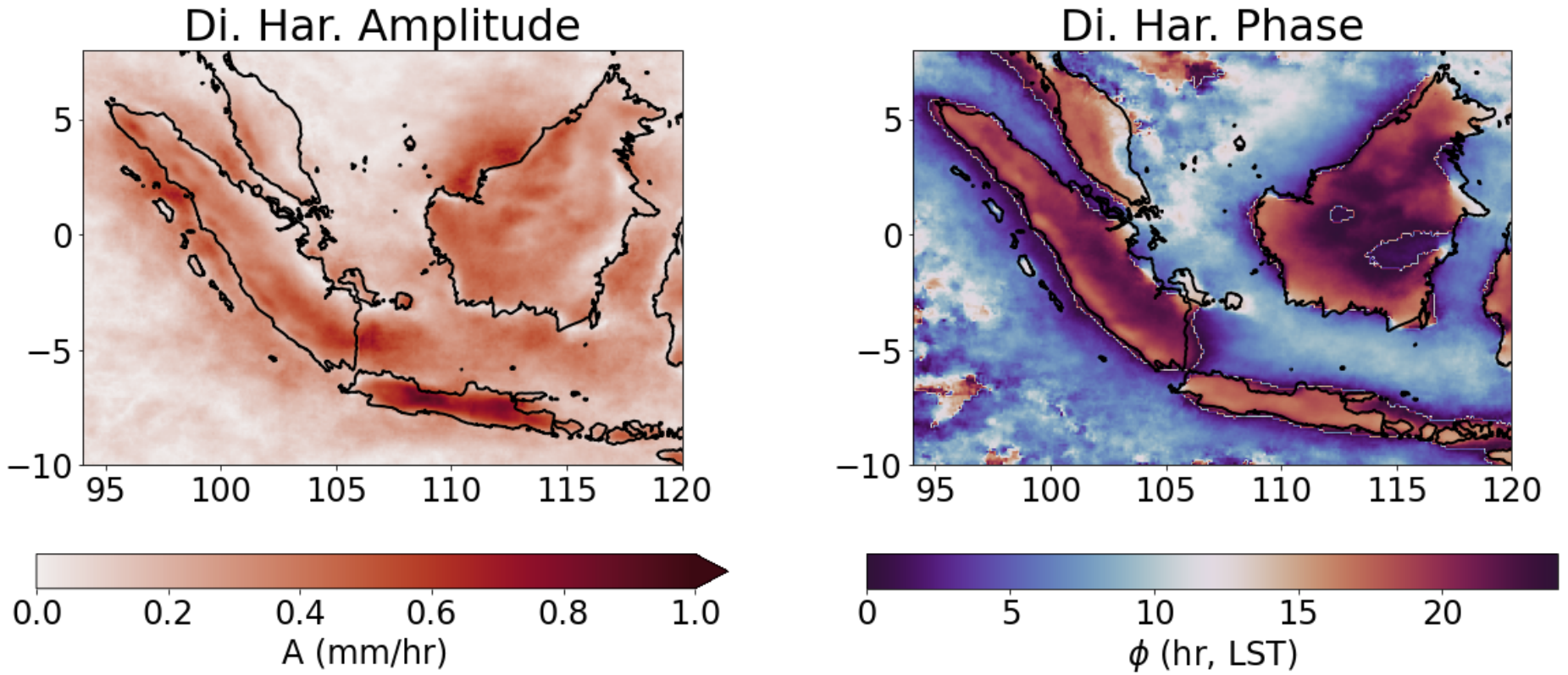
Session AS1.10 – Wednesday 25th May 2022

j.mustafa@uea.ac.uk

Characterisation of the Maritime Continent's diurnal cycle of precipitation in GPM-IMERG data

N = 903
(10 x DJF)

