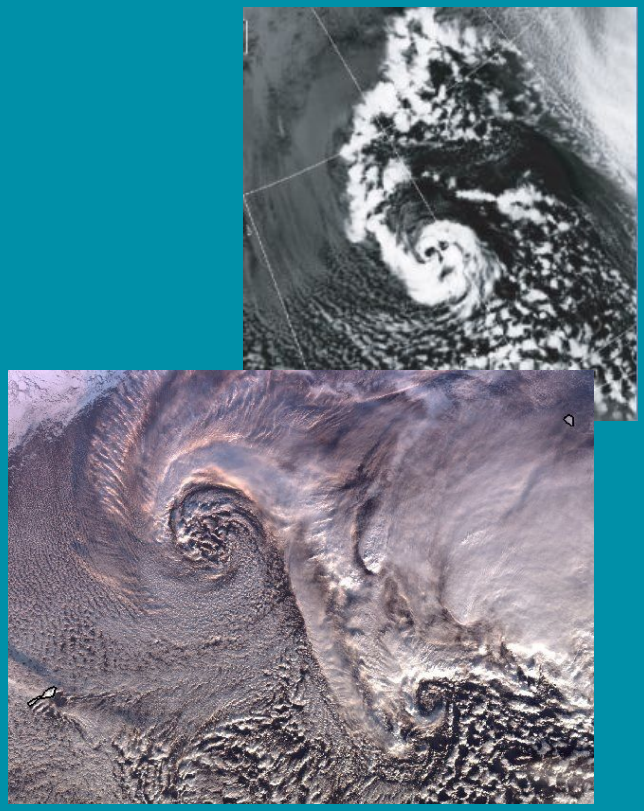
Norwegian Meteorological Institute

ECMWF

Polar lows in ECMWF versus Arome Arctic

Matilda Hallerstig and Linus Magnusson



ECMWF Graduate Trainee Programme

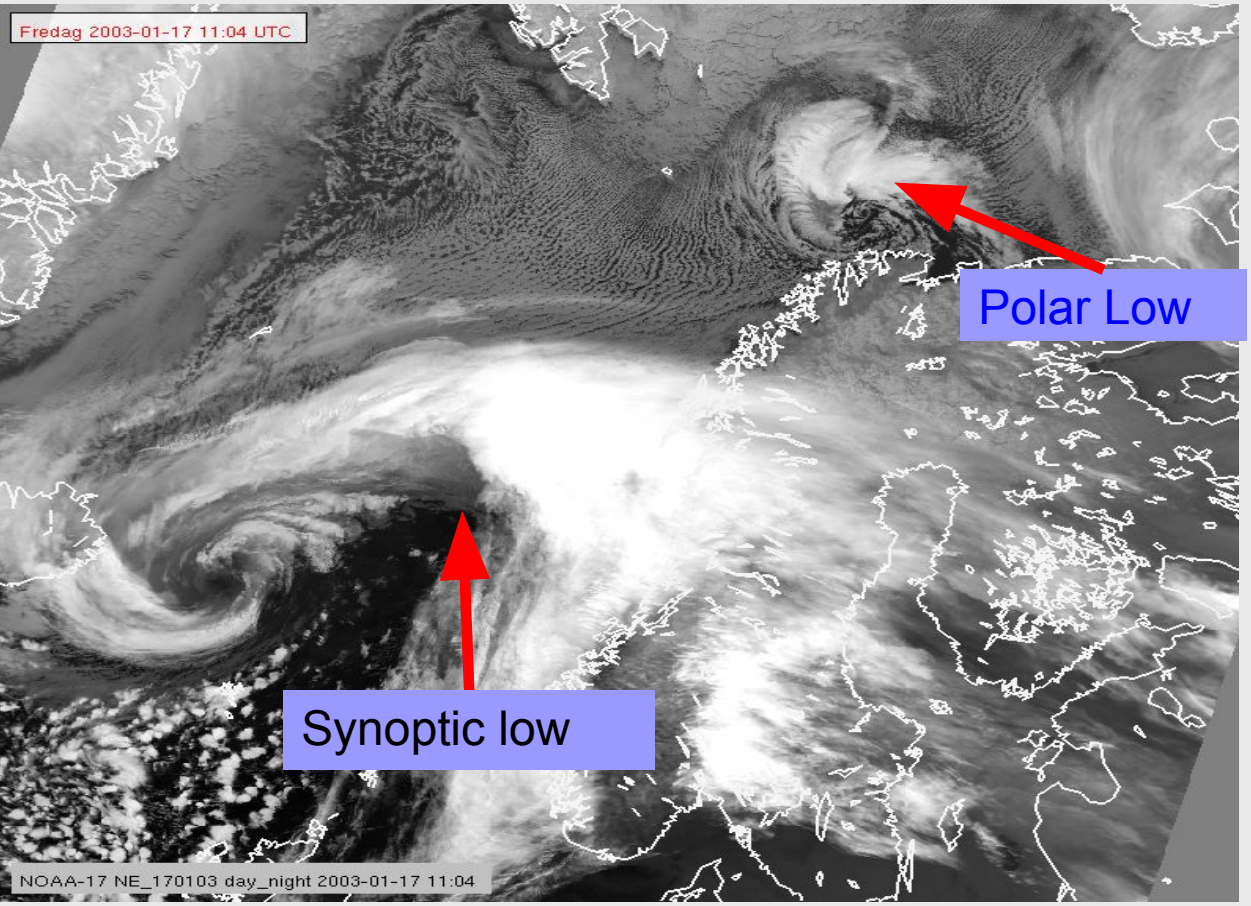
- Provides training for graduates from national weather services in the member states
- Promotes closer cooperation between ECMWF and the member states
- Some trainees continue as a regular employees at ECMWF after the training period
- Start with one year, can be extended to two years
- Trainees are paid partly by ECMWF and partly by their home institute

