

# ***Interactive comment on “Long-term trends of instability and associated parameters over the Indian region obtained using radiosonde network”***

**by Rohit Chakraborty et al.**

**Anonymous Referee #3**

Received and published: 17 October 2018

Main Comments: Figure 3d: The changes in EL, LI, and CAPE between 1980 and 2016 are difficult to believe and if true compelling. Have other studies shown such huge changes?

Changes in aerosol loading and subsequent changes in the morphology of clouds due to the aerosol indirect effect are not discussed and should be considered when examining trends in stability and precipitation over the Indian region. Please discuss the role of aerosol forcing may play in explaining these trends.

The authors look at trends in 16 different variables derived from radiosonde data. That makes for a difficult read. Might make sense to condense the variables to 8-10 by

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removing highly correlated variables.

It is difficult to determine the regional trends from the plots. Perhaps the means/trends for the 3 regions (coastal, interior, and other) can be separated vertically as opposed to stacked on top of each other in plots 4-6 and 8-9.

Specific Comments L36 to L48: I would suggest limiting your references to studies that focused on India. Alternatively, you need to explicitly state for what region and what time period the results you cite are valid.

L54: Increases in air pollution and greenhouse warming may have opposing effects on lower atmospheric stability. Don't group them together here.

L88-90. This sentence is confusing. Are you saying that typically a station has 2-7 gaps with each gap being less than one month in length? If yes, please say so.

Figure 1: Identify the sites with the serial number from Table 1A.

Figure 2: Sufficient space is available at the top of each plot to replace the acronyms with the actual names, e.g., CI → Central India

Figure 4: This set of plots confuses me. a) By inspecting these plots, is it possible to separate the west coast from the east coast and central India from Peninsula-India? b) Shouldn't there be a separate box and whisker plot for each region? c) I'd suggest flipping the vertical pressure coordinates so that high pressures are located near the bottom and low pressures near the top. d) How can the mean for a region be located at the 5th or 95th percentile? e) Why do I only sometimes see "whiskers"?

L114-116: Is rainfall or lightning required or is the determination strictly based on wind speed?

L135-136: "VT is found to lie exactly in the middle ..." Arguably, TTI or CT is more in the middle than VT.

L163: I do not see a trend in PWL.

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L168: "intensification in EL". This is confusing. Go with "increase in the height of the EL".

Table 1: Since the p tests always yield the same results, i.e., significant , I would suggest replacing those columns with columns that indicate the percent trend. I would also suggest adding a column that indicates the units.

L247: "TSS is found to increase drastically". What are the units for TSS. What do you mean by increasing drastically.

L261-262: Chicken and egg question: Is "more convective rain" the cause or consequence of changes in the LFC?

L271: What does it mean for T100 to strengthen?

L290: I find it questionable to look for periodicities of 16-20 years in a data set that is only twice that long.

L318: "Drastic" can mean different things to different people perhaps use a different adjective. Also, be specific as to which instability parameters showed "drastic" changes.

L325: EL  $\rightarrow$  EL height

L356: ozone breakup  $\rightarrow$  ozone decreases

L358: cooling effect  $\rightarrow$  cooling effect due to a reduction in downwelling long wave radiation

L395: What do you mean by "strong cooling due to ozone decomposition?"

L398: Why would the dearth of transported moisture affect that rat of pollutant dispersion by the winds?

L423: CAPE increases in all regions not just near the coast. Please rephrase bullet point 1. Also, "suffer" is a poor choice of words.

L426: "drastic" is a qualitative term - be more quantitative

L439: Are you certain this leads to a strong cooling effect in the troposphere? The increases in OH would lead to increases in the oxidation rates of CO and methane, which could lead to more ozone in the presence of NOx.

TEXT S1: S6: Free condensation → Free Convection S11: Parcel may continue moving past the EL due to upward momentum. S24: Add a reference to the supercell comment S25-32: "lifted from the LFC to the lowest 100 mb of the troposphere". This is incorrect. Please re-phrase this. I believe the moisture and temperature profiles are averaged over the lowest 100 hPa and then the resulting parcel is lifted to the LCL. S42: calculated as th → calculated as the S48: resaerch → research

#### Minor comments

L32 showed → shown L39: due to surface heating → due to increases in surface heating L46: extreme precipitations → extreme precipitation events L46: intense convective → intense convection L54: lower instability is reducing → lower tropospheric instability is decreasing L58: studies over India has → studies over India have L108: upto → up to L171: reduction VT → reduction in VT L192: higher in the coasts → higher at the coasts L195: "higher", Do you mean "more negative?" L217: "ttset" → test L223: "all the regions" → not true in the NE region L224: is minimum → is smallest L227: "also show an enhancement " → become more negative L243-244: Smallest changes in the NE and NW regions. The difference between inland and coast regions isn't that large (2 versus 2.375 degrees) L376: a dominant increase → an increase L380: resulting more → resulting in more L382: To prove this hypothesis → To test this hypothesis L383: increasing prominently → increasing L383: expand DLWRF acronym

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Interactive comment on *Atmos. Chem. Phys. Discuss.*, <https://doi.org/10.5194/acp-2018-565>, 2018.

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