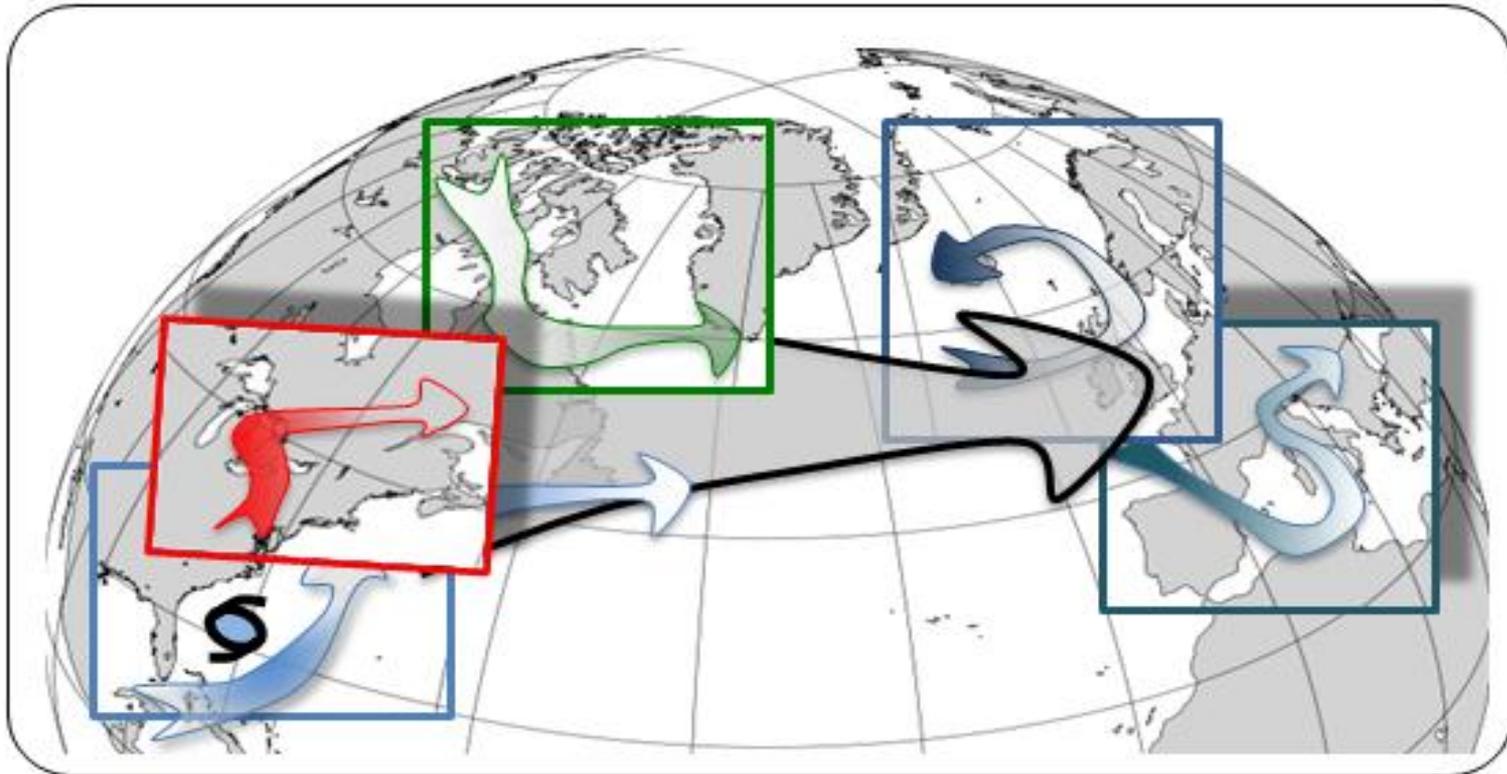
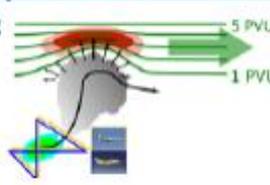
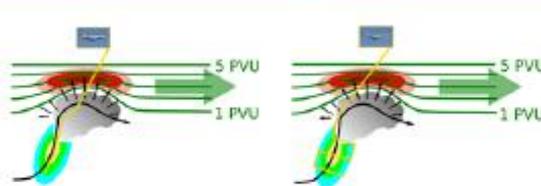
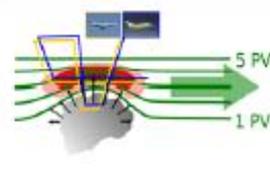
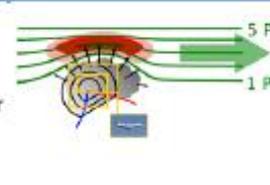
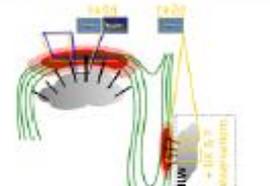


# NAWDEX – Weather Discussion

06 October 2016, Keflavik 17 UTC

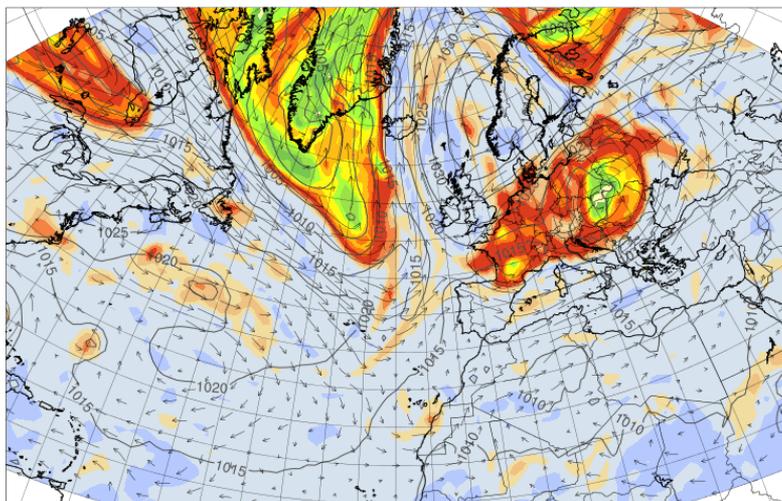


## 3.2.10 Overview of strategies

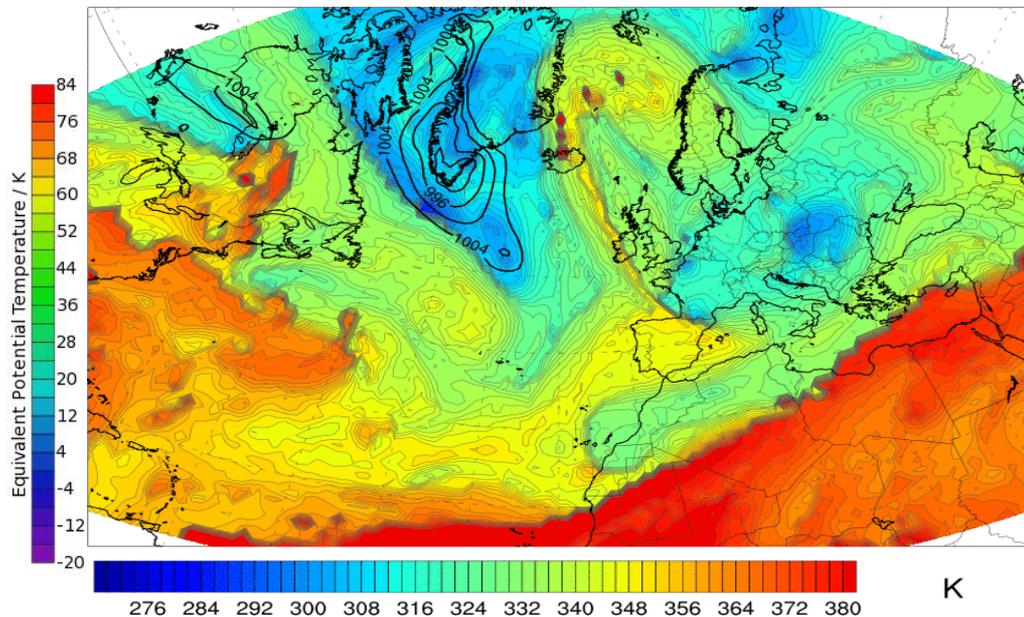
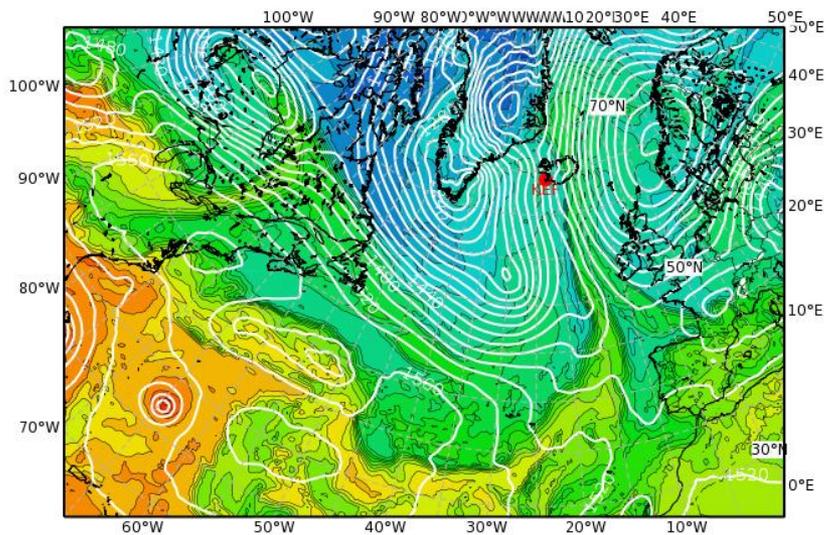
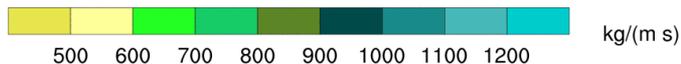
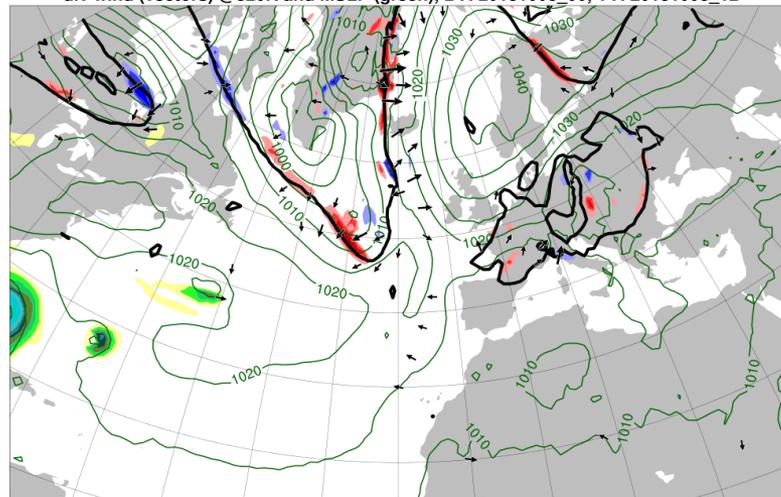
Aim	Planned observations	Flight strategy
Moisture Structure in the Boundary layer	<ul style="list-style-type: none"> <li>HALO observations of winds, water vapor and temperature (dropsondes, DIAL, HAMP radiometers)</li> <li>Falcon observation of winds (wind lidar)</li> </ul>	<ul style="list-style-type: none"> <li>several transects in the pre-saturated environment where lifting starts, e.g. the inflow region of WCBs before the ascent starts and clouds develop</li> <li>for the case that moisture source regions are within the range of the DLR Falcon, coordinated flights to measure moisture transport (horizontal and vertical) are possible</li> <li>radar observations to observe changing cloud structures in different forcing regimes</li> </ul> 
Mixed phase clouds	<ul style="list-style-type: none"> <li>HALO (dropsondes, radar, in-situ, radiometer, imager)</li> </ul>	<ul style="list-style-type: none"> <li>Along and across WCB variations of liquid cloud, snow and rain water path + integrated vapor transport</li> </ul> 
Upper level PV	<ul style="list-style-type: none"> <li>HALO temperature profiles (dropsondes &amp; radiometer temperatures)</li> <li>Falcon wind profiles (wind lidar)</li> </ul>	<ul style="list-style-type: none"> <li>repeated across-jet flight legs perpendicular to the wind direction</li> <li>enter a region of divergent WCB outflow along-jet control leg to investigate the assumption of small variation</li> <li>flight in region where dropsondes are allowed, drop at high frequency</li> </ul> 
Cyclonic systems	<ul style="list-style-type: none"> <li>HALO (dropsondes, in-situ, cloud radar)</li> </ul>	<ul style="list-style-type: none"> <li>Circular flight paths around center of cyclonic system</li> <li>Repeated observations along track of cyclonic system</li> <li>diabatic Rossby wave systems may be investigated with a similar strategy if far enough north to be in aircraft range</li> </ul> 
Impacts of tropopause waveguide uncertainty on HIW events	<ul style="list-style-type: none"> <li>HALO and Falcon</li> </ul>	<ul style="list-style-type: none"> <li>wind lidar, dropsondes</li> <li>upstream-downstream flights</li> </ul> 

# Analysis – Thu 7 Oct 2016, 12UTC PV320K, irrwind320K, THE850K, TH2PVU

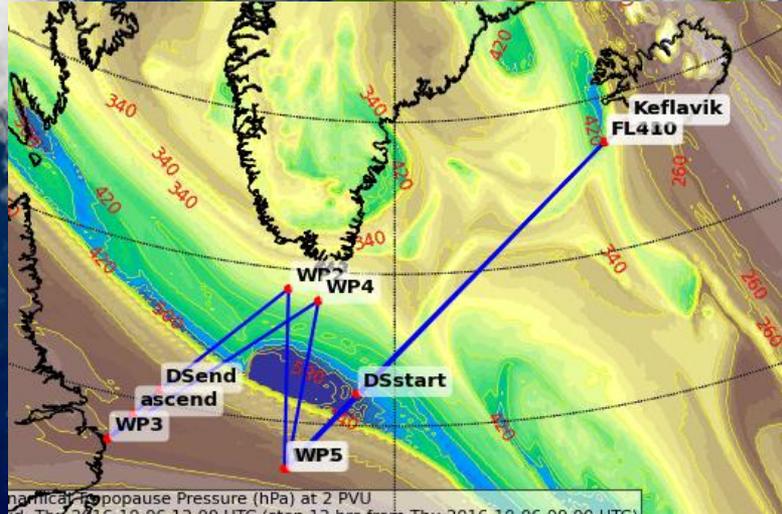
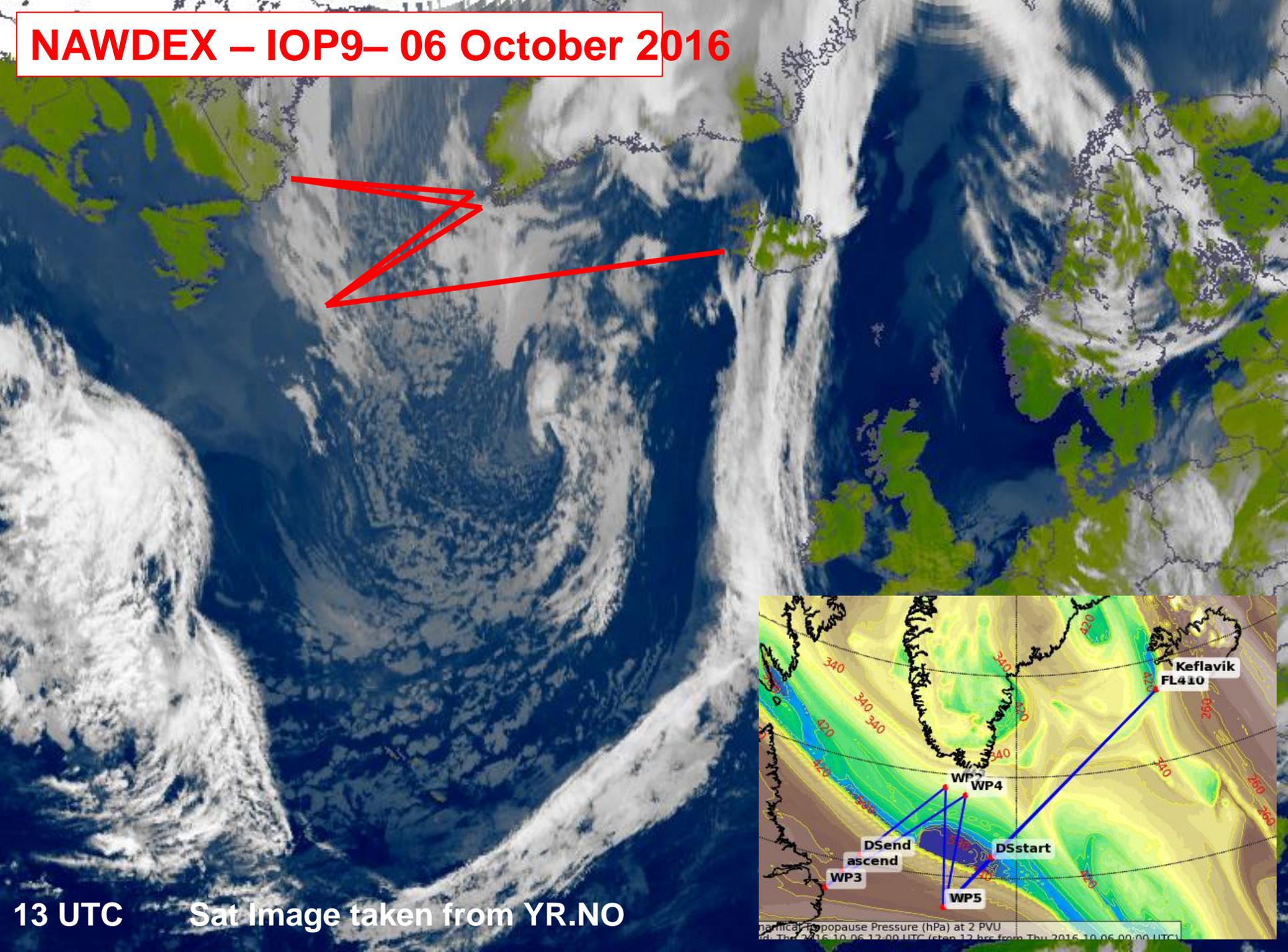
PV@320K at 20161006\_12



2 PVU (black), PV adv by div wind (shading),  
div wind (vectors) @320K and MSLP (green), BT: 20161006\_00, VT: 20161006\_12

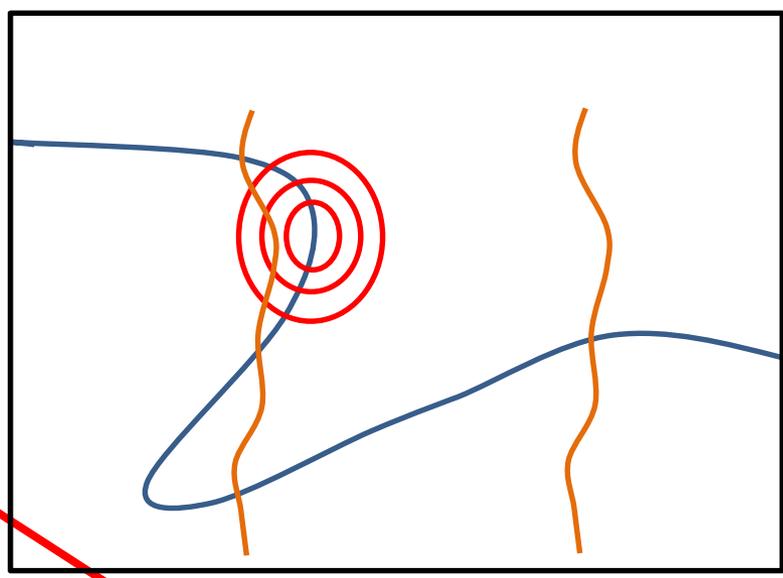
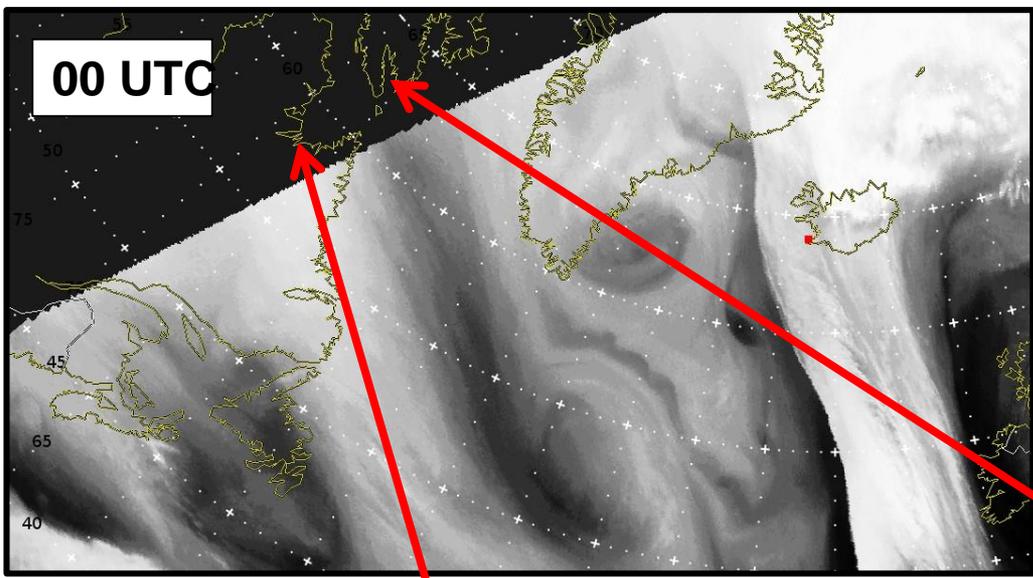


# NAWDEX – IOP9– 06 October 2016

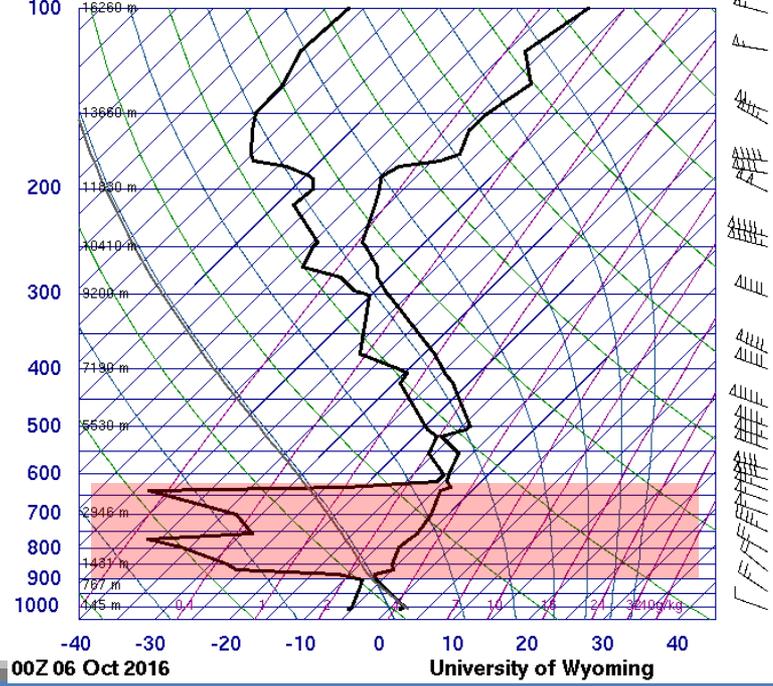


13 UTC Sat Image taken from YR.NO

panacea Topopause Pressure (hPa) at 2 PVU  
Thu 2016 10 06 12:00 UTC (step 12 hrs from Thu 2016 10 06 00:00 UTC)



