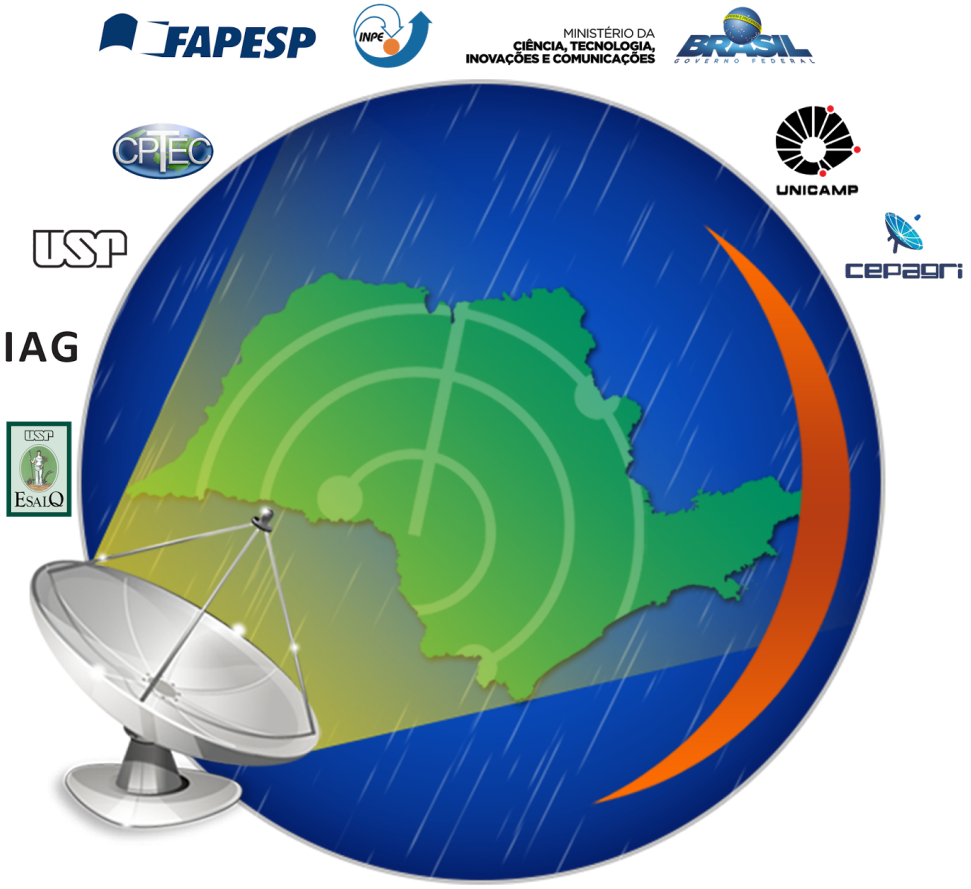

Weather report – 28 November 2017 – Campinas/SP

Summary:

1) Synoptic analysis and pre-convective environment

2) Verification

1) Synoptic analysis and pre-convective environment:

At 1200 UTC 28 November 2017 (Fig. 1), a midlevel trough associated with cold air aloft was moving northeastward over the Atlantic Ocean near the coast of Southern Brazil. The associated surface cold front had passed by the coast of São Paulo in the previous night (0000 to 0600 UTC) while the surface high pressure built farther South. This pattern was responsible for relatively cold low-level southeasterly flow in the coast of São Paulo state at 1200 UTC. High precipitation accumulations were observed in the Serra do Mar ridge due to orographic low-level convergence. Since the cold air could not move over the continent crossing the Serra do Mar ridge, the low-level temperature gradient was intensified along the coast as the colder air over the ocean was located nearby the warm continental air (Fig. 2).

