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The Changing State of Arctic Sea Ice



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December 7, 2009

This year, something unusual happened,
with implications for the future



We expected the ocean to be freezing to the north of Alaska...



Chukchi Sea

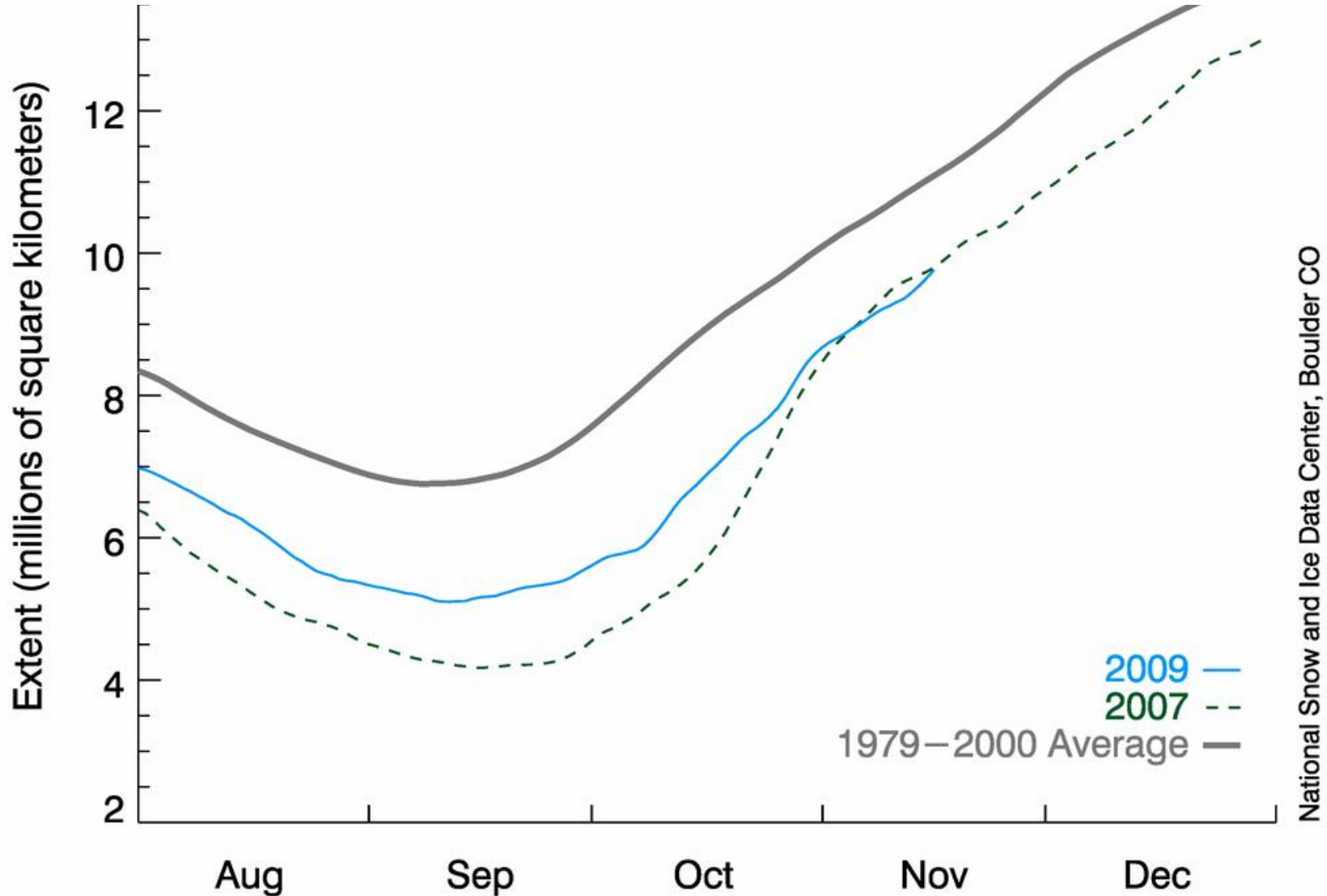
But we found the ocean was warm



Chukchi Sea

September 30, 2009

The slow fall freeze-up in 2009 suggested by the photos is also seen in satellite observations of Arctic sea ice extent, and was a surprise to scientists!