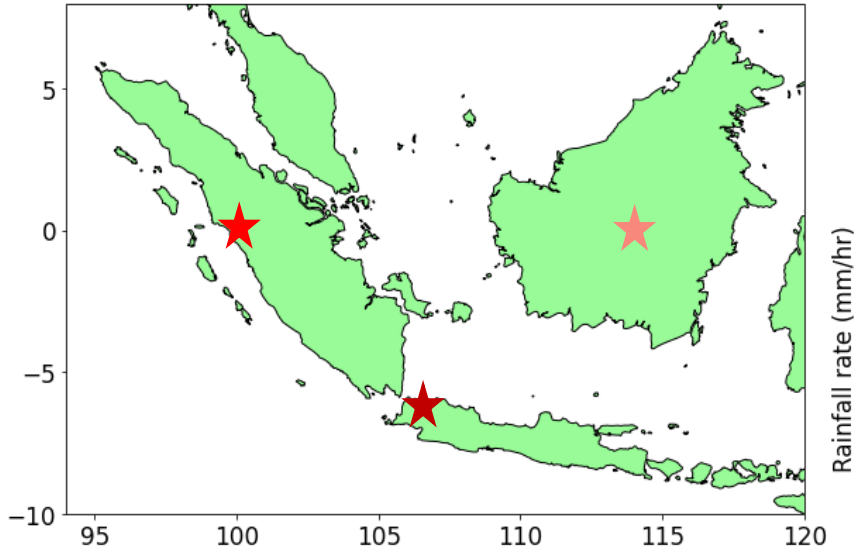


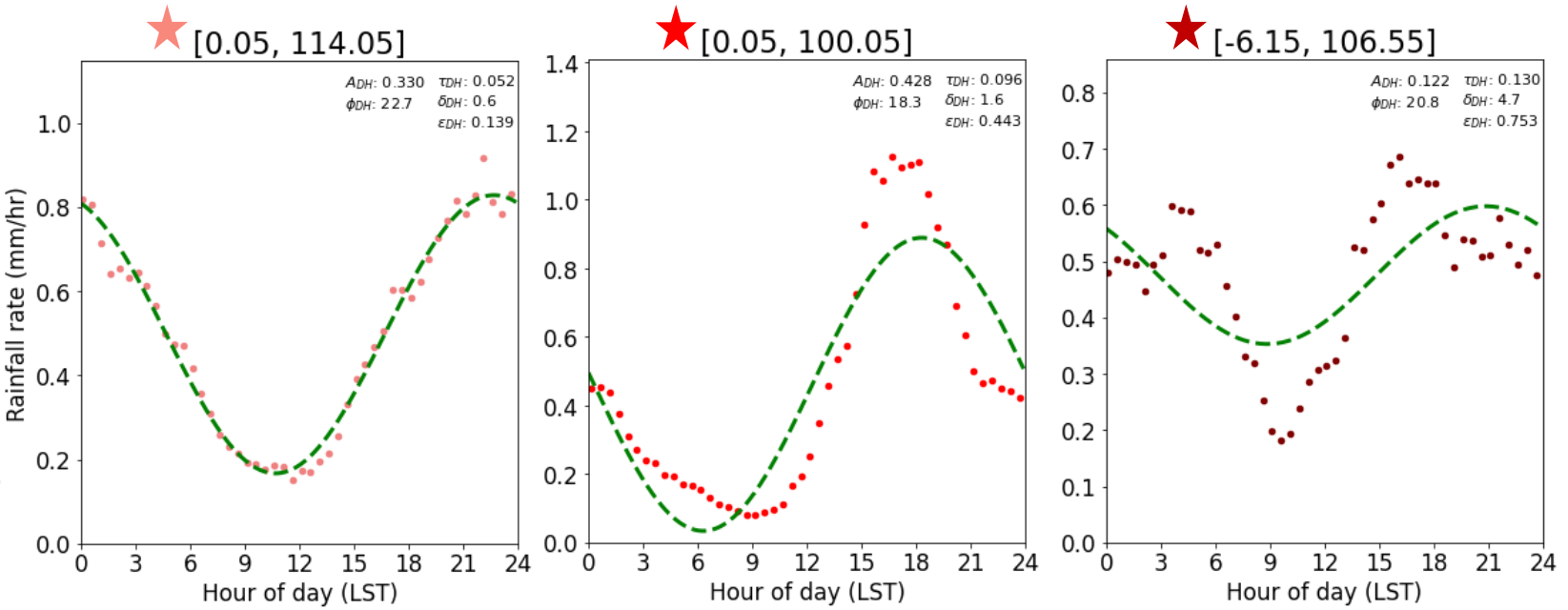
Di. Har. = First Diurnal Harmonic

Jack Mustafa, *Adrian Matthews, Rob Hall, Karen Heywood, Marina do Valle Chagas Azaneu*
University of East Anglia, UK

