SUPPLEMENT TO "SPATIO-TEMPORAL METHODS FOR ESTIMATING SUBSURFACE OCEAN THERMAL RESPONSE TO TROPICAL CYCLONES"

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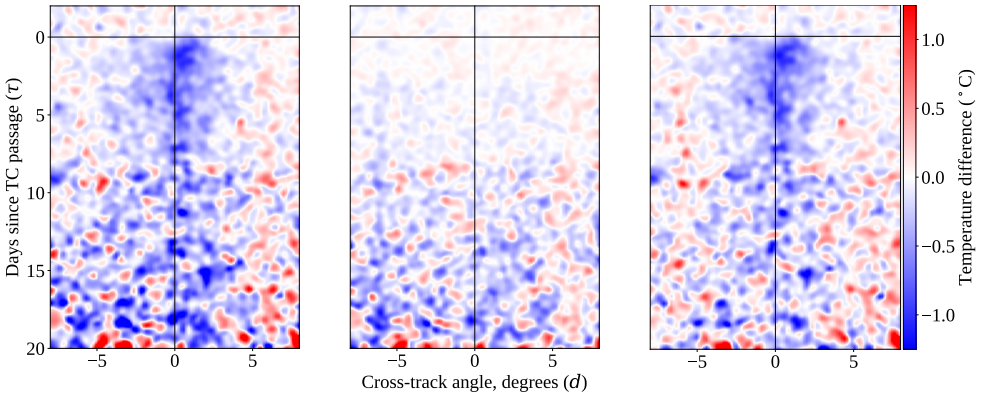
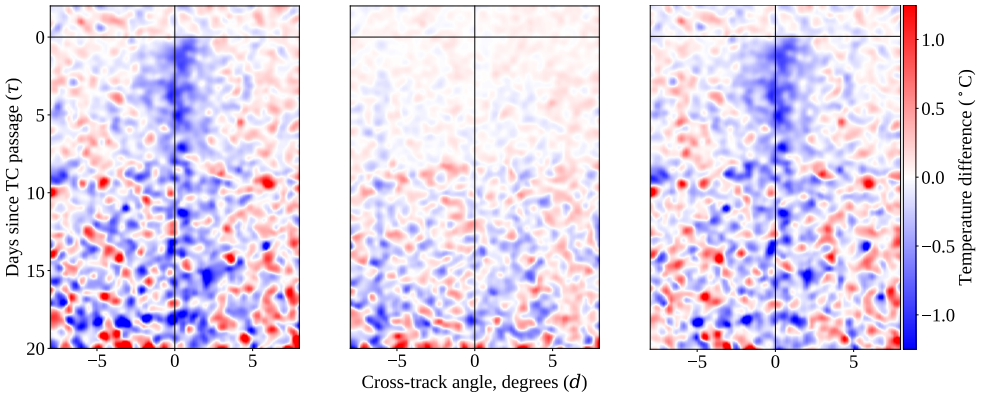
In this supplemental document, we present a comprehensive set of figures to illustrate the coefficients and fits from the seasonal mean field, Gaussian process, and thin plate spline models.

1. Seasonal mean field fits. Here we present the seasonal mean fields, as well as the raw and adjusted temperature differences, at all depths, for the entire set of profile pairs.



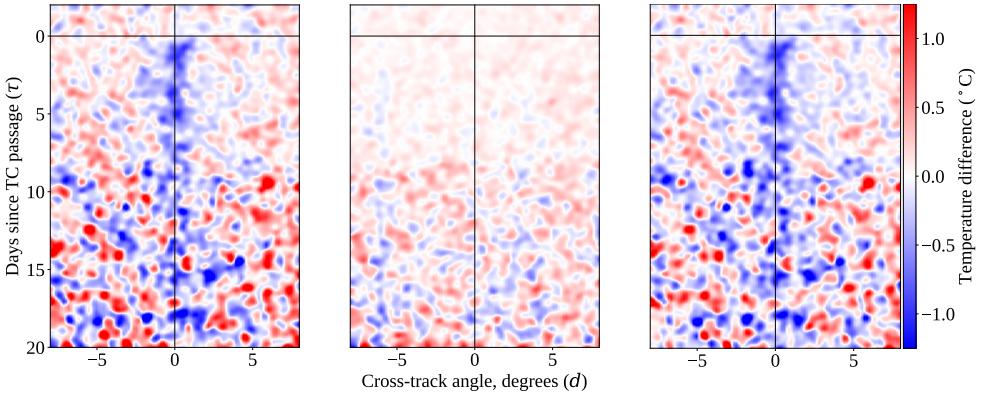
(a) Raw (b) Fitted mean field (c) Seasonally adjusted

Fig 1: Pressure level: 10 dbar



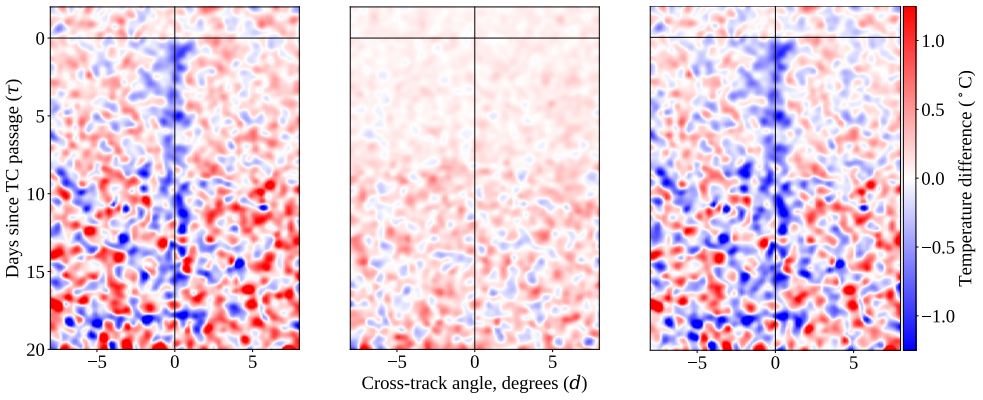
(a) Raw (b) Fitted mean field (c) Seasonally adjusted

Fig 2: Pressure level: 20 dbar



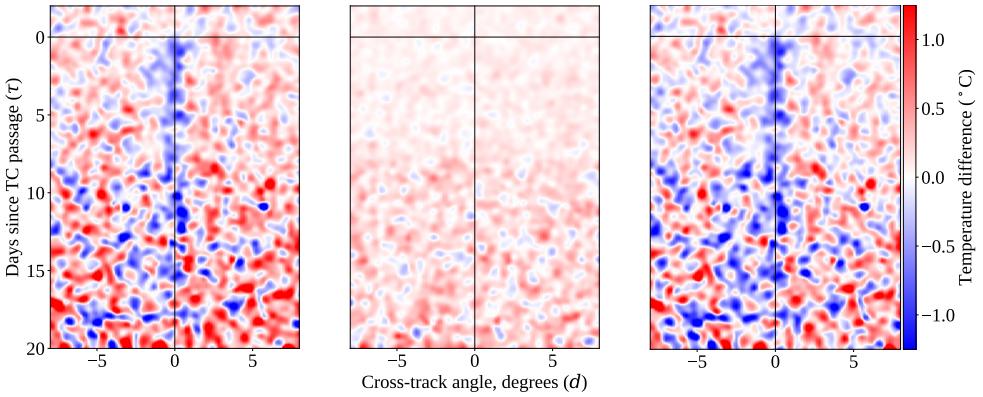
(a) Raw (b) Fitted mean field (c) Seasonally adjusted

Fig 3: Pressure level: 30 dbar



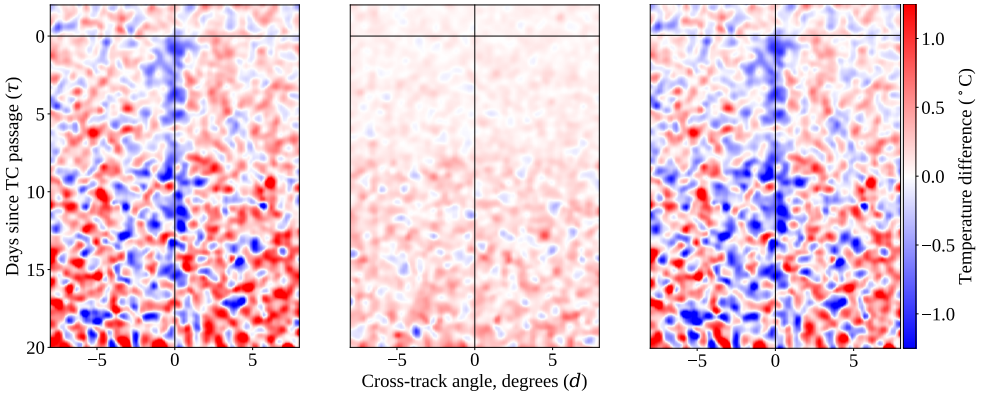
(a) Raw (b) Fitted mean field (c) Seasonally adjusted

Fig 4: Pressure level: 40 dbar



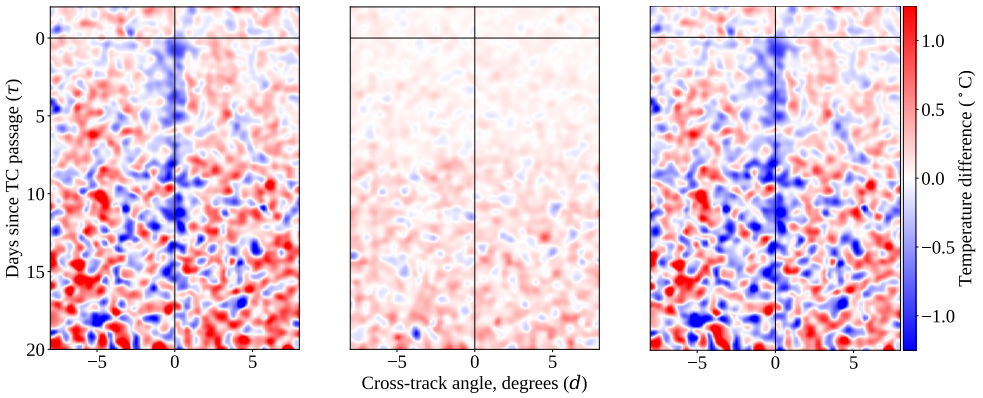
(a) Raw (b) Fitted mean field (c) Seasonally adjusted

