Sub-diurnal Variation of SST Gradients in Infrared Satellite Data

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‡ Retired – sailing somewhere off of the coast of France

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Outline

Acknowledgments

- Funding
  - NASA
  - State of Rhode Island and Providence Plantations

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Ocean Fronts

- The focus of this talk is on the sub-diurnal variability of SST gradients.
- It was motivated by the MS Thesis of my former student Kelsey Obenour:
  - Kelsey examined the 30 year trend in front probability in the global ocean
  - Using the global Pathfinder v. 5.2 4km fields for 1982-2010
  - With SST fronts determined with the Cayula-Cornillon algorithm
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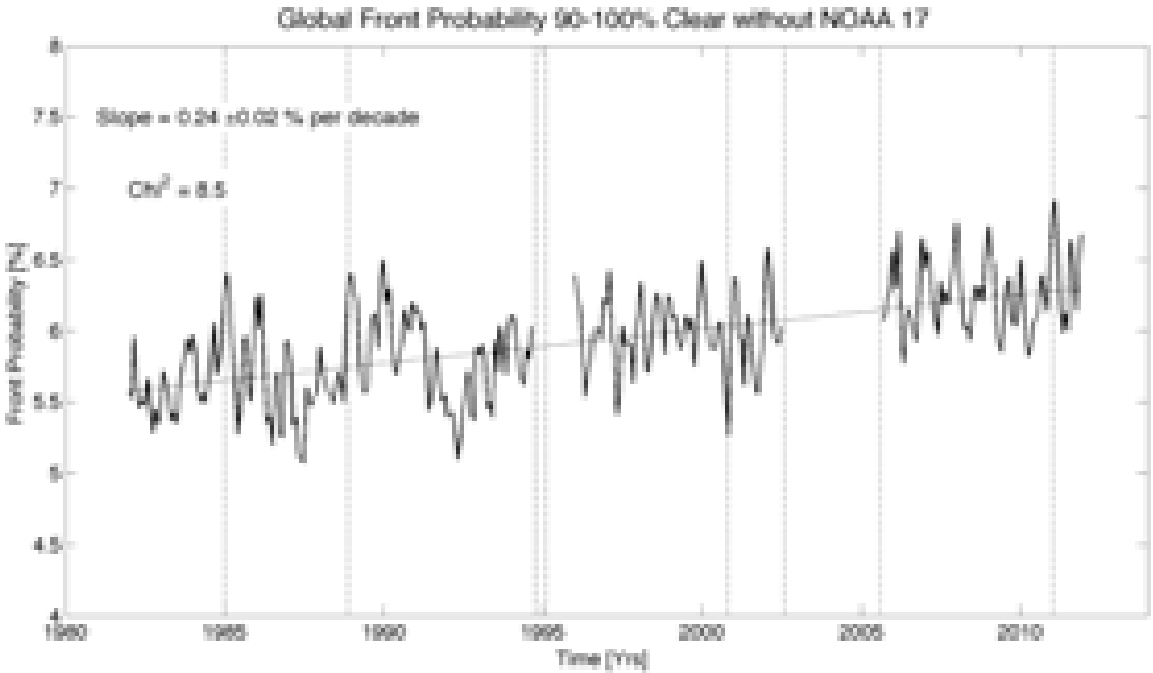

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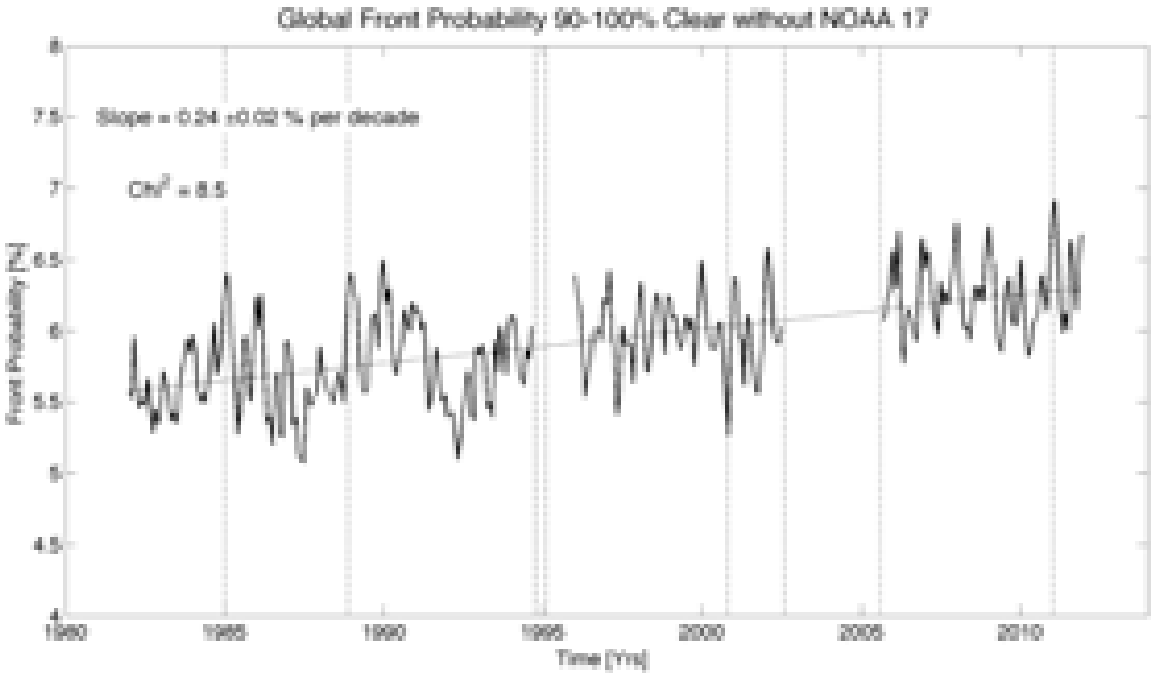

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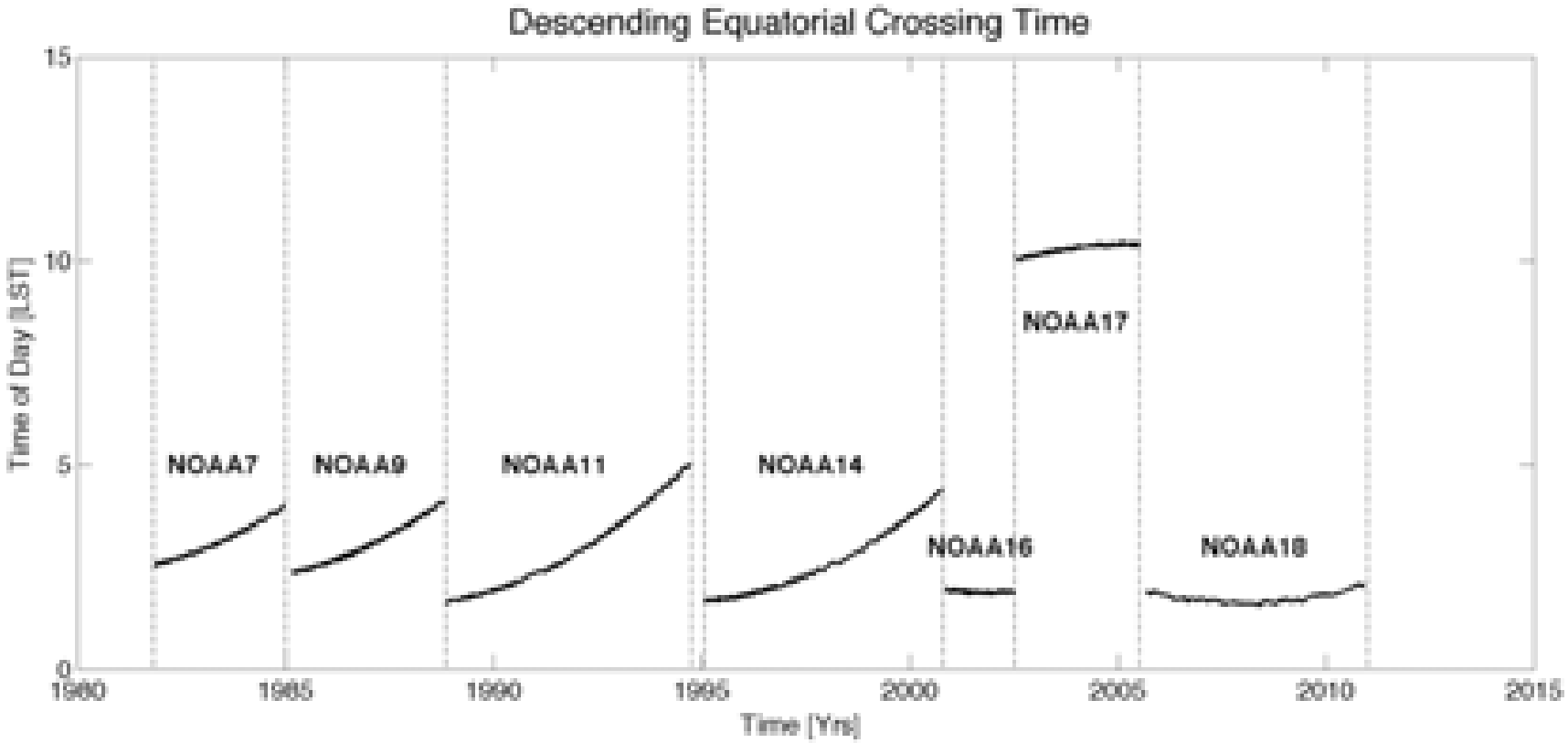
But my granddaughter was skeptical

The Issue

- One of her primary concerns was the drift in satellite orbits.



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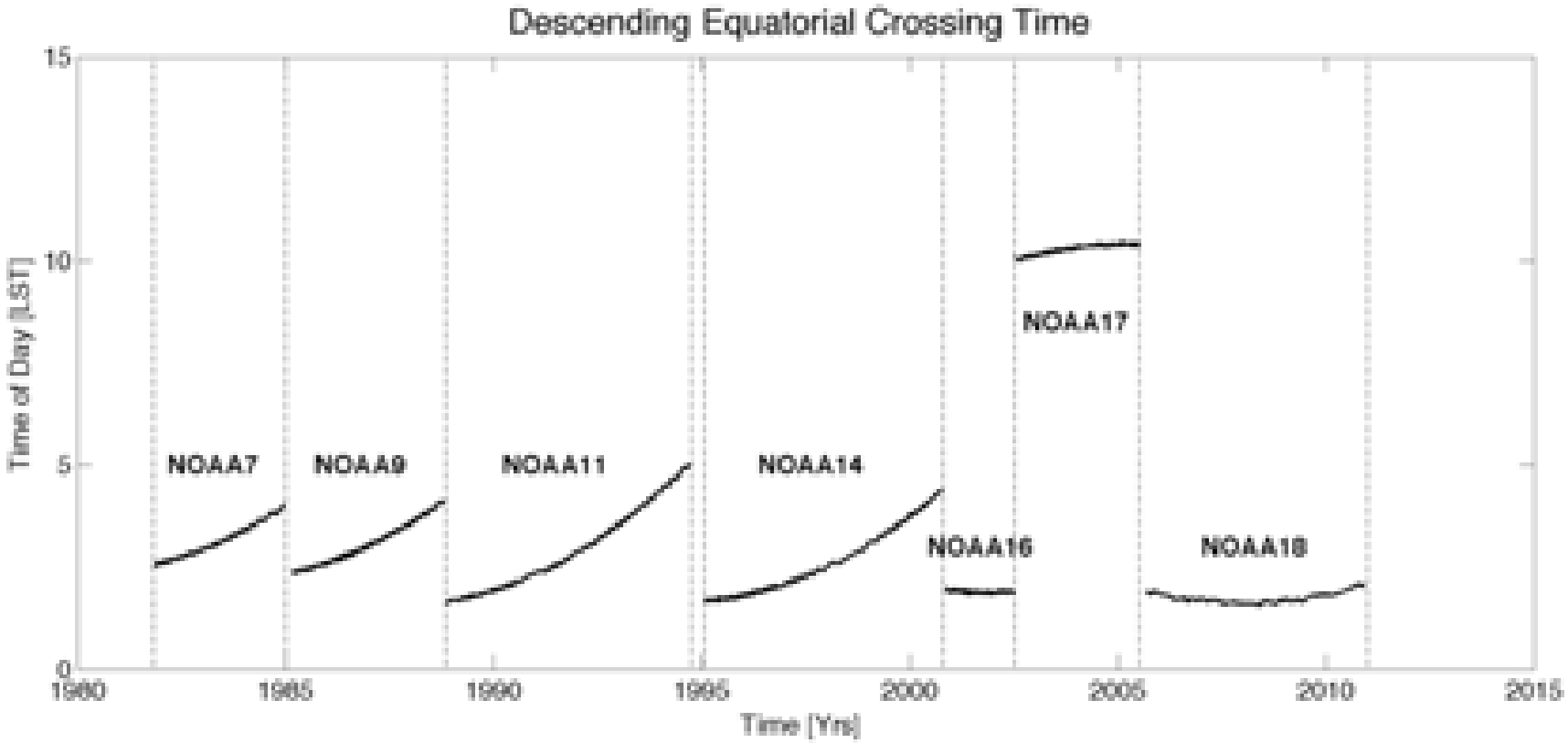

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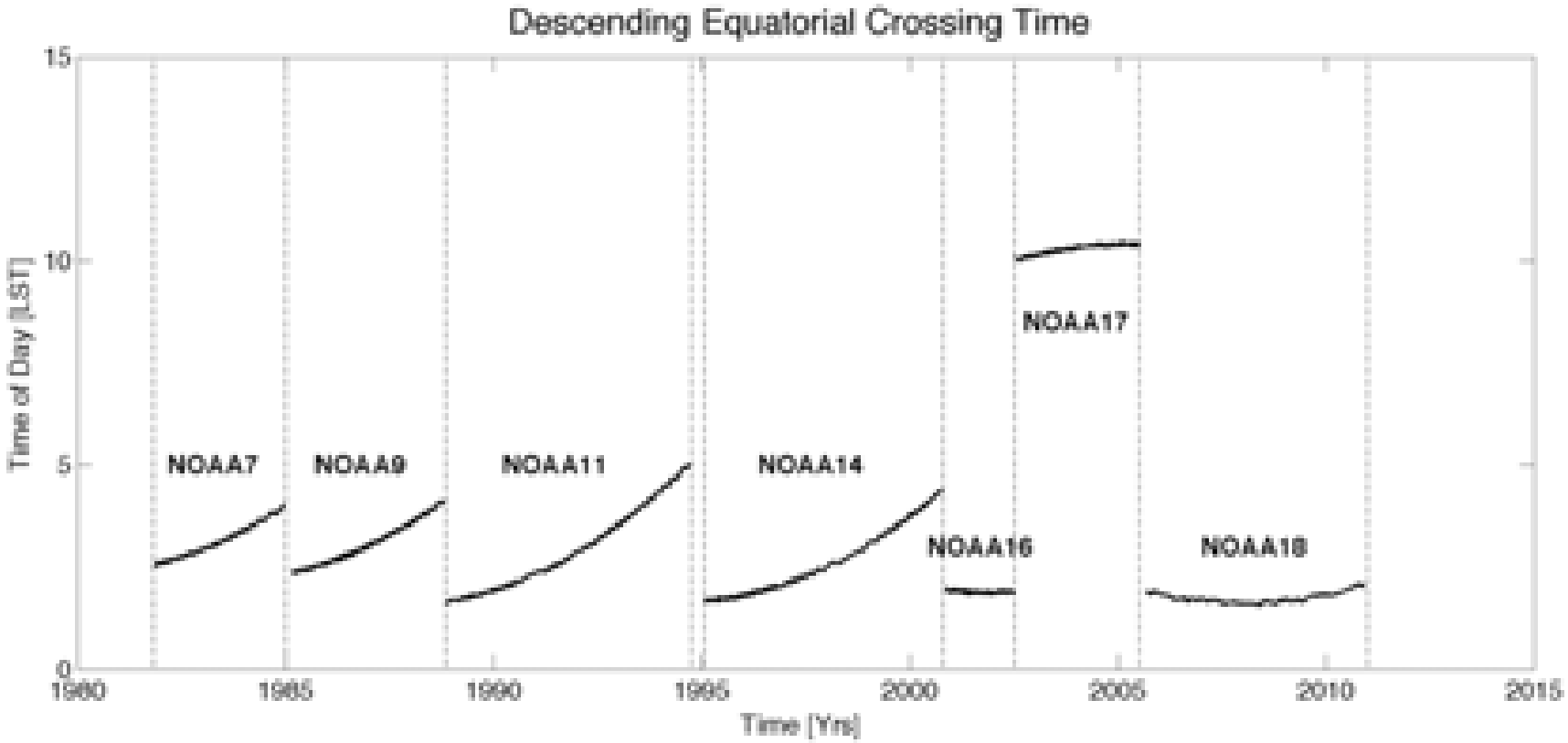

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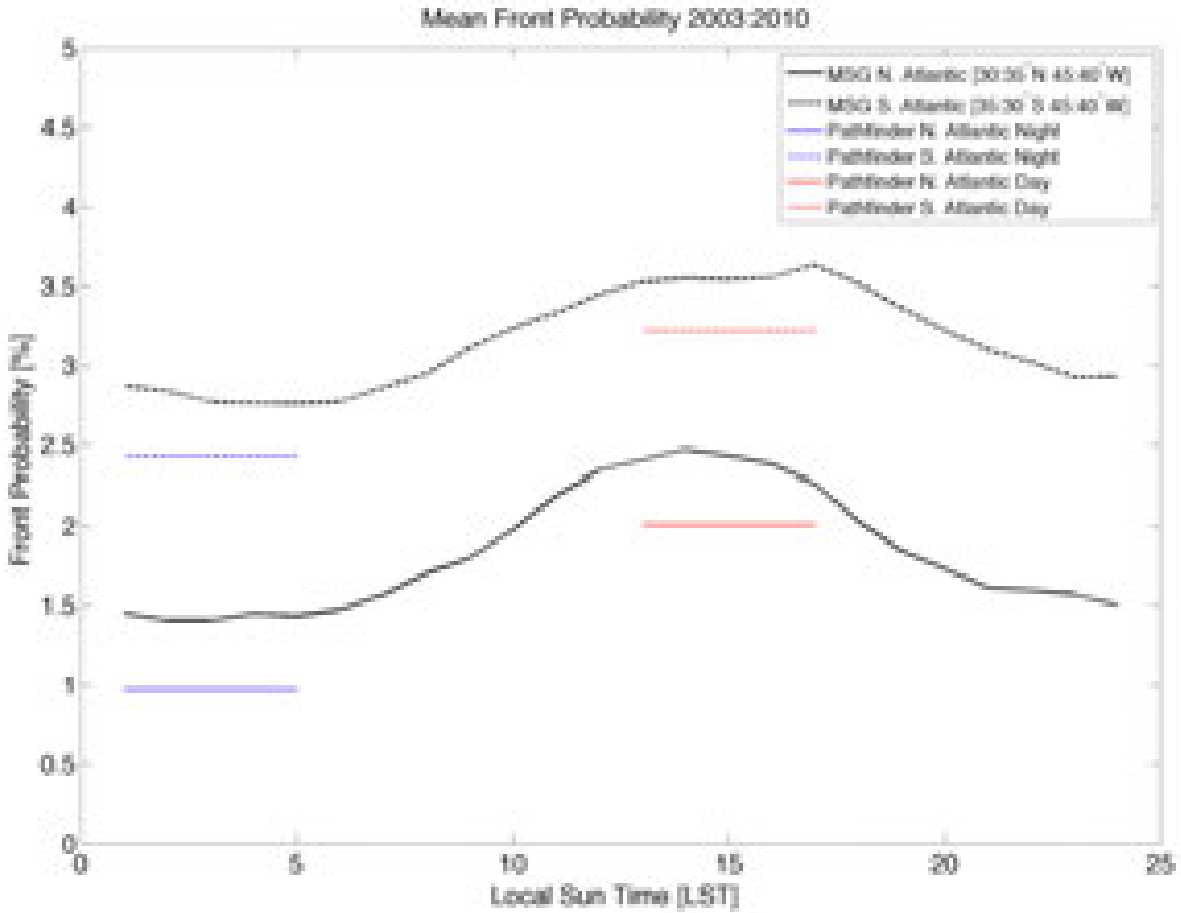

