climada module **country risk** 25 Oct 2014

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This module runs all (available) perils for one country. It generates earthquake (EQ), tropical cyclone (TC), torrential rain (TR) and storm surge (TS) hazard event sets and runs the risk calculation for a given country

```
country_risk=country_risk_calc(country_name,force_recalc,check_plots)
country_risk_report(country_risk,print_unsorted)
```

Procedure is as follows:
1) generate centroids for the country (uses climada_create_GDP_entity)
2) figure which hazards affect the country
3) create the hazard event sets, using
   - climada_tc_hazard_set (wind)
   - climada_tr_hazard_set (rain)
   - climada_ts_hazard_set (surge)
   - eq_global_hazard_set (earthquake)
4) run the risk calculation for all hazards

In essence, you define the country and the code runs the generation of centroids, default assets (from nightlight intensity, see climada module GDP_entity) and the EQ, TC, TR and TS hazard event sets. It even figures whether the country is exposed to more than one ocean basin and in such a case generates a suite of TC/TS/TR hazard event sets for each ocean basin. The code is ready for upgrade with additional hazards (usually a new hazard is a new climada module). That's why the code notifies the user if the specific hazard module is missing (even indicates the github location where to get it from).

Simply call e.g. `country_risk_calc('El Salvador')`. See code for details.

Behind the scenes, the code `centroids_generate_hazard_sets` does the heavy lifting, i.e. steps 2) and 3) from above. This way one can generate all relevant hazard sets with one call to `centroids_generate_hazard_sets` for any set of centroids (e.g. only a part of a country, a region, a city…[1]):

```
centroids_hazard_info=...
   centroids_generate_hazard_sets(centroids,force_recalc,check_plots)
```

The resulting structure `centroids_hazard_info` contains the names of the generated hazard sets (or the ones generated earlier if just called to check for step 2) in `centroids_hazard_info.res.hazard(i).hazard_set_file` (the somewhat complicated nested structure is due to the flexibility required by `country_risk_calc`).

[1] See e.g. the code `climada_cut_out_GDP_entity`
[2] Note that the number seven here corresponds to the 7th hazard analyzed (EQ). The report to stdout shows EQ as the first result, since `country_risk_report` sorts by descending damage, unless it is called with the second parameter (`print_unsorted`) set to 1.

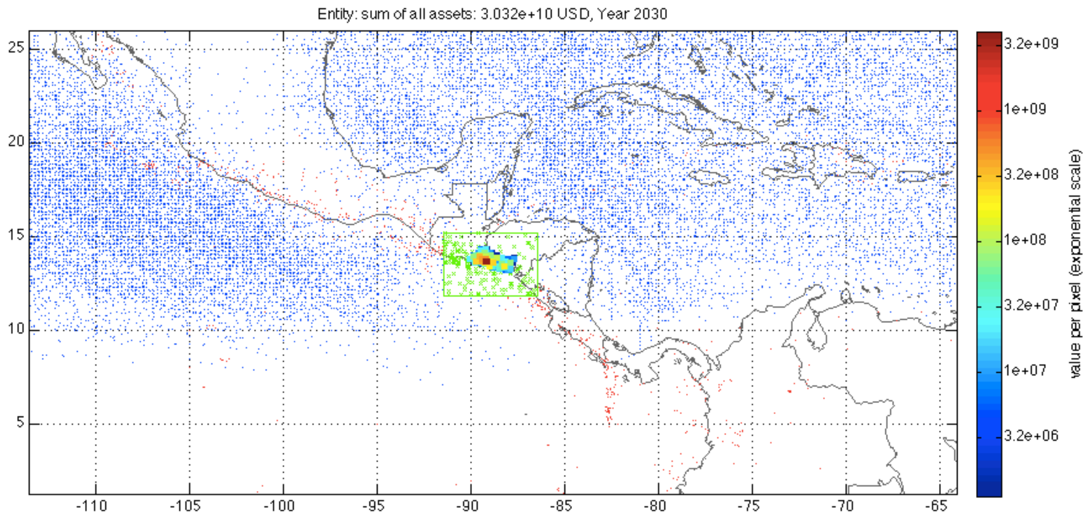

Figure: Step 1 (generate centroids, assets distribution) and step 2 (hazard selection). The green box shows the selection area around the country, the blue dots are all the TC track nodes (historic) and the red dots the epicenters (historic). This figure is generated if check_plot=1 in the call, e.g. `country_risk_calc('El Salvador',0,1)`.

