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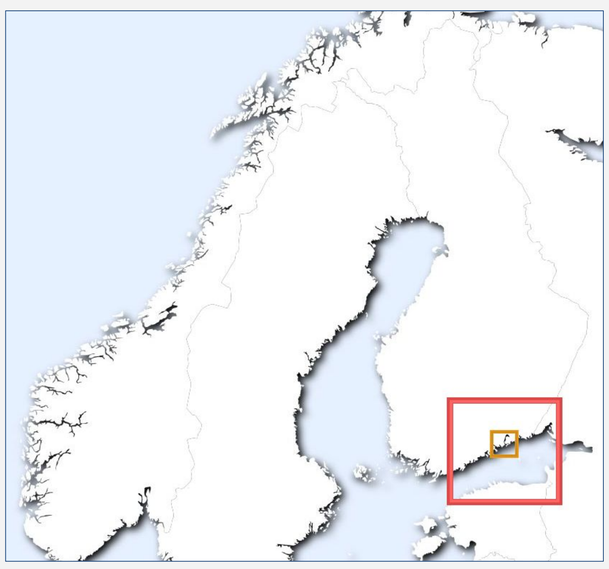
Simulated effects of land-sea contrasts in Southern Finland

1. Introduction

This study is part of nuclear safety project SAFIR18 focusing in behavior of boundary layer on land-sea contrasts. The idea is to simulate mesoscale features on heterogeneous surface, by using horizontal grid spacing of 500m. Harmonie simulations were validated using observations done near Loviisa nuclear power plant in spring 2015 with weather mast. In this poster temperature, at levels 50m, 75m and 115m, is compared between simulated and observed by select grid points for land, sea and coastline near the weather mast. The goal is to research is boundary layer simulated realistically and how simulations correspond to forcing of different surfaces. Colors in figs.: Observations in red, sea point in blue, land point in green and closest point to observation in purple.



Model configuration:
- Harmonie-Arome cy40 (trunk_14979)
- Nesting: ECMWF global short range forecasts updated hourly
- Re-initialized every 6 hours:
  - Upper air and sea surface: Nestor model blended with own forecast
  - Land surface: Assimilation of SYNOP data

Domain:
- 576 x 576 grid points with horizontal spacing of 500 m
- 65 levels (surface - 30 km)
- time step 15 s

Fig. 1. Red square: domain of simulations 577x576 grid points; orange square: area of validation results 101x121 grid points.

2. Results

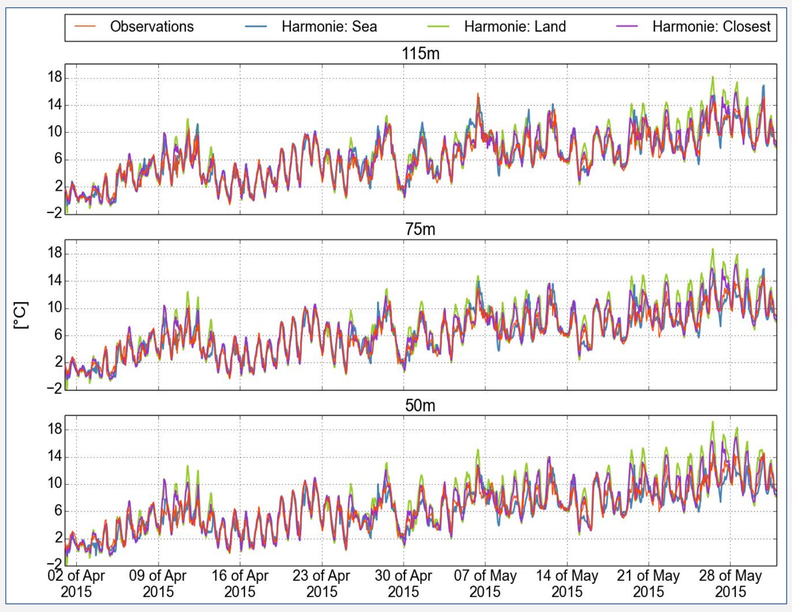


Fig. 2. Time series of temperature. Difference of day and night is clear, simulations corresponds well to behavior of observed temperatures in every height and gridpoint

Fig. 3. Average diurnal cycle of temperature. Closest correspondence in 115m. Model overestimates amplitude over land. Phase difference between land and sea evident.