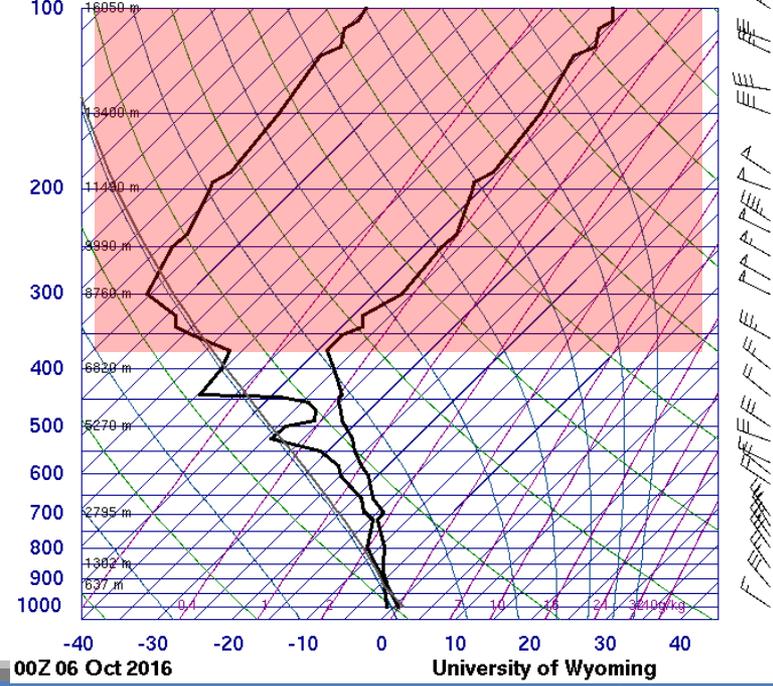
71906 YVP Kuujuaq



00Z 06 Oct 2016

University of Wyoming

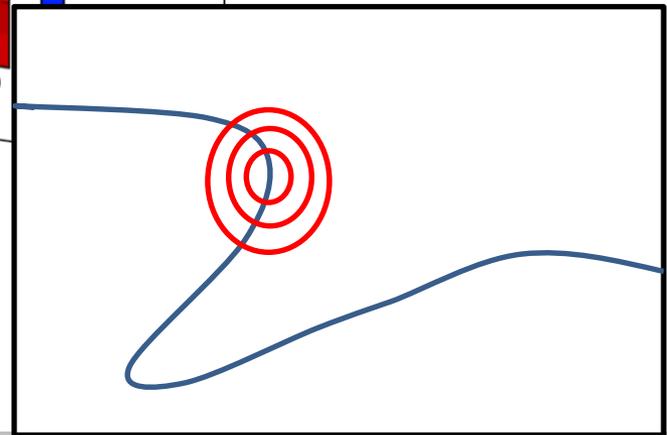
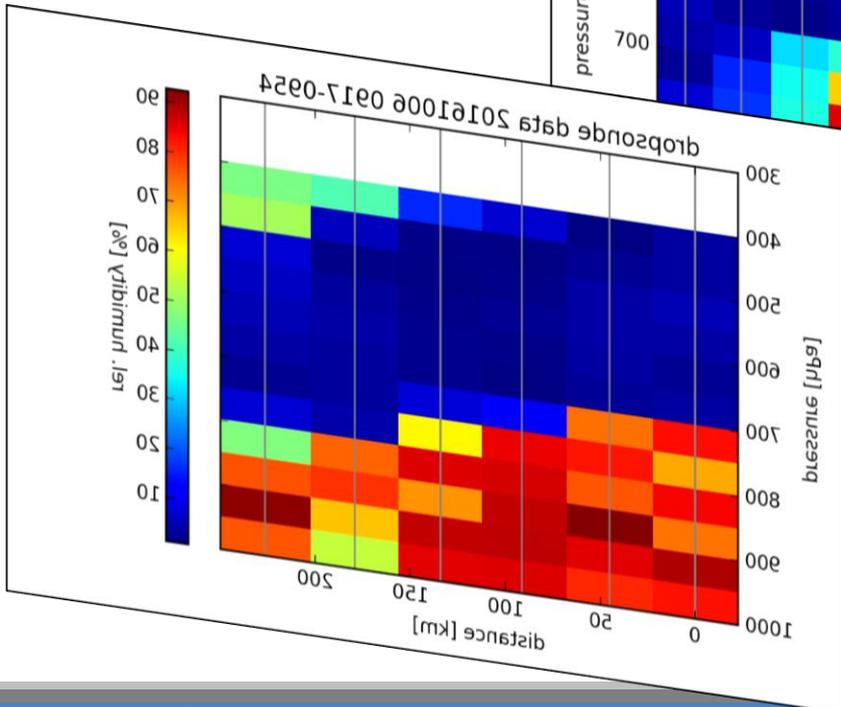
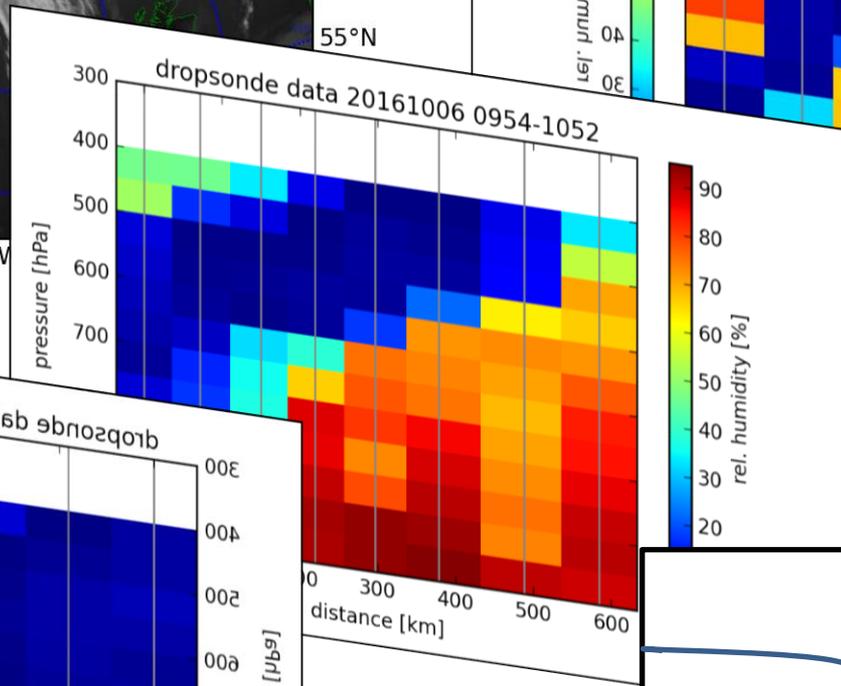
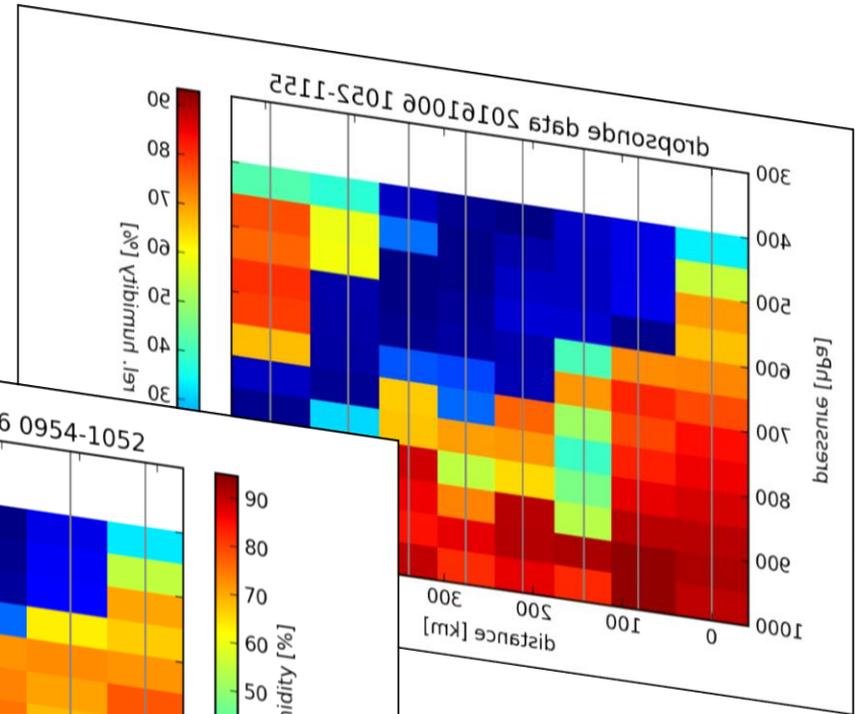
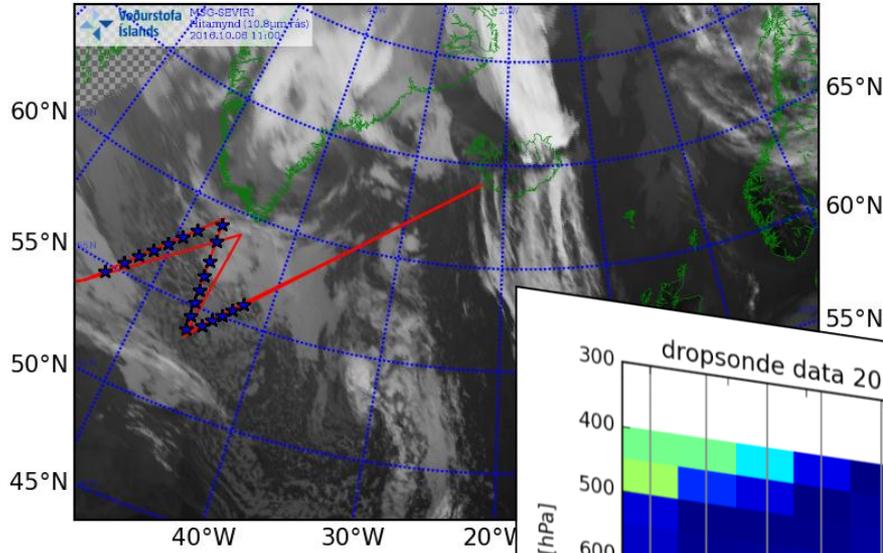
71909 YFB Iqaluit



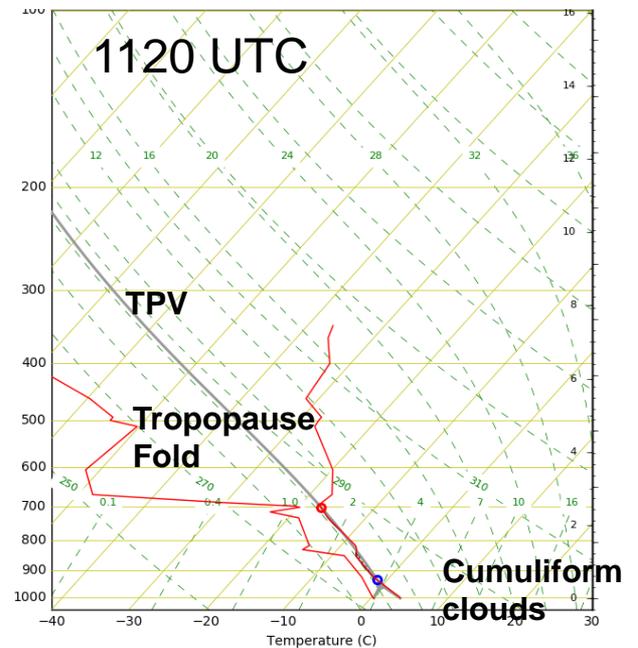
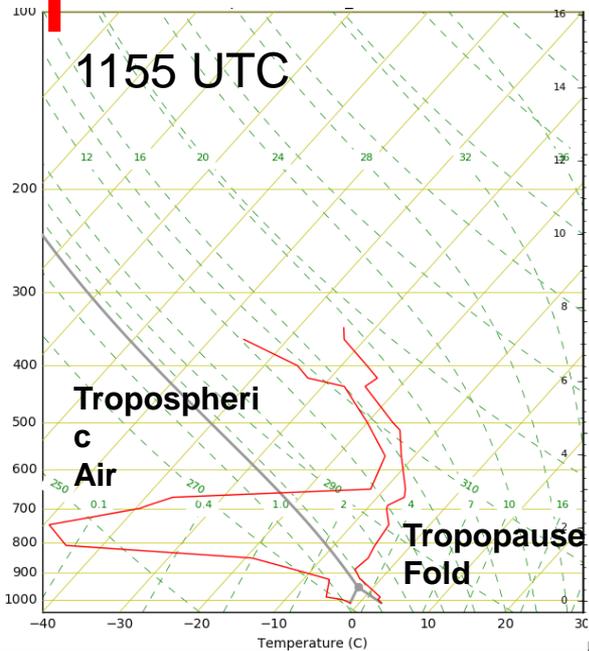
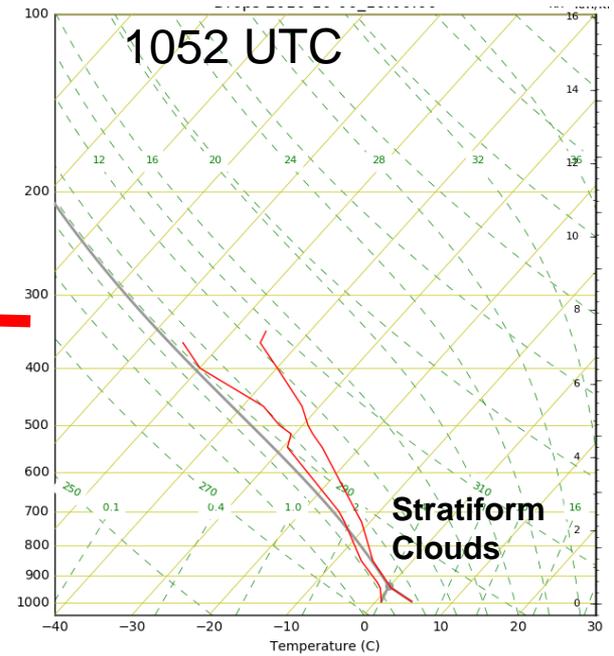
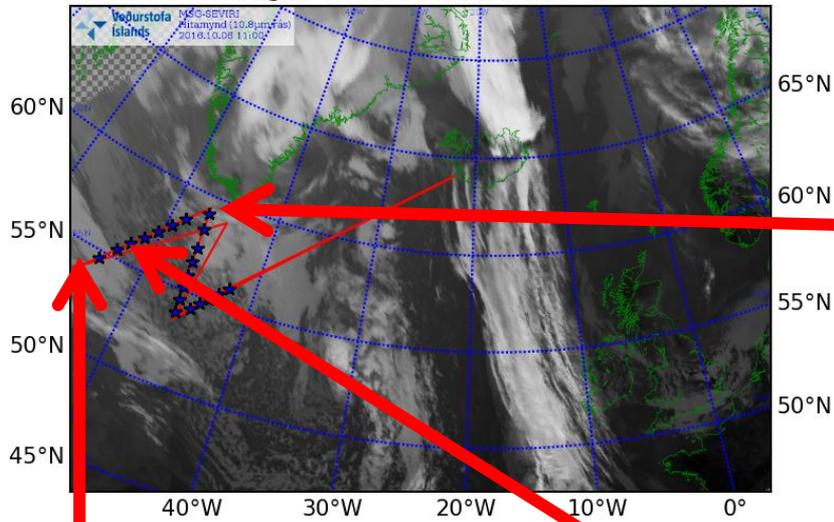
00Z 06 Oct 2016

University of Wyoming

# Flight Track 20161006 1100

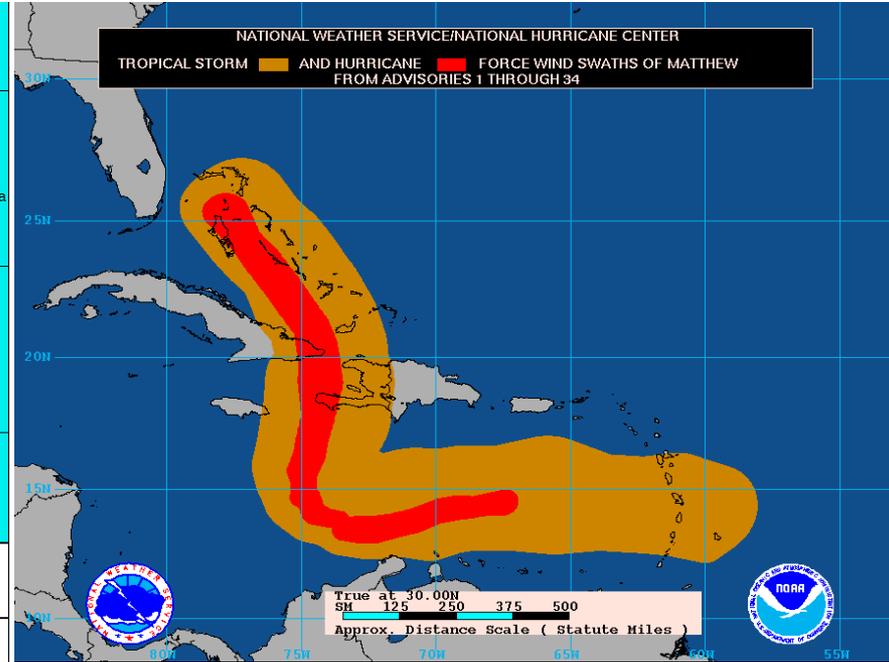
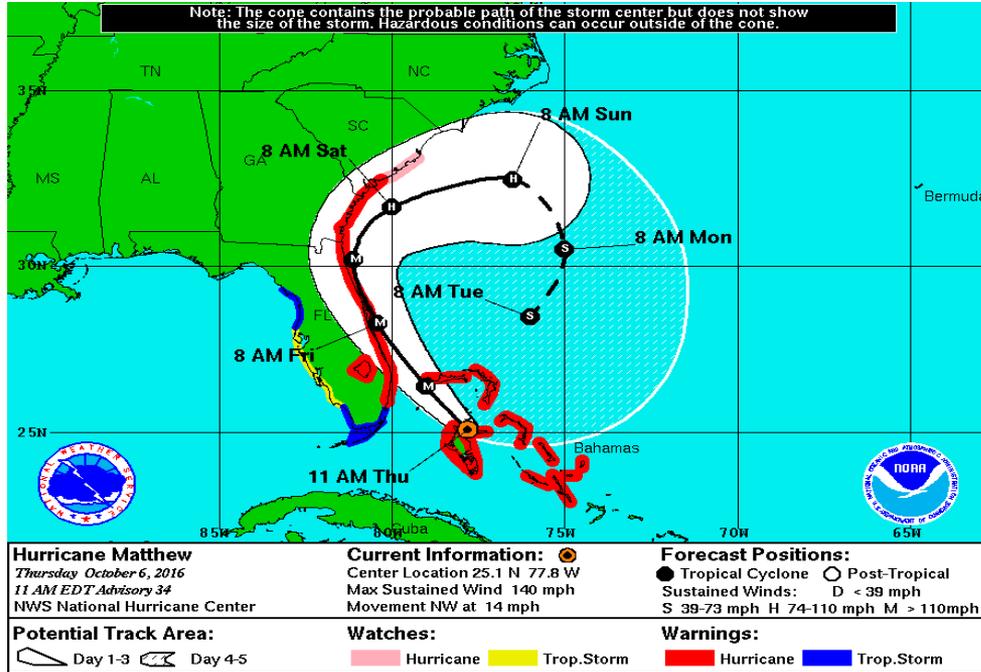


Flight Track 20161006 1100



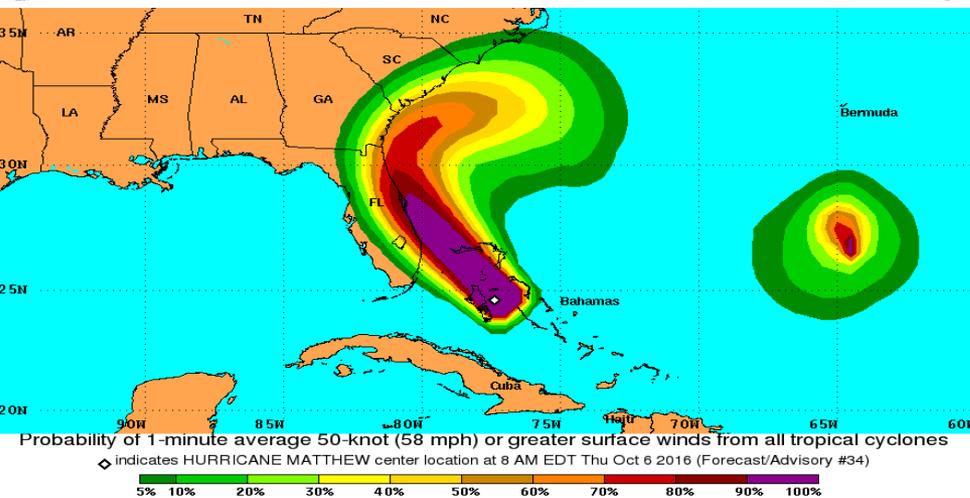
# Hurricane Matthew – latest update 1500 UTC

Note: The cone contains the probable path of the storm center but does not show the size of the storm. Hazardous conditions can occur outside of the cone.

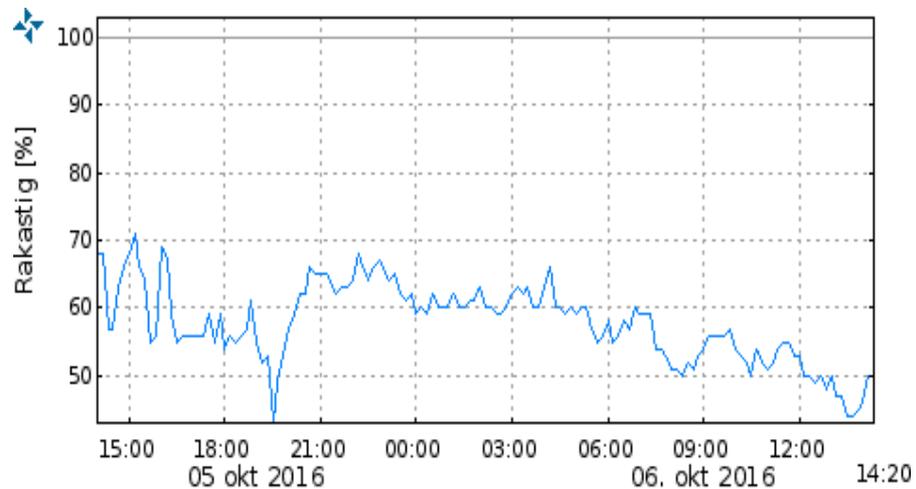
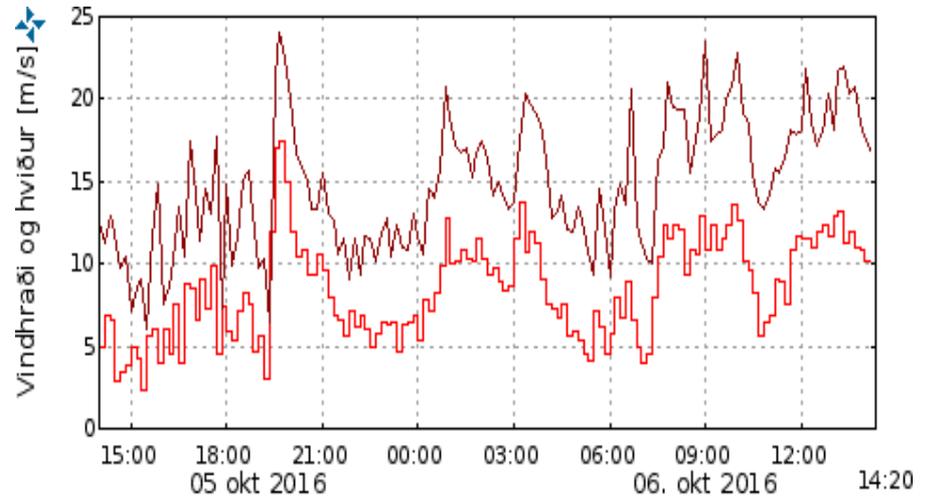
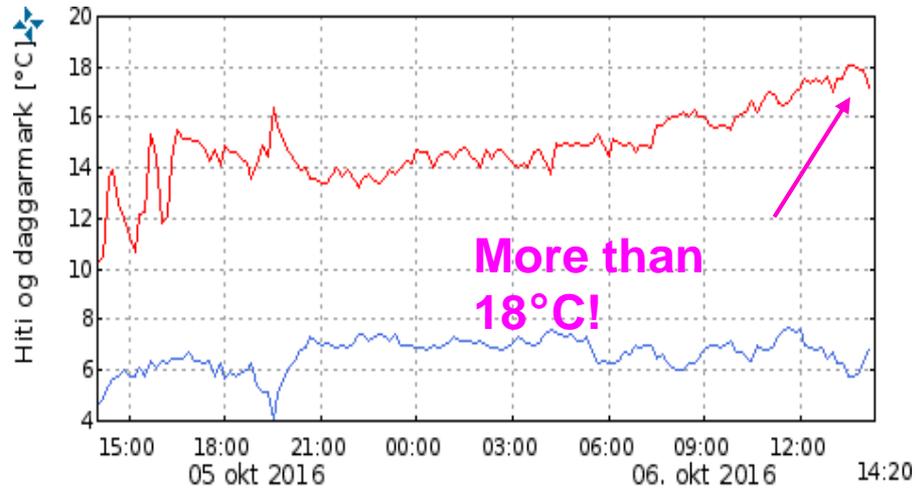


## 50-knot Wind Speed Probabilities

For the 96 hours (4 days) from 8 AM EDT Thu Oct 6 to 8 AM EDT Mon Oct 10

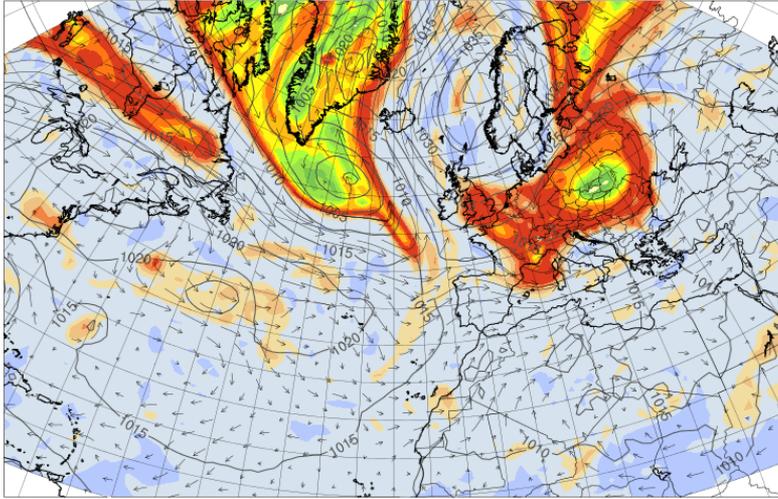


# Skjaldbingsstaðir, last 24 hours – temp, RH, wind+gusts, wind dir.

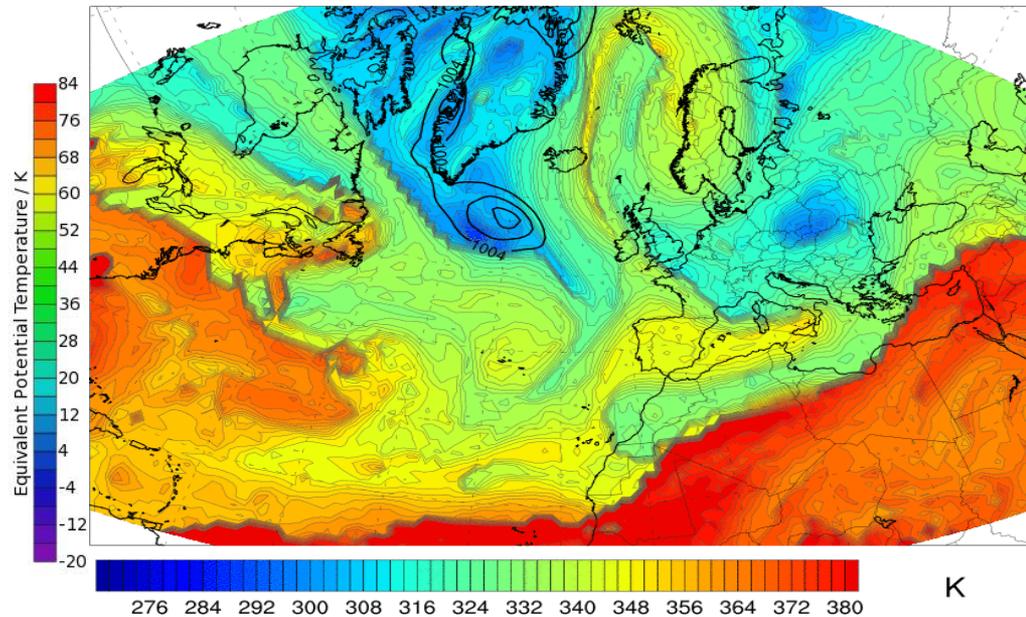
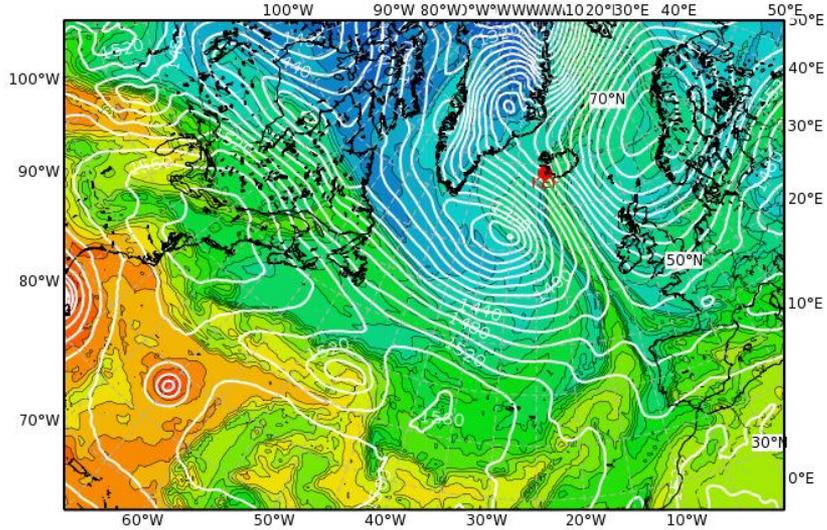
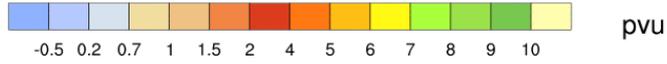
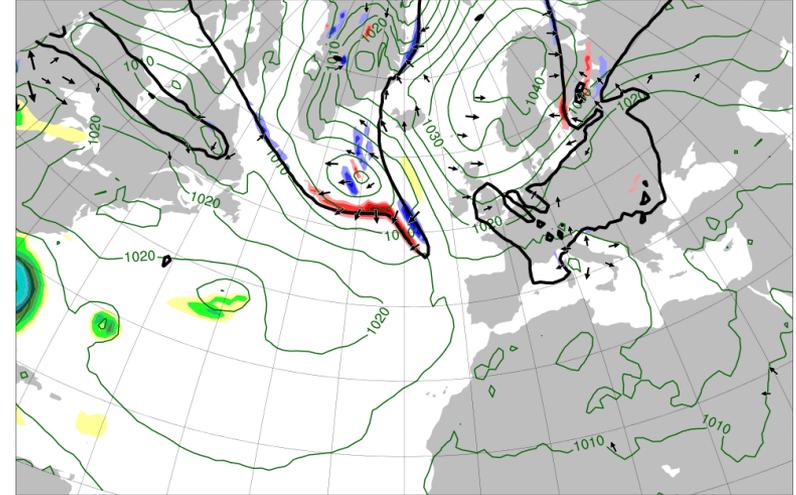


