4. Low Cloud Forecasting Techniques

(UKMO empirical forecasting techniques)

Turbulent Mixing Low Cloud

- Caused by low level moisture and wind shear in the boundary layer:
- Responsible for the formation of St and Sc
  - Turbulent stratus
  - Nocturnal stratus
  - Stratocumulus

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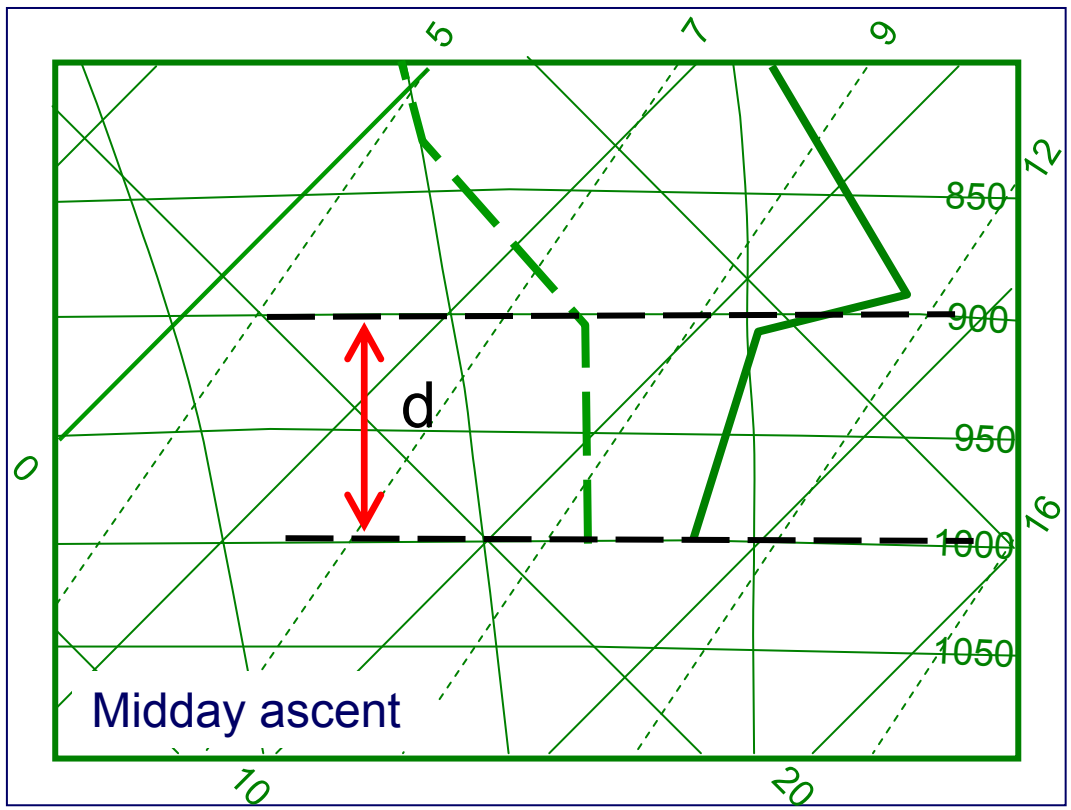
Turbulent Stratus and Stratocumulus

- Need to know the depth of the Mixing Layer (d)
- Identify a layer, ideally topped by an inversion
- In this example use the layer 1000 to 900 hPa



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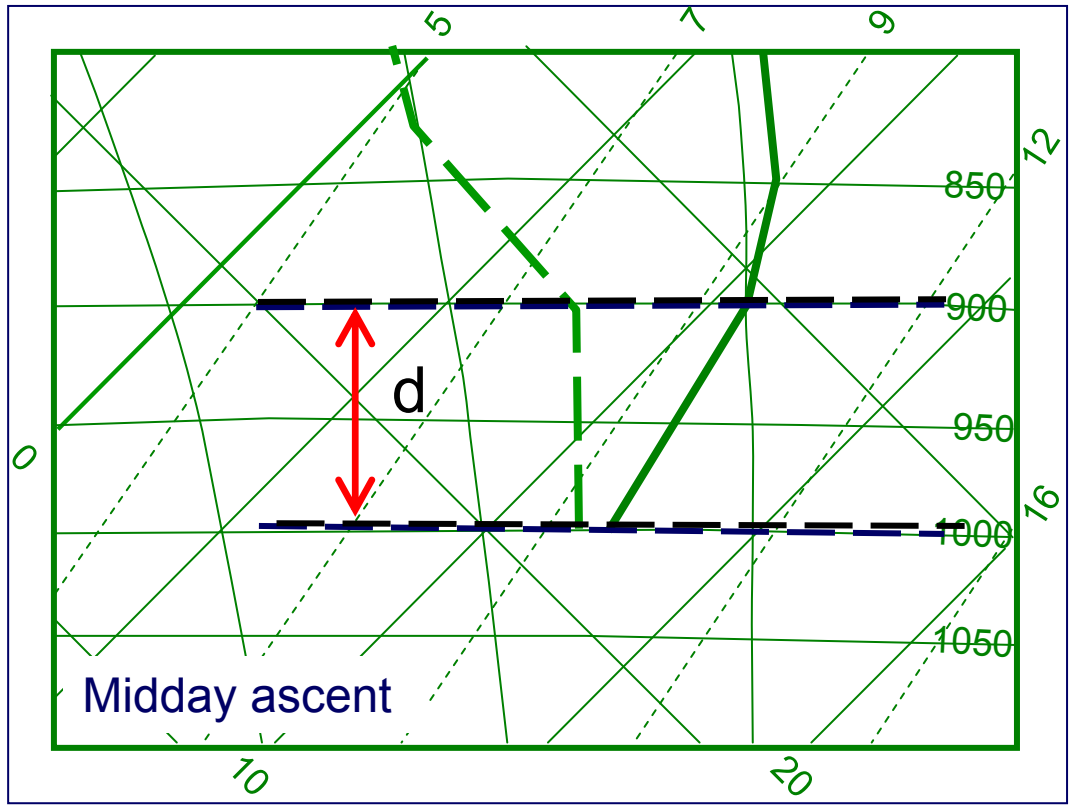
Turbulent Stratus and Stratocumulus

- In the absence of an inversion use the following empirical rule:

- $V_s \leq 16$ kts then
  $d = 200V_s$

- $V_s \geq 16$ kts then
  d = 3500 ft (night) or
  d = 4000 ft (day)