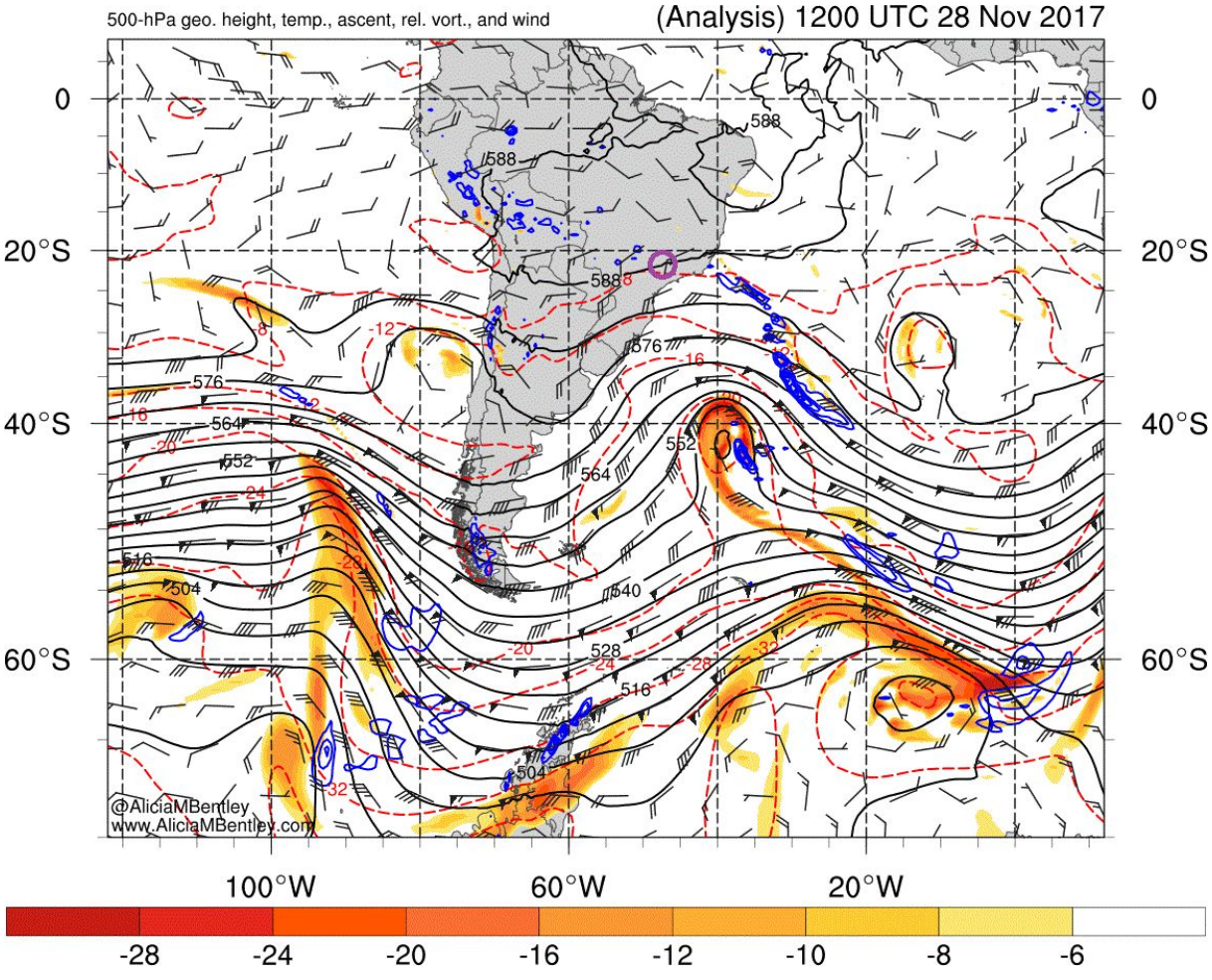

Figure 1: GFS analysis of cyclonic vorticity (shaded), upward motion (blue contours), geopotential height (black contours) and wind at 500 hPa at 1200 UTC 28 November 2017. The purple circle marks the Campinas region.

