Royal Netherlands
Meteorological Institute
Ministry of Transport,
Public Works and Water Management

The effect of a warming North-Sea on coastal precipitation

Jisk Attema, Geert Lenderink*

The North-Sea has a large influence on the distribution of precipitation over the Netherlands. Here we investigate how this precipitation distribution may change in the future. We analyzed a recent, state-of-the-art, ensemble of regional climate model integrations from the ENSEMBLES project. Potential improvements from higher resolution are also illustrated.

1. Coastal effect

1.1 Present day.

In autumn, warm and wet air above the sea leads to convective showers, which mainly rain out over the coastal region. This results in an increased amount of precipitation for coastal areas. The effect is opposite in spring. Cold and wet air coming from the sea starts to warm above land, but only leads to convective showers after it has moved some distance land inward, resulting in a drier coast (Figure A).

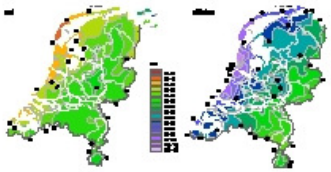

Figure A. Present day precipitation for May and October, from the KNMI Klimaat-atlas.

For summer a trend towards a wetter coastal zone compared to inland over the last 50 years is observed (red line figure B).

1.2 Climate change

The strength of the coastal effect in the future climate depends on changes in:

- The temperature difference between land and sea.
- The atmospheric circulation.
- The moisture content above sea.
- Drying above land in summer.

2. ENSEMBLES integrations

19 regional climate model integrations at 25 km resolution for the period 1950-2100 based on the A1B emission scenario.

2.1 Results

1. Mean precipitation change in line with KNMI'06 scenarios.
2. Small increases in coastal precipitation compared to land.
3. Effect is most notable in summer, but model spread is large.

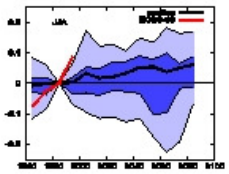

Figure B The 30-year running average of summer coastal effect in mm/day, relative to the period 1920-1930. We define the coastal effect as the difference between coastal (~50km from the sea) and inland precipitation.

2.2 Limitations

1. 25km resolution is low with respect to the features of interest.
2. Use of even coarser sea surface temperature (SST) from global models (~100km).

3. Added value of higher resolution

Results from the KNMI regional climate model RACMO @10km using high resolution SST (figure C) are shown in figure D.

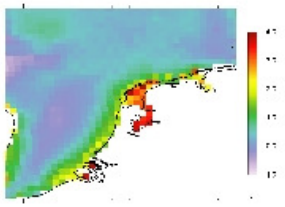

Figure C The difference in SST between the ERA-Interim and a high resolution SST (derived from NOAA and OSISAF satellites) for summer, averaged over 1986-2010. The satellite SST shows a warmer coastal zone.

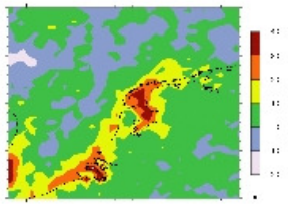

Figure D The relative difference in the 90th percentile of precipitation between a climate integration using the ERA-Interim SST and one using a high resolution satellite SST, for summer and fall over 1986-2010.

Warmer and more realistic SSTs near the coast leads to 10 to 20% higher, and more realistic, precipitation extremes in RACMO.

4. Conclusion

In ENSEMBLES a small increase in coastal precipitation is found, yet the model spread is large. ENSEMBLES is limited by unrealistic SSTs at low resolution. To improve more accurate SSTs are required. RACMO simulations show large potential influences of high resolution SSTs on extreme precipitation events.

* Royal Netherlands Meteorological Institute, PO Box 201, 3730 AE De Bilt, The Netherlands, e-mail: [illegible]