National Snow and Ice Data Center, Boulder CO

Sea ice is a thermostat for global climate,
and it is no longer functioning the way it used to

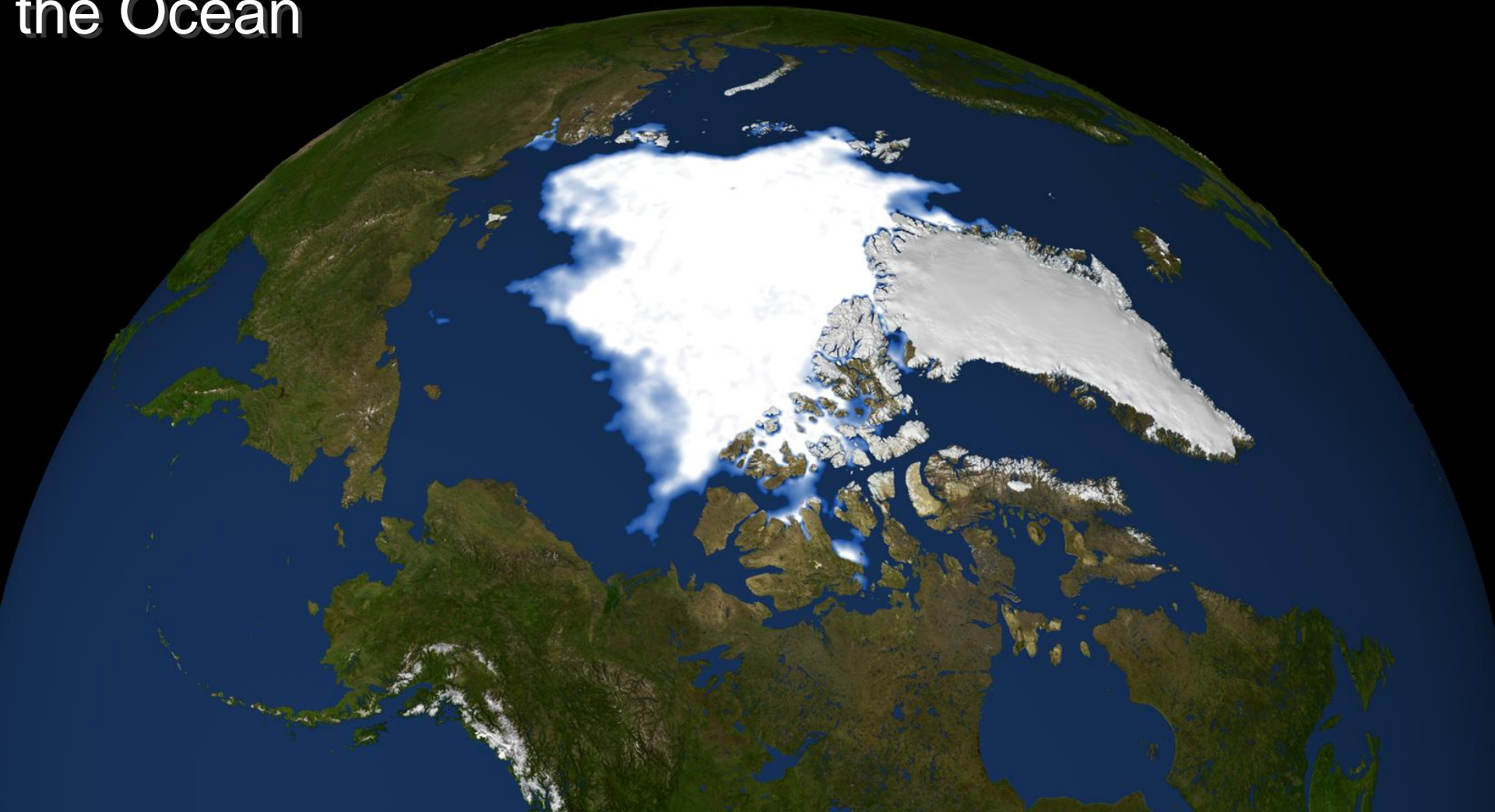


Sea ice is a memory mechanism which is changing in two ways:

slow rate of freeze-up and melting of thick multi-year ice

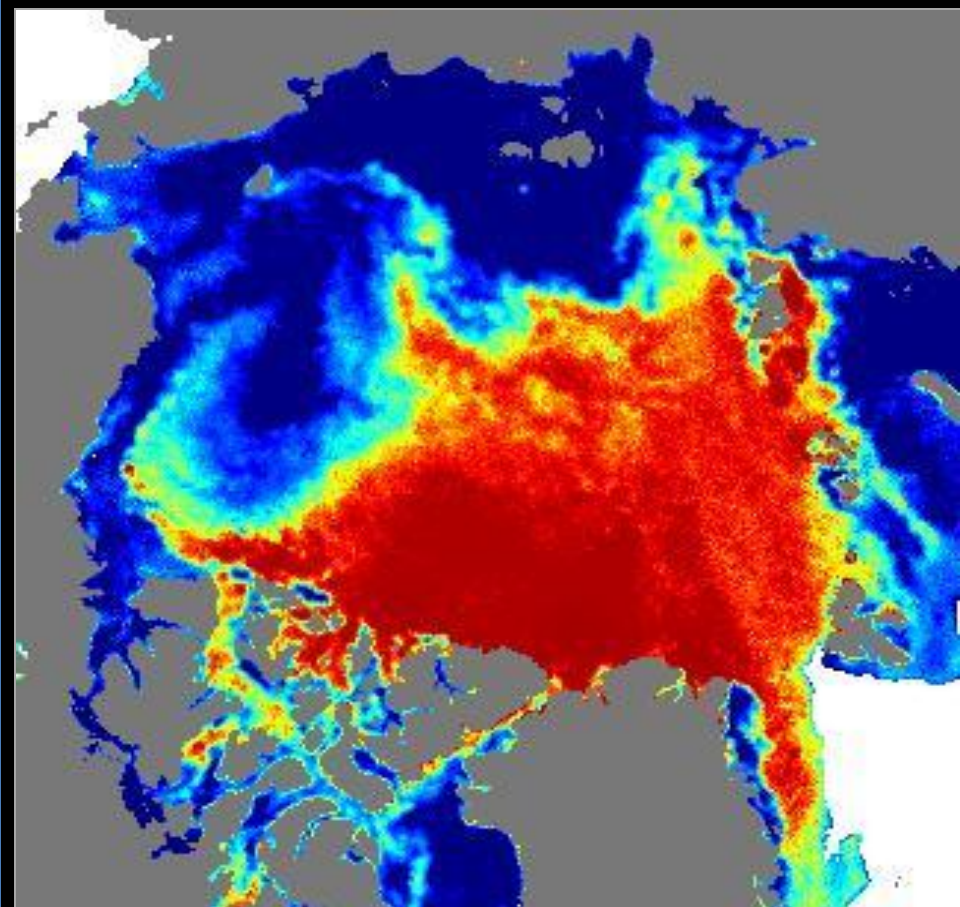


The Arctic is losing sea ice and storing extra heat in the Ocean

