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# A Met/Ocean Wish List for Feature & Coverage Portrayal using SLD/SE

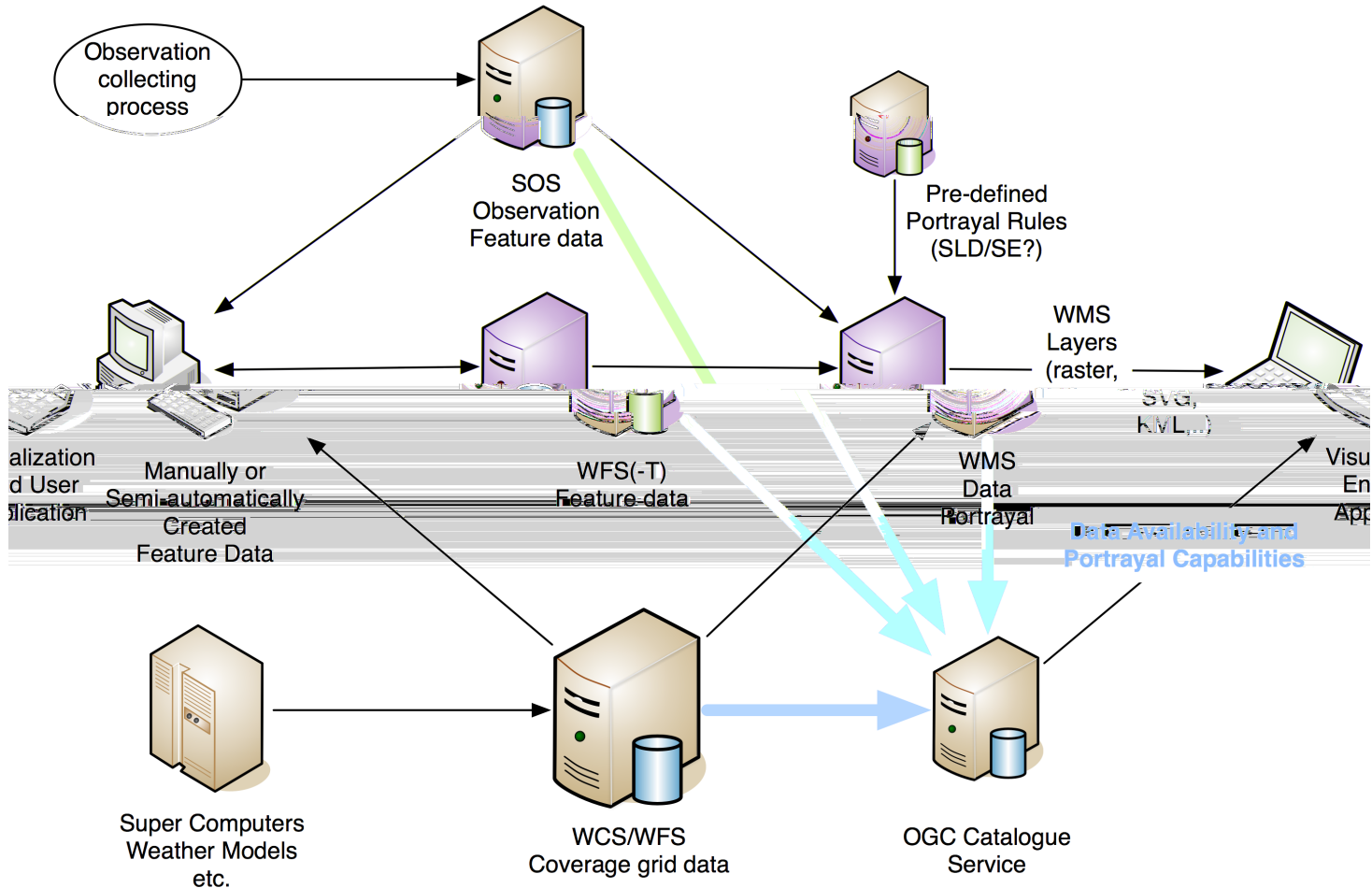
**Ilkka Rinne, Marko Pietarinen  
Finnish Meteorological Institute**

**OGC SLDSE Standards Working Group Meeting  
Frascati, Italy, 10<sup>th</sup> March 2010**



# Example Architectures

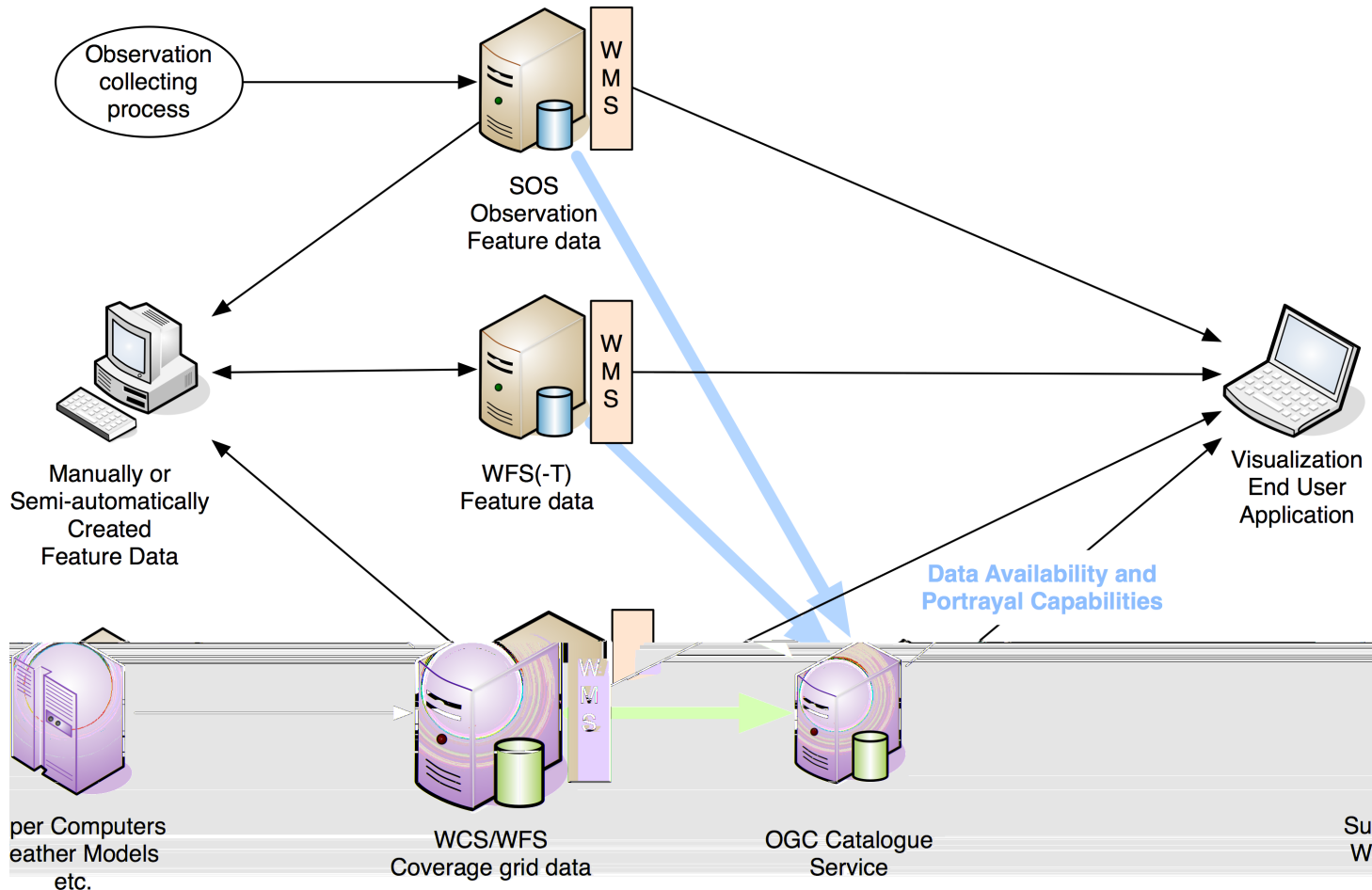
Component WMS model, Feature / Coverage Portrayal Service





