

# NUDAR Talk

NuTools MiniWorkshop  
for the Applied Antineutrino Technology  
Community

Glenn Jocher  
Ultralytics LLC  
July 24<sup>th</sup>, 2020



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Technology PUBLISHED BY MIT Review

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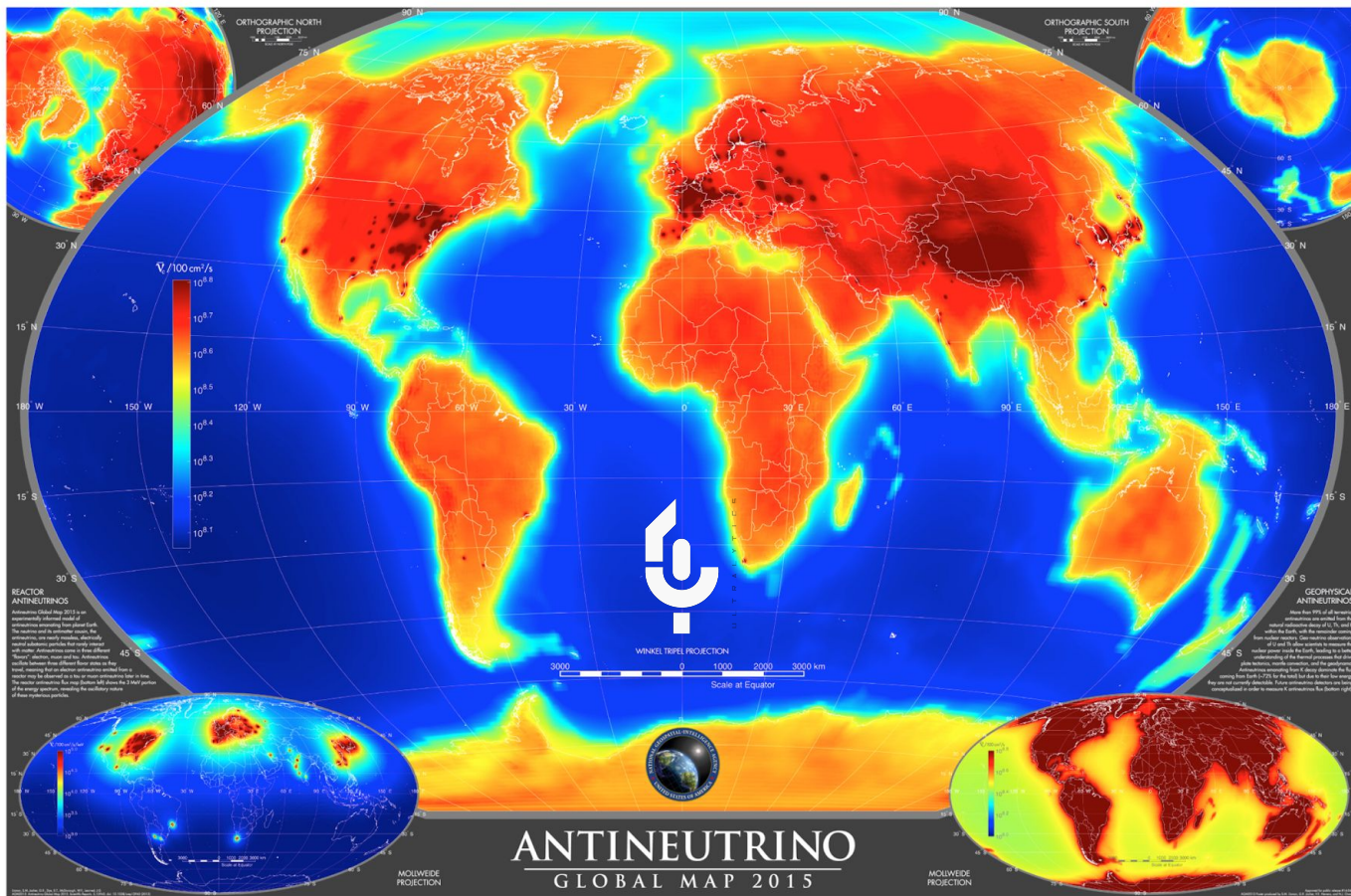
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NGA NATIONAL GEOSPATIAL-INTELLIGENCE AGENCY



