Processing of U and V-WIND maps from the ECMWF Integrated Forecast System

Introduction.

As output from various numerical weather prediction models, like those from ECMWF (in the Meteorological Data Dissemination Service) and from the Arpege model (Meteo France) a U and V wind map, at different pressure levels, is provided. The U-component represents the east-west component of the wind, while the V-component represents the north-south wind component.

The script transforms the various U and V-wind components from the IFS model into wind direction and wind speed. Here 0.5 degree maps are assumed and global coverage.

The file name conventions applicable are:

A_HVXA85ECMF040000_C_ECMF_20140204000000_an_v_850hPa_global_0p5deg_grib2.bin

and

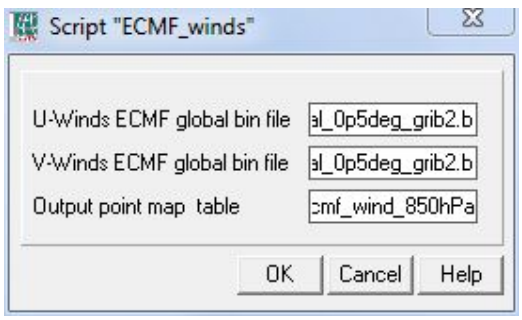
A_HUXA85ECMF040000_C_ECMF_20140204000000_an_u_850hPa_global_0p5deg_grib2.bin

These files are the v and u winds of the Analysis at 20140204 at 00:00 UTC at 850 hPA. Note that also forecasts are available and different pressure levels. The generic routine processes all files, substitute the file name accordingly, use of the extension is expected.

Running the script.

Download the ZIP file and copy the "ECMF_winds.Zip" file into the ILWIS subdirectory \Scripts and then Unzip the file. Copy the files ECMF_winds.grf, ECMF_winds.dom, ECMF_winds_east.grf and ECMF_winds_west.grf into the ILWIS sub-directory \System. Check if the file mpp2table.exe is available in the Start ILWIS sub-directory \Scripts. If all relevant service objects are copied into the respective sub-directories, select from the main menu the option "*Operations*" >> "*Script*" and select the script "*ECMF_winds*". From the pop-up script input window specify the input U and V wind maps and the output name for the point map and table, see figure 1. Note that the WFS-Ethiopia toolbox needs to be installed!

Figure 1: input layers needed to calculate wind direction – speed point map and table



Script listing.

```
// SCRIPT in conjunction with WFS-ETHIOPIA TOOLBOX

// Calculation of wind vectors (direction and speed)

// Input is processed layers from ECMF NWP model

// The U and V Wind maps are required in their original format

// Provide the full name of the U and V winds, including extension (bin)

// File name convention expected is for U-winds:
A_HUXA85ECMF040000_C_ECMF_20140204000000_an_u_850hPa_global_0p5deg_grib2.bin

// File name convention expected is for V-winds:
A_HVXA85ECMF040000_C_ECMF_20140204000000_an_v_850hPa_global_0p5deg_grib2.bin

// Method implemented according to http://www.ndbc.noaa.gov/wndav.shtml


rem import the U and V wind layers


!'%ILWIS_LOCATION%\Extensions\WFS_E-Toolbox\GDAL\bin\'gdal_translate.exe -of ilwis %1
ECMF_uwind.mpr

!'%ILWIS_LOCATION%\Extensions\WFS_E-Toolbox\GDAL\bin\'gdal_translate.exe -of ilwis %2
ECMF_vwind.mpr



rem create subset maps


ECMF_uwind_east.mpr:=MapSubMap(ECMF_uwind,2,1,360,360)

ECMF_uwind_west.mpr:=MapSubMap(ECMF_uwind,2,361,360,360)


ECMF_vwind_east.mpr:=MapSubMap(ECMF_vwind,2,1,360,360)

ECMF_vwind_west.mpr:=MapSubMap(ECMF_vwind,2,361,360,360)


rem add submap georef
```

```
setgrf ECMF_uwind_east.mpr ECMF_winds_east

setgrf ECMF_uwind_west.mpr ECMF_winds_west

setgrf ECMF_vwind_east.mpr ECMF_winds_east

setgrf ECMF_vwind_west.mpr ECMF_winds_west

rem glue maps using georef global

ECMF_uwind_remap.mpr:=MapGlue(ECMF_winds.grf,ECMF_uwind_west,ECMF_uwind_east,replace)

ECMF_vwind_remap.mpr:=MapGlue(ECMF_winds.grf,ECMF_vwind_west,ECMF_vwind_east,replace)



//Calculation wind speed and direction

direction_rad:=atan2(ECMF_uwind_remap,ECMF_vwind_remap)

direction_degree:=raddeg(direction_rad)

wind_speed:=sqrt((POW(ECMF_uwind_remap,2))+(POW(ECMF_vwind_remap,2)))

wind_speed.mpp:=PointMapFromRas(wind_speed)

direction_degree.mpp:=PointMapFromRas(direction_degree)

!cmd /c copy "%ILWIS_LOCATION%\scripts\mpp2table.exe"

!mpp2table.exe wind_speed.mpp wind_speed.tbt

!mpp2table.exe direction_degree.mpp direction_degree.tbt
```

```
windspeed.tbt:=TableChangeDomain(wind_speed.tbt,ECMF_wind.dom)

%3.tbt:=TableChangeDomain(direction_degree.tbt,ECMF_wind.dom)



tabcalc %3.tbt WindDirection:=name;

tabcalc %3.tbt WindSpeed:=ColumnJoin(windspeed.tbt,name);

calc %3.tbt;

tabcalc %3.tbt Scale_Speed:=WindSpeed*0.5;

delcol %3.tbt.name;

%3.mpp:=PointMapFromTable(%3,Coordinate)



!cmd /c del mpp2table.exe

!cmd /c del  ECMF_uwind_remap.mp*

!cmd /c del  ECMF_vwind_remap.mp*

!cmd /c del  ECMF_vwind_east.mp*

!cmd /c del  ECMF_uwind_east.mp*

!cmd /c del  ECMF_vwind_west.mp*

!cmd /c del  ECMF_uwind_west.mp*

!cmd /c del ECMF_uwind.*

!cmd /c del ECMF_vwind.*

!cmd /c del direction_rad.mp*

!cmd /c del direction_degree.mp*

!cmd /c del direction_degree.mp*
```

