International Mountain Conference

SEPTEMBER 14 - 18 2025

INNSBRUCK/AUSTRIA

PS 3.104: Do we need more atmospheric data in mountainous terrain? - the TEAMx field campaign and what we can learn from it

Applications: use of TEAMx data in environmental assessments

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Environmental assessments

- *Environmental resource assessment*

  Air, water, soil, biosphere, ecosystems, energy, human health…

- *Environmental impact assessment*

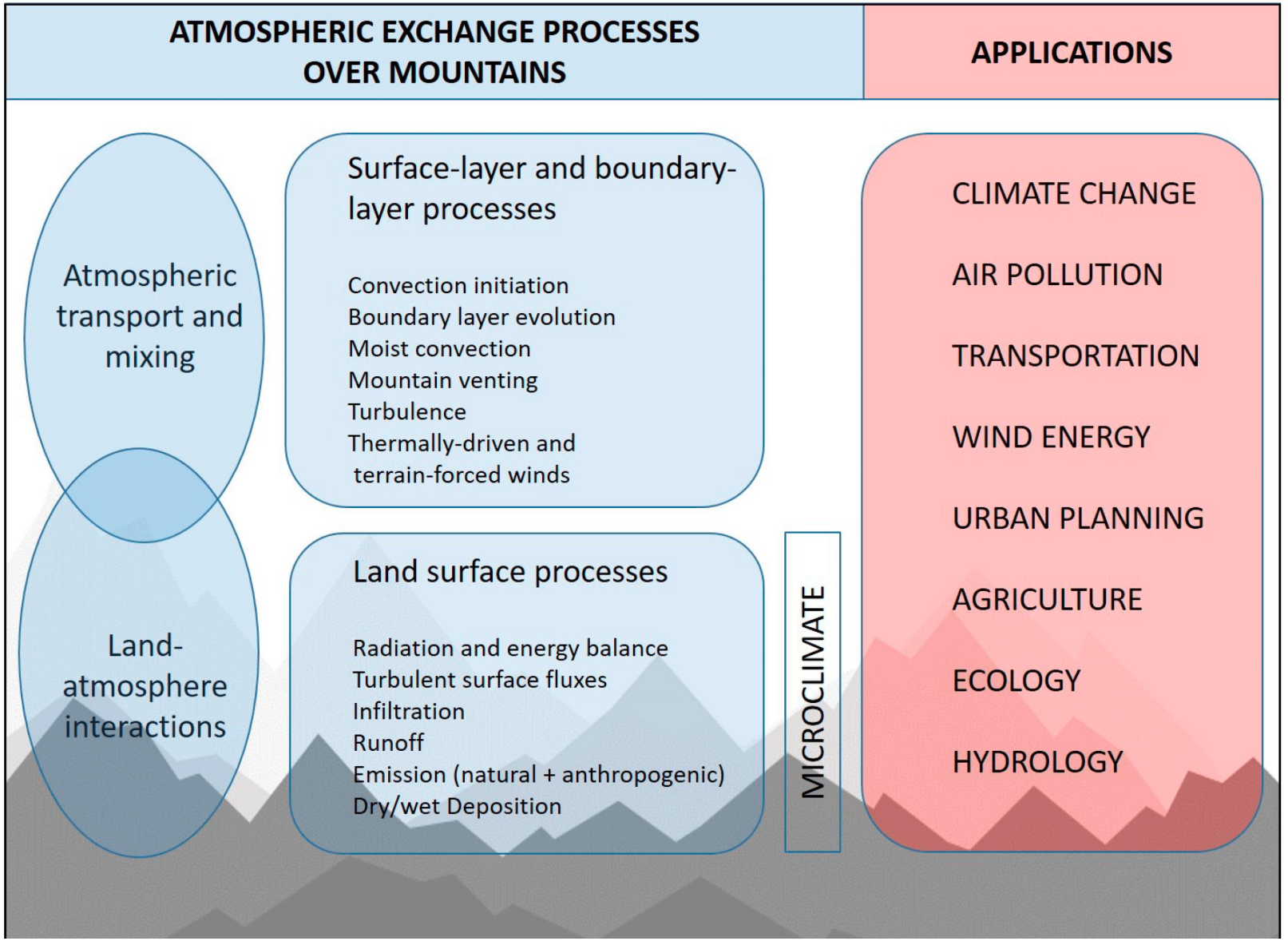
  Impact of anthropogenic activities on environmental systems, including weather and climate

Resources for environmental assessments

- *Observations*
- Analysis of data from instrumental observations in the environment

- *Predictions*
- Analysis of output from mathematical, numerical or data-driven modelling

