# The biology in polar marine environments

*Dipartimento Terra e Ambiente*
*Daniela Giordano: Istituto di Biochimica delle Proteine (IBP), Napoli*
*CNR Project TA.P02.021 "Climate change and adaptations in polar marine life"*

## Preliminary considerations:

Climate change affects every aspect of an organism's biology, from cellular physiology and biochemistry to food web and habitat

Biological research envisaged studies with a focus on how evolutionary patterns might have shaped the sensitivity of polar organisms to ongoing climate change

## Outstanding questions:

- How may temperature affect physiological mechanisms of adaptation?

- How does global warming affect species performance and population dynamics?

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## Challenges:

- Identification of links between tectonics, climate and evolution in the Northern and Southern regions
- Quantification of the variability between species in their levels of adaptation and capacities to resist change for understanding responses at the ecosystem level

*because*

Ecosystem level responses depend on a cascade of responses from the genomic through cellular to physiological and ecological: understanding the complexity of this cascade requires a very broad scale cross-disciplinary approach → bridges between different disciplines will provide a legacy of knowledge for studying life in the polar regions

## The lack:

- We still largely lack predictive models of such physiological responses in perturbed environments
- The ambition of polar biology is to determine the resistance and vulnerability to change, and the likelihood of "tipping points" in polar ecosystems

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## Tools:

**•Studies of physiological and molecular adaptations: the combination of functional studies at various levels of biological organisation with molecular work will lead us to an understanding of the evolutionary consequences of global warming building on extensive knowledge of the structure and functioning of polar ecosystems**

- ✓Gene function (transcription rate, role of promoter genes etc)
- ✓Reallocation of energy resources: protein synthesis, mitochondrial function (translation rate, post-translational modifications etc…)
- ✓Signal transduction
- ✓The role of chaperone proteins and the lack in heat shock response
- ✓The role of oxygen in the nature of several adaptations: oxygen imbalance and oxidative stress are common to many stress conditions at all levels of biological organisation
- ✓The importance of time in evolving adaptations

**•Application of advanced approaches *in situ*, in the laboratory (e.g. '*-omics*' approaches) and *in silico* (e.g. process modelling and advanced database mining) to provide an integrative view of the vulnerability of the polar biota**