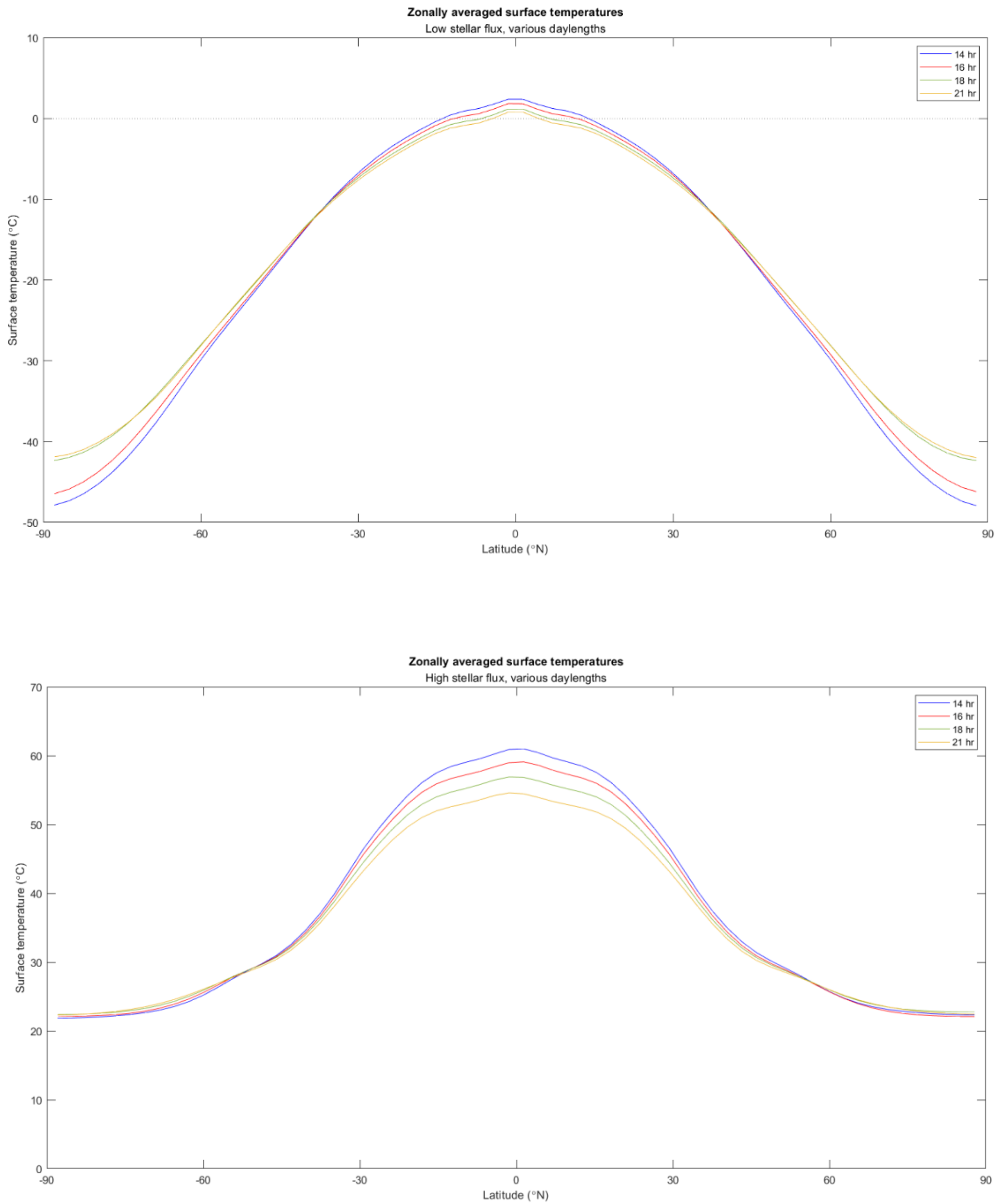

Figure 1: Zonally averaged surface temperature curves for (top) a stellar flux of 1000 W/m^2 and (bottom) 1370 W/m^2 and daylengths of (blue) 14, (red) 16, (green) 18, and (yellow) 21 hours. This is the average of the last 10 years of the simulation.