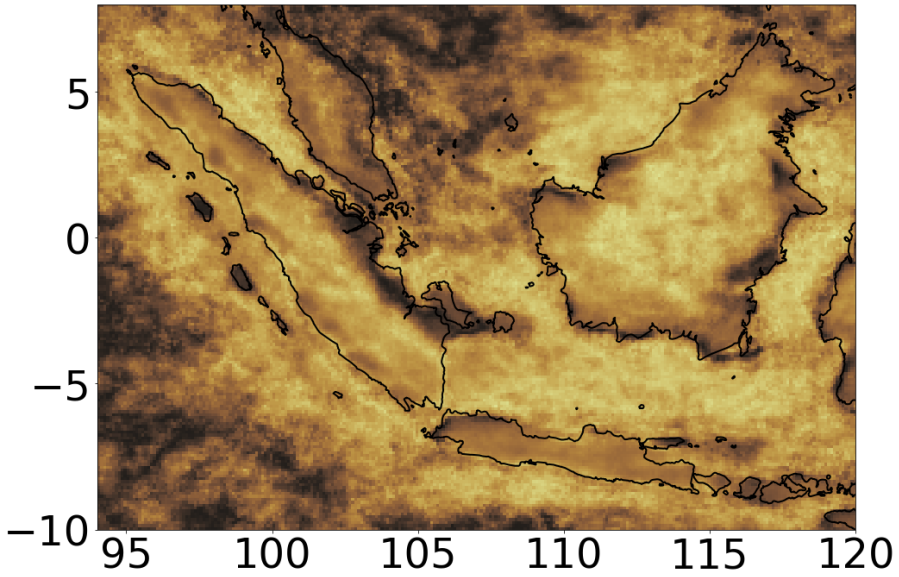
j.mustafa@uea.ac.uk

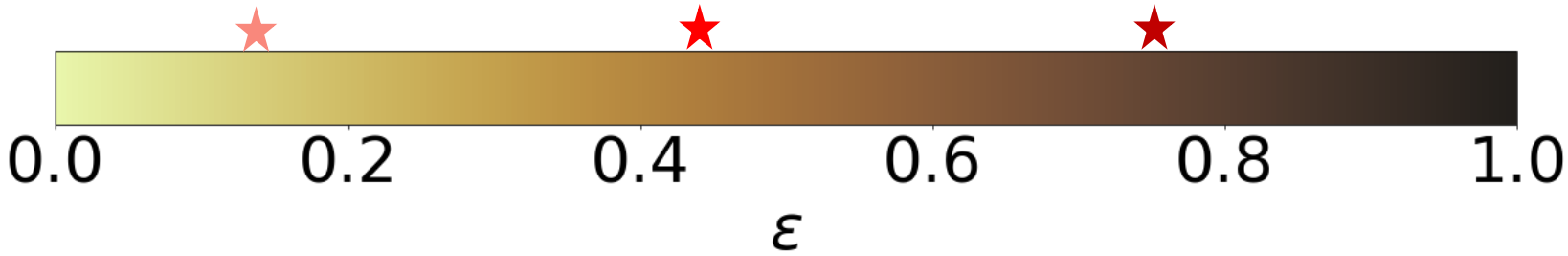
Diurnal cycle characterisation: First diurnal harmonic





Di. Har. Scaled Error



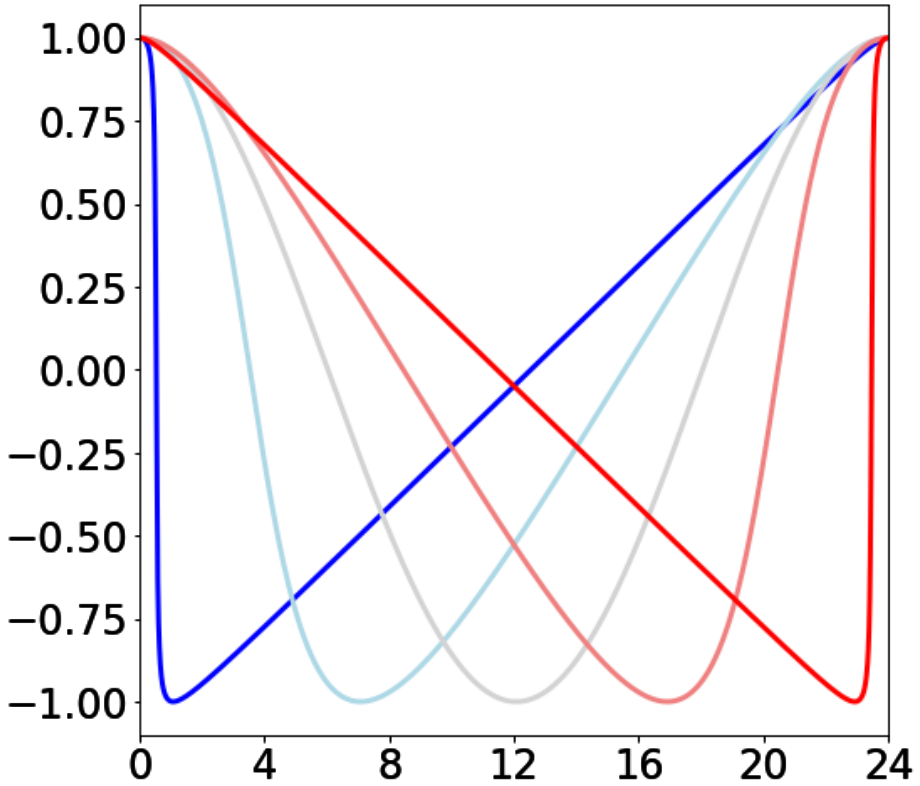


$$\varepsilon = \frac{\text{Root-Mean-Square Residual}}{\text{Standard Deviation}}$$

