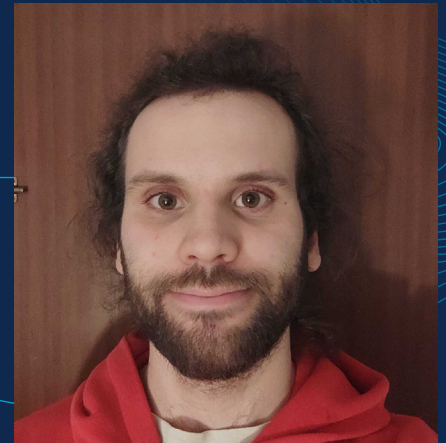


Understanding what is driving the wavenumber 5 pattern



MODELLING

GEOPOTENTIAL HEIGHT

HEATWAVES

SUMMARY

The counter intuitive phenomena in climate dynamics make it a very interesting subject to me. Despite it being based on simple assumptions, it gives rise to hard to explain processes and complex interactions.

In a similar way, in the last few decades, the atmosphere has shown changes in the shape of a large wave that spans over the whole hemisphere and is linked to persistent climate conditions like heatwaves and floods, and we need to understand what mechanisms cause it. Disentangling this interplay of processes could improve prediction of future climate and raise societal preparedness.

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EXPERTISE

Climate dynamics

Can you explain why/how your expertise is related to climate change?

Gerard Marcet-Carbonell: Initially, I really liked toying with mathematics, but climate physics captured my attention during my undergrad. Climate physics is rooted in classical mechanics, a branch of physics that describes everyday motion using, for instance, Newton's laws. Although most the principles are intuitive, there are specific atmospheric processes happening on Earth that fascinate me because they're so counter intuitive (Figure 1).

During my masters, I mainly studied modelling. Modelling is the process of turning real world processes into mathematical expressions that can be simulated on a computer. It's a framework used to run scientific experiments on a global scale. Using models to simulate the climate system allows you to overcome the limitation of not having different Earths to experiment with. When you couple it with a good physical understanding of the climate system, it leads to very good knowledge of the mechanisms and helps predict atmospheric processes.

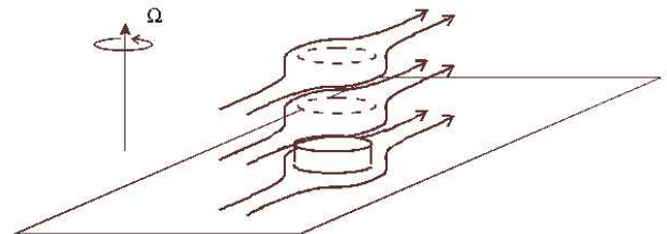


Figure 1. This sketch shows how fluids behave in rotating systems when rotation effects dominate (as sometimes happens on Earth). Under these circumstances, columns of fluid move uniformly and if there is an obstacle at the bottom, flow cannot go over it either.
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Within EXPECT, what's the focus of your research?

G.M-C.: The phenomenon that I am interested in is the Wave 5 pattern, based on observations from recent decades which showed warming that was not homogeneous at the surface (Figure 2). Looking at it from above, it has the shape of a wave. Although relatively little is known about what specific mechanisms are driving the wave pattern, it has consequences for society. There is an indication that the warming hotspots are related to circulation patterns (how large masses of air move in the atmosphere). These circulation changes could be linked to increased risks of floods, heat waves and other extreme events.

Understanding what drives these atmospheric processes is the first step towards improving predictions and future preparedness. By studying recent trends in pressure differences, I am trying to figure out how they occur and how they are related to heat extremes. Disentangling the different aspects of climate to get a coherent picture of what is happening is what I find most exciting.

How could we make climate science communication more effective?

G.M-C.: There is plenty of room for improvement when it comes to engaging the general public. When communicating science, you have to be very clear on how you deliver your message and adjust it to the audience accordingly. For instance, stressing the science community's consensus on well-established facts of climate change requires contextualizing the state of climate emergency we are in. Although there are specific phenomena we might not completely understand as a community, climate science as a whole is the closest thing we have to guide decision-making and take collective action to combat climate change.

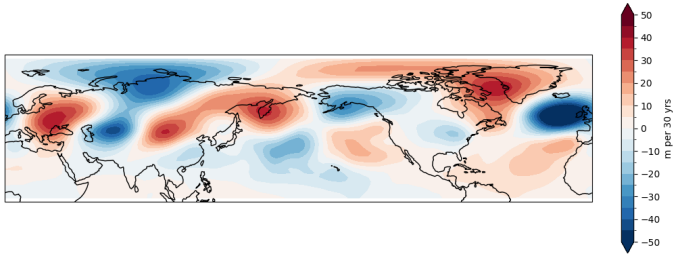




Figure 2: Wave-5 pattern. The red spots correspond to increases over the 1979-2014 period in pressure in high troposphere (about 12km of altitude) linked to increased anticyclonic conditions. While the blue spots show decreases linked to increased cyclonic activity.
 @ In review, Gerard Marquet-Carbonell, 2026

If you can tell a coherent story to others that is engaging, grounded in facts and gets people to understand science, that would be a good way forward. To reconnect science and society, we need to become better storytellers and be better prepared to engage in discussions without misleading others.




LOOKING FORWARD

Currently, I am very curious about the physical mechanisms behind these trends, but the fact that it has societal relevance grounds me. Instead of working in a vacuum, the practical purpose of heat wave prediction and preparation matters. On top of my scientific curiosity and drive to learn about climate, the societal relevance of climate change pushes me to go beyond my research and work on my communication skills.



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Funding



Funded by
 the European Union



UK Research
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