



Met office ASTEX simulations

Adrian Lock, Met office, UK



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- Apologies!
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- Composite LES: latest results



Apologies

- First: apologies for messing up the wind forcing in the composite cases so that I don't have those results yet
 - Corrected simulations still running – latest results at the end
- Second: I got carried away with the LES and completely forgot about the SCM simulations until last week but finish setting them up when I get back next week



A high resolution ASTEX forecast

Adrian Lock, Met office, UK

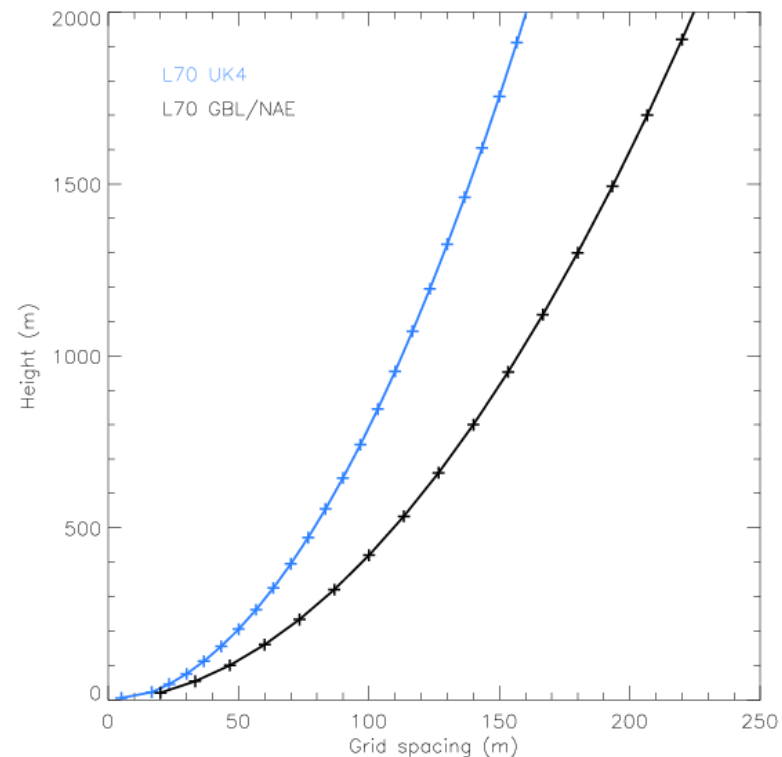
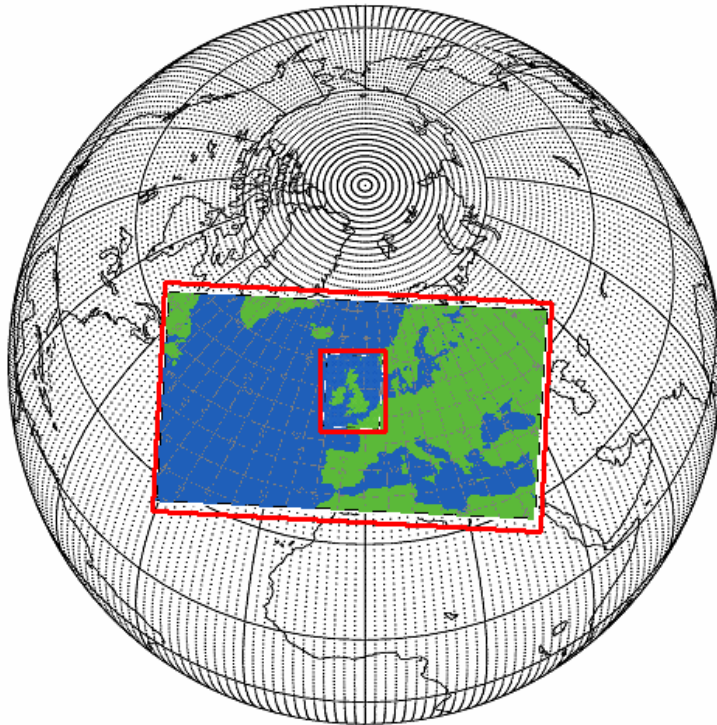


The operational forecast models

NWP (horizontal grid lengths, lid):

- Global: 25 km , 80km
- N.Atlantic/Europe: 12 km , 80km
- UK: 1.5 km , 40km

Vertical grids (lowest 2km):





Operational UKV set-up

- 744(622 1.5 km) x 928(810 1.5 km) points.
- 1.5 km over UK
 - Variable resolution stretching to 4 km away from UK
- 70 Levels: lowest at 5m for scalars (2.5m for winds), 16 levels below 1km
- 50s timestep
- 4 runs/day to T+36, since Autumn 2009
- Initial state from 3DVAR (4DVAR under development)



