SMART DECISIONS FOR CLIMATE AND NATURAL DISATER RISK

Building a relationship with University of Kentucky to advance geophysical research with a global risk hazard platform

Dr. Jerry Skees Professor Emeritus
Founder of Global Parametrics

GLOBAL PARAMETRICS

Notices and Disclaimers

- *This memorandum is provided by Global Parametrics R&D Inc. (**GP**), a public-private company incorporated in the Commonwealth of Kentucky, for informative and discussion purposes only and does not constitute a binding offer or invitation to enter into any collaboration of any nature.*

- *For the avoidance of doubt, this memorandum does not constitute an offer, invitation or inducement to subscribe for shares or any other participation in GP or in any other member of the GP Group of Companies or in NDF (UK) LP (**the Natural Disaster Fund). Neither this memorandum nor any part of it nor any information provided in connection herewith (the Materials) shall constitute, nor shall be read as constituting, an offer, invitation or inducement to buy or sell or subscribe for any investment or otherwise to engage in investment activity of any nature**. Further, the Materials do not constitute financial or investment advice of any nature and, in receiving the Materials, each recipient acknowledges that neither GP nor any of its affiliates is acting as a financial advisor in connection with the matters constituted by, and contemplated by, the Materials.*

- ***The information contained herein is strictly confidential and may not be disclosed to any other person or entity (apart from disclosure to your advisers) without GP's prior written authorisation.***

- *No representation, warranty, guarantee or commitment is made by GP (or by any other member of the GP Group of Companies) or NDF (UK) LP as to the accuracy or completeness of any of the information set out in the Materials.*

- *Global Parametrics Limited, a wholly owned subsidiary of GP's parent company (Global Parametrics Holding Company Limited), is an appointed representative of Mirabella Advisers LLP, which is authorised and regulated by the United Kingdom Financial Conduct Authority. Mirabella Financial Services LLP, a firm authorised and regulated by the Financial Conduct Authority, acts as the Manager to the Natural Disaster Fund and has seconded the investment team at Global Parametrics Limited to manage the Natural Disaster Fund.*

What we do

Global Parametrics (GP) is a commercial enterprise with a social mandate to create new financial markets. Backed by the United Kingdom and German governments, we offer innovative financial risk management solutions to increase resilience and expedite recovery from natural disasters in emerging economies.

HOW DO WE HELP OUR CLIENTS

ASSESS

GP has unmatched climate and seismic-based data analytics for businesses to assess exposures to natural disasters and plan investments accordingly.

MONITOR

GP develops tailored natural disaster risk tools offering near real-time and forecasted conditions to monitor and proactively plan for emerging events

RESPOND

GP structures and deploys financial hedging products for businesses to get rapid cash in order to recover from natural catastrophes

Examples of GP's Social Mission

GP is working on a range of resilience programs to structure tools and financial products for managing natural disasters for clients from microfinance banks (VisionFund International) to humanitarian groups (Oxfam) to large commercial entities.

01
VISIONFUND INTERNATIONAL ARDIS

Comprehensive financial risk management and response program to support recovery lending to VisionFund's microfinance

Launched Jan 1st 2018

02
OXFAM B-READY PROGRAM

Forecast based financing in partnership with Oxfam in the Philippines

Launched Jan 1st 2019

03
CLIMATE RESPONSE & RESILIANCE FACILITY

International Financial Institution (IFI) led program to provide emergency to protect banks against climate and seismic catastrophes

Targeted launch 1H 2019

04
ANTICIPATING FAMINE

Forecasting supply shocks and then price shocks to understand the increase in food insecurity

Ongoing development

Open Data / Accessible Data

Data accessibility is a significant barrier to entry for many in the research and teaching community outside of specialized units.

Public weather data repositories are populated with many different file types, can be very large, require significant transformation for use, need significant computing and/or storage, etc.

Researchers are better off spending their time doing research rather than learning a new mechanism for accessing data via one particular source – ESRI, Google Earth Engine, various raw file formats, etc.

What if…

The University of Kentucky were to host an open data environment offered by Global Parametrics that empowers the community with a vast store of structured geophysical and geographic data and the tools to cleanly extract well defined subsets to accelerate research, teaching and outreach?

GP is in discussions with the University of Kentucky Center for Computational Sciences to do just that

Weather and Seismic Data Available

Geophysical data for history (50 to 100 years), with the same process for real time to settle and forecast to build forecast products is available for any geography of interest.

Weather Variables

Daily data including

- Total precipitation
- Low temperature
- High temperature
- Peak wind speed
- Max snow depth
- Total surface evapotranspiration
- Peak heat stress
- Hours below freezing (0°C)
- Estimates of soil moisture
- Forecast extreme temperatures
- Forecast of precipitation

Earthquake and Tropical Cyclone Variables

Modelled Hazard Data

- Peak wind historical, real-time and forecast
- Peak storm surge historical, real-time and forecast
- Peak significant wave historical, real-time and forecast
- Peak ground acceleration

Modelled Impact Data

- Estimate of % structure damage
- Estimate of % contents damage
- Estimate of downtime
- Estimate of economic impact