TEAMx harvest and environmental assessments

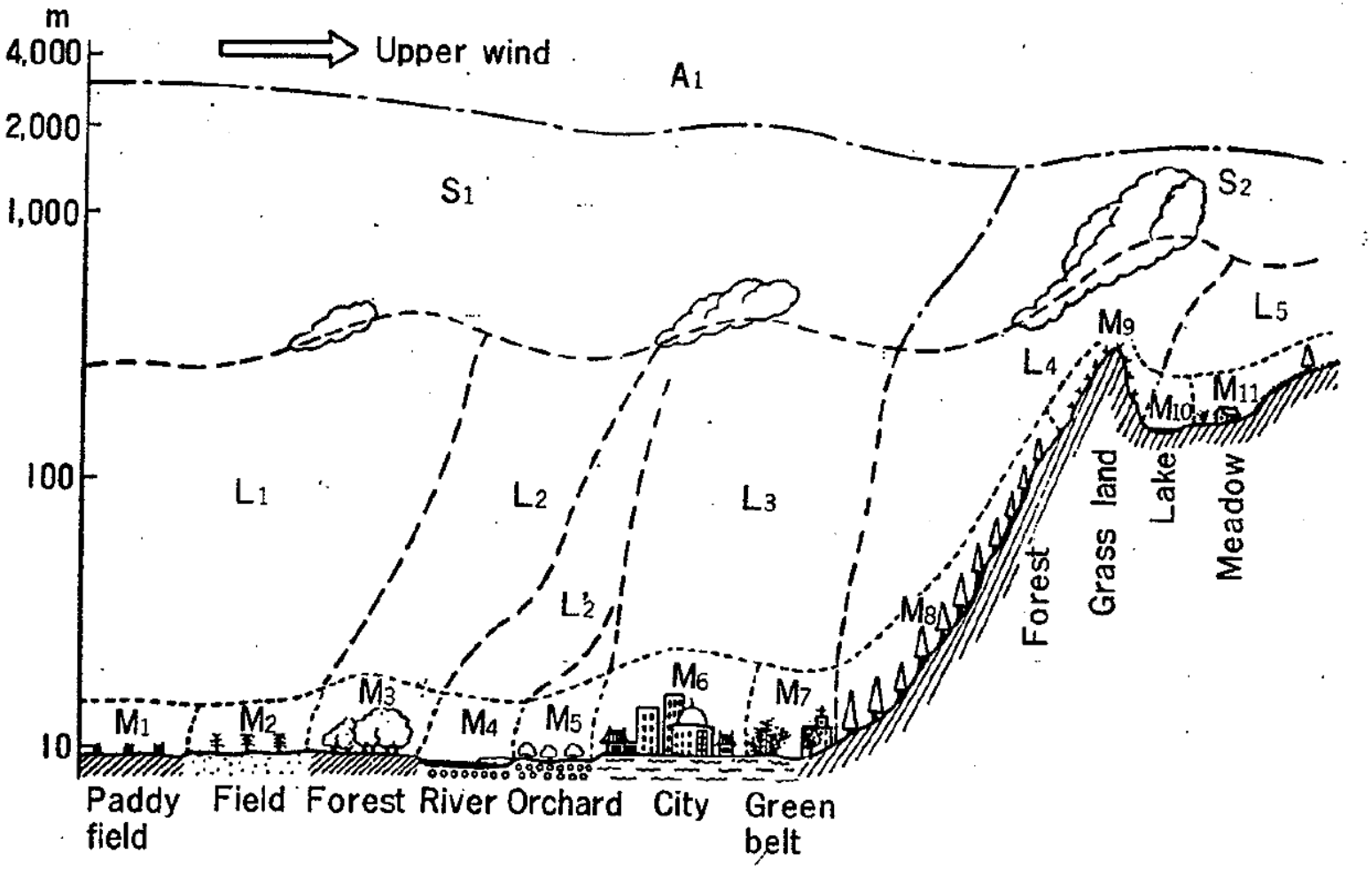


De Wekker et al. 2018

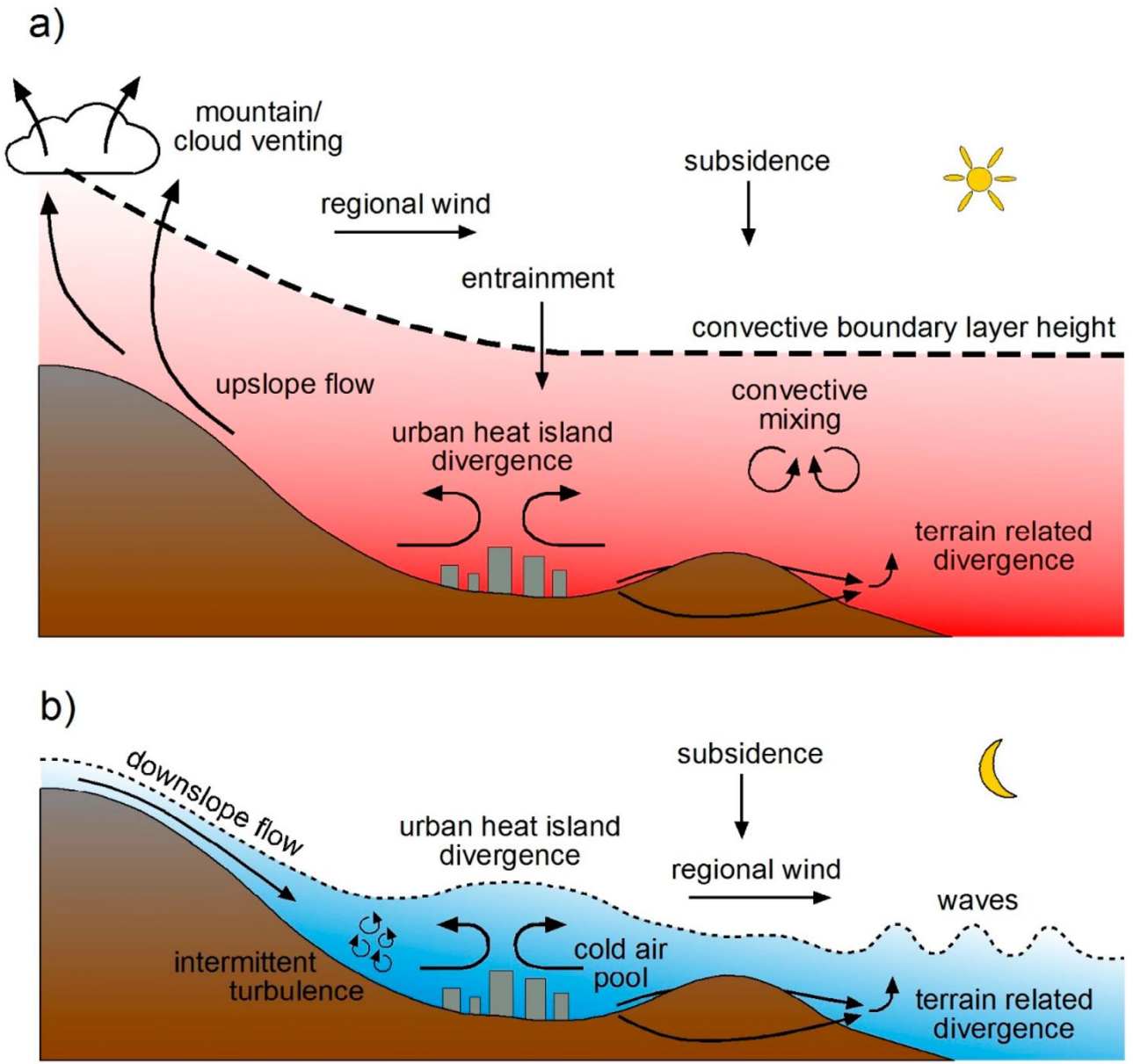
Environmental systems and climatic areas

Examples of micro-, local , and macroclimatic phenomena:
M_1-M_{11} : Microclimate,
L_1-L_5: Local climate,
S_1-S_2 Mesoclimate,
A_1: Macroclimate

(Yoshino 1961)