  Where V_s = surface wind Speed and d = depth of mixing layer



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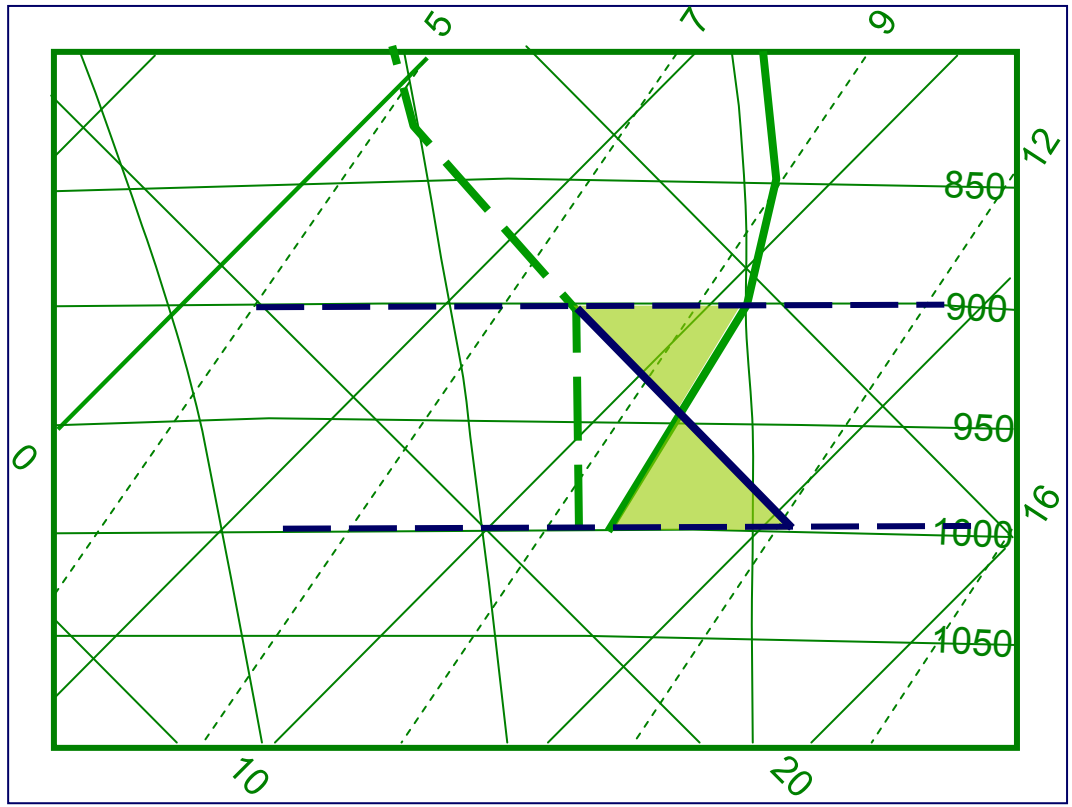
Turbulent Stratus and Stratocumulus

- Mixing causes the ELR to become approximately equal to DALR in time
- The line should be altered such that there are equal areas either side of the original ELR



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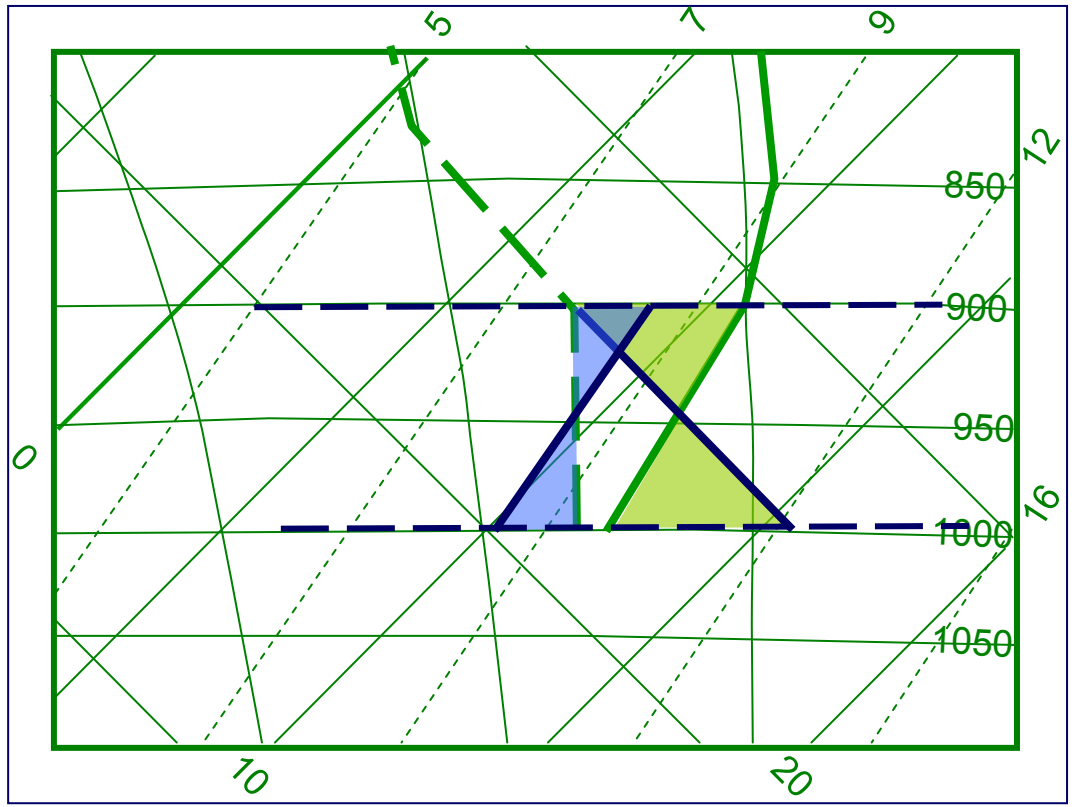
Turbulent Stratus and Stratocumulus

- Mixing also causes Hydrolapse = SHMR
- The line should be altered such that there are equal areas either side of the original Hydrolapse



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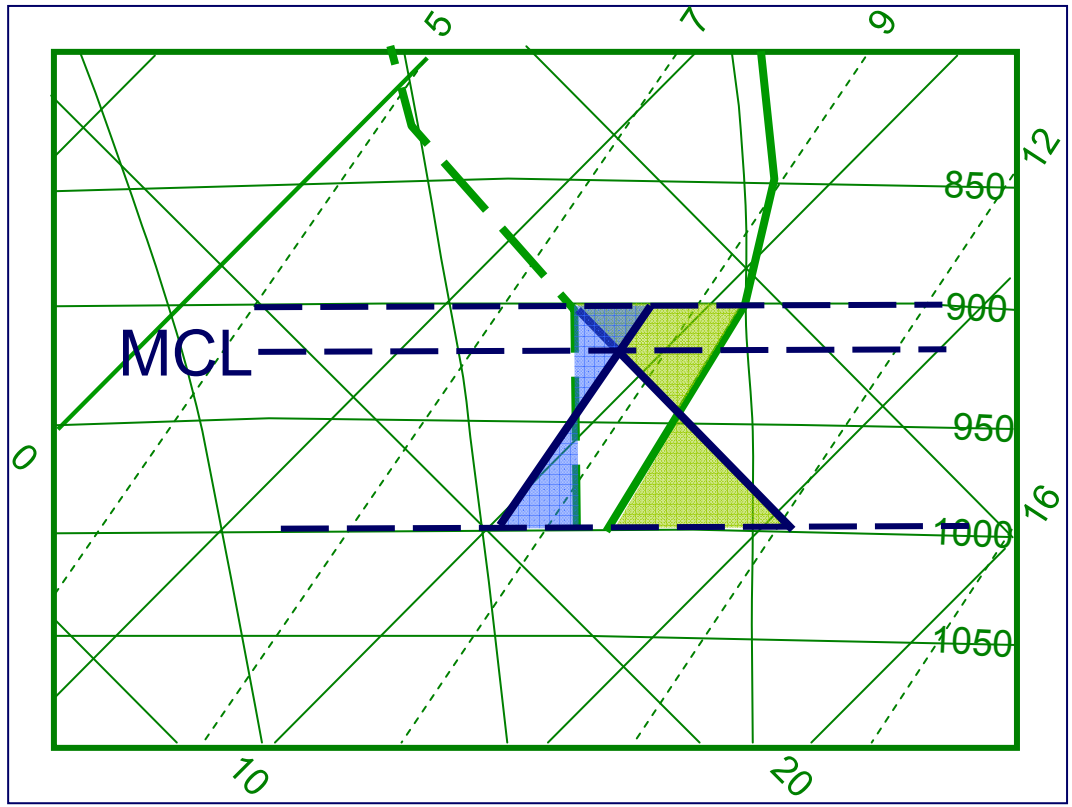
Turbulent Stratus and Stratocumulus