Fig 5: Pressure level: 50 dbar



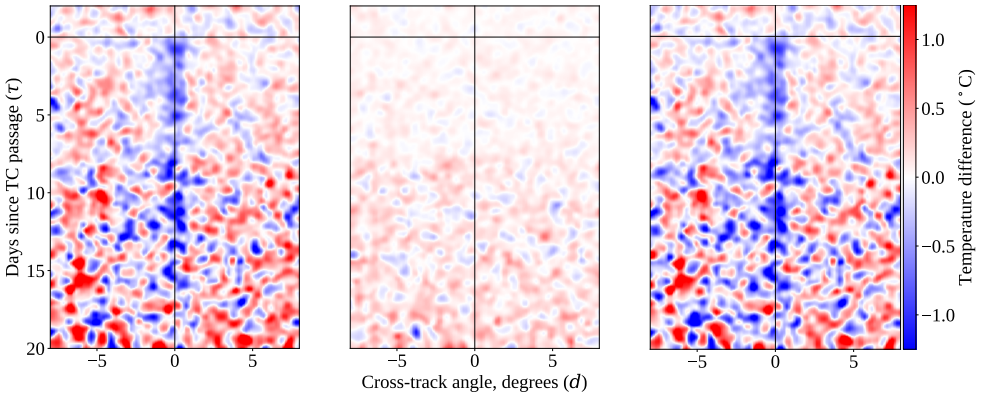
(a) Raw (b) Fitted mean field (c) Seasonally adjusted

Fig 6: Pressure level: 60 dbar



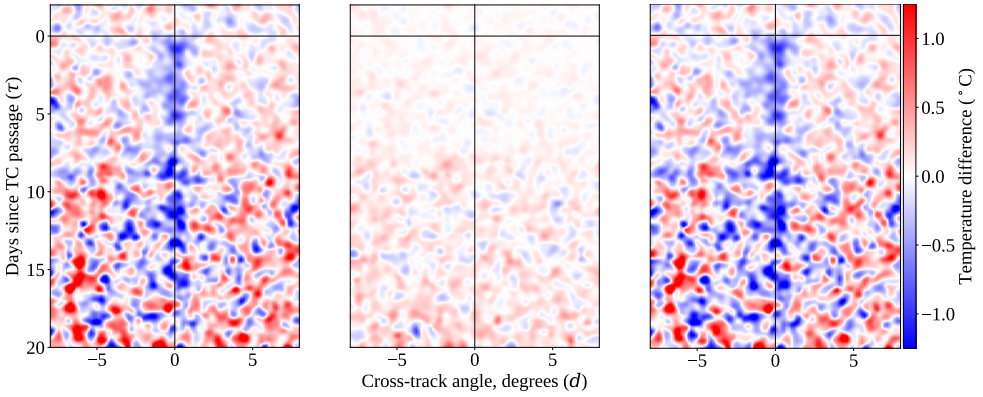
(a) Raw (b) Fitted mean field (c) Seasonally adjusted

Fig 7: Pressure level: 70 dbar



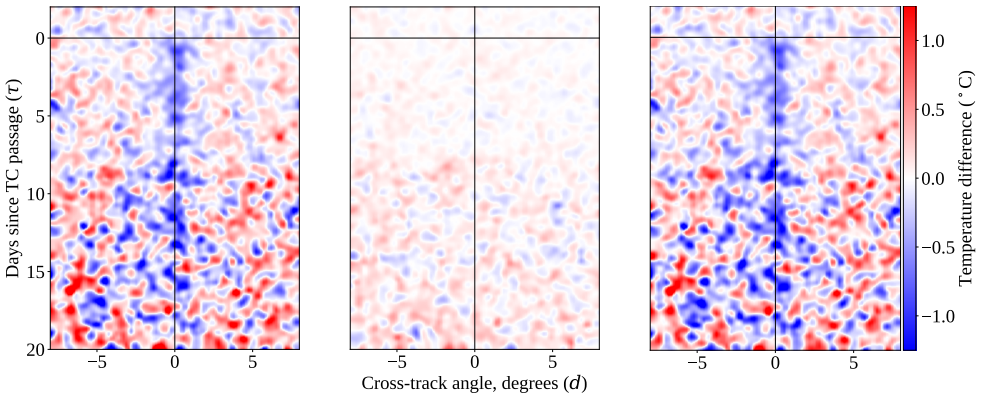
(a) Raw (b) Fitted mean field (c) Seasonally adjusted

Fig 8: Pressure level: 80 dbar



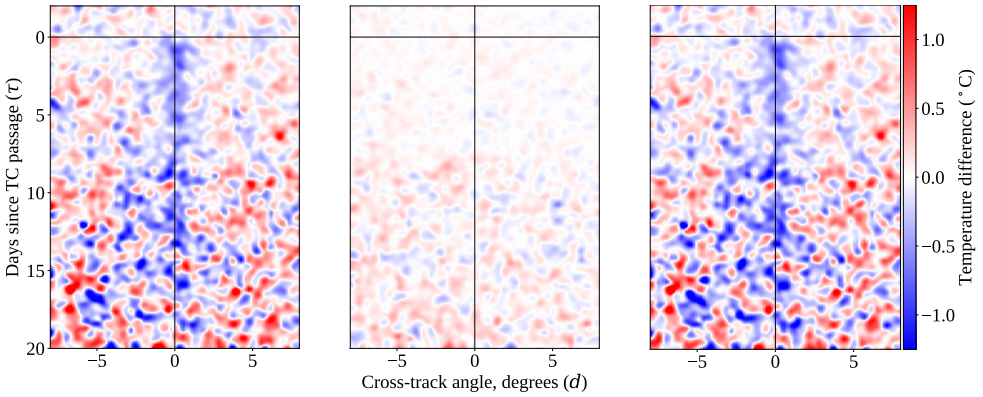
(a) Raw (b) Fitted mean field (c) Seasonally adjusted

Fig 9: Pressure level: 90 dbar



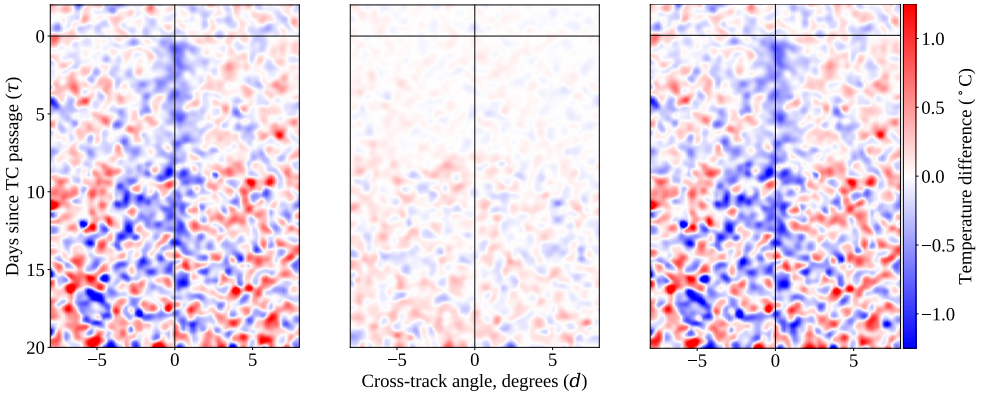
(a) Raw (b) Fitted mean field (c) Seasonally adjusted

Fig 10: Pressure level: 100 dbar



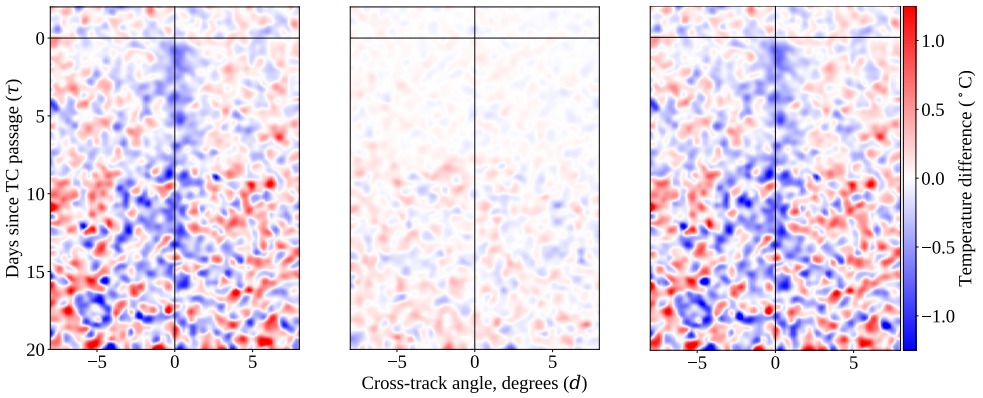
(a) Raw (b) Fitted mean field (c) Seasonally adjusted

Fig 11: Pressure level: 110 dbar



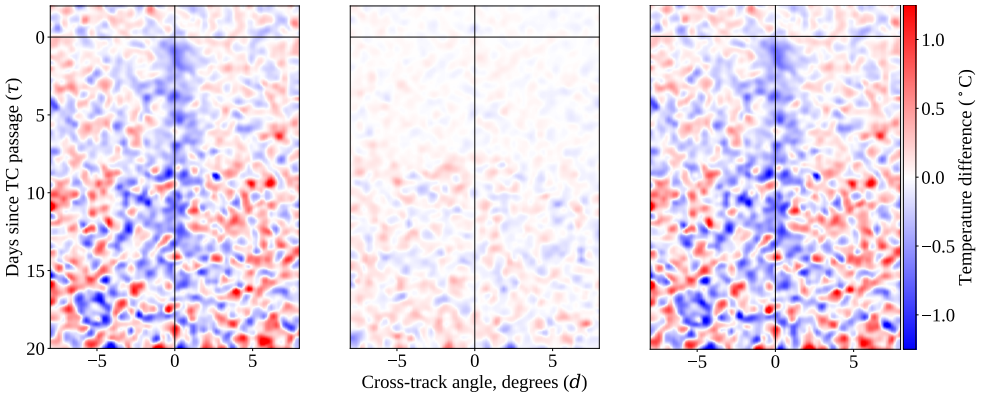
(a) Raw (b) Fitted mean field (c) Seasonally adjusted