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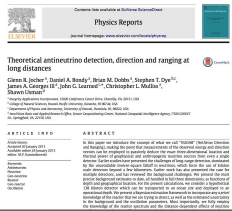
# Research Timeline



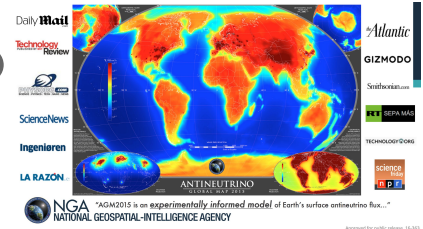
2009  
Neutrino Imaging Idea  
Start of NGA funding



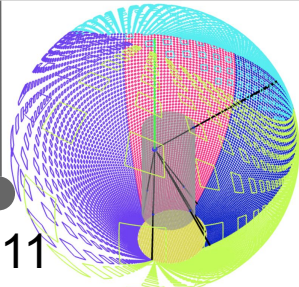
2013  
NUDAR Paper Published  
[10.1016/j.physrep.2013.01.005](https://doi.org/10.1016/j.physrep.2013.01.005)



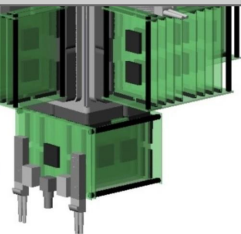
2015  
MTC deployed to NIST  
NGA publishes world's first neutrino map  
NTC Modeling