Interplaying phenomena



Air quality

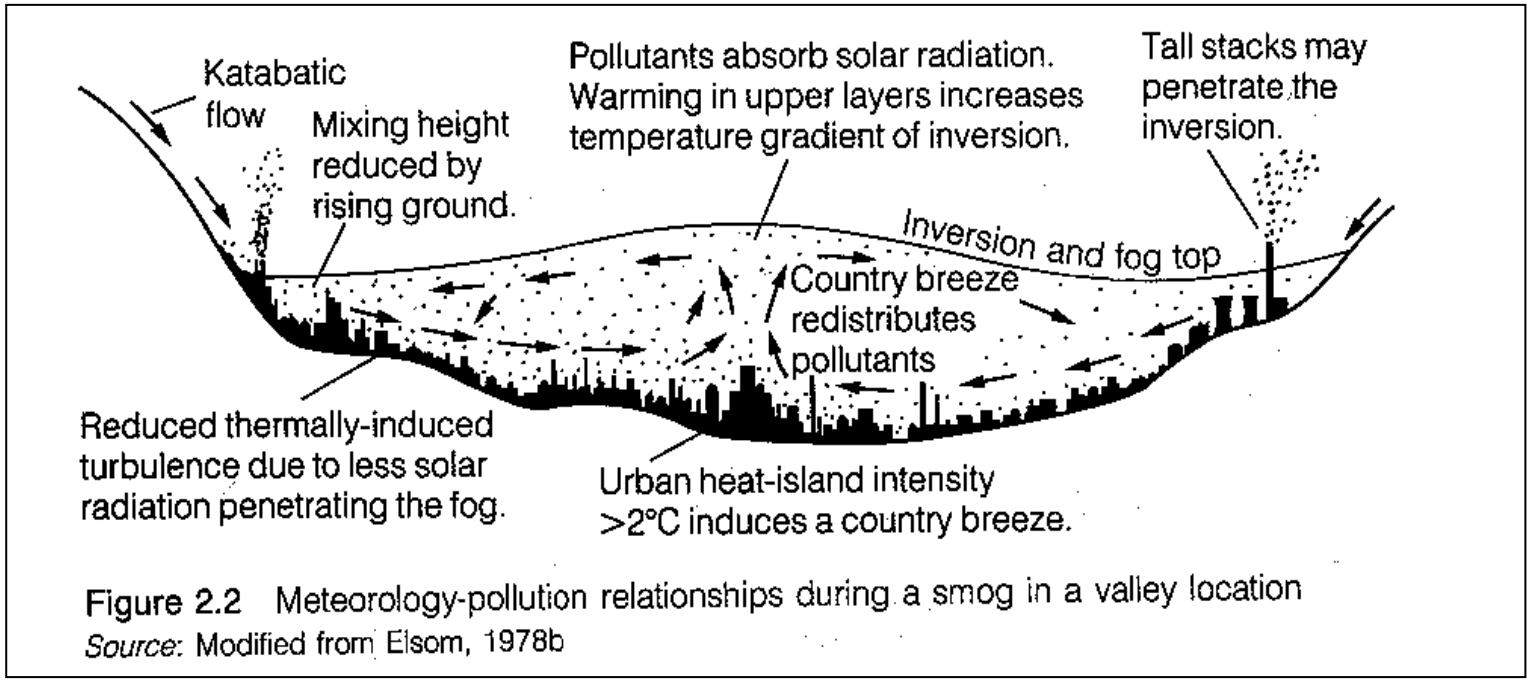
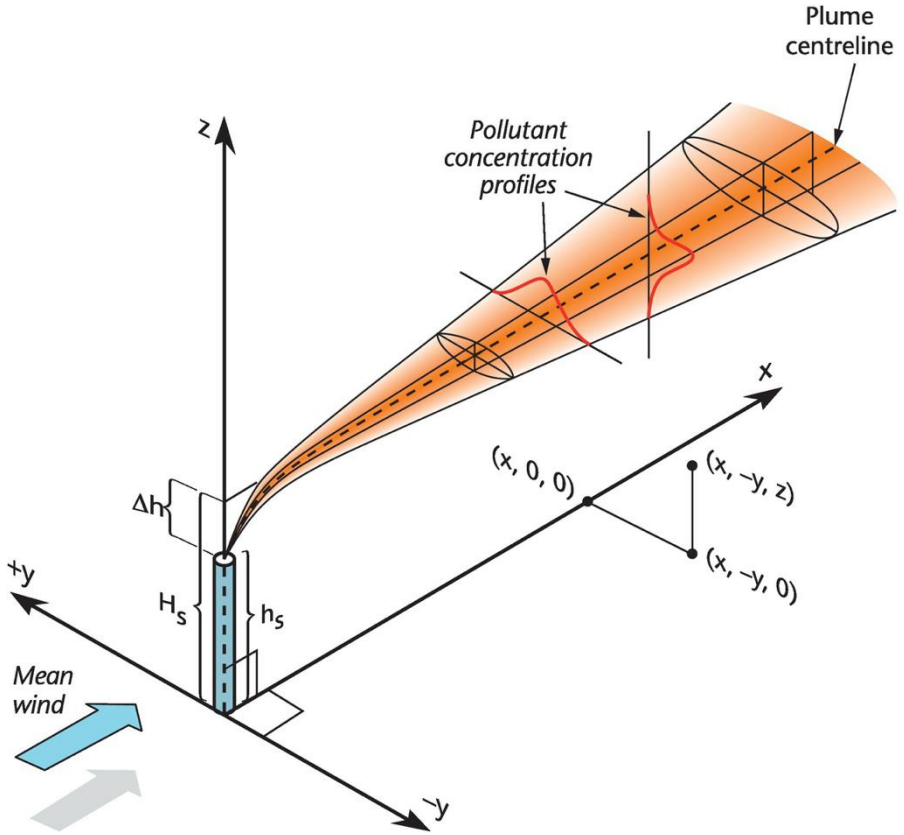


Figure 2.2 Meteorology-pollution relationships during a smog in a valley location
Source: Modified from Elsom, 1978b

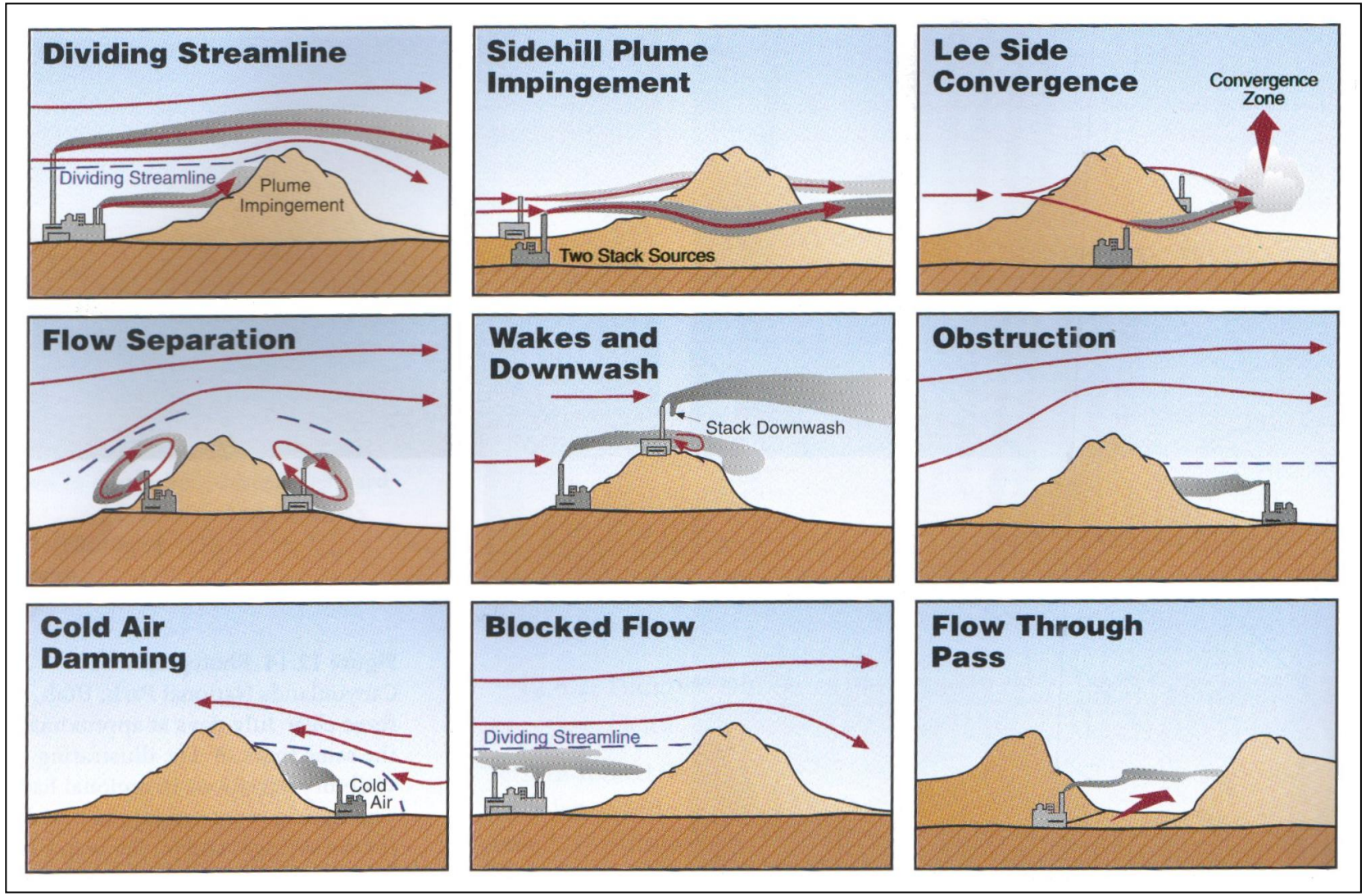
Steyn et al. 2008.

