EU-Circle Case study 5

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Rapid Winter Flooding (melting ice, narrow mountain streams, flooding) around Dresden, Germany

Dresden is the largest city in the Eastern part of Germany, Saxony, near the Czech border. It is crossed by the large river Elbe (its width is around 110m in Dresden) which comes from the Czech Republic and flows through Magdeburg and Hamburg into the North Sea. The region between Dresden and the Czech border, but also in the near surroundings in the Eastern and South-Western directions, is quite hilly with mountains up to ca. 1200 m. In the recent past (especially notable are the big floodings in 2002 and 2013) there has been quite some floodings caused by intense and long rain which led to floods of the Elbe.However, there is another threat which is happening more often and hence causing more damage because of the currently ongoing climate changes. In the mountains are lots of small mountain streams which are really small on a normal day (a typical one has a width of 1.5m and a depth of 0.5m). But in cases of heavy rains these small streams rapidly grow quite large (1-2h is not uncommon), especially compared to their normal size (sometimes they grow to their hundredfold size in respect of the amount of water they carry). This causes a lot of damage, especially as prediction and short-term prevention mechanisms are not really possible because of the small timescale. The damages caused by such events are quite local and often not related to the flooding of big rivers. In these regions there are often roads going through valley which are vital in a sense that if they are not available any more, quite long bypasses have to be taken. Additionally railways, especially railway bridges, are often effected as well. These two aspects show the impacts on the transport network.

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Analysis

Data from ECA&D: precipitation. Snow depth?

```
library(esd)
```

```
## Loading required package: ncdf4
```

```
## Loading required package: zoo
```

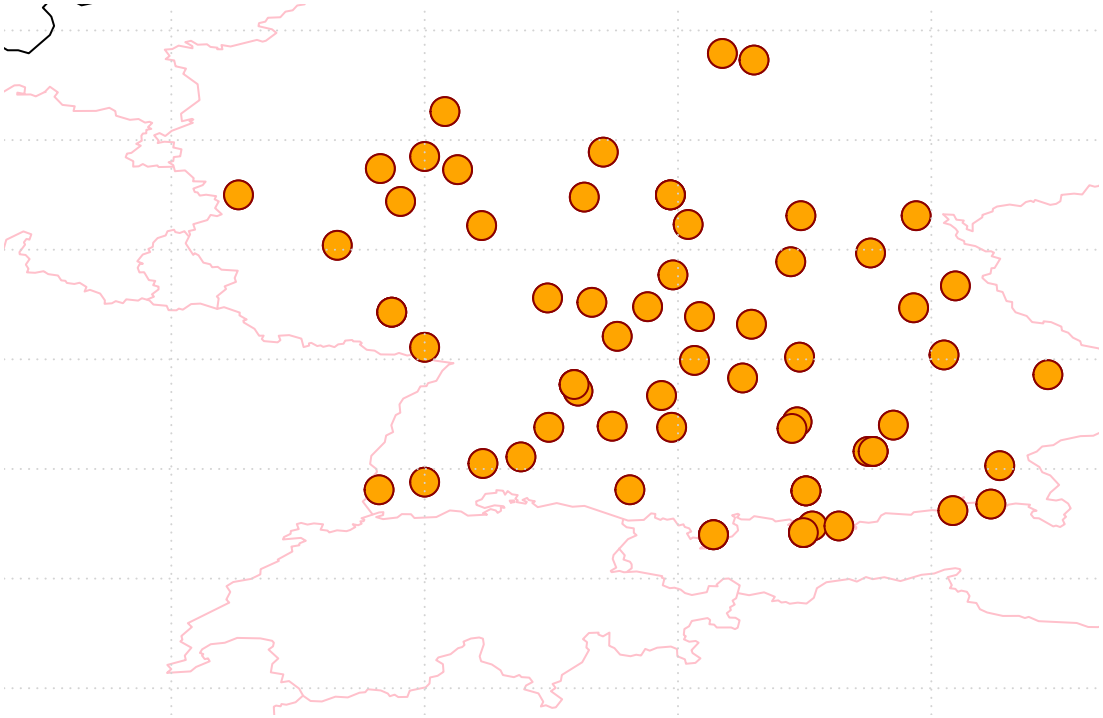
```
##
## Attaching package: 'zoo'
```

```
## The following objects are masked from 'package:base':
##
##     as.Date, as.Date.numeric
```

```
##
## Attaching package: 'esd'
```

```
## The following object is masked from 'package:base':
##
##     subset.matrix
```

```
ss <- select.station(param='precip',cntr='Germany',alt=250,nmin=70)
map(ss)
```