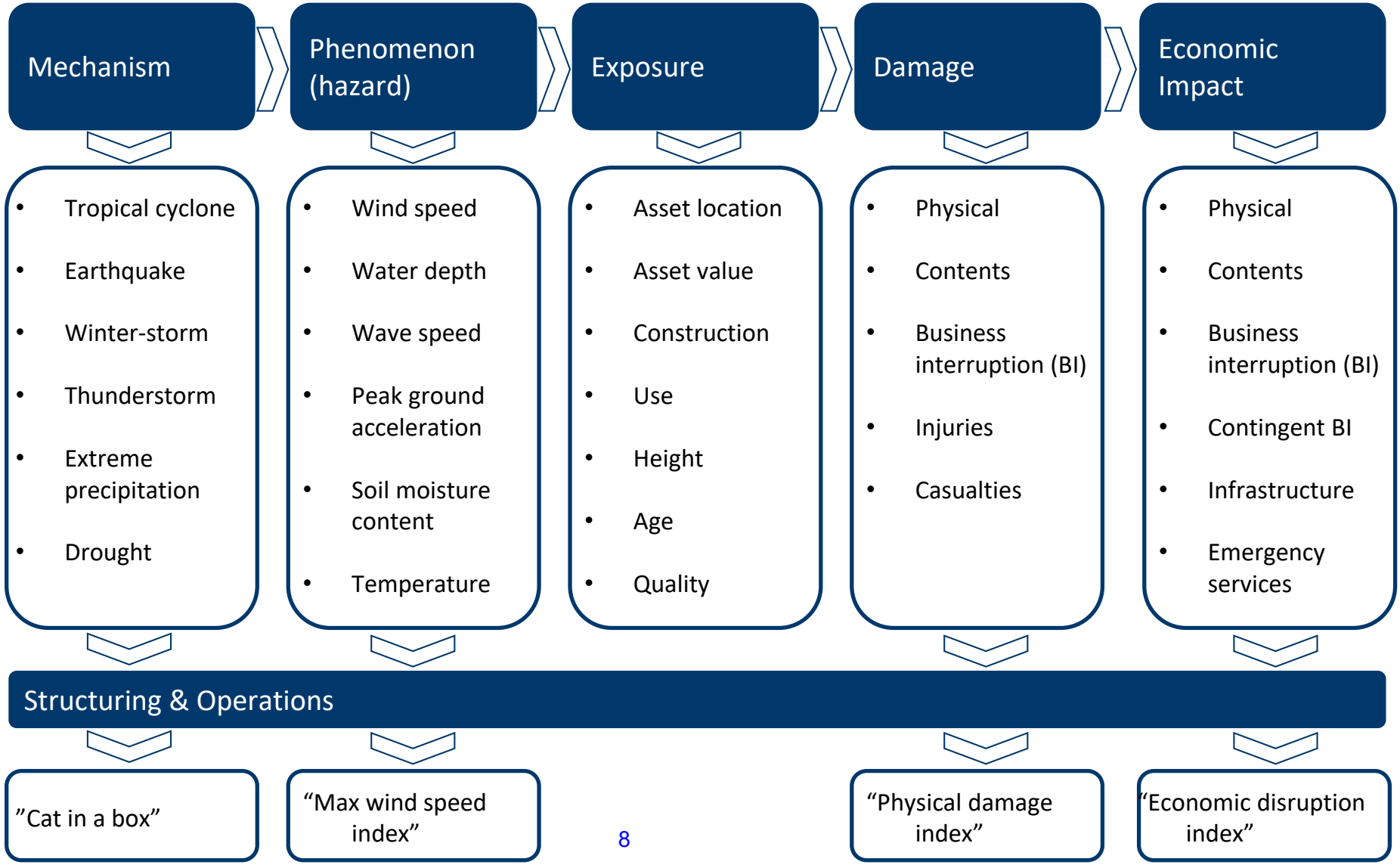
Sample of Scientific Data Sets

Data Class:	WX		TC	EQ	EX	PP
GP Hosted	*CFSR* *CFSv2* *GFS* *JRA55* *CHIRPS*	*GPCC* *ESA-CCI* *TRMM/GPM* *GSOD*	*IBTrACS* *JTWC*	*Centennial* *ISC-GEM*	*GeoNames* *OSM* *GADM* *GPW*	*MODIS* *GFSAD* *GEBCO* *ETOPO* *SRTM*
GP Generated	*MPAS* *GARW (WRF-ARW)*		*Fea* *GA-TCRM*	*Beria* *GEM-OQ*	*Macha* *Lachesis*	

GP organizes data into classes:

