Introduction
Conceptual Models
Sat(rep)Manu(al)

Ab Maas

EUMeTrain

eumetcal

Satrep Online

*A **conceptual model** is a model made of the composition of concepts, which are used to help people know, understand, or simulate a subject the model represents. Some models are physical objects; for example, a toy model which may be assembled, and may be made to work like the object it represents or a simple model of a meteorological phenomenon.*

Why conceptual models?

The human brain can store a lot of impressions,
but processing is a problem.

Communication
is even worse

Why conceptual models?

Why CM's in forecasting??

models

10.000

satellites

1000

radar

160

160.000

observations

CM's are not new

CM of a cyclone with fronts. Bjerknes 1918

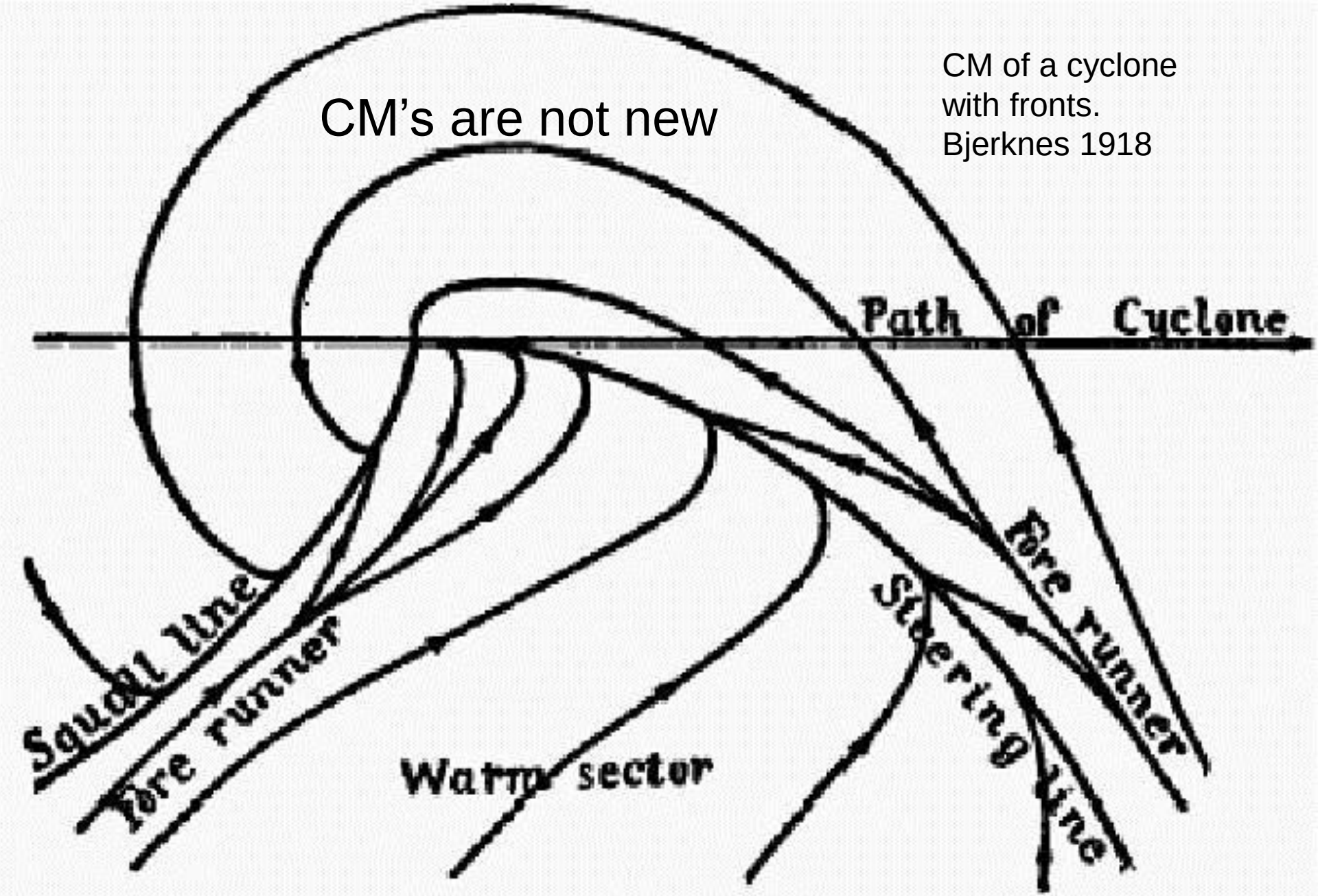
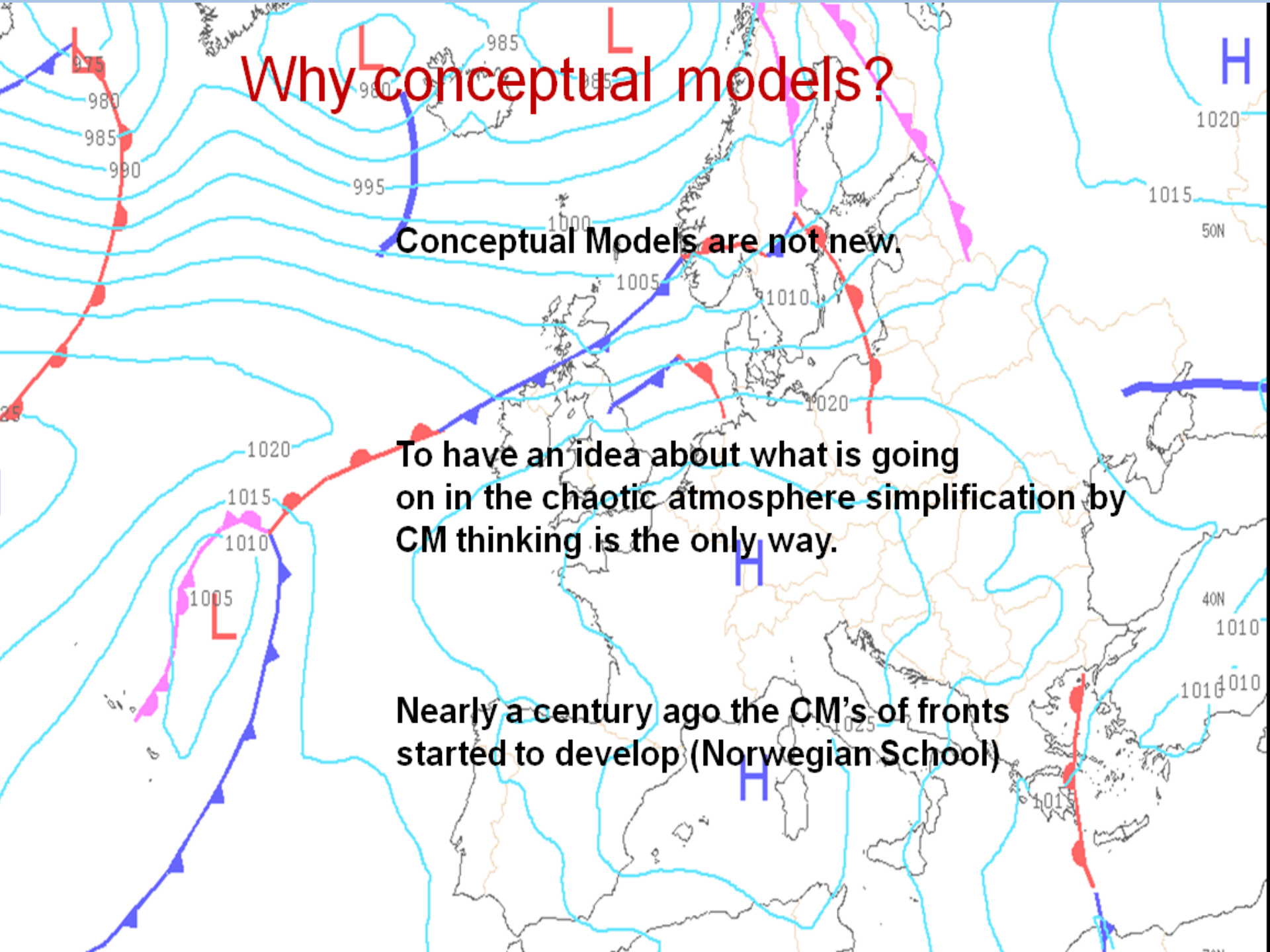


FIG. 1.—Lines of flow in a moving cyclone.

Why conceptual models?

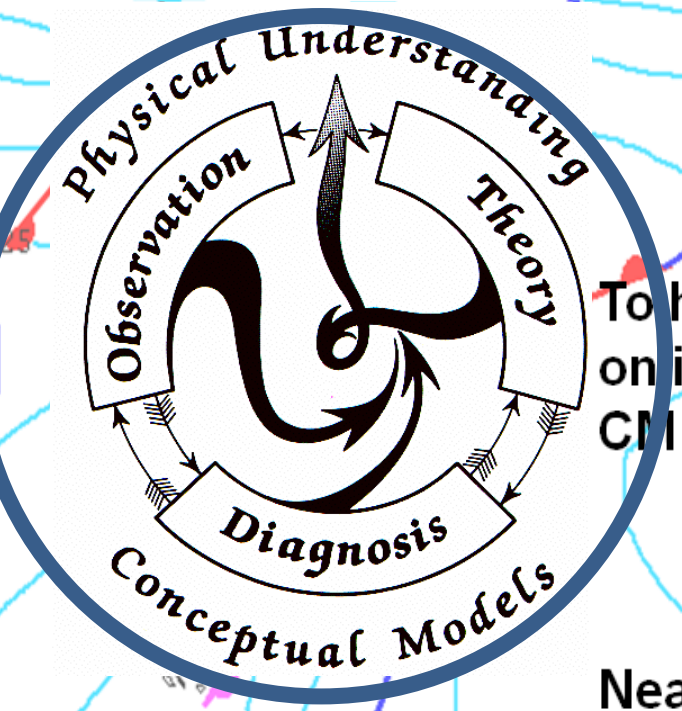


Conceptual Models are not new.

To have an idea about what is going on in the chaotic atmosphere simplification by CM thinking is the only way.

Nearly a century ago the CM's of fronts started to develop (Norwegian School)

Why conceptual models?



Conceptual Models are not new.

To have an idea about what is going on in the chaotic atmosphere simplification by CM thinking is the only way.

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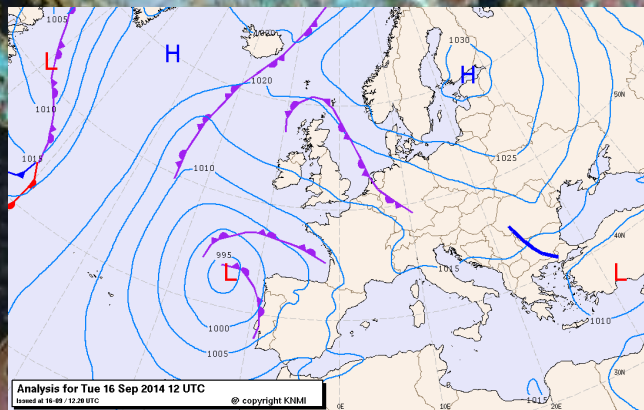
Conceptual models are abstractions of weather phenomena used for teaching and research.

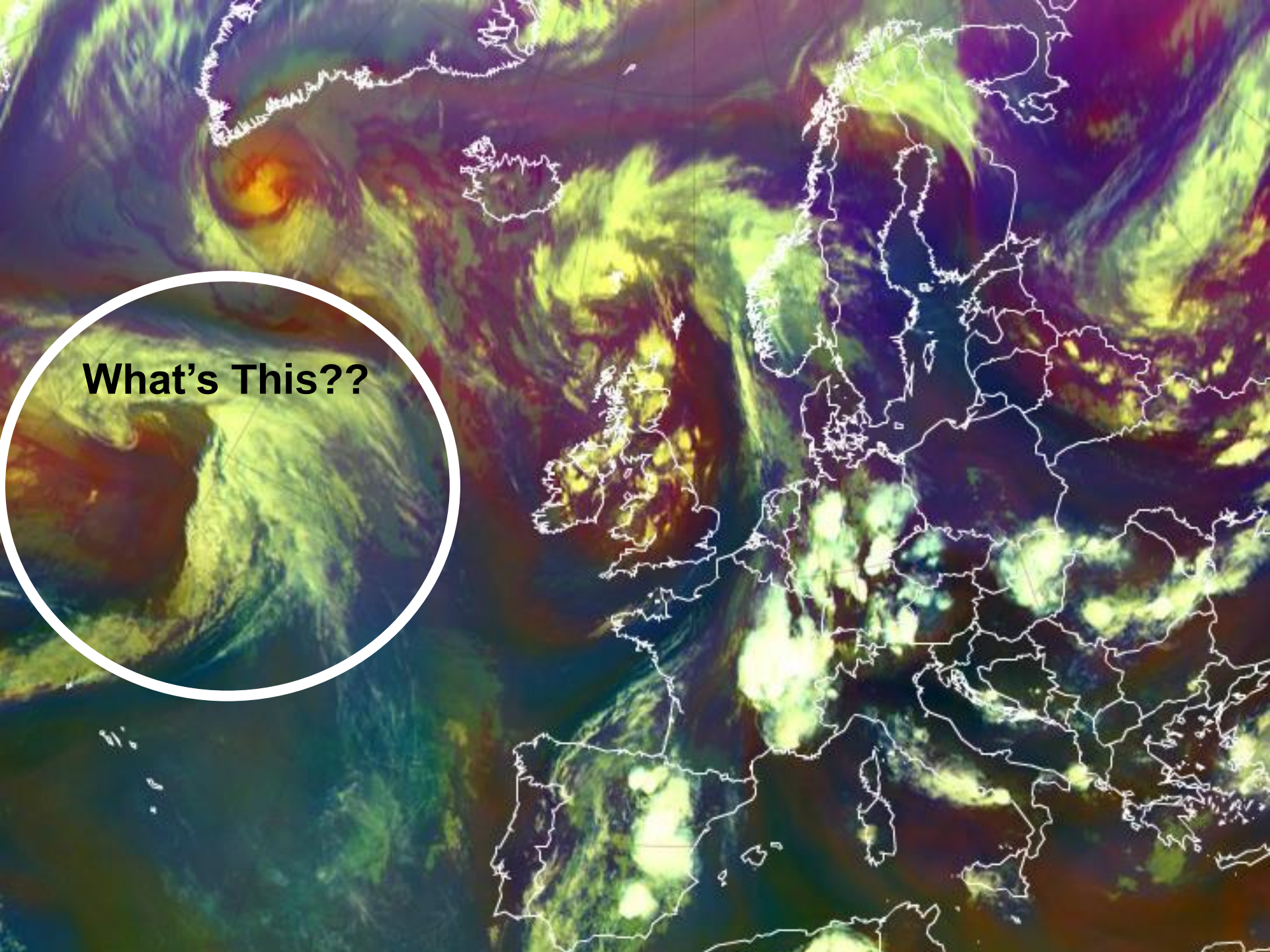
- Give scientists and forecasters a common language
- Synthesize lots of data and analysis into a visual schematic.
- Distill important processes and structures
- Omit unimportant details and variability among individual cases