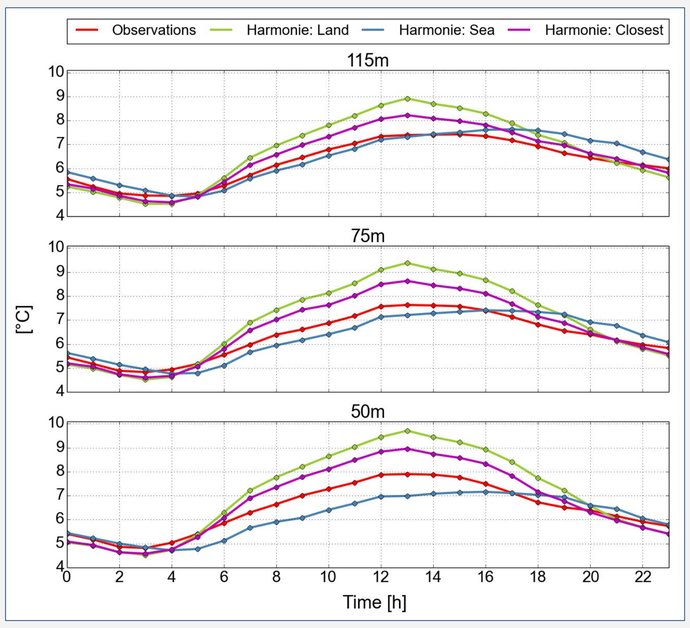
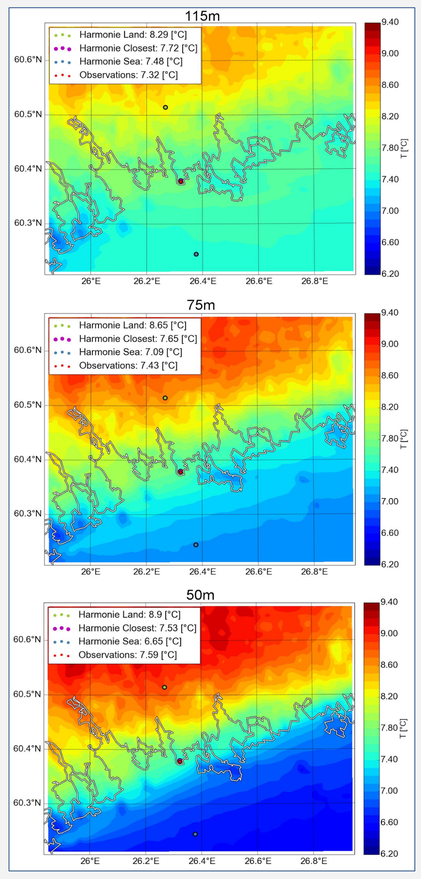
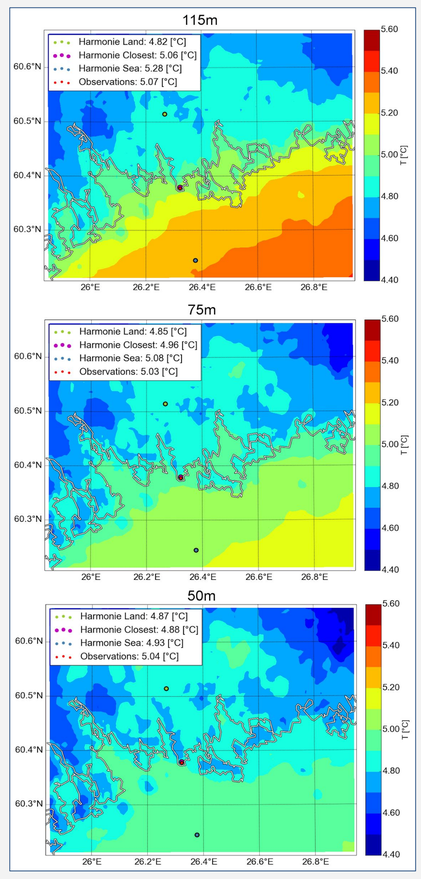


Fig. 4. Average day time temperature on coast. Day time is from 1pm to 5pm. The land-sea contrast decreases with height

Fig. 5. Average night time temperature on coast. Night time is from 0am to 4am. Strongest contrast in 115m height





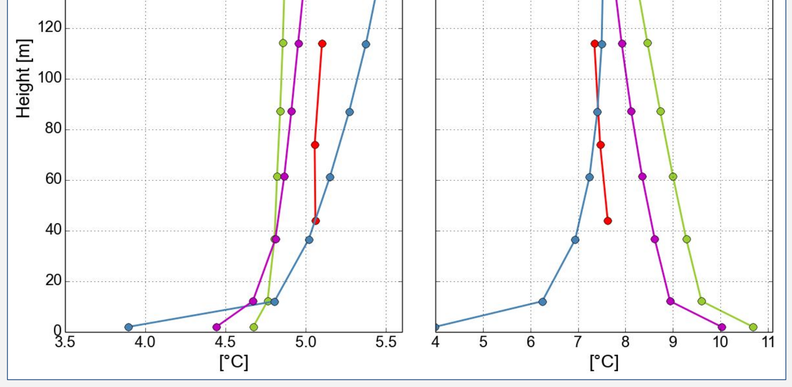


Fig. 6. Vertical profiles of temperature at day and night time. In land and coast points the shape corresponds to the observations, but diurnal amplitude is overestimated

Fig. 7. Vertical profiles of potential temperature. Over sea air is in stable state throughout the day. Over land there is an clear diurnal variation in the stability

Fig. 8. Pearson correlation coefficient R of observations and model field at day time. R is high everywhere, but strongest over coastline. In 50m strongest R on land and in 115m strongest R over sea.

