# Hydrology Research Articles are Becoming More Interdisciplinary

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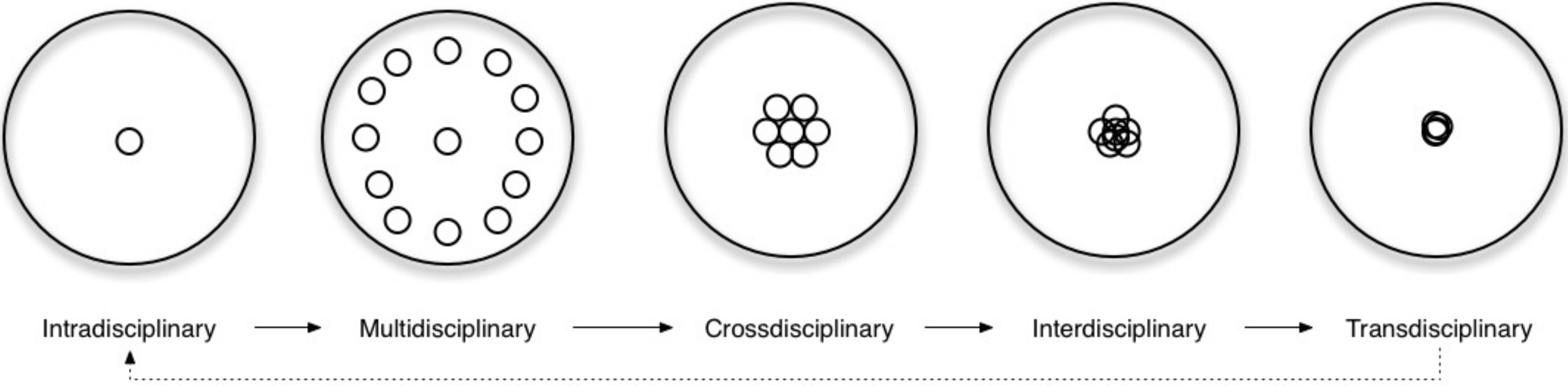
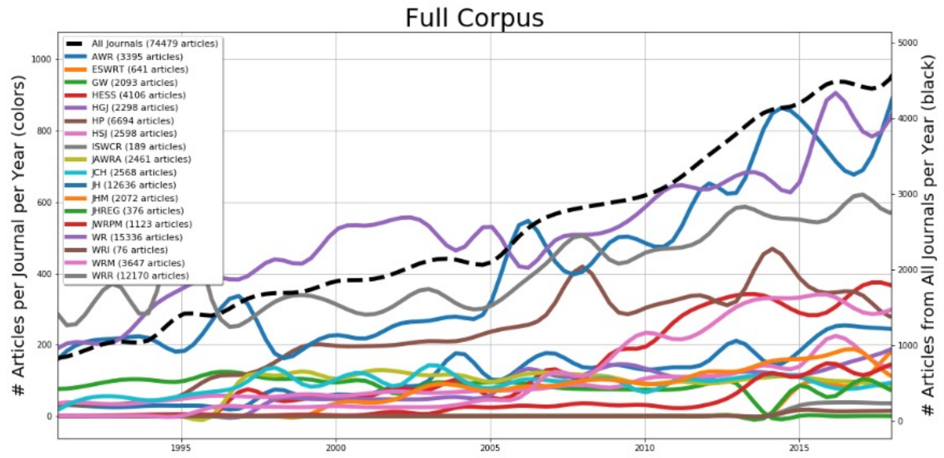
# What is Interdisciplinarity?