ECMWF Graduate trainees, left to Right:

Polly Schmederer (Austria),
Ruth Coughlan (Ireland),
Toni Jurlina (Croatia),
Matilda Hallerstig (Norway),
Milana Vuckovic (Serbia)
Not present:
Gabriella Szépszó (Hungary)

Photo: Dusan Vuckovic

What is a polar low?



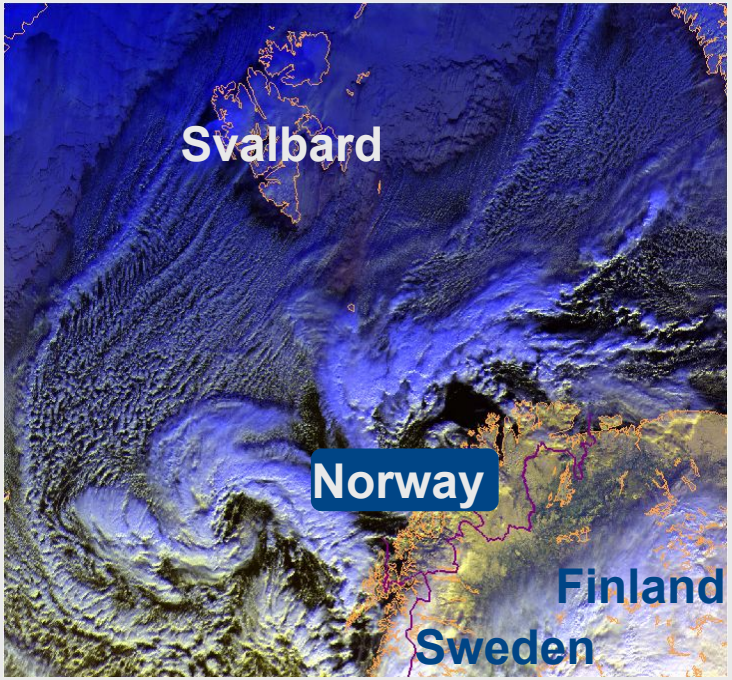
- Intense, small-scale lows over ocean
- North of the polar front

