Signal propagation delay induced by the Earth's troposphere is one of the major error sources in surface deformation monitoring using SAR Interferometry. The difficulty of modelling the delay mainly comes from the high temporal and spatial variation of water vapour. Numerical weather models (NWM) have recently raised a great interest in science because of its all-weather and worldwide capability for delay prediction. Here we investigate the feasibility of using the WRF (Weather Research and Forecasting) model for mitigating tropospheric delay in InSAR. The investigation is carried out by comparing the model predictions to a number of atmospheric-only interferograms over four different climatic regions (i.e., Hawaii, Mexico, the Netherlands and Southwest Australia) with and without strong land topography. Besides, we also compare the model predictions to radiosonde records that contain vertical profiles of air temperature, water vapour mixing ratio and precipitable water vapour (PWV). The comparison between radiosonde and WRF shows that the (time-varying) standard atmosphere with no lateral fluctuation can be fairly predicted by WRF. This results in a significant reduction of delay due to vertical stratification over mountainous regions. However, over flat regions WRF can hardly bring any delay reduction and it always significantly underestimates the delay variability due to turbulent mixing within the Earth’s atmospheric boundary layer. Therefore, we conclude that it is only feasible for NWM to mitigate delay due to vertical stratification over mountainous regions rather than turbulent mixing over flat terrains.