Runs are listed in Table 1. All runs are similar in that the base resolution is 512^3 and box size is $L_{\rm box} = 1150\,{\rm R}_\odot$, corresponding to base resolution of $2.25\,{\rm R}_\odot$.

Also $r_{\rm soft} = 2.4\,{\rm R}_\odot$. $P_{\rm amb} = 1.1\times10^4\,{\rm dyn\,cm^{-2}}$ and $\rho_{\rm amb} = 1.0\times10^{-9}\,{\rm g\,cm^{-3}}$.

The level 0 mesh contains $\sim 1.3\times10^8$ cells.

All runs except Run 165 are similar in that the entire AGB star is resolved at level 3 AMR (minimum), corresponding to a resolution $0.28\,{\rm R}_\odot$.

The level 3 mesh contains $\sim 1.0\times10^9$ cells at $t = 0$, reducing to $\sim 1.0\times10^7$ at the end of the simulation (estimated).

For Run 165, the star is resolved at level 2 AMR.

Test runs are augmented with an extra 2 or 4 AMR levels near the center of the AGB star using the "particle buffer" property in ASTROBEAR.

Run 165 was unsuccessful as the AGB star was highly unstable (Fig. 6).

Run 175 was too slow to complete 1 frame (up to $t = 1.2\,{\rm d}$) on 32 nodes and was therefore cancelled.

For comparison, Ohlmann+2016a used values $r_{\rm soft}/\delta > 5$, $\delta \sim 0.02\,{\rm R}_\odot$, $L_{\rm box} = 4700\,{\rm R}_\odot$.

Plan based on test results

Goal is to minimize energy gain and computational time.

Runs 173 and 177 show the best performance in these respects, with Run 173 being faster by about 25%, and Run 177 being slightly better at conserving energy (by about $2-3\%$).

Run 177 also has larger buffer zones around the level 3 grid which make for a smoother transition in refinement from the star to the ambient.

Run 177 incorporates several minor improvements to the code that were made after Run 175. These include writing the particle positions to a file at high time sampling (this might have contributed to the longer run time).

For these reasons, I plan to go with Run 177 despite the longer run time compared to Run 173.

Estimate of computational hours needed

Let us assume that we will be running the simulation for 700 days as for Run 164. Based on experience with Run 164 as well as the number of cells in each AMR level, I expect the simulation to be ~ 4 times faster after $t = 200\,{\rm d}$. Factoring in that I will have to sometimes use 16 or 32 nodes to speed up the wall time, which is less efficient compared to 8 nodes, I expect the average computation time per $1.2\,{\rm d}$ to be ~ 60 node-hours (compared to 120 node-hours for the test run). This translates to about $35,000$ node-hours.

The allocation (expiring Mar 30, 2020) is 186,000 node-hours, out of which about 164,000 remain. Therefore, this run is expected to use about 20–25% of the remaining time.

Additional AGB runs

The paper would be strengthened by doing an additional run with larger secondary mass. This would likely eject more envelope in a given time. We could double the secondary mass to $1.96\,{\rm M}_\odot$, almost equal to the ZAMS primary mass of $2\,{\rm M}_\odot$. But this is larger than the AGB primary mass of $1.79\,{\rm M}_\odot$, so may be too extreme.

Another option is to do a run that includes radiation transport. A run without radiation transport is likely to be criticized since the simulation time may become comparable to the thermal timescale.

Each of these options might require 20–25% of the remaing node-hours, so probably only one is possible.

Other CE runs

For the CE Jets project, we plan to do about 5 more runs, including an AGB run. This will require maybe 30% of the remaining time.

Table 1: Summary of test runs.

