

# 1 - First Design

Chris Reudenbach

## Assessment

### Purpose

Work in **pairs**. Objective: understand how precipitation stations are deployed in field hydrology and apply this logic to the **Burgwald region** ( $\sim 200 \text{ km}^2$ ).

#### 1. Study the examples

Read the table and the section on deployment rationales. Identify, for each case study, which principle dominates:

- Physiographic stratification
- Information-gain optimisation
- Hydrological coupling

#### Your notes

Summarise which rationale dominates in each example and why it fits the environmental setting.

#### 2. Develop your own concept

Design a **conceptual rain-gauge network** for the Burgwald. Decide where gauges should be placed and explain the reasoning using the three rationales as a framework.

#### Concept sketch

Describe or visualise the proposed network layout (schematic or georeferenced). A hand-drawn sketch or simple diagram may be uploaded.

### 3. Identify required datasets

List the **data and measurements** needed to implement the design. Focus on **primary environmental and technical inputs**, not pre-interpreted map products.

#### Examples

- Digital elevation model (DEM) and derived slope/exposure
- Land-cover and forest-structure data
- Radar reflectivity or gauge-adjusted precipitation fields
- Stream-gauge and discharge records
- Infrastructure and accessibility (power, communication, roads)

#### Data requirements

Separate **available** datasets (existing sources) from **missing/uncertain** ones that would require acquisition.

#### Output

Prepare a **one-page concept note or mini-poster** including: (1) conceptual network sketch, (2) key design rationale, (3) list of required datasets and measurement sources. Upload this as a PDF to the Ilias Folder Deliverables. Naming Convention: NAME1\_NAME2\_Task1.pdf

### Help

#### Selection of reference Designs

#### Selection and validation of reference sites

##### Purpose

Provide an explicit rationale for choosing benchmark catchments that reflect historical practice and current methodological standards in precipitation-network design.

##### Selection logic

- Long-term, quality-controlled hydro-meteorological data (>10 years).
- Explicit documentation of *why* and *where* gauges were deployed (peer-reviewed papers or technical reports).
- Representativeness across climatic and physiographic settings (arid–humid, lowland–upland, forested–open).
- Demonstrated influence in later modelling or network-optimisation studies.

##### Validation

Combine *empirical heritage* (Walnut Gulch, Reynolds Creek) with *analytical optimisation* (HYREX, CAOS, Henriksen 2024) to cover state-of-the-art and historical evolution.

## ⚠ Common pitfalls in selecting reference networks

### Typical mistakes

- Using short-term campaigns (< 2 years) without continuity or QC.
- Choosing networks without metadata; if siting rationale or maintenance history cannot be reconstructed, comparisons lose value.
- Relying on model-derived “virtual stations” instead of physical gauge networks.
- Ignoring physiographic context (e.g., urban/agricultural networks as proxies for forested uplands).
- Assuming modern equals better; some historical observatories remain superior due to documentation and consistency.

### Reminder

A benchmark network should be traceable, representative, and reproducible—not merely new or data-rich.

## How To find such references

### 💡 Classical literature search (from broad to benchmarked shortlist)

#### A. Define scope & inclusion criteria (before searching)

- Mesoscale (~100–300 km<sup>2</sup>) *field* catchments with dense rain-gauge networks.
- Must have: multi-year QC'd P (and ideally Q), documented siting/deployment rationale, accessible metadata.
- Ensure diversity: include at least one arid/semi-arid, one temperate upland/forested, and one radar-coupled design study.
- Exclude: < 2 years duration; purely model/virtual networks; no siting documentation.

#### B. Seed the search (databases)

- Web of Science / Scopus (structured), Google Scholar (recall), institutional repositories (USDA-ARS, NERC/NORA, national hydrological services).
- Boolean examples:
  - ("rain gauge" OR pluviometer) AND (network OR deployment OR siting) AND (catchment OR watershed) AND (design OR optimisation OR "kriging variance" OR "conditional entropy")
  - Add scale: ("experimental watershed" OR observatory) AND (km<sup>2</sup> OR "km<sup>2</sup>")
  - Add context: forest\* OR orograph\* OR upland, and for radar-coupled: radar AND gauge AND merging.

