

Responses to RC#4

Line 41: "observations alone" -> "current earth observations alone"

Response: We thank reviewer's comment. After revisit the whole paragraph, we decided to maintain the original sentence because the first sentence of the paragraph points out "Earth system observations" and it mentioned "characterization of the Earth system state" in the later part of the sentence.

Line 79: remove "with minimal code development" as it is hard to quantify how much development effort is needed.

Response: It has been removed in the revised manuscript.

Line 104-105: remove the last redundant sentence: "With that extended capability, the current system description leverages parts of the entire JEDI framework"

Response: Thanks for catching this up. The repeated sentence has been removed.

Line 130: "IODA-compliant files" -> "the IODA format"

Response: It has been modified to "IODA format".

Line 132-133: remove "reduces the need for custom preprocessing scripts"

Response: The "reduces the need for custom preprocessing scripts" has been removed in the revision.

Line 134-135: "by simulating observation equivalent quantities to observations" -> "by simulating model equivalent to observations". Please use the commonly used "model equivalent to observations" throughout the manuscripts, which is also what used in the JEDI documentation.

Response: Thank you for pointing this out. This term has been modified to "model equivalents of the observations" or "H(x)" throughout the manuscripts.

Line 138: "pre- and post-processing tasks": This description adds confusion instead. Suggest removing "pre- and post-processing " and only keeping "tasks"

Response: Thank you. The sentence has been revised to "Beyond forward modeling, the UFO also handles tasks such as specifying observations error, quality control, and bias correction based on observation-minus-background and observation-minus-analysis quantities."

Line 139-140: remove the additional explanations inside the parentheses as OMB and

OMA are already clear enough.

Response: Both have been removed. Please see the revised sentence above.

Line 146: "This architecture keeps the interpolation process uniform ..." -> "This process is uniform..."

Response: Thank you for the suggestion. We decided to maintain the original sentence because "This architecture" refers the whole design of JEDI framework rather than the process mentioned in the previous sentence.

Line 150-151: "with only horizontal interpolation involved during the forward calculation": this part is confusing as it does not explain the literal meaning of "identity" and users may misunderstand that it does "horizontal interpolation" which is actually done at the GeoVaL step instead of UFO. Consider revising.

Response: Thanks for the suggestion. It makes sense. This part has been revised to "The identity operator in UFO is used to generate the $H(x)$ quantities at the surface. This operator as default directly extracts the lowest model level in GeoVaLs, which are interpolated horizontally to observation locations."

Line 154: remove "For additional ..." -> "Additional"

Response: "For" has been removed in the revision.

Line 162: What does "This design supports a consistent two-step assimilation methodology across multiple platforms" mean? What does "two-step" refer to?

Response: Thank you for detailed review and raising this up. After revisiting it, we found that the sentence was unintentionally added. Hence, the sentence has been removed from the manuscript.

Line 185: "To this end...": Suggest first briefly mention that JEDI provides lots of model interfaces and then introduce VIND. This will give users a better picture of JEDI and also why we need VIND.

Response: Thanks for the comment. This section has been revised to "... the generic algorithms available in JEDI. JEDI currently includes interfaces tailored to specific models such as MPAS and FV3. In contrast, the Versatile Implementation for Native Data (VIND; Ménétrier et al., 2026) provides model-agnostic implementations of all required interfaces for shared components except for the forecast step. As a result, ..."

Line 190-191: "Integrating a new modeling system into VIND requires little to no additional development": It is some kind of exaggeration with "little to no additional

development". Suggest at least removing "to no".

Response: Thank you for the suggestion. This has been revised to “little additional development”.

Line 211: It is unclear what the gap is "between research-oriented and operational verification practices" here. Either add more descriptions about the gap or remove the sentence after the comma.

Response: Thanks for the comment. To improve the clarity, the revised sentence is “Together, these components provide a unified evaluation framework in which atmospheric composition forecasts can be systematically compared with in-situ and satellite retrievals in operational verification practices.”

Line 268-269: Suggest using "Dark Target" and "Deep Blue" [or "Dark Target (DT)" and "Deep Blue (DB)"] directly throughout the manuscript.

Response: Thank you for pointing this out. DT and DB have been used instead, because they have been defined in section 3.5.

Line 294: "cycle" -> "cycling"

Response: Thank you. It has been revised.

Line 377: Remove the extra "more" after "because"

Response: The extra “more” has been removed.

Line 391: "observation equivalents": Usually $H(x)$ is called "model equivalent to observations". Suggest to use this phrase consistently throughout the manuscript.

Response: Thanks for the comment. “observation equivalents” has been revised to “model equivalents of observations” or $H(x)$ in the revision.

Line 412-413: "While model (weather and aerosols) fields, observation operator, and aerosol optical properties are identical for the $H(x)$ calculation, ": You don't try to mean the model fields are identical, right? Do you actually mean the same set of model fields are used? It looks like this part may be removed without any damage?

Response: Yes, we like to emphasize the identical parts in $H(x)$ calculations among each panel in Figure 7 and indicates the differences, so we decided to maintain the original sentence in the manuscript.