Feature Fidelity Task Team

Peter Cornillon and Cristina Gonzalez Haro

URI

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Task Team Members

- Peter Cornillon (Co-Chair)
- Cristina Gonzalez Haro (Co-Chair)
- Owen Embury
- Irina Gladkova
- Lei Guan
- Jordi Isern-Fontanet
- Chris Merchant
- Gary Wick

Objective of the Feature Fidelity Task Team (F2T2)

To address the impact of artifacts and noise in satellite-derived SST fields on the faithful reproduction of mesoscale and smaller oceanographic features: fronts, eddies, gradients,...

- Specfically, features smaller than $\mathcal{O}(100\,\mathrm{km})$

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- One, which highlights a number of F2T2 issues, is discussed here (and in S2-ID-038).
  - It is based on the analysis presented by Prochaska in S2-ID-036.
  - 128×128 pixel squares were extracted from the L2 MODIS Aqua SST dataset if:
    - Nighttime
    - $>$ 90% clear
    - 2003-2019
  - $\approx 10^7$ such squares, which we refer to as cutouts.
  - Cutouts falling in 200 km-200 km-5 day non overlapping bins were combined.
  - Along-scan and along-track *structure functions* determined for the data in each bin.
  - The precision (standard deviation) of the SST retrievals determined for each bin.
  - These were examined as a function of **mean SST** in the bin and **geographically**.

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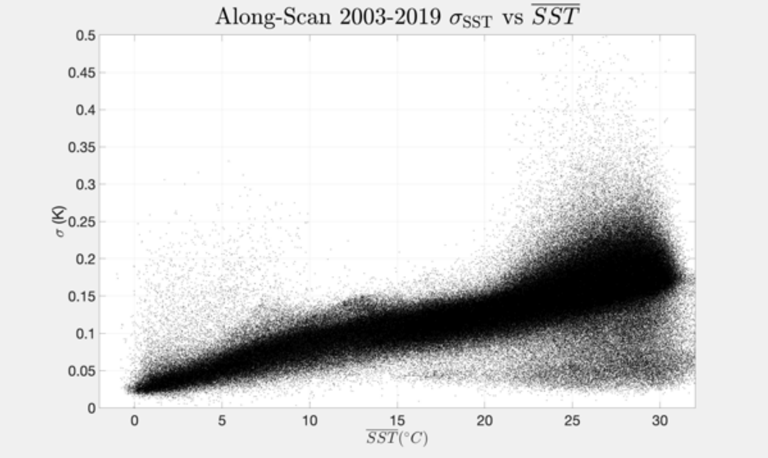
Three things to note:

- A well defined linear dependence of σ on mean SST
- A low σ region for mean SST above about 22°.
- The values for low $\overline{SST}$ are very close to the stated NEΔT of 0.03 K.



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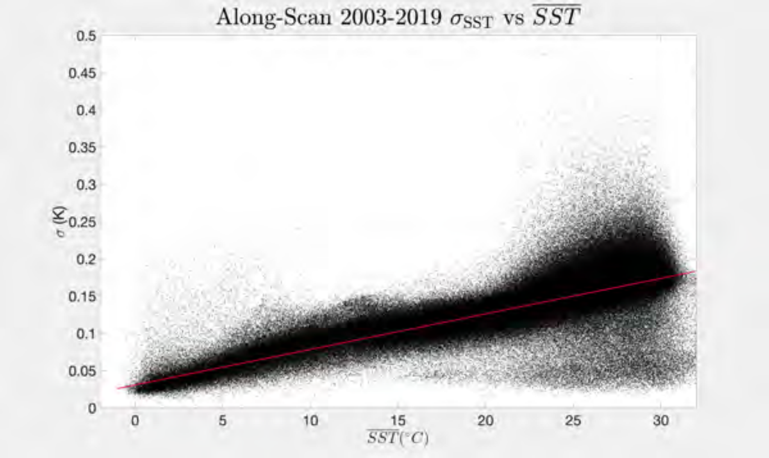