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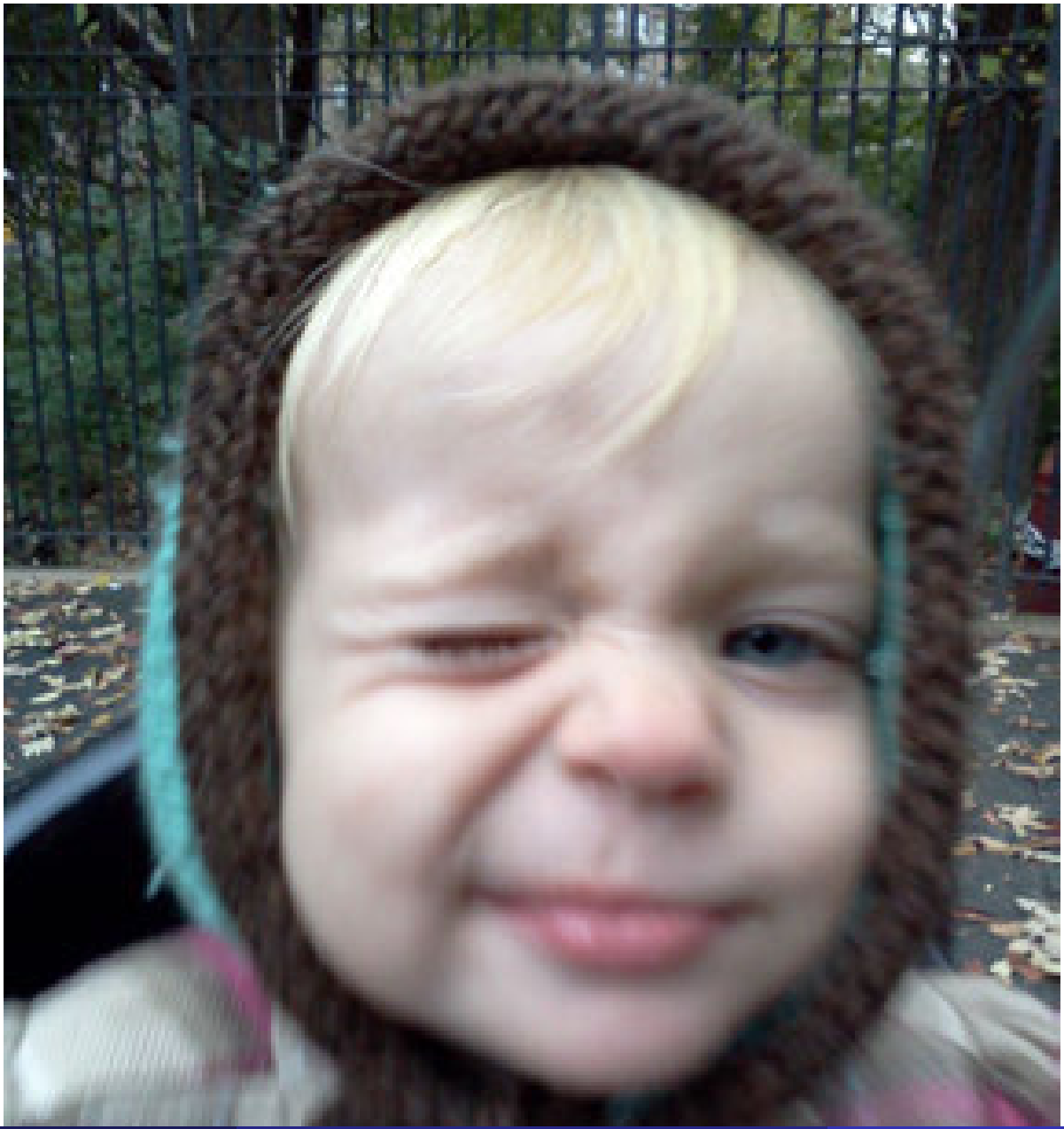

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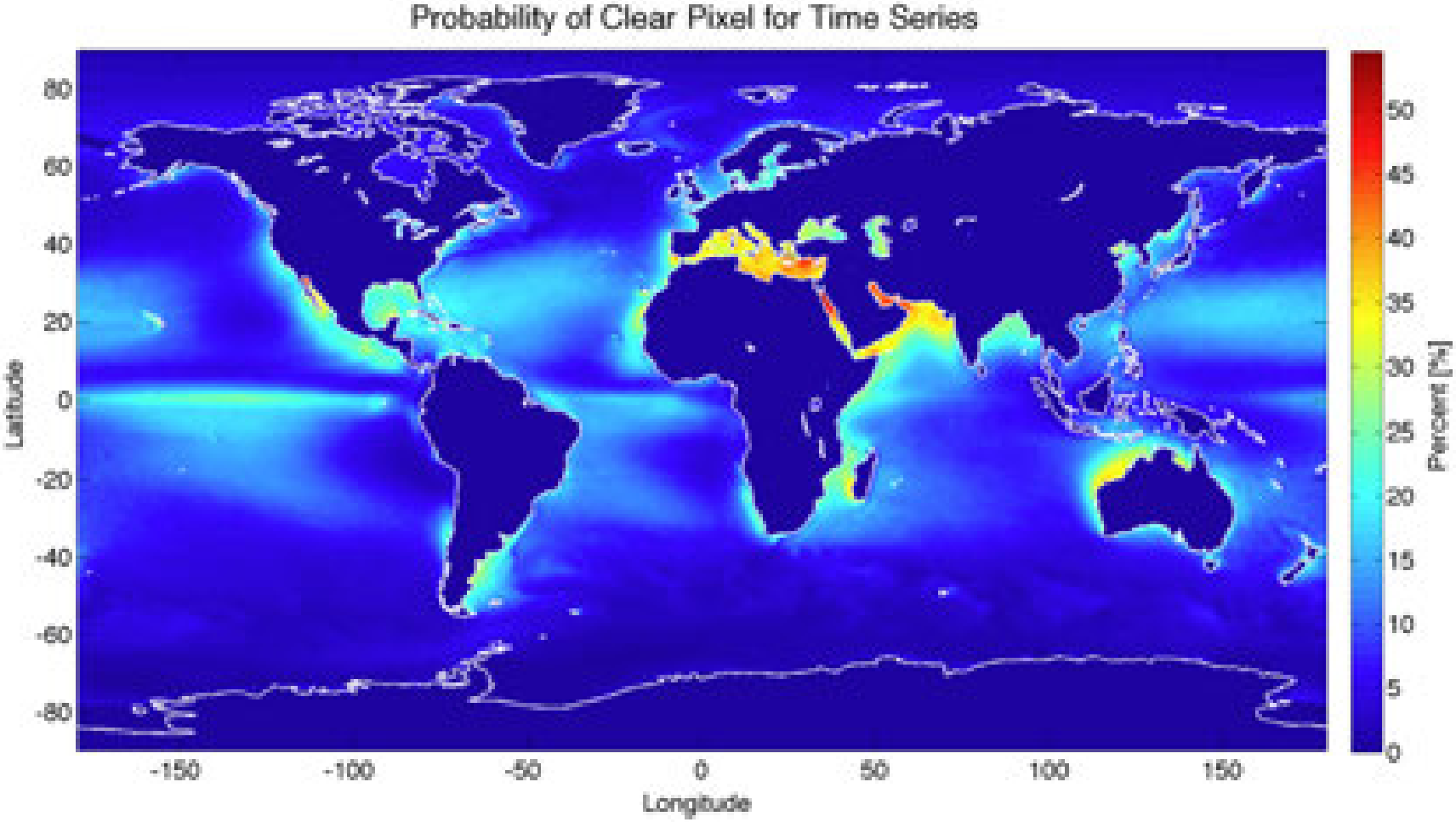

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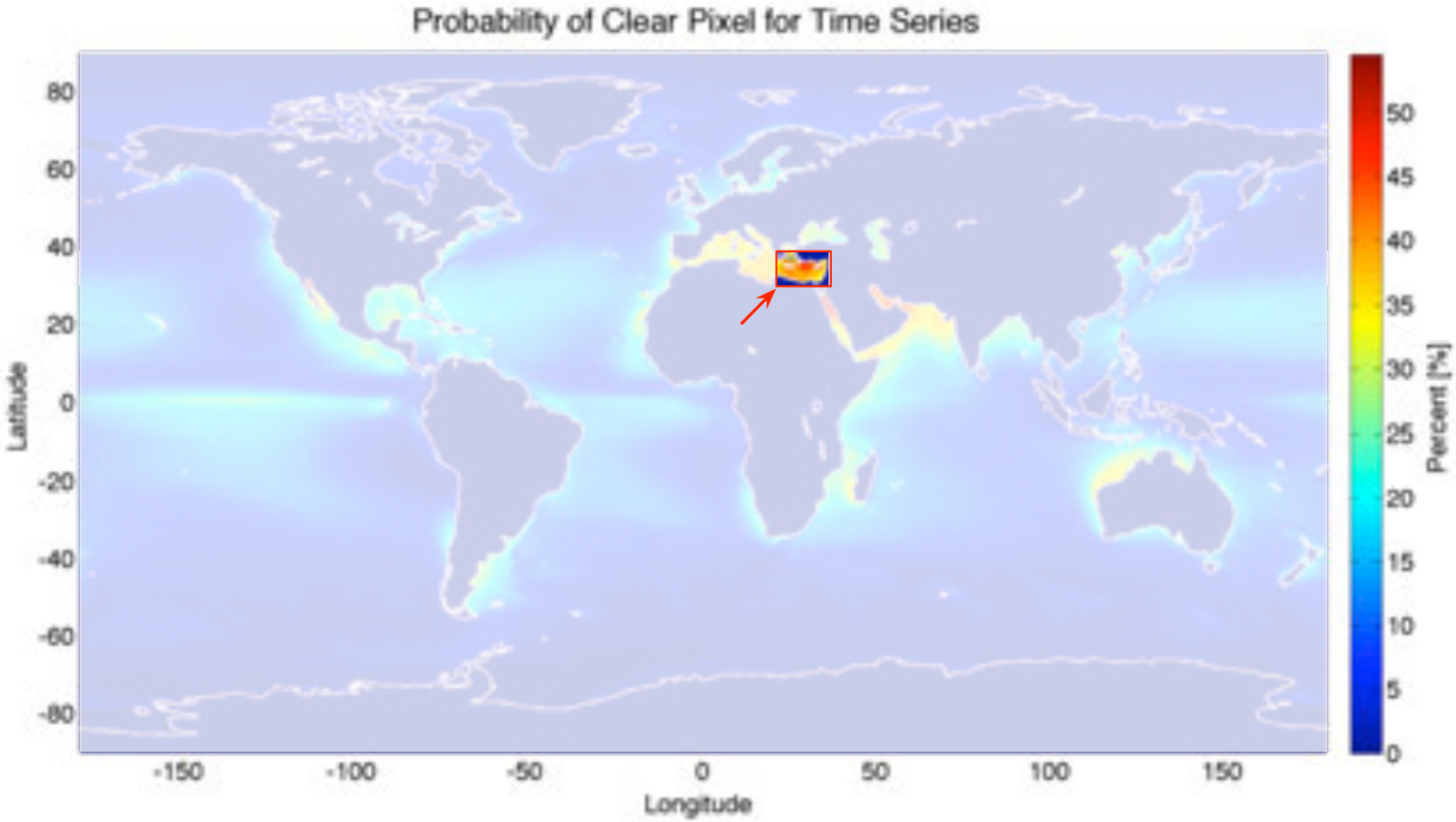

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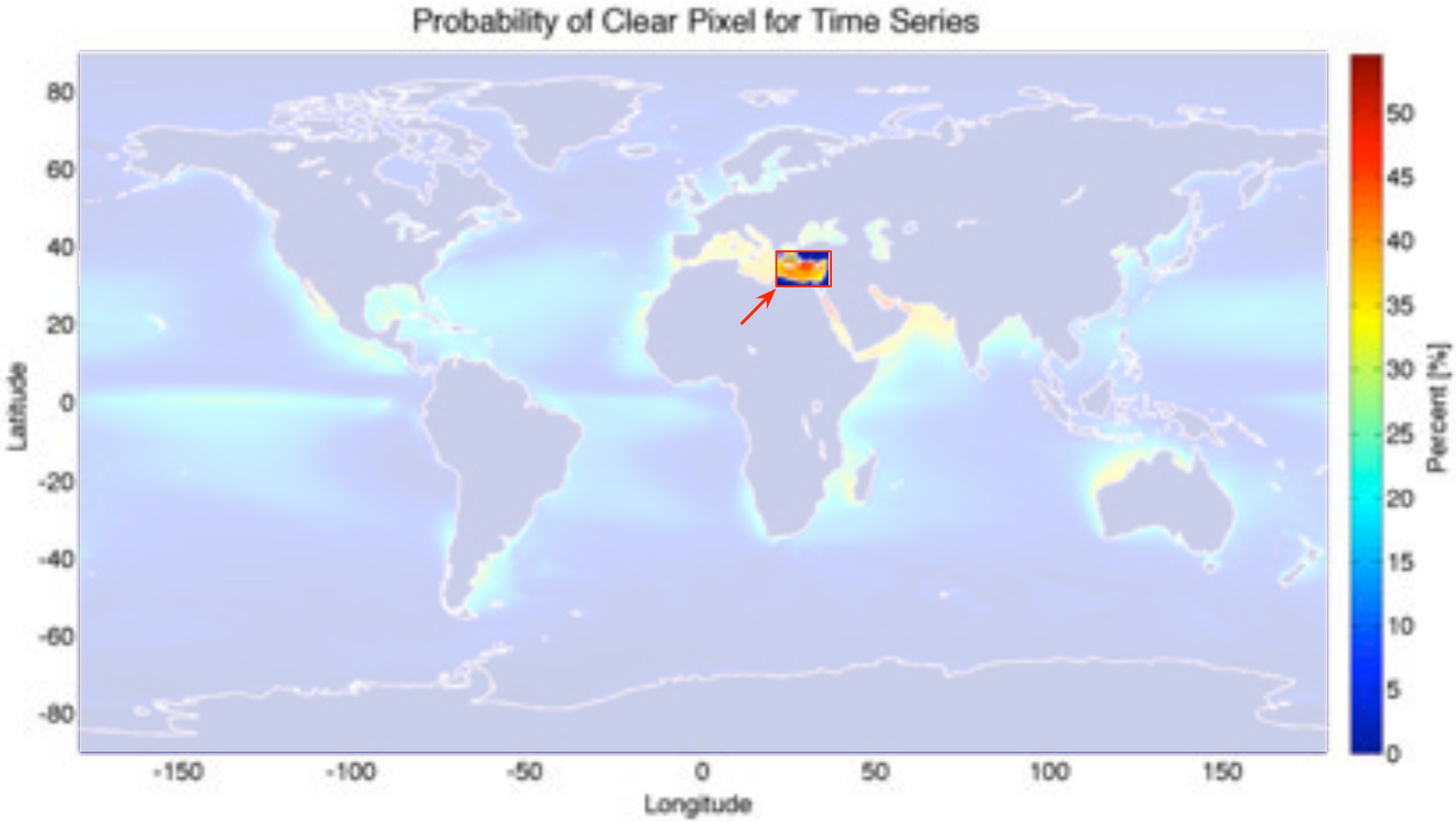

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Outline

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- Gradients were determined with the Sobel kernel

$$\begin{matrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{matrix} \qquad \begin{matrix} 1 & 2 & 1 \\ 0 & 0 & 0 \\ -1 & -2 & -1 \end{matrix}$$

- We use SEVIRI data
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  - 5km spatial resolution
  - Hourly data
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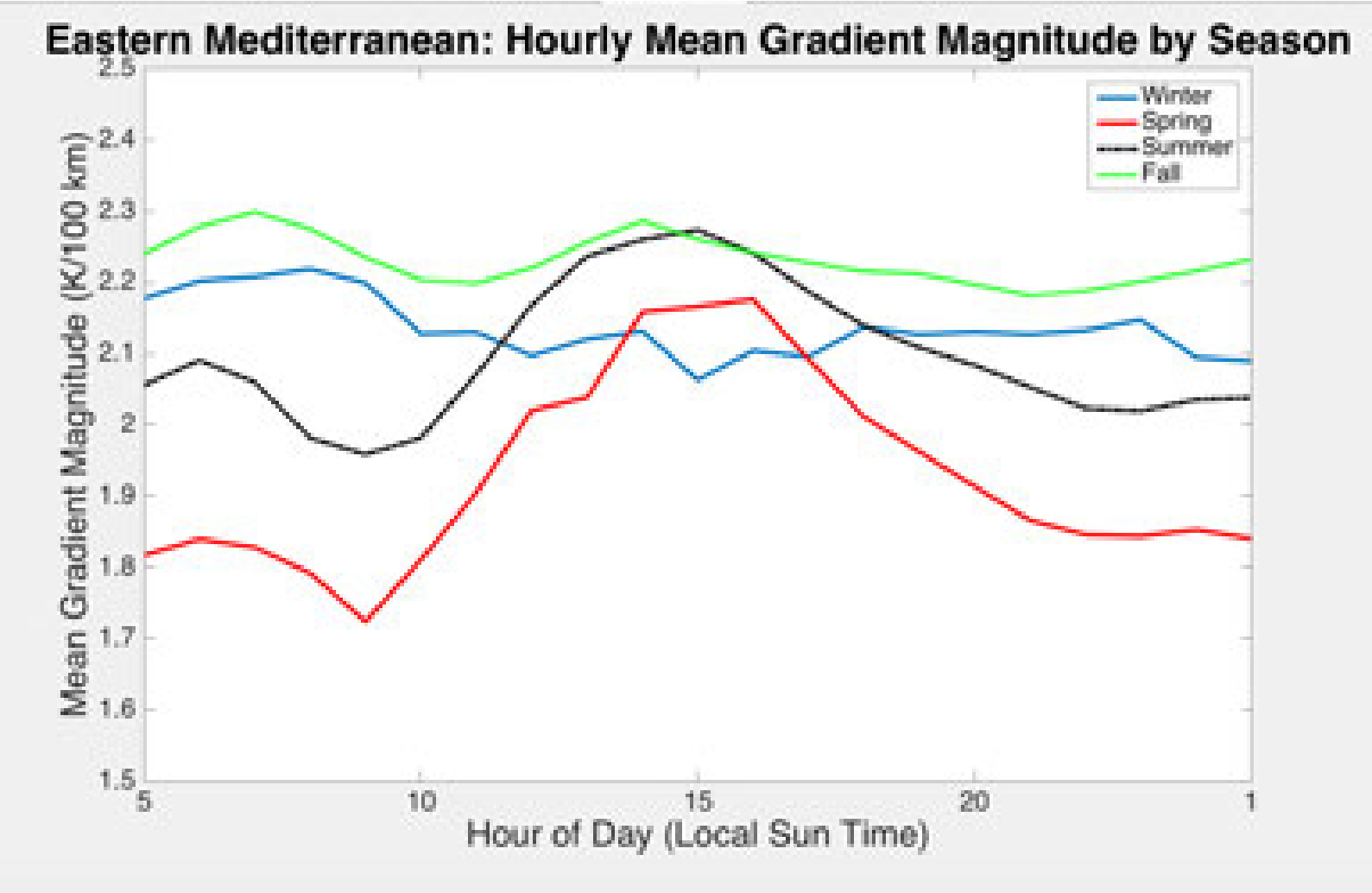
Diurnal Signal in Mean SST Gradients

- As with fronts, gradients show a significant diurnal signal.