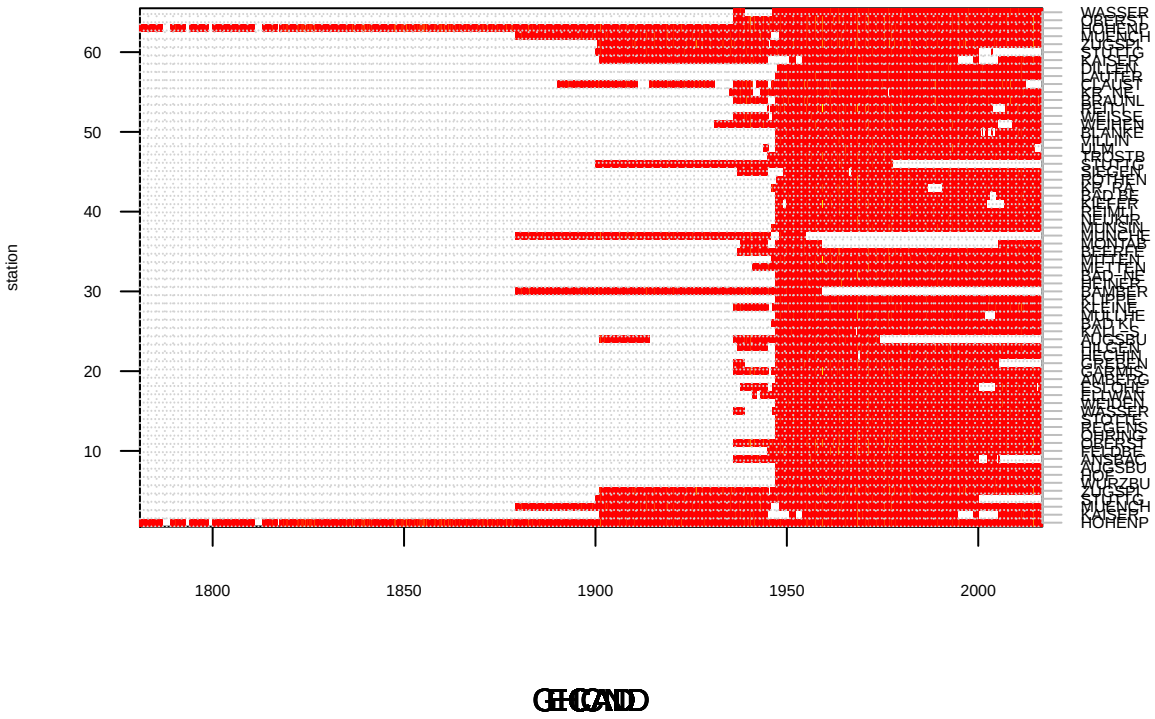


```
Y <- station(ss)
```

```
## [1] "Retrieving data from 65 records ..."
## [1] "1 PRECIP 100169 HOHENPEISSENBERG GERMANY ECAD"
## [1] "2 PRECIP 100179 KAISERSLAUTERN GERMANY ECAD"
## [1] "3 PRECIP 100189 MUENCHEN GERMANY ECAD"
## [1] "4 PRECIP 100209 STUTTGART GERMANY ECAD"
## [1] "5 PRECIP 100219 ZUGSPITZE GERMANY ECAD"
## [1] "6 PRECIP 102356 WURZBURG GERMANY ECAD"
## [1] "7 PRECIP 102364 HOF GERMANY ECAD"
## [1] "8 PRECIP 102396 AUGSBURG GERMANY ECAD"
## [1] "9 PRECIP 118306 ANSBACH-HENNENBACH GERMANY ECAD"
## [1] "10 PRECIP 120934 FELDBERG/SCHWARZWALD GERMANY ECAD"
## [1] "11 PRECIP 121114 OBERSTDORF GERMANY ECAD"
## [1] "12 PRECIP 121126 OHRINGEN GERMANY ECAD"
## [1] "13 PRECIP 121138 REGENSBURG GERMANY ECAD"
## [1] "14 PRECIP 121162 STOTTEN GERMANY ECAD"
## [1] "15 PRECIP 121174 WASSERKUPPE GERMANY ECAD"
## [1] "16 PRECIP 121186 WEIDEN GERMANY ECAD"
## [1] "17 PRECIP 121654 ELLWANGEN-RINDELBACH GERMANY ECAD"
## [1] "18 PRECIP 121966 ESLOHE GERMANY ECAD"
## [1] "19 PRECIP 122602 AMBERG-UNTERAMMERSRICHT GERMANY ECAD"
## [1] "20 PRECIP 122662 GARMISCH-PARTENKIRCHEN GERMANY ECAD"
## [1] "21 PRECIP 122986 GREBENHAIN-HERCHENHAIN GERMANY ECAD"
## [1] "22 PRECIP 123466 HECHINGEN GERMANY ECAD"
## [1] "23 PRECIP 123778 HILGENROTH GERMANY ECAD"
## [1] "24 PRECIP 123982 AUGSBURG (SANKT STEPHAN) GERMANY ECAD"
## [1] "25 PRECIP 124366 KALL-SISTIG GERMANY ECAD"
## [1] "26 PRECIP 124510 BAD KISSINGEN GERMANY ECAD"
## [1] "27 PRECIP 124522 MULLHEIM GERMANY ECAD"
## [1] "28 PRECIP 124546 KLEINER FELDBERG/TAUNUS GERMANY ECAD"
```

```
## [1] "29 PRECIP 124618 KLIPPENECK GERMANY ECAD"
## [1] "30 PRECIP 125014 BAMBERG (STERNWARTE) GERMANY ECAD"
## [1] "31 PRECIP 125806 HEINERSREUTH-VOLLHOF GERMANY ECAD"
## [1] "32 PRECIP 125974 BAD-NEUNKIRCHEN MERGENTHEIM GERMANY ECAD"
## [1] "33 PRECIP 126010 METTEN GERMANY ECAD"
## [1] "34 