Pushing climate projections towards decisions

A somewhat bumpy road

Nordic Adaptation Conference, 29th – 30th August Bergen

Luca Garrè - with various contributions from colleagues

30 August 2016

Climate projections in an engineering context

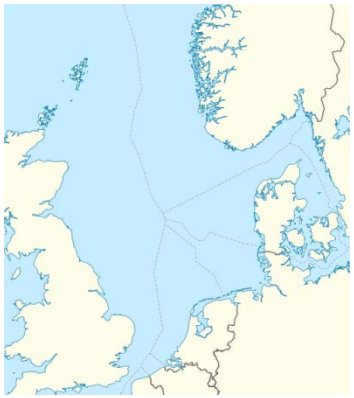
- A great deal the engineering analyses and safety checks resolve around the assessment of climate extremes (long return periods)

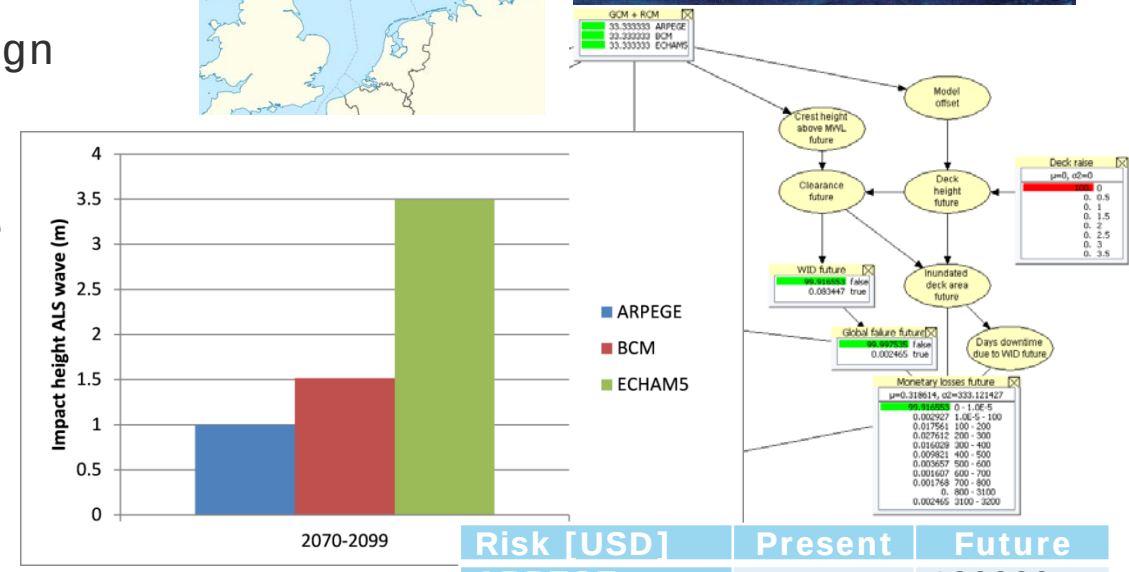
- Primary variables of interest are environmental parameters (waves, wind speeds, water levels)

- The idea is to use climate projections to evaluate design safety in the light of climate change and, if necessary, options to adaptation

Climate change implications on design safety of marine structures

- North sea offshore installation
- Structural reliability against waves
- Risk-based adaptation of the design of the installation
- Probability of wave impact on the upper-deck of the installation





Risk [USD]	Present	Future
ARPEGE		120000
BCM		182000
ECHAM5		654000
Average	67000	319000