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  - Are all gradients increasing?
  - Just those that were weak early in the morning?
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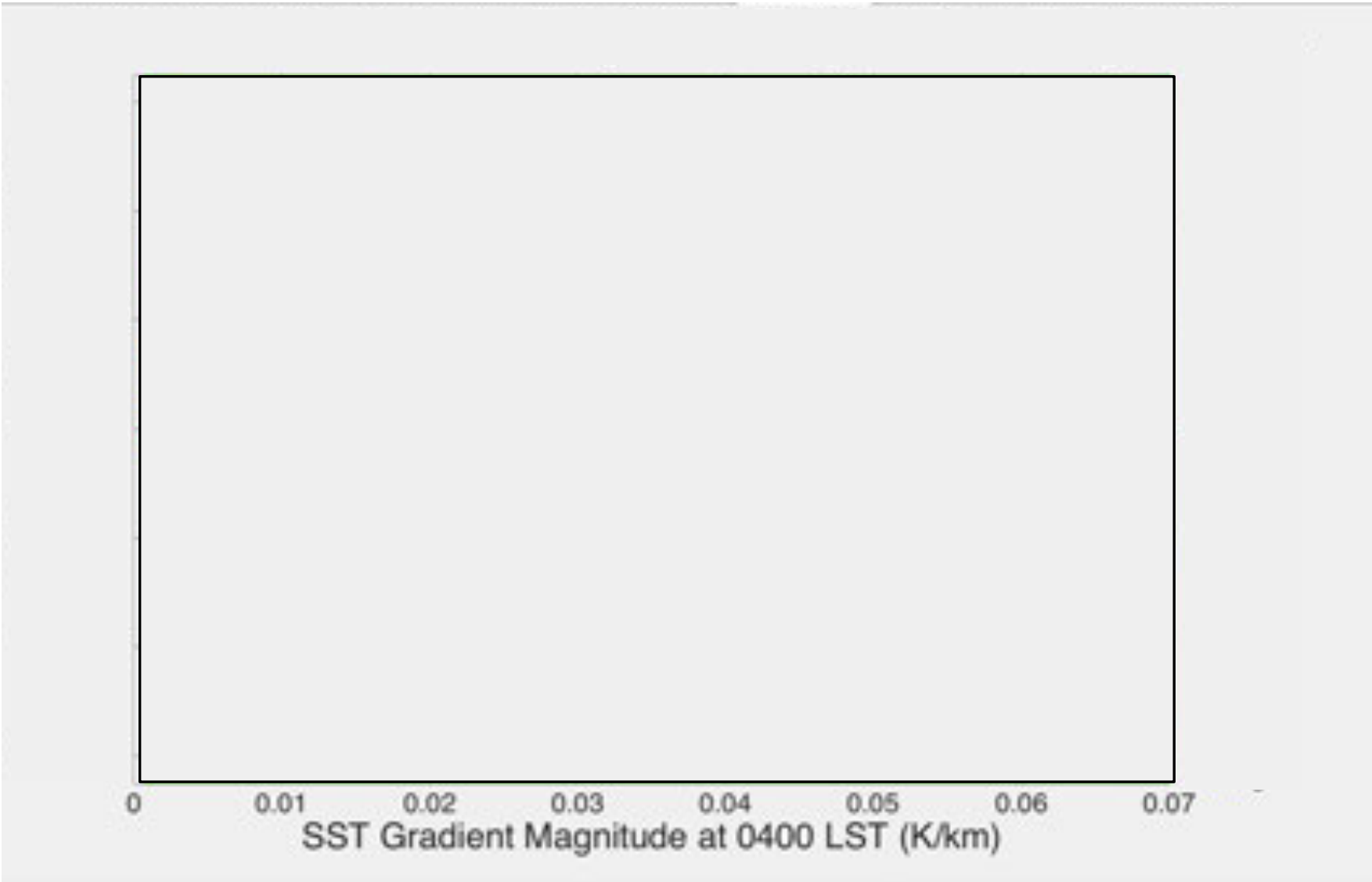

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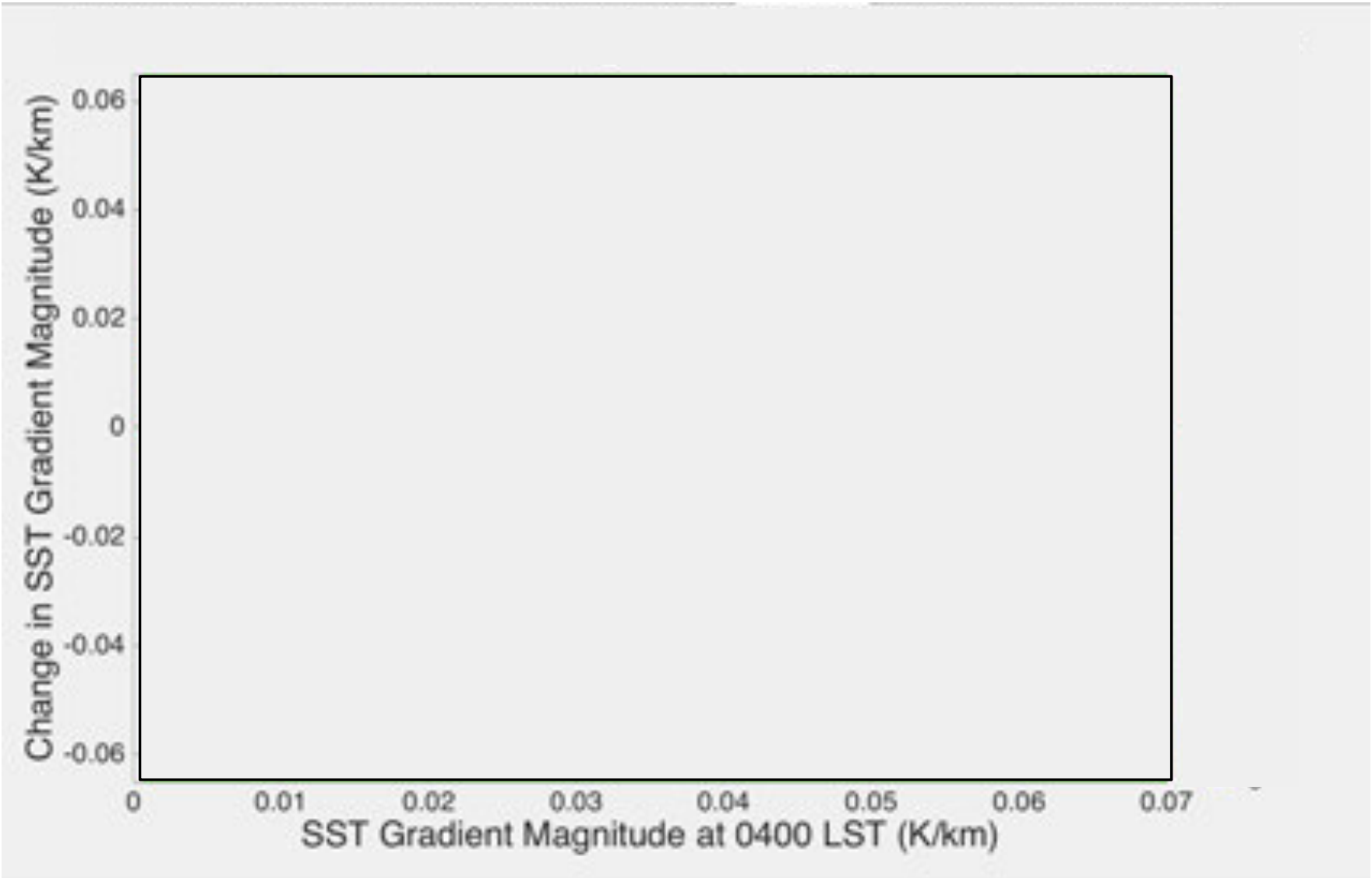

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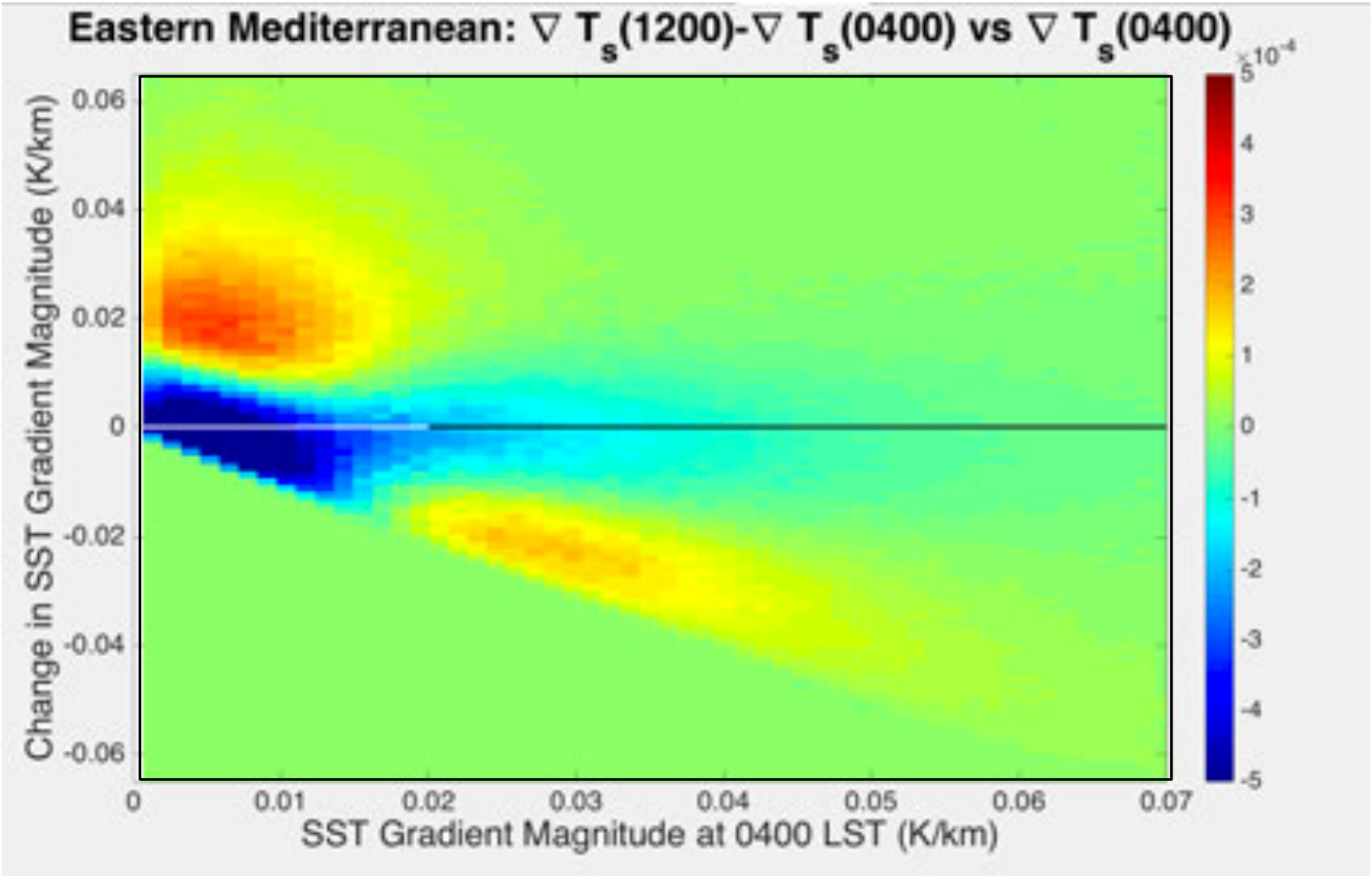

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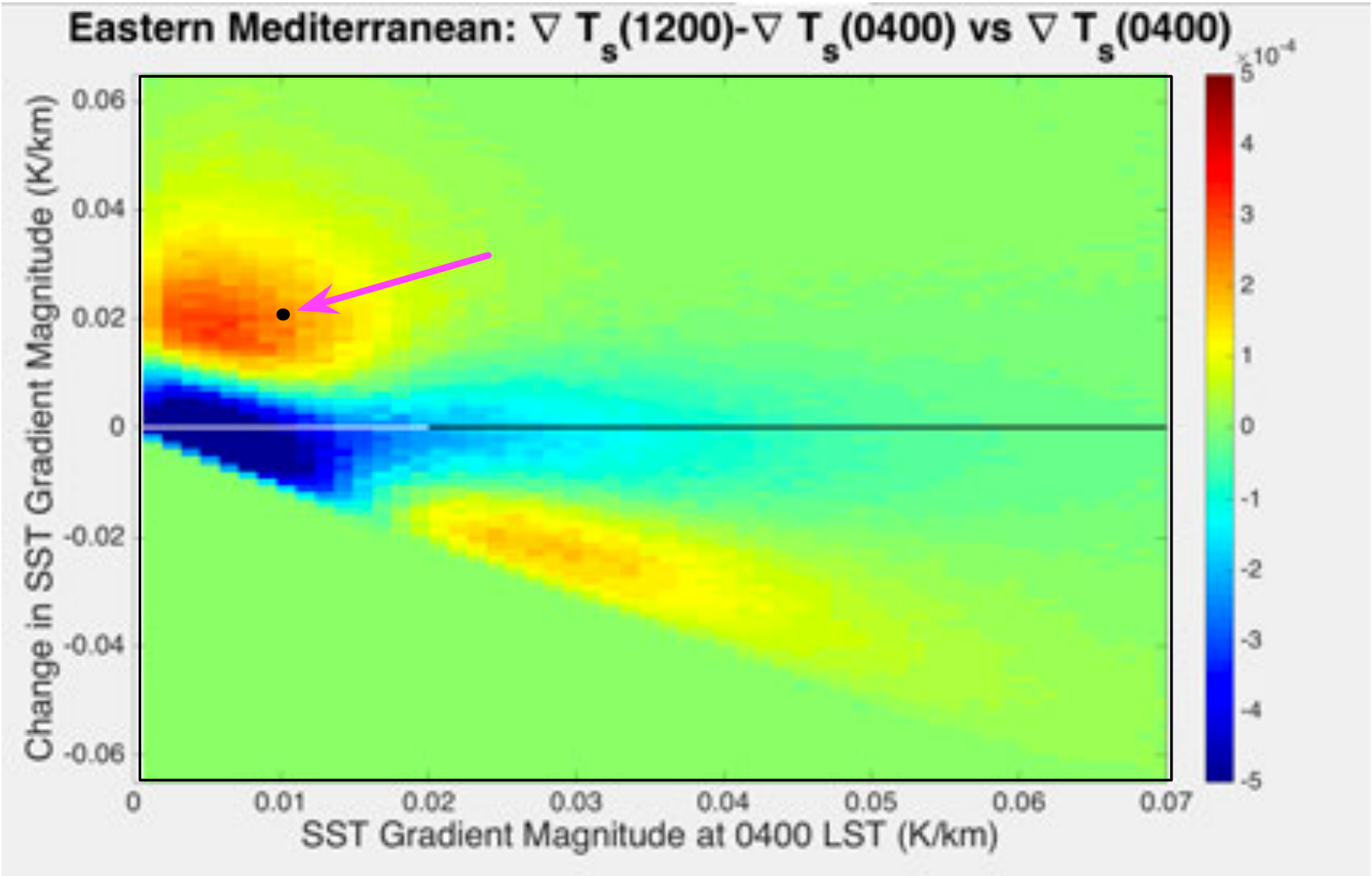

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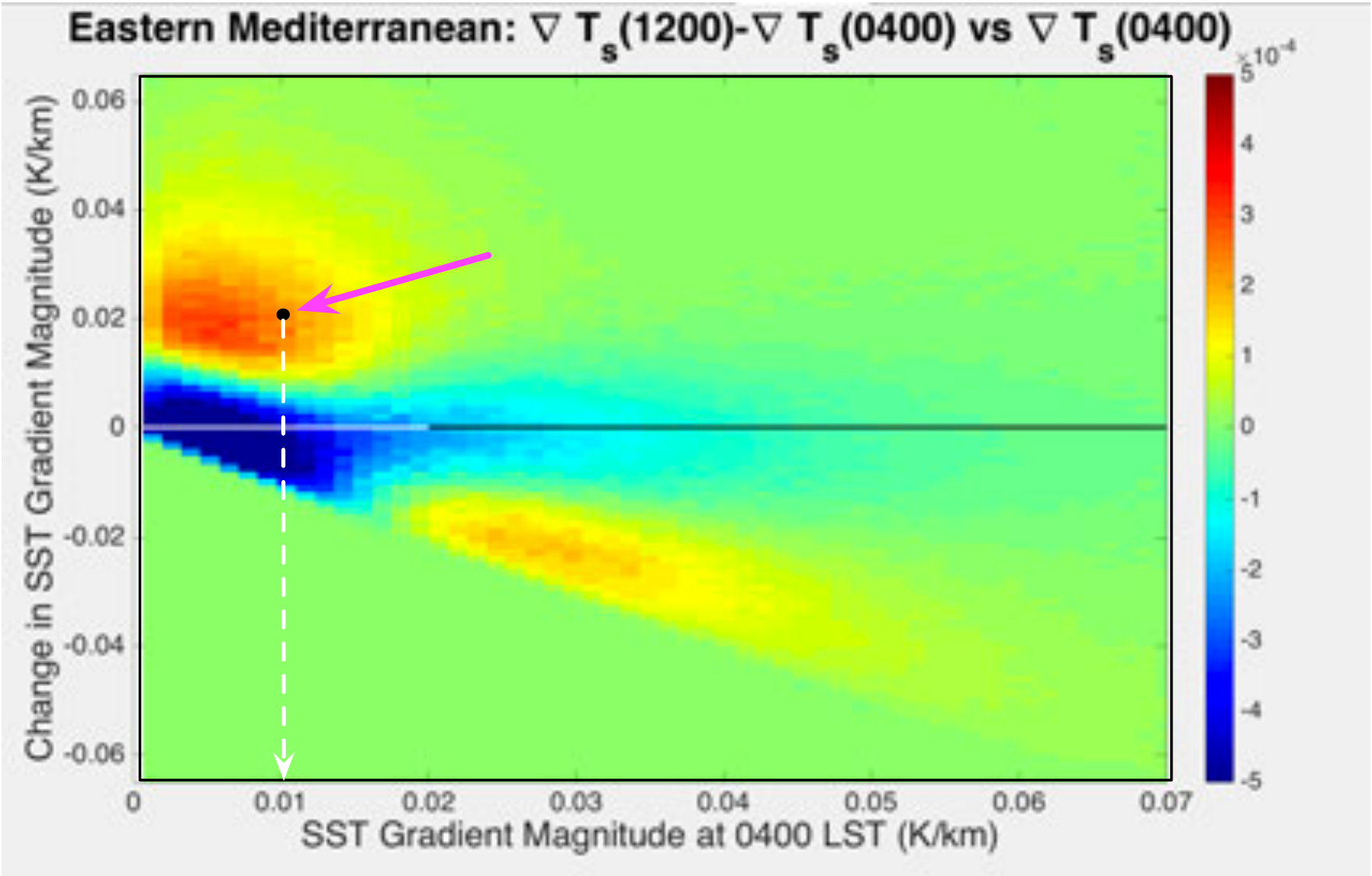