Fig 12: Pressure level: 120 dbar



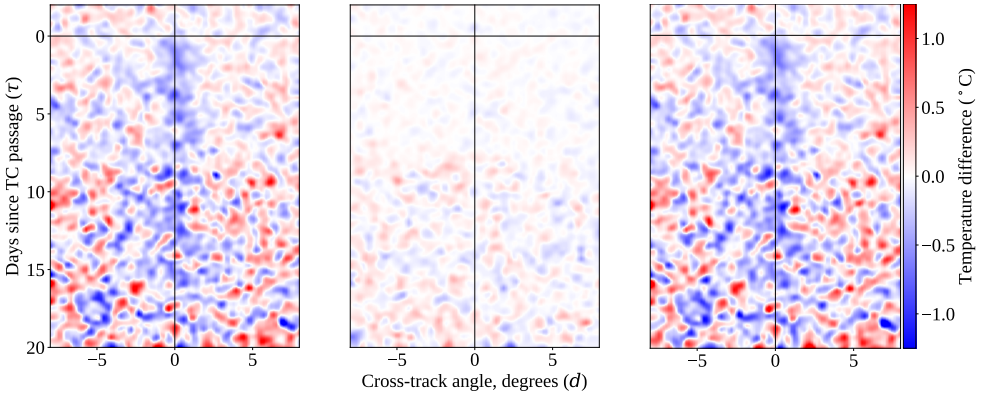
(a) Raw (b) Fitted mean field (c) Seasonally adjusted

Fig 13: Pressure level: 130 dbar



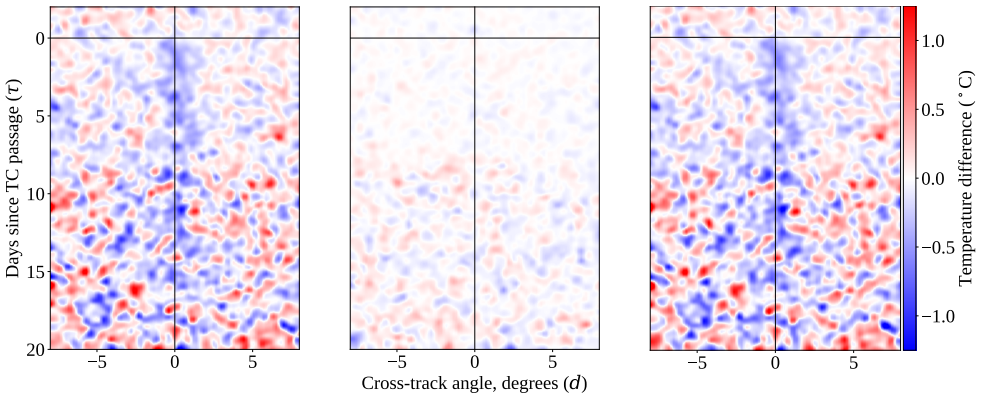
(a) Raw (b) Fitted mean field (c) Seasonally adjusted

Fig 14: Pressure level: 140 dbar



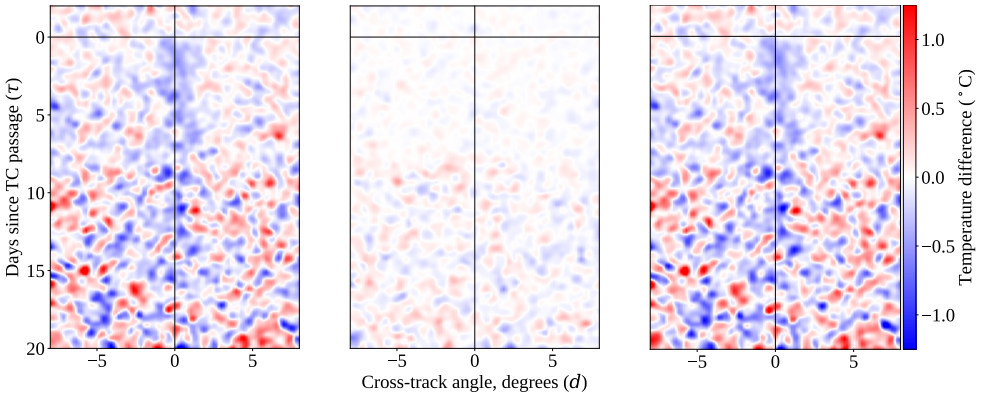
(a) Raw (b) Fitted mean field (c) Seasonally adjusted

Fig 15: Pressure level: 150 dbar



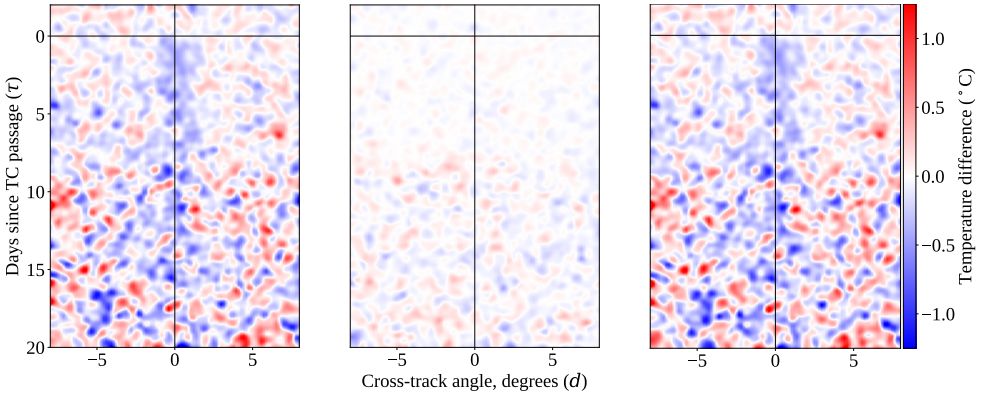
(a) Raw (b) Fitted mean field (c) Seasonally adjusted

Fig 16: Pressure level: 160 dbar



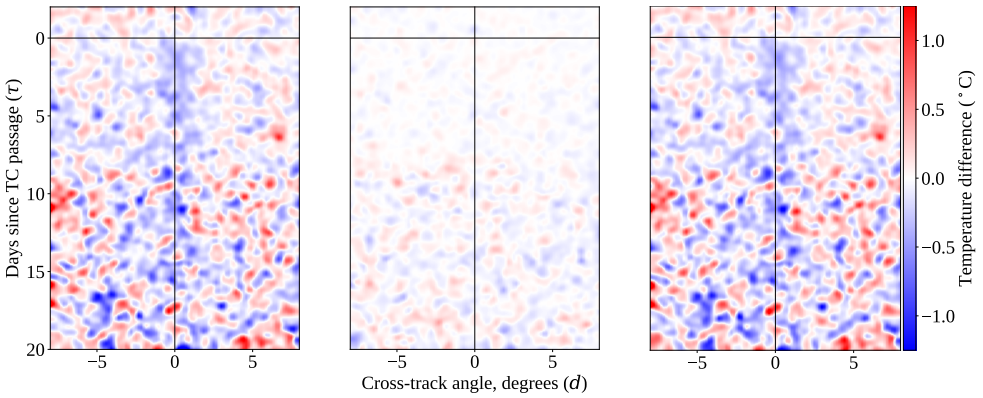
(a) Raw (b) Fitted mean field (c) Seasonally adjusted

Fig 17: Pressure level: 170 dbar



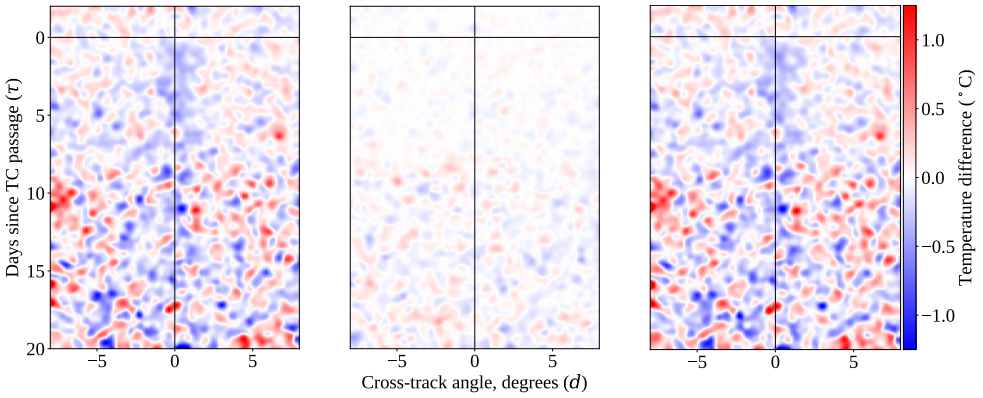
(a) Raw (b) Fitted mean field (c) Seasonally adjusted

Fig 18: Pressure level: 180 dbar



(a) Raw (b) Fitted mean field (c) Seasonally adjusted

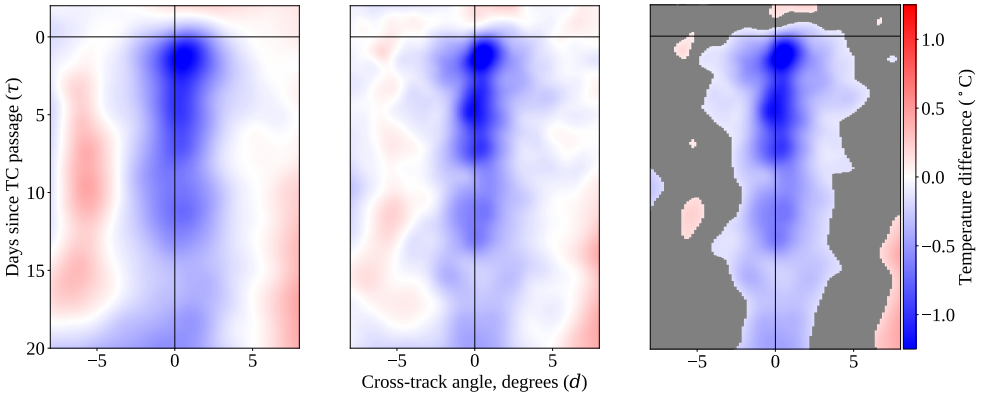
Fig 19: Pressure level: 190 dbar



(a) Raw (b) Fitted mean field (c) Seasonally adjusted

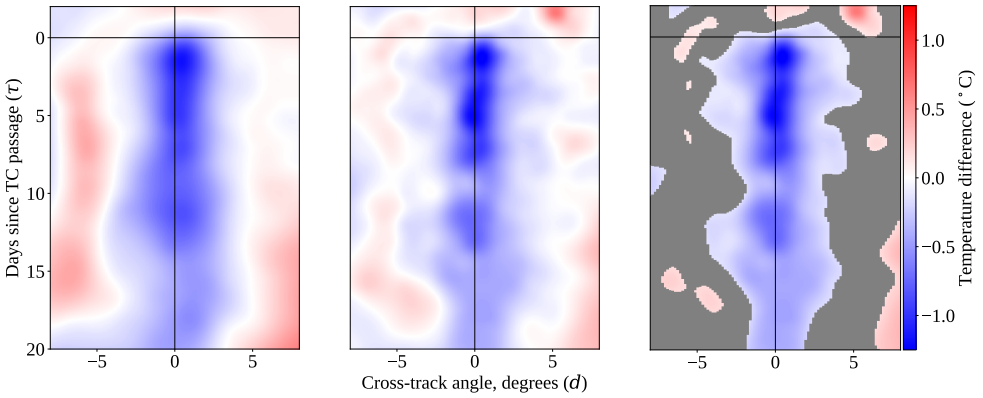
Fig 20: Pressure level: 200 dbar

2. Thin plate spline fits. Here we present the thin plate spline fits at all depths, for profile pairs incidental to TCs which were hurricane-strength (sustained winds of at least 64 knots) at time of passage.