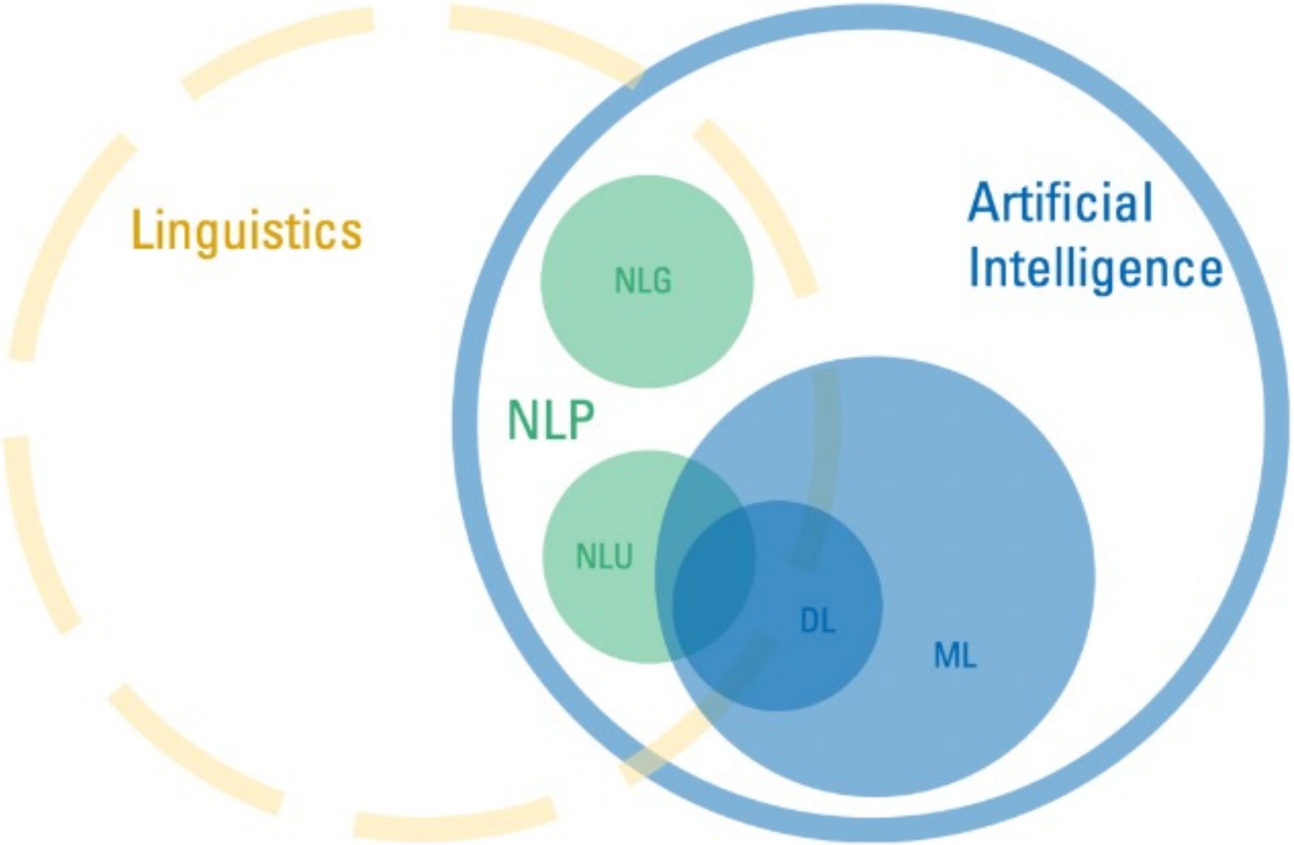

- **Intradisciplinary**: working within a single discipline.
- **Cross disciplinary**: viewing one discipline from the perspective of another.
- **Multidisciplinary**: people from different disciplines working together, each drawing on their disciplinary knowledge.
- **Interdisciplinary**: integrating knowledge and methods from different disciplines, using a real synthesis of approaches.
- **Transdisciplinary**: creating a unity of intellectual frameworks beyond the disciplinary perspectives.

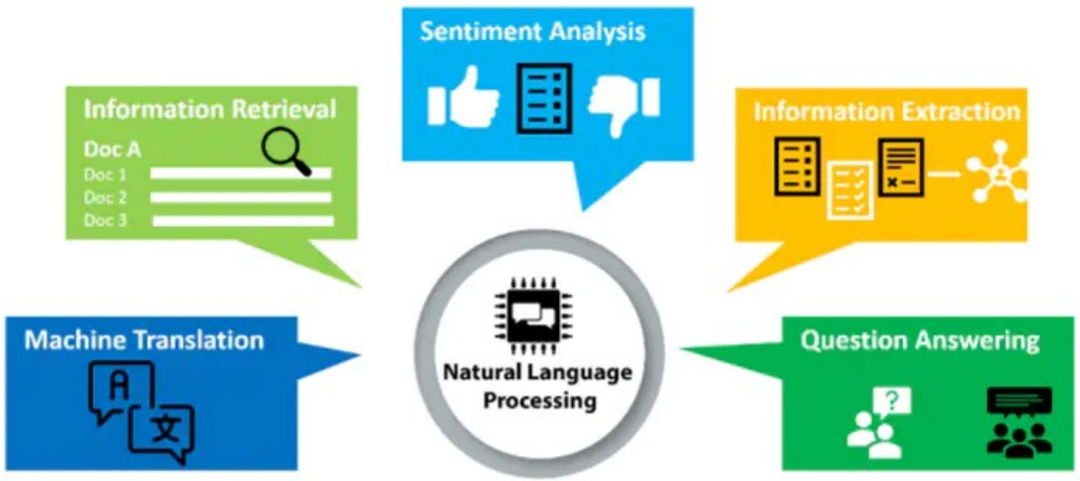
# The Push for Interdisciplinarity in Hydrology