# Forecast – Thu 7 Oct 2016, 00UTC PV320K, irrwind320K, THE850K, TH2PVU

PV@320K at 20161007\_00



2 PVU (black), PV adv by div wind (shading),  
div wind (vectors) @320K and MSLP (green), BT: 20161006\_00, VT: 20161007\_00

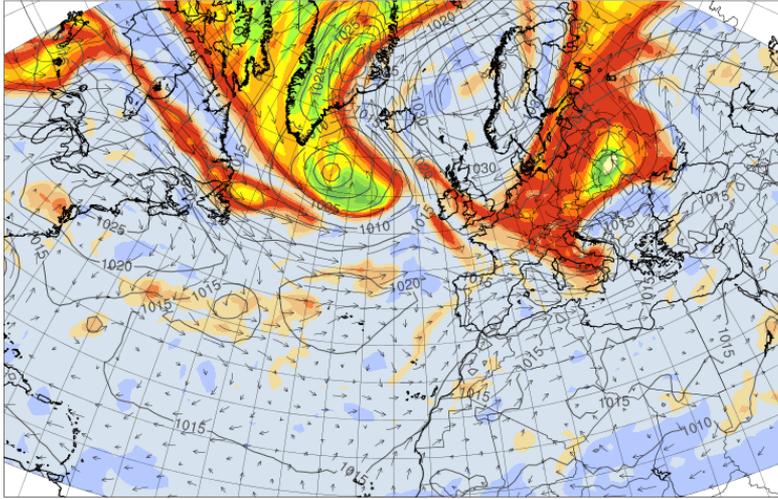


BT06/00Z

Keflavik, 06 October 2016

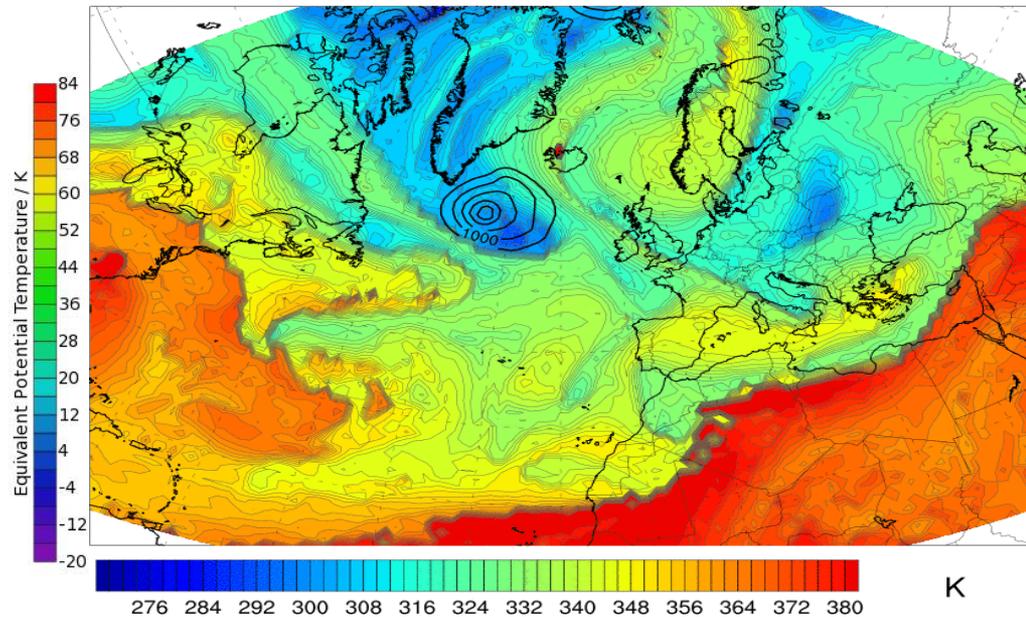
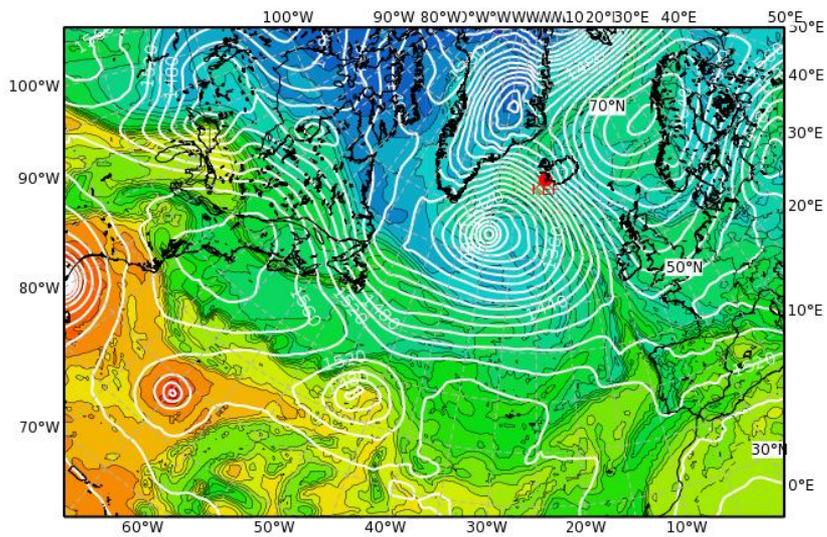
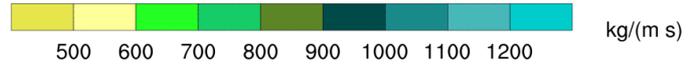
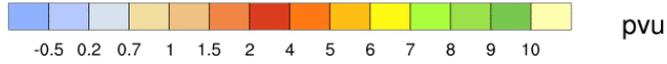
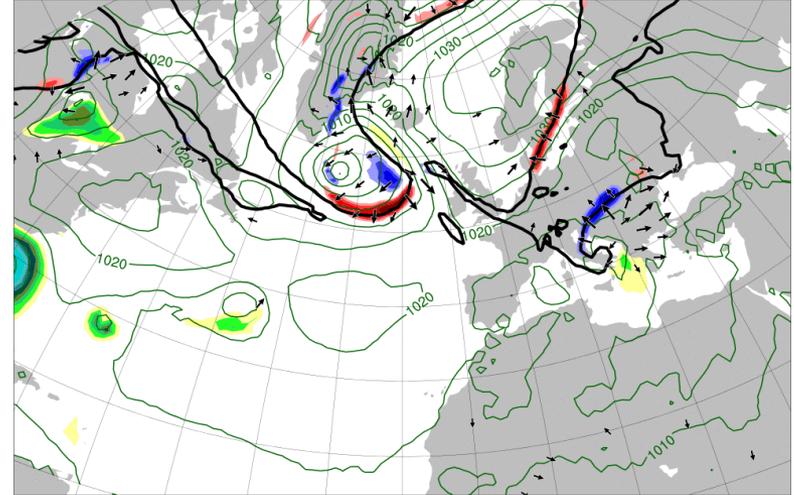
# Forecast – Fri 7 Oct 2016, 12UTC

PV@320K at 20161007\_12



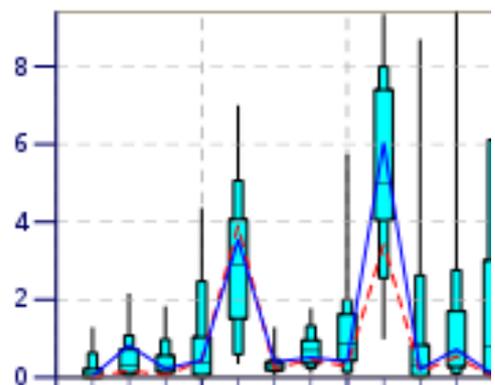
# PV320K, irrwind320K, THE850K, TH2PVU

2 PVU (black), PV adv by div wind (shading),  
div wind (vectors) @320K and MSLP (green), BT: 20161006\_00, VT: 20161007\_12

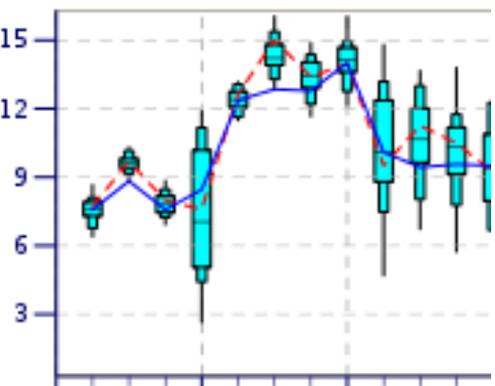


# Strong winds on Fri 7 Oct 2016

Total Precipitation (mm/6h)

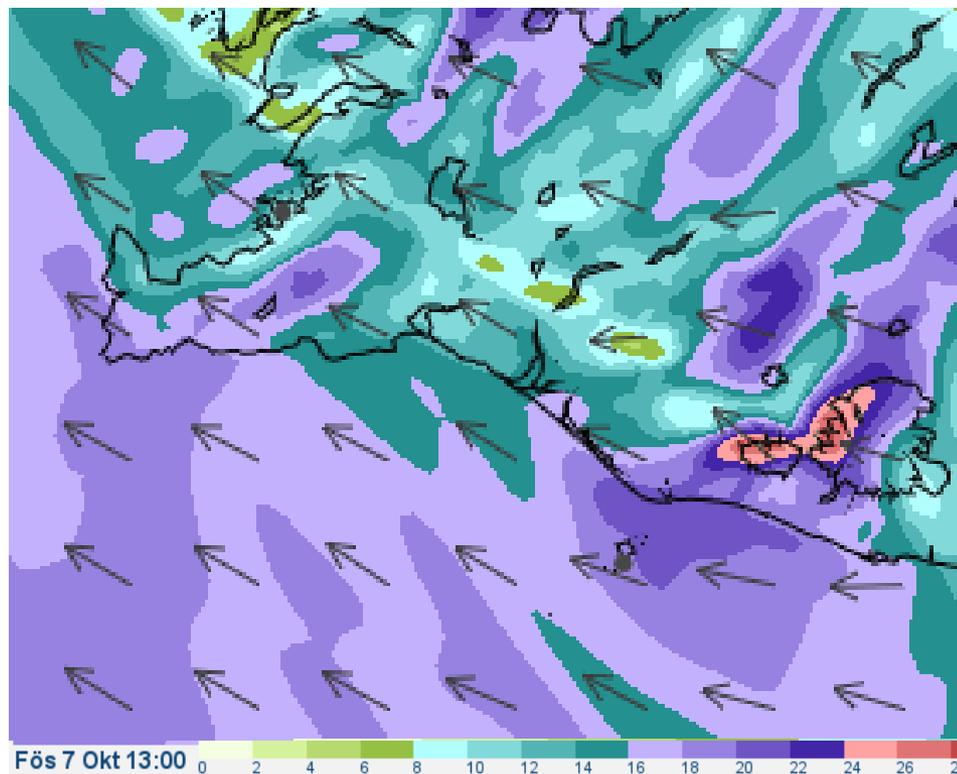


10m Wind Speed (m/s)



**ECMWF**

**Significant winds, weaker in the afternoon (possible gusts up to 20 m/s).**

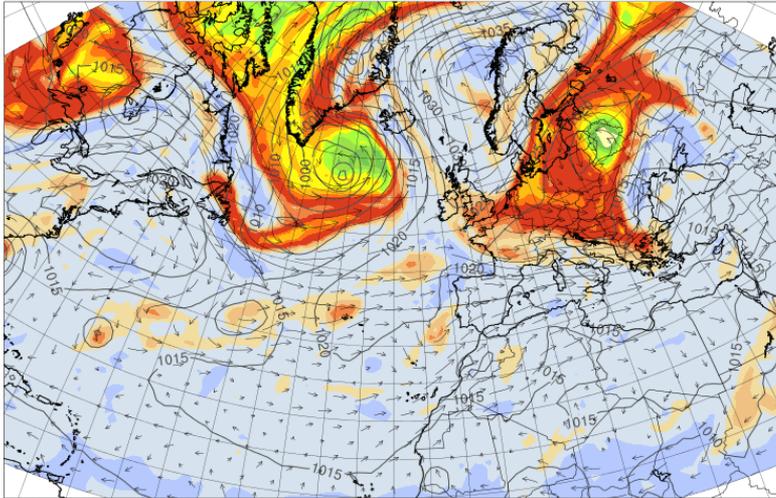


**HARMONIE 2.5km**

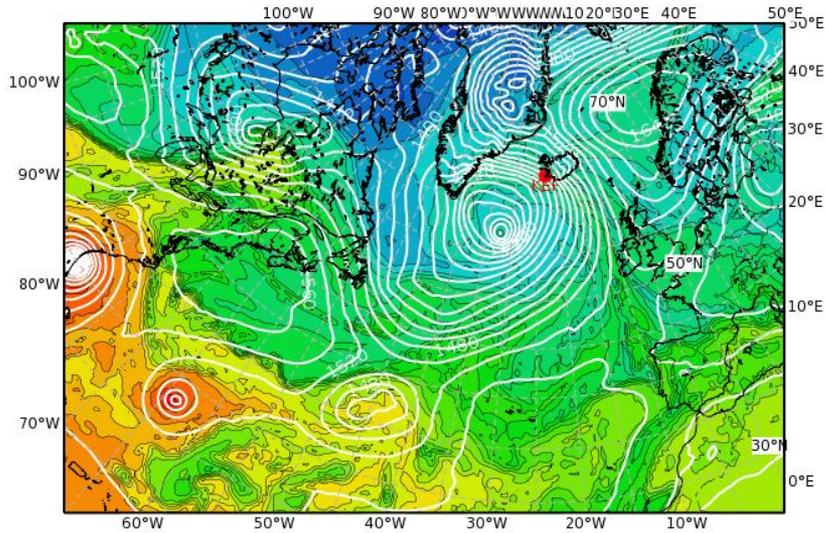
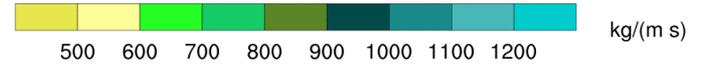
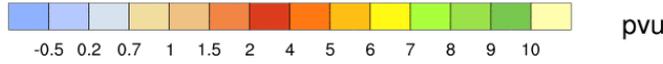
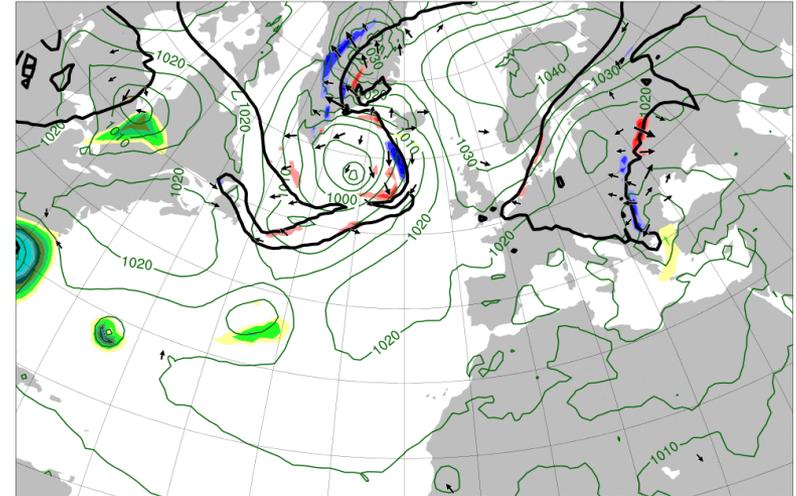
**Relatively quiet (10-12m/s) time spot around take-off time.**

# Forecast – Sat 8 Oct 2016, 00UTC PV320K, irrwind320K, THE850K, trajectories

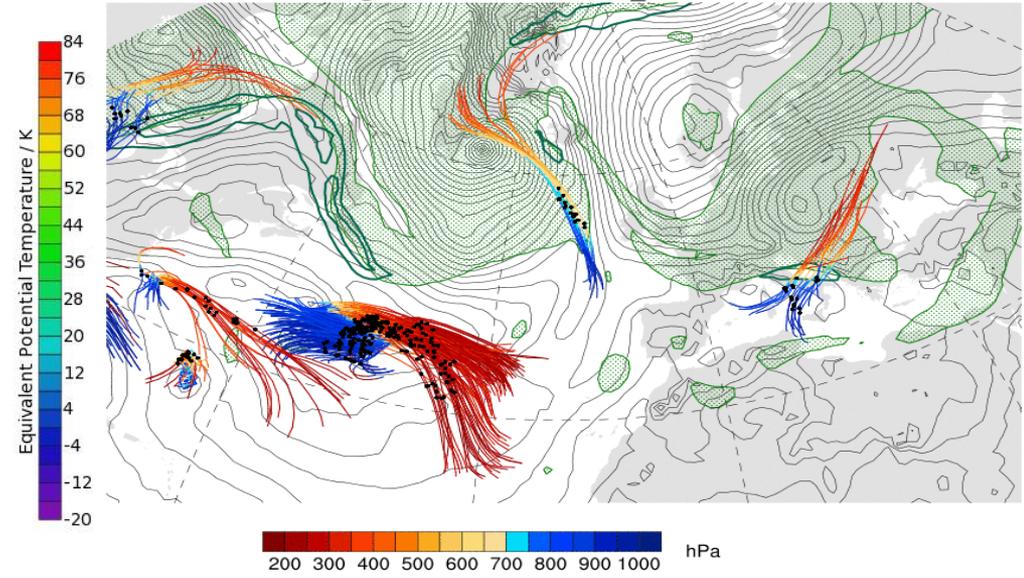
PV@320K at 20161008\_00



2 PVU (black), PV adv by div wind (shading),  
div wind (vectors) @320K and MSLP (green), BT: 20161006\_00, VT: 20161008\_00

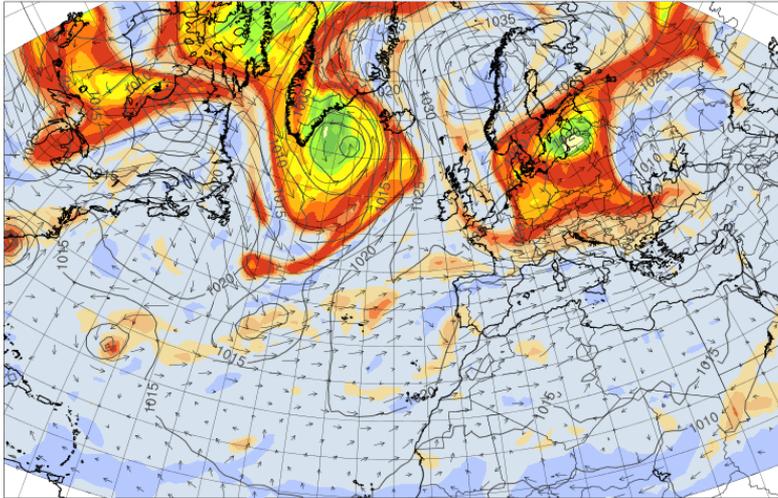


Trajectory start and SLP VT: 20161006\_00  
WCB outflow and PV@250hPa VT: 20161008\_00

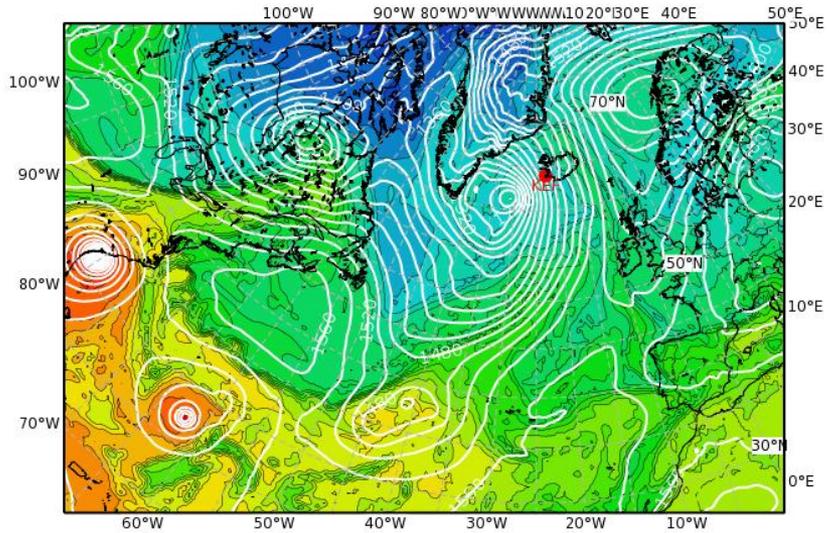
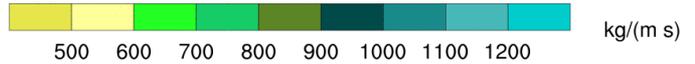
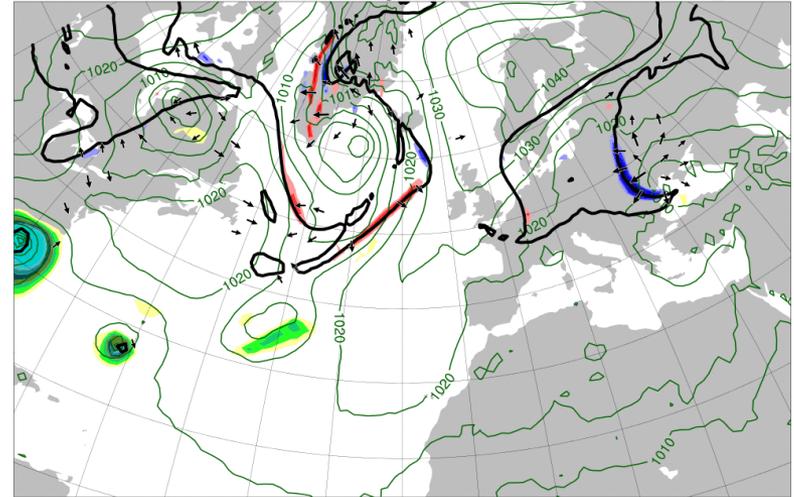


# Forecast – Sat 8 Oct 2016, 12UTC PV320K, irrwind320K, THE850K, trajectories

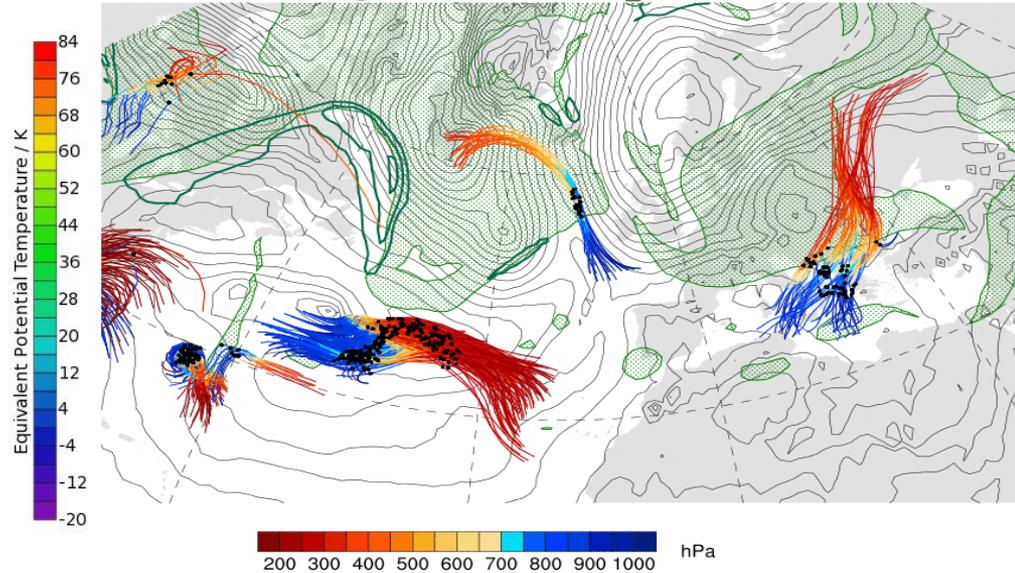
PV@320K at 20161008\_12



2 PVU (black), PV adv by div wind (shading),  
div wind (vectors) @320K and MSLP (green), BT: 20161006\_00, VT: 20161008\_12



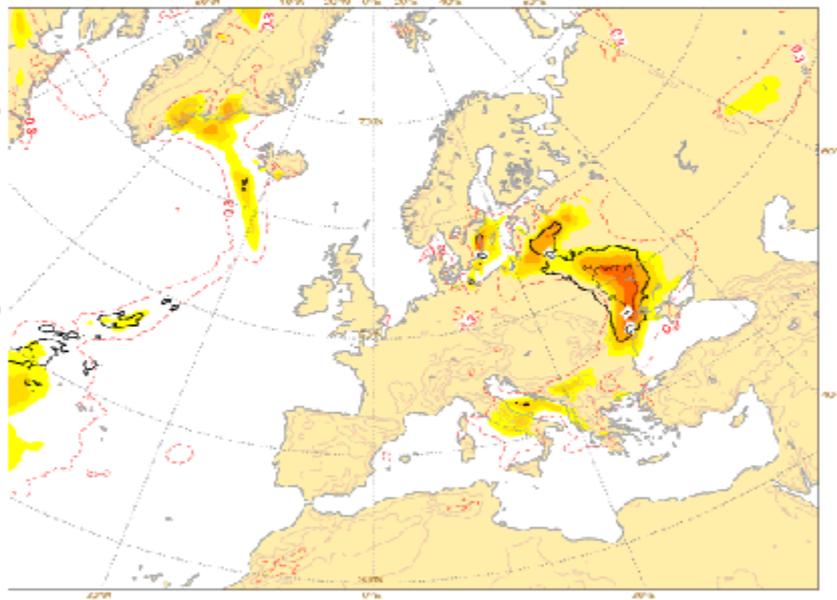
Trajectory start and SLP VT: 20161006\_12  
WCB outflow and PV@250hPa VT: 20161008\_12



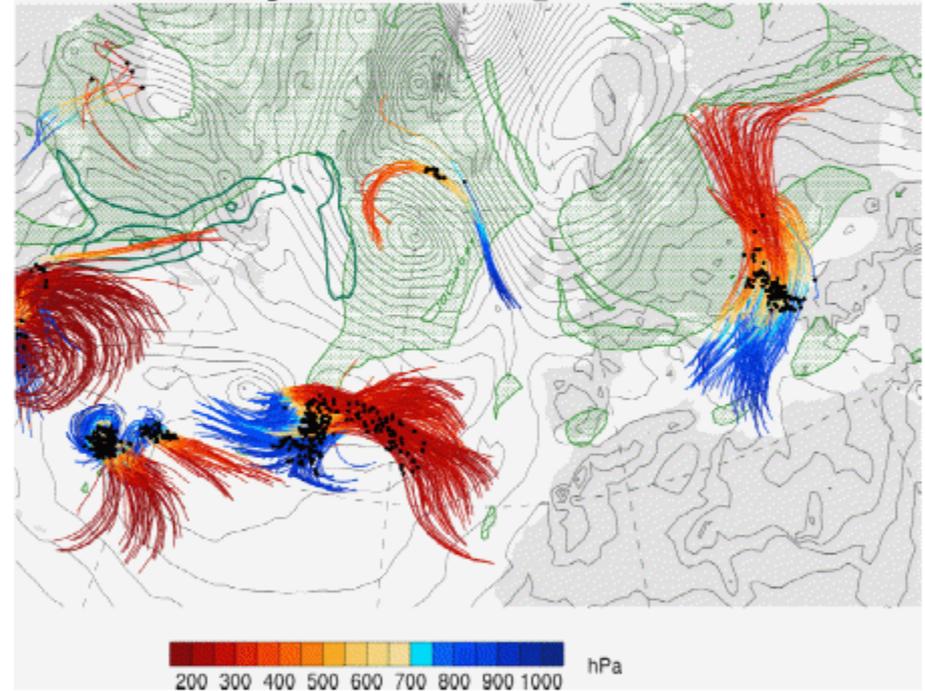
# Extreme forecast index for precipitation, WCB activity (based EC Ens 06/00Z)

