Carl-Gustaf Arvid Rossby first explained the large-scale motions of the atmosphere in terms of fluid mechanics.

Rossby came into meteorology and oceanography while studying under Vilhelm Bjerknes in Bergen in 1919, where Bjerknes' group was developing the groundbreaking concepts that became known as the Bergen School of Meteorology, including theory of the polar front.

Rossby waves and surface weather extremes

There is debate and speculation whether rapid climate change in the Arctic could affect circulation patterns in the mid-latitudes and affect the frequency or intensity of extreme weather events. The Arctic has been warming much faster than the rest of the planet (about three times the global rate), associated with a rapid decline in sea-ice extent. If parts of the world warm faster than others then of course gradients in the horizontal temperature distribution will change – in this case the equator-to-pole gradient – which then could affect large scale wind patterns.

Several dynamical mechanisms for this have been proposed recently. Francis and Vavrus (GRL 2012) argued that a reduction of the north-south temperature gradient would cause weaker zonal winds (winds blowing west to east) and therefore a slower eastward propagation of Rossby waves. A change in Rossby wave propagation has not yet been detected (Barnes 2013) but this does not mean that it will not change in the future. Slowly-traveling waves (or quasi-stationary waves) would lead to more persistent and therefore more extreme weather. Petoukhov et al (2013) actually showed that several recent high-impact extremes, both heat waves and flooding events, were associated with high-amplitude quasi-stationary waves. Intuitively it makes sense that slowly-propagating Rossby waves lead to more surface extremes.

These waves form in the mid-latitudes at the boundary of cold air to the north and warm air to the south. Thus, with persistent strongly meandering isotherms, some regions will experience cold and others hot conditions. Moreover, slow wave propagation would prolong certain weather conditions and therefore lead to extremes on timescales of weeks: One day with temperatures over 30oC in say Western Europe is not really unusual, but 10 or 20 days in a row will be. But although it intuitively makes sense, the link between high-amplitude Rossby waves and surface extremes was so far not properly documented in a statistical way. It is this piece of the puzzle which is addressed in the new paper by Screen and Simmonds recently published in Nature Climate Change (“Amplified mid-latitude planetary waves favour particular regional weather extremes”). -