2011  
Detector Modeling Begins  
MTC Idea takes form



2014  
Ultralytics Founded  
MTC Construction Begins



2016  
MTC run at NIST  
NTC Prototyping

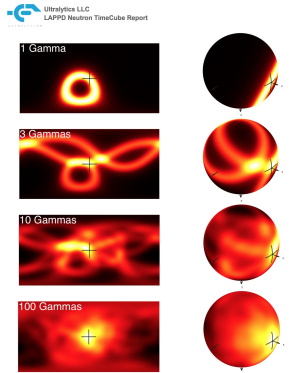
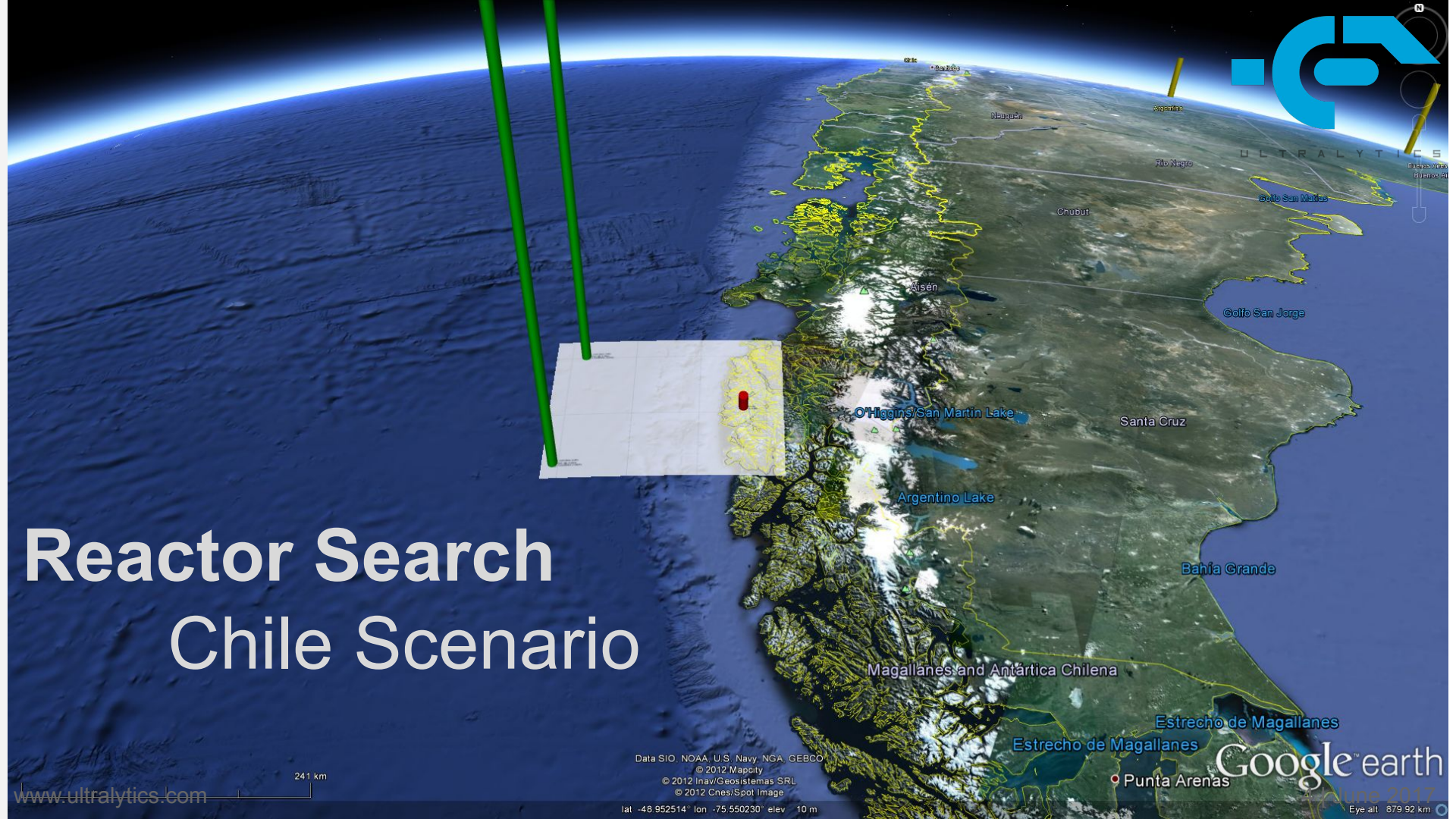


Figure 6 - Neural network reconstructed 1 MeV gamma angle cone blurring. Smear on the angle cones is defined by a spline fit to the 1 MeV gamma angle cone error histogram. In practice such a smear needs to be known a priori across a variety of energies, and the appropriate smear would be applied based on the estimated gamma energy.



ULTRALYTICS  
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# Reactor Search Chile Scenario

www.ultralitics.com

241 km

Data SIO, NOAA, U.S. Navy, NGA, GEBCO  
© 2012 Mapcity  
© 2012 Inav/Geosistemas SRL  
© 2012 Ches/Spot Image  
lat -48.952514° lon -75.550230° elev 10 m