7-9 Oct

Thu 06 Oct 2016 00 UTC @ECMWF t+24-95h VT: Fri 07 Oct 2016 00UTC - Mon 10 Oct 2016 00UTC  
Extreme forecast Index and Shift of Tails (black contours 0, 1, 2, 5, 8) for total precipitation



Trajectory start and SLP VT: 20161007\_00  
WCB outflow and PV@250hPa VT: 20161009\_00



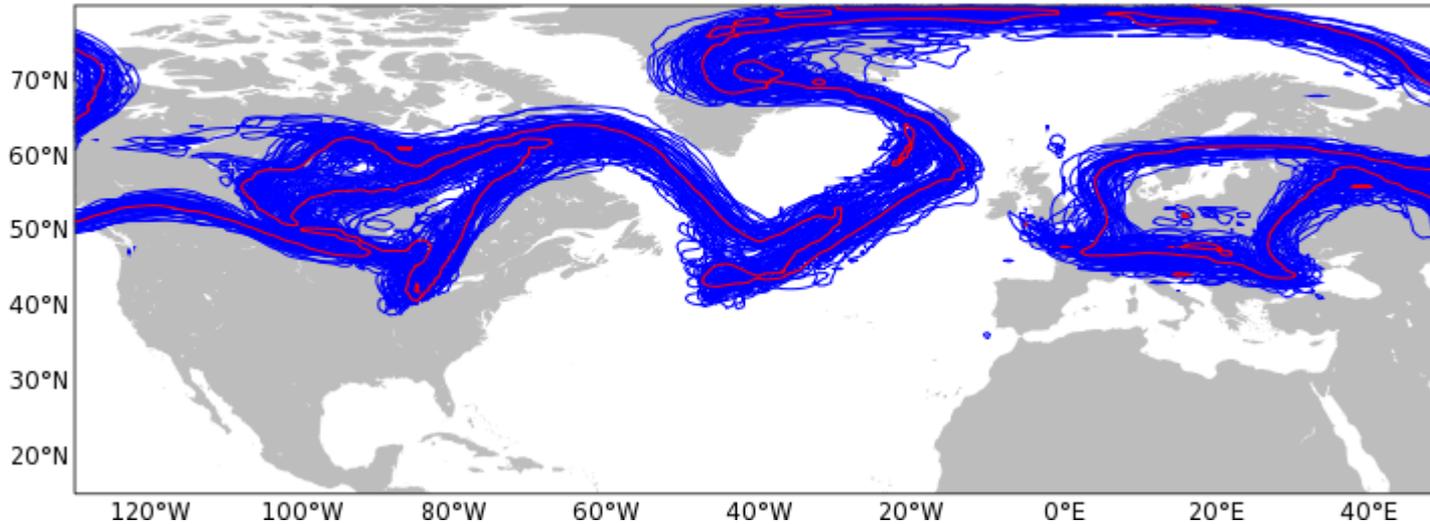
# 2PVU@320K, MSLP990 Spaghetti (based EC Ens 06/00Z)

ECMWF ENSEMBLE FC

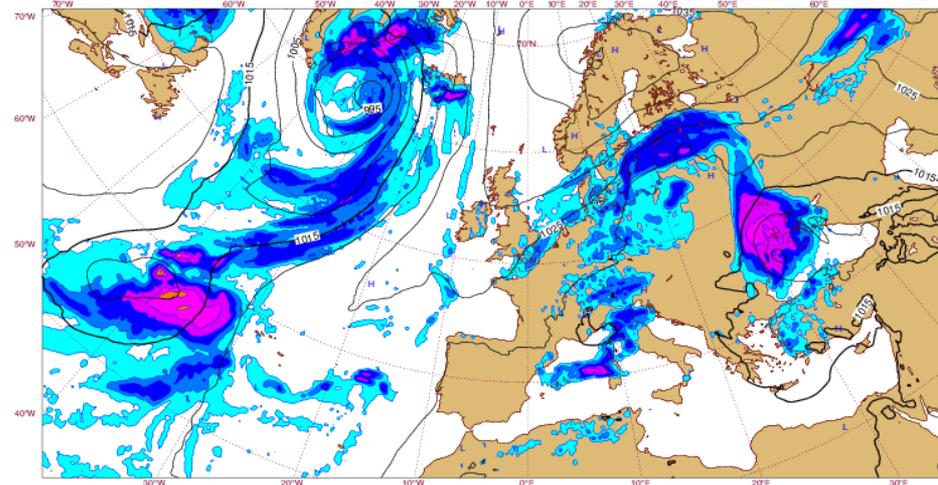
BT: 20161006 00UTC, VT: 20161008 12UTC

blue: perturbed, red: control

Sat 08/12Z

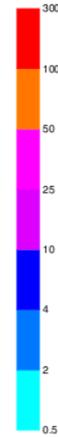
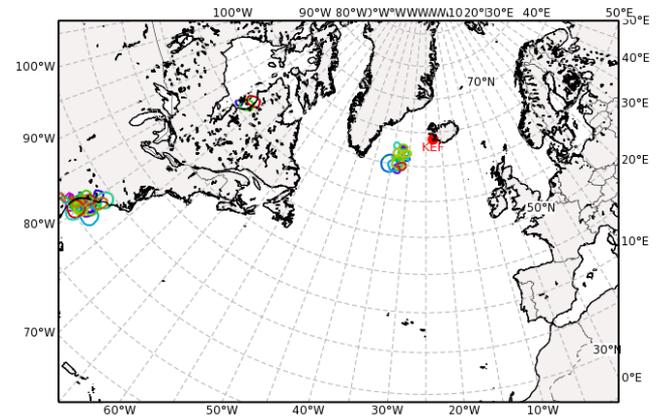


Thursday 06 October 2016 0000 UTC ECMWF t+60 VT: Saturday 08 October 2016 1200 UTC  
Surface: Mean sea level pressure / 12hr Accumulated precipitation (VT-6h/VT+6h)



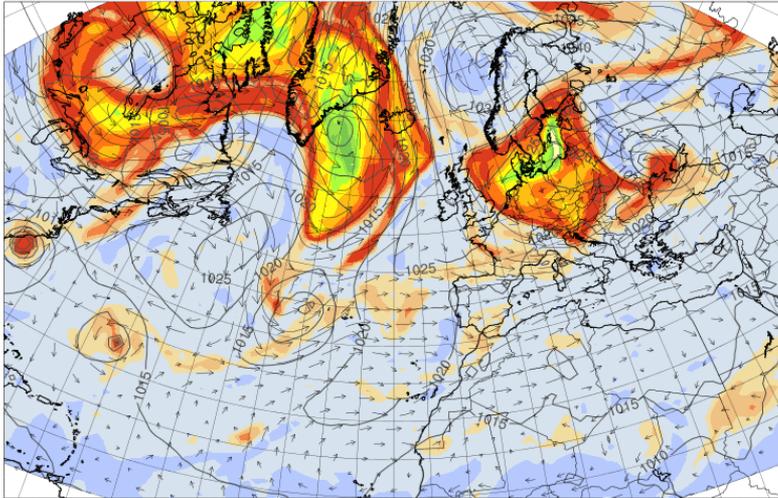
ECMWF ENS MSLP (990hPa-isoline)

Valid: Sat, 08 Oct 2016, 12 UTC (step 060 h from Thu, 06 Oct 2016, 00 UTC)

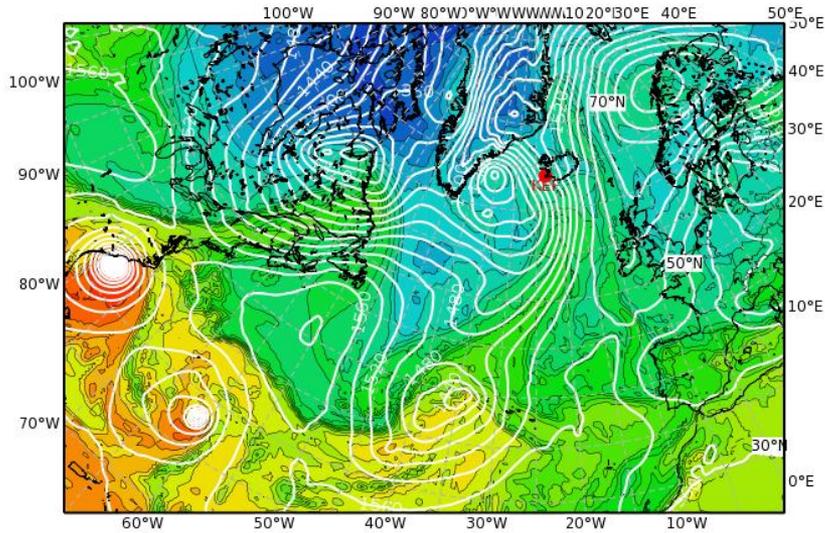
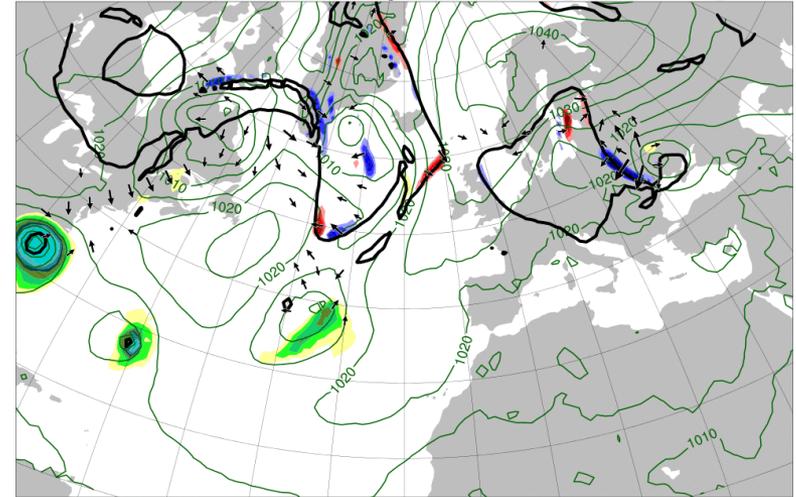


# Forecast – Sun 9 Oct 2016, 00UTC PV320K, irrwind320K, THE850K, trajectories

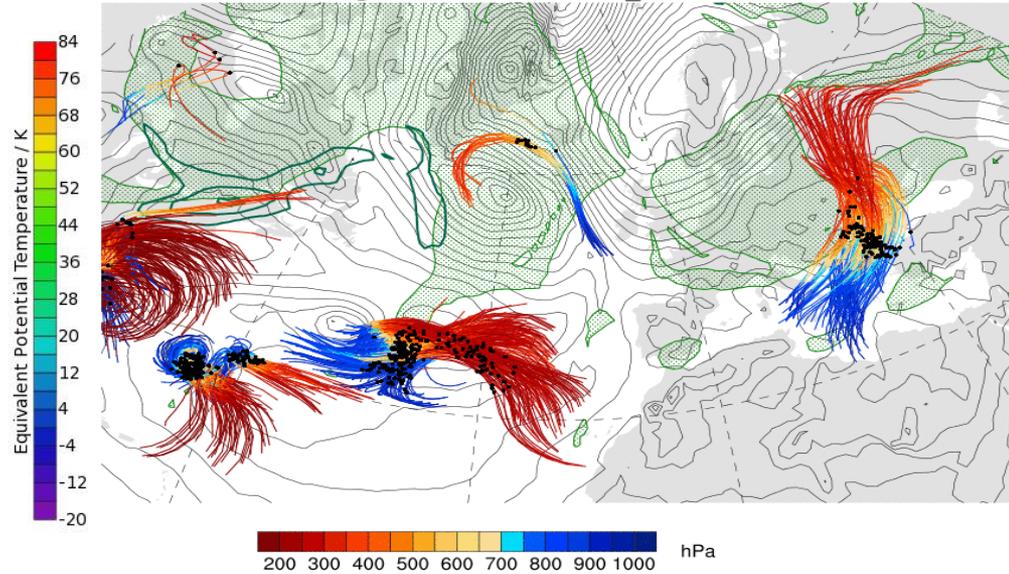
PV@320K at 20161009\_00



2 PVU (black), PV adv by div wind (shading),  
div wind (vectors) @320K and MSLP (green), BT: 20161006\_00, VT: 20161009\_00

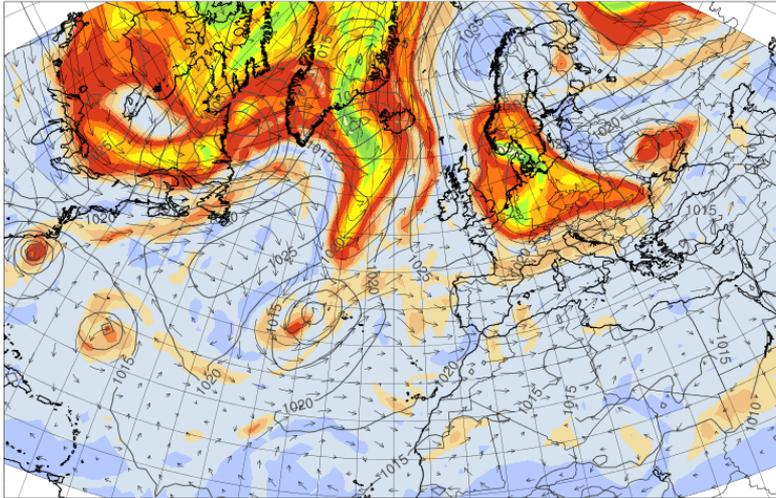


Trajectory start and SLP VT: 20161007\_00  
WCB outflow and PV@250hPa VT: 20161009\_00

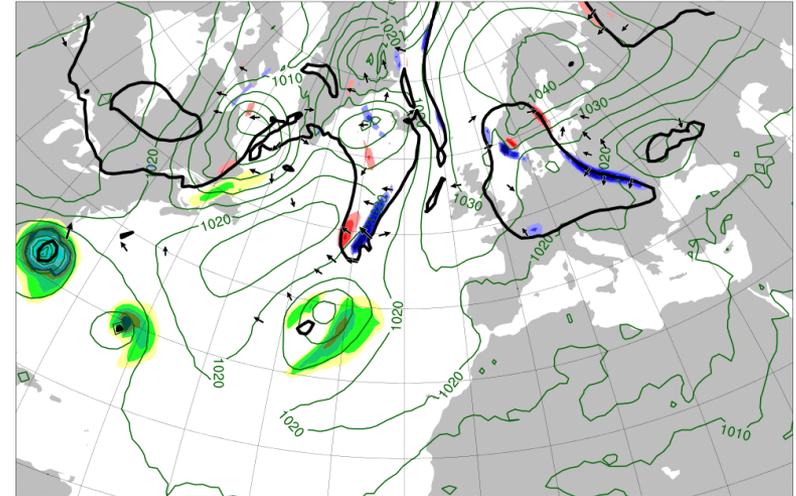


# Forecast – Sun 9 Oct 2016, 12UTC PV320K, irrwind320K, THE850K, trajectories

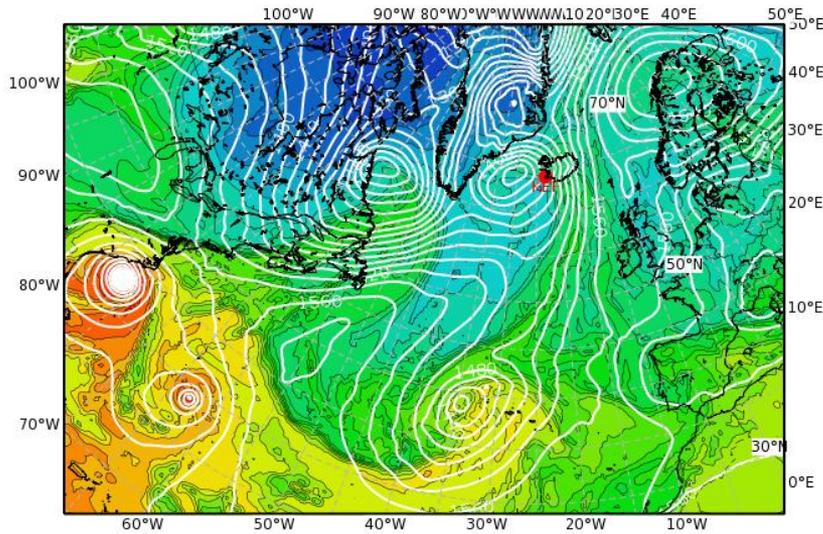
PV@320K at 20161009\_12



2 PVU (black), PV adv by div wind (shading),  
div wind (vectors) @320K and MSLP (green), BT: 20161006\_00, VT: 20161009\_12

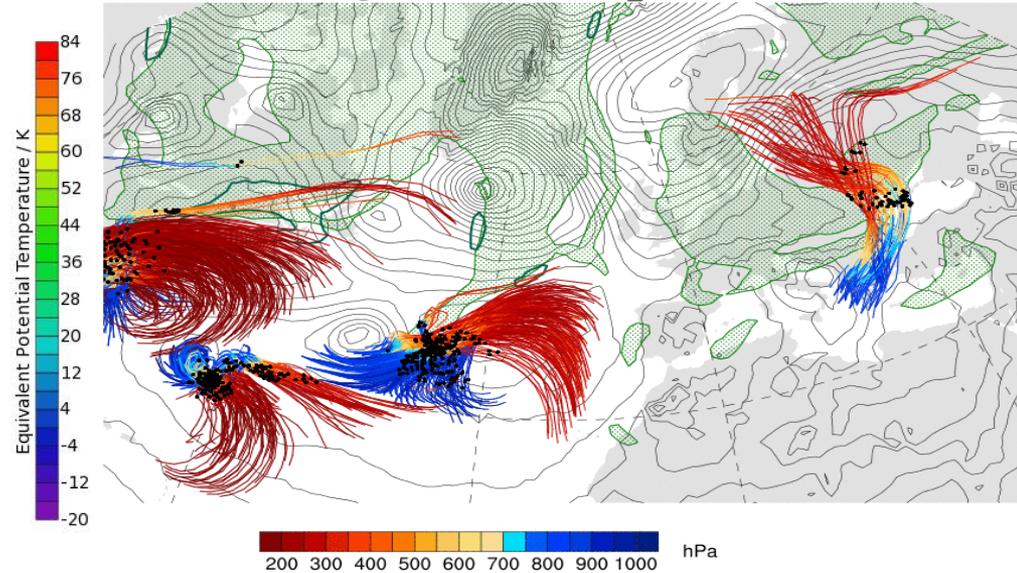


pvu  
-0.5 0.2 0.7 1 1.5 2 4 5 6 7 8 9 10



kg/(m s)  
500 600 700 800 900 1000 1100 1200

Trajectory start and SLP VT: 20161007\_12  
WCB outflow and PV@250hPa VT: 20161009\_12



hPa  
200 300 400 500 600 700 800 900 1000

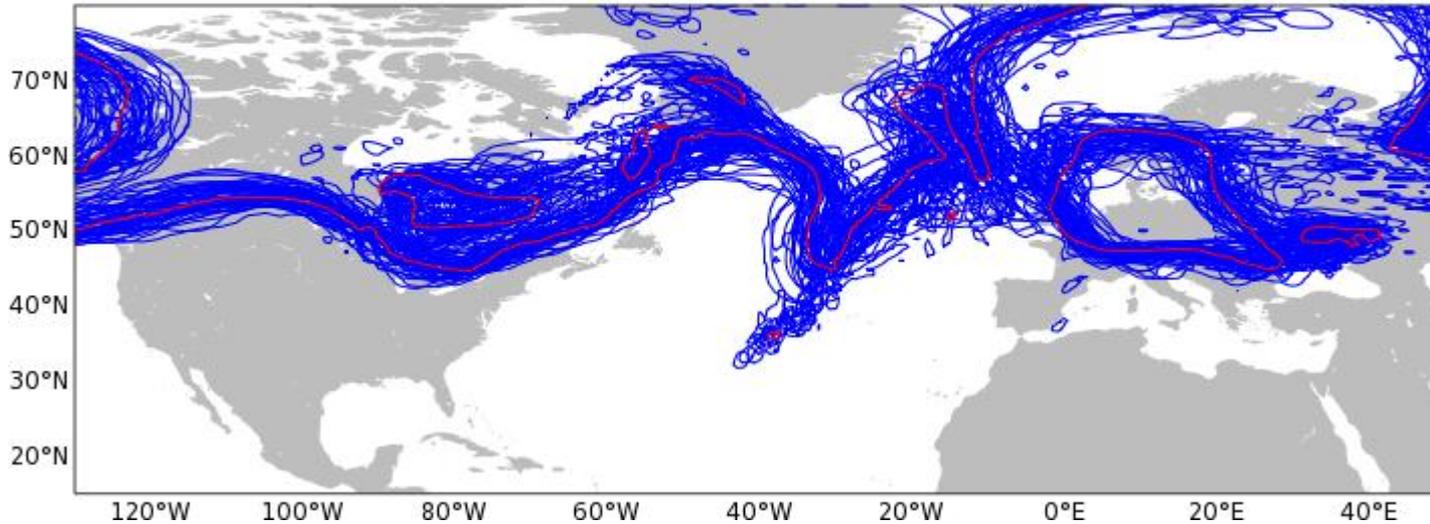
# 2PVU@320K, MSLP990 Spaghetti (based EC Ens 06/00Z)

ECMWF ENSEMBLE FC

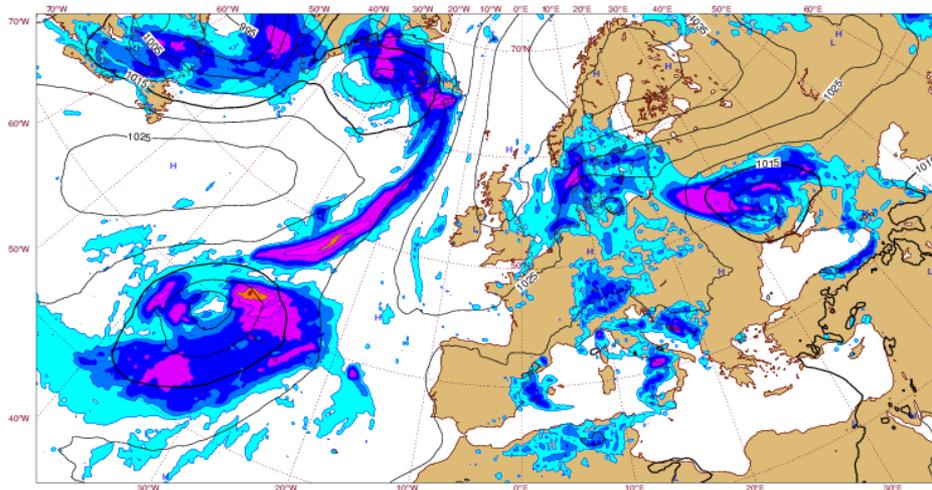
BT: 20161006 00UTC, VT: 20161009 12UTC

blue: perturbed, red: control

Sun 09/12Z

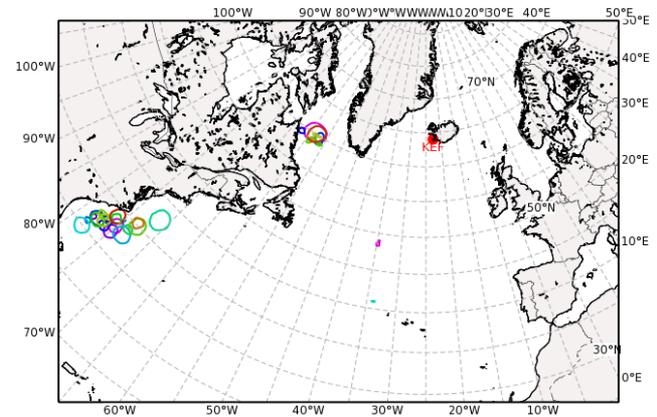


Thursday 06 October 2016 0000 UTC ECMWF t+84 VT: Sunday 09 October 2016 1200 UTC  
Surface: Mean sea level pressure / 12hr Accumulated precipitation (VT-6h/VT+6h)

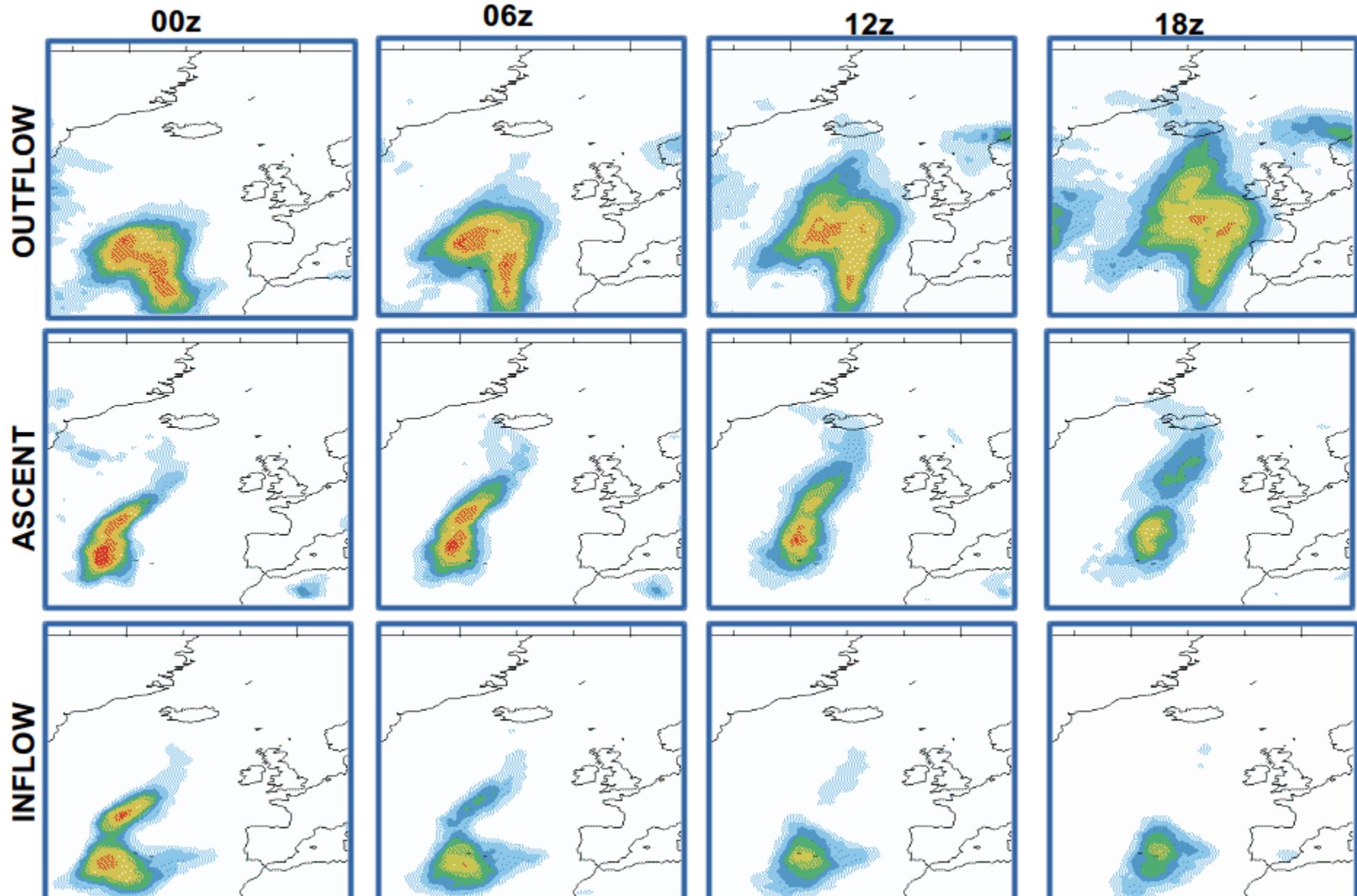


ECMWF ENS MSLP (990hPa-isoline)

