Zentralanstalt für Meteorologie und Geodynamik

APPLICATION OF STATISTICAL DOWNSCALING METHODS TO CLASSICAL AND NEW TASKS

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CONTENT OF PRESENTATION:

- *reclip:more*
- AM's dependence on distances
- Direct Downscaling onto Phenophases
- FishClim
- Conclusions

reclip:more

Austrian project on regional climate modelling

Project team: ArcSys, several Austrian Universities, ZAMG

ZAMG‘s tasks within *reclip:more*

- Empirical downscaling of the regional model runs (MM5, Aladin) to station coordinates
- Spatial refinement and interpolation of empirical downscaled series
- Snow-cover model to derive SWE from T, P

  + Desirable temporal resolution : 1 day

  + Desirable spatial resolution : 10 km => 1 km

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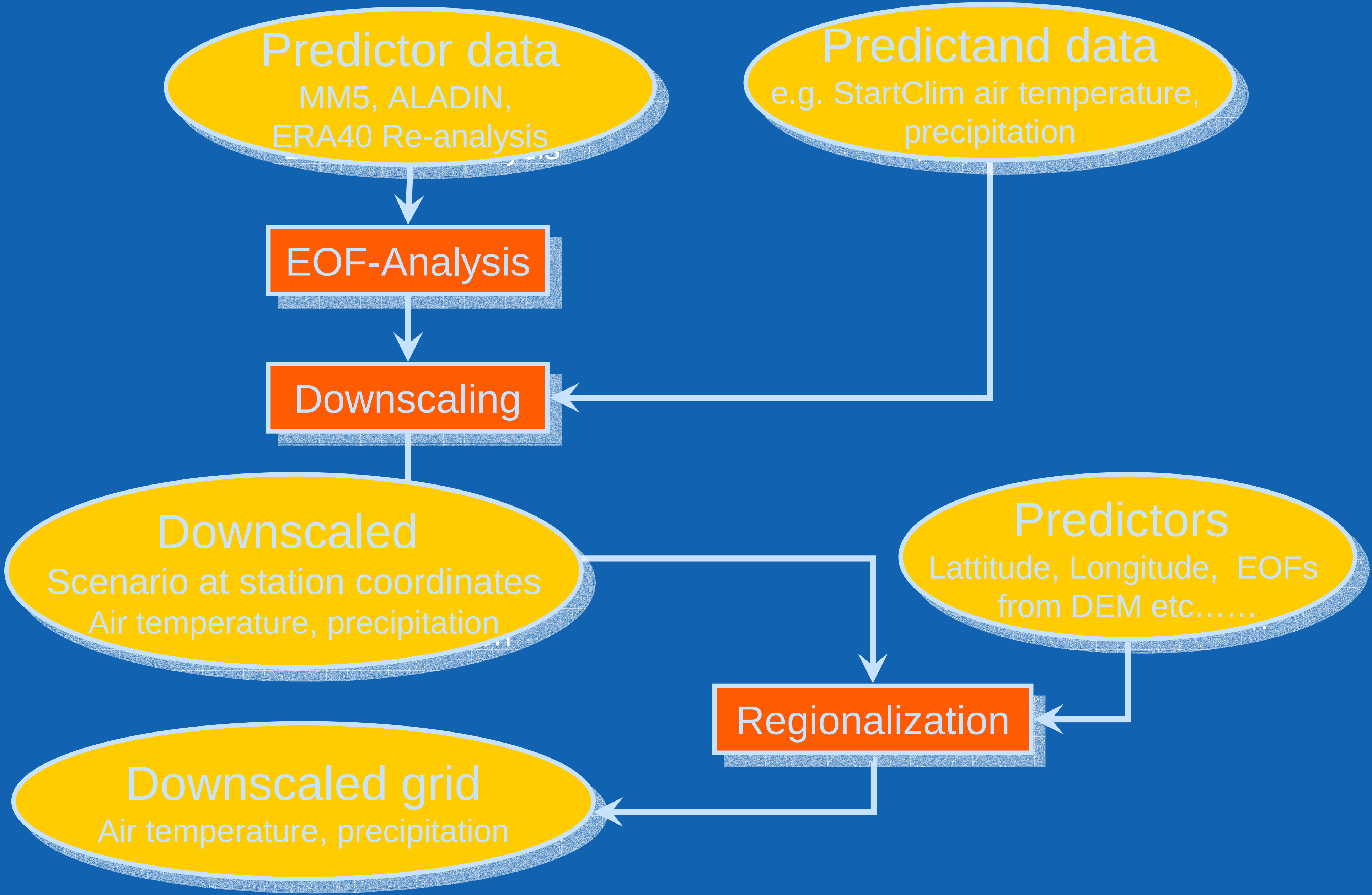