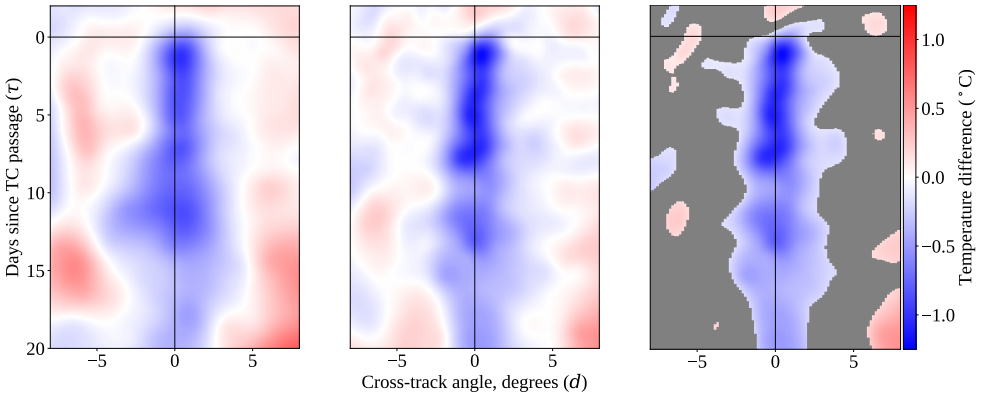
(a) No variance reweighting (b) Block covariance (c) Pointwise $\alpha = 0.05$ test

Fig 21: Pressure level: 10 dbar



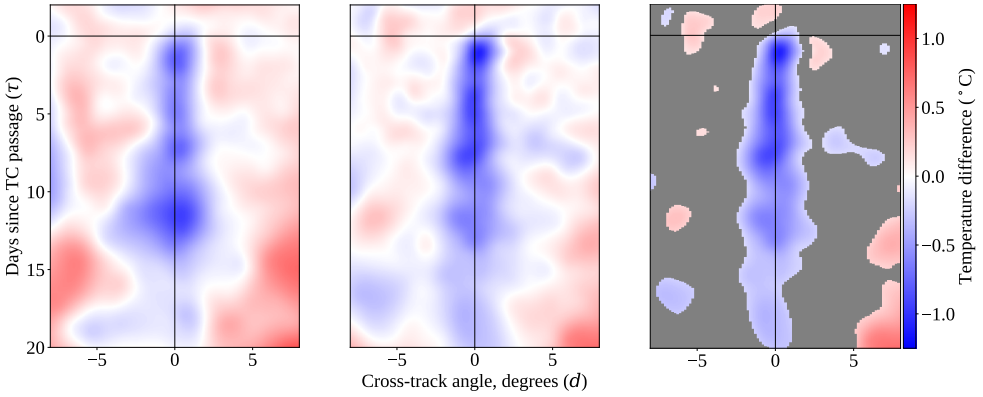
(a) No variance reweighting (b) Block covariance (c) Pointwise $\alpha = 0.05$ test

Fig 22: Pressure level: 20 dbar



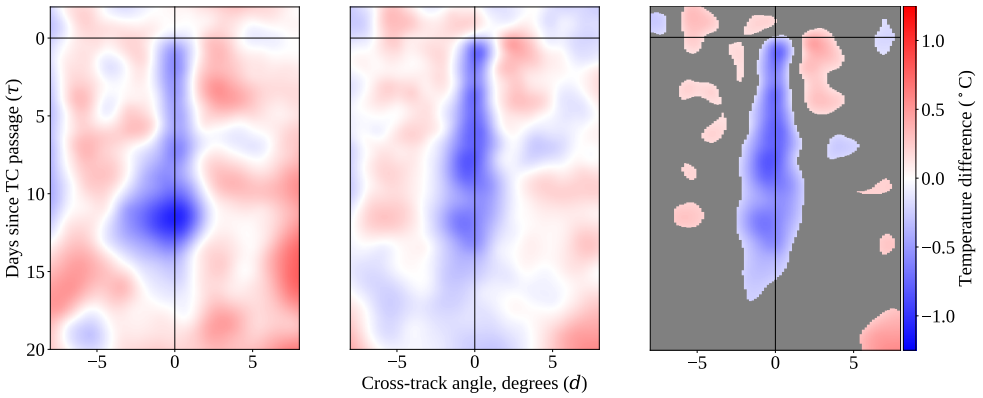
(a) No variance reweighting (b) Block covariance (c) Pointwise $\alpha = 0.05$ test

Fig 23: Pressure level: 30 dbar



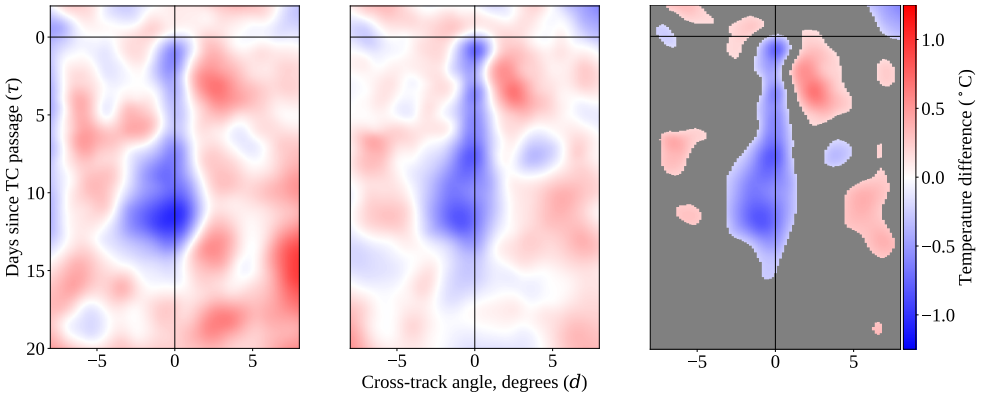
(a) No variance reweighting (b) Block covariance (c) Pointwise $\alpha = 0.05$ test

Fig 24: Pressure level: 40 dbar



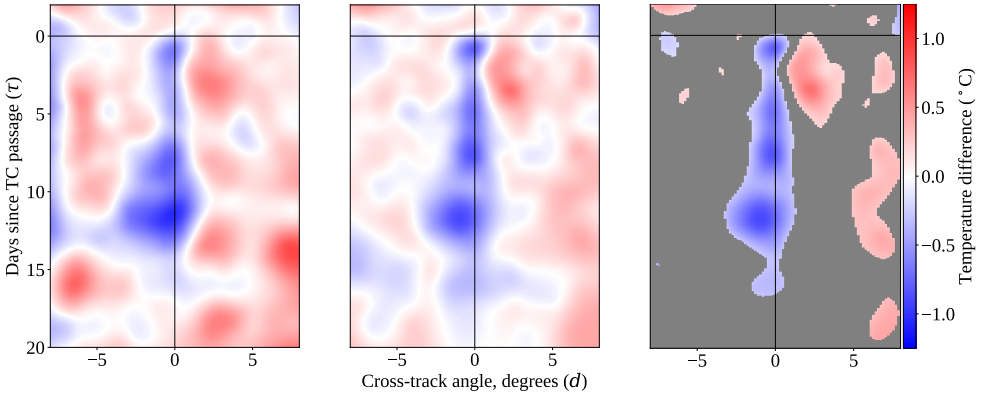
(a) No variance reweighting (b) Block covariance (c) Pointwise $\alpha = 0.05$ test

Fig 25: Pressure level: 50 dbar



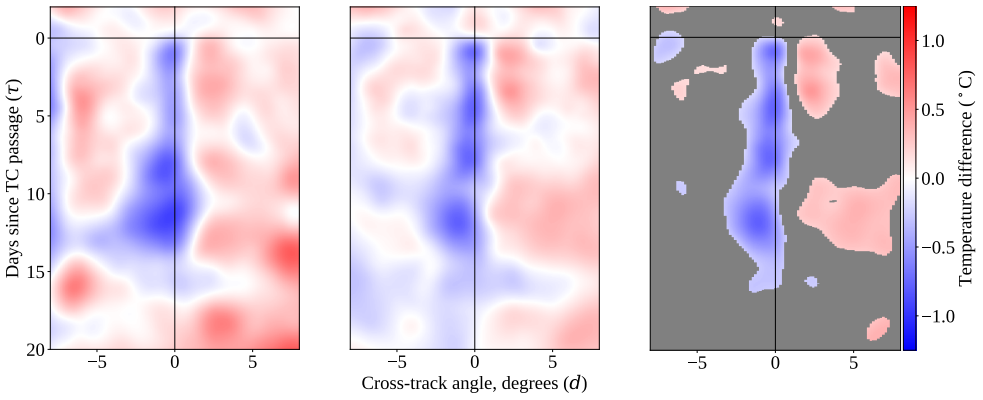
(a) No variance reweighting (b) Block covariance (c) Pointwise $\alpha = 0.05$ test