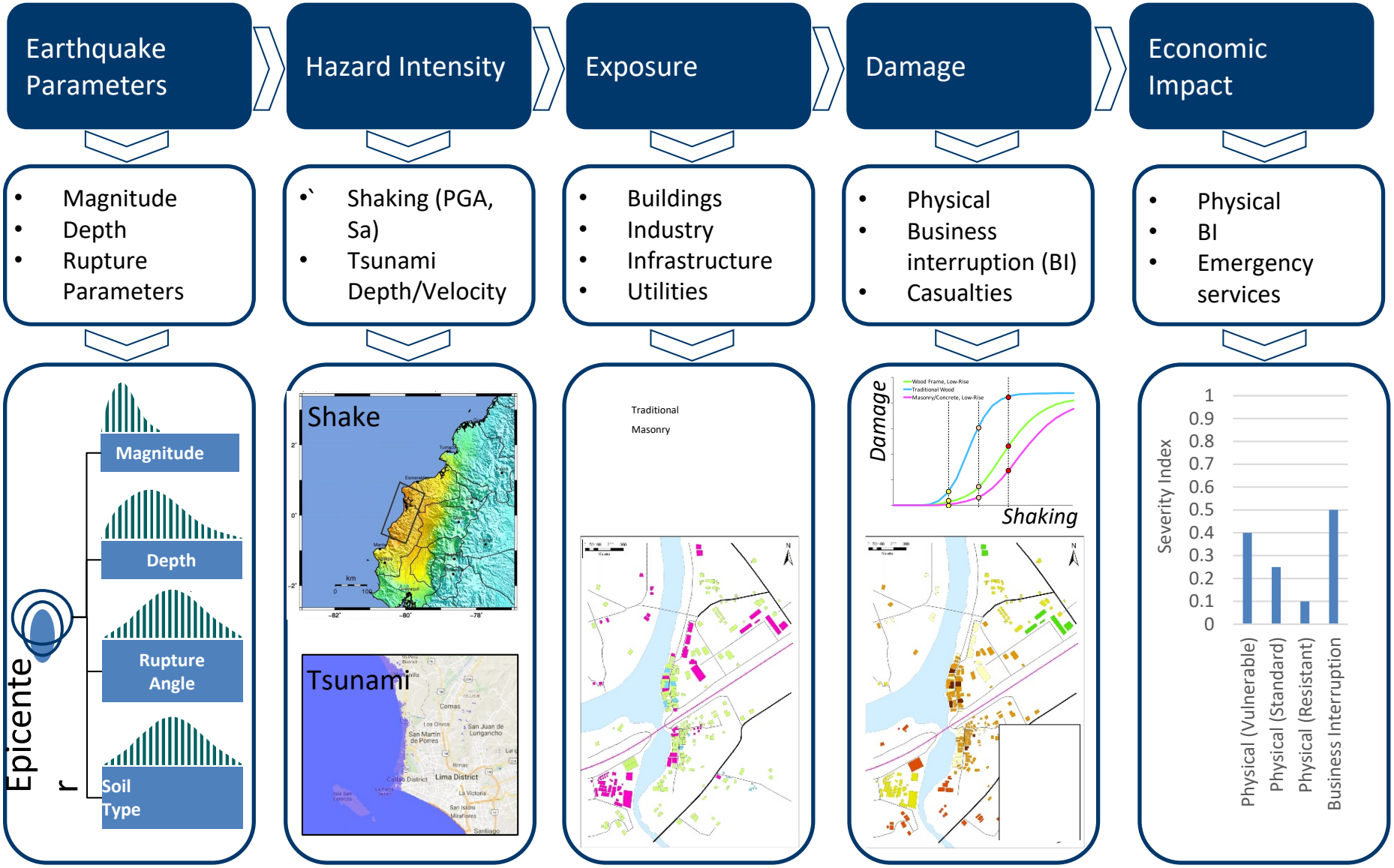
- WX – Weather
- TC – Tropical Cyclone (GP has tracks for all basins in the world)
- EQ – Earthquake (GP has history with focus on PGA working with GEM and Open Quake)
- EX – Exposure
- PP – Physical Properties

