

Turbulence characterization at the focal plane of the VLT Melipal



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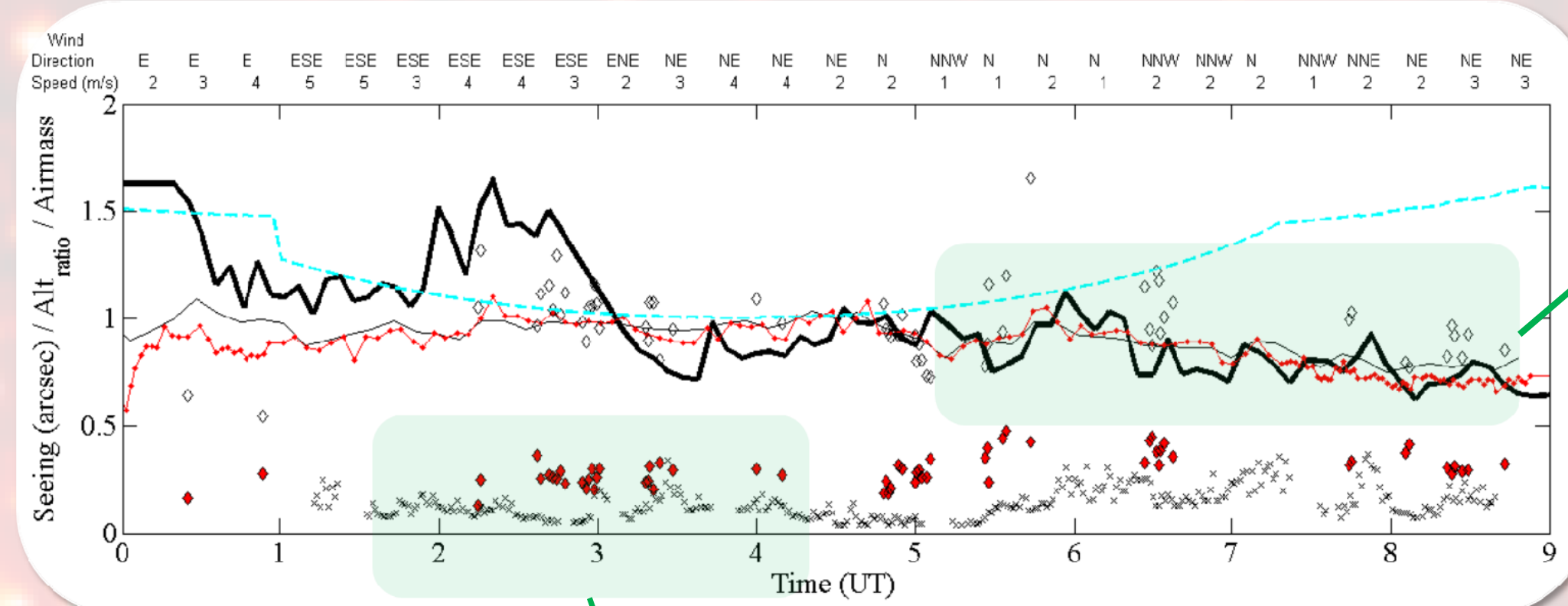
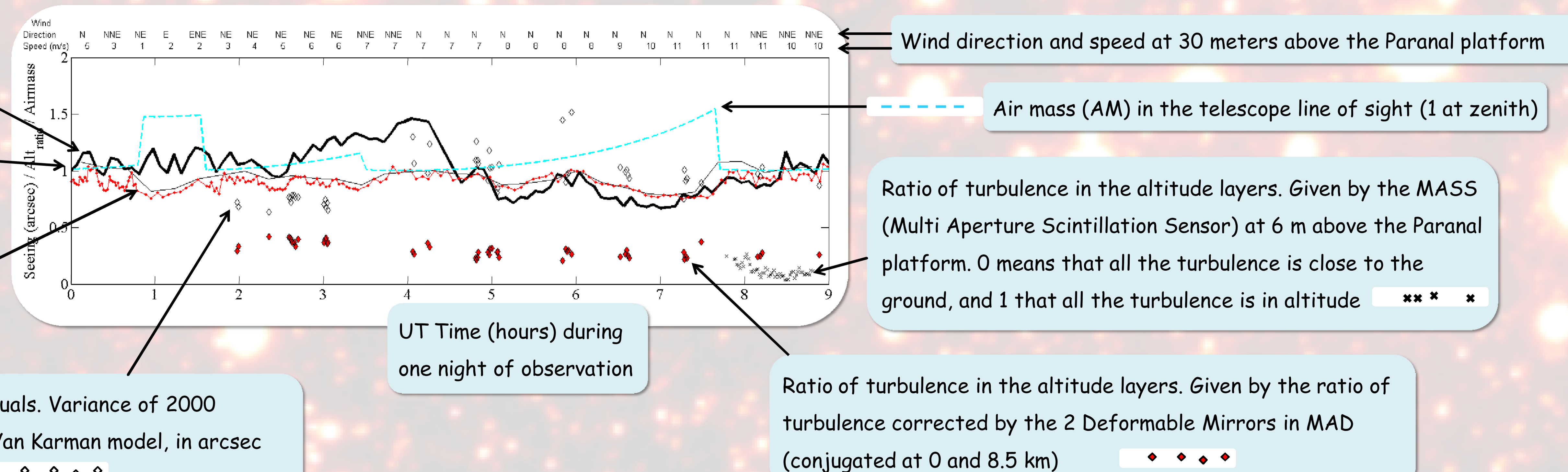
- ❖ November 2007: 7 nights of the Multi Conjugate Adaptive Optics Demonstrator (MAD, 7015-14) Science Demonstration at the VLT Melipal (UT3), Paranal, Chile.
- ❖ Recording of turbulence data from several monitors, at the telescope focal plane and outside its enclosure.
- ❖ Goal: Compare turbulence strength and profile measured by the seeing monitors and by the telescope, identify and explain the differences
- ❖ Crucial for the development of Ground Layer AO (GLAO) instruments in the frame of the AOF (7015-75) and of the future European ELT (7012-44)