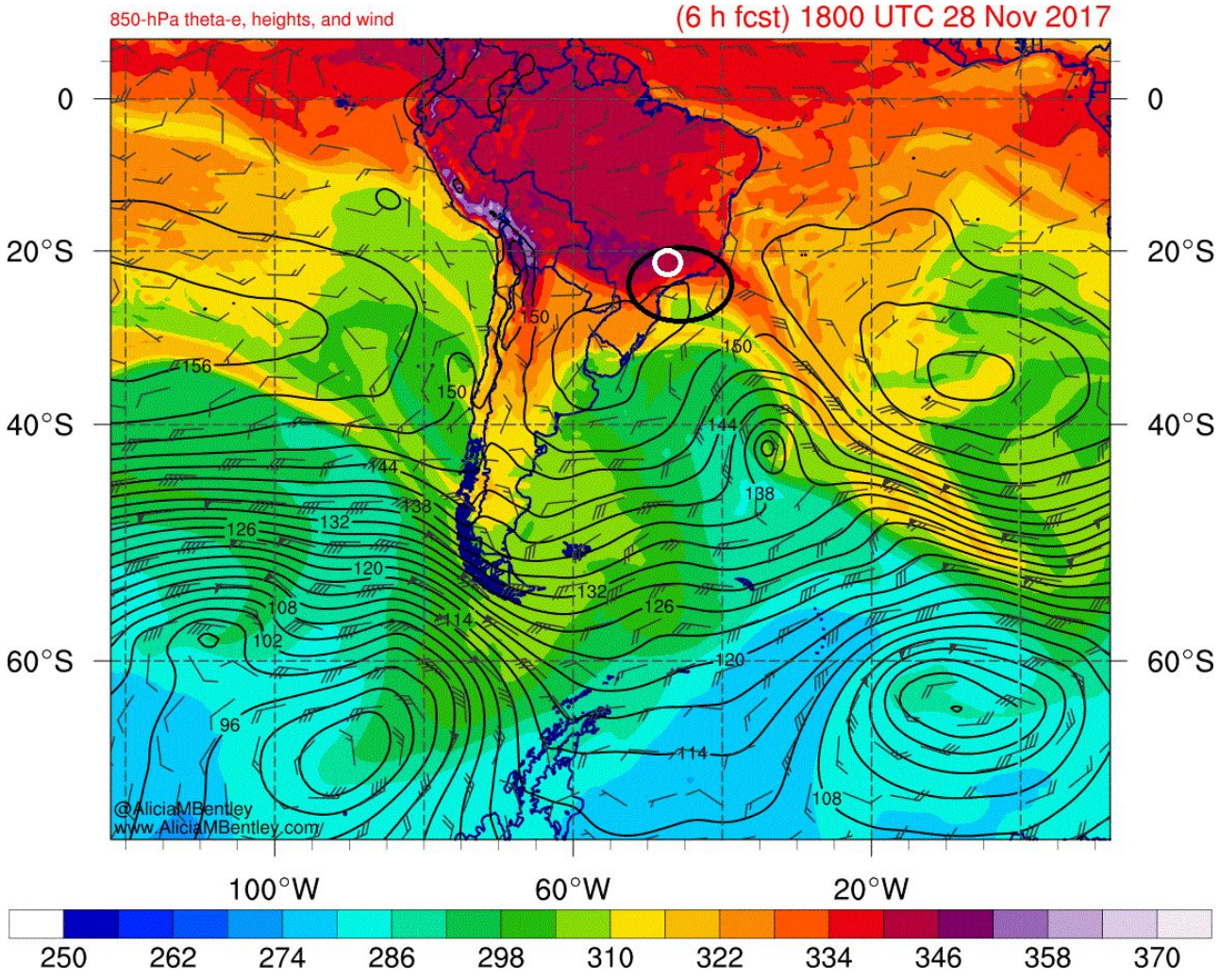

Figure 2: GFS analysis of equivalent potential temperature (shaded), geopotential height (black contours) and wind at 850 hPa at 1800 UTC 28 November 2017. The white circle marks the Campinas region.

Despite relatively cold and dry air being advected from the ocean toward the Campinas region, the lack of thick clouds and strong incoming solar radiation at 1200 UTC (Fig. 3a) were favorable for a rapid increase in temperature and consequently increase in CAPE during the afternoon. The Eta model forecast of surface-based CAPE at 1800 UTC (Fig. 4) was in the 1400-1600 J kg^{-1} range, which favors thunderstorms.

