Composite Maps for Extreme Rainfall in Indonesia

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Introduction

❑ Indonesia is located in tropical region with relatively high intensity of rain

❑Indonesia has been identified as one of the most vulnerable countries towards risk of nature disasters including Extreme Weather Events (EWEs)

❑This project aims to develop a supporting tool for forecasting the EWEs based on the corresponding large scale meteorological pattern (LSMP).

❑Finding and using such LSMP maps has improved the understanding and has predictability of EWEs forecast in the US (Grotjahn and Faure, 2008, Grotjahn, 2011)

❑We apply and develop the method to look for tropical extreme precipitation patterns.

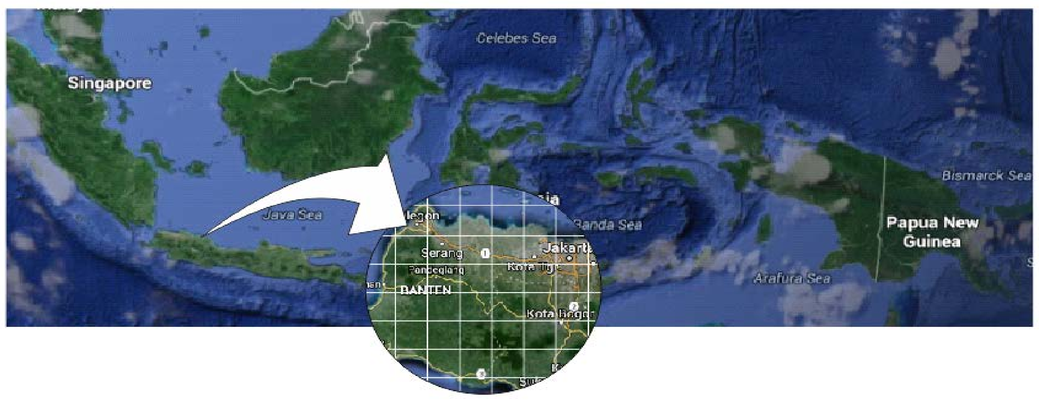
❑ This paper summarizes the meteorological patterns of some variables on the surface and at pressure levels.

❑ The following maps are presented: global mean, anomaly as well as the global significant test

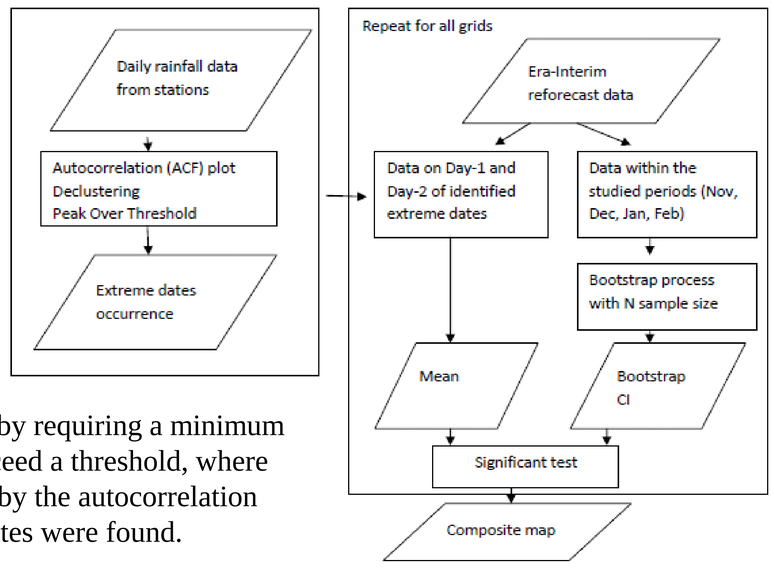
Data Used

❑ Era Interim Global Reanalysis data which are available at www.ecmwf.int. The dataset span from 1979 to 2015. List of variables:
- Surface level : Sea Surface Temperature and Mean Sea Level Pressure
- Pressure (850hPa and 200 hPa) level : Relative Humidity, Geopotential Height, Velocity potential, Streamfunction

❑ Daily rainfall observed from multiple rain gauge stations in Indramayu spanning from 1979 to 2006. There are **10 stations** having complete records of daily rainfall data.
❑ Indramayu lies on 107°52'–108°36' E and 6°15'–6°40' S along the coast of north Java island. Consists of 31 districts, 307 village and 8 sub-districts with total area of 204,0411 hectares