REFERENCE: Seeing measured by the DIMM (Differential Image Motion Monitor) at 6 m above the Paranal platform, in arc seconds

Seeing estimated from the VLT guide probe images FWHM (star PSF imaging at 5-50 Hz for telescope tracking), in arcsec
Corrected for the effects of wavelength, air mass and the outer scale

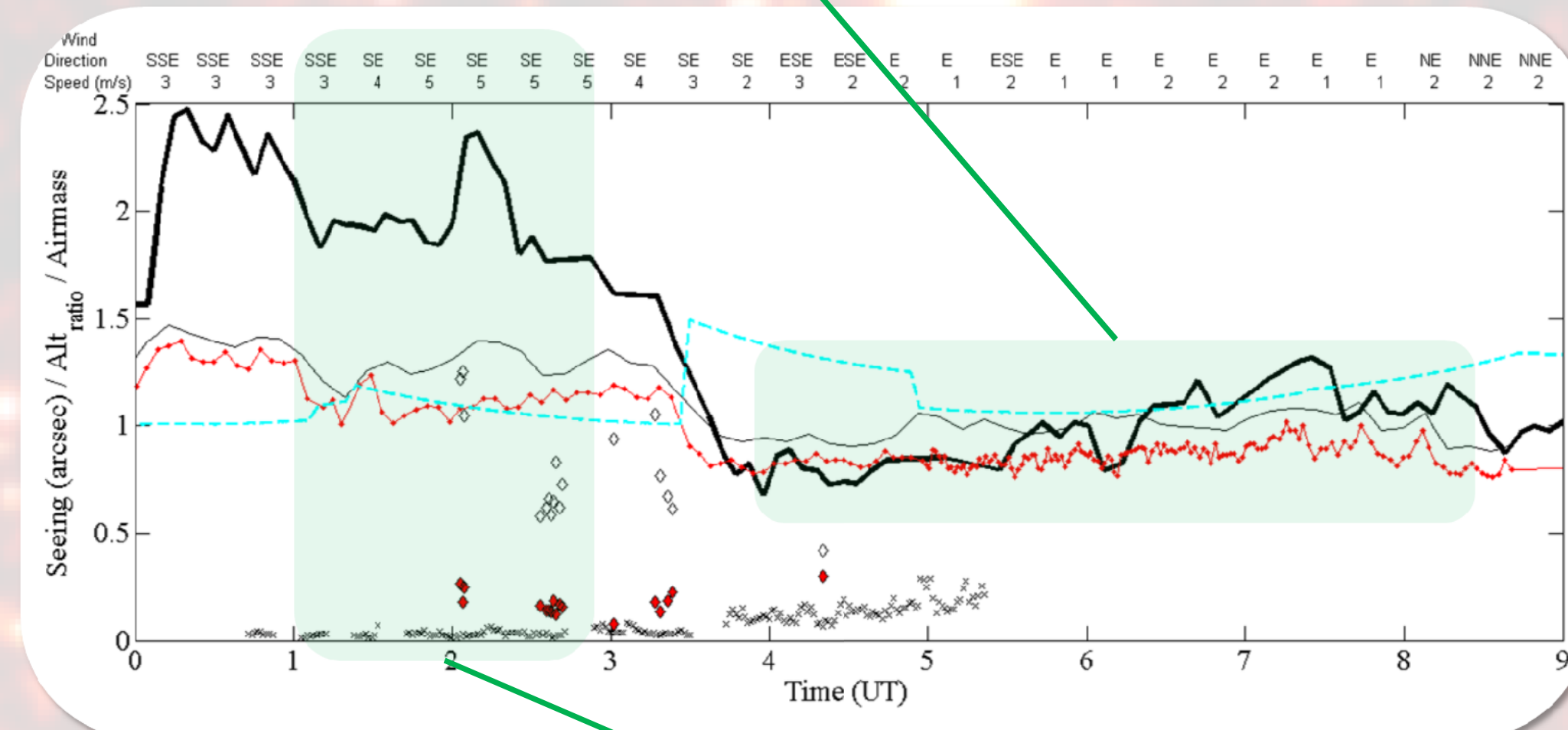
Seeing estimated from the VLT active optics Shack-Hartmann spots FWHM, in arcsec
Corrected for the effects of wavelength and air mass

Seeing estimated from MAD closed loop data: DM shape and wavefront residuals. Variance of 2000 iterations (at 400 Hz) projected on the Zernike polynomials and fitted to a Van Karman model, in arcsec
Corrected for the effects of wavelength and air mass