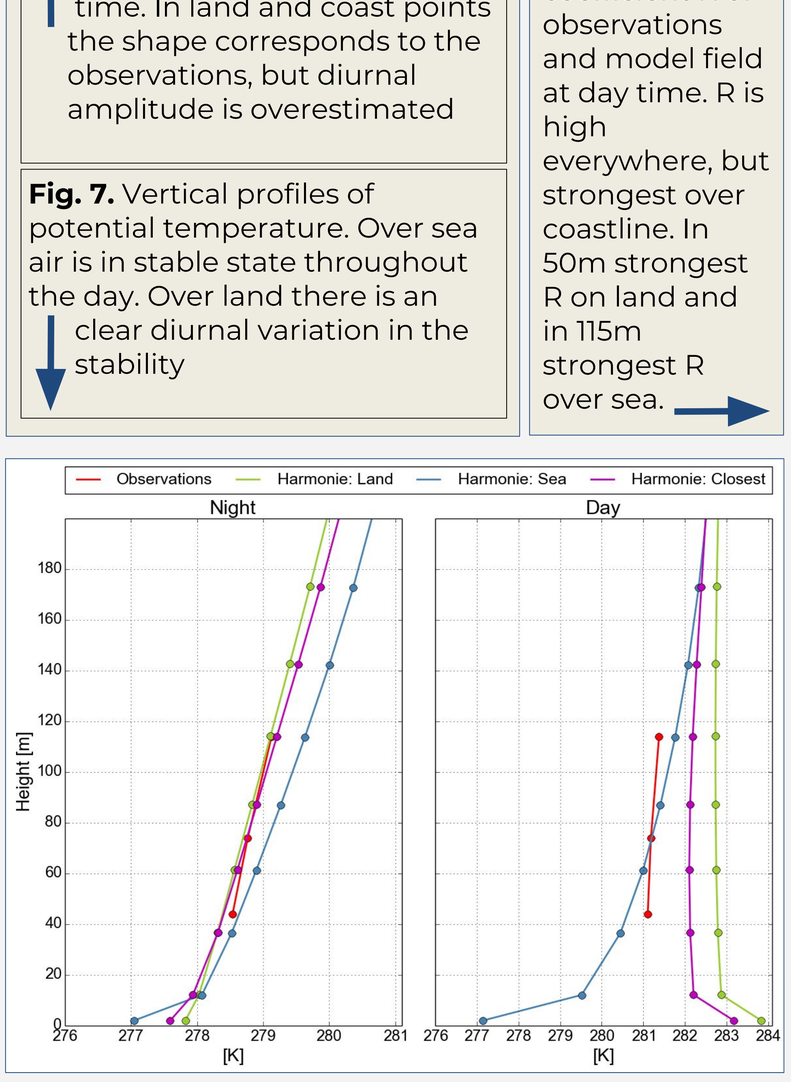


Fig. 9. Pearson correlation coefficient R at night time. Strong R in every height, strongest over coast. Small difference between land and sea.

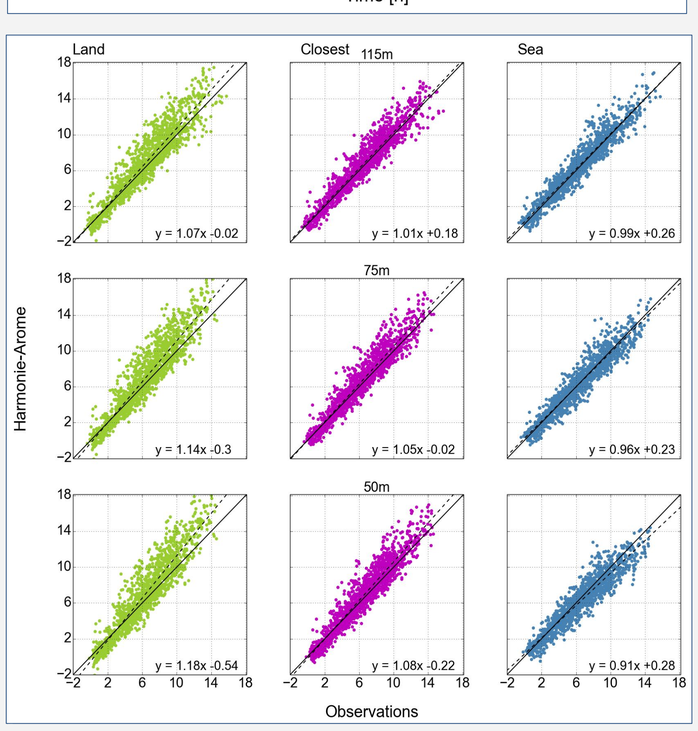


Fig. 10. Scatter plot of observations and simulations. Dashed line shows a least square fit.

3. Conclusions

- The land-sea contrast is well represented
- The response to the diurnal forcing at the surface is realistic
- A coastal zone, with properties different from both land and sea is realistically modeled as shown in fig 8. and 9.
- Simulated area is quite small to see larger scale differences between sea and land