Valid: Sun, 09 Oct 2016, 12 UTC (step 084 h from Thu, 06 Oct 2016, 00 UTC)



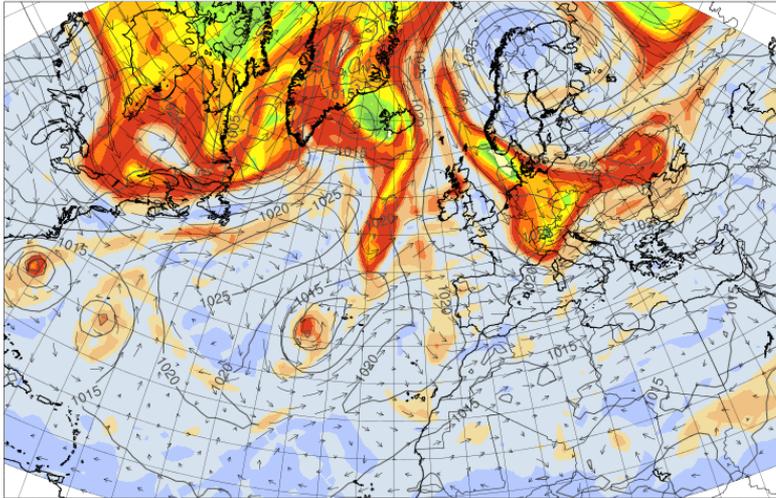
# WCB Ens Probabilities Sunday 9 Oct (BT: 06/00z)



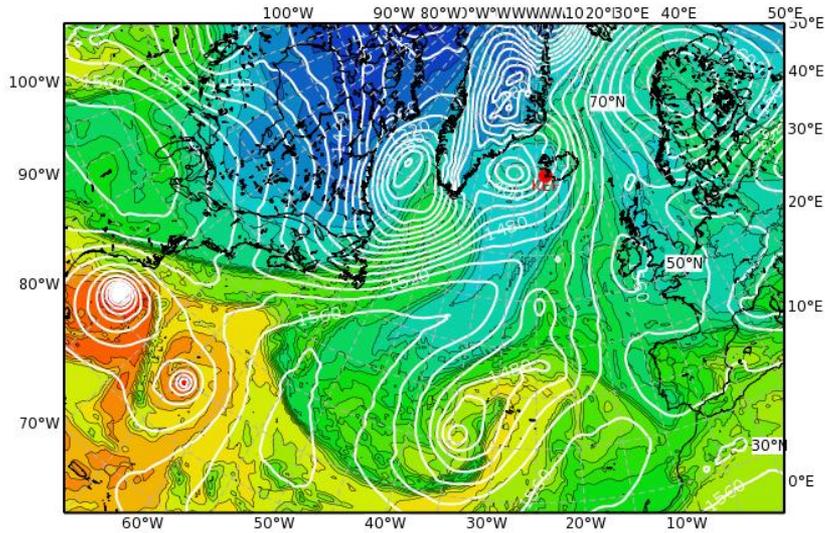
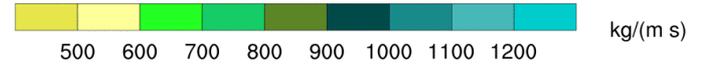
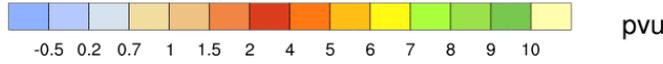
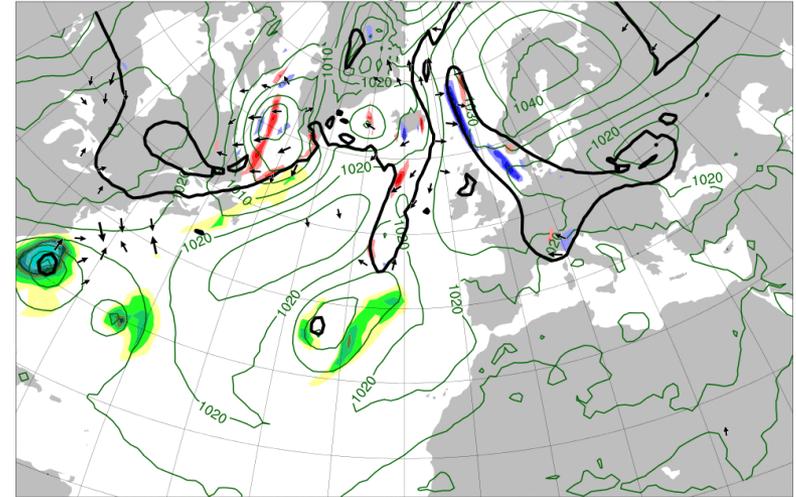
BT06/00Z

# Forecast – Mon 10 Oct 2016, 00UTC @ PV320K, irrwind320K, THE850K, trajectories

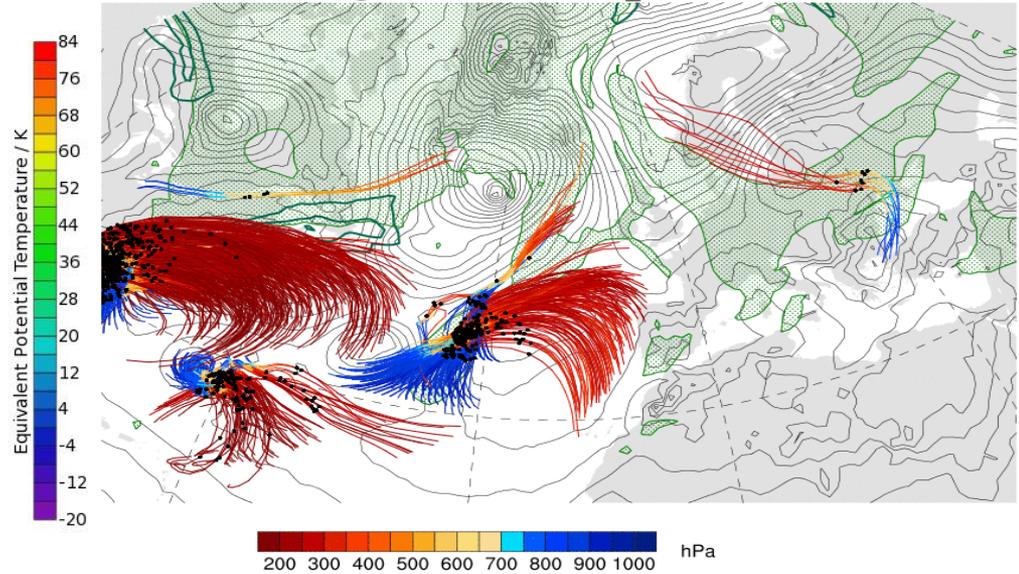
PV@320K at 20161010\_00



2 PVU (black), PV adv by div wind (shading),  
div wind (vectors) @320K and MSLP (green), BT: 20161006\_00, VT: 20161010\_00

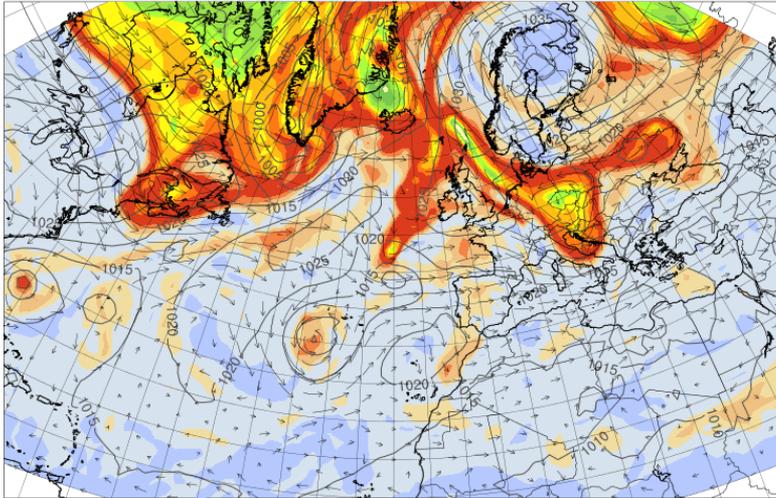


Trajectory start and SLP VT: 20161008\_00  
WCB outflow and PV@250hPa VT: 20161010\_00

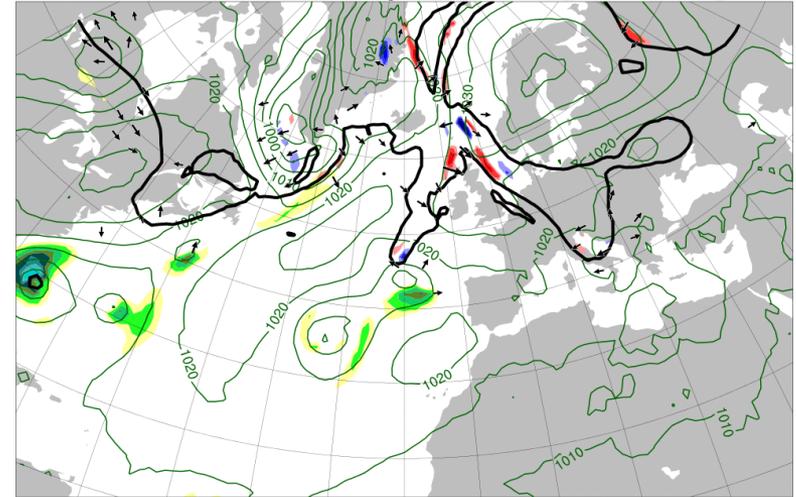


# Forecast – Mon 10 Oct 2016, 12UTC

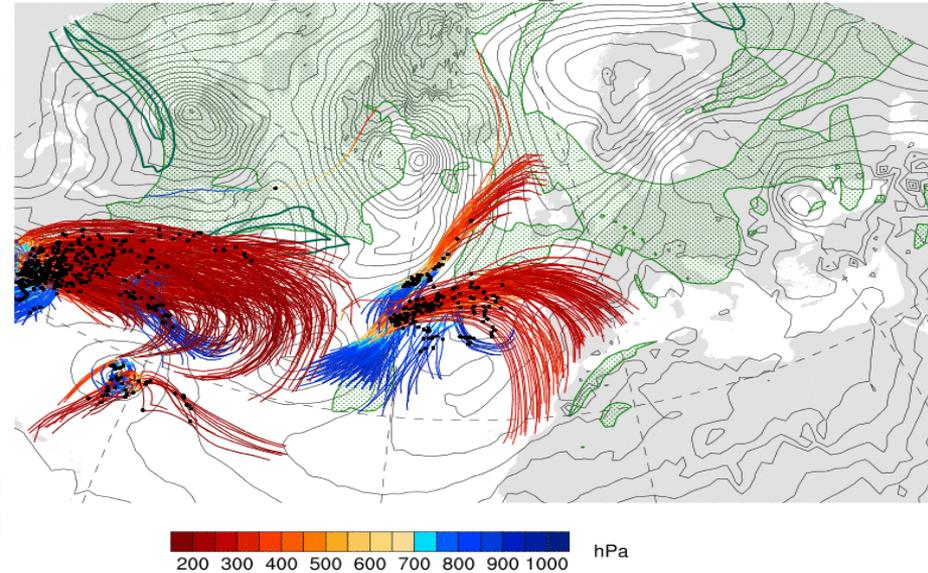
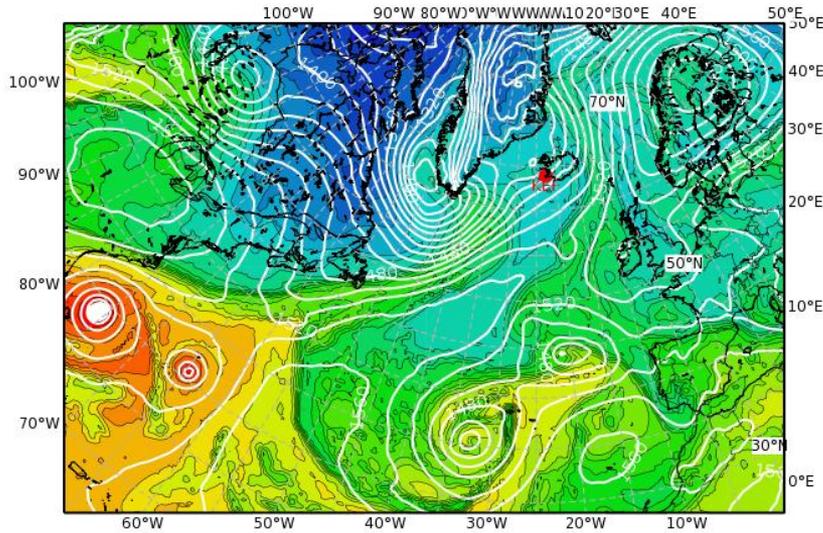
PV@320K at 20161010\_12



2 PVU (black), PV adv by div wind (shading),  
div wind (vectors) @320K and MSLP (green), BT: 20161006\_00, VT: 20161010\_12



Trajectory start and SLP VT: 20161008\_12  
WCB outflow and PV@250hPa VT: 20161010\_12



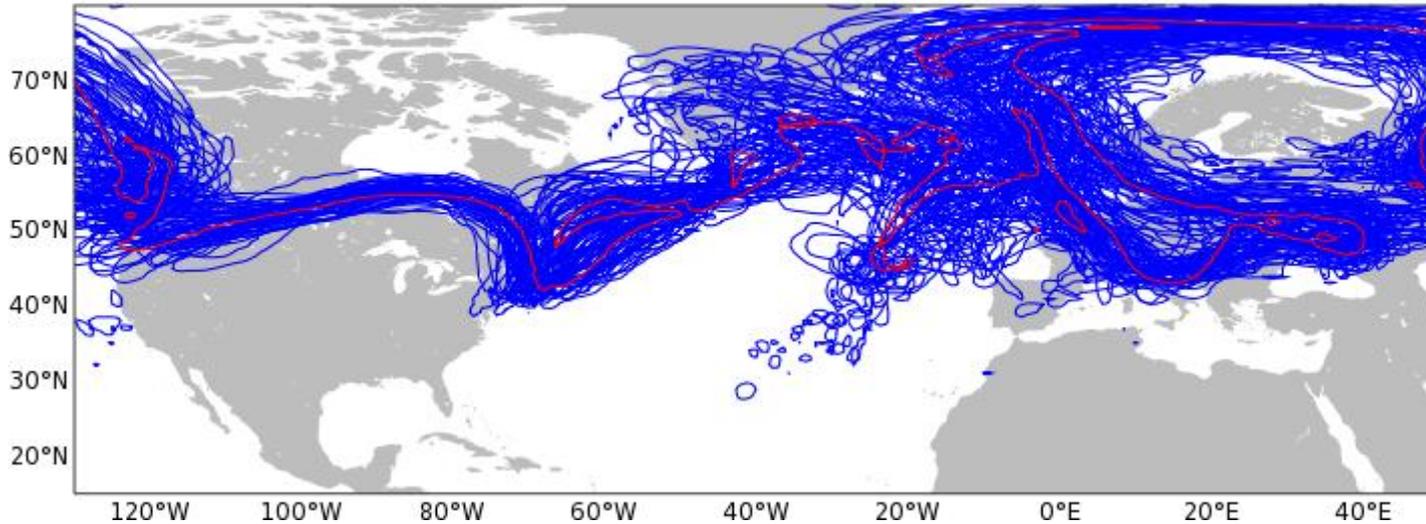
# 2PVU@320K, MSLP990 Spaghetti (based EC Ens 06/00Z)

ECMWF ENSEMBLE FC

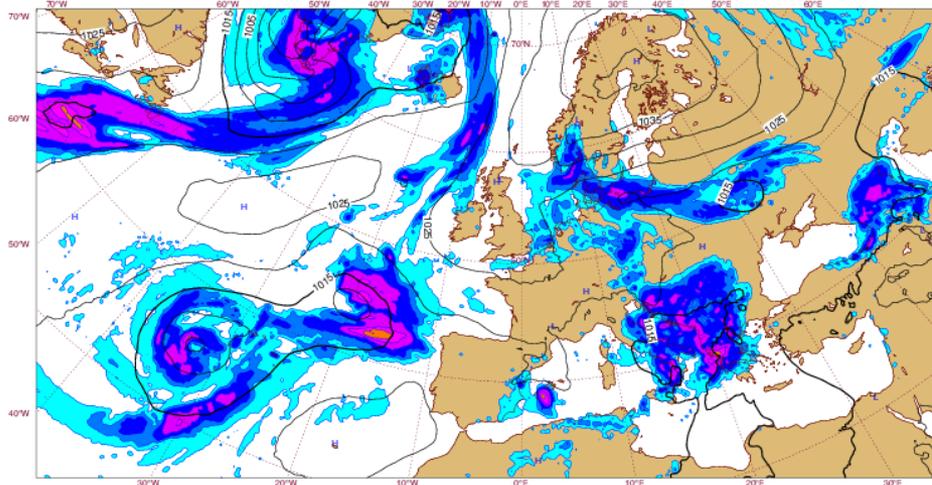
BT: 20161006 00UTC, VT: 20161010 12UTC

blue: perturbed, red: control

Mon 10/12Z

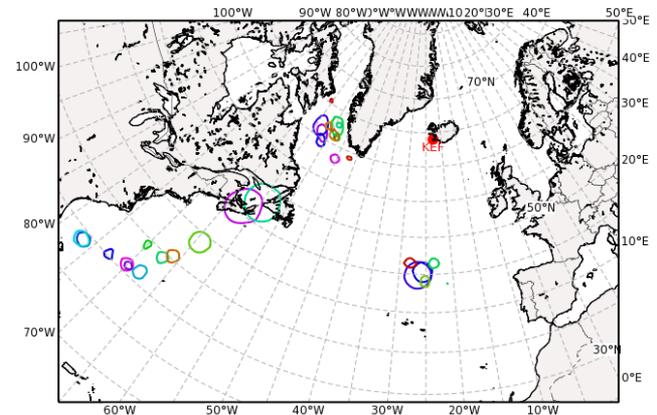


Thursday 06 October 2016 0000 UTC ECMWF t+108 VT: Monday 10 October 2016 1200 UTC  
Surface: Mean sea level pressure / 12hr Accumulated precipitation (VT-6h/VT+6h)

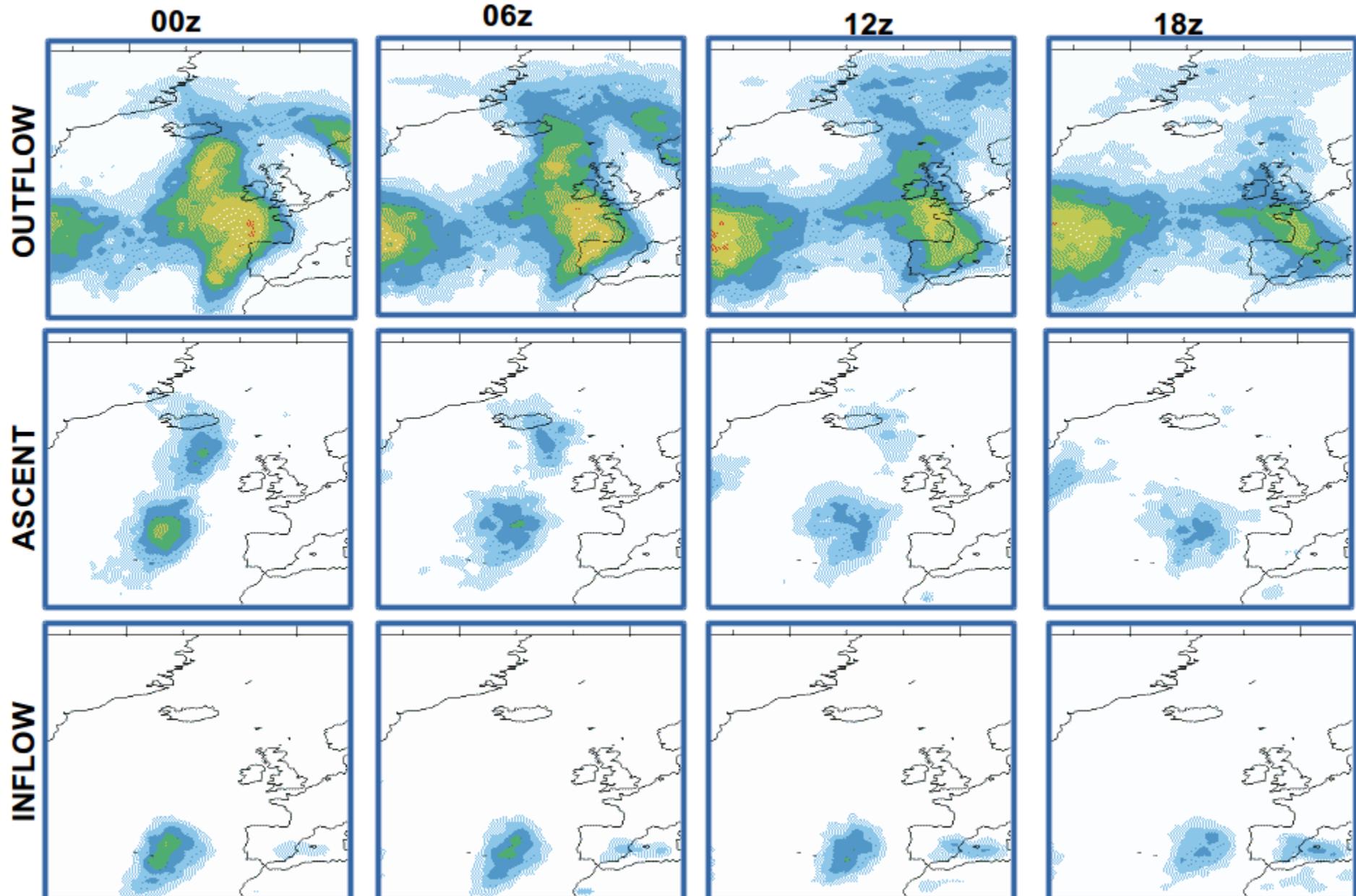


ECMWF ENS MSLP (990hPa-isoline)

Valid: Mon, 10 Oct 2016, 12 UTC (step 108 h from Thu, 06 Oct 2016, 00 UTC)



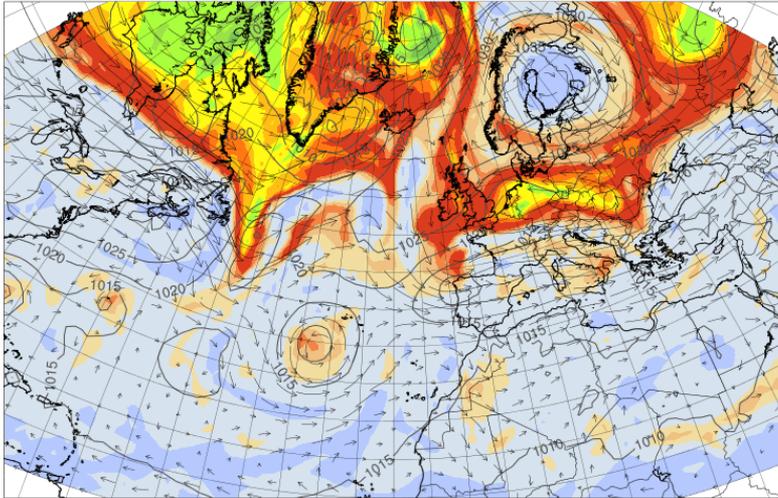
# WCB Ens Probabilities Monday 10 Oct (BT: 06/00z)



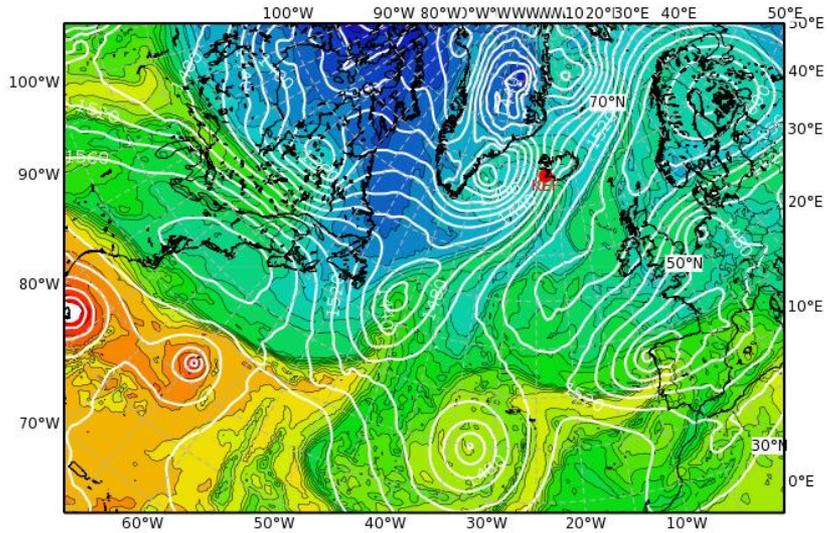
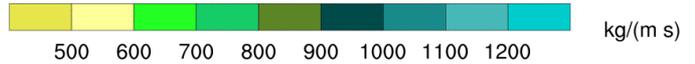
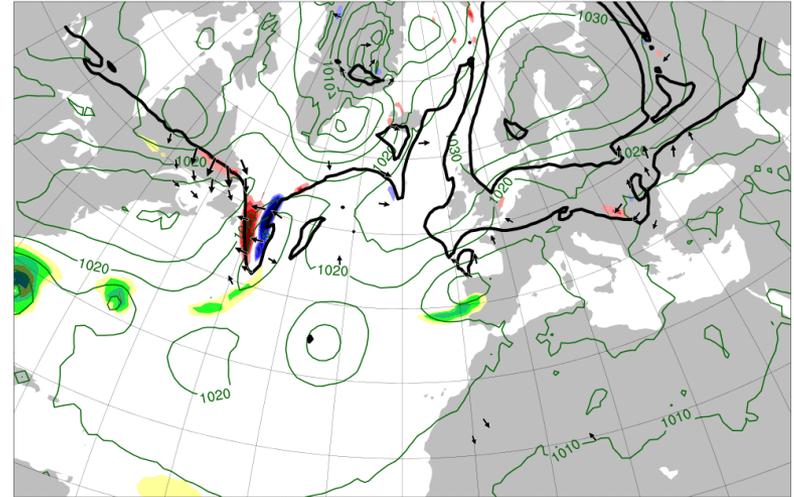
BT06/00Z

