We thank the reviewer for the comments that improve the quality of the paper. The detailed responses are given as follows. The reviewers' comments are shown in italic font, the responses are in regular blue font, and the revised text is in blue bold font.

Response to Referee #1

The values of photochemical indicators are widely used to determine the O3-NOx-VOC sensitivity with measurements, which has important policy implications. This work examined the effectiveness of four indicators such as PH2O2/PHNO3, and surface HCHO/NO2 with air quality models. It can provide decision-makers with some useful information when they use the photochemical indicators to make control strategies. The manuscript is well written and fits the scope of ACP, which is worthy of publication. However, there are a few questions as follows that need to be addressed to further improve the manuscript.

Major comments/questions:

Comment 1: *What are the influences of regional transport on the results?*

Response 1: Regional transport can alter the spatial distribution of NO_x and VOCs and thus influences O_3-precursor sensitivity. For example, Zhao et al. (2022) reported that O_3 production in the YRD tended to be NO_x-limited when source contribution from Zhejiang was elevated, which is mainly associated with the regional transport of VOCs from Zhejiang. Accordingly. the indicator (HO_2/OH) values increased. In contrast, O_3 production was VOC-limited with larger contributions from NO_x emissions in Jiangsu and Anhui, and HO_2/OH decreased. Therefore, we would expect that regional transport can change indicator values.

In this study, we determined O_3-precursor sensitivity for two simulation periods (2017 vs 2018) with different meteorology, and this can reflect the influence of regional transport on the effectiveness of photochemical indicators to some extent (see Section 3.2). As shown in Table 4, the accuracy is comparable in the two pairs of simulations, i.e., Sim_2017+Jiangsu vs Sim_2018+Jiangsu, Sim_2017+Other vs Sim_2018+Other. Although regional transport changes the values of indicators, it might have a minor influence on the performance of photochemical indicators.

Comment 2: *How will NH3 and inorganic aerosols such as sulfate, nitrate, and ammonium affect the HCHO/NOy and NOy?*

Response 2: NH_3 and inorganic aerosols do not affect HCHO. However, NH_3 can react with gaseous HNO_3, a major component of NO_y, to form particulate nitrate. Therefore, NH_3 affects the abundance of gaseous NO_y, particularly in cold seasons when the total nitrate (the sum of HNO_3 and particulate nitrate) predominantly resides in particles and under NH_3-deficient conditions. As NO_y generally includes gaseous components only when it is used as a (or a part of) photochemical indicator, the NH_3 concentration could affect the values of HCHO/NO_y and NO_y under certain conditions. The YRD region is in an NH_3-rich environment and the formation of nitrate is insensitive to the availability of NH_3 (Wang et al., 2011). Moreover, HNO_3 dominates the total nitrate in summer (Sun et al., 2022). Therefore, the impacts of NH_3 and inorganic aerosols on HCHO/NO_y and NO_y could be negligible in this study.

Some minor issues:

Comment 3: *Page 2 line 45: ", the O3 to nitric acid ratios (O3/HNO3), and NOy)"*

Response 3: Thank you for your comment. We made corrections in the main text.

Line 45: "…, the O_3 to nitric acid ratios (O_3/HNO_3), and NO_y) …"

Comment 4: *Figure 1. The letters are skewed.*

Response 4: Thank you for your comment. We have updated Figure 1 in the main text.

Comment 5: *Page 6 lines 138-140: Why are the 95th percentile for the VOC-limited grids and the 5th percentile for the NOx-limited grids chosen as the boundaries of the transition interval?*

Response 5: We used the 5th and 95th percentiles to define the NO_x-VOC transition following Sillman et al. (1998) and other studies (Xie et al., 2014; Peng et al., 2011). In these practices, the 5th percentile NO_x-limited values are mostly higher than the 95th percentile VOC-limited values, demonstrating that NO_x-limited and VOC-limited chemistry is successfully distinguished. On the other hand, the percentile values can remove extremely high values in VOC-limited locations and extremely low values in NO_x-limited locations.

Comment 6: *Page 11 lines 240-242: I suggest moving this part to the methodology section.*

Response 6: Thank you for your comment. We have moved the sentence "The feasibility of a given threshold for an indicator applied throughout a region or over a short-term period (the order of 1–2 years) is evaluated in section 3.2." to Lines 147-148 in the methodology section. However, we keep the other sentence "However, the methodology that is used to derive thresholds can also lead to distinct threshold values, and this is discussed in section 3.4." as it is, since we want to give a possible explanation of different threshold values derived in this study compared to other studies as shown in Table 3.

Comment 7: *Page 14 lines 295-296: This seems to conflict with your argument that the emission had no significant influence on the thresholds of PH2O2/PHNO3.*

Response 7: In Section 3.2, we pointed out that emissions had no significant influence on the performance of indicators in the determination of O_3-precursor sensitivity. This is based on the comparison between the case "Sim_2017+Jiangsu" and "Sim_2017+Other", which show similar accuracy despite different emissions in Jiangsu and other areas in the YRD (see Table 4). Here, the thresholds derived for one area are applicable to elsewhere on a regional scale. However, we think that thresholds may change with local emissions and thus are location-specific (see Lines 239-240). This could also be the case with significant changes (up to a 100% reduction) in VOC or NO_x emissions as in O_3 isopleth.

Comment 8: *The first row of Table 4 was incomplete.*

Response 8: Thank you for your comment. We have added names for Columns 1-2:

Table 4: Evaluation of the photochemical indicators in the YRD (unit of %).

Case	Indicators	ErrA_VOC	ErrB_VOC	ErrA_NO_x	ErrB_NO_x	OA
Sim_2017+Jiangsu	P_{H2O2}/P_{HNO3}	3.9	6.6	0.1	5.1	94.8
	$HCHO/NO_2$	2.9	5.7	0.0	5.1	94.9
	$HCHO/NO_y$	0.0	6.6	0.0	4.7	95.2
	NO_y	0.0	5.7	0.0	4.9	95.1
Sim_2017+Other	P_{H2O2}/P_{HNO3}	7.4	0.0	0.0	2.0	98.0
	$HCHO/NO_2$	2.2	0.0	0.0	1.7	98.3
	$HCHO/NO_y$	2.1	0.0	0.0	0.7	99.3
	NO_y	0.0	12.8	0.0	1.3	98.6

Sim_2018+Jiangsu	P_{H2O2}/P_{HNO3}	2.4	0.0	0.0	4.3	96.9
	$HCHO/NO_2$	0.0	0.8	0.0	7.0	94.8
	$HCHO/NO_y$	0.0	0.8	0.0	10.1	92.2
	NO_y	0.0	8.3	0.3	0.3	97.4
Sim_2018+Other	P_{H2O2}/P_{HNO3}	2.7	7.0	0.1	1.7	98.2
	$HCHO/NO_2$	6.2	14.3	0.1	1.6	98.0
	$HCHO/NO_y$	0.5	12.2	0.1	1.2	98.5
	NO_y	0.0	51.3	0.1	1.3	97.3

Comment 9: *Lines 450, 491, 521: The format of journal names should be consistent.*

Response 9: Thank you for your comment. We have updated the reference section.

References

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