Academic Impact and Recovery in Utah During the COVID-19 Pandemic

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Dover, New Hampshire

February 4th, 2024

Executive Summary

The COVID-19 pandemic has been an unprecedented disruption to public education, with Utah's school system facing significant challenges. This study provides a detailed analysis of the academic impact and recovery patterns in Utah, utilizing data from the Readiness Improvement Success Empowerment (RISE), Utah Aspire Plus (UA+) assessments. Our approach categorizes academic recovery into three distinct groups — lagging, on par, and leading — to clarify the complex effects of the pandemic. The findings reveal a pronounced academic lag in mathematics compared to English/Language Arts across Utah's schools, with varying degrees of impact among different demographic subgroups and grade levels. Notably, the impact was widespread across all achievement levels, with lower-achieving students in middle school grades, particularly in mathematics, experiencing the most substantial setbacks.

Growth analyses for the 2022-2023 period in Utah assessed whether learning rates in the education system have rebounded to pre-pandemic levels, a crucial factor for recovering from the pandemic-induced educational losses. The data indicated that student growth in English/language arts and mathematics in Utah schools has largely returned to normal, suggesting stabilization. However, this stabilization falls short of the true recovery needed to counterbalance the steep learning declines experienced between 2019 and 2021. The study also highlighted that students in the lower achievement quintiles continue to demonstrate slower growth and recovery rates. These insights are critical for Utah's education policymakers and stakeholders, emphasizing the need for targeted interventions, especially for lower-achieving students, to ensure equitable educational recovery and advancement. In the face of these challenges, the pandemic presents a pivotal opportunity for Utah to strengthen its education system with a renewed focus on equity and resilience.

Introduction

The COVID-19 pandemic brought significant disruptions to education across the United States, critically impacting student learning. This period witnessed an unprecedented decline in educational attainment, both in Utah and nationwide. The challenges posed by the pandemic-induced shift to remote learning and the ensuing instability in educational environments contributed to these declines. Recognizing the gravity of the situation, the Utah State Board of Education took proactive measures to assess the extent of the impact.

In response to this educational crisis, the Utah State Board of Education commissioned a comprehensive report in the Fall of 2020. This report aimed to leverage data from the state's 2021 RISE and UA+ assessments to evaluate the degree of learning loss among students. The findings of this report were pivotal in understanding the initial impacts of the pandemic on education. Following this,

Utah has commissioned two additional reports to monitor the ongoing situation. These reports focus on the extent of recovery, tracking how students in Utah are rebounding from the initial setbacks caused by the pandemic. The continuous analysis signifies the state's commitment to addressing the educational challenges and supporting student growth during these unprecedented times.

This report documents student performance in Utah at the 3 year mark since the beginning of the pandemic providing details on the extent to which students in Utah are recovering. It offers a comprehensive analysis of the progress made since the onset of the pandemic, charting the trajectory of student performance over time. This report delves into various metrics derived from statewide summative testing, comparing current data with pre-pandemic levels to gauge recovery in academic achievement. Importantly, the report highlights areas where progress is being made, as well as those that require further attention and resources. This ongoing assessment is crucial in informing policy decisions and educational practices, ensuring that the needs of all students are met as the state navigates the post-pandemic educational landscape.

Data & Analyses

The academic impact of the COVID-19 pandemic on student learning and recovery is a multi-faceted issue, defying a one-size-fits-all approach. This study is designed to provide Utah's educational stakeholders with actionable insights into the pandemic's academic repercussions. It aims to offer a deeper understanding of student performance during this period by identifying the specific groups of students affected, the content areas where the impact was most significant, and the magnitude of its impact as well as the recovery from those impacts. Grasping the full scope of COVID-19's influence on learning is a challenging yet essential undertaking to ensure that students receive the appropriate educational support they need.

To effectively discuss academic impact and recovery, it is crucial to make comparisons to a hypothetical scenario where the pandemic did not occur. This approach helps to address the critical question: Where would students be academically if the pandemic had never happened? The pandemic, along with the disruptions it caused to traditional learning environments, acted as a headwind, impeding students' academic progress from March 2020 through the 2020-2021 school year. This situation can be likened to a commuter delayed by an unexpected rainstorm. In the same way that we might speculate where the commuter would be if the storm had not occurred, we can use historical performance data to understand typical, pre-COVID student progress and compare this to actual progress made during the pandemic. This comparison allows us to gauge the extent to which the pandemic has slowed academic progress.

In this context, the pandemic has acted as a significant headwind. Consequently, the aim of educational programs and support initiatives is to create an academic tailwind. These efforts are designed to accelerate learning and help students catch up to the academic standing they would likely have achieved in the absence of the pandemic's disruptions.

The Utah State Board of Education (USBE) plays a crucial role in this endeavor, collecting high-quality assessment data that is instrumental in understanding student learning and achievement during the pandemic. This data also informs the state's and local districts' strategies for supporting learning recovery. This study quantifies changes in student academic performance, considering both achievement and growth. It does so by utilizing comprehensive, current, and historical assessment data from two key sources: the Utah Readiness Improvement Success Empowerment (RISE) and Utah Aspire Plus (UA+) assessments for summative assessment. These two assessment programs ensures a thorough analysis of the pandemic's educational impact across different student demographics from elementary through high school grades.

RISE Data from the RISE summative assessment are available for students in grades 3 through 8,

covering English/language arts and mathematics for the years 2021, 2022 and 2023. The RISE assessment scheduled for the spring of 2020 was canceled due to the COVID-19 pandemic. Consequently, the data from the spring 2019 RISE assessment serves as the pre-pandemic baseline for analyzing the pandemic's academic impact.

UA+ The UA+ assessment data encompass grades 9 and 10. Like RISE, the 2020 UA+ assessments were cancelled and the 2019 data provide the pre-pandemic point of comparison for analyses involving these assessments.

This study categorizes the pandemic into two broad phases for a structured analysis:

Impact Phase: The Impact Phase marks the onset of the pandemic, beginning in the latter part of the 2019-2020 academic year. This period was characterized by sudden and unprecedented disruptions to traditional educational practices, resulting in significant changes to teaching and learning processes.

Recovery Phase: The Recovery Phase commences with the 2021-2022 academic year. This phase represents a period of adaptation and response to the challenges posed by the pandemic, with a focus on regaining lost educational ground and implementing new strategies for learning.

The terms "Impact" and "Recovery" are used with a certain level of abstraction, as the actual extent to which students were affected by the pandemic and the nature of their recovery are empirical questions. For instance, it is possible that some students continued to experience educational setbacks during what is termed as the "Recovery Phase." Nonetheless, the 2021-2022 academic year is optimistically labeled as the Recovery Phase, with the expectation that it marked the beginning of a period where students started to regain lost academic ground.

With the onset of the pandemic in Spring 2020, remote education — where students attended classes virtually from home — became a widespread practice across the United States. This shift in the mode of education, combined with various other pandemic-induced challenges, created an unprecedented crisis in Utah's education system, affecting its students in a myriad of ways. The impact was not just academic; it encompassed economic, physical, and emotional dimensions, leaving a significant imprint on the educational landscape. Even now, the evolving situation with coronavirus variants continues to influence educational processes. The disruptions have been complex and far-reaching, affecting all aspects of the educational ecosystem.

In examining the Impact and Recovery phases, the series of three analyses produced thus far explored several research topics:

Student Population and Test Participation: This research topic delves into the demographics of Utah's student population, aiming to identify those who are included in the available academic impact/recovery data. It seeks to answer key questions about the composition of the student body: Who are the students in Utah's education system, and what is the subset of this population for which we have data to analyze the academic impact/recovery?

Academic Impact: This area of study focuses on evaluating the extent of COVID-19's disruptions on student academic performance and learning outcomes. It examines the impact during the critical period encompassing the latter part of the 2019-2020 academic year and the entire 2020-2021 academic year. The research will explore various dimensions: What content areas or domains were most affected? Which demographic groups, academic cohorts, individual schools, and school districts bore the brunt of these academic impacts? Additionally, the study will attempt to estimate the anticipated time required for academic recovery, taking into account the extent of disruptions caused by COVID-19.

Academic Recovery: This segment investigates the extent of academic recovery that students experienced during the 2021-2022 academic year following the initial impact of the pandemic. It aims to understand the areas of content where significant recovery was observed and to identify the groups – including different demographics, academic cohorts, schools, and school districts – that showed signs of academic recuperation. The objective is to gauge the recovery progress across various sectors of the education system in the wake of the pandemic.

Strategizing for effective recovery from the academic impacts of the COVID-19 pandemic necessitates a thorough understanding of the nature and extent of these impacts. In this context, the impact and recovery phases of the project are intrinsically linked and mutually informative. To mitigate the academic setbacks caused by the pandemic effectively, it is crucial to comprehend the specifics of these impacts. This understanding will inform targeted support, ensuring that resources are allocated efficiently and effectively. The key aspects to be addressed include:

Who? Identifying the students who were academically impacted by the pandemic is vital. This involves analyzing the demographics and characteristics of the affected student populations to tailor recovery strategies appropriately.

What? Understanding the specific content areas where students experienced academic setbacks is essential. This knowledge helps in focusing recovery efforts on the most affected subjects and skills.

How Much? Quantifying the extent of academic impact is crucial for gauging the severity of the setbacks and planning the necessary interventions to address them.

From the onset of the pandemic, Utah continues to be in a strong position to address these questions, thanks to its comprehensive data collection from annual state assessments. The state summative assessments in English/Language Arts (ELA) and mathematics, administered annually to students in grades 3 to 10, provide high-quality data on academic achievement. These data are instrumental in understanding the academic impact of the pandemic on students. In this report, we present a detailed analysis of data from Utah's assessment systems. The analysis aims to determine the extent of the academic impact and the subsequent recovery experienced by students, providing a comprehensive view of the educational landscape in Utah during and after the pandemic.

Student Population and Test Participation

As highlighted in previous reports, a notable consequence of the pandemic's disruptions to education was changes in student enrollment and test participation. Specifically, in 2021, participation rates on state assessments were depressed due to the pandemic. Understanding the nuances of these changes is critical for accurately interpreting student academic performance on assessments. This includes considerations of status (also referred to as achievement or attainment), trend, and growth. Utah, unlike many states, experienced a relatively modest drop in overall public school student enrollment in 2021. Based upon publicly available data on the USBE website (https://schools.utah.gov/datastatistics/reports) October 1st enrollment in the 2019-2020 school year in Utah stood at 666,858. In the following year, after the onset of the pandemic, 2020-2021 public school enrollment in Utah was 665,306.

However, more significant for the determination of academic impact is student participation in assessment data collection. Comprehensive educational assessments like RISE and UA+ are pivotal for understanding the academic performance of students and, consequently, investigating the academic

impact of the pandemic. Both assessments, crucial for this study, maintained excellent participation rates in the years 2021, 2022, and 2023, comparable to the participation in 2019 and 2020.

To estimate the impact and recovery associated with the pandemic, we utilize two complementary approaches to hypothesize where students would have been academically had the pandemic not occurred (these hypothetical scenarios are often referred to as counterfactuals). The two methods for calculating these counterfactuals are:

Status: Have Students Recovered This approach involves comparing the academic status (i.e., academic attainment) of similar groups of students before and during the pandemic. For instance, we compare the pre-pandemic status (e.g., percent proficient in 2019) of Grade 5 students in ELA with their pandemic counterparts in 2023. Have levels of student attainment returned to pre-pandemic levels?

Growth: Has the System Recovered This method compares the growth of students from 2018-2019 to 2022-2023 (growth impacted by the pandemic) with the growth of students from 2018 to 2019 (growth not impacted by the pandemic). An example is comparing the median student growth percentile (SGP) in 2019 for Grade 5 students in ELA with their pandemic counterparts in 2023 (Betebenner, 2008a; Betebenner, Iwaarden, Domingue, & Shang, 2024). Have rates of student learning sustained by the education system returned to normal?

The two approaches employed in this study address complementary aspects of academic recovery from the pandemic. The status approach, which is more commonly reported, evaluates whether students in a specific grade and content area are performing at levels comparable to those seen before the pandemic. In essence, pre-pandemic levels of achievement serve as a conservative estimate, or counterfactual, of where students might have been in terms of attainment had the pandemic not occurred.[1] This method of comparing achievement levels primarily addresses the question: Have students recovered to pre-pandemic levels of performance?

On the other hand, examining present growth rates in comparison to pre-pandemic growth provides insights into whether learning rates have returned to their pre-pandemic norms. It is established that learning rates significantly declined during the height of the pandemic. For students to catch up to the levels of attainment they would have achieved without the pandemic's interruption, their current growth must not only return to pre-pandemic rates but ideally exceed them, to compensate for the initial slowdown. At the very least, we would expect to see growth rates revert to pre-pandemic levels. Such a trend would suggest a recovery at the system level, although it might not yet be sufficient to indicate a full recovery at the student level.

To address the question of who is recovering (and to what extent), analyses were conducted across several relevant demographic/academic groupings including:

- Content Area by Grade (Recovery results beginning on page 23.)
- Content Area by Grade by Ethnicity (Recovery results beginning on page 40.)
- Content Area by Grade by Special Education Status (Recovery results beginning on page 105.)
- Content Area by Grade by Socio-Economic Status (Recovery results beginning on page 138.)
- Content Area by Grade by English Language Learner Status (Recovery results beginning on page 122.)

[1] Generally, using pre-pandemic levels of attainment as a benchmark is a *very* conservative approach to estimate where students would be today had the pandemic not occurred.

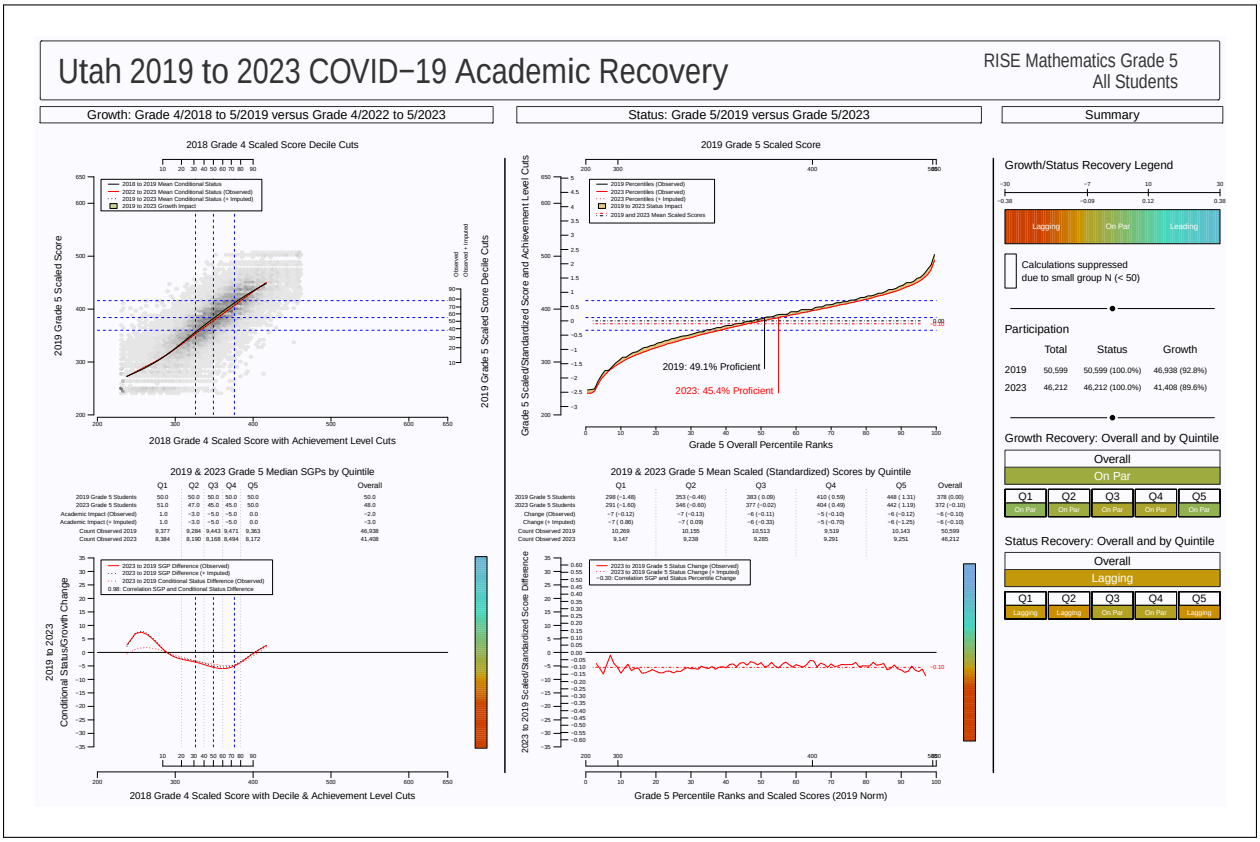

Figure 1: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 5 mathematics

- Content Area by Grade by Gender (Recovery results beginning on page 155.)

As will become apparent when examining the results referenced above, the sheer number of permutations possible in terms of who was impacted leads quickly to an overwhelming amount of information for a state department of education to both understand and take action on. Our effort in summarizing the academic impact results has been to make the results as parsimonious as possible so that all audiences can understand the outcomes.

To that end, the simple conceptual understanding of academic impact as a slowdown in student learning and academic recovery as a speedup can be tricky to communicate, especially to non-technical stakeholders. To help with understanding both student growth and status, we constructed visualizations to depict the slow down along with relevant statistics and summaries. Figure 1 illustrates academic impact using the Utah RISE data in terms of growth (left sub-figures) and status (right sub-figures).

The status and growth approaches each address distinct aspects of academic recovery. Status comparisons evaluate whether current students are reaching achievement levels comparable to their pre-pandemic peers. This method essentially seeks to answer whether students are attaining at levels they might have achieved if the pandemic had not occurred. On the other hand, growth comparisons focus on the rates of student learning, investigating whether these rates have reverted to pre-pandemic norms. While returning to normal, pre-pandemic rates of learning is essential, it may not be sufficient to fully compensate for the initial learning losses incurred. However, monitoring these rates is crucial in assessing whether students are on a trajectory to catch up.

The applicability of the status comparison is broad, extending across all grades and content areas. In contrast, the growth comparison is contingent upon the availability of growth data. For the RISE

and UA+ annual state assessments, growth data in 2023 is accessible for grades 4 through 10.

An important distinction to note is that growth comparisons typically involve the same set of students over time, whereas achievement comparisons often involve two different cohorts of students. This difference raises the possibility of selection bias in achievement comparisons, particularly if the cohorts differ significantly in key characteristics. Growth analyses are generally less susceptible to such bias and represent a more robust technical approach for assessing academic impact when data are available. In this study, both the status and growth approaches are employed to provide a comprehensive analysis of academic recovery.

To facilitate a clearer understanding of academic recovery, this analysis categorizes recovery into one of three distinct categories, based on the magnitude of recovery observed. These categories are applied to each demographic and academic group, with recovery assessed both overall and within specific achievement quintiles. The quintile breakdown provides insights into the uniformity of recovery across different achievement levels within each group. The categories for academic recovery are defined as follows:

Leading Indicates a significant recovery, where either the Growth Recovery in State Assessment is equal to or exceeds 10, or the Status Recovery in State Assessment is 0.12 or higher.

On Par Represents a moderate level of recovery, with Growth Recovery in State Assessment ranging between -7 and 10, or Status Recovery in State Assessment falling between -0.09 and 0.12.

Lagging Signifies a minimal or negative recovery, where Growth Recovery in State Assessment is less than or equal to -7, or Status Recovery in State Assessment is -0.09 or lower.

In the subsequent subsections, we delve into the methodologies used to calculate both growth and status impacts and recoveries. This includes detailing the specific metrics and benchmarks employed to assess and categorize the academic recovery of various student groups.

Status

To assess the increases or decreases in student assessment status, we calculate the equi-percentile change in status between two student cohorts: one pre-pandemic and the other during the pandemic. This is defined as:

$$\text{Status Impact} \equiv (\text{Scale Score}_{pre-pandemic} - \text{Scale Score}_{pandemic} | \text{Pre-pandemic Percentile Rank})$$

For instance, to analyze the status recovery in Grade 5 mathematics, we compare the scale score differences on the RISE assessment between 2019 (pre-pandemic) and 2023 (post-pandemic) at each percentile. The upper right panels of Figure 1 demonstrate this by illustrating the status impact for Grade 5 mathematics. These panels plot the 2019 and 2023 empirical cumulative distribution functions (ECDFs) and highlight the scale score change from 2019 to 2023 as a function of percentile rank. The area between these two ECDFs is shaded red, underscoring the observed decreases in scale scores between the two cohorts.

Moreover, the upper right panel also presents the achievement level cut-scores for Grade 5 mathematics as horizontal, blue, dashed lines. Changes in the percentage of students achieving proficiency are visible through the horizontal distance between the points where the two ECDFs intersect the proficiency cut-score line. Additionally, the mean scale scores for both the 2019 and 2023 cohorts are depicted, with the vertical distance between these lines representing the average scale score decrease.

The lower right panel of Figure 1 further elucidates these points by showing the actual scaled score and standardized scaled score differences observed in the top panel, between the 2019 and

2023 ECDFs. Summaries at each of the five quintile levels and an overall summary are provided, illustrating the variation in status impacts across different levels of student achievement.

Growth

To analyze student assessment data decreases with regard to growth, we compute the decrease in

$$\text{Growth Impact} \equiv \text{Median SGP}_{pre-pandemic} - \text{Median SGP}_{post-pandemic}$$

Student growth percentiles (SGPs) are conditional status percentiles utilizing up to two prior achievement scores. The upper left panel of Figure 1 is a scatterplot illustrating the grade 4 versus grade 5 scores of students. Superimposed on the scatter plot are two conditional splines: 2018 to 2019 (pre-pandemic) and 2022 to 2023 (post-pandemic). Pre-pandemic the observed grade 5 scores exceeded those of what was seen in 2023 during the pandemic recovery. The difference between these curves represents ongoing academic impact of the pandemic on student growth.

The lower left panel illustrates the decrease observed between the two conditional splines. Student growth percentiles associated with the pre-pandemic (2018 to 2019) and recovery (2022 to 2023) years are shows in the upper access. The SGPs are given by quintile as well as overall. Like with the status plots, the growth plots also show imputed data in terms of a 2023 conditional spline that is based on both the observed plus imputed scores. The lower panel shows the results for the imputed values as well.

Methodology

As discussed previously, examination of student academic impact and recovery relies heavily on the SGP growth model that Utah has used since 2011. Conceptualizing the pandemic as a headwind that decreased the learning velocity of students due to all of the edu-disruptions that occurred, it is necessary to have a growth model capable of examining decreases and increases in learning velocity (i.e., student growth) so as to understand whether and the extent to which impact/recovery is taking place.

In this section we describe the student growth percentile methodology. In general, SGPs are norm-referenced quantities that describe the rate of learning associated with a students as compared to students sharing the same academic scale score priors. In most operational situations, academic peers constitute the current group of students in the state so that the growth norms calculated are created from the current group of students. However, over the course of development of the SGP methodology, several states have desired to have the the growth norms fixed to a baseline cohort of students. These so called baseline SGPs have the capacity to detect whether student learning is accelerating/decelerated as they are anchored to a historical group of students.

For purposes of examining academic impact/recovery, we created historical growth norms for students from pre-pandemic data. Historical growth norms were created for skip year 2019 to 2021 analyses using 2017 to 2019 data, and also for consecutive year analyses using 2018 to 2019 data. These growth norms are the foundation of the growth analyses performed.

Please see Appendix: Growth Model beginning on Page 188 for a technical discussion of the SGP methodology.

Results

The communication of academic impact and recovery frequently relies on statistics commonly associated with state assessment systems. This discussion typically begins with basic descriptive results pertaining to both status and growth metrics. Student achievement data, often reported

as student proficiency, is a key metric derived from academic assessments. These data are usually summarized at various levels — school, district or state — indicating the percentage of students scoring proficient. Changes in this percentage are often utilized in setting goals within educational accountability systems.

In the context of pandemic-related academic recovery, a common approach for laypeople is to compare student performance before the pandemic to their current standing. This is most commonly done by examining changes in the percent proficient, which attempts to quantify how far students are "behind" their expected performance had the pandemic not occurred. It is important to note that state assessment systems tend to improve over time, suggesting that an accurate counterfactual scenario might show current proficiency levels several percentage points higher than those observed in 2019.

The significant academic impacts on students uncovered in earlier studies, coupled with Utah's commendable participation rate in assessments, render changes in percent proficient a useful, albeit crude, indicator of the extent of the the pandemics impact on students. In our in-depth analysis of the data, we did not solely rely on changes in percent proficient. Instead, we supplemented this with analyses of mean scale score differences. These differences were evaluated both in their unweighted form and after applying propensity score weighting, allowing us to express changes in terms of effect size. This comprehensive approach provides a more nuanced understanding of the academic impacts, offering insights that go beyond basic proficiency percentages and delve into the subtleties of scale score variations and their implications for educational recovery and policy.

RISE and UA+ achievement

In comparing the 2023 to 2019 RISE results across various grades, content areas, and demographic student groups, the data consistently reveal steep declines in both percent proficient and mean scale score. These achievement-based (i.e., status) comparisons offer insight into the extent of recovery, or lack thereof, to pre-pandemic levels of achievement.

- Between 2019 and 2023, declines in percent proficient ranged from 6.2% to 8.6% in English/language arts and from 9.2% to 13.4% in mathematics. However, from 2021 to 2023, these declines slightly moderated in English/language arts and more noticeably in mathematics. The overall declines from 2019 to 2023 in English/language arts ranged between 4.2% and 9.3%, and in mathematics, they ranged from 4.8% to 9.2%. For context, historical year-over-year improvement in percent proficient in Utah typically falls between 1% and 2%. Had the pandemic not occurred, the declines in achievement currently being seen would likely be 3% to 7% larger.

- The effect size declines based on mean scale score decreases from 2019 to 2023 were statistically significant, ranging between 0.2 and 0.4, varying by grade and content area. From 2019 to 2023, the effect size declines in English/language arts ranged from 0.15 to 0.38, indicating a continued but somewhat ameliorated impact.

These results highlight that the decreases in student achievement in Utah between 2019 and 2023 were significant during the initial phase (the impact phase) of the pandemic and remain considerable even as students have returned to traditional learning environments. The declines were more pronounced in mathematics than in English/language arts but were notable across all demographic student groups, reflecting a widespread and uniform impact.

Further analysis is required to understand the underlying factors contributing to these trends and to develop targeted strategies for mitigating these impacts. Such strategies may include focused interventions in specific grades or content areas where declines are most pronounced, as well as tailored

support for demographic groups that have been disproportionately affected. The ultimate goal is to not only restore students to pre-pandemic achievement levels but also to implement sustainable practices that foster continuous improvement and resilience against future disruptions.

Growth

The investigation into the pandemic's impact and subsequent recovery on academic growth focused on both RISE and UA+ data, utilizing historical student growth data for each. The aim was to assess the degree to which student academic growth decelerated during the impact phase (2019 to 2021) and potentially accelerated in the recovery phase (2022 and beyond). While changes in achievement, as discussed previously, indicate whether students have individually recovered, shifts in growth metrics serve as indicators of the broader education system's recovery. Essentially, this analysis seeks to determine if the education system has returned to generating learning gains at levels comparable to those seen before the pandemic.

The following sets of data were employed in the analysis of student growth:

- UA+ growth data spanning from 2019 to 2021, 2021 to 2022, 2022 to 2023 (excluding 2020, when UA+ was not administered) for Grades 9 and 10.
- RISE growth data from 2019 to 2021, 2021 to 2022, and 2022 to 2023 (excluding 2020, when RISE was not administered) for Grades 4 to 8 in English/language arts and mathematics (except 2021 when grades 5 to 8 were analyzed).

To gauge the pandemic's impact on learning, historical growth norms, represented by baseline student growth percentiles (SGPs), were used. These norms serve as a benchmark to measure the extent of learning slowdown during the pandemic. The pre-COVID base year of 2019 was used to establish these historical growth norms.

In these historical growth norms, the median SGP for the population is, by definition, 50, signifying that, prior to the pandemic, the average rate of student growth in the state was at this median level. Deviations from this median, particularly those below 50, are indicative of the extent to which student learning has been hindered by the pandemic. This approach allows for a nuanced understanding of the pandemic's impact on educational progress across different grades and subject areas. In particular, impacts on individual student growth would show up as values below 50 whereas levels above 50 would constitute rates of learning in excess of what was seen pre-pandemic.

RISE and UA+ growth

Utah growth data indicates a considerable academic impact due to the pandemic, with the effects being more pronounced in mathematics than in English/language arts.

- Across various grades, the median baseline SGPs in English/language arts showed a decline of 10 to 11 points from the baseline of 50 in 2019. In mathematics, the decline was more significant, ranging between 19 and 22 points. The decreases in English/language arts correspond to medium effect sizes, while those in mathematics are considered large. Despite some recovery in 2022 and 2023, growth rates hovered slightly below 50 across several grades and content areas, which has not been sufficient to fully catch students up.
- Analyzing by ethnicity, the decreases in median baseline SGPs in English/language arts varied from 10 to 14 points, while in mathematics, the range was 19 to 24 points.

- In terms of free/reduced lunch status, the decline in median baseline SGPs in English/ language arts was between 9 and 12 points, and in mathematics, it was between 19 and 20 points.
- For students with special education status, the decrease in median baseline SGPs in English/language arts was 11 points, whereas in mathematics, it was 7 points, decreasing from 36 in 2019 to 29 in 2021. This modest decrease in mathematics suggests that growth rates prior to the pandemic were already limited, thus the pandemic's impact was relatively less pronounced.
- English learners experienced a decrease of 14 points in English/language arts and 19 points in mathematics in median baseline SGPs.
- Gender-wise, the decrease in median baseline SGPs for males in English/language arts and mathematics were 12 and 17 points, respectively. For females, the decreases were 10 and 22 points, respectively.
- Considering the mode of instruction, the decreases in median baseline SGPs for English/language arts were 8, 11, and 17 for Hybrid, In-Person, and Remote settings, respectively. In mathematics, the decreases were more dramatic at 23, 14, and 32, respectively.
- When grouping students by their starting scale score decile in 2019, varying levels of academic impact were observed, dependent upon grade and content area. Notably, in middle school mathematics, higher-achieving students showed greater academic impact than their lower-achieving peers.
- Schools and school districts demonstrated a wide range of academic recovery, with some lagging behind while others are leading.

This comprehensive analysis reveals the multifaceted nature of the academic impact caused by the pandemic and the varying degrees of recovery across different student groups, school settings, and instructional modes.

Visualization of results

The data presented thus far elucidate the academic impact and recovery patterns discerned from the analysis of two assessment systems. To facilitate a clearer understanding of these complex results, we have employed visualizations that categorize academic recovery into three groups: lagging, on par, and leading. Specifically, Figure 2 offers an overview of student recovery, highlighting achievement differences from 2019 to 2023 across various grades and content areas in RISE, along with detailed subgroup analyses. A careful examination of this figure reveals key areas where students continue to experience lag due to the pandemic's impacts.

Key insights from this analysis include:

- A more pronounced academic lag in mathematics compared to English/Language Arts, although impacts in ELA were still significant.
- The extent of lag varied among demographic subgroups, with Hispanic students, for example, showing the largest lags in ELA.
- The academic impact in mathematics was more severe in middle school grades compared to elementary grades. Conversely, in ELA, elementary grades faced greater impacts than middle school grades.

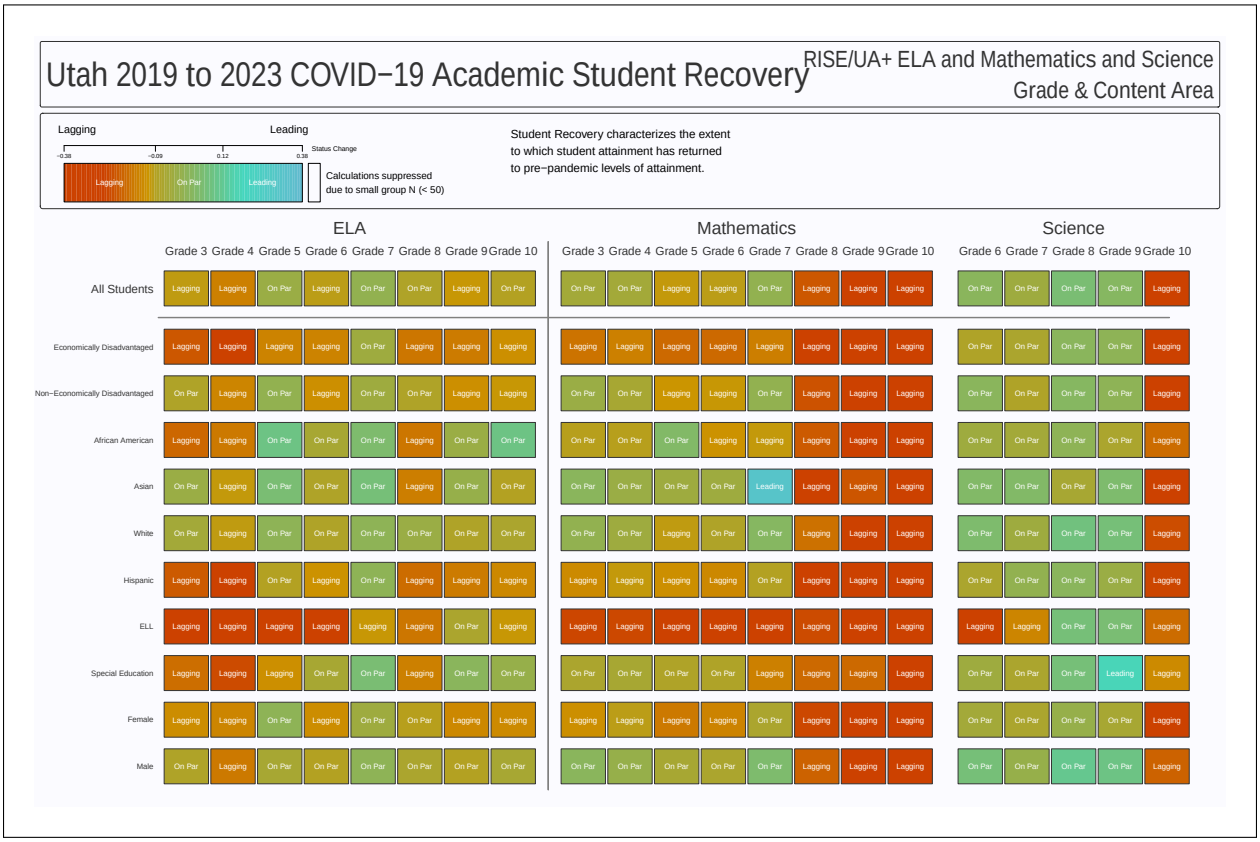

Figure 2: RISE Academic Student Impact/Recovery Overview for all students and student subgroups by grade and content area

Each rectangle in Figure 2 correlates with a detailed academic achievement impact result found in the Appendix, starting on page 23. For example, comprehensive results for Grade 8 mathematics are explored in Figure 23.

Delving deeper, Figure 2 is further segmented by achievement quintiles for each group represented. This dissection aims to ascertain the relationship between academic impact and students' achievement levels. Figure 3 presents these findings.

Each demographic subgroup is represented by two adjacent rows of rectangles in the visualization. The bottom row denotes within-demographic subgroup quintiles, while the top row illustrates demographic quintile subgroups defined by all students in the grade and content area. The width of the rectangles in the upper row reflects the proportion of students within the demographic subgroup belonging to that quintile. For instance, wider rectangles in the row associated with Asian students in the top quintile imply a disproportionate representation of Asian students in the highest achievement quintile for that grade and content area.

This approach not only simplifies the interpretation of complex datasets but also provides critical insights into the nuanced patterns of academic recovery across different student groups, grades, and subjects.

A crucial insight gleaned from visualizing these results is the disparate impact of status across the achievement spectrum. Notably, in almost all grades and content areas, lower achieving students lag further behind than high achieving students. An exception to this is in middle school mathematics students in the middle of the distribution are furthest behind.

In the 2022-2023 growth analyses, we assess how the education system's current rates of learning

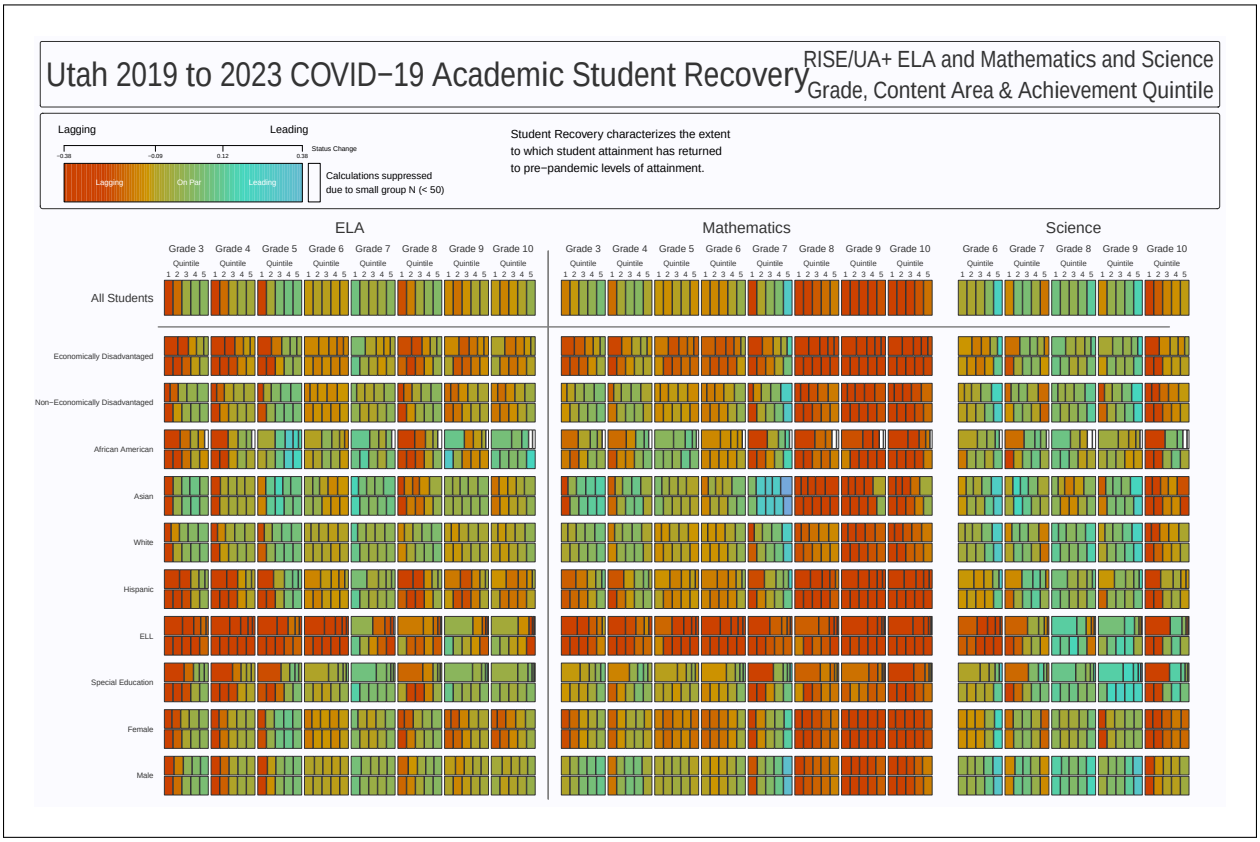

Figure 3: RISE Academic Impact Overview for all students and student subgroups by grade, content area, and achievement quintile

compare to those before the pandemic. The ideal scenario would see the system fostering higher learning rates than those pre-pandemic, as increased rates are crucial for helping students catch up to the academic standing they would have achieved without pandemic-related disruptions.

Figure 4 provides an overview of student growth from 2022 to 2023 relative to pre-pandemic growth rates. The data indicate that student growth in Utah in English/language arts and mathematics has largely reverted to pre-pandemic norms, signifying a state of stabilization. However, this stabilization must be contextualized within the backdrop of significant learning declines between 2019 and 2021. Thus, while achieving pre-pandemic growth rates is a positive development, it does not equate to the full recovery necessary to offset past learning losses.

The variation in growth is particularly evident when analyzing different achievement quintiles. In Figure 5, growth results are dissected both overall and across subgroup achievement quintiles. A detailed examination of these figures reveals that lower quintiles are marked with darker shades, indicating lower growth rates. This suggests that students in lower achievement quintiles are experiencing slower rates of growth and recovery compared to their higher-achieving counterparts. Such trends highlight the disproportionate impact of the pandemic on lower-achieving students and underscore the need for targeted interventions to support these learners effectively.

This nuanced understanding of growth patterns is instrumental in shaping policies and practices that are responsive to the varied needs of students across different achievement levels, ensuring equitable support and opportunities for recovery and advancement.

The analysis of academic impact and recovery, derived from two assessment systems, provides vital insights into the educational landscape post-pandemic. Visualizations categorizing academic

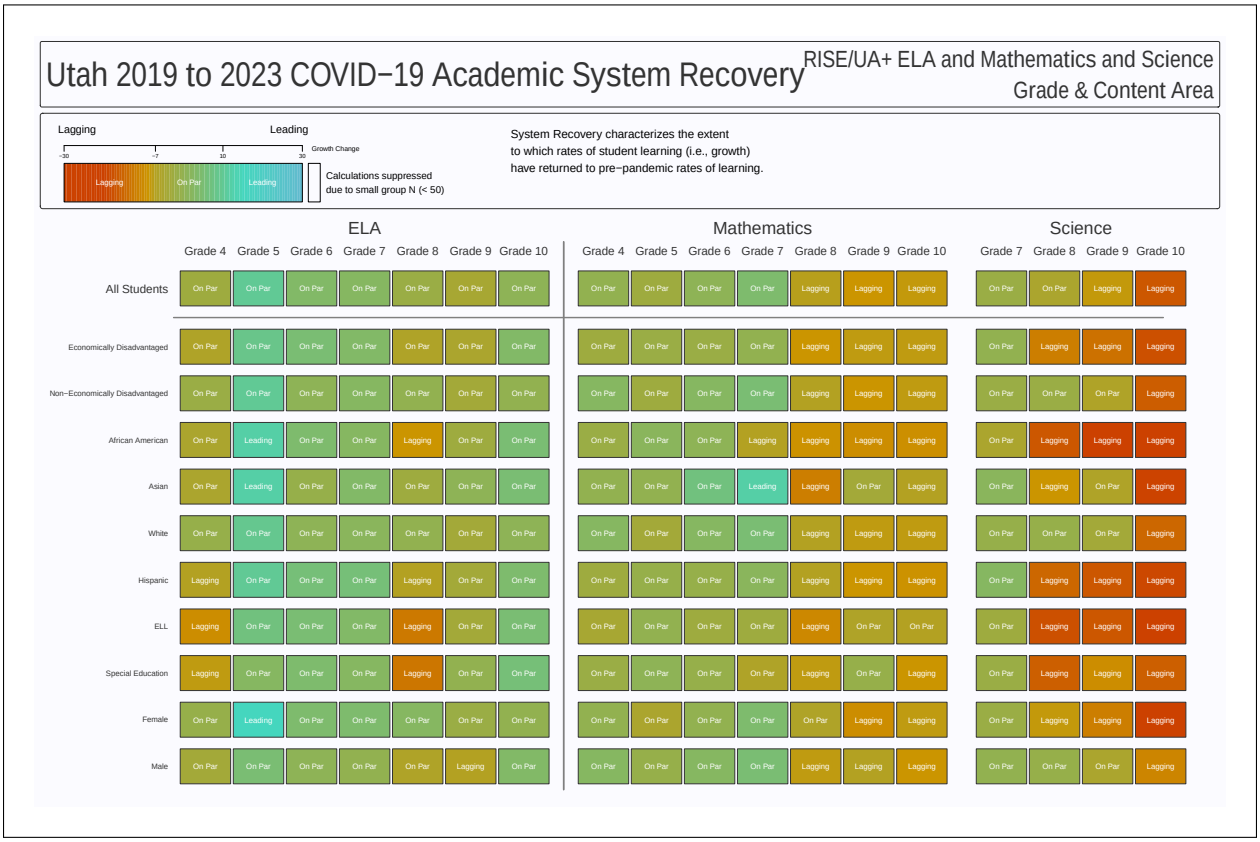

Figure 4: RISE Academic Recovery Overview for all students and student subgroups by grade and content area

recovery into three distinct groups — lagging, on par, and leading — have simplified the interpretation of complex data sets. Specifically, Utah data from 2019 to 2023 highlight key areas of lag in student achievement due to the pandemic's impacts. Notable findings include a more pronounced academic lag in mathematics compared to English/Language Arts, varying degrees of lag among different demographic subgroups, and the severity of impacts differing across grade levels.

The Utah data, presented in figures such as Figure 2 and Figure 3, demonstrate disparities across the achievement spectrum. For instance, lower-achieving students in most grades and content areas lagged further behind compared to higher-achieving students. Middle school mathematics was an exception, where students in the middle of the distribution were most impacted. UA+ analyses suggest that students were roughly on par with their pre-pandemic counterparts across almost all grades.

The 2022-2023 growth analyses aimed to assess whether current learning rates in the education system matched or exceeded pre-pandemic levels, crucial for compensating for the learning losses incurred during the pandemic. Despite the stabilization of growth rates in English/language arts and mathematics, as shown in Figure 4, this stabilization alone is insufficient for a full recovery from the substantial learning drops experienced between 2019 and 2021.

Furthermore, the growth analysis, particularly in Figure 5, revealed that students in lower achievement quintiles are experiencing slower recovery rates, emphasizing the need for targeted support. This comprehensive understanding of growth patterns is essential for developing policies and interventions that address the diverse needs of students and ensure equitable educational recovery and progress.

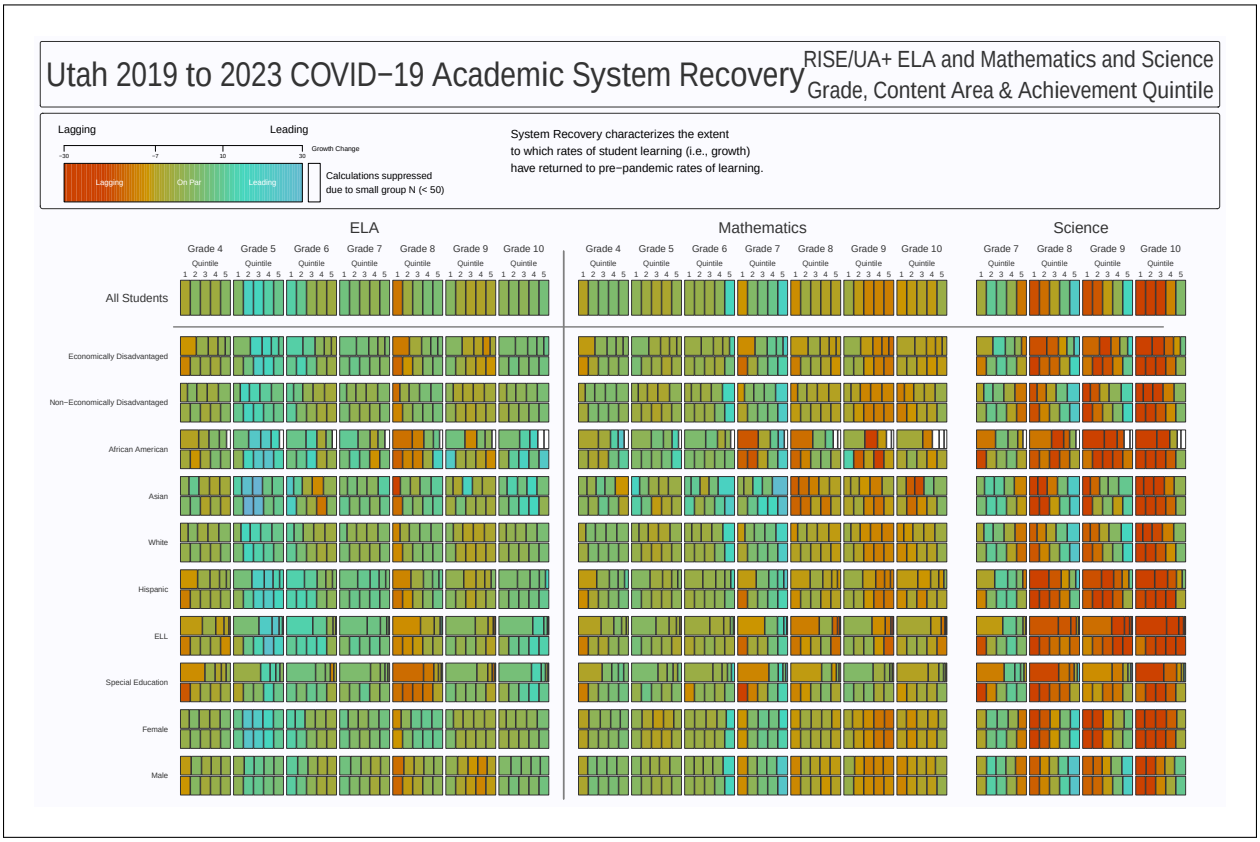

Figure 5: RISE Academic Recovery Overview for all students and student subgroups by grade and content area

School Level Impact and Recovery

The same methodology used to examine system level impact and recovery is utilized to examine school level impact and recovery. Specifically, for each school in Utah, we examine rates of learning (i.e. growth) across an impact time span and a recovery time spans:

Impact From 2019 to 2021 we examine the extent to which rates of learning decreased from pre-pandemic rates for students.

Recovery From 2021 to 2022 and 2022 to 2023 we examine the extent to which rates of learning recovered to or exceeded pre-pandemic rates for students.

It is important to note that growth is examined as opposed to status because Based upon different rates of impact and recovery, there is a desire to examine schools, particularly those demonstrating high rates of recovery where they are currently exceeding rates of learning observed pre-pandemic at the school.

Large Impact/Large Recovery Schools demonstrating a large slow down in learning from 2019 to 2021 and that also demonstrate high rates of learning in 2021 to 2022 and 2022 to 2023 compared to pre-pandemic rates of learning. Specifically, median SGP decline from 2019 to 2021 of at least 15 and median SGP increase from 2019 to 2022/2023 of at least 5.

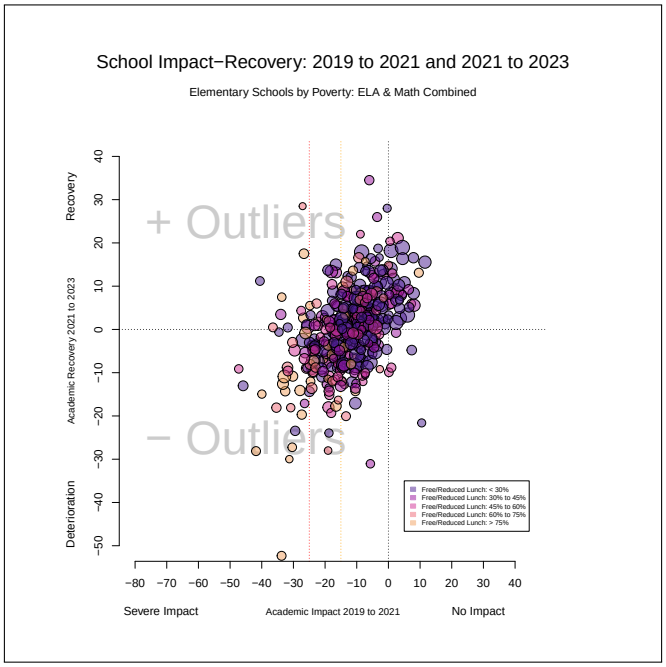

Figure 6: School level impact (2019 to 2021) versus recovery (2021 to 2023) for Utah elementary schools

Large Impact/Poor Recovery Schools demonstrating a large slow down in learning from 2019 to 2021 and that also demonstrate poor rates of learning in 2021 to 2022 and 2022 to 2023 compared to pre-pandemic rates of learning. Specifically, median SGP decline from 2019 to 2021 of at least 15 and median SGP decline from 2019 to 2022/2023 of at least 5.

Minimal Impact/Large Recovery Schools demonstrating little to no slow down in learning from 2019 to 2021 and that also demonstrate high rates of learning in 2021 to 2022 and 2022 to 2023 compared to pre-pandemic rates of learning. Specifically, median SGP decline from 2019 to 2021 of at most 5 and median SGP increase from 2019 to 2022/2023 of at least 5.

Figure **??** depicts impact (horizontal axis) versus recovery (vertical axis) for elementary schools in Utah. Each bubble in the figure is a school with the size of the bubble proportional to its size and the color of the bubble indicating percent free/reduced lunch. Impact (horizontal axis) and recovery (vertical axis) is quantified as the median SGP deviation from pre-pandemic levels (2019). Thus, schools to the left are schools whose growth declined substantially (large impact) from pre-pandemic levels whereas schools to the right are schools whose growth didn't decline (no impact). Similarly, schools toward the top are schools whose growth increased substantially (large recovery) from pre-pandemic levels whereas schools to the bottom are schools whose growth declined substantially (poor recovery).

Based upon analyses of Utah schools, 123 schools were identified as outliers:

- Large impact/large recovery 6
- Large impact/poor recovery 70
- Minimal impact/large recovery 47

Accompanying this report is a spreadsheet of impact/recovery of all Utah schools as well as identification of the 123 outlier schools. Given the nature of the pandemic and all of its ensuing disruptions

to education in 2020, declines in student growth demonstrated between 2019 and 2021 are likely related to those disruptions. However, the disruptions were diverse in nature in some cases related to remote schooling and in other cases could be related to familial issues such as parental loss of work. Similarly, increases in student learning in 2022 and 2023 above pre-pandemic levels could be caused by a variety of issues. We encourage people to exercise caution in attributing causal effects to the impact and recovery data contained therein.

Conclusion

For the past 3 1/2 years, the COVID-19 pandemic has stood as the single largest disruption to public education in the history of the United States. This unprecedented event caused significant upheavals in public education, leading to notable decreases in student learning and attainment. The analysis of Utah's RISE and UA+ assessment data has been pivotal in quantifying and understanding these impacts. Our approach, utilizing visualizations to categorize academic recovery into lagging, on par, and leading groups, has offered a clearer perspective on the multifaceted nature of these educational challenges.

The insights gained from this analysis are crucial. We observed a more pronounced academic lag in mathematics than in English Language Arts, with the extent of this lag varying across demographic subgroups and grade levels. For example, Hispanic students demonstrated the largest lags in ELA, while middle school grades faced more severe impacts in mathematics compared to elementary grades. This data not only sheds light on the areas where students have been most affected but also highlights the need for targeted intervention strategies.

Moreover, the growth analyses from 2022 to 2023 provided a window into the education system's recovery trajectory. While there has been a return to pre-pandemic norms in terms of growth rates, this stabilization has not been sufficient to counterbalance the learning losses incurred during the pandemic, particularly for students in lower achievement quintiles. The continued lag in growth for these students underscores the pandemic's disproportionate impact and the critical need for focused educational support.

As we move forward, it is imperative that these findings guide policy and decision-making in education. The goal should not only be to return to pre-pandemic levels of learning and attainment but to surpass them, ensuring that all students, regardless of their background or prior achievement levels, have the support and resources they need to thrive. This will require a concerted effort from educators, policymakers, and communities to develop and implement strategies that address the unique challenges and needs highlighted by this pandemic.

In conclusion, the COVID-19 pandemic has been a stark reminder of the vulnerabilities in our education system. However, it has also provided an opportunity to reflect, reassess, and rebuild with a stronger focus on equity and resilience. By continuing to monitor, analyze, and respond to the evolving educational landscape with data-driven strategies, we can strive to create a more robust and inclusive system that is better prepared for future challenges.

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Appendix: Recovery from 2022 to 2023

Each of the following figures shows the academic recovery associated with the pandemic on student RISE/UA+ assessments from 2022 to 2023. Each figure shows status based recovery and figures associated with grades 4, 5, 6, 7, and 8 show growth recovery. Summary results (overall and by quintile) for the subgroup analyzed are provided at the right of the figure in terms of both status and growth. Status based recovery indicates the extent to which students in the identified grade, content area and demographic subgroup have recovered to levels of attainment seen in 2019 (i.e., student level recovery). Growth based recovery indicates the extent to which students in the identified grade, content area and demographic subgroup have recovered to levels of growth seen in 2019 (i.e., system level recovery).

Academic Impact was delineated into 3 categories.

Leading Growth Impact ≤ -25 or Status Impact ≤ -0.4.

On Par $-25 <$ Growth Impact ≤ -15 or $-0.4 <$ Status Impact ≤ -0.25.

Lagging $-15 <$ Growth Impact ≤ -5 or $-0.25 <$ Status Impact ≤ -0.1.

Figure 7: RISE Academic Recovery Overview for all students and student subgroups by grade, content area and achievement quintile

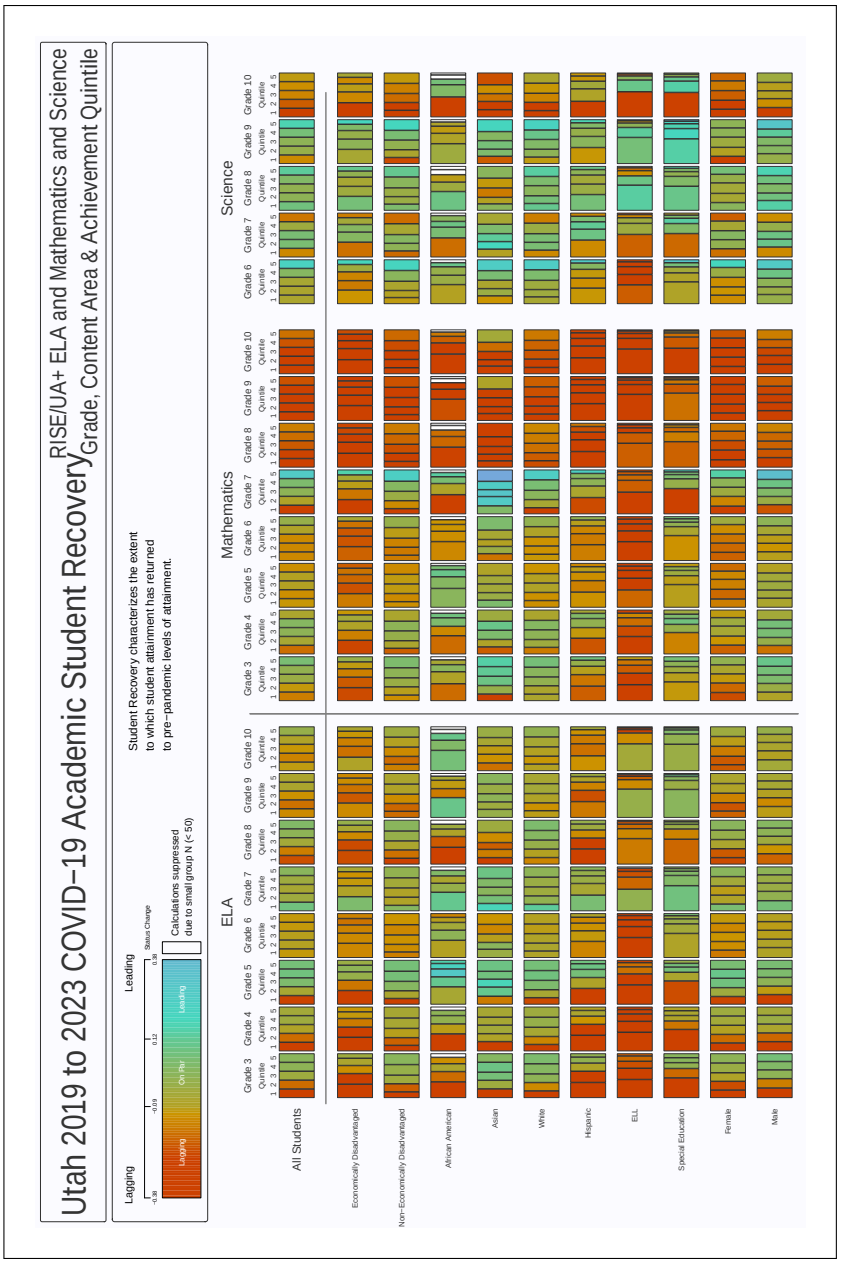

Figure 8: RISE Academic Recovery Overview for all students and student subgroups by grade, content area and achievement quintile

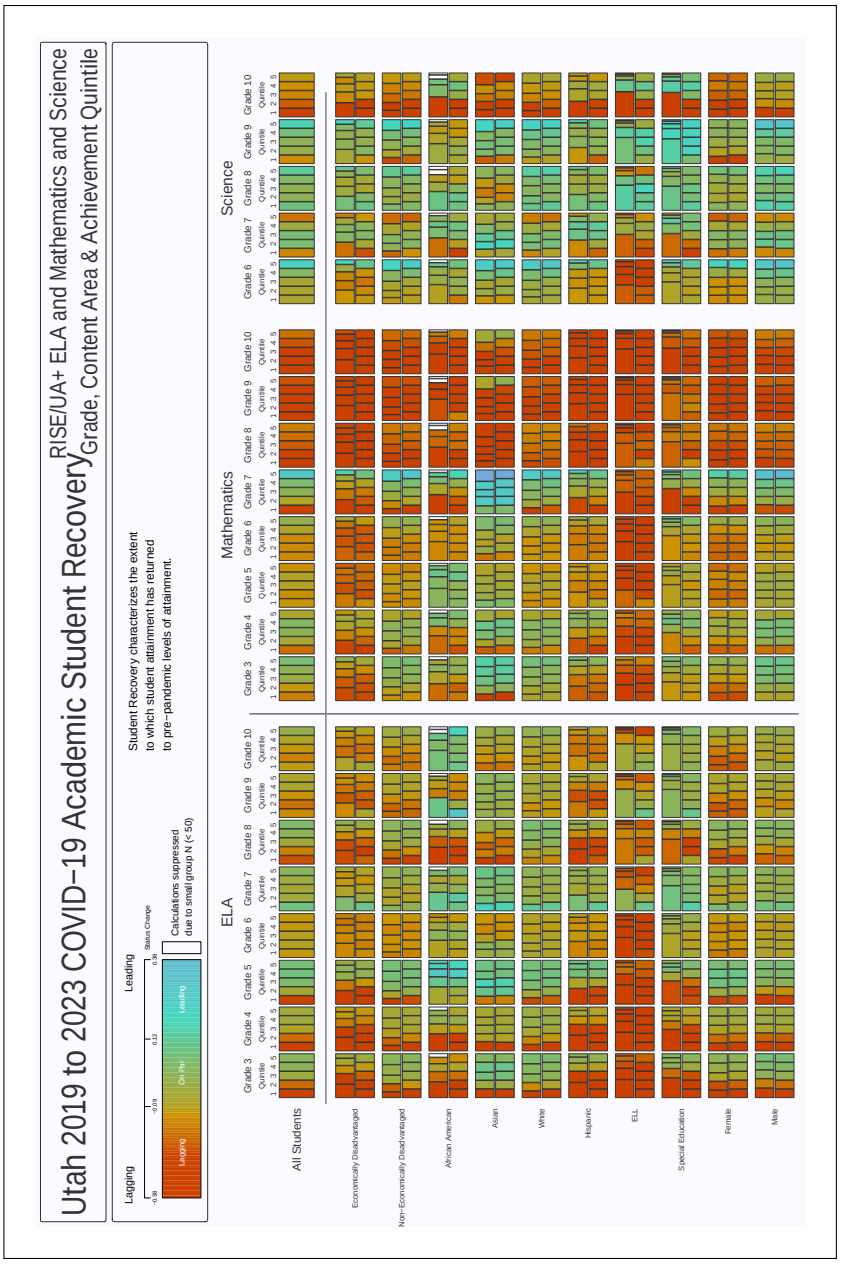

Figure 9: RISE Academic Recovery Overview for all students and student subgroups by grade, content area and achievement quintile

Grade by Content Area

The figures on the following pages illustrate pandemic related academic recovery for students grouped by grade (3, 4, 5, 6, 7, 8, 9 or 10) and content area (ELA or mathematics)

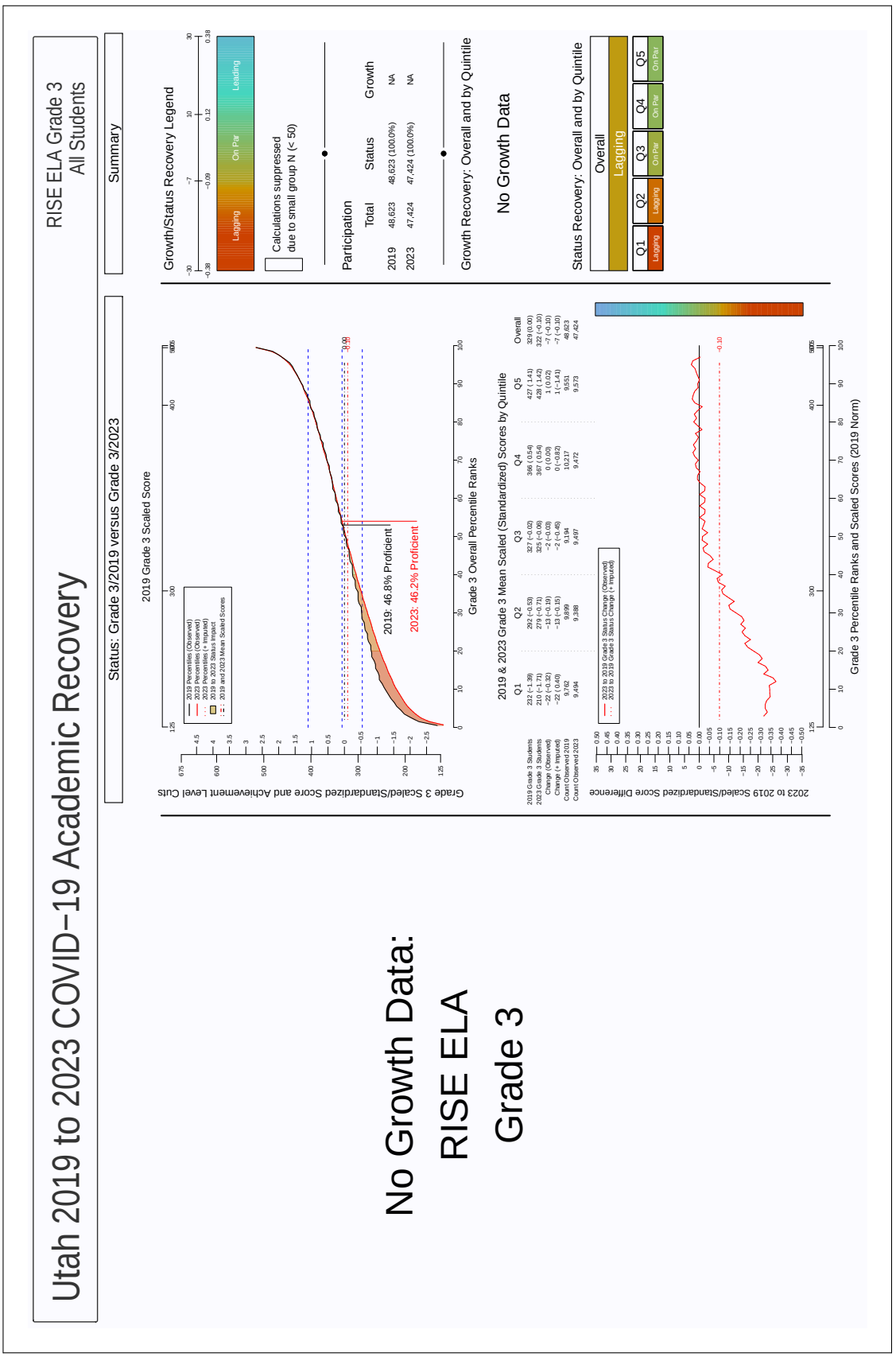

Figure 10: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 3 ELA

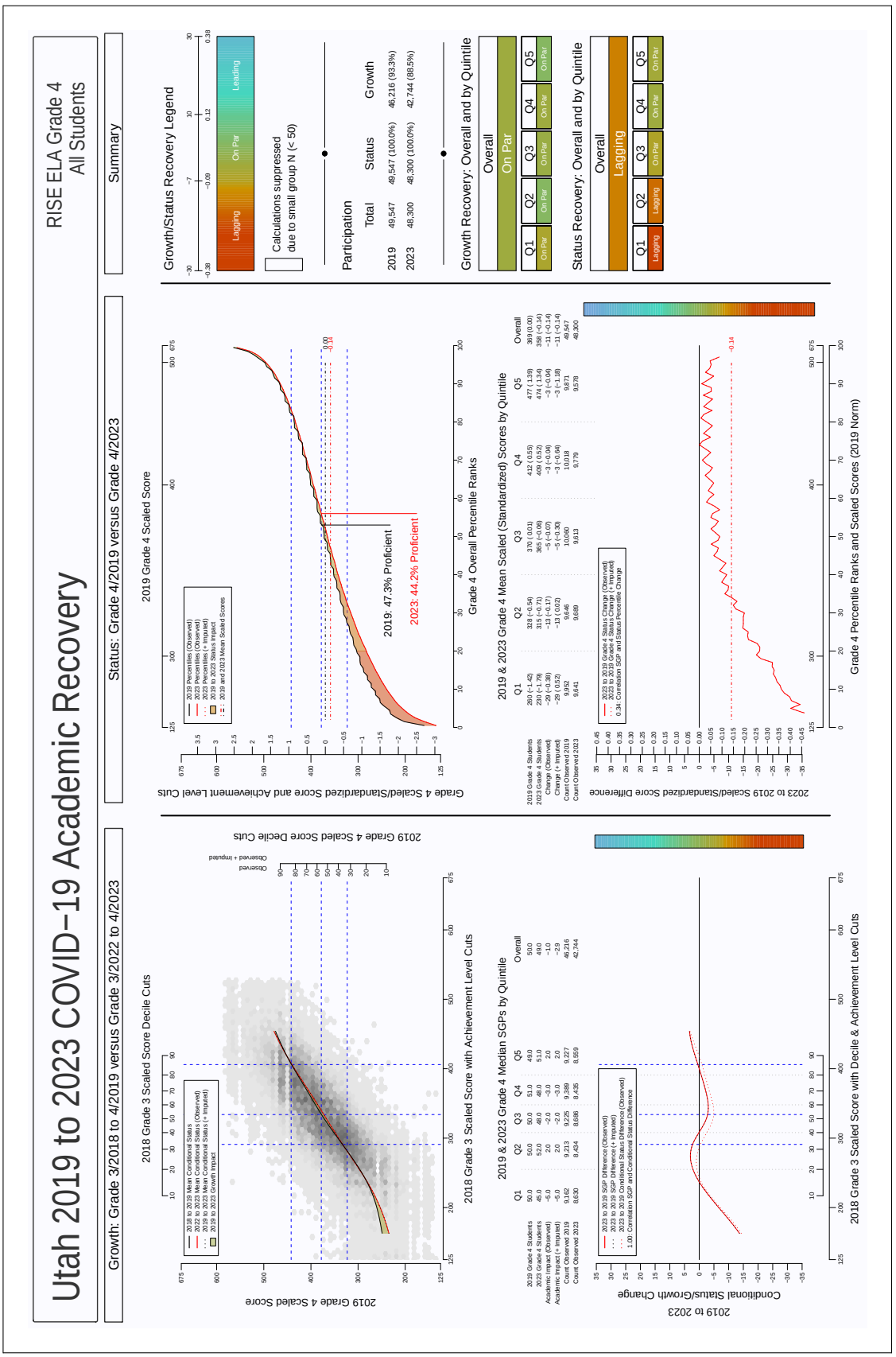

Figure 11: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 4 ELA

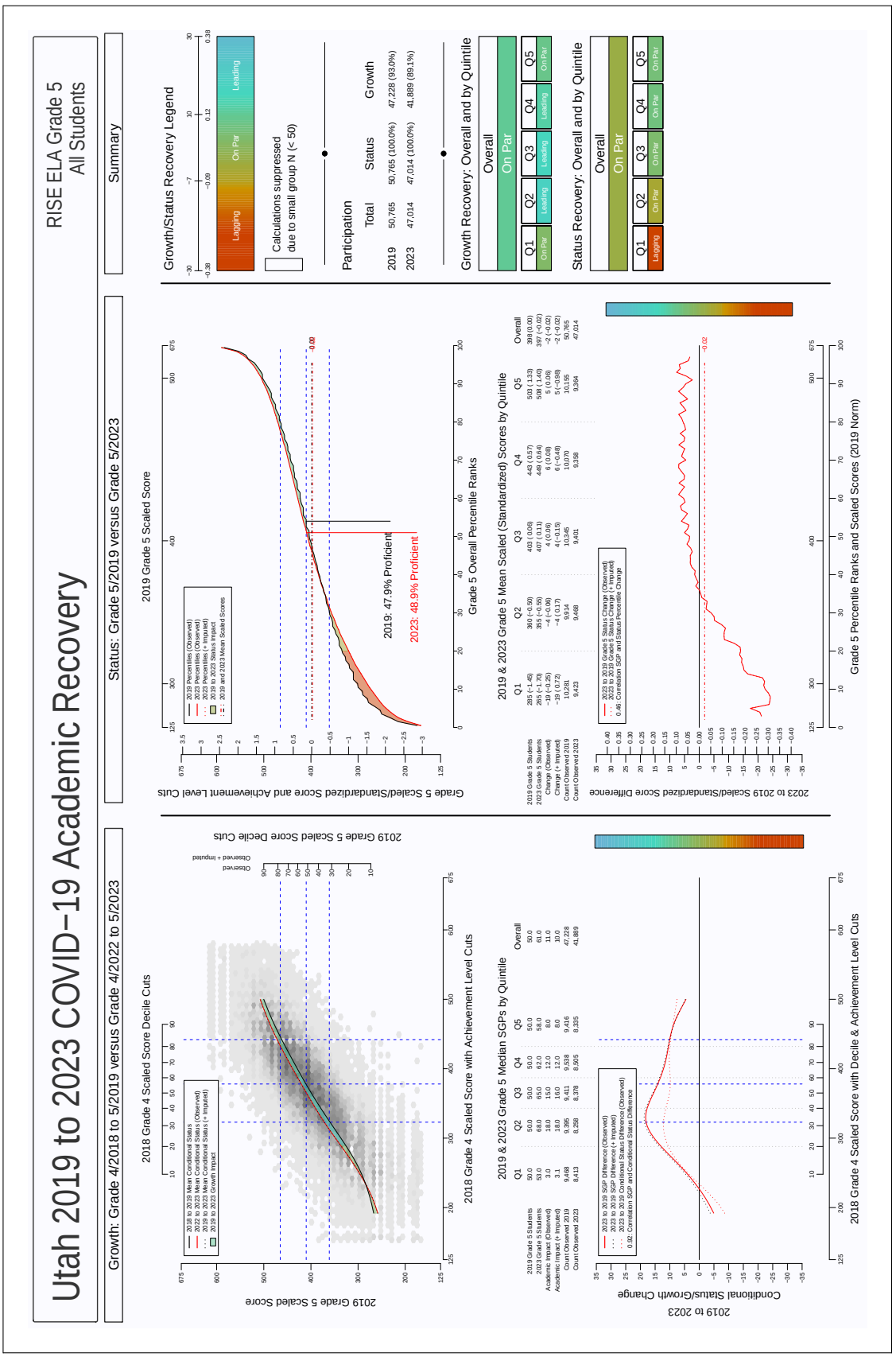

Figure 12: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 5 ELA

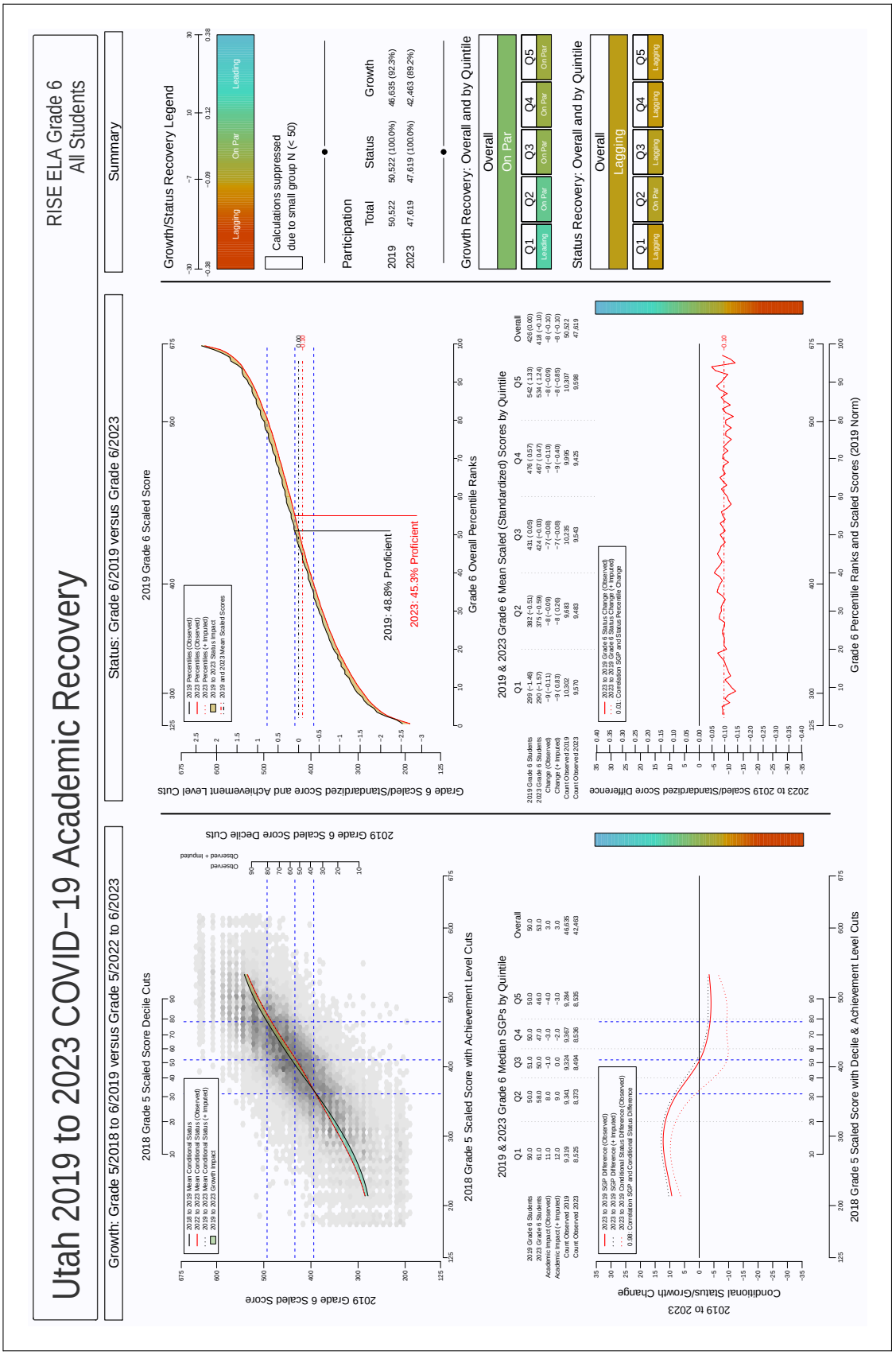

Figure 13: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 6 ELA

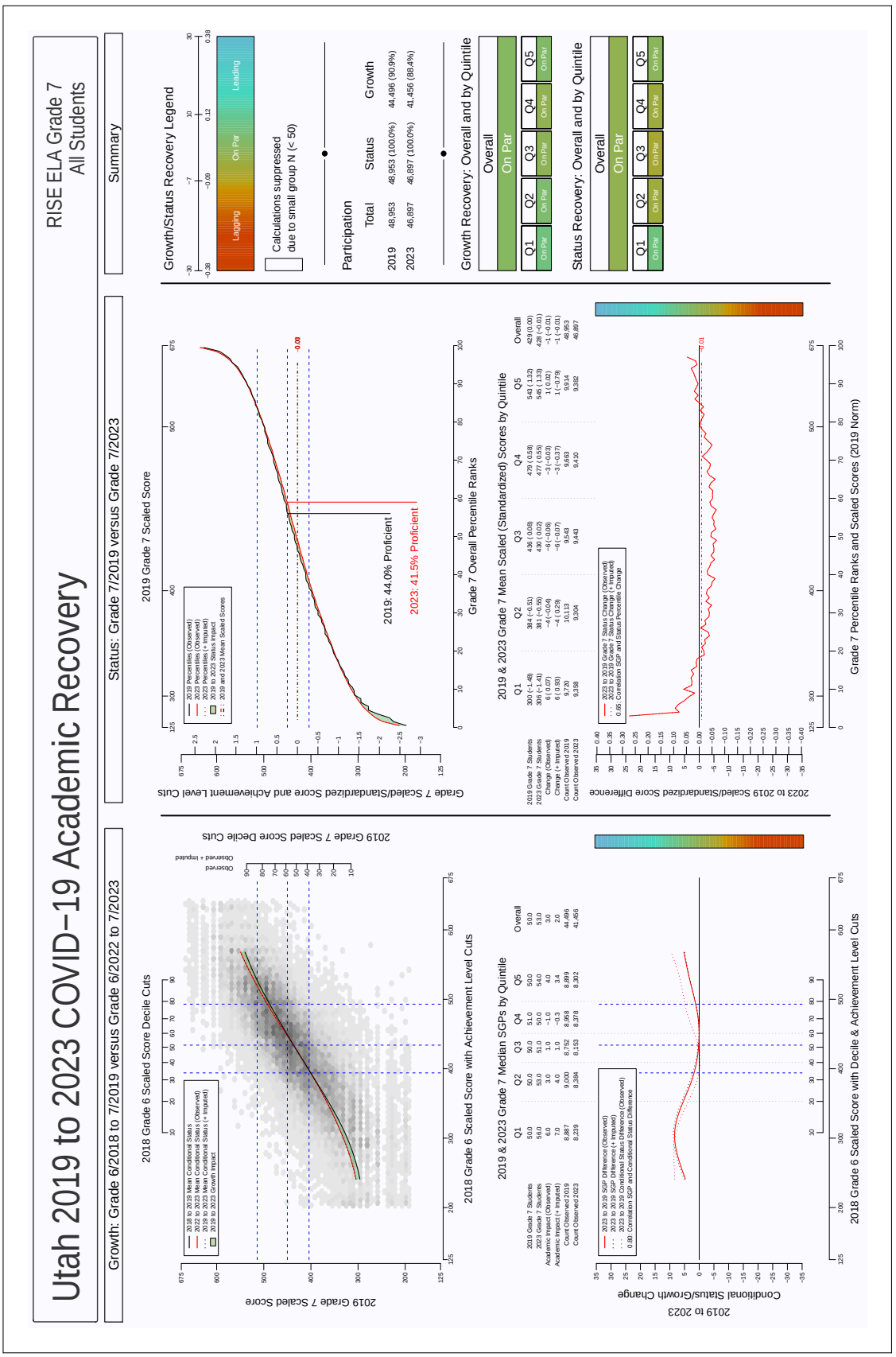

Figure 14: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 7 ELA

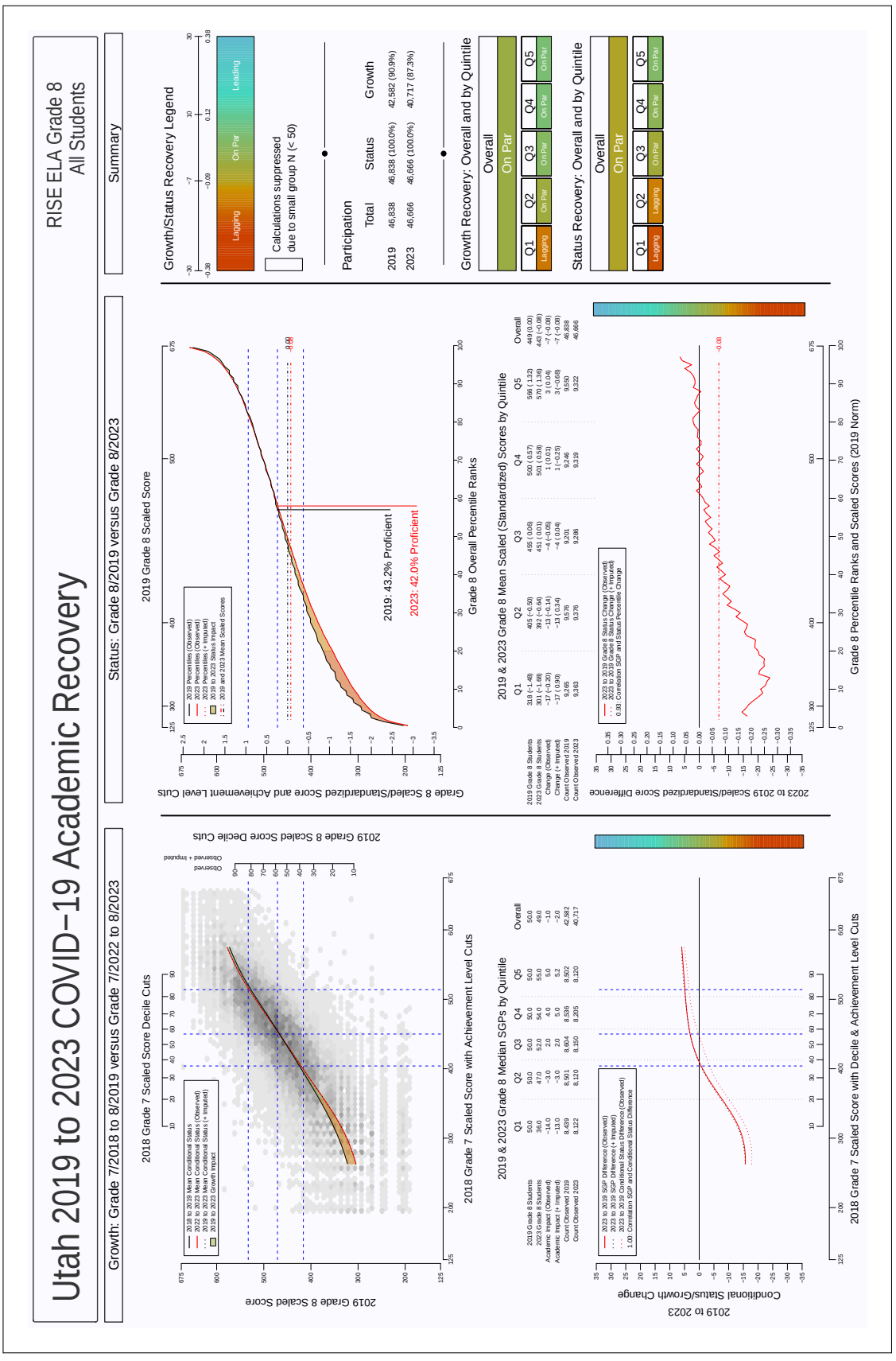

Figure 15: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 8 ELA

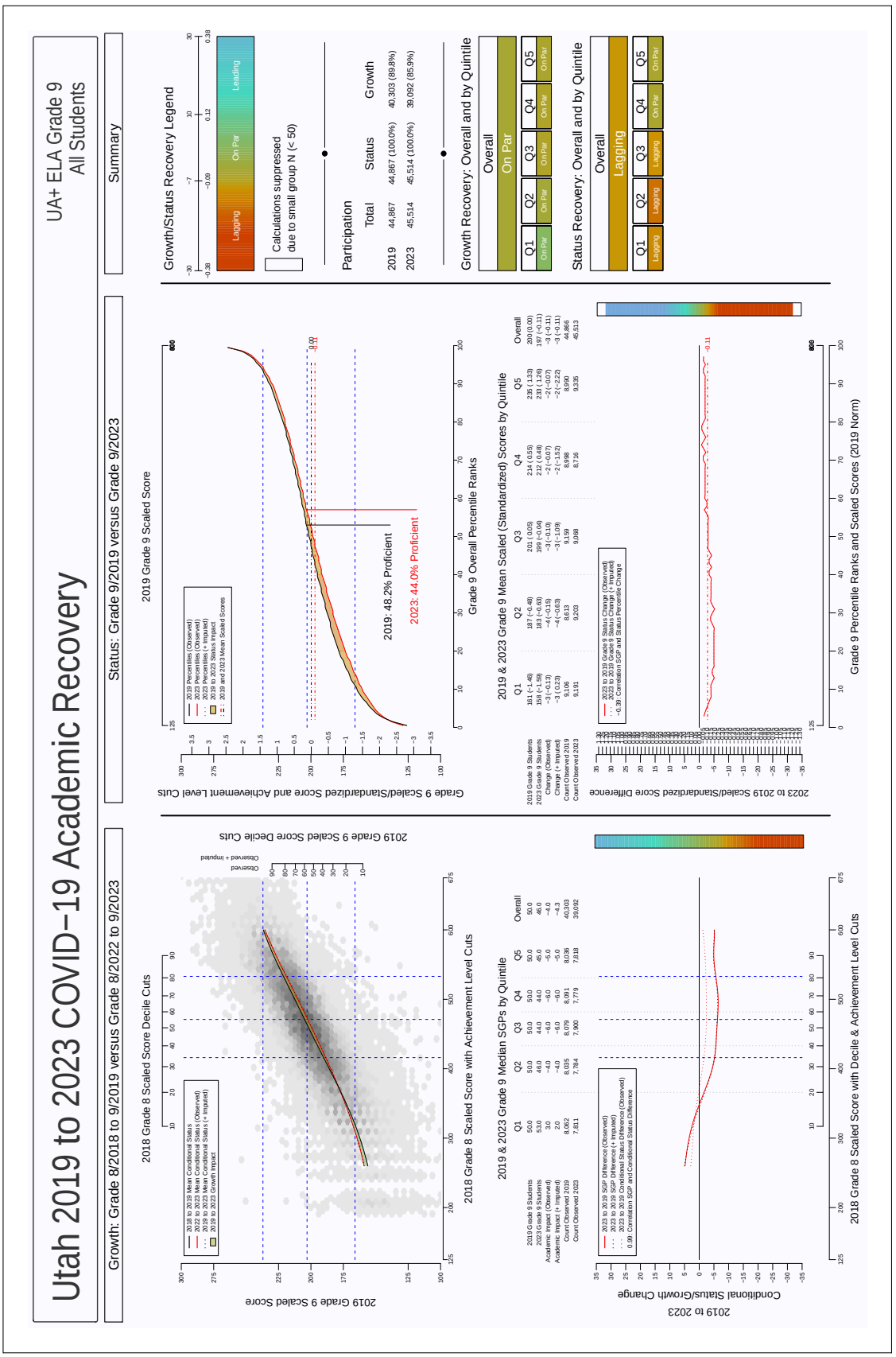

Figure 16: Utah UA+ academic recovery: Growth and status 2019 to 2023 grade 9 ELA