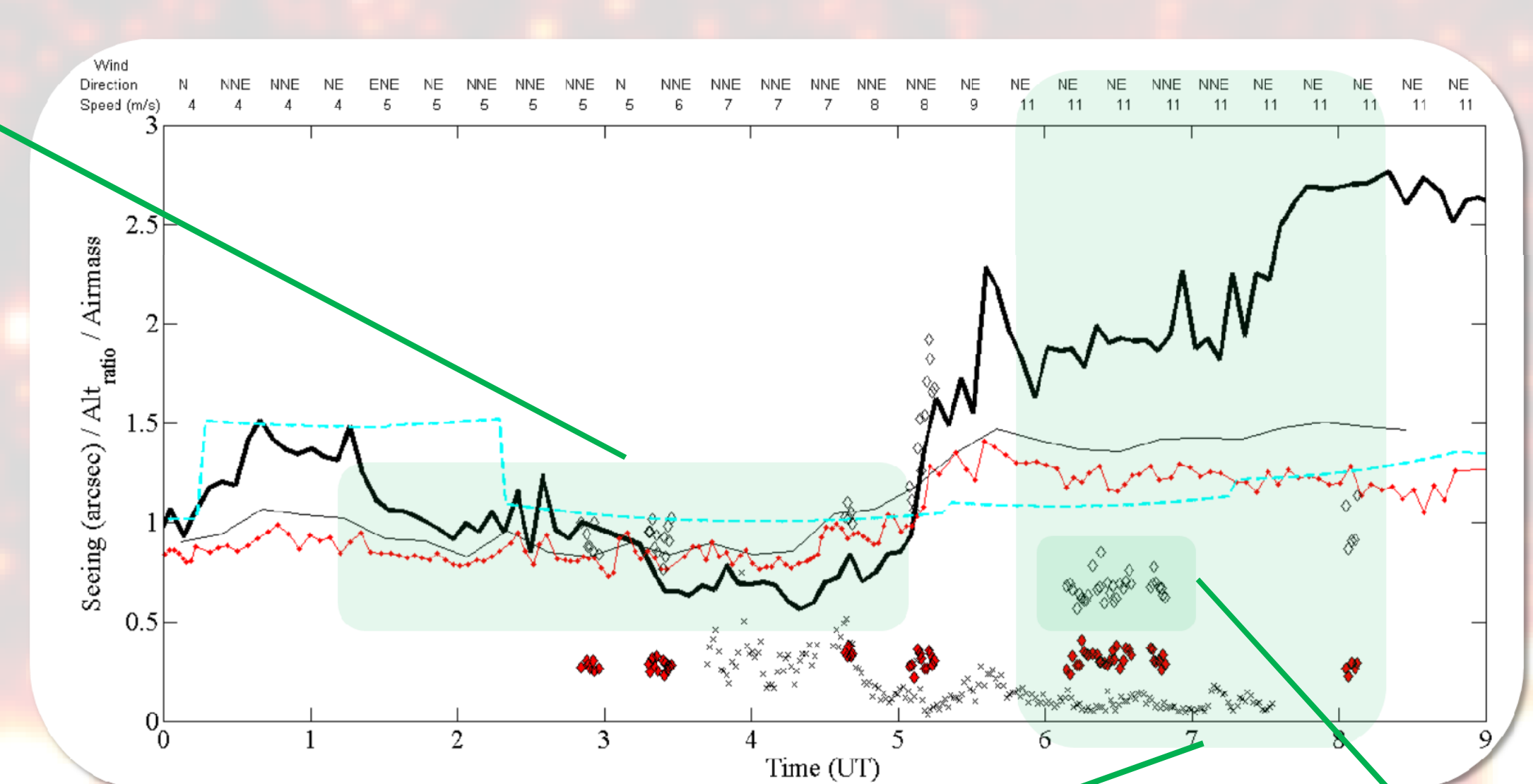


The ratio of altitude turbulence is usually overestimated by the MAD measurements. This is probably due to a bias in the estimation of this value, sensitive to the AO loop parameters and guide stars configuration.