Factors controlling pollutant concentration $\bar{c}$:

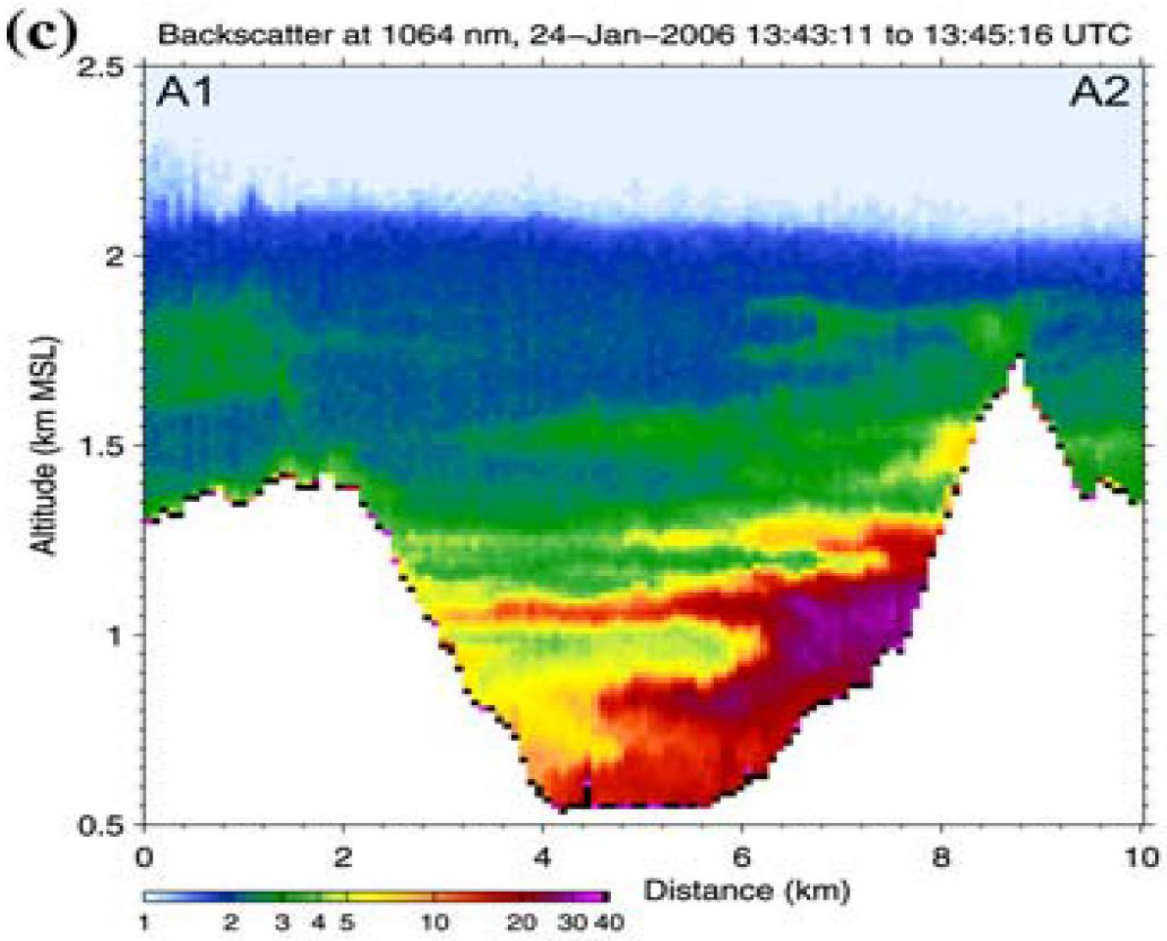


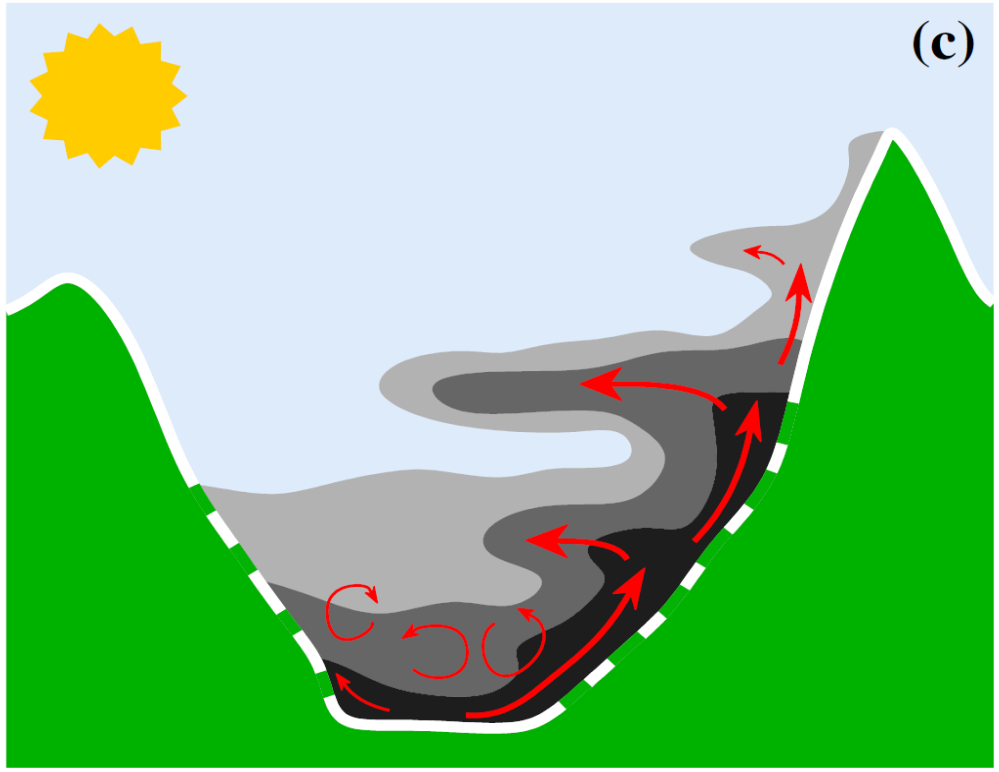
Oke et al. 2017

$$\frac{\partial \bar{c}}{\partial t} = \underbrace{-\bar{u}\frac{\partial \bar{c}}{\partial x} - \bar{v}\frac{\partial \bar{c}}{\partial y} - \overline{w}\frac{\partial \bar{c}}{\partial z}}_{\text{Advection}} + \underbrace{\frac{\partial}{\partial x}\left(K_x \frac{\partial \bar{c}}{\partial x}\right) + \frac{\partial}{\partial y}\left(K_y \frac{\partial \bar{c}}{\partial y}\right) + \frac{\partial}{\partial z}\left(K_z \frac{\partial \bar{c}}{\partial z}\right)}_{\text{Turbulent diffusion}} + \underbrace{S}_{\text{Sources/Sinks}}$$