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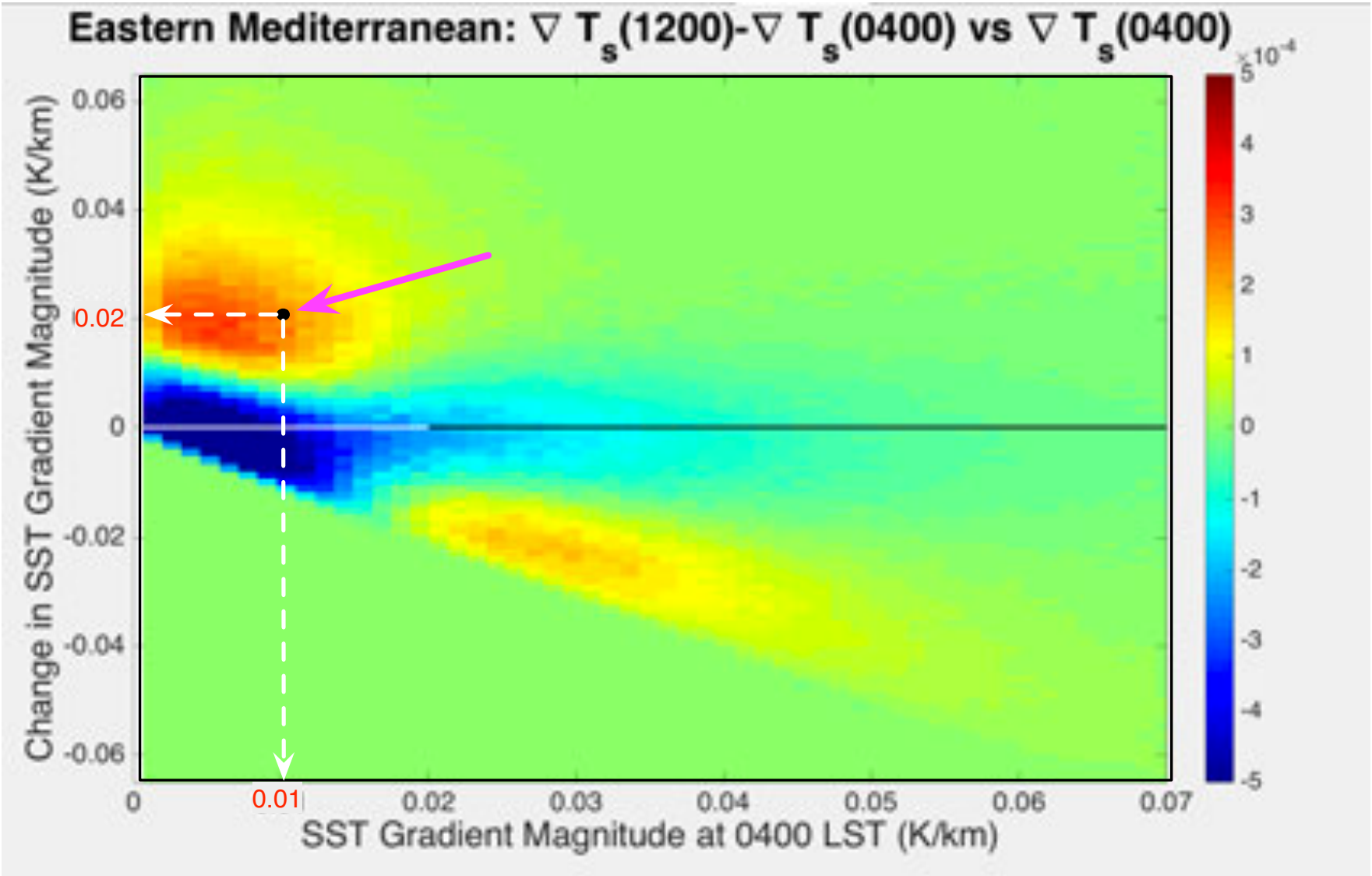

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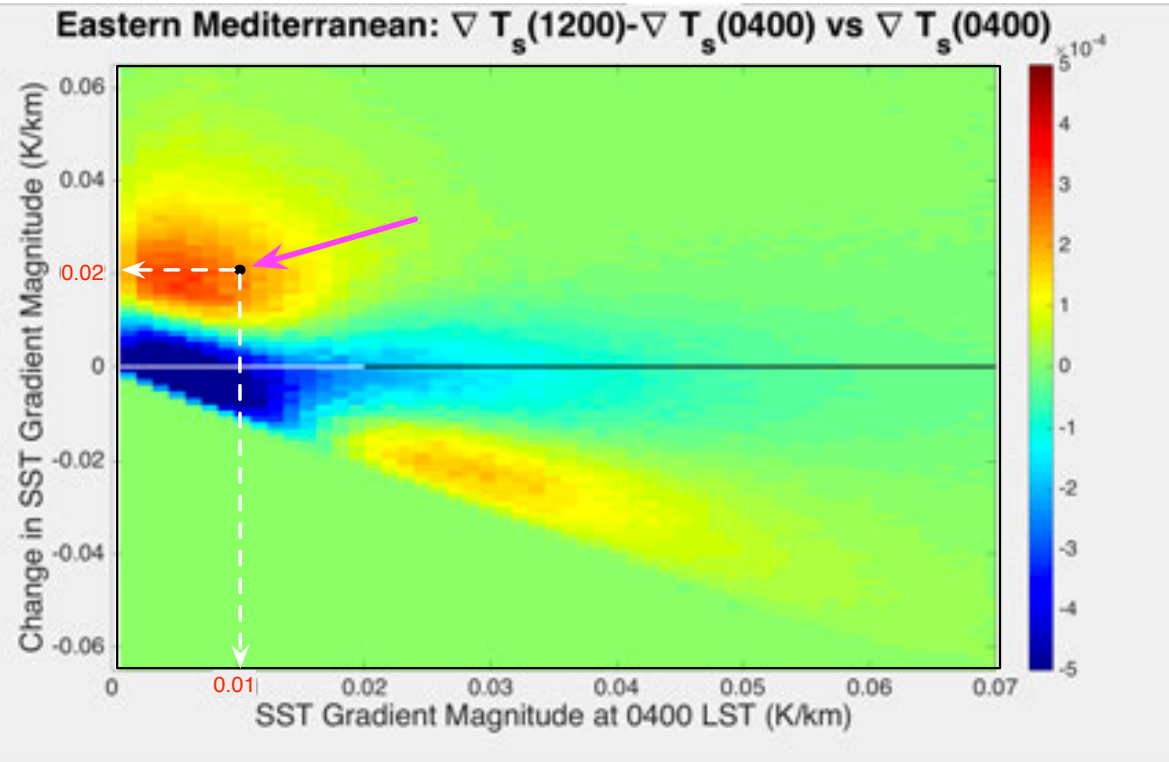

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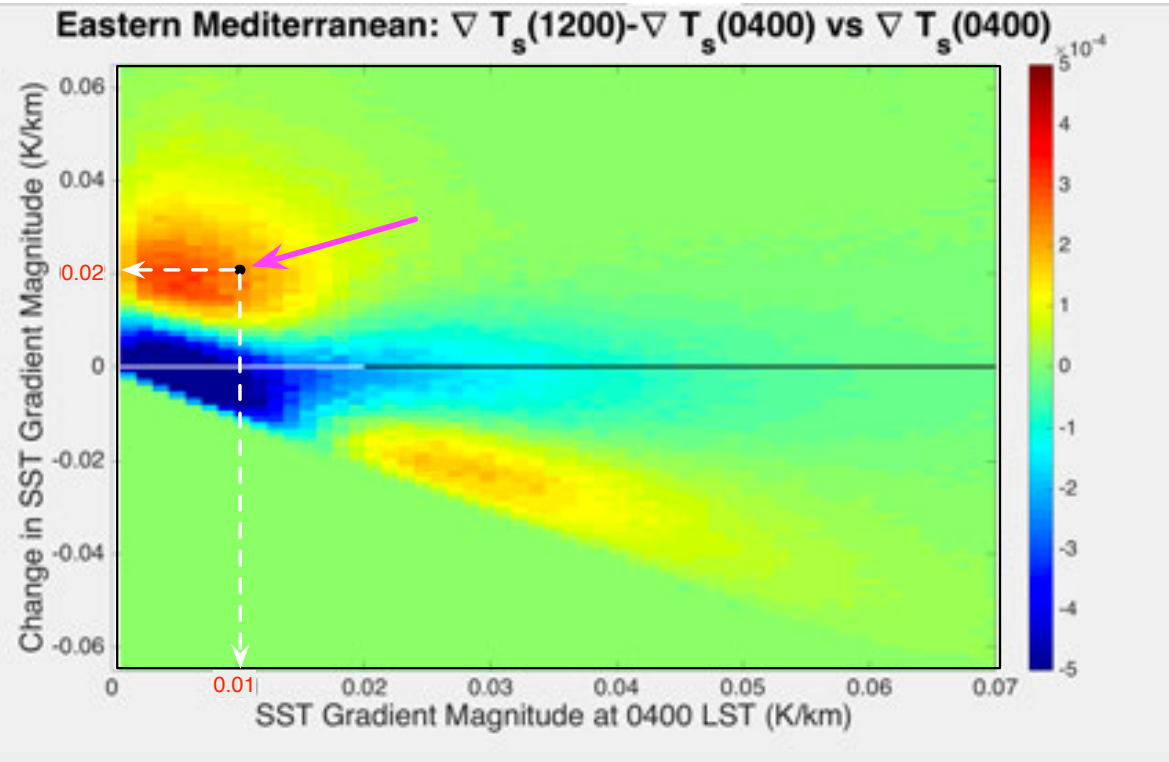

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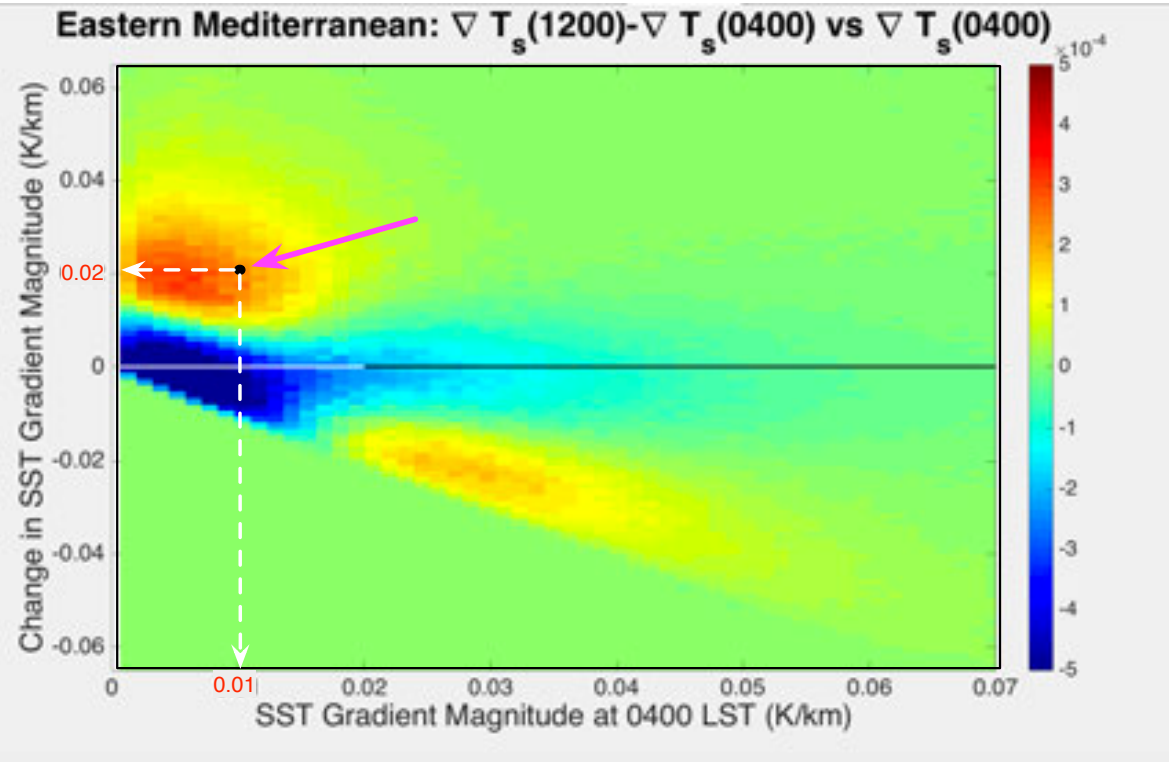

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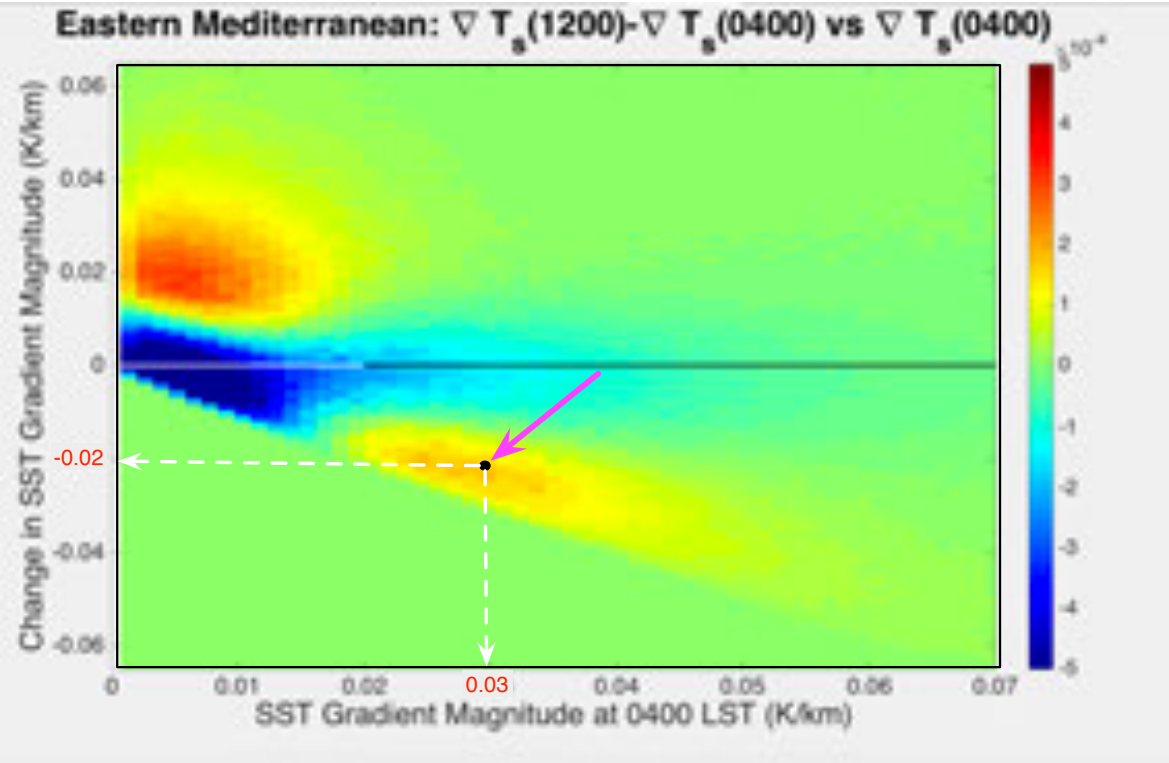

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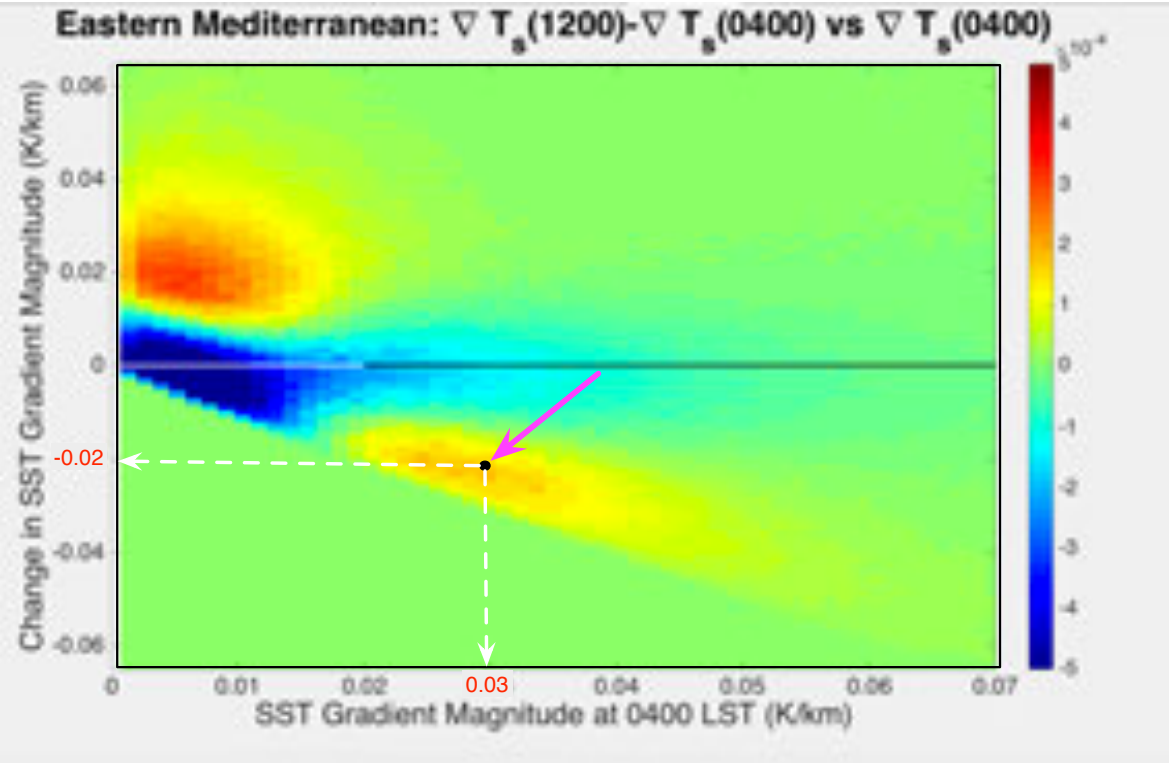