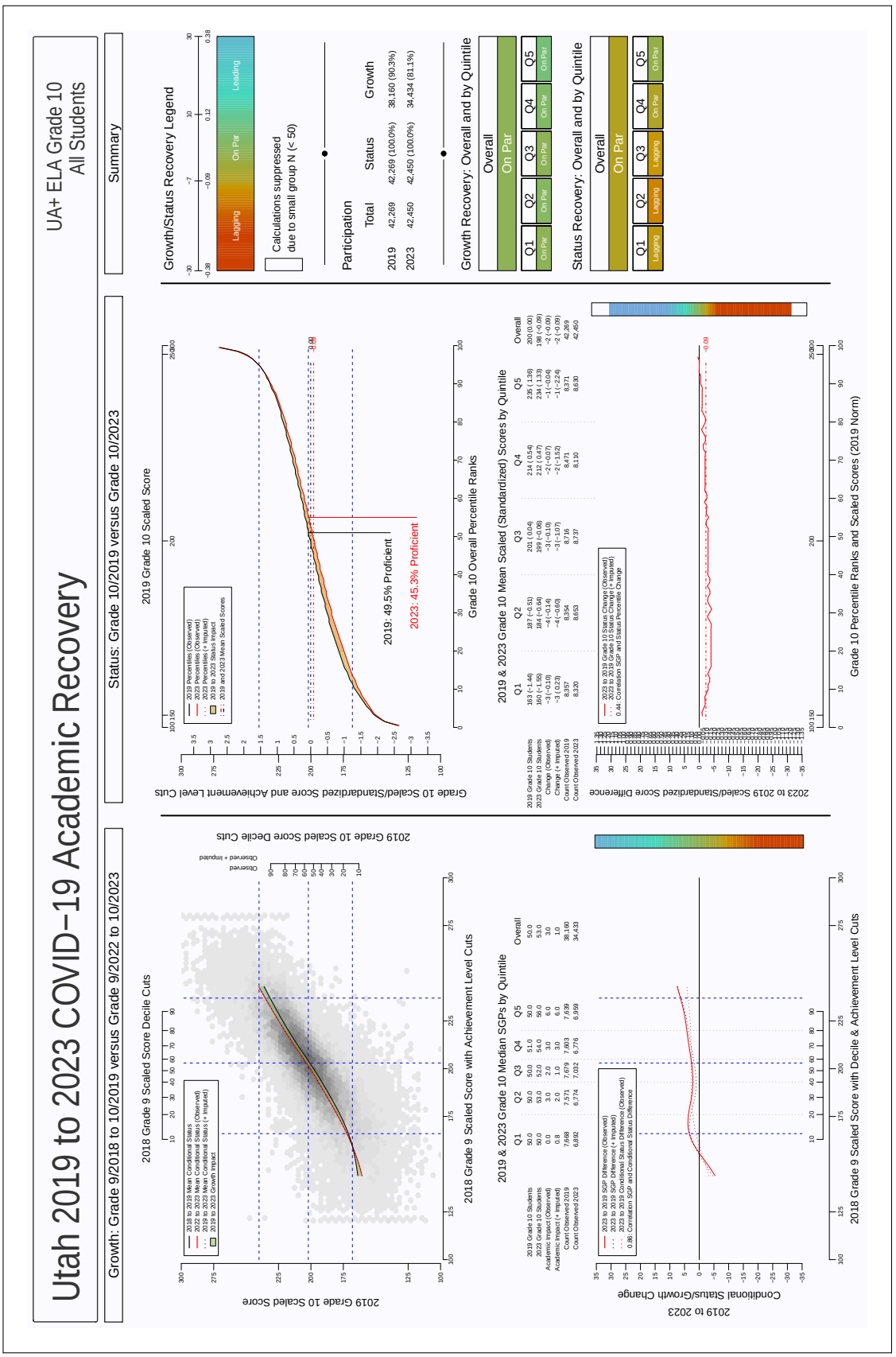

Figure 17: Utah UA+ academic recovery: Growth and status 2019 to 2023 grade 10 ELA

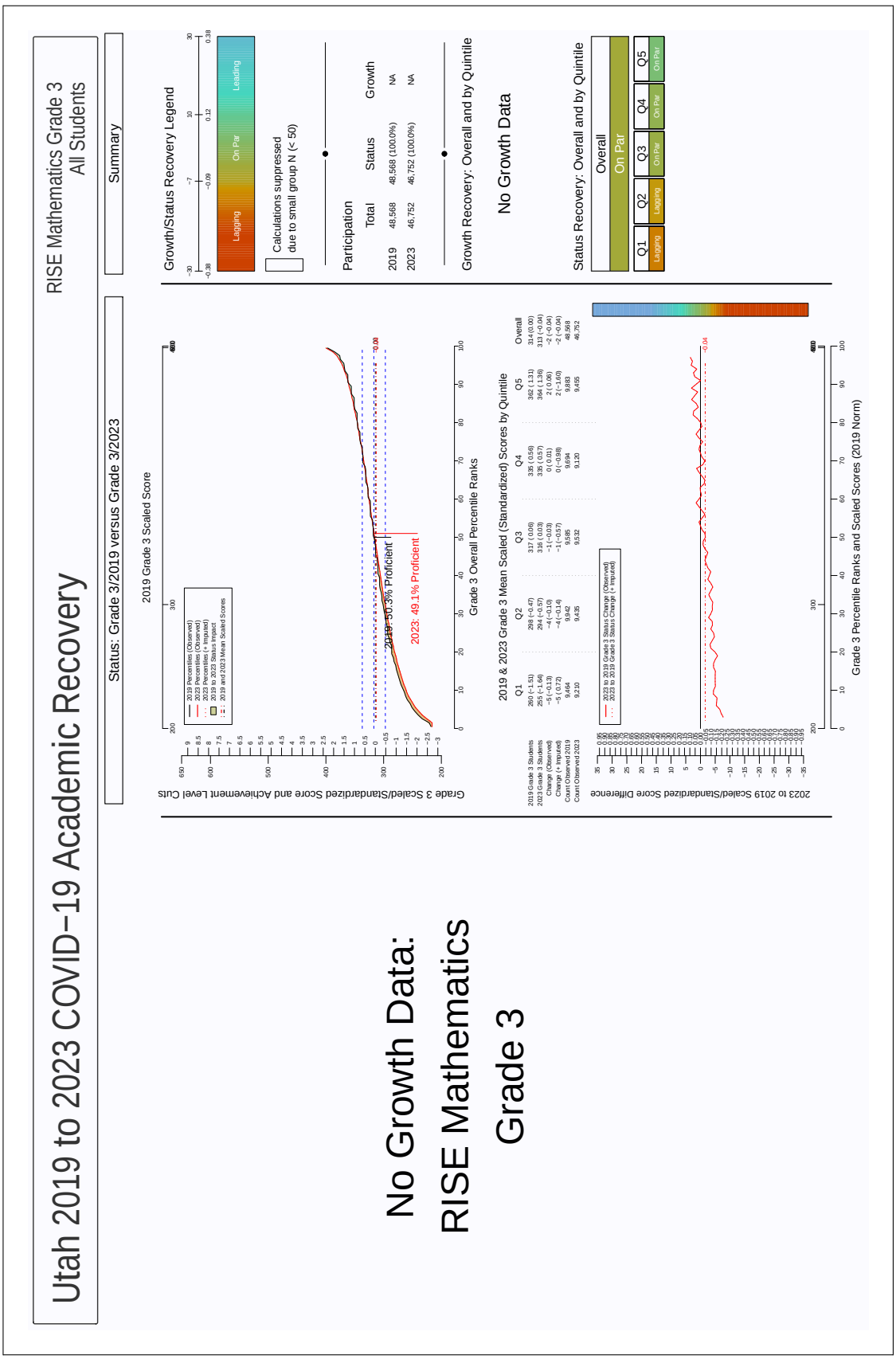

Figure 18: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 3 mathematics

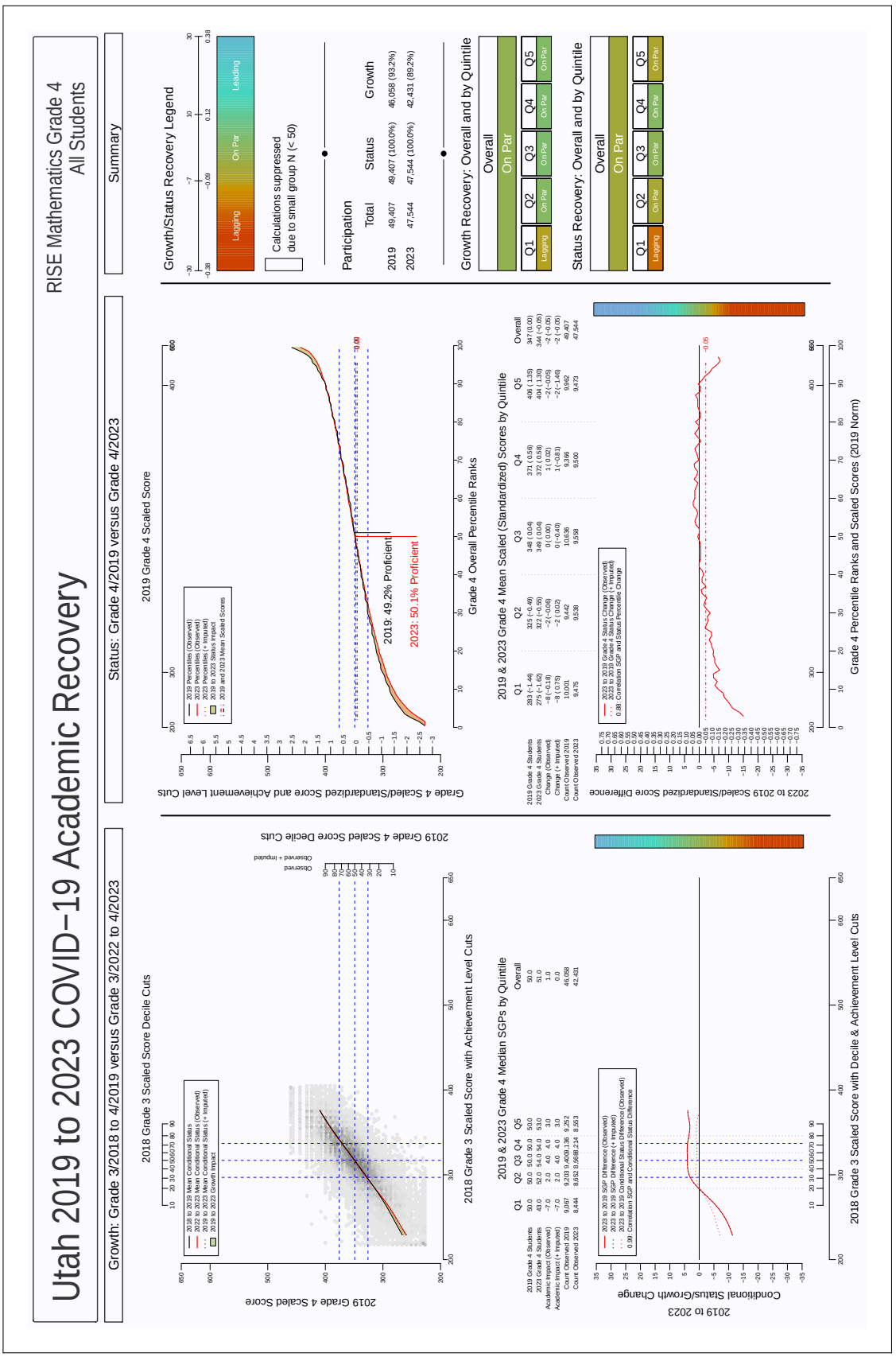

Figure 19: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 4 mathematics

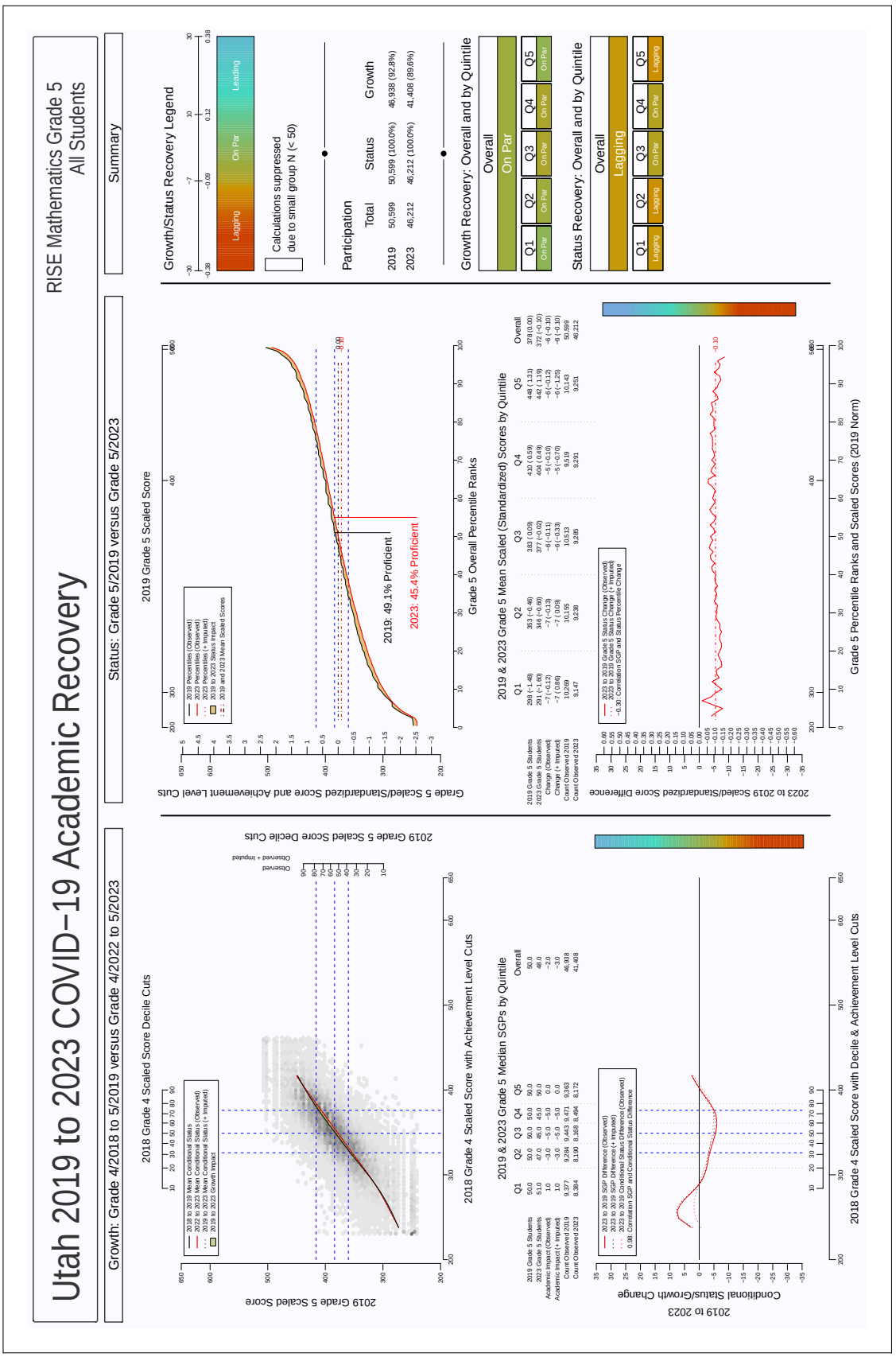

Figure 20: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 5 mathematics

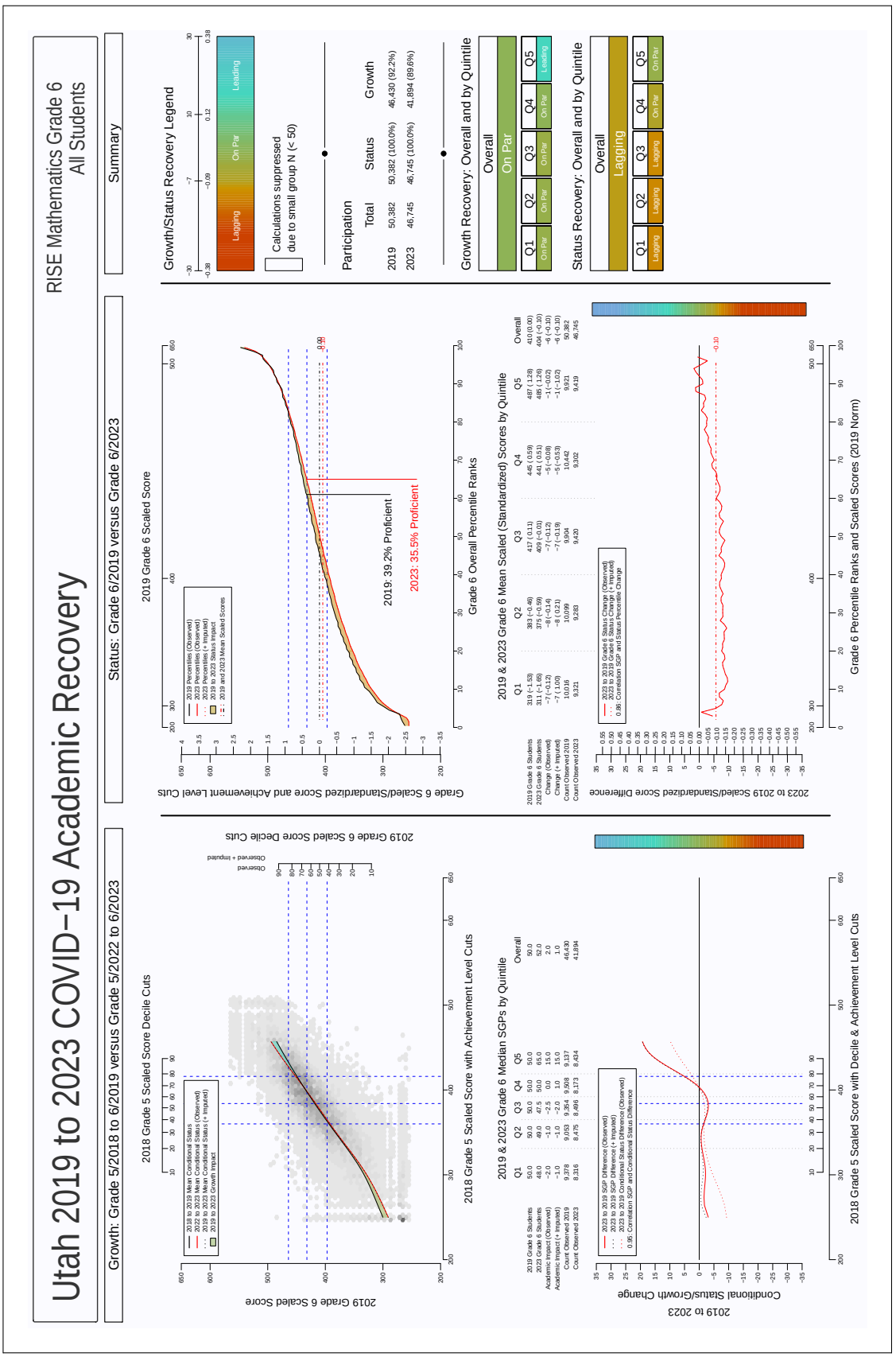

Figure 21: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 6 mathematics

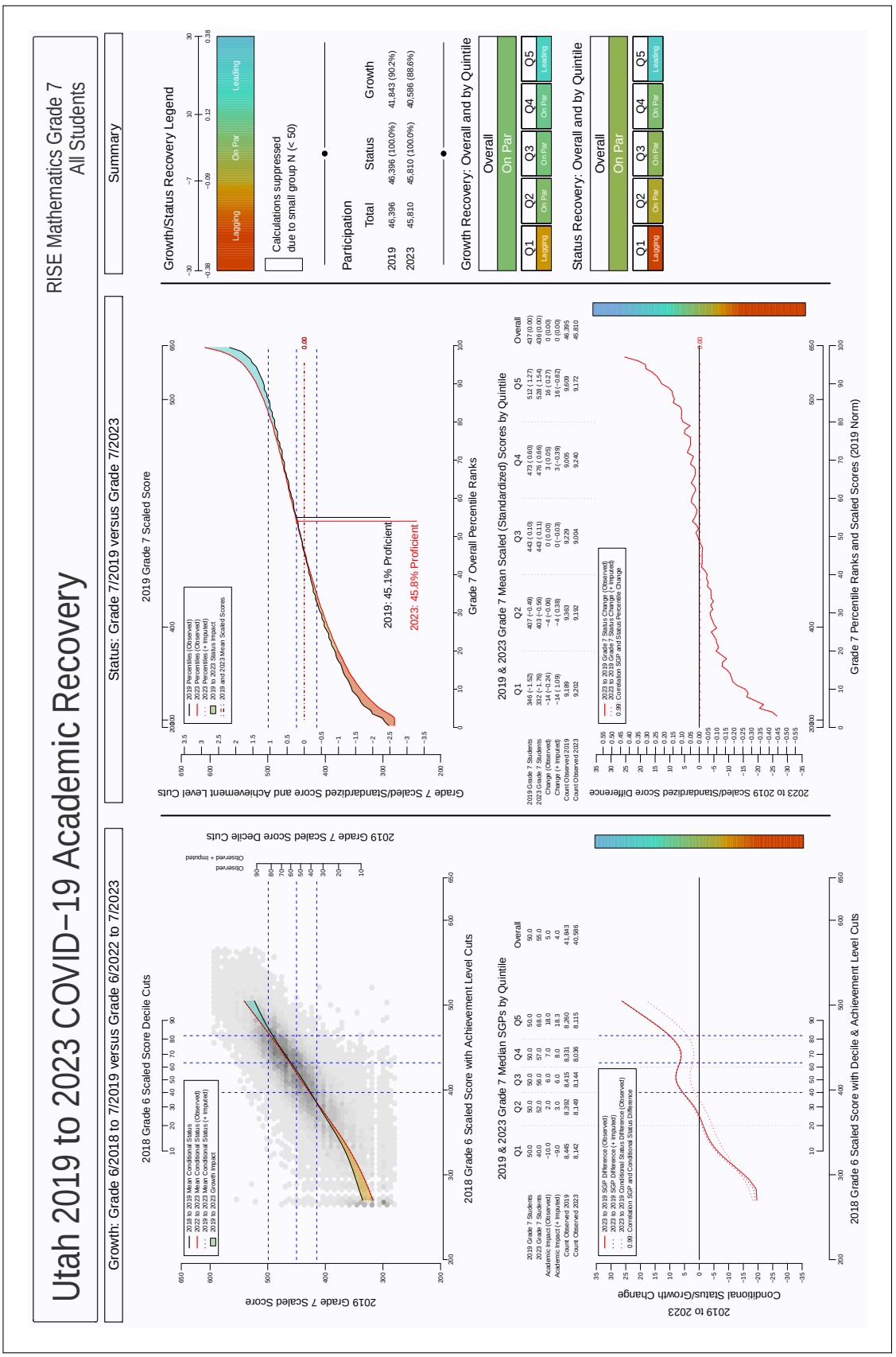

Figure 22: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 7 mathematics

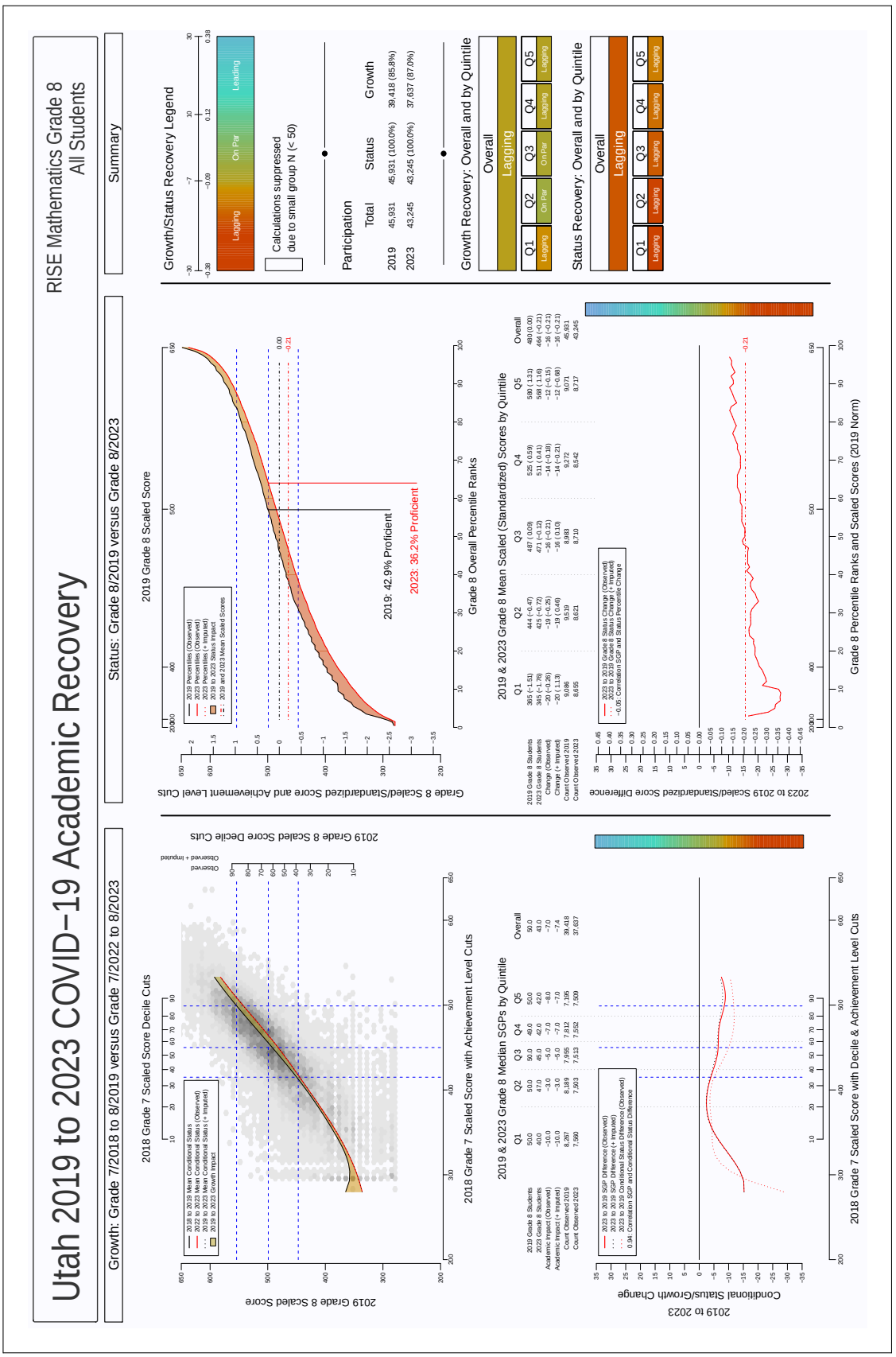

Figure 23: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 8 mathematics

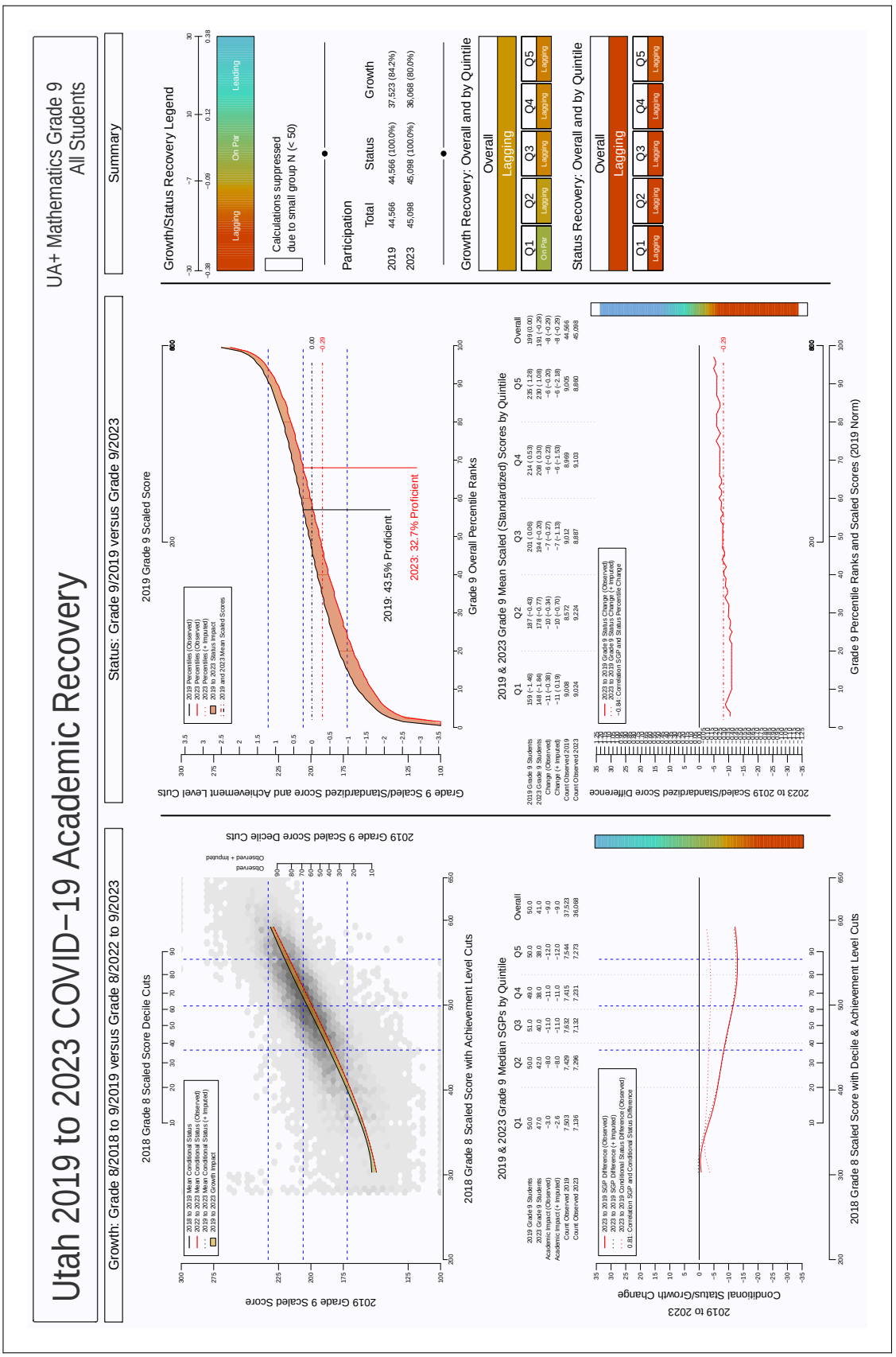

Figure 24: Utah UA+ academic recovery: Growth and status 2019 to 2023 grade 9 mathematics

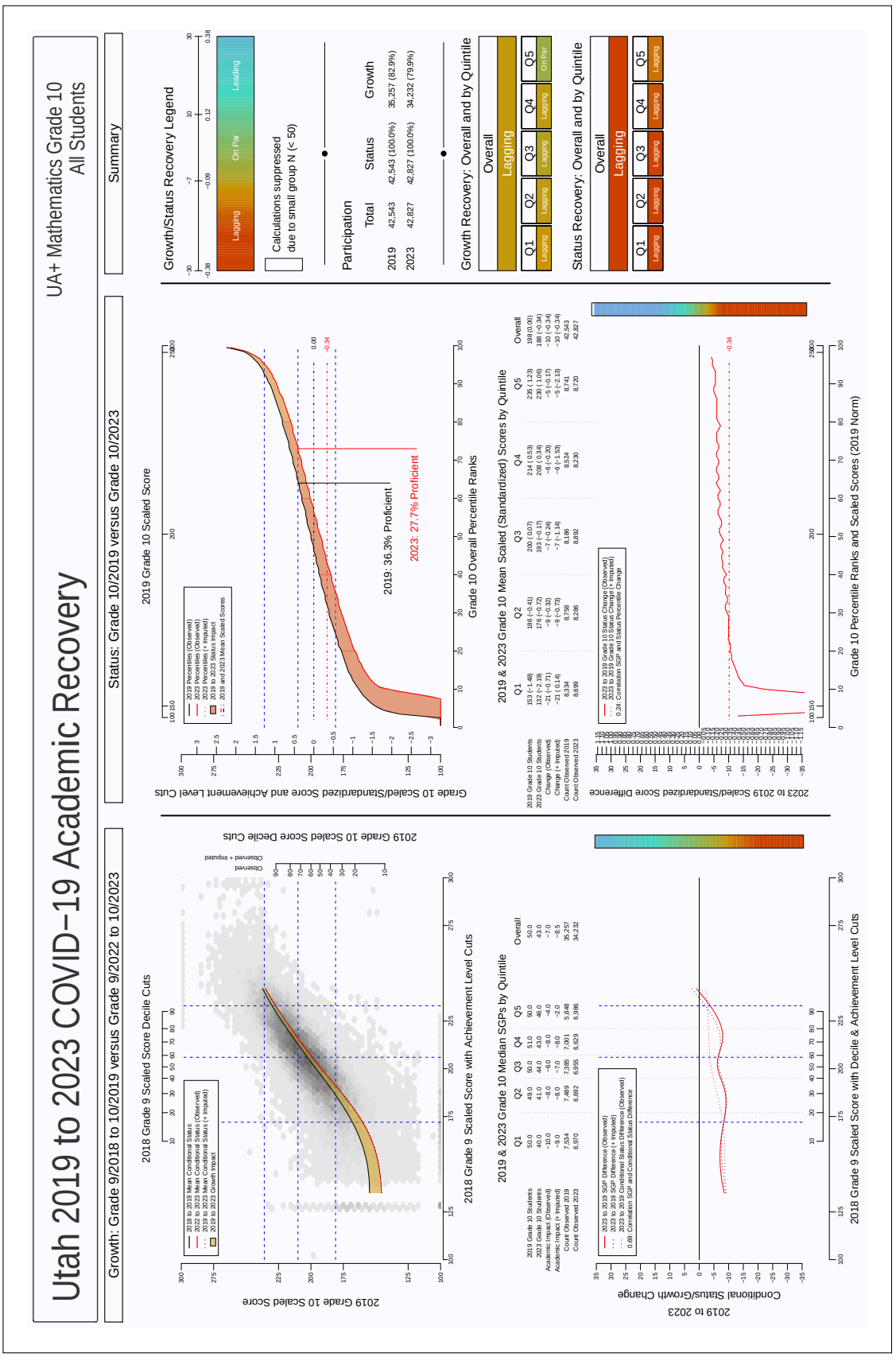

Figure 25: Utah UA+ academic recovery: Growth and status 2019 to 2023 grade 10 mathematics

Grade by Content Area by Ethnicity

The figures on the following pages illustrate pandemic related academic recovery for students grouped by grade (3, 4, 5, 6, 7, 8, 9 or 10), content area and ethnicity (ELA or mathematics for Asian, African American, Hispanic and white students)

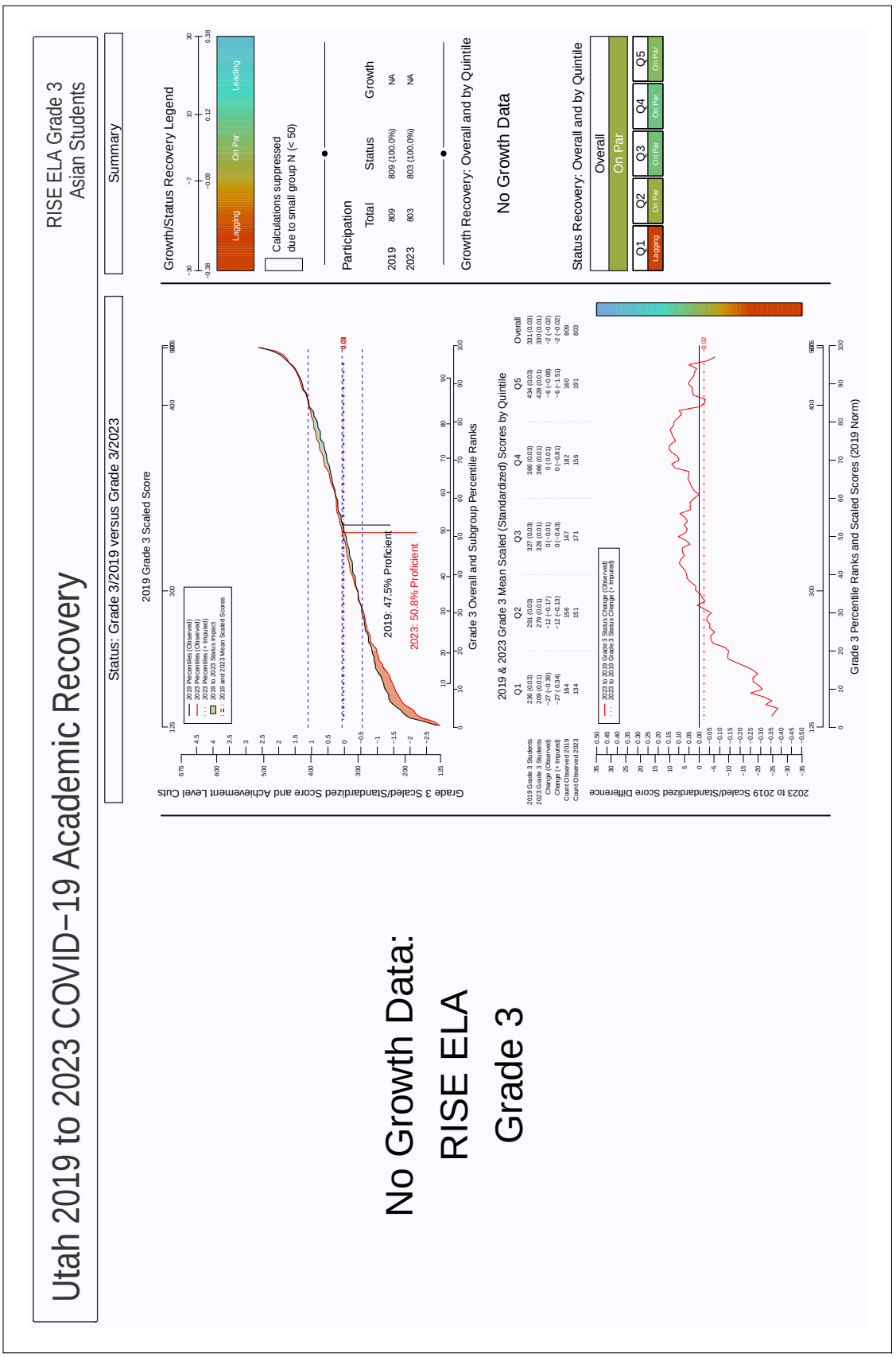

Figure 26: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 3 ELA, Asian students

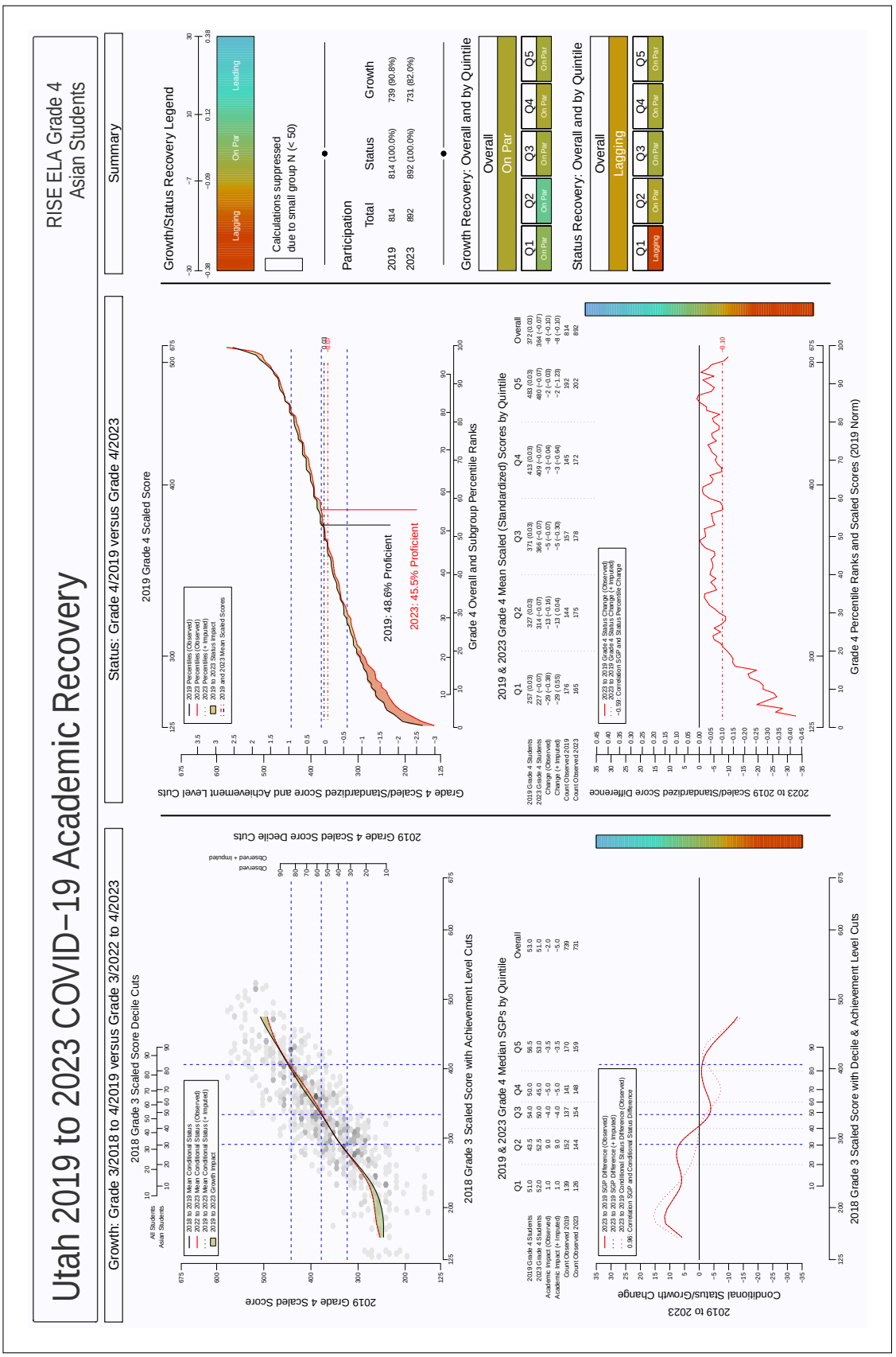

Figure 27: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 4 ELA, Asian students

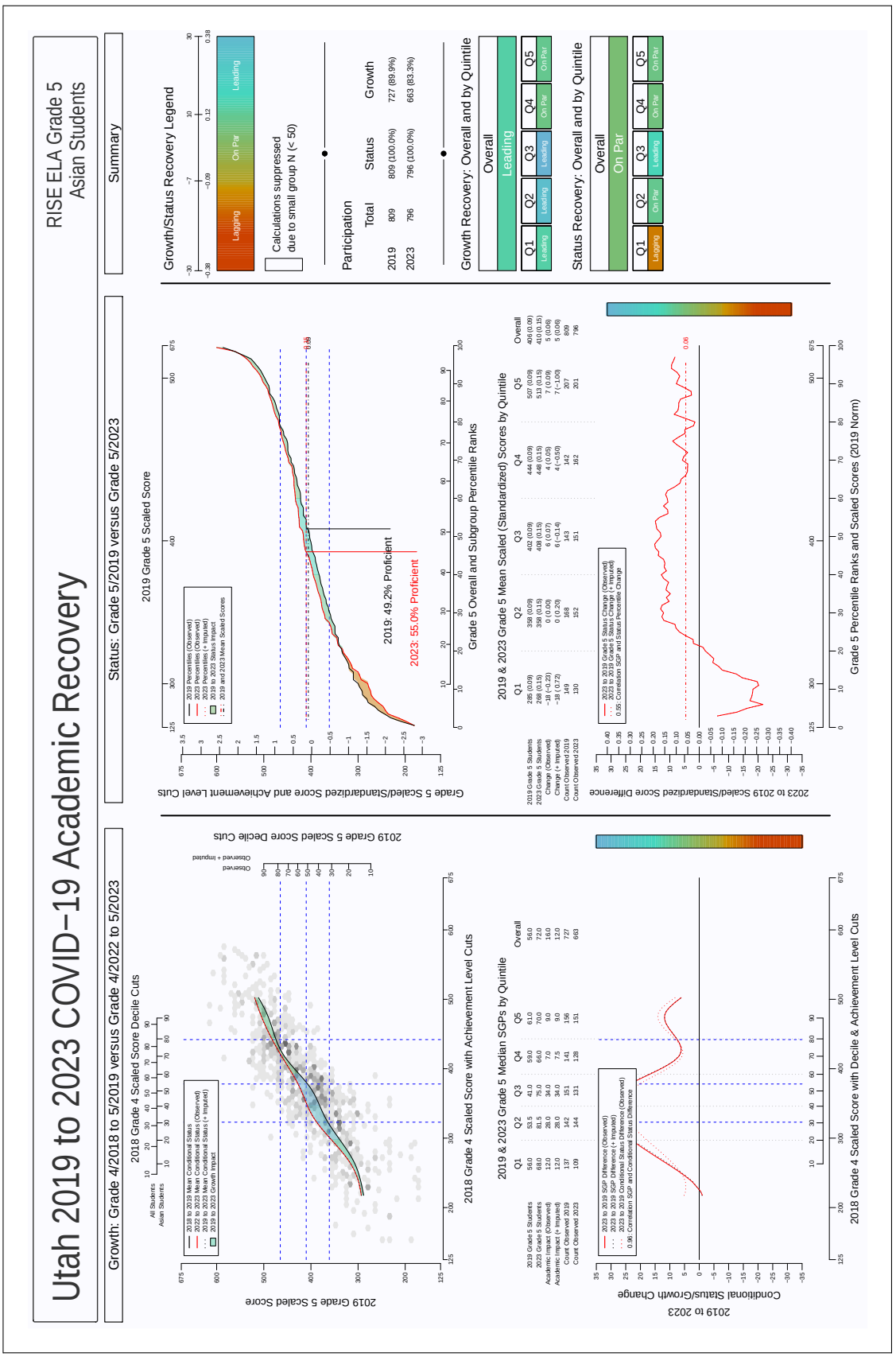

Figure 28: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 5 ELA, Asian students

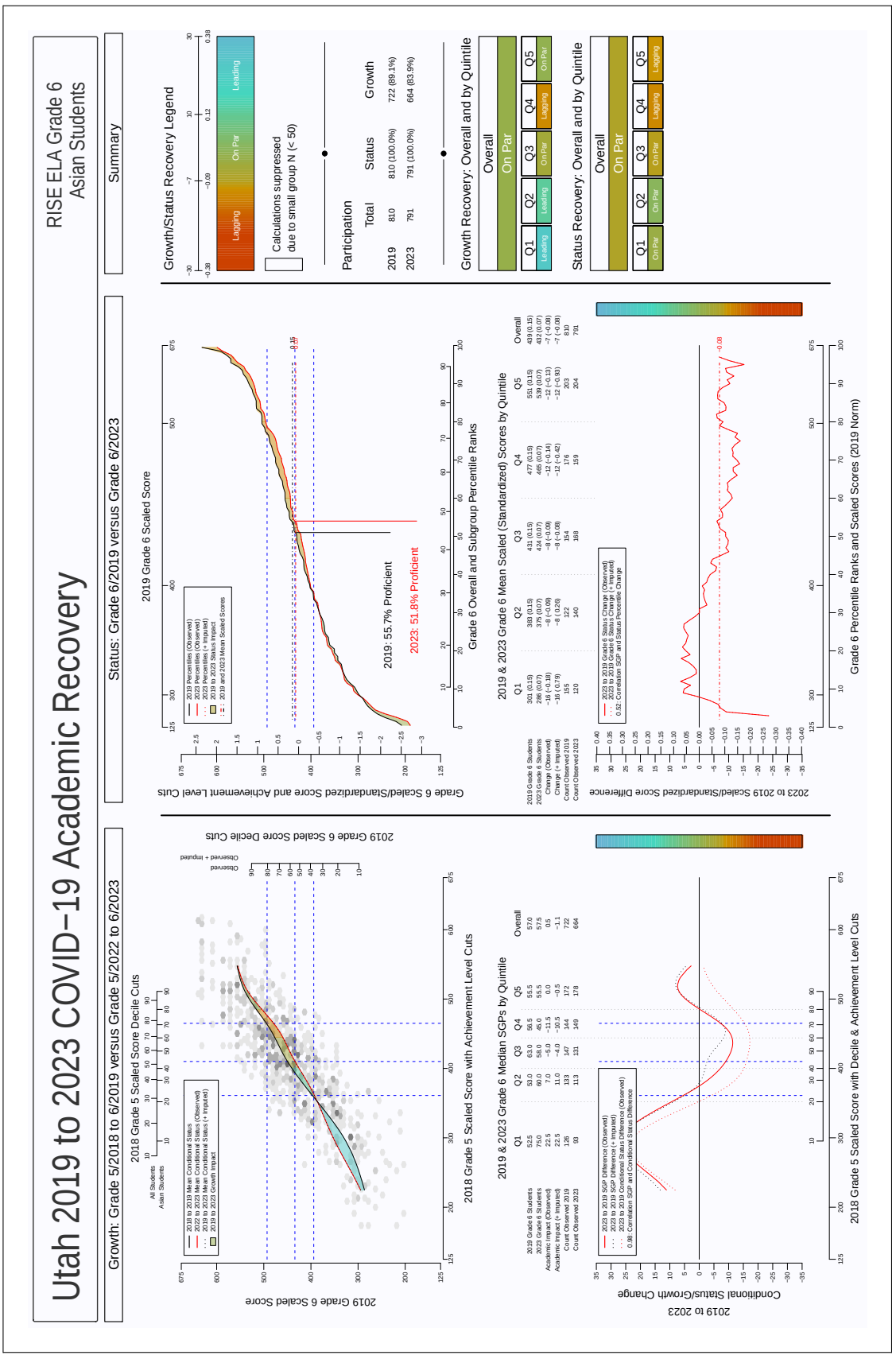

Figure 29: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 6 ELA, Asian students

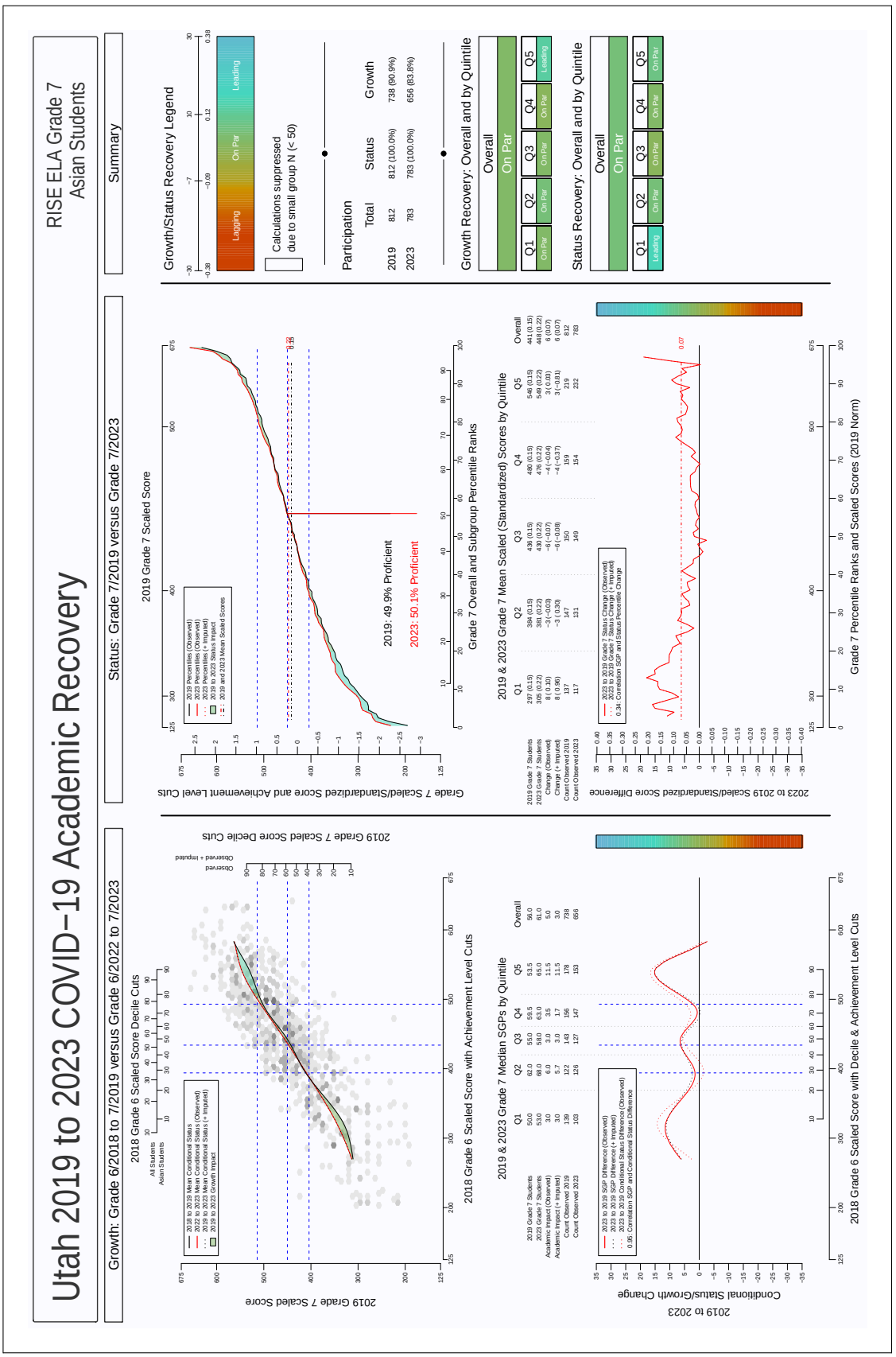

Figure 30: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 7 ELA, Asian students

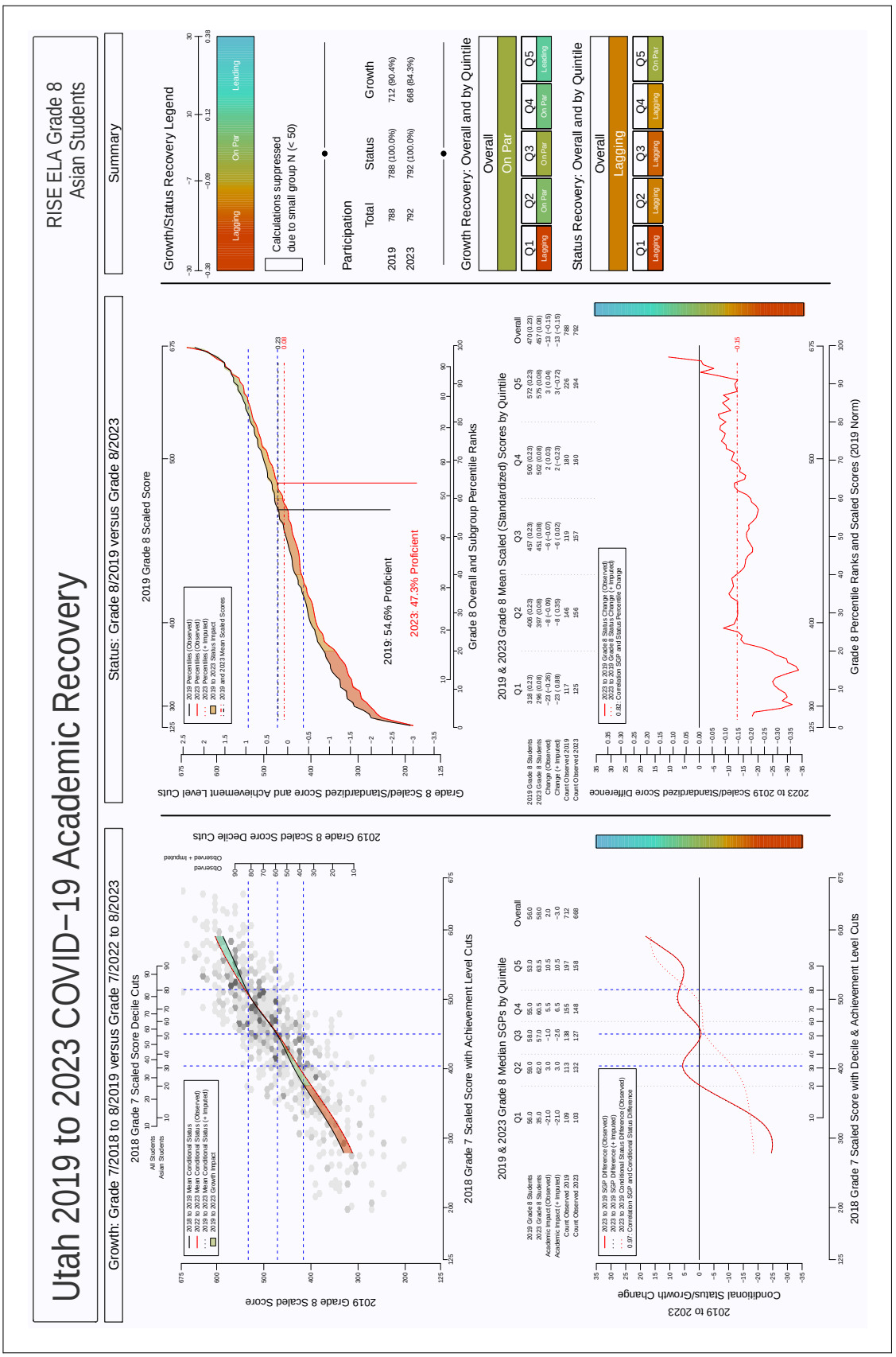

Figure 31: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 8 ELA, Asian students

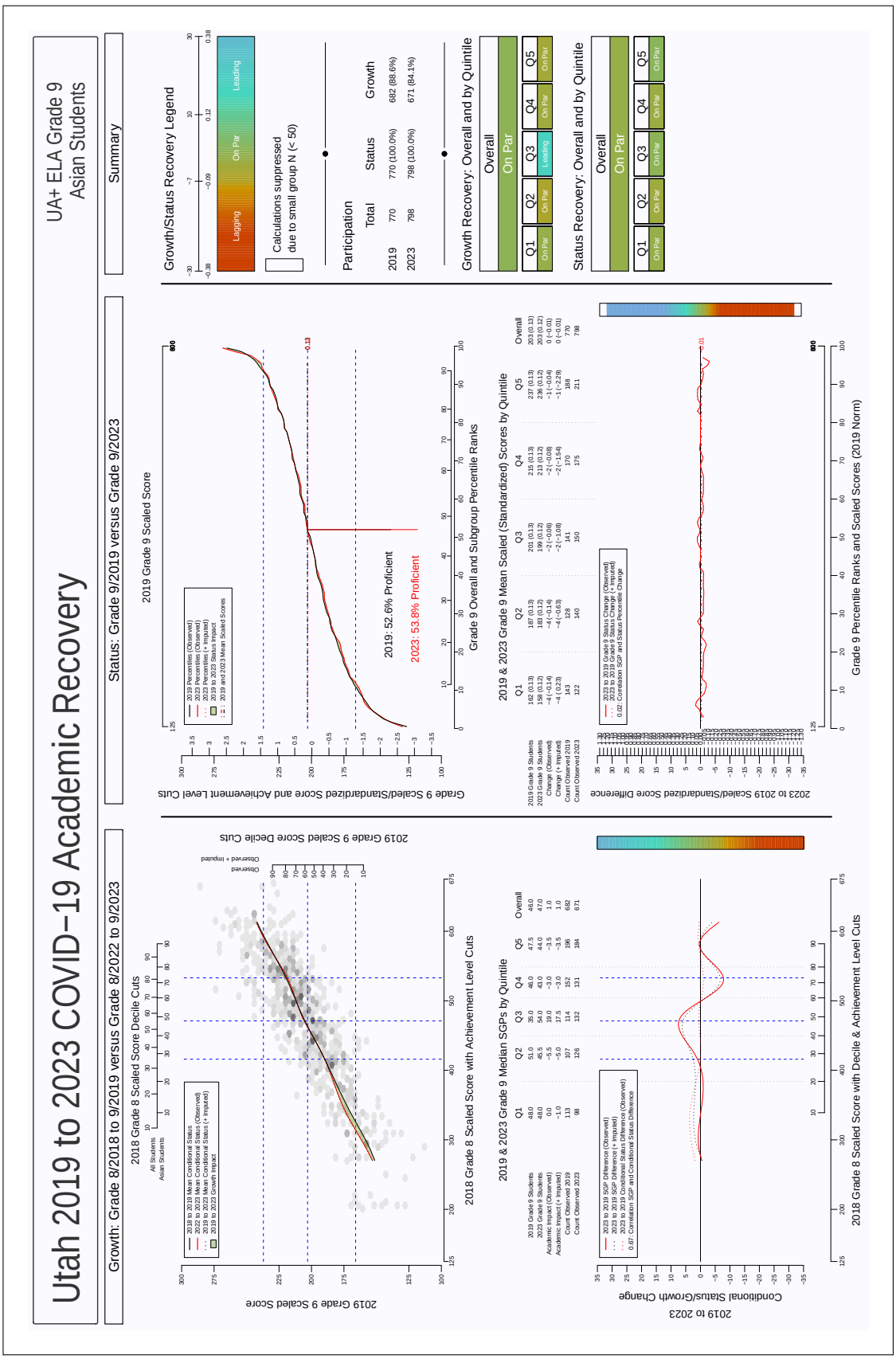

Figure 32: Utah UA+ academic recovery: Growth and status 2019 to 2023 grade 9 ELA, Asian students

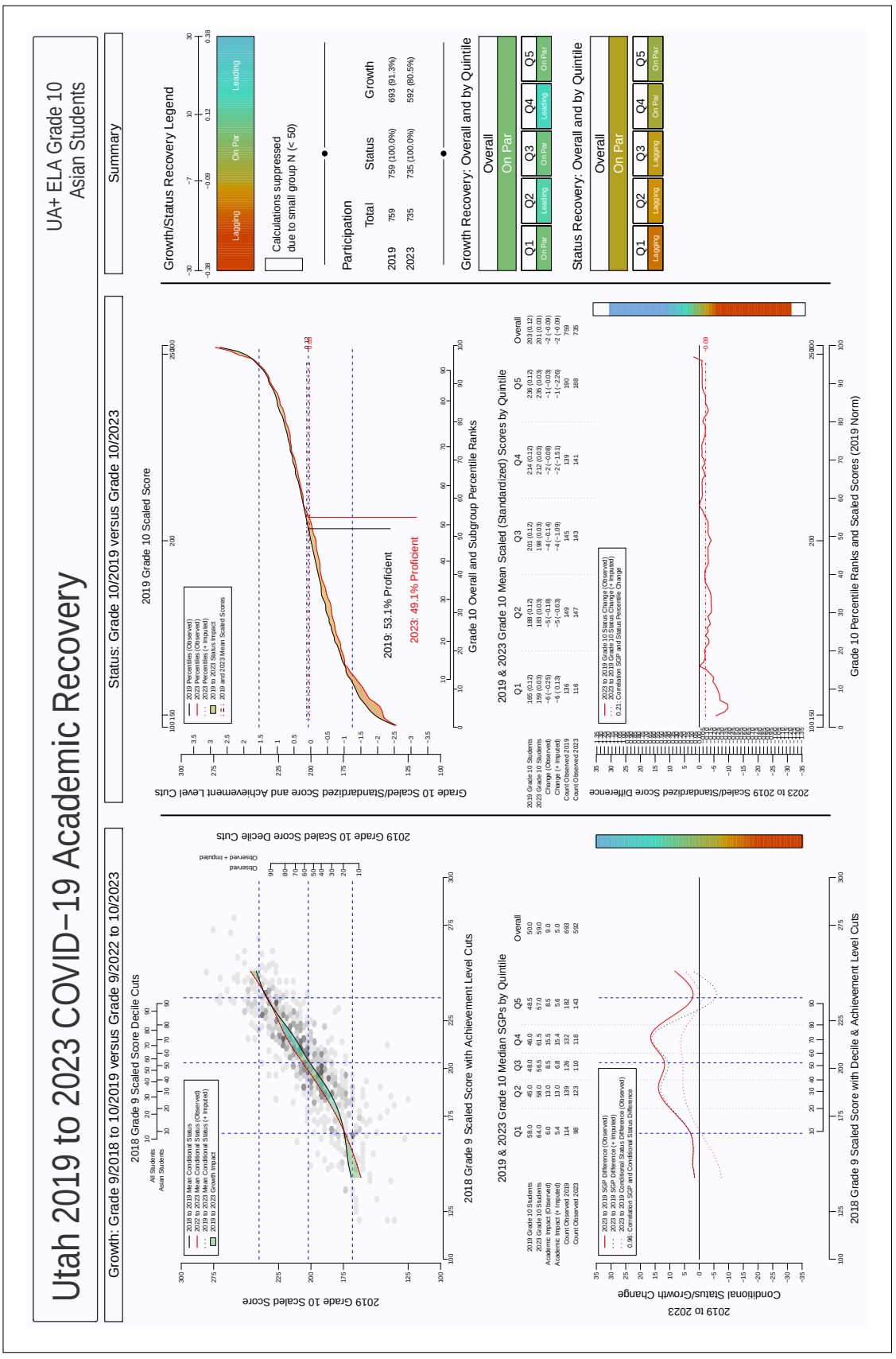

Figure 33: Utah UA+ academic recovery: Growth and status 2019 to 2023 grade 10 ELA, Asian students

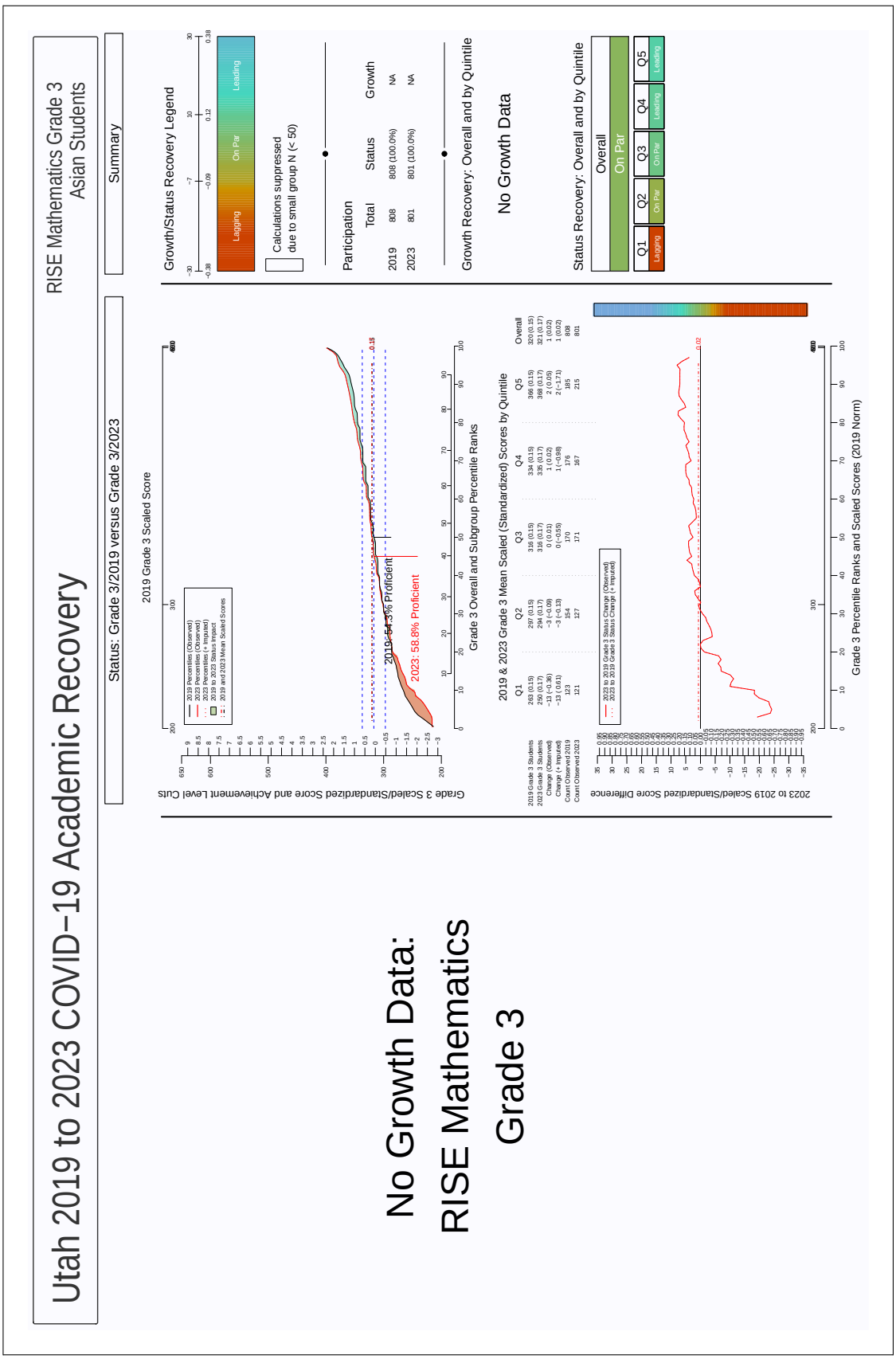

Figure 34: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 3 mathematics, Asian students

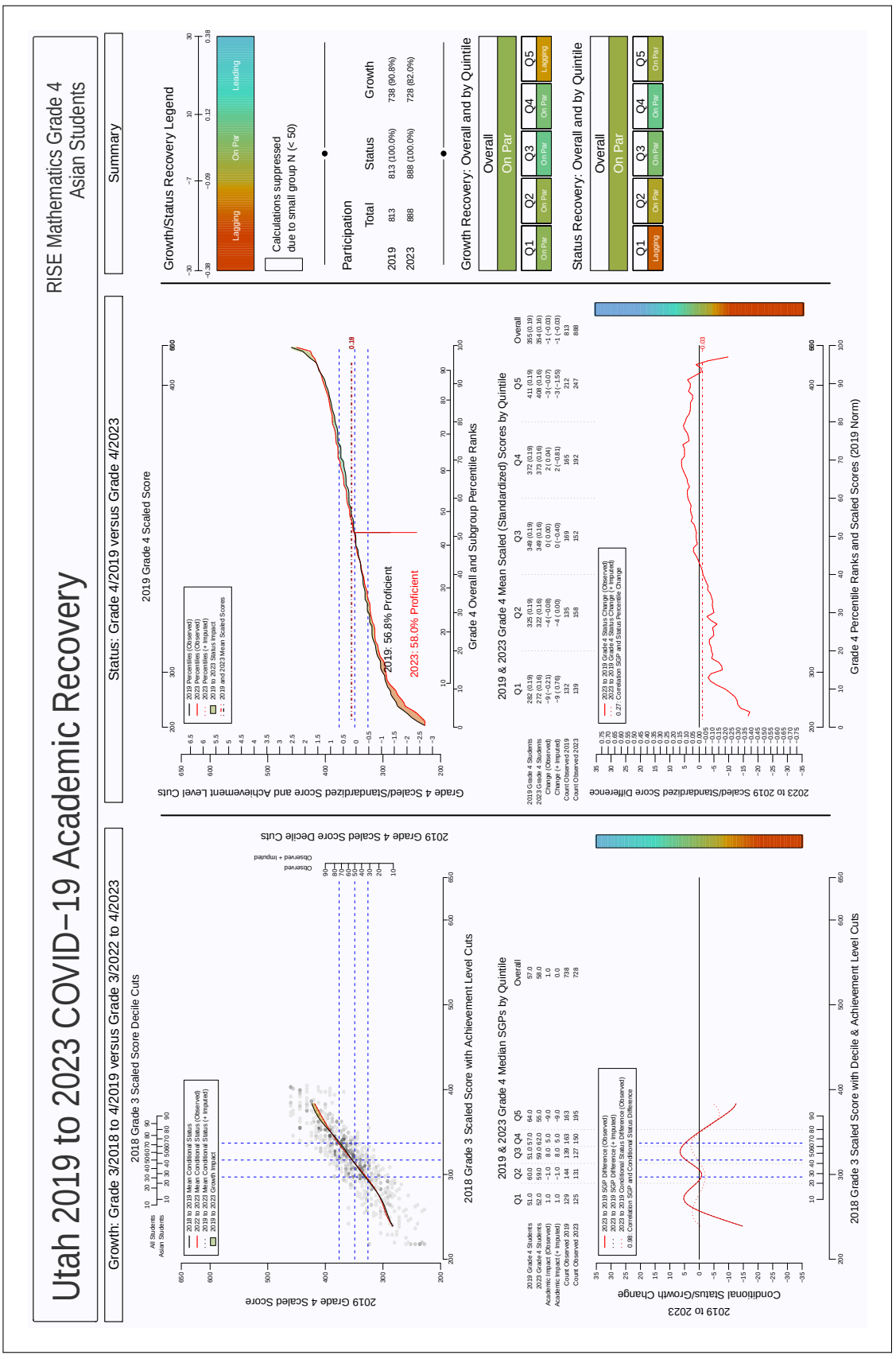

Figure 35: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 4 mathematics, Asian students

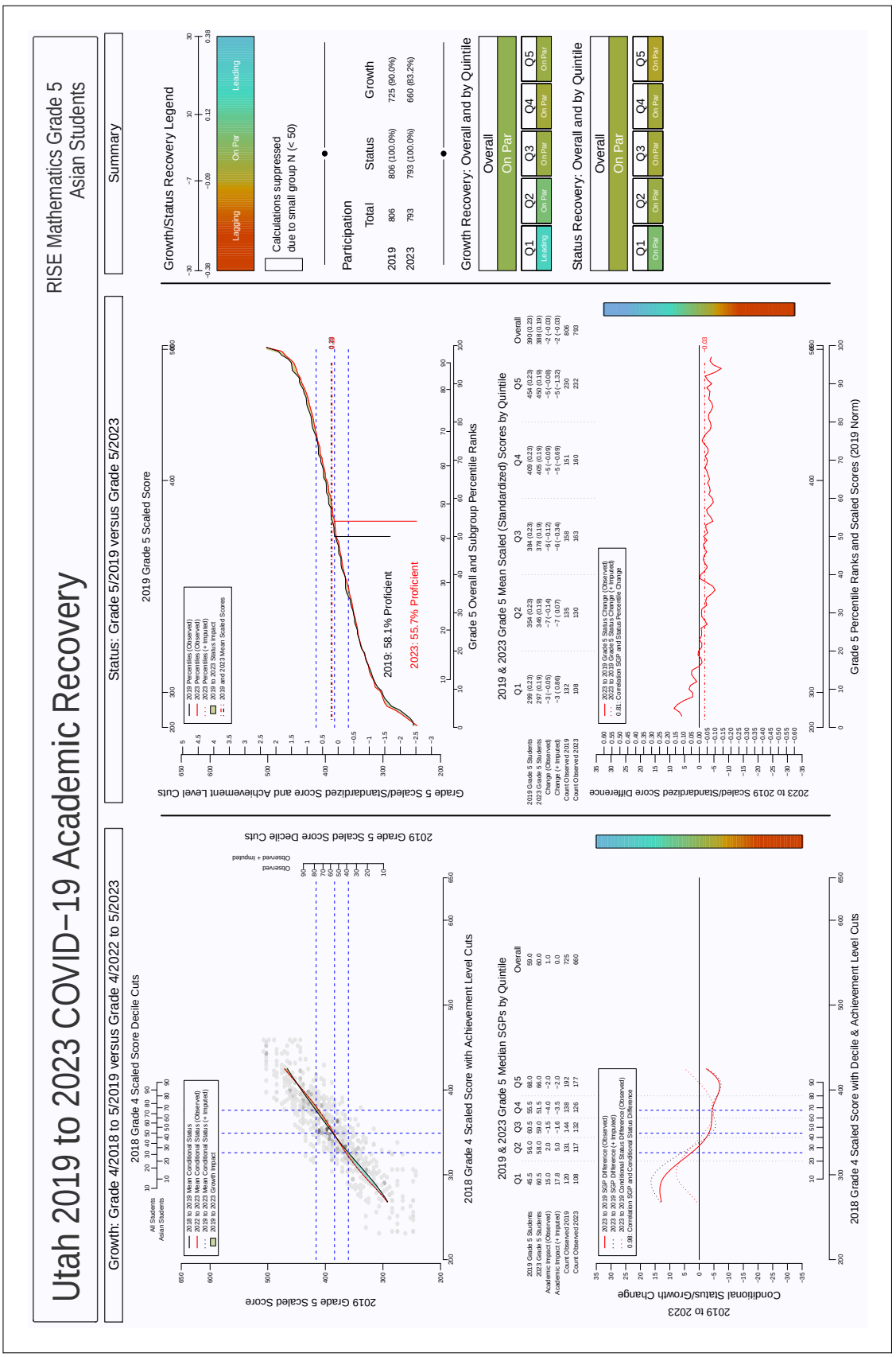

Figure 36: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 5 mathematics, Asian students

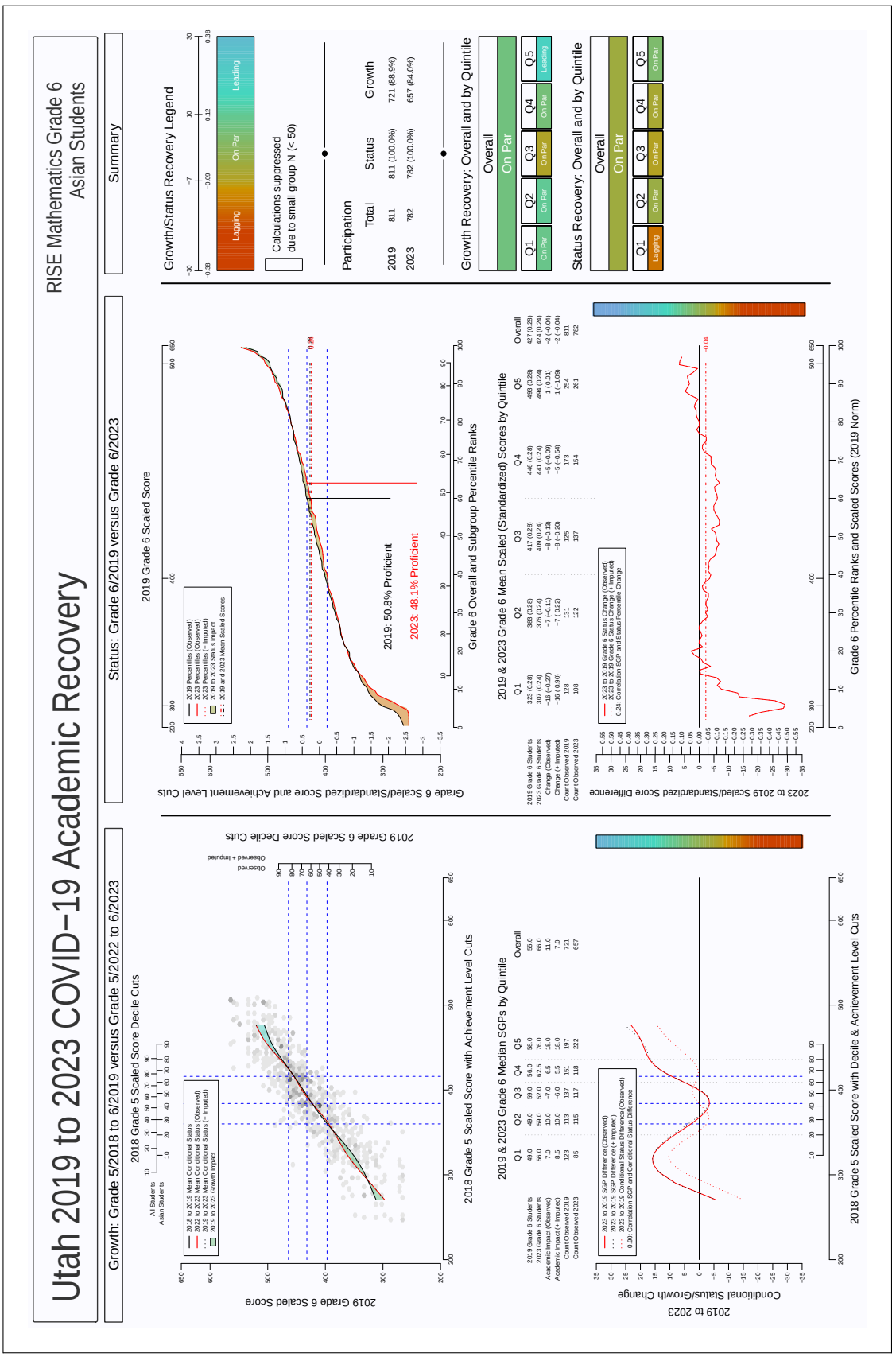

Figure 37: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 6 mathematics, Asian students

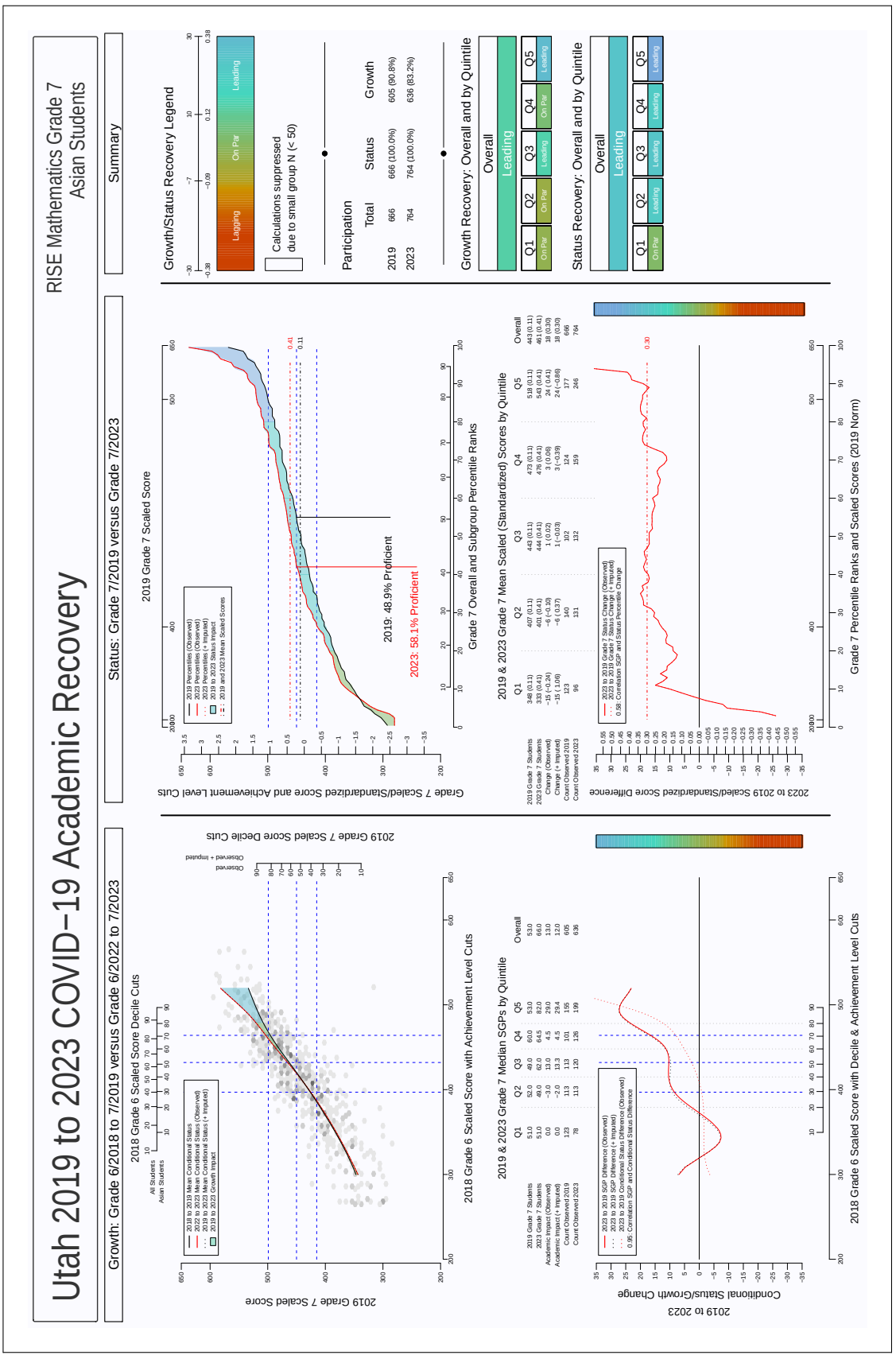

Figure 38: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 7 mathematics, Asian students

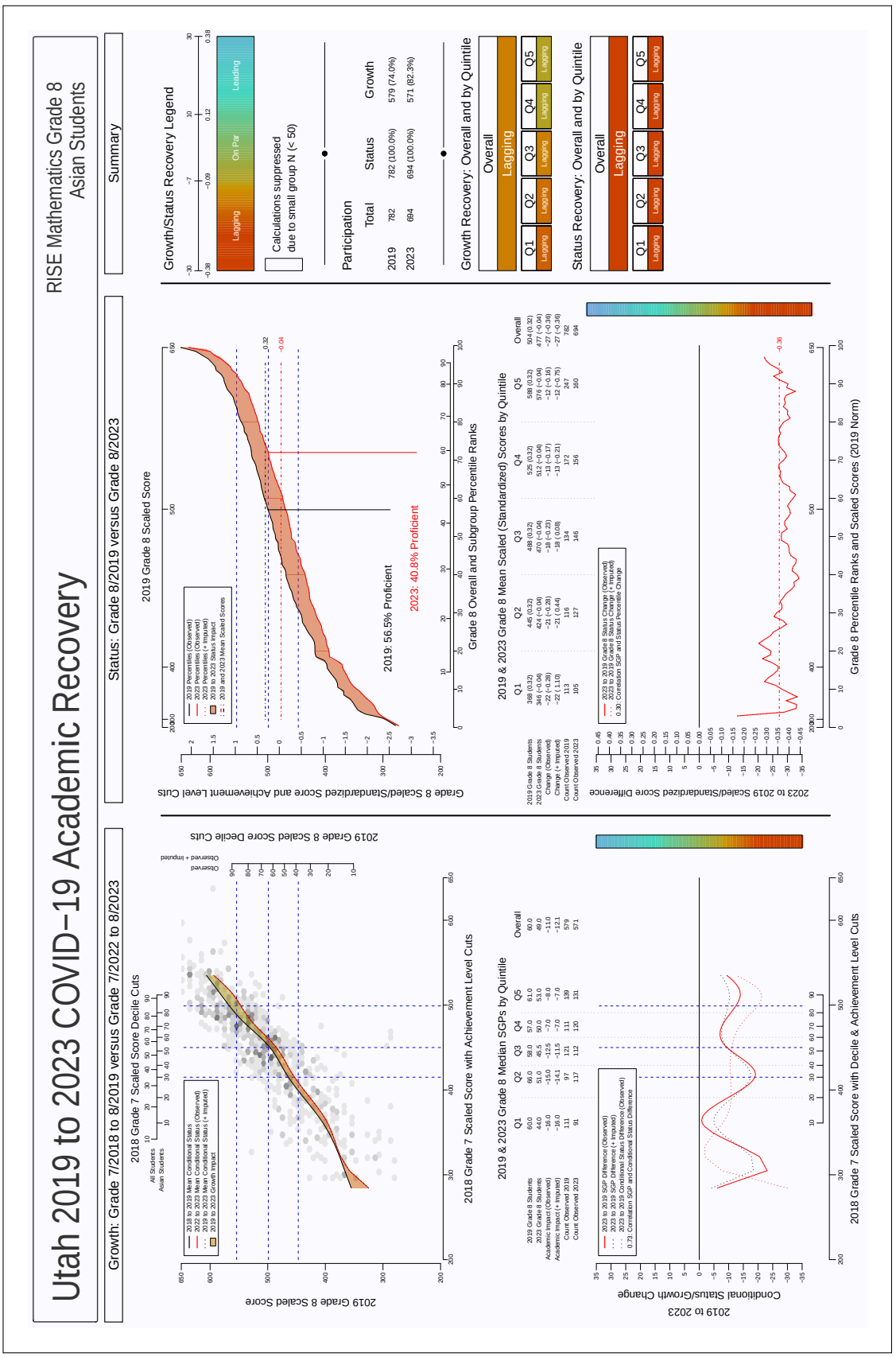

Figure 39: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 8 mathematics, Asian students