#### C. Backward & forward snowballing

- Backward: screen reference lists of key hits (observatories, radar–gauge reviews, optimisation papers).
- Forward: “Cited by” / “Times cited” to find design/upgrade papers and technical reports.

- For observatories: combine catchment name with "technical report" OR "instrumentation plan" OR "site manual".

#### **D. Screen & extract (mini-PRISMA mindset)**

- Maintain a log (query → results → screened → included; record exclusion reasons).
- Extract into a table: *Site / Area / Climate/Land cover / Gauge count & resolution / Deployment rationale (physiographic / info-gain / hydrological) / Docs/Links*.
- Validate with checklist: continuity 10 y; explicit siting rationale; scientific influence; data access.

#### **E. Stop rule**

- When each rationale has 1 high-quality case and 2 climatic/physiographic regimes are covered, freeze the shortlist and justify it with the checklist.

#### Optimised ChatGPT prompt (template)

Use the following prompt when an assistant is allowed to browse the web and compile **benchmark observatories** with explicit deployment rationale.

**Task:** Identify 5–7 benchmark hydrological field catchments (~100–300 km<sup>2</sup>) with dense rain-gauge networks where the deployment rationale (why/where/how gauges were placed) is explicitly documented in peer-reviewed papers or technical reports.

**Context:** We are designing a rain-gauge network for the Burgwald (forested upland, Germany). We need reference sites that reflect both state-of-the-art optimisation and historically grown observatories.

**Constraints & preferences:**

- Prioritize sources with explicit siting/deployment rationale (not just data).
- Include at least one arid/semi-arid, one temperate upland/forested, and one radar-gauge optimisation study.
- Prefer open-access or repository-backed documents (USDA-ARS, NERC/NORA, national hydrological services).
- Exclude short-term (<2 years) campaigns and purely model/virtual networks.

**Deliverables:**

1. A concise table: Site | Area (km<sup>2</sup>) | Climate/Land cover | Gauge density & time resolution | Dominant rationale (physiographic / information-gain / hydrological) | Why this site qualifies | Open link(s) (PDF/DOI/repository)
2. 4–6 bullet “selection/validation” notes (continuity, documentation quality, influence, data access).
3. 3–5 search strings for Web of Science / Scopus / Scholar.

**Important:**

- Use web browsing to verify links (prefer PDF/DOI/repository).

- Cite exact titles and years; avoid non-authoritative sources.
- If the siting rationale is only in a technical report, include that report.

Now begin. First list planned search queries, then produce the table and notes.

### Rationale

Role specification + constraints + explicit deliverables increase reproducibility and the proportion of authoritative sources returned.

### Validating the quality of AI-assisted literature results

Using large-language-model tools (e.g. ChatGPT) for academic research requires the same critical discipline as any other secondary data source.

A response generated by such a model is *not* evidence; it is a hypothesis that must be verified. To assess the **validity and reliability** of AI-generated content, apply the following multi-step check:

1. **Traceability** — Every claim or citation must be verifiable through an identifiable, accessible primary source (DOI, repository, or technical report).
  - If the model provides a reference, check that the DOI or link resolves correctly.
  - If it does not, the information cannot be treated as valid data.
2. **Cross-verification** — Confirm that at least one independent, authoritative publication (peer-reviewed or institutional) supports the same information.
  - Use Web of Science, Scopus, or Google Scholar to triangulate keywords or exact phrasing.
  - Contradictory evidence must be noted explicitly, not ignored.
3. **Context consistency** — Ensure that the terminology and scope of the AI response align with the disciplinary context (hydrology, RS, GIS).
  - Over-generalised or discipline-agnostic phrasing is a warning sign of low specificity.
4. **Completeness and bias check** — Evaluate whether the model omits critical perspectives (e.g. older but seminal field experiments, regional studies).
  - If the list looks too homogeneous or too recent, broaden the manual search.
5. **Reproducibility test** — Re-run the same prompt (or a slightly varied one) at a later time or with another model.
  - Stable, consistent core results indicate higher robustness; volatile or entirely different answers suggest low reliability.

**Rule of thumb:**

An AI-generated result is acceptable only when it is (a) traceable to verifiable sources, (b) internally consistent, and (c) replicable through manual or bibliographic methods.

If any of these conditions fail, the output must be treated as exploratory, not evidential.