Response to Reviewer 2

We thank the reviewer for the careful reading of our manuscript and for the constructive and insightful comments.

Comment 1 (Page 2, Lines 10–11 "sea-level rise") *Reviewer: "I am curious if this is correct. Subsidence leading to damage, of course, as this applies to any constructed object, but I haven't heard of any submerging airport yet. In addition, what makes an airport different from any other man made object in this respect?"*
Response: We thank the reviewer for raising this point. We agree that the framing in the abstract was imprecise in implying imminent submergence. The primary concern is not literal inundation of the airport superstructure in the near term, but rather the progressive loss of freeboard in coastal protection infrastructure (levees, revetments), increased exposure to tidal flooding during storm events, and the compounding effect of subsidence on relative sea-level rise. Airports are particularly consequential in this context because they are large, low-lying, operationally critical facilities with strict surface tolerances and long capital replacement cycles that make adaptation costly. We have revised the abstract to read: *"…infrastructure degradation from land subsidence and its compounding effect on relative sea-level rise exposure and coastal flood risk…"* to clarify that the vulnerability is geomorphic and operational rather than implying imminent submergence.

Comment 2 (Page 6, Lines 150–151 stratigraphic nomenclature) *Reviewer: "…it is a bit of a hodgepodge. It contains age (old/young), lithology (mud), depositional environment (alluvial) and depositional mechanism (artificial)…"*
Response: We fully agree with the reviewer's observation. The nomenclature used (Young Bay Mud, Old Bay Mud, Holocene alluvium, Pleistocene alluvium, artificial fill) reflects the legacy classification system established in the source geotechnical investigations (Fugro, 2013; Baldwin et al., 2018), which mix lithostratigraphic, chronostratigraphic, and genetic criteria. Because this classification is embedded in the primary geotechnical record at SFO and used consistently in all subsequent engineering assessments for the airport, we are not in a position to modify it without risking inconsistency with the underlying data sources. We have added a clarifying sentence to Section 2.3: *"We note that this nomenclature is inherited from legacy geotechnical reports and blends lithostratigraphic, chronostratigraphic, and genetic criteria; it is retained here for consistency with the source data."*

Comment 3 (Page 6, Line 155 "feet") *Reviewer: "For a European journal you should express this in meters."*
Response: We agree. The sentence at Line 155 has been revised to: *"…with thicknesses ranging between approximately 6 to 21 meters across the airport…"* (converted from 20–70 feet at 0.3048 m/ft). All remaining instances of imperial units have been converted throughout the manuscript.

Comment 4 (Page 6, Line 160 "is the Holocene alluvium") *Reviewer: "So old mud is of Pleistocene age?"*
Response: Yes, this is correct. As documented in Fugro (2013) and Baldwin et al. (2018), the Old Bay Mud (or "Yerba Buena Mud") at SFO is a Pleistocene-age estuarine deposit, which is distinct from the overlying Holocene-age Young Bay Mud. The Holocene alluvium is interbedded between the two bay mud units. We have added a clarifying phrase to Line 156 to make the age explicit: *"The old bay mud, a Pleistocene-age estuarine deposit, comprising dense to very dense sand and silty sand and stiff to very stiff clay, is generally more consolidated than the overlying Holocene-age young bay mud..."*

Comment 5 (Page 6, Line 161 "the basal unit") *Reviewer: "The basal unit of what? Of unconsolidated sediments, so below that is bedrock?"*
Response: We thank the reviewer for catching this ambiguity. The Pleistocene alluvium is the basal unit of the compressible Quaternary sediment column at SFO, below which lies denser, effectively non-deforming material (competent Tertiary/pre-Quaternary substrate) that is not anticipated to contribute meaningfully to surface deformation under present loading conditions. We have revised Line 161–163 to read: *"...the Pleistocene alluvium forms the basal unit of the compressible Quaternary sediment column, consisting of moderately dense clay, silt, and sand with gravel (Fugro, 2013). This stratum marks the approximate lower boundary of significant deformation, below which competent pre-Quaternary material is present, defining the effective mechanical basement of the profile."*

Comment 6 (Page 10, Lines 227–228 transient mechanisms / precipitation) *Reviewer: "Might be worth checking precipitation data...there is a strong relation between the three [soil composition, InSAR, precipitation/drought]."*
Response: This is an excellent suggestion. We agree that seasonal and inter-annual precipitation variability, including drought-induced shrinkage and wet-season swelling of fine-grained fill and bay mud, is a plausible contributor to the short-term non-linearities observed in the time series, particularly the 2021 reversals. While a full precipitation-InSAR correlation analysis is beyond the scope of this study, we have expanded Lines 227–228 to include precipitation as an explicit candidate mechanism: *"These may include regional seismic activity, rapid changes in hydraulic head, seasonal precipitation-driven pore pressure fluctuations, or episodic surface loading changes."* We also cite the reviewer's referenced work (doi: 10.1109/IGARSS55030.2025.11242744.) as an example of InSAR-precipitation coupling in artificial soils.

