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**Hydrology and Earth System Sciences Discussions**

# *Interactive comment on* "Scaling and trends of hourly precipitation extremes in two different climate zones – Hong Kong and the Netherlands" *by* G. Lenderink et al.

**G. Lenderink et al.**

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Thank you for your comments. Belows follows a more detailed response to the comments

1. Ambiguity of causes and effects.

We added a discussion on cause and effect in the first par. of section 2.2. " Relations between temperature and precipitation are difficult to asses because of an ambiguity of causes and effects, in particular over moisture-limited regions and the summer season \citep{Trenberth2005,Lenderink08}. Most important is the dependency of both



temperature and precipitation on the atmospheric circulation conditions. In summer, this causes a negative correlation between mean precipitation and temperature since high pressure systems cause warm weather with at the same time low relative humidity and low precipitation amounts. A prolonged period with dry weather could results in soil moisture depletion, with further reduced surface evaporation and temperature increases. This again implies a negative correlation between temperature and precipitation, which could be further enhanced by feedbacks from clouds. Yet, on a climatic time scale warmer temperatures are associated with increasing moisture (as discussed in the introduction) and on a global average precipitation increases. It is this causal relation – temperature increases causing moisture increases, causing increases in precipitation extremes – we are interested in and which we want to derive from present-day observations. We (partly) circumvented this ambiguity by taking, instead of the temperature, the dew point temperature as a direct measure of moisture in most of the analyses."

2. Could a systematic transition between these situations with temperature impact the relationship between Td and precipitation?

A response to this comments has been proved in the online discussion at 22nd June 2011

3. data quality of extremes in hourly precipitation.

Considering that the scaling is observed from different data sets and time periods (with different observing techniques) we do no expect the measurement of intense rainfall to be a main issue

4. Reference to Willet (2010) is added in the introduction

5. reference to Haerter et al (2010) is added at the end of the introduction.

6. reference work over the tropics from observations and models.

In response to this we added "Nevertheless, this shows that the premise that a temper-

ature rise, and the resulting humidity rise, leads to increases in precipitation extremes is not necessarily true for the (sub)tropics. This result, obtained from a long time series at one station, contrasts with the large sensitivities of daily precipitation extremes to the sea surface temperature, exceeding the C-C relation, obtained from averaging satellite observations over large areas in the tropics (Allan et al., 2010). A number of global climate models also project changes in precipitation extremes over the tropics exceeding the C-C relation, but the spread in global climate model simulations is also large due to contrasting dynamical responses (O'Gorman and Schneider, 2009; Gastineau and Soden, 2009; Allan et al., 2010; Sugiyama et al., 2010). Finally, two studies with a cloud resolving model for the tropics obtained changes in precipitation extremes roughly following the C-C relation (Muller et al., 2011; Romps, 2011). Clearly further research is needed to resolve these differences.

7. When do high dew point temperature occur.

In general this is a subject of current research, and will be reported in a next paper. We added in section 2.1 "strong precipitation events in summer mostly occur after a period of warm weather, with a retreating high pressure system over central Europe and a low pressure system approaching from the southwest. Under such conditions atmospheric humidity is typically high and mesoscale convective systems often develop above France and Belgium during daytime, giving rise to extreme precipitation during the evening and night in the Netherlands."

8. Upward trend in both extreme precipitation and dew point temperature in data from HKO

This is correct. But considering that there is no correspondence between the two (dew point temperature & precipitation intensity) on a smaller time scale we think it unlikely that they are causally related.

9. Apparent contradiction with decrease in monthly mean precipitation in the dry season.



You are right. Our statement was perhaps too imprecise and too strong. We were referring mainly to months in spring and early autumn, and not particularly to the dry months (NDJ). We changed the sentence to "Outside the wet season, in particular for spring and autumn, the results shows that climate change could have implications for the occurrence of extreme precipitation in Hong Kong."

The textual changes have been applied.

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 8, 4701, 2011.