MLT dynamics with SIMONe Peru: Initial Results

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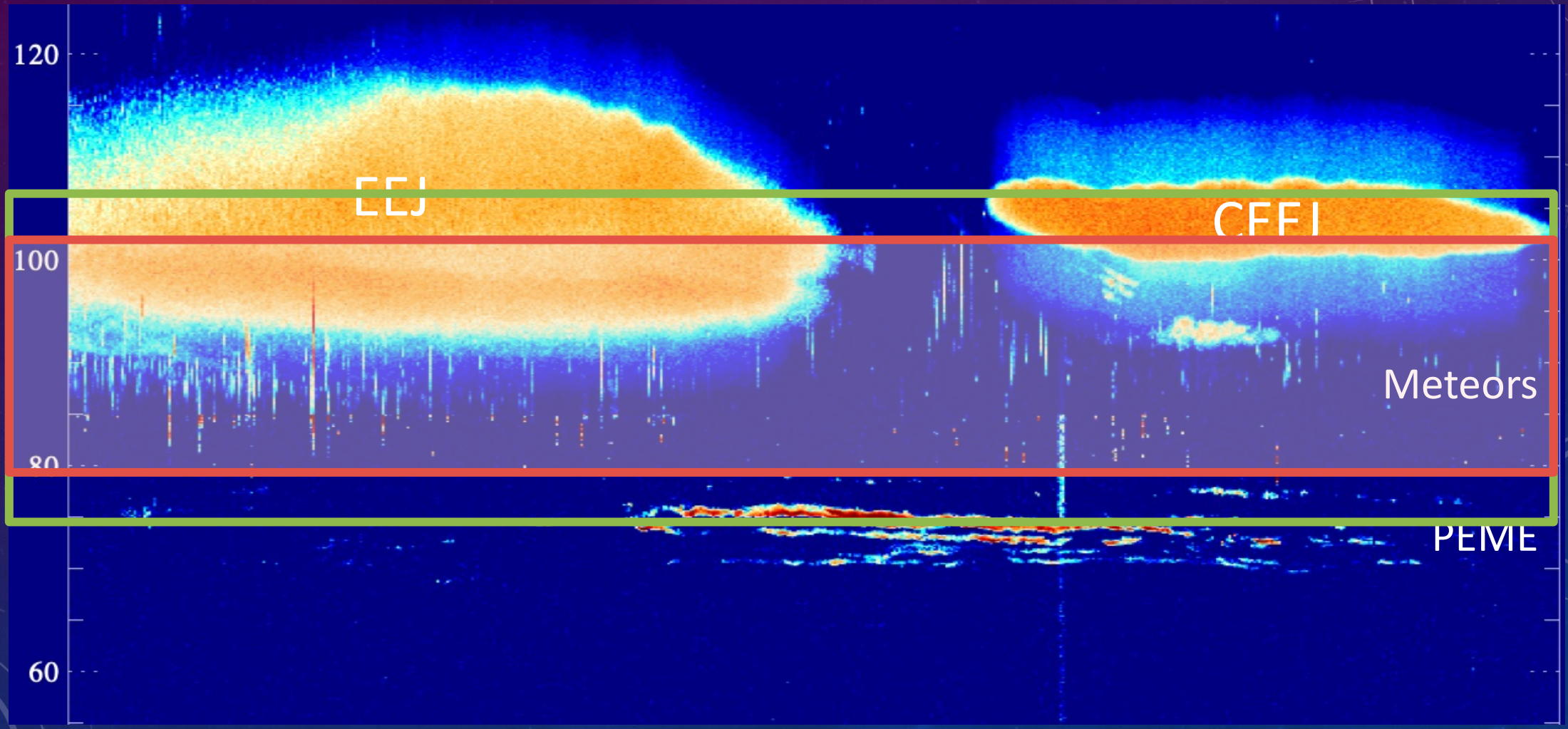
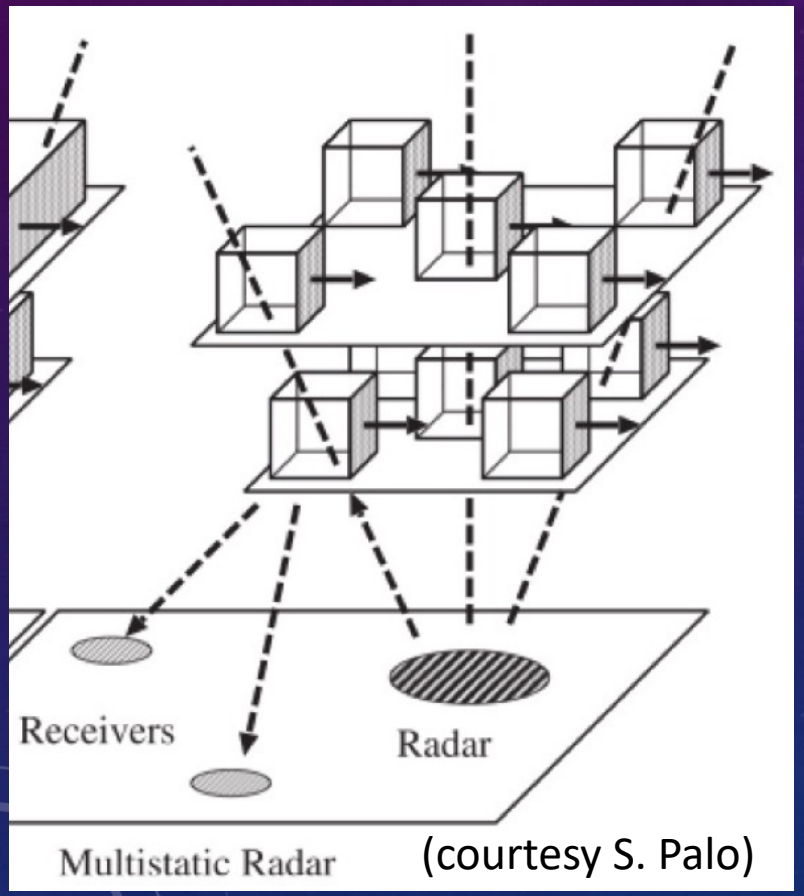
TYPICAL DAYTIME MLT ECHOES OVER JICAMARCA