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1. ERA40t2mdjf19601973 (larger domain)

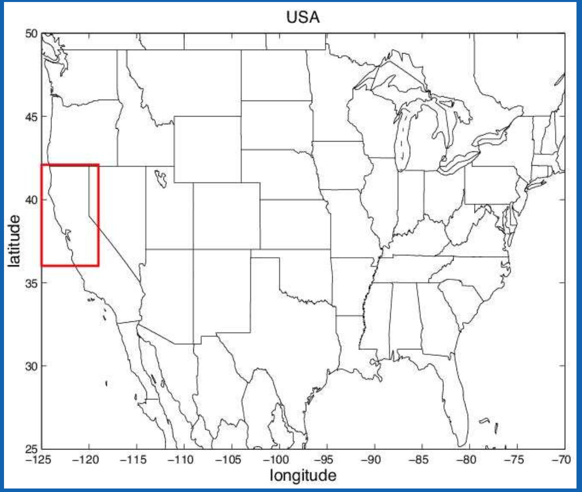
no.	station	lon	lat	alt	anmcorr	Rmse
1	Bregenz	9.7611	47.5111	436	0.7965091	2.911439
2	Eisenstadt	16.5611	47.8611	159	0.7367698	3.330668
3	Graz Uni	15.4478	47.0797	366	0.6964847	3.214418
4	Hohe Warte	16.3578	48.2611	203	0.7716681	3.141654
5	Hörsching	14.1911	48.2411	298	0.6999411	3.78304
6	Innsbruck Flugplatz	11.3553	47.2589	579	0.6375138	4.186523
7	Innsbruck Uni	11.385	47.2606	577	0.6649693	3.867943
8	Landeck	10.5667	47.1444	818	0.7146935	3.51888
9	Loibl	14.25	46.45	1098	0.7315351	3.215259
10	Mürzzuschlag	15.6886	47.6036	700	0.6343963	4.045131
11	St.Pölten	15.6322	48.2017	273	0.7594675	3.301286

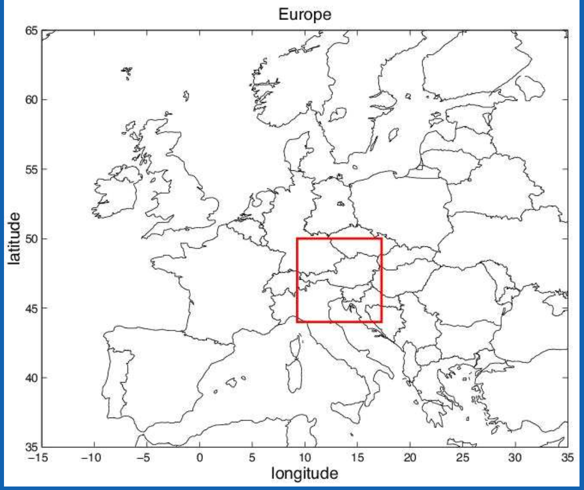
2. ERA40t2mdjf19601973 (smaller domain)

no.	Station	lon	lat	alt	anmcorr	Rmse
1	Bregenz	9.7611	47.5111	436	0.817454	2.744284
2	Eisenstadt	16.5611	47.8611	159	0.7482586	3.274988
3	Graz Uni	15.4478	47.0797	366	0.7372459	3.048826
4	Hohe Warte	16.3578	48.2611	203	0.7865295	3.041132
5	Hörsching	14.1911	48.2411	298	0.7175401	3.69501
6	Innsbruck Flugplatz	11.3553	47.2589	579	0.7257512	3.67814
7	Innsbruck Uni	11.385	47.2606	577	0.7580302	3.321995
8	Landeck	10.5667	47.1444	818	0.7884269	3.035613
9	Loibl	14.25	46.45	1098	0.7904816	2.846097
10	Mürzzuschlag	15.6886	47.6036	700	0.6964687	3.771448
11	St.Pölten	15.6322	48.2017	273	0.7702188	3.233656