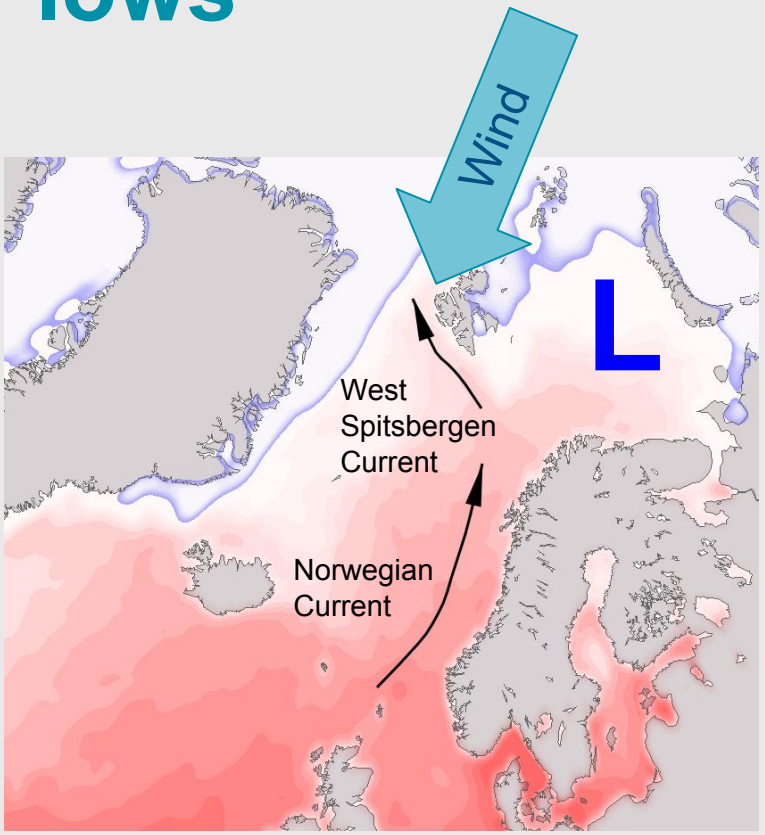
- Horizontal scale ca 100-1000 km
- Gale or stronger over sea
- Near gale or stronger at the coast

- “Arctic Hurricanes”

Formation of polar lows

- Cold Air Outbreak (CAO)
- Relatively warm sea surface
- Large vertical temperature gradient and strong convection
- Areas of high potential vorticity
- Upper trough and cold core

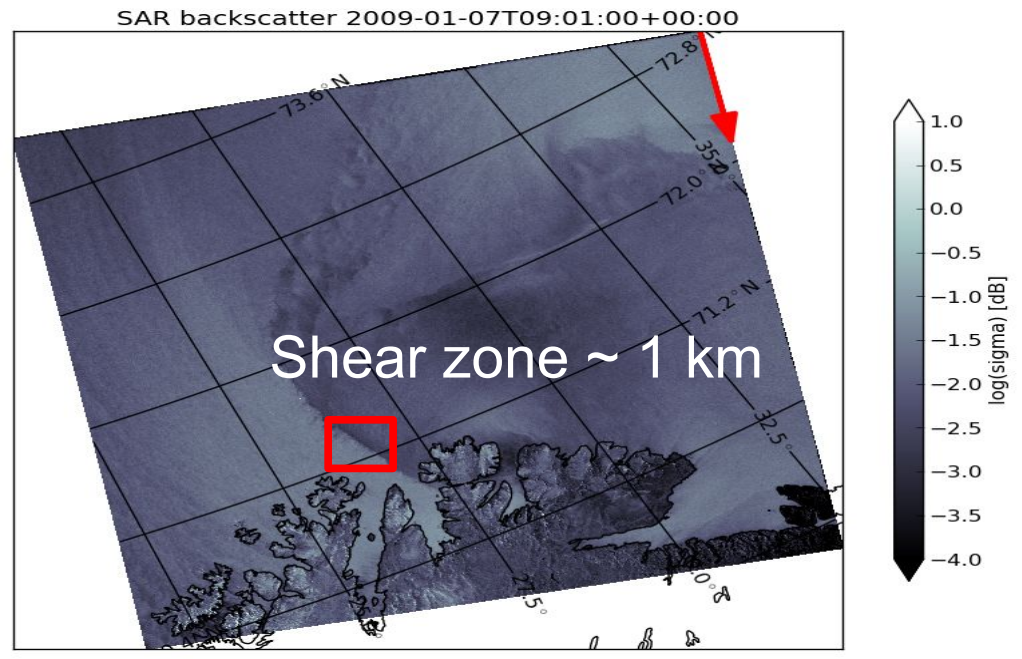




Short distance between warm ocean currents and sea ice makes European Arctic particularly prone to polar lows

Forecasting challenges

- Rapid development
- Sudden changes
- Heavy snow showers
  - low visibility
  - icing on aircrafts
  - avalanche danger
- Strong, gusty wind
  - turbulence
  - large waves
  - vessel icing
- Poorly resolved in low resolution global models
  -



Tromsø mountain observation (Kjølen 800 moh):
13:20z: 290 03kt (Calm)
13:50z: 340 53kt gusting 69kt
(Northwest storm 10)