Run	MaxLvl	δ $[\mathrm{R}_\odot]$	r_{soft}/δ	Size $[\mathrm{R}_\odot]$	Outer Buff [1D cells]	Inner Buff [1D cells]	Maxlevel Cells (3D)	Nodes	Comp time [hr/1.2 d]
164	3	0.28	9	—	16	—	—	128	~ 2
165	2	0.56	4	—	16	—	—	8	—
170	5	0.070	34	6	4	2	6×10^5	8	~ 11
173	5	0.070	34	24	4	2	4×10^7	16	~ 8
174	7	0.018	137	6	4	2	4×10^7	16	~ 20
175	7	0.018	137	24	4	2	3×10^9	32	~ 70 (est'd)
177	5	0.070	34	24	8	8	6×10^7	8	15
178	5	0.070	34	36	8	8	1.4×10^8	8	22
179	6	0.035	68	12	8	8	4×10^7	8	19
180	4	0.14	17	36	8	8	2×10^7	8	11

Triple systems

It would be interesting and relatively easy to run a simulation involving a triple system. We could stick to the RGB system studied in the papers. Can a second companion further out be coaxed to undergo spiral-in from drag with the CE-wind, and if so, can this lead to substantially more mass loss?

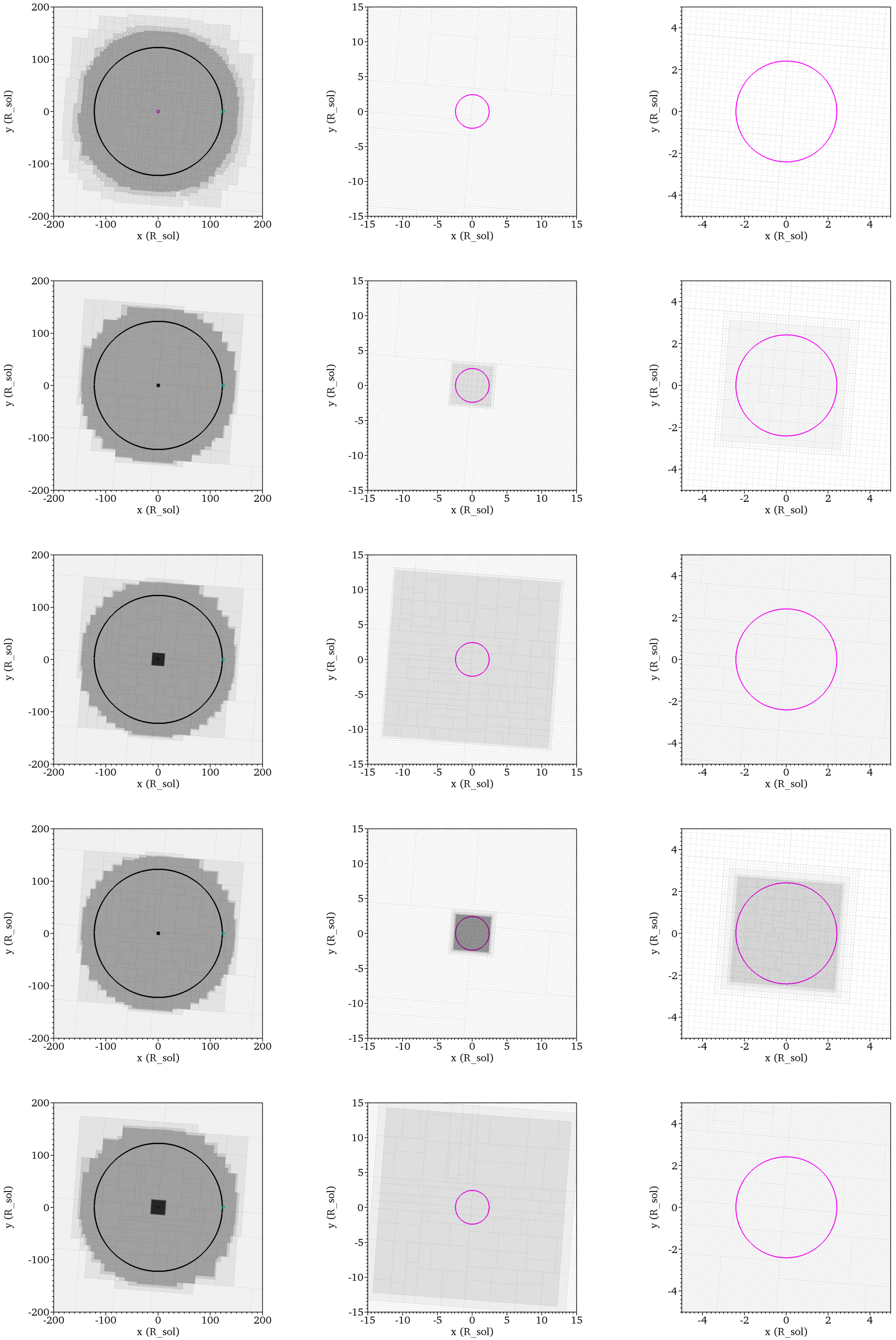

Figure 1: Rows from top to bottom show Runs 164, 170, 173, 174 and 177, respectively, at $t = 1.2\,\mathrm{d}$.

