A fundamental principle in non-equilibrium thermodynamics is the assumption of local equilibrium. However, we shall show that this assumption breaks down for thermal fluctuations. In contrast to fluctuations in fluids in equilibrium states, one finds always large-scale thermal fluctuations in fluids in non-equilibrium states, even far away from any hydrodynamic instability. These mesoscopic non-equilibrium fluctuations are no longer local, but encompass the entire system and are profoundly affected by confinement and gravity. The experimental evidence for these spectacular fluctuation phenomena will be reviewed. Most recently, it has been predicted that these non-equilibrium fluctuations will cause a new type of fluctuation-induced Casimir force in liquids.