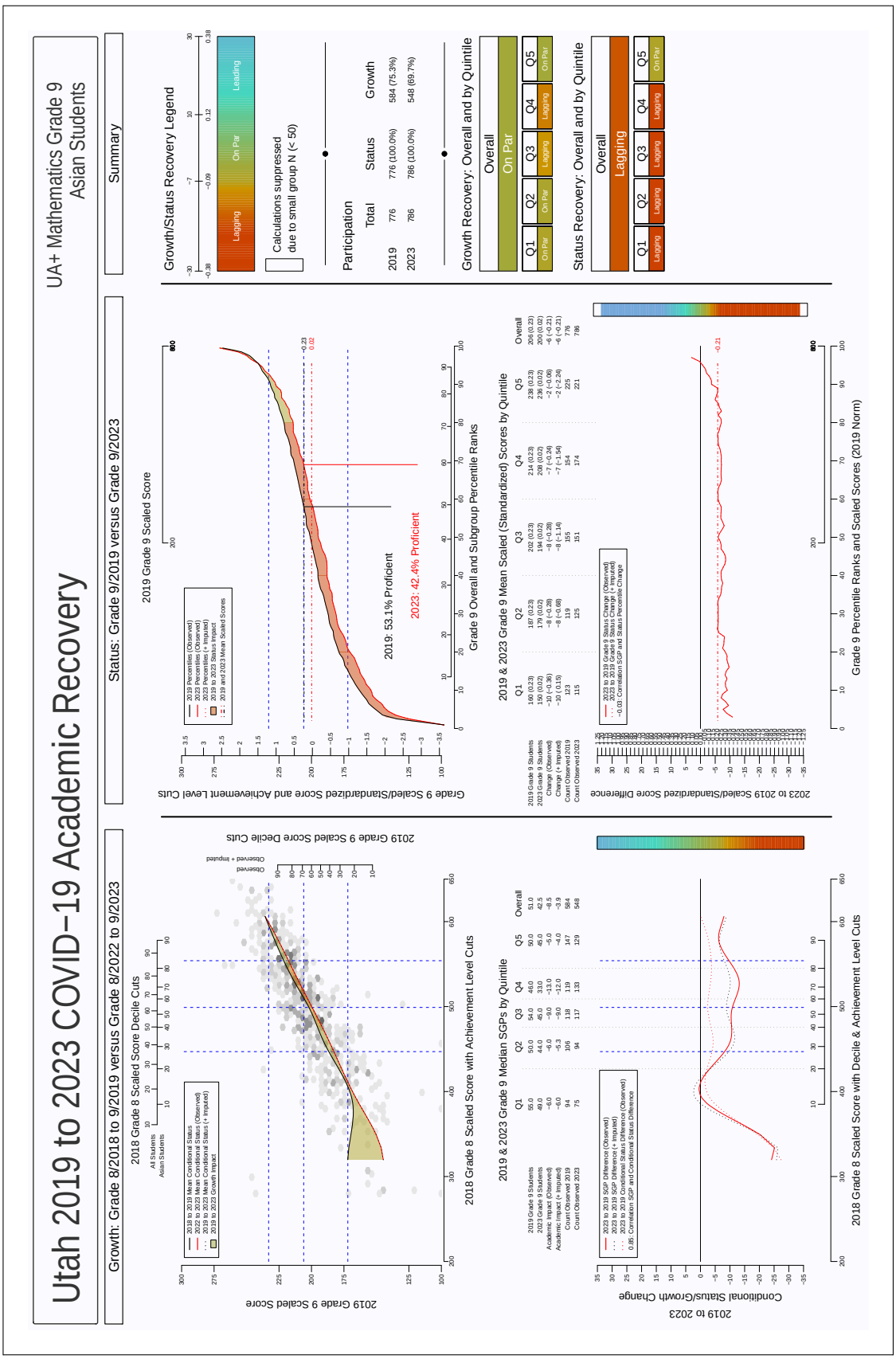

Figure 40: Utah UA+ academic recovery: Growth and status 2019 to 2023 grade 9 mathematics, Asian students

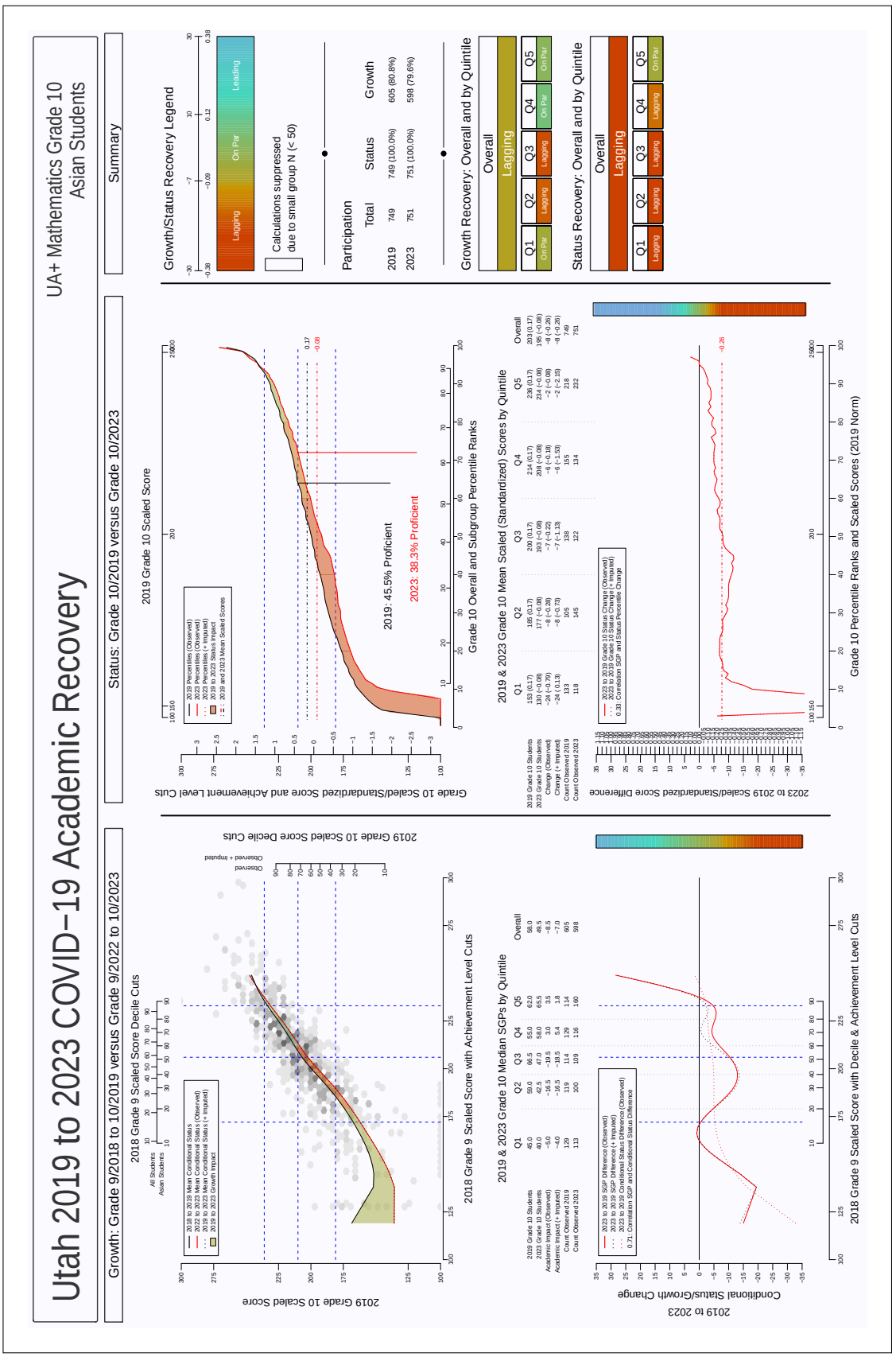

Figure 41: Utah UA+ academic recovery: Growth and status 2019 to 2023 grade 10 mathematics, Asian students

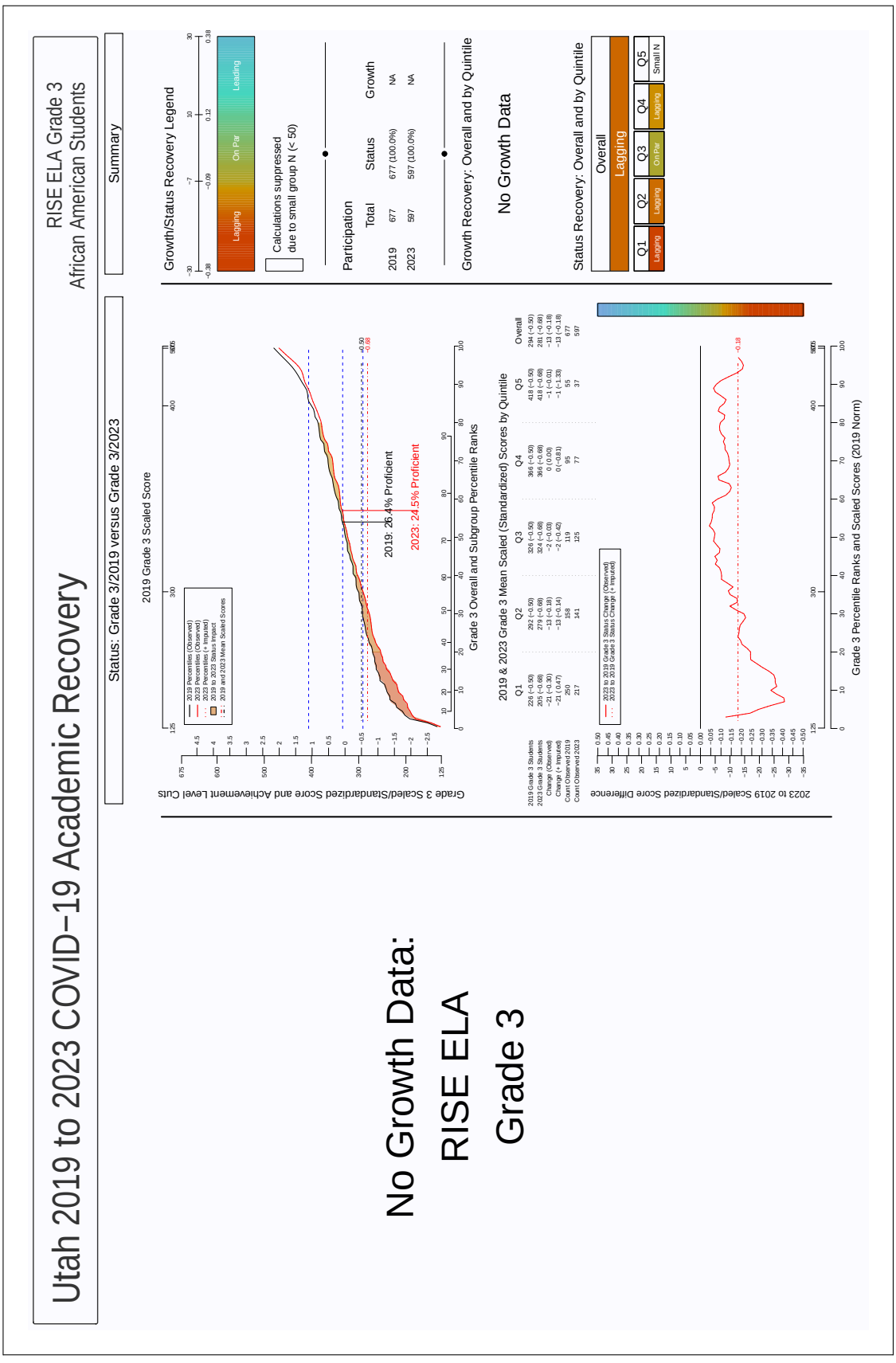

Figure 42: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 3 ELA, African American students

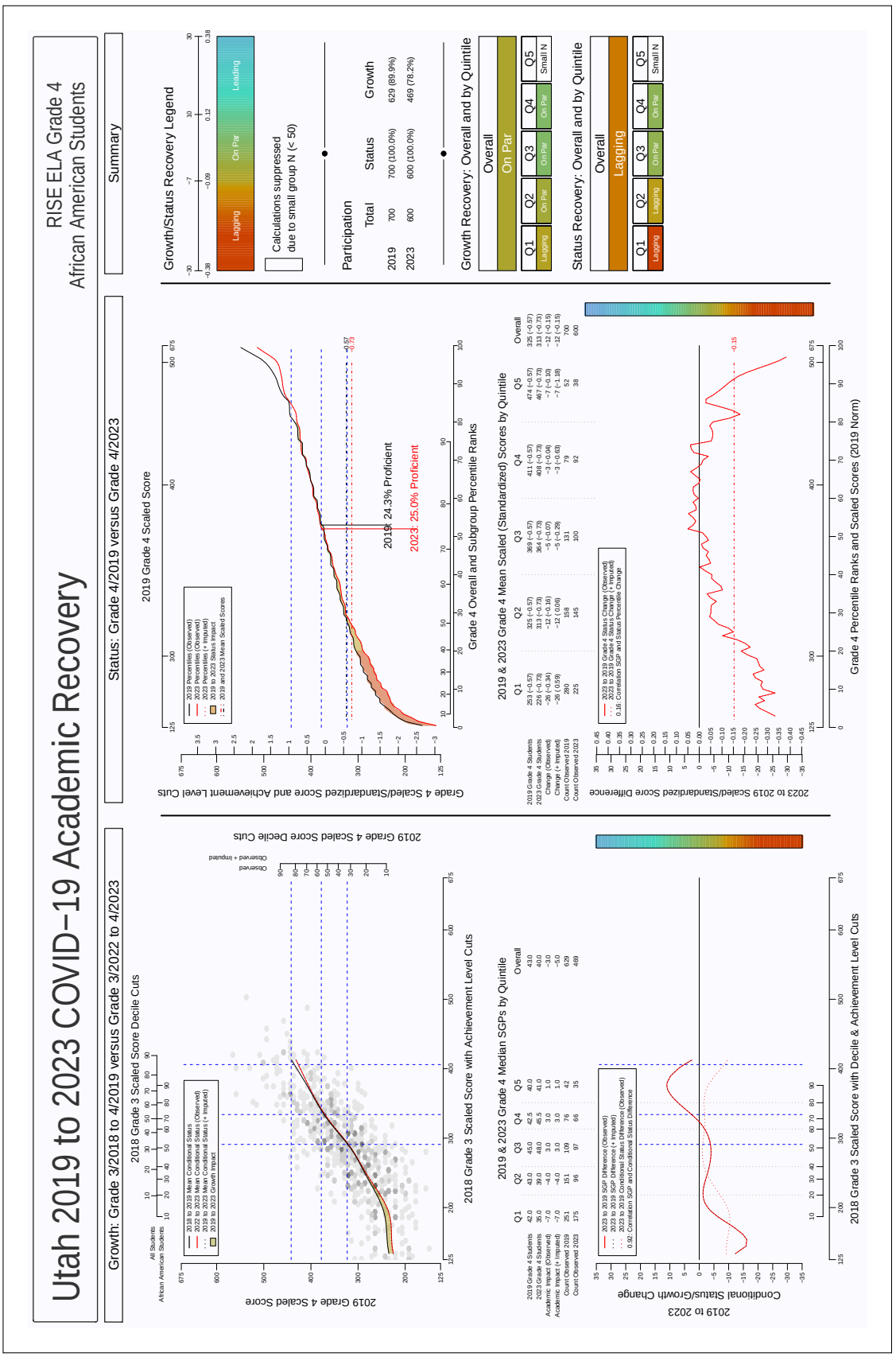

Figure 43: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 4 ELA, African American students

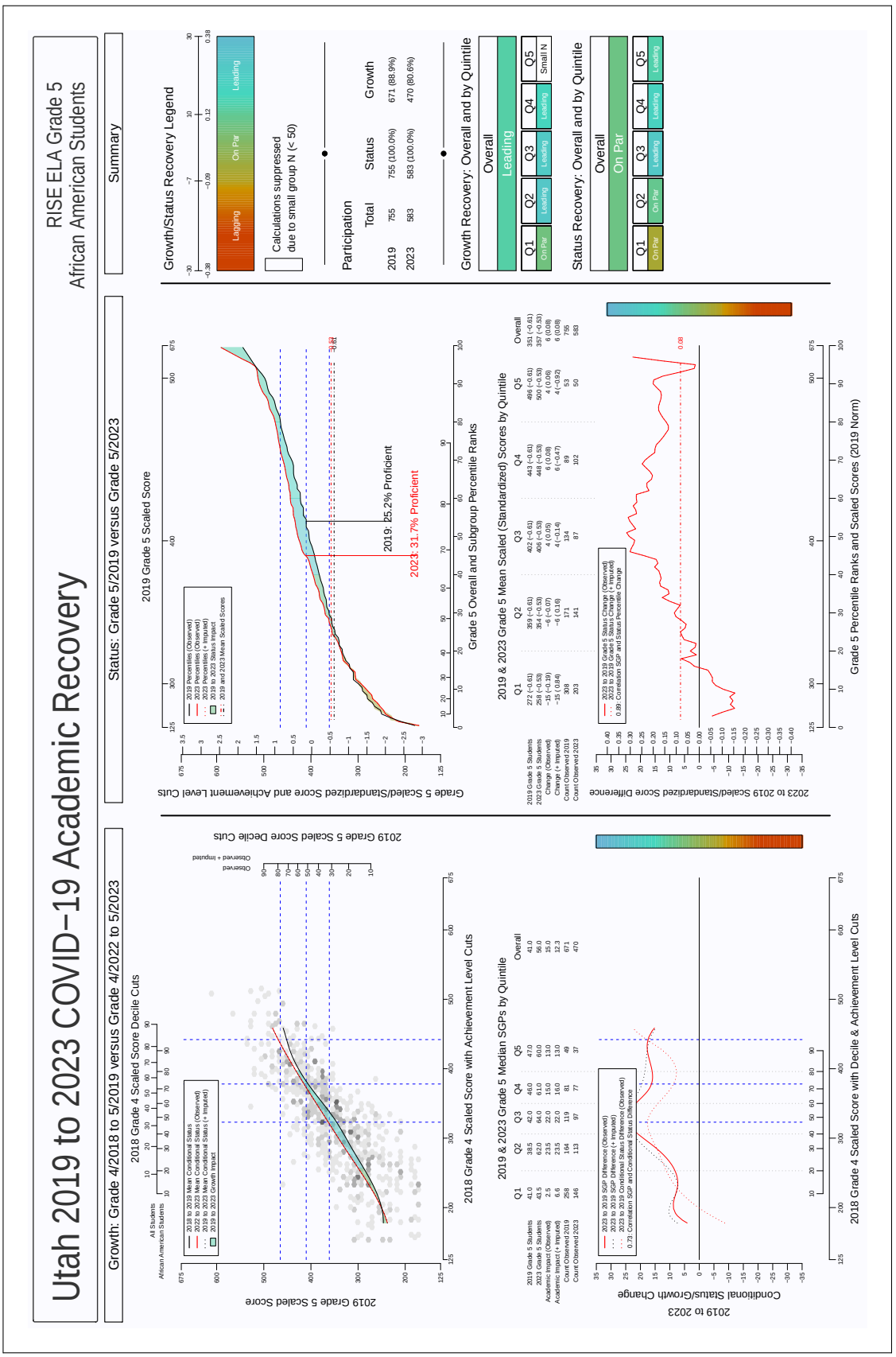

Figure 44: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 5 ELA, African American students

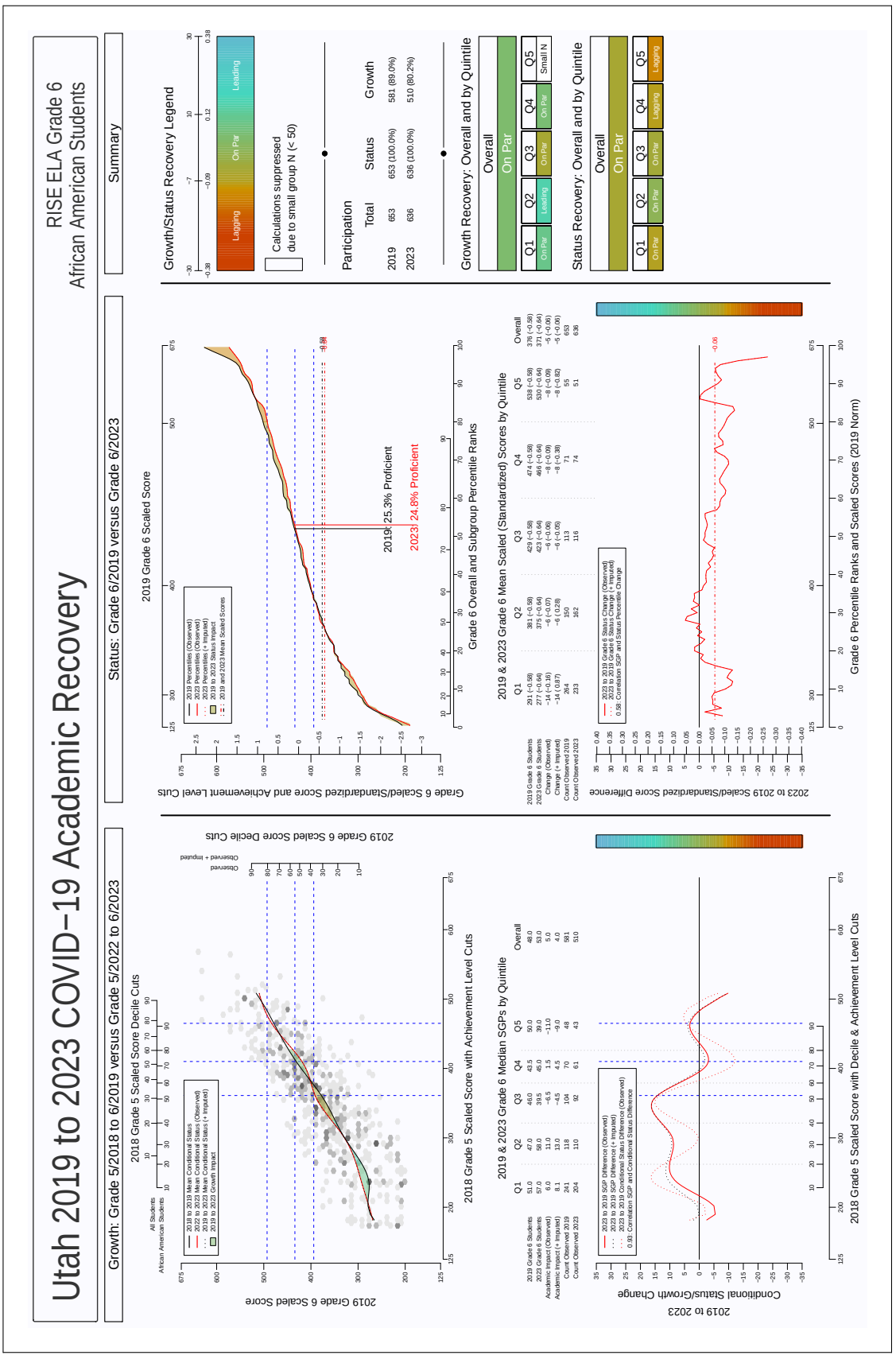

Figure 45: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 6 ELA, African American students

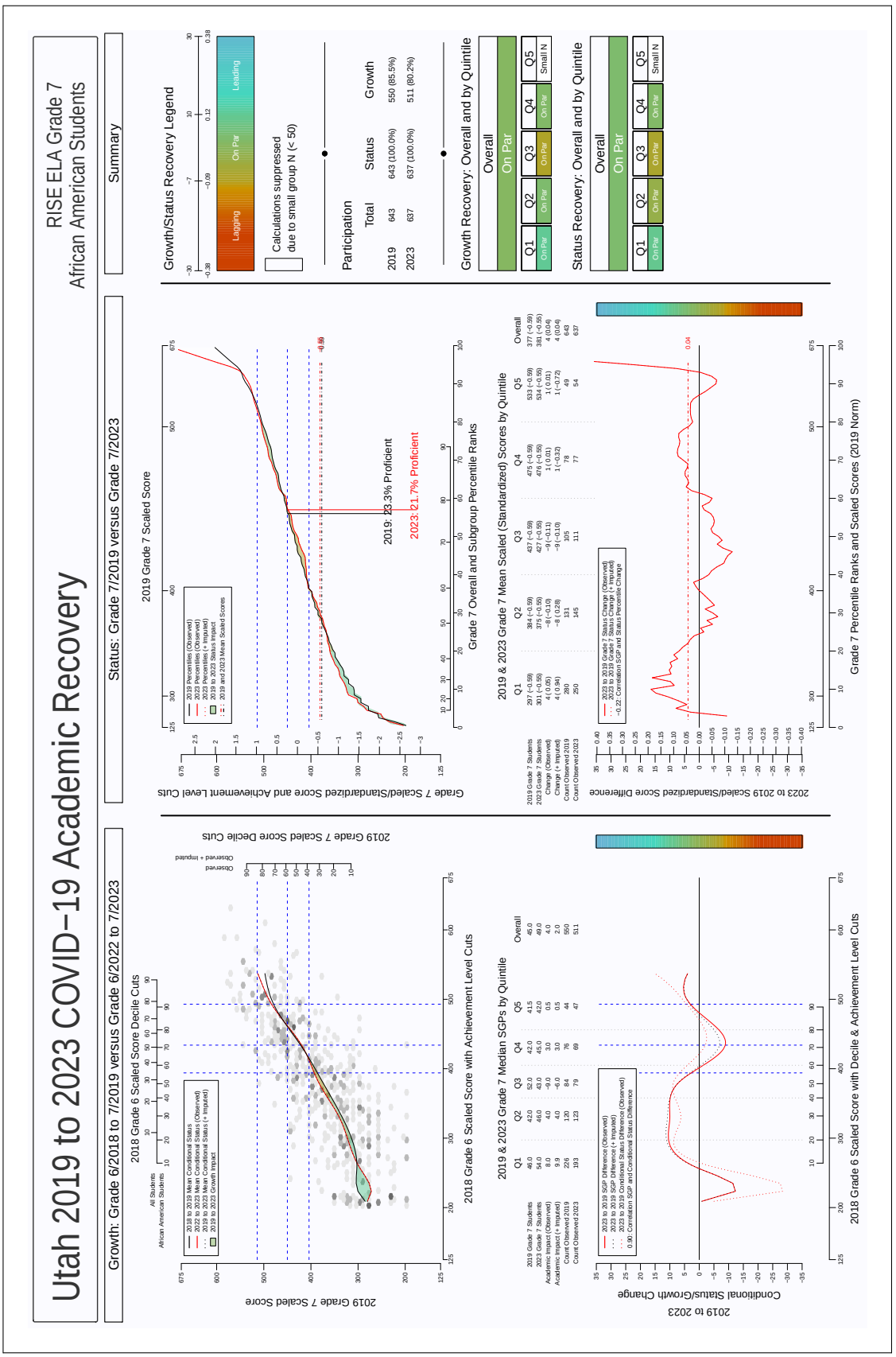

Figure 46: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 7 ELA, African American students

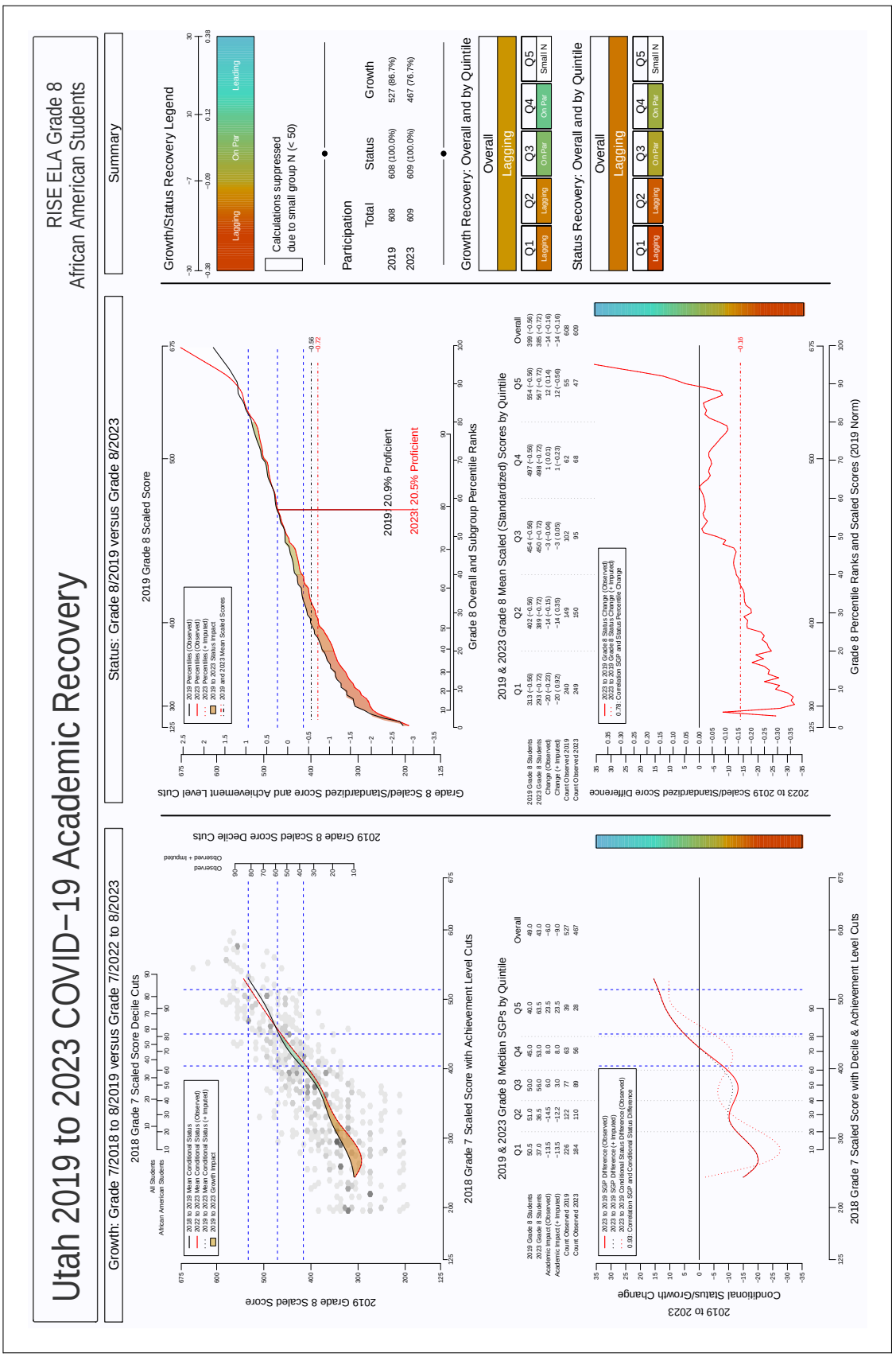

Figure 47: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 8 ELA, African American students

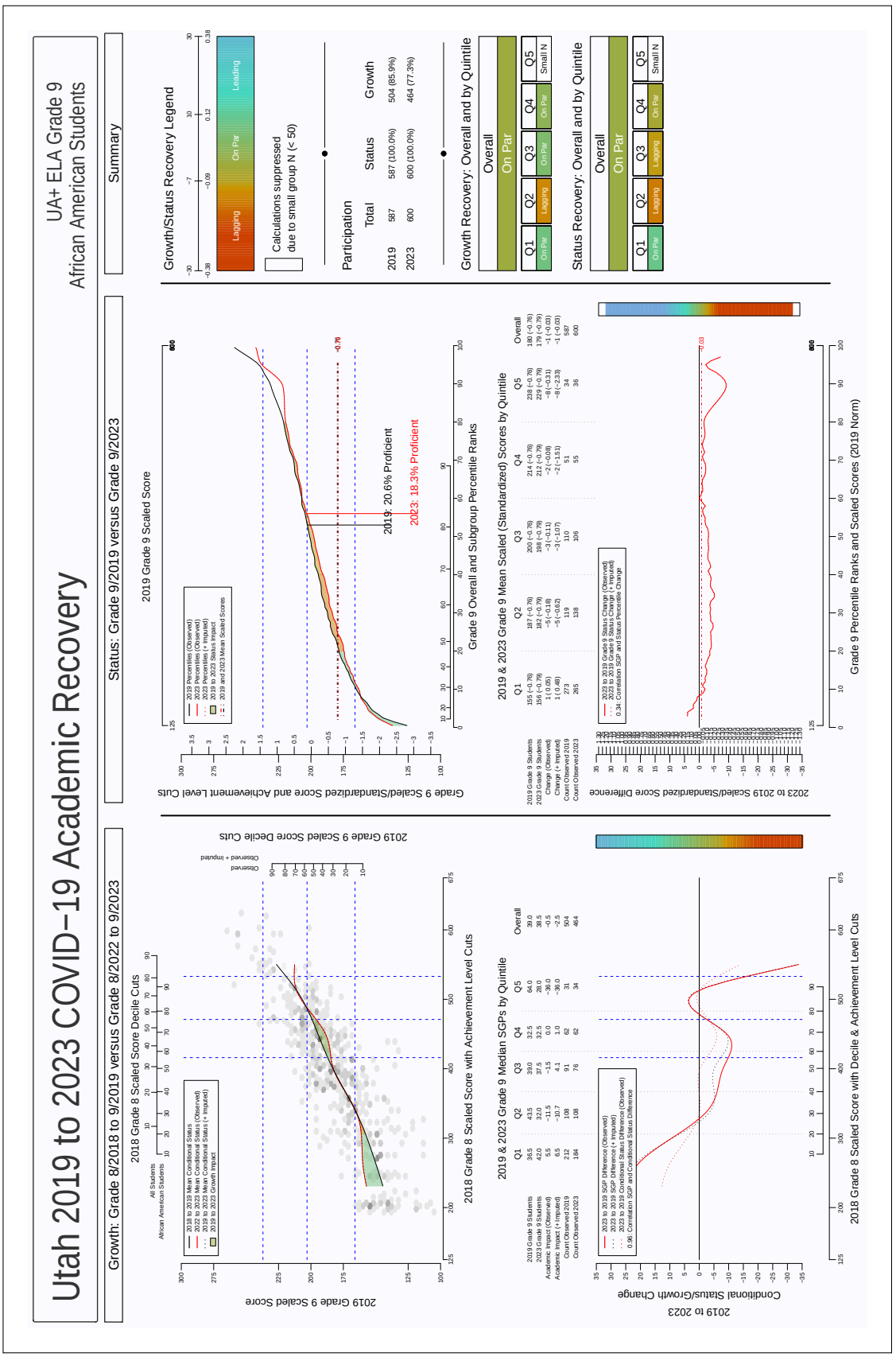

Figure 48: Utah UA+ academic recovery: Growth and status 2019 to 2023 grade 9 ELA, African American students

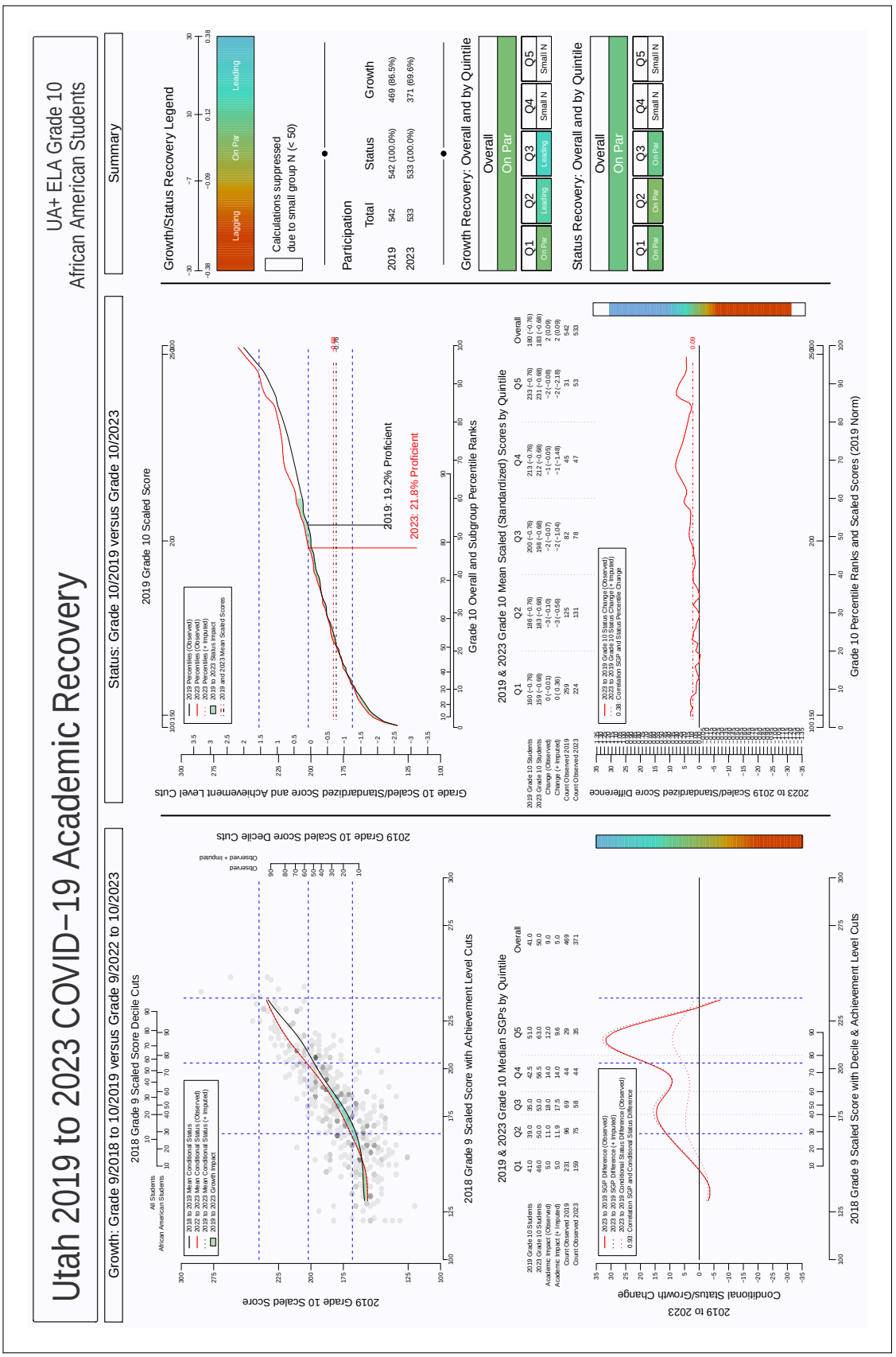

Figure 49: Utah UA+ academic recovery: Growth and status 2019 to 2023 grade 10 ELA, African American students

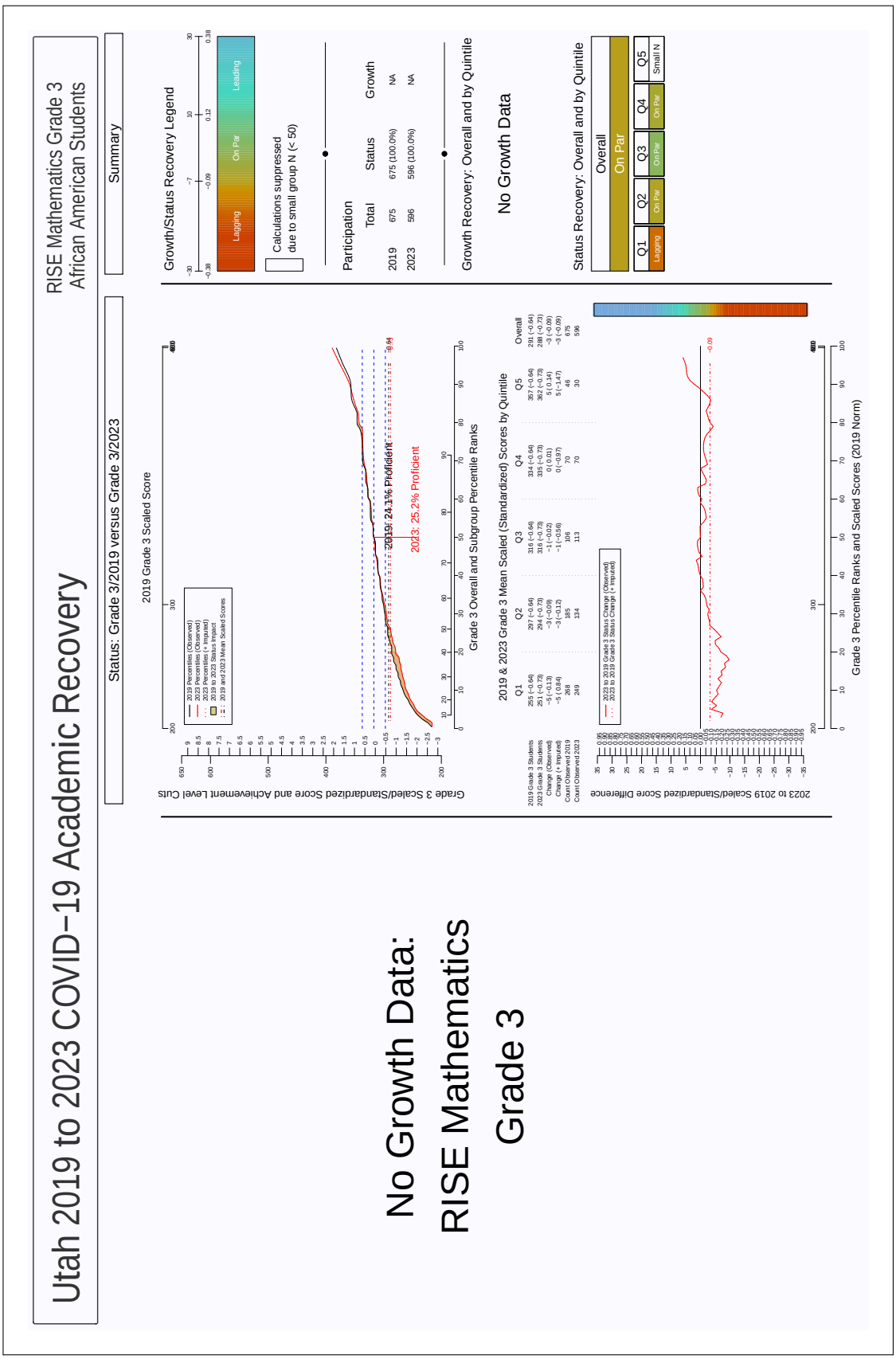

Figure 50: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 3 mathematics, African American students

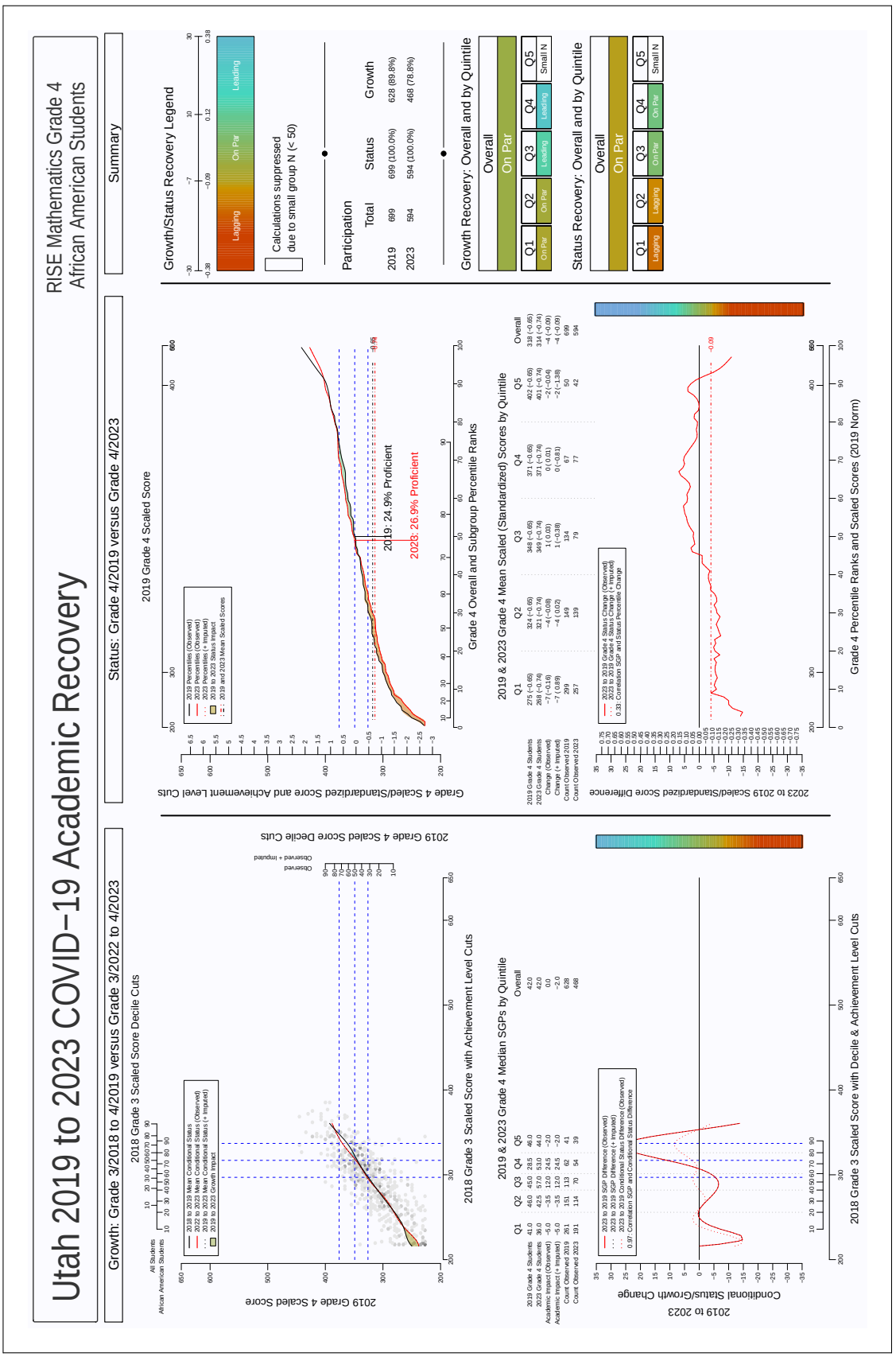

Figure 51: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 4 mathematics, African American students

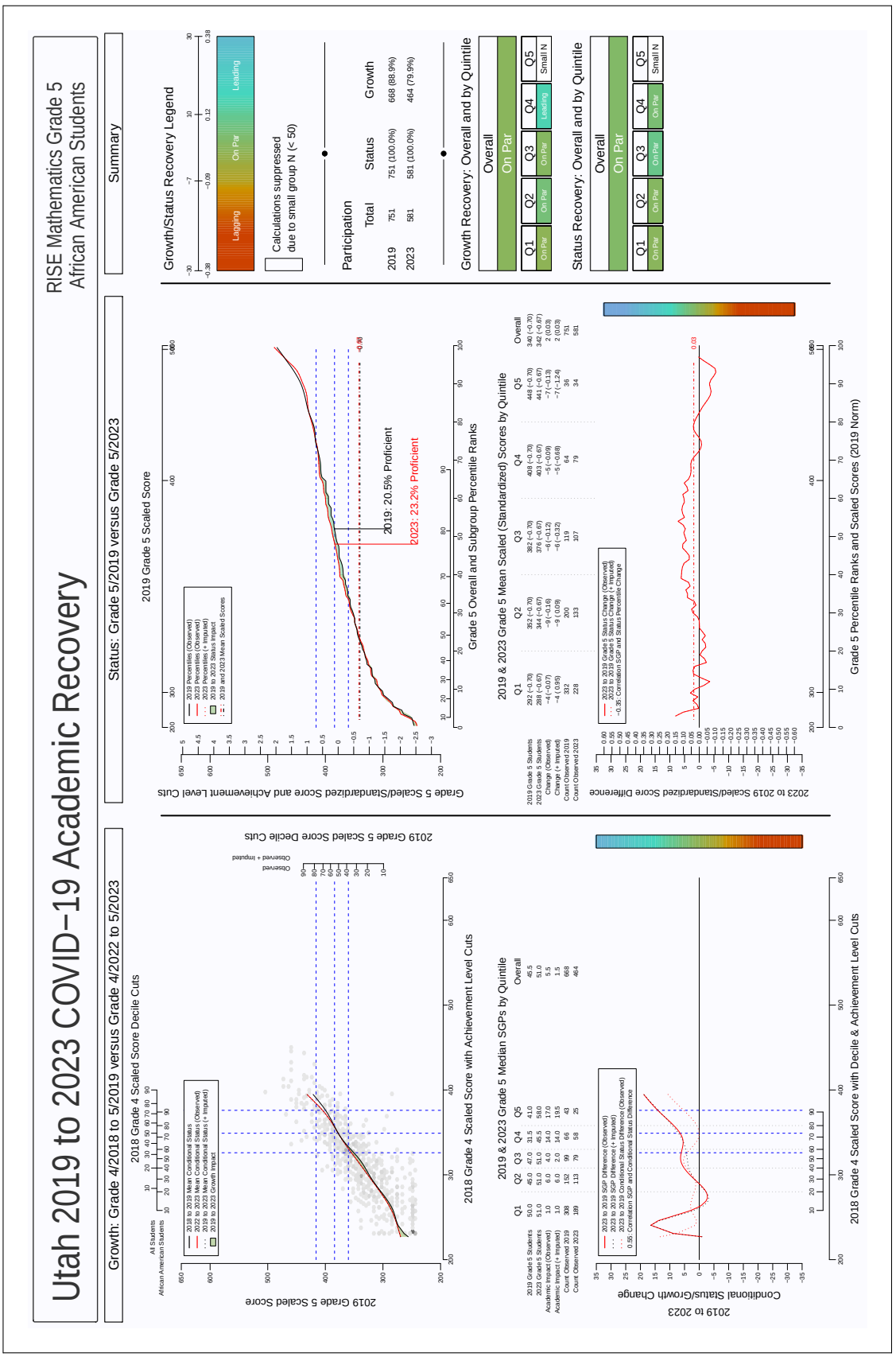

Figure 52: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 5 mathematics, African American students

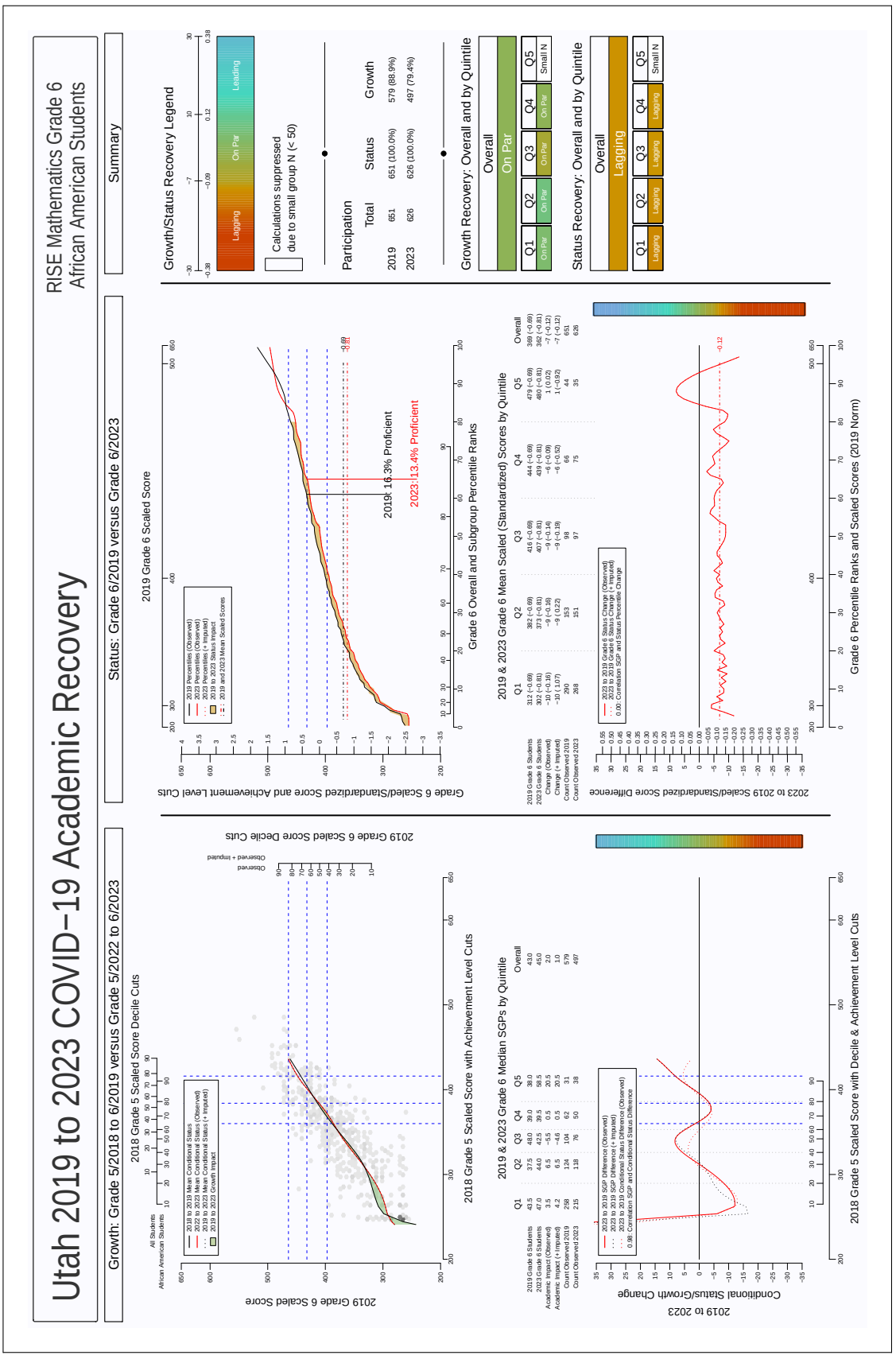

Figure 53: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 6 mathematics, African American students

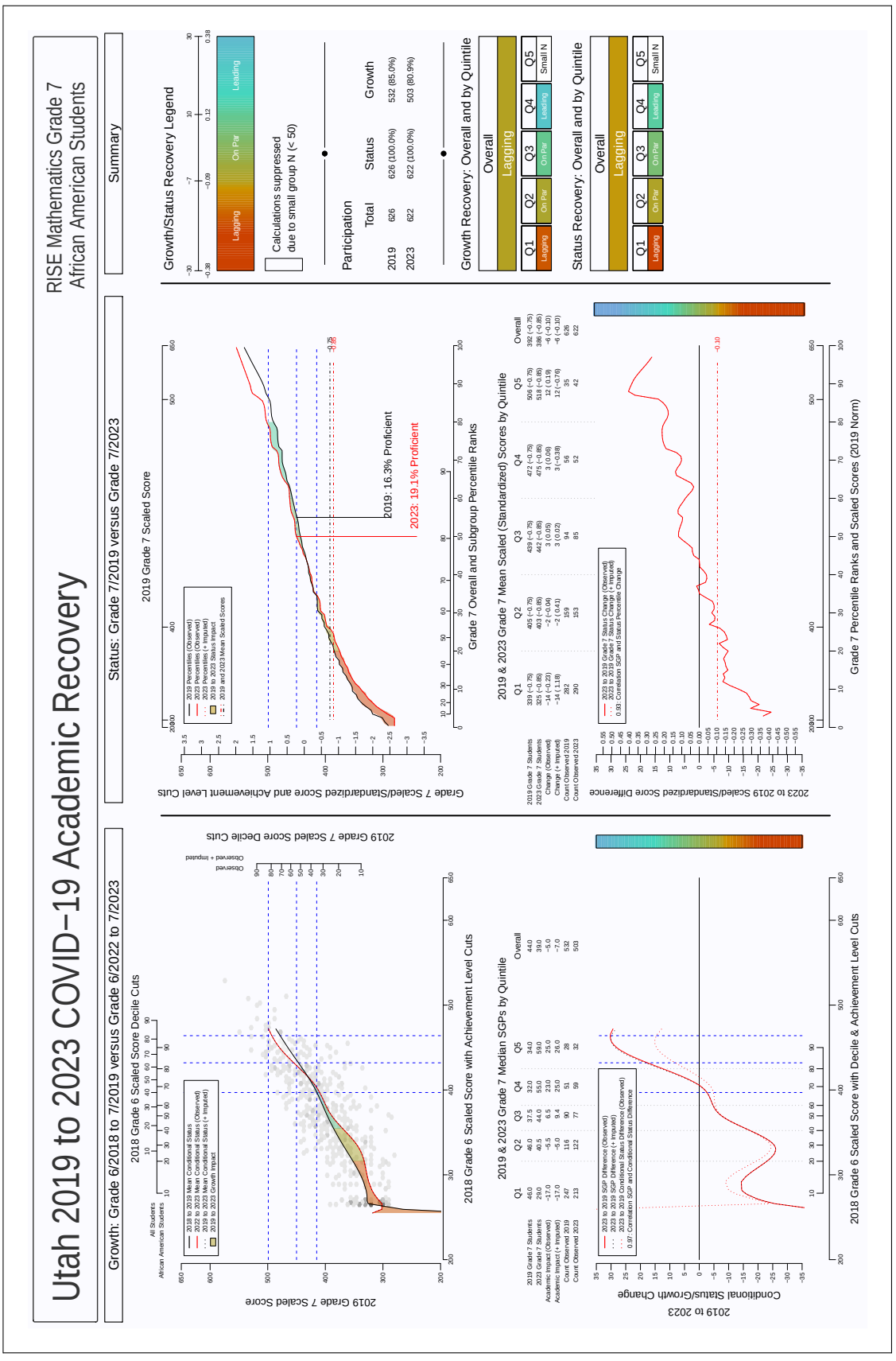

Figure 54: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 7 mathematics, African American students

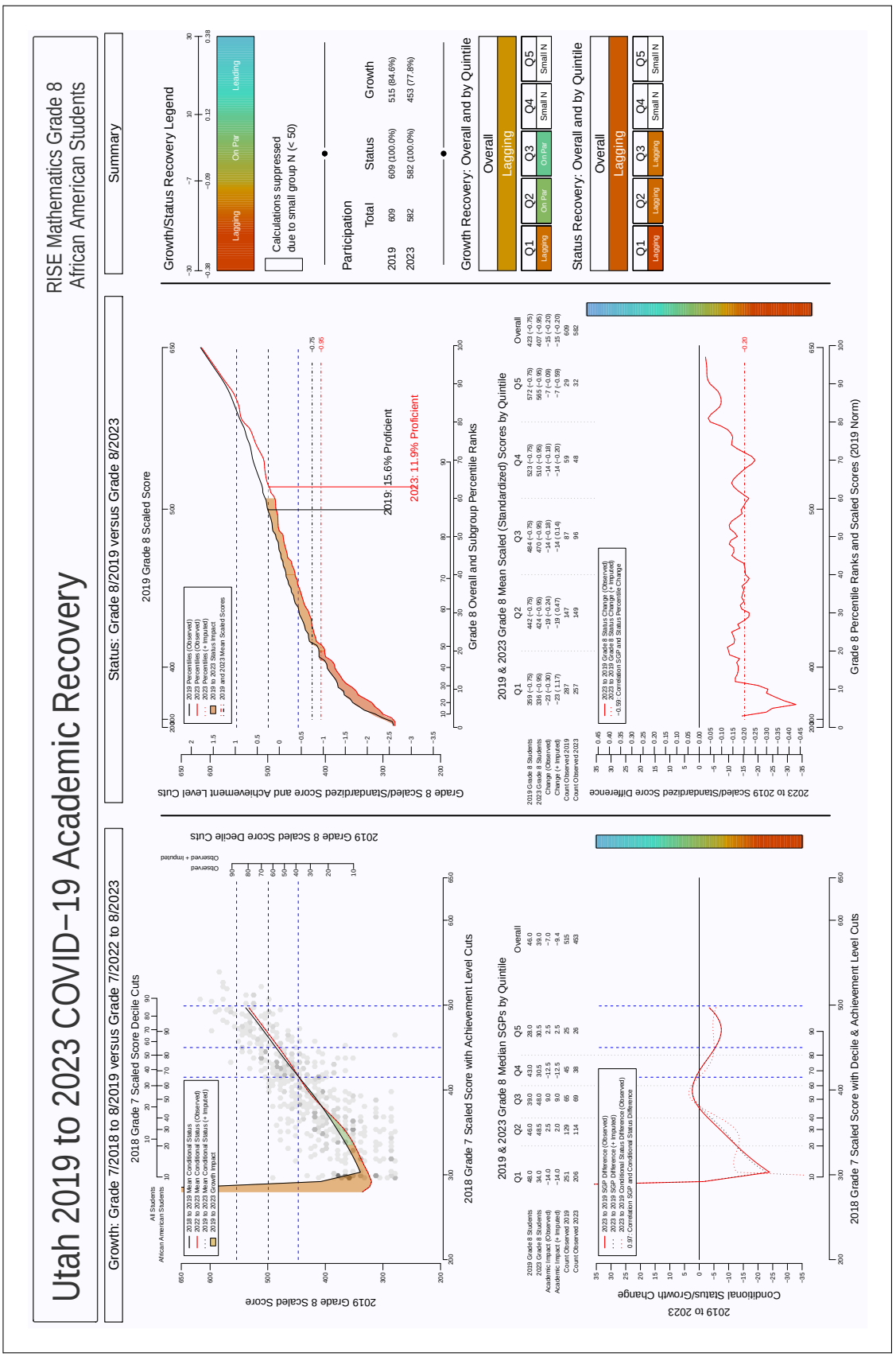

Figure 55: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 8 mathematics, African American students

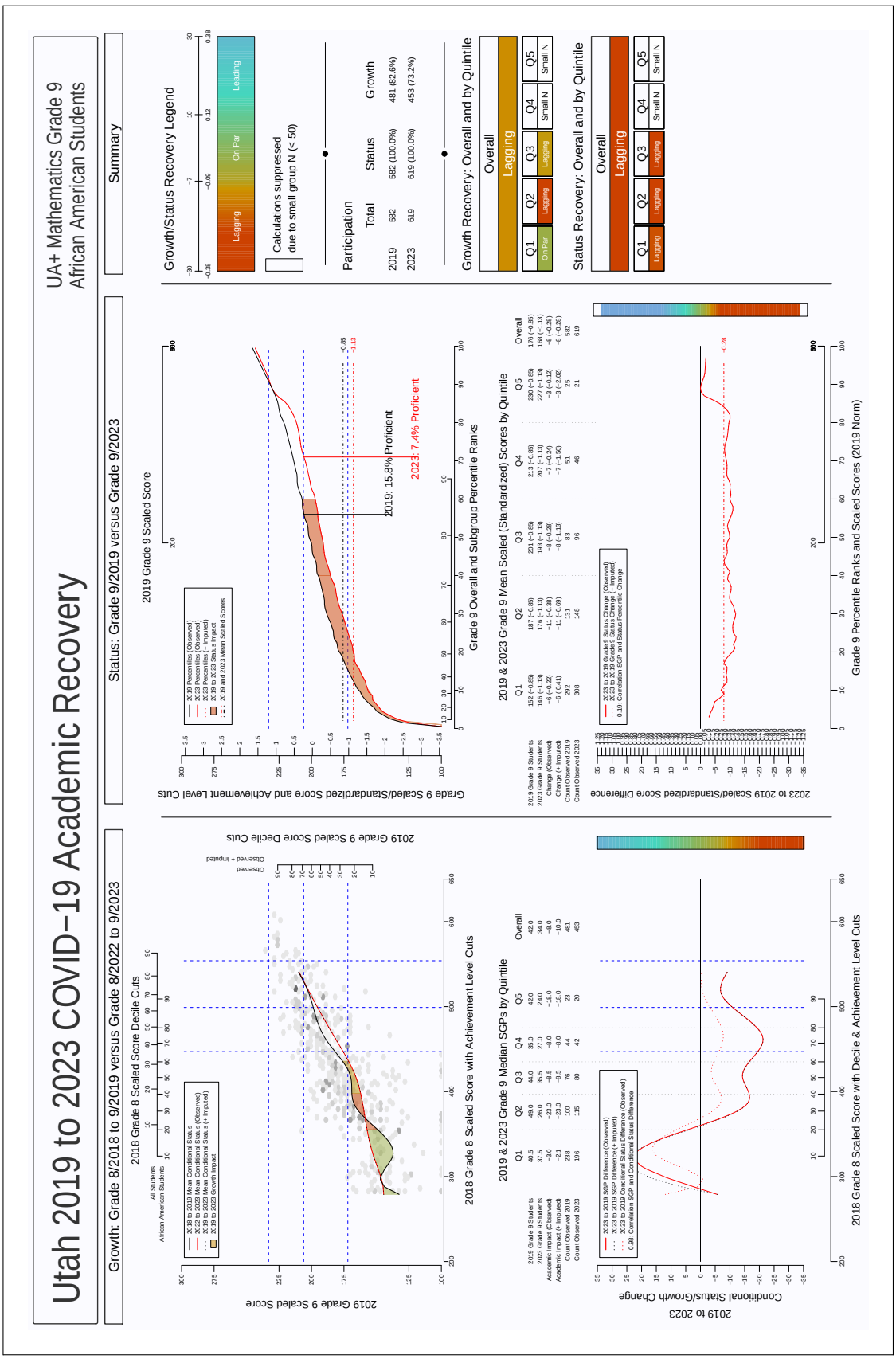

Figure 56: Utah UA+ academic recovery: Growth and status 2019 to 2023 grade 9 mathematics, African American students

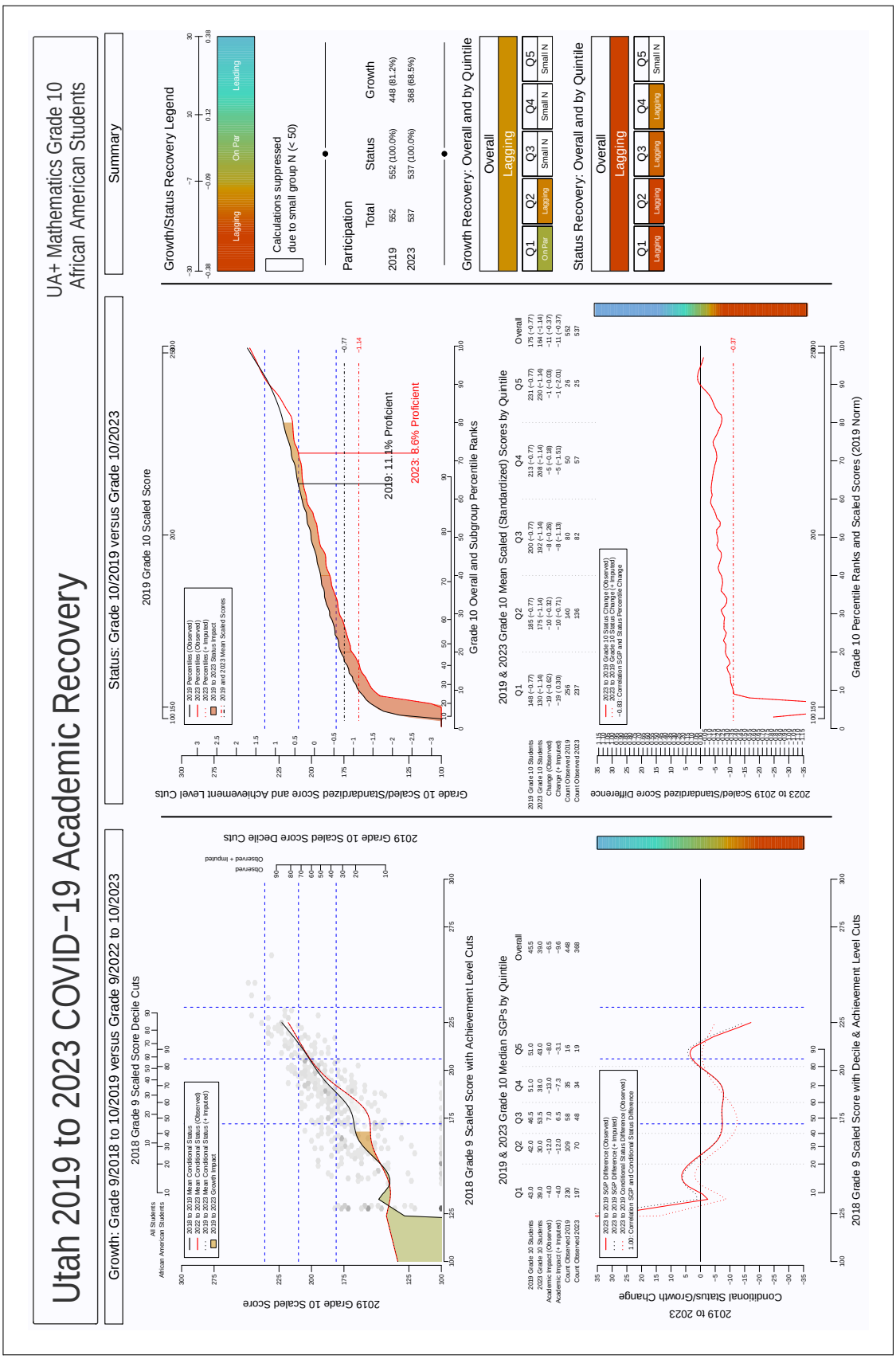

Figure 57: Utah UA+ academic recovery: Growth and status 2019 to 2023 grade 8 mathematics, African American students

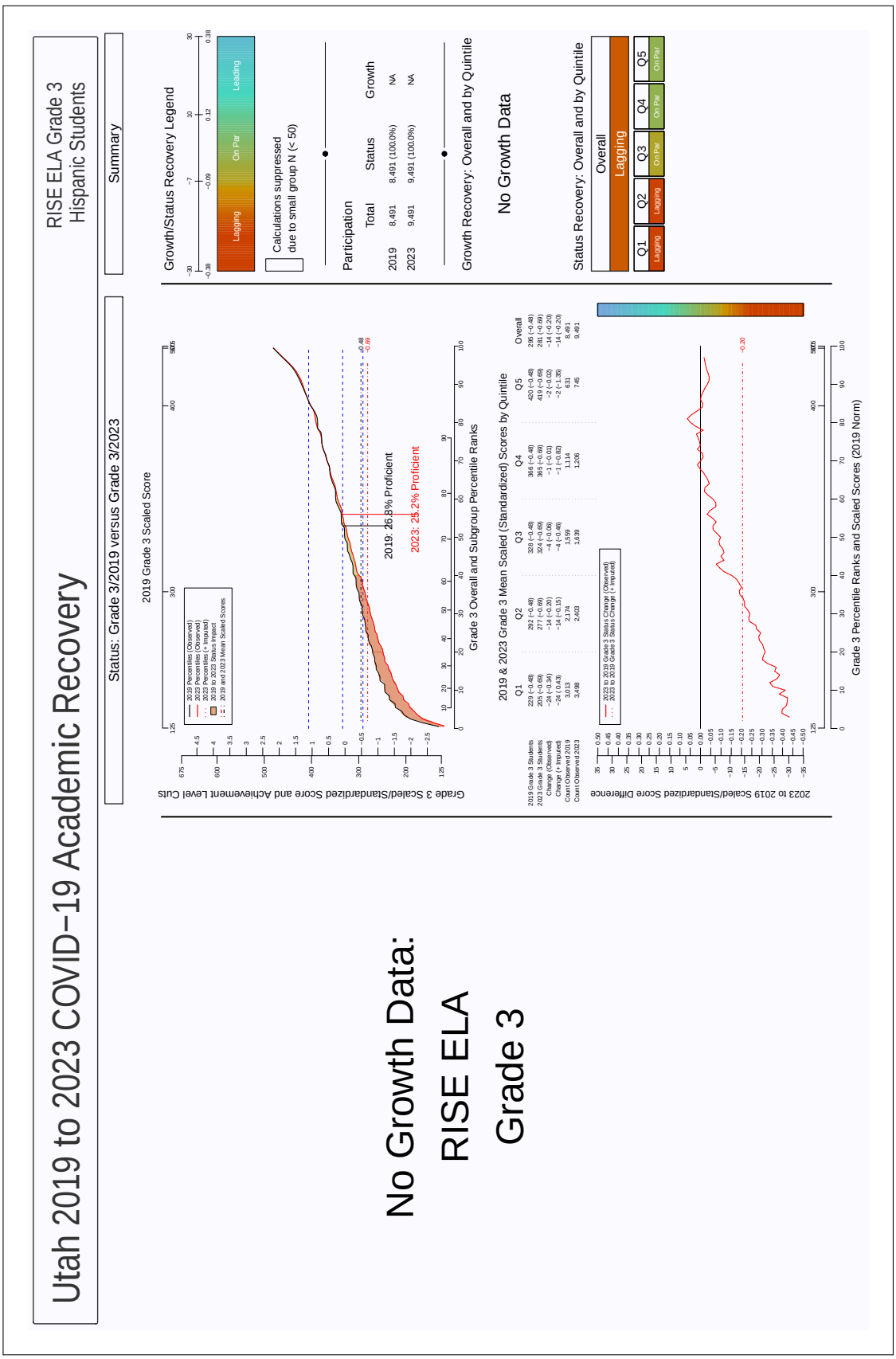

Figure 58: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 3 ELA, Hispanic students

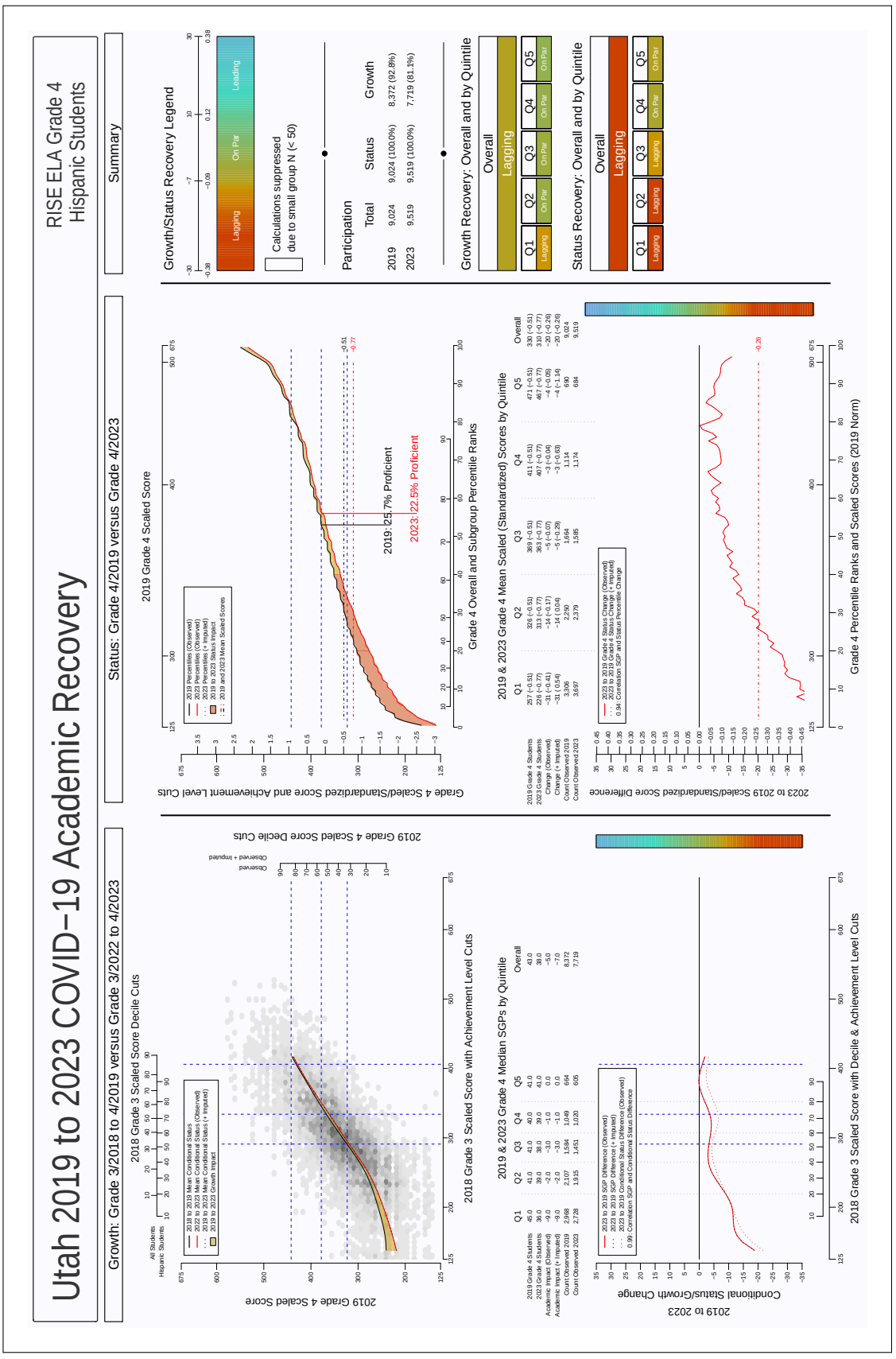

Figure 59: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 4 ELA, Hispanic students

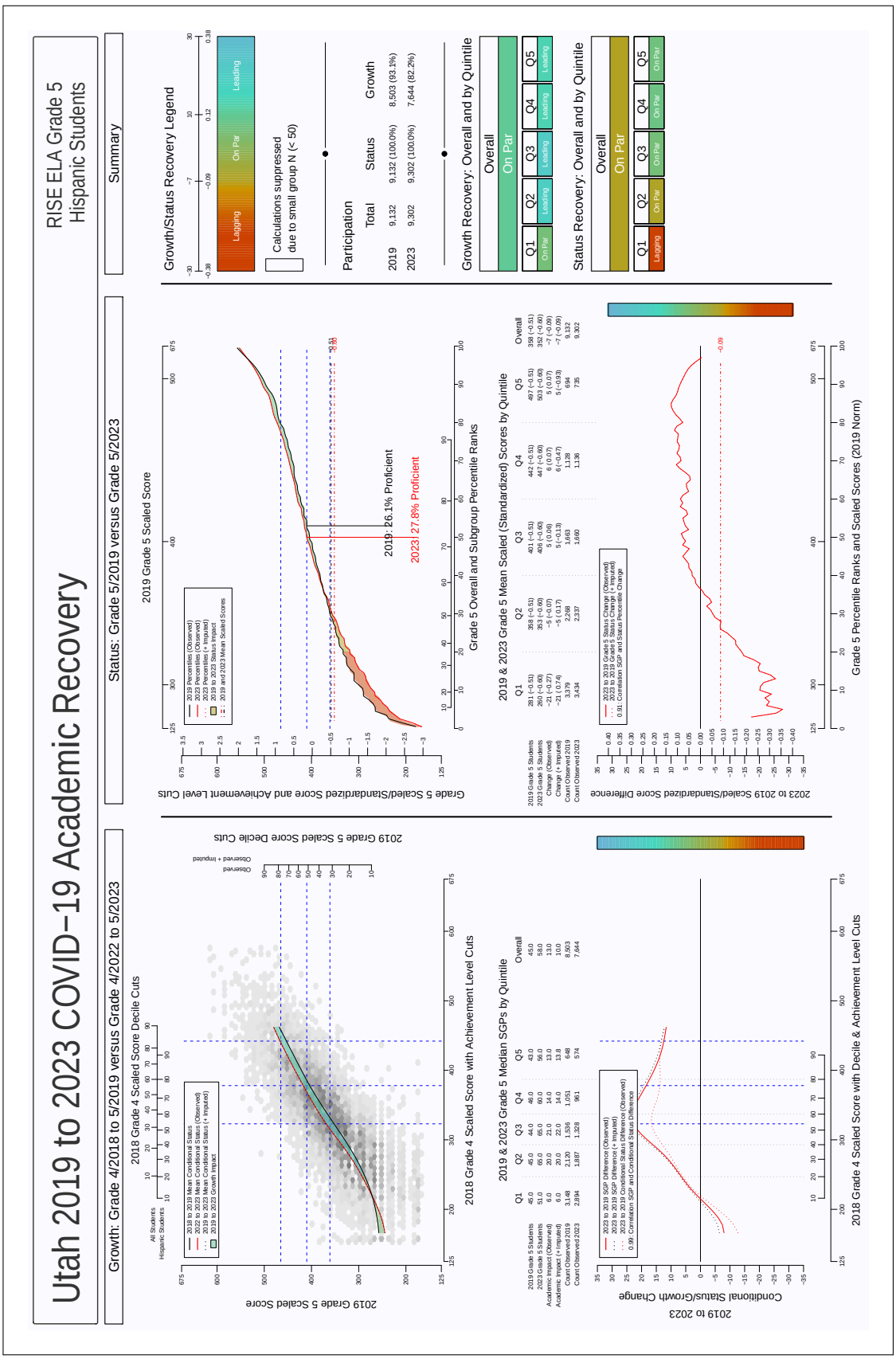

Figure 60: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 5 ELA, Hispanic students

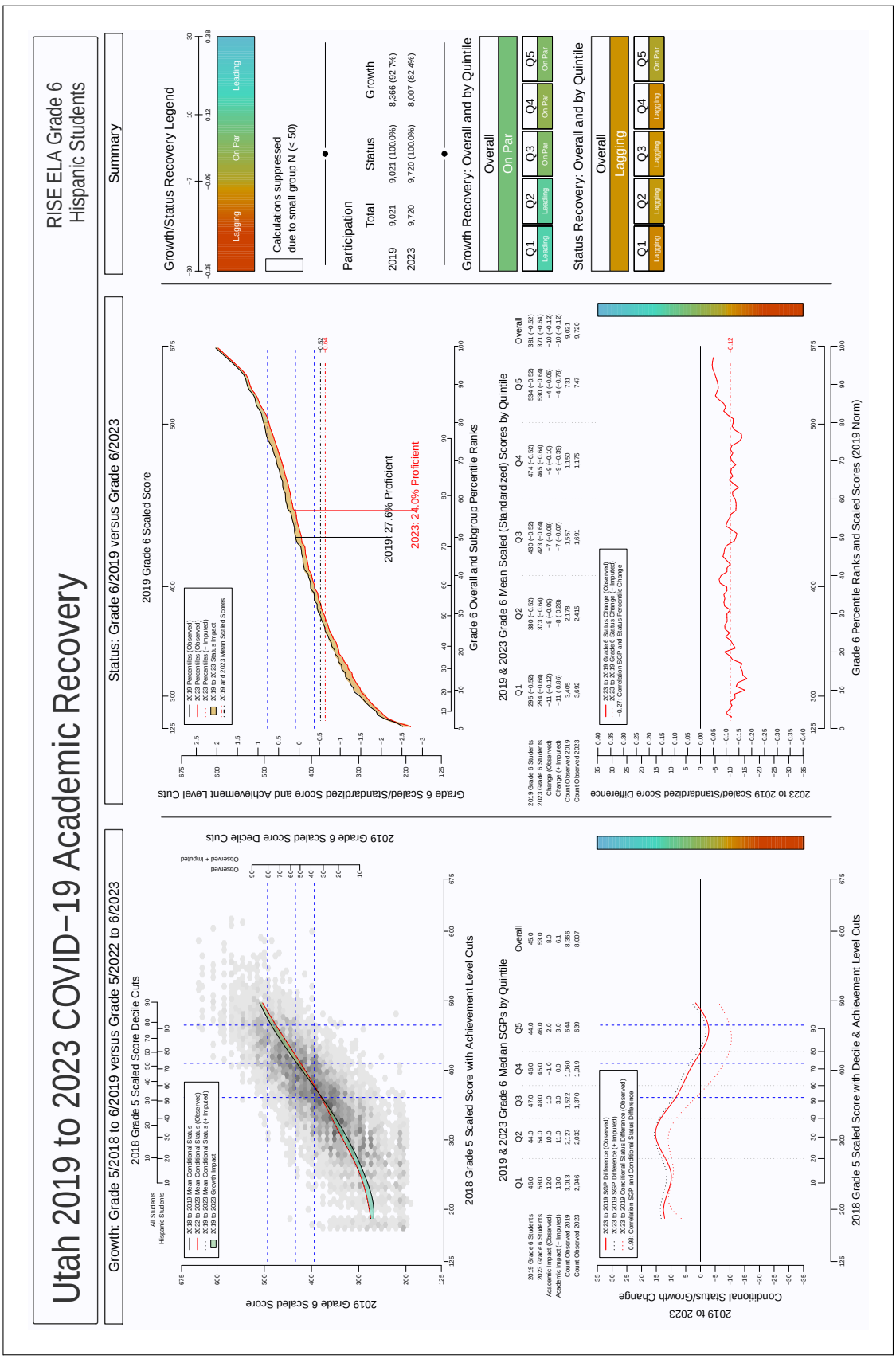

Figure 61: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 6 ELA, Hispanic students

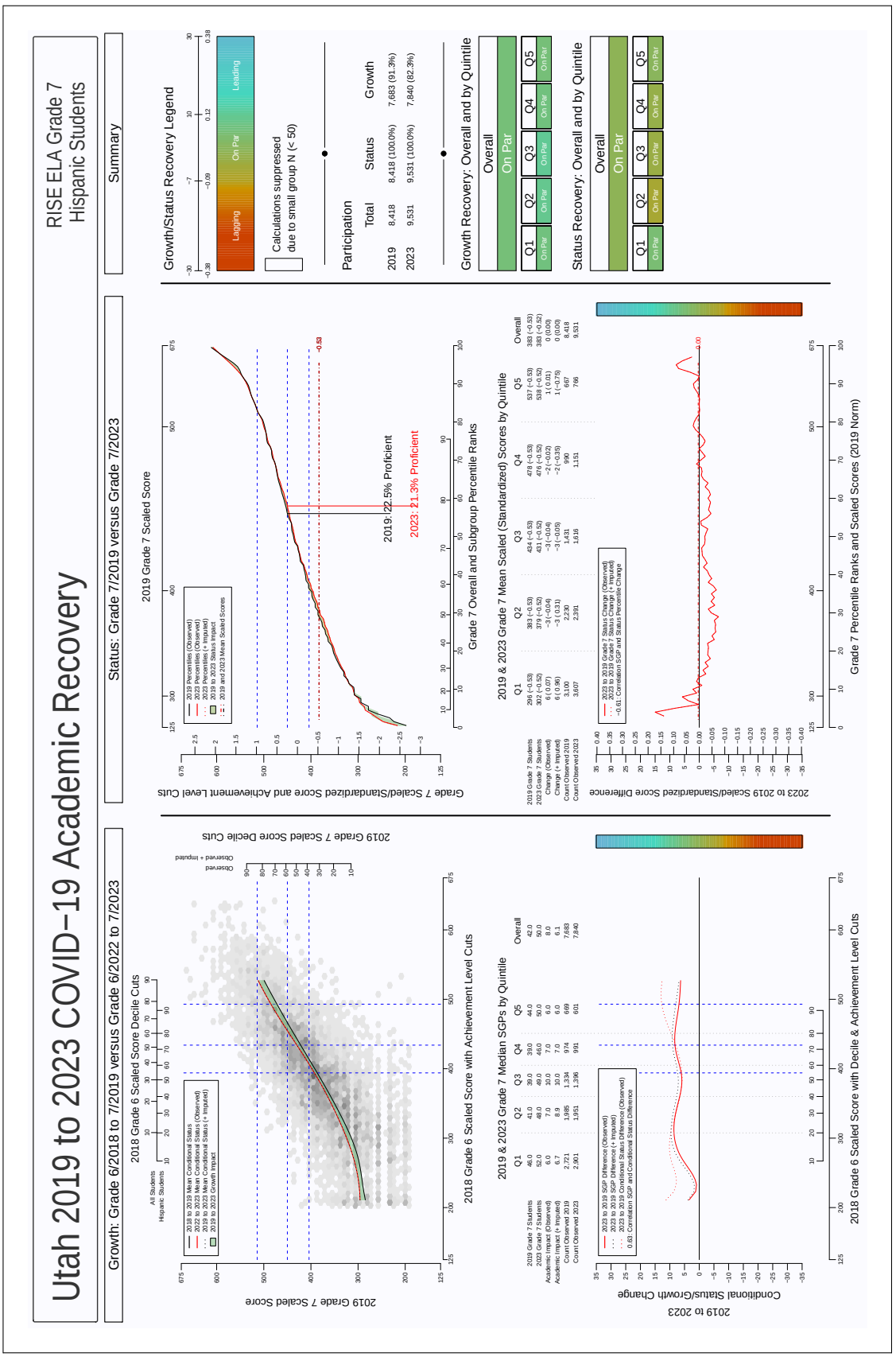

Figure 62: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 7 ELA, Hispanic students

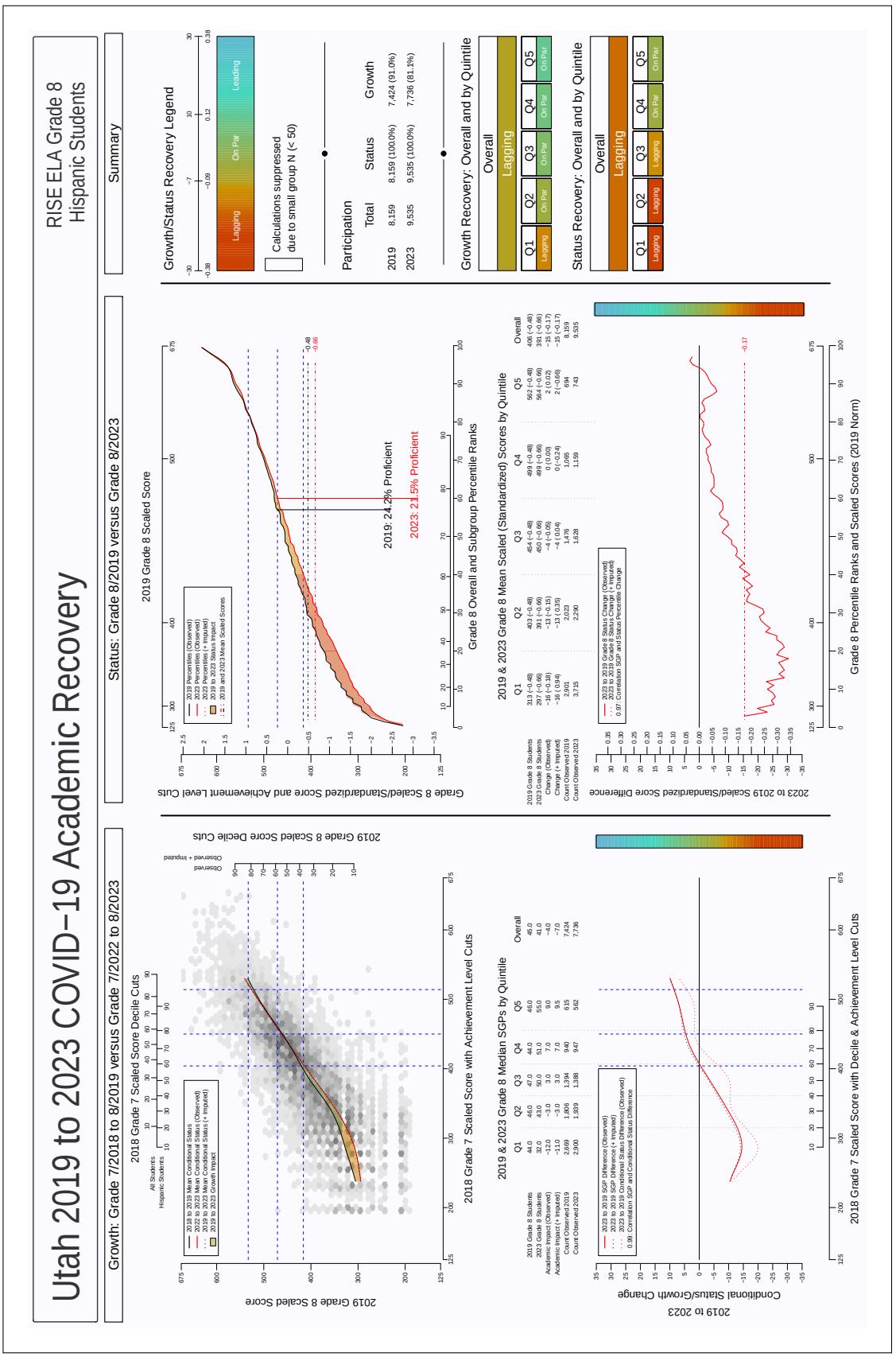

Figure 63: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 8 ELA, Hispanic students