Operational UKV set-up

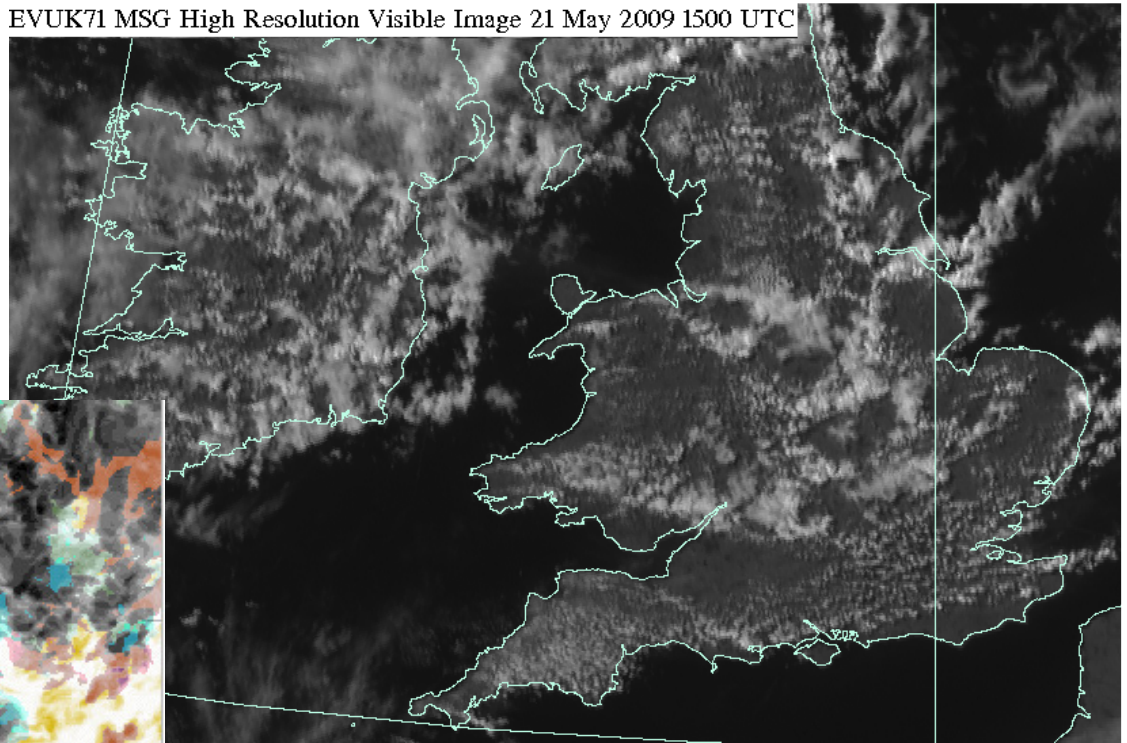
Physical parametrizations

- Same as global model, except:
 - Convection parametrization: none, but closure option to give “shallow” in low CAPE environments is used at 4km
 - Horizontal diffusion: “Smagorinsky-Lilly”
 - Microphysics: Prognostic rain
(also has prognostic ice but already in global model)
 - Drag: no orographic drag (either GWD or form drag via z_0)
 - Cloud: diagnostic (global now has prognostic cloud, “PC2”)
- So note PBL mixing in the vertical is the same
 - Lock et al (2000): K-profile+entrainment unstable, local Ri stable BLs
as the PBL turbulence is still unresolved

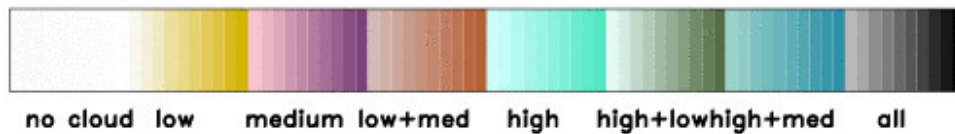
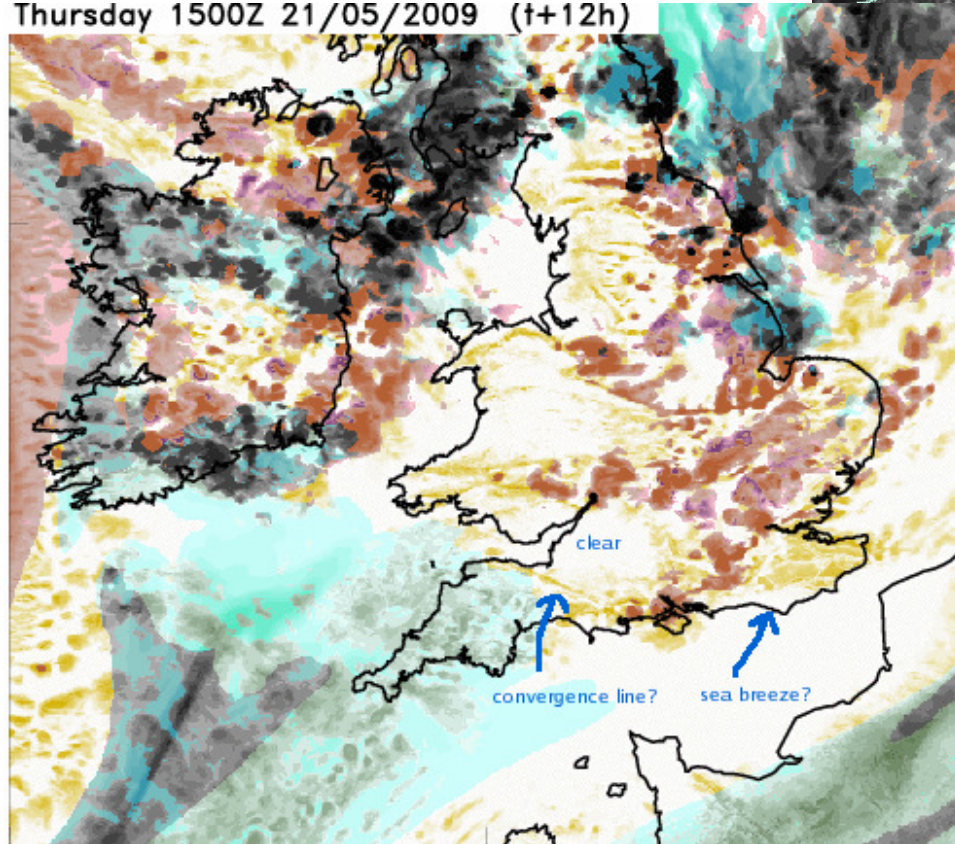
$$K = \lambda^2 Sf(Ri)$$
$$\lambda = c_s \Delta, c_s = 0.1$$