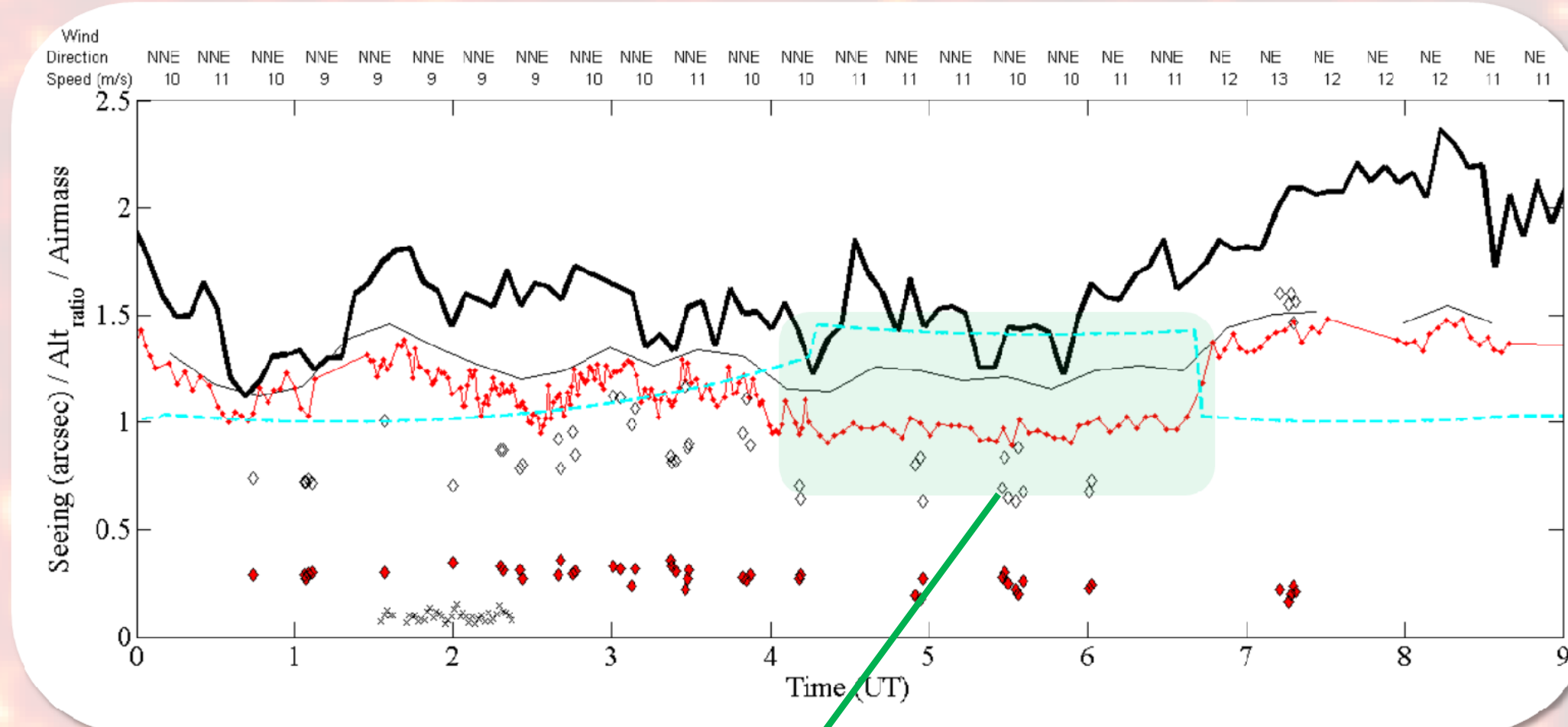
In general: good agreement between all seeing estimates. The MAD measurements show the most difference with the others, due to uncertainties in the seeing computation.