Whiteman 2000





Gohm et al. 2009

atmosphere

MDPI

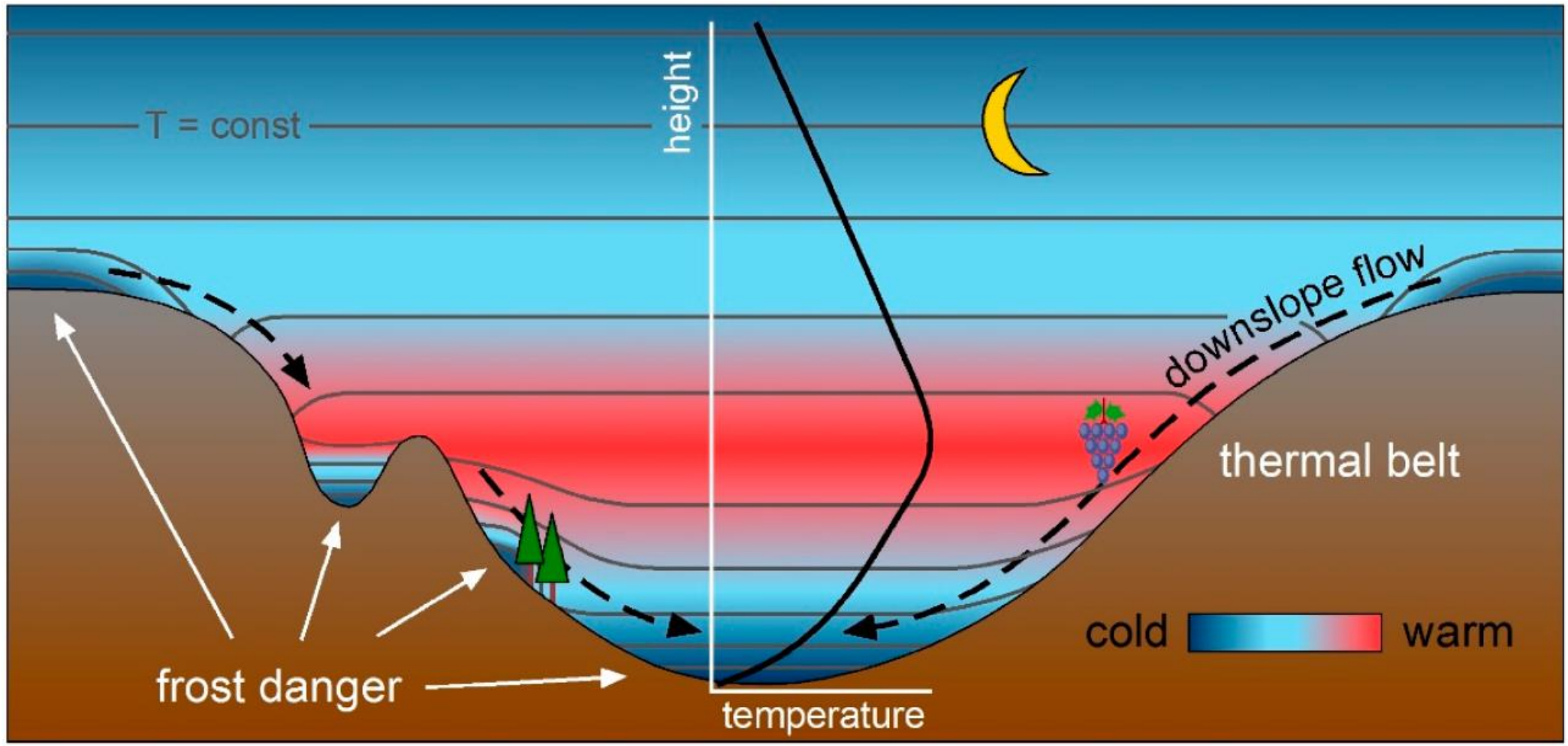
Review

Atmospheric Pollutant Dispersion over Complex Terrain: Challenges and Needs for Improving Air Quality Measurements and Modeling

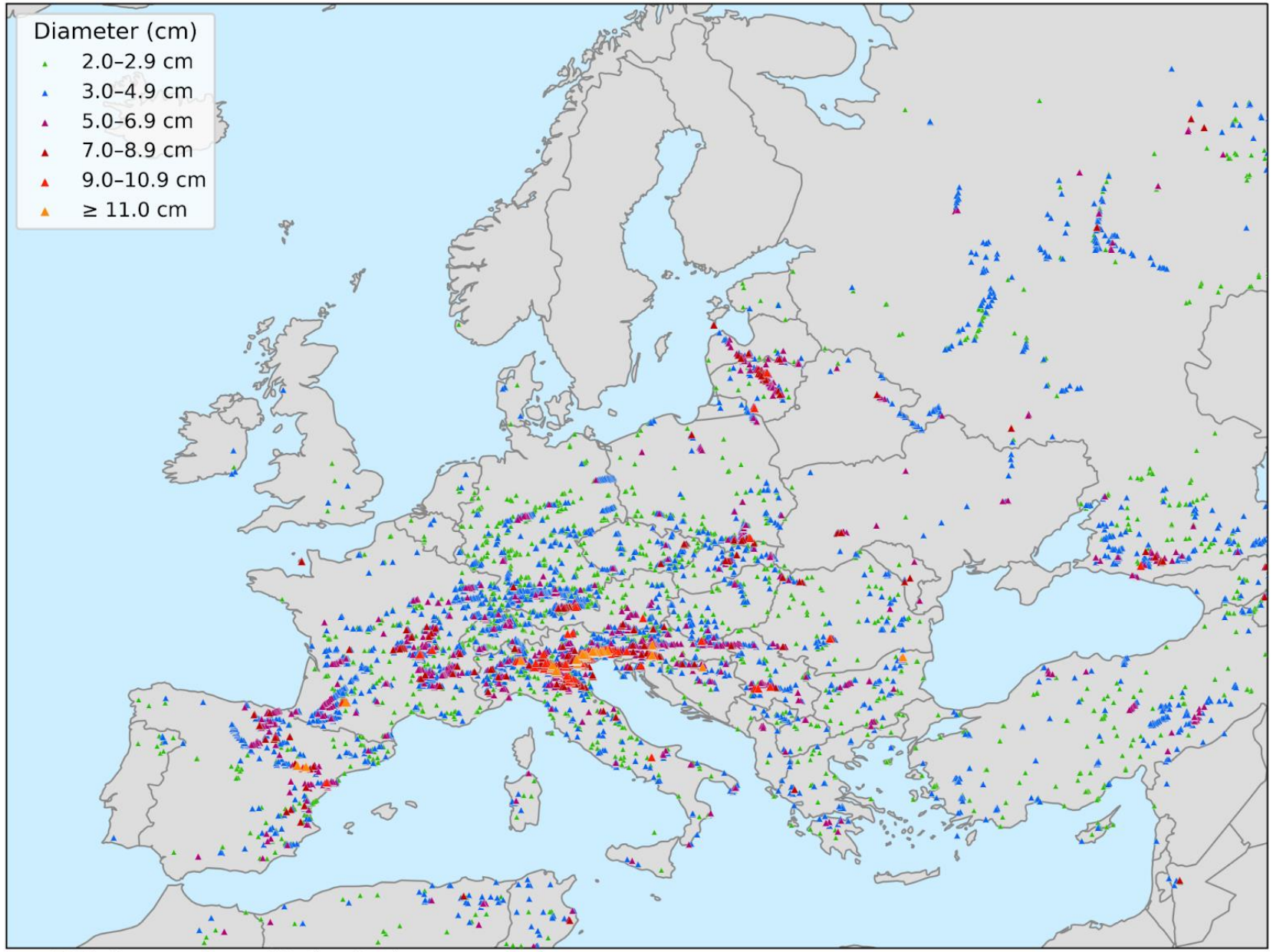
Lorenzo Giovannini [1,*], Enrico Ferrero [2], Thomas Karl [3], Mathias W. Rotach [3], Chantal Staquet [4], Silvia Trini Castelli [5] and Dino Zardi [1,6]