# Example Architectures

Integrated WMS model, Feature / Coverage Portrayal Service





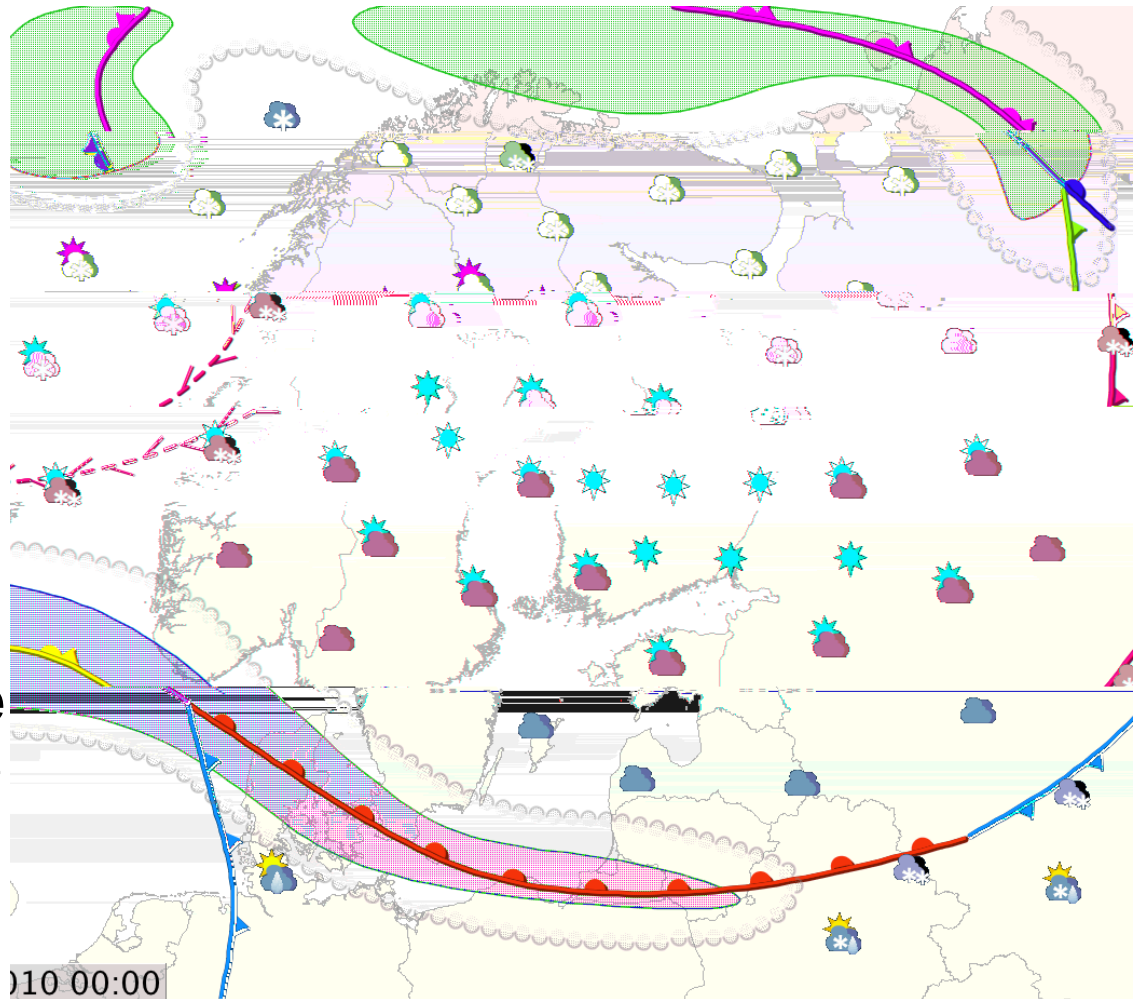
# Meteorological Feature Data

- **Typically complex Features.**
- **Rapidly changing, often incomplete information.**
- **Internationally agreed, legally mandated visualization rules, but not in machine-readable format.**
- **Examples:**
  - weather observations from fixed or mobile observation stations,
  - Human-crafted weather forecasts or analyses,
  - (Semi-)Automatically extracted Features describing observed or predicted weather conditions or phenomena (like storms).