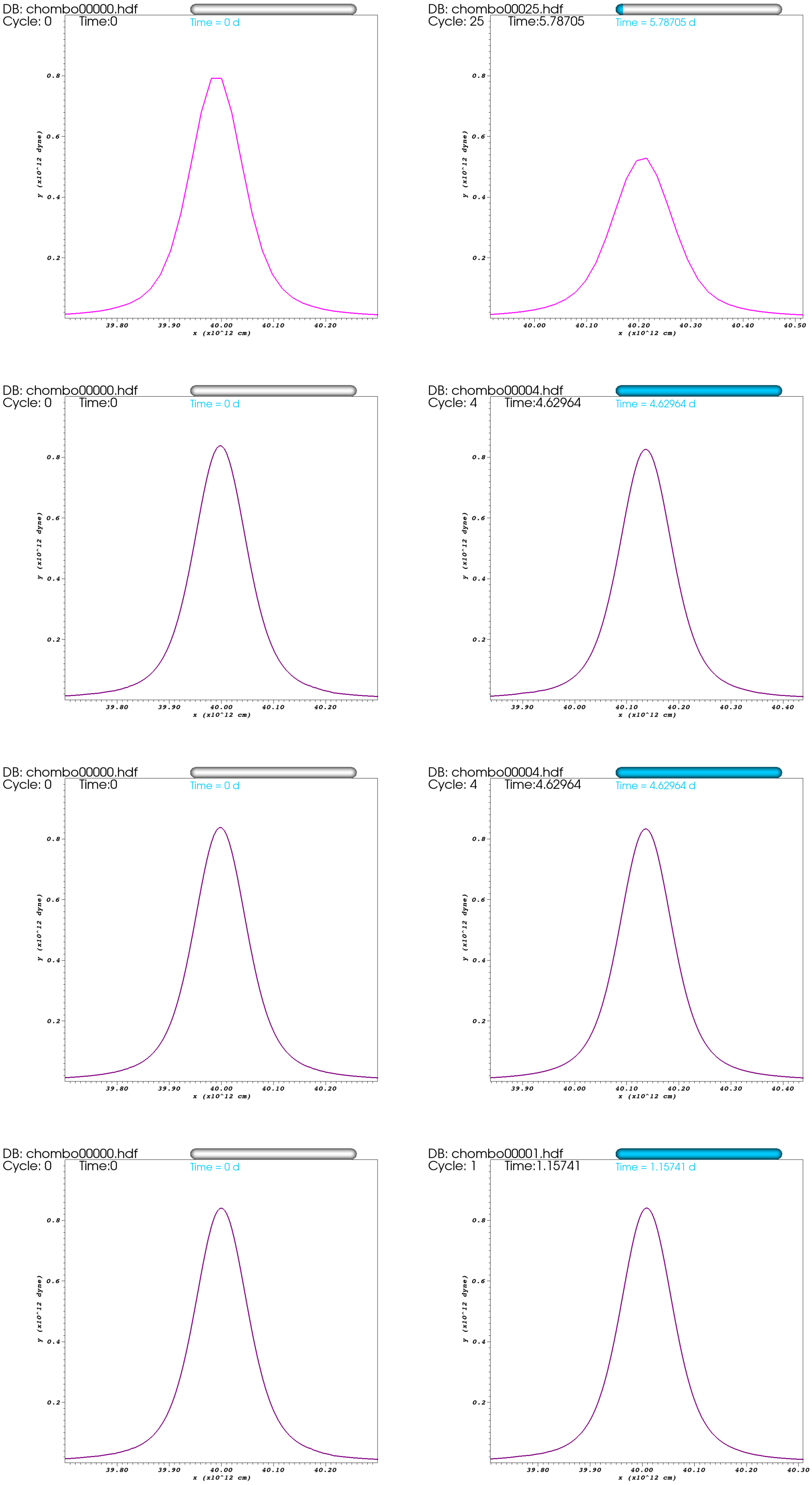

Figure 2: From top to bottom Runs 164, 170, 173 and 174. The right panels show snapshots at 5.8, 4.6, 4.6 and 1.2 days, respectively.

