Global high-resolution observational rainfall data set for convection-permitting model evaluation

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INTENSE aims to understand the nature and drivers of extreme sub-daily rainfall

- Lizzie Kendon and team, Robert Dunn, Nigel Roberts (UK Met Office)
- Stephen Blenkinsop, Steven Chan, Liz Lewis, Selma Guerreiro, Xiao-Feng Li (Newcastle University)
- INTENSE partners (especially Geert Lenderink, Seth Westra, Christoph Schär, Nicolina Ban, Jason Evans, Lisa Alexander, Renaud Barbero, Mari Tye, Andy Prein)

INTENSE: INTElligent use of climate models for adaptatioN to non-Stationary hydrological Extremes – also GEWEX GHP cross-cut on sub-daily precipitation
Global Energy and Water cycle EXchanges project

Developing consistent approach for quality control, including data homogenisation

GEWEX Cross-cut sub-daily rainfall (INTENSE)

Developing a comprehensive international repository for sub-daily precipitation data

Analysis of new observed dataset – indices, trends and process mechanisms

CPM model intercomparisons using common diagnostics, e.g. CORDEX Flagship Pilot Study

State of the science on:
(b) CPM projections: Kendon et al. 2017, BAMS.
Future change: Convection Permitting Models (CPMs)

CPM grid spacing ≤ 4 km
Explicitly represent convection without need for parameterisation scheme.

Many studies including CORDEX flagship pilot study – first comparisons of CPM over Alps

Needed for robust projections of change to duration and intensity of summer convective rainfall - Kendon et al, BAMS, 2017
The Met Office (UKMO) and ETH Zurich (ETH) are conducting pan-European 2.2km convection-permitting regional climate simulations, and contributing to the CORDEX flagship pilot study. Separate 12-km parameterised convection simulations are also carried out. None of the simulations use nudging.
So far, collected hourly data from ~25,000 stations...

**National datasets:** UK, US, Canada, Brazil, France, Germany, Spain, Portugal, Italy, Philippines, India, Norway, Sweden, The Netherlands, Finland, Australia, Kenya, Indonesia, Slovenia, Costa Rica, Argentina, Switzerland, Austria, Hungary, Panama, Ireland, Japan, Malaysia, Singapore, Dominica, Trinidad & Tobago
So far, collected hourly data from ~25,000 stations...

**Global dataset:** HadISD, approx. 10,000 stations (varying data quality, more useful data at 3h and 6h), freely available *sub-daily* precipitation data. Plus access to additional datasets (i.e. E Europe, China) to calculate indices.
So far, collected hourly data from ~25,000 stations...

See talk by Liz Lewis on Wed at 13:30: Creating a global sub-daily precipitation data set in **S4. Sub-daily Rainfall Extremes**
1. Quality control of hourly data (Blenkinsop et al, 2017; IJC & Lewis et al., submitted)

2. Adapt checks to work globally using CLIMDEX daily indices and DWD daily dataset (Lewis et al, in prep)

**Site specific tests**
- rain gauge metadata,
- implausible large values (1h & 24h records)
- Monthly maximum 1-day precipitation
- long dry periods due to gauge malfunction
  - accumulated totals (often at 9am)
    - repeated values
    - Change in resolution
    - Duplicate records

**Nearby gauge comparisons**
- Statistical test of consistency with nearby gauges but problematical for extremes in summer/autumn therefore only partially applied

**Multiple QC flags applied to each hour for each test**

**Automated rule base to define exclusions**

For example:
- all implausible hourly totals
- “large” hourly totals if in winter at 9am after ≥23 dry hours
- “large” hourly totals if after gauge non-operation (long dry spell)
## Produce new sub-daily precipitation indices from new global dataset

### Monthly maximum indices

- **Rx1hr** Monthly maximum 1-hour precipitation
- **Rx3hr** Monthly maximum 3-hour precipitation
- **Rx6hr** Monthly maximum 6-hour precipitation
- **Rx1hrP** Percent of daily total that fell in the Monthly maximum 1-hour precipitation

### Diurnal cycle indices

- **LW1H** Monthly likely wettest hour within a day
- **LD1H** Monthly likely driest hour within a day
- **DLW1H** Dispersion around Monthly likely wettest hour within a day
- **S1HII** Simple hourly precipitation intensity index
- **CW1H** Maximum length of wet spell

### Frequency/threshold indices

- **R10mm1hr** Monthly count of hours when PRCP ≥ 10mm
- **R20mm1hr** Monthly count of hours when PRCP ≥ 20mm
- **Rxmm1hr** Annual count of hours when PRCP ≥ nnmm, nn is a user defined threshold

### General indices

- **PRCPTOT1hr** Annual total precipitation in wet hours

*Lewis et al, in prep*
Assessing hourly rainfall climatology
Assessing hourly rainfall climatology
Example metrics: 20yr RL, monthly timing

Barbero et al, in prep
Example metrics: diurnal cycle

Barbero et al, in prep
Modelled and observed 10y growth factors from POT3 series

Hindcast has a lower 10-y growth factor for hourly extremes than the gauges

3-max per year: daily max hr precip Z(10)/Z(2)
mean = 1.537 ± 0.256

Chan et al, in prep
Peak season for POT3 series
Hindcast seasonality matches well with that of hourly extremes from gauges

Chan et al, in prep
Summary

We have collected a global sub-daily precipitation dataset, and applied automated quality control

- We have ~16,000 gauge records > 1yr data, ~11,000 > 10yr data
- We will develop sub-daily extreme precipitation indices at the station-level and gridded indices to be hosted on the DWD and CLIMDEX websites (end 2018)
- We will develop a set of climate model evaluation metrics/indices for assessment of high resolution simulations (end 2018) and satellite data products – we would appreciate input on metrics needed – should this be hosted alongside indices or elsewhere?
- We are testing model evaluation metrics using European-scale simulations but happy to provide metrics to additional modelling groups for testing and use in model evaluation.
- DWD will host the hourly gauge data (most not public) and an associated website with metadata (in progress).

There is great potential for further analysis and development of scientific studies using this new dataset
To find out more about INTENSE:
https://research.ncl.ac.uk/intense/
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INTENSE publications (2018)


INTENSE publications (2016-17)


INTENSE publications (2014-15)

