Universität Leipzig

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An interesting title about, EOF, Wind, Humidity and Climate

Masterarbeit

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vorgelegt von

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Abstract

Scientific documents often use LaTeX for typesetting. While numerous packages and templates exist, it makes sense to create a new one. Just because.

Contents

1 Preliminaries

2 Problem Analysis

3 Related Work

3.1 Climate simulation datasets

General infos from [4]:

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3.1.1 RCP Scenarios

3.1.2 Questions arising about using climate simulation datasets

- How many ensemble members are needed for a correct assessment?
- How to sort them out? Random?
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3.1.3 MPI-GE - The Max Planck Institute grand Ensemble

In [4] theere is much inforamtion available:

3.1.4 CMIP5 - Coupled Model Intercomparison Project

In [5]

3.2 Precipitation Literature

3.2.1 Saisonality in Precipitation variability

The work of Zveryaev

3.3 Means of moisture transport

3.3.1 vertically integrated water vapor transport

As proposed by Zhu and Newell in [7], one way of measuring moisture (p) transport is by vertically integrating over the different pressure levels the zonal and meridional fluxes $\overline{pu}$ and $\overline{pv}$.

An example of using this method can be found in [1] with many more references why this method is working well for these kinds of approaches. Also this paper lists some other methods of moisture transportation which are also used:

1. integrated water vapor distributions (see [2])
2. the lagrangian approach
3. stable oxygen isotope investigation

Also the authors of [1] make a twofold contribution to this work. Here it will be about the IVT of them. They used it to measure the moisture and displayed the first graphics of the woork, illustrating how an IVT map looks at a drought and during a flood. Also maps of the mean IVT during each months, displaying the intense raining/wet summers and dry winters

3.3.2 Moisture Budget

Yang, Liu, Ou, Liao, Cao, Chen, Jin, Zheng, Yang, and Su showed in their report [6] the directions of moisture flux on the continent borders based on the big ERA5 reanalysis. They measure the moisture based on a equation called the *Moisture Budget*, which is based on multiple Faktors:

1. Vertically integrated Moisture Convergence ($VIMC$): It is basically the gradient of the specific moisture in the air times the Wind vector
2. P is the precipitation
3. E is the evaporation

Furthermore they evaluateded the correlation between the moisture transport and the precipitation variability, which correlate to a significant extent.

3.4 Pattern analysis

3.4.1 Empirical Orthogonal Functions

See [3] for a big overview of EOF in atmospheric science.

See [1] for an similar approach as we plan it, except it only focuses on the past. They

4 Design

5 Evaluation

6 Conclusions and Future Work

6.1 Conclusions

6.2 Future Work

Bibliography

1. O. O. Ayantobo, J. Wei, B. Kang, and G. Wang. "Integrated moisture transport variability over China: patterns, impacts, and relationship with El Nino–Southern Oscillation (ENSO)". *Theoretical and Applied Climatology* 147, 2021, pp. 985–1002. URL: https://api.semanticscholar.org/CorpusID:244492291.

2. L. Gimeno, R. Nieto, M. Vázquez, and D. A. Lavers. "Atmospheric rivers: A mini-review". *Frontiers in Earth Science* 2, 2014, p. 2.

3. A. Hannachi, I. T. Jolliffe, and D. B. Stephenson. "Empirical orthogonal functions and related techniques in atmospheric science: A review". *International Journal of Climatology: A Journal of the Royal Meteorological Society* 27:9, 2007, pp. 1119–1152.

4. N. Maher, S. Milinski, L. Suarez-Gutierrez, M. Botzet, M. Dobrynin, L. Kornblueh, J. Kröger, Y. Takano, R. Ghosh, C. Hedemann, C. Li, H. Li, E. Manzini, D. Notz, D. Putrasahan, L. Boysen, M. Claussen, T. Ilyina, D. Olonscheck, T. Raddatz, B. Stevens, and J. Marotzke. "The Max Planck Institute Grand Ensemble: Enabling the Exploration of Climate System Variability". *Journal of Advances in Modeling Earth Systems* 11:7, 2019, pp. 2050–2069. DOI: https://doi.org/10.1029/2019MS001639. eprint: https://agupubs.onlinelibrary.wiley.com/doi/pdf/10.1029/2019MS001639. URL: https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2019MS001639.

5. K. E. Taylor, R. J. Stouffer, and G. A. Meehl. "An overview of CMIP5 and the experiment design". *Bulletin of the American meteorological Society* 93:4, 2012, pp. 485–498.

6. Y. Yang, C. Liu, N. Ou, X. Liao, N. Cao, N. Chen, L. Jin, R. Zheng, K. Yang, and Q. Su. "Moisture Transport and Contribution to the Continental Precipitation". *Atmosphere* 13:10, 2022. ISSN: 2073-4433. DOI: 10.3390/atmos13101694. URL: https://www.mdpi.com/2073-4433/13/10/1694.

7. Y. Zhu and R. E. Newell. "A Proposed Algorithm for Moisture Fluxes from Atmospheric Rivers". *Monthly Weather Review* 126:3, 1998, pp. 725–735. DOI: https://doi.org/10.1175/1520-0493(1998)126<0725:APAFMF>2.0.CO;2. URL: https://journals.ametsoc.org/view/journals/mwre/126/3/1520-0493_1998_126_0725_apafmf_2.0.co_2.xml.

8. I. I. Zveryaev. "Seasonality in precipitation variability over Europe". *Journal of Geophysical Research: Atmospheres* 109:D5, 2004. DOI: https://doi.org/10.1029/2003JD003668. eprint: https://agupubs.onlinelibrary.wiley.com/doi/pdf/10.1029/2003JD003668. URL: https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2003JD003668.