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Interactive comment on “Hygroscopic and chemical characterisation of Po Valley aerosol” by J. Bialek et al.

Anonymous Referee #1

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This work presents data from an aerosol sampling campaign undertaken during the summer in Italy's Po Valley. The area is influenced by urban emissions transported from nearby cities and industrial areas, depending on local meteorology. Organic hygroscopicity was anti correlated with overall GF and total organic mass, suggesting formation of organonitrates or organosulfates. Further, a "more hygroscopic" mode is suggested to have split into a "less hygroscopic" and "barely hygroscopic" mode, suggesting potential hydrophobic coating. The paper presents excellent techniques applied to a new context (Po Valley), but the major findings connecting aerosol composition and hygroscopicity are not new. Nonetheless, the manuscript is suitable for publication in ACP after the authors address the reviewer comments, with particular focus on the "major" comments outlined below.

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Major Comments: 1. The authors suggest in the abstract (P 3249 lines 5-12) that the More Hygroscopic (MH) mode undergoes a "transformation" into a LH and BH mode. This statement implies that the aerosol particles that comprise the MH mode undergo some sort of physical or chemical process that changes some of them to LH and some to BH aerosol. It is highly unlikely that any process could selectively transform some particles to BH and some LH. While I think that condensation of organic, non- or less-hygroscopic coating material is a plausible explanation for the reduction of MH particles to LH, it is far more likely that the BH mode has some source other than transformation of MH particles. This result is explained in more appropriate language on page 3263 lines 1-6. Consider revising these specific conclusions presented in the abstract.

2. The authors use PMF factor analysis with "focus on a 5-factor solution." While a 5-factor solution appears to be appropriate for Case 2, it seems that Case 1 would be more appropriately described by a 4-factor solution. The OOA 1 and OOA 2 factors in Case 1 closely follow one another, suggesting that those two factors describe essentially the same variability in data and indicating that they would be best represented as a single factor. Is there a compelling reason why the authors applied 5 factors to Case 1? The authors might consider an appendix with details on the method for choosing the best PMF solution to describe variability in AMS data.

3. The authors do a thorough job of presenting main results of the study, but provide little physical explanation for the observed trends. For example, the maximum concentrations in case 2 occurred early in the morning, with a decrease in concentration after that. Meteorological data are available - is this the result of a shallow inversion? Consider adding brief statements following presentation of main findings that propose explanations for observed trends, in order to aid the reader in better understanding the factors affecting aerosol formation and hygroscopicity in the Po Valley.

4. It is an important result that GF is lowest when nitrate is highest. There is also significant HOA present during this time. It is possible that organosulfate/nitrate production or hydrophobic coating layers are responsible for this behavior, but these phenomena are

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typically photochemically produced. What mechanism do the authors suggest forms organonitrates/organosulfates or hydrophobic coatings at night?

Minor Comments:

Consider distinguishing times as Local Time (LT)

3248 Line 6-10 in abstract is confusing as written. consider rewording.

3248 Line 13-14 - Clarify what "low diurnal temporal patterns" refers to

3248 Line 16 - remove "to" in typically to 50% of the mass

3248 Line 17 - non-refractory mass

3249 1-10 - Do these results apply to both cases or just case 2? Please clarify which results are generally applicable to the to the entire study and which apply to just one case.

3250 22-29 - It would be helpful here to give a range of GFs previously reported for SOA.

3259 5 - "that" should be "than"

3259 6-14 - Is there size-resolved PTOF AMS data to shed light on these trends? I expect that inorganics dominate the larger sizes and organics the smaller sizes, but size-resolved data to confirm would be nice.

3259 22 - OOA1?

(related to Major Comment 3 above) Could precipitating systems in 4.1.2 have contributed to the decrease in aerosol mass in late morning during Case 2? Or is boundary layer deepening the major cause?

(related to Major Comment 3 above) Fig 3 - SV-OOA is typically considered a marker for early-generation SOA products. Why then does it show such little diurnal variability?

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