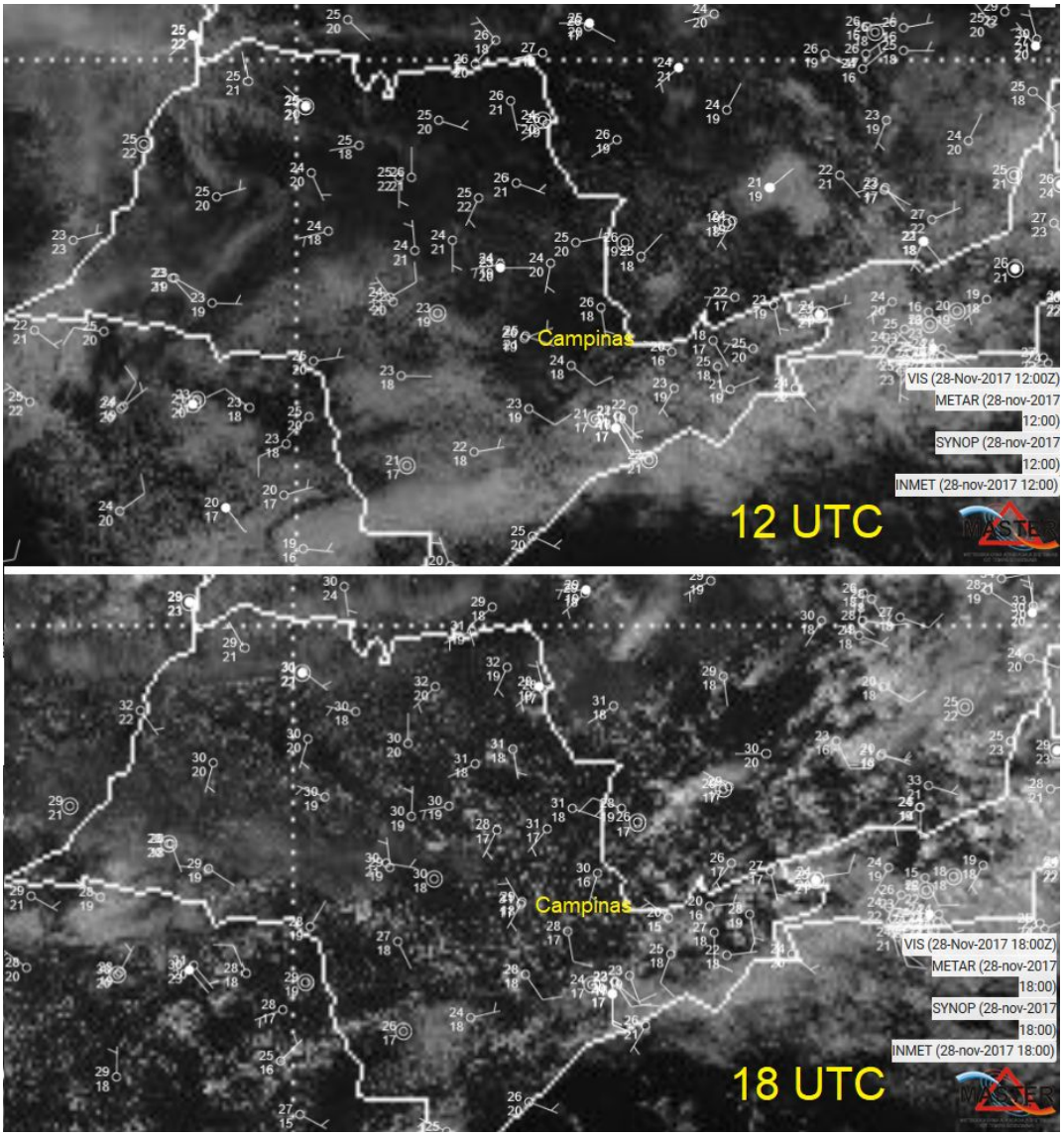

Figure 3: Surface observations superposed to visible GOES-13 satellite imagery at (a) 1200 UTC and (b) 1800 UTC.

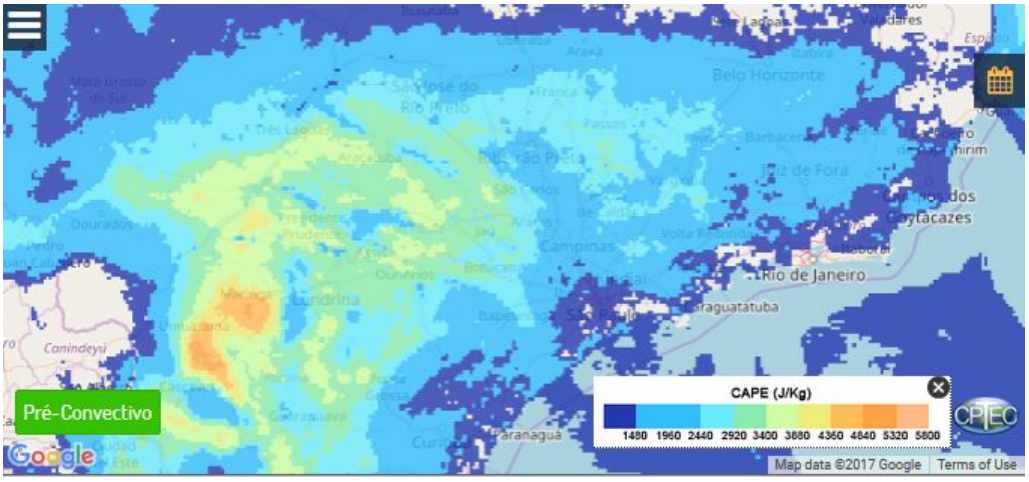

Figure 4: Surface-based CAPE forecast originated from the Eta/CPTEC regional model.