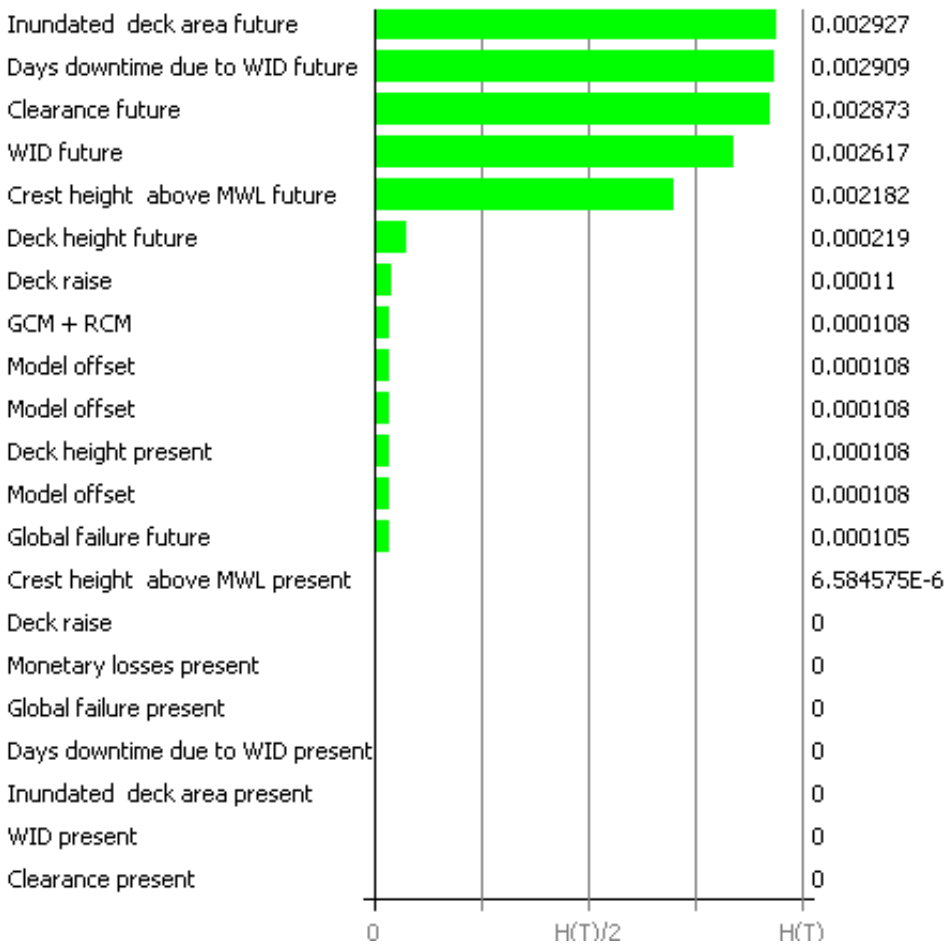
Hagen, Ø., Garrè, L. & Friis-Hansen, P., (2013). DNV-ADAPT framework for risk-based adaptation: a test case for the offshore industry. In Proceedings of ICOSSAR13, New York, USA.

Garrè, L. & Friis-Hansen, P., (2013). Using Bayesian Networks and value of information for risk-based adaptation to climate change: an application of the DNV-ADAPT framework. In Proceedings of ICOSSAR13, New York, USA.

Value Of Information (VOI)

- Value of information analysis[*]: if I was in the position to remove completely the uncertainty of one variable, which variable should I choose?