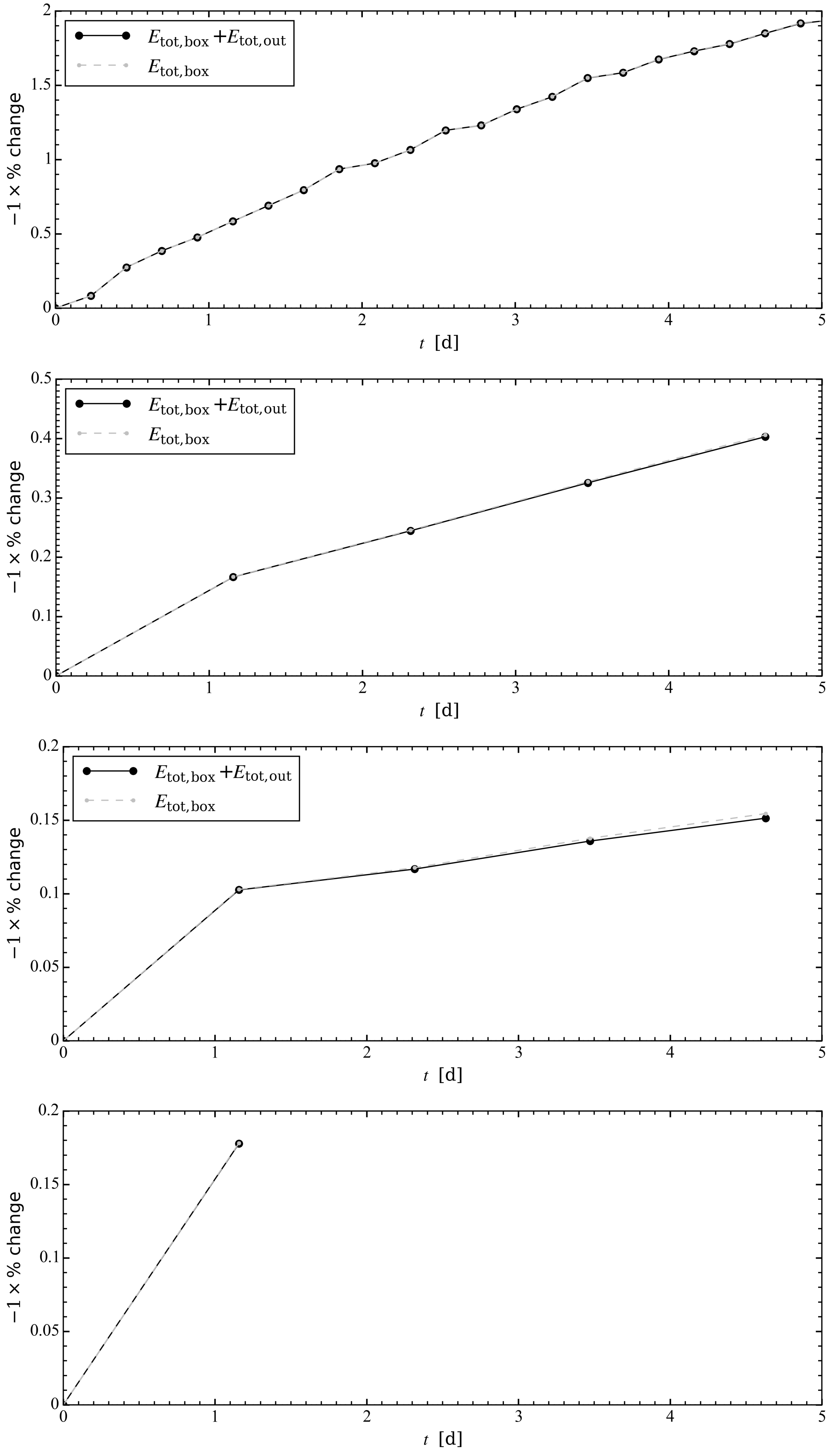

Figure 3: From top to bottom Runs 164, 170, 173 and 174.