https://doi.org/10.3390/atmos11060646

Agriculture and forestry


T = const
height
downslope flow
thermal belt
cold
warm
frost danger
temperature

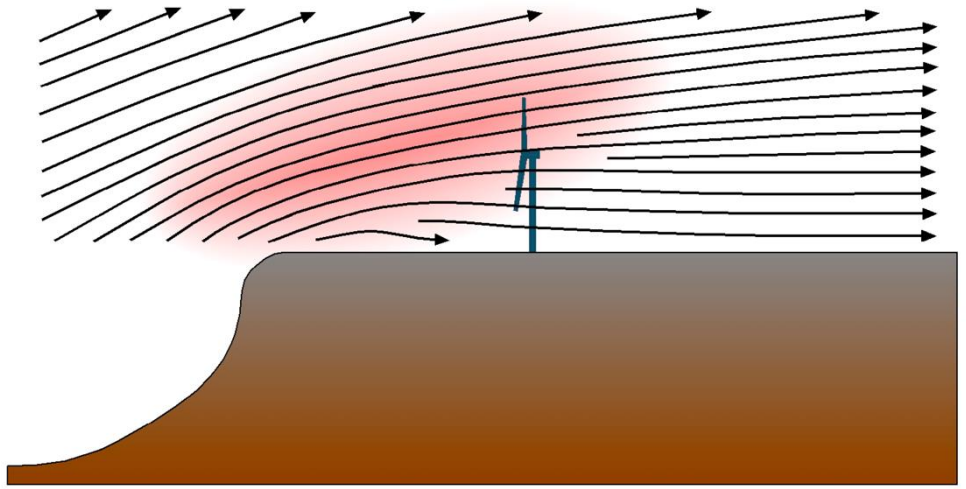
Hail reports in 2023



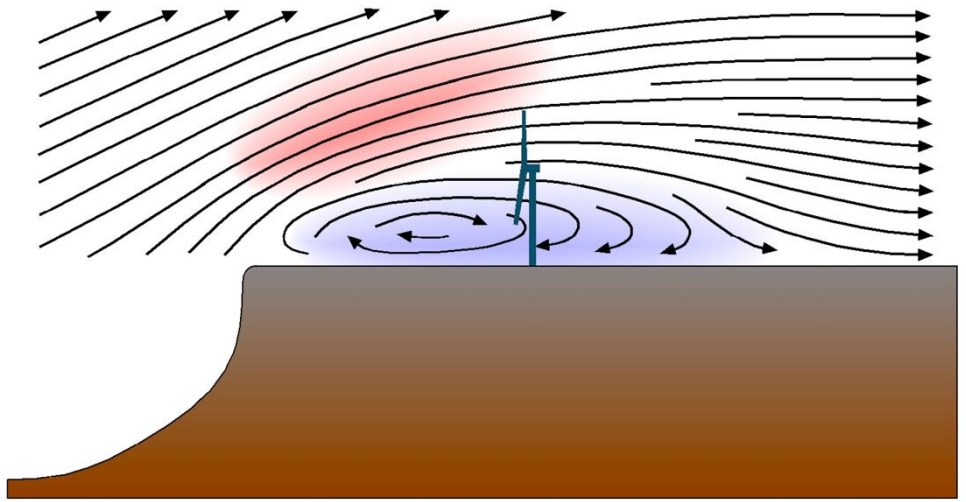
Source: ESSL, European Severe Weather Database: www.eswd.eu

Energy

a)



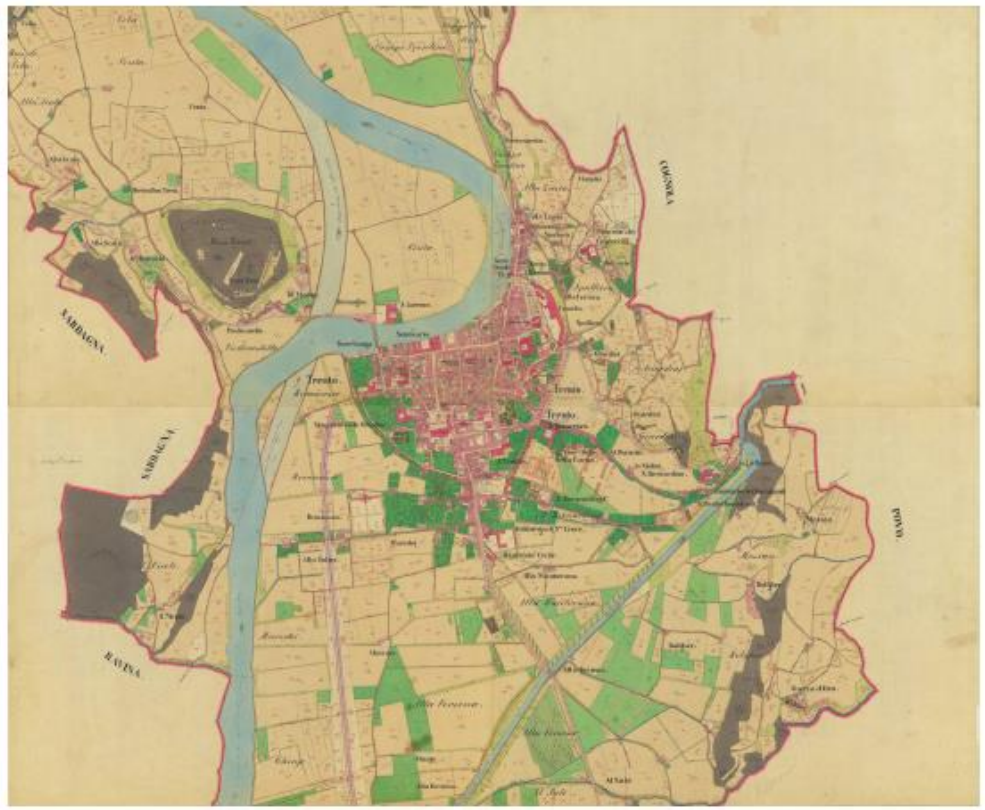
b)