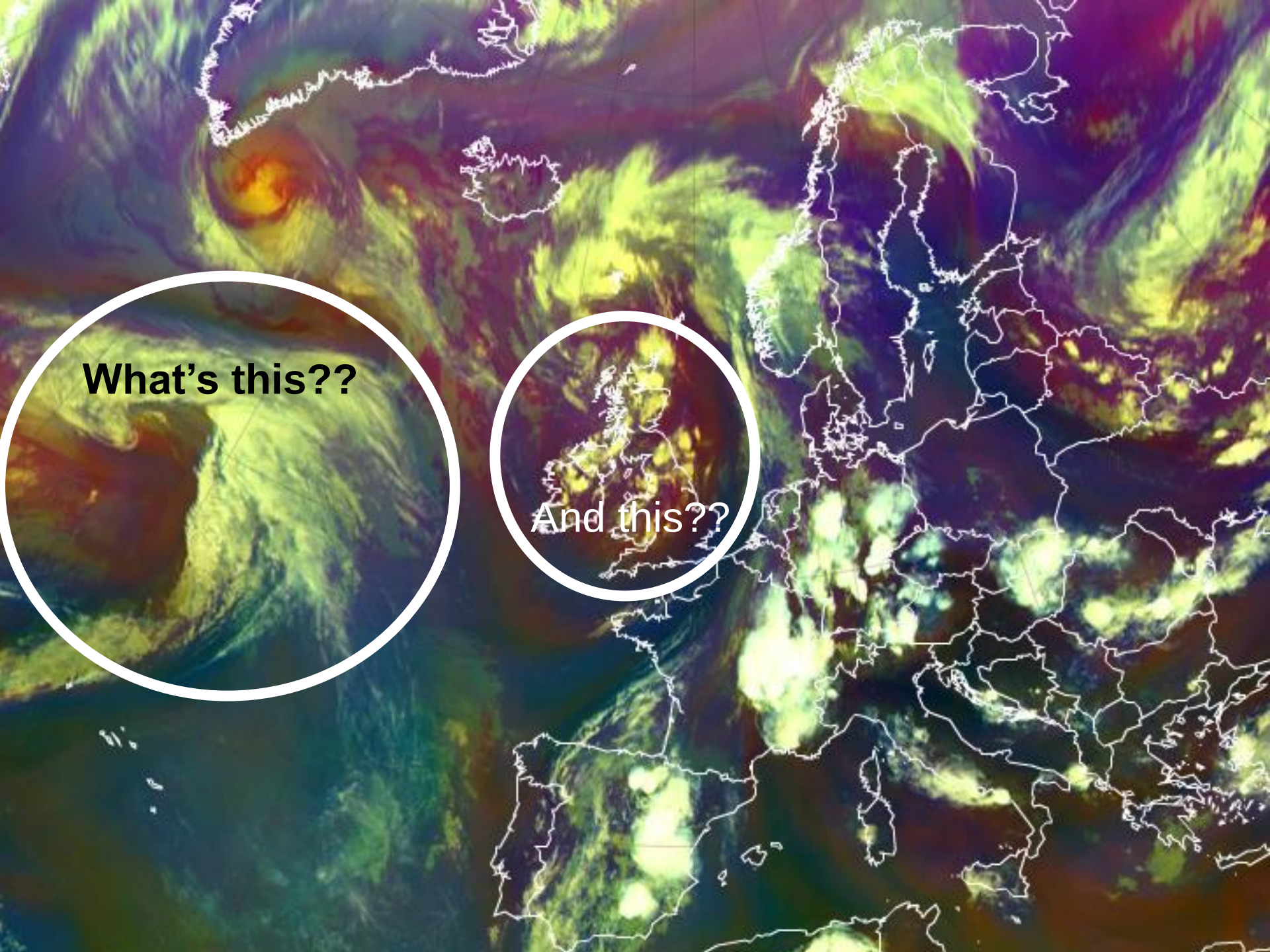
Prof. David Schulz

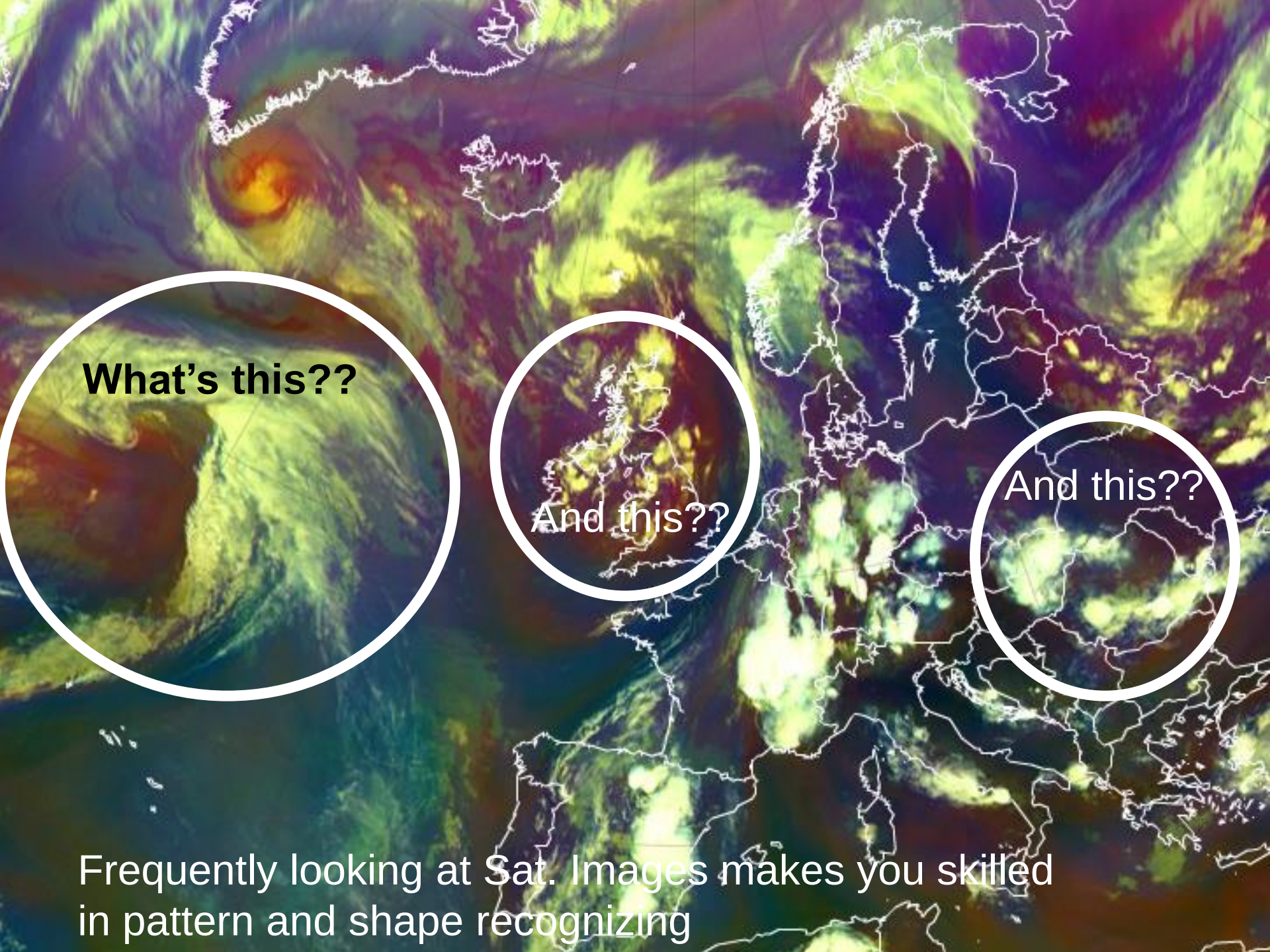
Satellites showed that there is much more than fronts alone



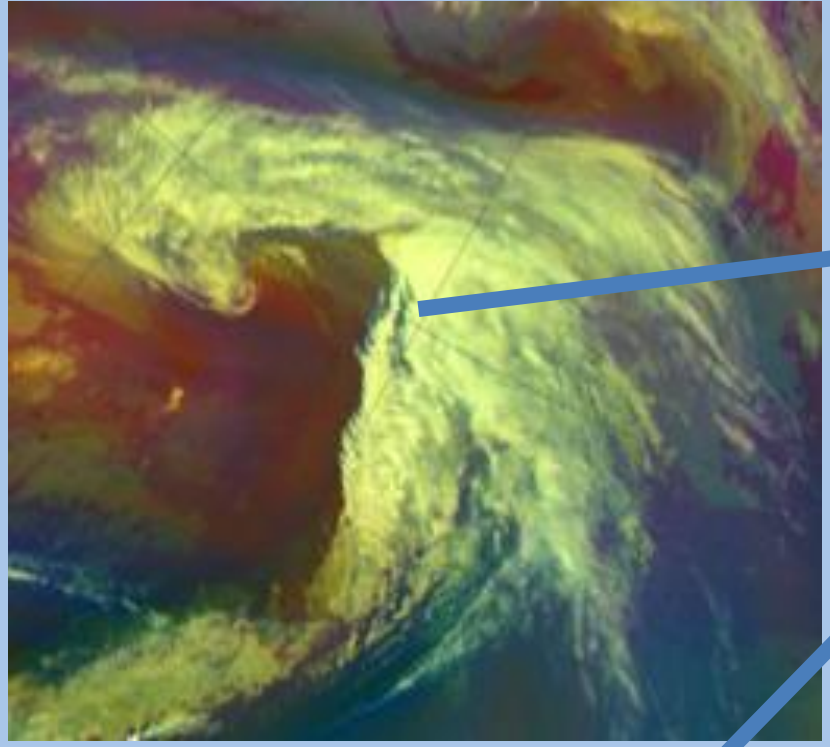

Much More!!


What's This??

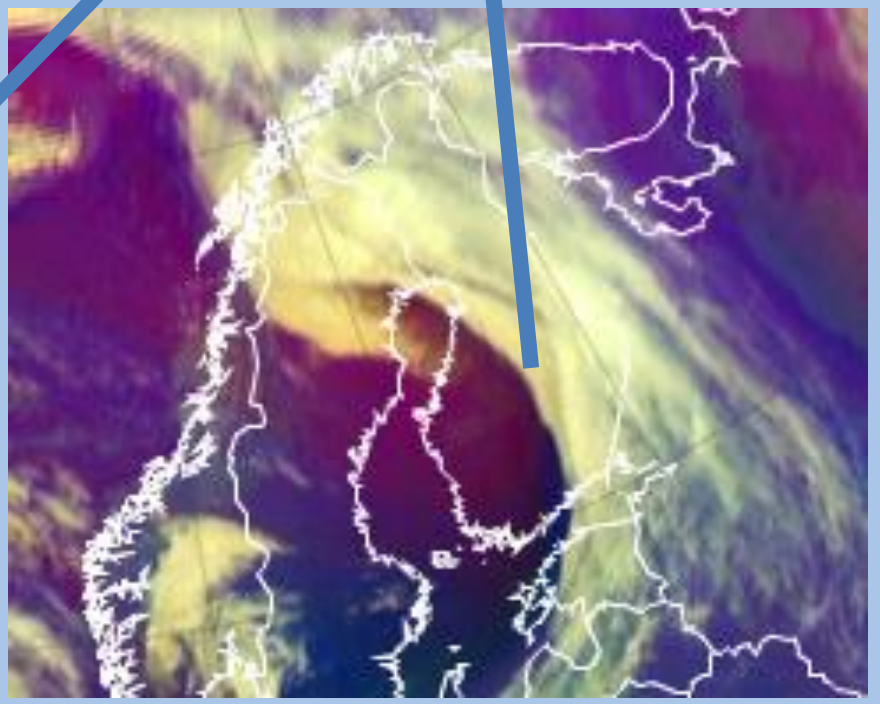

What's this??
And this??

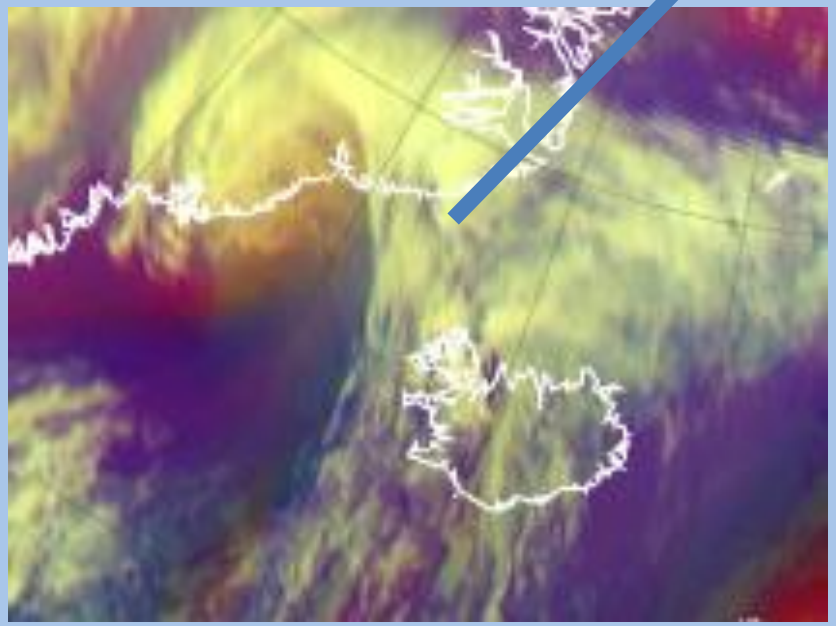


Frequently looking at Sat. Images makes you skilled in pattern and shape recognizing