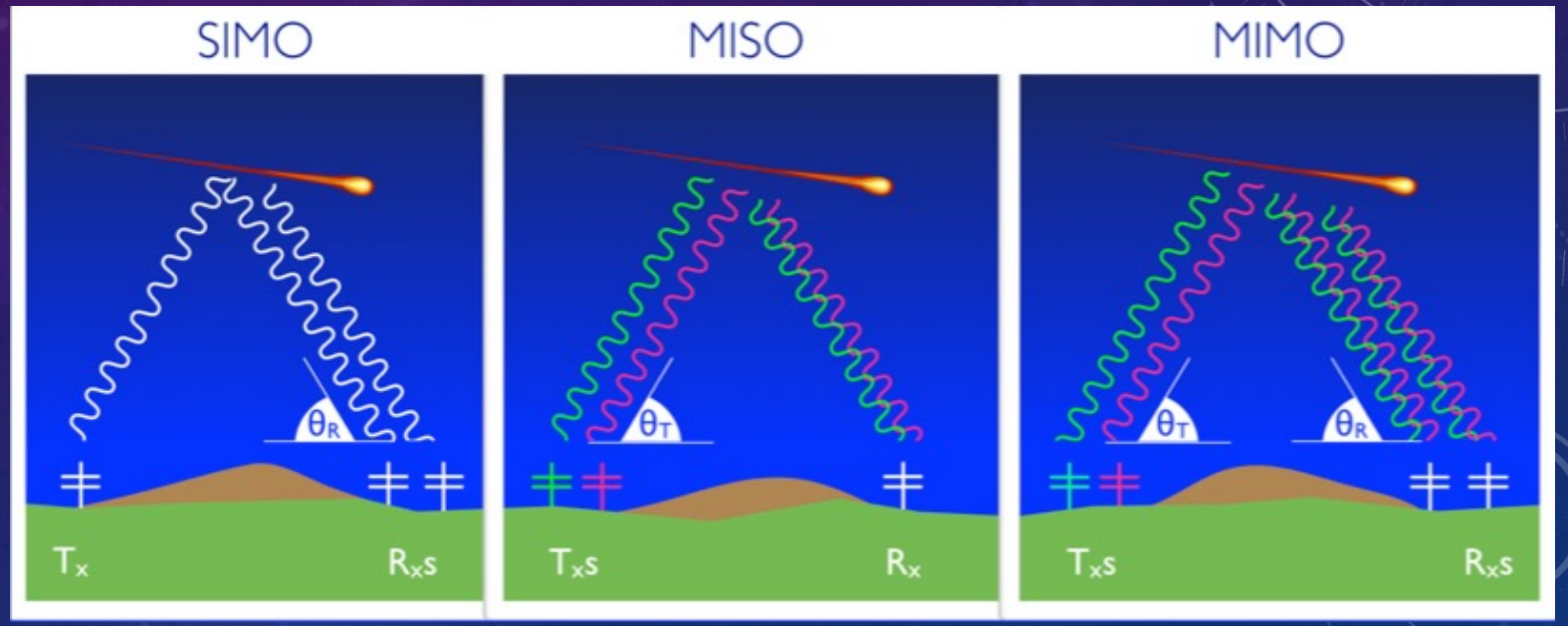
MLT WINDS OVER JICAMARCA

	MST	EEJ	Non-specular meteors	SMRs (JASMET)	SIMONe
Altitudes (km)	60-80	95-110	95-110	80-100	80-100
Time of day	Daytime	Daytime	Nighttime	All	All
Observing horizontal radius	3 km	5 km	3 km	200 km	< 50 km
Vertical resolution	150 m	1 km	150 m	3 km	< 2 km
Time resolution	1 min	5 min	1-2 seconds	2 h	< 1 h
Annual operations	< 100 h	< 100 h	< 20 h	< 500 h	24/7
Refernces	Lee et al., 2019	Shume et al. 2005	Oppenheim et al., 2009	Holdsworth et al., 2005	Chau et al. 2020