AM’s dependence on distances

- § AM’s key to success is based on an extensive archive of weather-patterns, on its potential to single out appropriate patterns and of course on the field(s) considered
- § We studied the effect of 5 distance measures (L2, xplvr, L1, cosine, Mahalanobis) on AM’s potential to estimate daily precipitation in the Sierra Nevada (SN) and the European Alps (AA)
- § To accomplish this we compared AM (SLP,SH7) to persistence





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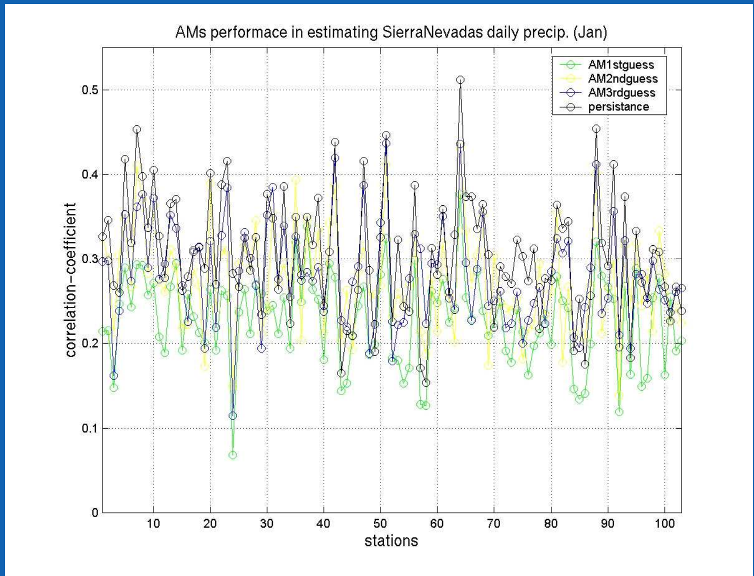
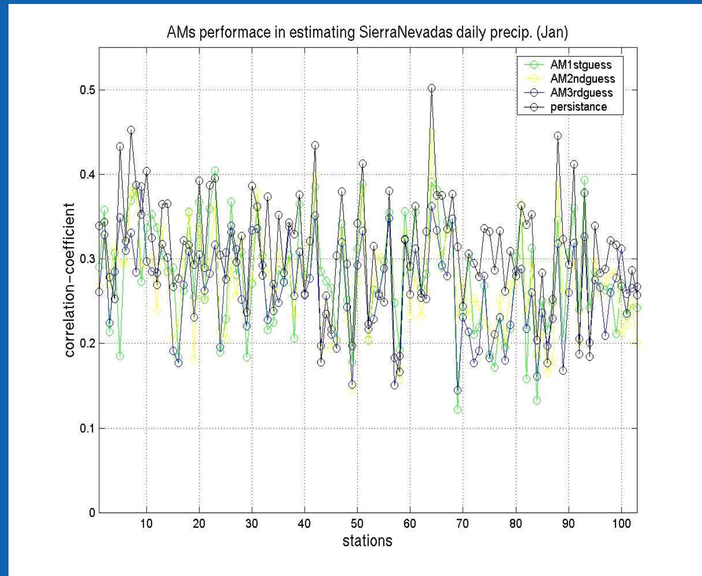
L2