Methodology



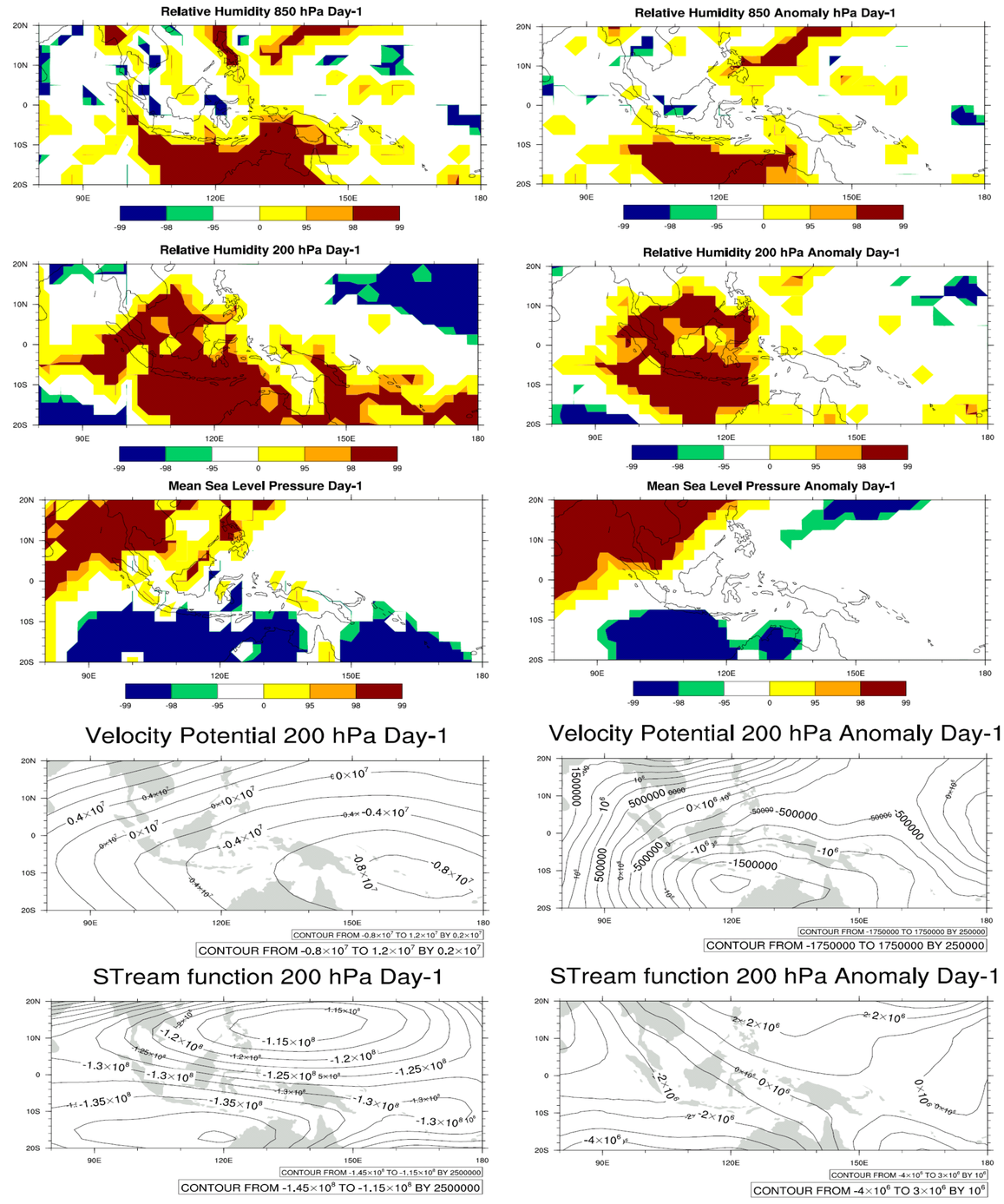
Dates are identified first by requiring a minimum number of stations to exceed a threshold, where declustering is informed by the autocorrelation function. M = 72 such dates were found.

Reanalysis data are identified are used to form composites from the EWE onset and (separately) the days leading up to onset. 'Day-1' is one day before onset. These composites are called 'target composites'.
Significant areas on the map are identified by comparing target composite values with the distribution of values from N ensemble averages, each formed from maps on M randomly selected dates.

Results

Definition of Extreme: *Rainfall in a day observed at minimum of 4 stations with total of rain more than 215 mm*

Composite % significance maps. Warm colors for high values, cool colors for unusually low values. Left column: total fields, right column anomalies w.r.t. long term daily means at each pt.



LSMP properties:

- Elevated relative humidity (RH) develops at upper levels 1 day before onset consistent with or facilitating deeper convection over Java. At lower levels RH notably high mainly S of Java.
- Lower troposphere: S of Java is low SLP. Streamfunction (Psi) has high peak there (from strong anomaly Psi) at 850mb => enhanced W rotational winds over Java; velocity potential (Chi) 850 has ridge over Java, enhanced gradient over Java Sea, strong convergent winds (N over Java, from High SLP to low SLP).
- Above: Psi at 200 lower values S of Java, higher N of Java => E rotational winds over Java. Chi has trough over Java enhanced by Chi anomaly (<0) extreme SE of Java causing strong Chi gradient over and directed towards NW => SE divergent winds over Java Sea.

Conclusions

- Extreme precipitation over Java is preceded by a large scale pattern (LSMP) in several variables with highly significant i.e. '*unusual*' regions (based on a bootstrap resampling test).
- *Unusual* anomalous velocity potential and *unusual* stream function south of Java (with opposite N of Java) create *over* Java: westerly rotational winds and northerly divergent winds at low level with enhanced convergence over Java, easterly rotational winds and southeasterly divergent winds in the upper troposphere.
- The region south of Java has *unusually*: low SLP and high relative humidity through the depth of the troposphere. *Unusually* high relative humidity at upper levels extends north over Java.
- Future work: explore evolution of areas N and S of Java and their connections to Indramayu

Literature cited

Grotjahn R. 2011, Identifying extreme hottest days from large scale upper air data: a pilit scheme to find California Central Valley Summer time maximum surface temperatures. Climate Dynamics.
Grotjahn , R. and Faure , G. 2008, Composite Predictor Maps of Extraordinary Weather Events in the Sacramento, California, Region. *Weather and Forecasting*, 23, 313 -235

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