MULTISTATIC SPECULAR METEOR RADAR AND SIMONE



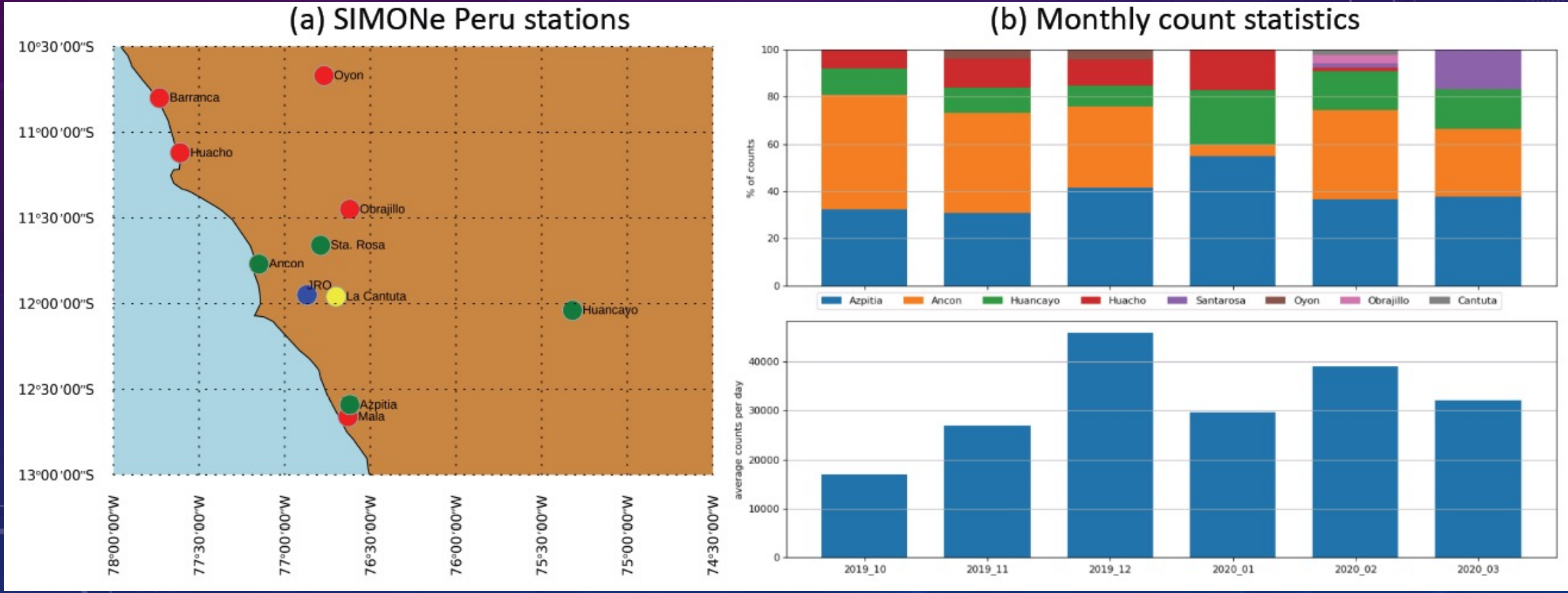
(courtesy S. Palo)



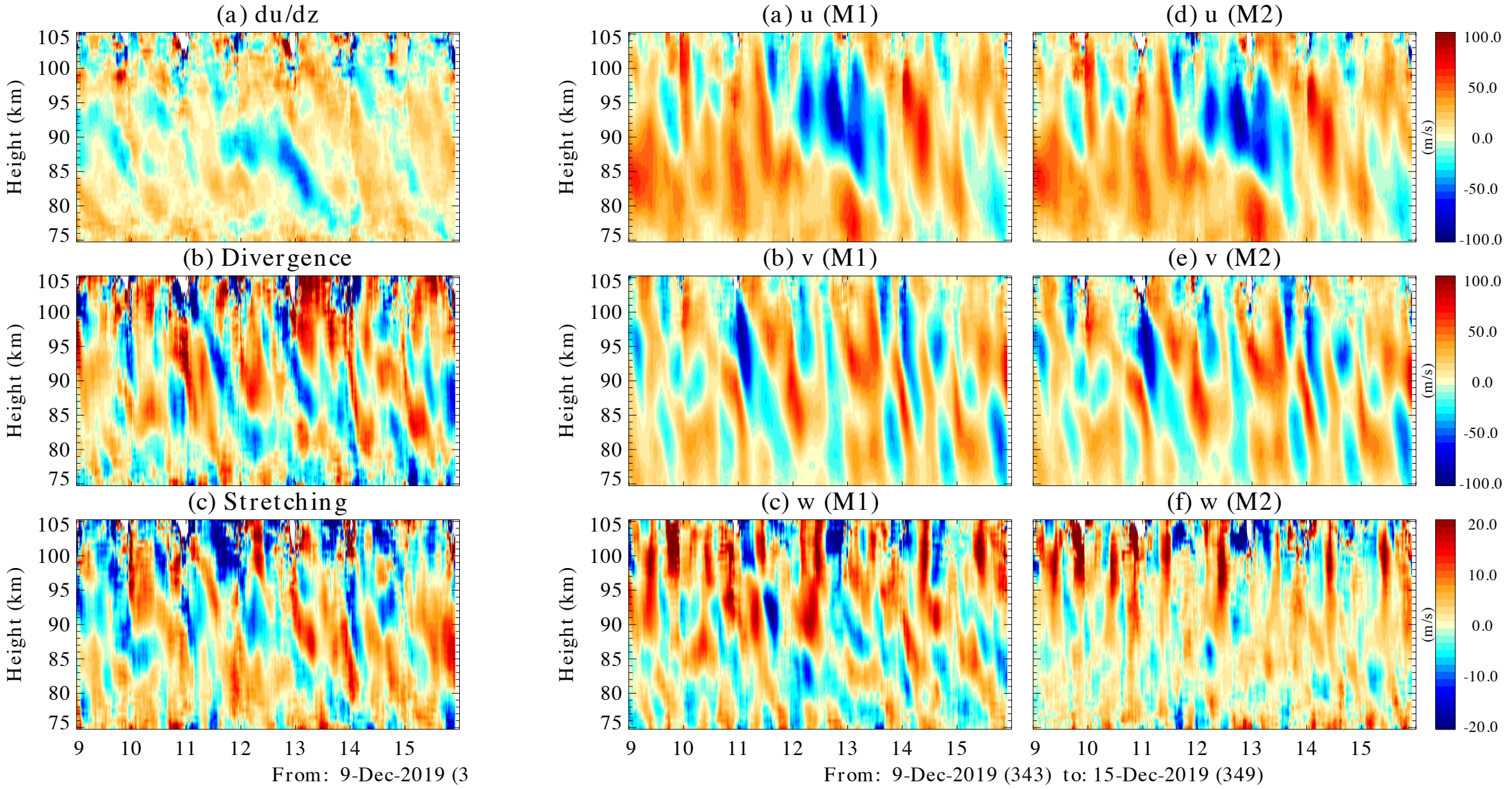
(Chau et al., 2019)

Spread Spectrum Interferometric Multistatic meteor radar Observing Network (SIMONe)

