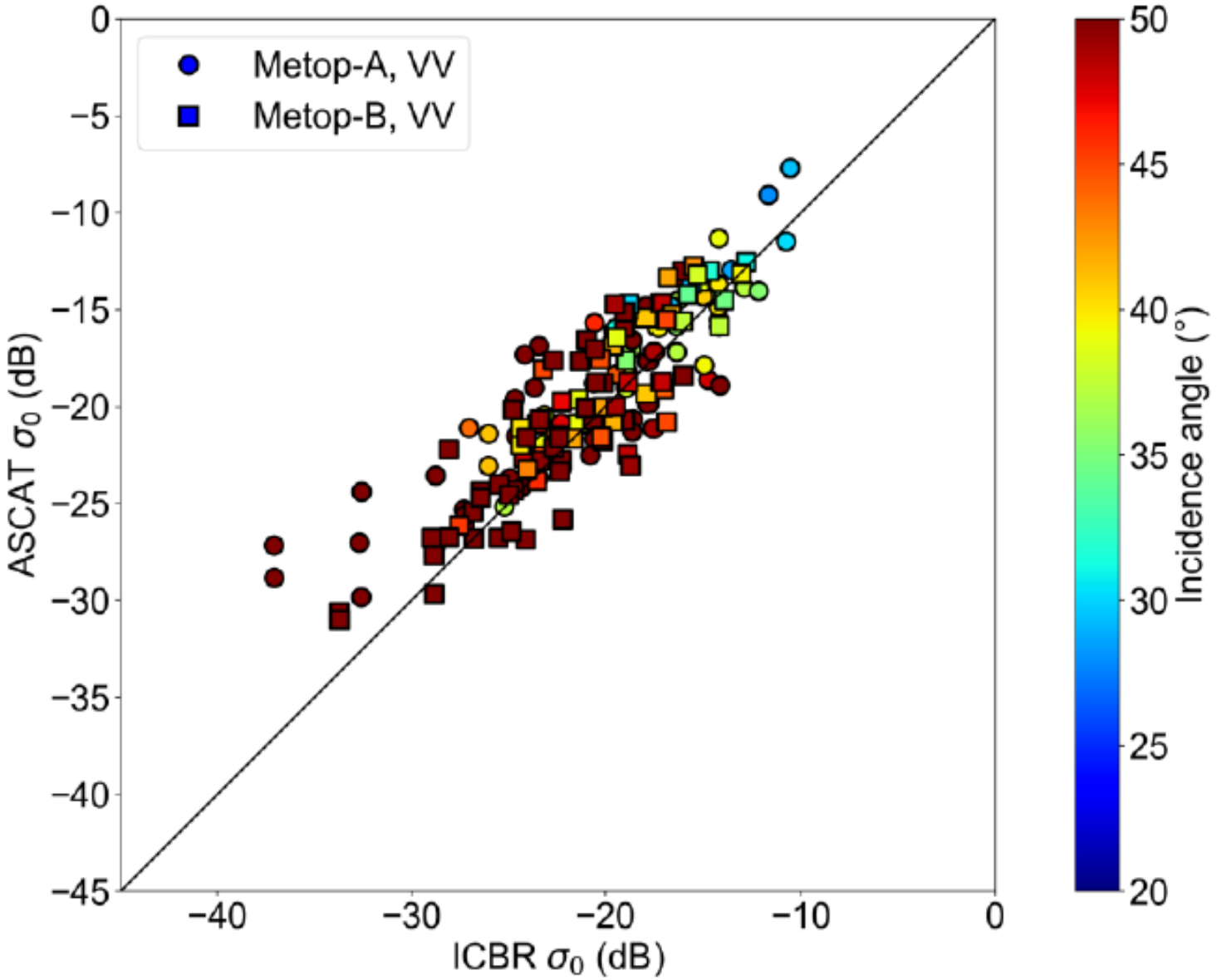
Satellite matchups: AMT29





Satellite matchups: AMT29





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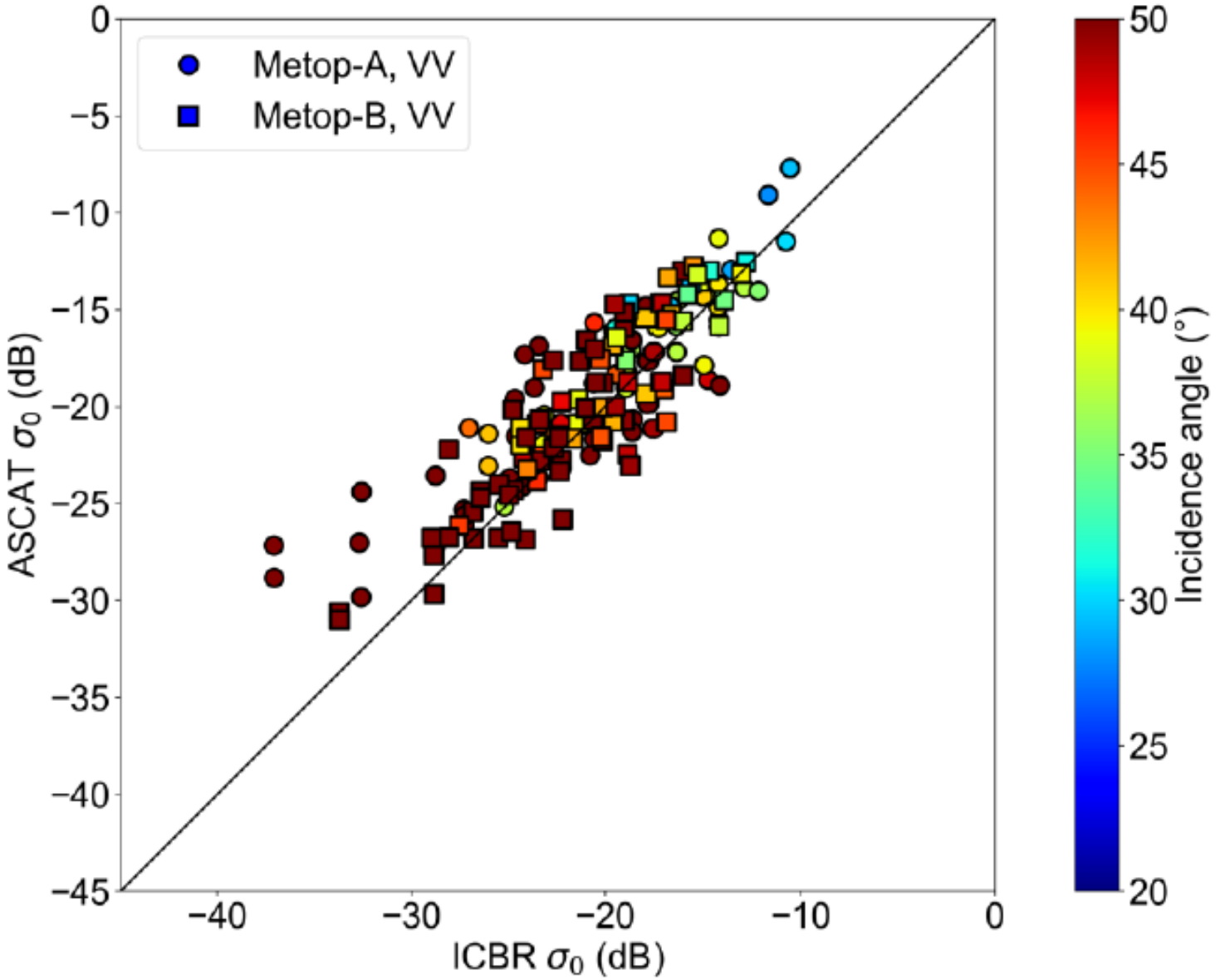

Summary and outlook

- Good quality EC CO_2 flux data possible with small fluxes
- Averaging required, but NOT into bins (better for looking at processes)
- ΔCO_2 threshold necessary when estimating K_{660}
- Difference between evasion and invasion K_{660} data?

- Relationship with radar backscatter comparable to relationship with wind speed
- In situ scattering observations compare well with satellite (Sentinel 1A/B and ASCAT) match ups
- Illustrates potential to make K_{660} estimates from satellite with directly-measured observations rather than an empirically-derived property

Future: - More data (next cruise left today, Covid-free!!)
- Link with other wave obs.?
- Higher wind speeds / rougher sea states?

Thanks for your attention