# Features, (Relatively) Simple Cases

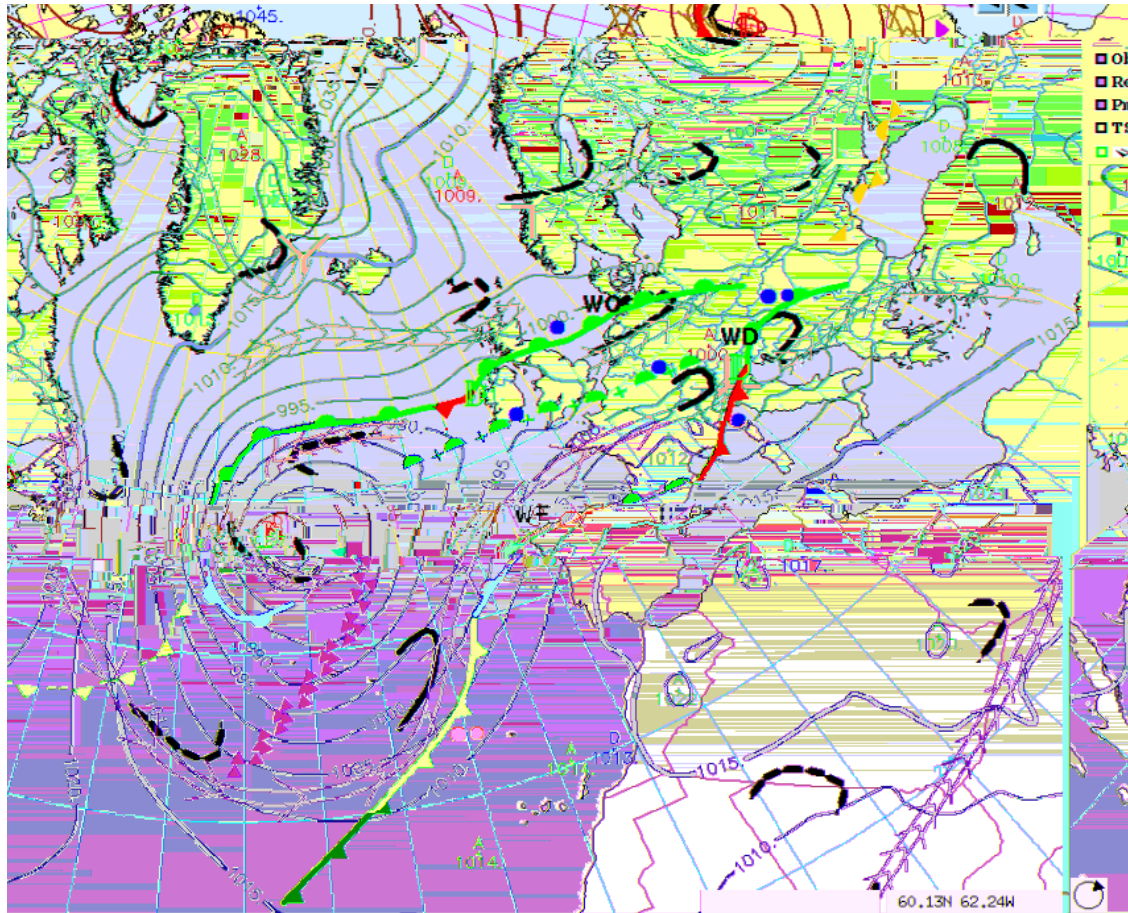
- **Image symbols, decorated lines, areas with color and/or hatch fill.**
- **BUT lines (and decorations) have direction, arrow heads.**
- **Line and area geometries may be defined with spline curves and rings.**





# Features, (Relatively) Simple Cases

- **Image symbols, decorated lines, areas with color and/or hatch fill.**
- **BUT lines (and decorations) have direction, arrow heads.**
- **Line and area geometries may be defined with spline curves and rings.**





# Symbology Is Mandated for WMO Members

## 3.2 Symbols

WMO Manual on  
the Global Data-  
Processing and  
Forecasting  
System, Part II,  
Appendix II-4