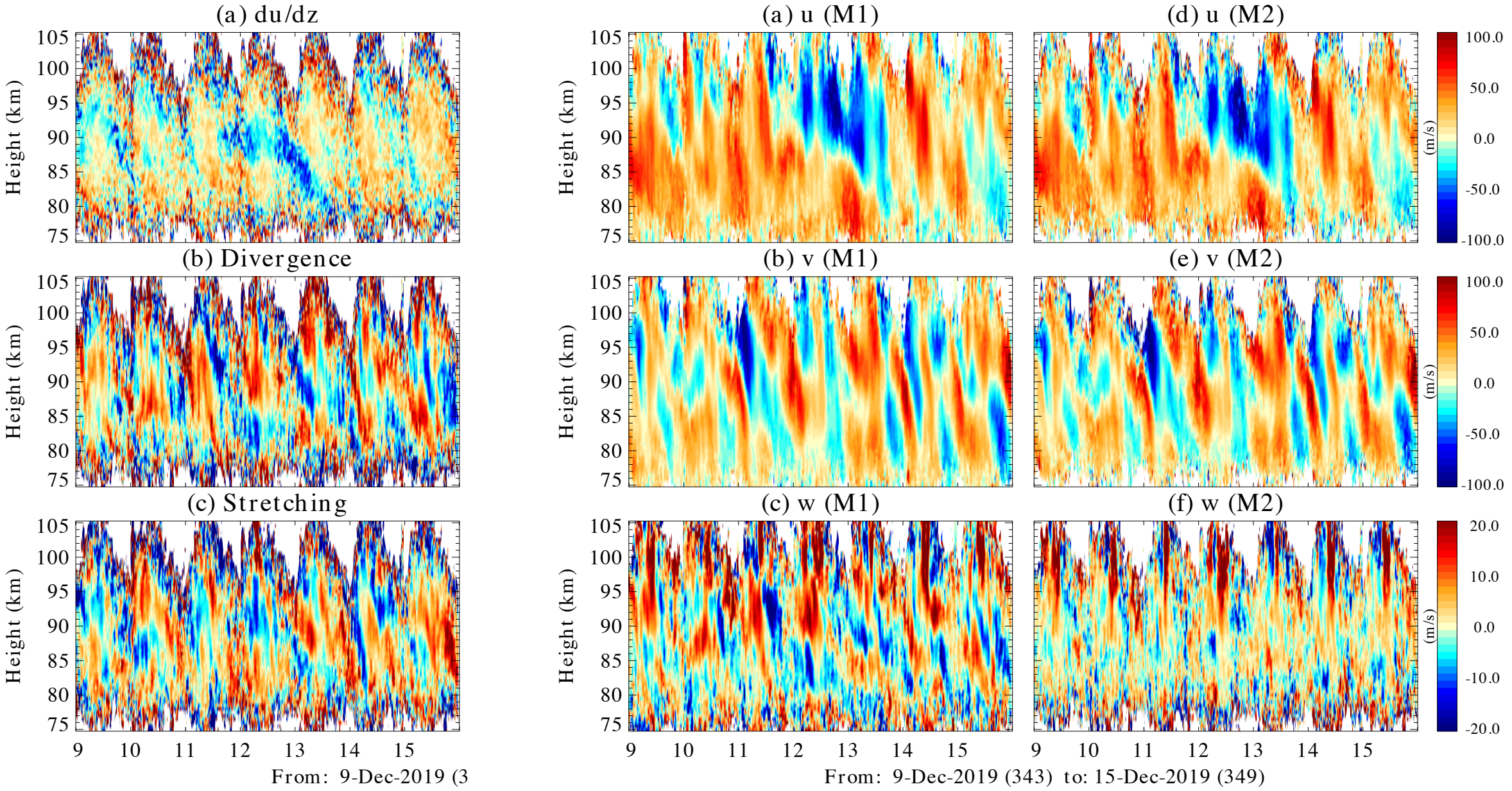
SIMONE PERU STATIONS AND STATISTICS



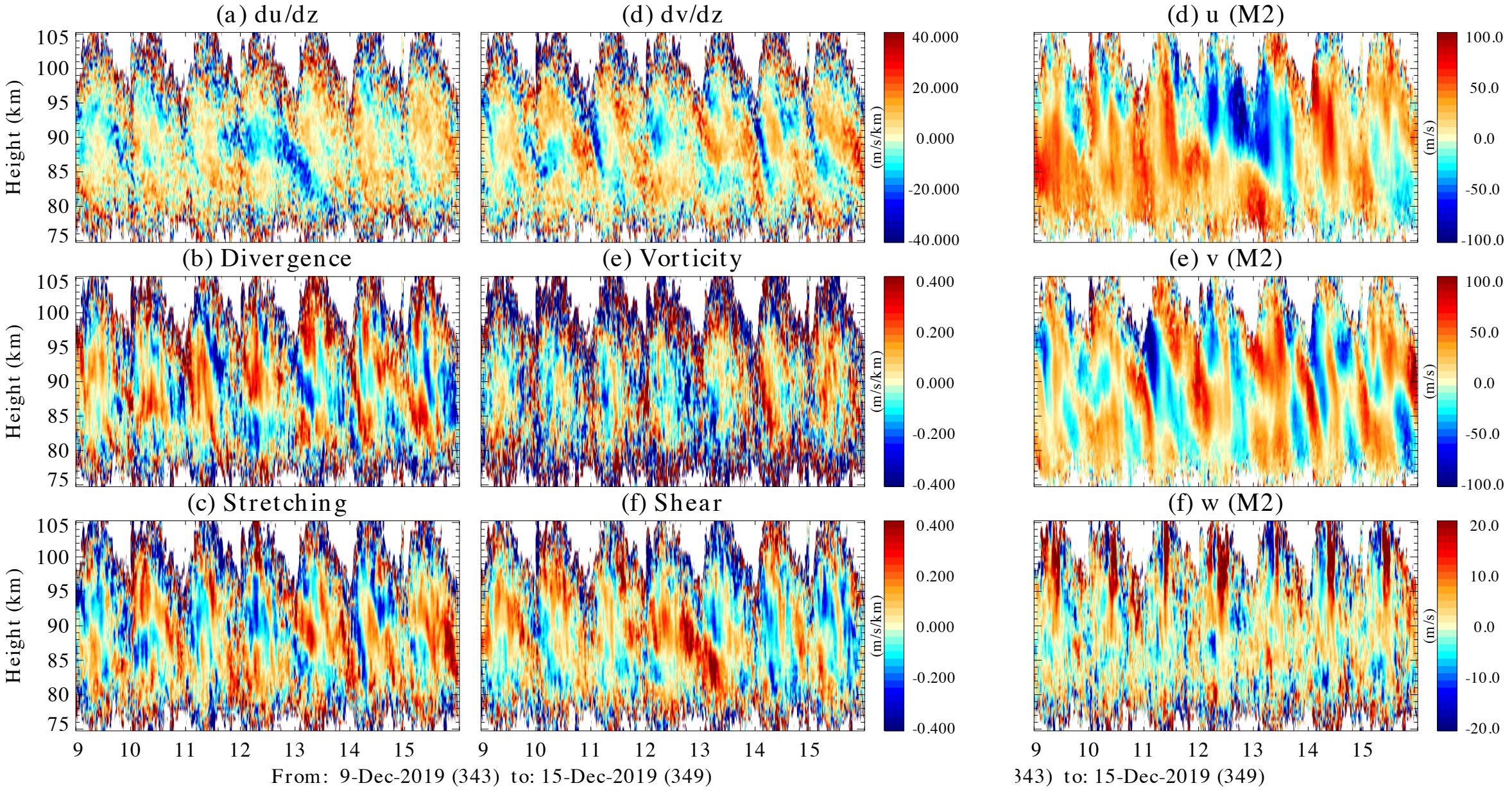
MEAN WINDS AND GRADIENTS (4 HOUR-4 KM)



MEAN WINDS AND GRADIENTS (1 HOUR-2 KM)



MEAN WINDS AND GRADIENTS (1 HOUR-2 KM)