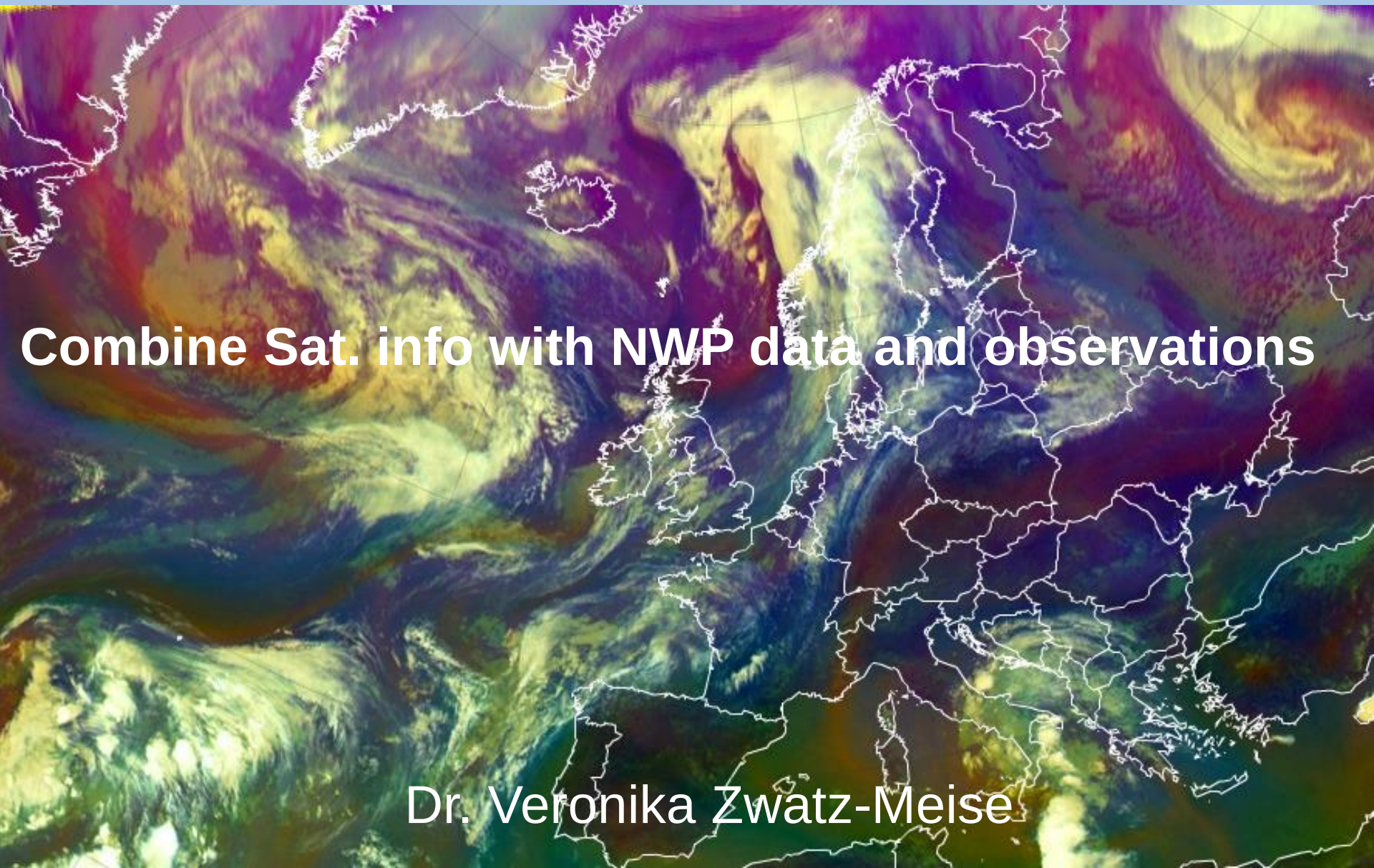


Similarities in shape and patterns in Cloud configurations give the first ideas of certain Conceptual Model