!cmd /c del direction_degree.pt*

!cmd /c del direction_degree.tb*

!cmd /c del wind_speed.mp*

!cmd /c del wind_speed.pt*

!cmd /c del wind_speed.tb*

!cmd /c del windspeed.tb*

!cmd /c del ECMF_uwind_*.grf

!cmd /c del ECMF_vwind_*.grf

!cmd /c del ECMF_winds_west.grf

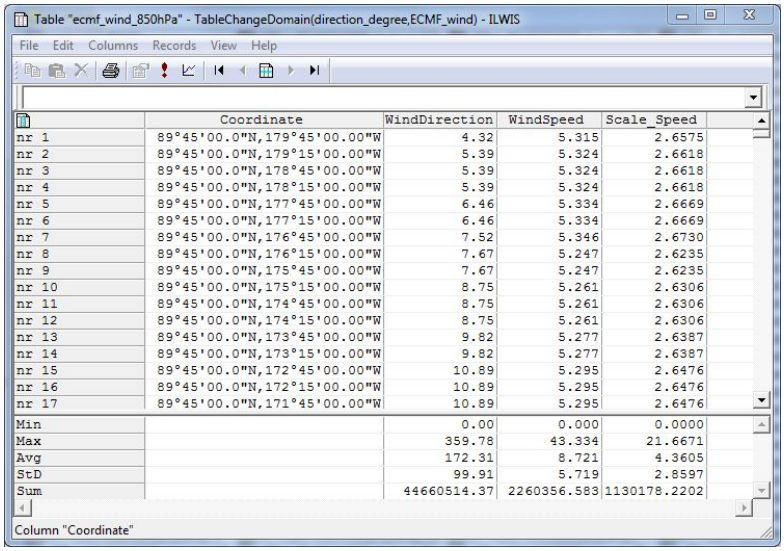
!cmd /c del ECMF_winds_east.grf

Note: the file “mpp2tables.exe” should be available in the ILWIS sub-directory \scripts! Furthermore note that here an “ID” domain has been created for the ECMF maps, assuming a map dimension of 360 lines by 720 columns (259186 ID’s are currently defined). It therefore expects a global map as input (at half degree spatial resolution)

Output.

When calculation has completed, two files have been created, a table and point map, according to the naming specifications as provided (see figure 1). Display the table, your result should resemble the one in figure 2. A column “Scale_speed” has been computed which can be used for visualization, in case of high wind speed at lower pressure levels.