MLT VERTICAL VELOCITIES FROM SIMONE

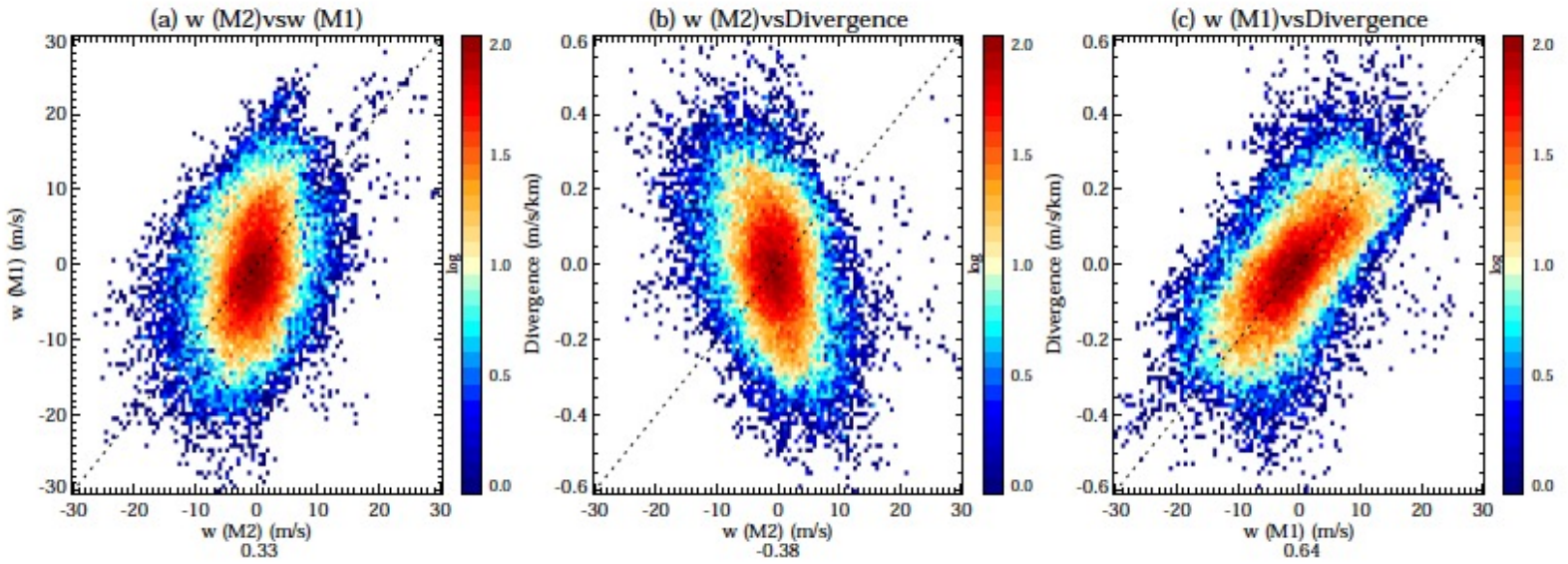