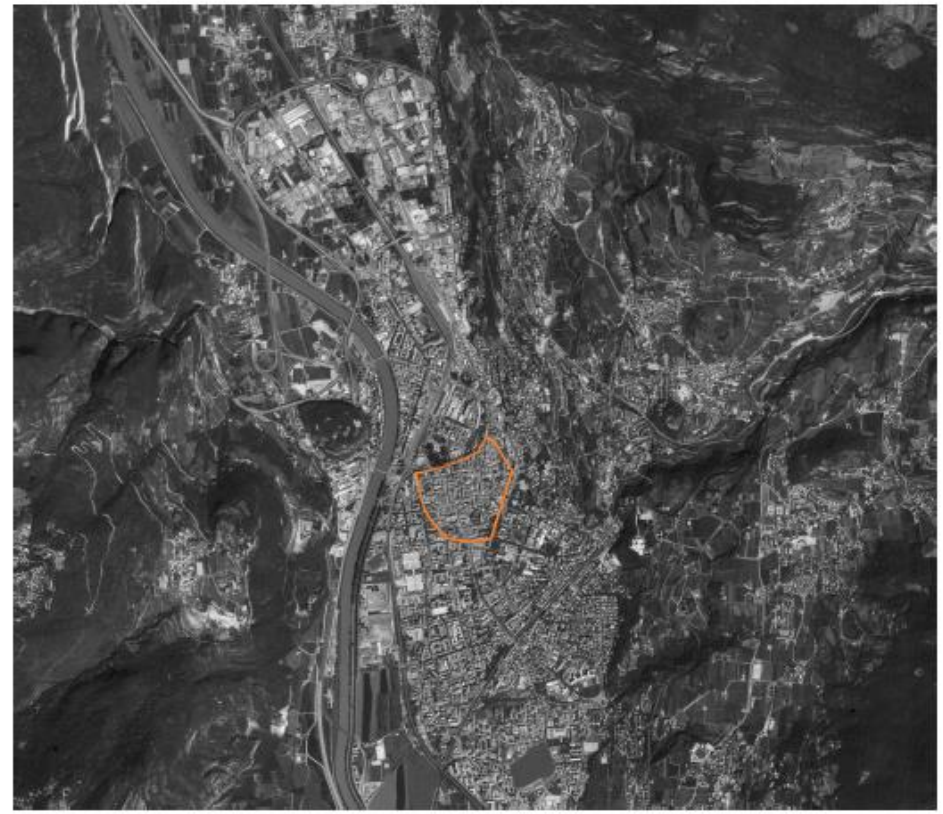
Human health

- Air quality
- Thermal comfort
- Pathogens
- …

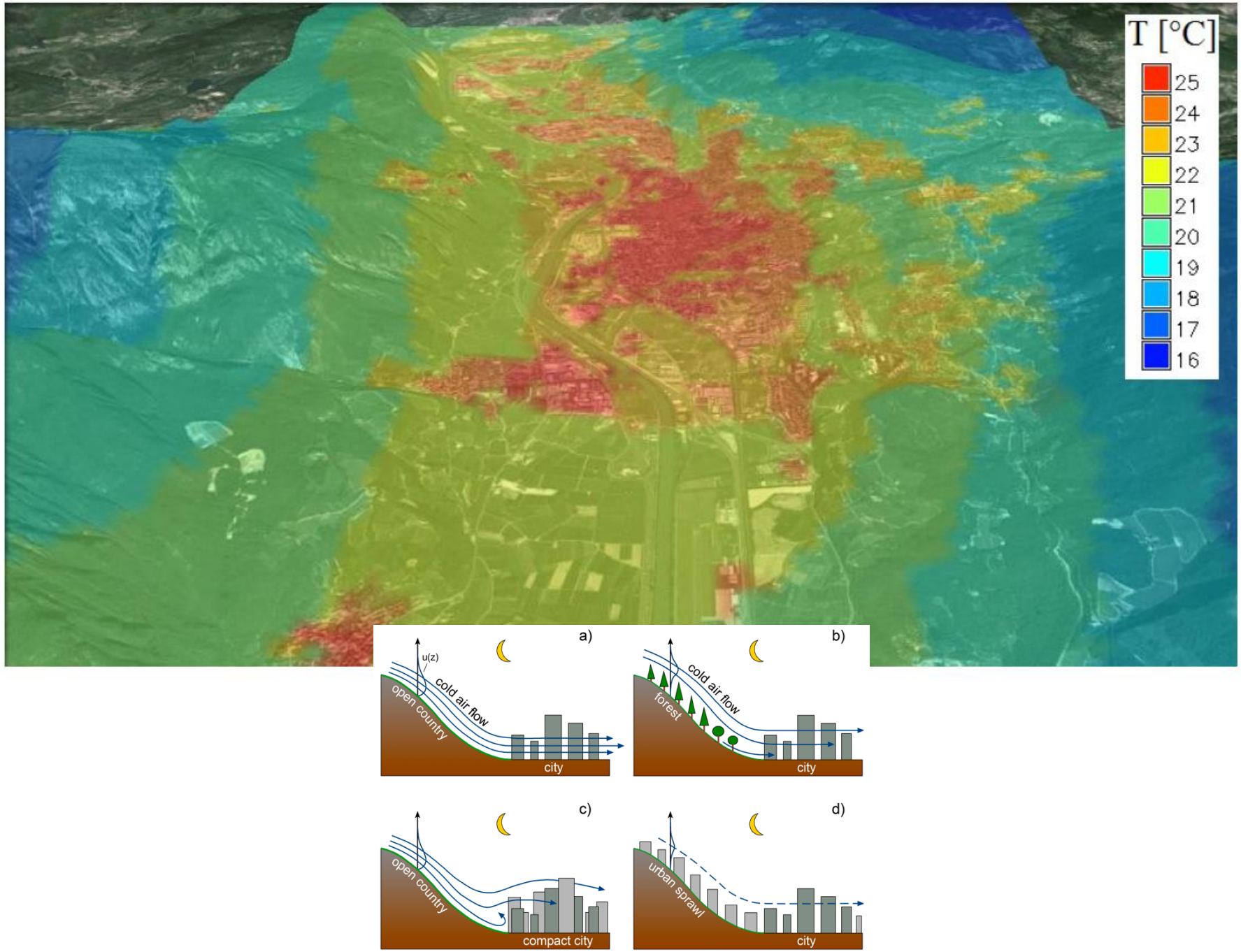
Trento ∼ 1860



Trento today



Giovannini et al 2016


T [°C]
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a)
u(z)
cold air flow
open country
city
b)
cold air flow
forest
city
c)
open country
compact city
d)
urban sprawl
city

Transport system safety

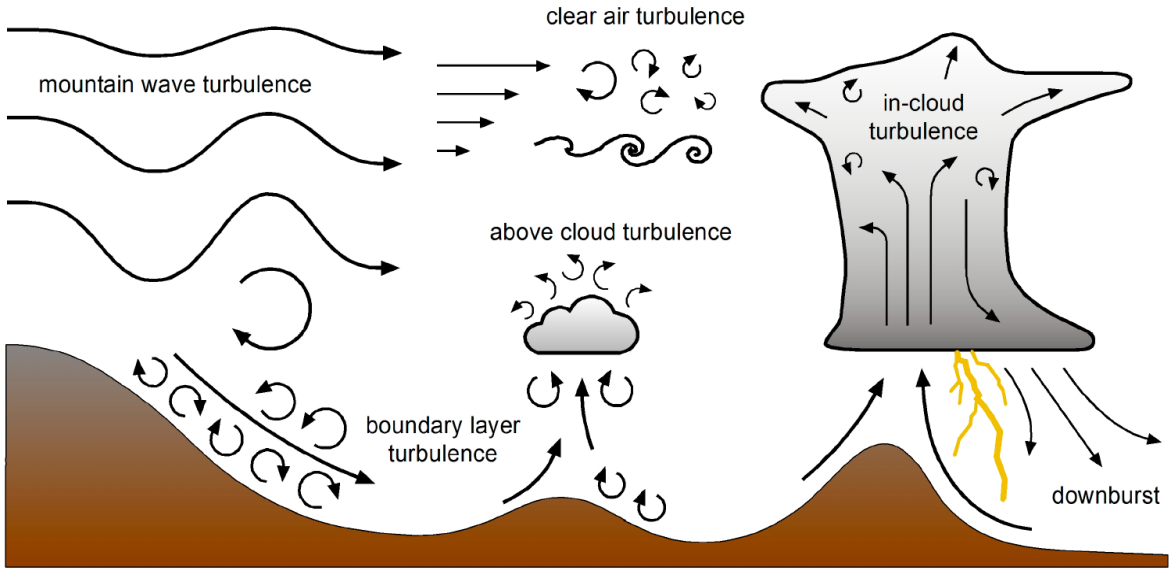
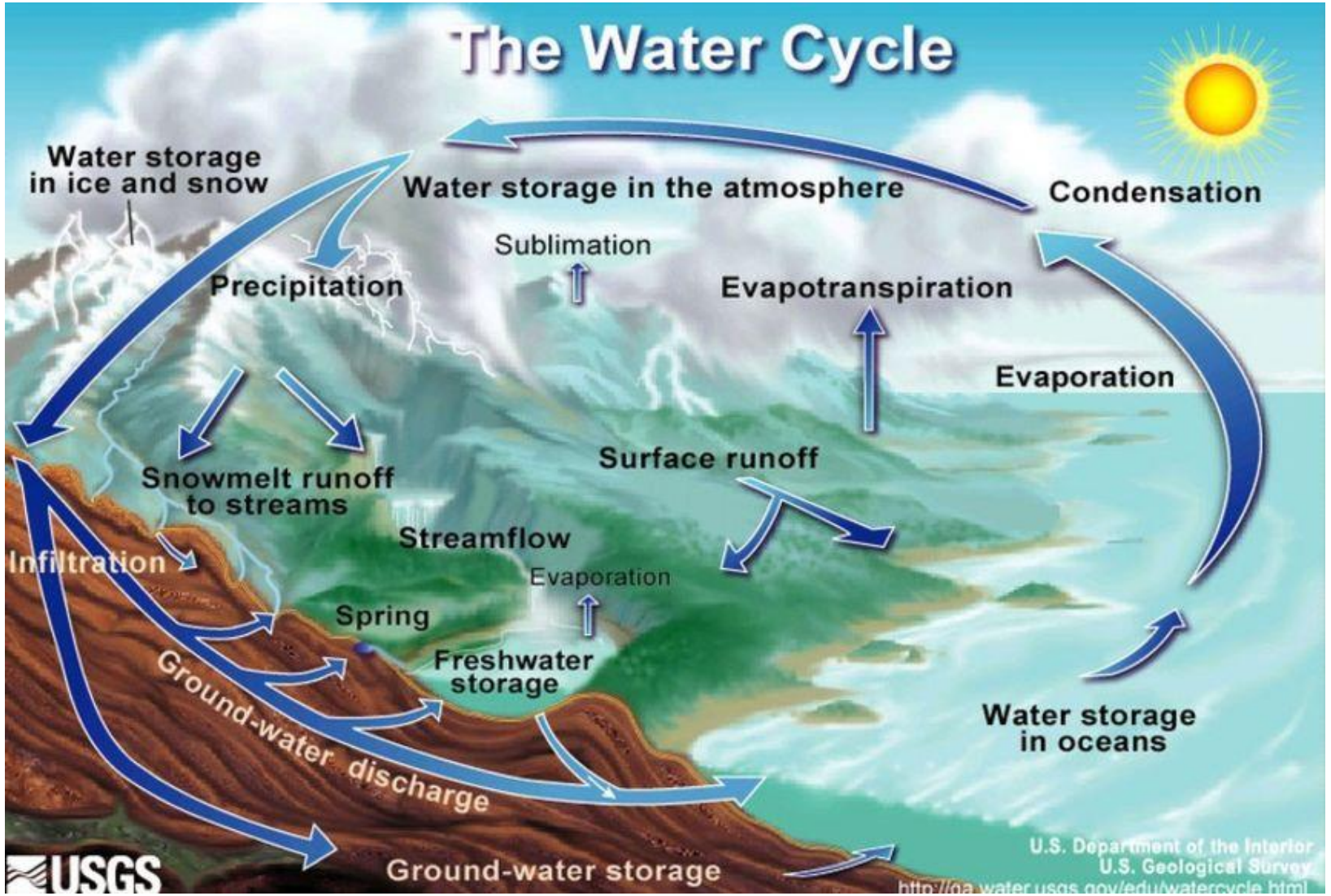