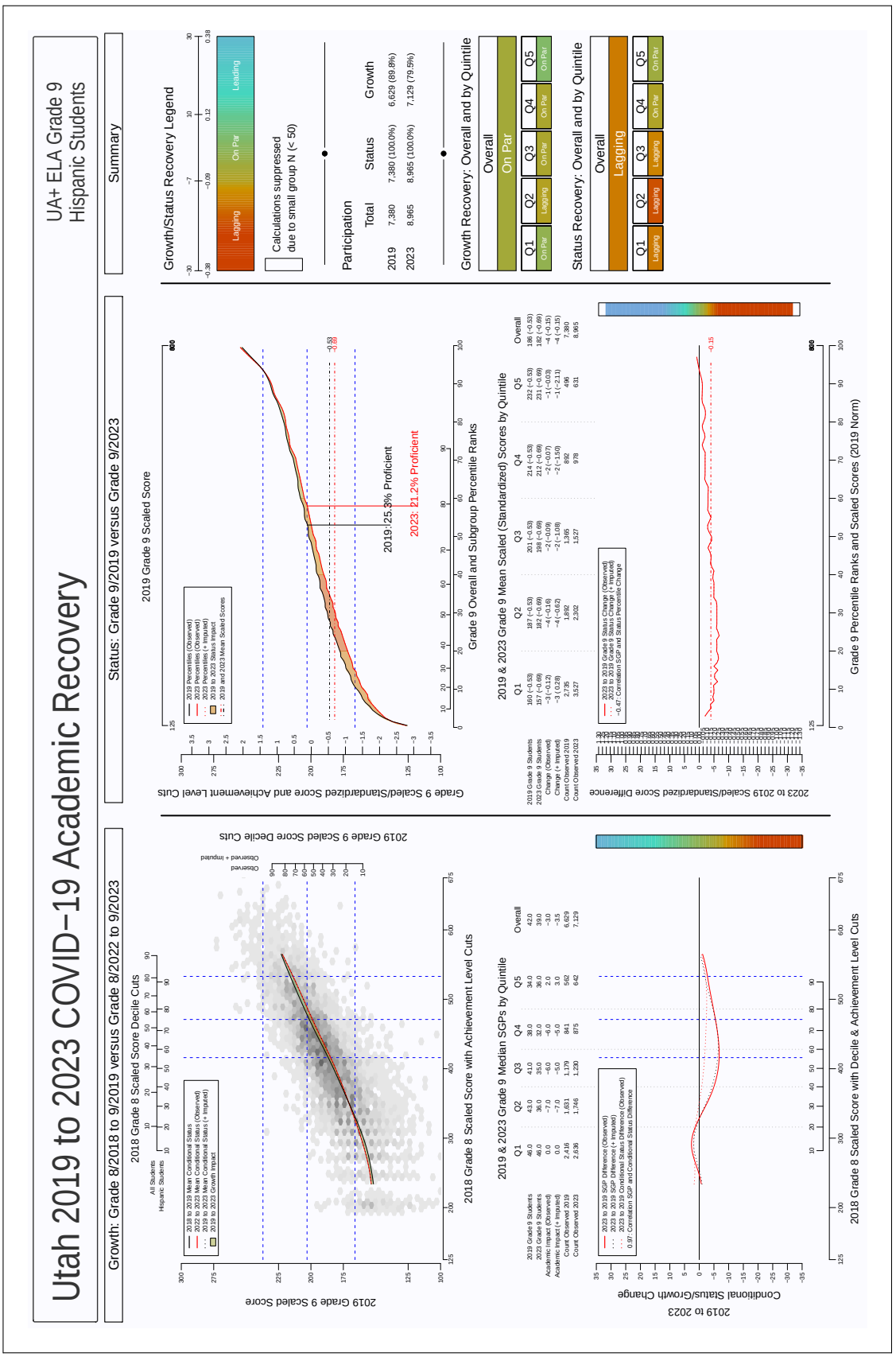

Figure 64: Utah UA+ academic recovery: Growth and status 2019 to 2023 grade 9 ELA, Hispanic students

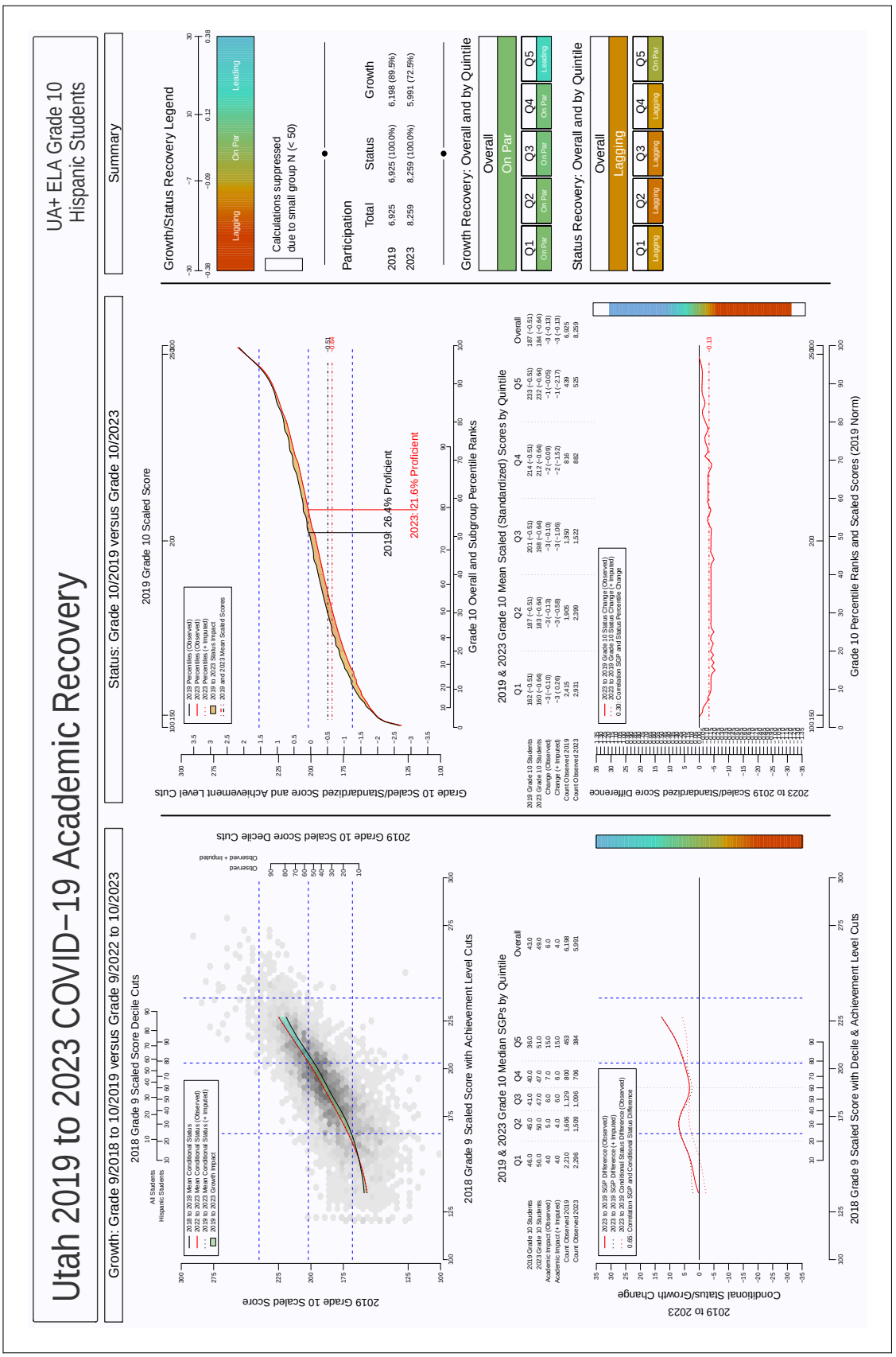

Figure 65: Utah UA+ academic recovery: Growth and status 2019 to 2023 grade 10 ELA, Hispanic students

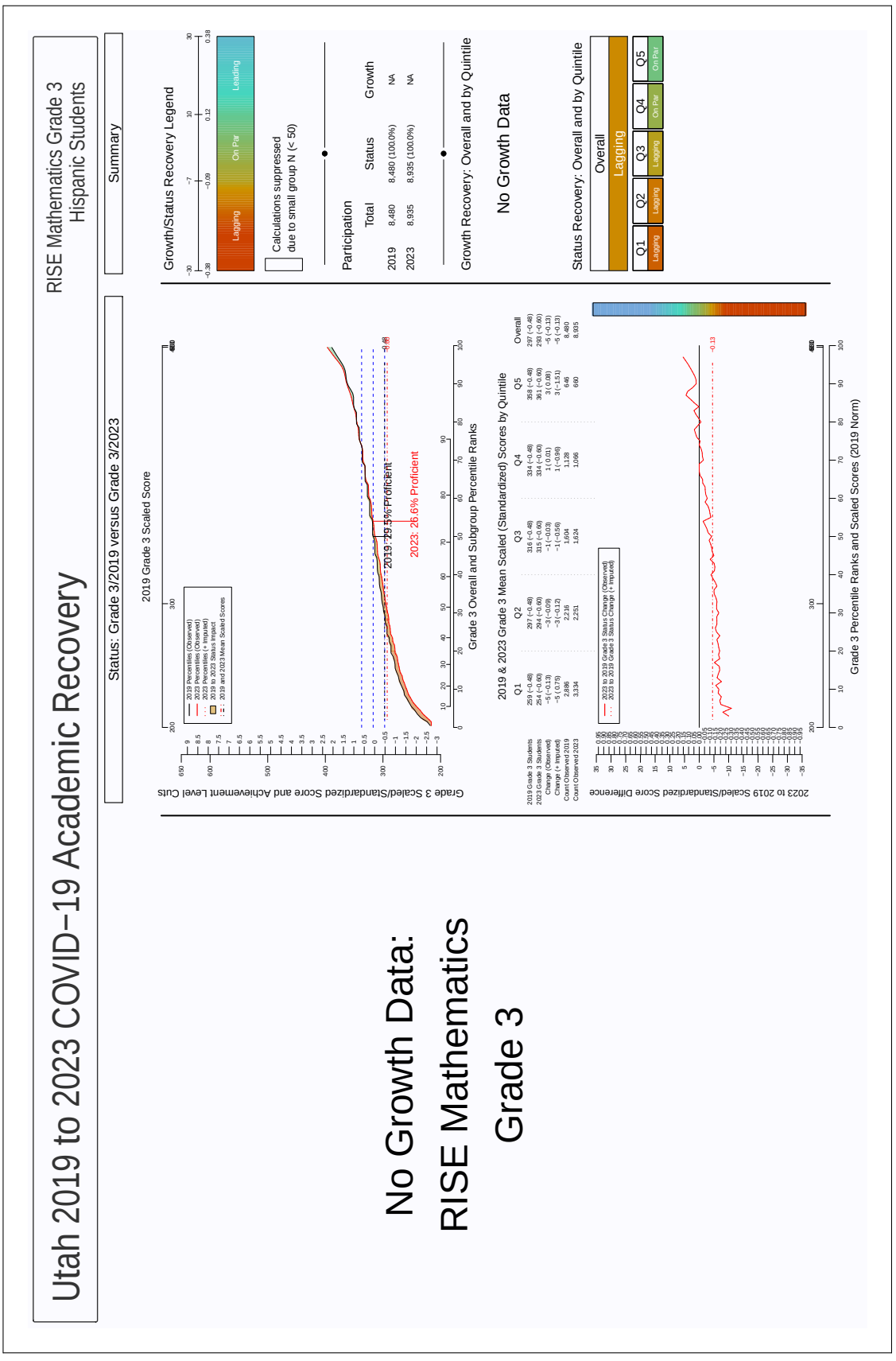

Figure 66: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 3 mathematics, Hispanic students

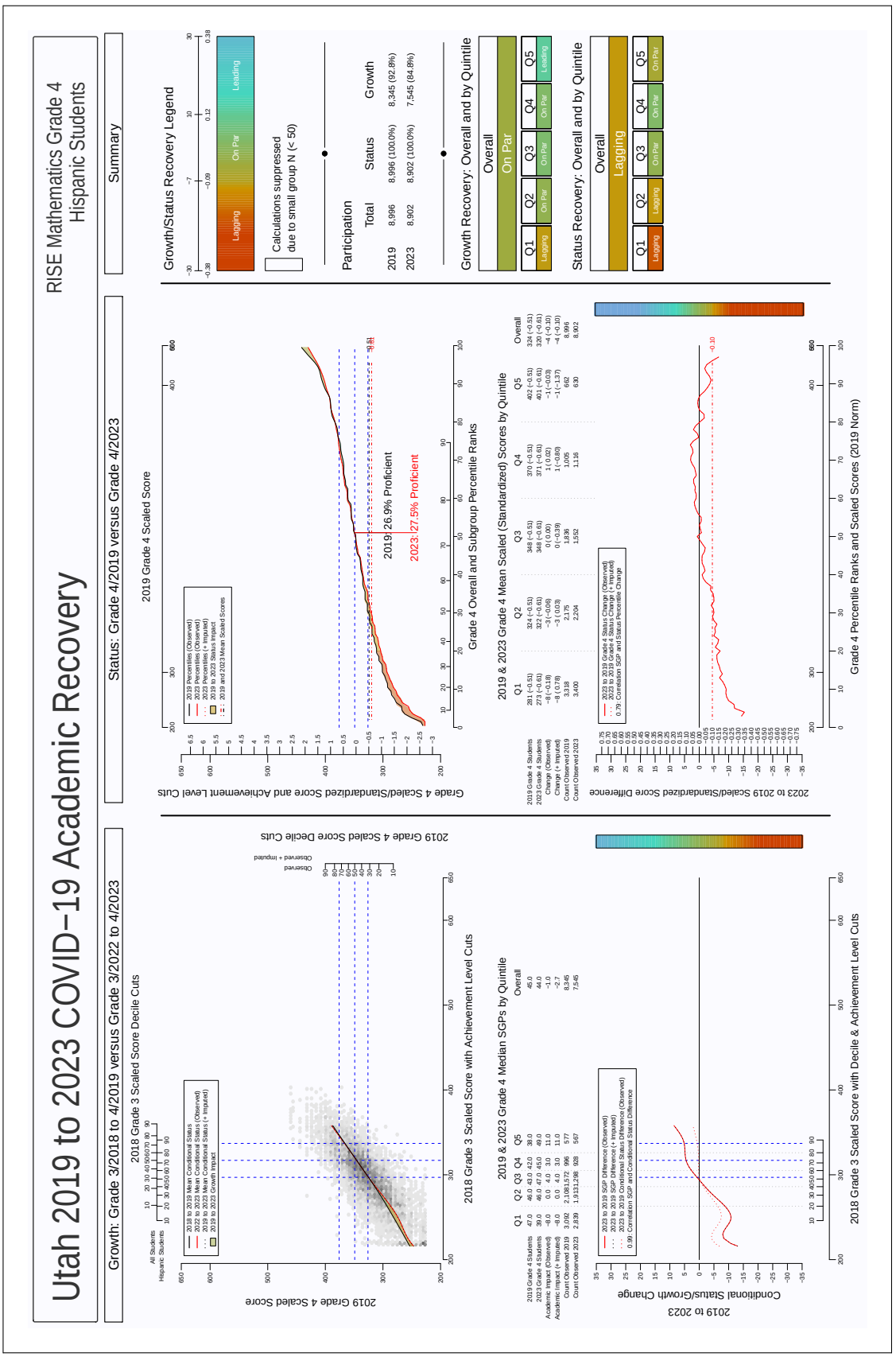

Figure 67: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 4 mathematics, Hispanic students

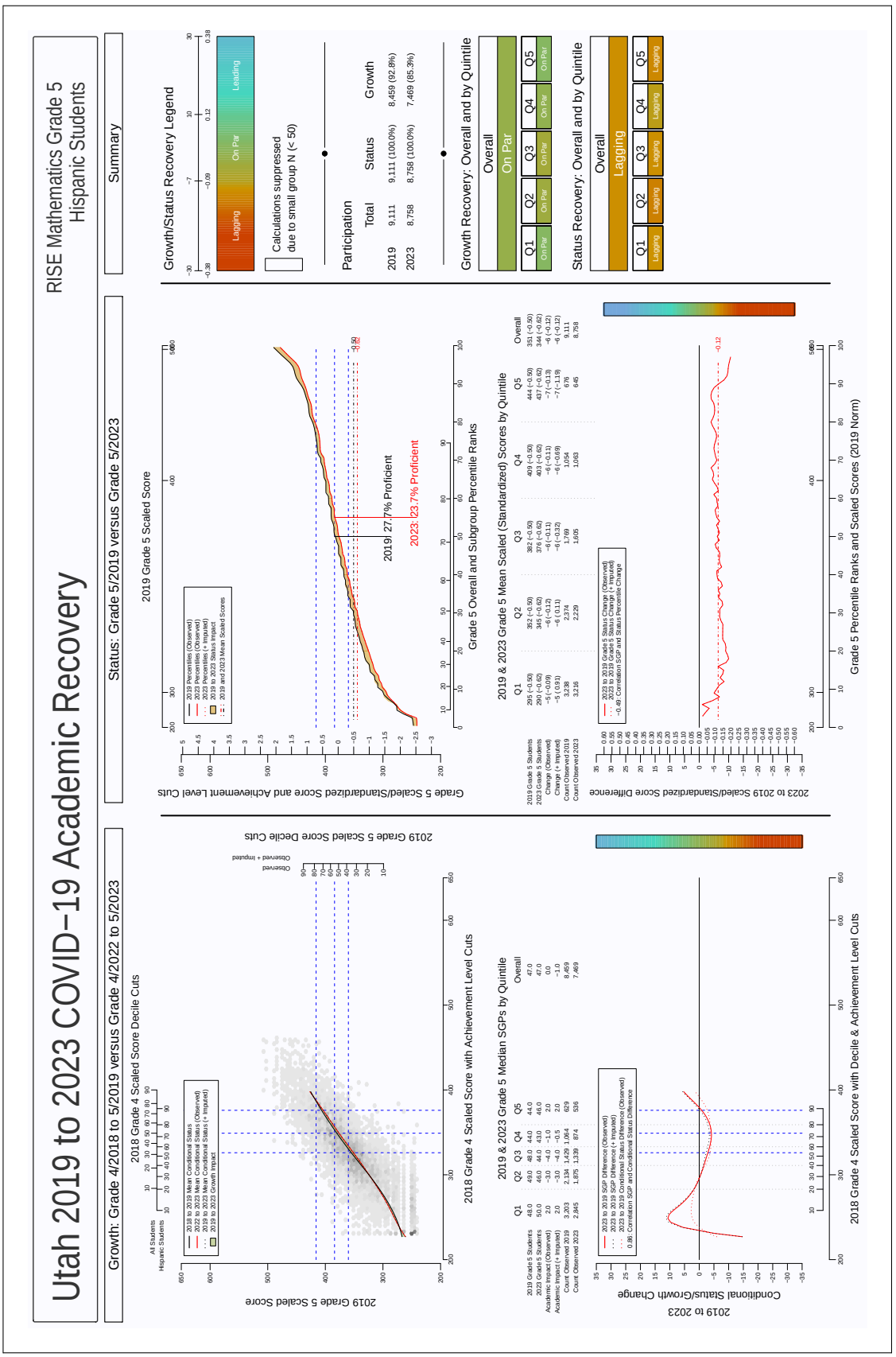

Figure 68: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 5 mathematics, Hispanic students

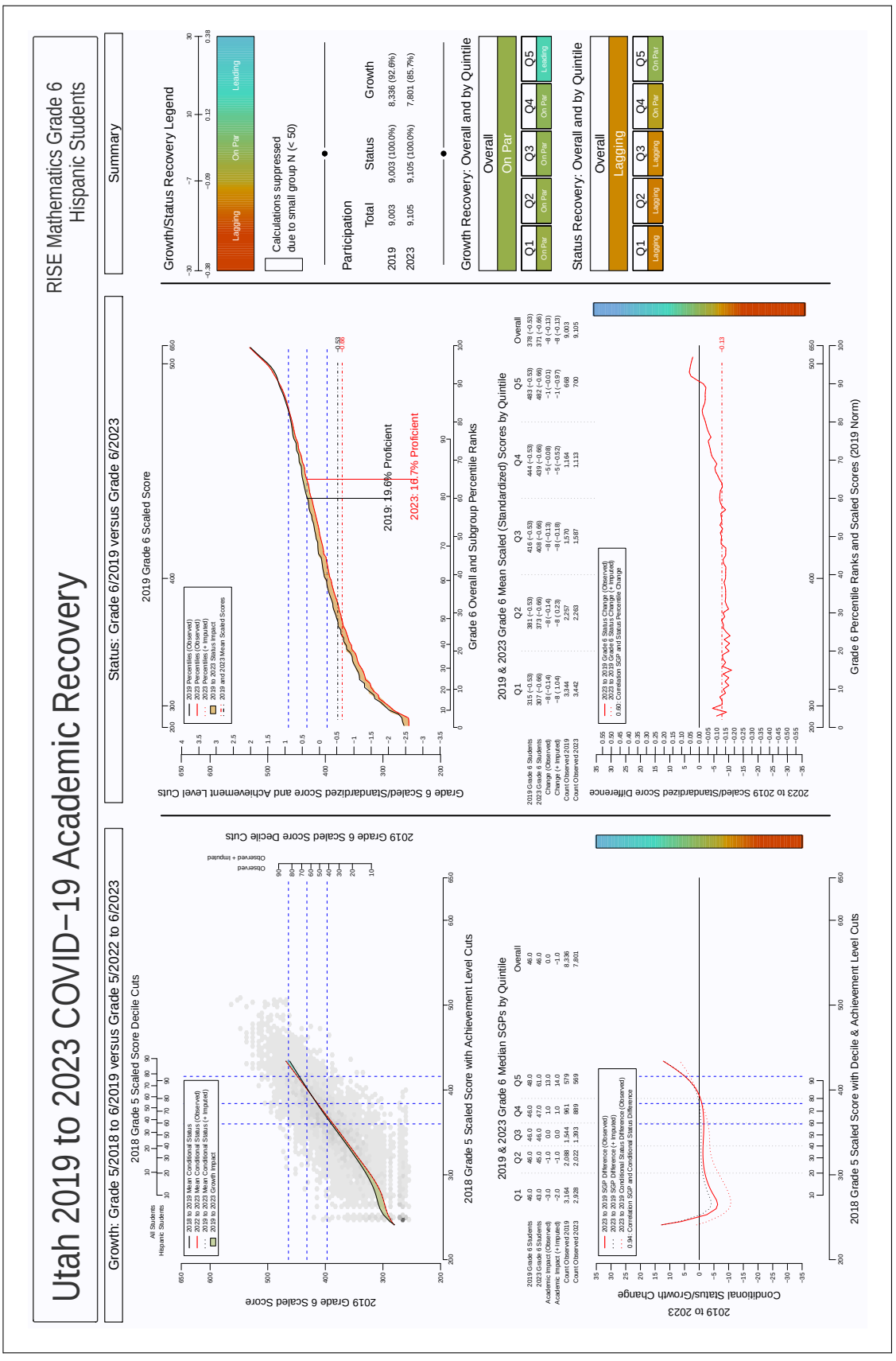

Figure 69: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 6 mathematics, Hispanic students

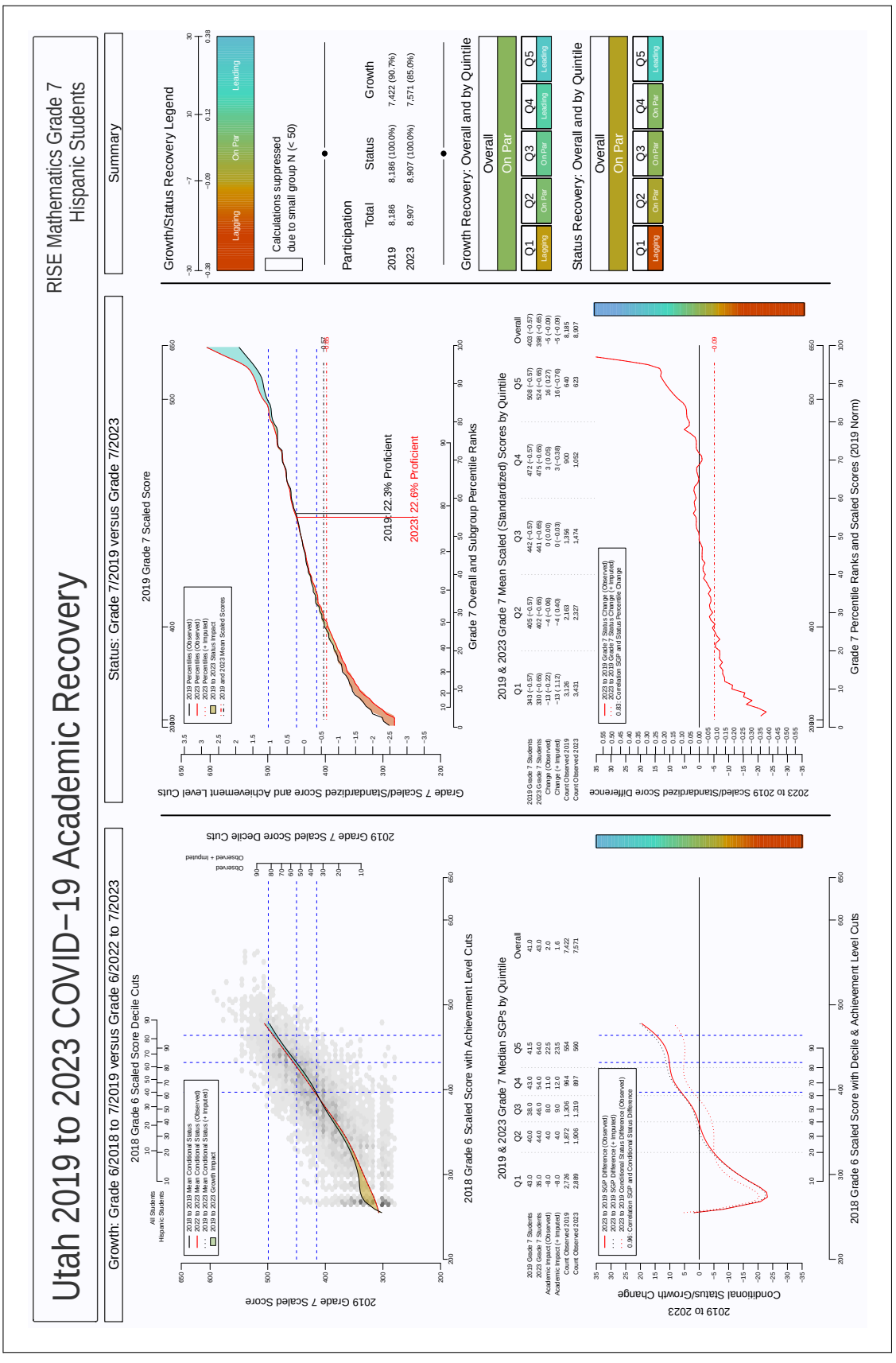

Figure 70: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 7 mathematics, Hispanic students

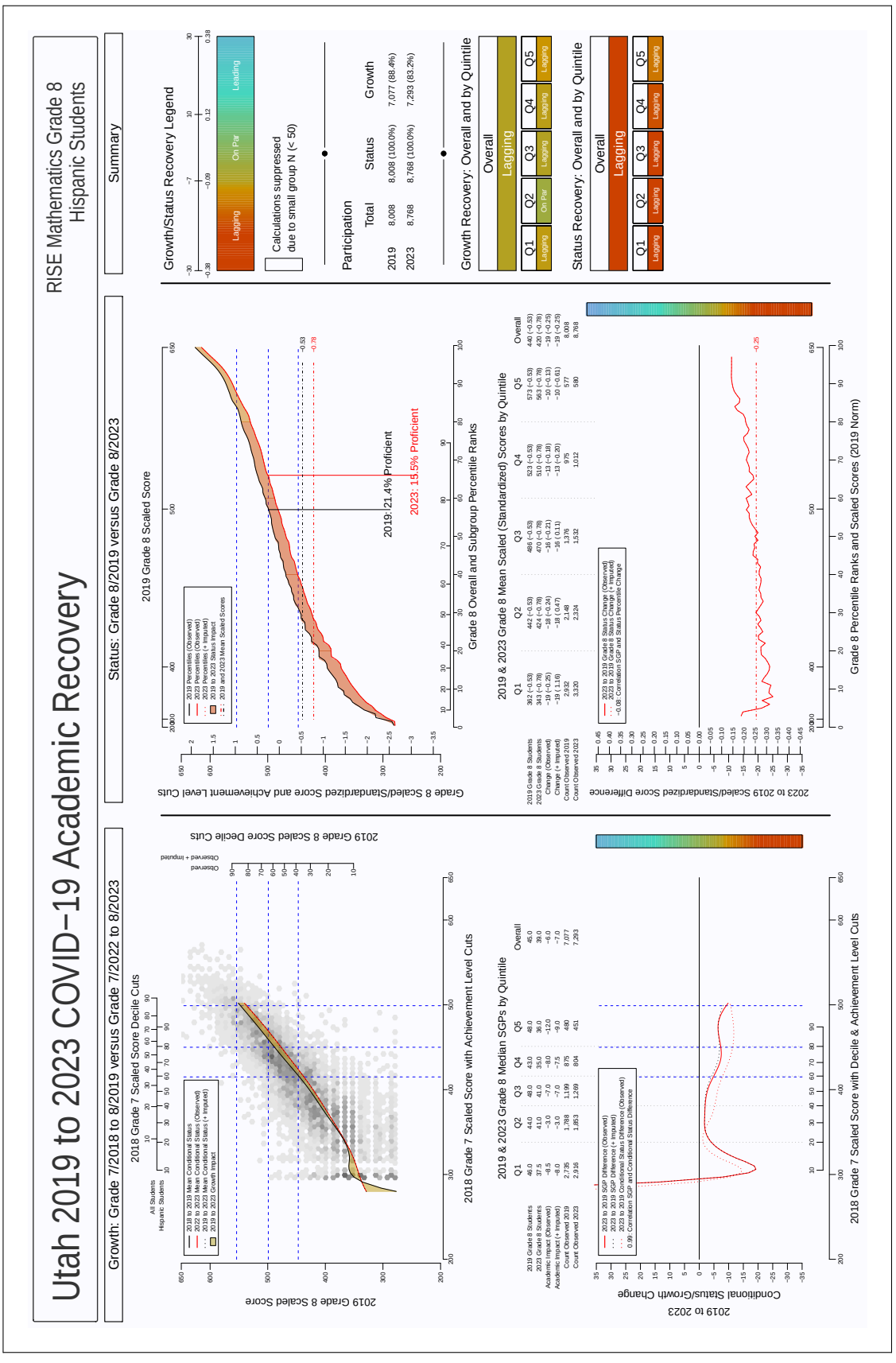

Figure 71: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 8 mathematics, Hispanic students

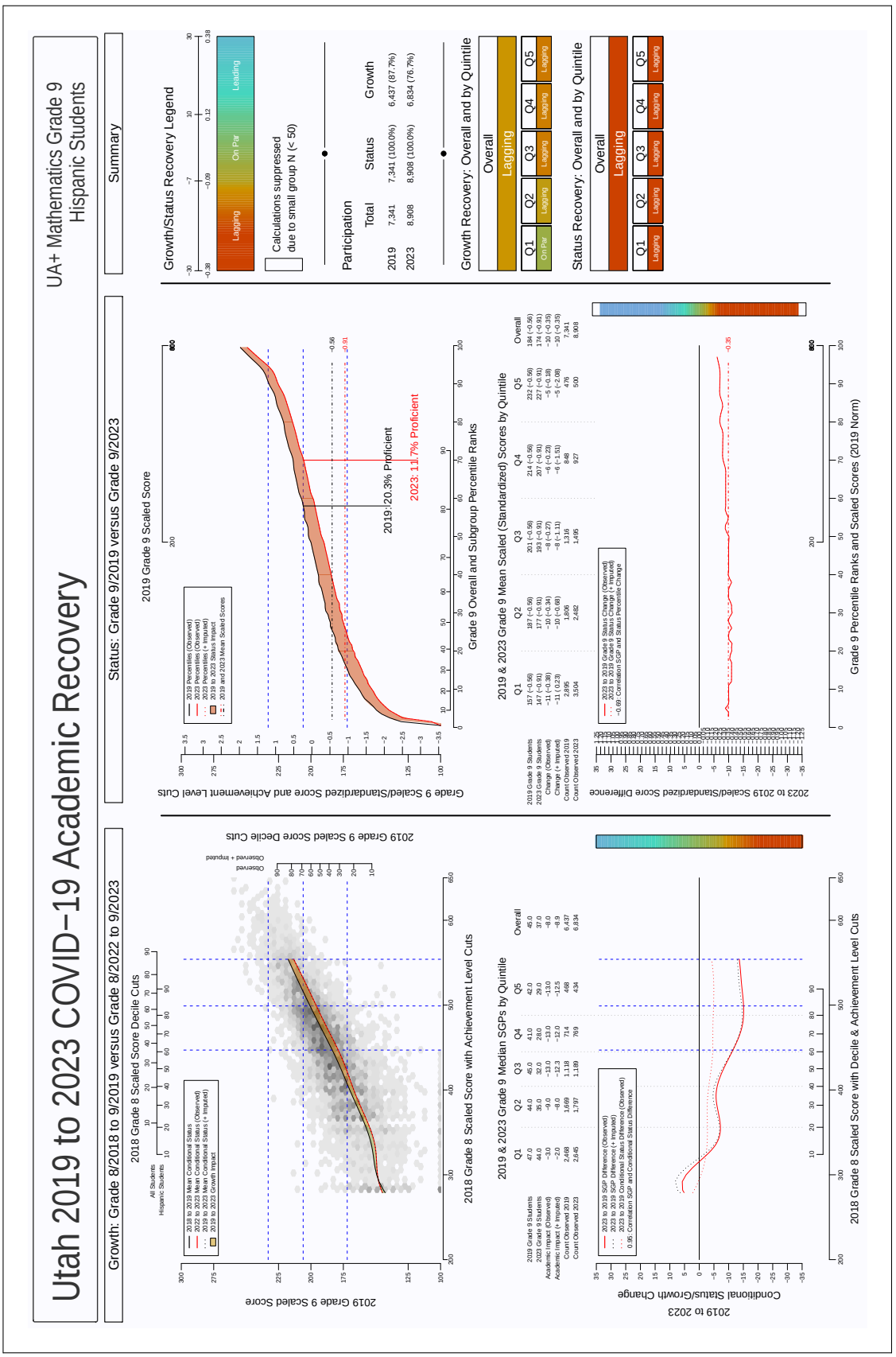

Figure 72: Utah UA+ academic recovery: Growth and status 2019 to 2023 grade 9 mathematics, Hispanic students

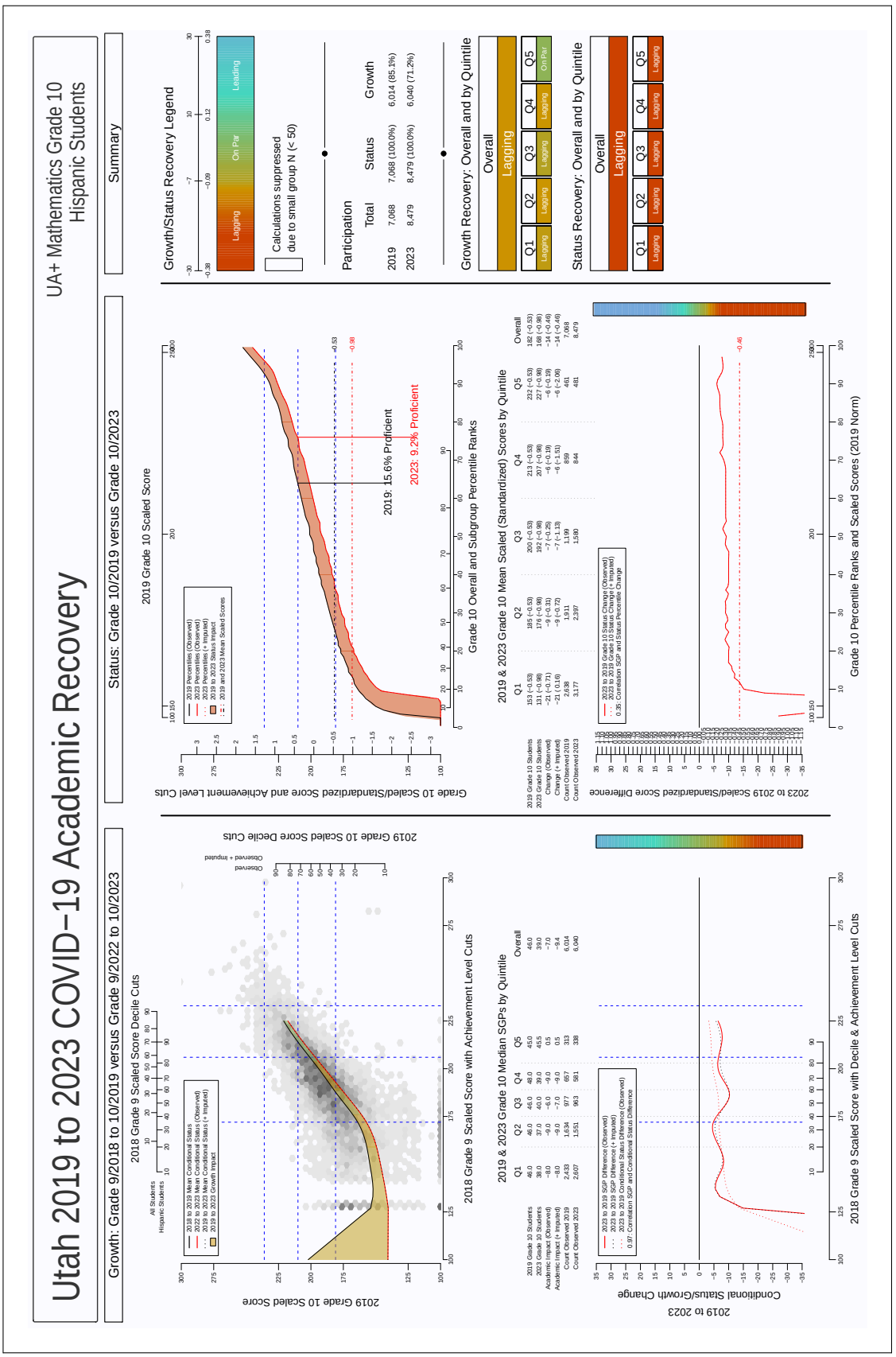

Figure 73: Utah UA+ academic recovery: Growth and status 2019 to 2023 grade 10 mathematics, Hispanic students

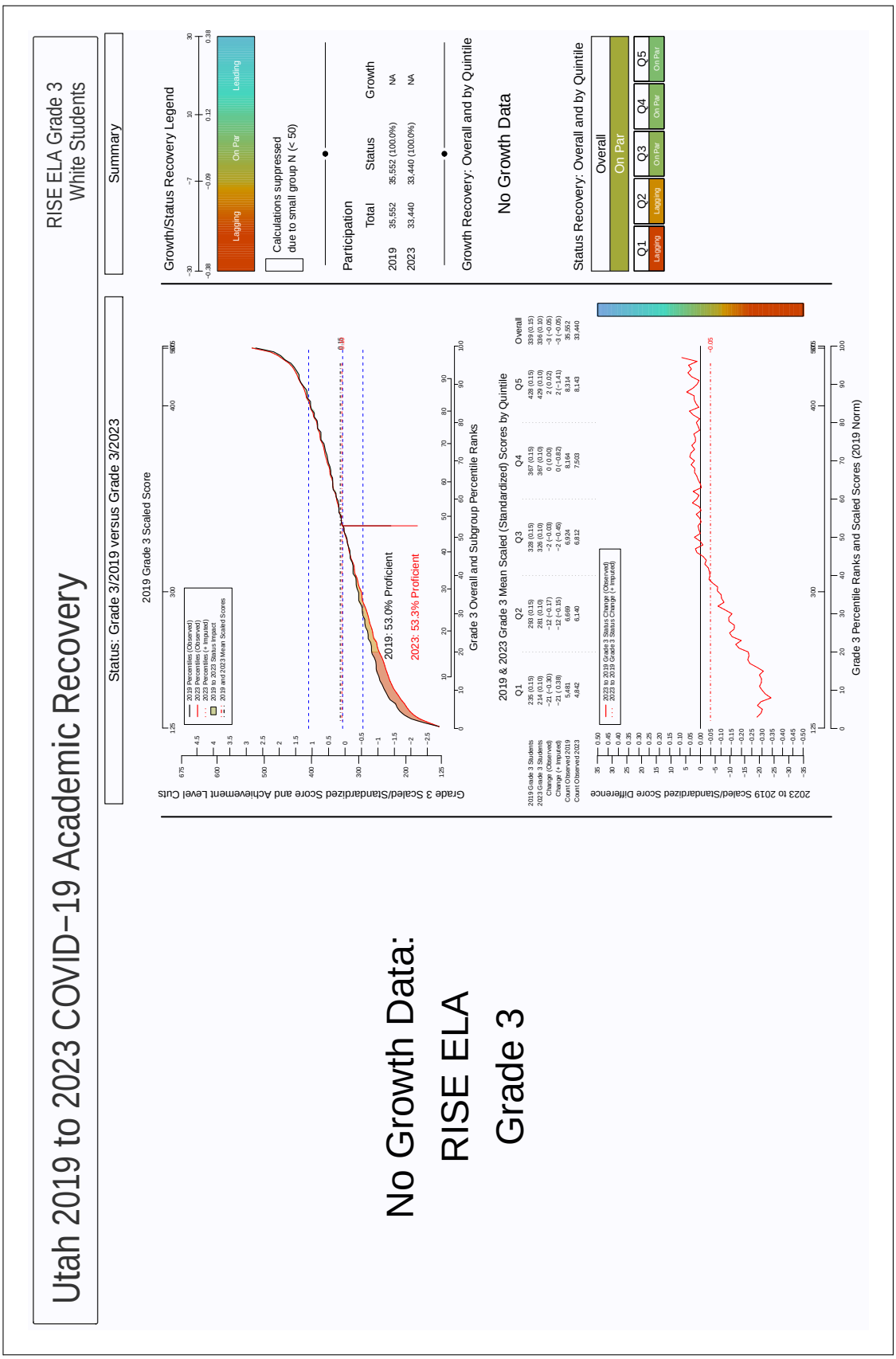

Figure 74: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 8 ELA, white students

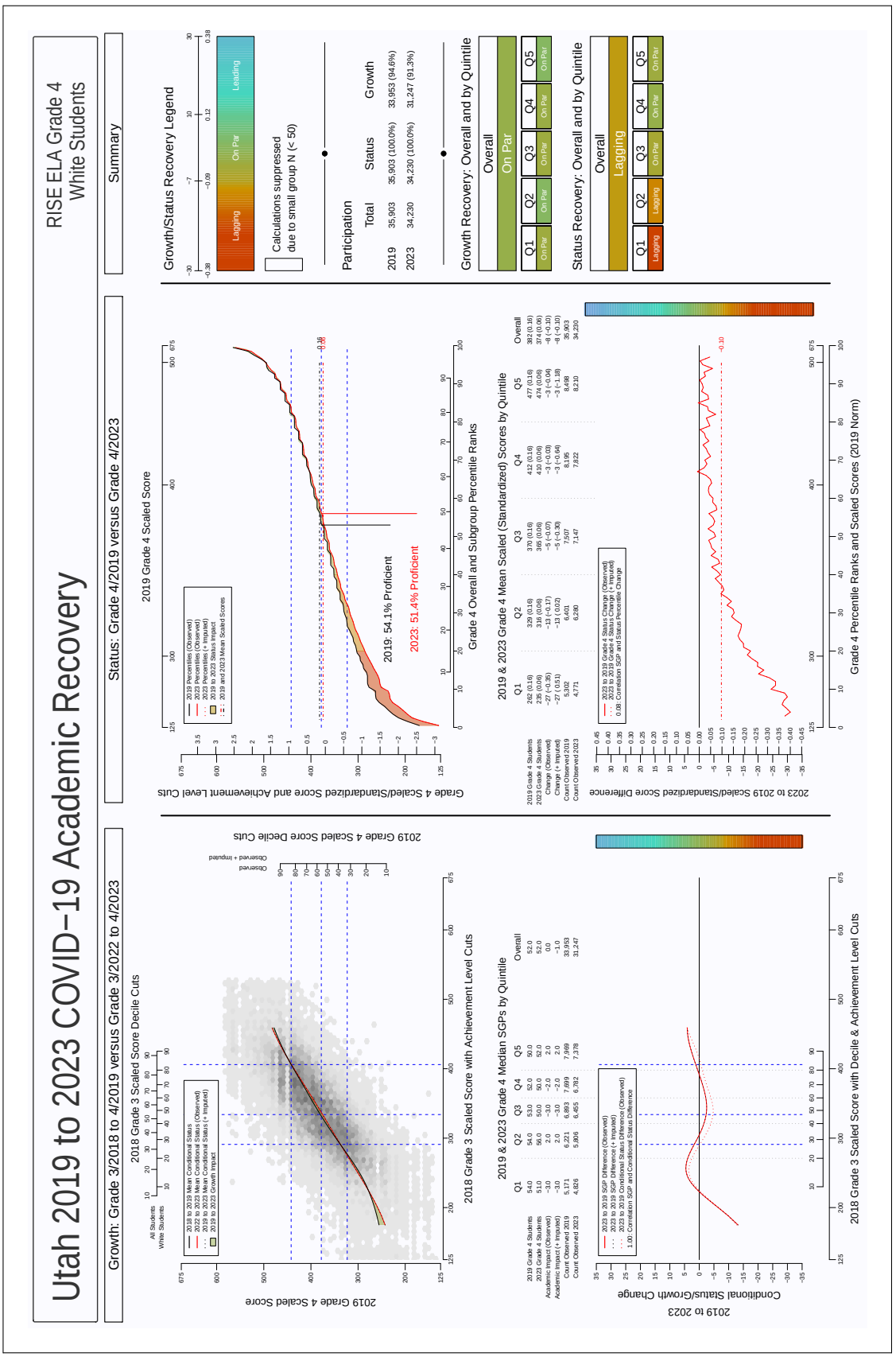

Figure 75: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 4 ELA, white students

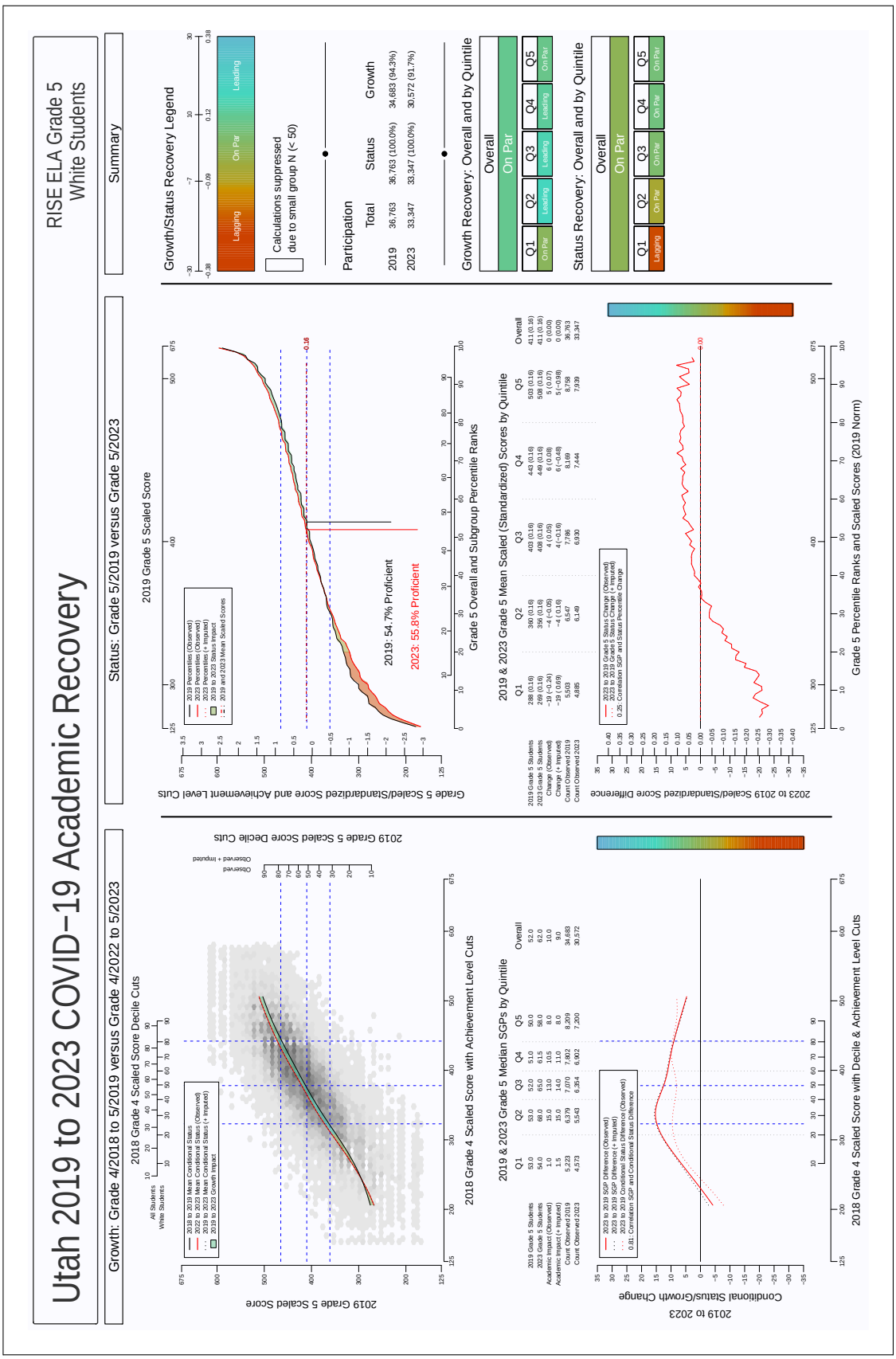

Figure 76: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 5 ELA, white students

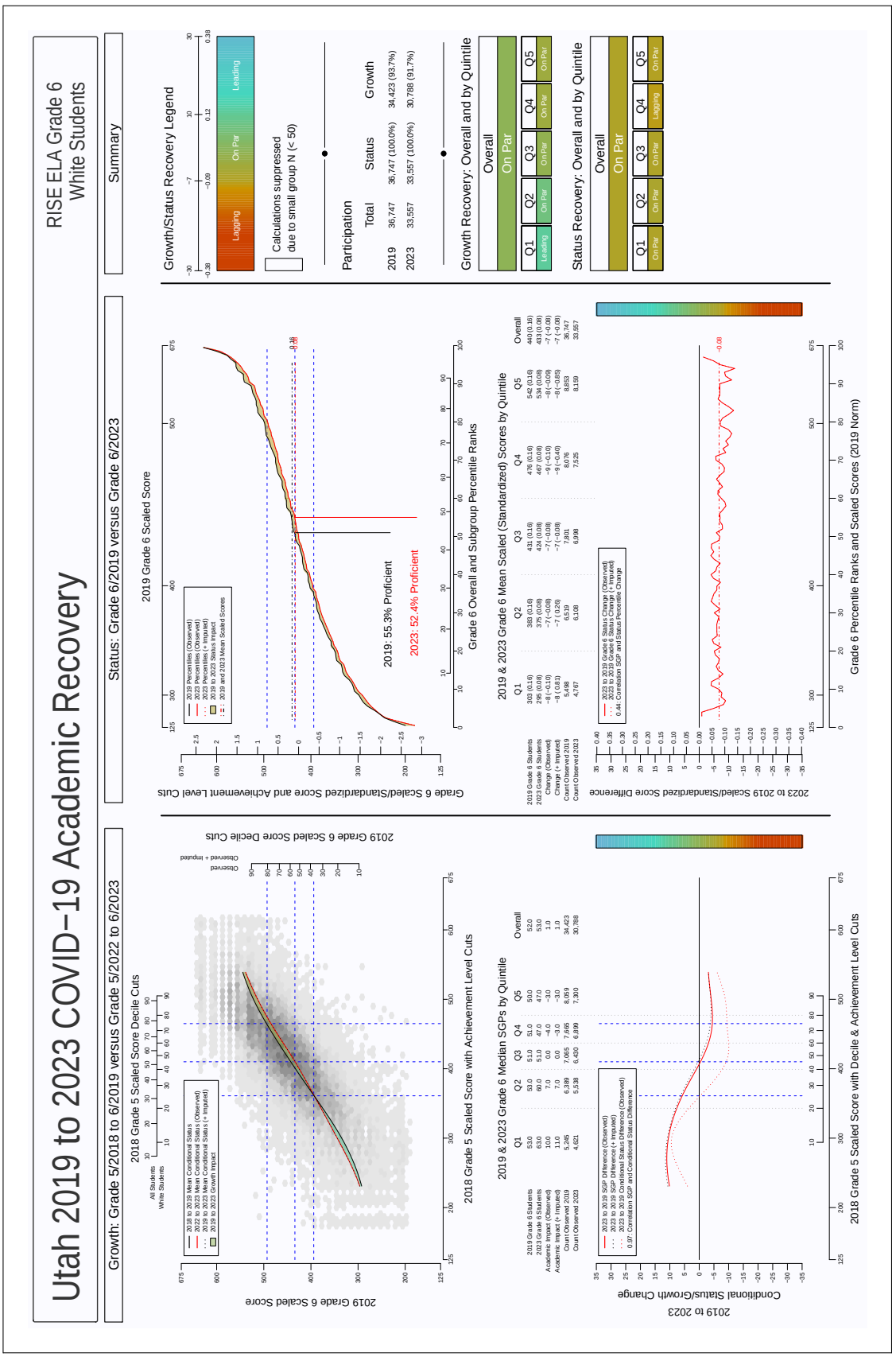

Figure 77: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 6 ELA, white students

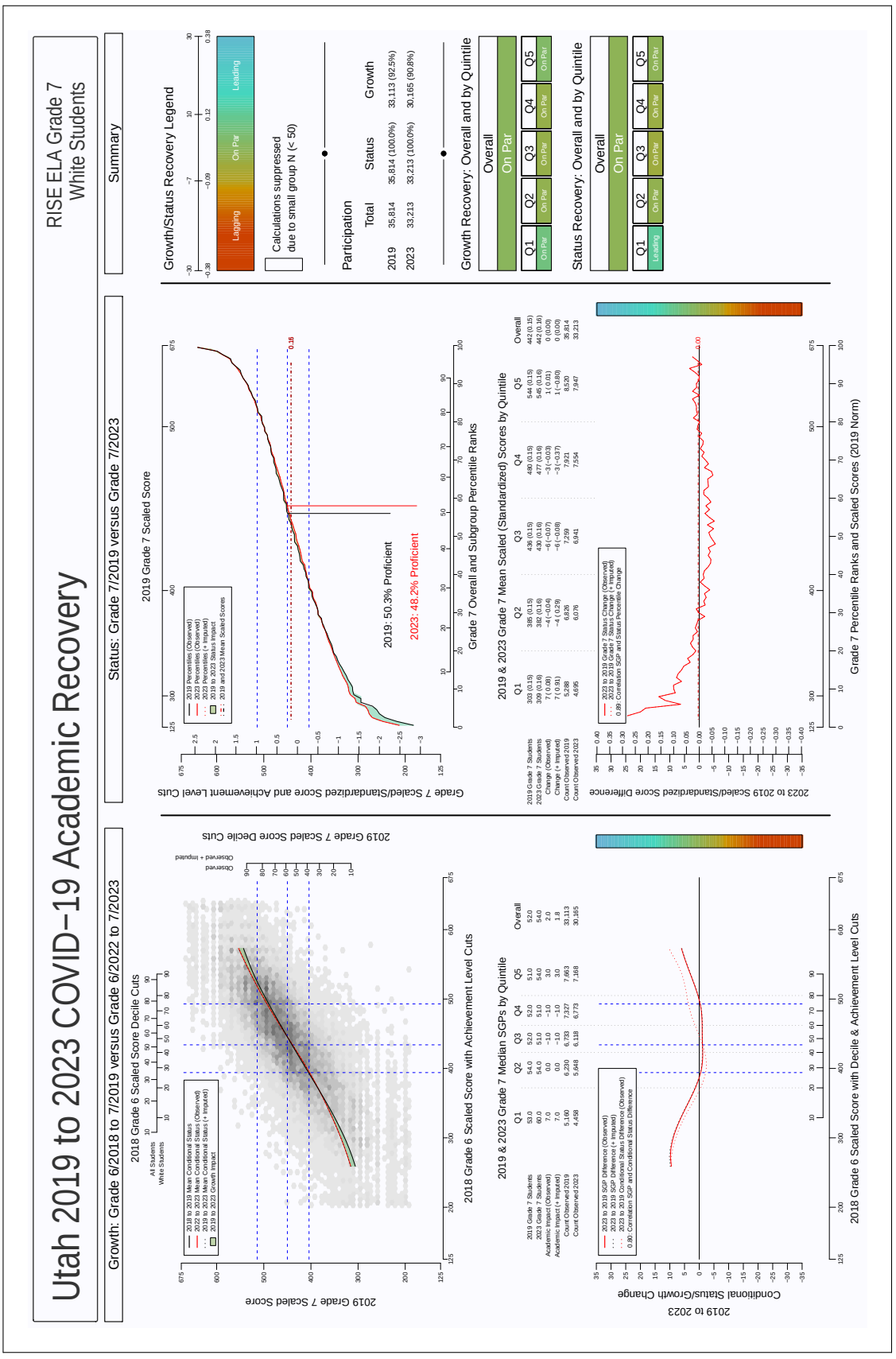

Figure 78: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 7 ELA, white students

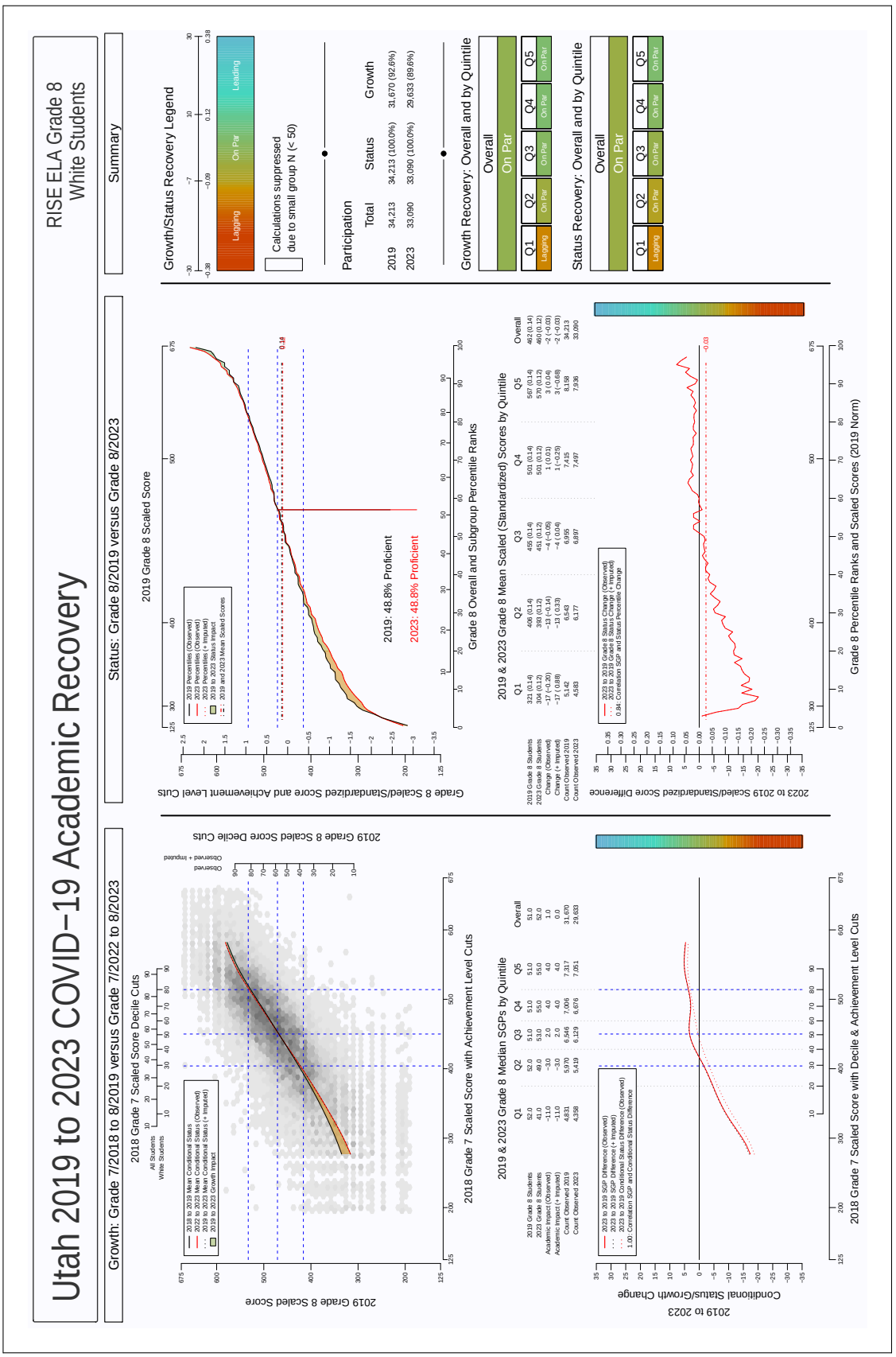

Figure 79: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 8 ELA, white students

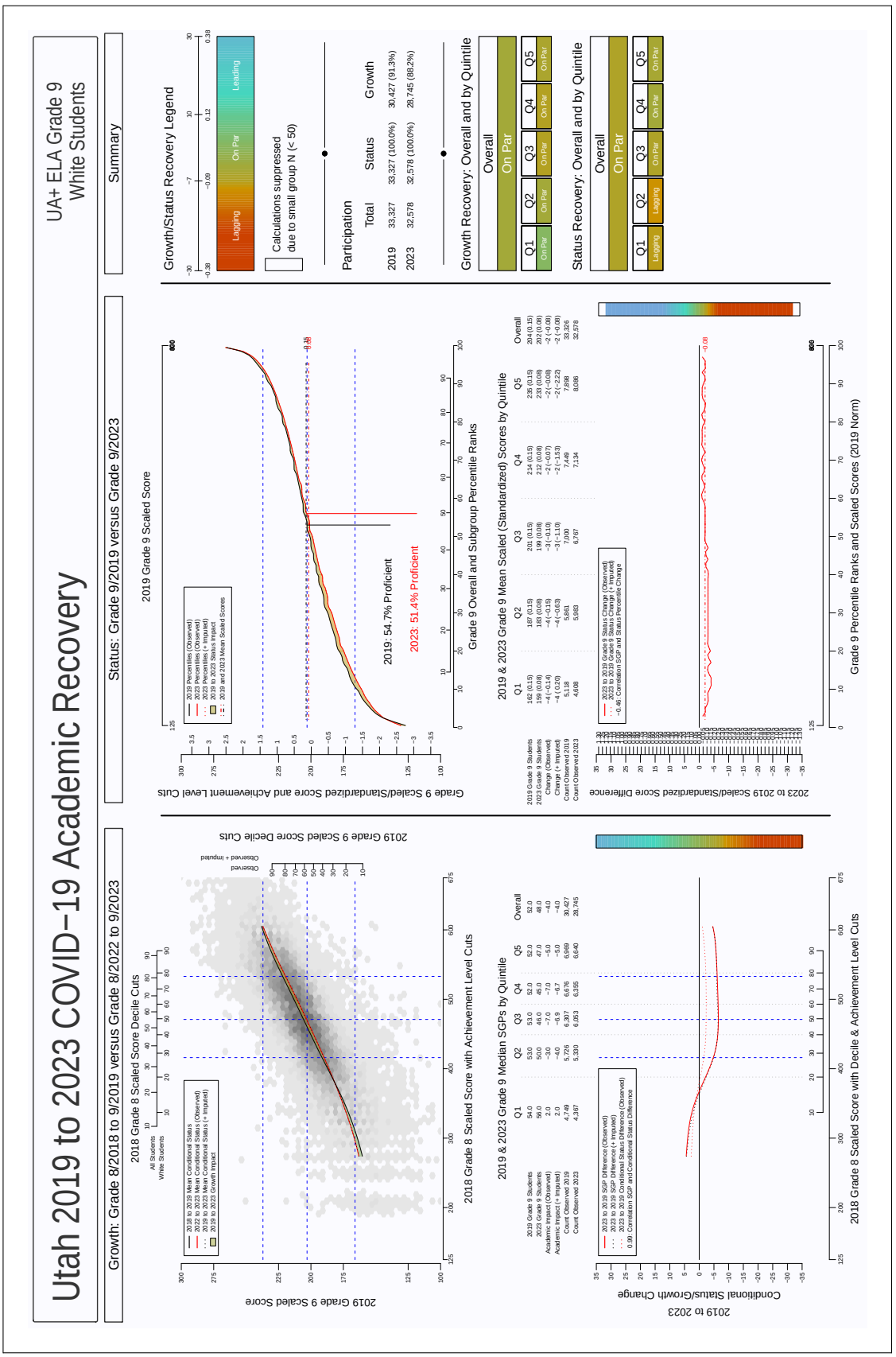

Figure 80: Utah UA+ academic recovery: Growth and status 2019 to 2023 grade 9 ELA, white students

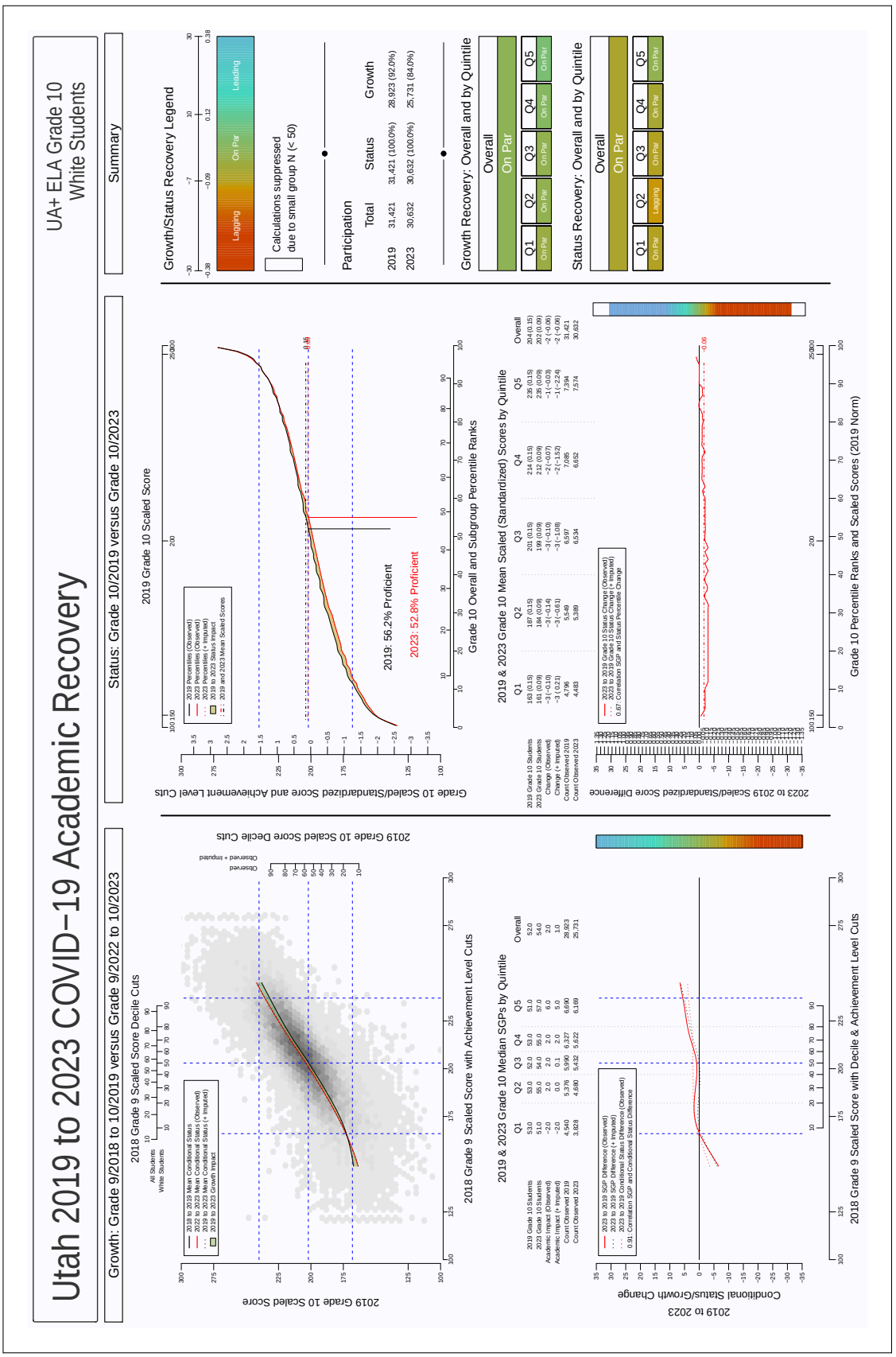

Figure 81: Utah UA+ academic recovery: Growth and status 2019 to 2023 grade 10 ELA, white students

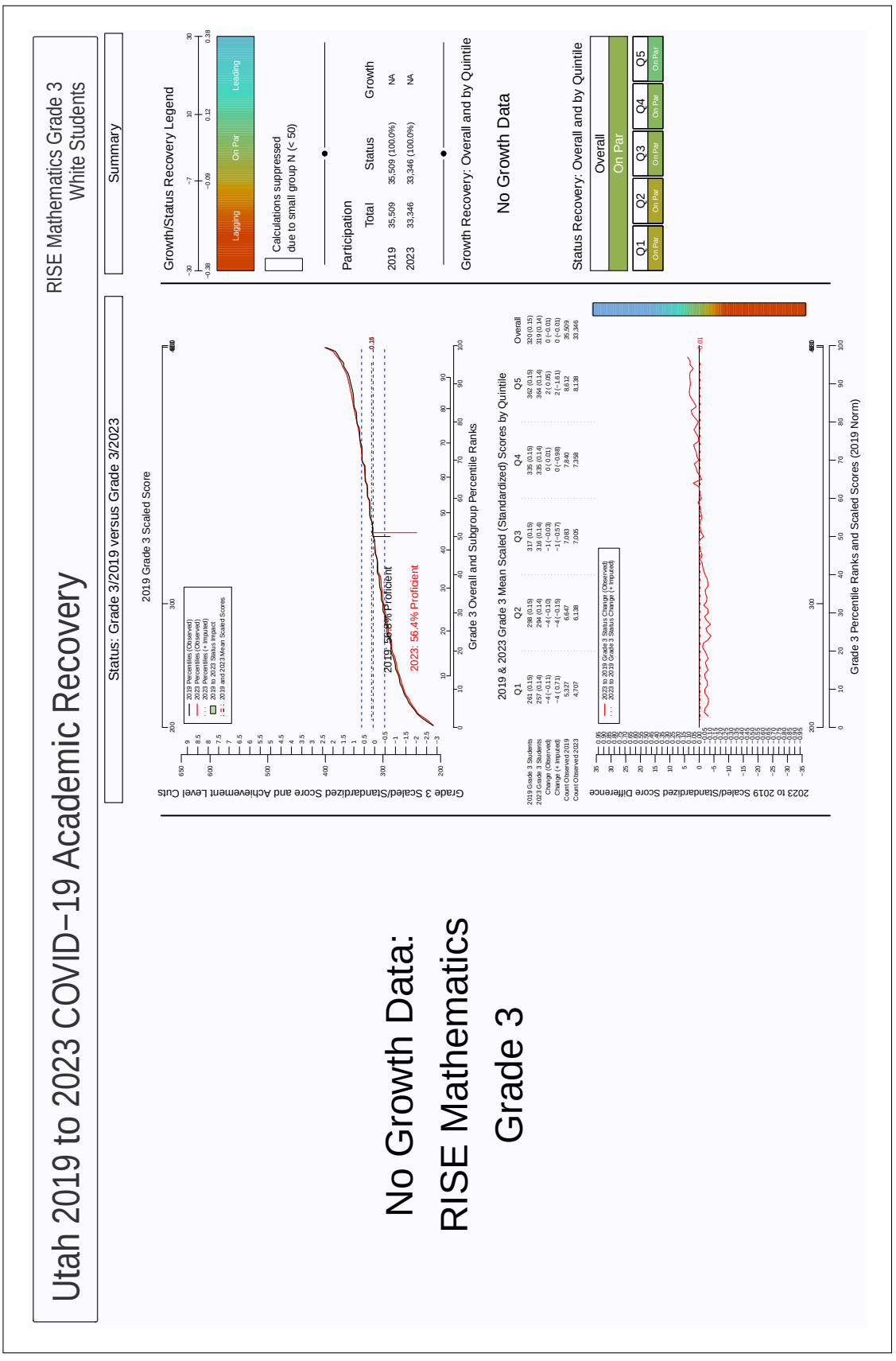

Figure 82: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 3 mathematics, white students

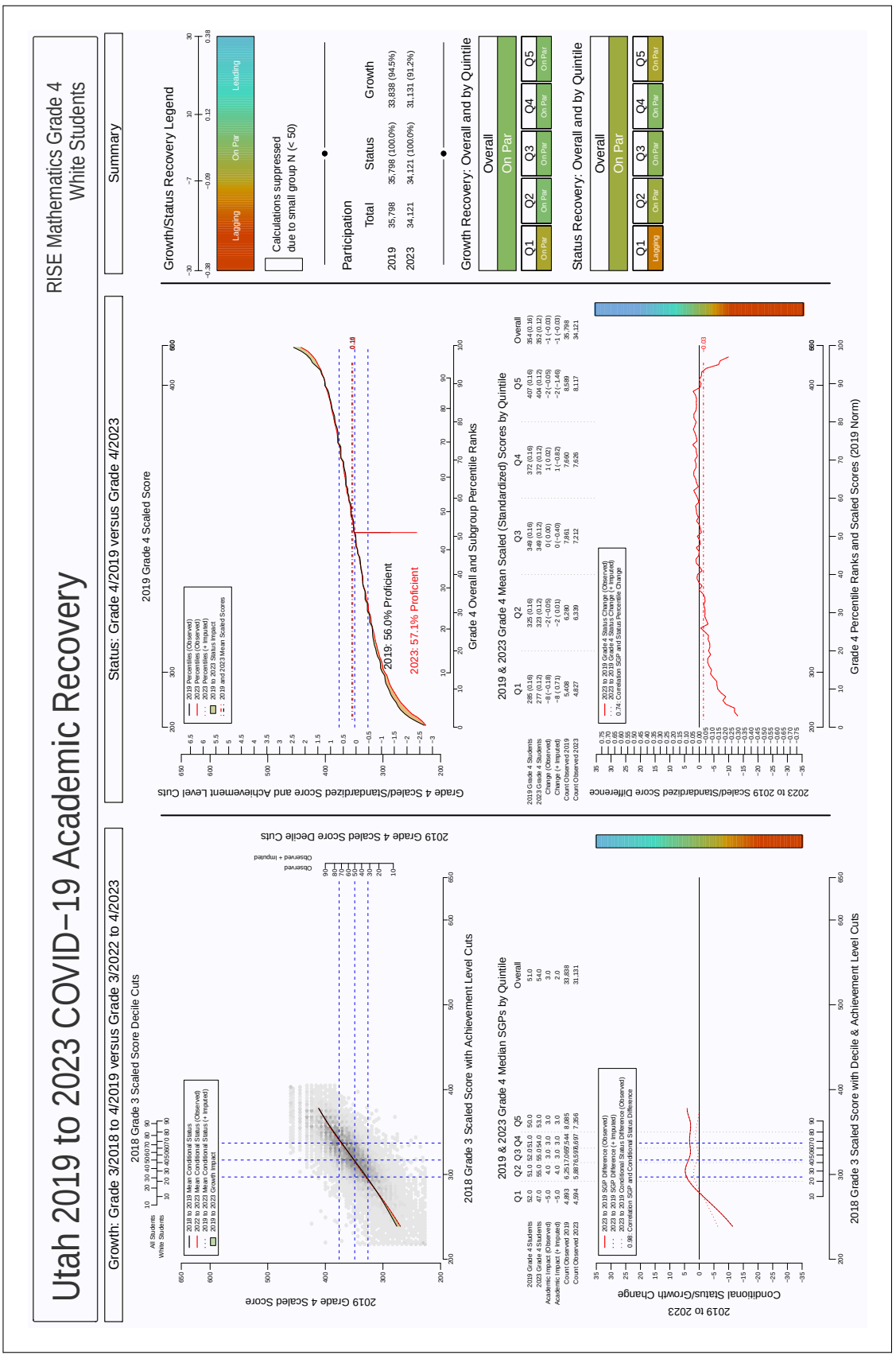

Figure 83: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 4 mathematics, white students

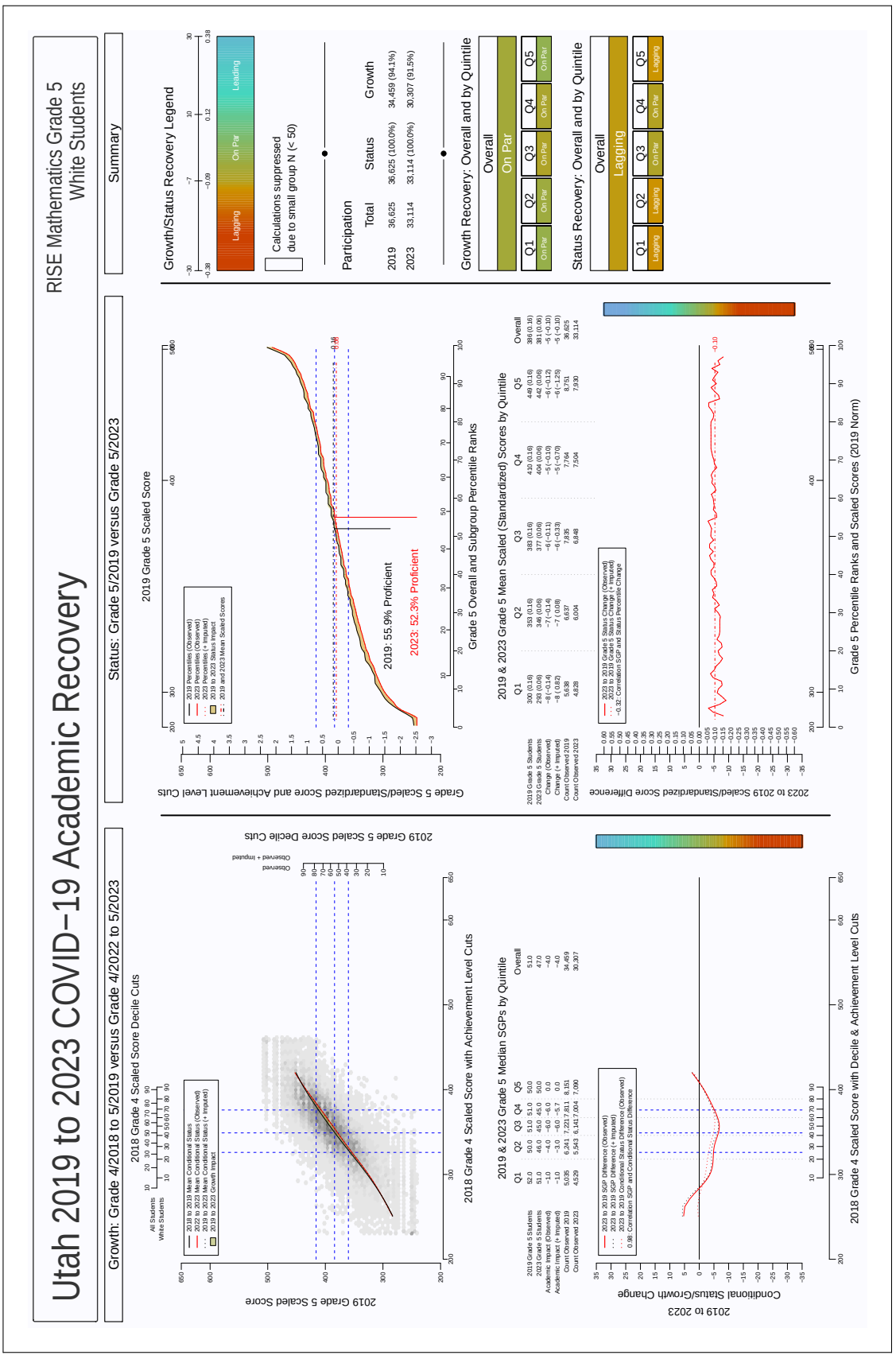

Figure 84: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 5 mathematics, white students

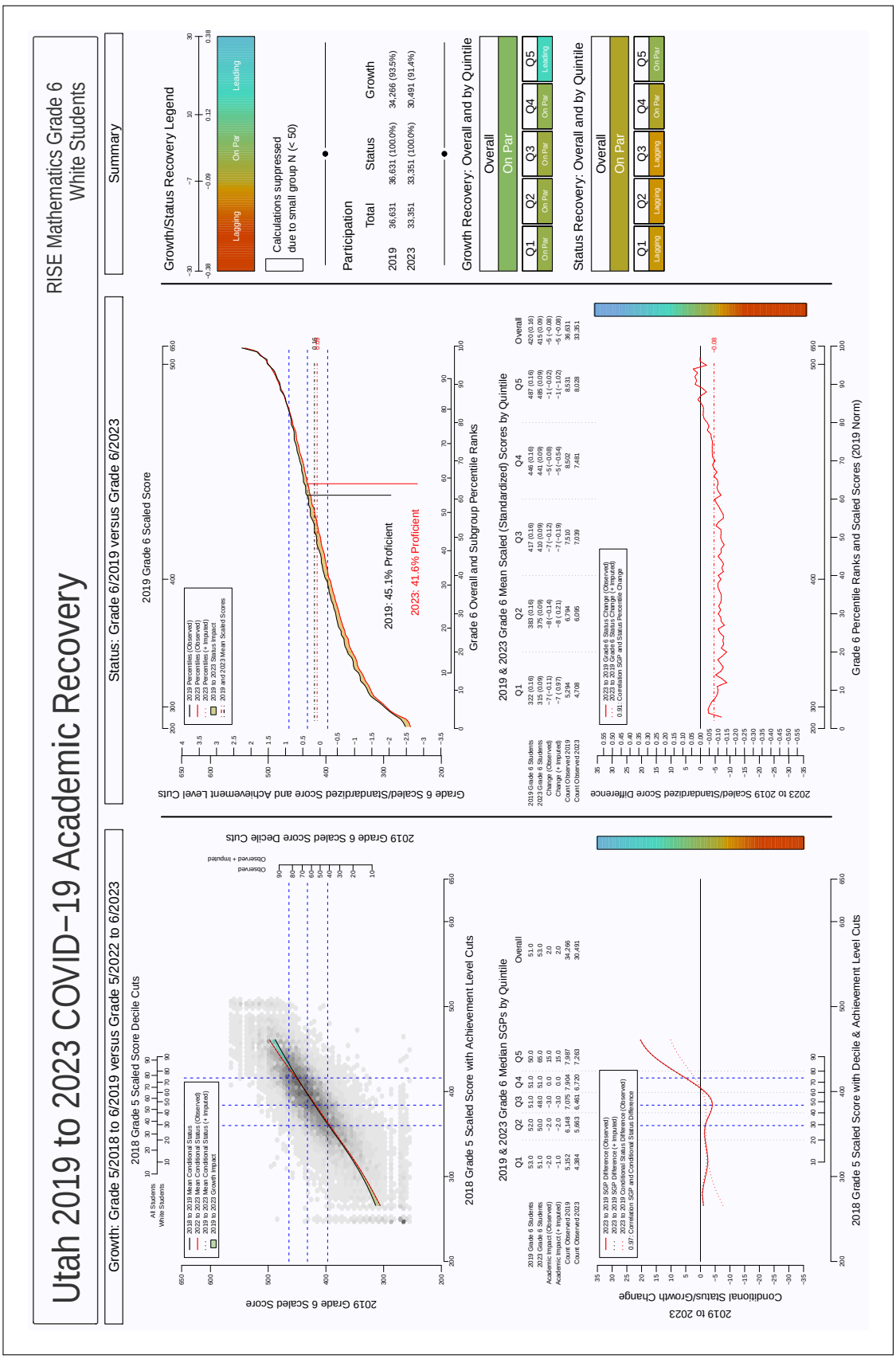

Figure 85: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 6 mathematics, white students

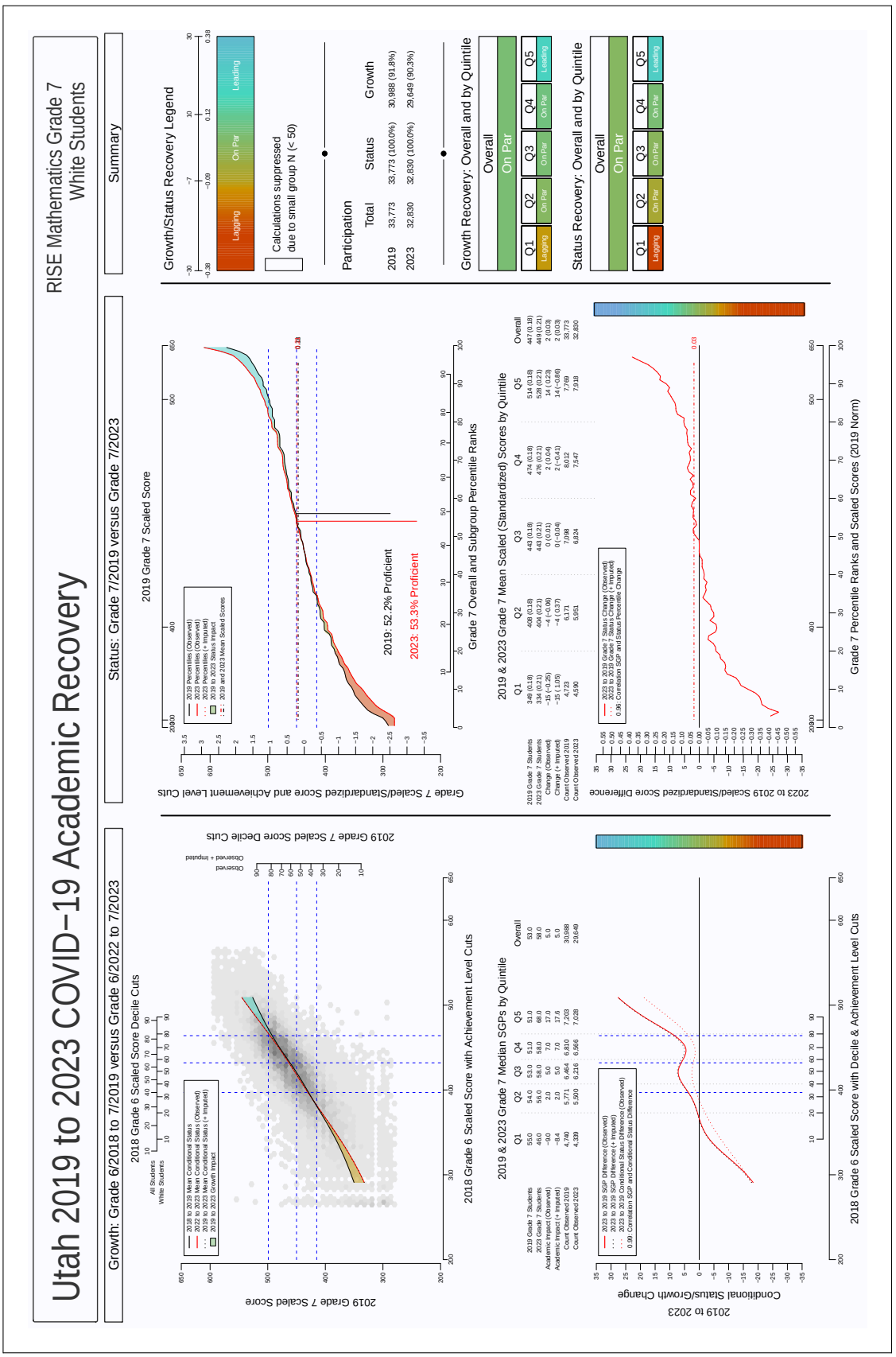

Figure 86: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 7 mathematics, white students

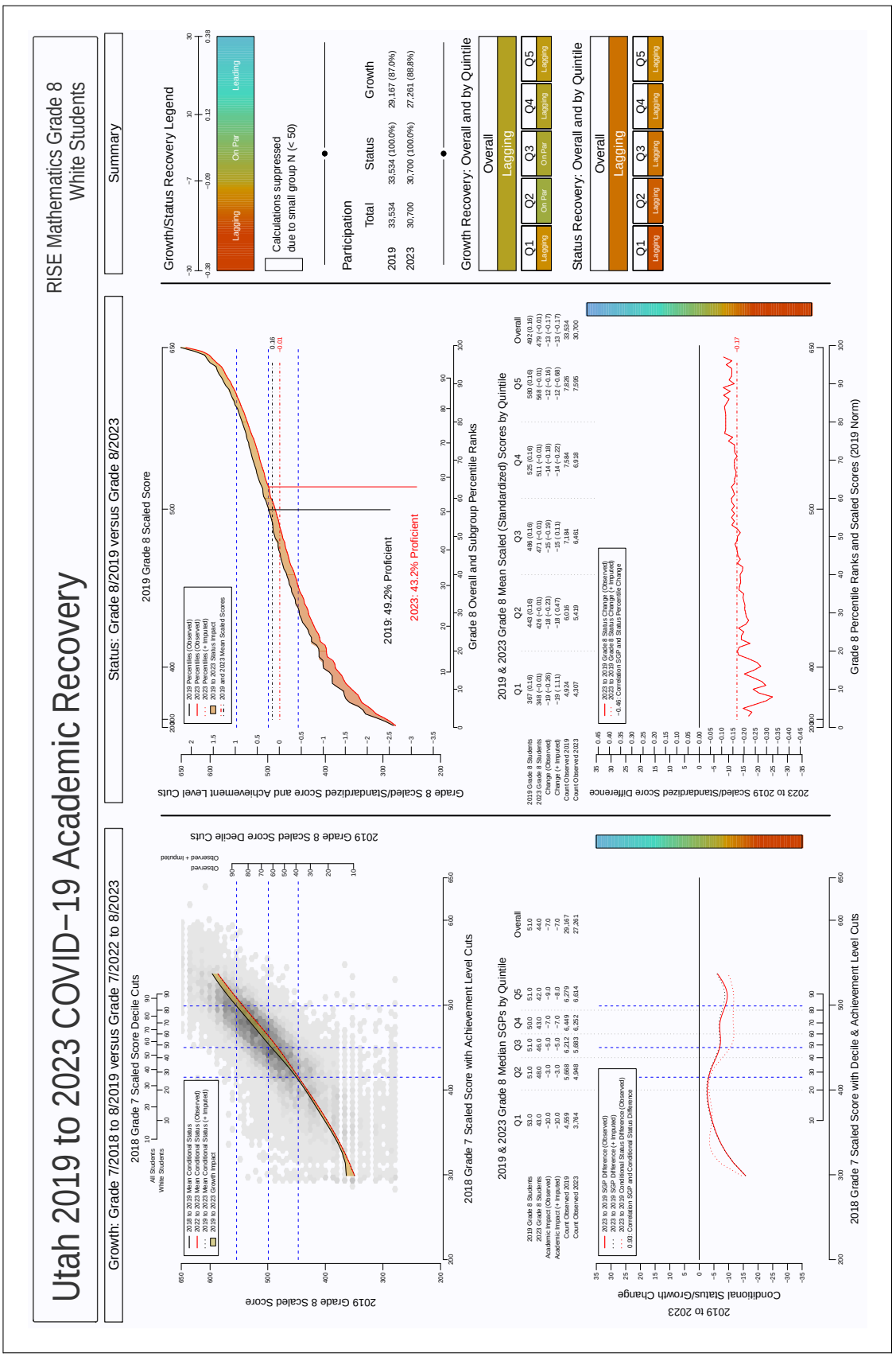

Figure 87: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 8 mathematics, white students

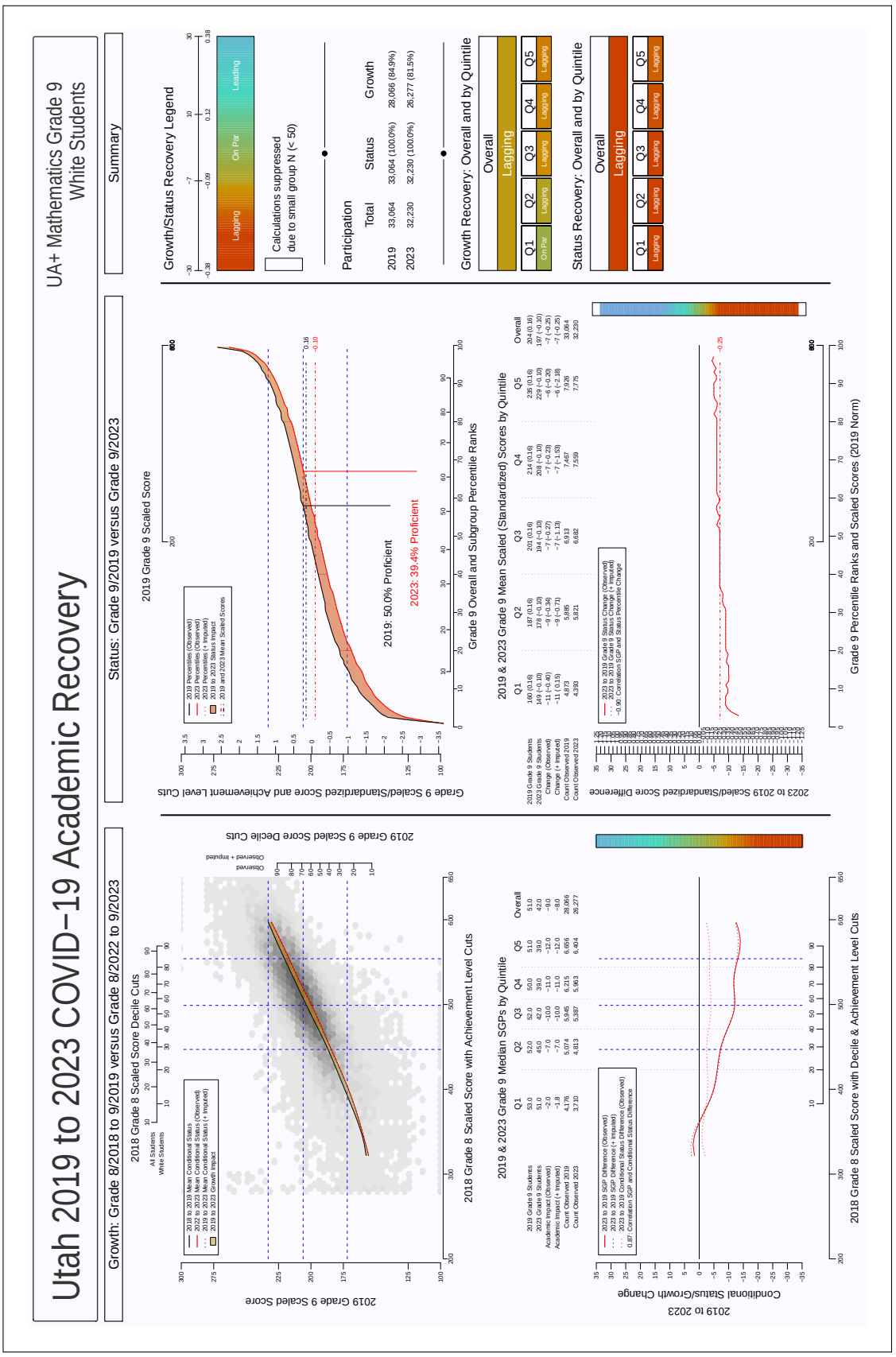

Figure 88: Utah UA+ academic recovery: Growth and status 2019 to 2023 grade 9 mathematics, white students

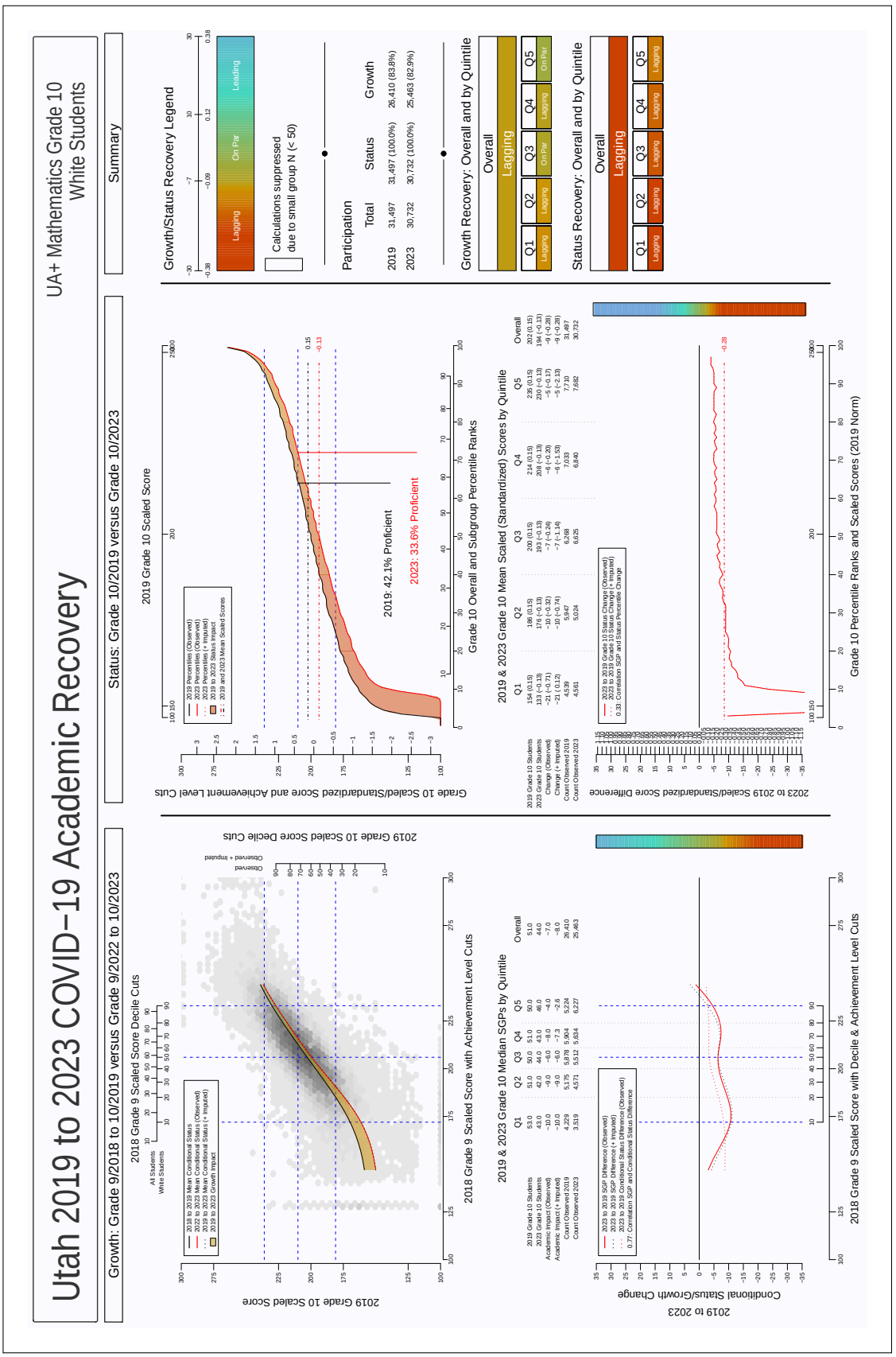

Figure 89: Utah UA+ academic recovery: Growth and status 2019 to 2023 grade 10 mathematics, white students

Grade by Content Area by Special Education

The figures on the following pages illustrate pandemic related academic impact for special education students grouped by grade (3, 4, 5, 6, 7, 8, 9 or 10) and content area (ELA or mathematics).

