Functional Peer Review Protocol for Climate Science Papers

Written by Linda van Garderen — lindavangarderen.com
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This protocol is designed to support a reviewing process that is practical, focused, and rewarding. It avoids abstract phrasing like *"adequate quality"* and replaces it with clear, grounded questions and actions. Whether you are new to peer review or looking to refine your approach, this guide offers structure without unnecessary complexity.

The Role of the Reviewer

As a referee, your role is to:

- **Validate** the paper's methods, results, and interpretations
- **Assess** its originality, relevance, and ethical soundness
- **Provide** constructive, specific feedback for improvement
- **Advise** the editor—while the final decision remains theirs

The steps outlined below are not strictly chronological. It's best to read through the full protocol before starting your review, and then keep it nearby as a reference throughout the process.

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1. Quick Skim for Scope and Structure

- Skim the **introduction**, **figures**, and **conclusion**.
- Ask:
  - Does the paper have a clear flow?
  - Are claims grounded early?
  - Are red flags like overreach or gaps visible?

2. Abstract Expectations & Questions

- Read the **abstract with focus**.
- Write down:
  - What you expect in terms of **methods**, **data**, and **claims**.
  - Immediate **questions** (e.g., *"Do they account for internal variability?"*).

These questions become your **guiding lens**.

Now, begin reading the **full paper**. At the very end, **return to your expectations and questions** and ask:

> Were they addressed? Did the paper deliver what it set out to do?

This allows you to focus while reading, then assess coherence and completeness afterward—without needing a second pass.

3. Identify the Core Scientific Claim

- While reading the main sections (methods, results, discussion), synthesize:
  - What is the paper's main hypothesis, question, or contribution?
  - How do the methods and results support this claim?

  Trace the logical thread of the paper as you go and note the central message.

4. Review Methods and Reproducibility

- Are methods clearly described and **replicable**?
- Check for:
  - Data sources and preprocessing
  - Temporal/spatial resolution
  - Model parameters
  - Uncertainty treatment or validation runs

5. Spot Vague Language

Here's what journals and reviews often say—without saying much:

Vague Term	Ask Instead
"Adequate method"	Can someone reproduce it from the description?
"Appropriate dataset"	Is it valid for the time/space scale being studied?
"Robust results"	Have sensitivity tests or alternative scenarios been run?
"High-quality data"	What are the biases, gaps, and preprocessing steps?

6. Evaluate Results, Figures, and Captions

- **Are results clear and valid?**
  - Do figures/tables support the paper's claims?
  - Are results compared to literature, baselines, or observations?
- **Are visual conventions followed?**
  - Axes labeled (with units)?
  - Intuitive color scales (e.g. blue=cool)?
  - Uncertainty shown (e.g. shading, error bars)?
  - Colorblind-friendly?
    - Use: Coblis Color Blindness Simulator
- **Are captions self-contained?**
  Each figure/table should:
  - Be numbered and referenced in the text
  - Include a short title or summary
  - Explain key variables, units, and data sources
  - Provide enough info to understand the figure without reading the main text

Good figures are more than decoration — they are standalone evidence.

7. Context and Limitations

- **Is the research well grounded in existing literature?**
  - Does it cite relevant prior work (not just cherry-picked studies)?
  - Are competing perspectives or findings acknowledged?
- **Are limitations discussed honestly?**
  - Do the authors explain what the study doesn't cover?
  - Are assumptions, uncertainties, or boundary conditions clearly stated?

Honest science doesn't pretend to be perfect — it places itself responsibly in context.

8. Spot Missing Elements

- Is something important **left out**?
  - Key mechanisms (e.g., land use, aerosols)?
  - External validation datasets?
  - Contradictory studies?
- Are **uncertainties buried or omitted**?

9. Final Review Summary (And Why It Matters)

Start with a **neutral summary** of the paper's content (fictional example): > *"The authors compare four regional climate models (RCMs) over southern Europe to evaluate their ability to simulate extreme heat events during 1980–2020. Using standardized heatwave indices and ERA5 reanalysis as a reference, they show that two models consistently overestimate intensity but capture spatial patterns well. The study emphasizes the need for bias correction in applied impacts research."*

Why this matters: - Shows editors you understand the work - Frames your comments for the authors - Helps spot misalignments between reviewers

Write your review in three parts:

1. **Main strengths**
   What does the paper do well? Highlight novelty, clarity, solid methodology, or valuable insights.
2. **Major comments**
   These are issues that affect the validity, clarity, or strength of the paper's conclusions.
   For example:
   - Unsupported claims
   - Missing data or comparisons
   - Ambiguous or incomplete methods
3. **Minor comments** *(structured by section)*
   These are smaller points aimed at improving clarity and polish.
   Organize them by paper section (e.g., Introduction, Methods, Results…) to make them easy

to follow.
You can include:

- Typos or unclear wording
- Caption or figure suggestions
- Requests for clarification or references

Grouping feedback like this keeps your review focused, constructive, and easy for both editors and authors to navigate.

Avoid empty phrases like:

- “Needs more work” –> “Missing validation against observational dataset X”
- “Not convincing” –> “Conclusion assumes linearity without testing nonlinearity”
- “Insufficient detail” –> “The methods lack description of spin-up procedure for model Y”

What if you genuinely feel something is “not convincing”?

That’s valid. Experienced reviewers often sense when something doesn’t hold — even before they can explain why. That’s not emotion; it’s **trained scientific intuition**.

Use it as a prompt: - Ask: *What exactly feels unsupported or incomplete?* - Re-examine the logic, evidence, framing, or what might be missing. - Then explain your hesitation in **specific, actionable terms**.

New to reviewing?
If you’re unsure whether something is flawed or just confusing, say so. It’s perfectly fine to write:
> *“I had difficulty following the logic in Section 3. It may be valid, but the argument isn’t clear to me as written.”*
This helps authors and editors know whether the issue is with the science itself or the way it’s communicated.

Reviewing is a scientific contribution—not a checkbox. Clarity, fairness, and specificity are what make a review valuable.