The soundings of 1200UTC of São Paulo (Fig. 5) depicted a relatively dry midtroposphere with layers of steep temperature lapse-rates. These layers are caused by forced subsidence behind the midlevel trough axis. The wind profile was very weak, and shear was only marginal for severe convection.

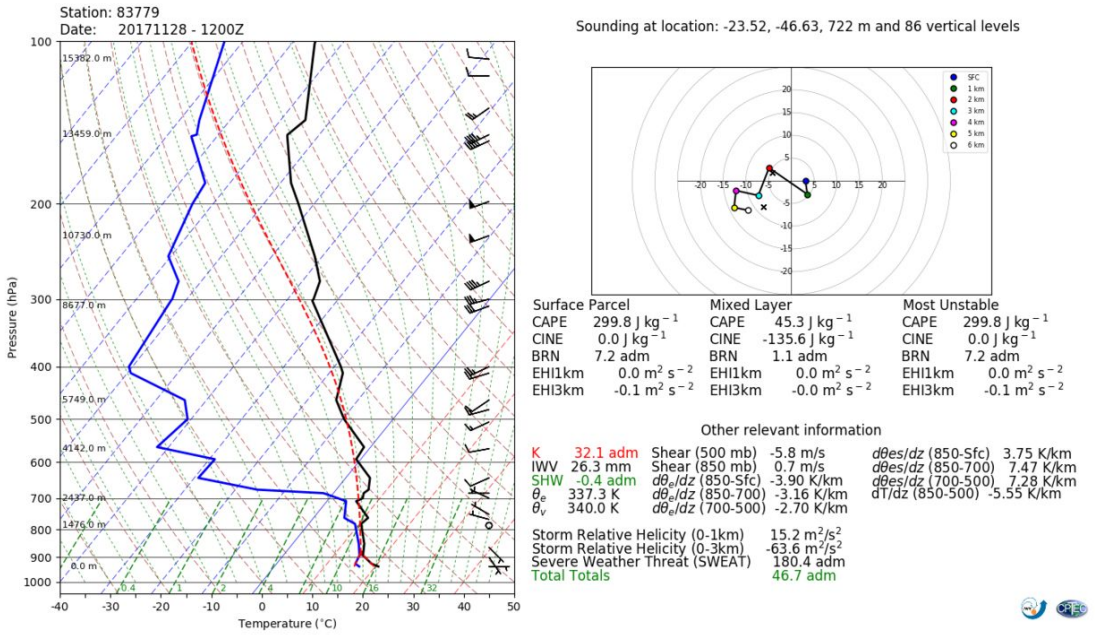

Figure 5: Skew-T/log p and hodograph of the São Paulo 1200 UTC sounding.

The high-resolution model forecasts by the 1-km WRF and 4-km BRAMS are shown in Fig. 6. The precipitation predicted for the 1800 UTC time was associated with isolated convective cells over and north of the Campinas region (center of figures) formed along convergence zones. All models were indicating potential for at least isolated storms.