j.mustafa@uea.ac.uk

Diurnal cycle characterisation: Alternative waveforms

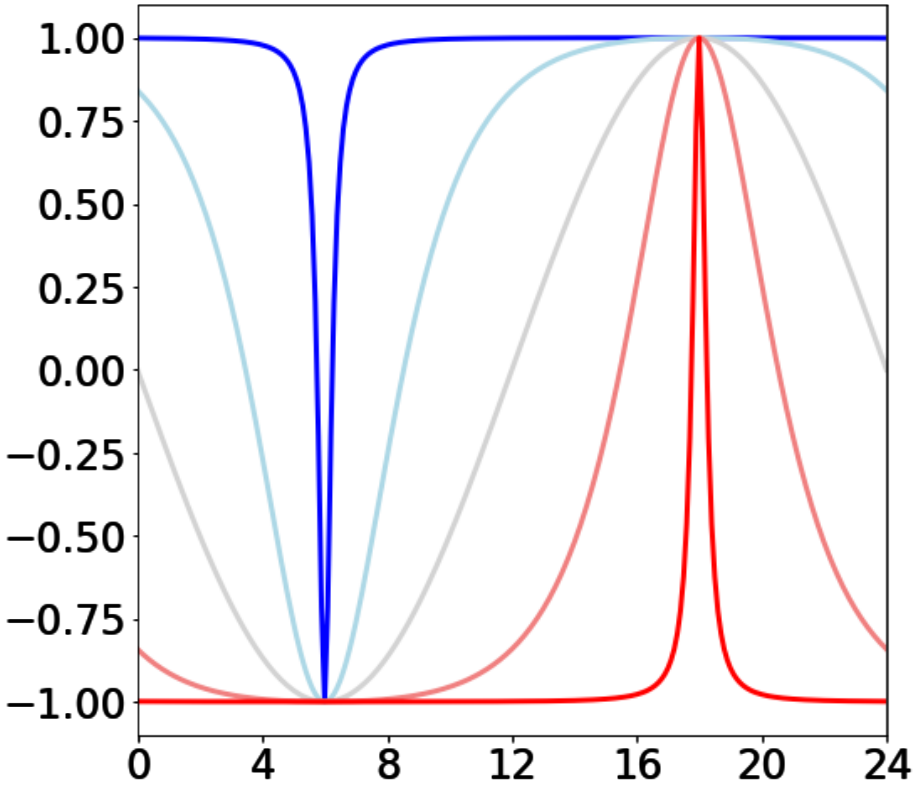
Skew (α)



α = - 1 α = 0 α = 1

(A=1, ϕ=0, c=0)

Spike (β)