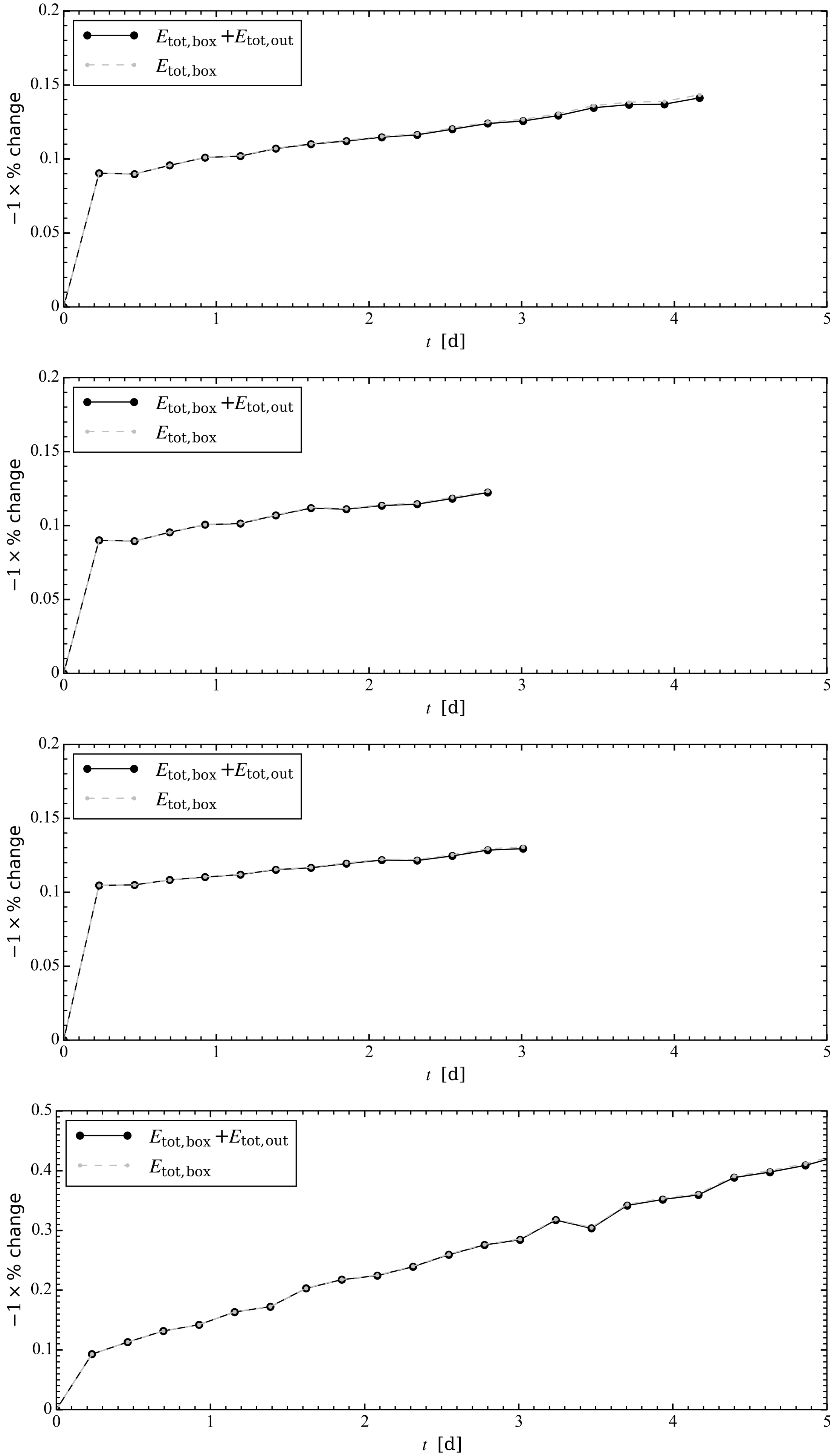

Figure 4: From top to bottom Runs 177, 178, 179 and 180.