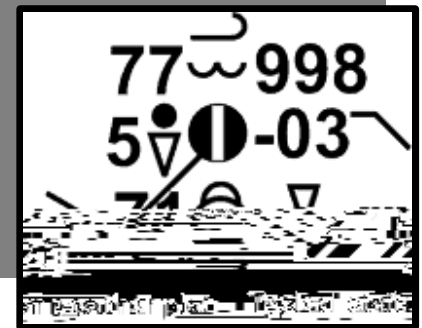
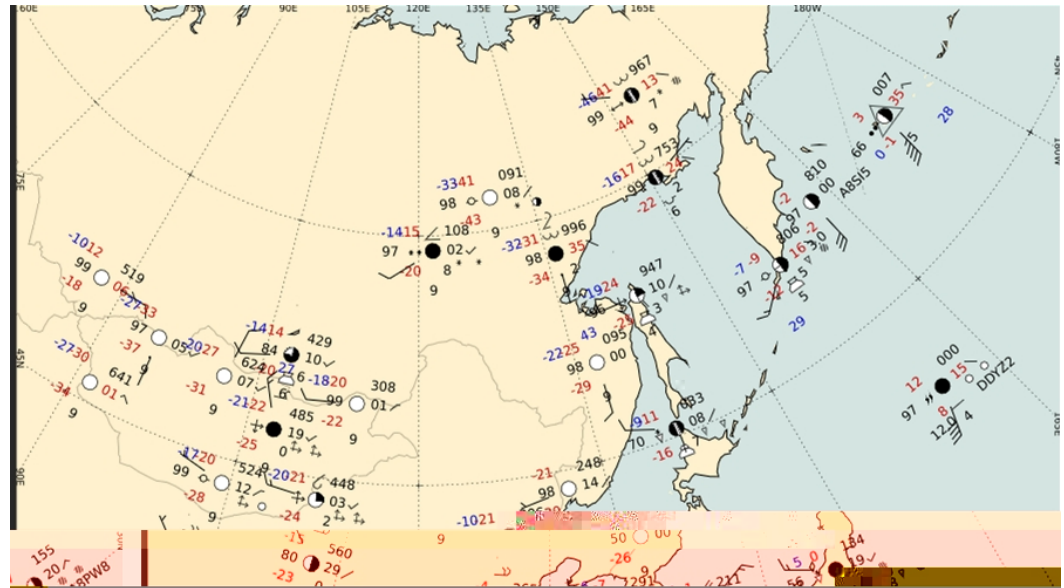
Term	Symbol		
	Monochromatic	Polychromatic	
1. Cold front at the surface	↑ ▲▲▲	—	} blue
2. Cold front above the surface	↑ △△△	- - -	
3. Cold front frontogenesis	↑ ▲ . ▲	.....	
4. Cold front frontolysis	↑ △ + △	////	
5. Warm front at the surface	↑ ◐◐◐	—	} red
6. Warm front above the surface	↑ ◑◑◑	- - -	
7. Warm front frontogenesis	↑ ◐ . ◐	.....	
8. Warm front frontolysis	↑ ◑ + ◑	////	
9. Occluded front at the surface	↑ ▲▲▲	—	} purple
10. Occluded front above the surface	↑ ◑◑◑	- - -	
11. Quasi-stationary front at the surface	▲▼▲▼	—	} alternate red and blue
12. Quasi-stationary front above the surface	◑◑◑	- - -	
13. Quasi-stationary front frontogenesis	▲ . ▼	.....	
14. Quasi-stationary front frontolysis	▲ + ▼	////	
15. Instability line	.....	.....	} black
16. Shear line	—	—	
17. Convergence line	—	—	} orange
18. Intertropical convergence zone	—	—	
19. Intertropical discontinuity	—	—	} alternate red and green
20. Axis of trough	—	—	
21. Axis of ridge	~~~~~	~~~~~	} black
	~~~~~	~~~~~	

NOTE: The separation of the two lines gives a qualitative representation of the width of the zone; the hatched lines may be added to indicate areas of activity.



# Features, More Challenging(?) Cases

- **Synop (ground weather observation) plots**
- **Several observation parameters combined in fixed positions around the observation position.**
- **Both graphical and text notation.**
- **Data probably some kind of O&M via an SOS/WFS interface.**

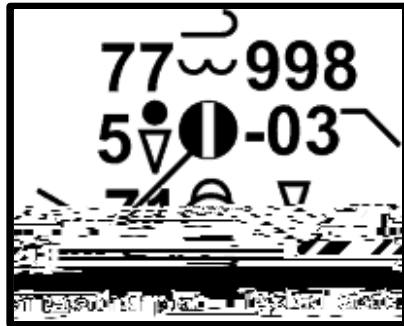






# Symbology for Ground Weather Observations Mandated for WMO Members

WMO Manual on the Global Data-Processing and Forecasting System, Part II, Appendix II-4



## APPENDIX II-4

### GRAPHICAL REPRESENTATION OF DATA, ANALYSES AND FORECASTS

#### 1. THE SURFACE PLOTTING MODEL

If it is required to plot the elements shown in the model, they should be placed in the relative positions shown. Any of the elements may be omitted.