- Where the two lines cross is the Mixing Condensation Level, i.e. the cloud base
- Note that surface temperature has risen and dew point fallen
- This is common when stratus forms at night



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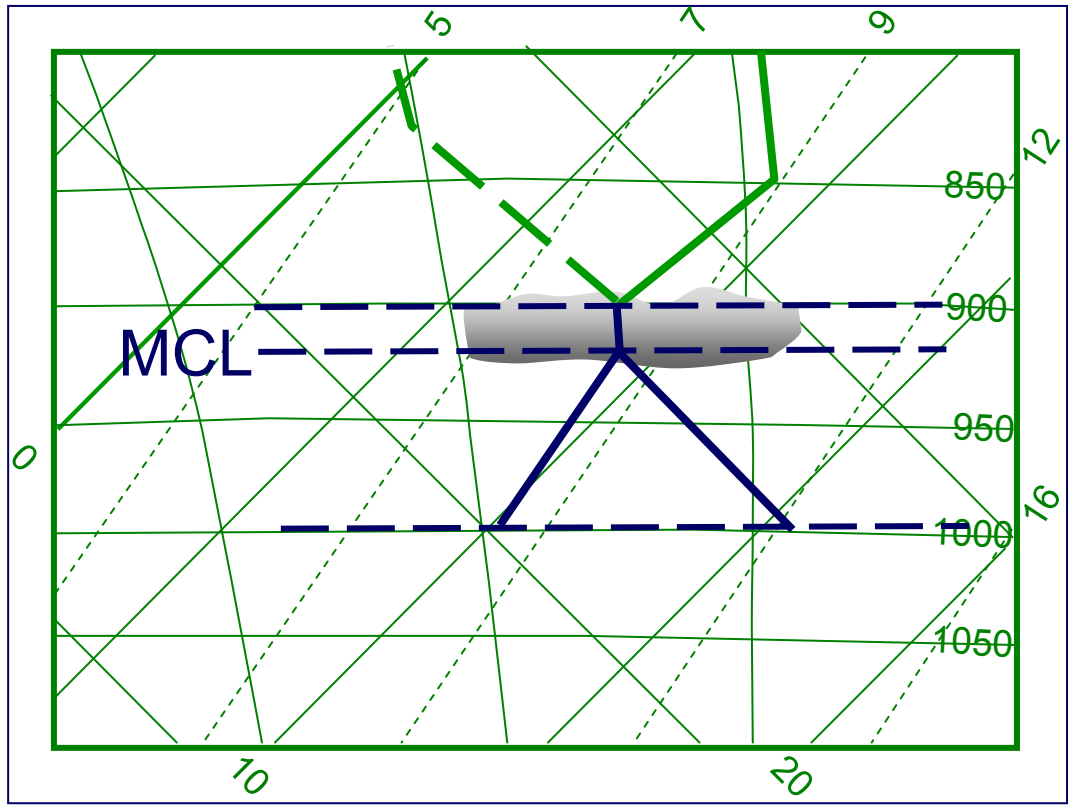
Turbulent Stratus and Stratocumulus

- Cloud may form between the MCL and the top of the Mixing Layer
- Resulting profile follows the SALR through the cloud



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Nocturnal stratus

1) Calculate Tfog
- Saunders fog technique

2) Determine top of surface mixing layer (h)
- $h \approx 75$ x surface wind speed

3) Calculate Tst
- Saunders stratus technique

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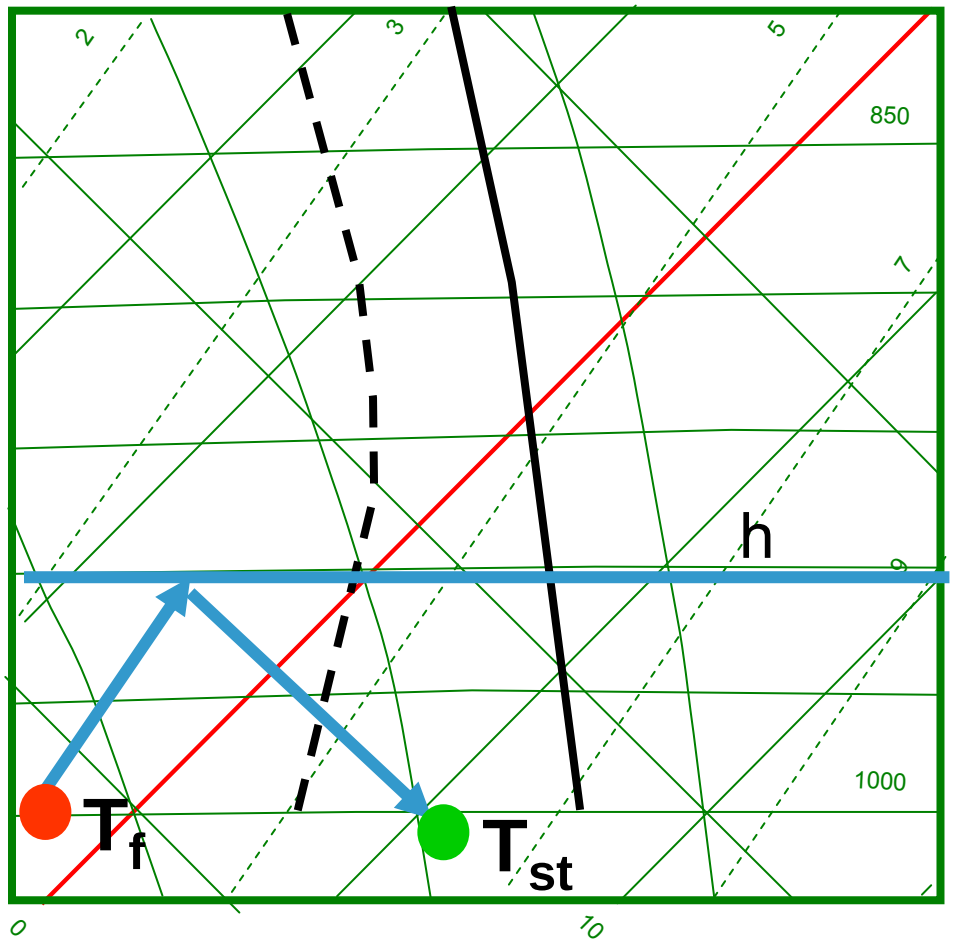
Saunders stratus formation technique



- 1200Z representative tephigram
- Use Saunders method to find the fog point, T_f
- Mark on top of surface mixing layer (h)
- Draw HMR to h
- Draw DALR to surface pressure
- Read off T_{st}

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Nocturnal stratus

1) Calculate Tfog
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2) Determine top of surface mixing layer (h)
- $h \approx 75 \times$ surface wind speed

3) Calculate Tst
- Saunders stratus technique
- Alternative methods

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Alternative methods

- Temperature where stratus is already present
- The morning's stratus clearance temperature minus 1 or 2°C
- The sea temperature if stratus is likely to be advected in from the sea

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Nocturnal stratus

1) Calculate Tfog
- Saunders fog technique

2) Determine top of surface mixing layer (h)
- $h \approx 75$ x surface wind speed

3) Calculate Tst
- Saunders stratus technique

4) Determine height of stratus
- Height = (Tst-Tdew)x350

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When will stratus clear?