Risk Modelling Framework



GLOBAL PARAMETRICS

Framework Applied to Earthquake



GLOBAL PARAMETRICS

Index for Drought for African Countries

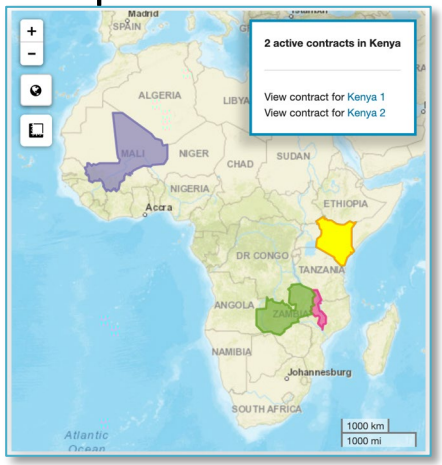
APIs

Visualizations

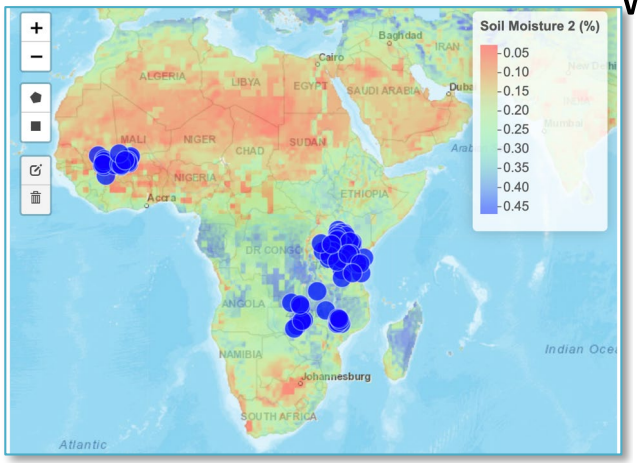
Financial Products

Analytics

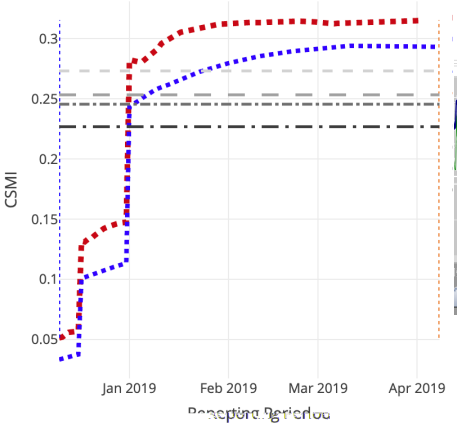
Exposure Data



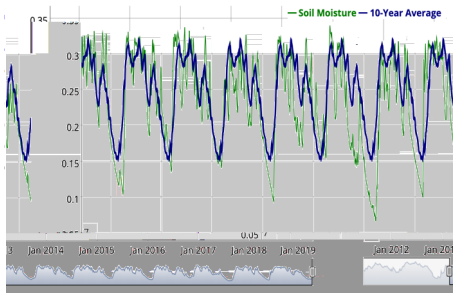
Hazard Platform



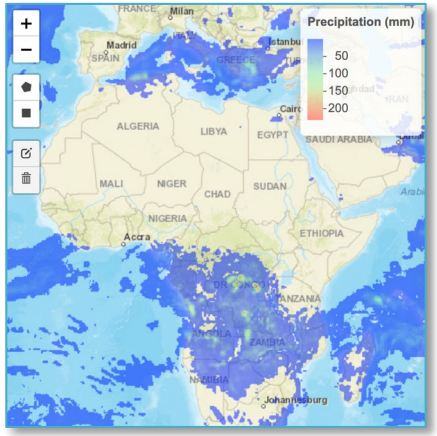
Weather Impact



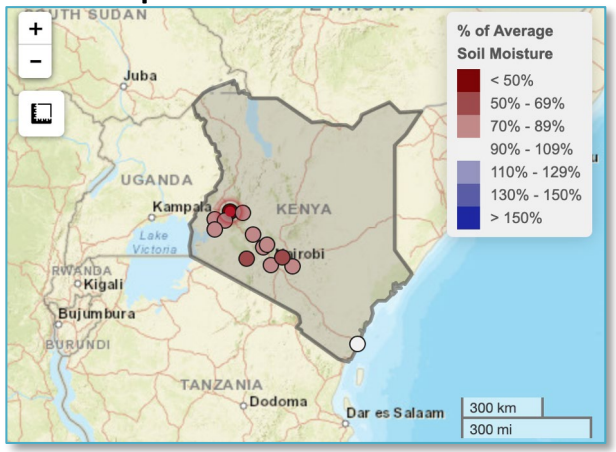
Historical



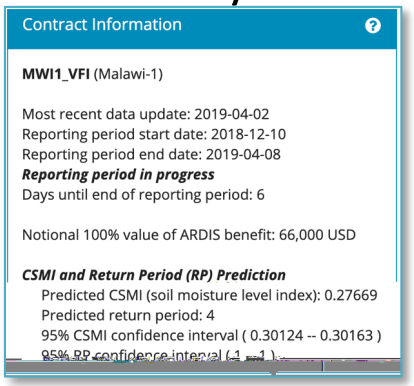
Hazard Data



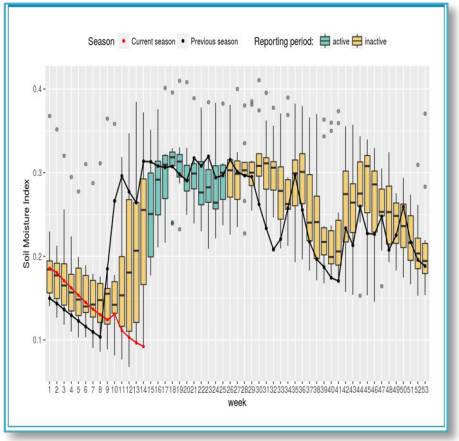
Impact Platform



Weather Payout



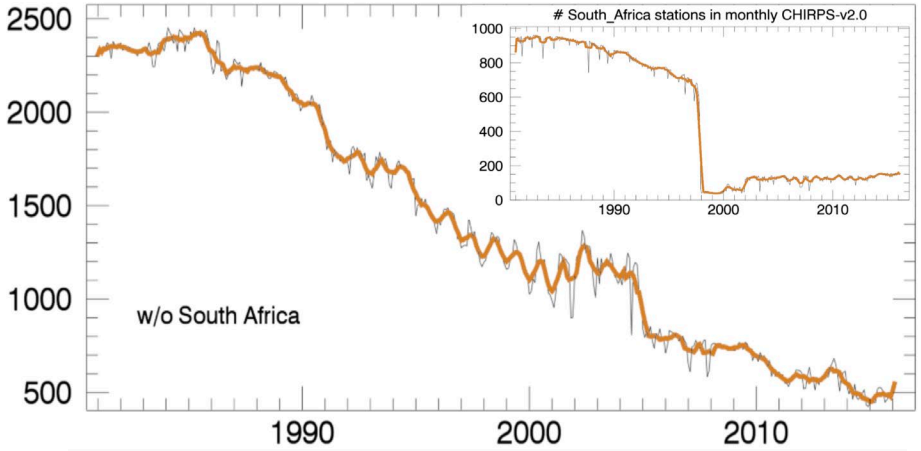
Probabilistic

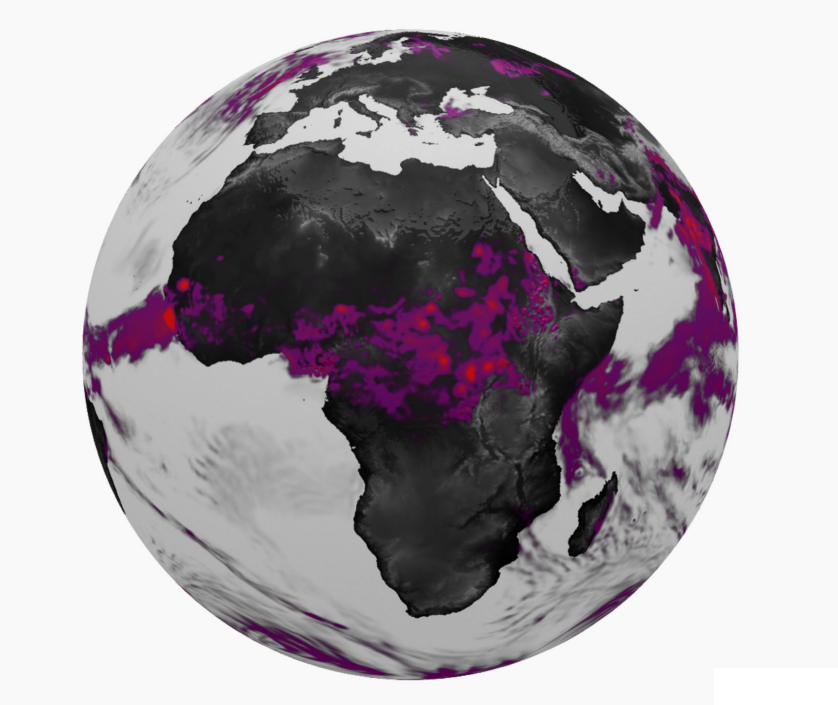


Comprehensive daily global view

- **GP creates predictive analytics using geophysical data from General Circulation Models (GCMs), probabilistic models, and earth observation**