$$VOI = c(d_{opt}) - E_x[c(x, d_{opt}{}^*)]$$



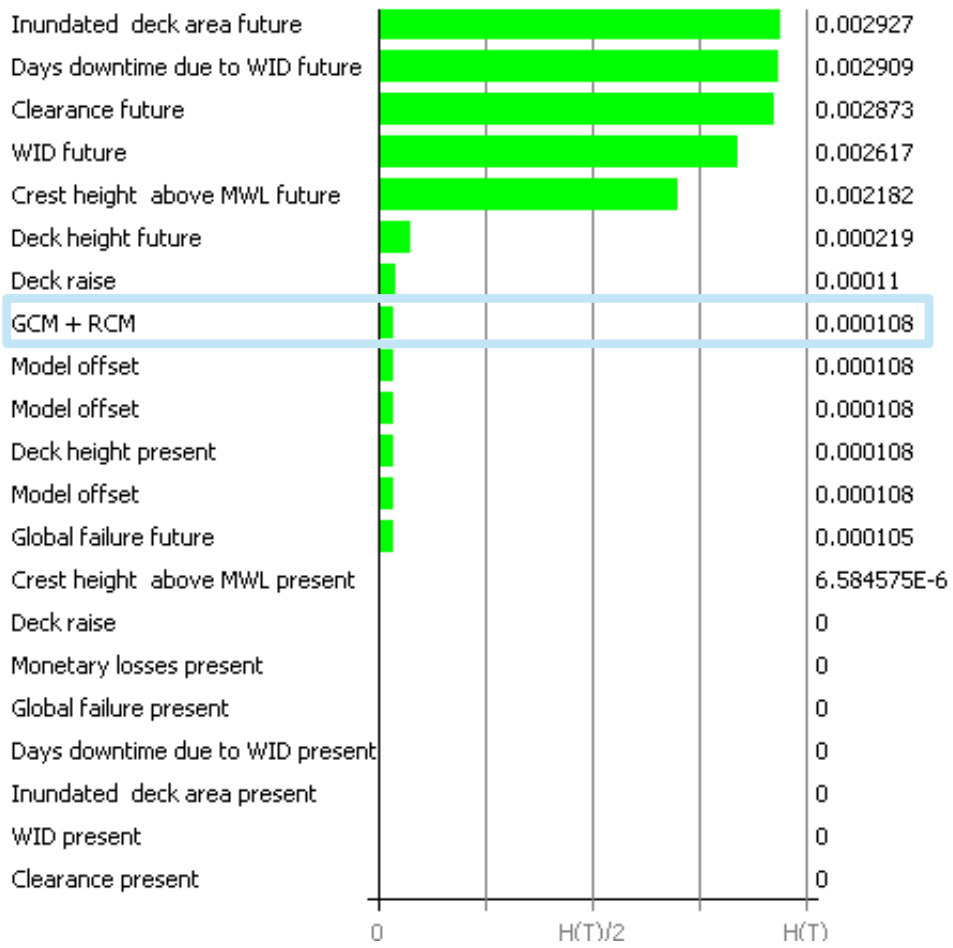
Vanem, E., Bitner-Gregersen, E., Eide, L.I., Garrè, L., Friis-Hansen, P. (2015). Uncertainties of Climate Modeling and Effects on Wave Induced Bending Moment. Society of Naval Architects and Marine Engineers (SNAME) Transactions. Vol. 122, pp. 65-92.

Value Of Information (VOI)

- Value of information analysis[*]: if I was in the position to remove completely the uncertainty of one variable, which variable should I choose?

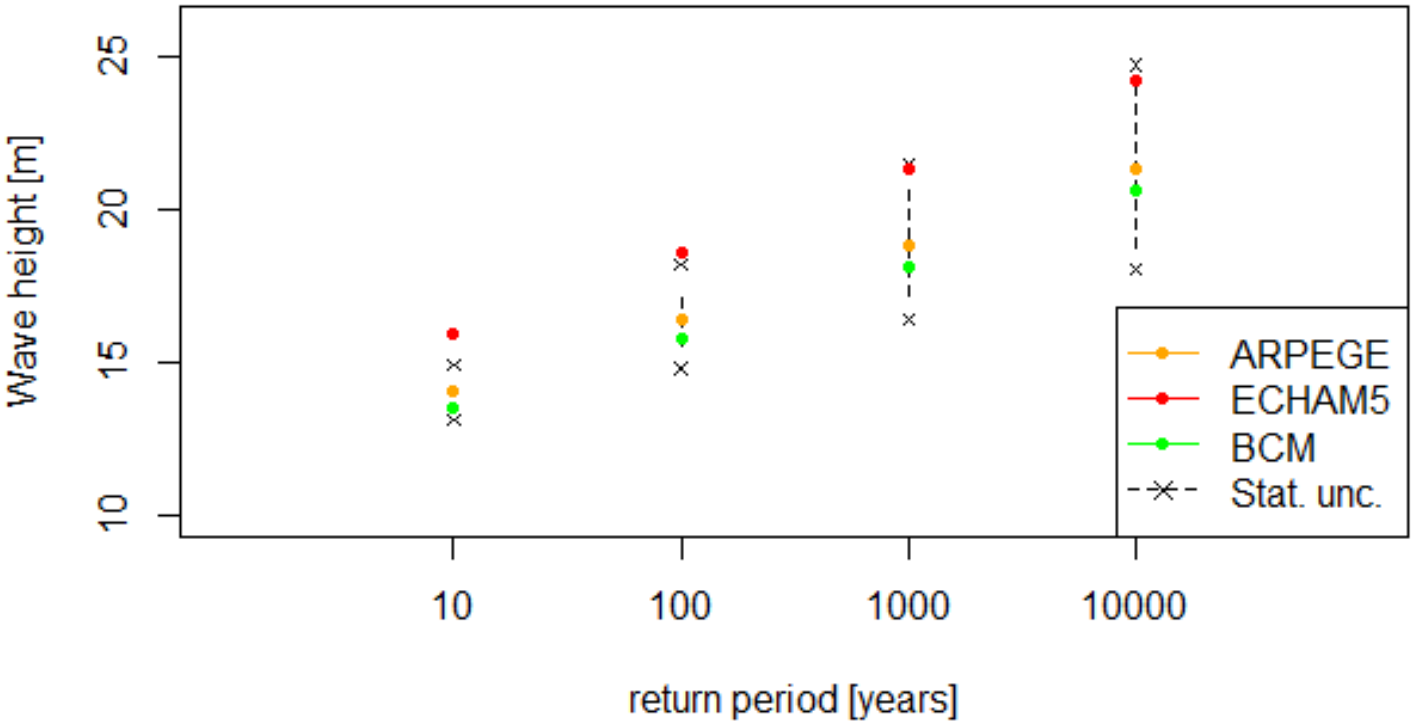
$$VOI = c(d_{opt}) - E_x[c(x, d_{opt}{}^*)]$$