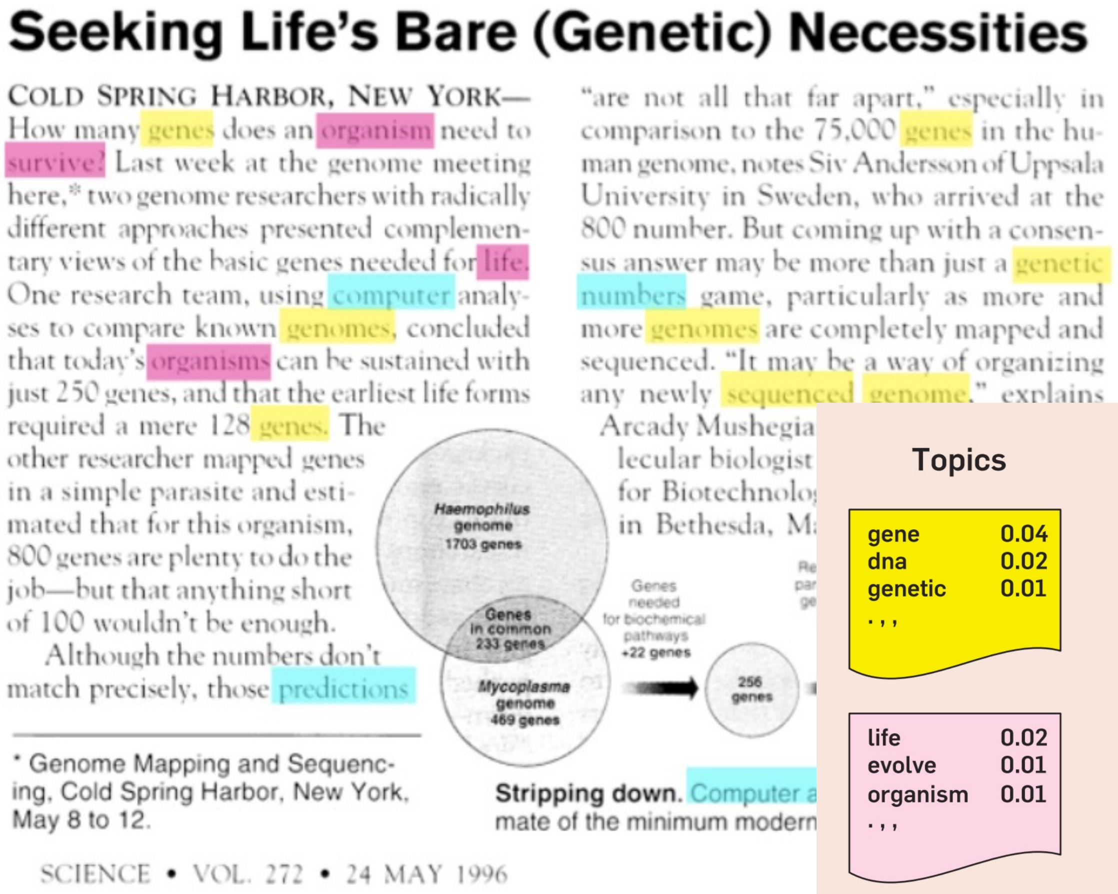

"We describe a **modern interdisciplinary science of hydrology** needed to develop an in-depth understanding of the dynamics of the connectedness between human and natural systems and to determine effective solutions to resolve the complex water problems that the world faces today. **Nearly, every theoretical hydrologic model introduced previously is in need of revision to accommodate how climate, land, vegetation, and socioeconomic factors interact, change, and evolve over time.**"

# Natural Language Processing – An Introduction



# Topic Modeling – Intuition



Seeking Life's Bare (Genetic) Necessities

COLD SPRING HARBOR, NEW YORK— How many genes does an organism need to survive? Last week at the genome meeting here,* two genome researchers with radically different approaches presented complementary views of the basic genes needed for life. One research team, using computer analyses to compare known genomes, concluded that today's organisms can be sustained with just 250 genes, and that the earliest life forms required a mere 128 genes. The other researcher mapped genes in a simple parasite and estimated that for this organism, 800 genes are plenty to do the job—but that anything short of 100 wouldn't be enough.

Although the numbers don't match precisely, those predictions

"are not all that far apart," especially in comparison to the 75,000 genes in the human genome, notes Siv Andersson of Uppsala University in Sweden, who arrived at the 800 number. But coming up with a consensus answer may be more than just a genetic numbers game, particularly as more and more genomes are completely mapped and sequenced. "It may be a way of organizing any newly sequenced genome," explains Arcady Mushegia... lecular biologist... for Biotechnolog... in Bethesda, Ma...



* Genome Mapping and Sequencing, Cold Spring Harbor, New York, May 8 to 12.

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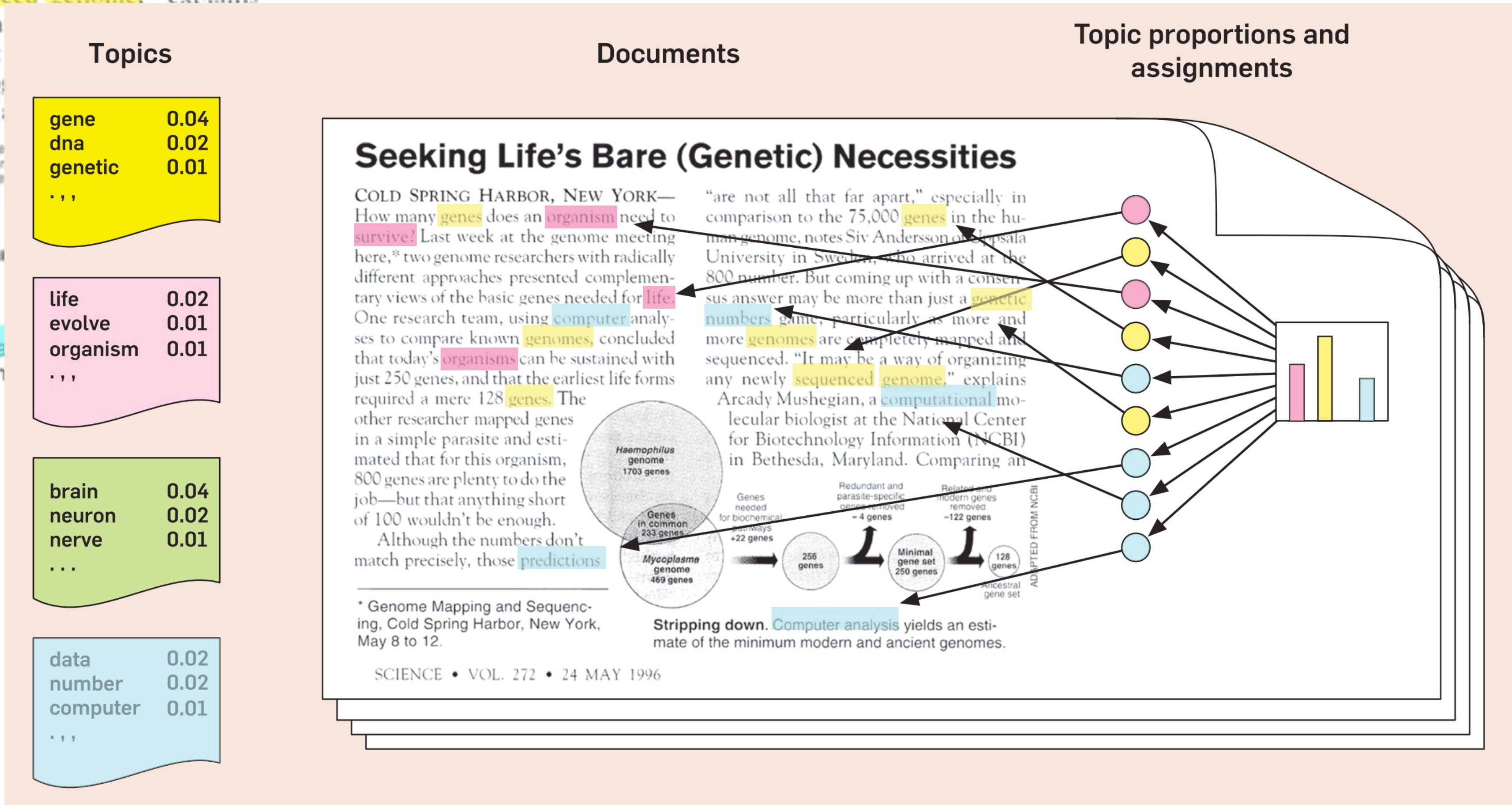
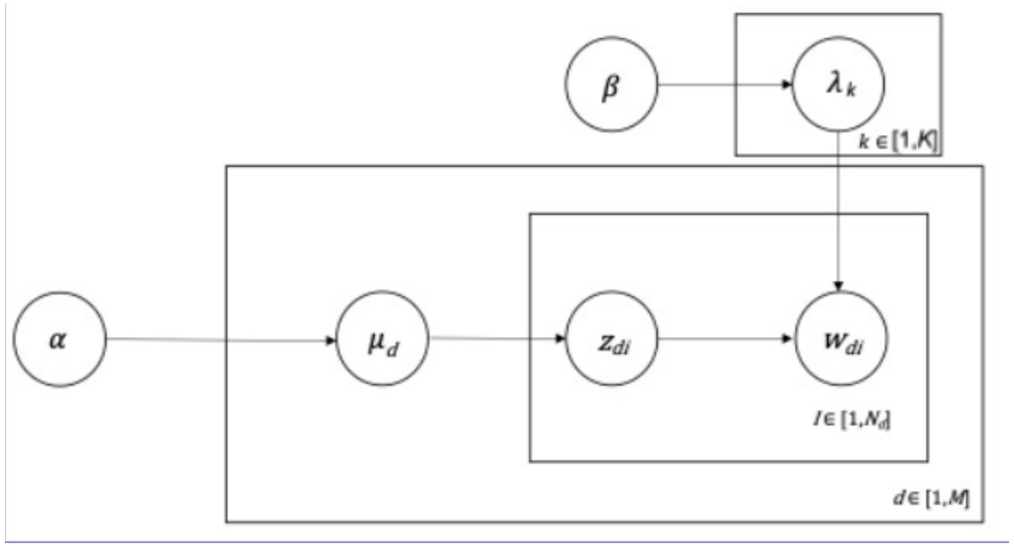