- This is necessary as reliable weather stations are generally not available in LMICs
- **GP uses multiple datasets initially vetted by the scientific community and further vetted/corrected by GP to give a robust view of the risk**
- Our innovation is the use of multiple climate and seismic models and a data platform that allows fast joins of these data with any geographical exposure on the planet
- **We create historical, real time, and forecast weather and natural disaster variables**

Inventory of active and reliable weather observation stations, Africa

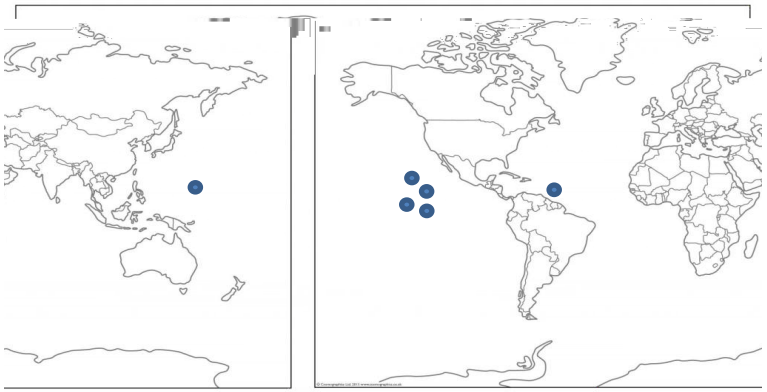




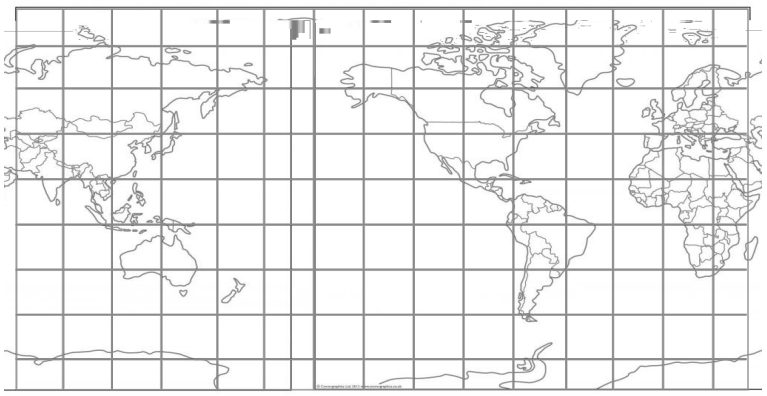
GP GLOBAL PARAMETRICS

Extraction by Any Geography

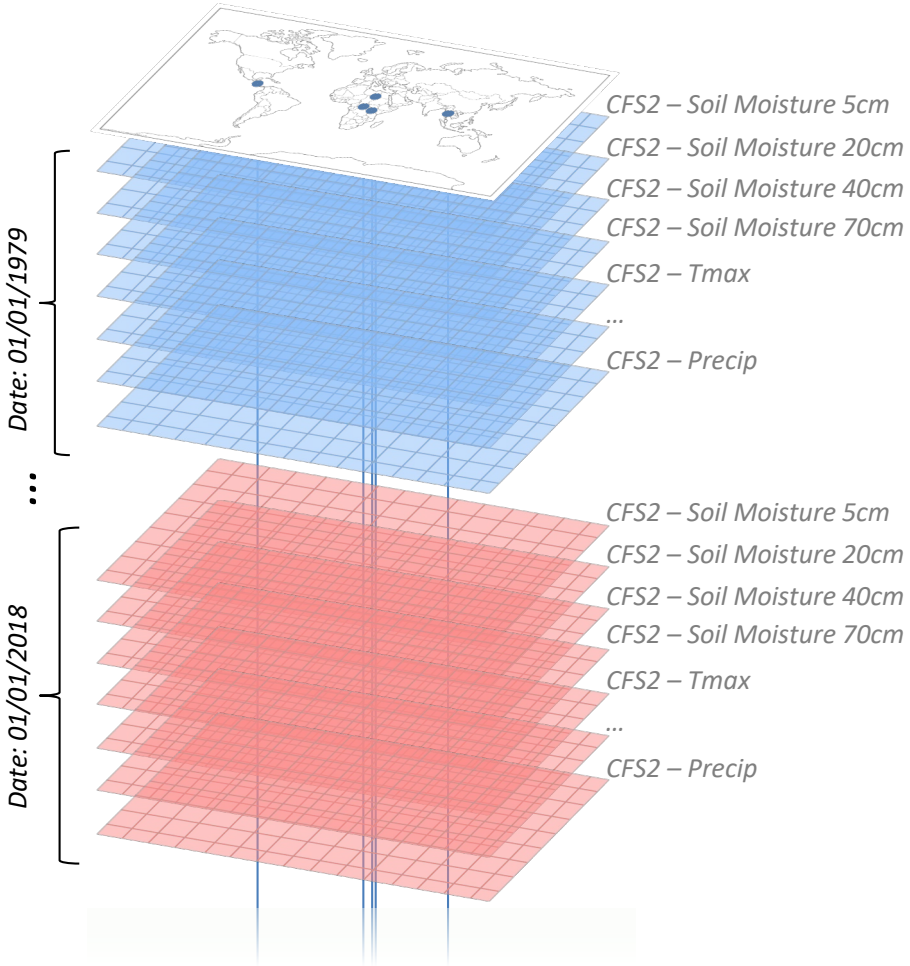
1. Define Exposure/Assets
(e.g., branch locations, admin1)