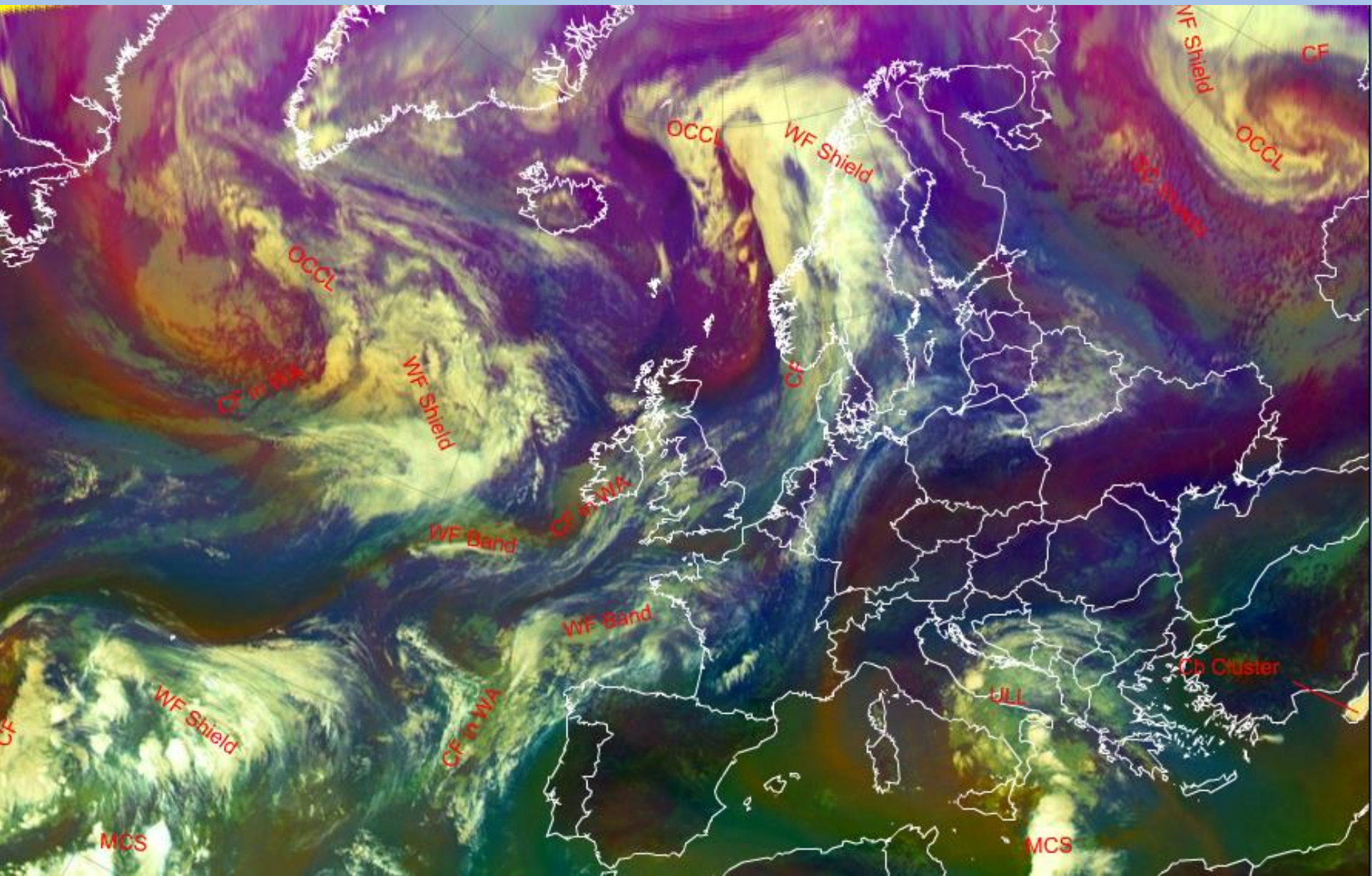


Using Satellite Images as a basis for analyzing CM's

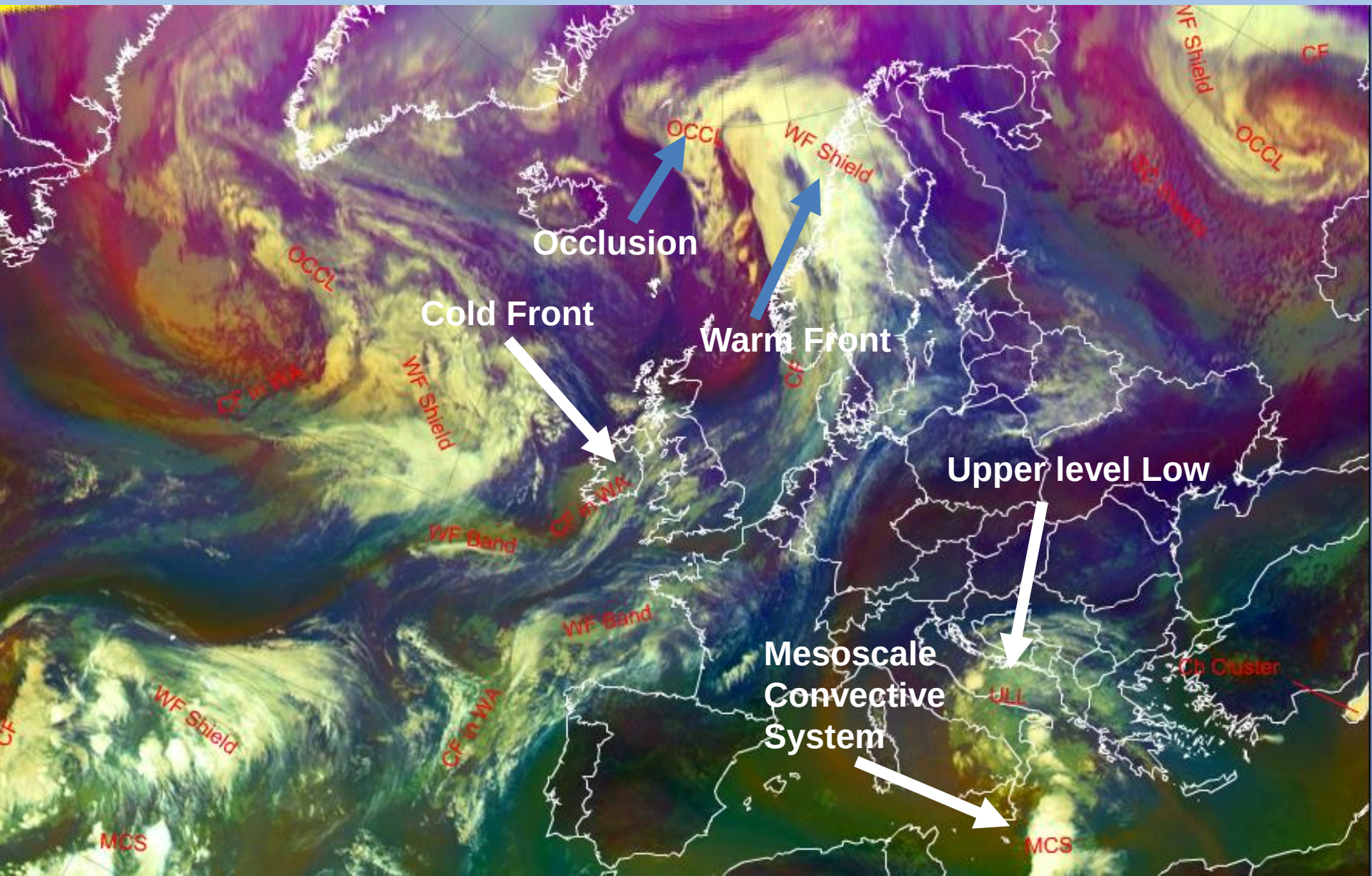


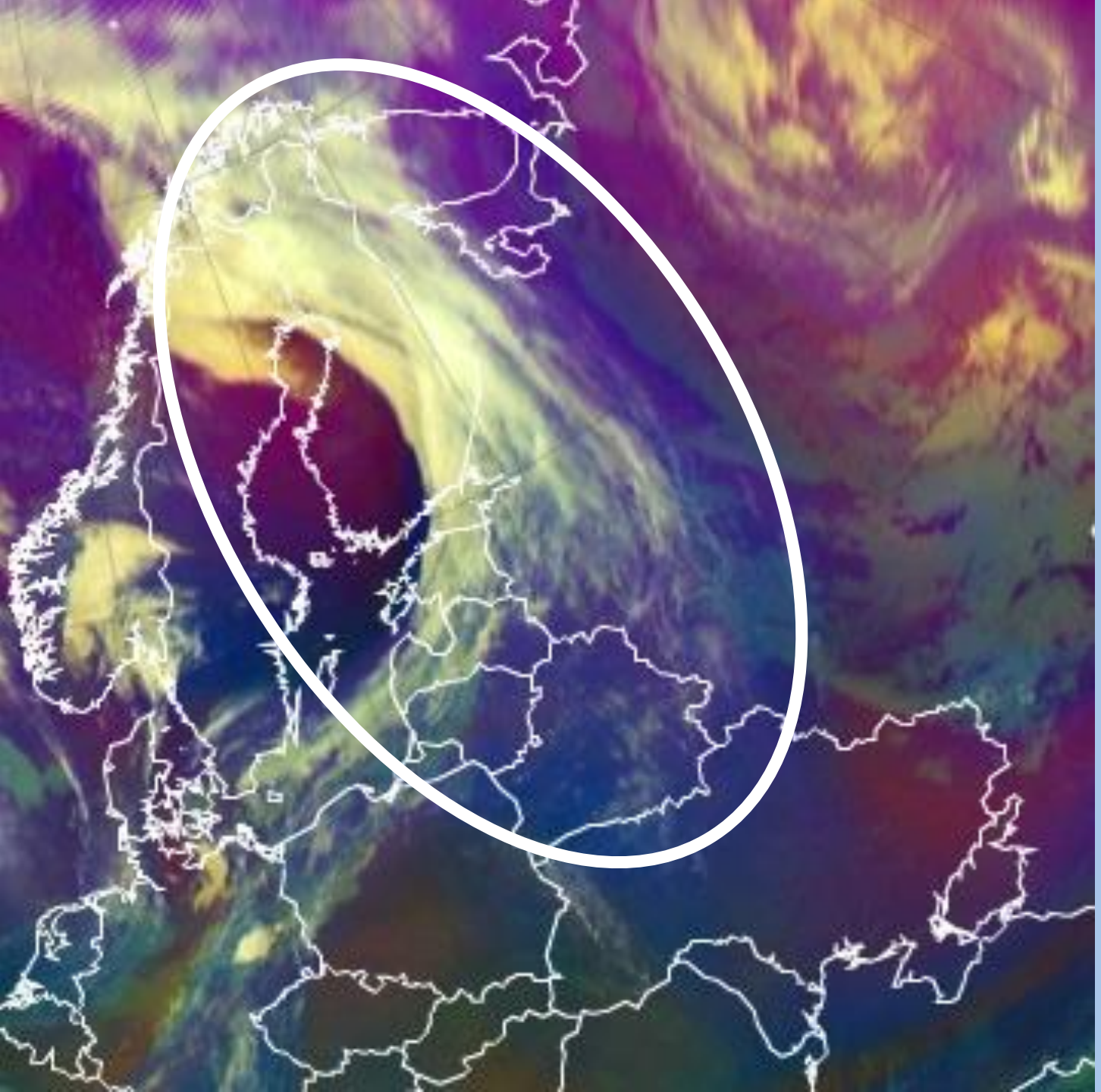
Dr. Veronika Zwatz-Meise

First guess of CM's from Sat. Image alone



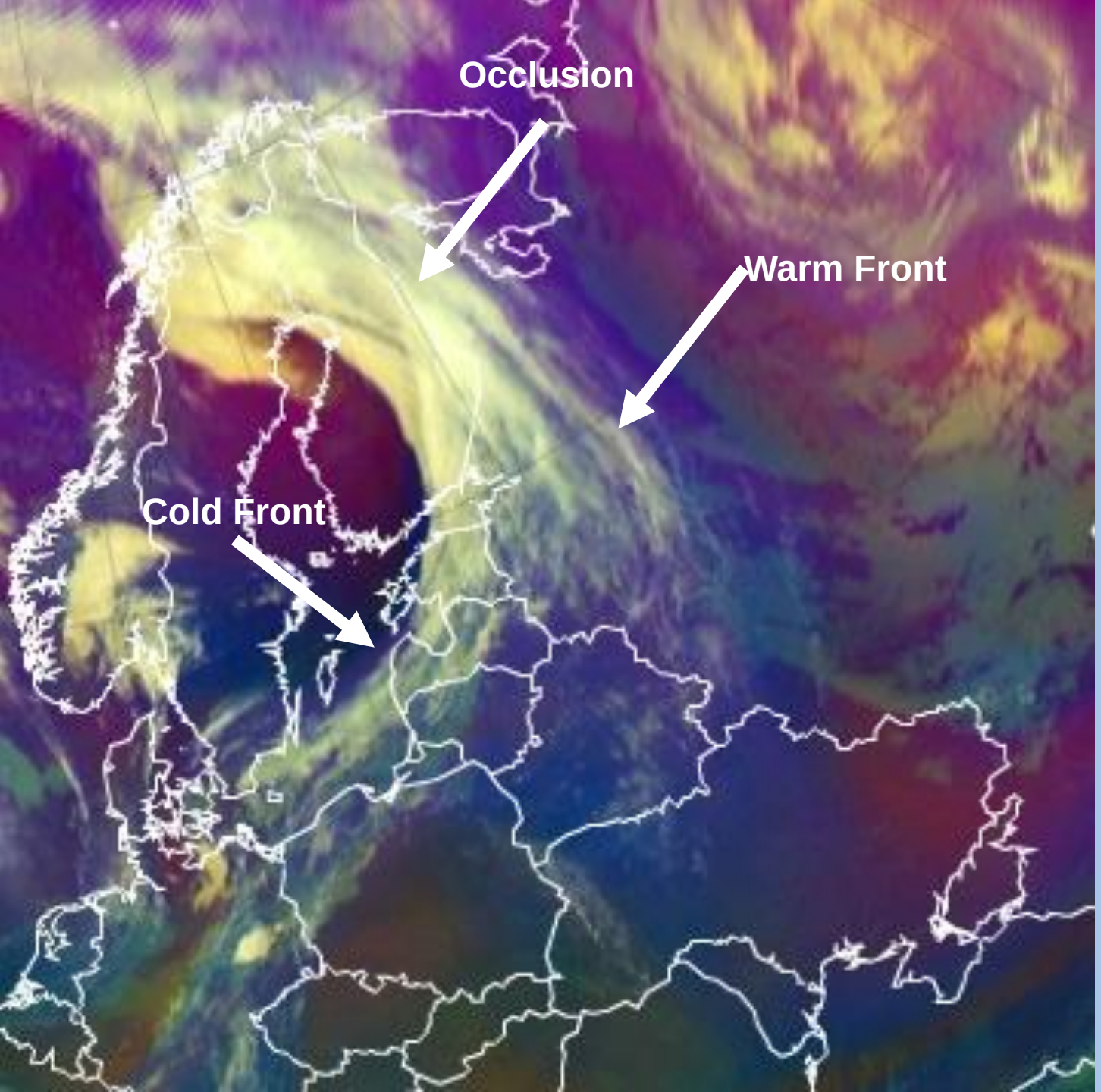
First guess of CM's from Sat. Image alone



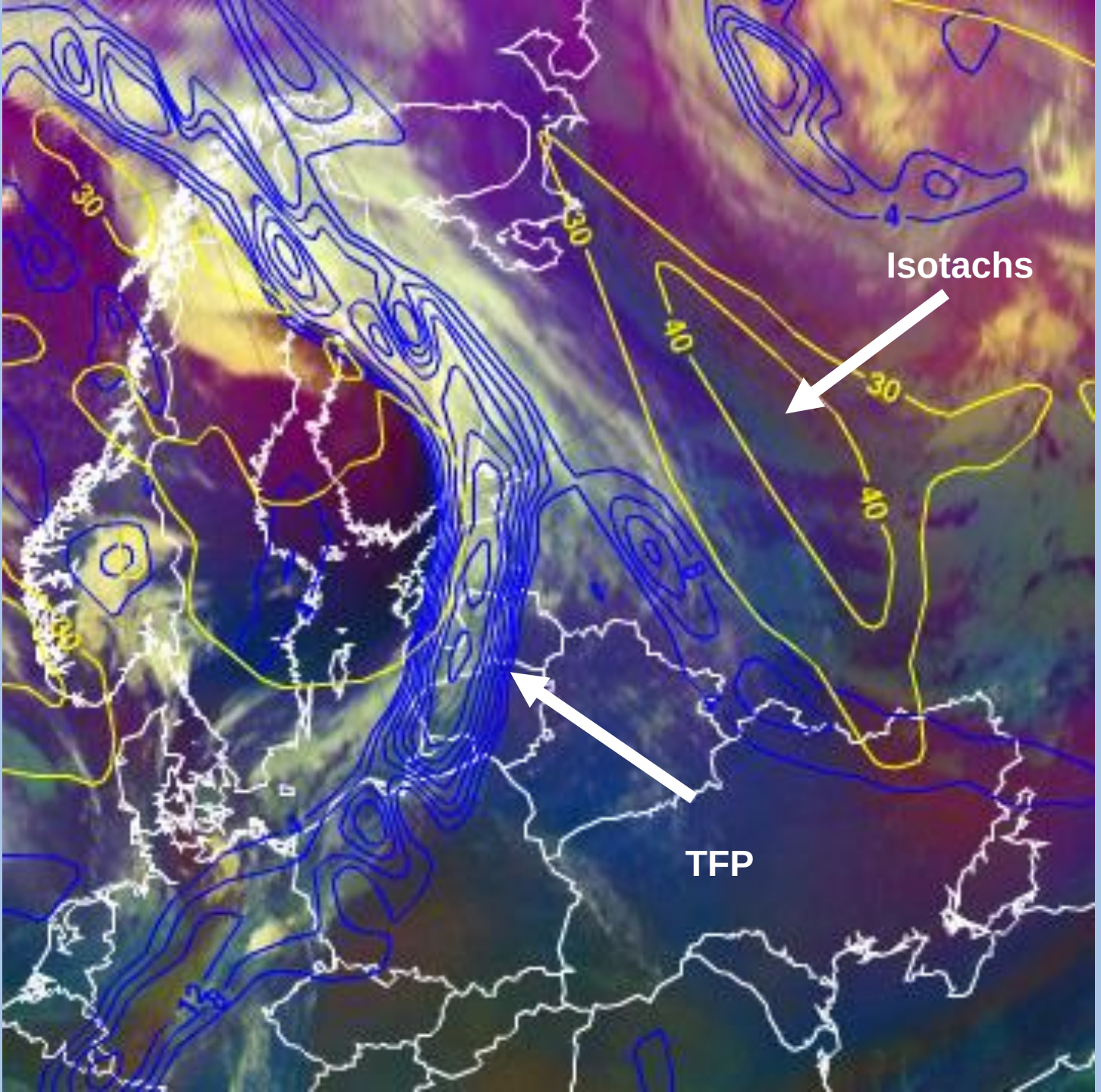


How to analyze a
Conceptual Model?

First!
Cloud feature
Here frontal system

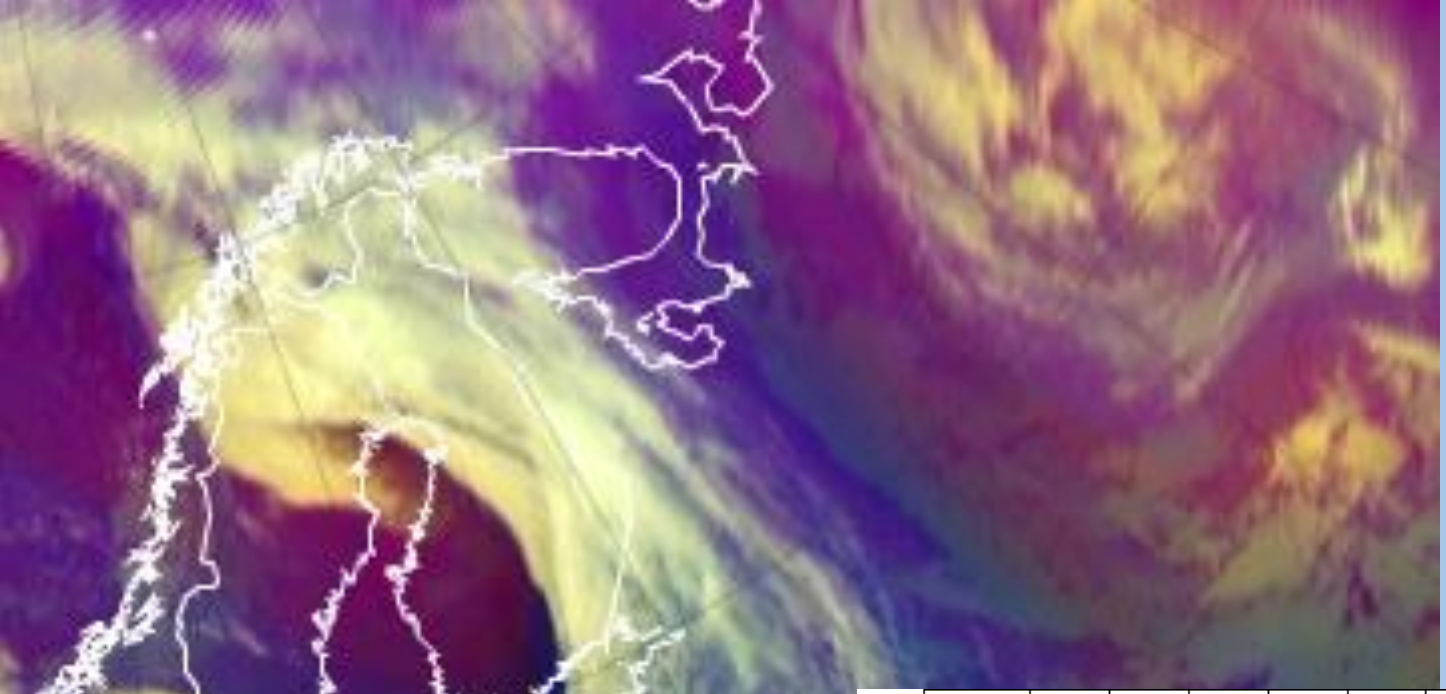


Knowledge of the Physical background (Here CF, WF and Occlusion)