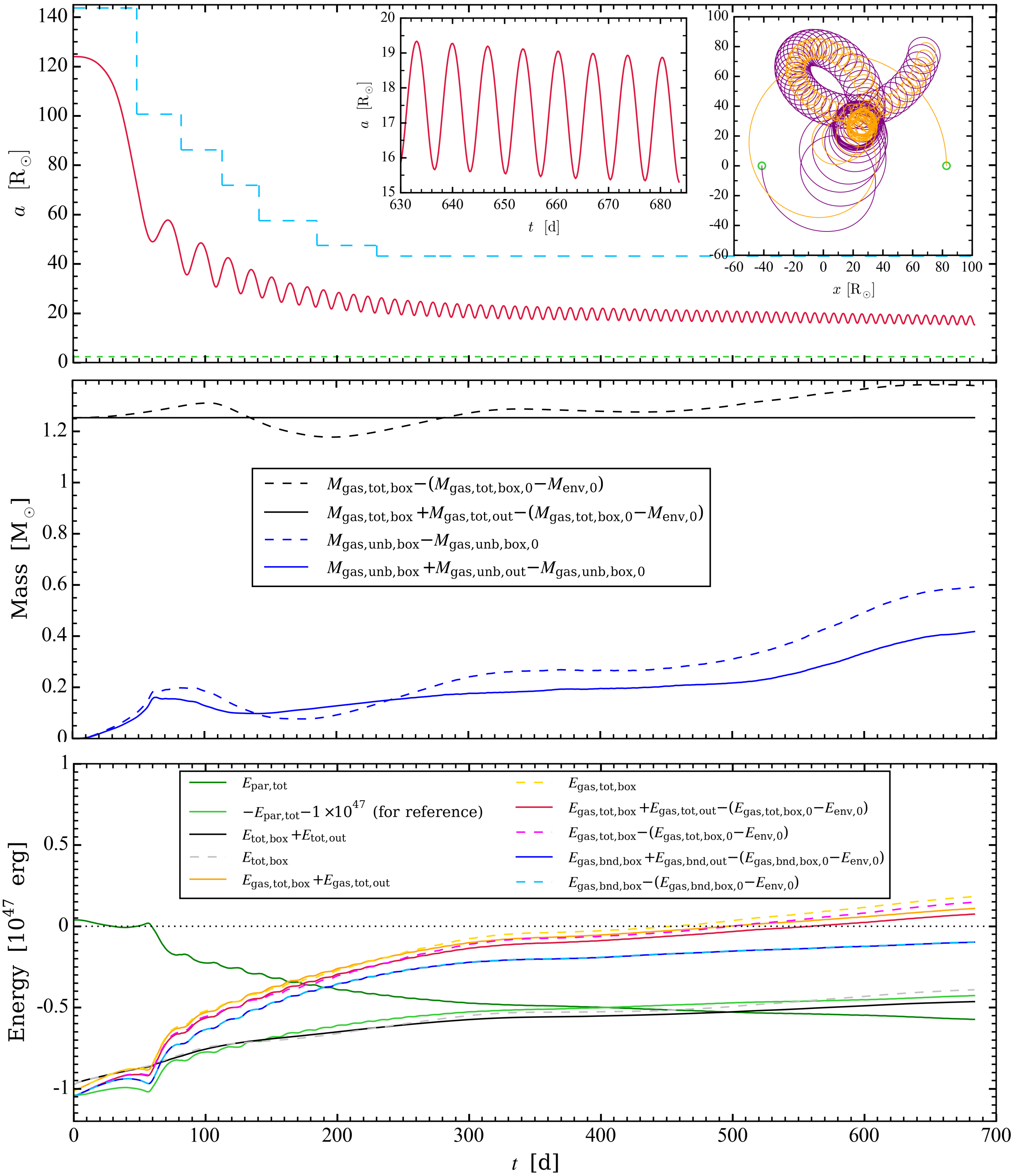

Figure 5: Orbit, mass and energy, Run 164.

