Aviation Meteorology :New challenges advising an Industry in Transition

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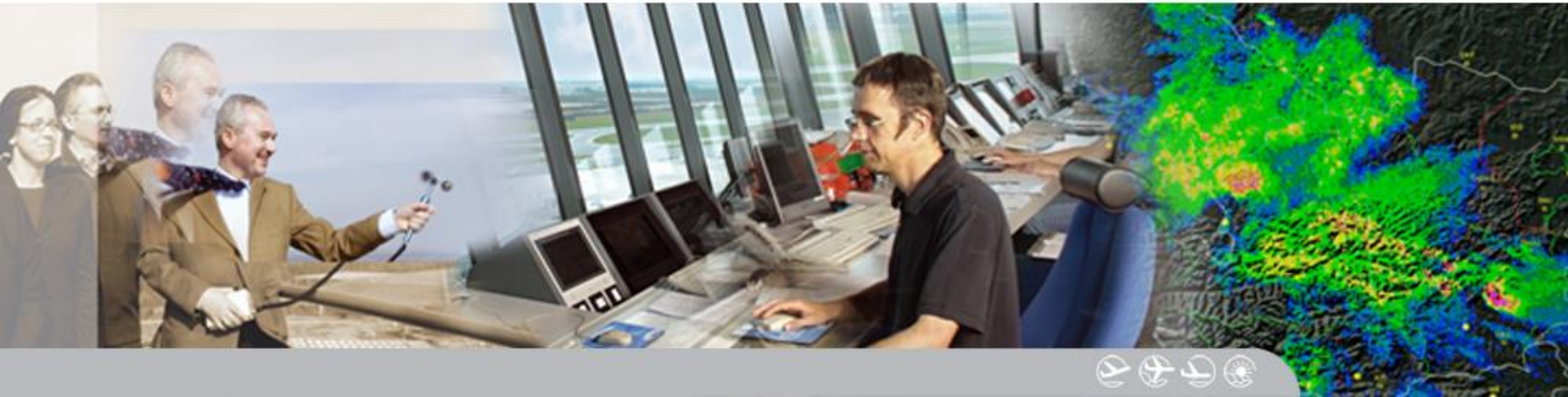


How will crises such as Climate Change and Pandemics affect the requirements and operating conditions of aviation?

- Mountainous regions show faster warming, higher incidence of high-impact weather
- Helicopters often only way to support stricken communities
- Short runways, high altitude, high temperatures limit endurance
- Changed flow pattern affect many processes from snow fall to convection location, intensity, speed of development
- Lee cyclogenesis?
- Call for climate-friendly trajectories
- Pandemics and reduced traffic may shift priorities in forecast parameters, projection and accuracy

Data issues

- Which data are currently available at high temporal and spatial resoluion
- What are the plans for additional such data
- Use of UAV?
- Surface properties, moisture , vegetation, snow cover
- Use of aircraft data

Special needs for forecasts/now-casts

- High Impact weather situations are typically linked to smaller scales and contain stochastic elements
- These scales are rarely observed over larger domains, and thus even verification and validation are problematic
- Safety and capacity related ATM applications require information and decision making on the timescale of a few minutes to a few hours, with an increasing demand for reliable outlooks to several days
- Reliable, accurate and consistent deterministic forecasts of such events will remain elusive for some time. Therefore, high-resolution ensemble prediction systems may provide useful information, e.g. by quantifying the MET uncertainty at the local level and on short time-scales, and estimate the risk of high impact, small-scale weather phenomena.