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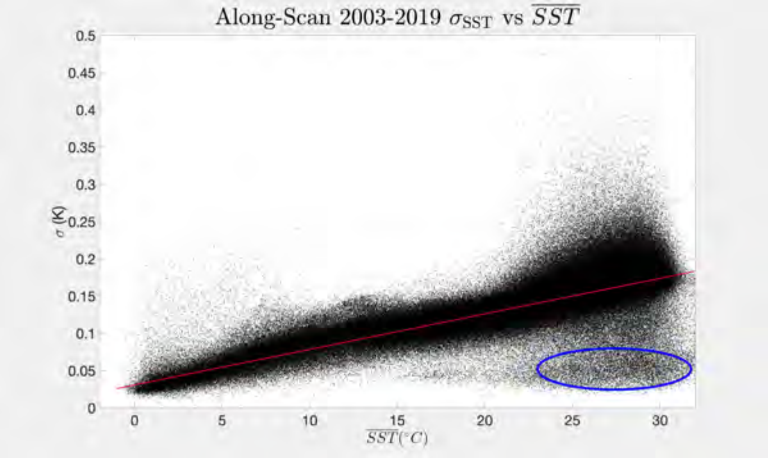

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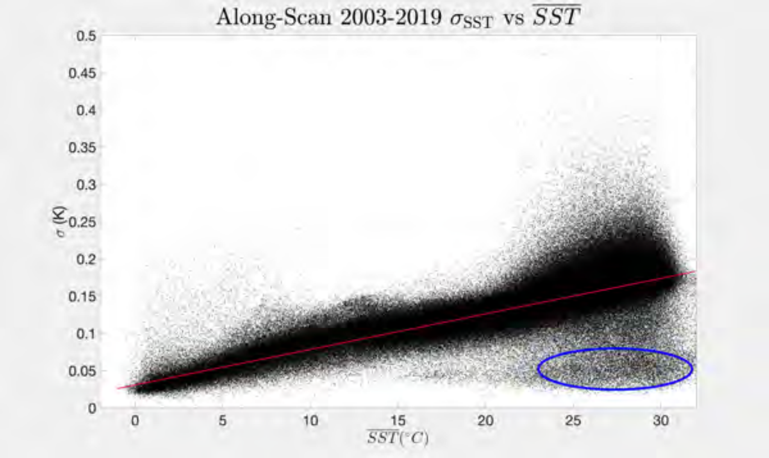
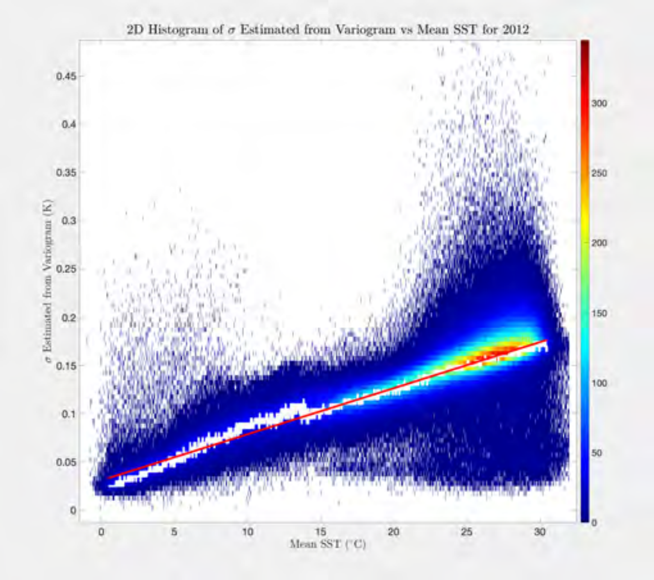
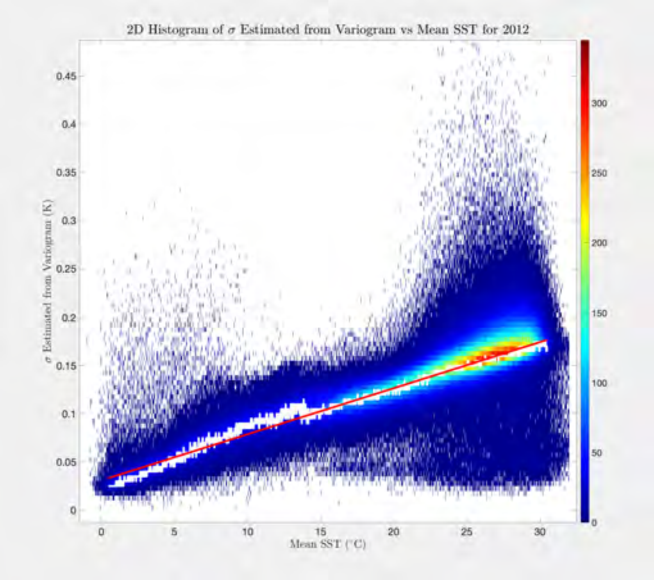