$T_g T_g$	$T_x T_x T_x$ or $T_n T_n T_n$	$C_H$	E or E'sss	
	TTT	$C_M$	PPPP/ $P_o P_o P_o$ or $a_3 h h h$ / $P_o P_o P_o$	
V V	$w w / w_1 w_1$ or $w_a w_a / w_1 w_1$	N	PPP	a
	$T_d T_d T_d$	$C_L N_n$ h or hh	$W_1 W_2 / w_1 w_1$ or $W_{a1} W_{a2} / w_1 w_1$	GG or GGgg
	$T_w T_w T_w$	$P_{wa} P_{wa} H_{wa} H_{wa}$ or $P_w P_w H_w H_w$	RRR/ $t_R$  $D_s V_s$	

$d_{w1} d_{w1} P_{w1} P_{w1} H_{w1} H_{w1}$   
 $d_{w2} d_{w2} P_{w2} P_{w2} H_{w2} H_{w2}$



# Symbology for Ground Weather Observations Mandated for WMO Members

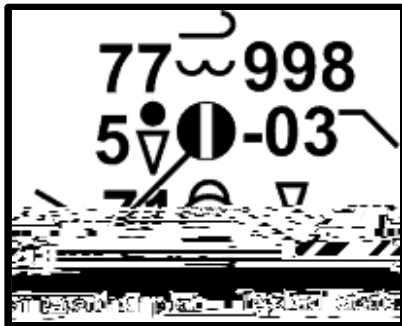
WMO Manual on the Global Data-Processing and Forecasting System, Part II, Appendix II-4

APPENDIX II-4

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WW	0	1	2	3	4	5	6	7	8	9
00					☰	∞	∫	⌘	ε	(⊄)
10	=	≡	≡	<	☺	)	(	↶	∇	)
20	,	·	*	:	~	∇	∇	∇	≡	↶

$C_H$	E or E'sss	
$C_M$	PPPP/ $P_o P_o P_o$ or $a_3 h h h$ / $P_o P_o P_o P_o$	
N	PPP	a
$C_L N_h$ h or hh	$W_1 W_2 / w_1 w_1$ or $W_{a1} W_{a2} / w_1 w_1$	GG or GGgg
$P_{wa} P_{wa} H_{wa} H_{wa}$ or $P_w P_w H_w H_w$	RRR/ $t_R$  $D_s v_s$	

$d_{w1} d_{w1} P_{w1} P_{w1} H_{w1} H_{w1}$

$d_{w2} d_{w2} P_{w2} P_{w2} H_{w2} H_{w2}$



# Symbology for Ground Weather Observations Mandated for WMO Members

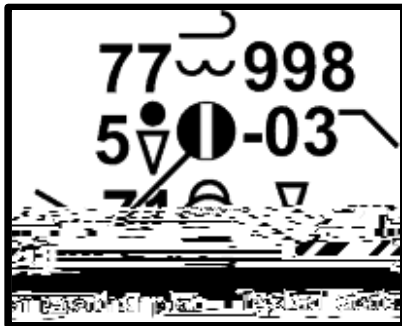
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WW	0	1	2	3	4	5	6	7	8	9				
00	$w_a w_b$	0	1	2	3	4	5	6	7	8	9	$C_H$	E or E'sss	
10	00					8	8					$C_M$	PPPP/ $P_o P_o P_o$ or $a_3 h h h$ / $P_o P_o P_o P_o$	
20	10	=	↔	↙								N	PPP	a
30	20	≡	⌋	⌋	⌋	⌋	⌋	⌋	⌋	⌋	⌋	$C_L N_h$	$W_1 W_2 / w_1 w_1$ or $W_{a1} W_{a2} / w_1 w_1$	GG or GGgg
40	30	≡	≡	≡	≡	≡	≡	≡	≡	≡	≡	$C_L N_h$	$W_1 W_2 / w_1 w_1$ or $W_{a1} W_{a2} / w_1 w_1$	GG or GGgg
50	40	☉	☉	☉	☉	☉	☉	☉	☉	☉	☉	$C_L N_h$	$W_1 W_2 / w_1 w_1$ or $W_{a1} W_{a2} / w_1 w_1$	GG or GGgg
60	50	☉	☉	☉	☉	☉	☉	☉	☉	☉	☉	$C_L N_h$	$W_1 W_2 / w_1 w_1$ or $W_{a1} W_{a2} / w_1 w_1$	GG or GGgg
70	60	☉	☉	☉	☉	☉	☉	☉	☉	☉	☉	$C_L N_h$	$W_1 W_2 / w_1 w_1$ or $W_{a1} W_{a2} / w_1 w_1$	GG or GGgg