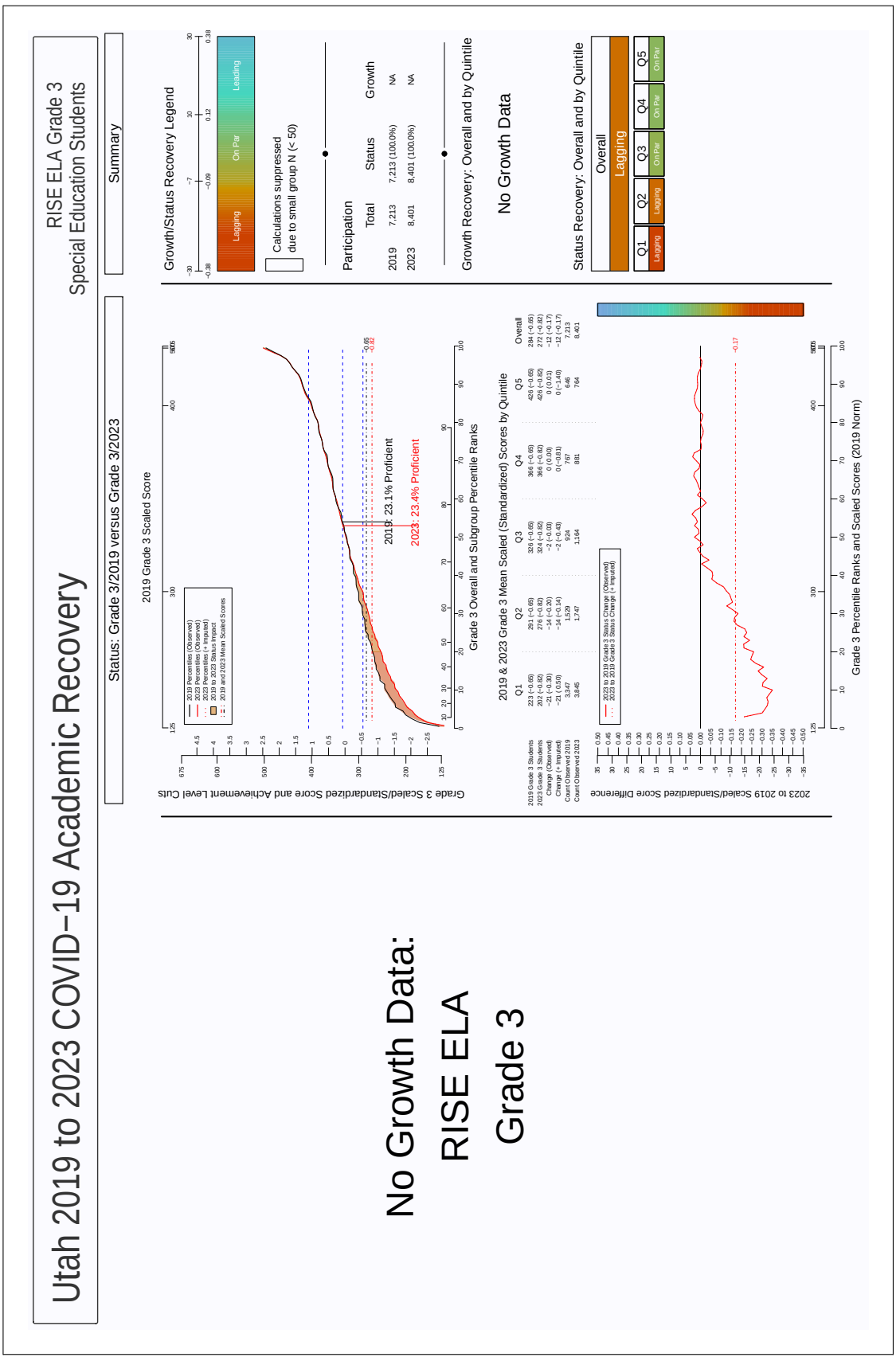

Figure 90: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 3 ELA, special education students

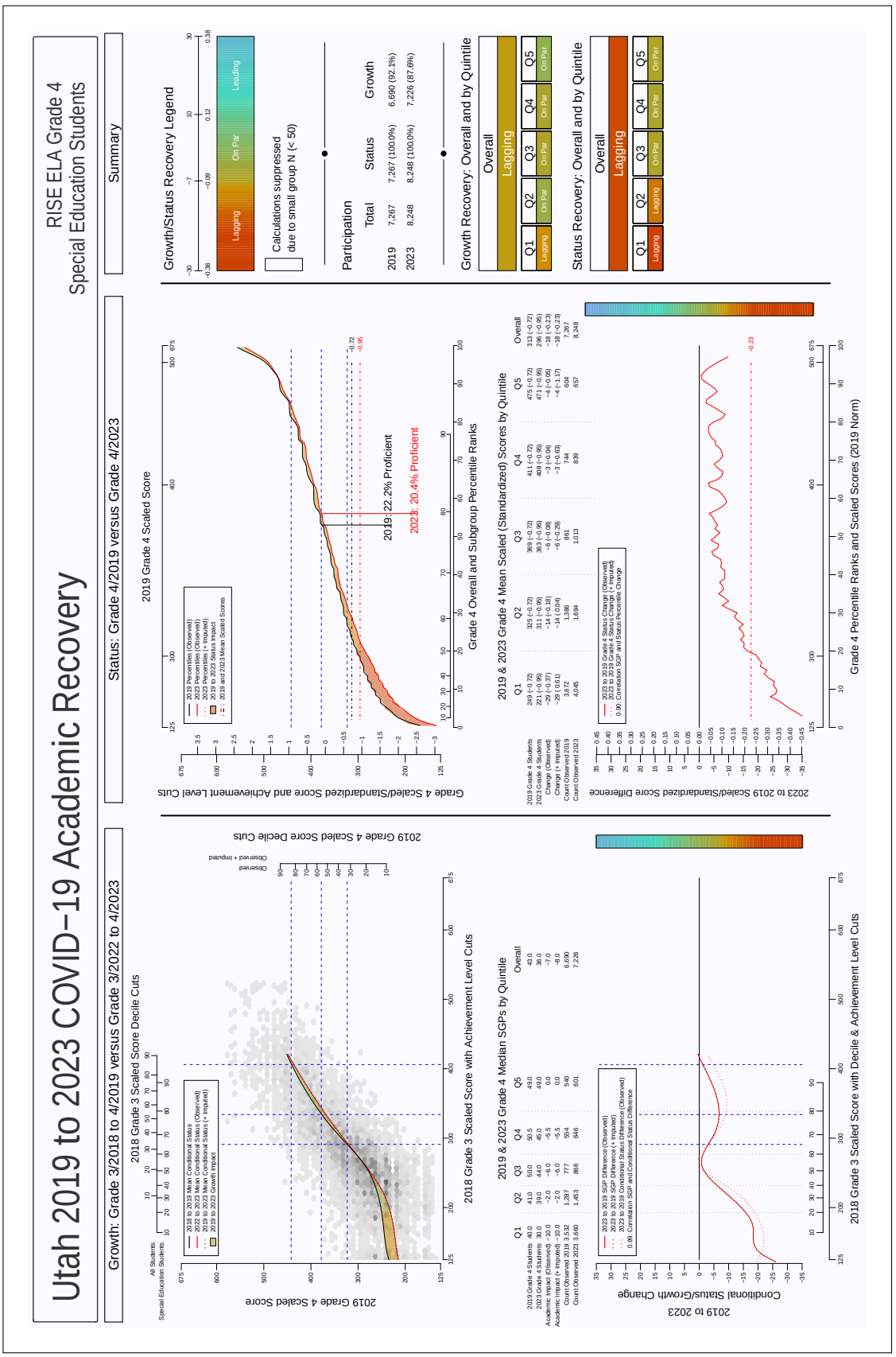

Figure 91: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 4 ELA, special education students

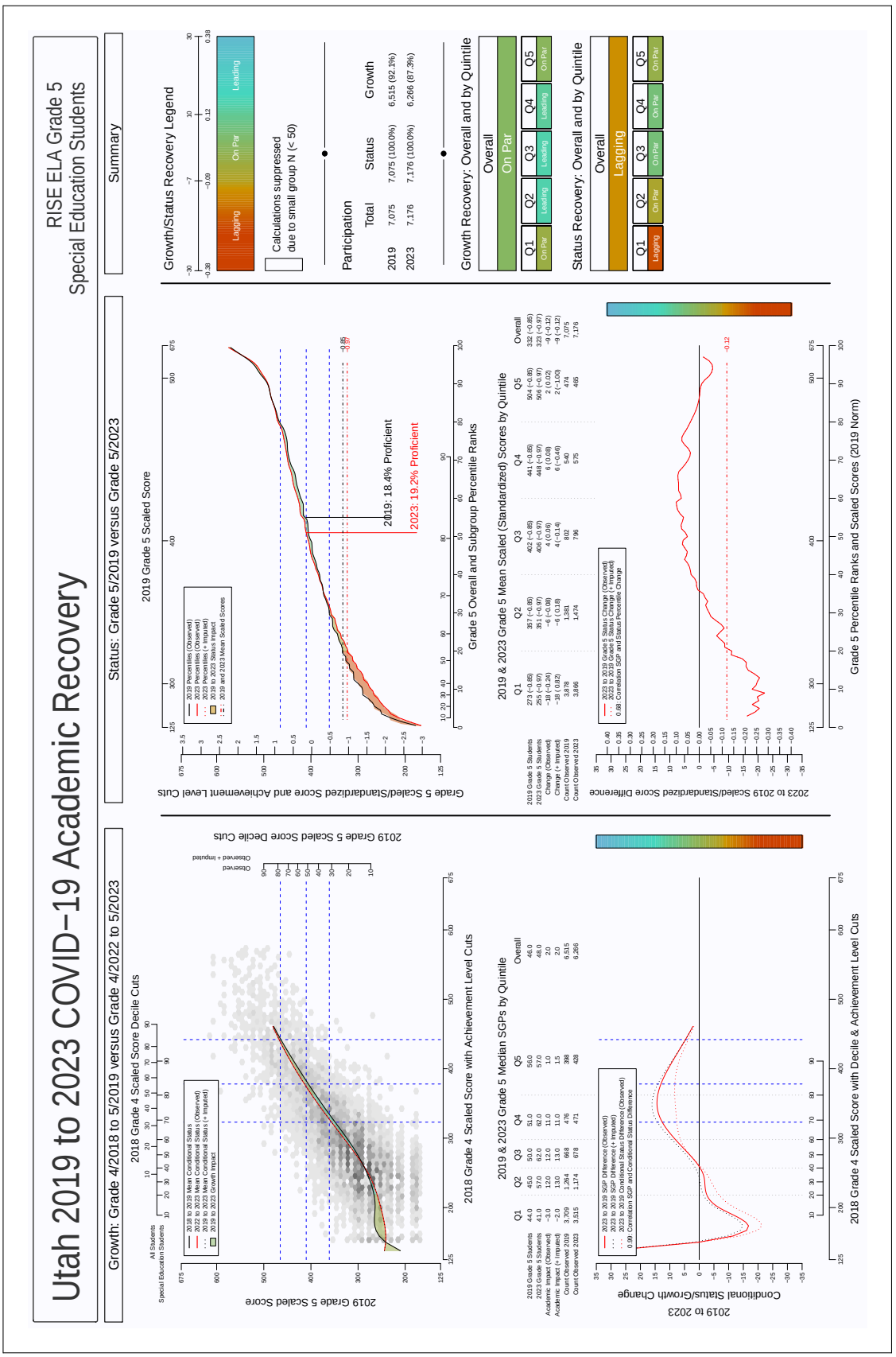

Figure 92: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 5 ELA, special education students

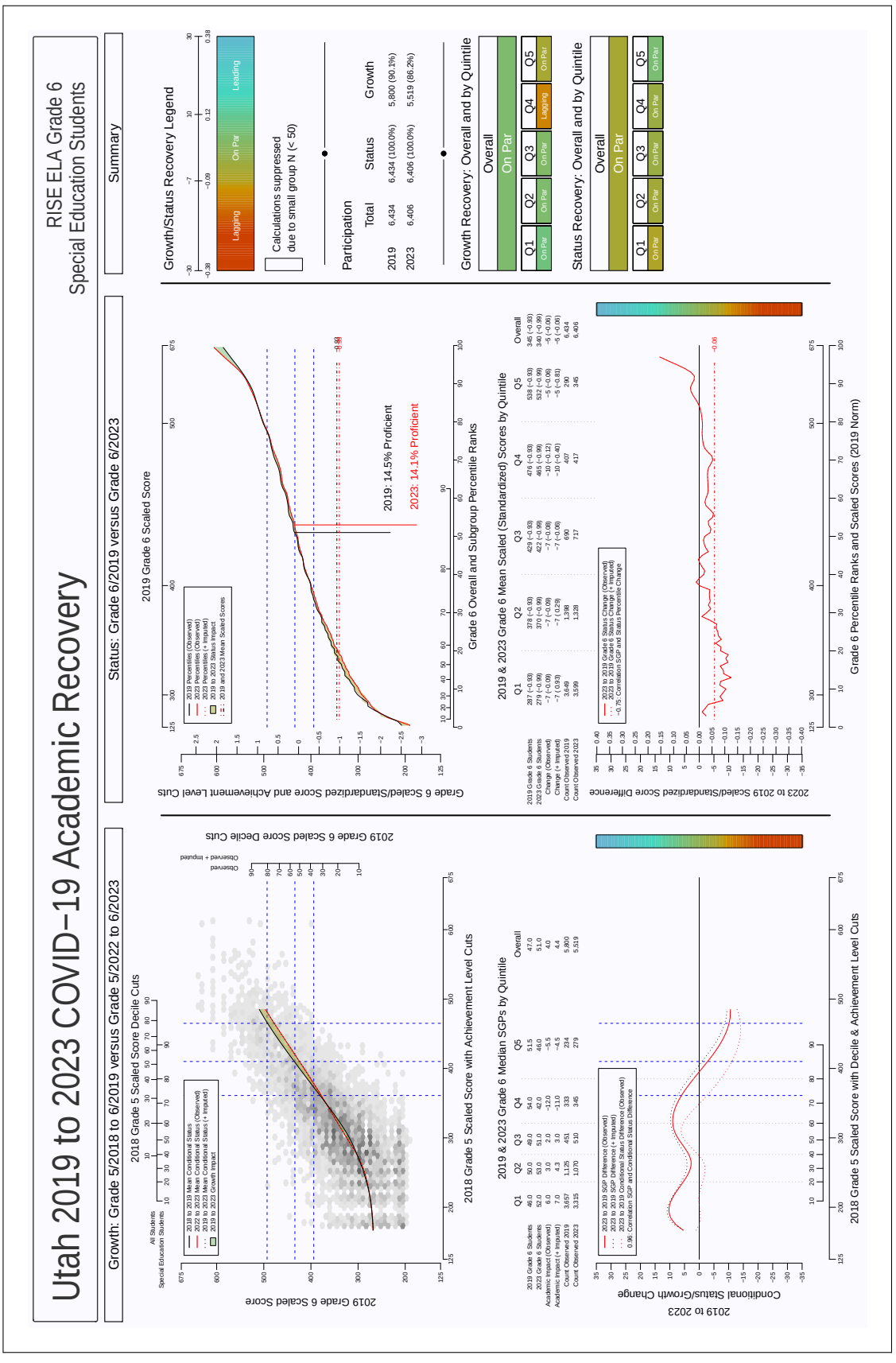

Figure 93: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 6 ELA, special education students

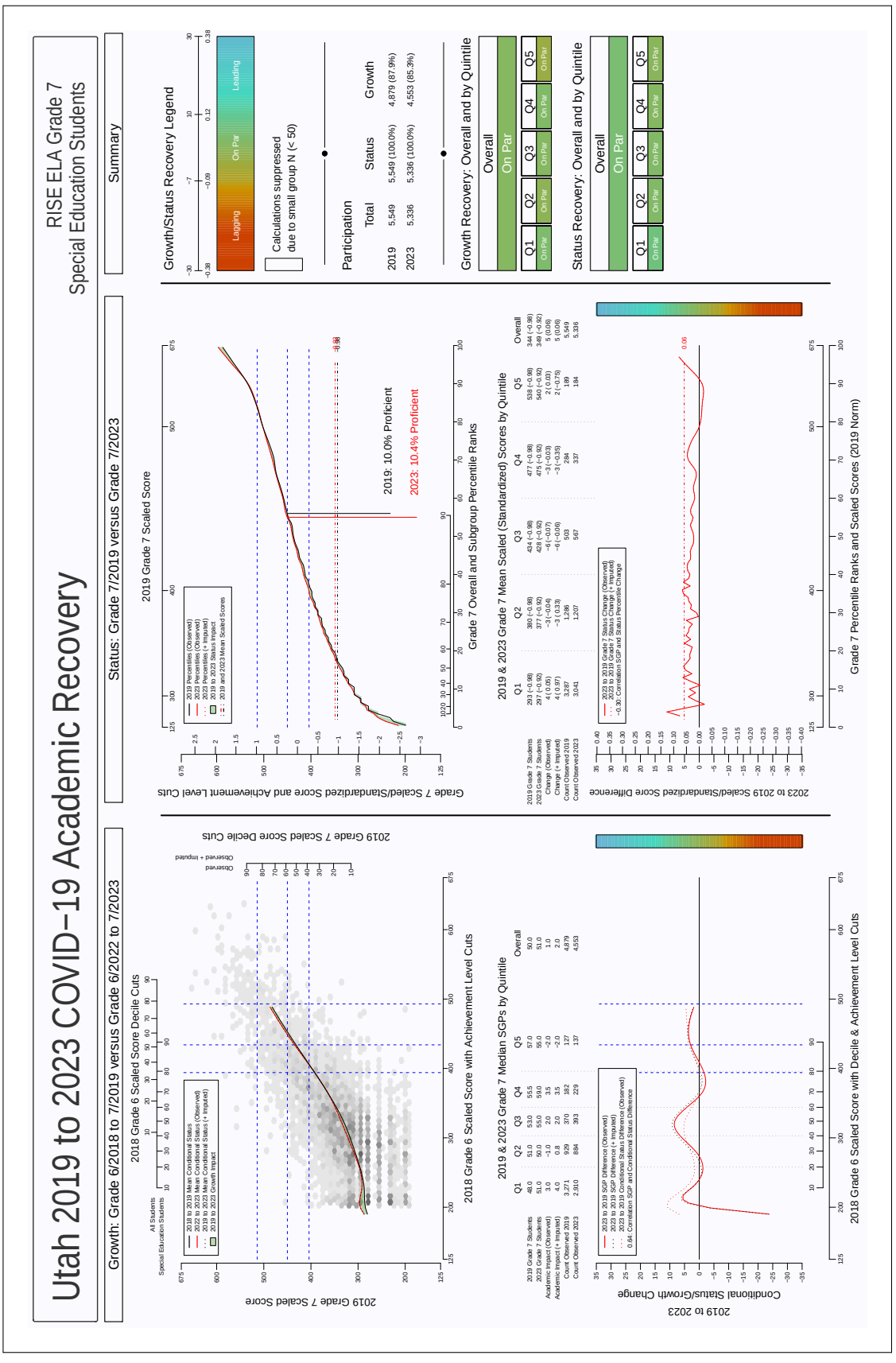

Figure 94: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 7 ELA, special education students

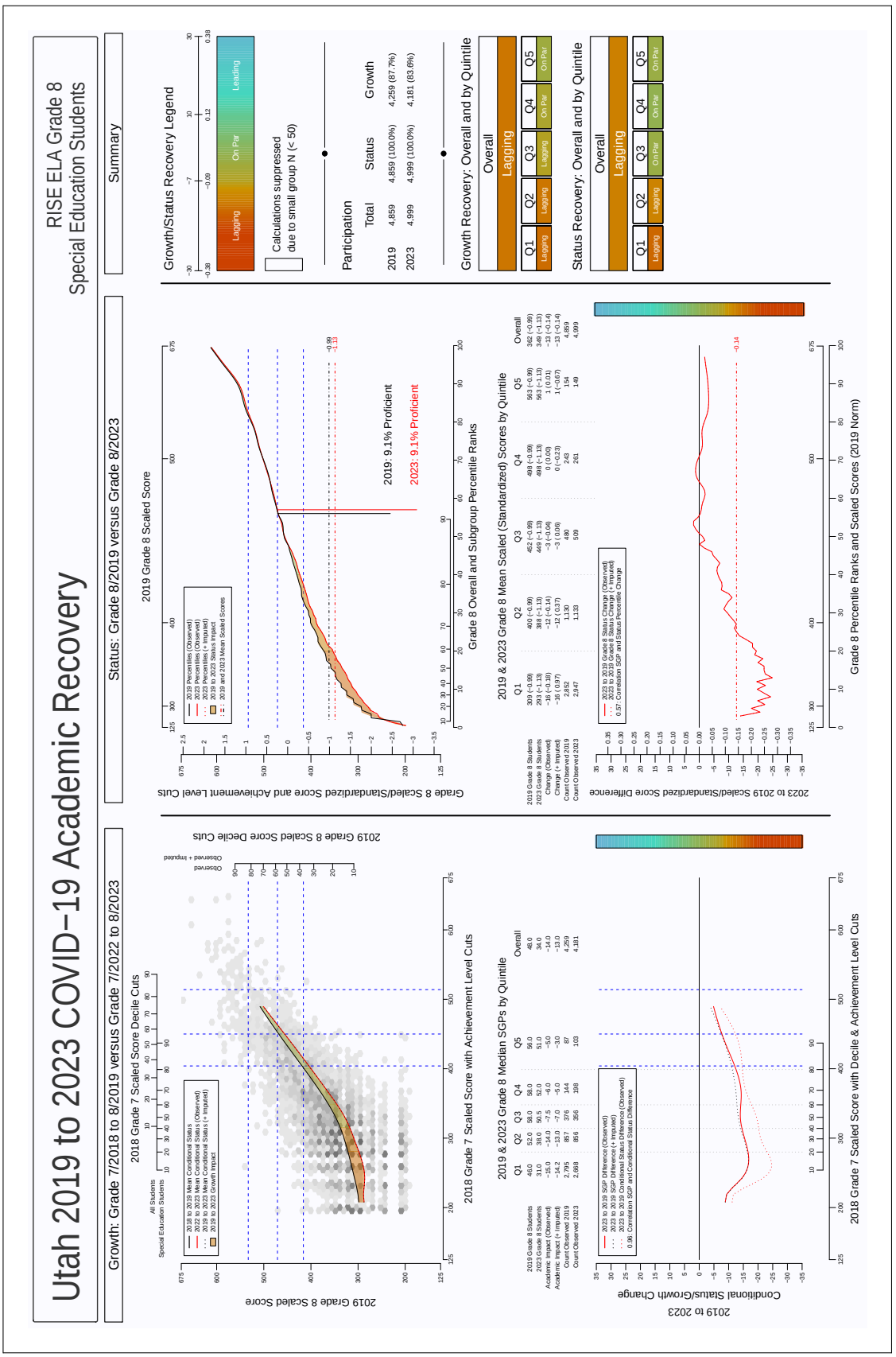

Figure 95: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 8 ELA, special education students

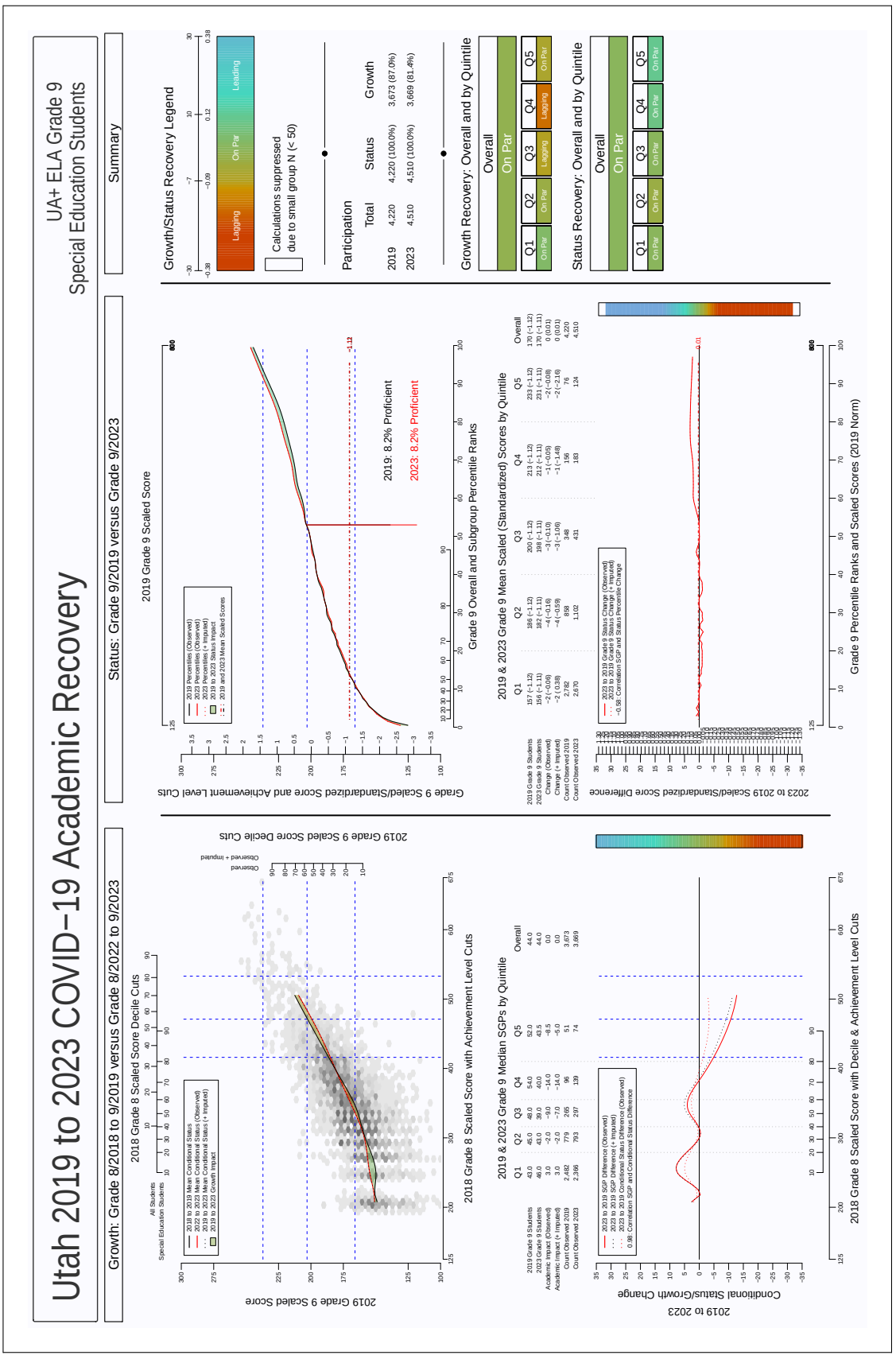

Figure 96: Utah UA+ academic recovery: Growth and status 2019 to 2023 grade 9 ELA, special education students

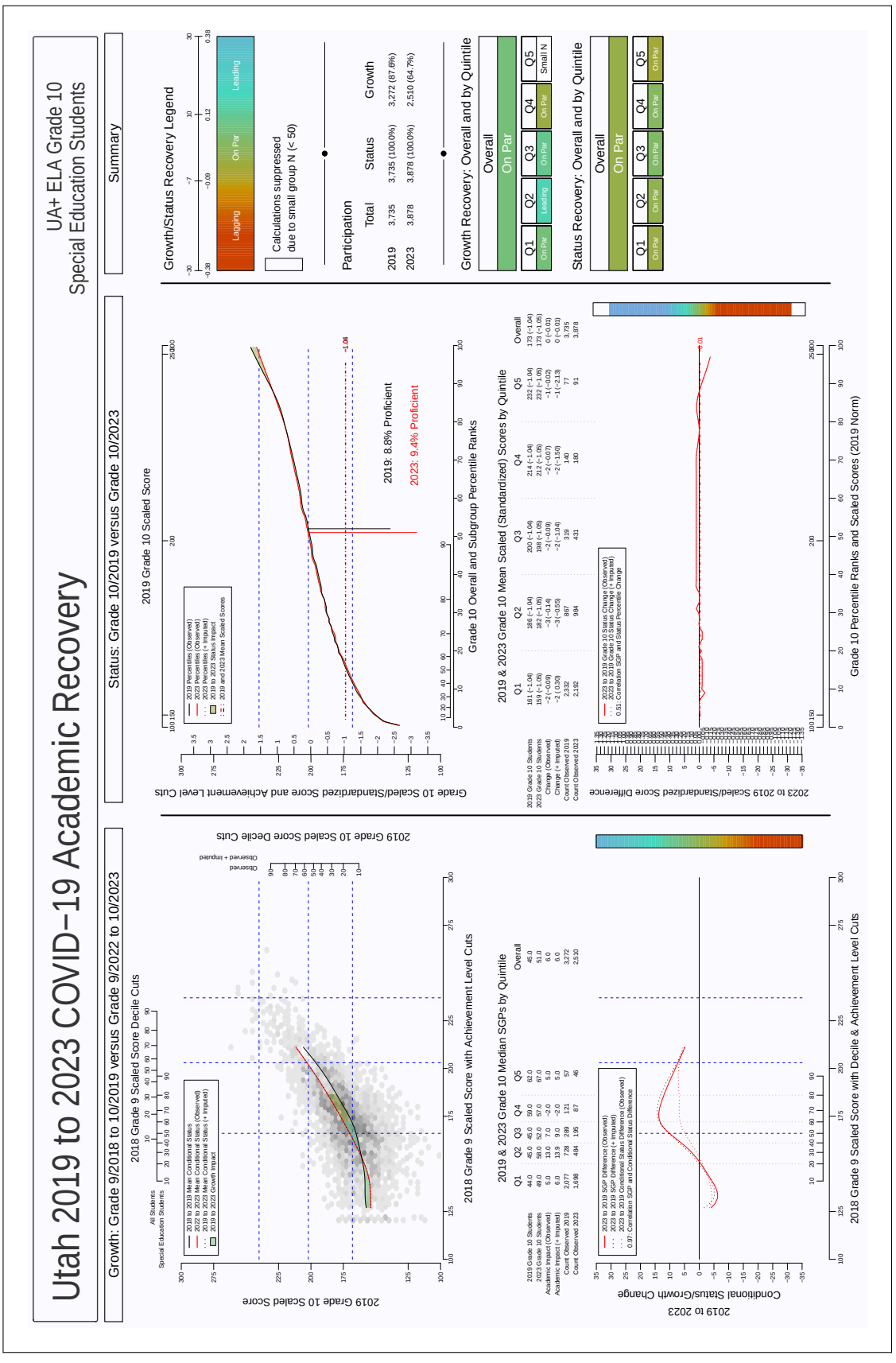

Figure 97: Utah UA+ academic recovery: Growth and status 2019 to 2023 grade 10 ELA, special education students

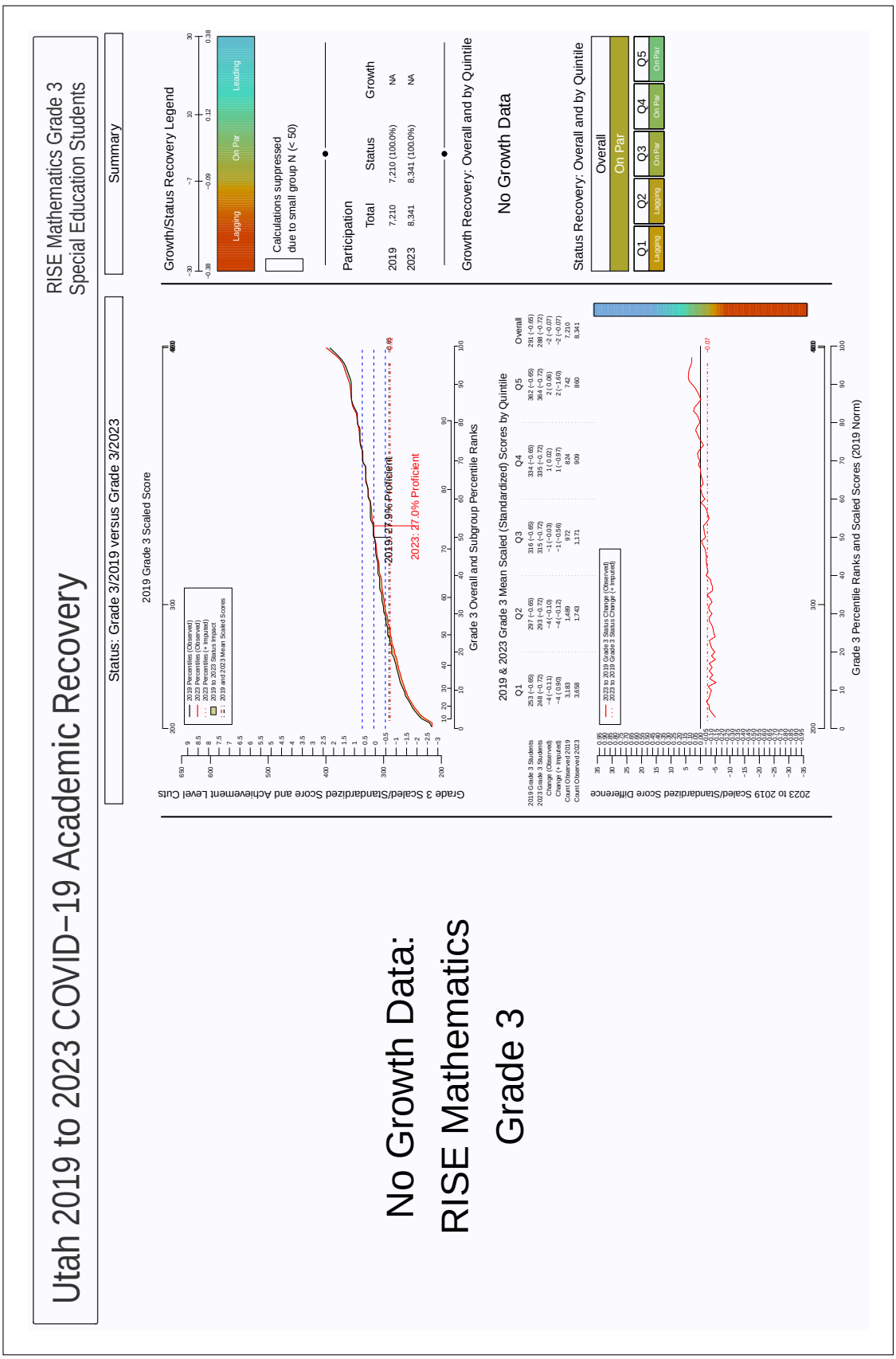

Figure 98: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 3 mathematics, special education students

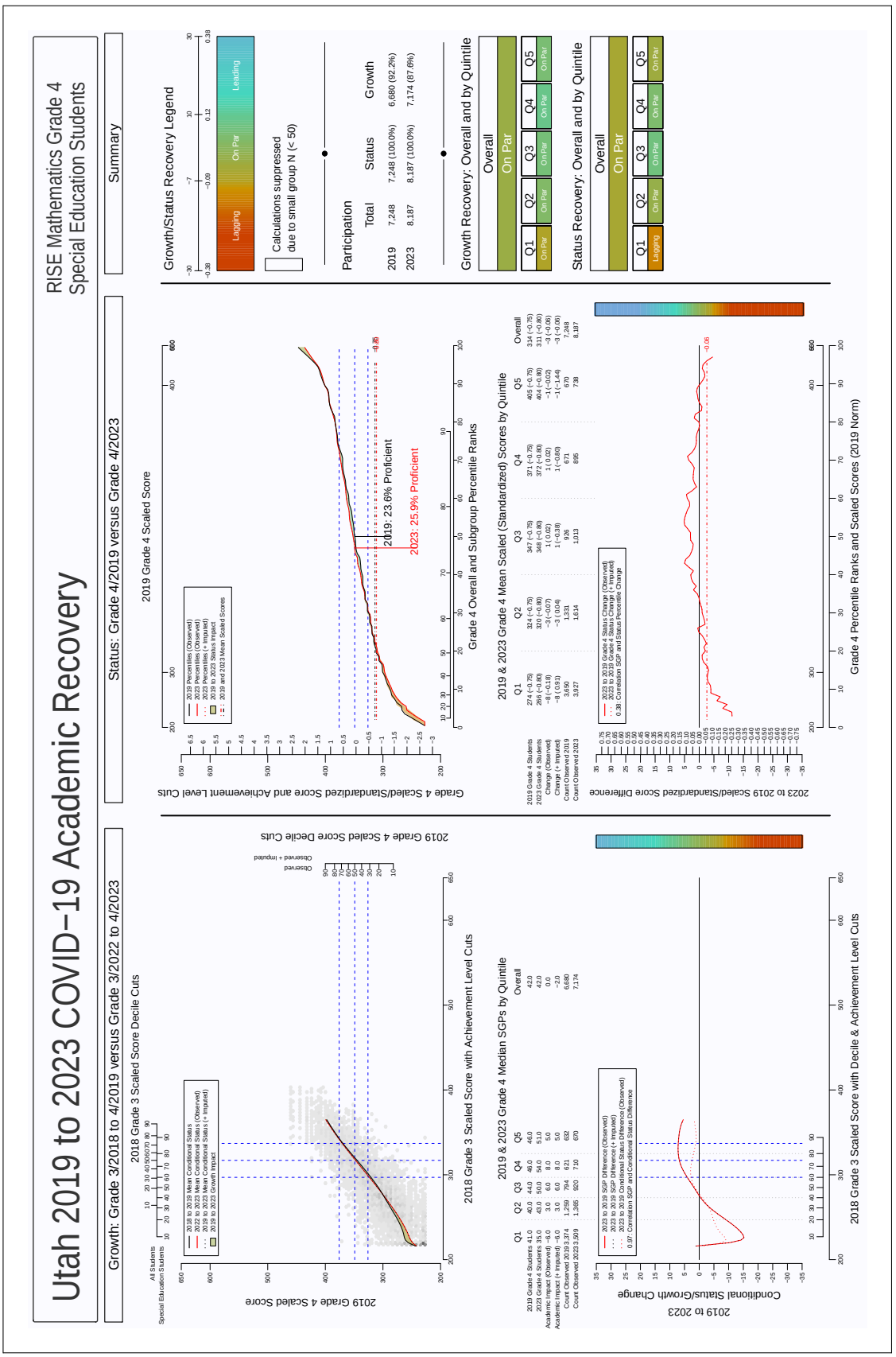

Figure 99: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 4 mathematics, special education students

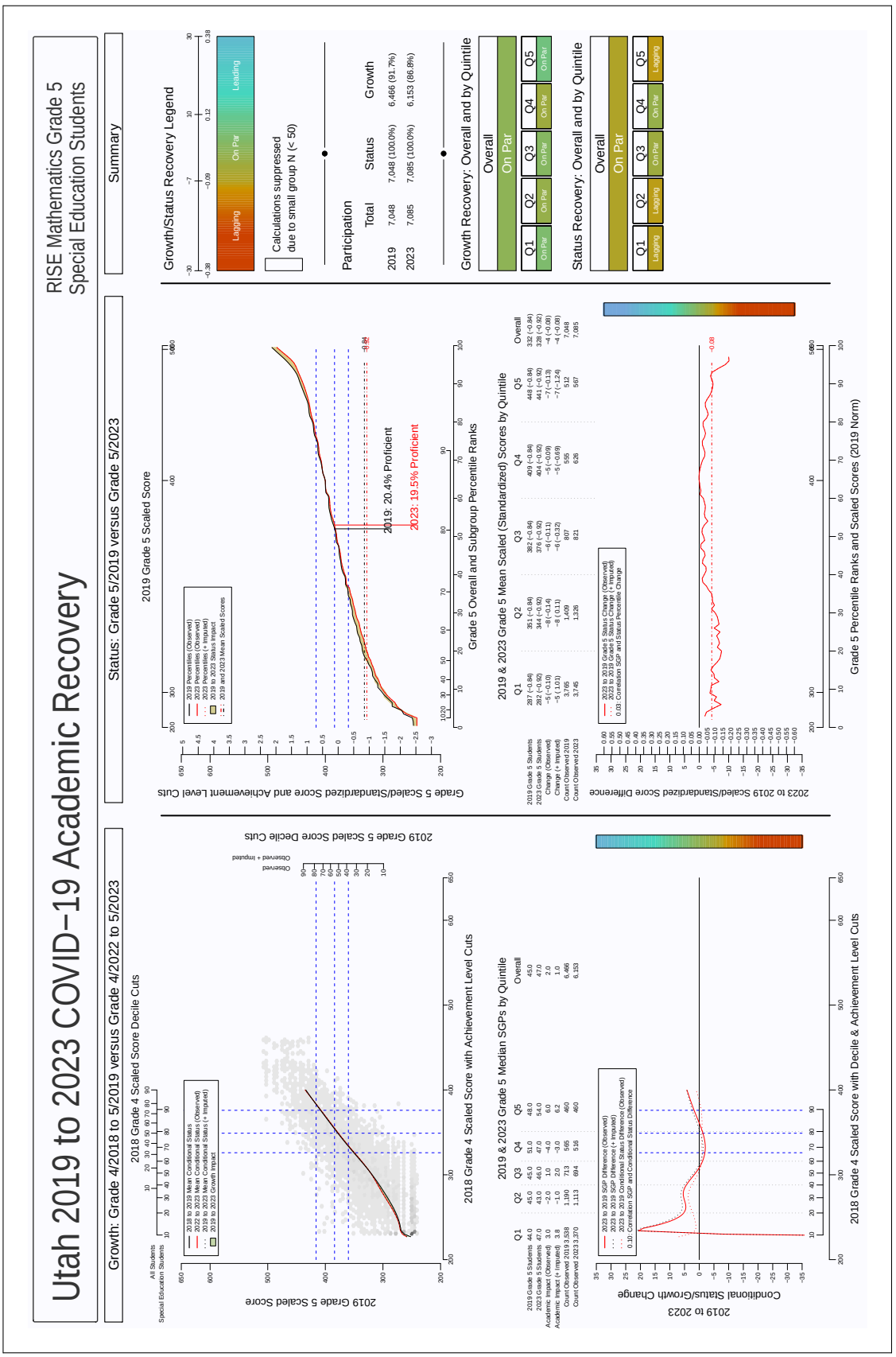

Figure 100: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 5 mathematics, special education students

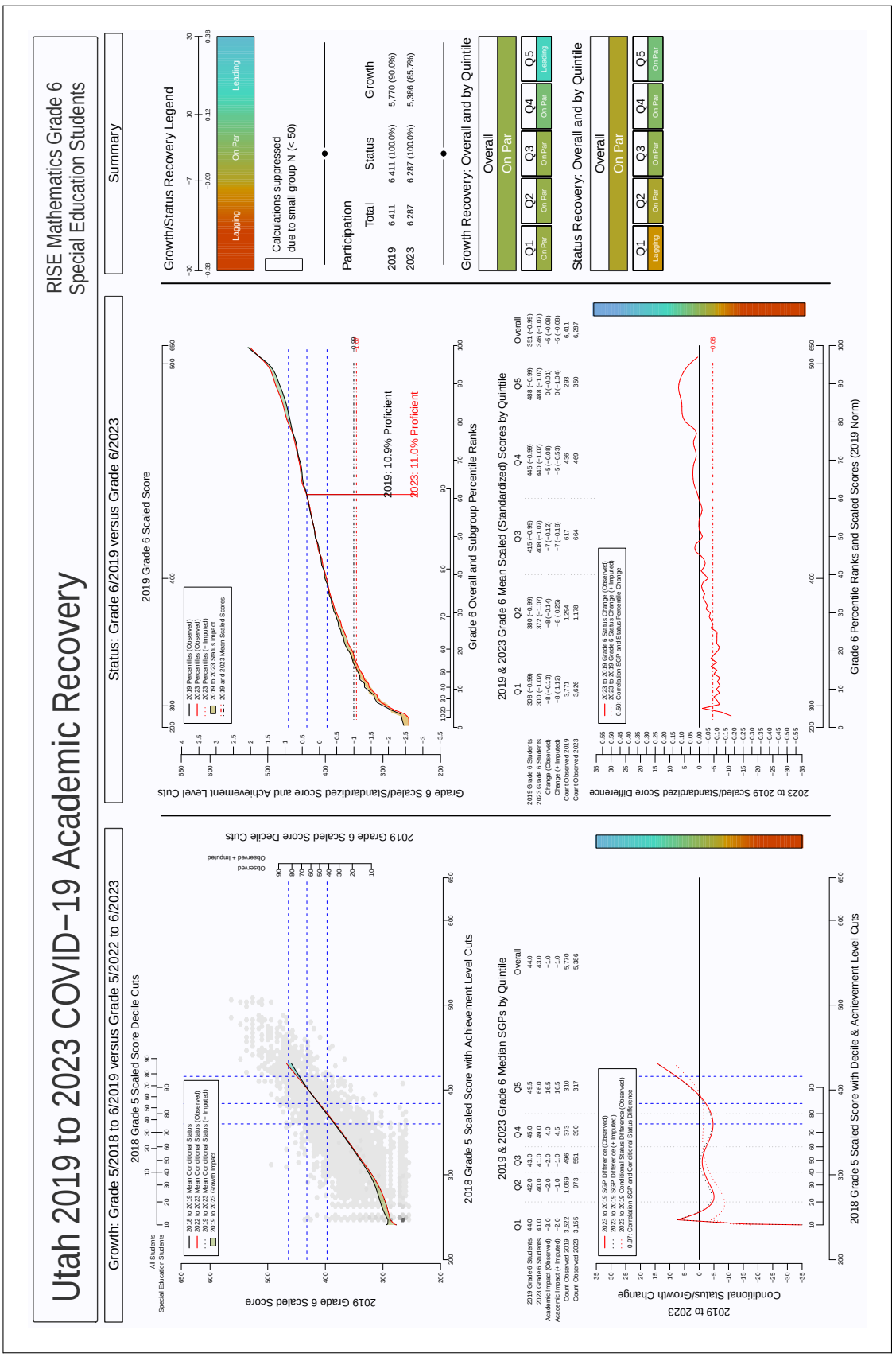

Figure 101: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 6 mathematics, special education students

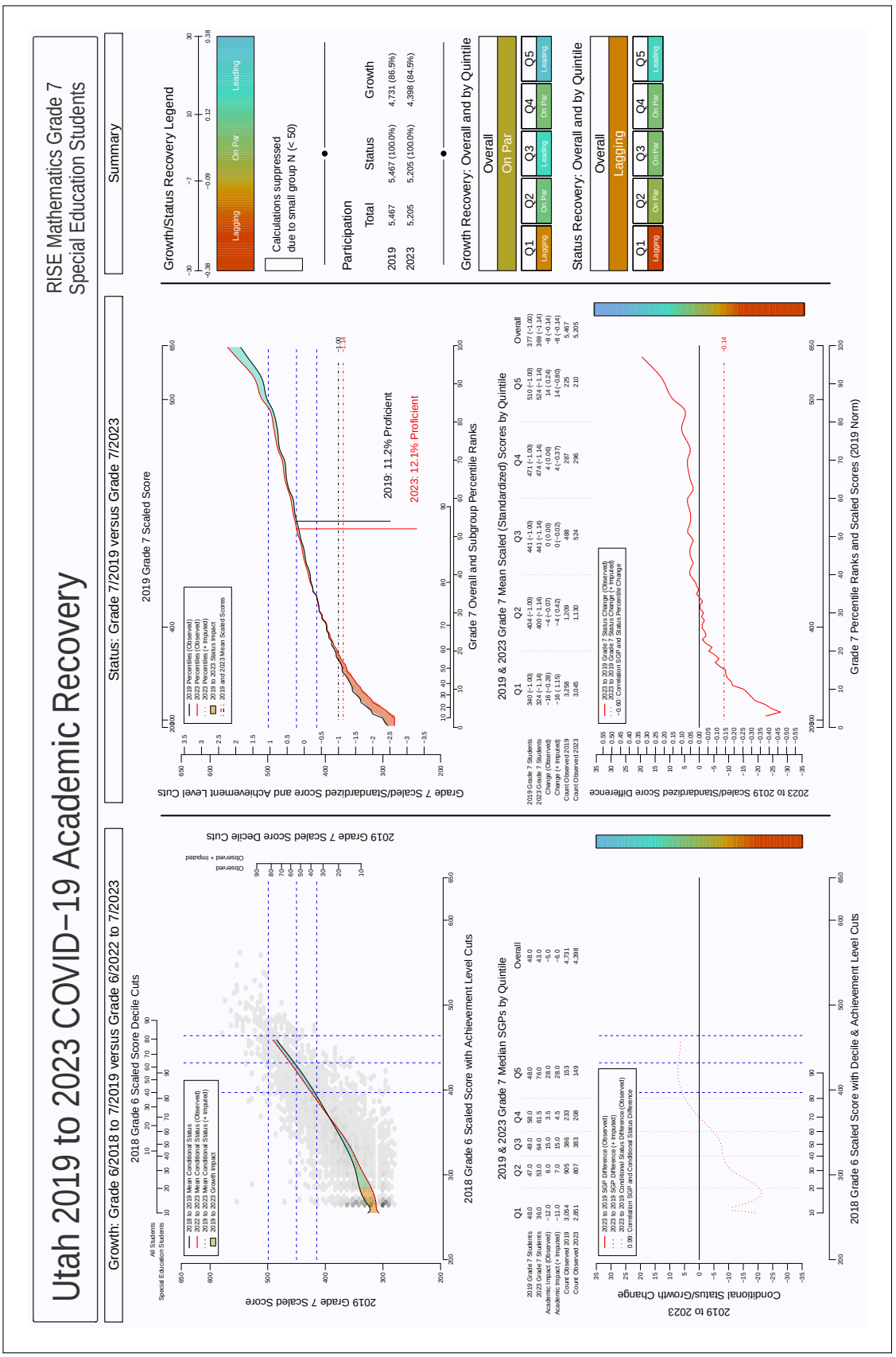

Figure 102: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 7 mathematics, special education students

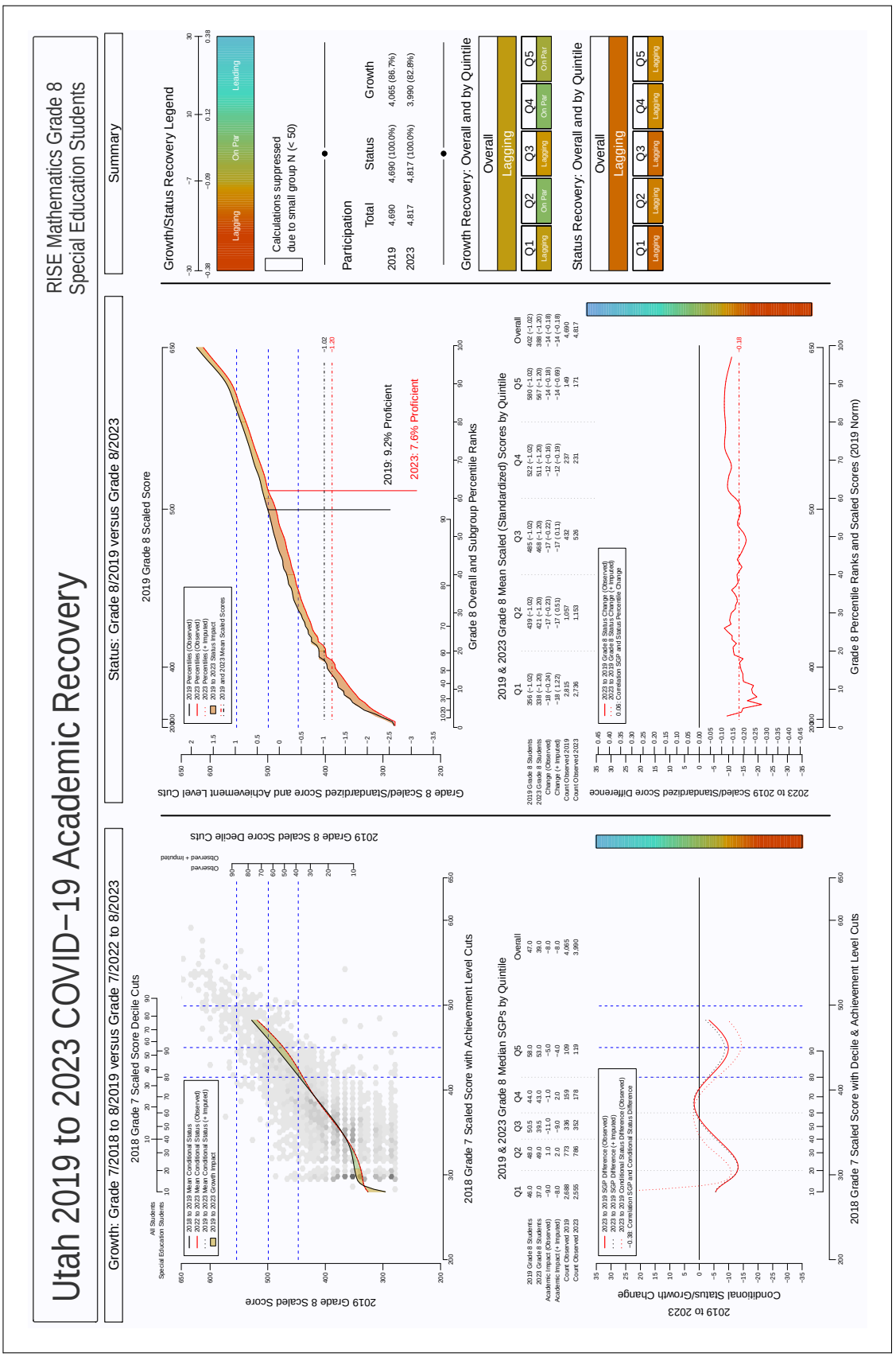

Figure 103: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 8 mathematics, special education students

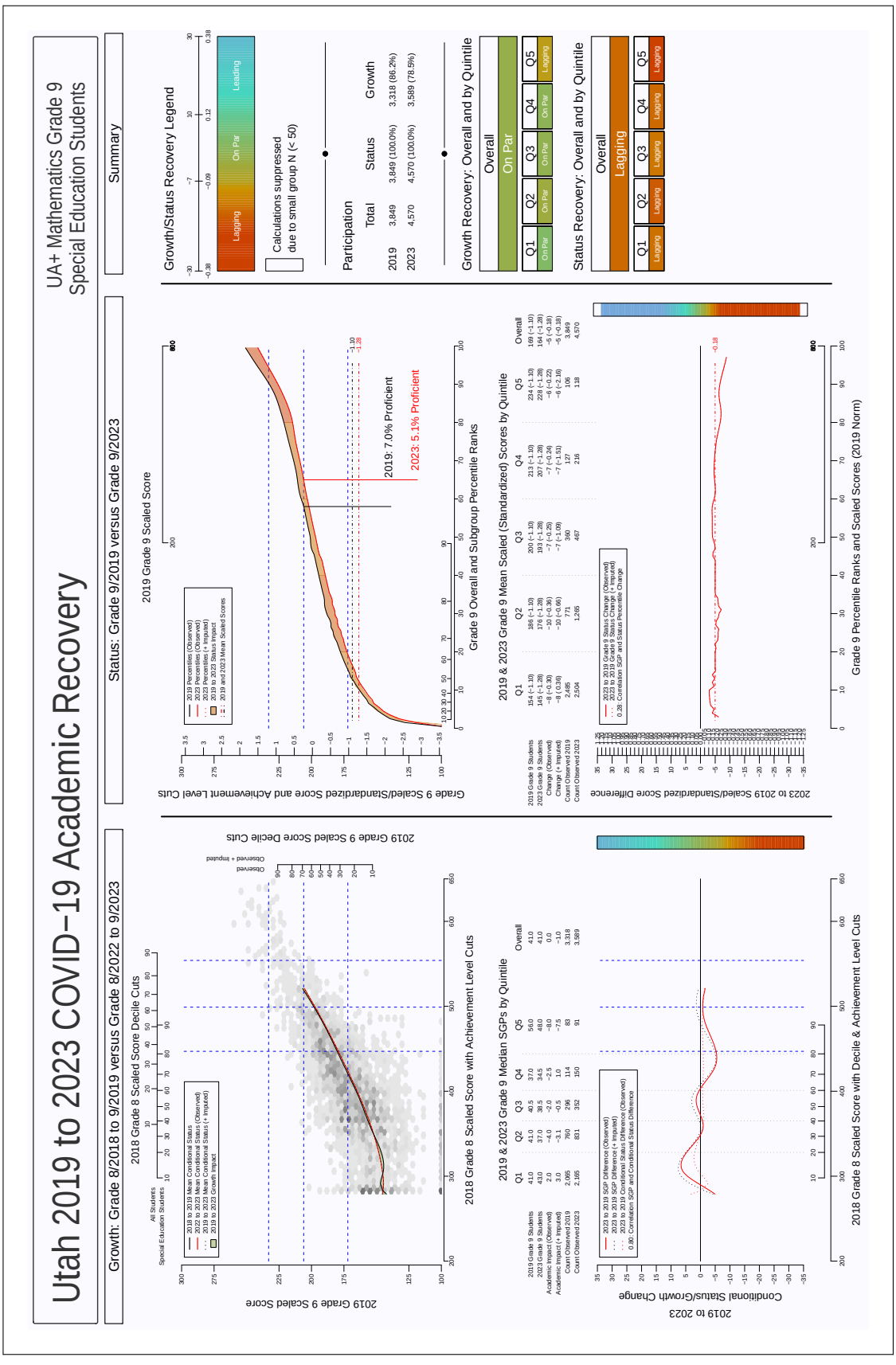

Figure 104: Utah UA+ academic recovery: Growth and status 2019 to 2023 grade 9 mathematics, special education students

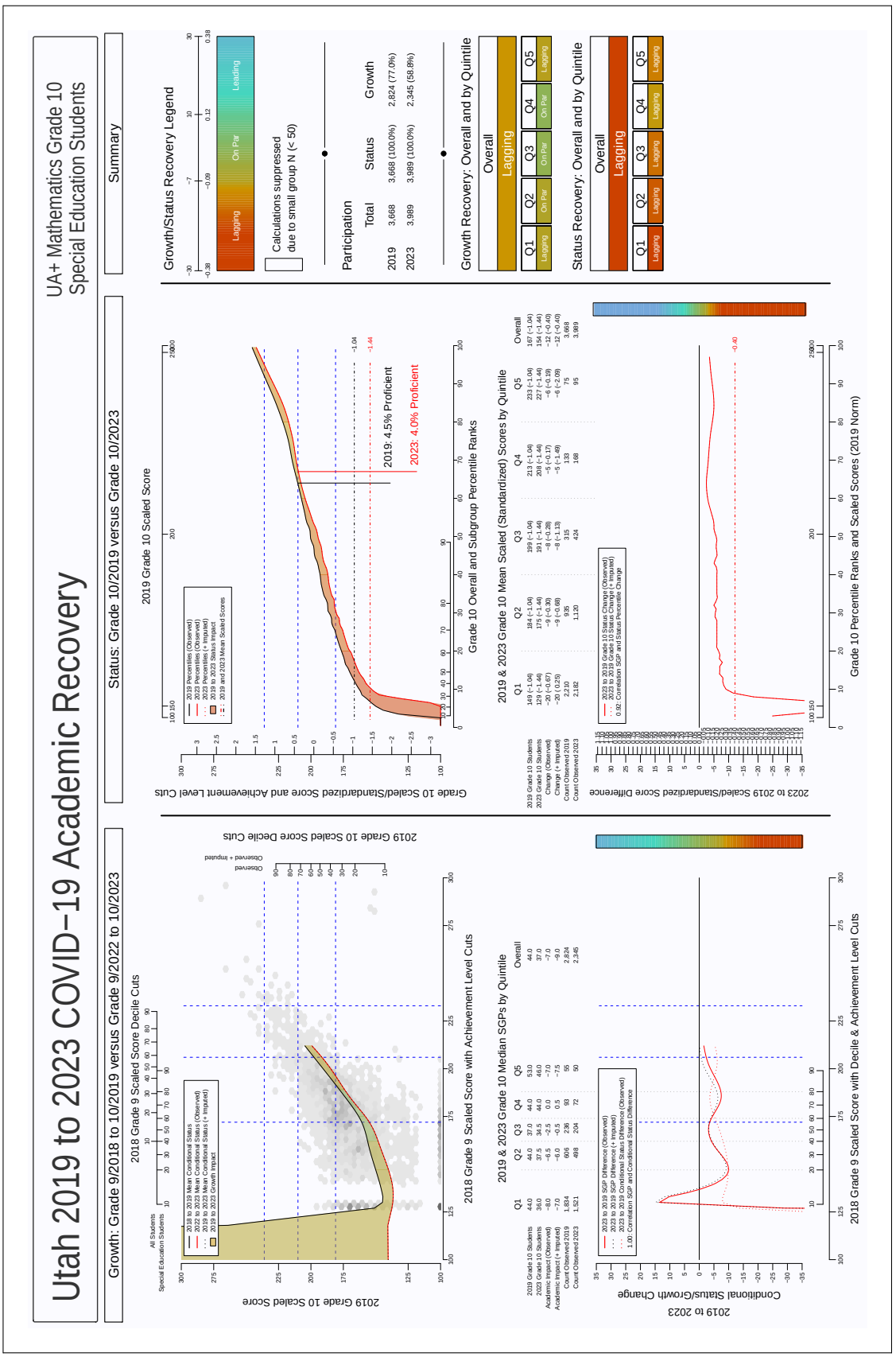

Figure 105: Utah UA+ academic recovery: Growth and status 2019 to 2023 grade 10 mathematics, special education students

Grade by Content Area by English Language Learner

The figures on the following pages illustrate pandemic related academic impact for English language learner students grouped by grade (3, 4, 5, 6, 7, 8, 9 or 10) and content area (ELA or mathematics)

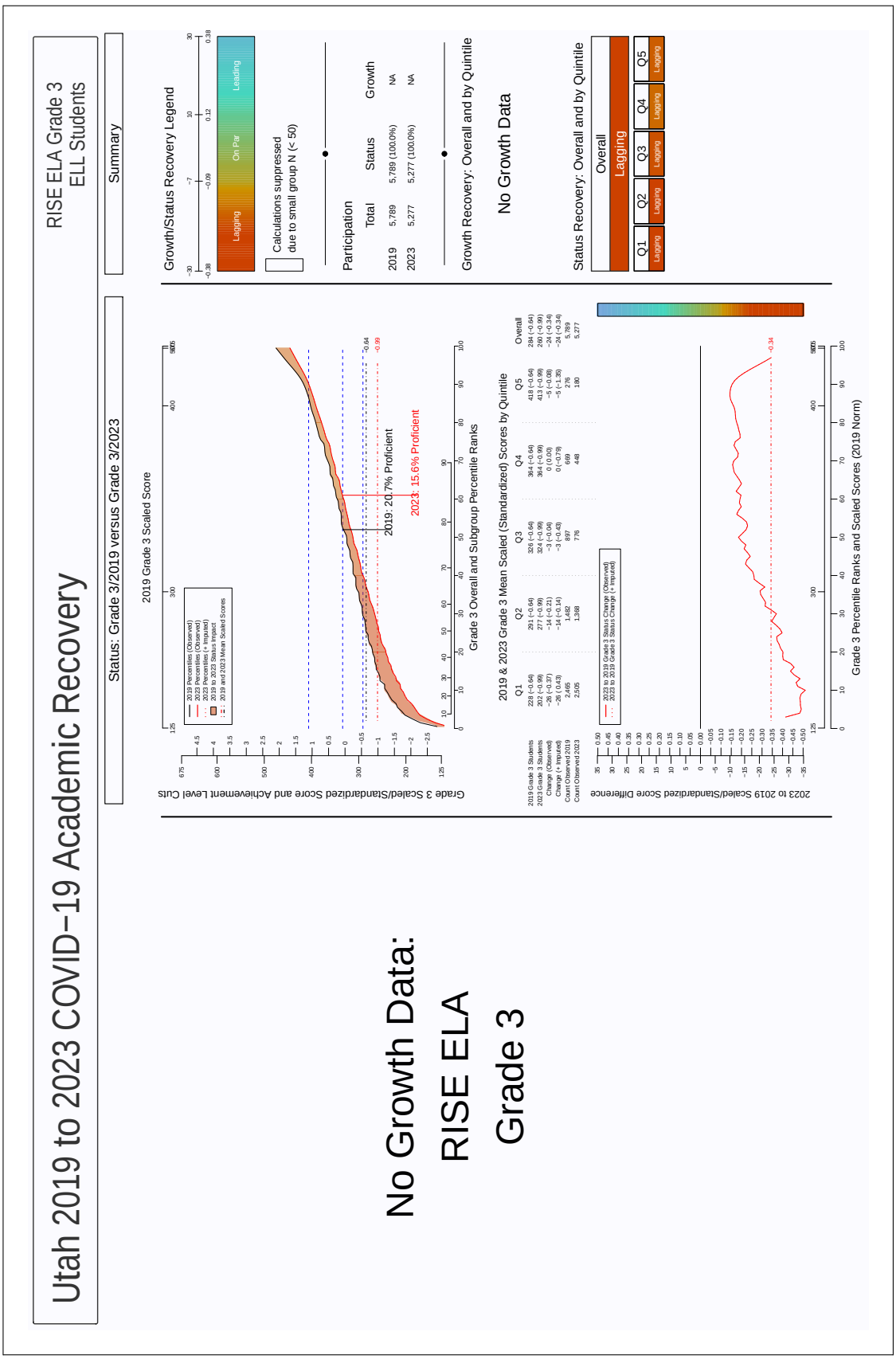

Figure 106: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 3 ELA, English language learner students

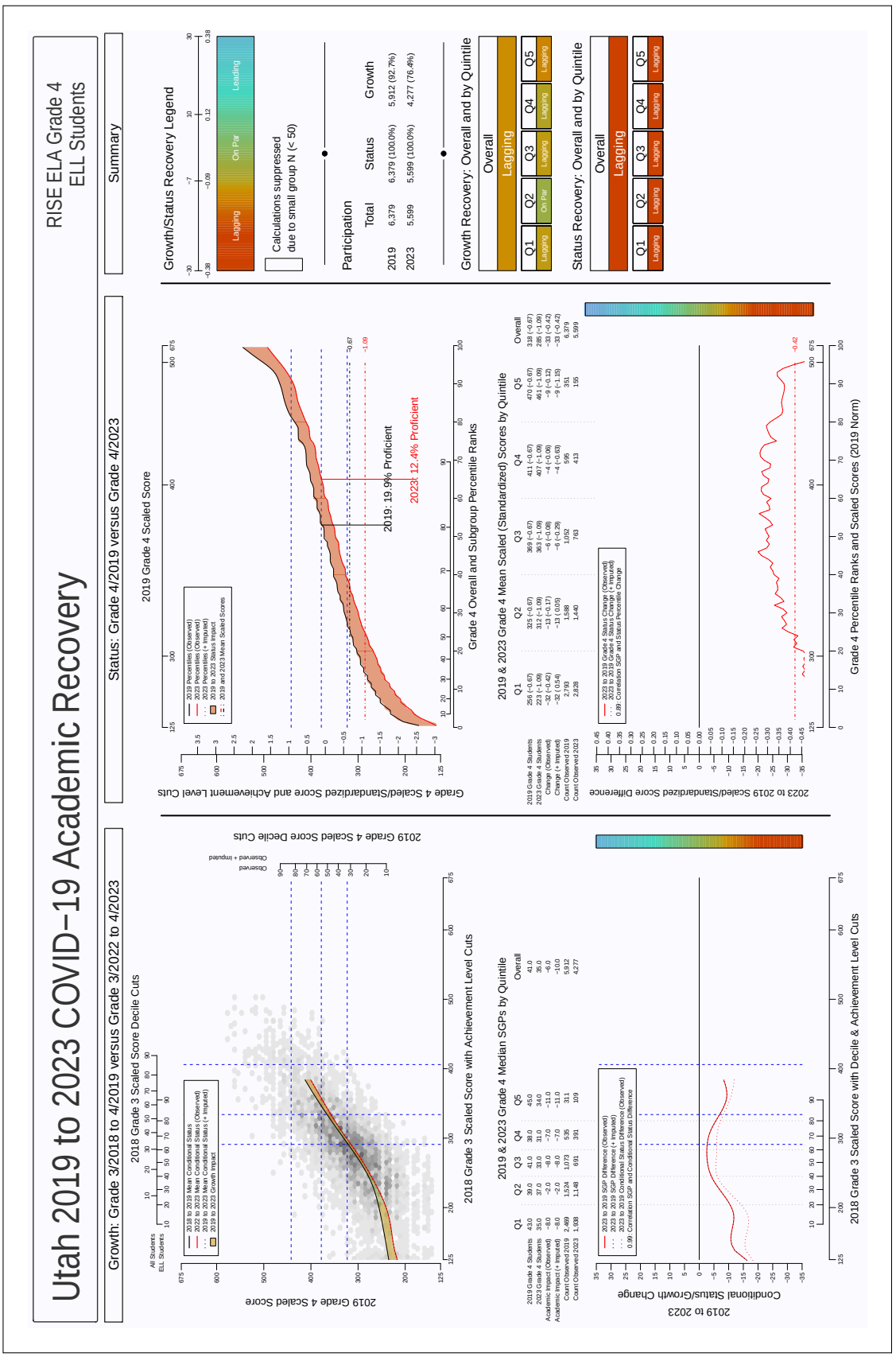

Figure 107: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 4 ELA, English language learner students

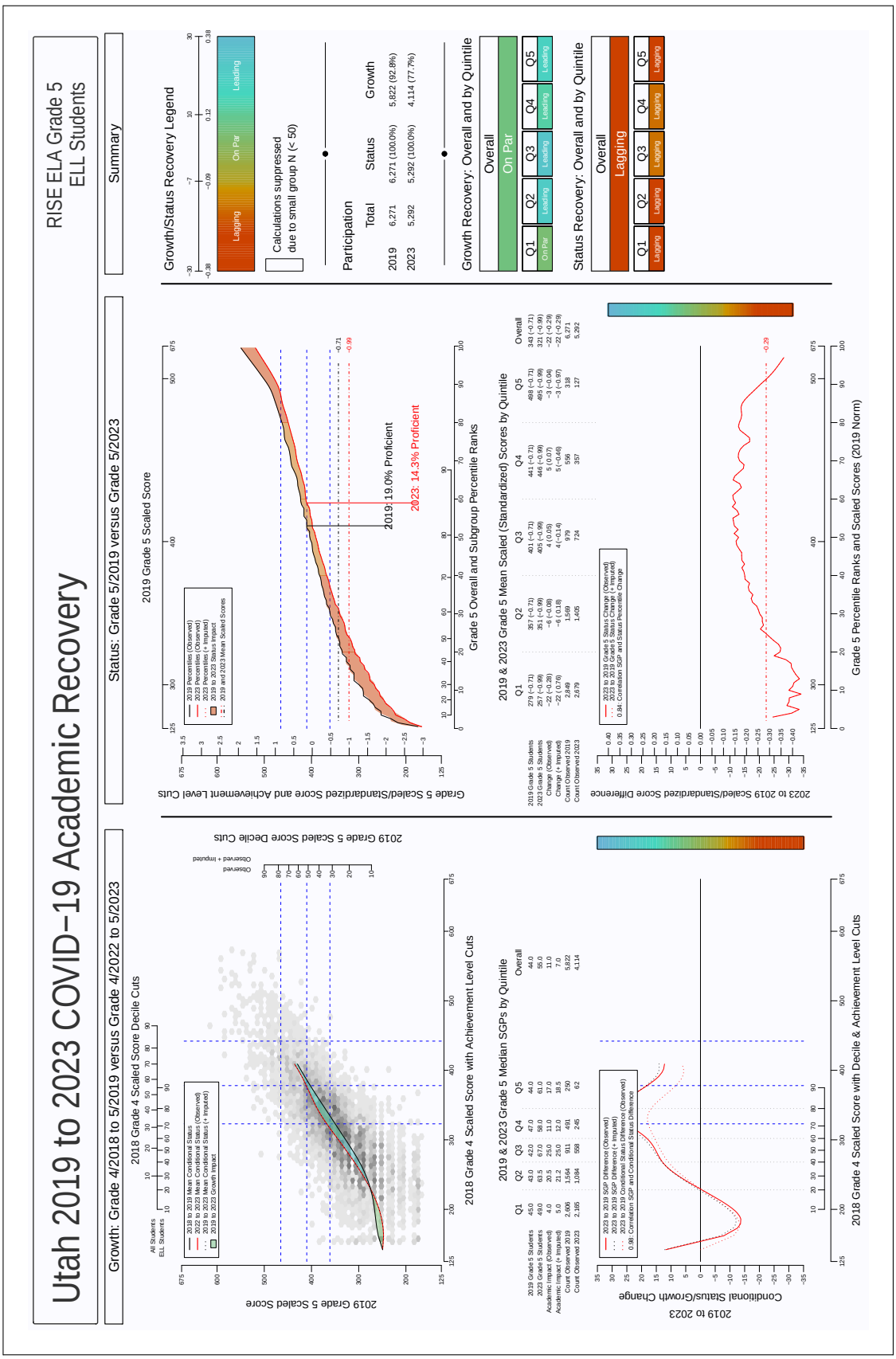

Figure 108: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 5 ELA, English language learner students

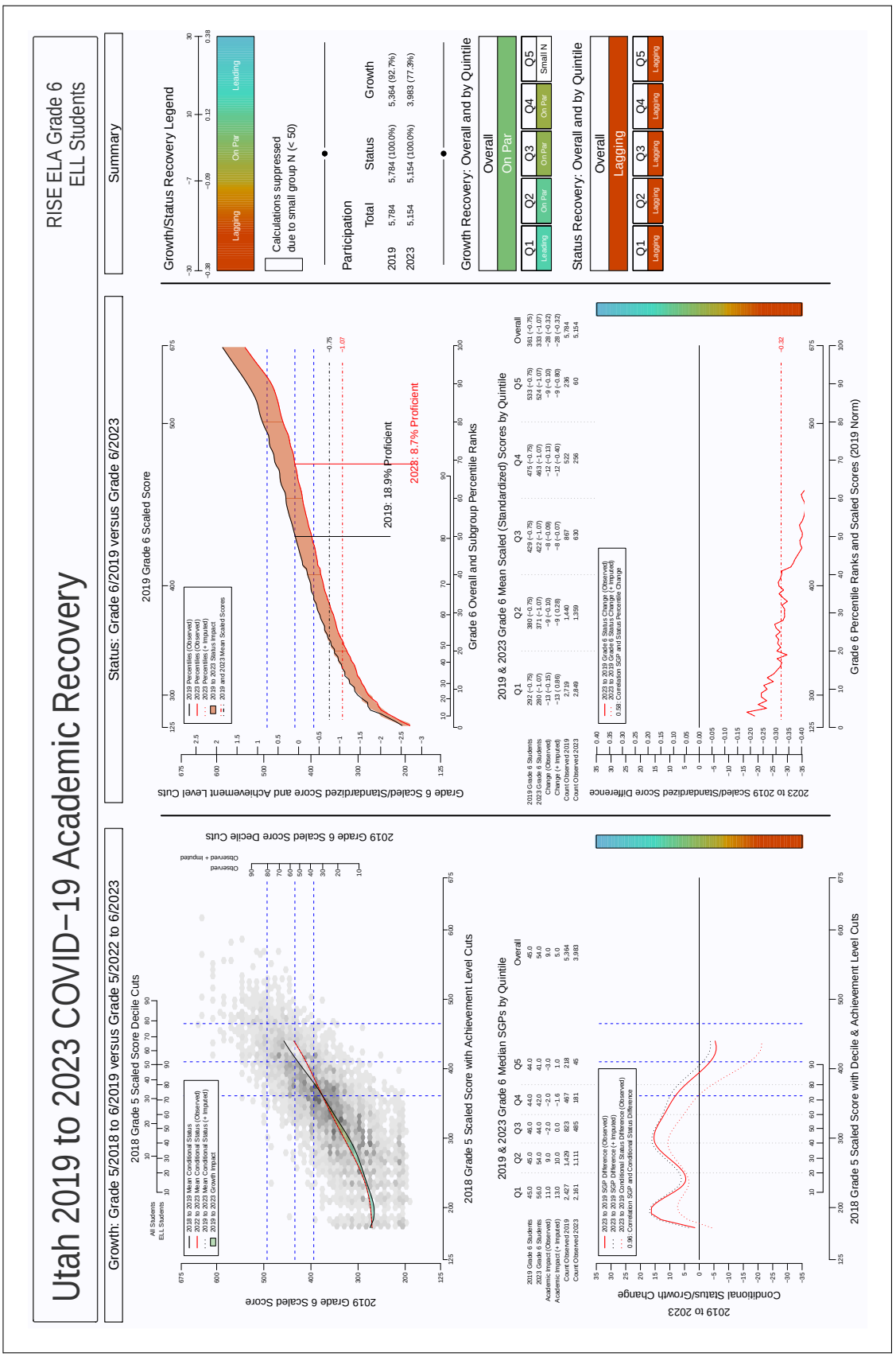

Figure 109: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 6 ELA, English language learner students

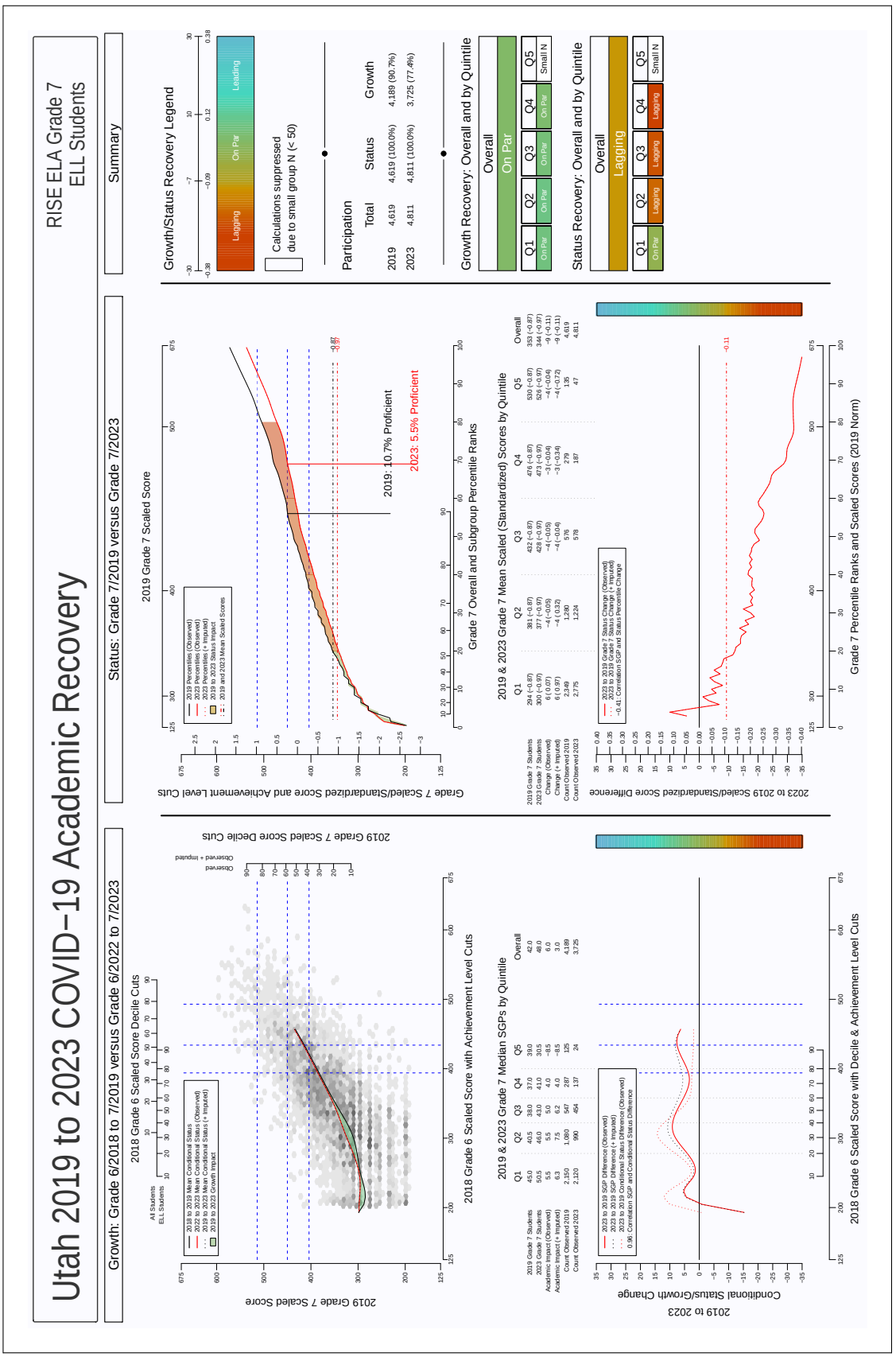

Figure 110: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 7 ELA, English language learner students