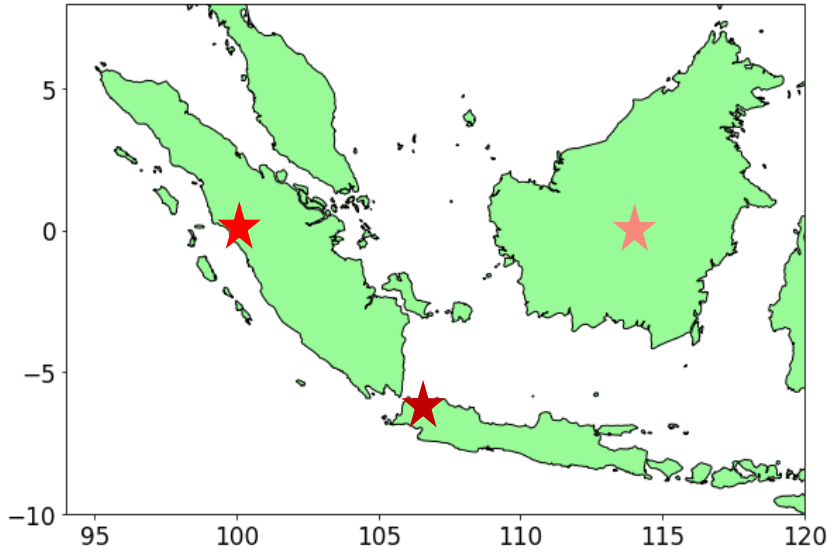


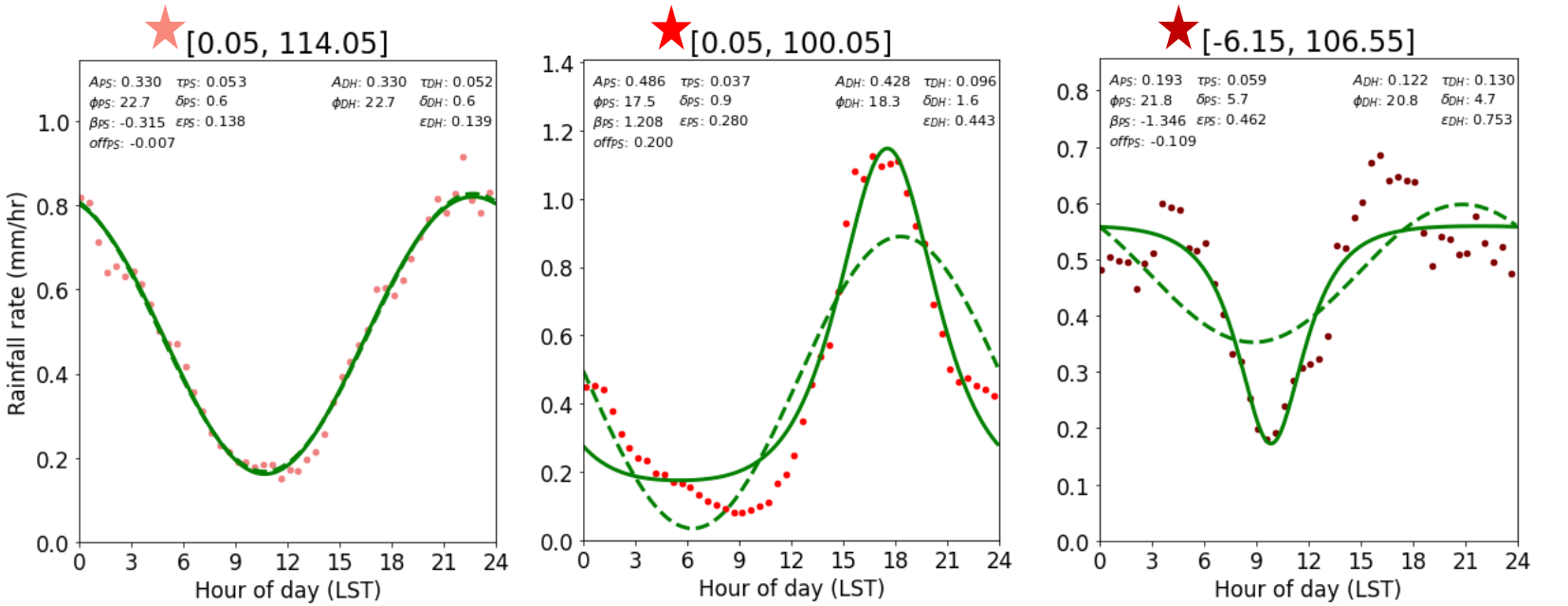
β = - π/2 β = 0 β = π/2

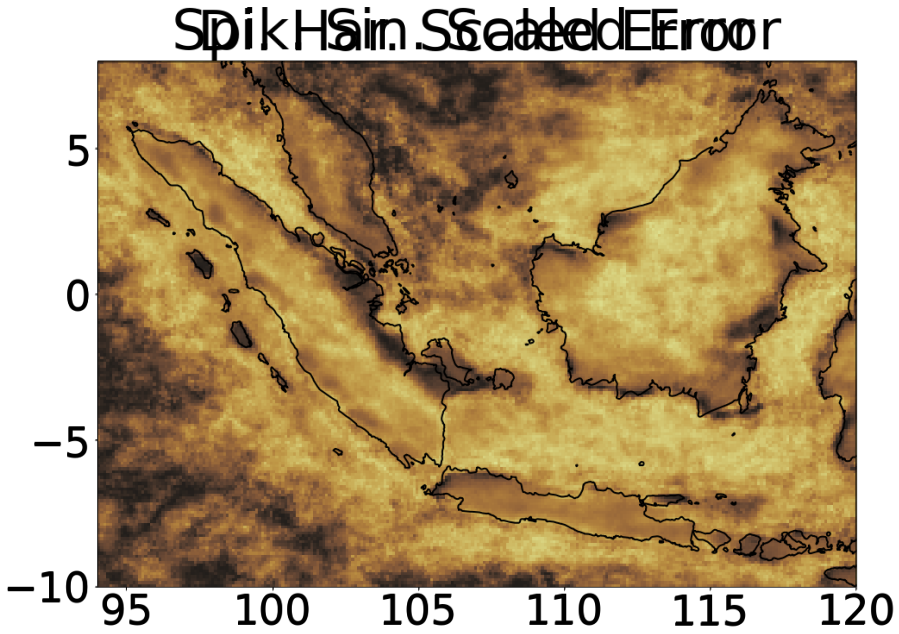
(A=1, ϕ=18, c=0)