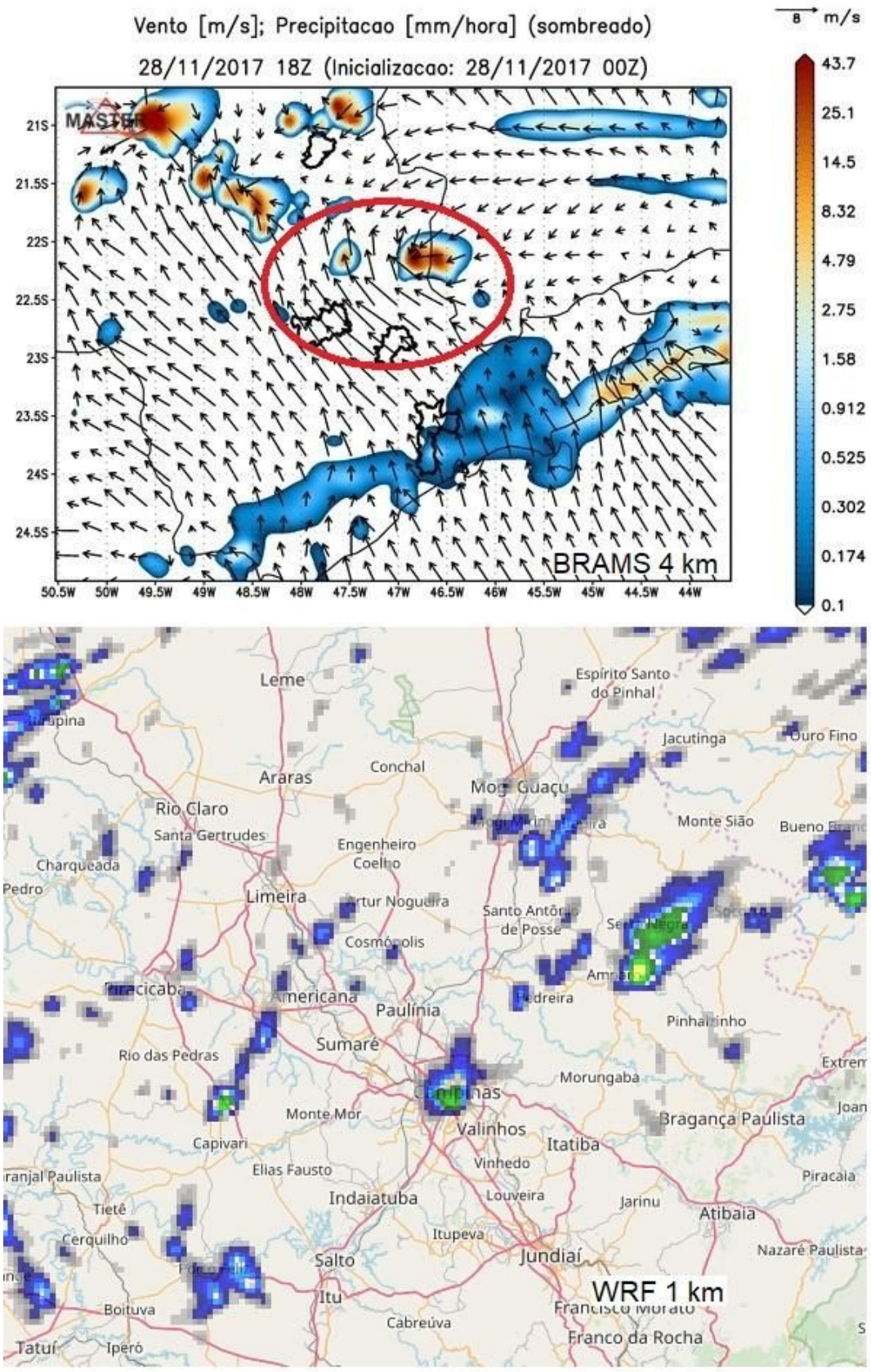

Figure 6: BRAMS 4km and WRF 1km forecasts for 1800 UTC 28 November 2017.

The consensual forecast for the afternoon of 28 November 2017 was for isolated thunderstorms to occur over the Campinas region but mainly to the north, given the greater moisture north of Campinas in association with the frontal passage. The weak shear and moderate CAPE predicted to the afternoon were indicating only a very limited severe weather probability. Storms were predicted to move northeastward.

2) Verification:

Fig. 3b evidence that only a few cumulus congestus formed near the Campinas region in the afternoon (1800 UTC), with no mature thunderstorm. The surface winds from the south and southeast in southeastern São Paulo state indicate that continuous cold and dry air may have limited storm formation. Possibly, dry entrainment in the updrafts between the lower and midtroposphere (Figs. 5, 7 and 8) was responsible for weakening of the updrafts in the cumulus stage.

Since no storm formed in the afternoon, the only operational routines were two soundings launched at 1500 UTC and 1800 UTC. The 1500 UTC sounding (Fig. 7) shows the possible reason for no thunderstorm formation in the region: a strong inversion layer at nearly 650 hPa. This inversion is dissipated at 1800 UTC (Fig. 8), but another inversion at nearly 550 hPa was causing relatively high convective inhibition at this time. A possible mechanism for the formation of these inversions is forced subsidence behind the midlevel trough. The 29 November 2017 0000 UTC sounding (Fig. 9) also shows a very stable troposphere with an inversion at nearly 900 hPa, and zero CAPE.