2. Select Mechanism, Technique/Model, & Phenomenon
(e.g., WX-CFS2-Soil Moisture, TC-SLOSH-Wind)

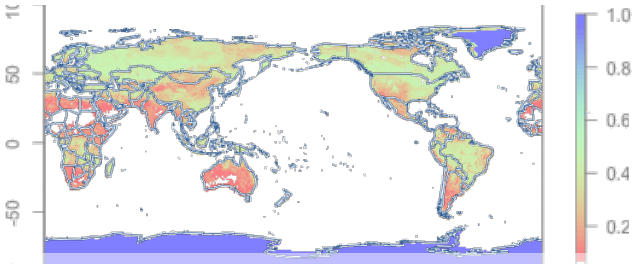


3. Extract Phenomena @ Exposures/Assets

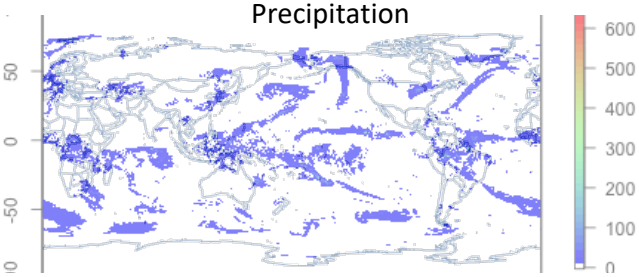


Simultaneous, correlated global data

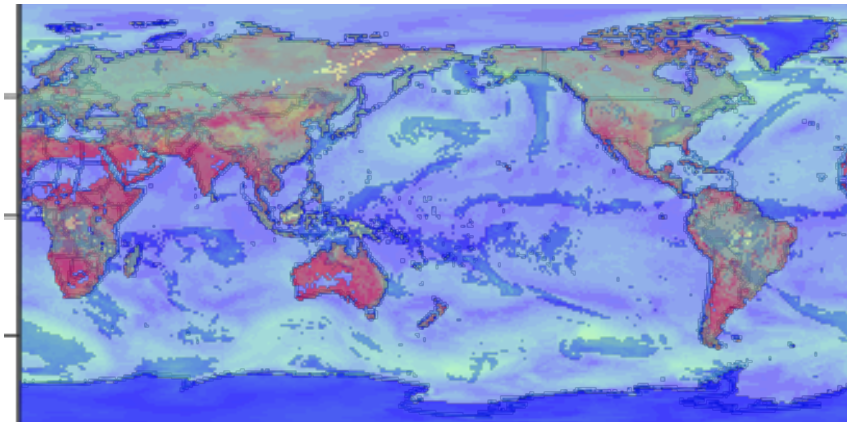
Soil Moisture



Precipitation

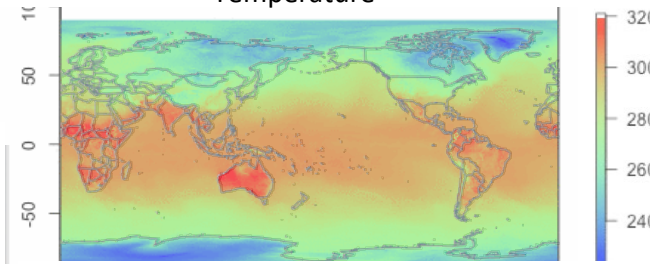


GCM decomposition into constituent variables facilitates fully-coupled global hazard analysis

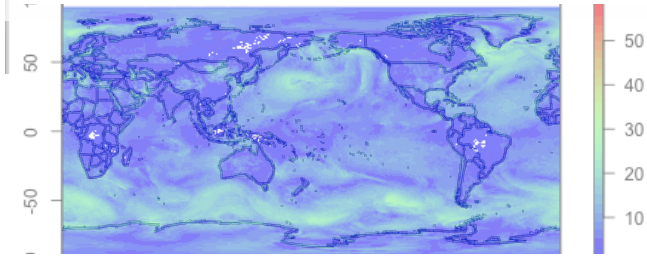


GCM reanalysis provide historical data, but the power of GCMs lies in their forecasting abilities