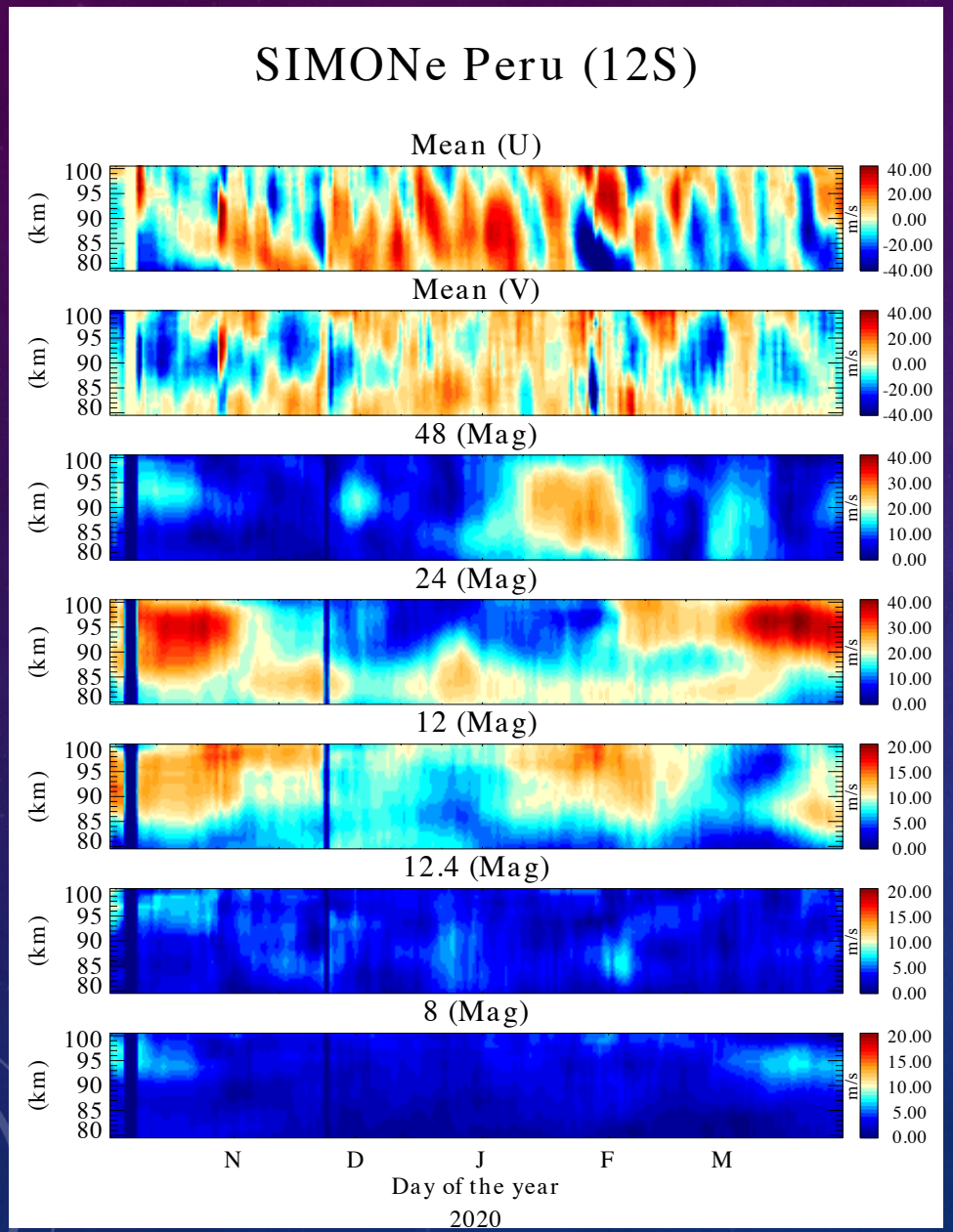
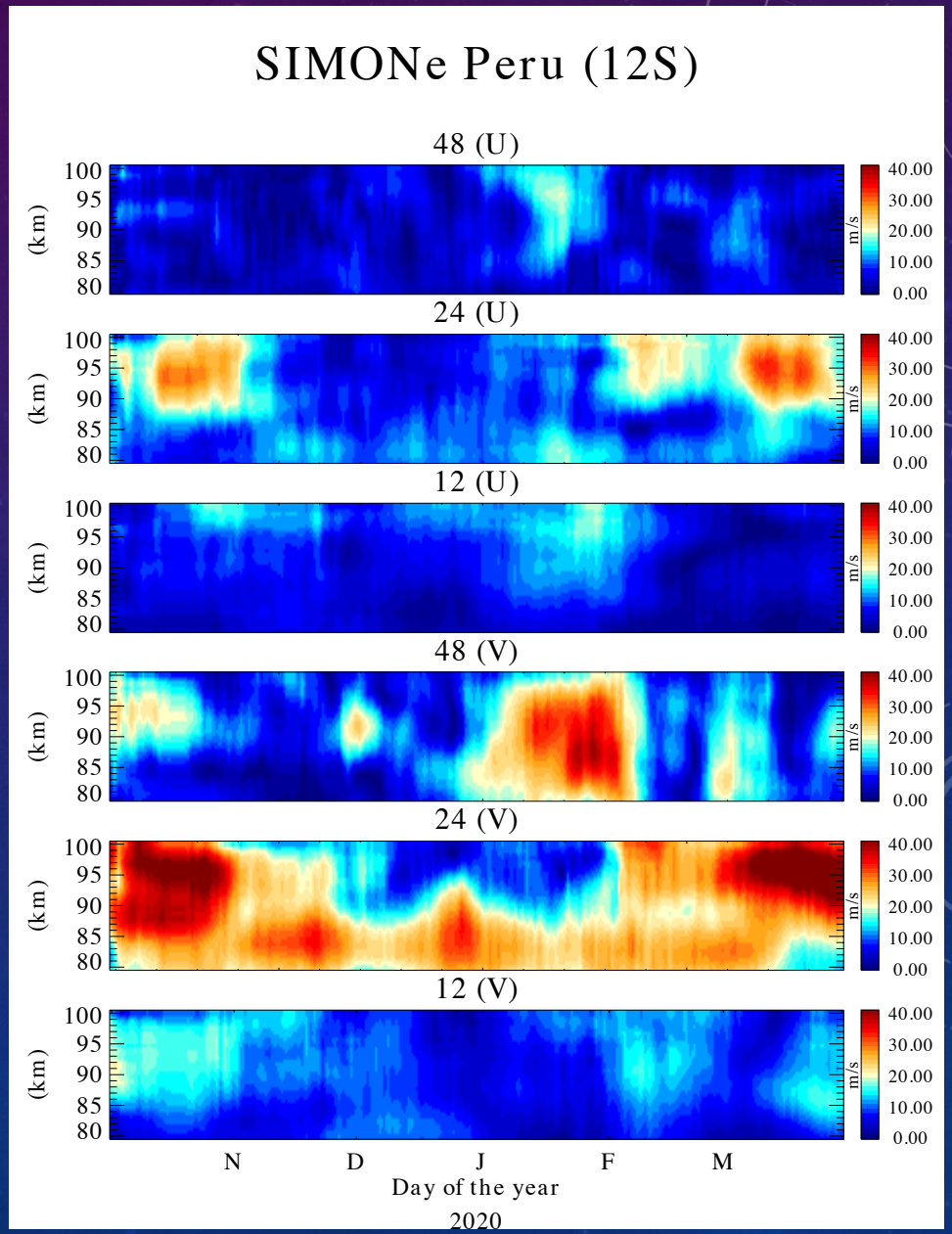