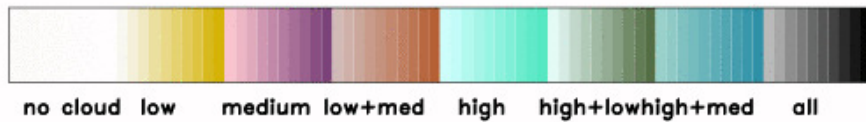
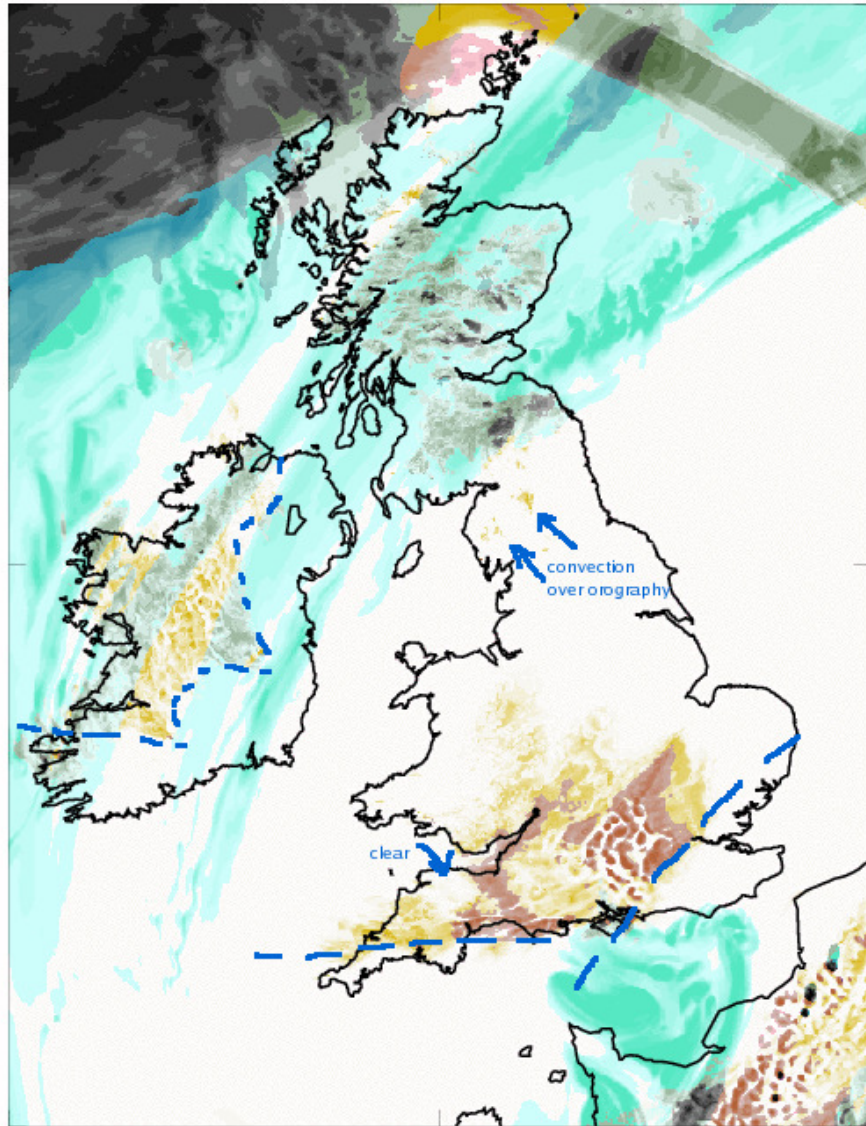
EVUK71 MSG High Resolution Visible Image 21 May 2009 1500 UTC



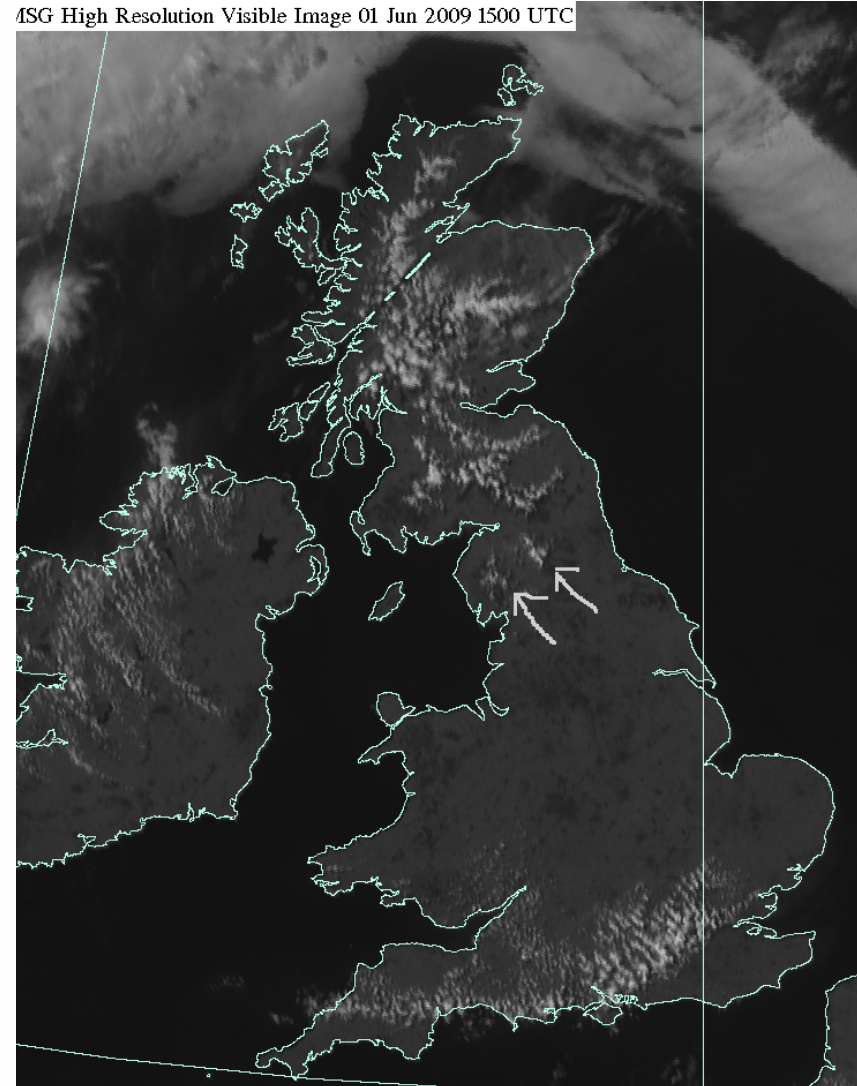
Thursday 1500Z 21/05/2009 (t+12h)



Monday 1500Z 01/06/2009 (t+12h)