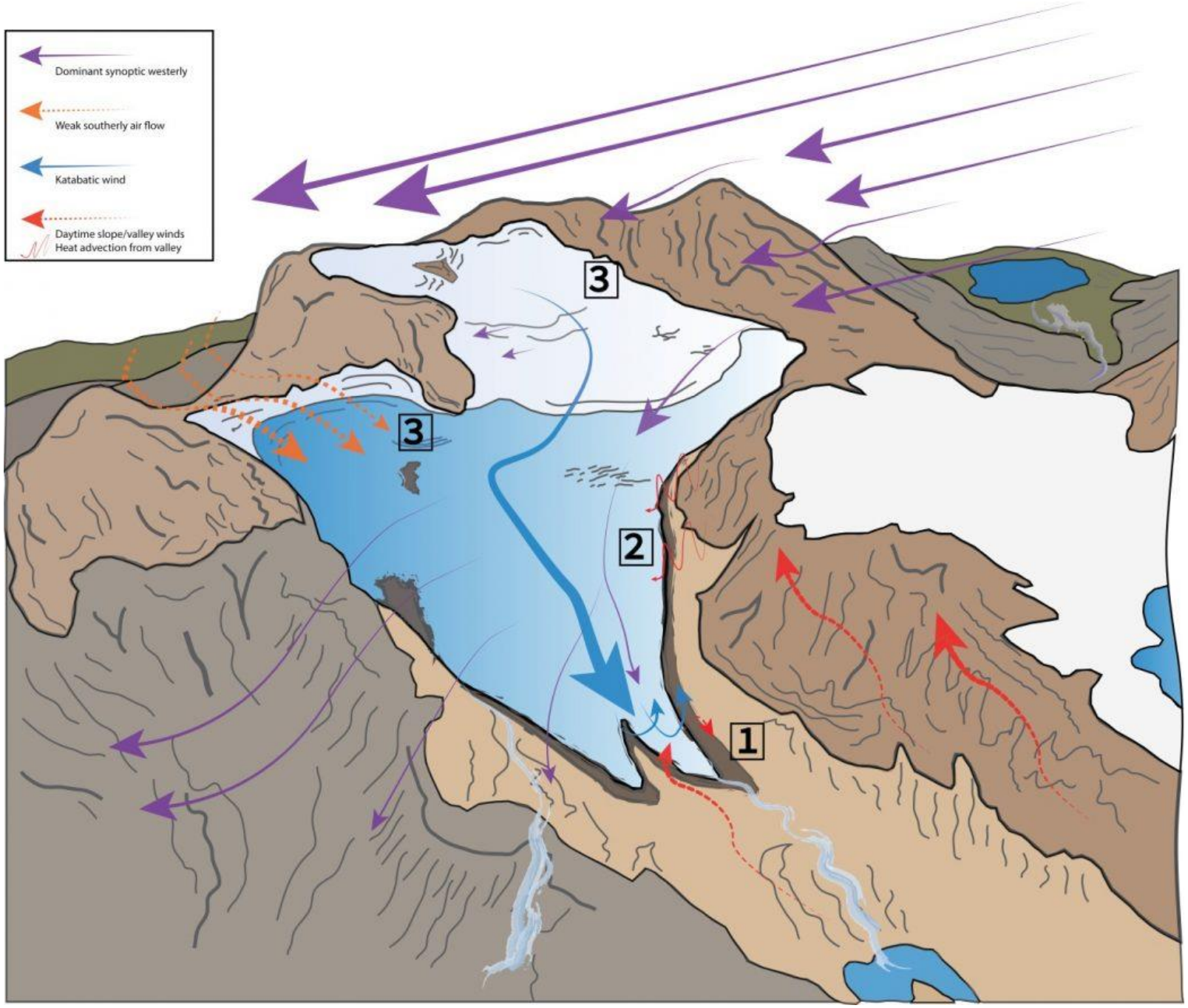
Figure 7. Some turbulence features over and near mountainous terrain relevant for aviation (adapted

Water

Many “spheres” involved:

- Hydrosphere
- Cryosphere
- Atmosphere
- Biosphere
- Lithosphere
- Soil
- ….




Dominant synoptic westerly
Weak southerly air flow
Katabatic wind
Daytime slope/valley winds
Heat advection from valley
3
3
2
1

Shaw 2017

atmosphere

MDPI

Review

Meteorological Applications Benefiting from an Improved Understanding of Atmospheric Exchange Processes over Mountains

Stephan F. J. De Wekker [1,*], Meinolf Kossmann [2], Jason C. Knievel [3], Lorenzo Giovannini [4], Ethan D. Gutmann [3] and Dino Zardi [4,5]

https://doi.org/10.3390/atmos9100371

Thank you for your kind attention!

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