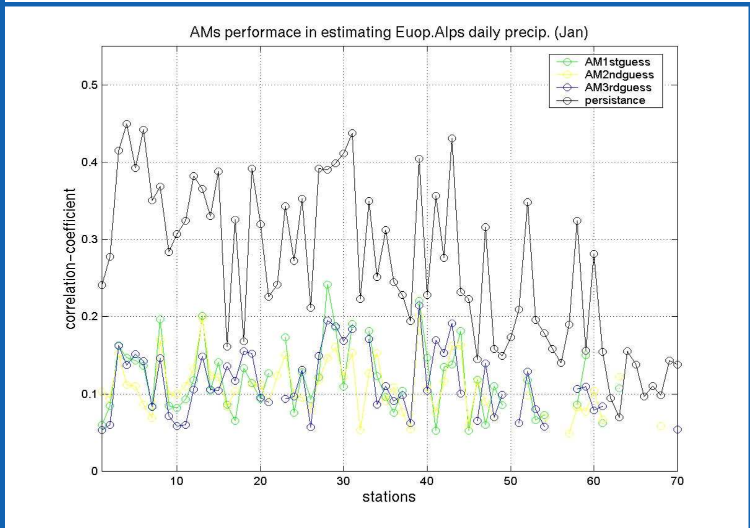
Mahalanobis

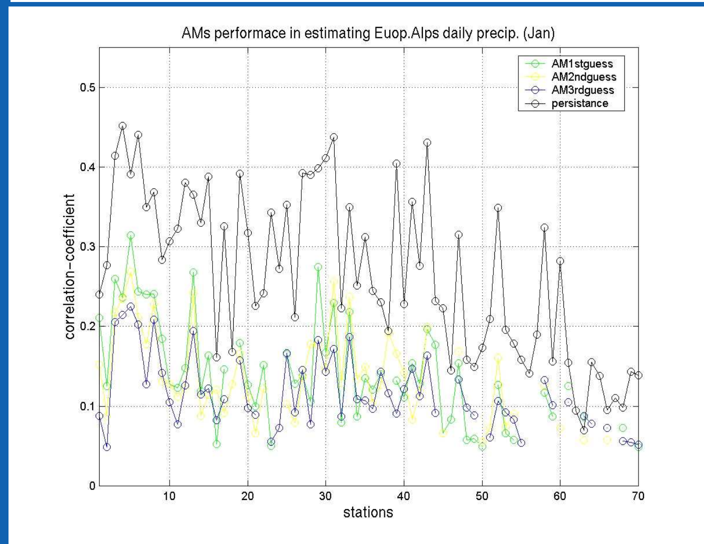
SN





AA





AM’s dependence on distances

- within SN AM performs comparable to persistence while in the AA AM performs way below persistence.

- Performance depends on the distance measure used and it is different for SN than for AA. In SN L2 performs well while within AA none of the measures perform well.

Direct Downscaling onto Phenophases

Matulla et al. 2003 (International Journal of Biometeorology)

§ The ‘normal’ approach when investigating e.g. the impact of potential changes of large scale climate on local scale phenophases is partitioned into 2 steps. First, downscaling on local scale temperature and precipitation and second entering these quantities into ecological models, simulating the plant’s reaction.

§ We investigated the performance of statistical downscaling that relates 17 phenophases throughout the seasonal cycle. In this study we assess two empirical downscaling techniques that link large scale atmospheric variables to local scale biosphere phenomena and, for comparative purposes, the local scale temperature.

Of course, this approach can be applied to any local scale time series responsive to weather/climate (glaciers, fish-fauna, etc.)