Fig 26: Pressure level: 60 dbar



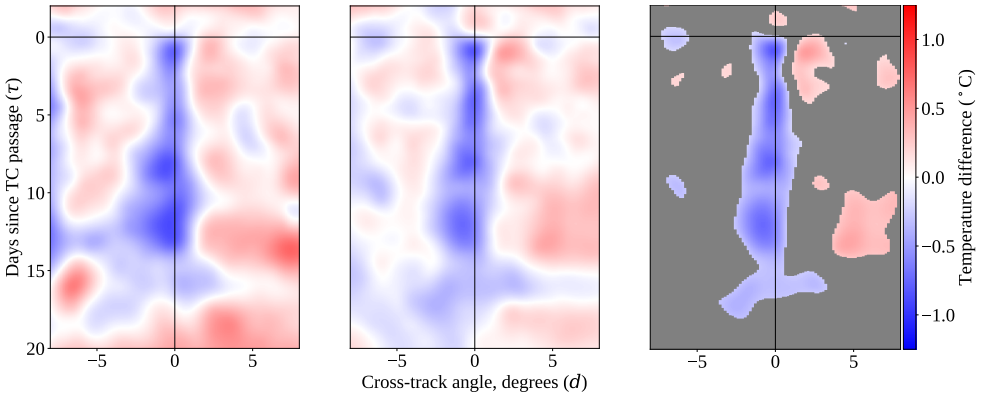
(a) No variance reweighting (b) Block covariance (c) Pointwise $\alpha = 0.05$ test

Fig 27: Pressure level: 70 dbar



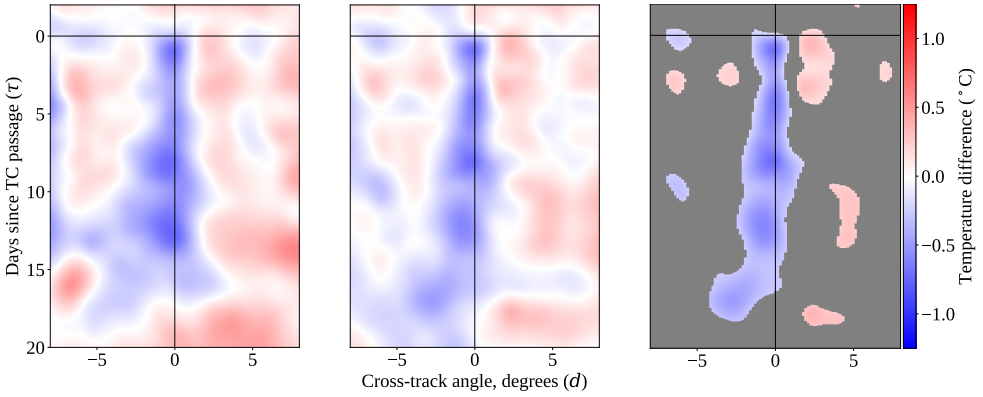
(a) No variance reweighting (b) Block covariance (c) Pointwise $\alpha = 0.05$ test

Fig 28: Pressure level: 80 dbar



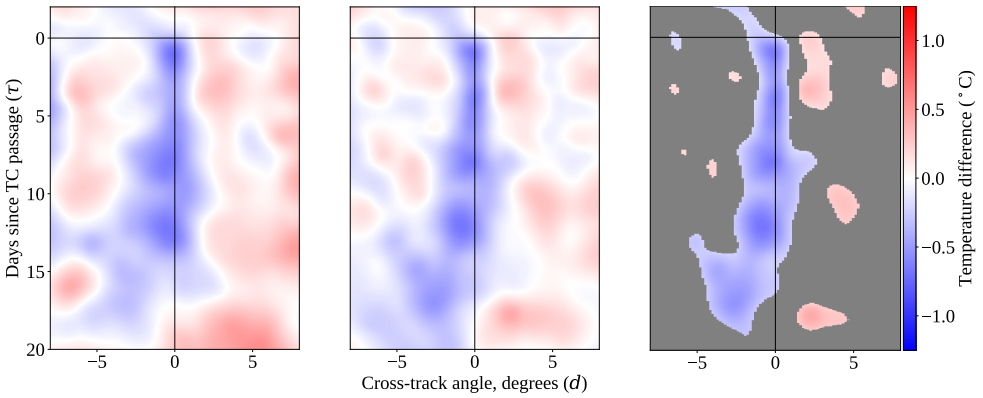
(a) No variance reweighting (b) Block covariance (c) Pointwise $\alpha = 0.05$ test

Fig 29: Pressure level: 90 dbar



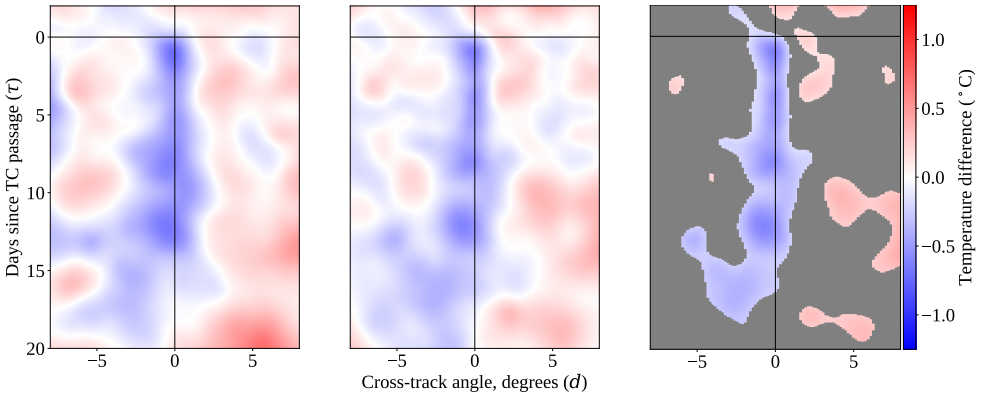
(a) No variance reweighting (b) Block covariance (c) Pointwise $\alpha = 0.05$ test

Fig 30: Pressure level: 100 dbar



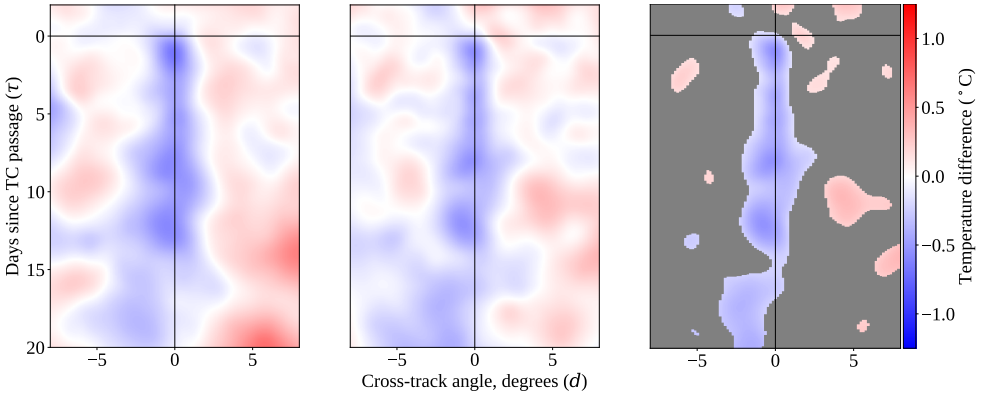
(a) No variance reweighting (b) Block covariance (c) Pointwise $\alpha = 0.05$ test

Fig 31: Pressure level: 110 dbar



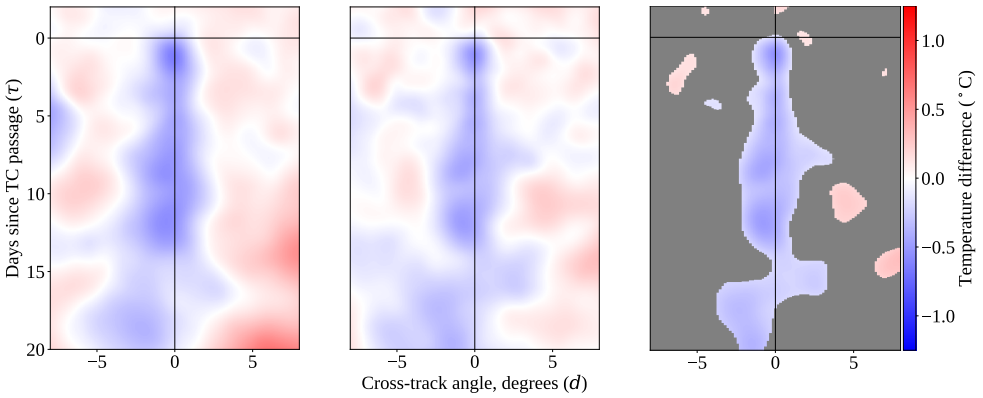
(a) No variance reweighting (b) Block covariance (c) Pointwise $\alpha = 0.05$ test

Fig 32: Pressure level: 120 dbar



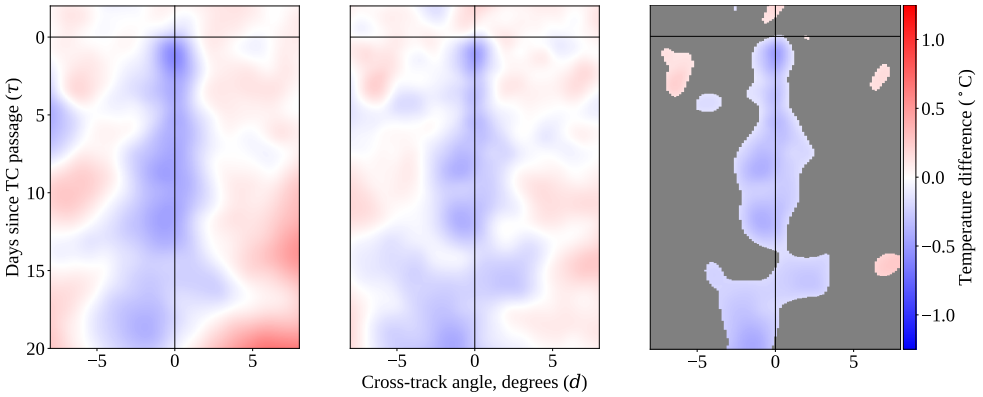
(a) No variance reweighting (b) Block covariance (c) Pointwise $\alpha = 0.05$ test