80	70	☉	☉	☉	☉	☉	☉	☉	☉	☉	☉	$C_L N_h$	$W_1 W_2 / w_1 w_1$ or $W_{a1} W_{a2} / w_1 w_1$	GG or GGgg
90	80	☉	☉	☉	☉	☉	☉	☉	☉	☉	☉	$C_L N_h$	$W_1 W_2 / w_1 w_1$ or $W_{a1} W_{a2} / w_1 w_1$	GG or GGgg
	90	☉	☉	☉	☉	☉	☉	☉	☉	☉	☉	$C_L N_h$	$W_1 W_2 / w_1 w_1$ or $W_{a1} W_{a2} / w_1 w_1$	GG or GGgg



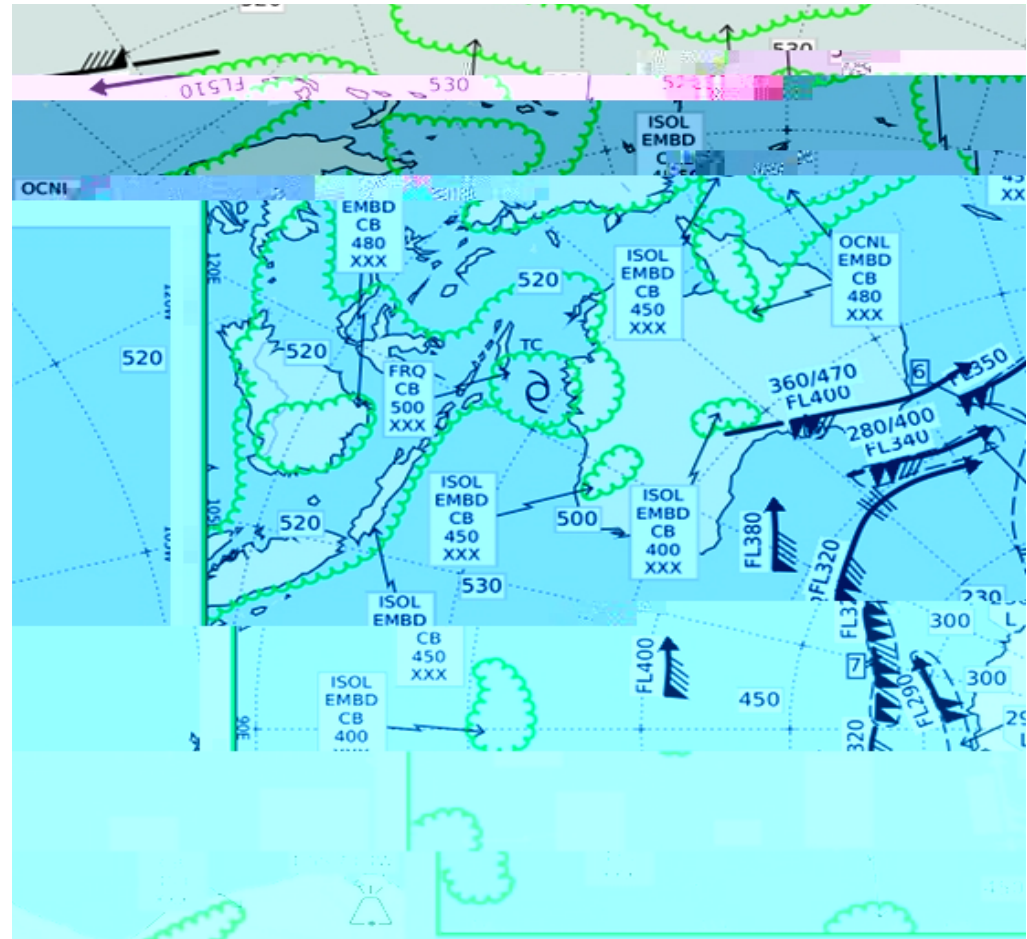






# Features, More Challenging(?) Cases

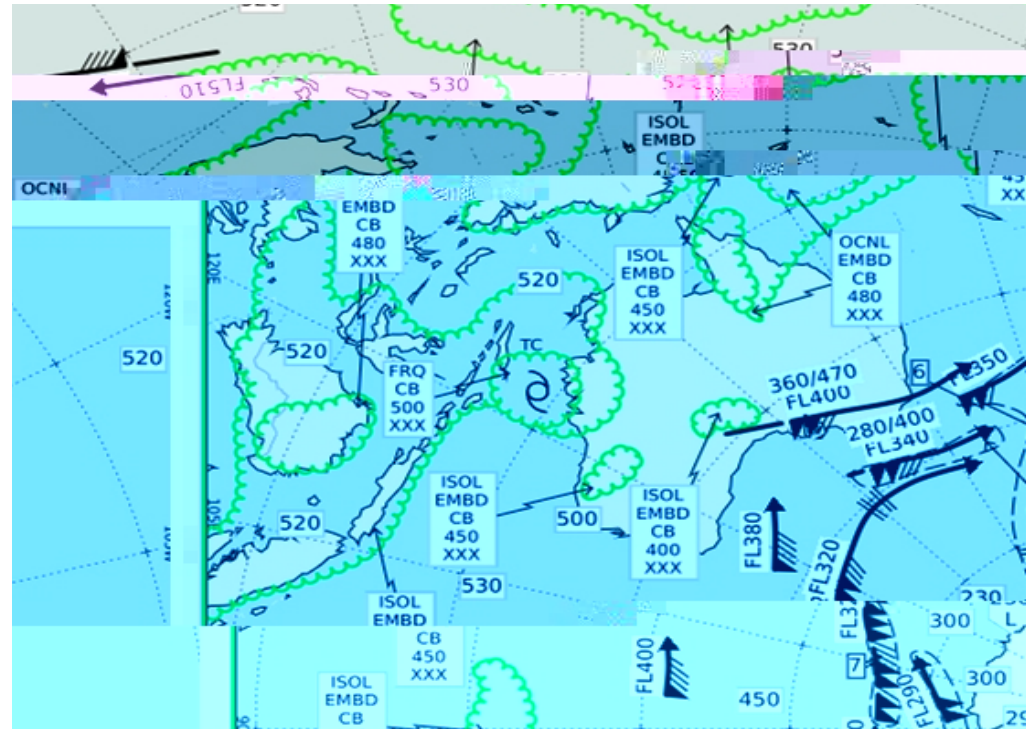
- **Significant Weather Charts (SigWx, SWC)**
- **Detached labeling**
- **Features may contain additional geospatial structure: wind speeds at specific points and heights along the jet lines.**





# Features, More Challenging(?) Cases

- **Significant Weather Charts (SigWx, SWC)**
- **Detached labeling**
- **Features may contain additional geospatial structure: wind speeds at specific points and heights along the jet lines.**



Wind arrows indicate the maximum wind in jet and the flight level at which it occurs. Significant changes (speed of 20 knots or more, 3 000 ft (less if practicable) in flight level) are marked by the double bar. In the example, at the double bar the wind speed is 225 km/h (120 kt).

The heavy line delineating the jet axis begins/ends at the points where a wind speed of 150 km/h (80 kt) is forecast.





# Legally Mandated Symbolology, Aviation Met

## 1. Symbols for significant weather

	Thunderstorms	•	Drizzle
	Tropical cyclone	////	Rain
	Severe squall line*	*	Snow
	Moderate turbulence	▽	Shower
	Severe turbulence	△	Hail
	Mountain waves	+	Widespread blowing snow
	Moderate aircraft icing	S	Severe sand or dust haze
	Severe aircraft icing	S	Widespread sandstorm or dust storm
	Widespread fog	∞	Widespread haze
	Radioactive materials in the atmosphere**	=	Widespread mist
	Volcanic eruption***	~	Widespread smoke
	Mountain obscuration	~	Freezing precipitation ****
		■	Visible ash cloud *****

\* In flight documentation for flights operating up to FL100. This symbol refers to "squall line".