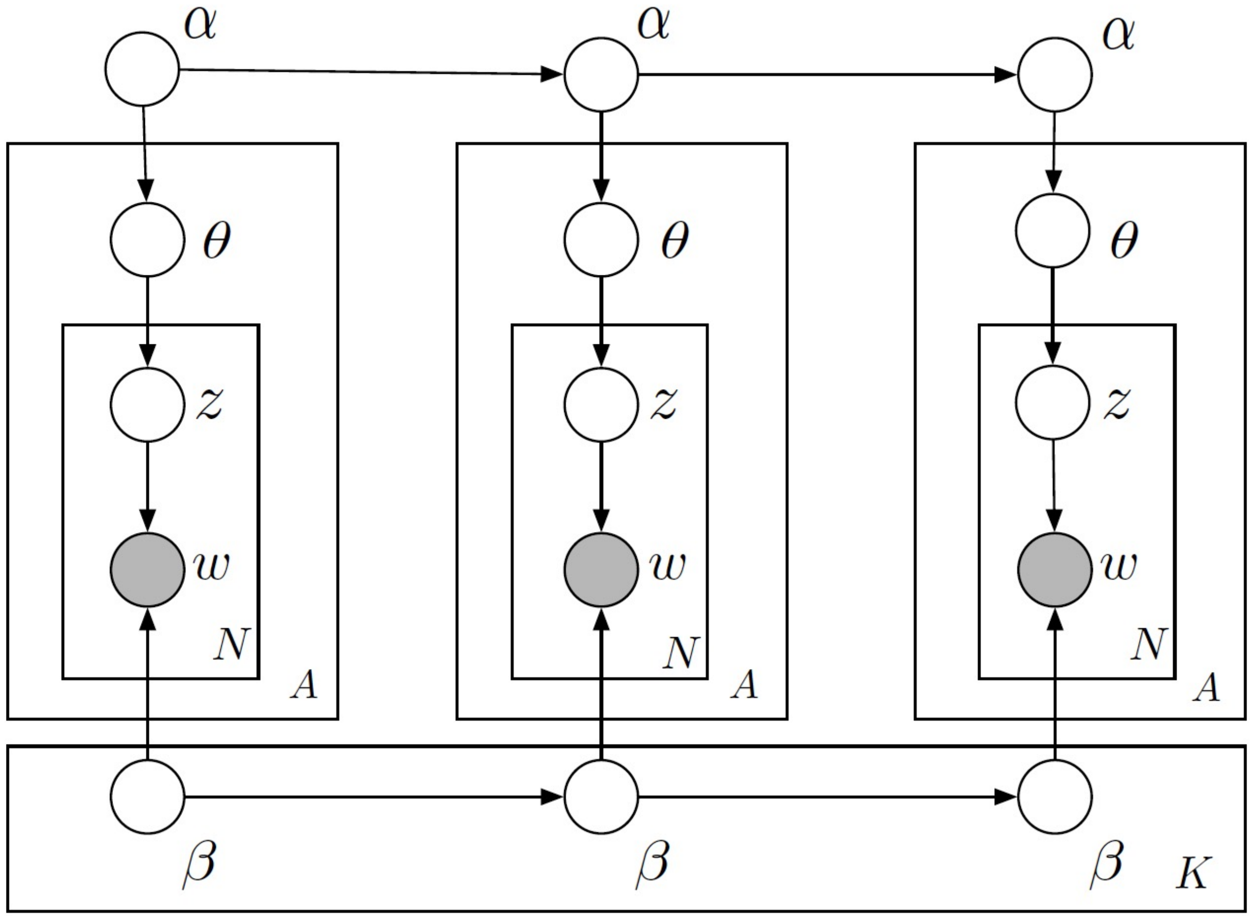
# Latent Dirichlet Allocation (LDA)