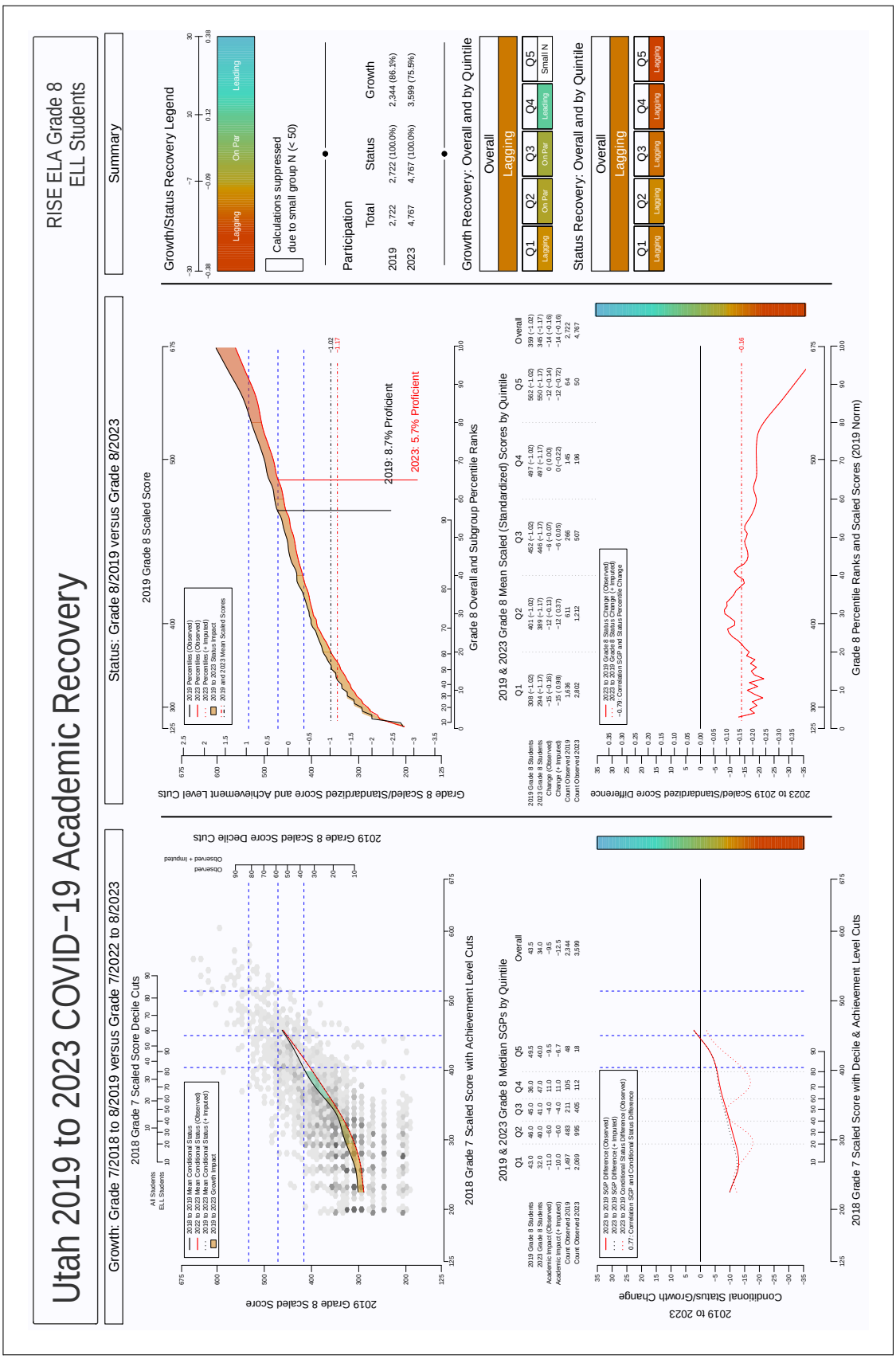

Figure 111: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 8 ELA, English language learner students

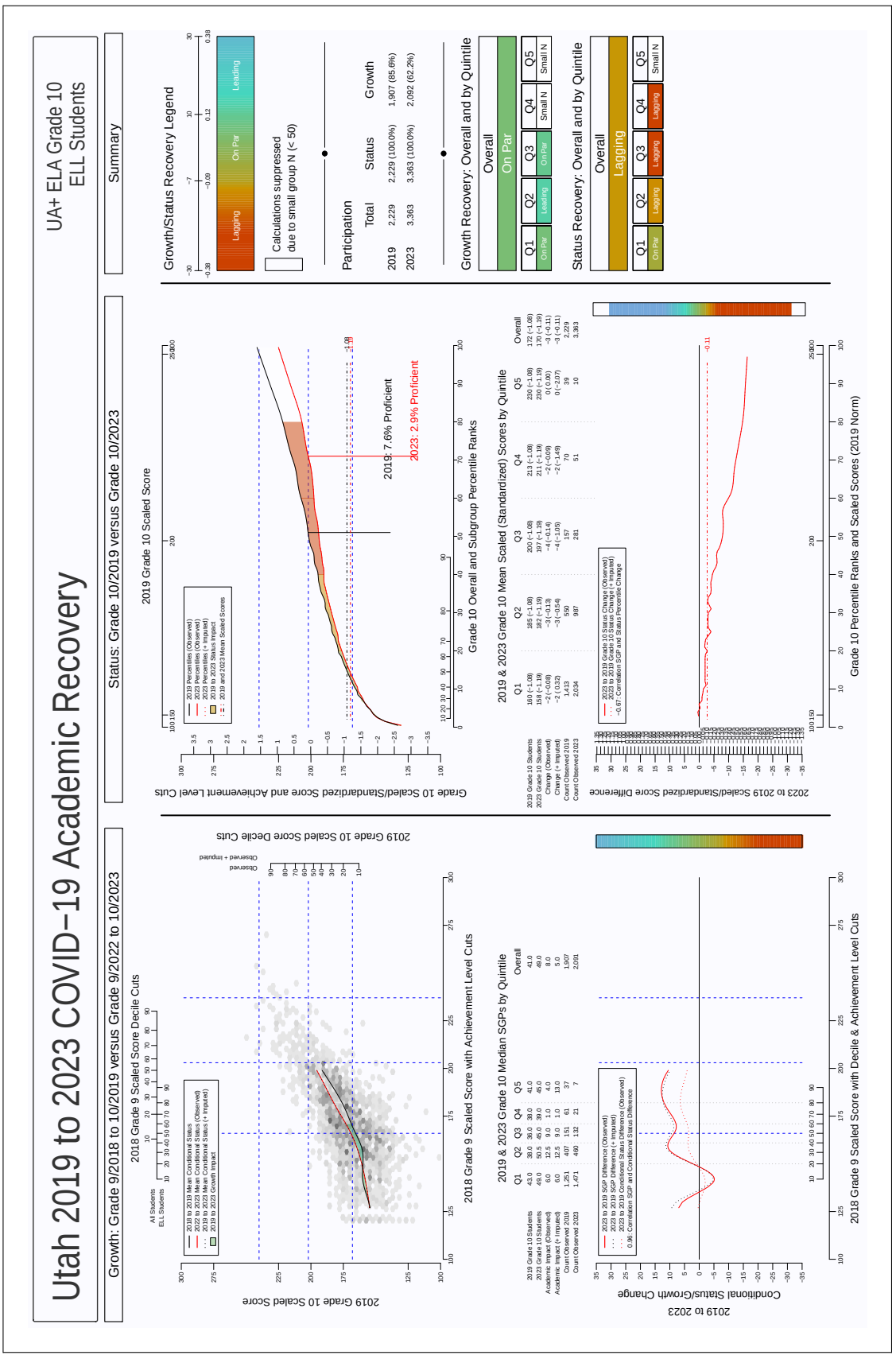

Figure 112: Utah UA+ academic recovery: Growth and status 2019 to 2023 grade 10 ELA, English language learner students

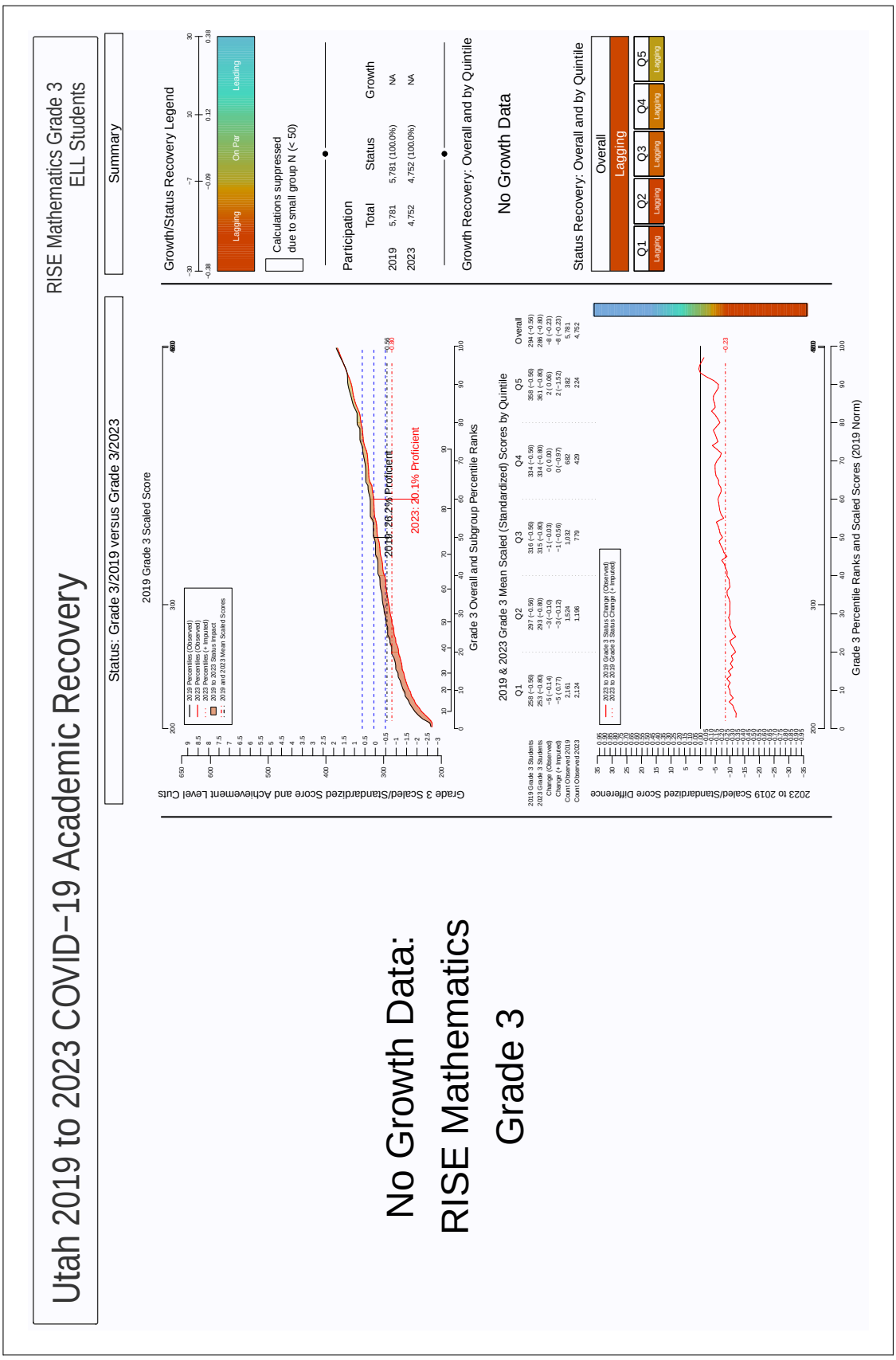

Figure 113: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 3 mathematics, English language learner students

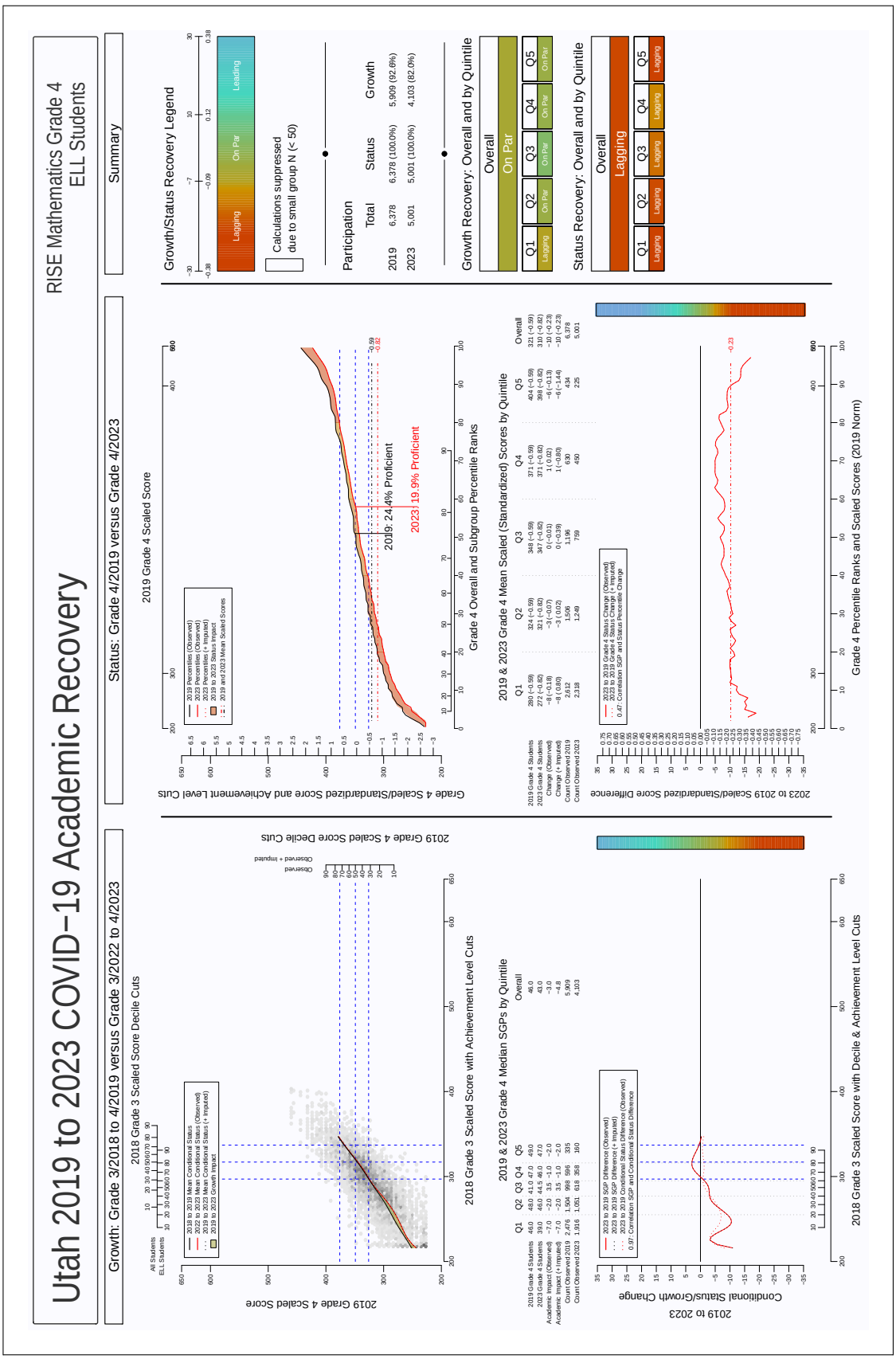

Figure 114: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 4 mathematics, English language learner students

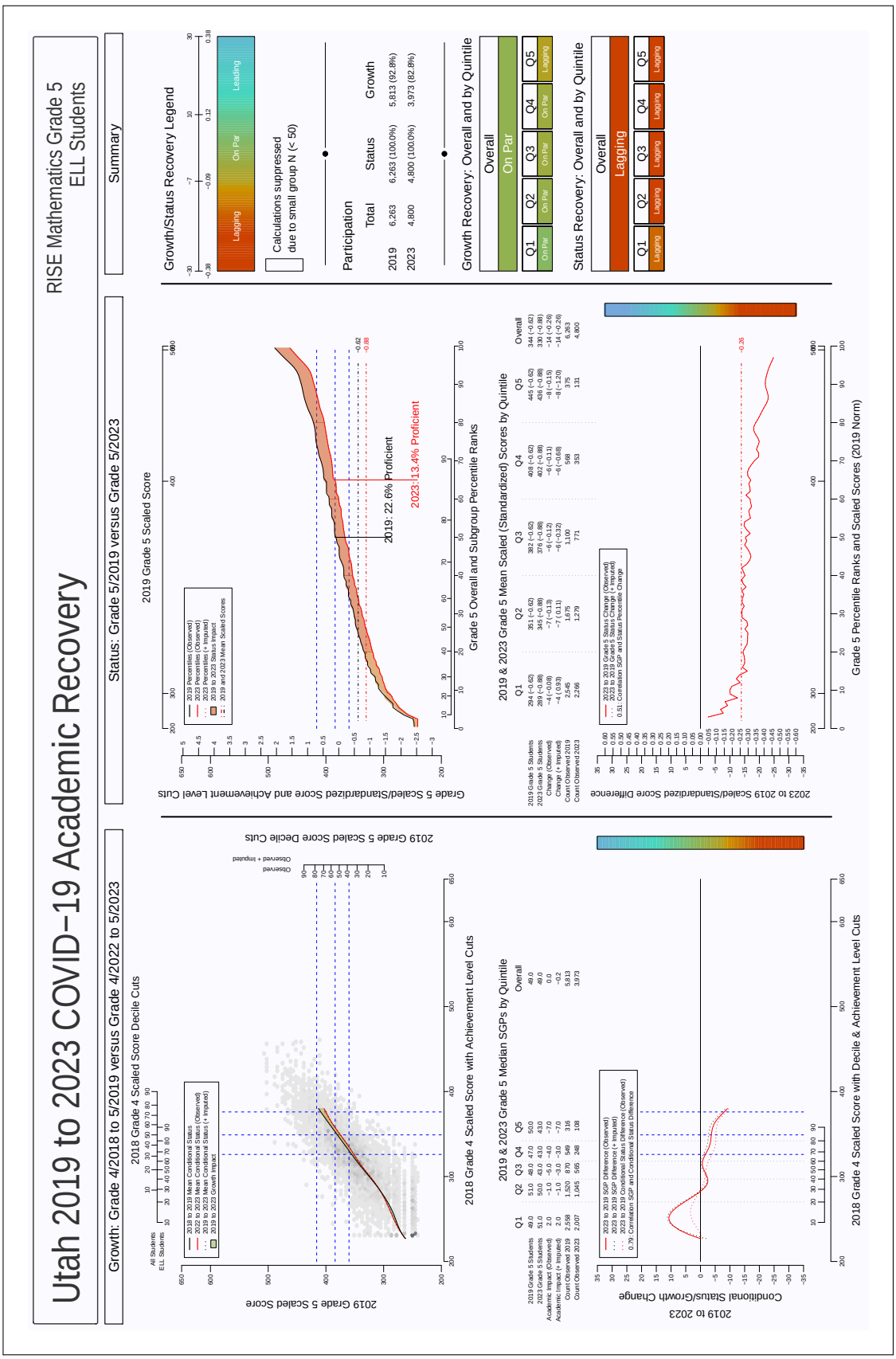

Figure 115: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 5 mathematics, English language learner students

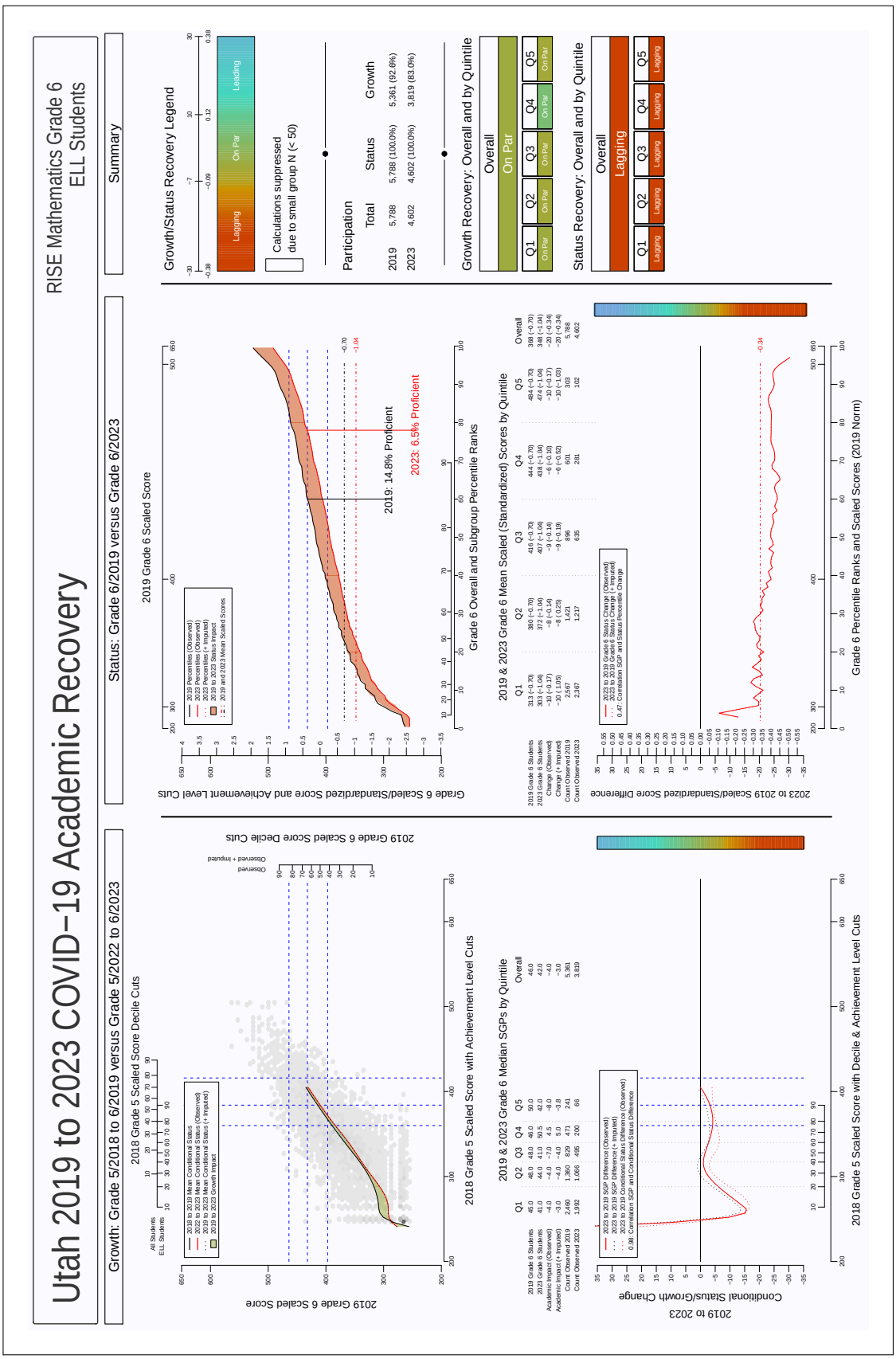

Figure 116: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 6 mathematics, English language learner students

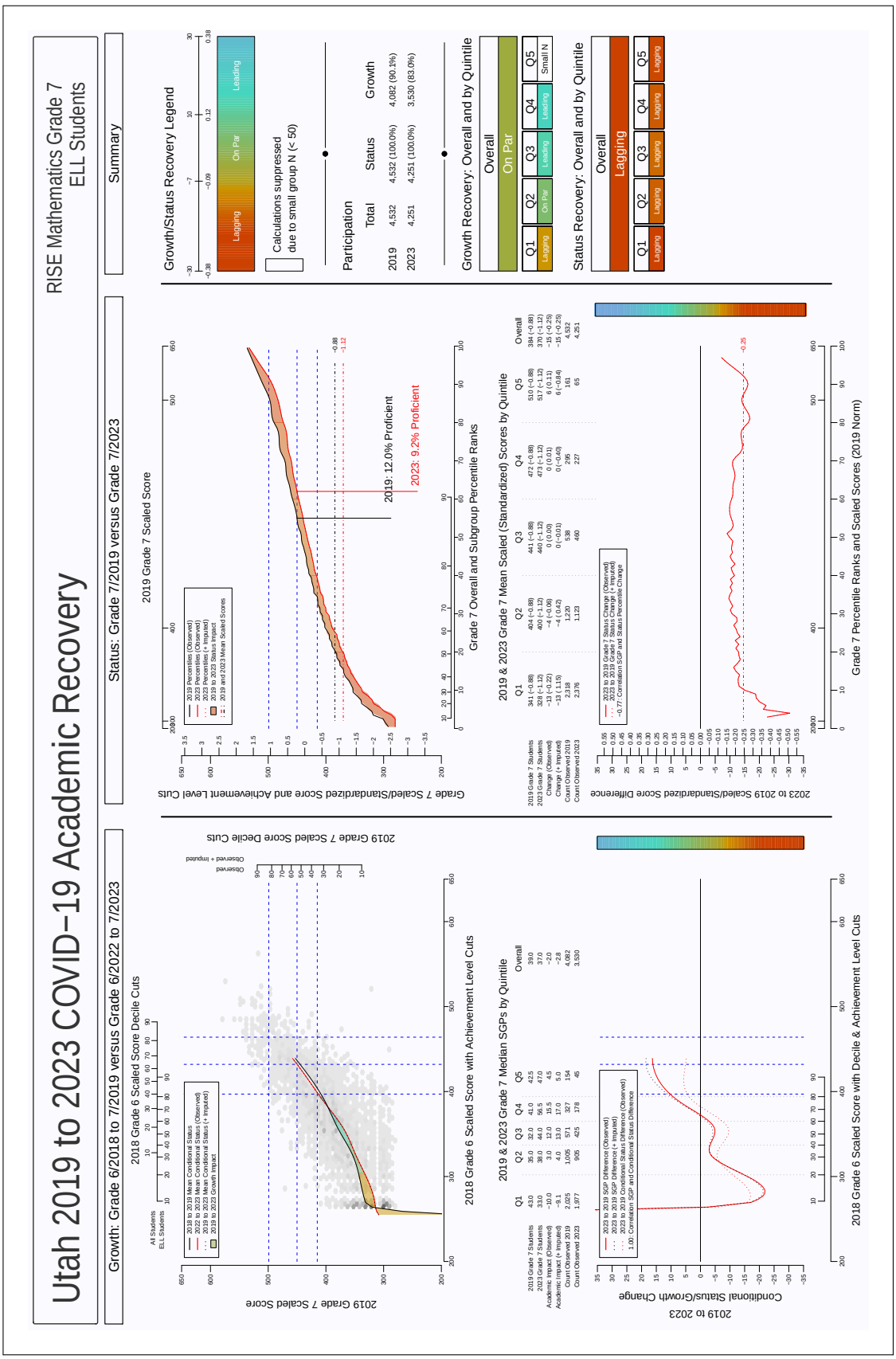

Figure 117: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 7 mathematics, English language learner students

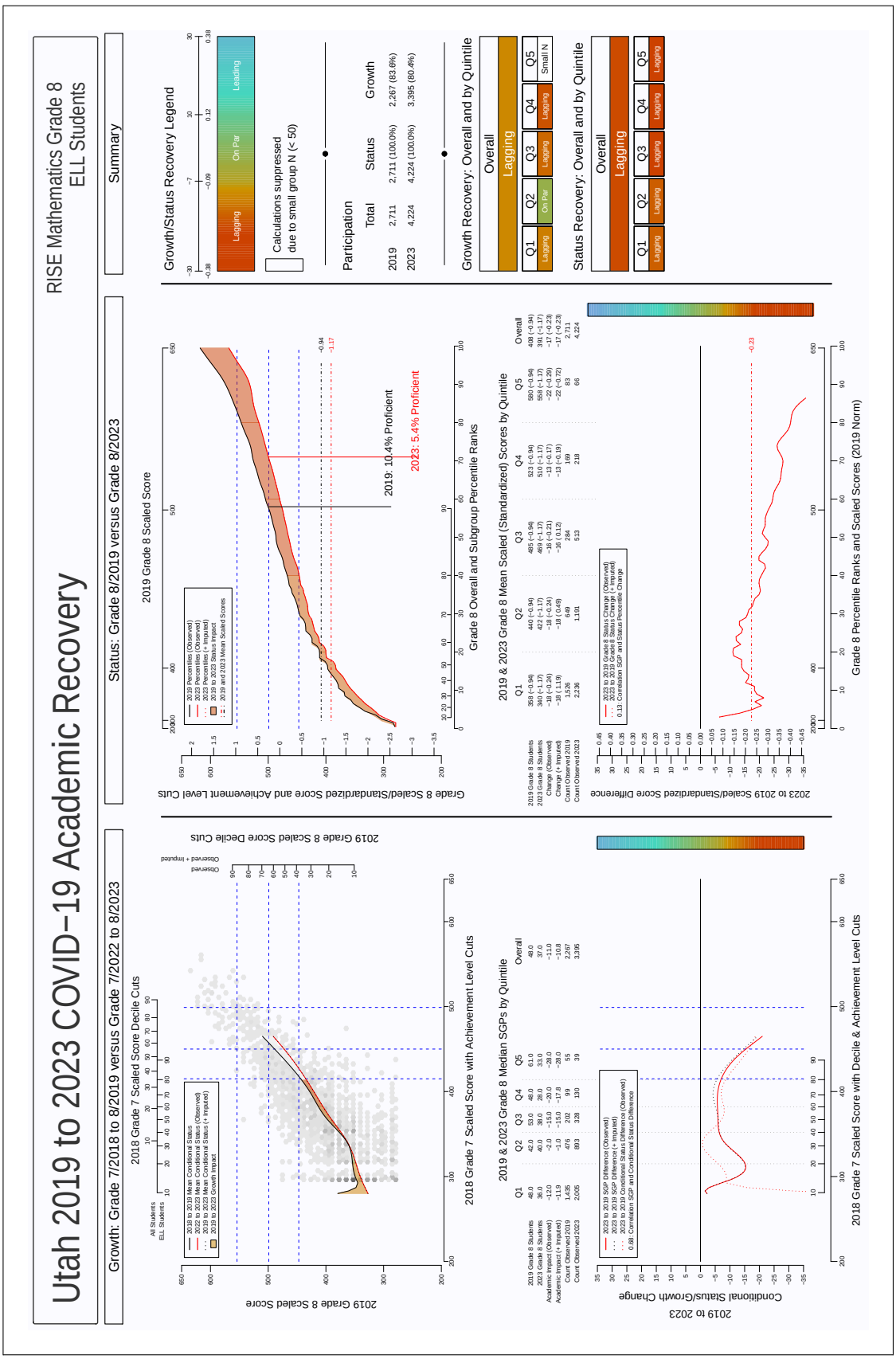

Figure 118: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 8 mathematics, English language learner students

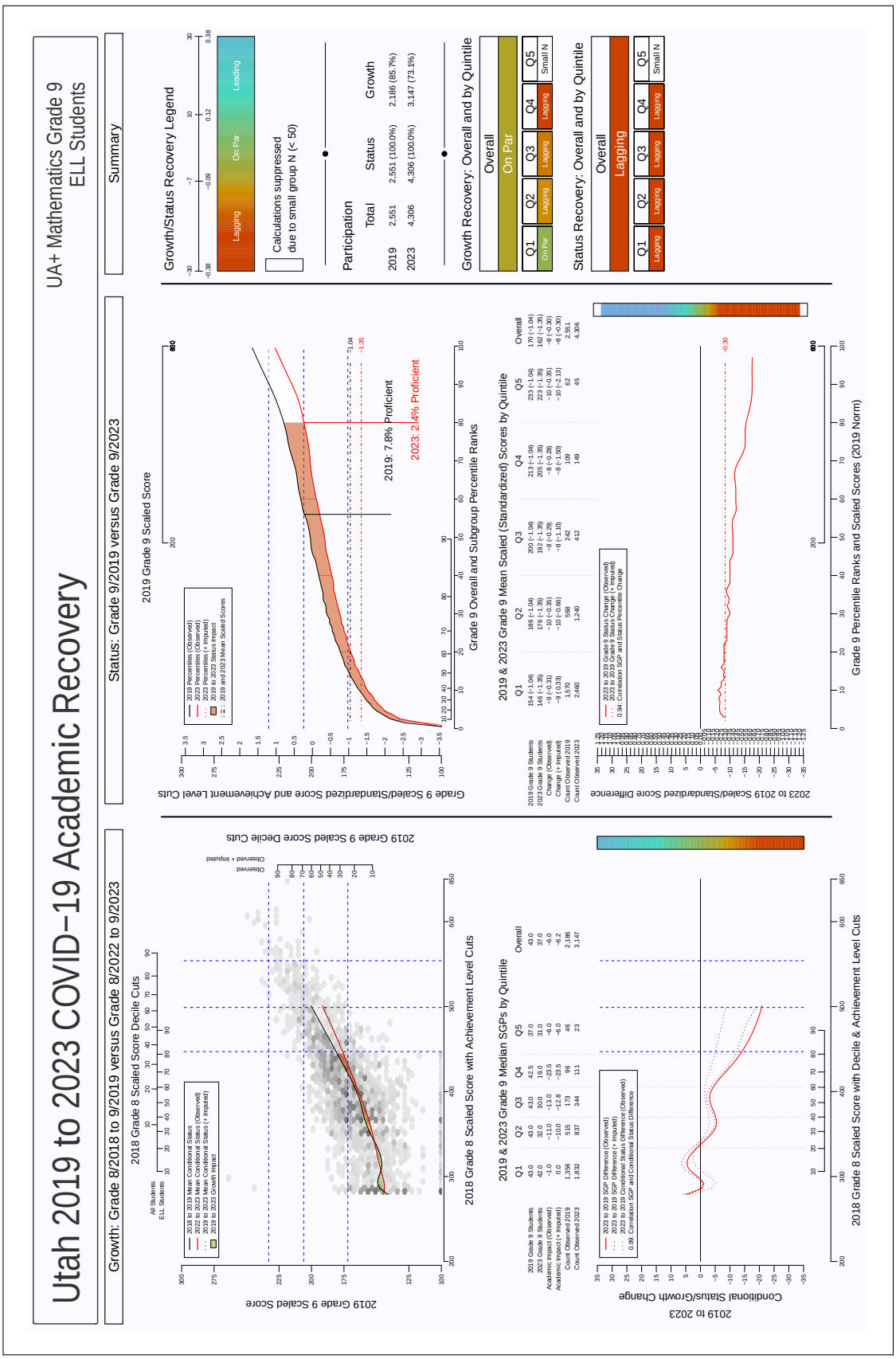

Figure 119: Utah UA+ academic recovery: Growth and status 2019 to 2023 grade 9 mathematics, English language learner students

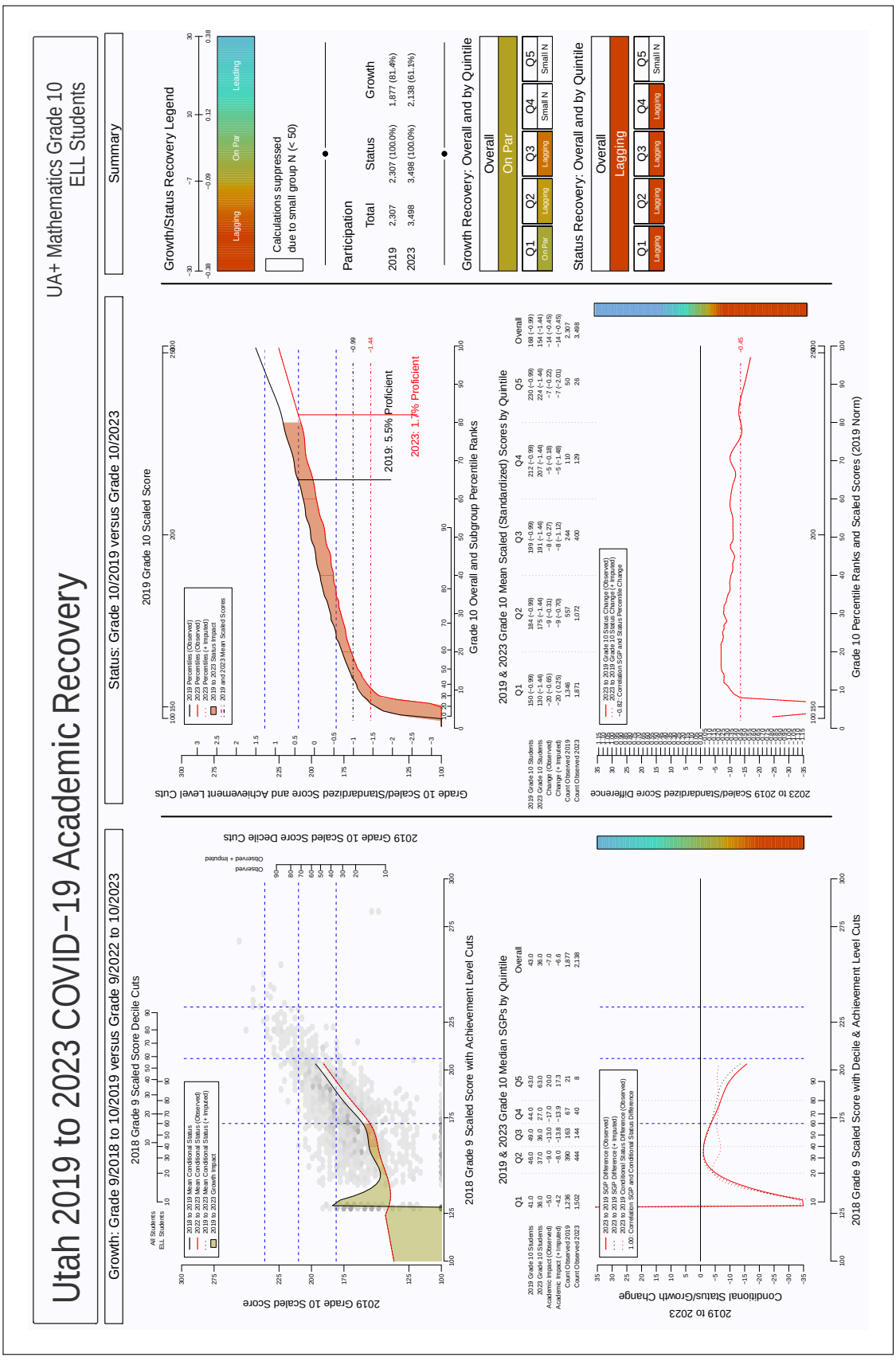

Figure 120: Utah UA+ academic recovery: Growth and status 2019 to 2023 grade 10 mathematics, English language learner students

Grade by Content Area by Socio-Economic Status

The figures on the following pages illustrate pandemic related academic impact for free/reduced lunch students grouped by grade (3, 4, 5, 6, 7, 8, 9 or 10) and content area (ELA or mathematics)

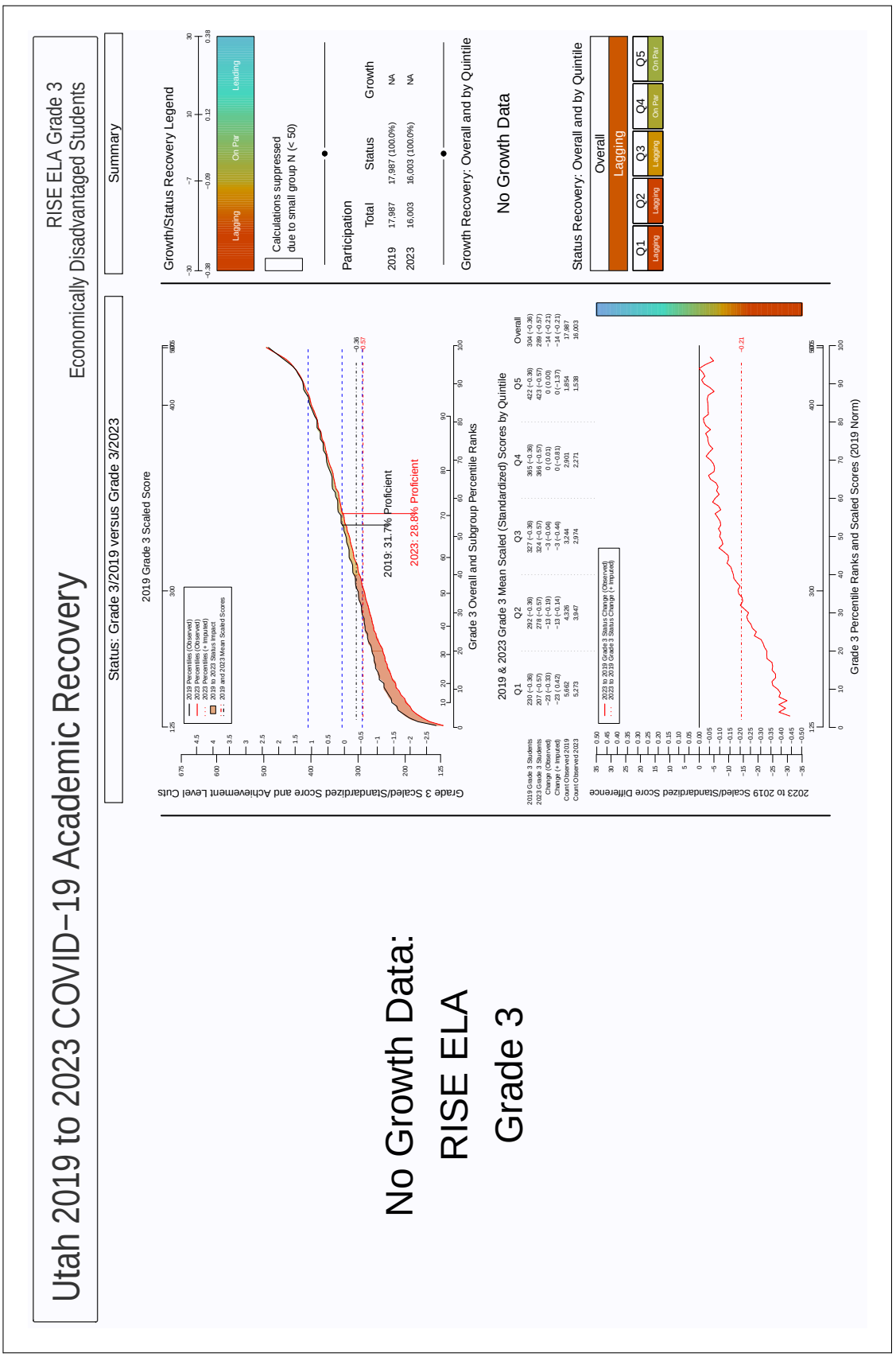

Figure 121: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 3 ELA, free/reduced lunch students

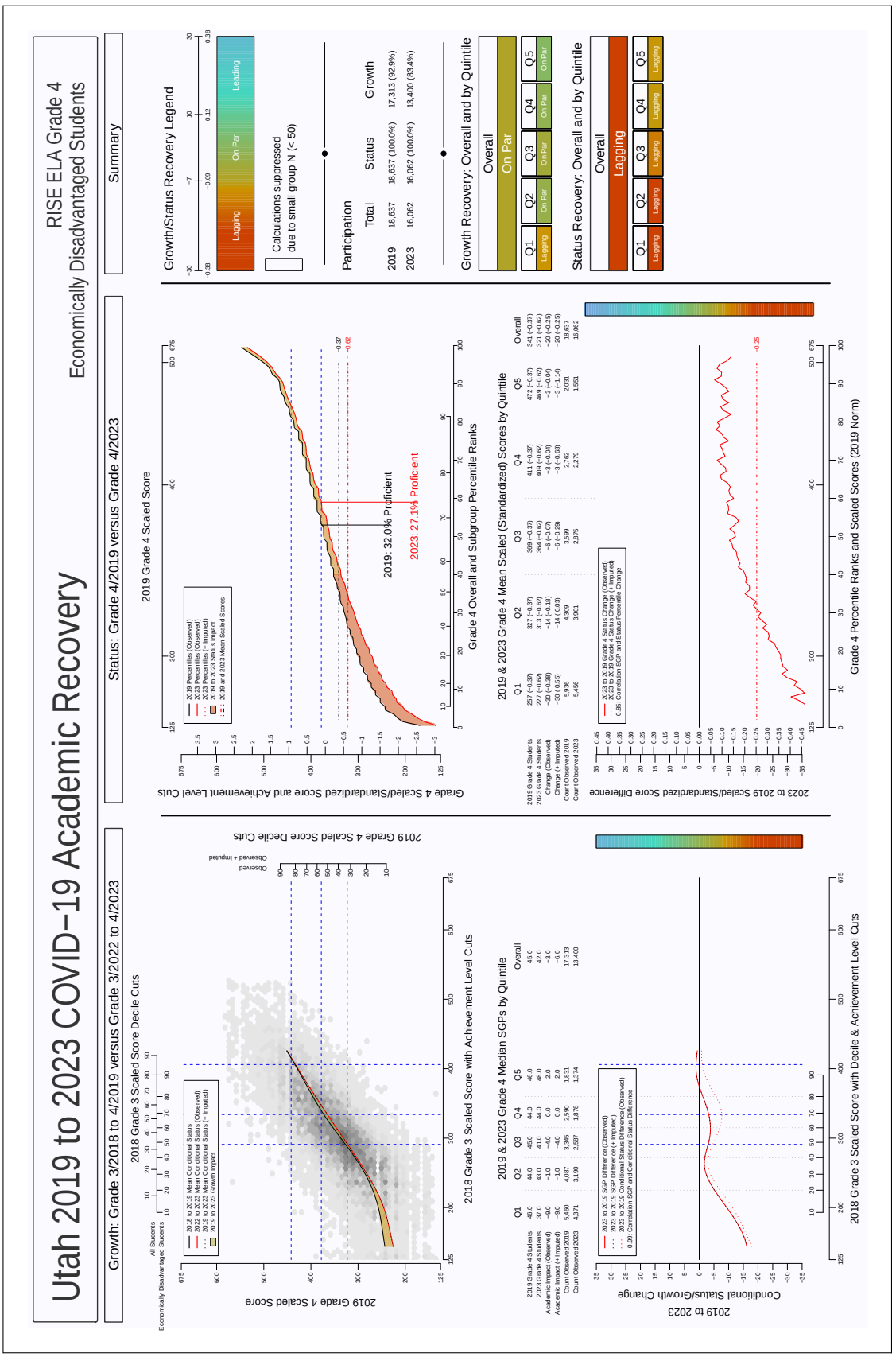

Figure 122: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 4 ELA, free/reduced lunch students

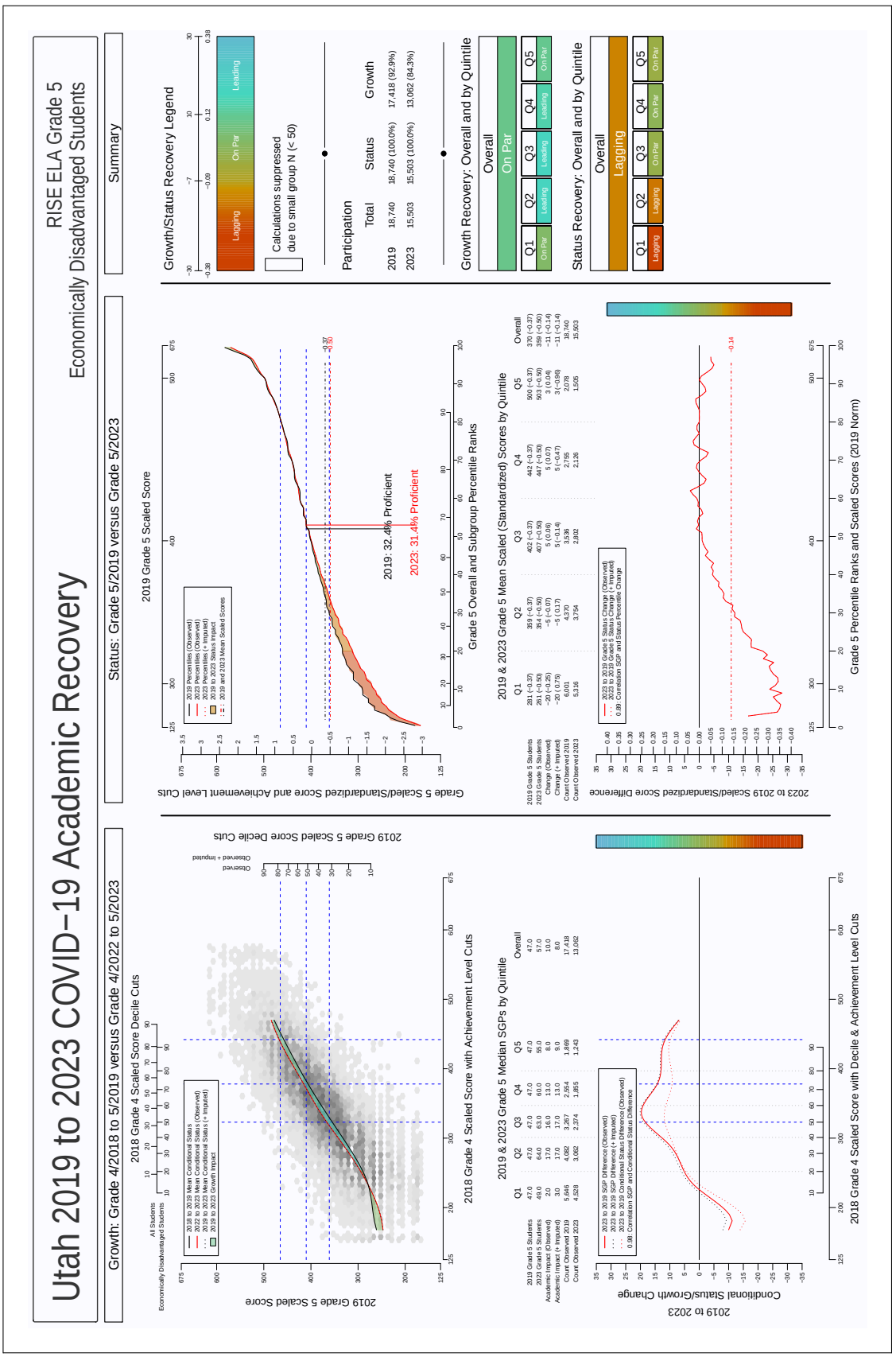

Figure 123: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 5 ELA, free/reduced lunch students

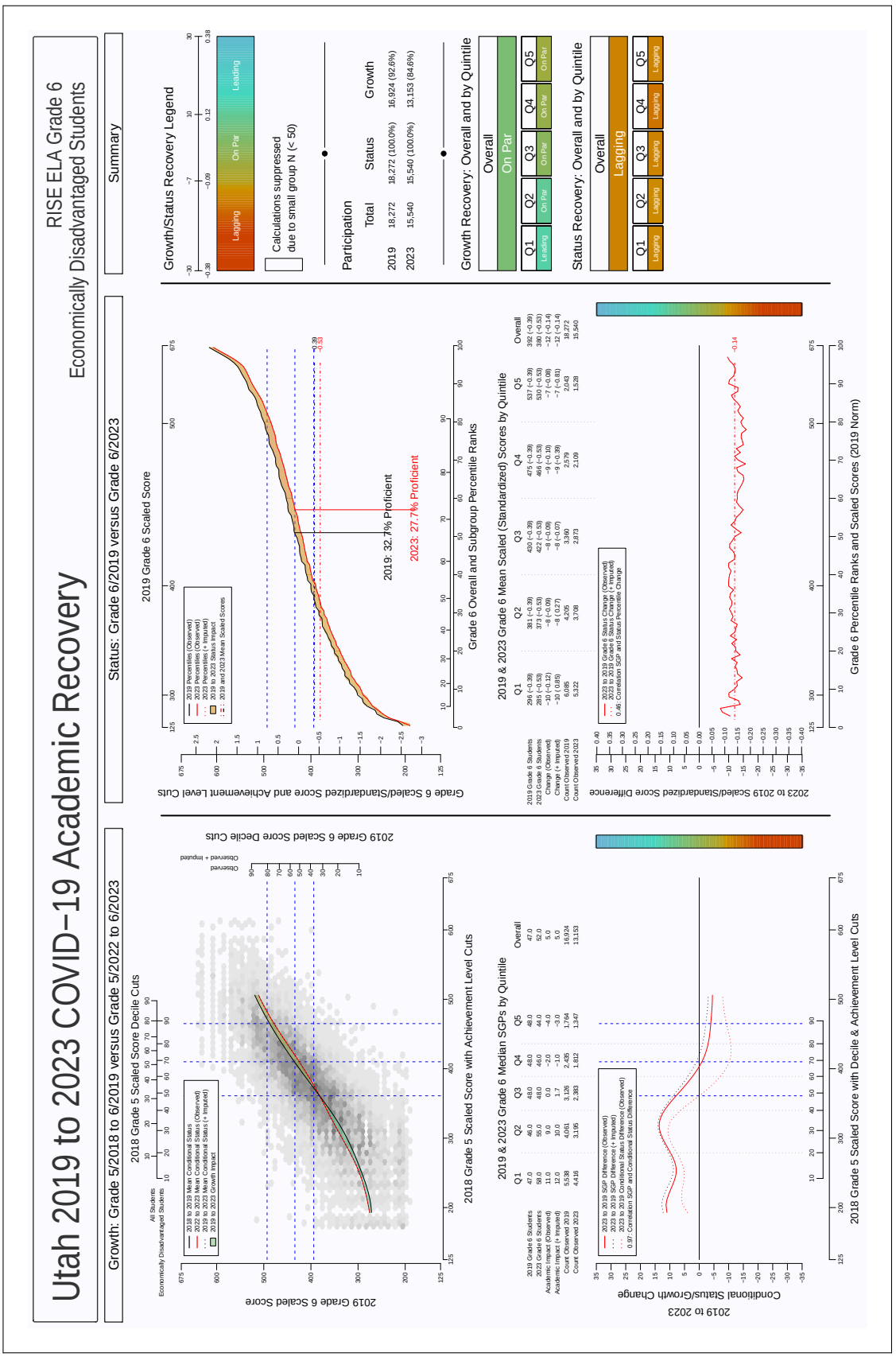

Figure 124: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 6 ELA, free/reduced lunch students

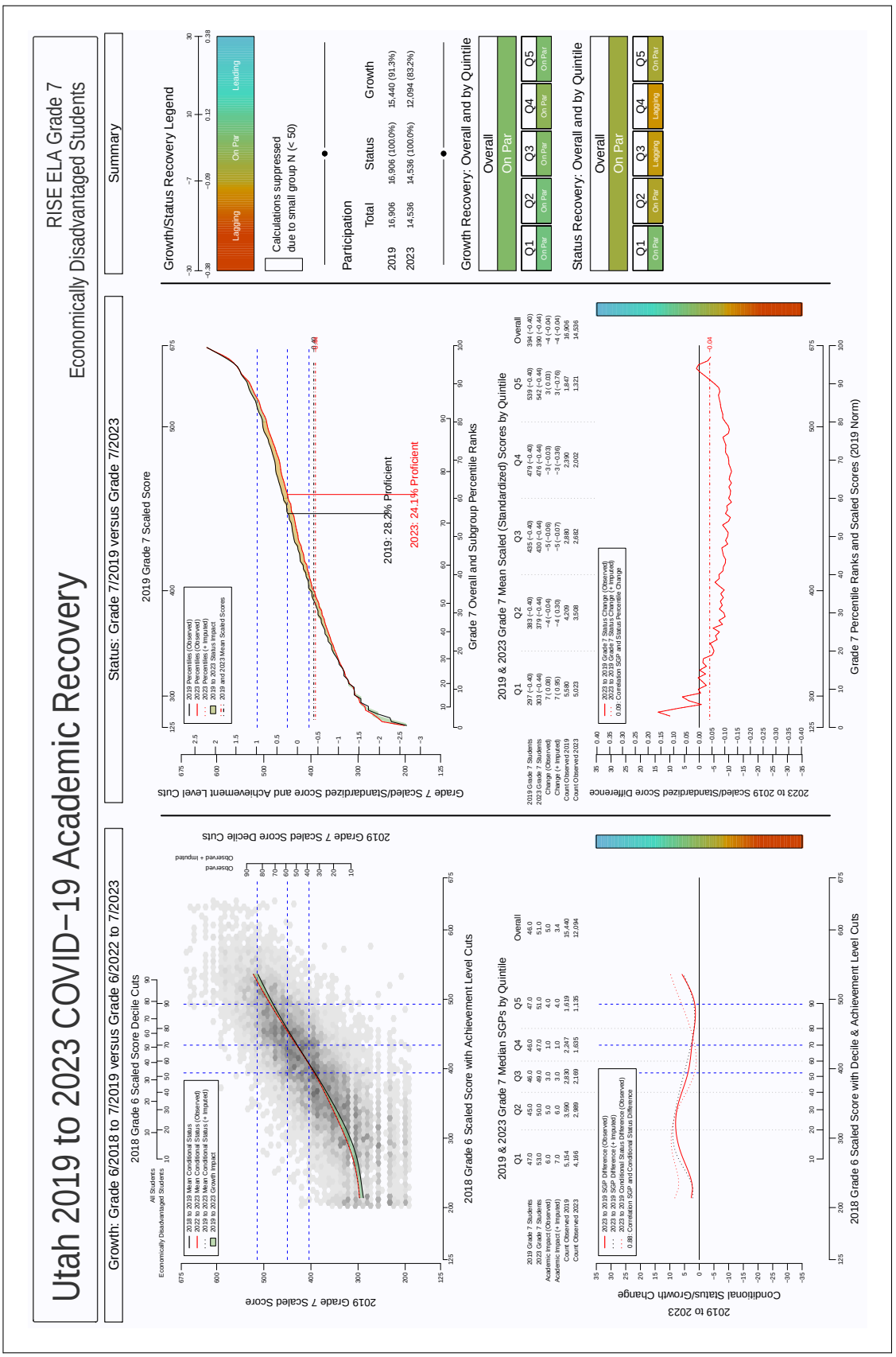

Figure 125: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 7 ELA, free/reduced lunch students

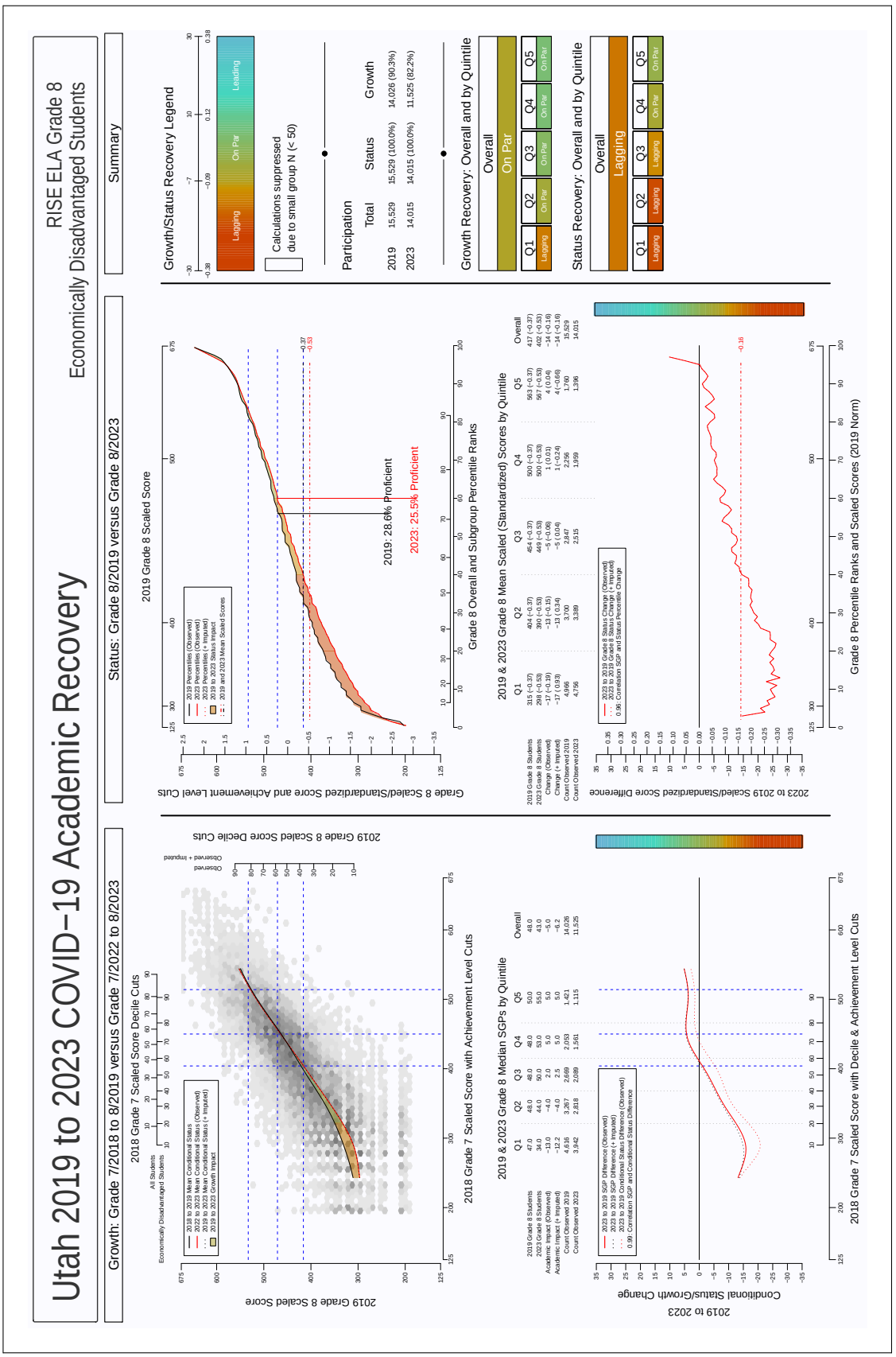

Figure 126: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 8 ELA, free/reduced lunch students

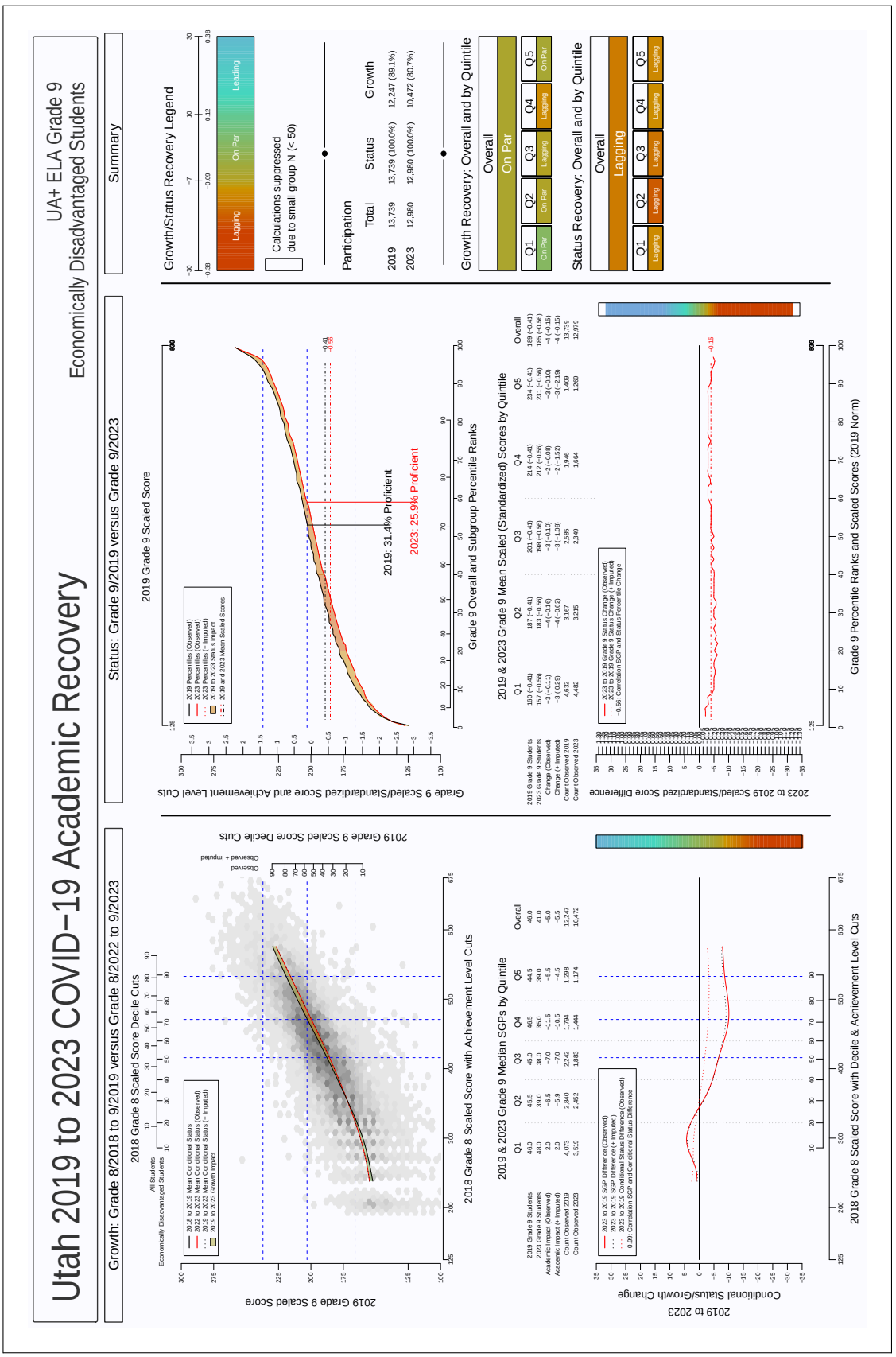

Figure 127: Utah UA+ academic recovery: Growth and status 2019 to 2023 grade 9 ELA, free/reduced lunch students

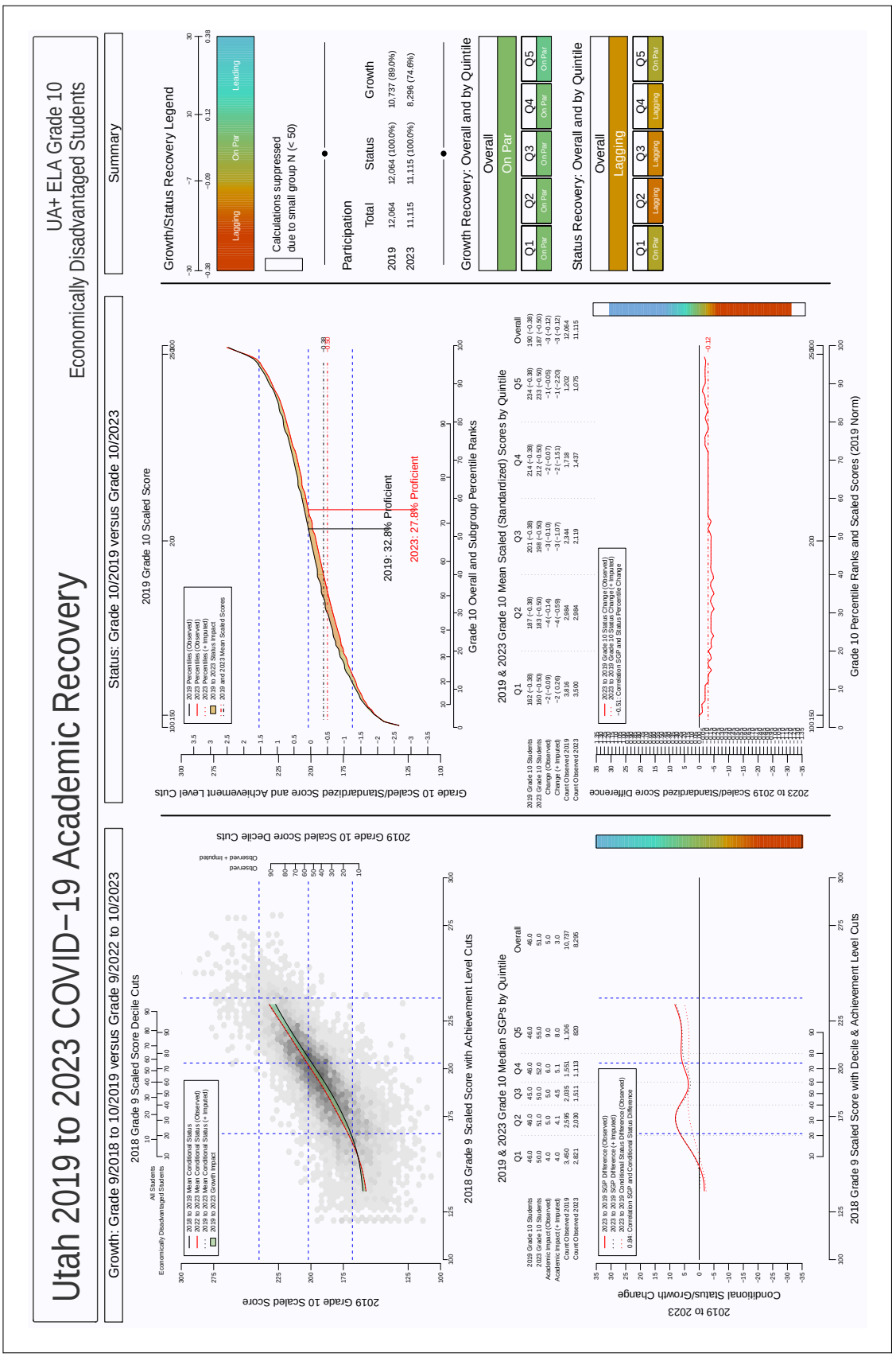

Figure 128: Utah UA+ academic recovery: Growth and status 2019 to 2023 grade 10 ELA, free/reduced lunch students

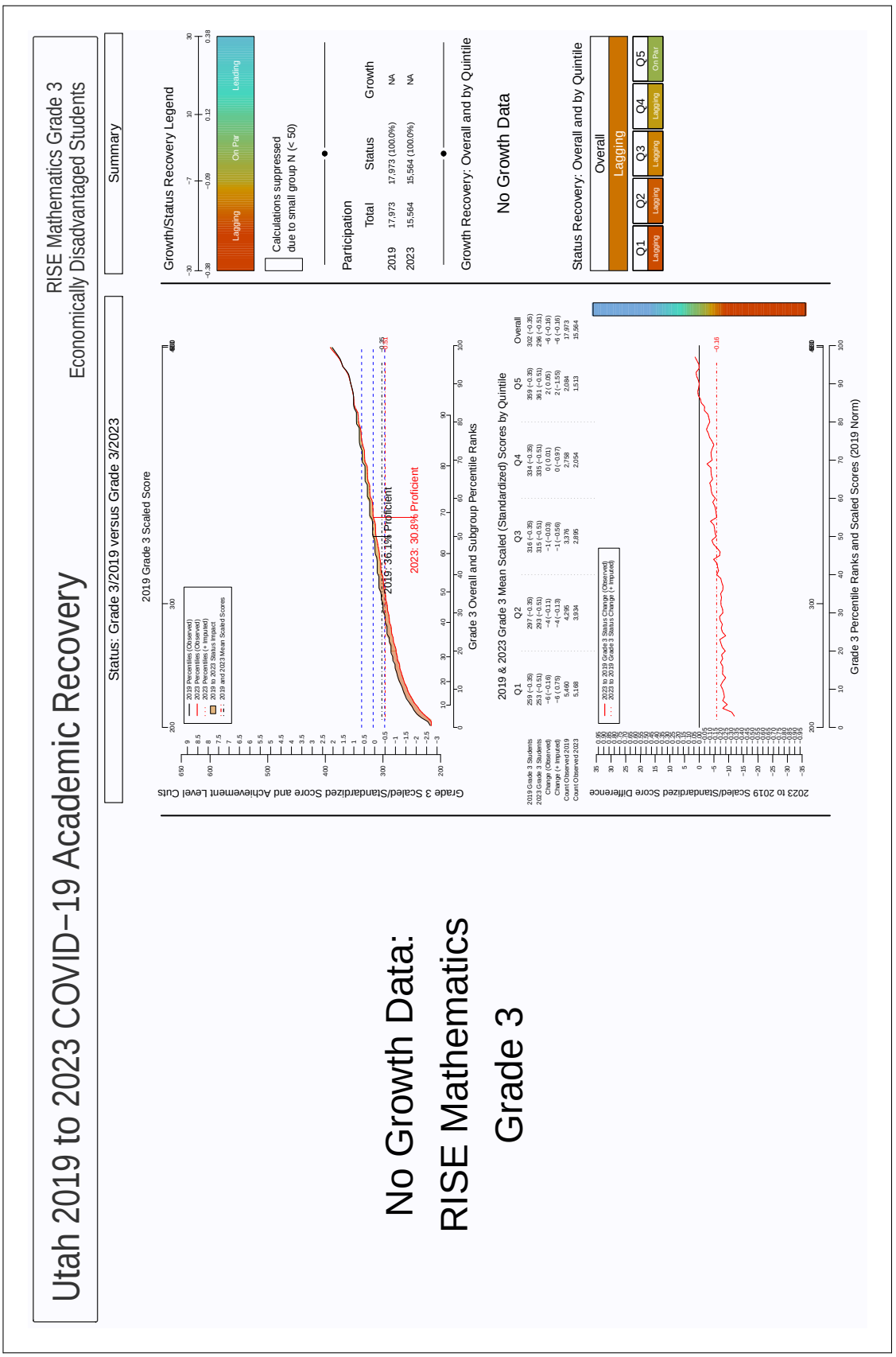

Figure 129: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 3 mathematics, free/reduced lunch students

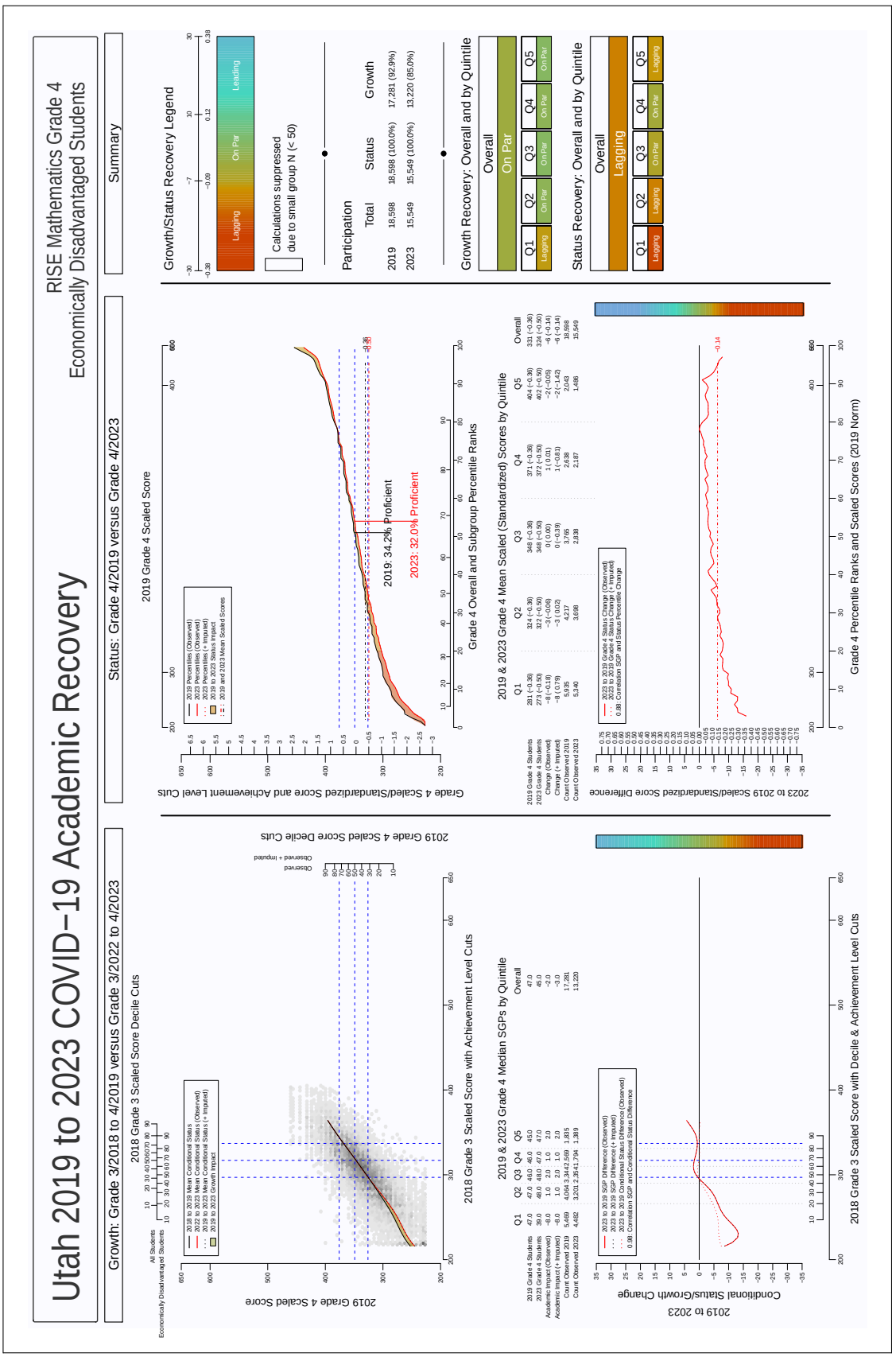

Figure 130: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 4 mathematics, free/reduced lunch students

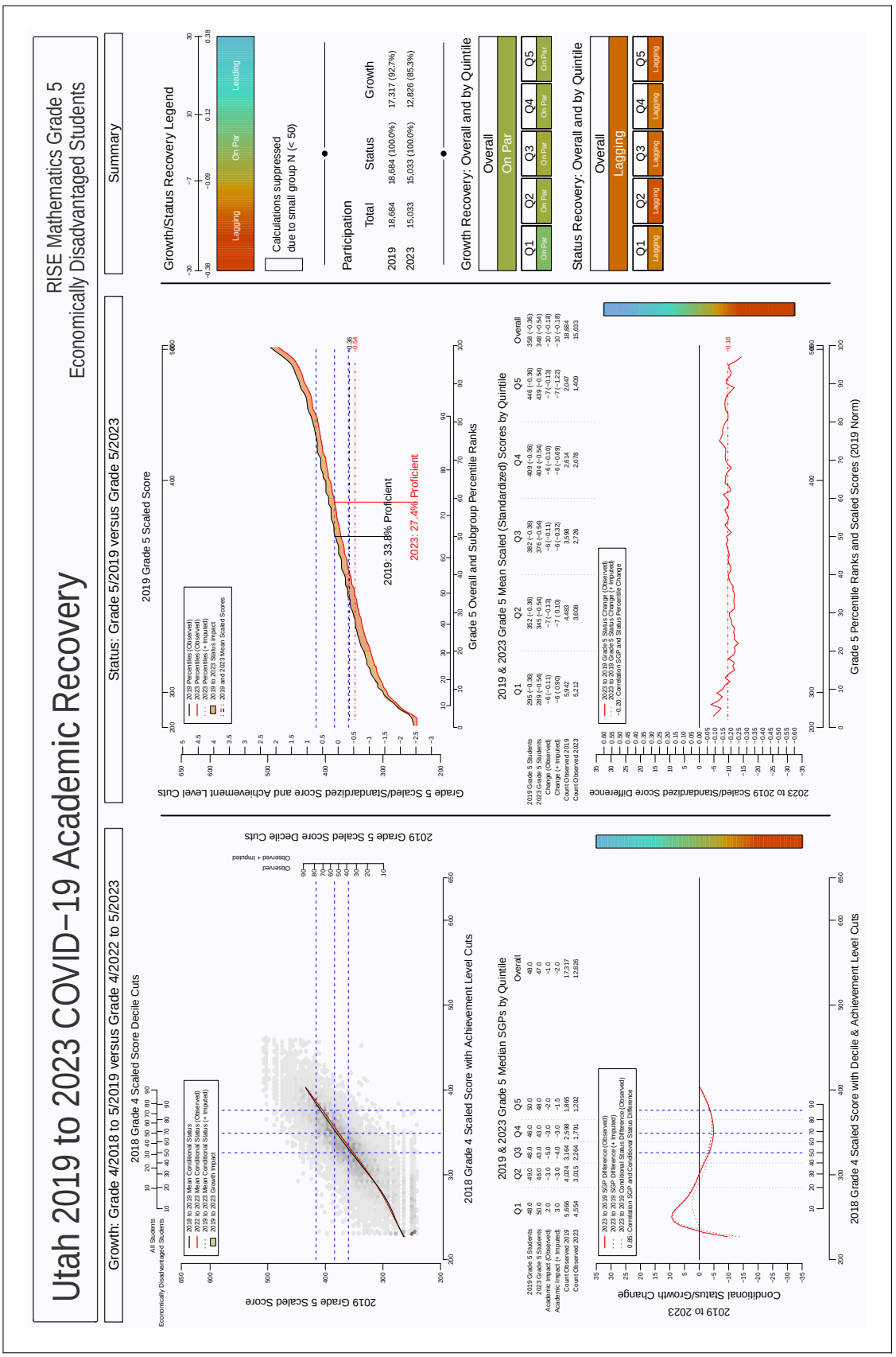

Figure 131: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 5 mathematics, free/reduced lunch students

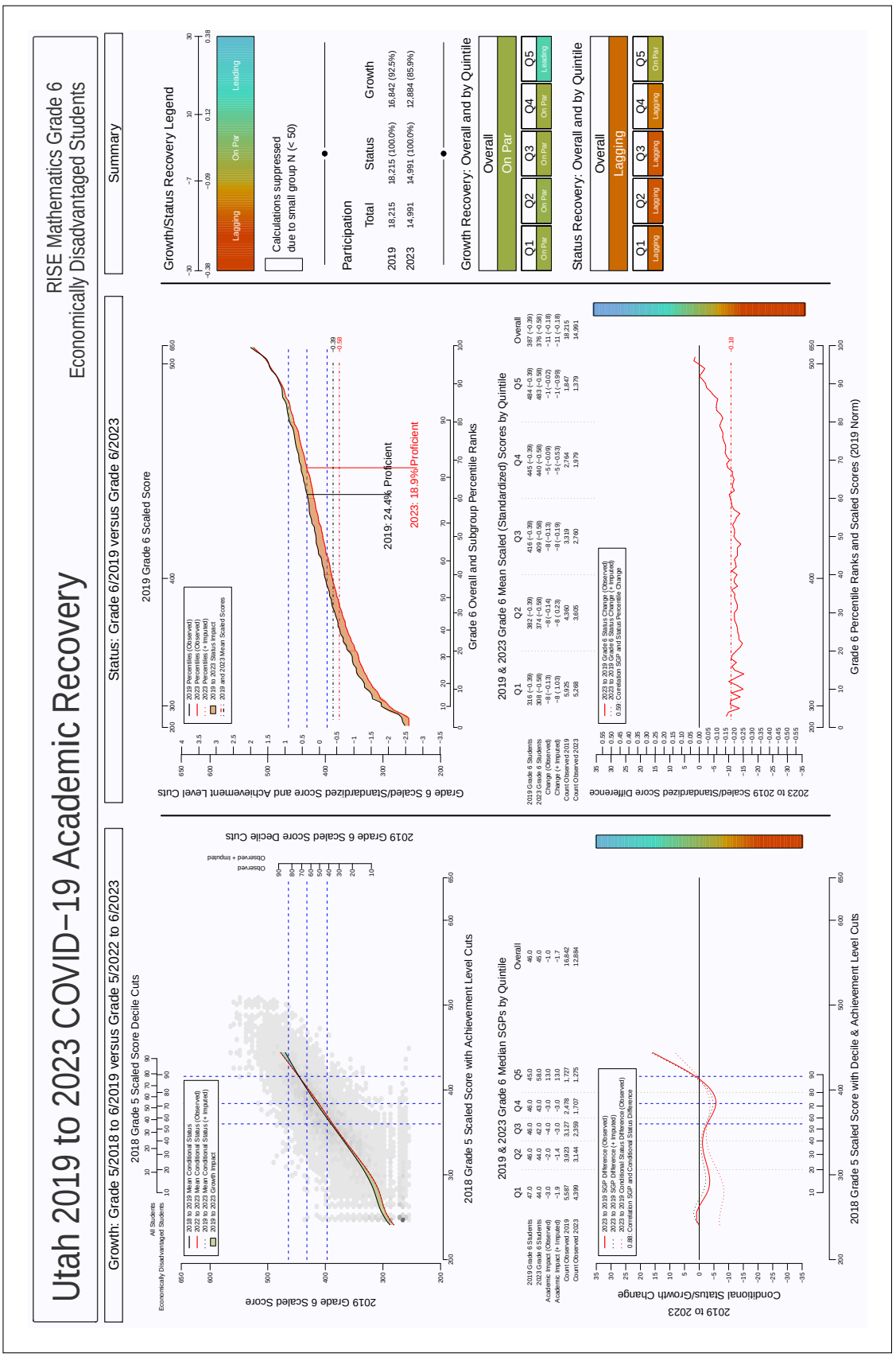

Figure 132: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 7 mathematics, free/reduced lunch students

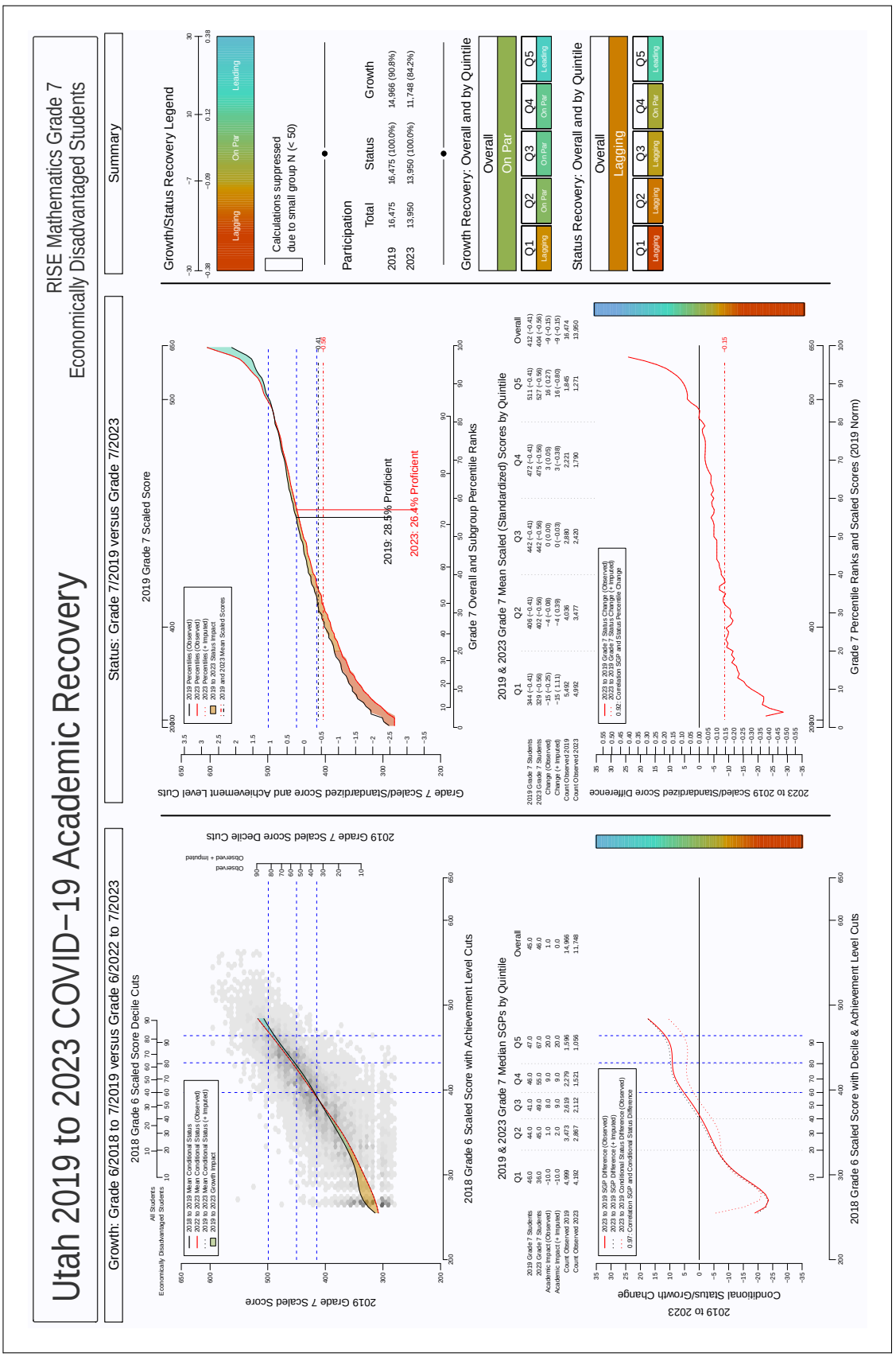

Figure 133: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 7 mathematics, free/reduced lunch students