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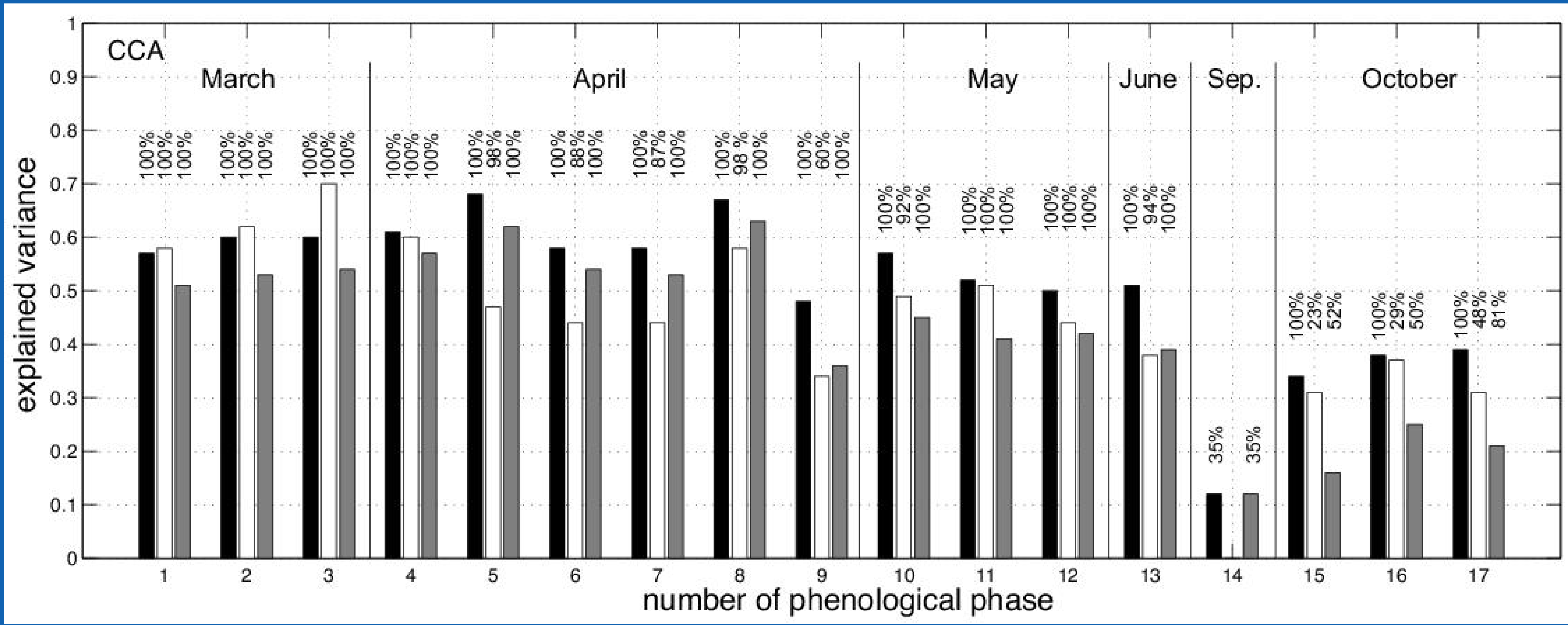
Direct Downscaling onto Phenophases Matulla et al. 2003 (International Journal of Biometeorology)



FishClim

§ The idea was to assess the impact of climate change on fish fauna. The strategy is to (i) use downscaled AOGCM scenarios for the first half of the 21st century for air-temperature and precipitation (ii) to establish a model that formulates water-temperature by means of air-temperature and discharge in order to translate the local scale scenarios into a water-temperature scenario and (iii) to evaluate the impact on fish communities by use of an aquatic ecosystem model that is driven by water-temperature.