Estrecho de Magallanes

Punta Arenas

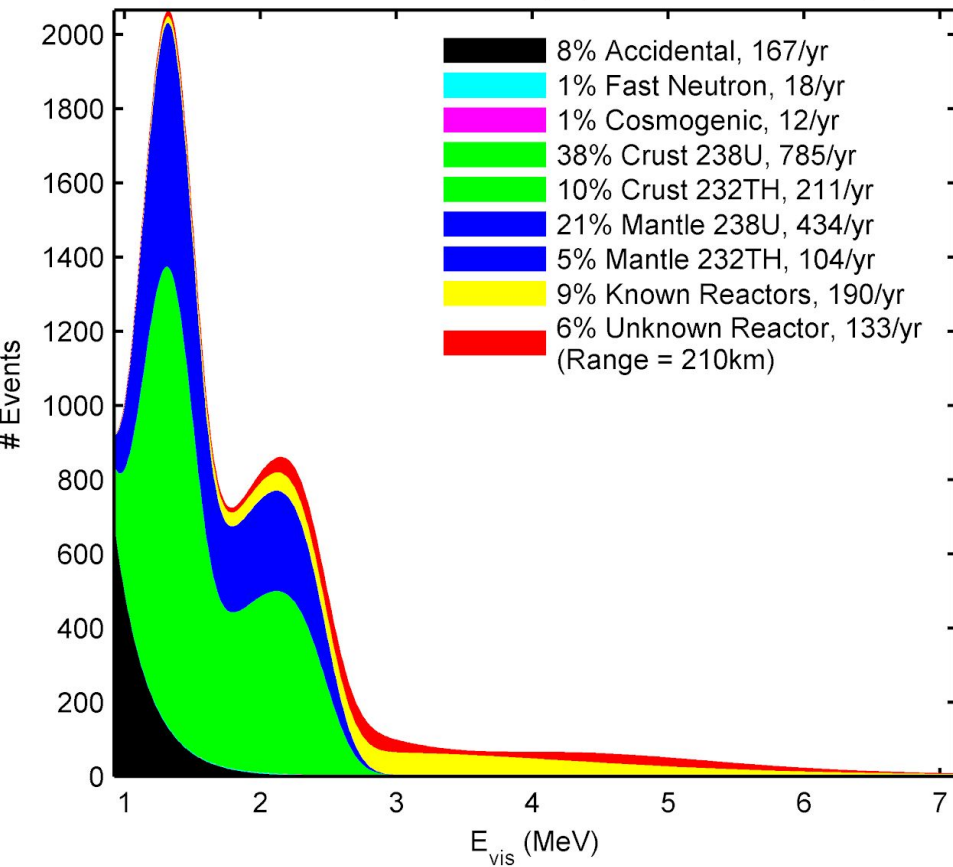
Google earth

June 2017  
Eye alt: 879.92 km

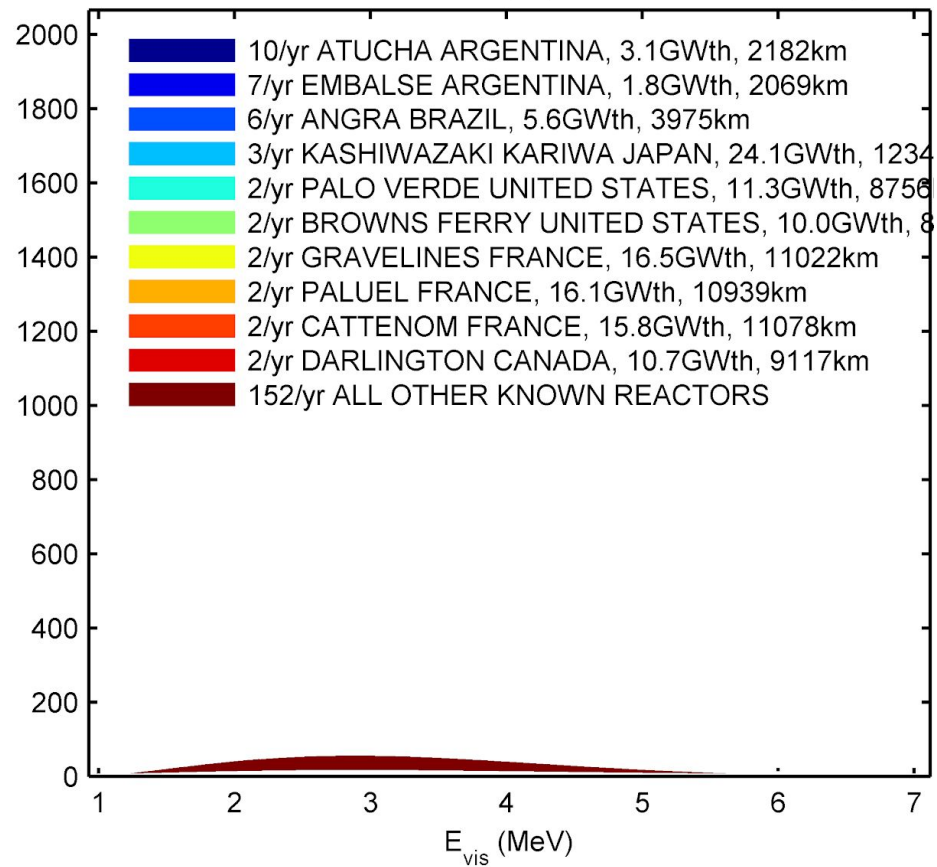
# Reactor Search - Chile Scenario



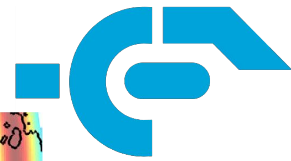
Detector 1 Measurement Sources,  $0.93\text{MeV}_{\text{vis}}$  energy cut  
 -3839m underwater, 91% duty cycle, 2054 total events/yr



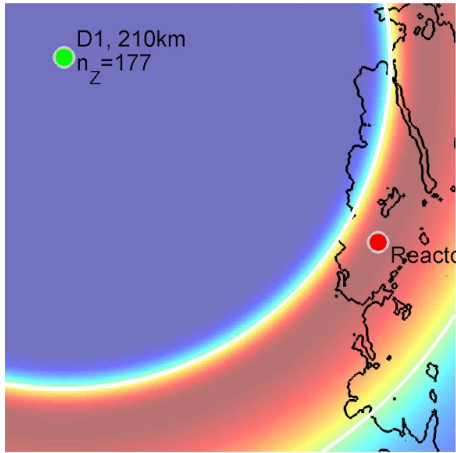
Detector 1 Measurement Sources,  $0.93\text{MeV}_{\text{vis}}$  energy cut  
 -3839m underwater, 91% duty cycle, 190 reactor events/yr