Three mechanisms

- Insolation
- increased wind
- advection of drier air

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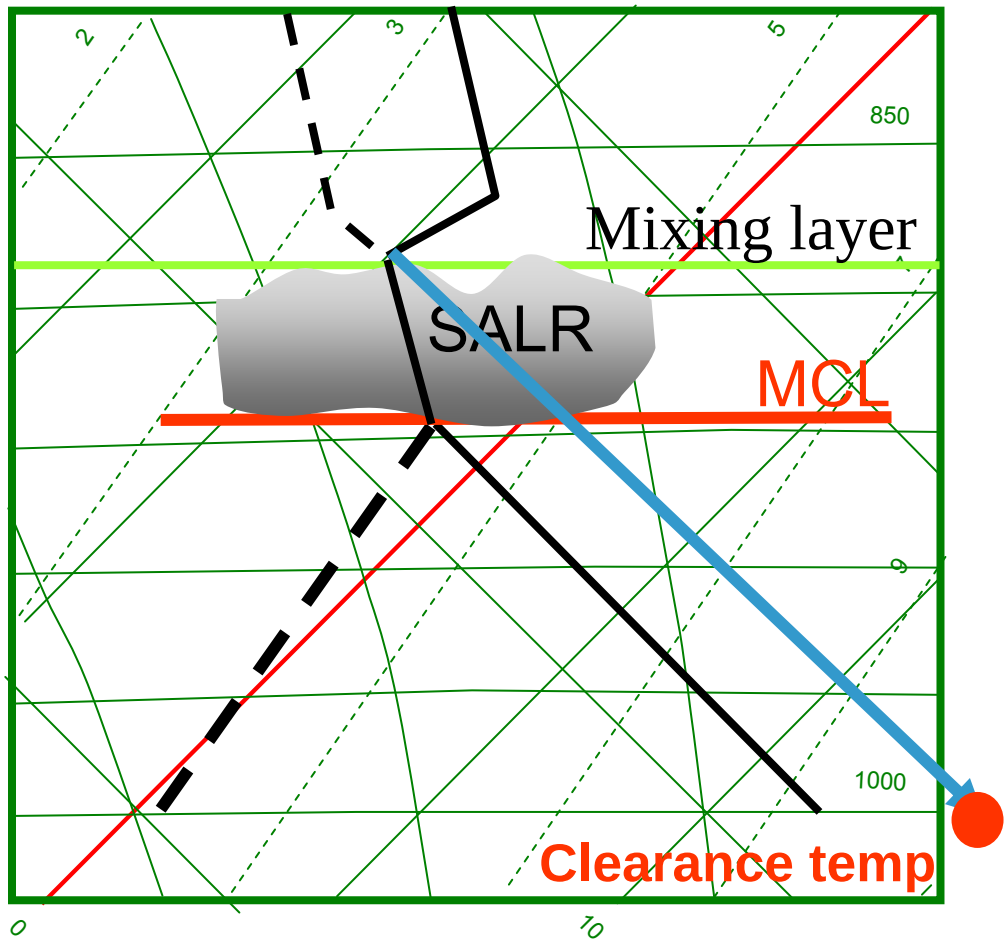
Clearance by insolation



- Draw a DALR from the stratus top to the surface pressure

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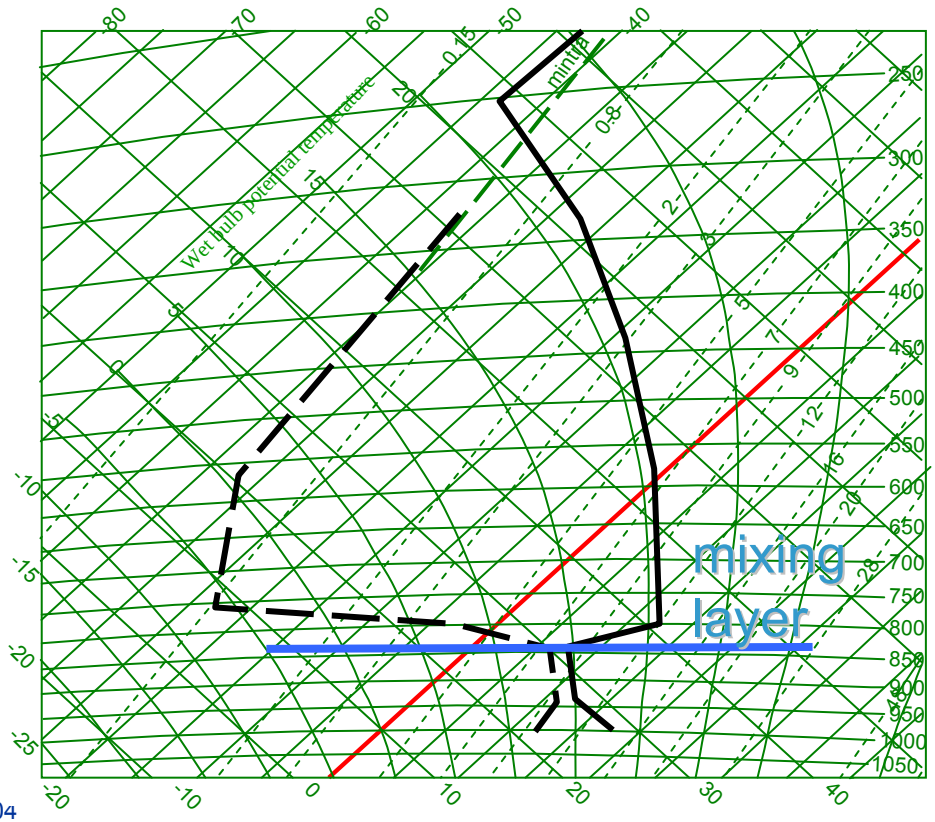
Clearance by increased wind

- Increasing the wind speed will deepen the mixing layer ...