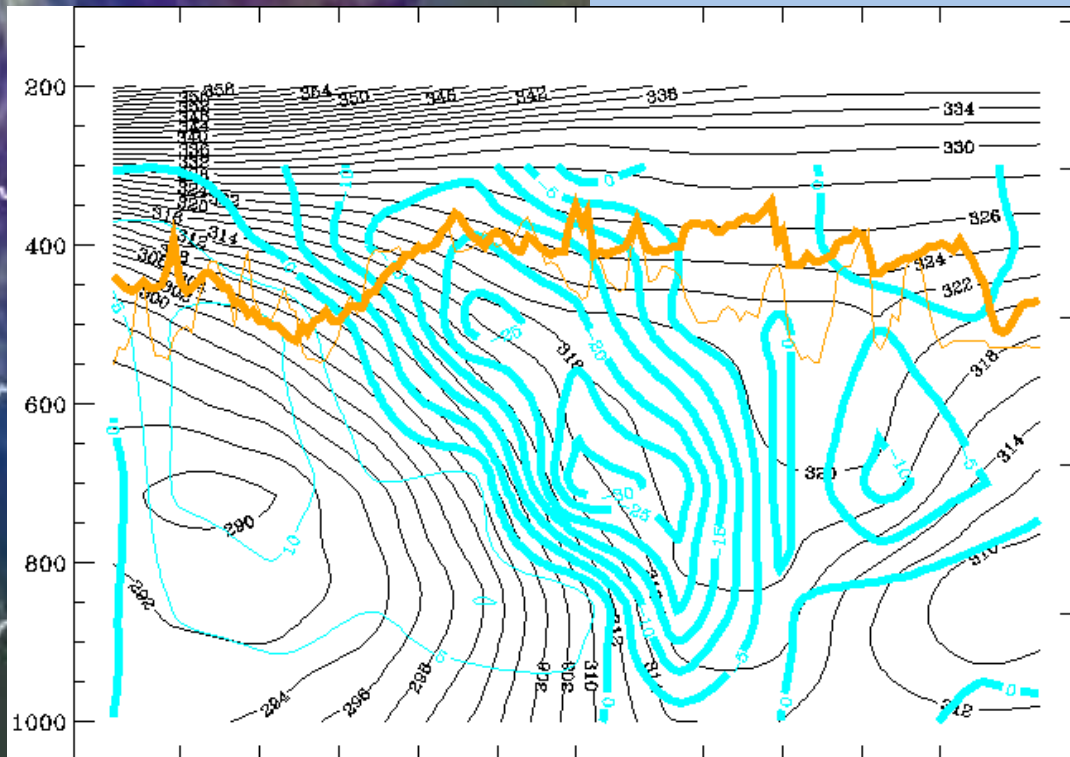


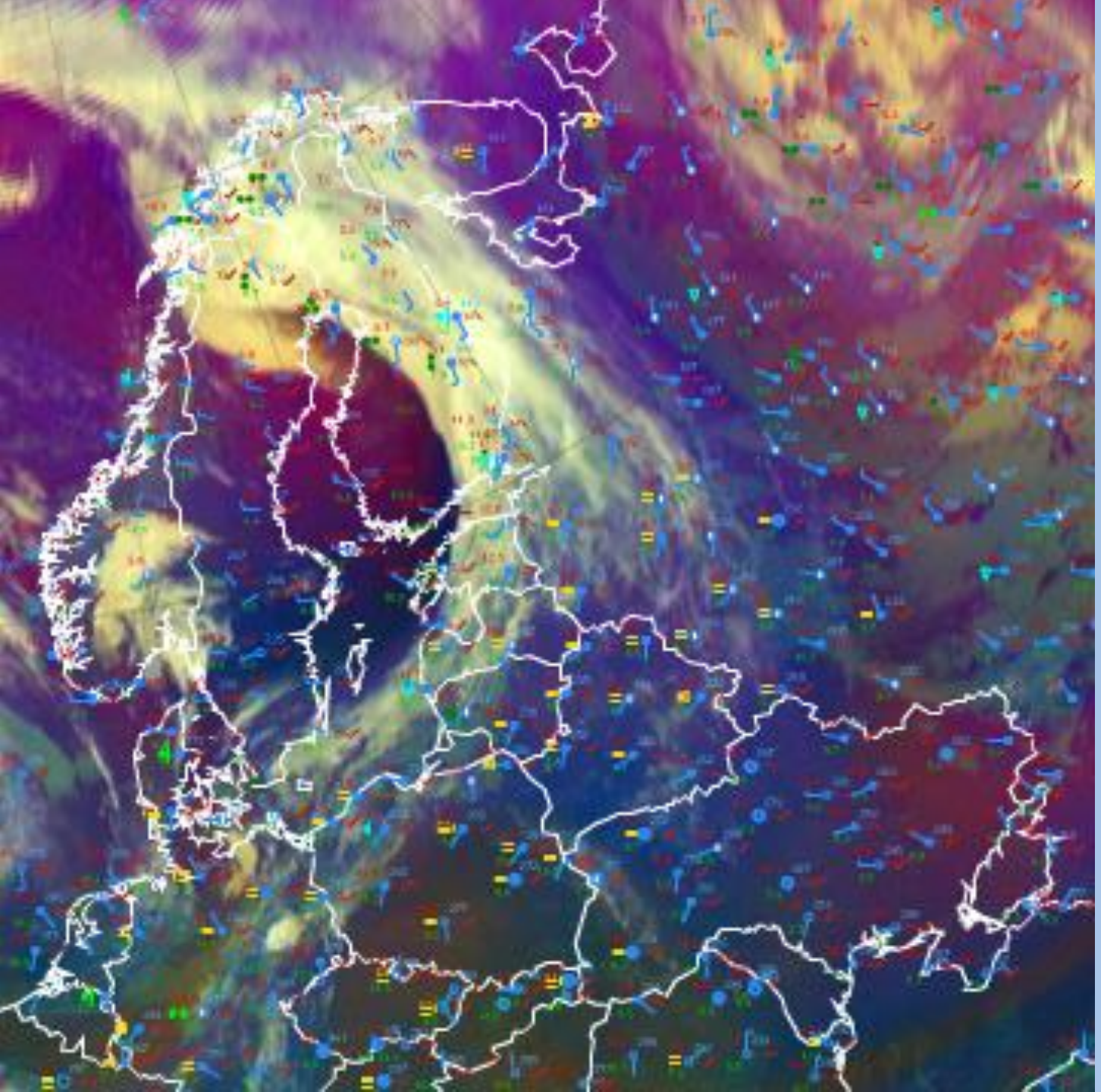
Cloud feature in combination with relevant model parameters(Thermal Front Parameter (TFP) and Isotachs 300 hPa)

Checking first guess



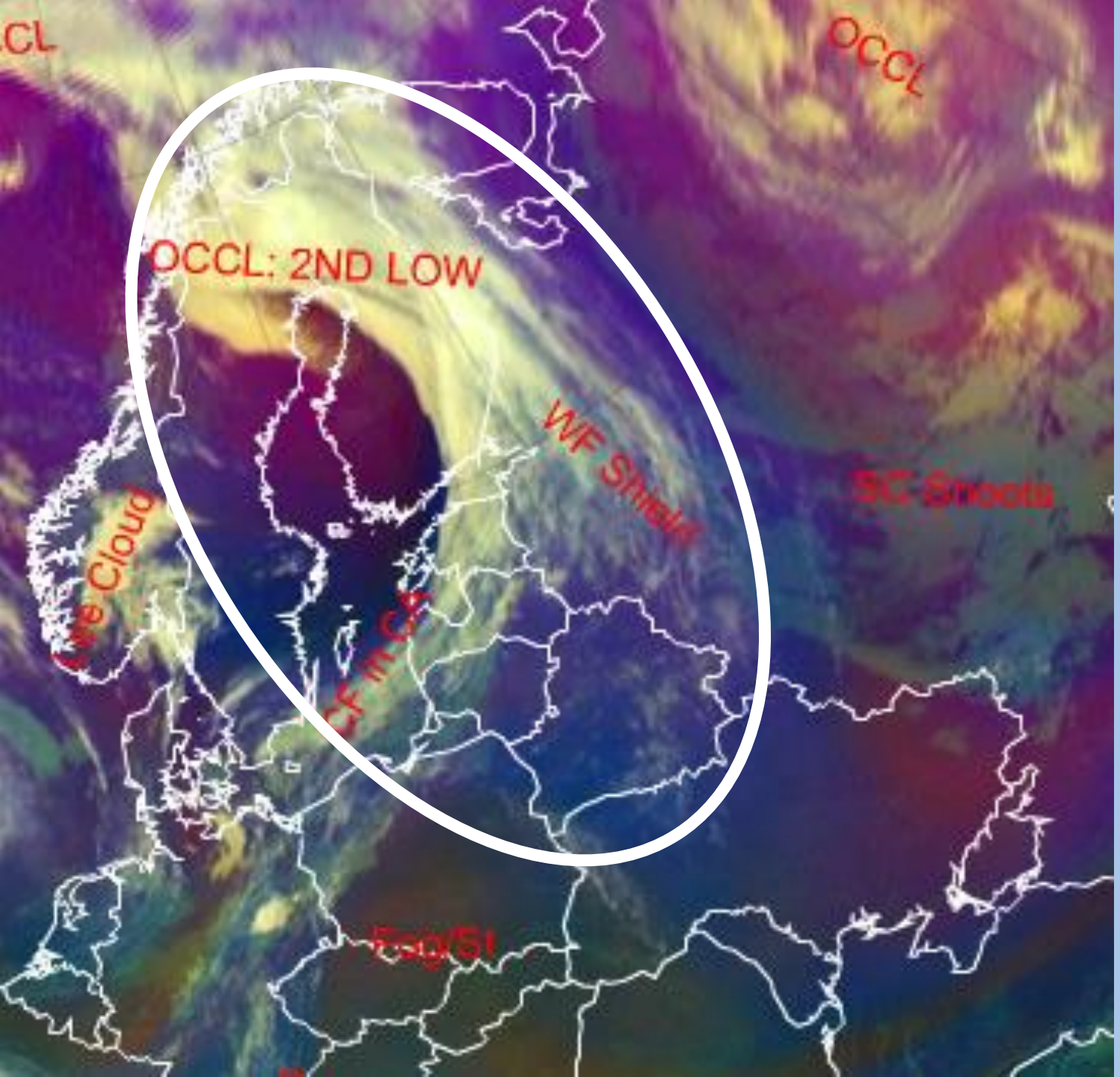
Cross Section (potential temperature and vertical velocity (ω))





Cloud feature
in combination
with observations

Weather events



Conceptual Models

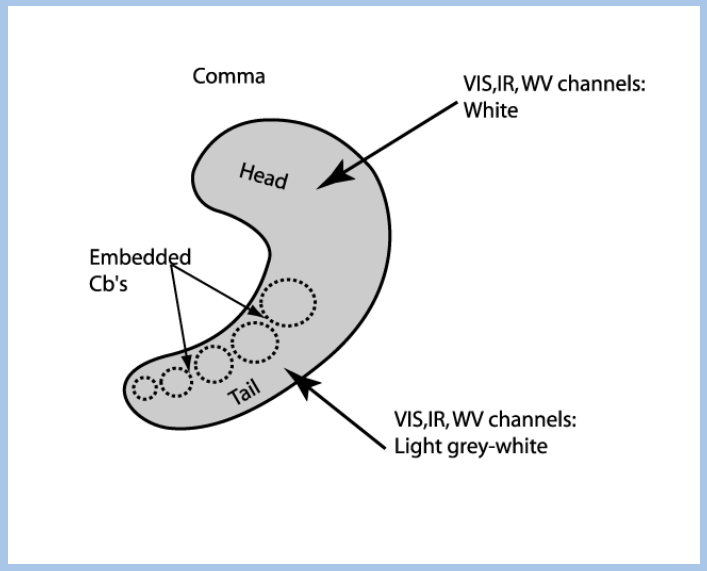
After investigation Confirmation

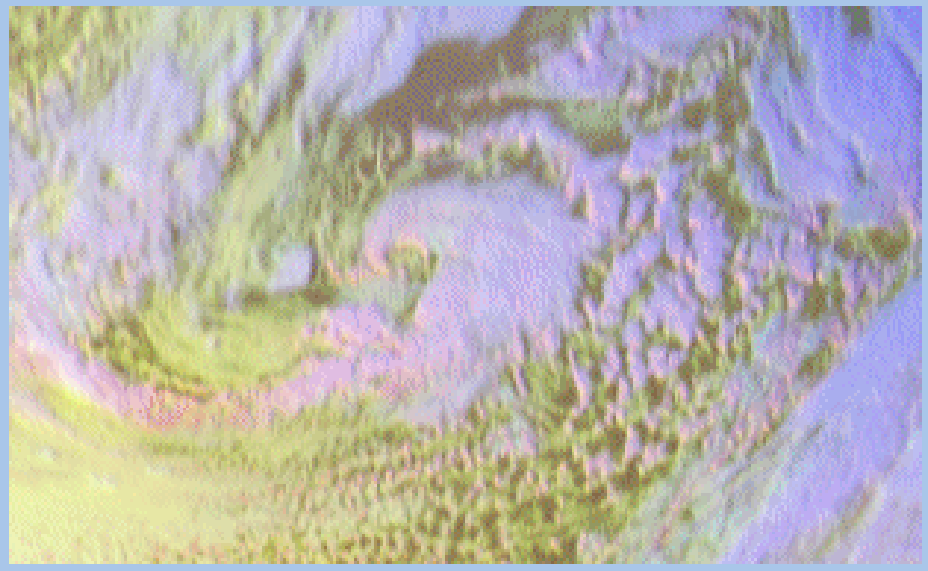
Achieving a 3D – or even 4D-mental weather picture.

Construction of a Conceptual Model in SatManu

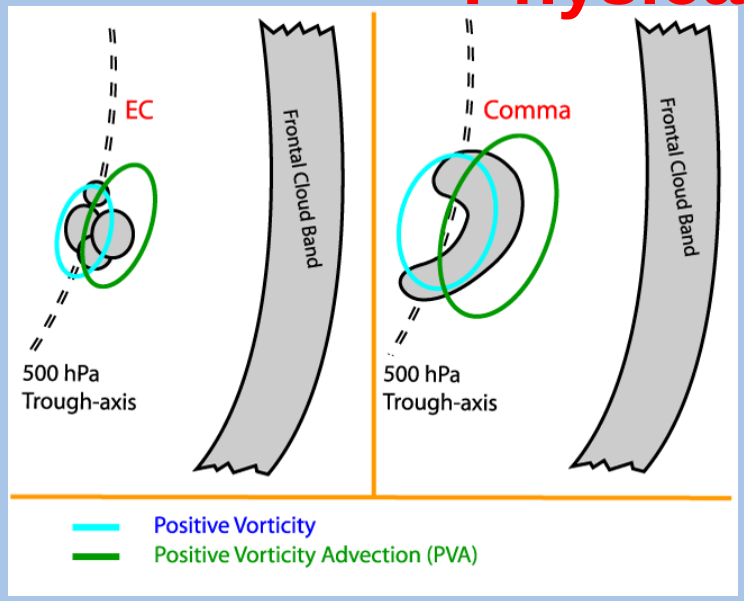
- Cloud Structure In Satellite Images
- Meteorological Physical Background
- Key Parameters
- Typical Appearance In Vertical Cross Sections
- Weather Events
- References

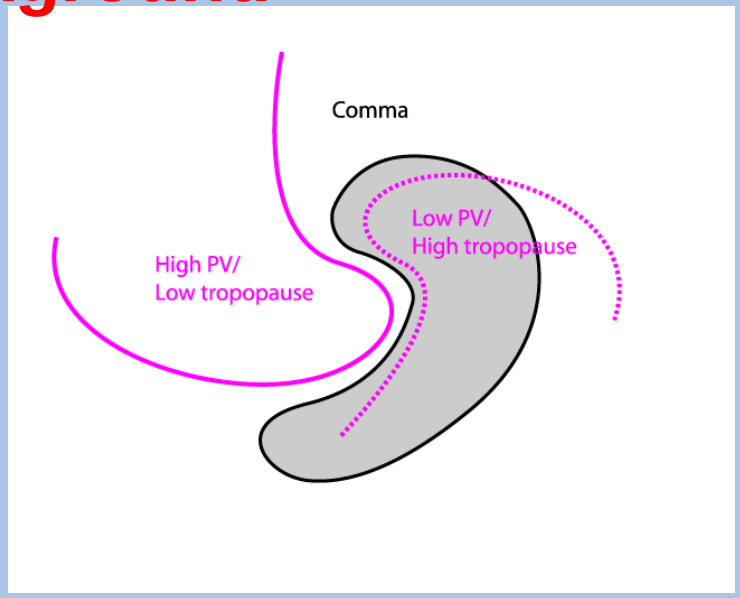
Construction of a Conceptual Model in SatManu
Cloud Structure in Satellite Image