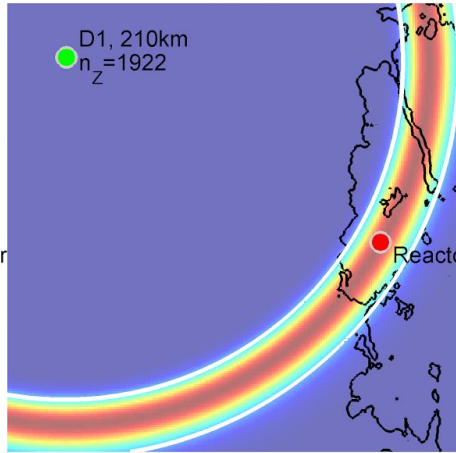
# Reactor Search - Chile Scenario



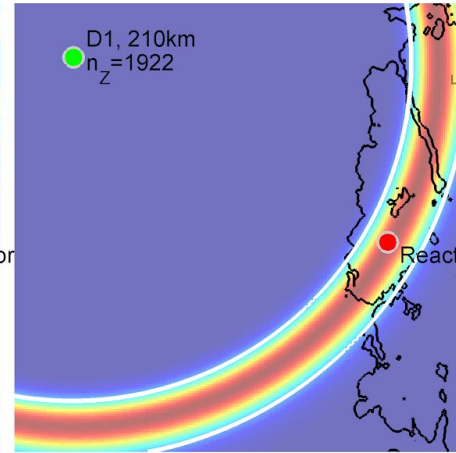
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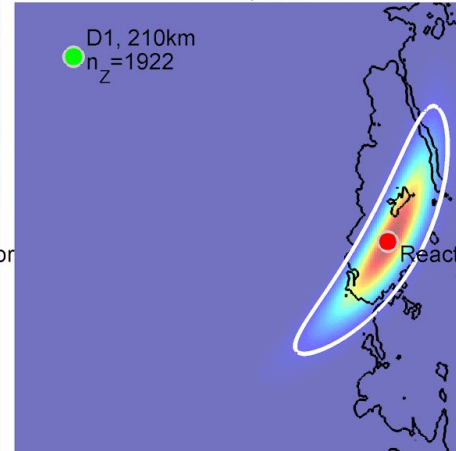
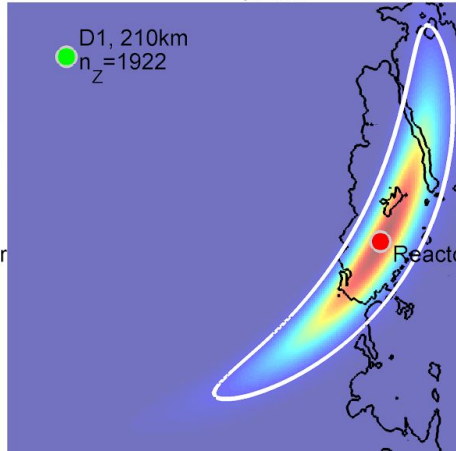
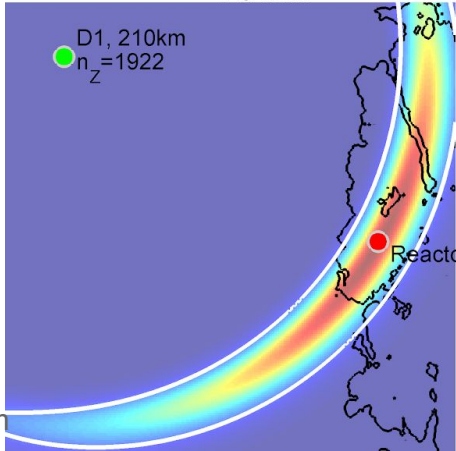
Count+Energy+Angle (Angle SNRx10)  
12524km<sup>2</sup>



Count+Energy+Angle (Angle SNRx20)  
7617km<sup>2</sup>



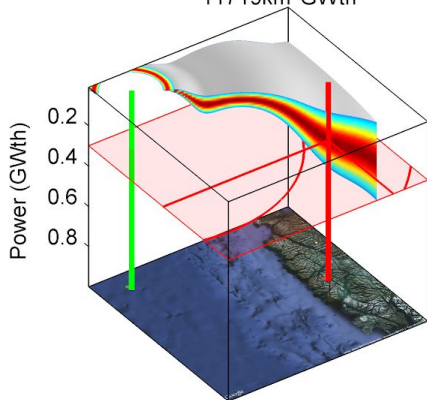
Count+Energy+Angle (Angle SNRx30)  
4372km<sup>2</sup>



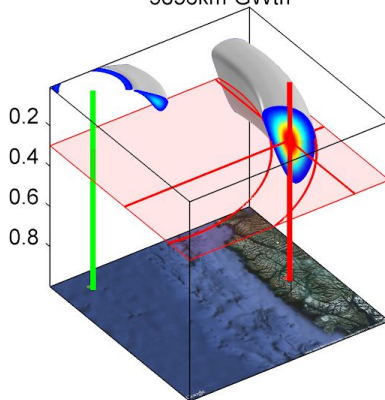
# Reactor Search - Chile Scenario



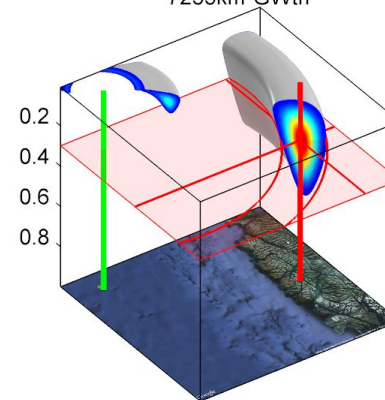
Count-Only, 3.4MeV  $E_\nu$  Cut  
11719km<sup>2</sup>GWth