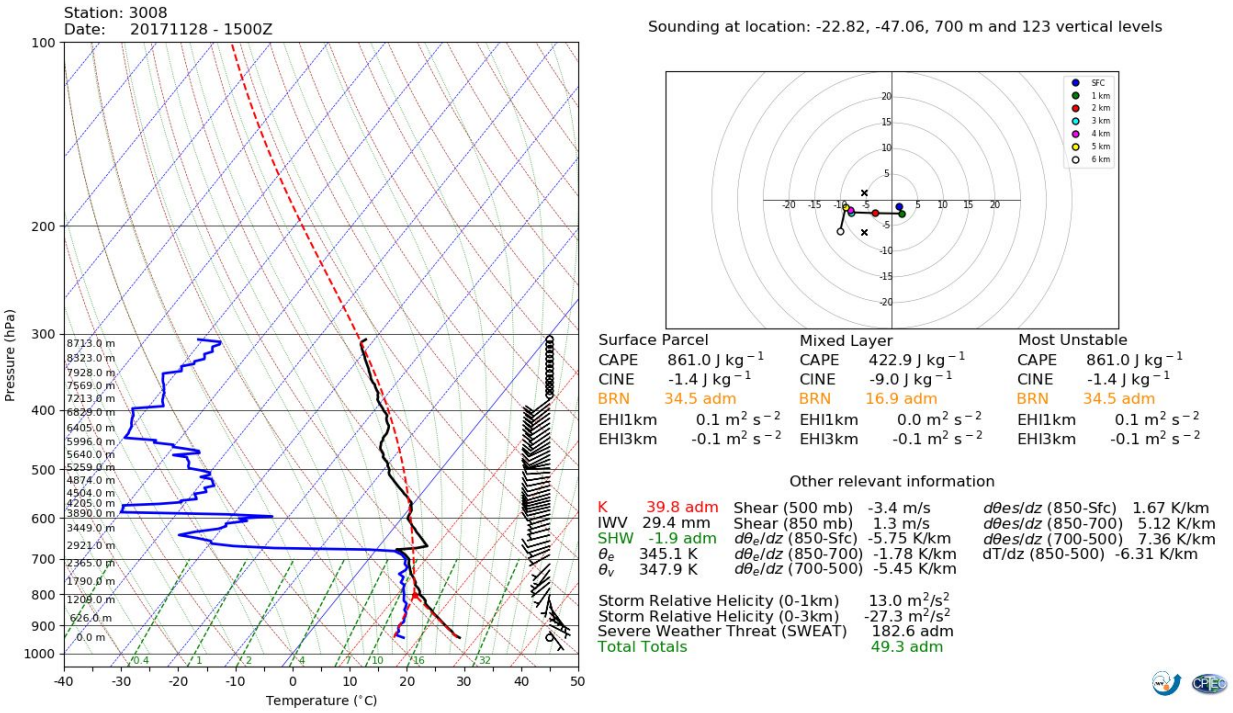

Figure 7: Skew-T/log p and hodograph of the Campinas-SP 1500 UTC sounding.