Fig 33: Pressure level: 130 dbar



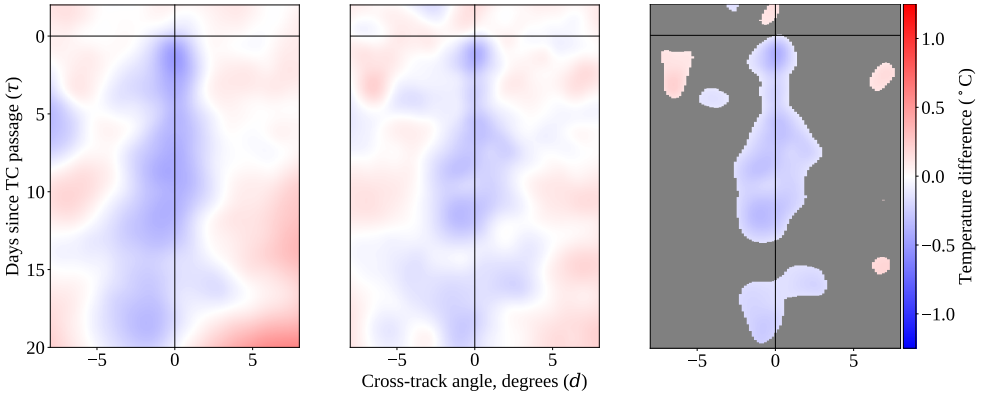
(a) No variance reweighting (b) Block covariance (c) Pointwise $\alpha = 0.05$ test

Fig 34: Pressure level: 140 dbar



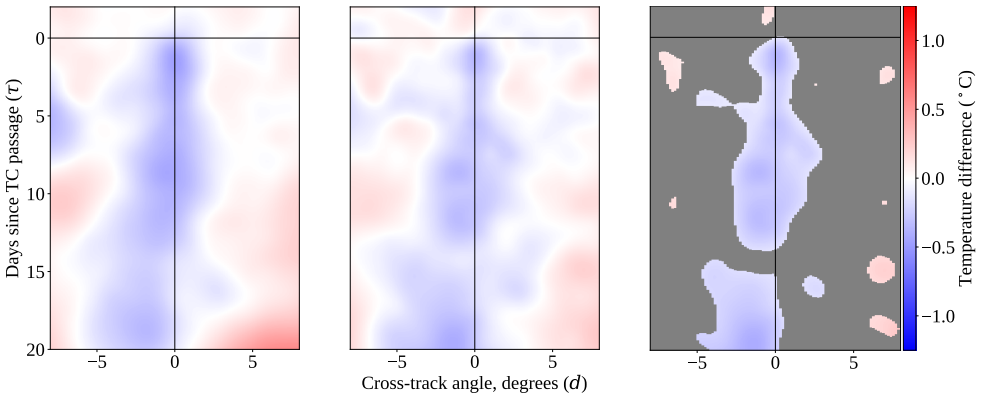
(a) No variance reweighting (b) Block covariance (c) Pointwise $\alpha = 0.05$ test

Fig 35: Pressure level: 150 dbar



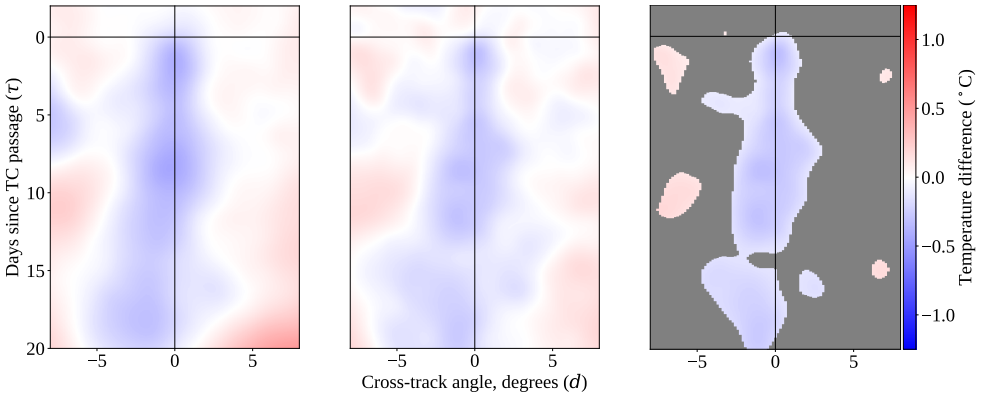
(a) No variance reweighting (b) Block covariance (c) Pointwise $\alpha = 0.05$ test

Fig 36: Pressure level: 160 dbar



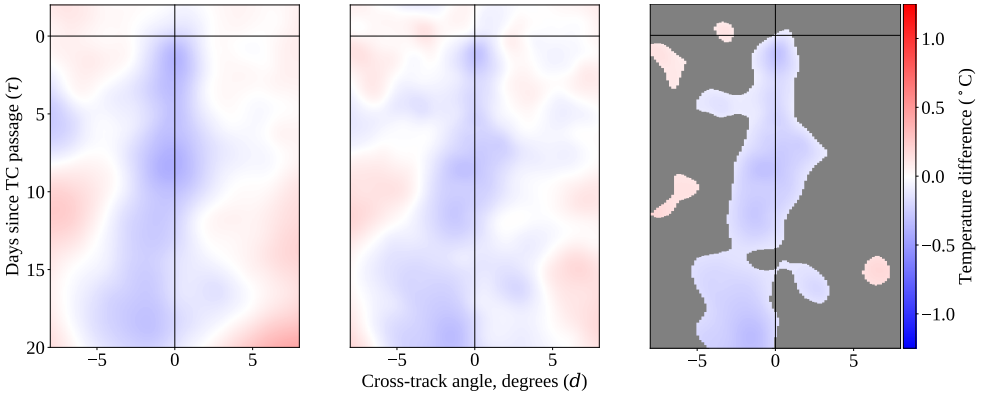
(a) No variance reweighting (b) Block covariance (c) Pointwise $\alpha = 0.05$ test

Fig 37: Pressure level: 170 dbar



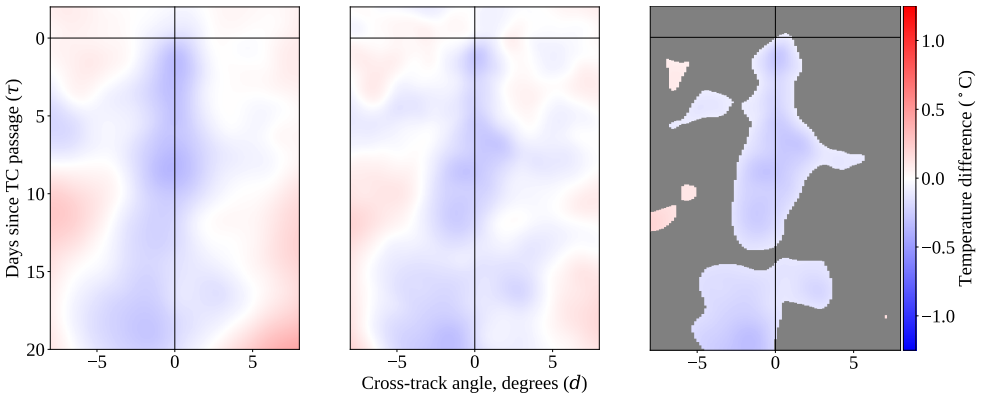
(a) No variance reweighting (b) Block covariance (c) Pointwise $\alpha = 0.05$ test

Fig 38: Pressure level: 180 dbar



(a) No variance reweighting (b) Block covariance (c) Pointwise $\alpha = 0.05$ test

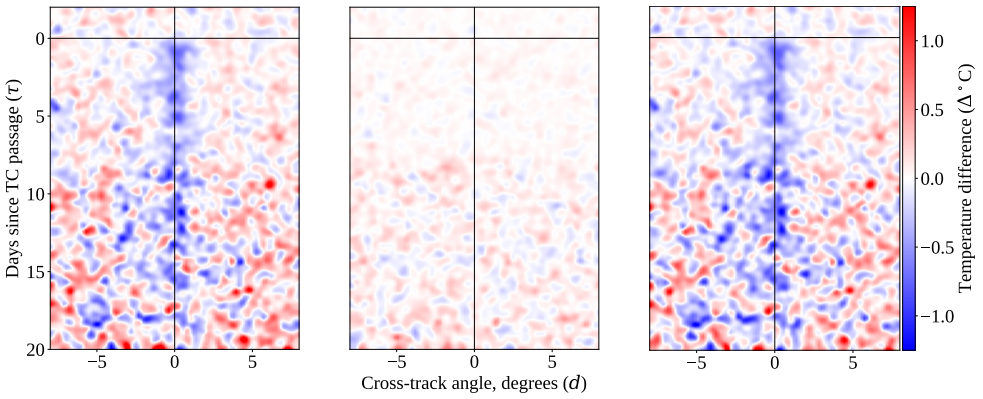
Fig 39: Pressure level: 190 dbar



(a) No variance reweighting (b) Block covariance (c) Pointwise $\alpha = 0.05$ test

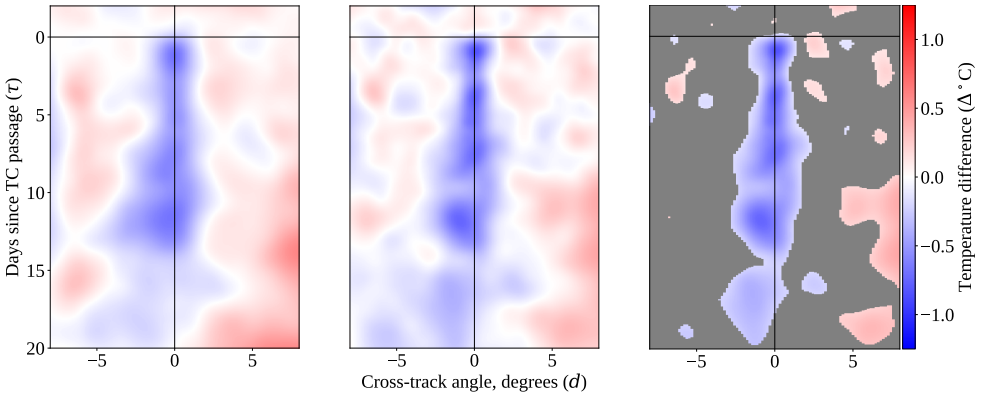
Fig 40: Pressure level: 200 dbar

3. Vertically averaged fits. Here we present the corresponding plots for the vertically averaged temperature difference analysis, as described in Section 5.6.



(a) Raw (b) Fitted mean field (c) Seasonally adjusted

Fig 41: The temperature differences and fitted seasonal mean field are lightly smoothed by an isotropic Gaussian kernel smoother with a bandwidth of $\sigma = 0.2$.