MSG High Resolution Visible Image 01 Jun 2009 1500 UTC



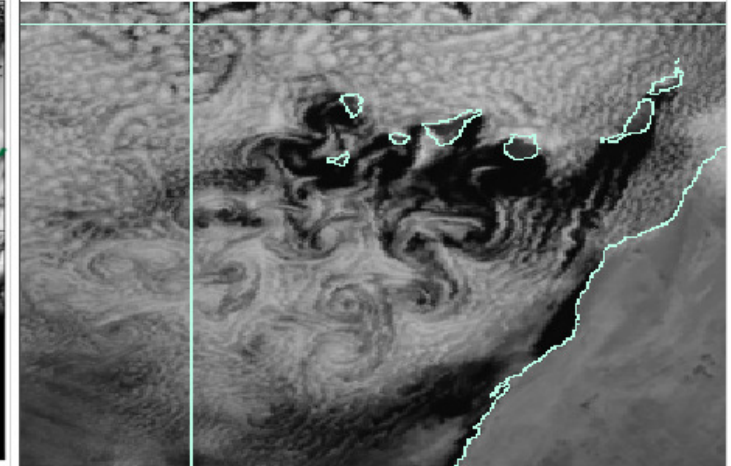
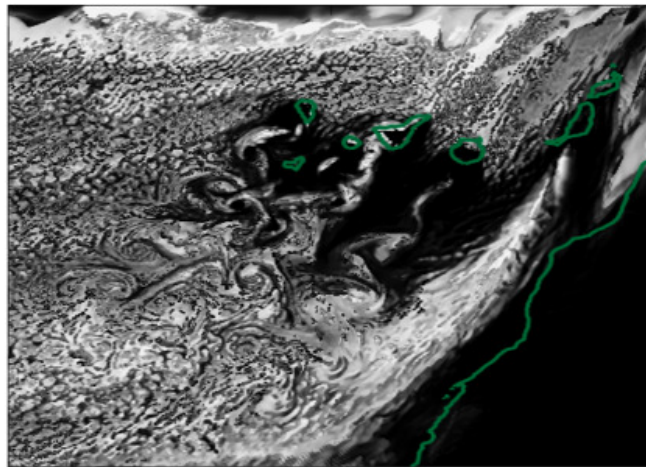
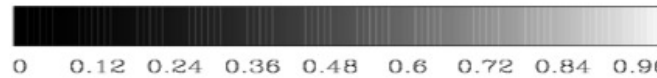
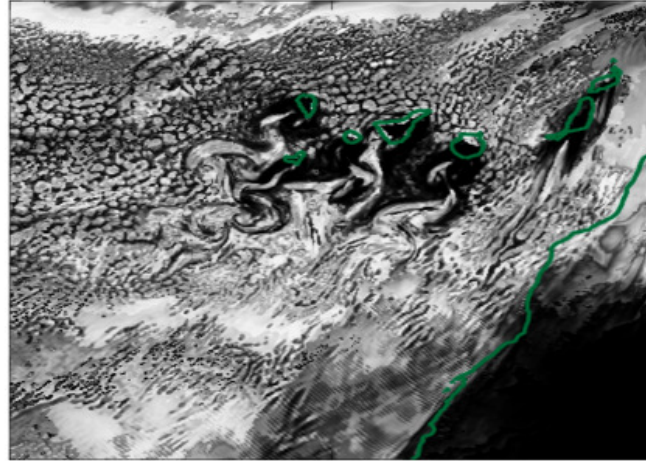
Convection over orography 01/06/09 15Z



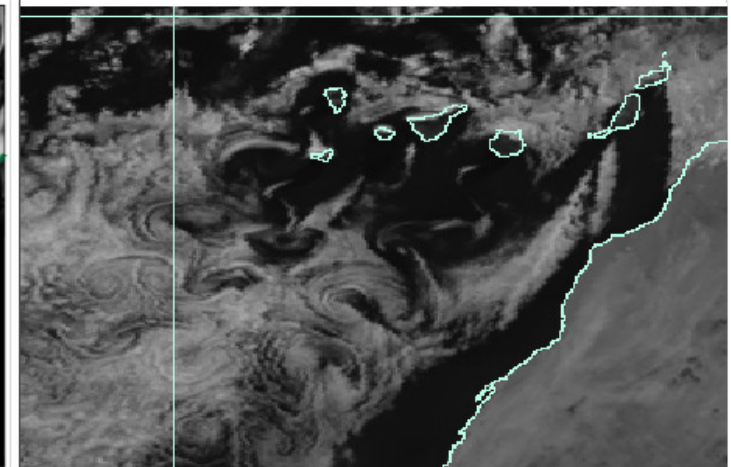
Stratocumulus break-up over the Canary Islands

- Actually 1km, rather than operational UKV 1.5km grid
- Inspired me to try an ASTEX forecast

Low Level Cloud Amount
6/6/10 10:00 1KM FULL DOMAIN



10Z



18Z



UM domains encompassing the 1st ASTEX Lagrangian flights

Run global UM for 48 hours from ERA-interim analysis for 12 UTC on 12th June 1992 to provide lateral boundary conditions for:

12km: 240^2 pts = 26.4° square

4km: 600^2 pts = 21.6° square

1.5km: 800×1000 pts = $10.8^\circ \times 13.5^\circ$

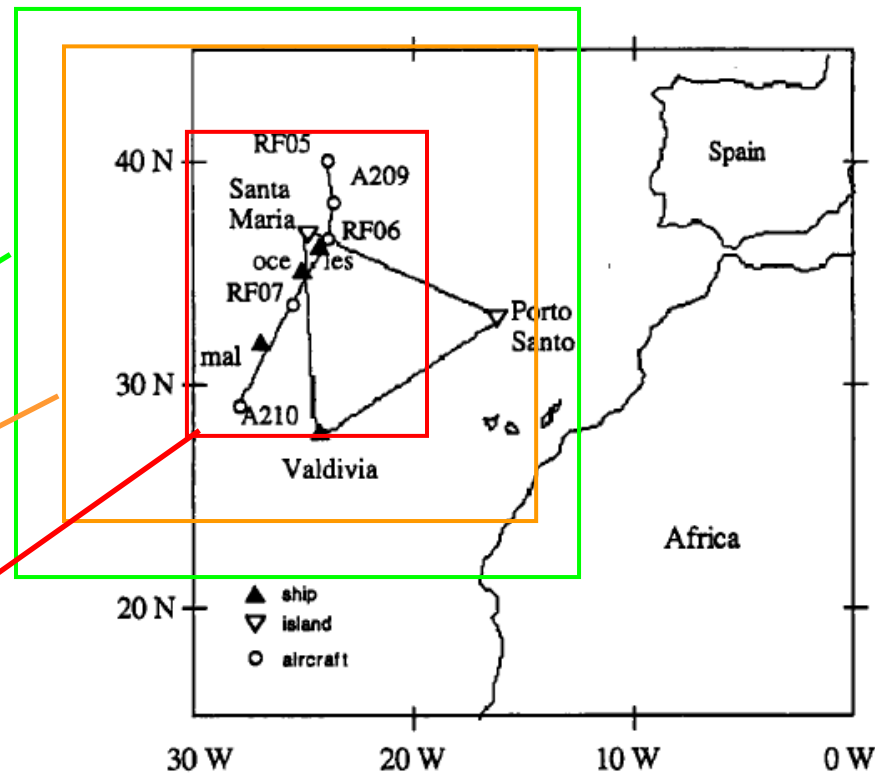


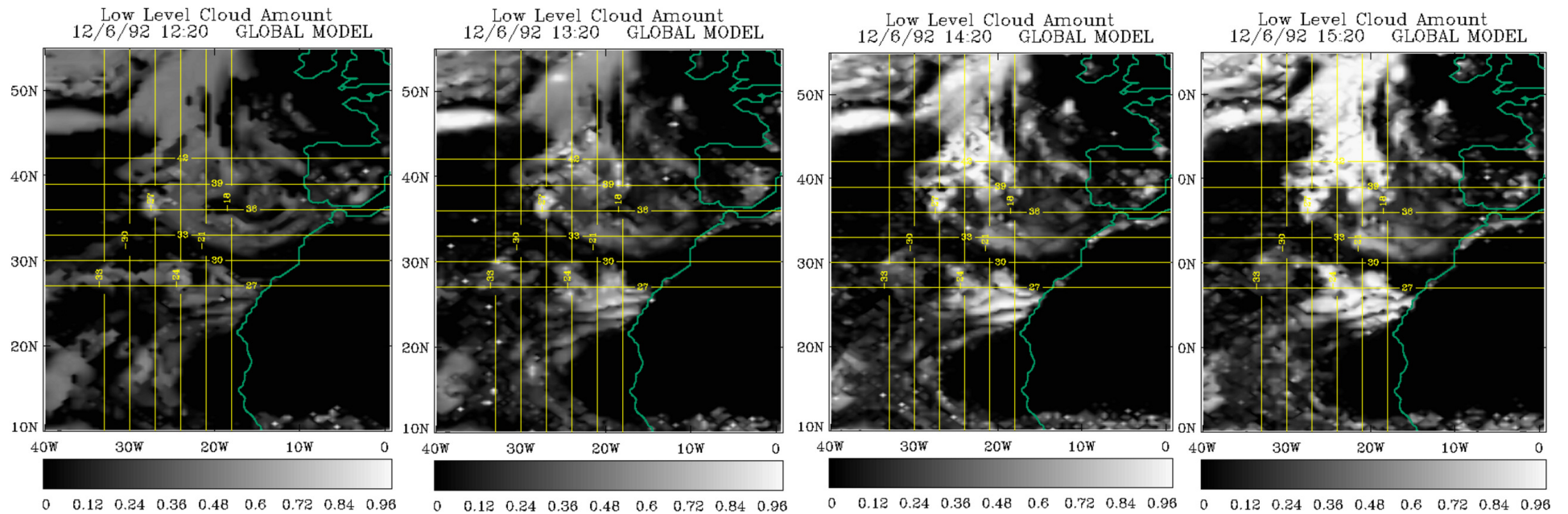
Figure 1. Map of ASTEX region showing the observation triangle. The curved line shows the trajectory of the first Lagrangian (from north to south) from 1600 UTC 12 June until 1600 UTC 14 June 1992. Indicated are the ASTEX triangle and the flights (open circles) of the NCAR Electra (RF05, RF06 and RF07) and the UK MRF C-130 (A209 and A210). Also shown are the locations of the radiosonde stations at 1200 UTC 14 June 1992: the islands (open triangles) of Porto Santo and Santa Maria, the ships (filled triangle) Valdivia, Malcolm Baldrige (mal), Oceanus (oce) and Le Suroit (les).

Figure from de Roode and Bretherton (1996)



Global model initial cloud

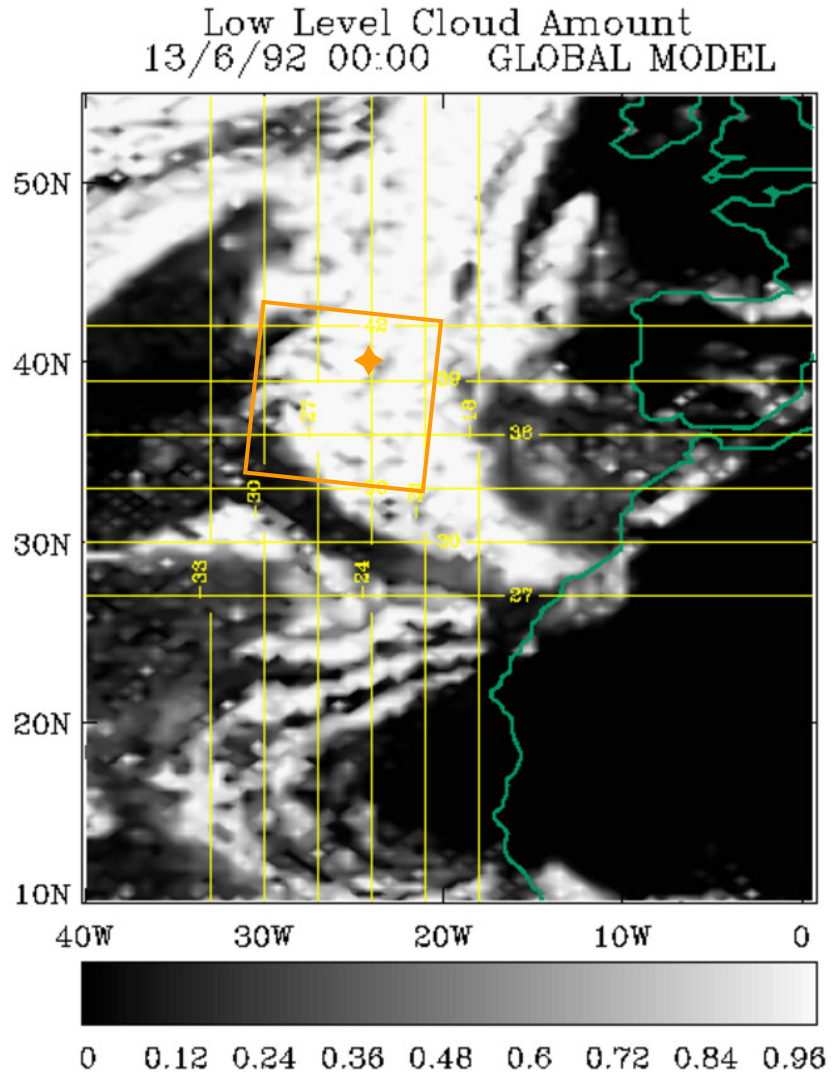
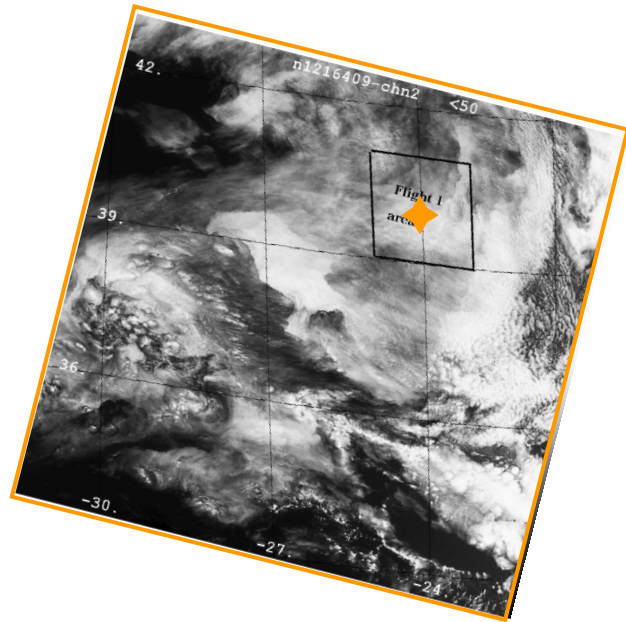
- Significant spin-up in low cloud over first few hours





