Review:

Latsch, et al. Improved detection of global NOx emissions from shipping in Sentinel-5P TROPOMI data.

Summary:

The authors present a sophisticated approach for detecting persistent pollution tracks along shipping lanes, using careful filtering of combined 6 years of TROPOMI NO_2 data. The resultant maps clearly reveal multiple tracks in each of the earth's oceans. The study is noteworthy in its detailed presentation of the methods used and the detection of tracks not previously identified in satellite data or that may otherwise be unknown. The authors test a variety of approaches, describing the pros and cons of each and perform quantitative model comparisons. I have only a few minor suggestions for clarification and possible modification of the filtering techniques that might overcome some of the shortcomings pointed out by the authors.

Overall, the authors have done due diligence in rigorous testing of their algorithm and particularly in their thorough analysis of the sources of the tracks visible in their final product. I believe a version of the paper close to its present form is worthy of publication. Below are a few minor corrections and suggestions.

Comments:

(1) There is a tradeoff between capture of fine detail, enhancement of weaker signals and suppression of coastline artifacts. Might a dynamic box size – smaller near coastlines and larger over open waters – mitigate some of these concerns? For a given track, the enhancement would also vary with box size, but this approach would allow all tracks to be captured in a single map. A track out at sea could be followed to and along a coastline without being lost in the clutter. SciPy generic_filter does not directly support spatially varying footprint sizes, but it should be straightforward to develop code for this. Depending on the difficulty of implementing this in the present study, it would be interesting to see an approach like this tested over a small region.

(2) Line 36: "Satellite retrievals of tropospheric…"

(3) Line 120: "…are used to high-pass filter…"

(4) Lines 138-139: CH flagging selects both clear scenes and cloudy scenes with low clouds. Is there a cloud-fraction threshold for the cloudy scenes?

(5) Line 182: "In the northern hemisphere, the higher NO_2 signal is detected only when the sea-ice extent is minimal (June – November), while during the winter season…"

(6) Lines 257-258: "…to investigate the individual impacts of various flagging criteria…"

(7) Line 323: "…smaller NO_2 values than the other criteria…"

(8) Lines 322-326: The differences in peak heights for CH flagging between the Indian Ocean and the Atlantic are attributed to the greater number of cloudy cases in the Atlantic. Is this because CH flagging, in general, includes both clear and low-altitude cloudy scenes?

(9) Line 388: Please briefly mention why the AMF of 0.8 was chosen. It is a reasonable value, but obviously the AMF can depend strongly on whether clouds are present, etc.

(10) Line 392: "Figure C1b…CAMS data"

(11) Line 394: "…TROPOMI NO_2 data (Fig. C1a)…"

(12) Line 398: "…TROPOMI NO_2 tVCDs (Fig. 11a)…"

(13) Line 416: Should the sentence read "Inadequate dilution in CAMS could lead to overestimated NOx…" ?