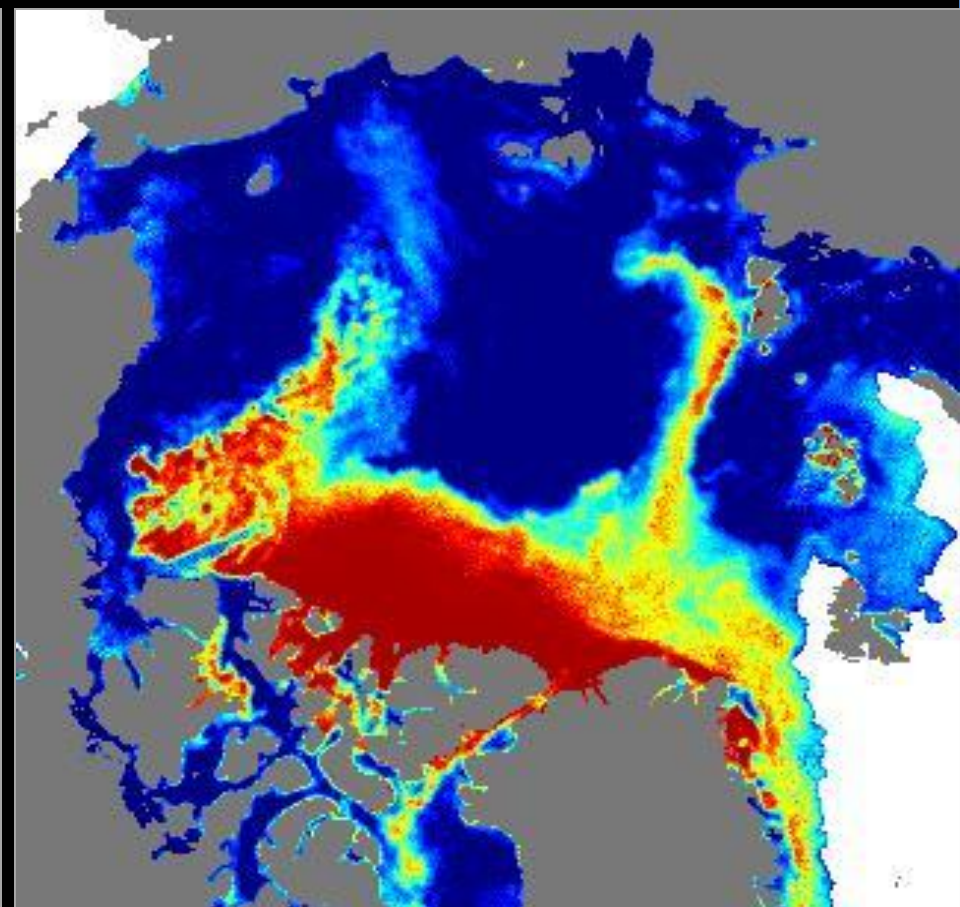


2008 Summer Minimum

Since 2004, most of the thick multi-year sea ice (red) has gone away and its return is unlikely