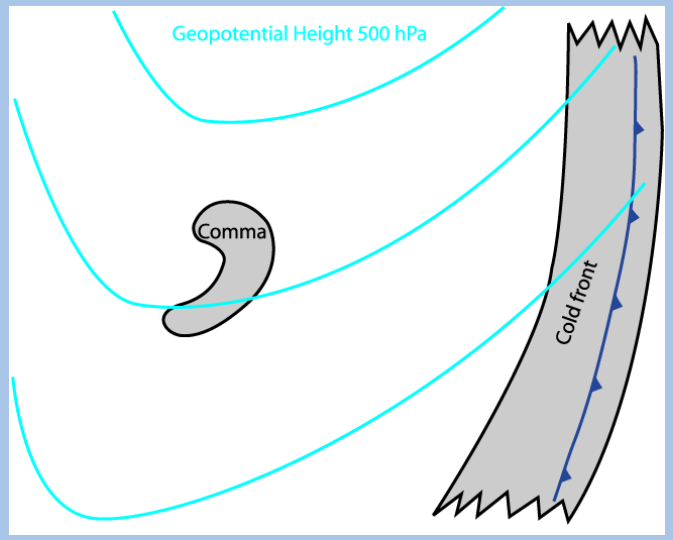


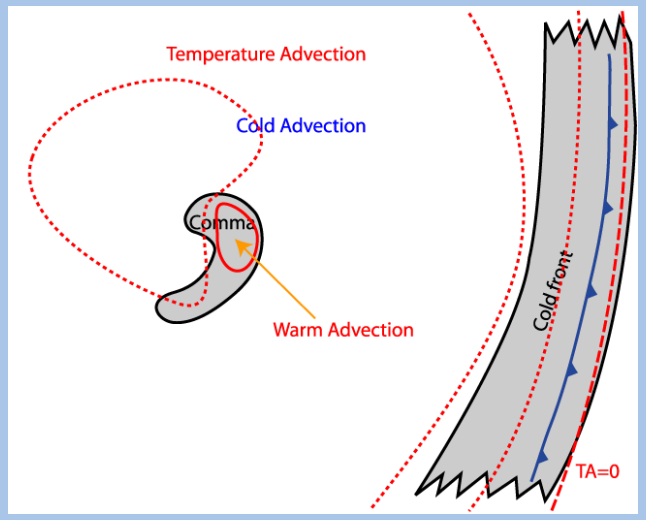
Physical Background



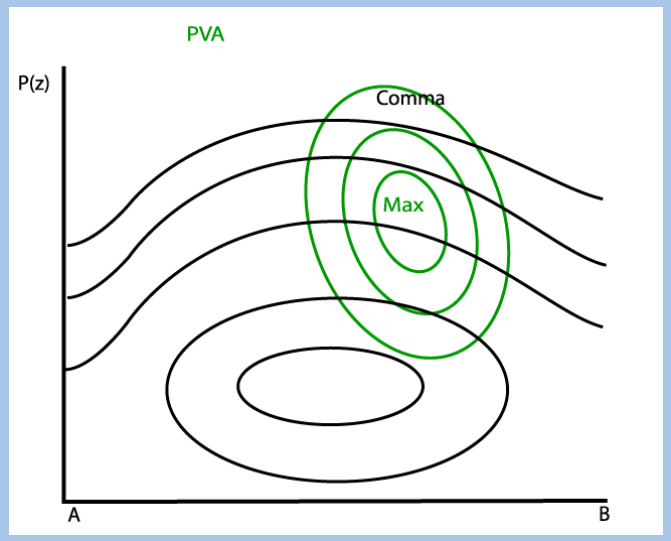


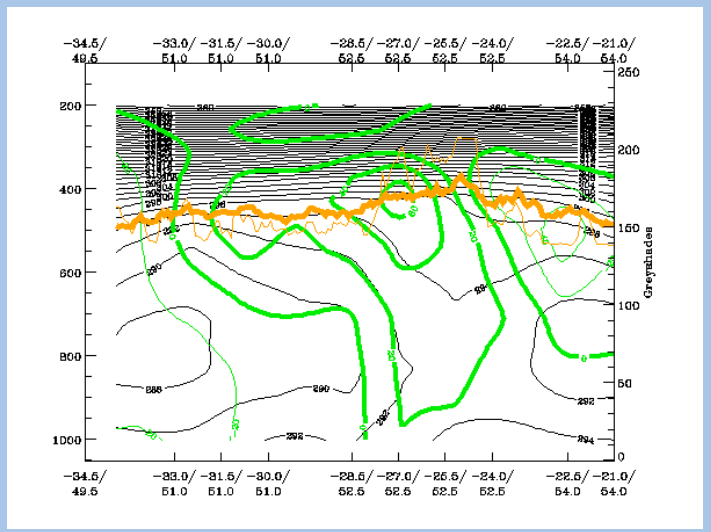
Construction of a Conceptual Model in SatManu
Key Parameters



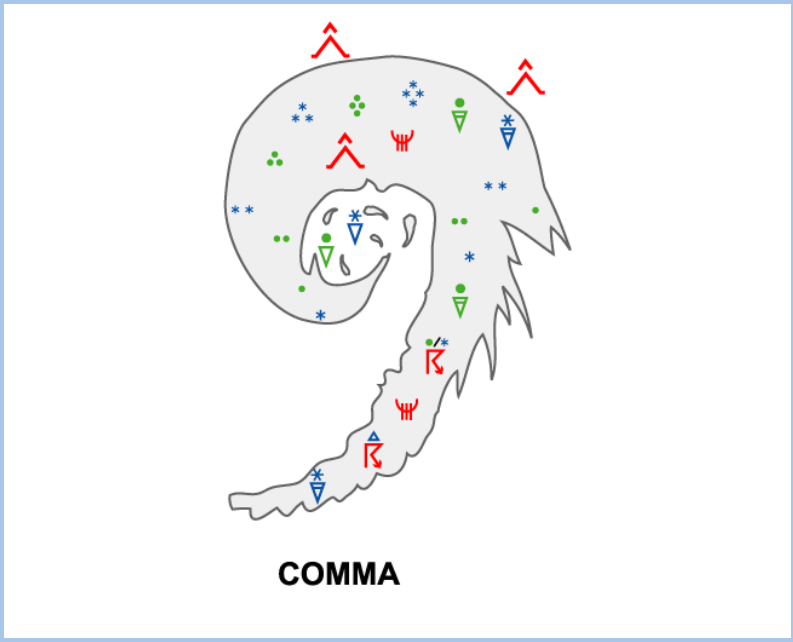


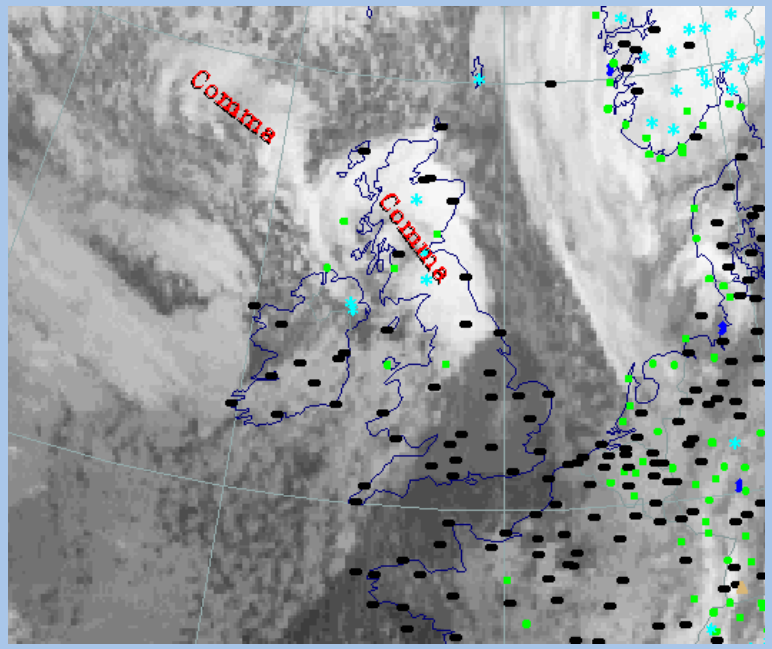
Cross Sections





Construction of a Conceptual Model in SatManu Weather Events





Comma - References

by ZAMG and KNMI

General Meteorology and Basics

- FORBES, LOTTES (1985): Classification of Mesoscale Vortices in Polar Airstreams and the Influence of the Large-scale Environment on their Evolutions, Tellus, 37A, 132 - 155
- RASMUSSEN (1979): The Polar Low as an Extratropical CISK Disturbance, Quart. J. Royal Meteor. Soc., 105, 531-549
- REED (1979): Cyclogenesis in Polar Air Streams, Monthly Weather Review, 107, 38-52
- TURNER, LACHLAN-COPE, THOMAS (1993): A Comparison of Arctic and Antarctic Mesoscale Vortices, J. Geophysical Research, 98, D7, 13019-13034

General Satellite Meteorology

- CARLETON, CARPENTER (1989): Satellite climatology of Polar Lows and Broadscale Climatic Associations for the Southern Hemisphere, Int. J. Climatology, 10 (3), 219-246
- CLAUD ET AL (1993): Satellite Observations of a Polar Low over the Norwegian Sea by Special Sensor Microwave Imager, Geosat, and TIOS-N Operational Vertical Sounder, J. Geophysical Research, 98, C8, 14487-14506

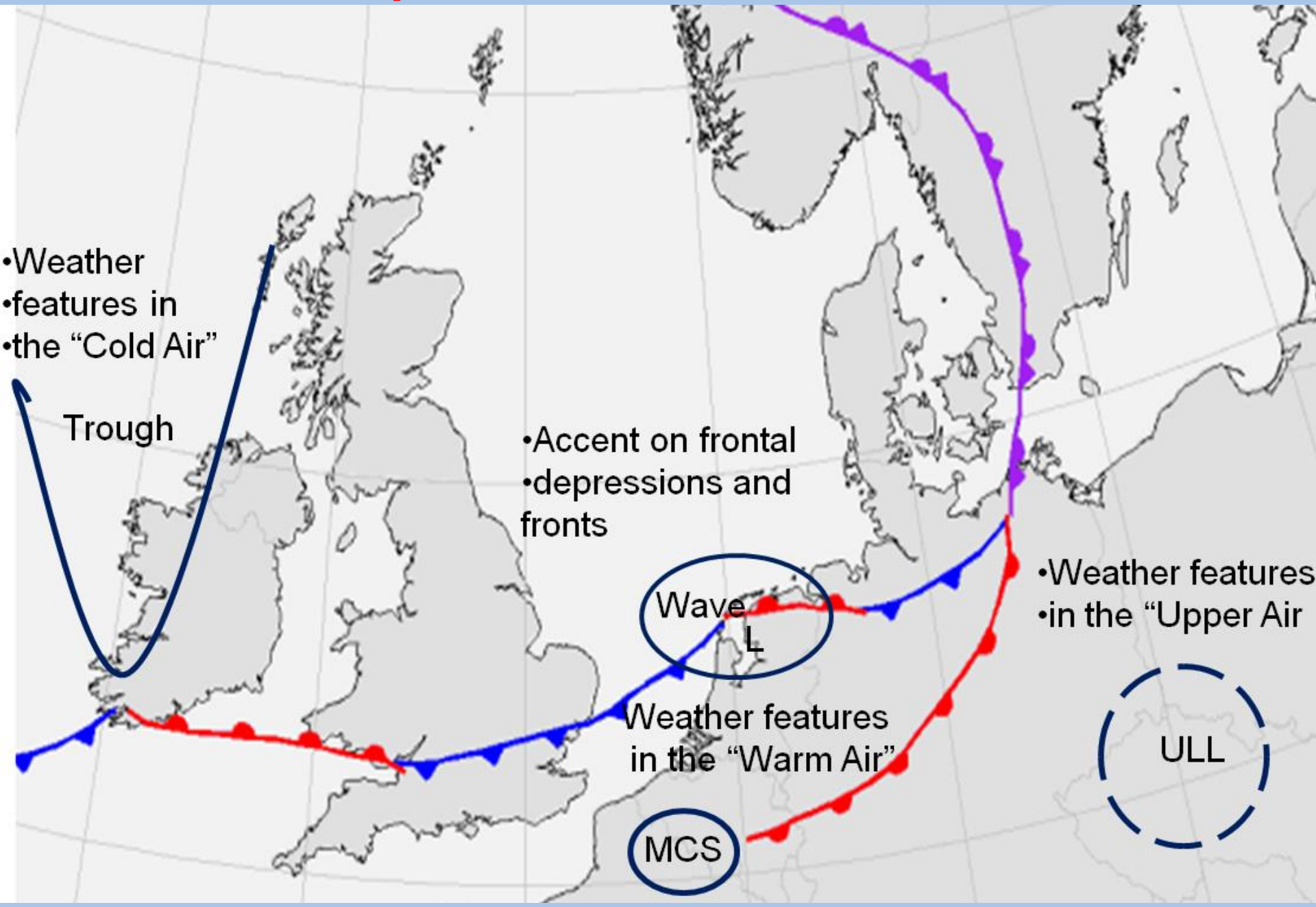
Specific Satellite Meteorology

- BROWNING (1993): Evolution of a Mesoscale Upper Tropospheric Vorticity Maximum and Comma Cloud from a Cloud-free Two-dimensional Potential Vorticity Anomaly, Quar. J. Meteor. Soc., 119, 513, 883-906
- CRAIG (1992): A Study of Two Cases of Comma-Cloud Cyclogenesis Using a Semigeostrophic Model, Monthly Weather Review, 2942-2961
- REED (1979): A Case study of Comma Cloud Development, Monthly Weather Review, 114, 1681-1695
- REED (1979): A Further Case study of Comma Cloud Development, Monthly Weather Review, 114, 1696 -17

The manual contains 50 conceptual models

- COLD FRONT
  - Arctic Cold Front
  - Cold Front
  - Cold Front in Cold Advection
  - Cold Front in Warm Advection
  - Split Front
- WARM FRONT
  - Detached Warm Front
  - Warm Front Band
  - Warm Front Shield
- OCCLUSION
  - Back-Bent Occlusion
  - Cold Air Development
  - Instant Occlusion
  - Occlusion: Cold Conveyor Belt Type
  - Occlusion: Warm Conveyor Belt Type
- BAROCLINIC BOUNDARY
  - Baroclinic Boundary
- SUBSTRUCTURES IN FRONTS AND INITIAL STAGES OF CYCLOGENESIS
  - Front Decay
  - Front Intensification by Jet Crossing
  - Rapid Cyclogenesis
  - Secondary Low Centres in Occlusion Cloud Bands
  - Upper Wave
  - Wave
- NON-FRONTAL SYNOPTIC SCALE PHENOMENA
  - Deformation Band
  - Thickness Ridge Cloudiness
  - Upper Level Low
  - Warm Conveyor Belt
- MESOSCALE PHENOMENA
  - Comma
  - Convergence Cloudiness
  - Enhanced Cumulus
  - Jet Fibres
  - Polar Low
- CONVECTIVE WEATHER FEATURES
  - Cumulonimbus Cluster
  - Cumulonimbus (Cb) and Mesoscale Convective System (MCS)
  - CONVECTIVE CLOUD FEATURES IN TYPICAL SYNOPTIC ENVIRONMENTS
    - At the Leading Edge of Frontal Cloud Bands
    - Enhancement of Convection by PV
    - Fair Weather Conditions
    - The Warm Sector
    - The Warm Sector: Spanish Plume
- OROGRAPHICAL WEATHER FEATURES
  - Barrage Cloud
  - Foehn
  - Orographic Effects on Frontal cloud
  - Lee Cloudiness
- LOW CLOUDS
  - Cloud Streets
  - Fog and Stratus
  - Stratocumulus Sheets
- WV STRUCTURES
  - Dark Stripes
  - Water Vapour Vortices
- SMALL SCALE CONCEPTUAL MODELS
  - Coastal Convergence
  - Convergence Lines Over Seas and Lakes
  - Non-orographic Convergence Lines
  - Orographically Induced Convergence Lines
  - Sea-Breeze

Conceptual models and air masses



The construction of the manual

MANUAL OF SYNOPTIC SATELLITE METEOROLOGY
MAIN PAGE

Version 6.8

BASICS

In this part of the Manual you will find explanations of the different satellite channels and introductions to the method of combining satellite imagery and numerical model parameters. Furthermore, there is a detailed definition of "Conceptual Model".