## Static LDA

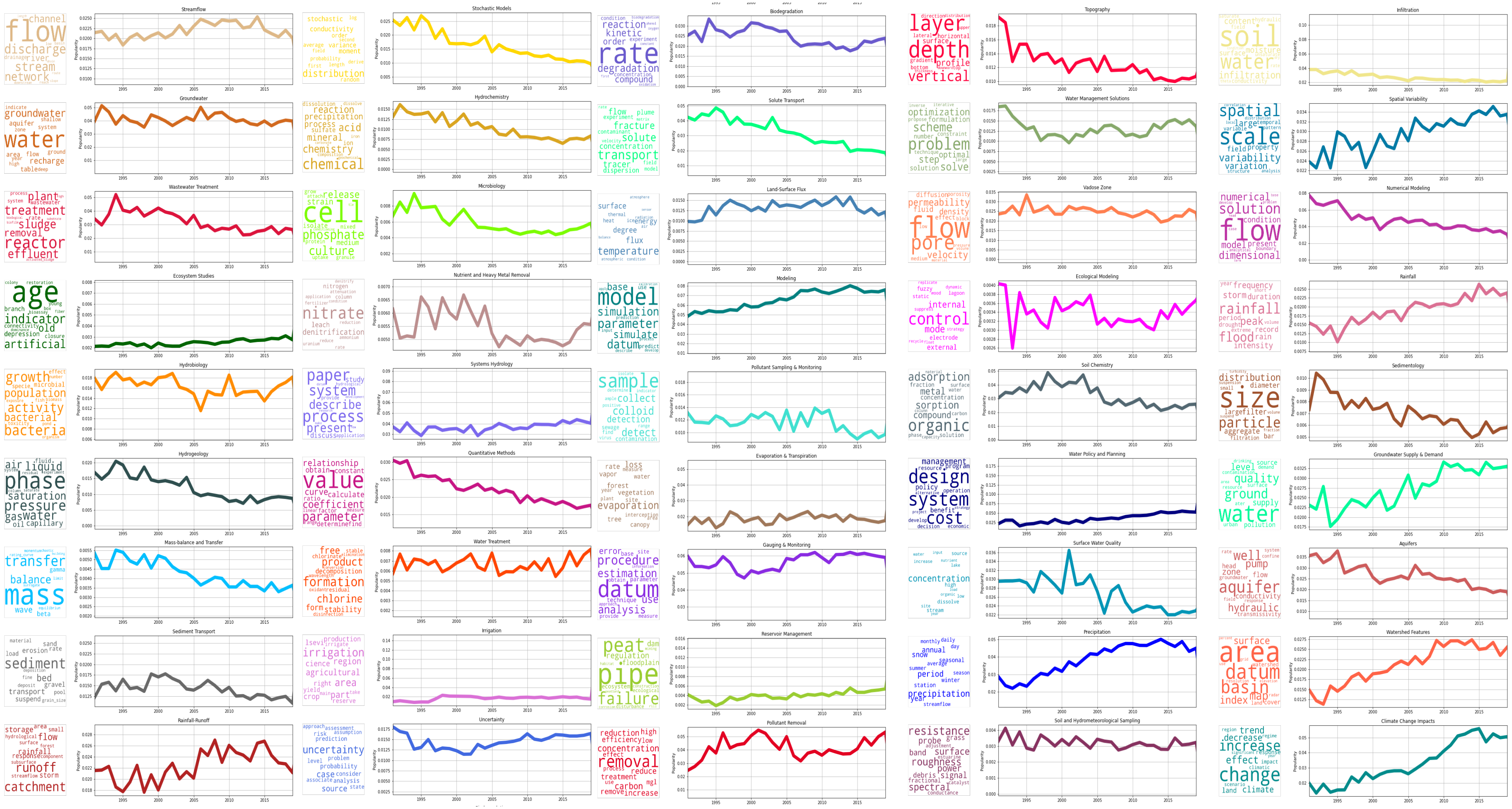



- $\mu_d$ – Per-document topic distribution
- $\lambda_k$ – Per-topic word distribution
- $\alpha$ - Dirichlet prior on the per-document topic distribution
- $\beta$ - Dirichlet prior on the per-topic word distribution
- $z_{di}$ – Topic assignment for each word
- $w_{di}$ - Generated word
- $K$ – Number of topics
- $k$ – Topic
- $M$ – Corpus