2D Histogram of σ Estimated from Variogram vs Mean SST for 2012
σ Estimated from Variogram (K)
Mean SST (°C)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0
5
10
15
20
25
30
0
50
100
150
200
250
300

Along-Scan $\sigma(\overline{SST})$: $\sigma = 0.031 + 0.0048 \times \overline{\mathrm{SST}}$
Along-Track $\sigma(\overline{SST})$: $\sigma = 0.038 + 0.0054 \times \overline{\mathrm{SST}}$



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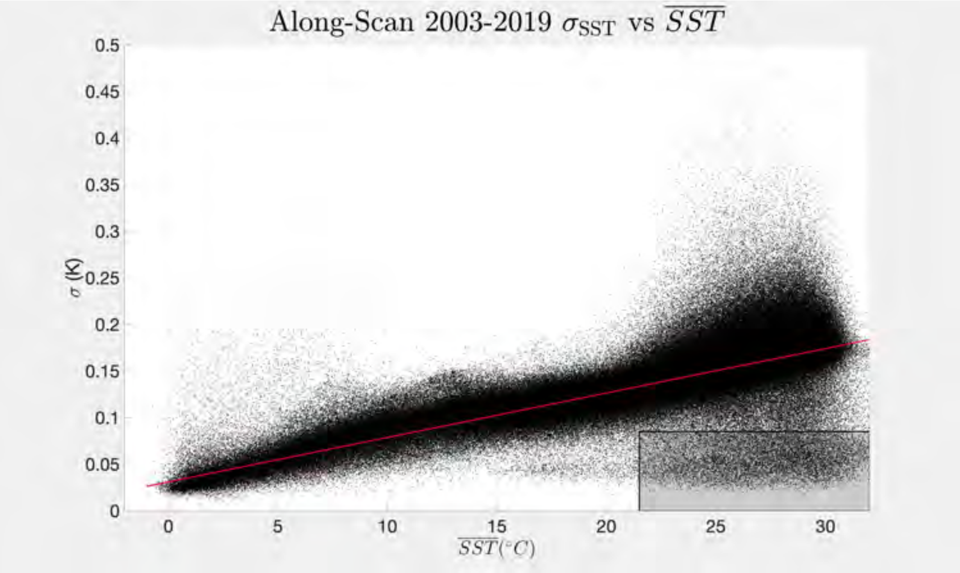