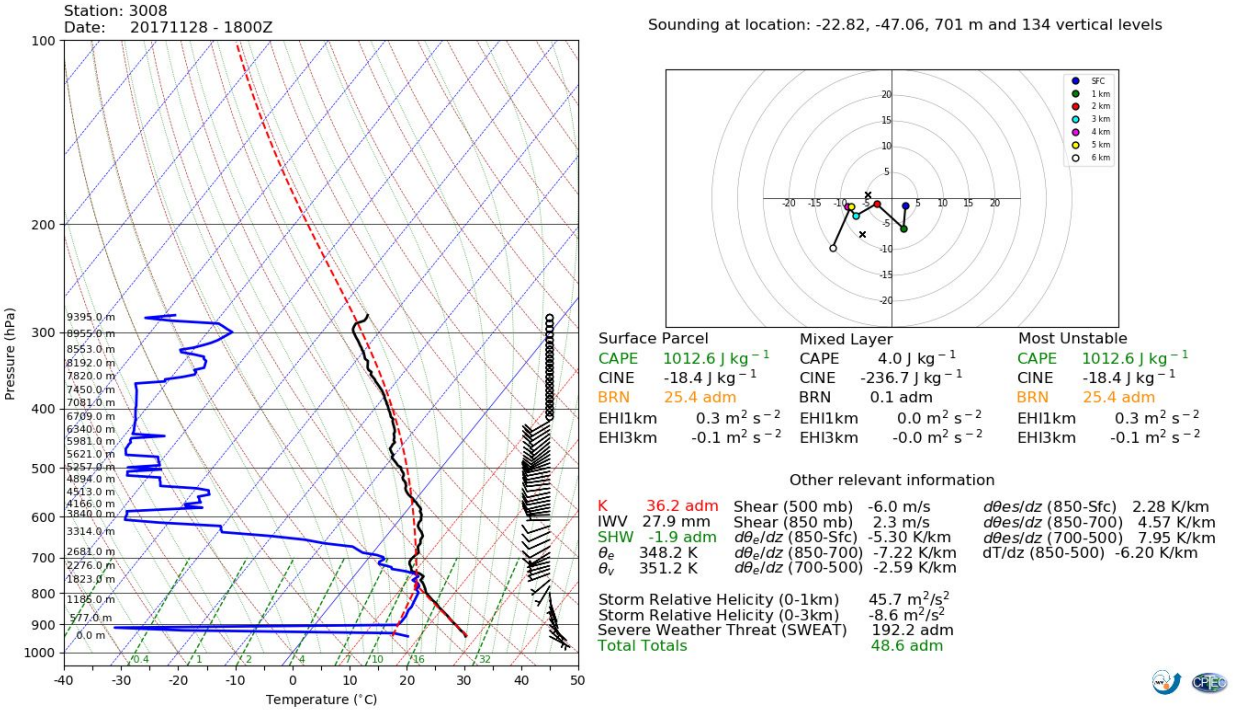

Figure 8: Skew-T/log p and hodograph of the Campinas-SP 1800 UTC sounding.

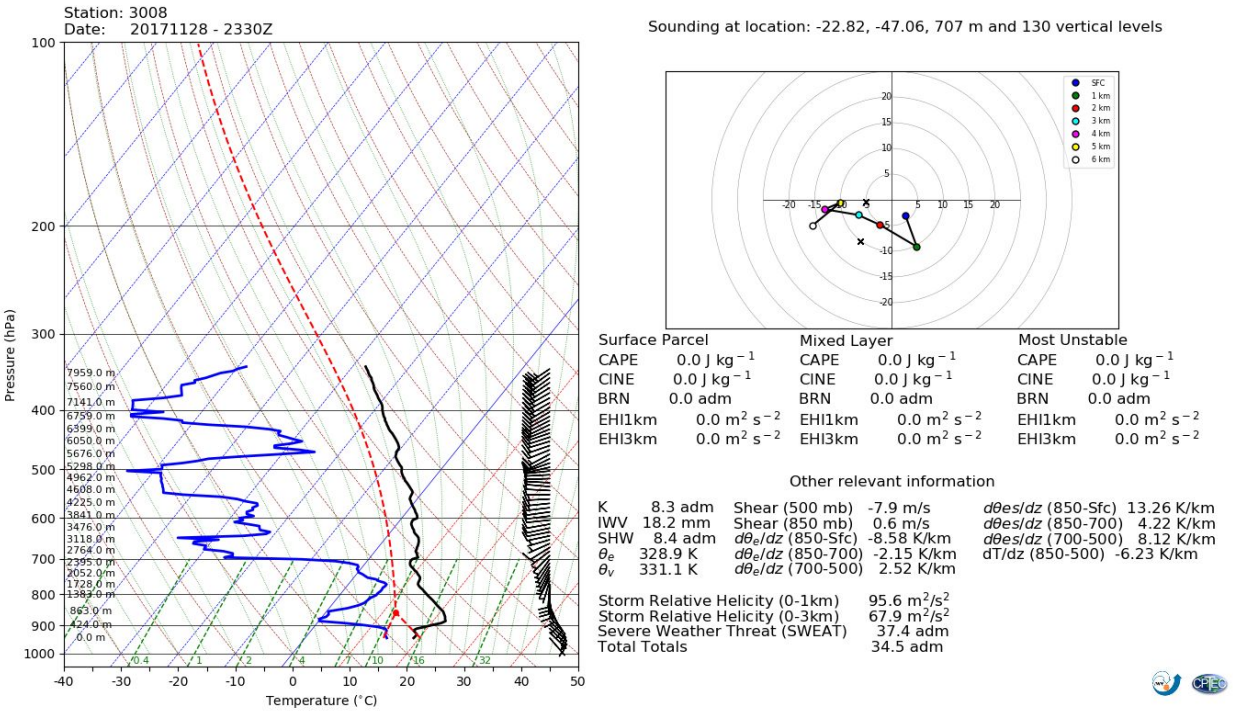

Figure 9: Skew-T/log p and hodograph of the Campinas 0000 UTC 29 November 2017 sounding .