## Sequential LDA



# Topics & Trends



### Rising Trends

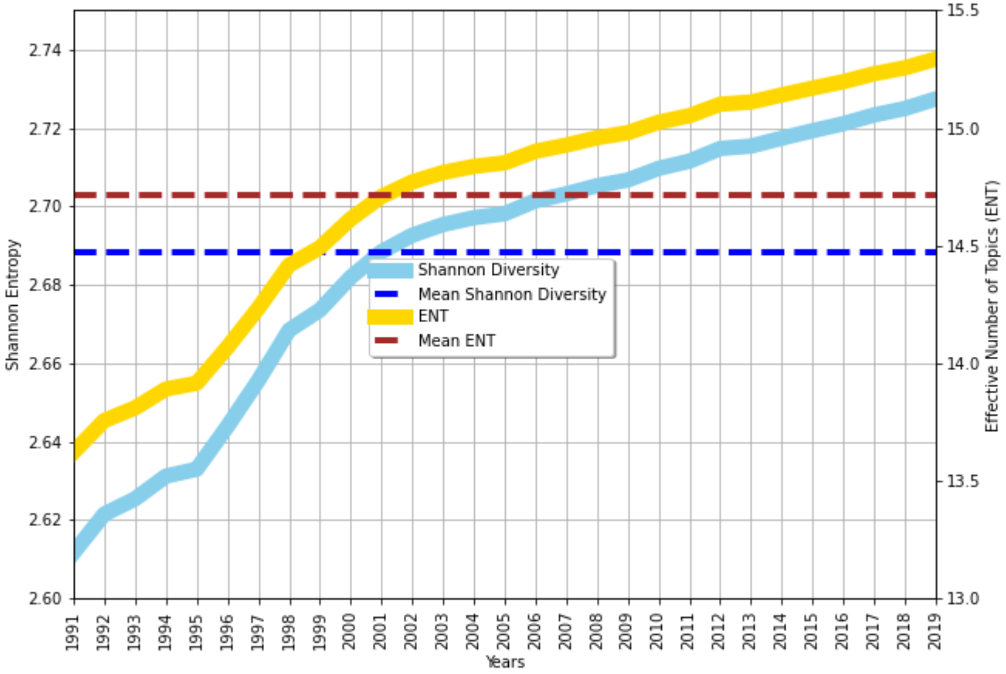
| Topic | p-val | BF10 |
|---|---|---|
| Rainfall-Runoff | 1.24E-04 | 253.82 |
| Water Policy and Planning | 2.42E-04 | 139.38 |
| Precipitation | 1.92E-04 | 171.40 |
| Spatial Variability | 8.20E-05 | 367.25 |
| Rainfall | 1.30E-04 | 242.14 |
| Groundwater Supply & Demand | 5.12E-09 | 2.50E+06 |
| Watershed Features | 5.61E-13 | 1.13E+10 |
| Climate Change Impacts | 1.06E-14 | 4.47E+11 |
| Ecosystem Studies | 4.46E-03 | 10.74 |

### Falling Trends

| Topic | p-val | BF10 |
|---|---|---|
| Wastewater Treatment | 4.86E-07 | 3.85E+04 |
| Hydrogeology | 1.41E-10 | 6.86E+07 |
| Mass-balance and Transfer | 1.94E-10 | 5.11E+07 |
| Stochastic Models | 1.34E-14 | 3.58E+11 |
| Hydrochemistry | 2.21E-11 | 3.79E+08 |
| Microbiology | 1.52E-07 | 1.11E+05 |
| Quantitative Methods | 5.38E-16 | 7.05E+12 |
| Surface Water Quality | 2.35E-06 | 9.13E+03 |
| Numerical Modeling | 3.54E-10 | 2.93E+07 |
| Sedimentology | 5.51E-08 | 2.83E+05 |
| Aquifers | 6.43E-10 | 1.69E+07 |

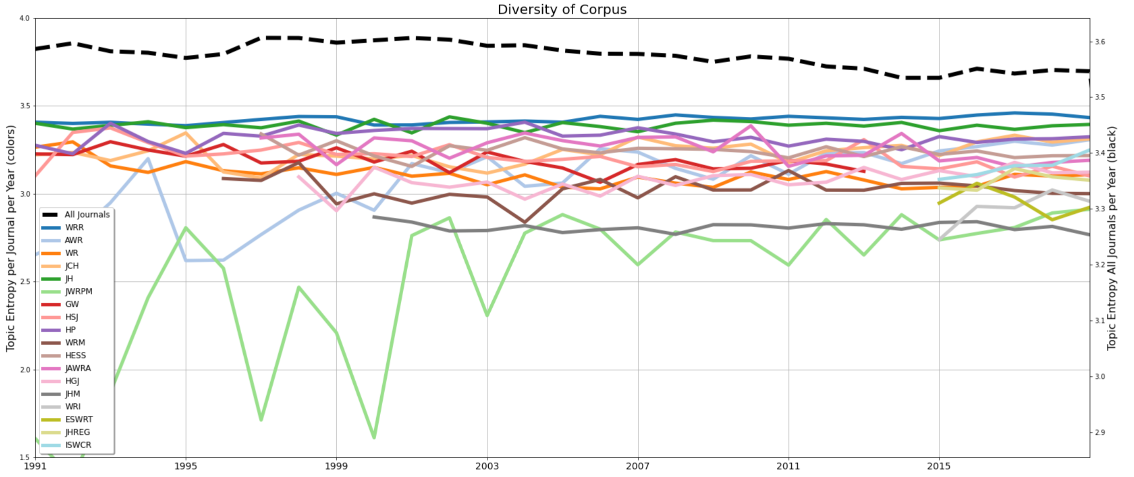
# Interdisciplinarity in Hydrology Literature

