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Agenda:

- Definition
- Key processes
- Climatology
- Forecasting
- Observing the PL by satellites
Definition of the polar low
(European Polar Low Work Group)

- ’A small, but fairly intense low in maritime areas’
- In cold air outbreaks (CAO) north of the polar front
- Diameter 100 - 600km
- Cyclonic curvature
Cold air outbreak

Synoptic low

Polar low
The weather in a polar low:

- Strong wind in western and northern parts
  - Average observed max wind 42kt
  - 25% have 50kt or more
  - Dense snow fall
  - Horizontal visibility < 100m
  - Vertical visibility < 100ft
  - Cb, icing and turbulence

- Eastern half usually less dramatic:
  - Clear eye
  - Off shore winds
Climatology of the polar low:

Areas:
- Norwegian Sea/ Barents Sea
- Japan Sea, Bering Sea
- West of Greenland, Ungava bay
- Northeastern Pacific
Key processes:

- Polar Lows develop from areas of instability:
  - Baroclinic, convective
  - Occlusions, troughs, convergence lines, etc.

- Destabilization of the lower layers, surface to 850 hPa:
  - Cold Arctic air is advected over warmer waters
  - Supply from the sea surface of latent and sensible heat

- Further destabilization of upper layers
  - Passage of cold air aloft
  - Unrestricted convection up to 400-500hPa
  - Upper trough in the Z500 hPa, with PVA and stretching of the column
Forecasting methodology:

Look for:

• Cold air outbreaks at low levels, -cloud streets, etc.
• Area of low level instability: Convergence zone, occlusion, Cb cluster, etc.
• Cold trough at 500hPa with PVA
• SST - T_{500} ≥ 44°C (can be less)
• Polar lows usually situated at the fringes of the cold cores.
1. The cold air outbreak
2. Low level disturbances

Old occlusions

Circulations

Convergence lines
The cold upper trough:

Trough @ Z500hPa with positive vorticity advection

SST- T500hPa ~ 44 to 50°C
How cold?

SST - $T_{500} \geq 44^\circ C$

- with exceptions!
Development in the model:

MSLP signature

Precipitation and cloud bands

Baroclinic zones, as seen from thickness or in the equivalent potential temperature @ 850 hPa
Surface wind:
! Sharp shear zones
! Check position of the model
Observing polar lows from satellites

Polar orbiting (North of 70 degrees North)
AVHRR infrared or visible
Using the Ascat for wind

Scatterometer winds observations from Ascat or Oceansat
Using the Ascat for wind

Hirlam 8km model winds vs. Ascat
Are both lows captured?
Scatterometer wind:
Absolute wind speed OK
Ambiguity in wind direction
Contaminated by rain
Insensitive to snow
Polar lows seen from SAR:

18 utc

21 utc

19:30 utc

Shear zone ~ 1-3 km, time to increase ~ 1-10 minutes
The 18.Nov. 2008 low: Early detection by SAR?

10 utc

12 utc

14 utc

20 utc
Surface signature in the SAR?
AVHRR vs. SAR

Signature of the polar low at surface vs. cloud top
Summary on polar lows:

- Small, fairly intense lows in the marine Arctic in the winter

Forecasting:
- Cold air outbreaks
- Areas of deep convective instability

Observing the polar low from satellites:
- AVHRR IR and visible for general cloud top
- Ascat for absolute wind speed
- SAR for qualitative detailed studies
Questions?

polarlow.met.no            www.yr.no