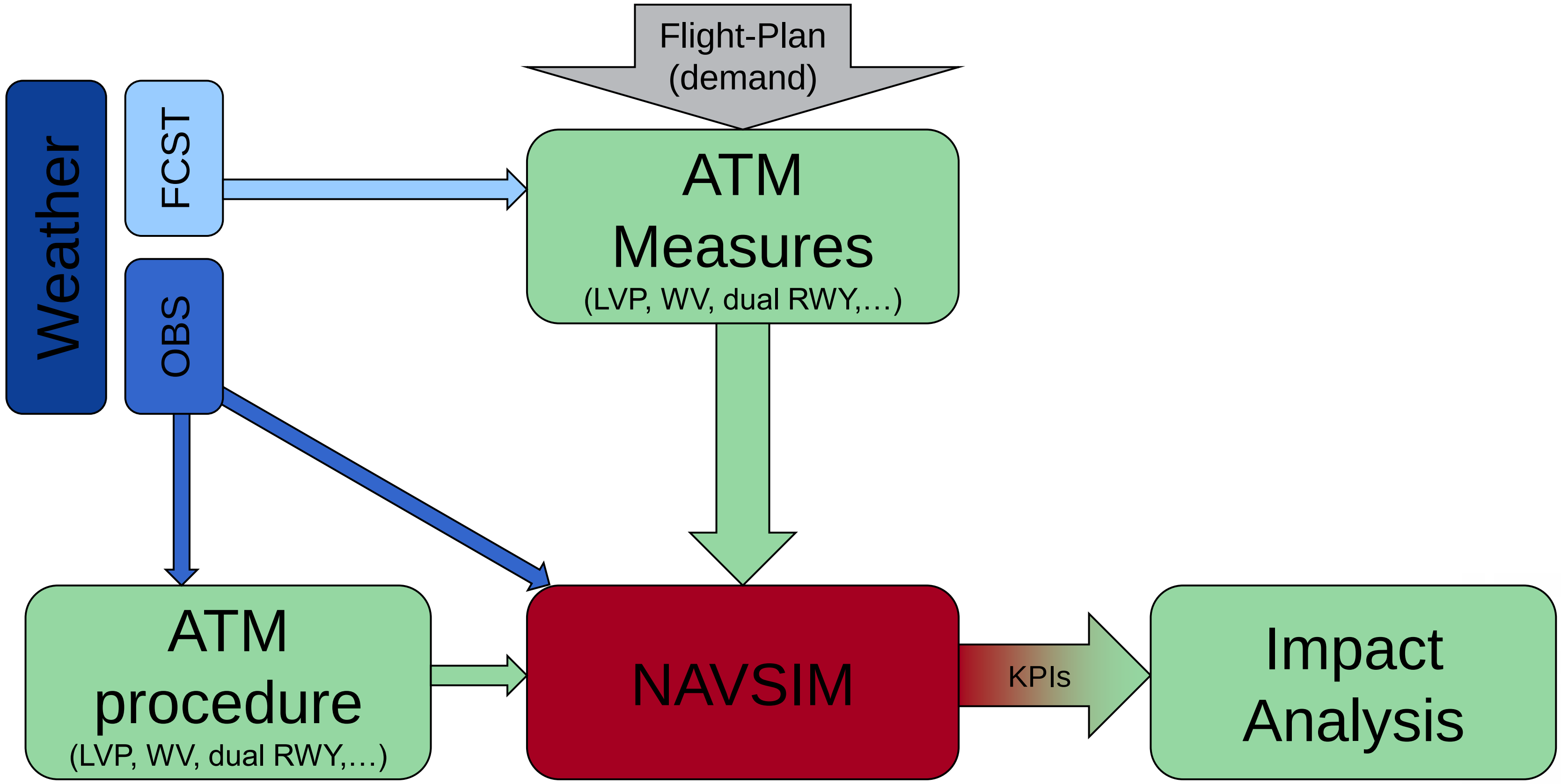
Weather (and related..) elements to be considered

- Visibility, often combined with Cloud Base as LVP conditions
- wind speed, intensity, direction (head-, crosswind) and gusts
- Icing Conditions (En-route, High Level, Need for de-icing, snow clearing)
- Precipitation (heavy, freezing, solid)
- Duration of weather events (onset, cessation)
- Thunderstorm / hail
- Lightning (shut down of ground operations)
- Turbulence at all levels