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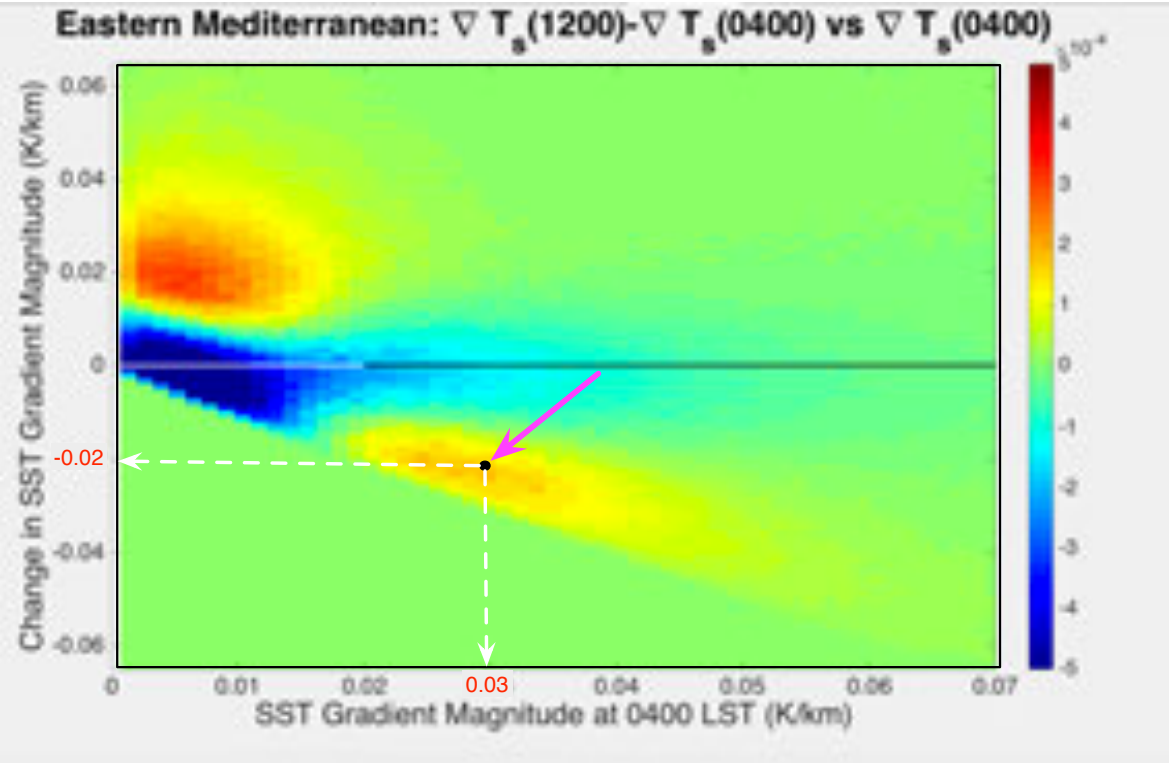

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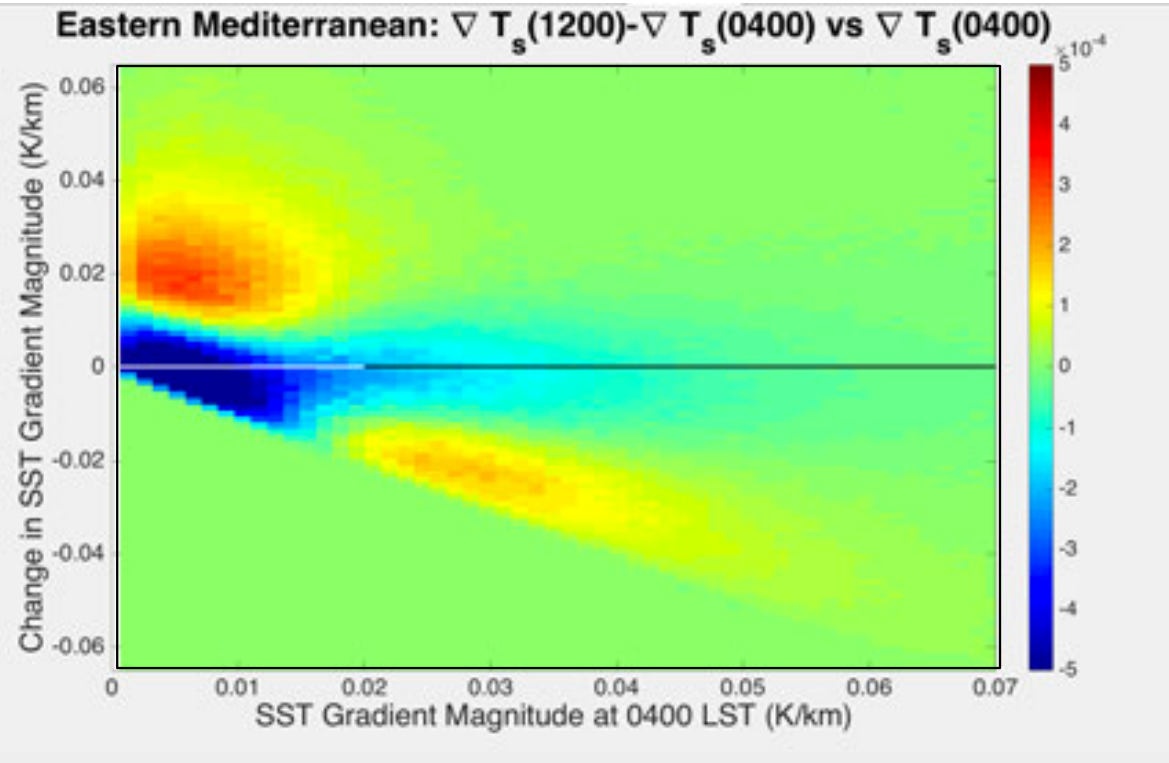

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- To reduce the impact of noise subtract 5 LST histogram from histogram.
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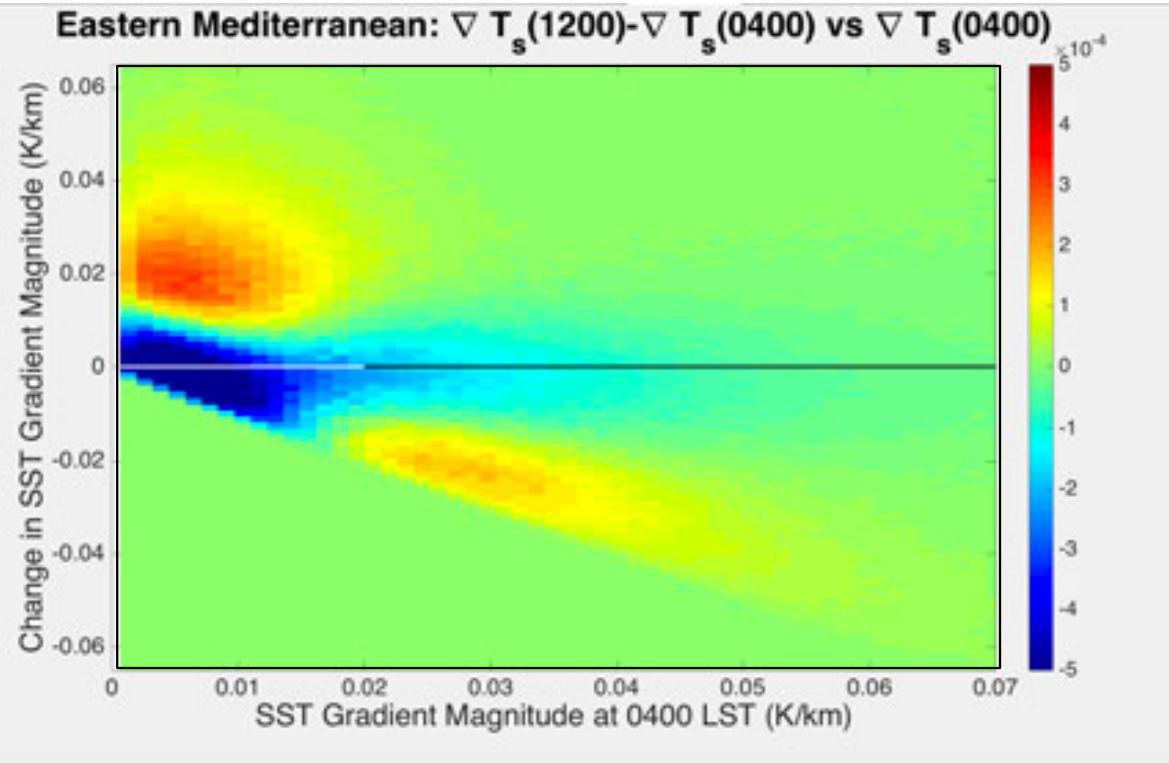

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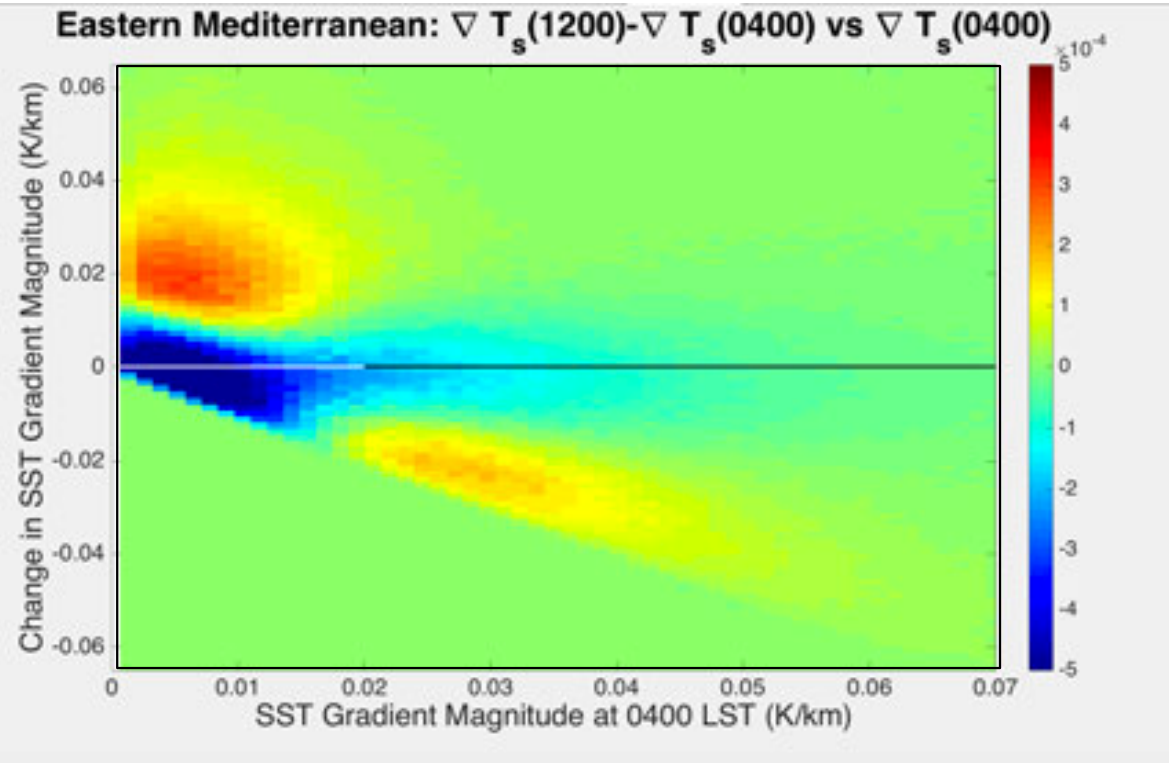

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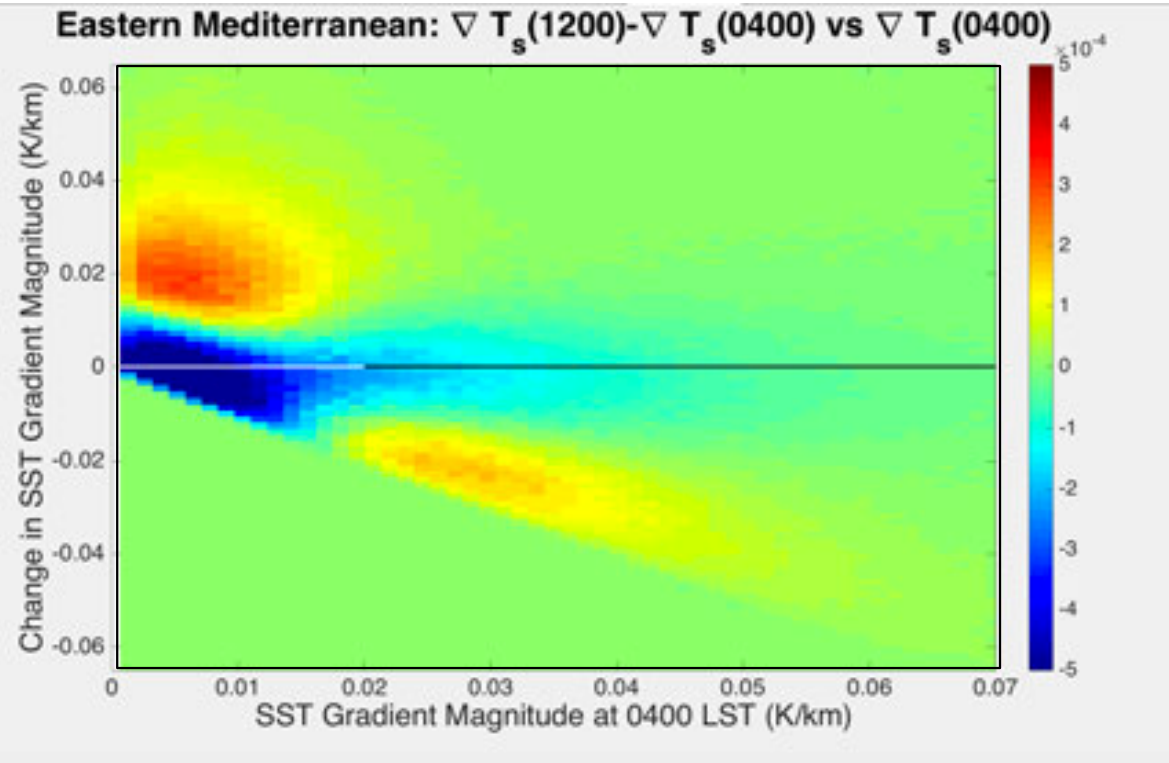

- Uncorrelated noise in the SST field $\Rightarrow$ displacements in the vertical away from 0.
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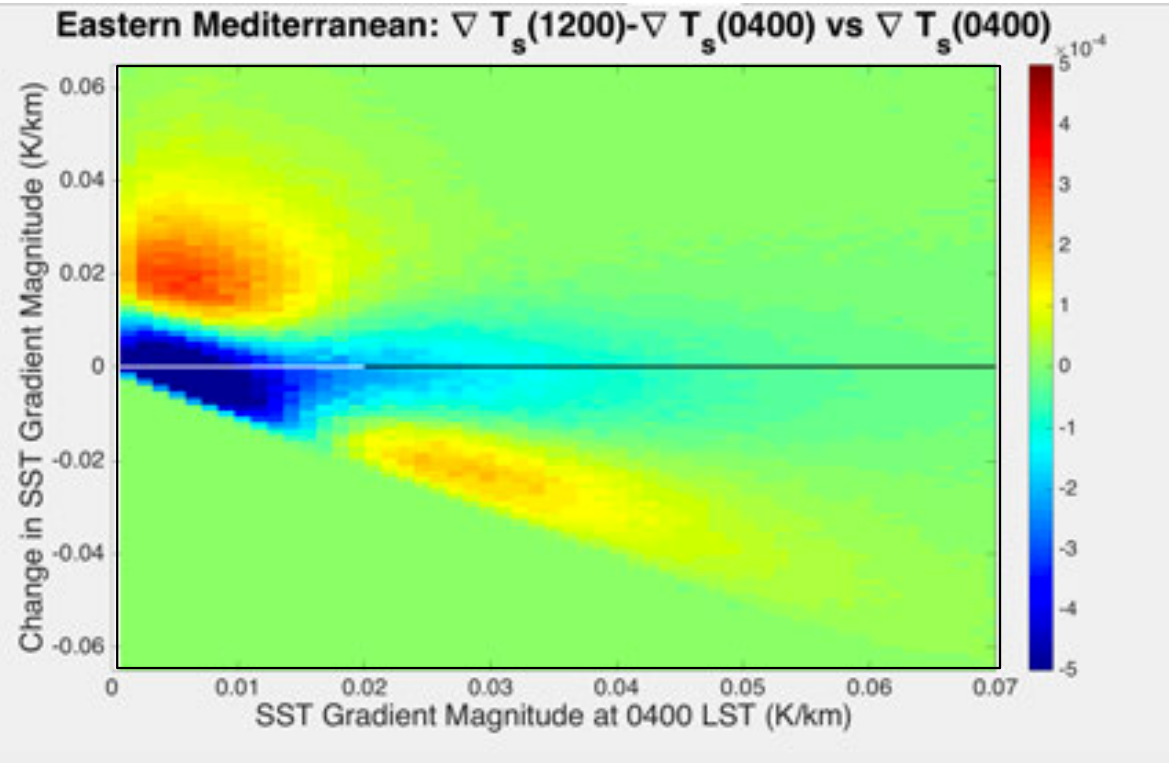

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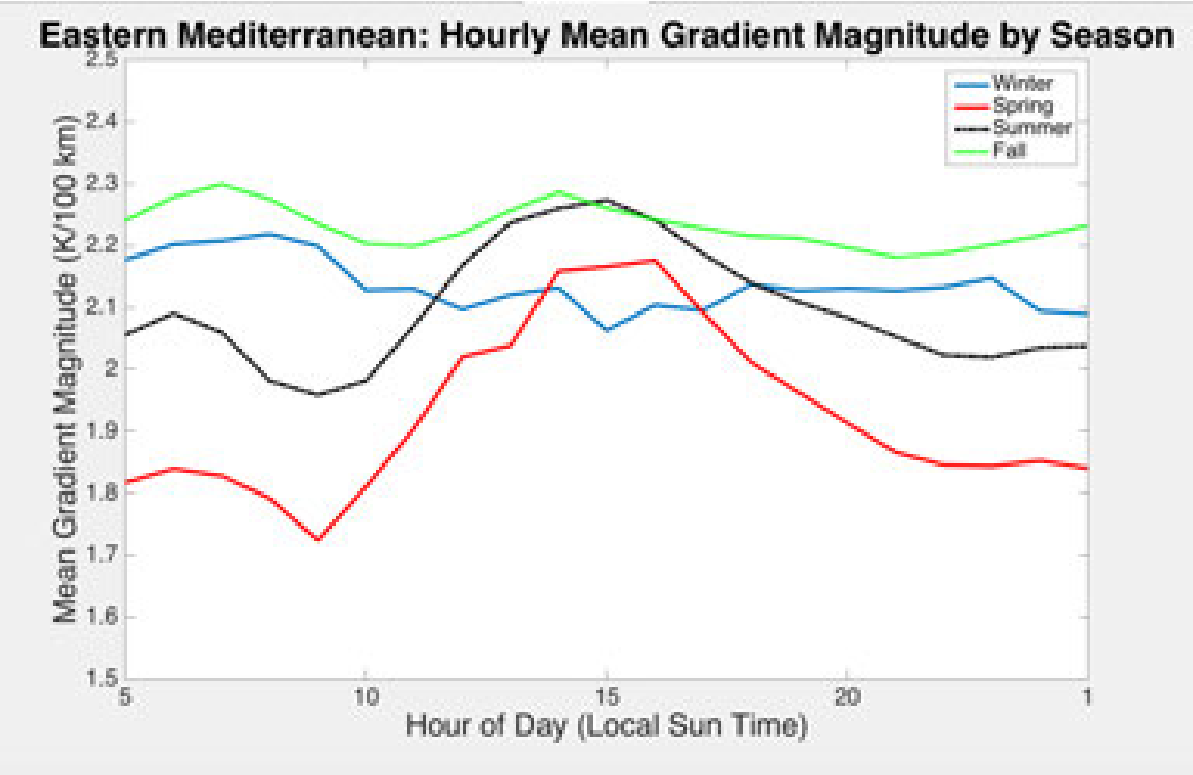