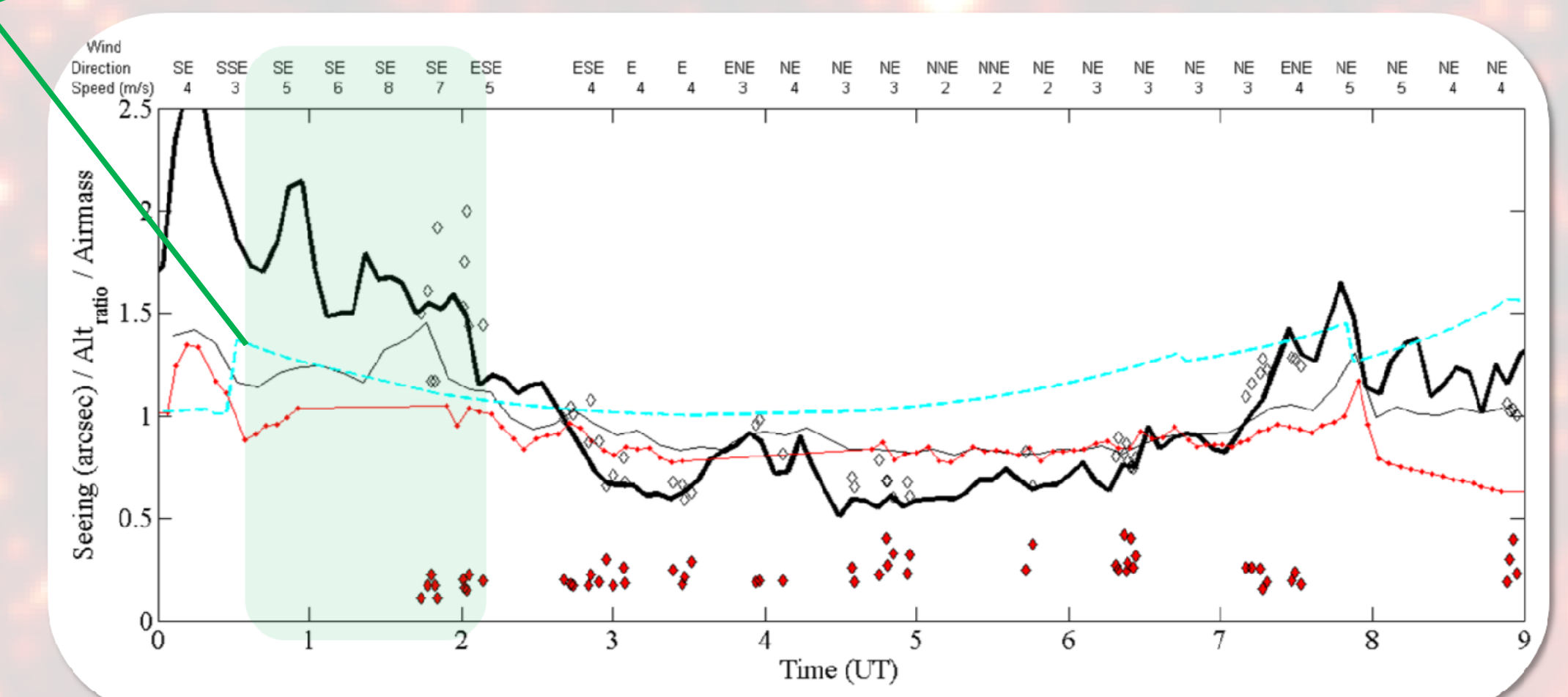
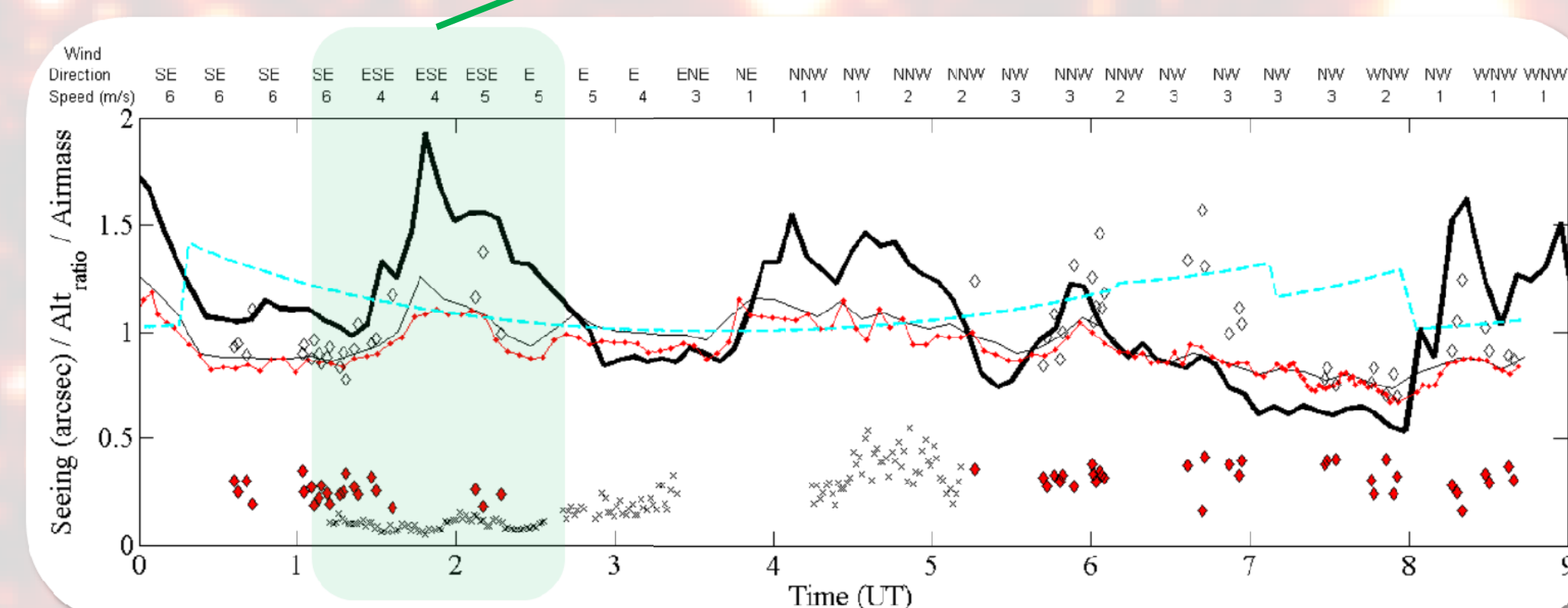
A strong contribution of the ground layer of turbulence creates an increase of seeing for the VLT, and a doubling of the DIMM seeing values! This is usually explained by a strong wind (> 10 m/s) and/or blowing from inland (SE) that creates a surface layer of turbulence, partially unseen by the telescope at 12 meters height.