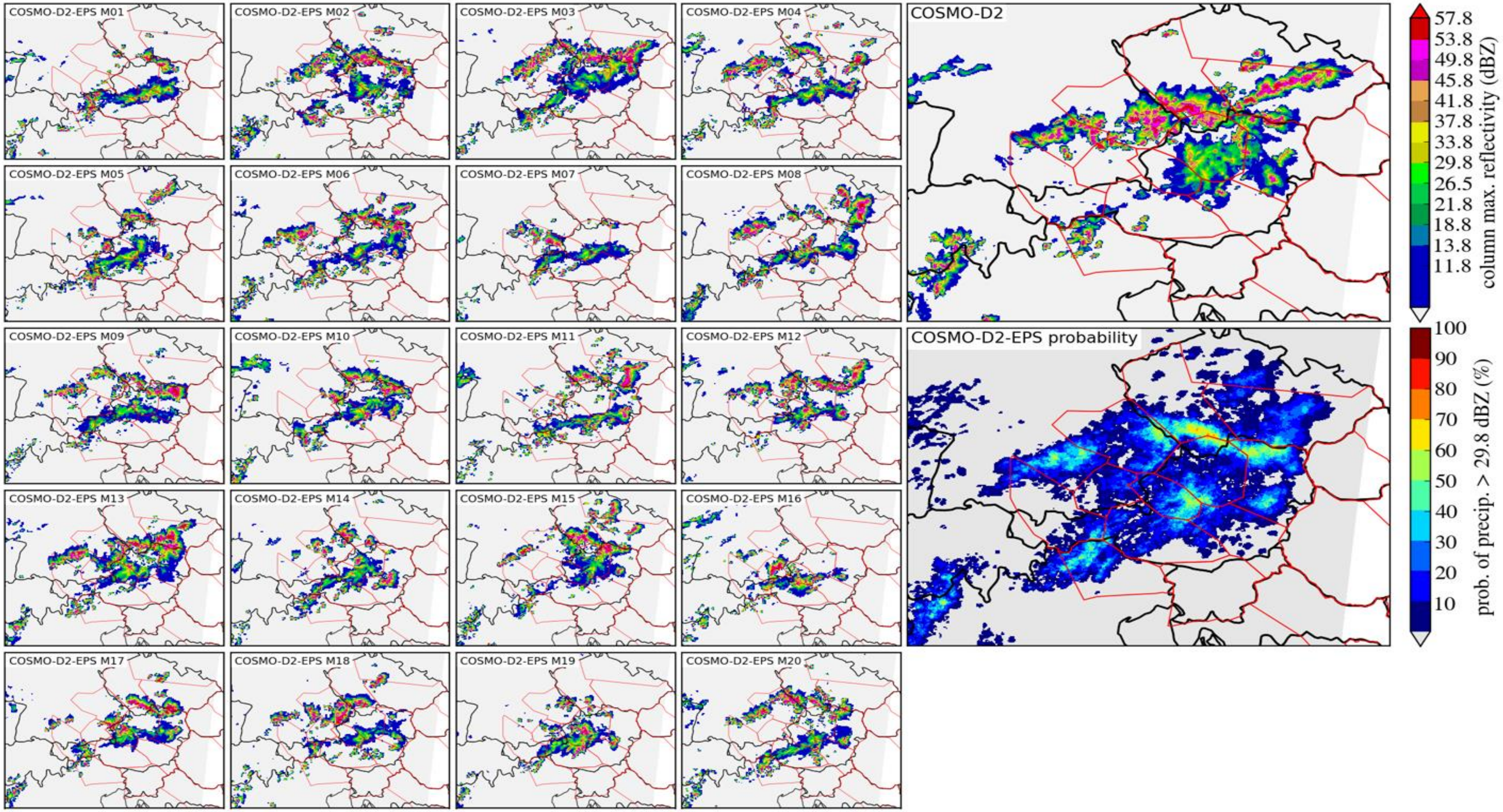
Priority subjects:

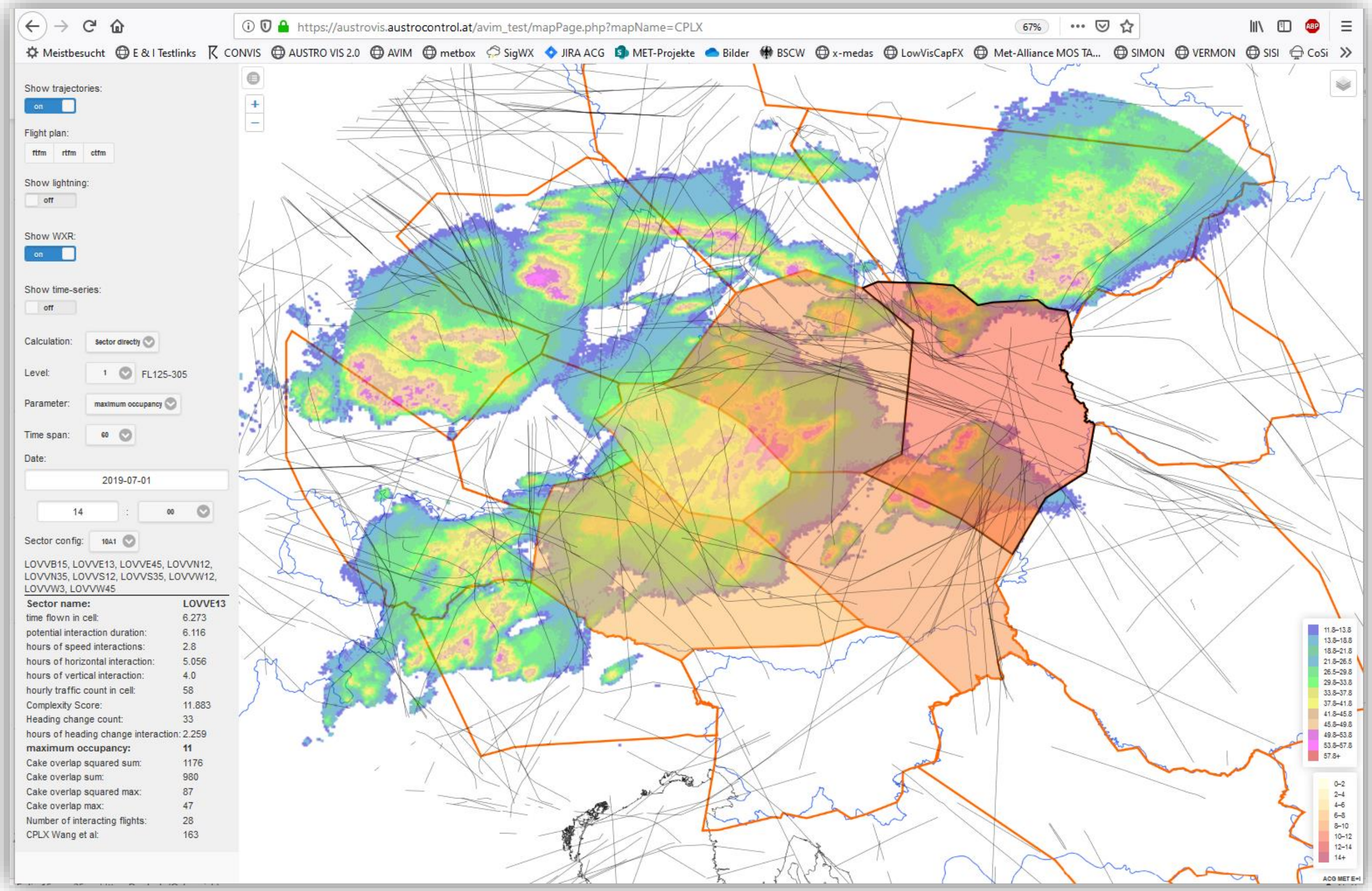
- Deep convection:
  - convection initiation over and in the vicinity of mountains
  - orographic modification of thunderstorm tracks (“channeling”, cloud tops and life cycle
  - High incidence of Deep Convection and dense air traffic
  - issue of early initiation and early decay of thunderstorms in operational forecast models
- Turbulence issues
- rotors and turbulence: fine-scale climatology at Alpine airports in relation to southerly / northerly / westerly foehn
- moderate/ severe turbulence in jet stream over the Alps
- “ground truth” for forecasting and verification
- □ How strong must a mountain wave be in order to cause “level busts”

Weather impact analysis



Comparison of DWD COSMO-D2-EPS and COSMO-D2 2.2 km forecasts
Run: 2019-07-01 09 UTC, Validity: 2019-07-01 15 UTC (+06h)





https://austrovis.austrocontrol.at/avim_test/mapPage.php?mapName=CPLX
67%
Meistbesucht
E & I Testlinks
CONVIS
AUSTRO VIS 2.0
AVIM
metbox
SigWX
JIRA ACG
MET-Projekte
Bilder
BSCW
x-medas
LowVisCapFX
Met-Alliance MOS TA...
SIMON
VERMON
SISI
CoSi
Show trajectories:
on
Flight plan:
ftfm rtfm ctfm
Show lightning:
off
Show WXR:
on
Show time-series:
off
Calculation: sector directly
Level: 1 FL125-305
Parameter: maximum occupancy
Time span: 60
Date:
2019-07-01
14 : 00
Sector config: 10A1
LOVVB15, LOVVE13, LOVVE45, LOVVN12, LOVVN35, LOVVS12, LOVVS35, LOVVW12, LOVVW3, LOVVW45
Sector name: LOVVE13
time flown in cell: 6.273
potential interaction duration: 6.116
hours of speed interactions: 2.8
hours of horizontal interaction: 5.056
hours of vertical interaction: 4.0
hourly traffic count in cell: 58
Complexity Score: 11.883
Heading change count: 33
hours of heading change interaction: 2.259
maximum occupancy: 11
Cake overlap squared sum: 1176
Cake overlap sum: 980
Cake overlap squared max: 87
Cake overlap max: 47
Number of interacting flights: 28
CPLX Wang et al: 163

Boundary layer questions

- Valley wind systems, their dynamics and interaction with convection, frontal systems, runway changes
- Role of surface properties, slopes and valley radiational warming interacting with cloudiness
- Scales resolved?