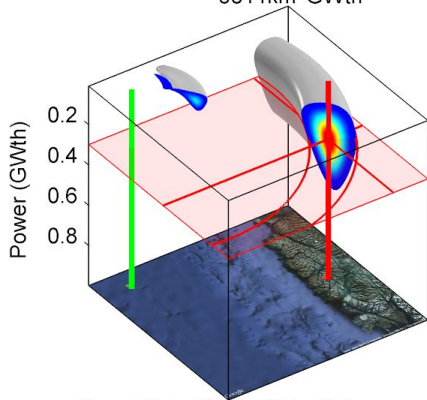
Count+Energy  
5836km<sup>2</sup>GWth



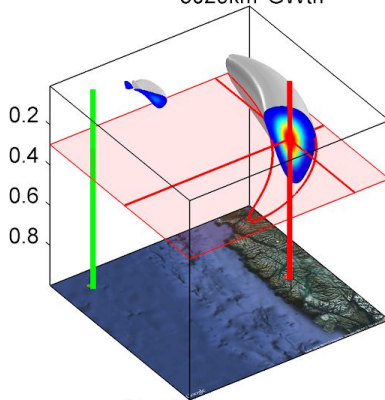
Count+Energy+Angle  
7255km<sup>2</sup>GWth



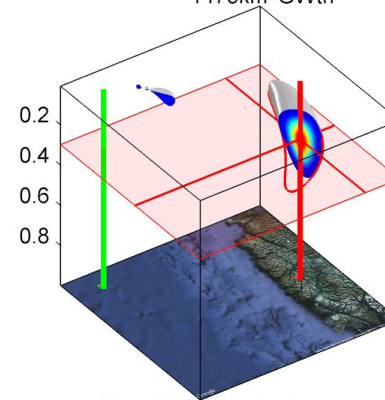
Count+Energy+Angle (Angle SNRx10)  
5811km<sup>2</sup>GWth



Count+Energy+Angle (Angle SNRx20)  
3029km<sup>2</sup>GWth



Count+Energy+Angle (Angle SNRx30)  
1475km<sup>2</sup>GWth

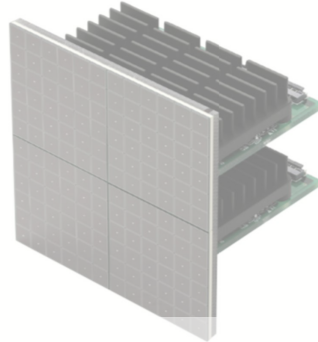
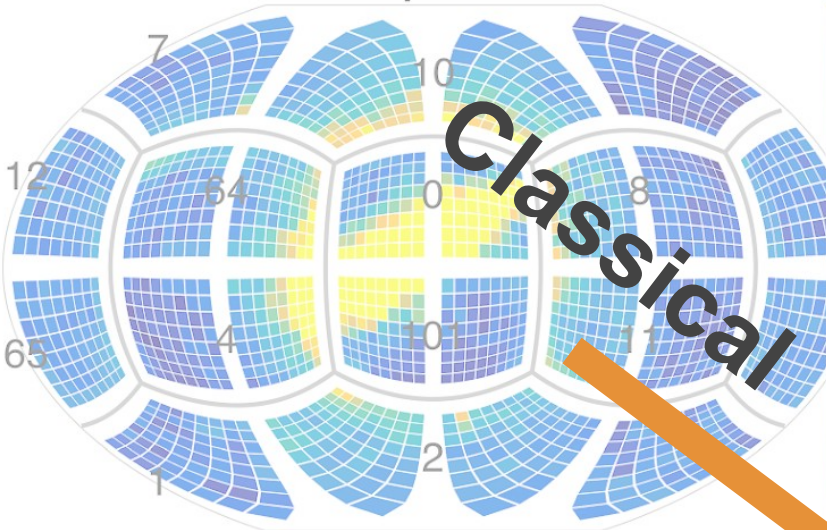


Count-Only, 3.4MeV  $E_\nu$  Cut  
22654km<sup>2</sup>

Count+Energy  
12749km<sup>2</sup>

Count+Energy+Angle  
12849km<sup>2</sup>

Amplitude



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- CLASSIFY
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Modern