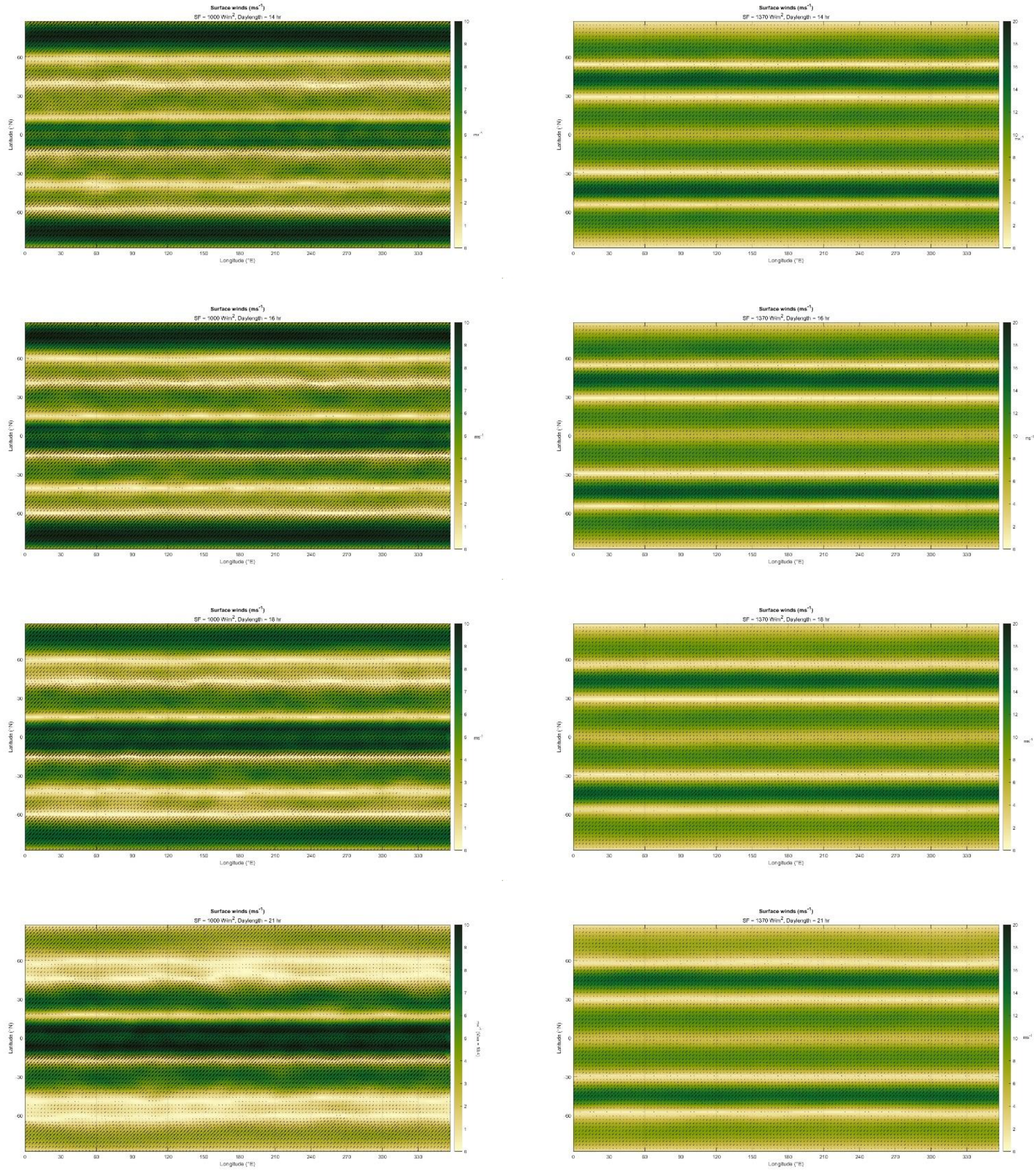

Figure 2*:* Surface winds for (left) a stellar flux of 1000 W/m^2 and (right) 1370 W/m^2 and daylengths of, from top to bottom, 14, 16, 18, and 21 hours. This is the average of the last 10 years of the simulation.

