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Proposal: SCIENTIFIC + ENGINEERING LEADERSHIP FELLOWSHIP

I am the Director for NCAR's Capacity Center for Climate and Weather Extremes (C3WE/MMM) and a Research Fellow at the North-West University, South Africa. I have an MSc in Dynamical Modeling and a PhD in Environmental Management.

My interests have always spanned both management and research. I started my career as a researcher at the South African Weather Service. I soon became involved in management and prior to joining NCAR, I was the Assistant Director of Research Programs and Project Manager for Operational Systems at the South African Weather Service. My move to NCAR was prompted by a desire for personal growth both as a researcher and as a manager.

I started my career at NCAR as a model developer for MM5 and WRF, and lead for the MM5 and WRF training modules. During this time my research interests evolved towards weather events on climate time scales, and I was asked to join a project developed by Greg Holland regarding the impact of climate change and variability on tropical cyclones. This project made it abundantly clear that extreme events in a changing climate are not only interesting from a research perspective, but vitally important for industry and decision-makers. This led to Greg and I co-founding the Capacity Center for Climate and Weather Extremes (C3WE), a center within MMM/NCAR that was established to advance our understanding of the dynamics and predictability of extreme weather events across time scales and foster private/public partnerships.

Over the last couple of years, C3WE has successfully nurtured several non-traditional partnerships. One such continuing partnership is with the re-insurance broking company Willis Towers Watson. For more than 10 years Willis has partially funded two positions at NCAR – A Senior Academic and a Research Fellow. These fellowships allow us to conduct research on topics of mutual interest and give Willis access to high-quality science from a reputable institute that they, in turn, can use for business decisions. The partnership is deeper and more meaningful than simple projects, allowing for mutually developed research and much stronger relationships.

Collectively, over the last couple of years, the C3WE team has also developed partnerships with other insurance and reinsurance agencies, water resource managers, the oil and gas industry, actuaries, and universities. Several successful collaborations have also been developed with staff in NCAR/UCAR, specifically from RAL, ACOM, COMET, and SciEd.

Some recent personal highlights in developing partnerships include:

- Exploring climate change impacts on energy production in the Gulf of Mexico with a Norwegian Reinsurance Company, and with a consortium of offshore energy companies;
- I lead a collaboration between NCAR and the Insurance Australia Group (IAG) that aims at understanding and predicting the impact of climate variability and change in Australia, specifically in regards to extreme weather events (*see attached letter of appreciation from IAG's perils manager, Mark Leplastrier*);
- I established a collaboration with the Australian James Cook University's (JCU) Cyclone Testing Station (CTS). One of the outcomes of this collaboration is a recent invitation to JCU to join the UCAR-NCAR International Affiliate program (*see below*);
- I established a collaboration with The Nature Conservancy (*see below*);
- I recently secured a new partnership with a Swiss Insurance company called PartnerRe;
- I am a member of the Society of Actuaries Catastrophe and Climate Strategic Research Program Steering Committee and a committee member of the Society of Actuaries Program Oversight Group;
- I am an Expert Advisor for an NSF EPSCoR Project: Basin Resilience to Extreme Events.

Two of these partnerships I would like to highlight are the James Cook University and The Nature Conservancy. These partnerships both resulted in what I loosely call *Research Fellows* or *entrepreneurs-in-residence*, i.e., JCU and TNC both fully support a researcher that is housed in and affiliated with C3WE. My requirements before establishing these "Fellowships" were that the researchers can only be affiliated with C3WE if their research aligns with the mission and vision of C3WE and if we collaboratively respond to and work on proposals.

Project Proposal

I believe that these private/public partnerships are now even more important, and I know that I am not alone in this belief. In fact, the latest draft NCAR strategic plan states that NCAR's core purpose going forward is ***science with and for society***. The strategic plan also states: "*High-impact atmospheric and geospace events, along with climate variability and change, strongly influence the sustainability of our physical environment and societal structures.*" and "*Today, we recognize the imperative to work closely with the diverse communities that constitute contemporary society.*"

Further, two of the three goals put forward in the Technology Transfer Strategic Plan are: "*Building effective private sector connections and partnerships*" and "*Capturing our impact: science that meets society's needs.*"

As mentioned before, C3WE has been successful in developing non-traditional partnerships. C3WE is not alone in this success, these partnerships are being developed throughout NCAR, with RAL specifically being very successful. The Technology Transfer Survey results¹ indicated that of

¹ https://www.ucar.edu/sites/default/files/documents/related-links/2019-04/UCAR_Tech_Transfer_Strategic_Plan_0.pdf

their respondents, more than 50% individually engage in some form of partnership building. This survey also highlighted the fact that individuals get frustrated when building these partnerships as they feel that there are not sufficient guidance and support from management for these efforts, and that there is not a consistent intuitionally wide “recipe” for building successful partnerships.