Initial stratocumulus

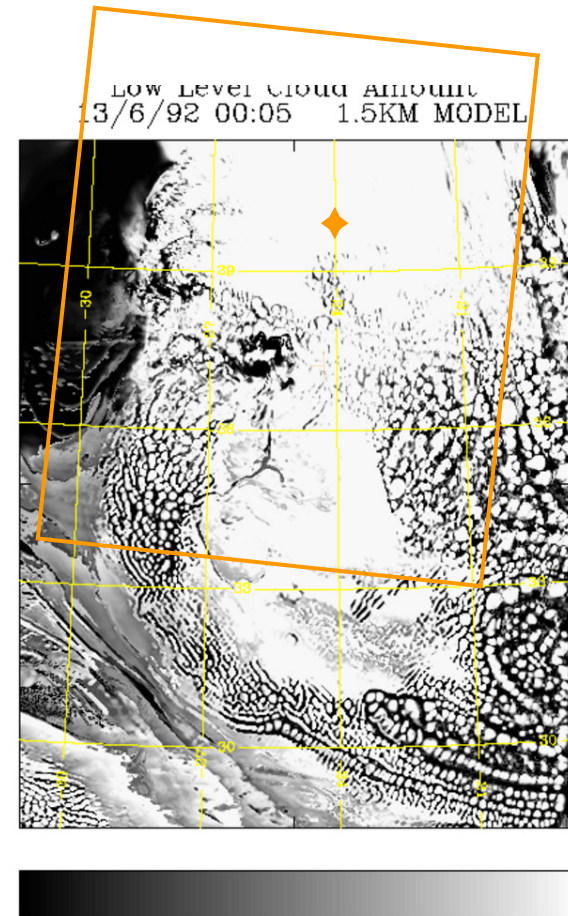
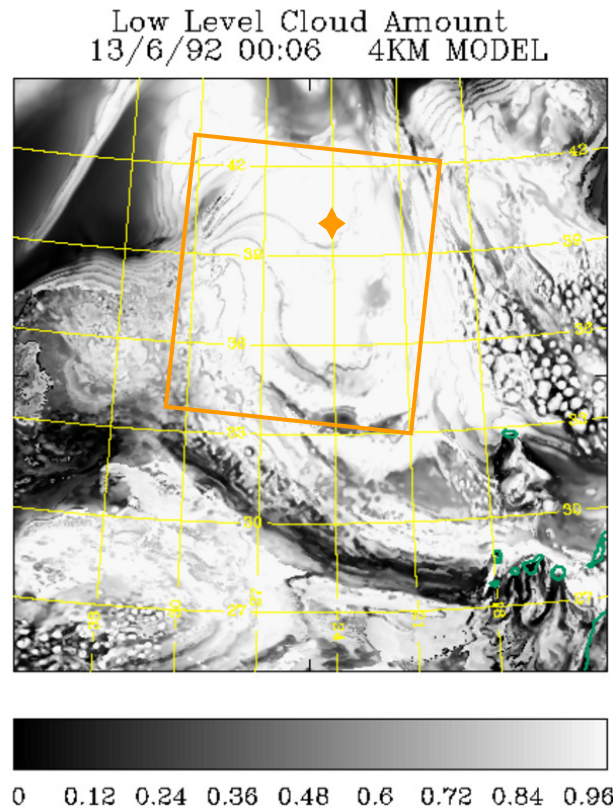
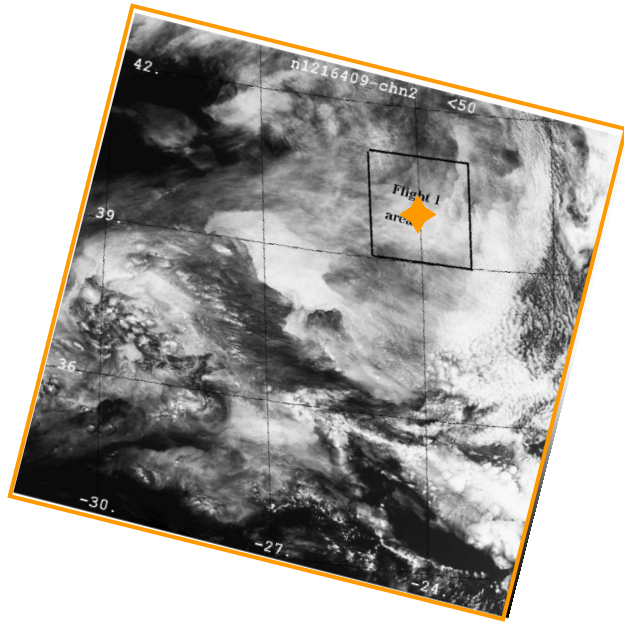
Actually comparing 09UTC 12th satellite with 00UTC 13th models