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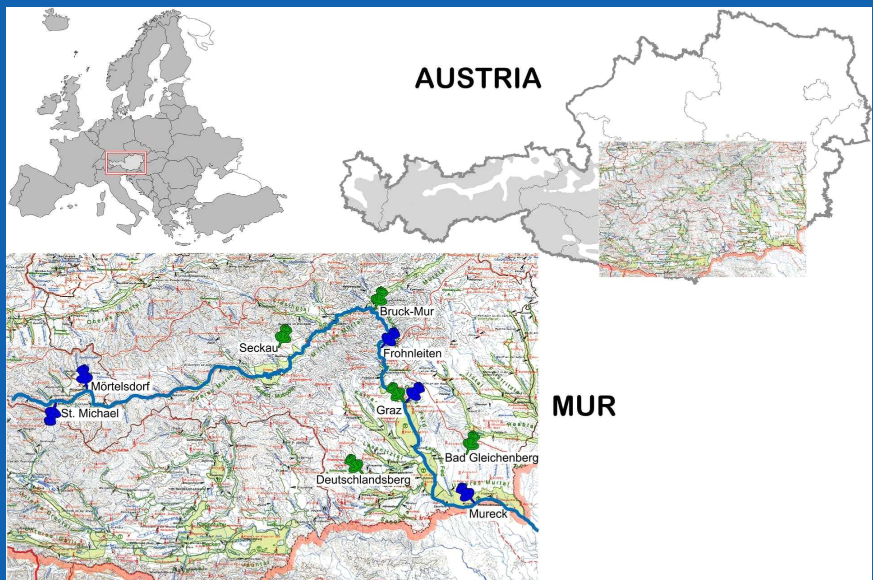
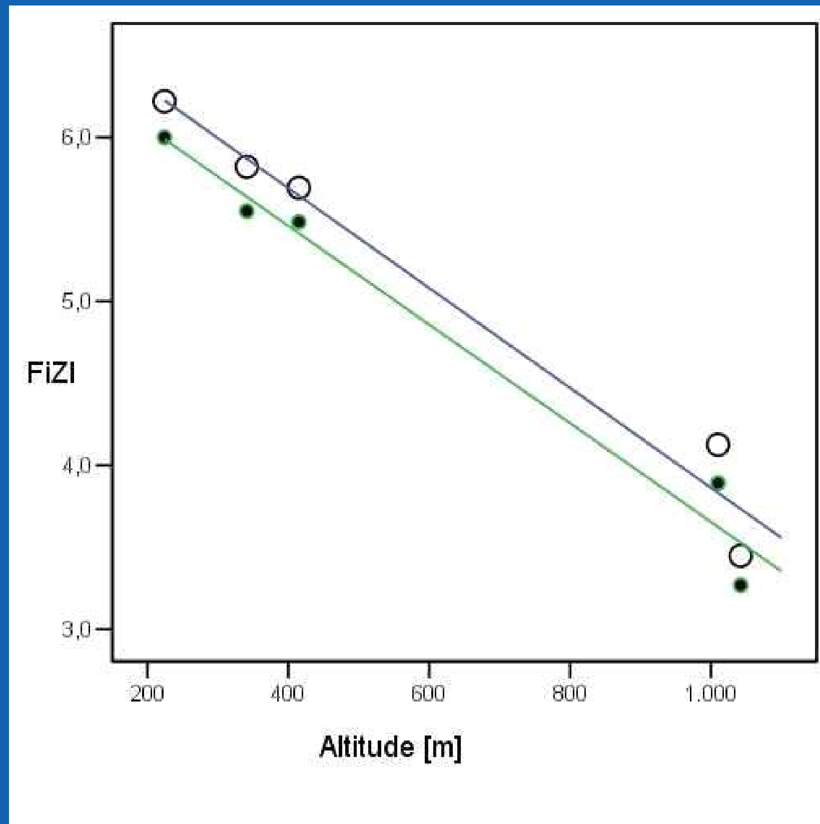
The simulated change is an increase of 0.22 FiZI, which corresponds to an upstream shift of approximately 25 km (Matulla et al. 2005, submitted).

Left panel: The Inner-Alpine river Mur, right panel: altitude versus fish-region-index (FiZI of 3.5 to 4.5 indicates the region between trout and grayling whereas a FiZI of 6.0 represents the barbel region. Green stands for observations and blue for the scenario.





FishClim

§ We found that the 'business as usual' emission scenario IS92a would cause an elevational shift of ~70 m in the fish assemblages. This would cause cyprinid species to advance against retreating salmonids. Hyporhithral river sectors would become Epipotamal. Thus, grayling (*Thymallus thymallus*) and Danube salmon (*Hucho hucho*) presently characteristic for the Mur river would be superseded by other species. Native brown trout (*Salmo trutta*), which are at present already under pressure of competition, may be at risk of losing their habitats in favour of invaders like the exotic rainbow trout (*Oncorhynchus mykiss*), which are more adapted to higher water-temperatures. Results suggest that the salmonid sport fishing of the river Mur may be adversely affected and sustain a loss in its high value due to projected changes in the fish communities.

CONCLUSIONS:

- In our understanding statistical downscaling is not at its end. It is an efficient, effective and cheap way to link different scales and hence an alternative to e.g. dynamical downscaling.
- Direct downscaling may serve as an innovative way to circumvent more difficult ecological modeling. (And there is a wide variety of applications.)
- In any case statistical downscaling sets the bar for other, more expensive methods which has to be surpassed by them in order to justify higher costs.
- Our experience is - when relating quantities that obey the same distribution CCA is, in general, the method of choice. AM is a good candidate for daily based non-normally distributed quantities as it inherently produces spatially meaningful results.