Comment 7 (Page 10, Line 234 "geotechnic") *Reviewer: Strikeout correction to "geotechnical".*
Response: Corrected. "Geotechnic" has been changed to "geotechnical" at Line 234 and in the Figure 2 caption (Line 271).

Comment 8 (Page 10, Lines 250–252 heterogeneous subsurface architecture / international examples) *Reviewer: "See also Verberne's PhD work…and Italy…Also in Florida…Maybe good to mention international examples of differentially subsiding infrastructure in coastal plains in the Discussion."*
Response: We thank the reviewer for these valuable references. We have incorporated them into the Discussion section alongside a broadened comparative context. Verberne et al. (2023), Verberne et al. (2025) and the Sharma et al. (2025) are now cited in the Discussion in the context of differential subsidence over heterogeneous coastal fills. We agree that broadening the international framing strengthens the paper's appeal, and this is addressed further in our response to Comment 13 below.

Comment 9 (Page 10, Line 253 "feet") *Reviewer: "Feet are not used in Europe, so please replace with meters."*
Response: Addressed. As noted in our response to Comment 3, all imperial units have been converted to SI. The parenthetical "(1.5 to 21 meters)" was already present at Line 253; we have removed the original "feet" reference, so the sentence now reads exclusively in meters.

Comment 10 (Figure 2 caption CPTs + InSAR literature) *Reviewer: "There are several other papers combining CPTs with InSAR in coastal subsiding settings…also check D. Peduto's work…it is good to add more international cases."*
Response: We agree and thank the reviewer for the pointer to Peduto's work. We have added multiple references in addition to the Verberne studies cited in Comment 8 when discussing the integrated CPT-InSAR methodology in Section 3.3 and the Discussion. This positions our SFO study within an established and growing body of multi-sensor geotechnical monitoring literature, which strengthens the paper's contextual framing for an international readership.

Comment 11 (Page 12, Lines 281–284 lithology vs. construction year) *Reviewer: "I also think contrast in lithology plays a role. The oldest phase is on a marsh, which are often mechanically most weak — more clayey. The subtidal deposits are often more sandy — you could optionally check this with your data."*
Response: This is an insightful point. The reviewer is correct that paleoenvironment and lithology are not fully separable in our dataset: tidal marsh facies in the 1943 reclamation

zone are characteristically more clay-rich, while shell flat and tidal flat facies tend toward sandier, lower-compressibility compositions. We have added a sentence to Section 3.4 acknowledging this confounding: *"We note that construction year and paleoenvironmental facies are partially co-located, such that the contrasting settlement behavior attributed to construction era likely also reflects intrinsic lithological differences, specifically, the greater clay content and lower shear strength of tidal marsh substrates compared to the sandier tidal flat and shell flat environments. These effects cannot be fully disentangled with the current dataset, and a lithofacies-resolved analysis is identified as a direction for future work."*

Comment 12 (Page 12, Line 299 construction improvement assumption)
Reviewer: "In fig 3b I clearly see there is a difference in facies…You should address this as an explaining factor other than improvement of construction techniques, do you have documentation of that, or do you assume it?"
Response: The reviewer raises a valid concern. The statement that reduced settlement in the 1974 reclamation phase reflects improvements in ground preparation and fill compaction is an inference consistent with the general engineering history documented in Fugro (2013), which notes that later reclamation phases at SFO employed improved hydraulic fill placement methods and, in some areas, preloading. However, we do not have primary construction records that formally document compaction standards applied to each phase. We have revised the language at Lines 282–284 to be more epistemically cautious: *"…areas constructed in 1974 show minimal deformation, which may reflect a combination of improved fill emplacement practices in later reclamation phases (Fugro, 2013) and, as noted below, the comparatively firmer lithological character of the underlying shell flat and tidal flat substrates relative to the earlier tidal marsh zones."* This directly links construction year to both the documented reclamation history and the lithological confounding raised in Comment 11.

Comment 13 (Page 16, Line 357 Discussion: international airport cases)
Reviewer: "…it would be great to mention/discuss international cases. Famous sinking airports are Nice (France) and Hong Kong. Also Schiphol Airport (Amsterdam) is at present almost 5m below mean sea-level."
Response: We are grateful for these references and fully agree that embedding SFO within an international context significantly strengthens the paper's impact. We have added a paragraph to the Discussion comparing SFO's subsidence regime to international cases.