January 2004

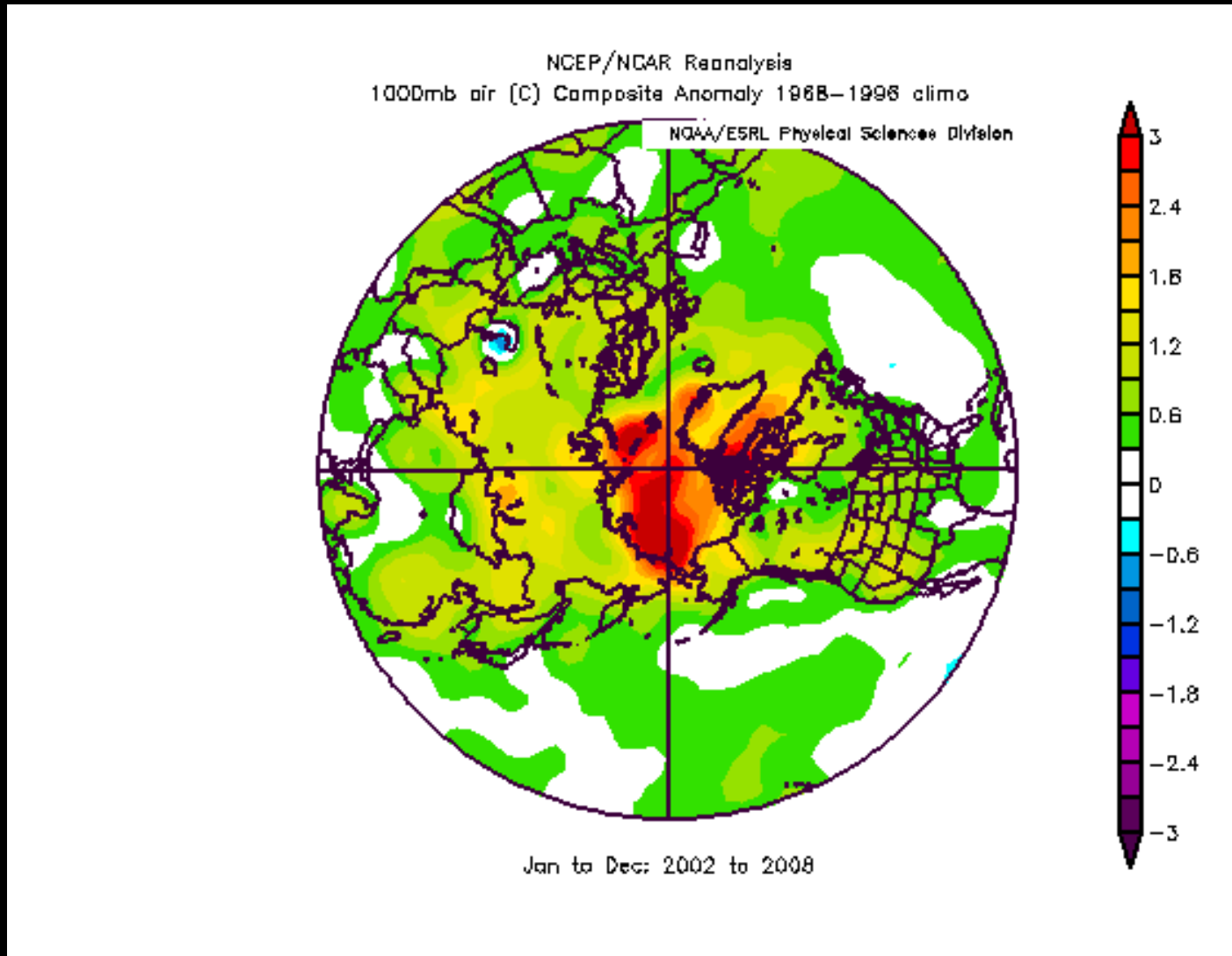


January 2008

The Arctic is warming faster than anywhere else



The Arctic is Earth's fastest-warming region as climate models predicted



2002-2008 Air Temperature Anomalies Relative to 1968-1996

Changes in sea ice are difficult to reverse,
and have global implications



As a result, a sea ice-free Arctic in summer is projected for 2035*, or sooner based on 2009 data



* Based on IPCC AR4 models, Wang and Overland (2009)

Northern continents will warm 3°C by 2050*



* Based on IPCC models, Walsh, et. al., 2005

Atmospheric teleconnections related to the loss of sea ice make it colder and snowier in East Asia



Arctic shipping is expanding in autumn



Species are
threatened



Commercial fisheries are expanding northward



The Arctic has moved to a new climate state, with physical and socio-economic impacts for the globe



Sea ice has a special function in climate:

It insulates the ocean, reflects sunlight, and melts/freezes



Impacts ...



Impacts

Atmosphere: *Large scale wind patterns impacted by loss of summer sea ice*

Sea Ice: *Multi-year sea ice is being replaced by first year sea ice*

Ocean: *Upper ocean remains warm and less salty*

Land: *Increased runoff in Siberia, less snow in North America, permafrost melting*

Greenland: *Ice sheet loss continues*

Biology and humans: *Arctic species impacted by loss of sea ice*

Thank you! Any questions ...?