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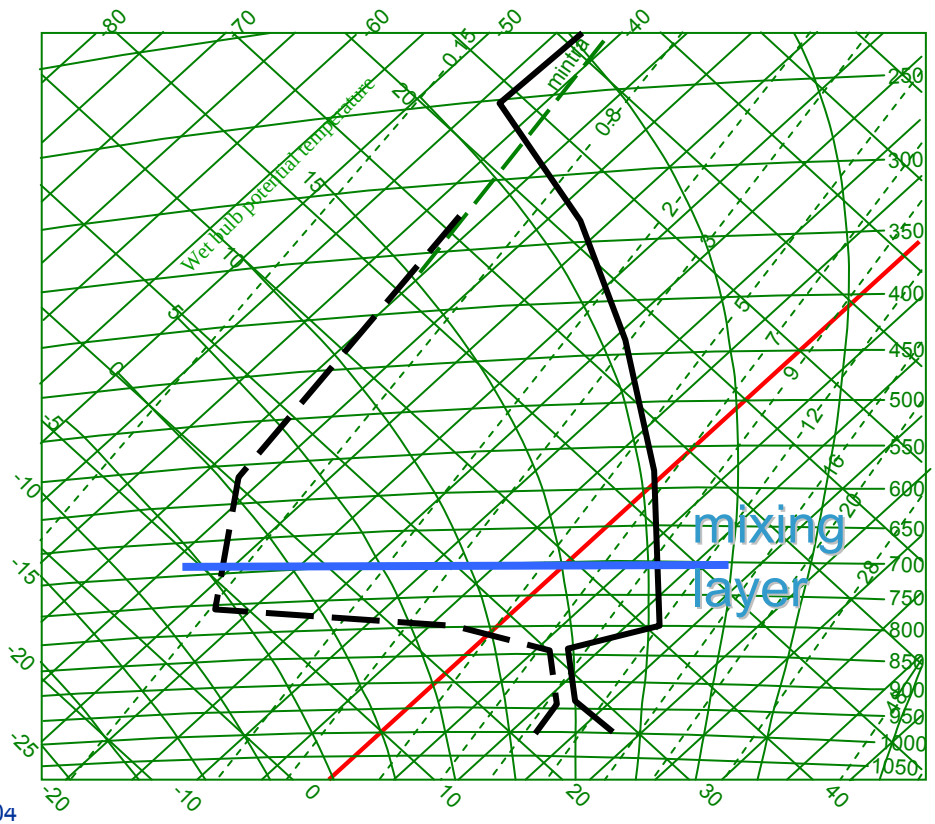
Clearance by increased wind

- … and can mix drier air from above into the cloudy layer which may disperse the stratus



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Clearance by advection of drier air

- drier air from another source may clear the stratus
- use satellite pictures to observe rear edge of stratus
- Example follows.

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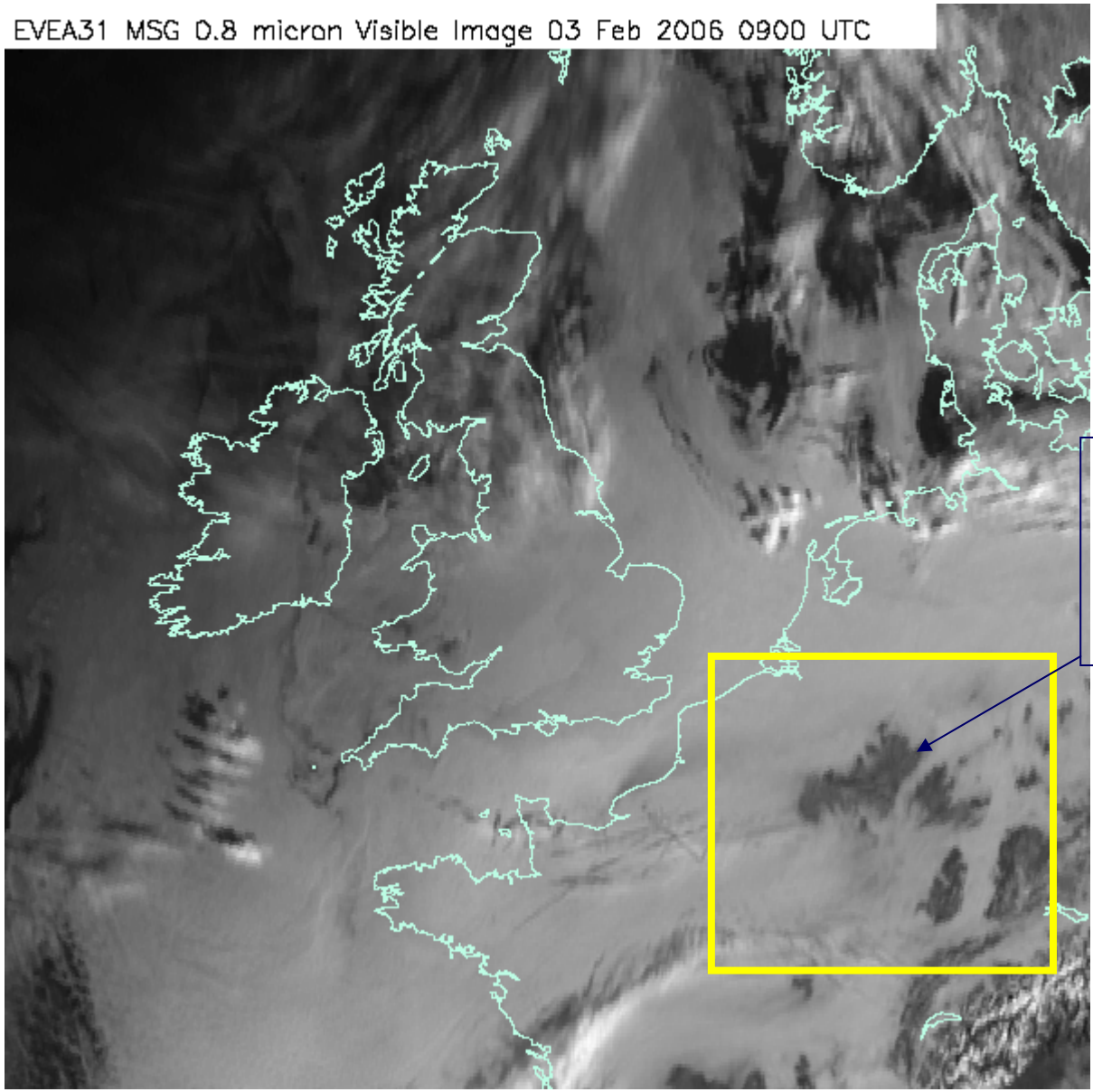
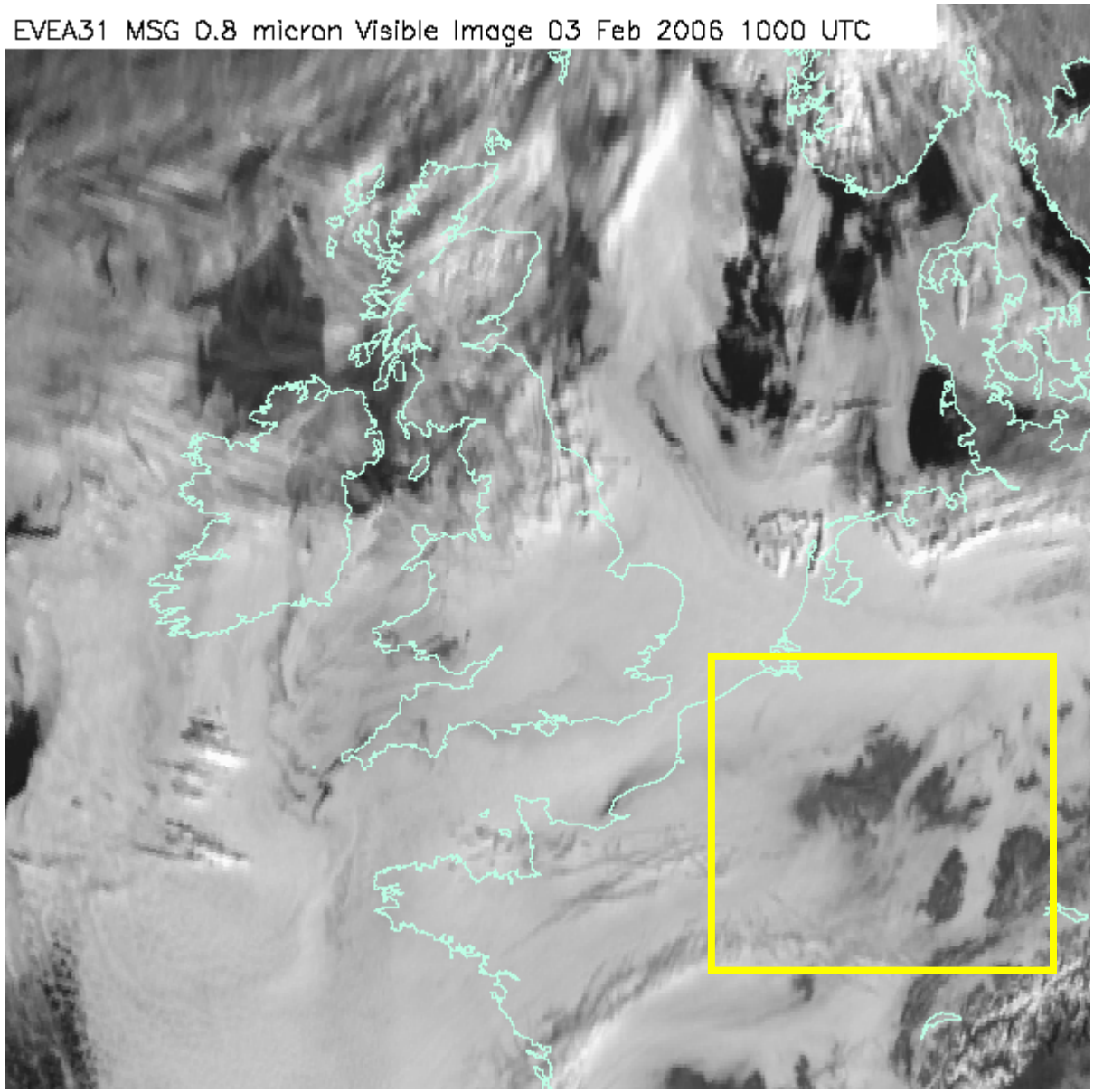