To encourage more private/public partnerships, I feel that a UCAR/NCAR wide model (“recipe”) for building partnerships should:

- Have strong management support;
- Show the benefit and value of these partnerships to both UCAR/NCAR and the partners;
- Align with the UCAR/NCAR strategic plan and mission;
- Have a funding structure to support the partnerships;
- Promote cross-laboratory collaborations;
- Encourage UCAR/NCAR/partner collaborative responses to RFPs.

Building a model like this will not happen overnight and will require a cross-UCAR/NCAR steering committee to develop. I propose a pilot project with a single partner that is currently collaborating with NCAR and wants to broaden their collaboration. This pilot project can be used to establish and stress test the building blocks for a UCAR/NCAR wide model.

The partner I propose for this pilot project is The Nature Conservancy. TNC is a current C3WE collaborator, we have a TNC supported researcher affiliated with C3WE, and TNC has indicated that they want to expand the current partnership. The expanded partnership will be cross-lab involving both C3WE/MMM and CGD. J-F Lamarque, Everette Joseph, representatives from TNC and I have discussed this already, and everyone is willing and interested in using this partnership as a way to develop a model that could then be refined as a UCAR/NCAR wide model for future private/public partnerships.

Being a UCAR Scientific + Engineering Leadership Fellow will help me develop my leadership skills. It will also provide me the opportunity to use the experience I have built up working with industry to help create an institutional-wide model for engaging with private/public partnership towards the goal of science with and for society.

A project like this will require involvement from most, if not all, of the sections in the President’s Office. Some of the most import will be:

- Government Relations/Business Development;
- Innovation-Technology Transfer;
- Corporate and Science Communications;
- Membership/Governance/University Relations.

Time Commitment: I would like to do a 6-month commitment, potentially spread out over 18+ months, rather than 12 months. Doing this will enable me to still fulfill my C3WE Director responsibilities and remain engaged in my research. I am flexible and are willing to negotiate the best terms for all involved.

Research Background

My current research activities all center around targeted projects aimed at understanding and predicting the impact of climate variability and change on extreme weather events. All of these projects are done in collaboration with industry partnerships.

One of my recent major research developments is the creation of a new community dynamical modeling approach (the Hybrid WRF Cyclone Model: Bruyère et al. 2019a) that can be used to create synthetic tropical cyclone events that are physically plausible but have not yet been observed.

In a current project, I am using the CESM Decadal Prediction Large Ensemble Project to create an outlook for the Insurance Australia Group (IAG) on predicted changes in tropical cyclones along the eastern coast of Australia. Another part of the IAG project led to the publishing of a state-of-the-science-report (Bruyère et al. 2019b) that was formally released at a symposium on Severe Weather in a Changing Climate (<https://www.iag.com.au/severe-weather-changing-climate>).

I have authored 38 peer review papers and four Technical Notes. Two of these papers were nominated for the NCAR paper of the year award. One of these papers won the MMM paper of the year award. I present a couple of papers at national and international conferences every year. Over the last six years, I have given 36 invited talks, of which 6 were keynote presentations.

Leadership Background

I have completed several training courses in Management, Supervisor Training, Service Delivery, and Project Management. Most recently, I attended the **NCAR Leadership Academy** (2017). I was also a **mentor** for the 2019 NCAR Leadership Academy.

I am the C3WE Director and directly or indirectly supervise 6 staff members. I have mentored and advised 11 PhD and MSc students, 2 Fulbright Scholars, SOARS, ASP Graduates, and ASP Post Doctorate Fellows.

I am very interested in continuing to develop my leadership skills and am specifically interested in gaining experience with the leadership at the NCAR Exec level as well as in Project Management.

Bruyère, et al., 2019a: Physically-Based Landfalling Tropical Cyclone Scenarios in Support of Risk Assessment. Weather and Climate Extremes. 26, <https://doi.org/10.1016/j.wace.2019.100229>.

Bruyère, et al., 2019b: Severe Weather in a Changing Climate. Insurance Australia Group (IAG). doi:<http://dx.doi.org/10.5065/nx7j-0s96>.