CONCEPTUAL MODELS

In this part of the Manual, you will find a detailed description of about fifty conceptual models in different scales.

SHORT VERSIONS

Here, all the conceptual models included in the Manual are summarized in a compact way. This is useful for quickly refreshing your knowledge.

EXERCISES

This part of the Manual contains exercises for each of the conceptual models. It can be used to test the knowledge you have gained in studying the Manual.

CASE STUDIES

In this part of the Manual, actual case studies show the applicability of the concept of "Conceptual Models".Most of the case studies have been developed for specific training courses in various parts of Europe.

CATASTROPHIC WEATHER EVENTS

Here, well-known catastrophic weather events - like floods, storms or avalanches - are presented from the viewpoint of the "Conceptual Model" concept.

BASICS

In this part of the Manual you will find explanations of the different satellite channels and an introduction to the method of combining satellite imagery and numerical model parameters. Furthermore, there is a detailed definition of "Conceptual Model".

- Satellite channels
  - Basic Channels
  - Artificial and Combination Channels
- Conceptual Models - Definition
- Relation of cloud features and numerical model parameters
  - Numerical parameters for synoptic- to mesoscale cloud systems
    - The Quasi-geostrophic Approach
    - Divergence
    - Vertical Motion - Omega Equation
    - Temperature Advection
    - Vorticity
    - Vorticity Advection
    - Potential Vorticity
    - Thermal Front Parameter
  - Numerical parameters for small scale convective cloud systems
    - Convection and Instability
    - Cape
    - Stability Indices
- Additional Tools
  - Vertical Cross Sections
  - Relative Streams

DIVERGENCE

$$\text{div}\, V_2 = \nabla V_2 = \frac{\partial u}{\partial x} + \frac{\partial v}{\partial y}$$

V_2	2–dimensional wind vector
u	zonal wind component
v	meridional wind component

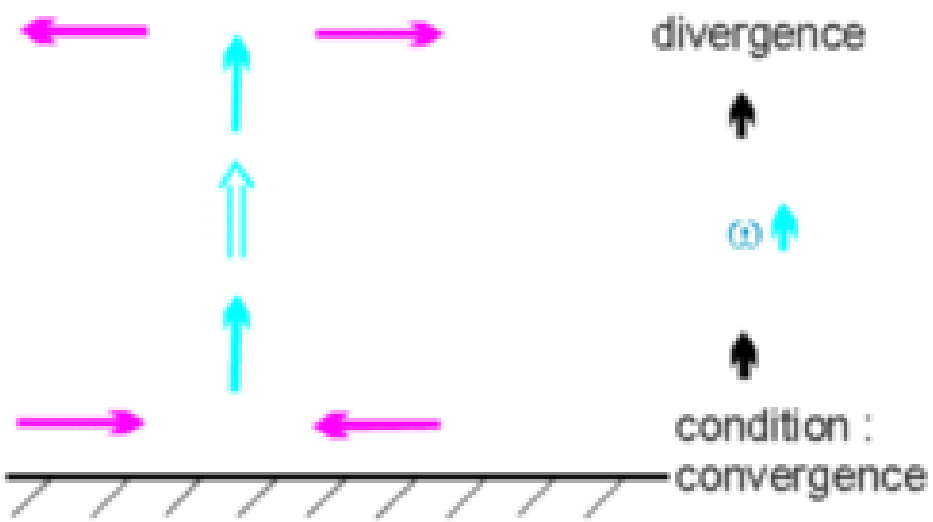
> 0	Divergence
< 0	Convergence

Divergence is a property of the flow field.

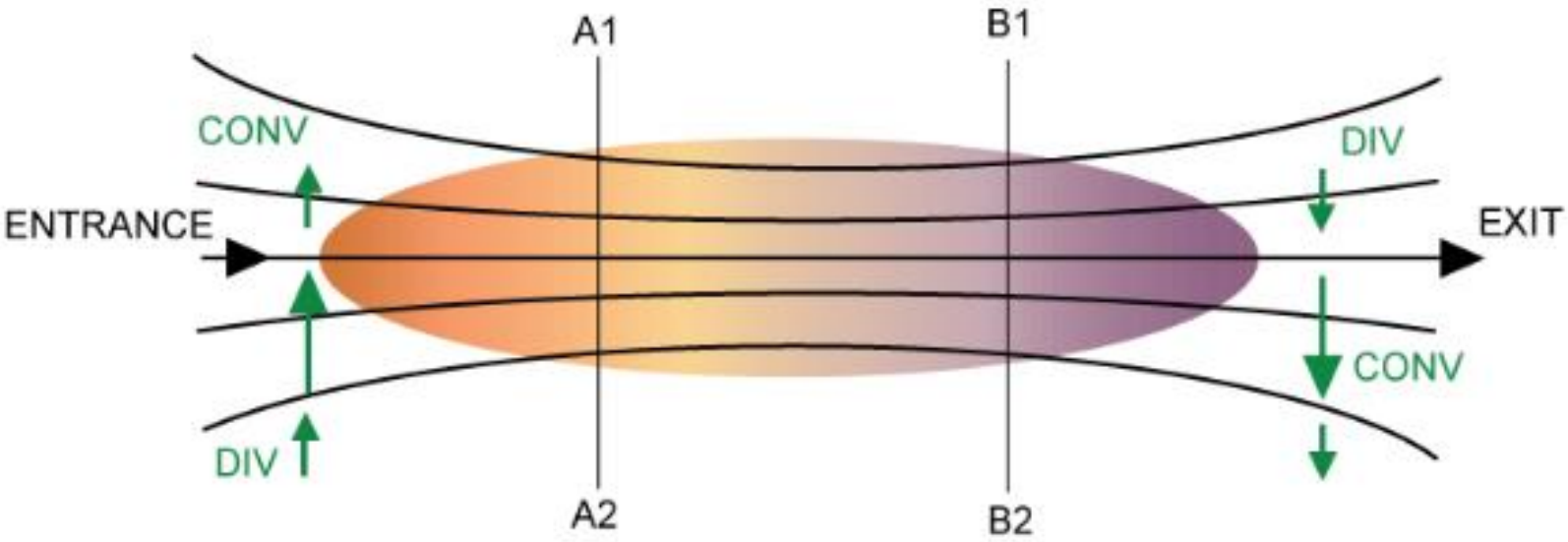
There is a connection to vertical motion through the Richardson equation:

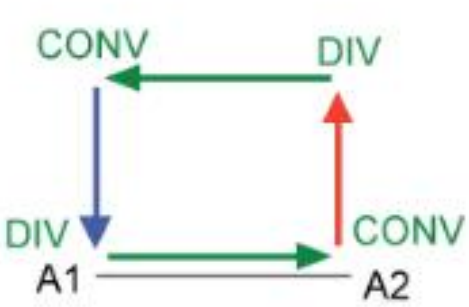
$$\text{div}_p\, V_2 = -\frac{\partial \omega}{\partial p}$$

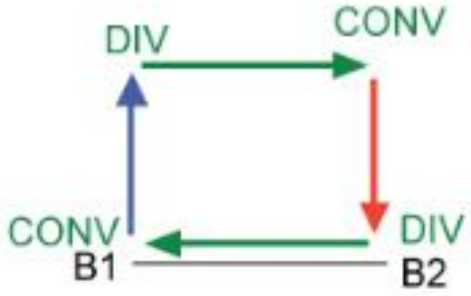
DIVERGENCE
Dynes scheme

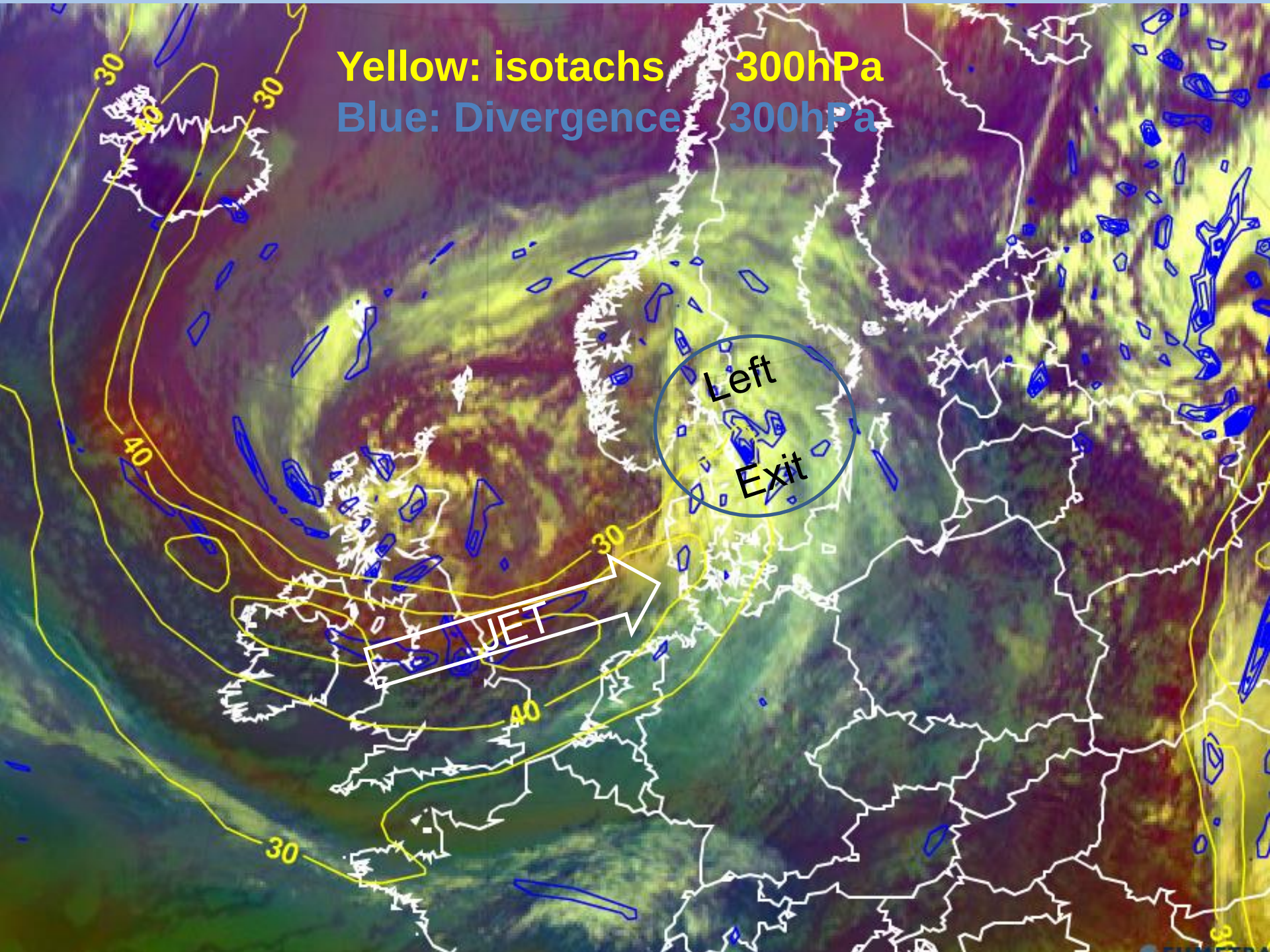


Divergence and Jetstreaks








Yellow: isotachs 300hPa
Blue: Divergence 300hPa
30
30
40
30
40
30
Left
Exit
JET

Contributing Countries

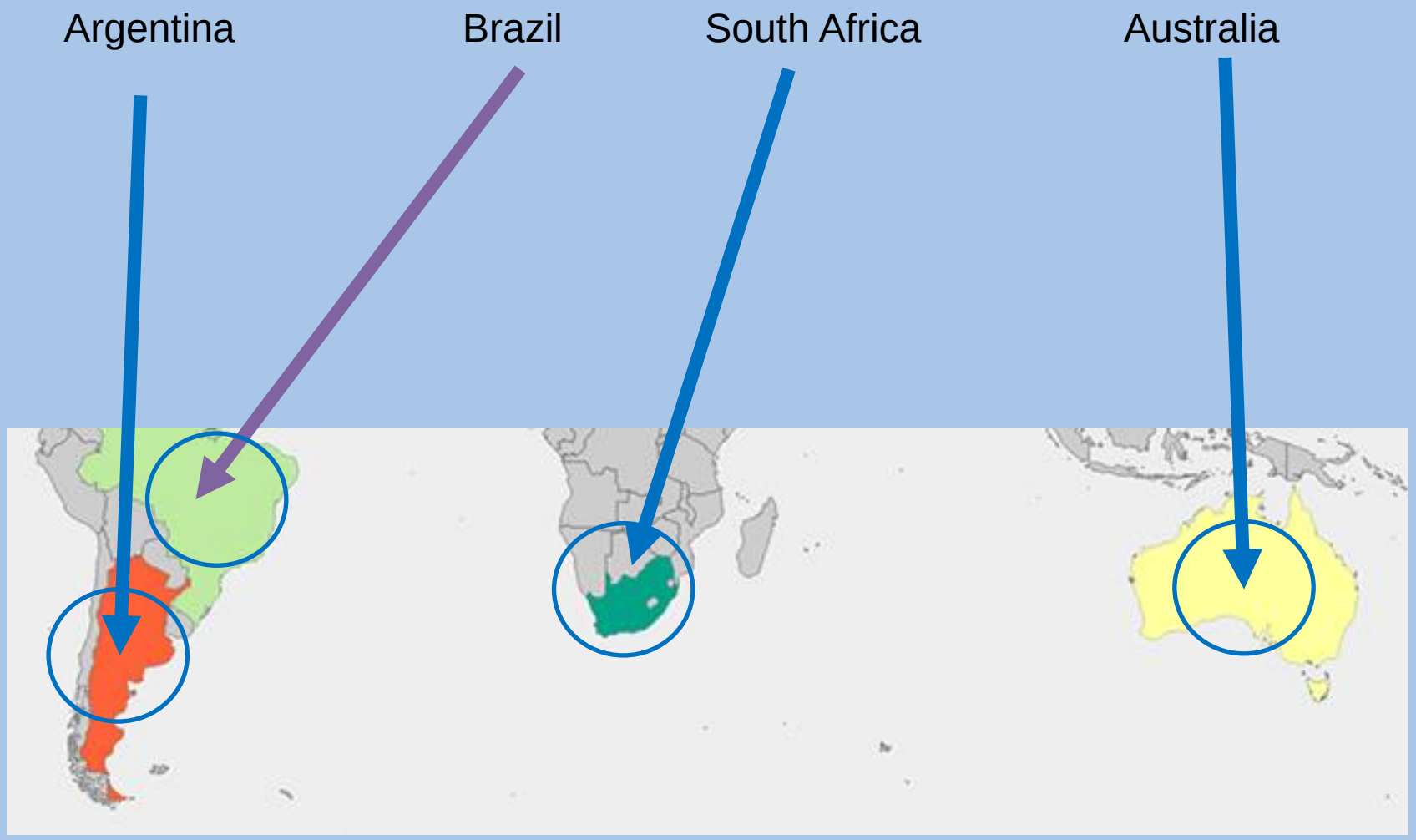
10 years project
Started in 1995

EUMETSAT

After 2005 maintenance and updating

EUMeTrain

Conceptual Models for Southern Hemisphere (CM4SH)