# Forecast – Tue 11 Oct 2016, 12UTC PV320K, irrwind320K, THE850K, trajectories

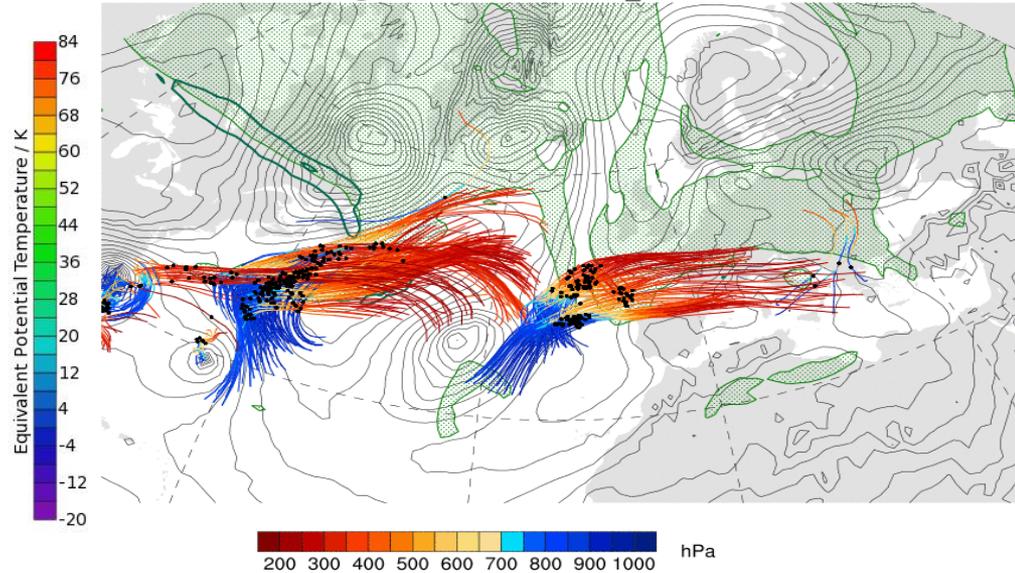
PV@320K at 20161011\_12



2 PVU (black), PV adv by div wind (shading),  
div wind (vectors) @320K and MSLP (green), BT: 20161006\_00, VT: 20161011\_12



Trajectory start and SLP VT: 20161009\_12  
WCB outflow and PV@250hPa VT: 20161011\_12



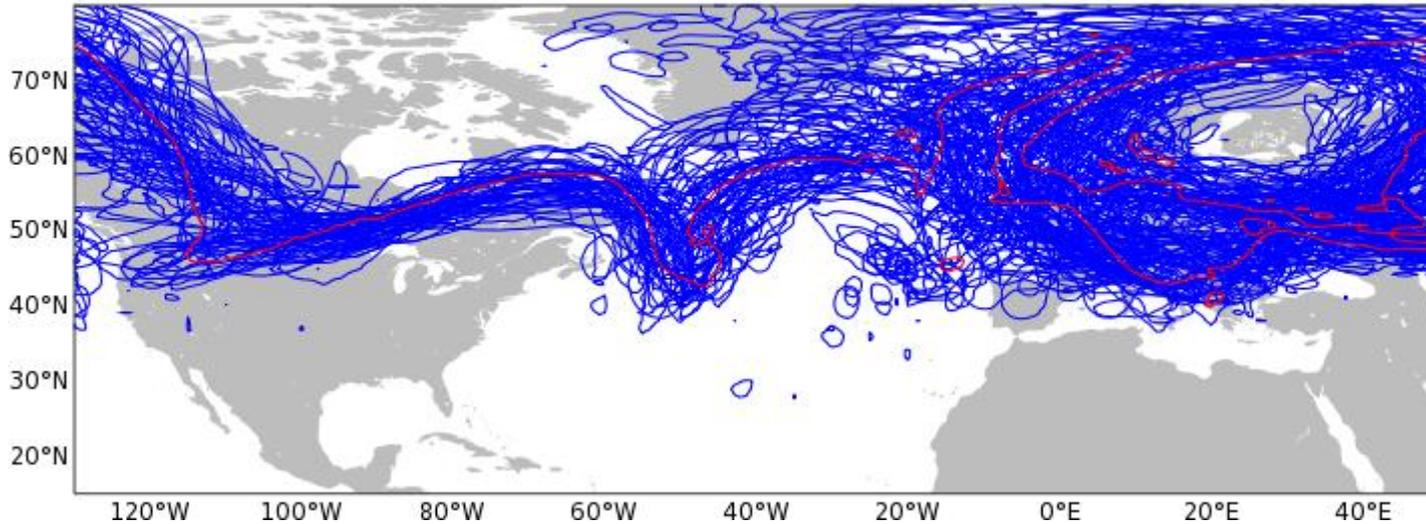
# 2PVU@320K, MSLP990 Spaghetti (based EC Ens 06/00Z)

ECMWF ENSEMBLE FC

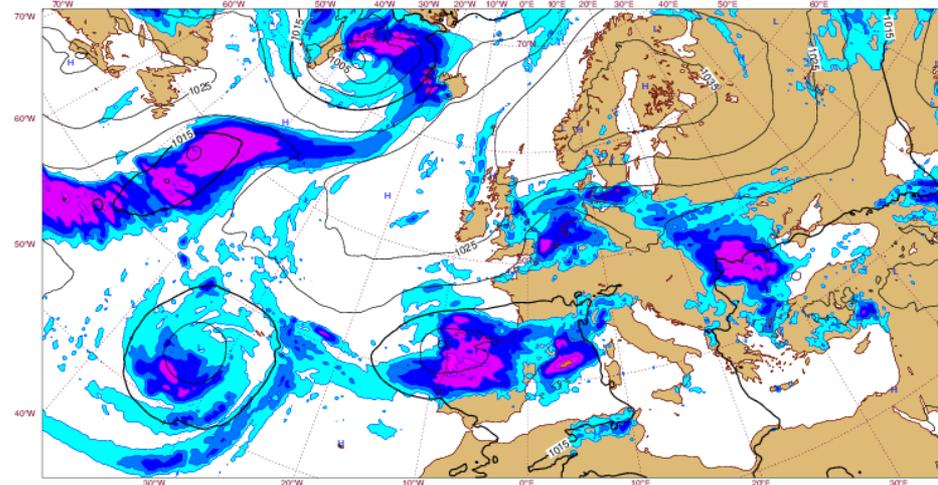
BT: 20161006 00UTC, VT: 20161011 12UTC

blue: perturbed, red: control

Tue 11/12Z

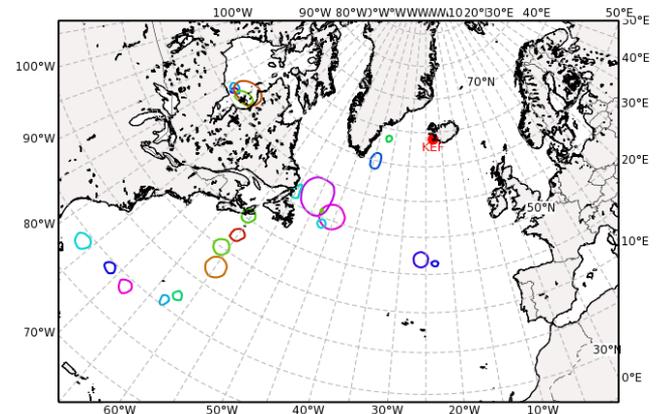


Thursday 06 October 2016 0000 UTC ECMWF t+132 VT: Tuesday 11 October 2016 1200 UTC  
Surface: Mean sea level pressure / 12hr Accumulated precipitation (VT-6h/VT+6h)



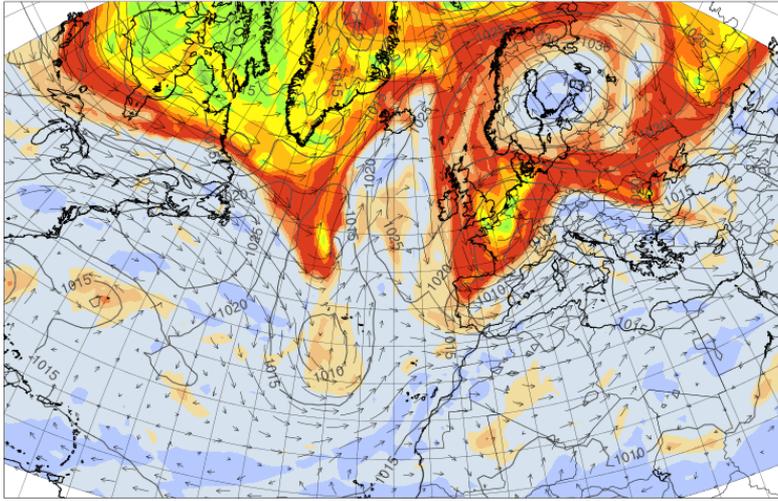
ECMWF ENS MSLP (990hPa-isoline)

Valid: Tue, 11 Oct 2016, 12 UTC (step 132 h from Thu, 06 Oct 2016, 00 UTC)

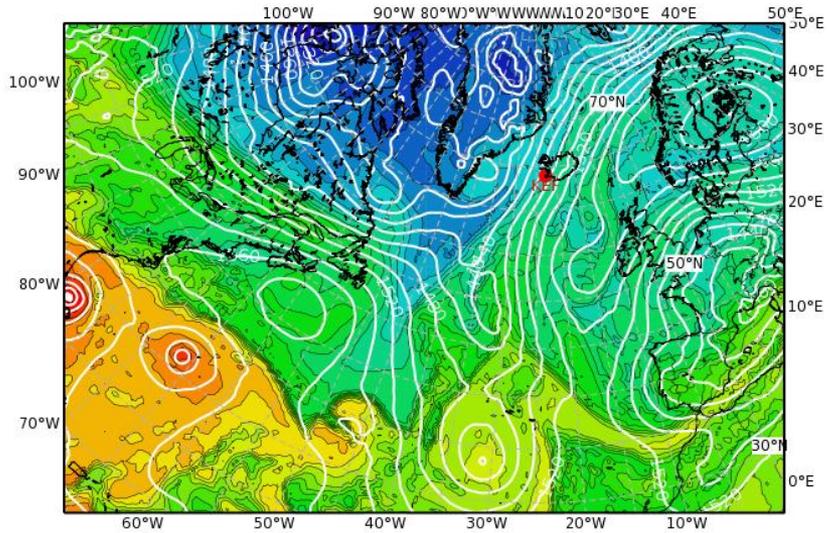
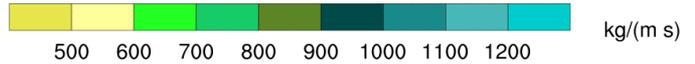
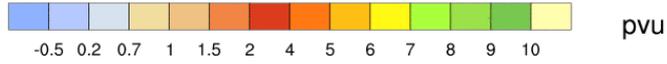
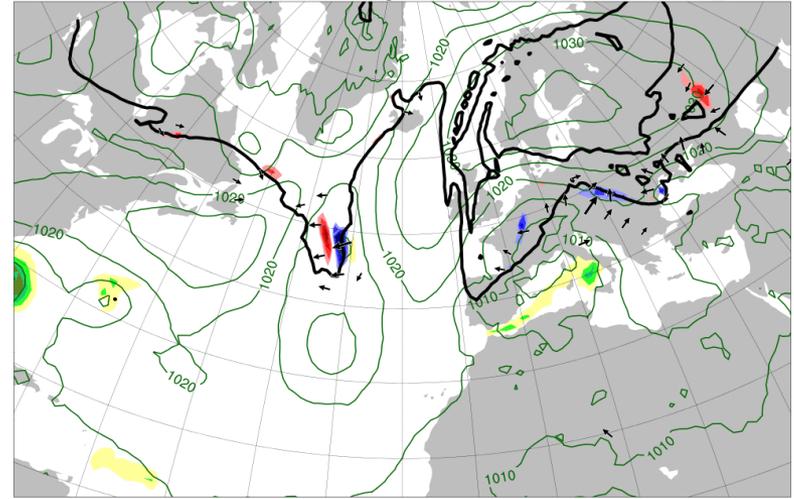


# Forecast – Wed 12 Oct 2016, 12UTC PV320K, irrwind320K, THE850K, trajectories

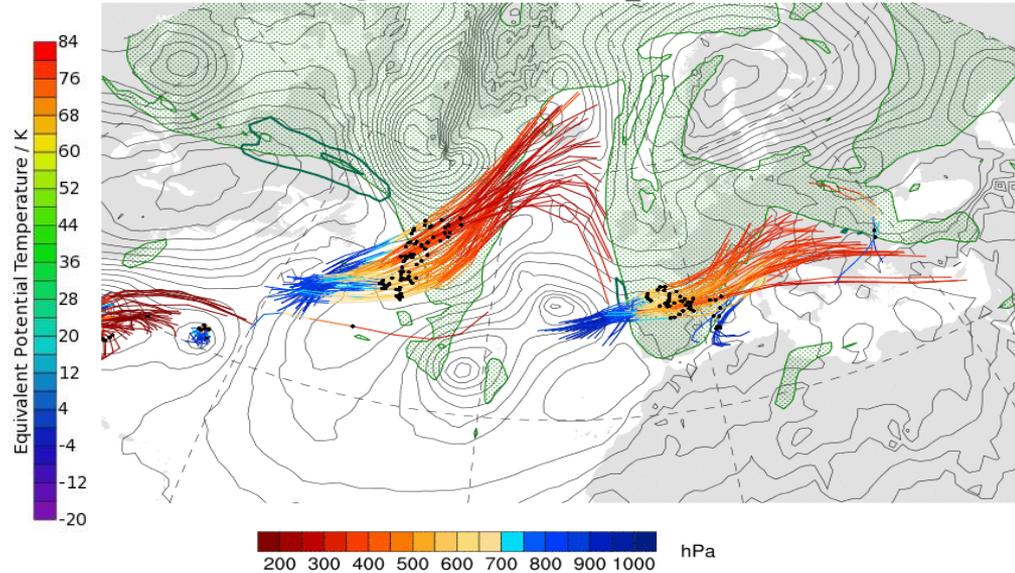
PV@320K at 20161012\_12



2 PVU (black), PV adv by div wind (shading),  
div wind (vectors) @320K and MSLP (green), BT: 20161006\_00, VT: 20161012\_12



Trajectory start and SLP VT: 20161010\_12  
WCB outflow and PV@250hPa VT: 20161012\_12



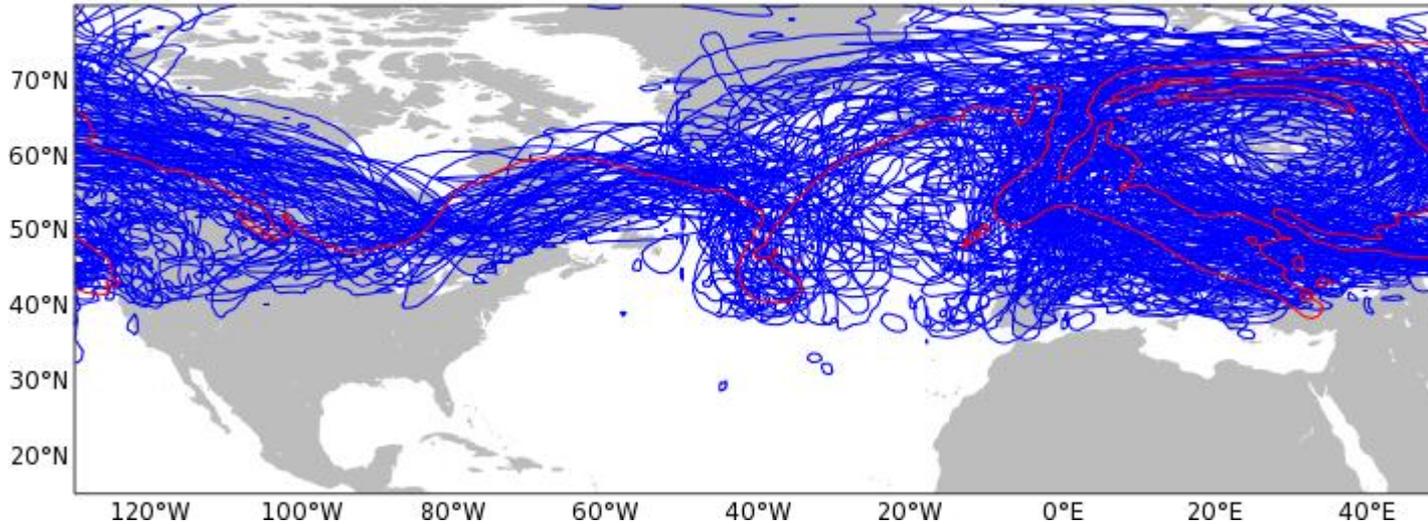
# 2PVU@320K, MSLP990 Spaghetti (based EC Ens 06/00Z)

ECMWF ENSEMBLE FC

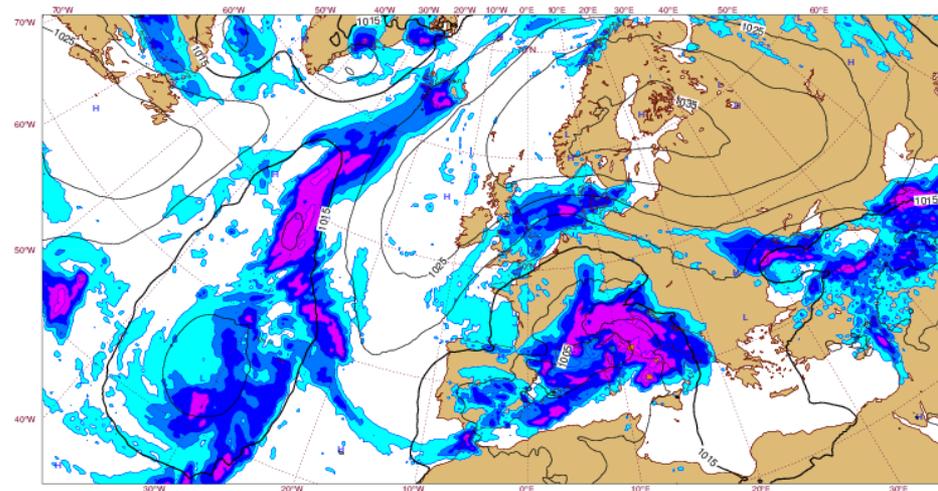
BT: 20161006 00UTC, VT: 20161012 12UTC

blue: perturbed, red: control

Wed 12/12Z

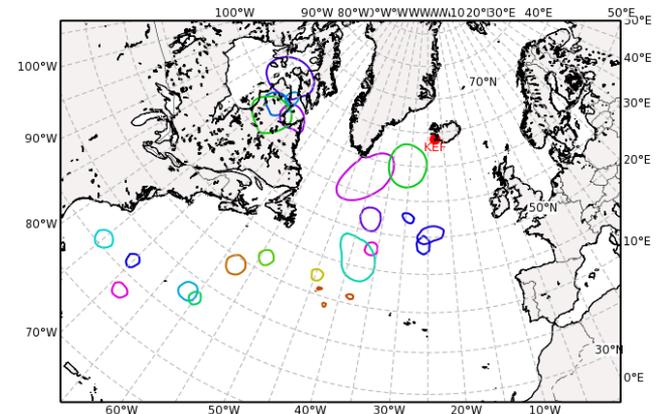


Thursday 06 October 2016 0000 UTC ECMWF t+156 VT: Wednesday 12 October 2016 1200 UTC  
Surface: Mean sea level pressure / 12hr Accumulated precipitation (VT-6h/VT+6h)



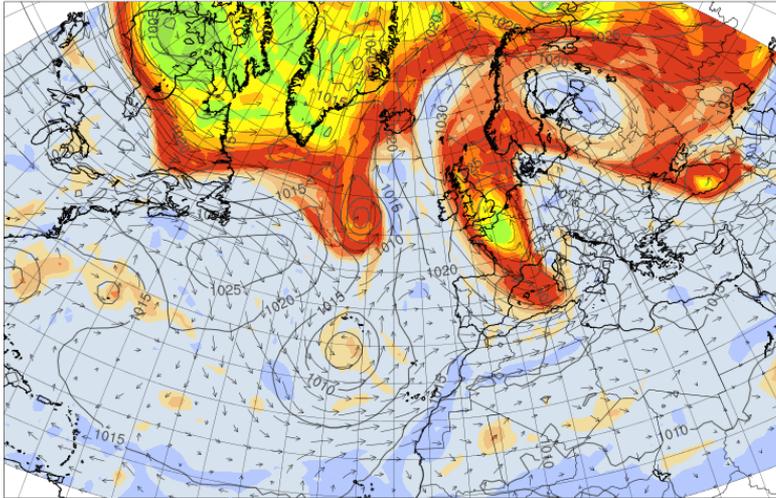
ECMWF ENS MSLP (990hPa-isoline)

Valid: Wed, 12 Oct 2016, 12 UTC (step 156 h from Thu, 06 Oct 2016, 00 UTC)

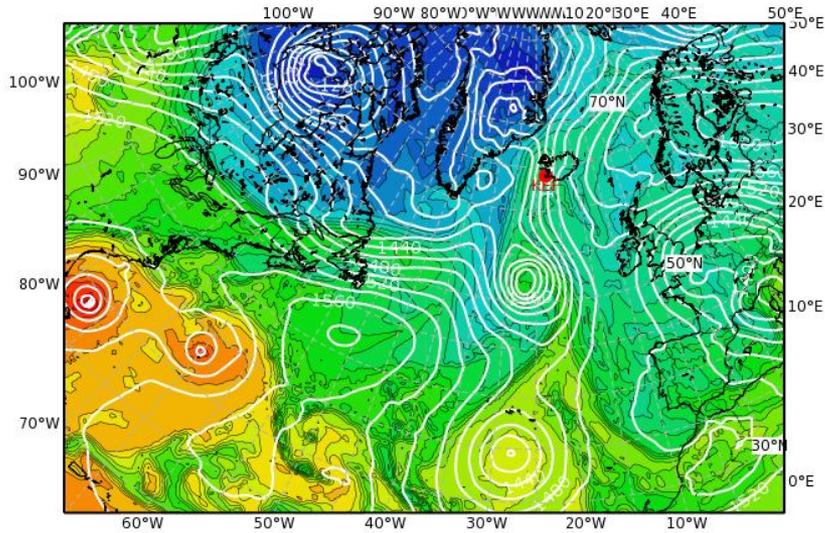
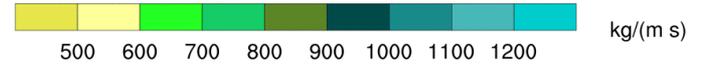
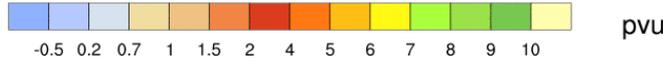
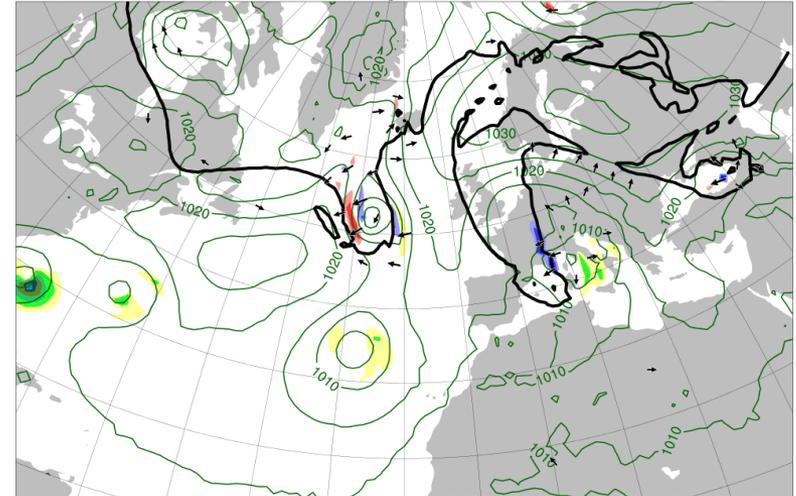


# Forecast – Thu 13 Oct 2016, 12UTC PV320K, irrwind320K, THE850K, trajectories

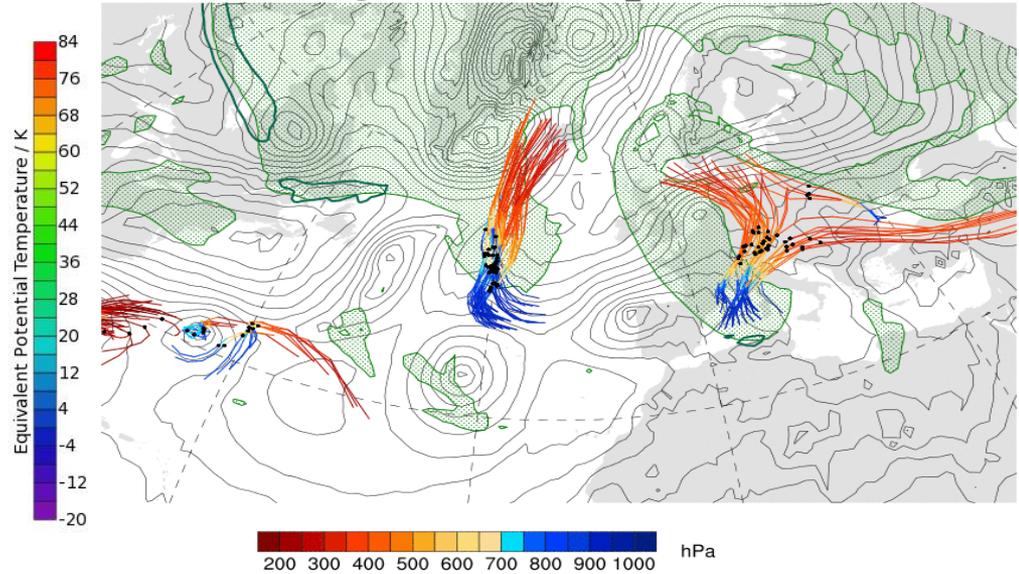
PV@320K at 20161013\_12



2 PVU (black), PV adv by div wind (shading),  
div wind (vectors) @320K and MSLP (green), BT: 20161006\_00, VT: 20161013\_12



Trajectory start and SLP VT: 20161011\_12  
WCB outflow and PV@250hPa VT: 20161013\_12