Figure 6. 2D histograms of vertical velocity estimates and horizontal divergence using the results between 82 and 92 km shown in Figures 4 and 5: (a) vertical estimates using M1 and M2, (b) vertical estimates using M2 (Figure 4f) and horizontal divergence (Figure 5b), and (c) vertical estimates using M1 (Figure 4c) and horizontal divergence. The Pearson correlation coefficient is indicated for each plot.

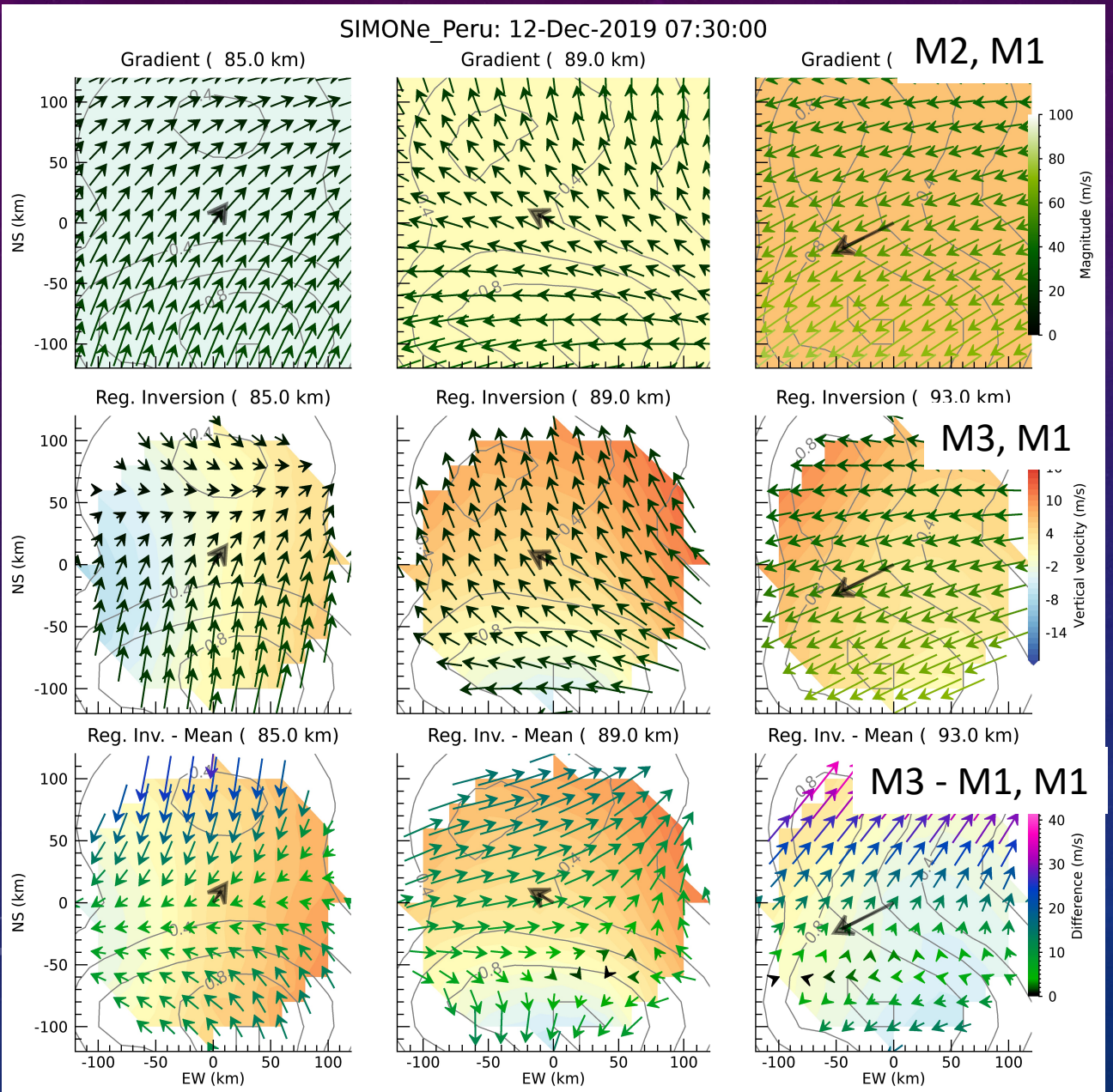
- Without considering gradients, previous estimates were contaminated by horizontal divergence.
- Including gradients, vertical velocity rms is smaller but still within +/- 5 m/s and showing tidal like features with large amplitudes.

