The development of three summertime mesoscale cyclones (MCs) over the northern Amundsen and Bellingshausen Sea from 10 to 12 January 1995 (during FROST SOP3) is studied by means of AVHRR data, ERS and SSM/I retrievals, and mesoscale numerical model data.

The most pronounced MC is investigated in detail. It had a diameter of about 800 km, a lifetime of more than 24 hours and reached the intensity of a polar low. The developments take place far away from the sea ice front or topography. The MCs are detected as cyclonic cloud signatures in the AVHRR imagery, and SSM/I retrievals show a distinct mesoscale signal in the fields of cloud liquid water, wind speed and integrated water vapour (IWV). The frontal structure of the most intense MC is depicted by high IWV gradients and a large near-surface wind shear. The collocation of ERS- and SSM/I-derived wind speeds shows good agreement (bias 1.1 m s-1, stddev 1.2 m s-1). ERS-derived wind vectors give no insight into the structure of the MCs, becauseof missing direct overpasses over the MCs by the narrow ERS scatterometer swaths, but they are used to validate numerical simulations. The numerical simulations using the mesoscale Norwegian Limited Area Model (NORLAM) show two of the MCs as short-wave baroclinic developments triggered by an upper-level trough, while a less significant third MC is not simulated by the model. In contrast to the satellite retrievals, the simulations give insight into the three-dimensional structure of the MCs. Model results are validated using satellite retrievals and some few available in-situ observations. This validation study shows the good quality of the numerical simulations for the IWV and the near-surface wind speed from SSM/I as well as for the near-surface wind vector from ERS over the simulation time of 36 hours. The differences between ERS and NORLAM wind vectors are 1.1 ñ 2.5 m s-1 (mean bias ñ std dev) and-3 ñ 25 deg for wind speed and direction, respectively. The validation using SSM/I retrievals yields a mean bias of 0.3 m s-1 (std dev 2.9 m s-1) for the wind speed, and of -2.5 kg m-2 (stddev 2.9 kg m-2) for the IWV.