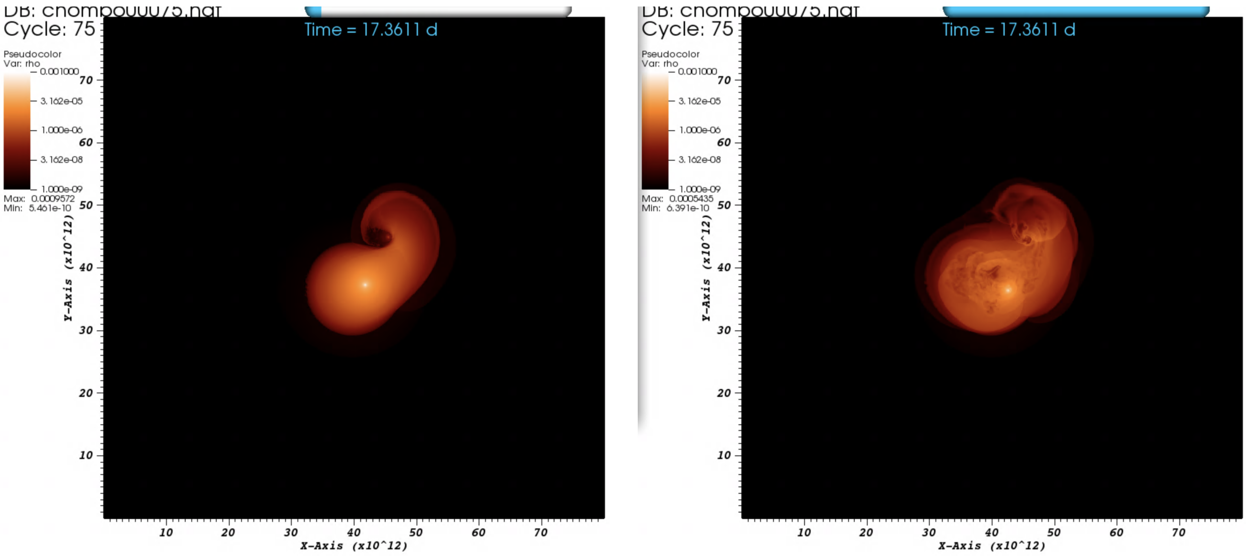

Figure 6: From left to right Runs 164 and 165.