- Climate model uncertainty, which is sizeable in this analysis, has however a considerably minor influence on the uncertainty of future losses than other variables.

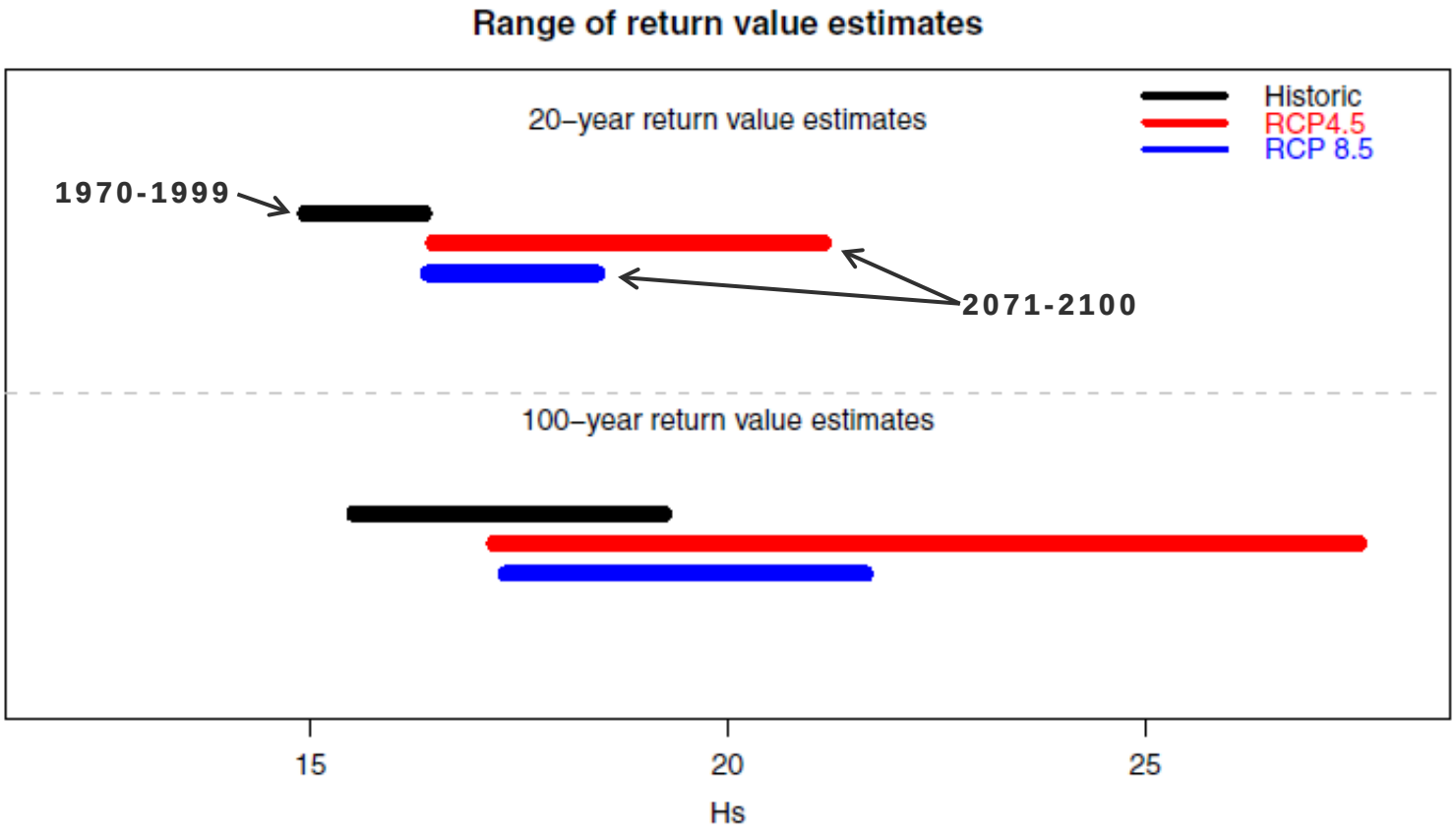


Vanem, E., Bitner-Gregersen, E., Eide, L.I., Garrè, L., Friis-Hansen, P. (2015). Uncertainties of Climate Modeling and Effects on Wave Induced Bending Moment. Society of Naval Architects and Marine Engineers (SNAME) Transactions. Vol. 122, pp. 65-92.