EVEA31 MSG 0.8 micron Visible Image 03 Feb 2006 0900 UTC
Area of drier air spreads south west with time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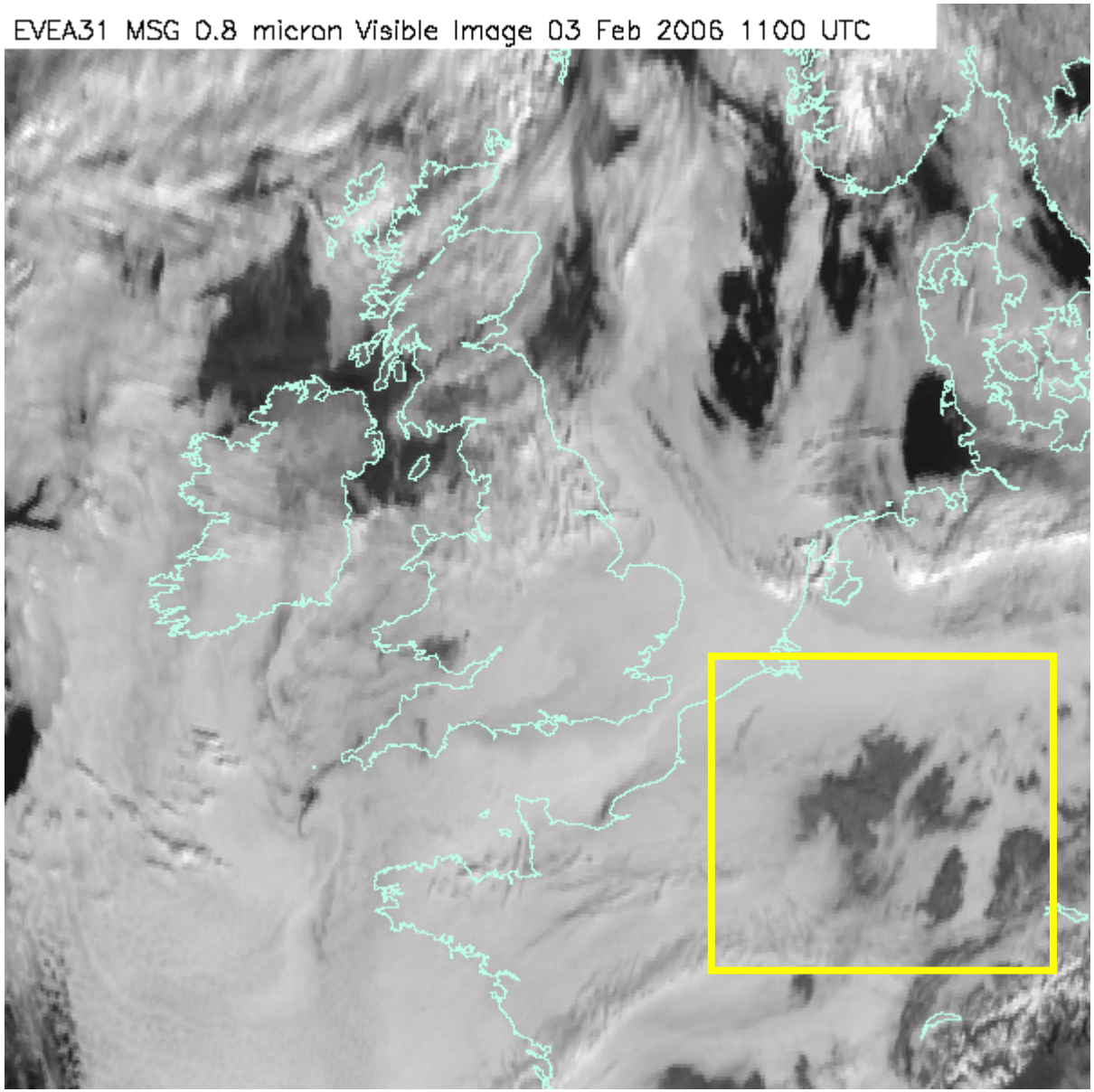
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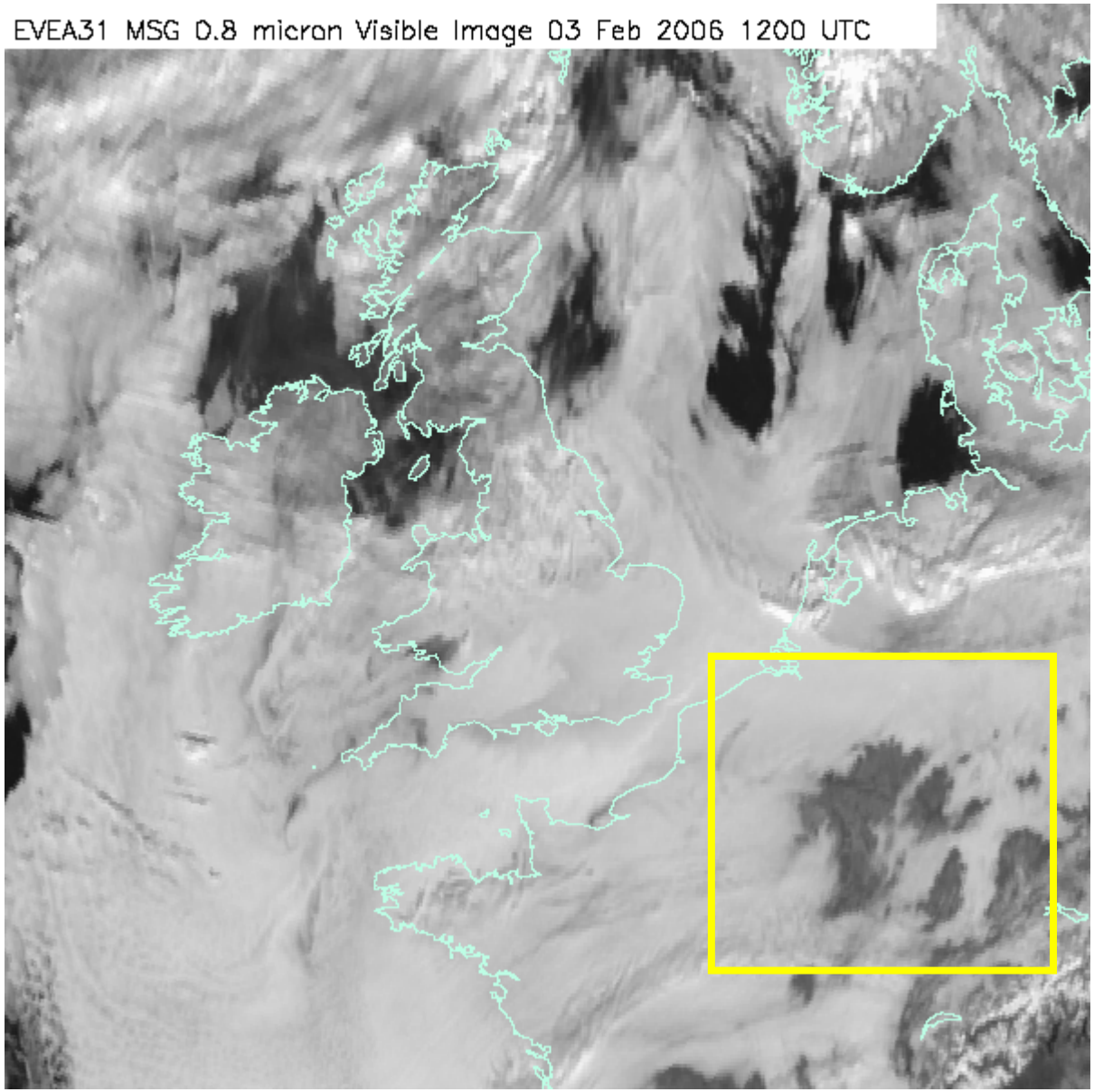
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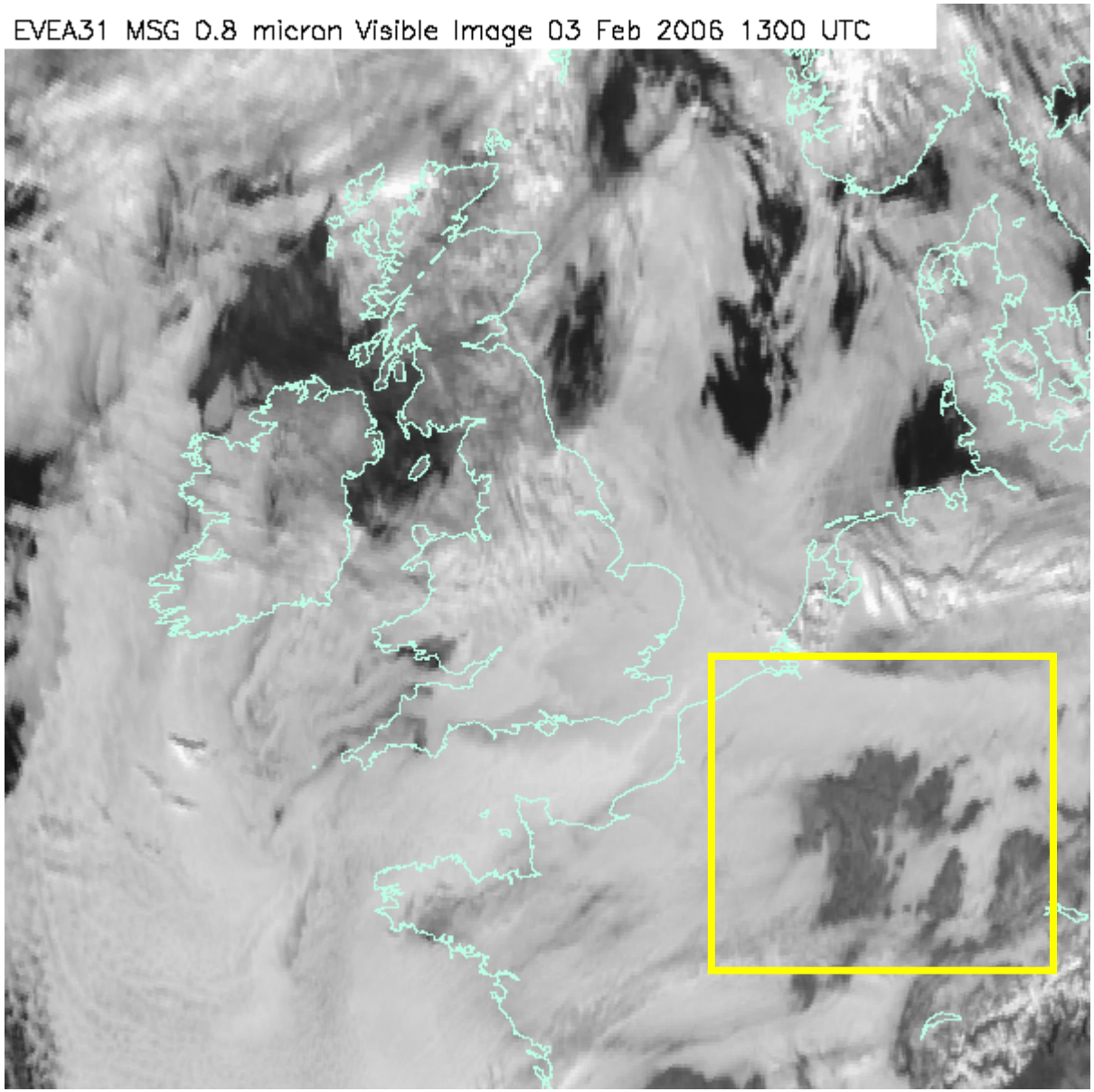
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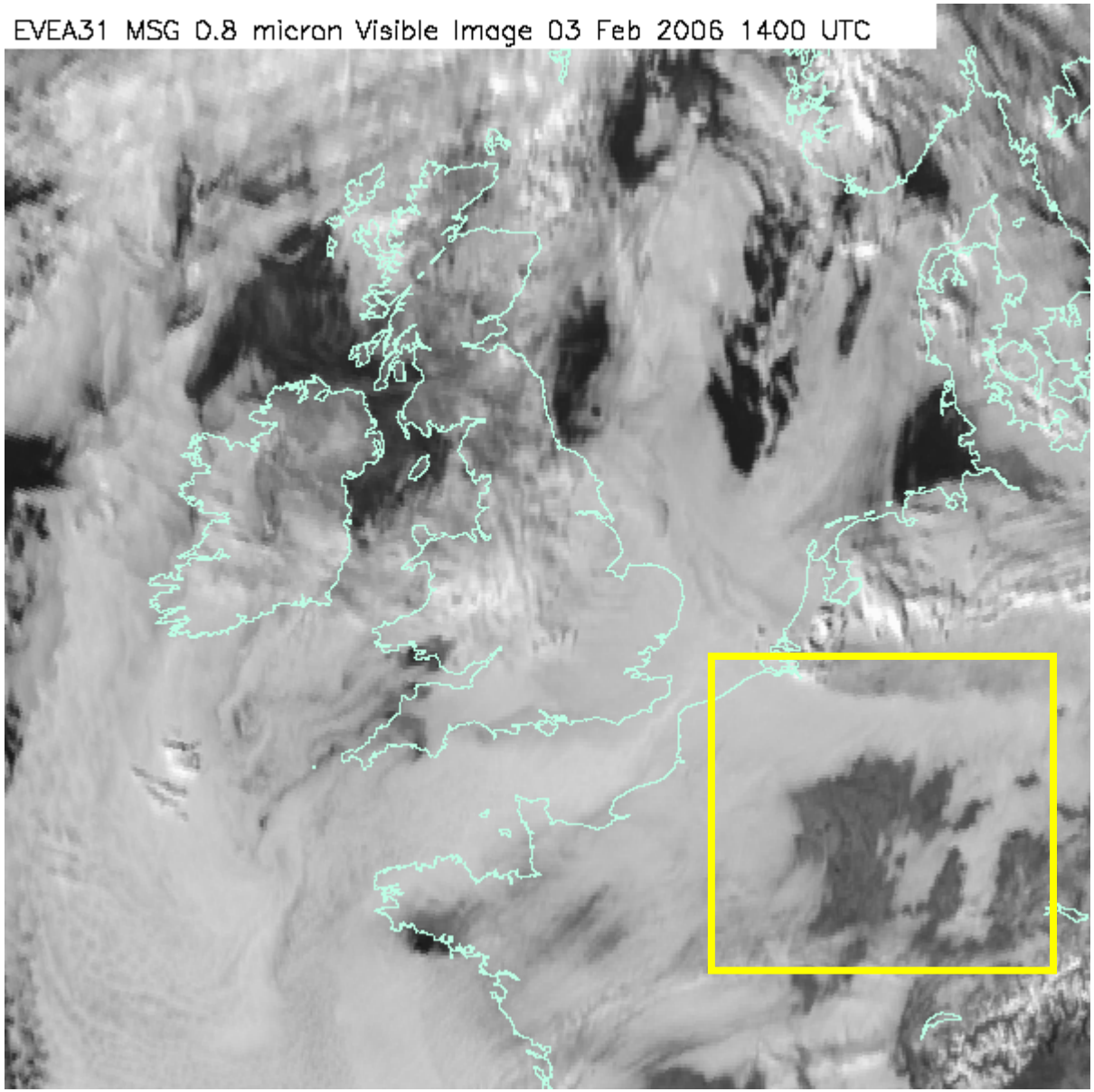
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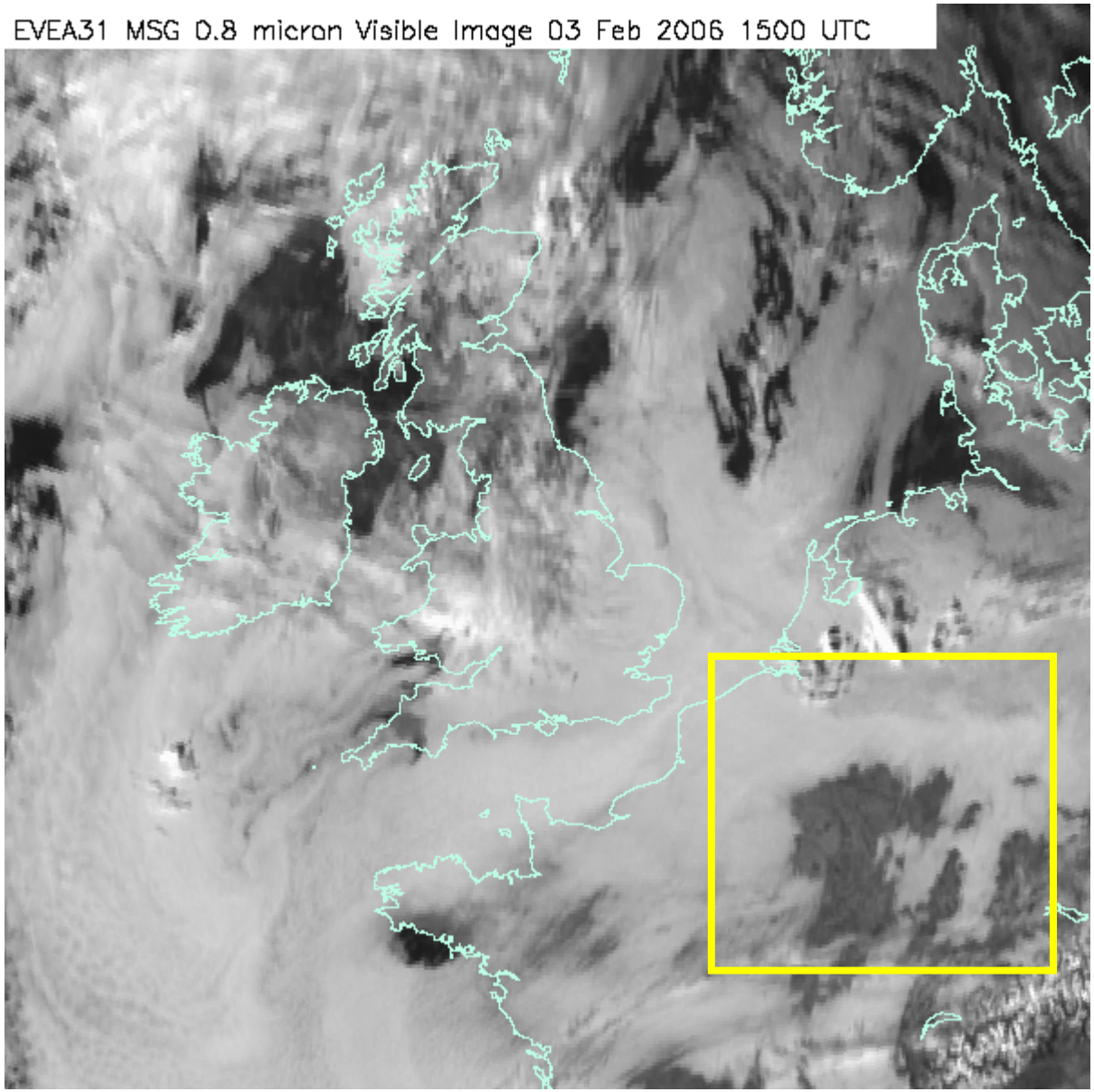
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LOW CLOUD FORECASTING QUIZ

1) What are the 2 main factors required for the formation of low cloud?

2) What is the relationship between the height of the base of stratus, the air temperature and the dewpoint?

3) What are the 3 primary ways of clearing stratus?

4) What 2 features on a tephigram can mark the top of a layer of cloud?

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LOW CLOUD FORECASTING QUIZ

1) What are the 2 main factors required for the formation of low cloud?

ANS: Low level moisture and turbulence (wind shear)

2) What is the relationship between the height of the base of stratus, the air temperature and the dewpoint?

ANS: $H_{st} = (T_{St}-T_{dew})x350$

3) What are the 3 primary ways of clearing stratus?

ANS: Increasing wind; drier air; insolation

4) What 2 features on a tephigram can mark the top of a layer of cloud?

ANS: Inversion; isothermal.

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Satellite

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