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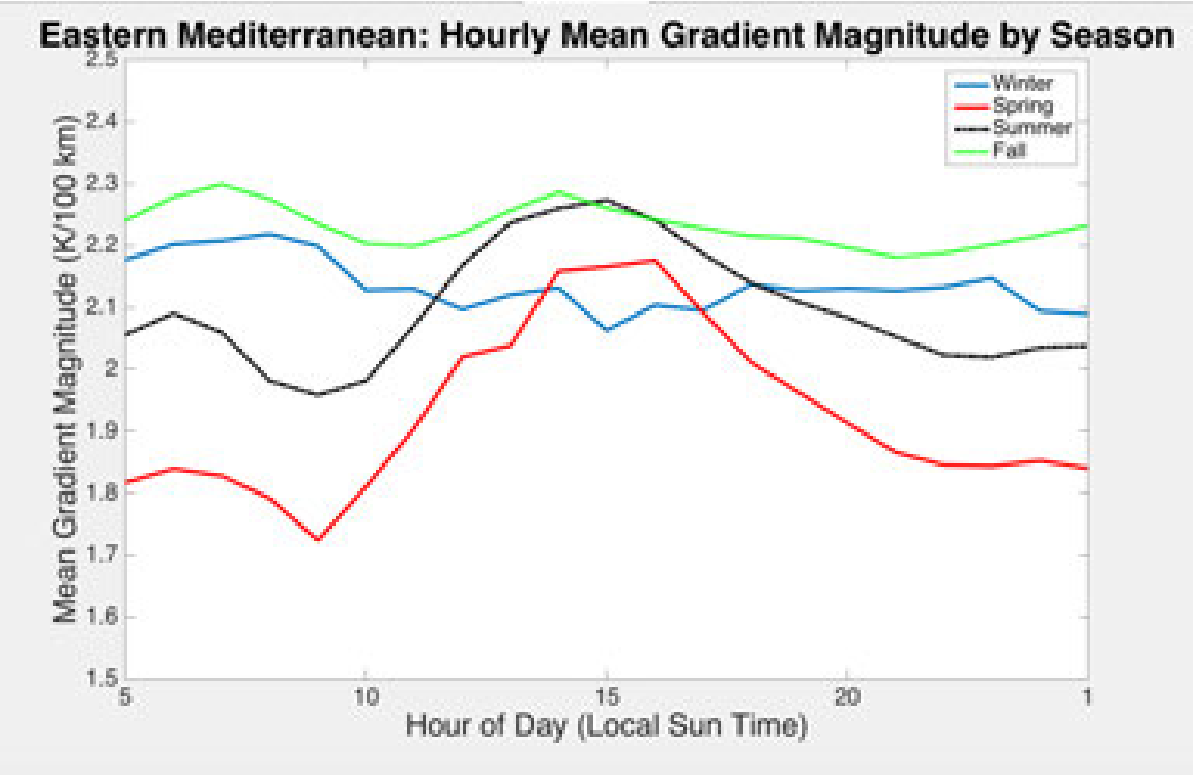

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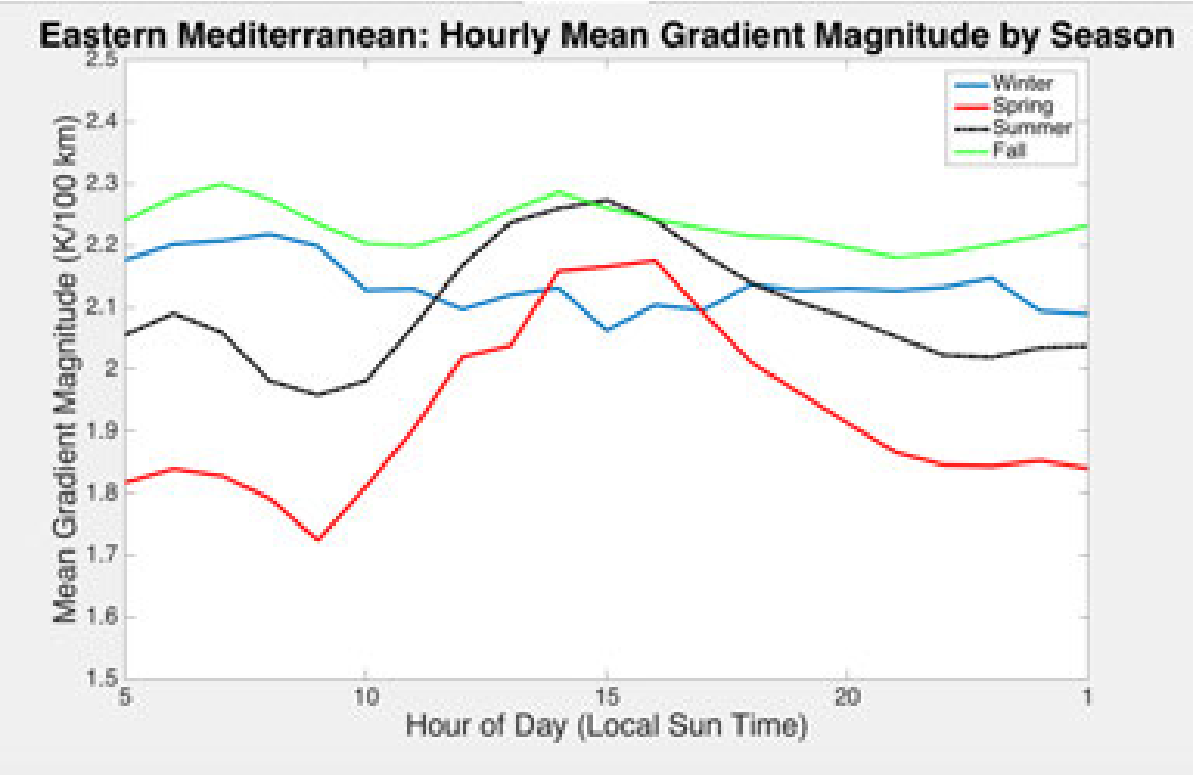

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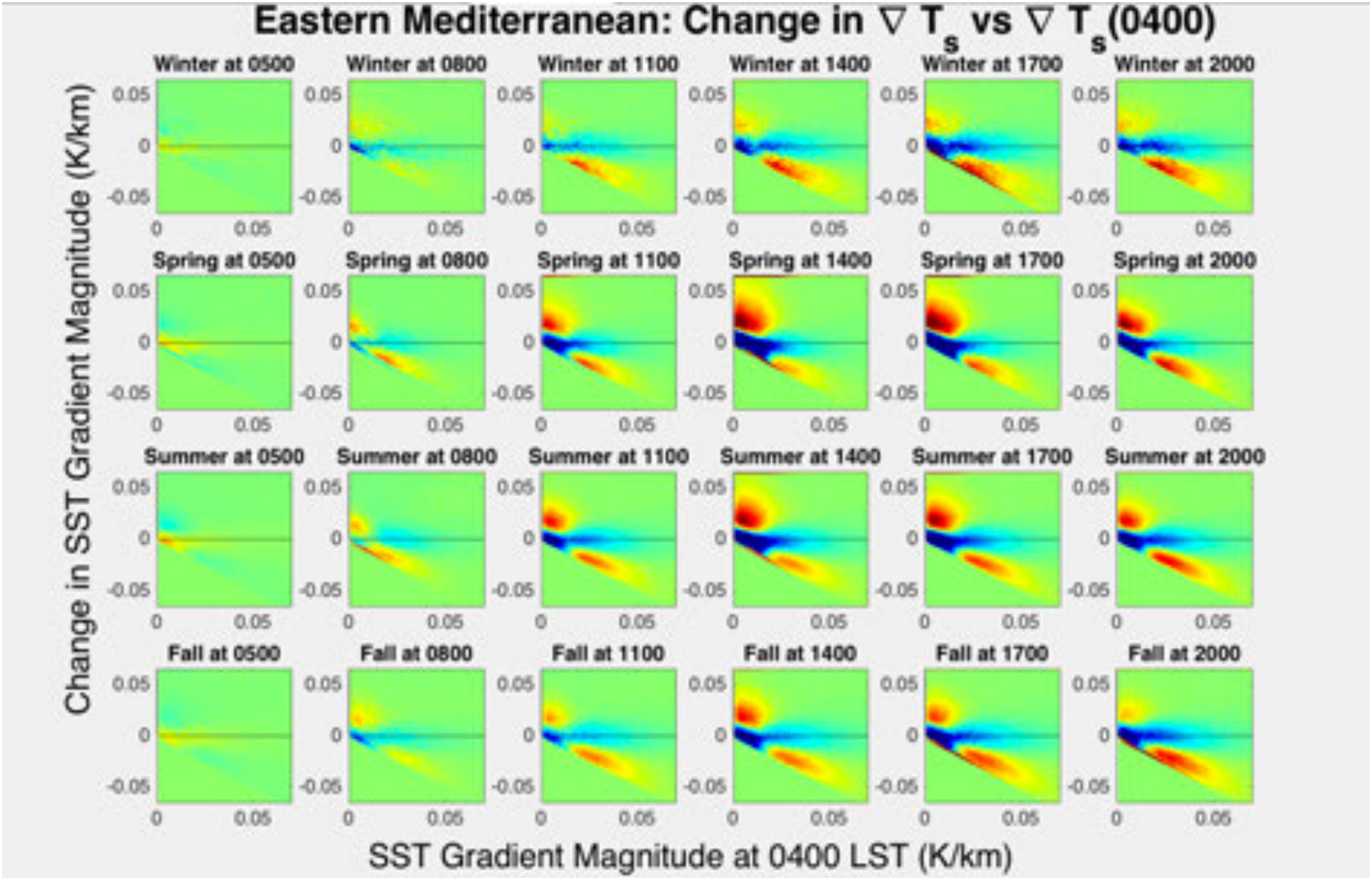

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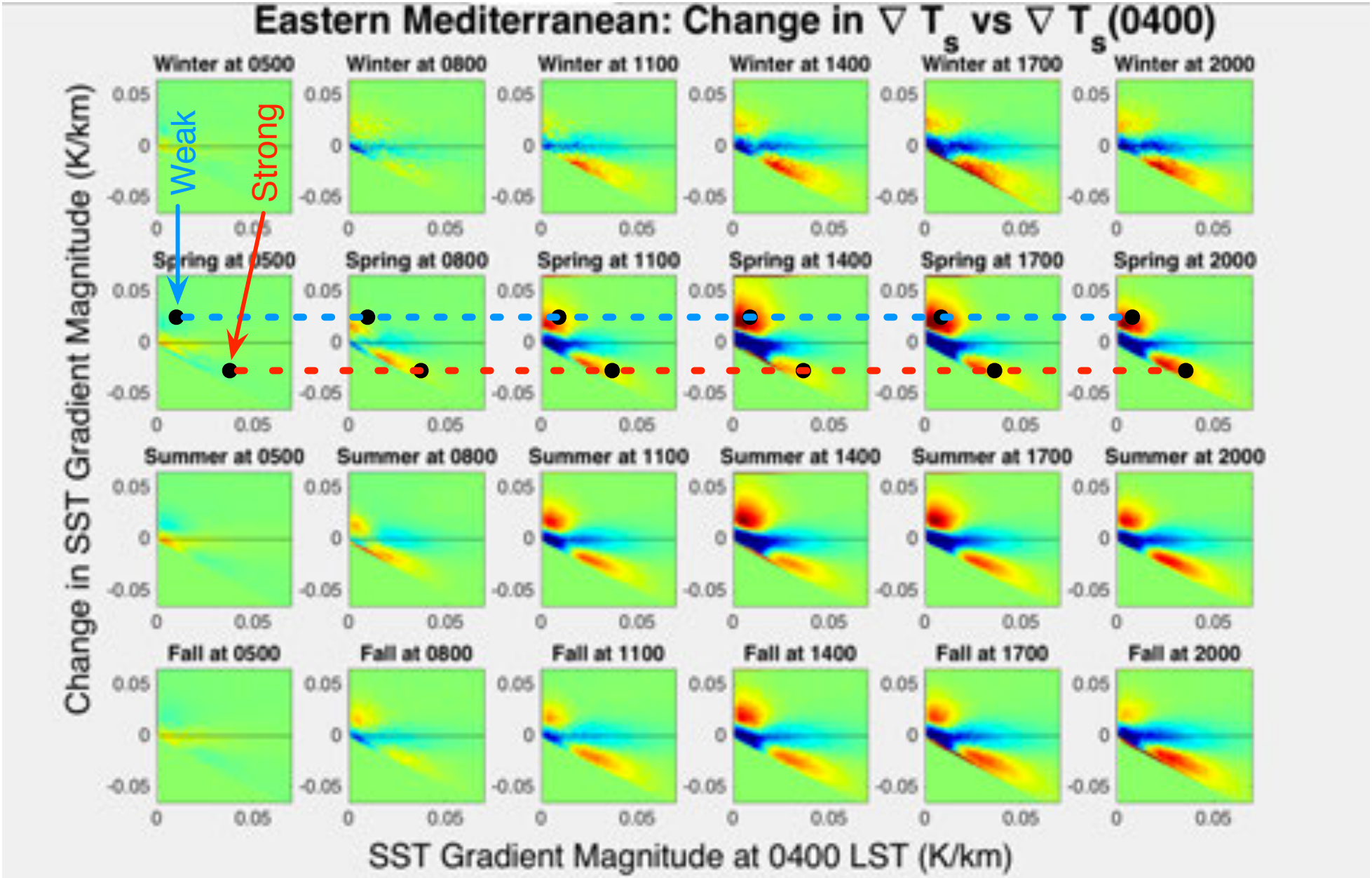
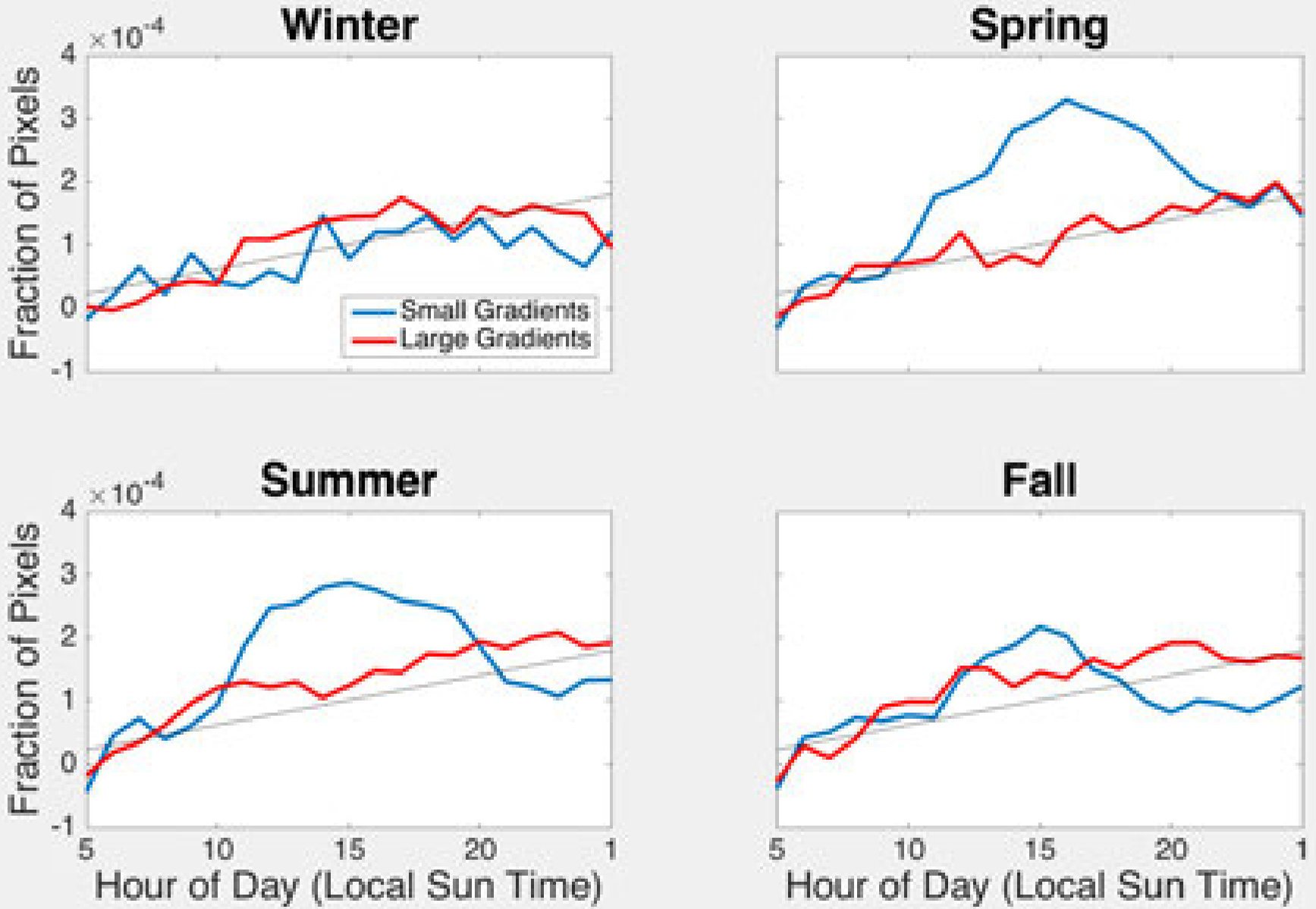


Seasonal Dependence Of Weak Gradients Which Get Stronger and . . .