Initial stratocumulus

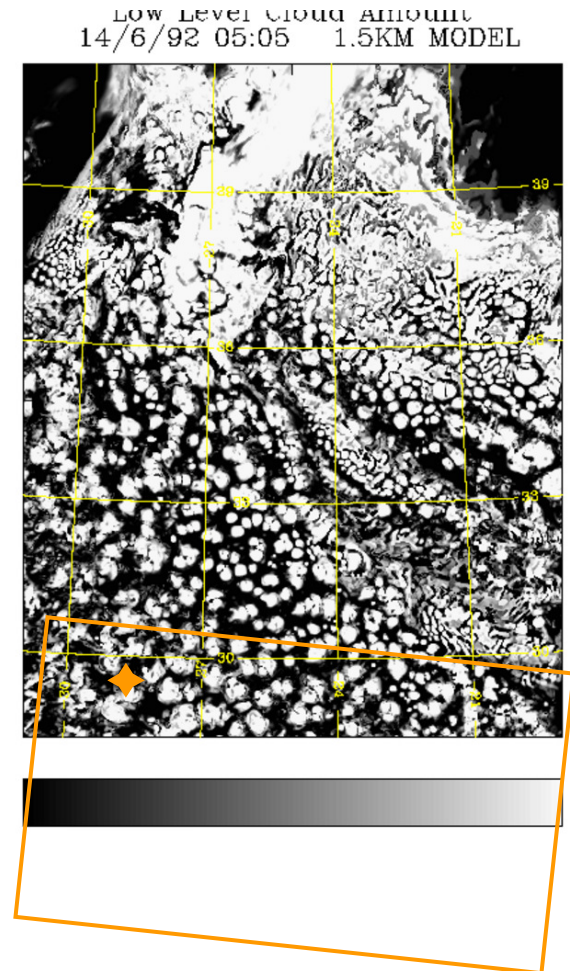
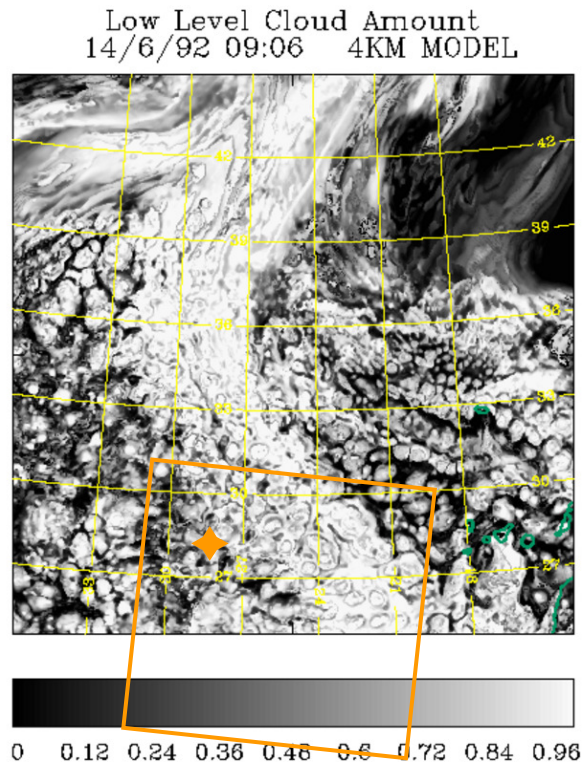
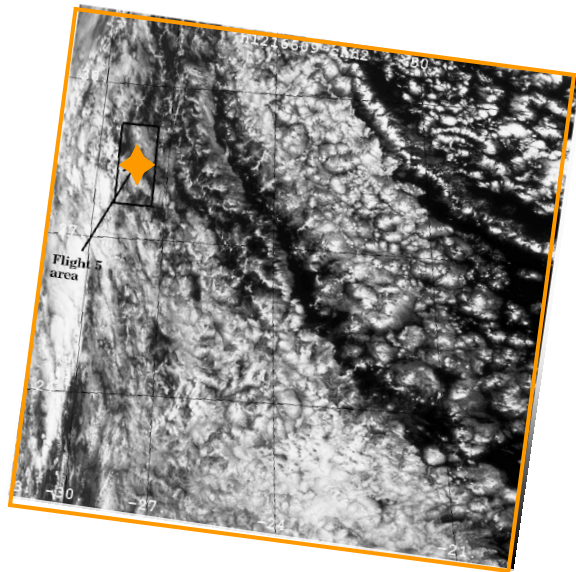
Actually comparing 09UTC 12th satellite with 00UTC 13th models





Final stratocumulus

Actually comparing 09UTC 14th satellite with 09UTC 14th 4km and 05UTC 1.5km models





- Separate animation?



ASTEX forecast further work

- Analyse the Lagrangian trajectory
 - Check SST and subsidence forcing
 - Compare model profiles with obs and LES
- Sensitivity tests
 - Switch on shallow convection parametrization
 - 3D Smagorinsky scheme
 - Test improved UM microphysics for drizzle (including Abel and Shipway fall speeds)