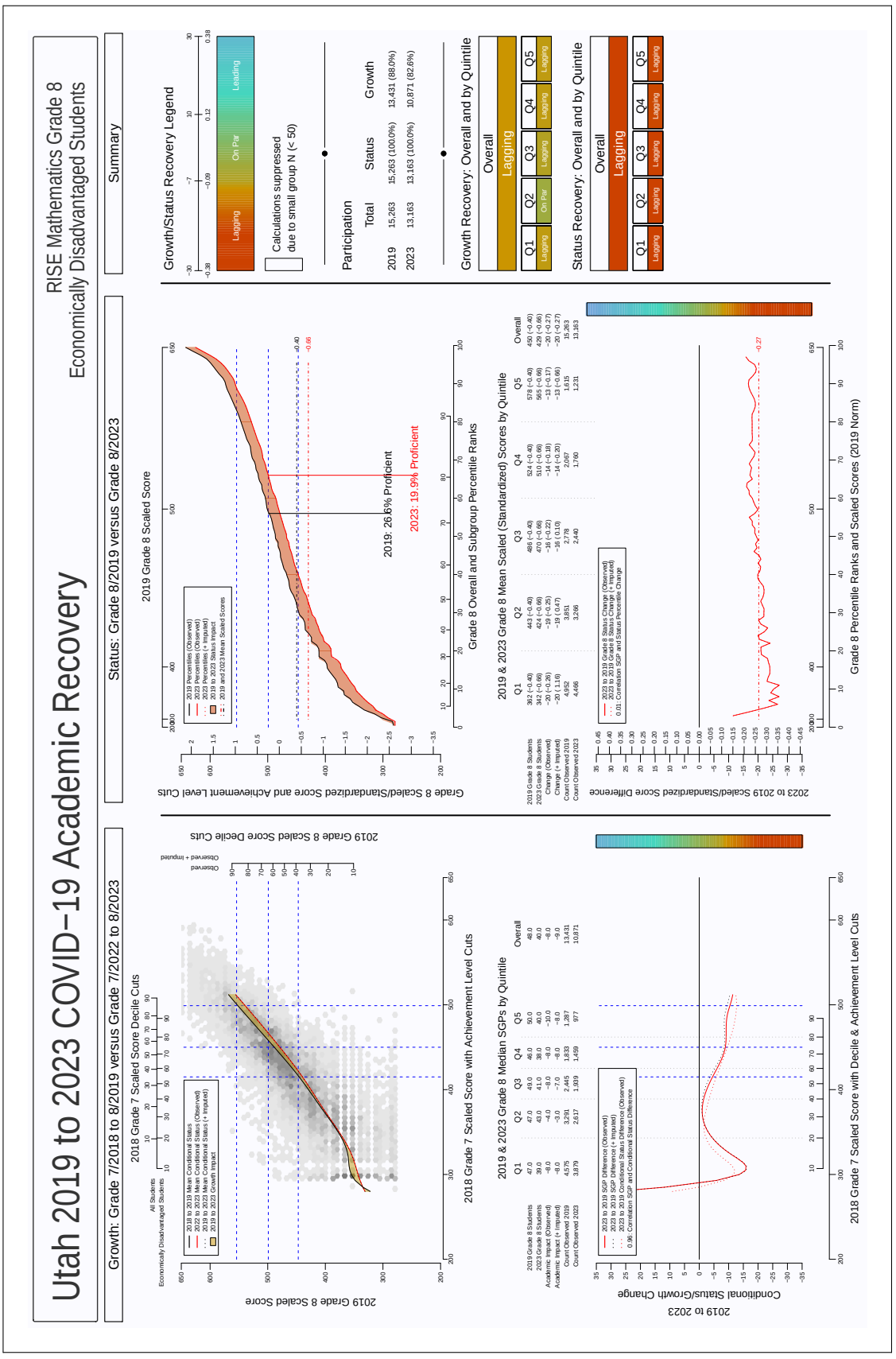

Figure 134: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 8 mathematics, free/reduced lunch students

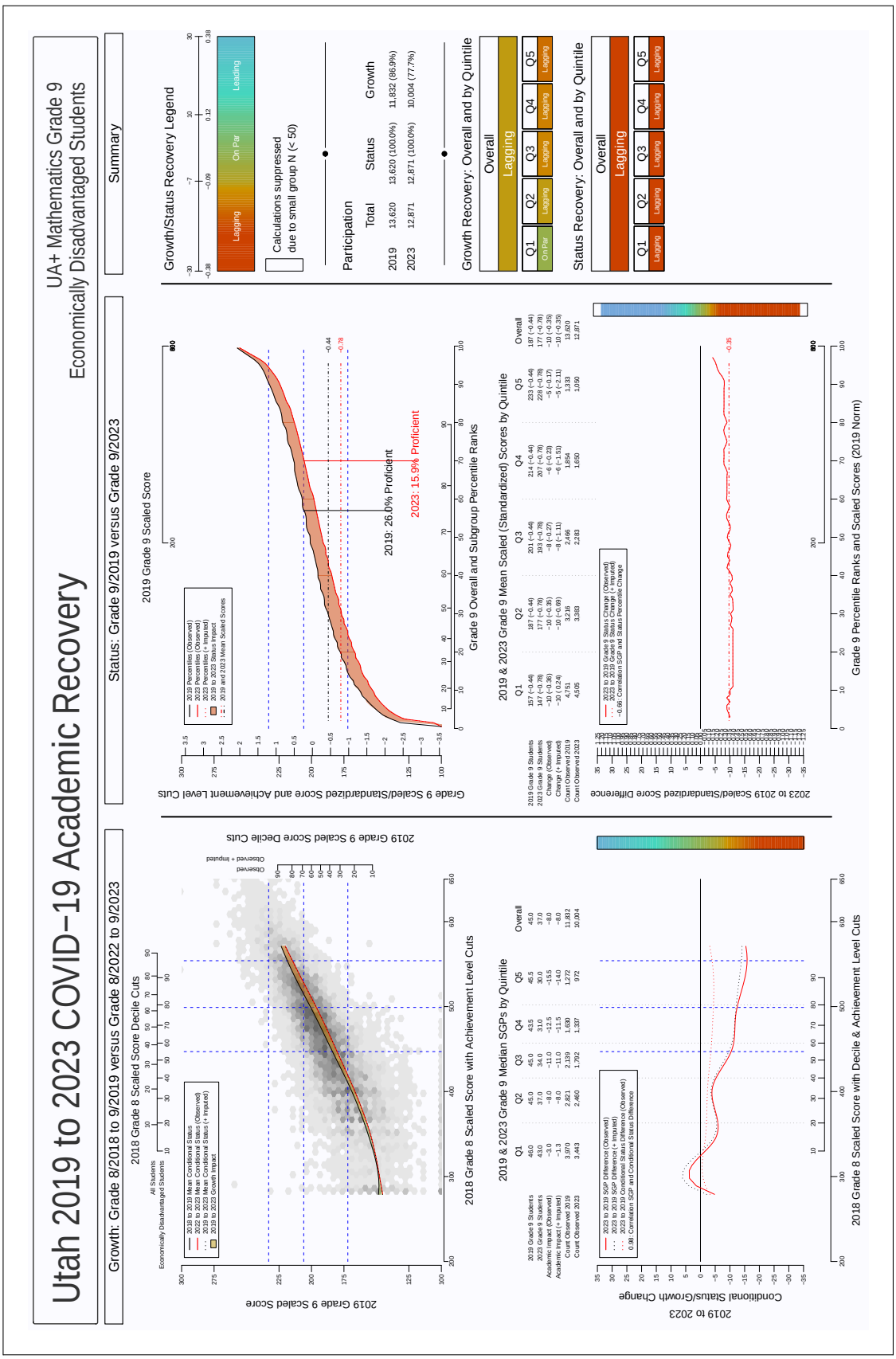

Figure 135: Utah UA+ academic recovery: Growth and status 2019 to 2023 grade 9 mathematics, free/reduced lunch students

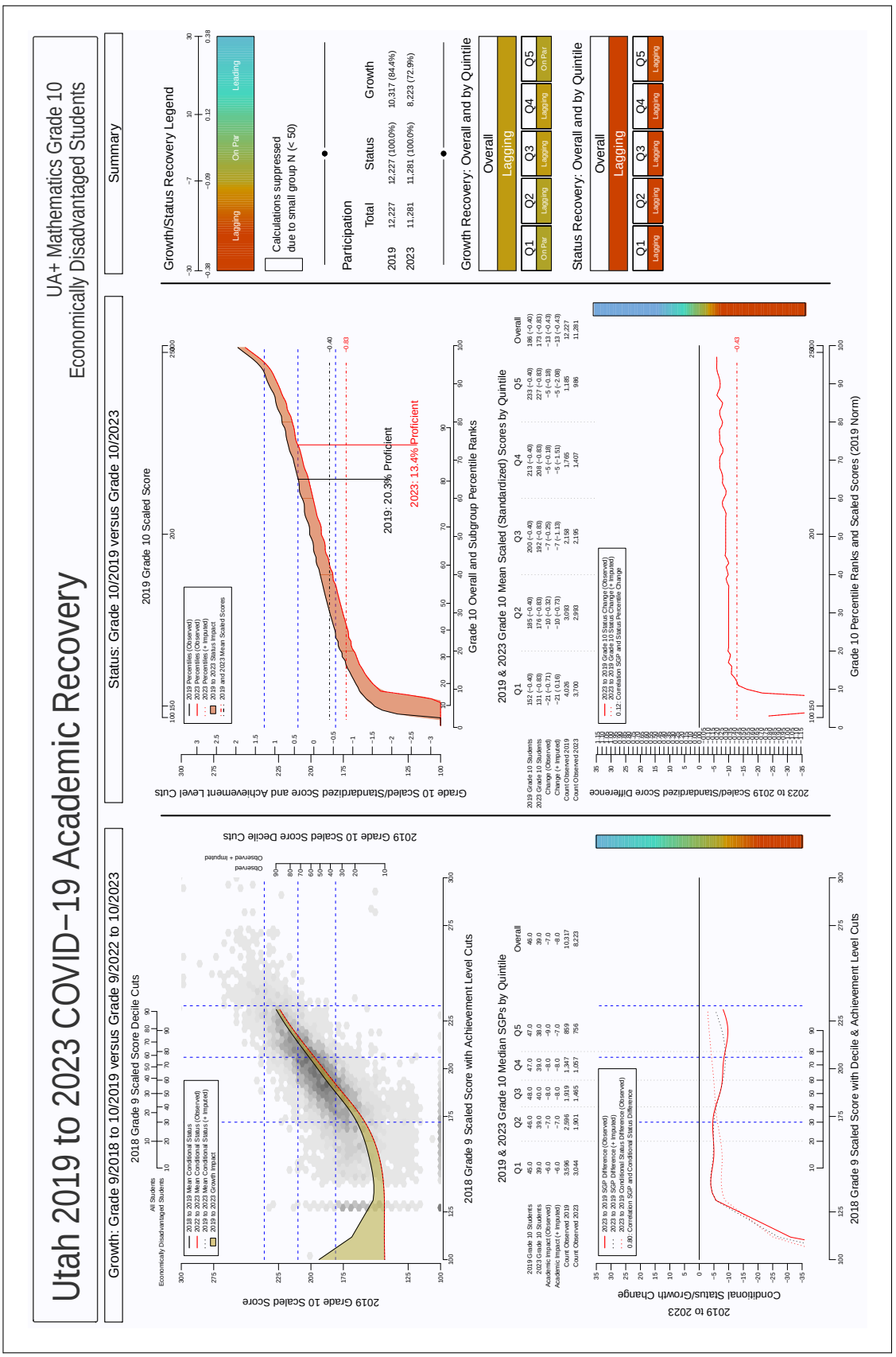

Figure 136: Utah UA+ academic recovery: Growth and status 2019 to 2023 grade 10 mathematics, free/reduced lunch students

Grade by Content Area by gender

The figures on the following pages illustrate pandemic related academic impact for male and female students grouped by grade (3, 4, 5, 6, 7, 8, 9 or 10) and content area (ELA or mathematics)

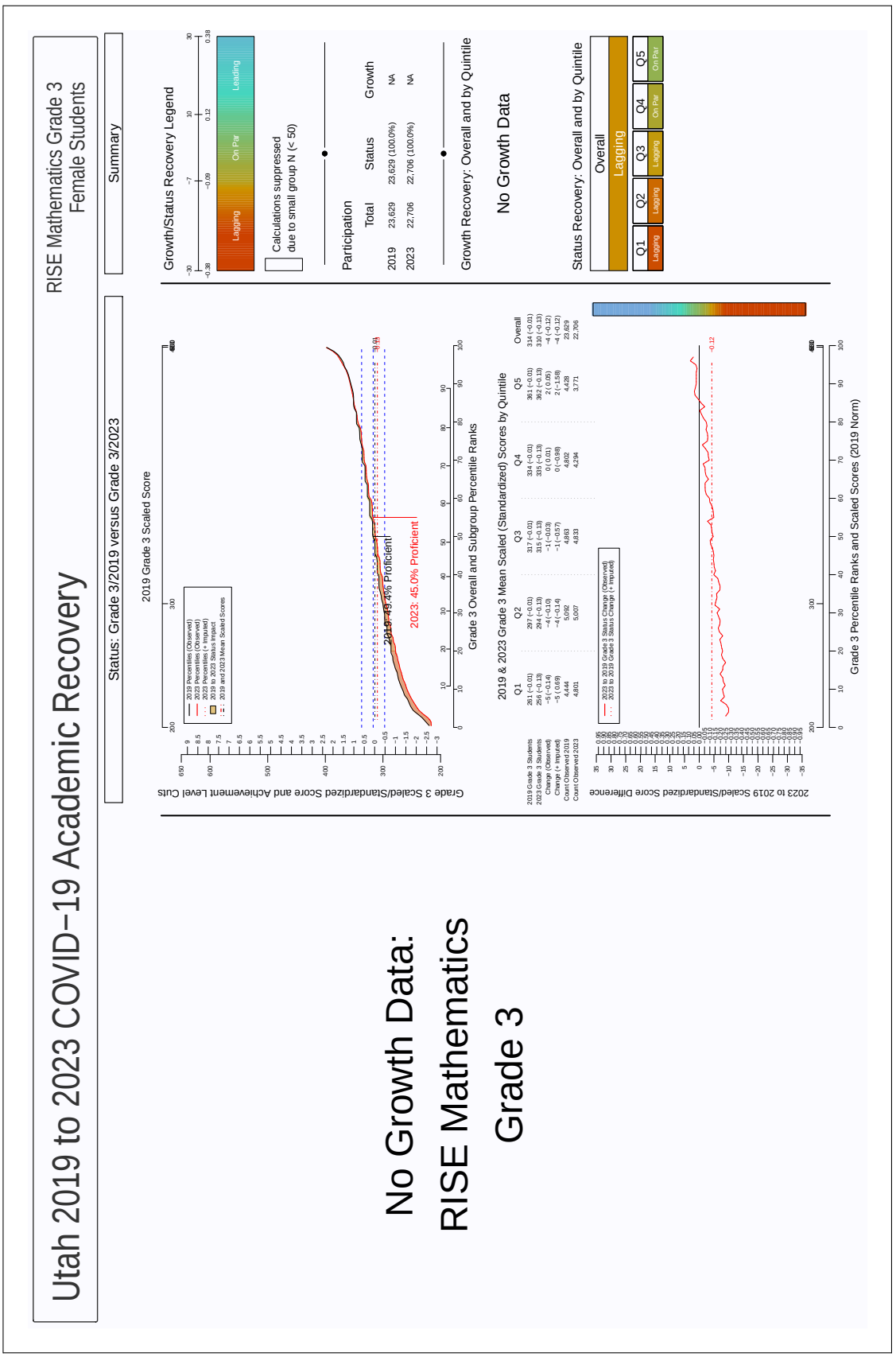

Figure 137: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 3 ELA, female students

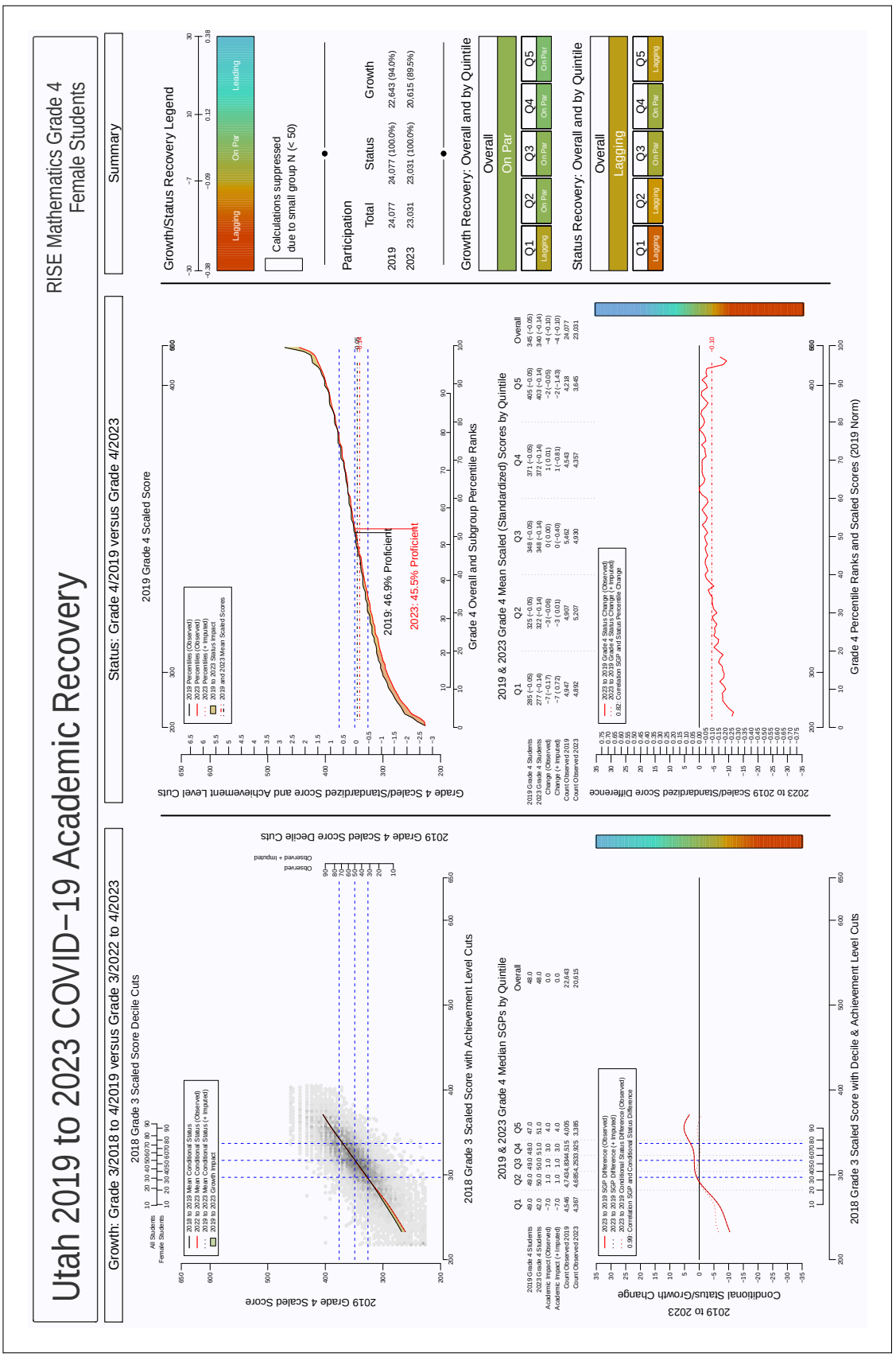

Figure 138: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 4 ELA, female students

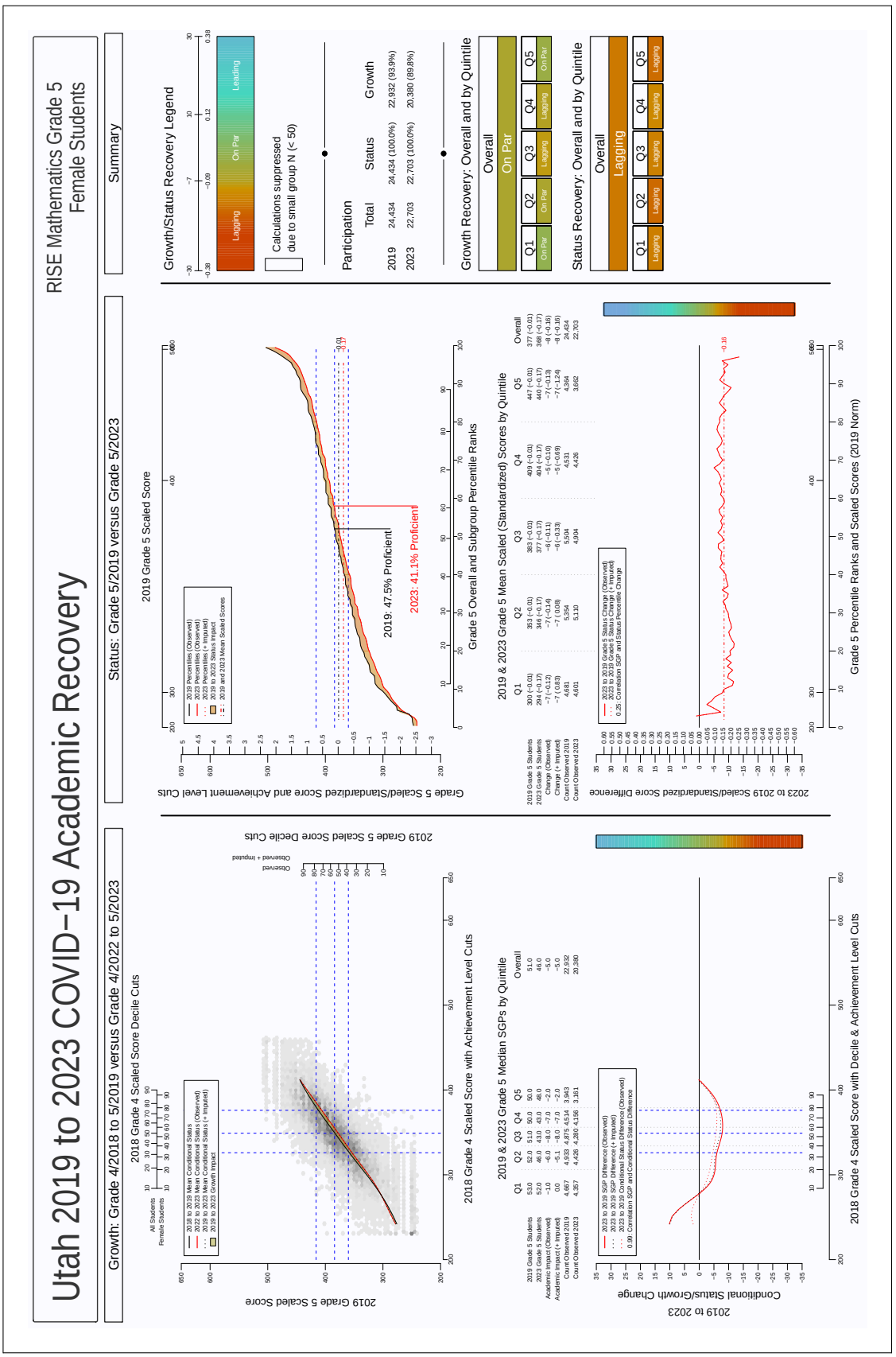

Figure 139: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 5 ELA, female students

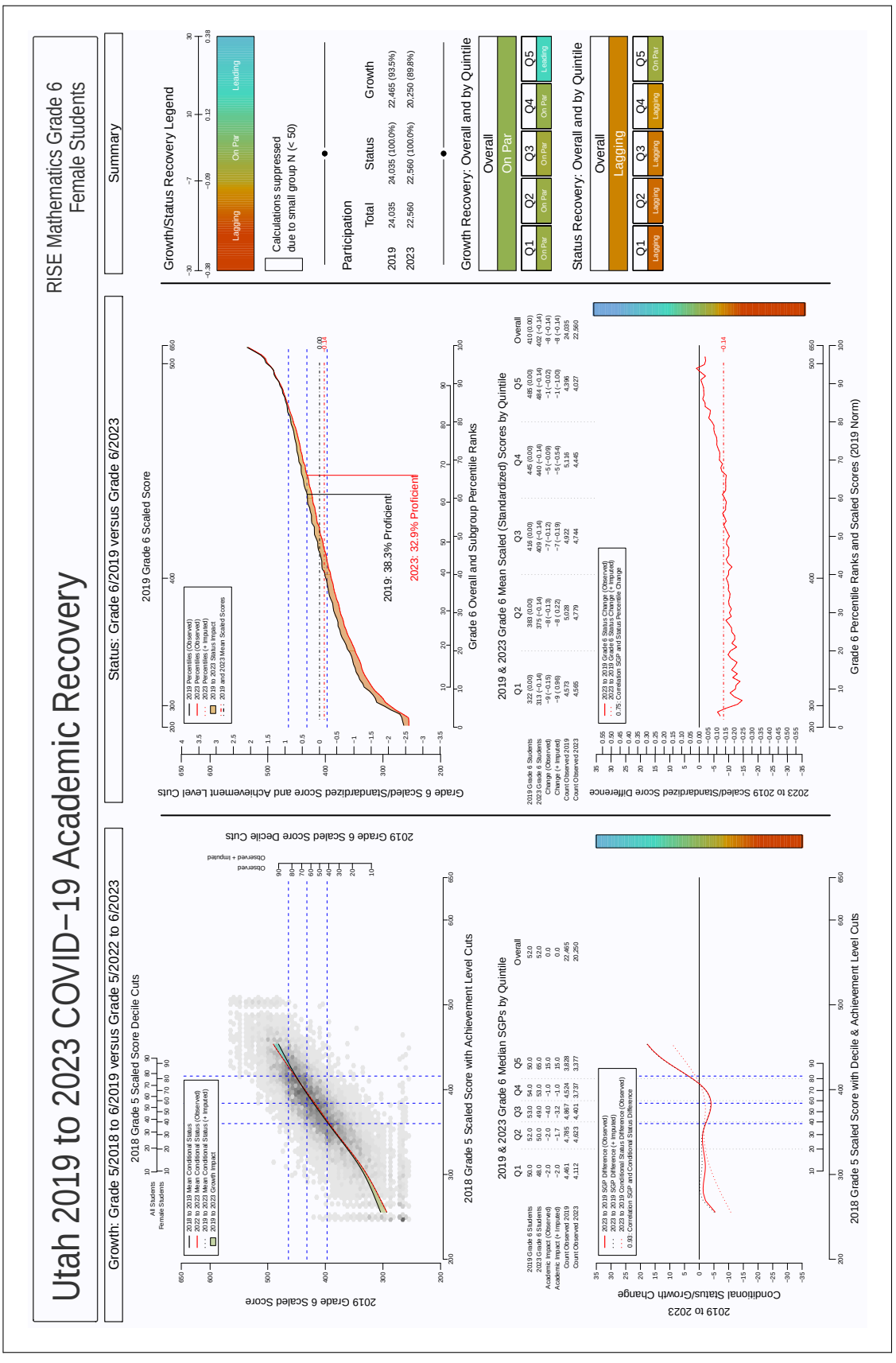

Figure 140: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 6 ELA, female students

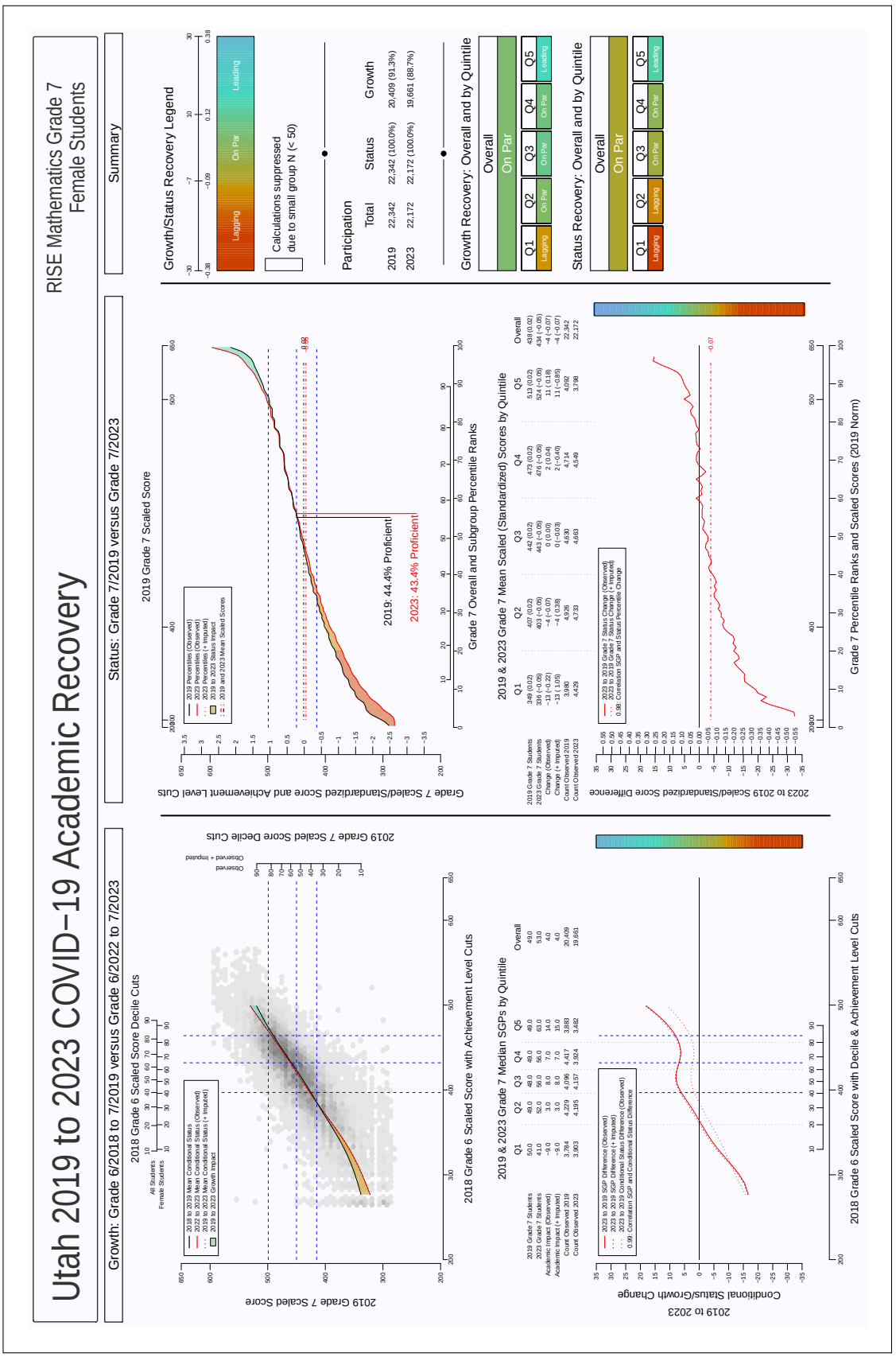

Figure 141: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 7 ELA, female students

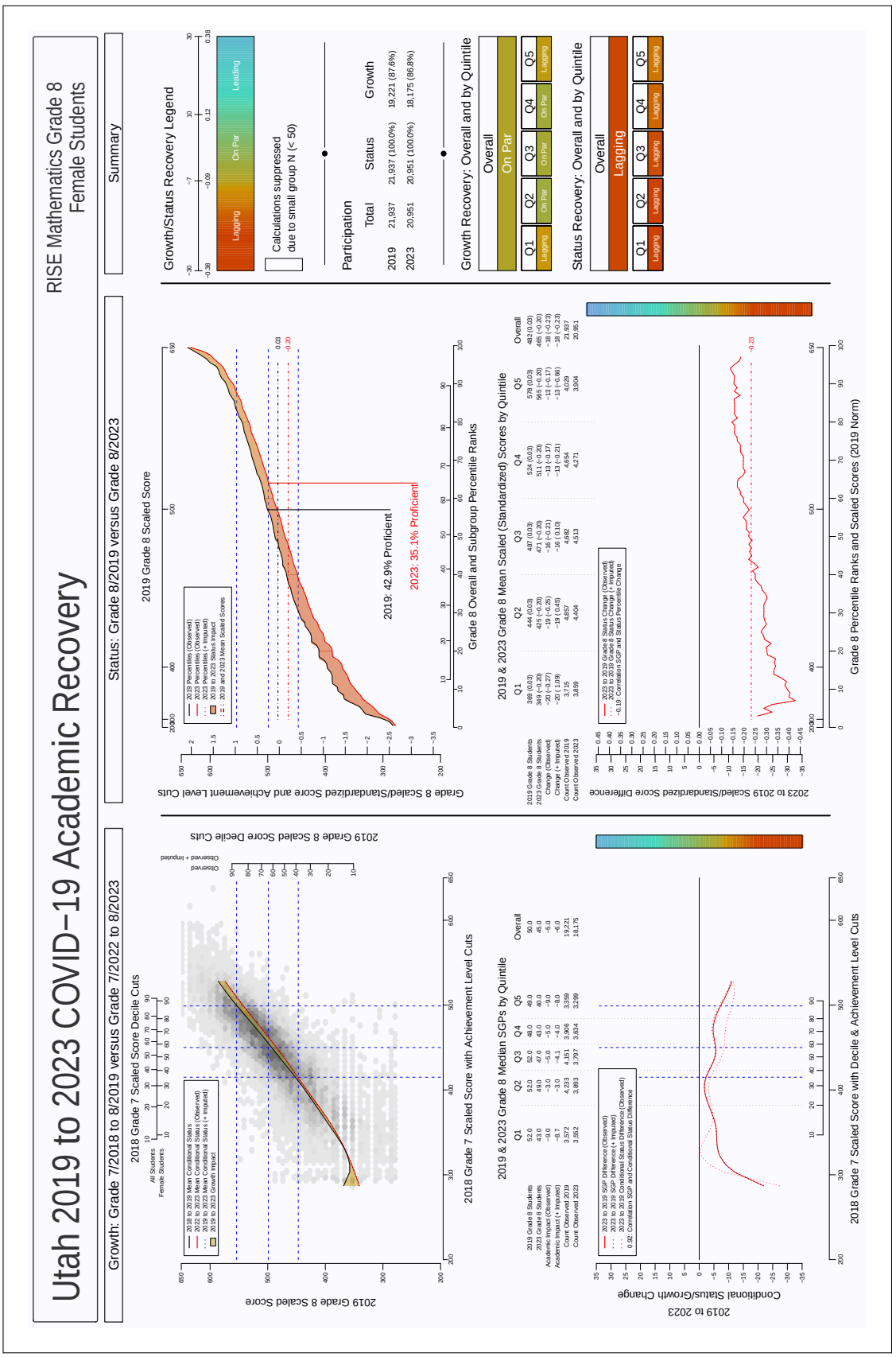

Figure 142: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 8 ELA, female students

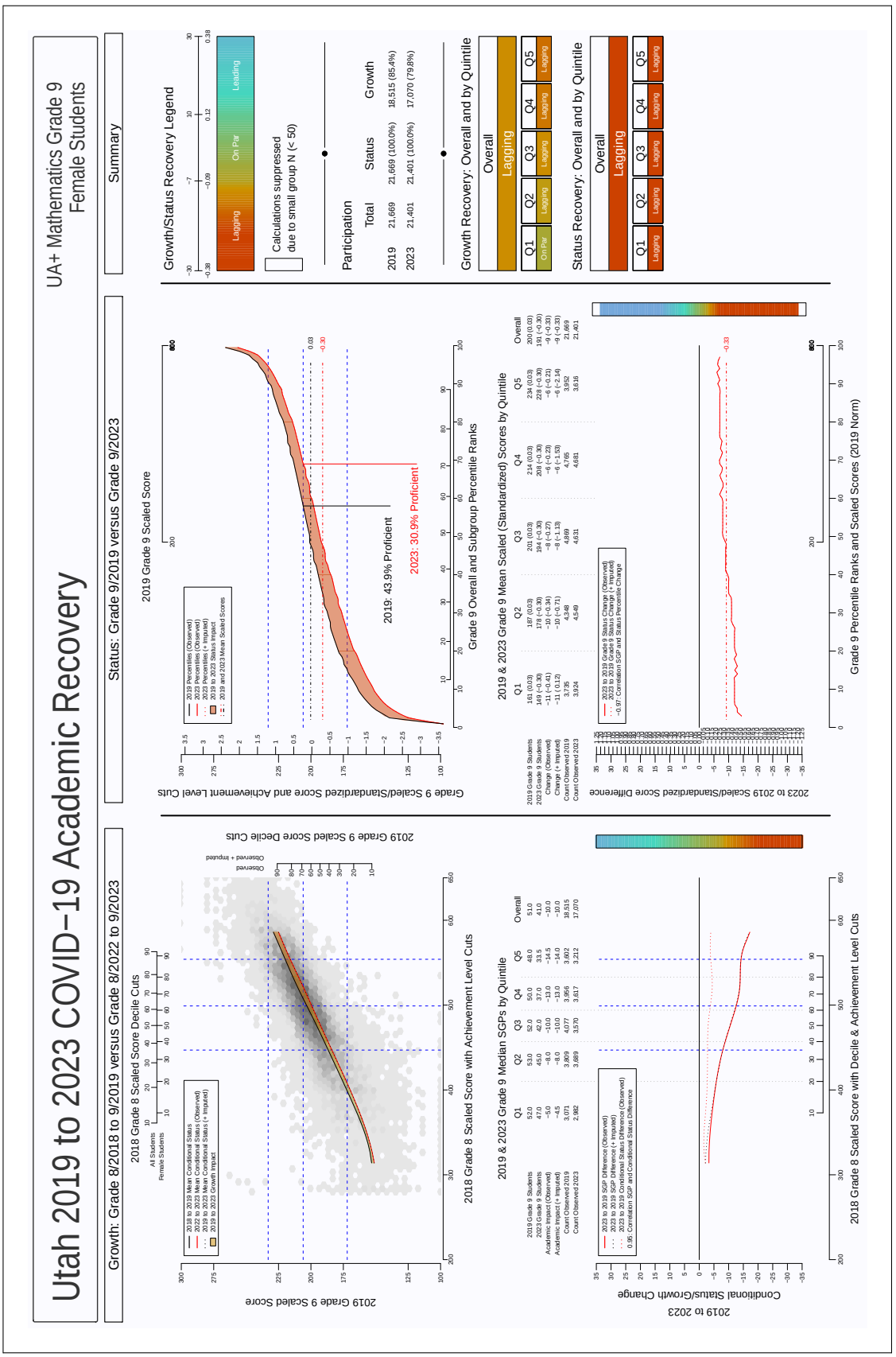

Figure 143: Utah UA+ academic recovery: Growth and status 2019 to 2023 grade 9 ELA, female students

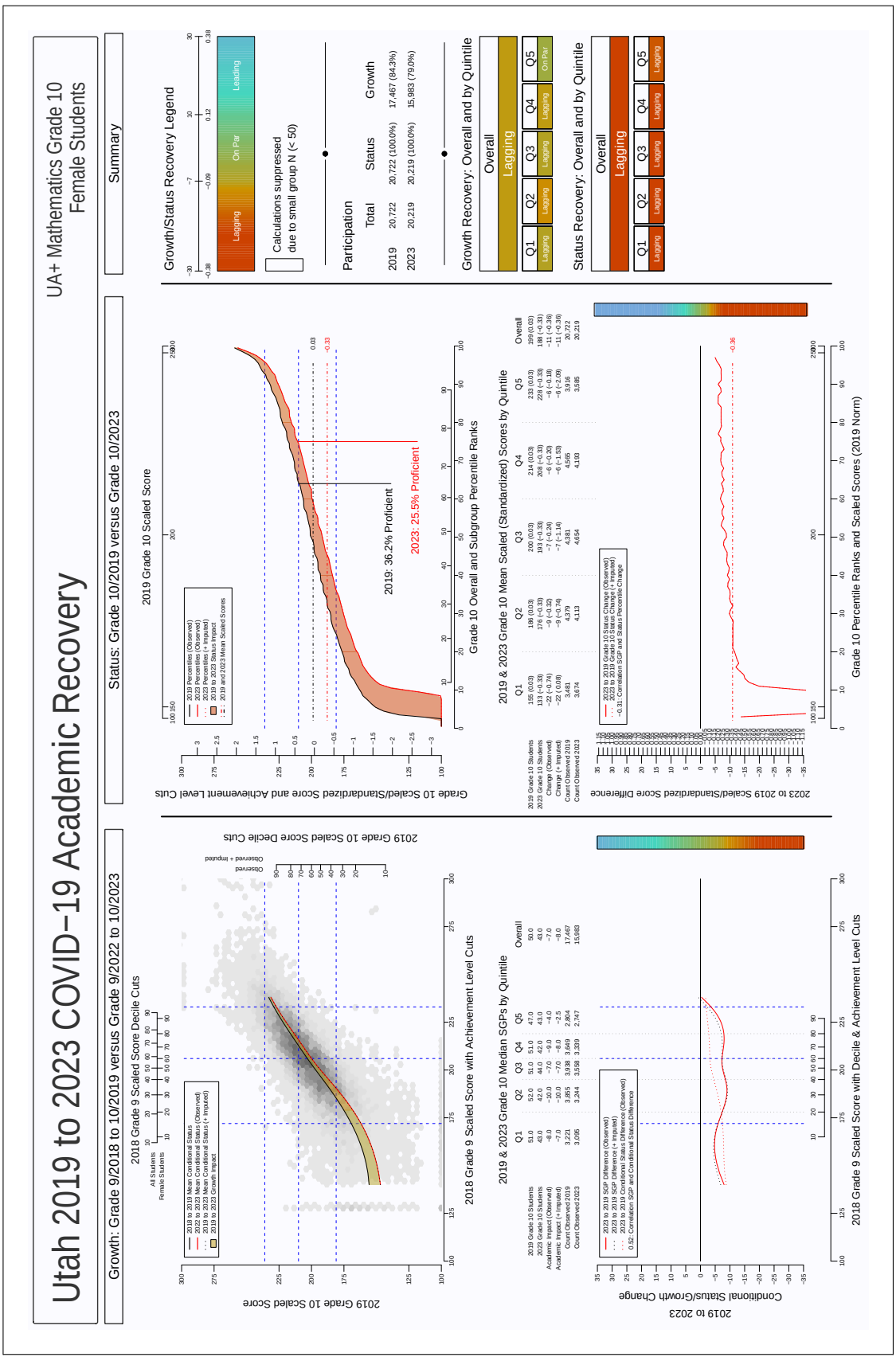

Figure 144: Utah UA+ academic recovery: Growth and status 2019 to 2023 grade 10 ELA, female students

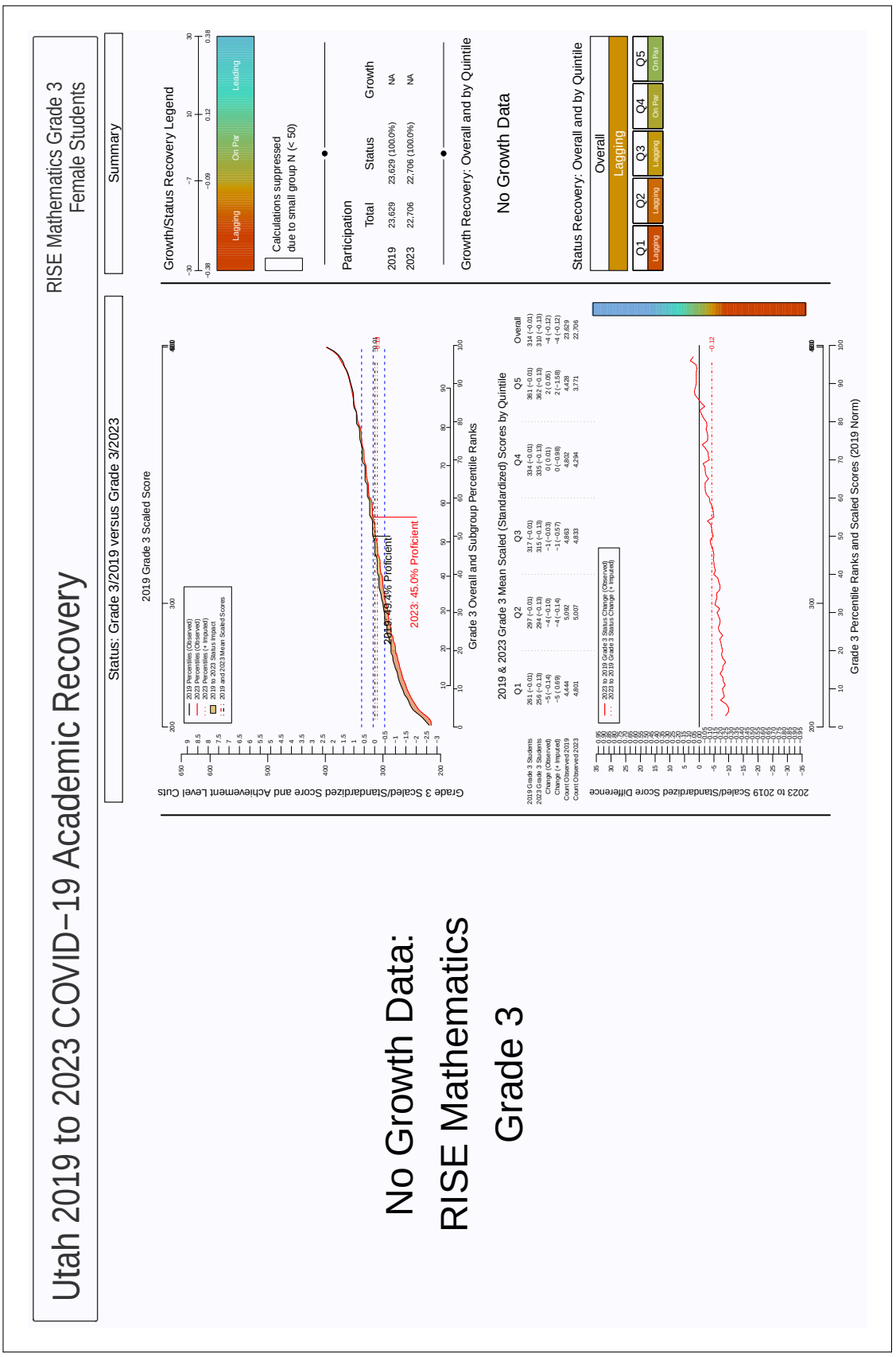

Figure 145: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 3 mathematics, female students

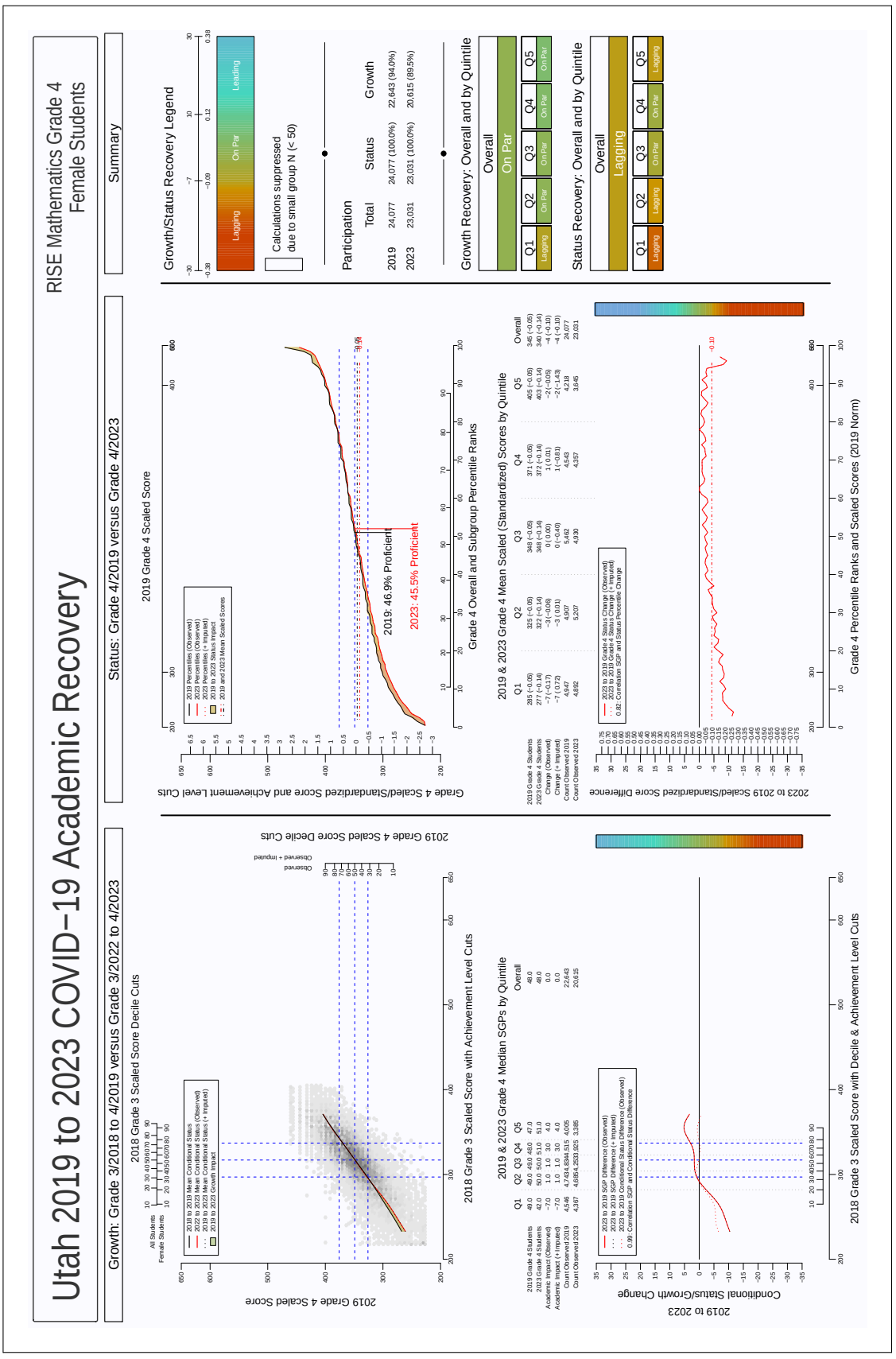

Figure 146: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 4 mathematics, female students

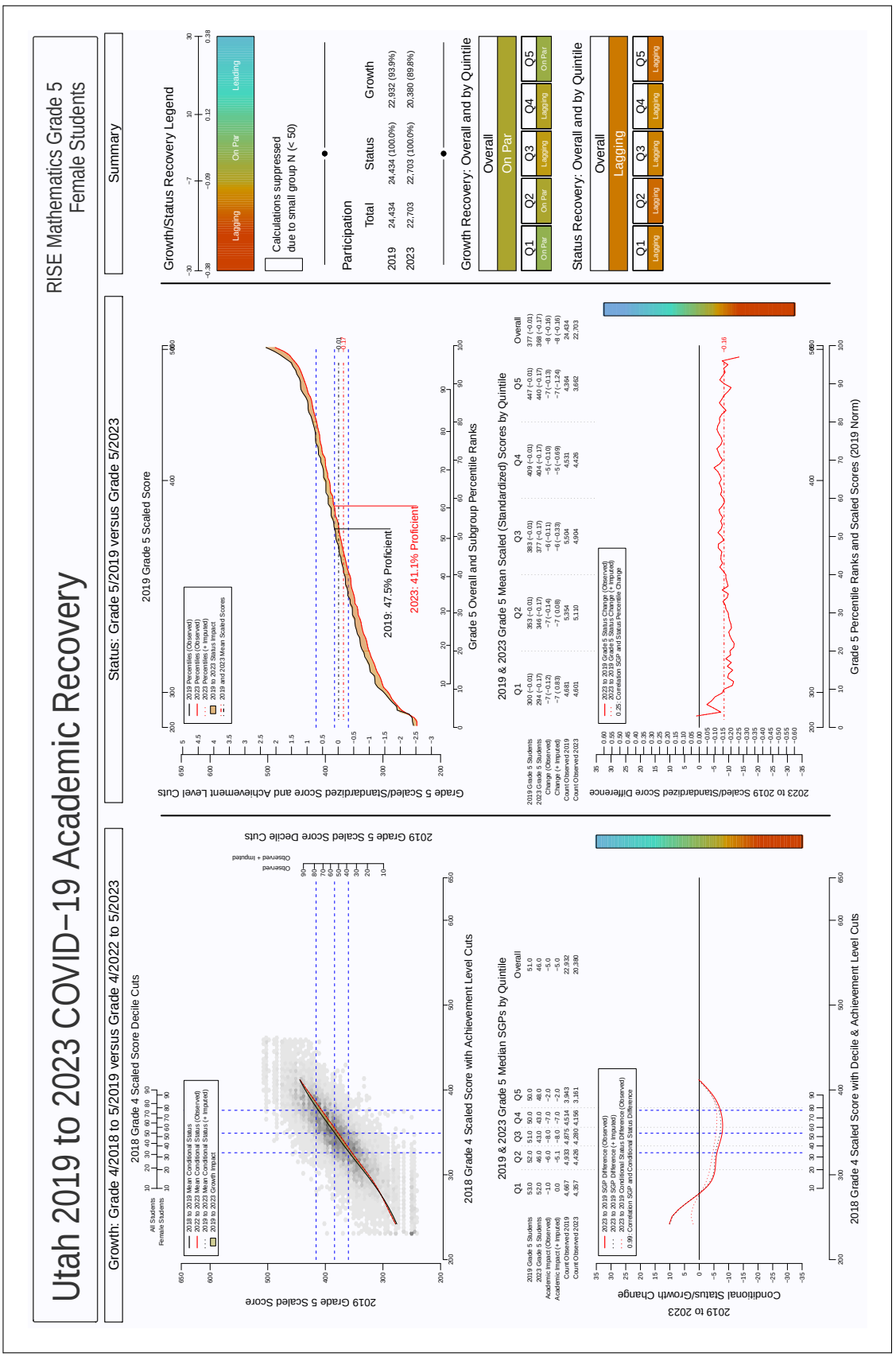

Figure 147: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 5 mathematics, female students

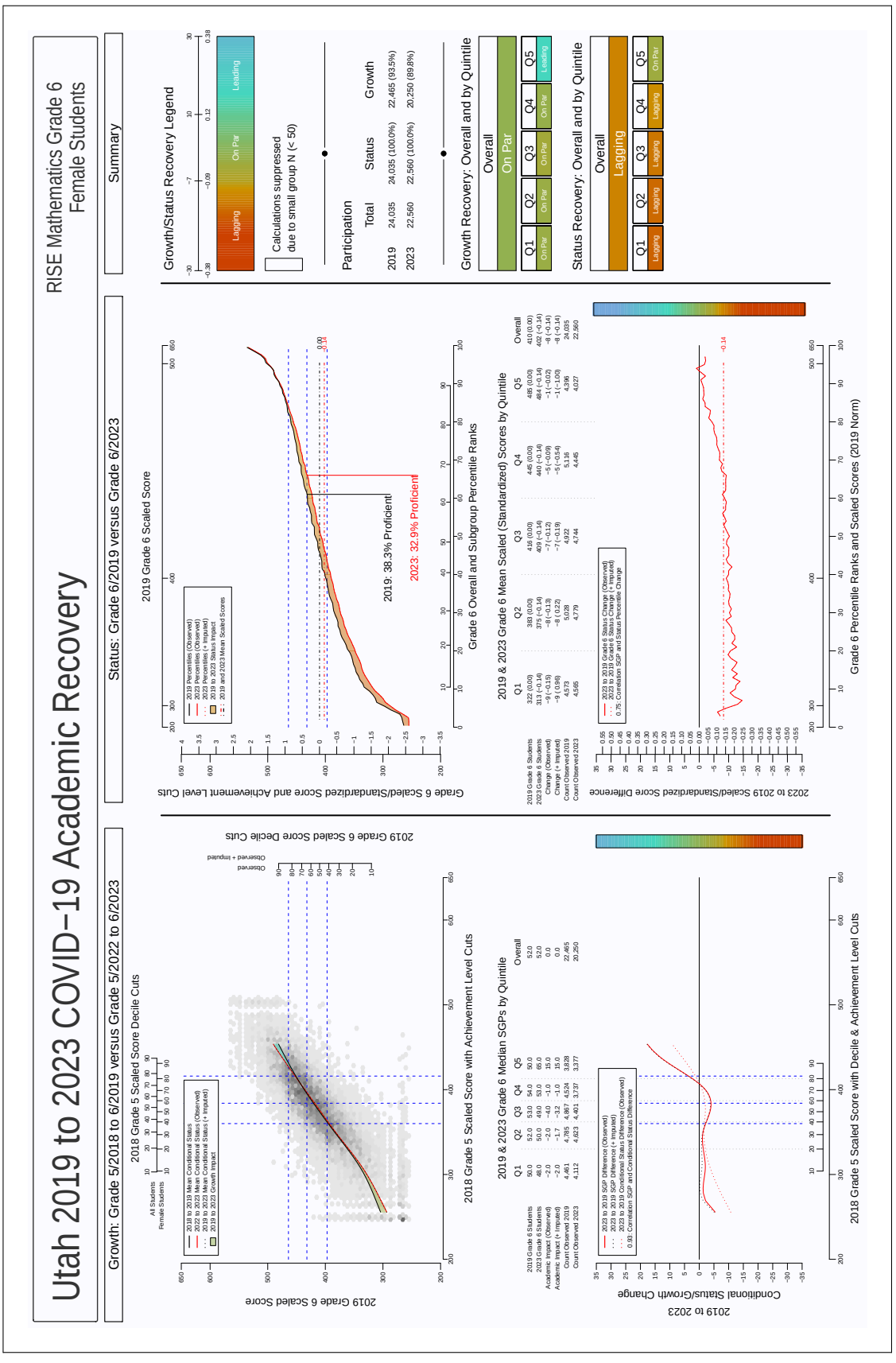

Figure 148: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 6 mathematics, female students

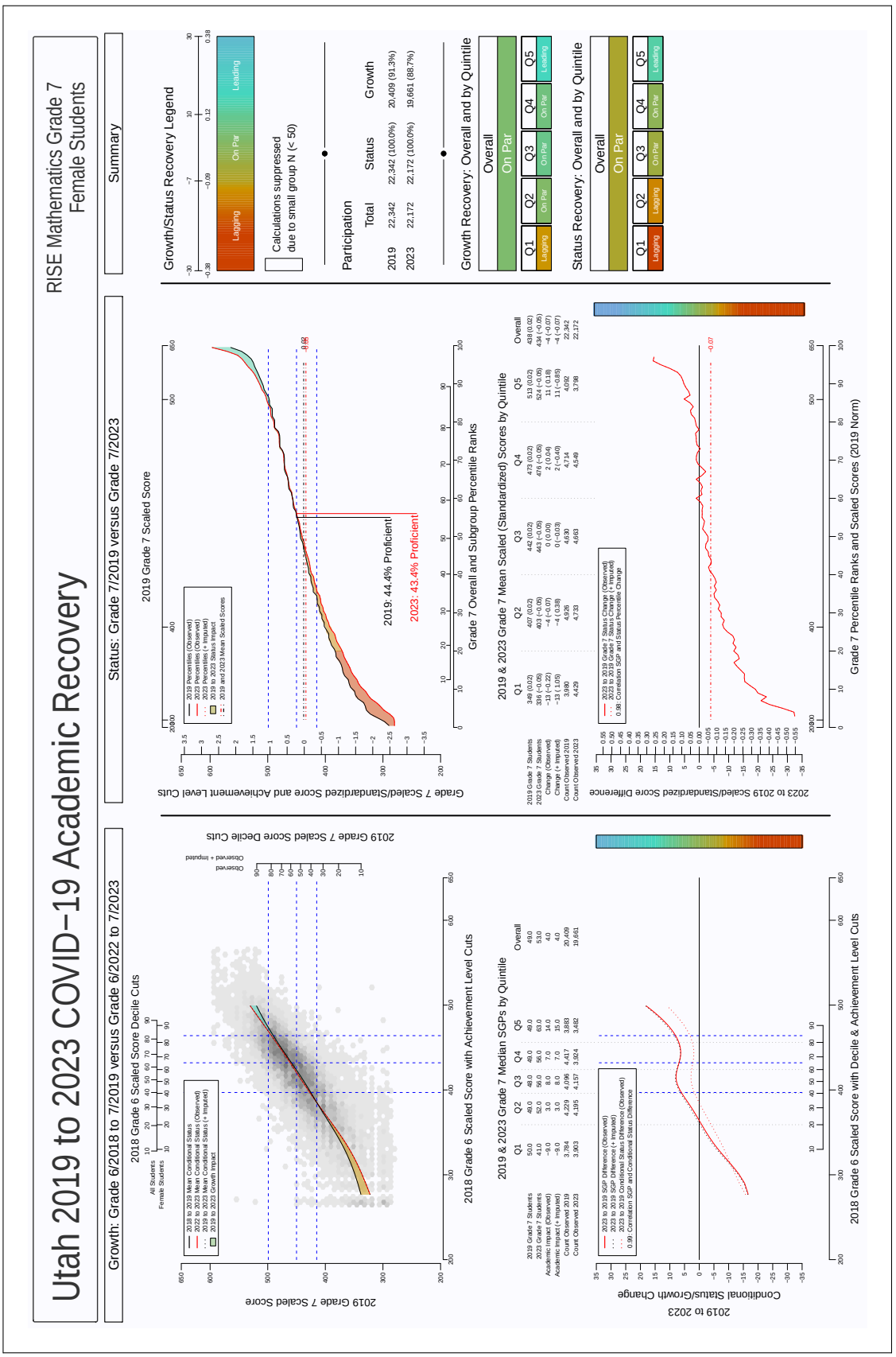

Figure 149: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 7 mathematics, female students

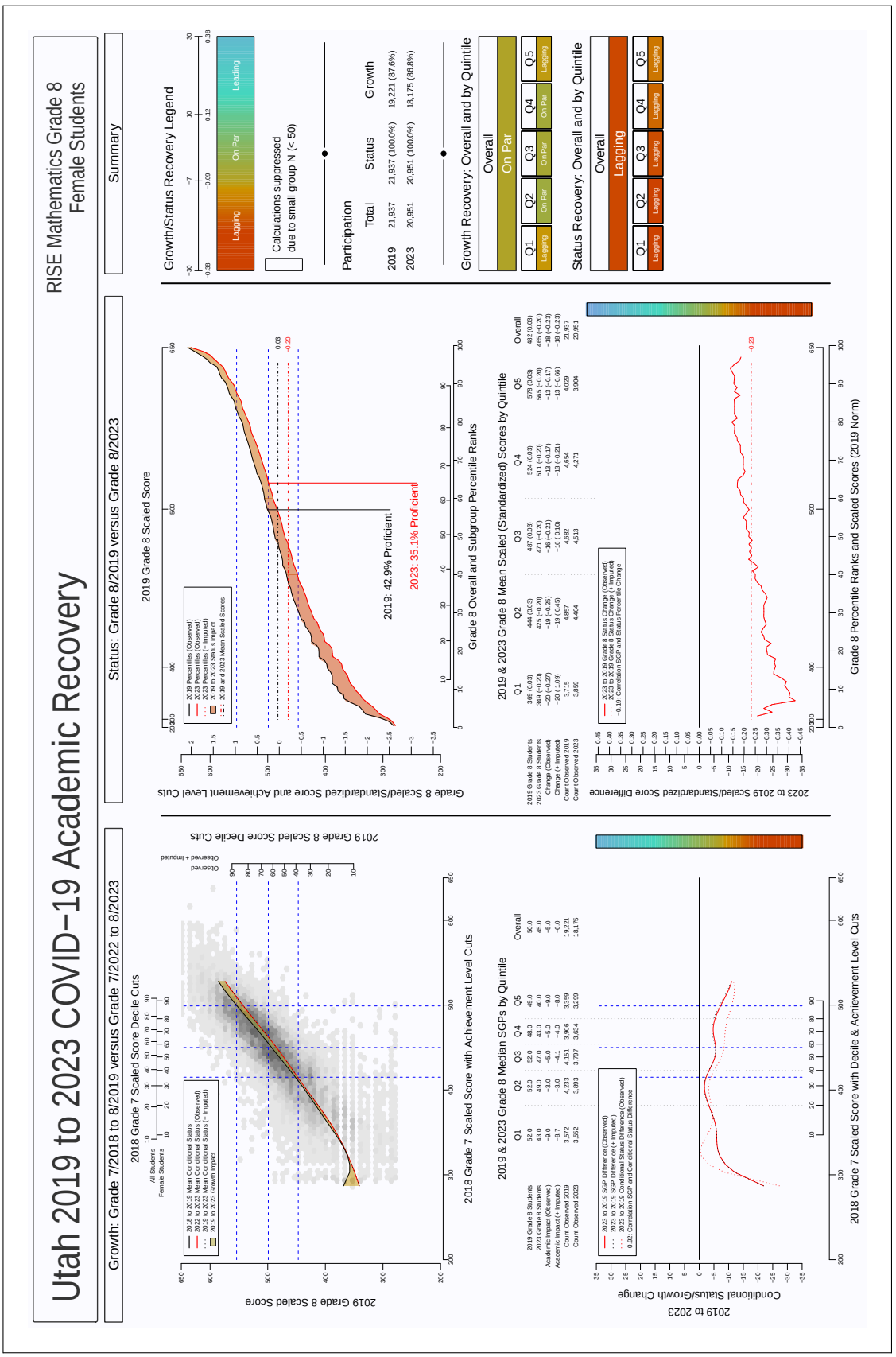

Figure 150: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 8 mathematics, female students

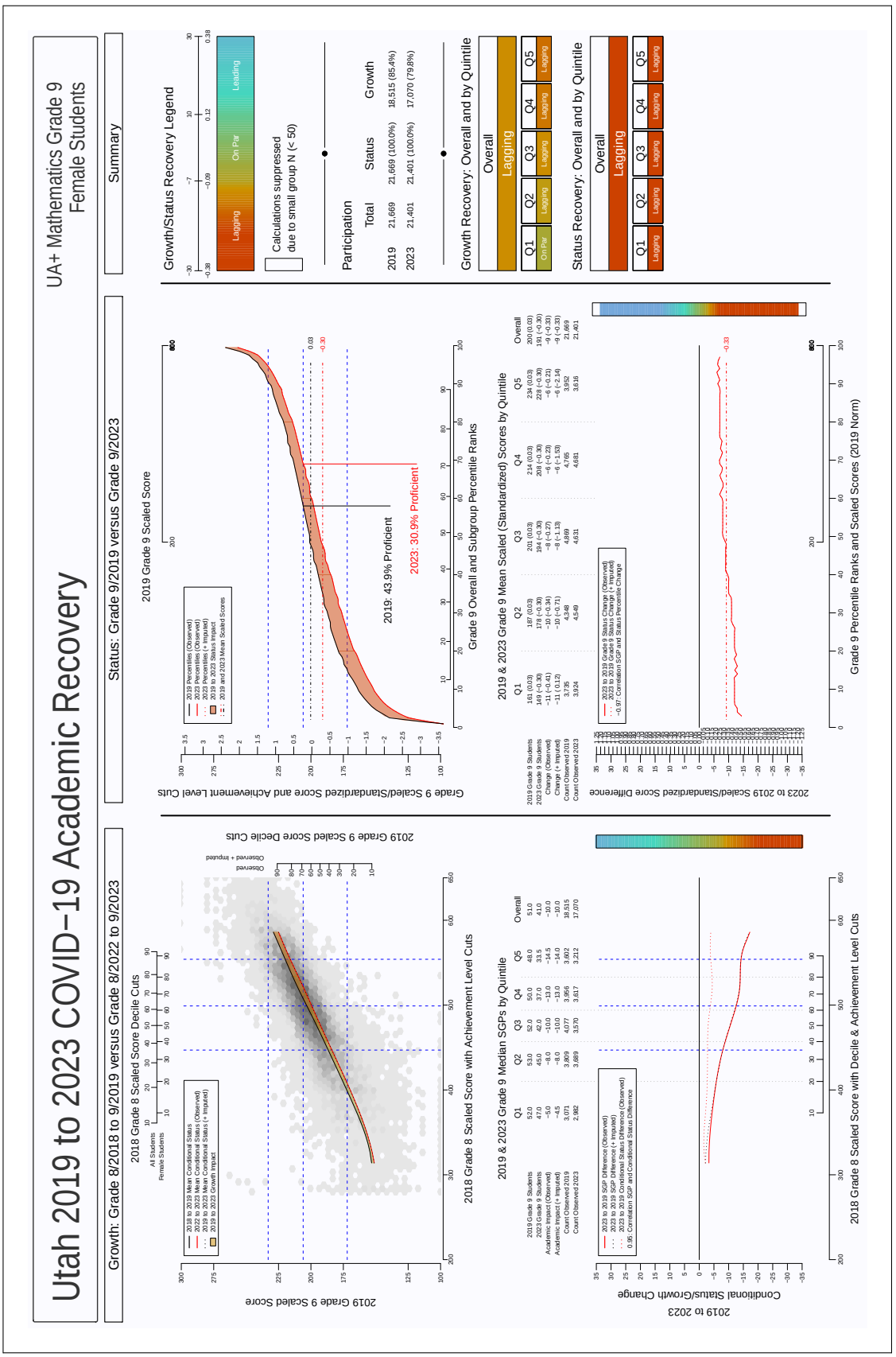

Figure 151: Utah UA+ academic recovery: Growth and status 2019 to 2023 grade 9 mathematics, female students

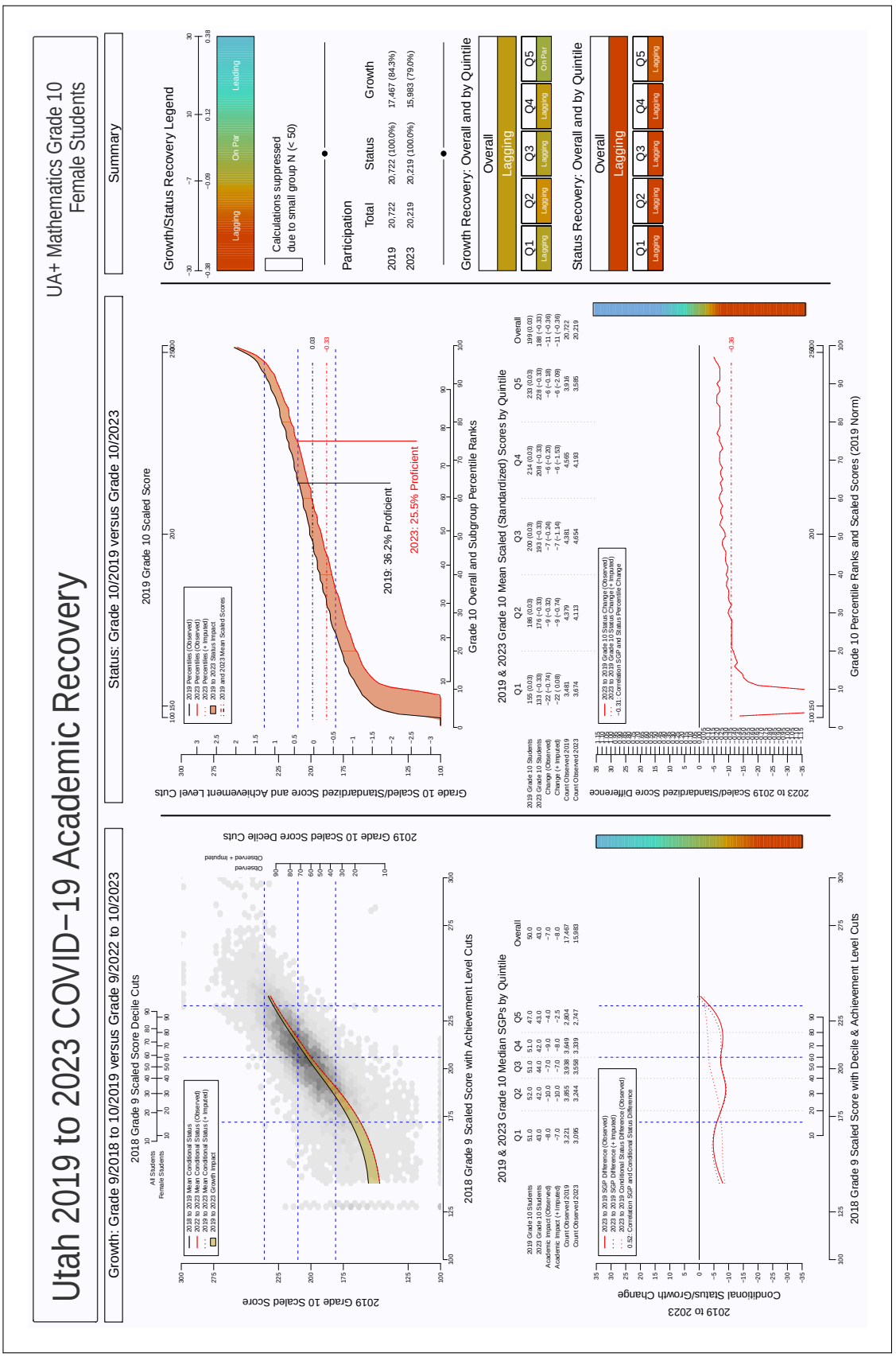

Figure 152: Utah UA+ academic recovery: Growth and status 2019 to 2023 grade 10 mathematics, female students

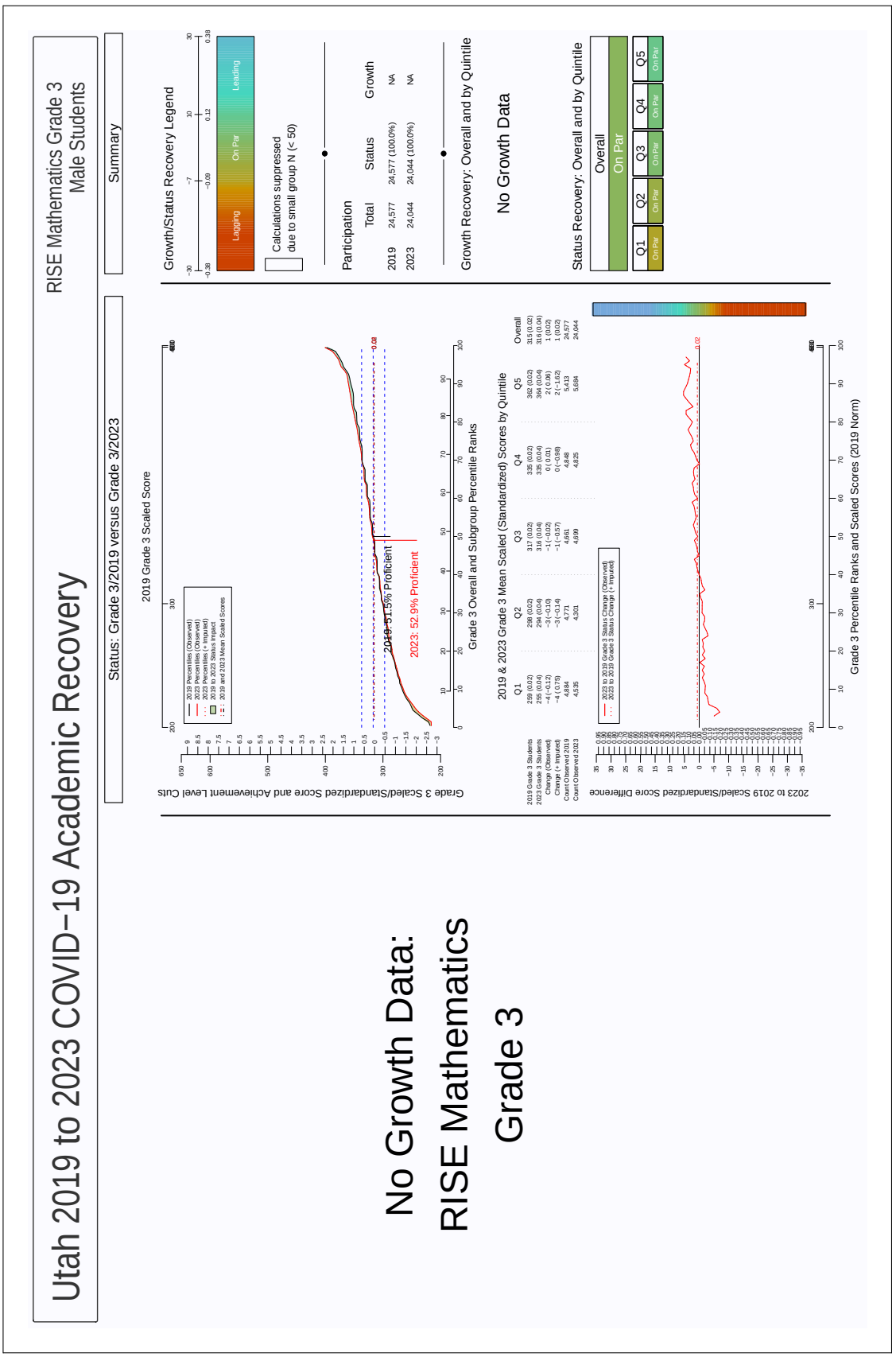

Figure 153: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 3 ELA, male students

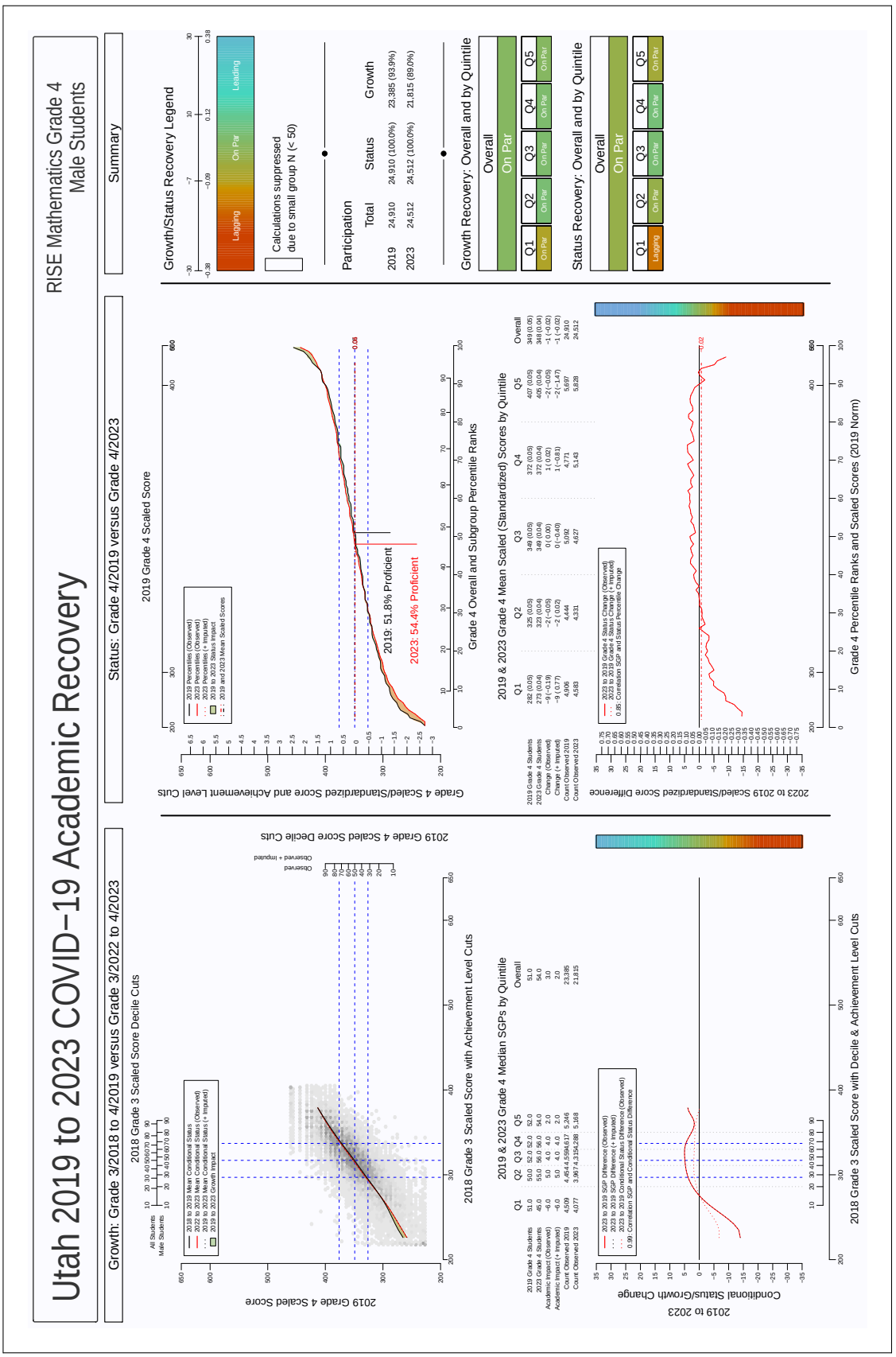

Figure 154: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 4 ELA, male students

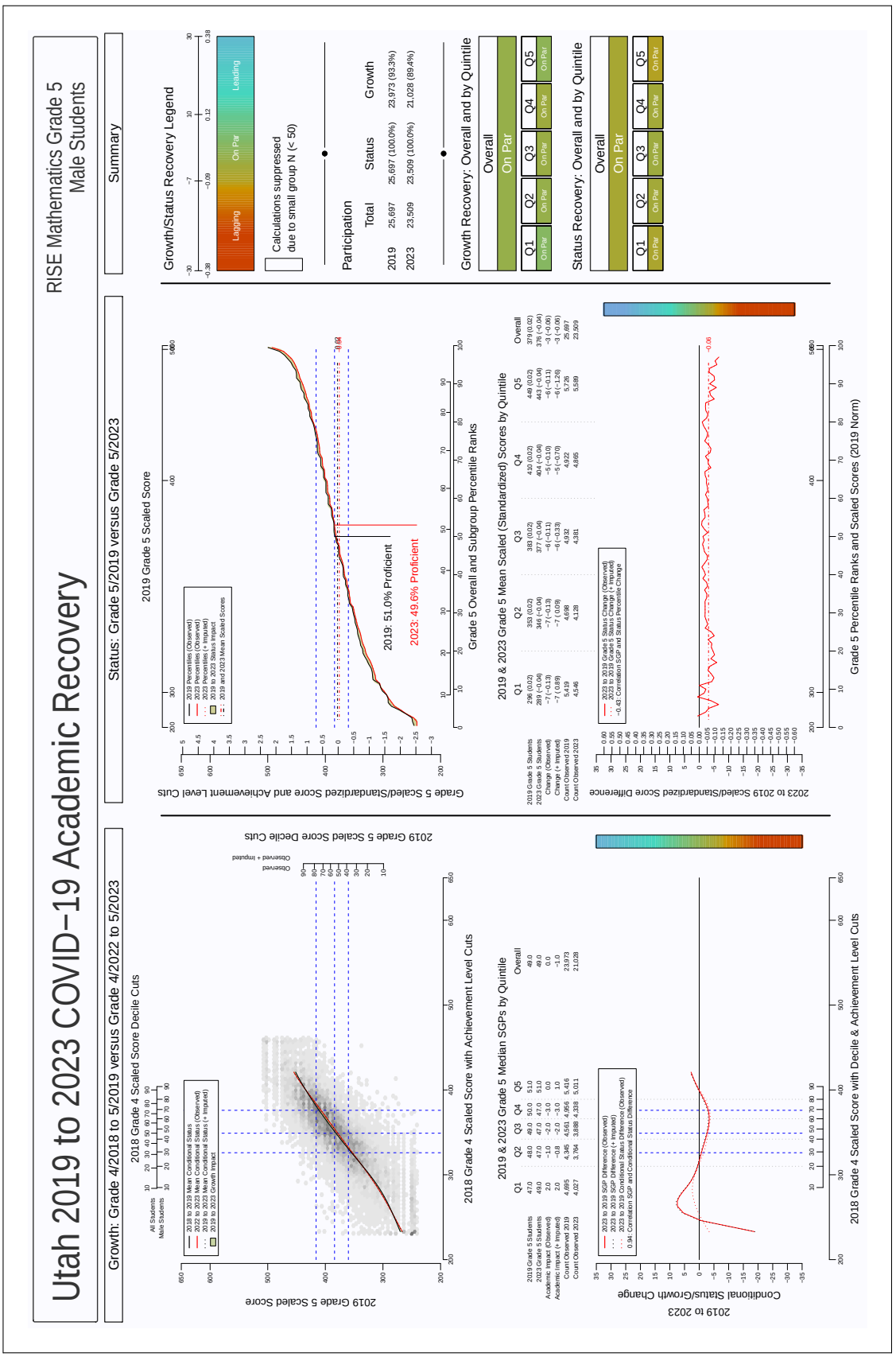

Figure 155: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 5 ELA, male students

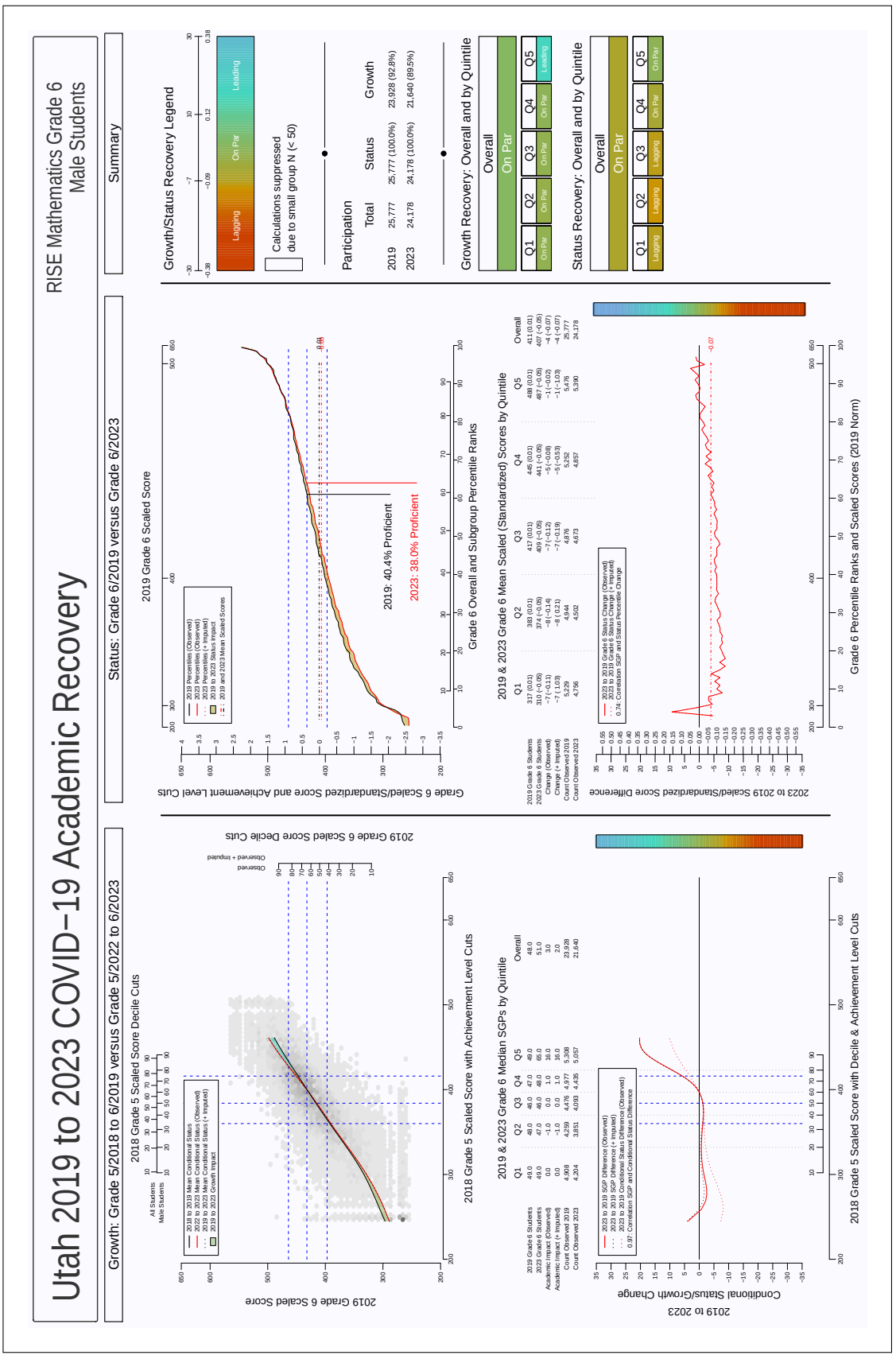

Figure 156: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 6 ELA, male students

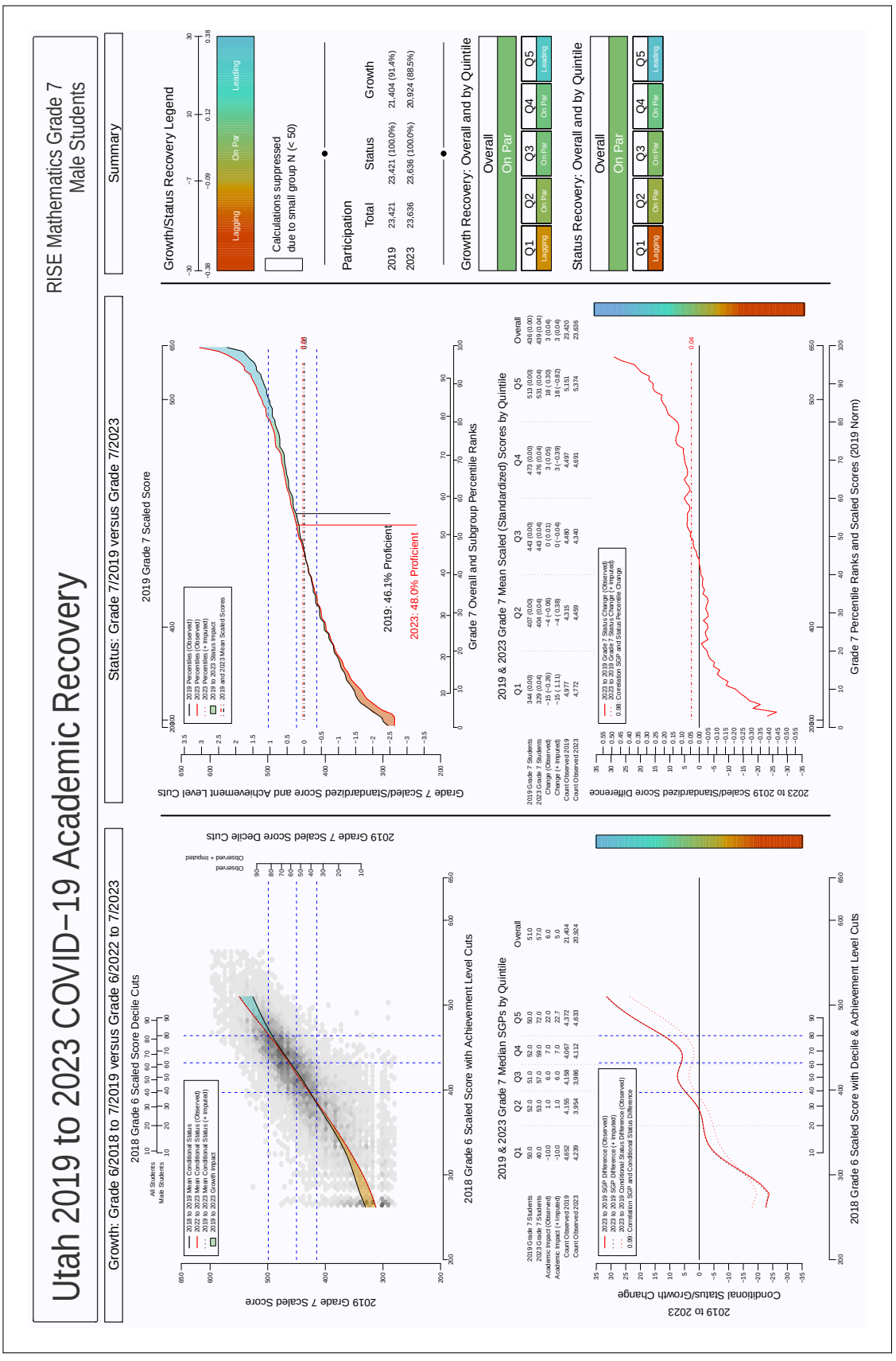

Figure 157: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 7 ELA, male students