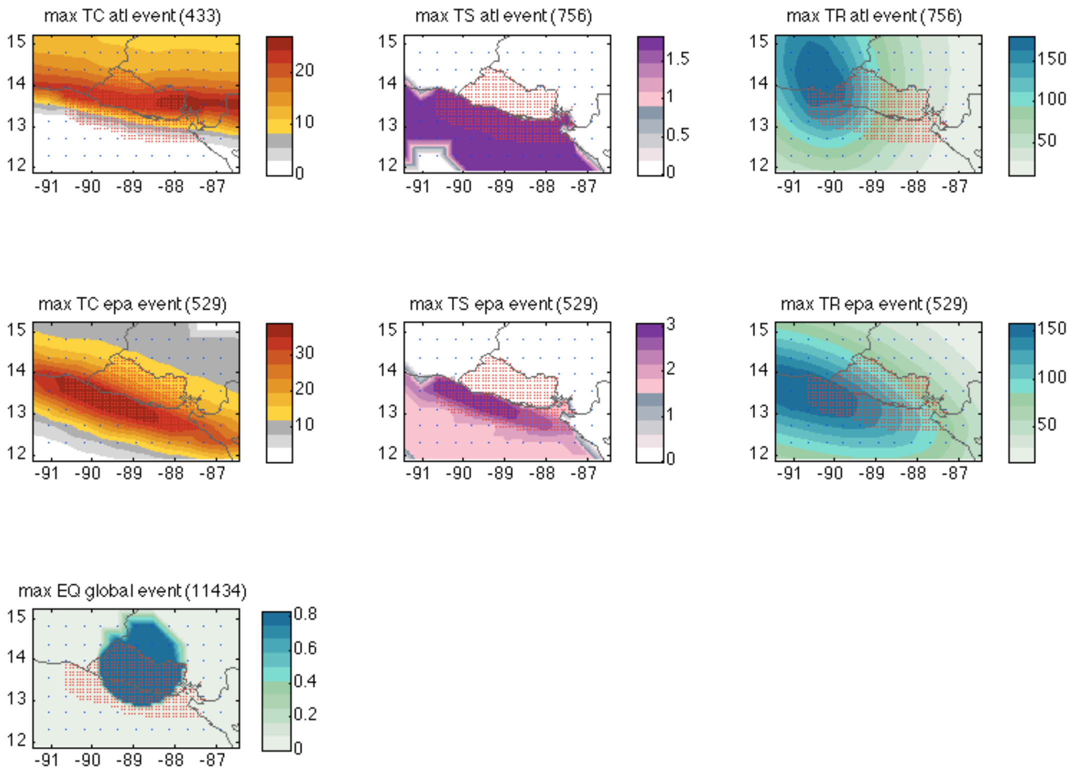

Figure: The most intense single event for all hazard generated for El Salvador (Step 3). Note that El Salvador is both exposed to tropical cyclones from the East and West, that's why there are two hazard events sets for TC/TS/TR, one for the West (atl for Atlantic), one for the East (epa for East Pacific Ocean). The earthquake model is global. Note further the nice feature of hazard (or peril) – dependent color scales; and the coarser resolution of centroids (blue) around the country (with red dots at high-density centroids) to support plotting hazard intensities around the country, too. This figure is generated if `check_plot=1` in the call, e.g. `country_risk_calc('El Salvador',0,1)`