Issues of climate change related to convection

- How are the characteristics of deep convection projected to change in the coming years and decades?
  - Degree of convection organization, cloud tops, intensity, stationarity
- Are existing findings on the changes of deep convection (lower frequency of occurrence but higher intensity) valid for the Alps?
- Is the gradual, climate-change-induced shift of the polar front jet stream modified by the Alps?
- Incidence of tornadic storms and MCS in the vicinity of the Alps (N and S), Role of moisture sources in pre-Alpine lakes?

Role of Synoptic-scale Flow and shear

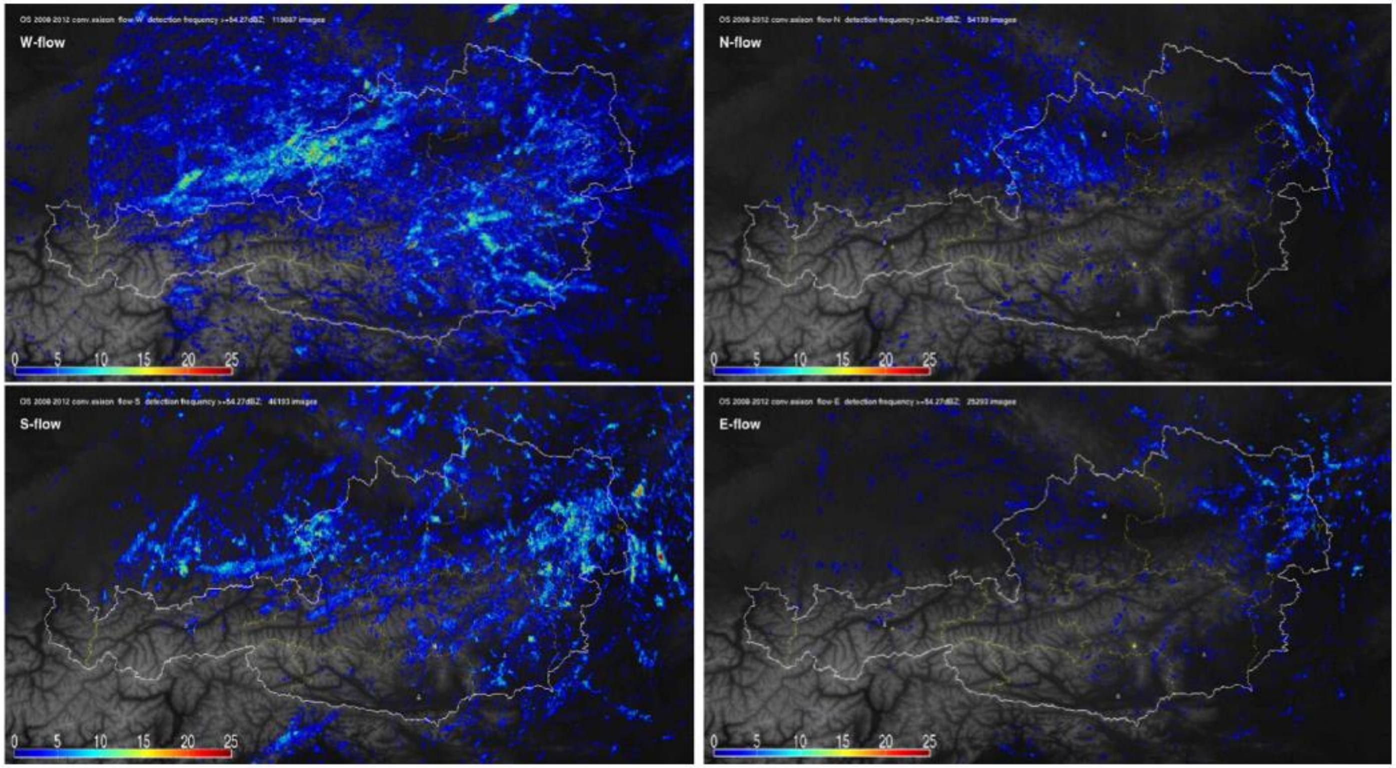


Fig. 6. As Fig. 2 but for frequency distributions of $Z \geq 54$ dBZ (absolute numbers) for different flow configurations (500 hPa) during the convective seasons 2008–2012 derived from Austrian composite consisting of 4 weather radars. From upper left to lower right: W-, N-, S- and E-flow.