Temperature



Wind Speed



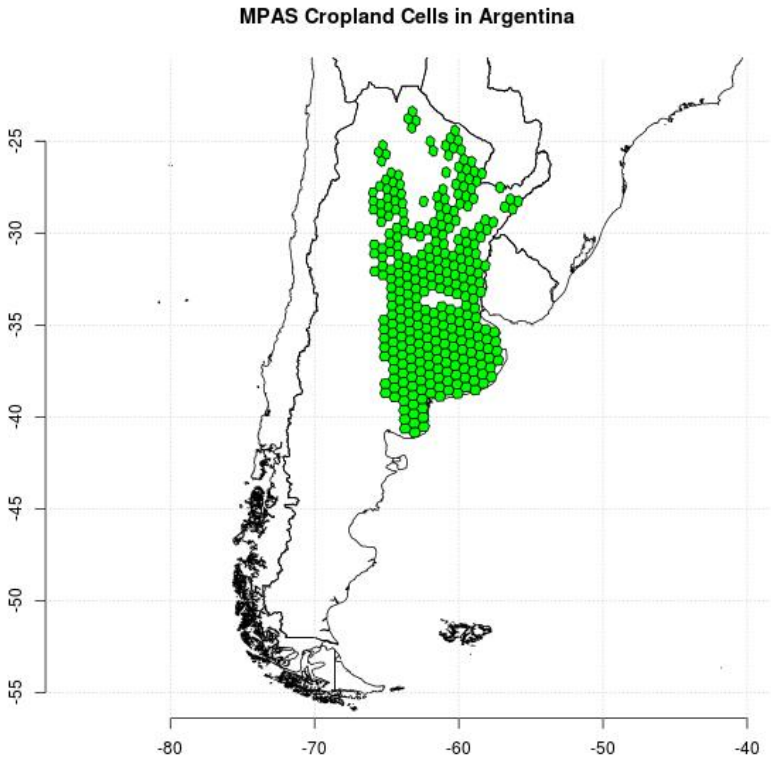
GP GLOBAL PARAMETRICS

MPAS Land Cover Classification

Based on USGS Classes

Categories 2-6 selected:
2 Dryland Cropland and Pasture
3 Irrigated Cropland and Pasture
4 Mixed Dryland/Irrigated Cropland/Pasture
5 Cropland/Grassland Mosaic
6 Cropland/Woodland Mosaic

Subset extracted and stored
as SQL PostGIS Exposures

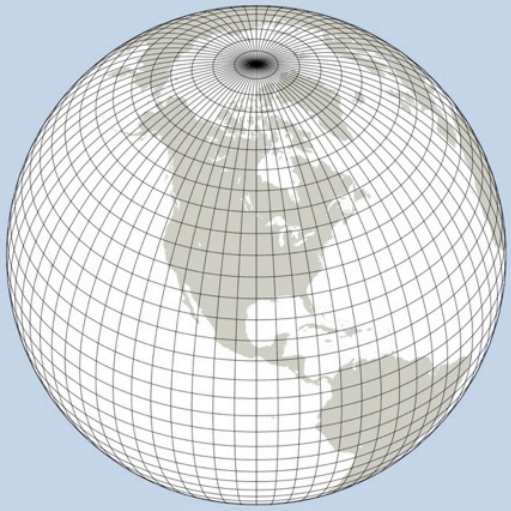


Details at http://www2.mmm.ucar.edu/wrf/users/docs/user_guide_V3/users_guide_chap3.htm#_Land_Use_and

Value of UK Running MPAS

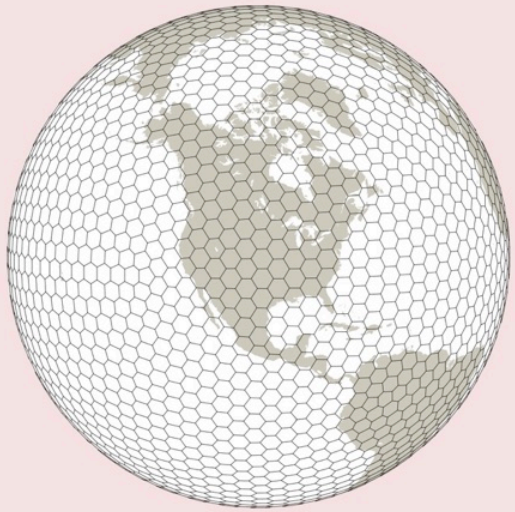
MPAS
Model for Prediction Across Scales

Why MPAS?
Significant differences between WRF and MPAS



WRF
Lat-Lon global grid

- Anisotropic grid cells
- Polar filtering required
- Poor scaling on massively parallel computers



MPAS
Unstructured Voronoi (hexagonal) grid

- Good scaling on massively parallel computers
- No pole problems

Model Prediction Across Scales (MPAS) Designed to address problems with traditional grid oriented modeling
Ongoing open source development by NCAR, LANL, IBM/Weather Company, and others

Value of UK Running MPAS

GP benefits from having backup MPAS simulations conducted by a third party, as well as access to University researchers in furthering their work.

UK benefits by “jump starting” an operationally-oriented weather modeling capacity in-house to facilitate agricultural weather, statistical, and computational science research.

Both parties benefit from having a platform to demonstrate to funding agencies a willingness and capacity to conduct this kind of research.

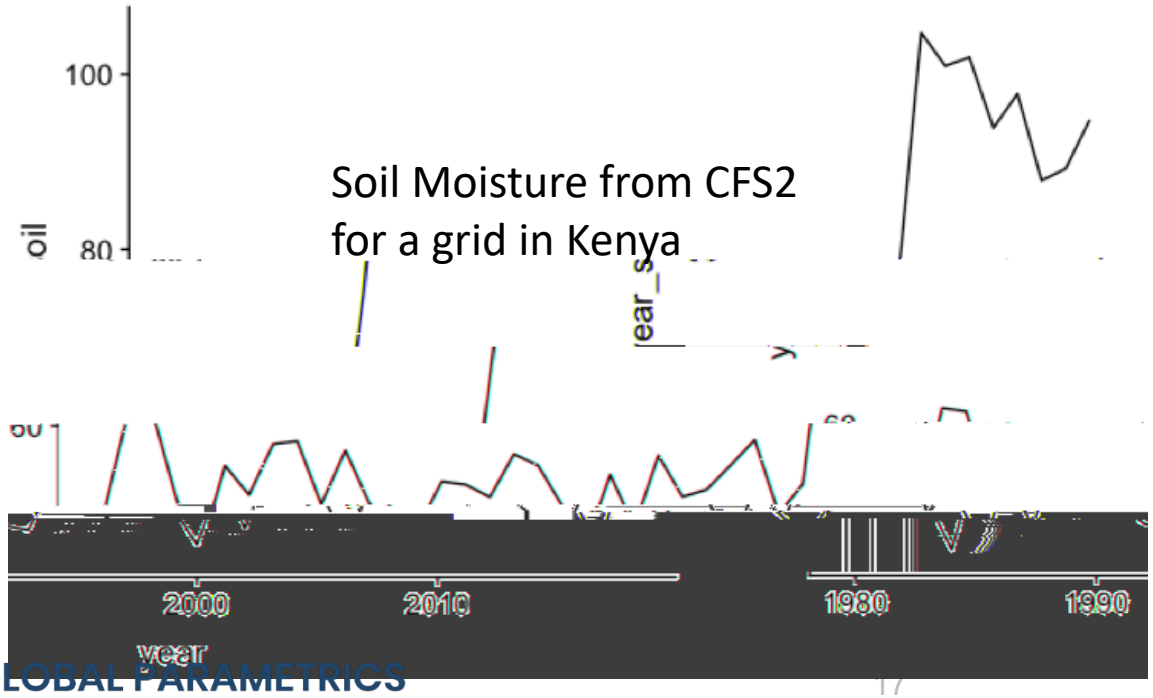
MPAS can be run to create history, real-time and forecast weather on a daily basis for the entire planet.