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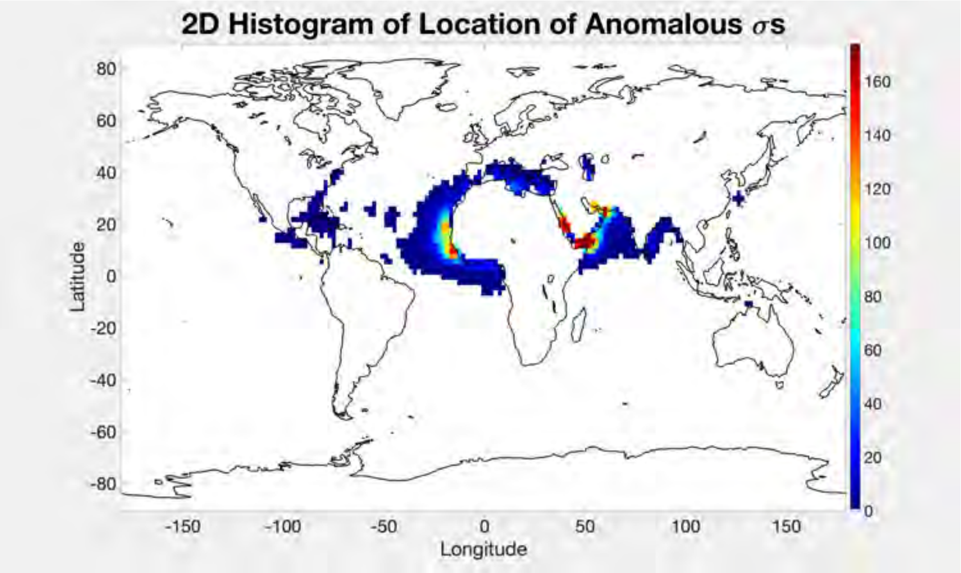

Impact on Feature Fidelity - A Simple Simulation

- Generate 10^4 3×3 pixel squares with a given x-gradient, no y-gradient, white noise.
- Determine the mean and σ of the Sobel gradient magnitude for each ensemble.
- For $\nabla_x \mathrm{SST} \approx 0.05\ K/km$, $|\nabla \mathrm{SST}|$ is overestimated by up to 50% with a $\sigma \approx 0.07\ K$

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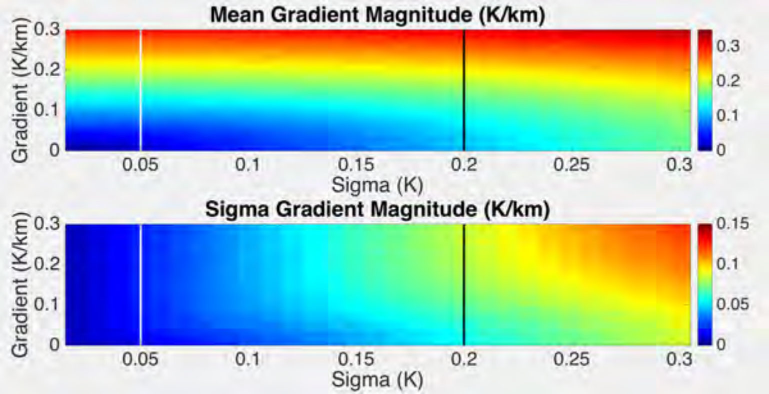

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   - The MODIS example is just one of a number of ways in which corrupted fields can impact FF.

Conclusions

- The MODIS example presented highlights several points with regard to feature fidelity:
  1. Hidden in 'quality' info generally presented are characteristics with significant impacts on FF
     - FF has, to a large extent, been overlooked in the generation (and characterization) of SST fields.
  2. The impacts may depend on location, SST, ... The issues are complicated.
  3. The highlighted problems presented here were uncovered in the **use** of the data.

- Two approaches have been proposed to quantify contributors to the degradation of FF.
  - Error propagation – the metrological approach.
  - Uncertainty determined from the SST fields themselves.
- The MODIS example underlines the potential complementarity of these approaches:
  - Approaches based on the actual SST fields can be used to inform the metrological approach.
  - With input from the user community providing substantial help in the process.

- Two suggestions that the GHRSST community might want to consider:
  1. Including in SST products estimates of precision based on the local structure function.
     - In general, the data are already in memory
     - And it is relatively straightforward to determine σ shown in the example above.
     - This would enable characterization of potential FF issues requiring further analysis.
  2. Seeking help from the user community in identifying problems related to FF
     - The MODIS example is just one of a number of ways in which corrupted fields can impact FF.

Please e-mail (to pcornillon@uri.edu) examples of problems you have encountered in current SST products, which have impacted your ability to analyze mesoscale and smaller oceanographic features.

Be sure to include: the issue, the product name, source, date & time...

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