\*\* The following information should be included at the side of the chart: radioactive materials symbol; latitude/longitude of accident site; date and time of accident; check NOTAM for further information.

\*\*\* The following information should be included at the side of the chart: volcanic eruption symbol; name and international number of volcano (if known); latitude/longitude; date and time of the first eruption (if known); Check SIGMETs and NOTAM or ASHTAM for volcanic ash.

\*\*\*\* This symbol does not refer to icing due to precipitation coming into contact with an aircraft which is at a very low temperature.

\*\*\*\*\* Visible ash cloud symbol applies only to model VAG not to SIGWX charts.

NOTE: Height indications between which phenomena are expected, top above base as per chart legend.

WMO Technical Regulations, Volume II, Meteorological Service for International Air Navigation, Chapter 3.1, Appendix 1-16

Originates from the "Chicago Convention", Annex 3

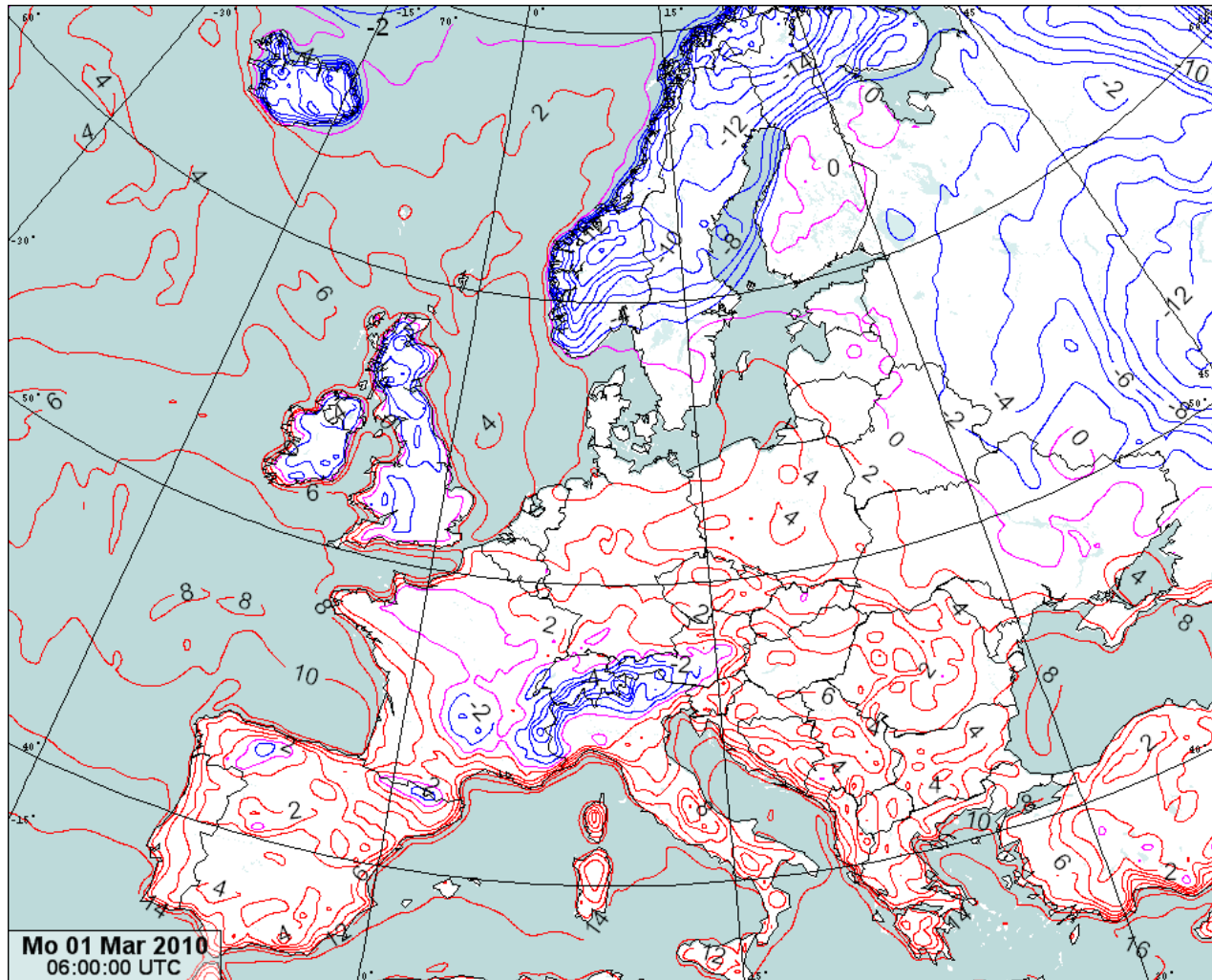
## 2. Fronts and convergence zones and other symbols used

	Cold front at the surface		Position, speed and level of max. wind FL 270
	Warm front at the surface		Convergence line
	Occluded front at the surface		Freezing level
	Quasi-stationary front at the surface		Intertropical convergence zone
	Tropopause High		State of the sea
	Tropopause Low		Sea-surface temperature
	Tropopause Level		Widespread Strong surface wind *
<p>Wind arrows indicate the maximum wind in jet and the flight level at which it occurs. Significant changes (speed of 20 knots or more, 3 000 ft (less if practicable) in flight level) are marked by the double bar. In the example, at the double bar the wind speed is 225 km/h (120 kt). The heavy line delineating the jet axis begins/ends at the points where a wind speed of 150 km/h (80 kt) is forecast.</p>			
<p>* This symbol refers to widespread surface wind speeds exceeding 60 km/h (30 kt)</p>			