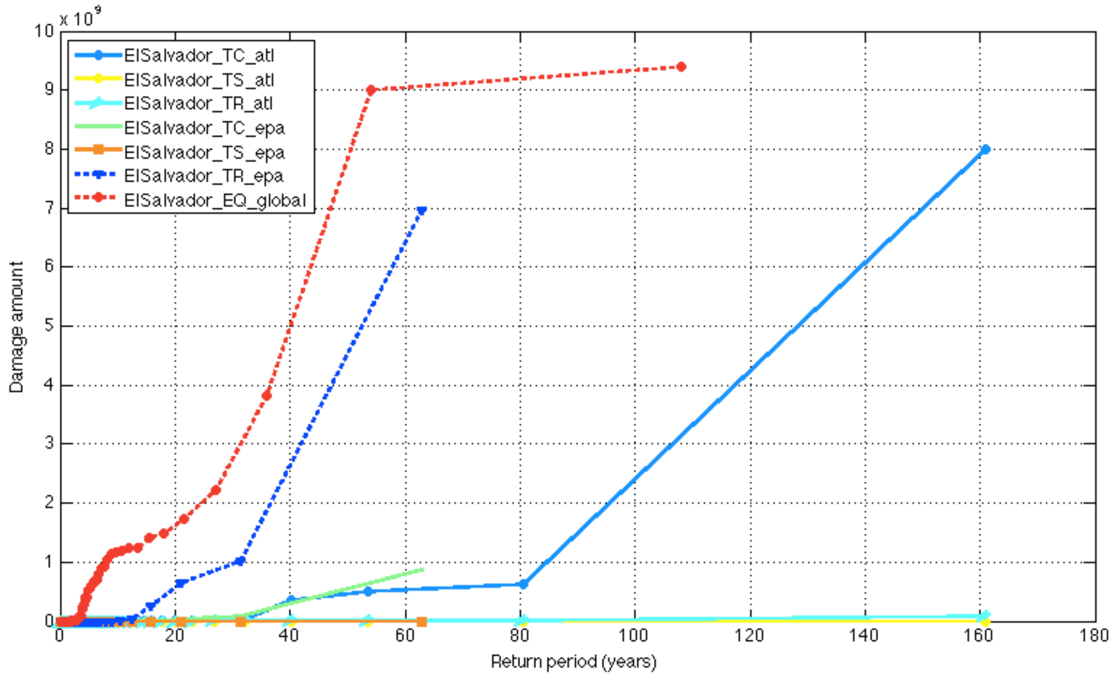

Figure: The resulting damage frequency curves (DFC) for all seven (!) hazards affecting El Salvador. This figure is generated if check_plot=1 in the call, e.g. `country_risk_calc('El Salvador',0,1)`.

If one runs some select countries, `country_risk_report` comes handy, e.g:

```
country_risk=country_risk_calc('Barbados')
country_risk(2)=country_risk_calc('El Salvador')
country_risk(3)=country_risk_calc('Costa Rica')
```

And then `country_risk_report(country_risk)` results in the following output to stdout:

```
Barbados (1)
  TR EL=36572051.496470 (8.481508%oo) Barbados_TR_atl
  TC EL=23083330.494007 (5.353308%oo) Barbados_TC_atl
  TS EL=7531.966739 (0.001747%oo)     Barbados_TS_atl
  EQ EL=0.000000 (0.000000%oo)        Barbados_EQ_global
ElSalvador (2)
  EQ EL=415631535.361110 (17.943889%oo) ElSalvador_EQ_global
  TR EL=141613002.072040 (6.113800%oo)ElSalvador_TR_epa
  TC EL=59386249.565168 (2.563858%oo) ElSalvador_TC_atl
  TC EL=16152772.894979 (0.697357%oo) ElSalvador_TC_epa
  TR EL=621784.438763 (0.026844%oo)   ElSalvador_TR_atl
  TS EL=0.000000 (0.000000%oo)        ElSalvador_TS_epa
  TS EL=0.000000 (0.000000%oo)        ElSalvador_TS_atl
Costa Rica (3)
  EQ EL=523833928.441207 (12.396559%oo) Costa Rica_EQ_global
  TR EL=1530537.767294 (0.036220%oo)  Costa Rica_TR_epa
  TC EL=73978.520263 (0.001751%oo)    Costa Rica_TC_epa
  TR EL=5765.009179 (0.000136%oo)     Costa Rica_TR_atl
  TS EL=1689.347413 (0.000040%oo)     Costa Rica_TS_atl
  TC EL=60.830655 (0.000001%oo)       Costa Rica_TC_atl
  TS EL=0.000000 (0.000000%oo)        Costa Rica_TS_epa
```

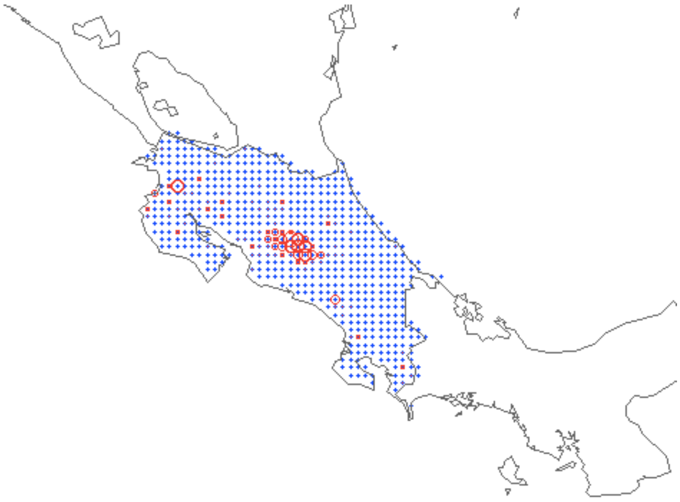

Figure: The local damage for a given peril for one country in spatial resolution (e.g. at each centroid), here for Costa Rica, e.g. (following from above resulting structure `country_risk`):

```
country_i=3; hazard_i=72;
climada_circle_plot(...
country_risk(country_i).res.hazard(hazard_i).EDS.ED_at_centroid,...
country_risk(country_i).res.hazard(hazard_i).EDS.assets.Longitude,...
country_risk(country_i).res.hazard(hazard_i).EDS.assets.Latitude)
```

[2] Note that the number seven here corresponds to the 7th hazard analyzed (EQ). The report to stdout shows EQ as the first result, since `country_risk_report` sorts by descending damage, unless it is called with the second parameter (`print_unsorted`) set to 1.