Figure 2: Final output table



	Coordinate	WindDirection	WindSpeed	Scale_Speed
nr 1	89°45'00.0"N,179°45'00.00"W	4.32	5.315	2.6575
nr 2	89°45'00.0"N,179°15'00.00"W	5.39	5.324	2.6618
nr 3	89°45'00.0"N,178°45'00.00"W	5.39	5.324	2.6618
nr 4	89°45'00.0"N,178°15'00.00"W	5.39	5.324	2.6618
nr 5	89°45'00.0"N,177°45'00.00"W	6.46	5.334	2.6669
nr 6	89°45'00.0"N,177°15'00.00"W	6.46	5.334	2.6669
nr 7	89°45'00.0"N,176°45'00.00"W	7.52	5.346	2.6730
nr 8	89°45'00.0"N,176°15'00.00"W	7.67	5.247	2.6235
nr 9	89°45'00.0"N,175°45'00.00"W	7.67	5.247	2.6235
nr 10	89°45'00.0"N,175°15'00.00"W	8.75	5.261	2.6306
nr 11	89°45'00.0"N,174°45'00.00"W	8.75	5.261	2.6306
nr 12	89°45'00.0"N,174°15'00.00"W	8.75	5.261	2.6306
nr 13	89°45'00.0"N,173°45'00.00"W	9.82	5.277	2.6387
nr 14	89°45'00.0"N,173°15'00.00"W	9.82	5.277	2.6387
nr 15	89°45'00.0"N,172°45'00.00"W	10.89	5.295	2.6476
nr 16	89°45'00.0"N,172°15'00.00"W	10.89	5.295	2.6476
nr 17	89°45'00.0"N,171°45'00.00"W	10.89	5.295	2.6476
Min		0.00	0.000	0.0000
Max		359.78	43.334	21.6671
Avg		172.31	8.721	4.3605
StD		99.91	5.719	2.8597
Sum		44660514.37	2260356.583	1130178.2202

To display the point map, double click the point map created and enter the settings as specified in figure 3, note that with the ID-domain used you can visualize the points using an arrow symbol and these can be scaled (for this purpose the column 'WindSpeed' or 'Scale_Speed' is used). The resulting map is given in figure 4 showing winds at 850 hPA – Analysis, using a vector file with the country boundaries for geographical reference.

Figure 3: Point map options using table attributes

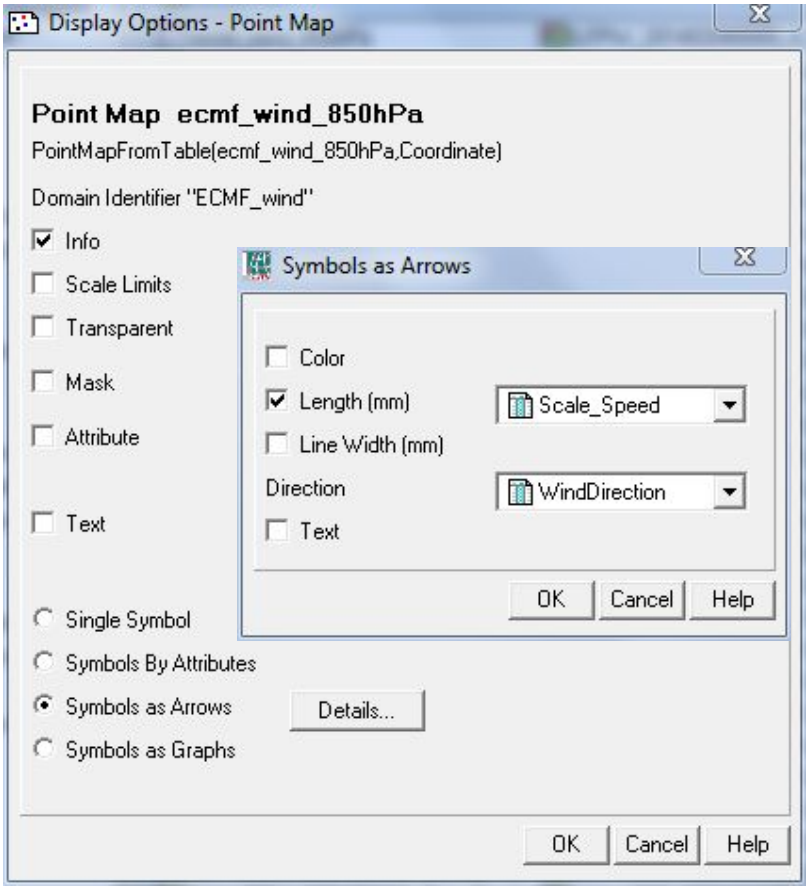


Figure 4: Resulting point map visualization