Cases

Criteria:

- Arome Arctic and ECMWF HRES available in archive.
- Within Arome Arctic domain
- Scatterometer winds available
- Interesting meteorology

2016-03-31

2016-11-27

2016-12-08

2017-01-19

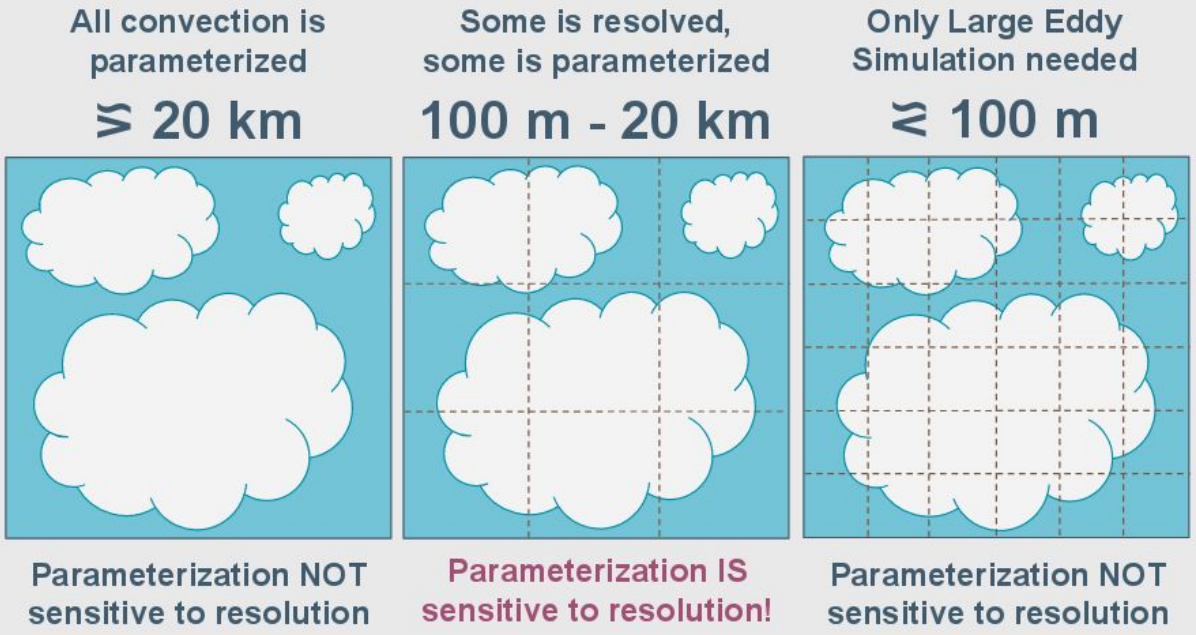
Tracking

- Determined starting point from satellite images
- Follow minimum mslp
- Tracks that followed wrong feature were removed
- Experiments:
  -
  - **Arome Arctic** **2,5 km**
  - ECMWF HRES 9 km
  - Ensemble control run 18 km
  - Ensemble members 18 km
  - Reference run (coupled ocean) 9 km
  -
  - **No convection parameterization** **9 km**
  - **5 km resolution** **5 km**