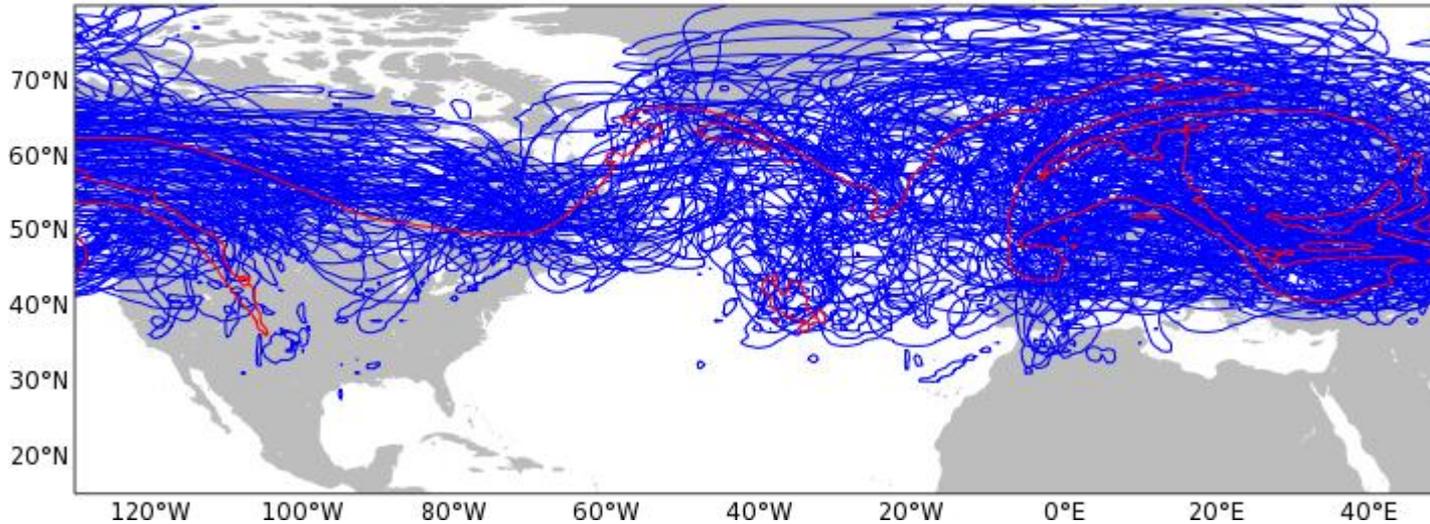
# 2PVU@320K, MSLP990 Spaghetti (based EC Ens 06/00Z)

ECMWF ENSEMBLE FC

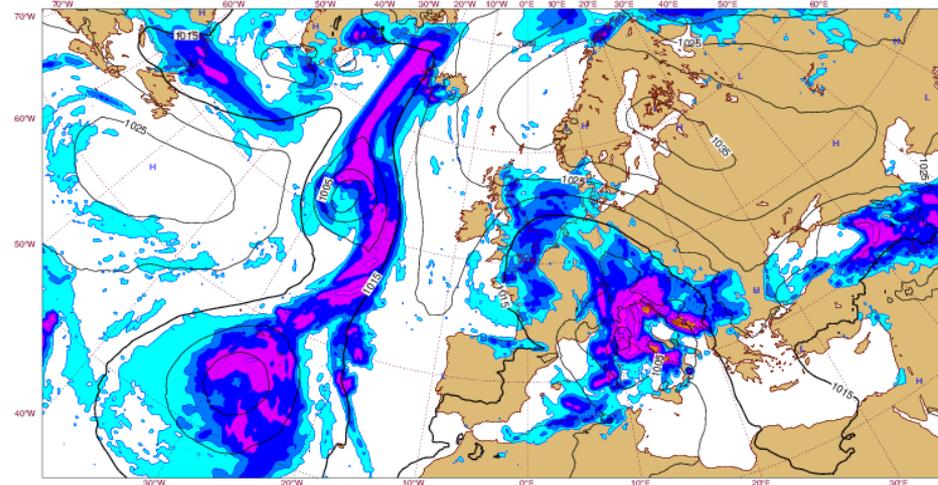
BT: 20161006 00UTC, VT: 20161013 12UTC

blue: perturbed, red: control

Thu 13/12Z

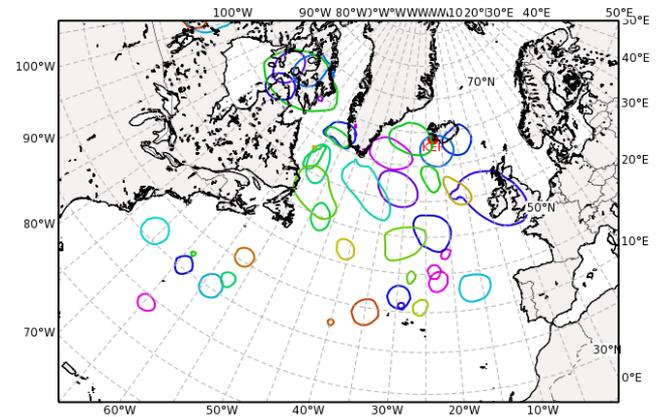


Thursday 06 October 2016 0000 UTC ECMWF t+180 VT: Thursday 13 October 2016 1200 UTC  
Surface: Mean sea level pressure / 12hr Accumulated precipitation (VT-6h/VT+6h)



ECMWF ENS MSLP (990hPa-isoline)

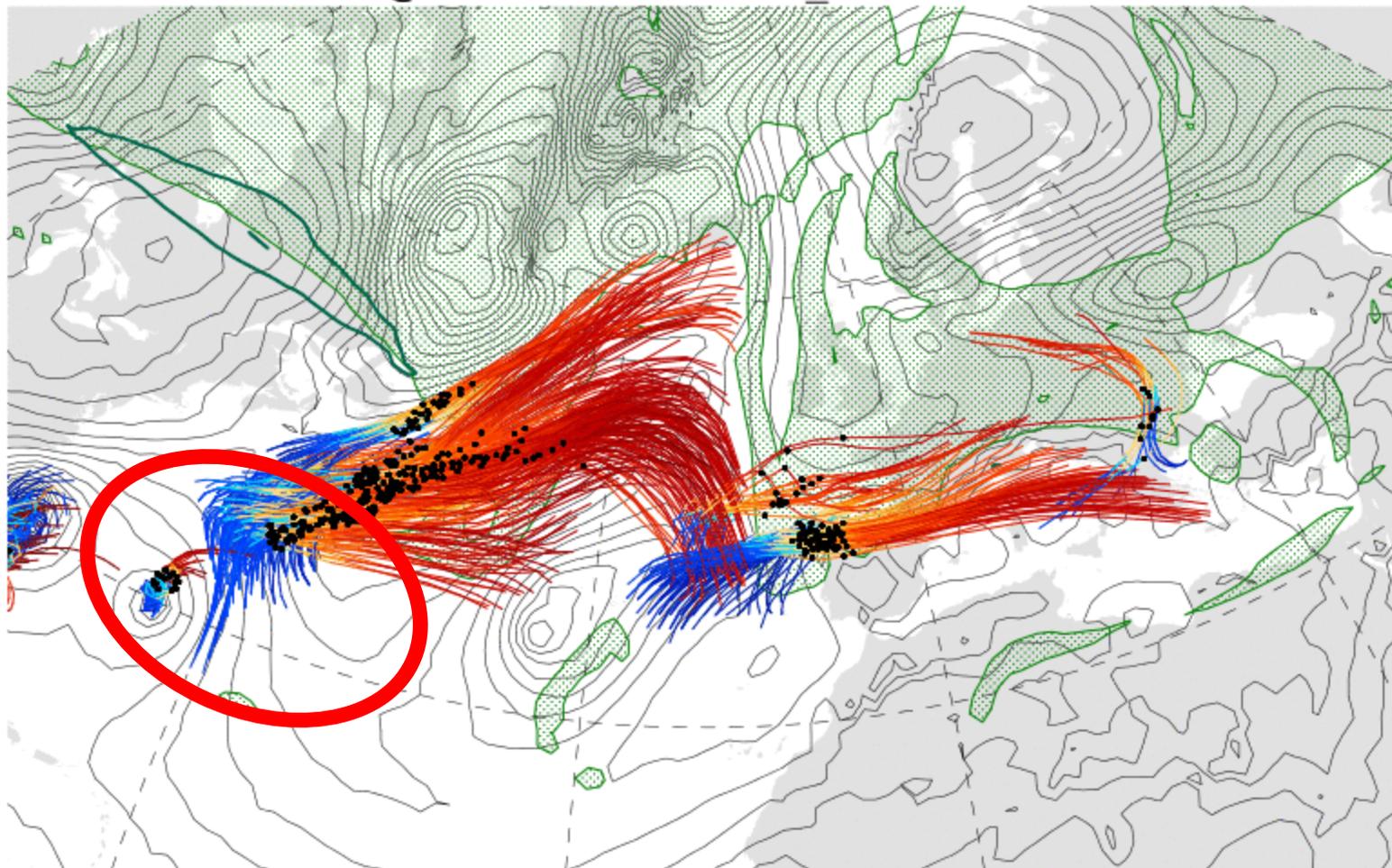
Valid: Thu, 13 Oct 2016, 12 UTC (step 180 h from Thu, 06 Oct 2016, 00 UTC)



## PRE ahead of Nicole?

Trajectory start and SLP VT: 20161010\_00

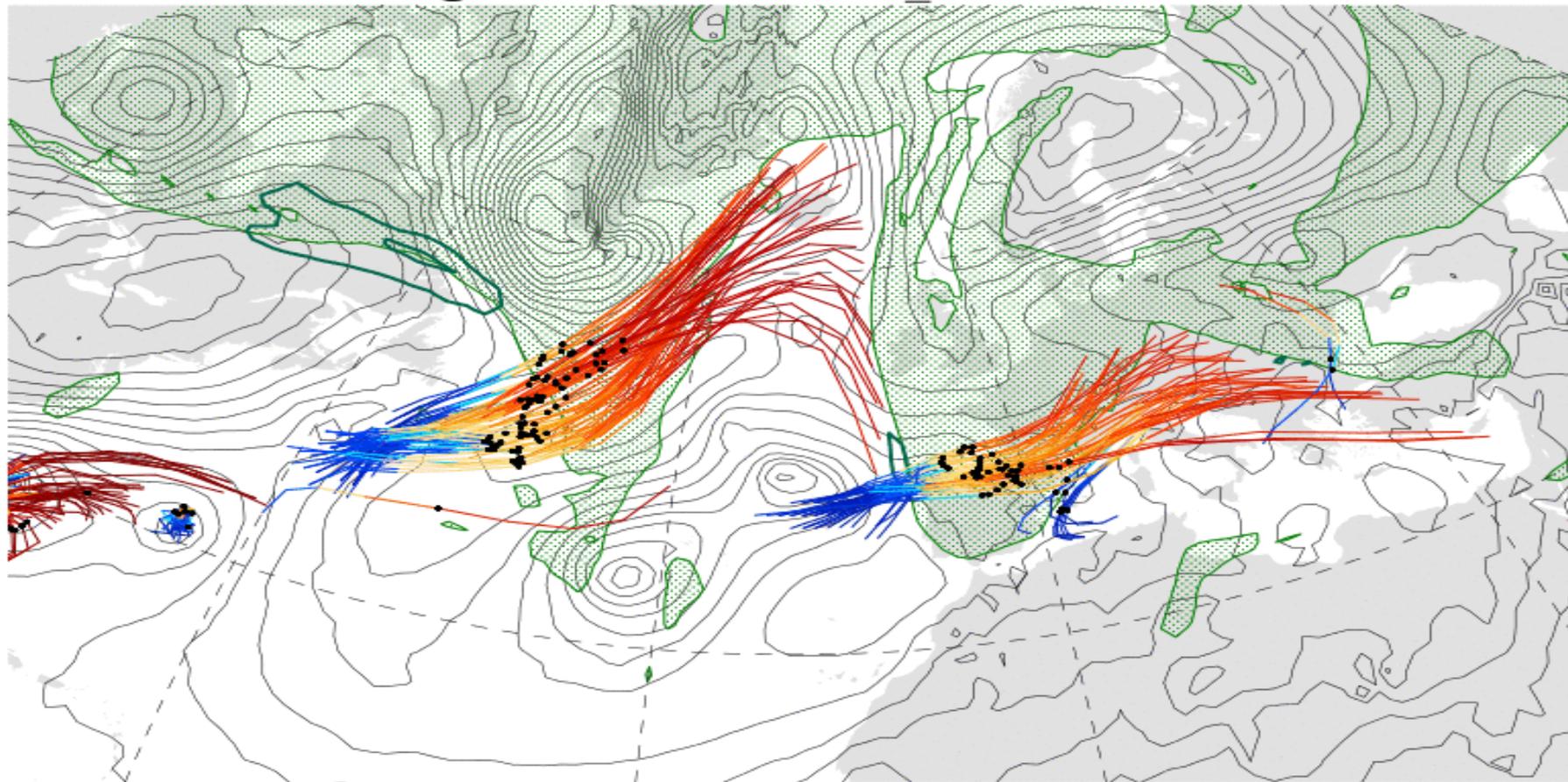
WCB outflow and PV@250hPa VT: 20161012\_00



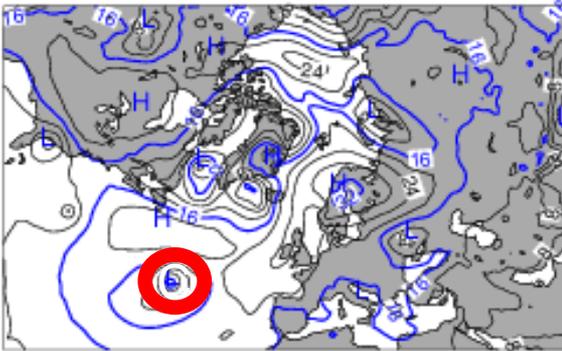
# Propagating away in the following day... (as DRW?)

Trajectory start and SLP VT: 20161010\_12

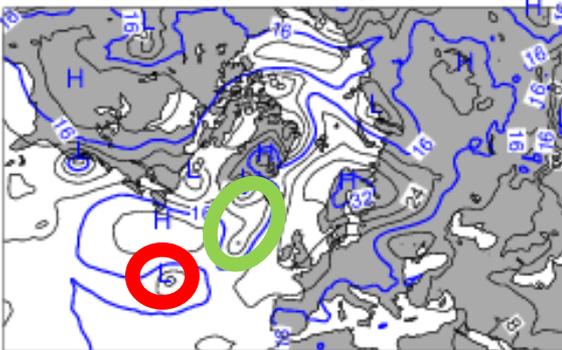
WCB outflow and PV@250hPa VT: 20161012\_12



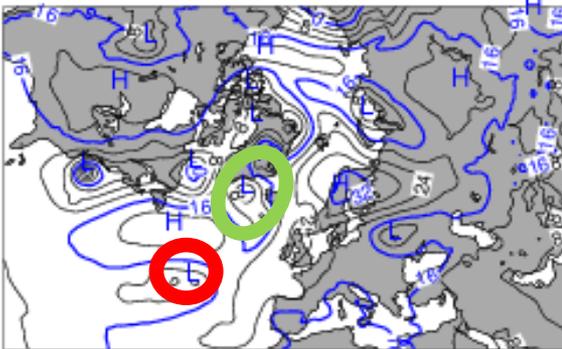
forecast11+84 VT:Sunday 9 October 2016 12UTC  
Cluster: 1(of 3), population: 20, repres. member: 13



forecast11+84 VT:Sunday 9 October 2016 12UTC  
Cluster: 2(of 3), population: 18, repres. member: 3



forecast11+84 VT:Sunday 9 October 2016 12UTC  
Cluster: 3(of 3), population: 13, repres. member: 24



## ENSEMBLE CLUSTER ANALYSIS FOR SUN 10/12UTC:

1. PV streamer “phases” with cyclone in mid-Atlantic, strong WCB in direction of Europe. None or very weak WCB activity over Iceland (20 members)
2. PV streamer partly enters in phase with Atlantic low but enhances also another pressure minimum to the north: weak WCB activity shooting above Iceland (18 members).
3. PV streamer does not “phase” at all with Atlantic low: weak WCB above Iceland (13 members).

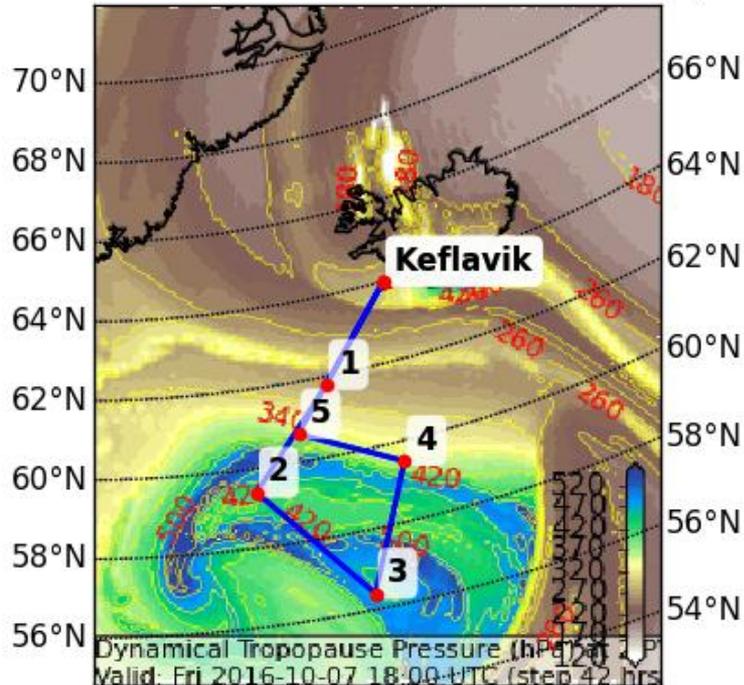
# FLIGHT PLANNING

Summary until  
Monday 10 Oct.

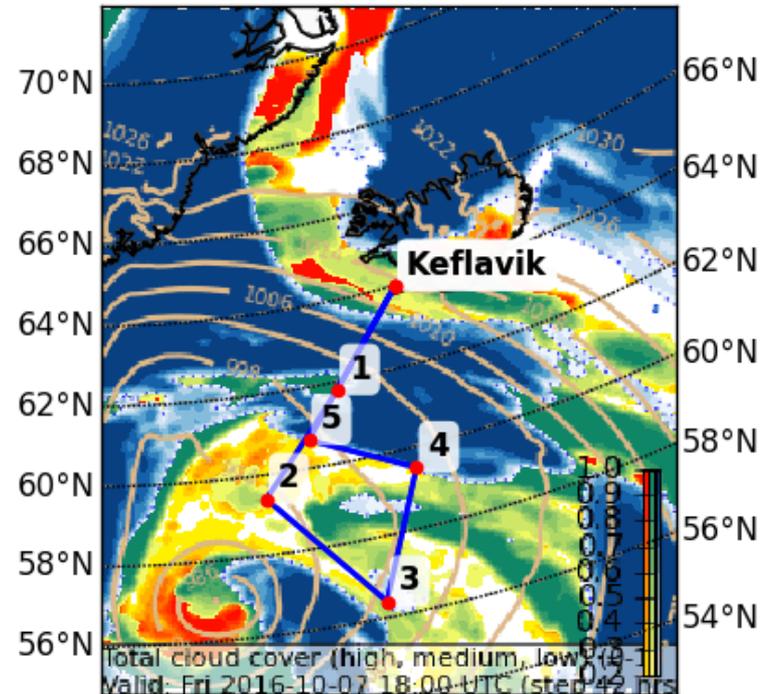
# Falcon flight Friday, 07 Oct

BT 06/00Z, VT 07/18Z

Dynamical Tropopause (Pressure (hPa)  
Valid: Fr 2016-10-07 18:00 UTC (step



Cloud Cover (0-1) (Total Cloud Cover)  
Valid: Fr 2016-10-07 18:00 UTC (step



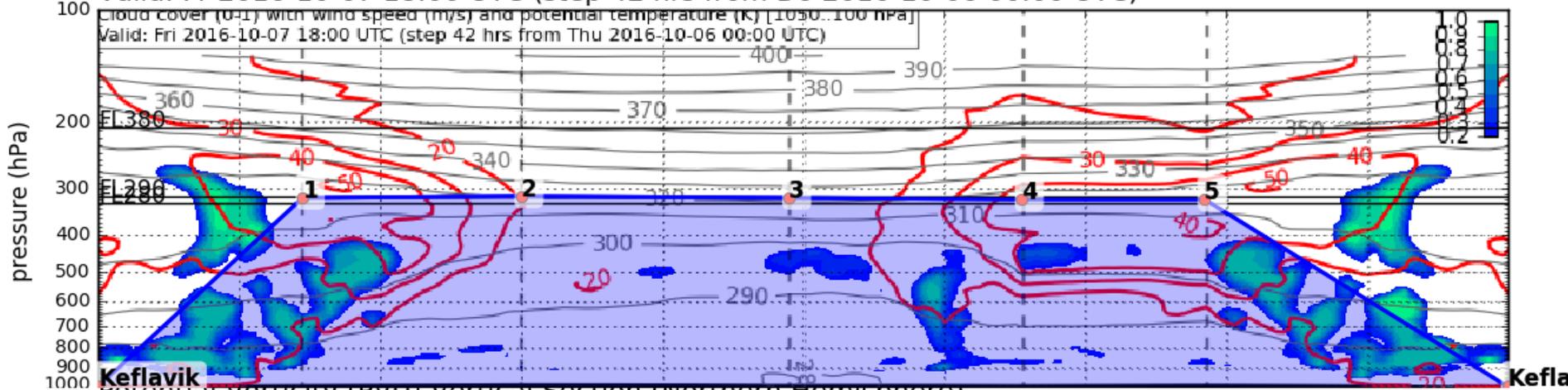
- Legs 3-5 coordinated with HALO
  - PV-meter legs
- Leg 4-5 must be ok for LIDAR, has been adjusted (southward) due to clouds
- Flight level constraints due to NAT TRACKS -> TBD how high we can go.
  - The higher the better, we asked for FL290

# Falcon flight Friday, 07 Oct

BT 06/00Z, VT 07/18Z

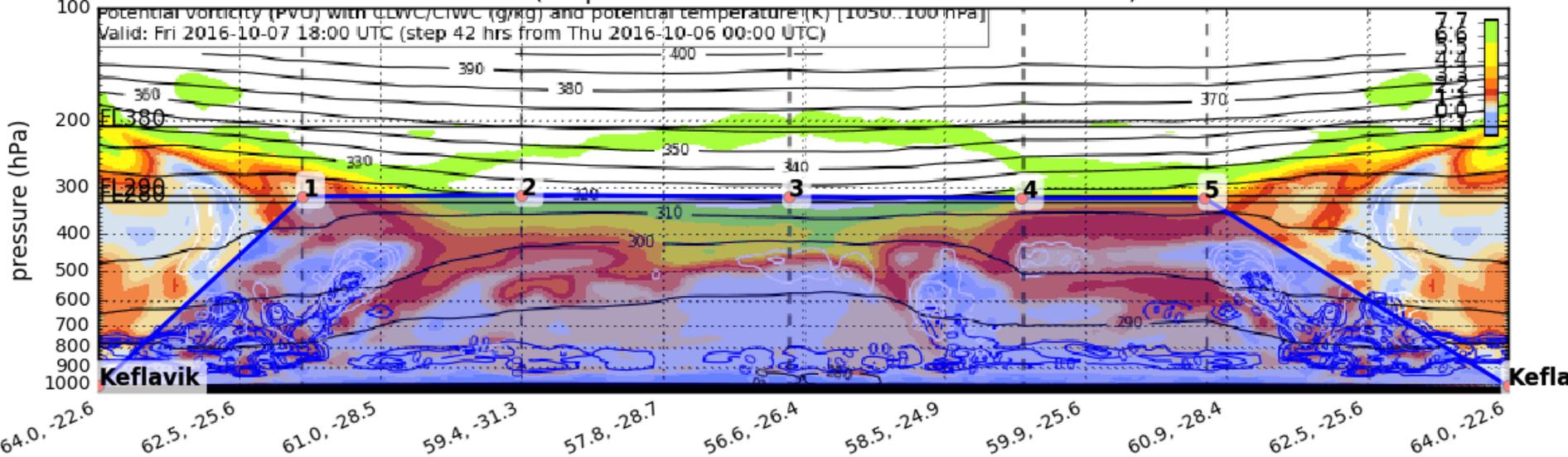
Cloud Cover (0-1) and wind Speed (m/s) vertical section

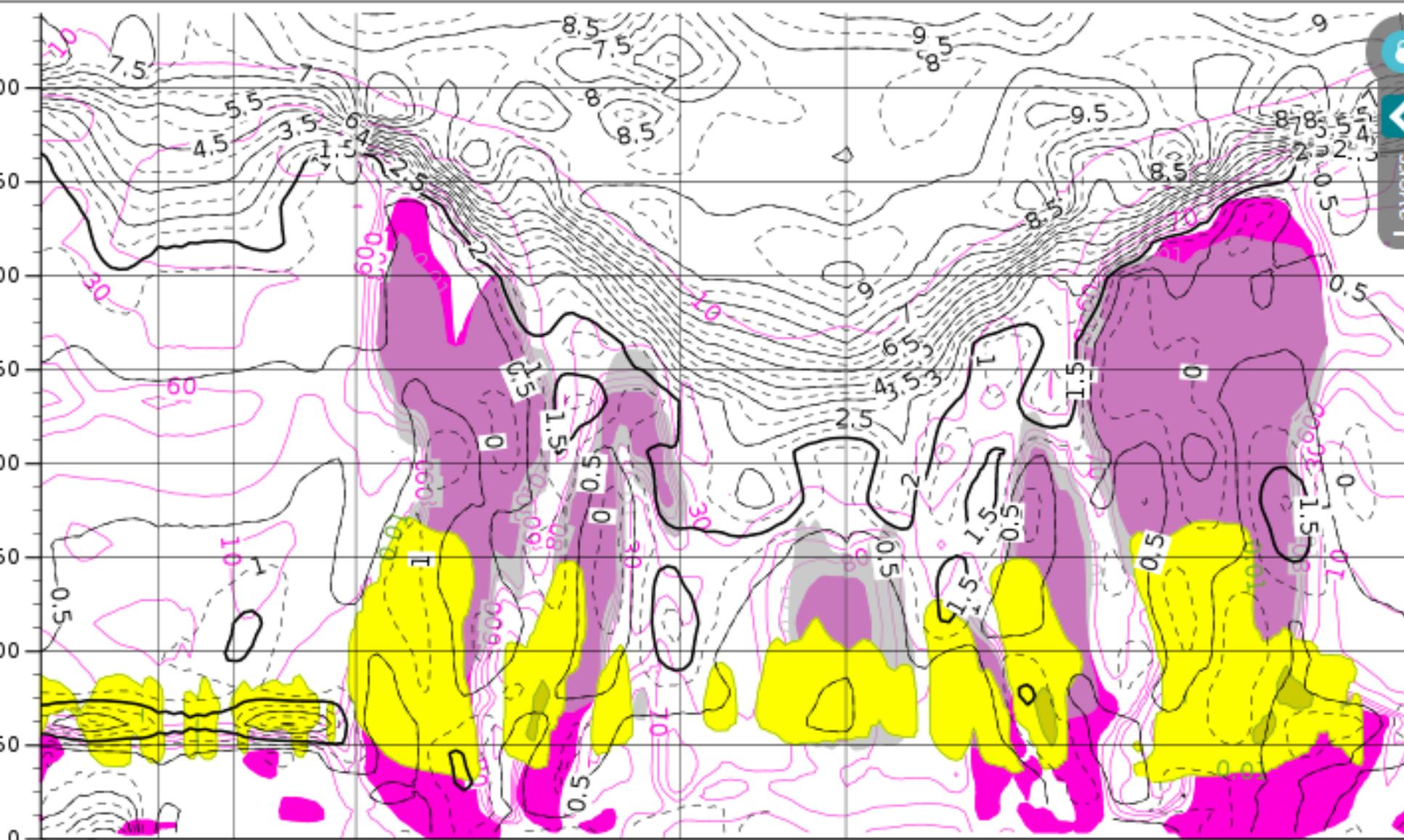
Valid: Fr 2016-10-07 18:00 UTC (step 42 hrs from Do 2016-10-06 00:00 UTC)