Having control of MPAS allows for consistent physics, resolution, and methods for all 3 time scales following an important aspect of risk evaluation that data should be developed in a consistent fashion.

What can go wrong?

Many researchers are unaware of the significant problems with so-called ‘reanalysis’ weather data:

a) Inconsistent history vs operational use;
b) Controlling agency not focused on issues to build a time-series appropriate to understand risk
   a) Agencies working with GCMs are working to improve the physics, resolution, etc. to provide better forecast
   b) The same agencies rarely perform the reanalysis with the new forecast models
c) Even for operational models, risk of discontinuation or unannounced changes in physics/operations



Soil Moisture from CFS2 for a grid in Kenya

Climate Forecast Systems v2 (CFS2 is commonly used in research. They change the resolution to about 22k vs 33k in April 2011. The discontinuity to the left begs for a bias correction. But they also made changes in 2014 and 2016

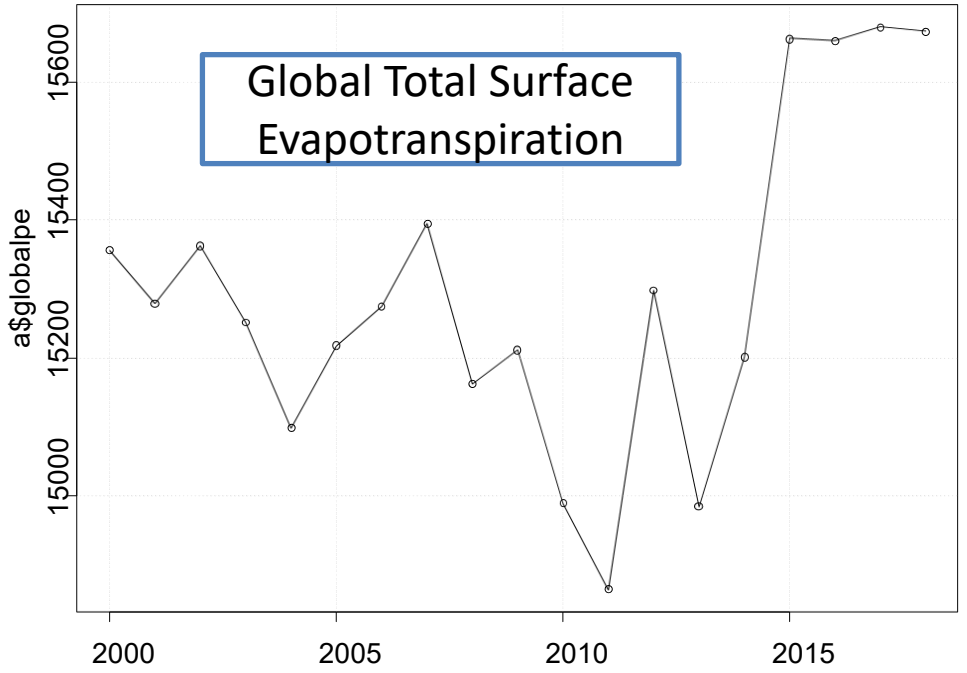
Into the Weeds

In late 2014 NCEP initiated a change in the way the data assimilation system works, in order to support higher resolutions in GFS as well as anticipating the upcoming GFS/FV3 runs. For the vast majority of modeling work this doesn't matter - it is less than a 2% difference in the mean estimates for total surface evapotranspiration. However, for any researcher wanted to understand or model extreme events, this bias is highly significant. Global total surface evapotranspiration change in 2014

GP's Scientists monitor these changes and incorporate them into the MPAS model to assure consistent data for history, real-time and forecast

By partnering with UK, we can rebuild the history with the latest forecasting and it can be done so that real-time and forecast will be using the same version of the model

With control, MPAS history, real-time, and forecast can be developed at different resolutions (e.g., 60k, 30k, 15k)



Summary

- ✓ GP's founder has deep roots in UK
- ✓ GP's R&D subsidiary is located in Lexington
- ✓ A partnership between GP and UK will give open access to GP's global data
- ✓ Using UK's HPC to run MPAS has multiple benefits for GP and UK
- ✓ GP collaborates with many global entities that may open new opportunities for researcher/ instructors
- ✓ In conjunction with NASA UK, GP has begun to offer internships for GP undergraduate and graduate student
- ✓ Several researchers at UK are ready to use GP's Data and Risk Hazard Platform
- ✓ GP's social programs will bring significant visibility to UK