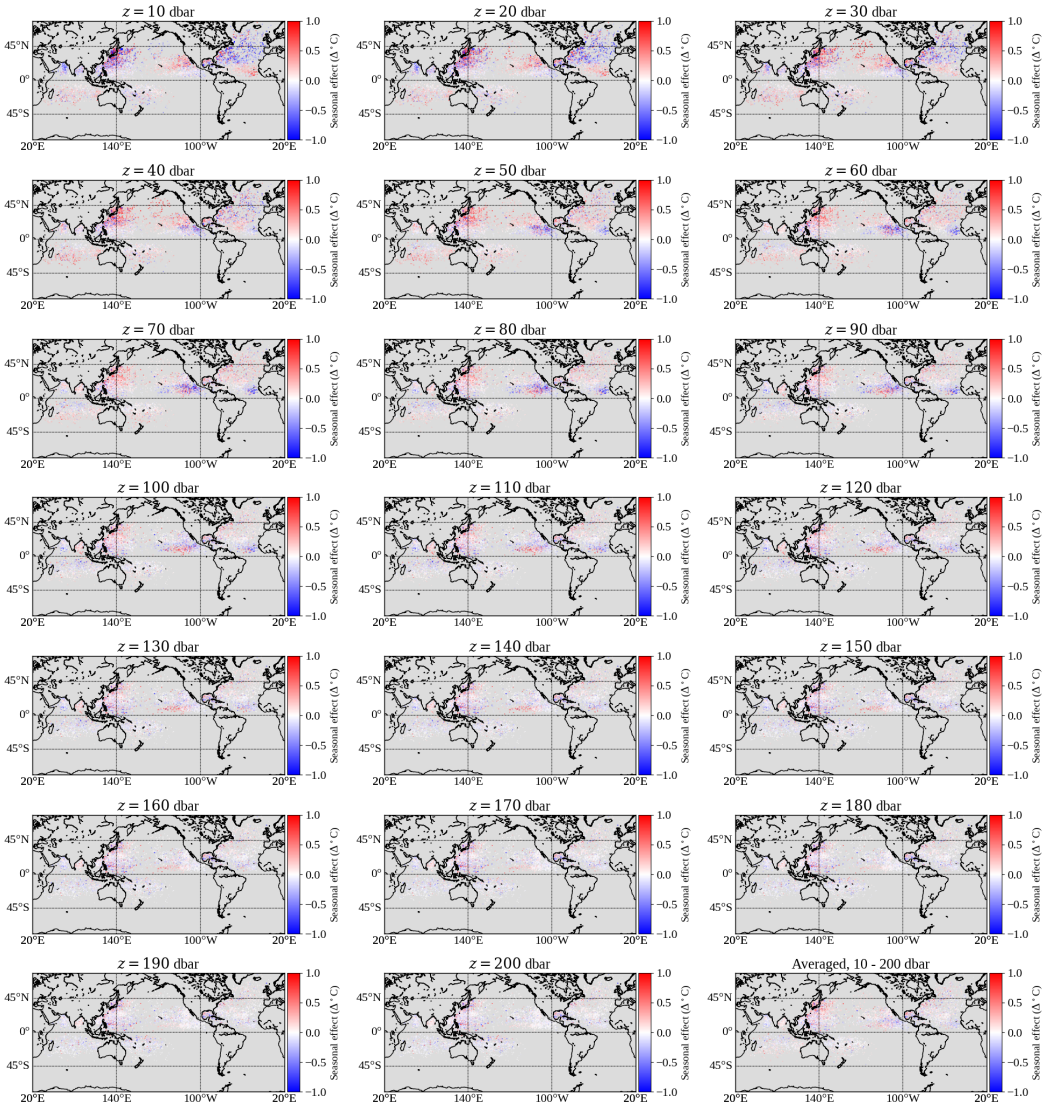


(a) No variance reweighting (b) Block covariance (c) Pointwise $\alpha = 0.05$ test

Fig 42: Thin plate spline fits for profile pairs incidental to a TC of hurricane-strength (sustained windspeed of at least 64 knots) at time of TC passage.

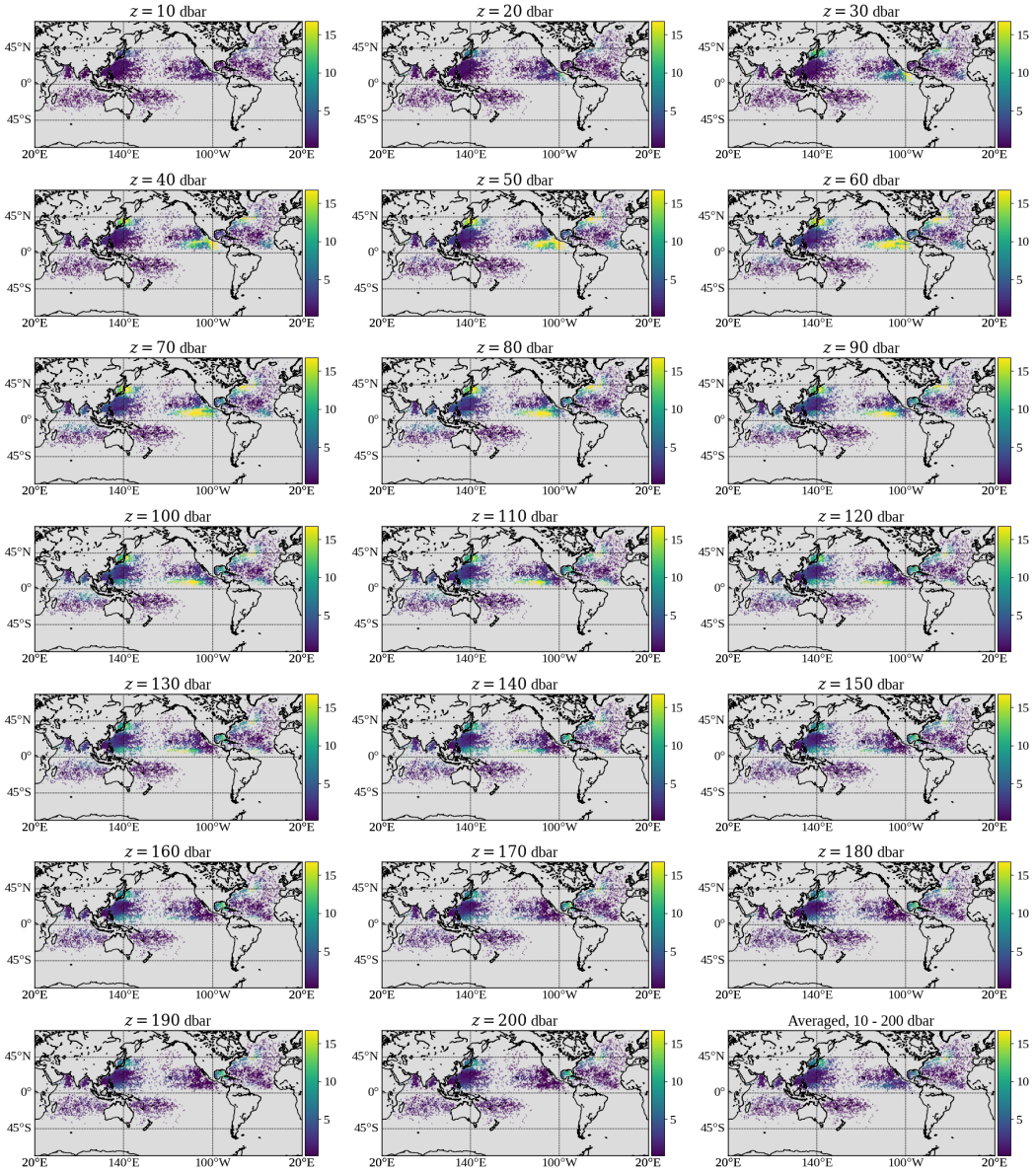
4. Seasonal mean field fits.

4.1. *Seasonal adjustments.* We plot the seasonal adjustment fitted to each profile pair in our dataset, at each pressure level $z = 10, 20, \ldots, 200$, as well as for the vertically averaged temperature profiles. This set of plots complements Figure 5a and is provided for completeness. At pressure levels $z = 30$ through $z = 150$, we observe an overall warming effect over the timespan of our data.

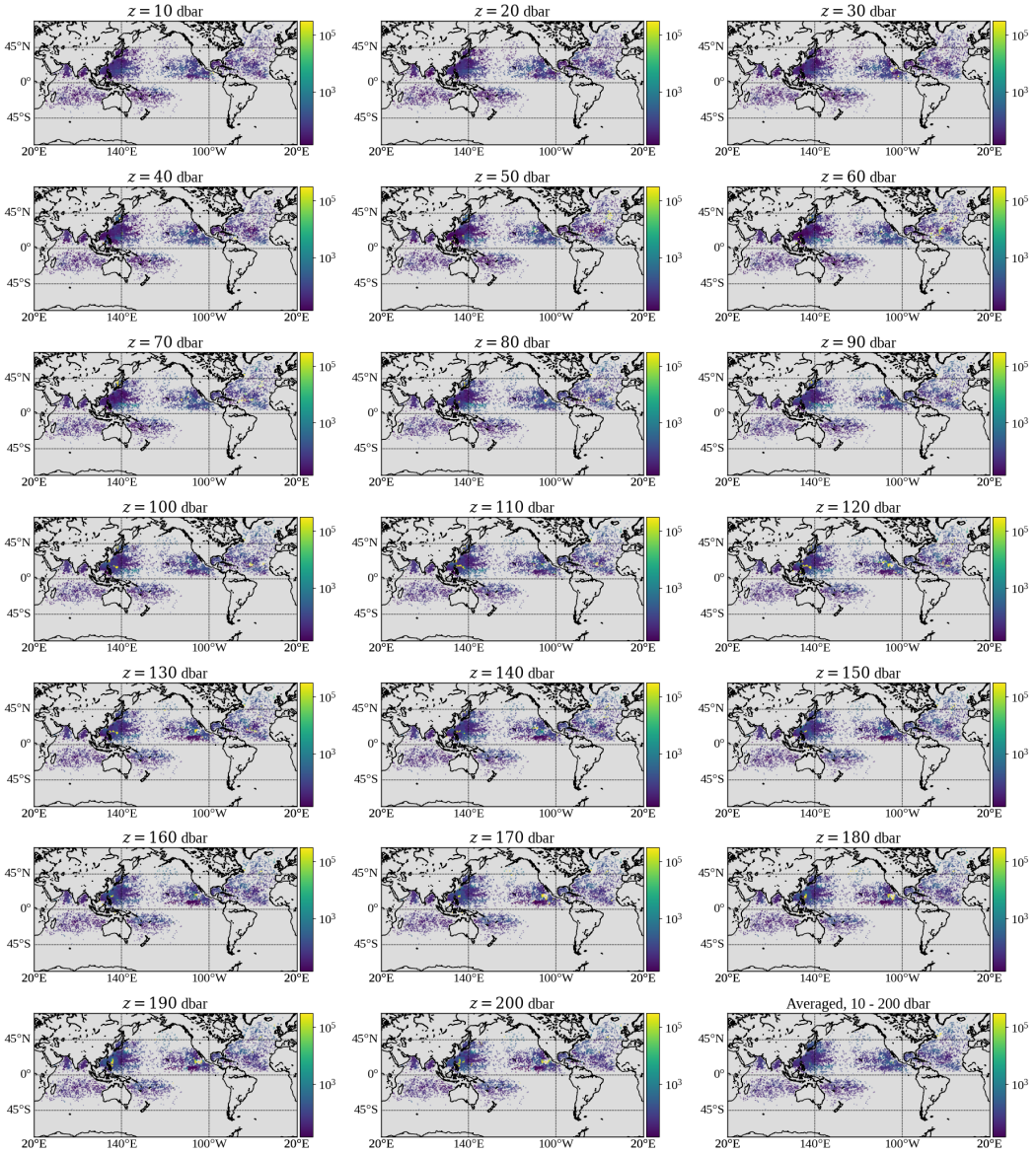


5. Gaussian process model fits. In this section, we plot the Gaussian process model coefficients fitted in Section 4.4, as well as the variances for the seasonally adjusted temperature differences implied by these coefficients.