In bad seeing conditions, the performance of the MCAO loop is poor and thus the seeing computation gives underestimated values.

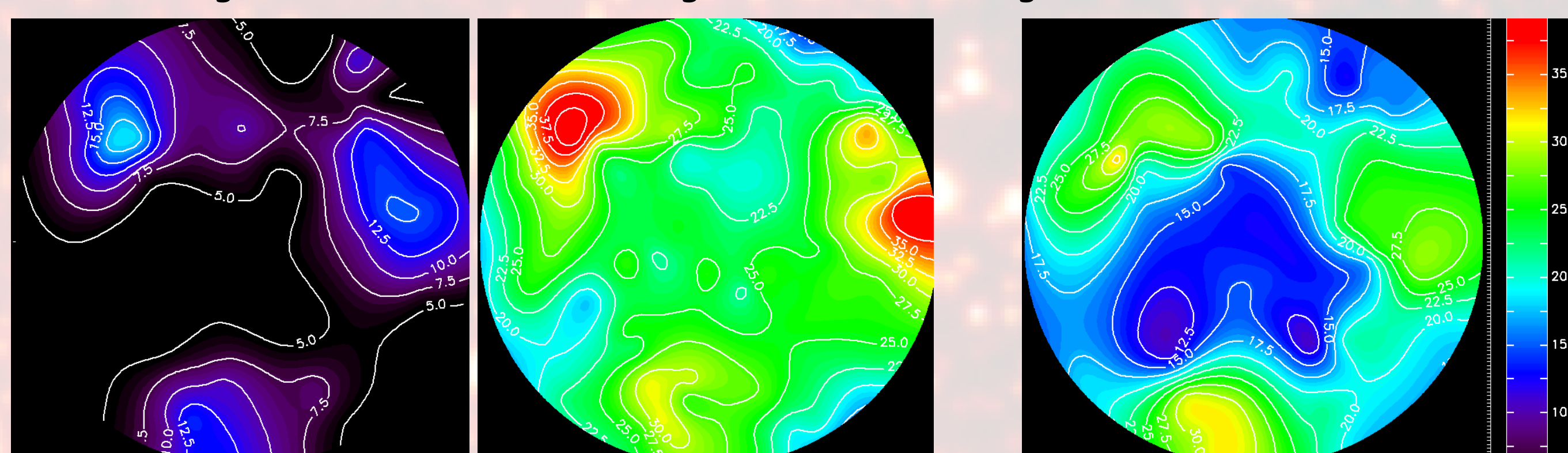


A combination of strong seeing and high air mass leads to an overestimation of the seeing estimated by the guide probe images, due to an elongation of the spot.



❖ Influence of the turbulence conditions on the performance of MAD (see also 7015-14)

Strehl ratio in the 2 arcmin FoV (in % at 2166 nm) in MCAO closed loop on the sky under different turbulence conditions:



Simulation of MCAO performance with MAD for a given seeing when the ratio of turbulence in altitude increases from 10% to 60% (every 10%)