Sampling uncertainty vs. climate model uncertainty



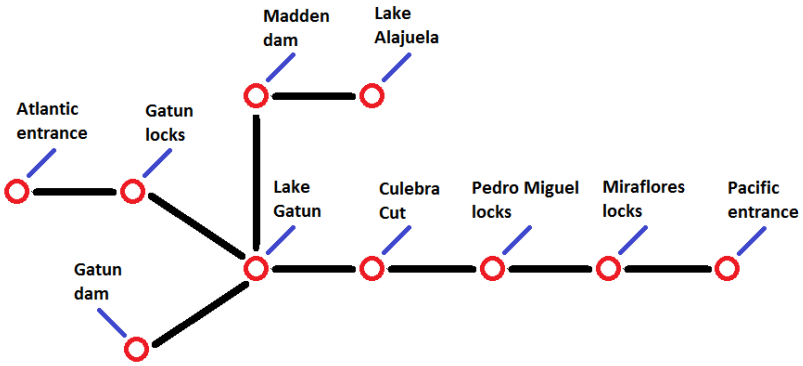
Statistical model uncertainty – wave data for the North Atlantic

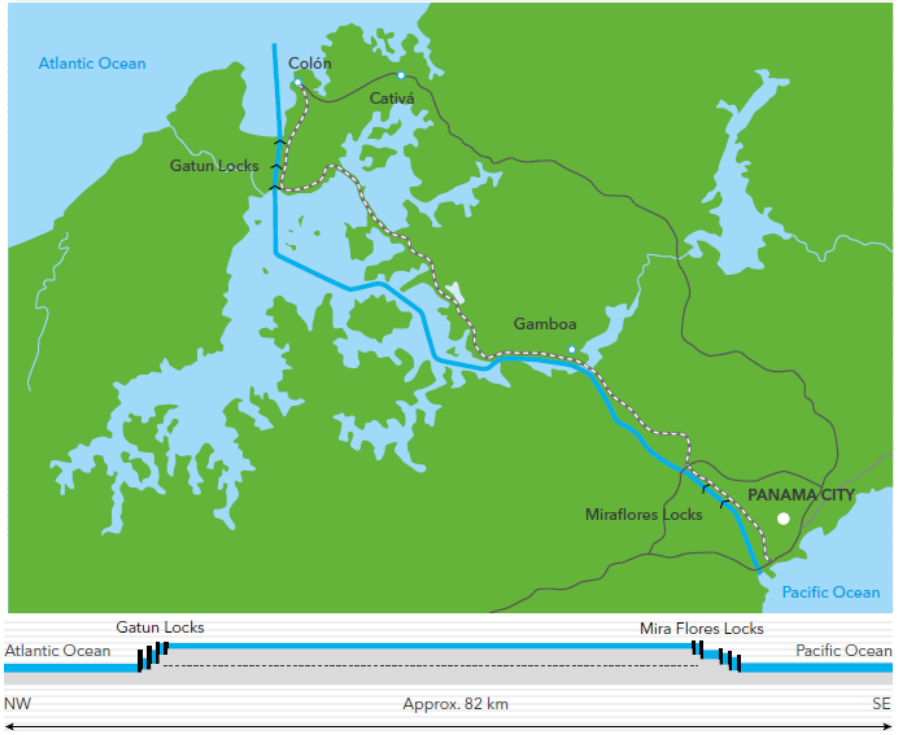


Vanem, E. (2015). Uncertainties in extreme value modelling of wave data in a climate change perspective. Journal of Ocean Engineering and Marine Energy. Vol. 1, pp. 339-359.