PRECIP 126106 MITTENWALD-BUCKELWIESEN GERMANY ECAD"
## [1] "35 PRECIP 126118 BEERFELDEN GERMANY ECAD"
## [1] "36 PRECIP 126178 MONTABAUR GERMANY ECAD"
## [1] "37 PRECIP 126274 MUNCHEN-BOTANISCHER GARTEN GERMANY ECAD"
## [1] "38 PRECIP 126322 MUNSINGEN-APFELSTETTEN GERMANY ECAD"
## [1] "39 PRECIP 126526 NEUKIRCHEN-HAUPTSCHWENDA GERMANY ECAD"
## [1] "40 PRECIP 126754 REIMLINGEN GERMANY ECAD"
## [1] "41 PRECIP 126874 KIEFERSFELDEN-GACH GERMANY ECAD"
## [1] "42 PRECIP 127030 BAD BERGZABERN GERMANY ECAD"
## [1] "43 PRECIP 127618 KR. RAVENSBURG WEINGARTEN GERMANY ECAD"
## [1] "44 PRECIP 127954 ROTHENBURG OB DER TAUBER GERMANY ECAD"
## [1] "45 PRECIP 128794 SIEGEN (KLARANLAGE) GERMANY ECAD"
## [1] "46 PRECIP 129142 STUTTGART-HOHENHEIM GERMANY ECAD"
## [1] "47 PRECIP 129478 TROSTBERG GERMANY ECAD"
## [1] "48 PRECIP 129586 ULM GERMANY ECAD"
## [1] "49 PRECIP 129634 VILLINGEN-SCHWENNINGEN GERMANY ECAD"
## [1] "50 PRECIP 129910 BLANKENRATH GERMANY ECAD"
## [1] "51 PRECIP 129982 WEIHENSTEPHAN-DURNAST GERMANY ECAD"
## [1] "52 PRECIP 130090 WEISSENBURG GERMANY ECAD"
## [1] "53 PRECIP 130918 REIT IM WINKL GERMANY ECAD"
## [1] "54 PRECIP 131638 BRAUNLAGE GERMANY ECAD"
## [1] "55 PRECIP 132334 KR. NECKAR-ODENWALD BUCHEN GERMANY ECAD"
## [1] "56 PRECIP 132562 CLAUSTHAL-ZELLERFELD GERMANY ECAD"
## [1] "57 PRECIP 132586 LAUTERTAL-OBERLAUTER GERMANY ECAD"
## [1] "58 PRECIP 132790 DILLENBURG GERMANY ECAD"
## [1] "59 PRECIP GM000002288 KAISERSLAUTERN GERMANY GHCND"
## [1] "60 PRECIP GM000002716 STUTTGART  GERMANY GHCND"
## [1] "61 PRECIP GM000004155 ZUGSPITZE  GERMANY GHCND"
## [1] "62 PRECIP GM000004199 MUENCHEN GERMANY GHCND"
## [1] "63 PRECIP GM000010962 HOHENPEISSENBERG GERMANY GHCND"
## [1] "64 PRECIP GME00121114 OBERSTDORF GERMANY GHCND"
## [1] "65 PRECIP GME00121174 WASSERKUPPE  GERMANY GHCND"
```

```
diagnose(Y)
```



Area total precipitation from gridded EOBS.