
On the formation of an icing atlas in Austria

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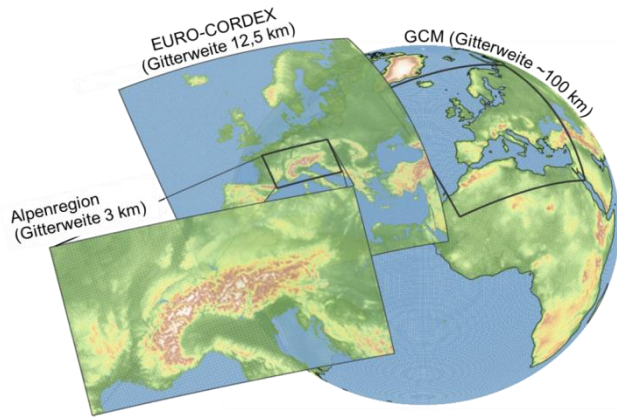
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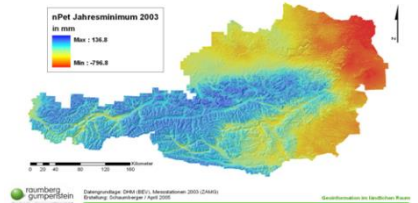


Methodology

- **COSMO-CLM (CCLM)** (Böhm et al. 2006) is dynamically downscaling ERA-Interim to 3 km grid spacing in the Alpine region and
- drives an icing model (Makkonen et al. 2001)



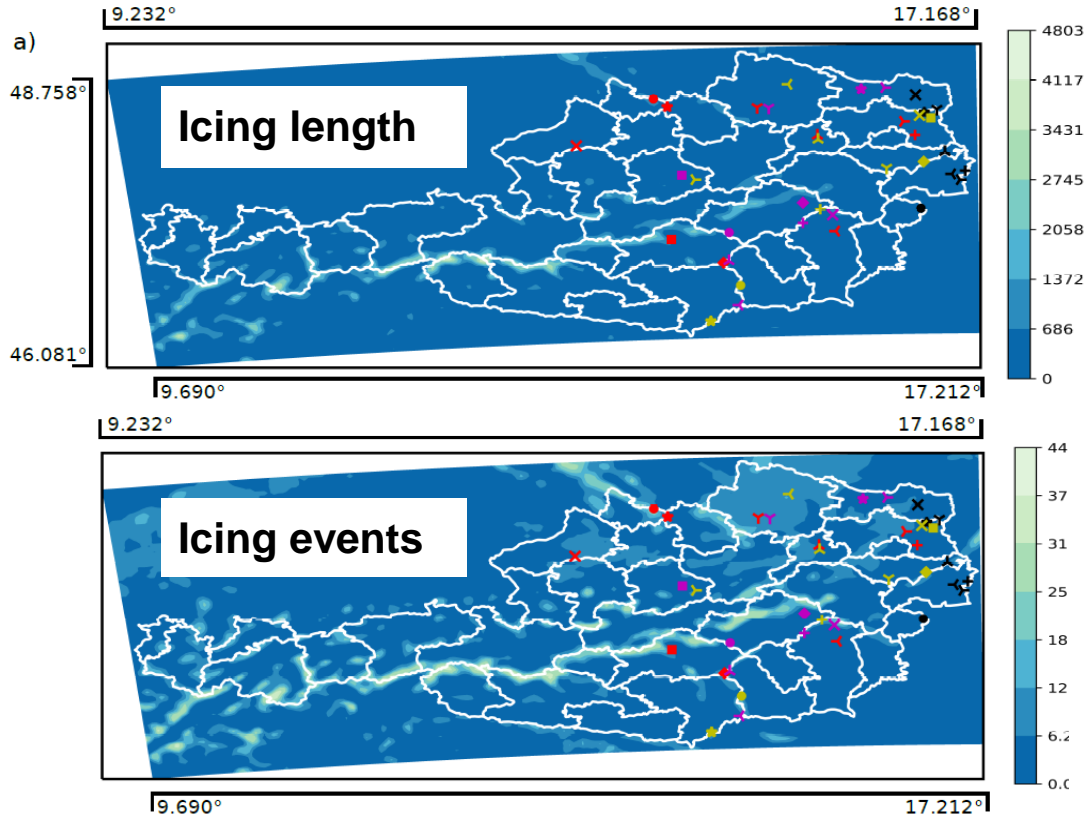
Icing model
Makkonen et al. (2001)



Ice masses, 3 km x 3 km grid
→ **Statistical analysis**
→ **Icing atlas**

- Period: 1989 to 2015
- Evaluation via expert knowledge (survey among wind turbine supervisors) and icing observed at wind stations

Results



- **Icing follows topography**
- **High icing frequency also in Lower/Upper Austria**
- **Icing in inner Alpine valleys and southern basins generally missed due to temperature inversions that are not properly captured by CCLM**
(Födermayr, 2017)

Results

- Comparison with icing at wind observation stations**

name of station	measurement		sea level [m]	height [m]	icing events [-]	CCLM	
	start	end				icing events [-]	icing events [-]
Geiereck	16. 08. 2014	08. 09. 2015	1615	52.5	22.0		5.0
Groß-Schweinbarth	20. 12. 2014	19. 01. 2016	243	85.5	4.0		7.0
Handalm	10. 11. 2012	11. 11. 2014	1845	52.5	26.0		3.7
Petzen A	22. 12. 2010	05. 09. 2011	2062	52.5	39.0		0.0
Prottes	16. 07. 2011	18. 07. 2012	215	80.7	6.0		3.0
Sommerein	19. 12. 2012	12. 02. 2014	162	80.7	41.0		5.3
Tattendorf_WM80	01. 09. 2009	29. 09. 2010	212	87.0	4.0		2.5
Böheimkirchen	21. 07. 2014	28. 07. 2015	347	101.8	1.0		6.0
Brunn ad.Wild	22. 02. 2013	01. 04. 2014	597	86.0	12.0		17.5
Ennsberg	12. 07. 2012	26. 05. 2014	1349	85.0	30.0		1.5
Fürstkogel	22. 08. 2013	26. 08. 2014	1433	85.5	28.0		7.0
Herrenstein	21. 10. 2009	11. 11. 2010	1413	61.5	20.0		9.5
Kraubathek	10. 10. 2013	21. 10. 2014	1474	85.5	22.0		0.0
Locatelli	19. 01. 2012	01. 10. 2013	340	61.9	5.0		6.5
Ochsenboden	27. 05. 2012	17. 09. 2013	1222	85.0	30.0		0.3
Roßkogel	12. 09. 2014	13. 10. 2015	1476	85.5	15.0		0.5
Sallingberg	21. 01. 2015	02. 02. 2016	756	101.7	13.0		15.0
Schwarzkogel	03. 10. 2014	27. 10. 2015	1693	52.0	36.0		10.0
Soboth	14. 06. 2013	30. 06. 2015	1413	63.5	45.0		2.7
Unterstinkenbrunn	19. 04. 2013	23. 04. 2014	186	100.7	3.0		3.7

- Icing events are in good agreement with low level stations
- In elevated areas (>1000 m), icing is underestimated
- ➔ Problem of comparability?
icing @ anemometer vs.
icing @ 3 cm cylinder