Outline of the European Union’s ice2sea project

Tony Payne  University of Bristol
Aim

- overall aim is to provide predictions of the contribution of **ice sheets, ice caps and glaciers** to global sea level for the **next 200 years**
- the project is a response to a direct call from the EU’s Framework 7 funding
- the project has 23 partners in 13 countries
- started April 2009 with most PDRAs in place Sept. 2009
- funding is €10M
- equates to rough 100 PDRA years
Methodology

• focus on next 200 years only (policy makers’ time scale)

• assuming that we can treat climate – ice interactions in an uncoupled way on these time scales

• global climate → regional climate → ice mass

• using IPCC Assessment Report 4 scenarios

• funded several models at each stage of the process
Work package structure

WP1: management

WP2: key glacial processes

WP4: projection of climate forcing

WP5: projection of glacial change

WP6: synthesis and dissemination

WP3: foundation and validation data
Work package 4

WP4.1: IPCC AR4 scenarios

WP4.2: regional atmospheric modelling
  - WP5.2: Greenland modelling
  - WP5.3: glaciers and ice caps

WP4.3: regional ocean modelling
  - WP5.2: Antarctic modelling
Work package 4

- use AR4 scenarios A1B and E1 for 2000 to 2200
- use HadCM3 and ECHAM4 results
- 1980-2000 with both models and ERA40
Work package 4.2

Regional atmosphere modelling

• use global results as boundary conditions (7 experiments)

• Antarctic ice sheet – van den Broeke (Utrecht) & Krinner (Grenoble)

• Greenland ice sheet – Danish Met. Institute, Gregory (Hadley Centre) & Fettweis (Liege)

• output surface mass balance terms and associated climate variables to ice sheet models

• Sept. 2010 for A1B / March 2011 for E1
Work package 4.3

Regional ocean modelling

- Antarctic ice sheet only – AWI FESOM model
- Global finite element model with cavities and higher resolution around Antarctica
- To supply melt rates and temperature/salinity fields
- Some plume modelling using T/S fields
**Work package structure**

- **WP1:** management
- **WP2:** key glacial processes
- **WP3:** foundation and validation data
- **WP4:** projection of climate forcing
- **WP5:** projection of glacial change
- **WP6:** synthesis and dissemination
Work package 2

Process studies

• Pattyn will run a grounding-line intercomparison with the aim of making recommendations to WP5 (Sept 2010)

• other WPs focussing on meltwater lubrication (AWI drilling programme in Greenland Summer 2010) and calving models
Work package 5

WP5.1: Intercomparison and data provision

WP5.2: Greenland and Antarctic ice sheet modelling

WP5.3: Glacier and ice cap modelling

WP4.1: Global climate data

WP4.2/3: Regional mass balance data

WP3.2: Regional mass balance data

WP4: Rerun experiments with new geometry

WP3.3: Glacier database
Work package 5.1

Intercomparison

• provide data from global and regional climate models
• provide boundary condition and geometry data for Greenland and Antarctica
• liaise with WP3 on validation data
• core groups funded for each ice sheet
• hoped that data sets will be available to wider community
• issues about publication, licensing etc need to be sorted

Thickness change from Davis and others 2005
Work package 5.1

Antarctic dataset

- 5 km gridded dataset
- all geometry and boundary conditions on common grid
- thickness, surface and bedrock consistent with one another and present-day grounding line
- will be freely available from pangaea.de repository

Images from Anne Le Brocq
Work package 5.2

Ice sheet modelling
• driven by regional A & O modelling
• direct surface mass balance predictions
• degree–day factors and climate variables needed if want to calculation locally (e.g., for oceans)
• verify against observed thinning rates for 1990 onwards
• assessment of the effects of parameter uncertainty
• effects not of coupling assess by rerunning regional climate models
Work package 5.2

Ice sheet modelling

• Antarctic ice sheet – Huybrechts (Brussels), Payne (Bristol) & Ritz (Grenoble)
• Greenland ice sheet – Danish Met. Institute, Huybrechts (Brussels) & Ritz (Grenoble)
• global * regional * ice = 12-18 models for each scenario
• assessment of the effects of parameter uncertainty
Work package 5.3

Glacier and ice cap modelling

- driven by global climate data directly
- groups in Utrecht (Oerlemans) and Zurich (Paul) funded for glaciers
- close links to GLIMS & WGMS projects through WP3
- Chilean group will model Patagonian ice caps
- BAS will model Antarctic Peninsula

Example of GLIMS data from Peru
Issues

• gaps for ice caps in particular Arctic Canada and Russia
• no work on Himalayan glaciers
• Greenland data sets
• initialization of higher-order ice sheet model is a real issue
• need fall back if grounding-line parameterizations fail or if validation poor