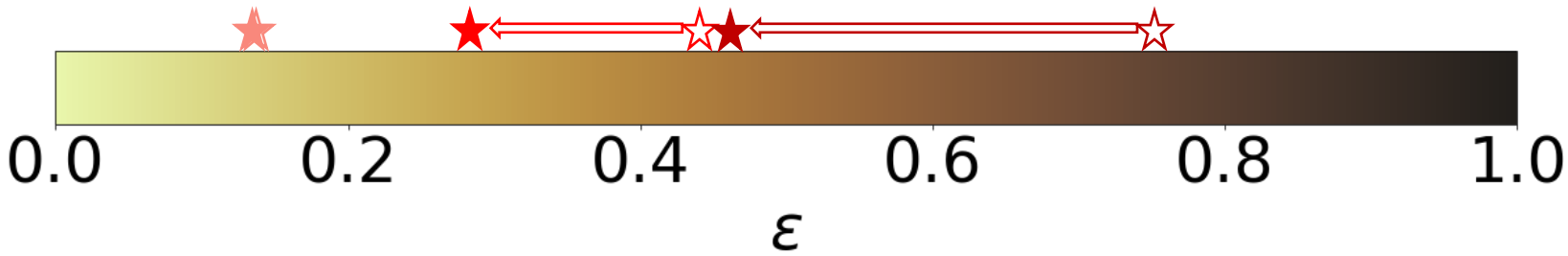
j.mustafa@uea.ac.uk

Diurnal cycle characterisation: Spiked sinusoid







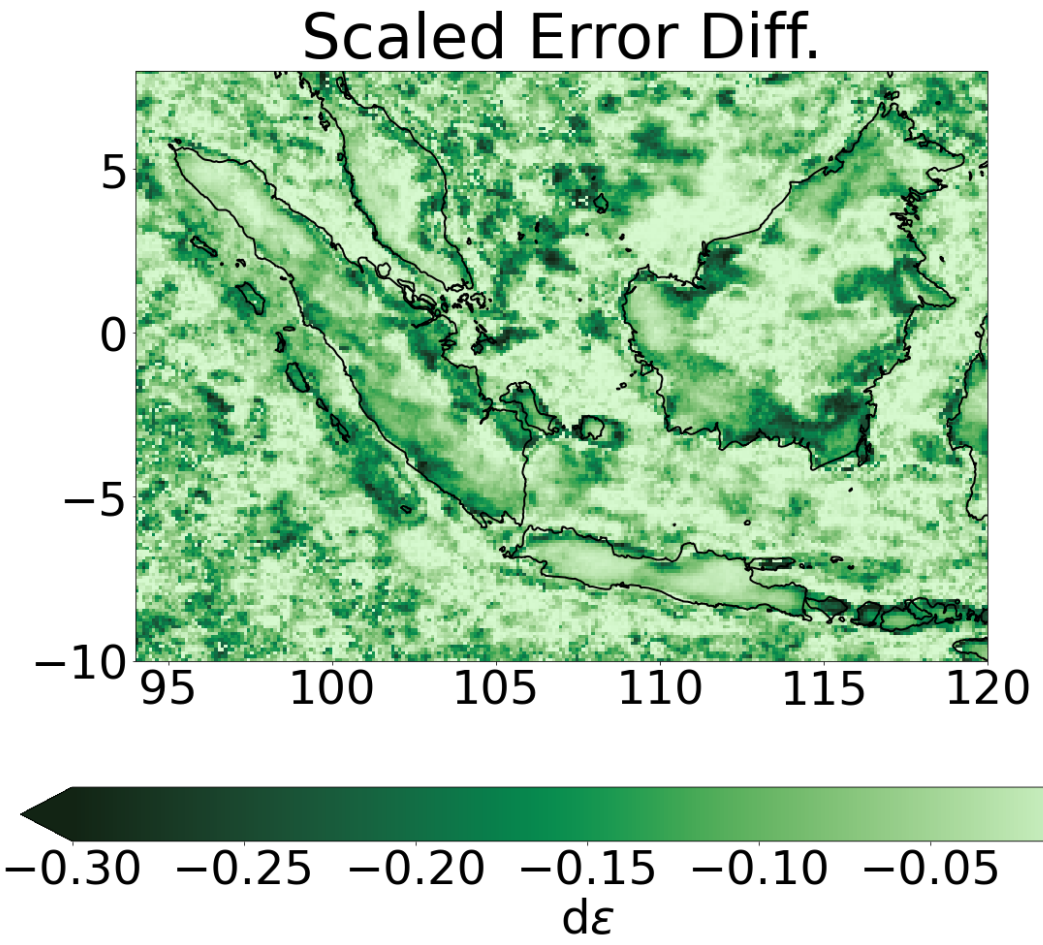


$$\varepsilon = \frac{\text{Root-Mean-Square Residual}}{\text{Standard Deviation}}$$

