Geophysical Research Abstracts, Vol. 8, 10363, 2006
SRef-ID: 1607-7962/gra/EGU06-A-10363

Impact of Greenhouse Warming on Alaskan coastal glaciers: a 60-year-long mass balance record from the Juneau Icefield

M.M. Miller (1) and B.F. Molnia (1,2)

(1) Glaciological and Arctic Sciences Institute, University of Idaho, Moscow, Idaho, USA (jirp@uidaho.edu, Fax: 208-882-6207), (2) U.S. Geological Survey, Reston, Virginia USA (bmolnia@usgs.gov / Fax: 703-648-6953)

The multi-decadal regime record of coastal glaciers in the panhandle of Southeastern Alaska provides insight into significant recent climatic influences on the physical and ecological environment of the Arctic and adjacent sub-Arctic. Since 1946, documenting the complexities of glacier behavior on the fifth largest icefield in the western hemisphere has been the focus of the Juneau Icefield Research Program (JIRP), a long-term climatic investigation, initiated and supported in its early years by the U.S. Office of Naval Research because of its concerns about changing climate effects on Arctic operations. A key result is the longest documentation of glacier mass balance change in North America. Considered as prototypes from termini to highest source névés are the rapidly downwasting Herbert, Mendenhall, Lemon Creek, Twin, Llewellyn, and Cathedral Massif Glaciers and the thickening and advancing Taku Glacier, the largest glacier in the southern half of the icefield. Covering an area of about 310 square kilometers, Taku Glacier, a multi-tributary glacier system, has been advancing since 1890. Special attention has been given to the total Taku-Lewellyn Glacier system, via a 180 km south to north transect across the primary crestal névé at an elevation of 1500-2000 m. Over the last 60 years, periodic re-mapping, annual mass balance and ELA measurements, comprehensive field station meteorological records and analyses, annual GPS flow surveys, and seismic depth profiling have provided an on-going regime history. This has been augmented with dendrochronology, lichenometry, and order-of-sequence studies of a festoon of 16 terminal moraines from Little Ice Age advances and retreats to document the pattern of historical glacier fluctuations since the 17th century. During the past 4 centuries periodicities of 5-17 yr, 25-30 yr,

and 85-90 yr have been identified. These cycles correlate with corpuscular solar radiation recorded by the Zurich Observatory since 1749. The coldest decade of the latest 90-year cycle occurred in 1905-15. An anticipated late-20th century minimum was not revealed, apparently counterbalanced since the late 1970s by over-riding Greenhouse Warming effects. The current decade is the warmest on Alaska's coast since the advent of instrumented meteorological records in the late-1860s. An observational model has been developed that introduces surface flow-lags to clarify system regime changes allied to the general atmospheric circulation on the eastern rim of the Gulf of Alaska. The regionally out-of-phase growth of the Taku Glacier is interpreted as a consequence of its multiple névé geometry and a significant inland shifting of the mean annual position of the Arctic Front over the past 30 years. Added to this has been a generally upward shift of freezing level into a zone of maximum icefield area, coincident with a marked rise in the névé line. JIRP annual mass balance records verify these changes and corroborate the global climatic implications. Since the early 1980s unusual El Nino and La Nina interplays relative to the heat balance of the North Pacific Ocean have strongly affected the coastal and atmospheric temperatures of south coastal Alaska. For the total Arctic, ongoing JIRP investigations support the proposition that an accelerated, large-scale, atmospheric-trace-element-pollution Greenhouse Warming has significantly influenced ongoing natural climate change. Over the past two decades, this includes excessive thinning and diminishment of sea ice over the Arctic Ocean and the increasing presence of summer open water in the North Pole sector and perimeter of the Arctic Basin.