The convective grey zone

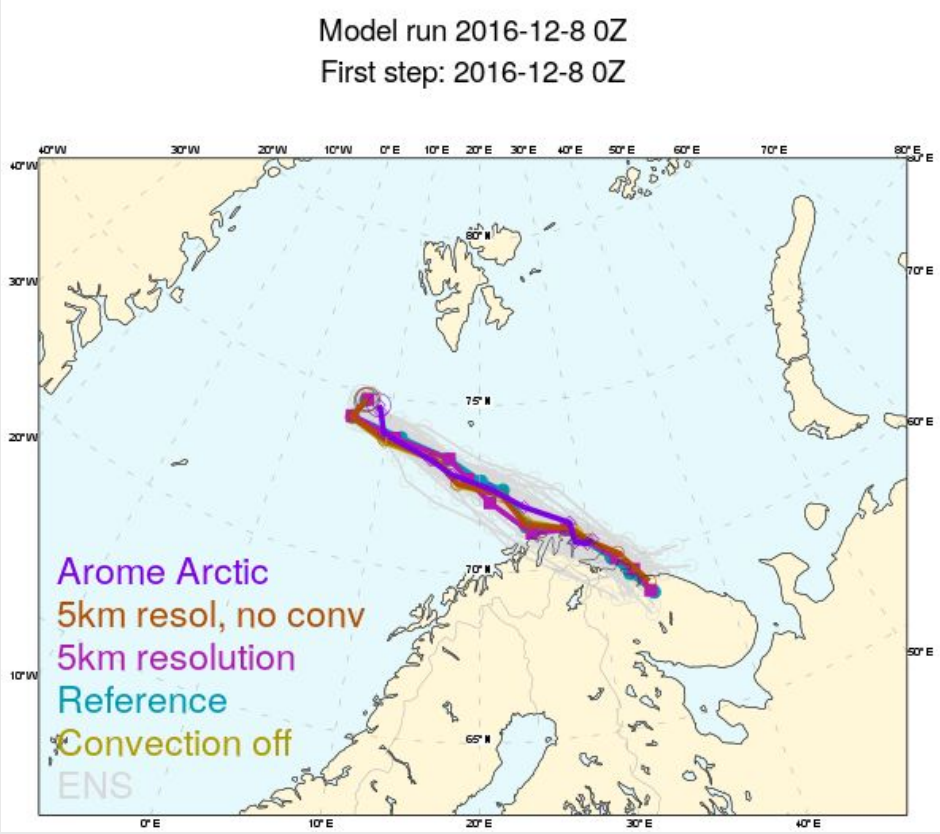
Horizontal resolution where convection is partly, but not fully resolved

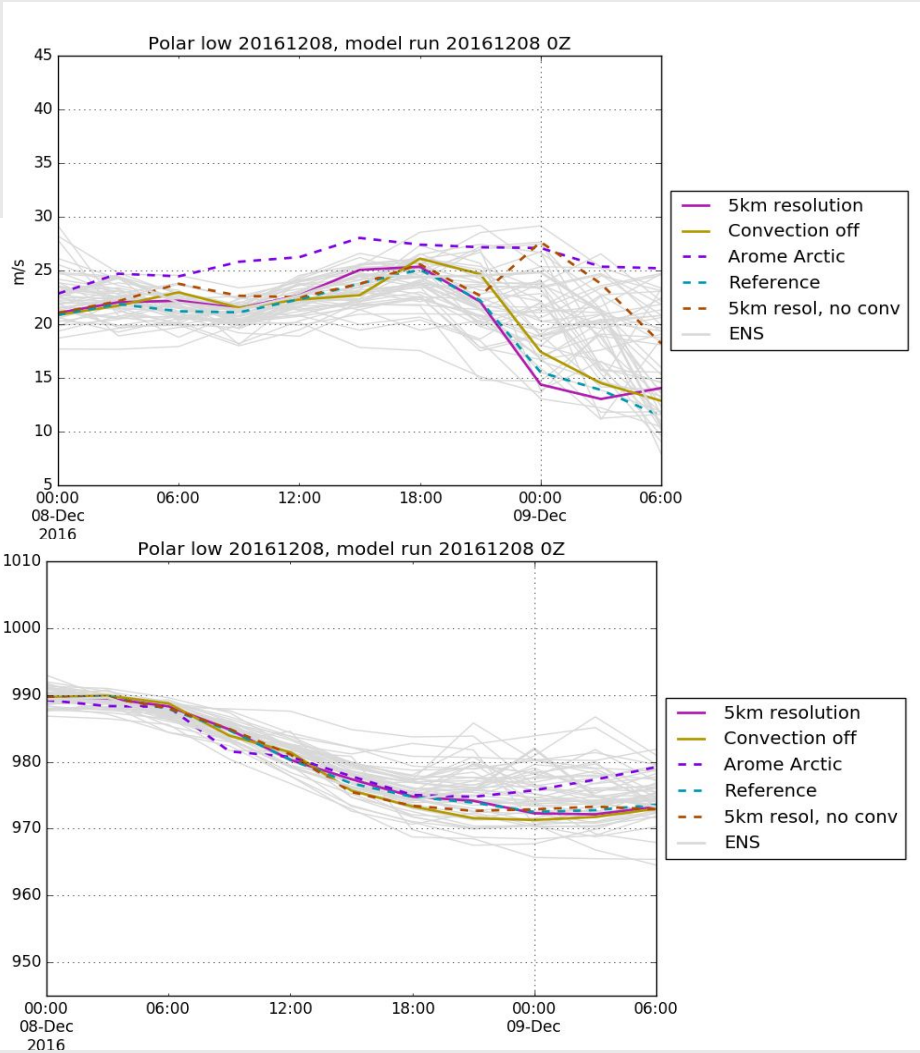
- At synoptic scale, turbulent flow is mostly 2D → numeric simplification is possible
- At smaller scales, turbulence must be considered 3-dimensional → more complex solutions are needed