Canal – system analysis

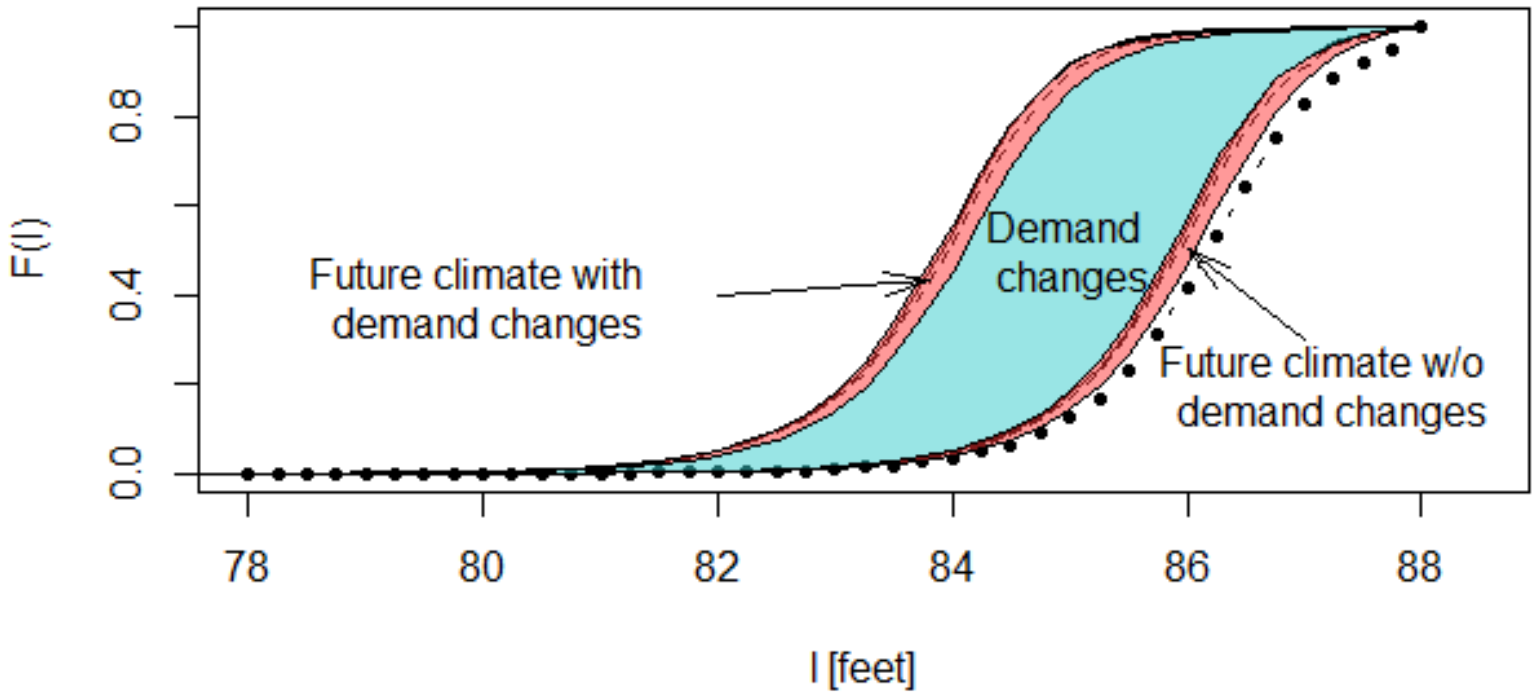
- The PC connects the Atlantic and the Pacific oceans;
- The PC is currently the world's major shipping crossway for ocean-going ships;





DNV GL (2014). Adaptation to a changing climate. Report.

Levels



Luca Garrè
Luca.garre@dnvgl.com

www.dnvgl.com

SAFER, SMARTER, GREENER

Ungraded

DNV·GL