Outline

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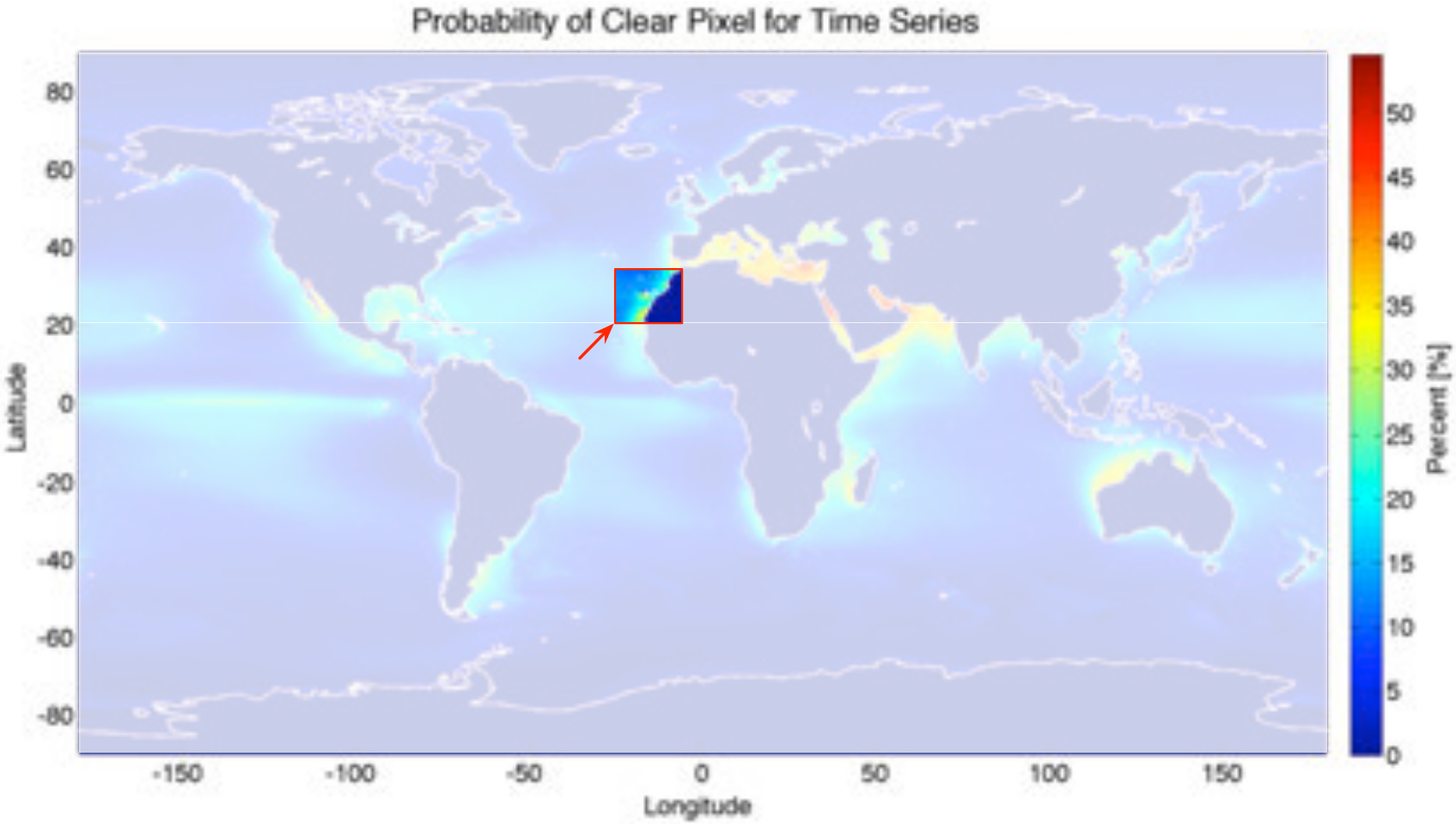
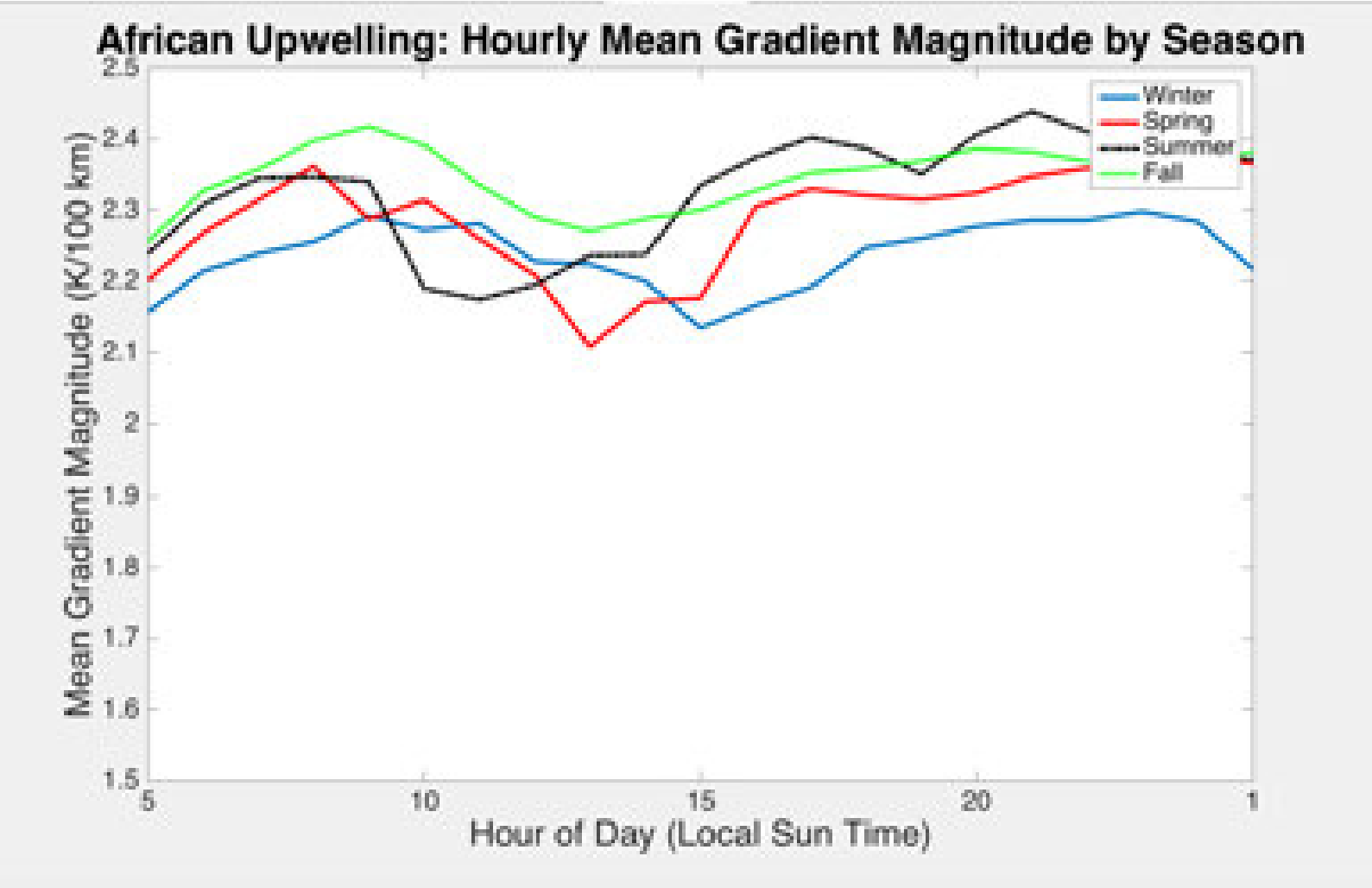


Diurnal Signal in Mean SST Gradients – Upwelling Region



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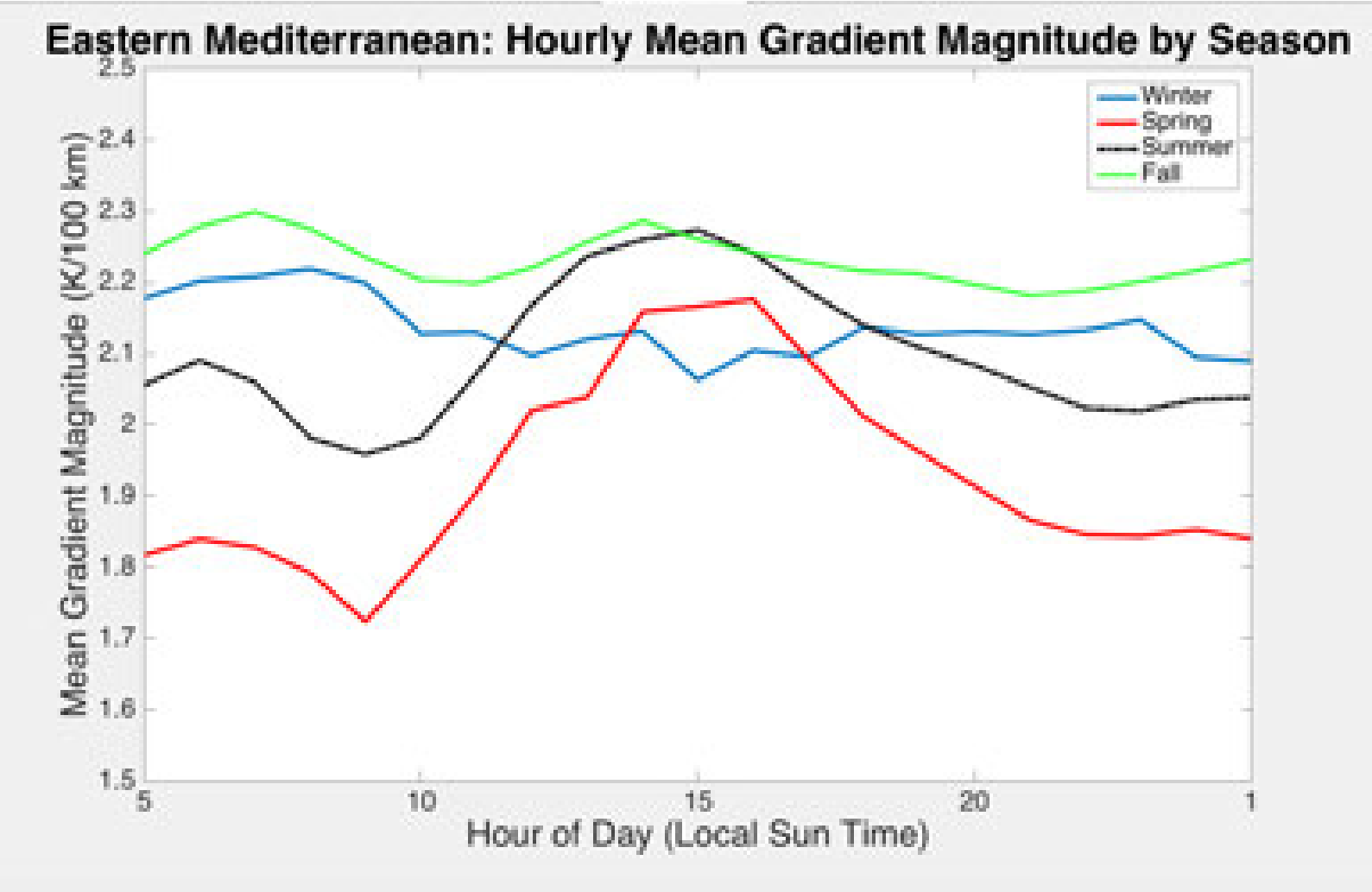

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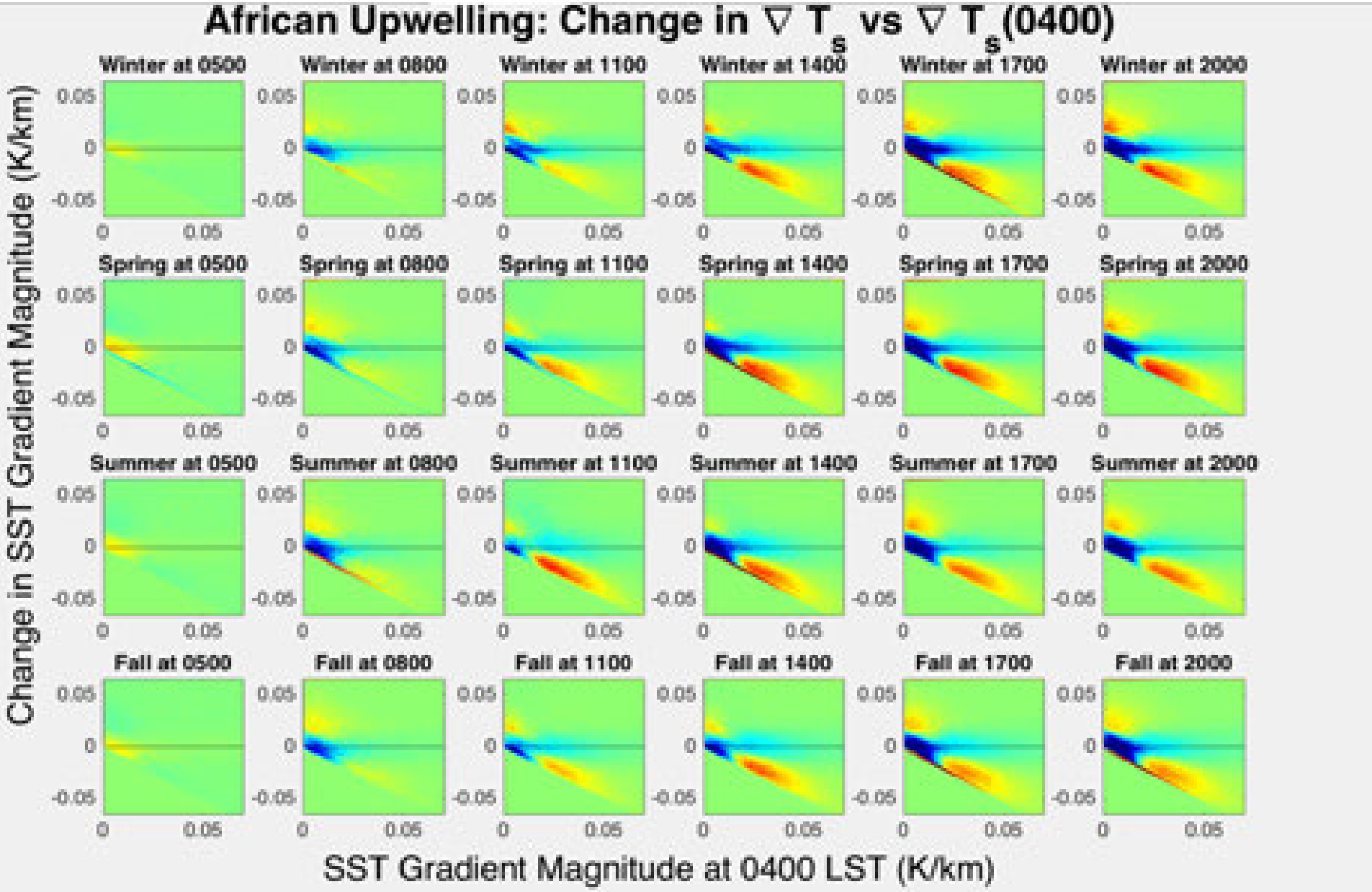

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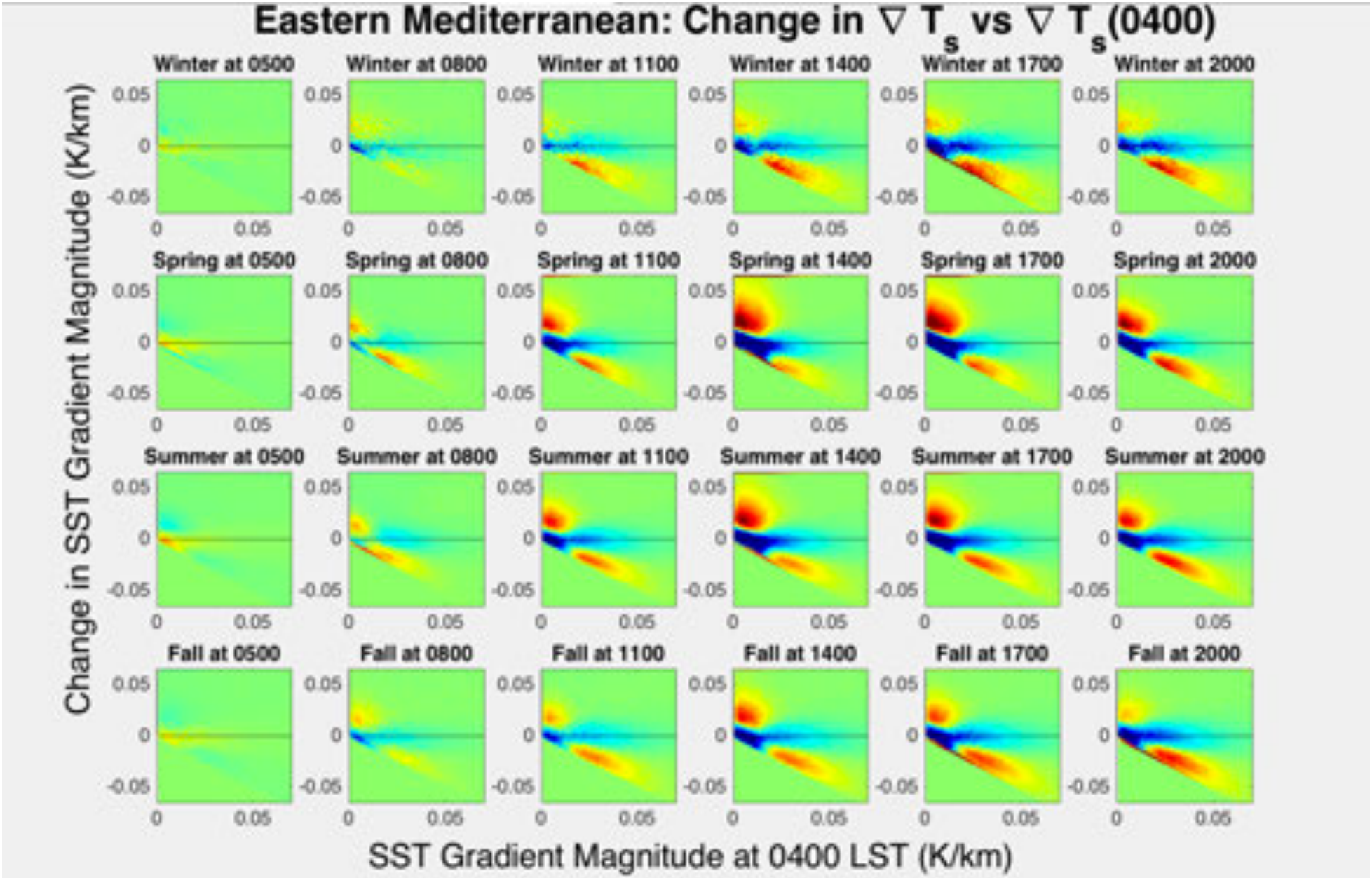