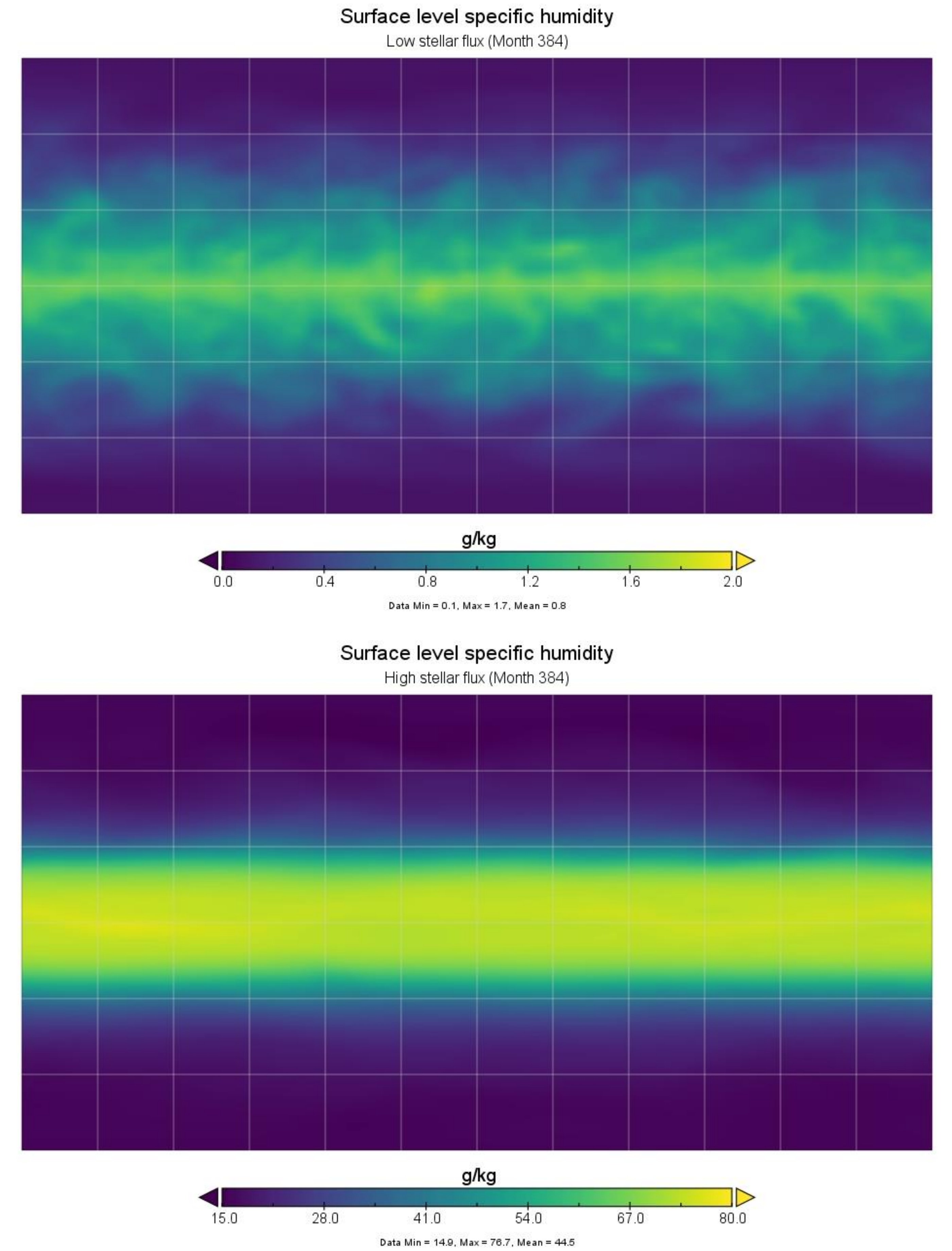

Figure 3: Surface level specific humidity (g/kg) for an aquaplanet with (top) low stellar flux and (bottom) high stellar flux. Note the large difference between the colour bar limits. We believe that the high stellar flux simulation is moving towards a runaway greenhouse effect.

Preliminary Results

- The change in solar constant (stellar flux = 1000 W/m^2 and 1370 W/m^2) has resulted in a very cold planet with an average surface temperature of ~-30 °C, and a very hot planet with an average surface temperature of ~50 °C respectively

Low stellar flux

- Equator to pole temperature difference = ~50 °C
- Fast rotation leads to weaker meridional heat transport, so equatorial temperatures increase while polar temperatures decrease compared to slower rotation rates
- Rotation rate has a larger impact at the polar latitudes compared to the equatorial regions
- Weak surface winds (0-10 m/s), that further weaken at the poles but strengthen at the equator as rotation rate slows
- Low specific humidity due to the low temperatures, leading to lack of water vapour greenhouse effect

High stellar flux

- Equator to pole temperature difference = ~40 °C
- Rotation rate has a larger impact at equatorial latitudes compared to the poles – this is the opposite of the low stellar flux simulation
- A 7 hour increase in rotation rate – from 21 hr to 14 hr daylength – increases the equatorial surface temperature by ~7 °C
- Surface winds are approximately double the strength of the low stellar flux simulation (0-20 m/s), due to the amount of heat required to be redistributed, but rotation rate has a smaller effect
- Surface wind circulation cells appear to move poleward slightly but the winds weaken towards the poles
- Very high specific humidity at the surface due to strong ocean evaporation, leading to an enhanced greenhouse effect which further amplifies surface temperatures
- This strong evaporation effect may be leading towards a runaway greenhouse effect, and this will be further explored by switching on the cloud module