## Per-article Diversity



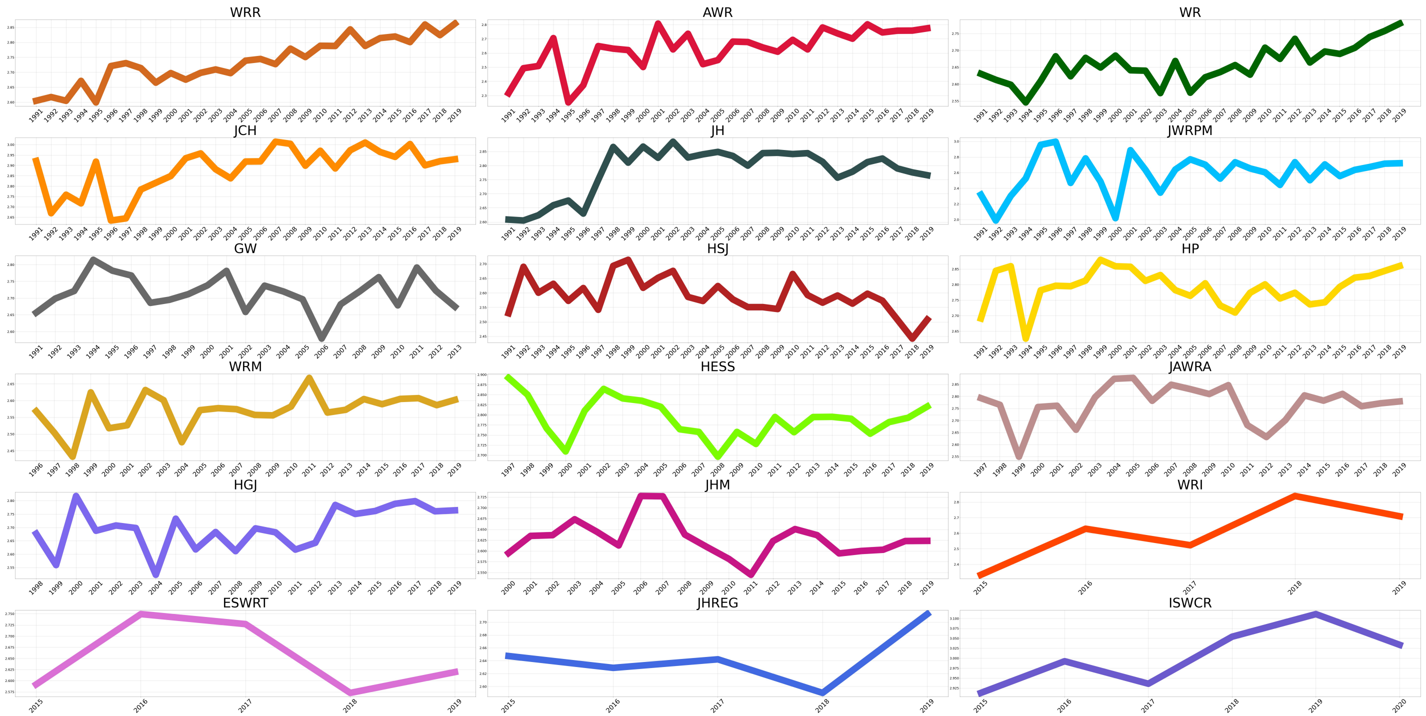

- ENT per article steadily rose from 13.62 in 1991 to 15.29 in 2019
- 4.44% rise in mean per article topic diversity translates to 12.26% rise in the number of equally-common topics per article

