Deltas in Depth scientific sessions Deltas in Depth Theme 1. Climate projections and extremes		
DD 1.3 Changing weather and impacts (continues 1.4)		
Chair	Dr. Daniela Jacob, Climate Service Center2.0, Hamburg, Germany	
Presentations	•	PhD Kathleen McInnes, CSIRO, Australia
	•	Dr. Rein Haarsma, KNMI, the Netherlands
	•	Dr. Reinout Boers, KNMI, the Netherlands
	•	Dr. Geert Lenderink, KNMI, the Netherlands
	•	Ronald van Haren, KNMI, the Netherlands

PhD Kathleen McInnes, CSIRO, Australia, Modelling extreme sea levels due to tropical cyclones: Examples for Fiji and Samoa

There are many contributing factors for extreme sea levels. Especially in small islands, extreme sea levels cause challenges. First, tide gauge records are short in time and spatially sparse. They rarely measure the occurrence of extreme sea levels, because they are typically located where waves effects are minimal. Therefore reliance on tide gauges for risk analysis may under-represent an important cause of inundation in small islands. Second, wind waves and swell can be a significant cause of extreme sea level inundation for steep shelved islands. Also, extreme waves are not necessarily caused by local storms. The last challenge is that wave extremes are rarely captured by tide gauges. In the context of tropical cyclone storm surges, we need methods to generate long records of extreme sea levels to estimate risks and the effect of climate variability and change. This can be achieved by synthetic cyclone generation which consists of analytic cyclone models and hydrodynamic models. Synthetic cyclones are used for estimating storm tide risk from tropical cyclones and are used to investigate the role of ENSO on extreme sea level risk on the Fiji islands and Samoa and used for assessing design heights for coastal infrastructure due to storm tides, waves and rising sea level.

Dr. Rein Haarsma, KNMI, the Netherlands, Dynamics of extra-tropical transition of tropical cyclones hitting Western Europe in a warmer climate

How will extreme winds in NW Europe change in the future? Future weather simulations try to simulate severe autumn storms. They show that there will be more storms of more than 11 Bft in Western Europe in the near future and future. Fully developed hurricanes with a full warm core will only increase in the future, but the weak tropical systems with a shallow warm core will already be enhanced in the near future. All extreme autumn storms have an a similar development and form warm seclusions. Those storms can make the extra-tropical transition. There will also be integrated vapor transport via the so-called atmospheric rivers. The smaller eastern tropical Atlantic warming reduces the amount of fully developed hurricanes that reach Europe, however, the weak tropical systems are not affected. Global warming can thus lead to an increase of severe storms in Western Europe. They have a tropical origin and reintensify when entering the baroclinic zone.

Dr. Reinout Boers, KNMI, the Netherlands, High resolution modelling improves the simulation of extreme winds in the coastal zone

The main question for the Netherlands is how do we keep our feet dry in the 21st century? For this we use the WTI, the Statutory Testing Framework for dyke protection. This is a periodic assessment of safety levels which is required by law. Extreme wind climatology is needed to drive the hydrodynamic models. A novel method is being developed using high-resolution NWP data. The most recent model Harmonie has a higher resolution than the older ERA-interim and therefore shows differences in the land-sea mask. High resolution modelling affects a larger region than just the coastal zone. Hydraulic load is as well as at the coast as around Lake Ijssel a problem. There is also a bias between the modeled wind speed and the observations, but the cause is unknown. For a given atmospheric reference, a higher/lower SST yields higher/lower winds than the reference. The ratio sea/land of wind speed depends on stability over sea, which therefore affects the strength of storms. Extreme wind speeds over land are underestimated, but the cause is still unknown. All this contributes to the conclusion that a downscaled high-resolution model is better than the ERA-interim, but this is dependent on the location. The model is a suitable tool to generate a 30-year wind climatology.

Dr. Geert Lenderink, KNMI, the Netherlands, Response of hourly precipitation extremes to climate perturbations: results from a mesoscale model

In recent years, the Netherlands experienced extreme precipitation. The relation between extremes and warming from observations explains the observed increase in hourly extremes of +15% in the Netherlands. These extremes are caused by organized mesoscale convective systems. They are underestimated and unresolved, or at best partly resolved, in present-day climate models. That's one reason why climate models underestimate the relation between precipitation intensity and moisture. The latest revolution in weather prediction mesoscale models is that they have a 2-3 km resolution. They use non-hydrostatic dynamics and resolve the largest convective motions in the atmosphere. By perturbing a mesoscale model we can successfully create future analogues, which will answer the question: how much rain would fall if the same event (same meteorological conditions) would occur in a warmer (or cooler) climate? From this perturbation we get about 12% per degree average over 12 cases, yet with a large inter-case spread.

Ronald van Haren, KNMI, the Netherlands, Resolution dependence of European winter precipitation in an atmospheric general circulation model

EC-Earth has high and medium resolution models. Both models are compared, looking at the spatial distribution of precipitation, evaporation and moisture convergence. It shows a more accurate representation of moisture convergence in most of the central and northern part of continental Europe in the high resolution model. There is no clear improvement in the southern part of Europe. In fact, in highland areas the agreement with ERA-Interim is in general worse because the orography in this model is more comparable with orography in the medium resolution model. In order to better understand the difference in moisture convergence we consider the moisture transport. The main differences in wind, moisture and transport are found over the Atlantic. This is the storm track region where extra-tropical cyclones form. These regions are associated with increased precipitation and winds and are subject to extreme weather events. Weather in Europe is heavily influenced by the storm track over the North Atlantic. The model calculates the storm track which appears to be too zonal in the medium resolution model. This is a common problem in the coarse resolution GCM's. In agreement with previous studies, the location of the storm track in the high resolution model is more realistic. It has fewer and/or less intense storms pass over central Europe. The high resolution model gives a more accurate representation of northern and central European winter precipitation. The medium resolution model has a larger positive bias in precipitation in most of the northern half of Europe. The synoptic systems are better simulated in the high resolution model, providing for a more accurate horizontal moisture transport and moisture convergence. The smaller precipitation bias in the high resolution model is largely unrelated to a difference in vertical velocity distribution. It is in agreement with less moisture transport over this area in the high resolution model. In areas with orography, the difference in vertical velocity distribution is more important.