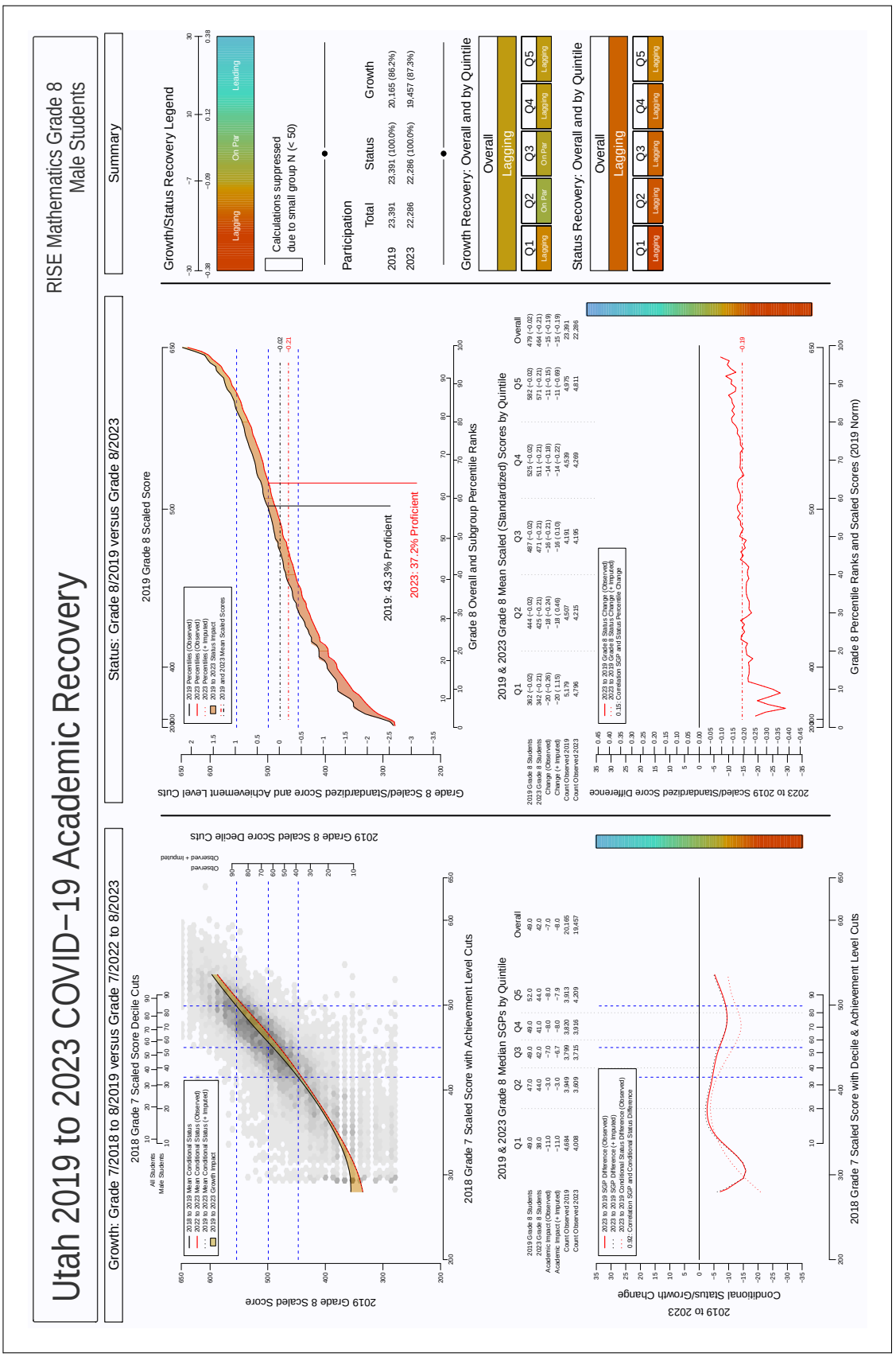

Figure 158: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 8 ELA, male students

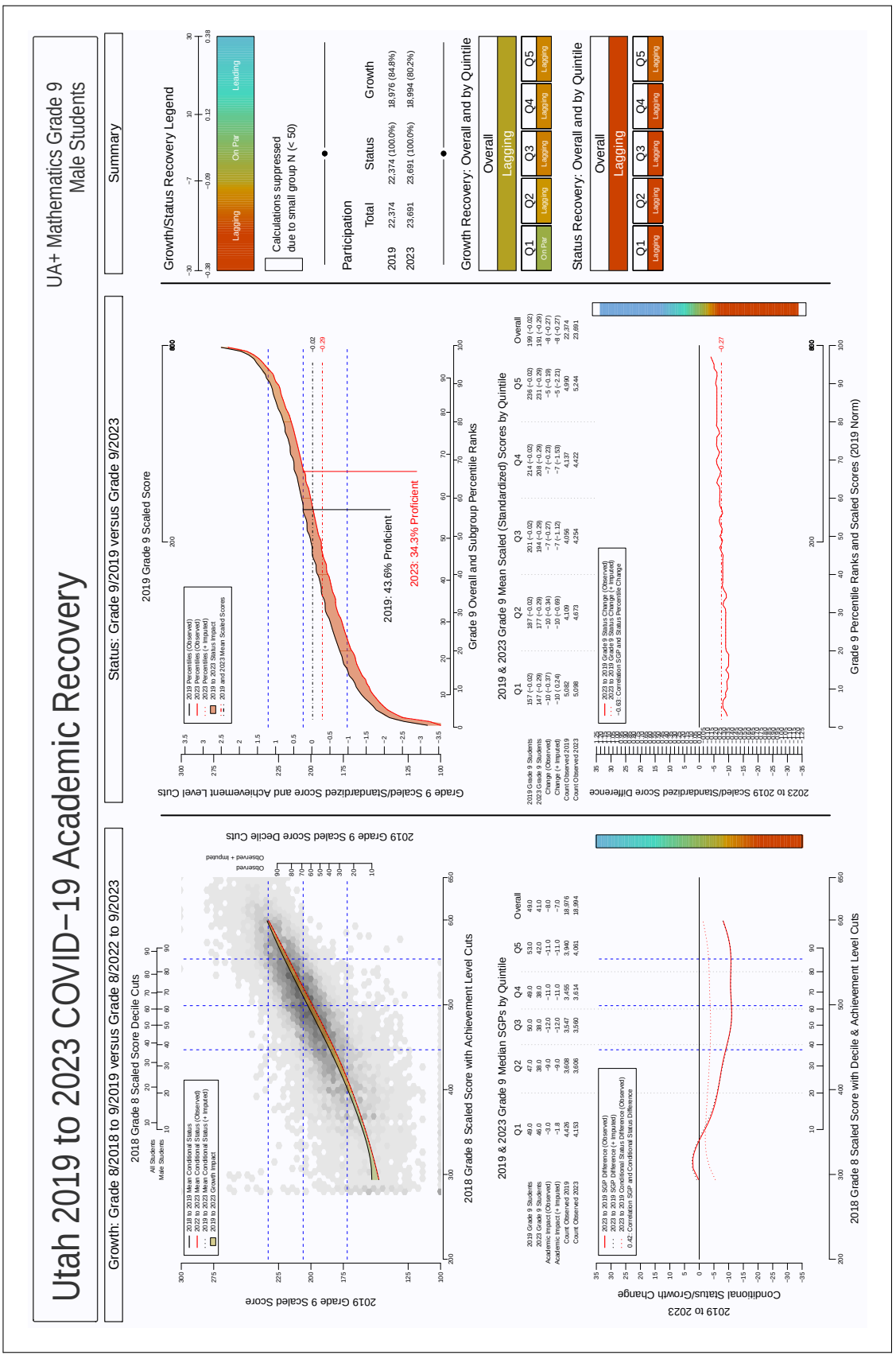

Figure 159: Utah UA+ academic recovery: Growth and status 2019 to 2023 grade 9 ELA, male students

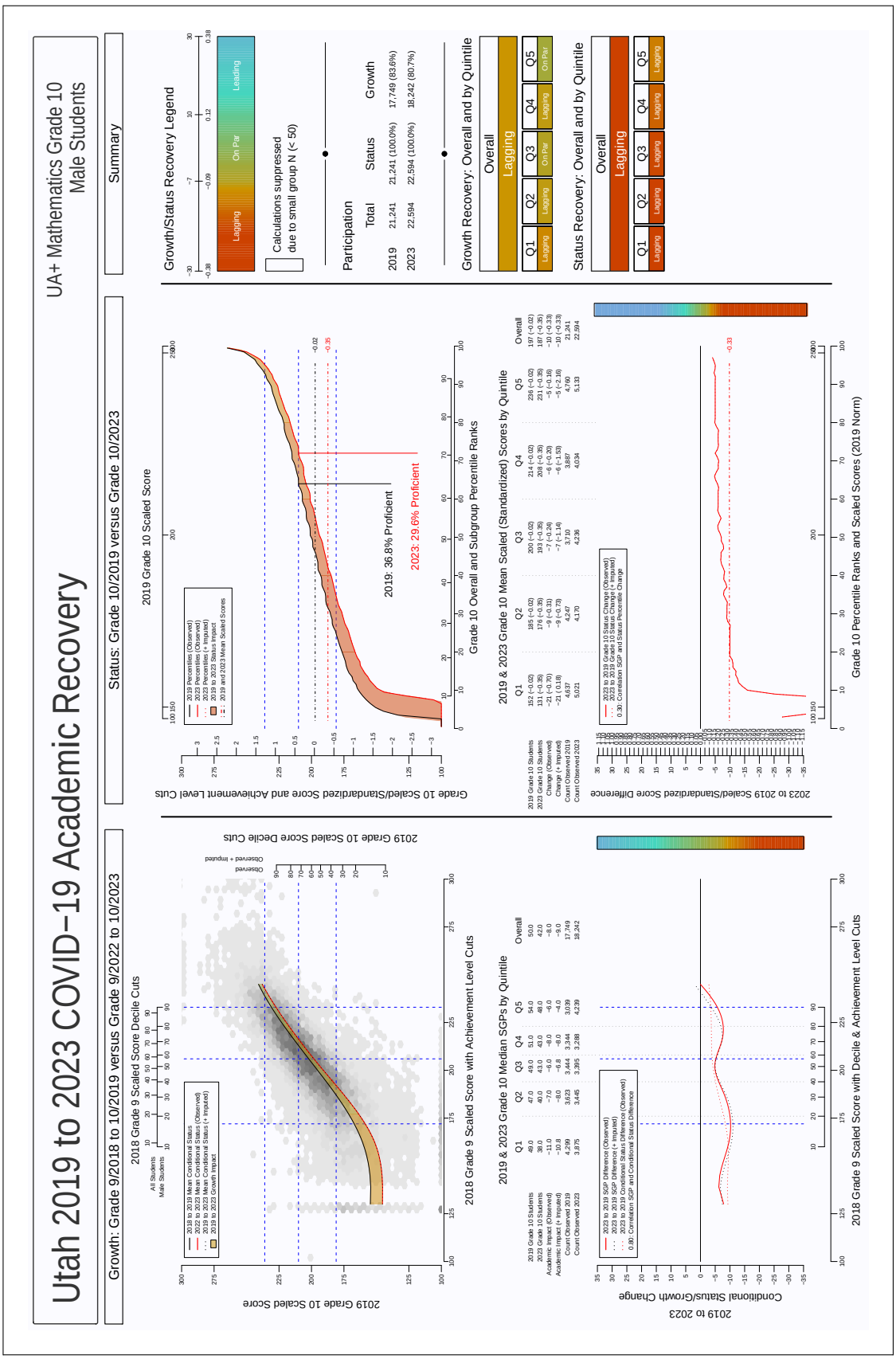

Figure 160: Utah UA+ academic recovery: Growth and status 2019 to 2023 grade 10 ELA, male students

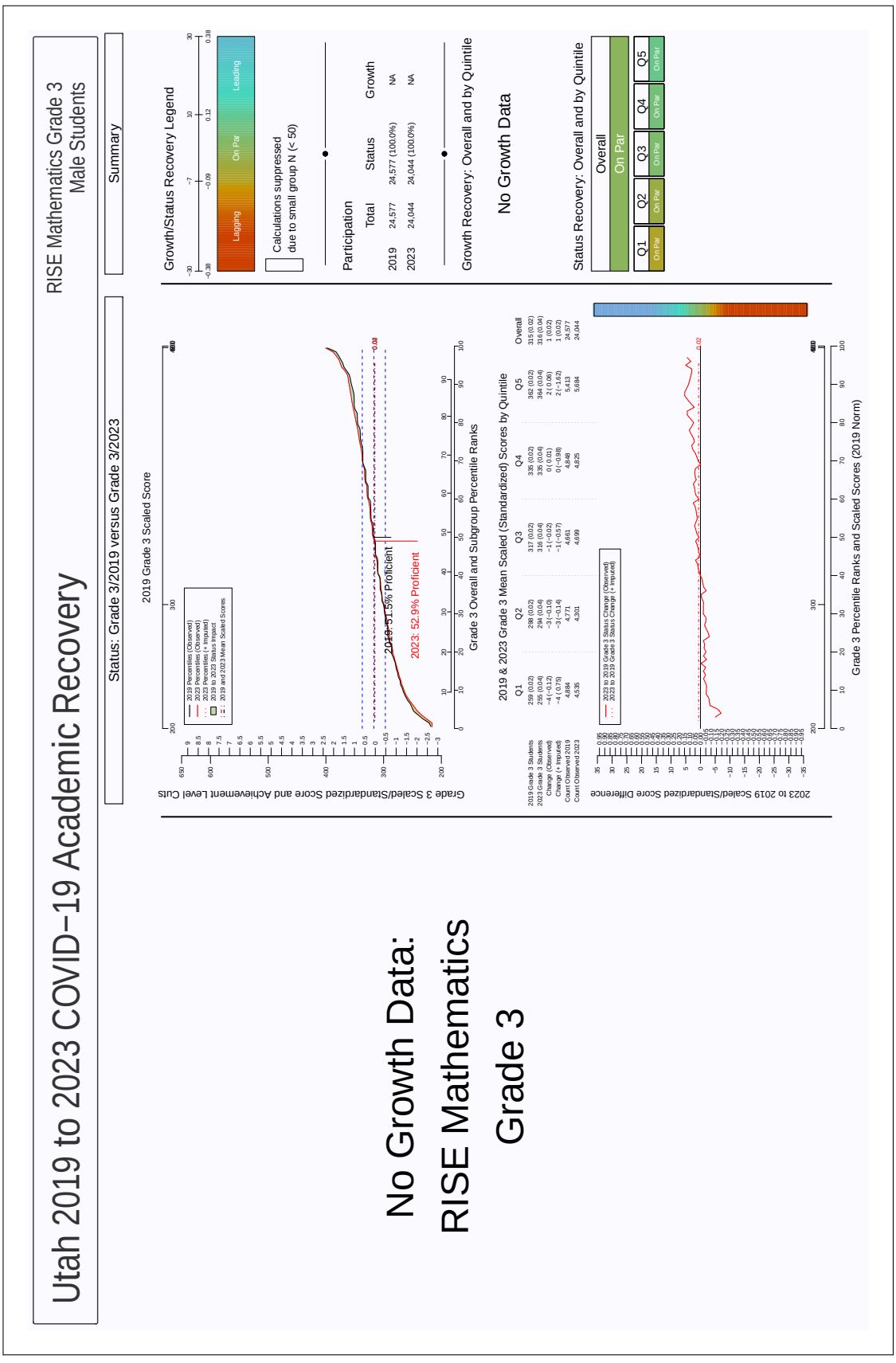

Figure 161: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 3 mathematics, male students

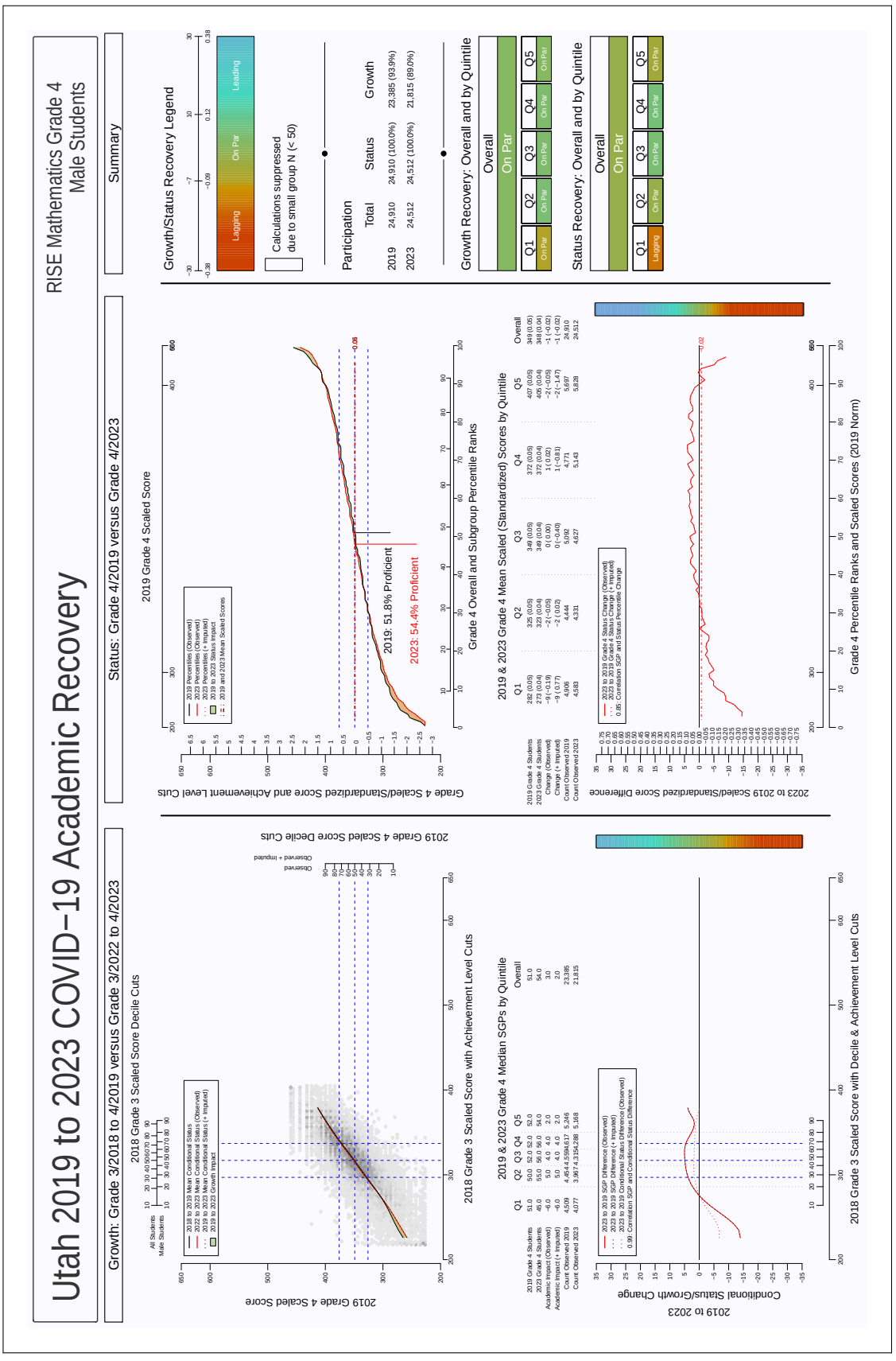

Figure 162: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 4 mathematics, male students

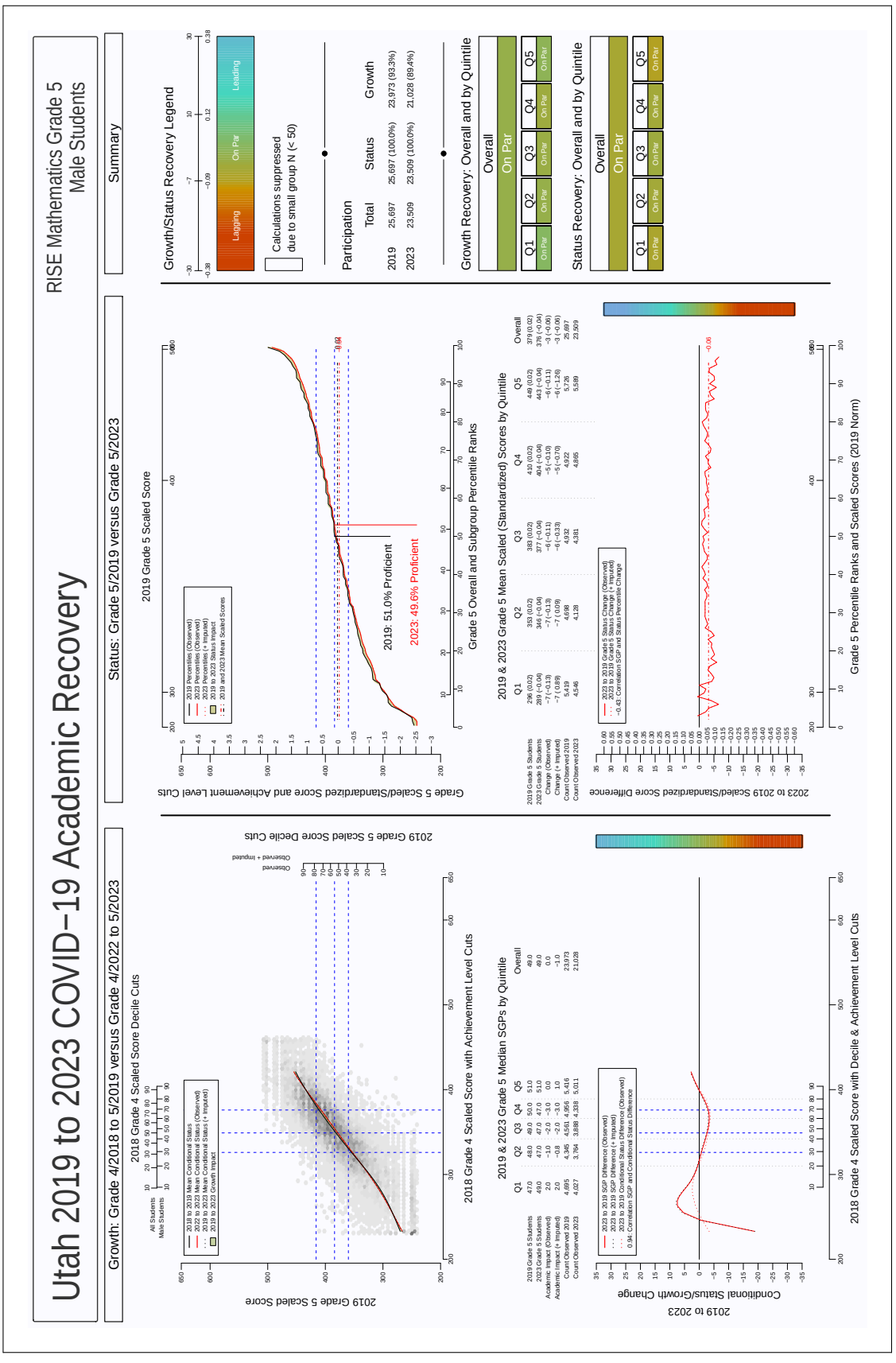

Figure 163: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 5 mathematics, male students

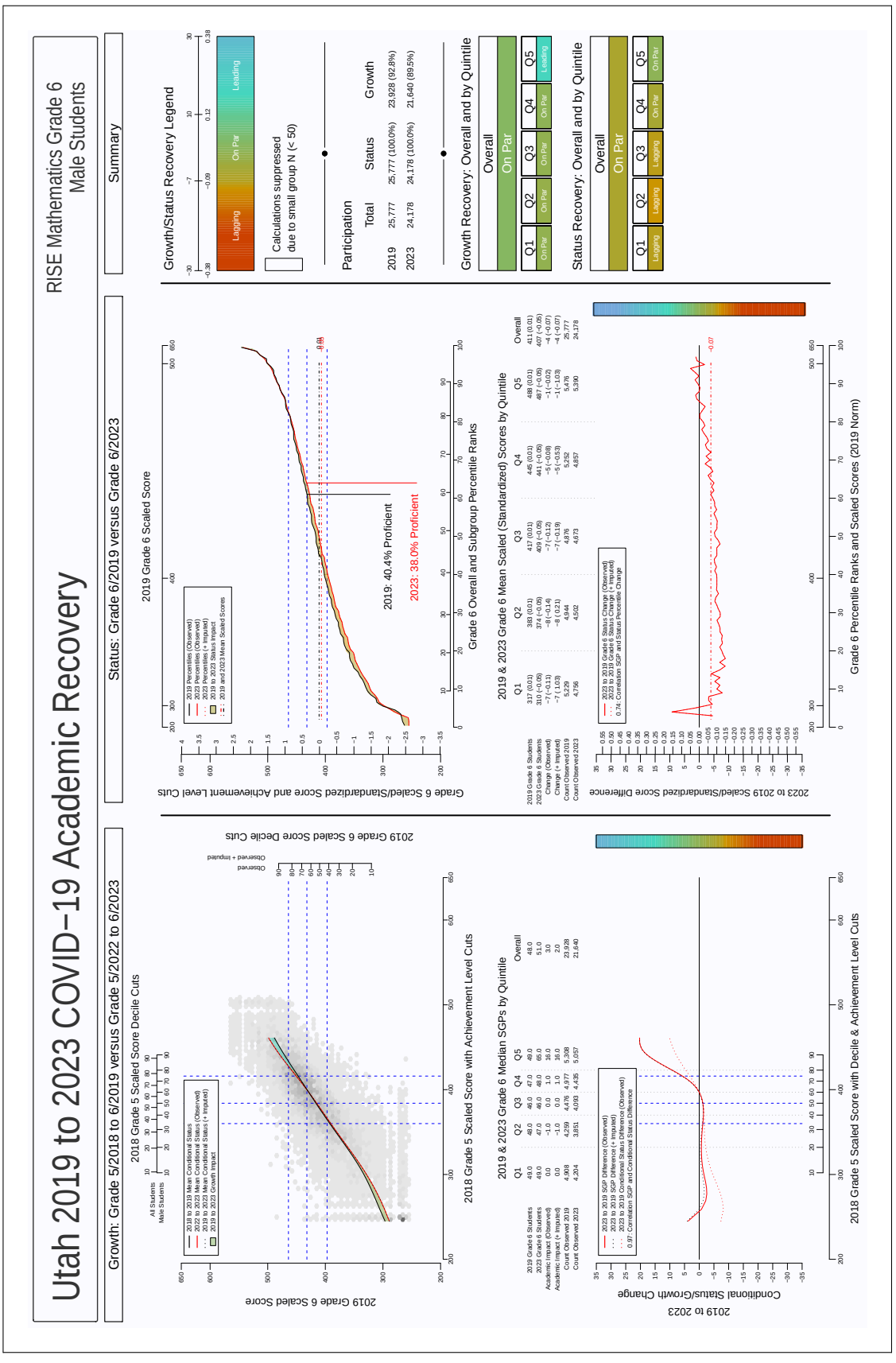

Figure 164: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 6 mathematics, male students

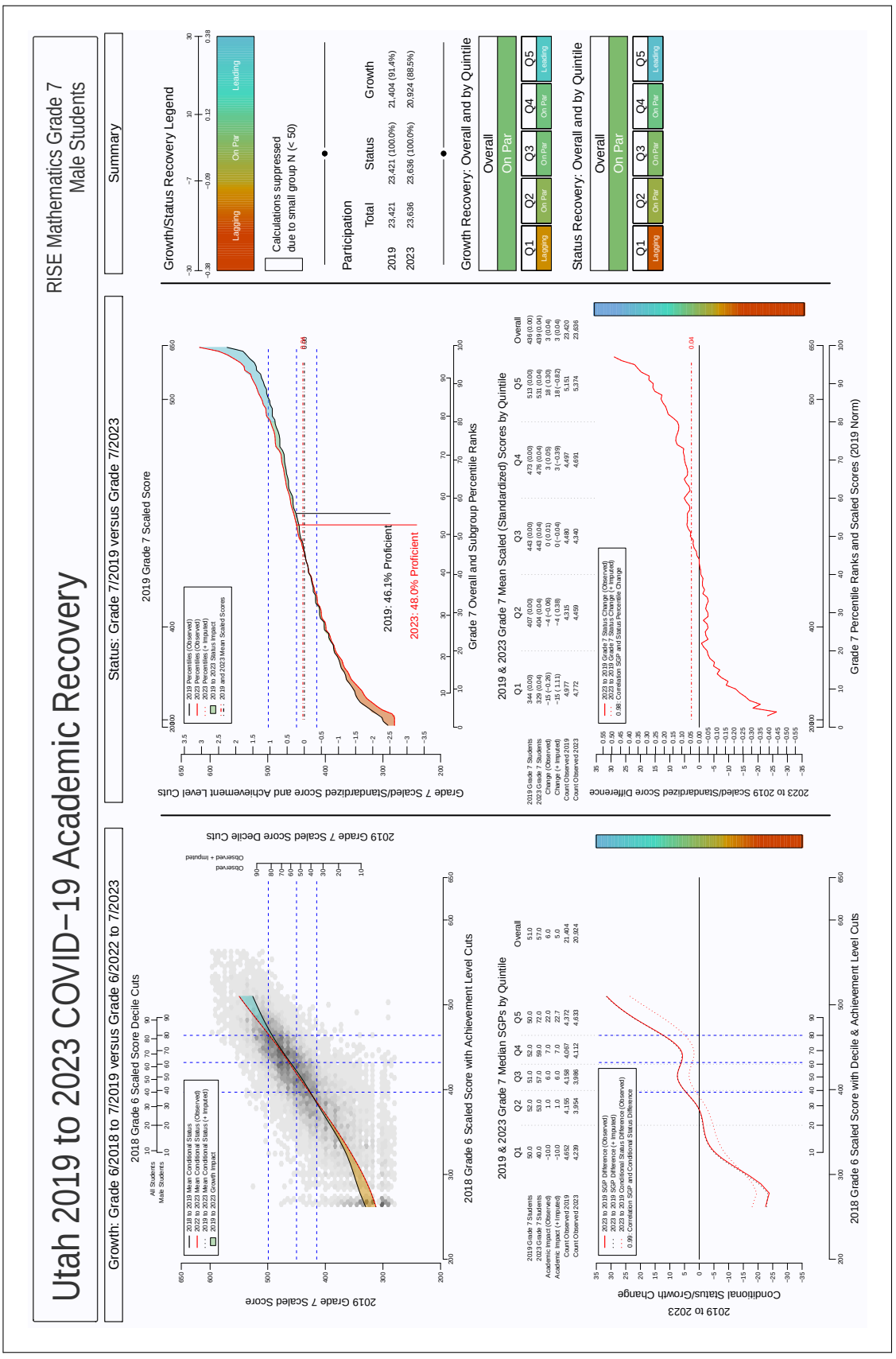

Figure 165: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 7 mathematics, male students

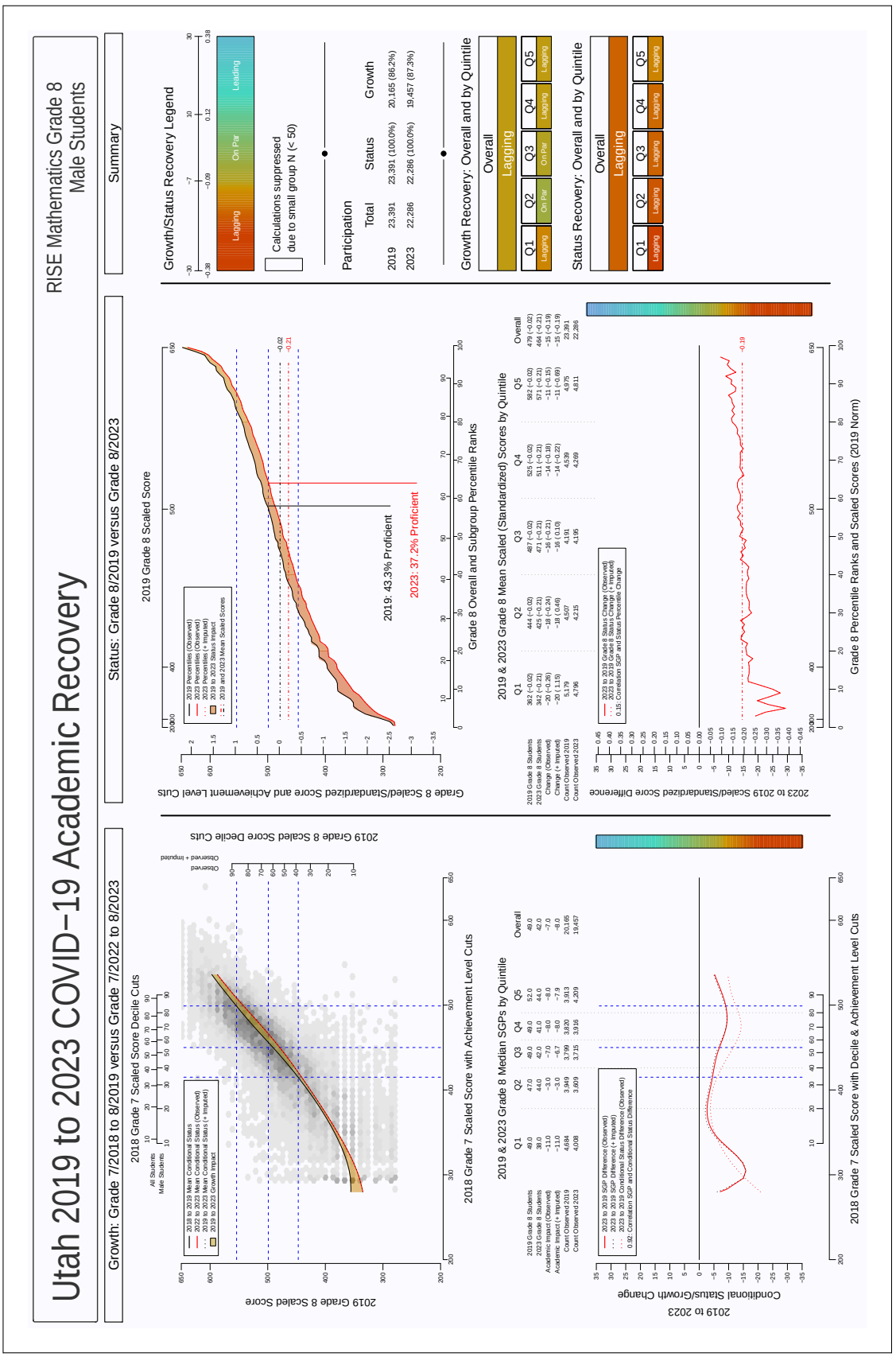

Figure 166: Utah RISE academic recovery: Growth and status 2019 to 2023 grade 8 mathematics, male students

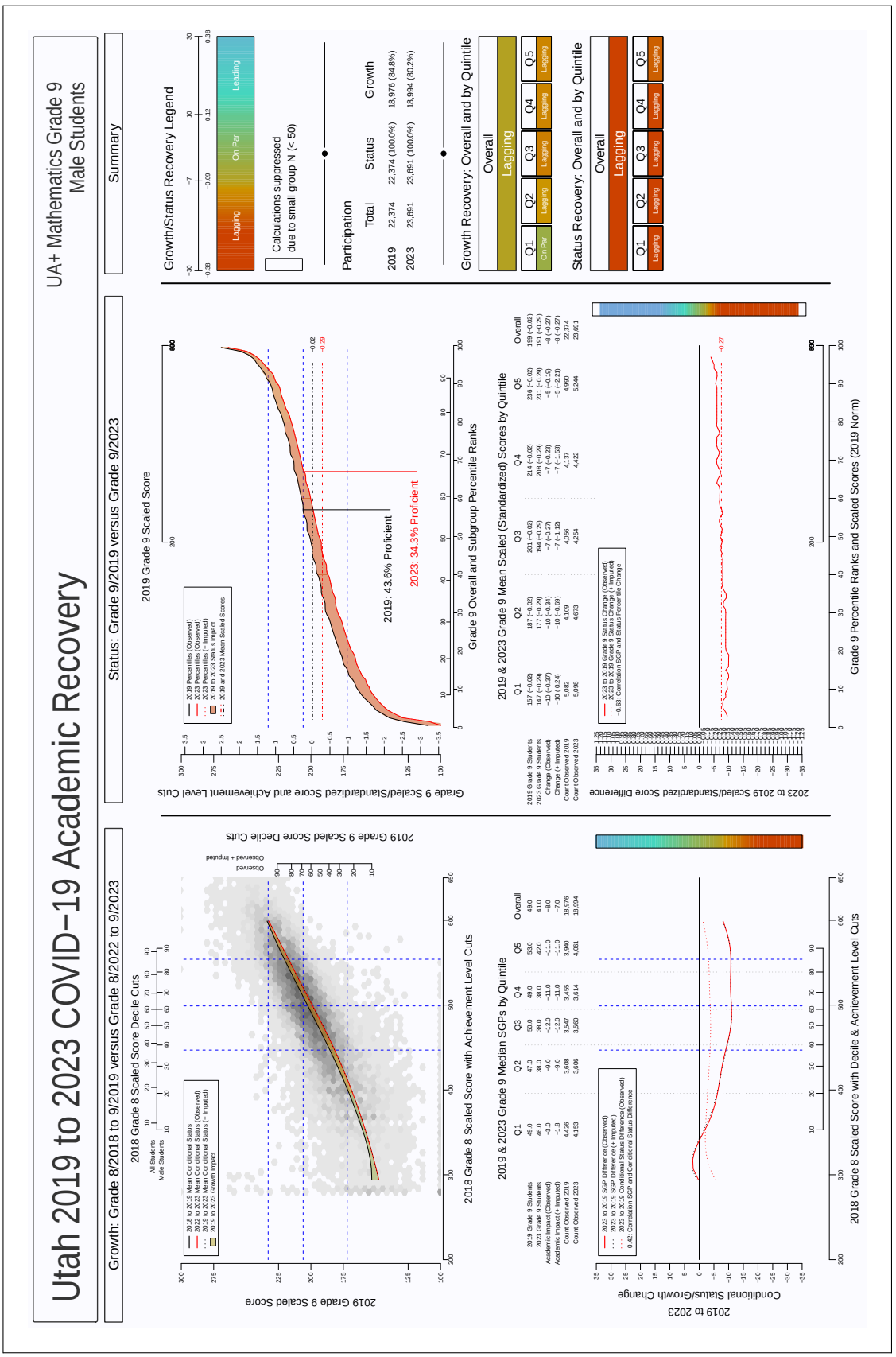

Figure 167: Utah UA+ academic recovery: Growth and status 2019 to 2023 grade 9 mathematics, male students

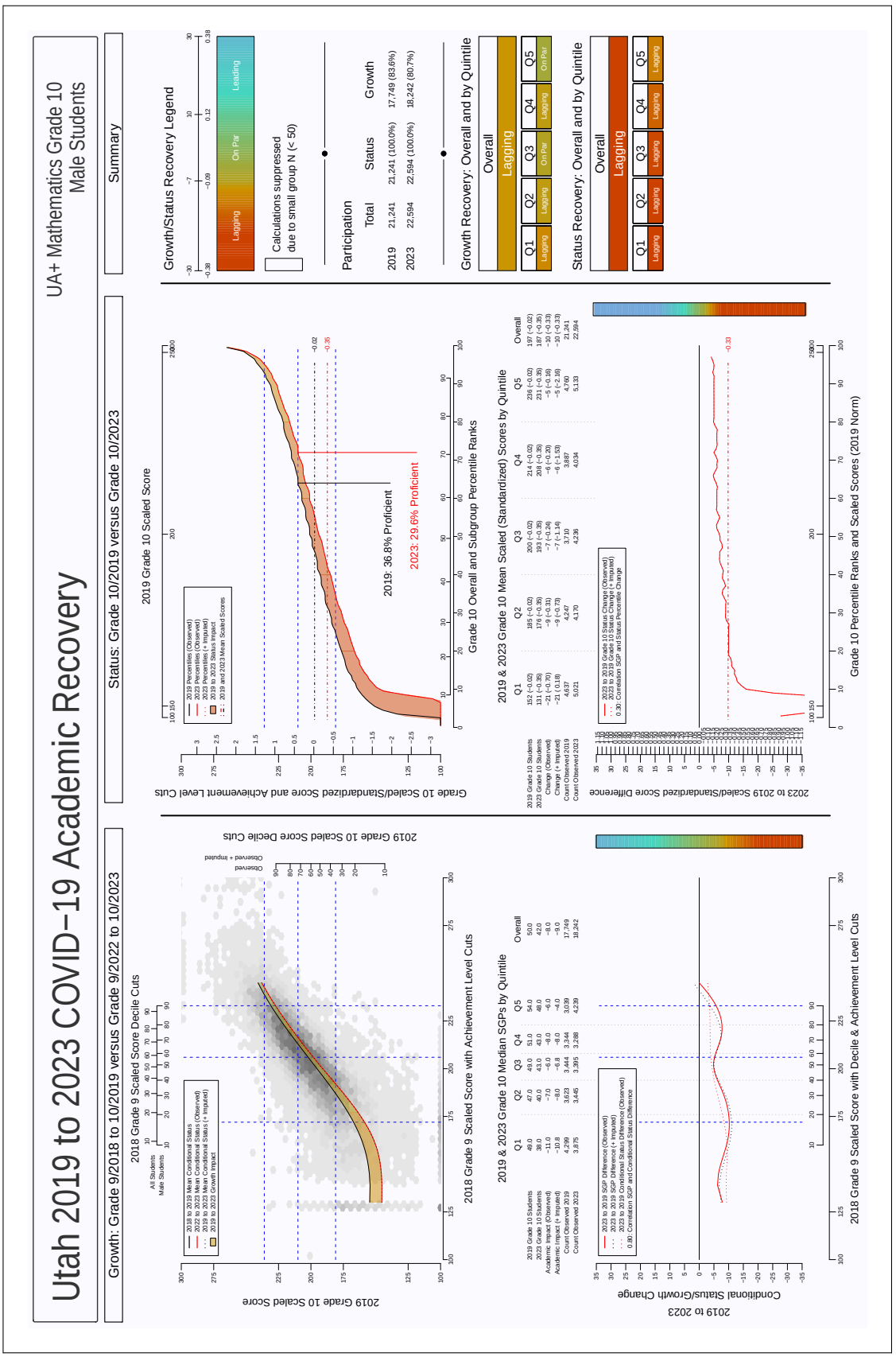

Figure 168: Utah UA+ academic recovery: Growth and status 2019 to 2023 grade 10 mathematics, male students

Appendix: Growth Model Technical Details

A Technical Overview of the Student Growth Percentile Methodology: Student Growth Percentiles and Percentile Growth Projections/Trajectories

Student Growth Percentiles

It is a common misconception that to quantify student progress in education, the subject matter and grades over which growth is examined must be on the same scale—referred to as a vertical scale. Not only is a vertical scale not necessary, but its existence obscures concepts necessary to fully understand student growth. Growth, fundamentally, requires change to be examined for a single construct like math achievement across time—*growth in what?*.

Consider the familiar situation from pediatrics where the interest is on measuring the height and weight of children over time. The scales on which height and weight are measured possess properties that educational assessment scales aspire towards but can never meet.[2]

> An infant male toddler is measured at 2 and 3 years of age and is shown to have grown 4 inches. The magnitude of increase—4 inches—is a well understood quantity that any parent can grasp and measure at home using a simple yardstick. However, parents leaving their pediatrician's office knowing only how much their child has grown would likely be wanting for more information. In this situation, parents are not interested in an absolute criterion of growth, but instead in a normative criterion locating that 4 inch increase alongside the height increases of similar children. Examining this height increase relative to the increases of similar children permits one to diagnose how (a)typical such an increase is.

Given this reality in the examination of change where scales of measurement are perfect, we argue that it is absurd to think that in education, where scales are at best quasi-interval, one can/should examine growth differently.[3]

Going further, suppose that scales did exist in education similar to height/weight scales that permitted the calculation of absolute measures of annual academic growth for students. The response to a parent's question such as, "How much did my child progress?", would be a number of scale score points—an answer that would leave most parents confused, wondering whether the number of points is good or bad. As in pediatrics, the search for a description regarding changes in achievement over

[2] Height and weight scales are interval (actually, ratio scales) where a unit increase reflects an equivalent increase in the underlying quality being measured no matter where on the scale the increase occurs.

[3] The scales on which students are measured are often assumed to possess properties similar to height and weight but they do not. Specifically, scales are assumed to be interval where it is assumed that a difference of 100 points at the lower end of the scale refers to the same difference in ability/achievement as 100 points at the upper end of the scale. See Lord (1975) and Yen (1986) for more detail on the interval scaling in educational measurement.

time (i.e., growth) is best served by considering a norm-referenced quantification of student growth—*a student growth percentile* (Betebenner, 2008b, 2009).

A student's growth percentile describes how (a)typical a student's growth is by examining his/her current achievement relative to his/her *academic peers*—those students beginning at the same place. That is, a student growth percentile examines the current achievement of a student relative to other students who have, in the past, "walked the same achievement path". Heuristically, if the state assessment data set were extremely large (in fact, infinite) in size, one could open the infinite data set and select out those students with the exact same prior scores and compare how the selected student's current year score compares to the current year scores of those students with the same prior year's scores—his/her academic peers. If the student's current year score exceeded the scores of most of his/her academic peers, in a normative sense they have done as well. If the student's current year score was less than the scores of his/her academic peers, in a normative sense they have not done as well.

The four panels of Figure 169 depict what a student growth percentile represents in a situation considering students having only two consecutive achievement test scores.[4]

Upper Left Panel Considering all pairs of prior year and current year scores for all students in the state yields a bivariate (two variable) distribution. The higher the distribution, the more frequent the pair of scores.

Upper Right Panel Taking account of prior achievement (i.e., conditioning upon prior achievement) fixes a the value of the prior year scale score (in this case at 600) and is represented by the red slice taken out of the bivariate distribution.

Lower Left Panel Conditioning upon prior achievement defines a *conditional distribution* which represents the distribution of outcomes on the current year test assuming a prior year score of 600. This distribution is indicated with the solid red curve.

Lower Right Panel The conditional distribution provides the context against which a student's current year achievement can be examined and understood in a norm-referenced fashion. Students with achievement in the upper tail of the conditional distribution have demonstrated high rates of growth relative to their academic peers whereas those students with achievement in the lower tail of the distribution have demonstrated low rates of growth. Students with current achievement in the middle of the distribution could be described as demonstrating "average" or "typical" growth.

In Figure 169, the student scores approximately 650 on the current year test. Within the conditional distribution, the value of 650 lies at the 75th percentile. Thus the student's growth from 600 in the prior year to 650 in the current year met or exceeded that of approximately 70 percent of students starting from the same place. Thus, relative to others with the same prior achievement score, this 50 point increase is above average. It is important to note that characterizing a student growth percentile as "adequate", "good", or "enough" requires a qualitative judgment to be rendered—growth standard setting. Later in this paper growth adequacy standards are investigated *vis-à-vis* state achievement levels.

Figure 169 also serves to illustrate the relationship between a vertical scale and student growth percentiles. Using the vertical scale implied by Figure 169, the student grew 50 points (from 600 to 650) between the prior and current year. This 50 points represents the absolute magnitude of change.

[4]By default, the SGP package (Betebenner et al., 2024) uses the entire achievement history of the student subject to some suitability conditions. Figure 169 is presented with just a single prior score to facilitate representing a conditional distribution.

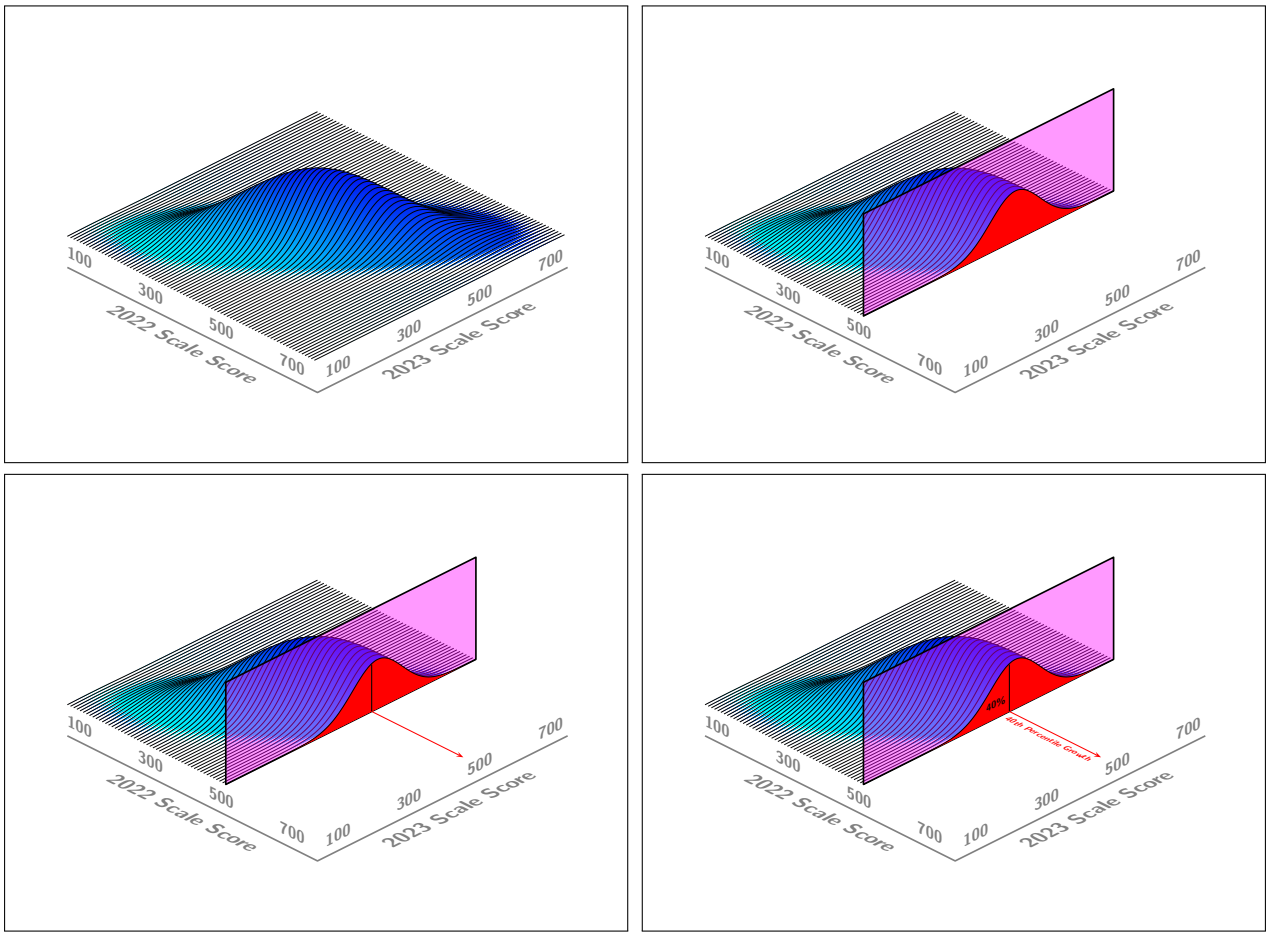

Figure 169: Figures depicting the distribution associated with 2022 (prior year) and 2023 (current year) student scale scores together with the conditional distribution and associated growth percentile

Quantifying the magnitude of change is scale dependent. For example, different vertical achievement scales in the prior and current year would yield different annual scale score increases: A scale score increase of 50 could be changed to a scale score increase of 10 using a simple transformation of the vertical scale on which all the students are measured. However, relative to other students, his/her growth has not changed—the growth percentile is invariant to scale transformations common in educational assessment (Briggs & Betebenner, 2009). Student growth percentiles normatively situate achievement change bypassing questions associated with the magnitude of change, and directing attention toward relative standing.

To fully understand how many states intend to use growth percentiles to make determinations about whether a student's growth is sufficient, the next section details specifics of how student growth percentiles are calculated. These calculations are subsequently used to calculate percentile growth projections/trajectories that are used to establish how much growth it will take for each student to reach his/her achievement targets.

Student Growth Percentile Calculation

Quantile regression is used to establish curvi-linear functional relationships between the cohort's prior scores and the cohort's current scores. Specifically, for each grade by subject cohort, quantile regression is used to establish 100 (1 for each percentile) curvi-linear functional relationships between

the students grade 3, grade 4, grade 5, and grade 6 prior scores and their grade 7 scores.[5] The result of these 100 separate analyses is a single coefficient matrix that can be employed as a look-up table relating prior student achievement to current achievement for each percentile. Using the coefficient matrix, one can plug in *any* grade 3, 4, 5, and 6 prior score combination to the functional relationship to get the percentile cutpoints for grade 7 conditional achievement distribution associated with that prior score combination. These cutpoints are the percentiles of the conditional distribution associated with the individual's prior achievement

Consider a student with the following mathematics scores:

Grade 3	Grade4	Grade 5	Grade 6	Grade 7
519	518	587	589	601

Table 1: Scale scores for a hypothetical student across 5 years in mathematics

Using the coefficient matrix derived from the quantile regression analyses based upon grade 3, 4, 5, and 6 scale scores as independent variables and the grade 7 scale score as the dependent variable together with this student's vector of grade 3, 4, 5, and 6 grade scale scores provides the scale score percentile cutpoints associated with the grade 7 conditional distribution for these prior scores.

1st	2nd	3rd	···	10th	···	25th	···	50th	51st	···	75th	···	90th	···	99th
514.8	534.9	543.9	···	566.9	···	584.8	···	600.5	601.3	···	616.9	···	630.1	···	653.8

Table 2: Percentile cutscores for grade 7 mathematics based upon the grade 3, 4, 5, and 6 mathematics scale scores given in Table 1

The percentile cutscores for 7th grade mathematics in Table 2 are used with the student's *actual* grade 7 mathematics scale score to establish his/her growth percentile. In this case, the student's grade 7 scale score of 601 lies above the 50th percentile cut and below the 51st percentile cut, yielding a growth percentile of 50. Thus, the progress demonstrated by this student between grade 6 and grade 7 exceeded that of 50 percent of his/her academic peers—those students with the same achievement history. States can qualify student growth by defining ranges of growth percentiles. For example, the Utah Growth Model designates growth percentiles between 40 and 60 as being *typical*. Using Table 2, another student with the exact same grade 3, 4, 5, and 6 prior scores but with a grade 7 scale score of 530, would have a growth percentile of 1, which is designated as *low*.

This example provides the basis for beginning to understand how growth percentiles in the SGP Methodology are used to determine whether a student's growth is *(in)adequate*. Suppose that in grade 6 a one-year (i.e., 7th grade) achievement goal/target of proficiency was established for the student. Using the lowest proficient scale score for 7th grade mathematics, this target corresponds to a scale score of 619. Based upon the results of the growth percentile analysis, this one year target corresponds to 78th percentile growth. Their growth, obviously, is less than this and the student has not met this individualized growth standard.

[5] For the mathematical details underlying the use of quantile regression in calculating student growth percentiles, see the Appendix *Student Growth Percentile Estimation* on 200.

Percentile Growth Projections/Trajectories

Building upon the example just presented involving only a one-year achievement target translated into a growth standard, this section extends this basic idea and shows how multi-year growth standards are established based upon pre-established achievement targets/goals. That is, by defining a future (e.g., a 3 year) achievement target for each student, we show how growth percentile analyses can be used to quantify what level of growth, expressed as a per/year growth percentile, is required by the student to reach his/her achievement target. Unique to the SGP Methodology is the ability to stipulate *both* what the growth standard is as well as how much the student actually grew in a metric that is informative to stakeholders.

Defining Adequate Growth

Establishing thresholds for growth for each student that can be used to make adequacy judgments requires pre-established achievement targets and a time-frame to reach the target for each student against which growth can be assessed (i.e., growth-to-standard). Adequacy in many contexts has been defined as *catching-up* and *keeping-up*:

Catch-Up Those students currently not "Proficient" are expected to reach "Proficient" within 4 years following the establishment of the achievement target or by grade 10, whichever comes sooner.[6]

Keep-Up Those students currently at or above "Proficient" are expected to remain at or above "Proficient" in all of the 4 years following the establishment of the achievement target or by grade 10, whichever comes sooner.

Move-Up Those students currently "Proficient" are expected to reach "Highly Proficient" within 4 years following the establishment of the achievement target or by grade 10, whichever comes sooner.

The previous definitions specify “4 years following the establishment of the achievement target” as the time frame. For example, an non-proficient 3rd grader would be expected to be "Proficient" by 7th grade, assuming a 1 grade per year progression. The first check of the student’s progress occurs in 4th grade, when the student’s growth over the last year is compared against targets calculated to assess their progress along a multi-year time-line. The question asked following the 4th grade for the student is: Did the student become "Proficient" and if not are they on track to become "Proficient" within 3 years?

Calculation of Growth Percentile Targets

As mentioned previously, the calculation of student growth percentiles across all grades and students results in the creation of numerous coefficient matrices that relate prior with current student achievement. These matrices constitute an annually updated statewide historical record of student progress. For the SGP Methodology, they are used to determine what level of percentile growth is necessary for each student to reach future achievement targets. For example, in the calculation of student growth percentiles in 2023 in Utah, the following coefficient matrices are produced:[7]

[6] The time frame of 4 years following the establishment of the achievement target is equivalent to within 3 years of when the first growth adequacy judgment is established for the student.

[7] Note that because Utah testing was cancelled in 2020, at present there is a maximum number of 3 consecutive prior achievement scores.

Grade 4 Using grade 3 prior achievement.

Grade 5 Using grade 4 and grades 3 & 4 prior achievement.

Grade 6 Using grade 5 and grades 4 & 5 prior achievement.

Grade 7 Using grade 6 and grades 5 & 6 prior achievement.

Grade 8 Using grade 7 and grades 6 & 7 prior achievement

Grade 9 Using grade 8 and grades 7 & 8 prior achievement.

Grade 10 Using grade 9 and grade 8 & 9 prior achievement

To describe how these numerous coefficient matrices are used together to produce 1, 2, 3, and 4 year growth targets, consider, for example, a 2023 4th grade student in mathematics with 3rd and 4th grade state mathematics scores of 290 ("Below Proficient") and 315 ("Below Proficient"), respectively. The following are the steps that transpire over 4 years to determine whether this student is on track to reach "Proficient".

August 2022 Accountability clock begins requiring students to reach state defined achievement targets within 4 years or by grade 10. In this example, the "Below Proficient" 3rd grade (in spring 2022) student under consideration is expected to be "Proficient" by grade 7 in 2026.

August 2023 Employing the coefficient matrices derived in the calculation of 2023 student growth percentiles:

- First, the coefficient matrix relating grade 4 with grade 3 prior achievement is used to establish the percentile cuts (i.e., one-year growth percentile projections/trajectories). If the student's actual 2023 growth percentile exceeds the percentile cut associated with "Proficient", then the student's one year growth is enough to reach "Proficient".[8] If the student reaches his/her achievement goal, then the accountability clock is reset for this student, with a new achievement goal of remaining "Proficient" for the next 4 years.
- Next, the 2 year growth percentile projections/trajectories are calculated, from 2022 to 2024. The student's actual grade 3 scale score together with the 99 hypothetical one-year growth percentile projections/trajectories derived in the previous step are plugged into the most recently derived coefficient matrix relating grade 5 with grade 3 & 4 prior achievement. This yields the percentile cuts (i.e., 2 year growth percentile projections/trajectories) for the student indicating what consecutive two-year 1st through 99th percentile growth (based upon the most recent student growth histories in the state) will lead to. Using the August 2022 achievement targets ("Proficient" by 7th grade, for this student), 2 year growth sufficient to reach the target is determined and the student's growth percentile is compared to this target. If the student's growth percentile exceeds this target, then the student is deemed on track to reach "Proficient".
- Next, the 3 year growth percentile projections/trajectories are established. The student's actual grade 3 scale score together with the 99 hypothetical 1 and 2 year growth percentile projections/trajectories derived in the previous step are plugged into the coefficient matrix relating grade 6 with grade 3, 4, & 5 prior achievement. This yields the percentile cuts

[8] Checking growth adequacy using one-year achievement targets is equivalent to confirming whether the student reached his/her one-year achievement target since the coefficient matrices used to produce the percentile cuts are based on current data.

(i.e., 3 year growth percentile projections/trajectories) for each student indicating what consecutive three-year 1st through 99th percentile growth (based upon the most recent student growth histories in the state) will lead to in terms of future achievement. Using the August 2022 achievement targets ("Proficient" by 7th grade, for this student), 3 year growth sufficient to reach the target is determined and the student's growth percentile is compared to this target. If the student's growth percentile exceeds this target then the student is deemed on track to reach "Proficient".

- Last, the 4 year growth percentiles projections/trajectories are established. The student's actual grade 3 scale score together with the 99 hypothetical 1, 2, and 3 year growth percentile projections/trajectories derived in the previous step are plugged into the coefficient matrix relating grade 7 with grade 3, 4, 5, & 6 prior achievement. This yields the percentile cuts (i.e., 4 year growth percentile projections/trajectories) for each student indicating what consecutive four-year 1st through 99th percentile growth (based upon the most recent student growth histories in the state) will lead to in terms of future achievement. Using the August 2022 achievement targets ("Proficient" by 7th grade for this student), 4 year growth sufficient to reach the target is determined and the student's growth percentile is compared to this target. If the student's growth percentile exceeds this target then the student is deemed on track to reach "Proficient".

August 2024 Employing the coefficient matrices derived in the calculation of 2024 student growth percentiles:

- First, with the student now presumably completing grade 5, the coefficient matrix relating grade 5 with grade 3 & 4 prior achievement is used to establish 99 percentile cuts (i.e., one-year growth percentile projections/trajectories). If the student's actual 2024 growth percentile exceeds the cut associated with "Proficient", then the student's one year growth was enough to reach "Proficient".[9] If the student reaches his/her achievement goal, then the accountability clock is reset for this student, with a new achievement goal of remaining "Proficient" for the next 4 years.
- Next, the student's grade 3 & 4 actual scores together with the 99 hypothetical one-year growth percentile projections/trajectories derived in the previous step are plugged into the coefficient matrix relating grade 6 with grade 3, 4, & 5 prior achievement. This yields 99 percentile cuts (i.e., 2 year growth percentile projections/trajectories) for the student indicating what consecutive two-year 1st through 99th percentile growth (based upon the most recent student growth histories in the state) will lead to in terms of future achievement. Using the August 2022 accountability achievement targets ("Proficient" by 7th grade for this student), 2 year growth sufficient to reach the target is determined and the student's growth percentile is compared to this target. If the student's growth percentile exceeds this target then the student is deemed on track to reach "Proficient".
- Finally, the student's grade 3 & 4 actual scores together with the 99 hypothetical 1 & 2 year growth percentile projections/trajectories derived in the previous steps are plugged into the coefficient matrix relating grade 7 with grade 3, 4, 5, & 6 prior achievement. This yields 99 percentile cuts (i.e., 3 year growth percentile projections/trajectories) for the student indicating what consecutive three-year 1st through 99th percentile growth (based upon the most recent student growth histories in the state) will lead to in terms of future achievement. Using the August 2022 accountability achievement targets ("Proficient" by

[9] Note, this is equivalent to just checking whether the student reached "Proficient" in 2024 since the coefficient matrices used to produce the 99 percentile cuts are based on 2024 data.

7th grade for this student), 3 year growth sufficient to reach the target is determined and the student growth percentile is compared to this target. If the student's growth percentile exceeds this target then the student is deemed on track to reach "Proficient".

- No 4 year targets are utilized because they exceed the time-frame initially established for the student to reach "Proficient".

August 2025 Employing the coefficient matrices derived in the calculation of 2025 student growth percentiles:

- First, with the student now presumably completing grade 6, the coefficient matrix relating grade 6 with grade 3, 4, & 5 prior achievement is used to establish 99 percentile cuts (i.e., one-year growth percentile projections/trajectories). If the student's actual 2025 growth percentile exceeds the cut associated with "Proficient", then the student's one year growth was enough to reach "Proficient".[10] If the student reaches his/her achievement goal, then the accountability clock is reset for this student, with a new achievement goal of remaining "Proficient" for the next 4 years.
- Next, the student's grade 3, 4, & 5 actual scores together with the 99 hypothetical one-year growth percentile projections/trajectories derived in the previous step are plugged into the coefficient matrix relating grade 7 with grade 3, 4, 5, & 6 prior achievement. This yields 99 percentile cuts (i.e., 2 year growth percentile projections/trajectories) for the student indicating what consecutive two-year 1st through 99th percentile growth (based upon the most recent student growth histories in the state) will lead to in terms of future achievement. Using the August 2022 accountability achievement targets ("Proficient" by 7th grade for this student), 2 year growth sufficient to reach the target is determined and the student's growth percentile is compared to this target. If the student's growth percentile exceeds this target then the student is deemed on track to reach "Proficient".
- No 3 or 4 year targets are utilized because they exceed the time-frame initially established for the student to reach "Proficient".

August 2026 Employing the coefficient matrices derived in the calculation of 2011 student growth percentiles:

- Because 2011 is the terminal year of the 4 year time frame established for the student to reach "Proficient" the student is deemed to have grown sufficiently if they have reached "Proficient".
- No 2, 3, or 4 year targets are utilized because they exceed the accountability time-frame initially established for the student to reach "Proficient".

The complexity of the process just described is minimized by the use of the R software environment in conjunction with an open source software library SGP developed by the state State Board of Education to calculate student growth percentiles and percentile growth projections/trajectories (R Development Core Team, 2023; Betebenner et al., 2024). Every year, following the loading of the data into the state State Board of Education data warehouse, student growth percentiles and percentile growth trajectories are calculated for each student. Once calculated, these values are easily used to make the yes/no determinations about the adequacy of each student's growth relative to his/her fixed achievement targets. These yes/no determinations are then used in aggregate to determine whether schools have met their AYP targets.

[10] Note, this is equivalent to just checking whether the student reached "Proficient" in 2025 since the coefficient matrices used to produce the 99 percentile cuts are based on 2025 data.

System-wide Growth and Achievement Charts

Operational work calculating student growth percentiles with state assessment data yields a large number of coefficient matrices derived from estimating Equation 2. These matrices, similar to a lookup table, "encode" the relationship between prior and current achievement scores for students in the norming group (usually an entire grade cohort of students for the state) across all percentiles and can be used both to qualify a student's current level growth as well as predict, based upon current levels of student progress, what different rates of growth (quantified in the percentile metric) will yield for students statewide.

When rates of growth necessary to reach performance standards are investigated, such calculations are often referred to as "growth-to-standard". These analyses serve a dual purpose in that they provide the growth rates necessary to reach these standards and also shed light on the standard setting procedure as it plays out across grades. To establish growth percentiles necessary to reach different performance/achievement levels, it is necessary to investigate what growth percentile is necessary to reach the desired performance level thresholds based upon the student's achievement history.

Establishing criterion referenced growth thresholds requires consideration of multiple future growth/achievement scenarios. Instead of inferring that prior student growth is indicative of future student growth (e.g., linearly projecting student achievement into the future based upon past rates of change), predictions of future student achievement are contingent upon initial student status (where the student starts) and subsequent rates of growth (the rate at which the student grows). This avoids fatalistic statements such as, "Student X is projected to be (not) "Proficient" in three years" and instead promotes discussions about the different rates of growth necessary to reach future achievement targets: "In order that Student X reach/maintain proficiency within three years, she will have to demonstrate *nth* percentile growth consecutively for the next three years." The change is phraseology is minor but significant. Stakeholder conversations turn from "where will (s)he be" to "what will it take?"

Parallel growth/achievement scenarios are more easily understood with a picture. Using the results of a statewide assessment growth percentile analyses, Figures 170 and 171 depict future growth scenarios in math and ELA, respectively, for a student starting in third grade and tracking that student's achievement time-line based upon different rates of annual growth expressed in the growth percentile metric. The figures depict the four state achievement levels across grades 3 to 10 in shades of dark to light gray (e.g., "Below Proficient", "Approaching Proficient", "Proficient" and "Highly Proficient") together with the 2011 achievement percentiles (inner most vertical axis) superimposed in white. Beginning with the student's achievement starting point at grade 3 a grade 4 achievement projection is made based upon the most recent growth percentile analyses derived using prior 3rd to 4th grade student progress. More specifically, using the coefficient matrices derived in the quantile regression of grade 4 on grade 3 (see Equation 2), predictions of what 10th, 20th, 40th, 50th, 60th, 80th, and 90th percentile growth lead to are calculated. Next, using these seven projected 4th grade scores combined with the student actual 3rd grade score, 5th grade achievement projections are calculated using the most recent quantile regression of grade 5 on grades 3 and 4. Similarly, using these seven projected 5th grade scores, the 6 projected 4th grade scores with the students actual third grade score, achievement projections to the 6th grade are calculated using the most recent quantile regression of grade 6 on grades 3, 4, and 5. The analysis extends recursively for grades 6 to 10 yielding the *percentile growth trajectories* in Figures 170 and 171. The figures allow stakeholders to consider what consecutive rates of growth, expressed in growth percentiles, yield for students starting at different points.

Figure 170 depicts percentile growth trajectories in mathematics for a student beginning at the threshold between achievement level 1 and achievement level 2. i Based upon the *achievement* per-

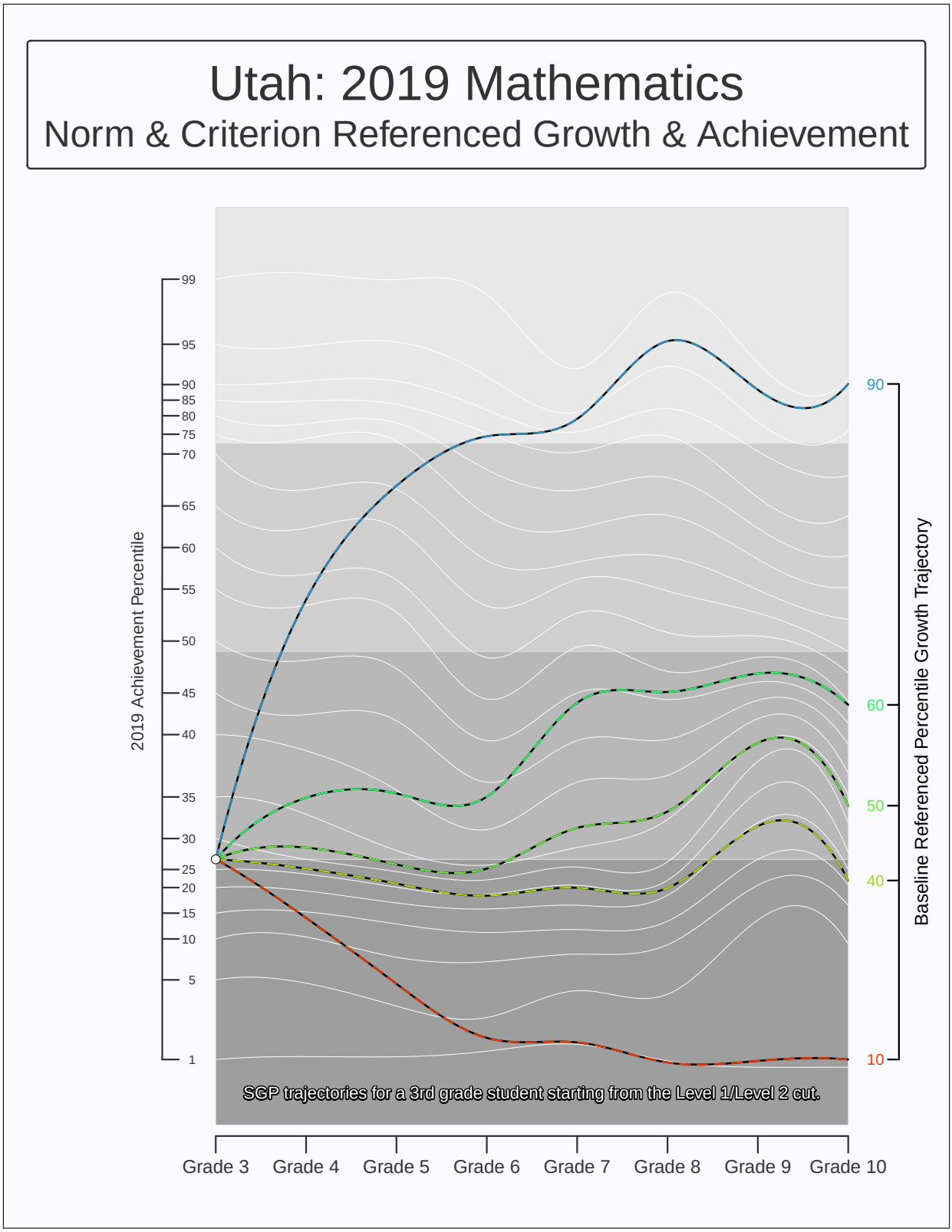

Figure 170: Growth chart depicting future mathematics achievement conditional upon consecutive 10th, 20th, 40th, 50th, 60th, 80th, and 90th percentile growth for a student beginning the third grade at the cutpoint between lowest and next to lowest achievement levels

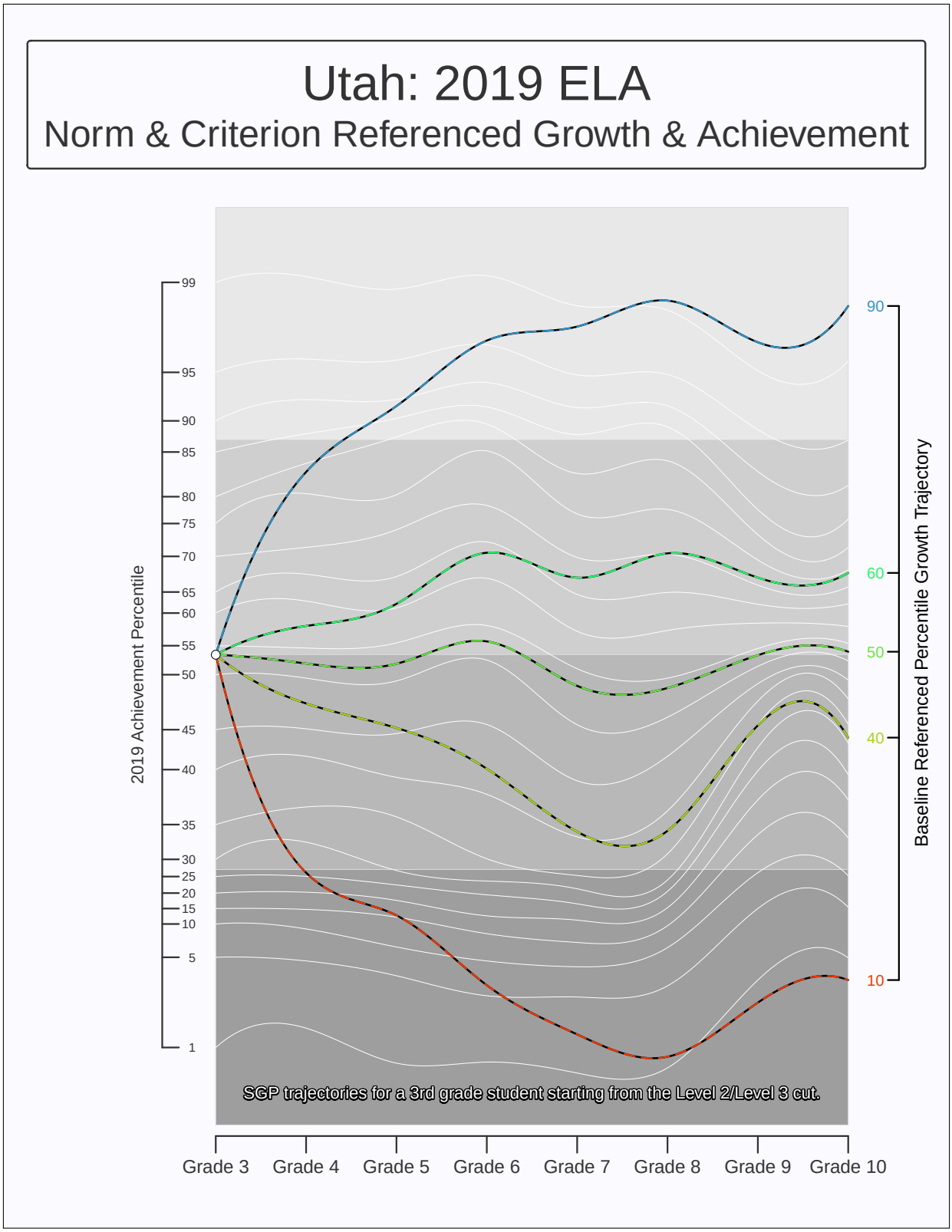

Figure 171: Growth chart depicting future ELA achievement conditional upon consecutive 10th, 20th, 40th, 50th, 60th, 80th, and 90th percentile growth for a student beginning the third grade at the cutpoint between the achievement level 2 and achievement level 3

centiles depicted (the white contour lines), approximately 7 percent of the population of 3rd graders rate as "Below Proficient". Moving toward grade 10, the percentage of "Below Proficient" students increases dramatically to near 35 percent. The black lines in the figure represent seven different growth scenarios for the student based upon consecutive growth at a given growth percentile, denoted by the right axis. At the lower end, for example, consecutive 10th percentile growth leaves the student, unsurprisingly, mired in the "Below Proficient" category. Consecutive 20th, 40th, 50th 60th, and 80th percentile growth also leave the student in the "Below Proficient" category. This demonstrates how difficult probabilistically, based upon current rates of progress, it is for students to move up in performance level in math statewide. Considering a goal of reaching "Proficient" or career and college readiness (next to top region) by 10th grade, a student would need to demonstrate growth percentiles consecutively in excess of 80 to reach this achievement target indicating how unlikely such a event currently is. In light of NCLB universal proficiency mandates, the growth necessary for non-proficient students to reach proficiency, absent radical changes to growth rates of students statewide, is likely unattainable for a large percentage of non-proficient students.

Figure 171 depicts percentile growth trajectories in ELA for a student beginning at the "Approaching Proficient"/"Proficient" threshold in grade 3. In a normative sense, the performance standards in ELA are less demanding than those in mathematics (particularly in the higher grades) with approximately 50 percent of students below "Proficient" in grades 3 to 10. The black lines in the figure represent seven growth scenarios for the hypothetical student based upon consecutive growth at a the given growth percentile. Compared with the growth required in mathematics, more modest growth is required to maintain proficiency in ELA. Typical growth (50th percentile growth) appears adequate for such a student to move up slightly into the proficiency category.

Student Growth Percentile Estimation

Calculation of a student's growth percentile is based upon the estimation of the conditional density associated with a student's score at time t using the student's prior scores at times $1, 2, \ldots, t-1$ as the conditioning variables. Given the conditional density for the student's score at time t, the student's growth percentile is defined as the percentile of the score within the time t conditional density. By examining a student's current achievement with regard to the conditional density, the student's growth percentile normatively situates the student's outcome at time t taking account of past student performance. The percentile result reflects the likelihood of such an outcome given the student's prior achievement. In the sense that the student growth percentile translates to the probability of such an outcome occurring (i.e., rarity), it is possible to compare the progress of individuals not beginning at the same starting point. However, occurrences being equally rare does not necessarily imply that they are equally "good." Qualifying student growth percentiles as "(in)adequate," "good," or as satisfying "a year's growth" is a standard setting procedure requiring external criteria (e.g., growth relative to state performance standards) combined with the wisdom and judgments of stakeholders.

Estimation of the conditional density is performed using quantile regression (Koenker, 2005). Whereas linear regression methods model the conditional mean of a response variable Y , quantile regression is more generally concerned with the estimation of the family of conditional quantiles of Y. Quantile regression provides a more complete picture of both the conditional distribution associated with the response variable(s). The techniques are ideally suited for estimation of the family of conditional quantile functions (i.e., reference percentile curves). Using quantile regression, the conditional density associated with each student's prior scores is derived and used to situate the student's most recent score. Position of the student's most recent score within this density can then be used to characterize the student's growth. Though many state assessments possess a vertical scale, such a scale is not necessary to produce student growth percentiles.

In analogous fashion to the least squares regression line representing the solution to a minimization problem involving squared deviations, quantile regression functions represent the solution to the optimization of a loss function (Koenker, 2005, p. 5). Formally, given a class of suitably smooth functions, $\mathcal{G}$, one wishes to solve

$$\arg\min_{g \in \mathcal{G}} \sum_{i=1}^{n} \rho_\tau(Y(t_i) - g(t_i)), \tag{1}$$

where t_i indexes time, Y are the time dependent measurements, and ρ_τ denotes the piecewise linear loss function defined by

$$\rho_\tau(u) = u \cdot (\tau - I(u < 0)) = \begin{cases} u \cdot \tau & u \geq 0 \\ u \cdot (\tau - 1) & u < 0. \end{cases}$$

The elegance of the quantile regression Expression 1 can be seen by considering the more familiar least squares estimators. For example, calculation of $\arg\min \sum_{i=1}^{n} (Y_i - \mu)^2$ over $\mu \in \mathbb{R}$ yields the sample mean. Similarly, if $\mu(x) = x'\beta$ is the conditional mean represented as a linear combination of the components of x, calculation of $\arg\min \sum_{i=1}^{n} (Y_i - x_i'\beta)^2$ over $\beta \in \mathbb{R}^p$ gives the familiar least squares regression line. Analogously, when the class of candidate functions $\mathcal{G}$ consists solely of constant functions, the estimation of Expression 1 gives the τth sample quantile associated with Y. By conditioning on a covariate x, the τth conditional quantile function, $Q_y(\tau|x)$, is given by

$$Q_y(\tau|x) = \arg\min_{\beta \in \mathbb{R}^p} \sum_{i=1}^{n} \rho_\tau(y_i - x_i'\beta).$$

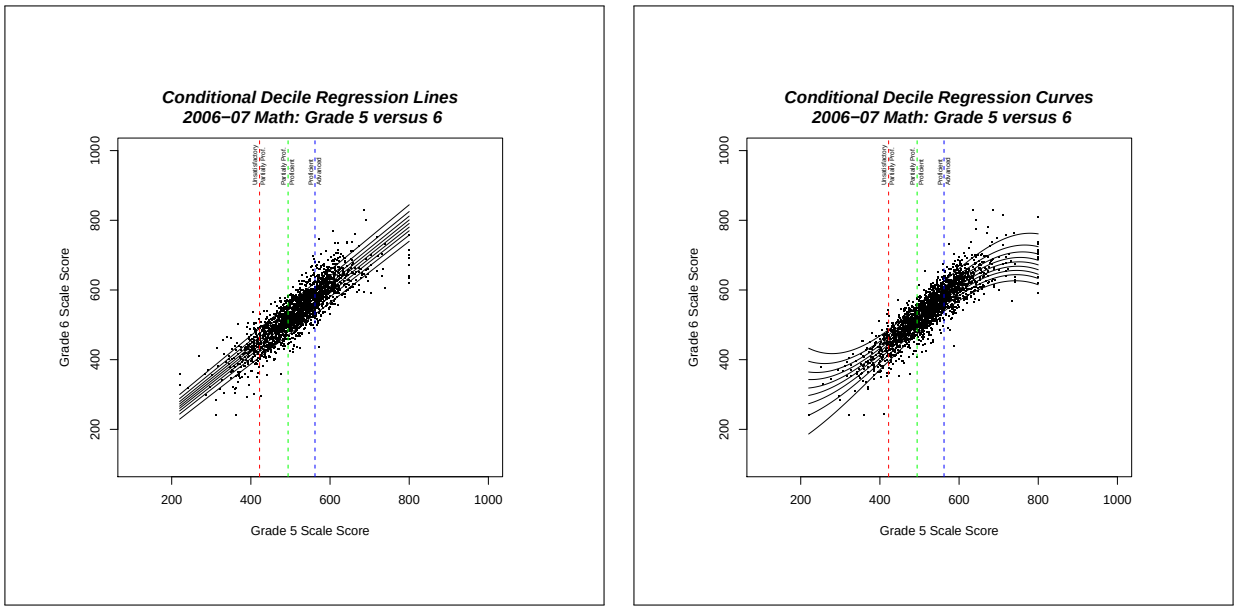

Figure 172: Linear and B-spline conditional deciles based upon bivariate math data, grades 5 and 6

In particular, if $\tau = 0.5$, then the estimated conditional quantile line is the median regression line.[11]

Following Wei & He (2006), we parametrize the conditional quantile functions as a linear combination of B-spline cubic basis functions.. B-splines are employed to accommodate non-linearity, heteroscedasticity and skewness of the conditional densities associated with values of the independent variable(s). B-splines are attractive both theoretically and computationally in that they provide excellent data fit, seldom lead to estimation problems (Harrell, 2001, p. 20), and are simple to implement in available software.

Figure 172 gives a bivariate representation of linear and B-splines parametrization of decile growth curves. The assumption of linearity imposes conditions upon the heteroscedasticity of the conditional densities. Close examination of the linear deciles indicates slightly greater variability for higher grade 5 scale scores than for lower scores. By contrast, the B-spline based decile functions better capture the greater variability at both ends of the scale score range together with a slight, non-linear trend to the data.

Calculation of student growth percentiles is performed using R (R Development Core Team, 2023), a language and environment for statistical computing, with SGP package (Betebenner et al., 2024). Other possible software (untested with regard to student growth percentiles) with quantile regression capability include SAS and Stata. Estimation of student growth percentiles is conducted using all available prior data, subject to certain suitability conditions. Given assessment scores for t occasions, $(t \geq 2)$, the τ-th conditional quantile for Y_t based upon $Y_{t-1}, Y_{t-2}, \ldots, Y_1$ is given by

$$Q_{Y_t}(\tau | Y_{t-1}, \ldots, Y_1) = \sum_{j=1}^{t-1} \sum_{i=1}^{3} \phi_{ij}(Y_j)\beta_{ij}(\tau), \tag{2}$$

where $\phi_{i,j}$, $i = 1, 2, 3$ and $j = 1, \ldots, t-1$ denote the B-spline basis functions. Currently, bases consisting of 7 cubic polynomials are used to "smooth" irregularities found in the multivariate assessment data. A bivariate rendering of this is found is Figure 172 where linear and B-spline conditional

[11] For a detailed treatment of the procedures involved in solving the optimization problem associated with Expression 1, see Koenker (2005), particularly Chapter 6.

deciles are presented. The cubic polynomial B-spline basis functions model the heteroscedasticity and non-linearity of the data to a greater extent than is possible using a linear parametrization.

Discussion of Model Properties

Student growth percentiles possess a number of attractive properties from both a theoretical as well as a practical perspective. Foremost among practical considerations is that the percentile descriptions are familiar and easily communicated to teachers and other non-technical stakeholders. Furthermore, implicit within the percentile quantification of student growth is a statement of probability. Questions of "how much growth is enough?" or "how much is a year's growth?" ask stakeholders to establish growth percentile thresholds deemed adequate. These thresholds establish growth standards that translate to probability statements. In this manner, percentile based growth forms a basis for discussion of rigorous yet attainable growth standards for all children supplying a normative context for Linn's (2003) existence proof with regard to student level growth.

In addition to practical utility, student growth percentiles possess a number of technical attributes well suited for use with assessment scores. The more important theoretical properties of growth percentiles include:

Robustness to outliers Estimation of student growth percentiles are more robust to outliers than is traditionally the case with conditional mean estimation. Analogous to the property of the median being less influenced by outliers than is the median, conditional quantiles are robust to extreme observations. This is due to the fact that influence of a point on the τ-th conditional quantile function is not proportional (as is the case with the mean) to the distance of the point from the quantile function but only to its position above or below the function (Koenker, 2005, p. 44).

Uncorrelated with prior achievement Analogous to least squares derived residuals being uncorrelated with independent variables, student growth percentiles are not correlated with prior achievement. This property runs counter to current multilevel approaches to measuring growth with testing occasion nested within students (Singer & Willett, 2003). These models, requiring a vertical scale, fit lines with distinct slopes and intercepts to each student. The slopes of these lines represent an average rate of increase, usually measured in scale score points per year, for the student. Whereas a steeper slope represents more learning, it is important to understand that using a normative quantification of growth, one cannot necessarily infer that a low achieving student with a growth percentile of 60 "learned as much" as a high achieving student with the same growth percentile. Growth percentiles bypass questions associated with magnitude of learning and focus on normatively quantifying changes in achievement.

Equivariance to monotone transformation of scale An important attribute of the quantile regression methodology used to calculate student growth percentiles is their invariance to monotone transformations of scale. This property, denoted by Koenker (2005) as *equivariance to monotone transformations* is particularly helpful in educational assessment where a variety of scales are present for analysis, most of which are related by some monotone transformation. For example, it is a common misconception that one needs a vertical scale in order to calculate growth. Because vertical and non-vertical scales are related via a monotone transformation, the student growth percentiles do not change given such alterations in the underlying scale. This result obviates much of the discussion concerning the need for a vertical scale in measuring growth.[12]

[12] As already noted with regard to pediatrics, the existence of nice "vertical" scales for measuring height and weight still leads to observed changes being normed.

Formally, given a monotone transformation h of a random variable Y,

$$Q_{h(Y)|X}(\tau|X) = h(Q_{Y|X}(\tau|X)).$$

This result follows from the fact that $\Pr(T < t|X) = \Pr(h(T) < h(t)|X)$ for monotone h. It is important to note that equivariance to monotone transformation does not, in general, hold with regard to least squares estimation of the conditional mean. That is, except for affine transformations h, $E(h(Y)|X) \neq h(E(Y|X))$. Thus, analyses built upon mean based regression methods are, to an extent, scale dependent.