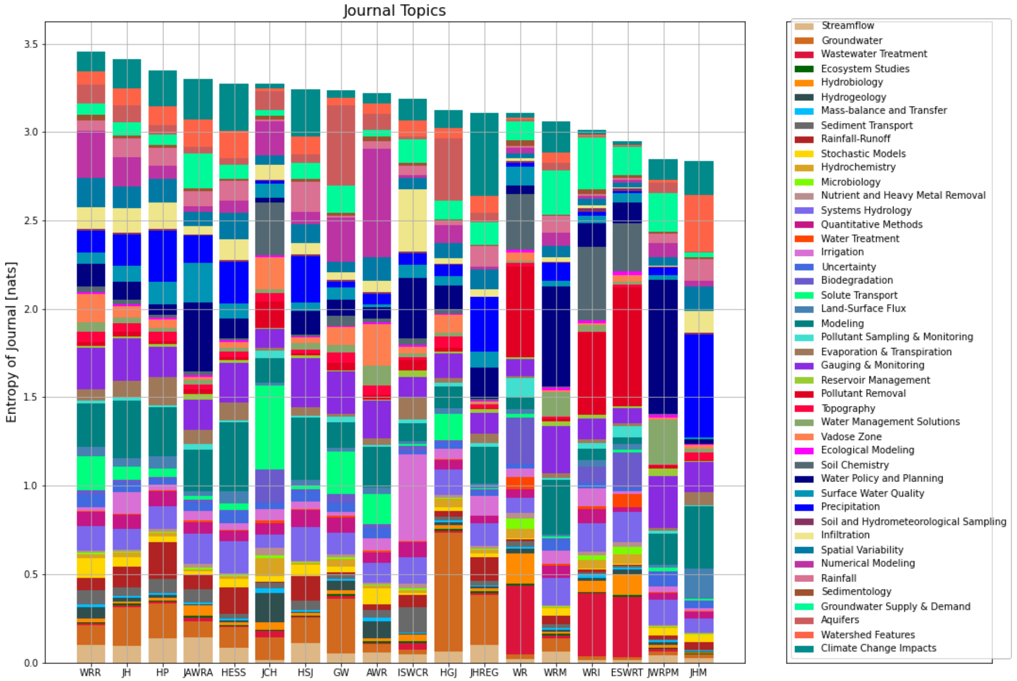
## Corpus Diversity



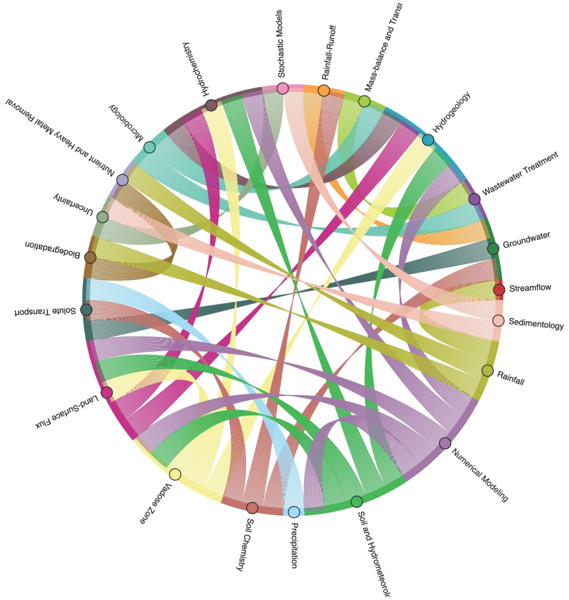

- No trend is observed for the entire corpus

# Interdisciplinarity Trend in Journals

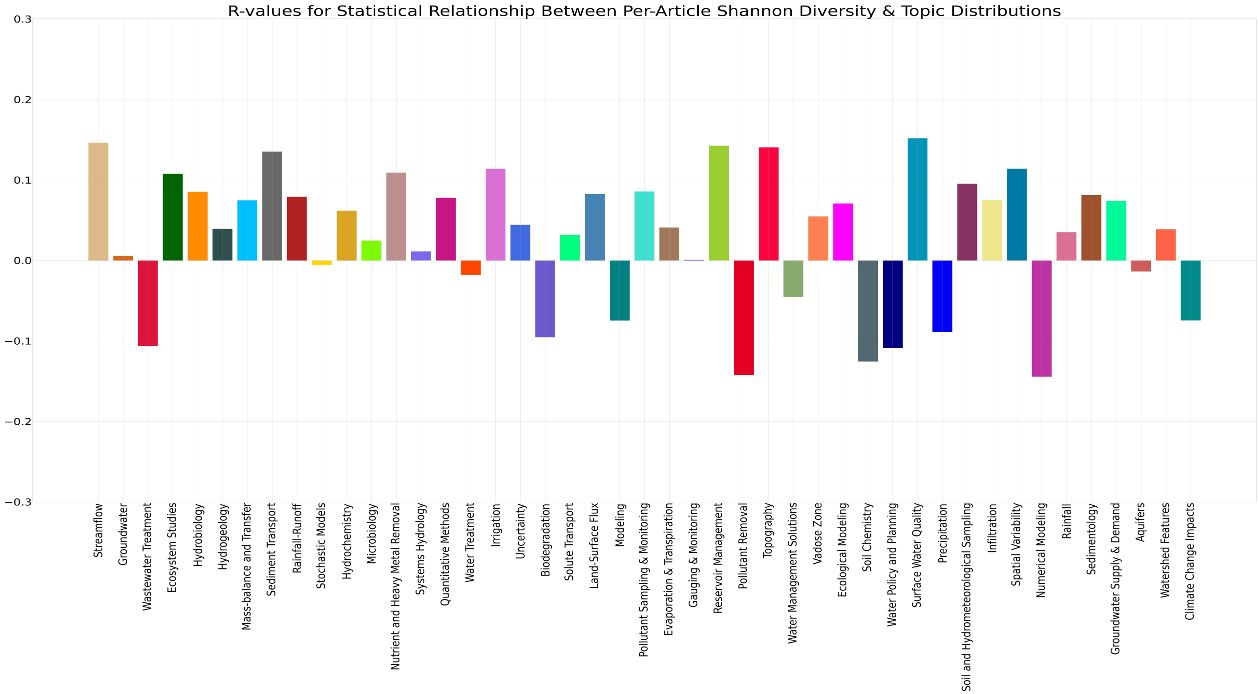


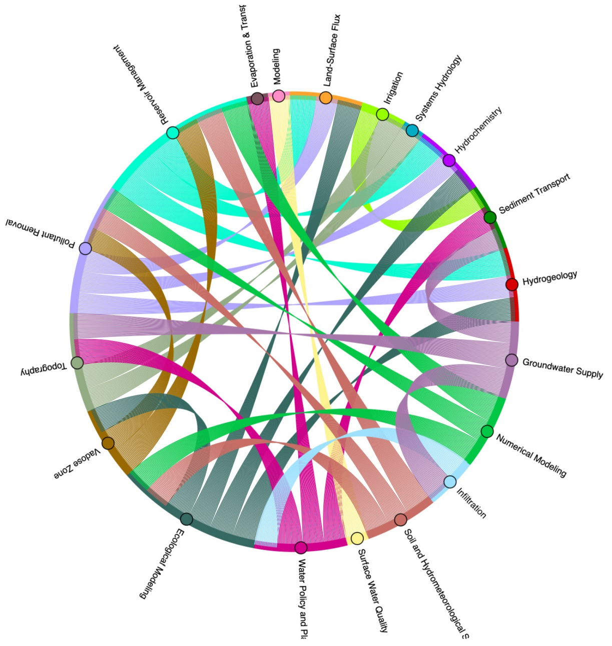



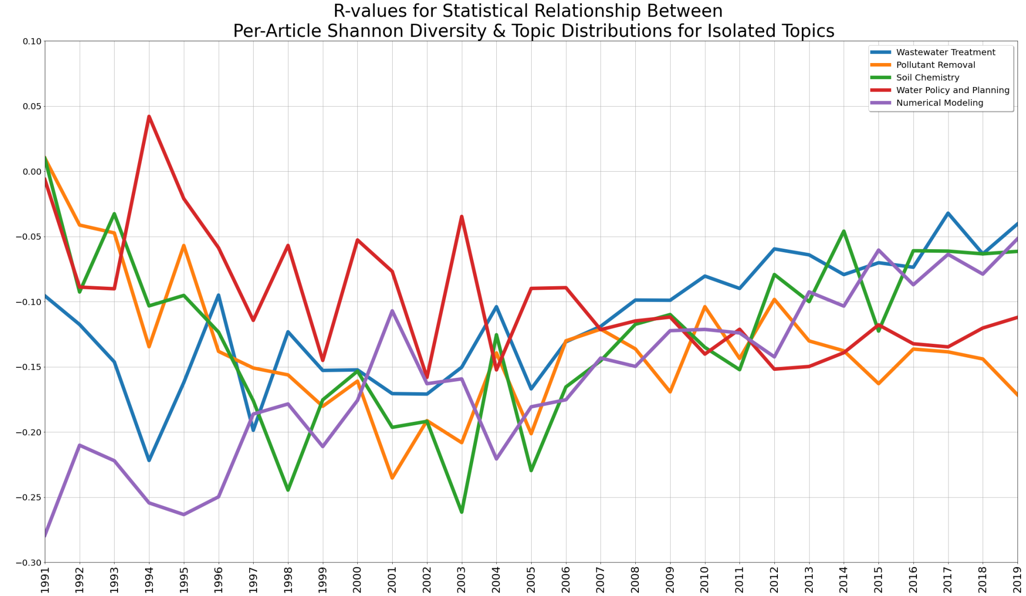
# Detecting Isolated Topics




Positive Correlations




Negative Correlations