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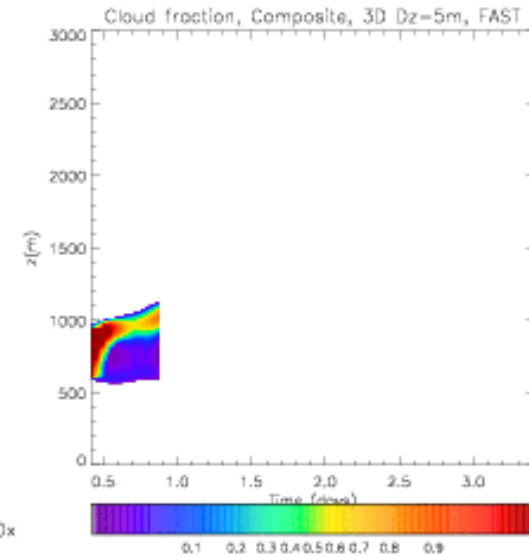
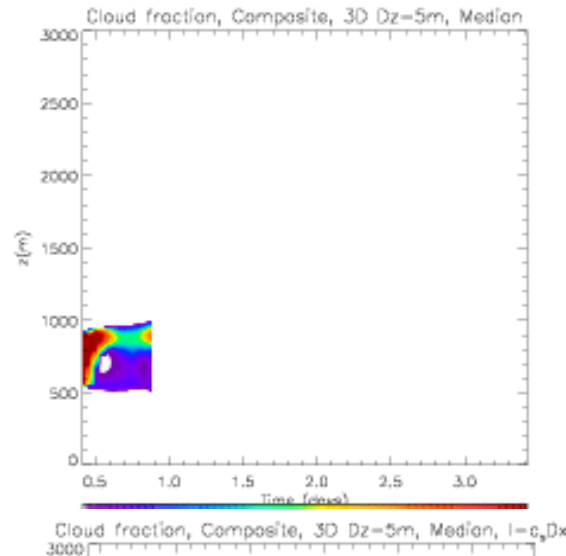
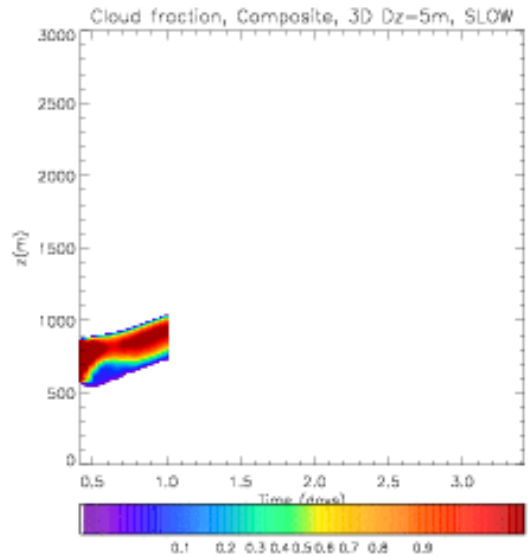


Composite cases

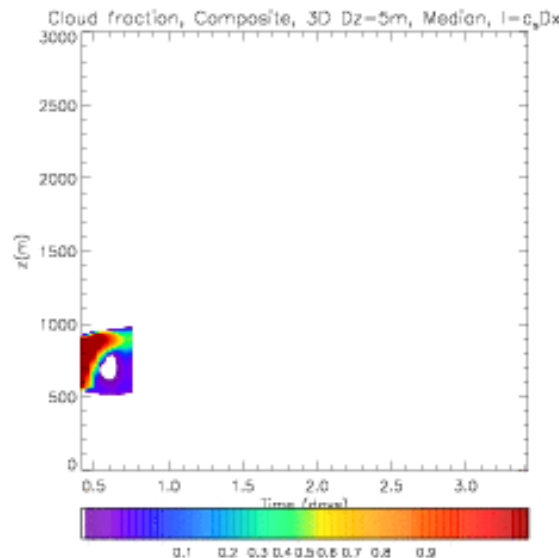


Met Office LES results

Composite cases with corrected winds
(still running)



- Old mixing length ($\sim D_x$ only) giving very similar results so far (only more slowly!):



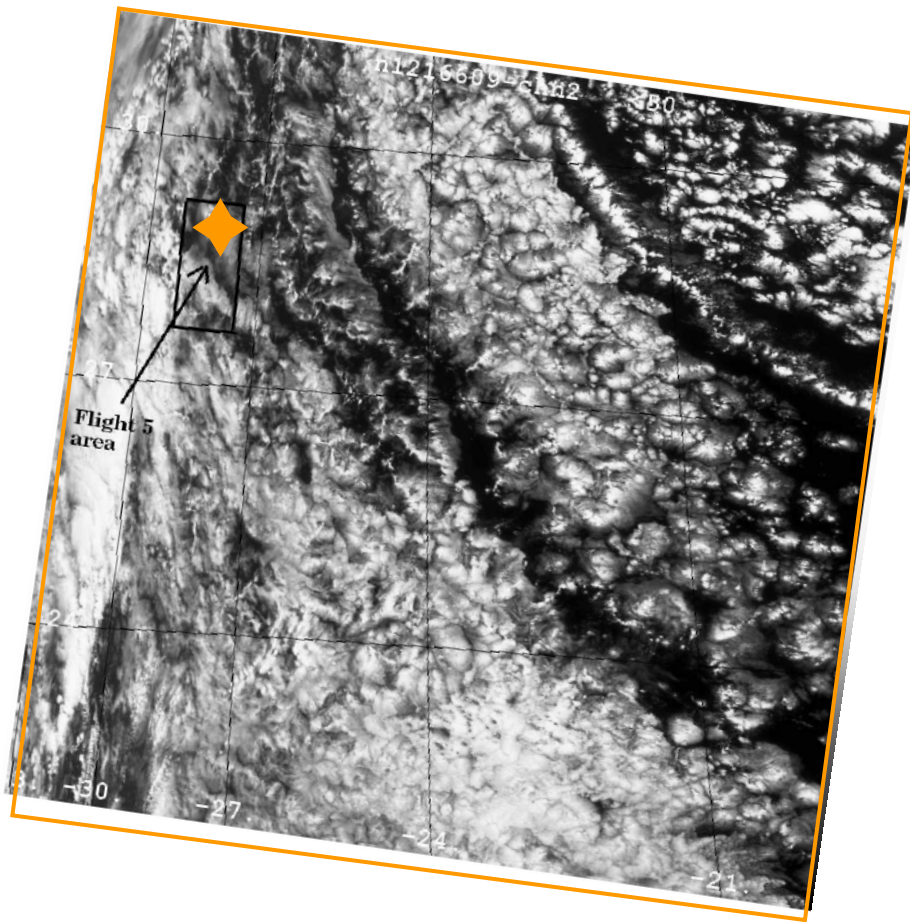


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Questions

Thank you



Low Level Cloud Amount
14/6/92 09:03 12KM MODEL