Semi automatic tracks

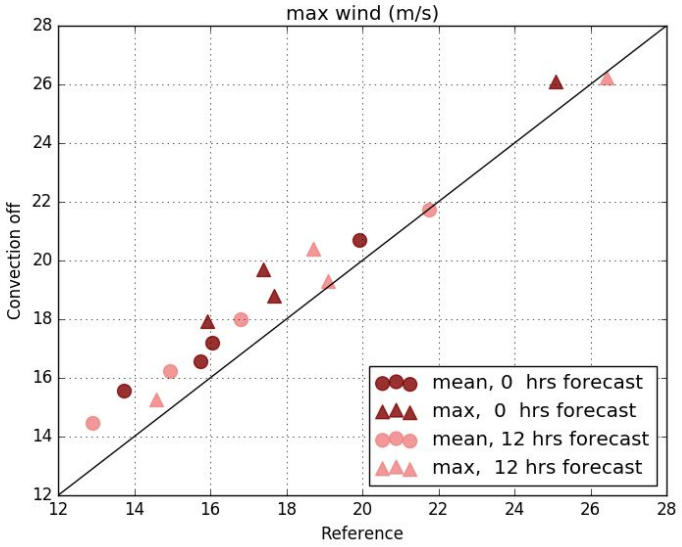
Example case 2016-12-08

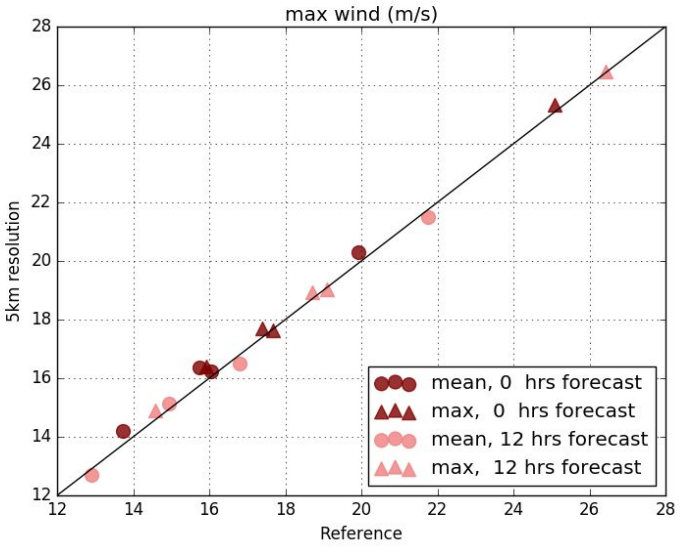


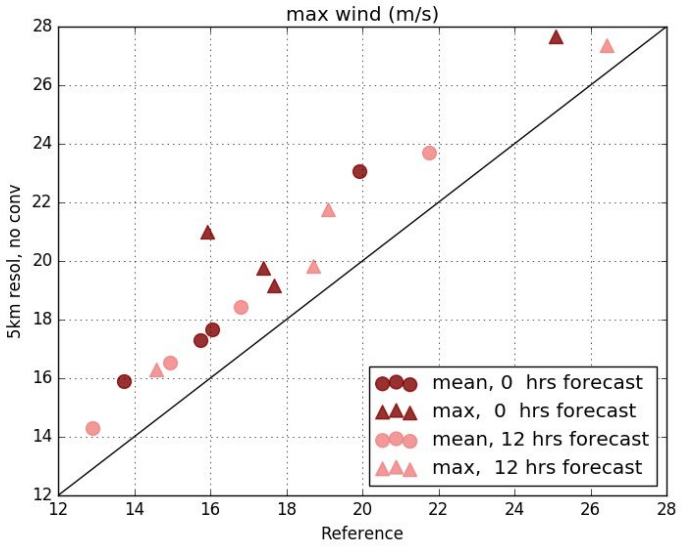


Parameterization versus resolution

Is the higher wind speeds in Arome Arctic due to higher resolution or due to different physics?







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Thank you for your attention