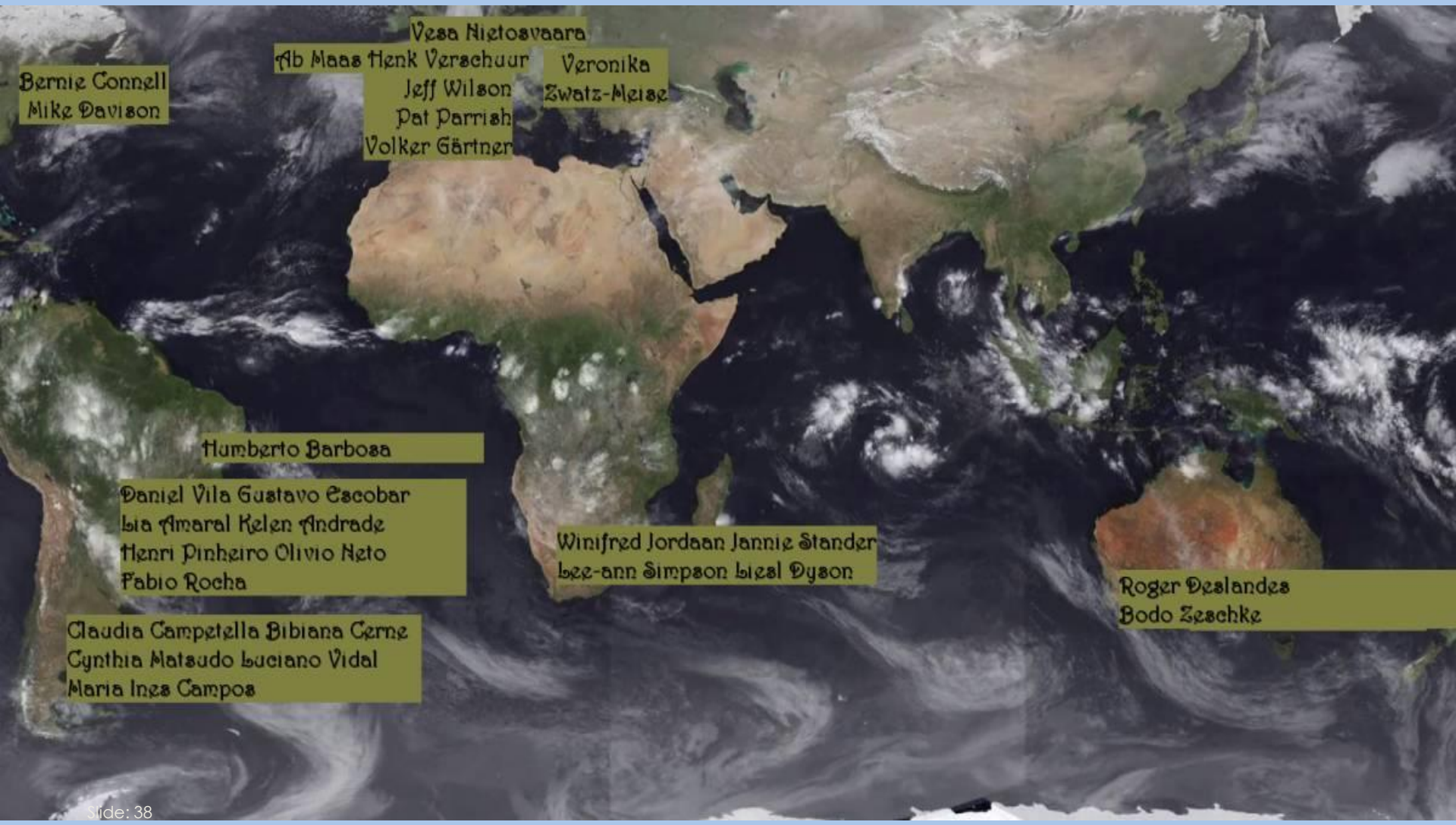


Project team: CoE experts

Review: CIRA + NOAA

Funding:

WMO+EUMETSAT



Project deliverables

1. A comprehensive list of existing literature
2. A quick-look collection of interesting cases
3. Conceptual Model descriptions

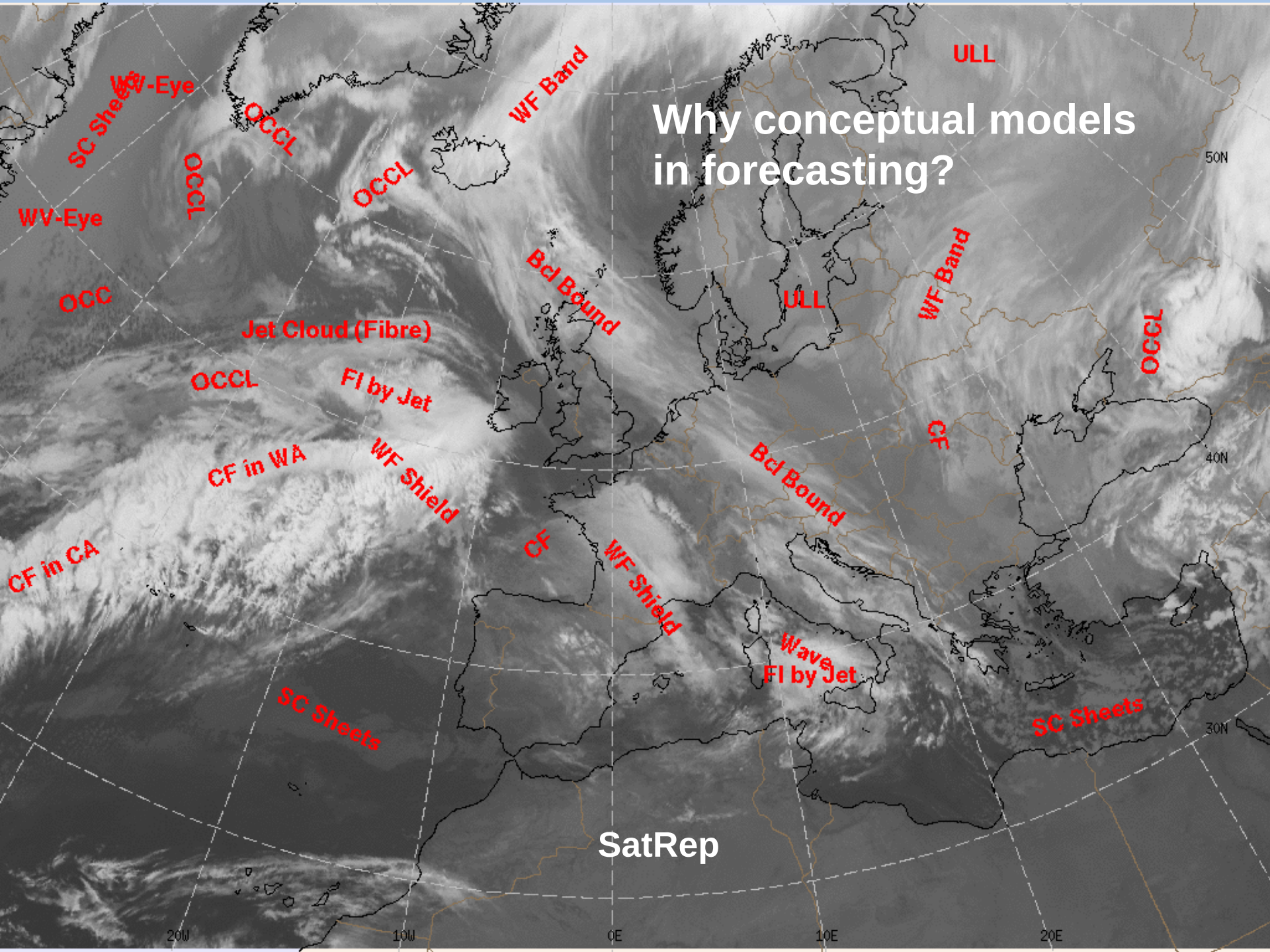
+ much more

Orientation sessions ...Inventories of SH Conceptual Models ...

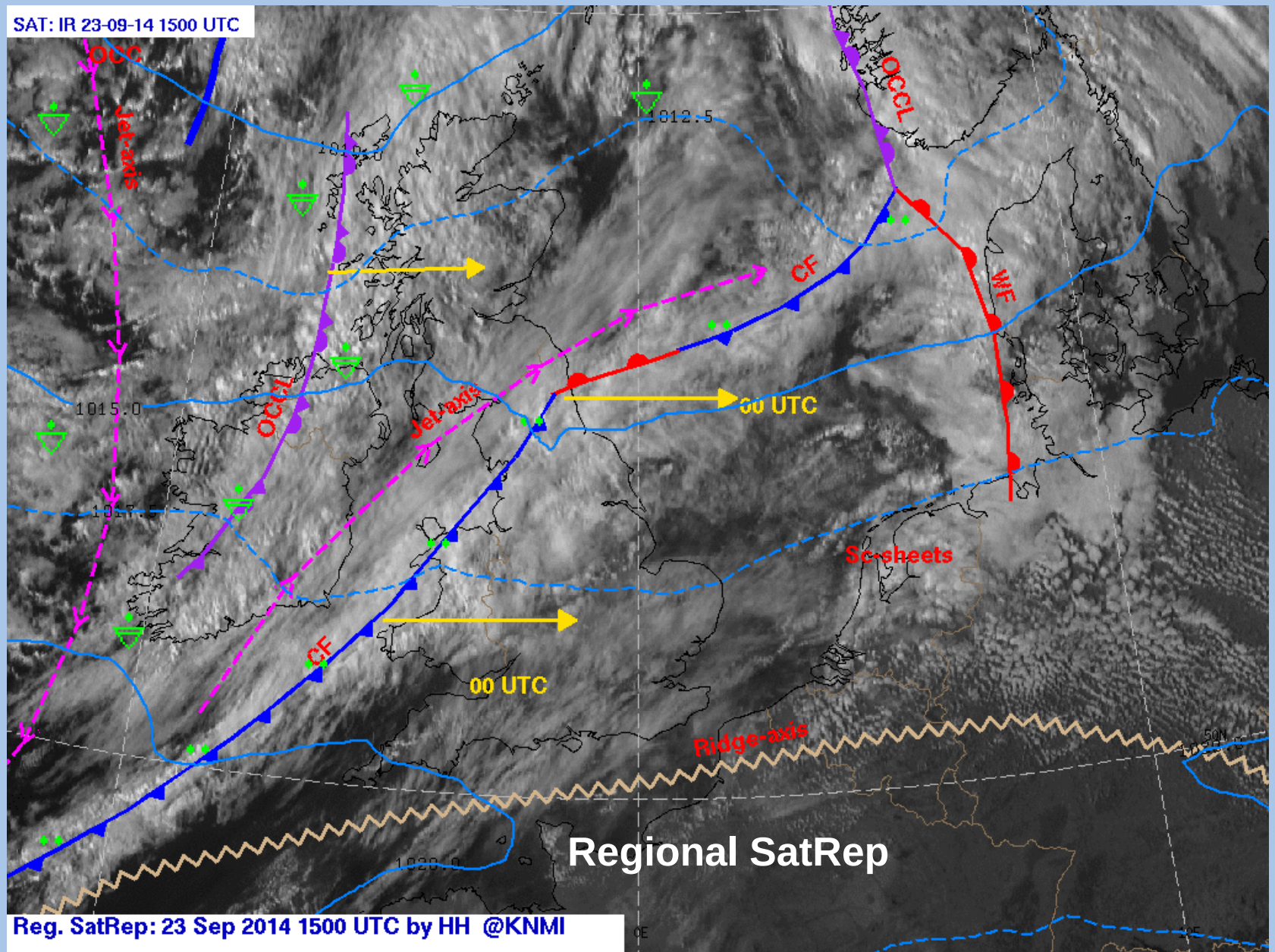
Training sessions...Sharing regional CMs across all teams

CM4SH part II to begin January 2015?!

1. Same partners + maybe one new…
2. Document 6-10 more CMs
3. https://sites.google.com/site/cmsforsh


Why conceptual models in forecasting?
ULL
WF Band
SC Sheets
WV-Eye
OCCL
OCCL
OCCL
WV-Eye
Bcl Bound
ULL
WF Band
OCC
Jet Cloud (Fibre)
OCCL
OCCL
Fl by Jet
CF
CF in WA
WF Shield
Bcl Bound
CF
WF Shield
CF in CA
Wave
Fl by Jet
SC Sheets
SC Sheets
SatRep
50N
40N
30N
20W
10W
0E
10E
20E

Why conceptual models in forecasting?



Why conceptual models in forecasting?

*CM's are not perfect… but…

*Help you to understand the most important Weather Phenomena

*Help you to keep alert in the nowcast period

*Help you in cases the NWP output is not confirm the reality

*Always think for your self as the expert.

*NWP output is also not perfect.

*But the combination of the two improve your forecast substantially

*Both can still be improved and broadened.

*Challenge to you ??

Thank You For

Your Attention