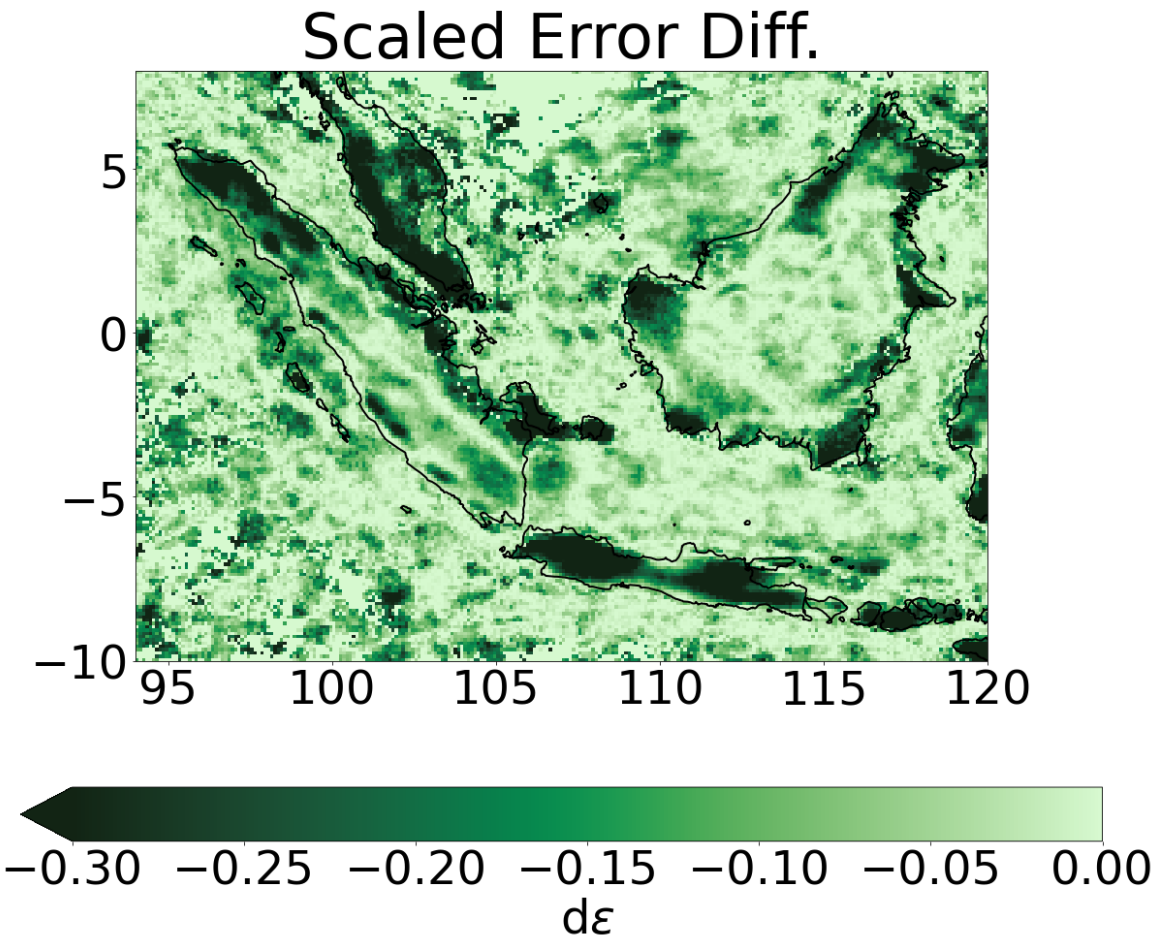
j.mustafa@uea.ac.uk

Diurnal cycle characterisation: Improvement in goodness of fit

Skewed Sinusoid



Spiked Sinusoid



j.mustafa@uea.ac.uk

Diurnal cycle characterisation: Summary

- The first diurnal harmonic gives a misleading amplitude and phase in some locations.
- Spiked sinusoid and skewed sinusoid best fitting can strongly improve the amplitude and phase representation.
- Presently working on identifying regions with similar dominant diurnal cycle character, e.g. Java has strong positive spike.
- This work will improve our qualitative understanding of the diurnal cycle.
- Best-fitting methodology highly transferable to other cycles in the sciences.

j.mustafa@uea.ac.uk

Bonus slides: Waveform formulae

Amplitude

Phase (of peak)

Mean

$$y = A\cos\left[\omega(t-\phi)\right] + c \qquad \omega = \frac{2\pi}{T}$$

Amplitude

Skew

Phase (of peak)

Mean

$$y = \frac{A}{\tan^{-1}\left[\frac{\alpha}{\sqrt{1-\alpha^2}}\right]} \tan^{-1}\left[\frac{\alpha\sin[\omega(t-\phi)+\cos^{-1}(\alpha)]}{1-\alpha\cos[\omega(t-\phi)+\cos^{-1}(\alpha)]}\right] + c$$

Phase (of peak)

Spike

Amplitude
(or "half-range")

Mean

$$y = A\left(\cos\left[\frac{\pi\tan^{-1}\left[\left(\frac{2 \mod_T\left[t-\phi-\frac{T}{2}\right]}{T}-1\right)\tan\left[\beta\right]\right]}{\beta}\right] + f\left[\beta\right]\right) + c$$

(Offset)

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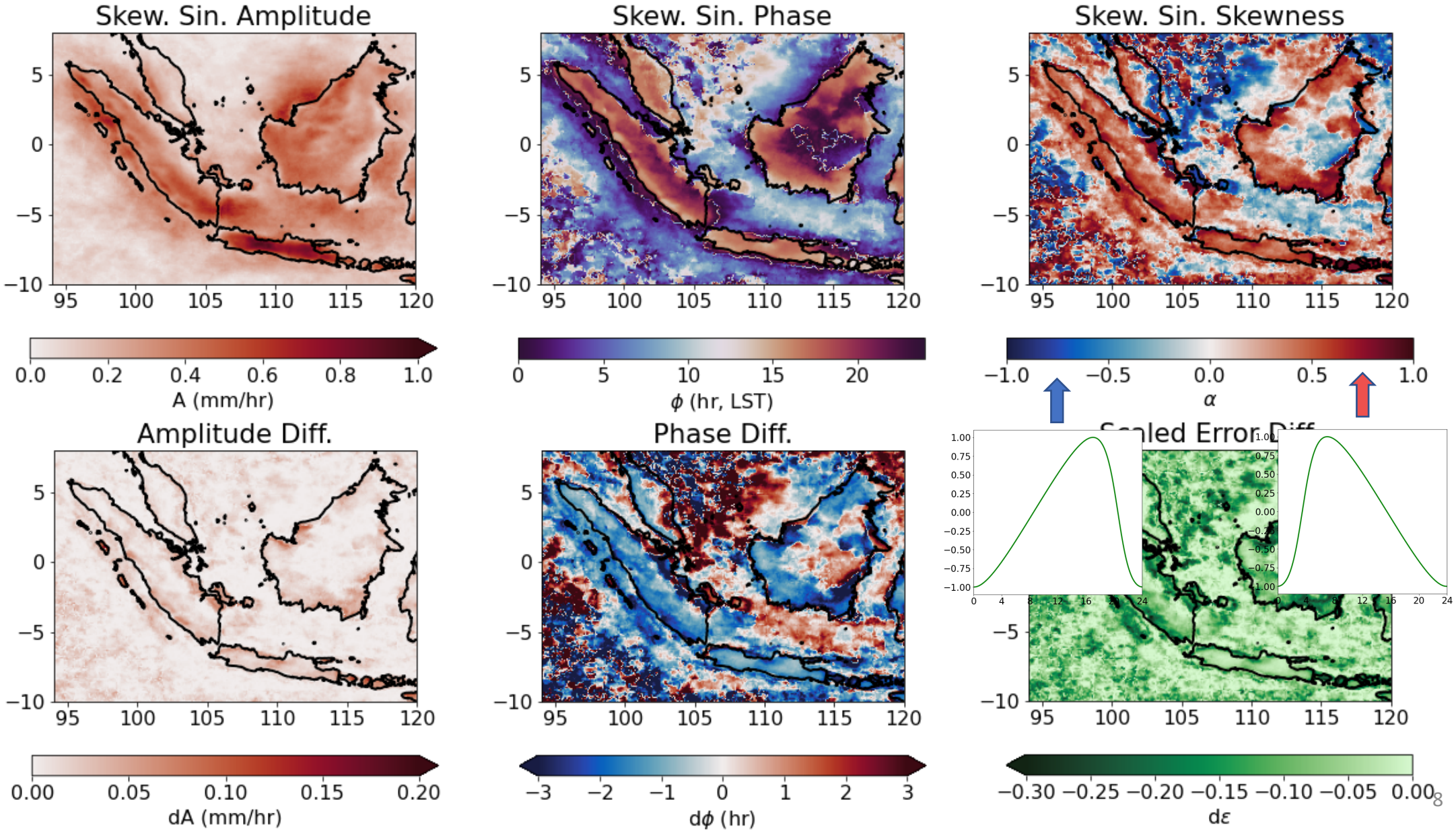
Bonus slides: Skewed sinusoid maps