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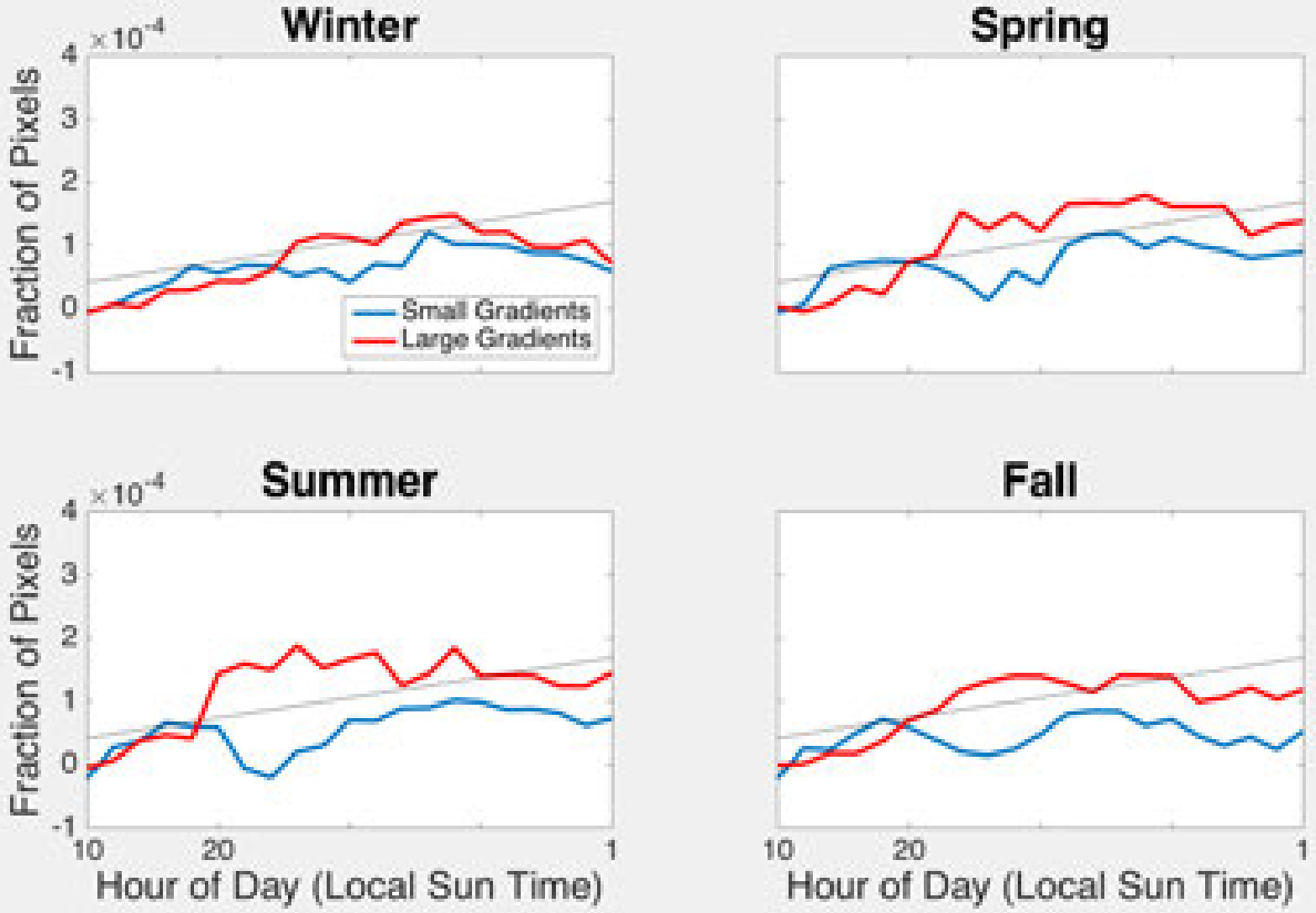
African Upwelling Region



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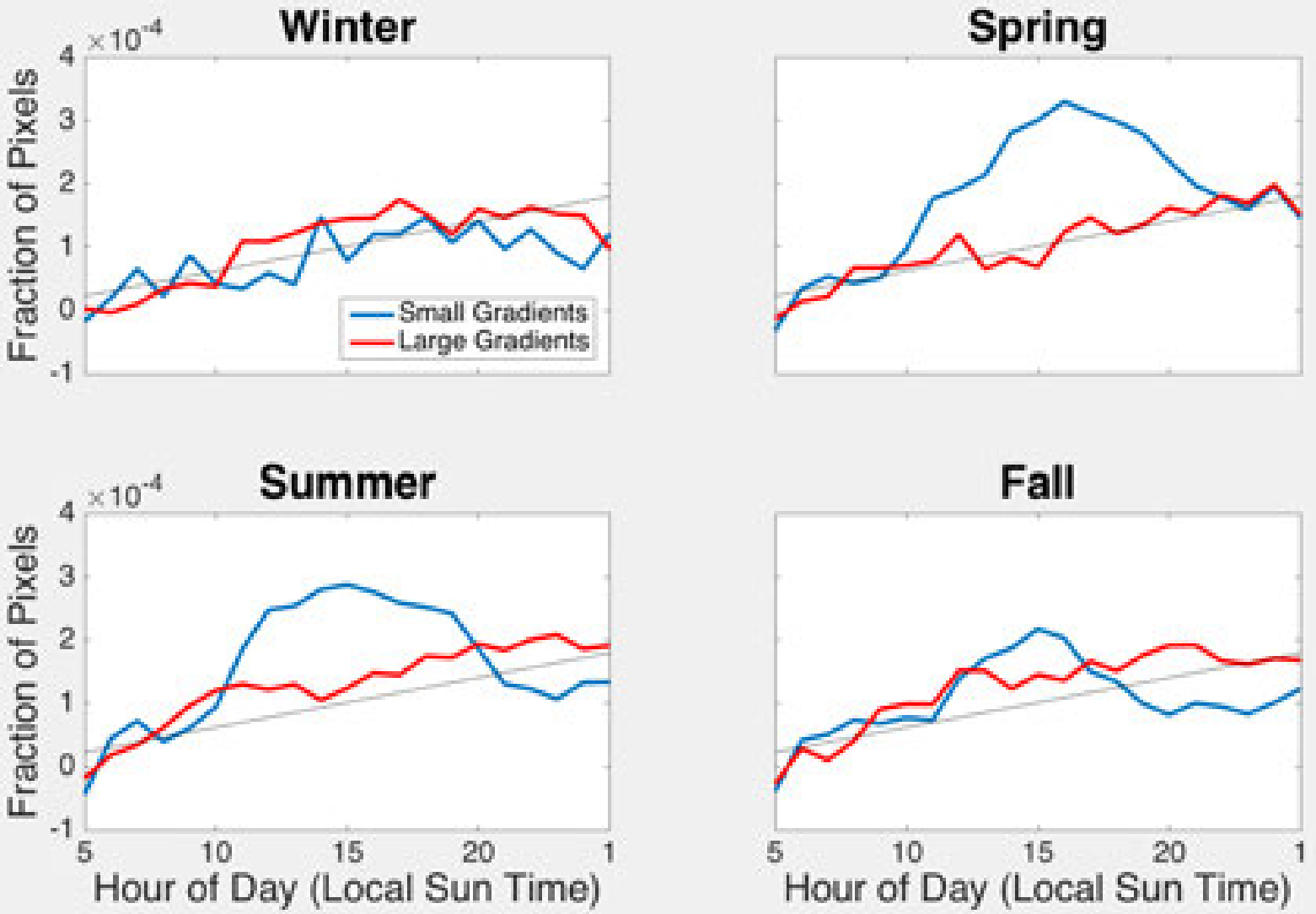
Eastern Mediterranean



Outline

Conclusions

- There is a significant diurnal signal in the $\overline{|\nabla T_s|}$ in the eastern Med
- The mean gradient tends to increase – substantially – from morning to mid-afternoon in Spring and Summer.
- With relatively little variability in fall and winter.
- Relatively stronger fronts tend to decrease over the course of the day in all seasons.
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A very BRIEF overview of Fan Wu's Poster

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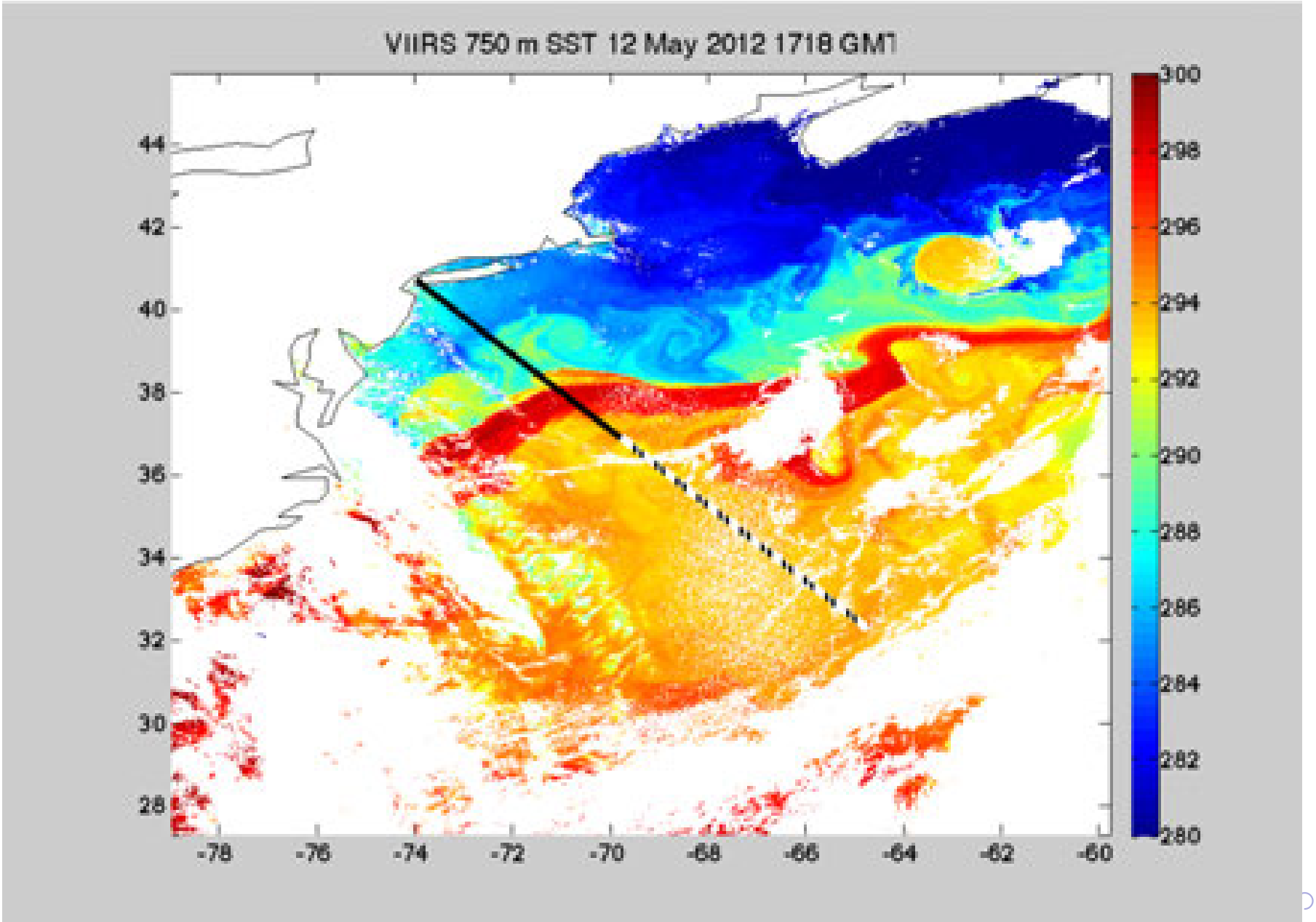
The SST Field – 12 May 2012 1718GMT



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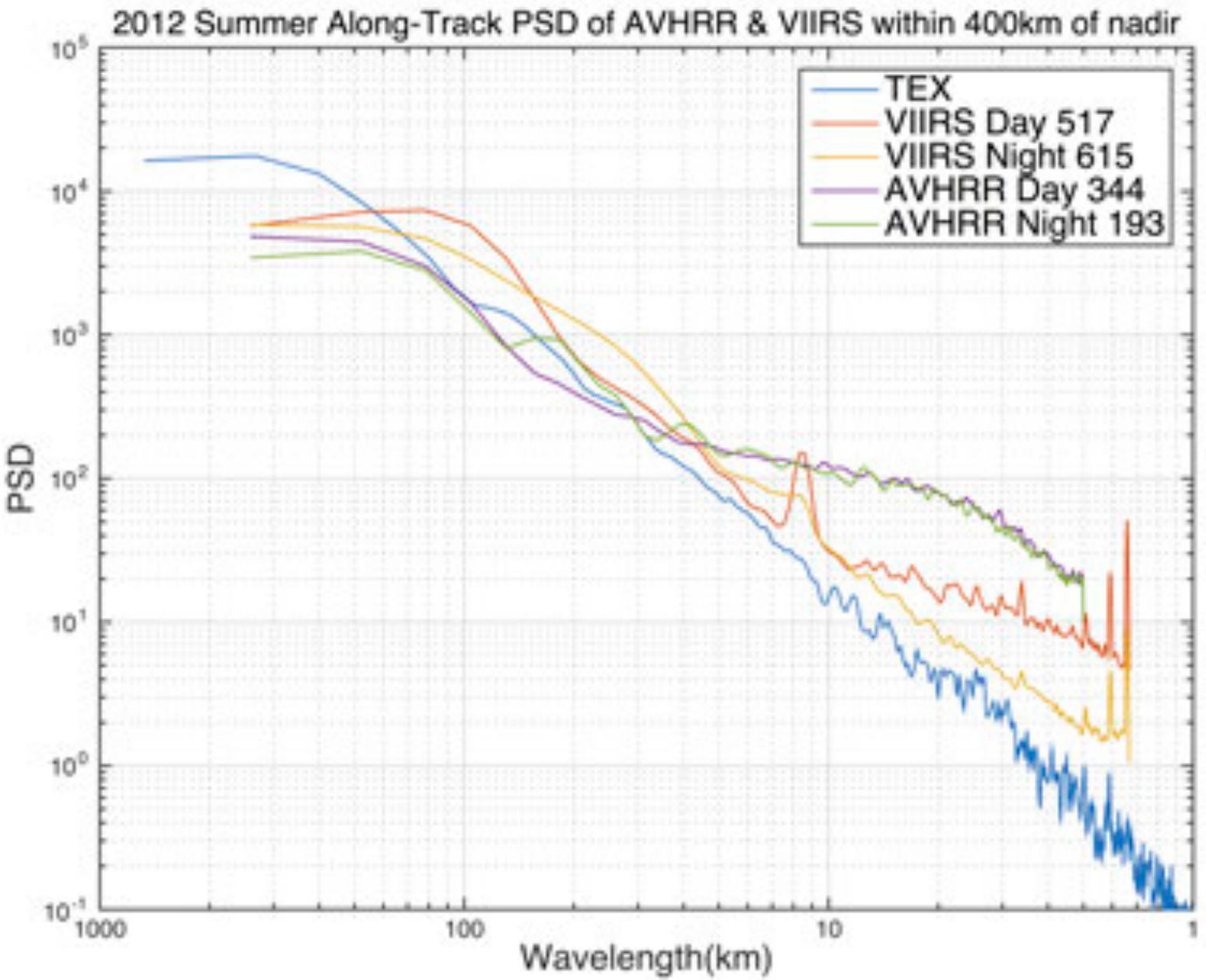
The Results


2012 Summer Along-Track PSD of AVHRR & VIIRS within 400km of nadir
TEX
VIIRS Day 517
VIIRS Night 615
AVHRR Day 344
AVHRR Night 193
PSD
Wavelength(km)
1000
100
10
1

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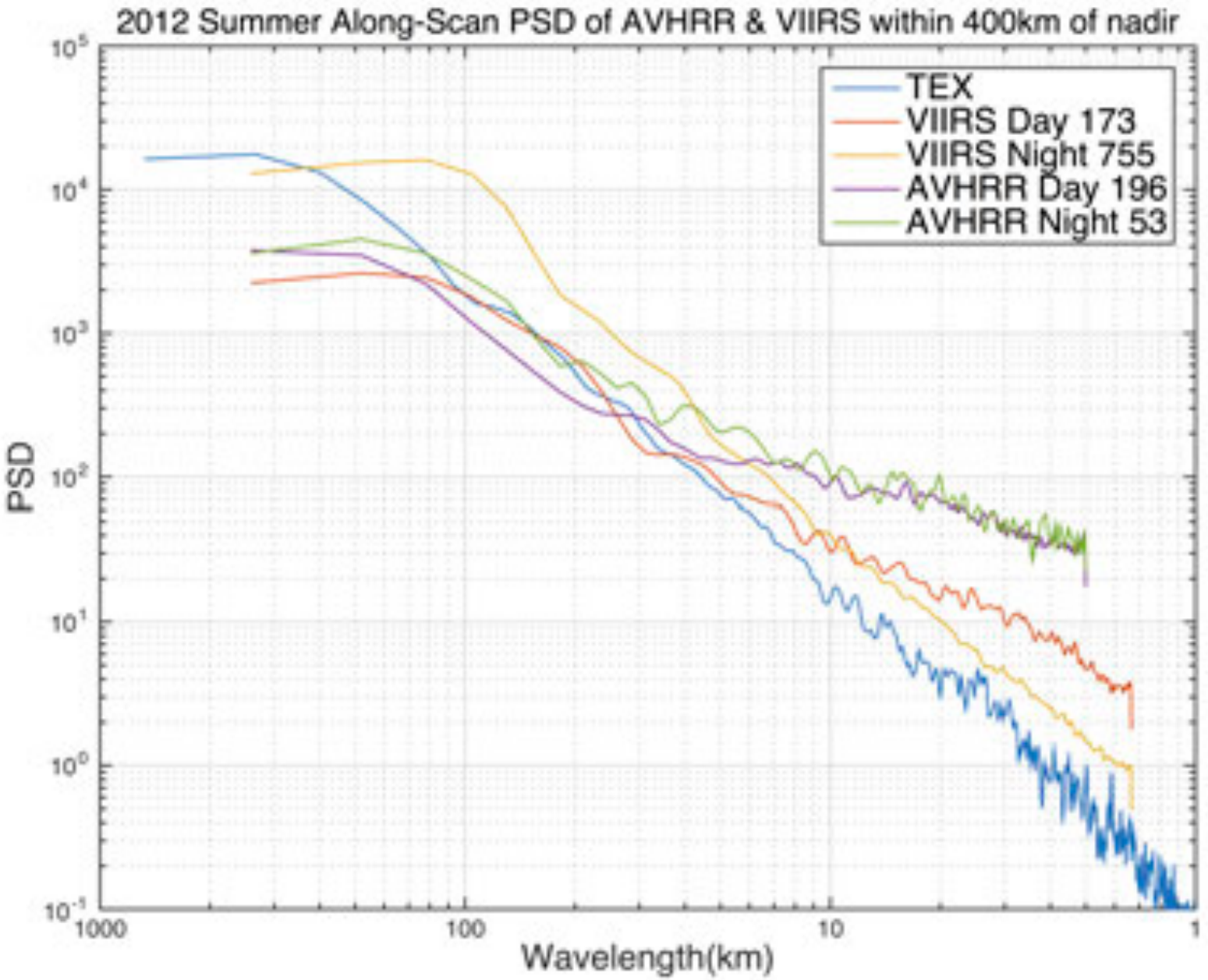
2012 Summer Along-Scan PSD of AVHRR & VIIRS within 400km of nadir
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VIIRS Day 173
VIIRS Night 755
AVHRR Day 196
AVHRR Night 53
PSD
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