Referee #2

We thank the referee for his (her) valuable comments and suggestions. Following is our response and the changes incorporated in the new version of the manuscript.

Referee's comment

SUMMARY AND GENERAL EVALUATION
The authors present an interesting spatio-temporal analysis of 4-dim solar data, for a flaring event, the preflare phase, and a Quiet Sun region. They use a Singular Value Decomposition method and investigate the multi-scale behavior of the physical parameter of the temperature T, and attempt to extract information on the heat flow dT/dx in a flare. The description of the method is clear, and the data analysis steps are described in sufficient detail. In the second half of the paper the authors try to extract information on the heat flux before and during a flare, where they arrive at the result that diffusive transport is not relevant in solar flares, which is at odds with other studies. If the authors can reconcile the interpretation of this controversial result in terms of the limitations of the used method, the paper may possibly be suitable for publication.

Authors' response:

We do not really say that diffusion is not relevant in solar flares in general, we say that, for the particular event analyzed, transport is dominated by advection. However, we only considered transport along the main direction of propagation of the heat front (x). Prompted by the referee's comments, we extended the analysis to the propagation in the perpendicular direction (y), where advection is not expected to play an important role, in order to capture the diffusive contribution. As a result, we have found a correlation between the heat flux, q_y and grad T would allow, in principle, to estimate a diffusion coefficient. This additional results are included in the present version of the manuscript; we do not mention anymore that diffusion is not observed. Only for transport along x it is subdominant.

Changes incorporated:

Page 18: The formulation for transport along y was added with boldface font, starting with line 343 and Figure 15 was incorporated to illustrate the results.

Page 18 Line 332 added:

In contrast, the negative temperature gradient has no clear correlation with Q(x) which seems to indicate that diffusion is not the main drive for the heat flux along *x in this particular event*.

DETAILED COMMENTS

Referee's comment:

In the Discussion and Conclusions the authors arrive at several important and some controversial results:
(1) "... a raw correlation between Fourier time scale and spatial scales during the flare, but not for pre-flare or quiet Sun. This may indicate that the flare-driven heat flows

tend to decay into smaller scales, in a cascade-like process." - Perhaps a reference and discussion can be made whether this is relevant to the scenario of "inverse MHD turbulent cascade" (e.g., Abramenko et al. 2003, ARep 47, 151, "Pre-Flare Changes in the Turbulence Regime for the Photospheric Magnetic Field in a Solar Active Region"; Antonucci et al. 1996, ApJ 456, 833 " Interpretation of the observed plasma turbulent velocities as a result of magnetic reconnection in solar flares"; LaRosa,T.N. and Moore,R.L. 1993, ApJ 418, 912-918, "A mechanism for bulk energization in the impulsive phase of solar flares: MHD turbulent cascade".

Authors' response:

We appreciate the referee's suggestion. It would certainly be interesting to do this discussion to enrich the paper. However, we have not included this because we decided to remove the interpretation of a cascading process, since, as pointed out by the other referee, this conclusion seems to be premature in the light of our results. We will take it into account for a future work on this subject.

Referee's comment:

(2) "... The pre-flare activity seems to produce larger low-amplitude fluctuations, characteristic of intermittency, which might herald the occurrence of the flare." — Discuss in this in the context of the paper by Abramenko et al. (2003), for instance.

Authors' response:

We thank the referee for the suggestion and we completely agree with its pertinence. We have included this discussion in the new version of the manuscript.

Changes incorporated:

Page 23 Line 412 added:
It is interesting to note that this result may be related to the findings of Abramenko et al. (2003) who also showed that there is evidence of intermittency in the magnetic field of an active region previous to the occurrence of a flare. They argue that this indicates that there is a turbulent phase before the flare, which would be in agreement with the intermittency in the temperature fluctuations found here.

Referee's comment:

(3) "A multi-scale analysis of the heat flux was also performed for the region associated with the flare. The thermal flux profiles along the main direction (x) of the flow were computed using original temperature maps and compared with the temperature variation along x, allowing to obtain the advection velocity profile. Diffusive transport is found to be not relevant." — This is contrary to other observational findings that the envelope of the flare area propagates like diffusive transport (Aschwanden 2012, ApJ 757, 94, "The spatio-temporal evolution of solar flares observed with AIA/SDO: Fractal diffusion, sub-diffusion, or logistic growth". The author’s result may be biased because they use a 1-dim transport model (in x-direction), with no transport in transverse direction.

Authors' response:

We are actually not implying that there is no diffusive transport. What we find is that, *in this case*, transport is dominated by convection because of the strong heat pulse. However, as explained above, the analysis of transport along *y* direction has modified this assertion. As pointed out by the referee, the 1D model produces a bias but this was offset by the addition of the transport in the perpendicular direction. Diffusive processes are much weaker than advection for transport along the direction of propagation of the heat front, but it is noticeable for transport in the perpendicular direction. We have commented this issue in the new version.

Changes incorporated:

Page 23 Line 420 added:

Diffusive transport is found to be sub-dominant and cannot be evaluated. A similar analysis was performed for transport along the direction perpendicular to the heat front propagation and in that case diffusion shows as an important contribution to transport.

Page 23 Line 428 added:

We point out that indications about a diffusive-like transport associated with a solar flare have been found by Aschwanden (2012) who actually found that the transport is sub-diffusive. This agrees with our result of Fig.7 which shows that the correlation of time and space scales corresponds with a sub-diffusive process.

Referee's comment:

Furthermore, they assume that there is no energy source inside the region of temperature maps (line 270). It would be more realistic to assume that the energy transport is isotropic in all directions, because the high-resolution images from AIA show that a flare entails many reconnection sites with magnetic field lines that go in all directions. Perhaps the authors can modify their heat flux model accordingly, or at least discuss the limitations of their model and what bias is expected in the diagnostics of the overall heat flux from a (point-like) flare source region.

Authors' response:

We are actually analyzing a small region very close to the brightest flaring region but that does not include it (see Fig. 3). The heat front moves away from the main flare site as it advances and penetrates into the region of study. The flare is not assumed to be point-like but rather it is outside our control volume. Therefore, it is valid to assume there are no energy sources inside the volume; most reconnection sites are in the flaring region which is outside. On the other hand, we cannot assume that transport is isotropic because of the strong contribution of advection which is directed along a specific direction in the case we study. But this issue is addressed by the modifications adding transport along *y*, as mentioned above. We have included a mention to the need of extending the model.

Changes incorporated:

Page 18 Line 343 added:

However, diffusive transport can be noticeable in the y direction where an important advection is not present. This can be studied with a similar analysis by averaging across the x direction. Notice that the averaging procedure is a simplification that would produce only approximate results.