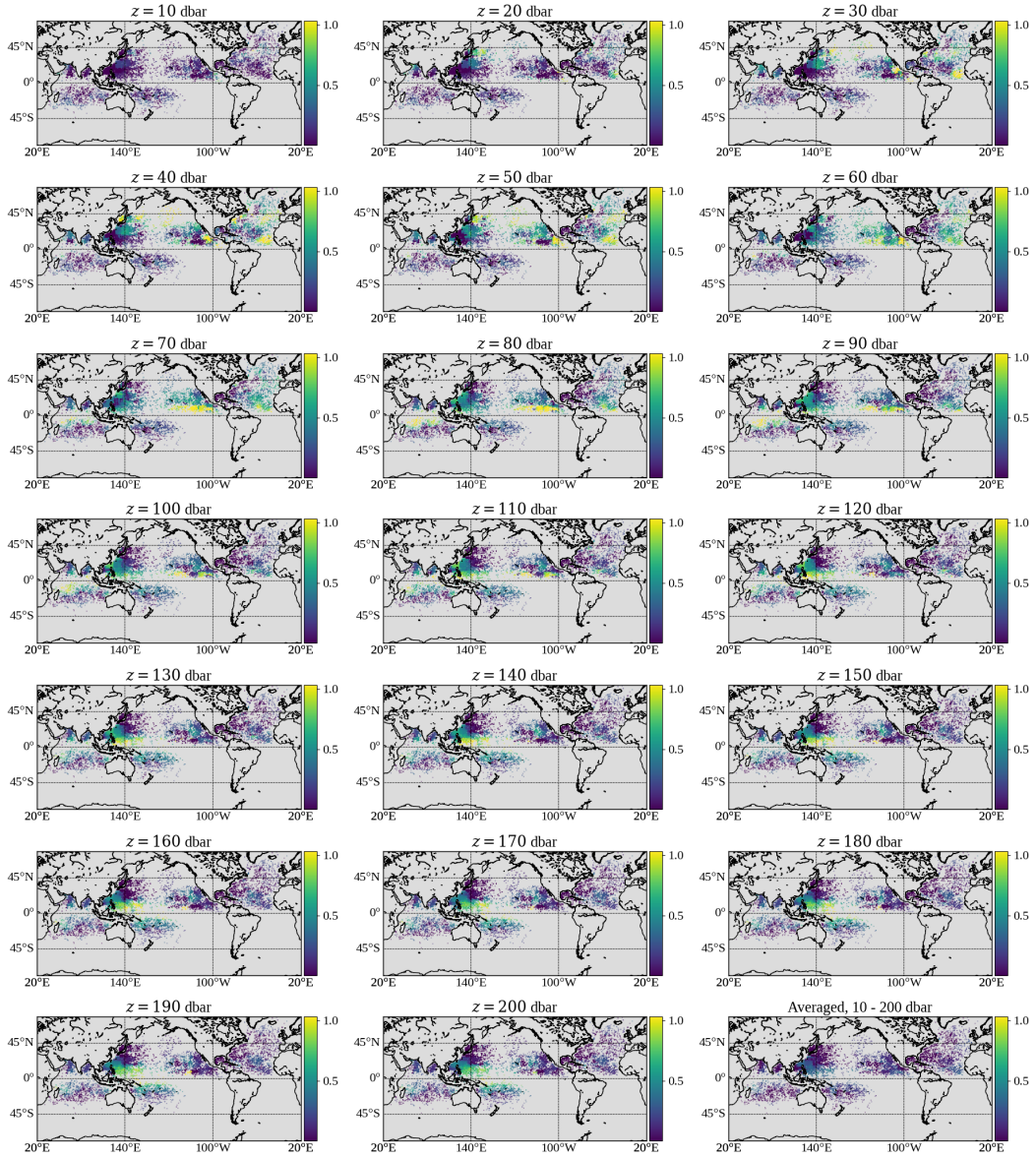
5.1. *Fitted ϕ coefficients.* Here we plot the ϕ parameters, fitted through maximum likelihood estimation at each pressure level $z = 10, 20, \ldots, 200$ and for the vertically averaged temperature profiles. Note that the colorscale is logarithmic.



5.2. *Fitted θ_t coefficients.* Here we plot the θ_t parameters, fitted through maximum likelihood estimation at each pressure level $z = 10, 20, \ldots, 200$ and for the vertically averaged temperature profiles.

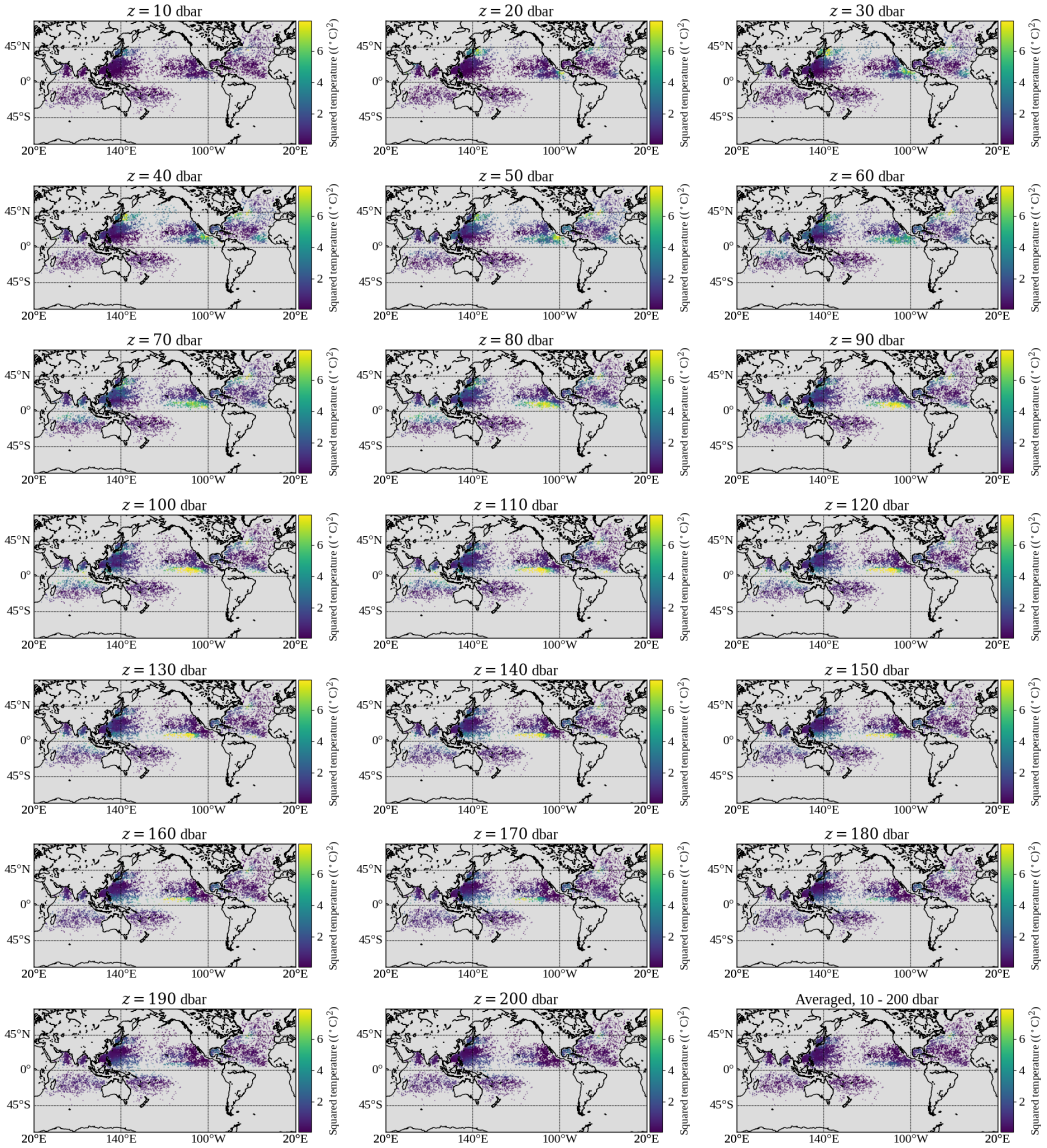


5.3. *Fitted σ coefficients.* Here we plot the σ parameters, fitted through maximum likelihood estimation at each pressure level $z = 10, 20, \ldots, 200$ and for the vertically averaged temperature profiles.



The fitted coefficients exhibit a spatial smoothness, suggesting a relative stability across the locally fitted models.

5.4. *Fitted variances.* Here we plot the variances for the seasonally adjusted temperature differences, as fitted by way of the Gaussian process model of Section 4.4, for each of the profile pairs in our dataset. These variances are fitted at each pressure level $z = 10, 20, \ldots, 200$, as well as for the vertically averaged temperature profiles.



Overall, we observe that the fitted variances are relatively homogeneous. Profile pairs with larger fitted variance are downweighted in the final thin plate spline fit of Section 4.5.