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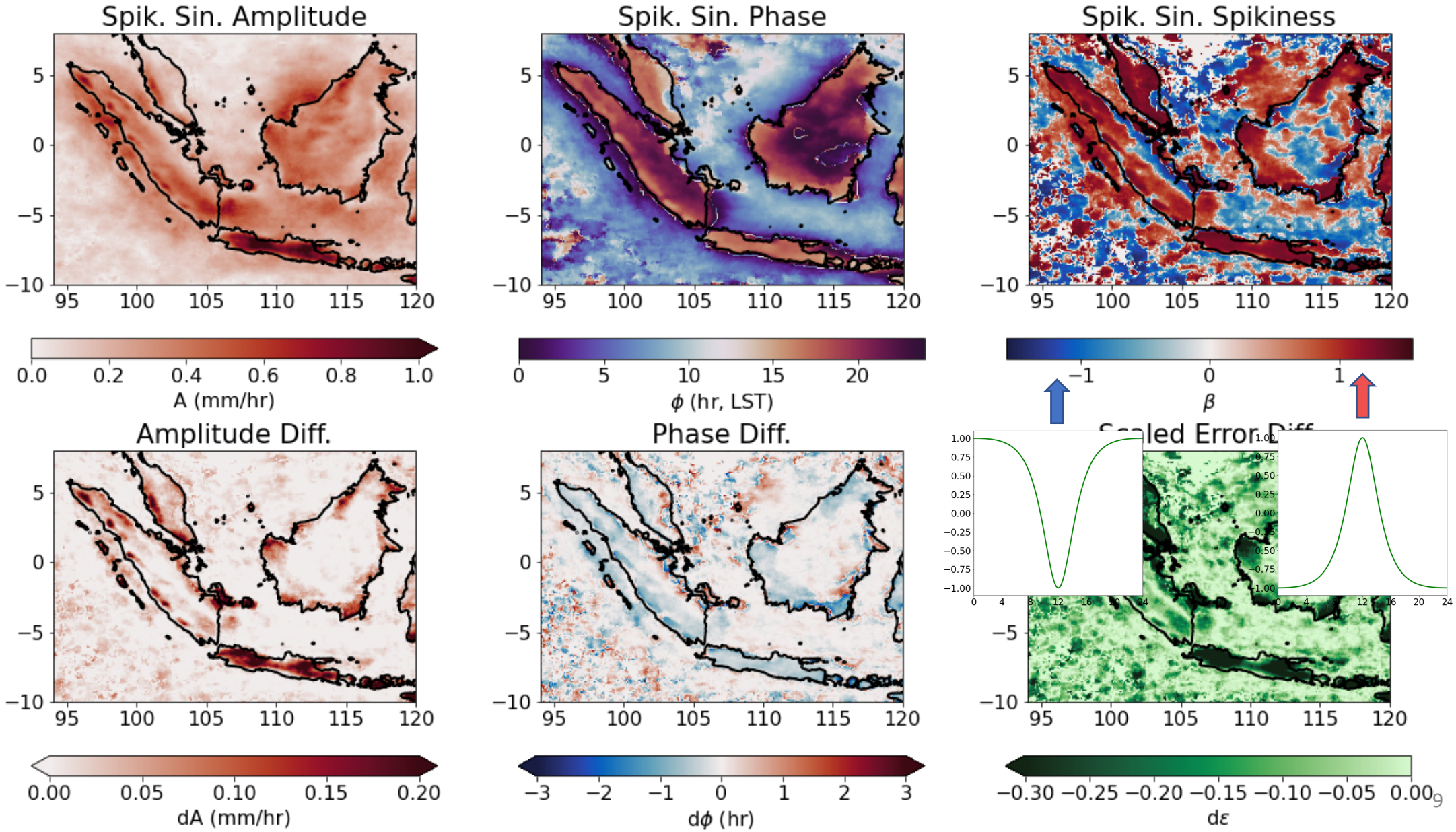
Bonus slides: Spiked sinusoid maps



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Bonus slides: Error improvement maps