MLT TIDES AND PLANETARY WAVES: FIRST 6 MONTHS





MLT MESOSCALE WIND FIELDS



M1: Homogeneous

$$\mathbf{k}_{Bi} \cdot \mathbf{u}_0(z,t) \quad = \quad 2\pi f_{di}$$

M2: Gradients

$$\mathbf{u}(x,y,z,t) \approx \mathbf{u}_0 + \frac{d\mathbf{u}}{dx}(x-x_0)\frac{d\mathbf{u}}{dy}(y-y_0) + \frac{d\mathbf{u}}{dz}(z-z_0)$$
$$\approx \mathbf{u}_0 + \mathbf{u}_x(x-x_0) + \mathbf{u}_y(y-y_0) + \mathbf{u}_z(z-z_0)$$

(Chau et al., 2017)

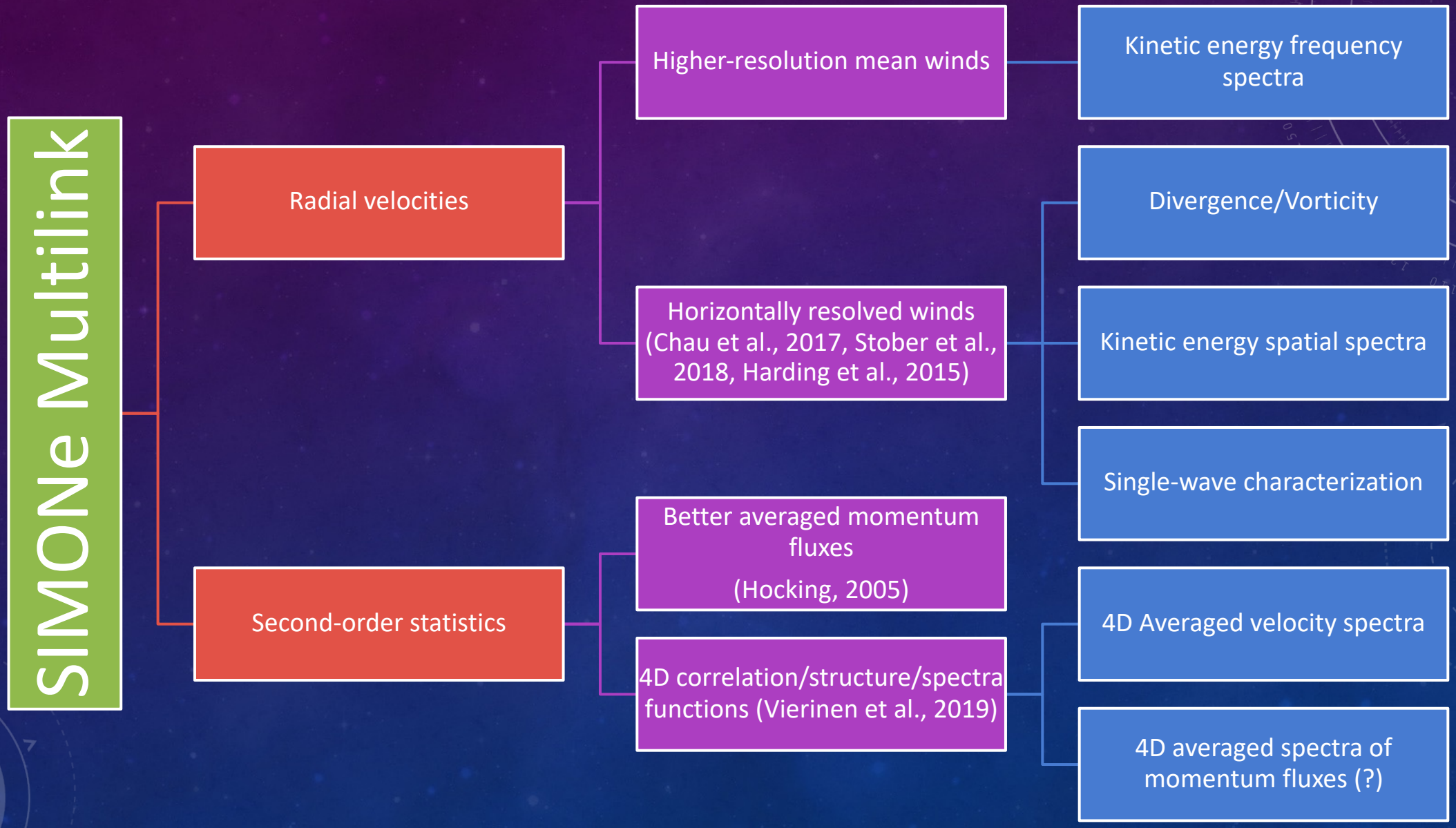
M3: Regularized inversion

$$\begin{aligned} &\text{minimize} && r(\bar{u}) \\ &\text{such that} && \|\Sigma^{-1/2}(A\bar{u} - \bar{d})\|_2^2 \leq \epsilon \end{aligned}$$

$$\text{minimize} \quad \|\Sigma^{-1/2}(A\bar{u} - \bar{d})\|_2^2 + \lambda_0 \|C\bar{u}\|_2^2$$

(Harding et al., 2015)

WHAT WE CAN DO WITH SIMONE?



SUMMARY

- SIMONe Peru is operational since October 2019.
- Hourly spatially-averaged horizontal wind components are routinely obtained
- Hourly vertical winds are obtained without horizontal divergence contamination, showing rms between a few m/s, and tidal-like structures also with a few m/s amplitudes.
- Gradients of horizontal winds and derived flow parameters are possible (horizontal divergence, relative vorticity, deformation).
- Mesocales features could be exploited in coordination with other measurements (ICON-MIGHTY, ISS-NIRAC).
- SIMONe is also able to detect echoes with strong RCSs (bolides, EEJ, non-specular meteor, meteor-head)
- Better resolution can be achieved by adding additional single-antenna receivers (e.g., a receiver on a boat to support a rocket campaign).