# Coverage Portrayal Needs: Isolines

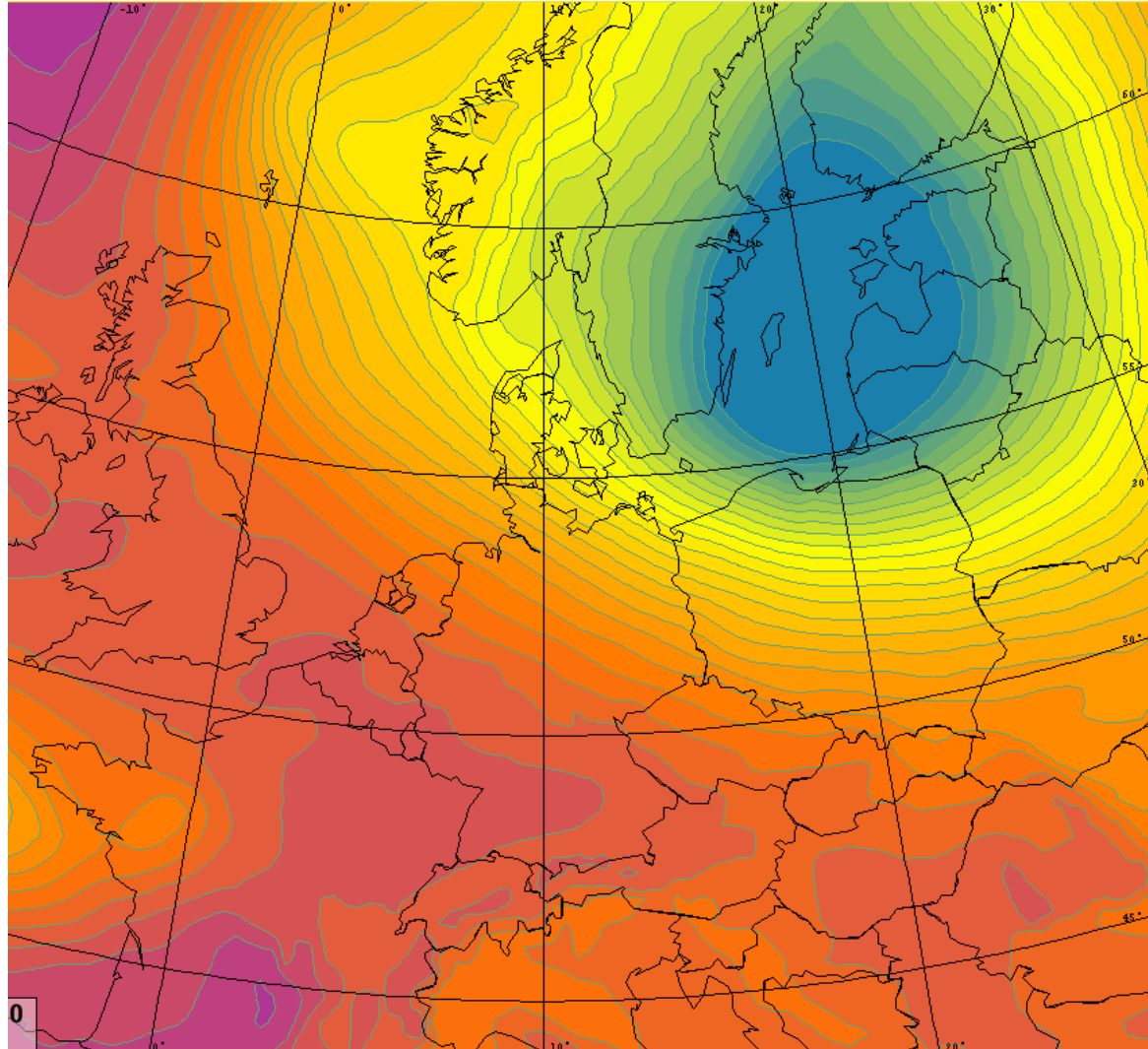
- **Line density definable.**
- **Coloring depending on the data ranges.**
- **“Smart” labels positioning along the isolines.**
- **Highlight the major isolines by increased line weight**





# Coverage Portrayal Needs: Contour Lines

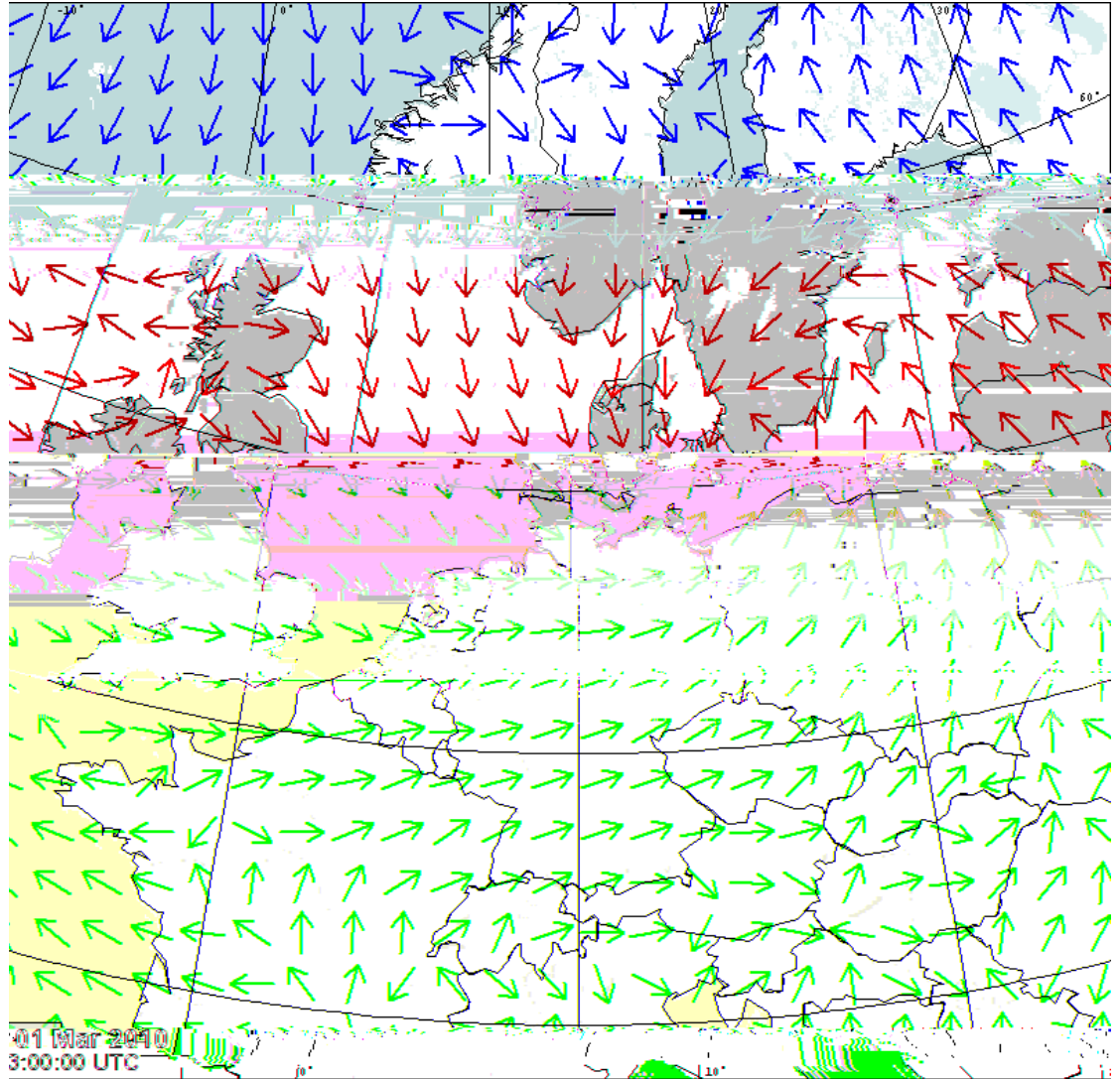
- **Color slides, several ranges depending on the data values.**
- **Possibly special ranges around the most interesting values (like temperature around zero)**
- **Some ranges may be transparent**





# Coverage Portrayal Needs: Wind Arrows

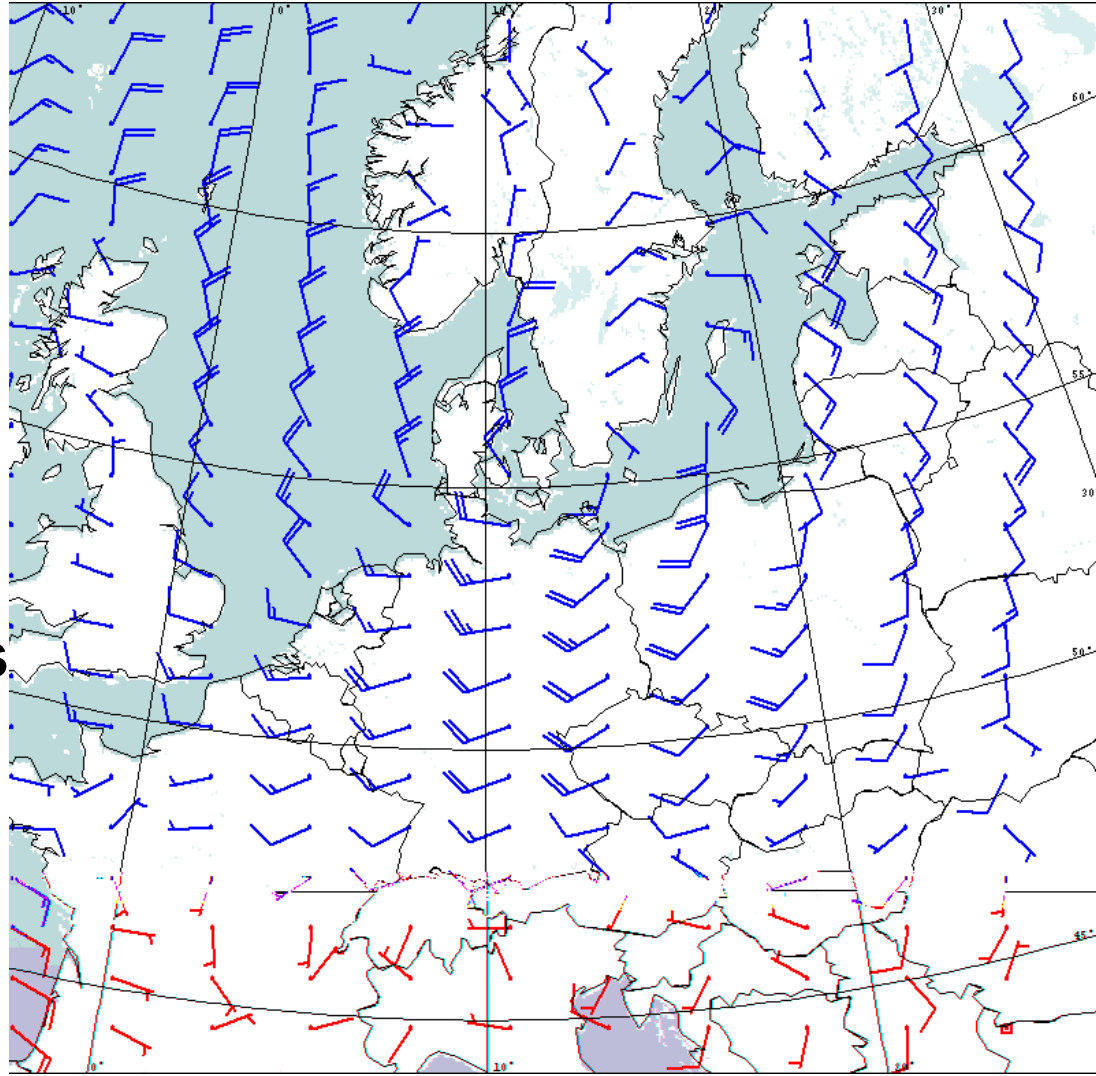
- **Line properties (size, weight) may depend on the data values.**
- **The visualization may depend on several parameters (wind speed, direction, others)**





# Coverage Portrayal Needs: Wind Barbs

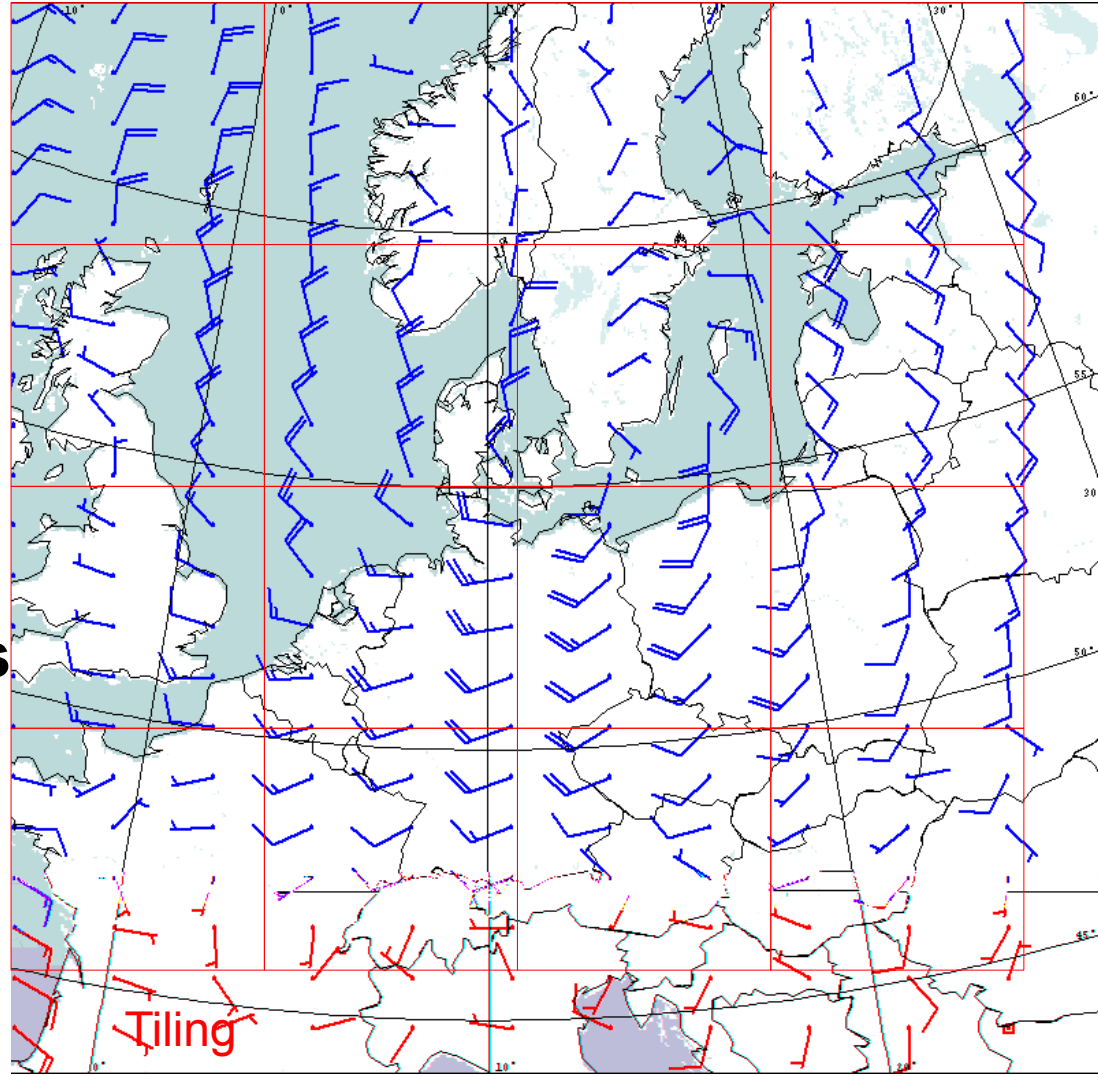
- **Line properties (size, weight) may depend on the data values.**
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- **Different handedness depending on the hemisphere**
- **Difficulties in tiling (WMTS)**





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# Avoid Cluttering, Adjust The Level Of Detail

- **Existing in SE: maxScaleDenominator and minScaleDenominator in se:RuleType.**
- **But we also need to be able to**
  - visualize the coverage data with different sampling on different map (zoom) scales.
    - WCPS?
  - calculate the categorization (for isolines) based on the map scale.



# Our Hopes for the SLD/SE

- **Language for formalizing the existing internationally agreed symbology and data visualization rules.**
  - Especially important for using the Met/Ocean data in non-met/ocean visualization software together with data from other domains.
  - Necessity for providing the data to non-experts in non-graphical formats (GML, binary grid formats).
- **A clean separation of visualization from the data in format that can be shared and re-used.**