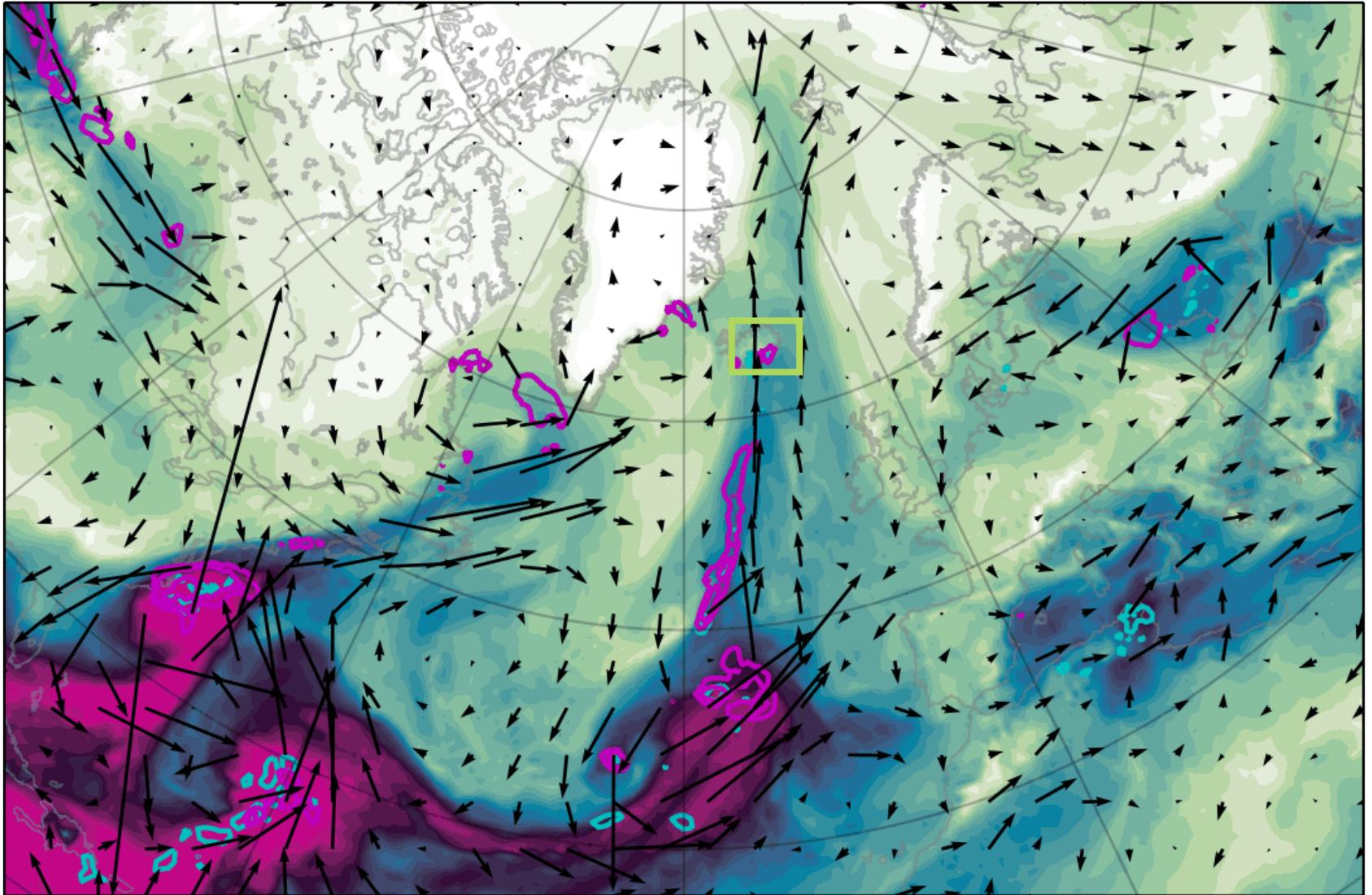
Potential vorticity (PVO) vertical section (Northern Hemisphere)

Valid: Fr 2016-10-07 18:00 UTC (step 42 hrs from Do 2016-10-06 00:00 UTC)

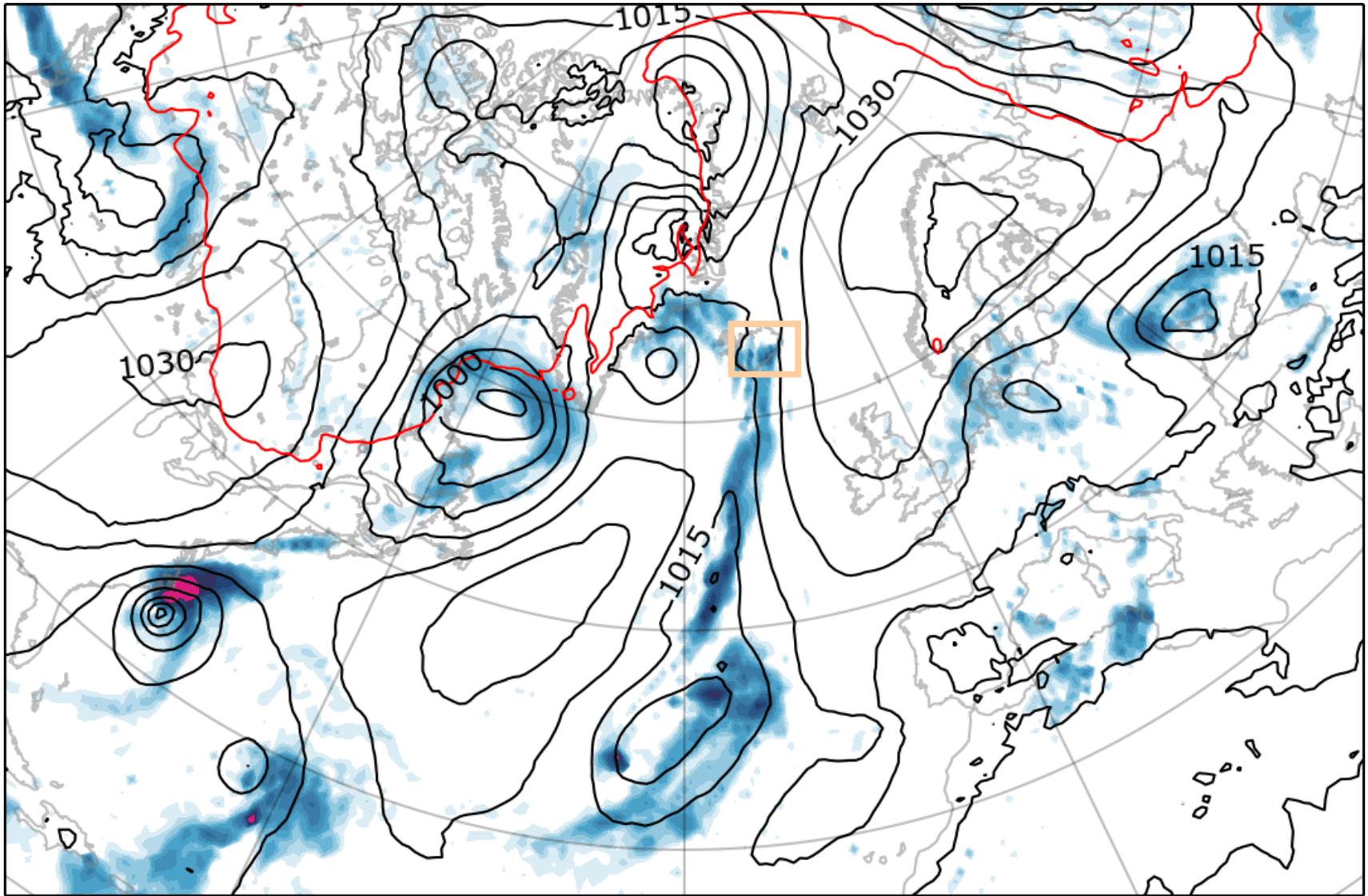




# EPATAN/NEAREX potential flight option 9 Oct 15 UTC



# EPATAN/NEAREX potential flight option 9 Oct 15 UTC



# HALO flight Sun/Mon 09/10 Oct

**System under investigation:**

**„Sunday PV streamer“**

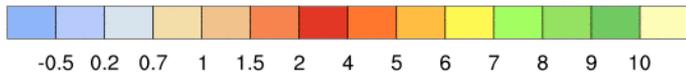
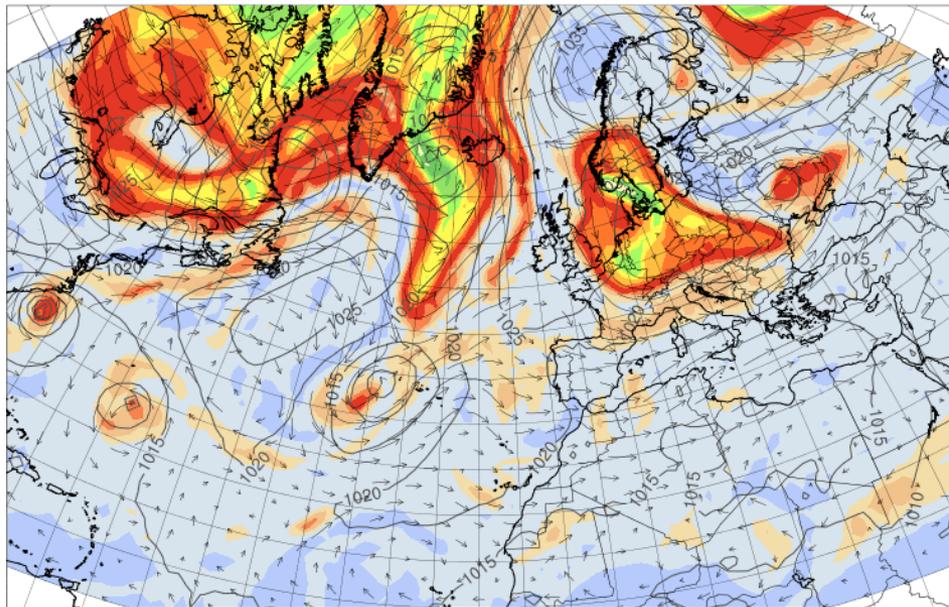
**Main objectives:**

- WCB ascent
- WCB interaction with PV streamer
- Structure of PV streamer
- Monday: intercomparison flight Safire, FAAM, Halo and Satellite

# HALO flight Sun 09 Oct

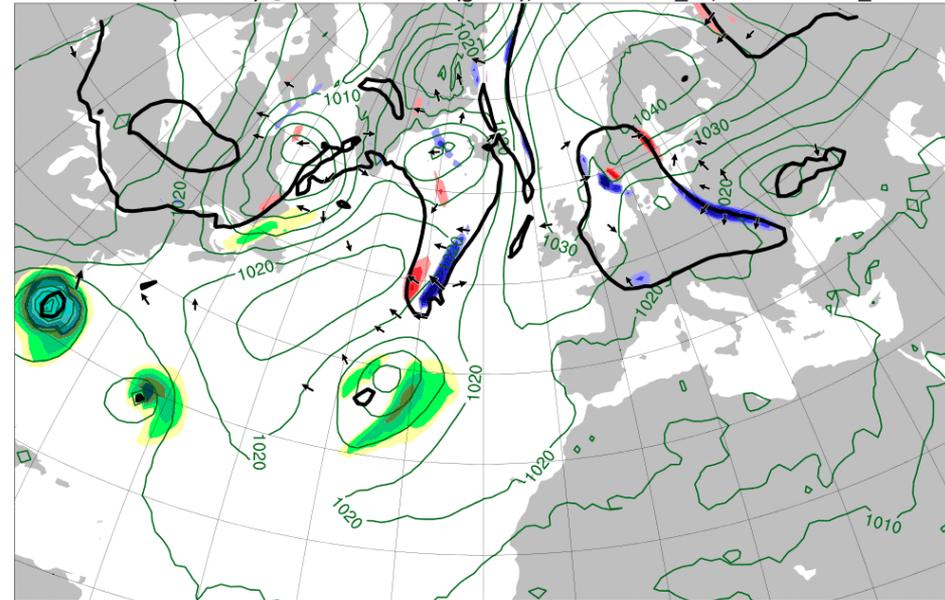
12 UTC

PV@320K at 20161009\_12

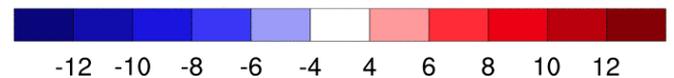


pvu

2 PVU (black), PV adv by div wind (shading),  
div wind (vectors) @320K and MSLP (green), BT: 20161006\_00, VT: 20161009\_12

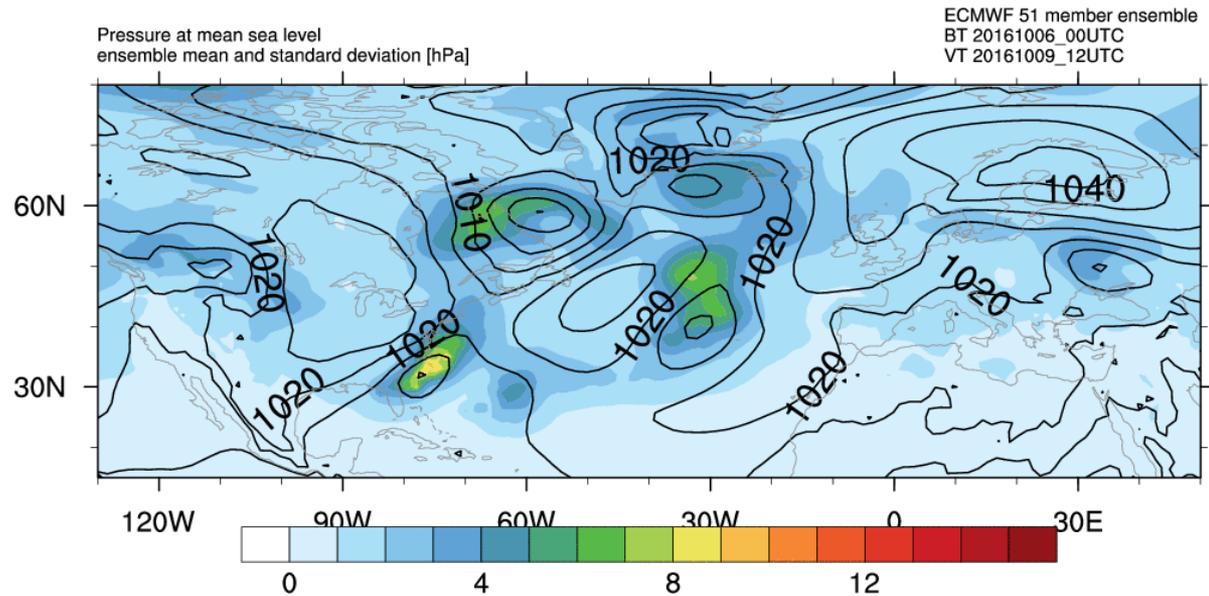
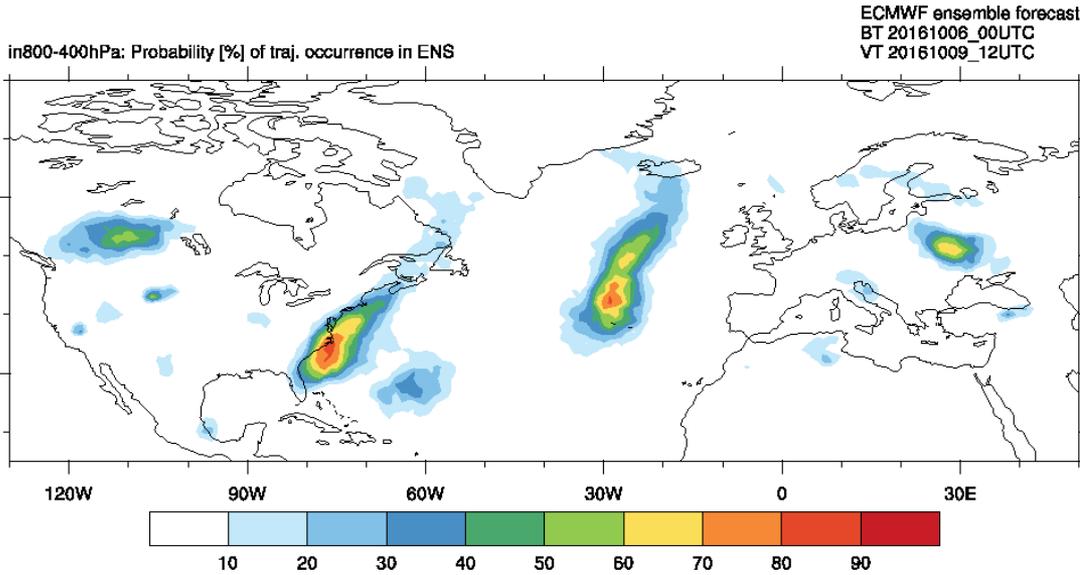


kg/(m s)

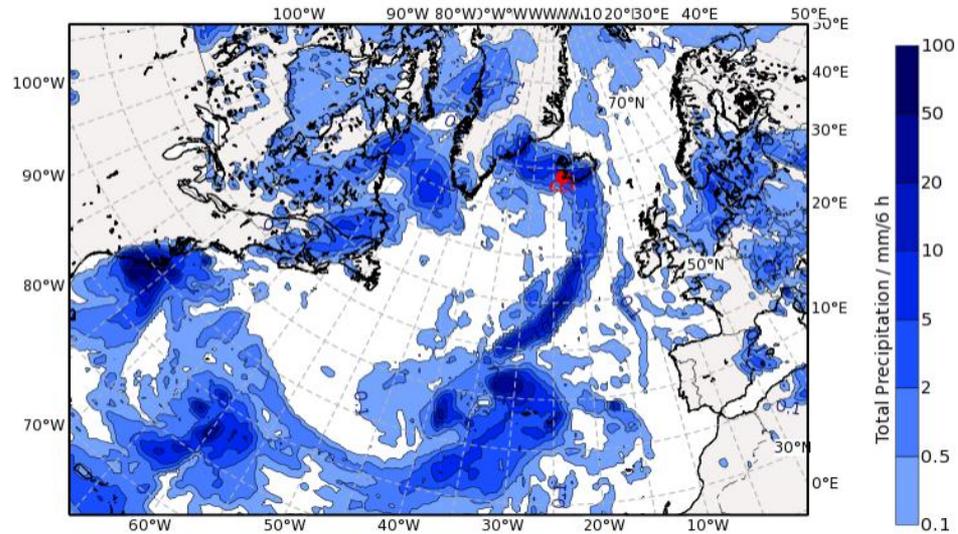
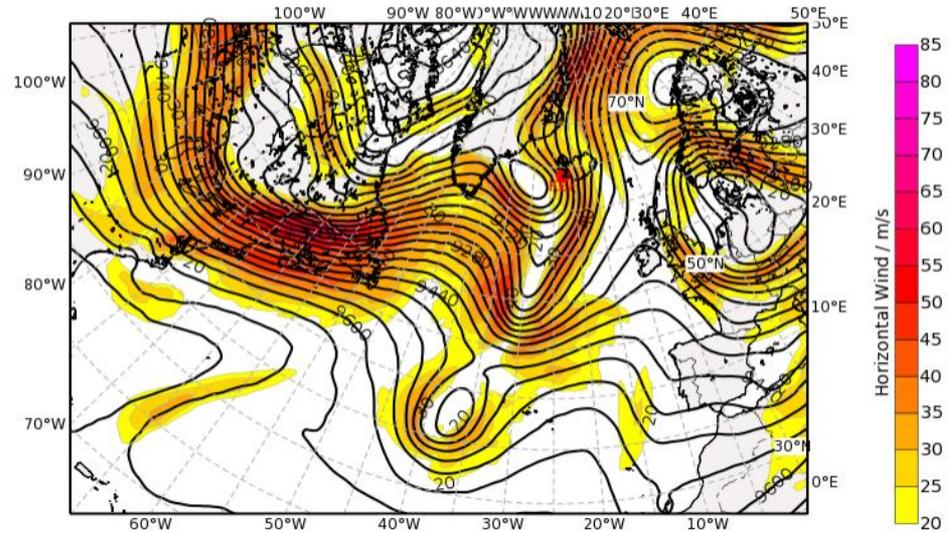


PVU/d

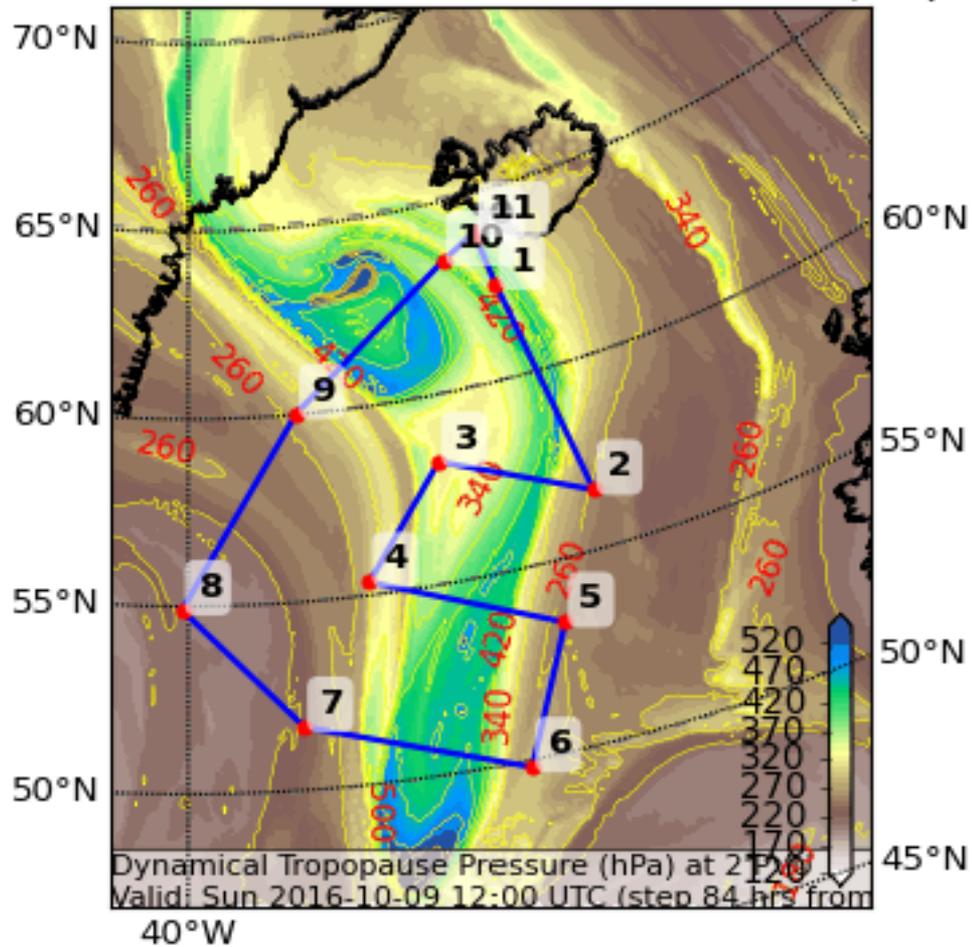
# HALO flight Sun 09 Oct



# HALO flight Sun 09 Oct

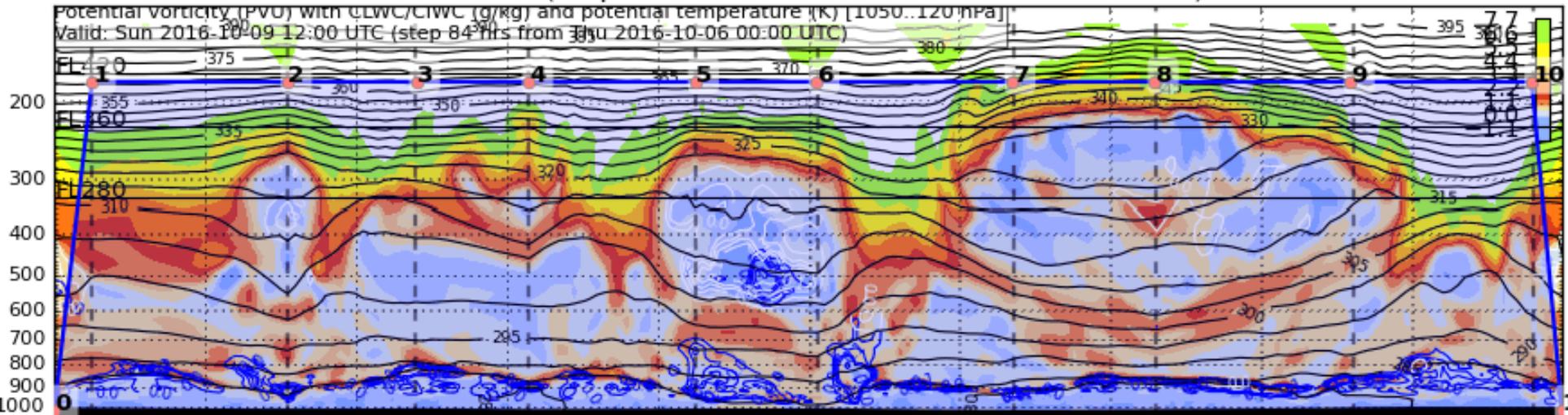


# HALO flight Sun 09 Oct

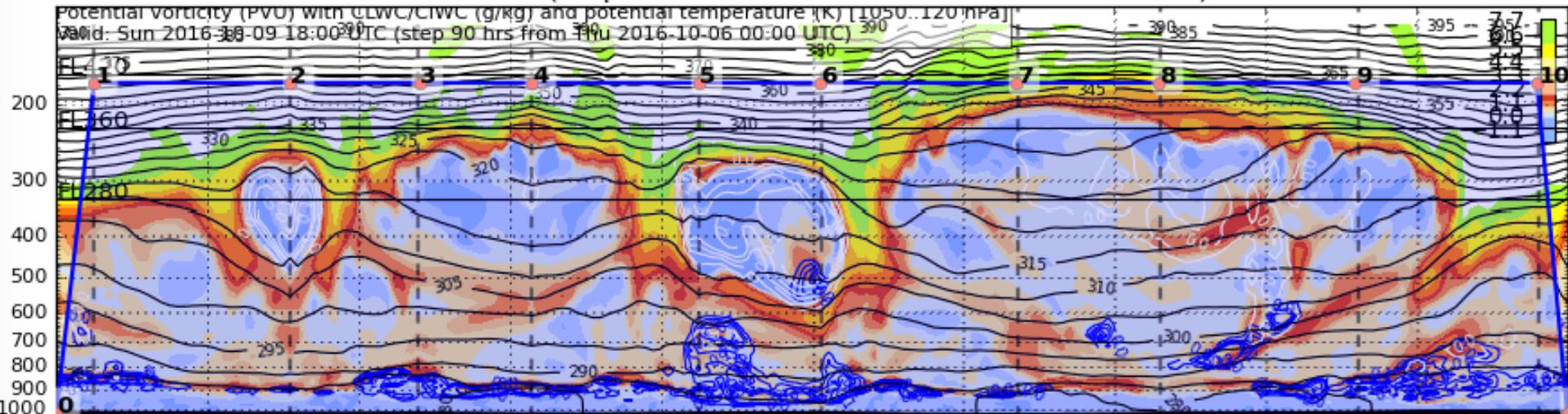


# HALO flight Sun 09 Oct

Valid: Sun 2016-10-09 12:00 UTC (step 84 hrs from Thu 2016-10-06 00:00 UTC)



Valid: Sun 2016-10-09 18:00 UTC (step 90 hrs from Thu 2016-10-06 00:00 UTC)



# HALO flight Mon 10 Oct

Sat overpass at 13:17 + Safire+FAAM+Halo

